Element Washington DC LLC
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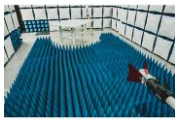

DATA REFERENCE REPORT
PART 22

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

Date of Testing:
4/6/2022 - 8/12/2022
Test Site/Location:
Element Washington DC LLC, Morgan Hill, CA, USA
Test Report Serial No.:
1C2205090043-01.BCG

FCC ID:	**BCG-A2684**
Applicant Name:	**Apple Inc.**

Reference Model:	A2622
Variant Model:	A2684 (A2859)
EUT Type:	Watch
FCC Classification:	PCS Licensed Transmitter Worn on Body (PCT)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

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

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.02

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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two watch device models, A2622 and A2684 (A2859), with high degree of similarity, reference model FCC ID: BCG-A2622 and variant model **FCC ID: BCG-A2684**. 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-A2622, while radiated and conducted spot-check verification has been performed on variant model FCC ID: BCG-A2684. 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-A2622	1C2205090042-01.BCG	RF Part 22 Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCG-A2622 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.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID:BCG-A2684**. 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 22.

Test Device Serial No.: *FN622250N6617WR4H, T7M2G97WC1, K96W0JGXNP*

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 BCM
LTE Band 5/26	-25.7
WCDMA 850	-25.7

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:	LF09D601GH
	w/ Cradle	Model:	LE1-POR-P1	S/N:	CYV1427015UE1EN01MP1J
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC217300381NR111
4	Pathfinder Falcon	Model:	920-11647-01	S/N:	HV007825
	SiP Socket	Model:	N/A	S/N:	X2920 P1 PF 142
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

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 various types of 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, Antennas BCM and FCM 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-A2684	
		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.

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:

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

And

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

Where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

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

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

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.77
Radiated Disturbance (<30MHz)	4.38
Radiated Disturbance (30MHz-1GHz)	4.75
Radiated Disturbance (1-18GHz)	5.20
Radiated Disturbance (>18GHz)	4.72

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:

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

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.

7.0 TEST RESULTS (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A2684

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-A2622	FCC ID: BCG-A2684	
						Average [dBm]	Average [dBm]	Average [dB]
LTE-B5	Radiated Spurious Emissions	QPSK	10MHz / 1/25 RB	L	1658.0	-67.02	-66.82	0.20
LTE-B5	Radiated Spurious Emissions	QPSK	10MHz / 1/25 RB	M	2509.5	-64.22	-63.41	0.81
LTE-B5	Radiated Spurious Emissions	QPSK	10MHz / 1/25 RB	H	1688.0	-67.28	-67.38	0.10
LTE-B5	Conducted Powers	QPSK	10MHz / 1/0 RB	M	836.5	24.96	25.24	0.28
LTE-B26	Conducted Powers	QPSK	10MHz / 1/0 RB	M	836.5	25.21	25.19	0.02
WCDMA B5	Conducted Powers	QPSK	5MHz	M	836.6	24.69	24.78	0.09

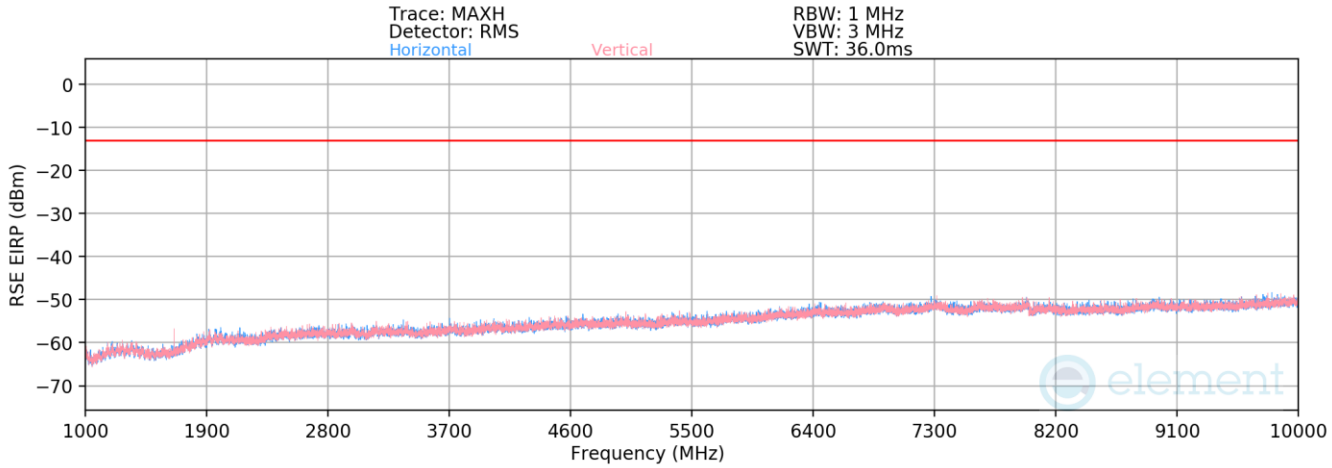
Table 7-1. Worst Case Spot-Check Results

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

7.2 Radiated Spurious Emissions

§2.1053, 22.917(a)

LTE



Plot 7-1. Radiated Spurious Emission above 1GHz (LTE Cell)

Bandwidth (MHz):	10
Frequency (MHz):	829.0
RB / Offset:	1 / 25

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]
1658.0	V	187	126	-76.82	-1.75	28.43	-66.82	-13.00	-53.82
2487.0	V	-	-	-78.32	2.98	31.66	-63.60	-13.00	-50.60
3316.0	V	-	-	-79.14	4.88	32.74	-62.52	-13.00	-49.52
4145.0	V	-	-	-79.23	5.72	33.49	-61.77	-13.00	-48.77

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

Bandwidth (MHz):	10
Frequency (MHz):	836.5
RB / Offset:	1 / 25

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]
1673.0	V	133	127	-76.63	-1.69	28.68	-66.57	-13.00	-53.57
2509.5	V	140	132	-77.94	2.79	31.85	-63.41	-13.00	-50.41
3346.0	V	-	-	-79.48	4.95	32.47	-62.79	-13.00	-49.79
4182.5	V	-	-	-79.09	5.42	33.33	-61.93	-13.00	-48.93

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

Bandwidth (MHz):	10
Frequency (MHz):	844.0
RB / Offset:	1 / 25

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]
1688.00	V	247	287	-77.56	-1.56	27.88	-67.38	-13.00	-54.38
2532.00	V	-	-	-78.14	2.70	31.56	-63.69	-13.00	-50.69
3376.00	V	-	-	-79.67	4.76	32.09	-63.17	-13.00	-50.17
4220.00	V	-	-	-78.98	5.64	33.66	-61.59	-13.00	-48.59

Table 7-4. Radiated Spurious Data (LTE Cell – High Channel)

7.3 Antenna BCM – ERP/EIRP

LTE-B5

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
10 MHz	QPSK	836.5	-25.70	1 / 0	25.24	**-2.61**	0.548	38.45	-41.06	**-0.46**	0.899	40.61	-41.07

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

LTE-B26

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
10 MHz	QPSK	836.5	-25.70	1 / 0	25.19	**-2.66**	0.542	38.45	-41.11	**-0.51**	0.889	40.61	-41.12

Table 7-6. Antenna BCM ERP/EIRP Data (LTE Band 26)

WCDMA B5

Frequency [MHz]	Mode	Conducted Power [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
836.60	WCDMA850	24.78	-25.70	**-3.07**	**0.493**	38.45	-41.52	**-0.92**	**0.809**	40.61	-41.53

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

8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCG-A2684** is in tolerance with reference model FCC ID: BCG-A2622 per FCC Approved Data Referencing Test Plan.

9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2205090042-01.BCG) from reference model FCC ID: BCG-A2622, which includes referenced data results.

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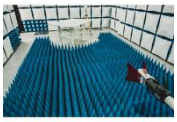

PART 22 MEASUREMENT REPORT

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

Date of Testing:
4/6/2022 - 8/12/2022
Test Site/Location:
Element Washington DC LLC. Morgan Hill, CA, USA
Test Report Serial No.:
1C2205090042-01.BCG

FCC ID:	**BCG-A2622**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A2622
EUT Type:	Watch
FCC Classification:	PCS Licensed Transmitter Worn on Body (PCT)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

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

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.02

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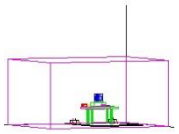
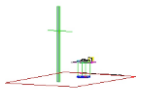


