



PART 24 MEASUREMENT REPORT

Applicant Name:

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

Date of Testing:

6/8/2021 - 7/31/2021

Test Site/Location:

PCTEST Lab. Morgan Hill, CA, USA

Test Report Serial No.:

1C2106070043-02.BCG

FCC ID:

BCG-A2475

Applicant Name:

Apple Inc.

Application Type:

Certification

Model:

A2475

EUT Type:

Watch

FCC Classification:

PCS Licensed Transmitter Worn on Body (PCT)

FCC Rule Part:

24

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.

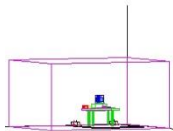

 Randy Ortanez
 President


FCC ID: BCG-A2475	 PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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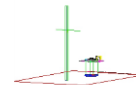
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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	PAR at 0.1% [dB]	EIRP		Emission Designator
						Max. Power [mW]	Max. Power [dBm]	
WCDMA1900	5 MHz	Spread Spectrum	1852.4 - 1907.6	4.0846	3.21	15.849	12.00	4M08F9W
Band 2	1.4 MHz	QPSK	1850.7 - 1909.3	1.1112	5.72	17.783	12.50	1M11G7W
		16QAM	1850.7 - 1909.3	1.1049	6.40	14.388	11.58	1M10D7W
	3 MHz	QPSK	1851.5 - 1908.5	2.7414	5.84	17.783	12.50	2M74G7W
		16QAM	1851.5 - 1908.5	2.7368	6.52	14.962	11.75	2M74D7W
	5 MHz	QPSK	1852.5 - 1907.5	4.5716	5.66	17.783	12.50	4M57G7W
		16QAM	1852.5 - 1907.5	4.5625	6.39	15.241	11.83	4M56D7W
	10 MHz	QPSK	1855 - 1905	9.1662	5.58	17.783	12.50	9M17G7W
		16QAM	1855 - 1905	5.4580	6.30	14.928	11.74	5M46D7W
	15 MHz	QPSK	1857.5 - 1902.5	13.7094	5.94	17.783	12.50	13M7G7W
		16QAM	1857.5 - 1902.5	6.0280	6.28	14.997	11.76	6M03D7W
	20 MHz	QPSK	1860 - 1900	18.2394	5.50	17.783	12.50	18M2G7W
		16QAM	1860 - 1900	7.6020	6.29	15.171	11.81	7M60D7W
Band 25	1.4 MHz	QPSK	1850.7 - 1914.3	1.1112	5.60	17.783	12.50	1M11G7W
		16QAM	1850.7 - 1914.3	1.1049	6.36	16.069	12.06	1M10D7W
	3 MHz	QPSK	1851.5 - 1913.5	2.7414	5.63	17.783	12.50	2M74G7W
		16QAM	1851.5 - 1913.5	2.7368	6.49	15.740	11.97	2M74D7W
	5 MHz	QPSK	1852.5 - 1912.5	4.5716	5.62	17.783	12.50	4M57G7W
		16QAM	1852.5 - 1912.5	4.5625	6.35	15.205	11.82	4M56D7W
	10 MHz	QPSK	1855 - 1910	9.1662	5.63	17.783	12.50	9M17G7W
		16QAM	1855 - 1910	5.4580	6.29	15.740	11.97	5M46D7W
	15 MHz	QPSK	1857.5 - 1907.5	13.7094	5.88	17.783	12.50	13M7G7W
		16QAM	1857.5 - 1907.5	6.0280	6.29	14.655	11.66	6M03D7W
	20 MHz	QPSK	1860 - 1905	18.2394	5.55	17.783	12.50	18M2G7W
		16QAM	1860 - 1905	7.6020	6.30	15.346	11.86	7M60D7W

Overview Table

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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 PCTEST Test Location

These measurement tests were conducted at the PCTEST 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 PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST 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.
- PCTEST 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 ISSED Standards (RSS).
- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISSED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID:BCG-A2475**. 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.

Test Device Serial No.: VY7XT20NH4, XG52X3G9PJ, T0JV6FY7L4

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, 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	LTE/WCDMA	UNII	UWB
	802.11 b/g/n	BDR, EDR, HDR4/8, LE	Mid band/ 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	✗	✓	✓	✓	✗

Table 2-1. Simultaneous Transmission Configurations

✓ = Support ; ✗ = NOT Support

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be config 10 and reported in UNII 802.11n (OFDM), BT and FCC part 27b test reports.

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2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Band	Antenna Gain (dBi)
LTE Band 25/2	-12.0
WCDMA 1900	-12.0

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	C2QKP008F6F3
	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:	A2687	S/N:	FV411420544MW6M4H
	w/Dock	Model:	X241	S/N:	N/A
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC035200UJMFR0AJ
	Apple Magnetic Charger	Model:	A2515	S/N:	DLC035202KRMFR0A2
4	Pathfinder Falcon	Model:	920-098626-01	S/N:	DLC034200APQ6PM1E
	SiP Socket	Model:	P2 X2010BPF 137	S/N:	DLC037700AYQ6PM1R
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A
6	Store Bracelet Assy1	Model:	N/A	S/N:	DLC1197001R19G21N

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 three materials, aluminum, stainless steel, and Titanium and 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.

2.6 Software and Firmware

The test was conducted with firmware version watchOS 8.0 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 document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26-2015/TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (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

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

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 ($\pm$ dB)
Conducted Bench Top Measurements	1.65
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz-1GHz)	4.30
Radiated Disturbance (1-18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

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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	3/31/2021	Annual	3/31/2022	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/11/2020	Annual	8/11/2021	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	9/28/2020	Annual	9/28/2021	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	9/15/2020	Annual	9/15/2021	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	5/3/2021	Annual	5/3/2022	205956
Keysight Technology	N9040B	UXA Signal Analyzer	12/19/2020	Annual	12/19/2021	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/16/2021	Annual	3/16/2022	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	6/11/2021	Annual	6/11/2022	101299
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	12/3/2020	Annual	12/3/2021	102327
Rohde & Schwarz	ESW44	EMI Test Receiver	8/6/2020	Annual	8/6/2021	101668
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2020	Annual	10/13/2021	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	9/24/2020	Annual	9/24/2021	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/29/2021	Annual	4/29/2022	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/5/2021	Annual	4/5/2022	100519

Table 5-1. Test Equipment

Notes:

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

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6.0 SAMPLE CALCULATIONS

Emission Designator

WCDMA Emission Designator

Emission Designator = 4M16F9W

WCDMA BW = 4.16 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

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-A2475
 FCC Classification: PCS Licensed Transmitter Worn on Body (PCT)
 Mode(s): WCDMA/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	2.1051, 24.238(a)	-13dBm at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Peak-Average Ratio	24.232(d)	< 13 dB	PASS	Section 7.5
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Frequency Stability	2.1055, 24.235	Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested	PASS	Section 7.8
	Effective Radiated Power / Equivalent Isotropic Radiated Power	24.232(c)	< 2 Watts max. EIRP	PASS	Section 7.6
RADIATED	Radiated Spurious Emissions	2.1053, 24.238(a)	-13dBm for all out-of-band emissions	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 PCTEST EMC Software Tool 1.0.

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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 $\geq 3 \times$ 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.

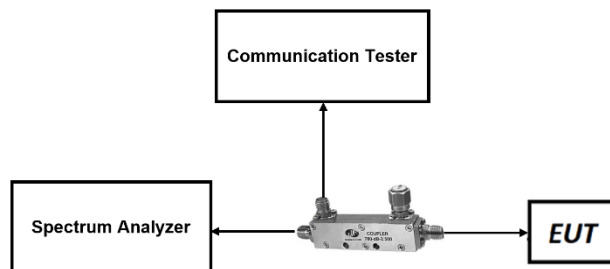


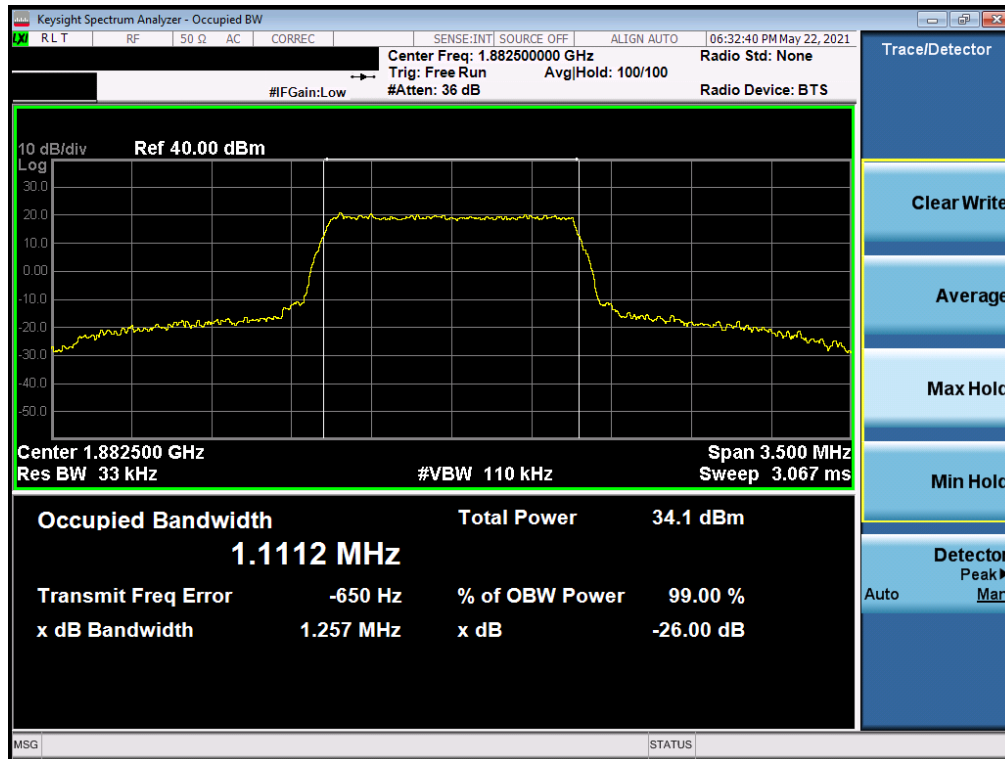
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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LTE Band 25/2

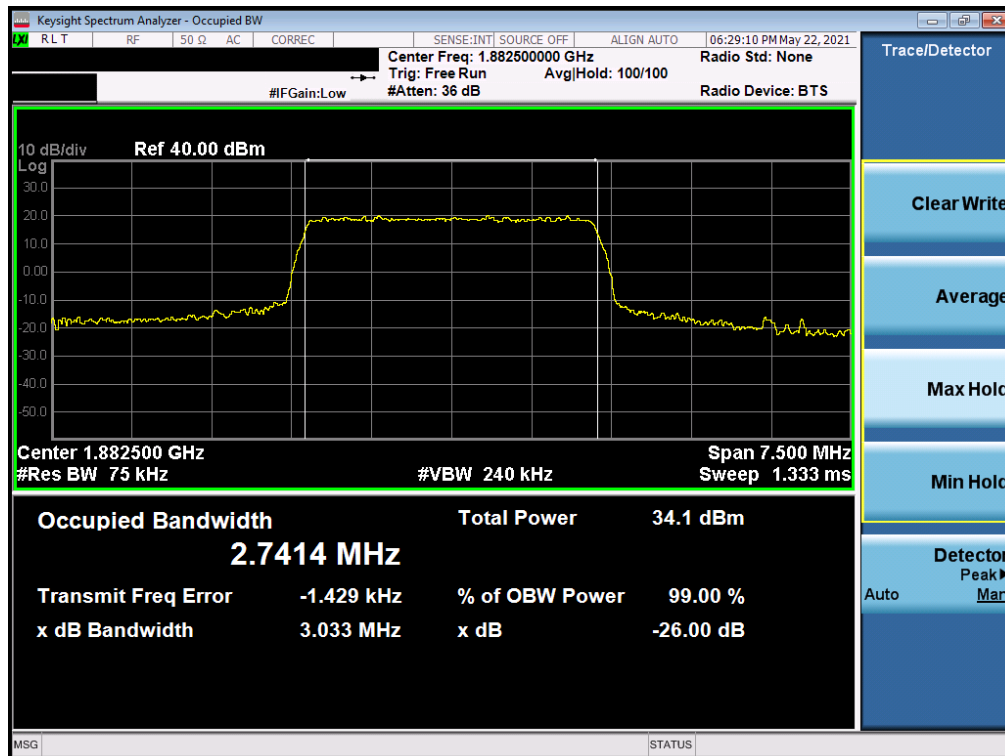


Plot 7-1. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz QPSK - Full RB Configuration)



Plot 7-2. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 16-QAM - Full RB Configuration)

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Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 14 of 88



Plot 7-3. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz QPSK - Full RB Configuration)

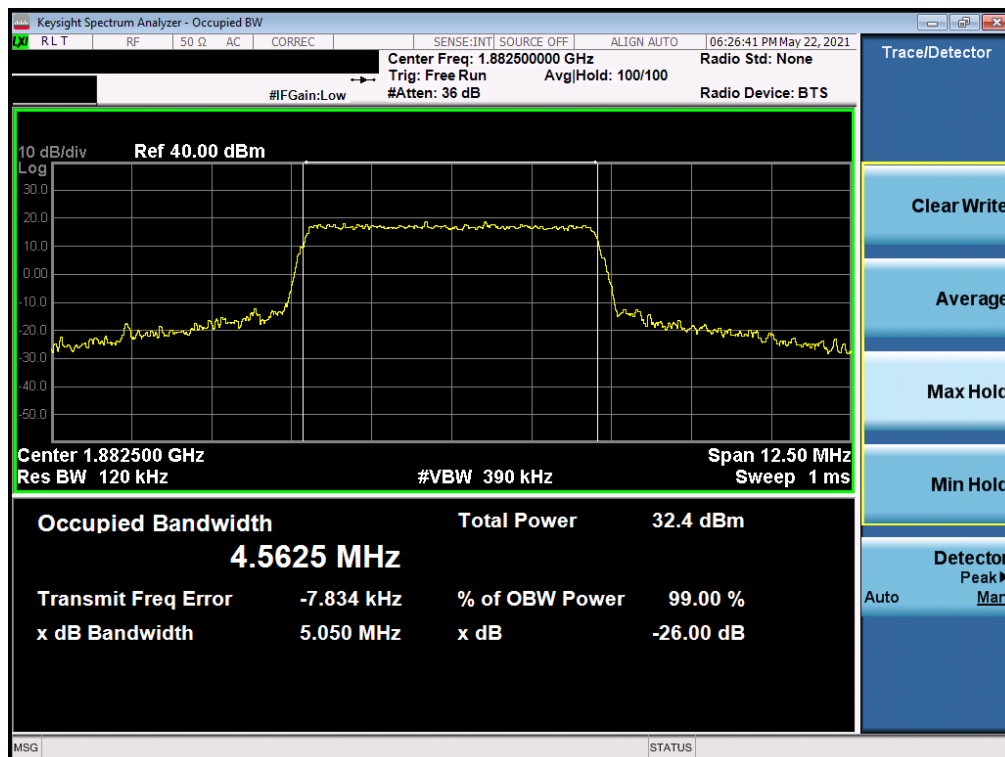


Plot 7-4. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 15 of 88

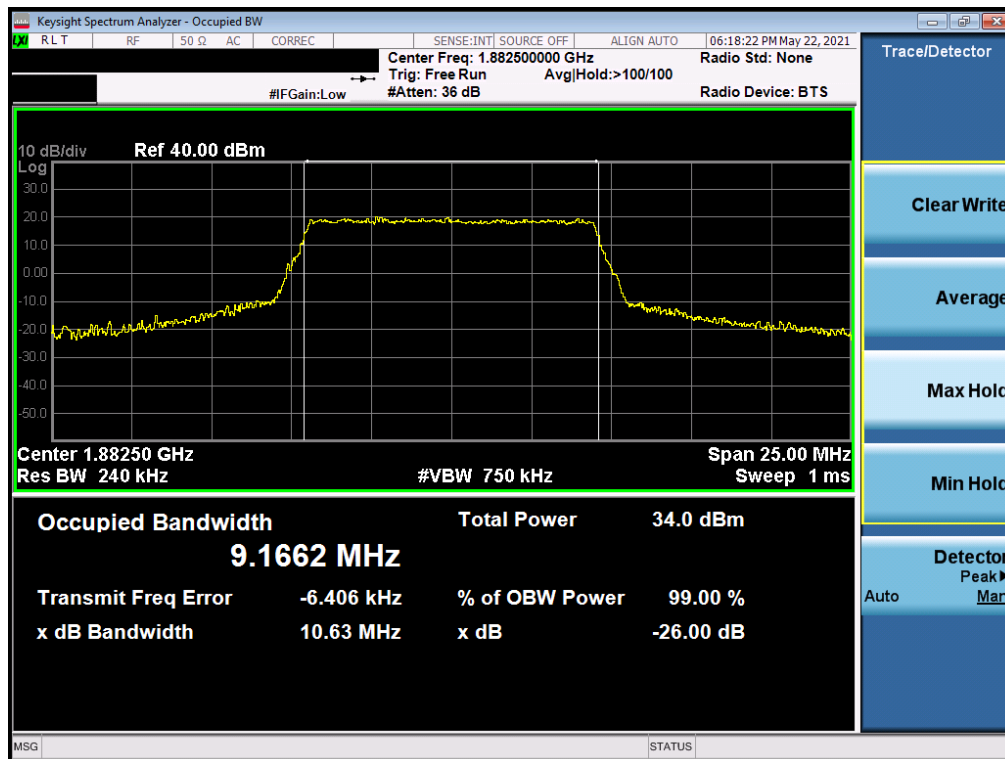


Plot 7-5. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz QPSK - Full RB Configuration)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 16 of 88

