



CLASS 2 PERMISSIVE CHANGE **TEST REPORT**

Report Number. : 12698625-E1V1

Applicant : QUALCOMM TECHNOLOGIES, INC.
5770 MOREHOUSE DRIVE,
SAN DIEGO, CA 92121, U.S.A.

Model : QCL-HUB-2.0-US

FCC ID : J9C2NET2LTE

IC : 2723A-2NET2LTE

EUT Description : WIRELESS DATA HUB

Test Standard(s) : FCC CFR47 PART 22 SUBPART H
FCC CFR47 PART 24 SUBPART E
FCC CFR47 PART 27 SUBPART F, H, L
INDUSTRY CANADA RSS-130 ISSUE 1
INDUSTRY CANADA RSS-132 ISSUE 3
INDUSTRY CANADA RSS-133 ISSUE 6
INDUSTRY CANADA RSS-139 ISSUE 3

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Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



NVLAP Lab code: 200065-0

Revision History

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1. ATTESTATION OF TEST RESULTS

Applicant Name and Address	QUALCOMM TECHNOLOGIES, INC. 5770 MOREHOUSE DRIVE, SAN DIEGO, CA 92121, U.S.A.
Model	QCL-HUB-2.0-US
FCC ID	J9C2NET2LTE
IC	2723A-2NET2LTE
EUT Description	WIRELESS DATA HUB
Serial Number	QUALC001T0003133 (RADIATED) G1ZCH0700179J01(CONDUCTED)
Date Tested	FEBRUARY 04, 2019 to MARCH 06, 2019
Applicable Standards	FCC CFR47 PART 22H, 24E, and 27F,H,L INDUSTRY CANADA RSS-130,132,133, 139
Test Results	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For UL Verification Services Inc. By: 	Prepared By: 
Frank Ibrahim Operations Leader Consumer Technology Division UL Verification Services Inc.	Eric Yu Test Engineer Consumer Technology Division UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.26:2015, FCC CFR 47 Part 2, Part 22, Part 24, Part 27, FCC KDB 971168 D01 v02r02/ D02 v01. IC RSS-130, RSS-132, RSS-133, RSS-139.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd
☐ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☒ Chamber I (ISED:2324A-5)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☐ Chamber J (ISED:2324A-6)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED:2324A-1)
	☐ Chamber G (ISED:22541-4)	☐ Chamber L (ISED:2324A-3)
	☐ Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

This EUT is a 2net2 device (LTE North American Version AT&T) that has the following radio modules:

- Wistron WWAN module, M14Q2F.
- Qualcomm Unlicensed Module, QCA WCN3660B.

5.2. MAXIMUM OUTPUT POWER

ERP/EIRP LIMIT

FCC: §2.1046, §22.913, §24.232, §27.50

RSS130§4.4, RSS132§5.4; RSS133§6.4, RSS139§6.5

EIRP/ERP TEST PROCEDURE

ANSI C63.26:2015/ TIA-603-E Clause 2.2.17

KDB 971168 D01Section 5.6

KDB 412172 D01

$ERP/EIRP = P_{Meas} + GT - LC$

where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as P_{Meas}, typically dBW or dBm);

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

GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);

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

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

The transmitter has a maximum average conducted and ERP / EIRP output powers as follows:

Note: for RF output power for WCDMA mode and for LTE bands (2, 4, 5, 12) 5 MHz BW, refer to original report number 11692709-E1V2.

LTE BAND 2

Part 24 / RSS 133								
EIRP Limit (W)		2.00						
Antenna Gain (dBi)		2.50						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	EIRP Average (dBm)	EIRP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	1850.7	1909.3	23.8	26.30	0.427	1100	1M10G7W
	16QAM			22.7	25.20	0.331	1080	1M08D7W
3.0	QPSK	1851.5	1908.5	23.7	26.20	0.417	2690	2M69G7W
	16QAM			22.6	25.10	0.324	2690	2M69D7W
10.0	QPSK	1855.0	1905.0	23.7	26.20	0.417	8930	8M93G7W
	16QAM			22.9	25.40	0.347	8930	8M93D7W
15.0	QPSK	1857.5	1902.5	24.0	26.50	0.447	13370	13M4G7W
	16QAM			23.2	25.70	0.372	13410	13M4D7W
20.0	QPSK	1860.0	1900.0	24.0	26.50	0.447	17850	17M9G7W
	16QAM			23.1	25.60	0.363	17850	17M9D7W

LTE BAND 4

Part 27 / RSS 139								
EIRP Limit (W)		1.00						
Antenna Gain (dBi)		0.50						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	EIRP Average (dBm)	EIRP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	1710.7	1754.3	23.8	24.30	0.269	1090	1M09G7W
	16QAM			23.1	23.60	0.229	1090	1M09D7W
3.0	QPSK	1711.5	1753.5	23.7	24.20	0.263	2690	2M69G7W
	16QAM			22.8	23.30	0.214	2690	2M69D7W
10.0	QPSK	1715.0	1750.0	23.9	24.40	0.275	8940	8M94G7W
	16QAM			22.4	22.90	0.195	8930	8M93D7W
15.0	QPSK	1717.5	1747.5	24.0	24.50	0.282	13400	13M4G7W
	16QAM			23.1	23.60	0.229	13410	13M4D7W
20.0	QPSK	1720.0	1745.0	24.0	24.50	0.282	17880	17M9G7W
	16QAM			22.9	23.40	0.219	17870	17M9D7W

LTE BAND 5 (FCC)

Part 22H								
ERP Limit (W)		7.00						
Antenna Gain (dBi)		-0.90						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	ERP Average (dBm)	ERP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	824.7	848.3	23.7	20.65	0.116	1090	1M09G7W
	16QAM			22.4	19.35	0.086	1090	1M09D7W
3.0	QPSK	825.5	847.5	23.5	20.45	0.111	2690	2M69G7W
	16QAM			22.2	19.15	0.082	2670	2M67D7W
10.0	QPSK	829.0	844.0	23.7	20.65	0.116	8970	8M97G7W
	16QAM			22.6	19.55	0.090	8940	8M94D7W

LTE BAND 5 (IC)

RSS 132								
EIRP Limit (W)		11.50						
Antenna Gain (dBi)		-0.90						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	EIRP Average (dBm)	EIRP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	824.7	848.3	23.7	22.80	0.191	1090	1M09G7W
	16QAM			22.4	21.50	0.141	1090	1M09D7W
3.0	QPSK	825.5	847.5	23.5	22.60	0.182	2690	2M69G7W
	16QAM			22.2	21.30	0.135	2670	2M67D7W
10.0	QPSK	829.0	844.0	23.7	22.80	0.191	8970	8M97G7W
	16QAM			22.6	21.70	0.148	8940	8M94D7W

LTE BAND 12 (FCC)

Part 27								
ERP Limit (W)		3.00						
Antenna Gain (dBi)		-2.80						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	ERP Average (dBm)	ERP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	699.7	715.3	23.9	18.95	0.079	1090	1M09G7W
	16QAM			23.3	18.35	0.068	1080	1M08D7W
3.0	QPSK	700.5	714.5	23.8	18.85	0.077	2690	2M69G7W
	16QAM			22.9	17.95	0.062	2690	2M69D7W
10.0	QPSK	704.0	711.0	23.7	18.75	0.075	8950	8M95G7W
	16QAM			22.8	17.85	0.061	8940	8M94D7W

LTE BAND 12 (IC)

RSS 130								
EIRP Limit (W)		5.00						
Antenna Gain (dBi)		-2.80						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	EIRP Average (dBm)	EIRP Average (W)	99% BW (kHz)	Emission Designator
1.4	QPSK	699.7	715.3	23.9	21.10	0.129	1090	1M09G7W
	16QAM			23.3	20.50	0.112	1080	1M08D7W
3.0	QPSK	700.5	714.5	23.8	21.00	0.126	2690	2M69G7W
	16QAM			22.9	20.10	0.102	2690	2M69D7W
10.0	QPSK	704.0	711.0	23.7	20.90	0.123	8950	8M95G7W
	16QAM			22.8	20.00	0.100	8940	8M94D7W

5.3. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version MSM8909.LA.1.3-00073.1_27_43.

5.4. MAXIMUM ANTENNA GAIN

Please see table below:

LTE Bands	Antenna Gain (dBi)
LTE BAND 2, 1850 - 1910 MHz	2.5
LTE BAND 4, 1710 - 1755 MHz	0.5
LTE BAND 5, 824 - 849 MHz	-0.9
LTE BAND 12, 699 - 716 MHz	-2.8

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT supports:

LTE Bands: Band 2, Band 4, Band 5, Band 12.

The worst-case scenario for all measurements is based on the average conducted output power measurement investigation results.

The EUT was investigated in three orthogonal orientations X/Y/Z, it was determined that X (Flatbed) orientation was worst-case orientation for cell bands; X (Flatbed) orientation was worst-case orientation for PCS/AWS bands.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
N/A	N/A	N/A	N/A

I/O CABLES (RF Conducted Test)

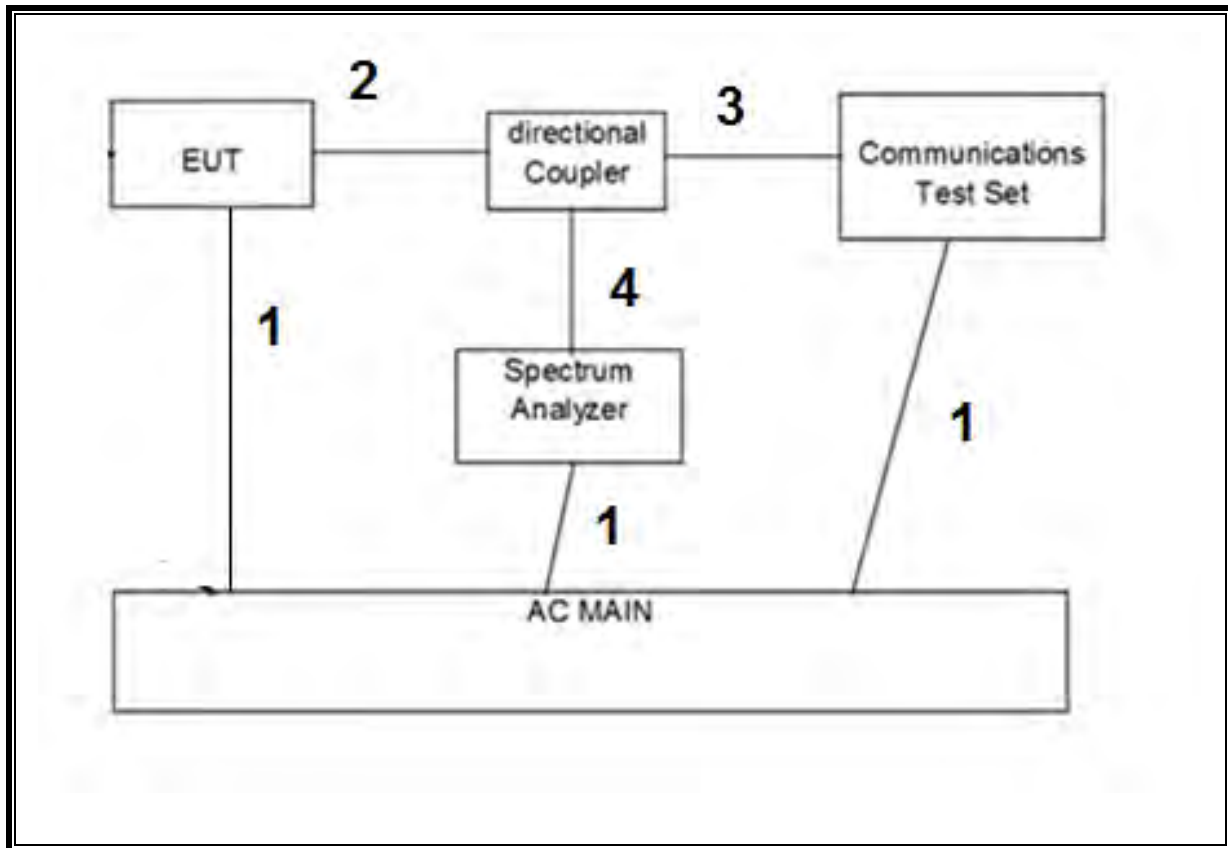
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US 115V	Un-shielded	2.0m	N/A
2	RF In/Out	1	EUT	Un-shielded	0.6m	N/A
3	RF In/Out	1	Communication Test Set	Un-shielded	1.2m	N/A
4	RF In/Out	1	Barrel	N/A	N/A	N/A

I/O CABLES (RF Radiated Test)

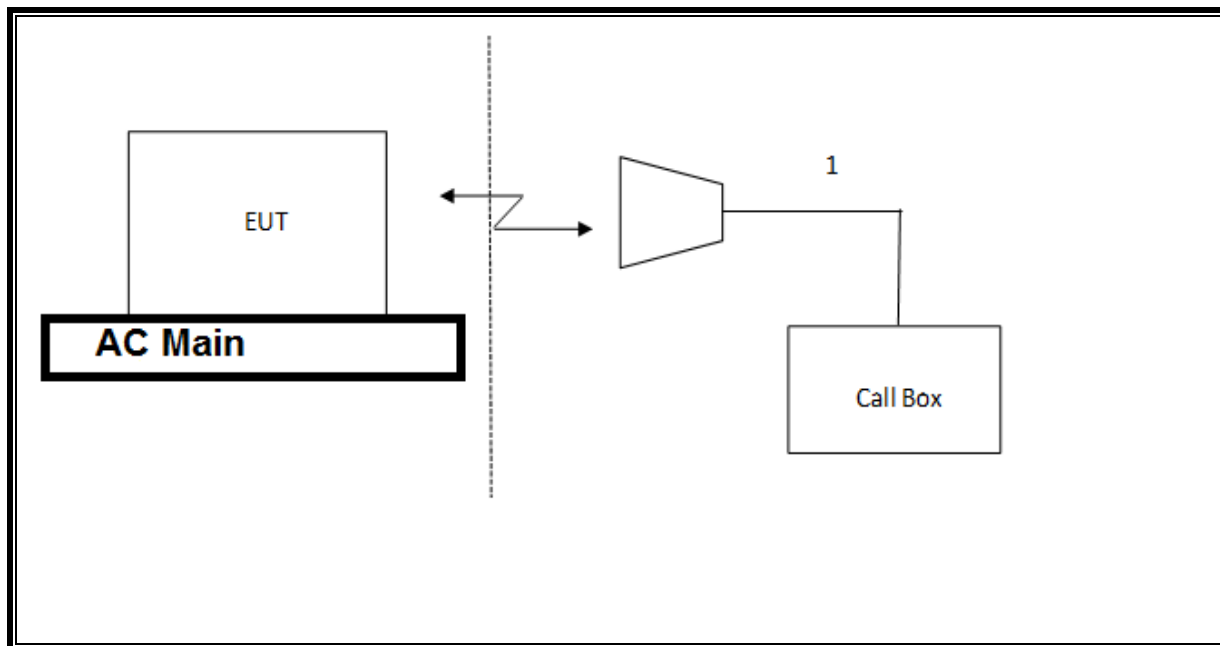
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	RF In/Out	1	Antenna	Un-shielded	5.0m	N/A

SETUP DIAGRAM

CONDUCTED SETUP



RADIATED SETUP



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment were utilized for the tests documented in this report:

Test Equipment List					
Description	Manufacturer	Model	ID Number	Cal Date	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T862	05/24/2018	05/24/2019
Amplifier, 1 to 18GHz	MITEQ	AFS42-00101800-25-S-42	PRE1782151	08/01/2018	08/01/2019
Wideband Communication Test Set, Call Box	R&S	CMW500	T948	02/17/2018	02/17/2019
High pass Filter, 2.7 GHz	Micro-Circuits	H2G518G6	T772	07/05/2018	07/05/2019
High pass Filter, 1.2 GHz	Micro-Tronics	HPM50108	T1737	04/17/2018	04/17/2019
High pass Filter, 1.5 GHz	Micro-Tronics	HPM50114	T1852	07/16/2018	07/16/2019
Wideband Communication Test Set, Call Box	R&S	CMW500	T1871	02/18/2018	02/18/2019
Directional Coupler	Krytar	152610	T922	06/18/2018	06/18/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T917	10/05/2018	10/05/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	04/16/2018	04/16/2019
Power Meter	Keysight	N1911A	T1268	06/25/2018	06/25/2019
Power Sensor	Keysight	N1921A	T1228	07/10/2018	07/10/2019
Chamber, Environmental	Thermotron	SE-600-10-10	T80	02/22/2018	02/22/2019

UL AUTOMATION SOFTWARE

CLT Software	UL	UL RF	Ver 7.6, November 11, 2017
Power Measurement Software	UL	UL RF	Ver 2.2, June 2017

NOTES:

- Equipment listed above that calibrated during the testing period was set for test after the calibration.
- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

7. RF OUTPUT POWER VERIFICATION

CONDUCTED OUTPUT POWER MEASUREMENT PROCEDURE

All LTE bands conducted average power is obtained from the CMW500 telecommunication test set.

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS_01".³

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

Network Signalling value	Requirements (sub-clause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	NA
NS_03	6.6.2.2.1	2, 4, 10, 23, 25, 35, 36	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2	41	5	>6	≤ 1
			10, 15, 20	See Table 6.2.4-4	
NS_05	6.6.3.3.1	1	10, 15, 20	≥ 50	≤ 1
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	n/a
NS_07	6.6.2.2.3 6.6.3.3.2	13	10	Table 6.2.4-2	Table 6.2.4-2
NS_08	6.6.3.3.3	19	10, 15	> 44	≤ 3
NS_09	6.6.3.3.4	21	10, 15	> 40	≤ 1
				> 55	≤ 2
NS_10		20	15, 20	Table 6.2.4-3	Table 6.2.4-3
NS_11	6.6.2.2.1	23 ¹	1.4, 3, 5, 10	Table 6.2.4-5	Table 6.2.4-5
...					
NS_32	-	-	-	-	-

Note 1: Applies to the lower block of Band 23, i.e. a carrier placed in the 2000-2010 MHz region.

Modes Tested:

- LTE 2
- LTE 4
- LTE 5
- LTE 12

RESULTS

7.1. LTE 2

ID:	39004	Date:	2/4/19
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OUTPUT POWER FOR LTE BAND 2 (1.4 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				18607 1850.7 MHz	18900 1880.0 MHz	19193 1909.3 MHz
1.4	QPSK	1	0	23.2	23.5	23.4
		1	2	23.1	23.8	23.4
		1	5	23.1	23.5	23.4
		3	0	23.0	23.7	23.3
		3	1	23.1	23.6	23.4
		3	2	23.1	23.7	23.5
		6	0	22.1	22.6	22.6
	16QAM	1	0	22.1	22.3	22.3
		1	2	22.0	22.0	22.5
		1	5	22.0	22.0	22.4
		3	0	21.7	22.4	22.7
		3	1	21.8	22.4	22.6
		3	2	22.0	22.5	22.6
		6	0	21.0	21.4	21.6

OUTPUT POWER FOR LTE BAND 2 (3.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				18615 1851.5 MHz	18900 1880.0 MHz	19185 1908.5 MHz
3.0	QPSK	1	0	23.1	23.6	23.4
		1	7	23.0	23.7	23.5
		1	14	23.2	23.6	23.5
		8	0	22.2	22.6	22.6
		8	4	22.1	22.6	22.5
		8	7	22.1	22.6	22.4
		15	0	22.1	22.6	22.5
	16QAM	1	0	21.9	22.4	22.2
		1	7	22.1	22.5	22.6
		1	14	21.8	22.6	22.3
		8	0	20.9	21.6	21.5
		8	4	20.9	21.6	21.6
		8	7	20.9	21.6	21.6
		15	0	20.9	21.6	21.5

OUTPUT POWER FOR LTE BAND 2 (10.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				18650	18900	19150
				1855.0 MHz	1880.0 MHz	1905.0 MHz
10.0	QPSK	1	0	23.3	23.5	23.6
		1	24	23.6	23.7	23.7
		1	49	23.2	23.3	23.4
		25	0	22.2	22.7	22.5
		25	12	22.2	22.7	22.5
		25	24	22.2	22.6	22.4
	16QAM	50	0	22.2	22.6	22.4
		1	0	22.0	22.4	22.4
		1	24	22.2	22.9	22.2
		1	49	22.0	22.3	22.4
		25	0	21.2	21.7	21.4
		25	12	21.3	21.8	21.5
		25	24	21.1	21.5	21.5
		50	0	21.1	21.5	21.3

OUTPUT POWER FOR LTE BAND 2 (15.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				18675	18900	19125
				1857.5 MHz	1880.0 MHz	1902.5 MHz
15.0	QPSK	1	0	23.1	23.5	23.4
		1	37	23.1	24.0	23.5
		1	74	23.1	23.8	23.3
		36	0	22.6	22.7	22.8
		36	16	22.1	22.6	22.4
		36	35	22.1	22.5	22.3
	16QAM	75	0	22.1	22.6	22.4
		1	0	22.2	22.5	22.4
		1	37	22.4	23.2	22.5
		1	74	21.8	23.0	21.6
		36	0	21.9	21.9	22.0
		36	16	21.6	21.6	21.6
		36	35	21.5	21.6	21.4
		75	0	21.8	21.7	22.1

OUTPUT POWER FOR LTE BAND 2 (20.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				18700	18900	19100
				1860.0 MHz	1880.0 MHz	1900.0 MHz
20.0	QPSK	1	0	23.0	23.5	23.1
		1	49	23.5	24.0	23.2
		1	99	23.2	23.4	22.9
		50	0	22.5	22.7	22.6
		50	24	22.5	22.7	22.4
		50	49	22.3	22.6	22.3
	16QAM	100	0	22.3	22.5	22.4
		1	0	22.2	22.4	22.2
		1	49	22.6	23.1	22.1
		1	99	22.3	22.4	21.1
		50	0	21.6	21.8	21.7
		50	24	21.7	21.7	21.4
		50	49	21.4	21.5	21.5
		100	0	21.4	21.4	21.4

7.2. LTE 4

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OUTPUT POWER FOR LTE BAND 4 (1.4 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				19957	20175	20393
				1710.7 MHz	1732.5 MHz	1754.3 MHz
1.4	QPSK	1	0	23.3	23.6	23.3
		1	2	23.6	23.5	23.5
		1	5	23.4	23.6	23.5
		3	0	23.4	23.6	23.5
		3	1	23.4	23.8	23.7
		3	2	23.4	23.6	23.7
		6	0	22.6	22.7	22.5
	16QAM	1	0	22.2	23.0	22.0
		1	2	22.5	23.1	22.0
		1	5	22.3	23.0	22.4
		3	0	22.6	22.9	22.1
		3	1	22.6	22.9	22.4
		3	2	22.6	22.9	22.4
		6	0	21.4	22.0	21.3

OUTPUT POWER FOR LTE BAND 4 (3.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				19965	20175	20385
				1711.5 MHz	1732.5 MHz	1753.5 MHz
3.0	QPSK	1	0	23.4	23.6	23.5
		1	7	23.6	23.6	23.6
		1	14	23.5	23.7	23.5
		8	0	22.5	22.8	22.5
		8	4	22.6	22.7	22.6
		8	7	22.5	22.7	22.5
		15	0	22.5	22.7	22.5
	16QAM	1	0	22.5	22.8	22.6
		1	7	22.4	22.6	22.4
		1	14	22.5	22.4	22.4
		8	0	21.3	21.8	21.4
		8	4	21.4	21.8	21.7
		8	7	21.4	21.8	21.6
		15	0	21.3	21.7	21.6

OUTPUT POWER FOR LTE BAND 4 (10.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20000	20175	20350
				1715.0 MHz	1732.5 MHz	1750.0 MHz
10.0	QPSK	1	0	23.6	23.6	23.7
		1	24	23.5	23.9	23.7
		1	49	23.5	23.6	23.8
		25	0	22.5	22.7	22.6
		25	12	22.6	22.7	22.6
		25	24	22.6	22.8	22.6
		50	0	22.6	22.8	22.5
	16QAM	1	0	22.3	22.4	22.3
		1	24	22.4	22.4	22.3
		1	49	22.3	22.4	22.2
		25	0	21.6	21.7	21.6
		25	12	21.8	21.7	21.6
		25	24	21.8	21.8	21.5
		50	0	21.7	21.6	21.5

OUTPUT POWER FOR LTE BAND 4 (15.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20025	20175	20325
				1717.5 MHz	1732.5 MHz	1747.5 MHz
15.0	QPSK	1	0	23.5	23.6	23.6
		1	37	23.9	23.9	24.0
		1	74	23.6	23.5	23.9
		36	0	22.5	22.7	22.6
		36	16	22.6	22.6	22.6
		36	35	22.7	22.7	22.7
		75	0	22.5	22.7	22.5
	16QAM	1	0	22.6	22.7	22.8
		1	37	23.0	22.8	23.1
		1	74	22.6	22.4	22.9
		36	0	21.6	21.8	21.5
		36	16	21.7	21.5	21.7
		36	35	21.6	21.6	21.6
		75	0	21.6	21.8	21.6

OUTPUT POWER FOR LTE BAND 4 (20.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20050	20175	20300
				1720.0 MHz	1732.5 MHz	1745.0 MHz
20.0	QPSK	1	0	23.3	23.4	23.8
		1	49	23.7	23.6	24.0
		1	99	23.2	23.4	23.8
		50	0	22.6	22.8	23.0
		50	24	22.6	22.7	22.8
		50	49	22.5	22.6	22.7
		100	0	22.6	22.7	22.6
	16QAM	1	0	22.2	22.3	22.8
		1	49	22.6	22.5	22.9
		1	99	22.3	22.5	22.8
		50	0	21.6	21.9	21.9
		50	24	21.7	21.8	21.9
		50	49	21.6	21.7	21.8
		100	0	21.7	21.8	21.7

7.3. LTE 5

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OUTPUT POWER FOR LTE BAND 5 (1.4 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20407	20525	20643
				824.7 MHz	836.5 MHz	848.3 MHz
1.4	QPSK	1	0	23.6	23.3	23.0
		1	2	23.7	23.3	23.0
		1	5	23.4	23.3	23.0
		3	0	23.7	23.3	23.1
		3	1	23.6	23.3	23.0
		3	2	23.6	23.1	23.0
		6	0	22.7	22.2	22.0
	16QAM	1	0	22.3	22.1	22.3
		1	2	22.3	22.2	22.3
		1	5	22.1	22.2	22.2
		3	0	22.0	22.4	22.3
		3	1	22.2	22.4	22.2
		3	2	22.4	22.3	22.1
		6	0	21.2	21.4	21.2

OUTPUT POWER FOR LTE BAND 5 (3.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20415	20525	20635
				825.5 MHz	836.5 MHz	847.5 MHz
3.0	QPSK	1	0	23.2	23.2	22.9
		1	7	23.2	23.5	23.1
		1	14	23.1	23.2	22.9
		8	0	22.3	22.1	22.0
		8	4	22.1	22.1	22.0
		8	7	22.1	22.2	22.0
		15	0	22.2	22.1	21.9
	16QAM	1	0	22.2	21.9	21.8
		1	7	22.1	22.1	22.1
		1	14	21.8	21.9	21.5
		8	0	21.0	21.1	21.0
		8	4	20.9	21.3	21.2
		8	7	20.9	21.3	21.2
		15	0	21.1	21.2	21.1

OUTPUT POWER FOR LTE BAND 5 (10.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				20450	20525	20600
				829.0 MHz	836.5 MHz	844.0 MHz
10.0	QPSK	1	0	23.6	23.3	23.4
		1	24	23.7	23.5	23.6
		1	49	23.5	23.3	23.3
		25	0	22.3	22.3	22.2
		25	12	22.3	22.4	22.2
		25	24	22.3	22.4	22.2
		50	0	22.3	22.3	22.2
	16QAM	1	0	22.3	22.4	22.3
		1	24	22.6	22.3	22.4
		1	49	22.1	22.1	22.3
		25	0	21.4	21.4	21.4
		25	12	21.5	21.6	21.5
		25	24	21.3	21.6	21.2
		50	0	21.2	21.5	21.3

7.4. LTE 12

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OUTPUT POWER FOR LTE BAND 12 (1.4 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				23017 699.7 MHz	23095 707.5 MHz	23173 715.3 MHz
1.4	QPSK	1	0	23.4	23.7	23.4
		1	2	23.4	23.7	23.7
		1	5	23.4	23.7	23.6
		3	0	23.5	23.6	23.6
		3	1	23.7	23.6	23.7
		3	2	23.7	23.9	23.7
		6	0	22.5	22.7	22.6
	16QAM	1	0	22.5	22.7	22.7
		1	2	22.4	22.8	22.9
		1	5	22.4	22.6	23.0
		3	0	22.2	22.8	22.9
		3	1	22.3	23.3	22.7
		3	2	22.3	23.2	22.9
		6	0	21.2	21.9	21.9

OUTPUT POWER FOR LTE BAND 12 (3.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				23025 700.5 MHz	23095 707.5 MHz	23165 714.5 MHz
3.0	QPSK	1	0	23.4	23.7	23.5
		1	7	23.7	23.8	23.7
		1	14	23.6	23.8	23.6
		8	0	22.5	22.8	22.7
		8	4	22.6	22.9	22.8
		8	7	22.7	22.7	22.6
		15	0	22.6	22.6	22.7
	16QAM	1	0	22.7	22.9	22.4
		1	7	22.6	22.7	22.8
		1	14	22.5	22.4	22.5
		8	0	21.6	21.8	21.6
		8	4	21.6	21.8	21.8
		8	7	21.5	21.7	21.8
		15	0	21.5	21.7	21.7

OUTPUT POWER FOR LTE BAND 12 (10.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Power		
				Conducted Average (dBm)		
				23060	23095	23130
				704.0 MHz	707.5 MHz	711.0 MHz
10.0	QPSK	1	0	23.4	23.5	23.4
		1	24	23.7	23.6	23.6
		1	49	23.4	23.6	23.7
		25	0	22.6	22.7	22.6
		25	12	22.7	22.6	22.7
		25	24	22.6	22.6	22.8
		50	0	22.6	22.6	22.7
	16QAM	1	0	22.3	22.5	22.5
		1	24	22.5	22.6	22.8
		1	49	21.9	22.4	22.3
		25	0	21.9	22.8	21.6
		25	12	21.7	21.6	21.6
		25	24	21.6	21.5	21.7
		50	0	21.6	21.7	21.8

8. CONDUCTED TEST RESULTS

8.1. OCCUPIED BANDWIDTH

RULE PART(S)

FCC: §2.1049

IC: RSS130, RSS132; RSS133 §2.3, RSS139

LIMITS

For reporting purposes only

TEST PROCEDURE

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the middle channel in each band. The 99% and -26dB bandwidths was also measured and recorded.

MODES TESTED

- LTE Band 2
- LTE Band 4
- LTE Band 5
- LTE Band 12

RESULTS

There is no limit required and power is the same for low, middle and high channel; therefore, only middle channel was tested.

