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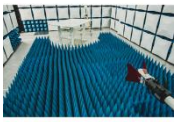

PART 27 MEASUREMENT REPORT

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
05/08/2023 - 08/10/2023
Test Report Issue Date:
8/10/2023
Test Site/Location:
Element Materials Technology Morgan Hill, CA, USA
Test Report Serial No.:
1C2305020012-06.BCG

FCC ID:	**BCG-A2982**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A2982, A2983
EUT Type:	Watch
FCC Classification:	PCS Licensed Transmitter Worn on Body (PCT)
FCC Rule Part:	27
Test Procedure(s):	ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

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 #2041.02

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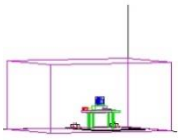
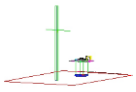


PART 27 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	EIRP		Emission Designator
					Max. Power [mW]	Max. Power [dBm]	
LTE Band 7	5 MHz	QPSK	2502.5 - 2567.5	4.5643	70.795	18.50	4M56G7W
		16QAM	2502.5 - 2567.5	4.5579	66.681	18.24	4M56D7W
	10 MHz	QPSK	2505 - 2565	9.1284	70.795	18.50	9M13G7W
		16QAM	2505 - 2565	5.4999	66.988	18.26	5M50D7W
	15 MHz	QPSK	2507.5 - 2562.5	13.7040	70.795	18.50	13M7G7W
		16QAM	2507.5 - 2562.5	6.7098	66.527	18.23	6M71D7W
	20 MHz	QPSK	2510 - 2560	18.2970	70.795	18.50	18M3G7W
		16QAM	2510 - 2560	8.0879	65.917	18.19	8M09D7W
LTE Band 41	5 MHz	QPSK	2498.5 - 2687.5	4.5595	56.234	17.50	4M56G7W
		16QAM	2498.5 - 2687.5	4.5437	50.466	17.03	4M54D7W
	10 MHz	QPSK	2501 - 2685	9.1214	56.234	17.50	9M12G7W
		16QAM	2501 - 2685	5.4996	50.582	17.04	5M50D7W
	15 MHz	QPSK	2503.5 - 2682.5	13.6300	56.234	17.50	13M6G7W
		16QAM	2503.5 - 2682.5	6.5048	50.119	17.00	6M50D7W
	20 MHz	QPSK	2506 - 2680	18.1650	56.234	17.50	18M2G7W
		16QAM	2506 - 2680	7.6820	49.545	16.95	7M68D7W

EUT Overview

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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 Materials Technology Test Location

These measurement tests were conducted at the Element Materials Technology facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology located in Morgan Hill, CA 95037, U.S.A.

- Element Materials Technology is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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 Materials Technology facility is a registered (22831) 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 Agreements (MRAs).

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID:BCG-A2982**. 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 27.

Test Device Serial No.: PQX5RHVHKN, L56LP6W1GF, HXNJ7PY2T6, FN6GU6000JV00000HT

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n UNII, 802.15.4 ab-NB, Bluetooth (1x, EDR, HDR4, HDR8, LE1M, LE2M), NFC, UWB, 60.5GHz Transmitter.

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Simultaneous Tx Config	Antenna FCM					
	WLAN	Bluetooth	802.15.4ab - NB	LTE/WCDMA	UNII	UWB
	802.11 b/g/n	BDR, EDR, HDR4/8, LE1/2M	O-QPSK	Mid/High Band	802.11 a/n	Ch.5/Ch.9
Config 1	✓	×	×	✓	×	✓
Config 2	×	✓	×	✓	×	✓
Config 3	×	✓	✓	✓	×	×
Config 4	✓	×	✓	✓	×	×
Config 5	×	✓	×	✓	✓	×
Config 6	×	✓	×	✓	×	✓
Config 7	✓	×	×	✓	×	×
Config 8	✓	×	✓	×	×	×
Config 9	✓	×	×	×	×	✓
Config 10	×	✓	×	×	✓	×
Config 11	×	✓	×	✓	×	×
Config 12	×	✓	✓	×	×	×
Config 13	×	✓	×	×	×	✓
Config 14	×	×	✓	✓	×	×
Config 15	×	×	×	✓	✓	×
Config 16	×	×	×	✓	×	✓

Table 2-1. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

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2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Band	Antenna Gain [dBi]
	Antenna FCM
LTE Band 7	-5.5
LTE Band 41	-6.5

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	FVFDHG8TP3XY
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB-C cable	Model:	N/A	S/N:	N/A
	w/ Charging Dock	Model:	A2921	S/N:	DQ812910BZZ08V222
	w/ Cradle	Model:	N/A	S/N:	CYV11630817A2SE03MEV1
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC217301501NR112
	Apple Magnetic Charger	Model:	A2515	S/N:	DLC217301EZ1NR11A
4	Pathfinder Mocha X3100	Model:	920-13353-01	S/N:	DLCGMW0007G00000N7
	SiP Socket	Model:	P1 N20X S PF 271	S/N:	FN6GTE0005G00000HS
5	DC Power Supply	Model:	SPS3010	S/N:	N/A
6	Store Sample Wristband	Model:	N/A	S/N:	DLC316300CU1QGKA2

Table 2-3. Test Support Equipment

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

The worst case configuration was investigated for all combinations of the various types of wristbands, metal and non-metal wristbands. The EUT was also investigated with and without wireless charger. The worst case configuration found was used for all testing.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

This device only supports 27RBs or less for 16-QAM uplink.

All possible simultaneous transmission configurations have been investigated and the worst case config has been reported.

Description	Bluetooth	LTE (Band 41)	UNII
Antenna	FCM	FCM	FCM
Channel	78	40620	36
Operating Frequency (MHz)	2480	2593	5180
Mode/Modulation	GFSK ePA	QPSK/1RB/20MHz	802.11n

Table 2-4. Worst Case Simultaneous Transmission Configuration

2.6 Software and Firmware

The test was conducted with firmware version watchOS 10 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

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

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26-2015, TIA-603-E-2016) and "Measurement Guidance for Certification of Licensed Digital Transmitters" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..None

3.2 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 and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. 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.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

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4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. 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	1.77
Radiated Disturbance (<30MHz)	4.30
Radiated Disturbance (30MHz-1GHz)	4.75
Radiated Disturbance (1-18GHz)	5.20
Radiated Disturbance (>18GHz)	4.72

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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
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	6/21/2023	Annual	6/21/2024	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	11/1/2022	Annual	11/1/2023	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	11/10/2022	Annual	11/10/2023	92009574
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/30/2023	Annual	3/30/2024	00218555
Keysight Technology	N9040B	UXA Signal Analyzer	3/10/2023	Annual	3/10/2024	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	6/2/2023	Annual	6/2/2024	100050
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/11/2023	Annual	5/11/2024	101619
Rohde & Schwarz	ESW44	EMI Test Receiver	6/6/2023	Annual	6/6/2024	101668
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	6/22/2023	Annual	6/22/2024	102356
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2022	Annual	10/13/2023	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	12/16/2022	Annual	12/16/2023	164715
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/2/2023	Annual	6/2/2024	100050
Rohde & Schwarz	HFH2-Z2	Loop Antenna	5/1/2023	Annual	5/1/2024	100519
Rohde & Schwarz	ENV216	Two-Line V-Network	6/8/2023	Annual	6/8/2024	192052
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	4/17/2023	Annual	4/17/2024	00304

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.

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6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7W
BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination of Any

QAM Modulation

Emission Designator = 8M45D7W
BW = 8.45 MHz
D = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of Any

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A2982

FCC Classification: PCS Licensed Transmitter Worn on Body (PCT)

Mode(s): LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Occupied Bandwidth	2.1049	N/A	N/A	Section 7.2
	Conducted Band Edge / Spurious Emissions (LTE Band 7)	2.1051, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	PASS	Sections 7.3, 7.4
	Conducted Band Edge / Spurious Emissions (LTE Band 41)			PASS	Sections 7.3, 7.4
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Equivalent Isotropic Radiated Power (LTE Band 7)	27.50(h)(2)	< 2 Watts max. EIRP	PASS	Section 7.5
	Equivalent Isotropic Radiated Power (LTE Band 41)			PASS	Section 7.5
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested	PASS	Section 7.7
RADIATED	Radiated Spurious Emissions (LTE Band 7)	2.1053, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	PASS	Section 7.6
	Radiated Spurious Emissions (LTE Band 41)			PASS	Section 7.6

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 was Element EMC Software Tool v1.1.

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7.2 Occupied Bandwidth

§2.1049

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. All ports were tested and only the worst case data were reported.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

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.

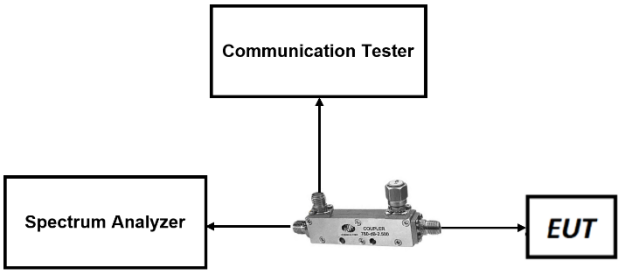

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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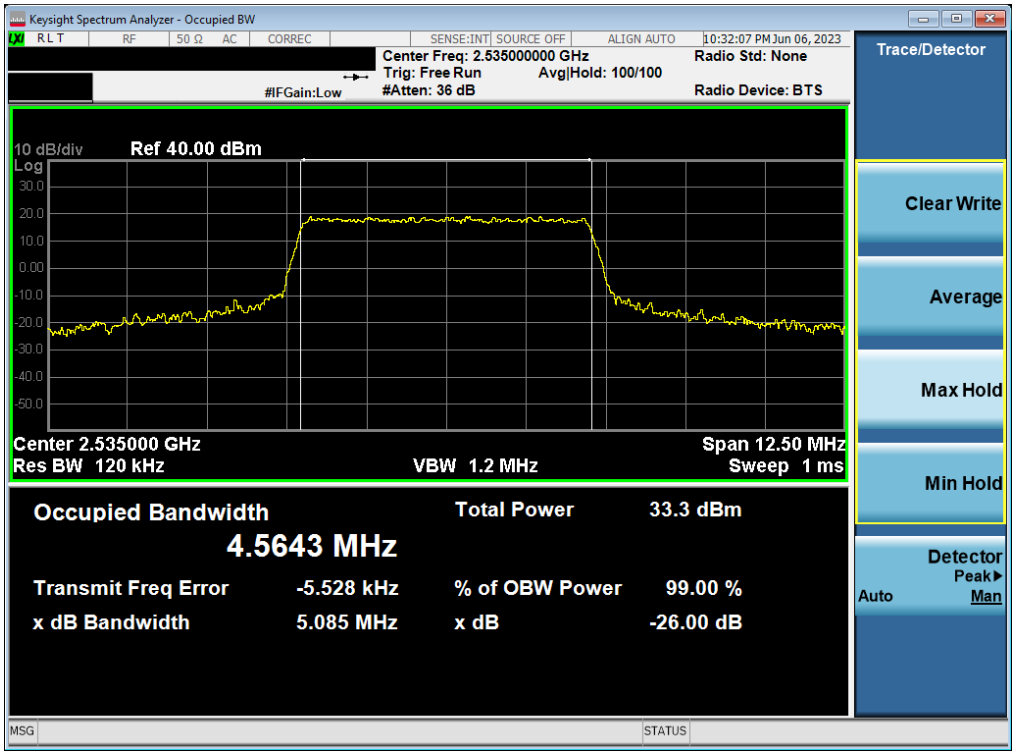
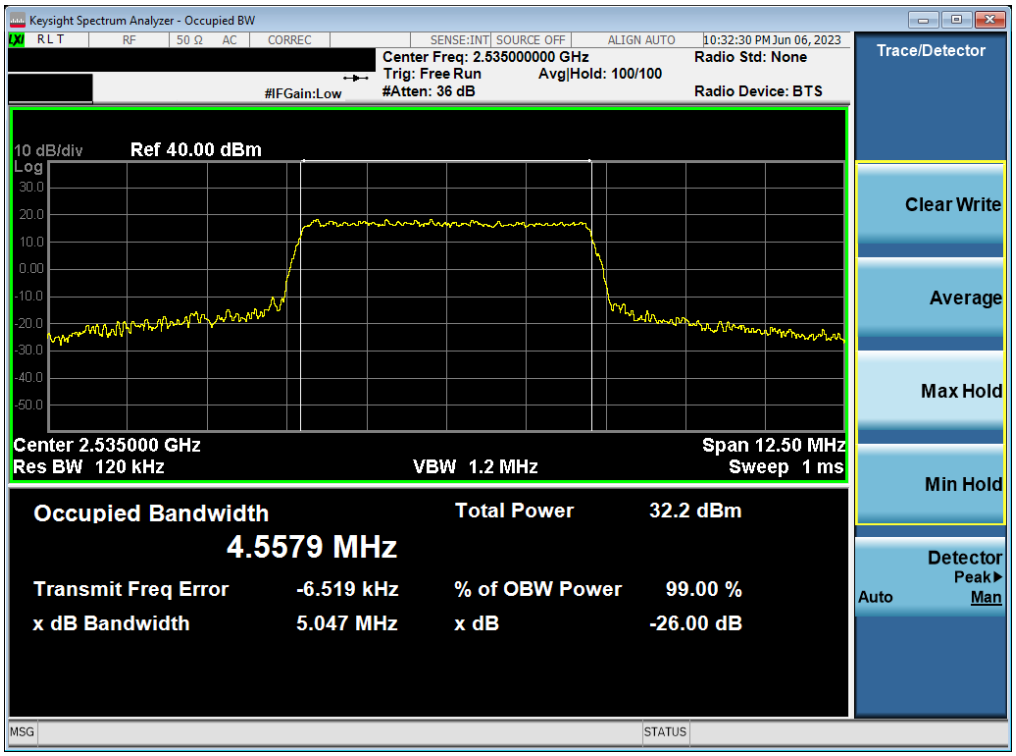
LTE Band 7



Plot 7-1. Occupied Bandwidth Plot (LTE Band 7 - 5MHz QPSK - Full RB)



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

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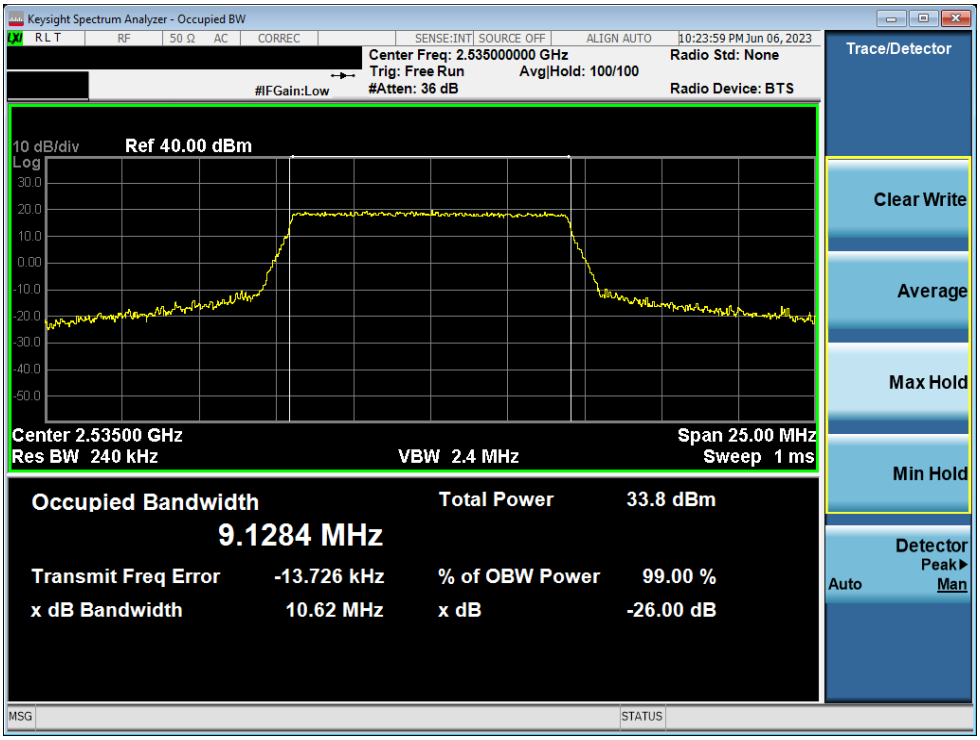
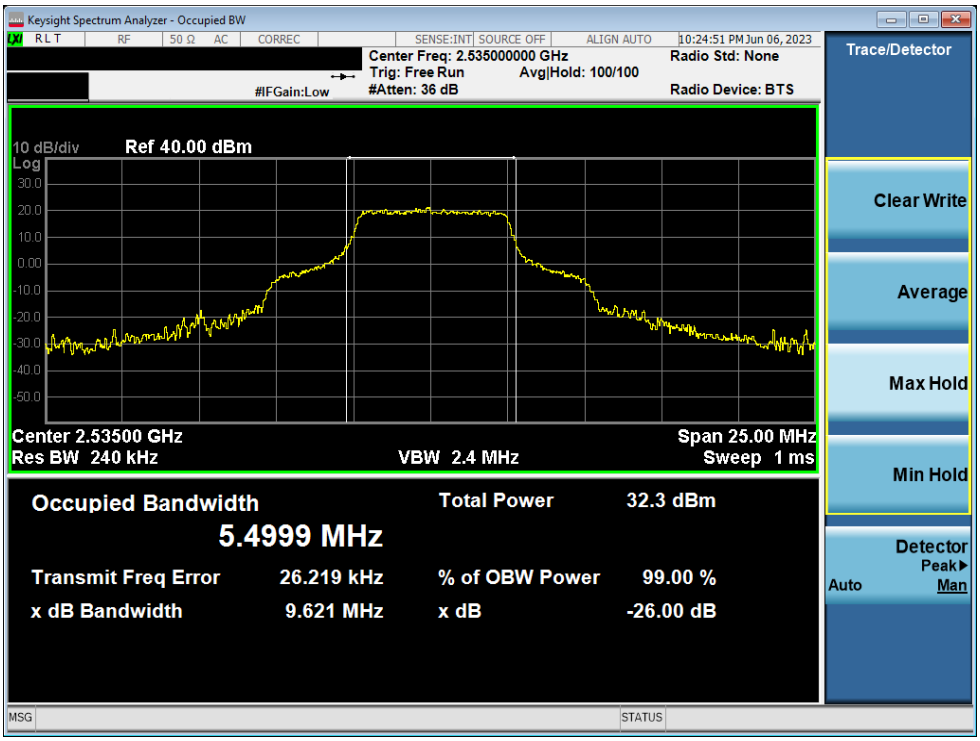


Plot 7-3. Occupied Bandwidth Plot (LTE Band 7 - 10MHz QPSK - Full RB)



Plot 7-4. Occupied Bandwidth Plot (LTE Band 7 - 10MHz 16-QAM - Full RB)

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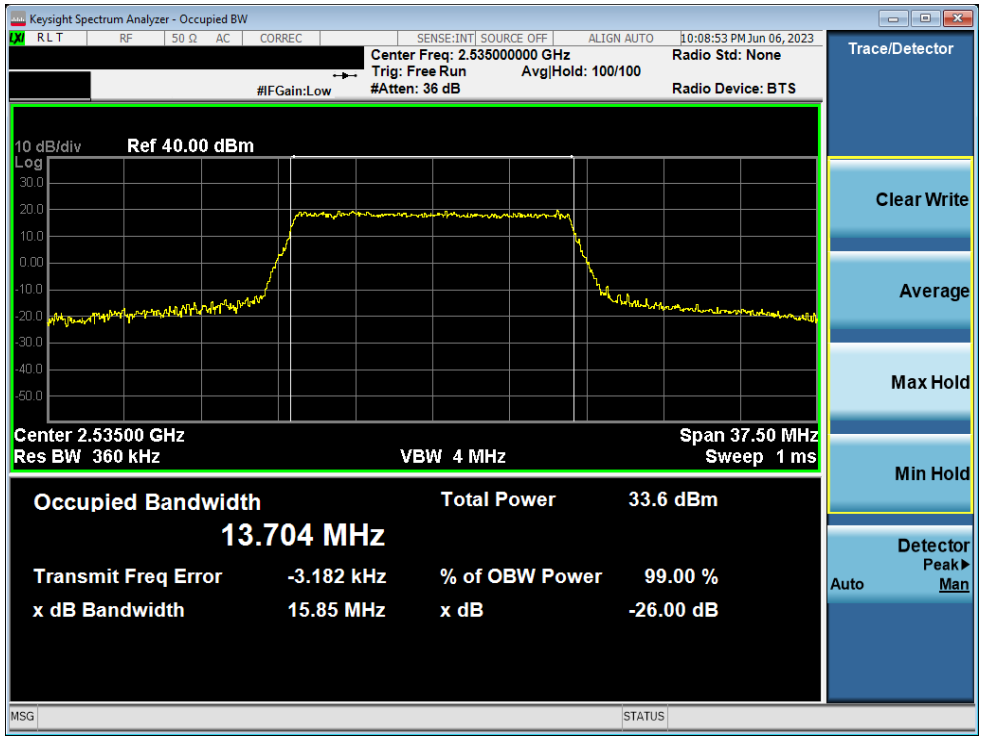
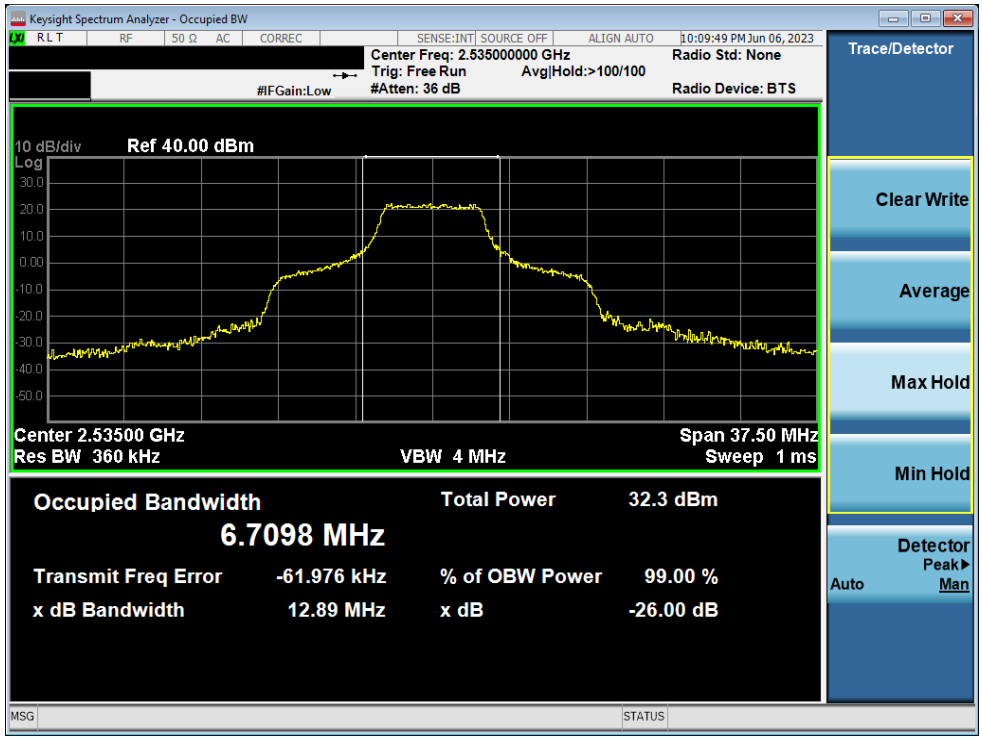


Plot 7-5. Occupied Bandwidth Plot (LTE Band 7 - 15MHz QPSK - Full RB)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 7 - 15MHz 16-QAM - Full RB)