PART 22 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	ERP		EIRP		Emission Designator
					Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	
WCDMA850	5 MHz	Spread Spectrum	826.4 - 846.6	4.0955	0.499	-3.02	0.818	-0.87	4M10F9W
Band 5	1.4 MHz	QPSK	824.7 - 848.3	1.1019	0.542	-2.66	0.889	-0.51	1M10G7W
		16QAM	824.7 - 848.3	1.1086	0.451	-3.46	0.740	-1.31	1M11D7W
	3 MHz	QPSK	825.5 - 847.5	2.7182	0.522	-2.82	0.857	-0.67	2M72G7W
		16QAM	825.5 - 847.5	2.7132	0.457	-3.40	0.750	-1.25	2M71D7W
	5 MHz	QPSK	826.5 - 846.5	4.5763	0.530	-2.76	0.869	-0.61	4M58G7W
		16QAM	826.5 - 846.5	4.5537	0.471	-3.27	0.773	-1.12	4M55D7W
	10 MHz	QPSK	829.0 - 844.0	9.0829	0.524	-2.81	0.859	-0.66	9M08G7W
		16QAM	829.0 - 844.0	5.4095	0.459	-3.38	0.753	-1.23	5M41D7W
Band 26	1.4 MHz	QPSK	824.7 - 848.3	1.1019	0.553	-2.57	0.908	-0.42	1M10G7W
		16QAM	824.7 - 848.3	1.1086	0.475	-3.23	0.780	-1.08	1M11D7W
	3 MHz	QPSK	825.5 - 847.5	2.7182	0.557	-2.54	0.914	-0.39	2M72G7W
		16QAM	825.5 - 847.5	2.7132	0.465	-3.33	0.762	-1.18	2M71D7W
	5 MHz	QPSK	826.5 - 846.5	4.5763	0.558	-2.53	0.916	-0.38	4M58G7W
		16QAM	826.5 - 846.5	4.5537	0.494	-3.06	0.811	-0.91	4M55D7W
	10 MHz	QPSK	829.0 - 844.0	9.0829	0.547	-2.62	0.897	-0.47	9M08G7W
		16QAM	829.0 - 844.0	5.4095	0.489	-3.11	0.802	-0.96	5M41D7W

EUT Overview

1.0 INTRODUCTION

1.1 Scope

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

1.2 Element 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

Measurements were performed at Element Washington DC LLC 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.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A2622**. 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 22.

Test Device Serial No.: FN6208702PD17WR3Y, N4F4NXRFX1, D60XJGQ37M

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.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Band	Antenna Gain [dBi]
	Antenna BCM
LTE Band 5/26	-25.7
WCDMA 850	-25.7

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	C2QKP008F6F3
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
	Apple iPhone	Model:	993-89846LL/A	S/N:	QHLHY57CJ9
2	Apple USB-C cable	Model:	N/A	S/N:	N/A
	w/ Charging Dock	Model:	N/A	S/N:	LF09D601GH
	w/ Cradle	Model:	LE1-POR-P1	S/N:	CYV1427015UE1EN01MP1J
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC035200UJMFR0AJ
4	Pathfinder Falcon	Model:	920-11647-01	S/N:	HV007825
	SiP Socket	Model:	N/A	S/N:	X2920 P1 PF 142
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

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

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

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

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

2.6 Software and Firmware

The test was conducted with firmware version watchOS 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.

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.

Deviation from Measurement Procedure……..None

3.2 Radiated Spurious Emissions

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

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

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

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

And

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

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.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012.All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.77
Radiated Disturbance (<30MHz)	4.38
Radiated Disturbance (30MHz-1GHz)	4.75
Radiated Disturbance (1-18GHz)	5.20
Radiated Disturbance (>18GHz)	4.72

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:

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

6.0 SAMPLE CALCULATIONS

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 = 8M62G7D
LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 8M45W7D
LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A2622

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, 22.917(a)	-13 dBm at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Effective Radiated Power / Equivalent Isotropic Radiated Power	22.913(a)(5)	< 7 Watts max. ERP	PASS	Section 7.5
	Frequency Stability	2.1055, 22.355	±2.5 ppm	PASS	Section 7.7
RADIATED	Radiated Spurious Emissions	2.1053, 22.917(a)	-13 dBm for all out-of-band emissions	PASS	Section 7.6

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.

1. 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.

2. 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.

3. 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.

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.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

Test Settings

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

Test Setup

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

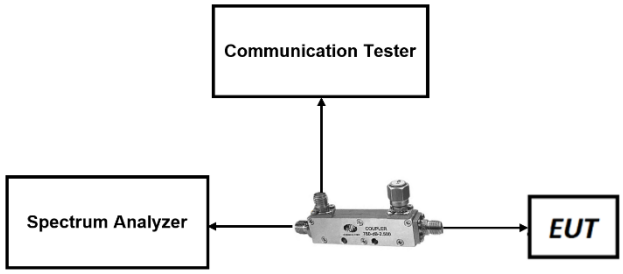
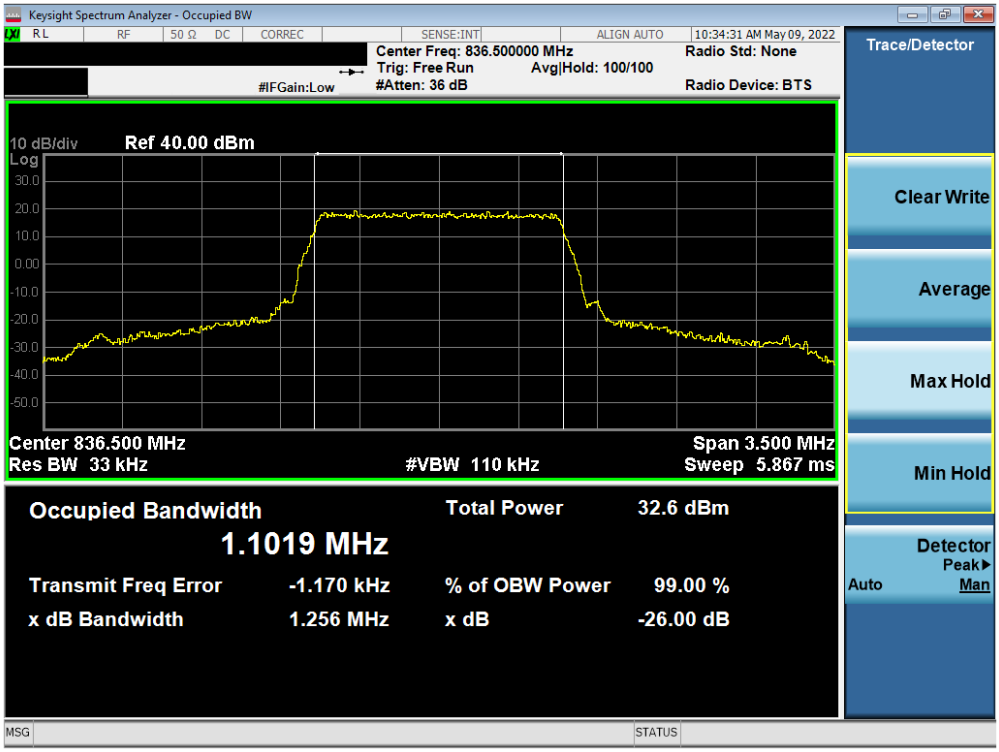


Figure 7-1. Test Instrument & Measurement Setup

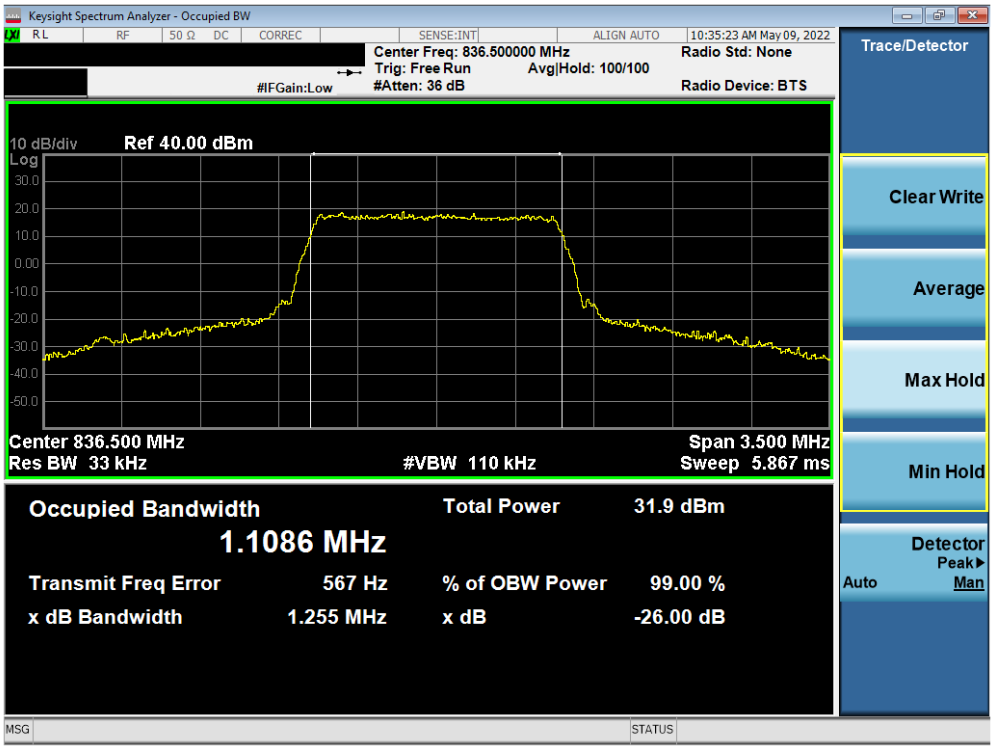
Test Notes

None.