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LTE2

Band	Mode	RB Allocation/RB Offset	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE BAND 2	1.4 MHz, QPSK	6/0	1880.0	1.10	1.27
	1.4 MHz, 16QAM			1.08	1.27
	3 MHz, QPSK	15/0		2.69	2.92
	3 MHz, 16QAM			2.69	2.97
	10 MHz, QPSK	50/0		8.93	9.71
	10 MHz, 16QAM			8.93	9.79
	15 MHz, QPSK	75/0		13.37	14.66
	15 MHz, 16QAM			13.41	14.60
	20 MHz, QPSK	100/0		17.85	19.29
	20 MHz, 16QAM			17.85	19.29

LTE4

Band	Mode	RB Allocation/RB Offset	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE BAND 4	1.4 MHz, QPSK	6/0	1732.5	1.09	1.25
	1.4 MHz, 16QAM			1.09	1.29
	3 MHz, QPSK	15/0		2.69	2.96
	3 MHz, 16QAM			2.69	2.98
	10 MHz, QPSK	50/0		8.94	9.87
	10 MHz, 16QAM			8.93	9.75
	15 MHz, QPSK	75/0		13.40	14.66
	15 MHz, 16QAM			13.41	14.76
	20 MHz, QPSK	100/0		17.88	19.14
	20 MHz, 16QAM			17.87	19.30

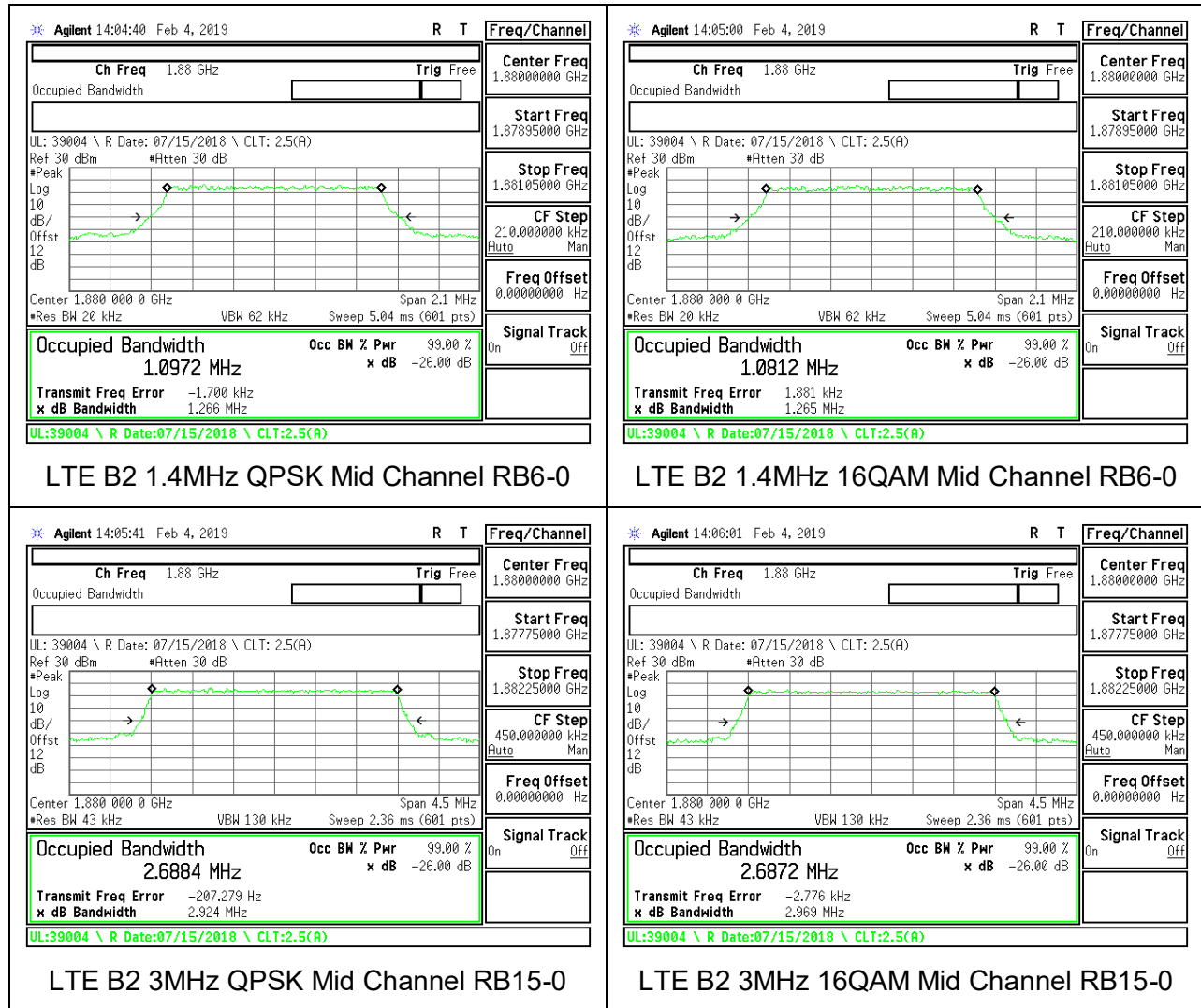
LTE5

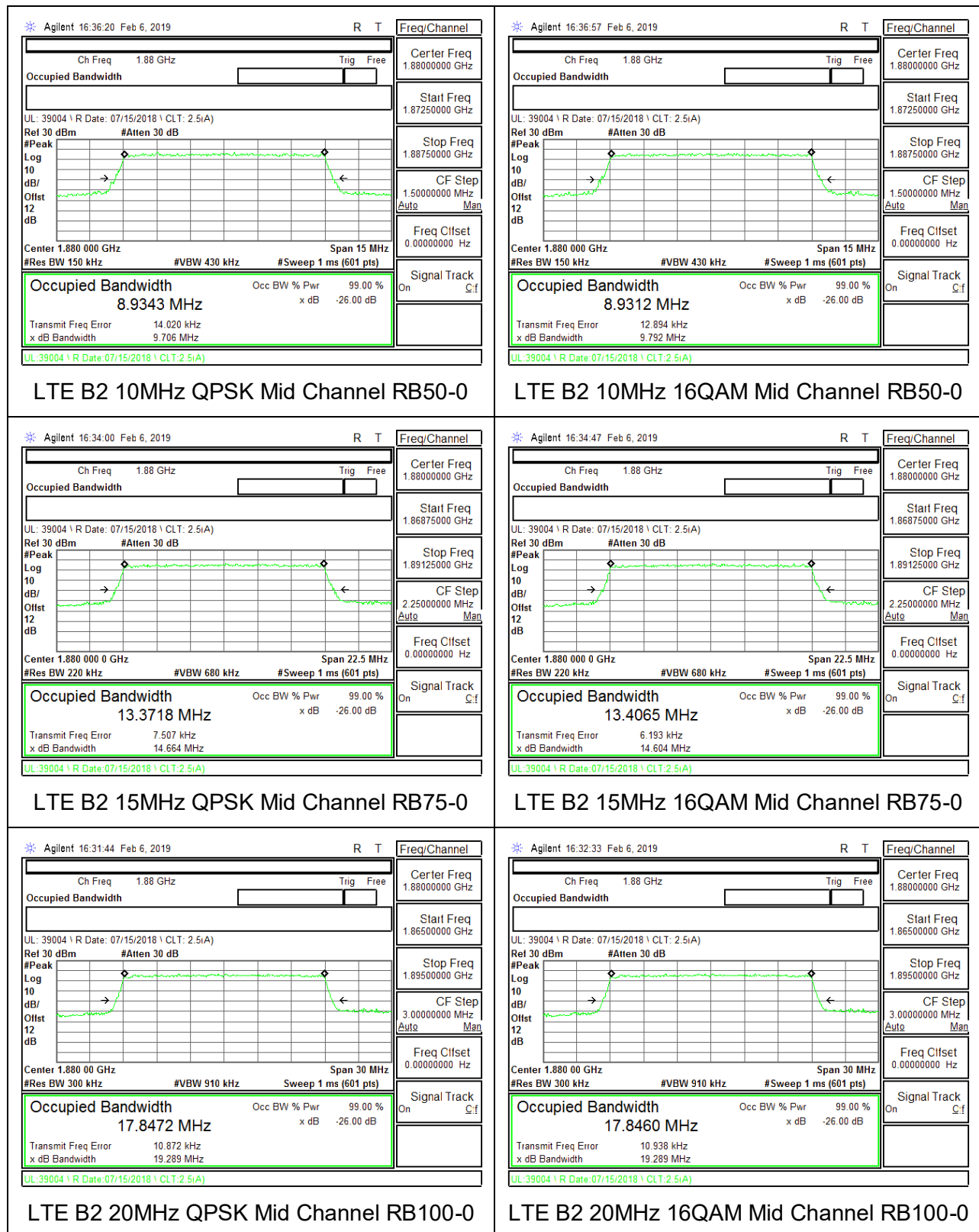
Band	Mode	RB Allocation/RB Offset	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE BAND 5	1.4 MHz, QPSK	6/0	836.5	1.09	1.28
	1.4 MHz, 16QAM			1.09	1.25
	3 MHz, QPSK	15/0		2.69	2.96
	3 MHz, 16QAM			2.67	2.91
	10 MHz, QPSK	50/0		8.97	9.89
	10 MHz, 16QAM			8.94	9.76

LTE12

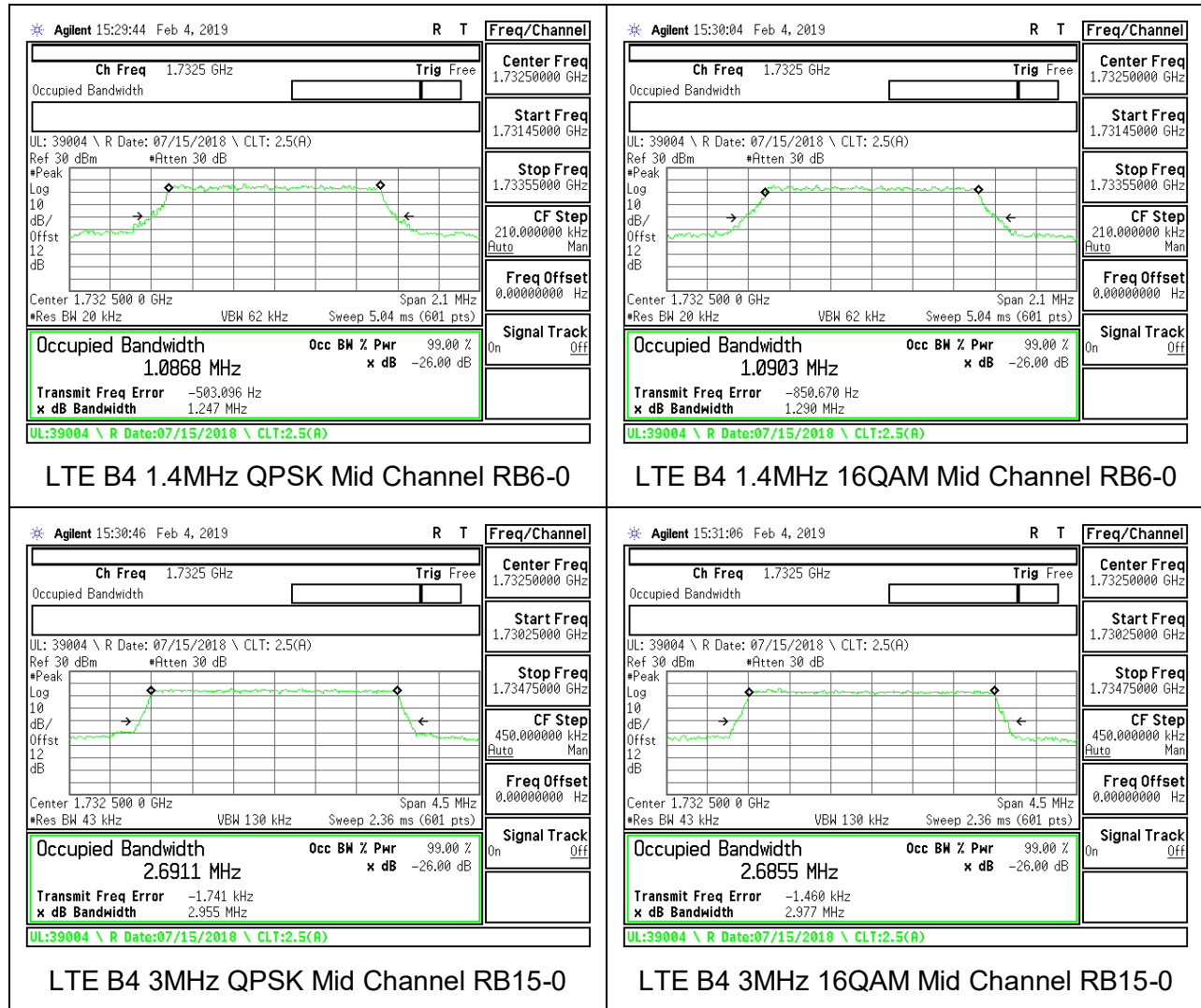
Band	Mode	RB Allocation/RB Offset	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE BAND 12	1.4 MHz, QPSK	6/0	707.5	1.09	1.28
	1.4 MHz, 16QAM			1.08	1.28
	3 MHz, QPSK	15/0		2.69	2.98
	3 MHz, 16QAM			2.69	2.97
	10 MHz, QPSK	50/0		8.95	9.83
	10 MHz, 16QAM			8.94	9.92

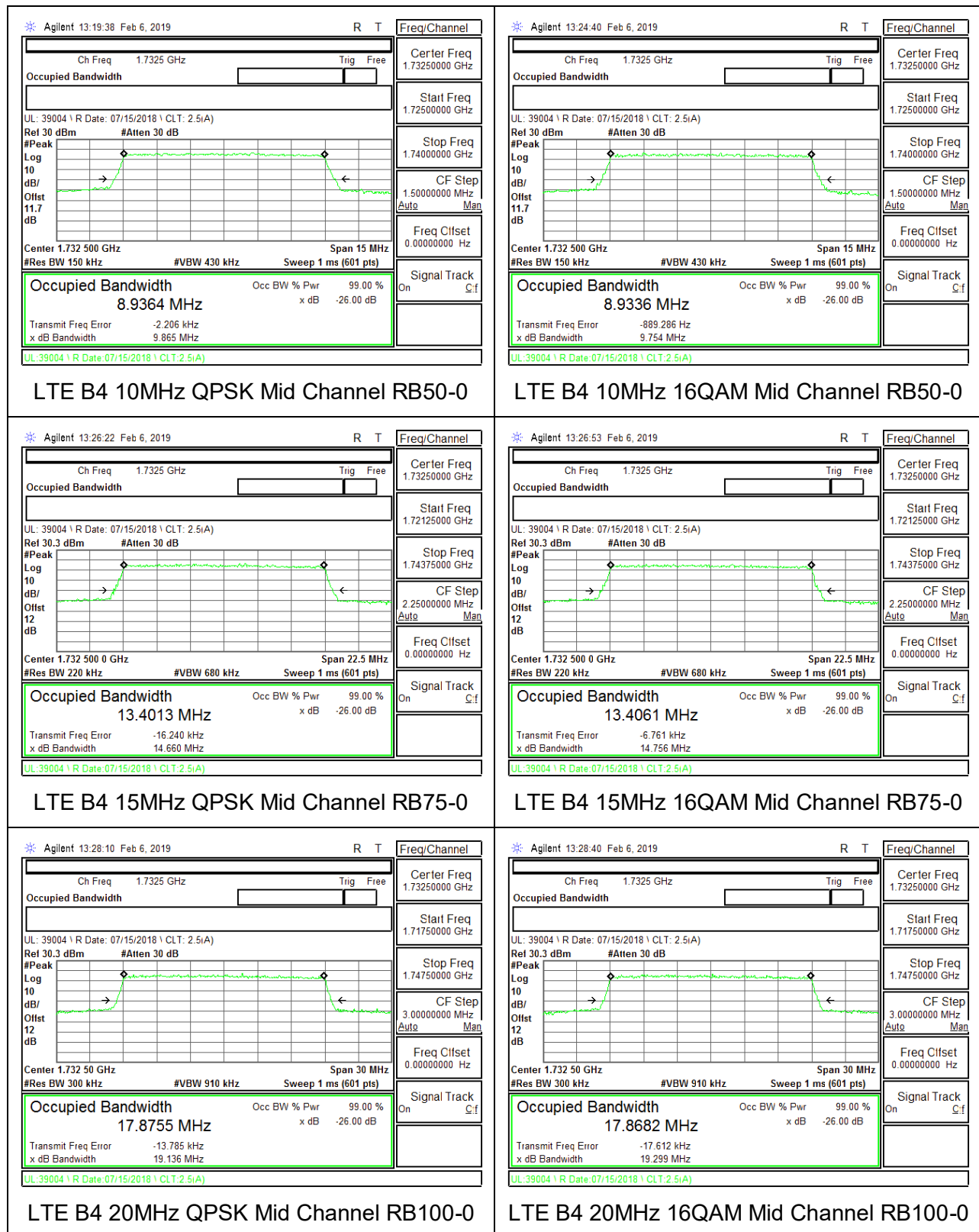
8.1.1. LTE BAND 2



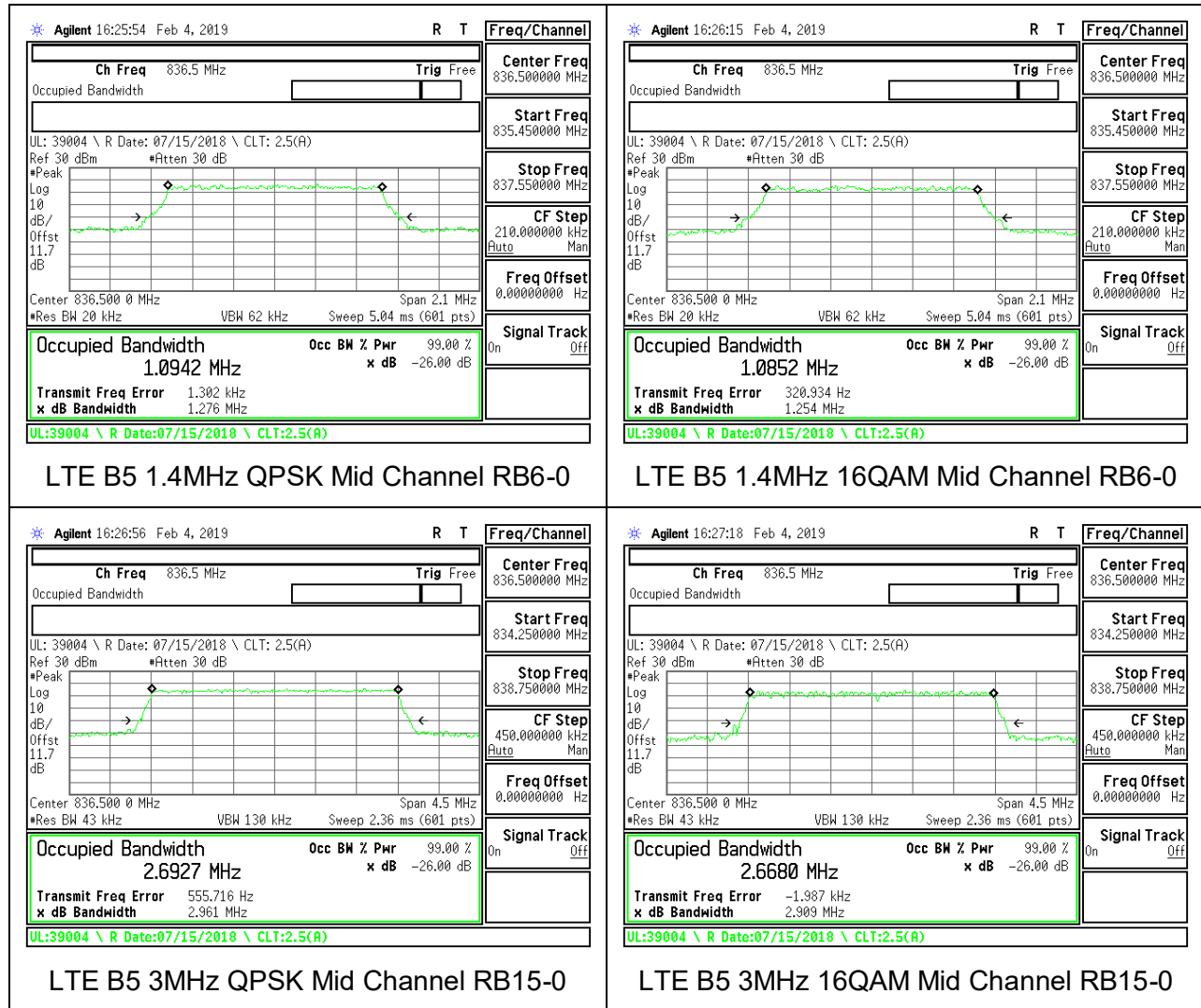


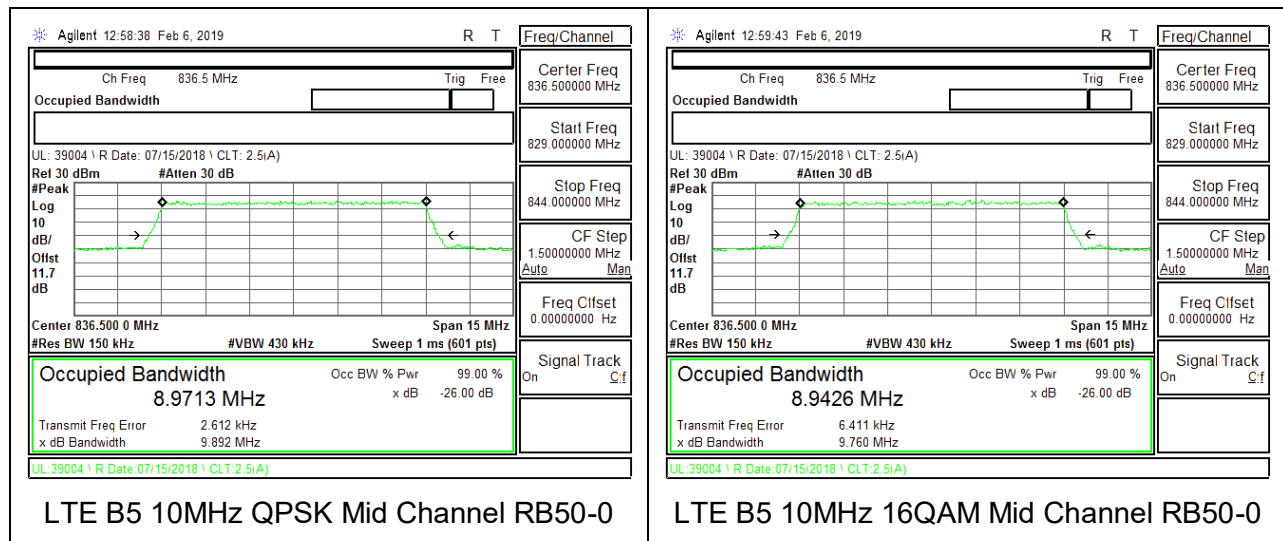
8.1.2. LTE BAND 4





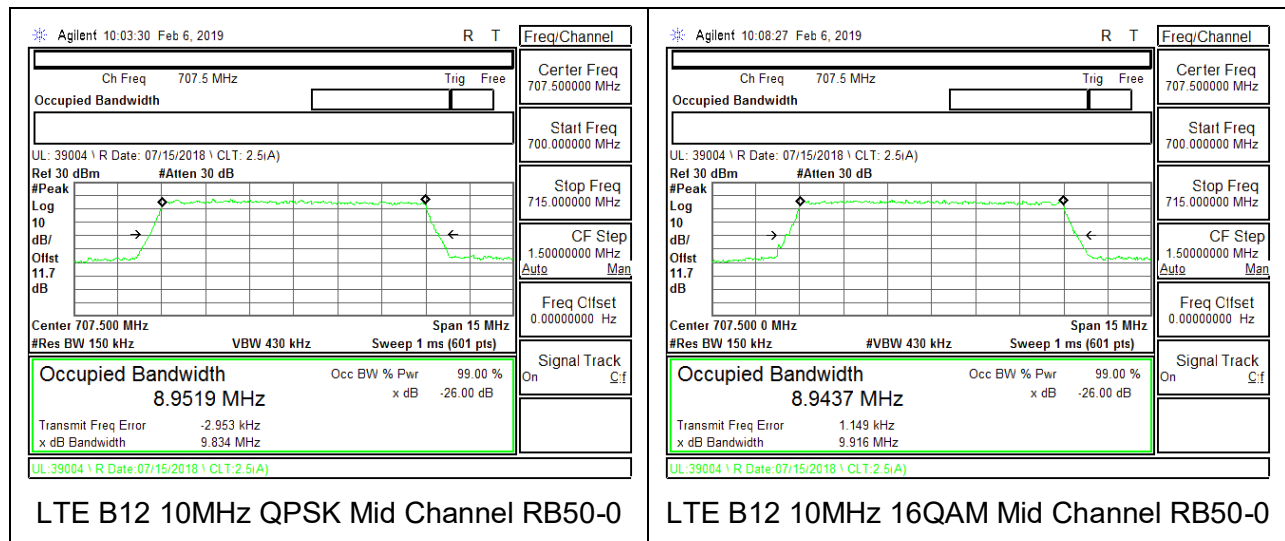
8.1.3. LTE BAND 5





8.1.4. LTE BAND 12





8.2. BAND EDGE AND EMISSION MASK

RULE PART(S)

FCC: §2.1051, §22.917, §24.238, §27.53

IC: RSS130§4.6, RSS132§5.5; RSS133§6.5, RSS139§6.6

LIMITS

FCC: §22.917, §24.238, §27.53(h)

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.

FCC: §27.53 (Band 12)

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS130§4.6

4.6.1 The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

4.6.2 In addition to the limit outlined in Section 4.6.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- (i) $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment, and
- (ii) $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment.

RSS132§5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

- (i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).
- (ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

RSS133§6.5

Equipment shall comply with the limits in (i) and (ii) below.

- (i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p(\text{watts})$.
- (ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p(\text{watts})$. If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

RSS139§6.6

- (i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, Footnote 2 which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p(\text{watts})$ dB.
- (ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p(\text{watts})$ dB.

TEST PROCEDURE

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

For each band edge measurement:

1. Set the spectrum analyzer span to include the block edge frequency.
2. Set a marker to point the corresponding band edge frequency in each test case.
3. Set display line at -13 dBm
4. Set resolution bandwidth to at least 1% of emission bandwidth.

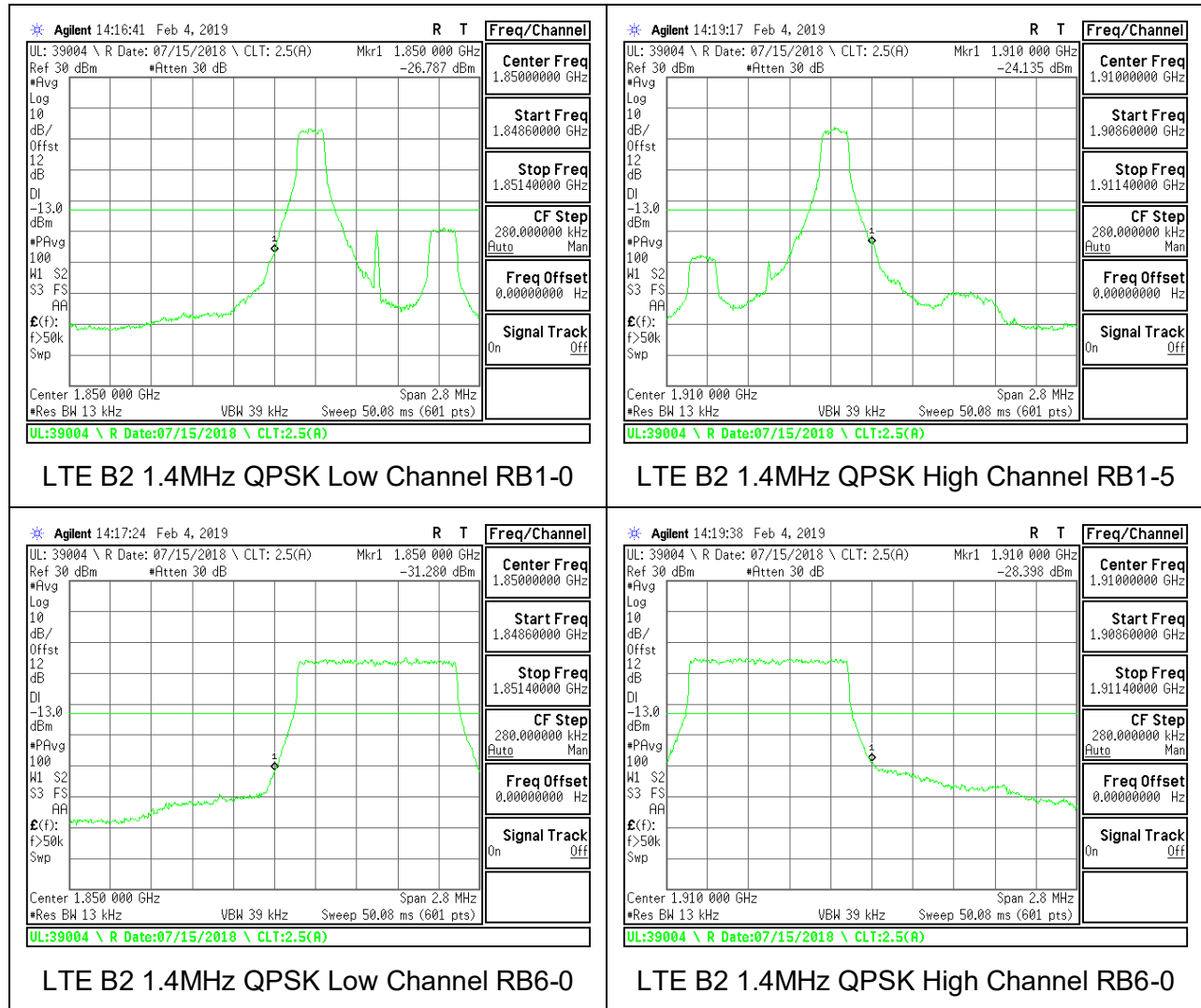
MODES TESTED

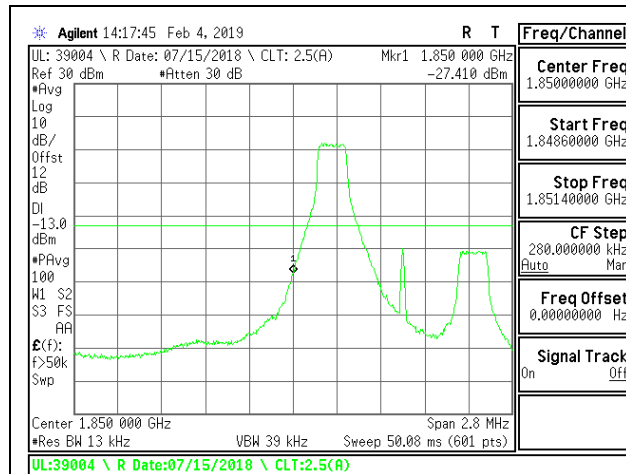
- LTE Band 2
- LTE Band 4
- LTE Band 5
- LTE Band 12

RESULTS

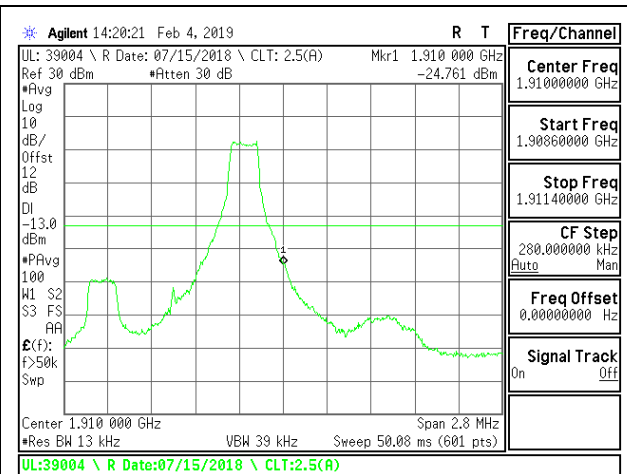
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8.2.1. LTE BAND 2 BANDEDGE

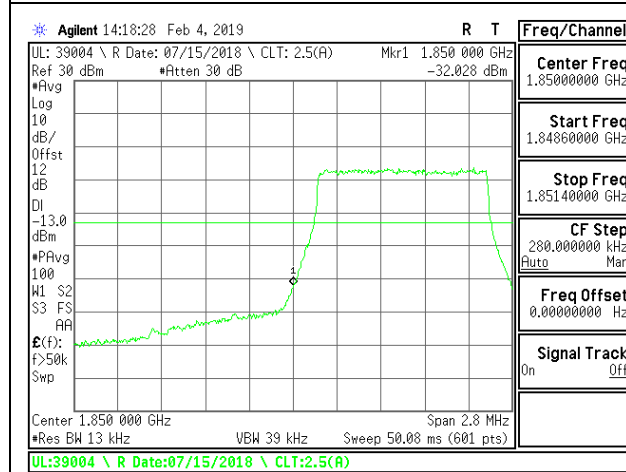




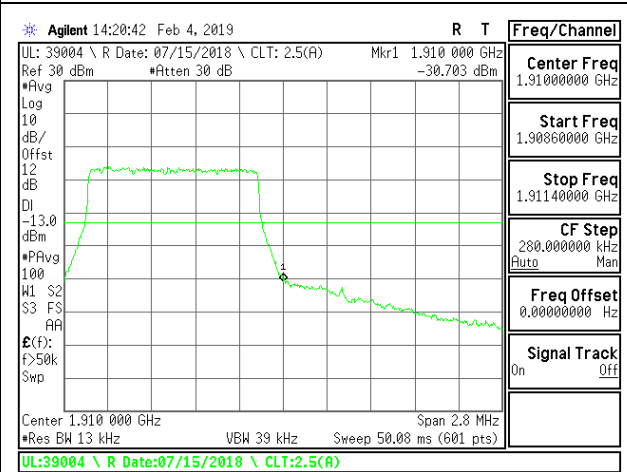
LTE B2 1.4MHz 16QAM Low Channel RB1-0



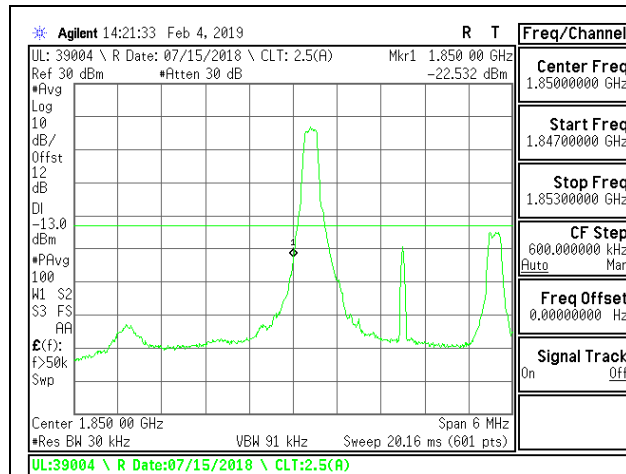
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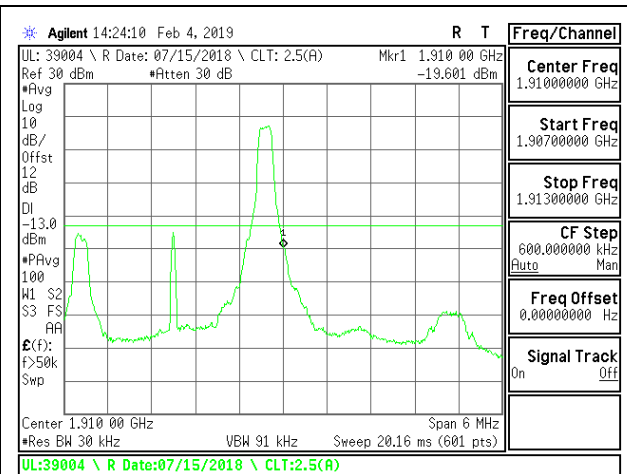
LTE B2 1.4MHz 16QAM Low Channel RB6-0



