

## 12. OUT OF BAND EMISSIONS

### RULE PART(S)

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

### LIMITS

Part 24.238(a) & Part 22.917(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.

Part 27: (m)(4) (4) For mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log (P)$  dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than  $43 + 10 \log (P)$  dB on all frequencies between 2490.5 MHz and 2496 MHz and  $55 + 10 \log (P)$  dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

### TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v02r02

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 a maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

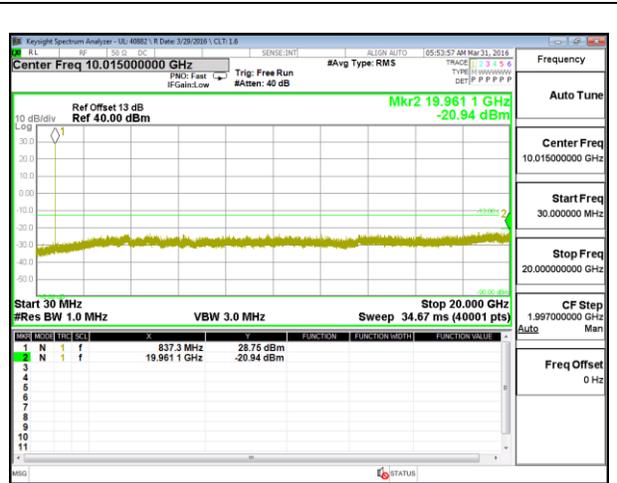
## 12.1. OUT OF BAND EMISSIONS RESULT AND PLOTS

### GSM

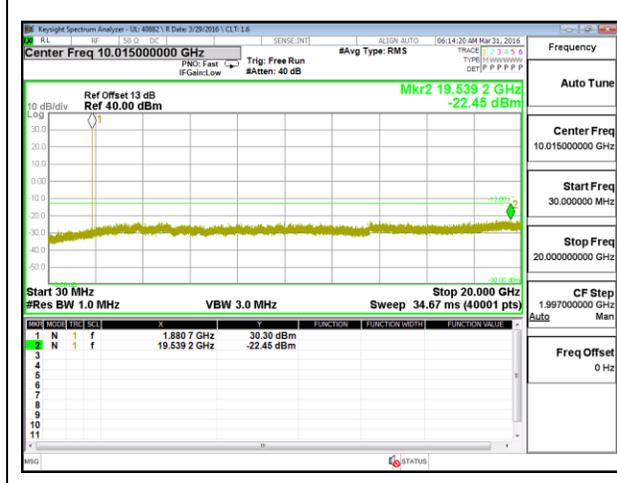
Band	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
GSM850	GPRS	824.2	-21.981	-13	-8.981
GSM850	GPRS	836.6	-22.381	-13	-9.381
GSM850	GPRS	848.8	-22.093	-13	-9.093
GSM850	EGPRS	824.2	-22.45	-13	-9.45
GSM850	EGPRS	836.6	-20.935	-13	-7.935
GSM850	EGPRS	848.8	-21.75	-13	-8.75
GSM1900	GPRS	1850.2	-22.459	-13	-9.459
GSM1900	GPRS	1880	-22.448	-13	-9.448
GSM1900	GPRS	1909.8	-22.443	-13	-9.443
GSM1900	EGPRS	1850.2	-22.245	-13	-9.245
GSM1900	EGPRS	1880	-22.502	-13	-9.502
GSM1900	EGPRS	1909.8	-22.456	-13	-9.456



