ELEMENT WASHINGTON DC LLC
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PART 24 / RSS-133 MEASUREMENT REPORT

Applicant Name:
Telit Communications S.p.A.
Viale Stazione di Prosecco 5/b
Trieste, 34010
Italy

Date of Testing:
03/21/2023 - 03/31/2023
Test Report Issue Date:
04/19/2023
Test Site/Location:
Element Lab., Columbia, MD, USA
Test Report Serial No.:
1M2303070020-02-R1.RI7

FCC ID:	**RI7LE910C1SNX**
IC:	**5131A-LE910C1SNX**
Applicant Name:	**Telit Communications S.p.A.**

Application Type:	Certification
Model/HVIN:	LE910C1-SNX
Additional Model/HVIN:	LE910C1-SNXD
EUT Type:	Module
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	24
ISED Specification:	RSS-133 Issue 6 Amendment 1, SRSP-510 Issue 5
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.

Note: This revised Test Report (S/N: 1M2303070020-02-R1.RI7) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 2	20 MHz	QPSK	1860 - 1900	0.427	26.31	17M9G7D
		16QAM	1860 - 1900	0.340	25.32	5M83W7D
	15 MHz	QPSK	1857.5 - 1902.5	0.434	26.37	13M5G7D
		16QAM	1857.5 - 1902.5	0.387	25.88	5M53W7D
	10 MHz	QPSK	1855 - 1905	0.427	26.30	9M00G7D
		16QAM	1855 - 1905	0.365	25.62	5M11W7D
	5 MHz	QPSK	1852.5 - 1907.5	0.419	26.22	4M58G7D
		16QAM	1852.5 - 1907.5	0.362	25.59	4M53W7D
	3 MHz	QPSK	1851.5 - 1908.5	0.457	26.60	2M72G7D
		16QAM	1851.5 - 1908.5	0.370	25.68	2M73W7D
	1.4 MHz	QPSK	1850.7 - 1909.3	0.438	26.42	1M10G7D
		16QAM	1850.7 - 1909.3	0.371	25.69	1M11W7D

EUT Overview

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 **Telit Module FCC ID: RI7LE910C1SNX / IC: 5131A-LE910C1SNX**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 24 and RSS-133. This device is tested as mobile equipment.

Test Device Serial No.: 350515859998620, 350515859998729

2.2 Device Capabilities

This device contains the following capabilities:

Multi-Band LTE

Note: The EUT is a Category 1 LTE module. For 16QAM operation, the Category 1 designation limits the maximum bandwidth of the module to 27RB's which is about 4.86MHz.

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.

For radiated testing, a GPS antenna (SN: 2J4301MPGF) and two LTE magnetic antennas (Model: WE14-LF-07) are connected to the output of the module simultaneously as the worst case.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version M0F.333006 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 power measurements, substitution method is used per the guidance of ANSI C63.26-2015. For emissions below 1GHz, a half-wave dipole is 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 with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_{d\ [dBm]} = P_{g\ [dBm]} - \text{cable loss}_{\ [dB]} + \text{antenna gain}_{\ [dBd/dBi]};$$

where P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_{g\ [dBm]}$ – cable loss $_{[dB]}$.

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	1/12/2023	Annual	1/12/2024	ETS
-	LTx1	Licensed Transmitter Cable Set	1/13/2023	Annual	1/13/2024	LTx1
Anritsu	MT8821C	Radio Communication Analyzer	N/A			6201525694
Espec	SCP-220	Environmental Chamber	5/25/2022	Annual	5/25/2023	OCPS5H0612K05
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/20/2021	Biennial	4/20/2023	00125518
Keysight Technologies	N9030A	PXA Signal Analyzer	9/6/2022	Annual	9/6/2023	MY54490576
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/29/2022	Annual	8/29/2023	100342
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	8/30/2022	Biennial	8/30/2023	A051107

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

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

Example: Spurious emission at 3700.40 MHz

The receive 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 analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Telit Communications S.p.A.

FCC ID: RI7LE910C1SNX

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): LTE

Test Condition	Test Description	FCC Part Section(s)	RSS Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power & Equivalent Isotropic Radiated Power	2.1046(a), 2.1046(c) 24.232(c)	RSS-Gen(6.12) RSS-133(6.4)	< 2 Watts max. EIRP	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	RSS-Gen(6.7)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions	2.1051, 24.238(a)	RSS-Gen(6.13), RSS-133(6.5)	> 43 + 10log10(P[Watts]) at Band Edge and for all out-of-band emissions	PASS	Sections 7.4, 7.5
	Peak-to-Average Ratio	24.232(d)	RSS-133(6.4)	≤ 13 dB	PASS	Section 7.6
	Frequency Stability	2.1055, 24.235	RSS-Gen(6.11), RSS-133(6.3)	Carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm	PASS	Section 7.8
RADIATED	Radiated Spurious Emissions	2.1053, 24.238(a)	RSS-Gen(6.13), RSS-133(6.5) RSS-133(6.6)	≥ 43 + 10 log (P[Watts]) dB of attenuation below transmitter power	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 were all 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) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.0.

7.2 Conducted Output Power Data and EIRP

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

Test Settings

1. Detector = RMS
2. Trace mode = trace average for continuous emissions, max hold for pulse emissions
3. Sweep time = auto couple
4. The trace was allowed to stabilize
5. Please see test notes below for RBW and VBW settings

Test Setup

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

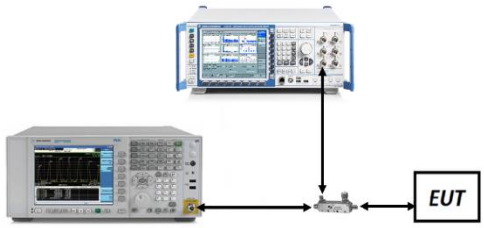


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. Conducted power measurements were evaluated using various combinations of RB size, RB offset, modulation, and channel bandwidth. Channel bandwidth data is shown in the tables below based only on the channel bandwidths that were supported in this device.

2. EIRP is calculated with conducted power and antenna gain.

3. This module is classified as Category 1 LTE which means that 16QAM only supports up to a maximum of 27RB's.

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
20 MHz	QPSK	18700	1860.0	1 / 50	22.38	3.50	25.88	0.387	33.01	-7.13
		18900	1880.0	1 / 50	22.74	3.50	26.24	0.421	33.01	-6.77
		19100	1900.0	1 / 50	22.81	3.50	26.31	0.427	33.01	-6.70
	16-QAM	18700	1860.0	1 / 99	21.43	3.50	24.93	0.311	33.01	-8.08
		18900	1880.0	1 / 0	21.73	3.50	25.23	0.333	33.01	-7.78
		19100	1900.0	1 / 99	21.82	3.50	25.32	0.340	33.01	-7.69
15 MHz	QPSK	18675	1857.5	1 / 37	22.67	3.50	26.17	0.414	33.01	-6.84
		18900	1880.0	1 / 37	22.87	3.50	26.37	0.434	33.01	-6.64
		19125	1902.5	1 / 37	22.82	3.50	26.32	0.428	33.01	-6.69
	16-QAM	18675	1857.5	1 / 37	22.28	3.50	25.78	0.379	33.01	-7.23
		18900	1880.0	1 / 0	22.25	3.50	25.75	0.376	33.01	-7.26
		19125	1902.5	1 / 37	22.38	3.50	25.88	0.387	33.01	-7.13
10 MHz	QPSK	18650	1855.0	1 / 0	22.58	3.50	26.08	0.406	33.01	-6.93
		18900	1880.0	1 / 0	22.80	3.50	26.30	0.427	33.01	-6.71
		19150	1905.0	1 / 49	22.51	3.50	26.01	0.399	33.01	-7.00
	16-QAM	18650	1855.0	1 / 0	21.65	3.50	25.15	0.327	33.01	-7.86
		18900	1880.0	1 / 0	22.12	3.50	25.62	0.365	33.01	-7.39
		19150	1905.0	1 / 25	21.86	3.50	25.36	0.343	33.01	-7.65
5 MHz	QPSK	18625	1852.5	1 / 12	22.72	3.50	26.22	0.419	33.01	-6.79
		18900	1880.0	1 / 12	22.63	3.50	26.13	0.410	33.01	-6.88
		19175	1907.5	1 / 12	22.54	3.50	26.04	0.402	33.01	-6.97
	16-QAM	18625	1852.5	1 / 12	22.09	3.50	25.59	0.362	33.01	-7.42
		18900	1880.0	1 / 12	21.82	3.50	25.32	0.340	33.01	-7.69
		19175	1907.5	1 / 12	21.77	3.50	25.27	0.337	33.01	-7.74
3 MHz	QPSK	18615	1851.5	1 / 7	23.10	3.50	26.60	0.457	33.01	-6.41
		18900	1880.0	1 / 0	22.76	3.50	26.26	0.423	33.01	-6.75
		19185	1908.5	1 / 7	22.63	3.50	26.13	0.410	33.01	-6.88
	16-QAM	18615	1851.5	1 / 7	22.14	3.50	25.64	0.366	33.01	-7.37
		18900	1880.0	1 / 7	21.91	3.50	25.41	0.348	33.01	-7.60
		19185	1908.5	1 / 7	22.18	3.50	25.68	0.370	33.01	-7.33
1.4 MHz	QPSK	18607	1850.7	1 / 0	22.92	3.50	26.42	0.438	33.01	-6.59
		18900	1880.0	1 / 3	22.72	3.50	26.22	0.419	33.01	-6.79
		19193	1909.3	1 / 3	22.42	3.50	25.92	0.391	33.01	-7.09
	16-QAM	18607	1850.7	1 / 3	22.19	3.50	25.69	0.371	33.01	-7.32
		18900	1880.0	1 / 0	21.75	3.50	25.25	0.335	33.01	-7.76
		19193	1909.3	1 / 0	21.46	3.50	24.96	0.314	33.01	-8.05

Table 7-2. Conducted power measurements

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.

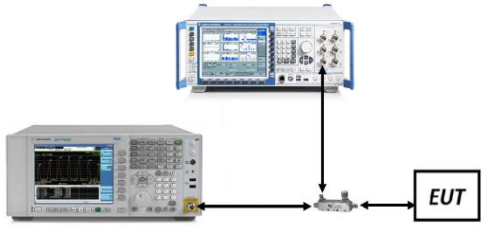
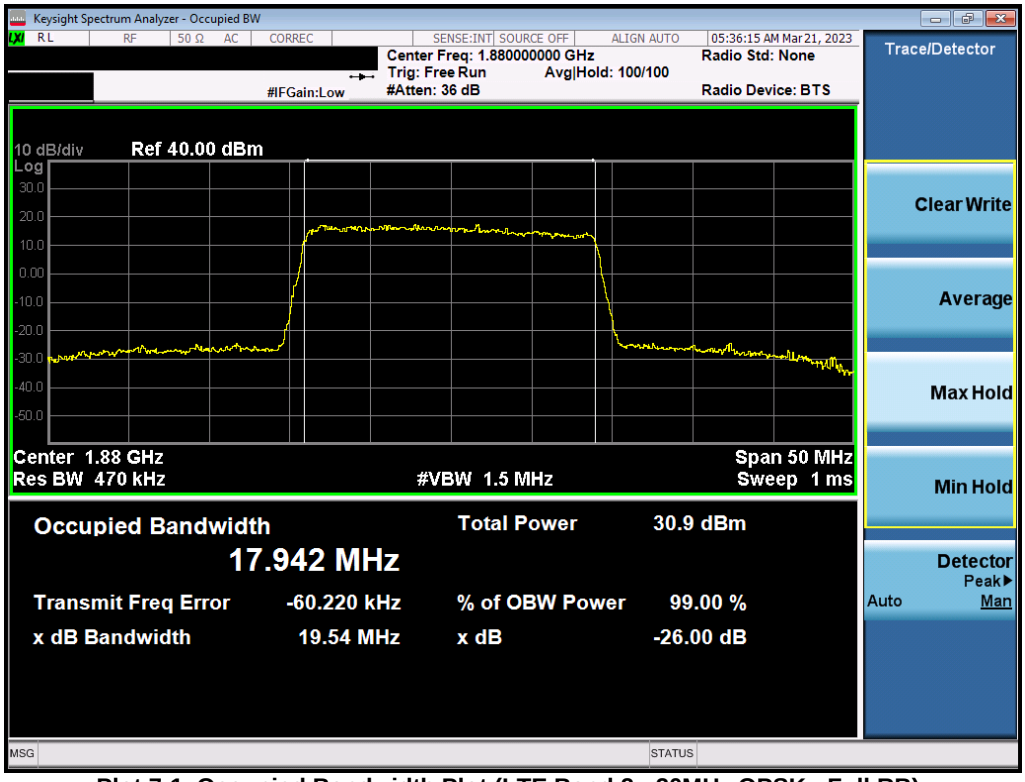


Figure 7-2. Test Instrument & Measurement Setup

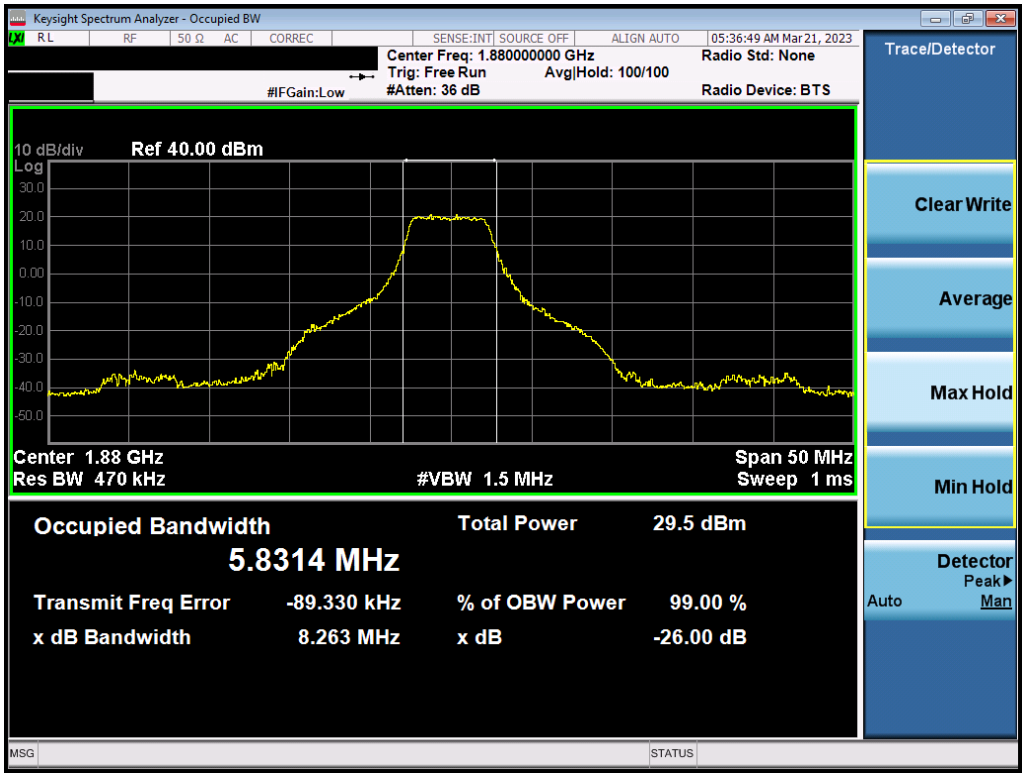
Test Notes

None.

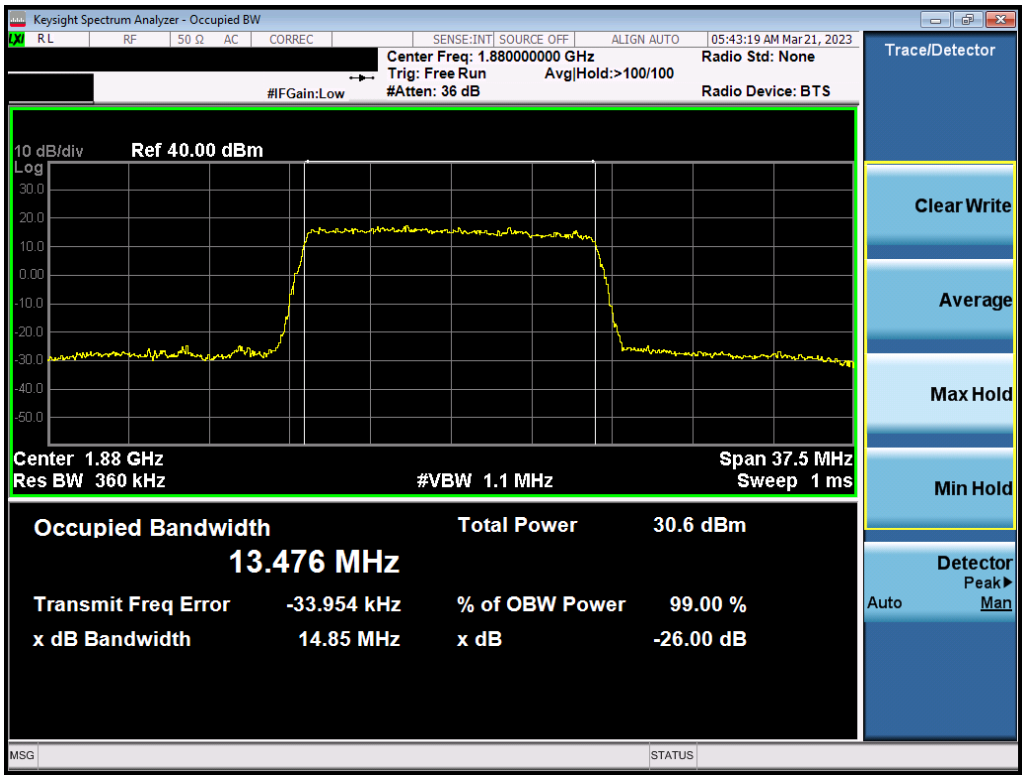
LTE Band 2



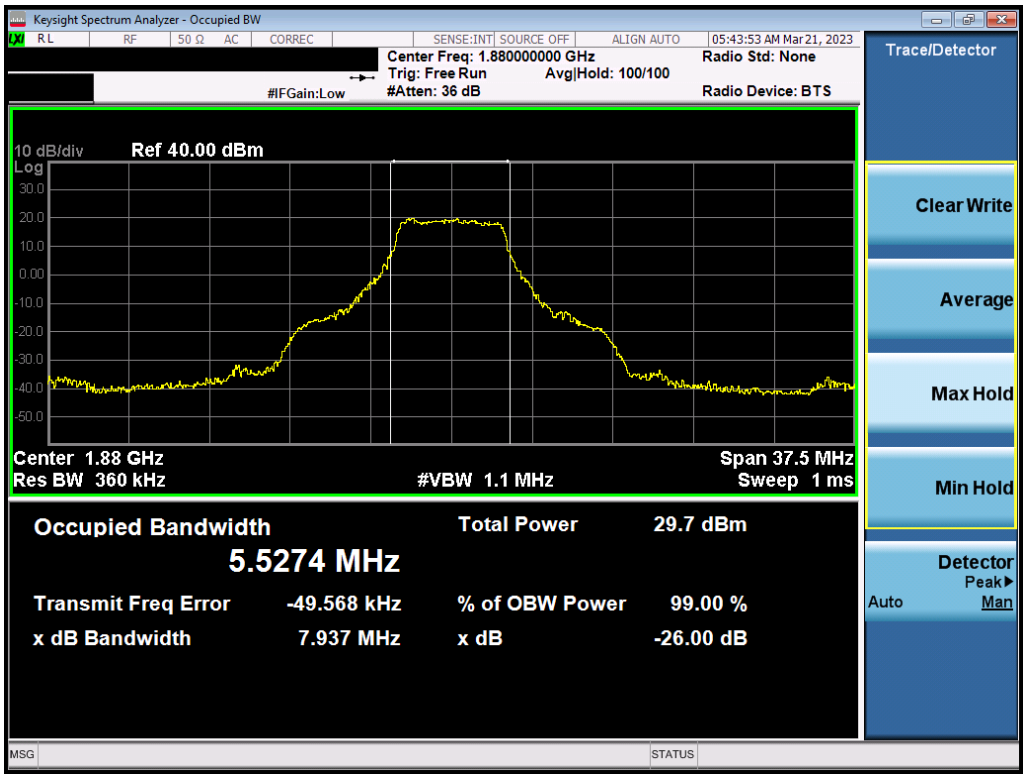
Plot 7-1. Occupied Bandwidth Plot (LTE Band 2 - 20MHz QPSK - Full RB)