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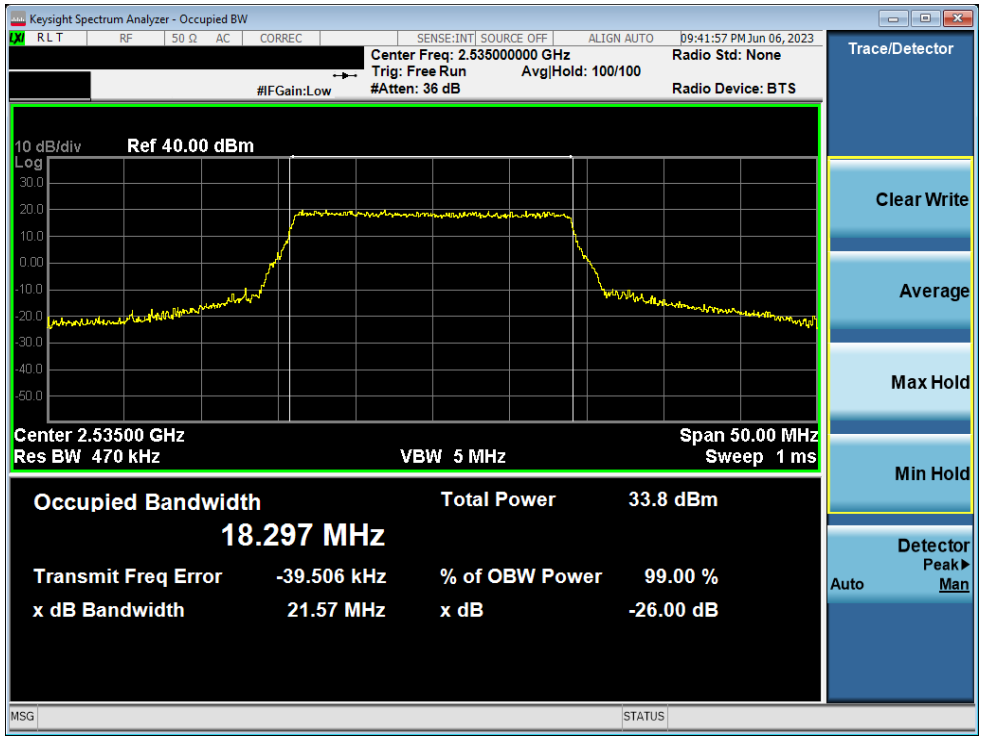
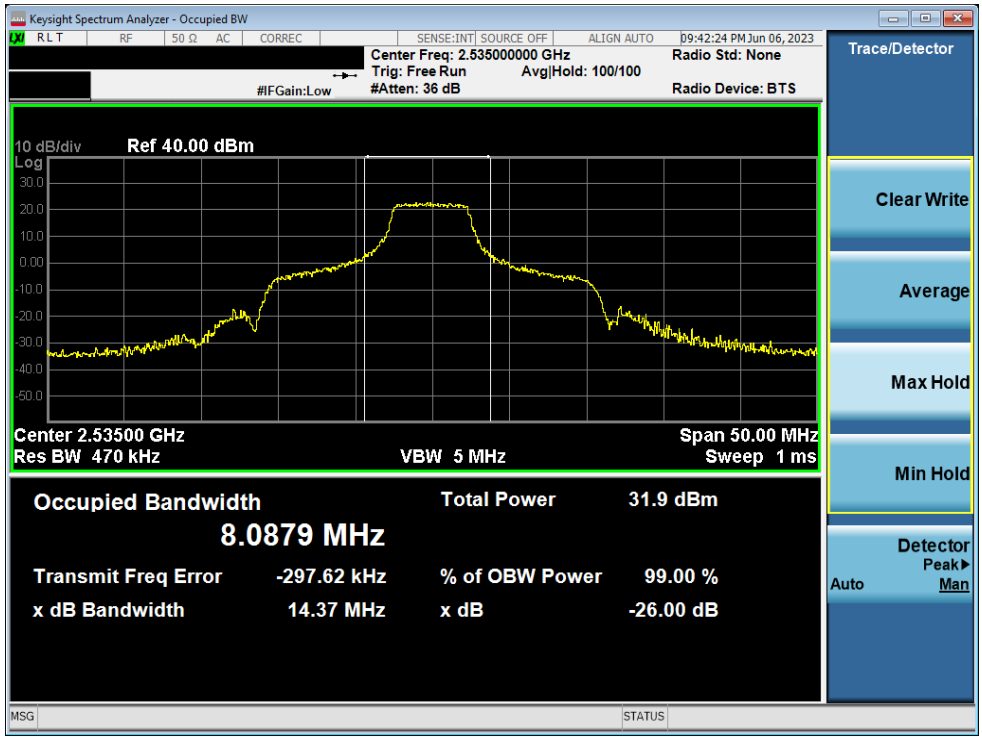


Plot 7-7. Occupied Bandwidth Plot (LTE Band 7 - 20MHz QPSK - Full RB)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 7 - 20MHz 16-QAM - Full RB)

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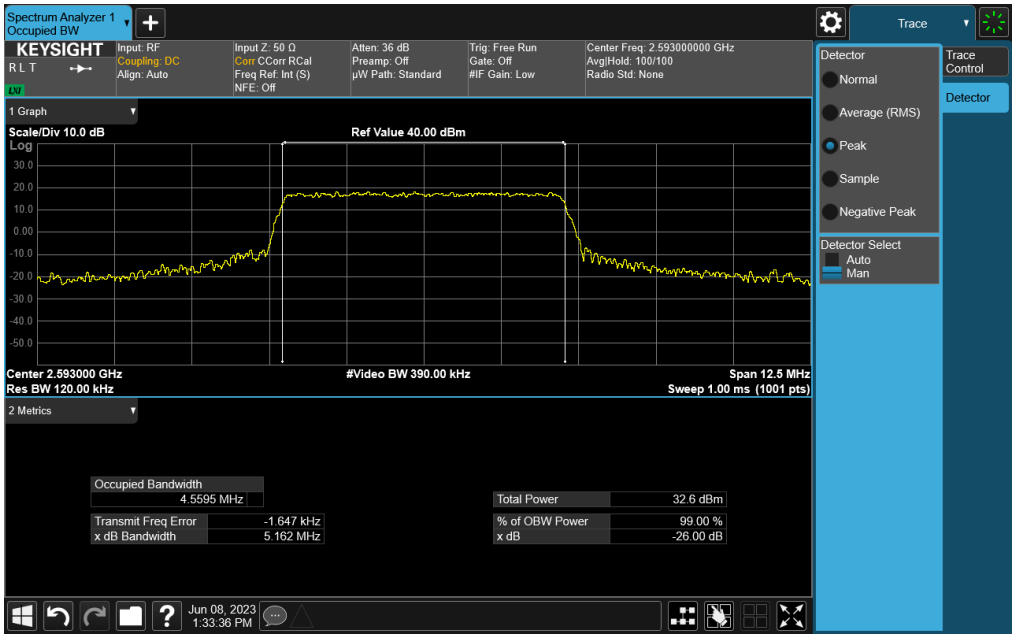
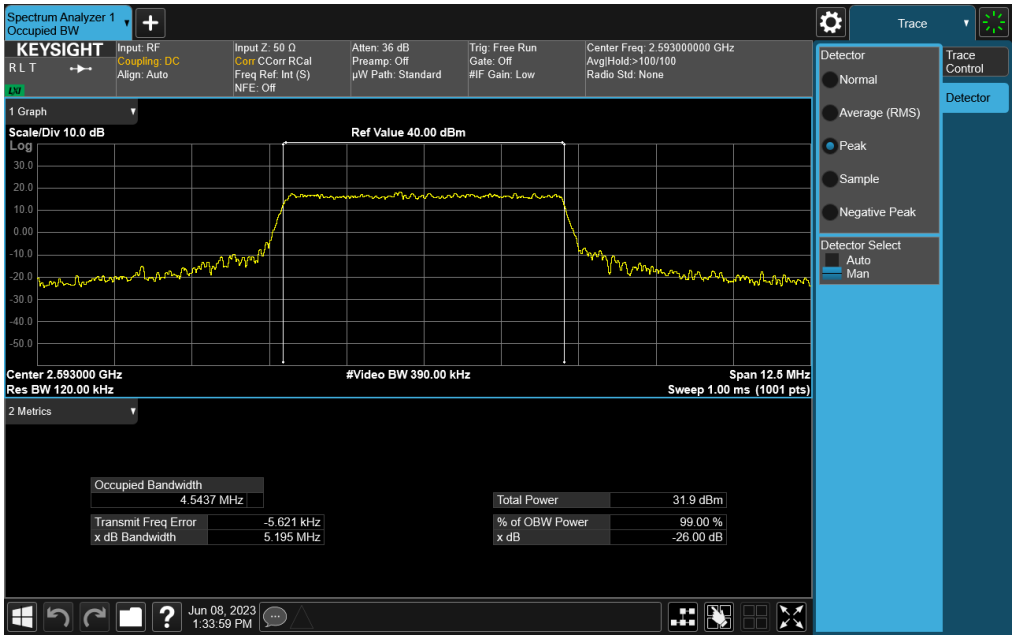
LTE Band 41



Plot 7-9. Occupied Bandwidth Plot (LTE Band 41 - 5MHz QPSK - Full RB)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 41 - 5MHz 16-QAM - Full RB)

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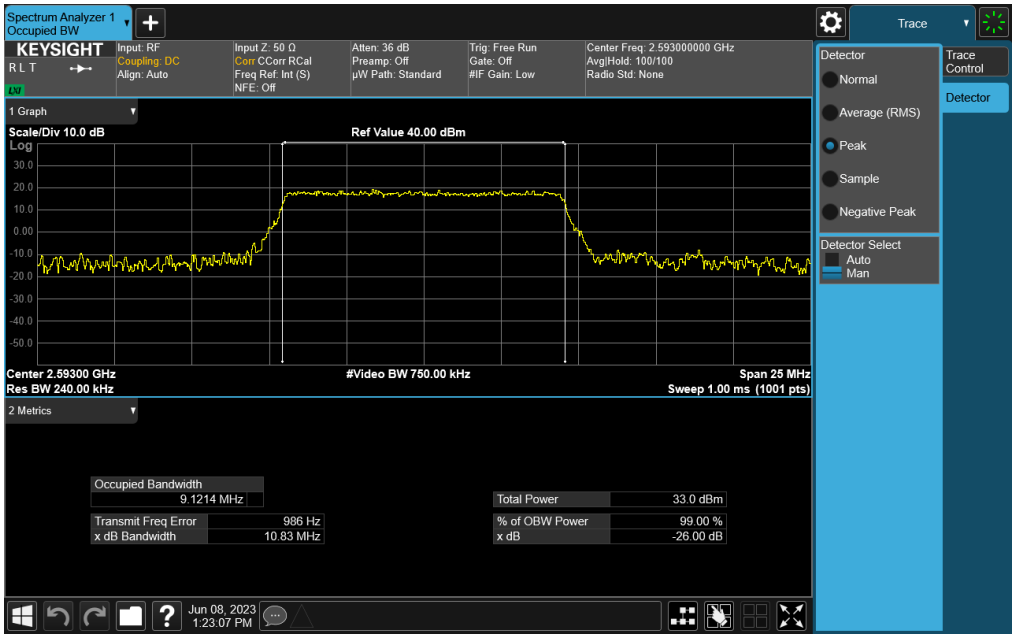
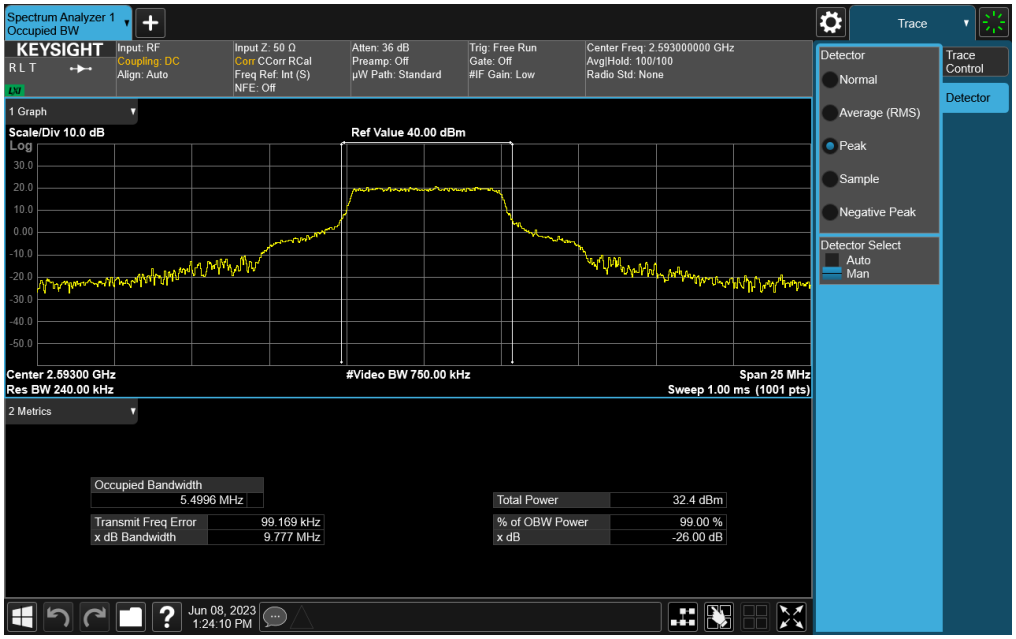


Plot 7-11. Occupied Bandwidth Plot (LTE Band 41 - 10MHz QPSK - Full RB)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 41 - 10MHz 16-QAM - Full RB)

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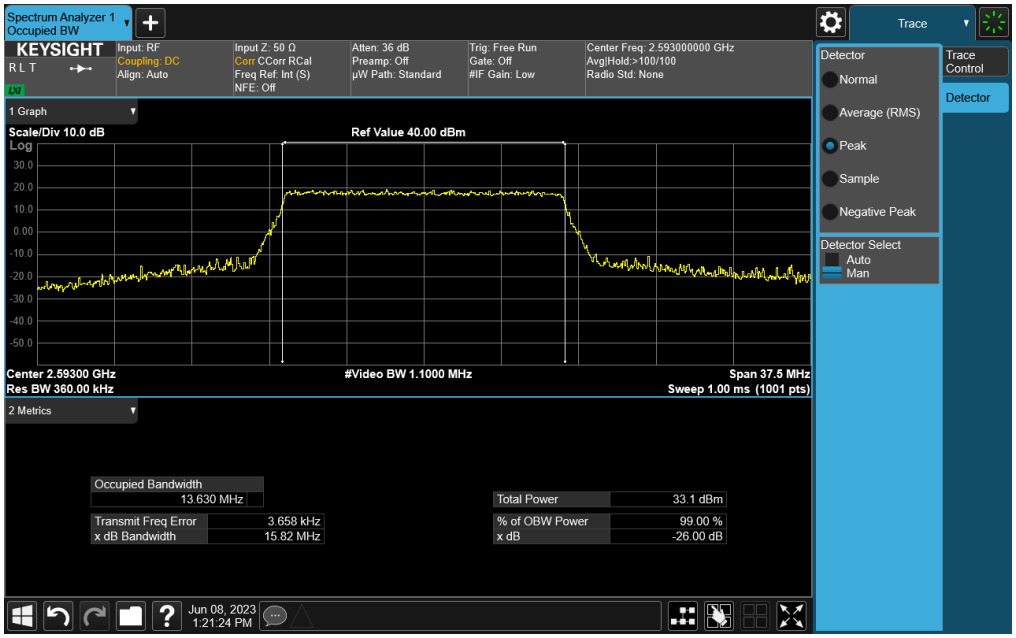
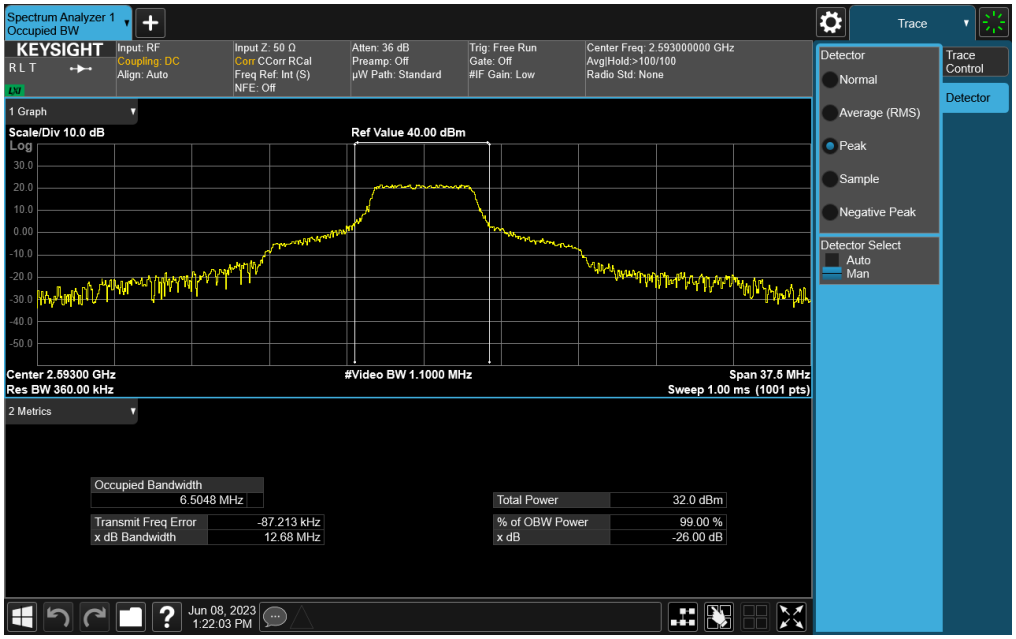


Plot 7-13. Occupied Bandwidth Plot (LTE Band 41 - 15MHz QPSK - Full RB)



Plot 7-14. Occupied Bandwidth Plot (LTE Band 41 - 15MHz 16-QAM - Full RB)

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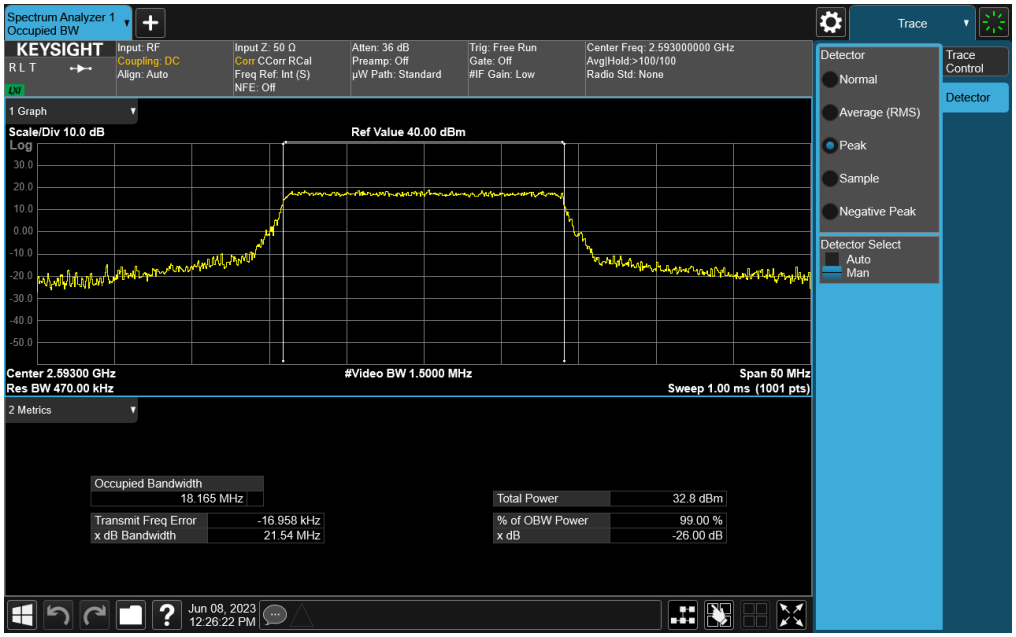
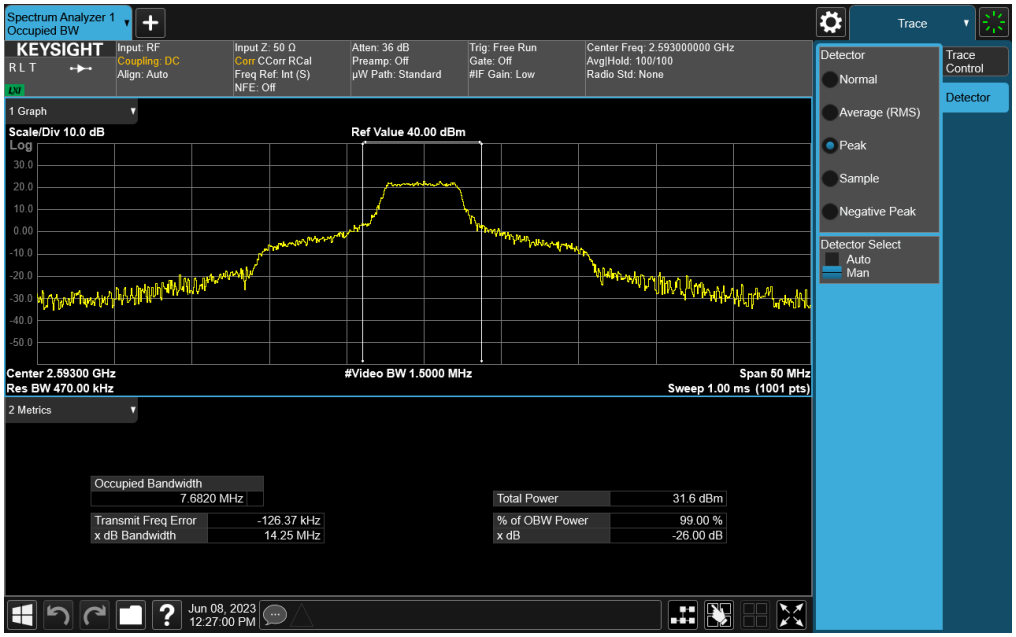


Plot 7-15. Occupied Bandwidth Plot (LTE Band 41 - 20MHz QPSK - Full RB)



Plot 7-16. Occupied Bandwidth Plot (LTE Band 41 - 20MHz 16-QAM - Full RB)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, §27.53(a), §27.53(m)

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. All ports were tested and only the worst case data were reported.

For LTE Bands 7 and 41, the minimum permissible attenuation level of any spurious emission is 55 + 10log$_{10}$(P$_{[Watts]}$).

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (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.

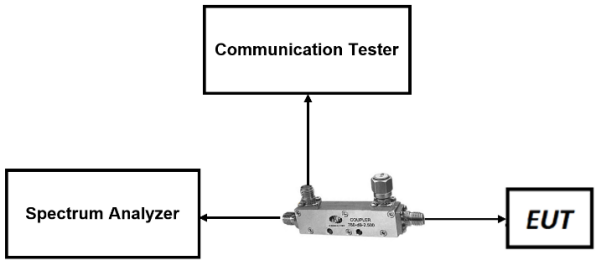

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

1. 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. However, 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. 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.