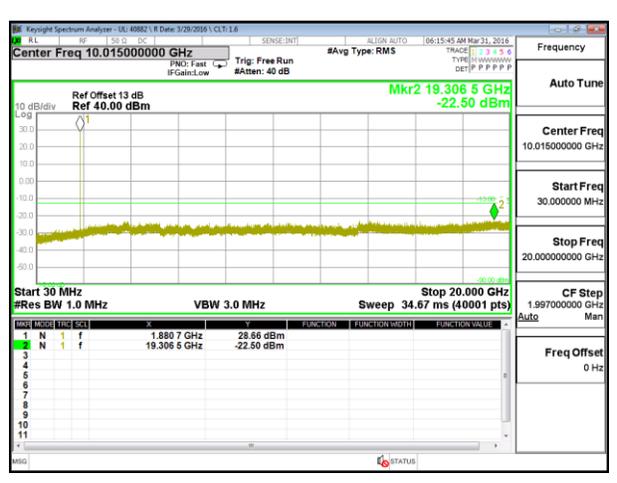
GSM850 GPRS Middle Channel



GSM850 EGPRS Middle Channel



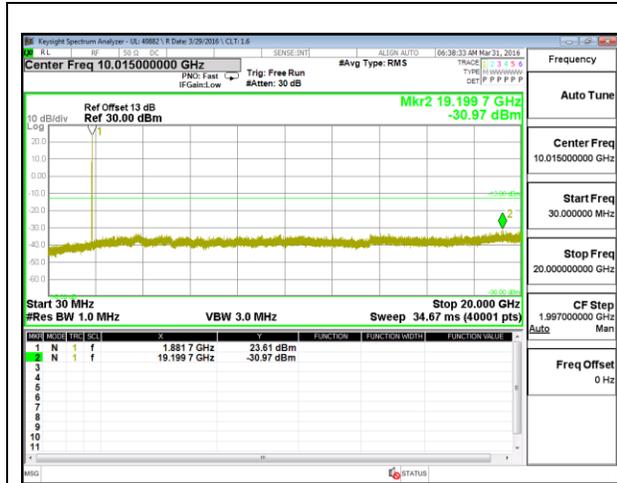
GSM1900 GPRS Middle Channel



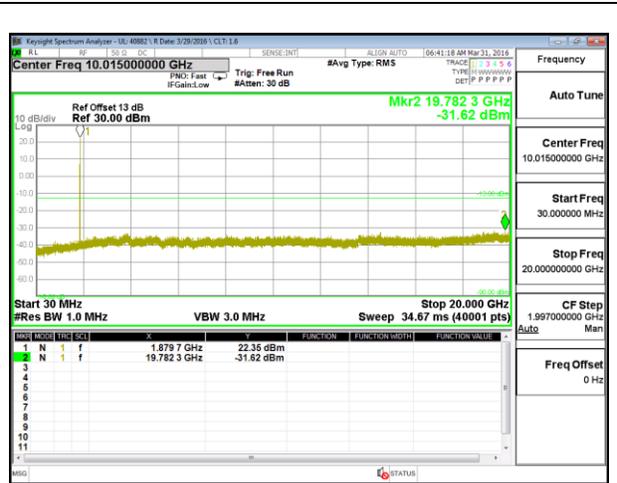
GSM1900 EGPRS Middle Channel

**WCDMA**

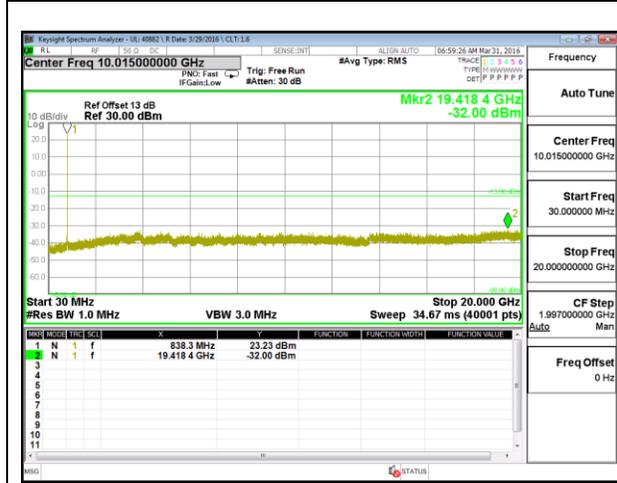
Band	Mode	f (MHz)	Spur (dBm)	99% BW (MHz)	Delta (dB)
Band 2	REL99	1852.4	-30.943	-13	-17.943
Band 2	REL99	1880	-30.972	-13	-17.972
Band 2	REL99	1907.6	-31.85	-13	-18.85
Band 2	HSDPA	1852.4	-32.038	-13	-19.038
Band 2	HSDPA	1880	-31.615	-13	-18.615
Band 2	HSDPA	1907.6	-32.182	-13	-19.182
Band 5	REL99	826.4	-32.355	-13	-19.355
Band 5	REL99	836.6	-32.001	-13	-19.001
Band 5	REL99	846.6	-31.38	-13	-18.38
Band 5	HSDPA	826.4	-32.349	-13	-19.349
Band 5	HSDPA	836.6	-32.121	-13	-19.121
Band 5	HSDPA	846.6	-32.134	-13	-19.134