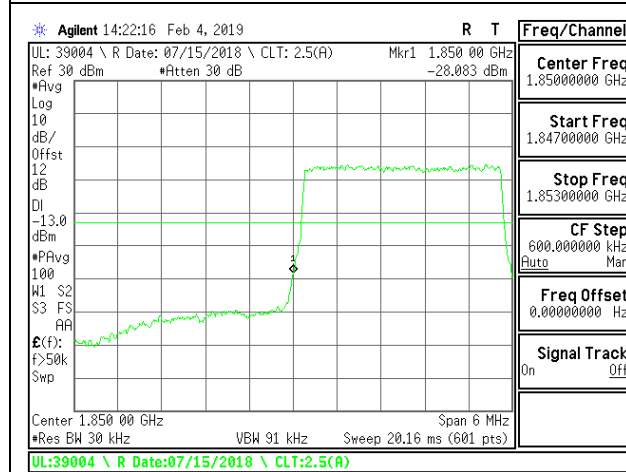
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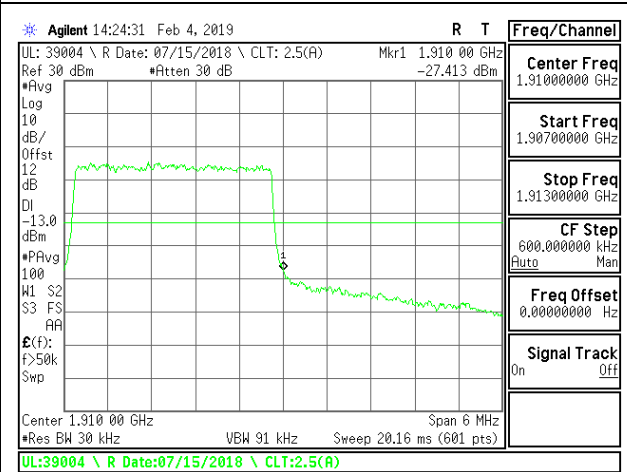
LTE B2 3MHz QPSK Low Channel RB1-0



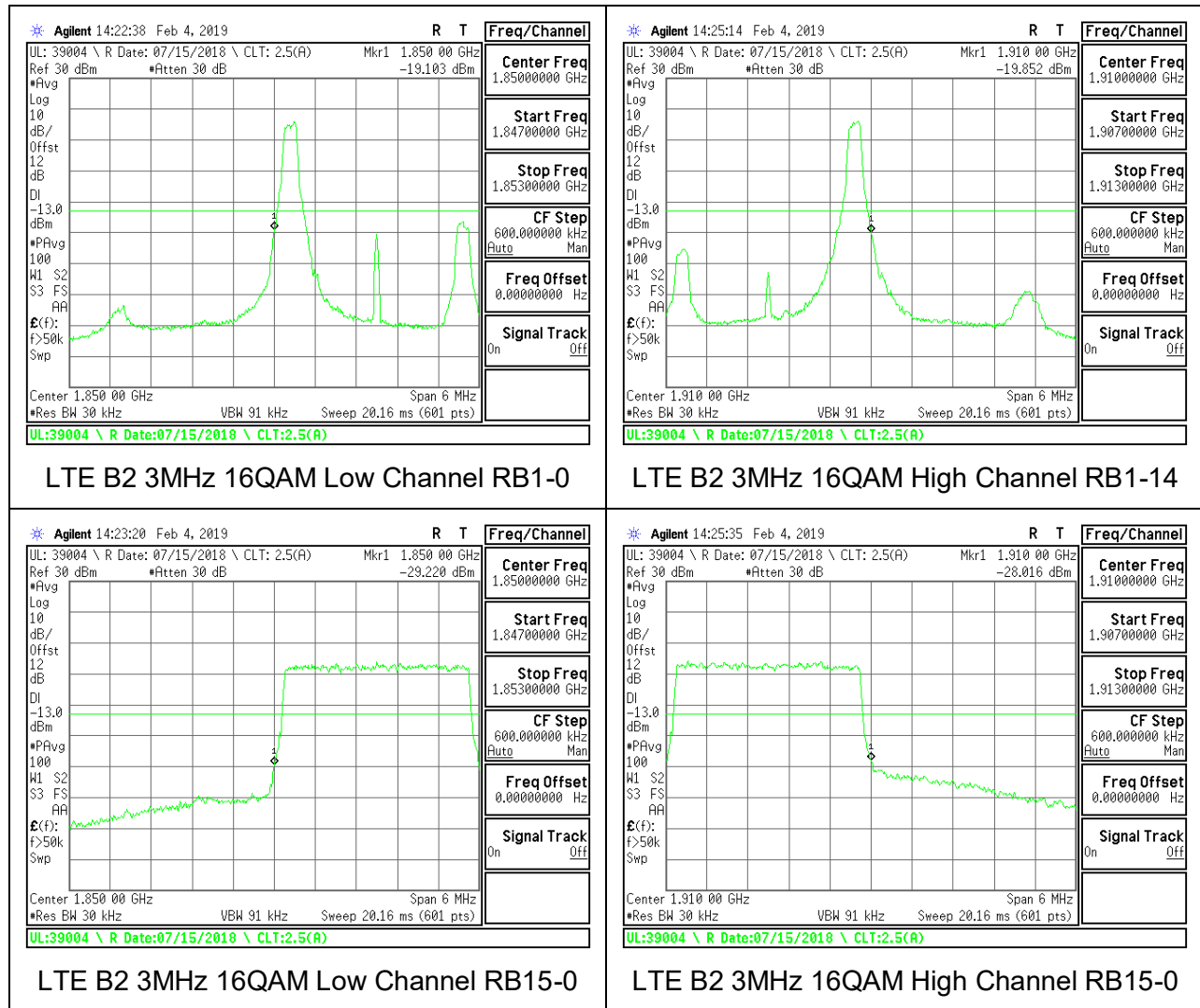
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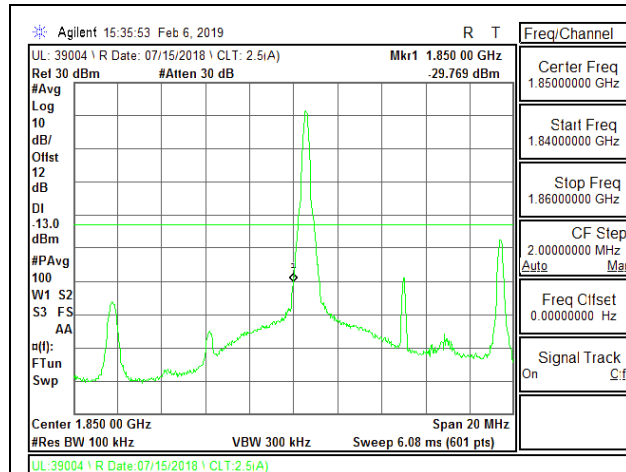


LTE B2 3MHz QPSK Low Channel RB15-0

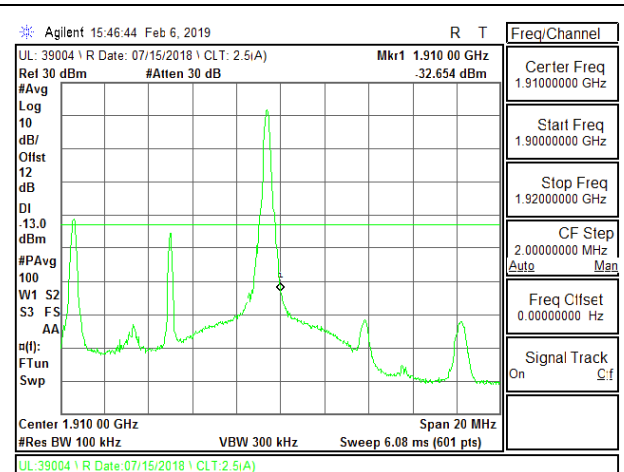


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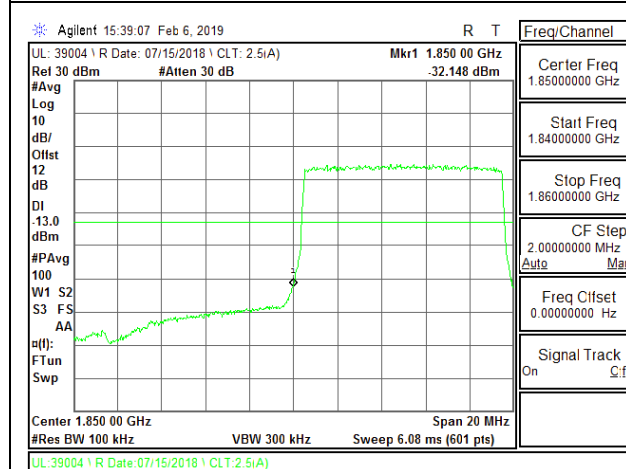




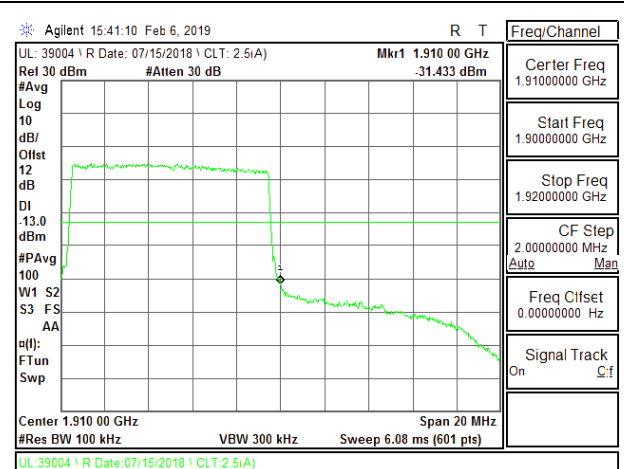
LTE B2 10MHz QPSK Low Channel RB1-0



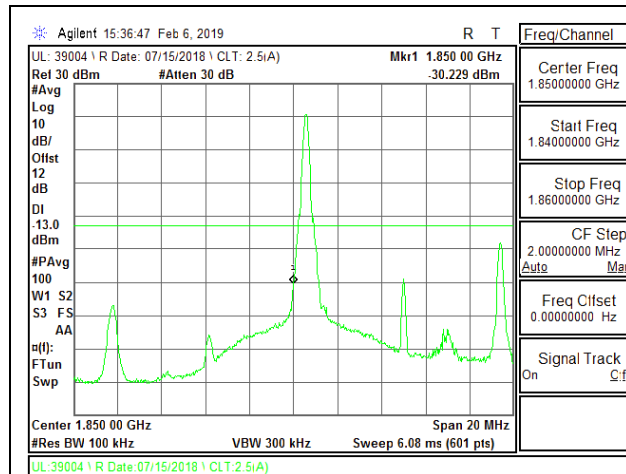
LTE B2 10MHz QPSK High Channel RB1-49



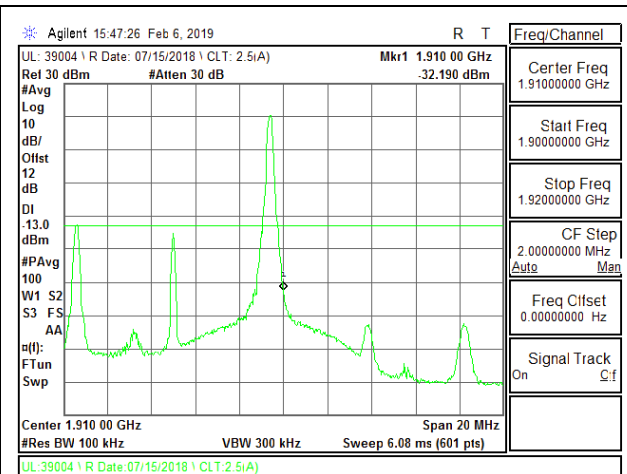
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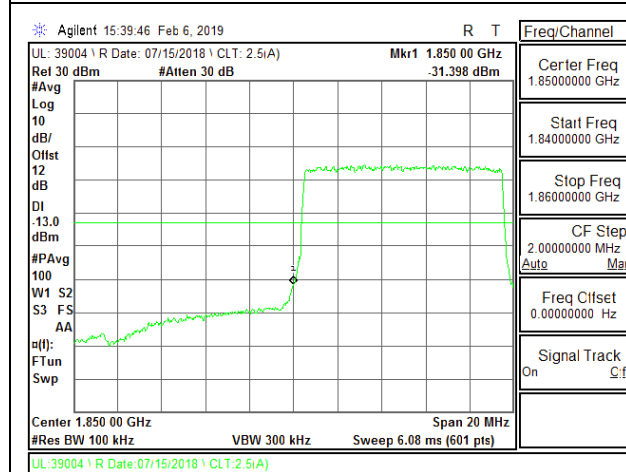
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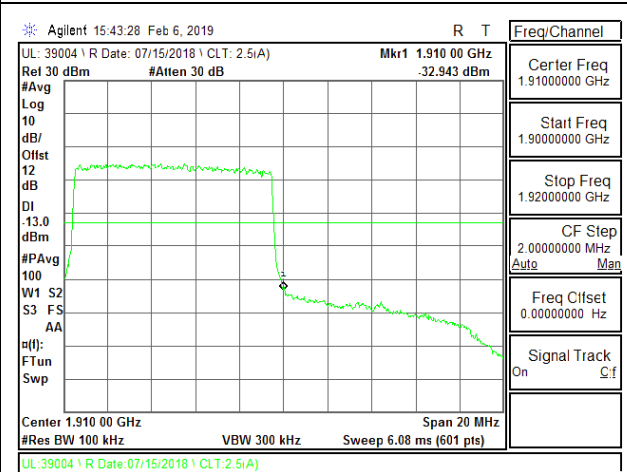
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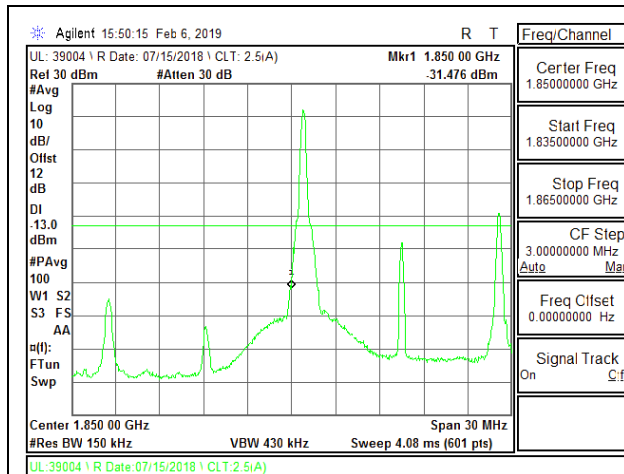
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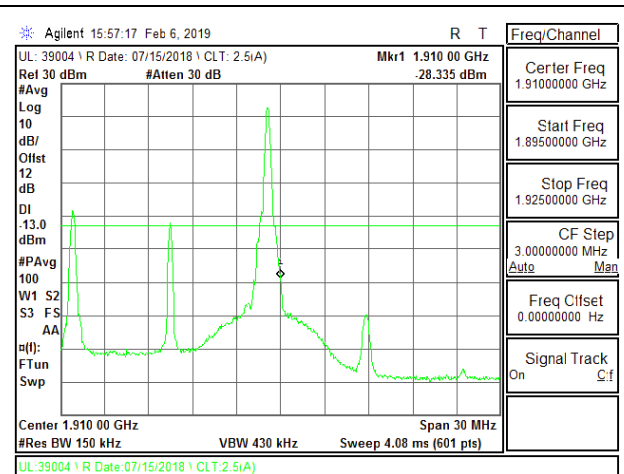
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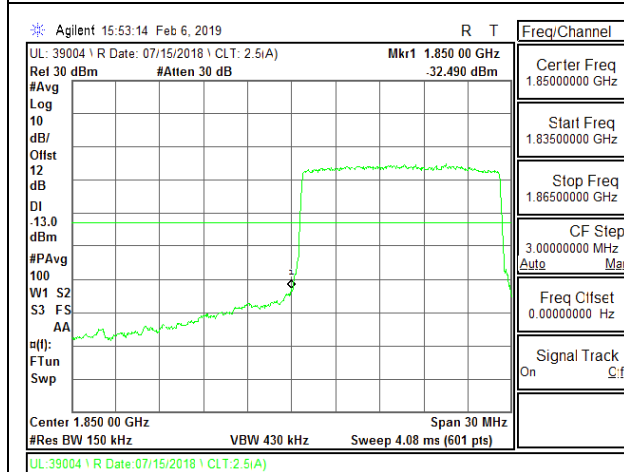
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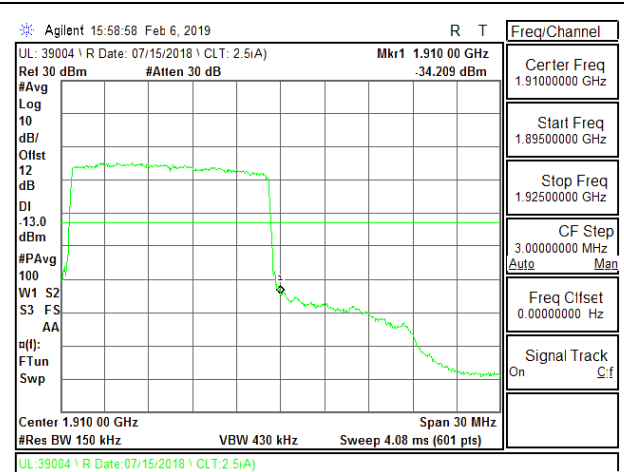
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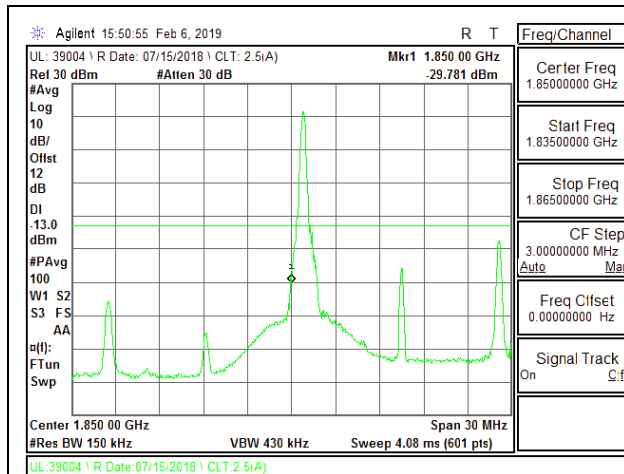
LTE B2 15MHz QPSK High Channel RB1-74



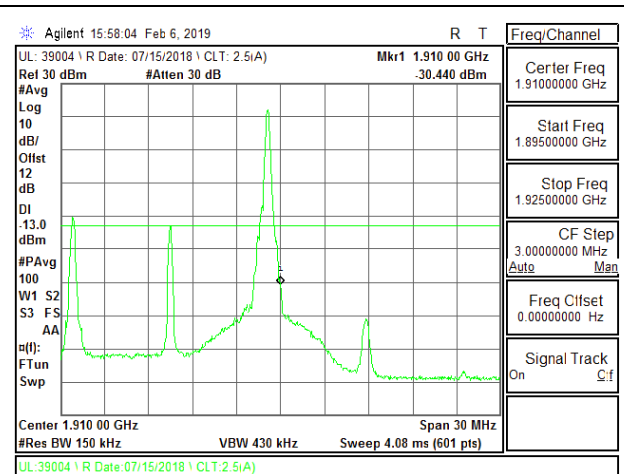
LTE B2 15MHz QPSK Low Channel RB75-0



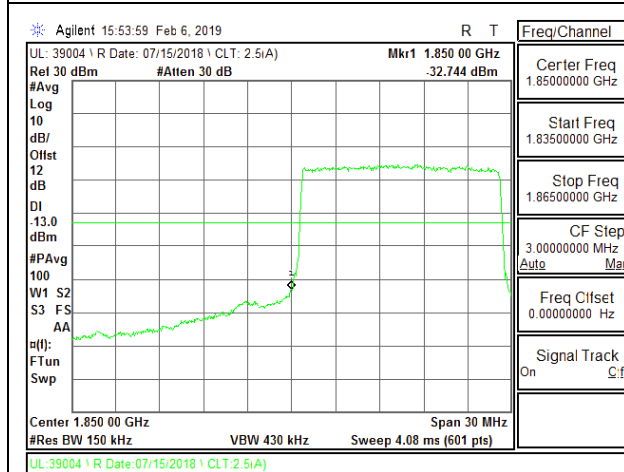
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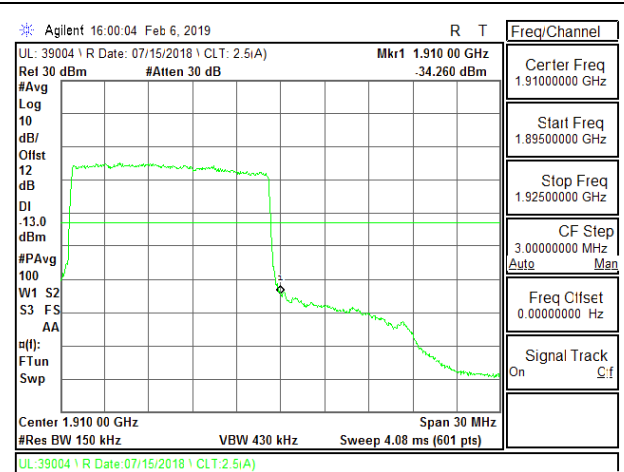
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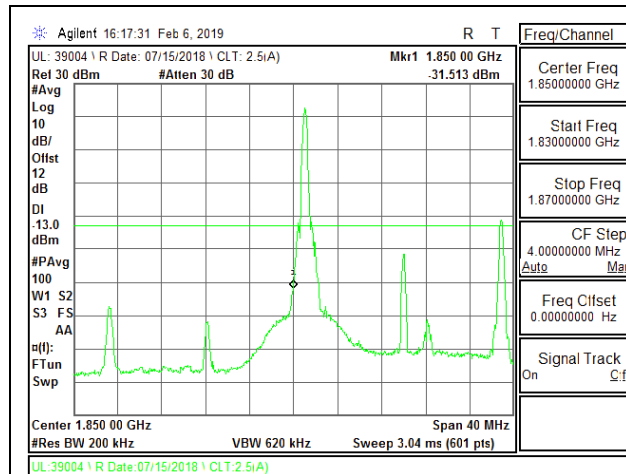
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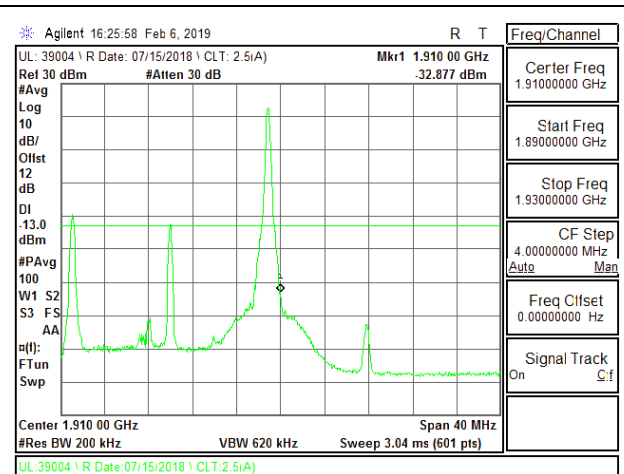
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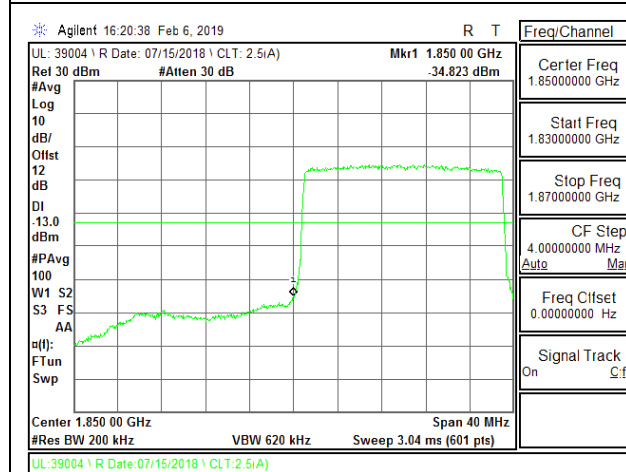
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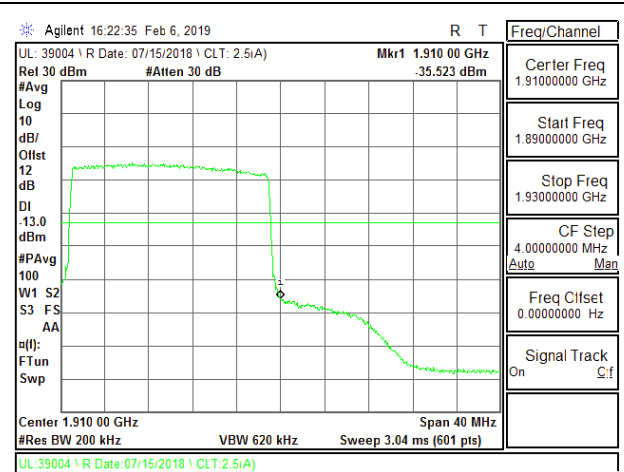
LTE B2 20MHz QPSK Low Channel RB1-0



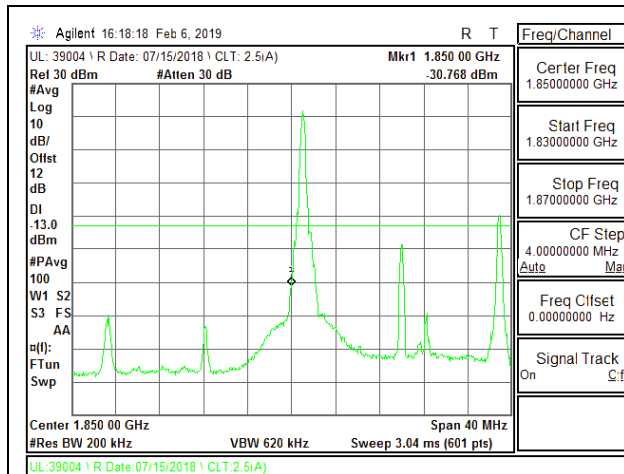
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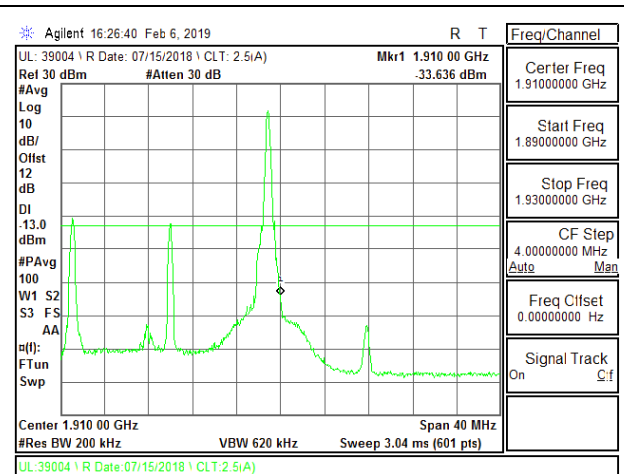
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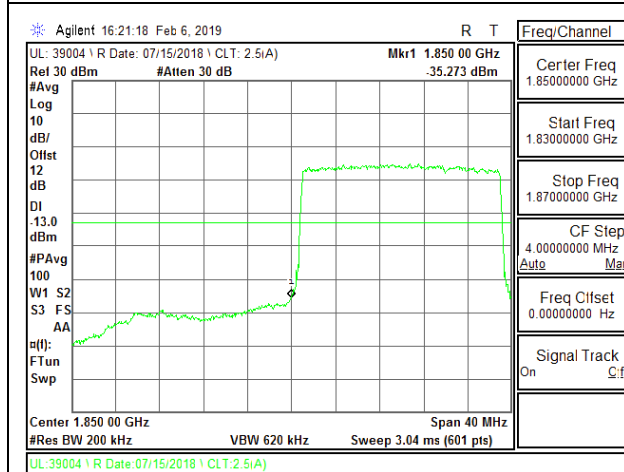
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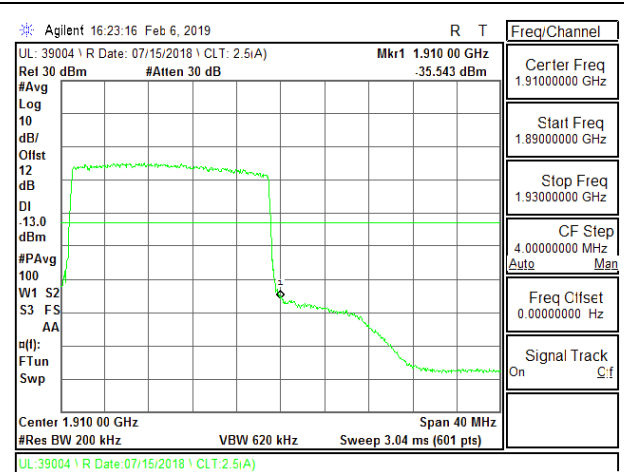
LTE B2 20MHz 16QAM Low Channel RB1-0



LTE B2 20MHz 16QAM High Channel RB1-99

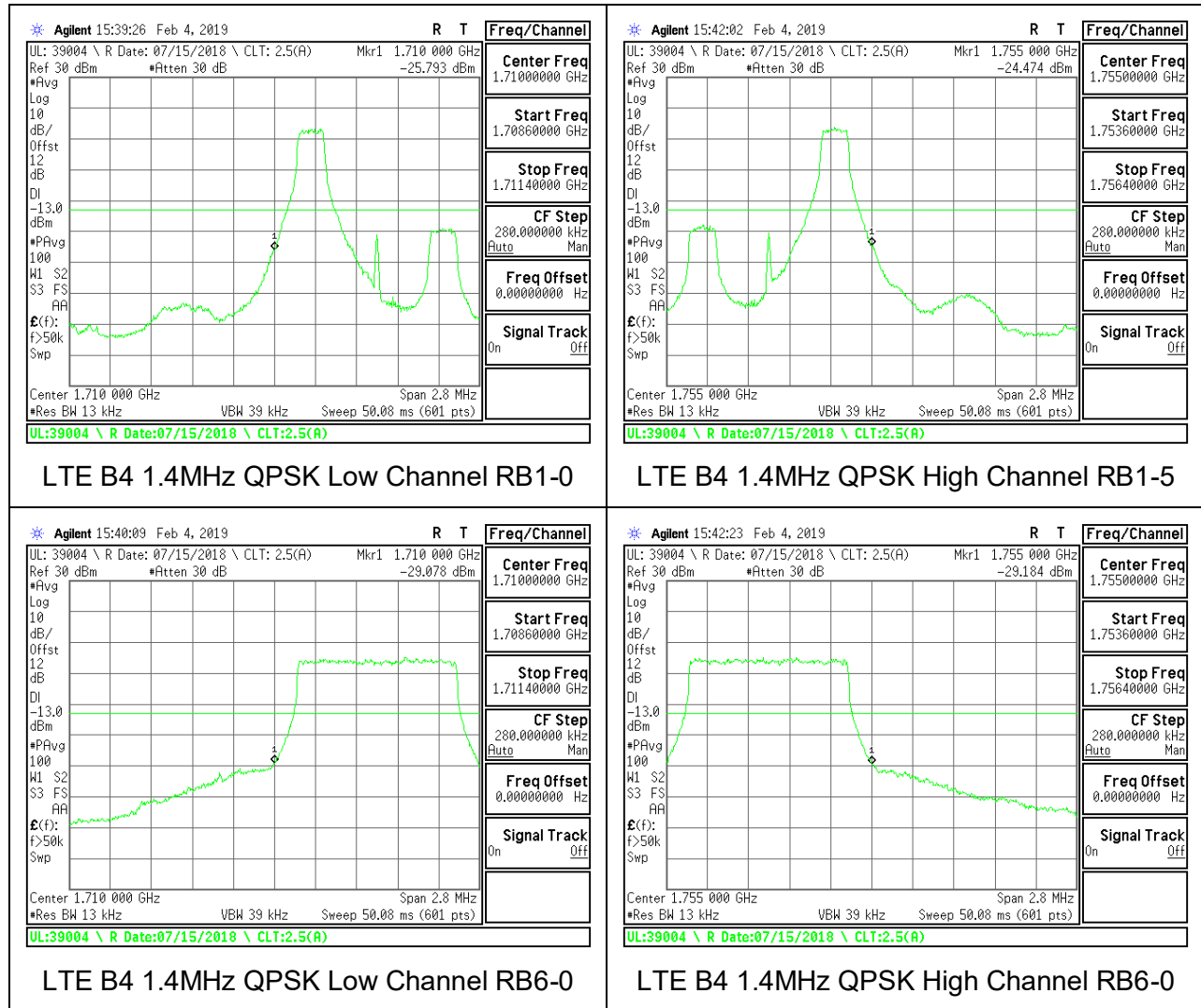


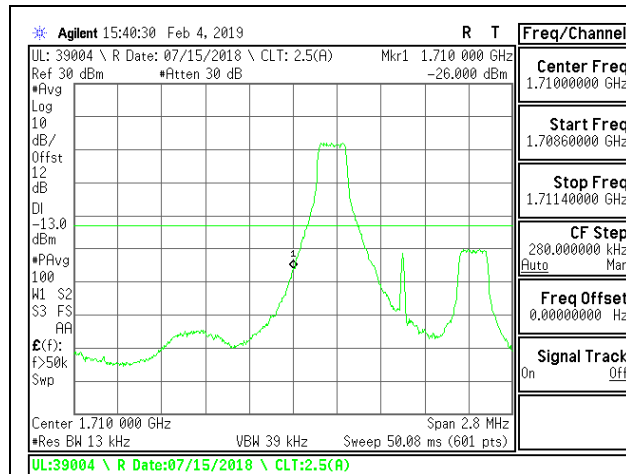
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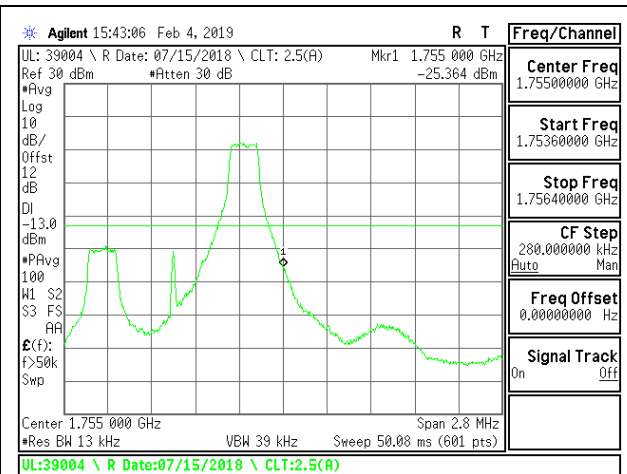
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8.2.2. LTE BAND 4 BANDEDGE

