

DATA REFERENCE REPORT PART 24

Applicant Name:

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

Date of Testing:

5/4/2022 - 8/10/2022

Test Site/Location:

Element Washington DC LLC, Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090041-02.BCG

FCC ID:

BCG-A2775

Applicant Name:

Apple Inc.

Reference Model:

A2774

Variant Model:

A2775 (A2858)

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.



RJ Ortanez
Executive Vice President



FCC ID: BCG-A2775	 element	PART 24 DATA REFERENCE REPORT	Approved by: Technical Manager
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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two watch device models, A2774 and A2775 (A2858), with high degree of similarity, reference model FCC ID: BCG-A2774 and variant model **FCC ID: BCG-A2775**. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCG-A2774, while radiated and conducted spot-check verification has been performed on variant model FCC ID: BCG-A2775. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

Equipment Class	Reference Model FCC ID	Reference Report	Report Title
PCT	BCG-A2774	1C2205090040-02.BCG	RF Part 24 Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCG-A2774 test report has been included in Appendix A

1.2 Element Washington DC LLC Test Location

These measurement tests were conducted at the ELEMENT Washington DC LLC 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

- ELEMENT WASHINGTON DC LLC 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 WASHINGTON DC LLC facility is a registered (22831) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A2775**. 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.: FCGJ4LCV4, WFYT4N230R, M1X9562DDJ

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.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Band	Antenna Gain (dBi)
	Antenna FCM
LTE Band 25/2	-10.2
WCDMA 1900	-10.2

Table 2-1. 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:	N/A	S/N:	DQ812910CU008V22F
	w/ Cradle	Model:	LA2-BD-LG-P1	S/N:	N-0017525-02
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:	DLC03770065Q6PM1W
	SIP Socket	Model:	N/A	S/N:	P1 X2539B PF096
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A
6	Store Sample Wristband	Model:	N/A	S/N:	DLC219400361YDQ2W

Table 2-2. 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 emissions tests.

The worst case configuration was investigated for all combinations of the two materials, aluminum, and stainless steel, 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 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.

Per FCC Approved Data Referencing Test Plan, Antenna C spot-check measurements have been conducted and reported. Spot-check Test Plan can be referred to below Table 2-3.

Technology	Test Case	FCC ID: BCG-A2775	
		Mode	Channel
WCDMA, LTE	Radiated Spurious Emissions (>1GHz)	LTE Band 5, 2, 7 Max BW, 1RB, QPSK	Low, Mid, High
WCDMA, LTE	Conducted Power	All Certified Bands: Highest BW only, 1 RB, Modulation with the highest power	Mid

Table 2-3. FCC Approved Spot-Check Test Plan

Output powers were measured and confirmed to be consistent between Reference and Variant models prior to testing.

2.6 Software and Firmware

The test was conducted with firmware version watchOS 9.0 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 Measurement 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.

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:

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

And

$$\text{EIRP}_{[\text{dBm}]} = E_{[\text{dB}\mu\text{V/m}]} + 20\log D - 104.8;$$

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 ($\pm$ dB)
Conducted Bench Top Measurements	1.77
Radiated Disturbance (<30MHz)	4.38
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	6/10/2022	Annual	6/10/2023	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/13/2021	Annual	8/13/2022	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	10/26/2021	Annual	10/26/2022	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	5/11/2022	Annual	5/11/2023	205956
Keysight Technology	N9040B	UXA Signal Analyzer	2/8/2022	Annual	2/8/2023	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/4/2022	Annual	3/4/2023	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	5/19/2022	Annual	5/19/2023	101299
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	1/6/2022	Annual	1/6/2023	102327
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/11/2021	Annual	10/11/2022	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	11/4/2021	Annual	11/4/2022	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/18/2022	Annual	4/18/2023	100050
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	1/25/2022	Annual	1/25/2023	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/3/2022	Annual	4/3/2023	100546

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.

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6.0 SAMPLE CALCULATIONS

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 (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.
 FCC ID: BCG-A2775
 FCC Classification: PCS Licensed Transmitter Worn on Body (PCT)
 Mode(s): WCDMA/LTE

Technology	Test Configurations					Reference Model	Variant Model	Delta
	Test Description	Modulation	BW / RB Config	Channel	Measurement Frequency [MHz]	FCC ID: BCG-A2774	FCC ID: BCG-A2775	Average [dB]
						Average [dBm]	Average [dBm]	
WCDMA B2	Radiated Spurious Emissions	QPSK	5 MHz	L	5557.2	-58.79	-57.92	0.87
WCDMA B2	Radiated Spurious Emissions	QPSK	5 MHz	M	5640.0	-59.94	-59.76	0.18
WCDMA B2	Radiated Spurious Emissions	QPSK	5 MHz	H	5722.8	-57.73	-57.06	0.67
LTE Band 2	Conducted Powers	QPSK	20MHz / 1/0 RB	M	1882.5	24.18	24.19	0.01
LTE Band 25	Conducted Powers	QPSK	20MHz / 1/0 RB	M	1882.5	23.99	24.16	0.17
WCDMA B2	Conducted Powers	QPSK	5MHz	M	1880.0	23.82	23.89	0.07

Table 7-1. Worst Case Spot-Check Results

Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC Approved Data Referencing Test Plan.

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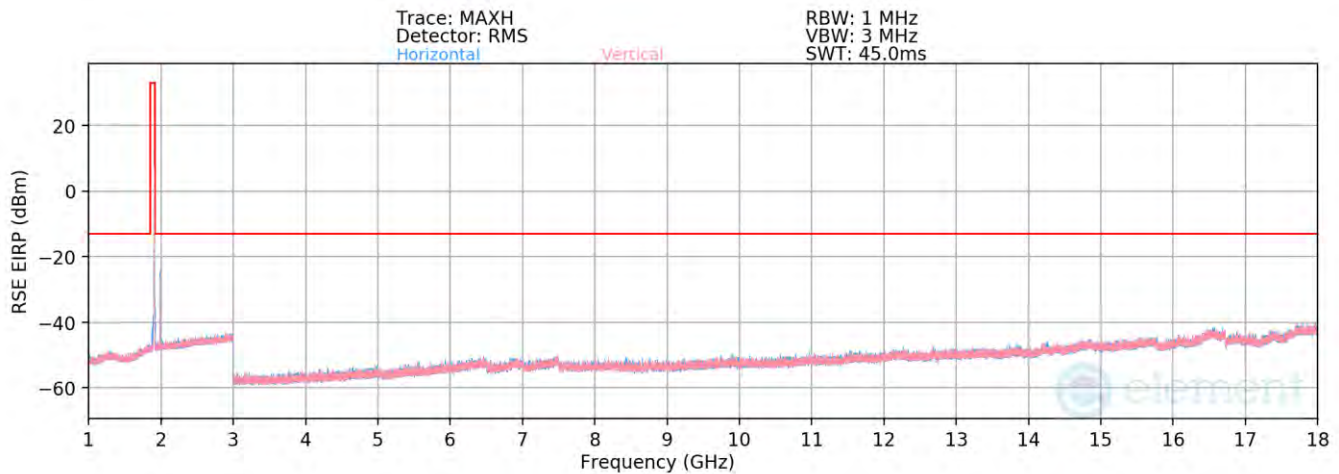
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7.2 Radiated Spurious Emissions

§2.1053, 24.238(a)

WCDMA Band 2



Plot 7-1. Radiated Spurious Emission above 1GHz (WCDMA Band 2)

Mode:	WCDMARMC
Channel:	9262
Frequency (MHz):	1852.4

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]
3704.8	V	138	176	-72.50	2.38	36.88	-58.38	-13.00	-45.38
5557.2	V	298	158	-75.11	5.45	37.34	-57.92	-13.00	-44.92
7409.6	H	-	-	-80.40	8.76	35.36	-59.89	-13.00	-46.89
9262.0	H	-	-	-81.66	8.99	34.33	-60.93	-13.00	-47.93
11114.4	H	-	-	-81.69	10.62	35.93	-59.32	-13.00	-46.32

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

Mode:	WCDMARMC
Channel:	9400
Frequency (MHz):	1880

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3760.0	V	109	168	-74.66	2.18	34.52	-60.73	-13.00	-47.73
5640.0	V	298	147	-76.84	5.34	35.50	-59.76	-13.00	-46.76
7520.0	H	-	-	-81.55	8.74	34.19	-61.07	-13.00	-48.07
9400.0	H	-	-	-81.52	9.20	34.68	-60.58	-13.00	-47.58
11280.0	H	-	-	-81.82	10.60	35.78	-59.48	-13.00	-46.48

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

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Mode:	WCDMA RMC
Channel:	9538
Frequency (MHz):	1907.6

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]
3815.2	H	-	-	-77.85	2.18	31.33	-63.93	-13.00	-50.93
5722.8	V	298	152	-74.56	5.76	38.20	-57.06	-13.00	-44.06
7630.4	H	-	-	-82.24	9.44	34.20	-61.06	-13.00	-48.06
9538.0	H	-	-	-81.50	9.21	34.71	-60.55	-13.00	-47.55
11445.6	H	-	-	-81.85	10.97	36.12	-59.13	-13.00	-46.13

Table 7-4. Radiated Spurious Data (WCDMA Band 2 – High Channel)

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7.3 Antenna BCM – ERP/EIRP

LTE-B2

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
20 MHz	QPSK	1880.00	-10.20	1 / 0	24.19	13.99	25.06	33.01	-19.02

Table 7-5. Antenna BCM ERP/EIRP Data (LTE Band 2)

LTE-B25

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
20 MHz	QPSK	1882.50	-10.20	1 / 0	24.16	13.96	24.89	33.01	-19.05

Table 7-6. Antenna BCM ERP/EIRP Data (LTE Band 25)

WCDMA B2

Frequency [MHz]	Mode	Conducted Power [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1880.00	WCDMA1900	23.89	-10.20	13.69	23.39	33.01	-19.32

Table 7-7. Antenna BCM ERP/EIRP Data (WCDMA Band 2)

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8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCG-A2775** is in tolerance with reference model FCC ID: BCG-A2774 per FCC Approved Data Referencing Test Plan.

FCC ID: BCG-A2775		PART 24 DATA REFERENCE REPORT	Approved by: Technical Manager
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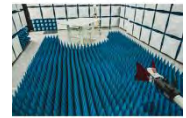
9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2205090040-02.BCG) from reference model FCC ID: BCG-A2774, which includes referenced data results.

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PART 24 MEASUREMENT REPORT

Applicant Name:

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

Date of Testing:

5/4/2022 - 8/10/2022

Test Site/Location:

Element Washington DC LLC
Morgan Hill, CA, USA

Test Report Serial No.:

1C2205090040-02.BCG

FCC ID:

BCG-A2774

Applicant Name:

Apple Inc.

Application Type:

Certification

Model:

A2774

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.

RJ Ortanez
Executive Vice President



FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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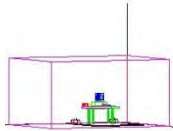
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PART 24 MEASUREMENT REPORT



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	4.0907	3.23	23.227	13.66	4M09F9W
Band 2	1.4 MHz	QPSK	1850.7 - 1914.3	1.1078	5.67	25.763	14.11	1M11G7W
		16QAM	1850.7 - 1914.3	1.1101	6.31	21.528	13.33	1M11D7W
	3 MHz	QPSK	1851.5 - 1913.5	2.7344	5.77	26.062	14.16	2M73G7W
		16QAM	1851.5 - 1913.5	2.7275	6.44	21.627	13.35	2M73D7W
	5 MHz	QPSK	1852.5 - 1912.5	4.5670	5.76	25.823	14.12	4M57G7W
		16QAM	1852.5 - 1912.5	4.5570	6.40	22.131	13.45	4M56D7W
	10MHz	QPSK	1855 - 1910	9.1160	5.65	25.235	14.02	9M12G7W
		16QAM	1855 - 1910	5.4668	6.27	21.677	13.36	5M47D7W
	15 MHz	QPSK	1857.5 - 1907.5	13.6887	5.88	25.468	14.06	13M7G7W
		16QAM	1857.5 - 1907.5	6.3963	6.27	21.577	13.34	6M40D7W
	20 MHz	QPSK	1860 - 1905	18.2657	5.54	25.586	14.08	18M3G7W
		16QAM	1860 - 1905	7.9994	6.28	22.080	13.44	8M00D7W
Band 25	1.4 MHz	QPSK	1850.7 - 1914.3	1.1078	5.63	25.942	14.14	1M11G7W
		16QAM	1850.7 - 1914.3	1.1101	6.36	21.577	13.34	1M11D7W
	3 MHz	QPSK	1851.5 - 1913.5	2.7344	5.75	25.468	14.06	2M73G7W
		16QAM	1851.5 - 1913.5	2.7275	6.50	21.627	13.35	2M73D7W
	5 MHz	QPSK	1852.5 - 1912.5	4.5670	5.76	26.242	14.19	4M57G7W
		16QAM	1852.5 - 1912.5	4.5570	6.36	22.131	13.45	4M56D7W
	10 MHz	QPSK	1855 - 1910	9.1160	5.58	25.882	14.13	9M12G7W
		16QAM	1855 - 1910	5.4668	6.23	22.080	13.44	5M47D7W
	15 MHz	QPSK	1857.5 - 1907.5	13.6887	5.88	25.119	14.00	13M7G7W
		16QAM	1857.5 - 1907.5	6.3963	6.22	22.080	13.44	6M40D7W
	20 MHz	QPSK	1860 - 1905	18.2657	5.57	25.293	14.03	18M3G7W
		16QAM	1860 - 1905	7.9994	6.25	21.677	13.36	8M00D7W

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 Washington DC LLC Test Location

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

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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 Washington DC LLC facility is a registered (22831) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID:BCG-A2774**. 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.: CY6RMQ6D0X, PQ92YF5W40, DLC215300C0171C3Q

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, LE1/2M	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

Note:

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be config 10 and reported in RF UNII, RF Bluetooth and RF 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)
	Antenna FCM
LTE Band 25/2	-10.2
WCDMA 1900	-10.2

Table 2-2. Highest Antenna Gain

Note: Antenna Specifications has been attached to Appendix A

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:	N/A	S/N:	DQ812910CU008V22F
	w/ Cradle	Model:	LA2-BD-LG-P1	S/N:	N-0017525-02
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:	DLC03770065Q6PM1W
	SiP Socket	Model:	N/A	S/N:	P1 X2539B PF096
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A
6	Store Sample Wristband	Model:	N/A	S/N:	DLC219400361YDQ2W

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 two materials, aluminum, and stainless steel, 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.

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

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.

2.6 Software and Firmware

The test was conducted with firmware watchOS 9.0 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	1.77
Radiated Disturbance (<30MHz)	4.38
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	6/10/2022	Annual	6/10/2023	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/13/2021	Annual	8/13/2022	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	10/26/2021	Annual	10/26/2022	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	5/11/2022	Annual	5/11/2023	205956
Keysight Technology	N9040B	UXA Signal Analyzer	2/8/2022	Annual	2/8/2023	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/4/2022	Annual	3/4/2023	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	5/19/2022	Annual	5/19/2023	101299
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	1/6/2022	Annual	1/6/2023	102327
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/11/2021	Annual	10/11/2022	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	11/4/2021	Annual	11/4/2022	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/18/2022	Annual	4/18/2023	100050
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	1/25/2022	Annual	1/25/2023	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/3/2022	Annual	4/3/2023	100546

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.

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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-A2774
 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)	-13 dBm 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)	-13 dBm 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 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 $\geq 3 \times$ 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.

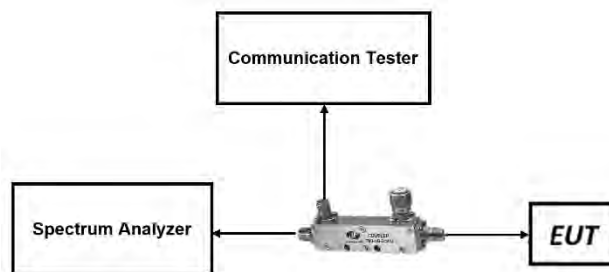


Figure 7-1. Test Instrument & Measurement Setup

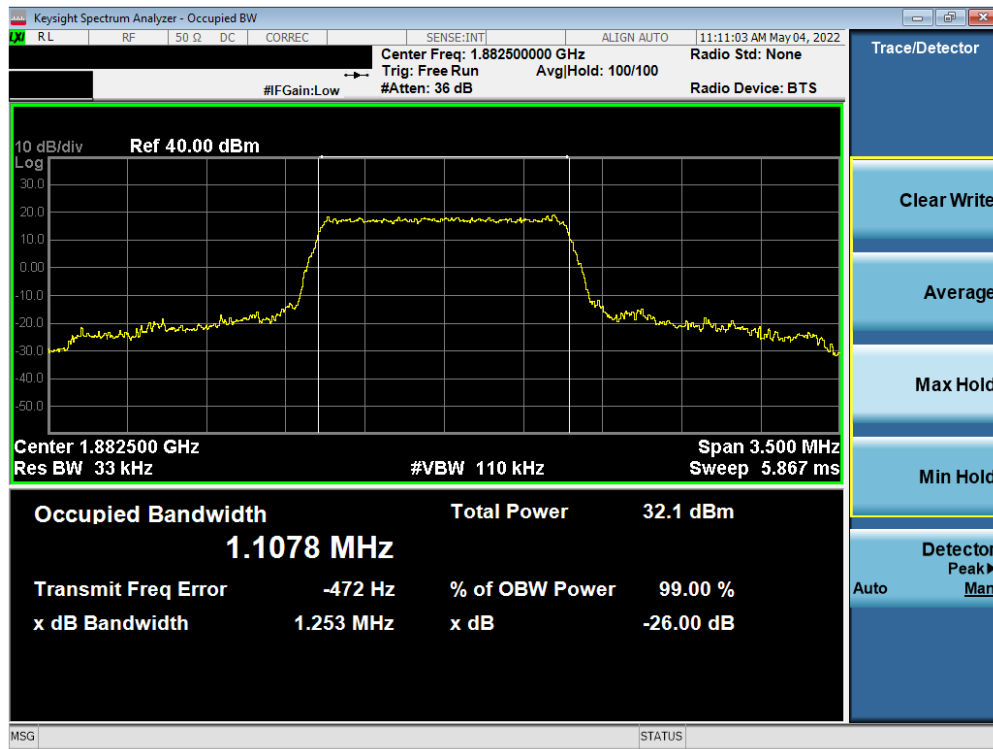
Test Notes

None.

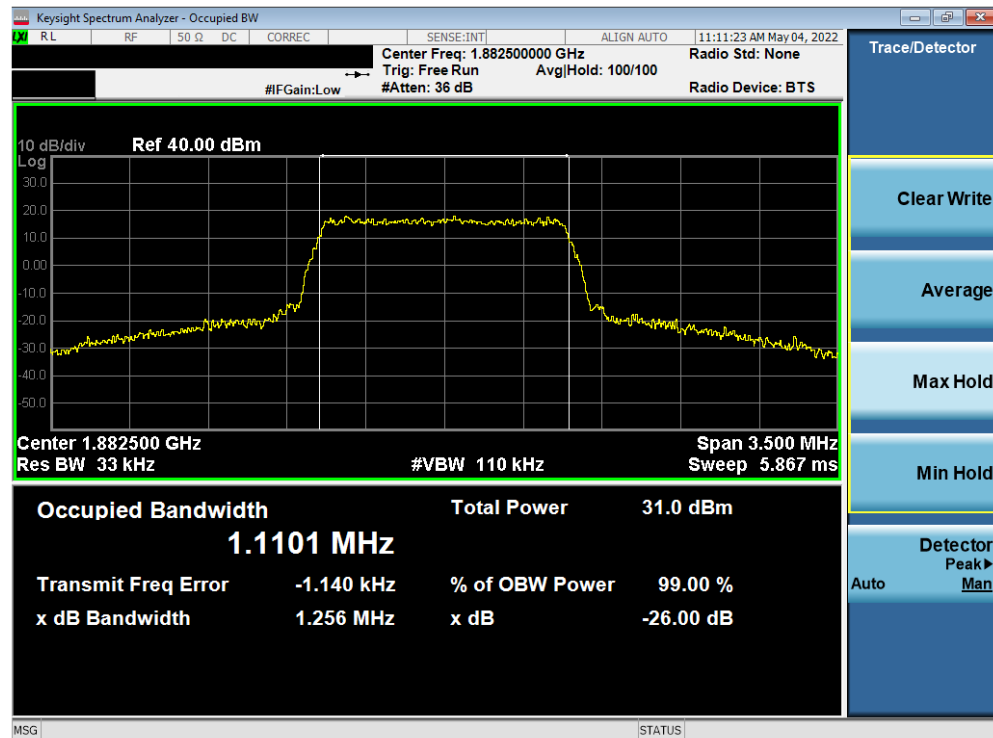
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 25/2



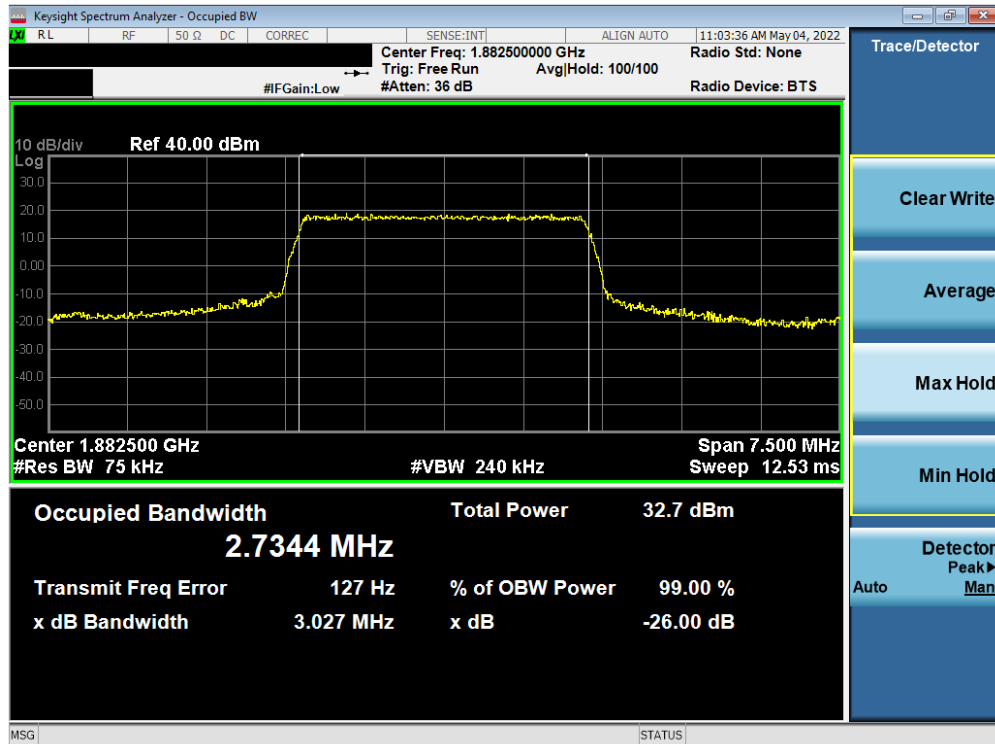
Plot 7-1. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz QPSK - Full RB Configuration)



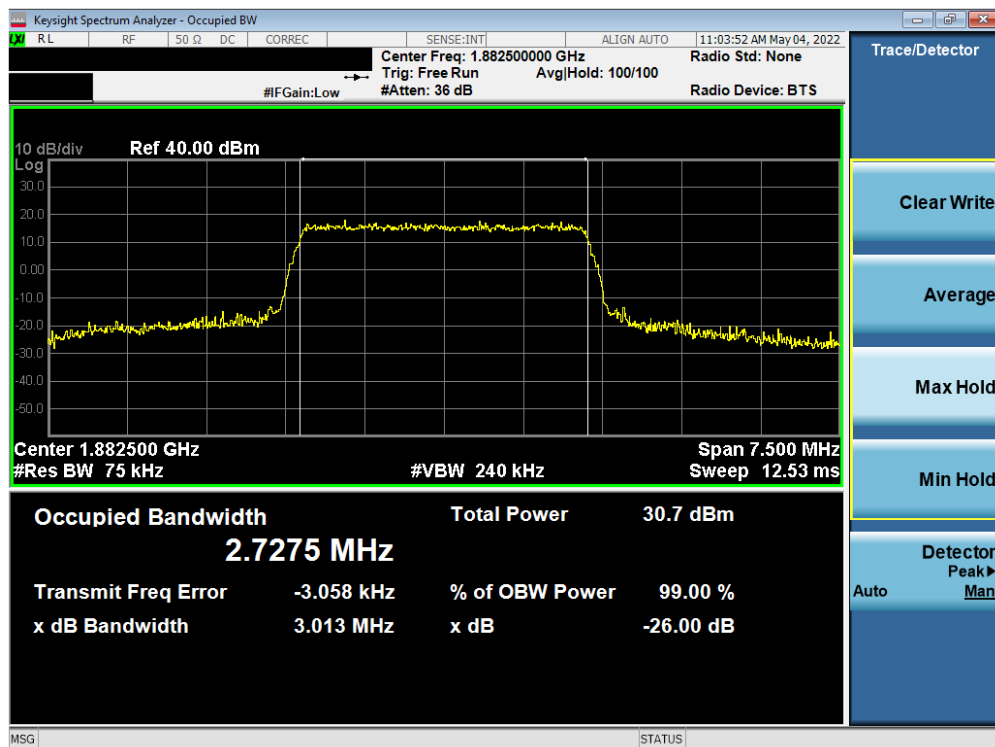
Plot 7-2. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-3. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz QPSK - Full RB Configuration)

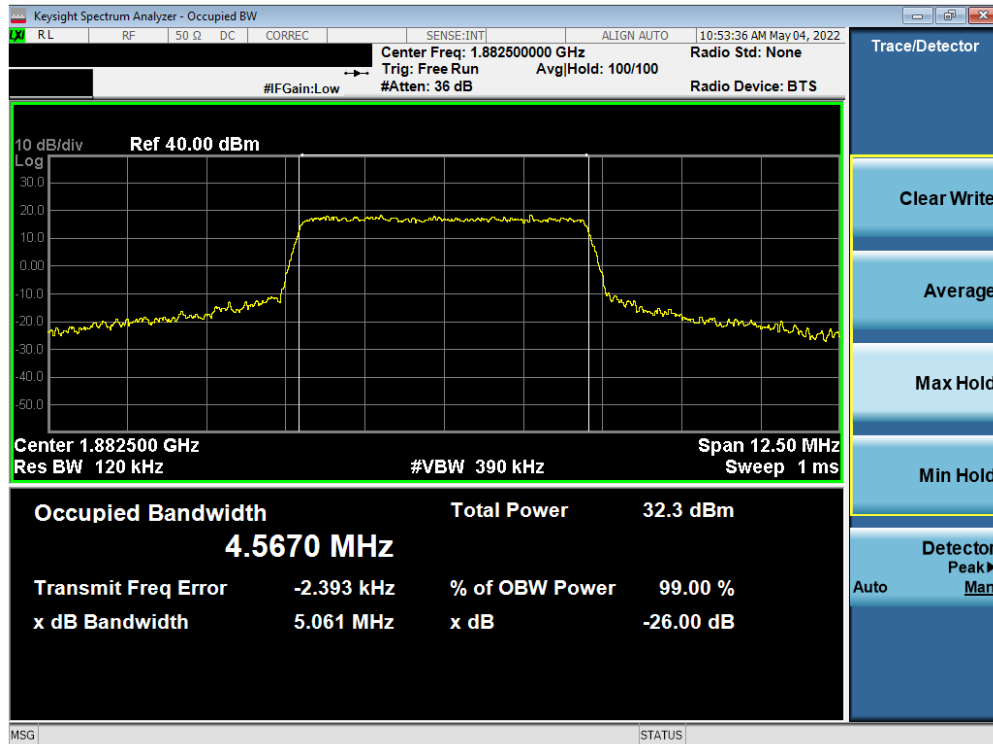


Plot 7-4. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-5. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz QPSK - Full RB Configuration)

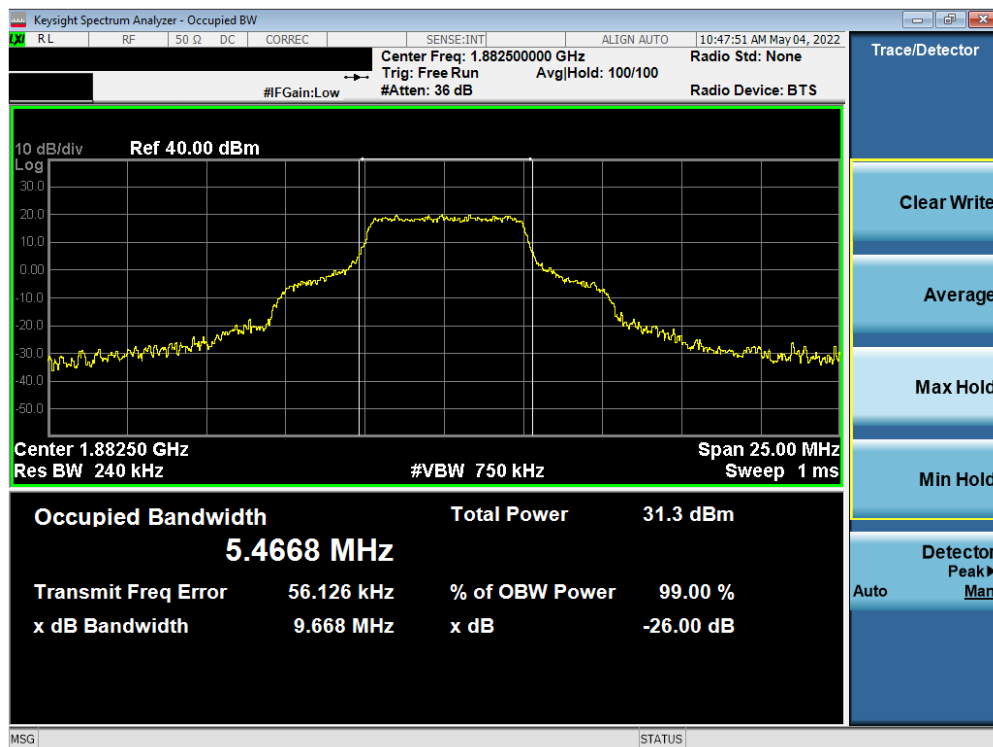


Plot 7-6. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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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)

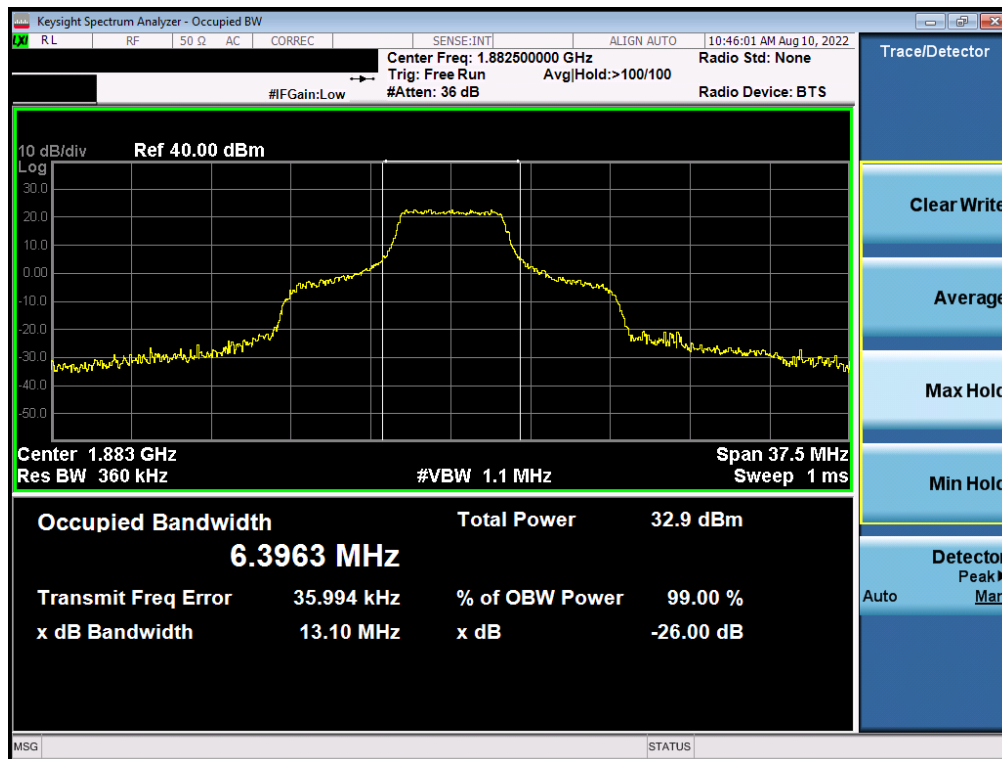
FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 17 of 90