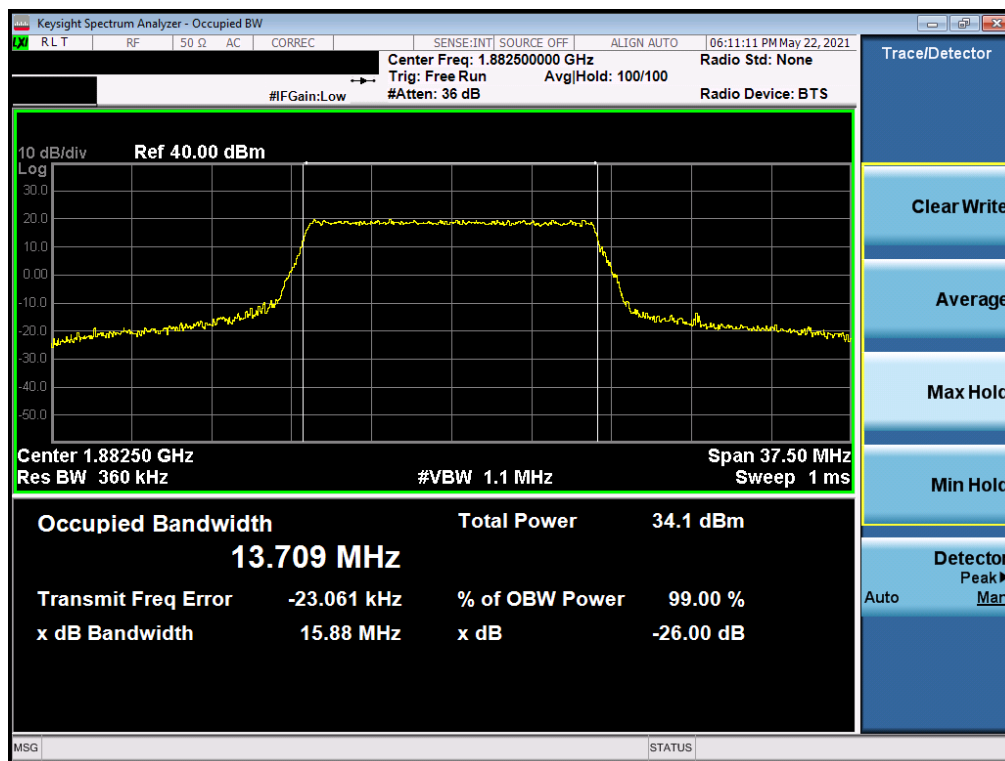


Plot 7-7. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz QPSK - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 17 of 88

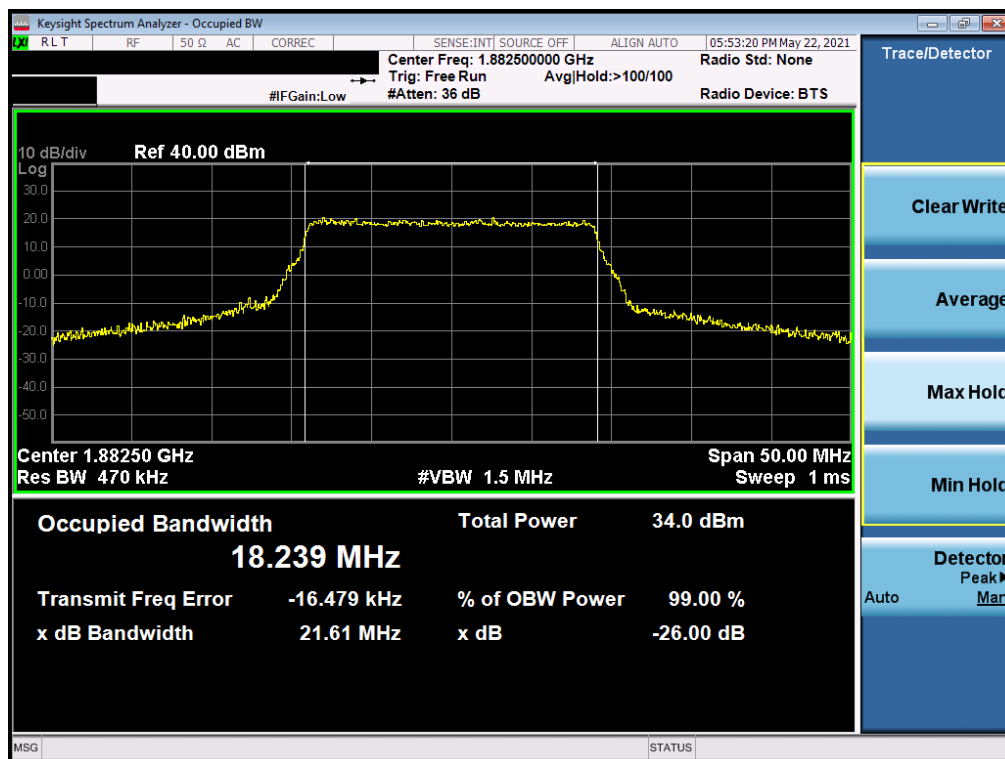


Plot 7-9. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz QPSK - Full RB Configuration)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 18 of 88



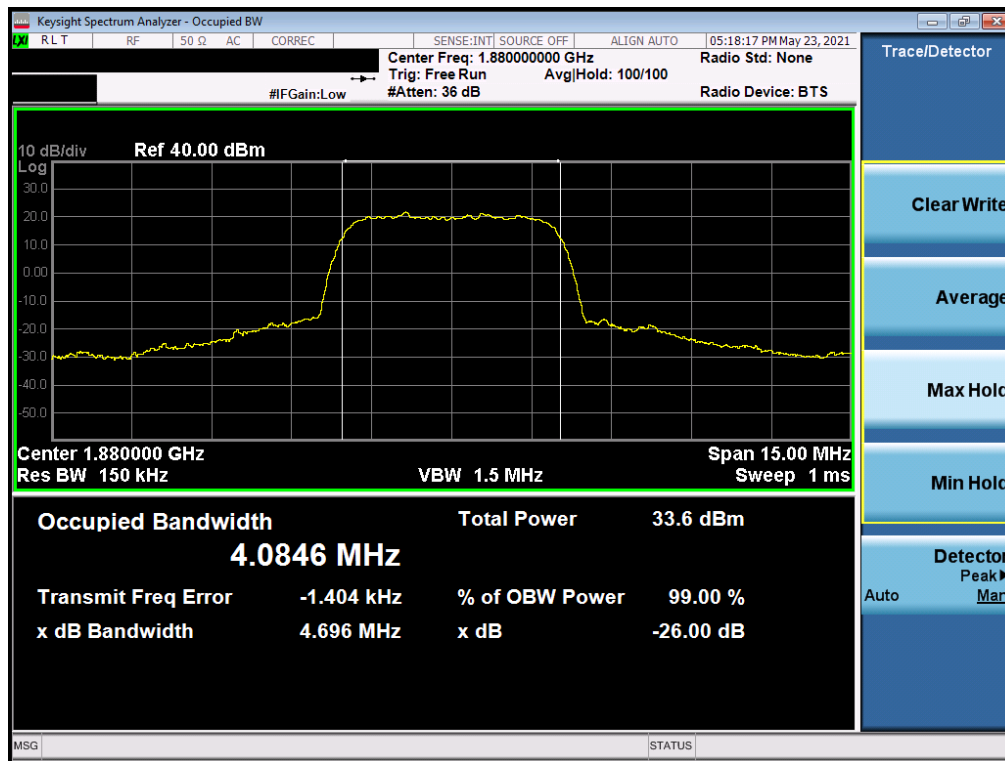
Plot 7-11. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz QPSK - Full RB Configuration)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 19 of 88

WCDMA PCS



Plot 7-13. Occupied Bandwidth Plot (WCDMA, Ch. 9400)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 20 of 88

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, §24.238(a)

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.

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

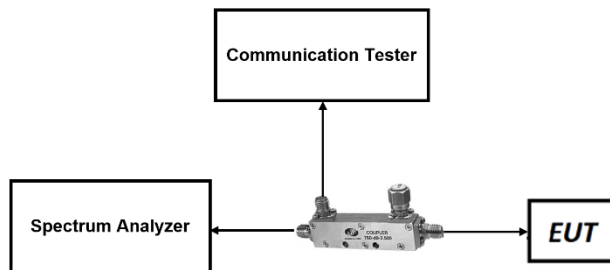


Figure 7-2. Test Instrument & Measurement Setup

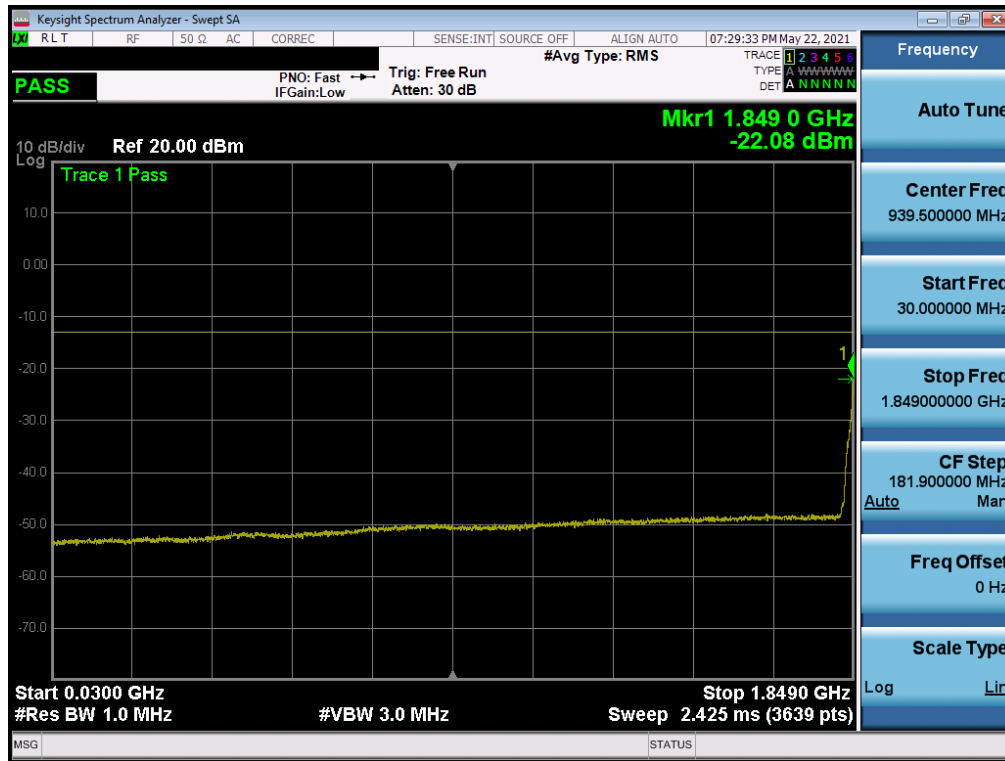
FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 21 of 88

Test Notes

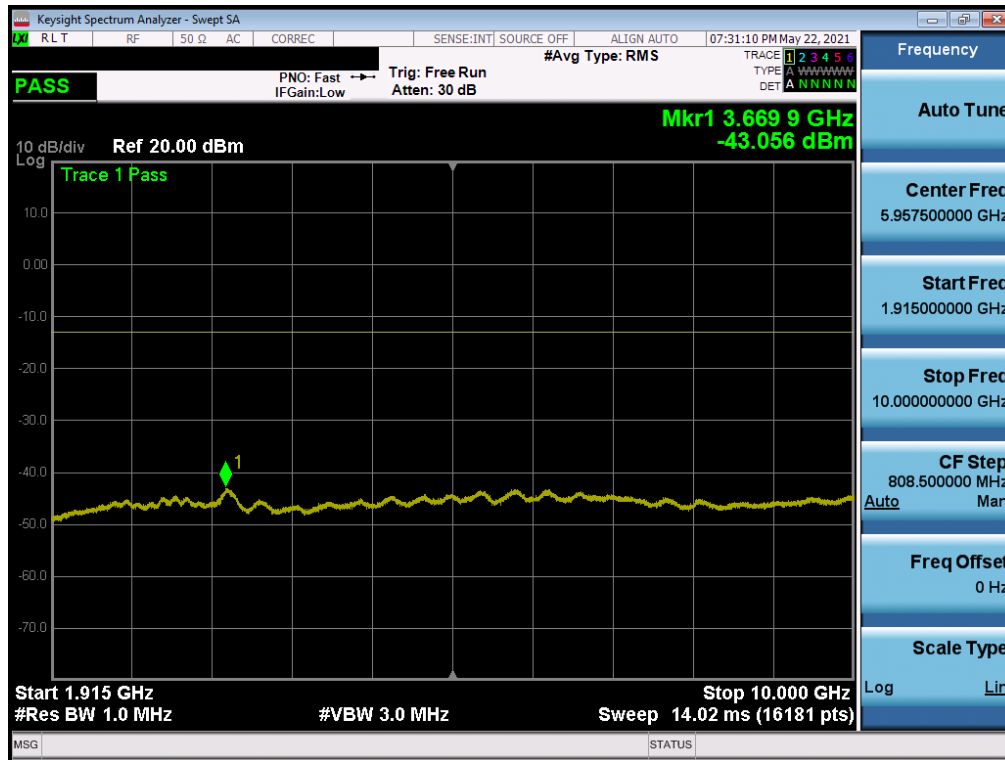
1. Per Part 24, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 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.

FCC ID: BCG-A2475	 PCTEST® Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 22 of 88