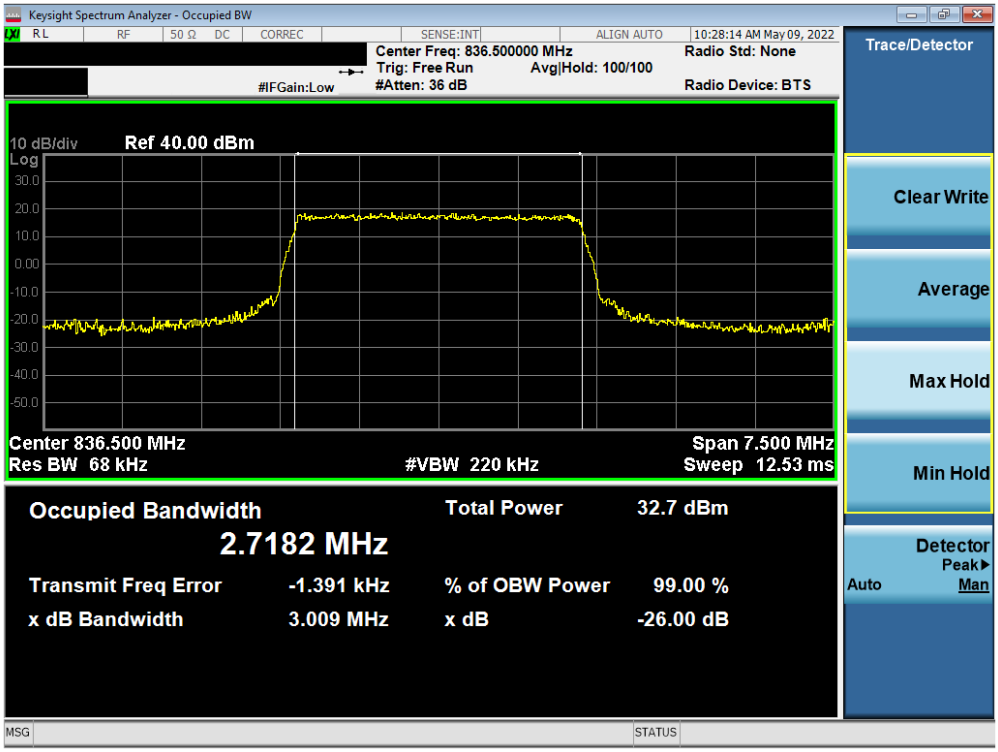
LTE Band 26/5



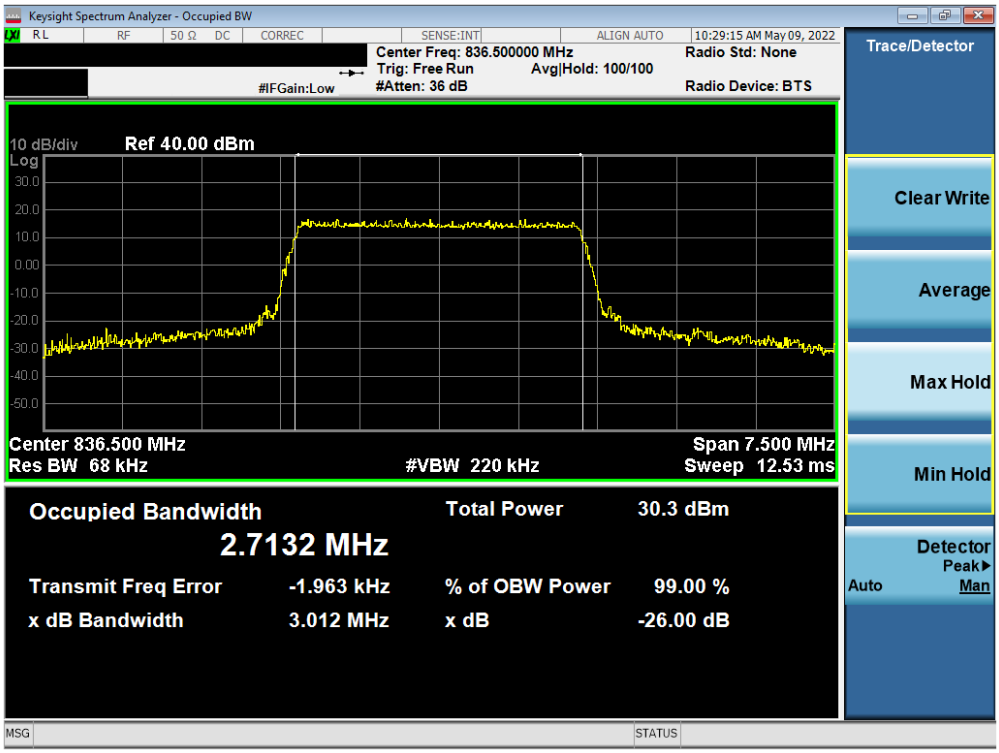
Plot 7-1. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz QPSK - Full RB Configuration)



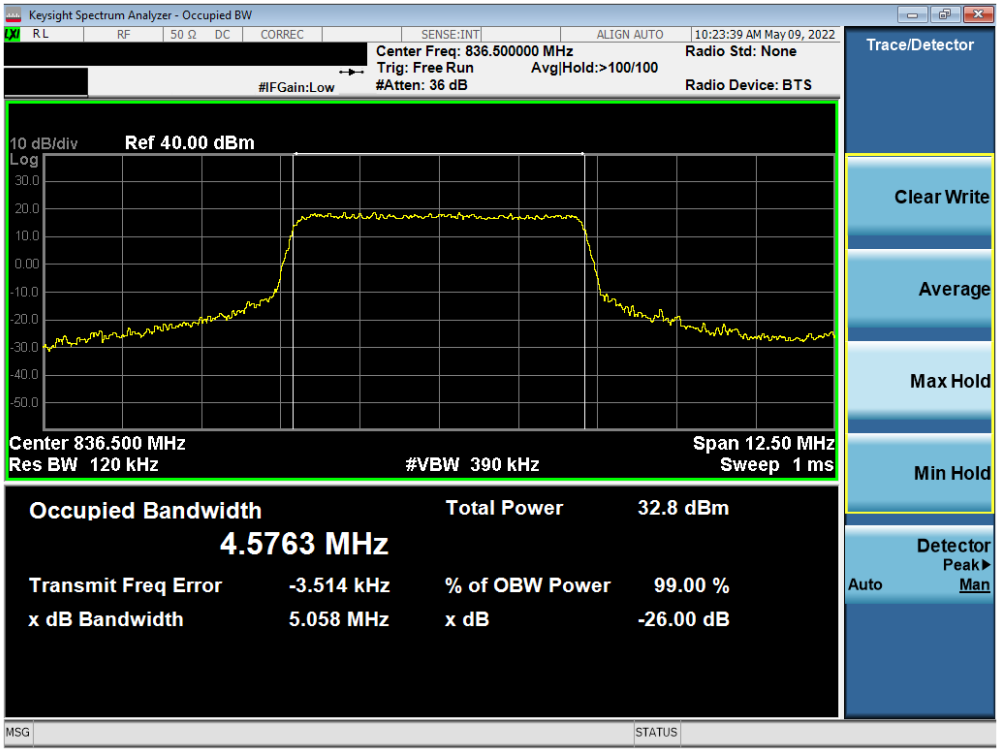
Plot 7-2. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 16-QAM - Full RB Configuration)



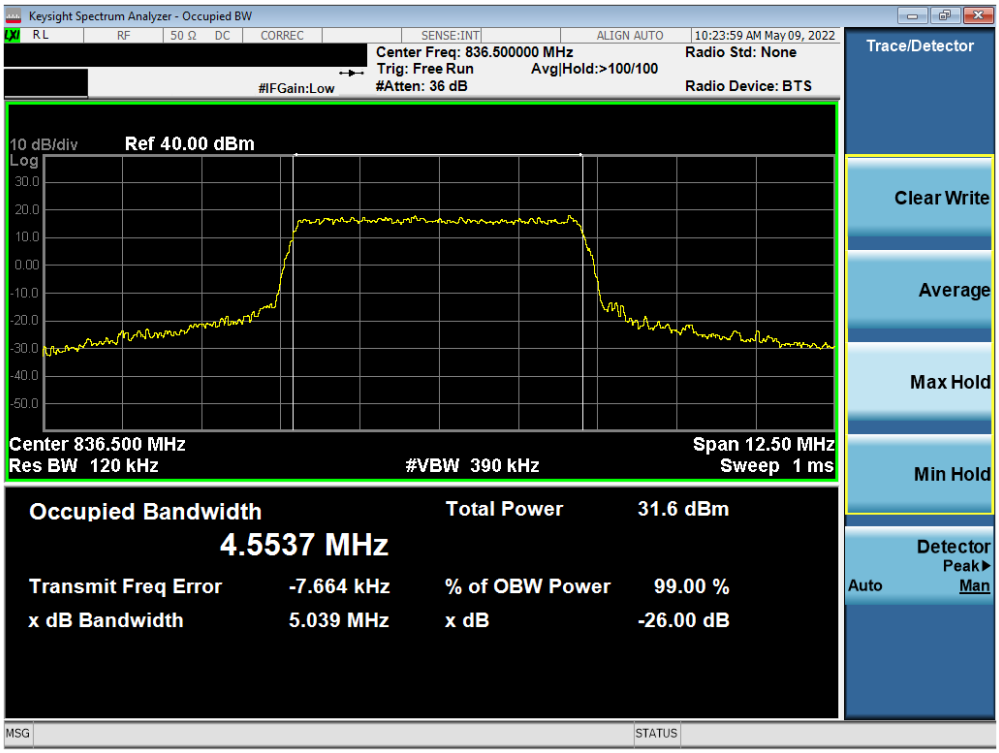
Plot 7-3. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz QPSK - Full RB Configuration)