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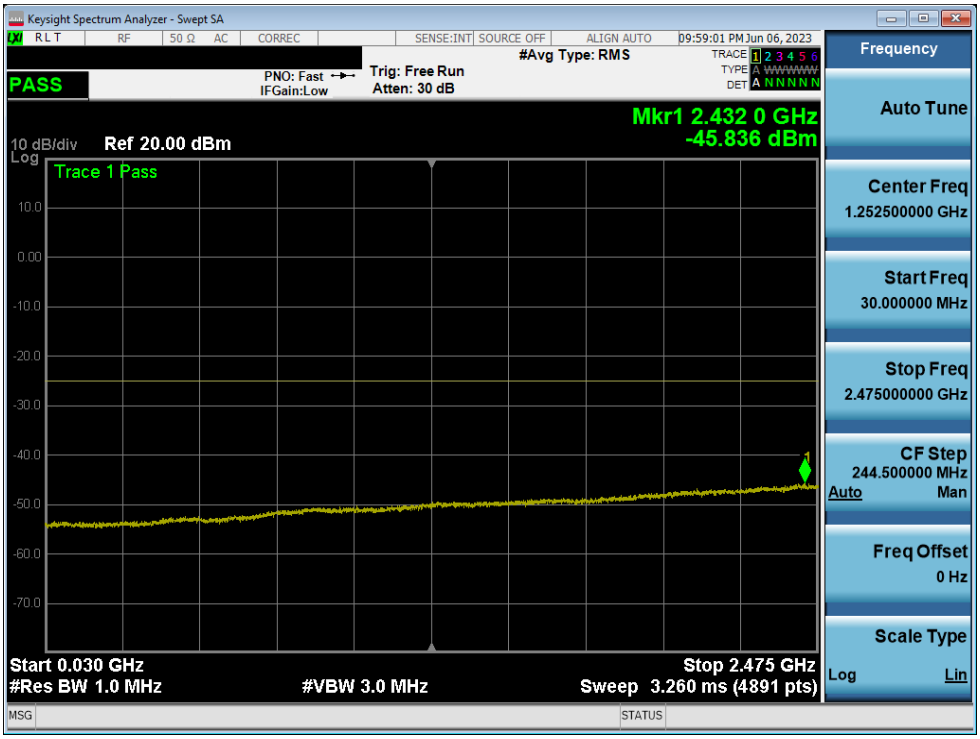
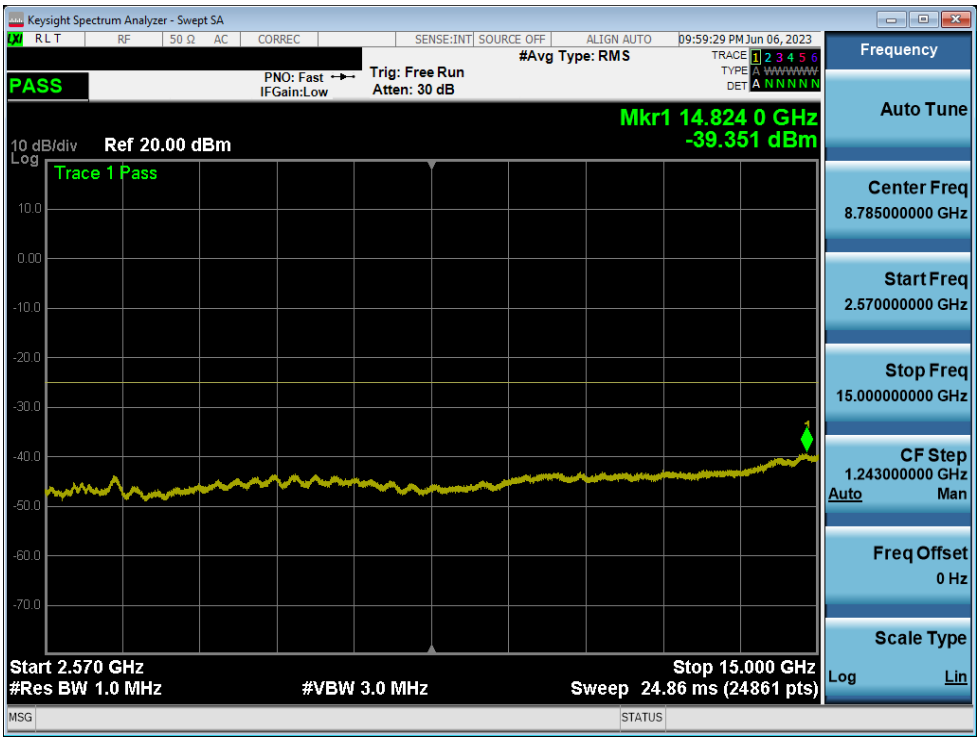
LTE Band 7



Plot 7-17. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-18. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

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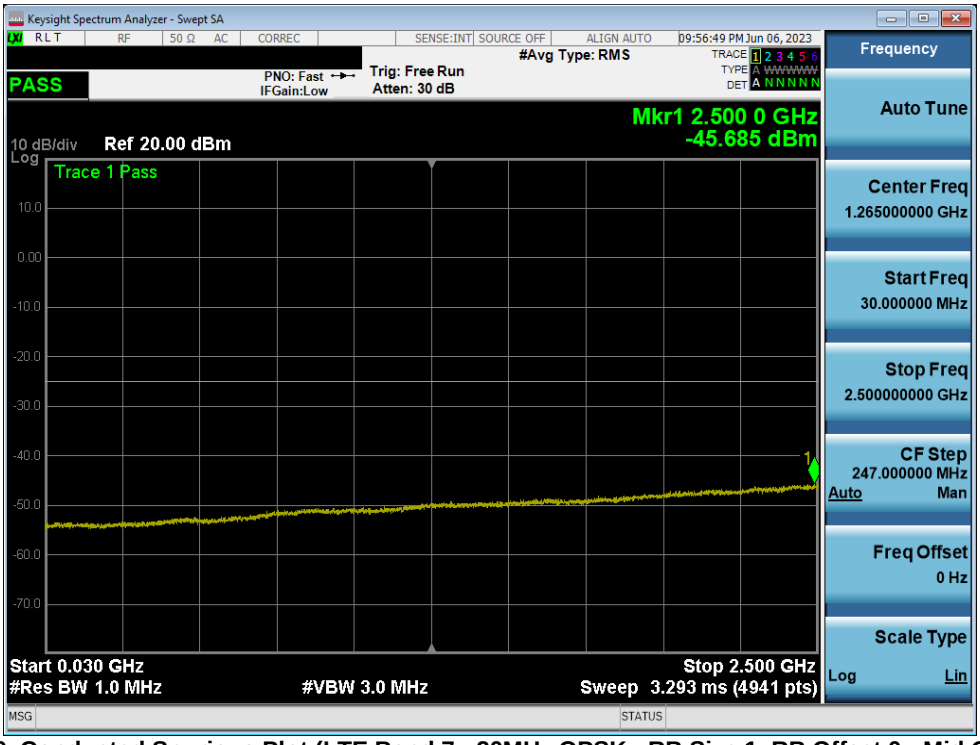
Plot 7-19. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-20. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

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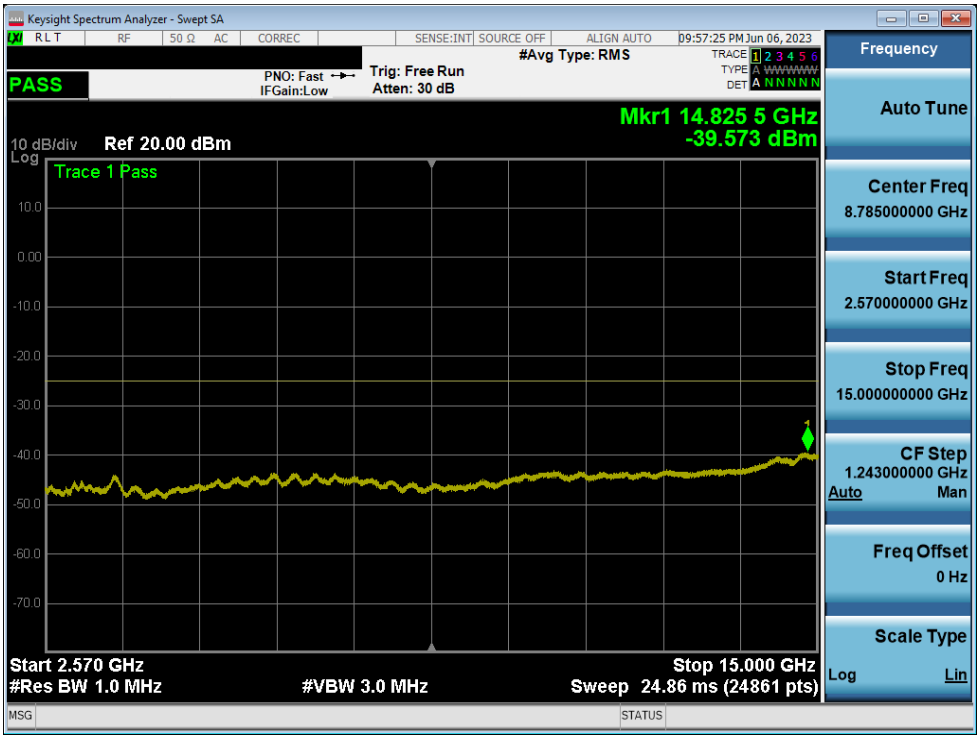

Plot 7-21. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

Plot 7-22. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

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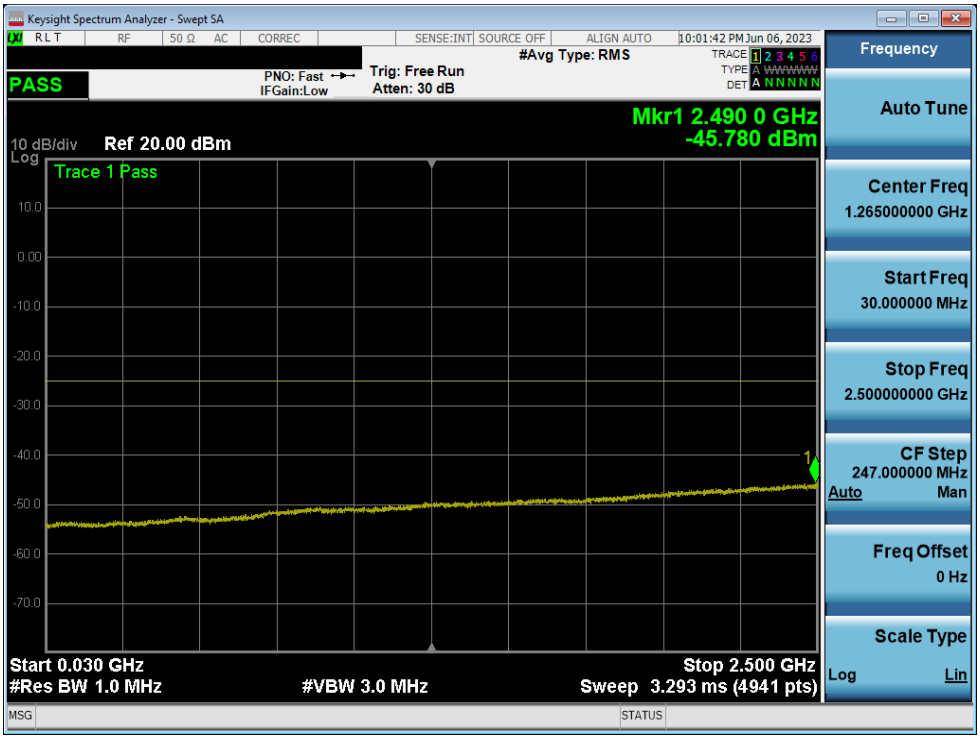
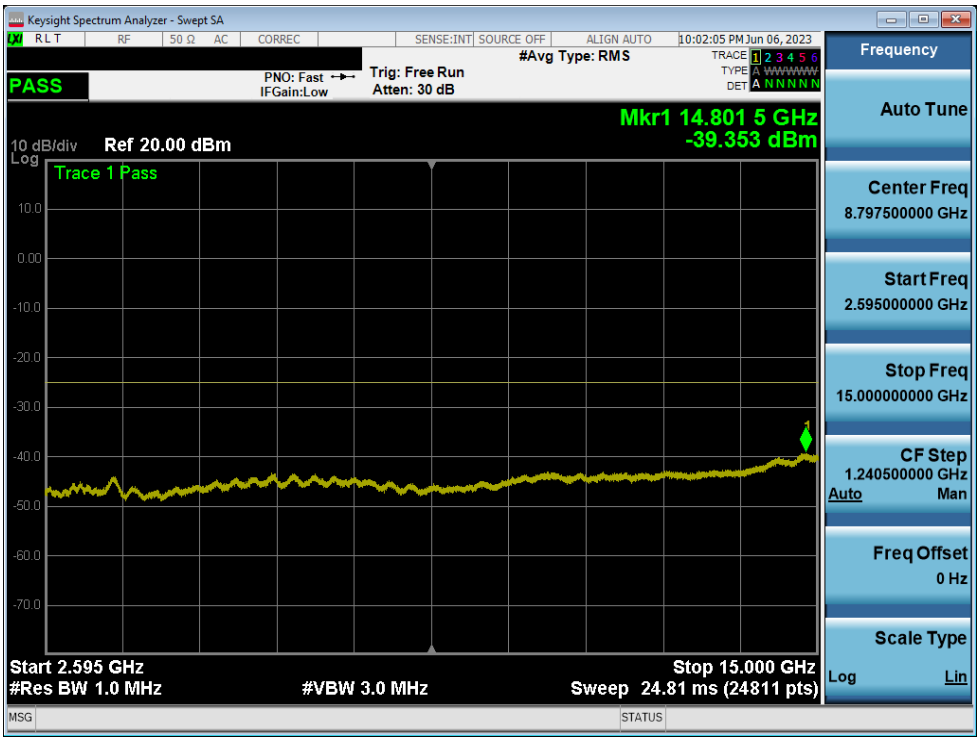


Plot 7-23. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-24. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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Plot 7-25. Conducted Spurious Plot (LTE Band 7 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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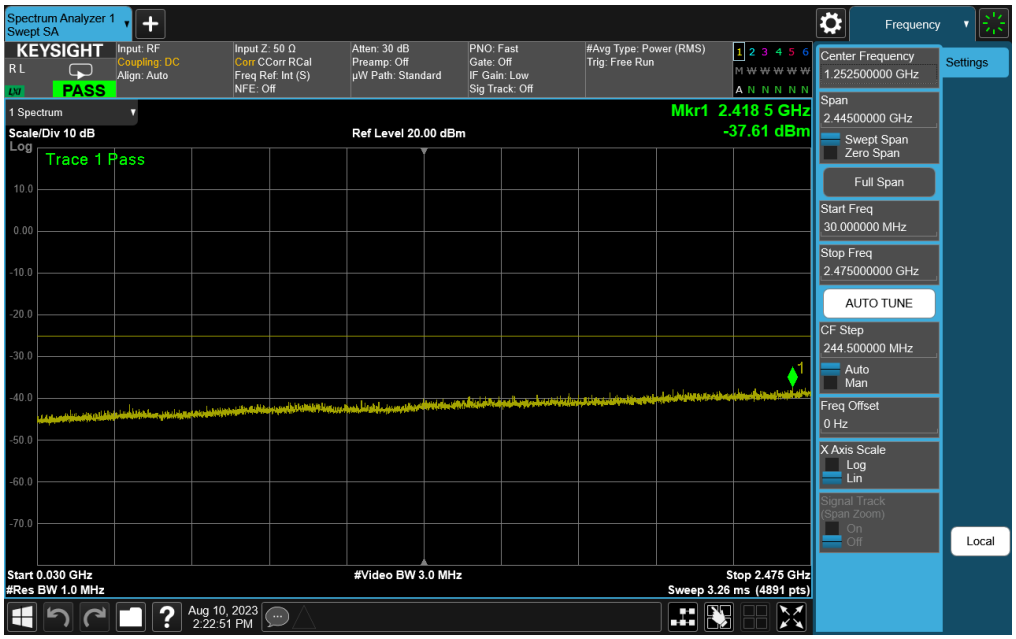
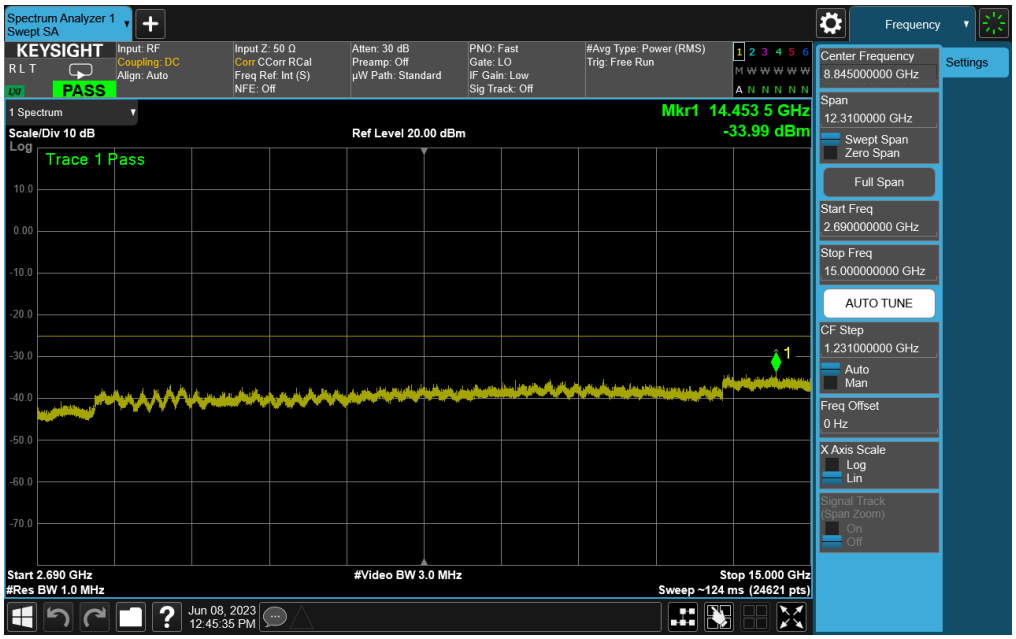
LTE Band 41



Plot 7-26. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-27. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

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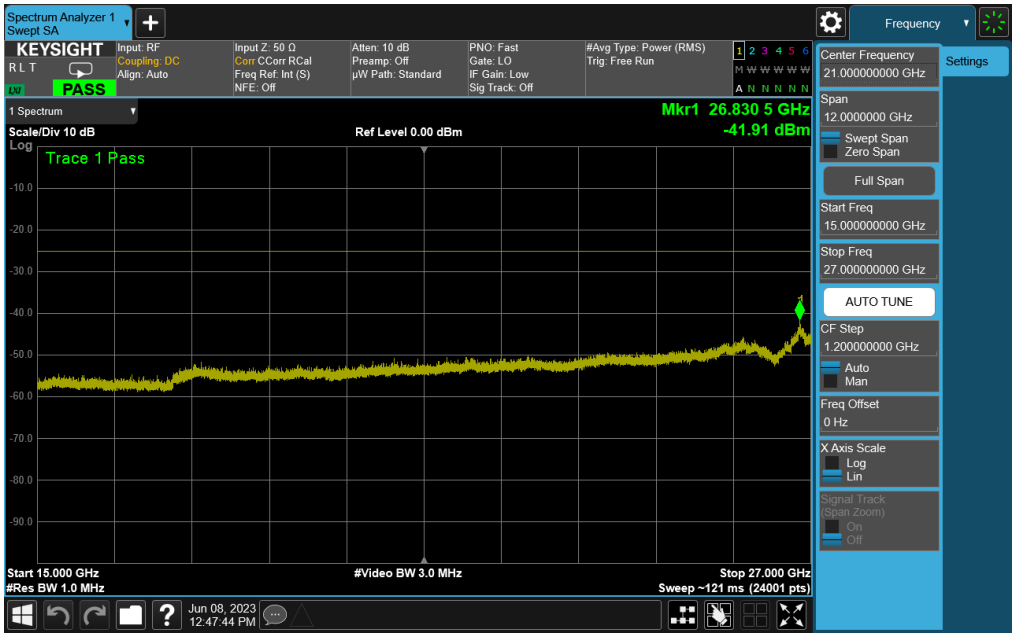
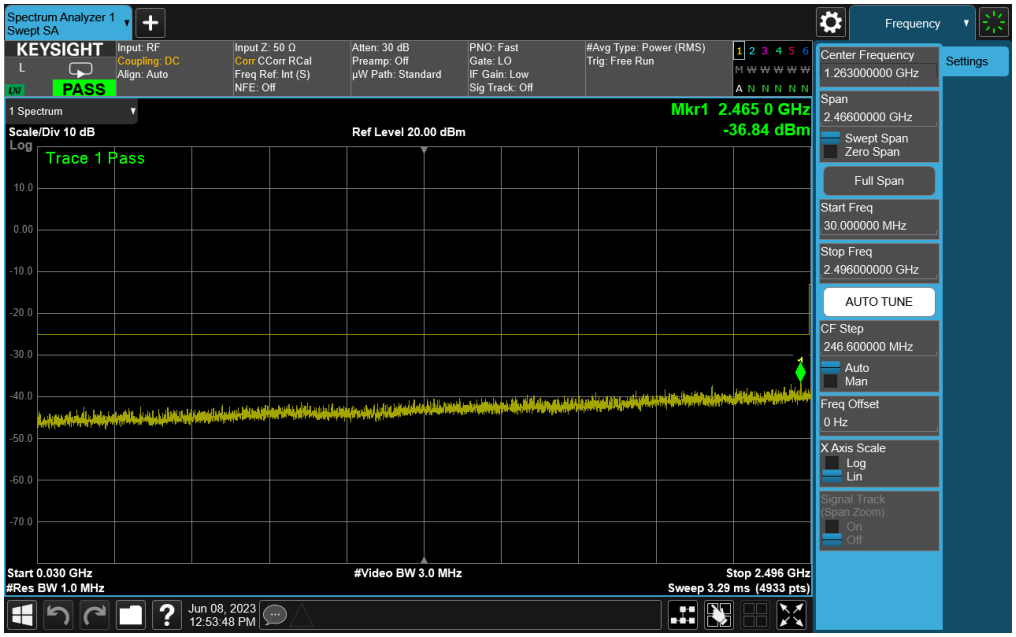


Plot 7-28. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-29. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

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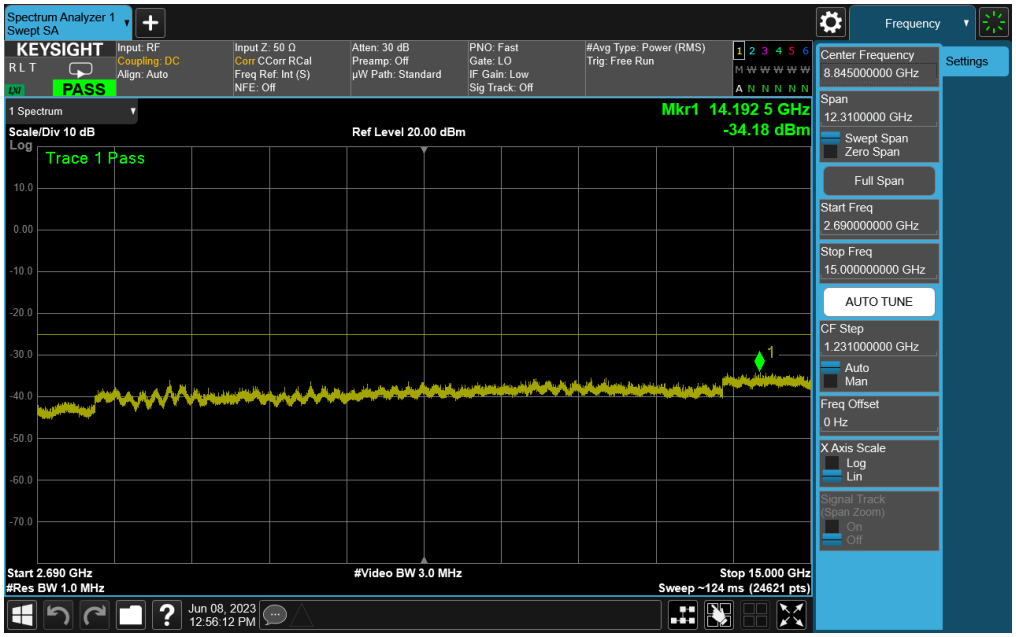
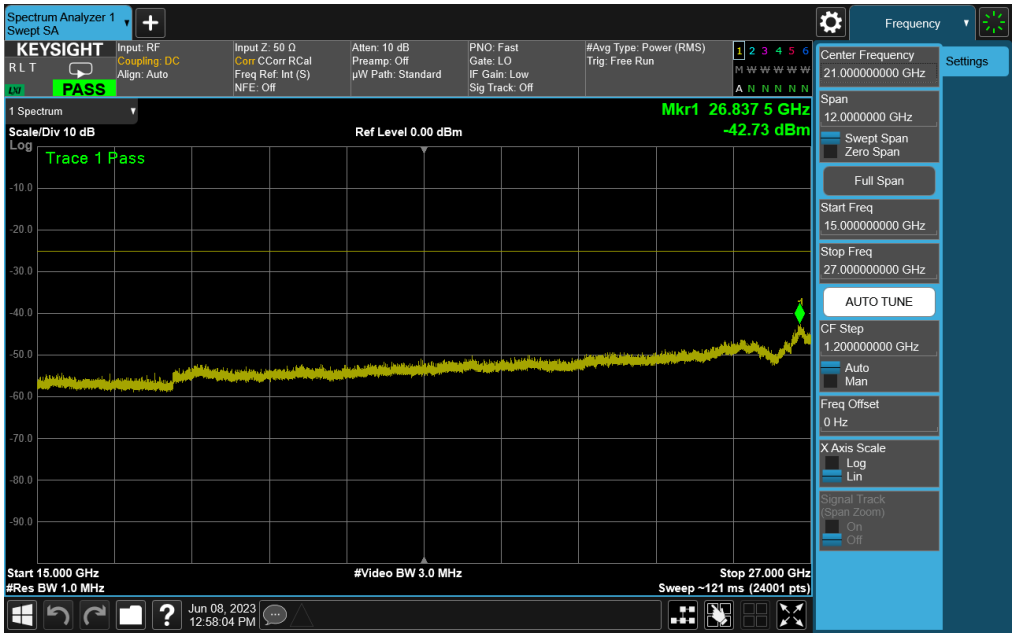


