ELEMENT WASHINGTON DC LLC
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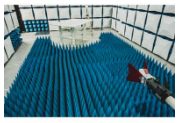

PART 27 MEASUREMENT REPORT

Applicant Name:
Centum Research & Technology S.L
Fonte das Abelleiras S/N
Edificio Citexvi
36310 Vigo (Spain)

Date of Testing:
01/06/2023 – 02/03/2023
Test Report Issue Date:
02/23/2023
Test Site/Location:
Element Lab., Columbia, MD, USA
Test Report Serial No.:
1M2212270143-03.2A93U

FCC ID:	**2A93U-55041-402**
APPLICANT:	**Centum Research & Technology S.L**

Application Type:	Certification
Model:	Lifeseeker Mini S10
EUT Type:	Geolocation System
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	27
Test Procedure(s):	ANSI C63.26-2015

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

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MEASUREMENT REPORT
FCC Part 27

Mode	Bandwidth	Tx Frequency Range [MHz]	Conducted Power		Emission Designator
			Max. Power [W]	Max. Power [dBm]	
LTE Band 66	5 MHz	2112.5 - 2177.5	0.176	22.46	4M90G7D
LTE Band 12	5 MHz	731.5 - 743.5	0.181	22.57	4M99G7D
LTE Band 13	5 MHz	748.5 - 753.5	0.143	21.56	4M94G7D

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Test Location

These measurement tests were conducted at the Element Laboratory located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element Lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

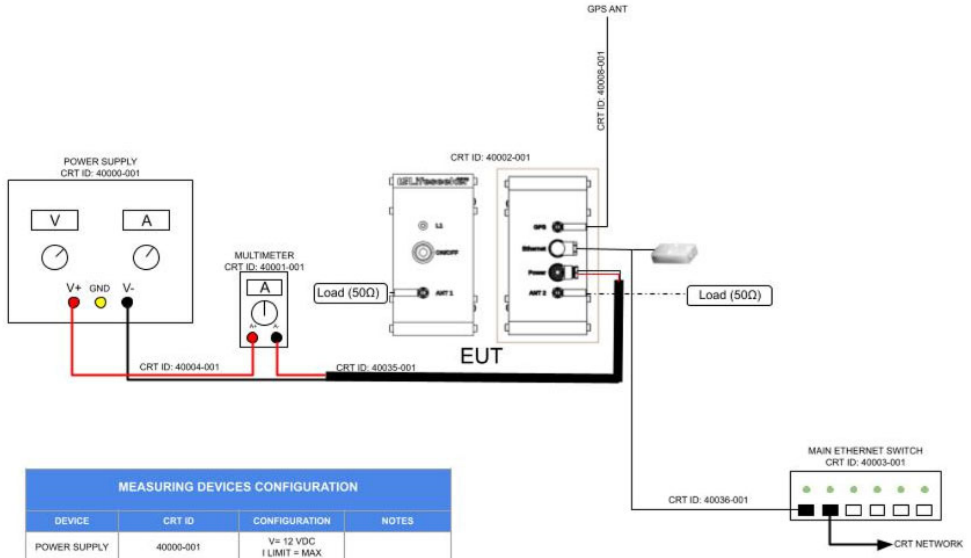
2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Centum Geolocation System FCC ID: 2A93U-55041-402**. The test data contained in this report pertains only to the emissions due to the EUT's LTE Band 66,12 and 13 operation under the provisions of Part 27. The EUT generates LTE signal. The EUT can transmit two different LTE band signals at the same time with its multiple antenna port. EUT was set up to operate as shown below with a 12 VDC power source with current limitation of 10A. Server equipment was used to control the RF functions of the EUT.

The EUT supports two output antennas and is capable of transmitting simultaneously on both antennas though not on the same band.

Test Device Serial No.: 213025



MEASURING DEVICES CONFIGURATION			
DEVICE	CRT ID	CONFIGURATION	NOTES
POWER SUPPLY	40000-001	V= 12 VDC I LIMIT = MAX	
NETWORK ANALYZER	40014-001	See Test Procedure	

2.2 Device Capabilities

This device contains the following capabilities:

LTE Bands 2, 12, 13, 26, and 66 (with 5MHz operation only)

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.
Per ANSI C63.26 Section 5.2.5.3, full testing was performed on a single port due to the fact that both antenna ports are driven by identical hardware and output power settings.

2.4 Software and Firmware

The test was conducted with software/firmware version 3.7.11 v2.8.4 installed on the EUT

2.5 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..……None

3.2 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements, the field strength conversion method is used per the formulas in Section 5.2.7 of ANSI C63.26-2015. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$ where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015.

4.0 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 uncertainty shown below 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.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	ETS	EMC Cable and Switch System	8/11/2022	Annual	8/11/2023	ETS
-	WL25-3	Licensed Transmitter Cable Set	8/15/2022	Annual	8/15/2023	WL25-3
Emco	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9704-5182
Espec	ESX-2CA	Environmental Chamber	5/25/2022	Biennial	5/25/2024	17620
Keysight Technologies	N9020A	MXA Signal Analyzer	3/15/2022	Annual	3/15/2023	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	8/18/2022	Annual	8/18/2023	MY54490576
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	8/25/2022	Annual	8/25/2023	100348

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of “N/A” shown in this list was not used to make direct calibrated measurements.

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 8M45W7D

LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (1564 MHz)

The average spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80).

7.0 TEST RESULTS

7.1 Summary

Company Name: Centum

FCC ID: 2A93U-55041-402

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power	2.1046, 27.50(c)(3)	N/A	PASS	Section 7.2
	Effective Radiated Power (Band 12)	27.50(b)(9)	≤ 30 Watts max. ERP	PASS	Section 7.2
	Effective Radiated Power (Band 13)	27.50(c)(9)	≤ 30 Watts max. ERP	PASS	Section 7.2
	Equivalent Isotropic Radiated Power (Band 66)	27.50(d)(4)	≤ 1 Watts max. EIRP	PASS	Section 7.2
	Occupied Bandwidth	2.1049	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions	2.1051, 27.53(c)(1), 27.53(c)(4), 27.53(g), 27.53(h)(1)	≥ 43 + 10 log (P[Watts]) dB at Band Edge and for all out-of-band emissions	PASS	Sections 7.4, 7.5
	Conducted Band Edge / Spurious Emissions (LTE Band 13)	2.1051, 27.53(c)(4)	≥ 65 + 10 log (P[Watts]) dB for operations between 763-775 MHz and 793-805 MHz in a 6.25kHz band segment	PASS	Sections 7.4, 7.5
	Peak-to-Average Ratio	27.50(d)(5)	≤ 13 dB	PASS	Section 7.6
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block	PASS	Section 7.8
RADIATED	Radiated Spurious Emissions	2.1053, 27.53 (c)(1), 27.53(g), 27.53(h)(1)	≥ 43 + 10 log (P[Watts]) dB at Band Edge and for all out-of-band emissions	PASS	Section 7.7
	Radiated Spurious Emissions (LTE Band 13)	2.1053, 27.53(f)	≤-40dBm/MHz	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in Section 7.0 were taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is "Chamber Automation," Version 1.3.1.

7.2 Conducted Output Power Data / Effective Radiated Power/ Equivalent Isotropic Radiated Power

Test Overview

All emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 - Section 5.2.4.4.1

Test Settings

1. Power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. Span = 2 - 3 times the OBW
3. RBW = 1 – 5% of the expected OBW
4. VBW ≥ 3 x RBW
5. No. of sweep points > 2 x span / RBW
6. Sweep time = auto-couple
7. Detector = RMS
8. Trigger is set to "free run" for signals with continuous operation.
9. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
10. Trace mode = trace averaging (RMS) over 100 sweeps
11. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

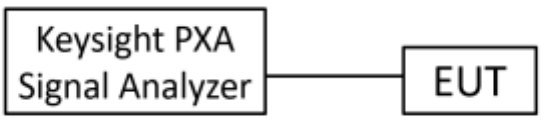


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

The applicant has declared the usage of a 2.8dBi antenna for frequencies around 2170MHz and 0.62dBi antenna for frequencies around 700MHz with this system and hence the ERP is calculated accordingly.

Bandwidth	Channel	Frequency [MHz]	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
5 MHz	66461	2112.5	22.34	2.8	25.14	0.327	30.00	-4.86
	66886	2155.0	22.46	2.8	25.26	0.336	30.00	-4.74
	67111	2177.5	22.43	2.8	25.23	0.333	30.00	-4.77

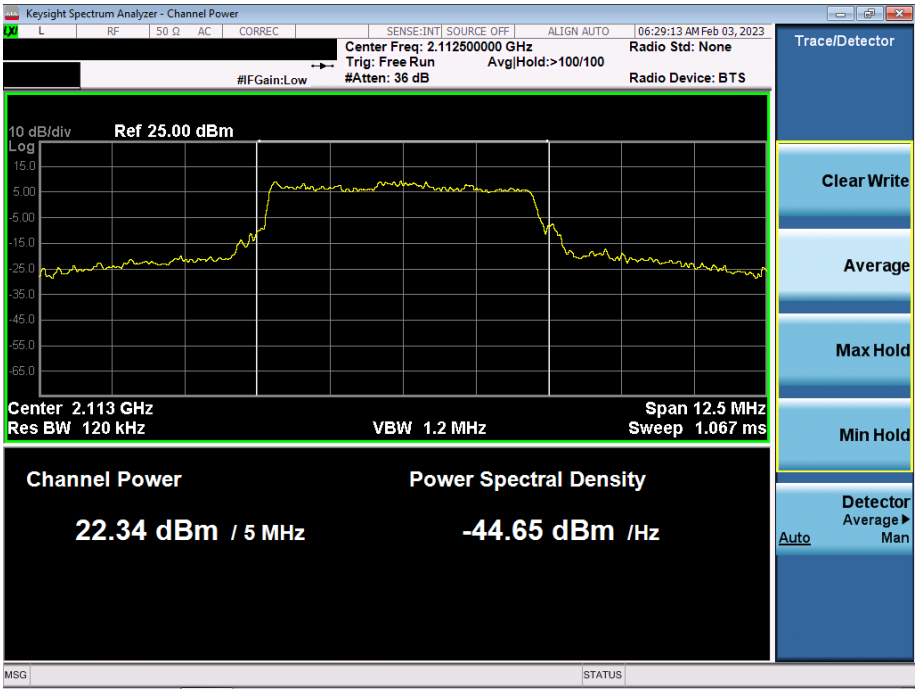
Table 7-3. Transmitter Conducted Output Power (LTE Band 66)

Bandwidth	Channel	Frequency [MHz]	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
5 MHz	5035	731.5	22.41	0.62	23.03	0.201	20.88	0.122	44.77	-23.89
	5095	737.5	22.43	0.62	23.05	0.202	20.90	0.123	44.77	-23.87
	5155	743.5	22.57	0.62	23.19	0.208	21.04	0.127	44.77	-23.73

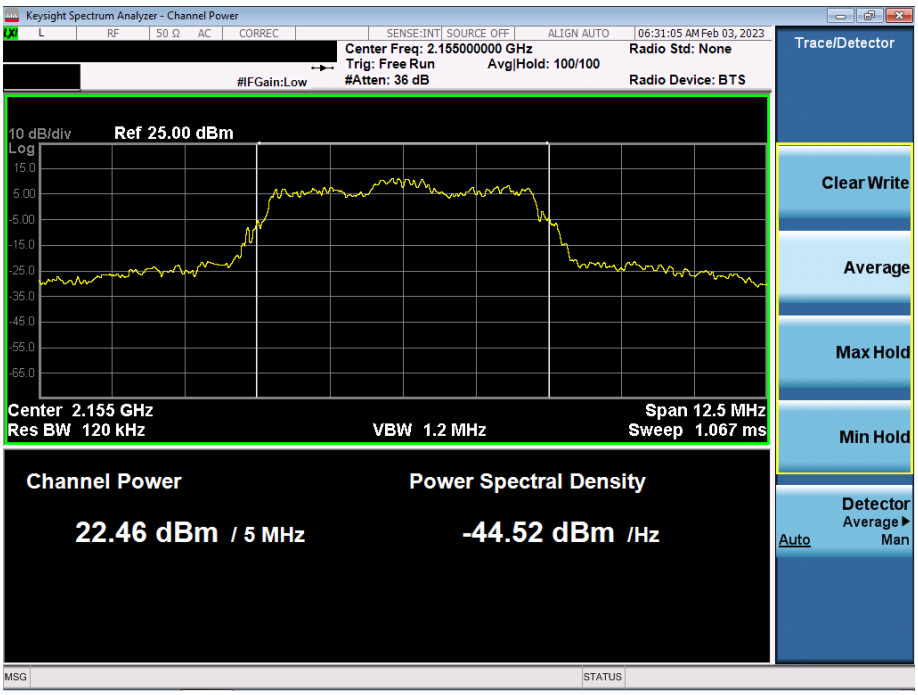
Table 7-4. Transmitter Conducted Output Power (LTE Band 12)

Bandwidth	Channel	Frequency [MHz]	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
5 MHz	5205	748.5	21.39	0.62	22.01	0.159	19.86	0.097	44.77	-24.91
	5230	751.0	21.28	0.62	21.90	0.155	19.75	0.094	44.77	-25.02
	5255	753.5	21.56	0.62	22.18	0.165	20.03	0.101	44.77	-24.74

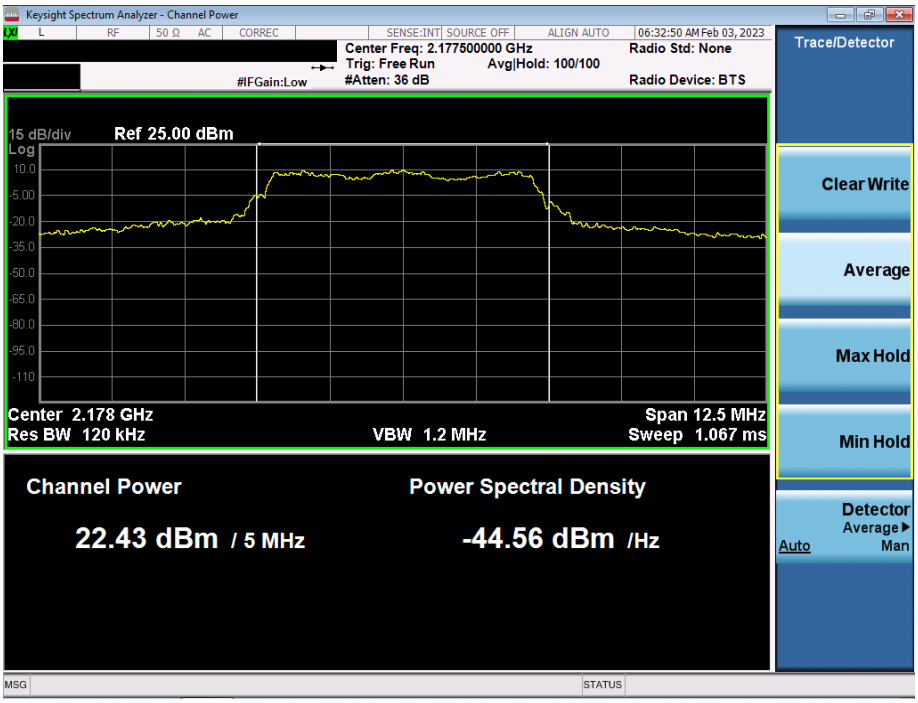
Table 7-5. Transmitter Conducted Output Power (LTE Band 13)



