

6 Band Edge and Conducted Spurious Emissions

6.1 Test Result

Test Description	Basic Standards		Test Result
Conducted Spurious Emissions and Band Edge	FCC 2.1051 FCC 22.917(a) FCC 24.238(a) FCC 27.53(g) FCC 27.53(h) FCC 27.53(m)(4)	RSS-130 (4.6.1) RSS-132 (5.5) RSS-133 (6.5.1) RSS-139 (6.6) RSS-199 (4.5)	Pass

6.2 Test Method

The conducted power at the EUT antenna port of the band edge (out-of-band) and spurious band emissions are measured by means of a calibrated spectrum analyzer. The spectrum is investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. The power of any emissions outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) measured in watts by at least $43 + 10 \log(P)$ dB for all bands except for band 7. In the case of band 7, the emissions shall be attenuated by at least $40 + 10 \log(P)$ 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. In addition, just for band 7, 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. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Every available bandwidth was investigated and the worst-case measurements are reported at the lowest and highest channels in each band.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions	Bands 2, 4, 5 & 12	Band 7
Temperature:	23.2 – 23.6 °C	23.4 °C
Relative Humidity:	52.5 – 52.8 %	51.3 %
Atmospheric Pressure:	97.4 – 97.8 kPa	98.3 kPa

6.4 Test Equipment

Bands 2, 4, 5 & 12

Test End Date: 23-Jul-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	16085221	24-Jul-2018
RF CABLE	1134	GORE	B094785	25-Jul-2019
RF CABLE	141	HUBER & SUHNER	B095588	25-Jul-2019
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15032	CNR
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101743	25-Jul-2019
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	ROHDE & SCHWARZ	B094874	25-Jan-2020

- Unless otherwise noted, equipment is on a 1-year calibration cycle.
- Based on manufacturer's specifications, the CMW 500 is on a 2-year calibration cycle.

Band 7

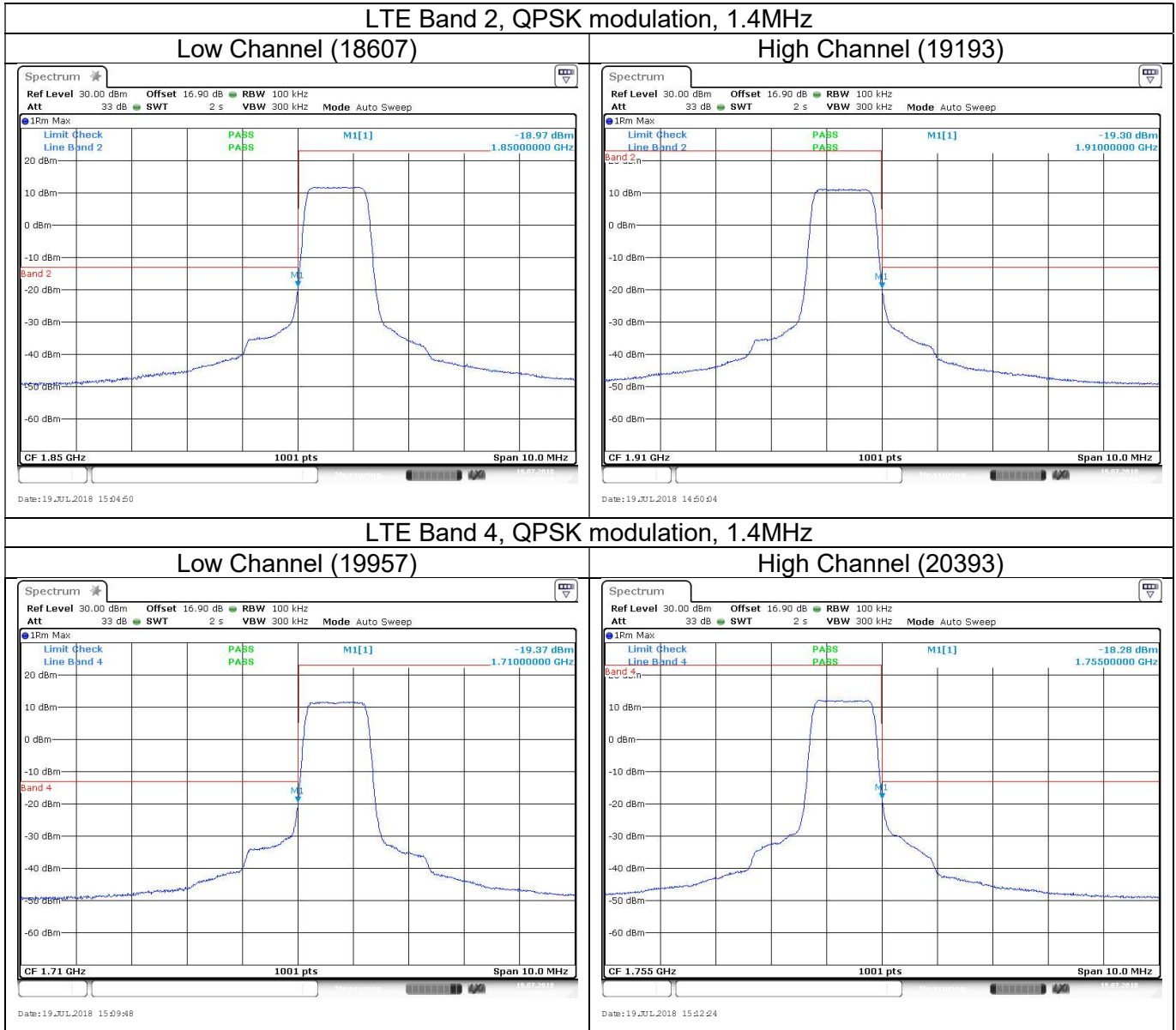
Test End Date: 27-Aug-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	1134	GORE	B094785	25-Jul-2019
RF CABLE	141	HUBER & SUHNER	B095588	25-Jul-2019
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15032	CNR
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	B101743	25-Jul-2019
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	ROHDE & SCHWARZ	B094874	25-Jan-2020

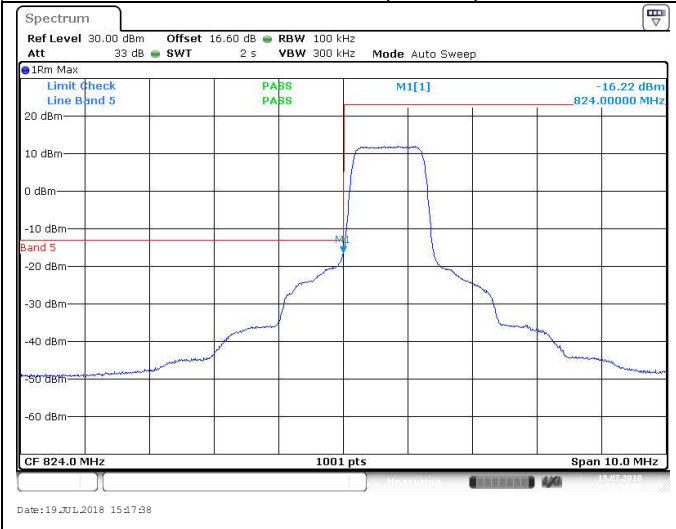
- Unless otherwise noted, equipment is on a 1-year calibration cycle.
- Based on manufacturer's specifications, the FSV30 & CMW 500 are on a 2-year calibration cycle.

6.5 Test Data - Band Edge



LTE Band 5, QPSK modulation, 1.4MHz

Low Channel (20407)

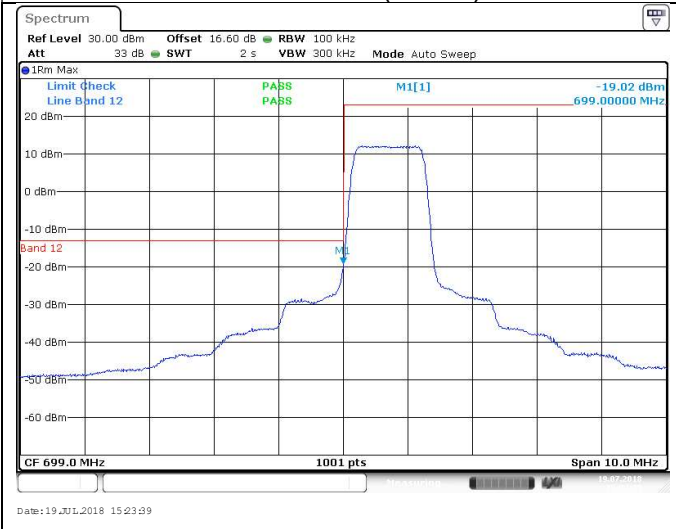


High Channel (20643)

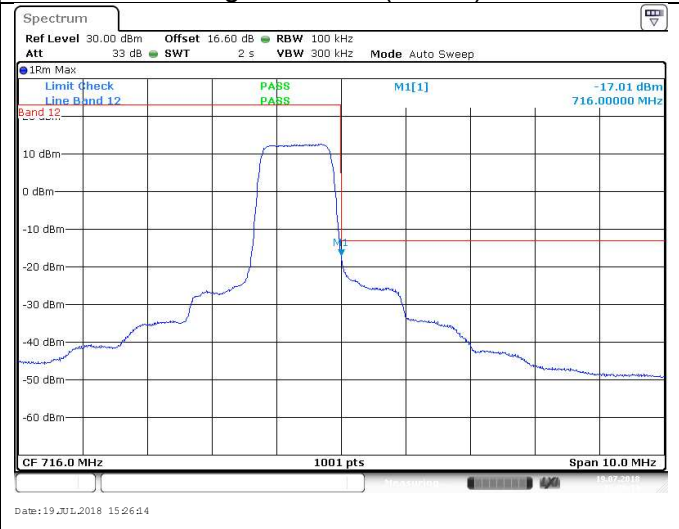


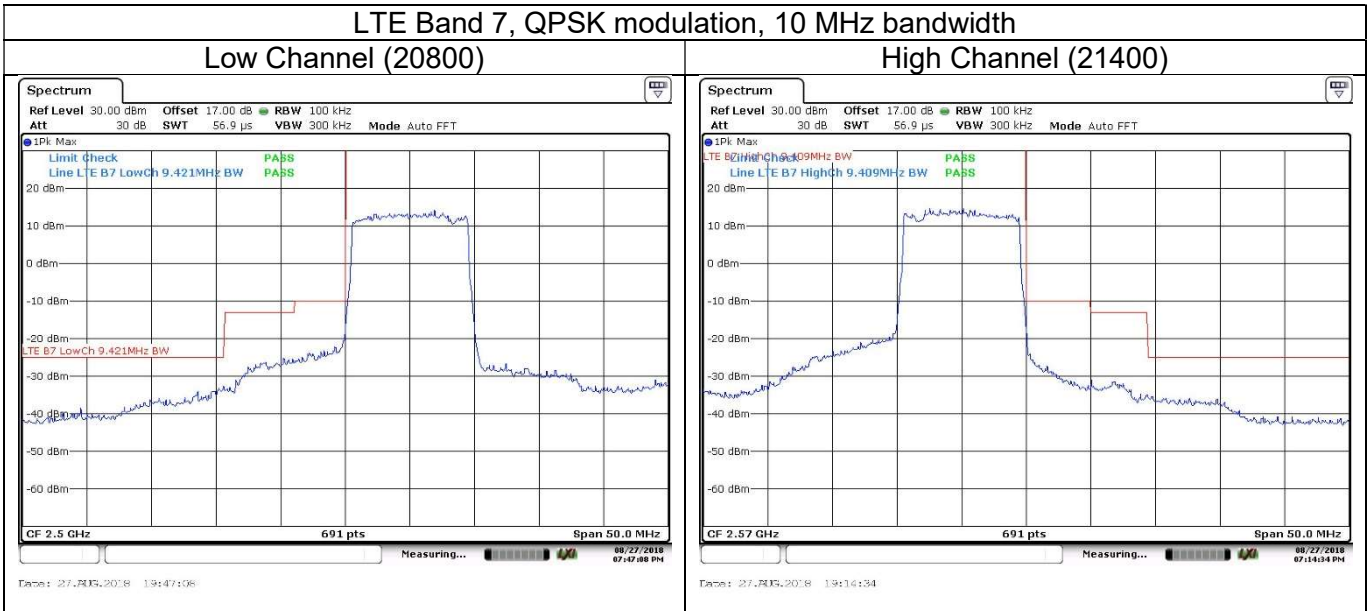
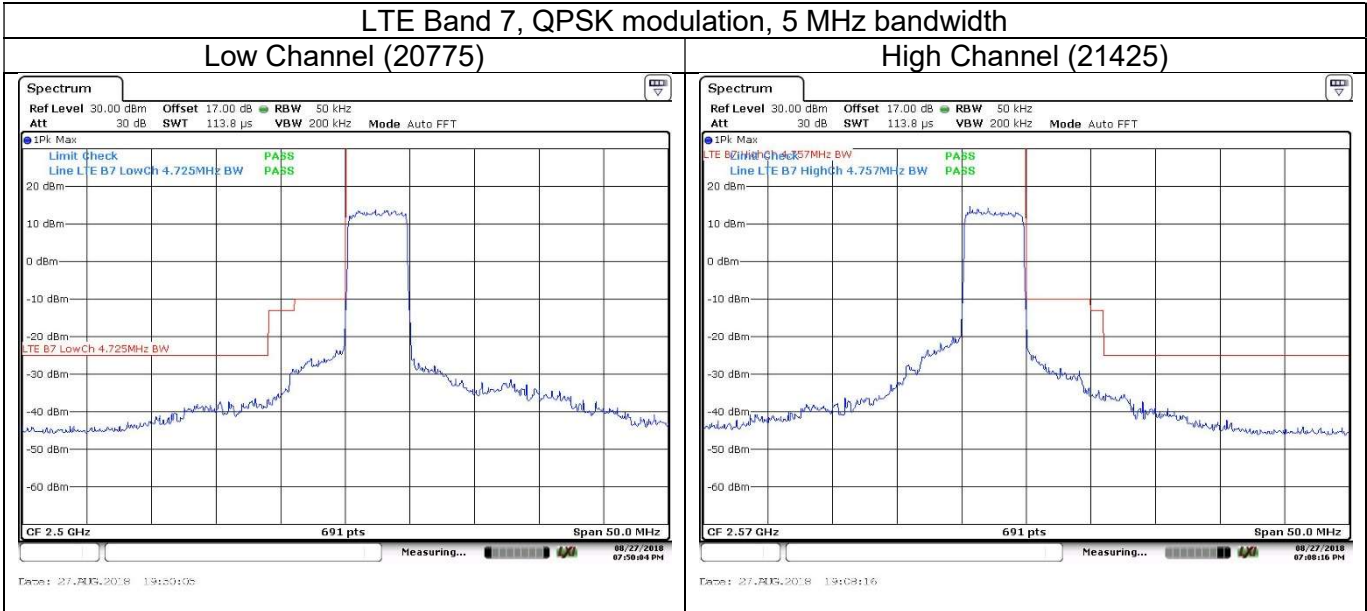
LTE Band 12, QPSK modulation, 1.4MHz

Low Channel (23017)



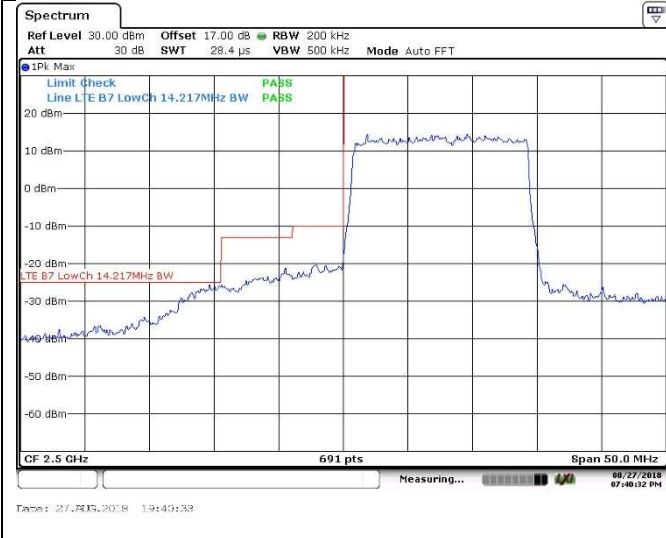
High Channel (23173)



