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FCC LTE REPORT

FCC Certification

Applicant Name:
LG Electronics MobileComm U.S.A., Inc.

Address:
1000 Sylvan Avenue, Englewood Cliffs NJ 07632

Date of Issue:
September 28, 2016

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1609-F026
HCT FRN: 0005866421

FCC ID:	**ZNFKTH**
APPLICANT:	**LG Electronics MobileComm U.S.A., Inc.**

FCC Model(s):	LGV34
EUT Type:	GSM/WCDMA/LTE Phone with WLAN, Bluetooth and NFC
FCC Classification:	Licensed Portable Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§2 , §27

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	ERP	
				Max. Power (W)	Max. Power (dBm)
LTE – Band13 (5)	779.5 –784.5	4M51G7D	QPSK	0.056	17.52
		4M50W7D	16QAM	0.046	16.61
LTE – Band13 (10)	782.0	8M98G7D	QPSK	0.057	17.56
		8M96W7D	16QAM	0.044	16.45

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	ERP	
				Max. Power (W)	Max. Power (dBm)
LTE – Band17 (5)	706.5 – 713.5	4M50G7D	QPSK	0.084	19.23
		4M50W7D	16QAM	0.065	18.10
LTE – Band17 (10)	709.0 – 711.0	8M97G7D	QPSK	0.074	18.67
		8M98W7D	16QAM	0.061	17.85

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by
: Ki Hyun Kim
Test engineer of RF Team

Approved by
: Jong Seok Lee
Manager of RF Team

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1609-F026	September 28, 2016	- First Approval Report

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MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	LG Electronics MobileComm U.S.A., Inc.	
Address:	1000 Sylvan Avenue, Englewood Cliffs NJ 07632	
FCC ID:	ZNFKTH	
Application Type:	Certification	
FCC Classification:	Licensed Portable Transmitter Held to Ear (PCE)	
FCC Rule Part(s):	§2 , §27	
EUT Type:	GSM/WCDMA/LTE Phone with WLAN, Bluetooth and NFC	
FCC Model(s):	LGV34	
Tx Frequency:	779.5 MHz –784.5 MHz (LTE – Band 13 (5MHz)) 782 MHz (LTE – Band 13 (10 MHz)) 706.5 MHz – 713.5 MHz (LTE – Band 17 (5 MHz)) 709.0 MHz – 711.0 MHz (LTE – Band 17 (10 MHz))	
Max. RF Output Power:	Band 13 (5 MHz) : Band 13 (10 MHz) : Band 17 (5 MHz) : Band 17 (10 MHz) :	0.056 W (QPSK) (17.52 dBm) 0.046 W (16-QAM) (16.61 dBm) 0.057 W (QPSK) (17.56 dBm) 0.044 W (16-QAM) (16.45 dBm) 0.084 W (QPSK) (19.23 dBm) 0.065 W (16-QAM) (18.10 dBm) 0.074 W (QPSK) (18.67 dBm) 0.061 W (16-QAM) (17.85 dBm)
Emission Designator(s):	Band 13 (5 MHz) : Band 13 (10 MHz) : Band 17 (5 MHz) : Band 17 (10 MHz) :	4M51G7D (QPSK) / 4M50W7D (16-QAM) 8M98G7D (QPSK) / 8M96W7D (16-QAM) 4M50G7D (QPSK) / 4M50W7D (16-QAM) 8M97G7D (QPSK) / 8M98W7D (16-QAM)
Date(s) of Tests:	August 30, 2016 ~ September 27, 2016	
Antenna Specification	Manufacturer: Antenna type: Peak Gain:	AT&C Co.LTD. LMA(All in one) Antenna Band 13: -5.24 dBi Band 17: -8.07 dBi

2. INTRODUCTION

2.1. EUT DESCRIPTION

The LG Electronics MobileComm U.S.A., Inc LGV34 GSM/WCDMA/LTE Phone with WLAN, Bluetooth and NFC consists of LTE 13 and 17.

2.2. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.3. TEST FACILITY

The Fully-anechoic chamber and conducted measurement facility used to collect the radiated data are located at the **74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA**.

3. DESCRIPTION OF TESTS

3.1 ERP RADIATED POWER AND RADIATED SPURIOUS EMISSIONS

Note: ERP(Effective Radiated Power)

Test Procedure

Radiated emission measurements are performed in the Fully-anechoic chamber. The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-D-2010 Clause 2.2.17. The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission. The level and position of the maximized emission is recorded with the spectrum analyzer using a RMS detector.
A half wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.
The power is calculated by the following formula;

$$P_{d(dBm)} = Pg_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dB)}$$

Where: $P_d$is the dipole equivalent power and $P_g$is the generator output power into the substitution antenna.

Radiated spurious emissions

: Frequency Range : 9 kHz ~ 10^{th} Harmonics of highest channel fundamental frequency.

3.2 BLOCK B FREQUENCY RANGE (775 – 788 MHz)

§27.5(b)

746-758 MHz, 775-788 MHz, and 805-806 MHz bands. The following frequencies are available for licensing pursuant to this part in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands:

(1) Two paired channels of 1 megahertz each are available for assignment in Block A in the 757-758 MHz and 787-788 MHz bands.

(2) Two paired channels of 1 megahertz each are available for assignment in Block B in the 775-776 MHz and 805-806 MHz bands.

(3) Two paired channels of 11 megahertz each are available for assignment in Block C in the 746-757 MHz and 776-787 MHz bands. In the event that no licenses for two channels in this Block C are assigned based on the results of the first auction in which such licenses were offered because the auction results do not satisfy the applicable reserve price, the spectrum in the 746-757 MHz and 776-787 MHz bands will instead be made available for assignment at a subsequent auction as follows:

(i) Two paired channels of 6 megahertz each available for assignment in Block C1 in the 746-752 MHz and 776-782 MHz bands.

(ii) Two paired channels of 5 megahertz each available for assignment in Block C2 in the 752-757 MHz and 782-787 MHz band.

3.3 BLOCK B FREQUENCY RANGE (704 – 710 and 734 – 740 MHz, 777 – 792 MHz)

§27.5(c)

698-746 MHz Band. The following frequencies are available for licensing pursuant to this part in the 698–746 MHz band: (1) Three paired channel blocks of 12 MHz each are available for assignment as follows :
Block A : 698 – 704 MHz and 728 – 734 MHz ;
Block B : 704 – 710 MHz and 734 – 740 MHz ; and
Block C : 710 – 716 MHz and 740 – 746 MHz.

The EUT is only being authorized for operation in Blocks B and C.

5.1.1 Peak power measurements with a spectrum/signal analyzer or EMI receiver

The following procedure can be used to determine the total peak output power.

a) Set the RBW ≥ OBW.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 2 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Ensure that the number of measurement points ≥ span/RBW.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the peak amplitude level.

5.2.2 Procedures for use with a spectrum/signal analyzer when EUT cannot be configured to transmit continuously and sweep triggering/signal gating cannot be properly implemented

If the EUT cannot be configured to transmit continuously (burst duty cycle < 98%), then one of the following procedures can be used. The selection of the applicable procedure will depend on the characteristics of the measured burst duty cycle.

Measure the burst duty cycle with a spectrum/signal analyzer or EMC receiver can be used in zero-span mode if the response time and spacing between bins on the sweep are sufficient to permit accurate measurement of the burst on/off time of the transmitted signal.

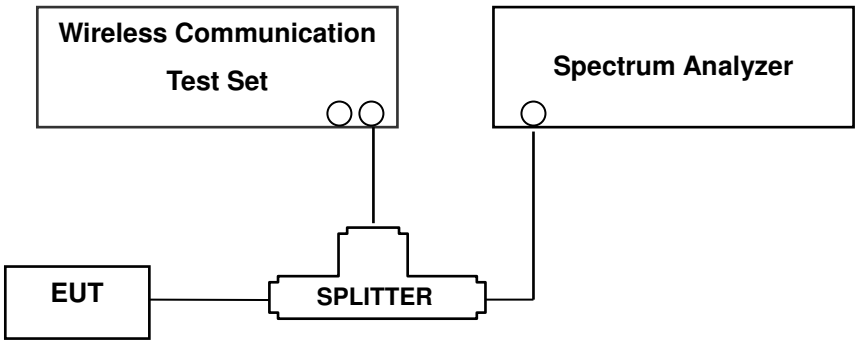
5.2.2.2 Constant burst duty cycle

If the measured burst duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then:

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 ≥ 3 x RBW.
d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = RMS (power averaging).
g) Set sweep trigger to “free run”.
h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
j) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission).
For example, add 10 log (1/0.25) = 6 dB if the duty cycle is a constant 25%.

3.4 OCCUPIED BANDWIDTH.

Test set-up



(Configuration of conducted Emission measurement)

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

Test Procedure

OBW is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 4.2.

The EUT makes a call to the communication simulator. The power was measured with R&S Spectrum Analyzer. All measurements were done at 3 channels(low, middle and high operational range.)

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

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL.

Test Procedure

Spurious and harmonic emissions at antenna terminal is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 6.0.

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer.

The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P) dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz bandwidth may be employed. 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

Additionally, for operations in the 776-788MHz band, the power of any emission outside the licensee's frequency band of operation shall be attenuated below the transmitted power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 776-788MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43+10log(P)dB.

(2) On all frequencies between 763-775 and 793-805MHz, by a factor not less than 65+10log(P)dB in a 6.25kHz band segment.

For operations in the 788–793 MHz band, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769–775 MHz and 799–805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

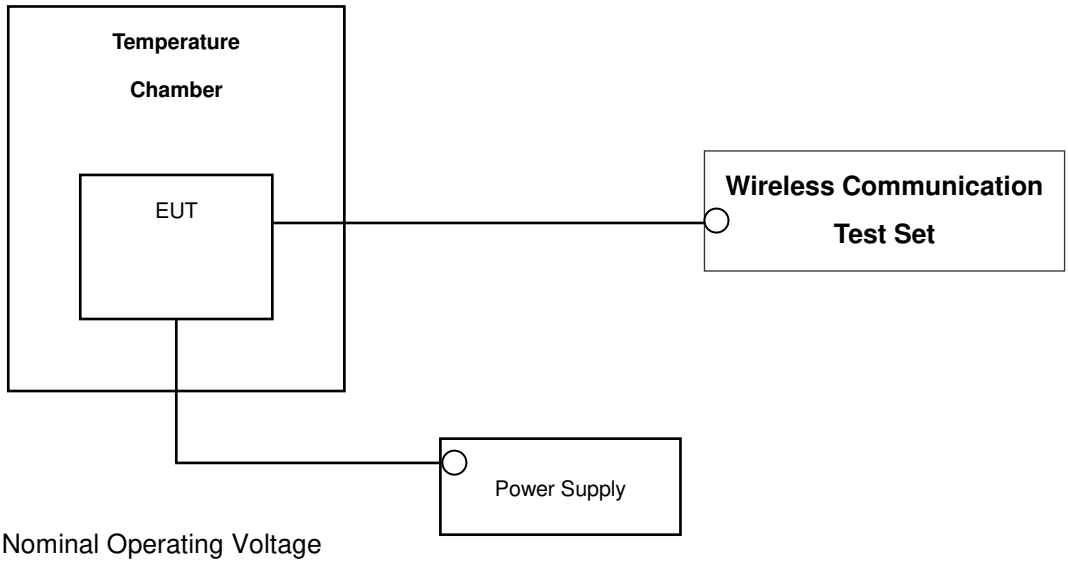
(2) On any frequency between 775–788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB

NOTES: The analyzer plot offsets were determined by below conditions.

- For LTE Band 13, total offset 27.0 dBm = 30 dBm attenuator + 6 dBm Divider + 1.0 dBm RF cables.
- For LTE Band 17, total offset 26.9 dBm = 20 dBm attenuator + 6 dBm Divider + 0.9 dBm RF cables.

3.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

Test Set-up



* Nominal Operating Voltage

Test Procedure

Frequency stability is tested in accordance with ANSI/TIA-603-D-2010 section 2.2.2

The frequency stability of the transmitter is measured by:
a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from the end point to 100 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification **—** the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block

Time Period and Procedure:

The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
1. The equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.

2. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

NOTE: The EUT is tested down to the battery endpoint.

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Interval	Calibration Due
CERNEX	CBLU1183540B-01/ POWER AMP	25540	Annual	05/13/2017
Wainwright	WHKX 10-900-1000-15000-40SS/H.P.F	5	Annual	08/04/2017
Wainwright	WHKX10-2700-3000-18000-40SS/H.P.F	3	Annual	08/04/2017
Hewlett Packard	11667B / Power Splitter	10545	Annual	02/15/2017
Hewlett Packard	11667B / Power Splitter	11275	Annual	04/29/2017
ITECH	IT6720/ Power Supply	0100215626700119	Annual	11/02/2016
Schwarzbeck	UHAP/ Dipole Antenna	557	Biennial	03/23/2017
Schwarzbeck	UHAP/ Dipole Antenna	558	Biennial	03/23/2017
EXP	EX-TH400/ Chamber	None	Annual	05/31/2017
Schwarzbeck	BBHA 9120D/ Horn Antenna	9210D-1298	Biennial	10/16/2016
Schwarzbeck	BBHA 9120D/ Horn Antenna	9210D-1299	Biennial	10/16/2016
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170342	Biennial	04/30/2017
Schwarzbeck	BBHA 9170/ Horn Antenna(15~35GHz)	BBHA9170124	Biennial	04/30/2017
Agilent	N9020A/Signal Analyzer	MY52090906	Annual	05/13/2017
Hewlett Packard	8493C/ATTENUATOR	17280	Annual	06/22/2017
REOHDE&SCHWARZ	FSV40-N/Signal Analyzer	101068-SZ	Annual	09/23/2017
Agilent	8960 (E5515C)/ Base Station	MY48360800	Annual	10/30/2016
Anritsu Corp.	MT8820C/Wideband Radio Communication Tester	6200863156	Annual	02/26/2017
Anritsu Corp.	MT8820C/Wideband Radio Communication Tester	6201026545	Annual	02/16/2017
Schwarzbeck	VULB9160/ Bilog Antenna	3150	Biennial	11/17/2016
Schwarzbeck	VULB9160/ Bilog Antenna	3368	Biennial	10/10/2016
REOHDE&SCHWARZ	FMZB 1513/Loop Antenna	1513-175	Biennial	02/23/2018

5. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	6.07

6. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS
2.1051, 27.53(c), 27.53(g)	Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	< 43 +10 $\log_{10}$ (P[Watts]) at Band Edge and for all-of-band emissions <65 + 10 log (P[Watts]) in a 6.25kHz bandwidth for emissions in the 777–787 MHz bands		PASS
* 2.1046	Conducted Output Power	N/A		PASS
2.1055, 27.54	Frequency stability / variation of ambient temperature	Emission must remain in band		PASS
27.50(b)(10),(c)(10)	Effective Radiated Power	< 3 Watts max. ERP	RADIATED	PASS
2.1053, 27.53(g)	Undesirable Out-of-Band Emissions	< 43 +10 log10 (P[Watts]) for all out-of-band emissions		PASS
2.1053, 27.53(f)	Undesirable Emissions in the 1559 – 1610 MHz band	< -70dBW/MHz EIRP (wideband) < -80dBW EIRP (narrowband)		PASS

Note regarding all Emission Mask test plots:

The FCC limit is 65 + 10$\log_{10}$($P_{[Watts]}$) = -35 dBm in a 6.25 kHz bandwidth. Since it was not possible to set the resolution bandwidth to 6.25 kHz with the available equipment, a bandwidth of 10 kHz was used instead to show compliance. By using a 10 kHz bandwidth, the limit was adjusted by 10$\log_{10}$(10 kHz/6.25 kHz) = 2.04 dB. Thus, the limit shown in all emission mask plots for all available modulation types was -35 dBm + 2.04 dB = -32.96 dBm.