Plot 7-30. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



Plot 7-31. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

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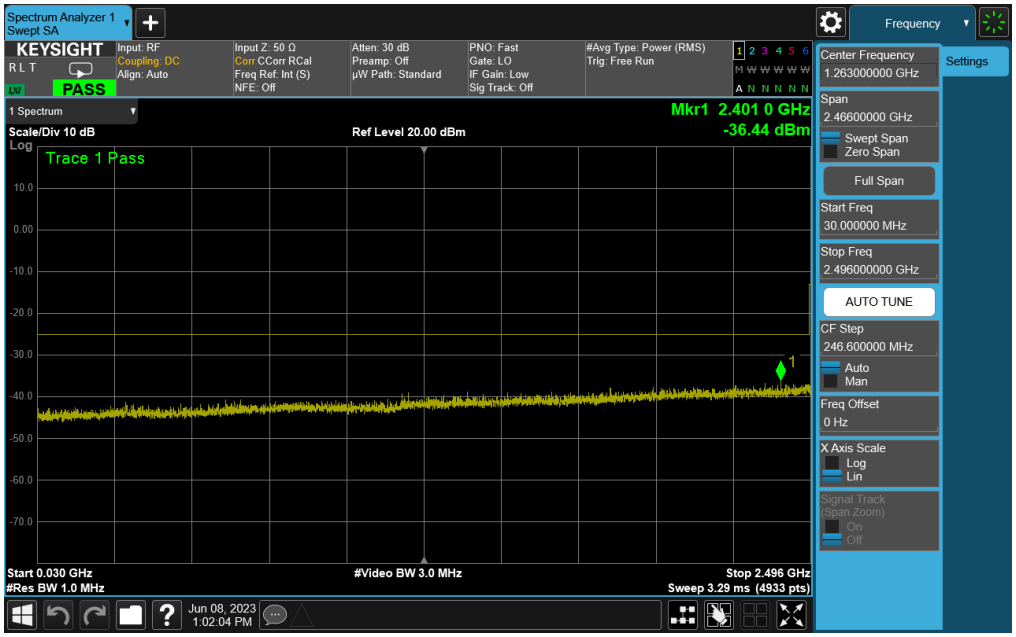
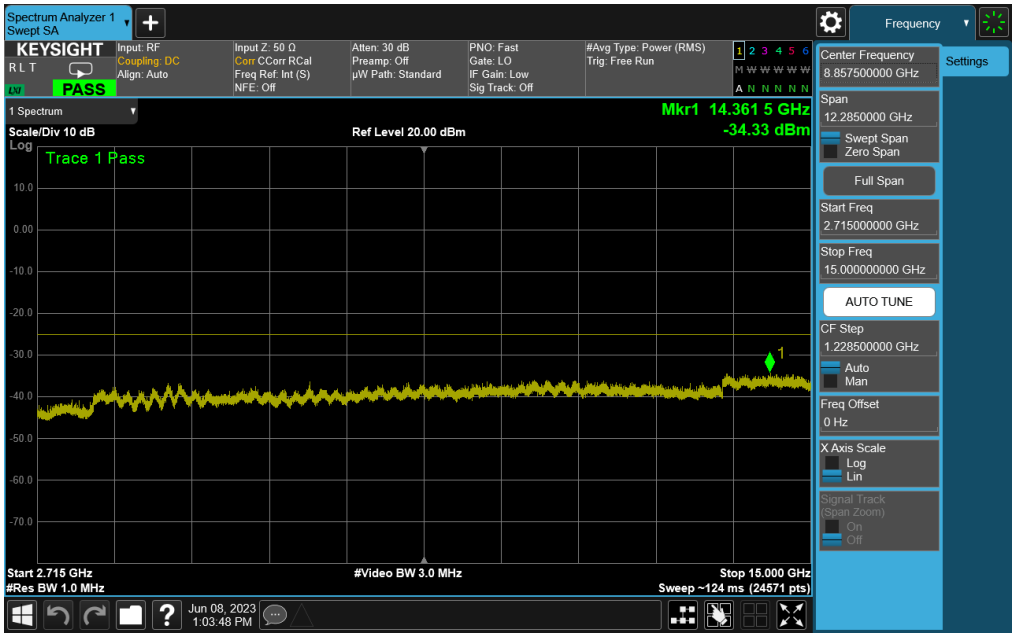


Plot 7-32. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-33. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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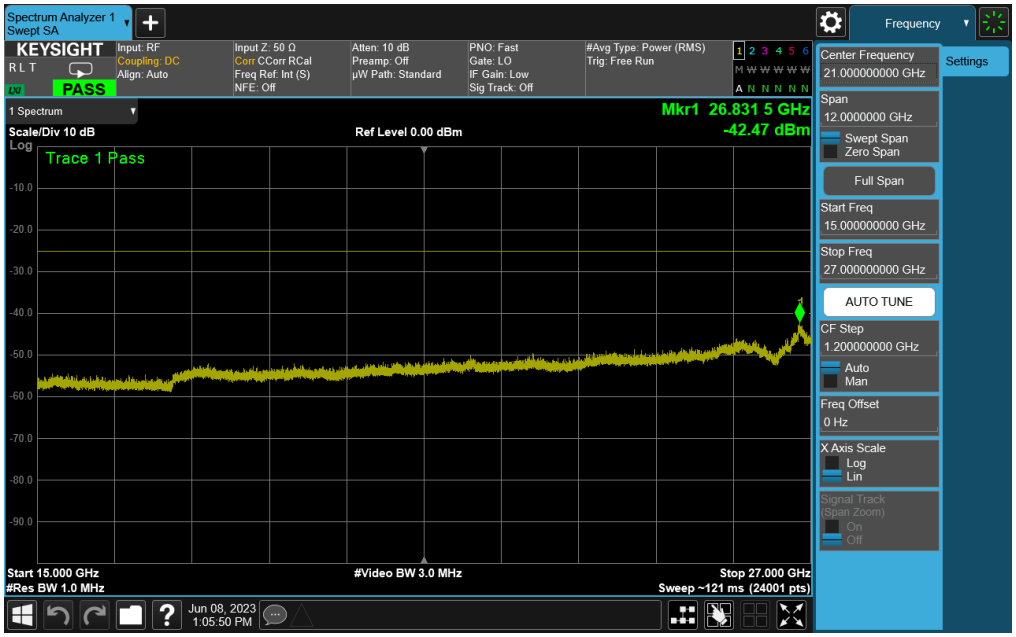

Plot 7-34. Conducted Spurious Plot (LTE Band 41 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §27.53(a), §27.53(m)

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.

For LTE Bands 7 and 41, the minimum permissible attenuation level is noted in the Test Notes on the following page.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

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.

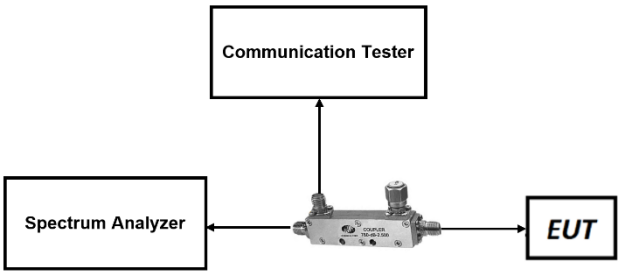

Figure 7-3. Test Instrument & Measurement Setup

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Test Notes

1. Per 27.53(h), 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.

2. Per 27.53(m) for operations in the BRS/EBS bands, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz.

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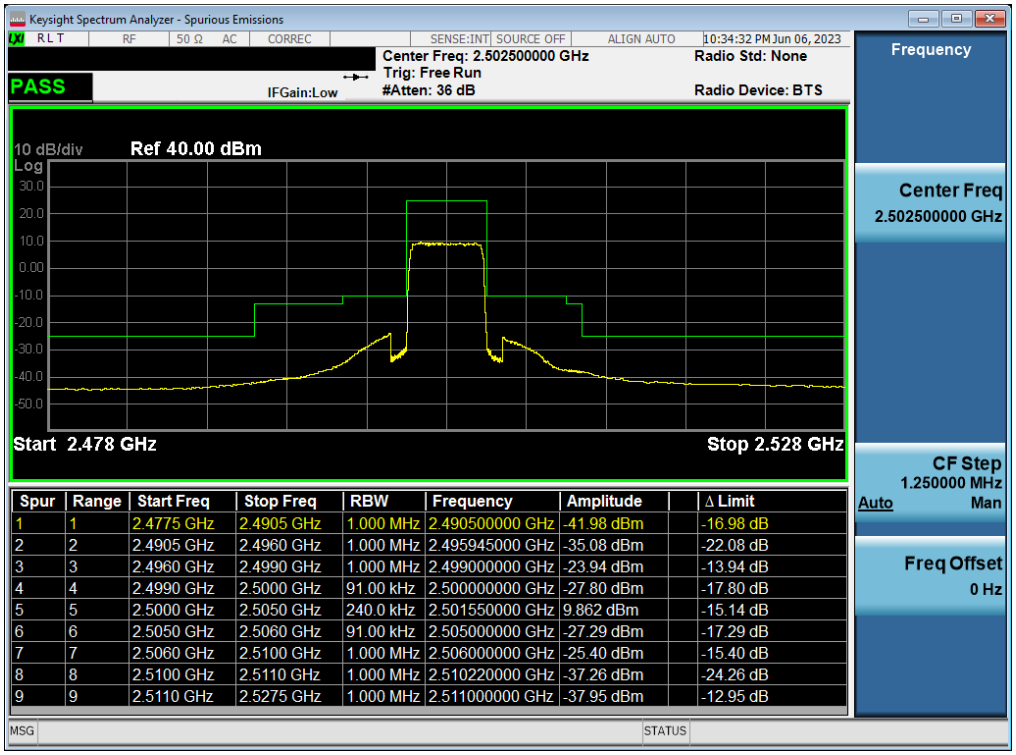
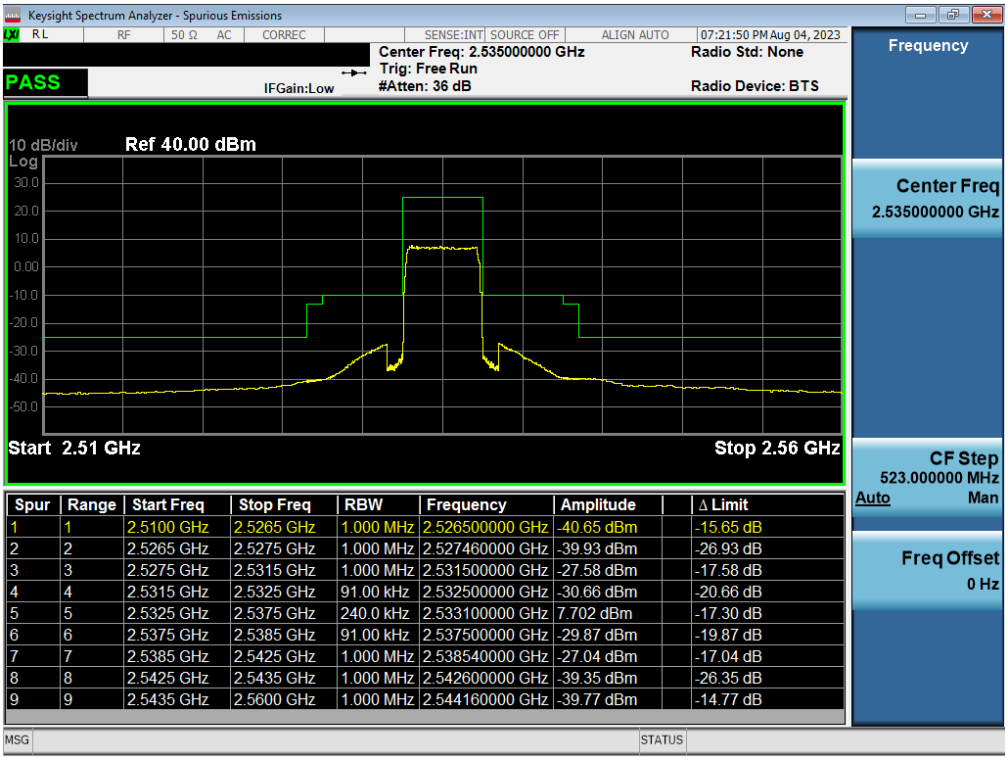
LTE Band 7



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4775 GHz	2.4905 GHz	1.000 MHz	2.490500000 GHz	-41.98 dBm	-16.98 dB
2	2	2.4905 GHz	2.4960 GHz	1.000 MHz	2.495945000 GHz	-35.08 dBm	-22.08 dB
3	3	2.4960 GHz	2.4990 GHz	1.000 MHz	2.499000000 GHz	-23.94 dBm	-13.94 dB
4	4	2.4990 GHz	2.5000 GHz	91.00 kHz	2.500000000 GHz	-27.80 dBm	-17.80 dB
5	5	2.5000 GHz	2.5050 GHz	240.0 kHz	2.501550000 GHz	9.862 dBm	-15.14 dB
6	6	2.5050 GHz	2.5060 GHz	91.00 kHz	2.505000000 GHz	-27.29 dBm	-17.29 dB
7	7	2.5060 GHz	2.5100 GHz	1.000 MHz	2.506000000 GHz	-25.40 dBm	-15.40 dB
8	8	2.5100 GHz	2.5110 GHz	1.000 MHz	2.510220000 GHz	-37.26 dBm	-24.26 dB
9	9	2.5110 GHz	2.5275 GHz	1.000 MHz	2.511000000 GHz	-37.95 dBm	-12.95 dB

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



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.5100 GHz	2.5265 GHz	1.000 MHz	2.526500000 GHz	-40.65 dBm	-15.65 dB
2	2	2.5265 GHz	2.5275 GHz	1.000 MHz	2.527460000 GHz	-39.93 dBm	-26.93 dB
3	3	2.5275 GHz	2.5315 GHz	1.000 MHz	2.531500000 GHz	-27.58 dBm	-17.58 dB
4	4	2.5315 GHz	2.5325 GHz	91.00 kHz	2.532500000 GHz	-30.66 dBm	-20.66 dB
5	5	2.5325 GHz	2.5375 GHz	240.0 kHz	2.533100000 GHz	7.702 dBm	-17.30 dB
6	6	2.5375 GHz	2.5385 GHz	91.00 kHz	2.537500000 GHz	-29.87 dBm	-19.87 dB
7	7	2.5385 GHz	2.5425 GHz	1.000 MHz	2.538540000 GHz	-27.04 dBm	-17.04 dB
8	8	2.5425 GHz	2.5435 GHz	1.000 MHz	2.542600000 GHz	-39.35 dBm	-26.35 dB
9	9	2.5435 GHz	2.5600 GHz	1.000 MHz	2.544160000 GHz	-39.77 dBm	-14.77 dB

Plot 7-36. Middle ACP Plot (LTE Band 7 - 5MHz QPSK – Full RB)

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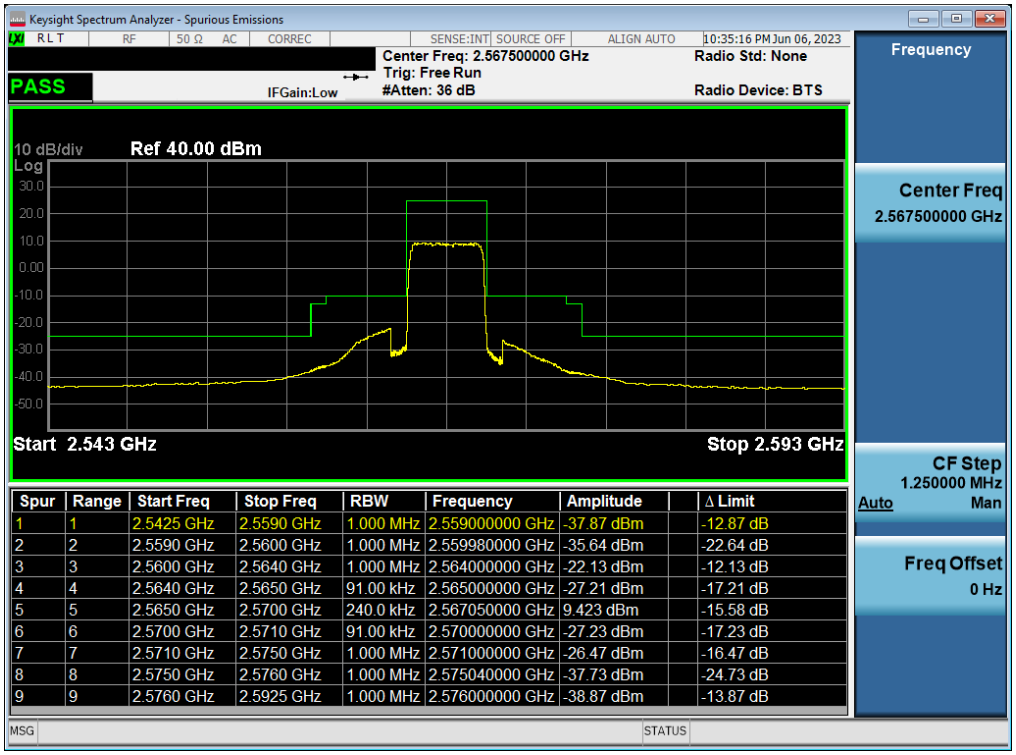
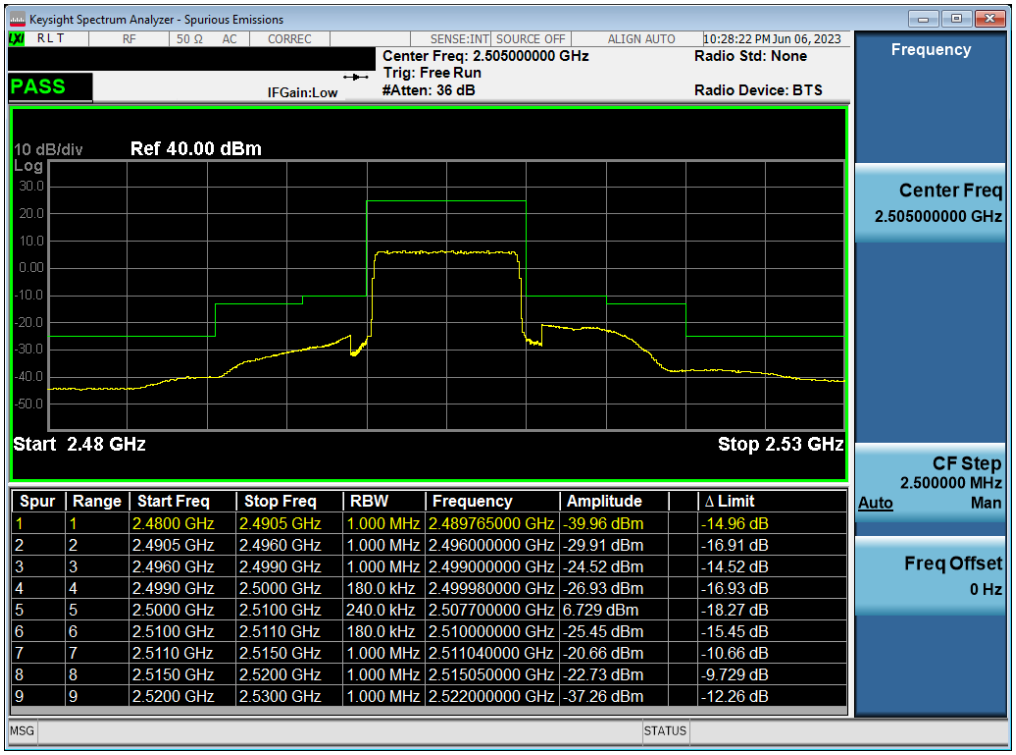


Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.5425 GHz	2.5590 GHz	1.000 MHz	2.559000000 GHz	-37.87 dBm	-12.87 dB
2	2	2.5590 GHz	2.5600 GHz	1.000 MHz	2.559980000 GHz	-35.64 dBm	-22.64 dB
3	3	2.5600 GHz	2.5640 GHz	1.000 MHz	2.564000000 GHz	-22.13 dBm	-12.13 dB
4	4	2.5640 GHz	2.5650 GHz	91.00 kHz	2.565000000 GHz	-27.21 dBm	-17.21 dB
5	5	2.5650 GHz	2.5700 GHz	240.0 kHz	2.567050000 GHz	9.423 dBm	-15.58 dB
6	6	2.5700 GHz	2.5710 GHz	91.00 kHz	2.570000000 GHz	-27.23 dBm	-17.23 dB
7	7	2.5710 GHz	2.5750 GHz	1.000 MHz	2.571000000 GHz	-26.47 dBm	-16.47 dB
8	8	2.5750 GHz	2.5760 GHz	1.000 MHz	2.575040000 GHz	-37.73 dBm	-24.73 dB
9	9	2.5760 GHz	2.5925 GHz	1.000 MHz	2.576000000 GHz	-38.87 dBm	-13.87 dB

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



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4800 GHz	2.4905 GHz	1.000 MHz	2.489765000 GHz	-39.96 dBm	-14.96 dB
2	2	2.4905 GHz	2.4960 GHz	1.000 MHz	2.496000000 GHz	-29.91 dBm	-16.91 dB
3	3	2.4960 GHz	2.4990 GHz	1.000 MHz	2.499000000 GHz	-24.52 dBm	-14.52 dB
4	4	2.4990 GHz	2.5000 GHz	180.0 kHz	2.499980000 GHz	-26.93 dBm	-16.93 dB
5	5	2.5000 GHz	2.5100 GHz	240.0 kHz	2.507700000 GHz	6.729 dBm	-18.27 dB
6	6	2.5100 GHz	2.5110 GHz	180.0 kHz	2.510000000 GHz	-25.45 dBm	-15.45 dB
7	7	2.5110 GHz	2.5150 GHz	1.000 MHz	2.511040000 GHz	-20.66 dBm	-10.66 dB
8	8	2.5150 GHz	2.5200 GHz	1.000 MHz	2.515050000 GHz	-22.73 dBm	-9.729 dB
9	9	2.5200 GHz	2.5300 GHz	1.000 MHz	2.522000000 GHz	-37.26 dBm	-12.26 dB

Plot 7-38. Lower ACP Plot (LTE Band 7 - 10MHz QPSK – Full RB)

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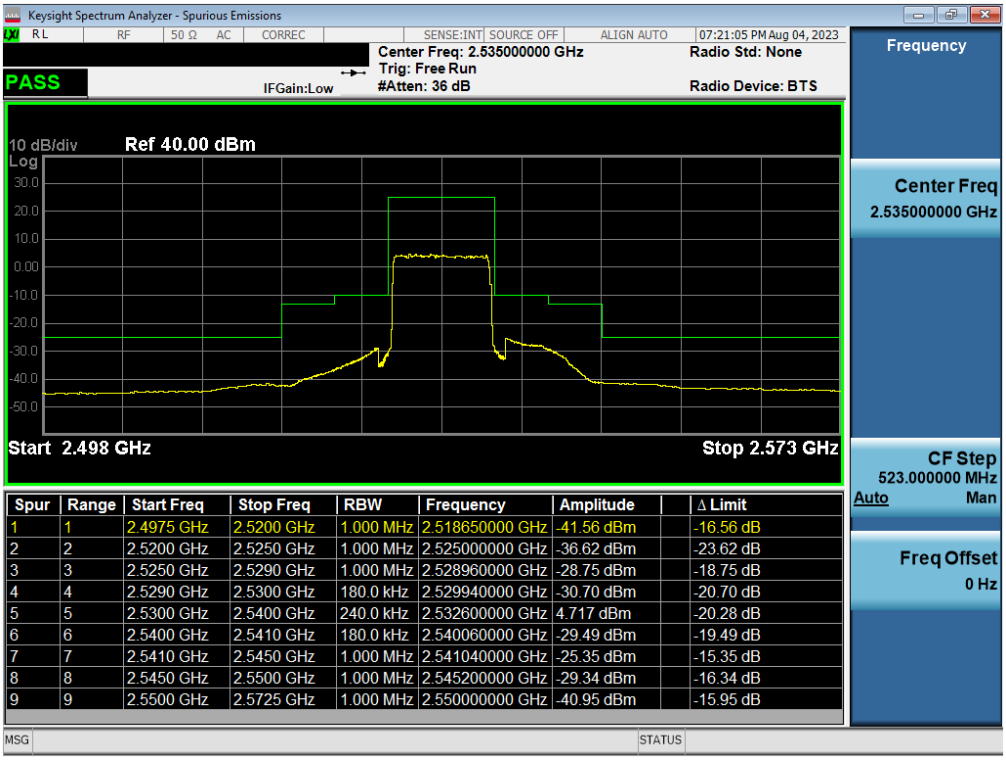
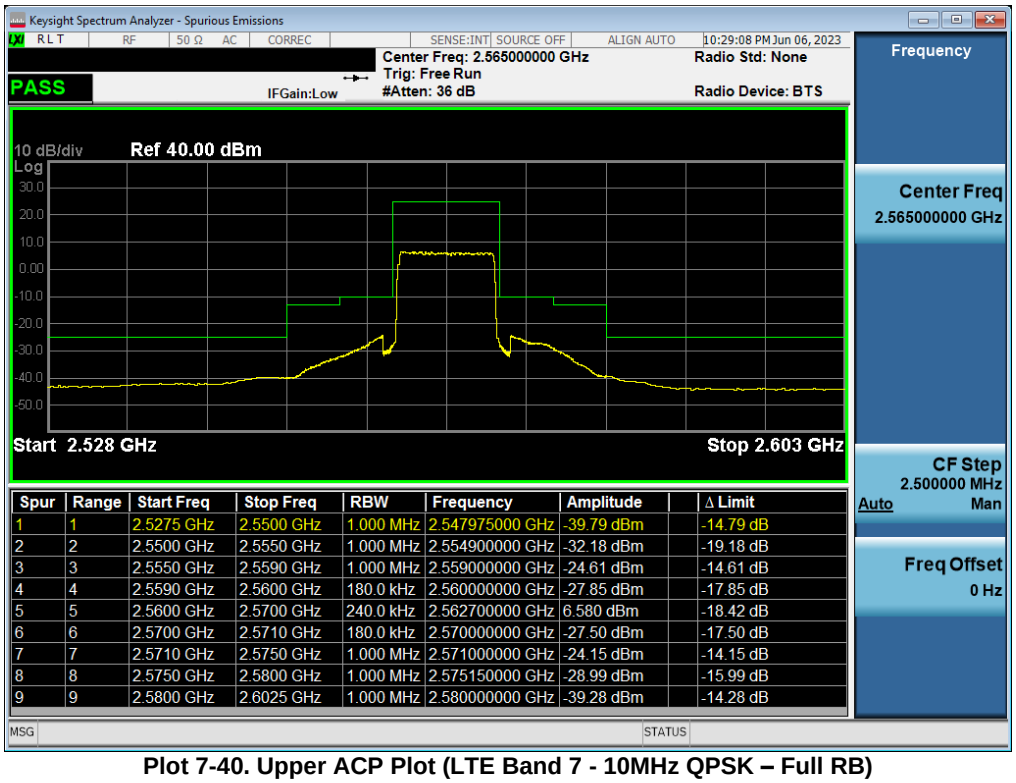


Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4975 GHz	2.5200 GHz	1.000 MHz	2.518650000 GHz	-41.56 dBm	-16.56 dB
2	2	2.5200 GHz	2.5250 GHz	1.000 MHz	2.525000000 GHz	-36.62 dBm	-23.62 dB
3	3	2.5250 GHz	2.5290 GHz	1.000 MHz	2.528960000 GHz	-28.75 dBm	-18.75 dB
4	4	2.5290 GHz	2.5300 GHz	180.0 kHz	2.529940000 GHz	-30.70 dBm	-20.70 dB
5	5	2.5300 GHz	2.5400 GHz	240.0 kHz	2.532600000 GHz	4.717 dBm	-20.28 dB
6	6	2.5400 GHz	2.5410 GHz	180.0 kHz	2.540060000 GHz	-29.49 dBm	-19.49 dB
7	7	2.5410 GHz	2.5450 GHz	1.000 MHz	2.541040000 GHz	-25.35 dBm	-15.35 dB
8	8	2.5450 GHz	2.5500 GHz	1.000 MHz	2.545200000 GHz	-29.34 dBm	-16.34 dB
9	9	2.5500 GHz	2.5725 GHz	1.000 MHz	2.550000000 GHz	-40.95 dBm	-15.95 dB

Plot 7-39. Middle ACP Plot (LTE Band 7 - 10MHz QPSK – Full RB)



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.5275 GHz	2.5500 GHz	1.000 MHz	2.547975000 GHz	-39.79 dBm	-14.79 dB
2	2	2.5500 GHz	2.5550 GHz	1.000 MHz	2.554900000 GHz	-32.18 dBm	-19.18 dB
3	3	2.5550 GHz	2.5590 GHz	1.000 MHz	2.559000000 GHz	-24.61 dBm	-14.61 dB
4	4	2.5590 GHz	2.5600 GHz	180.0 kHz	2.560000000 GHz	-27.85 dBm	-17.85 dB
5	5	2.5600 GHz	2.5700 GHz	240.0 kHz	2.562700000 GHz	6.580 dBm	-18.42 dB
6	6	2.5700 GHz	2.5710 GHz	180.0 kHz	2.570000000 GHz	-27.50 dBm	-17.50 dB
7	7	2.5710 GHz	2.5750 GHz	1.000 MHz	2.571000000 GHz	-24.15 dBm	-14.15 dB
8	8	2.5750 GHz	2.5800 GHz	1.000 MHz	2.575150000 GHz	-28.99 dBm	-15.99 dB
9	9	2.5800 GHz	2.6025 GHz	1.000 MHz	2.580000000 GHz	-39.28 dBm	-14.28 dB

Plot 7-40. Upper ACP Plot (LTE Band 7 - 10MHz QPSK – Full RB)

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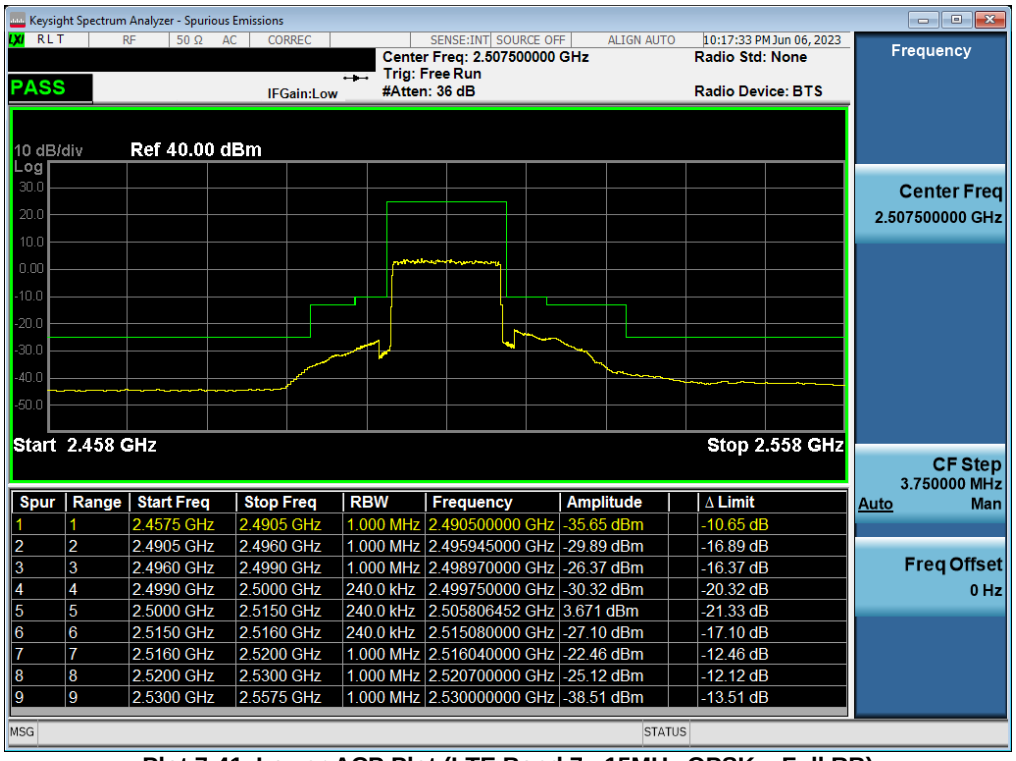
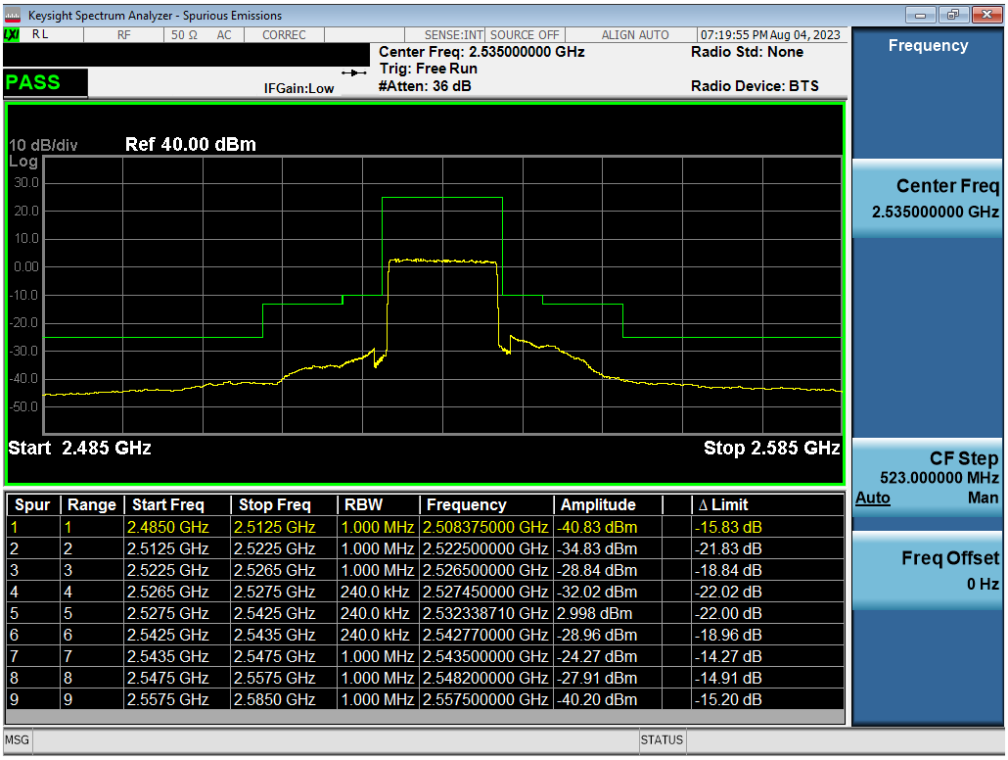


Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4575 GHz	2.4905 GHz	1.000 MHz	2.490500000 GHz	-35.65 dBm	-10.65 dB
2	2	2.4905 GHz	2.4960 GHz	1.000 MHz	2.495945000 GHz	-29.89 dBm	-16.89 dB
3	3	2.4960 GHz	2.4990 GHz	1.000 MHz	2.498970000 GHz	-26.37 dBm	-16.37 dB
4	4	2.4990 GHz	2.5000 GHz	240.0 kHz	2.499750000 GHz	-30.32 dBm	-20.32 dB
5	5	2.5000 GHz	2.5150 GHz	240.0 kHz	2.505806452 GHz	3.671 dBm	-21.33 dB
6	6	2.5150 GHz	2.5160 GHz	240.0 kHz	2.515080000 GHz	-27.10 dBm	-17.10 dB
7	7	2.5160 GHz	2.5200 GHz	1.000 MHz	2.516040000 GHz	-22.46 dBm	-12.46 dB
8	8	2.5200 GHz	2.5300 GHz	1.000 MHz	2.520700000 GHz	-25.12 dBm	-12.12 dB
9	9	2.5300 GHz	2.5575 GHz	1.000 MHz	2.530000000 GHz	-38.51 dBm	-13.51 dB

Plot 7-41. Lower ACP Plot (LTE Band 7 - 15MHz QPSK – Full RB)



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4850 GHz	2.5125 GHz	1.000 MHz	2.508375000 GHz	-40.83 dBm	-15.83 dB
2	2	2.5125 GHz	2.5225 GHz	1.000 MHz	2.522500000 GHz	-34.83 dBm	-21.83 dB
3	3	2.5225 GHz	2.5265 GHz	1.000 MHz	2.526500000 GHz	-28.84 dBm	-18.84 dB
4	4	2.5265 GHz	2.5275 GHz	240.0 kHz	2.527450000 GHz	-32.02 dBm	-22.02 dB
5	5	2.5275 GHz	2.5425 GHz	240.0 kHz	2.532338710 GHz	2.998 dBm	-22.00 dB
6	6	2.5425 GHz	2.5435 GHz	240.0 kHz	2.542770000 GHz	-28.96 dBm	-18.96 dB
7	7	2.5435 GHz	2.5475 GHz	1.000 MHz	2.543500000 GHz	-24.27 dBm	-14.27 dB
8	8	2.5475 GHz	2.5575 GHz	1.000 MHz	2.548200000 GHz	-27.91 dBm	-14.91 dB
9	9	2.5575 GHz	2.5850 GHz	1.000 MHz	2.557500000 GHz	-40.20 dBm	-15.20 dB

Plot 7-42. Middle ACP Plot (LTE Band 7 - 15MHz QPSK – Full RB)

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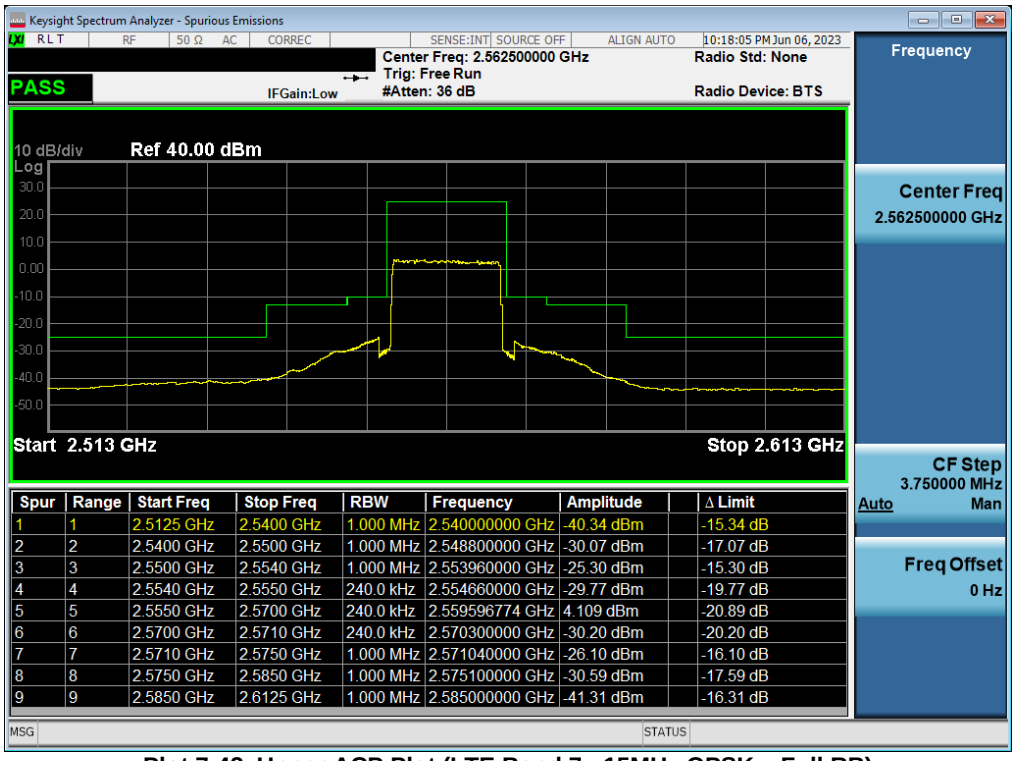
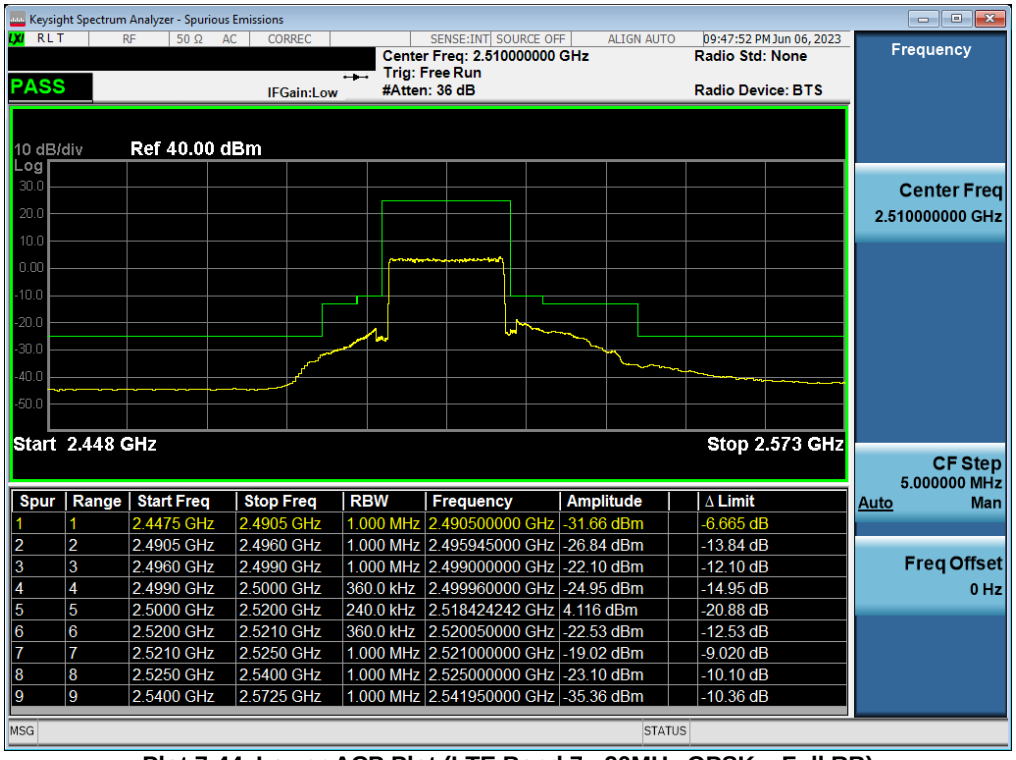


Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.5125 GHz	2.5400 GHz	1.000 MHz	2.540000000 GHz	-40.34 dBm	-15.34 dB
2	2	2.5400 GHz	2.5500 GHz	1.000 MHz	2.548800000 GHz	-30.07 dBm	-17.07 dB
3	3	2.5500 GHz	2.5540 GHz	1.000 MHz	2.553960000 GHz	-25.30 dBm	-15.30 dB
4	4	2.5540 GHz	2.5550 GHz	240.0 kHz	2.554660000 GHz	-29.77 dBm	-19.77 dB
5	5	2.5550 GHz	2.5700 GHz	240.0 kHz	2.559596774 GHz	4.109 dBm	-20.89 dB
6	6	2.5700 GHz	2.5710 GHz	240.0 kHz	2.570300000 GHz	-30.20 dBm	-20.20 dB
7	7	2.5710 GHz	2.5750 GHz	1.000 MHz	2.571040000 GHz	-26.10 dBm	-16.10 dB
8	8	2.5750 GHz	2.5850 GHz	1.000 MHz	2.575100000 GHz	-30.59 dBm	-17.59 dB
9	9	2.5850 GHz	2.6125 GHz	1.000 MHz	2.585000000 GHz	-41.31 dBm	-16.31 dB

Plot 7-43. Upper ACP Plot (LTE Band 7 - 15MHz QPSK – Full RB)



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4475 GHz	2.4905 GHz	1.000 MHz	2.490500000 GHz	-31.66 dBm	-6.665 dB
2	2	2.4905 GHz	2.4960 GHz	1.000 MHz	2.495945000 GHz	-26.84 dBm	-13.84 dB
3	3	2.4960 GHz	2.4990 GHz	1.000 MHz	2.499000000 GHz	-22.10 dBm	-12.10 dB
4	4	2.4990 GHz	2.5000 GHz	360.0 kHz	2.499960000 GHz	-24.95 dBm	-14.95 dB
5	5	2.5000 GHz	2.5200 GHz	240.0 kHz	2.518424242 GHz	4.116 dBm	-20.88 dB
6	6	2.5200 GHz	2.5210 GHz	360.0 kHz	2.520050000 GHz	-22.53 dBm	-12.53 dB
7	7	2.5210 GHz	2.5250 GHz	1.000 MHz	2.521000000 GHz	-19.02 dBm	-9.020 dB
8	8	2.5250 GHz	2.5400 GHz	1.000 MHz	2.525000000 GHz	-23.10 dBm	-10.10 dB
9	9	2.5400 GHz	2.5725 GHz	1.000 MHz	2.541950000 GHz	-35.36 dBm	-10.36 dB

Plot 7-44. Lower ACP Plot (LTE Band 7 - 20MHz QPSK – Full RB)

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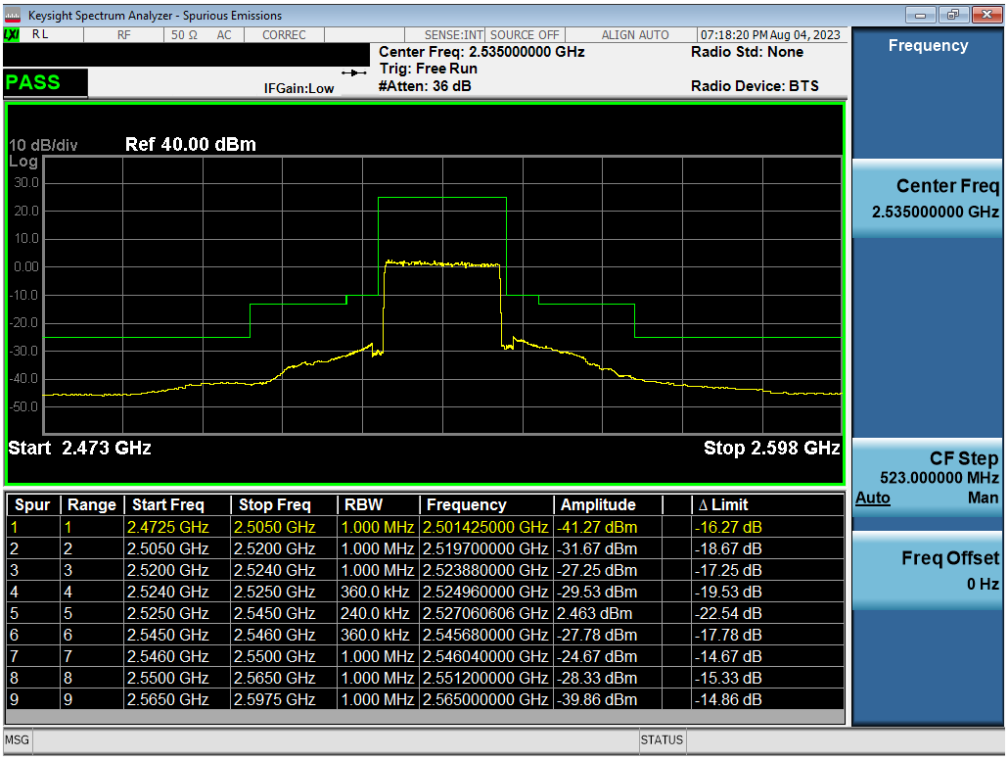
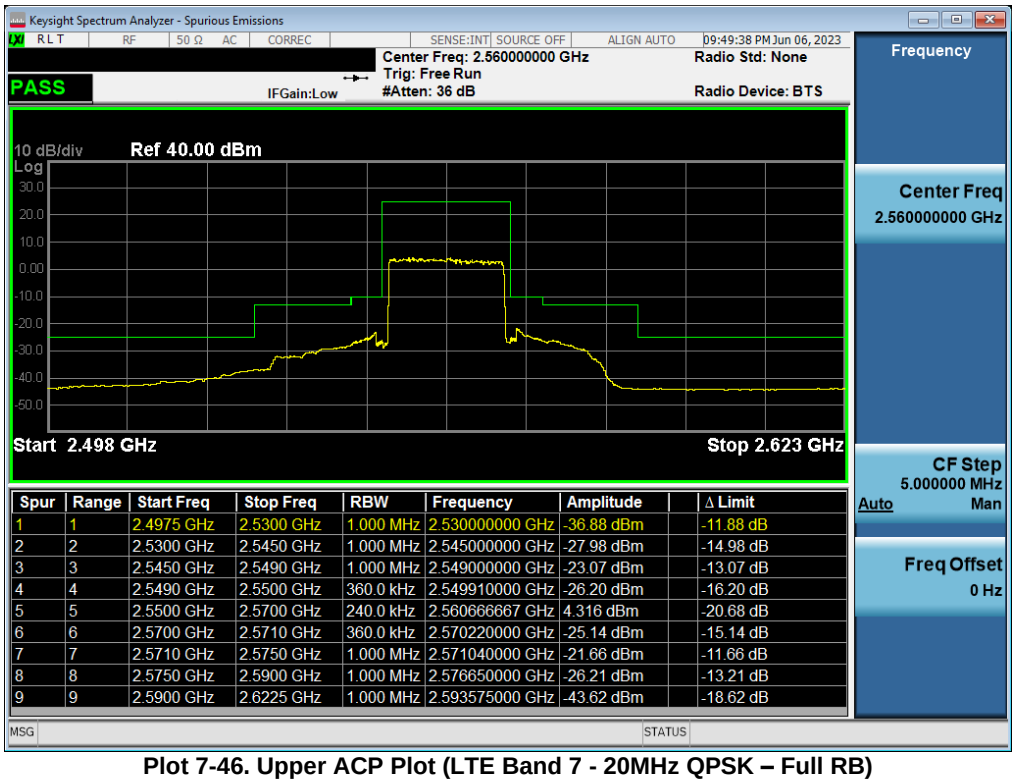


Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4725 GHz	2.5050 GHz	1.000 MHz	2.501425000 GHz	-41.27 dBm	-16.27 dB
2	2	2.5050 GHz	2.5200 GHz	1.000 MHz	2.519700000 GHz	-31.67 dBm	-18.67 dB
3	3	2.5200 GHz	2.5240 GHz	1.000 MHz	2.523880000 GHz	-27.25 dBm	-17.25 dB
4	4	2.5240 GHz	2.5250 GHz	360.0 kHz	2.524960000 GHz	-29.53 dBm	-19.53 dB
5	5	2.5250 GHz	2.5450 GHz	240.0 kHz	2.527060606 GHz	2.463 dBm	-22.54 dB
6	6	2.5450 GHz	2.5460 GHz	360.0 kHz	2.545680000 GHz	-27.78 dBm	-17.78 dB
7	7	2.5460 GHz	2.5500 GHz	1.000 MHz	2.546040000 GHz	-24.67 dBm	-14.67 dB
8	8	2.5500 GHz	2.5650 GHz	1.000 MHz	2.551200000 GHz	-28.33 dBm	-15.33 dB
9	9	2.5650 GHz	2.5975 GHz	1.000 MHz	2.565000000 GHz	-39.86 dBm	-14.86 dB

Plot 7-45. Middle ACP Plot (LTE Band 7 - 20MHz QPSK – Full RB)