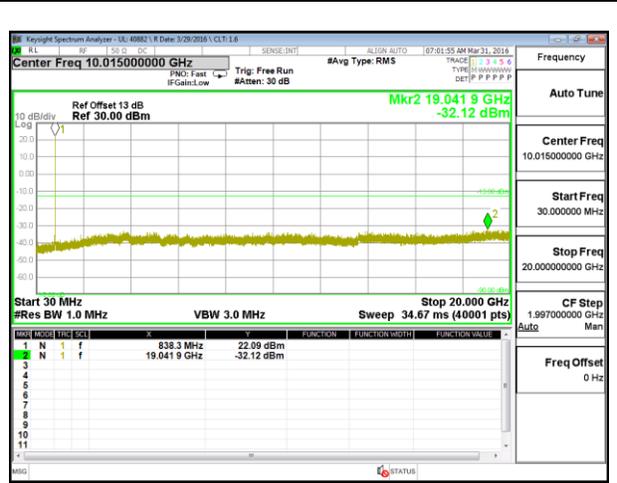
B2 REL99 Middle Channel



B2 HSDPA Middle Channel



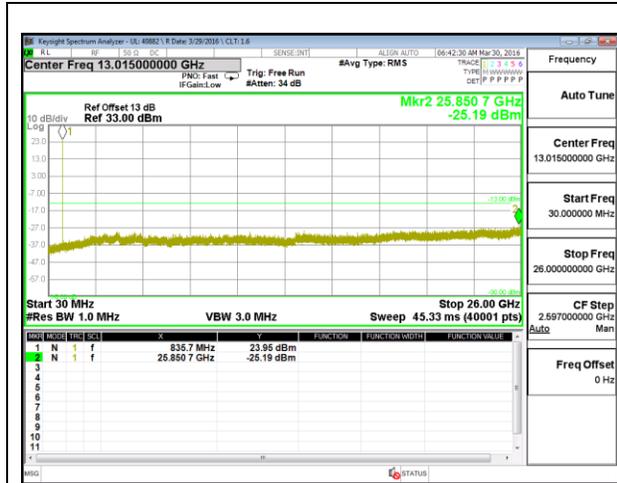
B5 REL99 Middle Channel



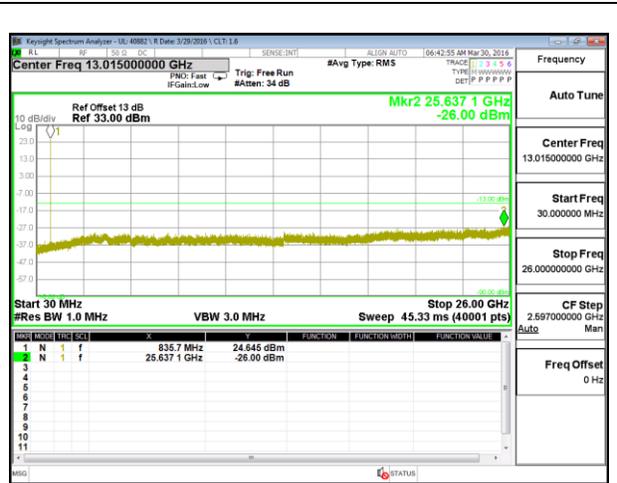
B5 HSDPA Middle Channel

**LTE Band 5**

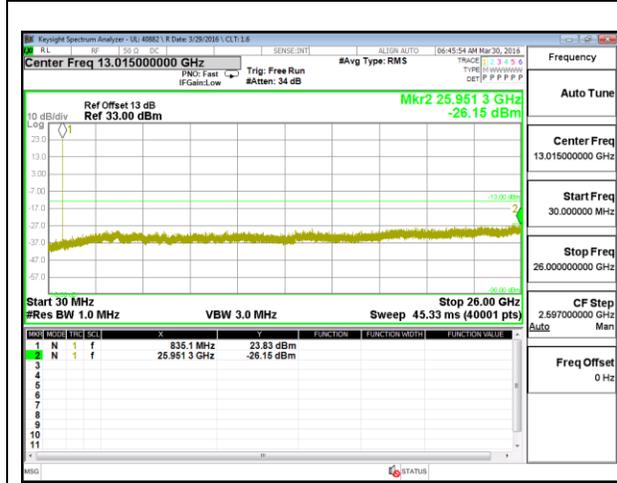
BW(MHz)	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
1.4	QPSK	824.7	-26.16	-13	-13.16
1.4	QPSK	836.5	-25.19	-13	-12.19
1.4	QPSK	848.3	-25.44	-13	-12.44
1.4	16QAM	824.7	-26.01	-13	-13.01
1.4	16QAM	836.5	-26.00	-13	-13.00
1.4	16QAM	848.3	-25.87	-13	-12.87
3	QPSK	825.5	-25.95	-13	-12.95
3	QPSK	836.5	-26.15	-13	-13.15
3	QPSK	847.5	-25.56	-13	-12.56
3	16QAM	825.5	-25.83	-13	-12.83
3	16QAM	836.5	-25.80	-13	-12.8
3	16QAM	847.5	-26.15	-13	-13.15
5	QPSK	826.5	-25.97	-13	-12.97
5	QPSK	836.5	-25.31	-13	-12.31
5	QPSK	846.5	-26.11	-13	-13.11
5	16QAM	826.5	-25.82	-13	-12.82
5	16QAM	836.5	-25.58	-13	-12.58
5	16QAM	846.5	-26.29	-13	-13.29
10	QPSK	829	-25.74	-13	-12.74
10	QPSK	836.5	-25.69	-13	-12.69
10	QPSK	844	-26.06	-13	-13.06
10	16QAM	829	-25.49	-13	-12.49
10	16QAM	836.5	-26.28	-13	-13.28
10	16QAM	844	-26.12	-13	-13.12