LTE Band 25/2

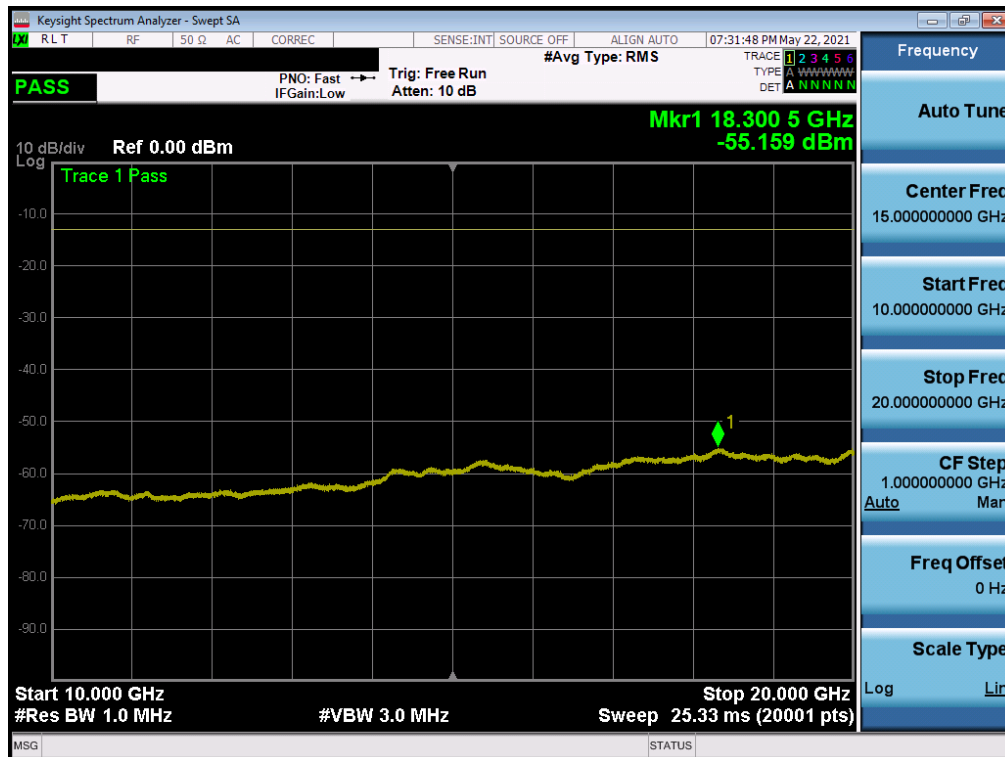


Plot 7-14. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

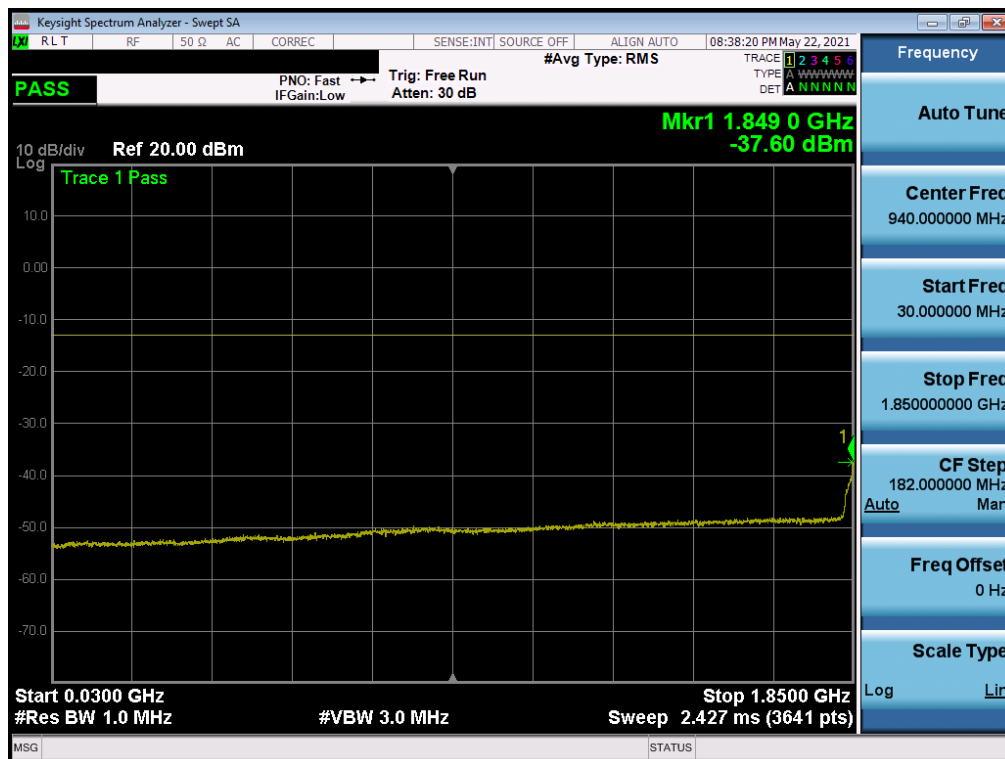


Plot 7-15. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 23 of 88

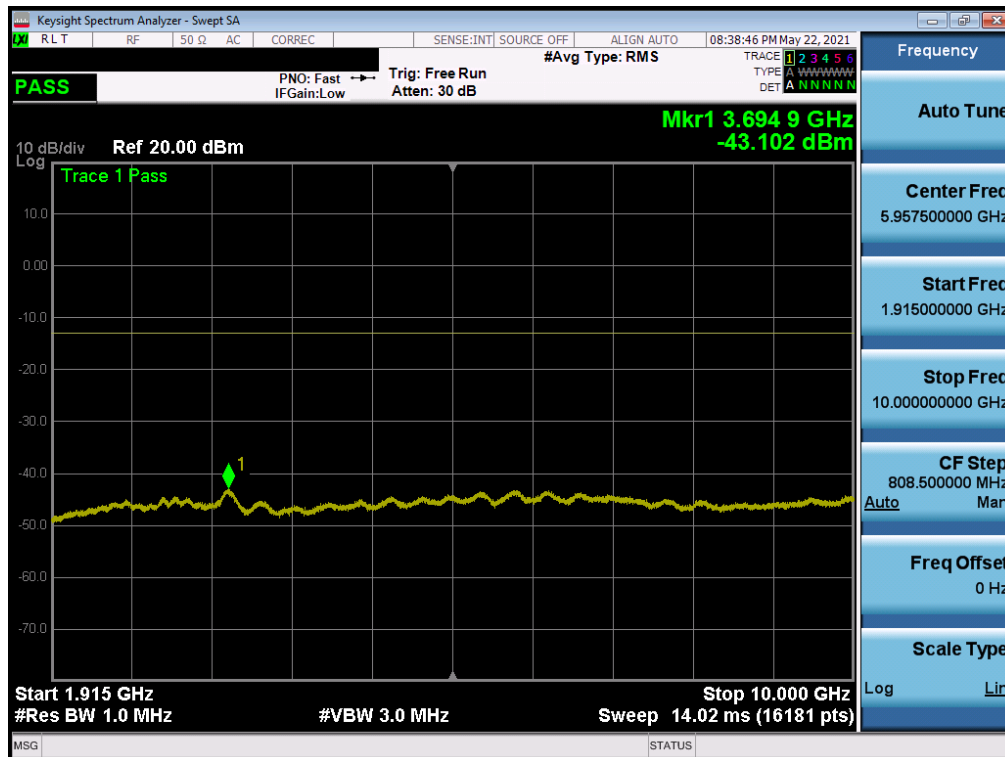


Plot 7-16. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

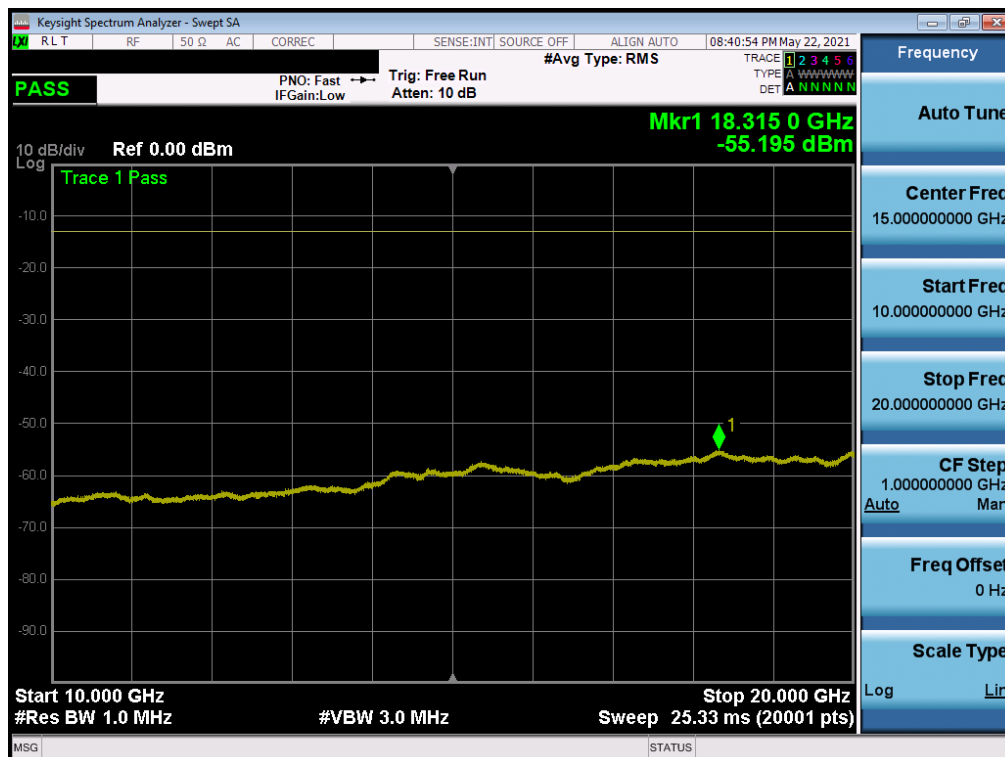


Plot 7-17. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 24 of 88

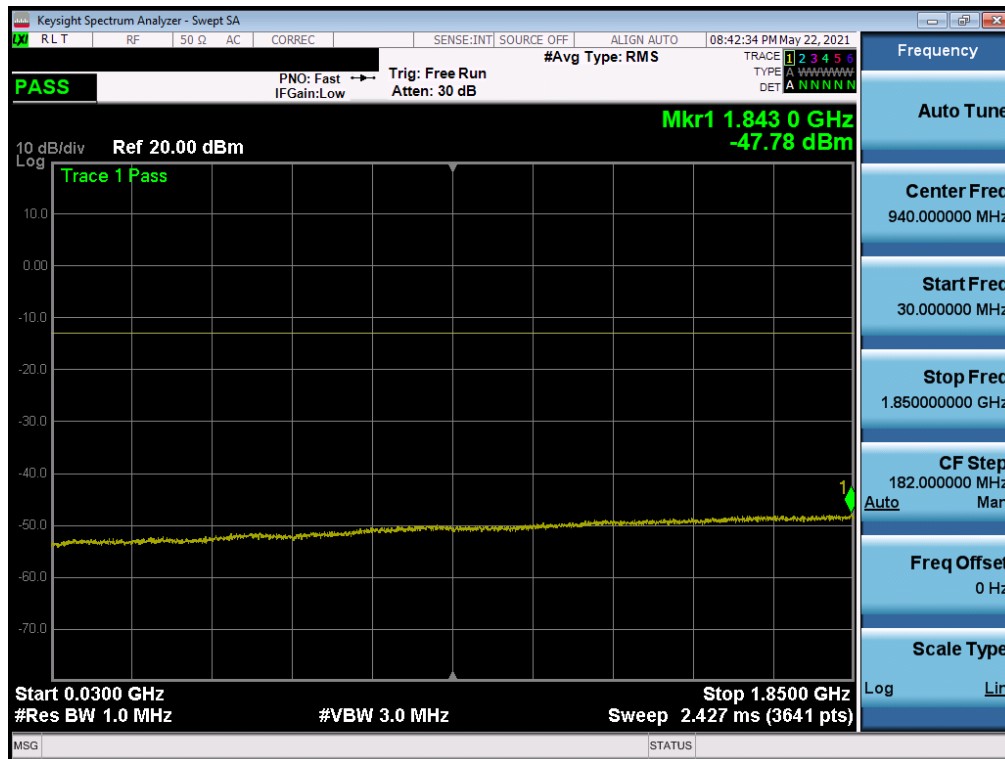


Plot 7-18. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

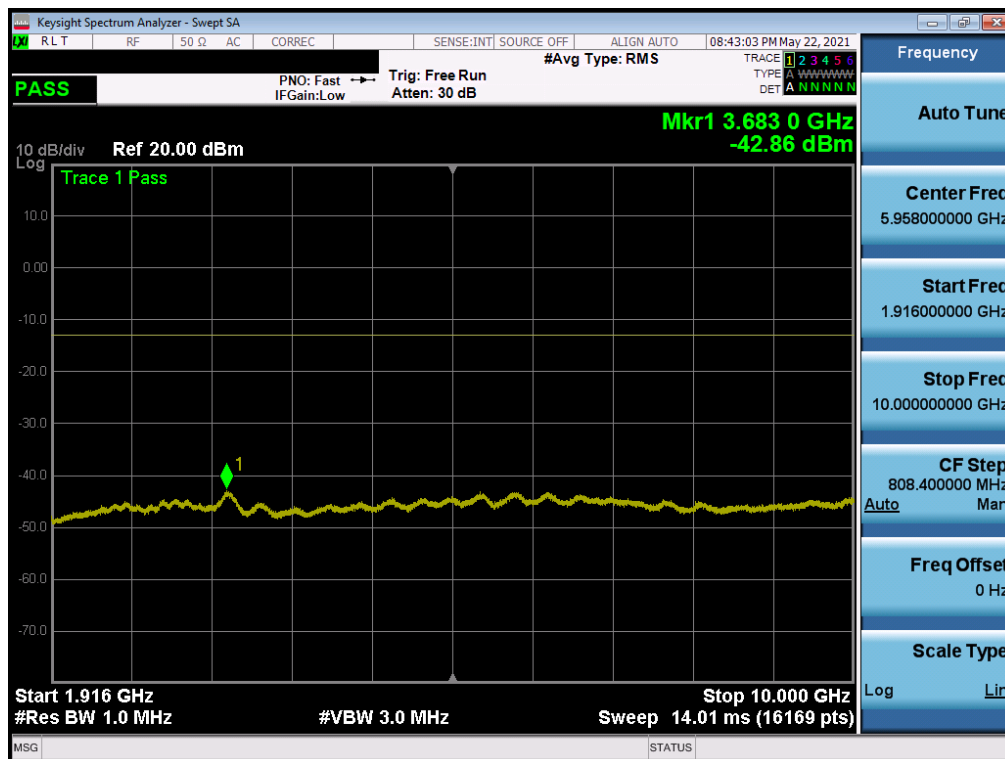


Plot 7-19. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 25 of 88

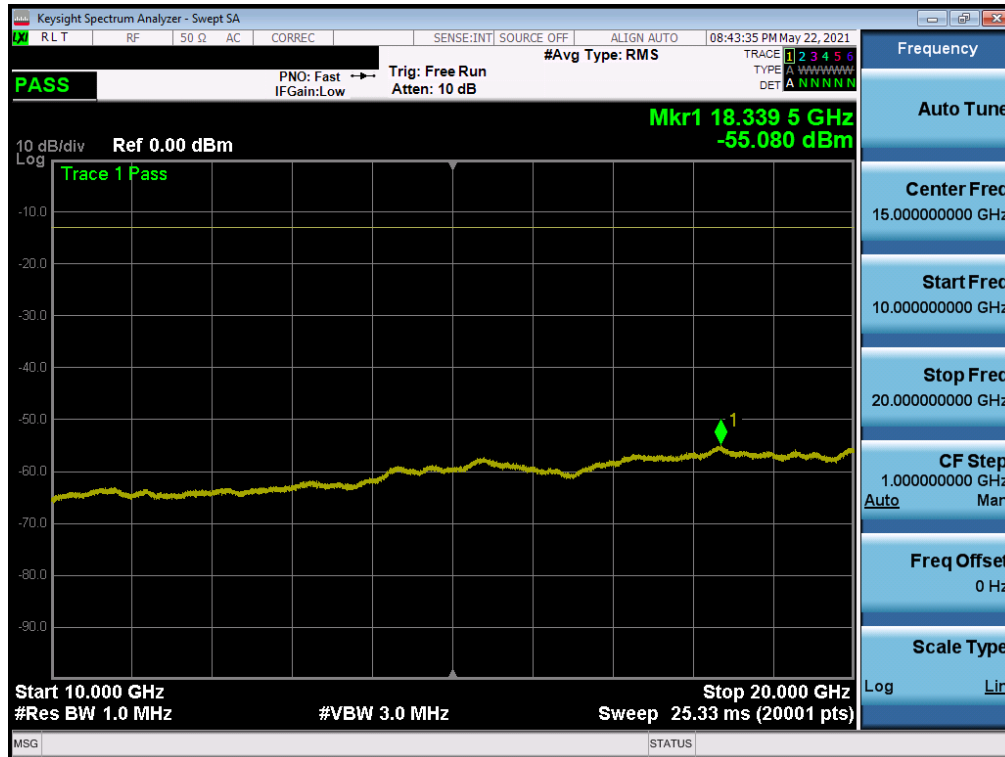


Plot 7-20. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-21. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

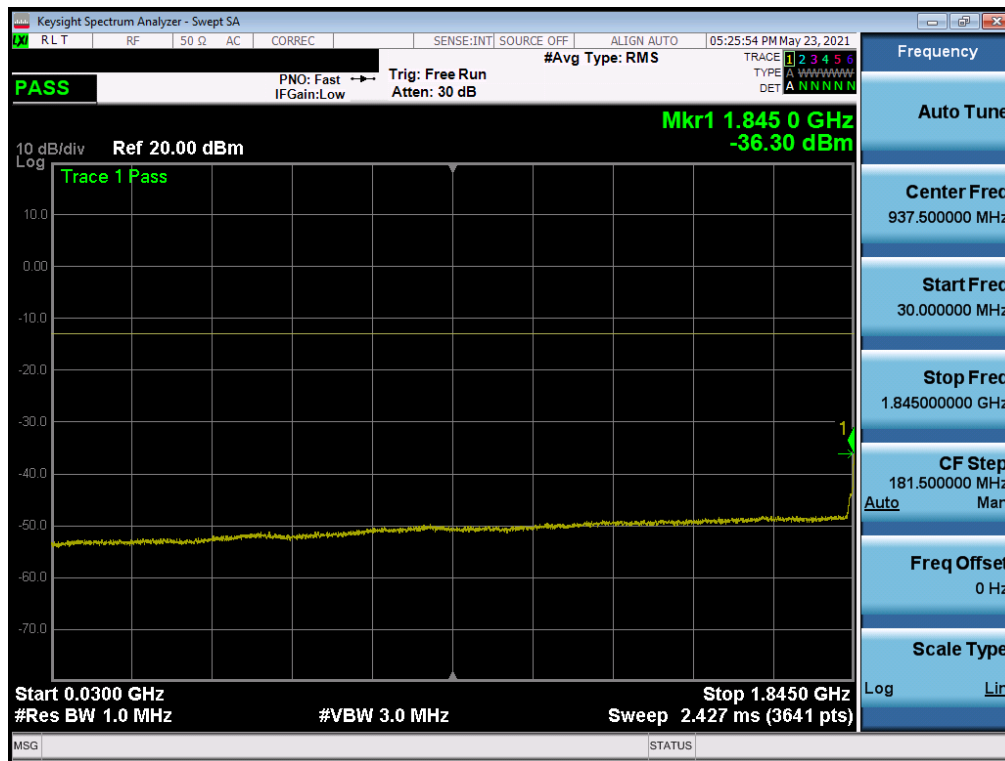
FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 26 of 88



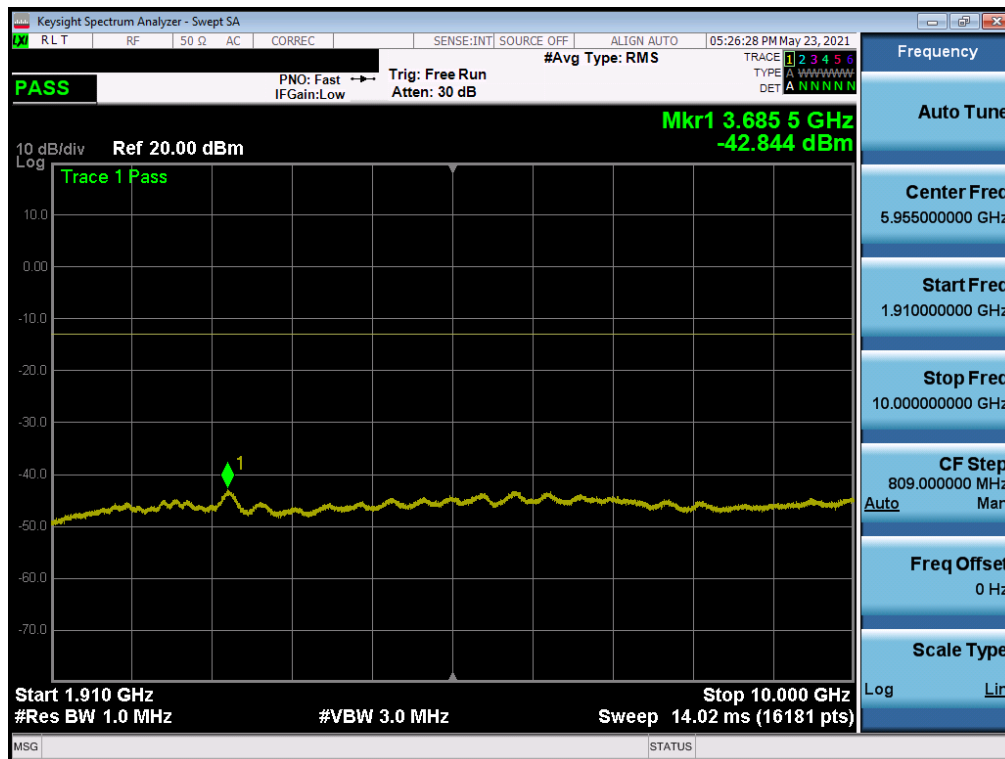
Plot 7-22. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 27 of 88