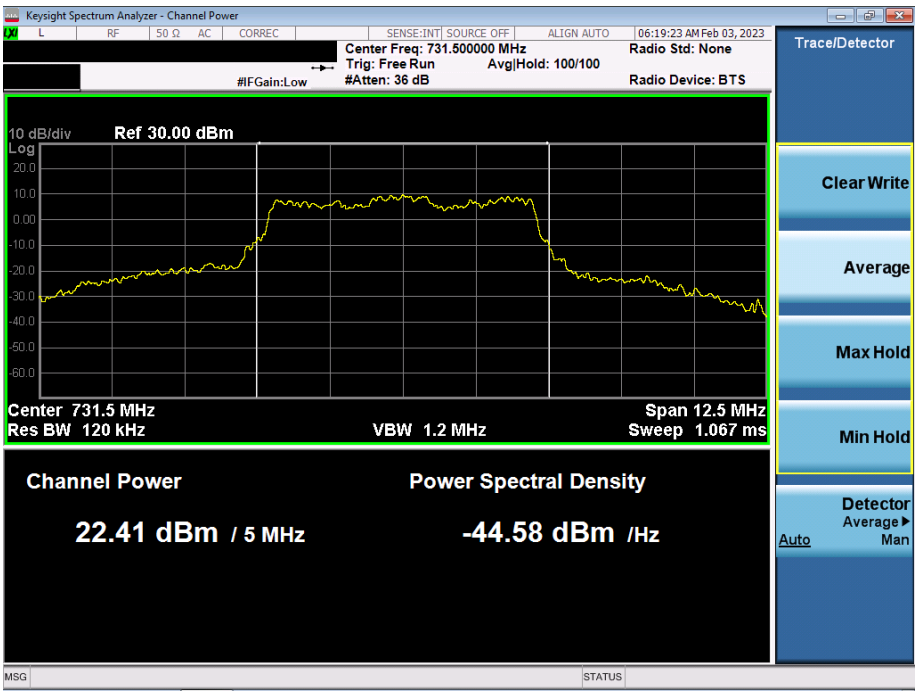
Plot 7-1. Transmitter Conducted Output Power Plot (LTE Band 66 - 5MHz QPSK - Full RB- Low)



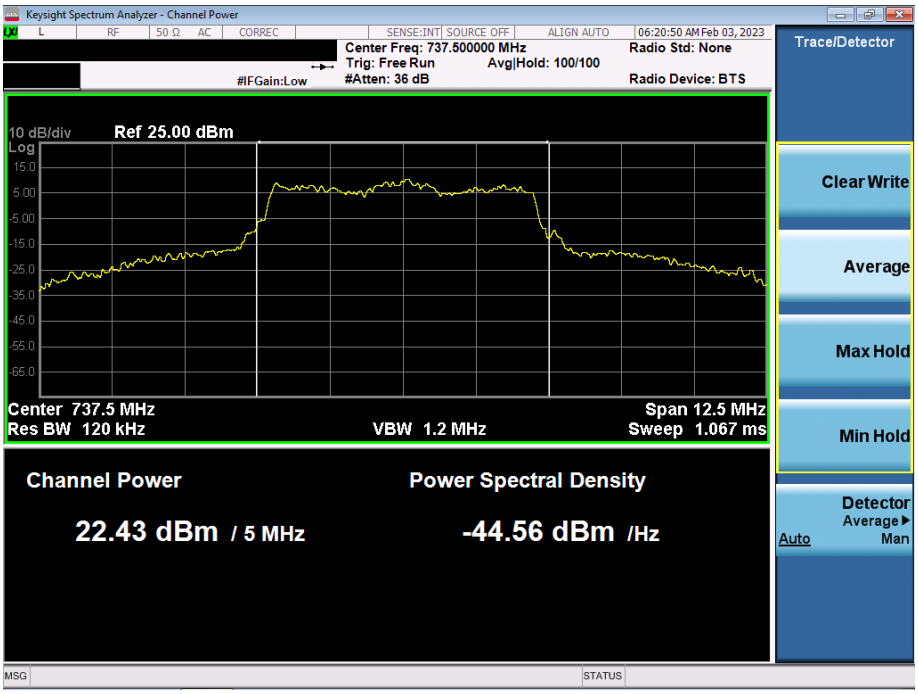
Plot 7-2. Transmitter Conducted Output Power Plot (LTE Band 66 - 5MHz QPSK - Full RB- Mid)



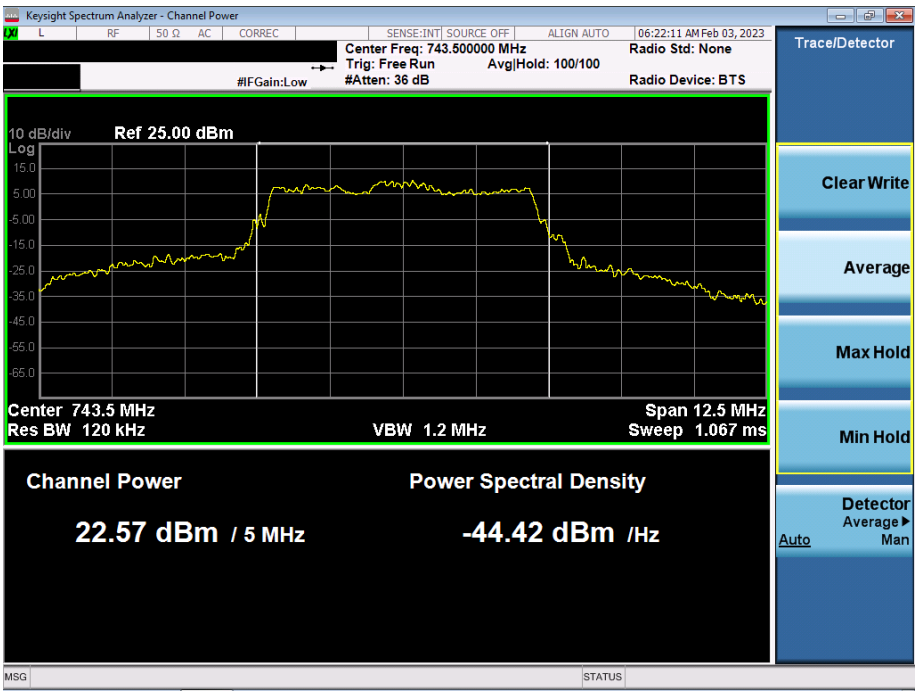
Plot 7-3. Transmitter Conducted Output Power Plot (LTE Band 66 - 5MHz QPSK - Full RB- High)



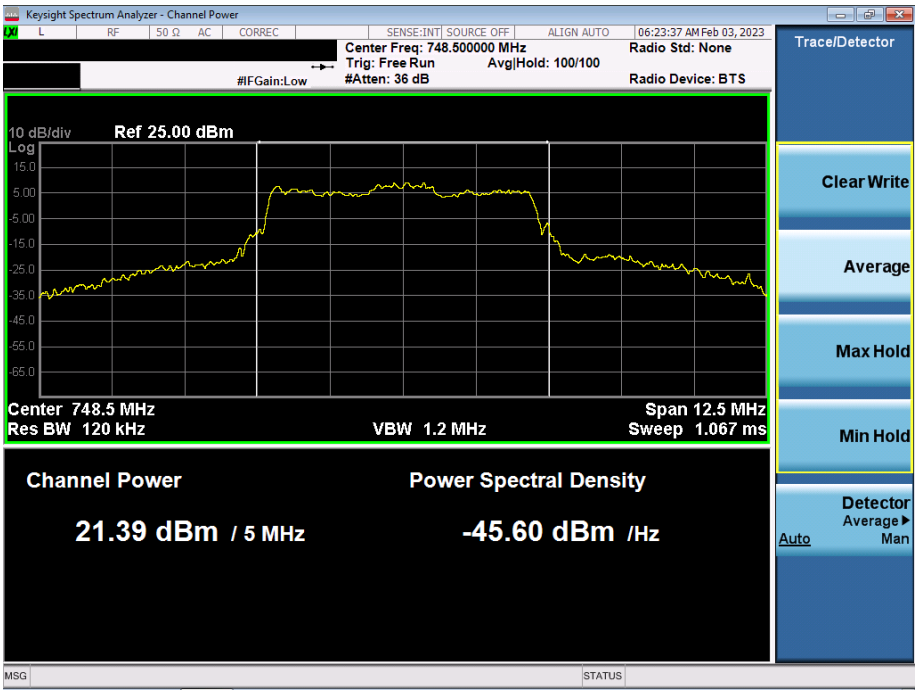
Plot 7-4. Transmitter Conducted Output Power Plot (LTE Band 12 - 5MHz QPSK - Full RB- Low)



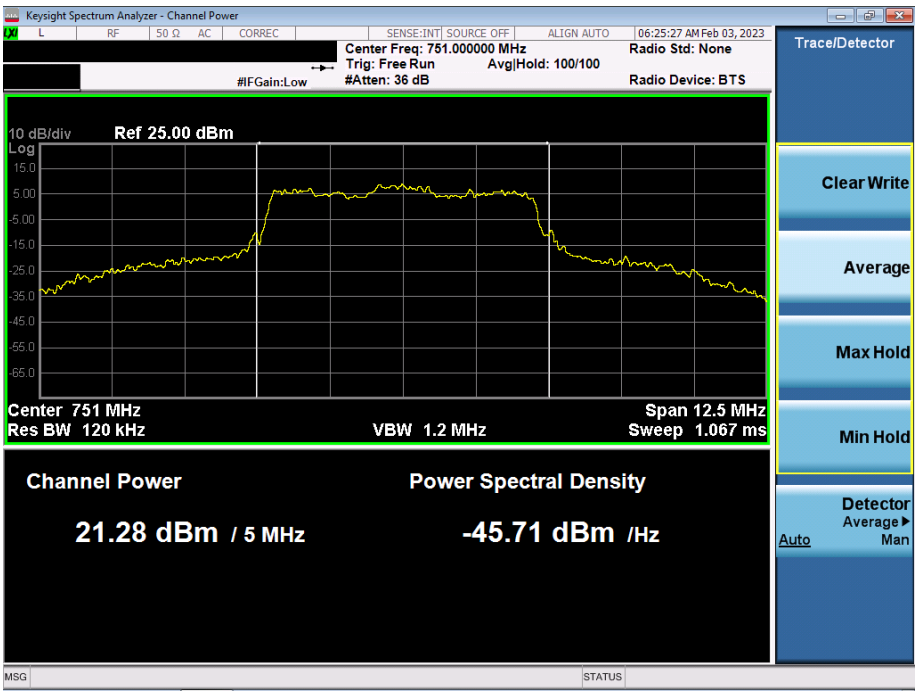
Plot 7-5. Transmitter Conducted Output Power Plot (LTE Band 12 - 5MHz QPSK - Full RB- Mid)



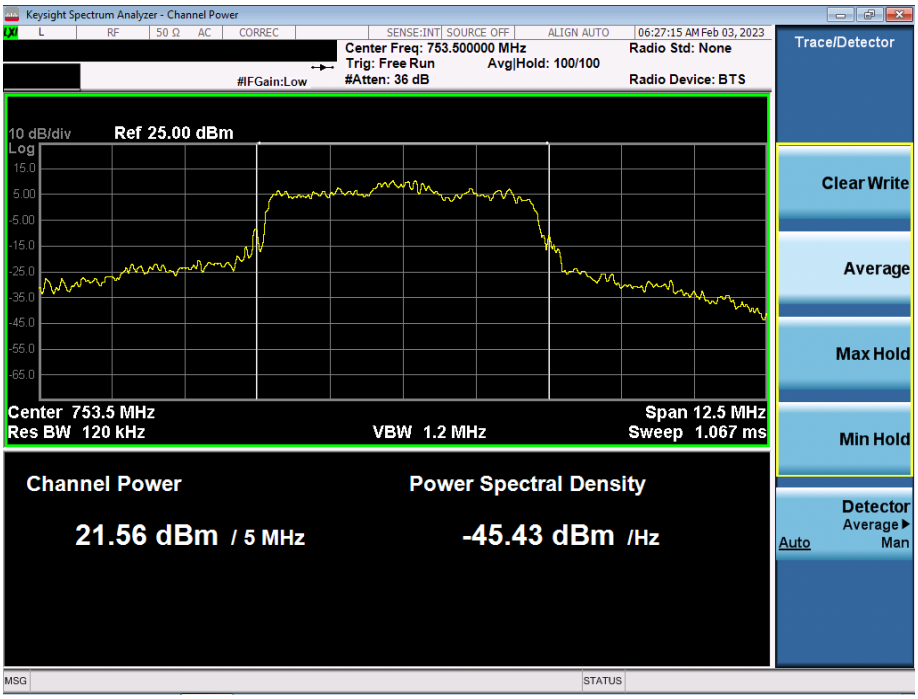
Plot 7-6. Transmitter Conducted Output Power Plot (LTE Band 12 - 5MHz QPSK - Full RB- High)



Plot 7-7. Transmitter Conducted Output Power Plot (LTE Band 13 - 5MHz QPSK - Full RB- Low)



Plot 7-8. Transmitter Conducted Output Power Plot (LTE Band 13 - 5MHz QPSK - Full RB- Mid)



Plot 7-9. Transmitter Conducted Output Power Plot (LTE Band 13 - 5MHz QPSK - Full RB- High)

7.3 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

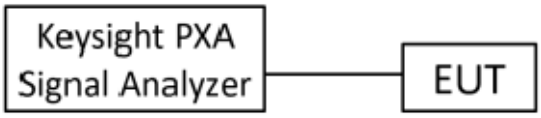
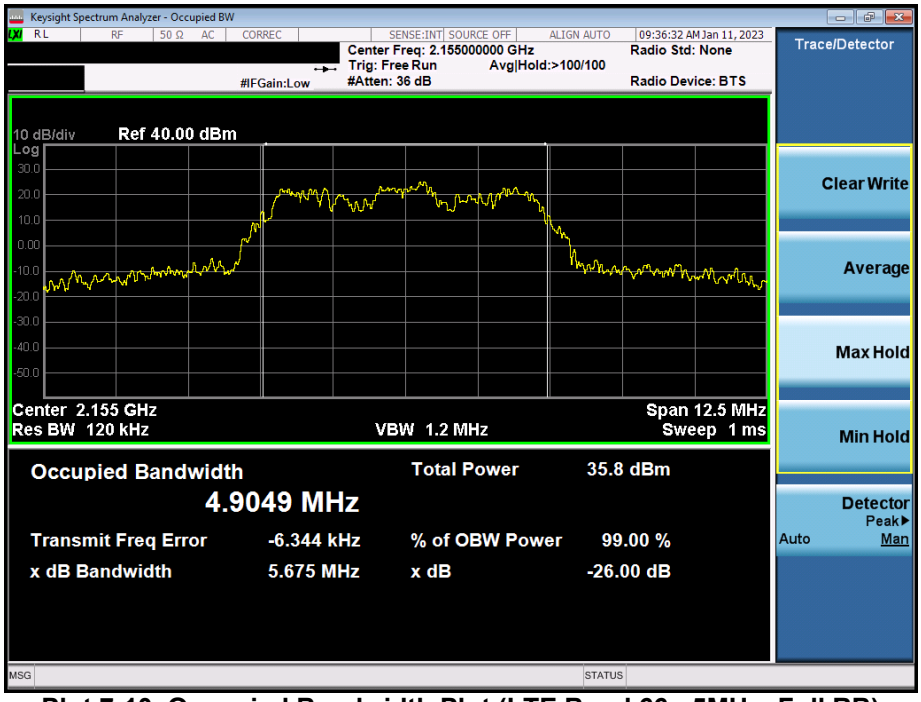


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

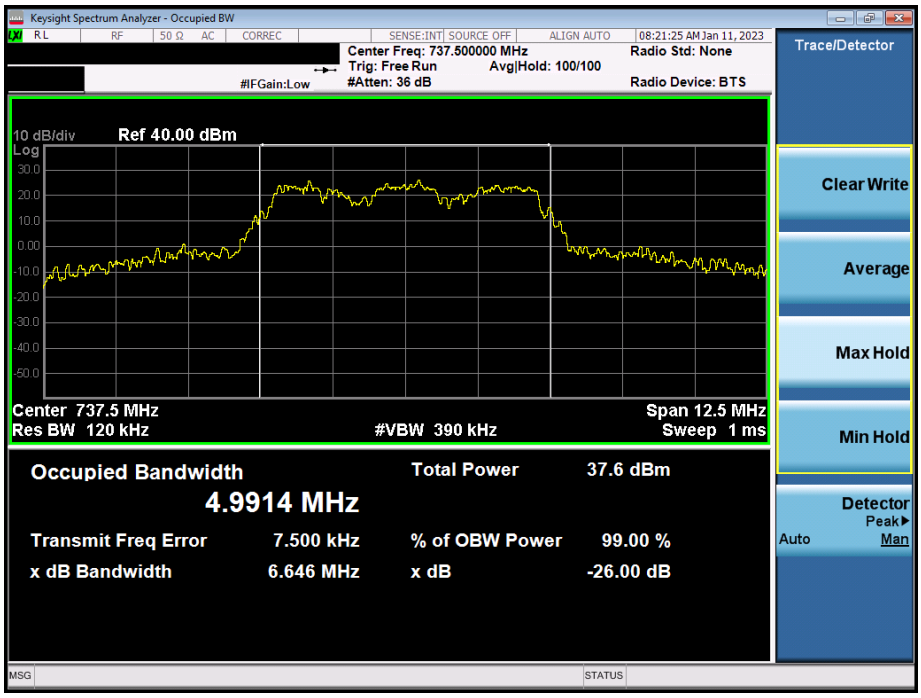
None.