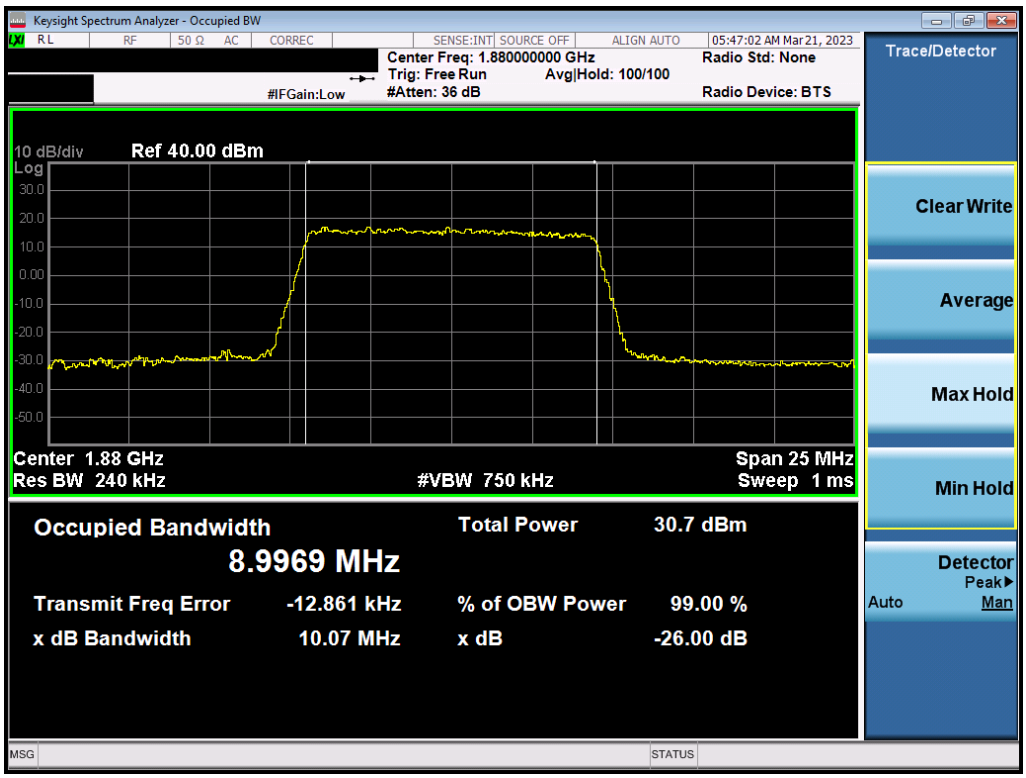
Plot 7-2. Occupied Bandwidth Plot (LTE Band 2 - 20MHz 16-QAM - 27 RB)



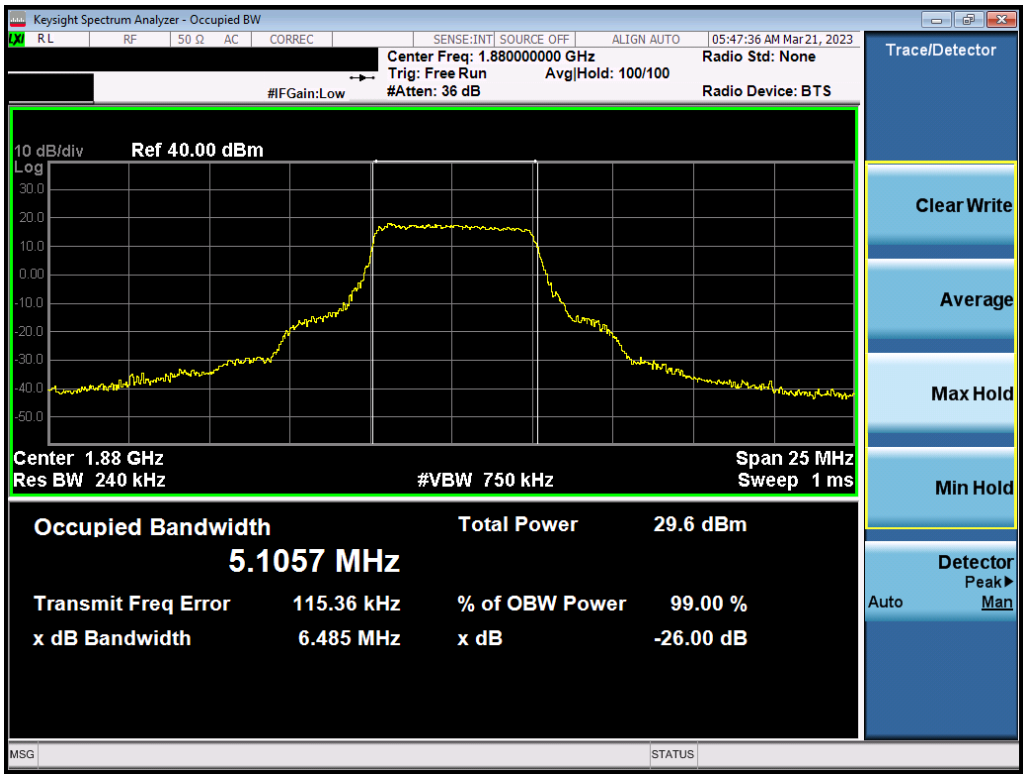
Plot 7-3. Occupied Bandwidth Plot (LTE Band 2 - 15MHz QPSK - Full RB)



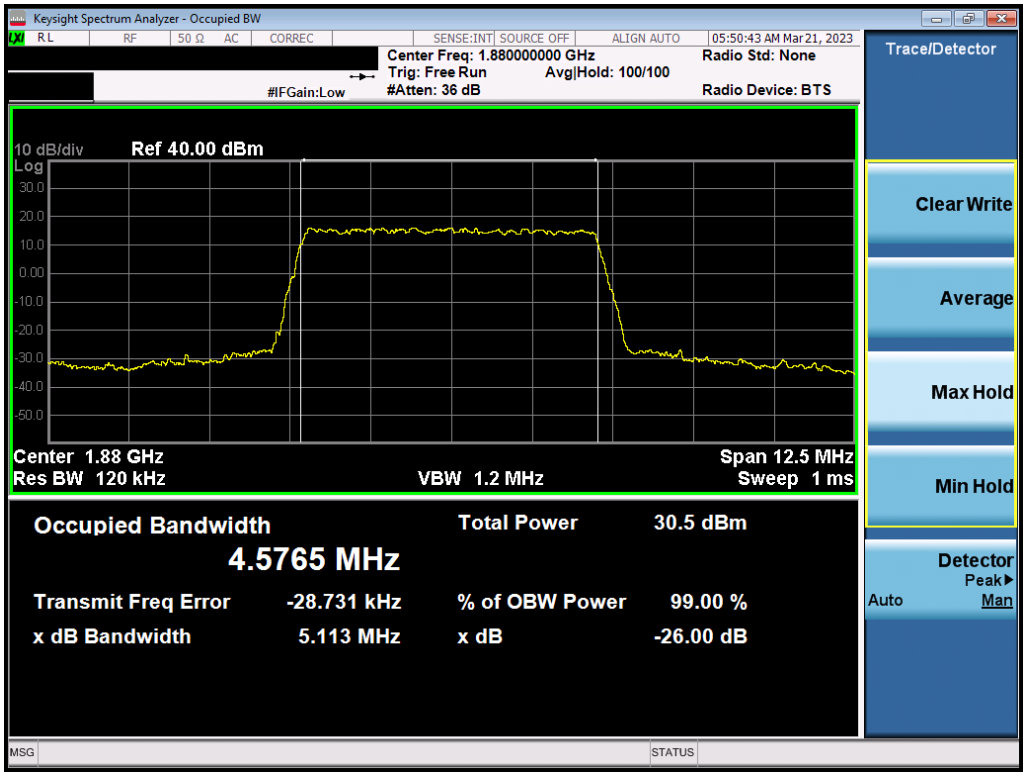
Plot 7-4. Occupied Bandwidth Plot (LTE Band 2 - 15MHz 16-QAM - 27 RB)



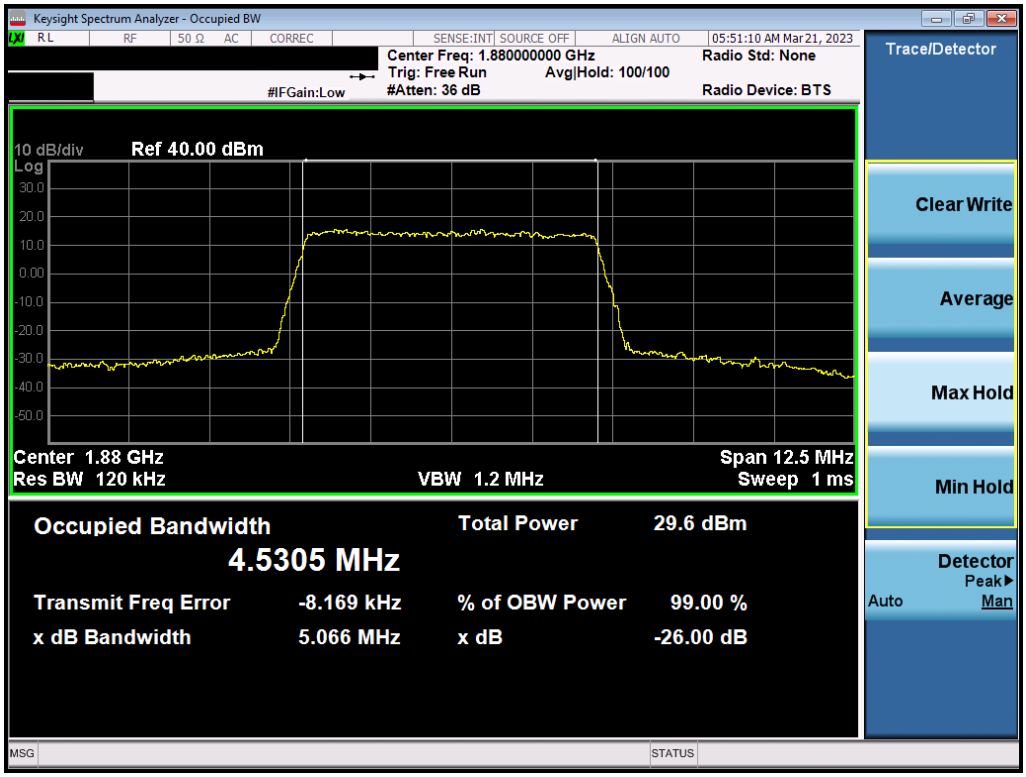
Plot 7-5. Occupied Bandwidth Plot (LTE Band 2 - 10MHz QPSK - Full RB)



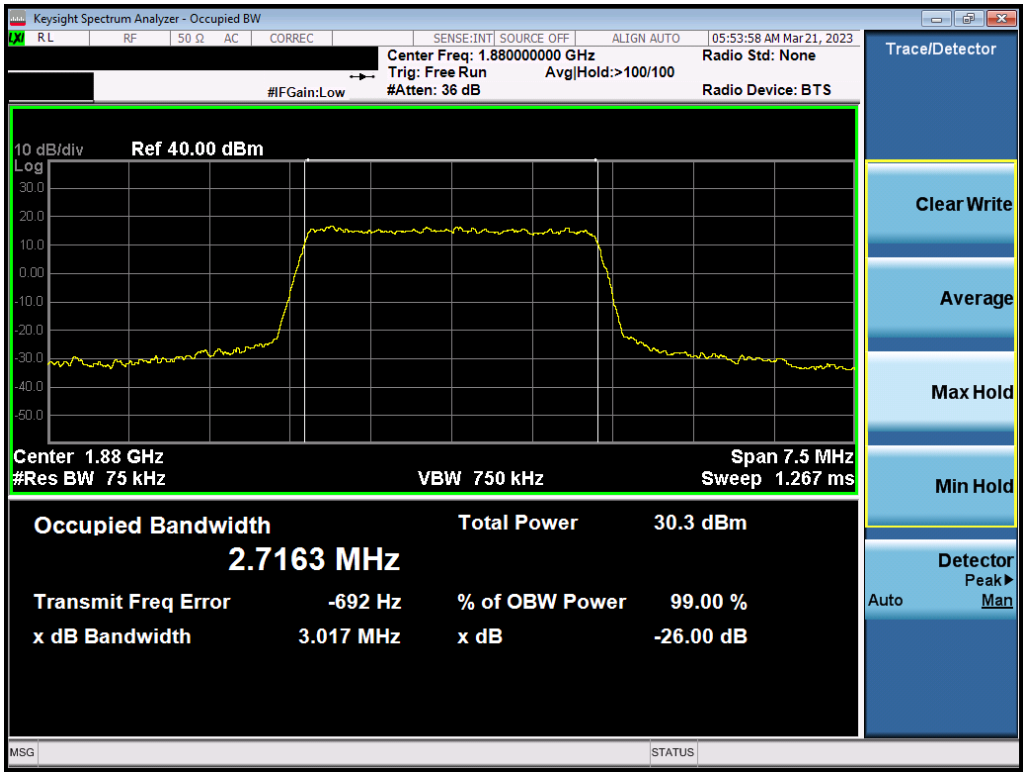
Plot 7-6. Occupied Bandwidth Plot (LTE Band 2 - 10MHz 16-QAM - 27 RB)



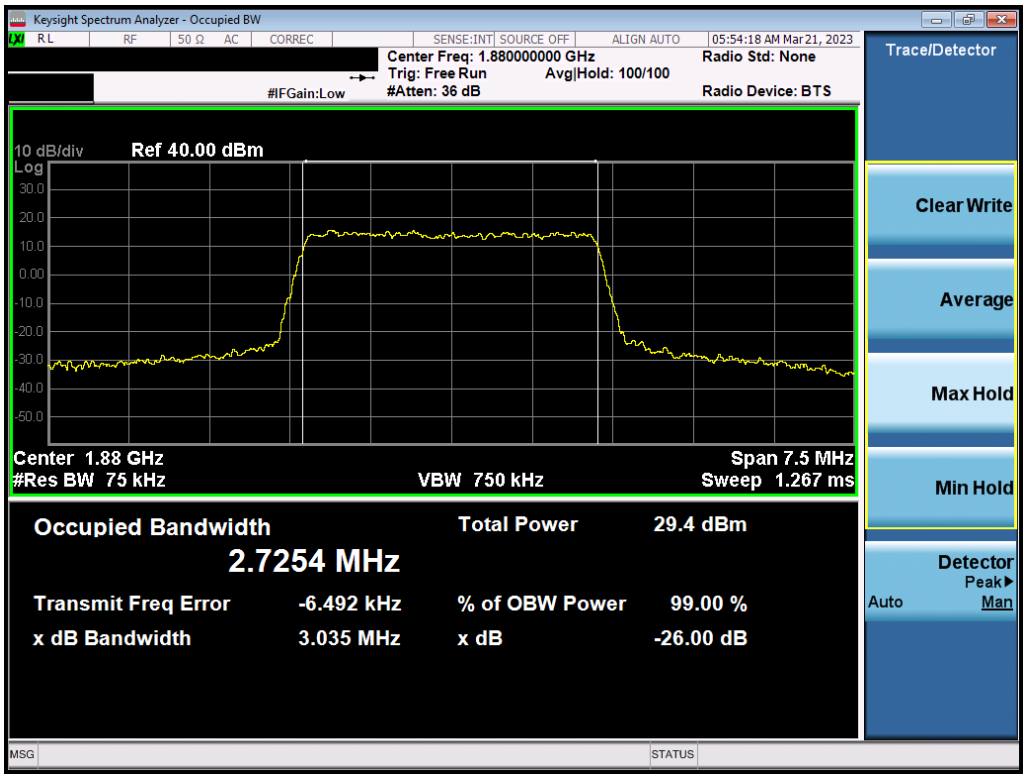
Plot 7-7. Occupied Bandwidth Plot (LTE Band 2 - 5MHz QPSK - Full RB)



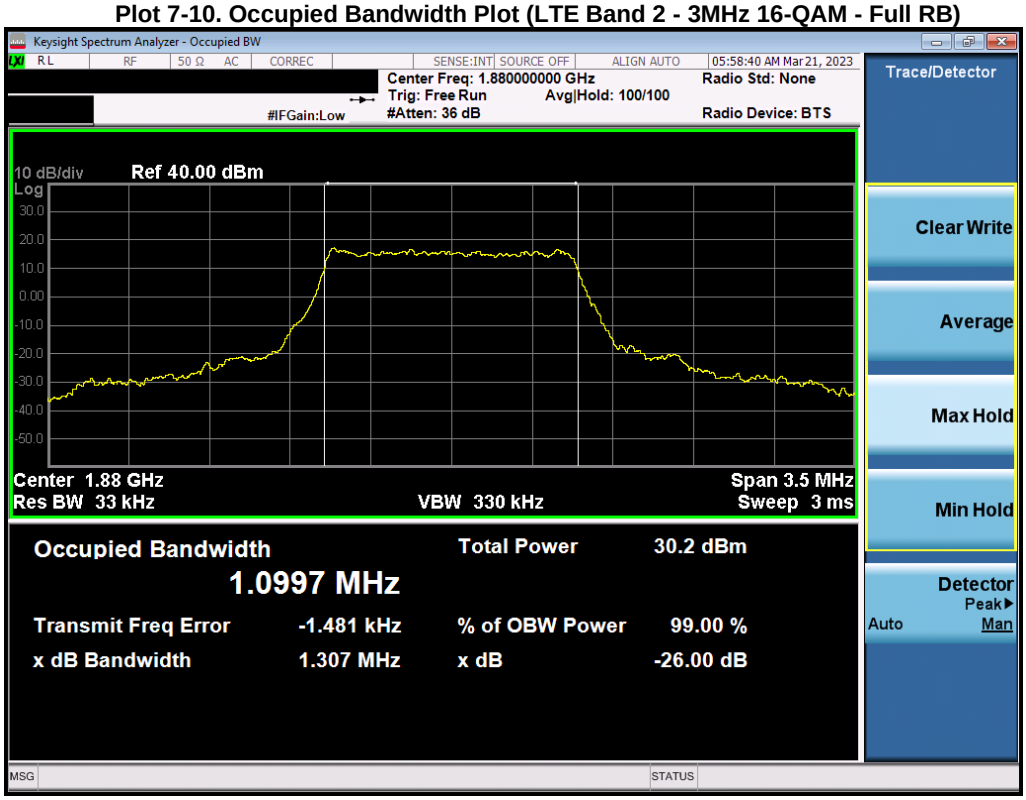
Plot 7-8. Occupied Bandwidth Plot (LTE Band 2 - 5MHz 16-QAM - Full RB)