WCDMA PCS

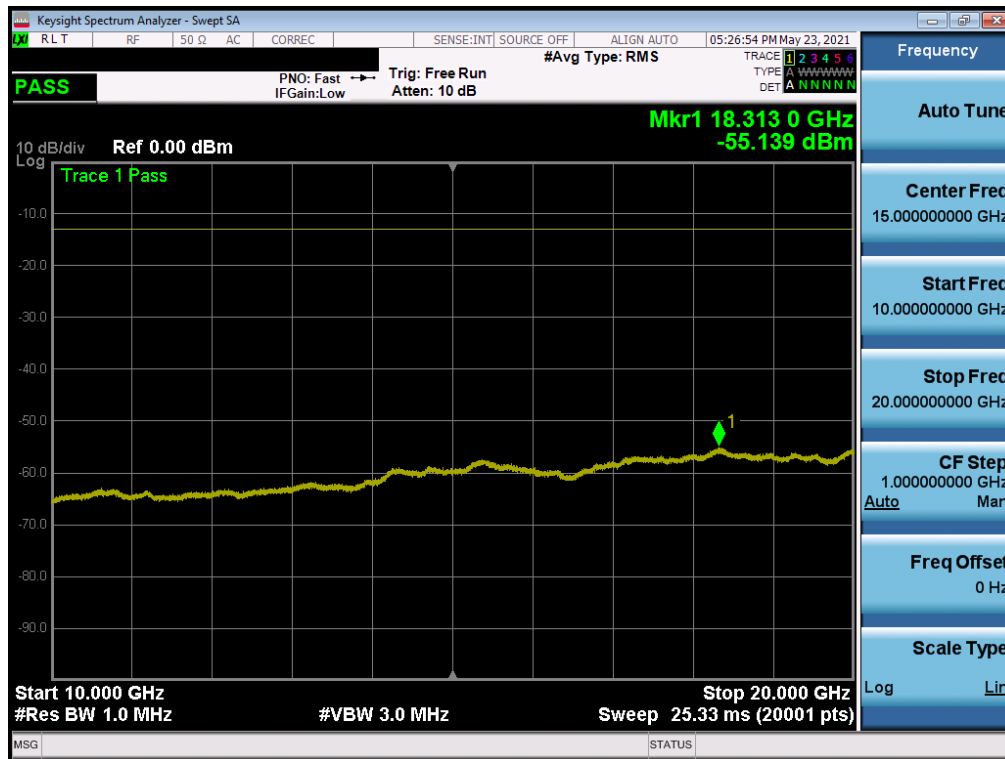


Plot 7-23. Conducted Spurious Plot (WCDMA Ch. 9262)

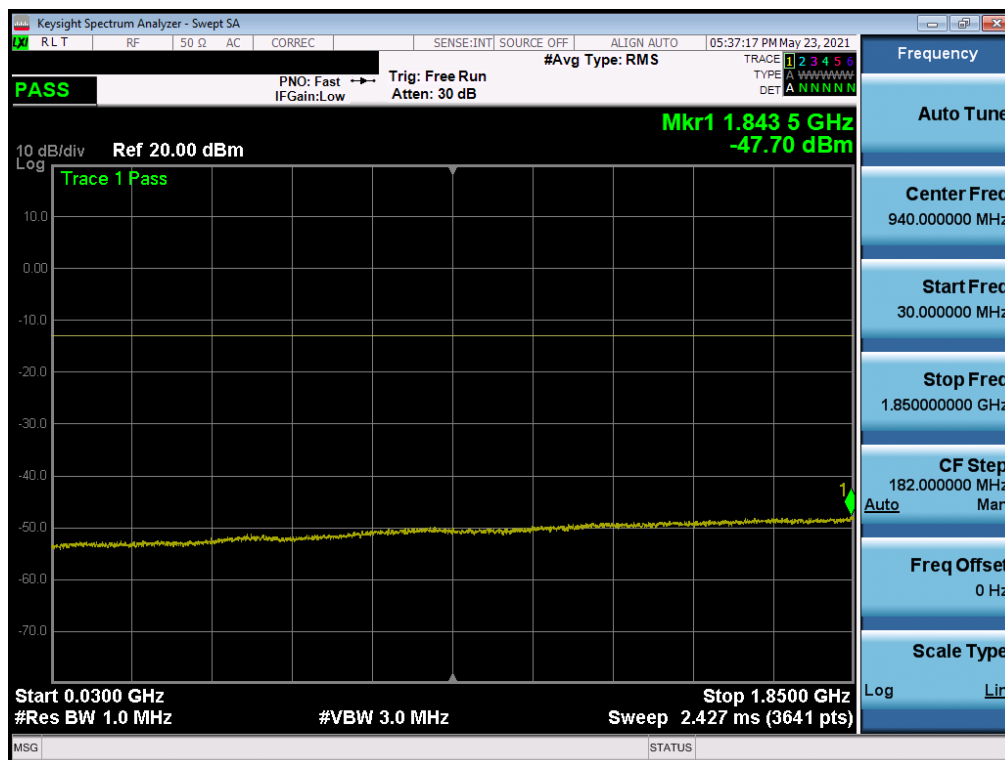


Plot 7-24. Conducted Spurious Plot (WCDMA Ch. 9262)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 28 of 88

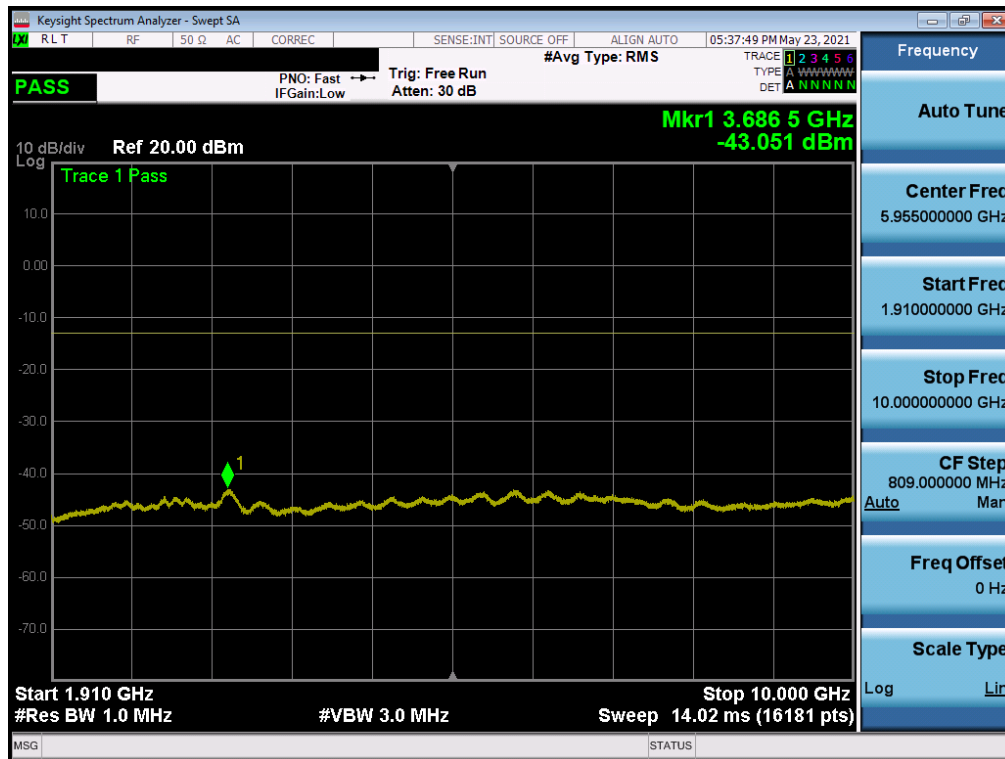


Plot 7-25. Conducted Spurious Plot (WCDMA Ch. 9262)

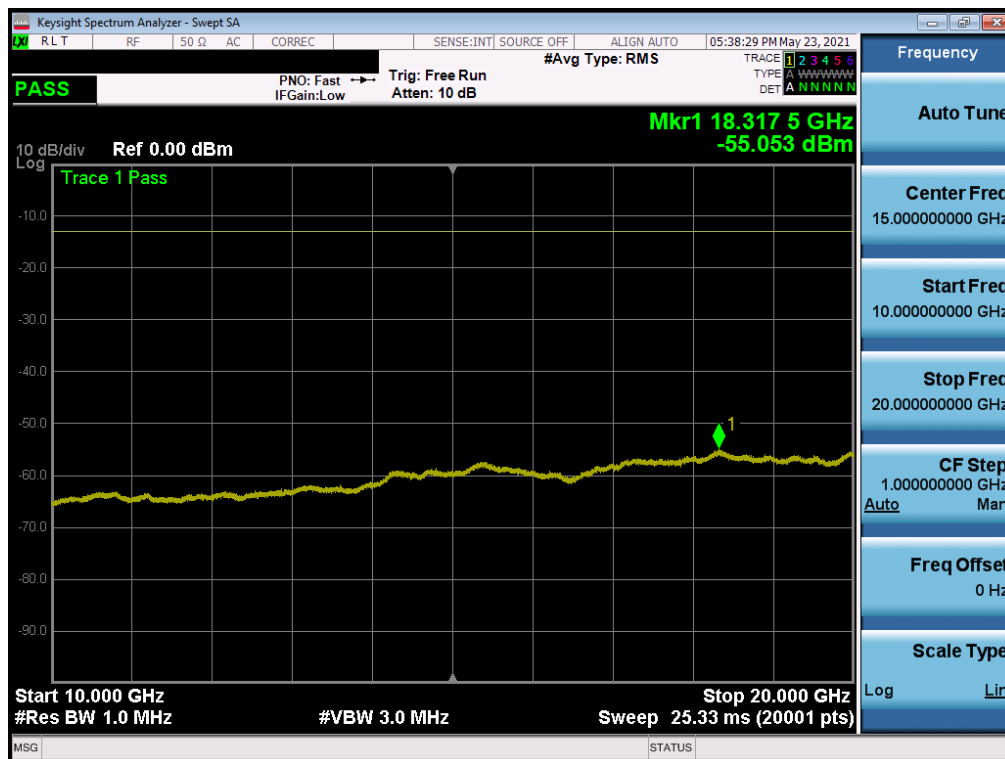


Plot 7-26. Conducted Spurious Plot (WCDMA Ch. 9400)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 29 of 88

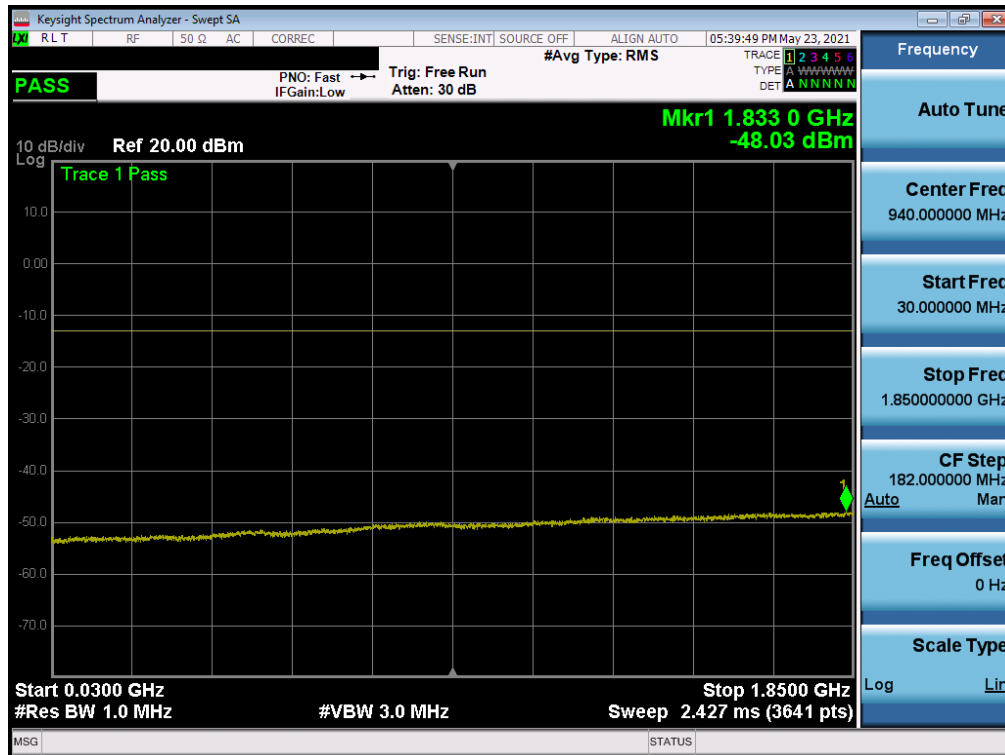


Plot 7-27. Conducted Spurious Plot (WCDMA Ch. 9400)

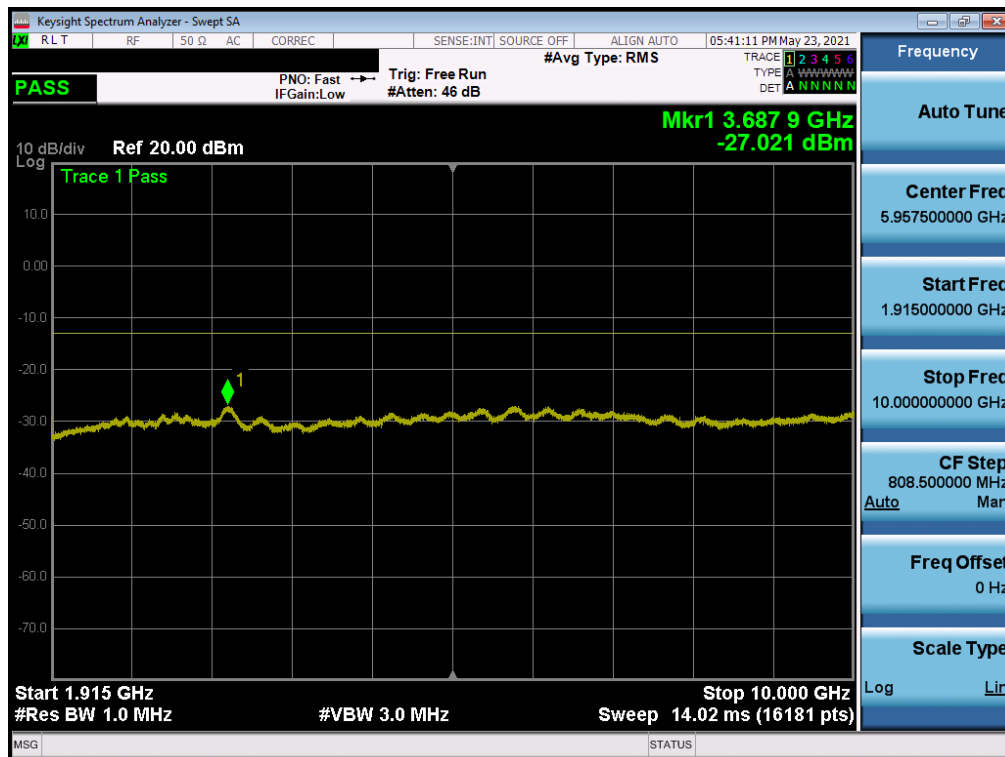


Plot 7-28. Conducted Spurious Plot (WCDMA Ch. 9400)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 30 of 88



Plot 7-29. Conducted Spurious Plot (WCDMA Ch. 9538)



Plot 7-30. Conducted Spurious Plot (WCDMA Ch. 9538)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 31 of 88



Plot 7-31. Conducted Spurious Plot (WCDMA Ch. 9538)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 32 of 88

7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §24.238(a)

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

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

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 $\geq 1\%$ of the emission bandwidth
4. VBW $\geq 3 \times$ RBW
5. Detector = RMS
6. Number of sweep points $\geq 2 \times$ 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.