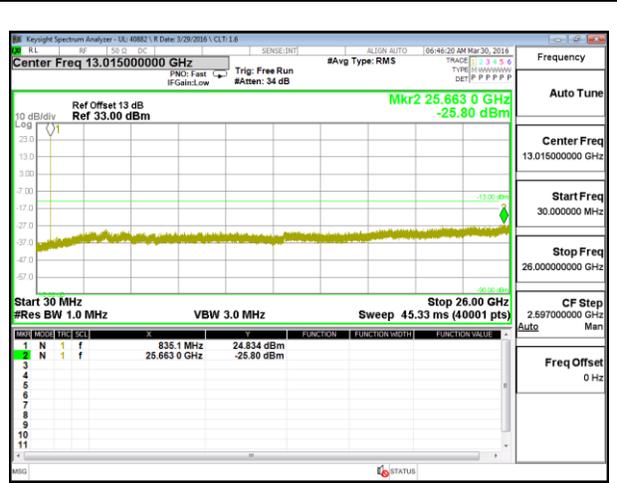
LTE B5 1.4MHz QPSK Middle Channel



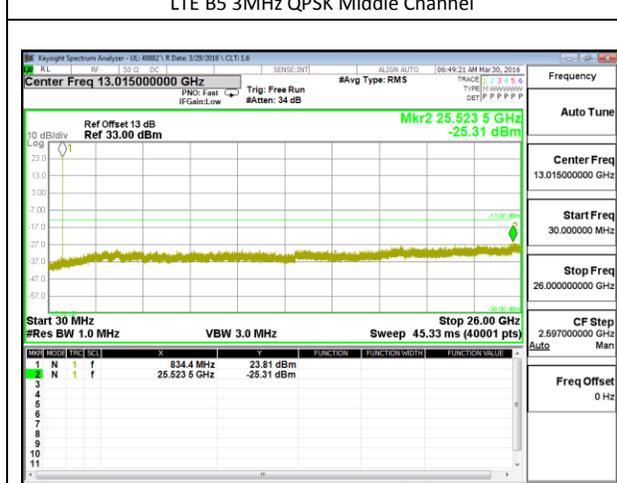
LTE B5 1.4MHz 16QAM Middle Channel



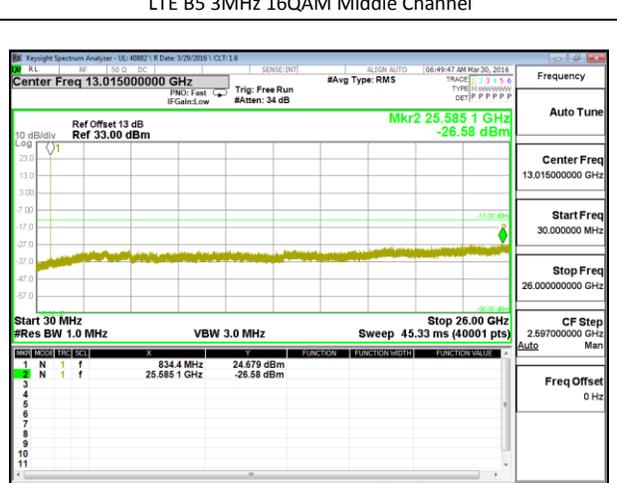
LTE B5 3MHz QPSK Middle Channel



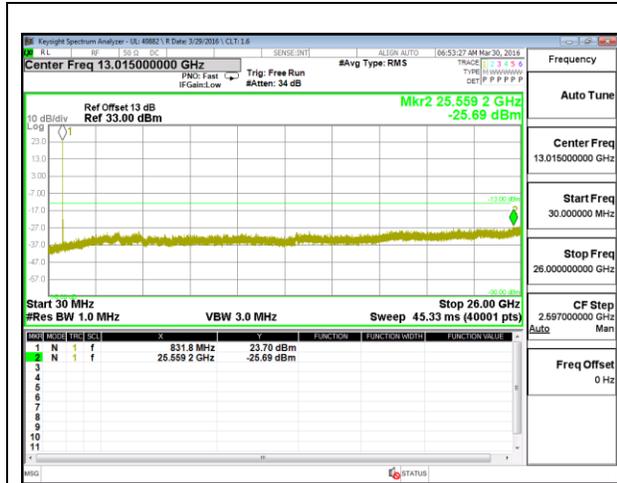
LTE B5 3MHz 16QAM Middle Channel



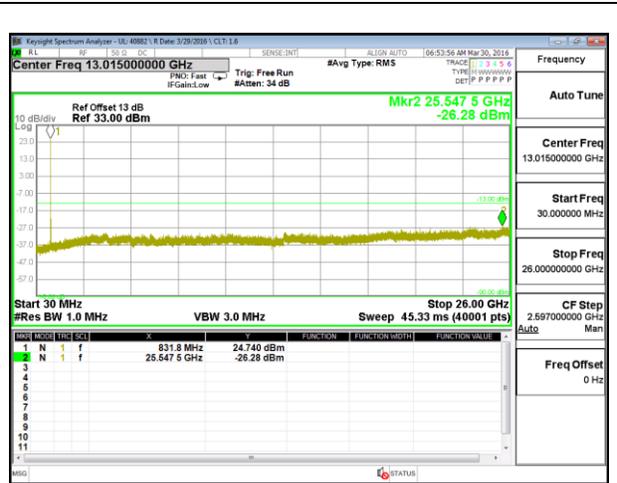
LTE B5 5MHz QPSK Middle Channel



LTE B5 5MHz 16QAM Middle Channel



LTE B5 10MHz QPSK Middle Channel



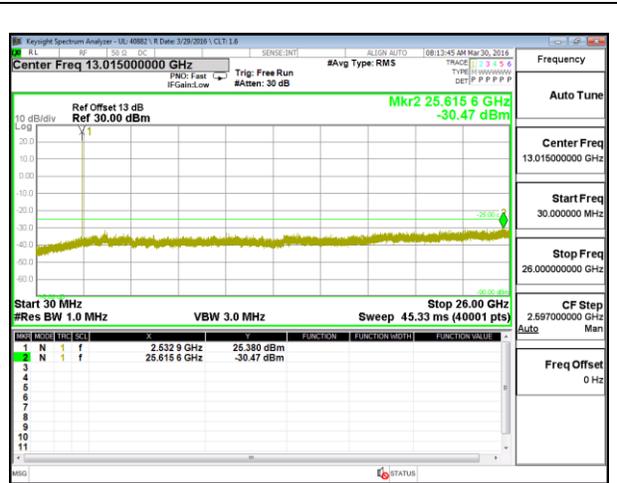
LTE B5 10MHz 16QAM Middle Channel

**LTE Band 7**

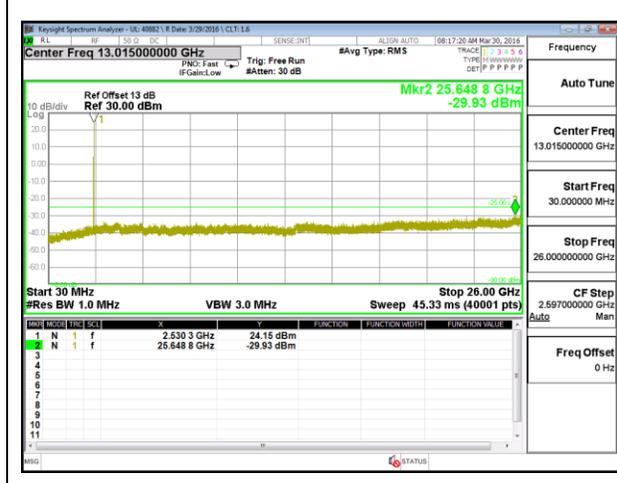
BW(MHz)	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
5	QPSK	2502.5	-29.88	-25	-4.88
5	QPSK	2535	-30.29	-25	-5.29
5	QPSK	2567.5	-29.89	-25	-4.89
5	16QAM	2502.5	-30.19	-25	-5.19
5	16QAM	2535	-30.47	-25	-5.47
5	16QAM	2567.5	-30.12	-25	-5.12
10	QPSK	2505	-30.28	-25	-5.28
10	QPSK	2535	-29.94	-25	-4.94
10	QPSK	2565	-30.29	-25	-5.29
10	16QAM	2505	-29.79	-25	-4.79
10	16QAM	2535	-29.53	-25	-4.53
10	16QAM	2565	-29.84	-25	-4.84
15	QPSK	2507.5	-30.44	-25	-5.44
15	QPSK	2535	-30.18	-25	-5.18
15	QPSK	2562.5	-29.16	-25	-4.16
15	16QAM	2507.5	-29.66	-25	-4.66
15	16QAM	2535	-30.16	-25	-5.16
15	16QAM	2562.5	-29.75	-25	-4.75
20	QPSK	2510	-30.32	-25	-5.32
20	QPSK	2535	-30.4	-25	-5.4
20	QPSK	2560	-29.95	-25	-4.95
20	16QAM	2510	-29.85	-25	-4.85
20	16QAM	2535	-29.94	-25	-4.94
20	16QAM	2560	-30.02	-25	-5.02