LTE Band 66



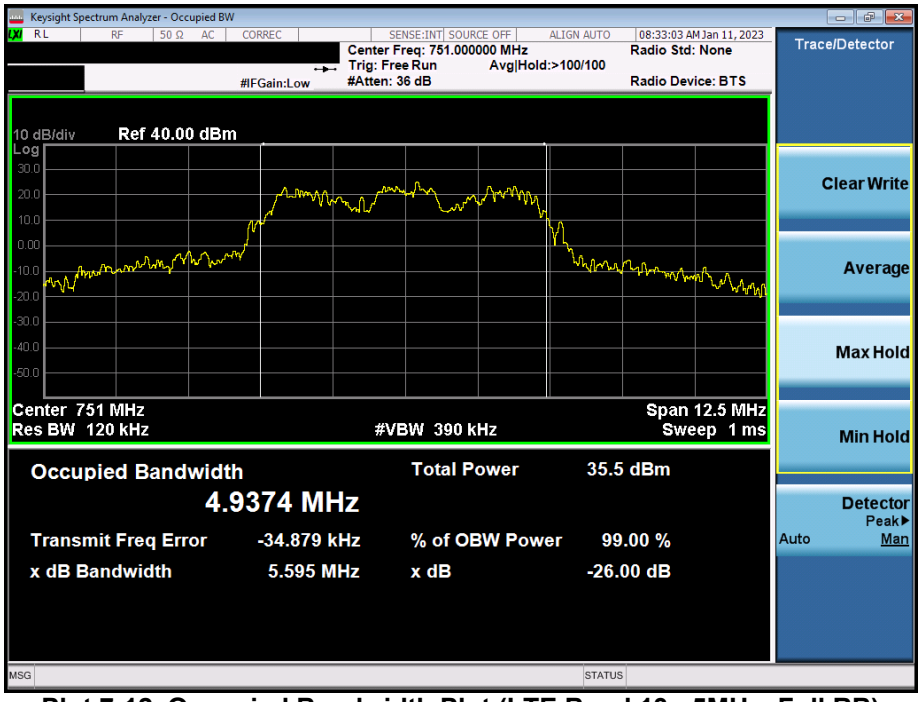
Plot 7-10. Occupied Bandwidth Plot (LTE Band 66 - 5MHz- Full RB)

LTE Band 12



Plot 7-11. Occupied Bandwidth Plot (LTE Band 12 - 5MHz- Full RB)

LTE Band 13



Plot 7-12. Occupied Bandwidth Plot (LTE Band 13 - 5MHz- Full RB)

7.4 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

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. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

On all frequencies between 763-775 MHz and 793-805 MHz, the minimum permissible attenuation level is not less than 65 + 10 log (P) dB in a 6.25 kHz band segment.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 18GHz (separated into at least two plots per channel)
2. RBW ≥ 100kHz
3. VBW ≥ 3 x RBW
4. Detector = RMS
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

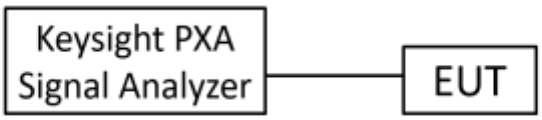
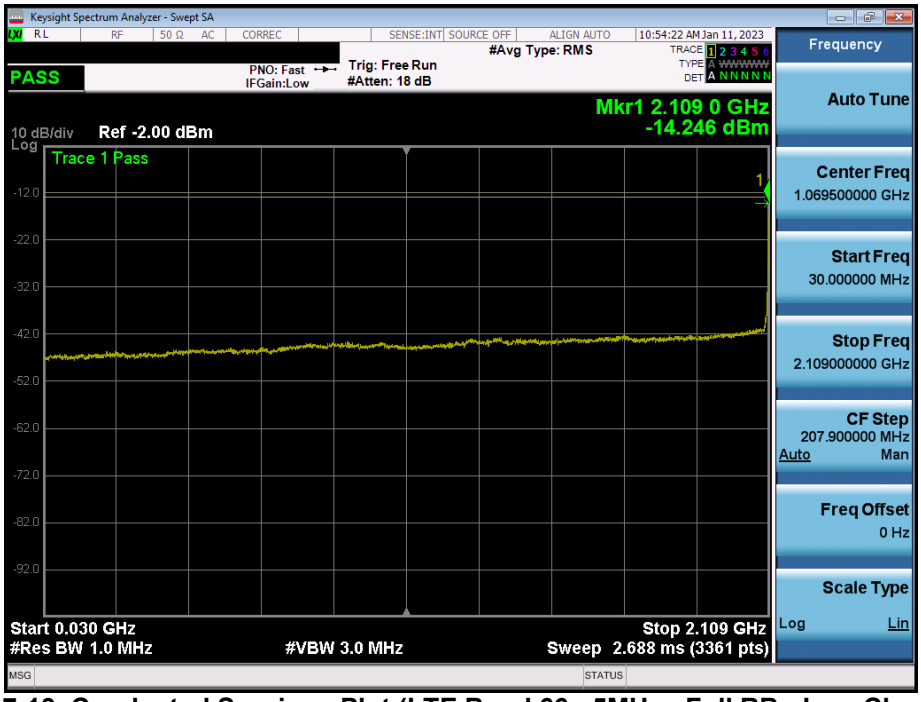


Figure 7-3. Test Instrument & Measurement Setup

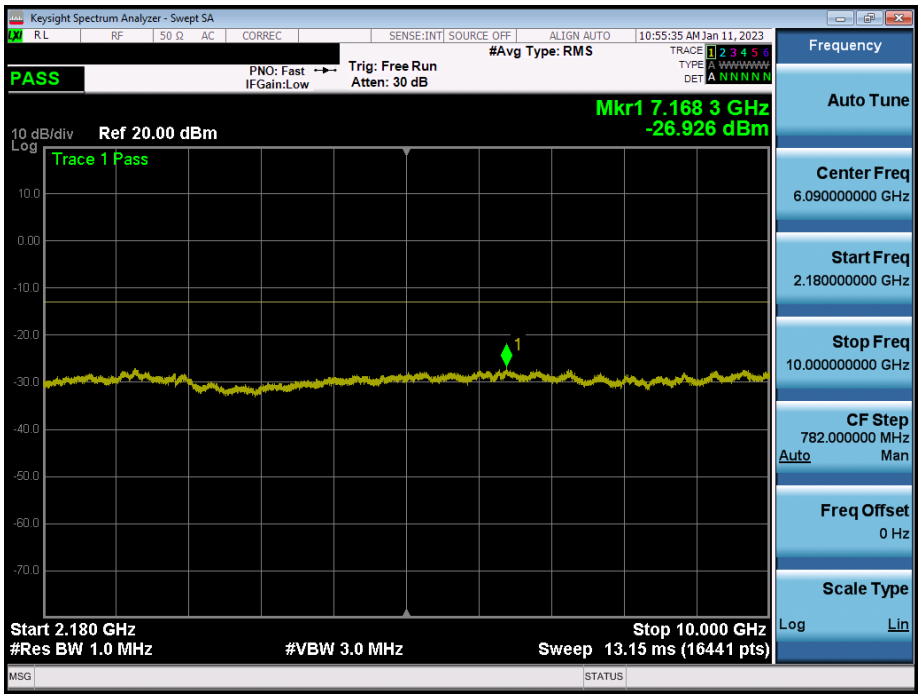
Test Notes

1. Per Part 27, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz.
2. For operation of LTE Band 12 and 13 as per Part 27.53, it requires using RBW = 100kHz or greater for all frequencies while Band 66 requires using RBW = 1MHz for all frequencies
3. The measurements in the frequency range, 763-775 MHz and 793-805 MHz are shown to be compliant while measured with RBW = 100kHz

LTE Band 66



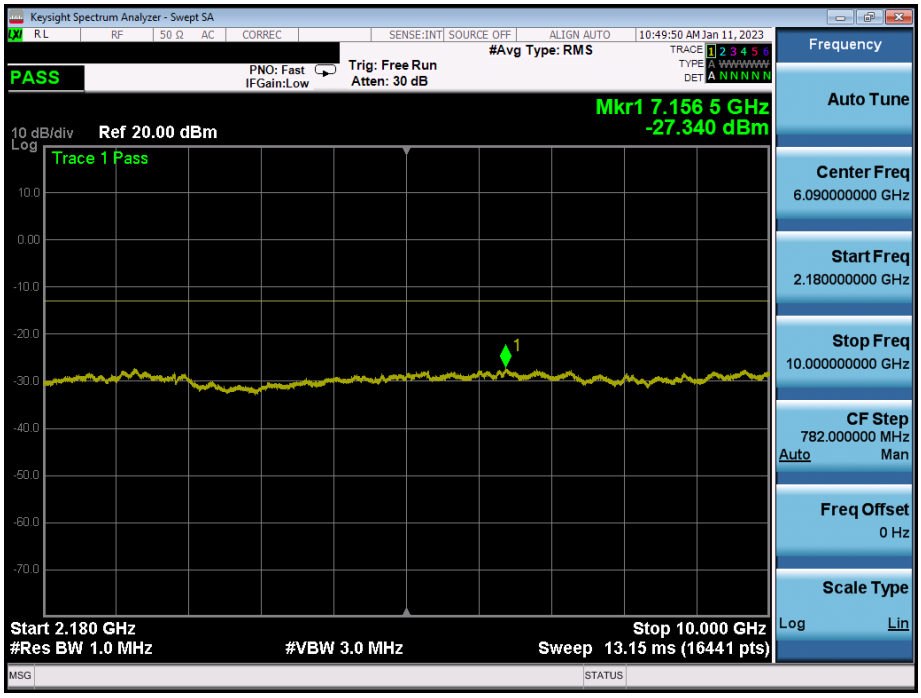
Plot 7-13. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Low Channel)



Plot 7-14. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Low Channel)

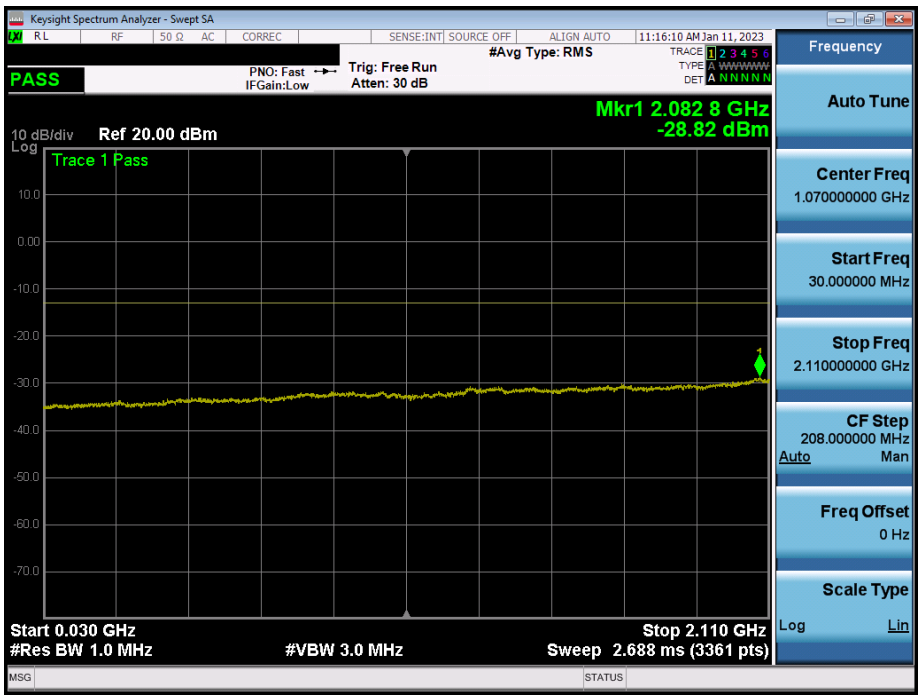
Plot 7-15. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Low Channel)

Plot 7-16. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Mid Channel)

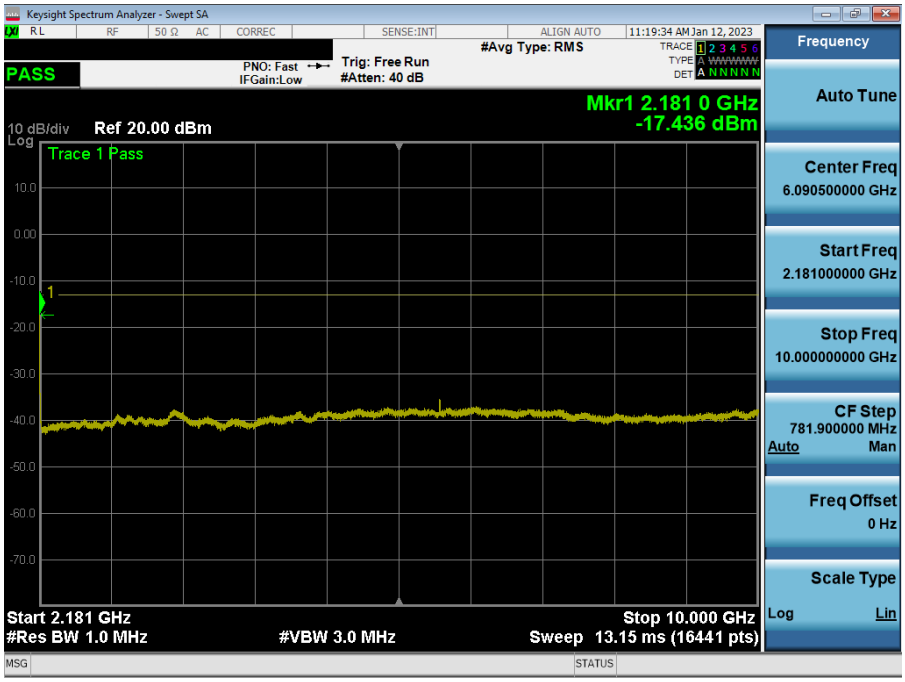


Plot 7-17. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Mid Channel)