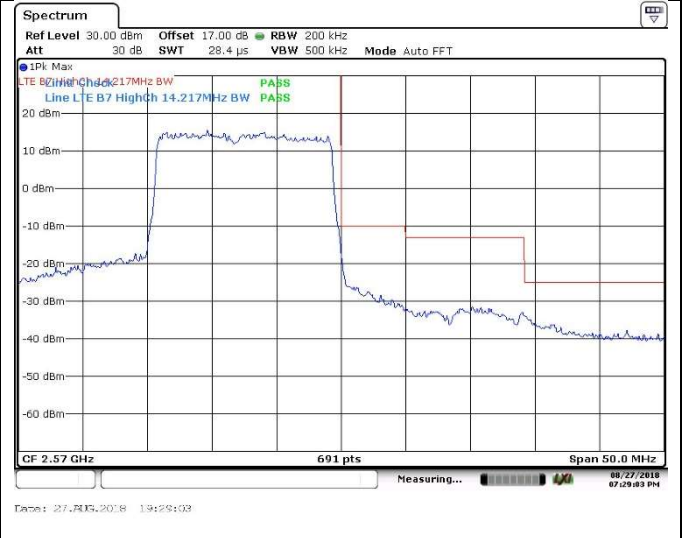


LTE Band 7, QPSK modulation, 15 MHz bandwidth

Low Channel (20825)

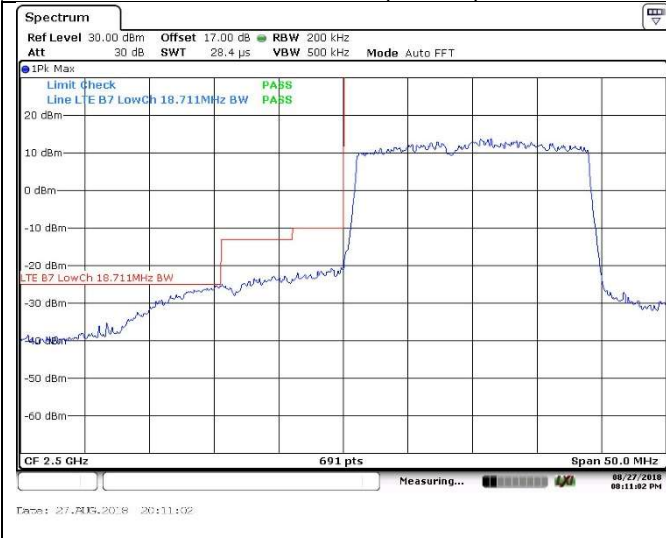


High Channel (21375)



LTE Band 7, QPSK modulation, 20 MHz bandwidth

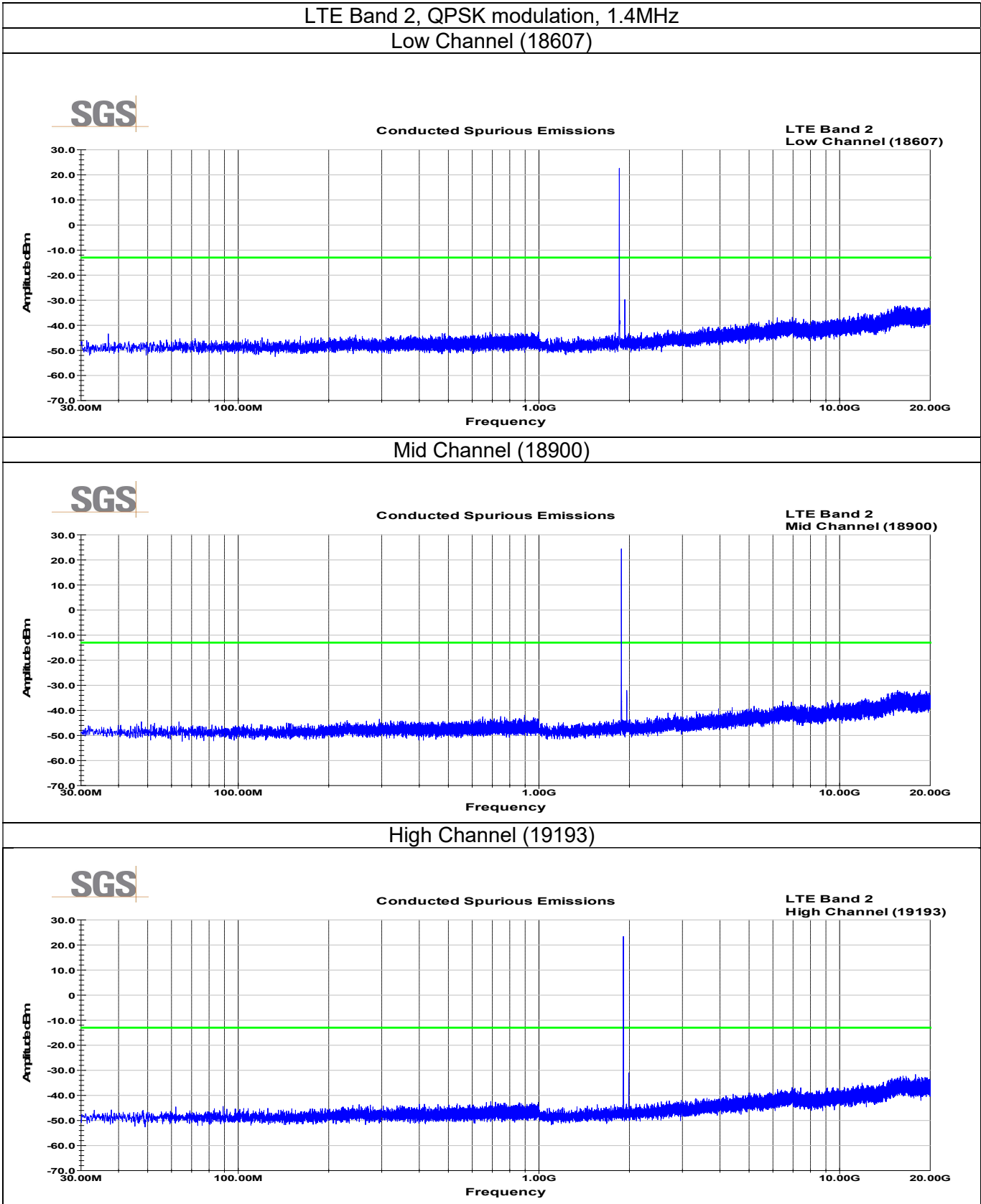
Low Channel (20850)



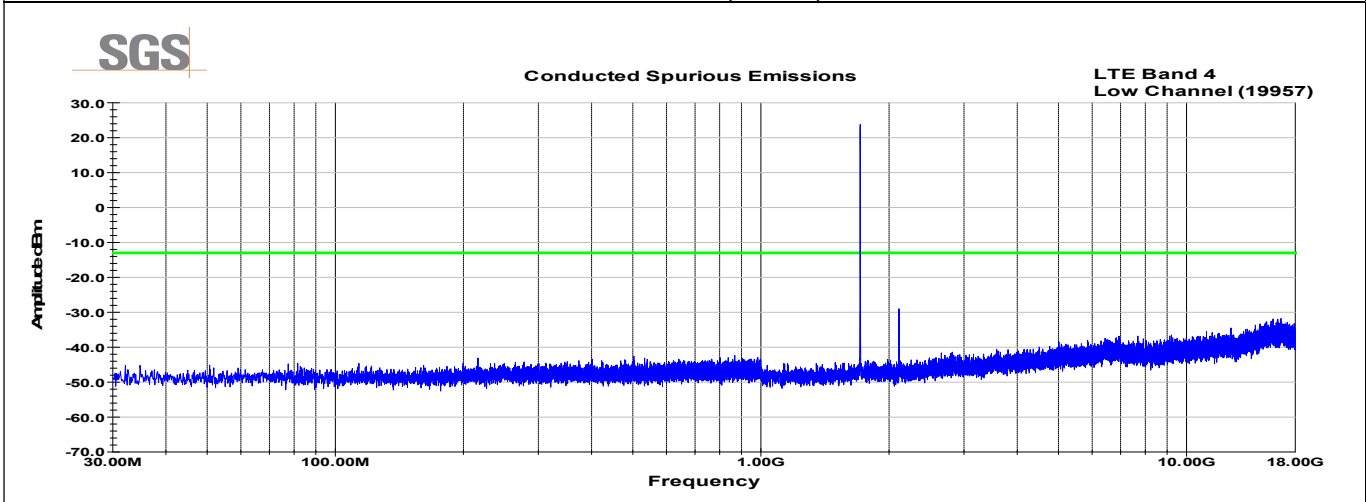
High Channel (21350)



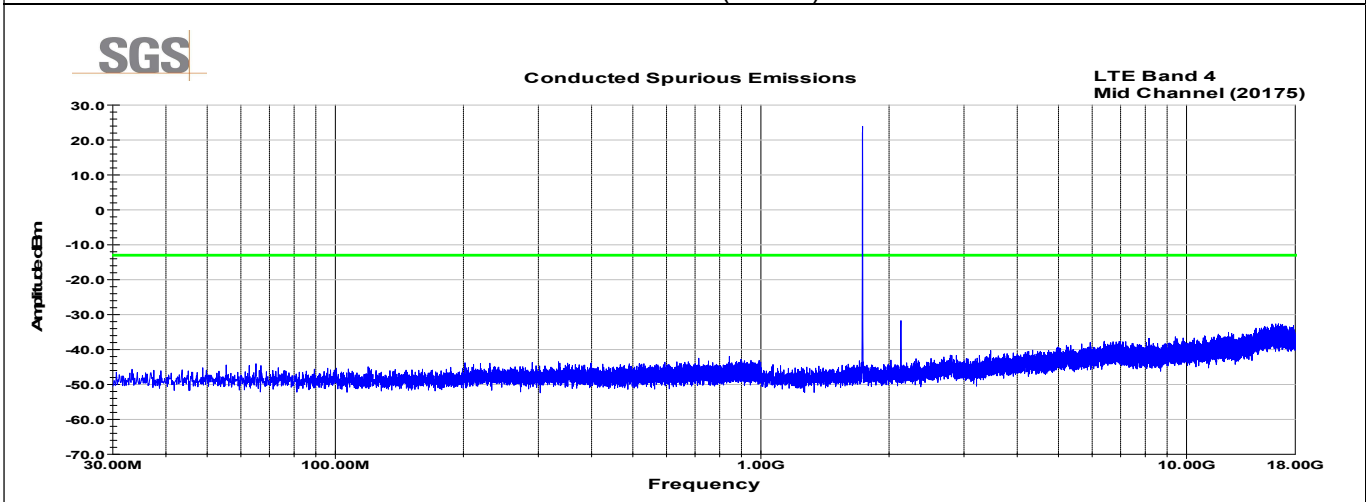
6.6 Test Data - Conducted Spurious Emissions



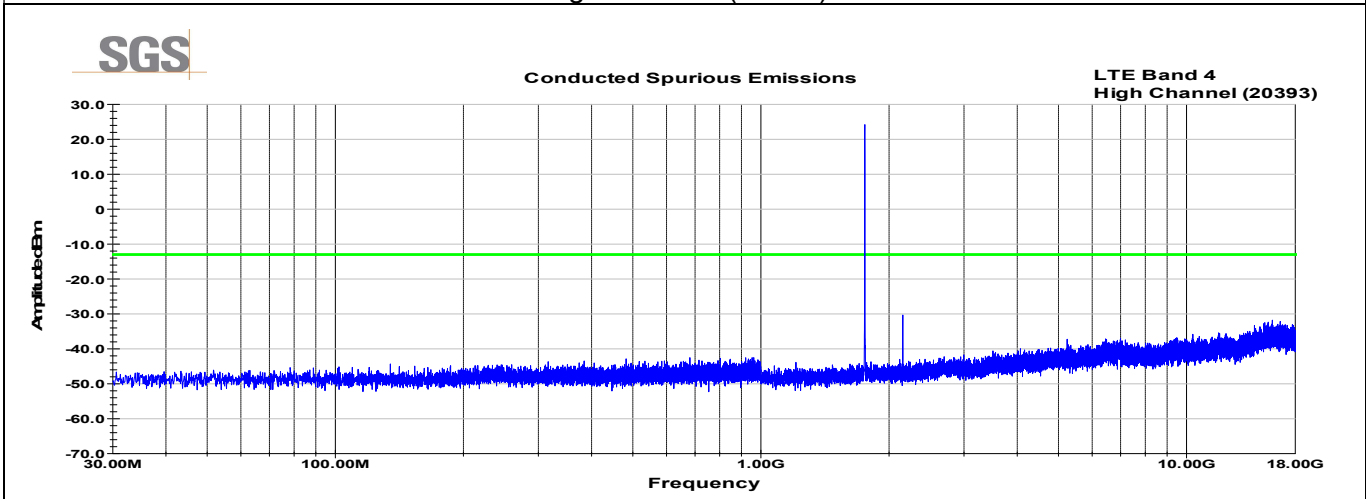
LTE Band 4, QPSK modulation, 1.4MHz
 Low Channel (19957)



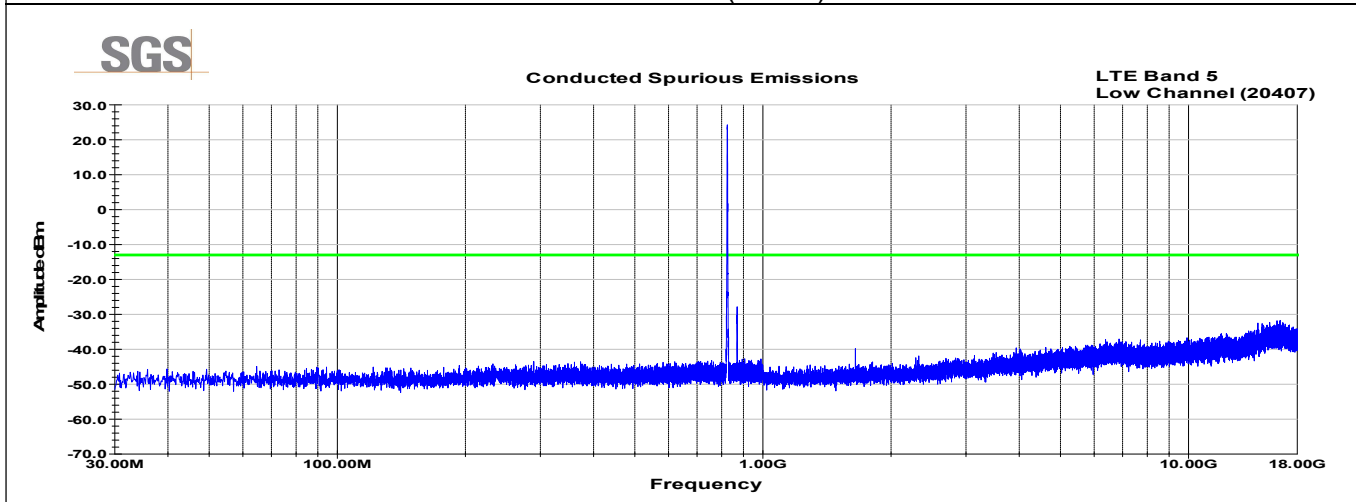
Mid Channel (20175)