7. SAMPLE CALCULATION

A. ERP Sample Calculation

Mode	Ch./ Freq.		Measured Level(dBm)	Substitute LEVEL(dBm)	Ant. Gain (dBd)	C.L	Pol.	Limit	ERP	
	channel	Freq.(MHz)						W	W	dBm
LTE Band 17	23790	710.0	-32.09	28.83	-10.21	0.81	V	< 3.00	0.060	17.81

ERP = Substitute LEVEL(dBm) + Ant. Gain – CL(Cable Loss)

1) The EUT mounted on a wooden tripod is 2.5 meter above test site ground level.
2) During the test , the turn table is rotated and the antenna height is found.
3) Record the field strength meter's level.
4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power (**ERP**).

B. Emission Designator

QPSK Modulation

Emission Designator = 4M48G7D

LTE BW = 4.48 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

16QAM Modulation

Emission Designator = 4M48W7D

LTE BW = 4.48 MHz

W = main carrier modulated in a combination of two or more of the following modes; amplitude, angle, pulse

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

8. TEST DATA

8.1 EFFECTIVE RADIATED POWER (Band 13)

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
779.5	5 MHz	QPSK	-31.86	29.48	-10.23	1.75	H	< 3.00	0.056	17.50
		16-QAM	-33.06	28.28	-10.23	1.75	H		0.043	16.30
782.0		QPSK	-32.03	29.51	-10.24	1.76	H		0.056	17.51
		16-QAM	-33.05	28.49	-10.24	1.76	H		0.045	16.49
784.5		QPSK	-32.11	29.53	-10.25	1.76	H		0.056	17.52
		16-QAM	-33.02	28.62	-10.25	1.76	H		0.046	16.61

Effective Radiated Power Data (5 MHz Band 13 LTE)

Note: All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
782.0	10 MHz	QPSK	-31.98	29.56	-10.24	1.76	H	< 3.00	0.057	17.56
		16-QAM	-33.09	28.45	-10.24	1.76	H		0.044	16.45

Effective Radiated Power Data (5 MHz Band 13 LTE)

Note: All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case

NOTES:

Effective Radiated Power Output Measurements by Substitution Method

according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:

The EUT was placed on a non-conductive styrofoam resin table 3-meters from the receive antenna. The receive antenna height and turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. For LTE signals, RBW = 1-5% of the OBW, not to exceed 1MHz, VBW ≥ 3 x RBW, Detector = RMS. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the dipole is measured. The ERP is recorded.

Also, we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. The worst case of the EUT is x plane in LTE mode. Also worst case of detecting Antenna is horizontal polarization in LTE mode.

8.2 EFFECTIVE RADIATED POWER (Band 17)

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
706.5	5 MHz	QPSK	-32.65	30.41	-10.08	1.68	V	< 3.00	0.073	18.65
		16-QAM	-33.80	29.26	-10.08	1.68	V		0.056	17.50
710.0		QPSK	-32.40	30.70	-10.08	1.68	V		0.078	18.94
		16-QAM	-33.26	29.84	-10.08	1.68	V		0.064	18.08
713.5		QPSK	-32.17	30.99	-10.08	1.68	V		0.084	19.23
		16-QAM	-33.30	29.86	-10.08	1.68	V		0.065	18.10

Effective Radiated Power Data (5 MHz Band 17 LTE)

Note: All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
709.0	10 MHz	QPSK	-32.66	30.43	-10.08	1.68	V	< 3.00	0.074	18.67
		16-QAM	-33.70	29.39	-10.08	1.68	V		0.058	17.63
710.0		QPSK	-32.70	30.40	-10.08	1.68	V		0.073	18.64
		16-QAM	-33.55	29.55	-10.08	1.68	V		0.060	17.79
711.0		QPSK	-32.71	30.42	-10.09	1.68	V		0.073	18.65
		16-QAM	-33.51	29.62	-10.09	1.68	V		0.061	17.85

Effective Radiated Power Data (10 MHz Band 17 LTE)

Note: All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case

NOTES:

Effective Radiated Power Output Measurements by Substitution Method

according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:

The EUT was placed on a non-conductive styrofoam resin table 3-meters from the receive antenna. The receive antenna height and turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. For LTE signals, RBW = 1-5% of the OBW, not to exceed 1MHz, VBW ≥ 3 x RBW, Detector = RMS. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the dipole is measured. The ERP is recorded.

Also, we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. The worst case of the EUT is y plane in LTE mode. Also worst case of detecting Antenna is vertical polarization in LTE mode.

8.3 RADIATED SPURIOUS EMISSIONS

8.3.1 RADIATED SPURIOUS EMISSIONS (5 MHz Band 13 LTE)

▣OPERATING FREQUENTY: 784.50 MHz

▣ MEASURED OUTPUT POWER: 17.52 dBm = 0.056 W

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 30.52 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	dBc
23205 (779.5)	2,338.50	-52.29	10.77	-59.09	2.65	V	-50.97	68.49
	3,118.00	-55.78	11.54	-60.91	2.99	V	-52.36	69.88
	3,897.50	-56.08	12.65	-58.74	3.54	V	-49.63	67.15
23230 (782.0)	2,346.00	-53.54	10.78	-60.61	2.66	V	-52.49	70.01
	3,128.00	-55.90	11.57	-60.62	3.05	V	-52.10	69.62
	3,910.00	-56.52	12.67	-59.07	3.56	H	-49.96	67.48
23255 (784.5)	2,353.50	-54.93	10.78	-62.26	2.66	V	-54.14	71.66
	3,138.00	-53.37	11.59	-58.20	3.01	H	-49.62	67.14
	3,922.50	-56.56	12.67	-59.41	3.59	V	-50.33	67.85

NOTES:

1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:
2. We are performed all frequency to 10th harmonics from 9 kHz. Measurements above show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case
5. We are performed 16QAM and QPSK modulations. The worst case data are reported in the table above.

8.3.2 RADIATED SPURIOUS EMISSIONS (10 MHz Band 13 LTE)

▣OPERATING FREQUENTY: 782.00 MHz

▣ MEASURED OUTPUT POWER: 17.56 dBm = 0.057 W

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 log_{10} (W) = 30.56 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	dBc
23230 (782.00)	2,346.00	-52.56	10.78	-59.63	2.66	V	-51.51	69.07
	3,128.00	-55.71	11.57	-60.43	3.05	H	-51.91	69.47
	3,910.00	-55.28	12.67	-57.83	3.56	V	-48.72	66.28

NOTES:

1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:
2. We are performed all frequency to 10th harmonics from 9 kHz. Measurements above show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case
5. We are performed 16QAM and QPSK modulations. The worst case data are reported in the table above.

8.3.2.1 RADIATED SPURIOUS EMISSIONS (1559 ~ 1610 MHz Band)

▣ OPERATING FREQUENTY: 779.5 MHz, 782.0 MHz, 784.5 MHz

▣ MEASURED OUTPUT POWER: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ WIDEBAND EMISSION LIMIT: -70 dBW/ MHz (= -40 dBm/ MHz)

Operating Frequency (MHz)	Measured Frequency (MHz)	EMISSION TYPE	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	MARGIN (dB)
779.5	1,603.75	WIDEBAND	-52.51	8.98	-63.72	2.3	H	-57.04	17.04
782.0	1,597.84		-52.90	8.98	-64.11	2.30	H	-57.43	17.43
784.5	1,595.91		-52.84	8.96	-54.88	2.30	H	-48.22	8.22

8.3.2.2 RADIATED SPURIOUS EMISSIONS (1559 ~ 1610 MHz Band)

▣ OPERATING FREQUENTY: 782.00 MHz

▣ MEASURED OUTPUT POWER: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ WIDEBAND EMISSION LIMIT: -70 dBW/ MHz (= -40 dBm/ MHz)

Operating Frequency (MHz)	Measured Frequency (MHz)	EMISSION TYPE	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	MARGIN (dB)
782.0	1,577.41	WIDEBAND	-52.04	8.90	-62.80	2.30	H	-56.20	16.20

8.3.3 RADIATED SPURIOUS EMISSIONS (5 MHz Band 17 LTE)

▣OPERATING FREQUENTY: 713.5 MHz

▣ MEASURED OUTPUT POWER: 19.23 dBm = 0.084 W

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 32.23 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	dBc
23755 (706.50)	1,413.00	-54.91	8.03	-63.14	2.21	V	-57.32	76.55
	2,119.50	-55.25	10.46	-63.57	2.56	V	-55.67	74.90
	2,826.00	-55.97	11.18	-61.73	2.87	V	-53.42	72.65
23790 (710.00)	1,420.00	-56.50	8.09	-66.59	2.24	V	-60.74	79.97
	2,130.00	-56.11	10.47	-63.36	2.72	V	-55.61	74.84
	2,840.00	-55.74	11.19	-61.64	2.86	V	-53.31	72.54
23825 (713.50)	1,427.00	-55.46	8.15	-64.35	2.22	V	-58.42	77.65
	2,140.50	-55.89	10.49	-63.74	2.56	V	-55.81	75.04
	2,854.00	-55.35	11.20	-61.57	2.87	V	-53.24	72.47

NOTES:

1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:
2. We are performed all frequency to 10th harmonics from 9 kHz. Measurements above show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case
5. We are performed 16QAM and QPSK modulations. The worst case data are reported in the table above.

8.3.4 RADIATED SPURIOUS EMISSIONS (10 MHz Band 17 LTE)

▣OPERATING FREQUENTY: 709.00 MHz

▣ MEASURED OUTPUT POWER: 18.67 dBm = 0.074 W

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 31.67 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	ERP (dBm)	dBc
23780 (709.00)	1,418.00	-53.99	8.09	-64.08	2.24	H	-58.23	76.90
	2,127.00	-54.42	10.47	-61.83	2.56	V	-53.92	72.59
	2,836.00	-55.34	11.19	-61.10	2.88	V	-52.79	71.46
23790 (710.00)	1,420.00	-52.88	8.09	-62.98	2.23	H	-57.12	75.79
	2,130.00	-55.03	10.47	-62.44	2.56	H	-54.53	73.20
	2,840.00	-53.70	11.19	-59.60	2.86	H	-51.27	69.94
23800 (711.00)	1,422.00	-54.45	8.09	-64.55	2.23	V	-58.69	77.36
	2,133.00	-54.47	10.47	-61.88	2.56	H	-53.97	72.64
	2,844.00	-55.91	11.19	-61.83	2.86	V	-53.50	72.17

NOTES:

1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010 June 24, 2010:
2. We are performed all frequency to 10th harmonics from 9 kHz. Measurements above show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. All of RB size has been tested for emissions and ERP, with the 1RB configuration observed as the worst case
5. We are performed 16QAM and QPSK modulations. The worst case data are reported in the table above.

8.4 OCCUPIED BANDWIDTH

Band	Band Width (MHz)	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
13	5	782.0	QPSK	25	0	4.5120
			16-QAM	25	0	4.4997
	10		QPSK	50	0	8.9795
			16-QAM	50	0	8.9597

Band	Band Width (MHz)	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
17	5	710.0	QPSK	25	0	4.4990
			16-QAM	25	0	4.4955
	10		QPSK	50	0	8.9674
			16-QAM	50	0	8.9807

- Plots of the EUT's Occupied Bandwidth are shown Page 32 ~ 35.

8.5 CONDUCTED SPURIOUS EMISSIONS

▣ FACTORS FOR FREQUENCY

Frequency Range (GHz)	Factor [dB]
0.03 – 1	27.145
1 – 5	26.960
5 – 10	27.542
10 – 15	28.439
15 – 20	29.144
Above 20	30.148

NOTES:

Factor(dB) = Cable Loss + Attenuator + Power Splitter

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
13	5	779.5	3.31492	26.960	-58.50	-31.540	-13.00
		782.0	2.65466	26.960	-57.62	-30.660	
		784.5	6.59125	27.542	-58.53	-30.988	
	10	782.0	3.72718	26.960	-58.98	-32.020	

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
17	5	706.5	3.6915	26.960	-59.653	-32.693	-13.00
		710.0	3.3131	26.960	-60.288	-33.328	
		713.5	3.6770	26.960	-59.926	-32.966	
	10	709.0	6.3096	27.542	-59.669	-32.127	
		710.0	3.7259	26.960	-59.472	-32.512	
		711.0	3.1965	26.960	-58.435	-31.475	

NOTES:

1. Conducted Spurious Emissions was Tested QPSK Modulation, Resource Block Size 1 and Resource Block Offset 0

2. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)

- Plots of the EUT's Conducted Spurious Emissions are shown Page 47 ~ 53.

8.5.1 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 36 ~ 46.