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	2.4975 GHz	2.5300 GHz	1.000 MHz	2.530000000 GHz	-36.88 dBm	-11.88 dB
2	2	2.5300 GHz	2.5450 GHz	1.000 MHz	2.545000000 GHz	-27.98 dBm	-14.98 dB
3	3	2.5450 GHz	2.5490 GHz	1.000 MHz	2.549000000 GHz	-23.07 dBm	-13.07 dB
4	4	2.5490 GHz	2.5500 GHz	360.0 kHz	2.549910000 GHz	-26.20 dBm	-16.20 dB
5	5	2.5500 GHz	2.5700 GHz	240.0 kHz	2.560666667 GHz	4.316 dBm	-20.68 dB
6	6	2.5700 GHz	2.5710 GHz	360.0 kHz	2.570220000 GHz	-25.14 dBm	-15.14 dB
7	7	2.5710 GHz	2.5750 GHz	1.000 MHz	2.571040000 GHz	-21.66 dBm	-11.66 dB
8	8	2.5750 GHz	2.5900 GHz	1.000 MHz	2.576650000 GHz	-26.21 dBm	-13.21 dB
9	9	2.5900 GHz	2.6225 GHz	1.000 MHz	2.593575000 GHz	-43.62 dBm	-18.62 dB

Plot 7-46. Upper ACP Plot (LTE Band 7 - 20MHz QPSK – Full RB)

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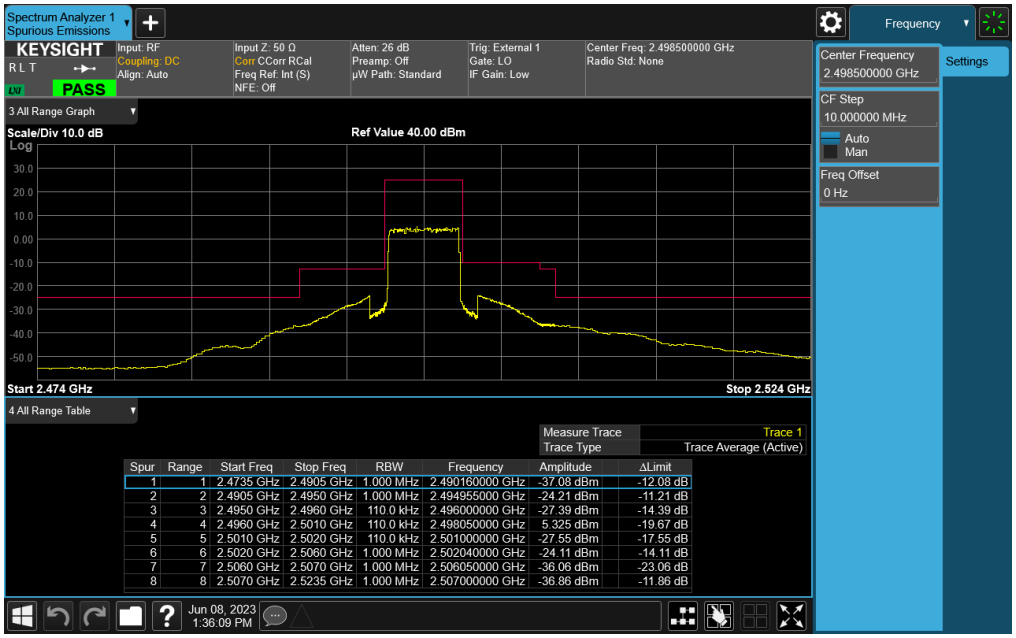
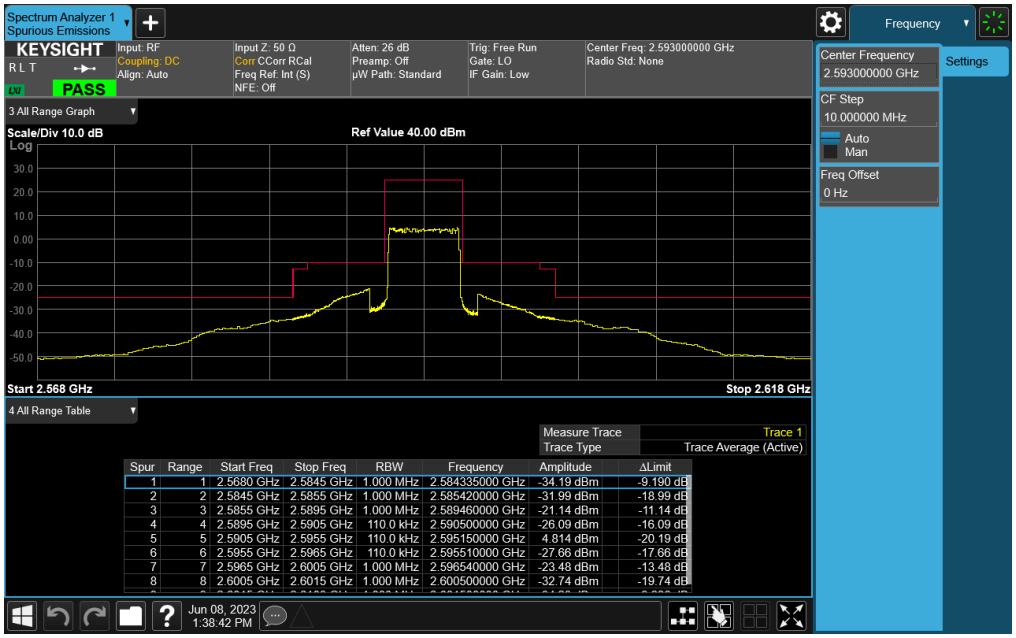
LTE Band 41



Plot 7-47. Lower ACP Plot (LTE Band 41 - 5MHz QPSK – Full RB)



Plot 7-48. Middle ACP Plot (LTE Band 41 - 5MHz QPSK – Full RB

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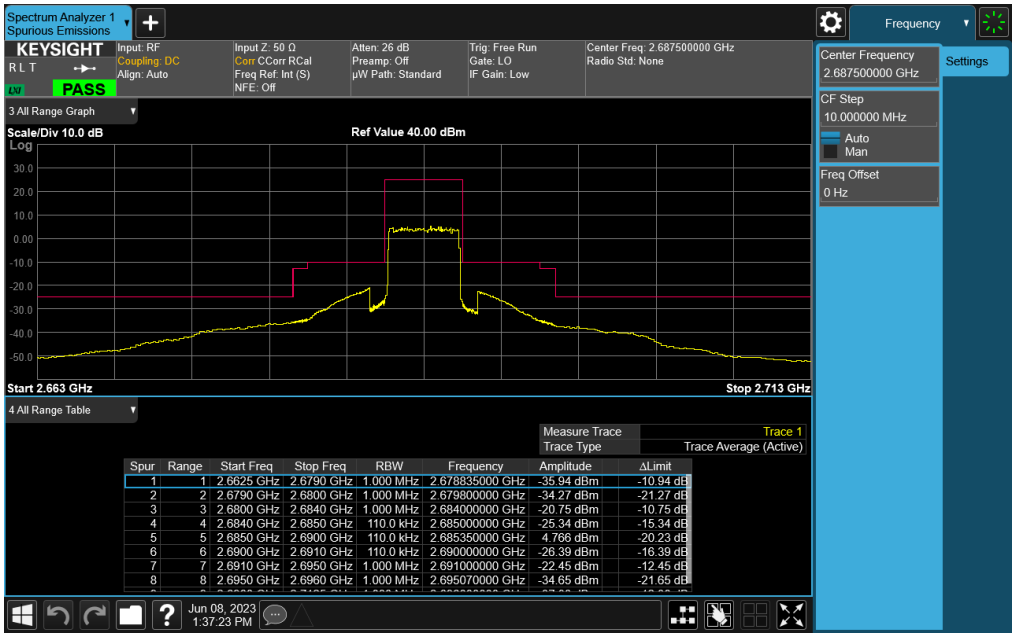
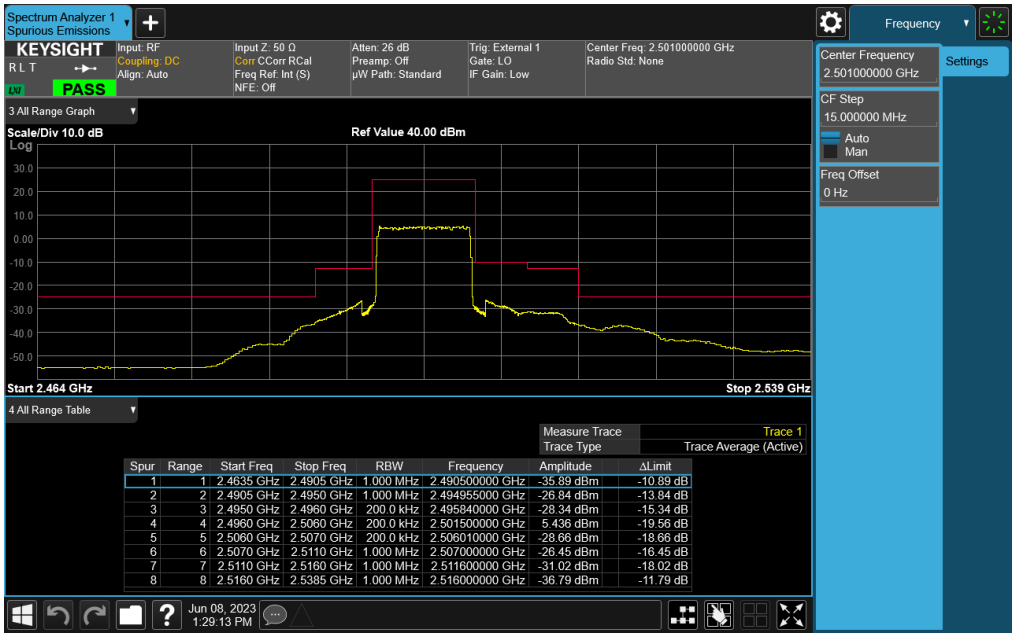


Plot 7-49. Upper ACP Plot (LTE Band 41 - 5MHz QPSK – Full RB)



Plot 7-50. Lower ACP Plot (LTE Band 41 - 10MHz QPSK – Full RB)

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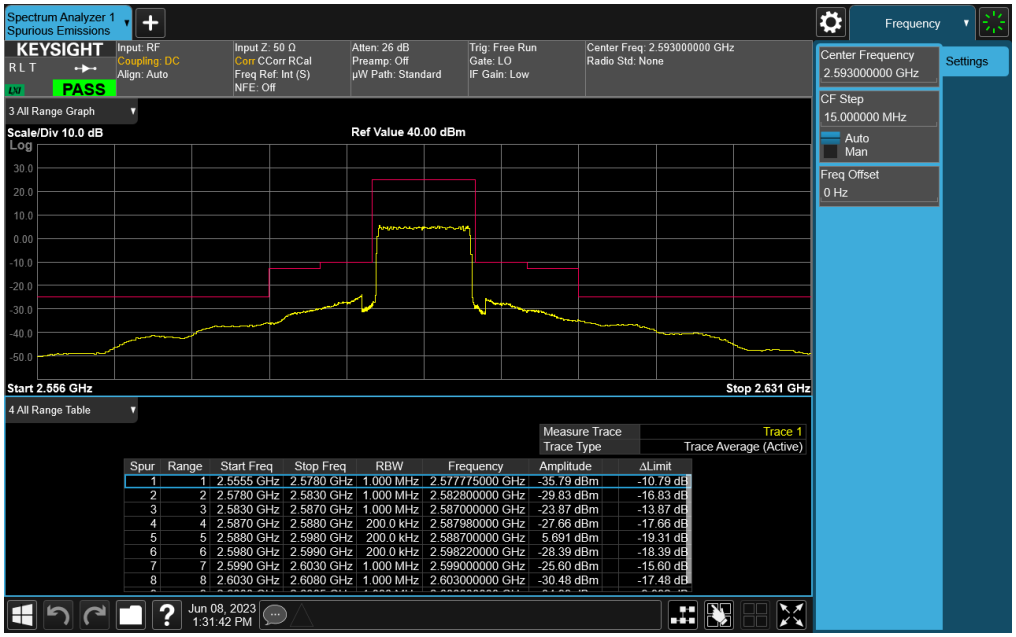
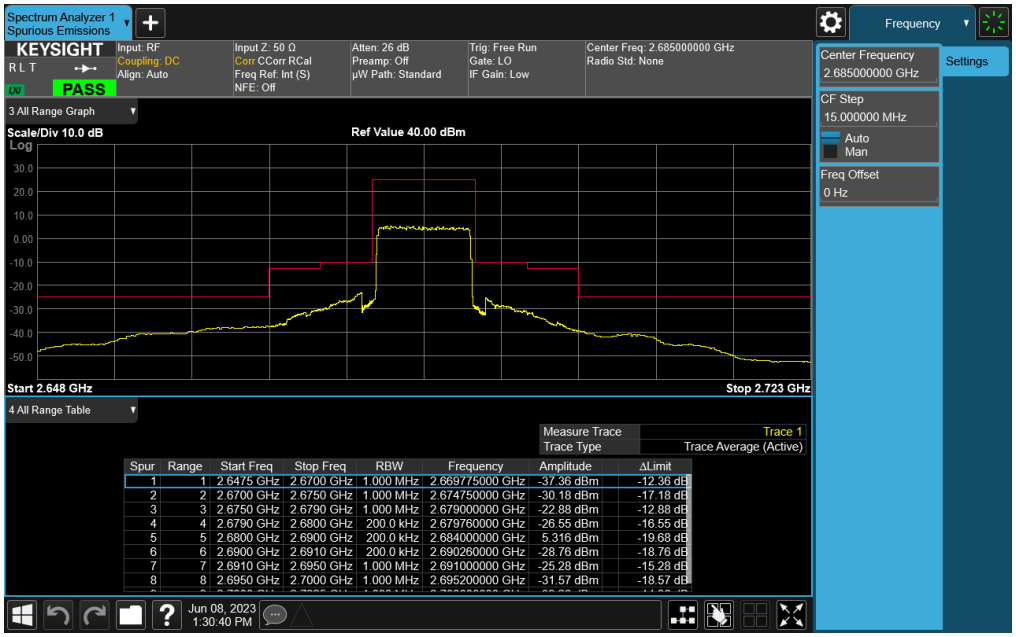


Plot 7-51. Middle ACP Plot (LTE Band 41 - 10MHz QPSK – Full RB)



Plot 7-52. Upper ACP Plot (LTE Band 41 - 10MHz QPSK – Full RB)

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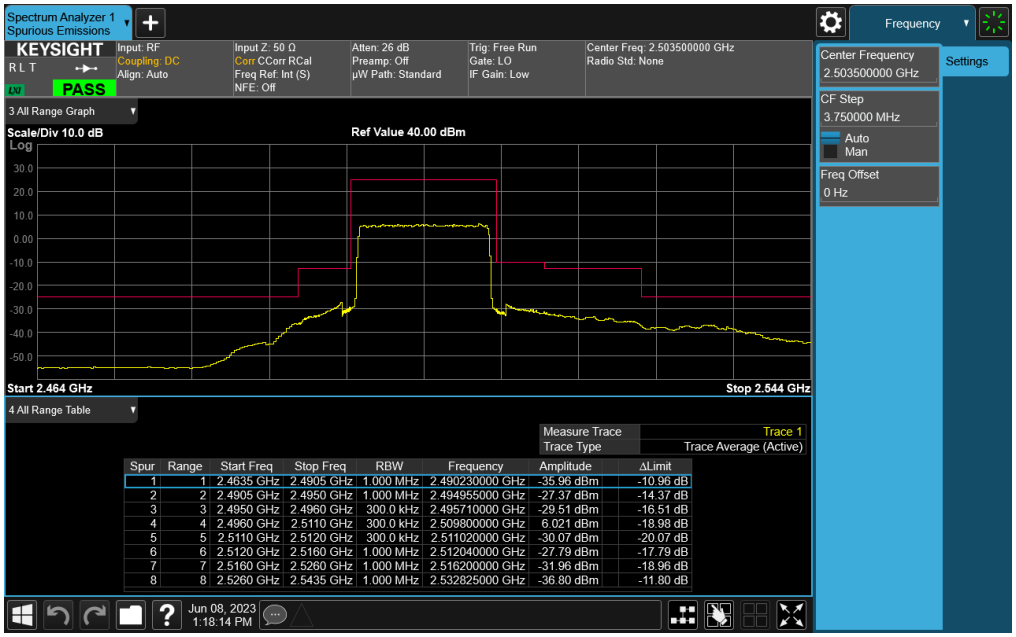
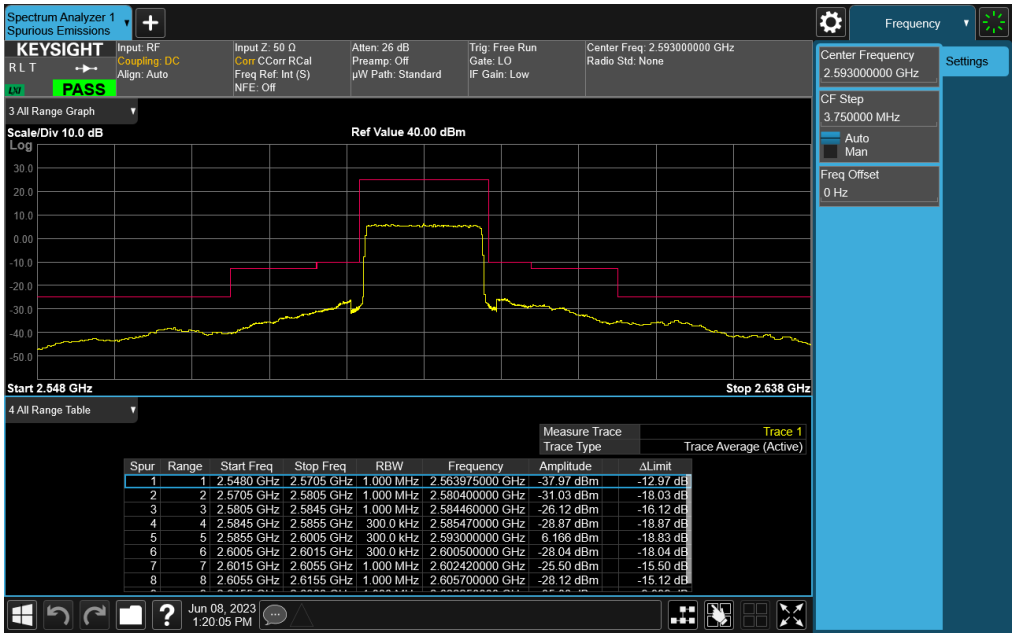


Plot 7-53. Lower ACP Plot (LTE Band 41 - 15MHz QPSK – Full RB)



Plot 7-54. Middle ACP Plot (LTE Band 41 - 15MHz QPSK – Full RB)

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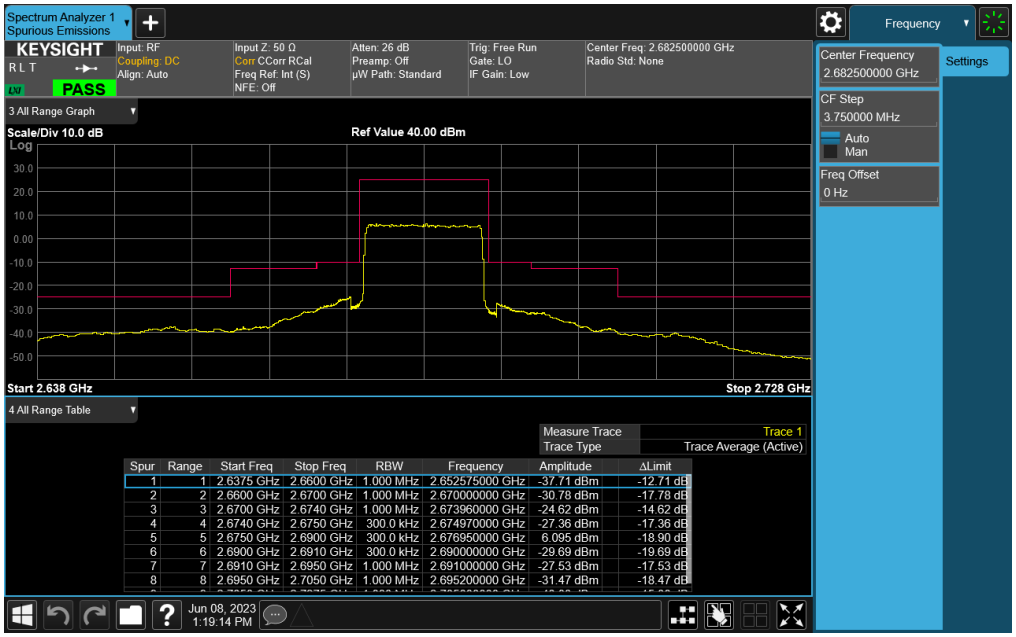
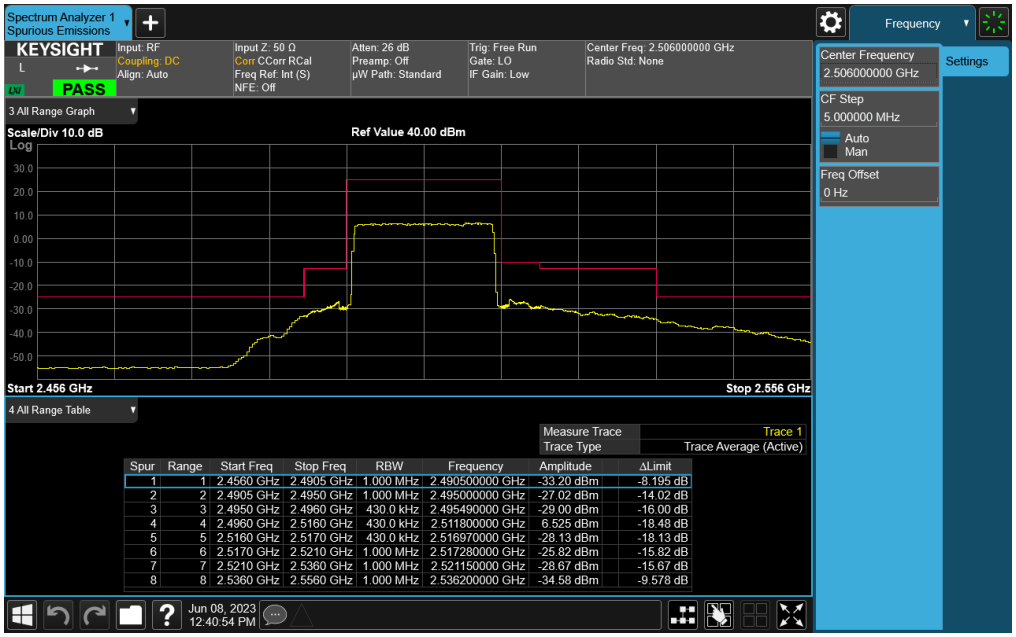


Plot 7-55. Upper ACP Plot (LTE Band 41 - 15MHz QPSK – Full RB)



Plot 7-56. Lower ACP Plot (LTE Band 41 - 20MHz QPSK – Full RB)

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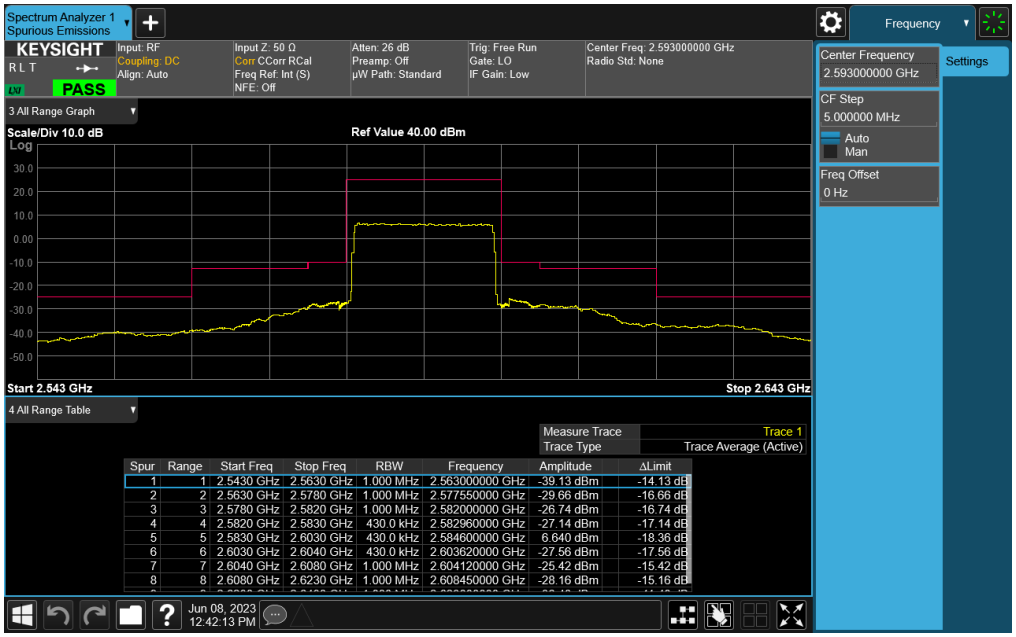
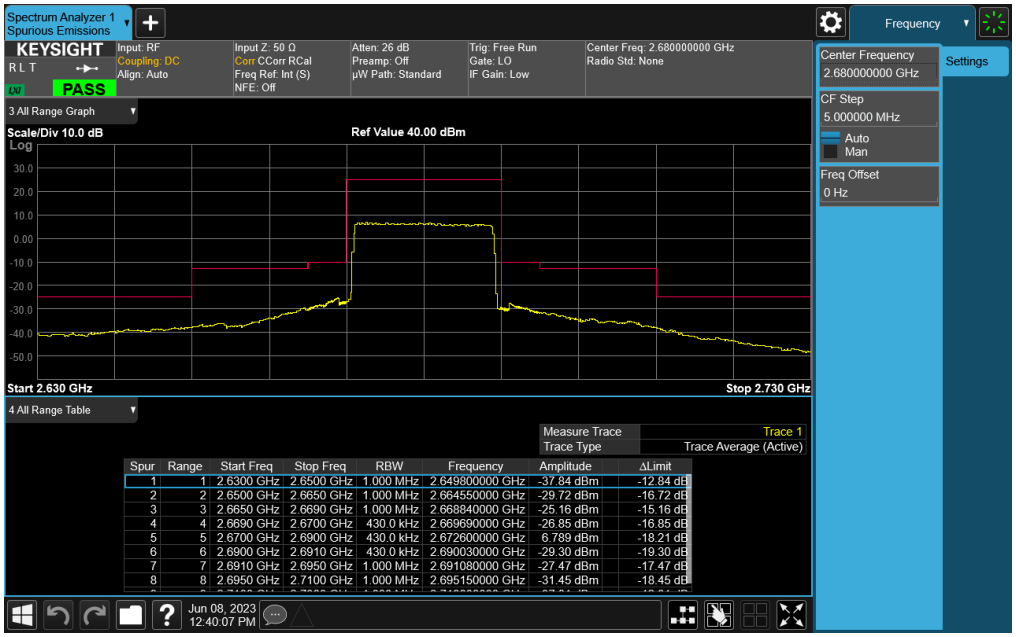


Plot 7-57. Middle ACP Plot (LTE Band 41 - 20MHz QPSK – Full RB)



Plot 7-58. Upper ACP Plot (LTE Band 41 - 20MHz QPSK – Full RB)

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7.5 Radiated Power (EIRP)

§27.50(a)(3), §27.50(h)(2)

Test Overview

Equivalent Isotropic Radiated Power (EIRP) measurements are calculated by adding highest antenna gain to maximum measured conducted output power. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI C63.26-2015 – Section 5.2.5.5

Test Settings

The relevant equation for determining the ERP or EIRP from the conducted RF output power measured is:

EIRP = PMeas – LC + GT

Where:

EIRP = Equivalent Isotropic Radiated Power (expressed in the same units as PMeas, typically dBW or dBm)

PMeas = measured transmitter output power or PSD, in dBW or dBm

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

GT = gain of the transmitting antenna, in dBi (EIRP)

Test Setup

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

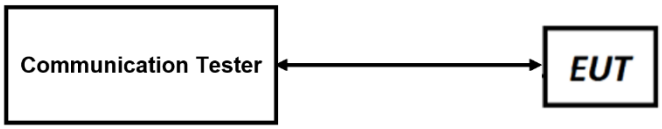

Figure 7-4. EIRP Measurement Setup

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Test Notes

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

2. This unit was tested with its standard battery.

3. The Level (dBm) readings in the table were taken with a correction table loaded into the base station simulator. The correction table was used to account for the signal attenuation in the connecting cable between the transmitter and antenna.