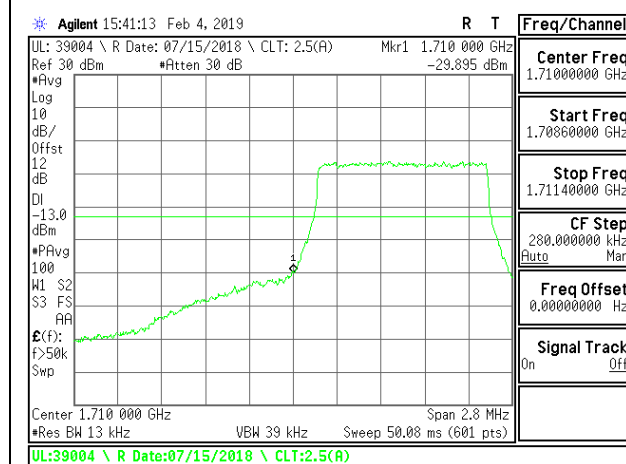




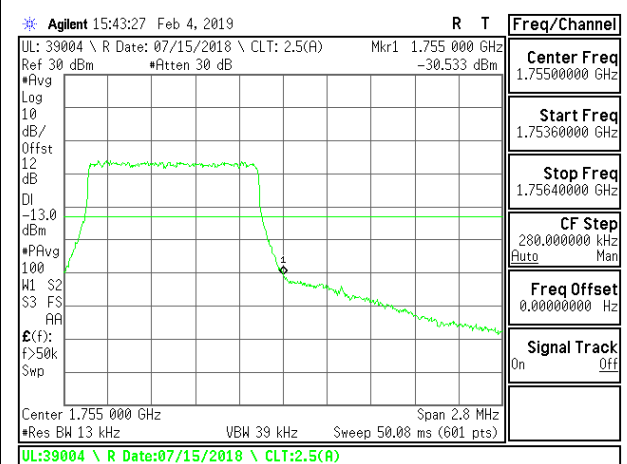
LTE B4 1.4MHz 16QAM Low Channel RB1-0



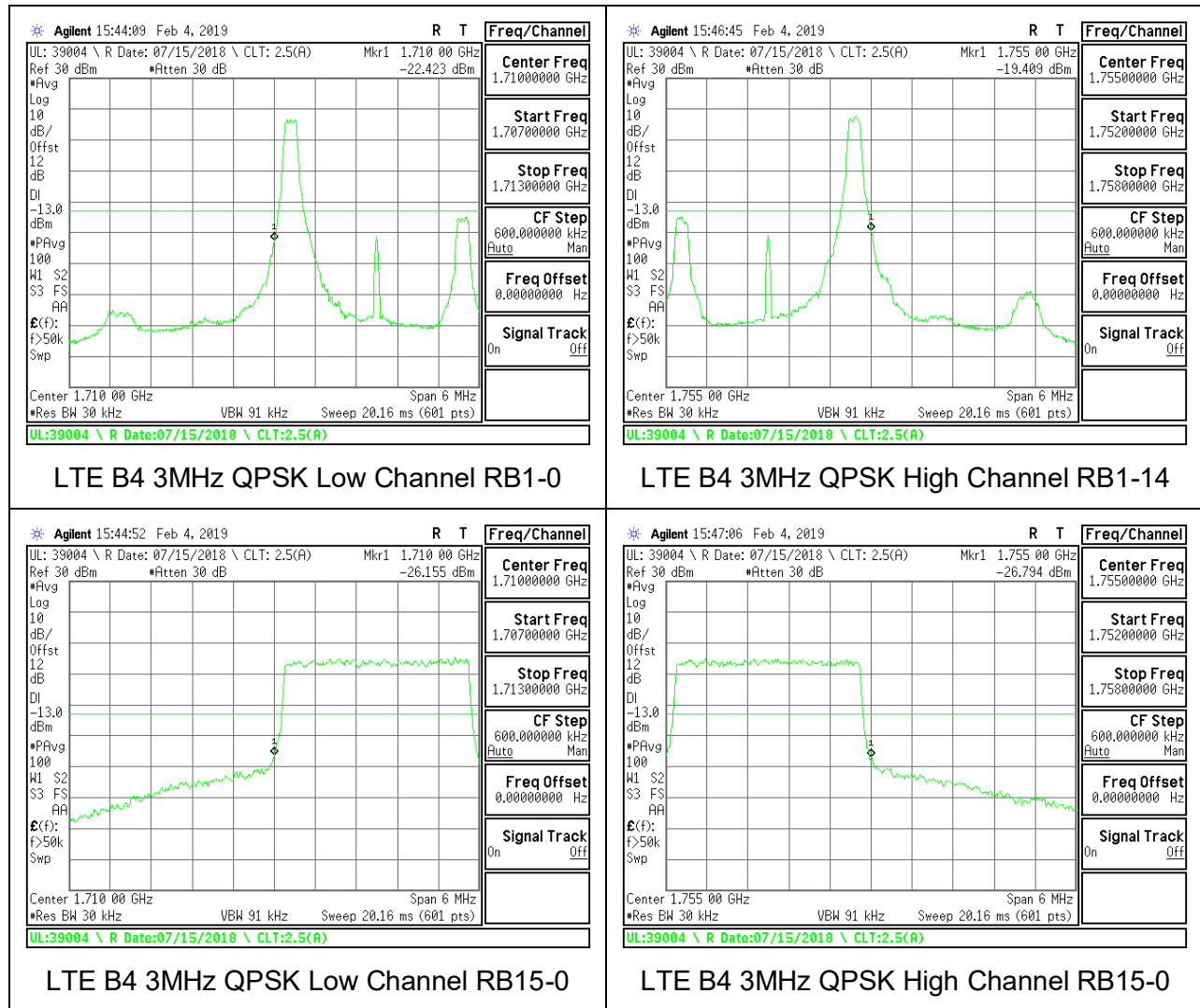
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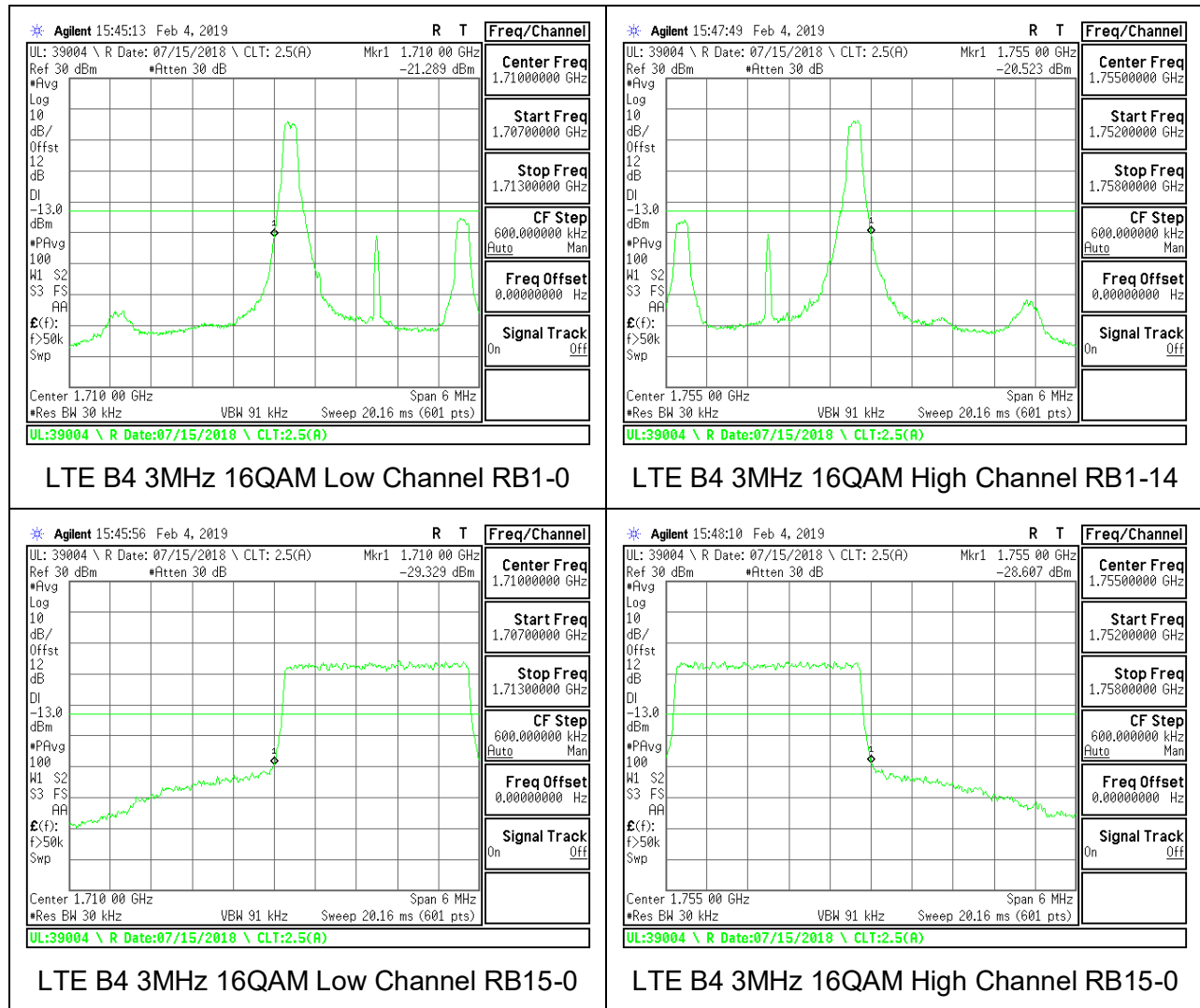


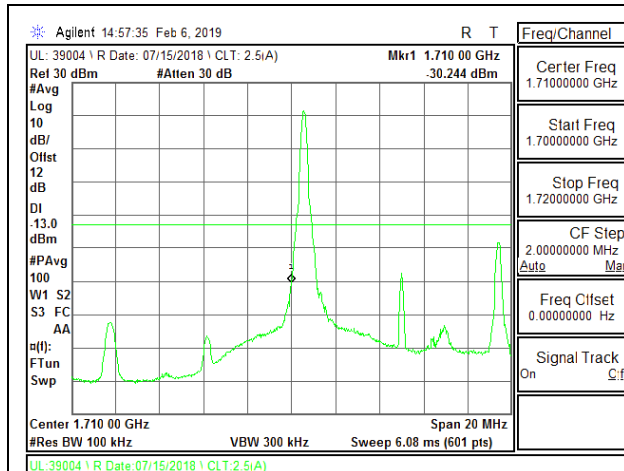
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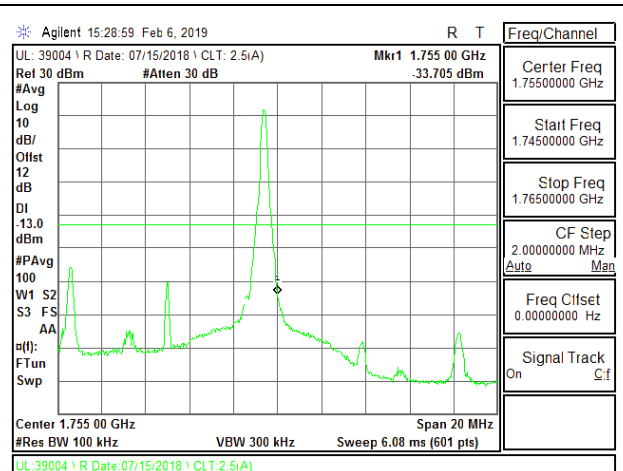
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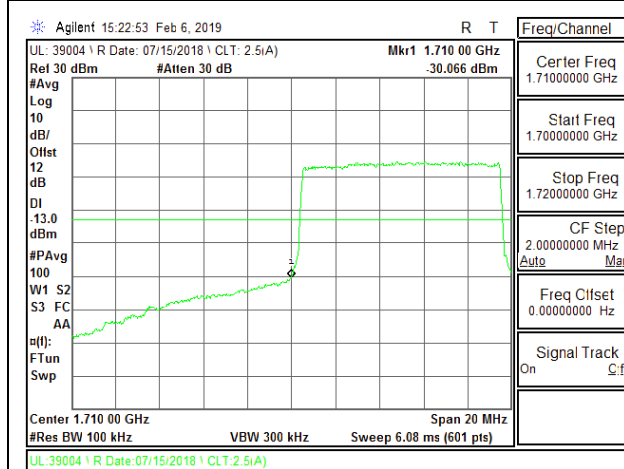




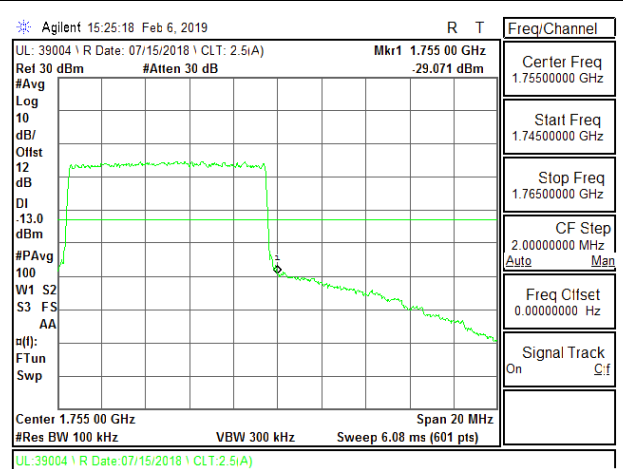
LTE B4 10MHz QPSK Low Channel RB1-0



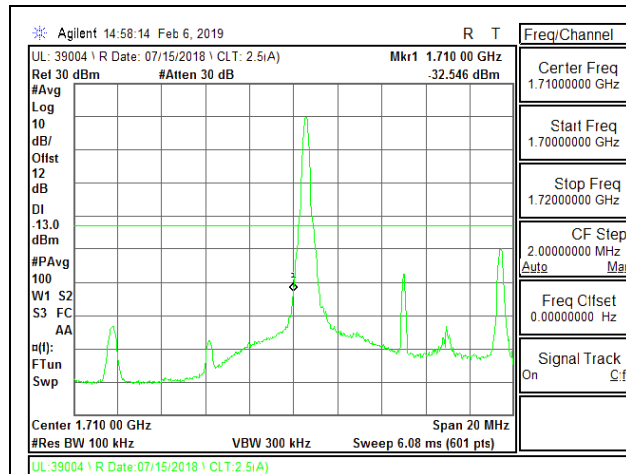
LTE B4 10MHz QPSK High Channel RB1-49



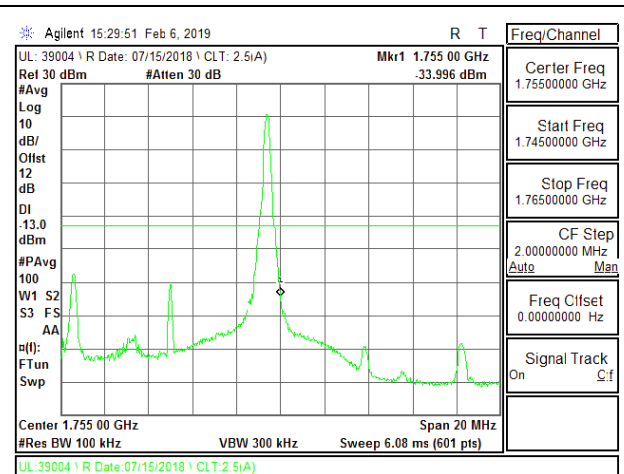
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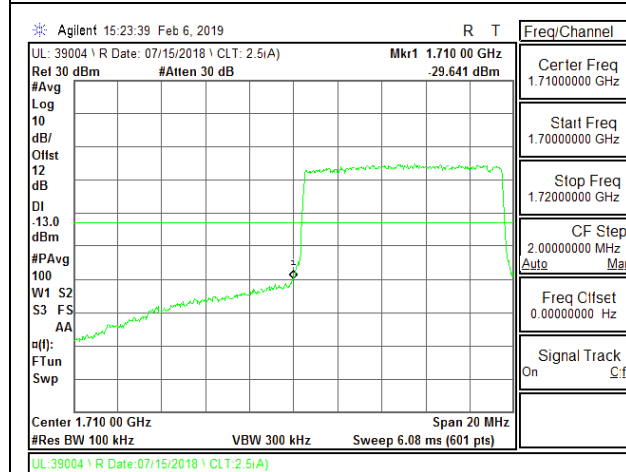
LTE B4 10MHz QPSK High Channel RB50-0



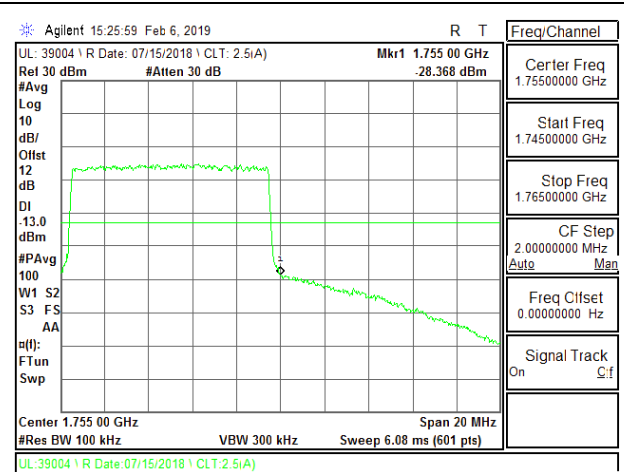
LTE B4 10MHz 16QAM Low Channel RB1-0



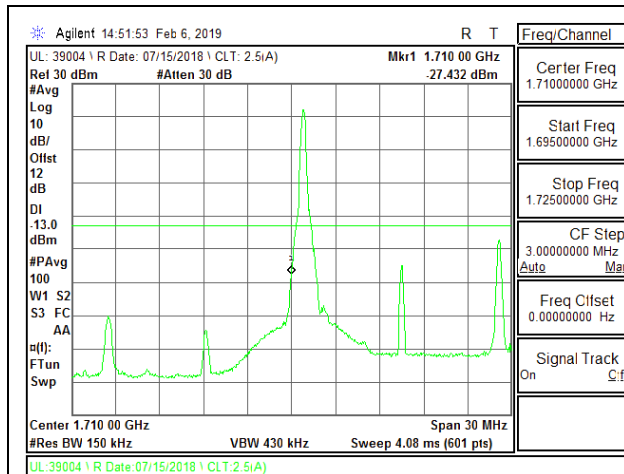
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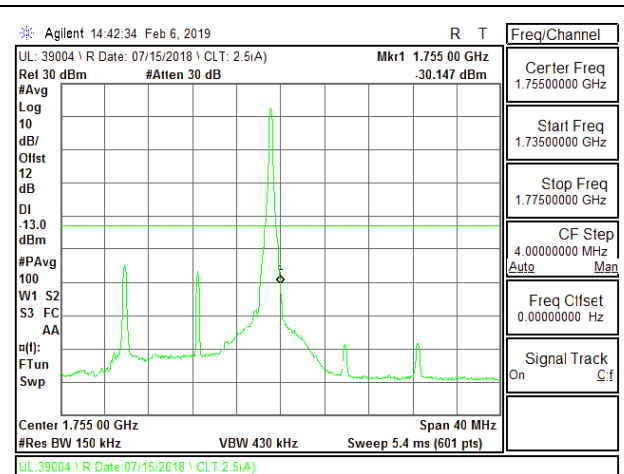
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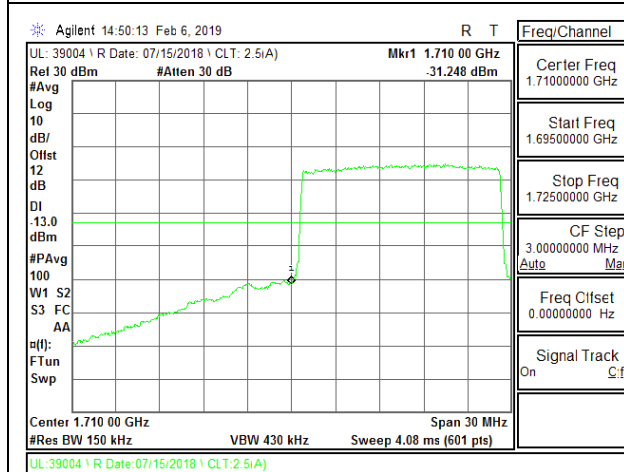
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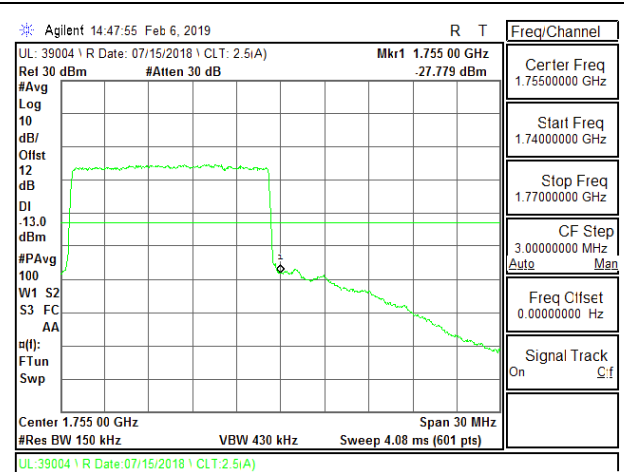
LTE B4 15MHz QPSK Low Channel RB1-0



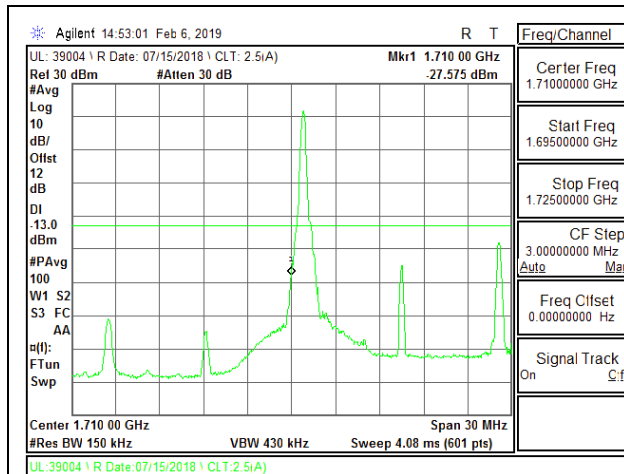
LTE B4 15MHz QPSK High Channel RB1-74



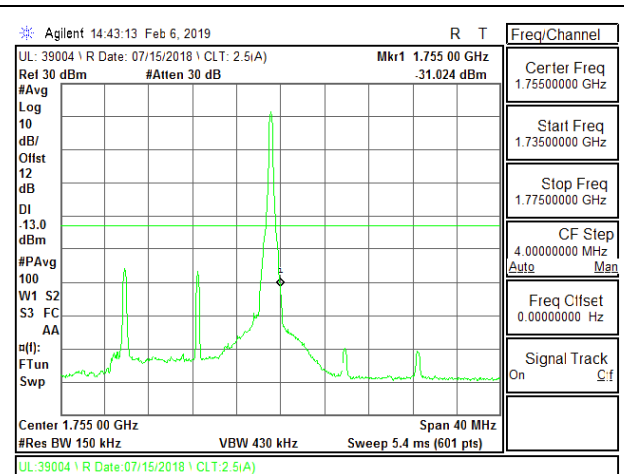
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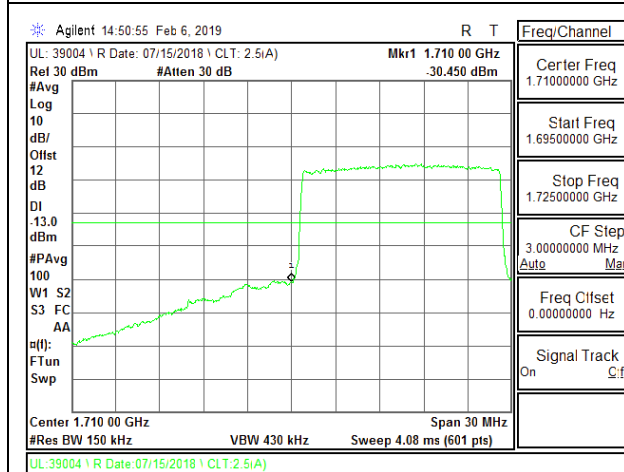
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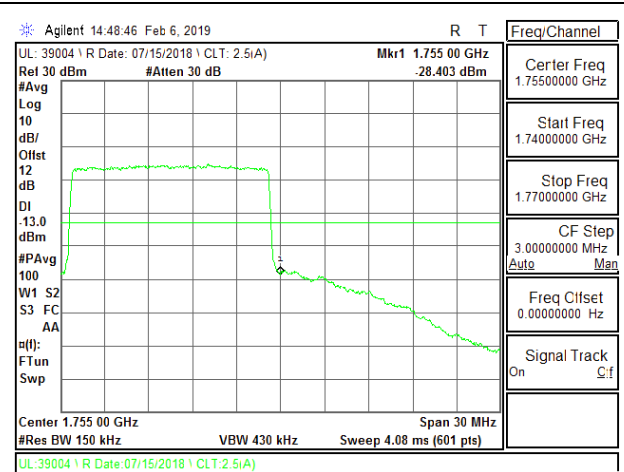
LTE B4 15MHz 16QAM Low Channel RB1-0



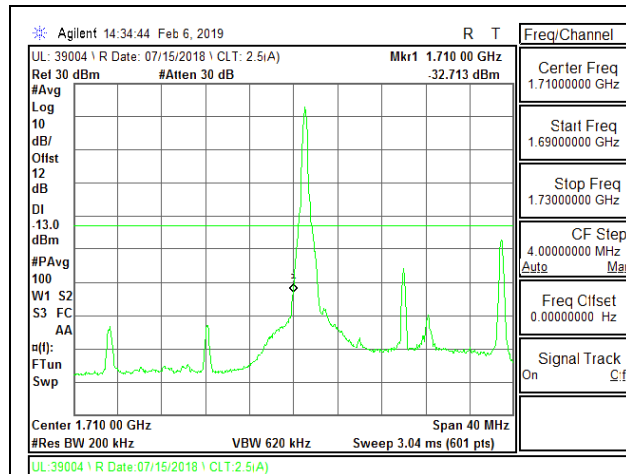
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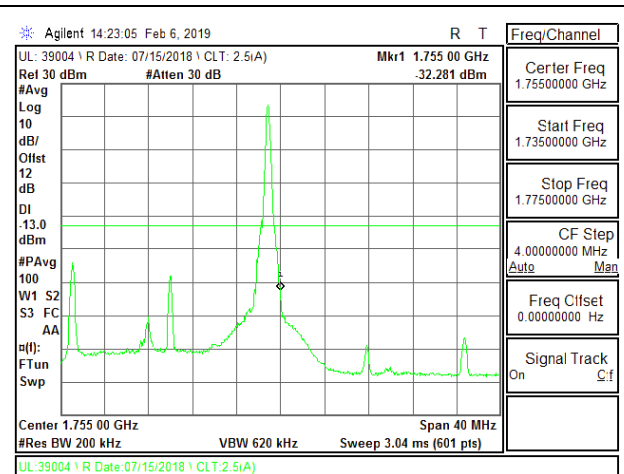
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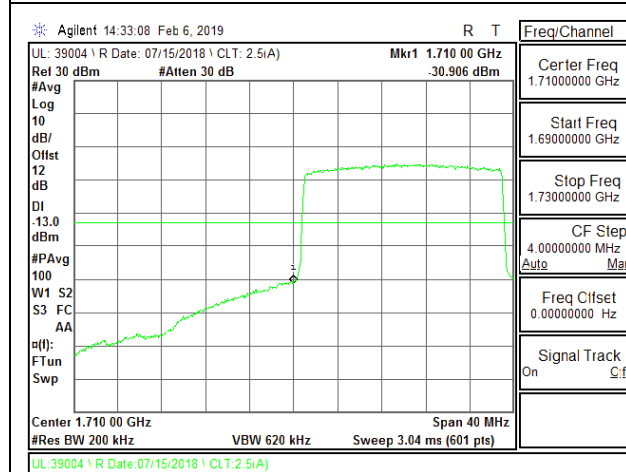
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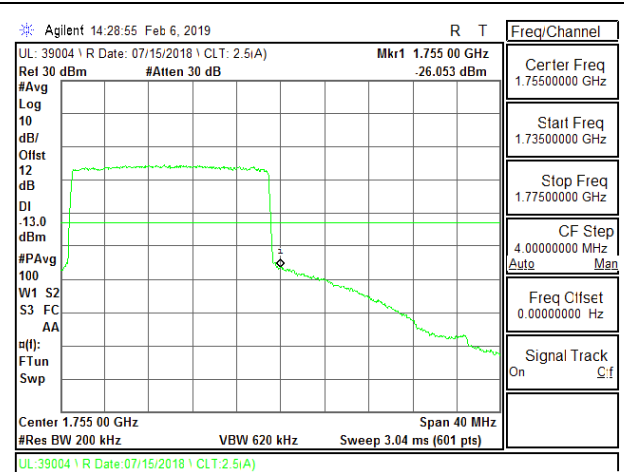
LTE B4 20MHz QPSK Low Channel RB1-0



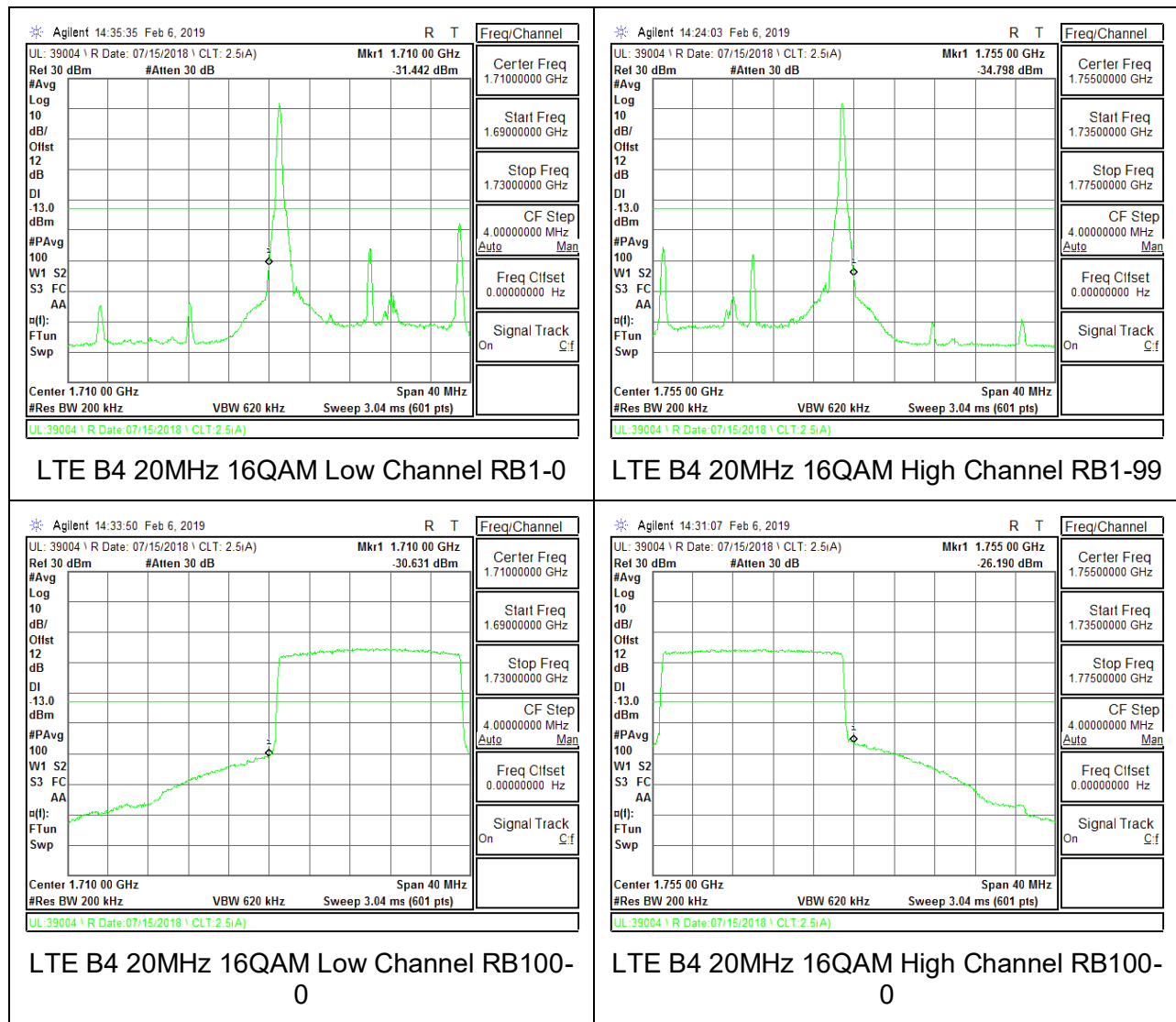
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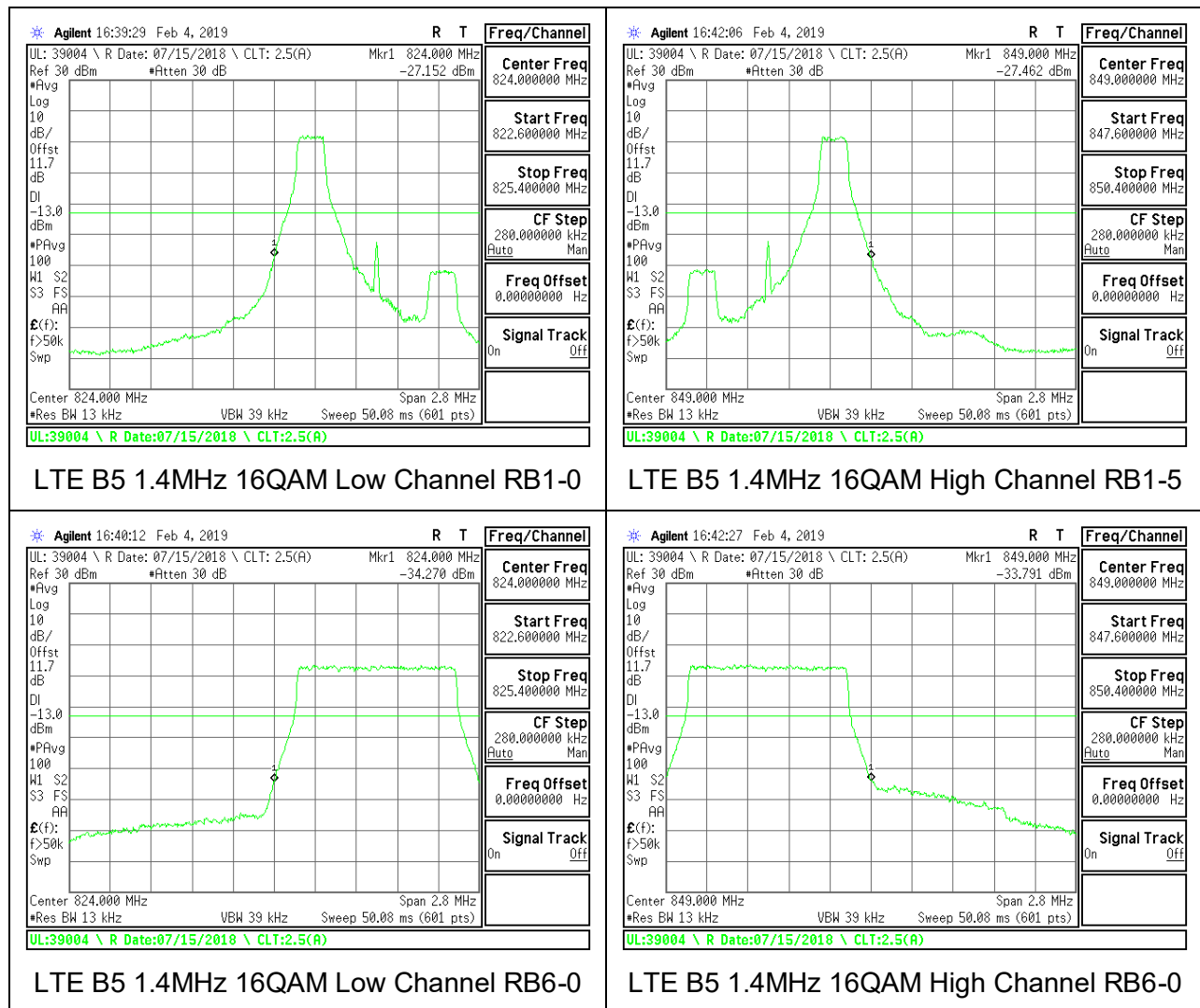