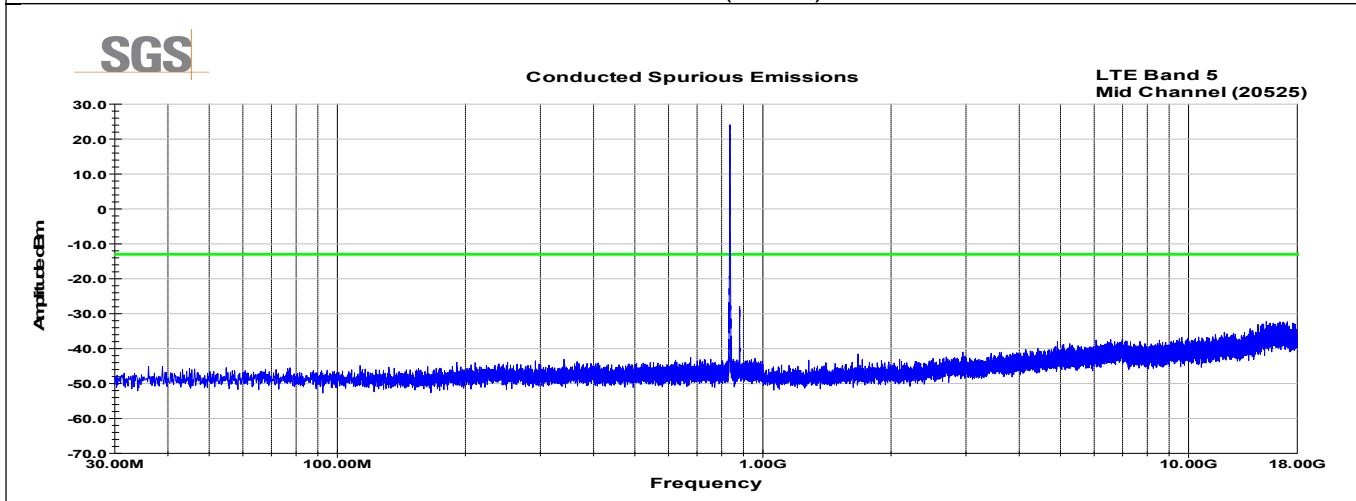
High Channel (20393)



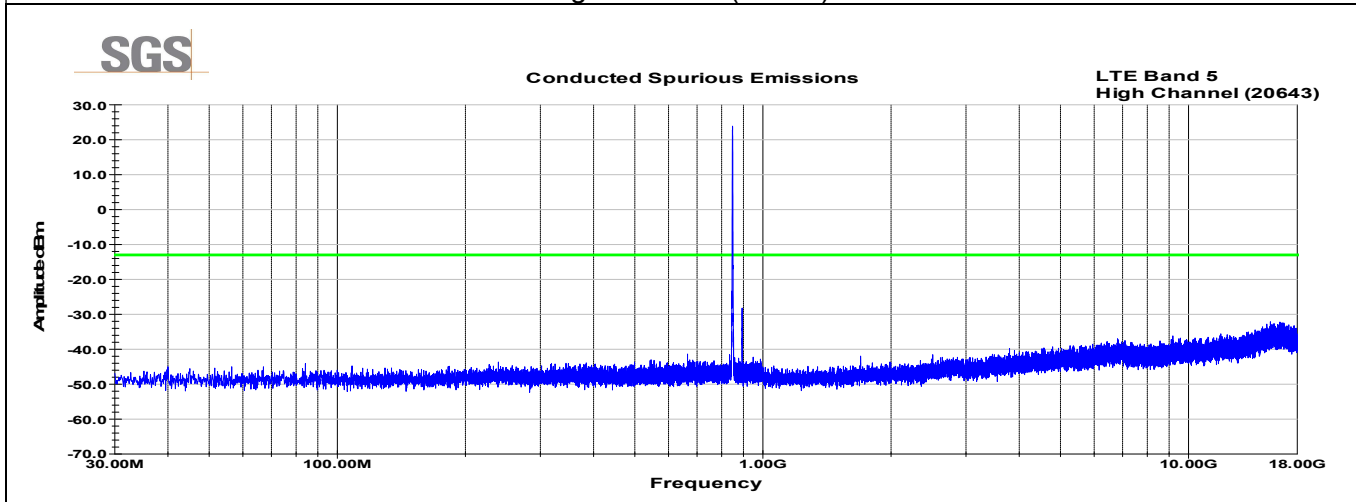
LTE Band 5, QPSK modulation, 1.4MHz
 Low Channel (20407)



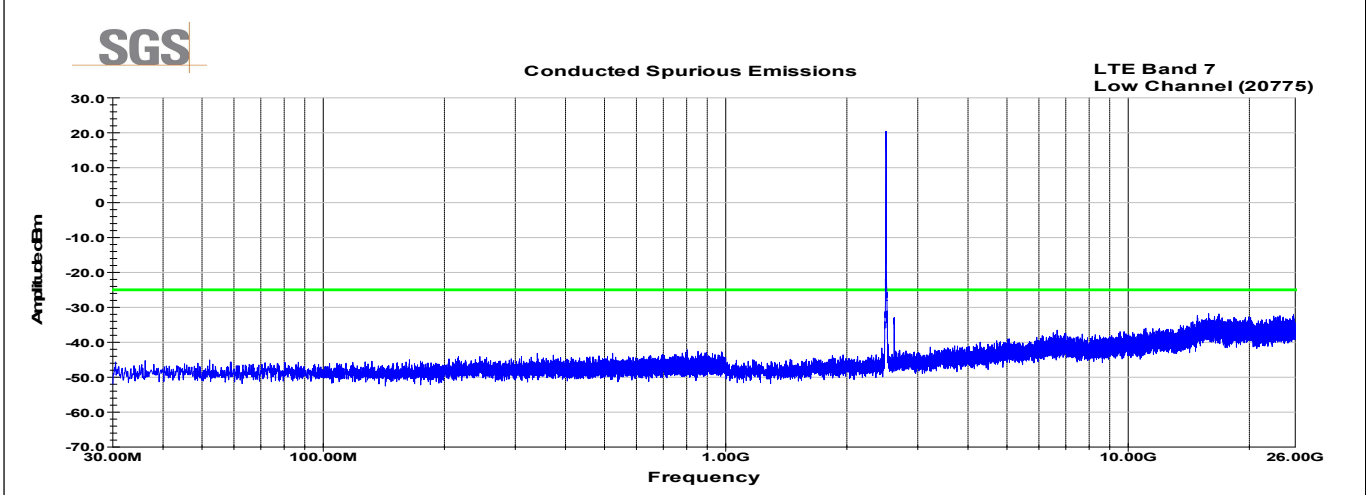
Mid Channel (20525)



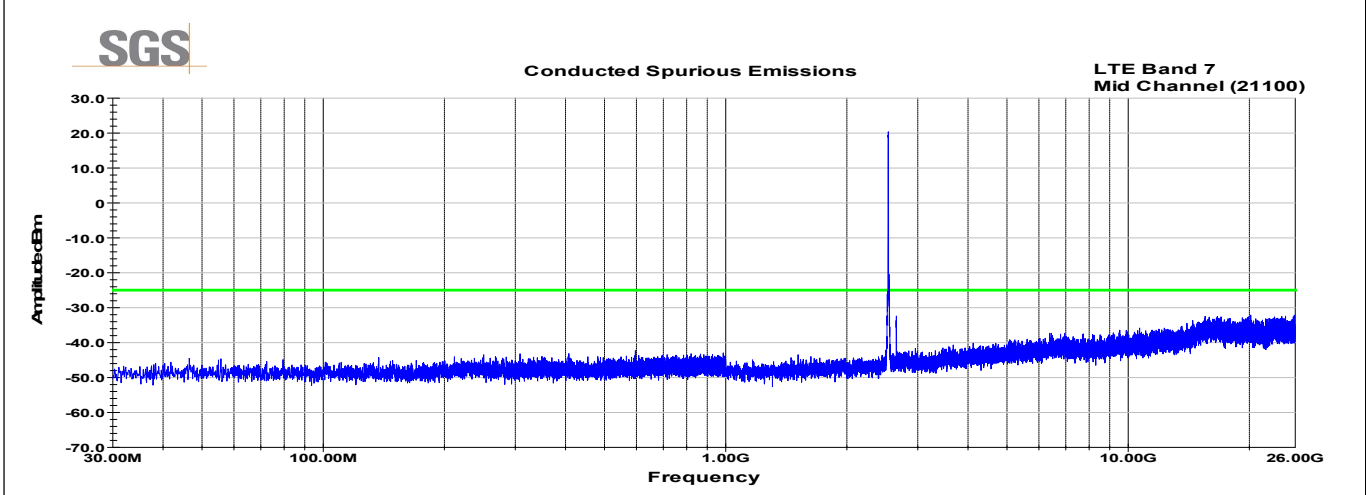
High Channel (20643)



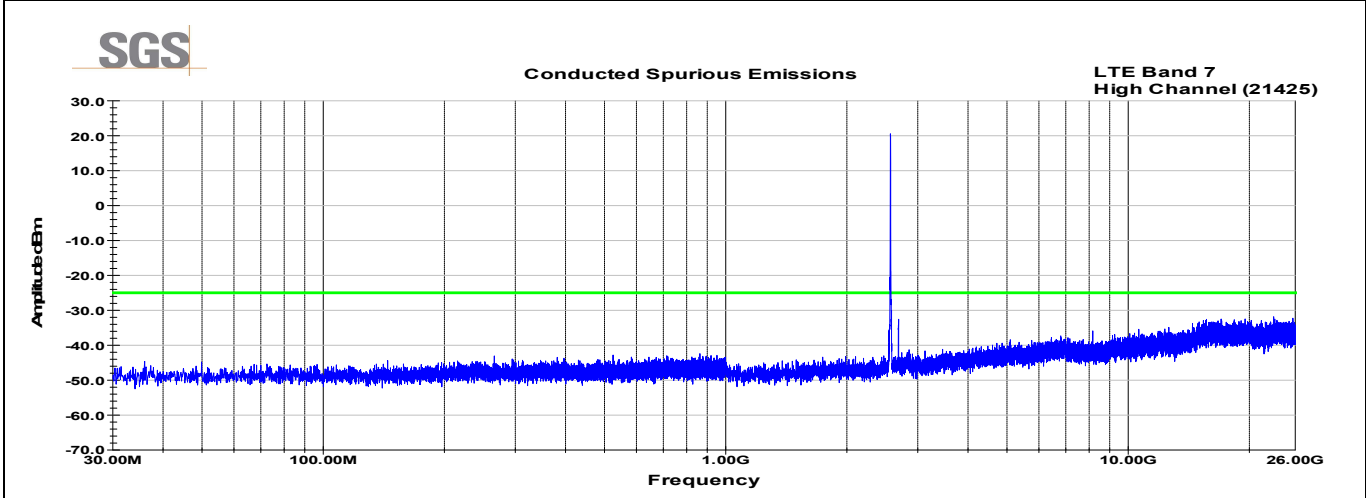
LTE Band 7, QPSK modulation, 5 MHz bandwidth
Low Channel (20775)



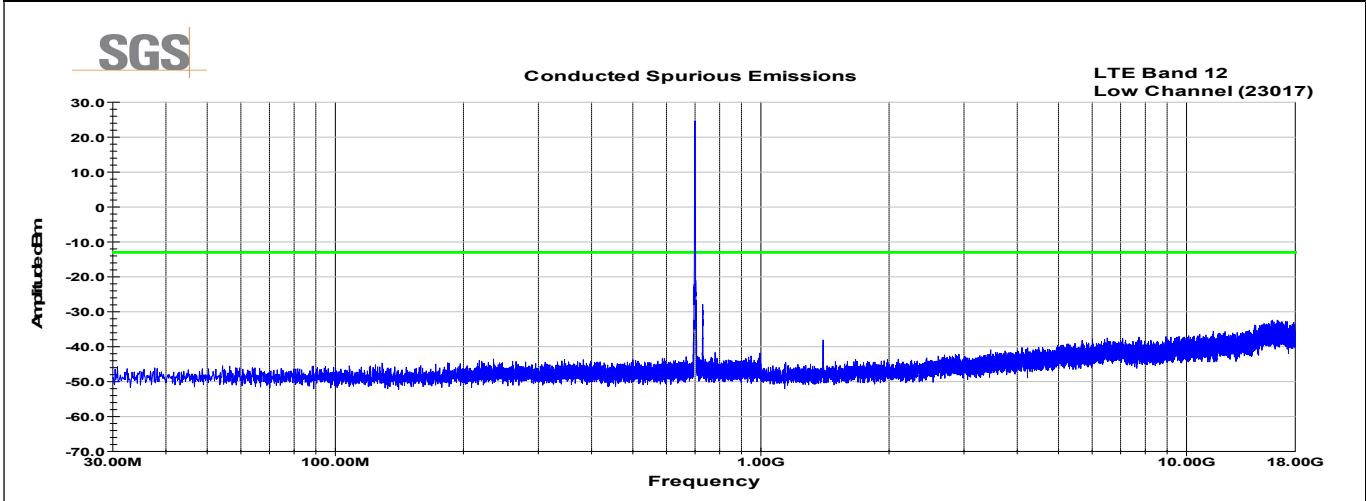
Mid Channel (21100)



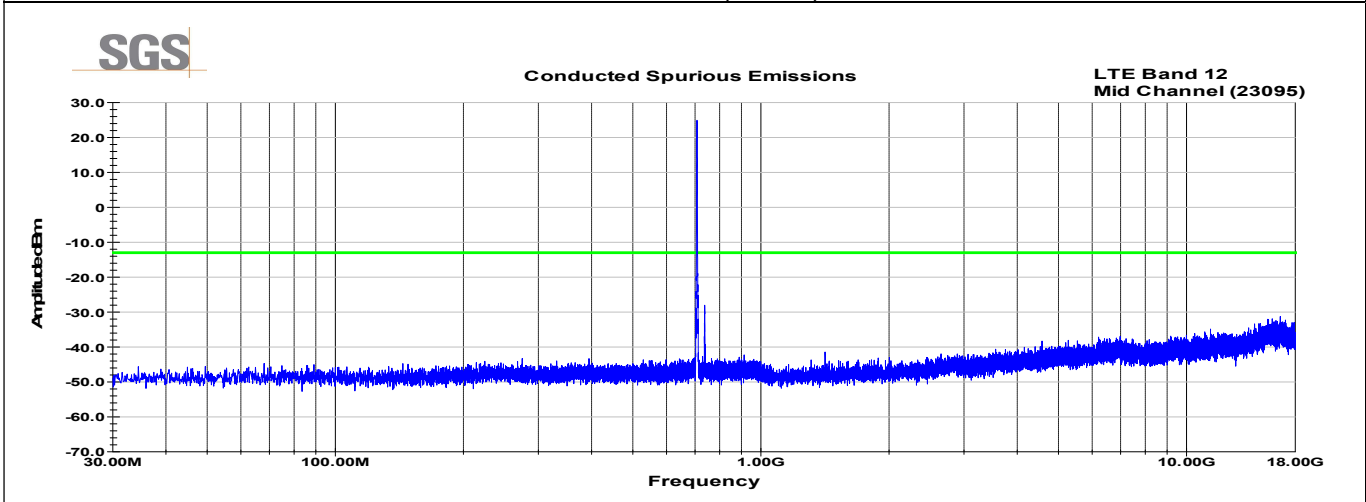
High Channel (21425)



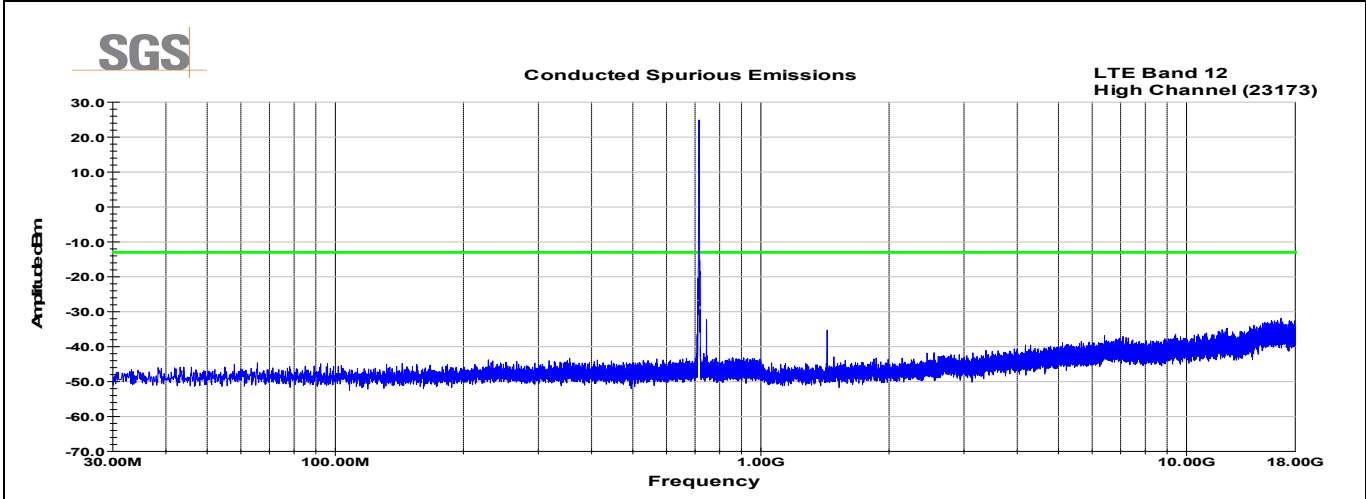
LTE Band 12, QPSK modulation, 1.4MHz
 Low Channel (23017)



Mid Channel (23095)



High Channel (23173)



7 Effective Radiated Power

7.1 Test Result

Test Description	Basic Standards	Test Result
Effective Radiated Power	FCC 22.913(a)(5) FCC 27.50(c)(9)	Pass
Effective Isotropic Radiated Power	FCC 24.232(c) FCC 27.50(d)(4) FCC 27.50(h)(2) RSS-130 (4.4) RSS-132 (5.4) RSS-133 (6.4) RSS-139 (6.5) RSS-199 (4.4)	Pass

7.2 Test Method

Because the EUT is provided with a coaxial port but no antenna, ERP/EIRP measurements were taken by measuring the conducted output power and defining the maximum gain antenna that may be used while maintaining compliance with the applicable limits.