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

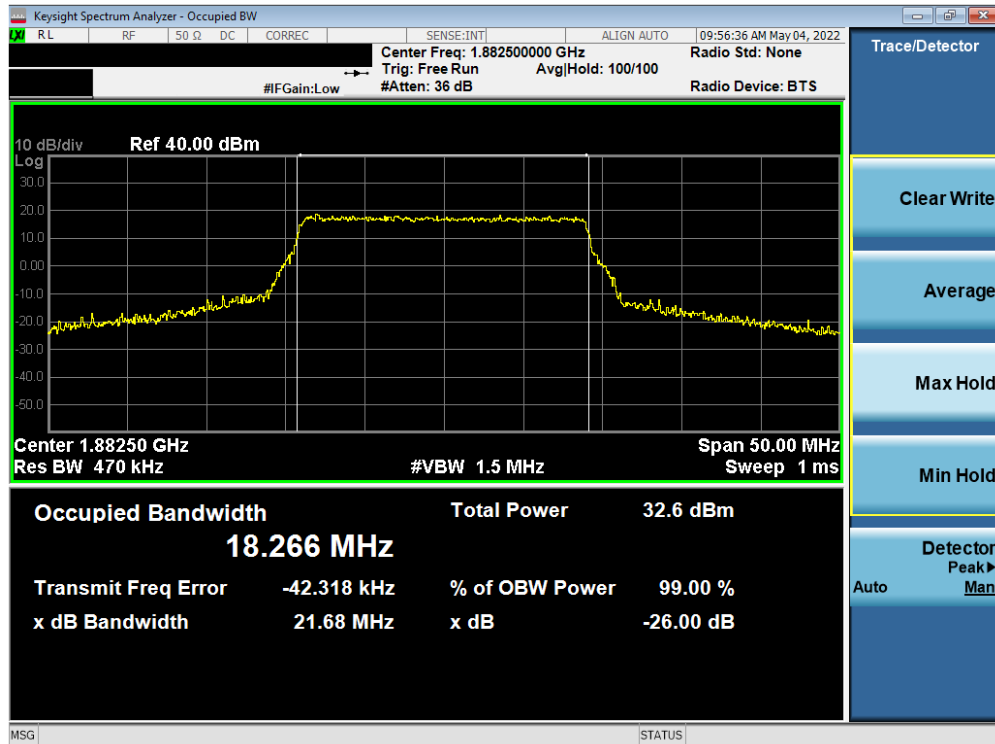


Plot 7-10. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 18 of 90

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

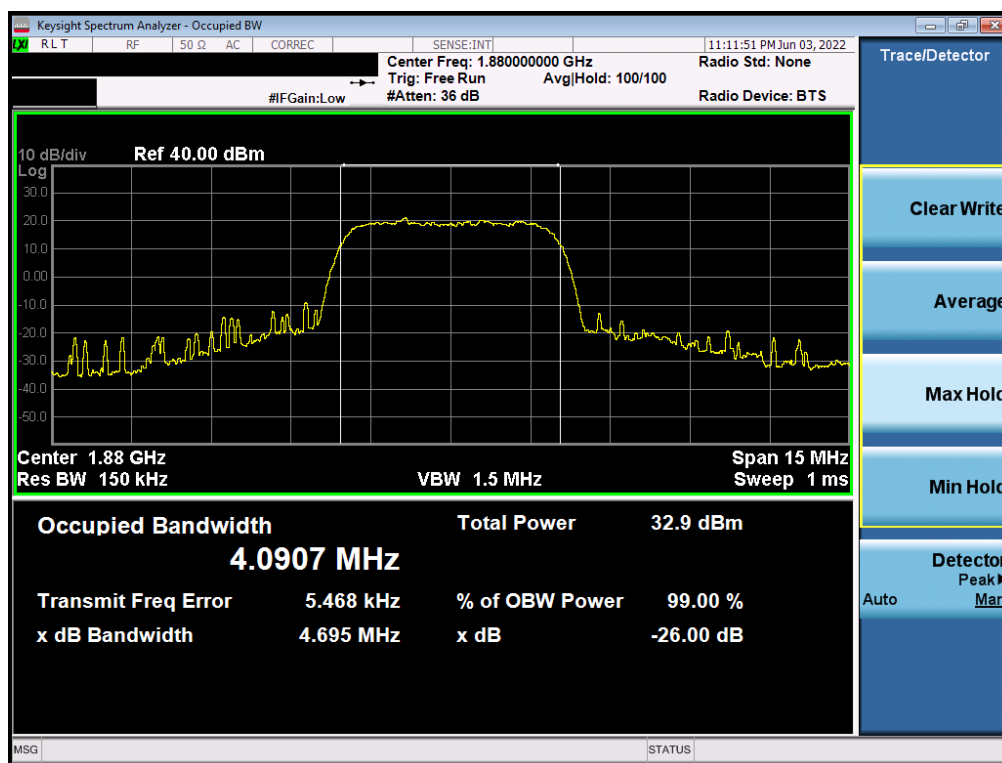


Plot 7-12. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-13. Occupied Bandwidth Plot (WCDMA, Ch. 9400)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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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.

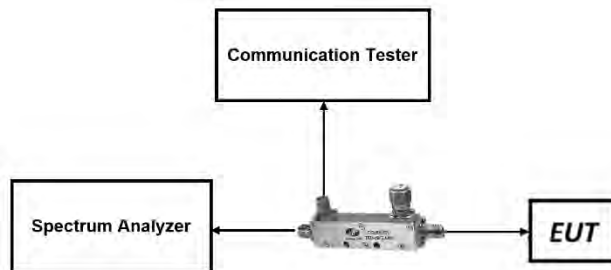


Figure 7-2. Test Instrument & Measurement Setup

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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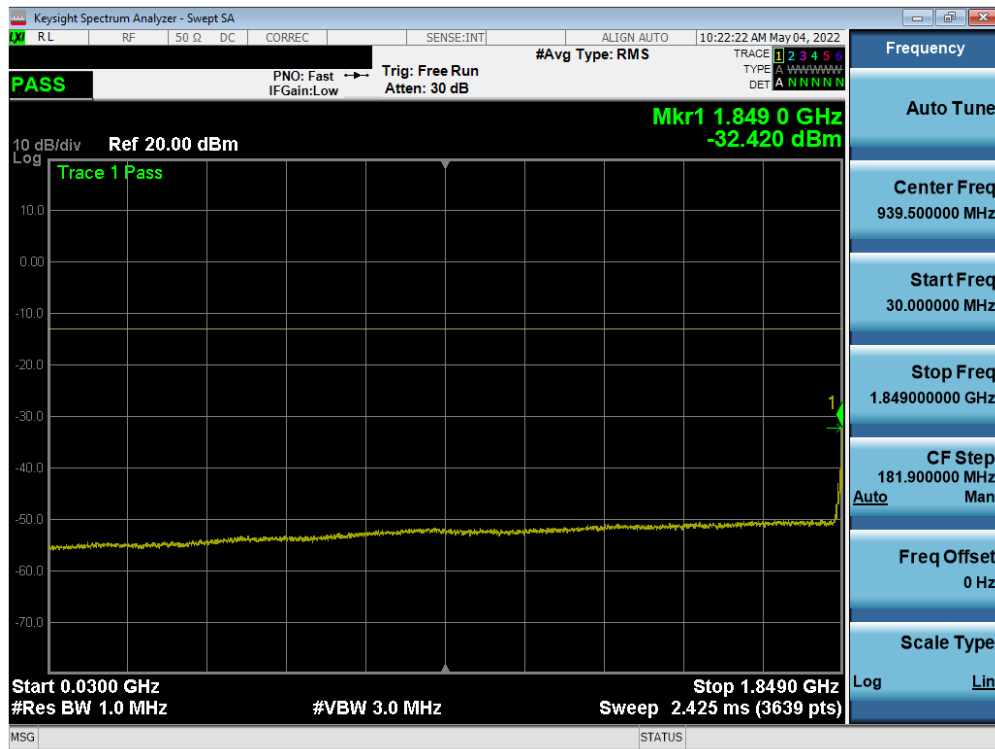
Test Notes

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.

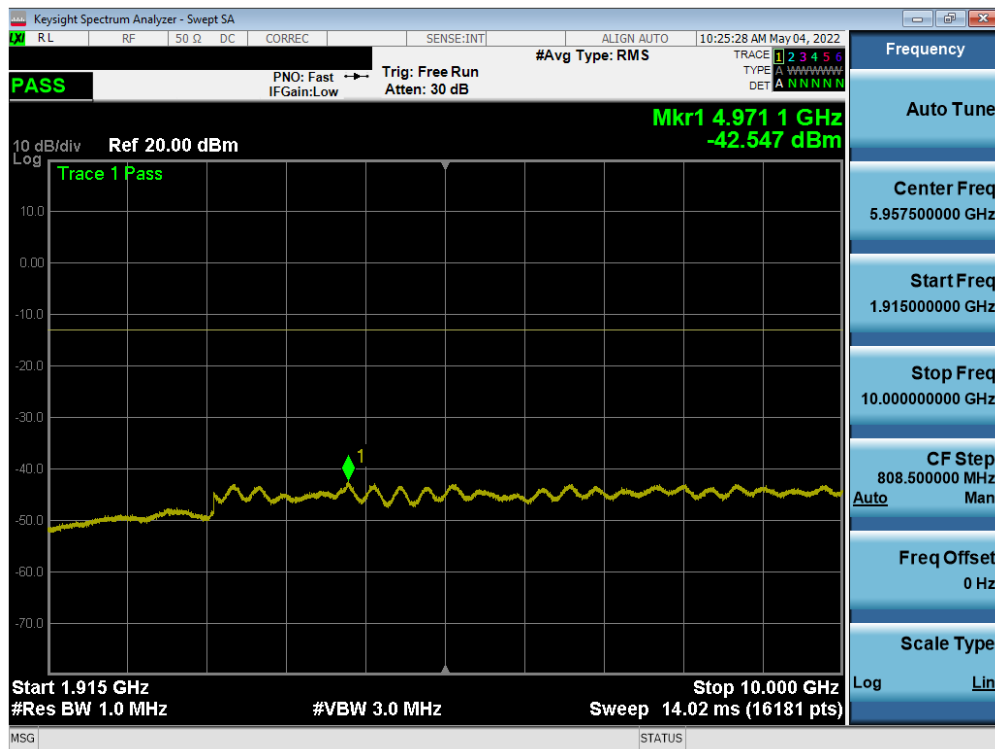
FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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LTE Band 25/2

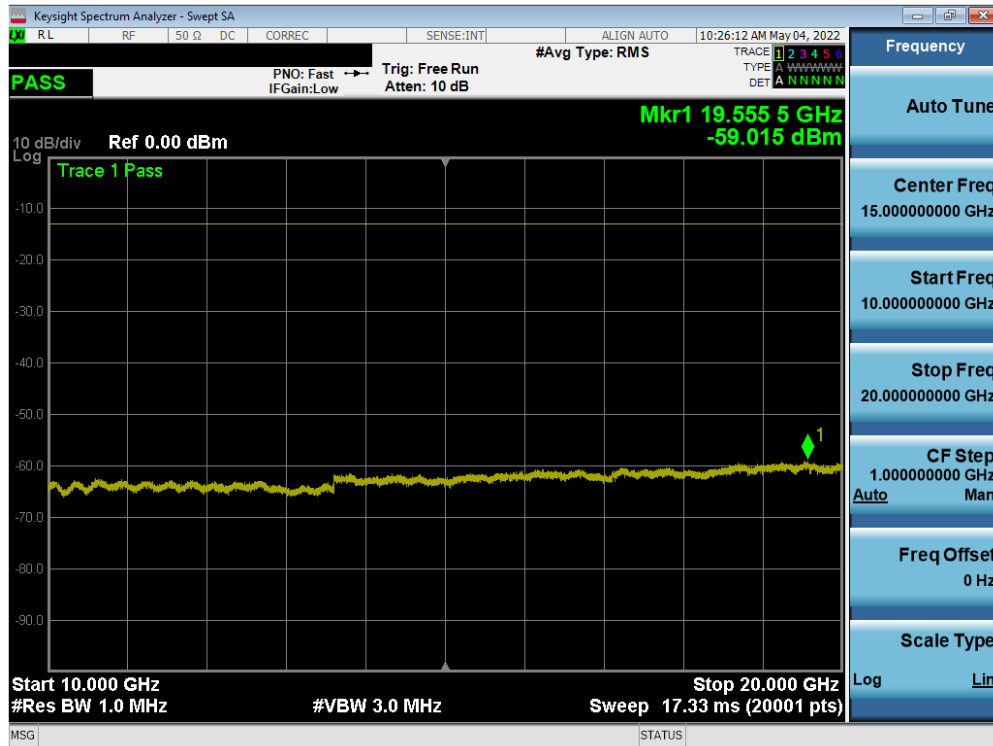


Plot 7-14. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

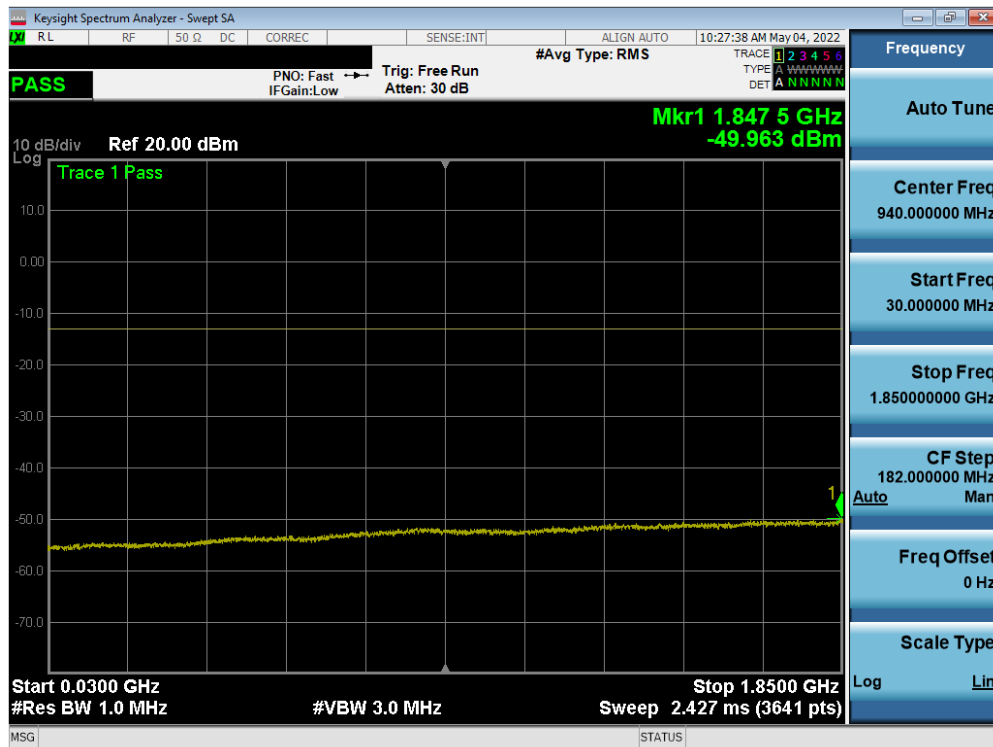


Plot 7-15. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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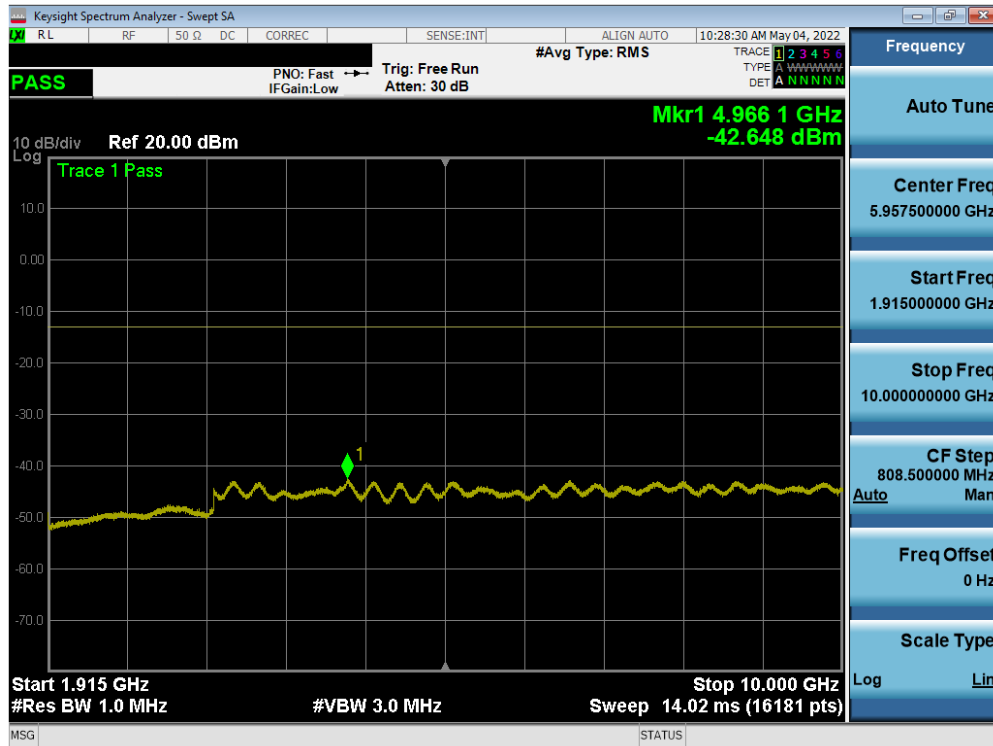


Plot 7-16. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

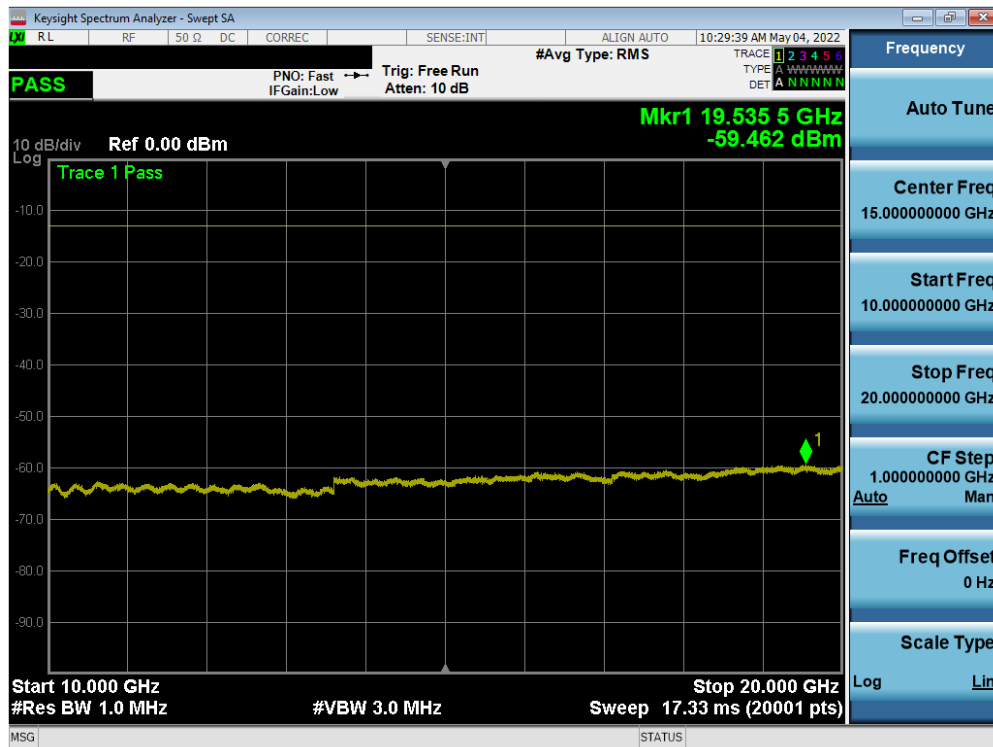


Plot 7-17. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-18. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

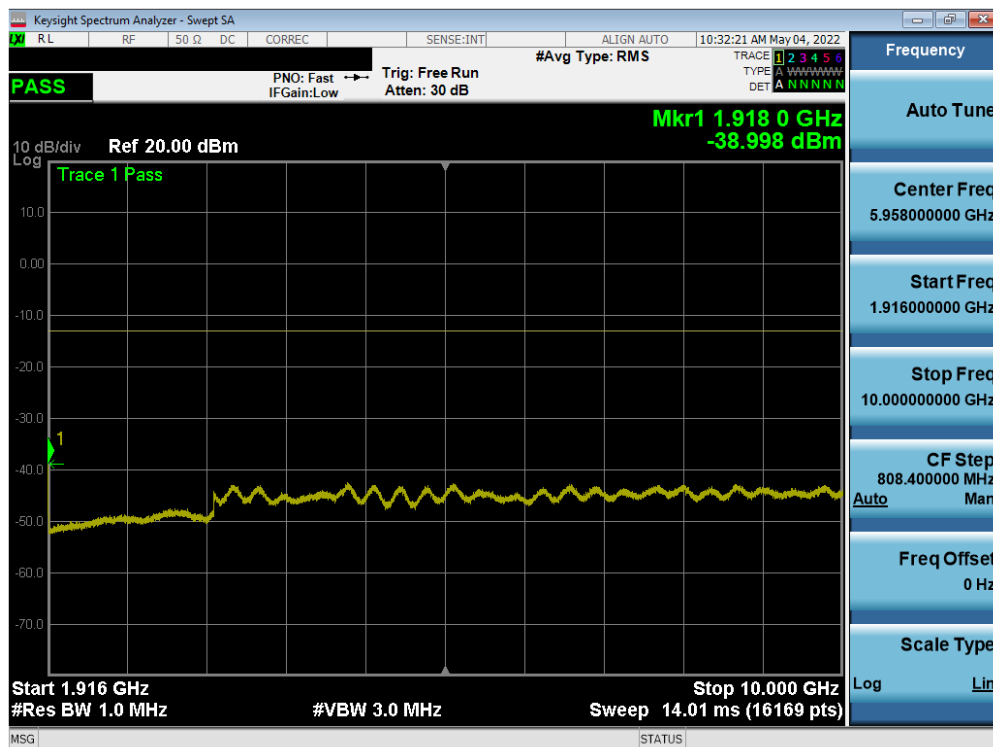


Plot 7-19. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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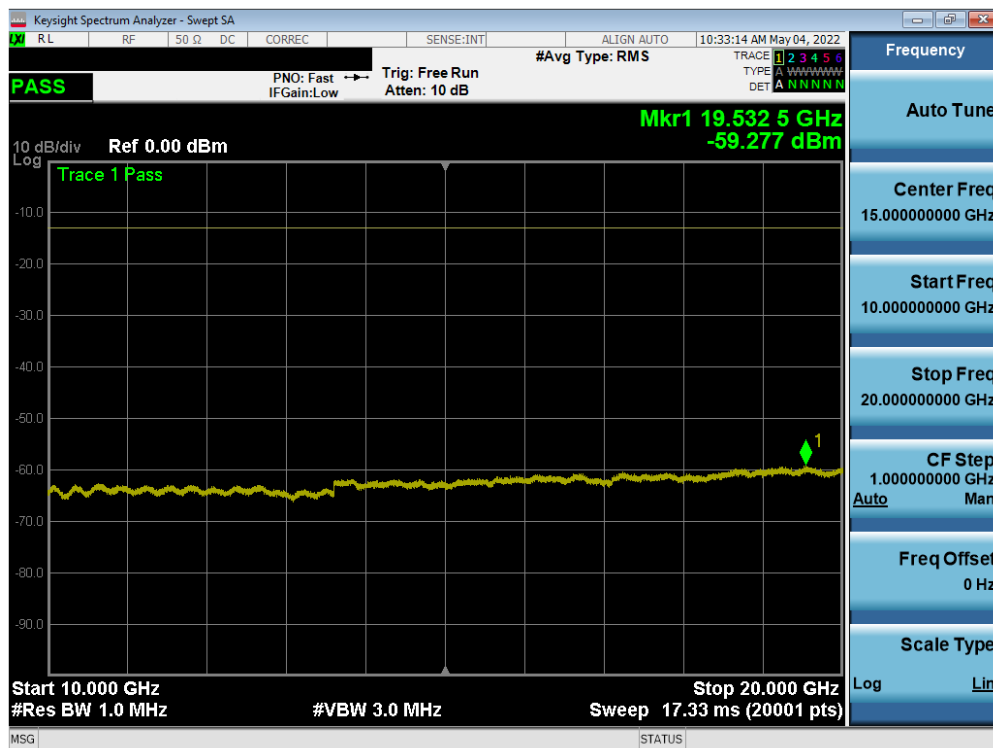
Plot 7-20. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



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

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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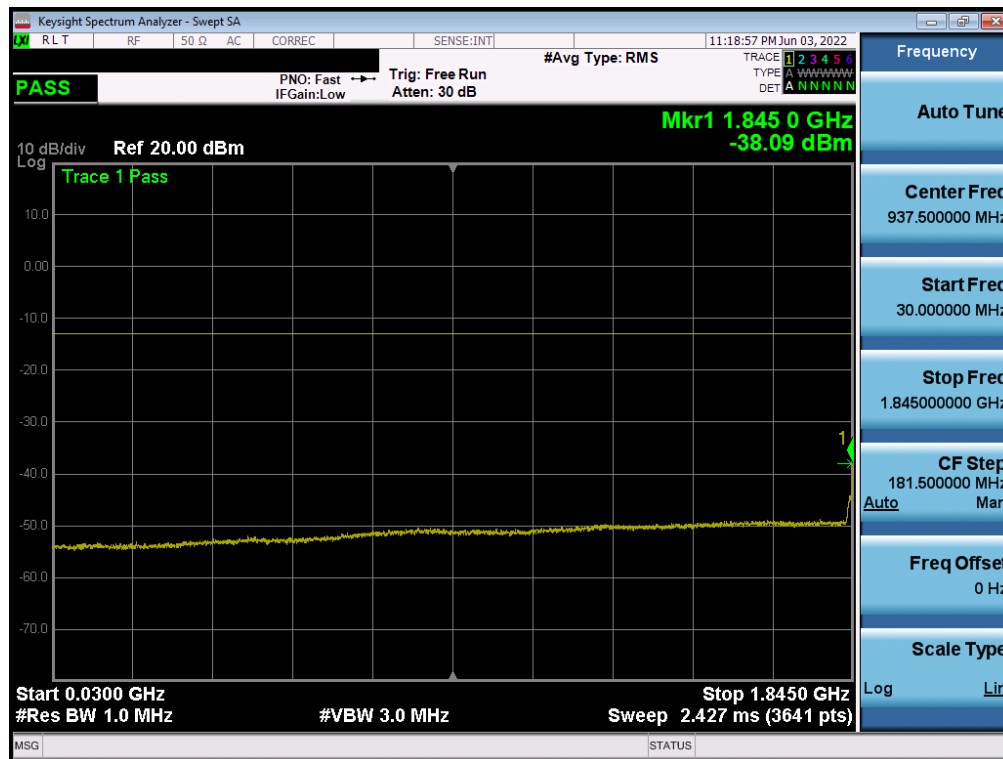
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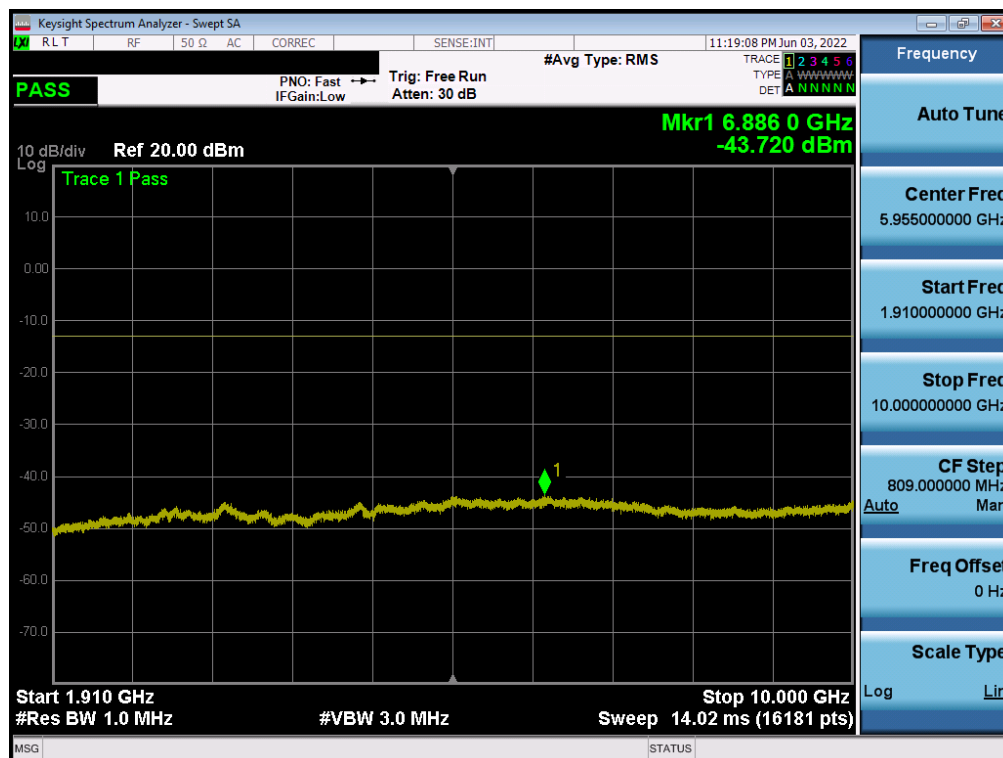
Plot 7-22. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-23. Conducted Spurious Plot (WCDMA Ch. 9262)

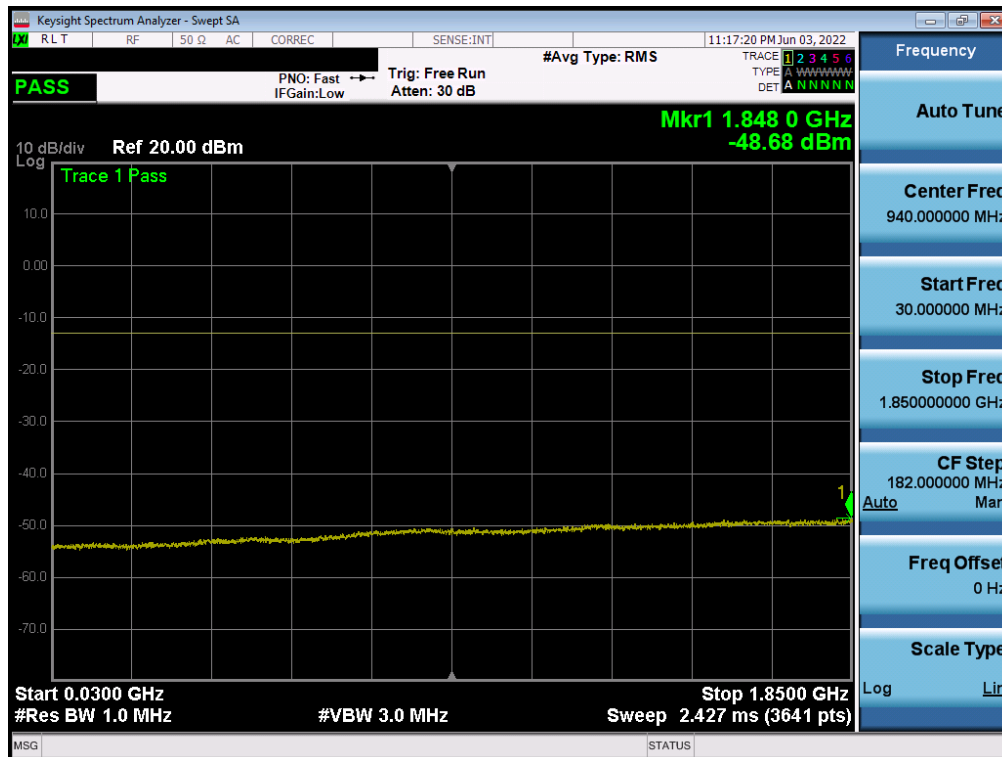


Plot 7-24. Conducted Spurious Plot (WCDMA Ch. 9262)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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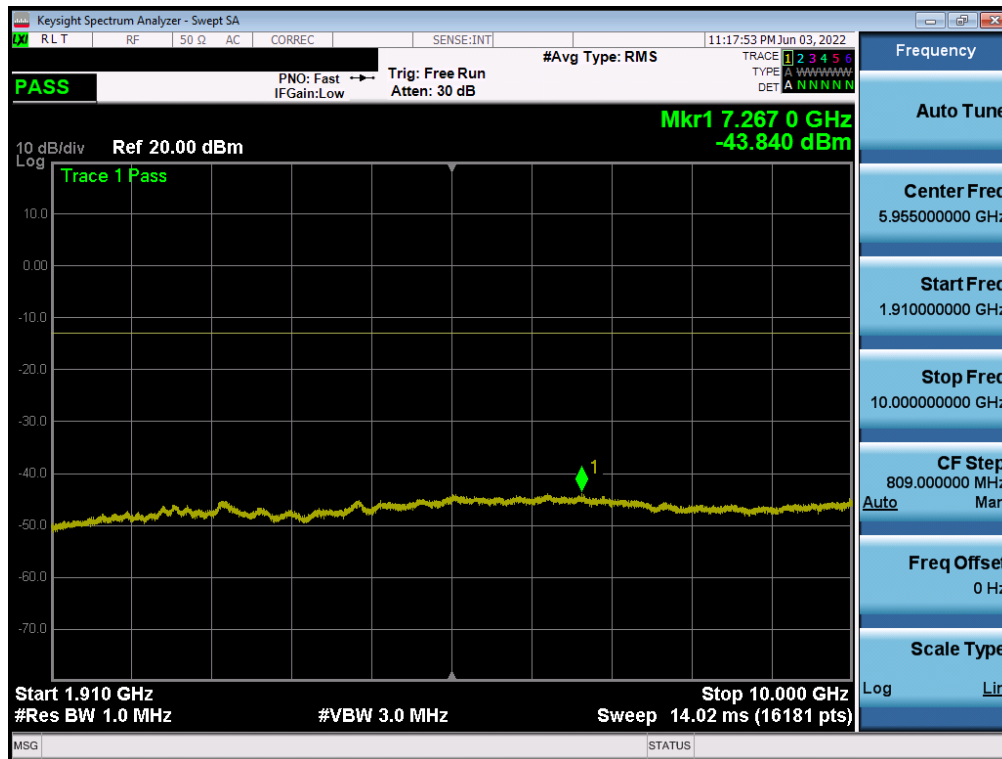