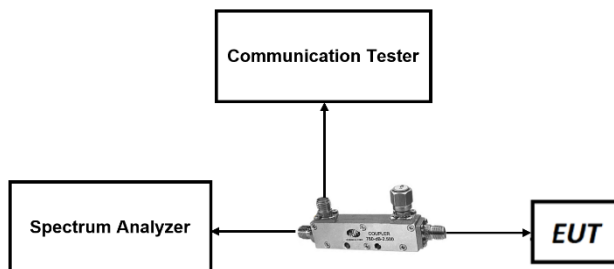


Figure 7-3. Test Instrument & Measurement Setup

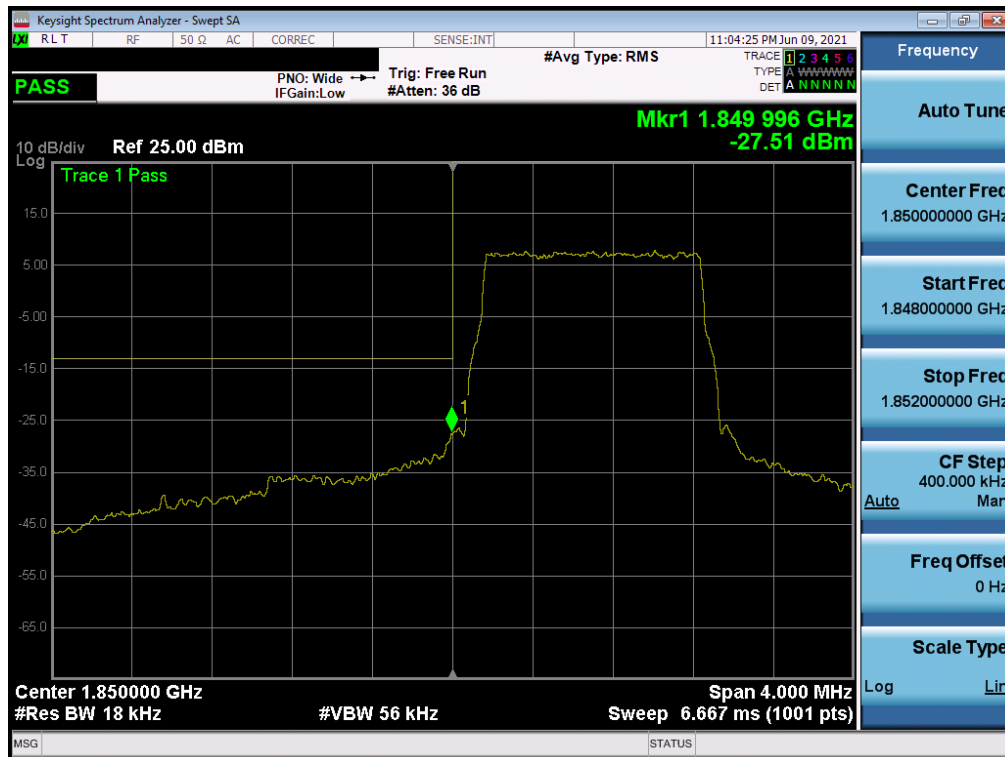
FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 33 of 88

Test Notes

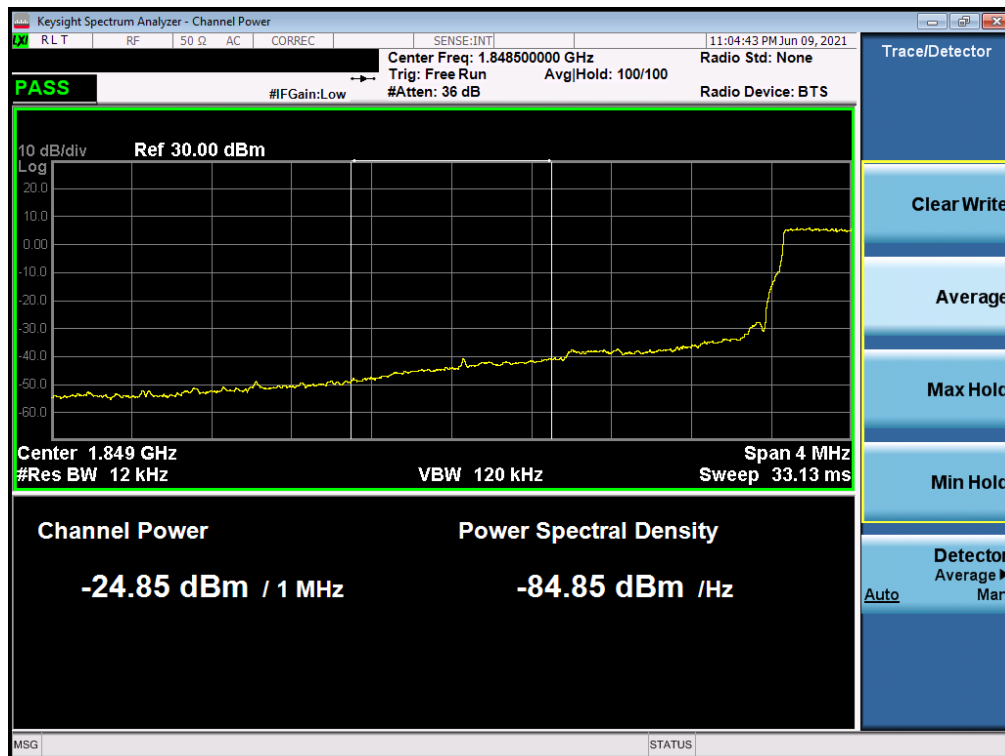
1. Per 24.238(a), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission 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.

FCC ID: BCG-A2475	 PCTEST [®] Proud to be part of  element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 34 of 88

LTE Band 2



Plot 7-32. Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

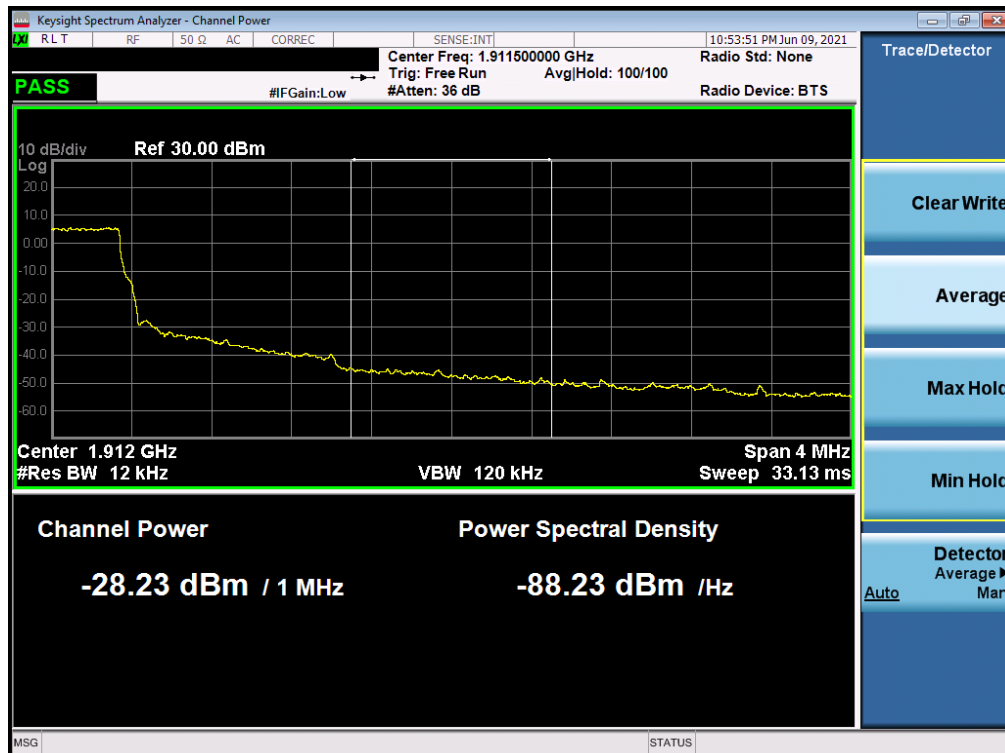


Plot 7-33. Extended Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 35 of 88

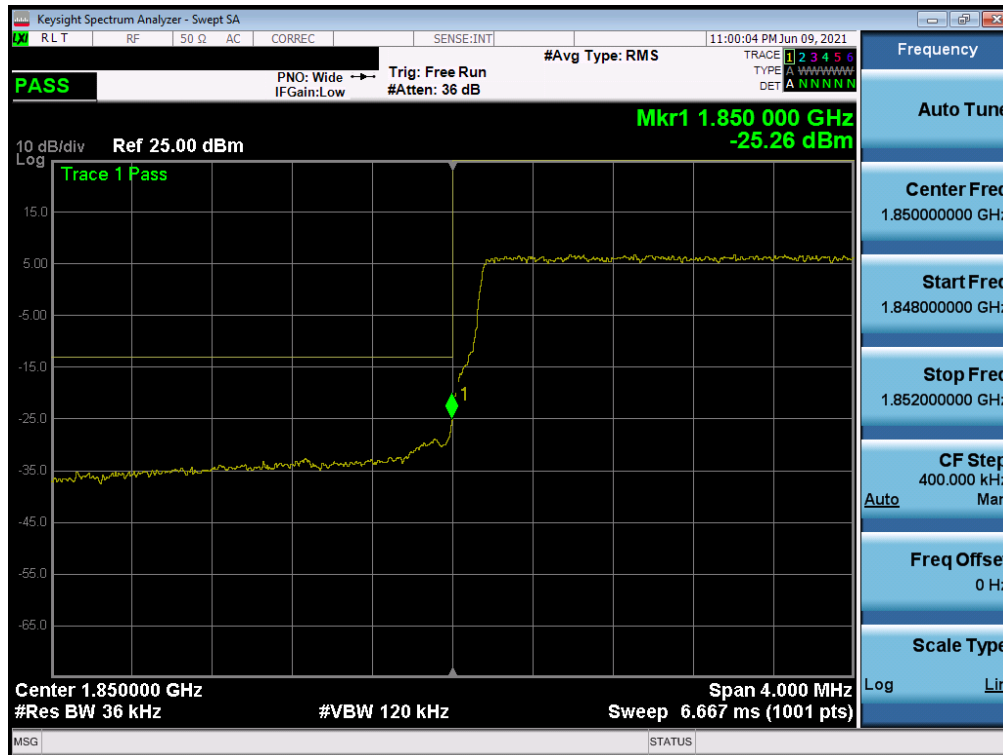


Plot 7-34. Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

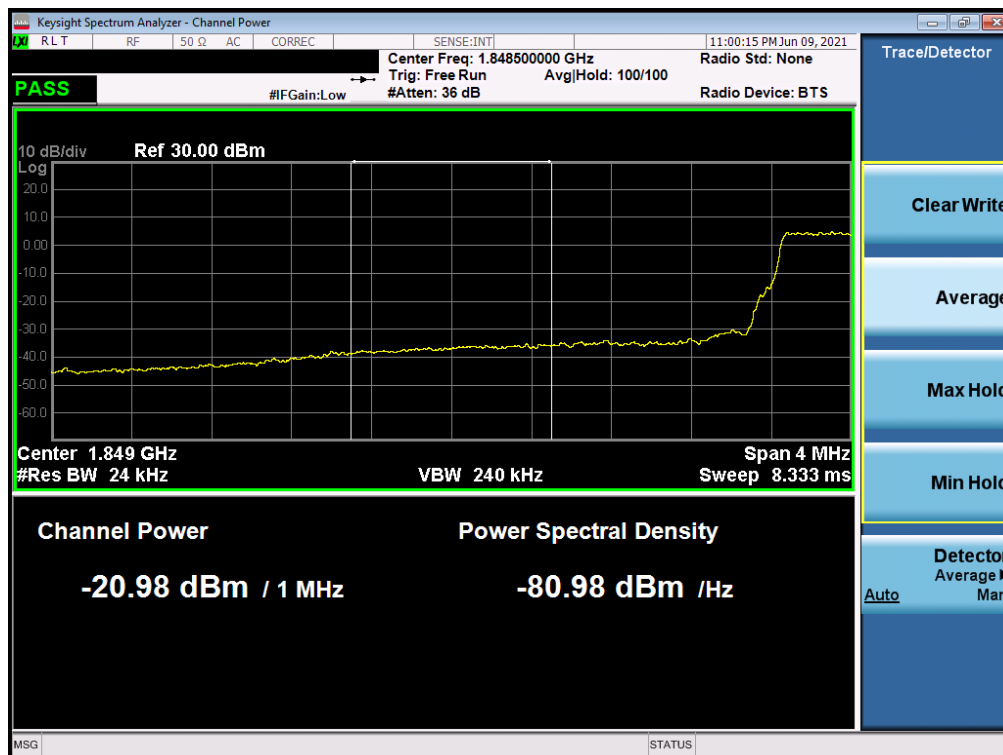


Plot 7-35. Extended Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 36 of 88



Plot 7-36. Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

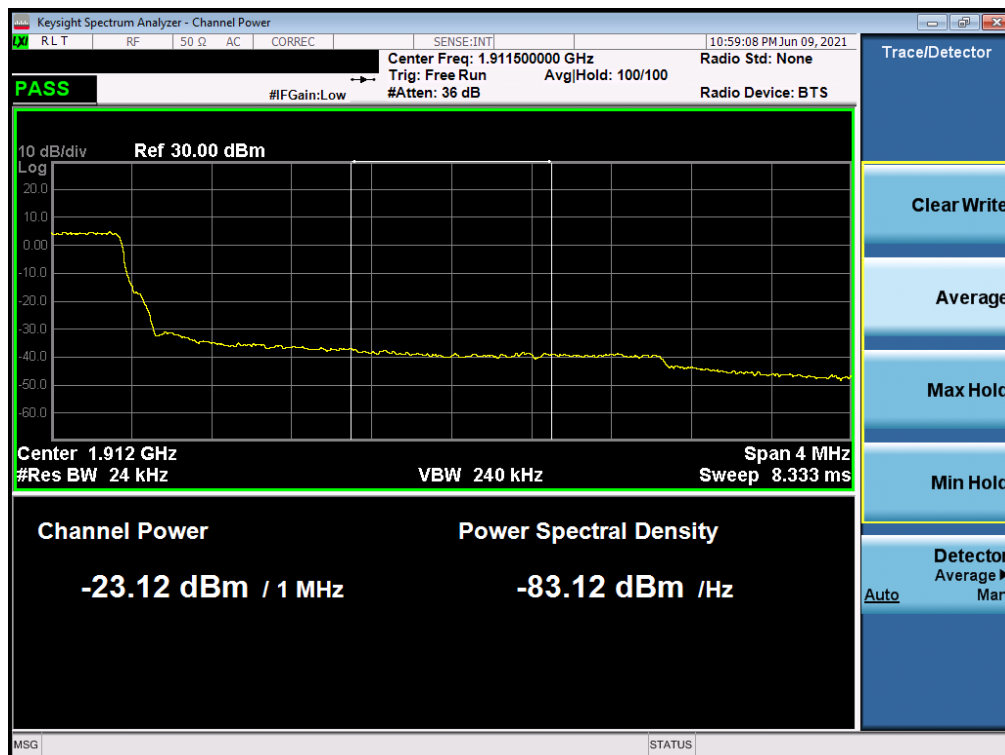


Plot 7-37. Extended Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 37 of 88

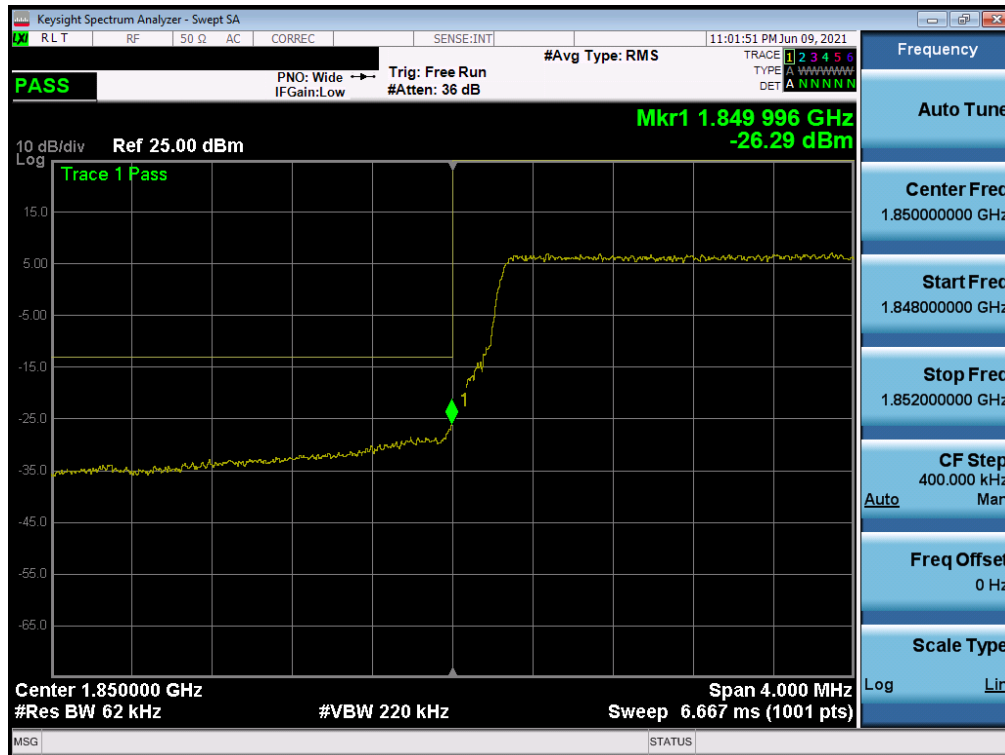


Plot 7-38. Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

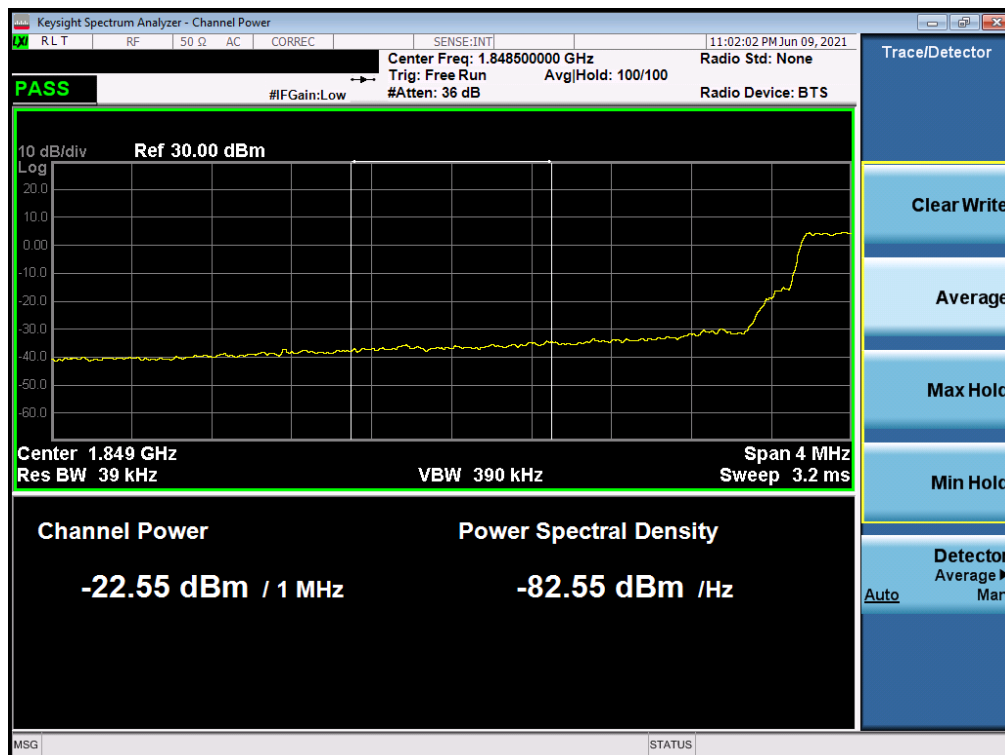


Plot 7-39. Extended Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 38 of 88