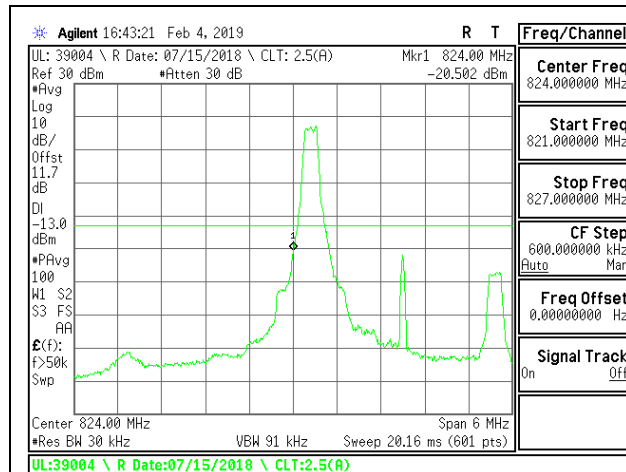
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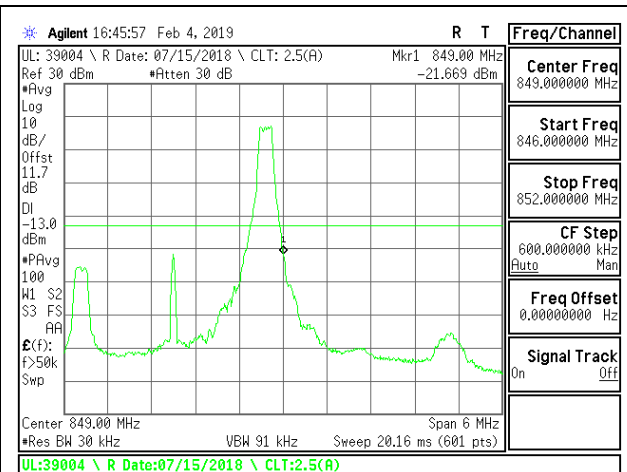
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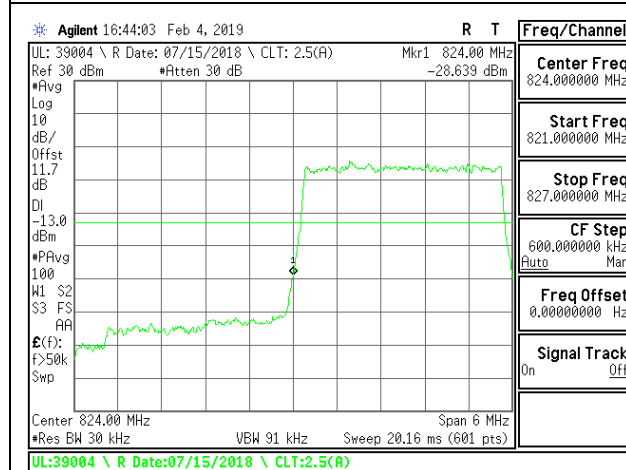




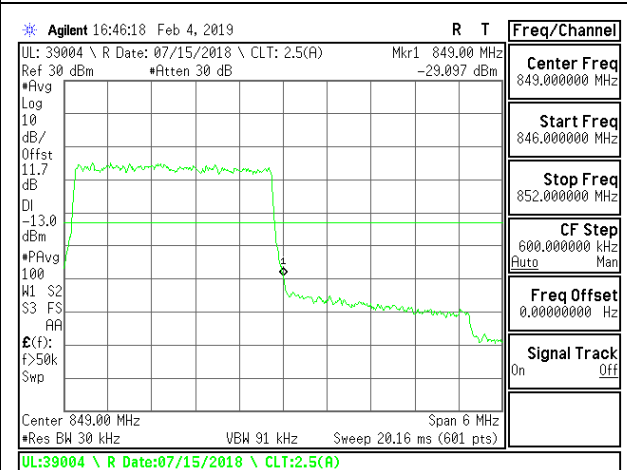
LTE B5 3MHz QPSK Low Channel RB1-0



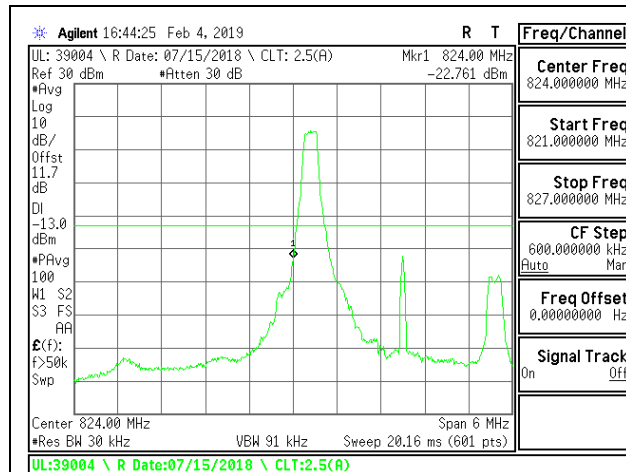
LTE B5 3MHz QPSK High Channel RB1-14



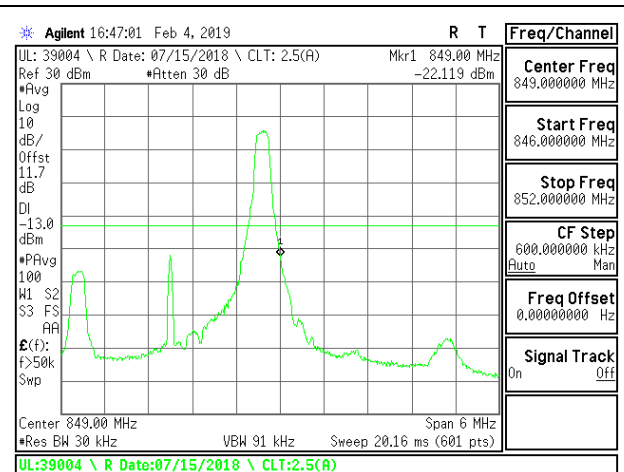
LTE B5 3MHz QPSK Low Channel RB15-0



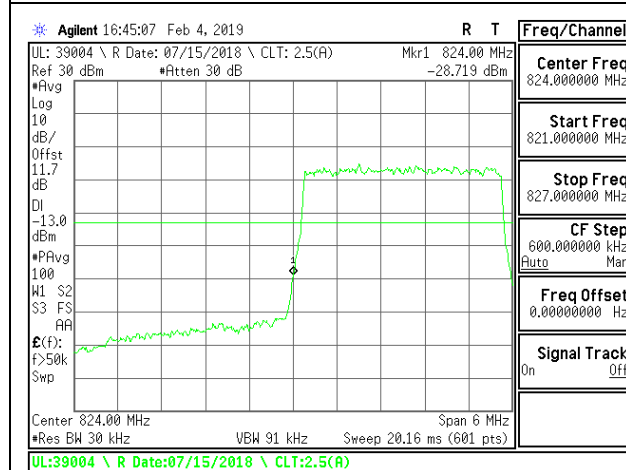
LTE B5 3MHz QPSK High Channel RB15-0



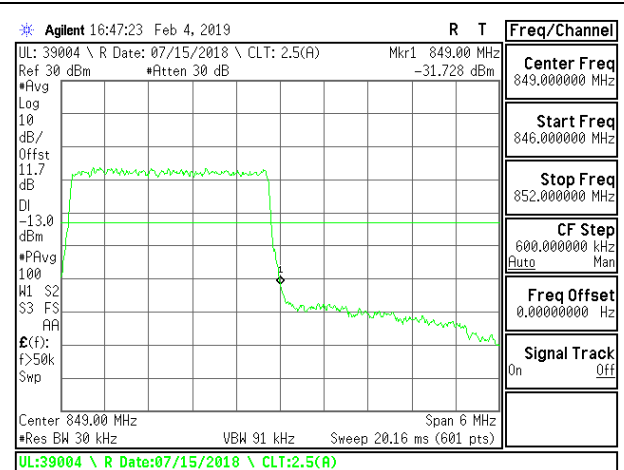
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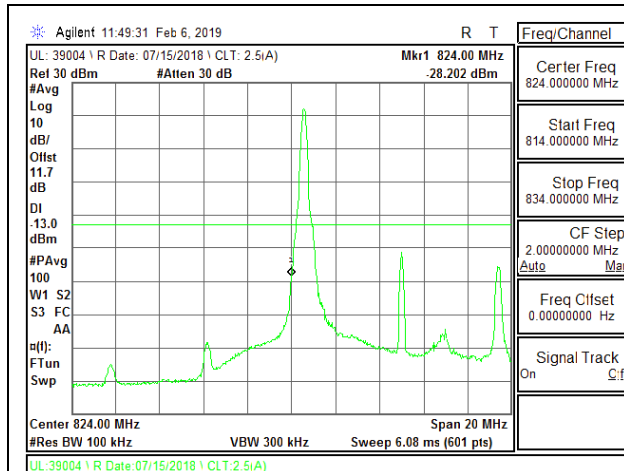
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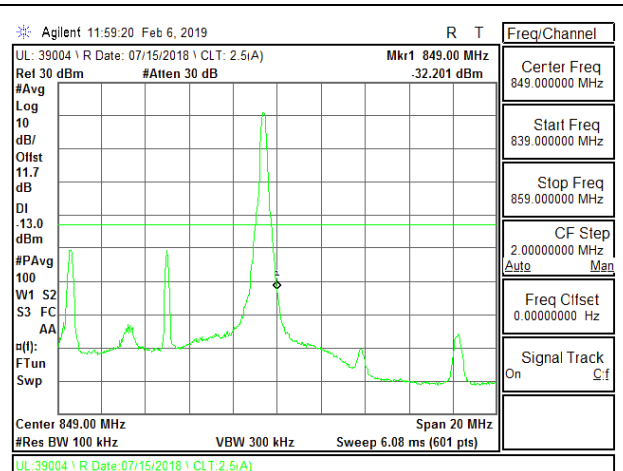
LTE B5 3MHz 16QAM Low Channel RB15-0



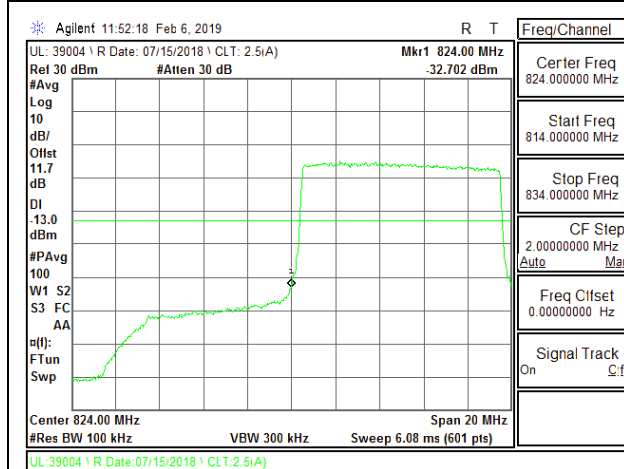
LTE B5 3MHz 16QAM High Channel RB15-0



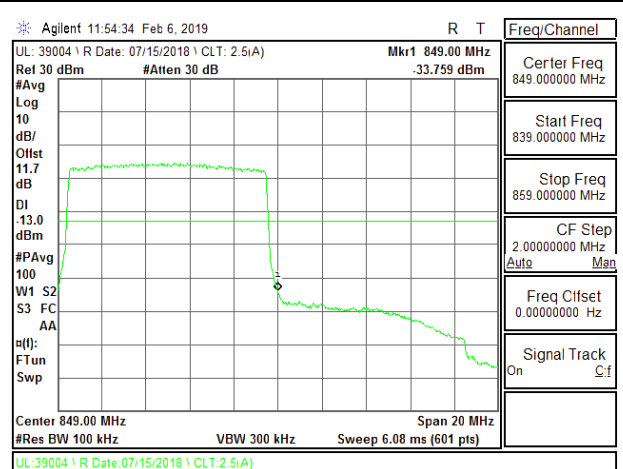
LTE B5 10MHz QPSK Low Channel RB1-0



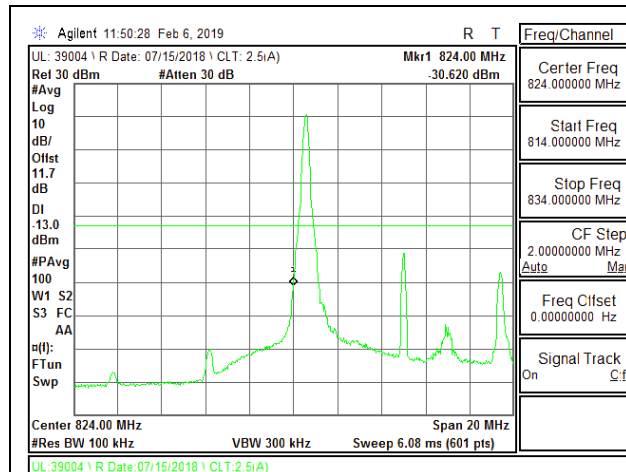
LTE B5 10MHz QPSK High Channel RB1-49



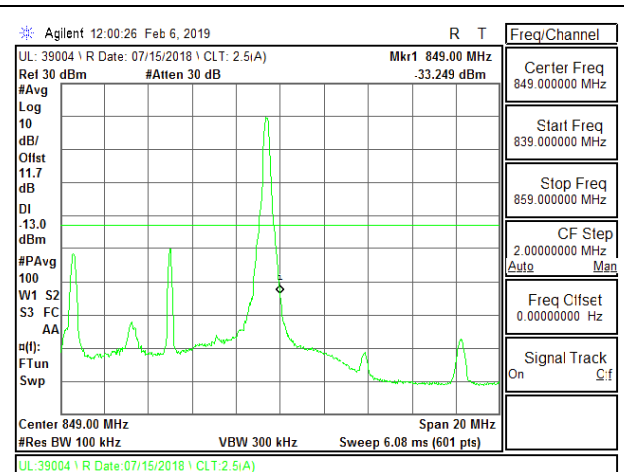
LTE B5 10MHz QPSK Low Channel RB50-0



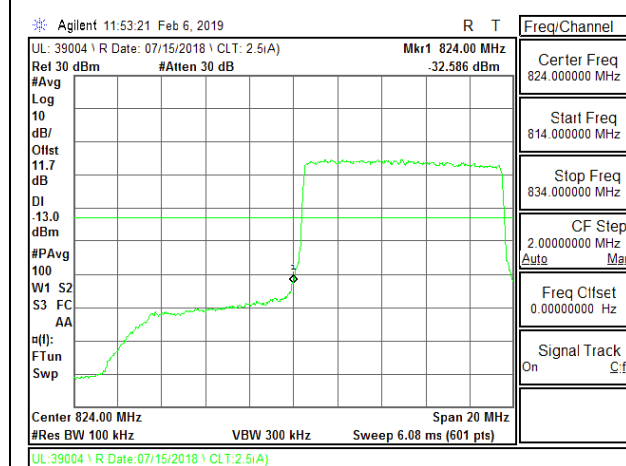
LTE B5 10MHz QPSK High Channel RB50-0



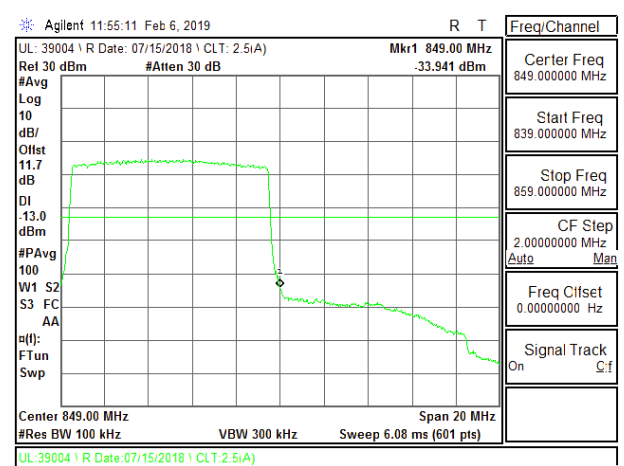
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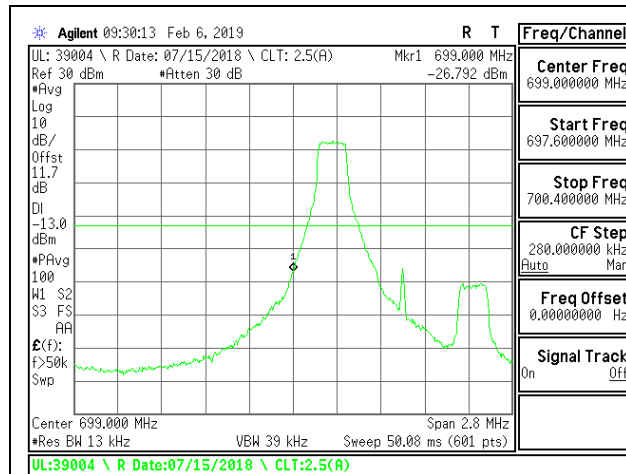
LTE B5 10MHz 16QAM High Channel RB1-49



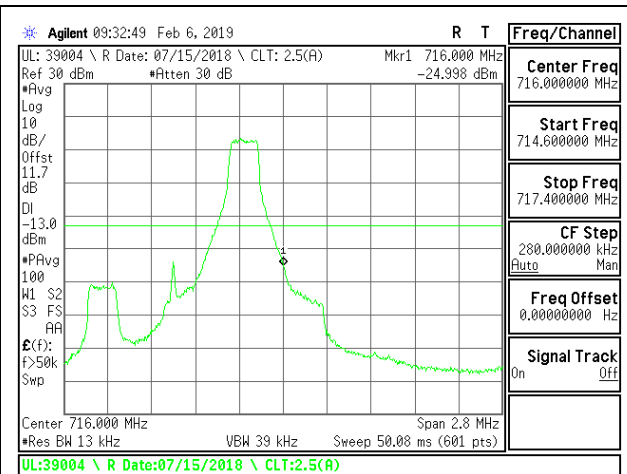
LTE B5 10MHz 16QAM Low Channel RB50-0



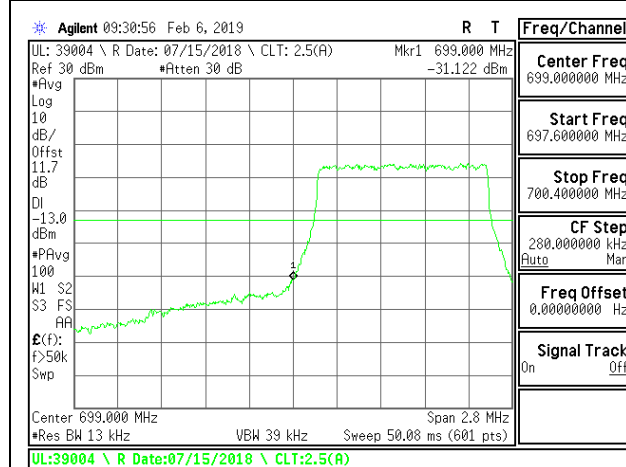
LTE B5 10MHz 16QAM High Channel RB50-0



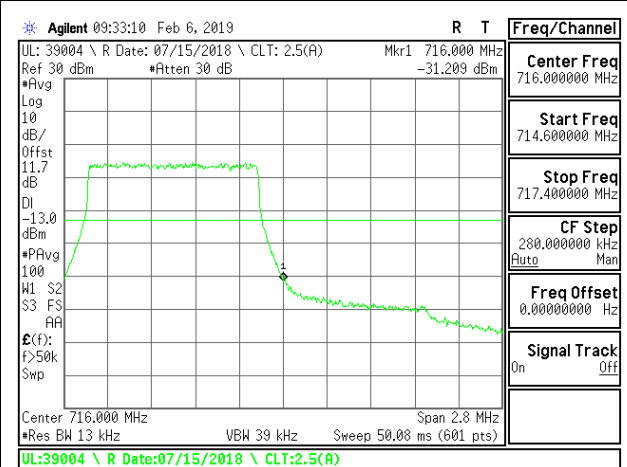
LTE B12 1.4MHz 16QAM Low Channel RB1-0



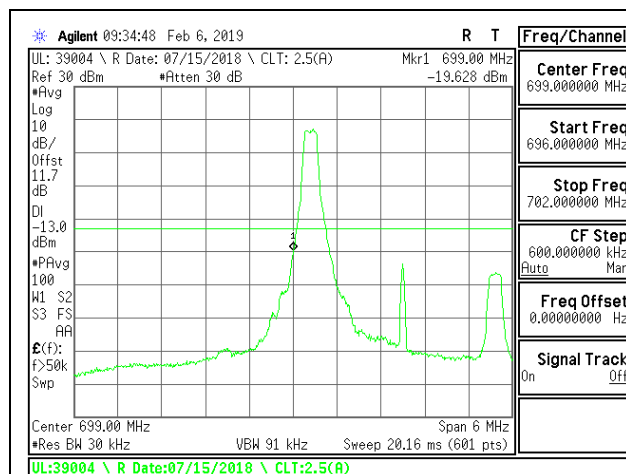
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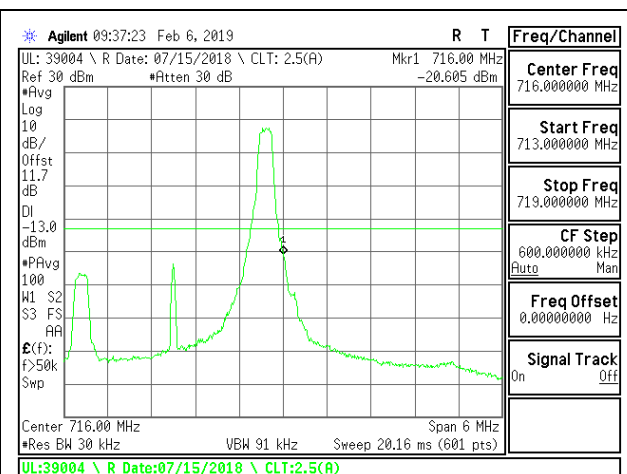
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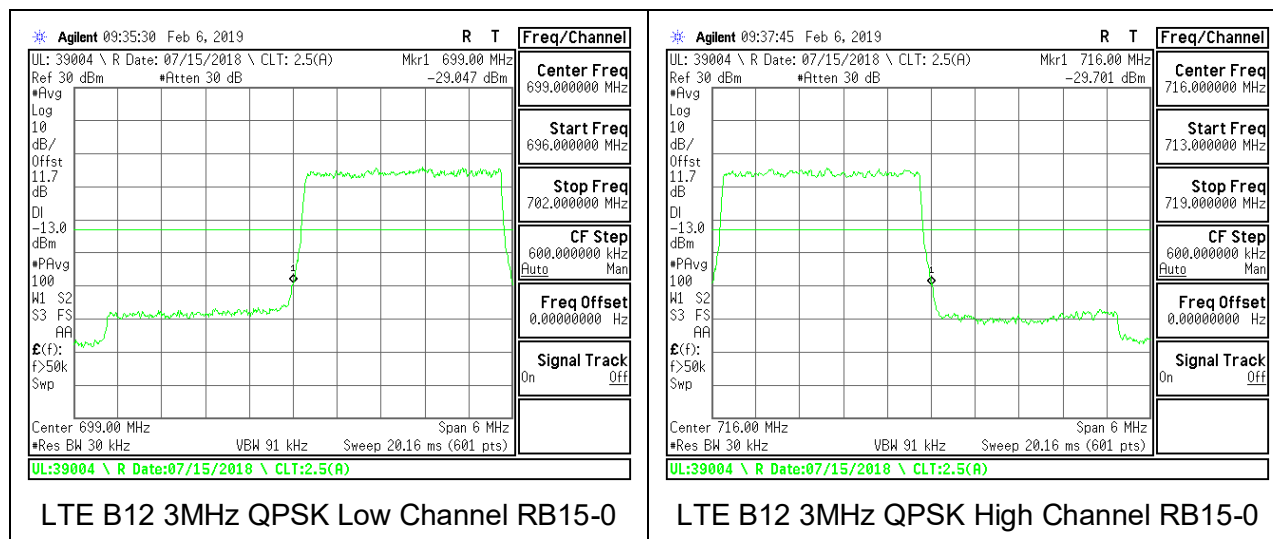
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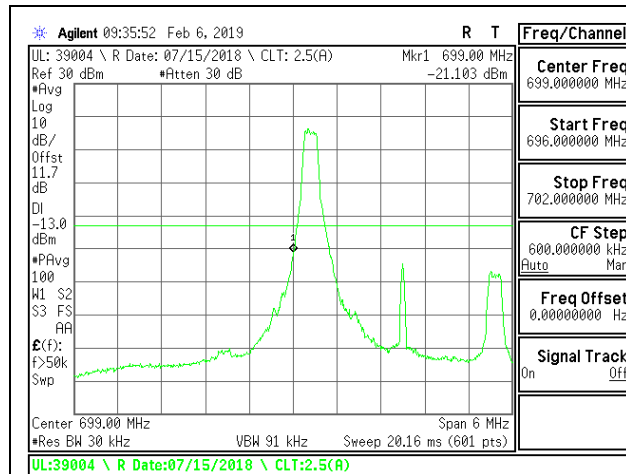


LTE B12 3MHz QPSK Low Channel RB1-0

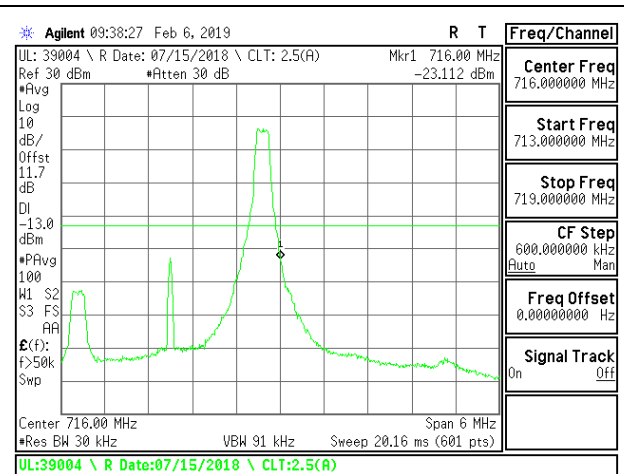


LTE B12 3MHz QPSK High Channel RB1-14

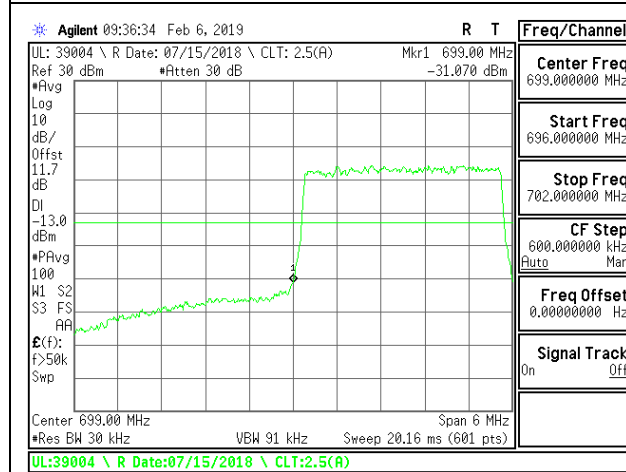




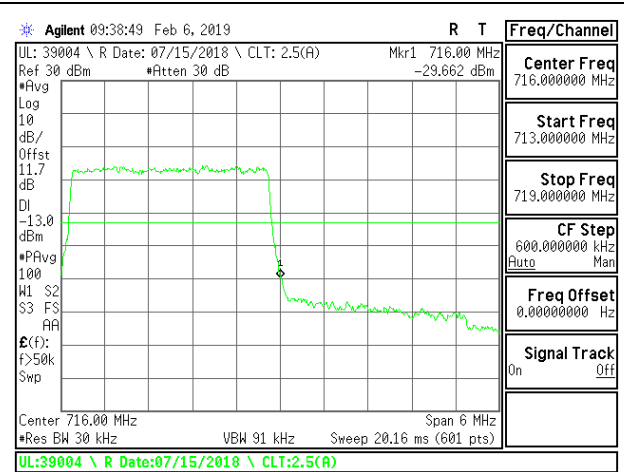
LTE B12 3MHz 16QAM Low Channel RB1-0



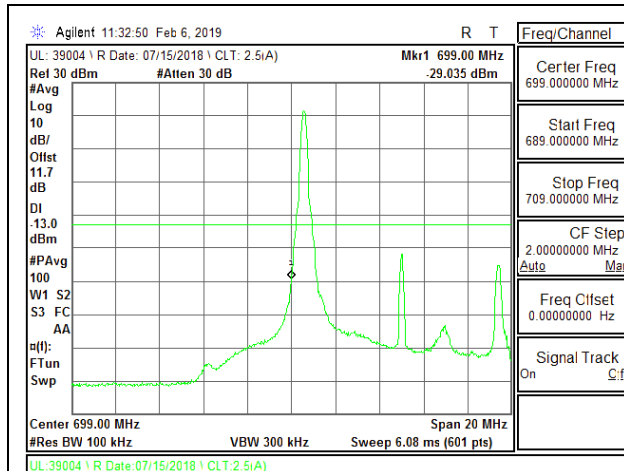
LTE B12 3MHz 16QAM High Channel RB1-14



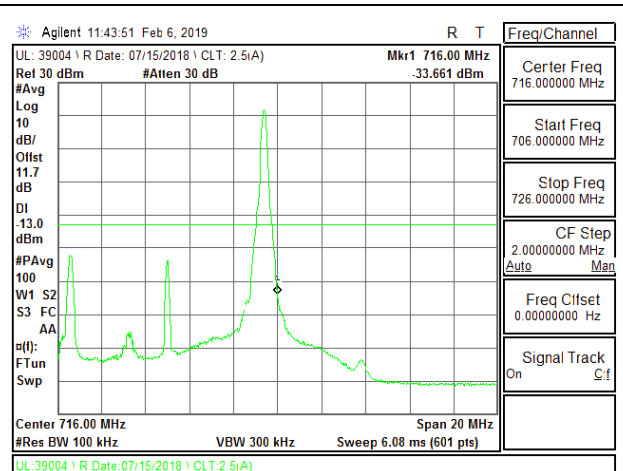
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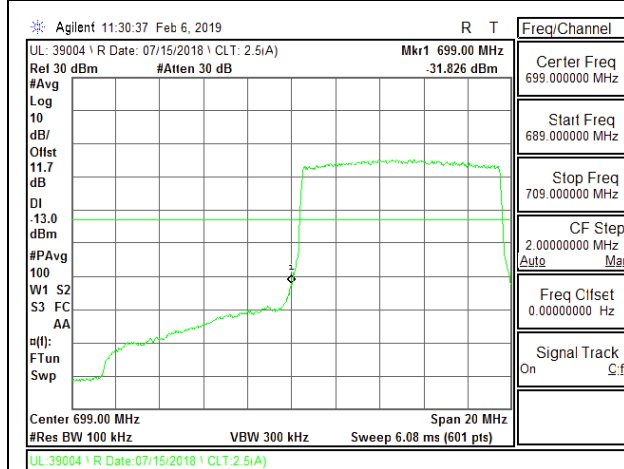
LTE B12 3MHz 16QAM High Channel RB15-0