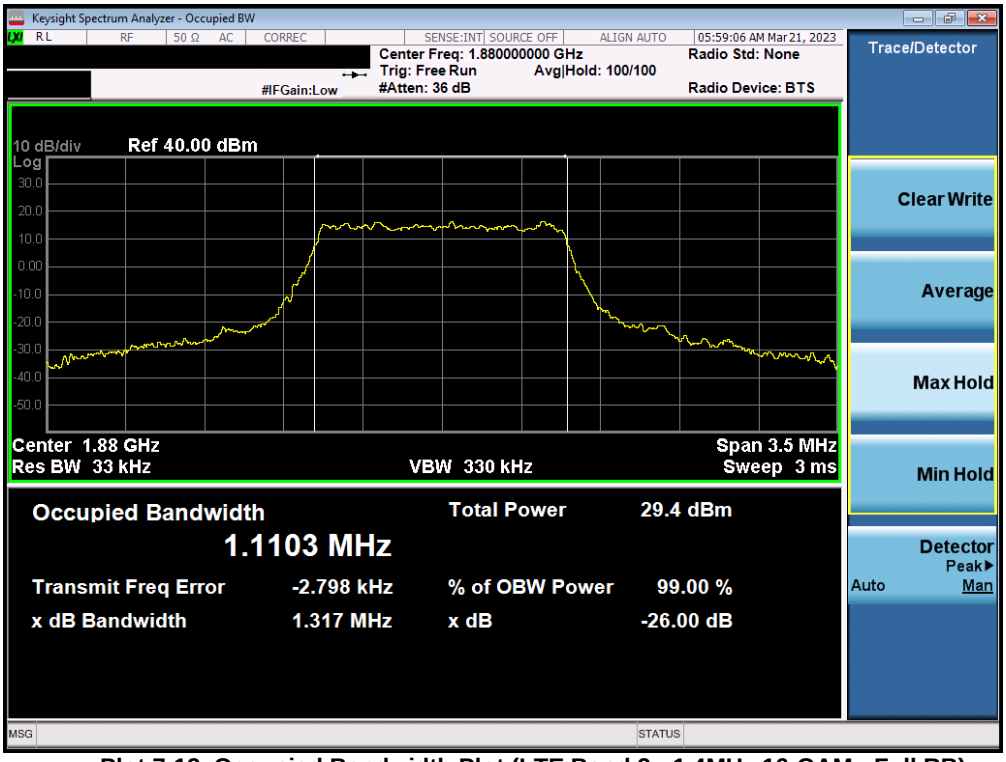
Plot 7-9. Occupied Bandwidth Plot (LTE Band 2 - 3MHz QPSK - Full RB)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 2 - 3MHz 16-QAM - Full RB)



Plot 7-11. Occupied Bandwidth Plot (LTE Band 2 - 1.4MHz QPSK - Full RB)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 2 - 1.4MHz 16-QAM - 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.

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 20GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

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

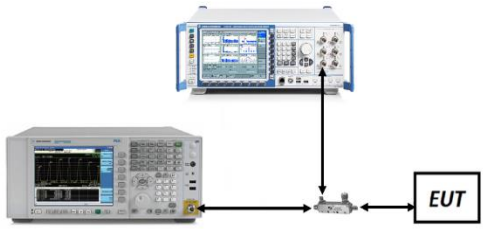
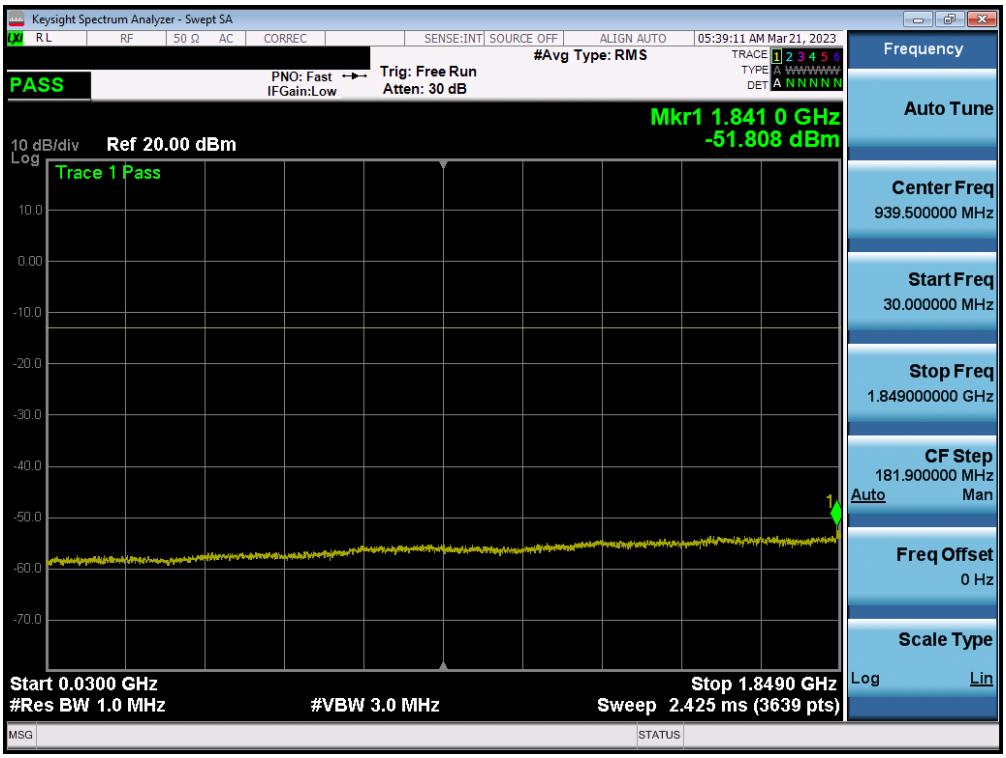


Figure 7-3. Test Instrument & Measurement Setup

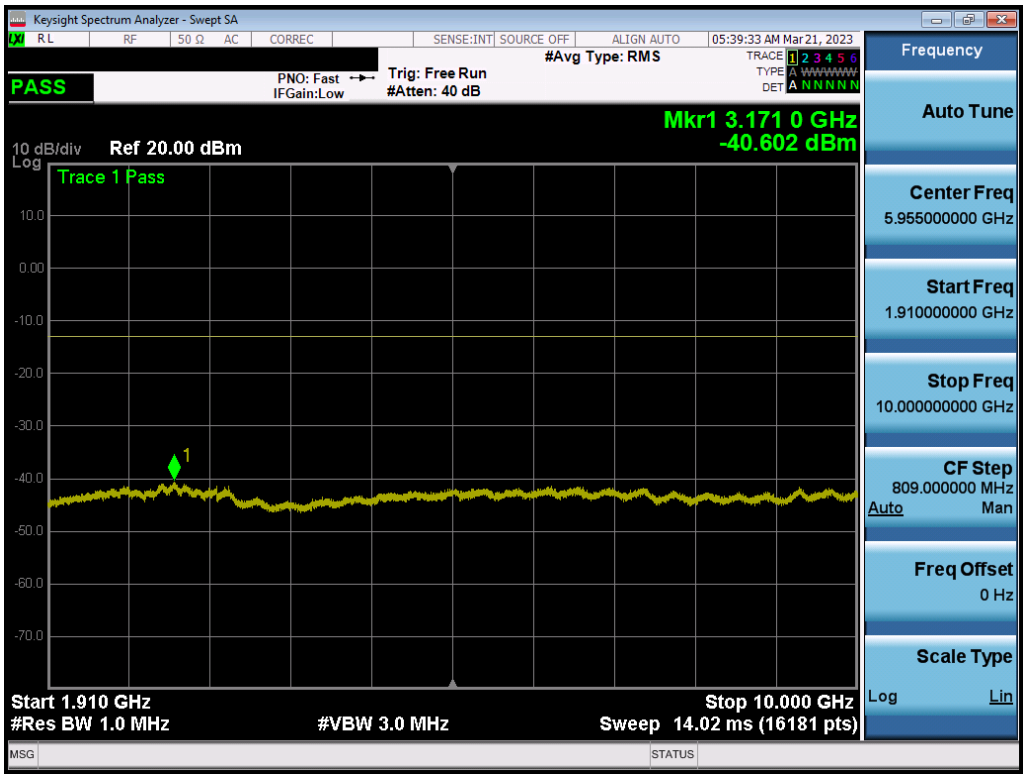
Test Notes

Per Part 24 and RSS-133, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz.

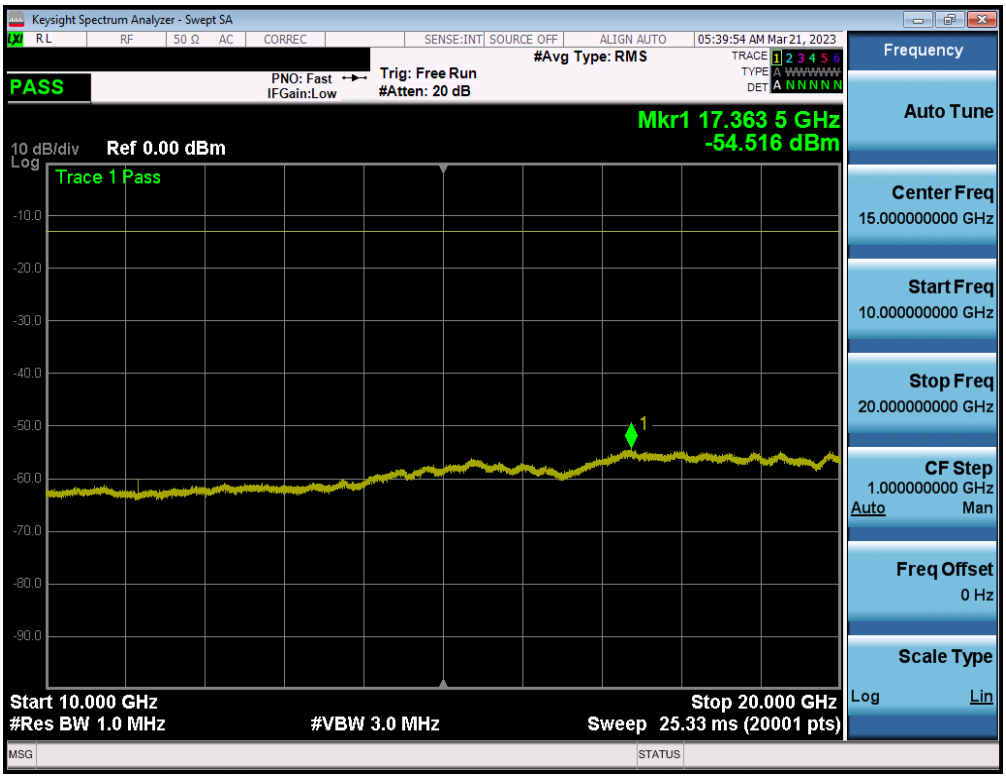
LTE Band 2



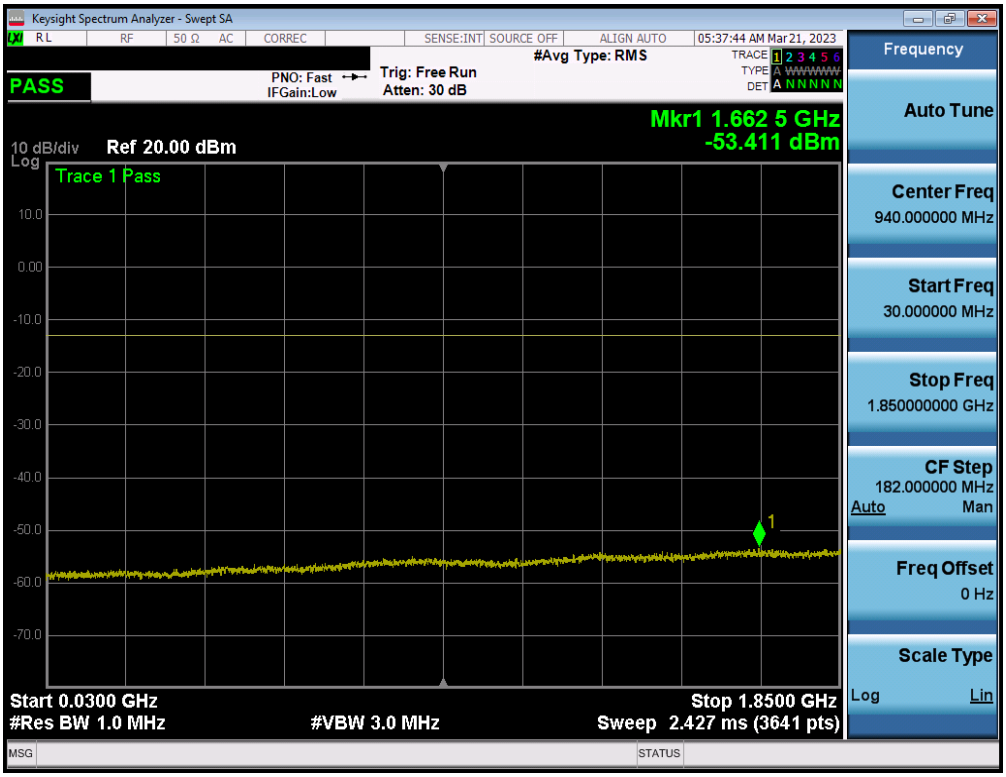
Plot 7-13. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Low Channel)



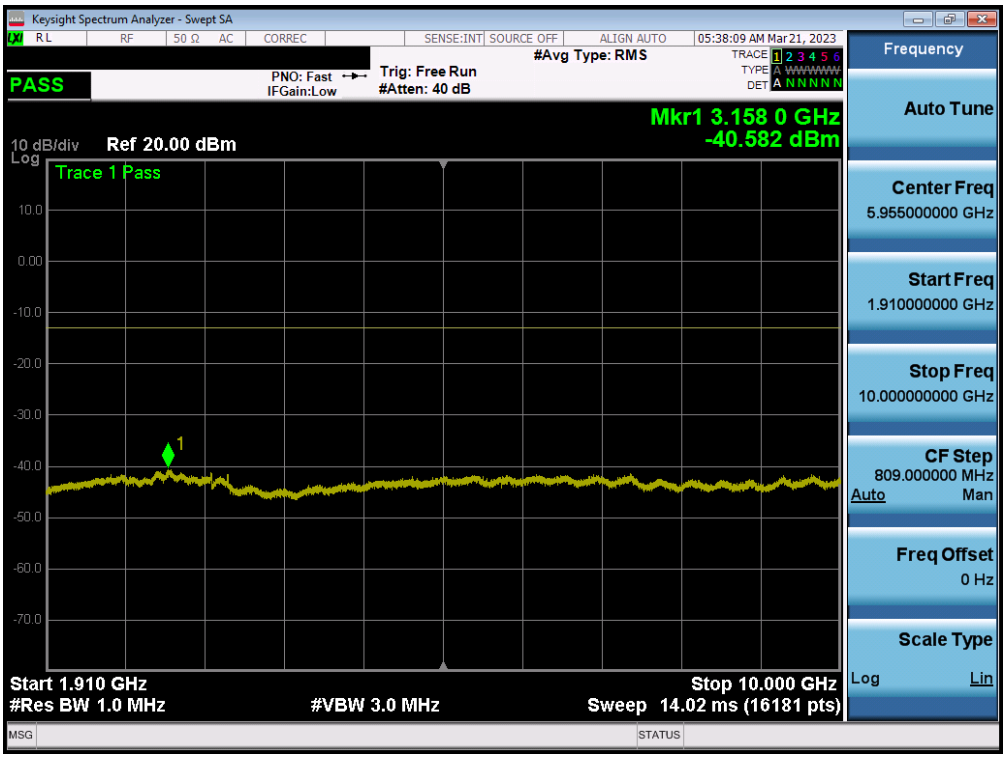
Plot 7-14. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Low Channel)



Plot 7-15. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Low Channel)

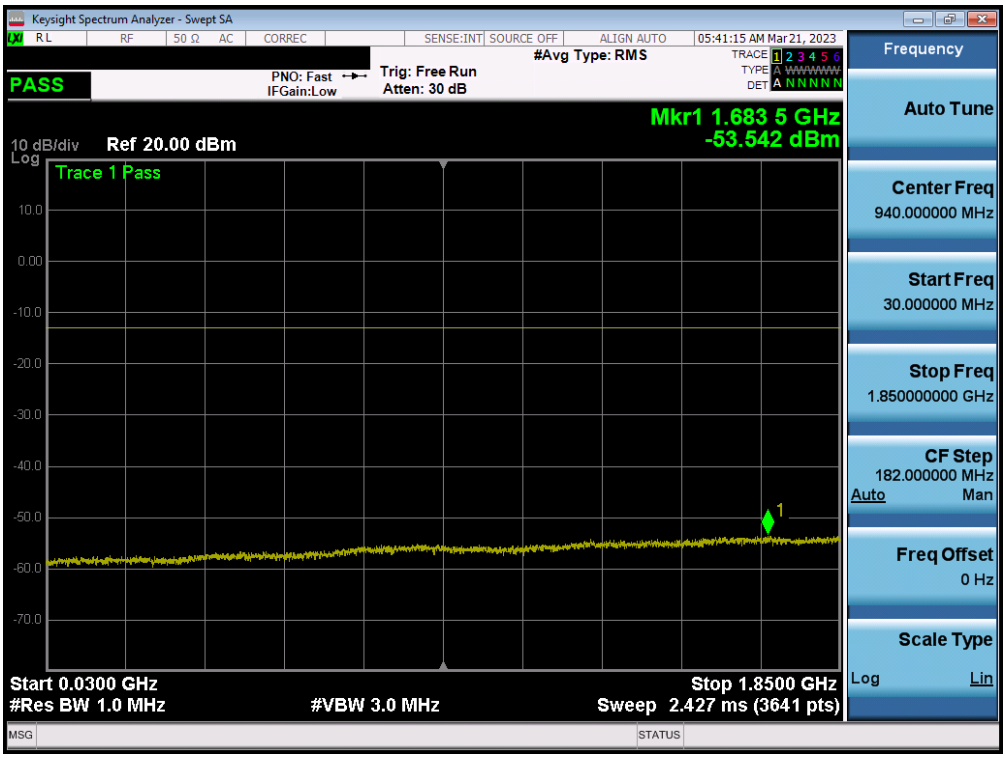


Plot 7-16. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Mid Channel)