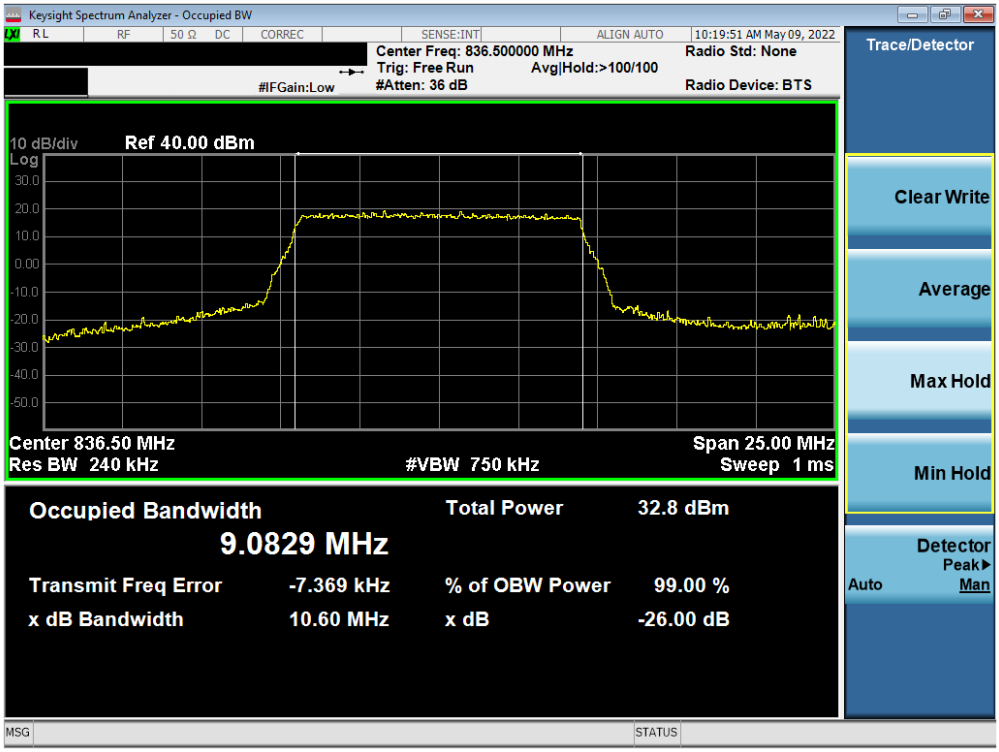
Plot 7-4. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 16-QAM - Full RB Configuration)



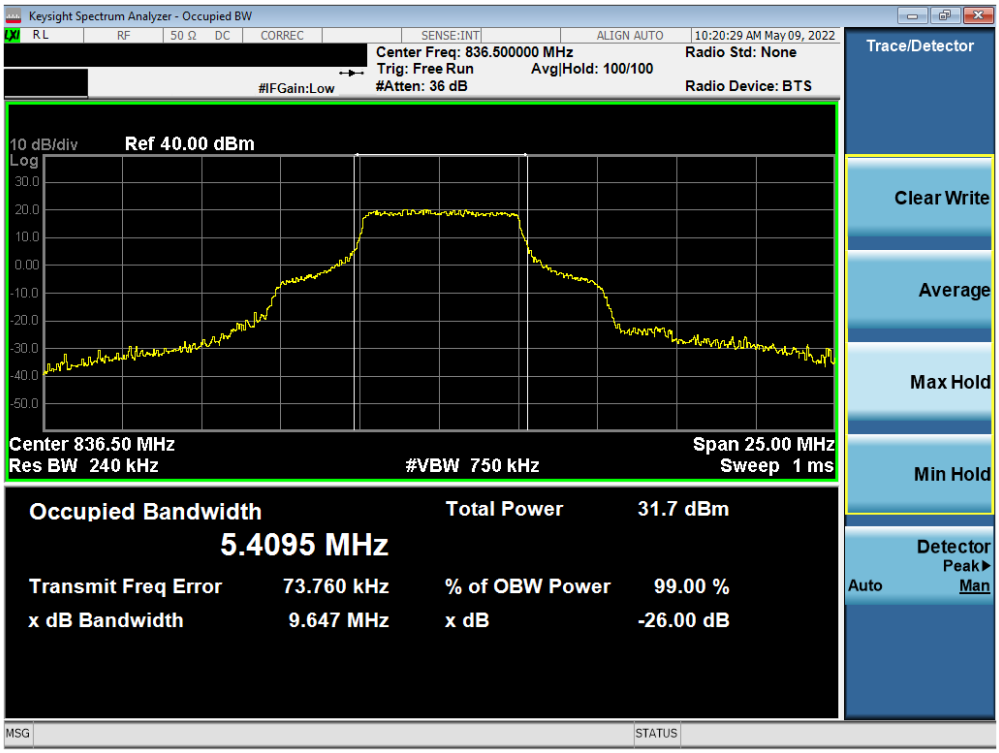
Plot 7-5. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB Configuration)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB Configuration)

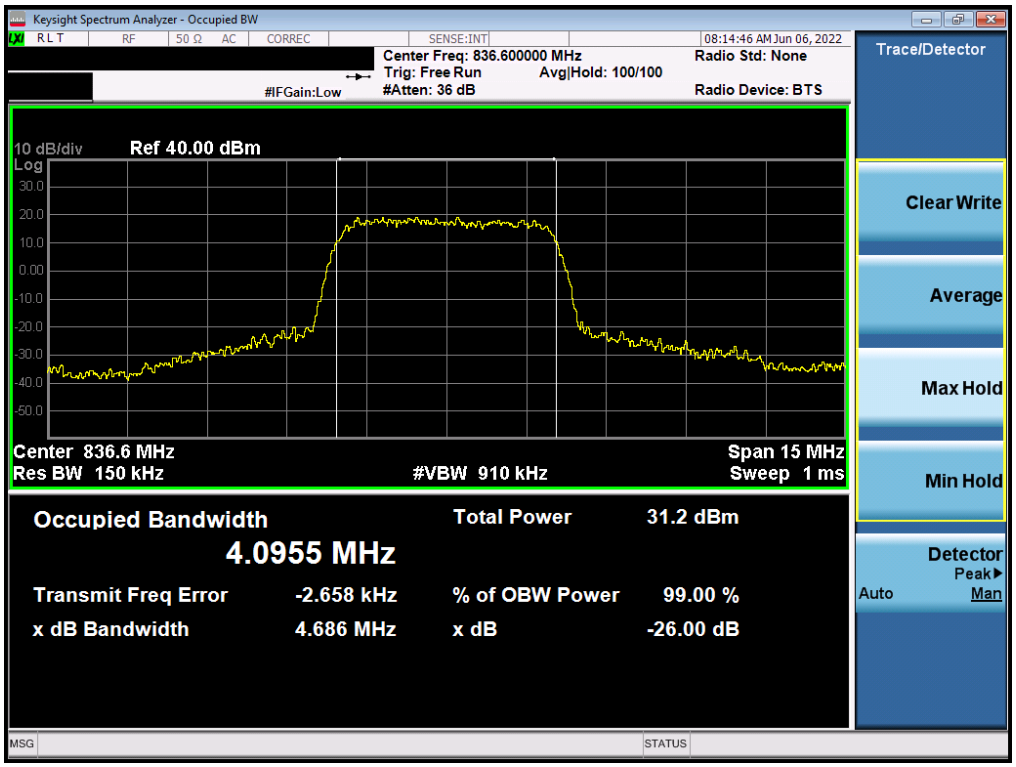


Plot 7-7. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB Configuration)

WCDMA Cell



Plot 7-9. Occupied Bandwidth Plot (WCDMA, Ch. 4183)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, 22.917(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.