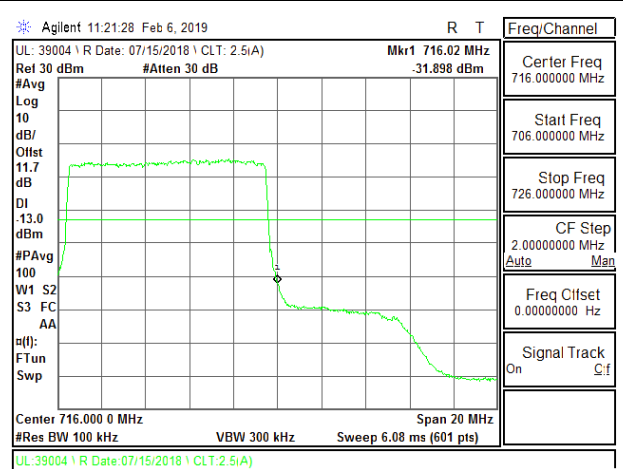
LTE B12 10MHz QPSK Low Channel RB1-0



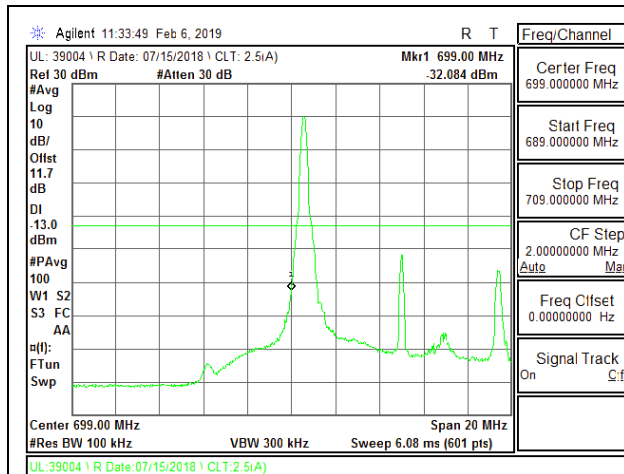
LTE B12 10MHz QPSK High Channel RB1-49



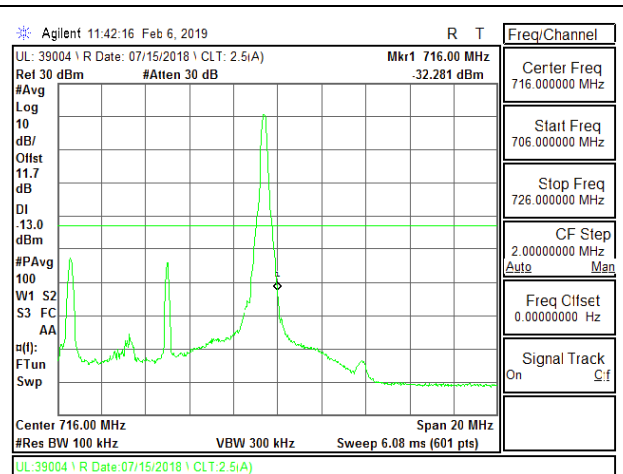
LTE B12 10MHz QPSK Low Channel RB50-0



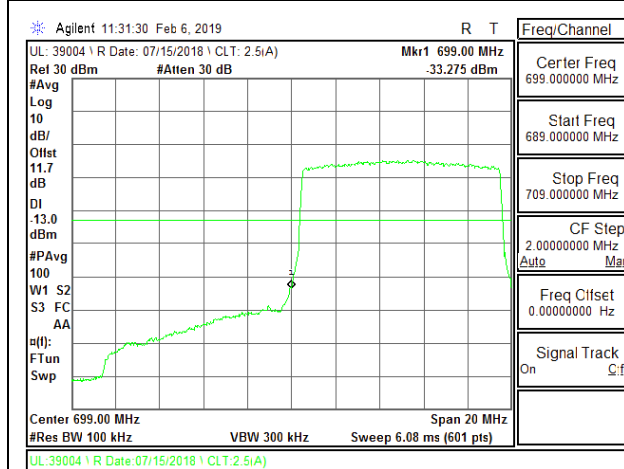
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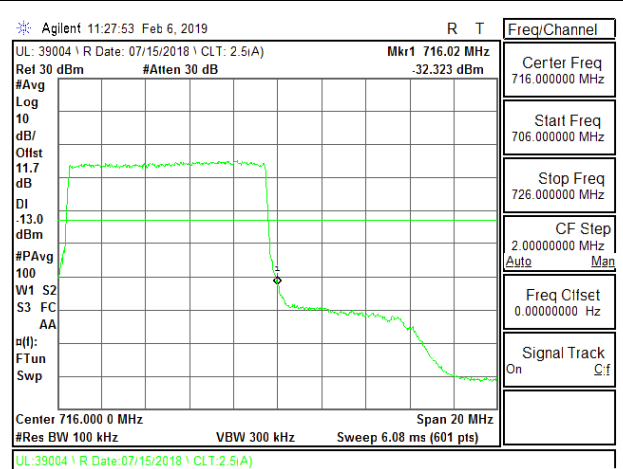
LTE B12 10MHz 16QAM Low Channel RB1-0



LTE B12 10MHz 16QAM High Channel RB1-49



LTE B12 10MHz 16QAM Low Channel RB50-0



LTE B12 10MHz 16QAM High Channel RB50-0

8.3. OUT OF BAND EMISSIONS

RULE PART(S)

FCC: §2.1051, §22.901, §22.917, §24.238, §27.53

IC:RSS130§4.6, RSS132§5.5; RSS133§6.5, RSS139§6.6

LIMITS

FCC: §22.917, §24.238, §27.53 (g), (h)

The minimum permissible attenuation level of any spurious emissions is $43 + 10 \log (P)$ dB where transmitting power (P) in Watts.

RSS130§4.6, RSS132§5.5, RSS133§6.5, RSS139§6.6

The minimum permissible attenuation level of any spurious emissions is $43 + 10 \log (P)$ dB where transmitting power (P) in Watts.

TEST PROCEDURE

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

For each out of band emissions measurement:

- Set display line at -13 dBm
- Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz. (NOTE: Worst case set RBW/VBW to 1MHz/3MHz)

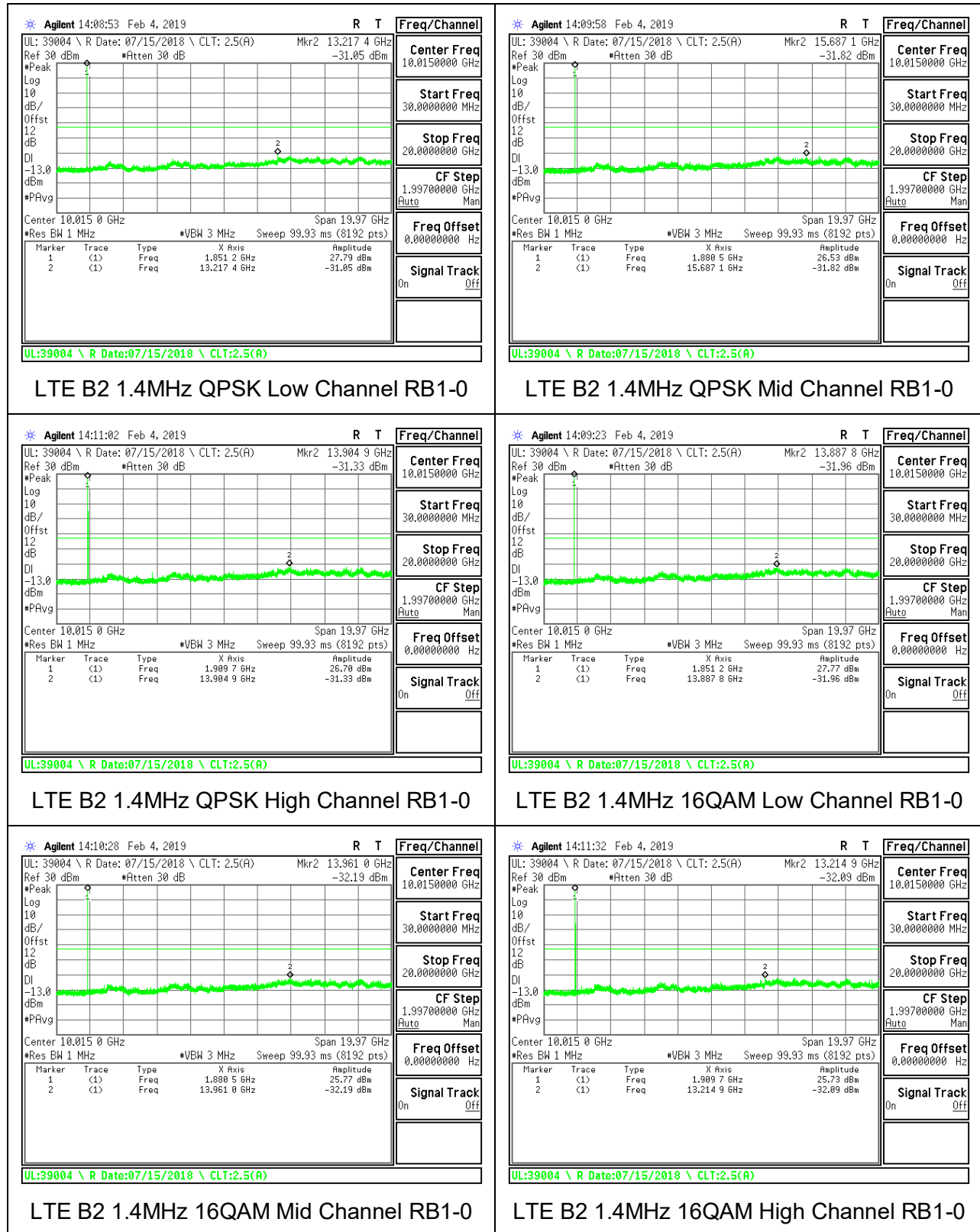
MODES TESTED

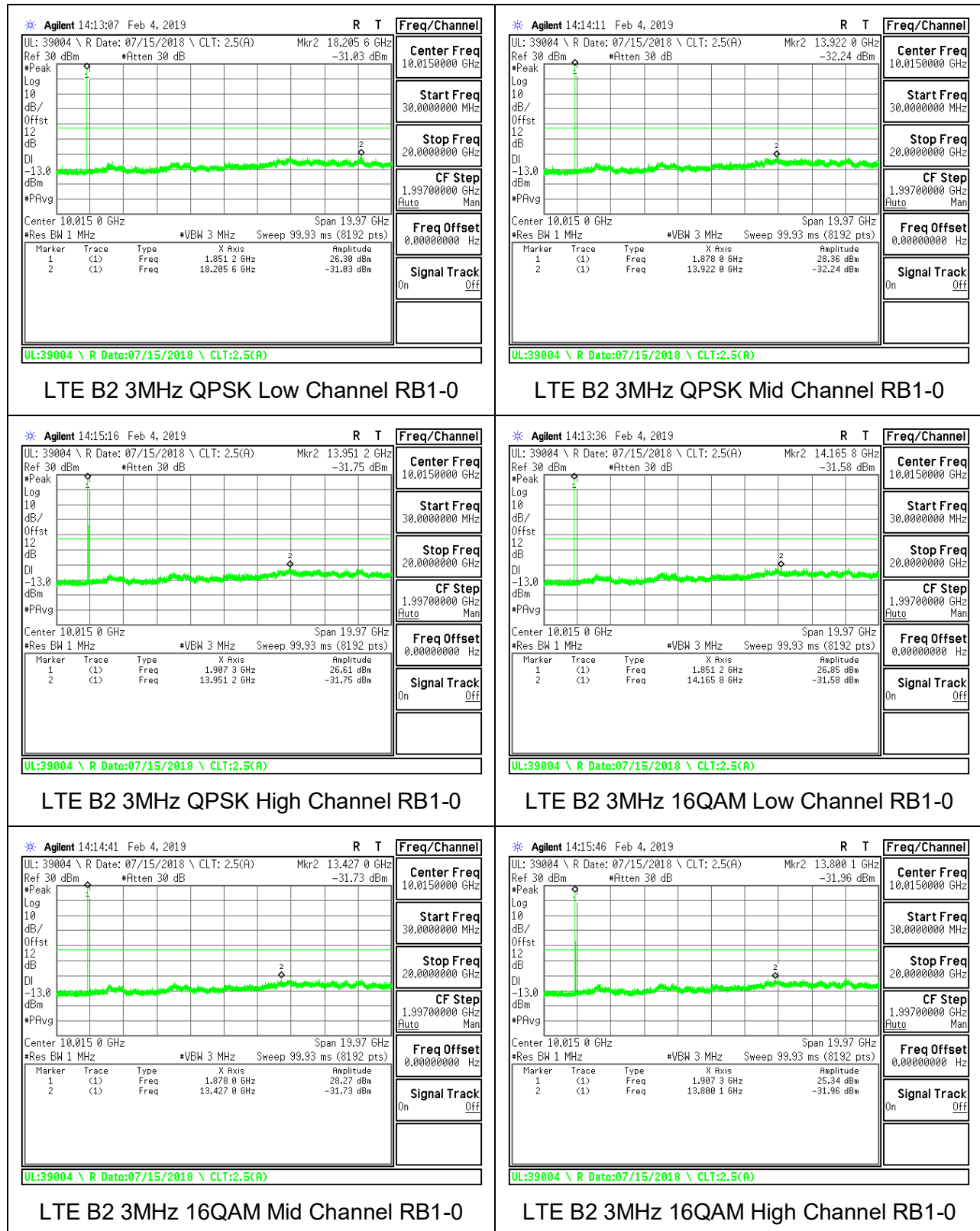
- LTE Band 2
- LTE Band 4
- LTE Band 5
- LTE Band 12

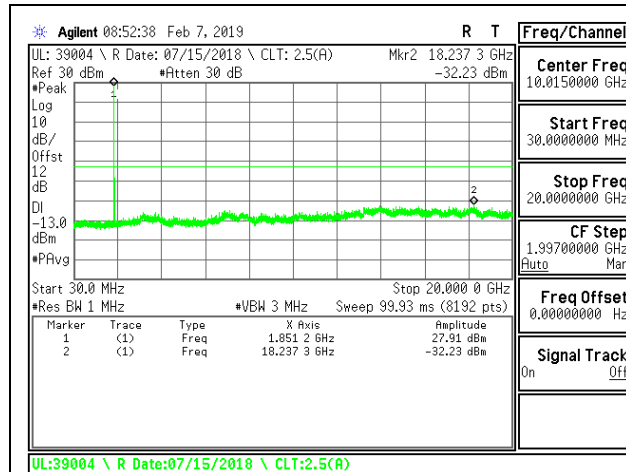
RESULTS

ID:	39004	Date:	2/4/19
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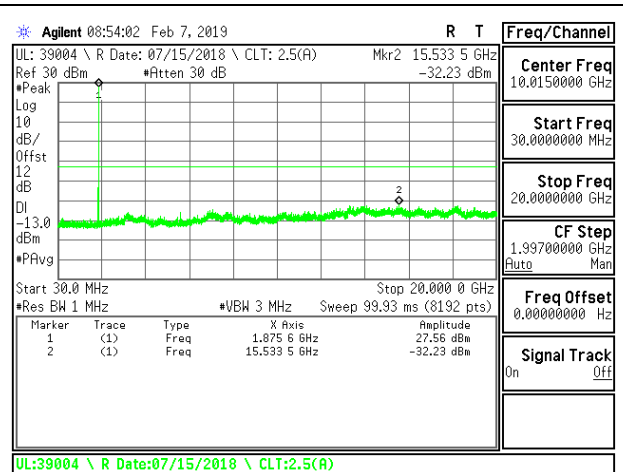
8.3.1. LTE BAND 2



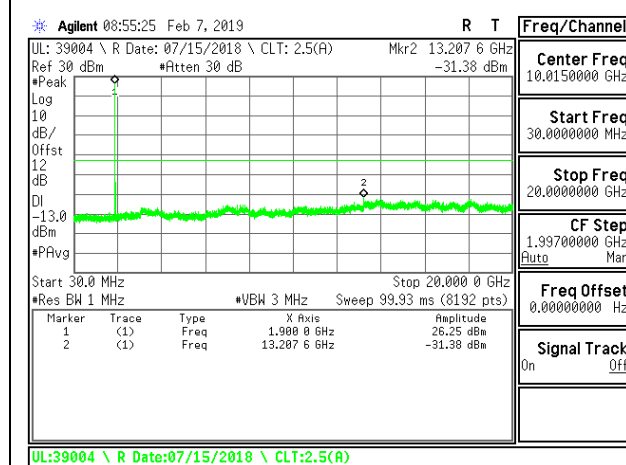




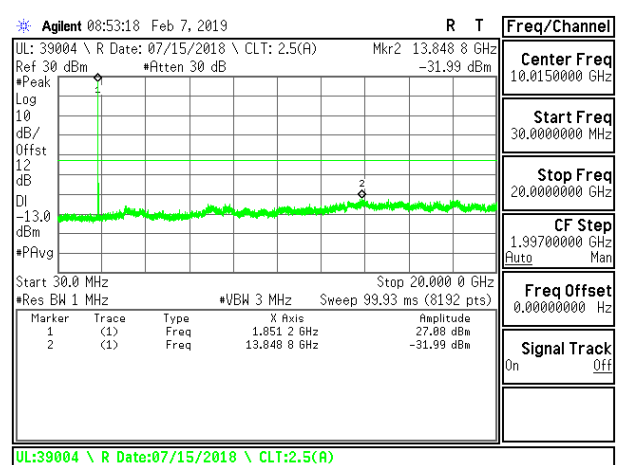
LTE B2 10MHz QPSK Low Channel RB1-0



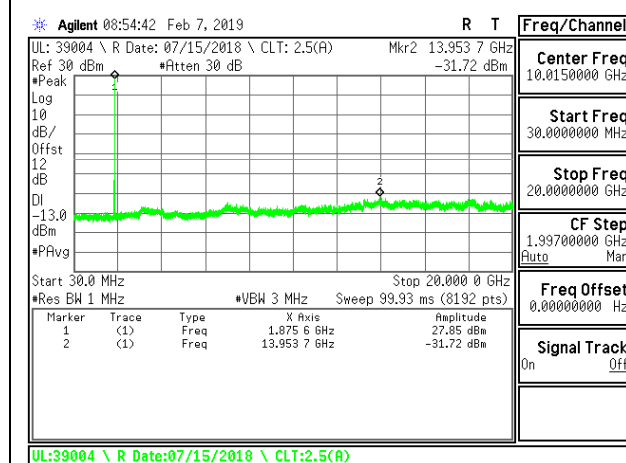
LTE B2 10MHz QPSK Mid Channel RB1-0



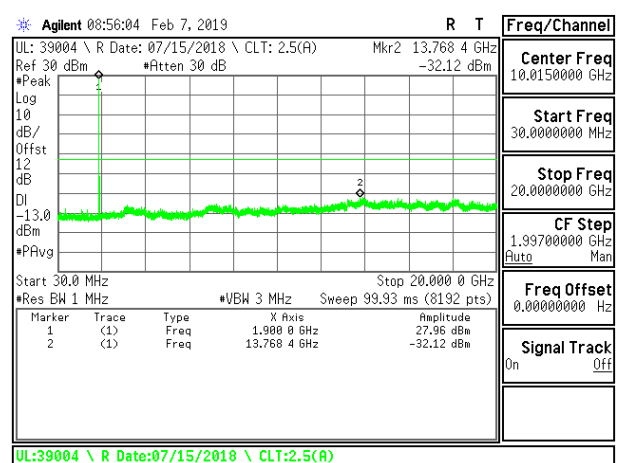
LTE B2 10MHz QPSK High Channel RB1-0



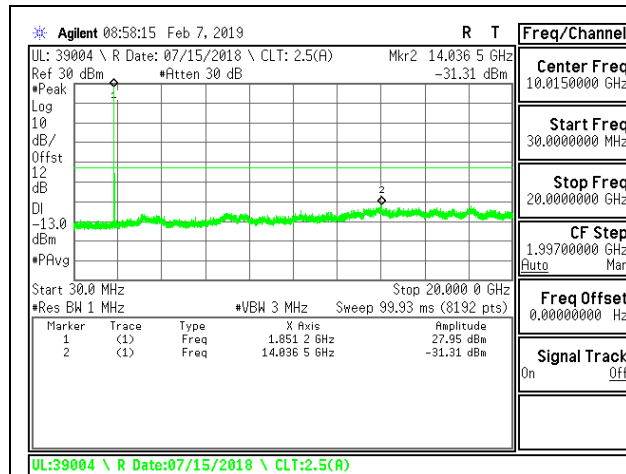
LTE B2 10MHz 16QAM Low Channel RB1-0



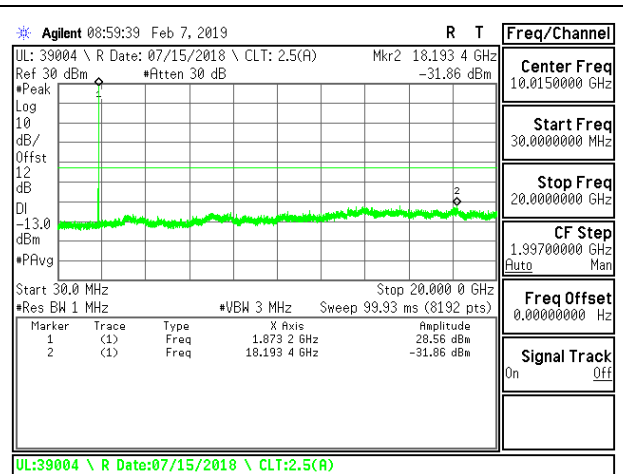
LTE B2 10MHz 16QAM Mid Channel RB1-0



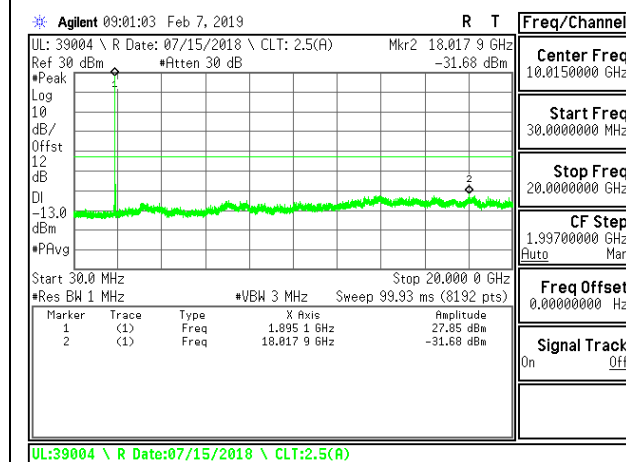
LTE B2 10MHz 16QAM High Channel RB1-0



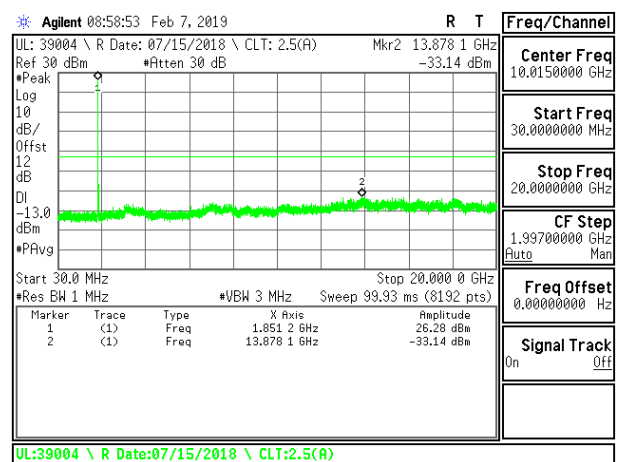
LTE B2 15MHz QPSK Low Channel RB1-0



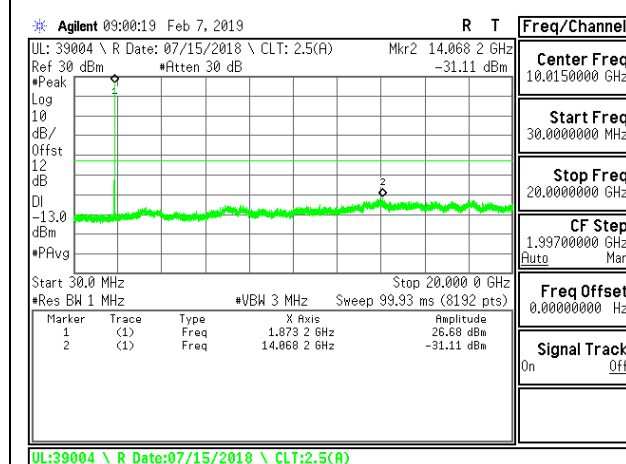
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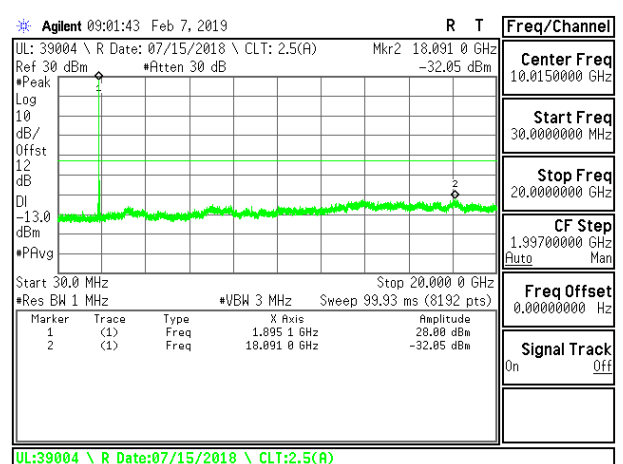
LTE B2 15MHz QPSK High Channel RB1-0