Plot 7-25. Conducted Spurious Plot (WCDMA Ch. 9262)

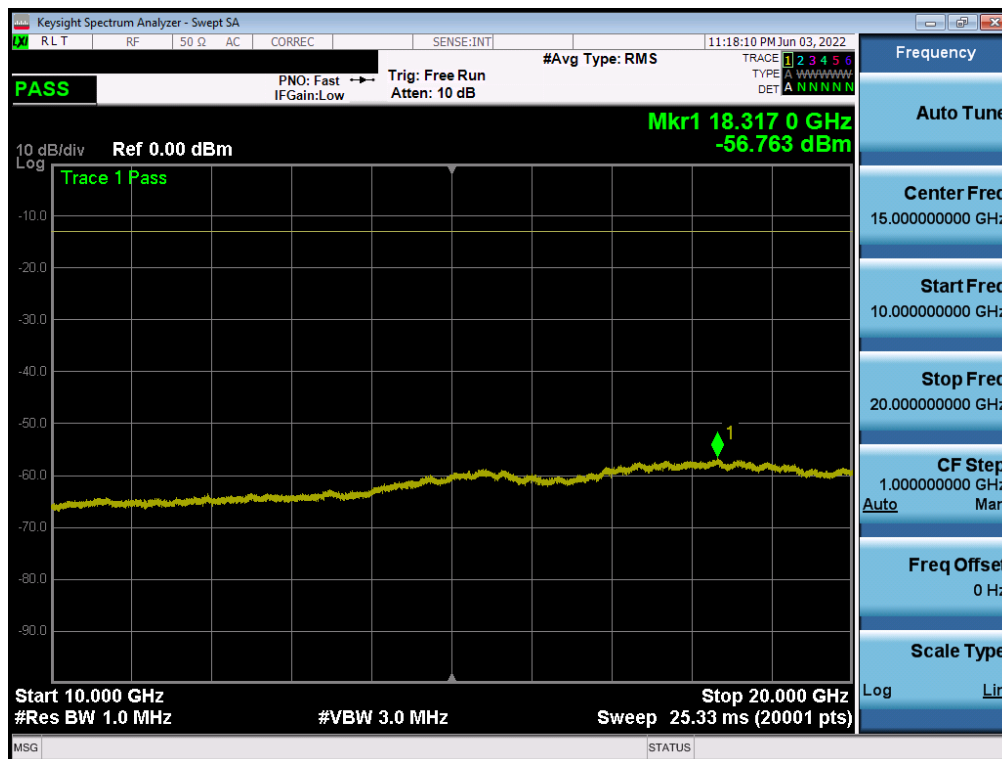


Plot 7-26. Conducted Spurious Plot (WCDMA Ch. 9400)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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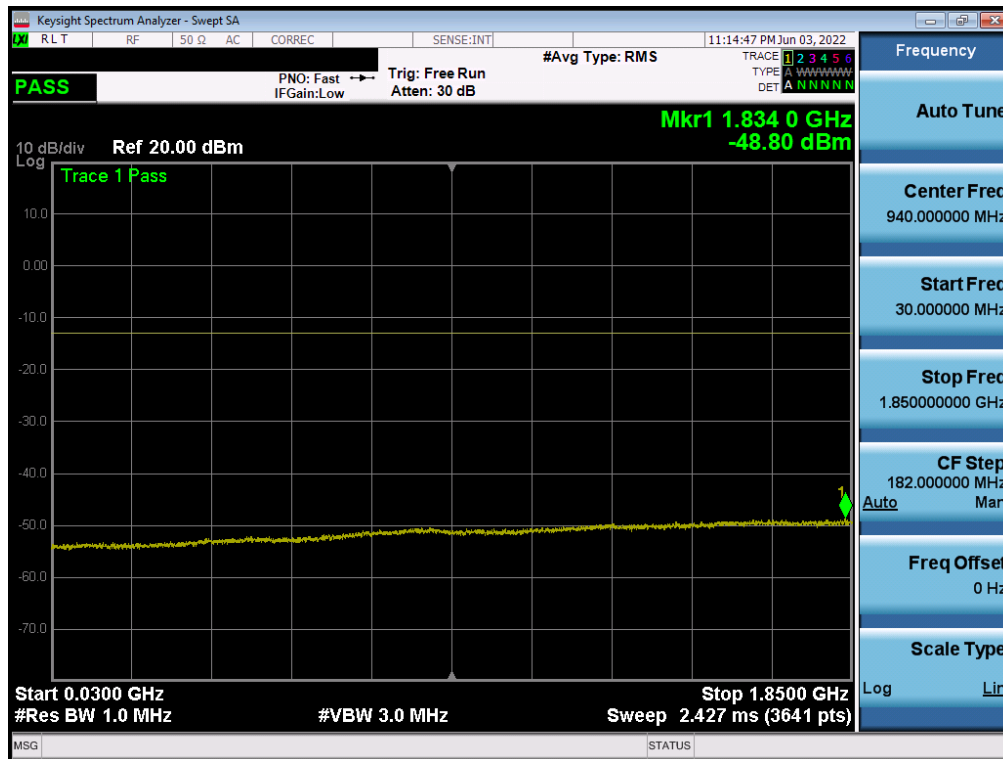


Plot 7-27. Conducted Spurious Plot (WCDMA Ch. 9400)

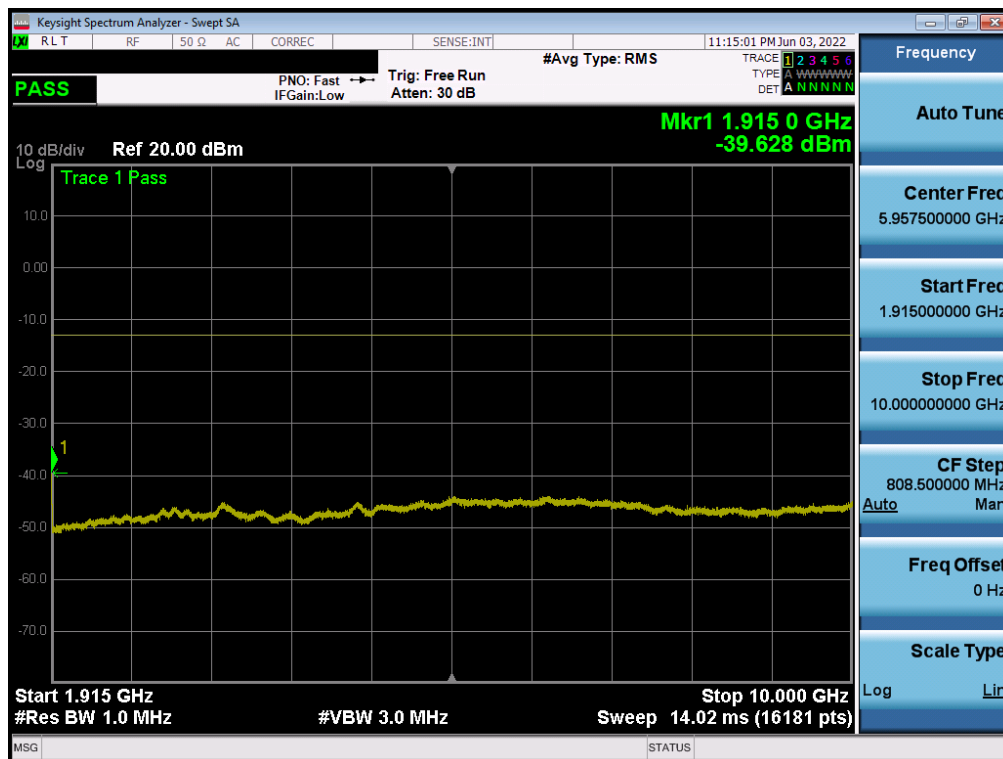


Plot 7-28. Conducted Spurious Plot (WCDMA Ch. 9400)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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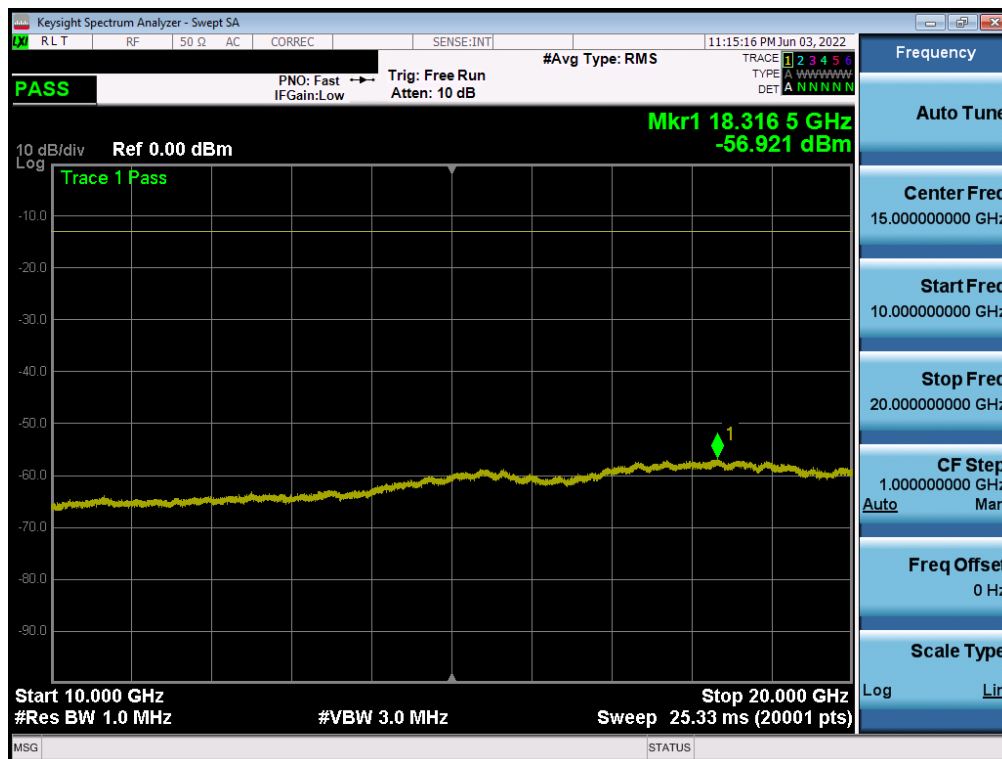


Plot 7-29. Conducted Spurious Plot (WCDMA Ch. 9538)



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

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-31. Conducted Spurious Plot (WCDMA Ch. 9538)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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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. $\text{RBW} \geq 1\%$ of the emission bandwidth
4. $\text{VBW} \geq 3 \times \text{RBW}$
5. Detector = RMS
6. Number of sweep points $\geq 2 \times \text{Span}/\text{RBW}$
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.

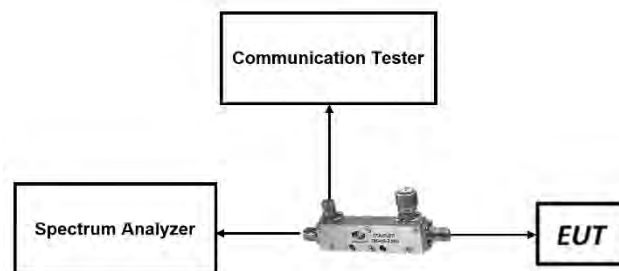


Figure 7-3. Test Instrument & Measurement Setup

FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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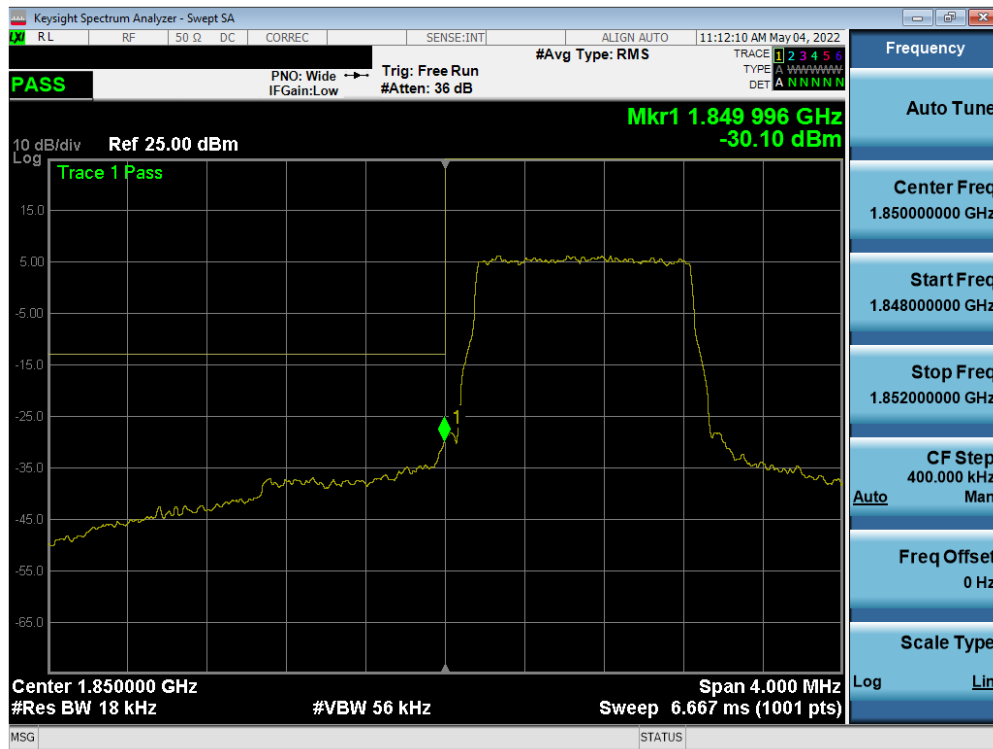
Test Notes

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.

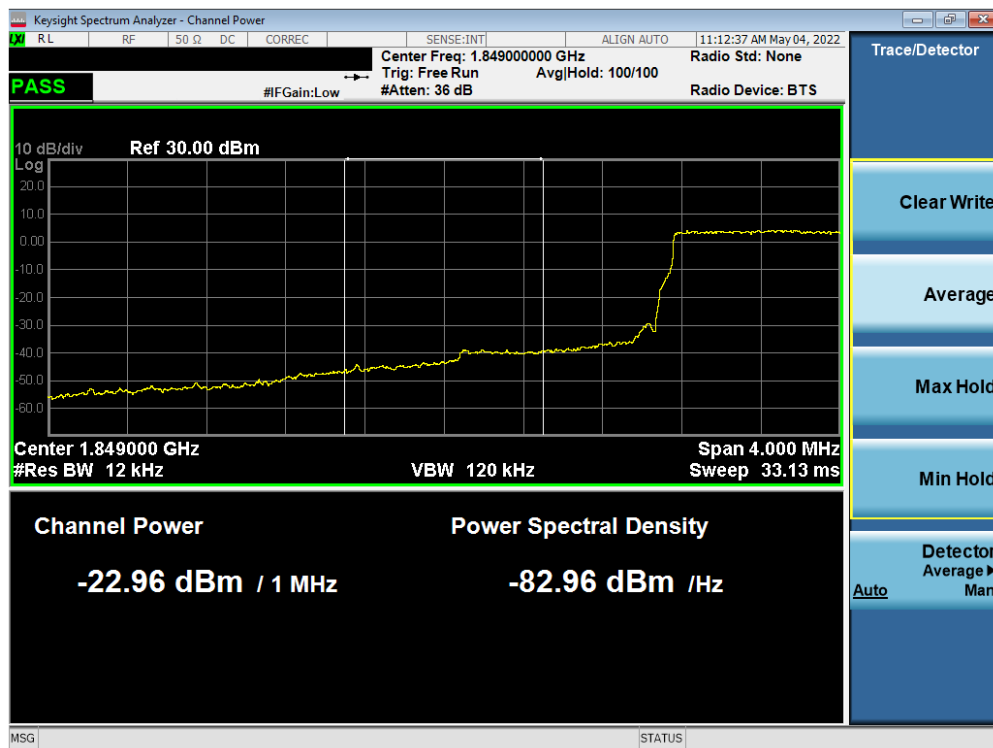
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 34 of 90

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LTE Band 25



Plot 7-32. Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)



Plot 7-33. Extended Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

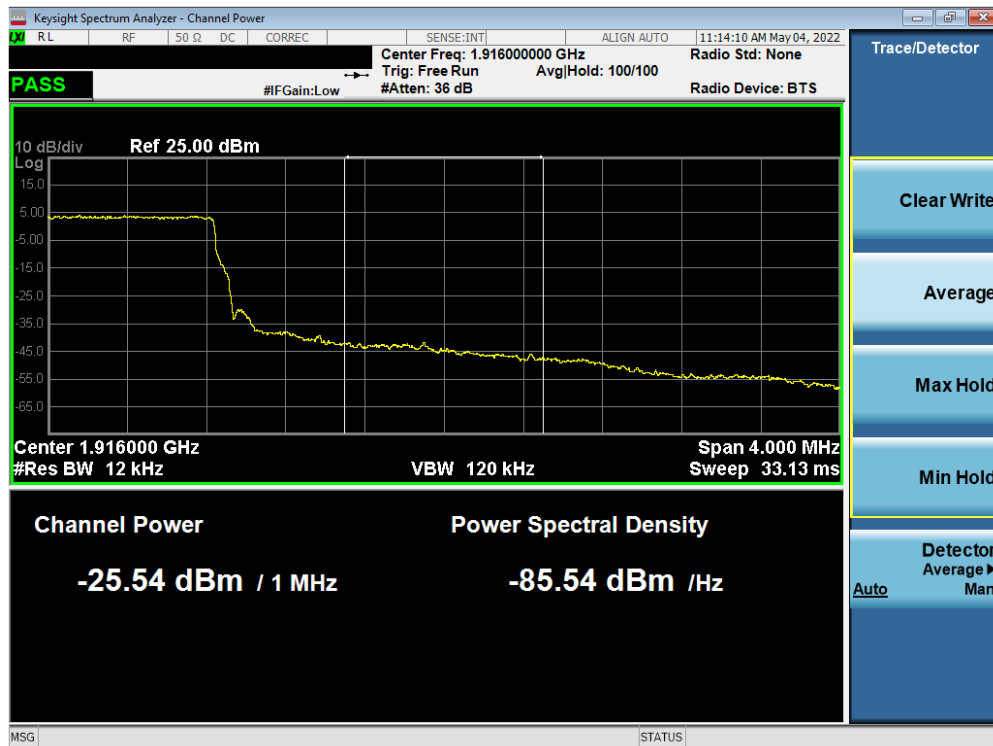
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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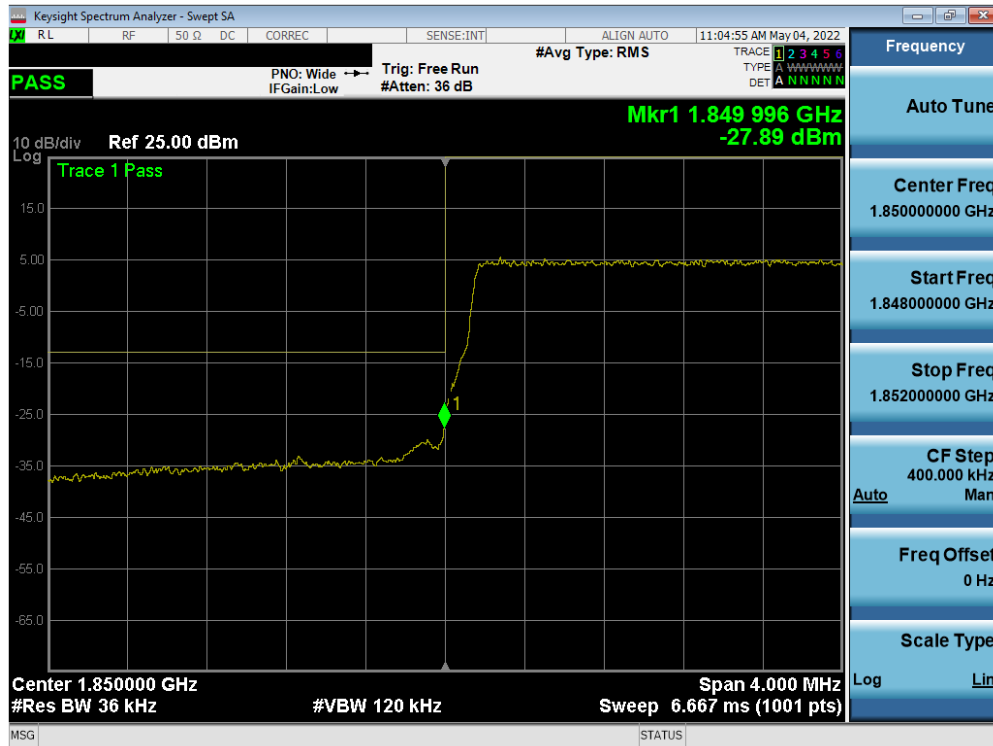


Plot 7-34. Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

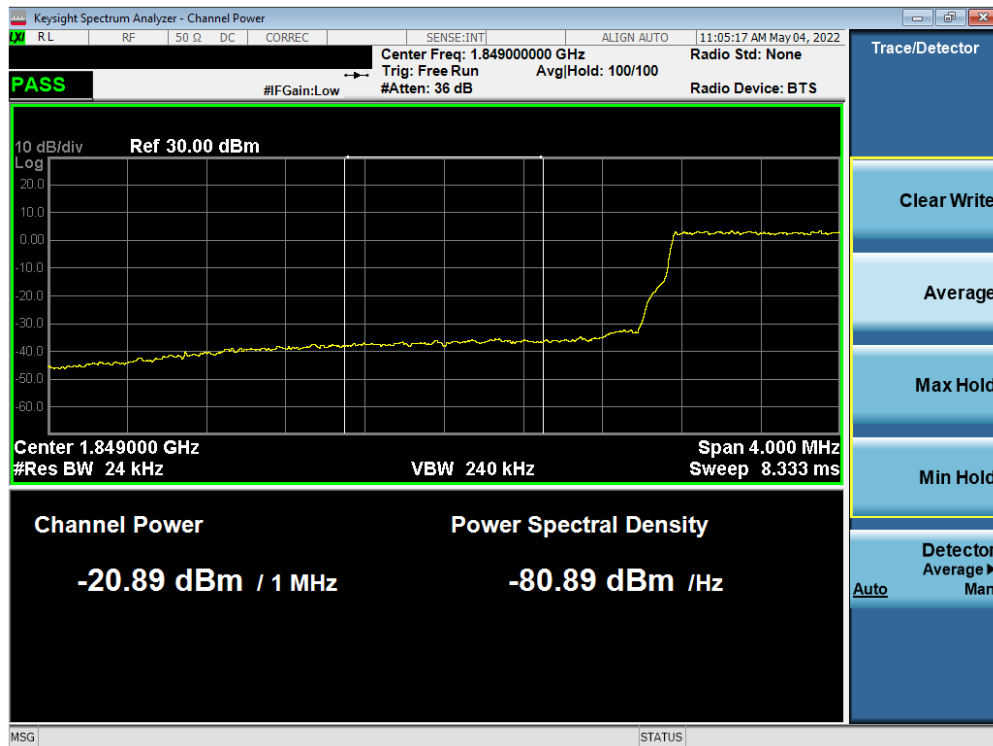


Plot 7-35. Extended Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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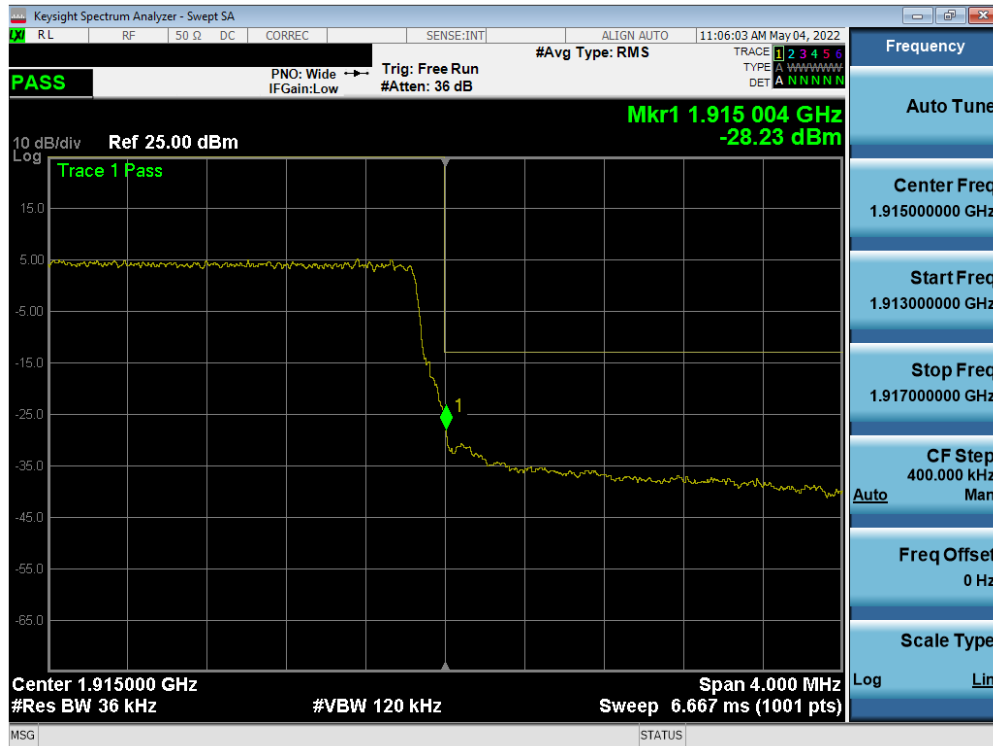
Plot 7-36. Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



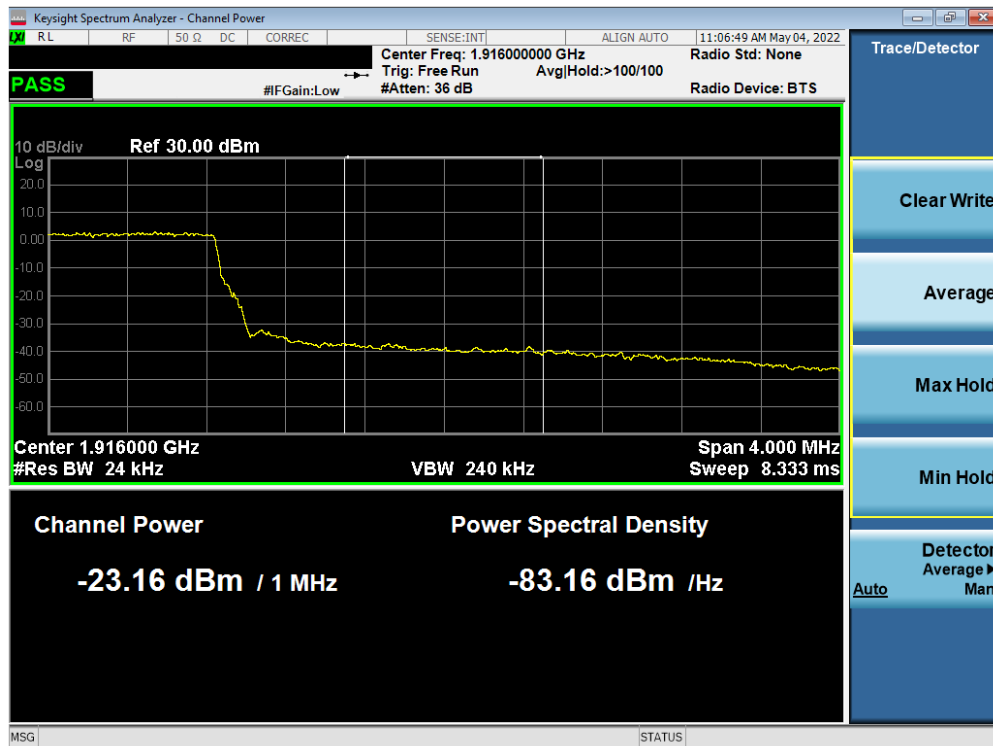
Plot 7-37. Extended Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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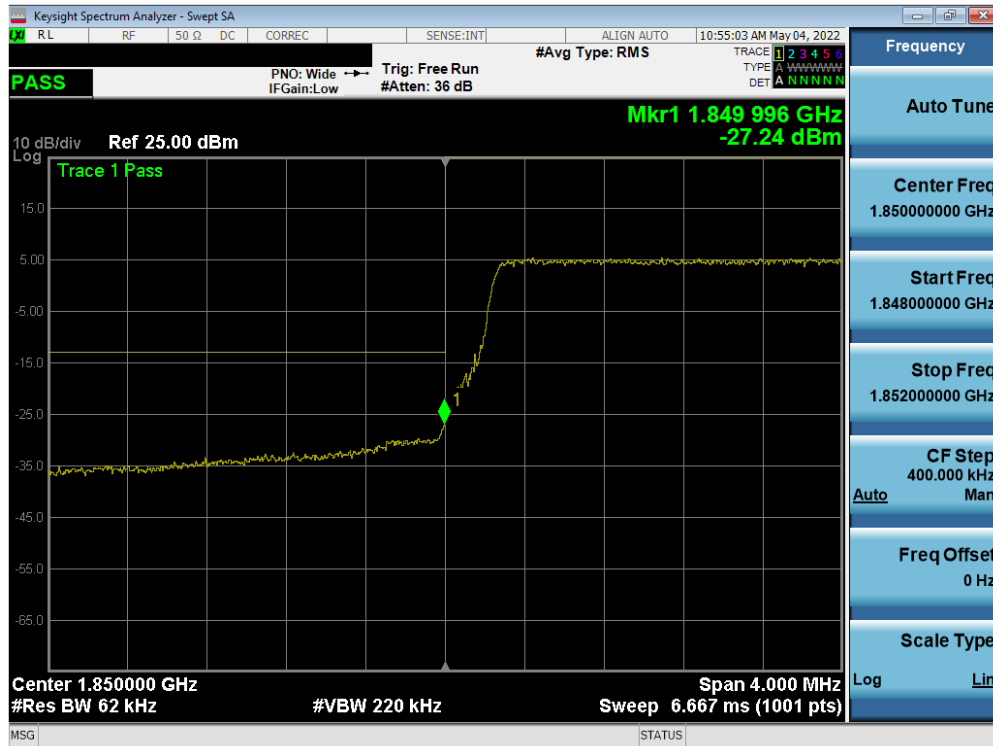
Plot 7-38. Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