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

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

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

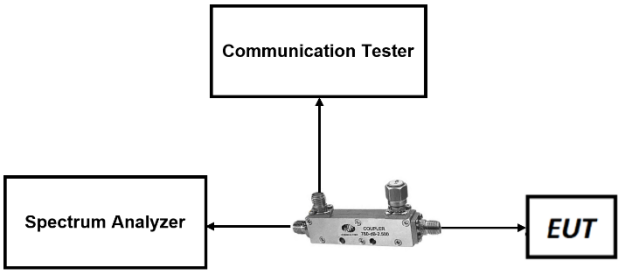
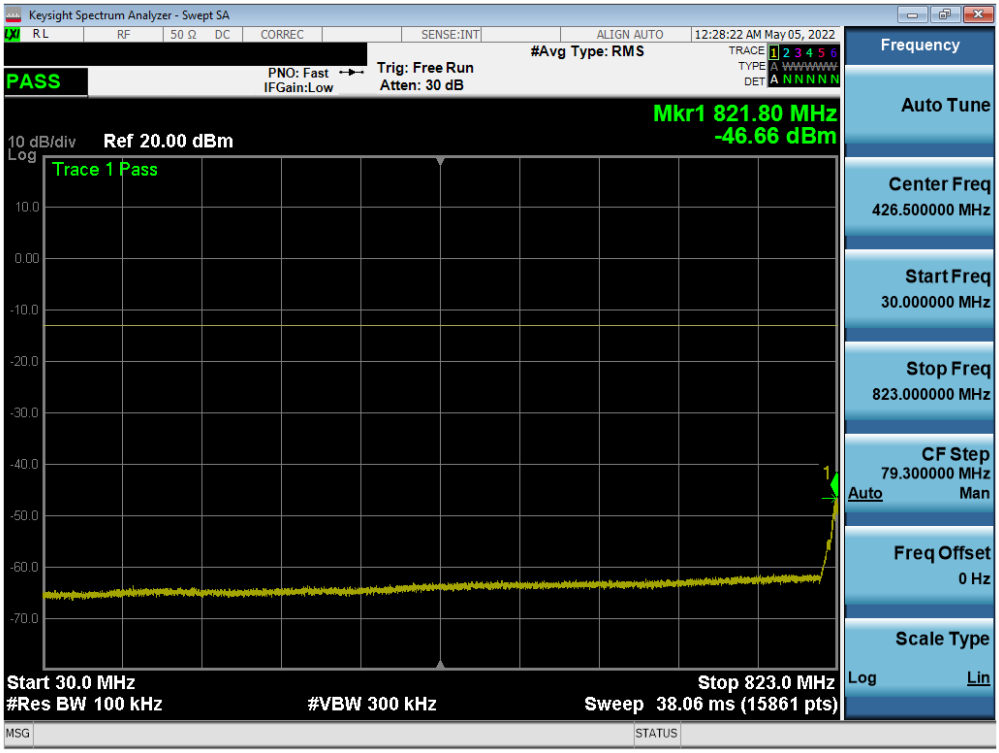


Figure 7-2. Test Instrument & Measurement Setup

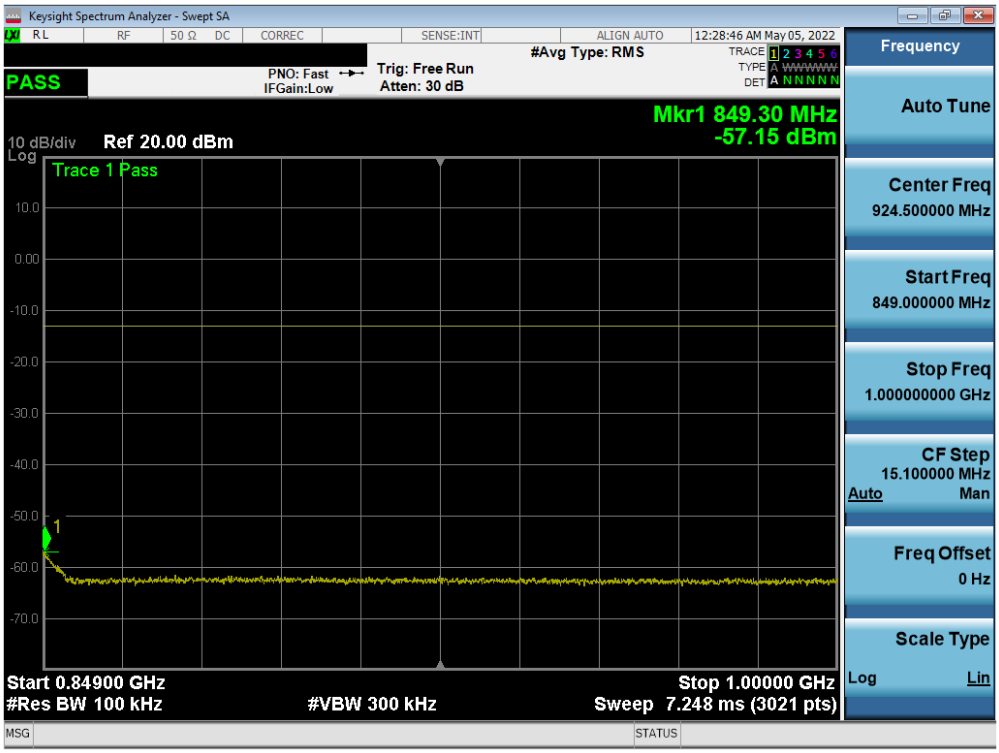
Test Notes

1. Per Part 22, 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.

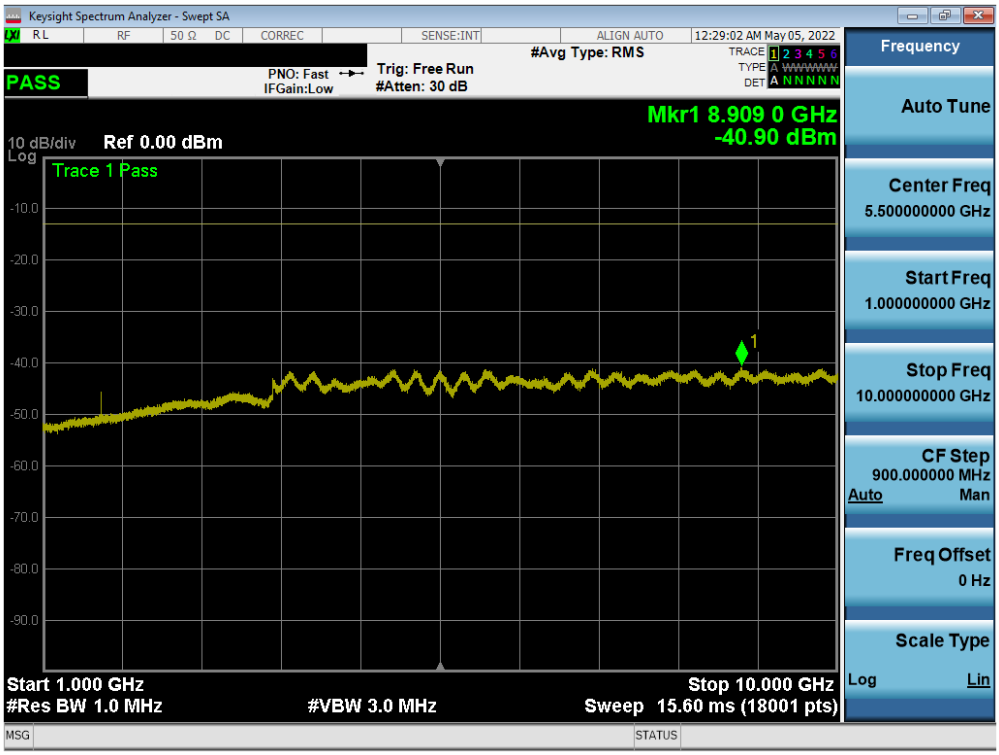
LTE Band 26/5



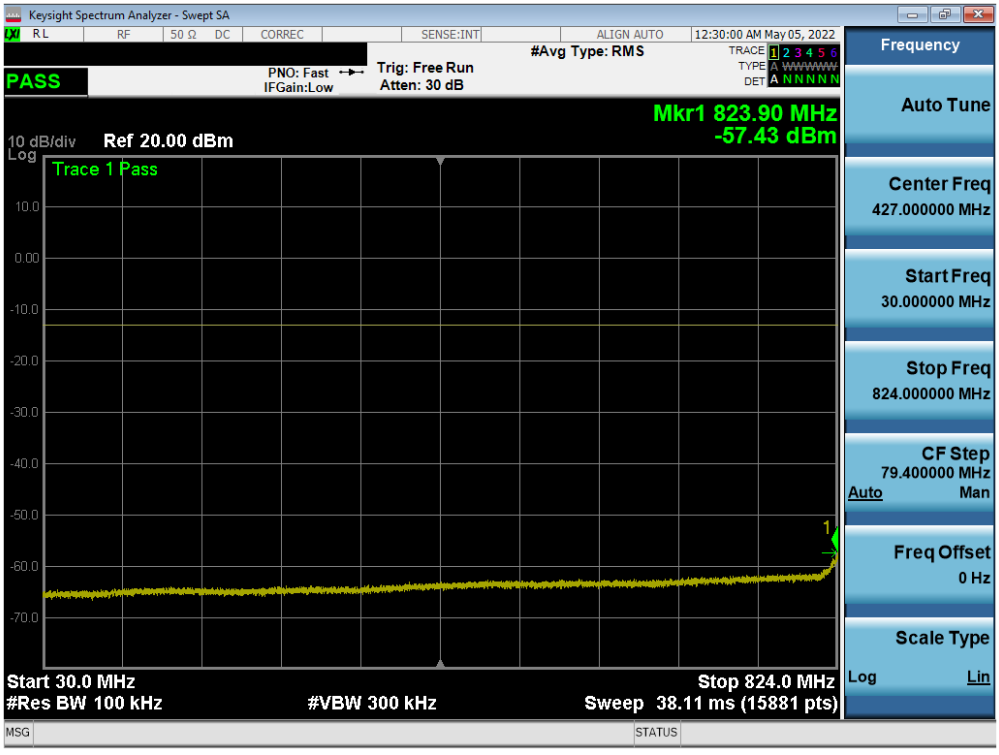
Plot 7-10. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