8.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

8.6.1 FREQUENCY STABILITY (5 MHz Band 13 LTE)

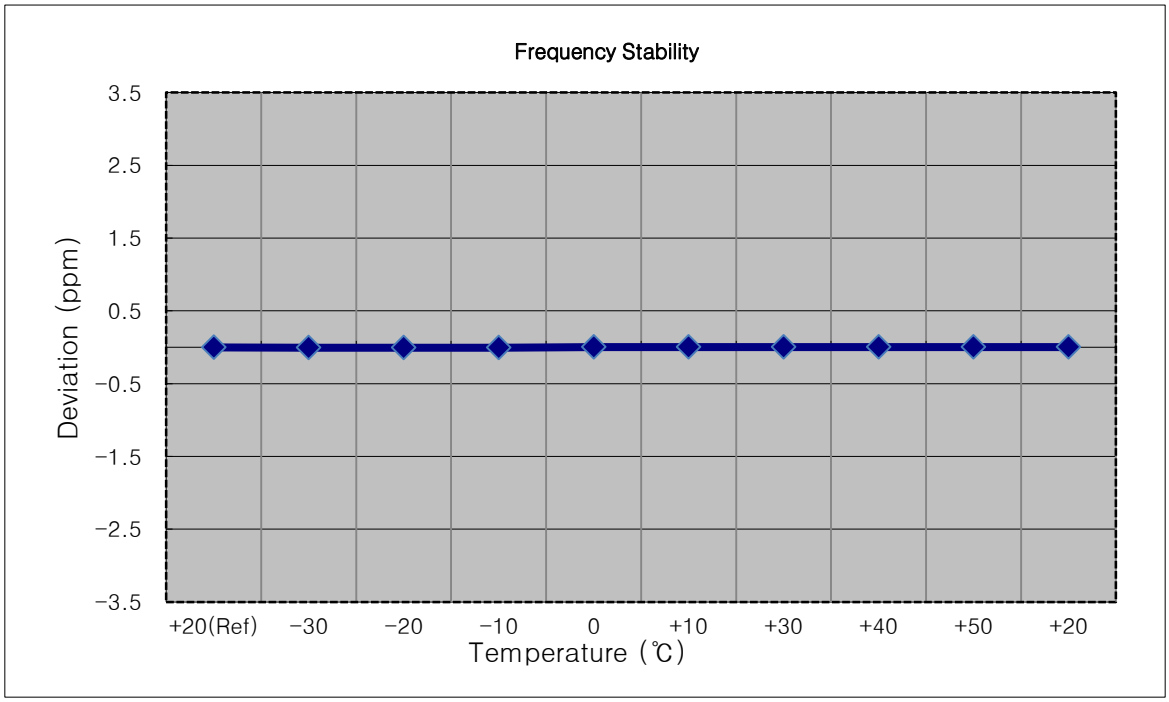
▣OPERATING FREQUENCY: 782,000,000 Hz

▣CHANNEL: 23230 (5 MHz)

▣REFERENCE VOLTAGE: 3.85 VDC

▣DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.85	+20(Ref)	781 999 995	0.0	0.000 000	0.000
100%		-30	781 999 991	-4.0	-0.000 001	-0.005
100%		-20	781 999 992	-3.3	0.000 000	-0.004
100%		-10	781 999 990	-5.0	-0.000 001	-0.006
100%		0	781 999 998	2.5	0.000 000	0.003
100%		+10	781 999 999	3.4	0.000 000	0.004
100%		+30	781 999 998	2.5	0.000 000	0.003
100%		+40	781 999 998	2.4	0.000 000	0.003
100%		+50	781 999 997	2.0	0.000 000	0.003
Batt. Endpoint	3.60	+20	781 999 998	2.6	0.000 000	0.003



8.6.2 FREQUENCY STABILITY (10 MHz Band 13 LTE)

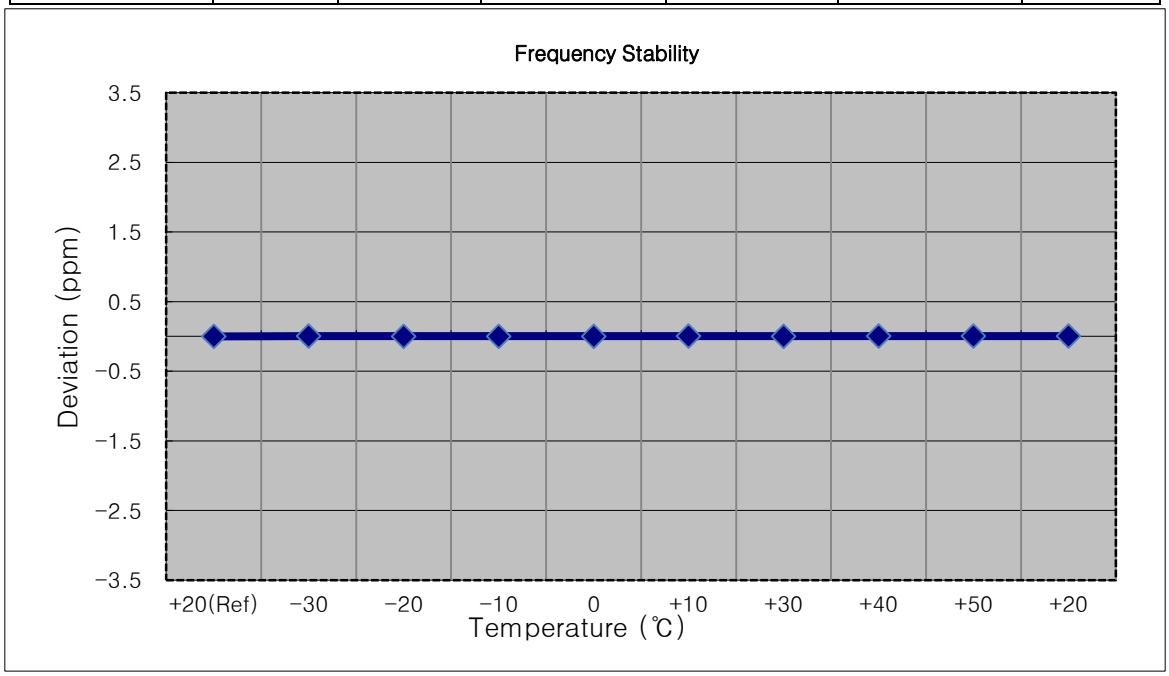
▣OPERATING FREQUENCY: 782,000,000 Hz

▣CHANNEL: 23230 (10 MHz)

▣REFERENCE VOLTAGE: 3.85 VDC

▣DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.85	+20(Ref)	782 000 006	0.0	0.000 000	0.000
100%		-30	782 000 009	3.6	0.000 000	0.005
100%		-20	782 000 008	2.7	0.000 000	0.003
100%		-10	782 000 009	2.9	0.000 000	0.004
100%		0	782 000 009	2.8	0.000 000	0.004
100%		+10	782 000 010	3.8	0.000 000	0.005
100%		+30	782 000 009	3.3	0.000 000	0.004
100%		+40	782 000 010	3.9	0.000 000	0.005
100%		+50	782 000 009	3.6	0.000 000	0.005
Batt. Endpoint	3.60	+20	782 000 010	4.2	0.000 001	0.005



8.6.3 FREQUENCY STABILITY (5 MHz Band 17 LTE)

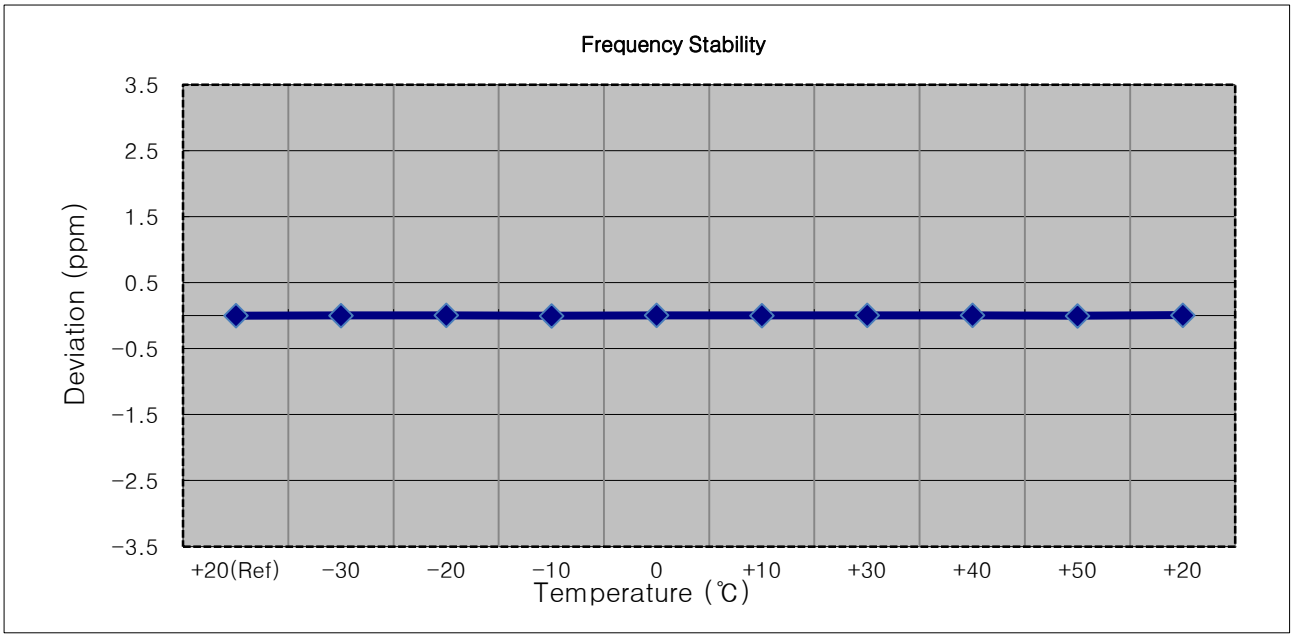
▣OPERATING FREQUENCY: 710,000,000 Hz

▣CHANNEL: 23790 (5 MHz)

▣REFERENCE VOLTAGE: 3.85 VDC

▣DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.85	+20(Ref)	710 000 003	0.0	0.000 000	0.0000
100%		-30	710 000 005	2.2	0.000 000	0.0031
100%		-20	710 000 005	2.8	0.000 000	0.0039
100%		-10	710 000 000	-2.2	0.000 000	-0.0031
100%		0	710 000 006	3.7	0.000 001	0.0052
100%		+10	710 000 004	1.4	0.000 000	0.0020
100%		+30	710 000 006	3.5	0.000 000	0.0049
100%		+40	710 000 006	3.4	0.000 000	0.0048
100%		+50	710 000 000	-2.8	0.000 000	-0.0039
Batt. Endpoint	3.60	+20	710 000 007	4.2	0.000 001	0.0059



8.6.4 FREQUENCY STABILITY (10 MHz Band 17 LTE)

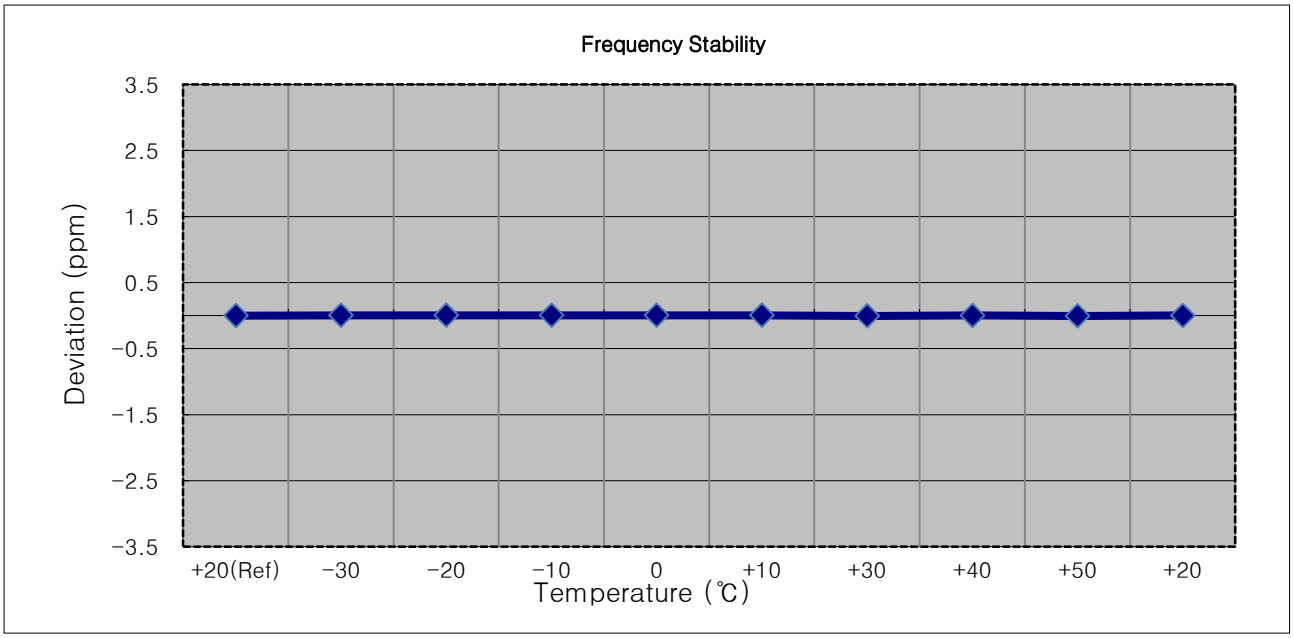
▣OPERATING FREQUENCY: 710,000,000 Hz

▣CHANNEL: 23790 (10 MHz)

▣REFERENCE VOLTAGE: 3.85 VDC

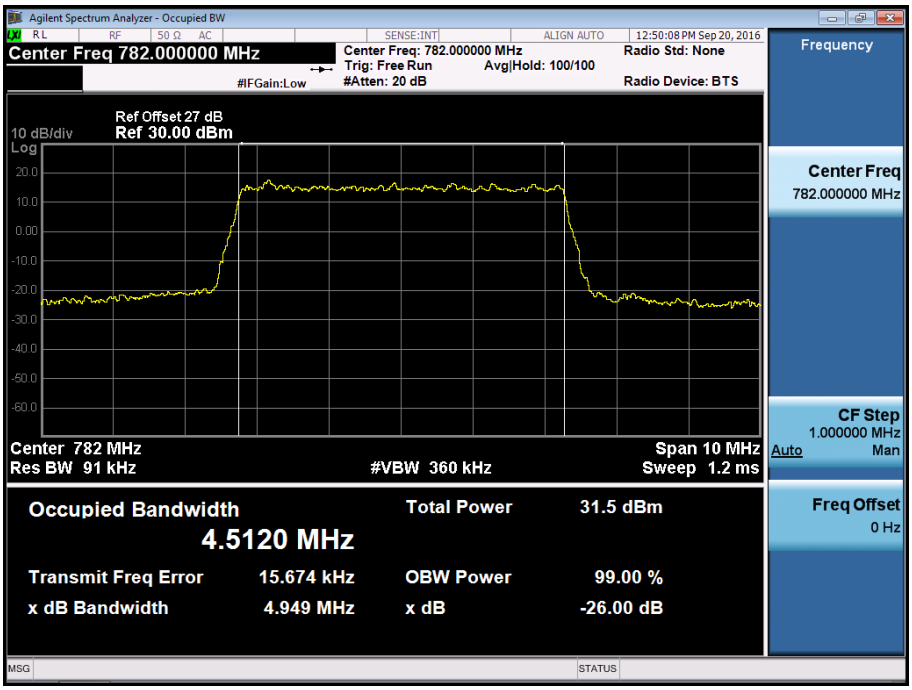
▣DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.85	+20(Ref)	710 000 003	0.0	0.000 000	0.0000
100%		-30	710 000 006	2.7	0.000 000	0.0038
100%		-20	710 000 006	2.3	0.000 000	0.0032
100%		-10	710 000 007	3.3	0.000 000	0.0046
100%		0	710 000 007	3.3	0.000 000	0.0046
100%		+10	710 000 006	3.1	0.000 000	0.0044
100%		+30	709 999 999	-4.6	-0.000 001	-0.0065
100%		+40	710 000 005	2.1	0.000 000	0.0030
100%		+50	710 000 000	-3.2	0.000 000	-0.0045
Batt. Endpoint	3.60	+20	710 000 005	1.4	0.000 000	0.0020