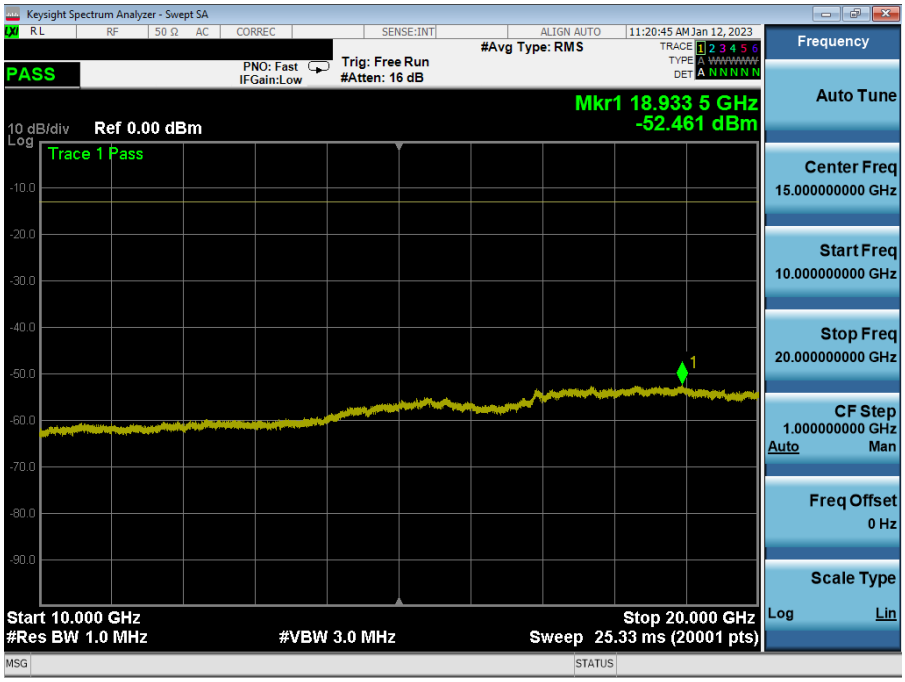
Plot 7-18. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - Mid Channel)



Plot 7-19. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - High Channel)

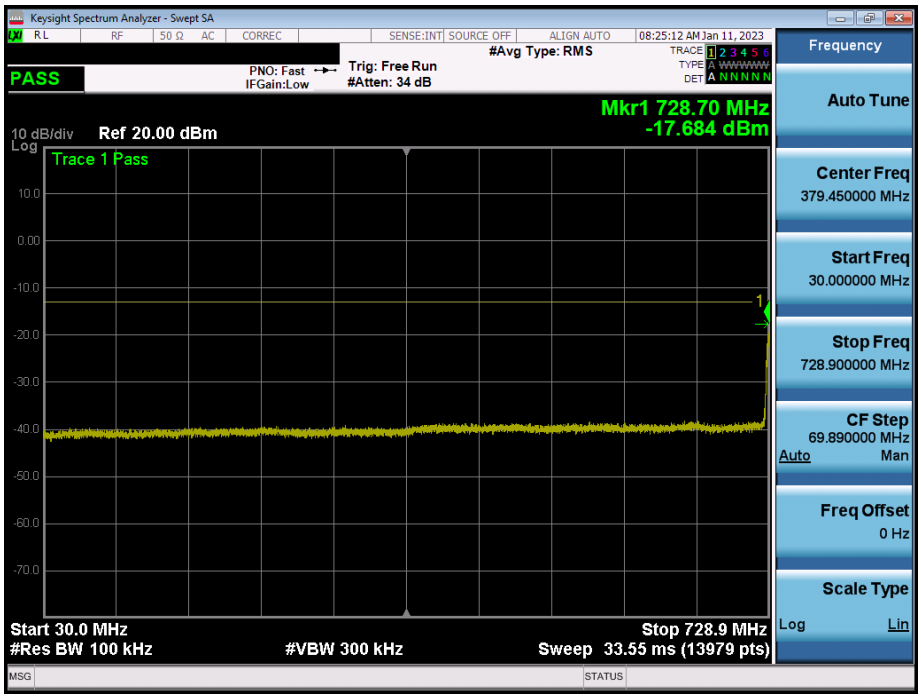


Plot 7-20. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - High Channel)

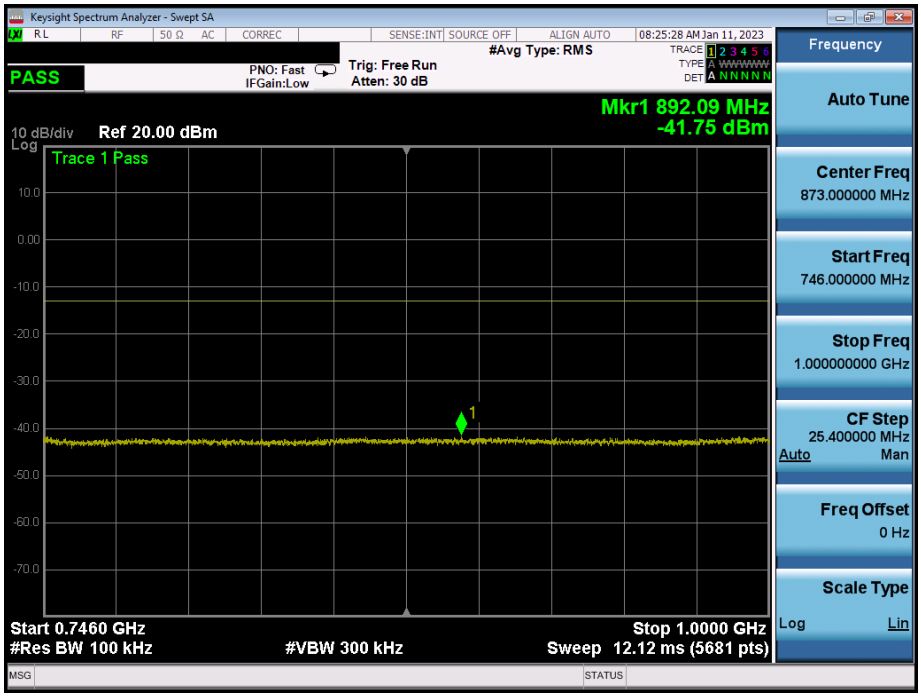


Plot 7-21. Conducted Spurious Plot (LTE Band 66 - 5MHz - Full RB - High Channel)

LTE Band 12

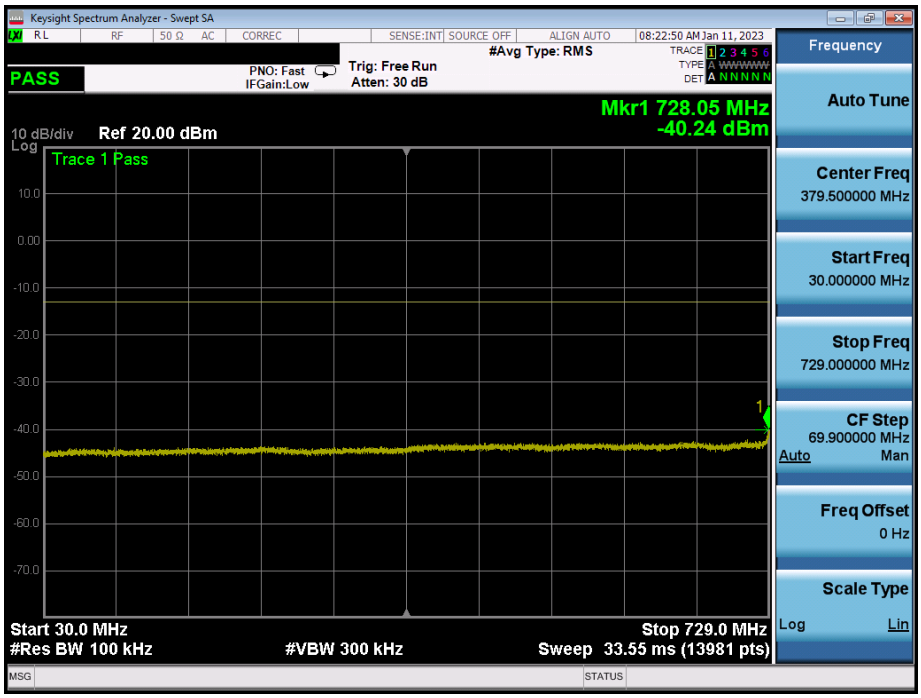


Plot 7-22. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Low Channel)

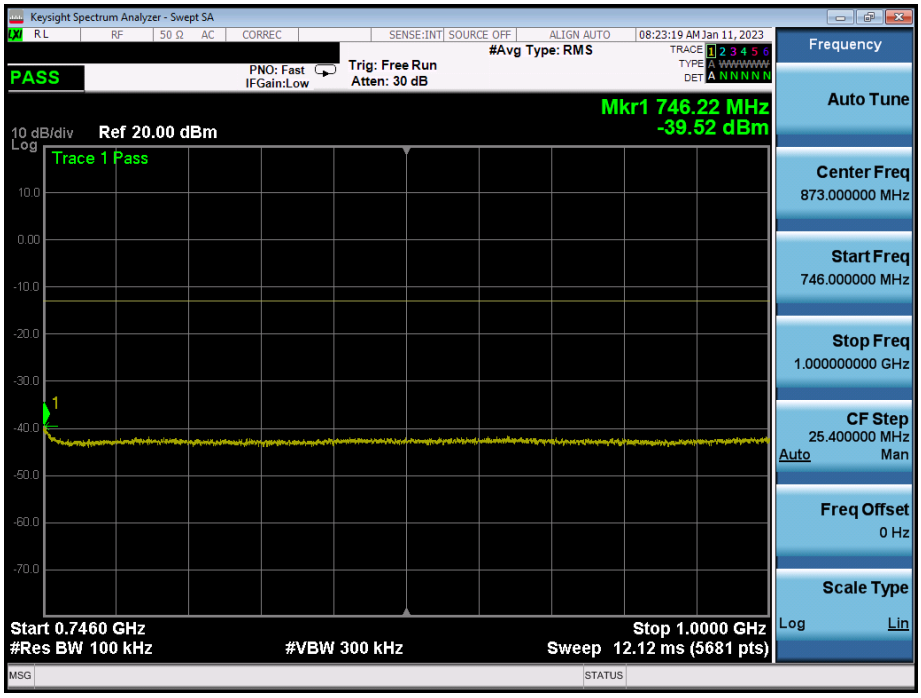


Plot 7-23. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Low Channel)

Plot 7-24. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Low Channel)

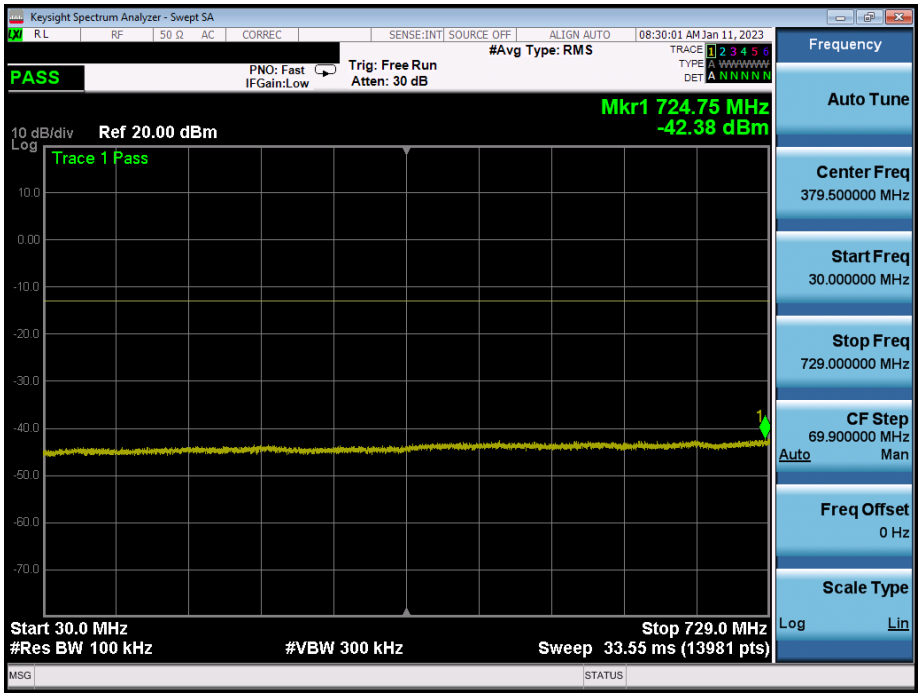


Plot 7-25. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Mid Channel)



Plot 7-26. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Mid Channel)

Plot 7-27. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - Mid Channel)



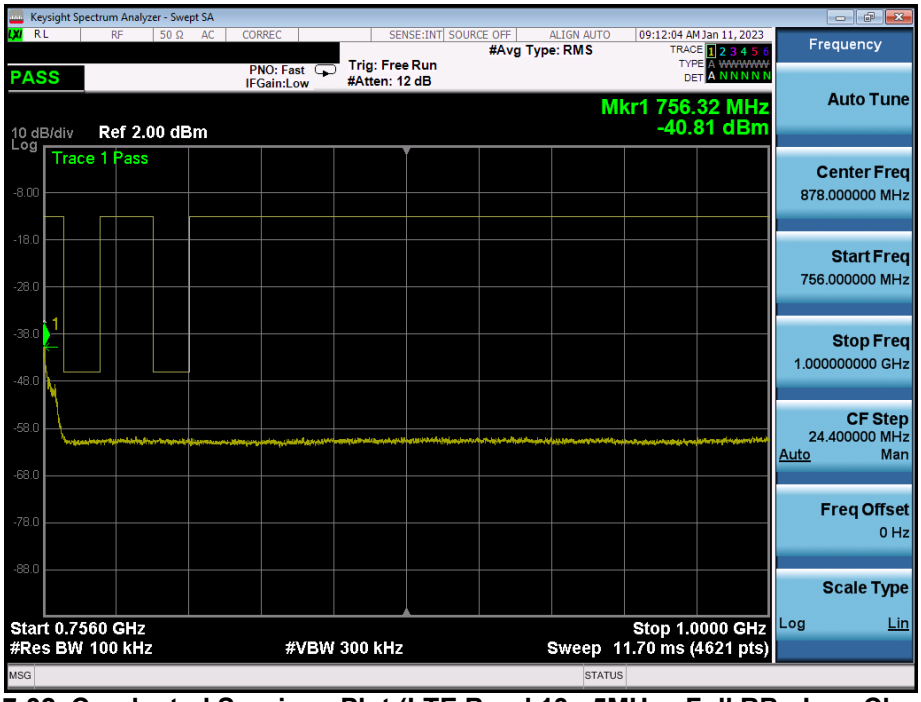
Plot 7-28. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - High Channel)

Plot 7-29. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - High Channel)

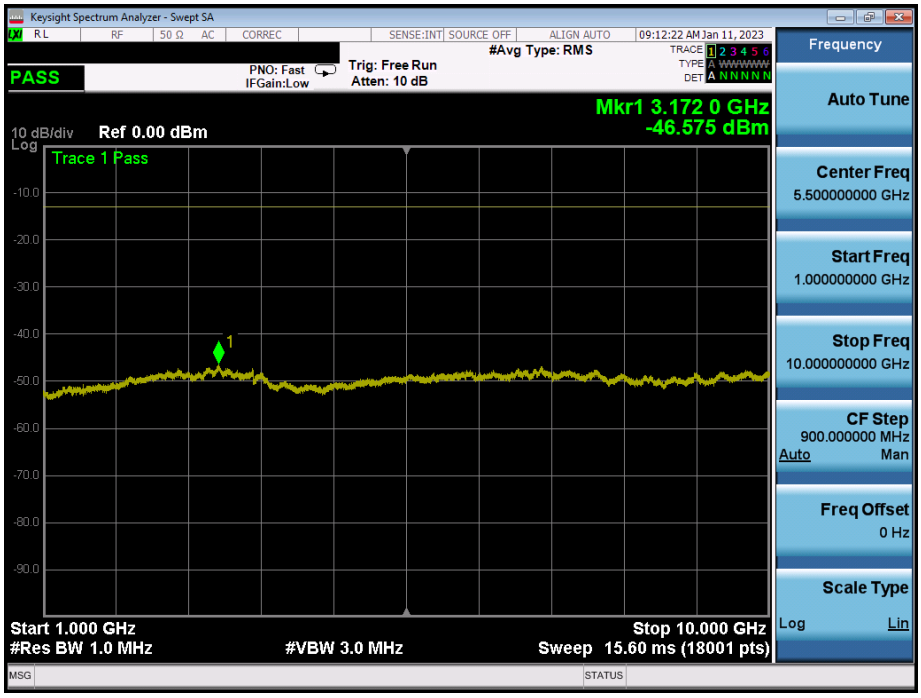
Plot 7-30. Conducted Spurious Plot (LTE Band 12 - 5MHz - Full RB - High Channel)