Plot 7-40. Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

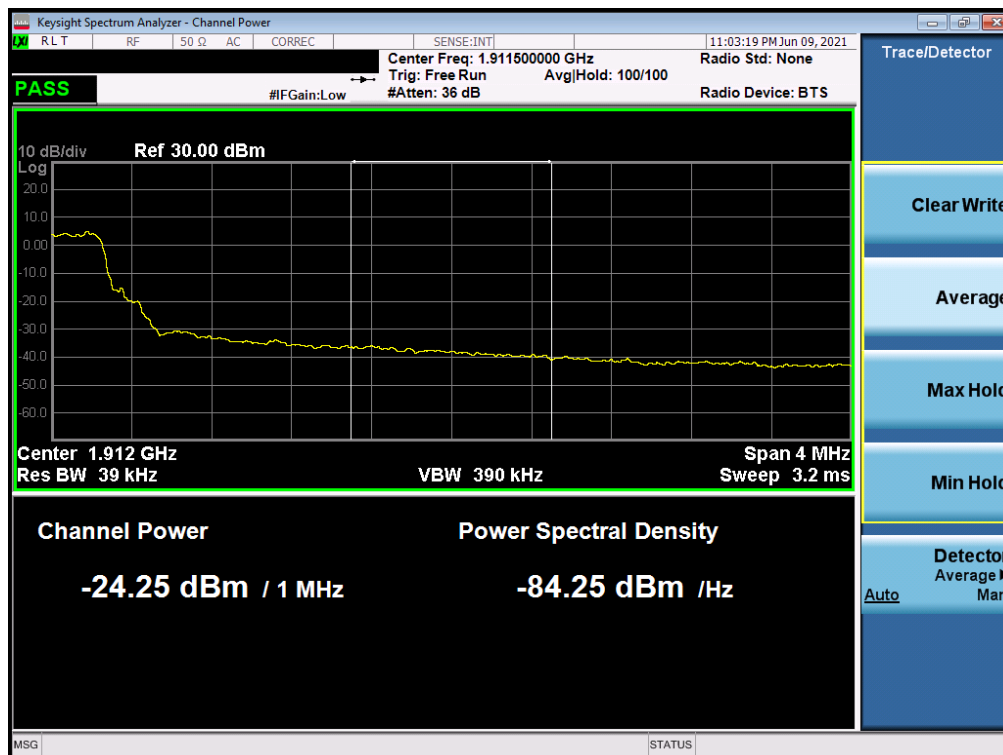


Plot 7-41. Extended Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 39 of 88

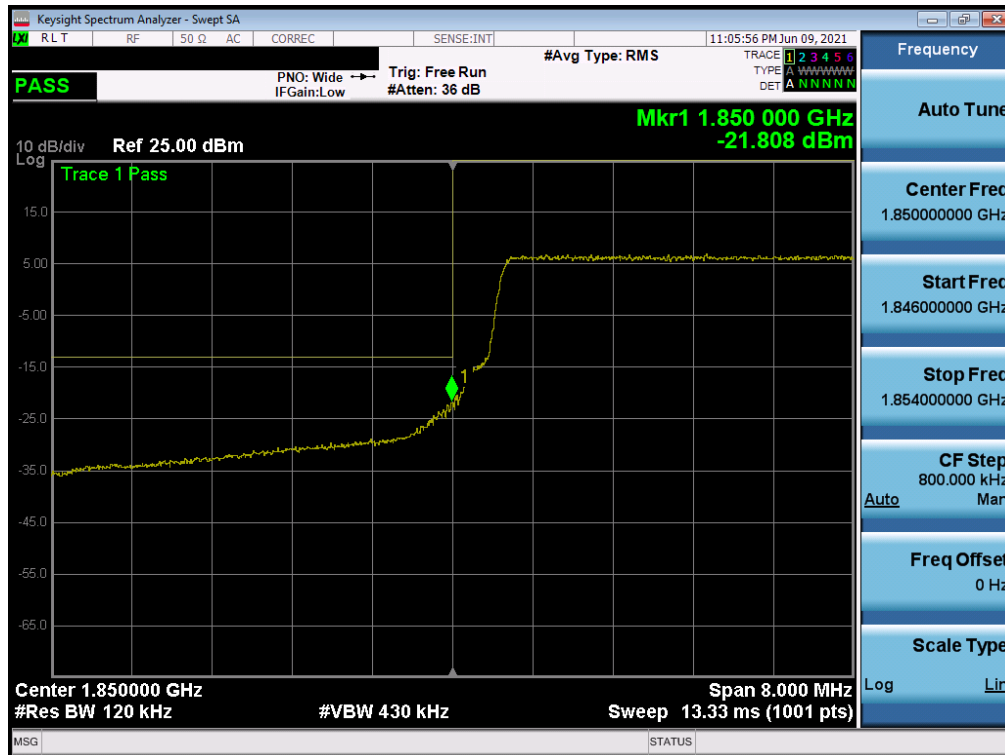


Plot 7-42. Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

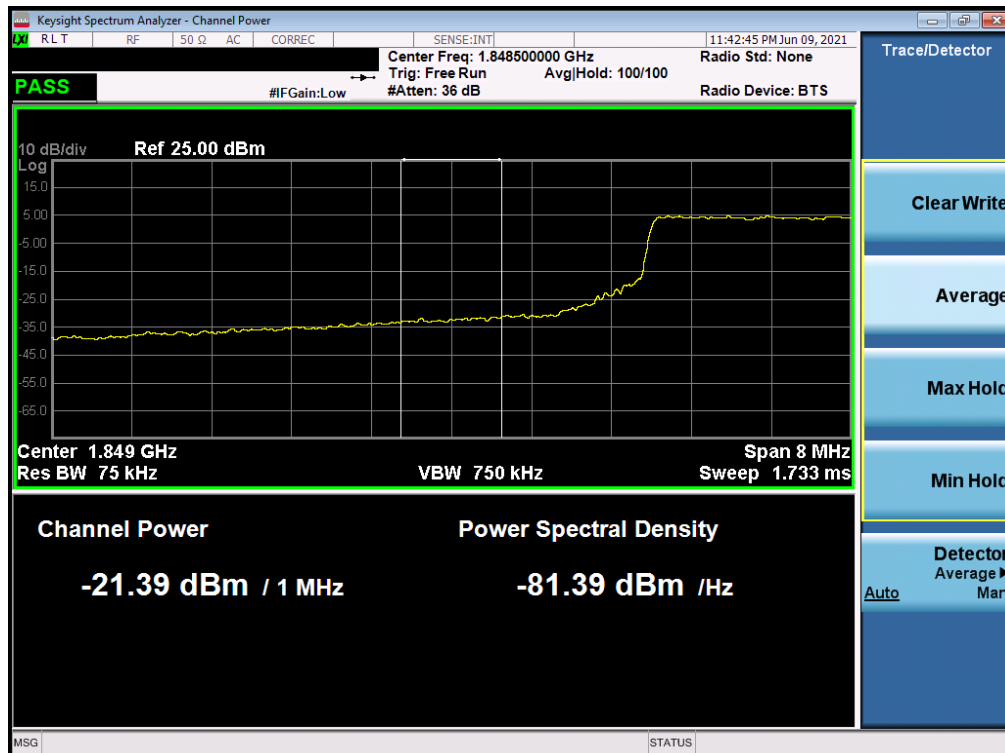


Plot 7-43. Extended Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 40 of 88

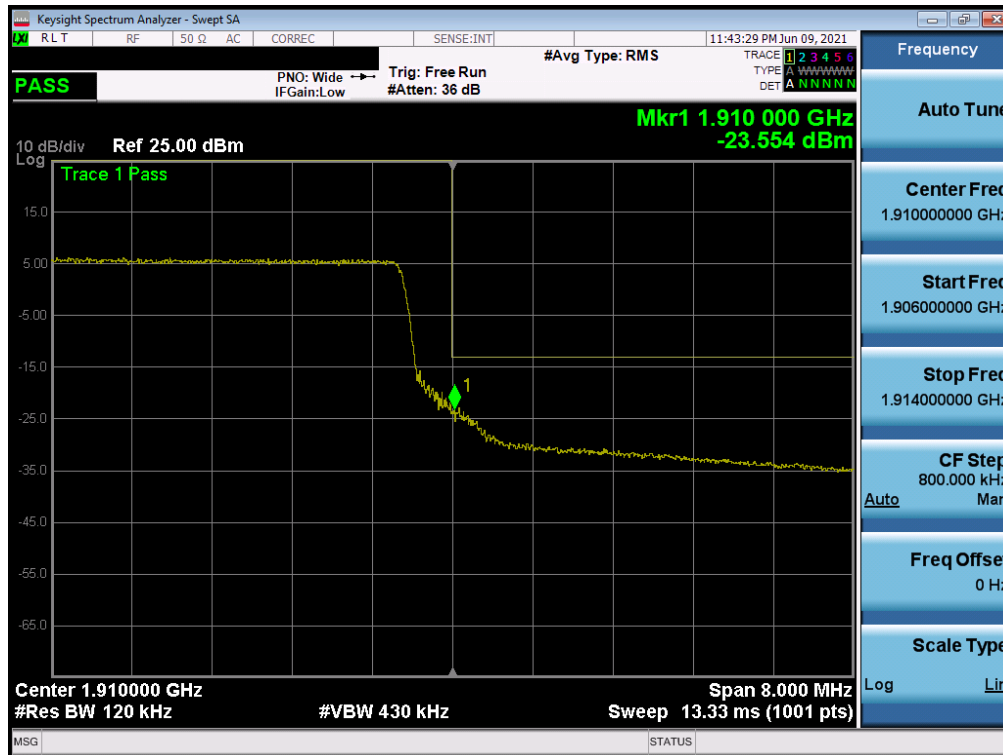


Plot 7-44. Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

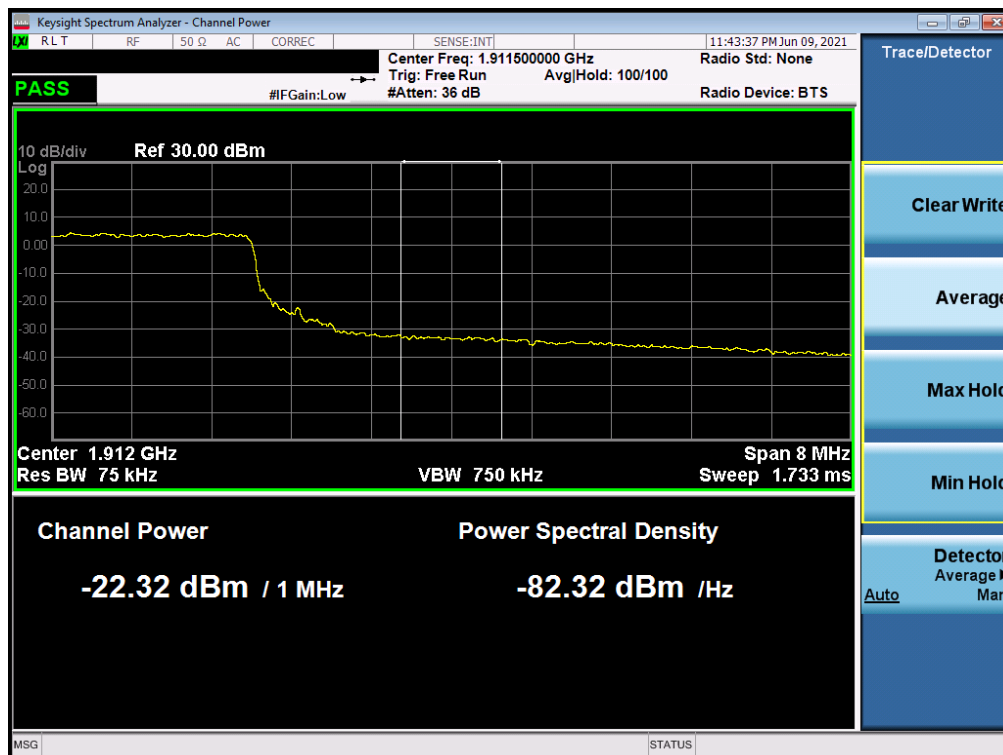


Plot 7-45. Extended Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 41 of 88

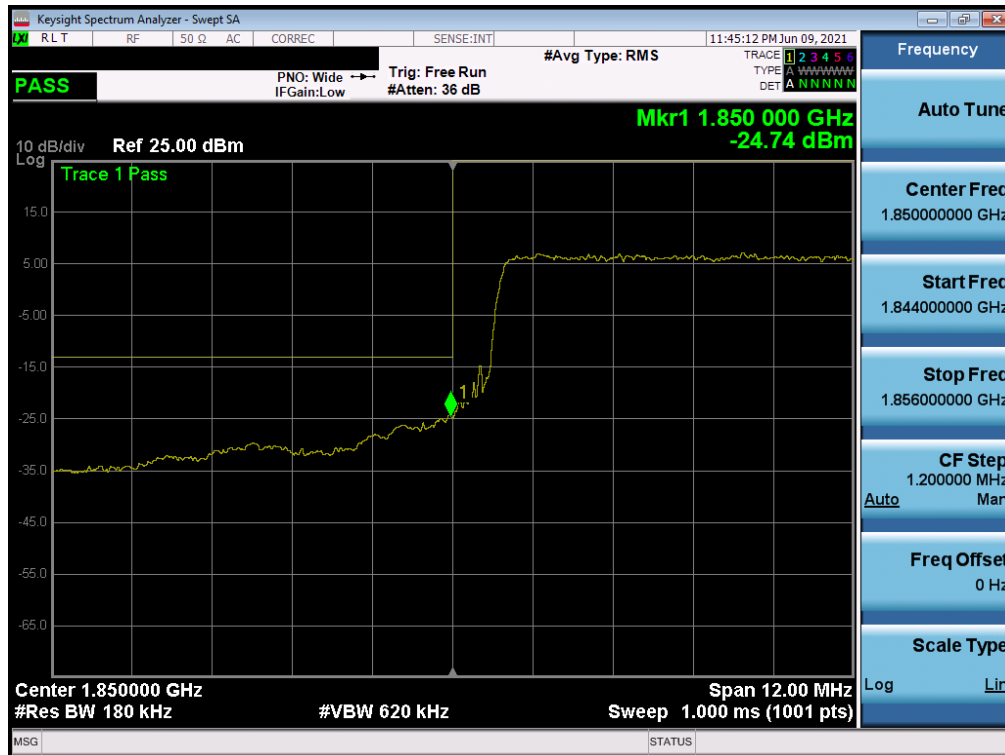


Plot 7-46. Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

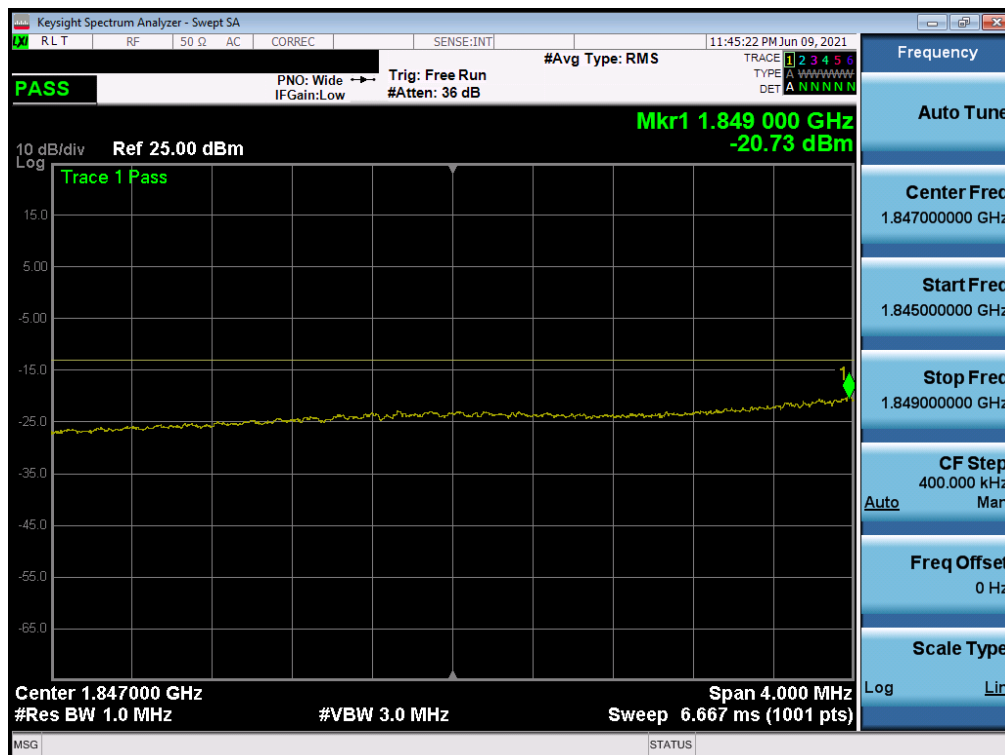


Plot 7-47. Extended Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-48. Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)