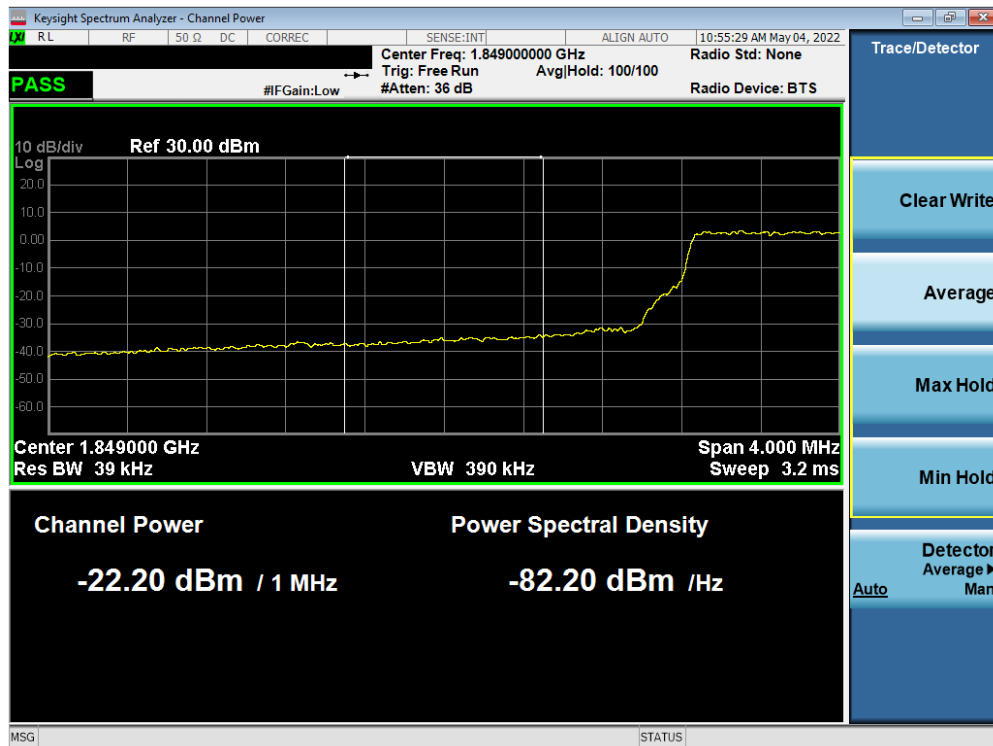
Plot 7-39. Extended Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 38 of 90

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Plot 7-40. Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)



Plot 7-41. Extended Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

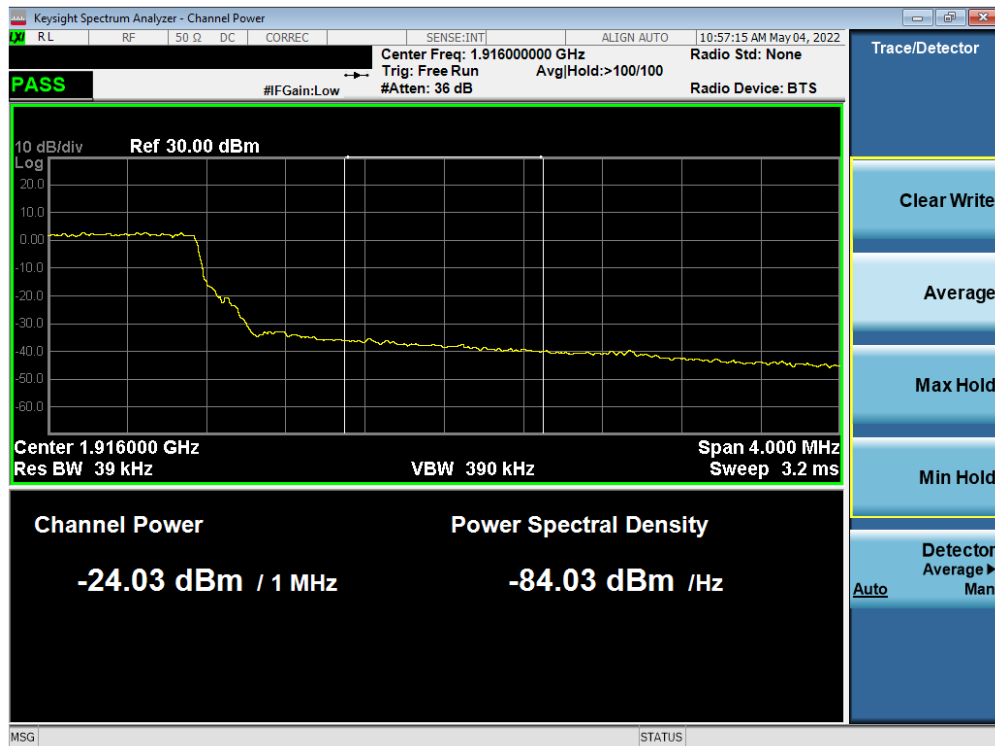
FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 39 of 90

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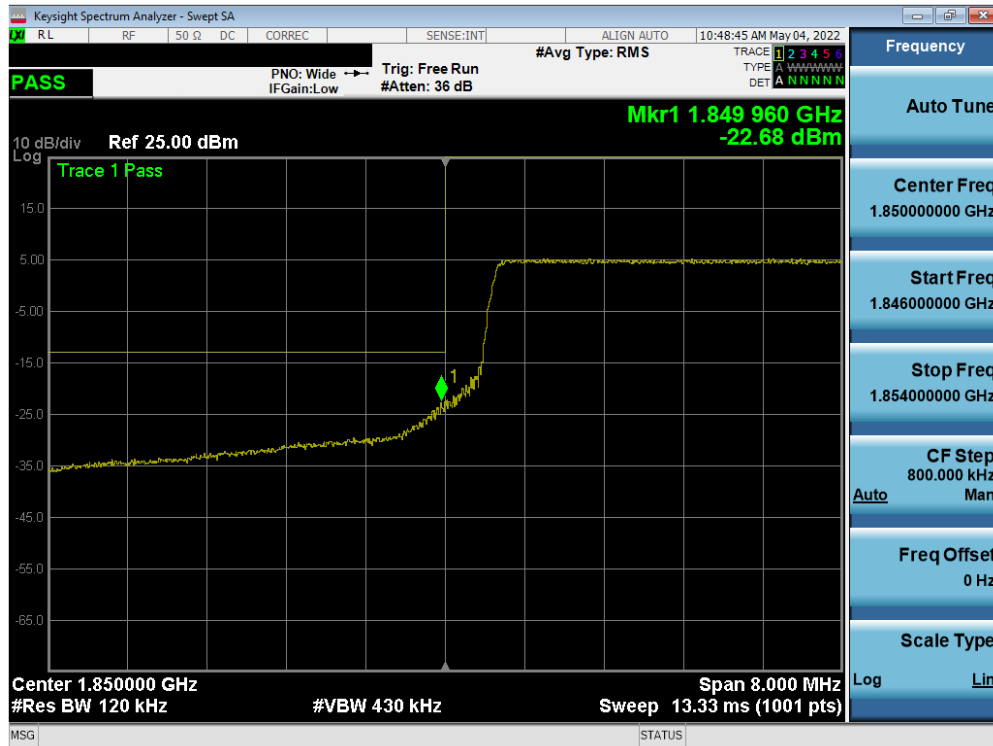


Plot 7-42. Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

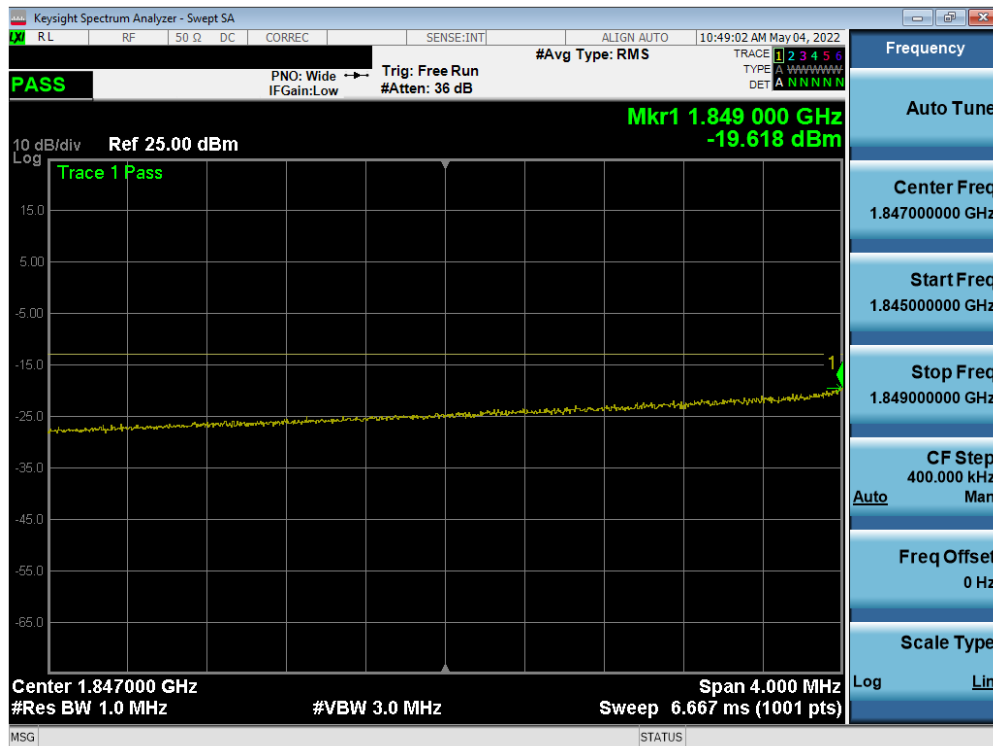


Plot 7-43. Extended Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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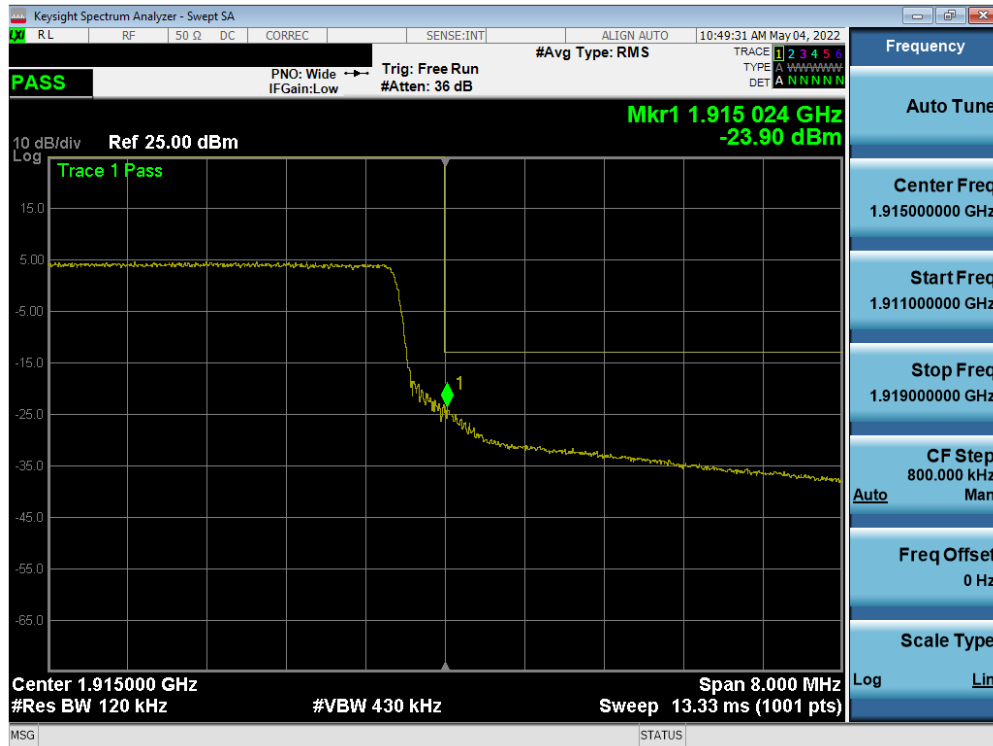


Plot 7-44. Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)



Plot 7-45. Extended Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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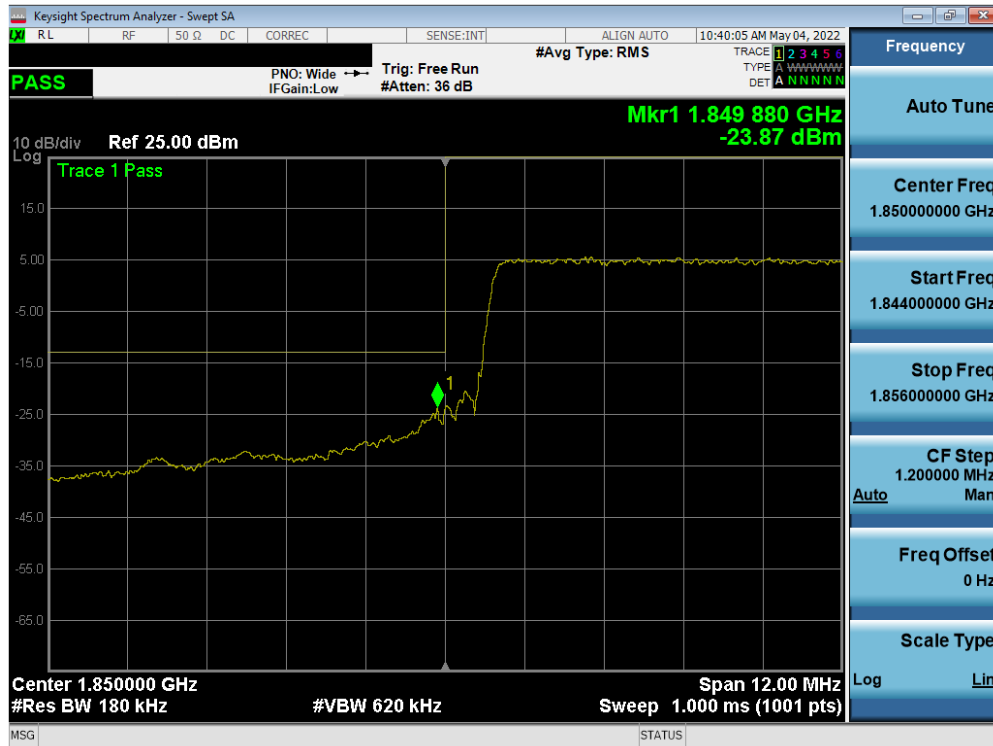


Plot 7-46. Upper Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)

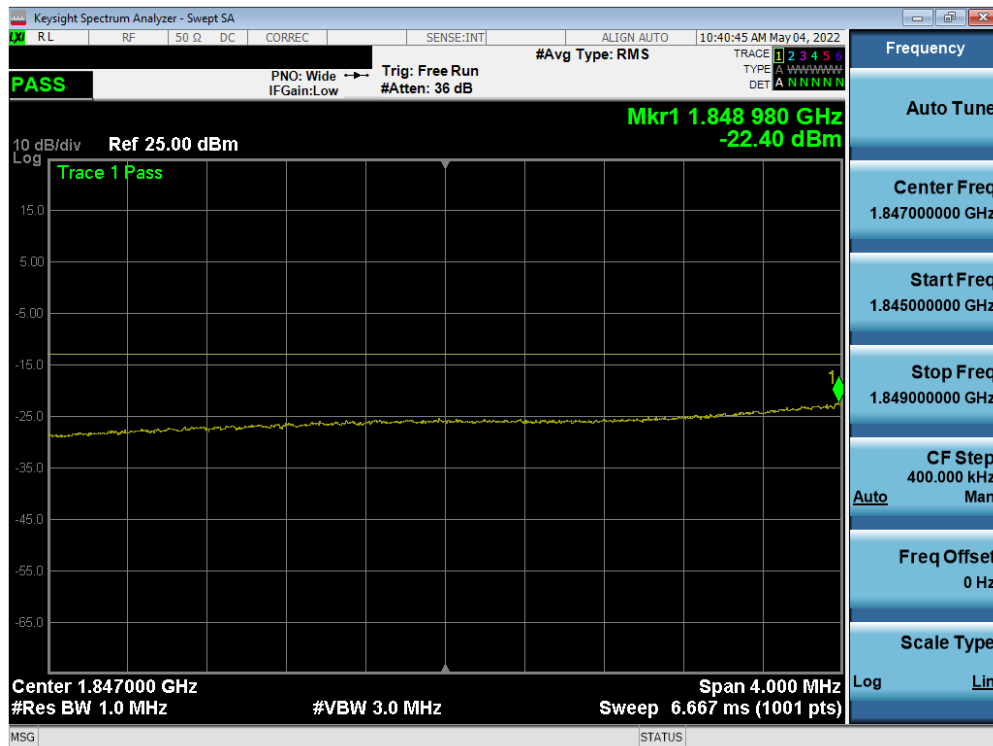


Plot 7-47. Extended Upper Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 42 of 90



Plot 7-48. Lower Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)



Plot 7-49. Extended Lower Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 43 of 90

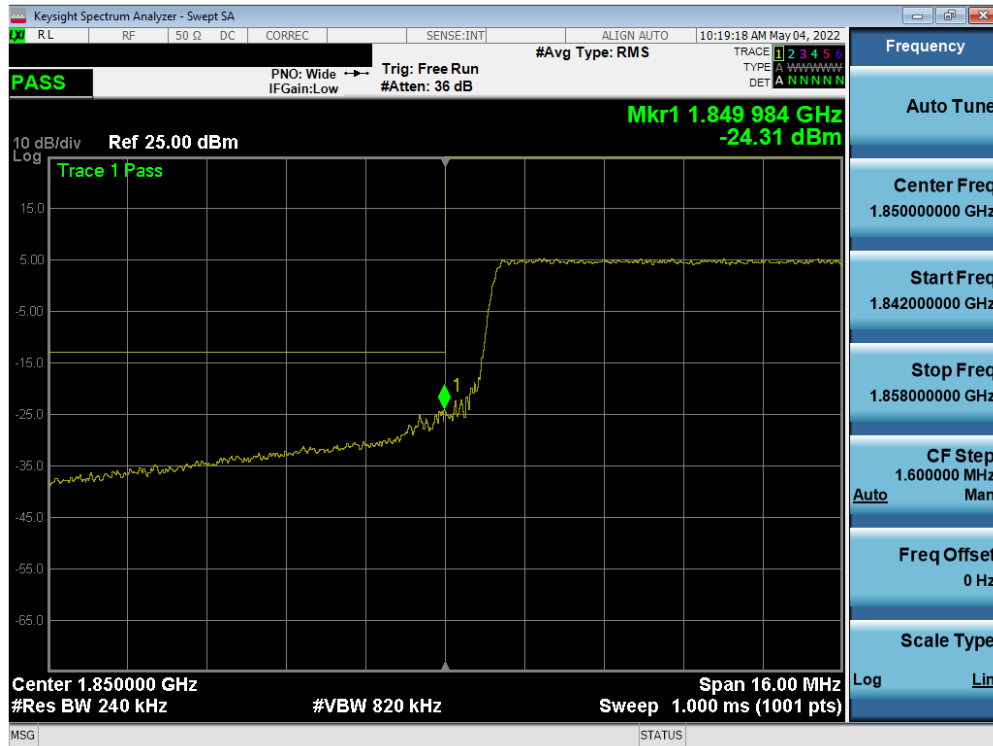


Plot 7-50. Upper Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)

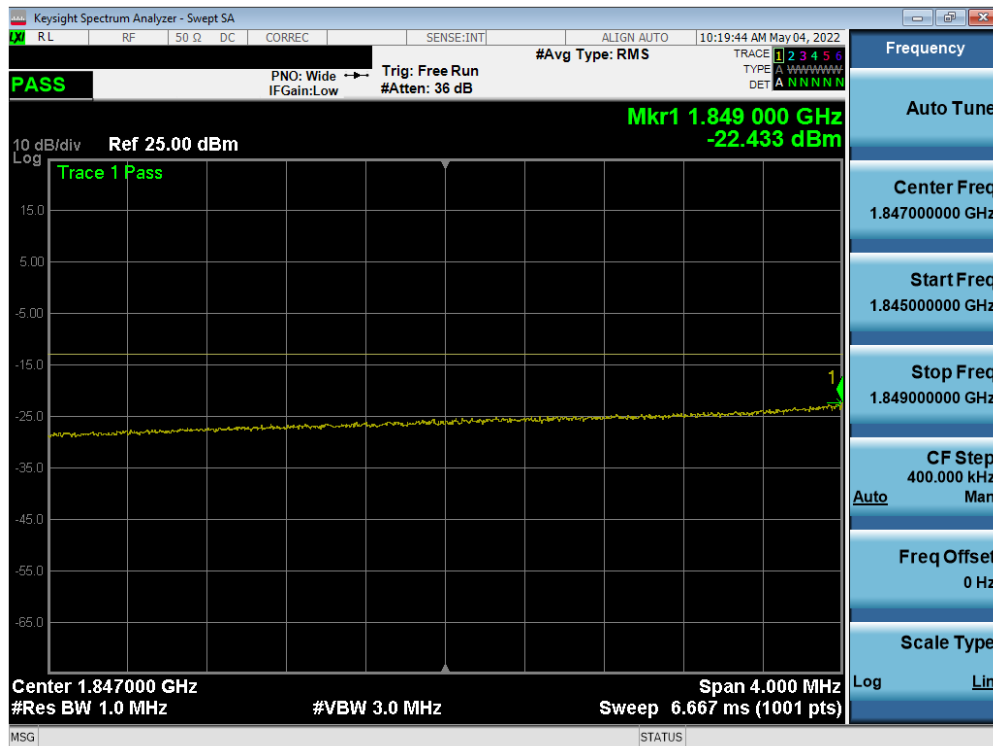


Plot 7-51. Extended Upper Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 44 of 90

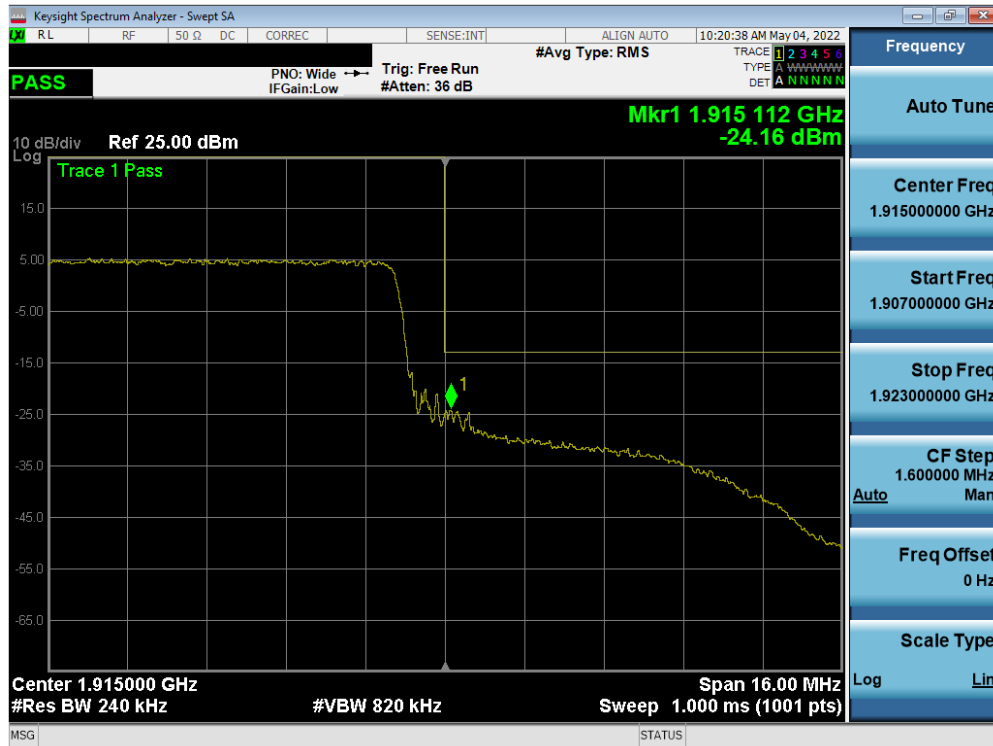


Plot 7-52. Lower Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)



Plot 7-53. Extended Lower Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 45 of 90



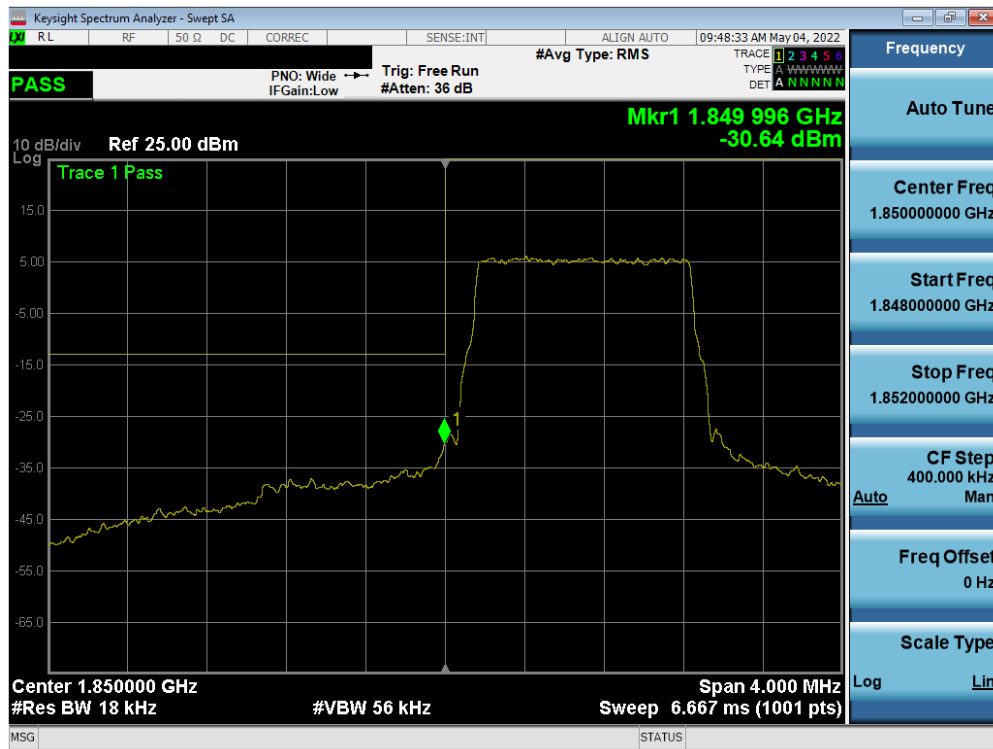
Plot 7-54. Upper Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)



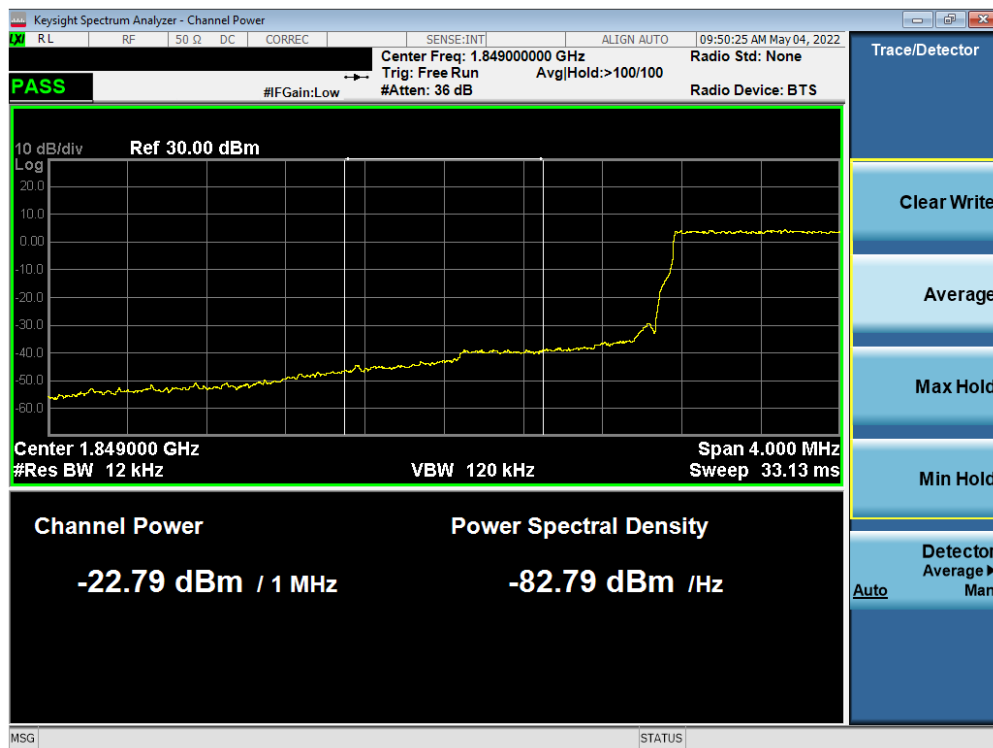
Plot 7-55. Extended Upper Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 46 of 90

LTE Band 2



Plot 7-56. Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)



Plot 7-57. Extended Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

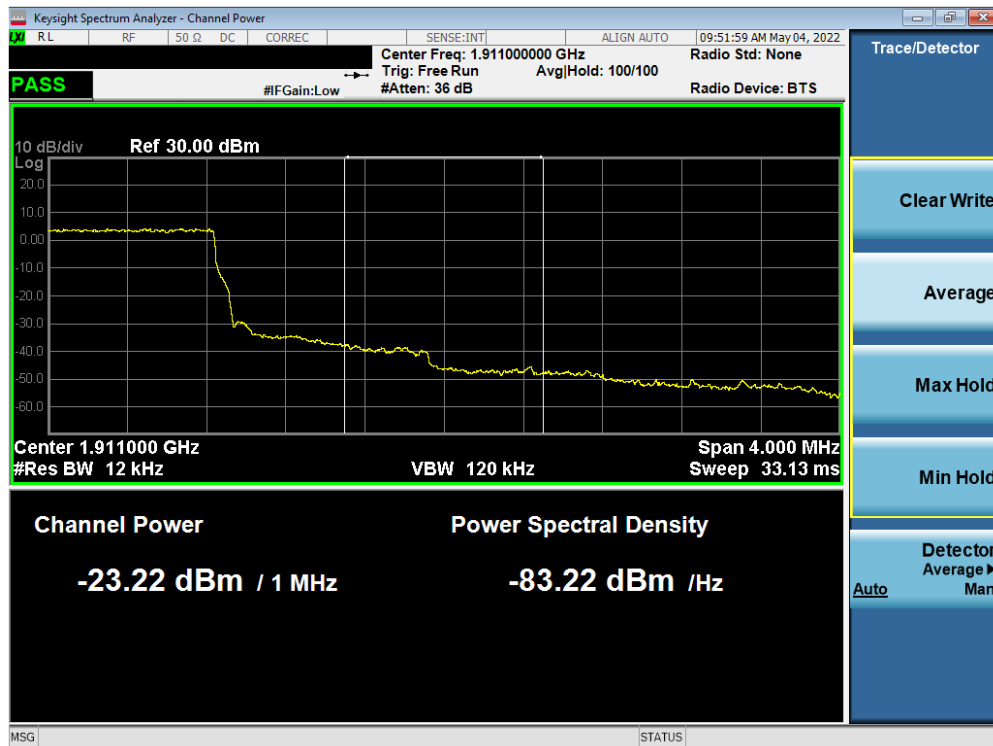
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 47 of 90

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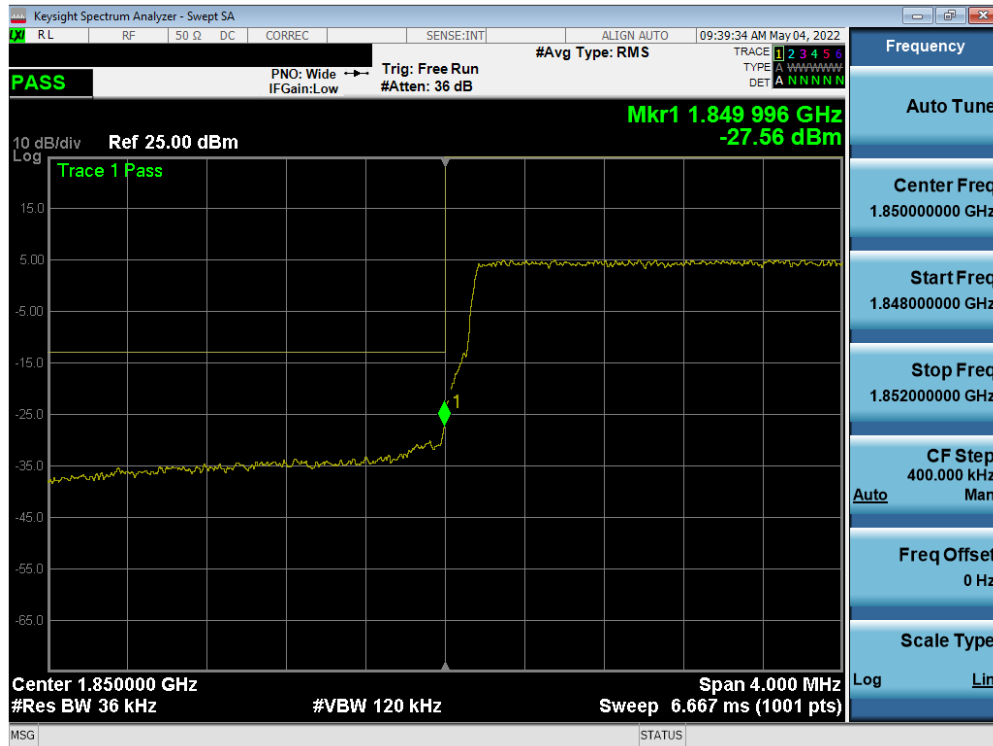