Band 13

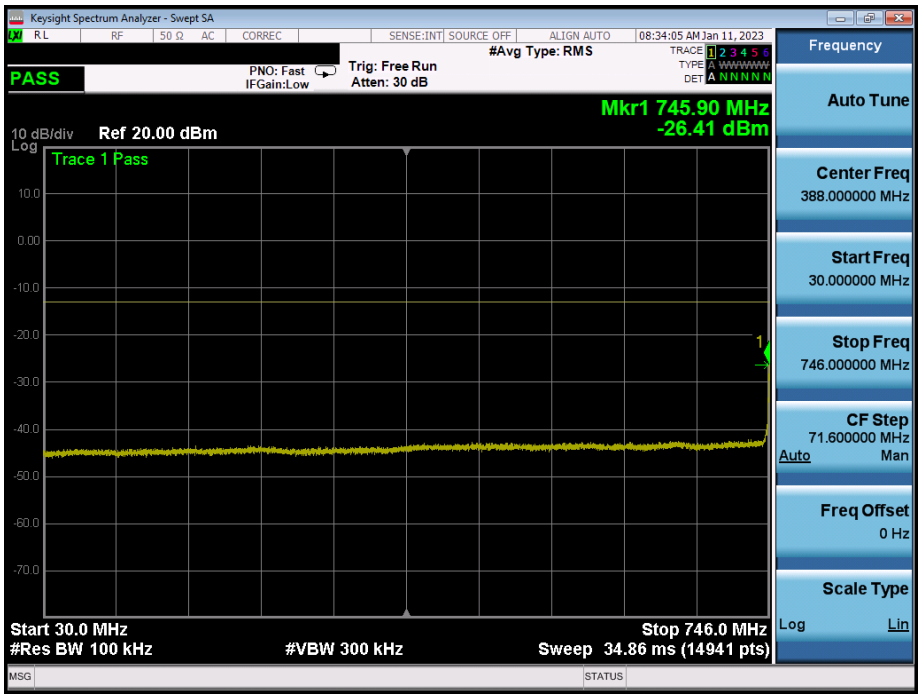
Plot 7-31. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Low Channel)



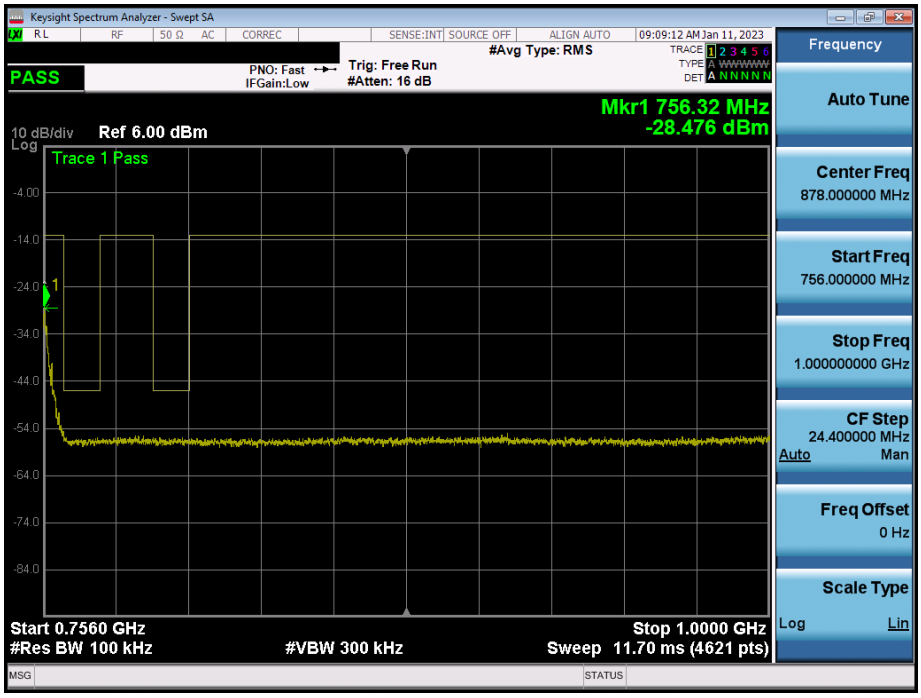
Plot 7-32. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Low Channel)



Plot 7-33. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Low Channel)



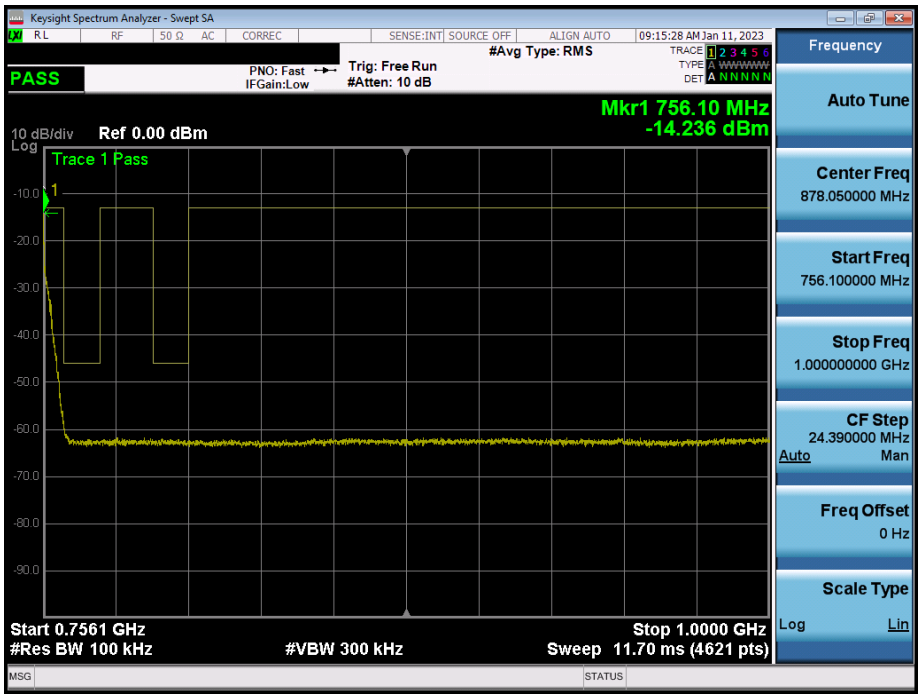
Plot 7-34. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Mid Channel)



Plot 7-35. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Mid Channel)

Plot 7-36. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - Mid Channel)

Plot 7-37. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - High Channel)



Plot 7-38. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - High Channel)

Plot 7-39. Conducted Spurious Plot (LTE Band 13 - 5MHz - Full RB - High Channel)

7.5 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

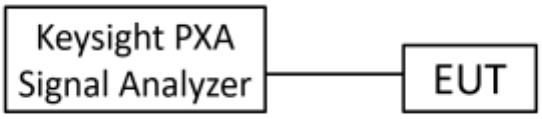


Figure 7-4. Test Instrument & Measurement Setup

Test Notes

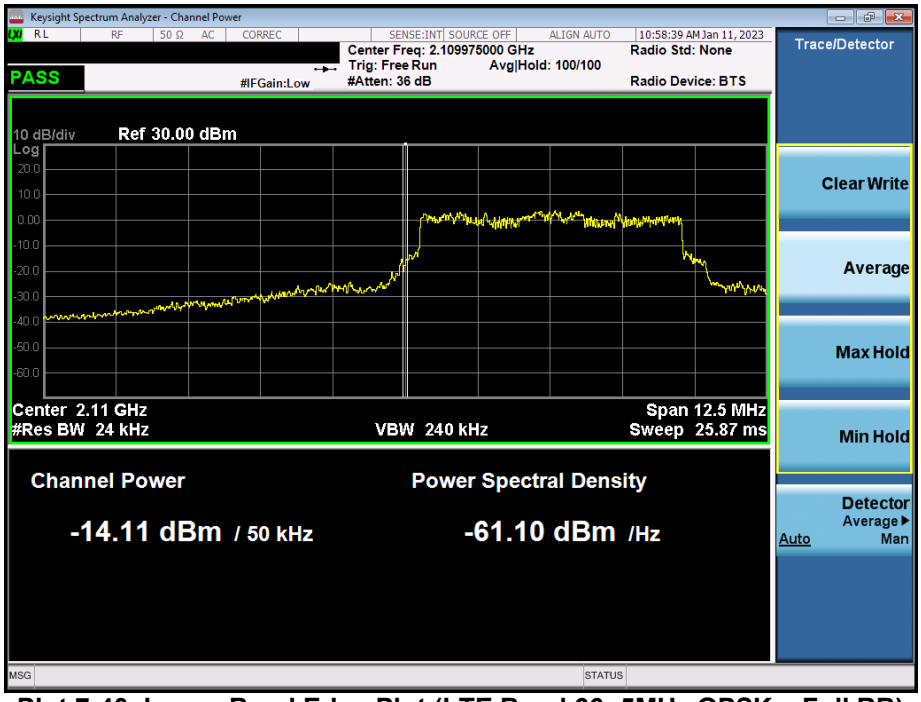
1. Per 27.53(g) for operations in the 698 – 746MHz bands, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

2. Per 27.53(c)(5) for operations in the 746-758 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

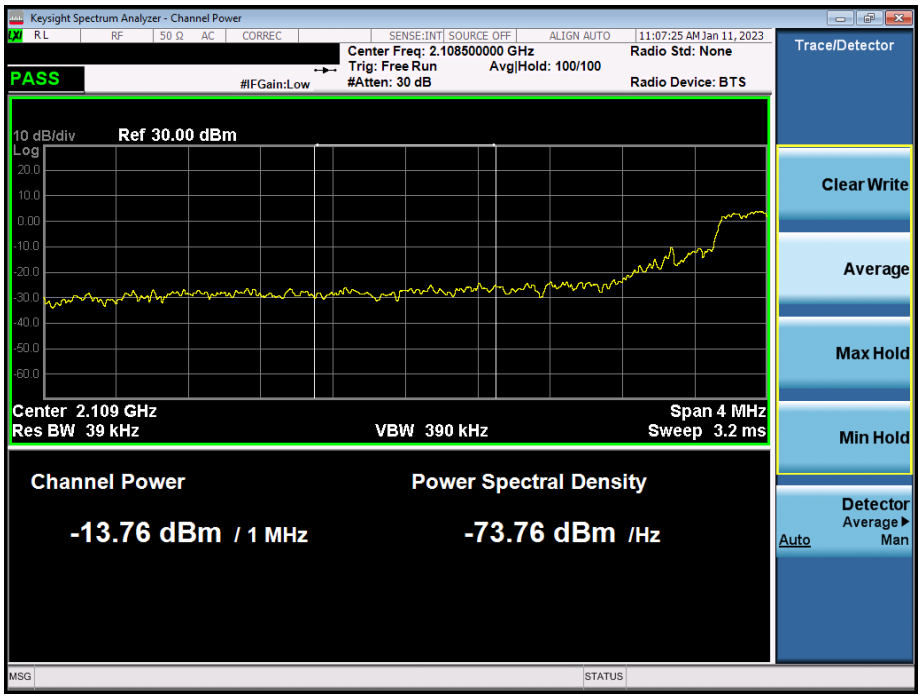
3. For all plots showing emissions in the 763 – 775MHz and 793 – 805MHz band, the FCC limit per 27.53(c)(4) is 65 + 10 $\log_{10}$(P) = -35dBm in a 6.25kHz bandwidth.

4. Per 27.53(h)(1) for operations in the 2110 - 2180 MHz band, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

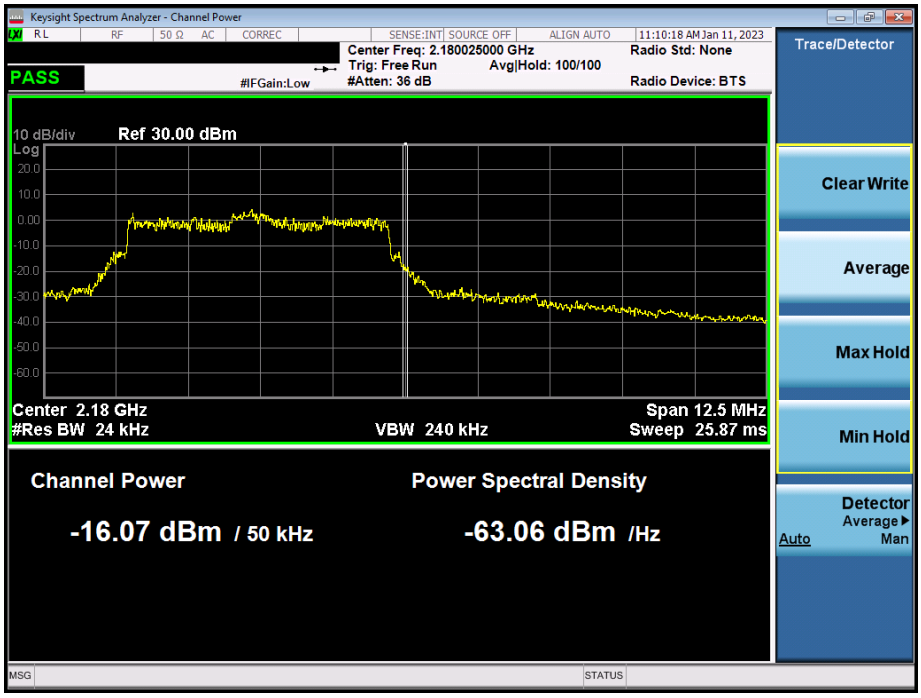
LTE Band 66



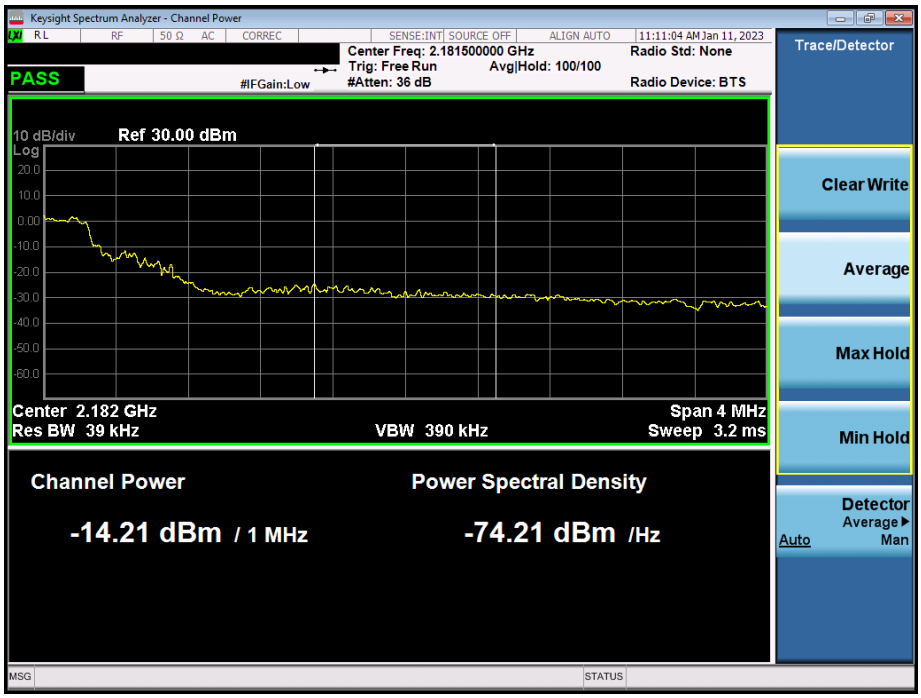
Plot 7-40. Lower Band Edge Plot (LTE Band 66- 5MHz QPSK – Full RB)