Plot 7-49. Extended Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 43 of 88

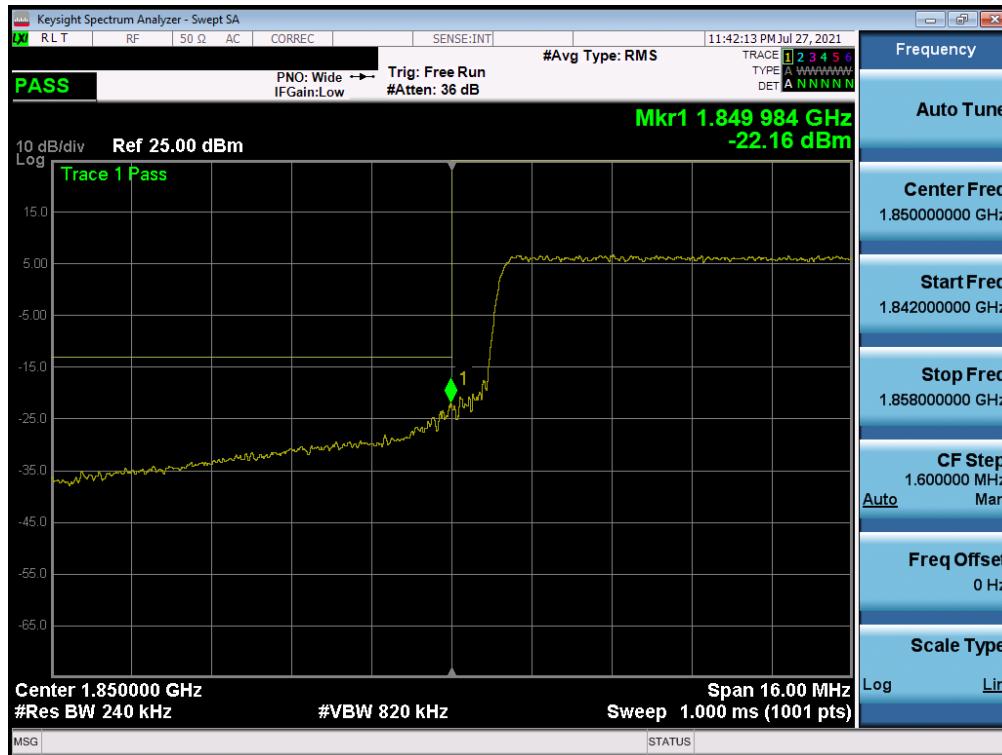


Plot 7-50. Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

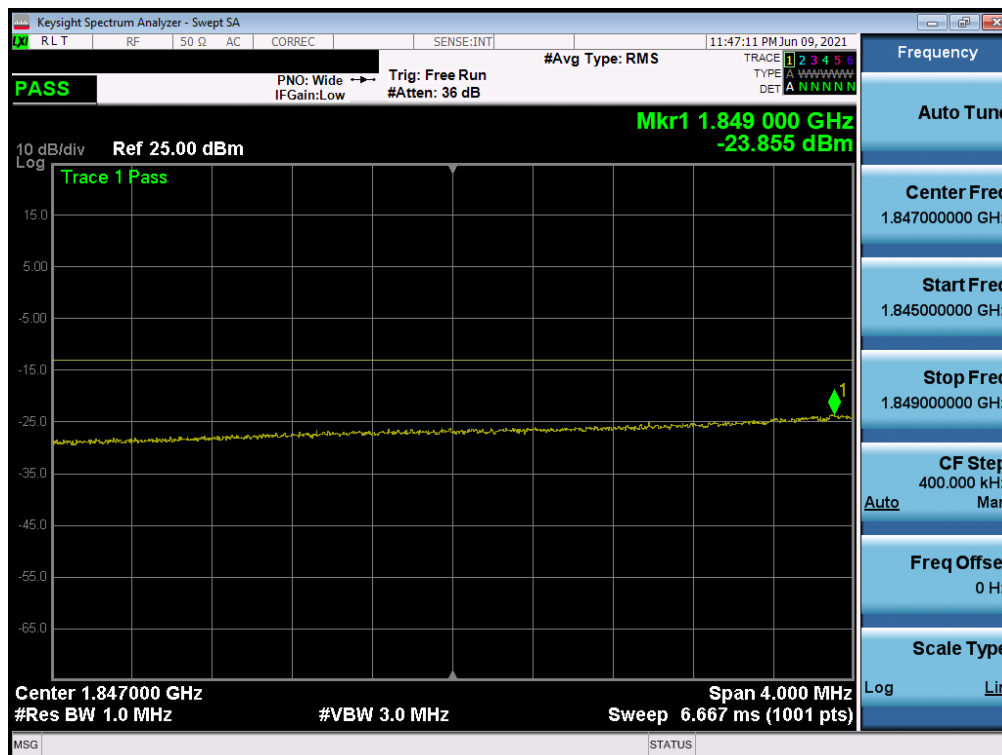


Plot 7-51. Extended Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
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Plot 7-52. Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)



Plot 7-53. Extended Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 45 of 88



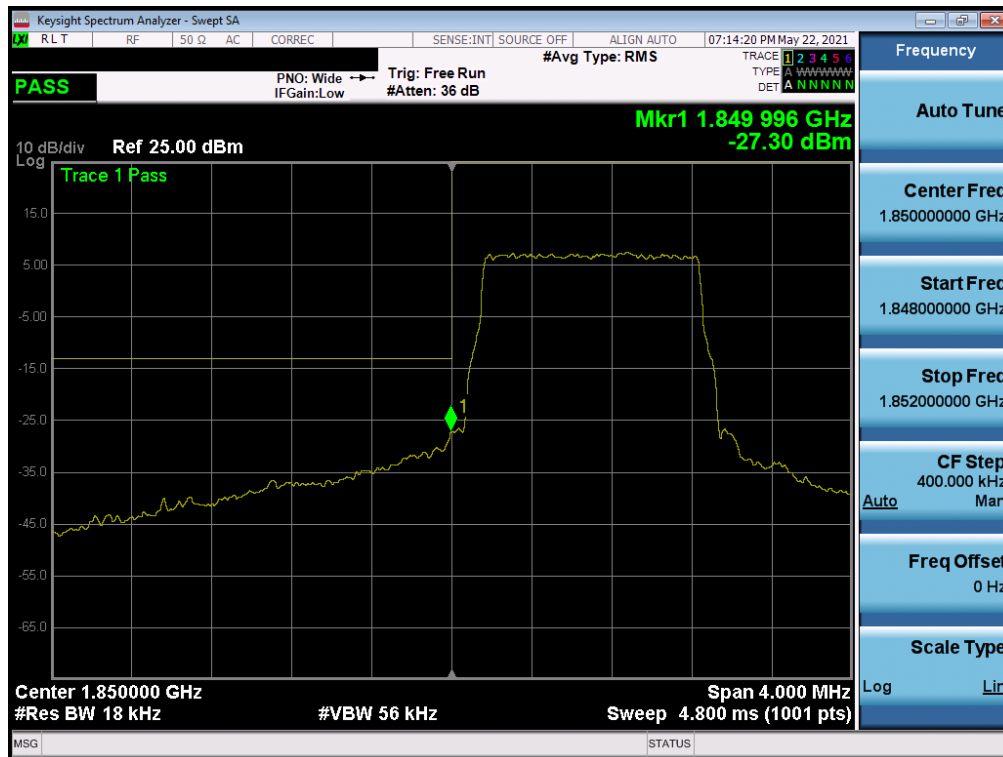
Plot 7-54. Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)



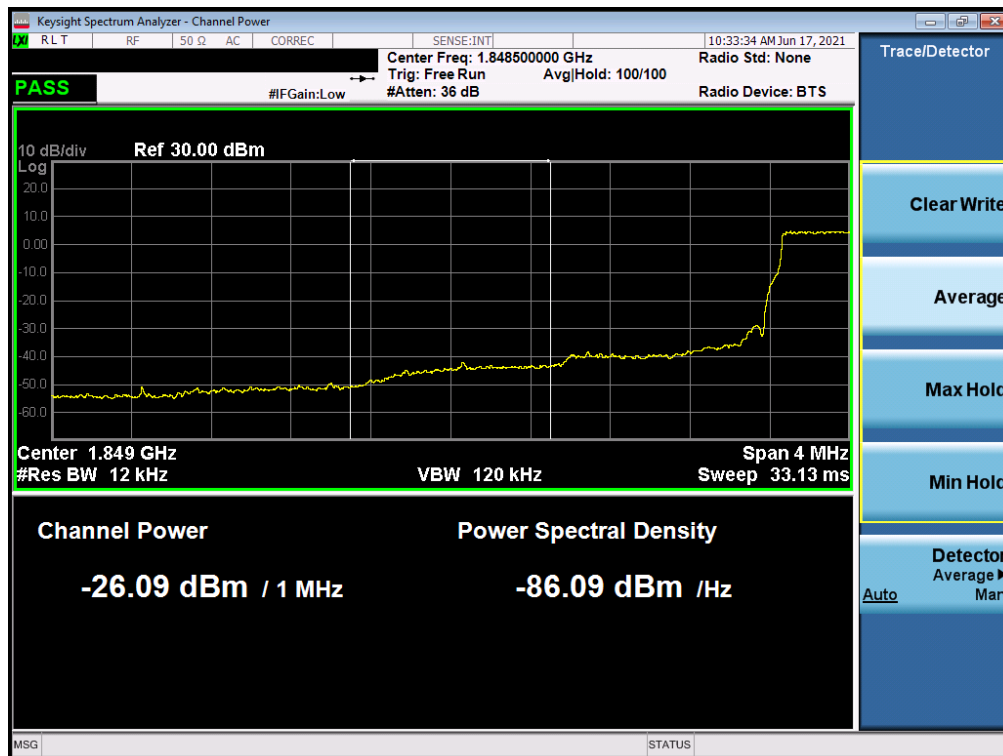
Plot 7-55. Extended Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 46 of 88

LTE Band 25

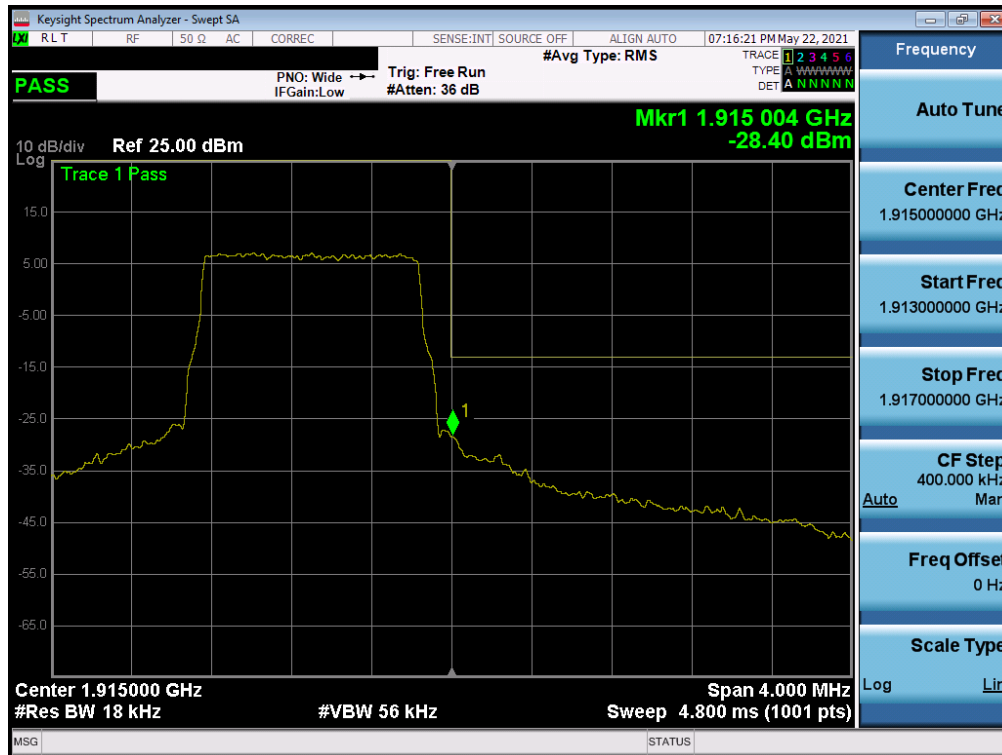


Plot 7-56. Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

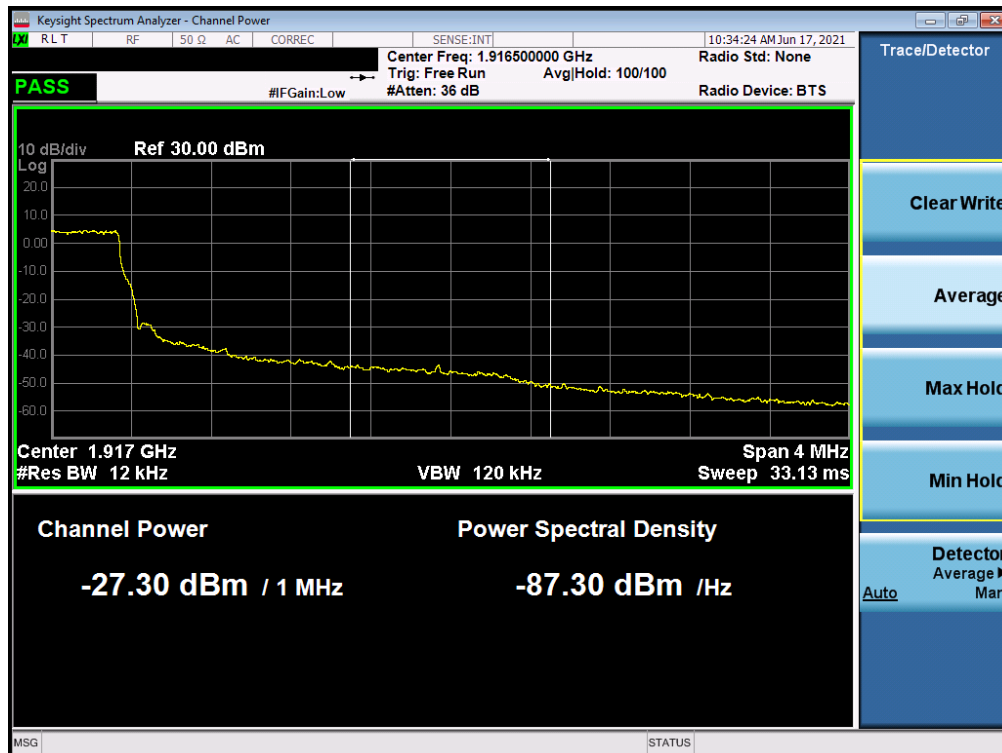


Plot 7-57. Extended Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 47 of 88