Plot 7-58. Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

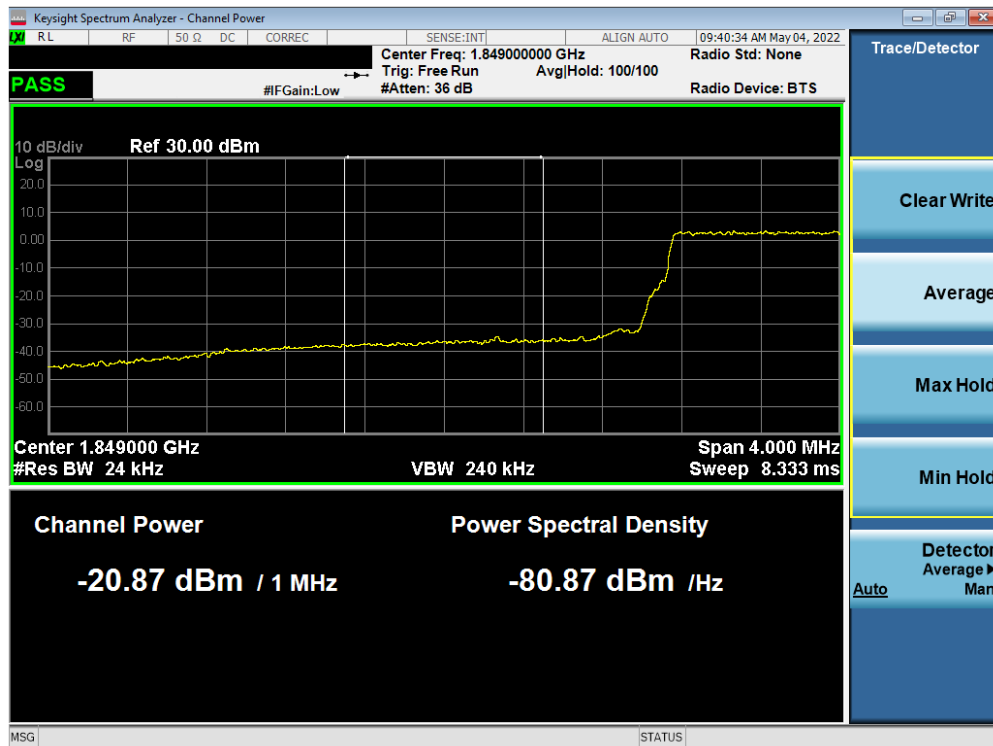


Plot 7-59. Extended Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 48 of 90

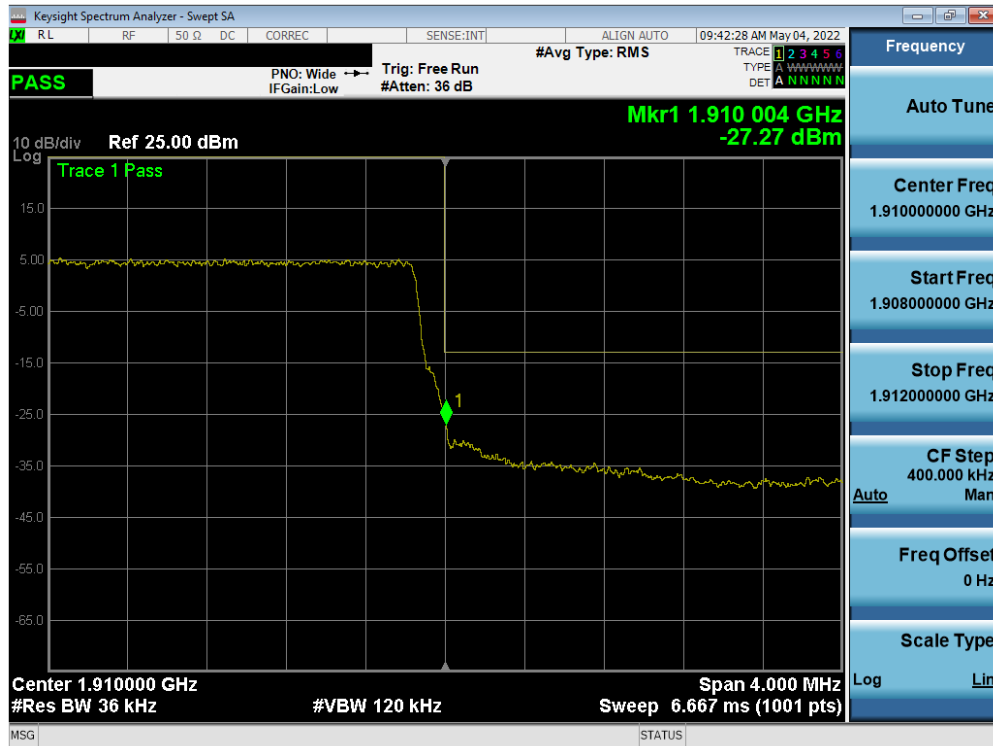


Plot 7-60. Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

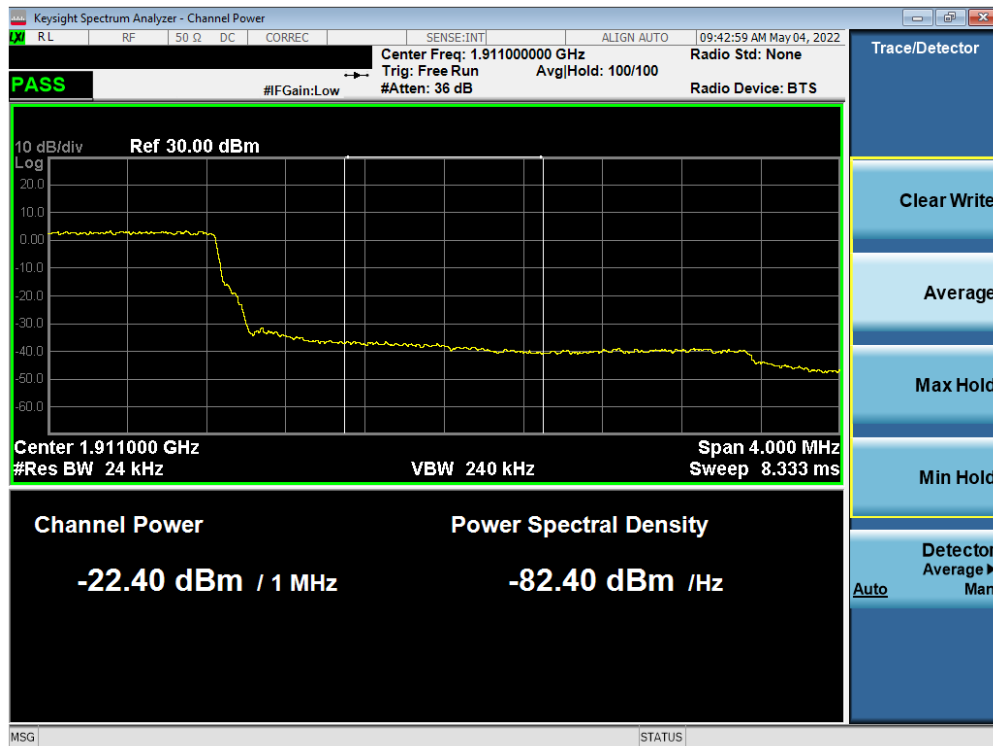


Plot 7-61. Extended Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 49 of 90



Plot 7-62. Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

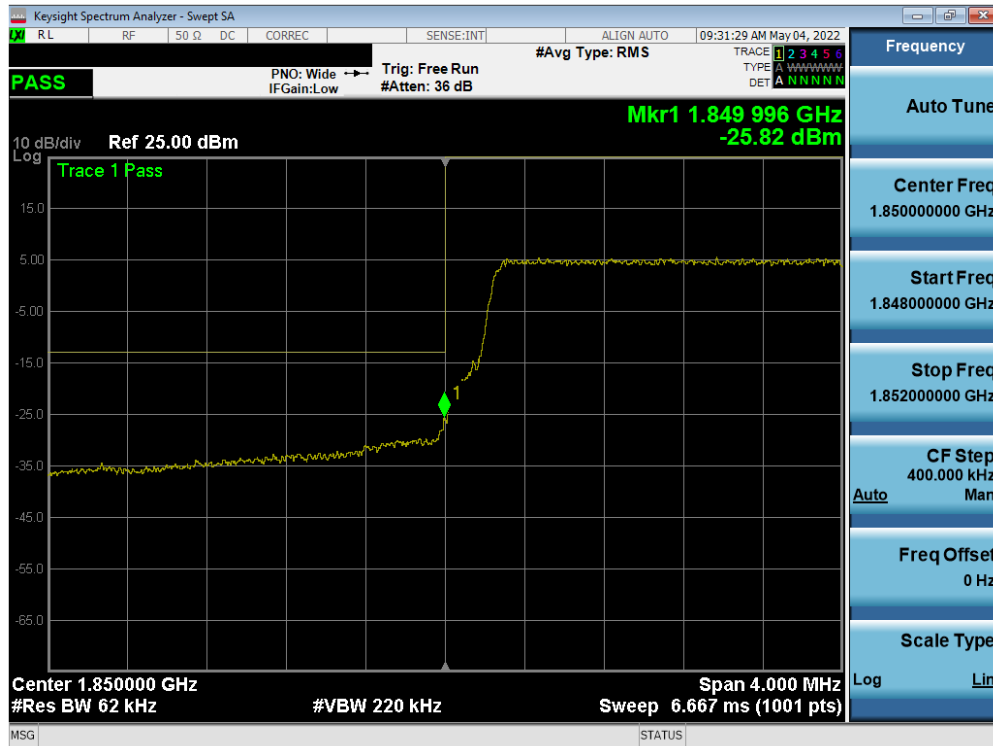


Plot 7-63. Extended Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

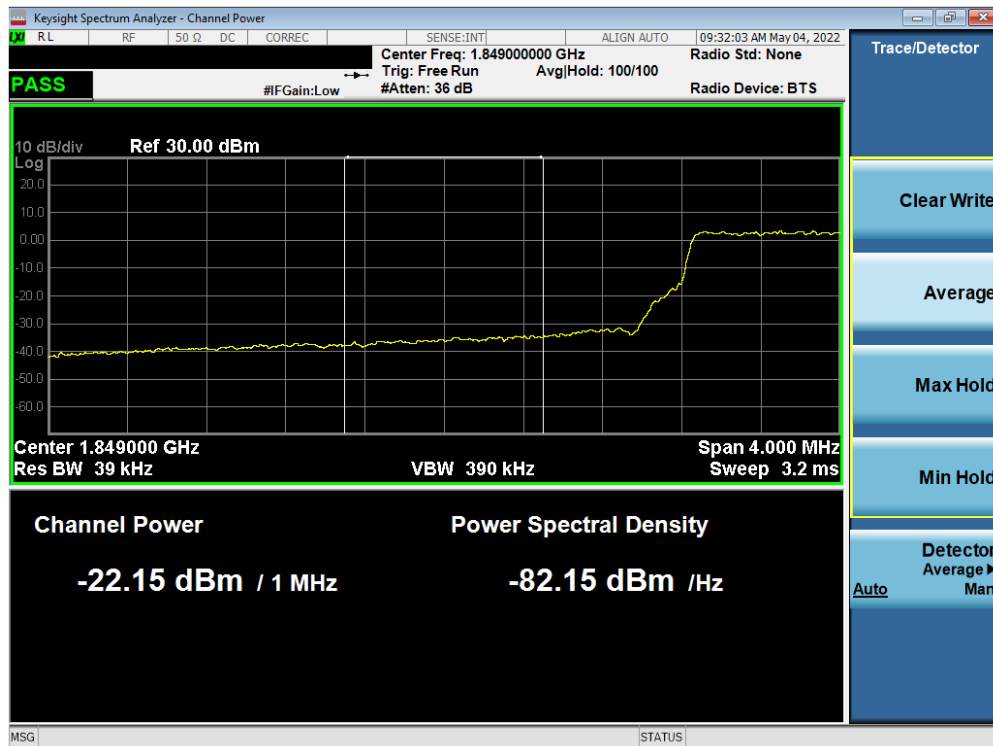
FCC ID: BCG-A2774		PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 50 of 90

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Plot 7-64. Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

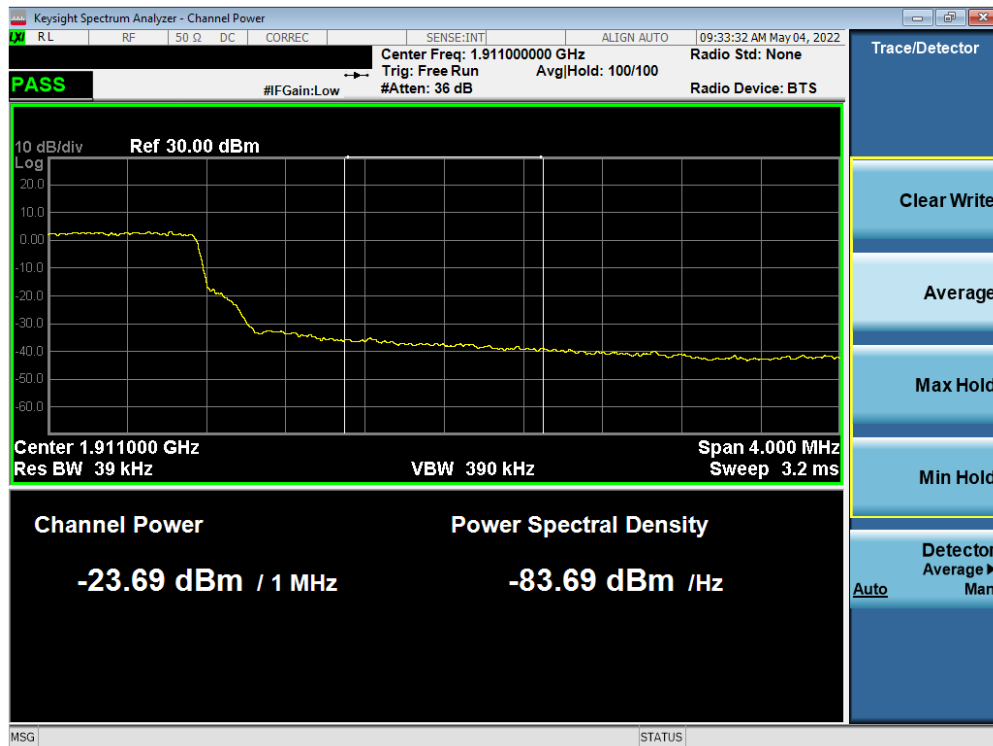


Plot 7-65. Extended Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 51 of 90

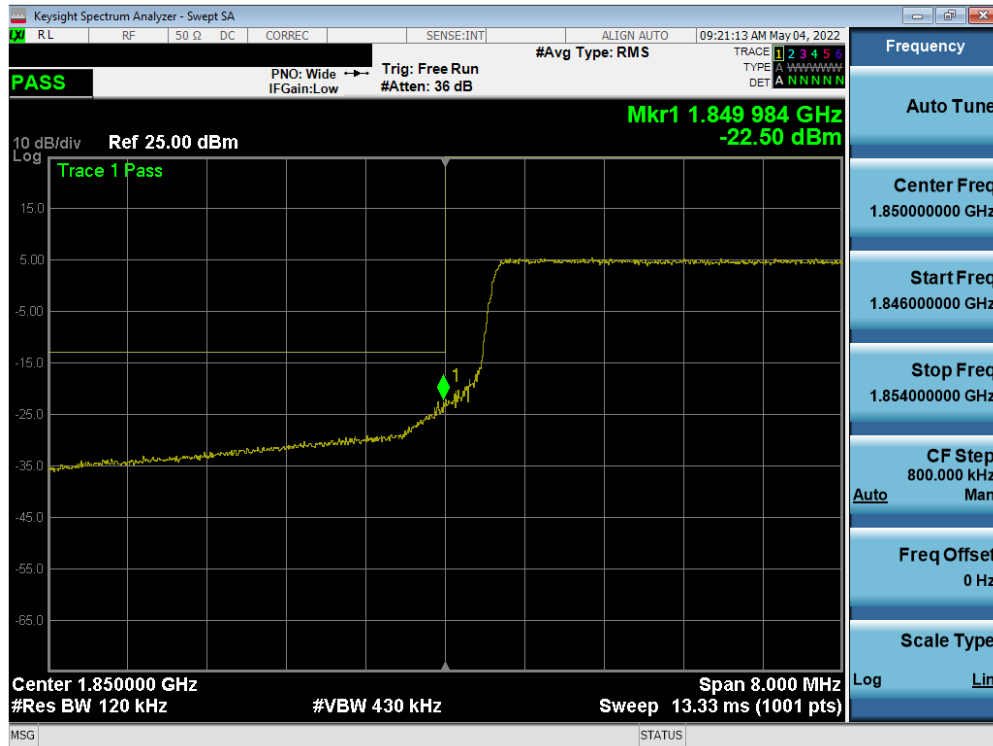


Plot 7-66. Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

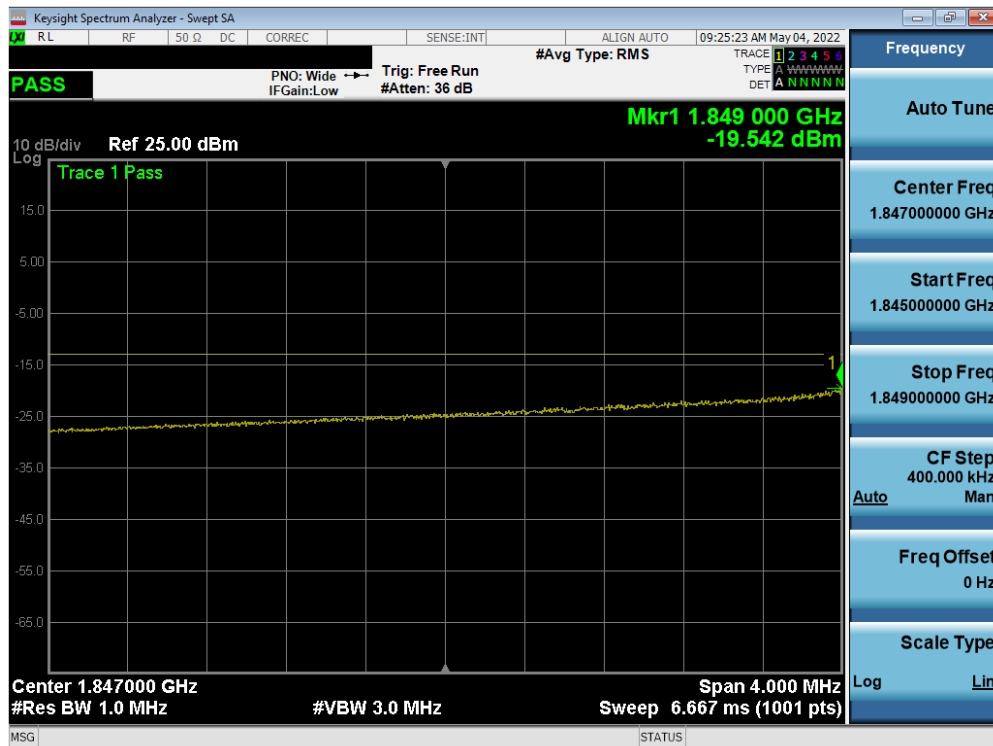


Plot 7-67. Extended Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 52 of 90

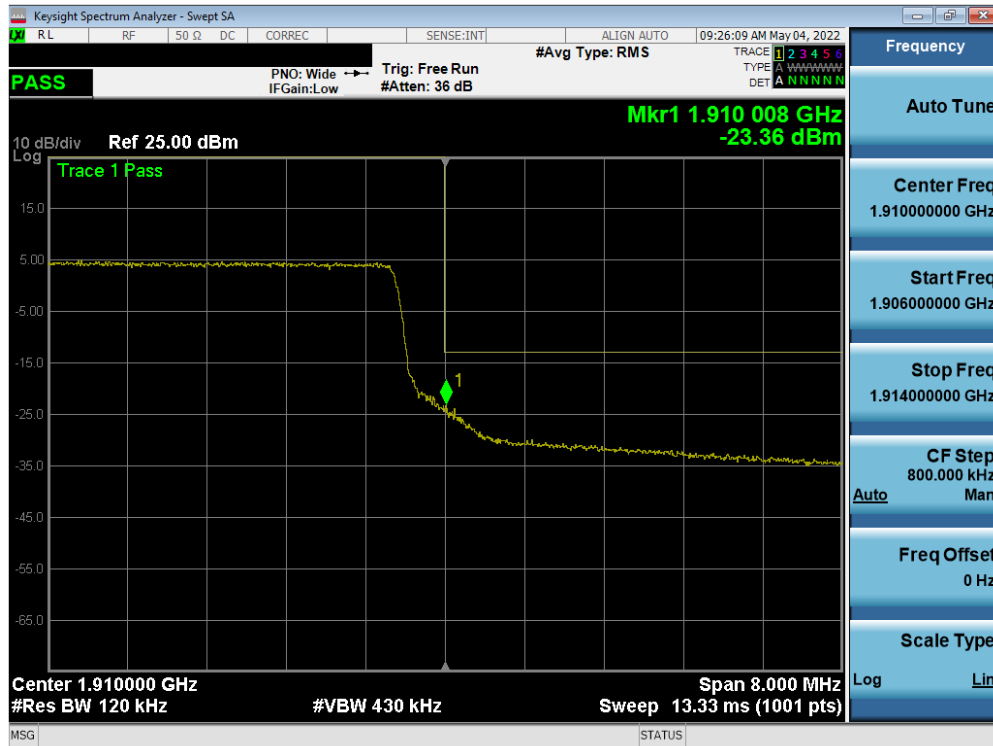


Plot 7-68. Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

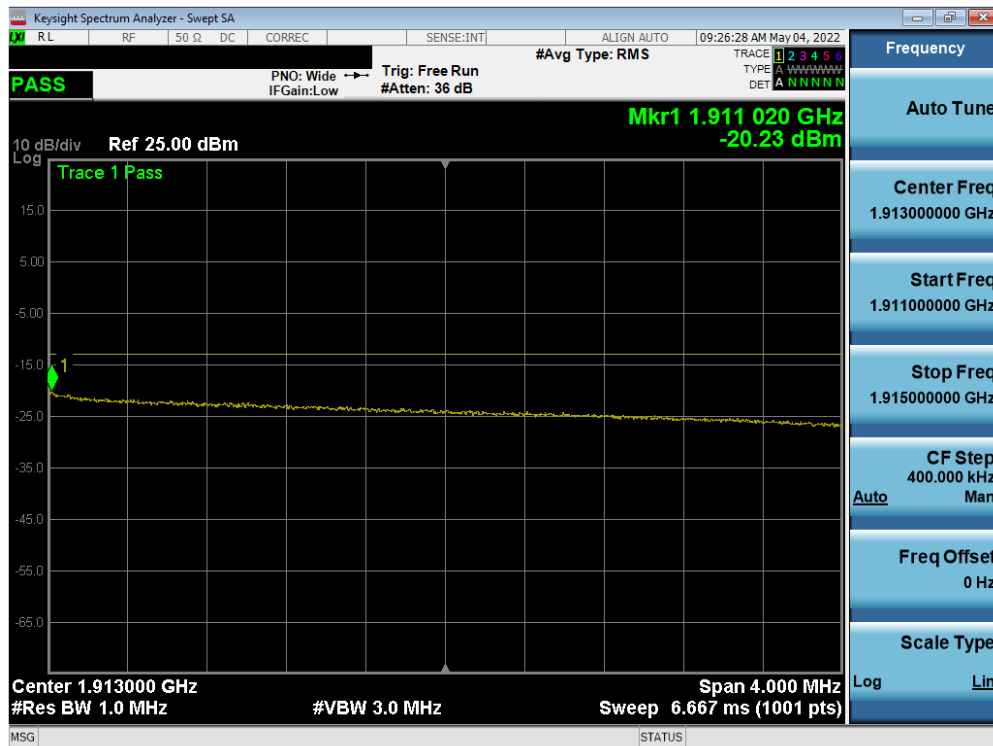


Plot 7-69. Extended Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 53 of 90

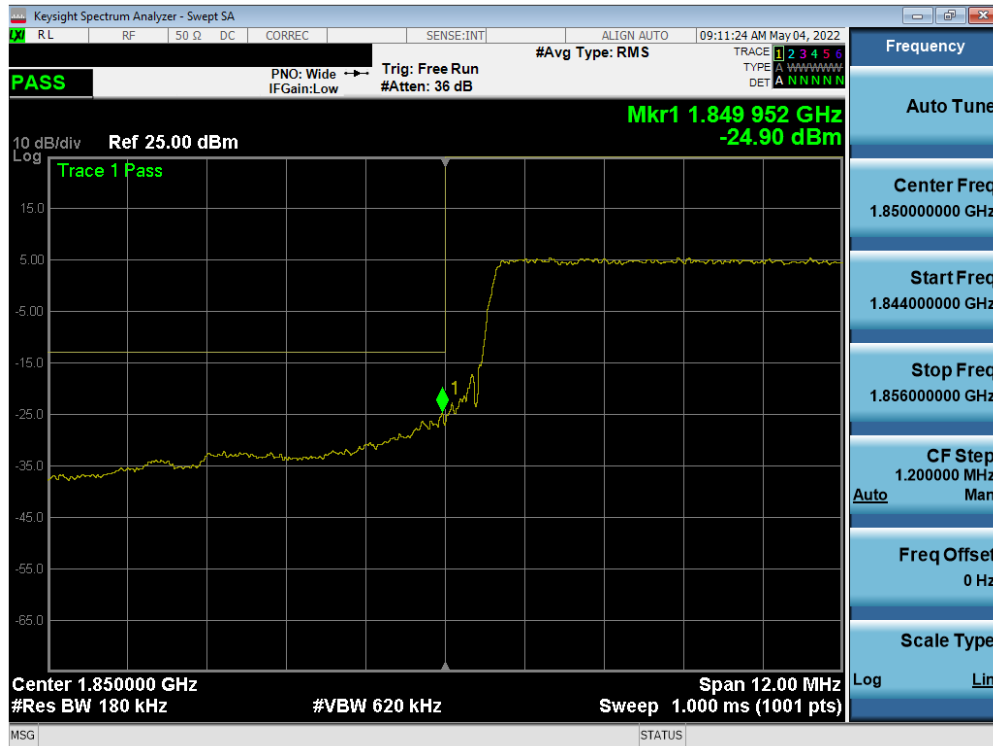


Plot 7-70. Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

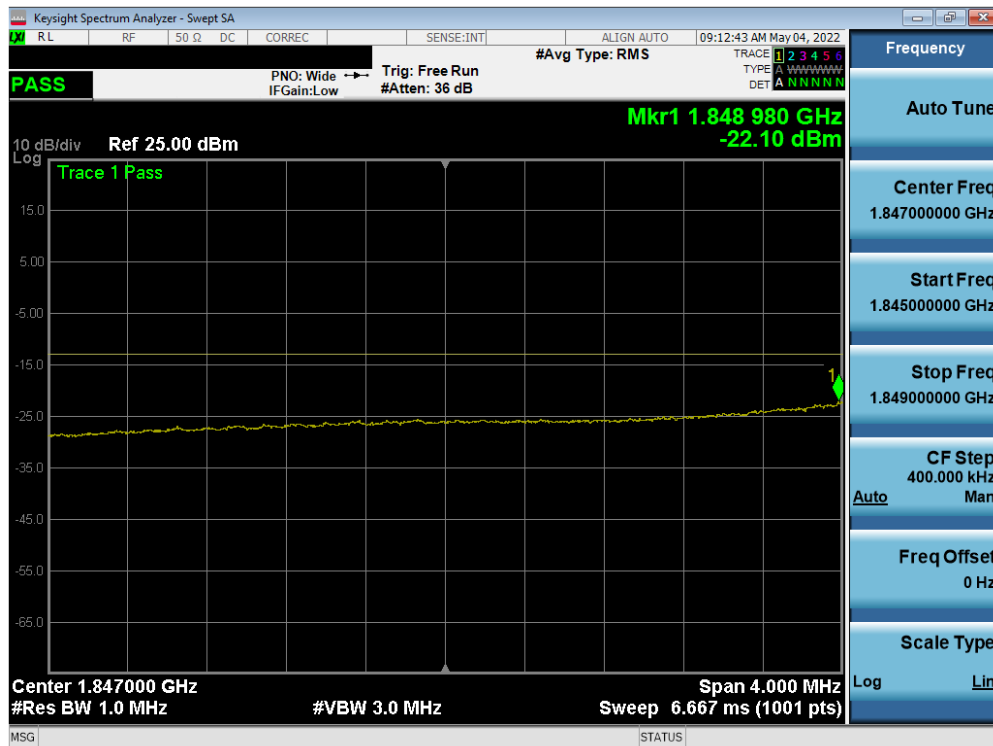


Plot 7-71. Extended Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 54 of 90

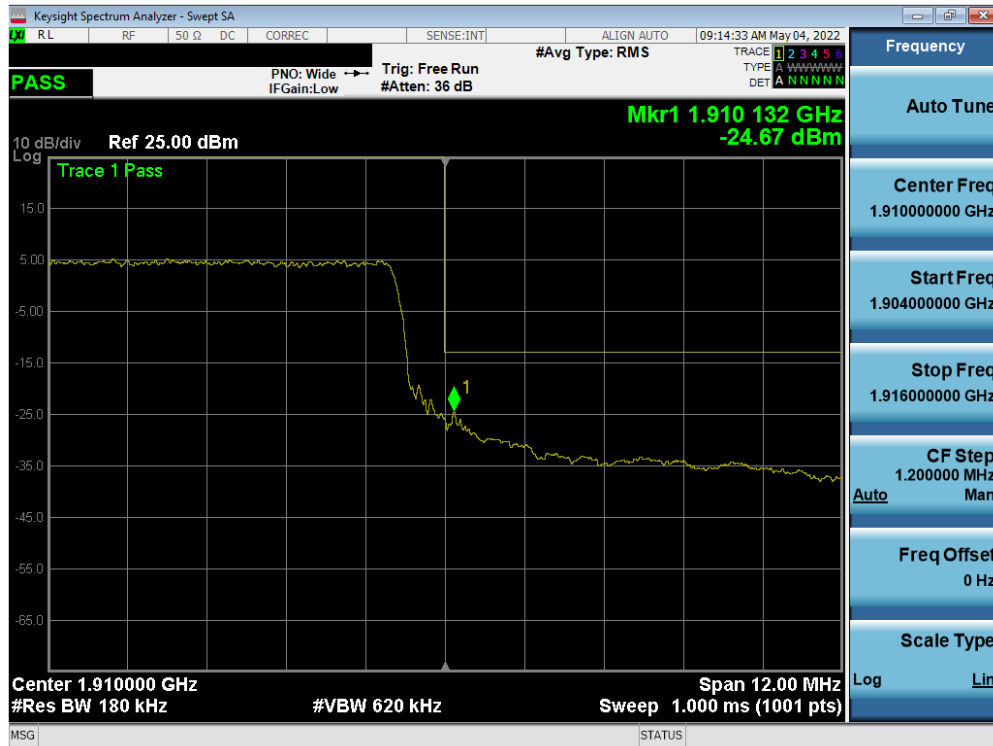


Plot 7-72. Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)



Plot 7-73. Extended Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 55 of 90