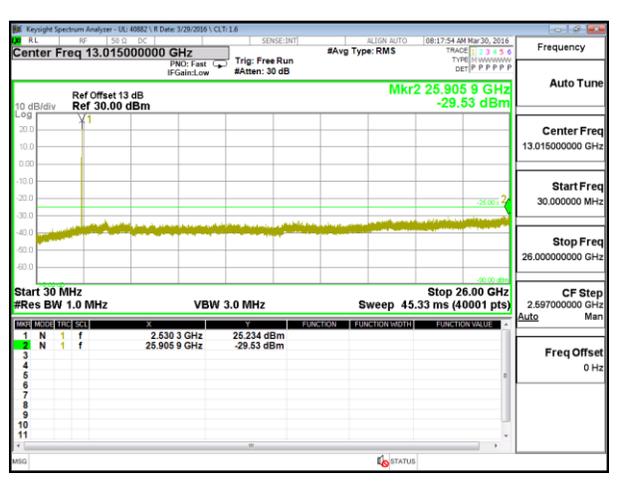
LTE B7 5MHz QPSK Middle Channel



LTE B7 5MHz 16QAM Middle Channel



LTE B7 10MHz QPSK Middle Channel



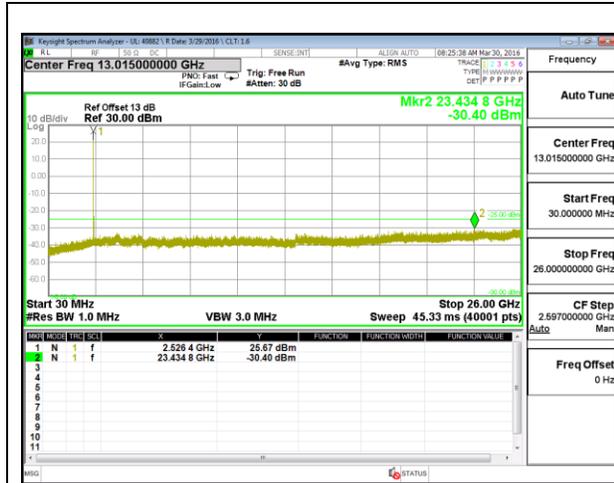
LTE B7 10MHz 16QAM Middle Channel



LTE B7 15MHz QPSK Middle Channel



LTE B7 15MHz 16QAM Middle Channel



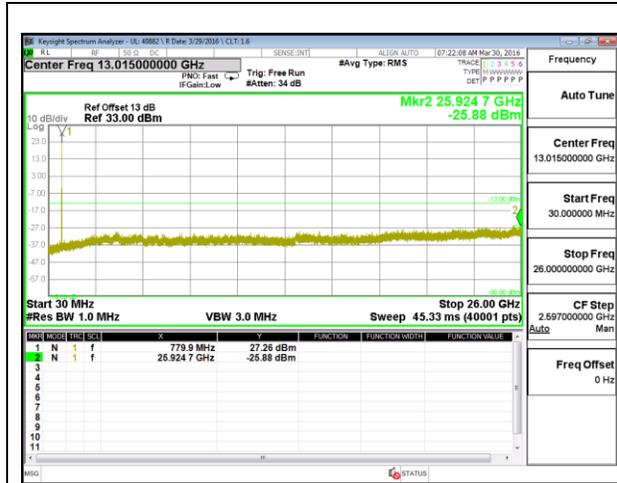
LTE B7 20MHz QPSK Middle Channel



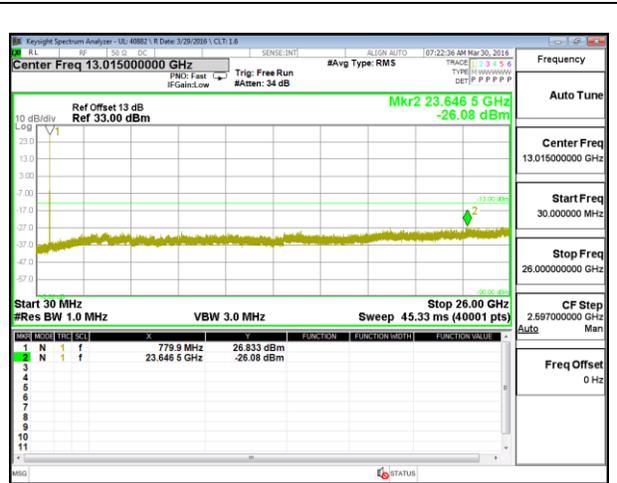
LTE B7 20MHz 16QAM Middle Channel

**LTE Band 13**

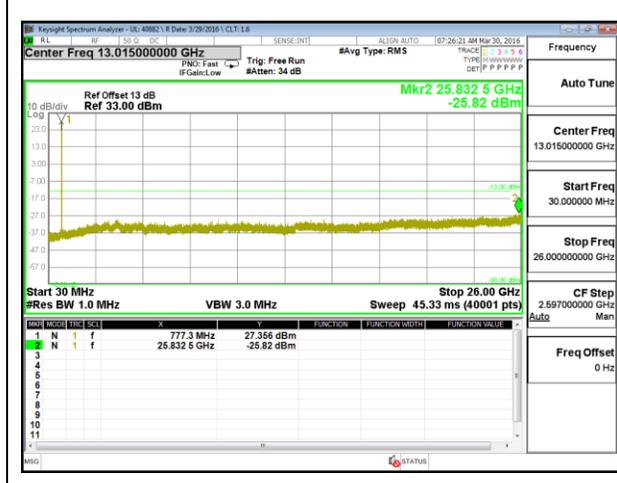
BW(MHz)	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
5	QPSK	779.5	-25.51	-13	-12.51
5	QPSK	782	-25.88	-13	-12.88
5	QPSK	784.5	-25.72	-13	-12.72
5	16QAM	779.5	-20.66	-13	-7.66
5	16QAM	782	-26.08	-13	-13.08
5	16QAM	784.5	-26.08	-13	-13.08
10	QPSK	782	-25.82	-13	-12.82
10	16QAM	782	-25.56	-13	-12.56