7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

7.4 Test Equipment

None

7.5 Test Data

Band of Operation		Conducted Power w/tolerance dBm	Antenna Gain	Cable Loss	Average EIRP		FCC EIRP Limit W	% of Limit	Verdict
Type	MHz				dBm	W			
LTE Band 2	1850-1910	25.0	5.0	0.0	30.0	1.000	2.0	50%	Pass
LTE Band 4	1710-1755	25.0	5.0	0.0	30.0	1.000	1.0	100%	Pass
LTE Band 5	824-849	25.0	1.0	0.0	26.0	0.398	7.0	6%	Pass
LTE Band 7	2500-2570	25.0	5.0	0.0	30.0	1.000	2.0	50%	Pass
LTE Band 12	699-716	25.0	5.0	0.0	30.0	1.000	30.0	3%	Pass

Band of Operation		Conducted Power w/tolerance dBm	Antenna Gain	Cable Loss	Average EIRP		ISED EIRP Limit W	% of Limit	Verdict
Type	MHz				dBm	mW			
LTE Band 2	1850-1910	25.0	5.0	0.0	30.0	1.000	2.0	50%	Pass
LTE Band 4	1710-1755	25.0	5.0	0.0	30.0	1.000	1.0	100%	Pass
LTE Band 5	824-849	25.0	1.0	0.0	26.0	0.398	11.5	3%	Pass
LTE Band 7	2500-2570	25.0	5.0	0.0	30.0	1.000	2.0	50%	Pass
LTE Band 12	699-716	25.0	5.0	0.0	30.0	1.000	50.0	2%	Pass

Note: Antenna gain was determined from maximum gain while still meeting the ERP/EIRP limits and the RF exposure requirements at 20cm.

8 Radiated Spurious Emissions

8.1 Test Result

Test Description	Basic Standards		Test Result
Radiated Spurious Emissions	FCC 2.1053 FCC 22.917(a) FCC 24.238(a) FCC 27.53(g) FCC 27.53(h) FCC 27.53(m)(4) ANSI/TIA-603-D-2010	RSS-GEN (6.13) RSS-130 (4.6) RSS-132 (5.5) RSS-133 (6.5.1) RSS-139 (6.6) RSS-199 (4.5)	Pass

8.2 Test Method

The radiated power emanating from the EUT of the band edge (out-of-band) and spurious band emissions are measured by means of a calibrated spectrum analyzer. The spectrum is investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. The power of any emissions outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) measured in watts by at least $43 + 10 \log (P)$ dB for all bands except for band 7. In the case of band 7, the emissions shall be attenuated by at least $40 + 10 \log (P)$ 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. In addition, just for band 7, 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. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The EUT was manipulated through each of its three orthogonal axes with the measurement oriented in both vertical and horizontal polarizations.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester.

The measurements were performed at the low, middle, and high channels.

8.3 Test Site

SGS 3m Chamber, Suwanee, GA (validated to ANS C63.4: 2014 below and above 1GHz)

Environmental Conditions

Temperature: 23.4 – 24.3 °C
 Relative Humidity: 47.2 – 54.7 %
 Atmospheric Pressure: 97.5 – 98.2 kPa

8.4 Test Equipment

30-1000MHz

Test End Date: 26-Jul-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	16-Oct-2018
RF CABLE	NMS-290-236.2-NMS	FLORIDARF LABS	B095020	23-Jul-2019
RF CABLE	NFS-290-78.7-NFS	FLORIDARF LABS	B095019	24-Jul-2019
RF CABLE	SF106	HUBER & SUHNER	B079659	23-Jul-2019
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	27-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	1206247	28-Feb-2019
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	ROHDE & SCHWARZ	B094874	25-Jan-2020

1-18GHz

Test End Date: 10-Aug-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	2-Jul-2019
RF CABLE	NMS-290-236.2-NMS	FLORIDARF LABS	B095020	23-Jul-2019
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	15003	27-Jul-2019
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	1206247	28-Feb-2019
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	ROHDE & SCHWARZ	B094874	25-Jan-2020

18-26GHz

Test End Date: 7-Aug-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, HORN (SMALL)	LB-180400-20-C-KF	A-INFO	15007	30-Mar-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	25-Jul-2019
RF CABLE	SF102	HUBER & SUHNER	B079823	25-Jul-2019
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	27-Jul-2019
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	1206247	28-Feb-2019
WIDEBAND RADIO COMMUNICATION TESTER	CMW500	ROHDE & SCHWARZ	B094874	25-Jan-2020

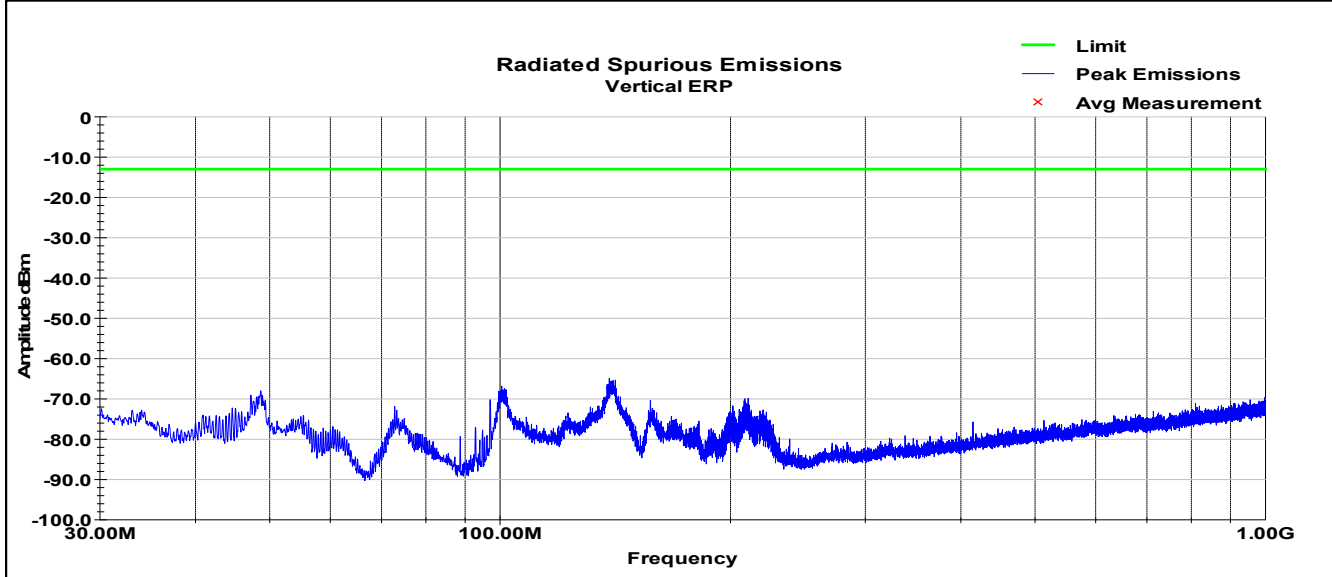
- Unless otherwise noted, equipment is on a 1-year calibration cycle.
- Based on manufacturer's specifications, the CMW 500 is on a 2-year calibration cycle.

8.5 Test Data

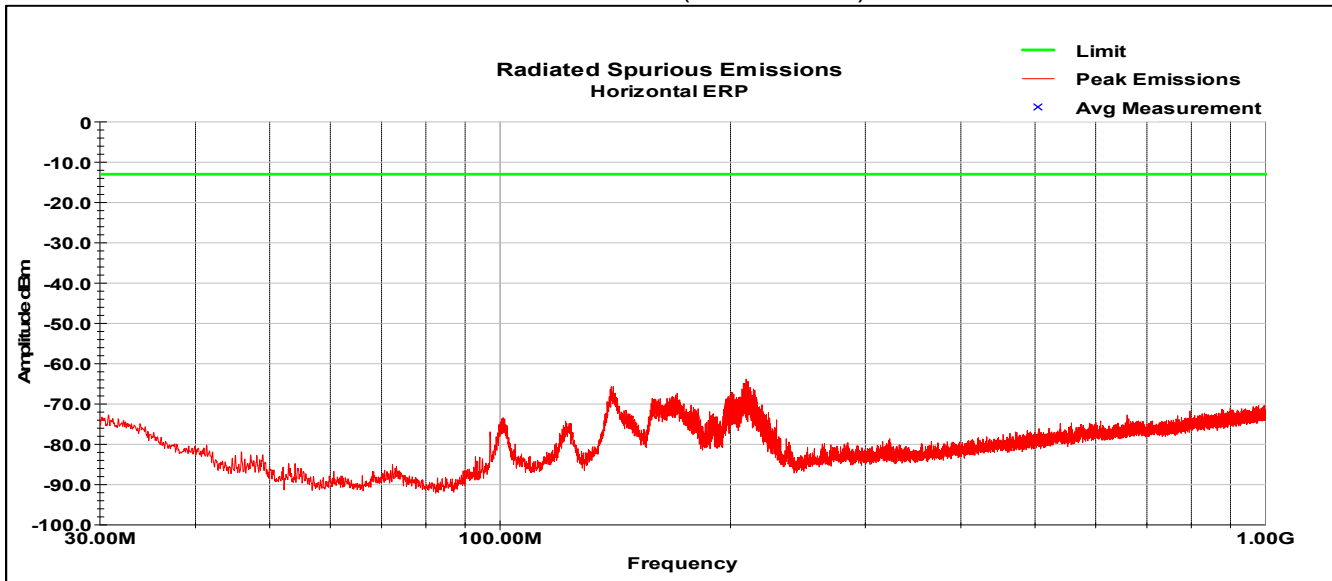
LTE Band 2, QPSK modulation, 1.4MHz

Low Channel (18607)

Vertical Data (30-1000MHz)



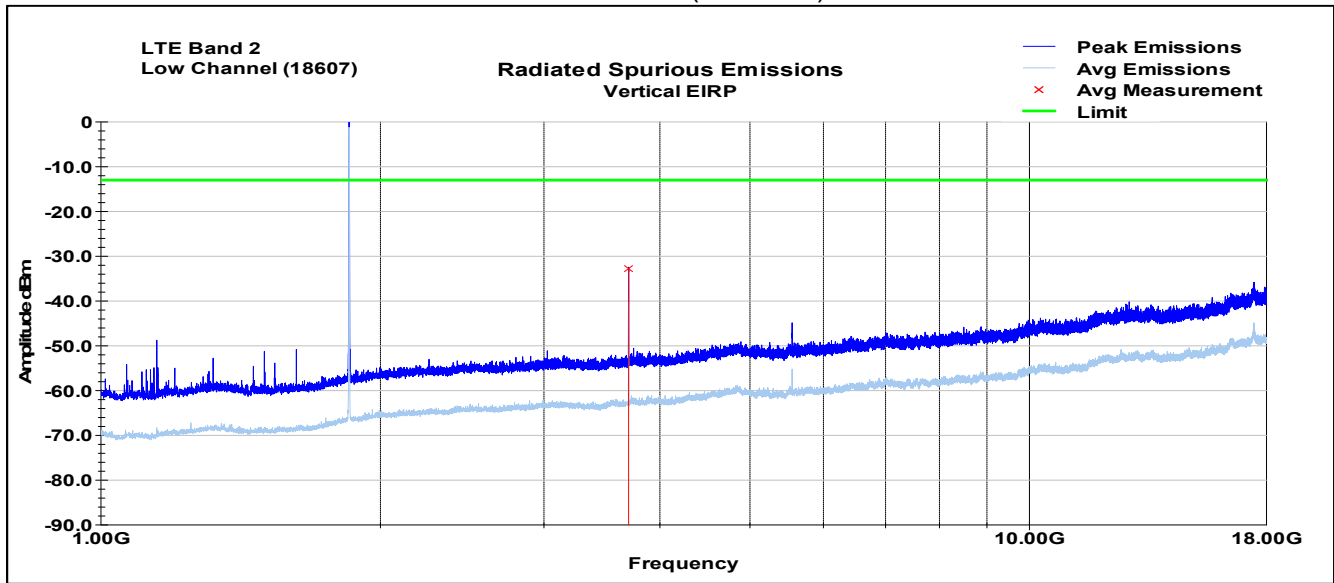
Horizontal Data (30-1000MHz)



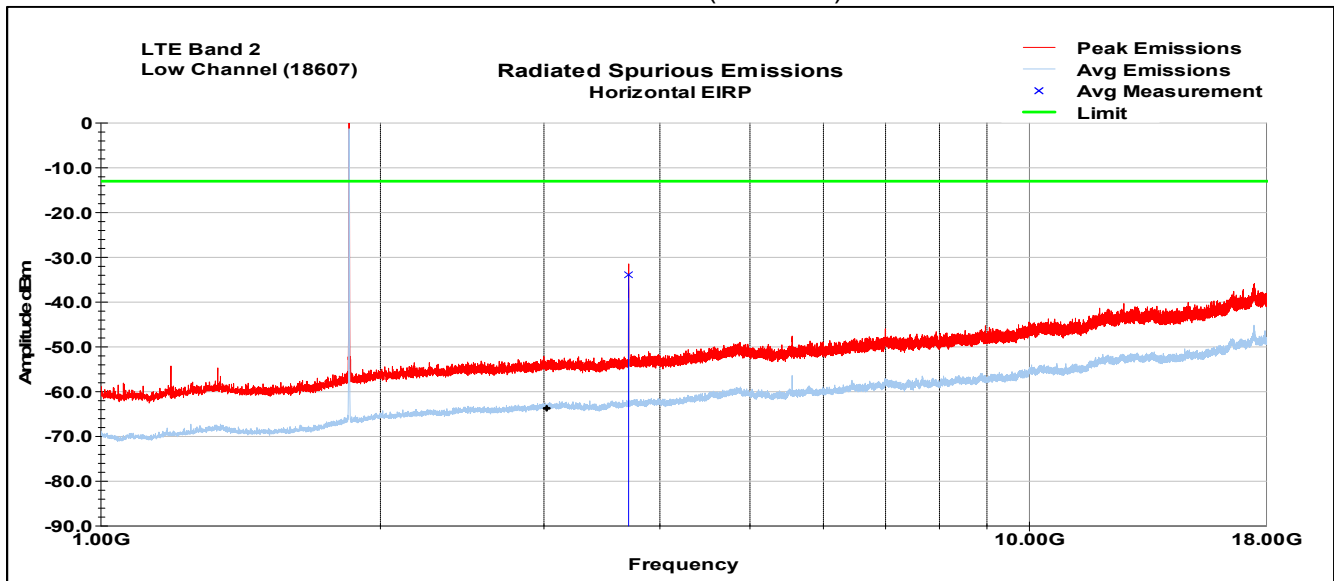
LTE Band 2, QPSK modulation, 1.4MHz

Low Channel (18607)