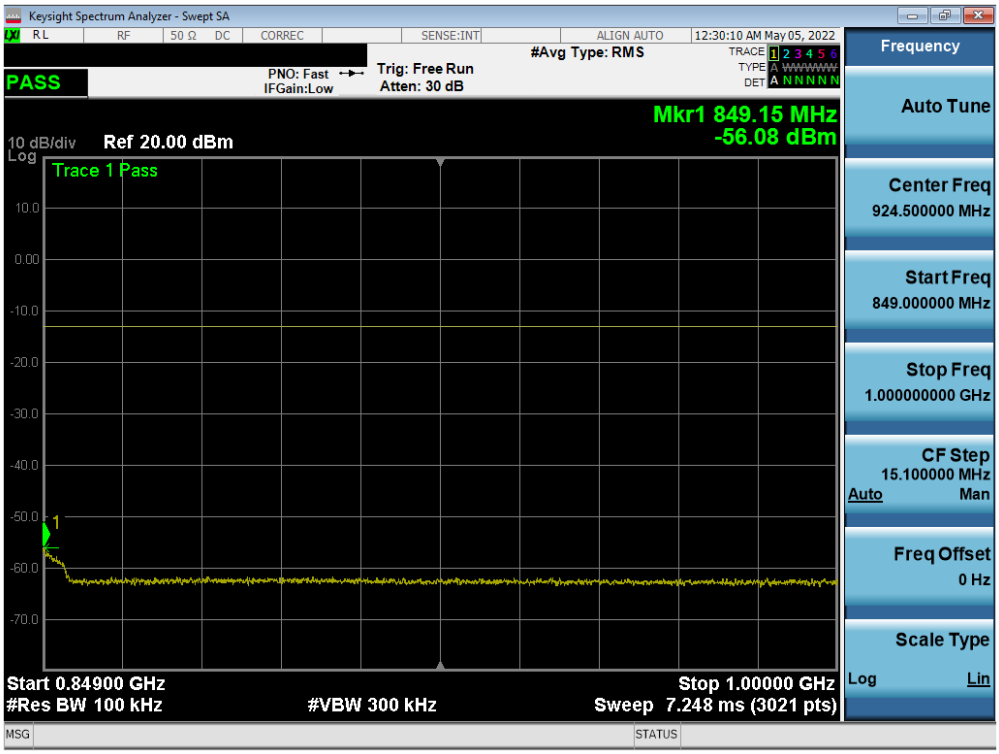
Plot 7-11. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



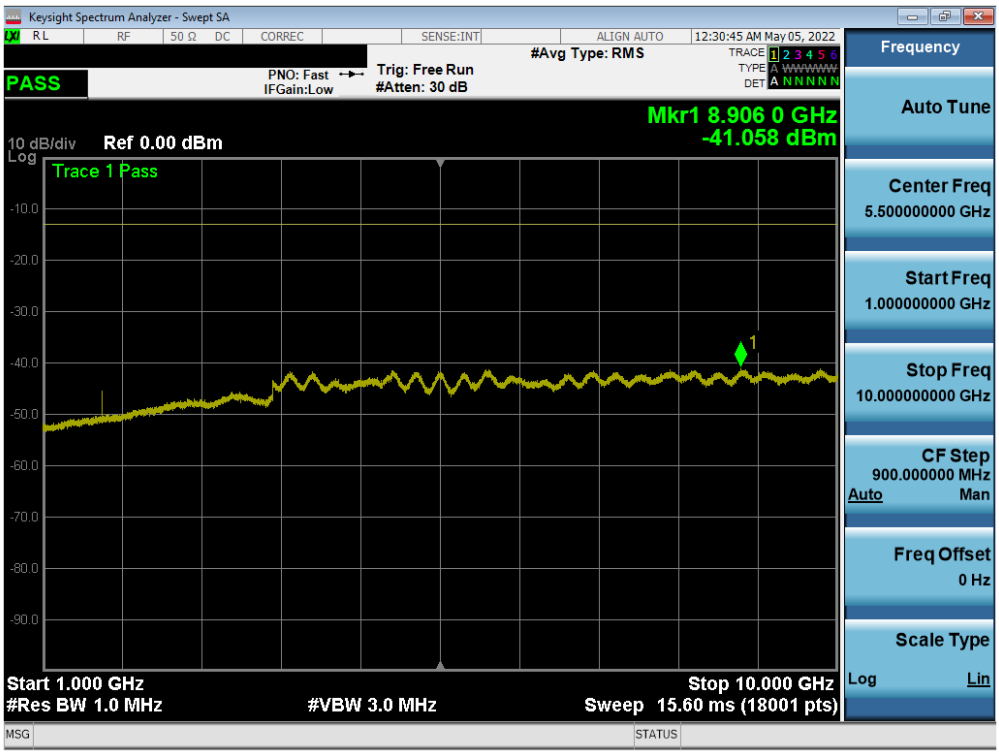
Plot 7-12. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



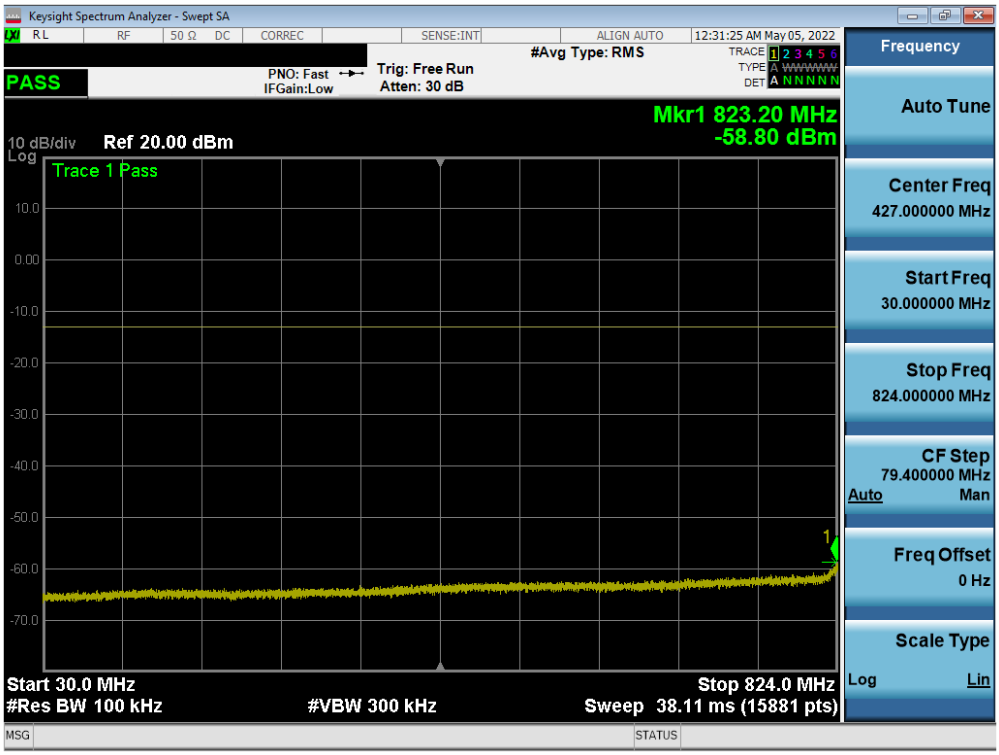
Plot 7-13. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



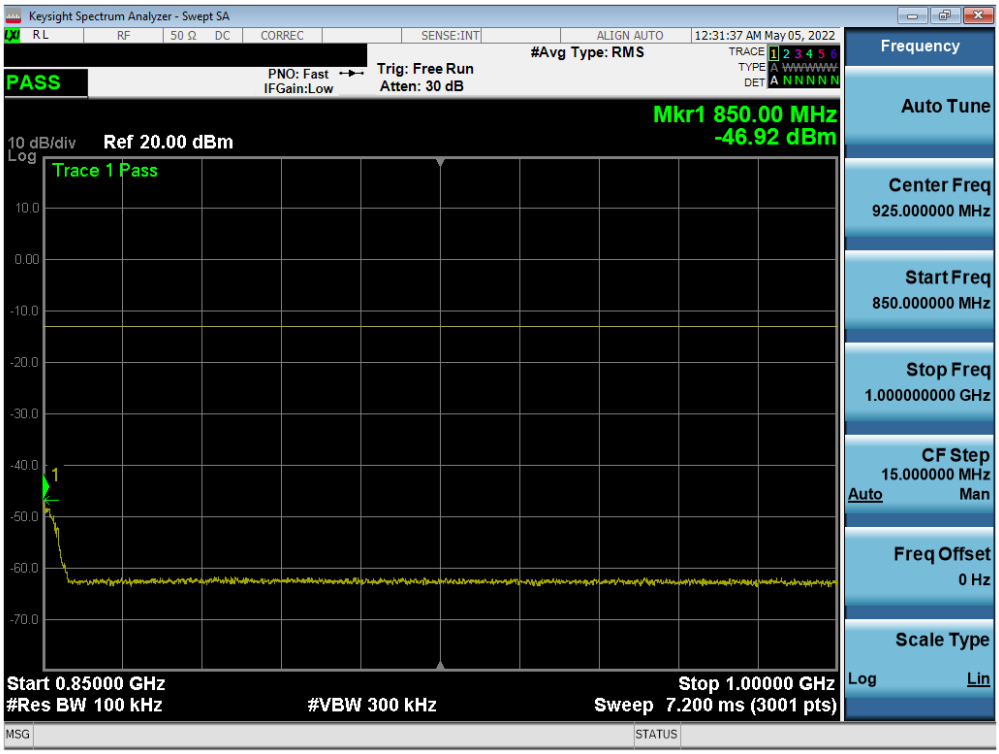
Plot 7-14. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