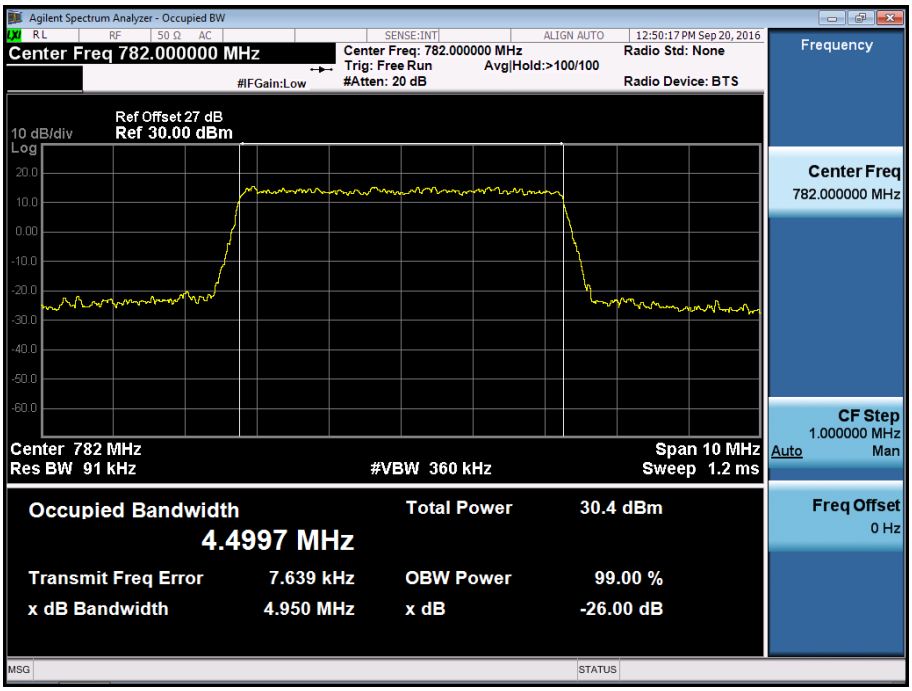


9. TEST PLOTS

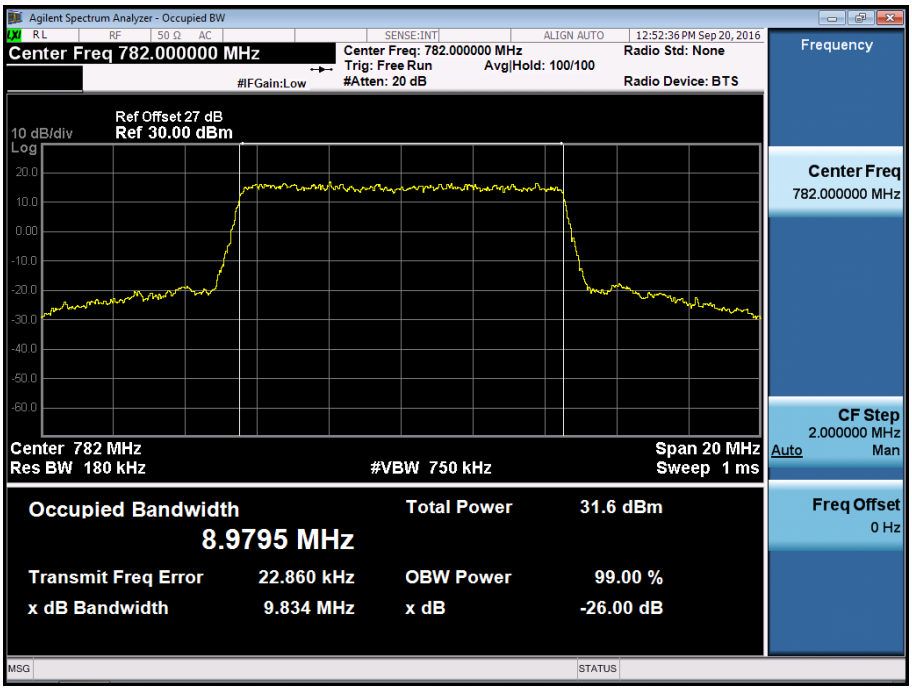
BAND 13. Occupied Bandwidth Plot (Ch.23230 QPSK RB 25) 5 MHz



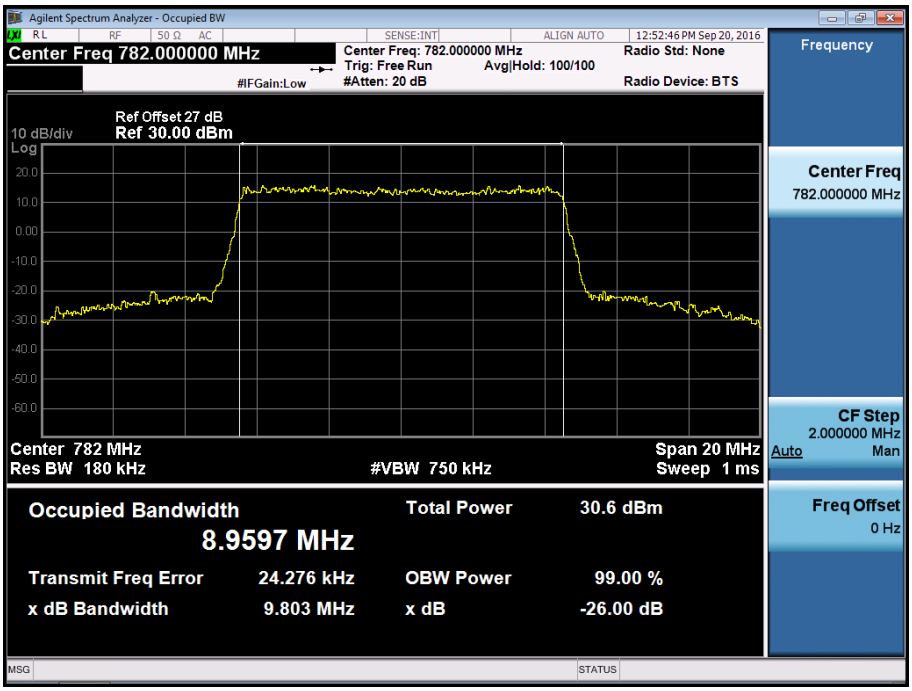
BAND 13. Occupied Bandwidth Plot (Ch.23230 16-QAM RB 25) 5 MHz



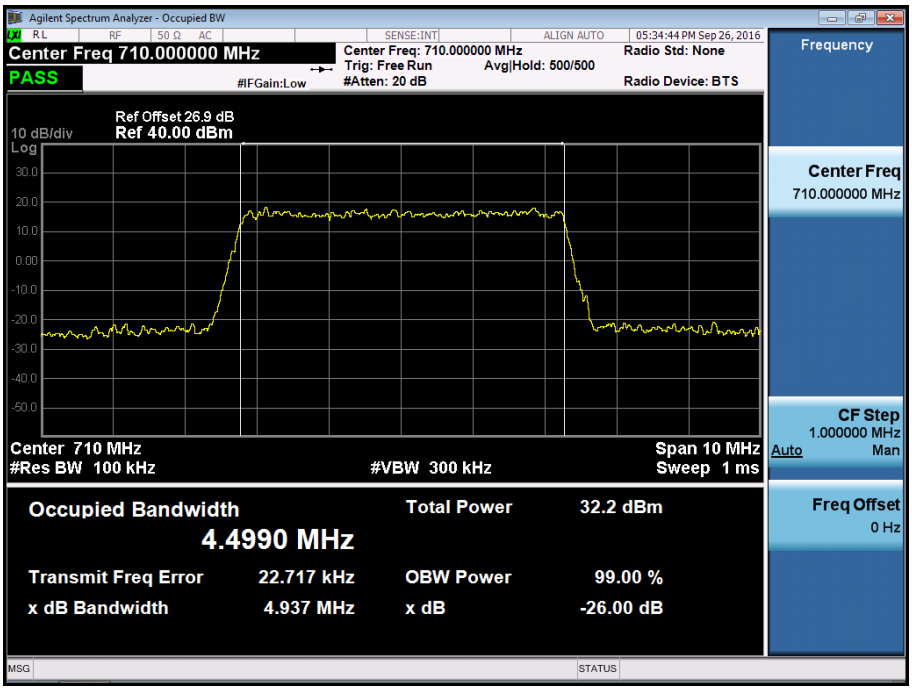
BAND 13. Occupied Bandwidth Plot (Ch.23230 QPSK RB 50) 10 MHz



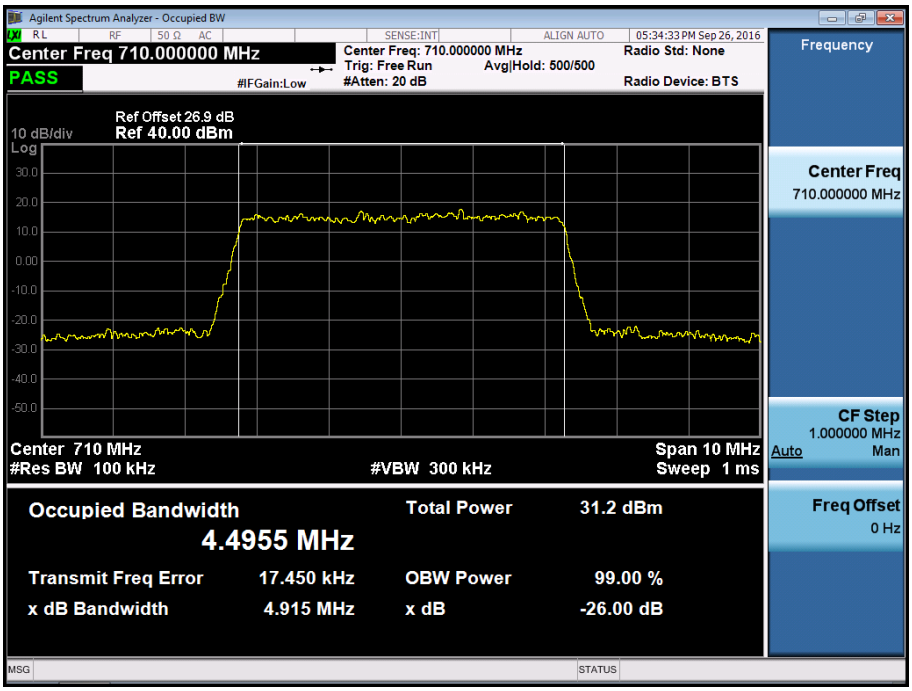
BAND 13. Occupied Bandwidth Plot (Ch.23230 16-QAM RB 50) 10 MHz



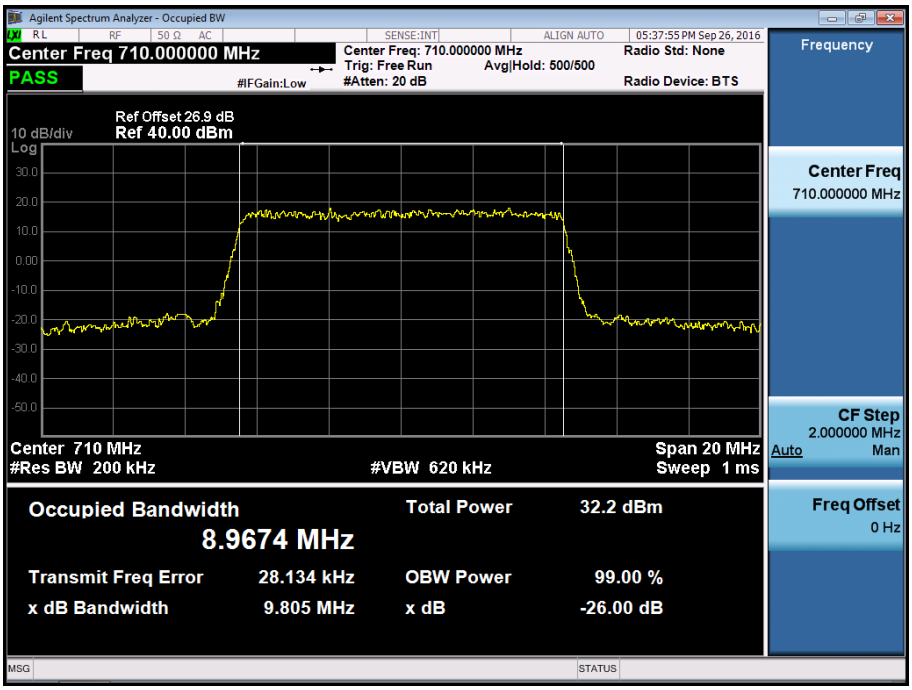
BAND 17. Occupied Bandwidth Plot (5M BW Ch.23790 QPSK RB 25)



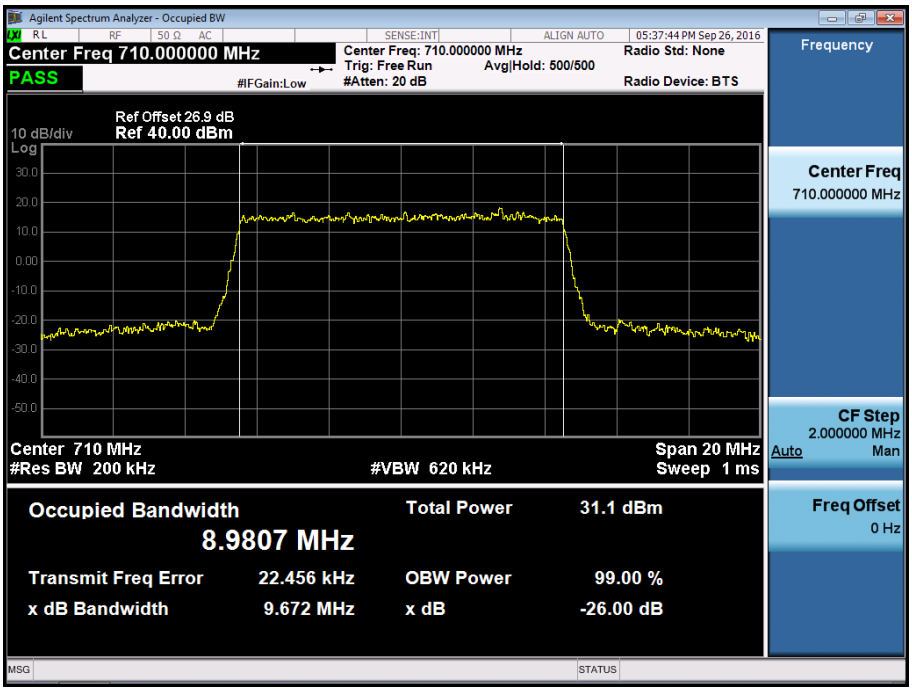
BAND 17. Occupied Bandwidth Plot (5M BW Ch.23790 16QAM RB 25)



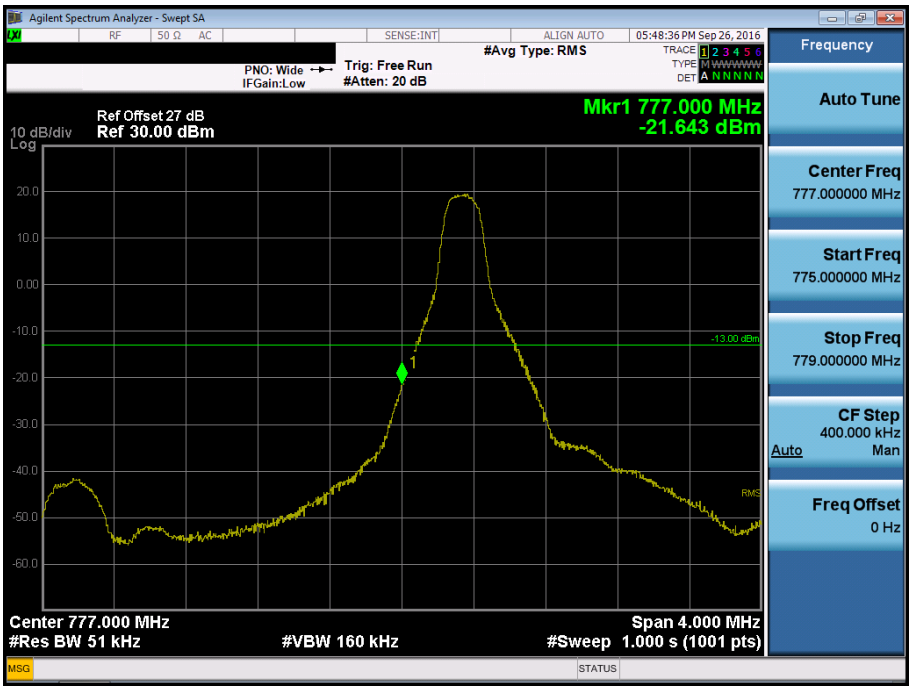
BAND 17. Occupied Bandwidth Plot (10M BW Ch.23790 QPSK RB 50)