Vertical Data (1-18GHz)



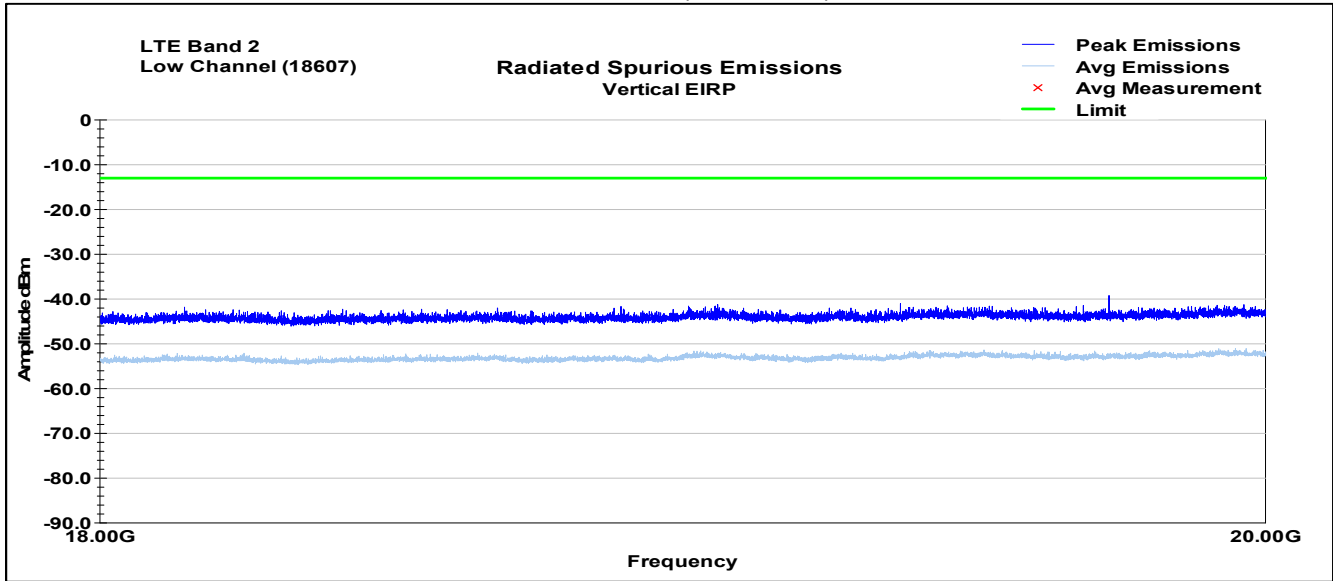
Horizontal Data (1-18GHz)



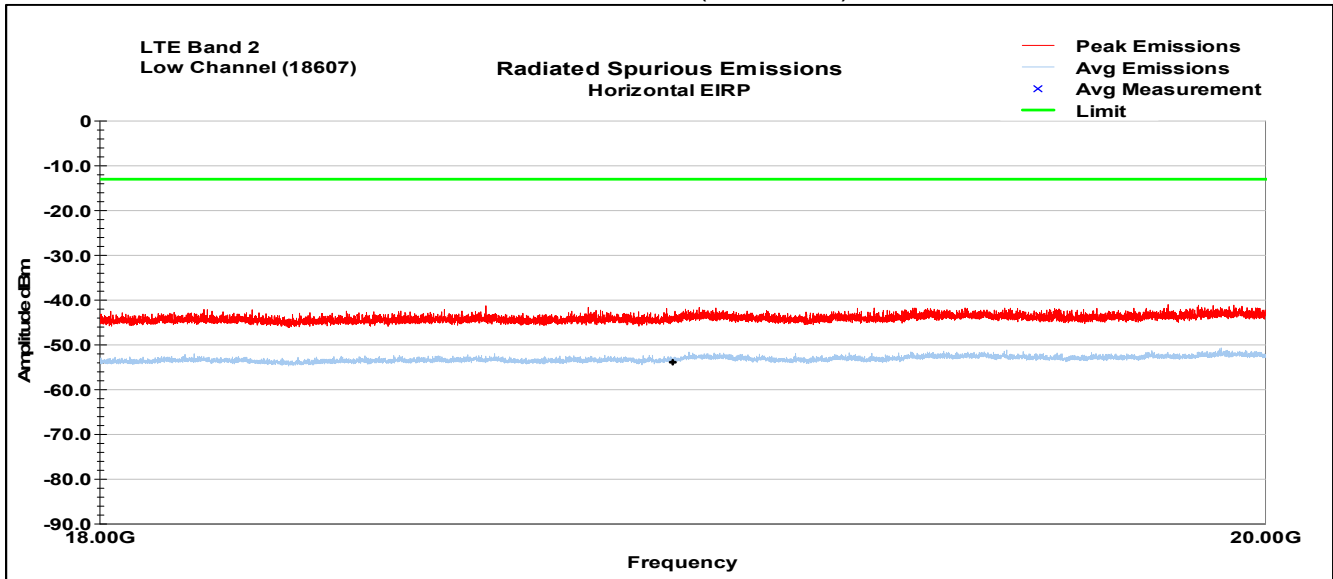
LTE Band 2, QPSK modulation, 1.4MHz

Low Channel (18607)

Vertical Data (18-20GHz)



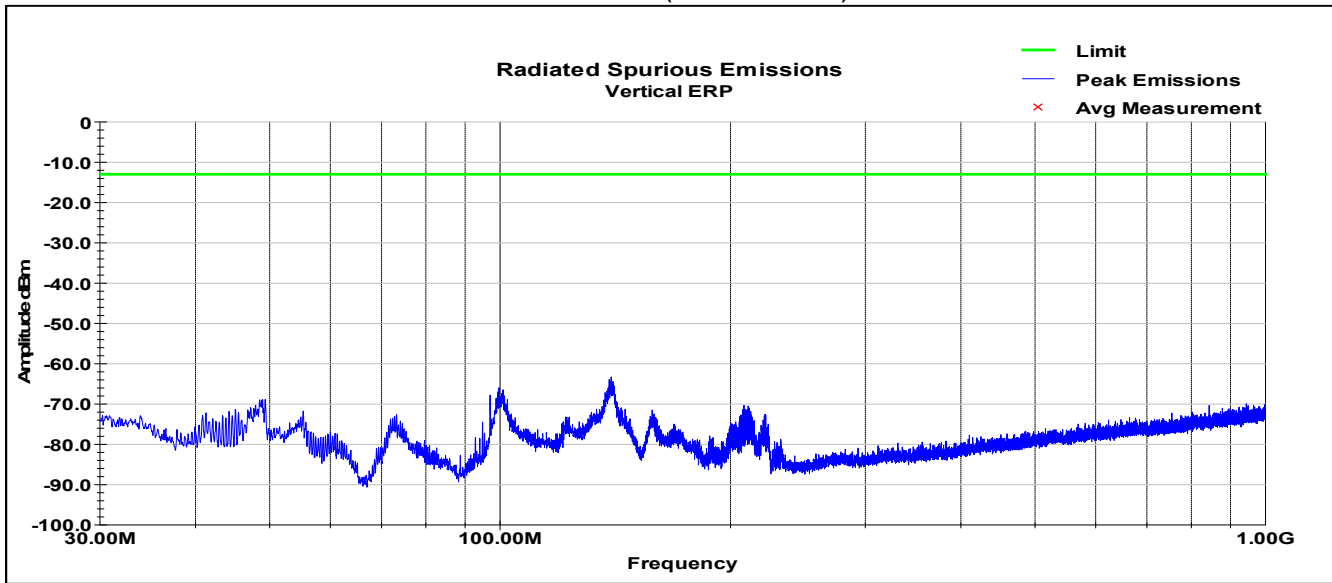
Horizontal Data (18-20GHz)



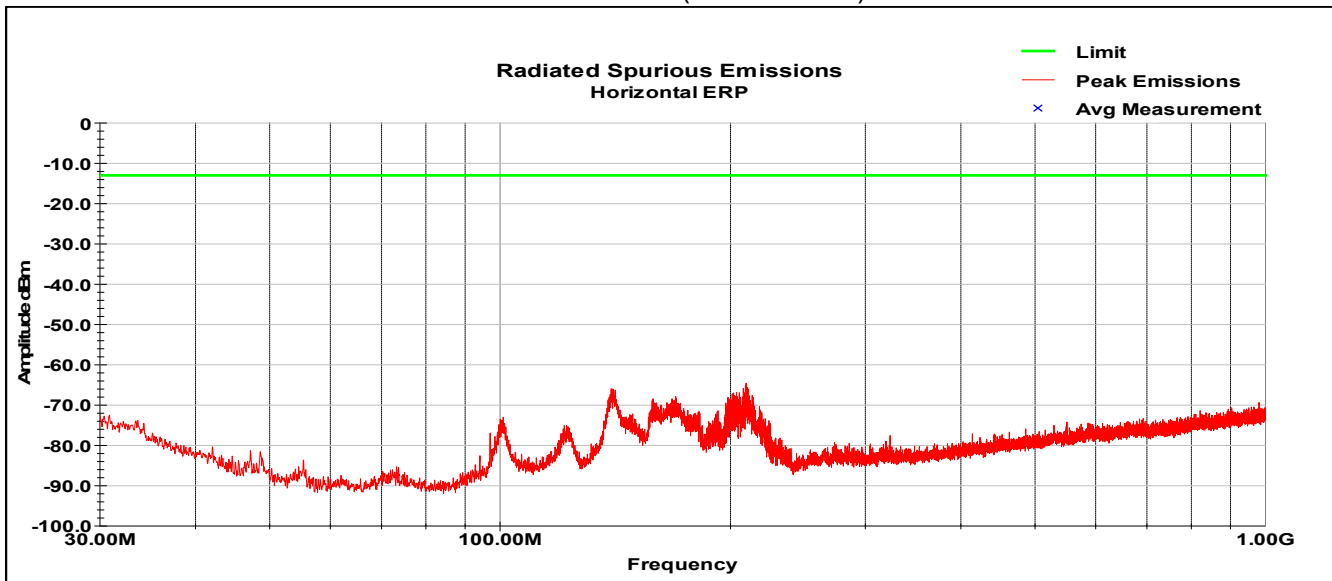
LTE Band 2, QPSK modulation, 1.4MHz

Mid Channel (18900)

Vertical Data (30-1000MHz)



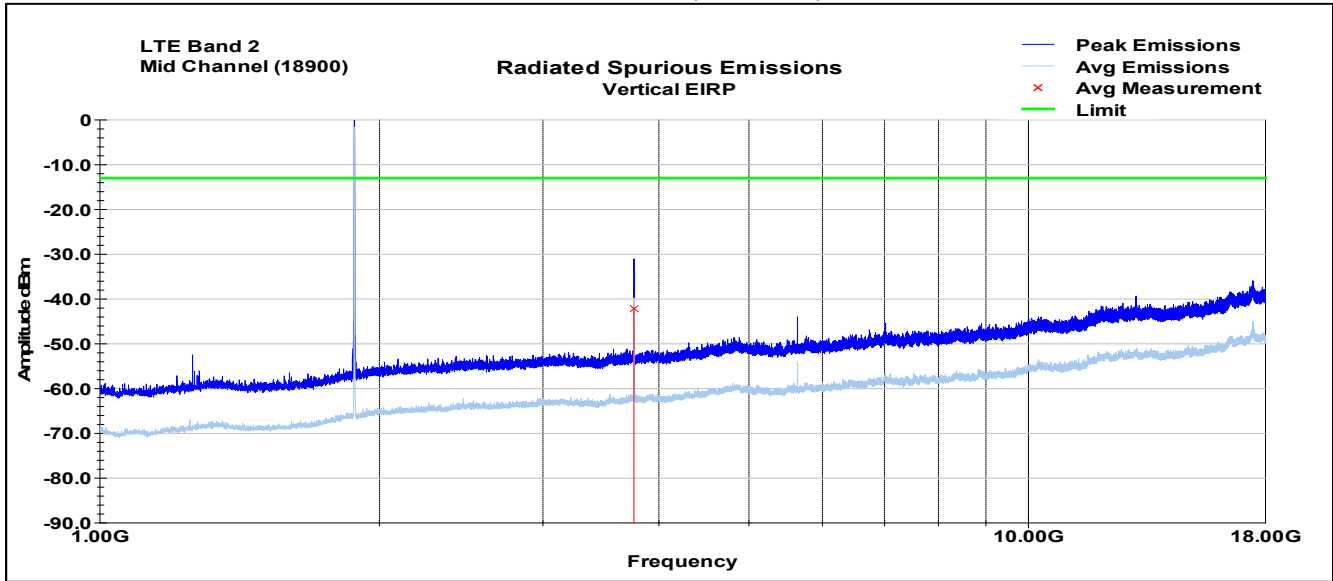
Horizontal Data (30-1000MHz)



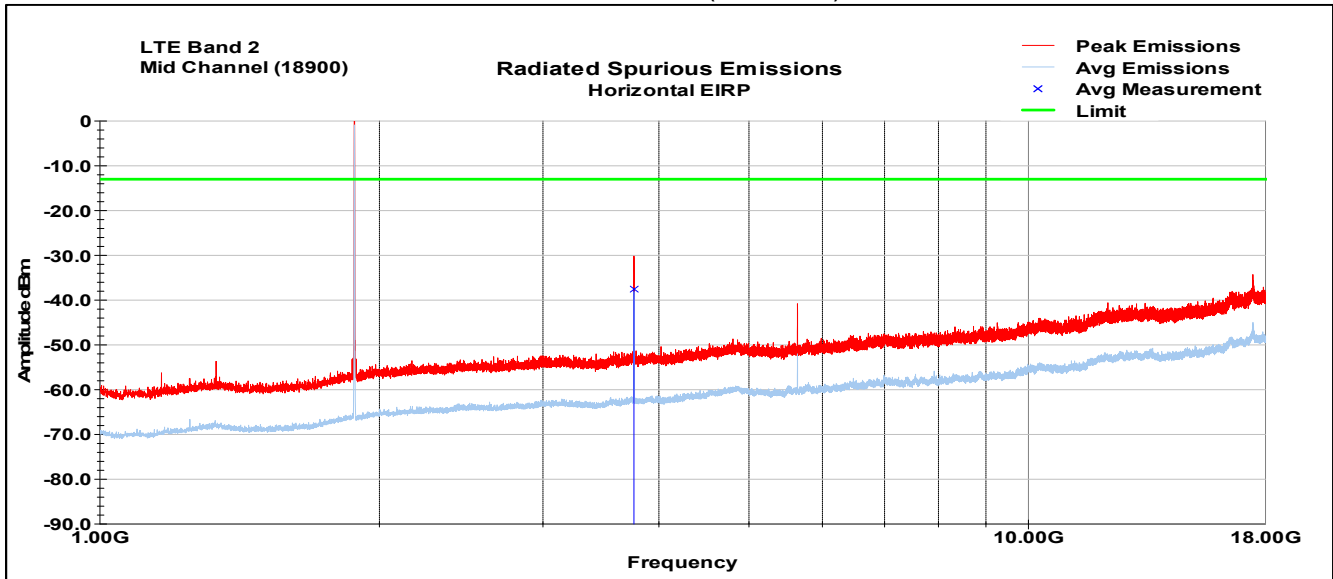
LTE Band 2, QPSK modulation, 1.4MHz

Mid Channel (18900)

Vertical Data (1-18GHz)