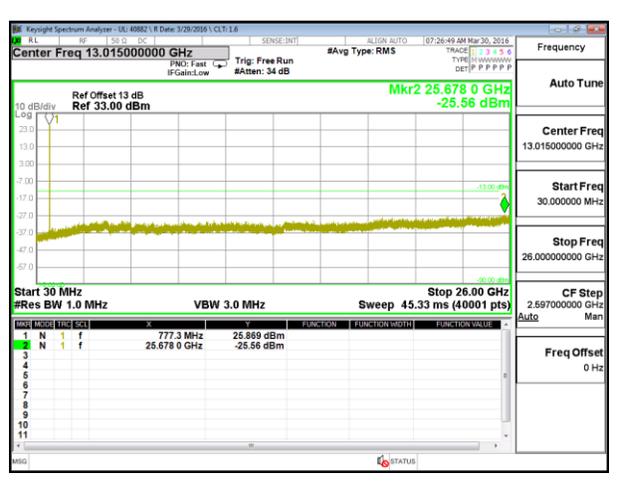
LTE B13 5MHz QPSK Middle Channel



LTE B13 5MHz 16QAM Middle Channel



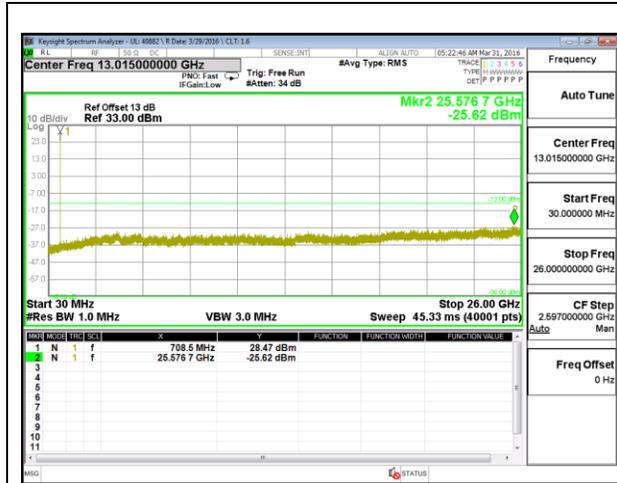
LTE B13 10MHz QPSK Middle Channel



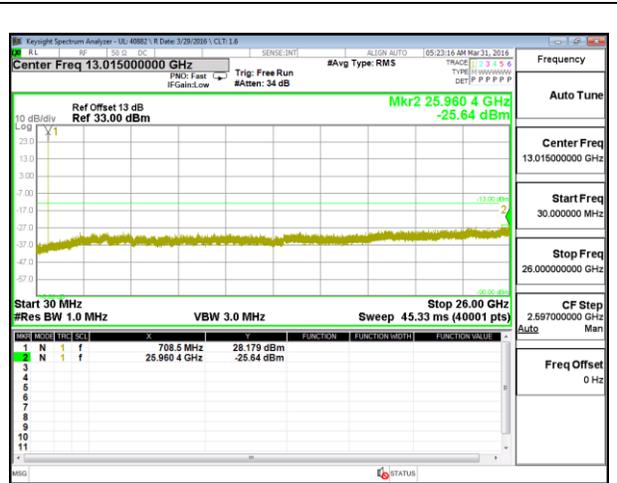
LTE B13 10MHz 16QAM Middle Channel

**LTE Band 17**

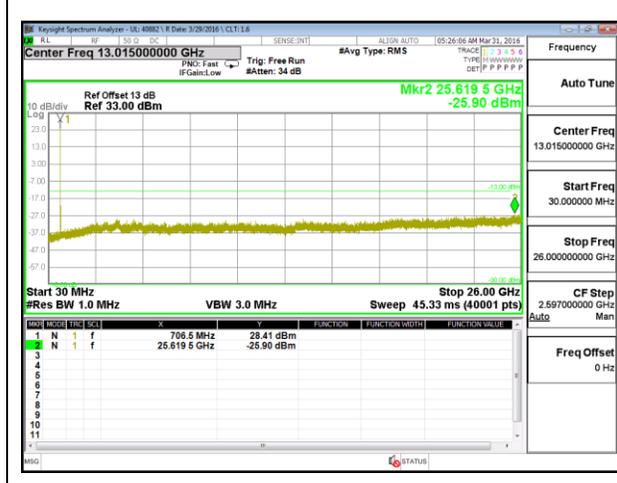
BW(MHz)	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
5	QPSK	706.5	-26.01	-13	-13.01
5	QPSK	710	-25.62	-13	-12.62
5	QPSK	713.5	-25.71	-13	-12.71
5	16QAM	706.5	-25.99	-13	-12.99
5	16QAM	710	-25.64	-13	-12.64
5	16QAM	713.5	-25.60	-13	-12.60
10	QPSK	709	-25.25	-13	-12.25
10	QPSK	710	-25.90	-13	-12.90
10	QPSK	711	-25.73	-13	-12.73
10	16QAM	709	-25.82	-13	-12.82
10	16QAM	710	-25.75	-13	-12.75
10	16QAM	711	-26.10	-13	-13.10



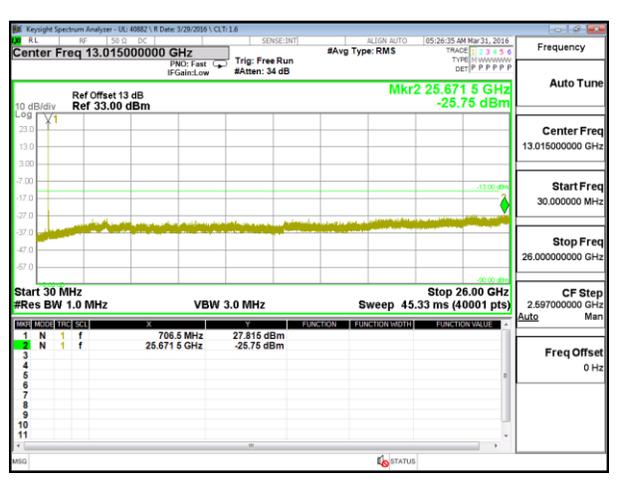
LTE B17 5MHz QPSK Middle Channel



LTE B17 5MHz 16QAM Middle Channel



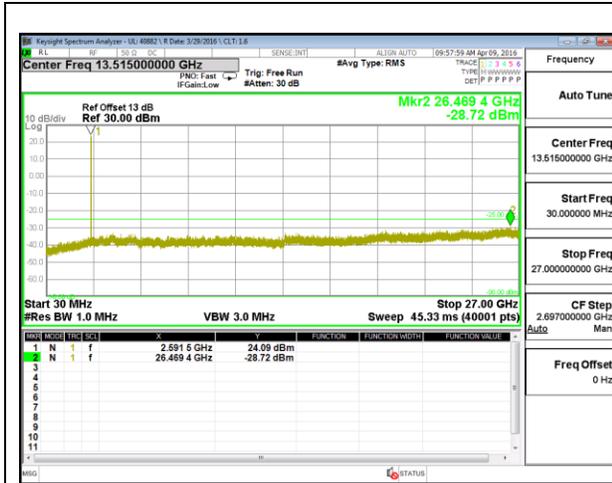
LTE B17 10MHz QPSK Middle Channel



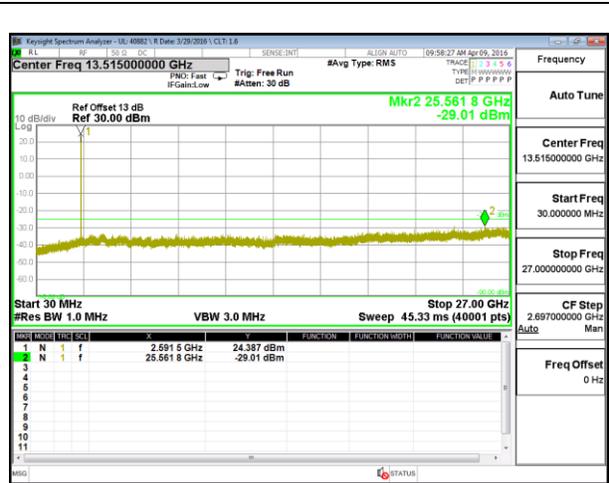
LTE B17 10MHz 16QAM Middle Channel

**LTE Band 41**

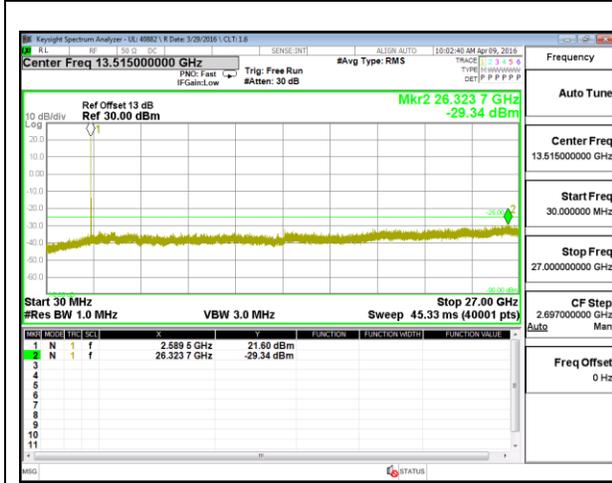
BW(MHz)	Mode	f (MHz)	Spur (dBm)	Spec (dBm)	Delta (dB)
5	QPSK	2498.5	-29.92	-25	-4.92
5	QPSK	2593	-28.72	-25	-3.72
5	QPSK	2687.5	-29.32	-25	-4.32
5	16QAM	2498.5	-29.39	-25	-4.39
5	16QAM	2593	-29.01	-25	-4.01
5	16QAM	2687.5	-29.59	-25	-4.59
10	QPSK	2501	-29.33	-25	-4.33
10	QPSK	2593	-29.34	-25	-4.34
10	QPSK	2685	-29.83	-25	-4.83
10	16QAM	2501	-29.44	-25	-4.44
10	16QAM	2593	-29.22	-25	-4.22
10	16QAM	2685	-29.28	-25	-4.28
15	QPSK	2503.5	-29.48	-25	-4.48
15	QPSK	2593	-29.09	-25	-4.09
15	QPSK	2682.5	-29.35	-25	-4.35
15	16QAM	2503.5	-28.68	-25	-3.68
15	16QAM	2593	-29.65	-25	-4.65
15	16QAM	2682.5	-28.67	-25	-3.67
20	QPSK	2506	-29	-25	-4
20	QPSK	2593	-29.35	-25	-4.35
20	QPSK	2680	-29.86	-25	-4.86
20	16QAM	2506	-29.81	-25	-4.81
20	16QAM	2593	-29.54	-25	-4.54
20	16QAM	2680	-29.13	-25	-4.13