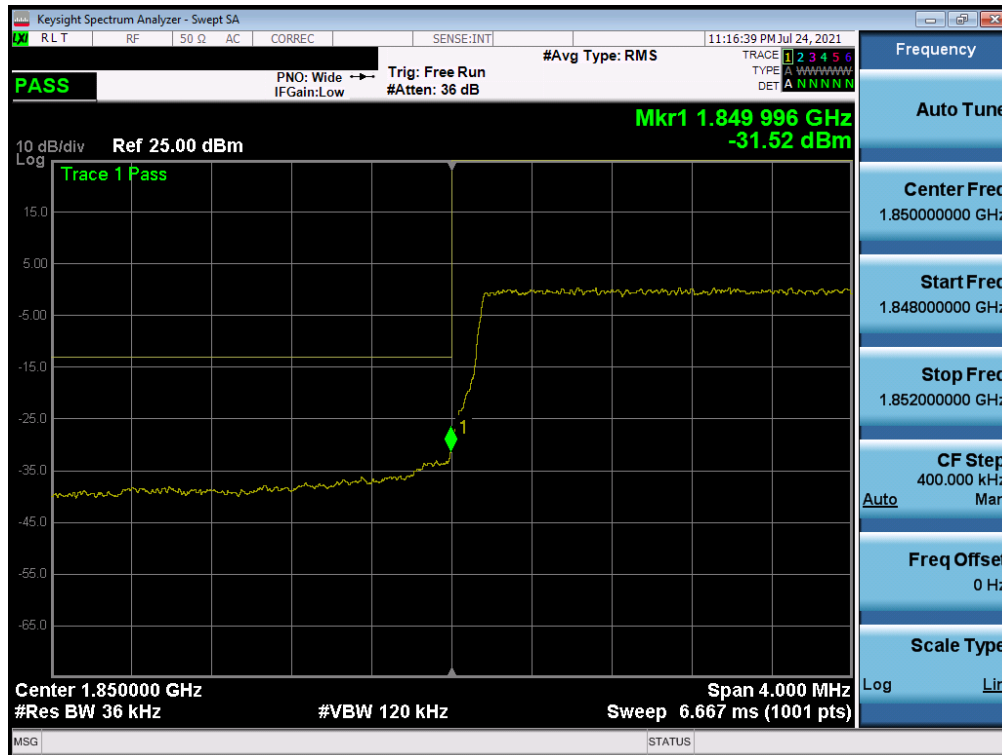


Plot 7-58. Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

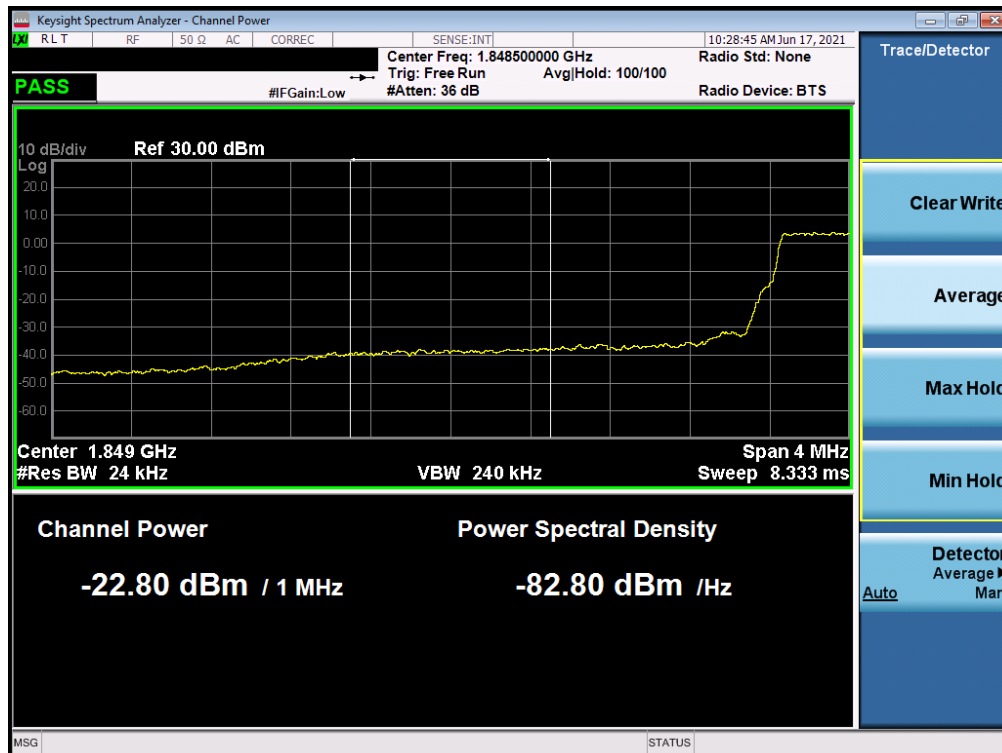


Plot 7-59. Extended Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 48 of 88



Plot 7-60. Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

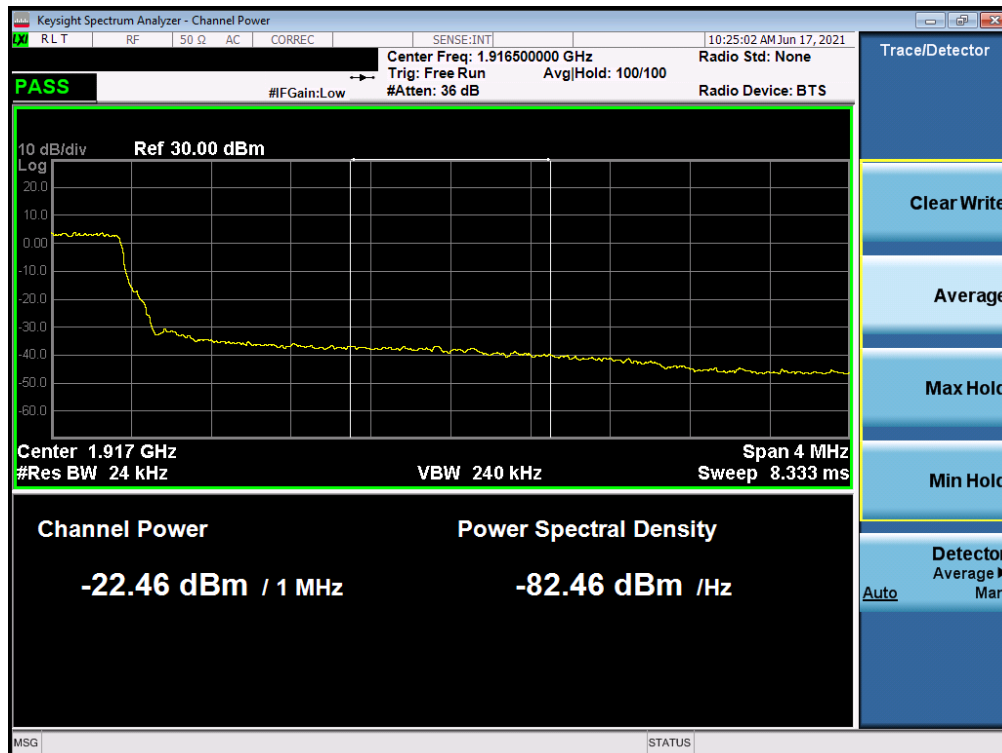


Plot 7-61. Extended Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 49 of 88

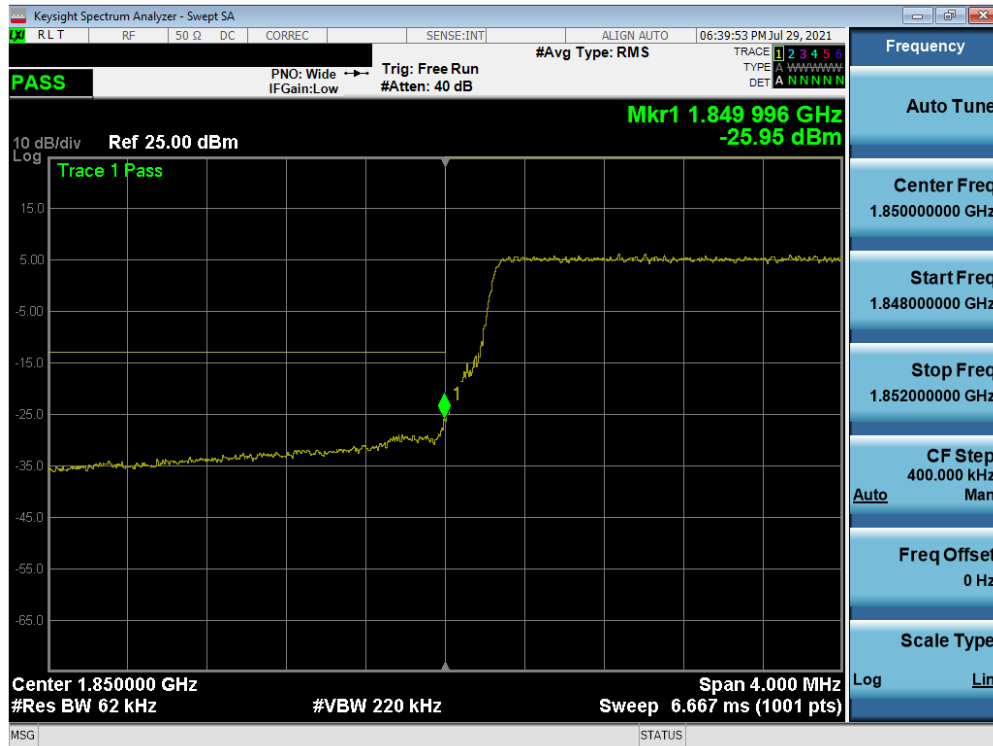


Plot 7-62. Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

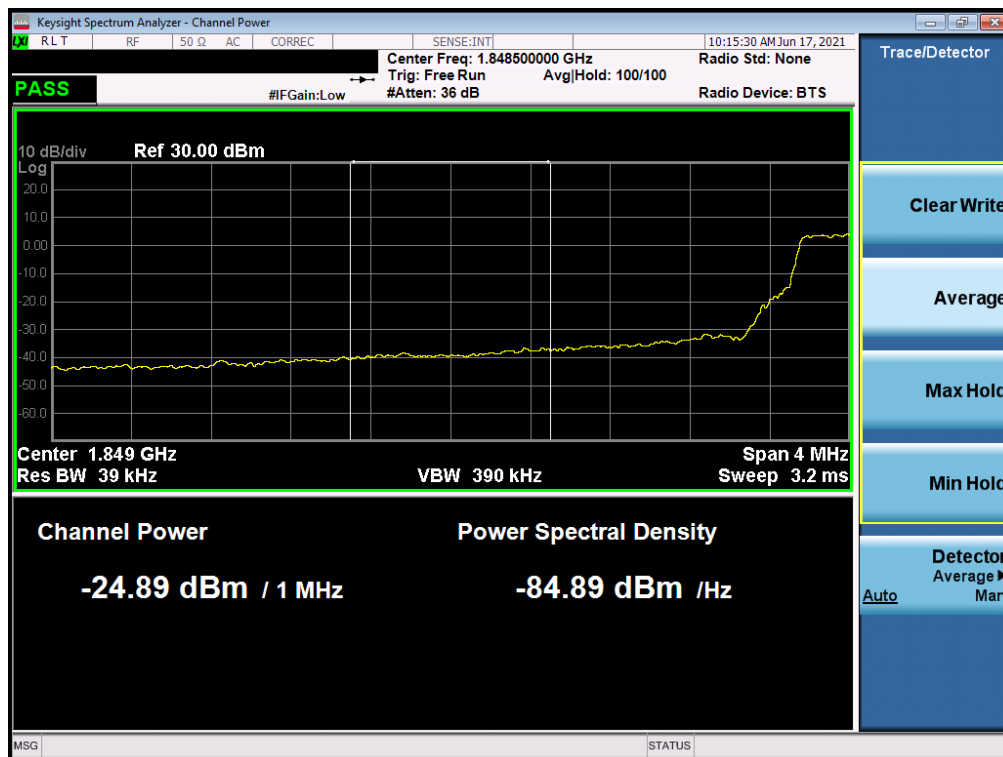


Plot 7-63. Extended Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 50 of 88



Plot 7-64. Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

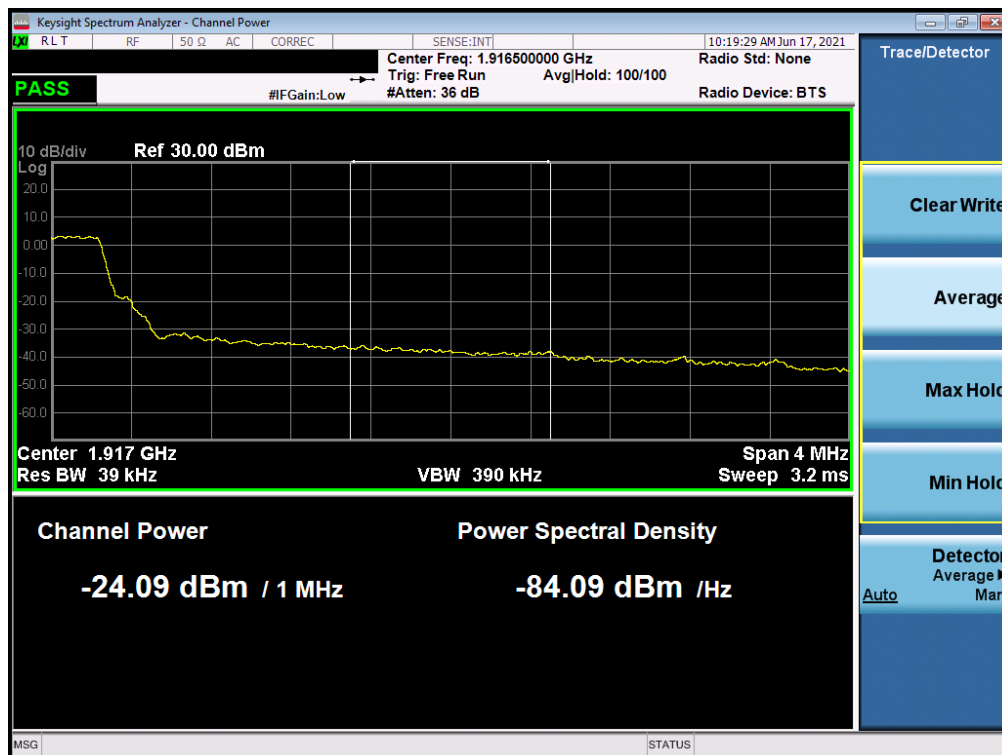


Plot 7-65. Extended Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 51 of 88

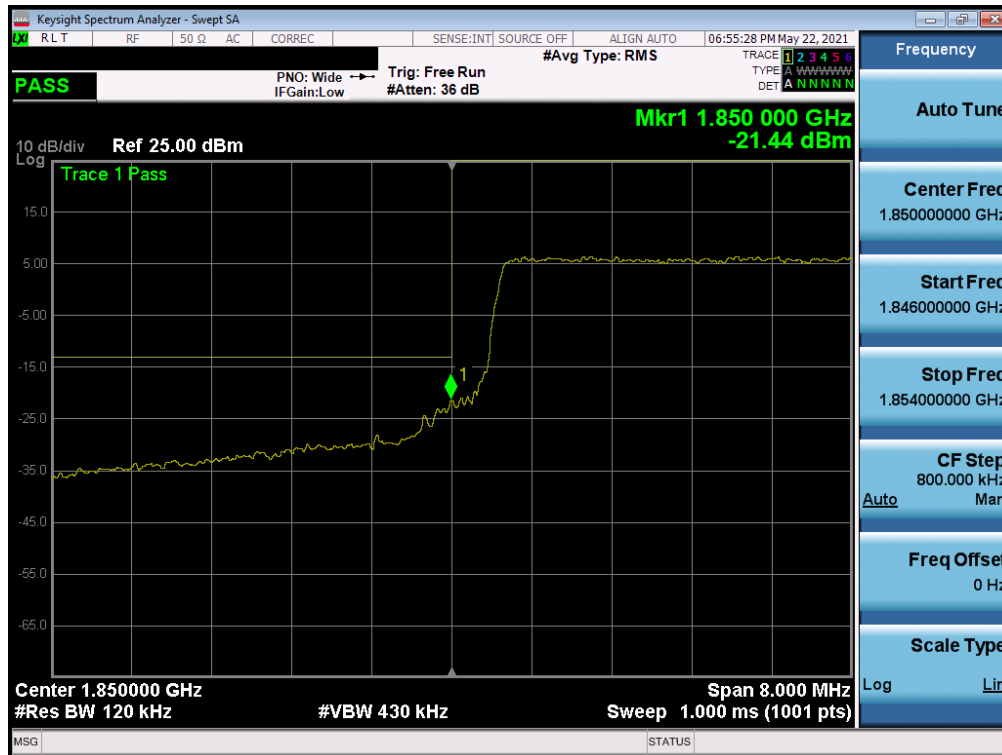


Plot 7-66. Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

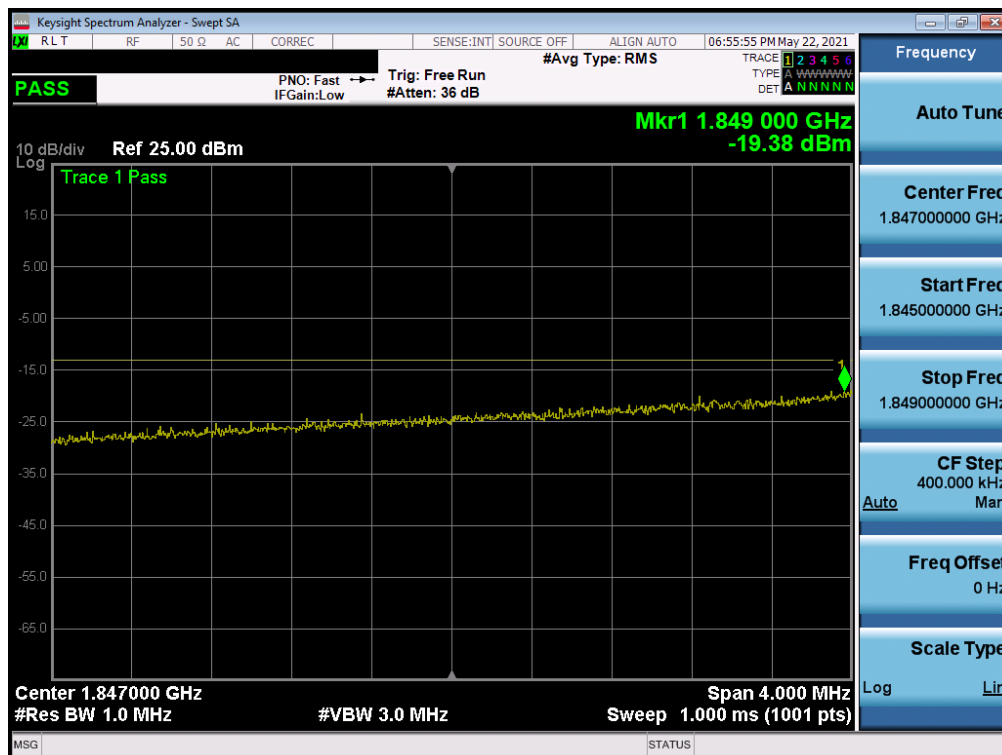


Plot 7-67. Extended Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 52 of 88



Plot 7-68. Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)



Plot 7-69. Extended Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2475	PCTEST Proud to be part of element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: 1C2106070043-02.BCG	Test Dates: 06-08-2021 - 07-31-2021	EUT Type: Watch	Page 53 of 88