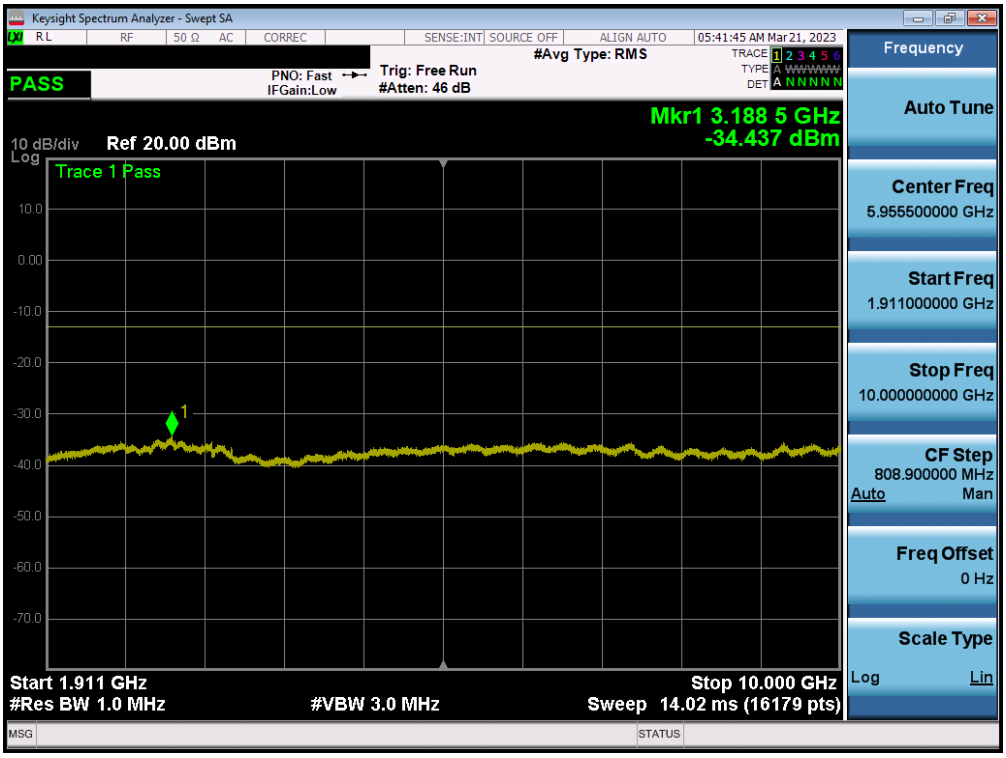


Plot 7-17. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Mid Channel)

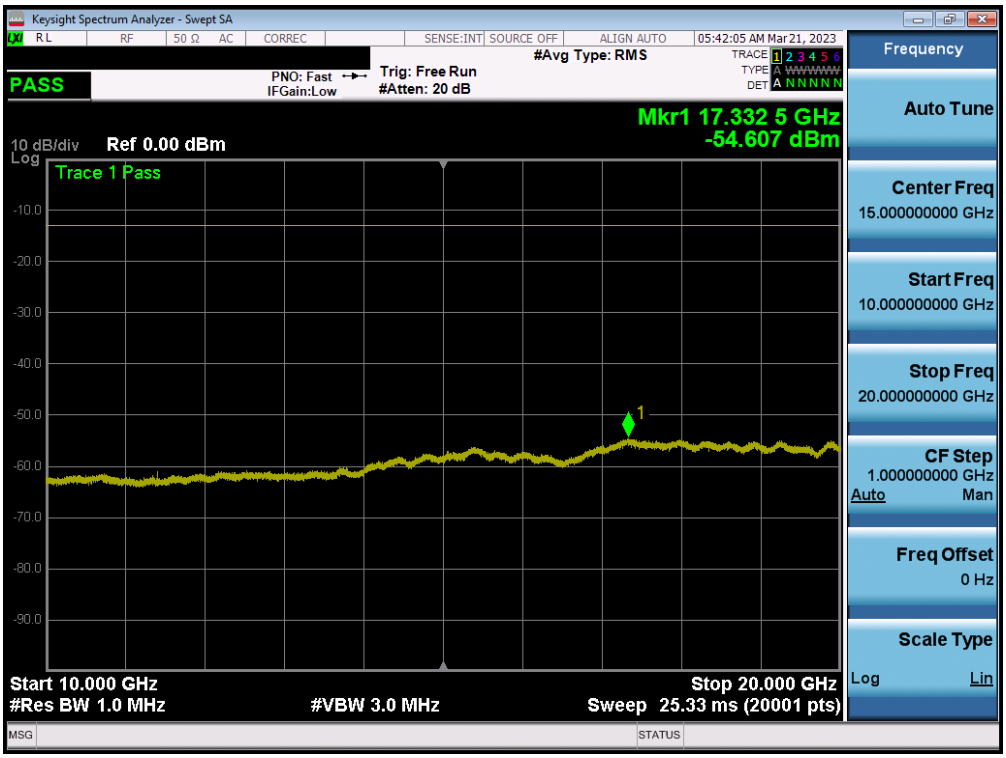
Plot 7-18. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - Mid Channel)



Plot 7-19. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - High Channel)



Plot 7-20. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - High Channel)



Plot 7-21. Conducted Spurious Plot (LTE Band 2 - 20MHz QPSK - 1RB - 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 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.

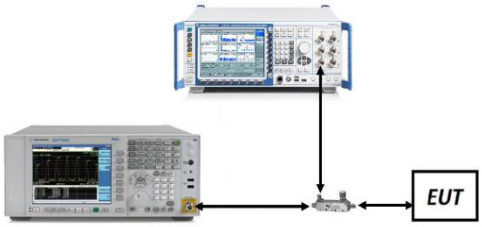


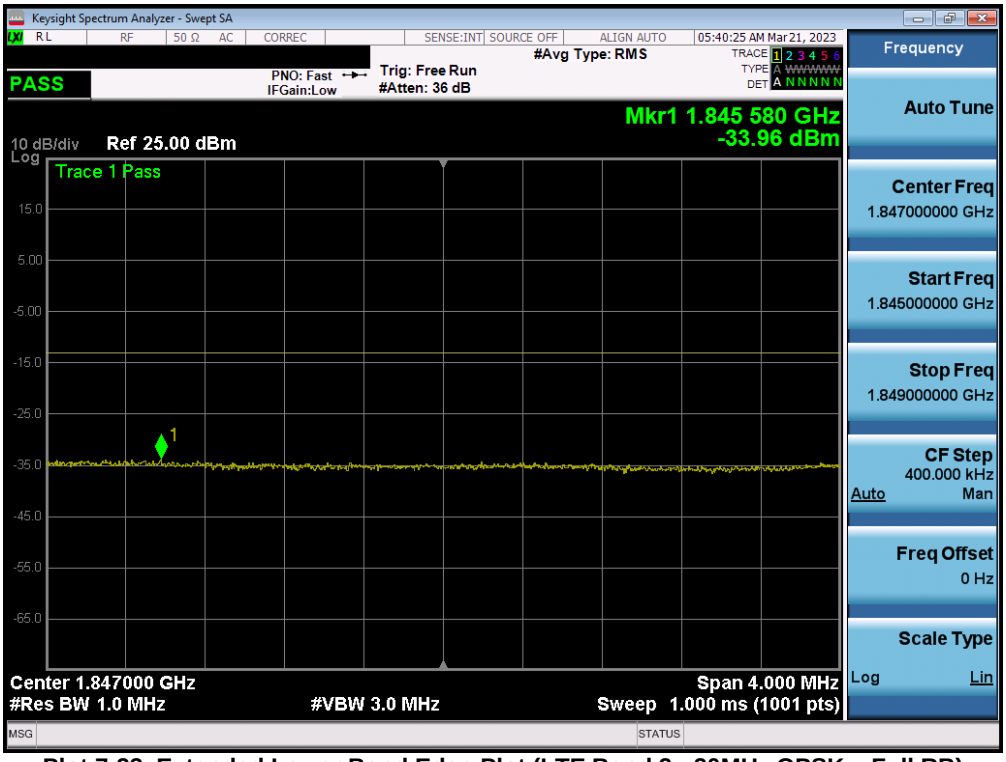
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

Per 24.238(b) and RSS-133(6.5), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

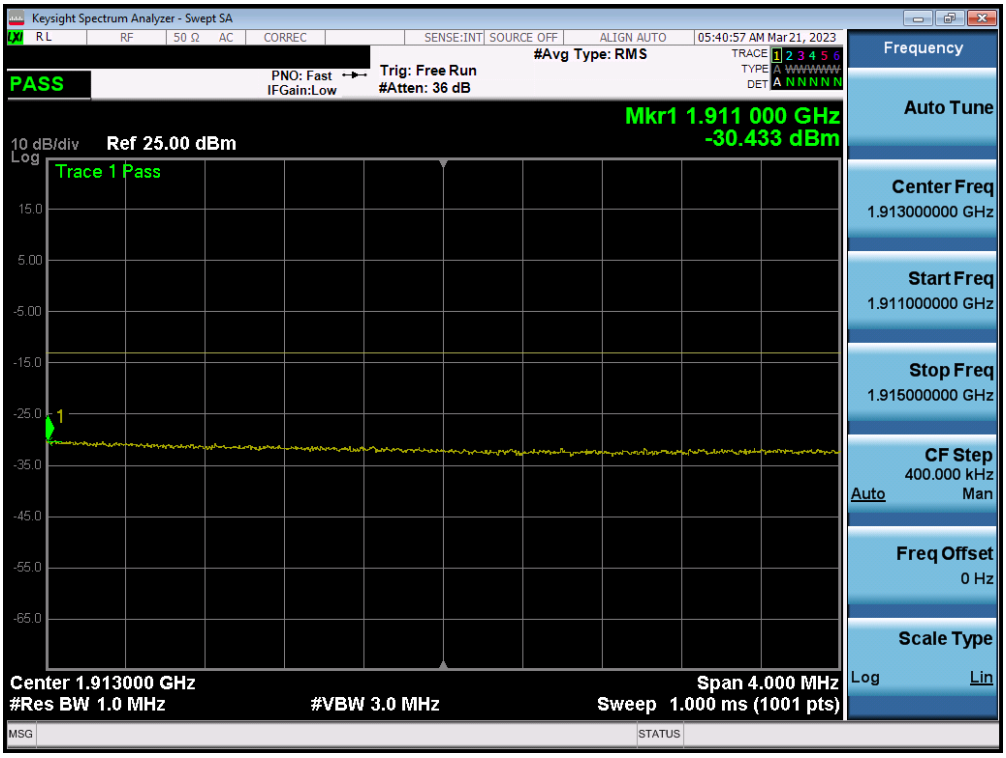
LTE Band 2

Plot 7-22. Lower Band Edge Plot (LTE Band 2 - 20MHz QPSK – Full RB)

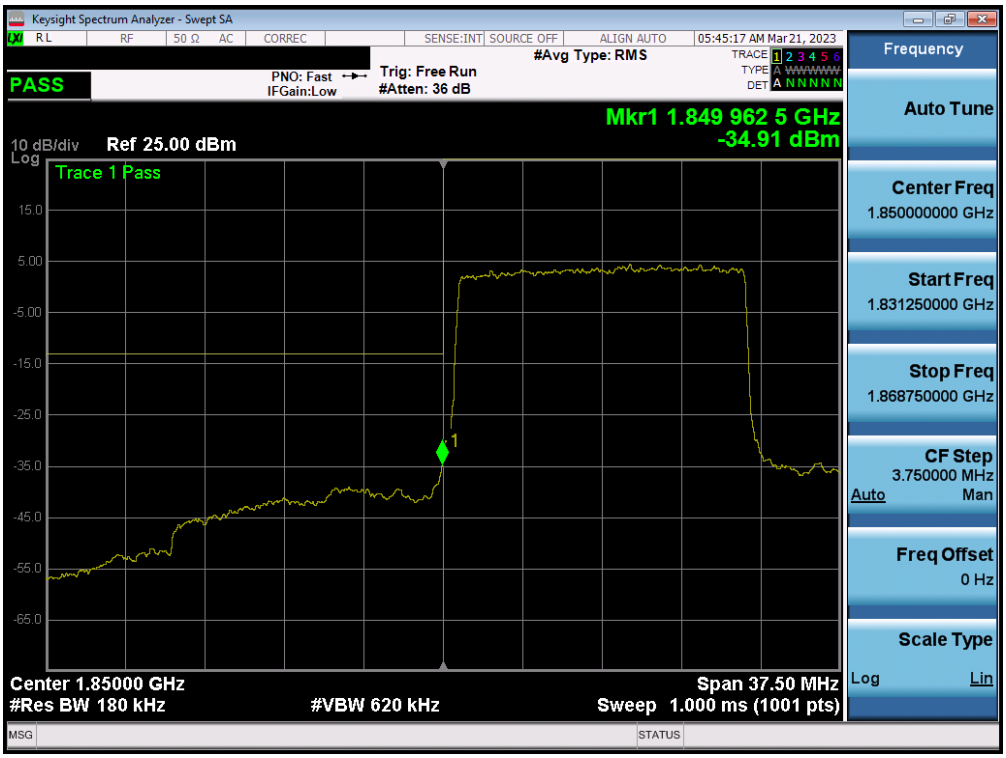


Plot 7-23. Extended Lower Band Edge Plot (LTE Band 2 - 20MHz QPSK – Full RB)

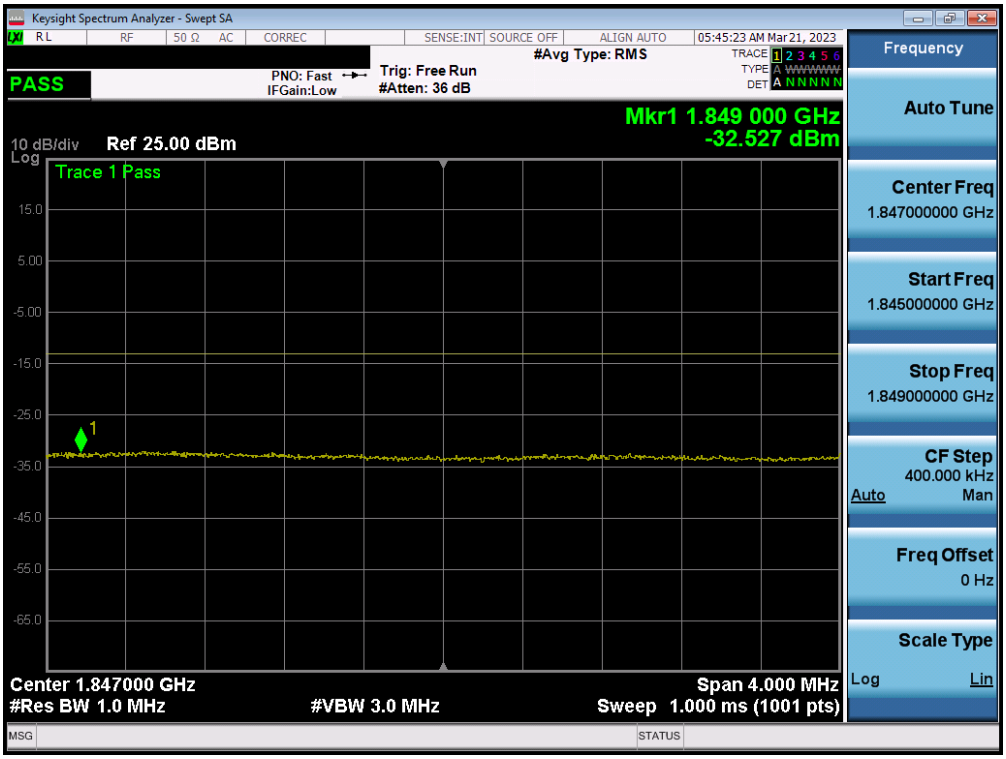
Plot 7-24. Upper Band Edge Plot (LTE Band 2 - 20MHz QPSK – Full RB)



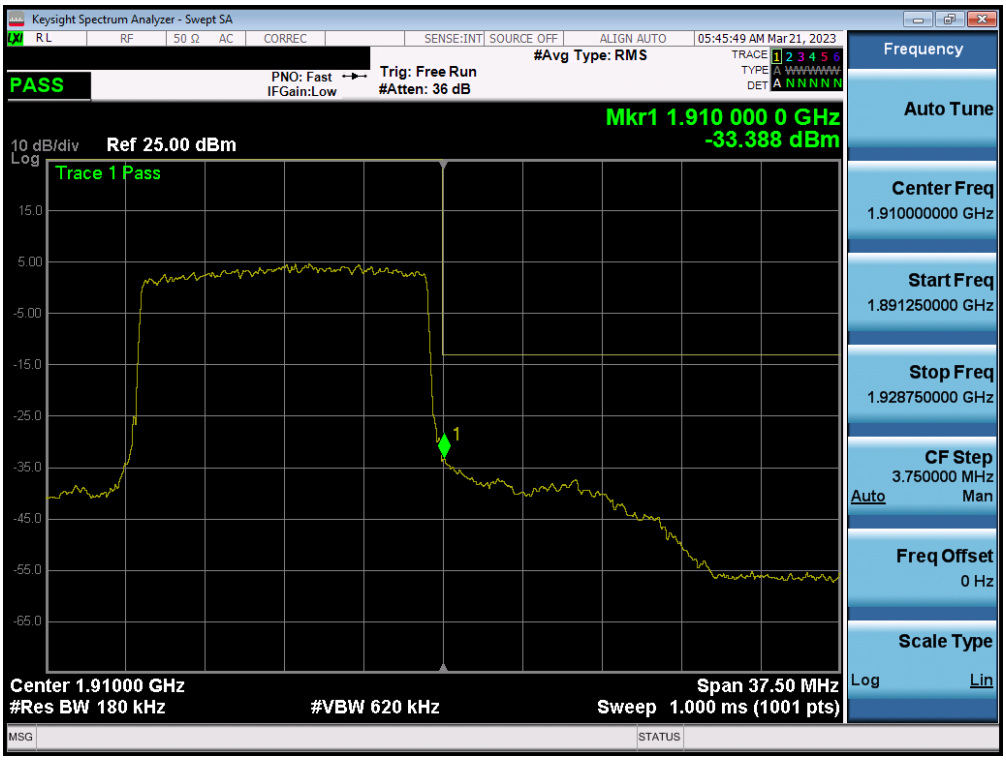
Plot 7-25. Extended Upper Band Edge Plot (LTE Band 2 - 20MHz QPSK – Full RB)