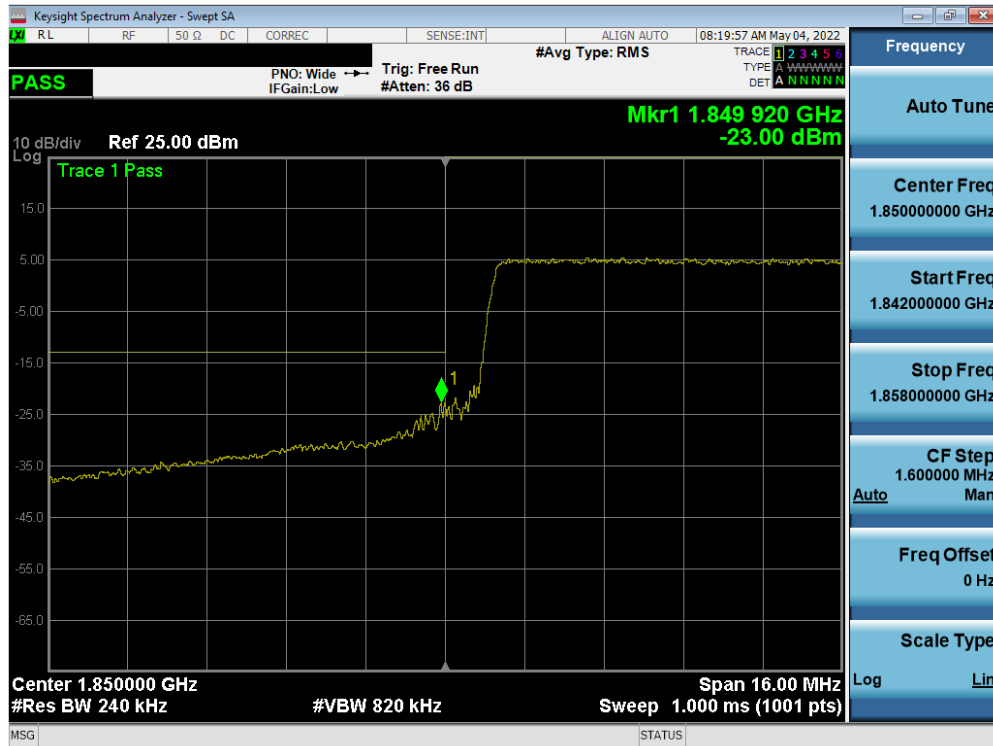


Plot 7-74. Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

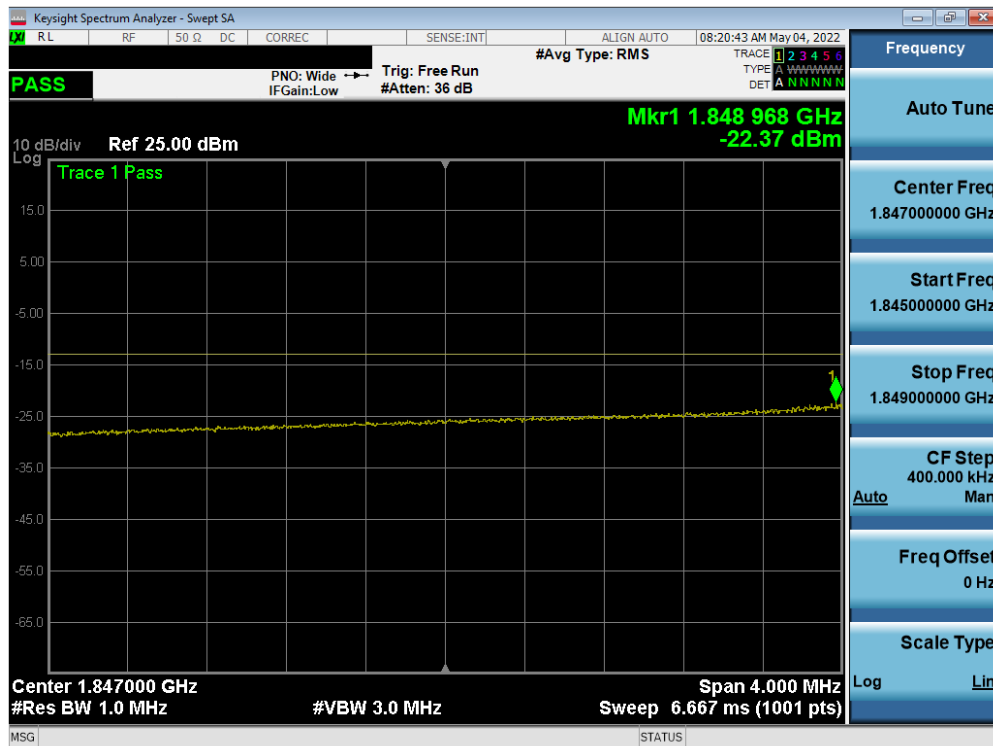


Plot 7-75. Extended Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 56 of 90

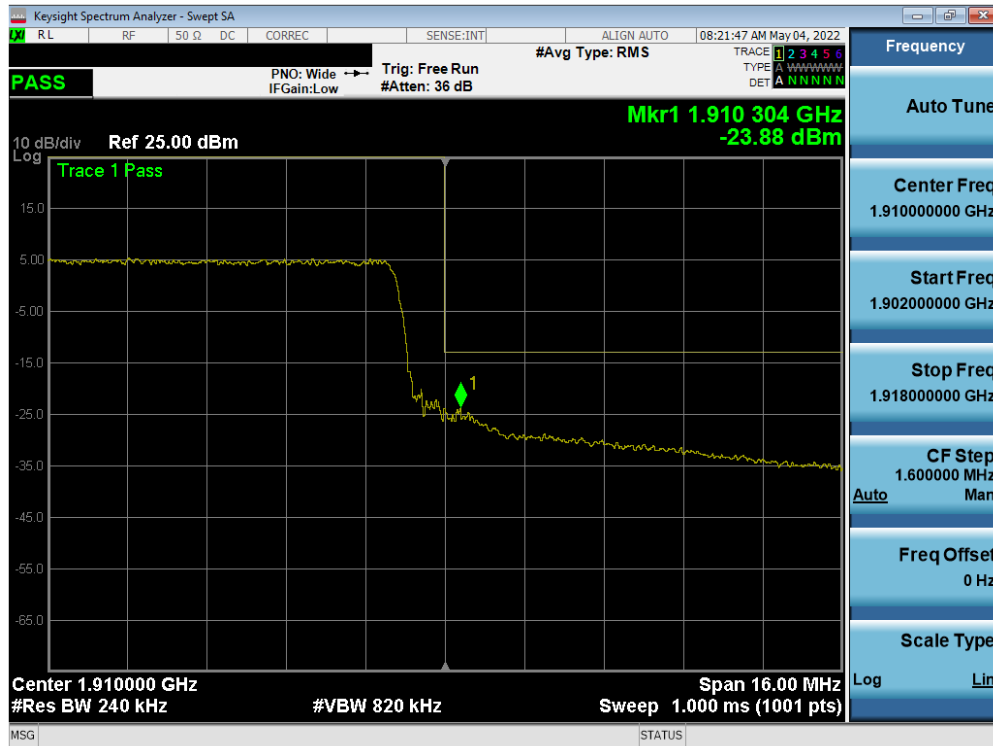


Plot 7-76. Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)



Plot 7-77. Extended Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 57 of 90

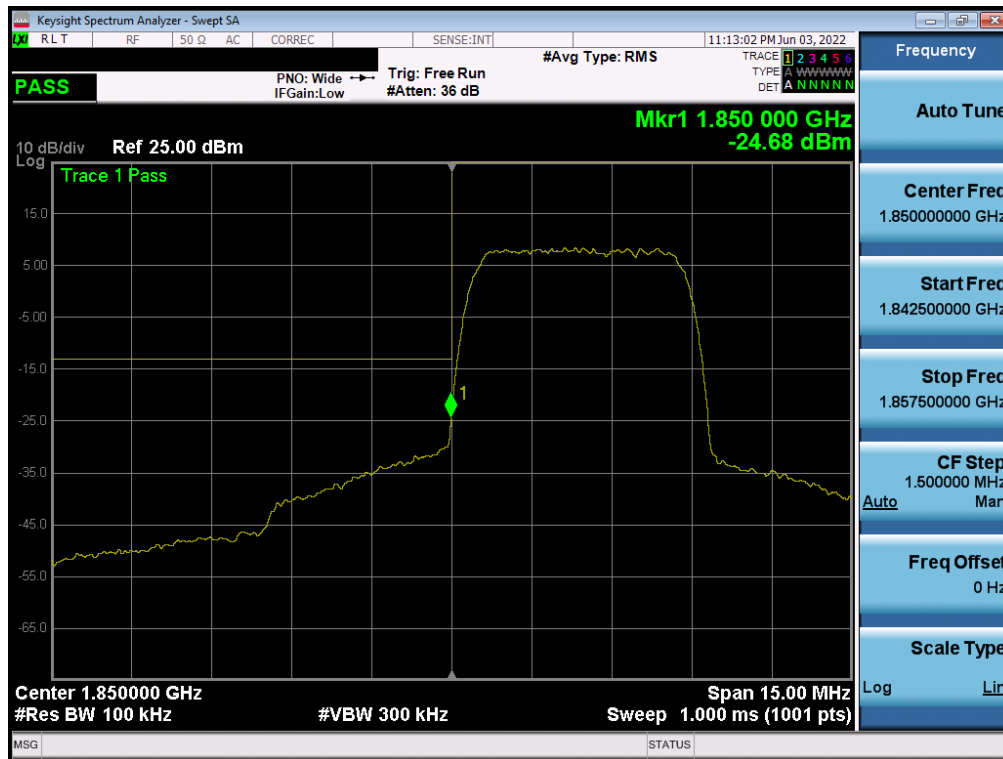


Plot 7-78. Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

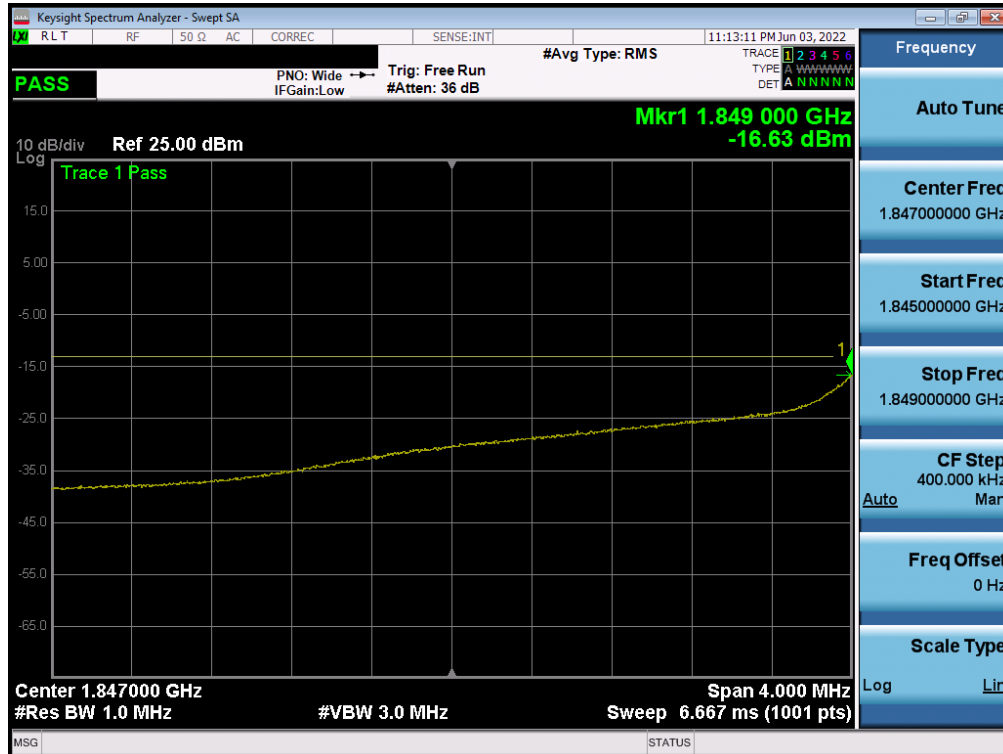


Plot 7-79. Extended Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 58 of 90



Plot 7-80. Lower Band Edge Plot (WCDMA PCS – Ch. 9262)



Plot 7-81. Extended Lower Band Edge Plot (WCDMA PCS – Ch. 9262)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 59 of 90



Plot 7-82. Upper Band Edge Plot (WCDMA PCS – Ch. 9538)



Plot 7-83. Extended Upper Band Edge Plot (WCDMA PCS – Ch. 9538)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 60 of 90

7.5 Peak-Average Ratio

§24.232(d)

Test Overview

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

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.7.1

Test Settings

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

Test Setup

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



Figure 7-4. Test Instrument & Measurement Setup

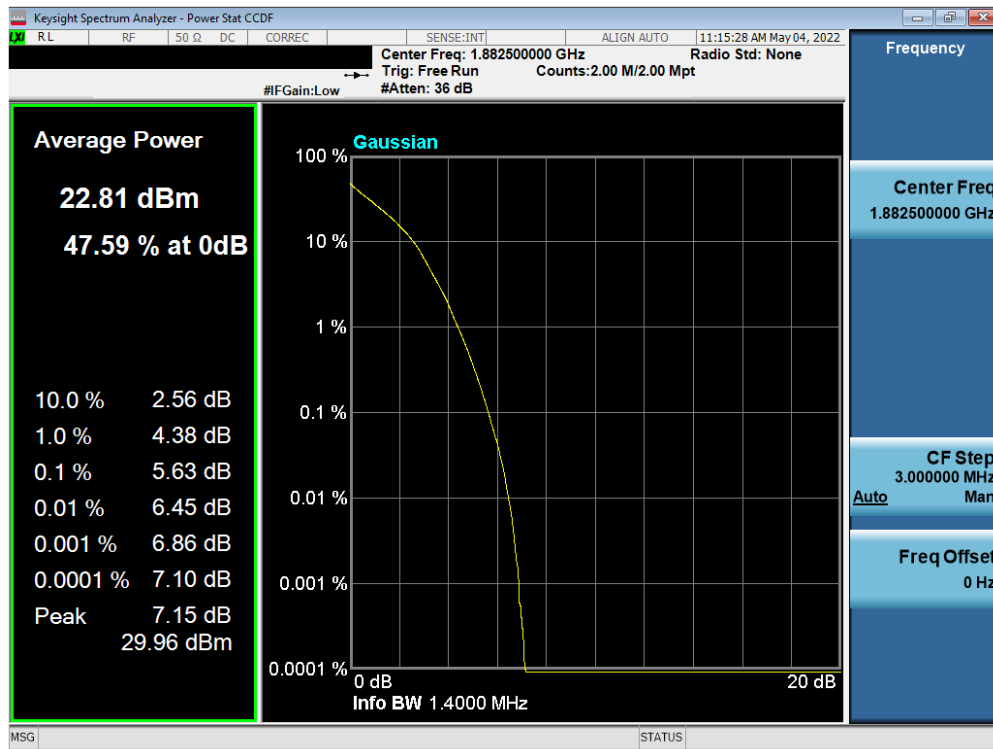
Test Notes

None.

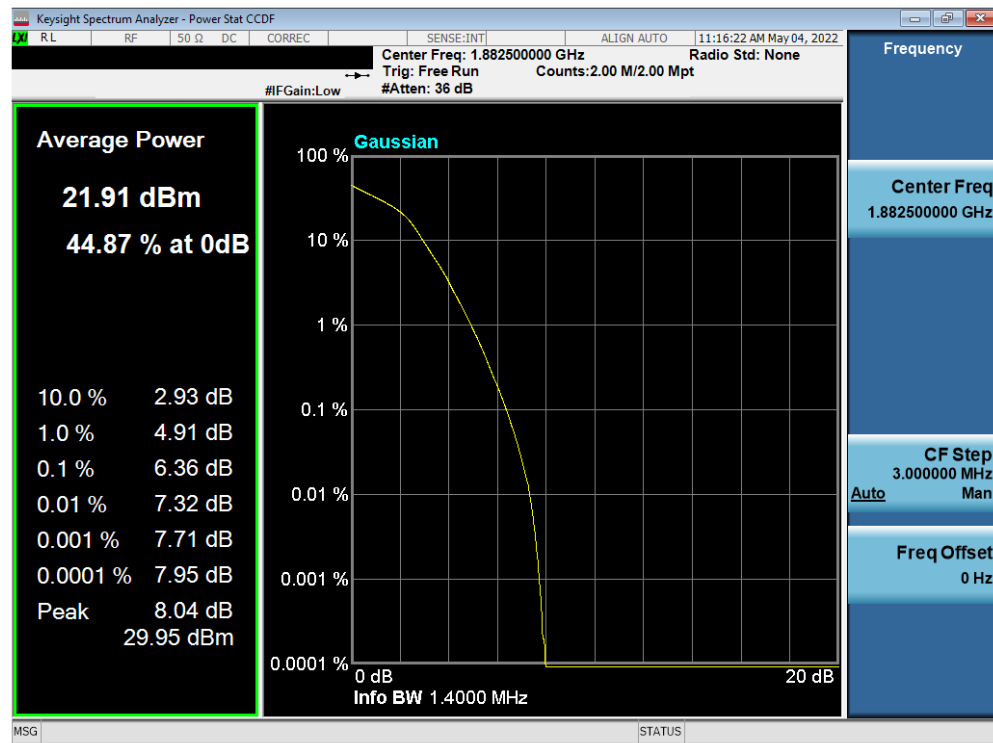
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 61 of 90

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LTE Band 25



Plot 7-84. PAR Plot (LTE Band 25 - 1.4MHz QPSK - Full RB Configuration)

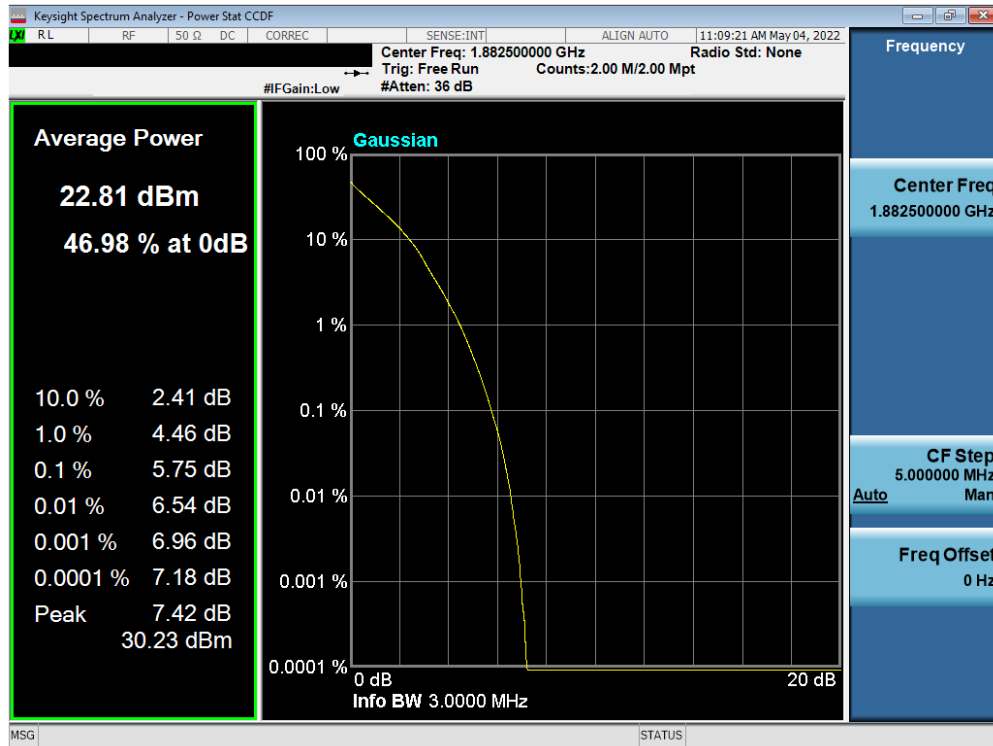


Plot 7-85. PAR Plot (LTE Band 25 - 1.4MHz 16-QAM - Full RB Configuration)

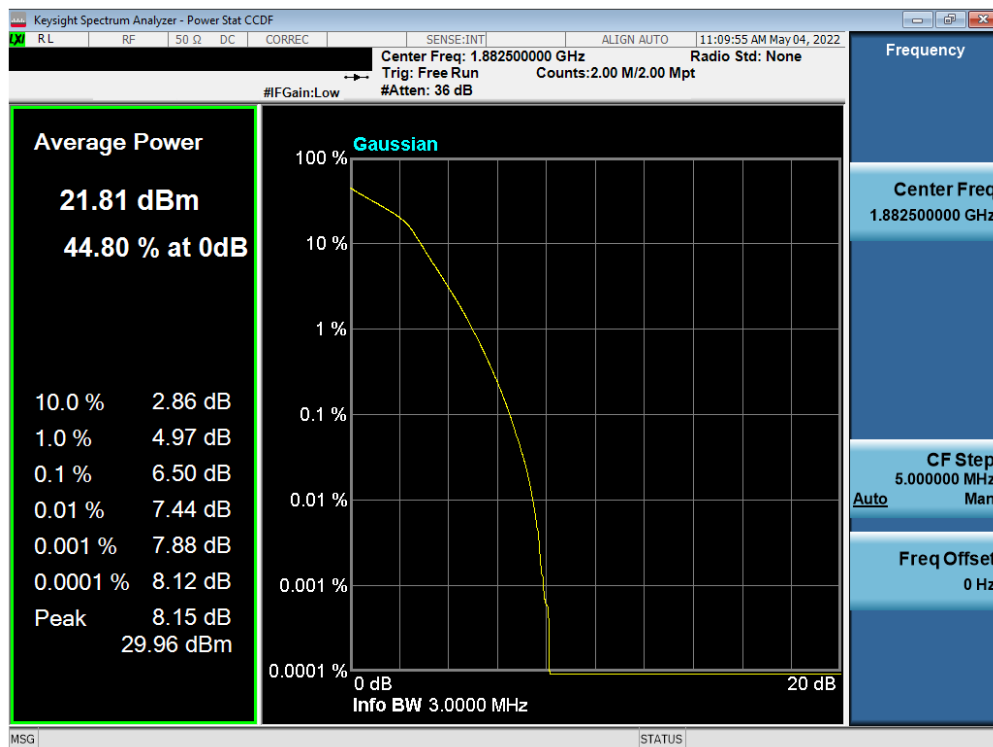
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 62 of 90

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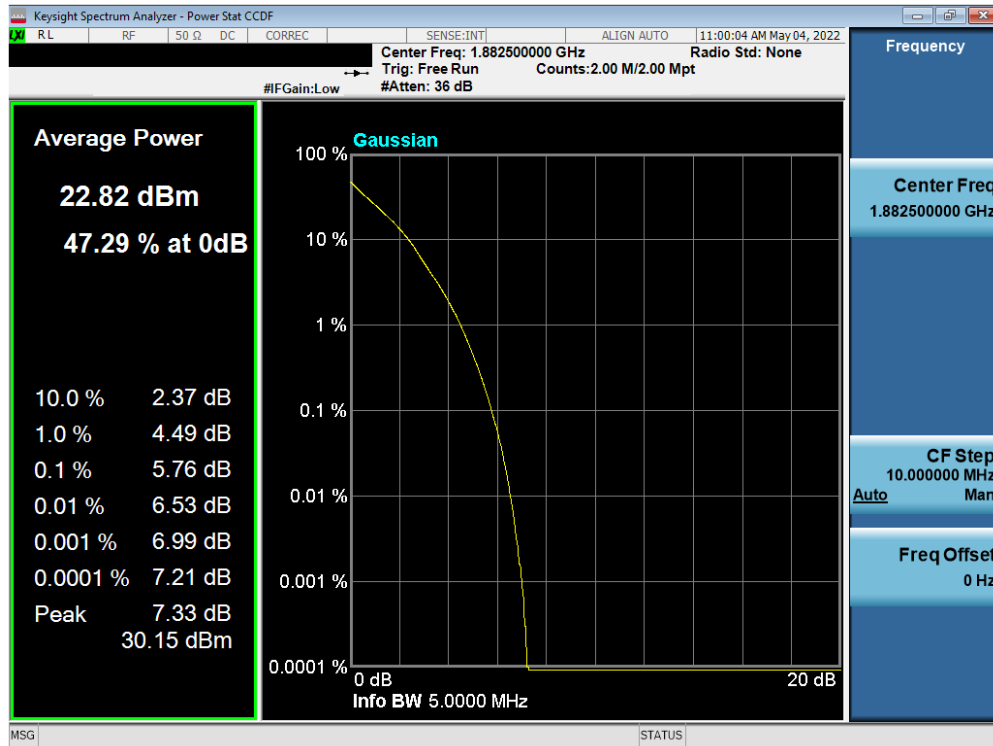
Plot 7-86. PAR Plot (LTE Band 25 - 3MHz QPSK - Full RB Configuration)



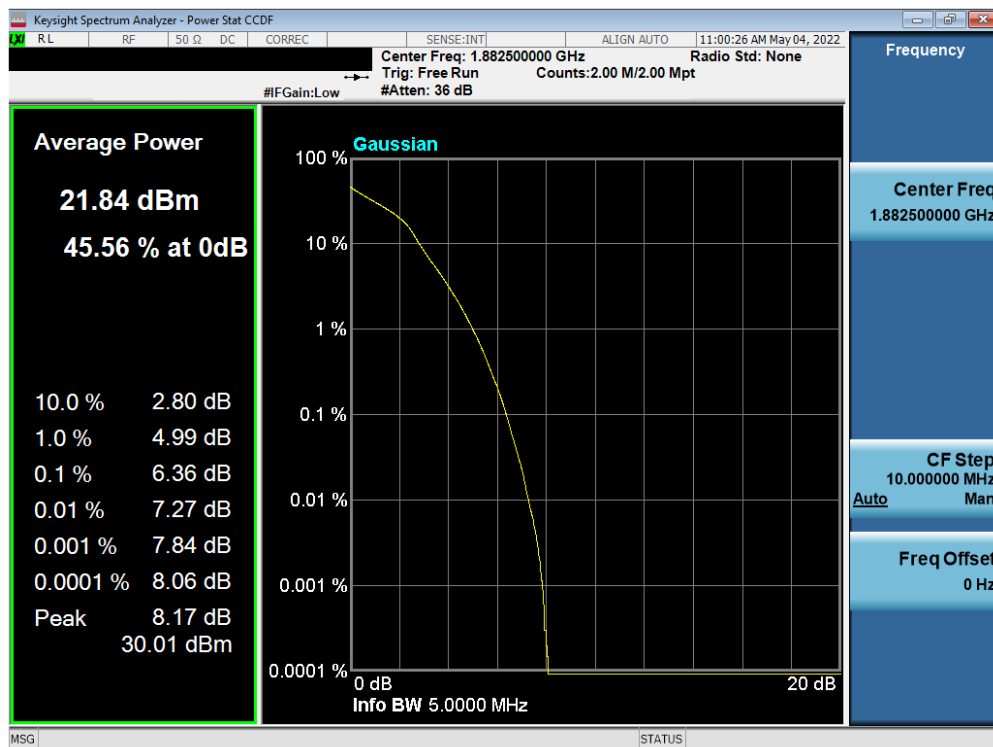
Plot 7-87. PAR Plot (LTE Band 25 - 3MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 63 of 90

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Plot 7-88. PAR Plot (LTE Band 25 - 5MHz QPSK - Full RB Configuration)

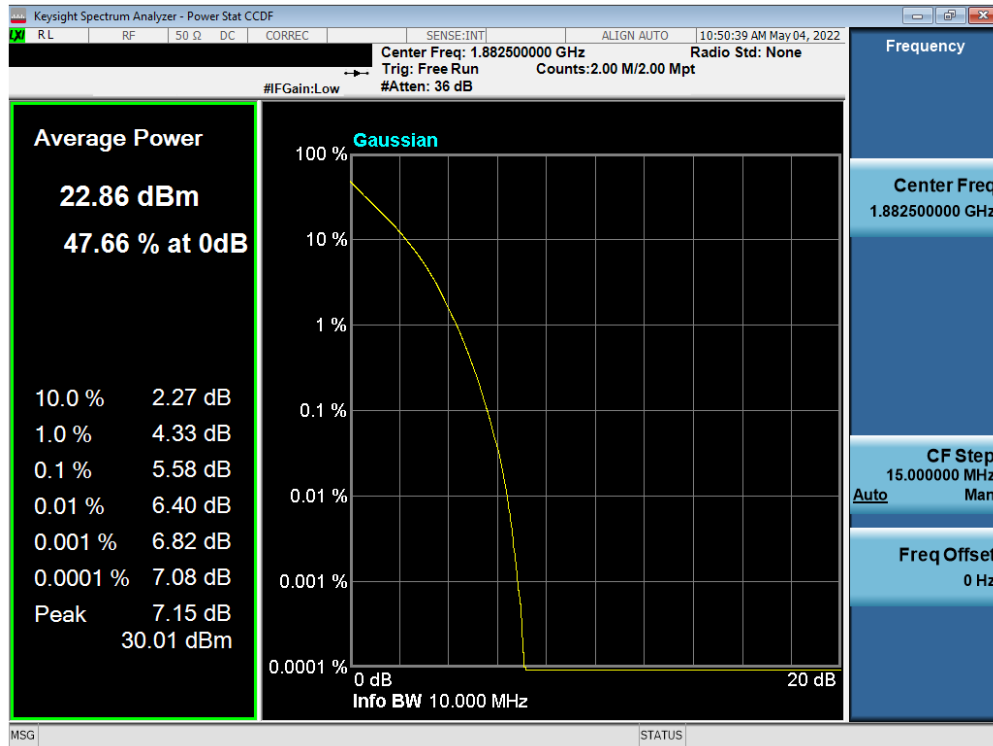


Plot 7-89. PAR Plot (LTE Band 25 - 5MHz 16-QAM - Full RB Configuration)

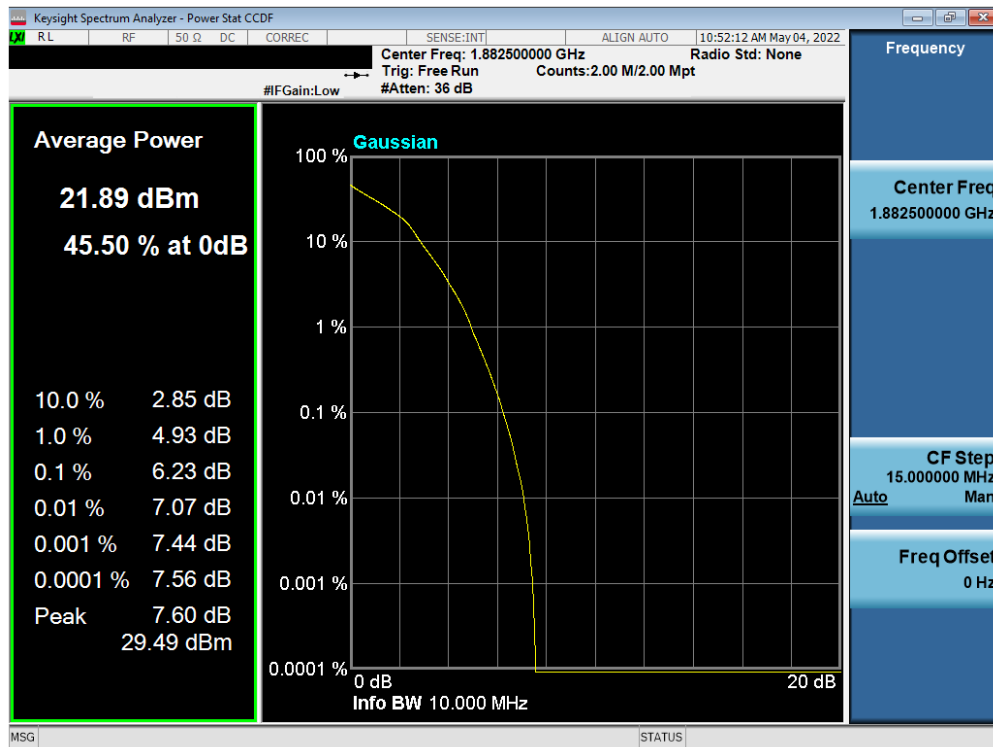
FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 64 of 90