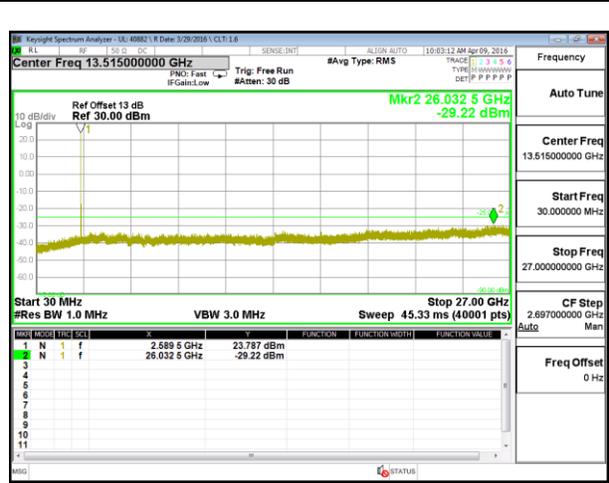
LTE B41 5MHz QPSK Middle Channel



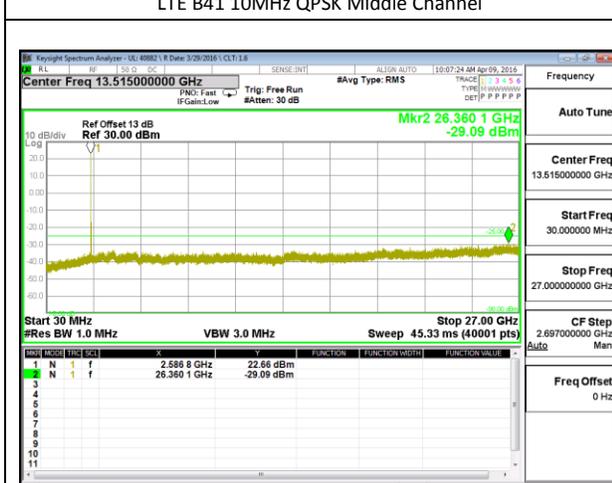
LTE B41 5MHz 16QAM Middle Channel



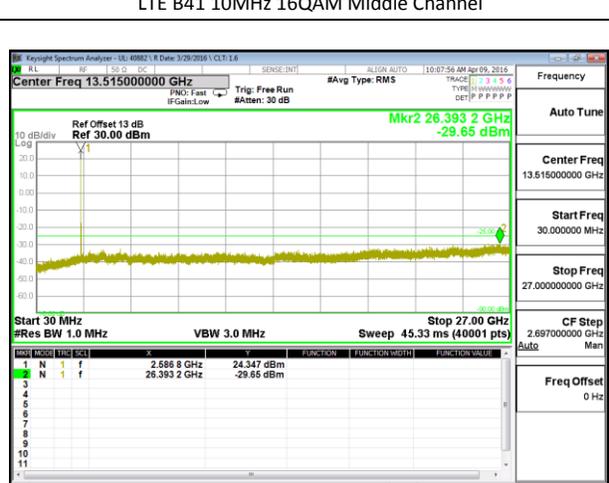
LTE B41 10MHz QPSK Middle Channel



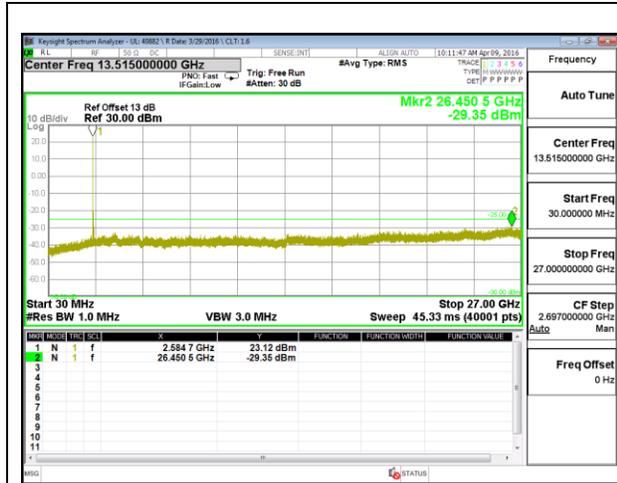
LTE B41 10MHz 16QAM Middle Channel



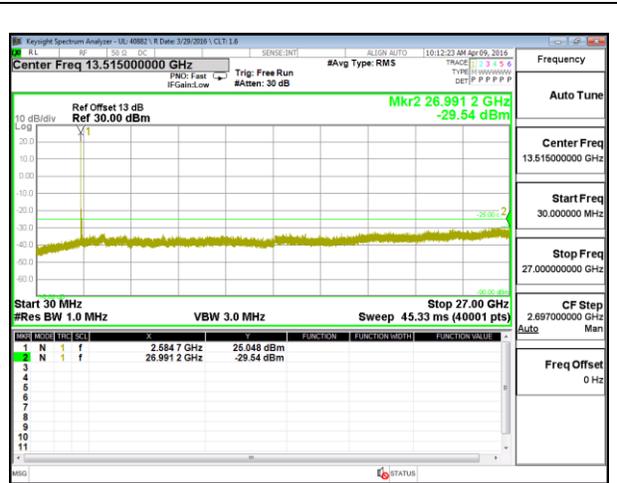
LTE B41 15MHz QPSK Middle Channel



LTE B41 15MHz 16QAM Middle Channel



LTE B41 20MHz QPSK Middle Channel



LTE B41 20MHz 16QAM Middle Channel

## **13. FREQUENCY STABILITY**

### **RULE PART(S)**

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

### **LIMITS**

§22.355 - The carrier frequency shall not depart from the reference frequency in excess of  $\pm 2.5$  ppm for mobile stations.