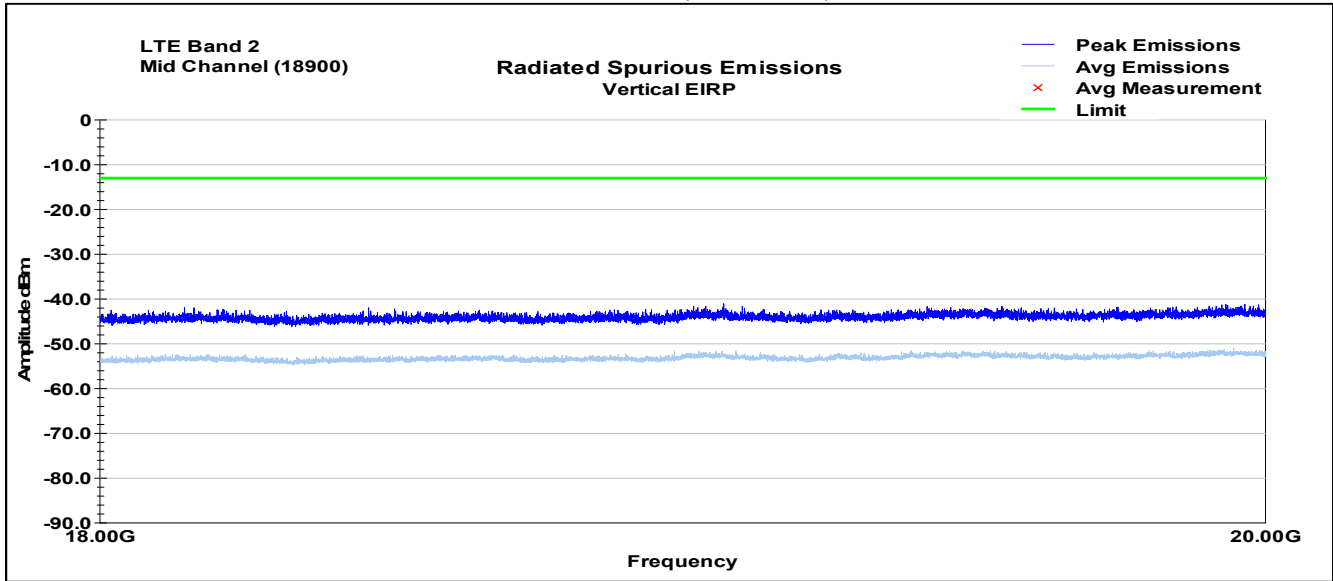
Horizontal Data (1-18GHz)



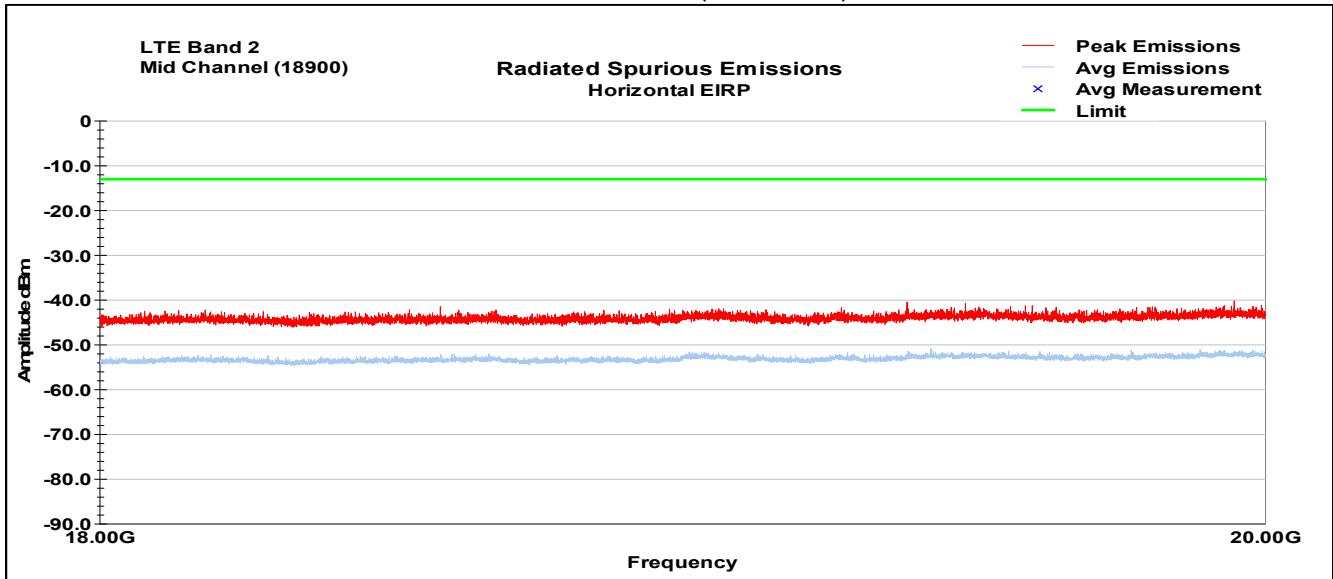
LTE Band 2, QPSK modulation, 1.4MHz

Mid Channel (18900)

Vertical Data (18-20GHz)



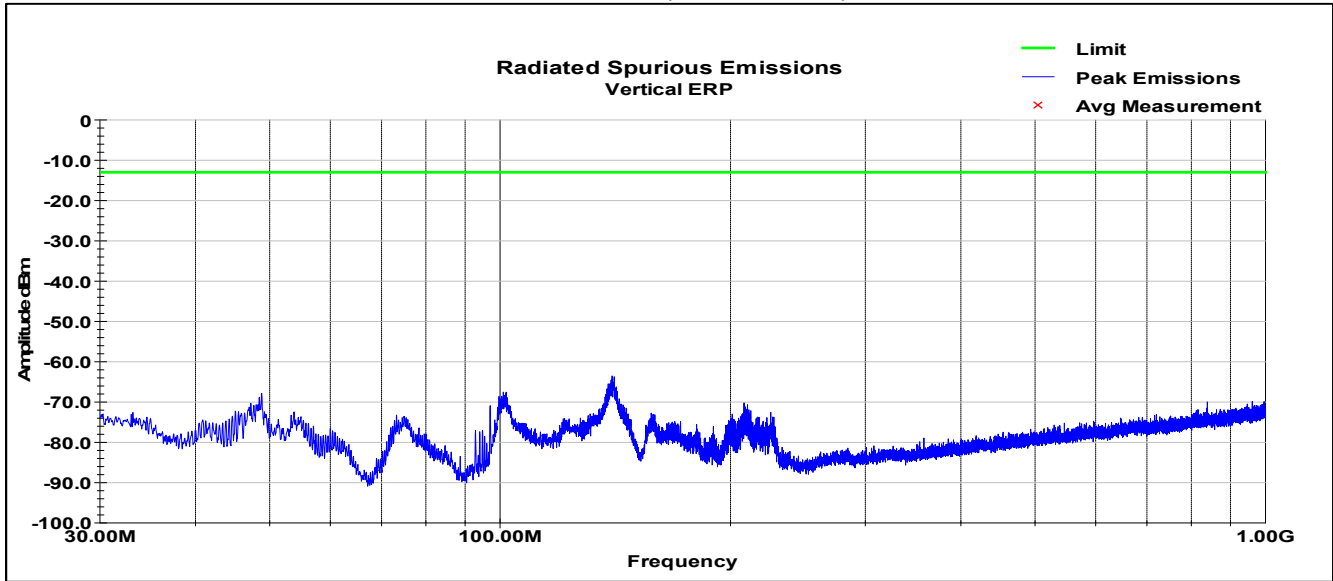
Horizontal Data (18-20GHz)



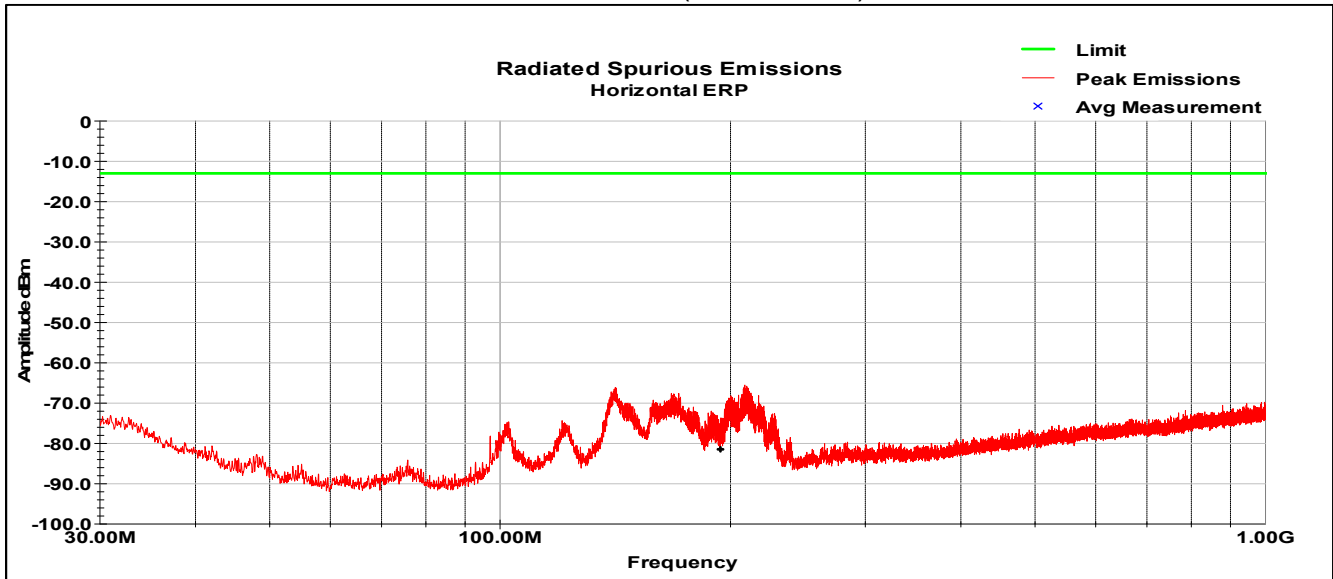
LTE Band 2, QPSK modulation, 1.4MHz

High Channel (19193)

Vertical Data (30-1000MHz)



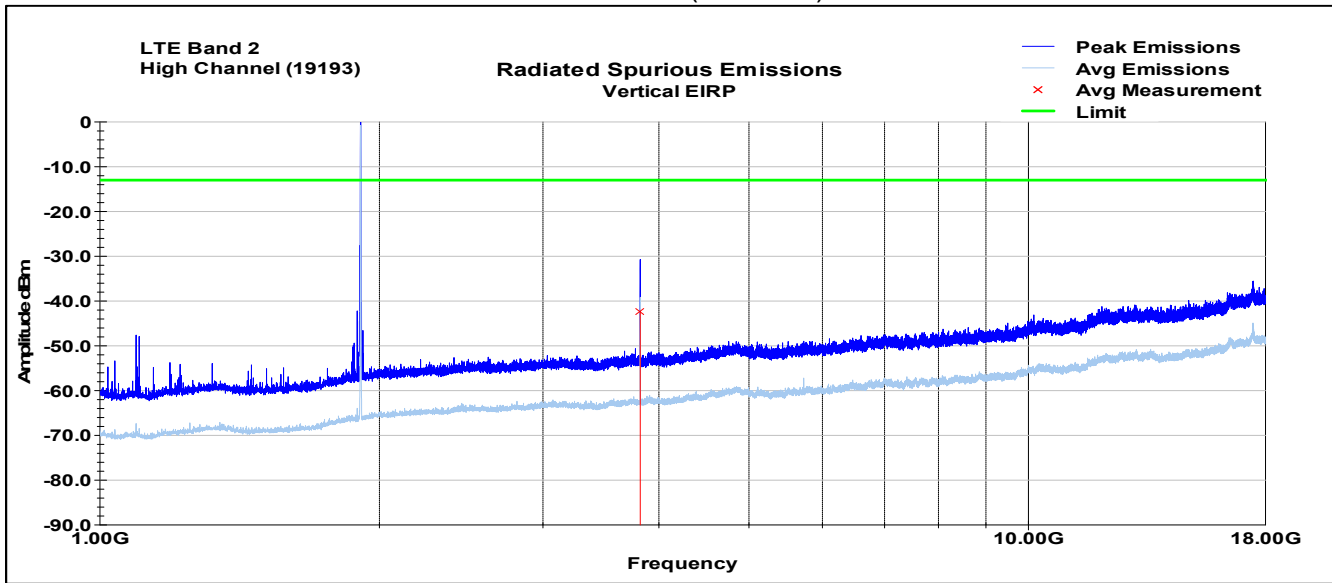
Horizontal Data (30-1000MHz)



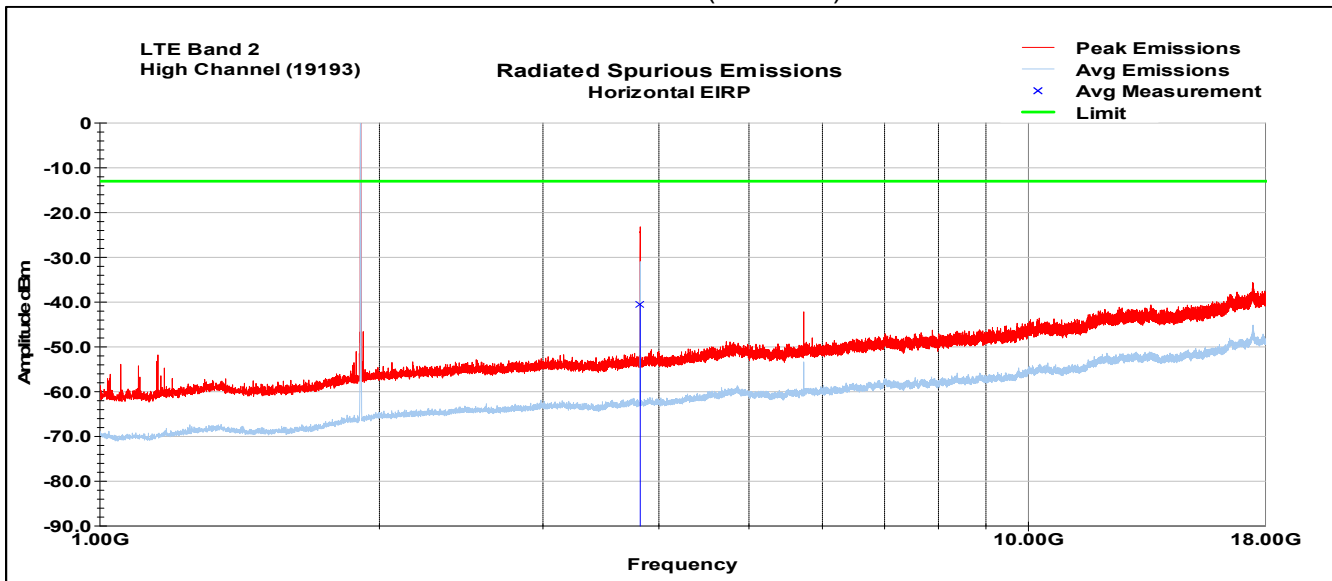
LTE Band 2, QPSK modulation, 1.4MHz

High Channel (19193)

Vertical Data (1-18GHz)