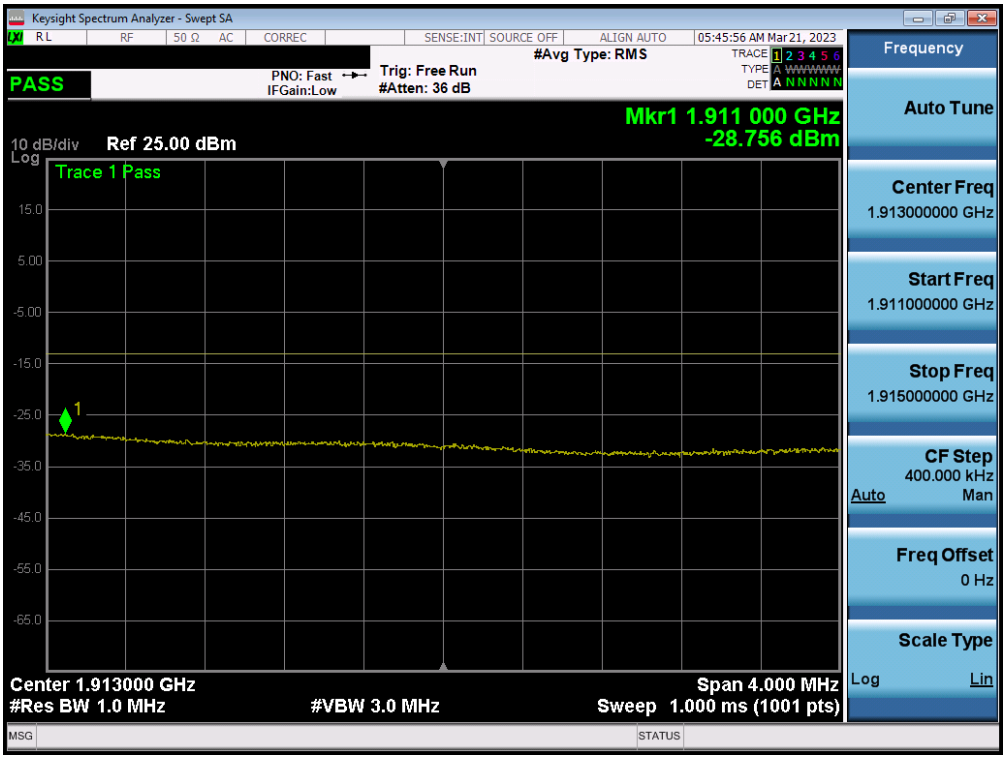
Plot 7-26. Lower Band Edge Plot (LTE Band 2 - 15MHz QPSK – Full RB)



Plot 7-27. Extended Lower Band Edge Plot (LTE Band 2 - 15MHz QPSK – Full RB)

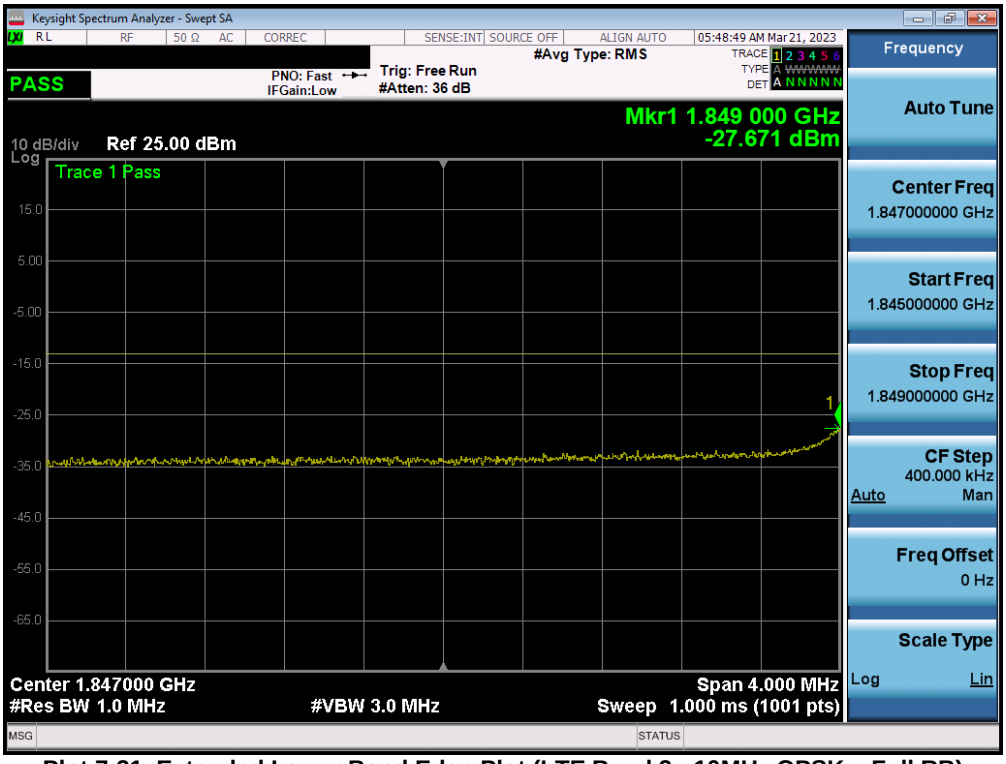


Plot 7-28. Upper Band Edge Plot (LTE Band 2 - 15MHz QPSK – Full RB)



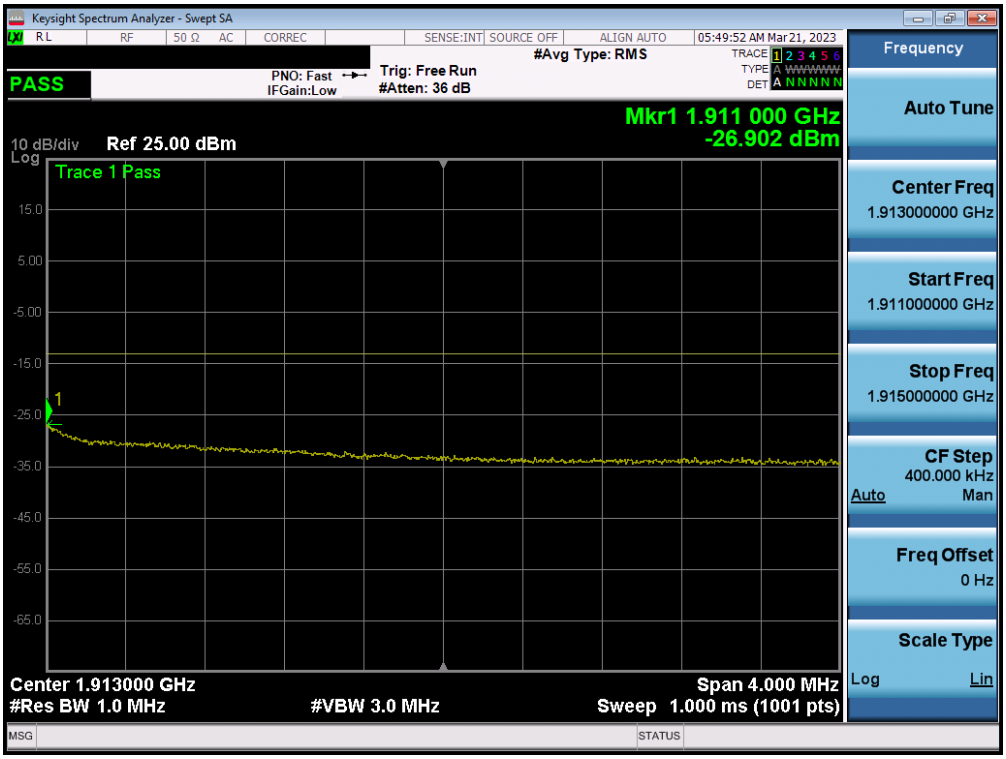
Plot 7-29. Extended Upper Band Edge Plot (LTE Band 2 - 15MHz QPSK – Full RB)

Plot 7-30. Lower Band Edge Plot (LTE Band 2 - 10MHz QPSK – Full RB)

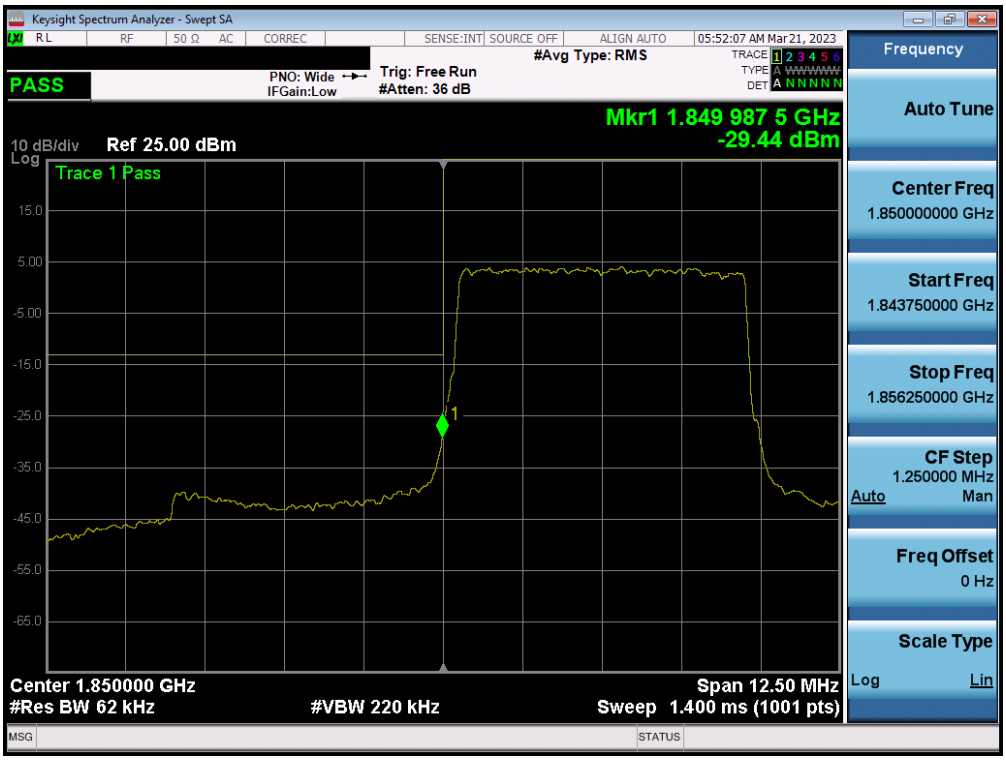


Plot 7-31. Extended Lower Band Edge Plot (LTE Band 2 - 10MHz QPSK – Full RB)

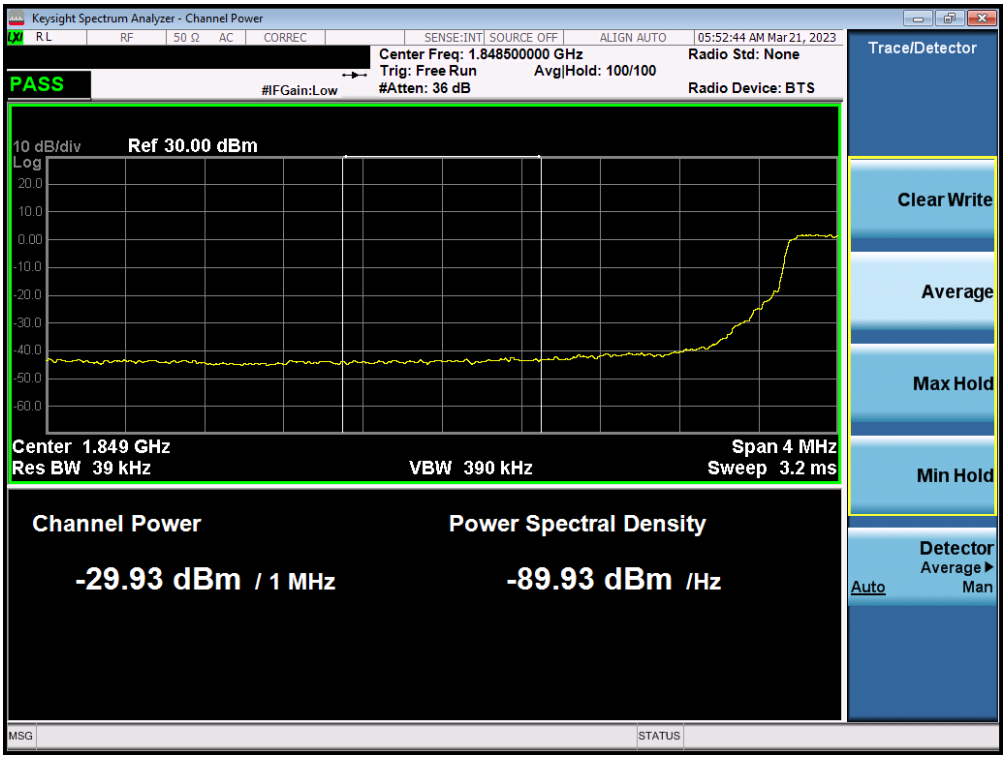
Plot 7-32. Upper Band Edge Plot (LTE Band 2 - 10MHz QPSK – Full RB)



Plot 7-33. Extended Upper Band Edge Plot (LTE Band 2 - 10MHz QPSK – Full RB)

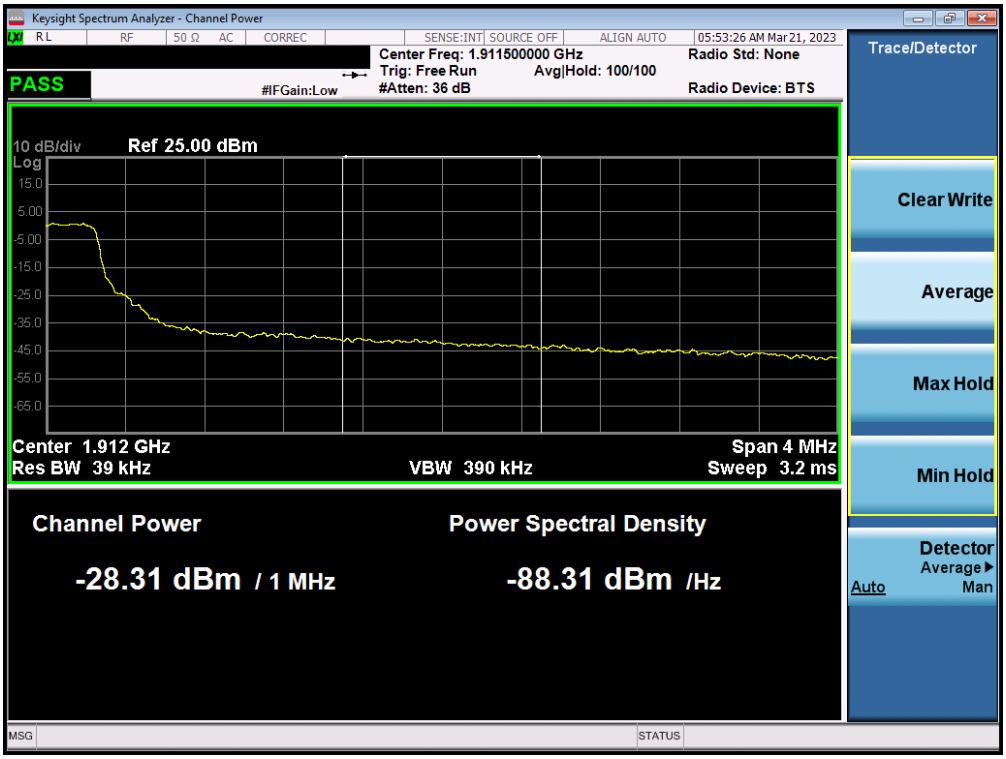


Plot 7-34. Lower Band Edge Plot (LTE Band 2 - 5MHz QPSK – Full RB)

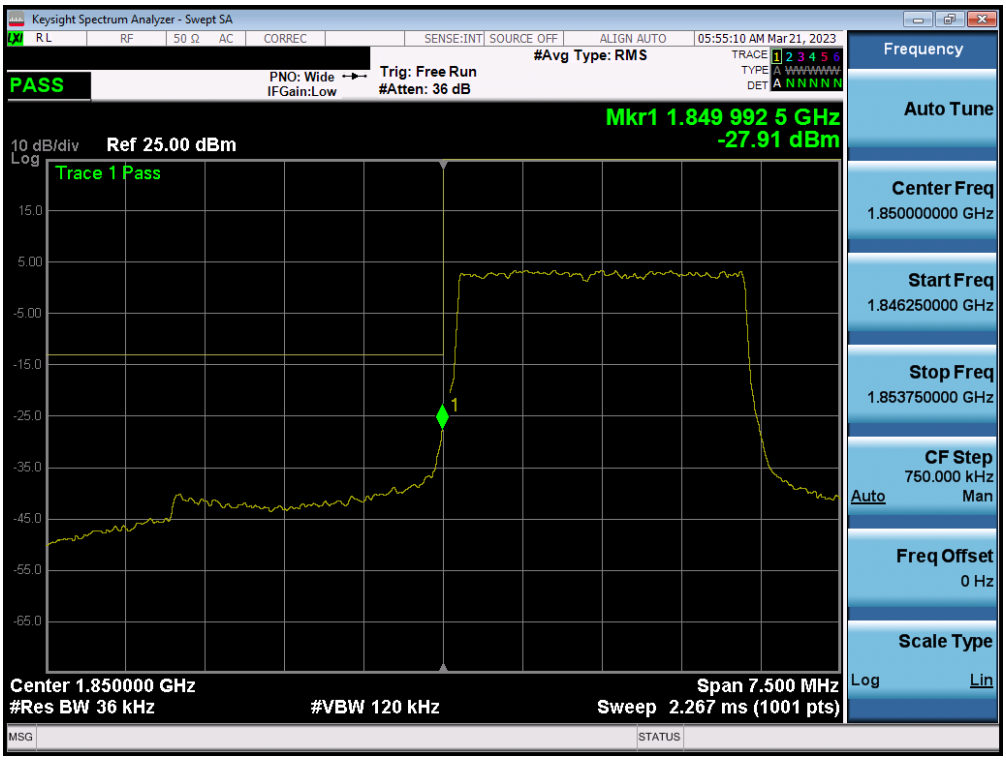


Plot 7-35. Extended Lower Band Edge Plot (LTE Band 2 - 5MHz QPSK – Full RB)

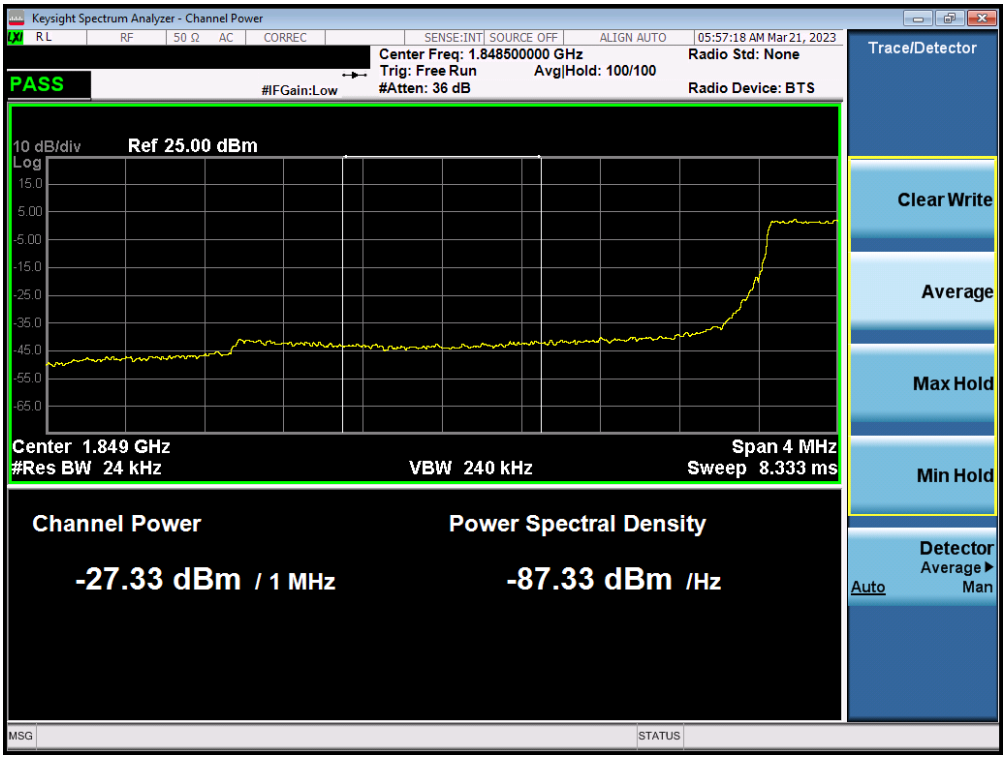
Plot 7-36. Upper Band Edge Plot (LTE Band 2 - 5MHz QPSK – Full RB)