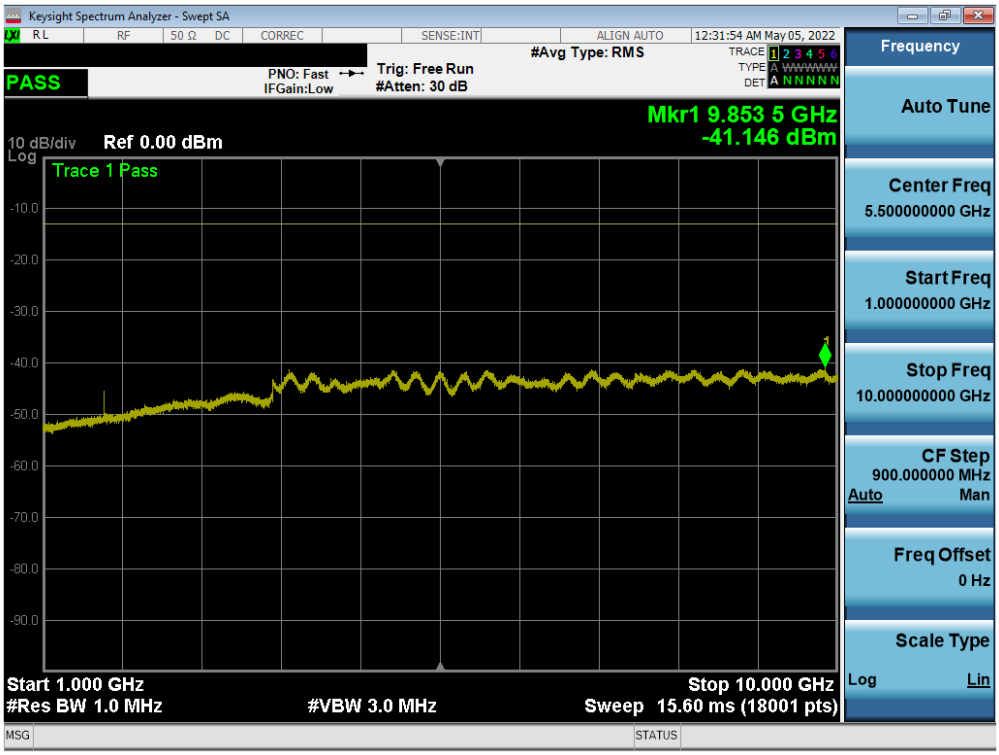
Plot 7-15. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