Plot 7-41. Lower Band Edge Plot (LTE Band 66- 5MHz QPSK – Full RB)

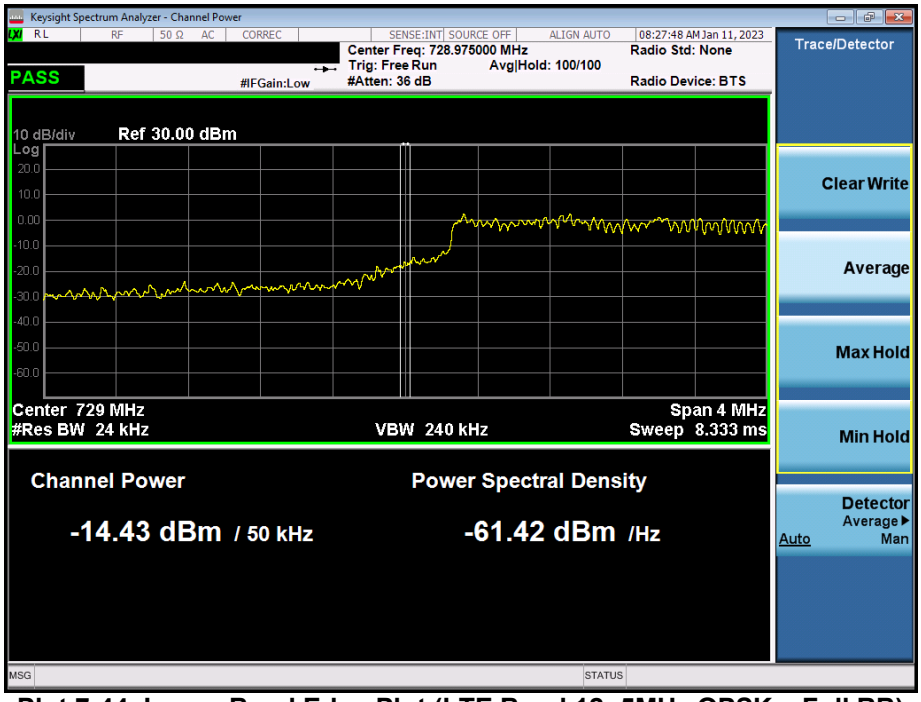


Plot 7-42. Upper Band Edge Plot (LTE Band 66- 5MHz QPSK – Full RB)

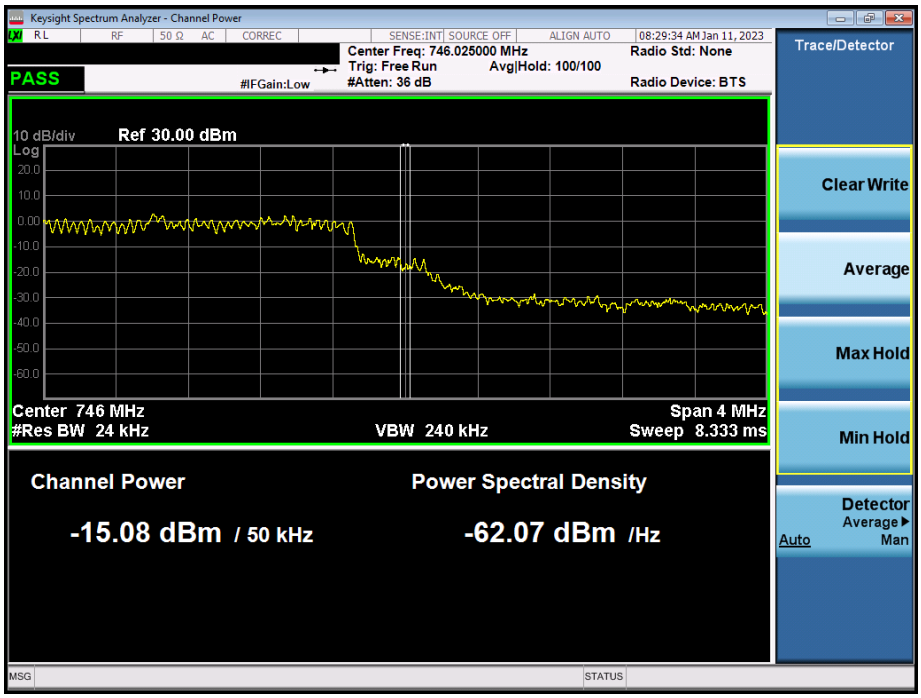


Plot 7-43. Upper Band Edge Plot (LTE Band 66- 5MHz QPSK – Full RB)

LTE Band 12

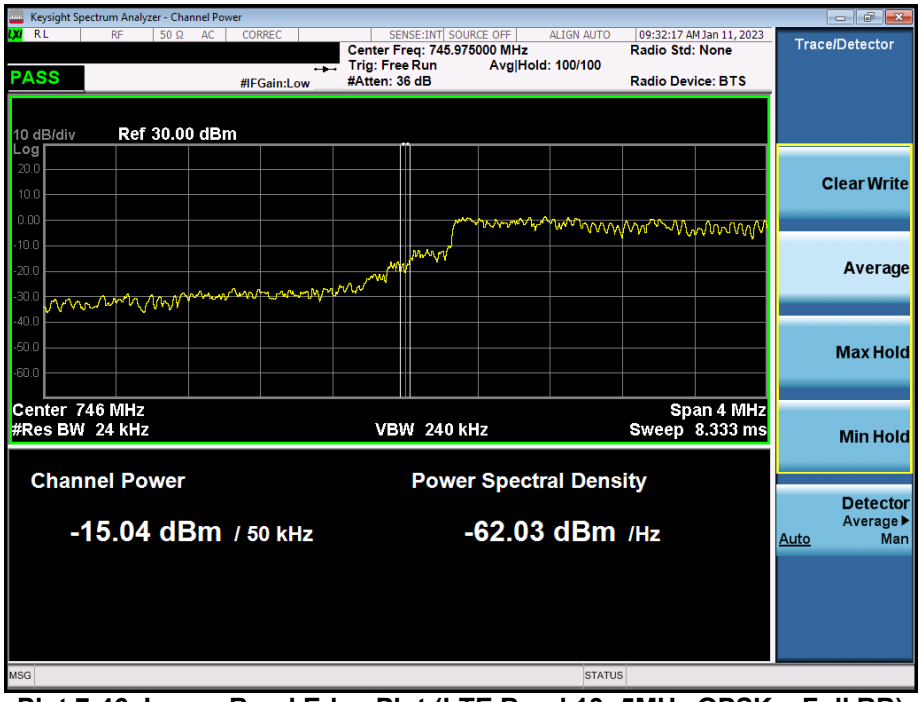


Plot 7-44. Lower Band Edge Plot (LTE Band 12- 5MHz QPSK – Full RB)



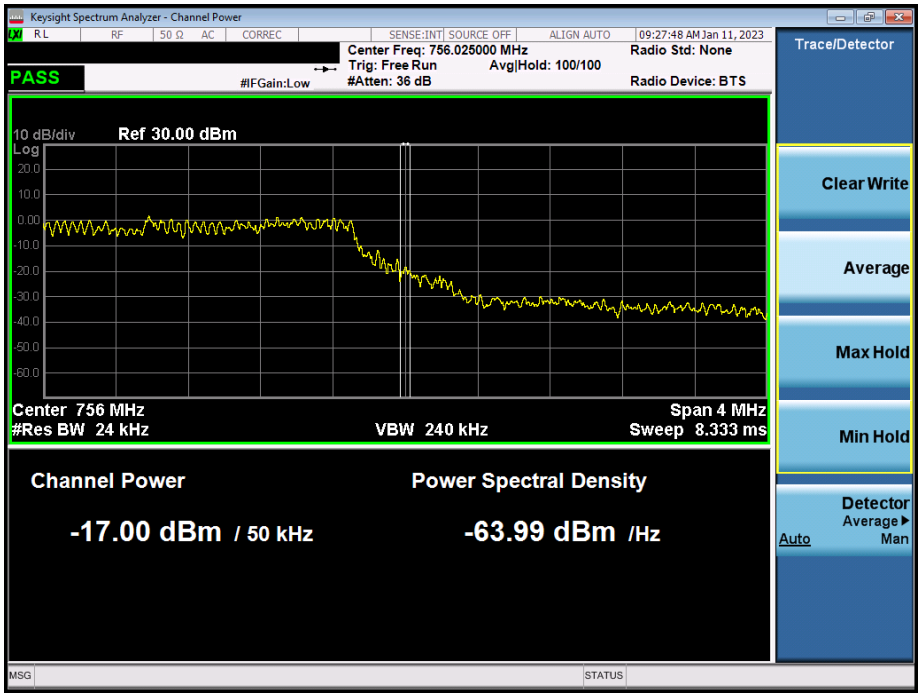
Plot 7-45. Upper Band Edge Plot (LTE Band 12- 5MHz QPSK – Full RB)

Band 13

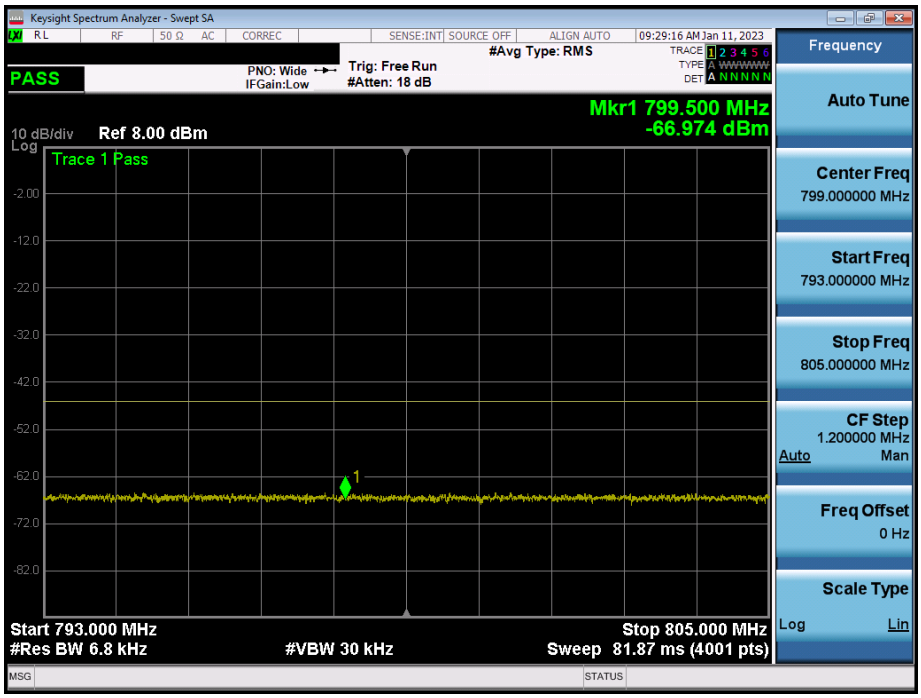


Plot 7-46. Lower Band Edge Plot (LTE Band 13- 5MHz QPSK – Full RB)

Plot 7-47. Lower Emission Mask Plot (LTE Band 13- 5MHz QPSK – Full RB)



Plot 7-48. Upper Band Edge Plot (LTE Band 13- 5MHz QPSK – Full RB)



Plot 7-49. Upper Emission Mask Plot (LTE Band 13- 5MHz QPSK – Full RB)

7.6 Peak-Average Ratio

Test Overview

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.3.4

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW ≥ OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

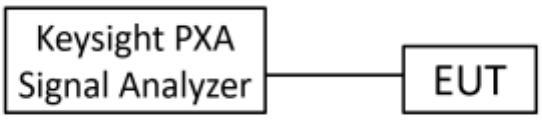
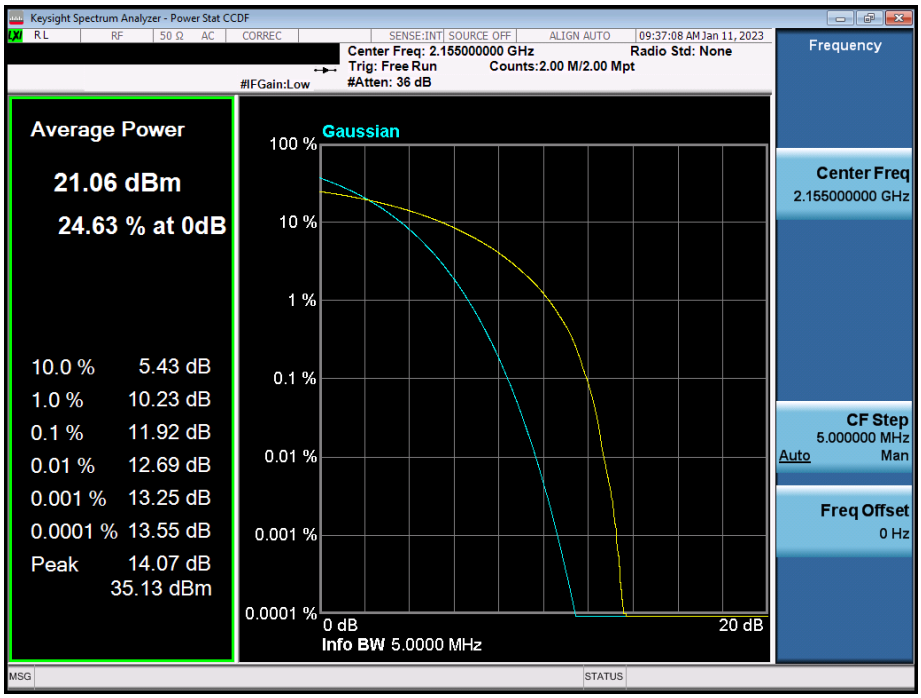


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

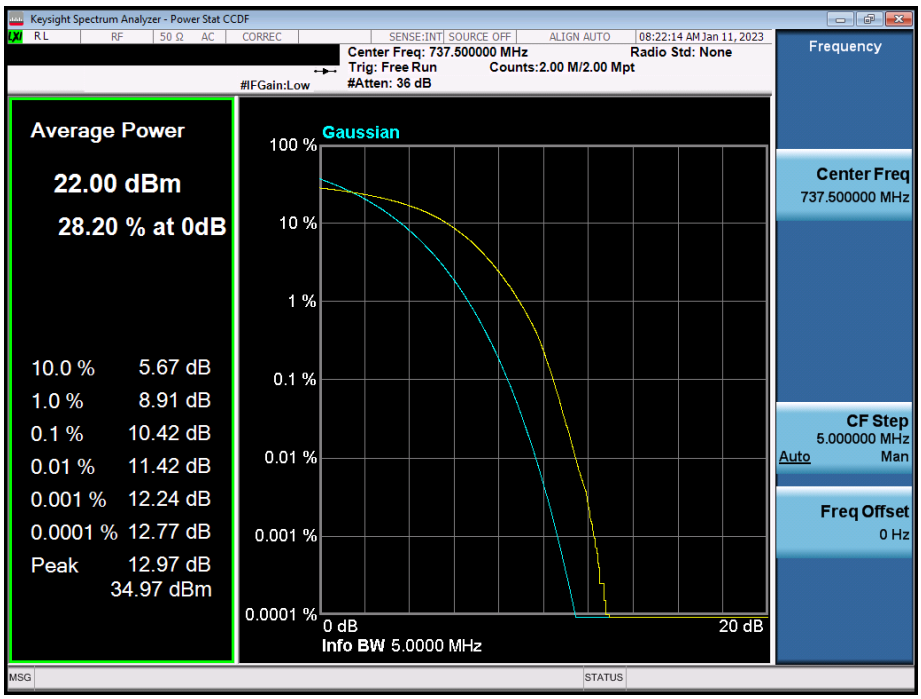
None.