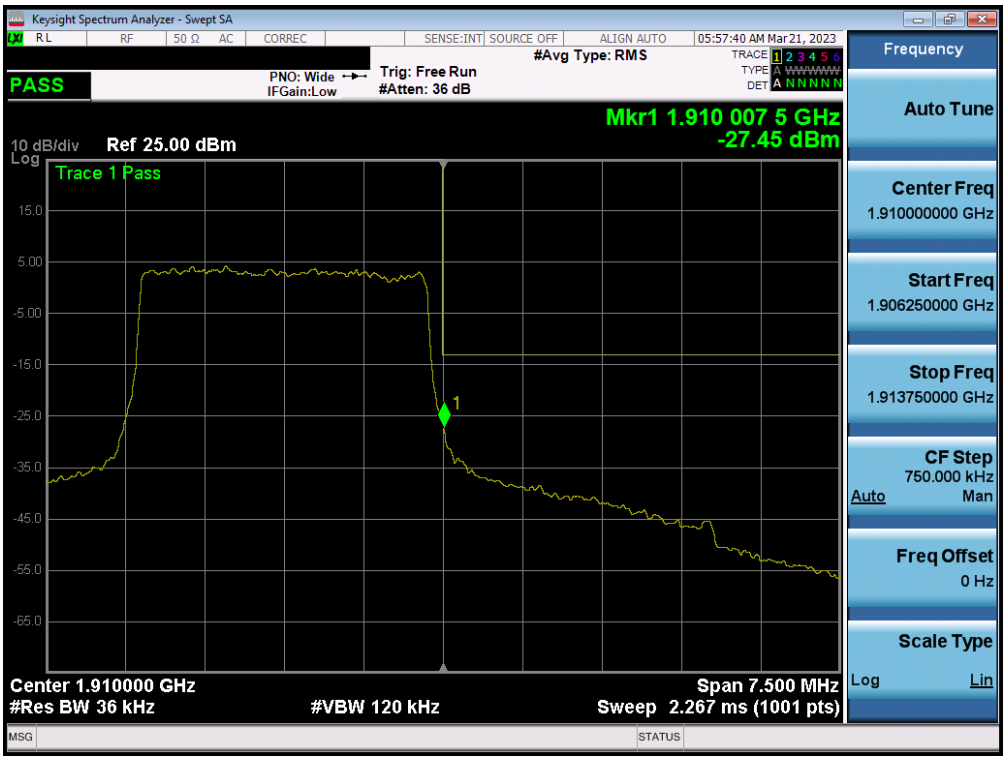
Plot 7-37. Extended Upper Band Edge Plot (LTE Band 2 - 5MHz QPSK – Full RB)



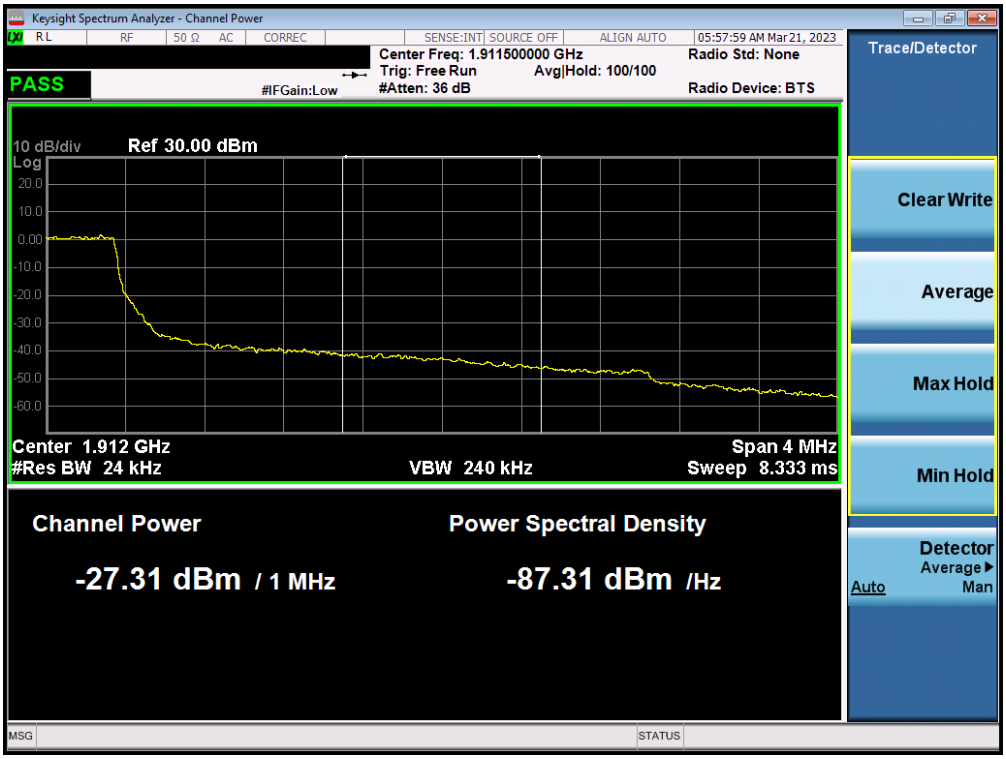
Plot 7-38. Lower Band Edge Plot (LTE Band 2 - 3MHz QPSK – Full RB)



Plot 7-39. Extended Lower Band Edge Plot (LTE Band 2 - 3MHz QPSK – Full RB)

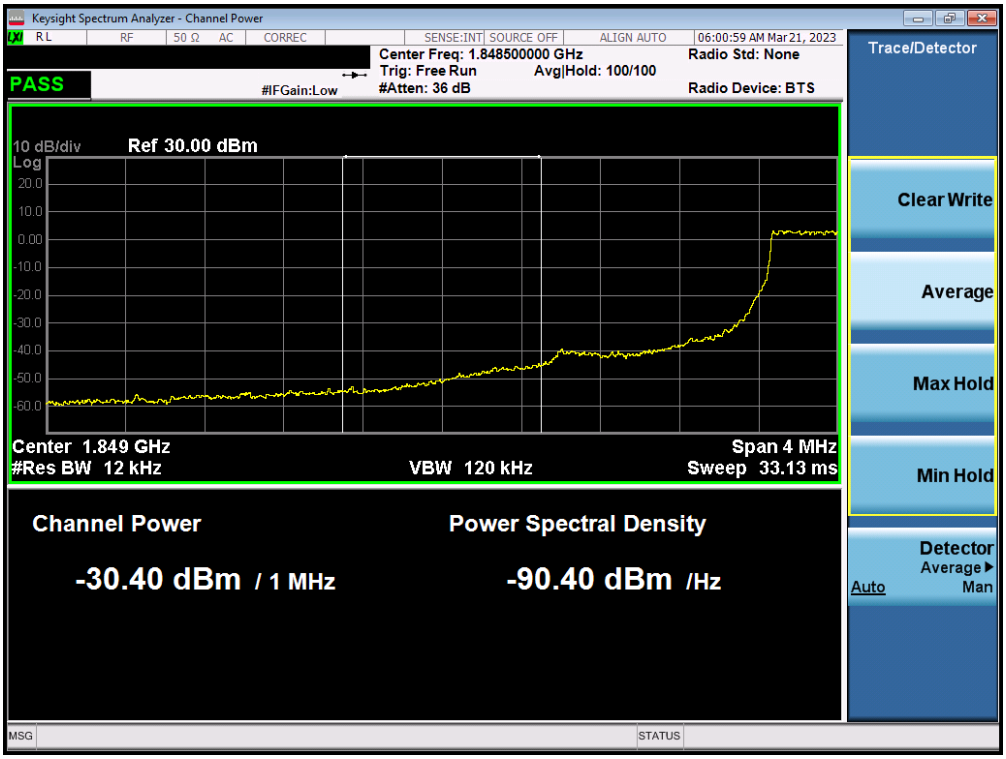


Plot 7-40. Upper Band Edge Plot (LTE Band 2 - 3MHz QPSK – Full RB)



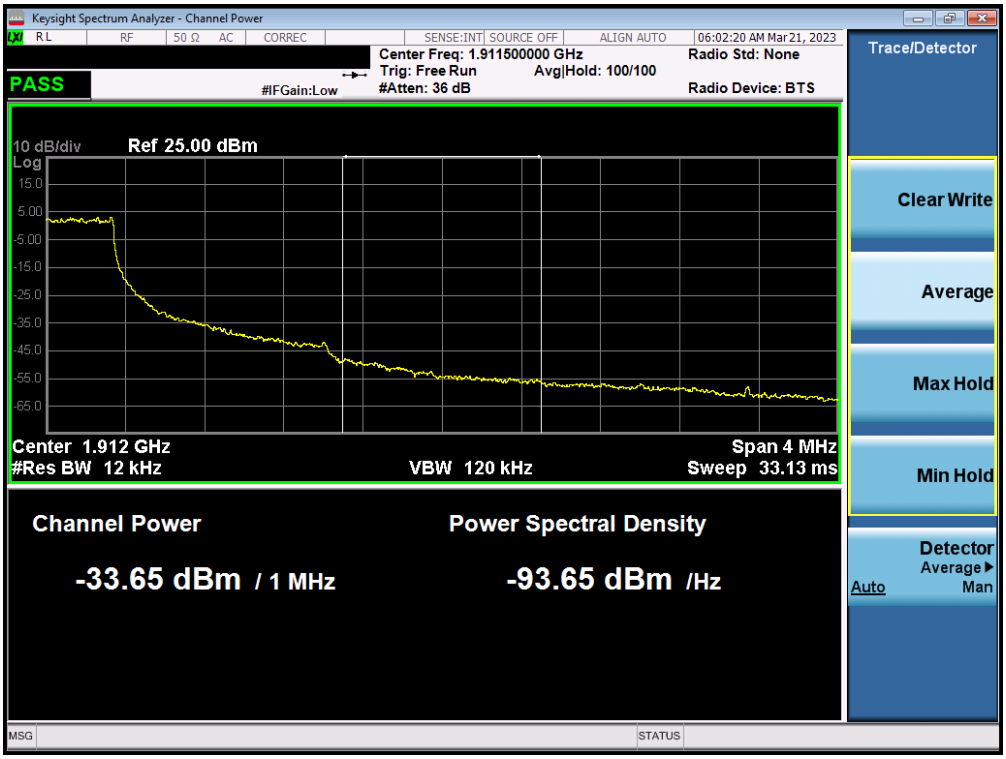
Plot 7-41. Extended Upper Band Edge Plot (LTE Band 2 - 3MHz QPSK – Full RB)

Plot 7-42. Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB)



Plot 7-43. Extended Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB)

Plot 7-44. Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB)



Plot 7-45. Extended Upper Band Edge Plot (LTE Band 2 – 1.4MHz 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.

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

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.

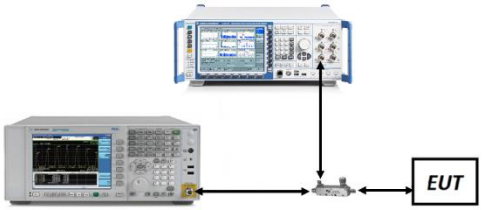
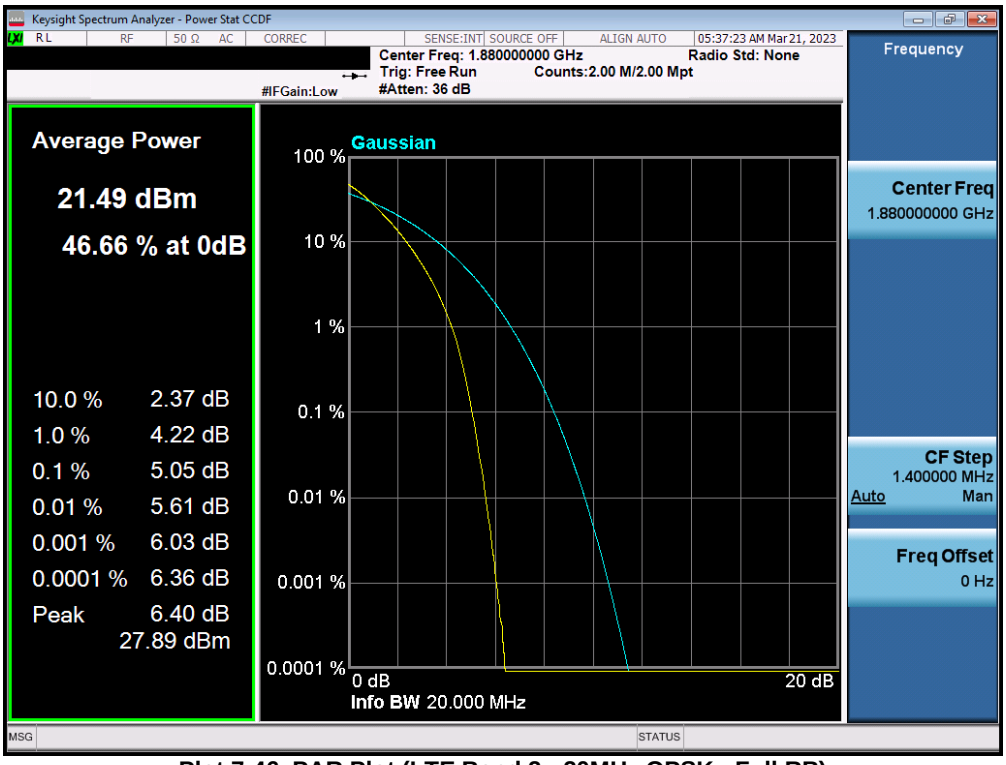


Figure 7-5. Test Instrument & Measurement Setup

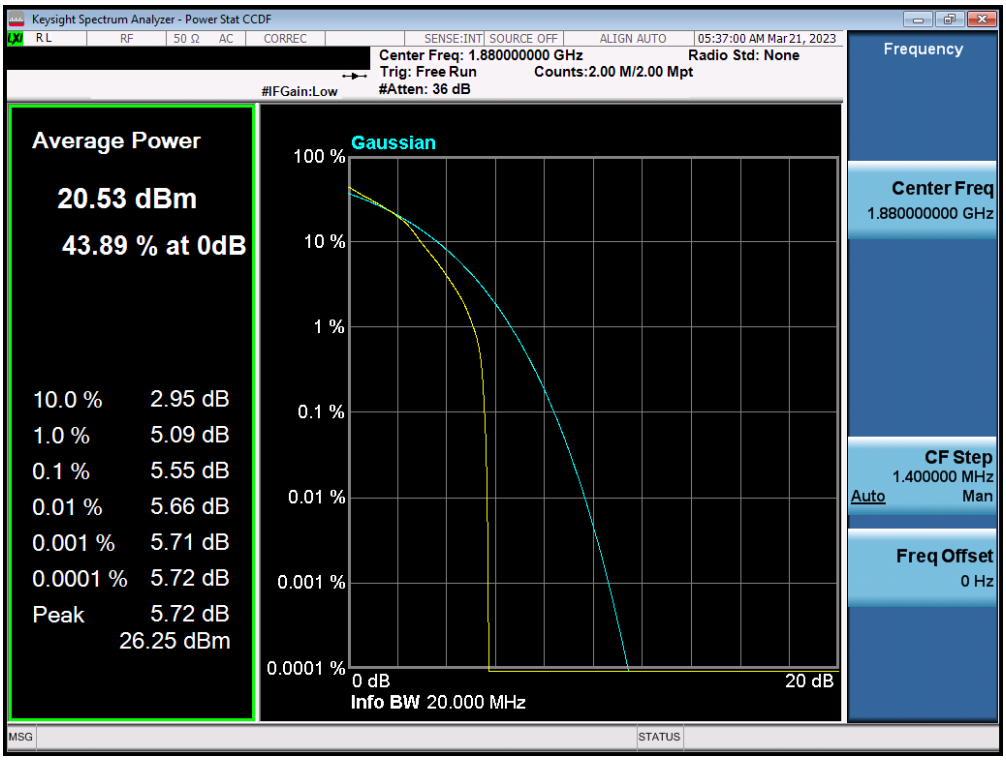
Test Notes

None.