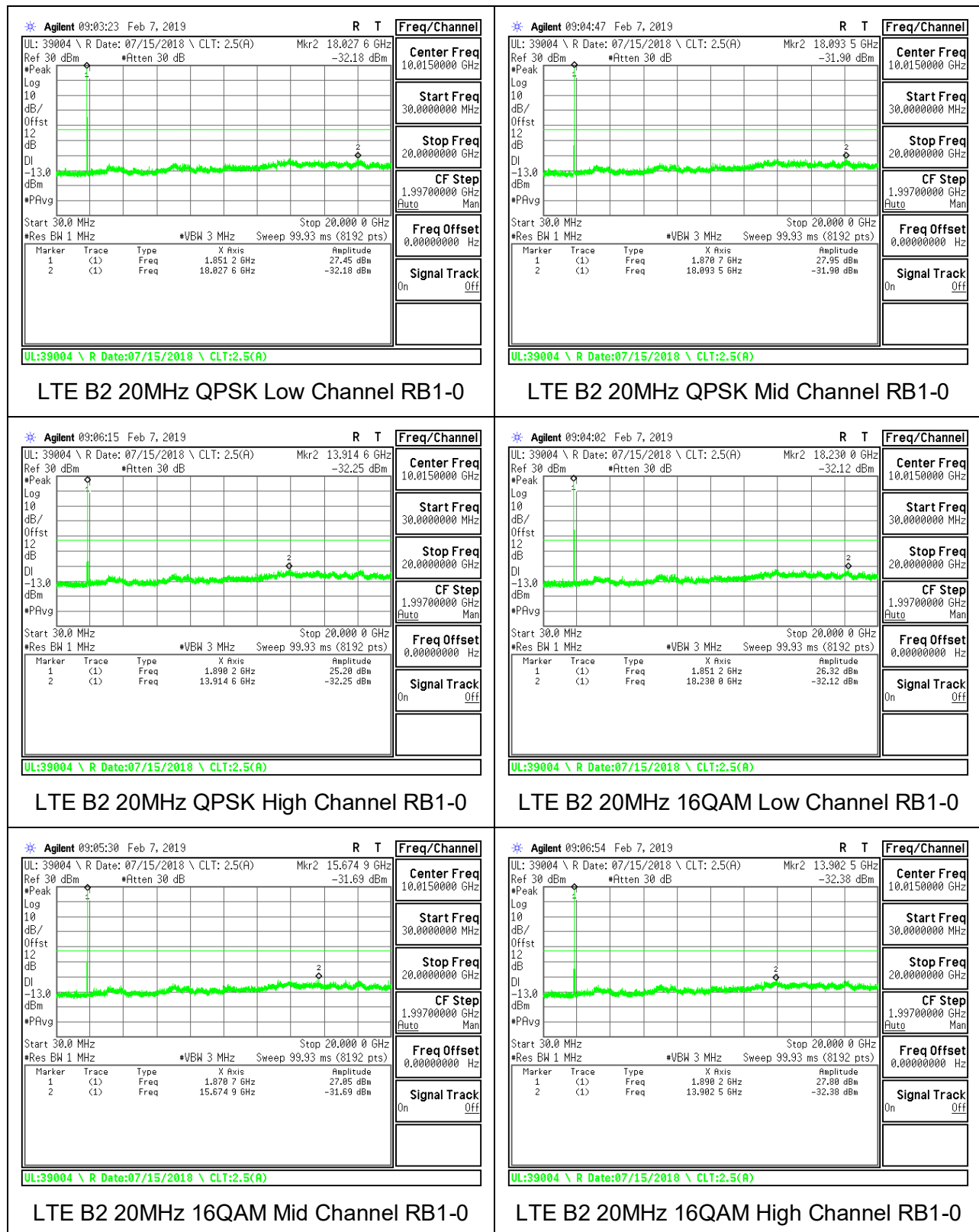
LTE B2 15MHz 16QAM Low Channel RB1-0



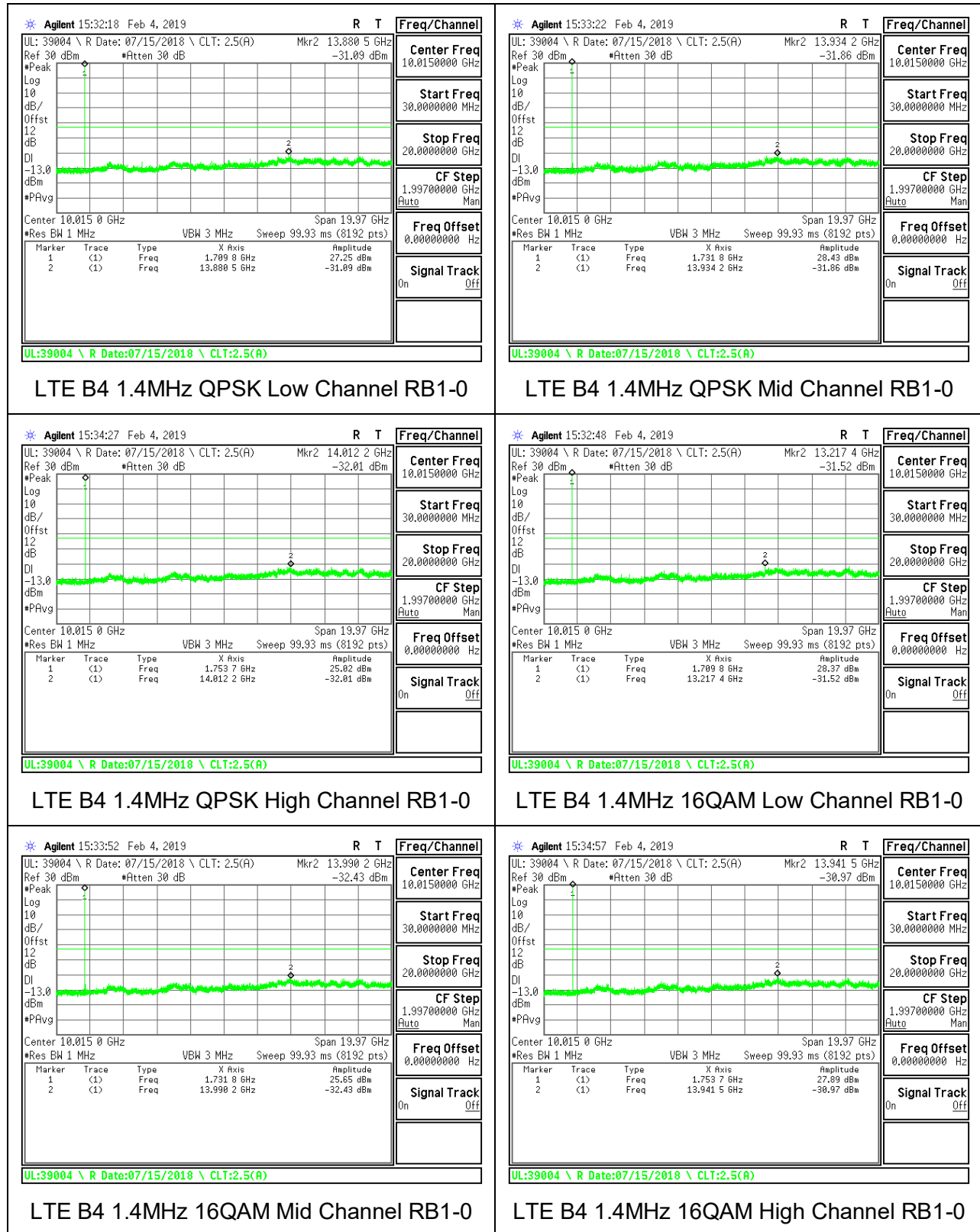
LTE B2 15MHz 16QAM Mid Channel RB1-0

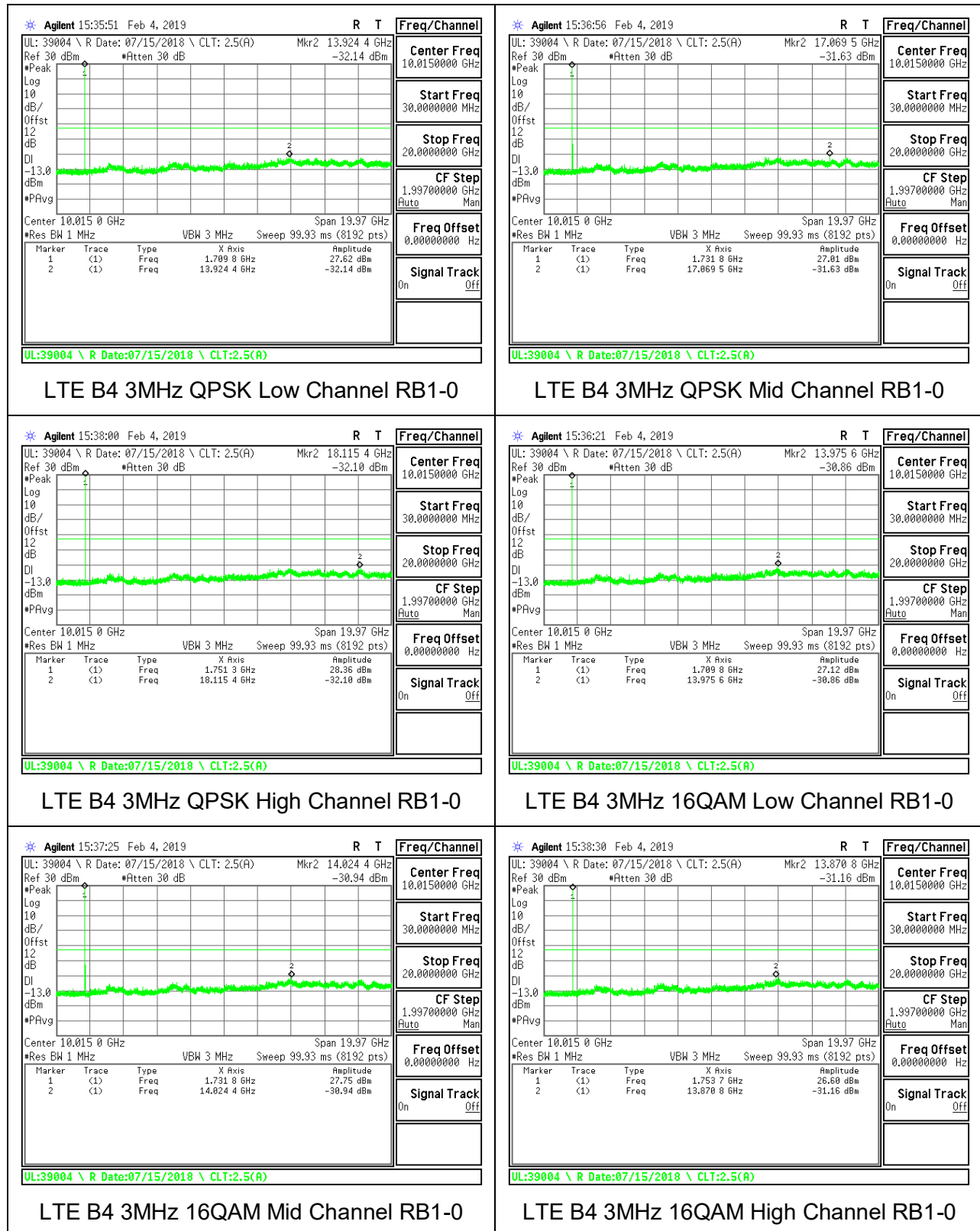


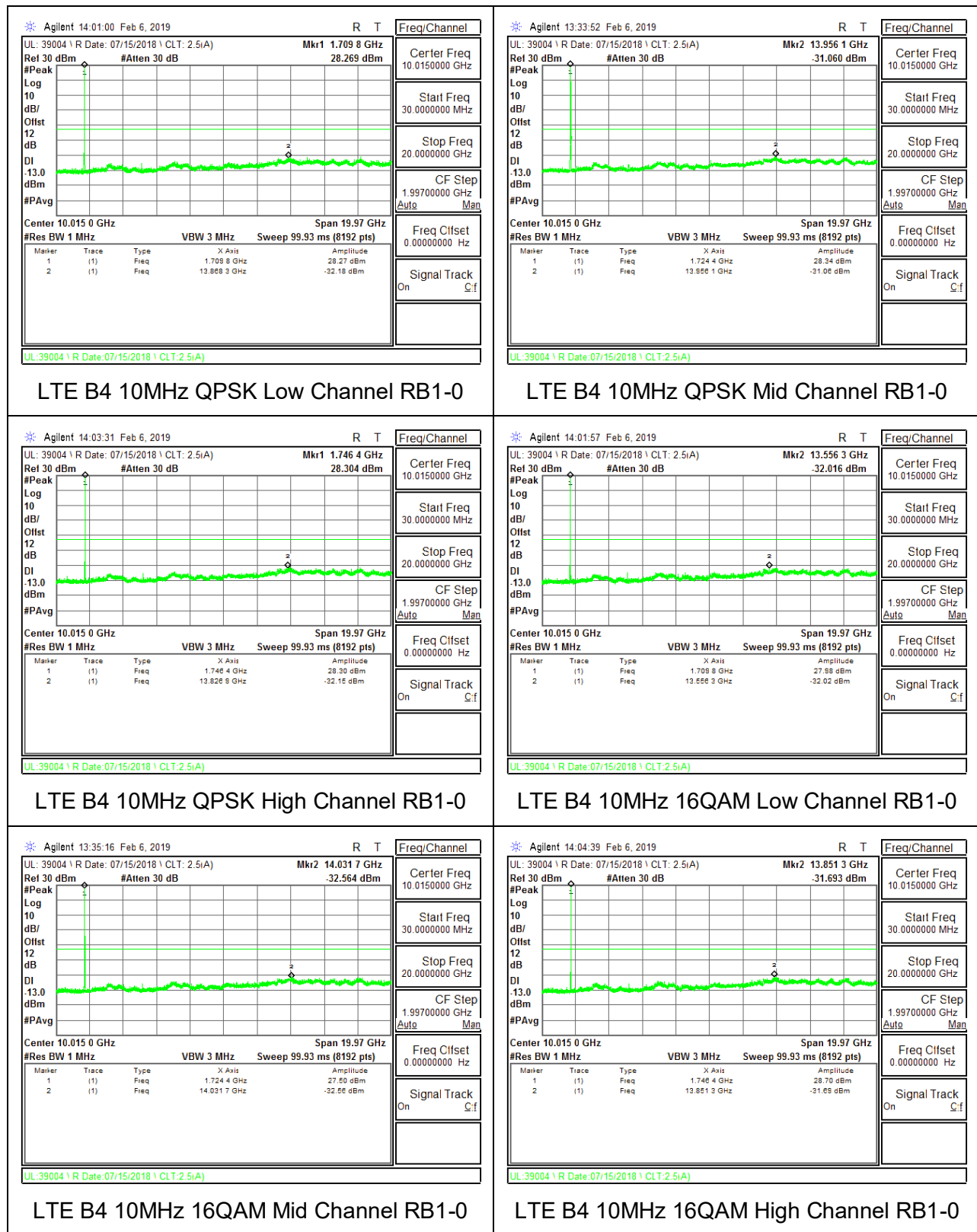
LTE B2 15MHz 16QAM High Channel RB1-0

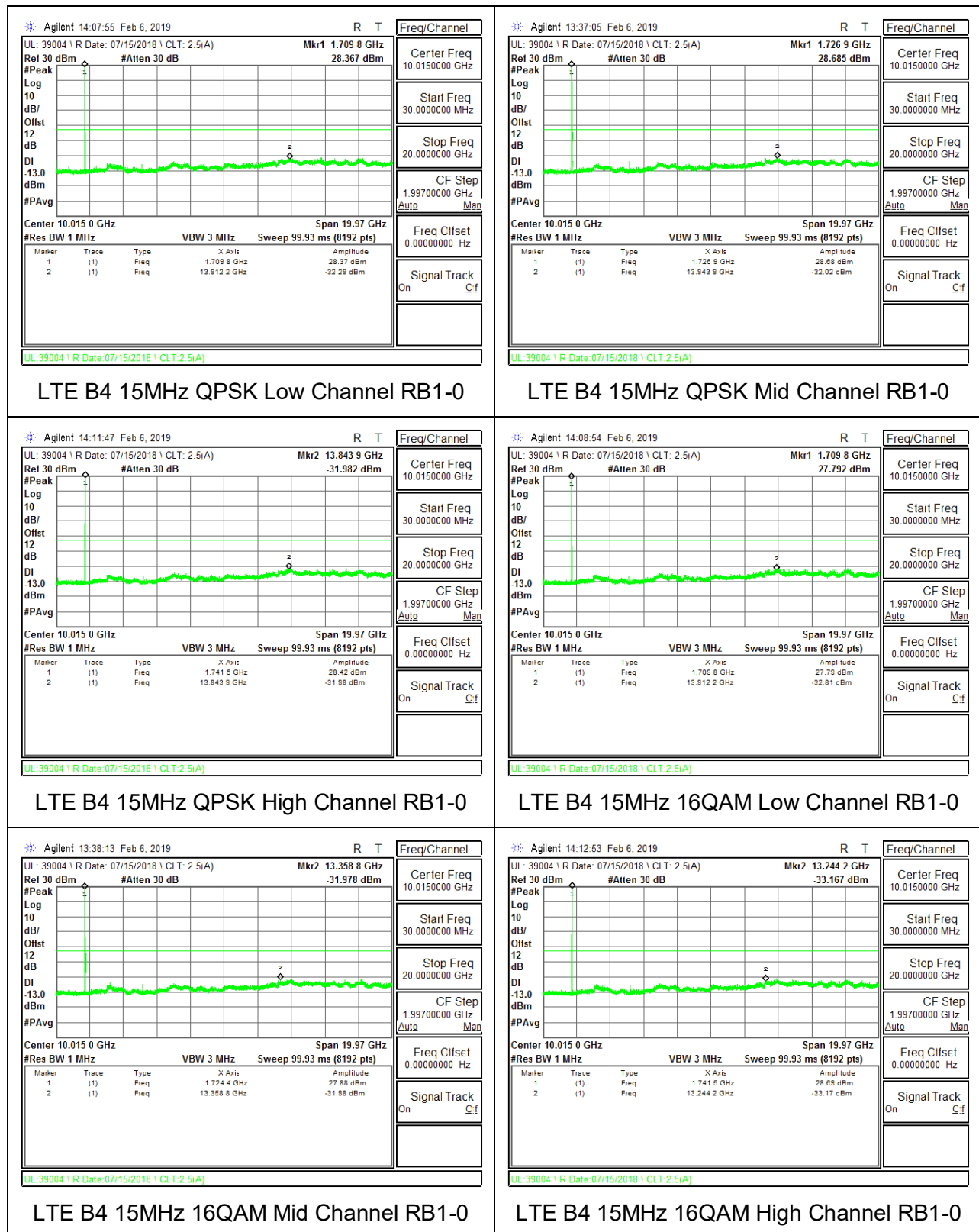


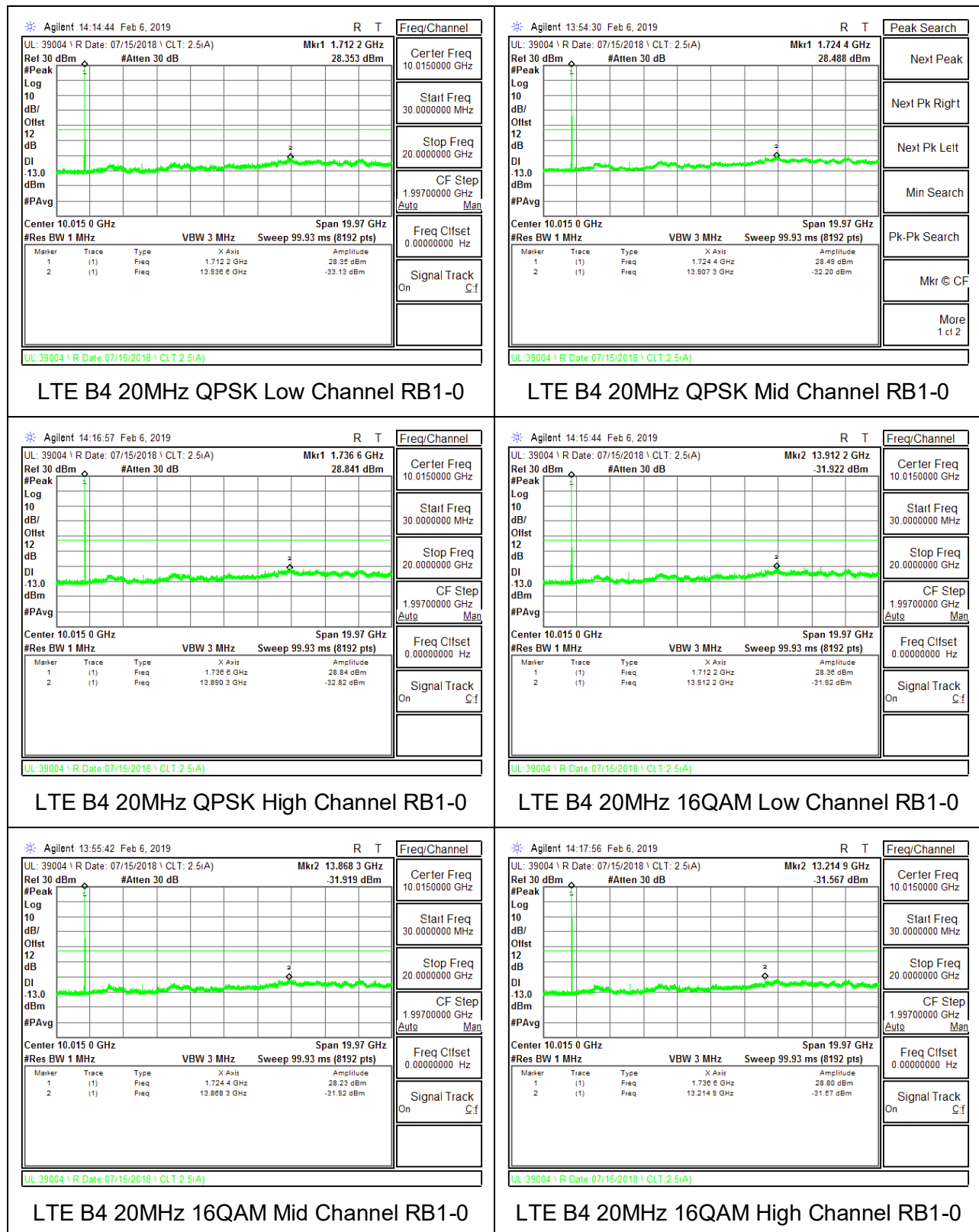
8.3.2. LTE BAND 4



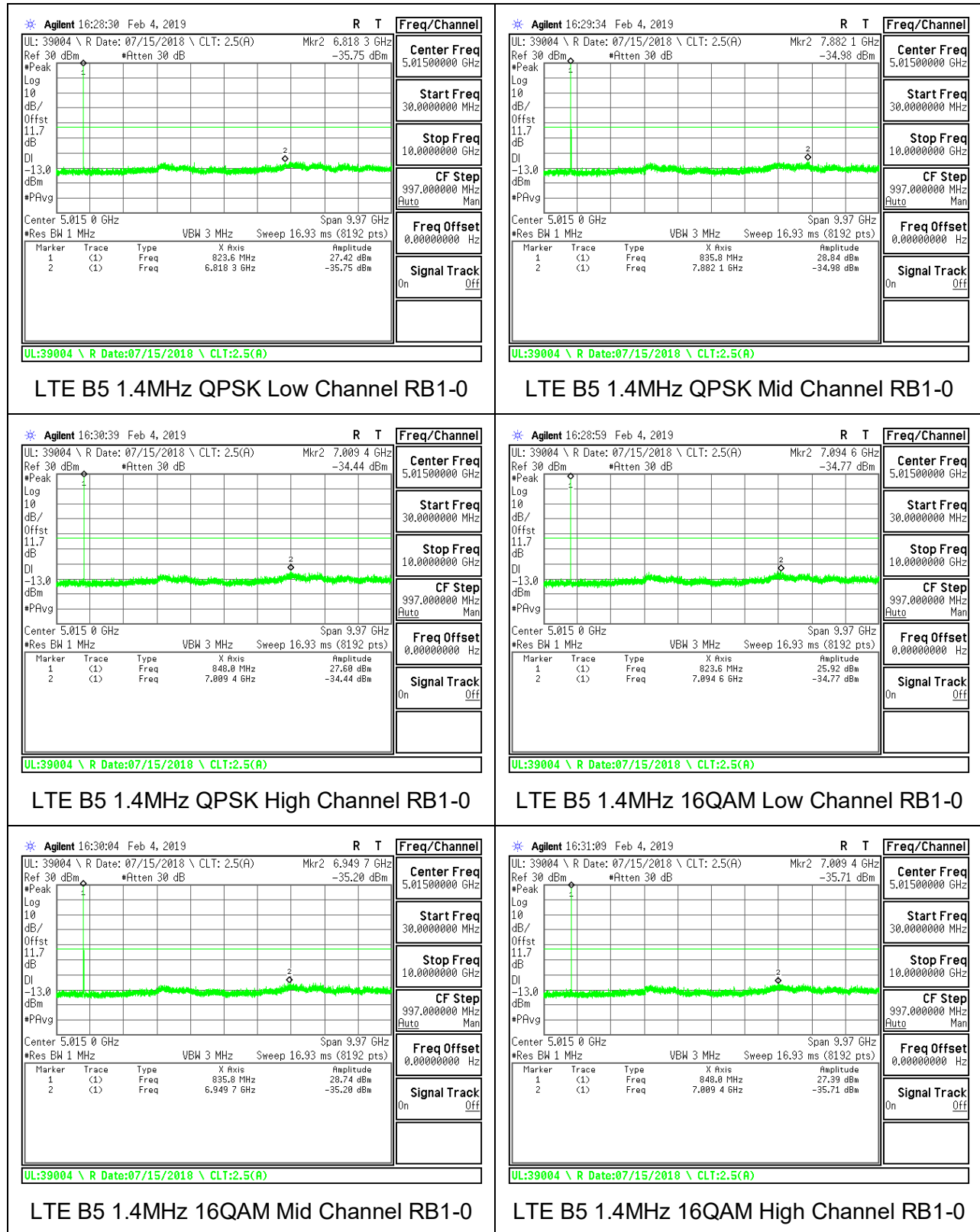


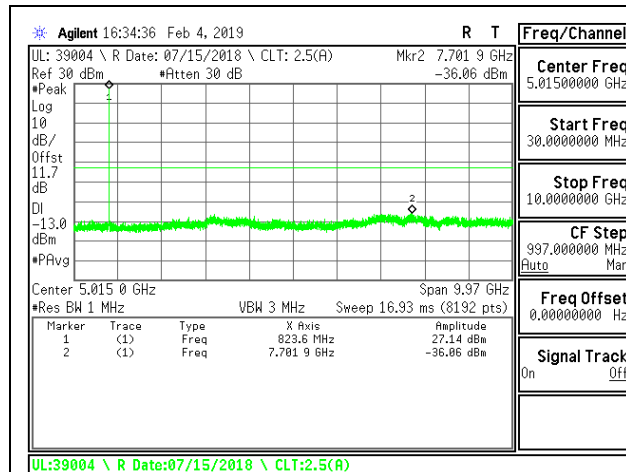




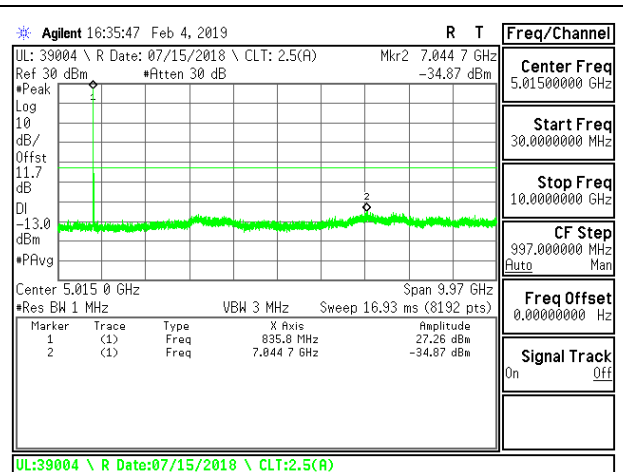


8.3.3. LTE BAND 5

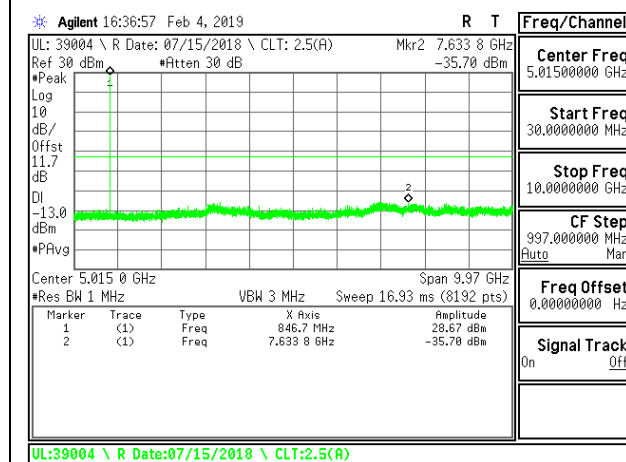




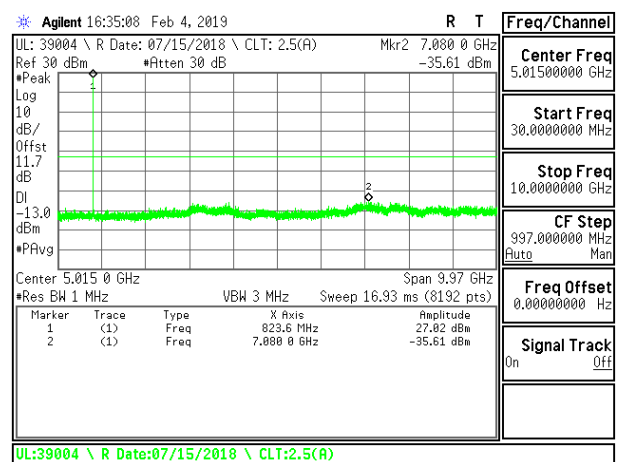
LTE B5 3MHz QPSK Low Channel RB1-0



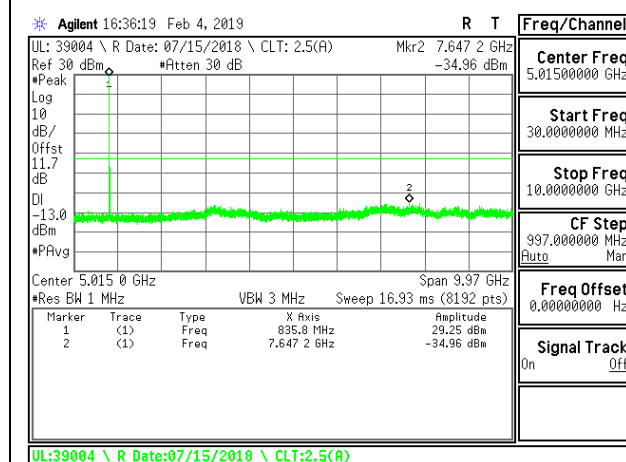
LTE B5 3MHz QPSK Mid Channel RB1-0



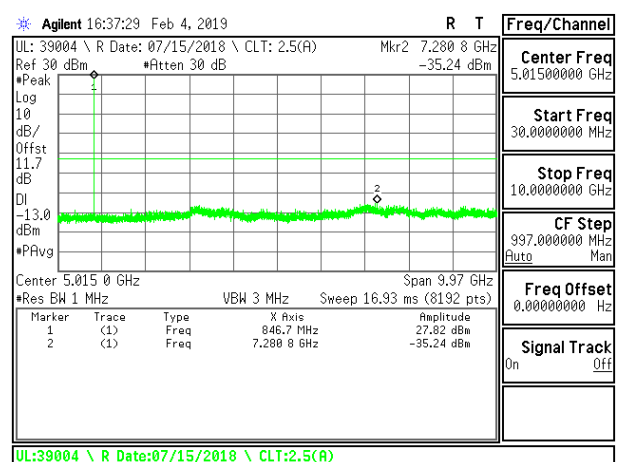
LTE B5 3MHz QPSK High Channel RB1-0



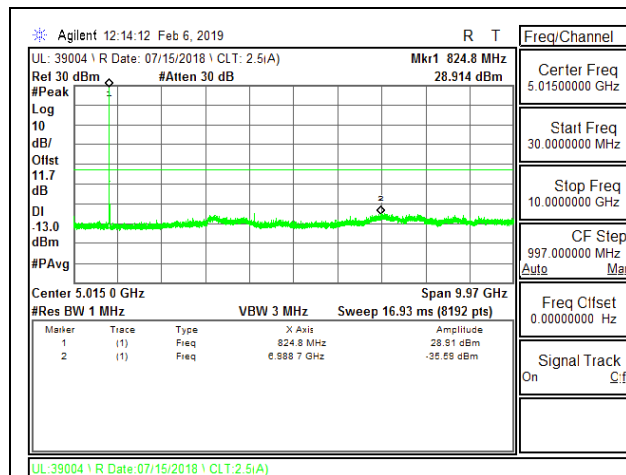
LTE B5 3MHz 16QAM Low Channel RB1-0



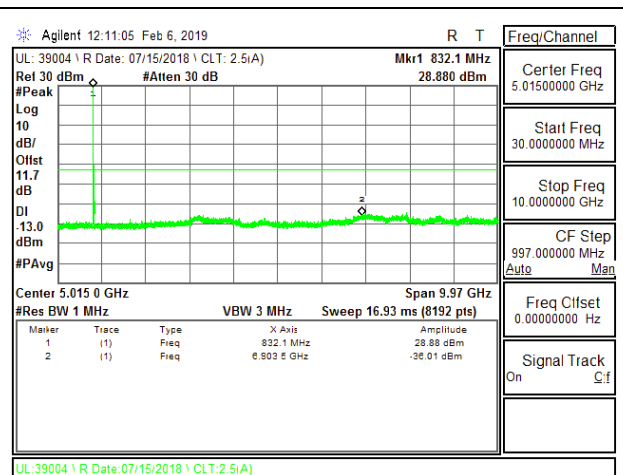
LTE B5 3MHz 16QAM Mid Channel RB1-0



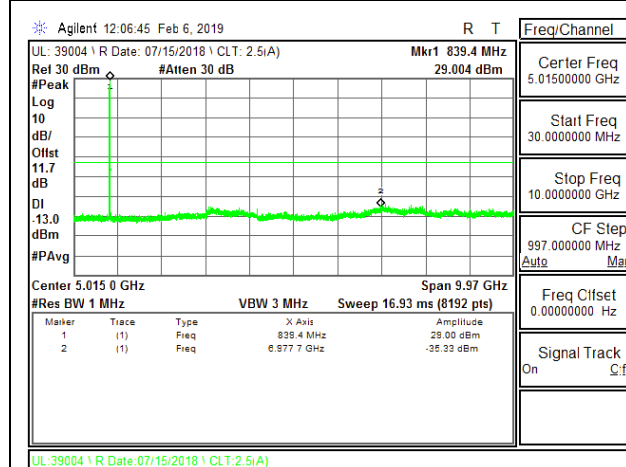
LTE B5 3MHz 16QAM High Channel RB1-0



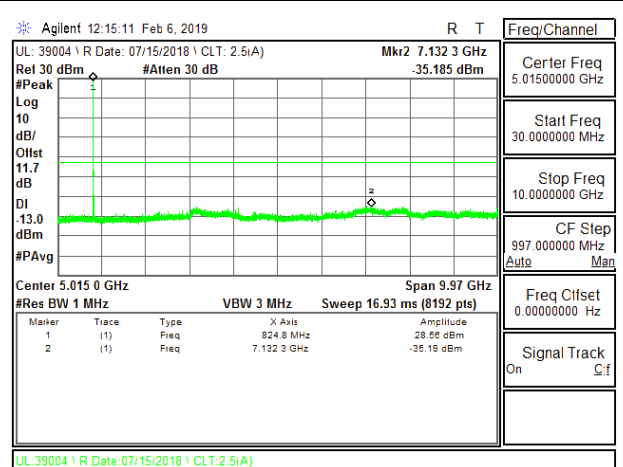
LTE B5 10MHz QPSK Low Channel RB1-0



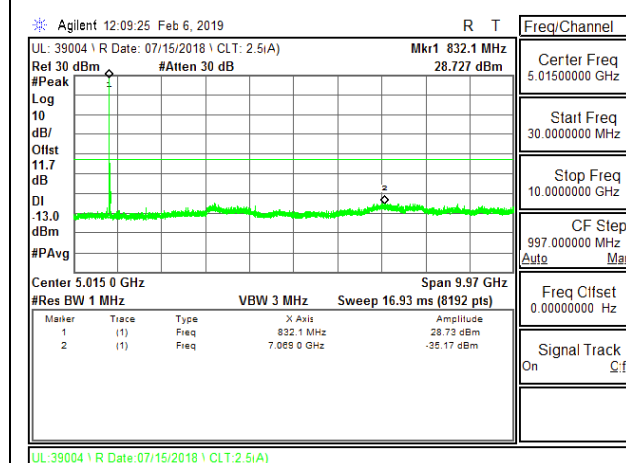
LTE B5 10MHz QPSK Mid Channel RB1-0



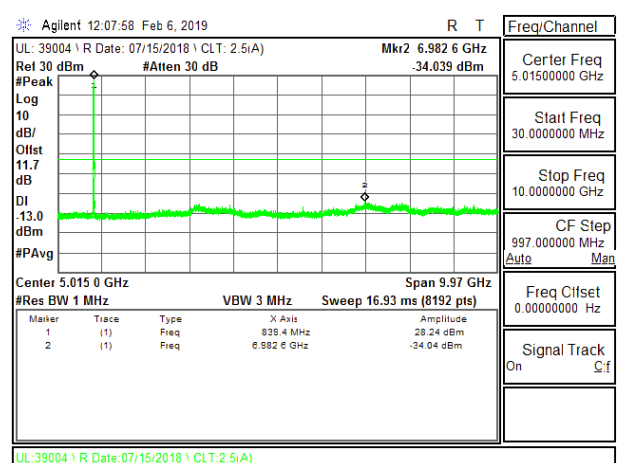
LTE B5 10MHz QPSK High Channel RB1-0



LTE B5 10MHz 16QAM Low Channel RB1-0

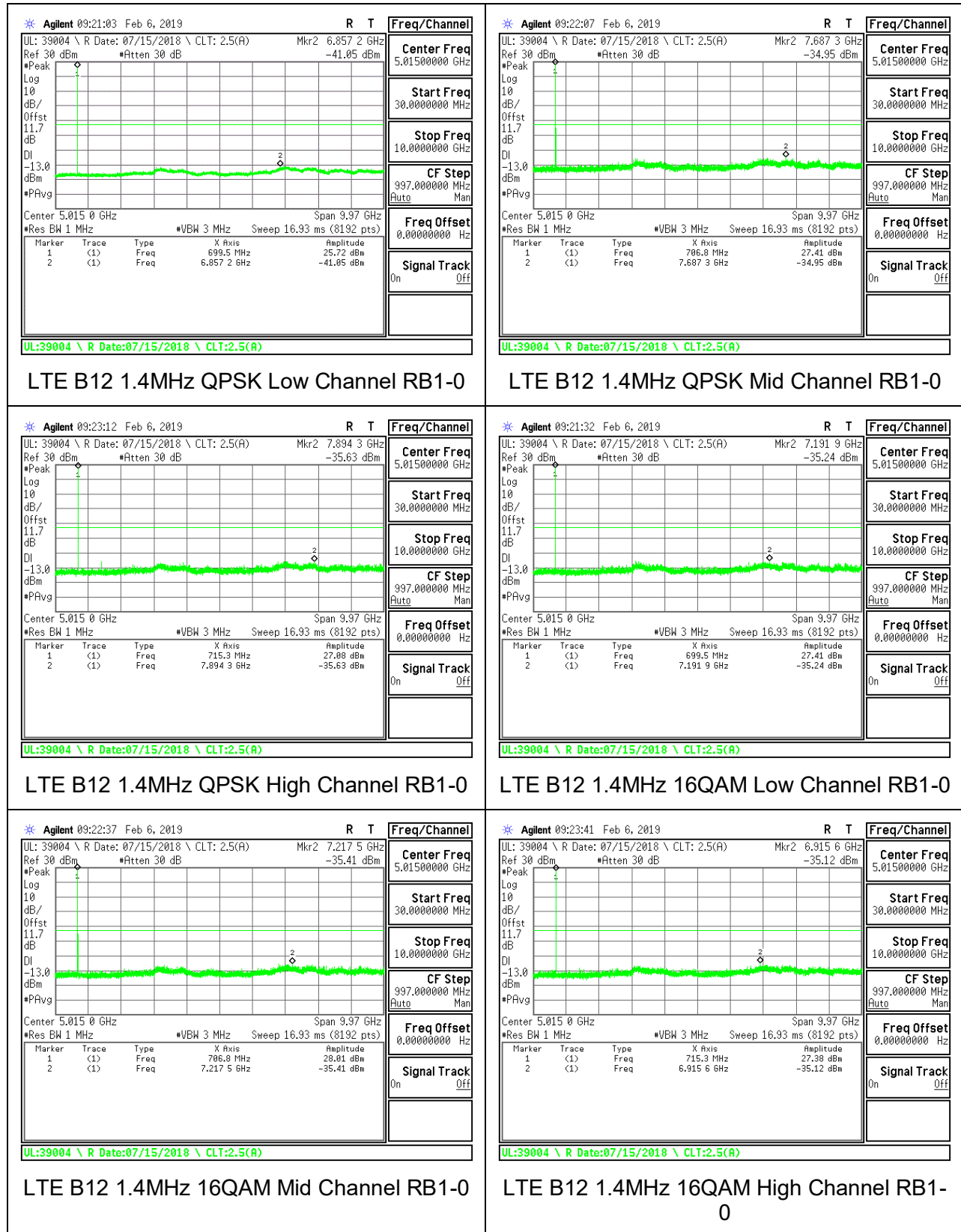


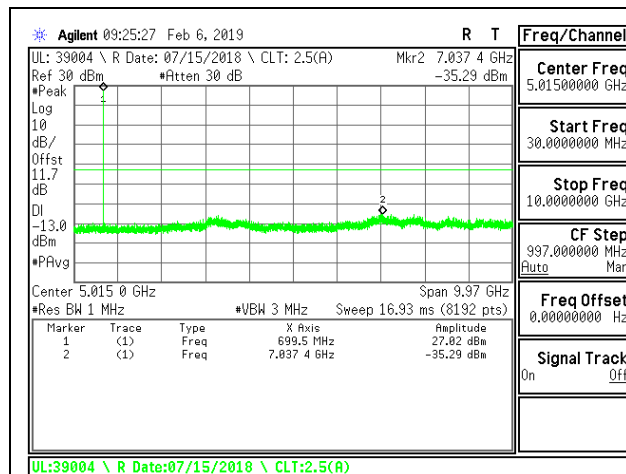
LTE B5 10MHz 16QAM Mid Channel RB1-0



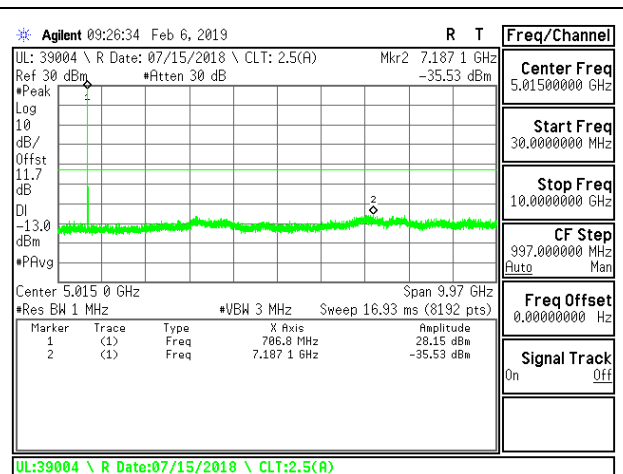
LTE B5 10MHz 16QAM High Channel RB1-0

8.3.4. LTE BAND 12

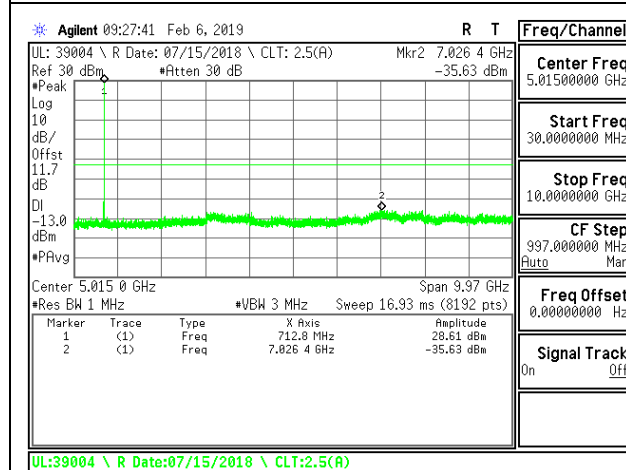




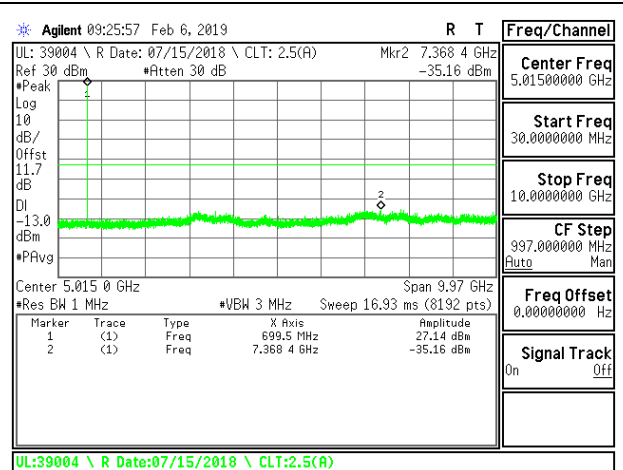
LTE B12 3MHz QPSK Low Channel RB1-0



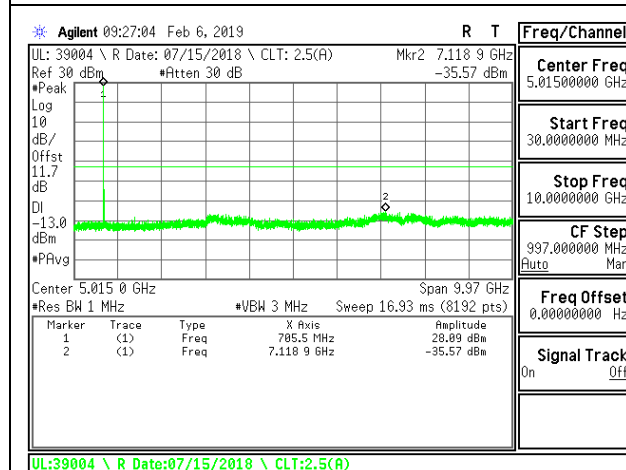
LTE B12 3MHz QPSK Mid Channel RB1-0



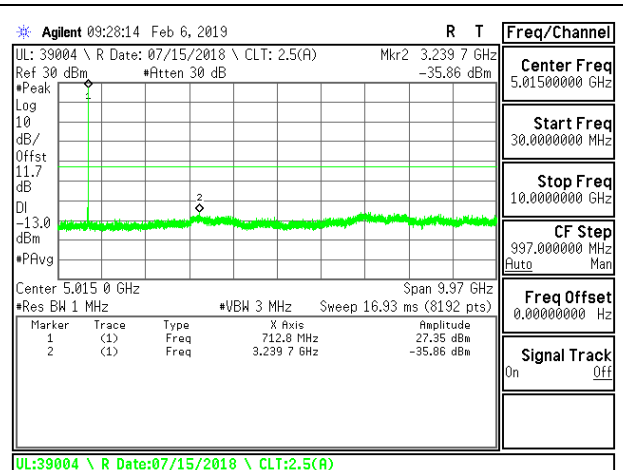
LTE B12 3MHz QPSK High Channel RB1-0



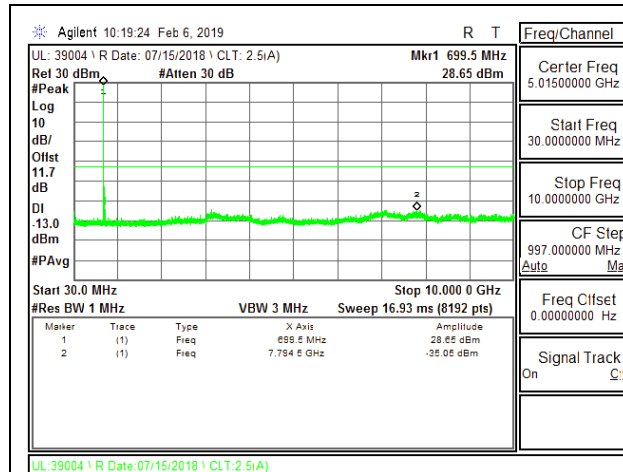
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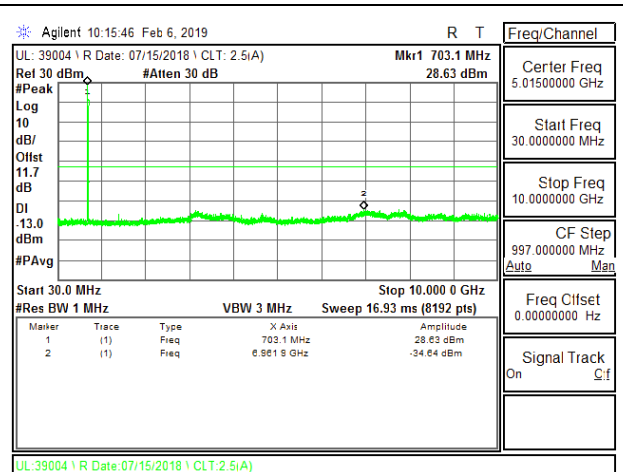
LTE B12 3MHz 16QAM Mid Channel RB1-0



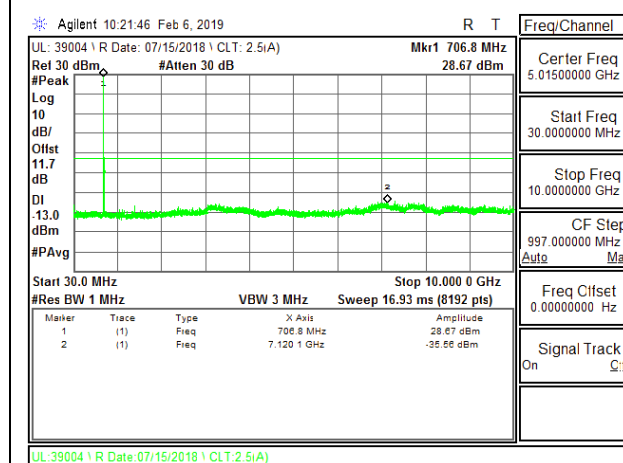
LTE B12 3MHz 16QAM High Channel RB1-0



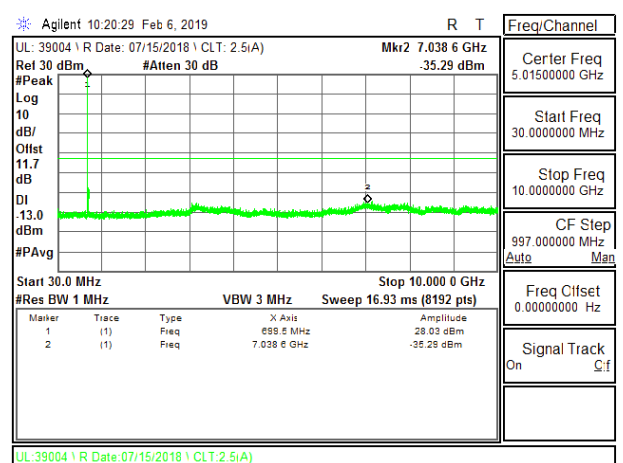
LTE B12 10MHz QPSK Low Channel RB1-0



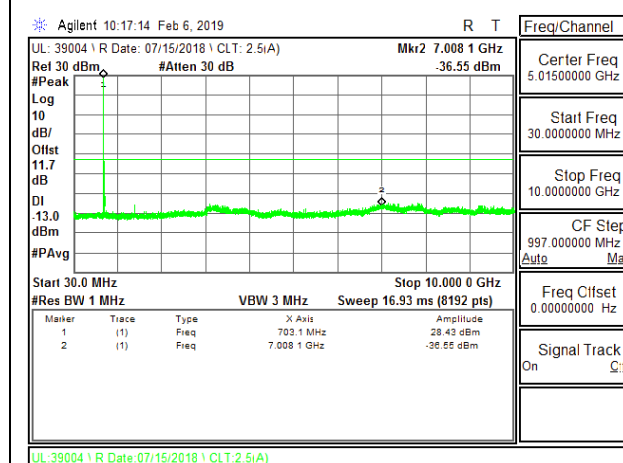
LTE B12 10MHz QPSK Mid Channel RB1-0



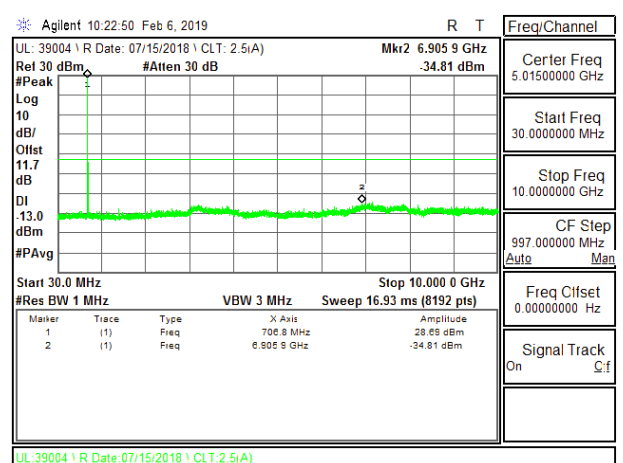
LTE B12 10MHz QPSK High Channel RB1-0



LTE B12 10MHz 16QAM Low Channel RB1-0



LTE B12 10MHz 16QAM Mid Channel RB1-0



LTE B12 10MHz 16QAM High Channel RB1-0

8.4. FREQUENCY STABILITY

RULE PART(S)

FCC: §2.1055, §22.355, §24.235, §27.54

RSS130§4.3, RSS132§5.3; RSS133§6.3, RSS139§6.4

LIMITS

FCC: §22.355

The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

FCC: §24.235 & §27.54

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS130§4.3

The transmitter frequency stability limit shall be determined as follows:

- a. The frequency offset shall be measured according to the procedure described in RSS-Gen and recorded;
- b. Using a resolution bandwidth of 1% of the occupied bandwidth, a reference point at the unwanted emission level which complies with the attenuation of $43 + 10 \log_{10} p$ (watts) on the emission mask of the lowest and highest channel shall be selected, and the frequency at these points shall be recorded as f_L and f_H respectively.

The applicant shall ensure frequency stability by showing that f_L minus the frequency offset and f_H plus the frequency offset shall be within the frequency range in which the equipment is designed to operate.

RSS132§5.3

The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 SRSP for mobile stations and ± 1.5 ppm for base stations.

In lieu of meeting the above stability values, the test report may show that the frequency stability is sufficient to ensure that the occupied bandwidth stays within each of the sub-bands (see Section 5.1) when tested to the temperature and supply voltage variations specified in RSS-Gen.

RSS133§6.3

The carrier frequency shall not depart from the reference frequency, in excess of ± 2.5 ppm for mobile stations and ± 1.0 ppm for base stations.