LTE Band 66



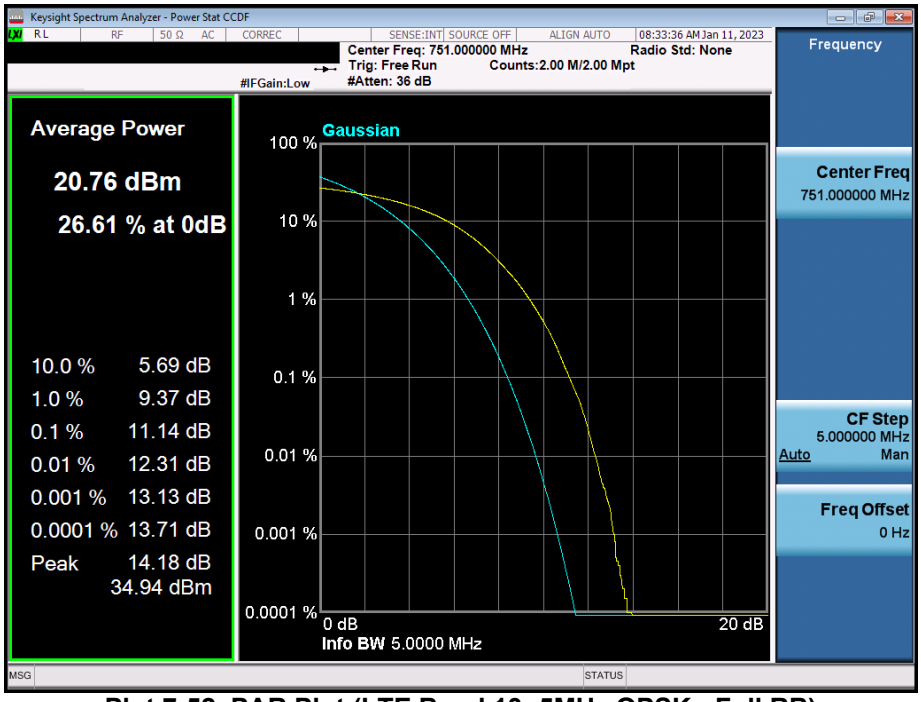
Plot 7-50. PAR Plot (LTE Band 66- 5MHz QPSK - Full RB)

LTE Band 12



Plot 7-51. PAR Plot (LTE Band 12- 5MHz QPSK - Full RB)

LTE Band 13



Plot 7-52. PAR Plot (LTE Band 13- 5MHz QPSK - Full RB)

7.7 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an external antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

ANSI C63.26-2015 – Section 5.5.4

Test Settings

1. RBW = 100kHz or greater for LTE Band 12 & 13 and 1MHz for LTE Band 66
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

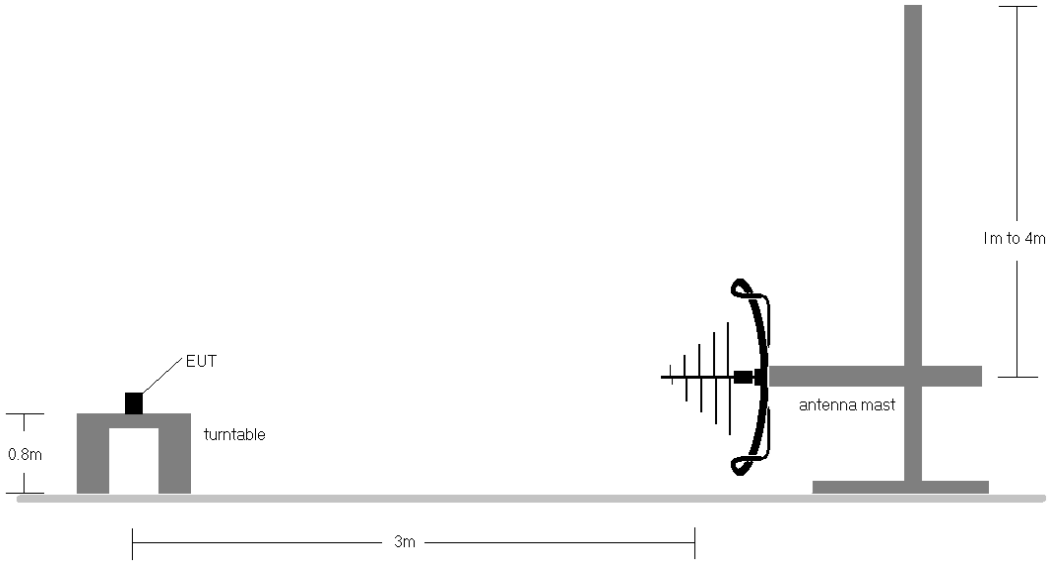


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

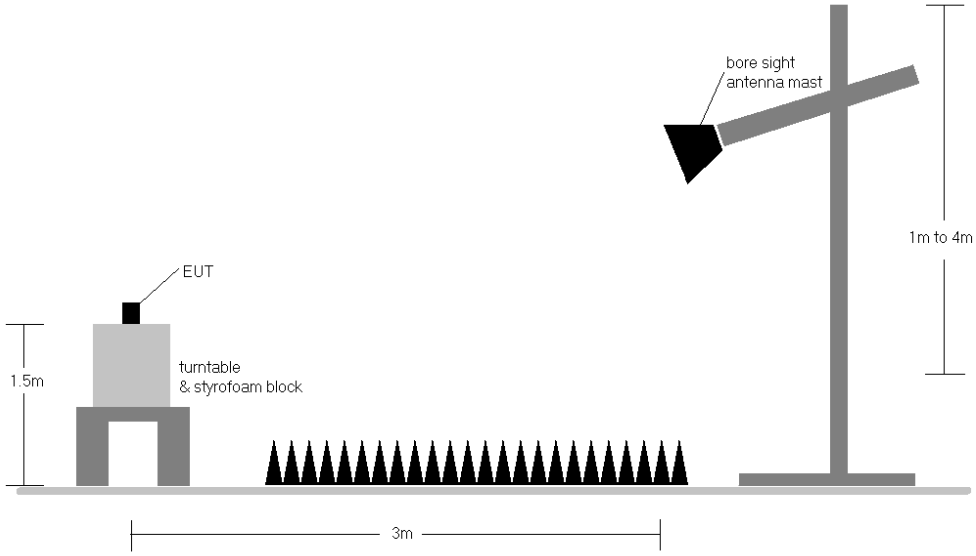


Figure 7-7. Test Instrument & Measurement Setup > 1GHz

Test Notes

1) Field strengths are calculated using the Measurement quantity conversions in ANSI C63.26-2015 Section 5.2.7:
   a) E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   b) EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

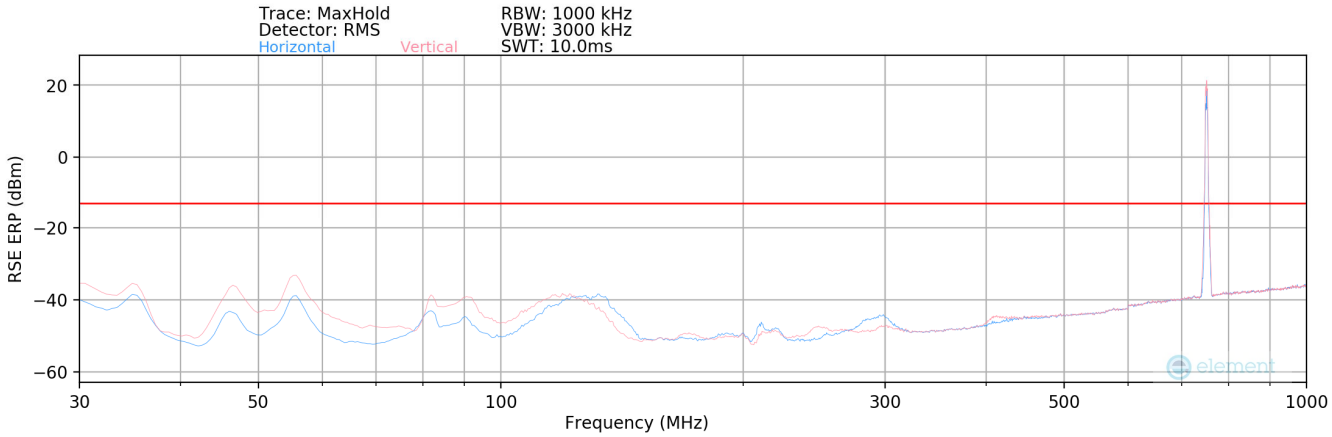
3) The radiated spurious emissions data is taken in the worst-case configuration which is with LTE Band 66/12/13 operating simultaneously with another supported LTE band as shown in this section.

4) This unit was tested with an external 12 VDC power source

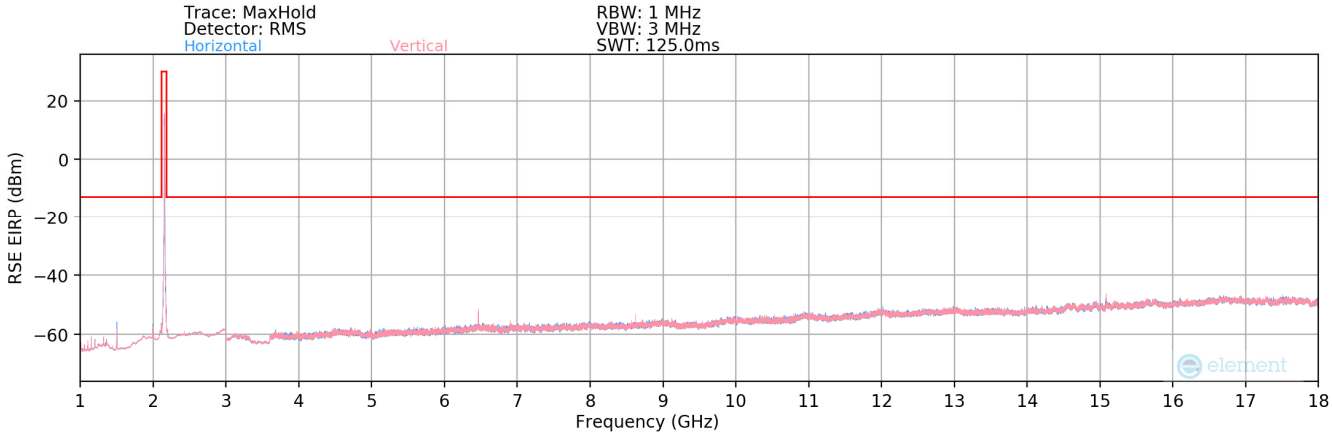
5) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

LTE Band 66 – LTE Band 13



Plot 7-53. Radiated Spurious Plot (LTE Band 66- LTE Band 13)- Below 1GHz



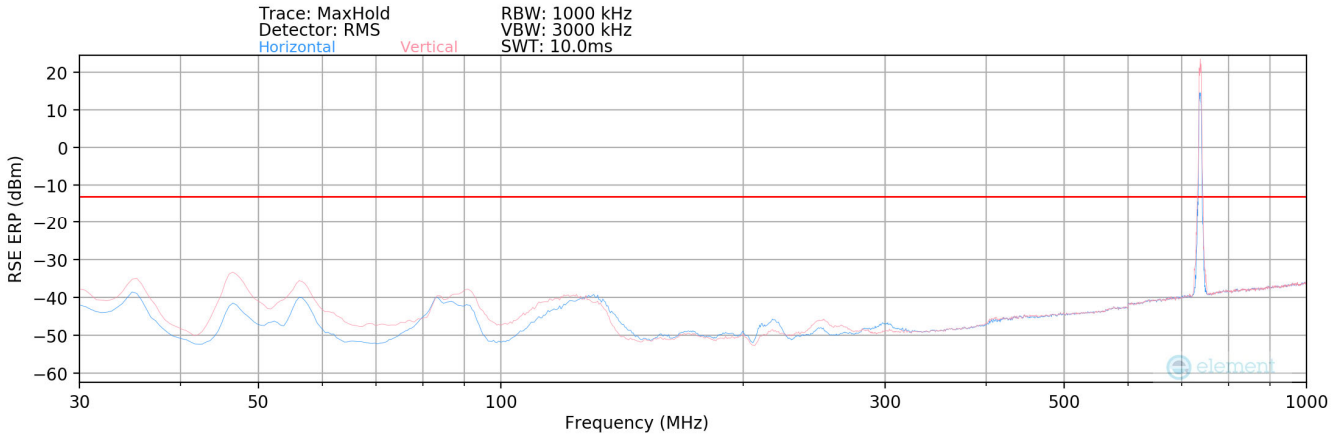
Plot 7-54. Radiated Spurious Plot (LTE Band 66- LTE Band 13)- 1-18GHz

Bandwidth (MHz):	5 & 5
Frequency (MHz):	2155 & 751
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

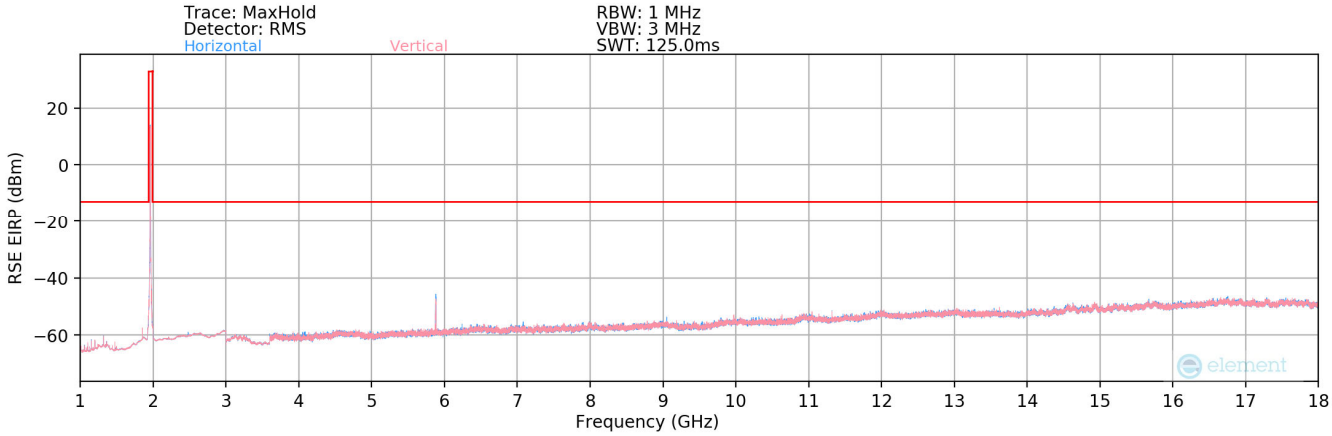
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
653.00	H	-	-	-82.12	28.12	53.00	-42.26	-13.00	-29.26
1359.00	H	286	134	-68.59	-2.98	35.43	-59.83	-13.00	-46.83
2057.00	H	395	277	-71.23	-0.81	34.96	-60.30	-13.00	-47.30
3461.00	H	-	-	-78.78	2.67	30.89	-64.37	-13.00	-51.37
4963.00	H	-	-	-79.09	3.89	31.80	-63.45	-13.00	-50.45
6464.50	H	280	121	-78.23	6.90	35.67	-59.59	-13.00	-46.59
8620.00	H	291	252	-78.22	8.38	37.16	-58.10	-13.00	-45.10