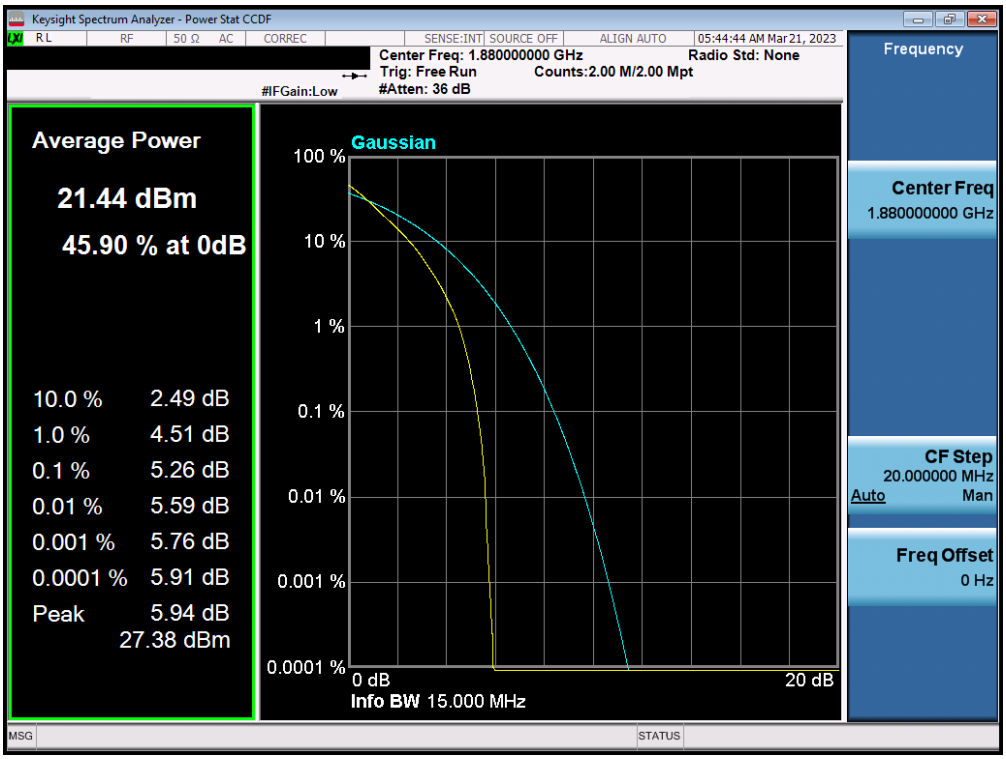
LTE Band 2



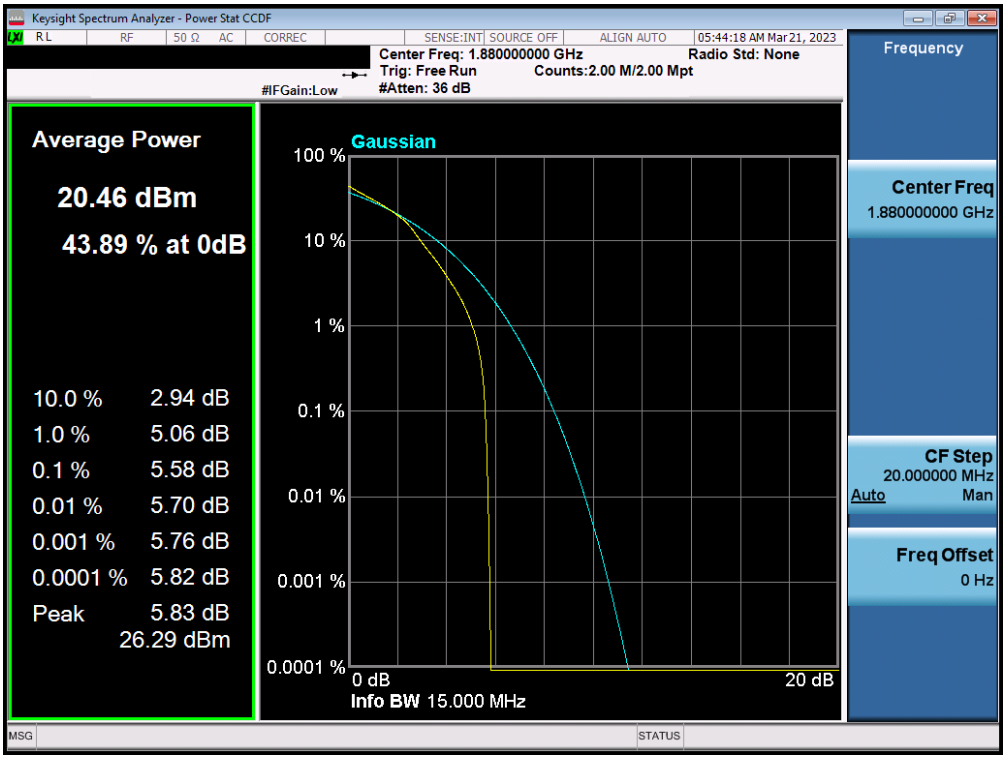
Plot 7-46. PAR Plot (LTE Band 2 - 20MHz QPSK - Full RB)



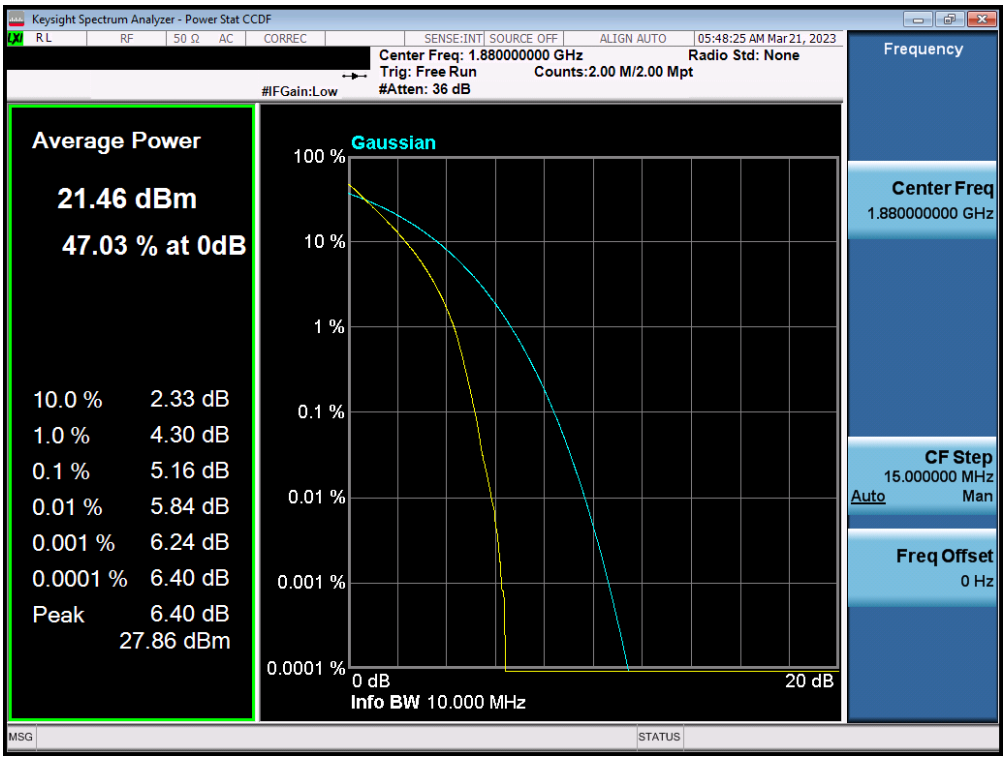
Plot 7-47. PAR Plot (LTE Band 2 - 20MHz 16-QAM - 27 RB)



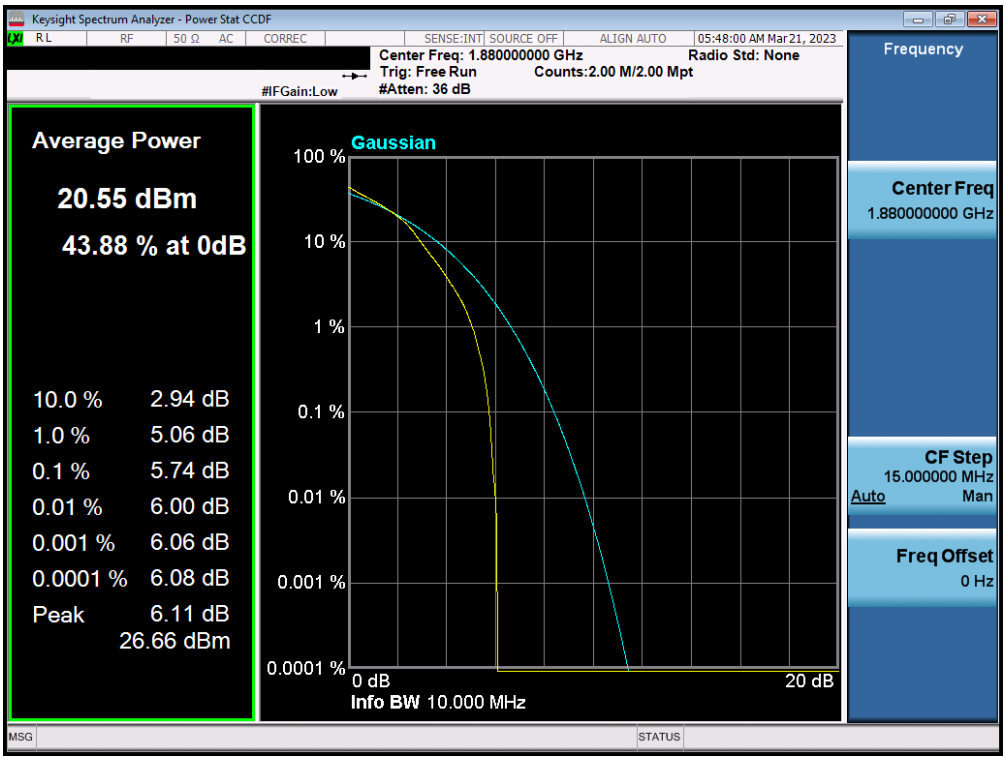
Plot 7-48. PAR Plot (LTE Band 2 - 15MHz QPSK - Full RB)



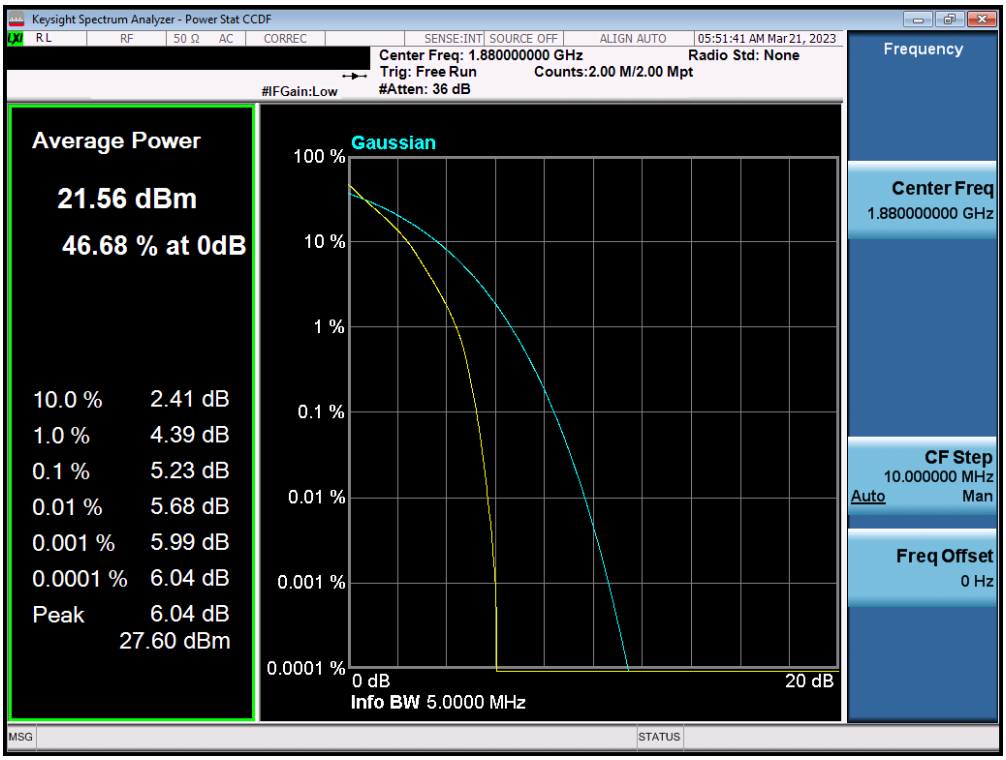
Plot 7-49. PAR Plot (LTE Band 2 - 15MHz 16-QAM - 27 RB)



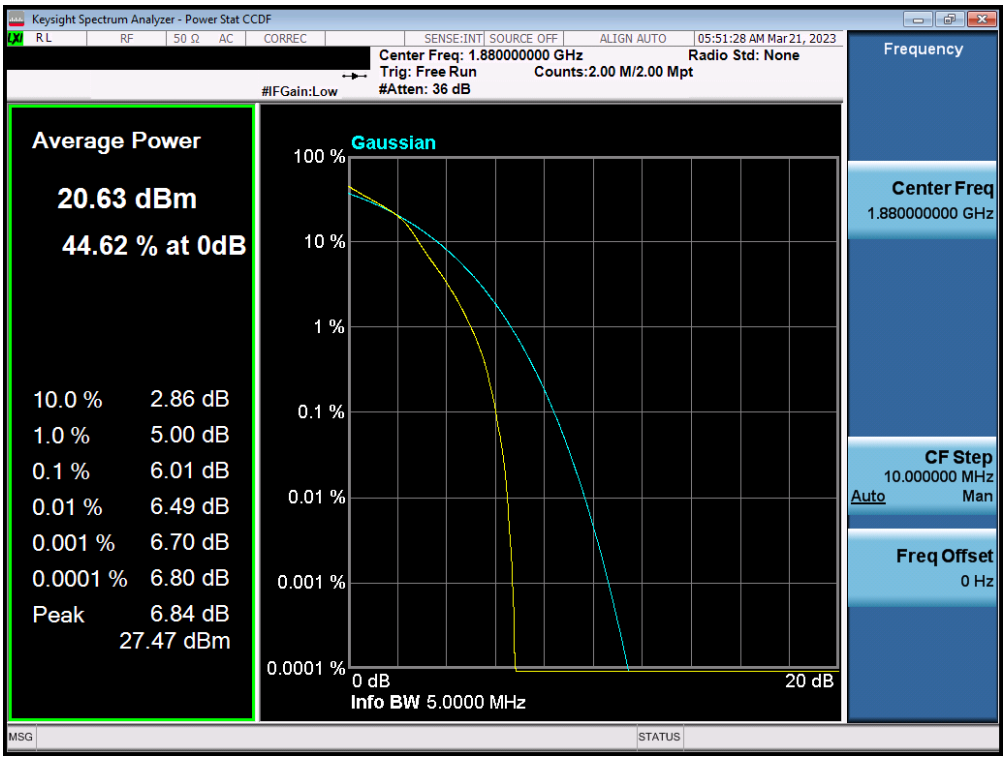
Plot 7-50. PAR Plot (LTE Band 2 - 10MHz QPSK - Full RB)



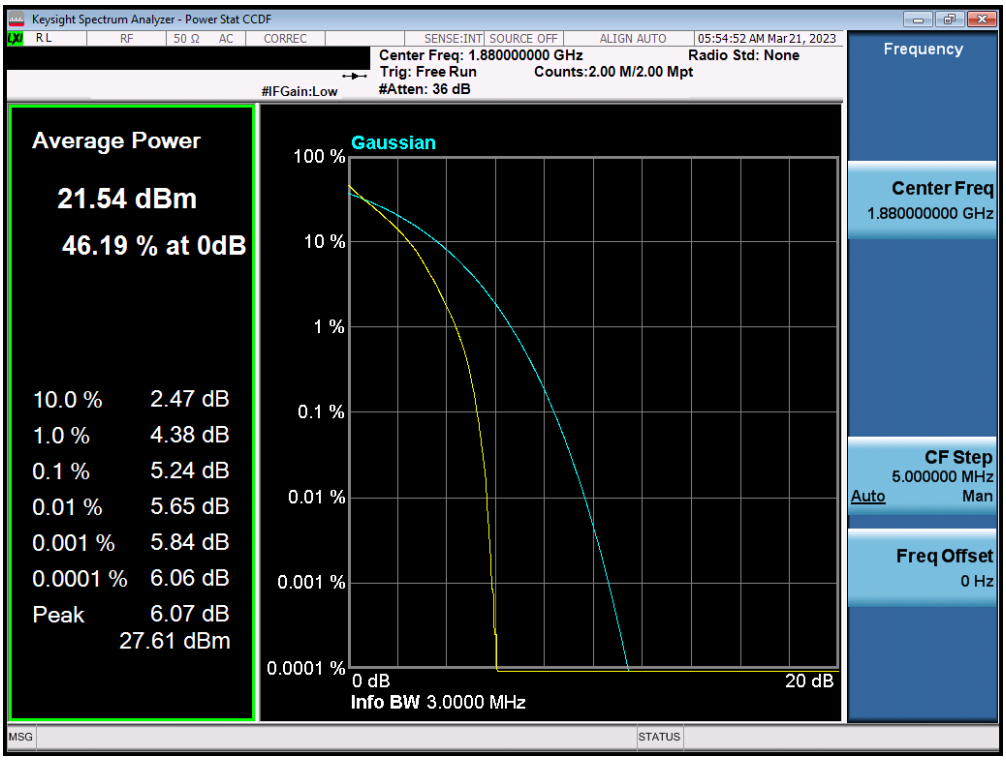
Plot 7-51. PAR Plot (LTE Band 2 - 10MHz 16-QAM - 27 RB)



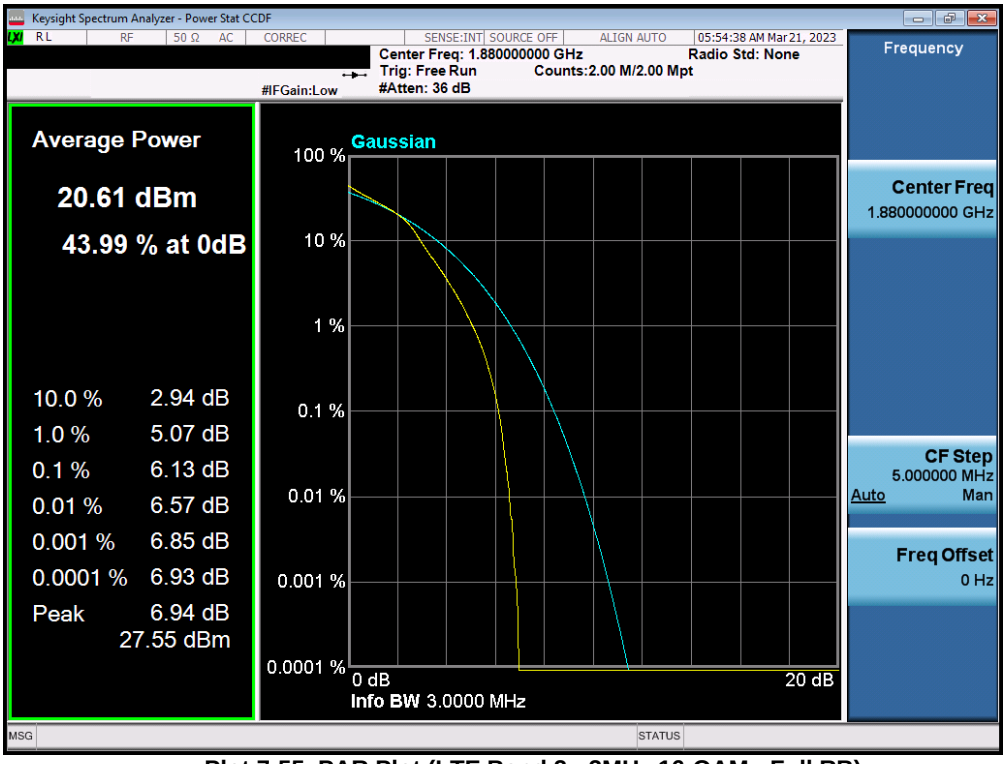
Plot 7-52. PAR Plot (LTE Band 2 - 5MHz QPSK - Full RB)