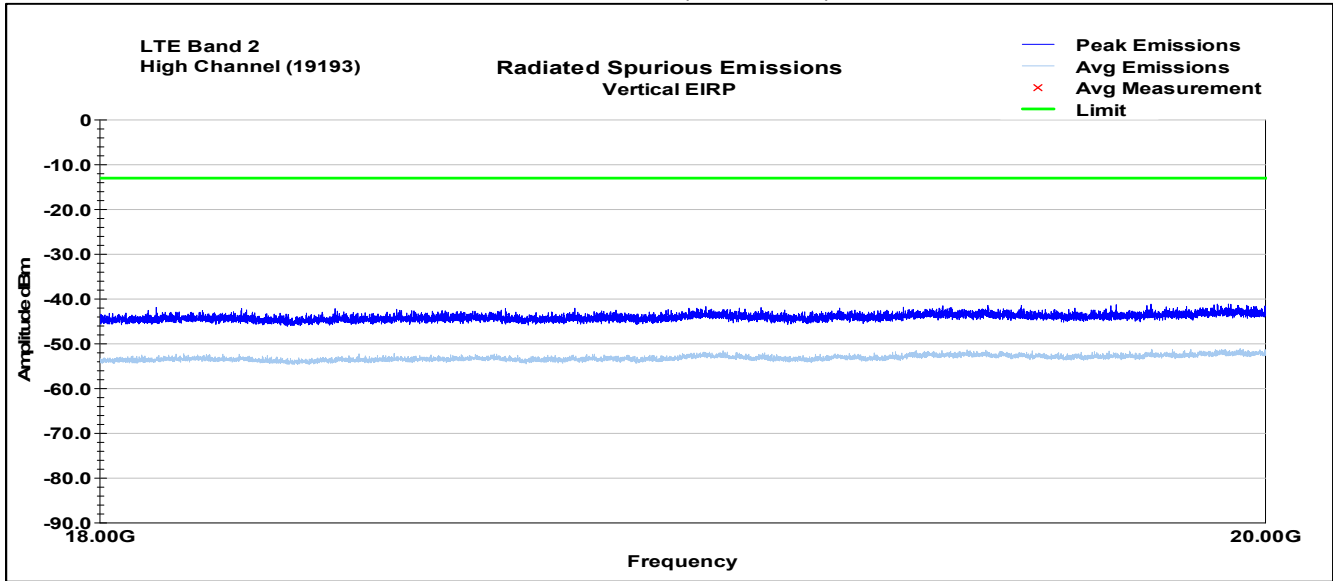
Horizontal Data (1-18GHz)



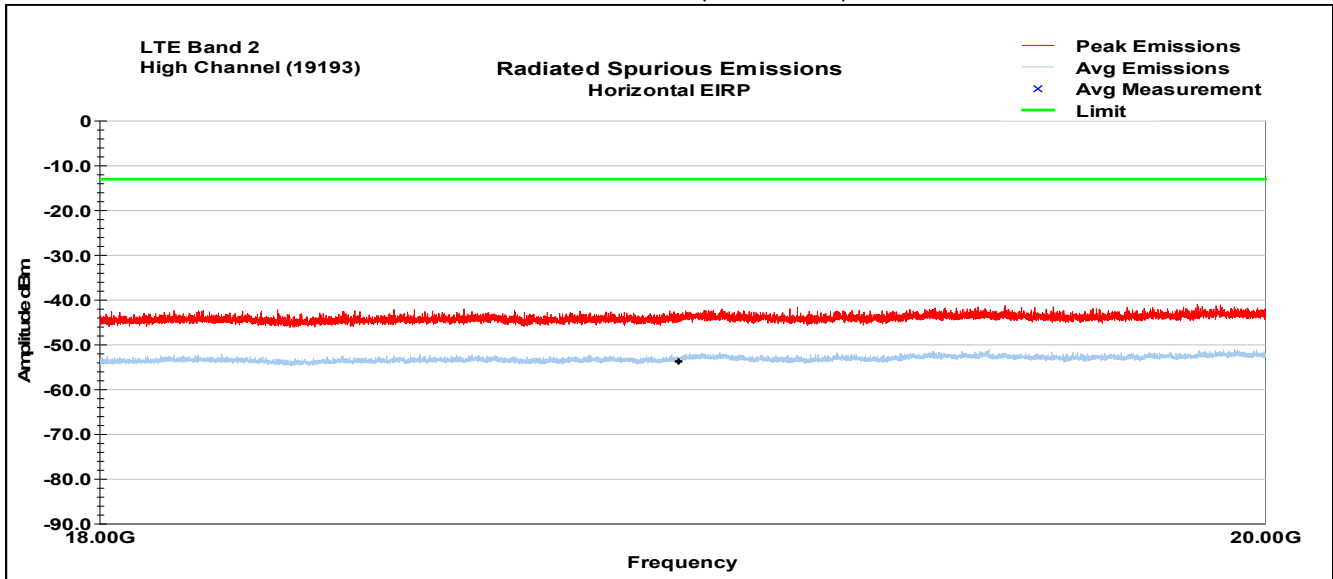
LTE Band 2, QPSK modulation, 1.4MHz

High Channel (19193)

Vertical Data (18-20GHz)



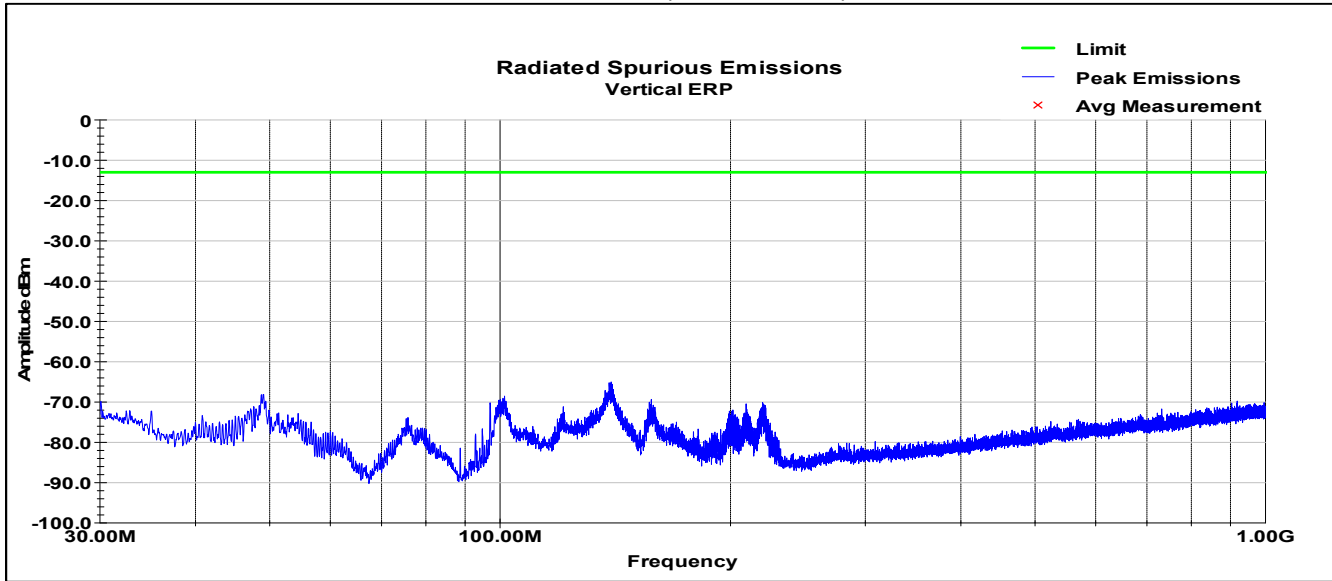
Horizontal Data (18-20GHz)



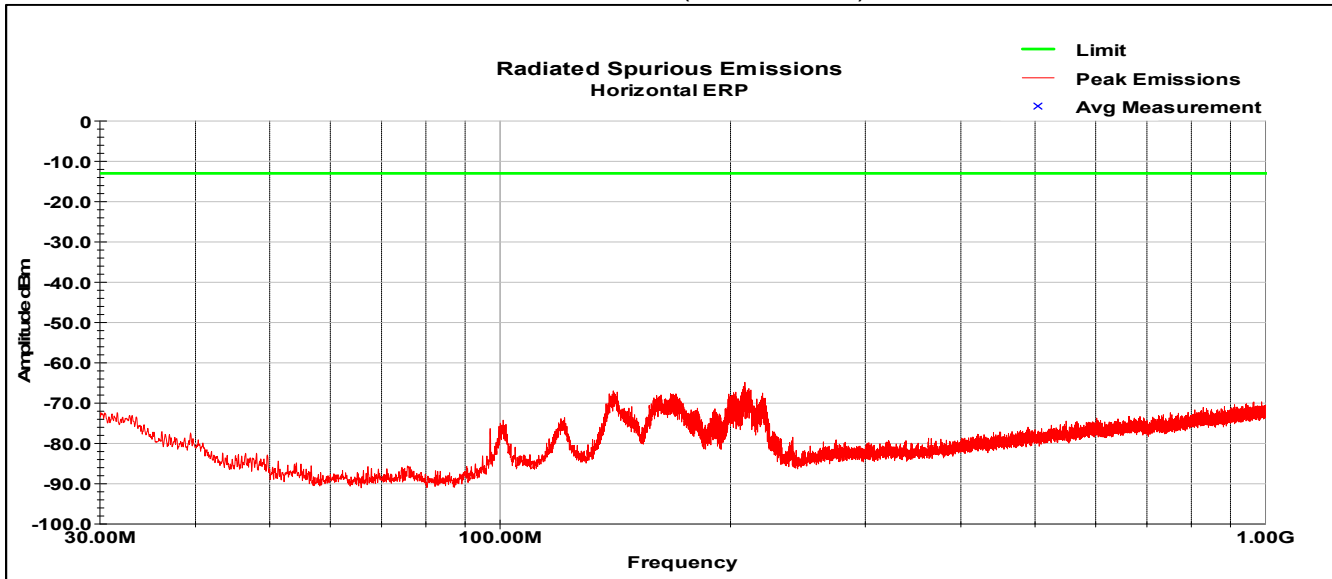
LTE Band 4, QPSK modulation, 1.4MHz

Low Channel (19957)

Vertical Data (30-1000MHz)



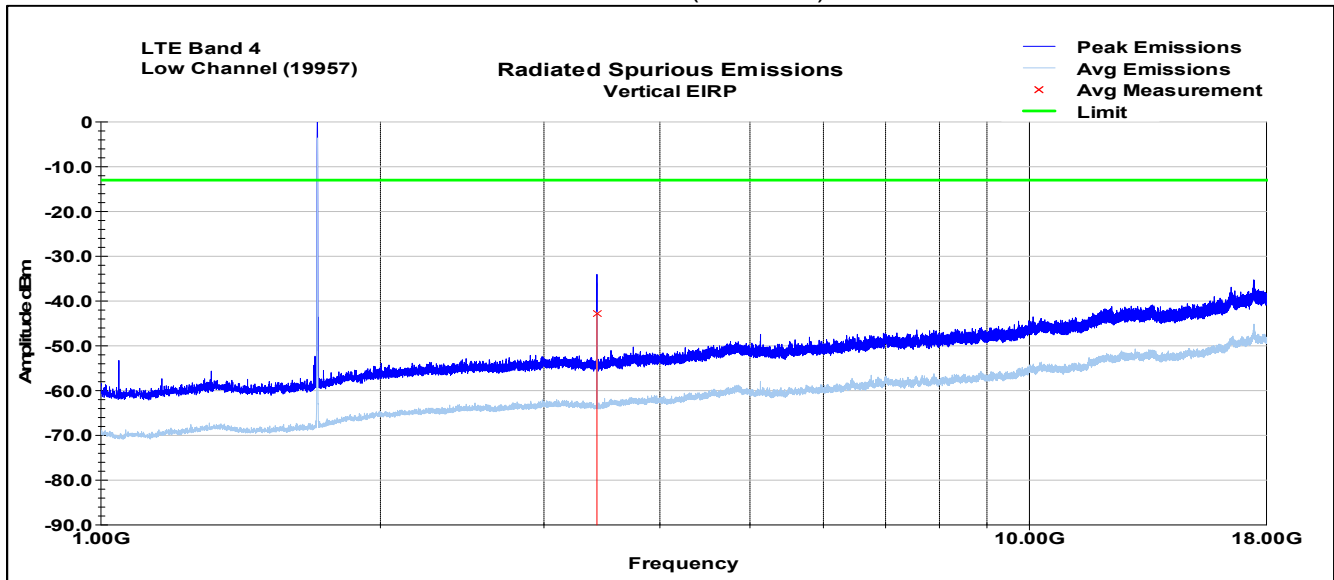
Horizontal Data (30-1000MHz)



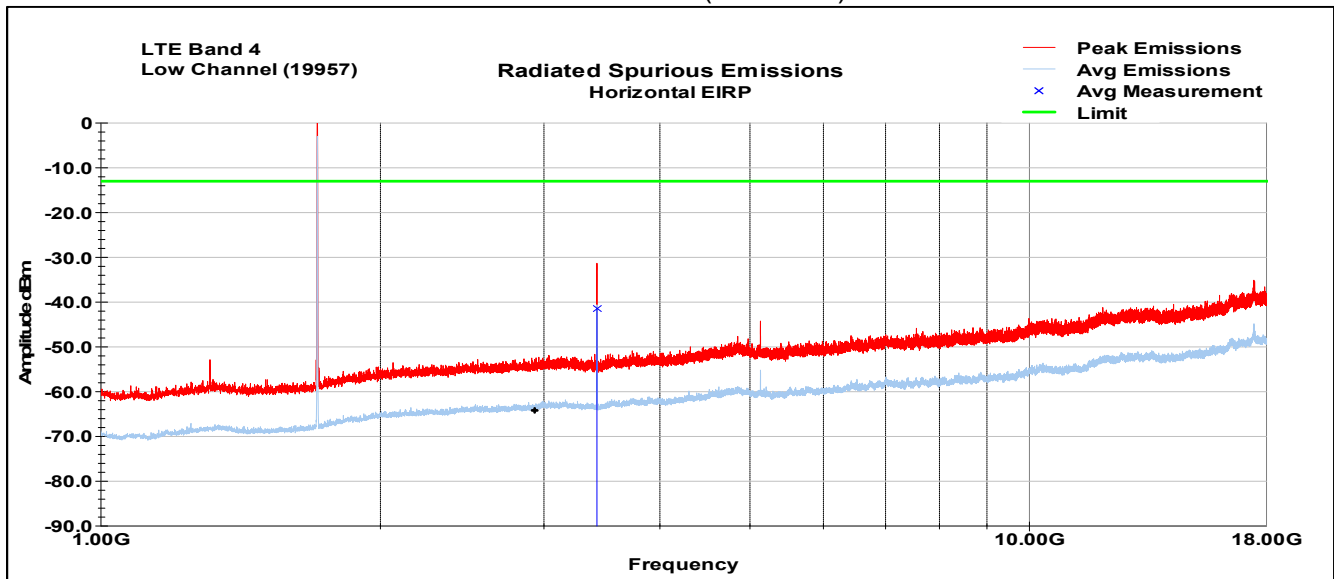
LTE Band 4, QPSK modulation, 1.4MHz

Low Channel (19957)

Vertical Data (1-18GHz)



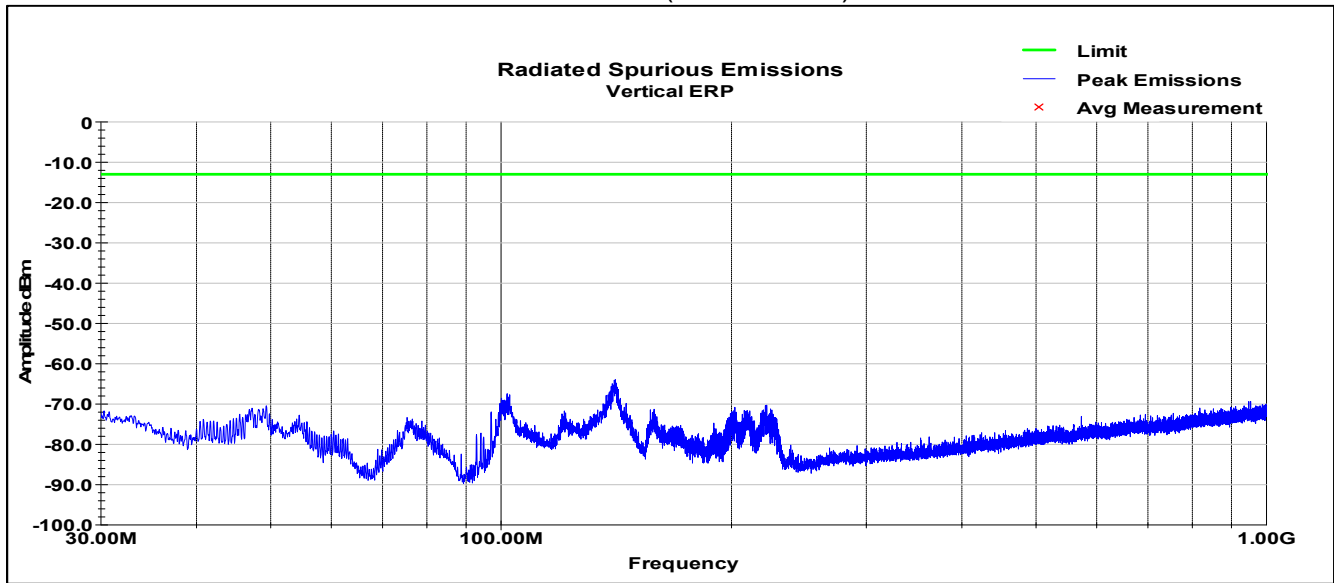
Horizontal Data (1-18G Hz)