In lieu of meeting the above stability values, the test report may show that the frequency stability is sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

RSS139§6.4

The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

TEST PROCEDURE

Use CMW 500 with Frequency Error measurement capability.

- Temp. = -30°C to +50°C
- Voltage = (85% - 115%)
Low voltage, 102VAC, Normal, 120VAC and High voltage, 138VAC.
End Voltage, 101VAC.

Frequency Stability vs Temperature:

The EUT is place inside a temperature chamber. The temperature is set to 20°C and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until +50°C is reached.

Frequency Stability vs Voltage:

The peak frequency error is recorded (worst-case).

MODES TESTED

- LTE Band 2
- LTE Band 4
- LTE Band 5
- LTE Band 12

RESULTS

See the following pages.

8.4.1. LTE BAND 2

QPSK (20MHz BANDWIDTH)

ID:	19480 BS	Date:	2/12/19
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Limit		1850	1910	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	1851.1064	1908.8628		
Extreme (50C)		1851.1064	1908.8628	-7.4	-0.004
Extreme (40C)		1851.1064	1908.8628	-7.8	-0.004
Extreme (30C)		1851.1064	1908.8628	-9.2	-0.005
Extreme (10C)		1851.1064	1908.8628	-8.8	-0.005
Extreme (0C)		1851.1064	1908.8628	-8.2	-0.004
Extreme (-10C)		1851.1064	1908.8628	-8.4	-0.004
Extreme (-20C)		1851.1064	1908.8628	-8.6	-0.005
Extreme (-30C)		1851.1064	1908.8628	-8.1	-0.004
20C	15%	1851.1064	1908.8628	-9.3	-0.005
	-15%	1851.1064	1908.8628	-8.6	-0.005
	End Point	1851.1064	1908.8628	-9.3	-0.005

8.4.2. LTE BAND 4

QPSK (20MHz BANDWIDTH)

ID:	19480 BS	Date:	2/12/19
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Limit		1710	1755	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	1711.1258	1753.8680		
Extreme (50C)		1711.1258	1753.8680	6.4	0.004
Extreme (40C)		1711.1258	1753.8680	5.7	0.003
Extreme (30C)		1711.1258	1753.8680	6.1	0.004
Extreme (10C)		1711.1258	1753.8680	-7.0	-0.004
Extreme (0C)		1711.1258	1753.8680	6.1	0.004
Extreme (-10C)		1711.1258	1753.8680	6.2	0.004
Extreme (-20C)		1711.1258	1753.8680	8.0	0.005
Extreme (-30C)		1711.1258	1753.8680	6.9	0.004
20C	15%	1711.1258	1753.8680	-5.6	-0.003
	-15%	1711.1258	1753.8680	5.8	0.003
	End Point	1711.1258	1753.8680	5.5	0.003

8.4.3. LTE BAND 5

QPSK (10MHz BANDWIDTH)

ID:	19480 BS	Date:	2/12/19
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Limit		824	849	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	824.5497	848.4376		
Extreme (50C)		824.5497	848.4376	4.5	0.005
Extreme (40C)		824.5497	848.4376	-4.1	-0.005
Extreme (30C)		824.5497	848.4376	-4.5	-0.005
Extreme (10C)		824.5497	848.4376	-4.7	-0.006
Extreme (0C)		824.5497	848.4376	3.6	0.004
Extreme (-10C)		824.5497	848.4376	3.8	0.005
Extreme (-20C)		824.5497	848.4376	3.8	0.005
Extreme (-30C)		824.5497	848.4376	-4.5	-0.005
20C	15%	824.5497	848.4376	-4.4	-0.005
	-15%	824.5497	848.4376	-4.5	-0.005
	End Point	824.5497	848.4376	-4.4	-0.005

8.4.4. LTE BAND 12

QPSK (10MHz BANDWIDTH)

ID:	19480 BS	Date:	2/12/19
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Limit		699	716	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	699.5581	715.4589		
Extreme (50C)		699.5581	715.4589	4.2	0.006
Extreme (40C)		699.5581	715.4589	-3.7	-0.005
Extreme (30C)		699.5581	715.4589	-4.5	-0.006
Extreme (10C)		699.5581	715.4589	-4.6	-0.006
Extreme (0C)		699.5581	715.4589	-3.2	-0.005
Extreme (-10C)		699.5581	715.4589	-3.9	-0.005
Extreme (-20C)		699.5581	715.4589	4.9	0.007
Extreme (-30C)		699.5581	715.4589	4.0	0.006
20C	15%	699.5581	715.4589	-3.8	-0.005
	-15%	699.5581	715.4589	-4.2	-0.006
	End Point	699.5581	715.4589	-4.3	-0.006

8.5. PEAK TO AVERAGE RATIO

LIMITS

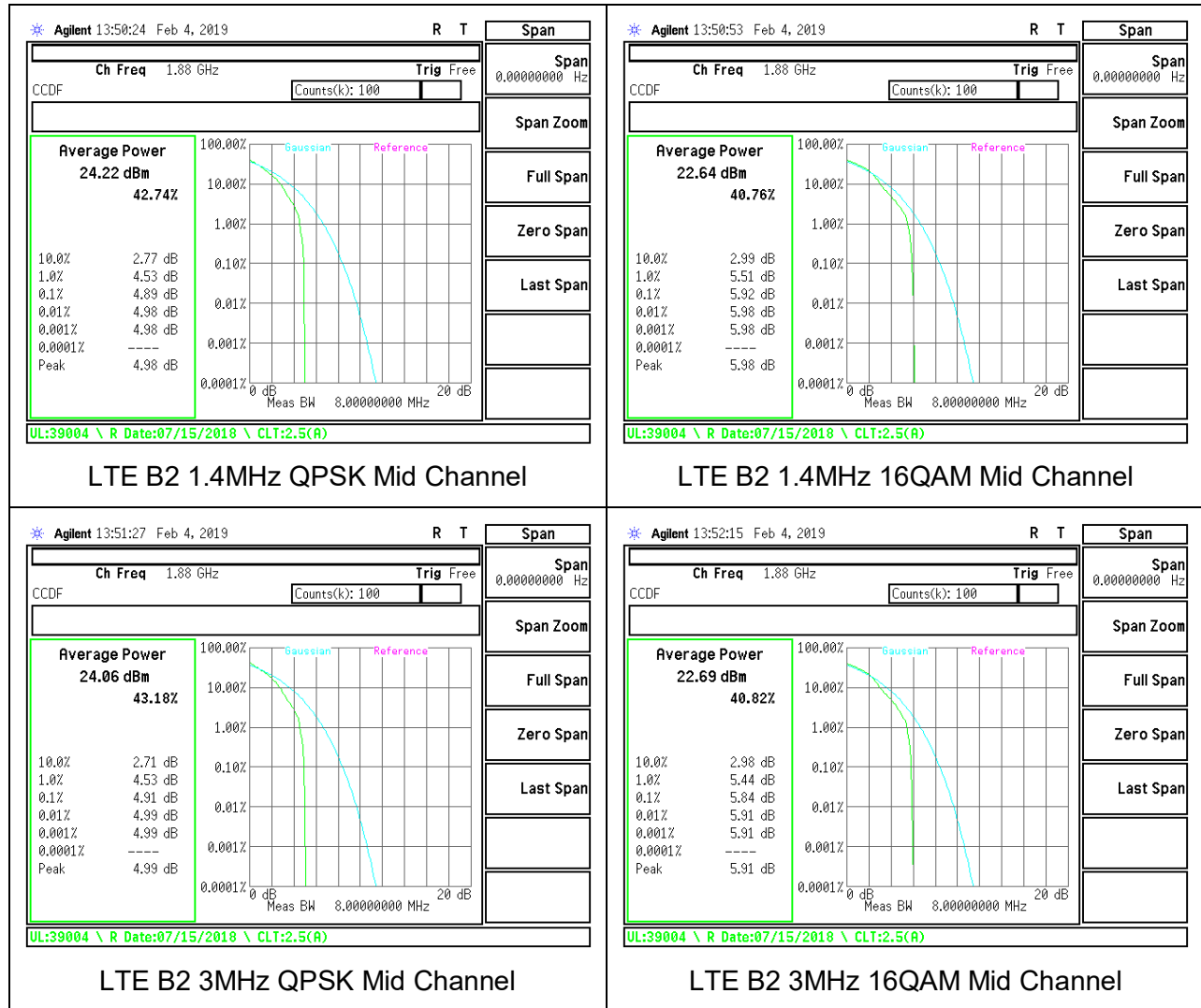
In addition, the peak to average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

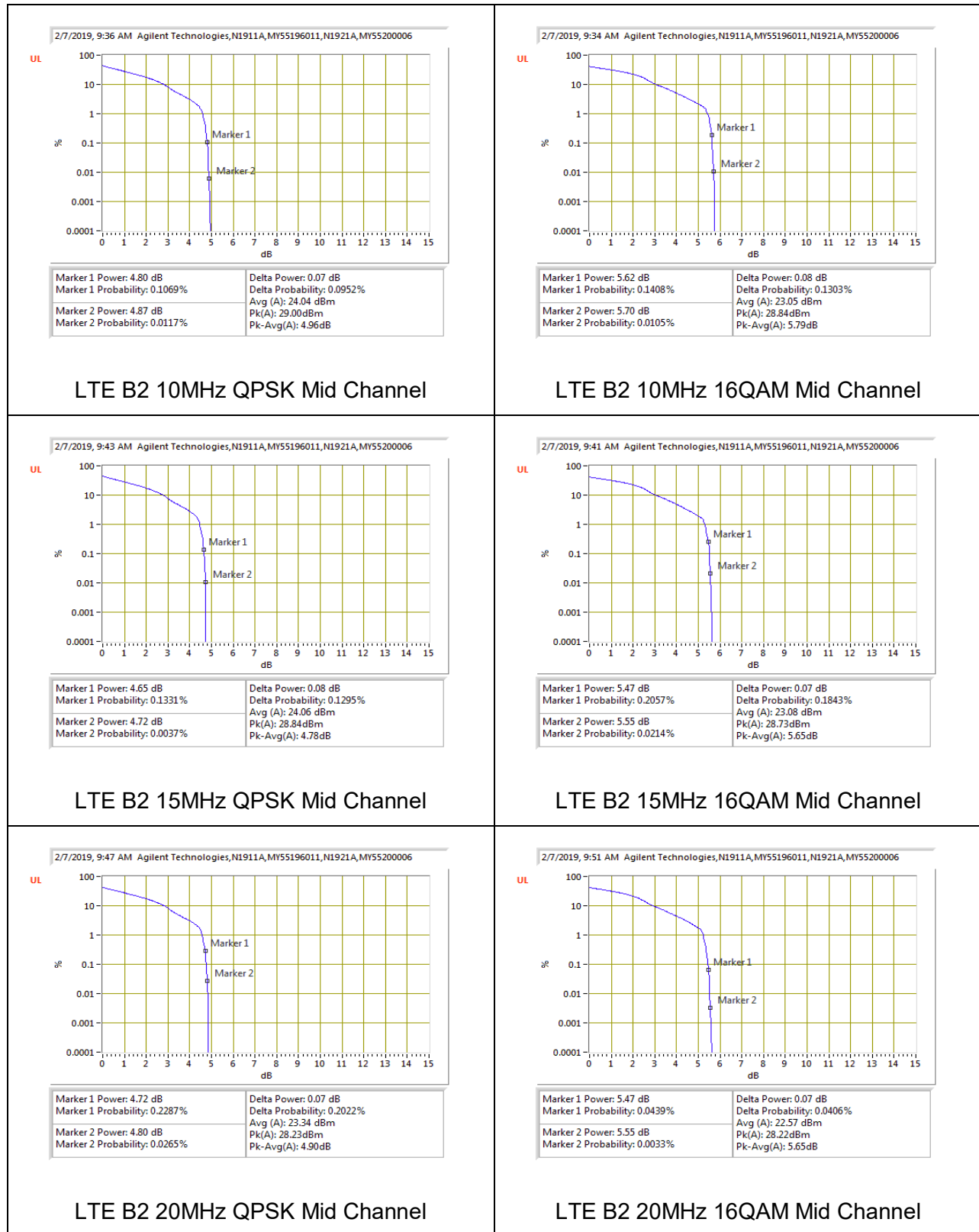
RESULT

LAT 1 antenna was used to measure as the worst case. The results from all CCDF plots are passed with 13dB peak-to-average power ratio criteria.

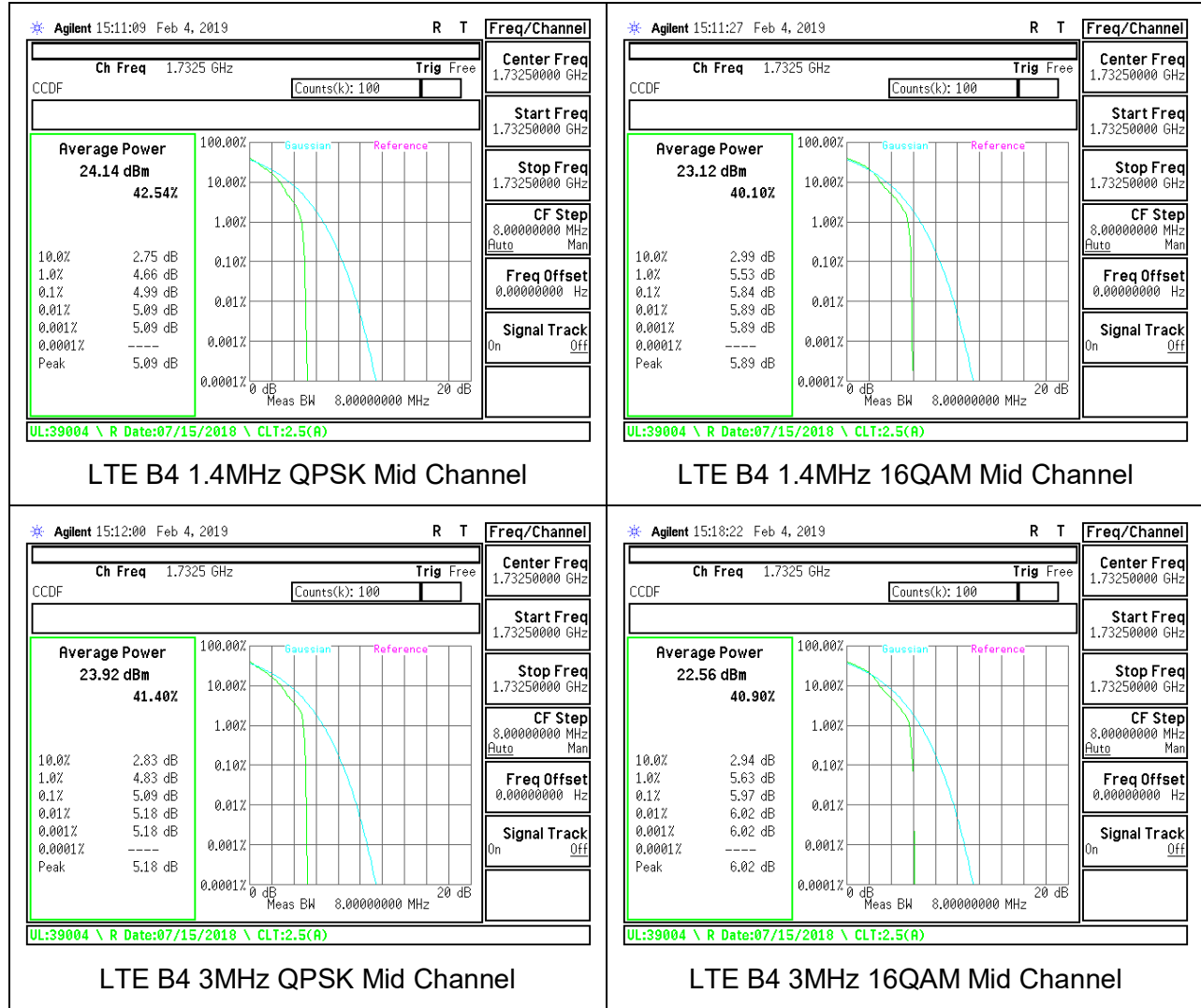
ID:	39004	Date:	2/4/19
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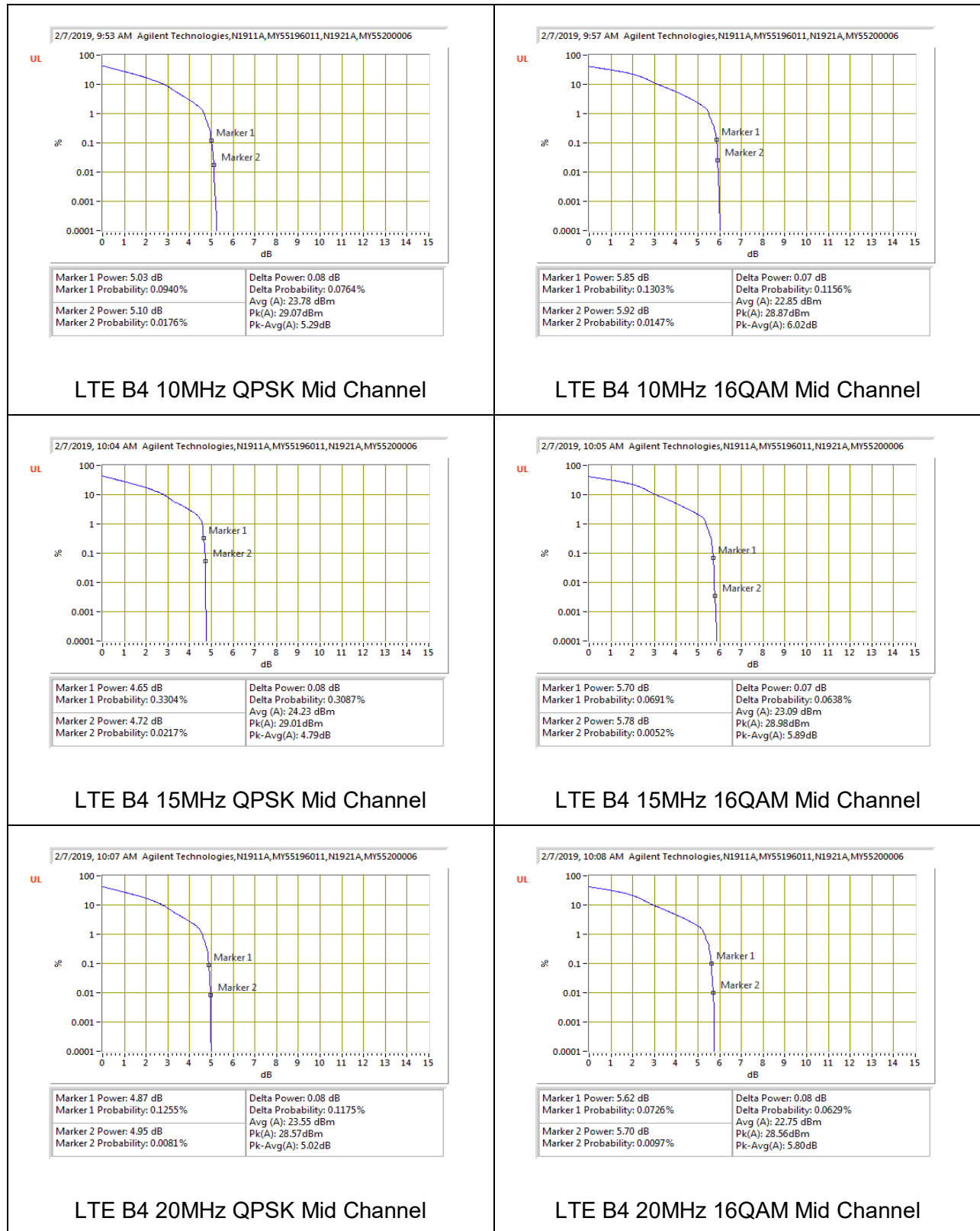
8.5.1. LTE BAND 2





8.5.2. LTE BAND 4





8.5.3. LTE BAND 5