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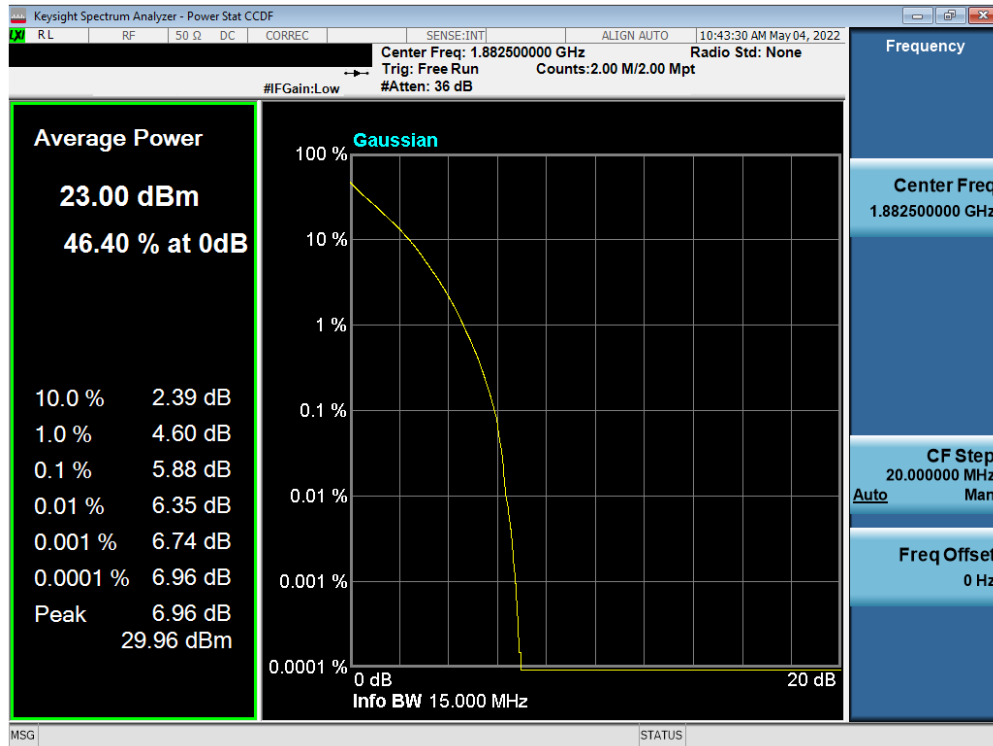


Plot 7-90. PAR Plot (LTE Band 25 - 10MHz QPSK - Full RB Configuration)

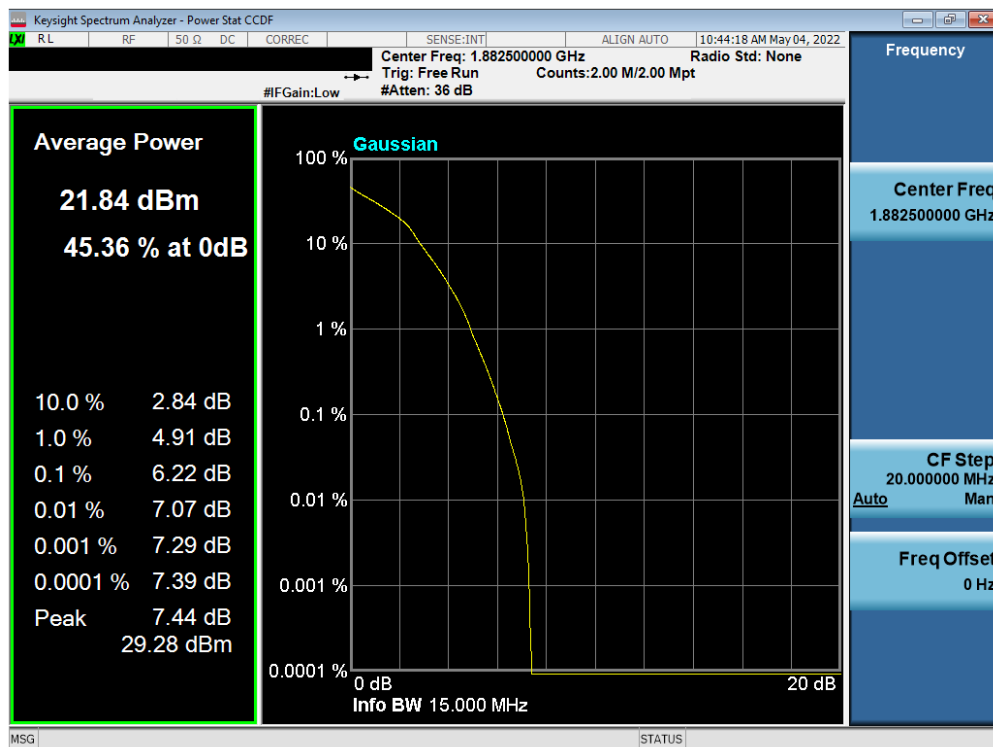


Plot 7-91. PAR Plot (LTE Band 25 - 10MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 65 of 90



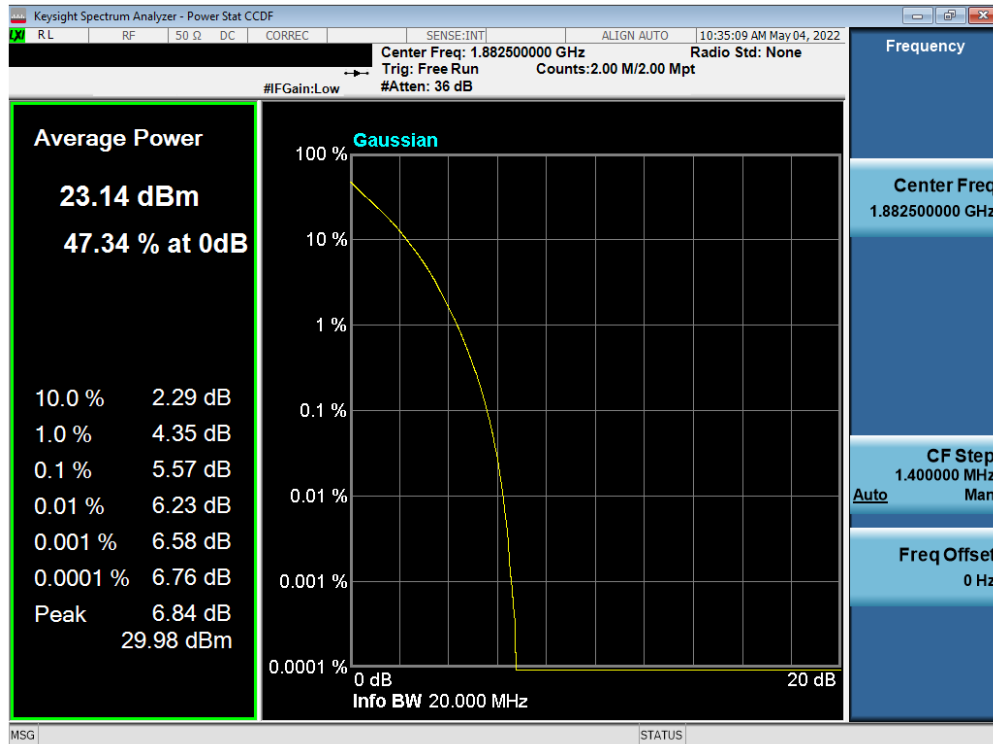
Plot 7-92. PAR Plot (LTE Band 25 - 15MHz QPSK - Full RB Configuration)



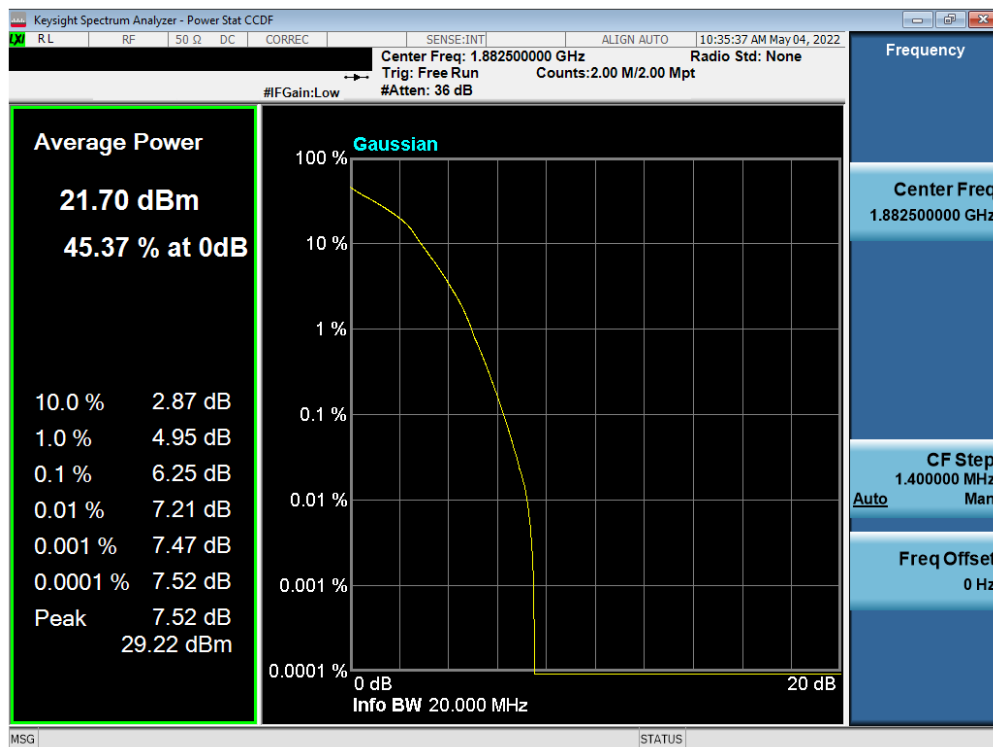
Plot 7-93. PAR Plot (LTE Band 25 - 15MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 66 of 90

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Plot 7-94. PAR Plot (LTE Band 25 - 20MHz QPSK - Full RB Configuration)

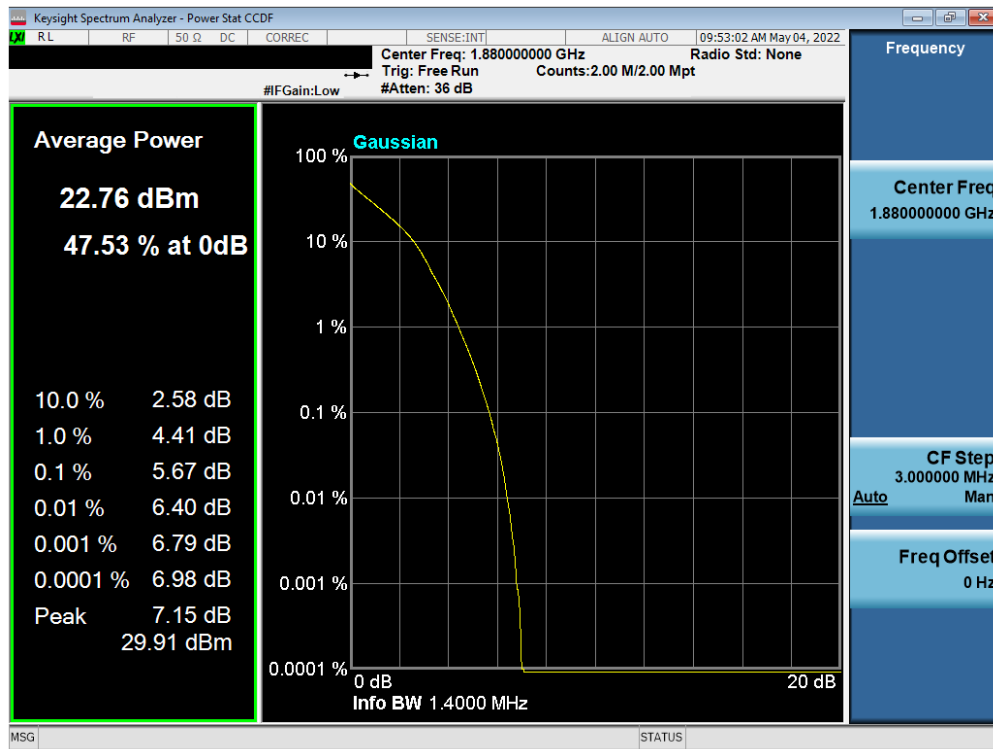


Plot 7-95. PAR Plot (LTE Band 25 - 20MHz 16-QAM - Full RB Configuration)

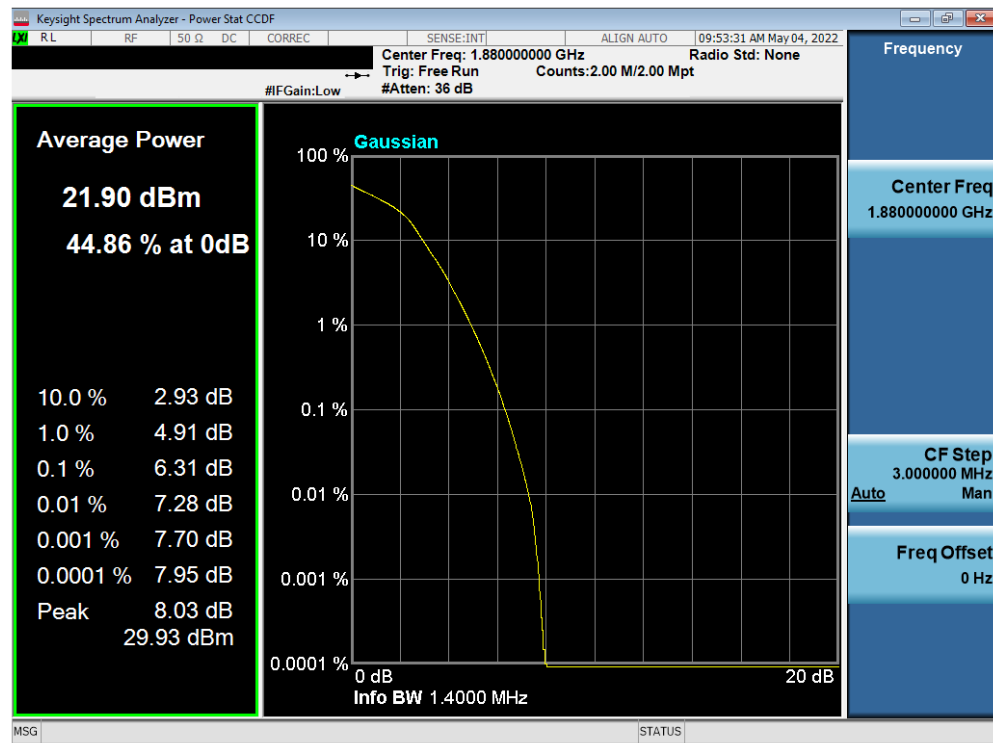
FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 67 of 90

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LTE Band 2



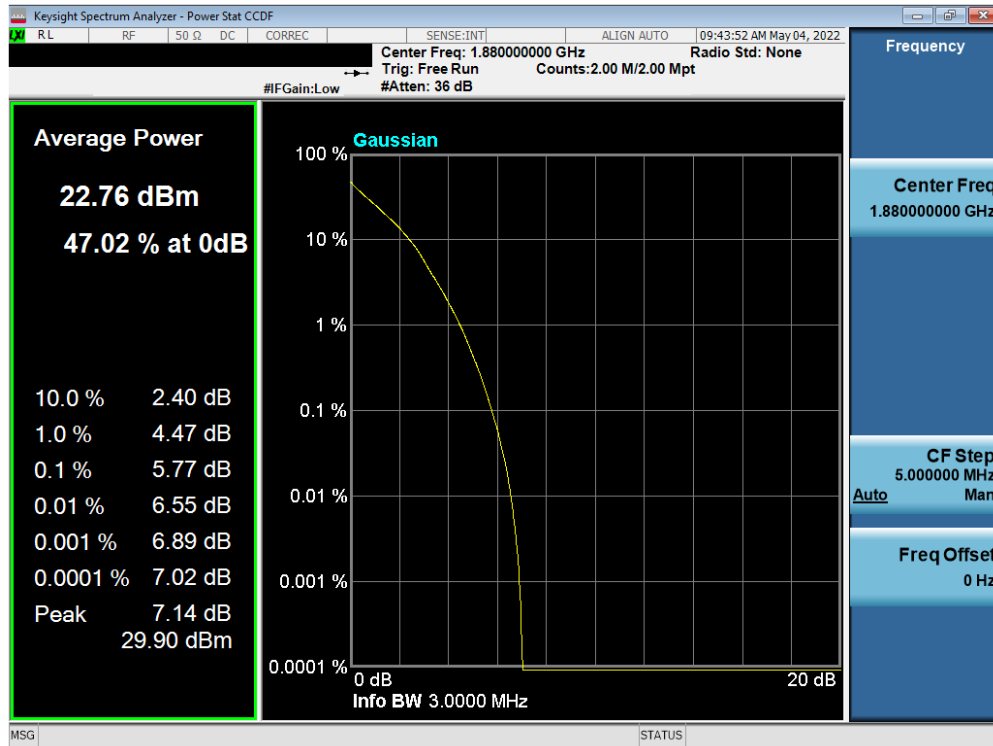
Plot 7-96. PAR Plot (LTE Band 2 - 1.4MHz QPSK - Full RB Configuration)



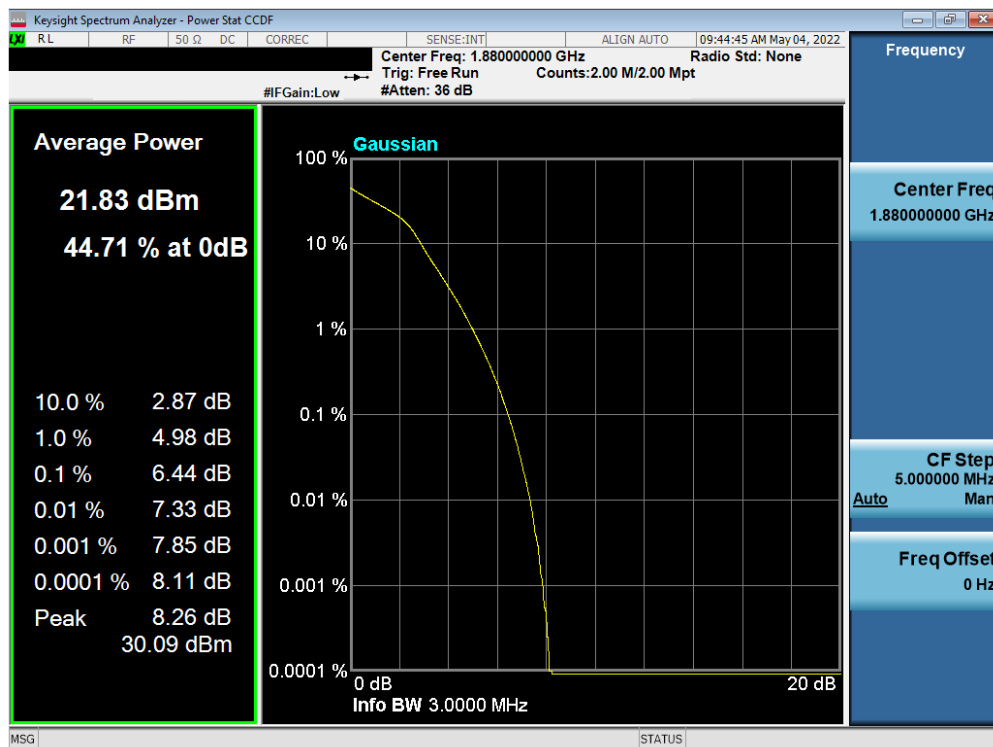
Plot 7-97. PAR Plot (LTE Band 2 - 1.4MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 68 of 90

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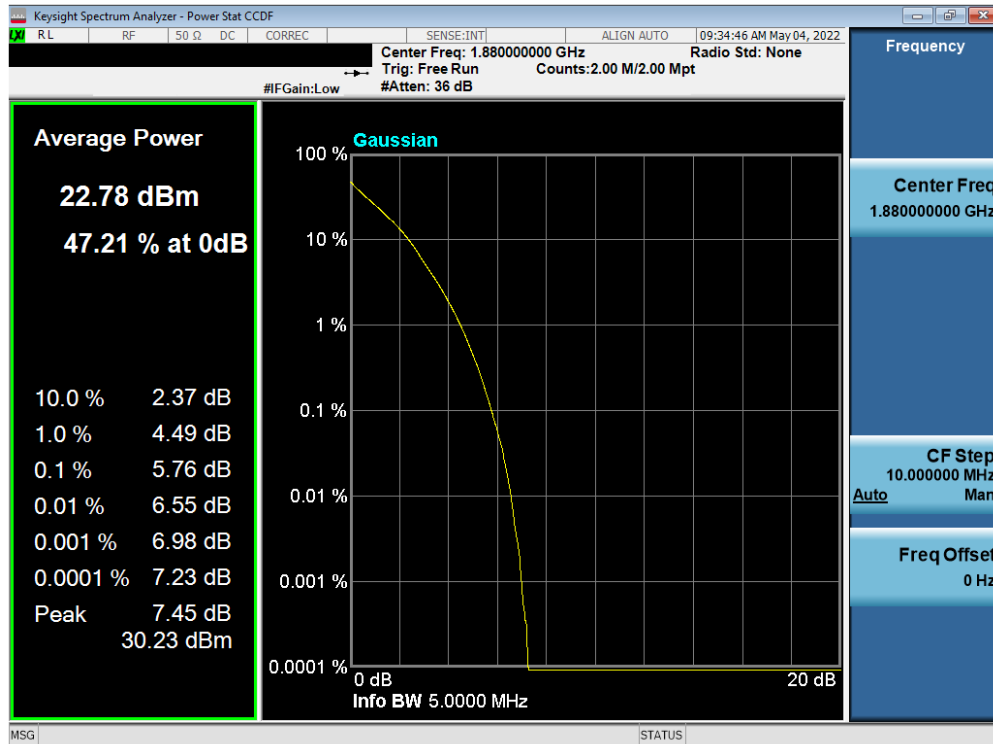
Plot 7-98. PAR Plot (LTE Band 2 - 3MHz QPSK - Full RB Configuration)



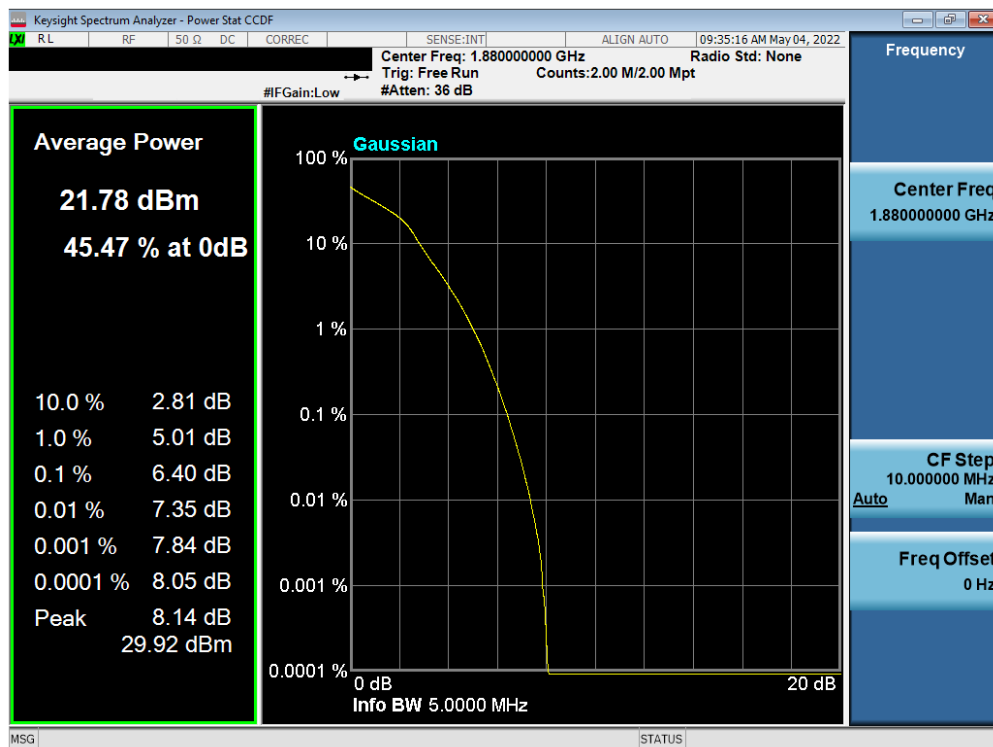
Plot 7-99. PAR Plot (LTE Band 2 - 3MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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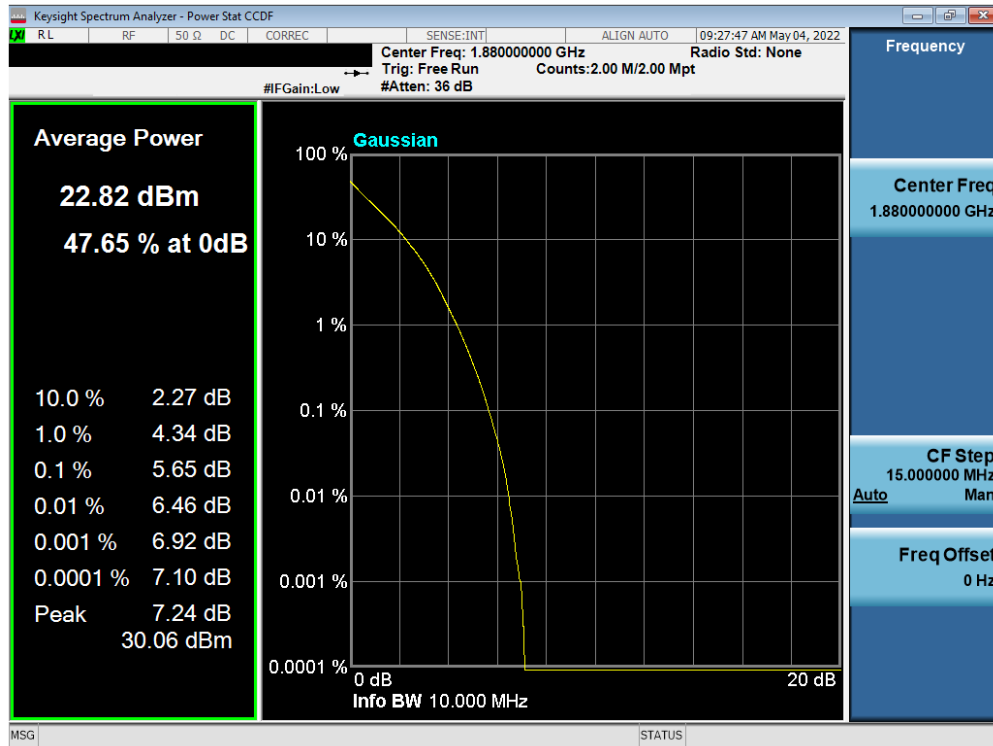
Plot 7-100. PAR Plot (LTE Band 2 - 5MHz QPSK - Full RB Configuration)



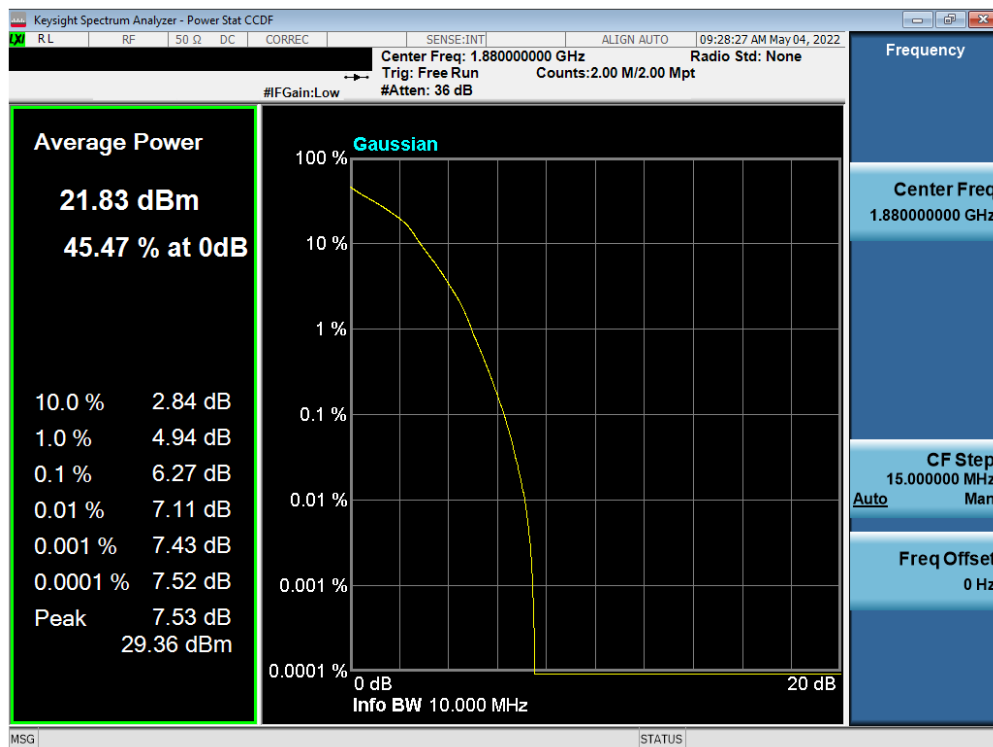
Plot 7-101. PAR Plot (LTE Band 2 - 5MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 70 of 90

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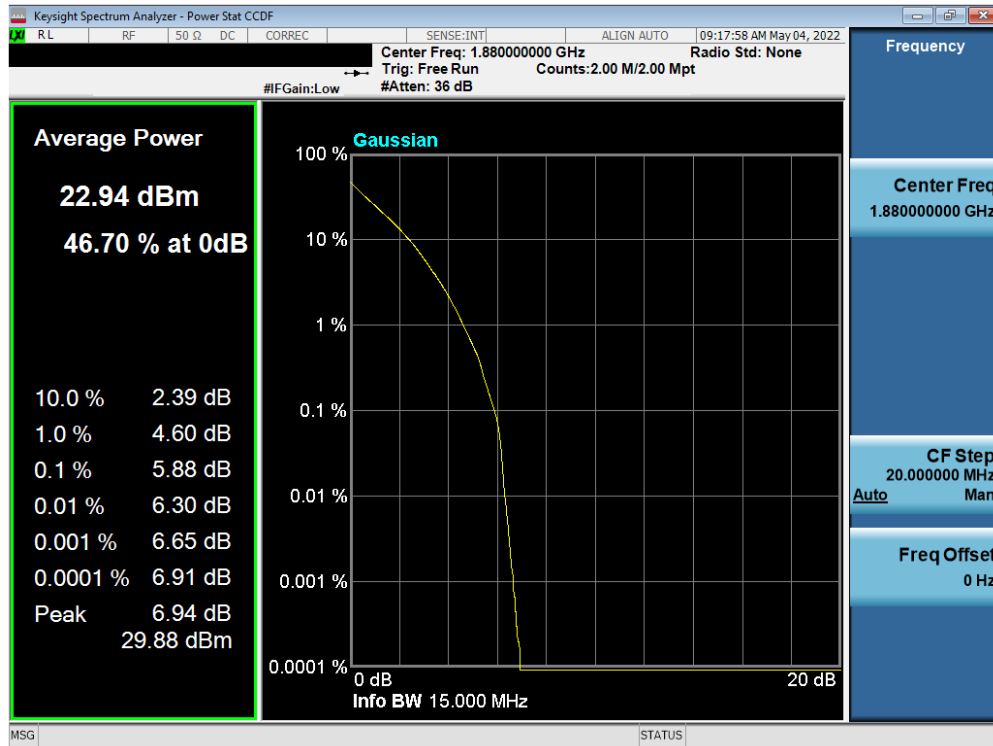
Plot 7-102. PAR Plot (LTE Band 2 - 10MHz QPSK - Full RB Configuration)



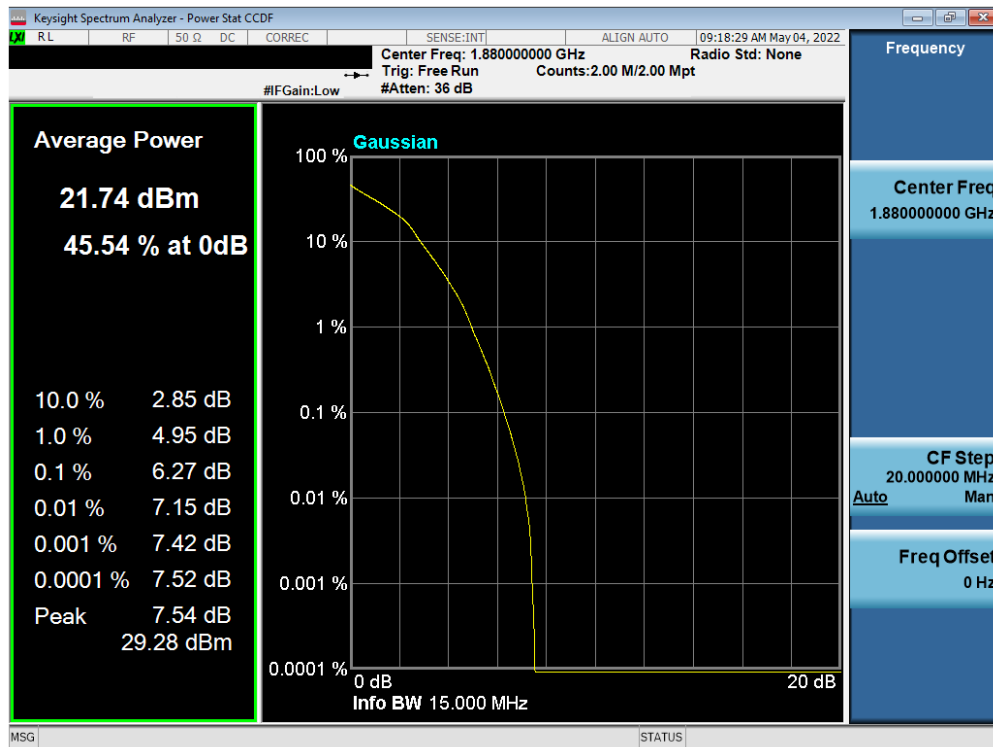
Plot 7-103. PAR Plot (LTE Band 2 - 10MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-104. PAR Plot (LTE Band 2 - 15MHz QPSK - Full RB Configuration)