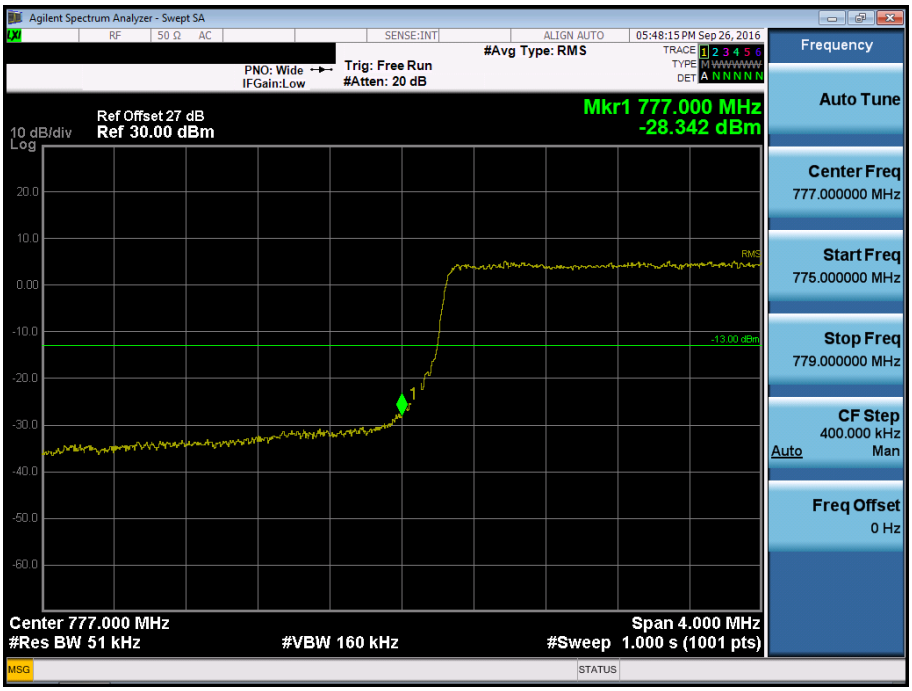
BAND 17. Occupied Bandwidth Plot (10M BW Ch.23790 16QAMRB 50)



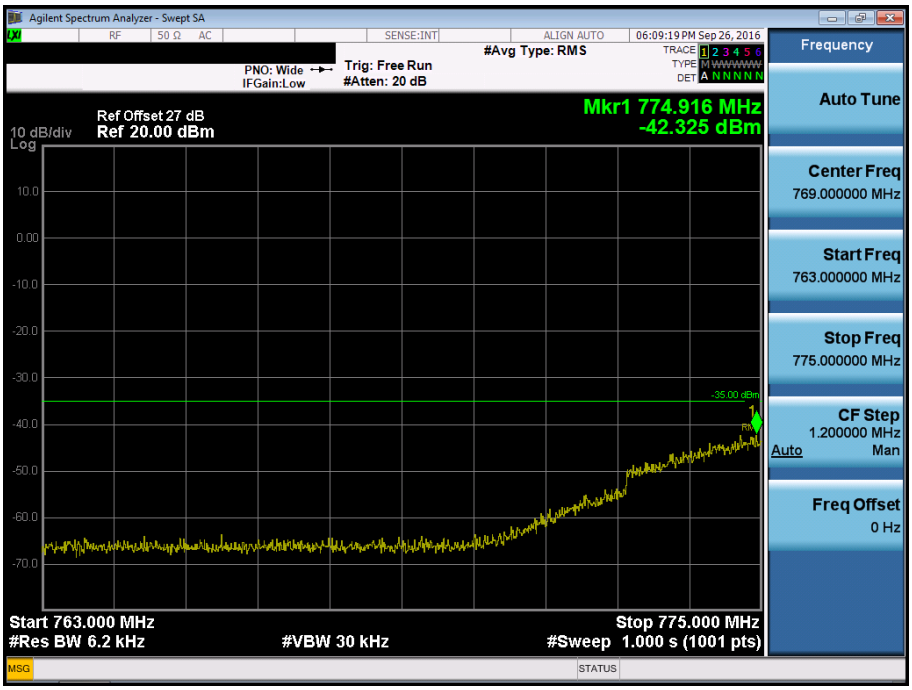
Band 13 Lower Band Edge Plot (5M BW Ch.23205 QPSK_RB1 OFFSET0)



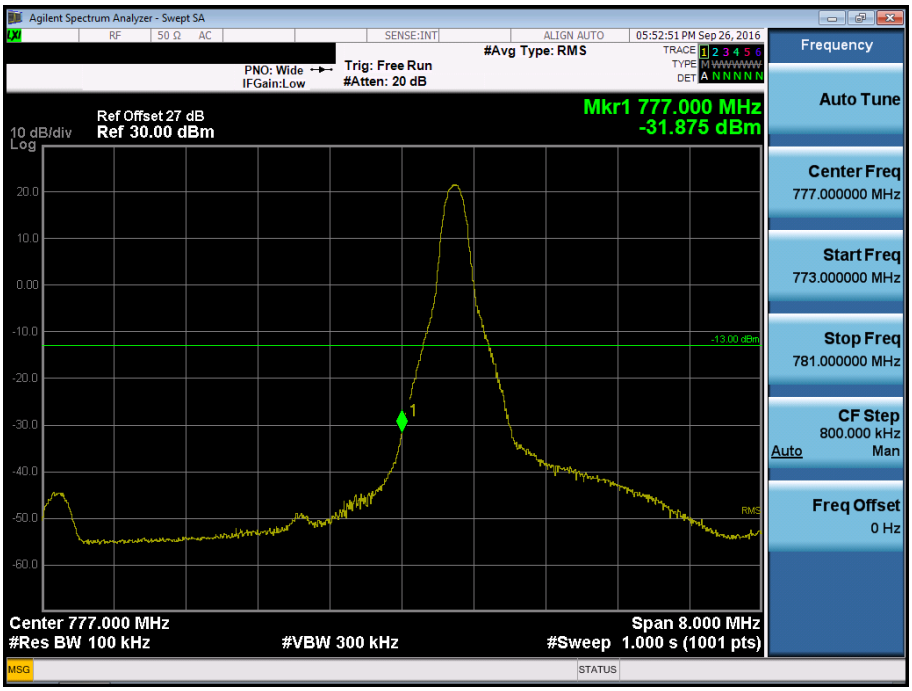
Band 13 Lower Band Edge Plot (5M BW Ch.23205 QPSK_RB25)



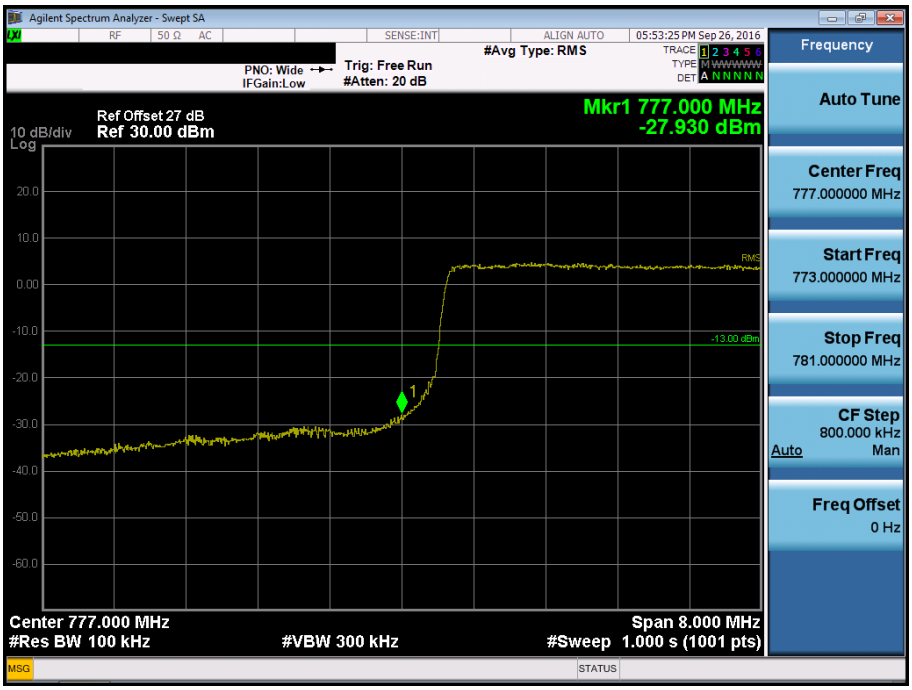
Band 13 Lower Emission Mask (763 MHz ~ 775 MHz) Plot (5M BW Ch.23205 QPSK_RB25_0)



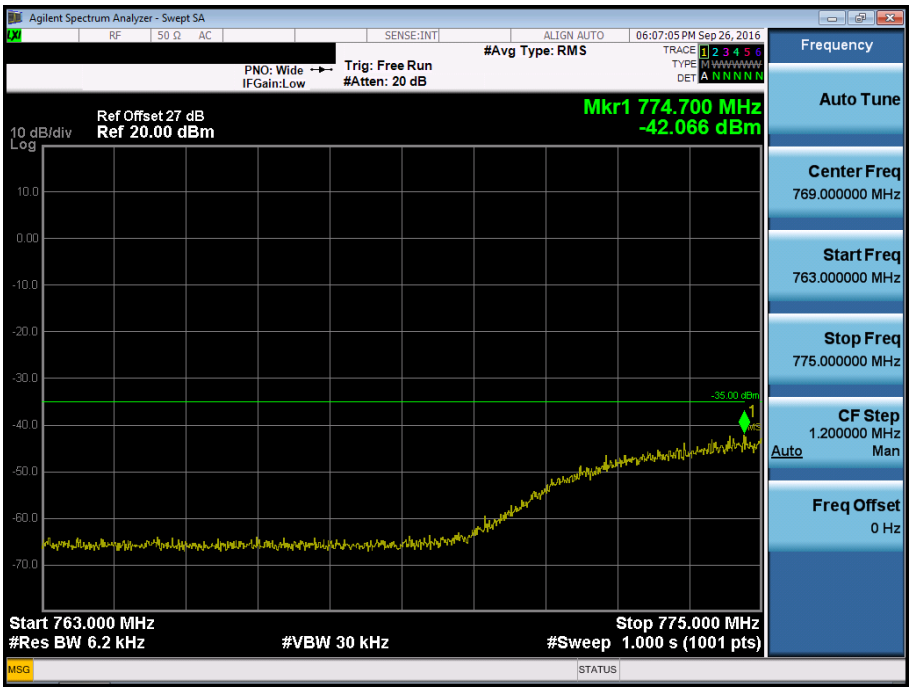
Band 13 Lower Band Edge Plot (10M BW Ch.23230 QPSK_RB1 OFFSET0)



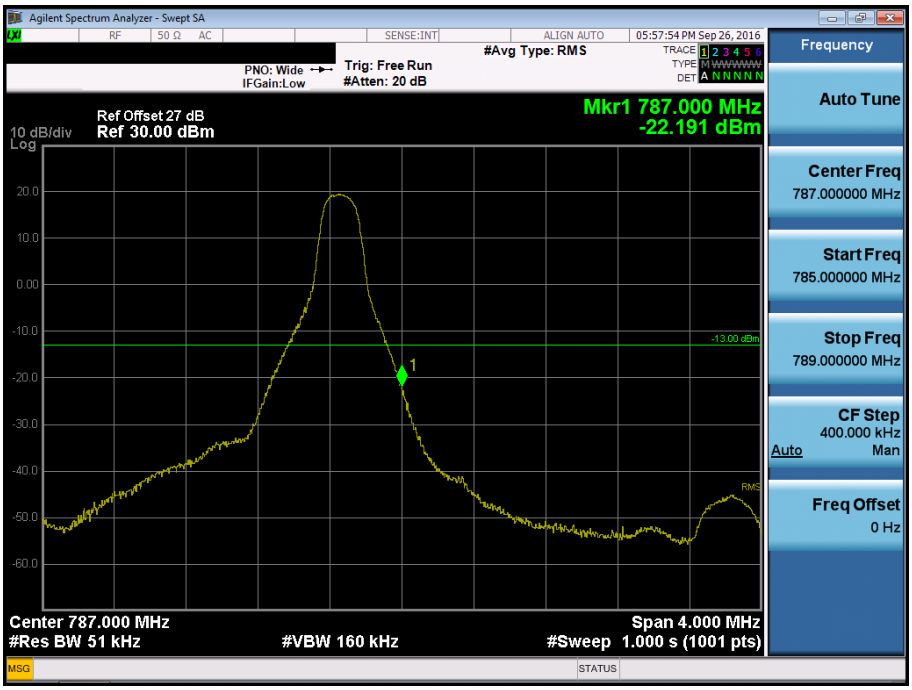
BAND 13. Lower Band Edge Plot (10M BW Ch.23230 QPSK RB 50)



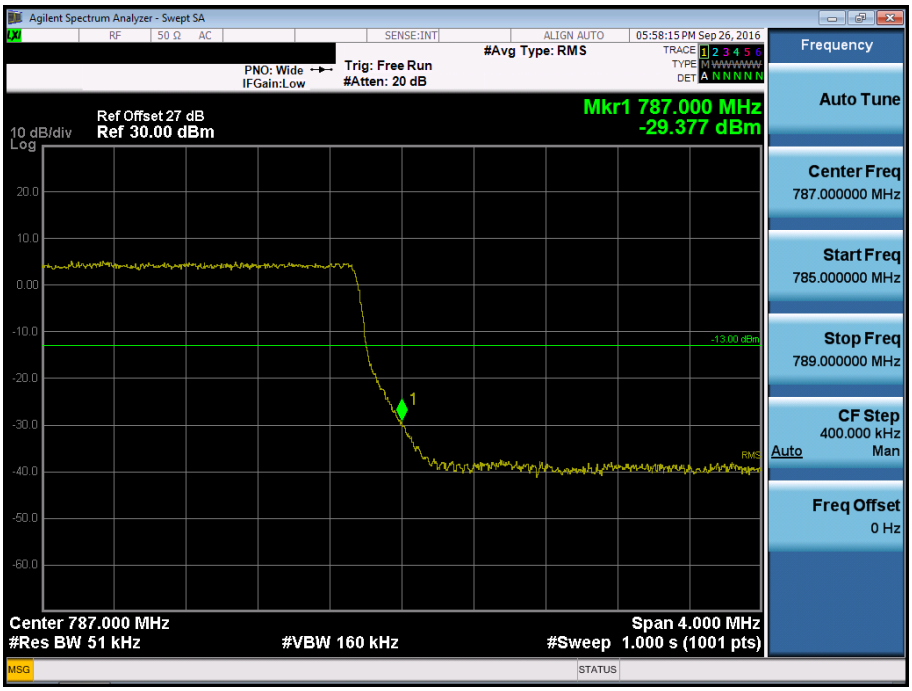
Band 13 Lower Emission Mask (763 MHz ~ 775 MHz) Plot (10M BW Ch.23230 QPSK_RB50_0)