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LTE Band 7

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
5 MHz	QPSK	2502.5	-5.50	1 / 12	24.00	**18.50**	70.795	33.01	-14.51
		2535.0	-5.50	1 / 12	24.00	**18.50**	70.795	33.01	-14.51
		2567.5	-5.50	1 / 24	23.79	18.29	67.453	33.01	-14.72
	16-QAM	2567.5	-5.50	1 / 24	23.74	18.24	66.681	33.01	-14.77
10 MHz	QPSK	2505.0	-5.50	1 / 25	24.00	**18.50**	70.795	33.01	-14.51
		2535.0	-5.50	1 / 0	23.92	18.42	69.502	33.01	-14.59
		2565.0	-5.50	1 / 49	23.95	18.45	69.984	33.01	-14.56
	16-QAM	2505.0	-5.50	1 / 0	23.76	18.26	66.988	33.01	-14.75
15 MHz	QPSK	2507.5	-5.50	1 / 37	24.00	**18.50**	70.795	33.01	-14.51
		2535.0	-5.50	1 / 74	23.96	18.46	70.146	33.01	-14.55
		2562.5	-5.50	1 / 74	23.79	18.29	67.453	33.01	-14.72
	16-QAM	2562.5	-5.50	1 / 0	23.73	18.23	66.527	33.01	-14.78
20 MHz	QPSK	2510.0	-5.50	1 / 50	24.00	**18.50**	70.795	33.01	-14.51
		2535.0	-5.50	1 / 99	23.97	18.47	70.307	33.01	-14.54
		2560.0	-5.50	1 / 99	24.00	**18.50**	70.795	33.01	-14.51
	16-QAM	2560.0	-5.50	1 / 0	23.69	18.19	65.917	33.01	-14.82

Table 7-2. Antenna FCM EIRP Data (LTE Band 7)

LTE Band 41

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
5 MHz	QPSK	2498.5	-6.50	1 / 24	24.00	**17.50**	56.234	33.01	-15.51
		2593.0	-6.50	1 / 12	23.81	17.31	53.827	33.01	-15.70
		2687.5	-6.50	1 / 12	23.88	**17.38**	54.702	33.01	-15.63
	16-QAM	2687.5	-6.50	1 / 12	23.53	17.03	50.466	33.01	-15.98
10 MHz	QPSK	2501.0	-6.50	1 / 0	23.80	17.30	53.703	33.01	-15.71
		2593.0	-6.50	1 / 49	23.66	17.16	52.000	33.01	-15.85
		2685.0	-6.50	1 / 49	24.00	**17.50**	56.234	33.01	-15.51
	16-QAM	2685.0	-6.50	1 / 0	23.54	17.04	50.582	33.01	-15.97
15 MHz	QPSK	2503.5	-6.50	1 / 0	23.79	17.29	53.580	33.01	-15.72
		2593.0	-6.50	1 / 0	23.68	17.18	52.240	33.01	-15.83
		2682.5	-6.50	1 / 0	24.00	**17.50**	56.234	33.01	-15.51
	16-QAM	2682.5	-6.50	1 / 37	23.50	17.00	50.119	33.01	-16.01
20 MHz	QPSK	2506.0	-6.50	1 / 0	23.85	17.35	54.325	33.01	-15.66
		2593.0	-6.50	1 / 0	23.73	17.23	52.845	33.01	-15.78
		2680.0	-6.50	1 / 0	24.00	**17.50**	56.234	33.01	-15.51
	16-QAM	2680.0	-6.50	1 / 0	23.45	16.95	49.545	33.01	-16.06

Table 7-3. Antenna FCM EIRP Data (LTE Band 41)

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7.6 Radiated Spurious Emissions

§2.1053, 27.53(m)

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized broadband hybrid antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed while the EUT is operating at maximum power and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

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

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Test Setup

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

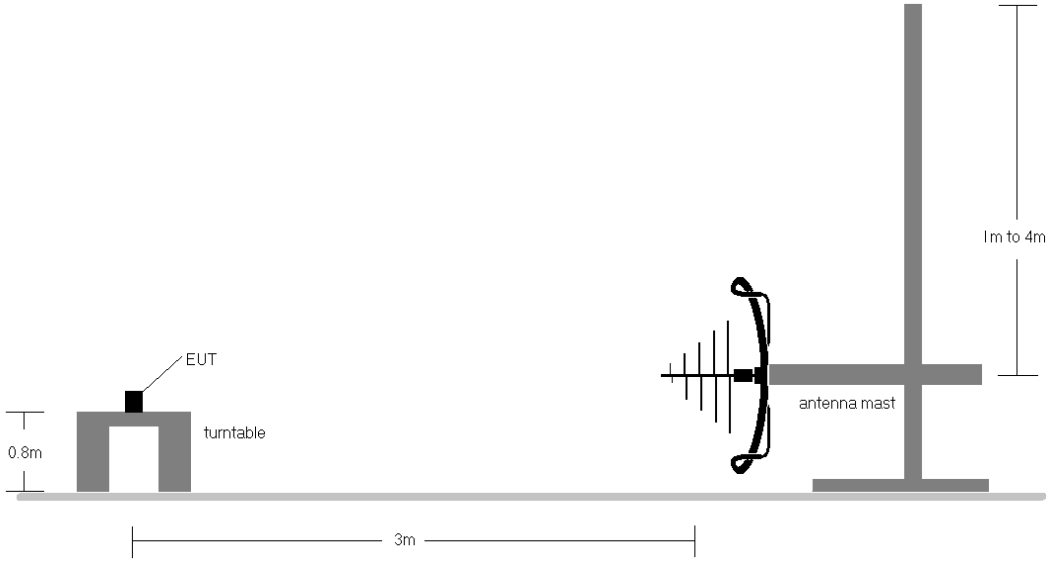

Figure 7-5. Test Instrument & Measurement Setup < 1GHz

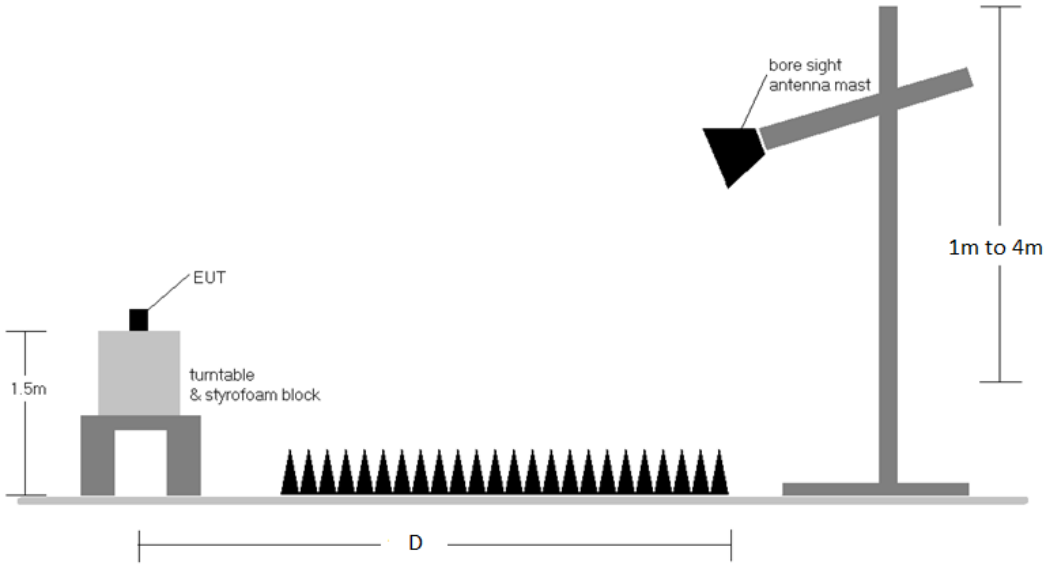

Figure 7-6. Test Instrument & Measurement Setup >1 GHz

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Test Notes

1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
    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. This unit was tested with its standard battery.

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

5. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

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

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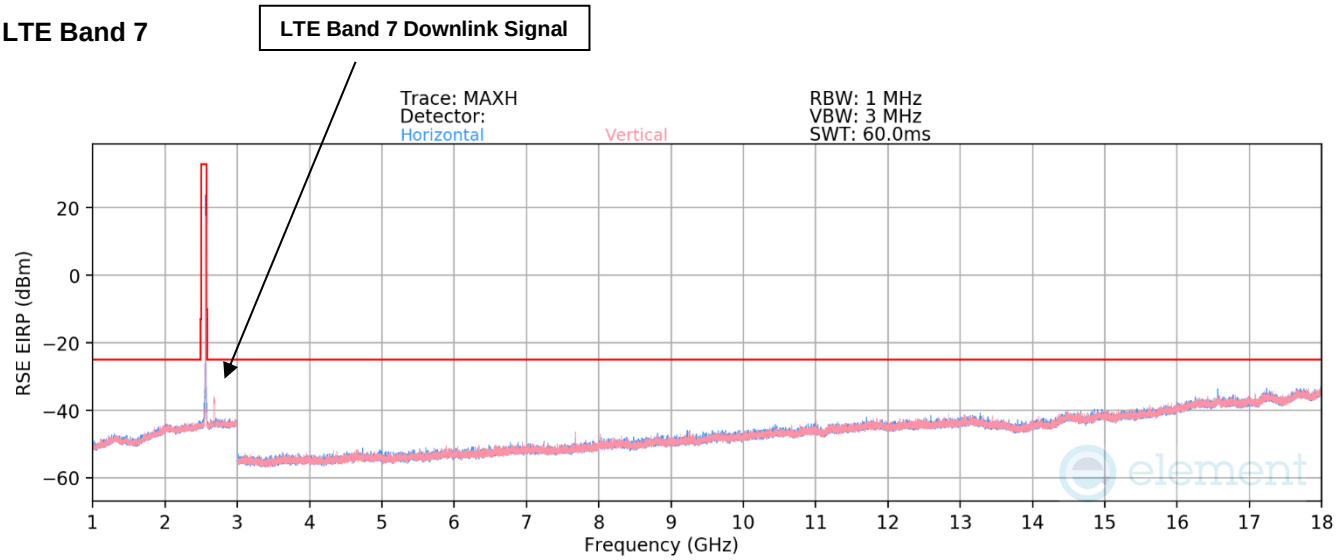
7.6.1 Antenna FCM – Radiated Spurious Emission Measurements

LTE Band 7



Plot 7-59. Antenna FCM Radiated Spurious Plot above 1GHz (LTE Band 7)

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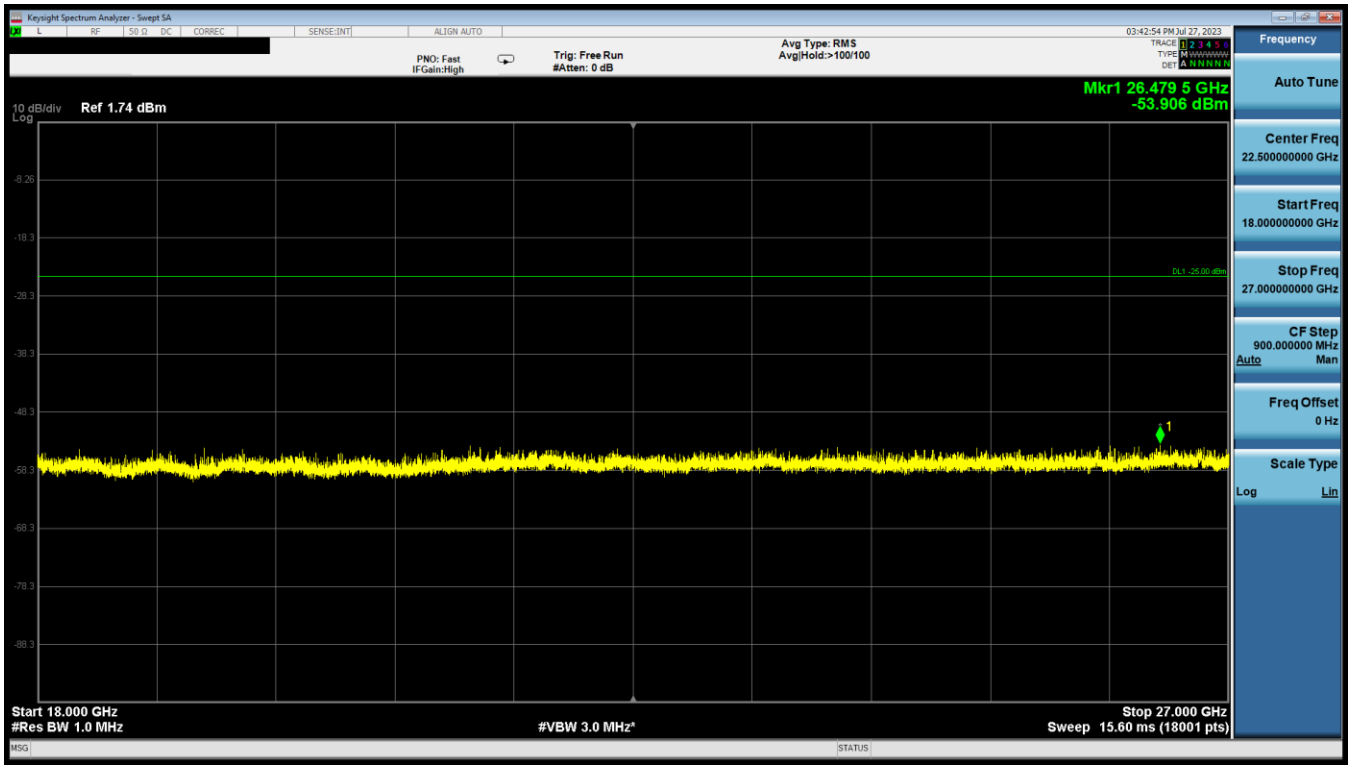
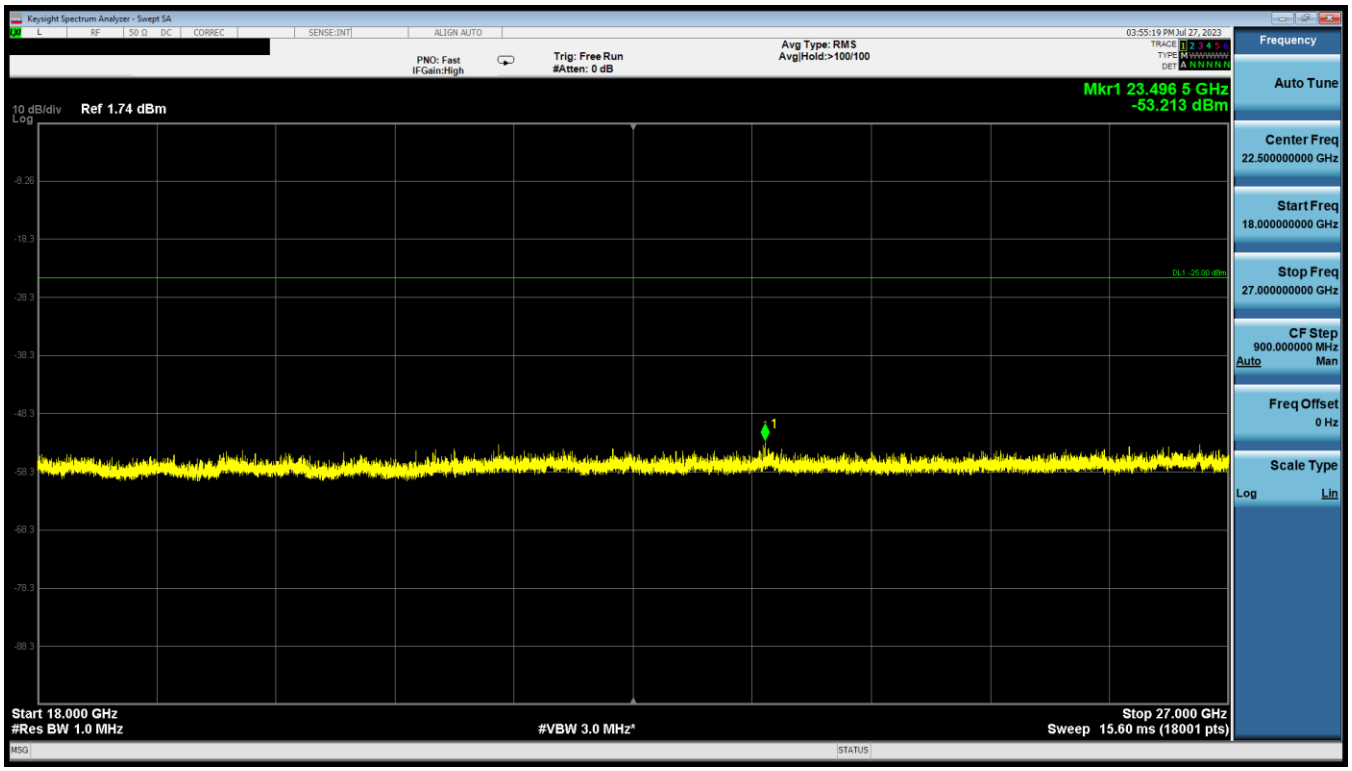


Plot 7-60. Antenna FCM Radiated Spurious Plot above 18GHz (LTE Band 7, Pol. H)



Plot 7-61. Antenna FCM Radiated Spurious Plot above 18GHz (LTE Band 7, Pol. V)

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Bandwidth (MHz):	20
Frequency (MHz):	2510.0
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]
5020.0	V	347	344	-79.52	5.14	32.62	-62.64	-25.00	-37.64
7530.0	V	264	148	-71.89	8.62	43.73	-51.53	-25.00	-26.53
10040.0	V	-	-	-84.23	10.78	33.55	-61.70	-25.00	-36.70
12550.0	V	-	-	-84.66	13.59	35.93	-59.33	-25.00	-34.33

Table 7-4. Antenna FCM Radiated Spurious Data (LTE Band 7 - Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	2535.0
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]
5070.0	V	312	353	-79.17	5.58	33.41	-61.85	-25.00	-36.85
7605.0	V	257	143	-79.53	8.76	36.23	-59.03	-25.00	-34.03
10140.0	V	244	52	-74.52	10.86	43.34	-51.92	-25.00	-26.92
12675.0	V	-	-	-80.10	13.89	40.79	-54.46	-25.00	-29.46
15210.0	V	-	-	-80.92	16.84	42.92	-52.34	-25.00	-27.34
17745.0	V	-	-	-79.61	22.77	50.16	-45.10	-25.00	-20.10

Table 7-5. Antenna FCM Radiated Spurious Data (LTE Band 7 - Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	2560.0
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]
5120.00	V	305	322	-78.82	5.50	33.68	-61.58	-25.00	-36.58
7680.00	V	257	146	-70.85	8.63	44.78	-50.47	-25.00	-25.47
10240.00	V	102	41	-73.48	10.62	44.14	-51.12	-25.00	-26.12
12800.00	V	-	-	-81.36	14.32	39.96	-55.30	-25.00	-30.30
15360.00	V	-	-	-81.48	17.29	42.81	-52.45	-25.00	-27.45

Table 7-6. Antenna FCM Radiated Spurious Data (LTE Band 7 - High Channel)

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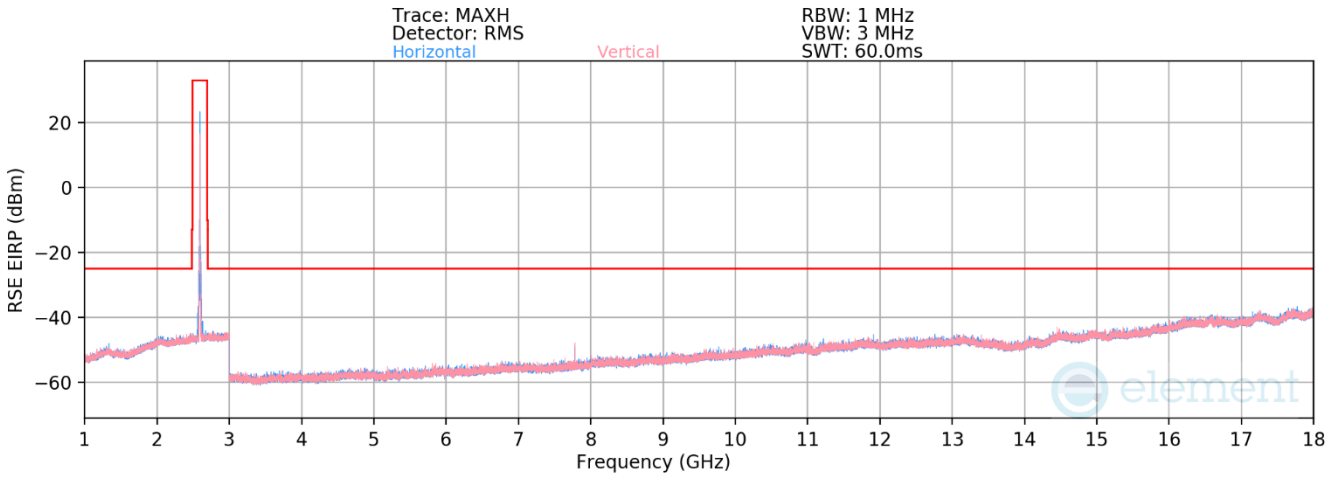
LTE Band 41



Plot 7-62. Antenna FCM Radiated Spurious Plot above 1GHz (LTE Band 41)