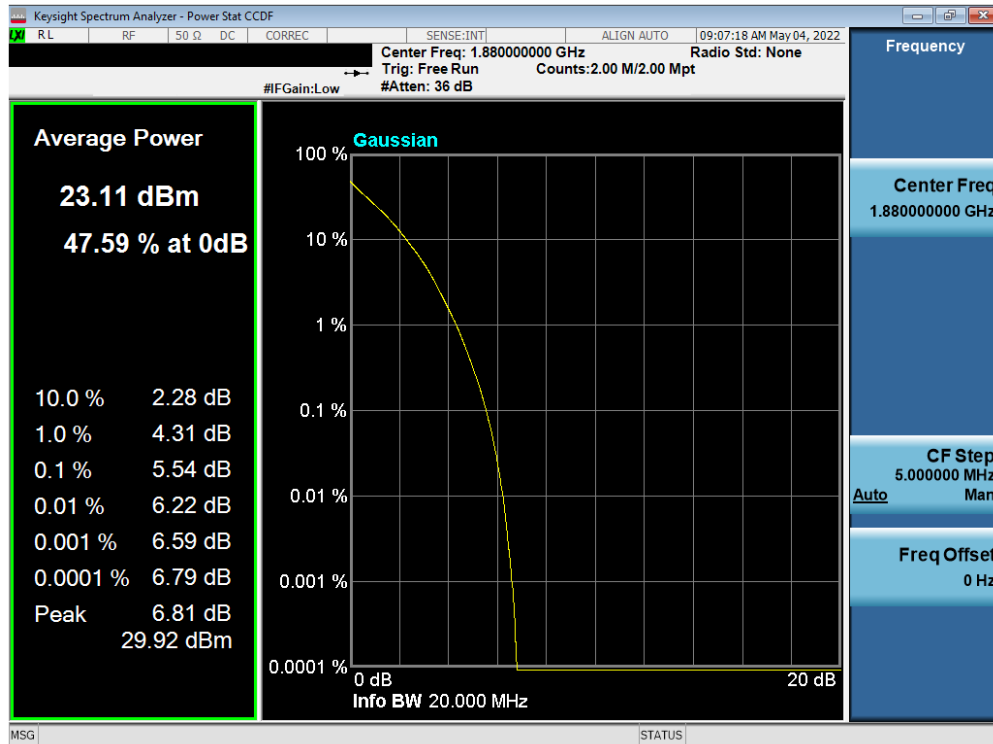


Plot 7-105. PAR Plot (LTE Band 2 - 15MHz 16-QAM - Full RB Configuration)

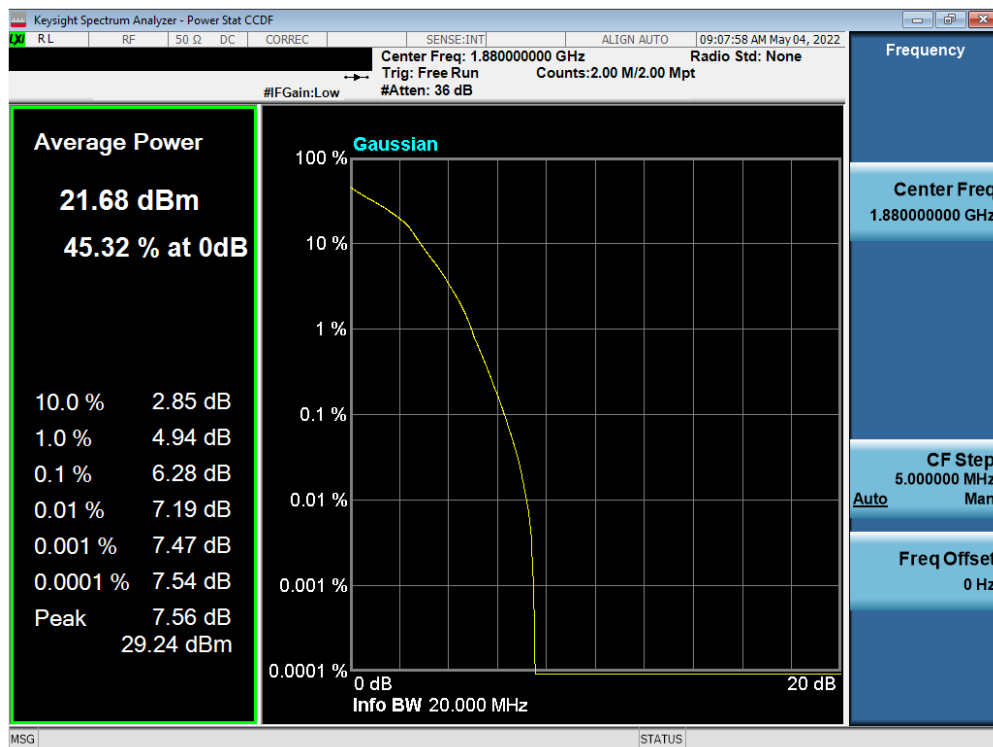
FCC ID: BCG-A2774	 PART 24 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1C2205090040-02.BCG	Test Dates: 5/4/2022 - 8/10/2022	EUT Type: Watch	Page 72 of 90

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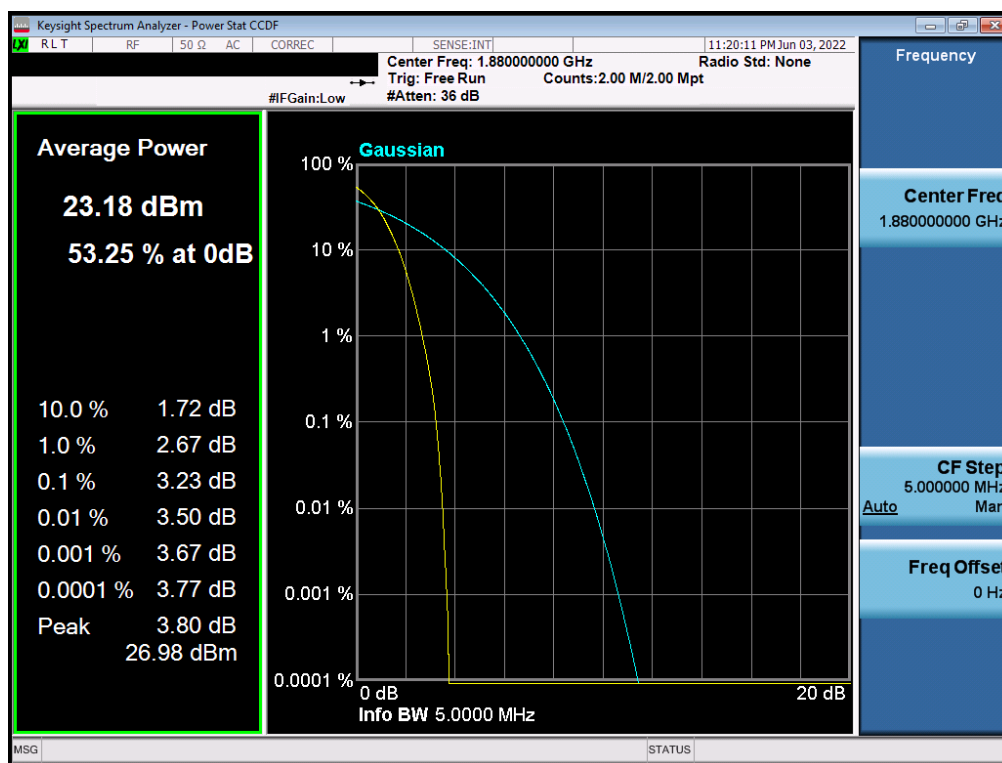


Plot 7-106. PAR Plot (LTE Band 2 - 20MHz QPSK - Full RB Configuration)



Plot 7-107. PAR Plot (LTE Band 2 - 20MHz 16-QAM - Full RB Configuration)

FCC ID: BCG-A2774	element	PART 24 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-108. PAR Plot (WCDMA, Ch. 9400)

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7.6 Radiated Power (EIRP)

§24.232(c)

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 EIRP from the conducted RF output power measured is:

$$\text{EIRP} = \text{PMeas} - \text{LC} + \text{GT}$$

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.

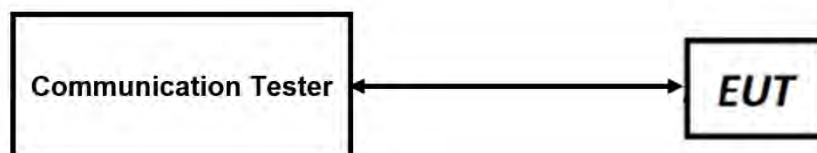


Figure 7-5. EIRP Measurement Setup

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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.
4. The Ant. Gains (GT) are listed in dBi.
5. This device employs UMTS technology with WCDMA (AMR/RMC) and HSDPA capabilities. The EUT was tested under all configurations and the highest power is reported in WCDMA mode with HSDPA Inactive at 12.2 kbps RMC and TPC bits all set to "1".

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Antenna FCM LTE Band 25

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	1850.7	-10.20	1 / 3	24.04	13.84	24.210	33.01	-19.17
		1882.5	-10.20	1 / 5	24.09	13.89	24.491	33.01	-19.12
		1914.3	-10.20	1 / 3	24.34	14.14	25.942	33.01	-18.87
	16-QAM	1882.5	-10.20	1 / 5	23.54	13.34	21.577	33.01	-19.67
3 MHz	QPSK	1851.5	-10.20	1 / 14	24.00	13.80	23.988	33.01	-19.21
		1882.5	-10.20	1 / 0	24.26	14.06	25.468	33.01	-18.95
		1913.5	-10.20	1 / 0	24.12	13.92	24.660	33.01	-19.09
	16-QAM	1882.5	-10.20	1 / 7	23.55	13.35	21.627	33.01	-19.66
5 MHz	QPSK	1852.5	-10.20	1 / 24	24.07	13.87	24.378	33.01	-19.14
		1882.5	-10.20	1 / 24	24.39	14.19	26.242	33.01	-18.82
		1912.5	-10.20	1 / 24	24.03	13.83	24.155	33.01	-19.18
	16-QAM	1882.5	-10.20	1 / 0	23.65	13.45	22.131	33.01	-19.56
10 MHz	QPSK	1855.0	-10.20	1 / 0	24.33	14.13	25.882	33.01	-18.88
		1882.5	-10.20	1 / 0	24.25	14.05	25.410	33.01	-18.96
		1910.0	-10.20	1 / 0	24.13	13.93	24.717	33.01	-19.08
	16-QAM	1882.5	-10.20	1 / 25	23.64	13.44	22.080	33.01	-19.57
20 MHz	QPSK	1857.5	-10.20	1 / 74	24.20	14.00	25.119	33.01	-19.01
		1882.5	-10.20	1 / 0	24.07	13.87	24.378	33.01	-19.14
		1907.5	-10.20	1 / 0	24.04	13.84	24.210	33.01	-19.17
	16-QAM	1907.5	-10.20	1 / 0	23.64	13.44	22.080	33.01	-19.57
	QPSK	1860.0	-10.20	1 / 0	24.08	13.88	24.434	33.01	-19.13
		1882.5	-10.20	1 / 0	23.99	13.79	23.933	33.01	-19.22
		1905.0	-10.20	1 / 50	24.23	14.03	25.293	33.01	-18.98
	16-QAM	1905.0	-10.20	1 / 50	23.56	13.36	21.677	33.01	-19.65

Table 7-2. Antenna FCM EIRP Data (LTE Band 25)

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Antenna FCM LTE Band 2

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	1850.7	-10.20	1 / 5	24.07	13.87	24.378	33.01	-19.14
		1880.0	-10.20	1 / 3	24.11	13.91	24.604	33.01	-19.10
		1909.3	-10.20	1 / 3	24.31	14.11	25.763	33.01	-18.90
	16-QAM	1880.0	-10.20	1 / 5	23.53	13.33	21.528	33.01	-19.68
3 MHz	QPSK	1851.5	-10.20	1 / 14	24.09	13.89	24.491	33.01	-19.12
		1880.0	-10.20	1 / 0	24.36	14.16	26.062	33.01	-18.85
		1908.5	-10.20	1 / 0	24.08	13.88	24.434	33.01	-19.13
	16-QAM	1880.0	-10.20	1 / 0	23.55	13.35	21.627	33.01	-19.66
5 MHz	QPSK	1852.5	-10.20	1 / 24	24.16	13.96	24.889	33.01	-19.05
		1880.0	-10.20	1 / 24	24.15	13.95	24.831	33.01	-19.06
		1907.5	-10.20	1 / 12	24.32	14.12	25.823	33.01	-18.89
	16-QAM	1880.0	-10.20	1 / 0	23.65	13.45	22.131	33.01	-19.56
10 MHz	QPSK	1855.0	-10.20	1 / 49	24.19	13.99	25.061	33.01	-19.02
		1880.0	-10.20	1 / 49	24.22	14.02	25.235	33.01	-18.99
		1905.0	-10.20	1 / 49	24.05	13.85	24.266	33.01	-19.16
	16-QAM	1880.0	-10.20	1 / 0	23.56	13.36	21.677	33.01	-19.65
15 MHz	QPSK	1857.5	-10.20	1 / 0	24.26	14.06	25.468	33.01	-18.95
		1880.0	-10.20	1 / 0	24.15	13.95	24.831	33.01	-19.06
		1902.5	-10.20	1 / 37	24.10	13.90	24.547	33.01	-19.11
	16-QAM	1880.0	-10.20	1 / 74	23.54	13.34	21.577	33.01	-19.67
20 MHz	QPSK	1860.0	-10.20	1 / 99	24.28	14.08	25.586	33.01	-18.93
		1880.0	-10.20	1 / 0	24.18	13.98	25.003	33.01	-19.03
		1900.0	-10.20	1 / 50	24.12	13.92	24.660	33.01	-19.09
	16-QAM	1900.0	-10.20	1 / 50	23.64	13.44	22.080	33.01	-19.57

Table 7-3. Antenna FCM EIRP Data (LTE Band 2)

Antenna FCM WCDMA PCS

Frequency [MHz]	Mode	Conducted Power [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1852.40	WCDMA1900	23.81	-10.20	13.61	22.961	33.01	-19.40
1880.00	WCDMA1900	23.82	-10.20	13.62	23.014	33.01	-19.39
1907.60	WCDMA1900	23.86	-10.20	13.66	23.227	33.01	-19.35

Table 7-4. Antenna FCM EIRP Data (WCDMA PCS)

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7.7 Radiated Spurious Emissions

§2.1053, 24.238(a)

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 tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements 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 $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $\geq 2 \times$ 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.

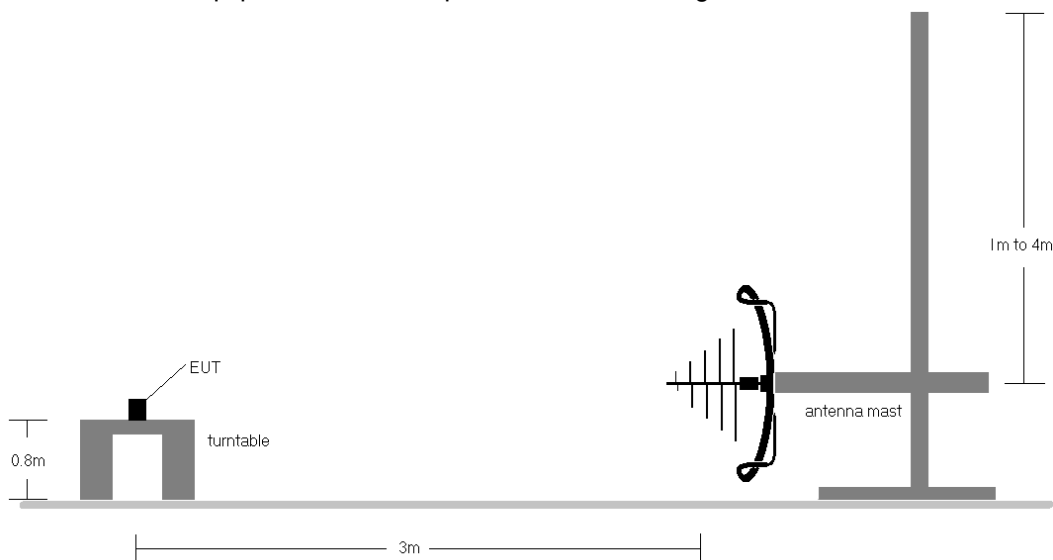


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

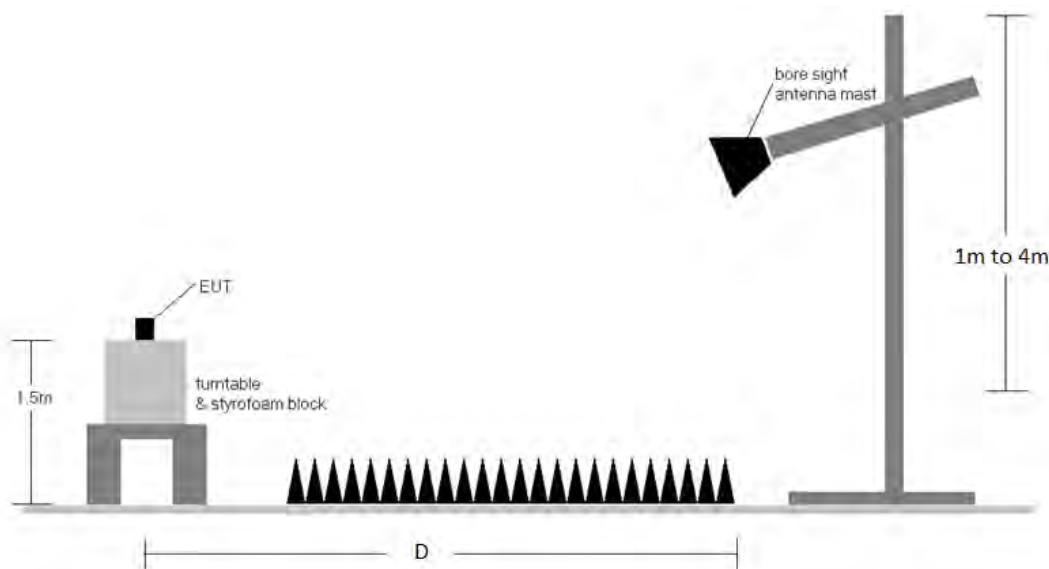


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

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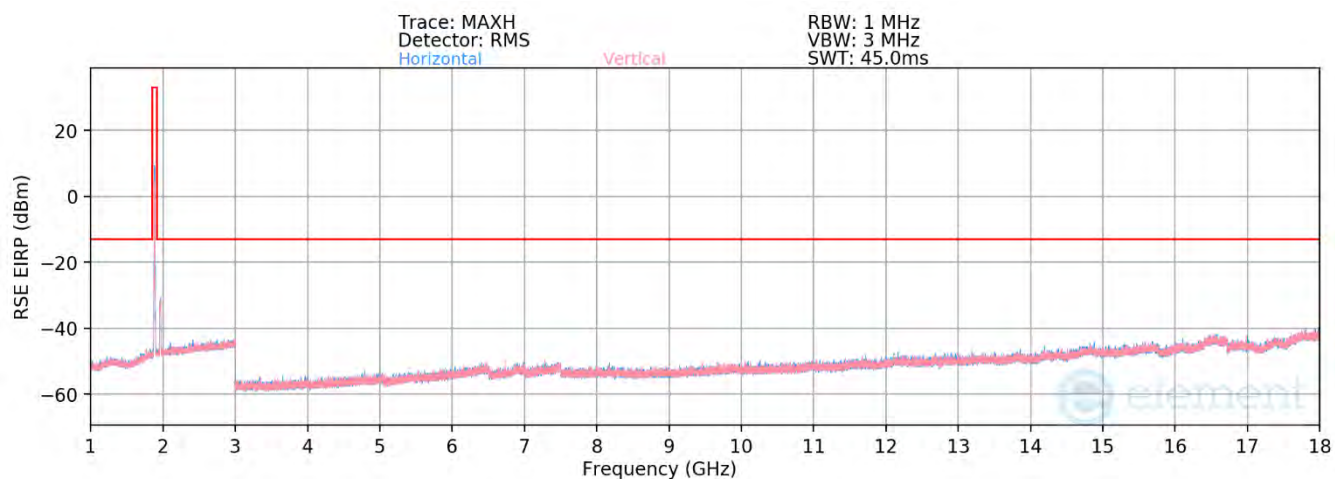
Test Notes

1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
 - a. $E(\text{dB}\mu\text{V}/\text{m}) = \text{Measured amplitude level (dBm)} + 107 + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$
 - b. $\text{EIRP (dBm)} = E(\text{dB}\mu\text{V}/\text{m}) + 20\log D - 104.8$; where D is the measurement distance in meters.
2. This device employs UMTS technology with WCDMA (AMR/RMC) and HSDPA capabilities. The EUT was tested under all configurations and the highest power is reported in WCDMA mode with HSDPA Inactive at 12.2 kbps RMC and TPC bits all set to "1".
3. 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.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.
6. 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.
7. No significant emissions were found for below 1GHz and Above 18GHz measurement.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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7.7.1 Antenna FCM – Radiated Spurious Emission Measurement LTE Band 25/2



Plot 7-109. Antenna FCM Radiated Spurious Plot (LTE Band 25/2)

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Bandwidth (MHz):	20
Frequency (MHz):	1860.0
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]
3720.0	H	-	-	-80.33	4.74	31.41	-63.85	-13.00	-50.85
5580.0	H	315	307	-73.53	6.94	40.41	-54.84	-13.00	-41.84
7440.0	H	-	-	-82.54	10.13	34.58	-60.68	-13.00	-47.68
9300.0	H	-	-	-83.33	11.71	35.38	-59.88	-13.00	-46.88
11160.0	H	-	-	-84.22	14.48	37.26	-58.00	-13.00	-45.00

Table 7-5. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1882.5
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]
3765.0	V	-	-	-80.07	4.88	31.81	-63.44	-13.00	-50.44
5647.5	V	311	110	-69.01	7.43	45.42	-49.84	-13.00	-36.84
7530.0	V	-	-	-82.95	10.24	34.29	-60.97	-13.00	-47.97
9412.5	V	-	-	-83.28	12.37	36.09	-59.17	-13.00	-46.17
11295.0	V	-	-	-84.30	14.47	37.17	-58.09	-13.00	-45.09

Table 7-6. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1905.0
RB / Offset:	2 / 50

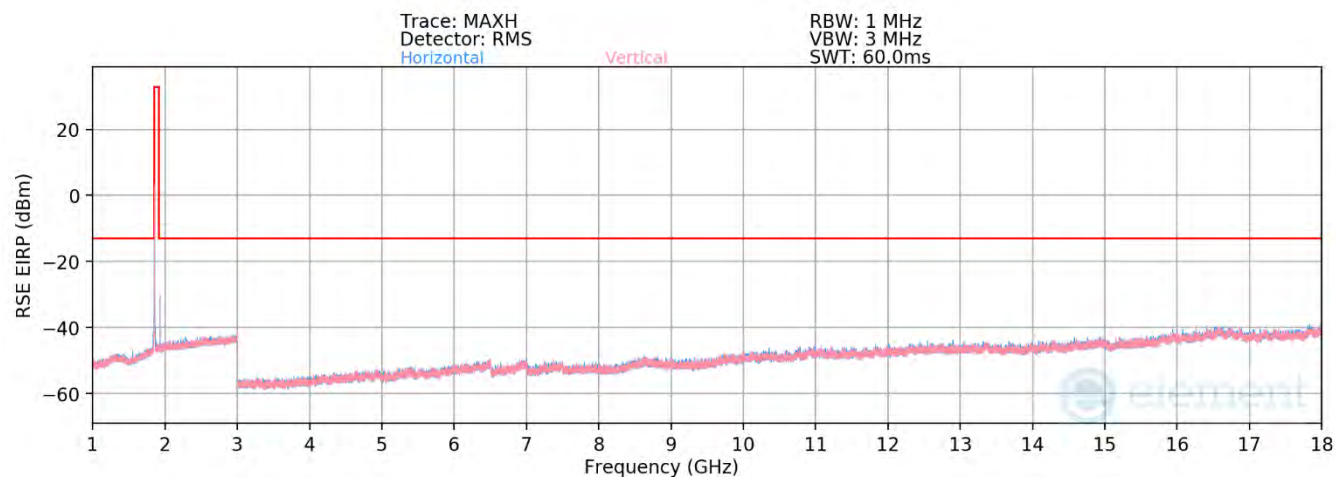
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3810.00	H	-	-	-80.36	4.76	31.40	-63.86	-13.00	-50.86
5715.00	H	106	293	-77.88	7.83	36.95	-58.31	-13.00	-45.31
7620.00	H	-	-	-83.01	10.45	34.44	-60.82	-13.00	-47.82
9525.00	H	-	-	-83.88	12.63	35.75	-59.50	-13.00	-46.50
11430.00	H	-	-	-84.29	14.46	37.17	-58.09	-13.00	-45.09

Table 7-7. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – High Channel)

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WCDMA PCS



Plot 7-110. Antenna FCM Radiated Spurious Plot (WCDMA PCS)

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Mode:	WCDMA RMC
Channel:	9262
Frequency (MHz):	1852.4

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]
3704.8	H	-	-	-80.90	6.23	32.33	-62.93	-13.00	-49.93
5557.2	V	398	162	-80.12	9.59	36.47	-58.79	-13.00	-45.79
7409.6	H	-	-	-83.07	12.08	36.01	-59.25	-13.00	-46.25
9262.0	H	-	-	-83.99	13.43	36.44	-58.82	-13.00	-45.82

Table 7-8. Antenna FCM Radiated Spurious Data (WCDMA PCS – Low Channel)

Mode:	WCDMA RMC
Channel:	9400
Frequency (MHz):	1880

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3760.0	V	369	358	-80.47	6.04	32.57	-62.69	-13.00	-49.69
5640.0	V	178	162	-80.63	8.94	35.31	-59.94	-13.00	-46.94
7520.0	H	-	-	-83.20	12.56	36.36	-58.90	-13.00	-45.90
9400.0	H	-	-	-84.01	14.46	37.45	-57.81	-13.00	-44.81
11280.0	H	-	-	-84.31	16.59	39.28	-55.98	-13.00	-42.98

Table 7-9. Antenna FCM Radiated Spurious Data (WCDMA PCS – Mid Channel)

Mode:	WCDMA RMC
Channel:	9538
Frequency (MHz):	1907.6

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]
3815.2	H	-	-	-80.82	5.91	32.09	-63.17	-13.00	-50.17
5722.8	V	400	198	-78.44	8.96	37.52	-57.73	-13.00	-44.73
7630.4	V	-	-	-82.45	12.19	36.74	-58.52	-13.00	-45.52
9538.0	V	-	-	-84.32	14.43	37.11	-58.15	-13.00	-45.15
11445.6	V	-	-	-84.29	16.74	39.45	-55.80	-13.00	-42.80

Table 7-10. Antenna FCM Radiated Spurious Data (WCDMA PCS – High Channel)

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7.8 Frequency Stability / Temperature Variation

\$2.1055, \$24.235

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 24 the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI C63.26-2015

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

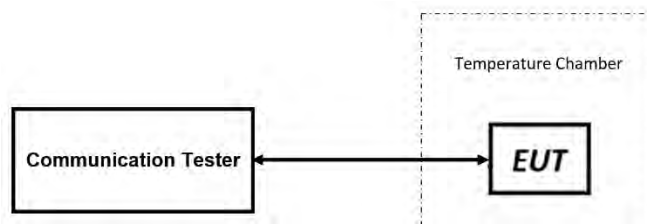


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

1. None.

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Frequency Stability / Temperature Variation

LTE Band 25/2							
			Low Channel Frequency (Hz):		1,860,000,000		
			High Channel Frequency (Hz):		1,905,000,000		
			Ref. Voltage (VDC):		3.80		
Voltage (%)	Power (VDC)	Temp (°C)	Low Freq. (Hz)	High Freq. (Hz)	Low Freq. Dev. (Hz)	High Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	1,860,000,000	1,905,000,001	0.68	1.63	0.00000009
		- 20	1,859,999,999	1,905,000,000	0.21	0.75	0.00000004
		- 10	1,859,999,999	1,904,999,999	-0.62	-0.79	-0.00000004
		0	1,859,999,999	1,904,999,999	-0.47	-0.59	-0.00000003
		+ 10	1,859,999,998	1,904,999,999	-0.87	-0.69	-0.00000005
		+ 20 (Ref)	1,859,999,999	1,904,999,999	0.00	0.00	0.00000000
		+ 30	1,859,999,998	1,904,999,999	-0.92	-0.47	-0.00000005
		+ 40	1,859,999,999	1,905,000,000	-0.69	0.58	-0.00000004
		+ 50	1,859,999,999	1,904,999,999	-0.70	-0.54	-0.00000004
Battery Endpoint	3.40	+ 20	1,860,000,000	1,904,999,998	0.39	-1.29	-0.00000007

Table 7-11. LTE Band 25/2 Frequency Stability Data

Note: The lowest and highest channel of this band have been tested and is determined to remain operating in-band over the temperature and voltage range as tested

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WCDMA PCS

WCDMA PCS							
			Low Channel Frequency (Hz):		1,852,400,000		
			High Channel Frequency (Hz):		1,907,600,000		
			Ref. Voltage (VDC):		3.80		
Voltage (%)	Power (VDC)	Temp (°C)	Low Freq. (Hz)	High Freq. (Hz)	Low Freq. Dev. (Hz)	High Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	1,852,400,000	1,907,599,999	0.55	-0.39	0.00000003
		- 20	1,852,400,000	1,907,599,999	0.48	-0.64	-0.00000003
		- 10	1,852,399,998	1,907,599,998	-0.85	-1.02	-0.00000005
		0	1,852,399,999	1,907,599,998	-0.75	-0.88	-0.00000005
		+ 10	1,852,399,999	1,907,599,998	-0.57	-0.79	-0.00000004
		+ 20 (Ref)	1,852,399,999	1,907,599,999	0.00	0.00	0.00000000
		+ 30	1,852,400,000	1,907,599,999	0.48	-0.67	-0.00000004
		+ 40	1,852,400,000	1,907,599,998	0.88	-1.07	-0.00000006
Battery Endpoint	3.40	+ 50	1,852,399,999	1,907,600,000	-0.64	0.92	0.00000005
		+ 20	1,852,399,998	1,907,600,000	-1.42	0.91	-0.00000008

Table 7-12. WCDMA PCS Frequency Stability Data

Note: The lowest and highest channel of this band have been tested and is determined to remain operating in-band over the temperature and voltage range as tested

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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-A2774** complies with all the requirements of Part 24 of the FCC rules.

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9.0 APPENDIX A

Antenna gains provided by manufacturer:

Cellular Antenna Gain (FCM), Type: IFA			
Band	Frequency (MHz)	Horizontal (dBi)	Vertical (dBi)
1	1921.6	-10.6	-10.5
1	1950.0	-10.4	-10.6
1	1978.4	-10.7	-10.5
3	1711.6	-12.5	-9.0
3	1747.5	-12.7	-10.3
3	1783.4	-12.7	-10.8
7	2502.6	-6.8	-6.7
7	2535.0	-8.9	-8.6
7	2567.4	-9.1	-9.0
25	1851.0	-10.8	-10.4
25	1882.4	-10.7	-10.2
25	1914.0	-10.3	-10.2
39	1882.6	-10.8	-10.4
39	1900.0	-10.3	-10.3
39	1917.4	-10.6	-10.4
40	2302.6	-7.3	-7.5
40	2350.0	-7.9	-7.9
41	2498.6	-6.8	-6.7
41	2593.0	-8.8	-9.0
41	2687.4	-8.4	-8.1

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