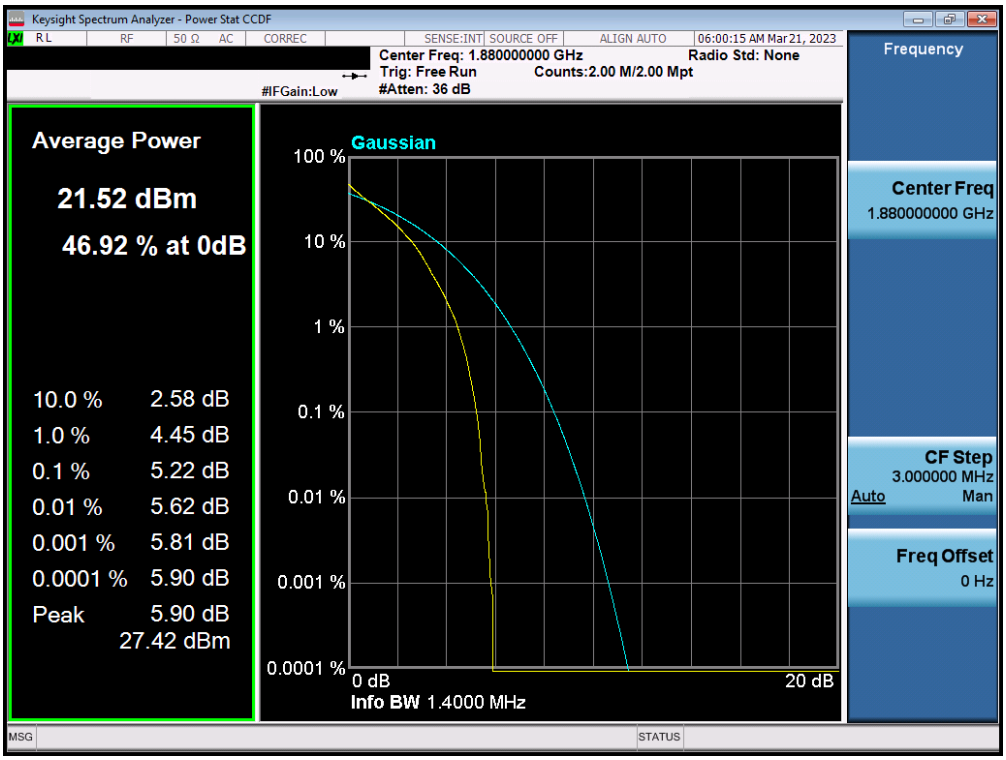
Plot 7-53. PAR Plot (LTE Band 2 - 5MHz 16-QAM - Full RB)



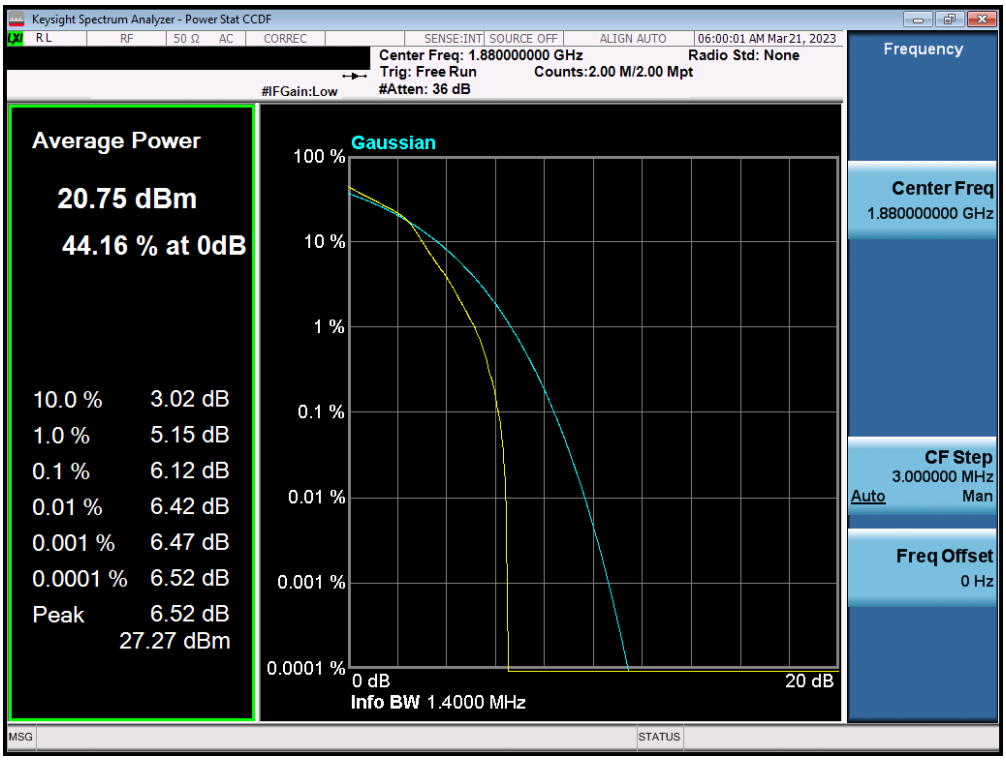
Plot 7-54. PAR Plot (LTE Band 2 - 3MHz QPSK - Full RB)



Plot 7-55. PAR Plot (LTE Band 2 - 3MHz 16-QAM - Full RB)



Plot 7-56. PAR Plot (LTE Band 2 - 1.4MHz QPSK - Full RB)



Plot 7-57. PAR Plot (LTE Band 2 - 1.4MHz 16-QAM - 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 for emissions below 1GHz and 1MHz for emissions above 1GHz
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.

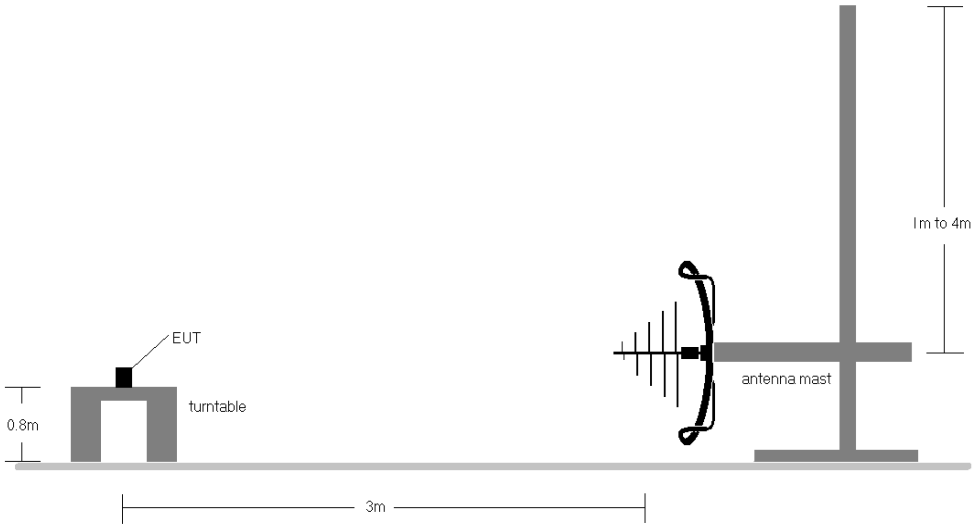


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

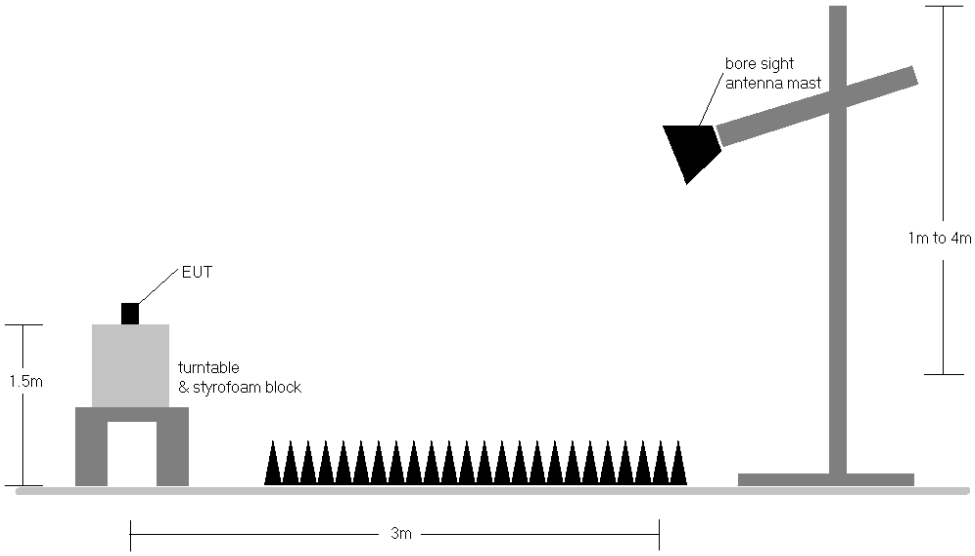


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

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.

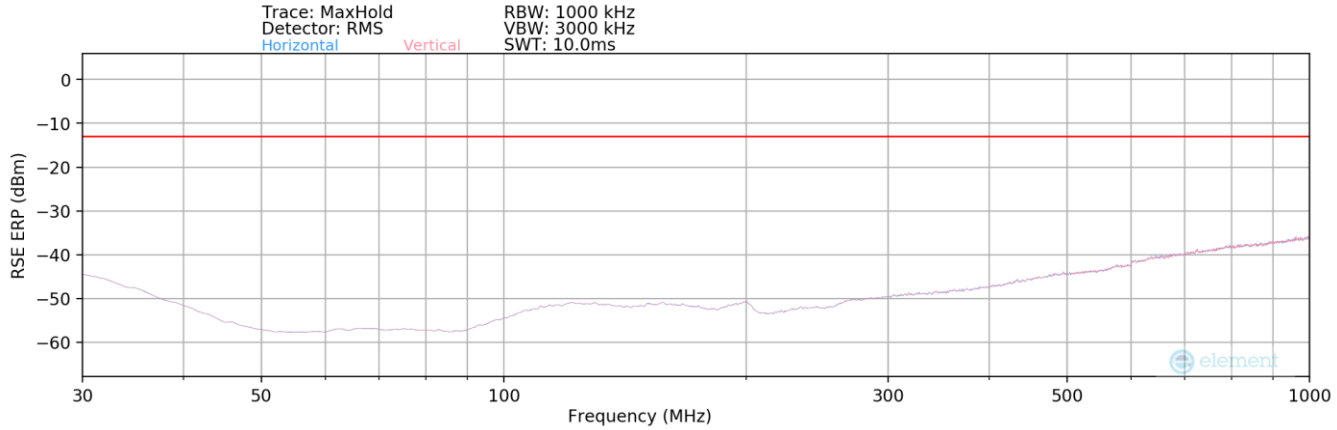
2) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

3) Emissions below 18GHz were measured at a 3-meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

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

5) Compliance with the receiver spurious emissions requirement under RSS-133 (6.6) is addressed in this section.

LTE Band 2

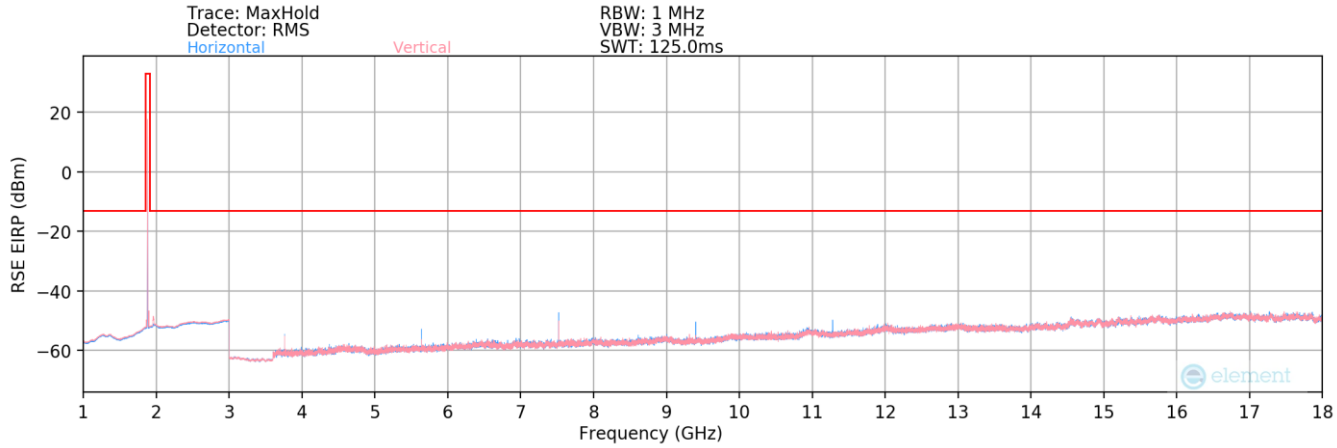


Plot 7-58. Radiated Spurious Plot (LTE Band 2)

Bandwidth (MHz):	20
Frequency (MHz):	1880
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	ERP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
799.02	H	-	-	-89.81	30.21	47.40	-50.01	-13.00	-37.01

Table 7-3. Radiated Spurious Data (LTE Band 2 – Mid Channel)



Plot 7-59. Radiated Spurious Plot (LTE Band 2)

Bandwidth (MHz):	20
Frequency (MHz):	1860
RB / Offset:	1 / 50

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]
3720.00	H	140	189	-69.04	3.08	41.04	-54.22	-13.00	-41.22
5580.00	H	303	117	-71.82	4.81	39.99	-55.26	-13.00	-42.26
7440.00	H	191	146	-64.40	6.93	49.53	-45.73	-13.00	-32.73
9300.00	H	264	115	-65.80	8.66	49.86	-45.40	-13.00	-32.40
11160.00	H	234	95	-71.01	11.43	47.42	-47.84	-13.00	-34.84
13020.00	H	-	-	-81.80	14.28	39.48	-55.78	-13.00	-42.78
14880.00	H	201	182	-80.07	15.86	42.79	-52.47	-13.00	-39.47
16740.00	H	-	-	-81.91	18.33	43.42	-51.84	-13.00	-38.84

Table 7-4. Radiated Spurious Data (LTE Band 2 – Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1880
RB / Offset:	1 / 50

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]
3760.00	H	156	187	-68.94	2.86	40.92	-54.34	-13.00	-41.34
5640.00	H	292	112	-70.47	5.14	41.67	-53.59	-13.00	-40.59
7520.00	H	309	146	-68.83	7.14	45.31	-49.94	-13.00	-36.94
9400.00	H	360	193	-71.86	9.39	44.53	-50.73	-13.00	-37.73
11280.00	H	398	215	-73.29	11.51	45.22	-50.03	-13.00	-37.03
13160.00	H	-	-	-81.84	13.50	38.66	-56.60	-13.00	-43.60
15040.00	H	243	187	-81.01	15.71	41.70	-53.56	-13.00	-40.56
16920.00	H	-	-	-82.04	18.13	43.09	-52.16	-13.00	-39.16

Table 7-5. Radiated Spurious Data (LTE Band 2 – Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1900
RB / Offset:	1 / 50

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]
3800.00	H	149	185	-61.91	2.74	47.83	-47.42	-13.00	-34.42
5700.00	H	302	108	-67.06	5.00	44.94	-50.32	-13.00	-37.32
7600.00	H	305	146	-67.31	7.43	47.12	-48.14	-13.00	-35.14
9500.00	H	390	192	-70.54	9.31	45.77	-49.49	-13.00	-36.49
11400.00	H	393	215	-74.05	11.99	44.94	-50.32	-13.00	-37.32
13300.00	H	-	-	-81.58	13.81	39.23	-56.03	-13.00	-43.03
15200.00	H	214	188	-79.28	16.51	44.23	-51.03	-13.00	-38.03
17100.00	H	-	-	-81.57	17.61	43.04	-52.22	-13.00	-39.22

Table 7-6. Radiated Spurious Data (LTE Band 2 – High 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 24, 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

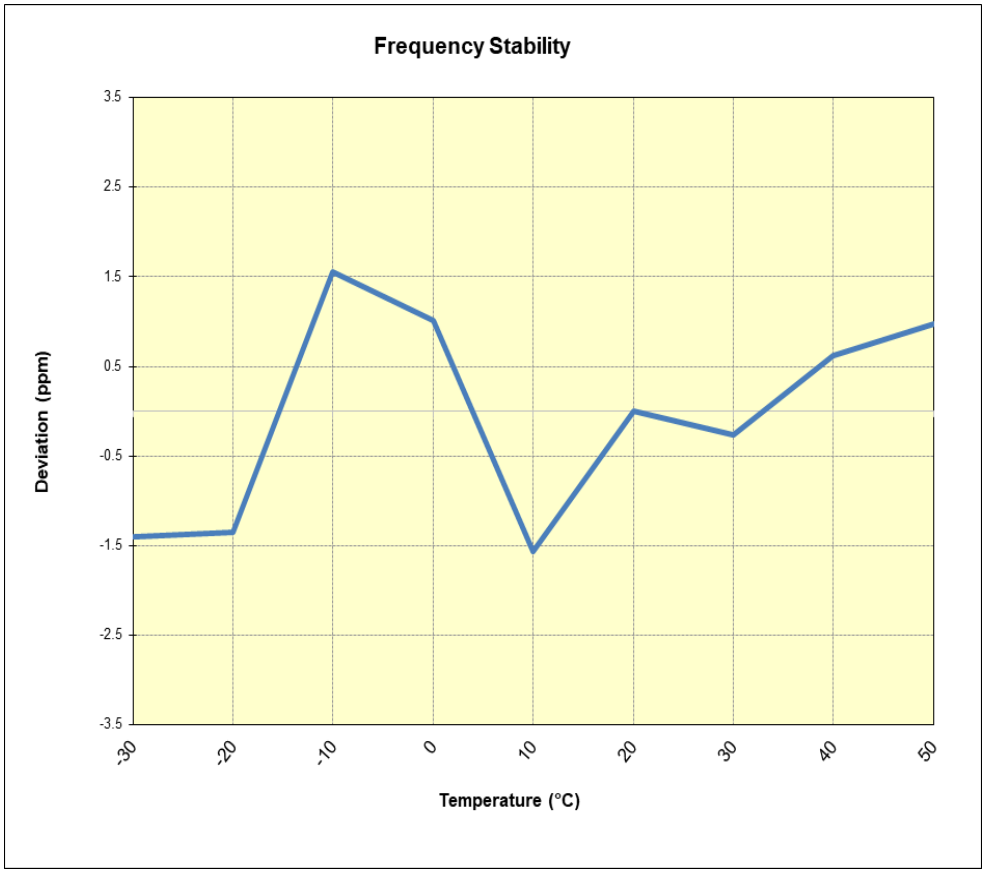
None

LTE Band 2

LTE Band 2	
Operating Frequency (Hz):	1,880,000,000
Ref. Voltage (VDC):	3.90

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.90	- 30	1,880,013,158	-2,631	-0.0001400
		- 20	1,880,013,262	-2,527	-0.0001344
		- 10	1,880,018,717	2,928	0.0001557
		0	1,880,017,698	1,909	0.0001015
		+ 10	1,880,012,855	-2,934	-0.0001561
		+ 20 (Ref)	1,880,015,789	0	0.0000000
		+ 30	1,880,015,284	-505	-0.0000269
		+ 40	1,880,016,959	1,170	0.0000622
		+ 50	1,880,017,626	1,837	0.0000977
85 %	3.32	+ 20	1,880,016,925	1,136	0.0000604
115 %	4.49	+ 20	1,880,157,623	141,834	0.0075443

Table 7-7. LTE Band 2 Frequency Stability Data



Plot 7-60. LTE Band 2 Frequency Stability Chart

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Telit Module FCC ID: RI7LE910C1SNX / IC: 5131A-LE910C1SNX** complies with all the requirements of Part 24 of the FCC rules and RSS-133 of the ISED rules.