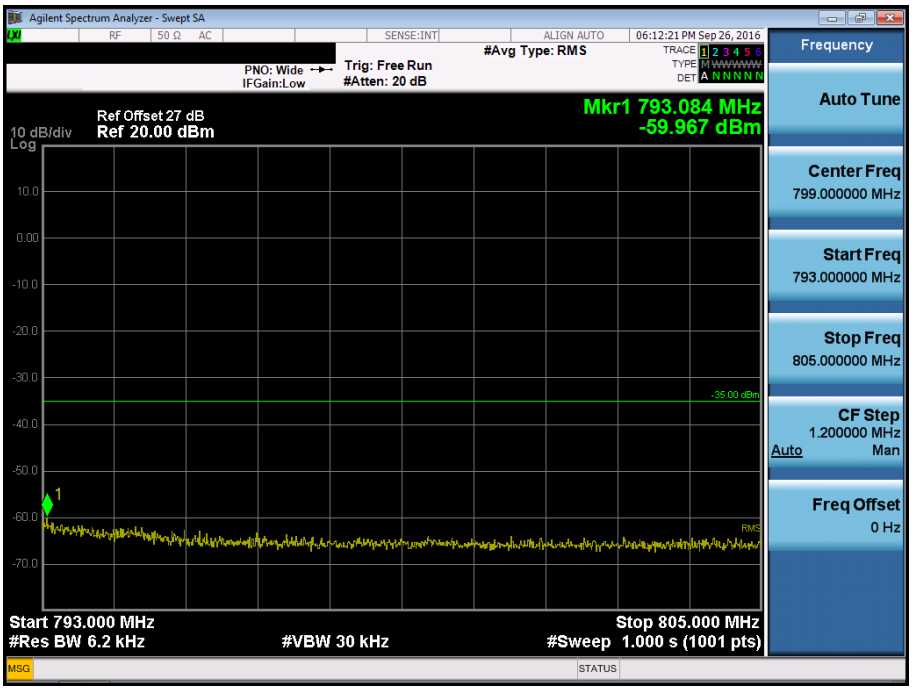
Band 13 Upper Band Edge Plot (5M BW Ch.23255 QPSK_RB1_Offset 24)



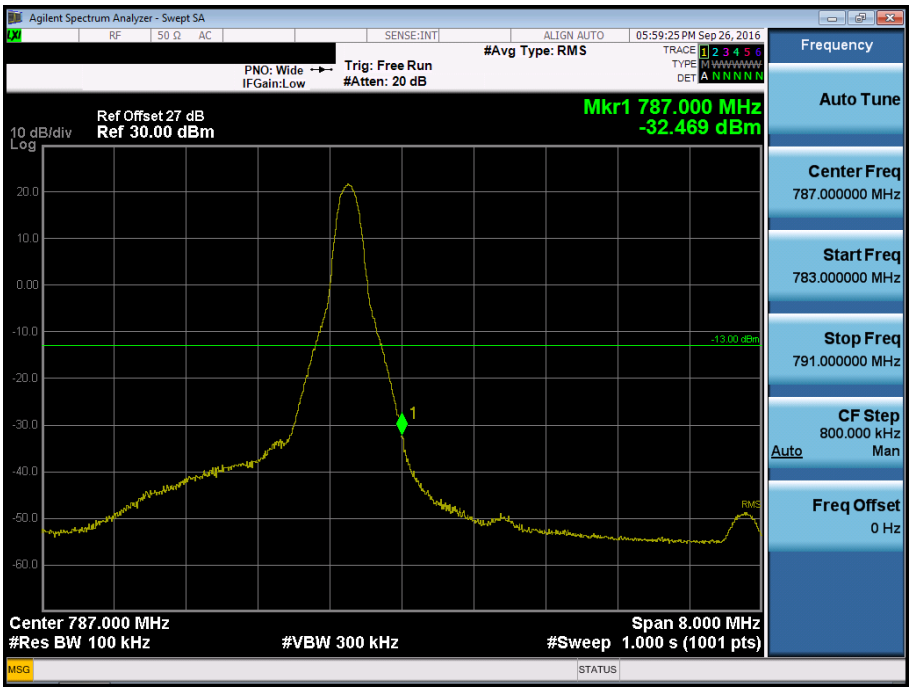
Band 13 Upper Band Edge Plot (5M BW Ch.23255 QPSK_RB25)



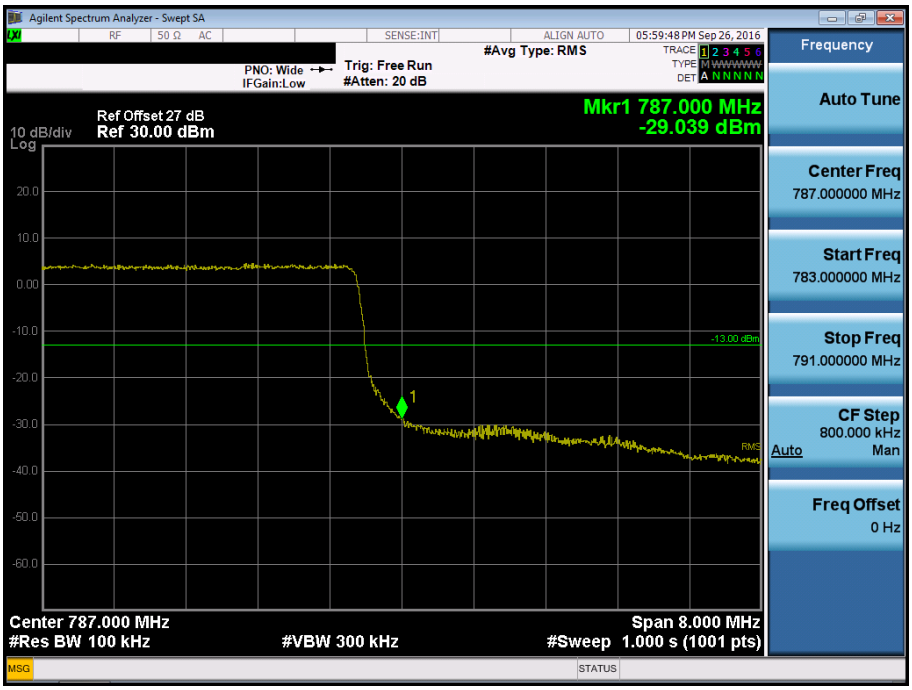
Band 13 Upper Emission Mask (793 MHz ~805 MHz) Plot (5M BW Ch.23255 QPSK_RB25_0)



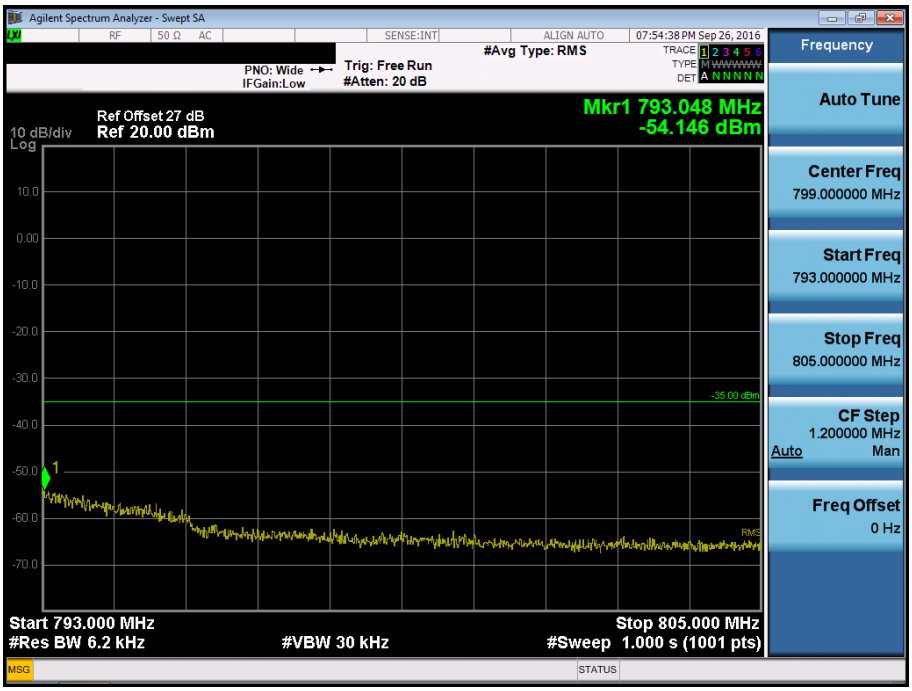
Band 13 Upper Band Edge Plot (10M BW Ch.23230 QPSK_RB1_Offset 24)



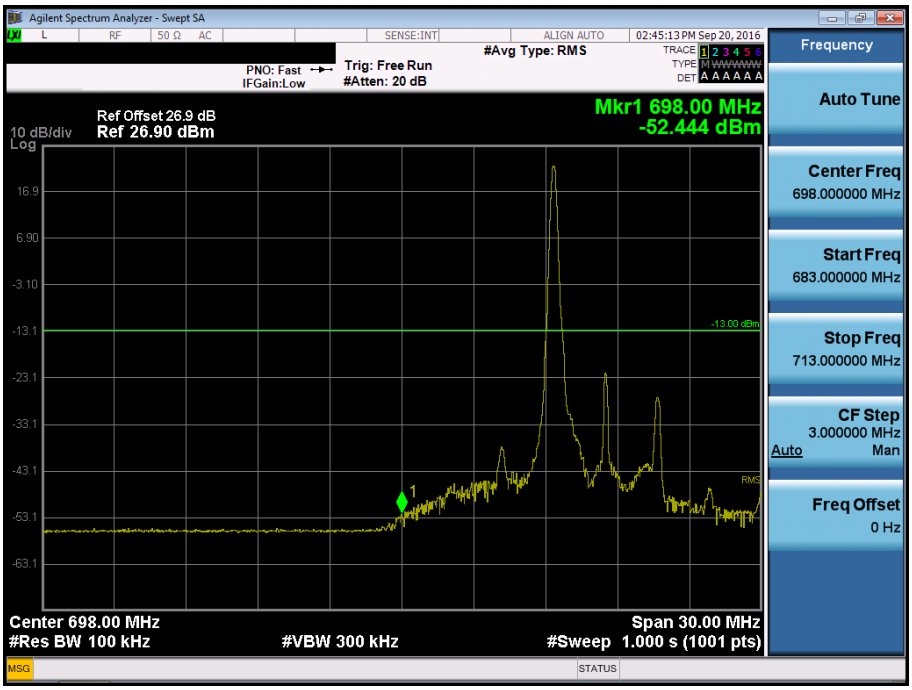
Band 13 Upper Band Edge Plot (10M BW Ch.23230 QPSK_RB50)



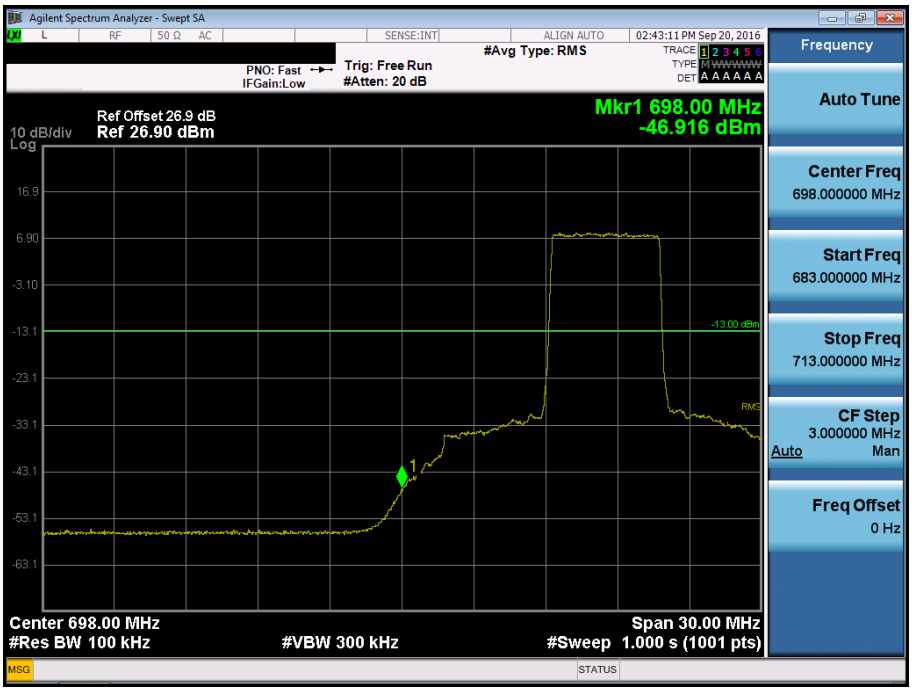
Band 13 Upper Emission Mask (793 MHz ~805 MHz) Plot (10M BW Ch.23230 QPSK_RB50_0)



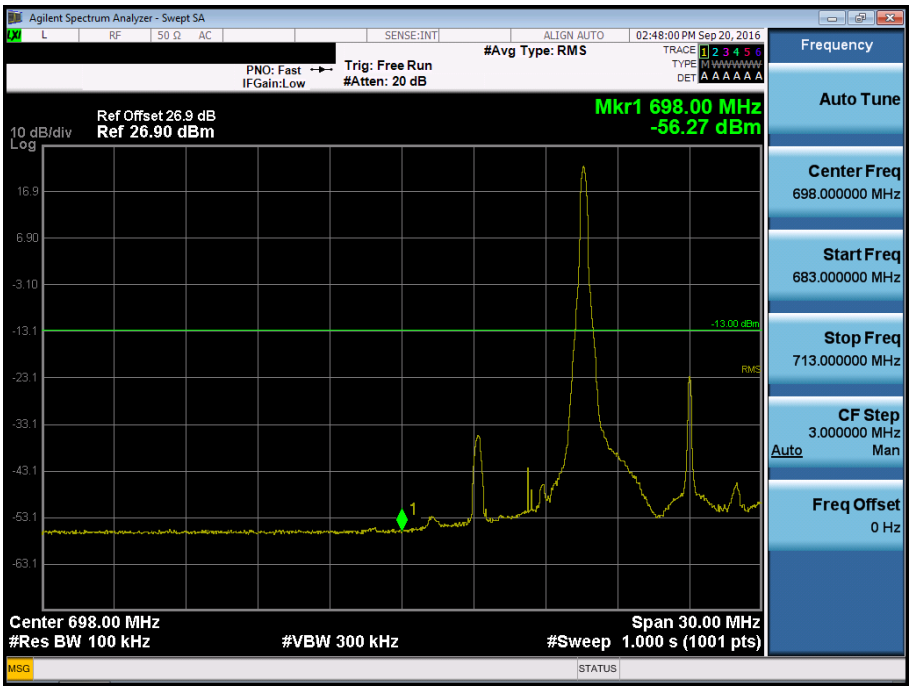
Band 17 Lower Band Edge Plot (5M BW Ch.23755 QPSK_RB1 OFFSET0)