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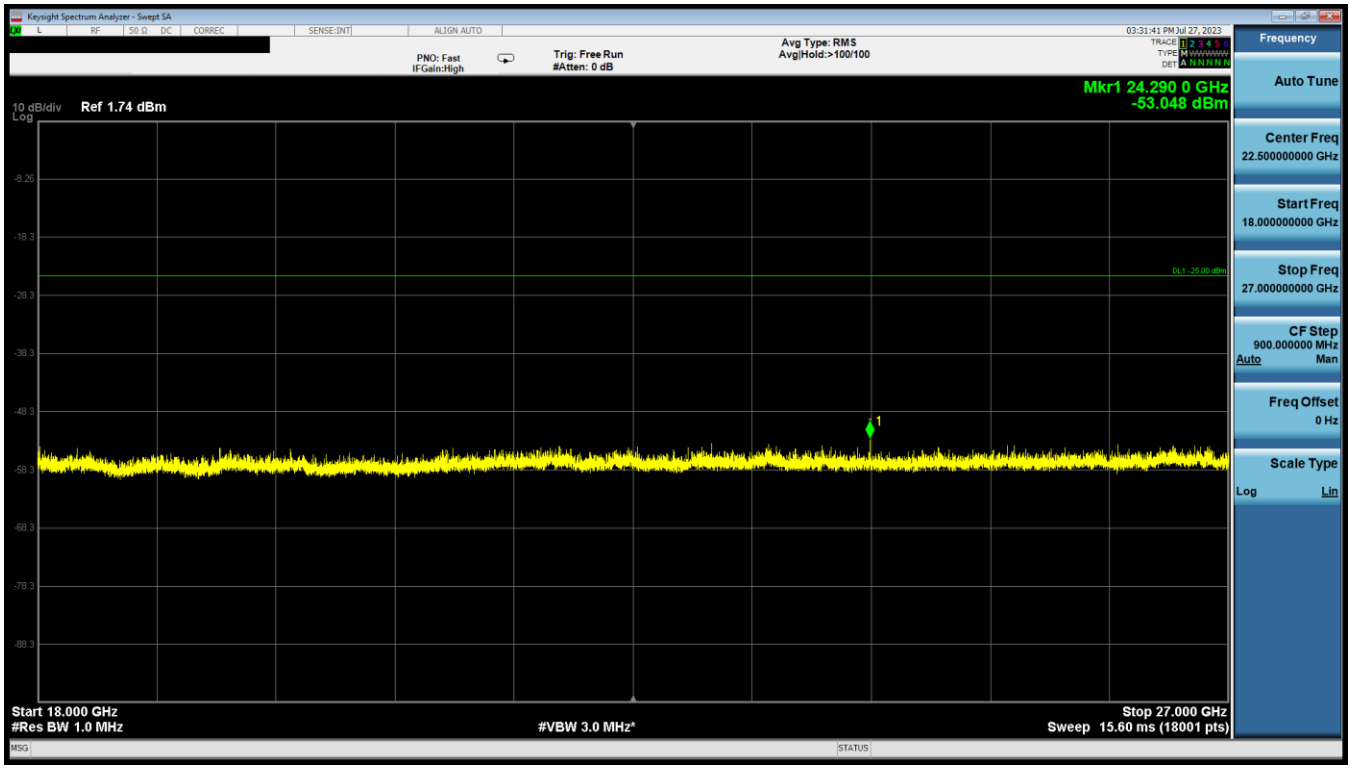
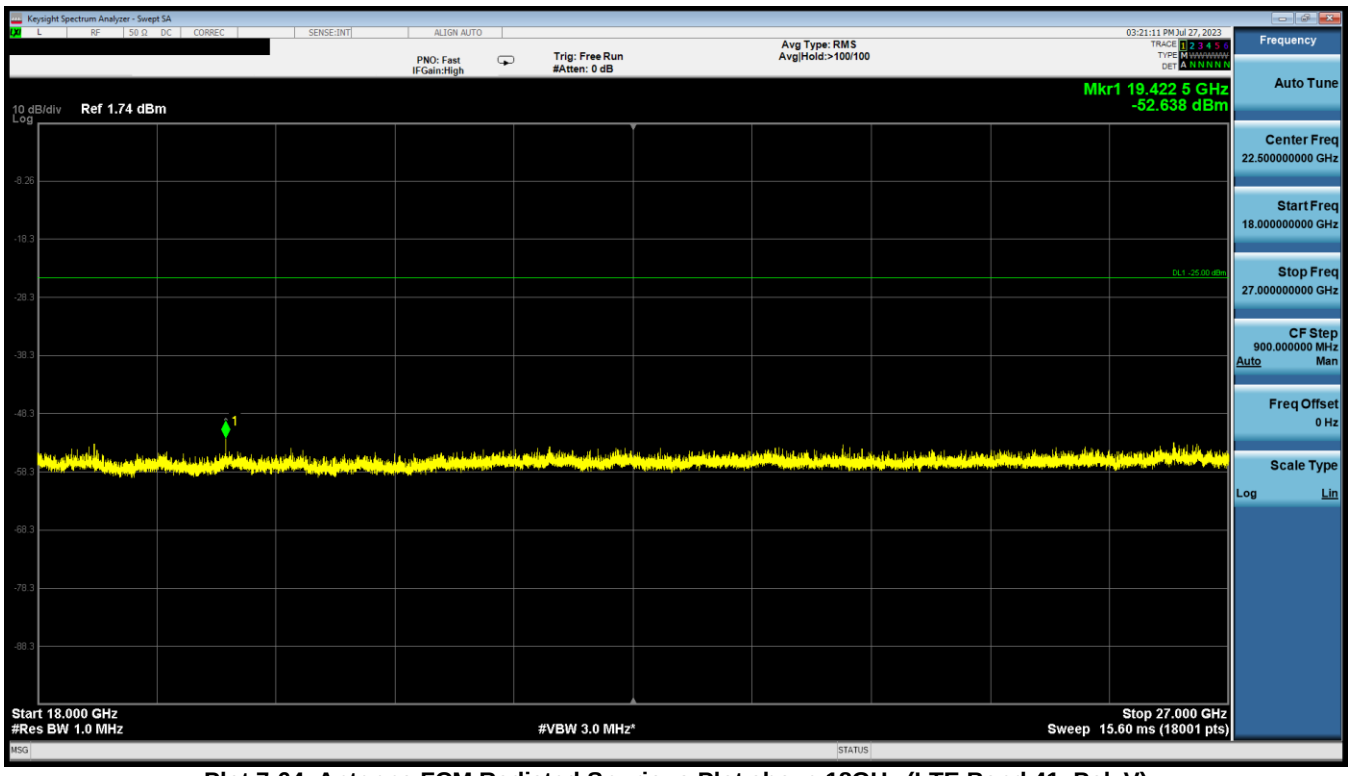


Plot 7-63. Antenna FCM Radiated Spurious Plot above 18GHz (LTE Band 41, Pol. H)



Plot 7-64. Antenna FCM Radiated Spurious Plot above 18GHz (LTE Band 41, Pol. V)

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Bandwidth (MHz):	20
Frequency (MHz):	2506.0
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]
5012.0	V	319	48	-76.00	4.83	35.83	-59.43	-25.00	-34.43
7518.0	V	271	158	-74.19	8.67	41.48	-53.77	-25.00	-28.77
10024.0	V	115	32	-72.97	10.47	44.50	-50.76	-25.00	-25.76
12530.0	V	-	-	-80.07	14.32	41.25	-54.01	-25.00	-29.01
15036.0	V	-	-	-80.27	16.85	43.58	-51.67	-25.00	-26.67

Table 7-7. Antenna FCM Radiated Spurious Data (LTE Band 41 - Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	2593.0
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]
5186.0	V	298	329	-76.40	5.63	36.23	-59.03	-25.00	-34.03
7779.0	V	271	141	-76.12	8.88	39.76	-55.50	-25.00	-30.50
10372.0	V	102	25	-73.21	11.34	45.13	-50.13	-25.00	-25.13
12965.0	V	-	-	-80.36	14.29	40.93	-54.33	-25.00	-29.33
15558.0	V	-	-	-80.35	17.84	44.49	-50.77	-25.00	-25.77

Table 7-8. Antenna FCM Radiated Spurious Data (LTE Band 41 - Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	2680.0
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]
5360.0	H	257	304	-78.94	5.94	34.00	-61.26	-25.00	-36.26
8040.0	H	243	26	-75.39	8.88	40.49	-54.76	-25.00	-29.76
10720.0	H	118	69	-74.31	11.51	44.20	-51.05	-25.00	-26.05
13400.0	H	-	-	-80.58	14.35	40.77	-54.49	-25.00	-29.49
16080.0	H	-	-	-79.65	18.58	45.93	-49.32	-25.00	-24.32

Table 7-9. Antenna FCM Radiated Spurious Data (LTE Band 41 - High Channel)

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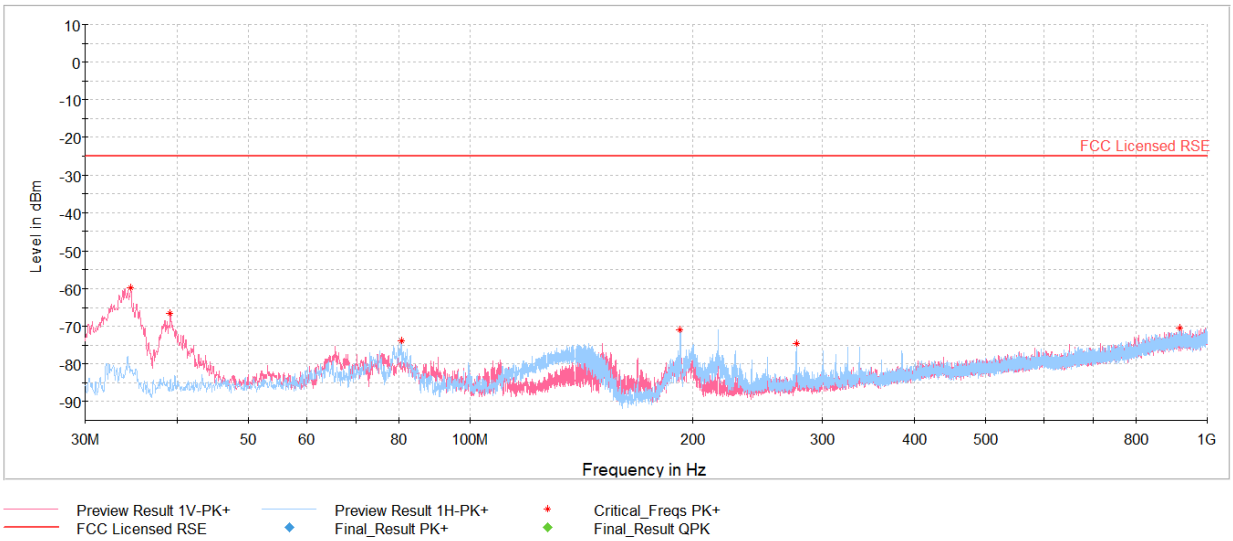
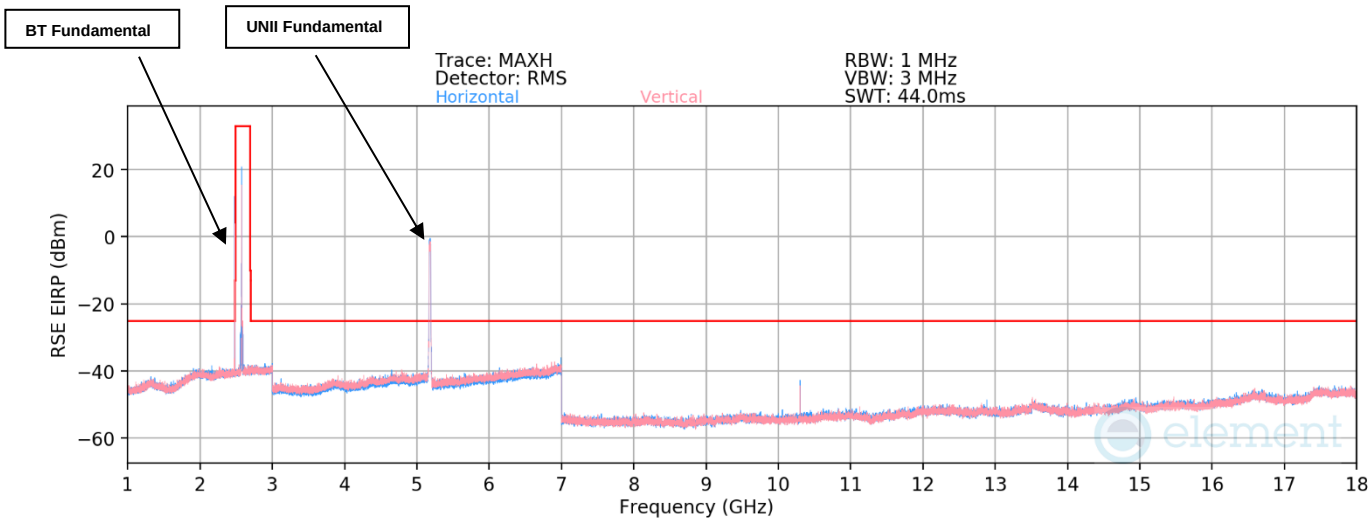
7.6.2 Simultaneous Tx Radiated Spurious Emissions Measurements

Description	Bluetooth	LTE (Band 41)	UNII
Antenna	FCM	FCM	FCM
Channel	78	40620	36
Operating Frequency (MHz)	2480	2593	5180
Mode/Modulation	GFSK ePA	QPSK/1RB/20MHz	802.11n

Table 7-10. Worst Case Simultaneous Transmission Configuration



Plot 7-65. Antenna FCM Radiated Spurious Emissions -Simultaneous Transmission 30MHz – 1GHz



Plot 7-66. Antenna FCM Radiated Spurious Emissions -Simultaneous Transmission 1GHz – 18GHz

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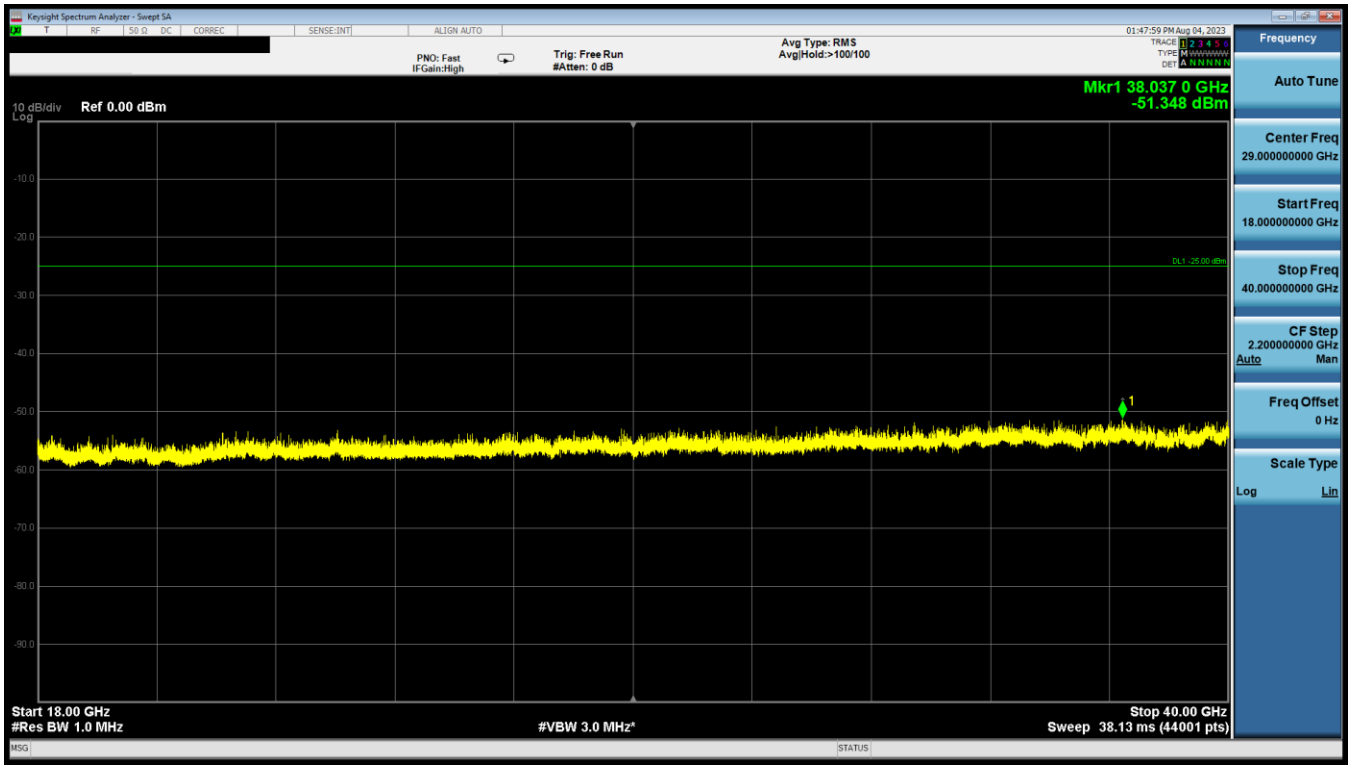
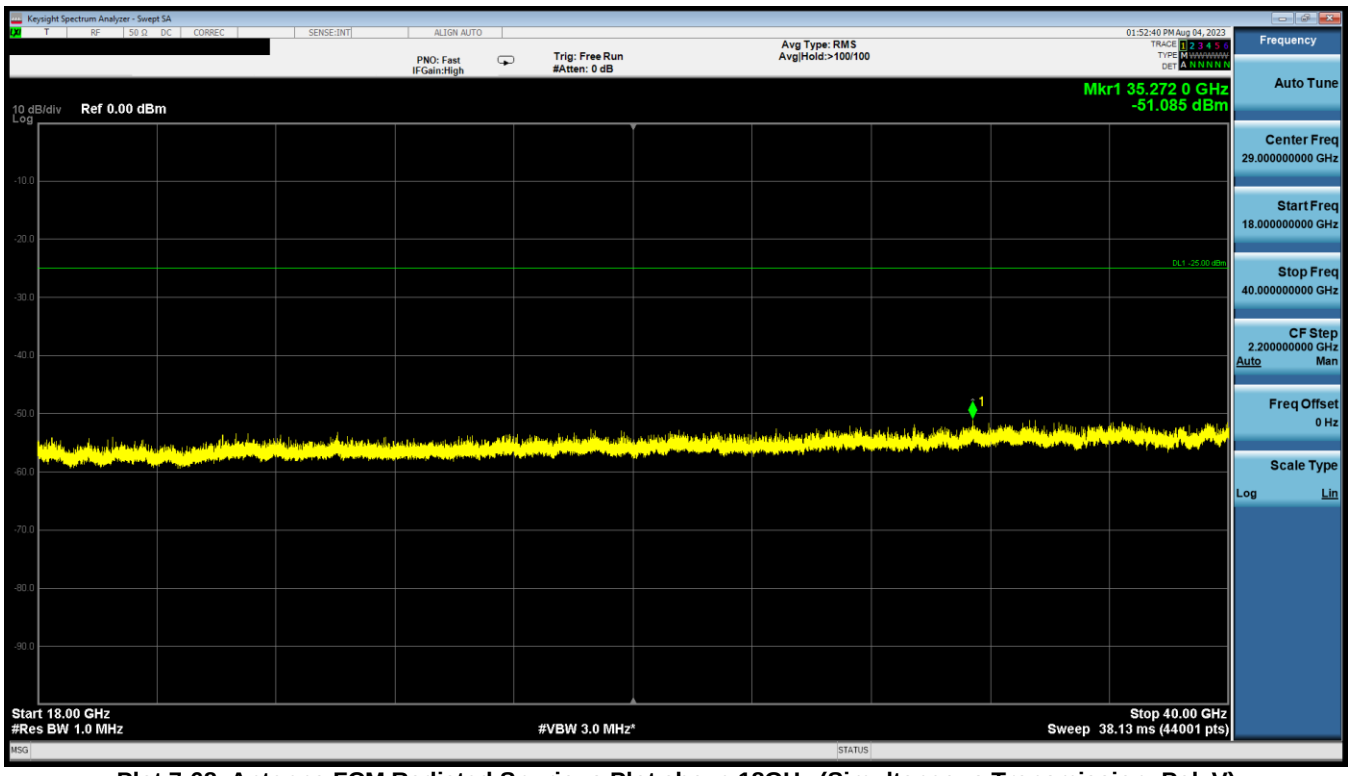


Plot 7-67. Antenna FCM Radiated Spurious Plot above 18GHz (Simultaneous Transmission, Pol. H)



Plot 7-68. Antenna FCM Radiated Spurious Plot above 18GHz (Simultaneous Transmission, Pol. V)

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Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Peak	V	-	-	-67.84	13.93	53.09	73.98	-20.89
7440.00	Peak	V	298	190	-69.95	9.08	46.13	73.98	-27.85
12400.00	Peak	V	-	-	-71.20	12.33	48.13	73.98	-25.85
10360.00	Peak	V	-	-	-70.13	10.20	47.07	68.23	-21.16
15540.00	Avg	V	-	-	-85.03	16.09	38.06	53.98	-15.92
15540.00	Peak	V	-	-	-73.17	16.09	49.92	73.98	-24.06

Table 7-11. Antenna FCM BT and UNII Harmonics Emissions Measurement in Simultaneous Transmission Mode

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]
7752.0	V	250	138	-79.84	9.39	36.55	-58.71	-25.00	-33.71
10336.0	V	287	182	-80.88	10.08	36.20	-59.06	-25.00	-34.06
12920.0	V	-	-	-82.39	12.82	37.43	-57.82	-25.00	-32.82
15504.0	V	-	-	-84.12	16.16	39.04	-56.22	-25.00	-31.22
2376.0	V	132	182	-75.22	6.59	38.37	-56.89	-25.00	-31.89
2688.0	V	124	186	-70.18	8.23	45.05	-50.21	-25.00	-25.21

Table 7-12. Antenna FCM LTE Harmonics and Intermodulation Emissions Measurement in Simultaneous Transmission Mode

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7.7 Frequency Stability / Temperature Variation

§2.1055, §27.54

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015 and TIA-603-E-2016. 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

TIA-603-E-2016

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

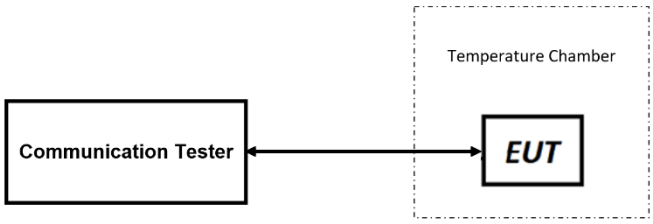

Figure 7-7. Test Instrument & Measurement Setup

Test Notes

None.

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LTE Band 7

Operating Band Lower Boundary (GHz)	2.500
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	Measured Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	2.501061805	-0.0010618
		- 20	2.501050089	-0.0010501
		- 10	2.501019603	-0.0010196
		0	2.501019460	-0.0010195
		+ 10	2.501008113	-0.0010081
		+ 20 (Ref)	2.501034991	-0.0010350
		+ 30	2.501049584	-0.0010496
		+ 40	2.501038567	-0.0010386
		+ 50	2.501046934	-0.0010469
Battery Endpoint	3.40	+ 20	2.501041781	-0.0010418

Table 7-13. LTE Band 7 Lower Boundary Frequency Stability Data

LTE Band 7

Operating Band Upper Boundary (GHz)	2.570
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	Measured Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	2.568932183	-0.0010678
		- 20	2.568941537	-0.0010585
		- 10	2.569030560	-0.0009694
		0	2.569030774	-0.0009692
		+ 10	2.569038556	-0.0009614
		+ 20 (Ref)	2.569028131	-0.0009719
		+ 30	2.569028243	-0.0009718
		+ 40	2.569038027	-0.0009620
		+ 50	2.569020713	-0.0009793
Battery Endpoint	3.40	+ 20	2.569038125	-0.0009619

Table 7-14. LTE Band 7 Upper Boundary Frequency Stability Data

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LTE Band 41

Operating Band Lower Boundary (GHz)	2.496
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	Low Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	2.497077482	-0.0010775
		- 20	2.497050766	-0.0010508
		- 10	2.497087540	-0.0010875
		0	2.497079953	-0.0010800
		+ 10	2.497080718	-0.0010807
		+ 20 (Ref)	2.497100185	-0.0011002
		+ 30	2.497093397	-0.0010934
		+ 40	2.497088650	-0.0010887
		+ 50	2.497073828	-0.0010738
Battery Endpoint	3.40	+ 20	2.497088821	-0.0010888

Table 7-15. LTE Band 41 Lower Boundary Frequency Stability Data

LTE Band 41

Operating Band Upper Boundary (GHz)	2.690
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	High Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	2.688963187	-0.0010368
		- 20	2.688974941	-0.0010251
		- 10	2.689039120	-0.0009609
		0	2.689048531	-0.0009515
		+ 10	2.689056738	-0.0009433
		+ 20 (Ref)	2.689018603	-0.0009814
		+ 30	2.689000921	-0.0009991
		+ 40	2.689021565	-0.0009784
		+ 50	2.688992096	-0.0010079
Battery Endpoint	3.40	+ 20	2.689847265	-0.0001527

Table 7-16. LTE Band 41 Upper Boundary Frequency Stability Data

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the Apple **Watch FCC ID: BCG-A2982** complies with all the requirements of Part 27 of the FCC rules.

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