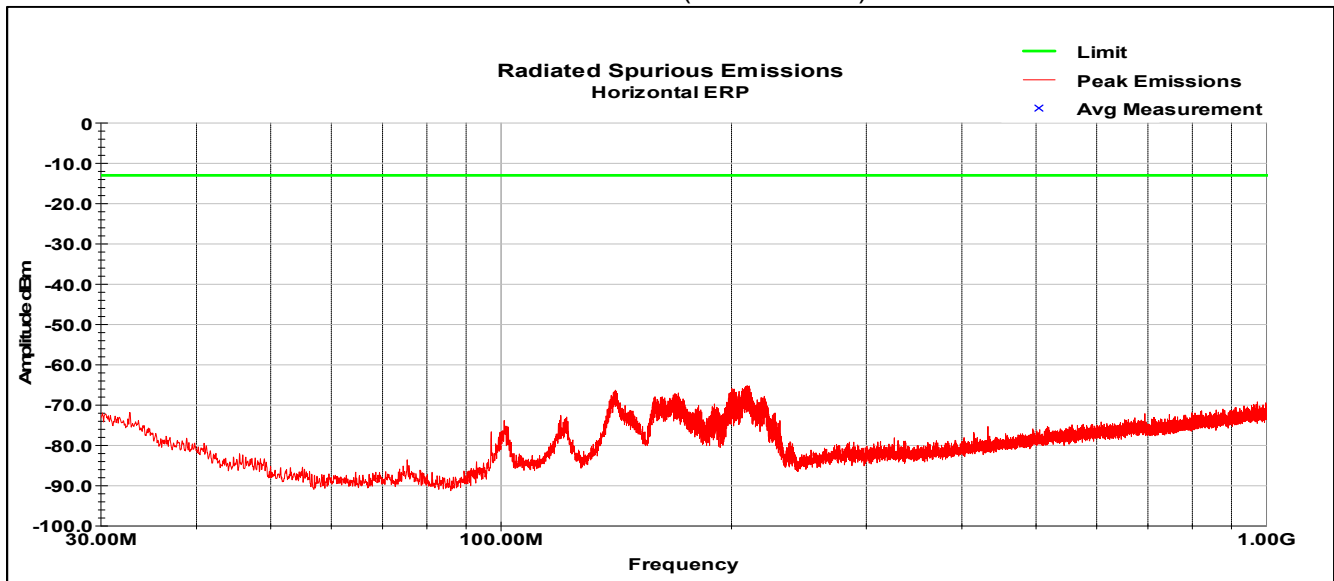
LTE Band 4, QPSK modulation, 1.4MHz

Mid Channel (20175)

Vertical Data (30-1000MHz)



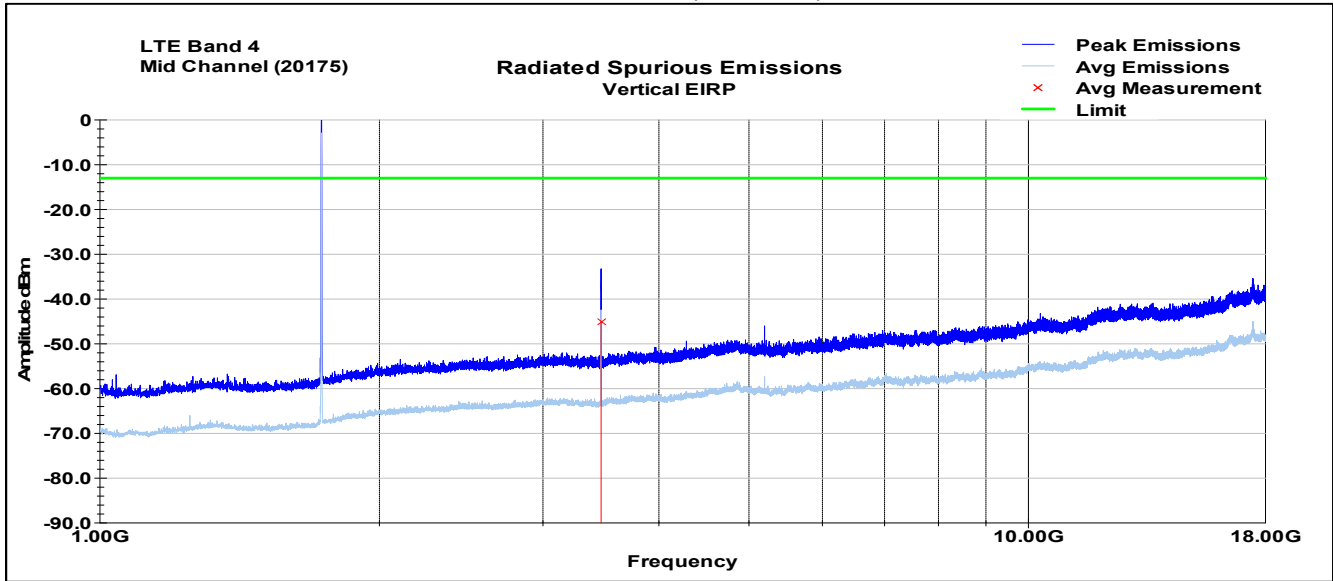
Horizontal Data (30-1000MHz)



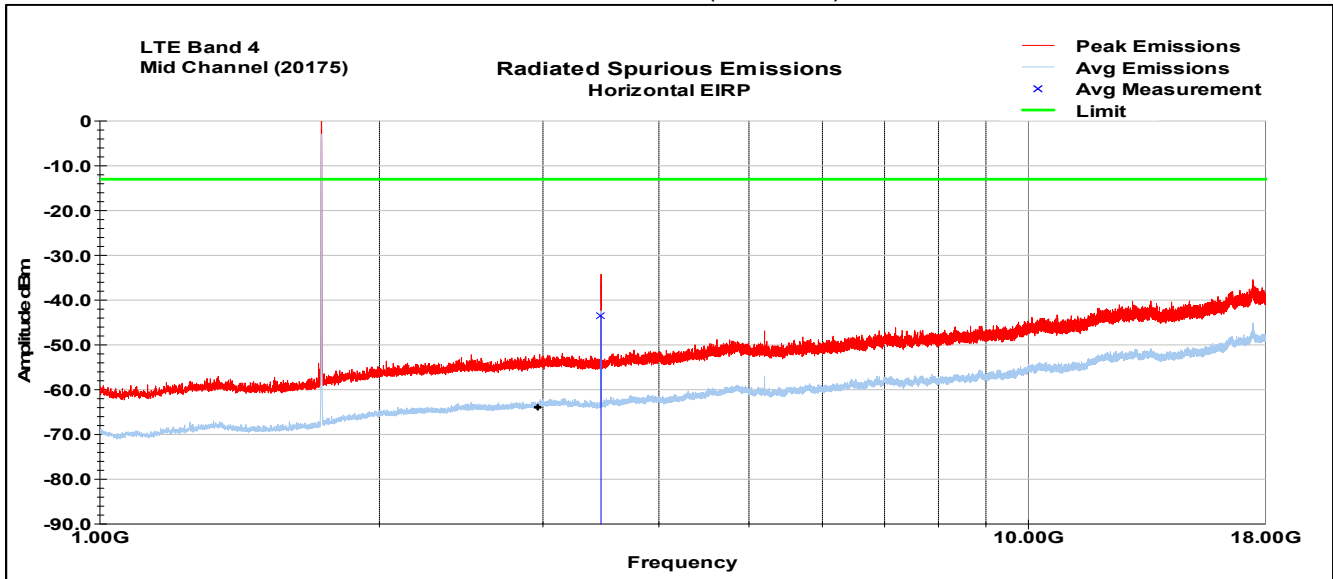
LTE Band 4, QPSK modulation, 1.4MHz

Mid Channel (20175)

Vertical Data (1-18GHz)



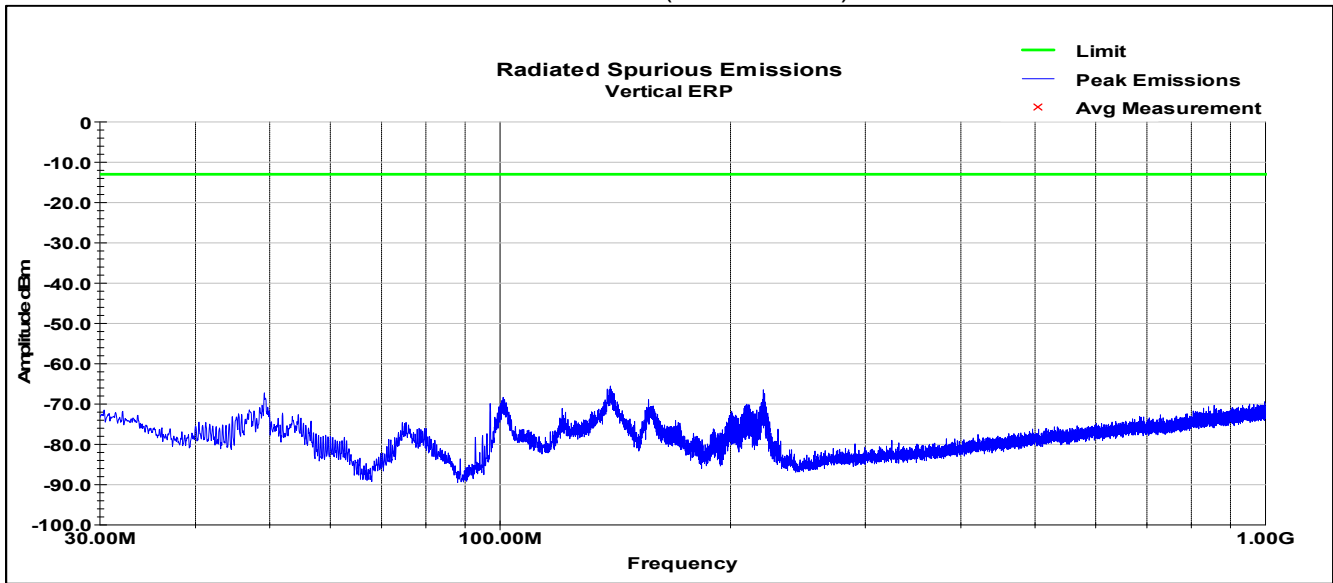
Horizontal Data (1-18GHz)



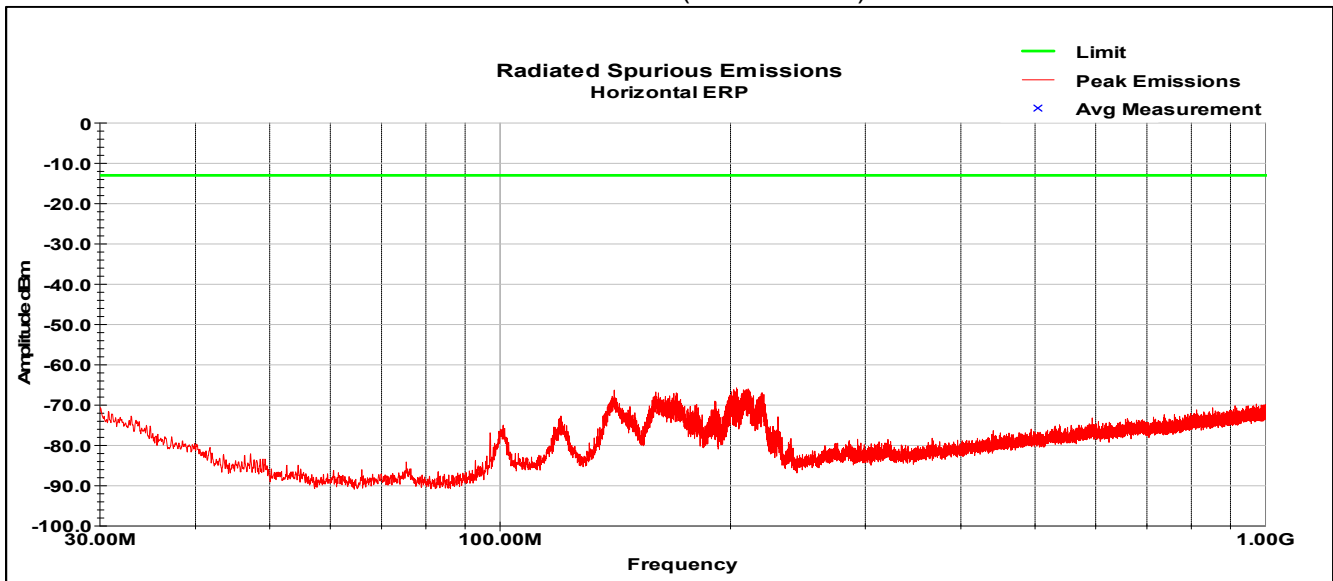
LTE Band 4, QPSK modulation, 1.4MHz

High Channel (20393)

Vertical Data (30-1000MHz)



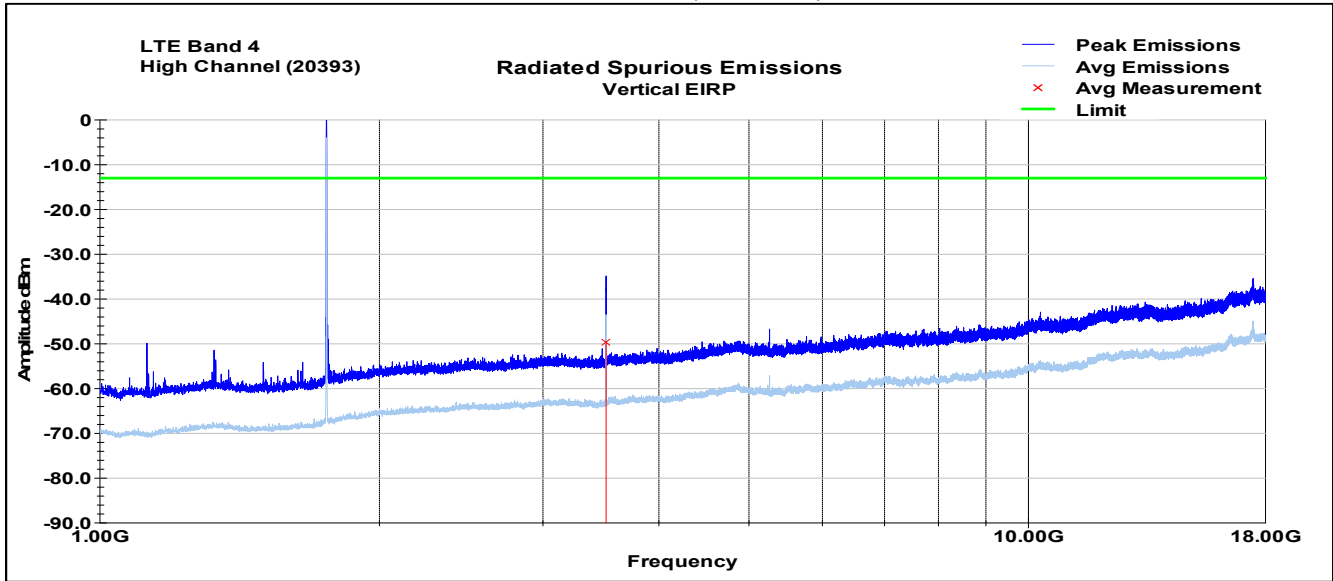
Horizontal Data (30-1000MHz)



LTE Band 4, QPSK modulation, 1.4MHz

High Channel (20393)

Vertical Data (1-18GHz)



Horizontal Data (1-18GHz)