Table 7-5. Radiated Spurious Data (LTE Band 66- LTE Band 13 – Mid Channel)

LTE Band 12 – LTE Band 2



Plot 7-55. Radiated Spurious Plot (LTE Band 12- LTE Band 2)- Below 1GHz



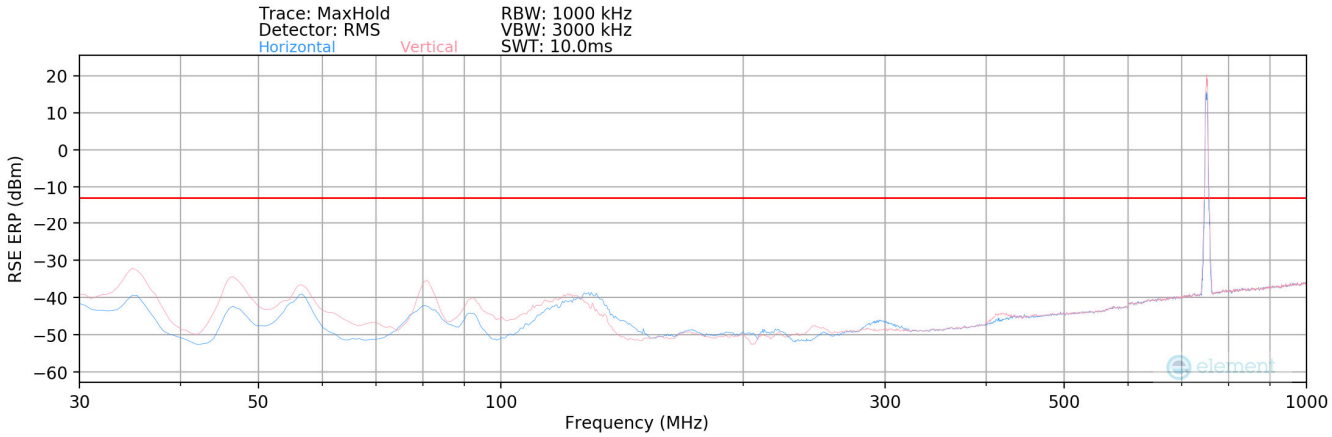
Plot 7-56. Radiated Spurious Plot (LTE Band 12- LTE Band 2)- 1-18GHz

Bandwidth (MHz):	5 & 5
Frequency (MHz):	737.5MHz & 1960MHz
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

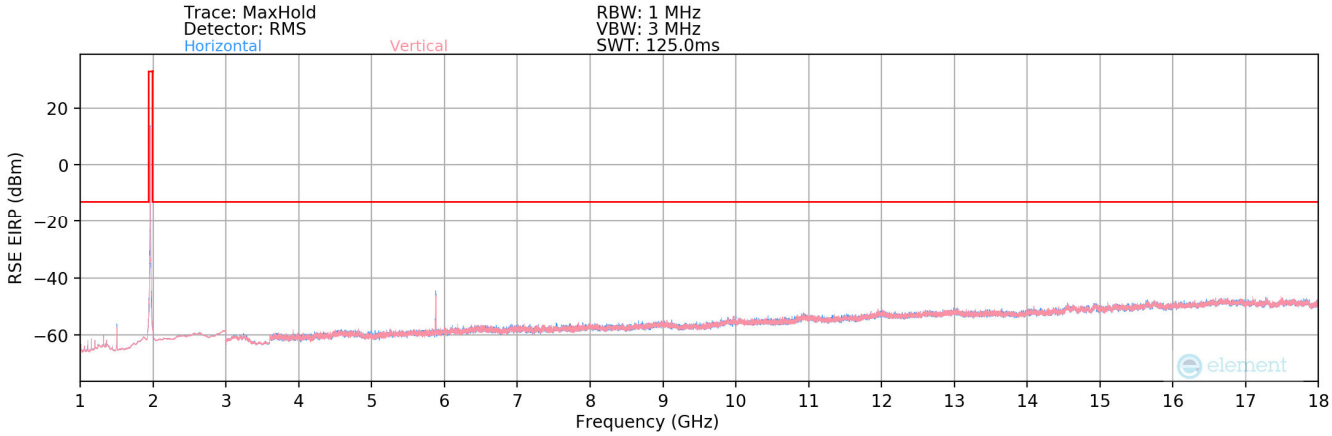
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
485.00	V	-	-	-84.56	25.75	48.19	-47.07	-13.00	-34.07
1359.70	V	158	304	-71.22	-2.98	32.80	-62.45	-13.00	-49.45
1360.70	V	-	-	-81.33	5.09	30.76	-64.50	-13.00	-51.50
5895.00	V	240	107	-66.02	5.50	46.48	-48.78	-13.00	-35.78
6850.00	V	-	-	-79.96	7.28	34.32	-60.94	-13.00	-47.94
11200.00	V	-	-	-81.39	11.58	37.19	-58.06	-13.00	-45.06

Table 7-6. Radiated Spurious Data (LTE Band 12- LTE Band 2 – Mid Channel)

LTE Band 13 – LTE Band 2



Plot 7-57. Radiated Spurious Plot (LTE Band 13- LTE Band 2)- Below 1GHz



Plot 7-58. Radiated Spurious Plot (LTE Band 13-LTE Band 2)- 1-18GHz

Bandwidth (MHz):	5 & 5 MHz
Frequency (MHz):	751MHz & 1960MHz
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
457.80	H	-	-	-82.56	25.13	49.57	-45.69	-13.00	-32.69
1400.00	H	155	241	-67.57	-3.71	35.72	-59.54	-13.00	-46.54
2875.00	H	-	-	-75.42	1.13	32.71	-62.55	-13.00	-49.55
3168.90	H	-	-	-74.66	2.57	34.91	-60.34	-13.00	-47.34
4377.80	H	-	-	-76.58	3.24	33.66	-61.60	-13.00	-48.60
5880.00	H	191	234	-63.52	5.38	48.86	-46.40	-13.00	-33.40
6795.60	H	-	-	-79.62	7.05	34.43	-60.83	-13.00	-47.83

Table 7-7. Radiated Spurious Data (LTE Band 13- LTE Band 2 – Mid Channel)

7.8 Frequency Stability / Temperature Variation

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI C63.26-2015 – Section 5.6

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes 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.
3. 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.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

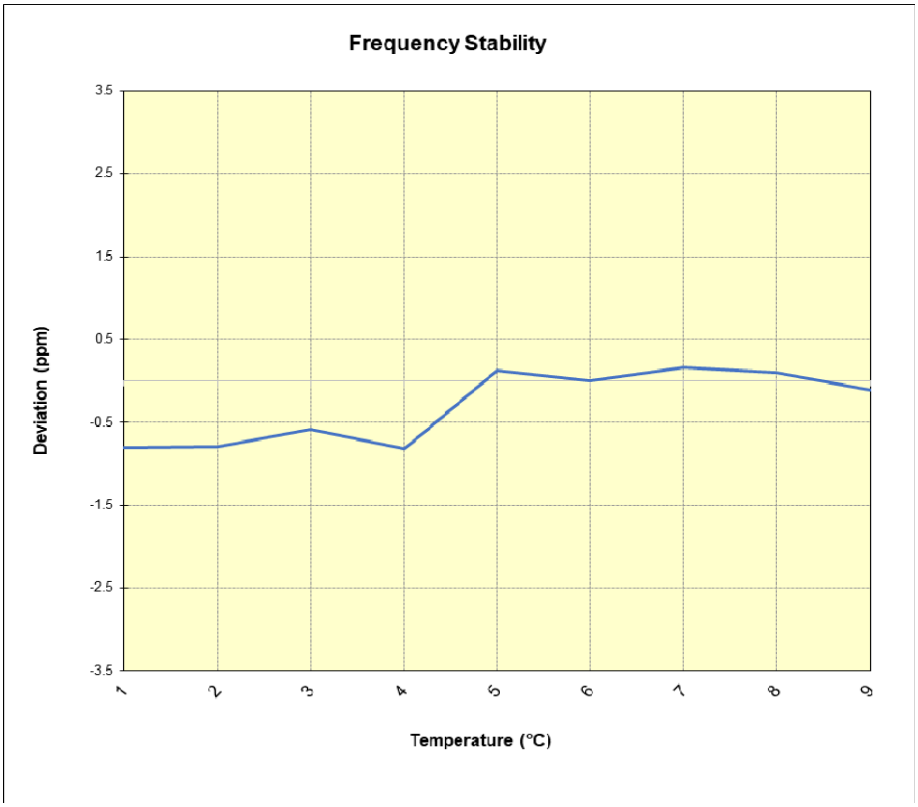
None

LTE Band 66

Operating Frequency (Hz):	2,155,000,000
Ref. Voltage (VDC):	12.00

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	12.00	- 30	2,155,011,463	-1,748	-0.0000811
		- 20	2,155,011,513	-1,698	-0.0000788
		- 10	2,155,011,946	-1,265	-0.0000587
		0	2,155,011,456	-1,755	-0.0000814
		+ 10	2,155,013,481	270	0.0000125
		+ 20 (Ref)	2,155,013,211	0	0.0000000
		+ 30	2,155,013,561	350	0.0000162
		+ 40	2,155,013,423	212	0.0000098
		+ 50	2,155,012,984	-227	-0.0000105
85%	10.20	+ 20	2,155,013,996	785	0.0000364
110%	13.80	+ 20	2,155,013,487	276	0.0000128

Table 7-8. LTE Band 66 Frequency Stability Data



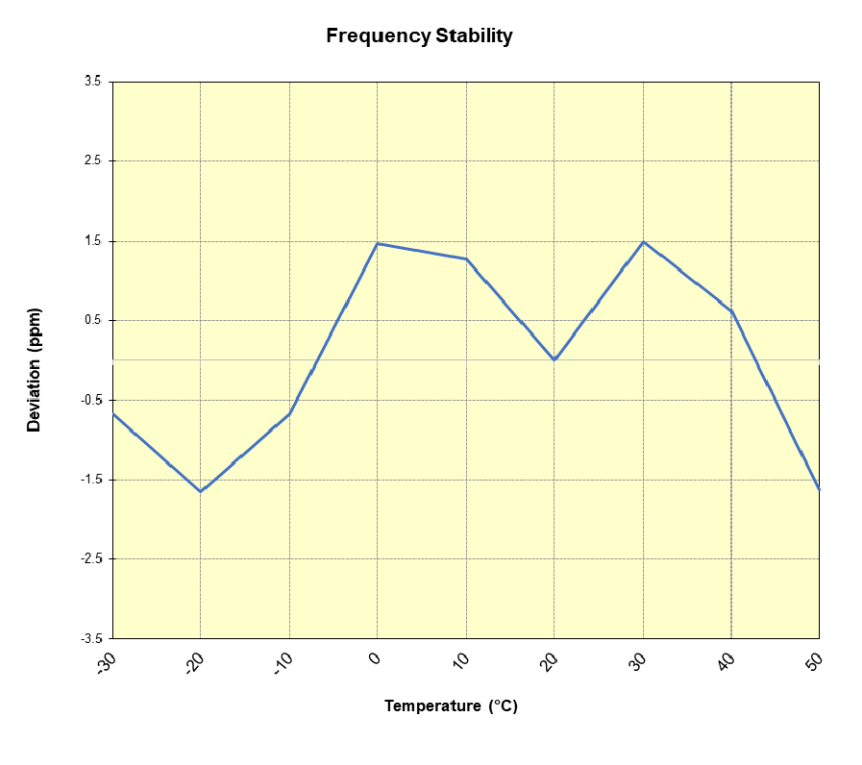
Plot 7-59. LTE Band 66 Frequency Stability Chart

LTE Band 12

Operating Frequency (Hz):	737,500,000
Ref. Voltage (VDC):	12.00

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	12.00	- 30	737,499,989	-495	-0.0000671
		- 20	737,499,264	-1,220	-0.0001654
		- 10	737,499,989	-495	-0.0000671
		0	737,501,566	1,082	0.0001467
		+ 10	737,501,421	937	0.0001271
		+ 20 (Ref)	737,500,484	0	0.0000000
		+ 30	737,501,588	1,104	0.0001497
		+ 40	737,500,944	460	0.0000624
		+ 50	737,499,281	-1,203	-0.0001631
85%	10.20	+ 20	737,501,631	1,147	0.0001555
110%	13.80	+ 20	737,500,213	-271	-0.0000367

Table 7-8. LTE Band 12 Frequency Stability Data



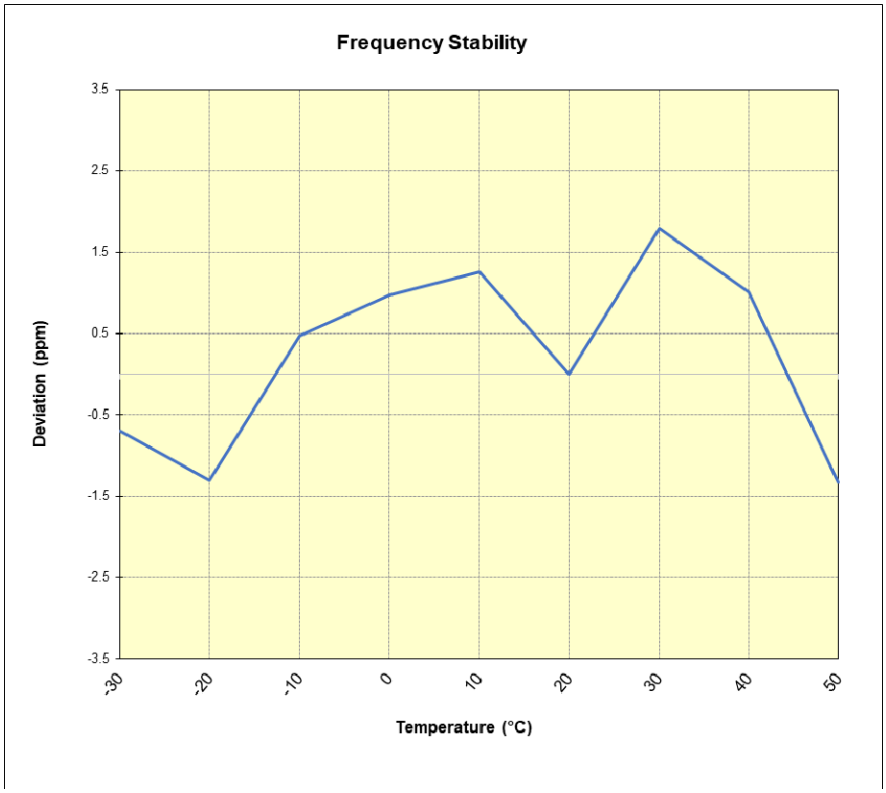
Plot 7-60. LTE Band 12 Frequency Stability Chart

LTE Band 13

Operating Frequency (Hz):	751,000,000
Ref. Voltage (VDC):	12.00

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	12.00	- 30	750,991,687	-525	-0.0000699
		- 20	750,991,233	-979	-0.0001304
		- 10	750,992,566	354	0.0000471
		0	750,992,946	734	0.0000977
		+ 10	750,993,154	942	0.0001254
		+ 20 (Ref)	750,992,212	0	0.0000000
		+ 30	750,993,564	1,352	0.0001800
		+ 40	750,992,975	763	0.0001016
		+ 50	750,991,214	-998	-0.0001329
85%	10.20	+ 20	750,991,459	-753	-0.0001003
110%	13.80	+ 20	750,990,299	-1,913	-0.0002547

Table 7-8. LTE Band 13 Frequency Stability Data



Plot 7-61. LTE Band 13 Frequency Stability Chart

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Centum Geolocation System FCC ID: 2A93U-55041-402** complies with all the requirements of Part 27 of the FCC rules.