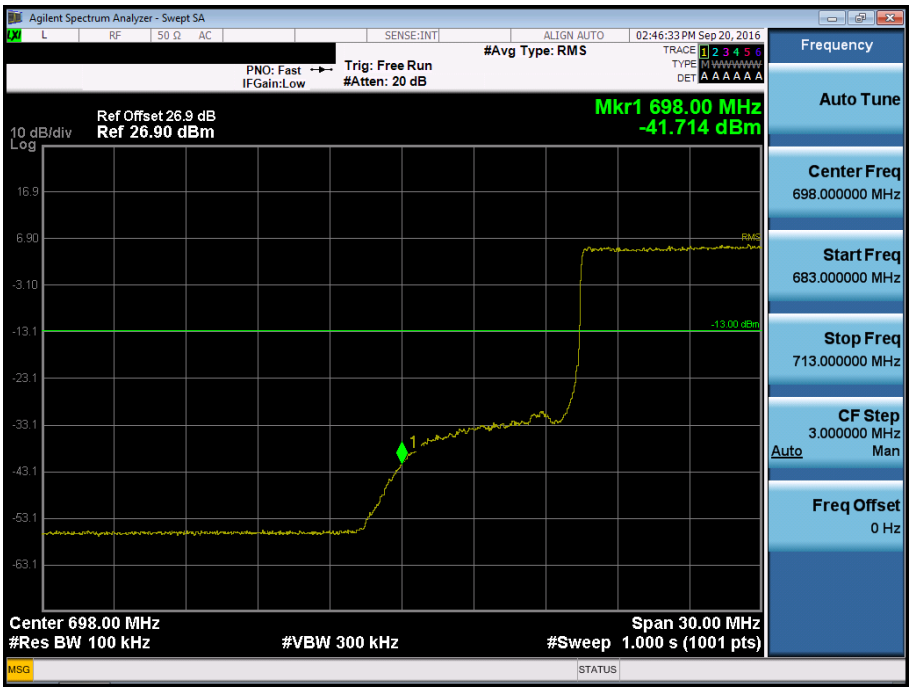
Band 17 Lower Band Edge Plot (5M BW Ch.23755 QPSK_RB25)



Band 17 Lower Band Edge Plot (10M BW Ch.23780 QPSK_RB1 OFFSET0)



Band 17 Lower Band Edge Plot (10M BW Ch.23780 QPSK_RB50_0)

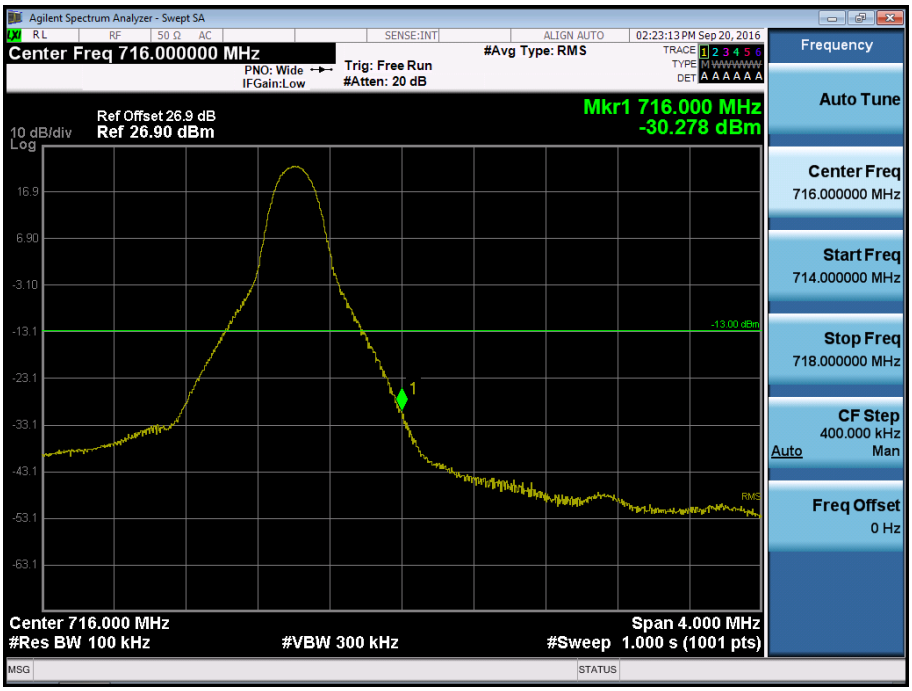


Band 17 Upper Band Edge Plot (5M BW Ch.23825 QPSK_RB1_Offset 24)

Band 17 Upper Band Edge Plot (5M BW Ch.23825 QPSK_RB25)

Band 17 Upper Extended Band Edge Plot (5M BW Ch.23825 QPSK_RB25_0)

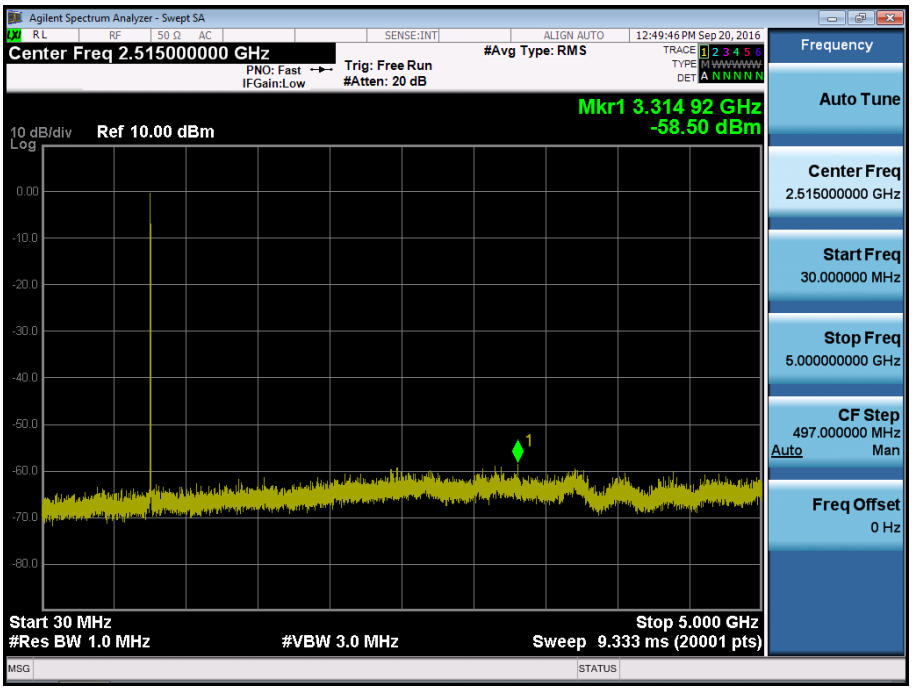
Band 17 Upper Band Edge Plot (10M BW Ch.23800 QPSK_RB1_Offset 49)



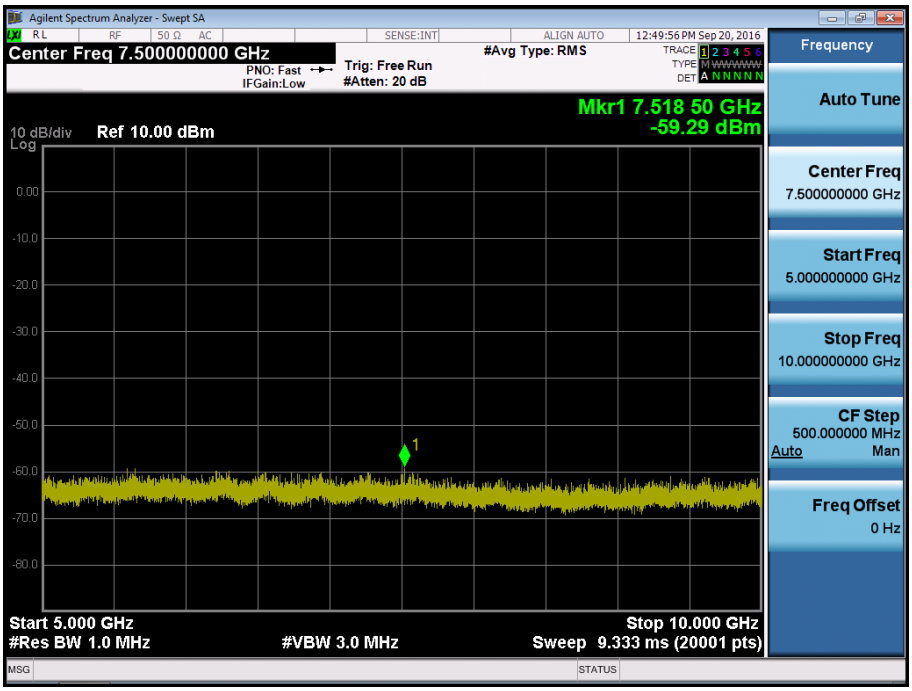
Band 17 Upper Band Edge Plot (10M BW Ch.23800 QPSK_RB50)

Band 17 Upper Extended Band Edge Plot (10M BW Ch.23800 QPSK_RB50_0)

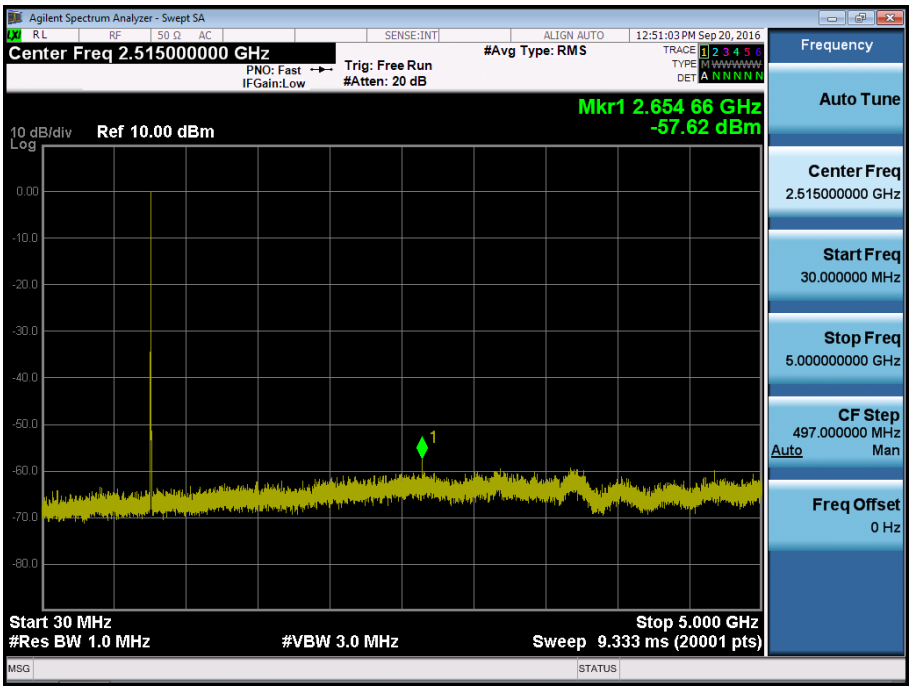
BAND 13. Conducted Spurious Plot_1 (23205ch_5MHz_QPSK_RB 1_0)



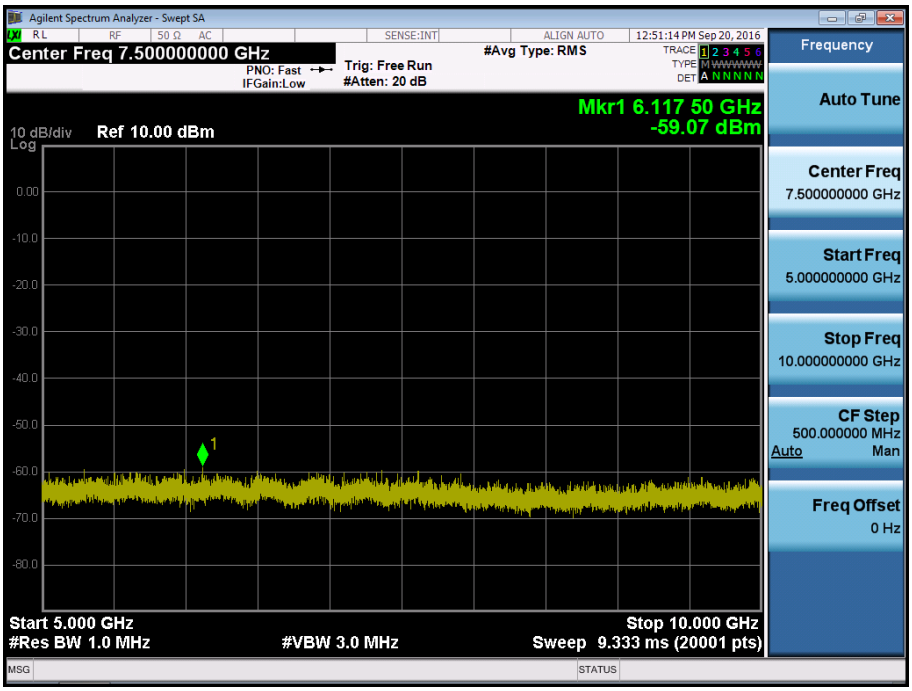
BAND 13. Conducted Spurious Plot_2 (23205ch_5MHz_QPSK_RB 1_0)



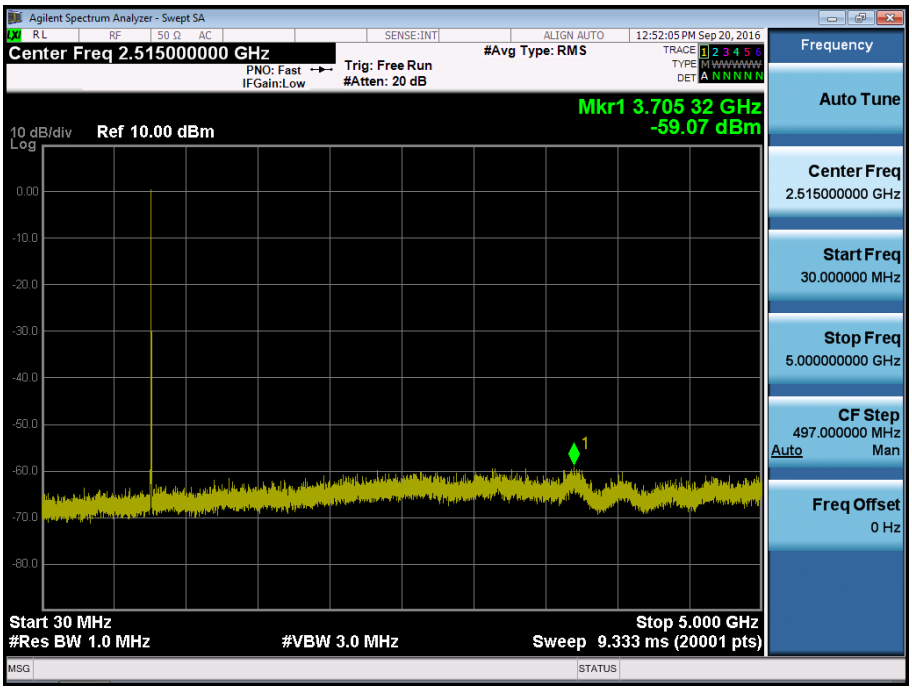
BAND 13. Conducted Spurious Plot_1 (23230ch_5MHz_QPSK_RB 1_0)