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

§27.54 - The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### **TEST PROCEDURE**

Per KDB 971168 D01 Power Meas License Digital Systems v02r02

### 13.1. FREQUENCY STABILITY RESULTS

**LTE Band 5**

Reference Frequency: Mid Channel 836.5 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.250 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	836.500002	-0.001	2.5
3.80	40	836.500002	-0.001	2.5
3.80	30	836.500002	-0.001	2.5
<b>3.80</b>	<b>20</b>	<b>836.500001</b>	<b>0</b>	<b>2.5</b>
3.80	10	836.500000	0.001	2.5
3.80	0	836.500000	0.000	2.5
3.80	-10	836.500000	0.001	2.5
3.80	-20	836.500002	-0.001	2.5
3.80	-30	836.499999	0.002	2.5

Reference Frequency: PCS Mid Channel 836.5 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 2091.250 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>836.500001</b>	<b>0</b>	<b>2.5</b>
4.20	20	836.500017	-0.001	2.5
3.60	20	836.500018	-0.001	2.5

**WCDMA B2**

Reference Frequency: Mid Channel 1880 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	1879.999999	0.001	2.5
3.80	40	1880.000001	0.000	2.5
3.80	30	1880.000001	0.000	2.5
<b>3.80</b>	<b>20</b>	<b>1880.000001</b>	<b>0</b>	<b>2.5</b>
3.80	10	1880.000001	0.000	2.5
3.80	0	1880.000001	0.000	2.5
3.80	-10	1880.000002	0.000	2.5
3.80	-20	1880.000000	0.001	2.5
3.80	-30	1880.000003	-0.001	2.5

Reference Frequency: PCS Mid Channel 1880 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 4700.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>1880.000001</b>	<b>0</b>	<b>2.5</b>
4.20	20	1880.000001	0.000	2.5
3.60	20	1879.999999	0.001	2.5

**LTE Band 13**

Reference Frequency: Mid Channel 782 MHz @ 20°C				
Limit: to stay +/- 2.5 ppm = 1955.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	782.000001	-0.004	2.5
3.80	40	782.000001	-0.003	2.5
3.80	30	782.000001	-0.003	2.5
<b>3.80</b>	<b>20</b>	<b>781.999998</b>	<b>0</b>	<b>2.5</b>
3.80	10	782.000001	-0.003	2.5
3.80	0	781.999998	0.000	2.5
3.80	-10	782.000001	-0.003	2.5
3.80	-20	782.000001	-0.004	2.5
3.80	-30	782.000001	-0.004	2.5

Reference Frequency: PCS Mid Channel 782 MHz @ 20°C				
Limit: to stay +/- 2.5 ppm = 1955.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>781.999998</b>	<b>0</b>	<b>2.5</b>
4.20	20	782.0000003	-0.002	2.5
3.60	20	782.0000002	-0.002	2.5

**LTE Band 17**

Reference Frequency: Mid Channel 710 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 1775.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	710.000001	-0.001	2.5
3.80	40	710.000001	0.000	2.5
3.80	30	709.999999	0.003	2.5
<b>3.80</b>	<b>20</b>	<b>710.000001</b>	<b>0</b>	<b>2.5</b>
3.80	10	710.000001	0.000	2.5
3.80	0	709.999999	0.003	2.5
3.80	-10	709.999999	0.003	2.5
3.80	-20	710.000001	0.000	2.5
3.80	-30	710.000001	0.000	2.5

Reference Frequency: PCS Mid Channel 710 MHz @ 20°C Limit: to stay +/- 2.5 ppm = 1775.000 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>710.000001</b>	<b>0</b>	<b>2.5</b>
4.20	20	710.0000006	0.000	2.5
3.60	20	710.0000008	0.000	2.5

**LTE Band 41**

Reference Frequency: Mid Channel 2593 MHz @ 20°C				
Limit: to stay +/- 2.5 ppm = 6482.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.80	50	2593.000001	0.000	2.5
3.80	40	2593.000000	0.001	2.5
3.80	30	2593.000002	0.000	2.5
<b>3.80</b>	<b>20</b>	<b>2593.000001</b>	<b>0</b>	<b>2.5</b>
3.80	10	2593.000000	0.000	2.5
3.80	0	2592.999999	0.001	2.5
3.80	-10	2593.000001	0.000	2.5
3.80	-20	2593.000000	0.000	2.5
3.80	-30	2592.999999	0.001	2.5

Reference Frequency: PCS Mid Channel 2593 MHz @ 20°C				
Limit: to stay +/- 2.5 ppm = 6482.500 Hz				
Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
<b>3.80</b>	<b>20</b>	<b>2593.000001</b>	<b>0</b>	<b>2.5</b>
4.20	20	2593.000001	0.000	2.5
3.60	20	2593	0.000	2.5

## 14. RADIATED TEST RESULTS

### 14.1. RADIATED POWER (ERP & EIRP)

#### RULE PART(S)

FCC: §2. 1046, §22. 913, §24. 232 and §27.50

#### LIMITS

22.913 (a) - The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

24.232 (c) - Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

27.50 (b) - (10) Portable stations (handheld devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP. (LTE B13)

27.50 (c) - (10) Portable stations (handheld devices) are limited to 3 watts ERP; (LTE B17)

27.50 (h) - (2) Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power. (LTE B41 & 7)

In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13dB.

#### TEST PROCEDURE

ANSI / TIA / EIA 603D Clause 2.2.17; PSA setting reference to 971168 D01 v02r02

For peak power measurement with a PSA:

a) Set the RBW  $\geq$  OBW; b) Set VBW  $\geq 3 \times$  RBW; c) Set span  $\geq 2 \times$  RBW; d) Sweep time = auto couple; e) Detector = peak; f) Ensure that the number of measurement points  $\geq$  span/RBW; g) Trace mode = max hold;

For average power measurement with a PSA:

a) Set span to at least 1.5 times the OBW; b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz; c) Set VBW  $\geq 3 \times$  RBW; d) Set number of points in sweep  $\geq 2 \times$  span / RBW; e) Sweep time = auto-couple; f) Detector = RMS (power averaging); g) Use free run trigger If burst duty cycle  $\geq 98$ ; h) Use trigger to capture bursts If burst duty cycle  $< 98$ ; i) Trace average at least 100 traces in power averaging (*i.e.*, RMS) mode. j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function.