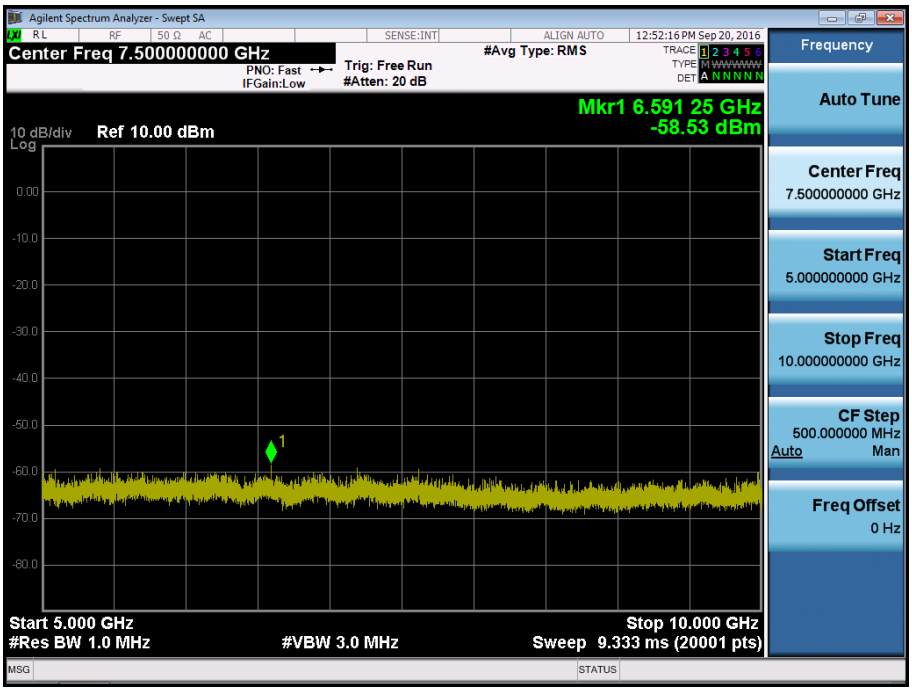
BAND 13. Conducted Spurious Plot_2 (23230ch_5MHz_QPSK_RB 1_0)



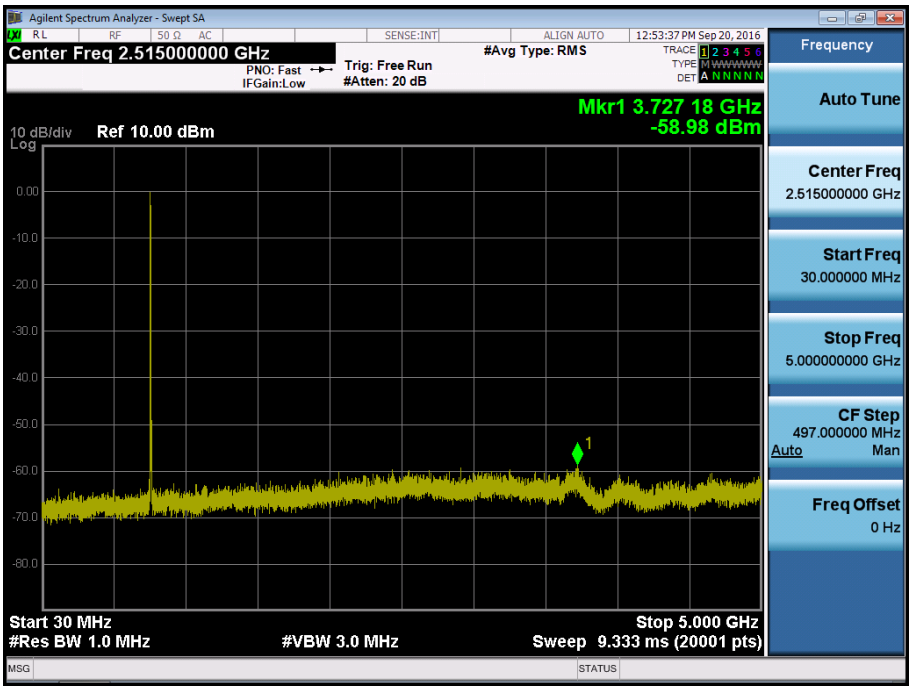
BAND 13. Conducted Spurious Plot_1 (23255ch_5MHz_QPSK_ RB 1_0)



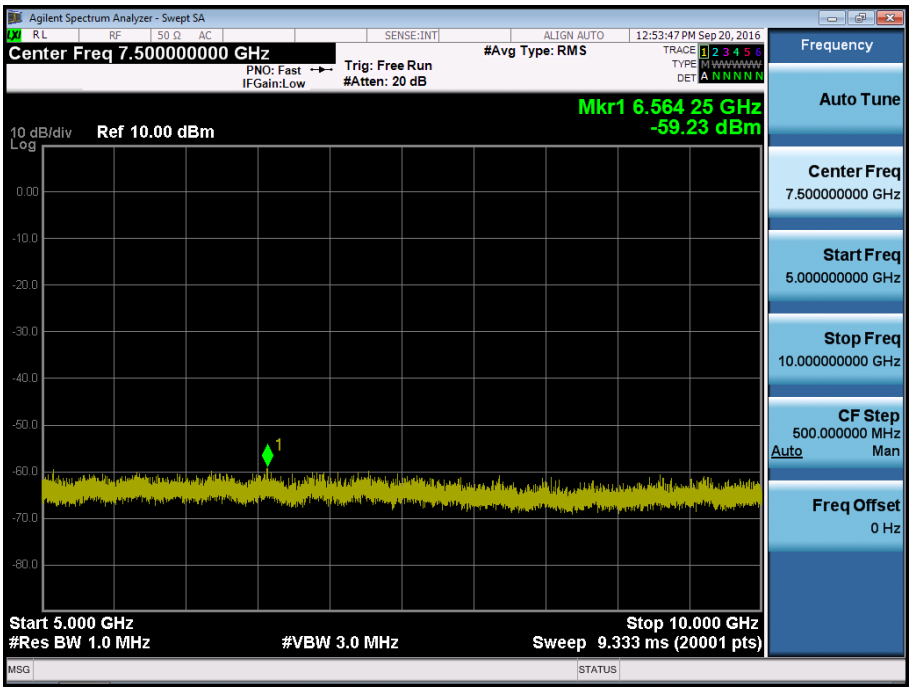
BAND 13. Conducted Spurious Plot_2 (23255ch_5MHz_QPSK_ RB 1_0)



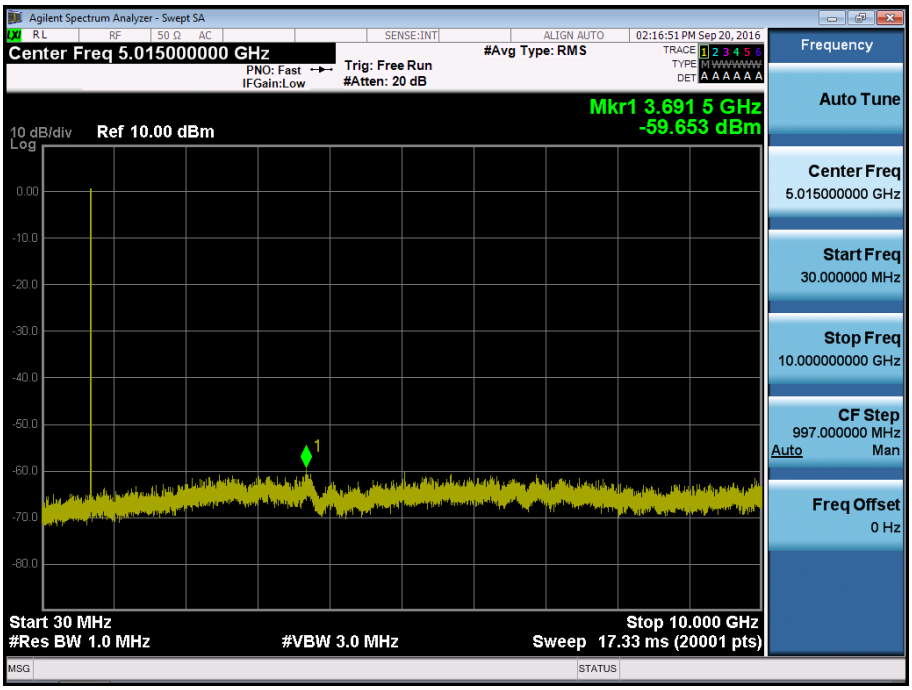
BAND 13. Conducted Spurious Plot 1 (Ch.23230 10 MHz QPSK RB 1, Offset 0)



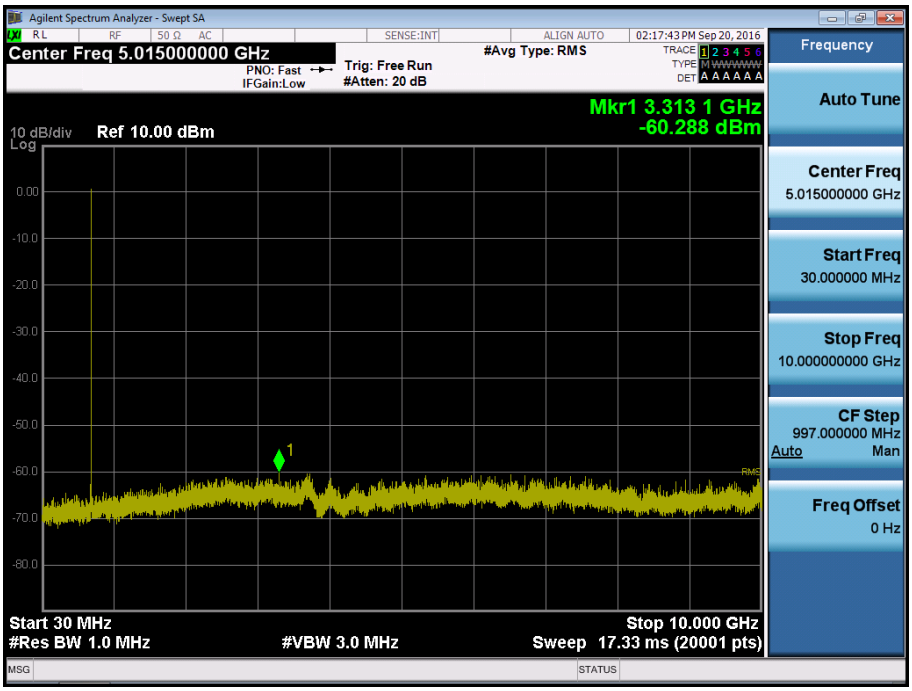
BAND 13. Conducted Spurious Plot 2 (Ch.23230 10 MHz QPSK RB 1, Offset 0)



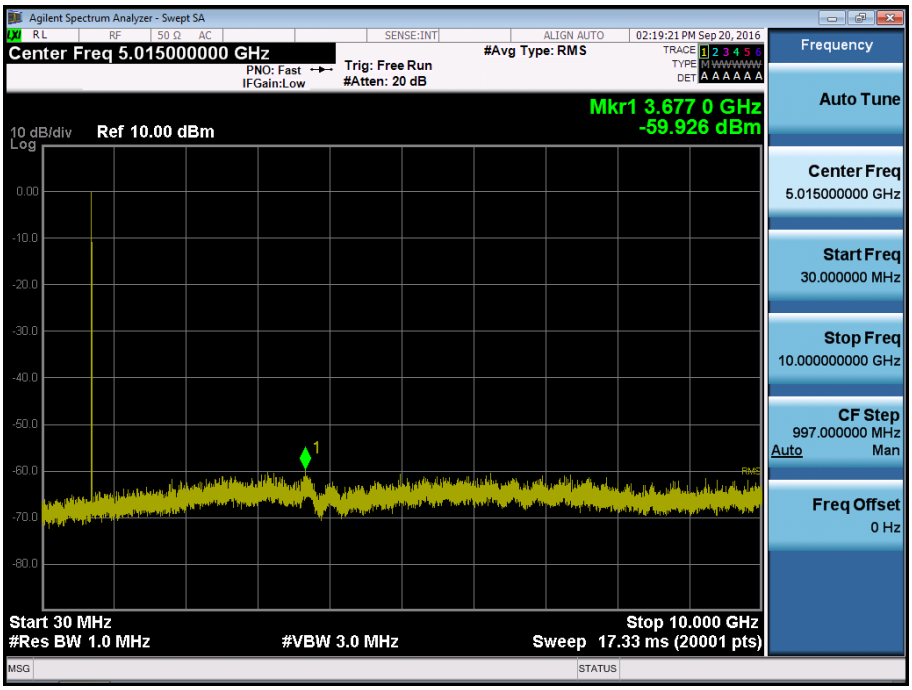
BAND 17. Conducted Spurious Plot_ (23755ch_5MHz_QPSK_RB 1_0)



BAND 17. Conducted Spurious Plot_ (23790ch_5MHz_QPSK_RB 1_0)

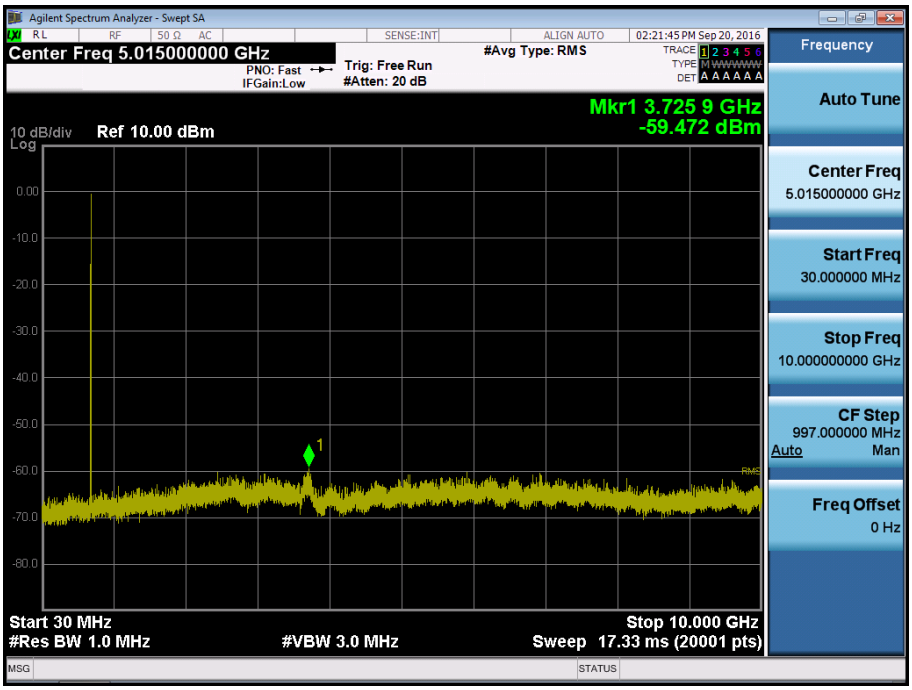


BAND 17. Conducted Spurious Plot_ (23825ch_5MHz_QPSK_ RB 1_0)



BAND 17. Conducted Spurious Plot_ (23780ch_10MHz_QPSK_RB 1_0)

BAND 17. Conducted Spurious Plot_ (23790ch_10MHz_QPSK_RB 1_0)



BAND 17. Conducted Spurious Plot_ (23800ch_10MHz_QPSK_RB 1_0)