Plot 7-16. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

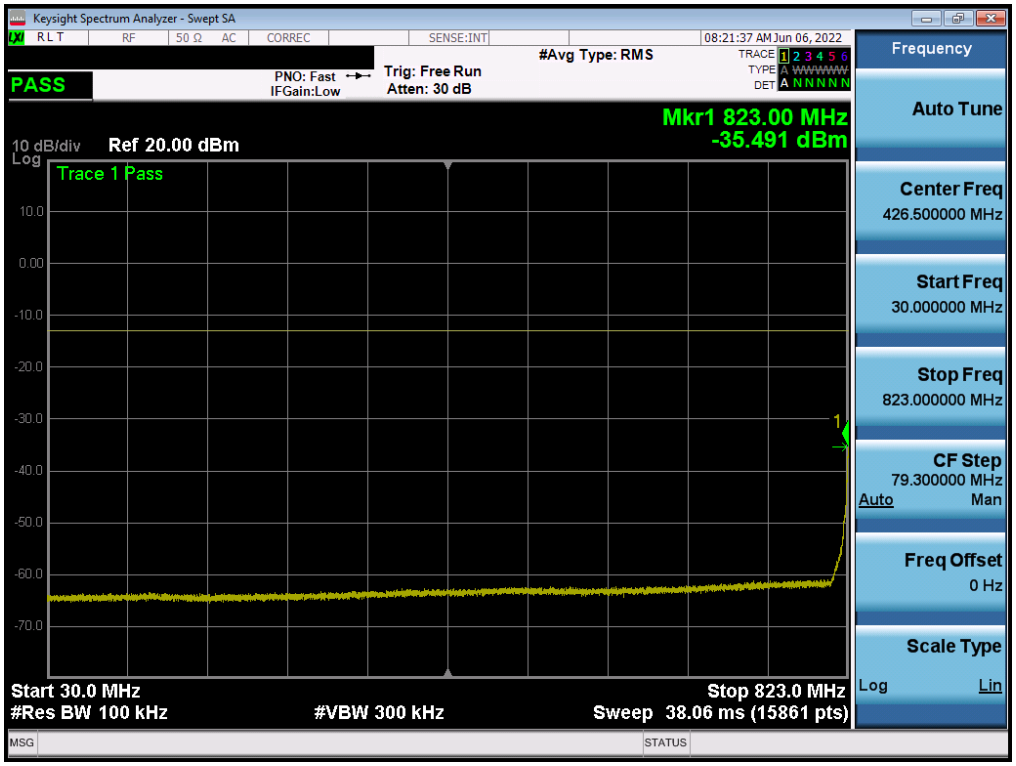


Plot 7-17. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

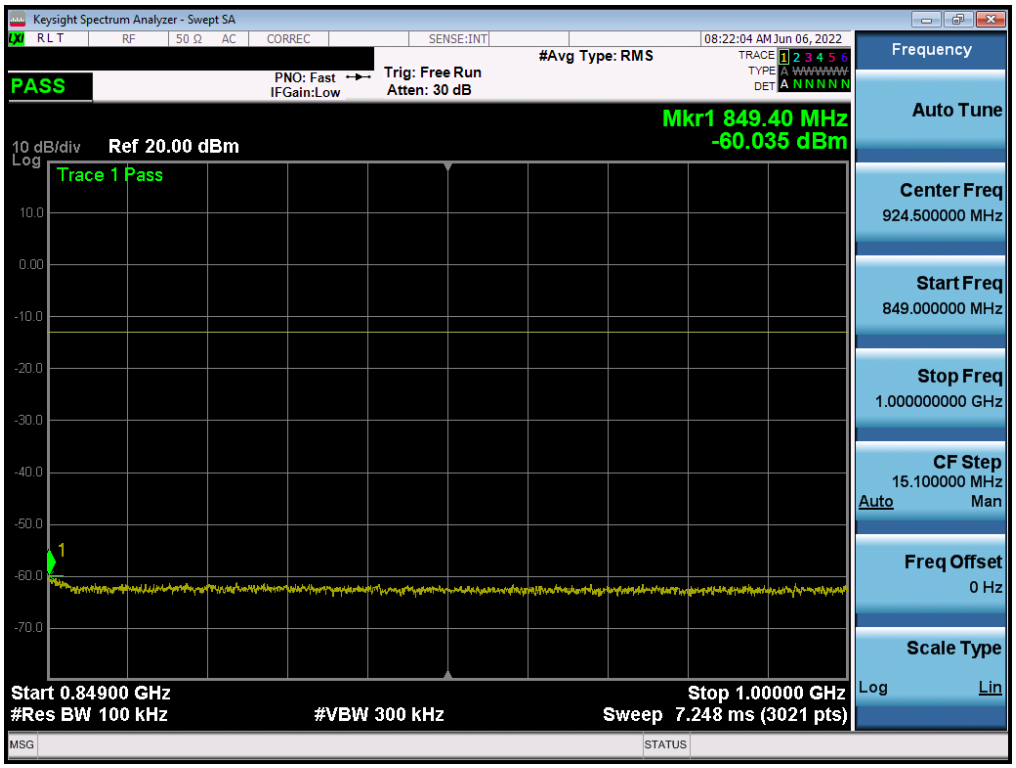


Plot 7-18. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

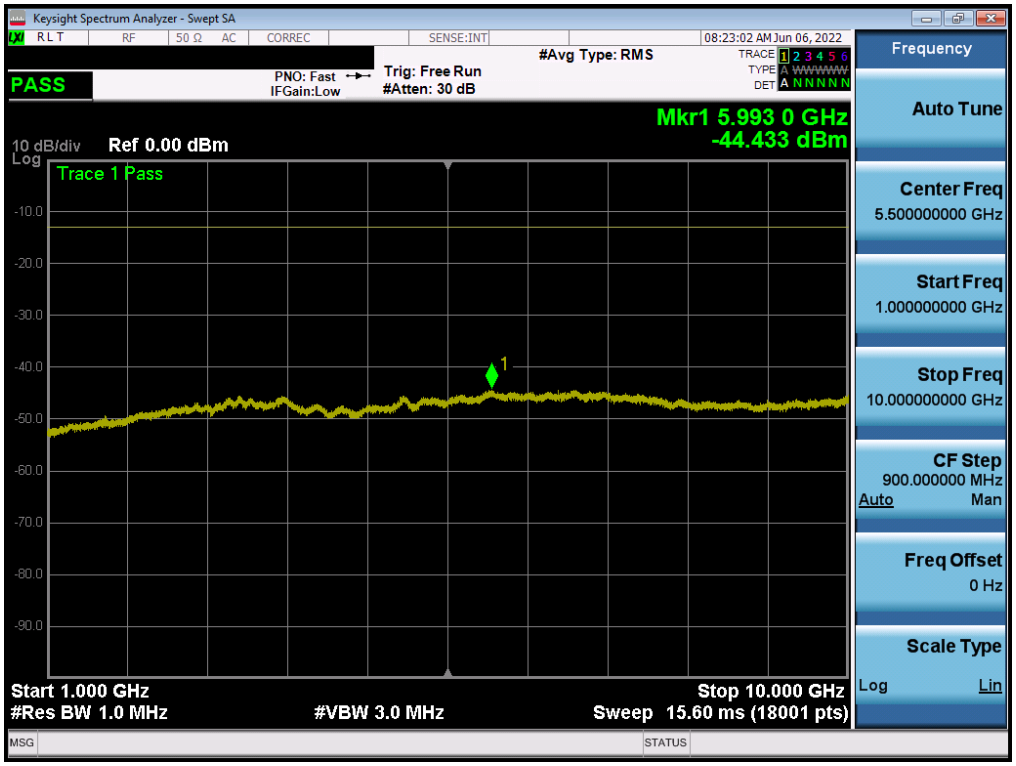
WCDMA Cell



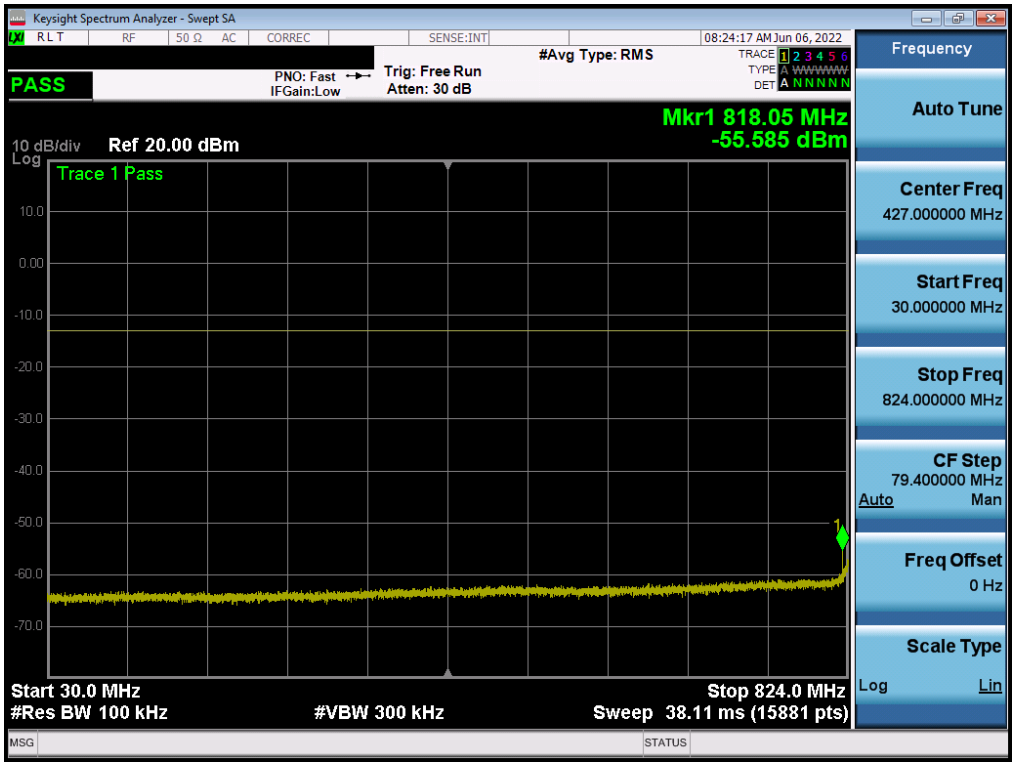
Plot 7-19. Conducted Spurious Plot (WCDMA Ch. 4132)



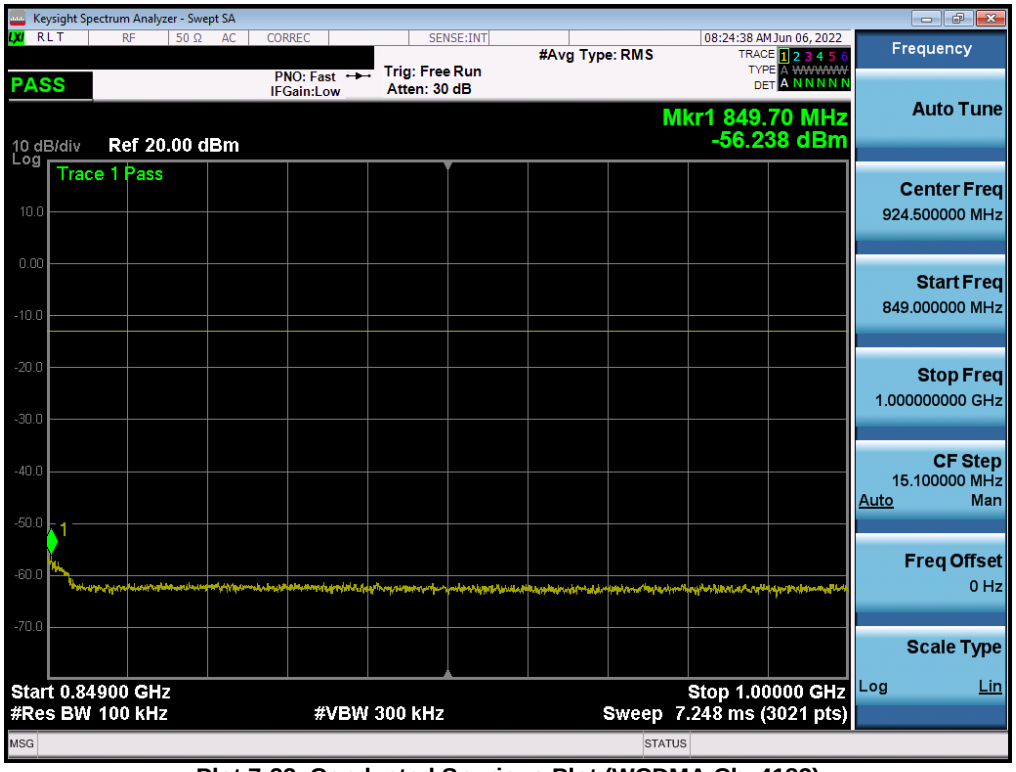
Plot 7-20. Conducted Spurious Plot (WCDMA Ch. 4132)



Plot 7-21. Conducted Spurious Plot (WCDMA Ch. 4132)

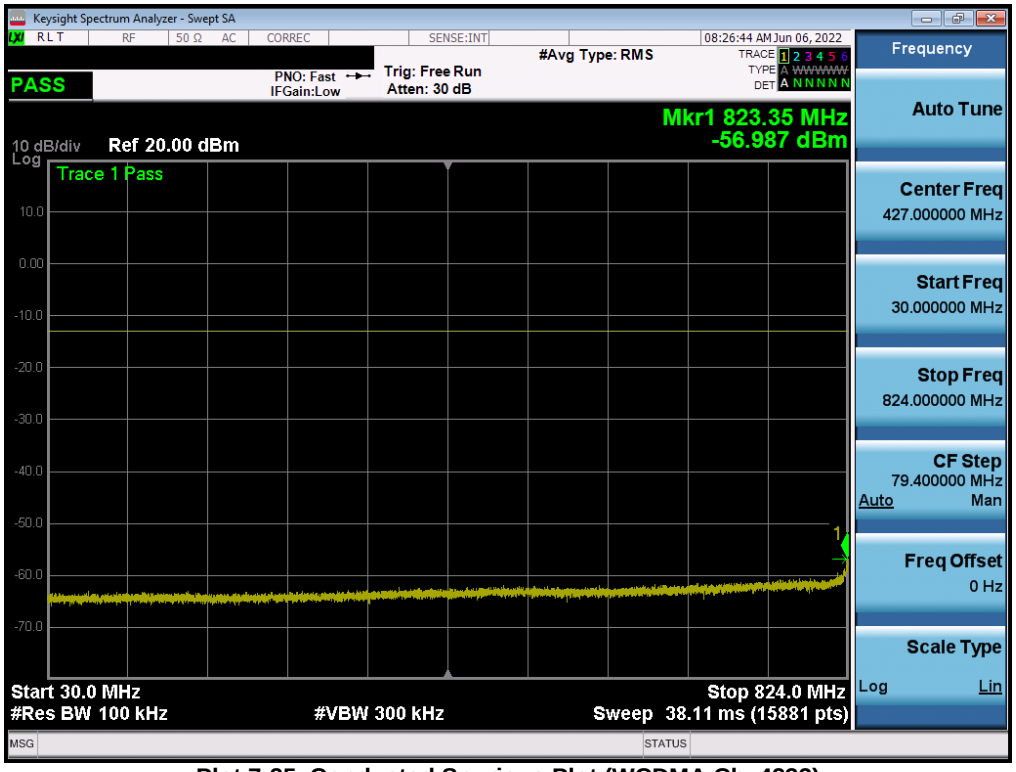


Plot 7-22. Conducted Spurious Plot (WCDMA Ch. 4183)

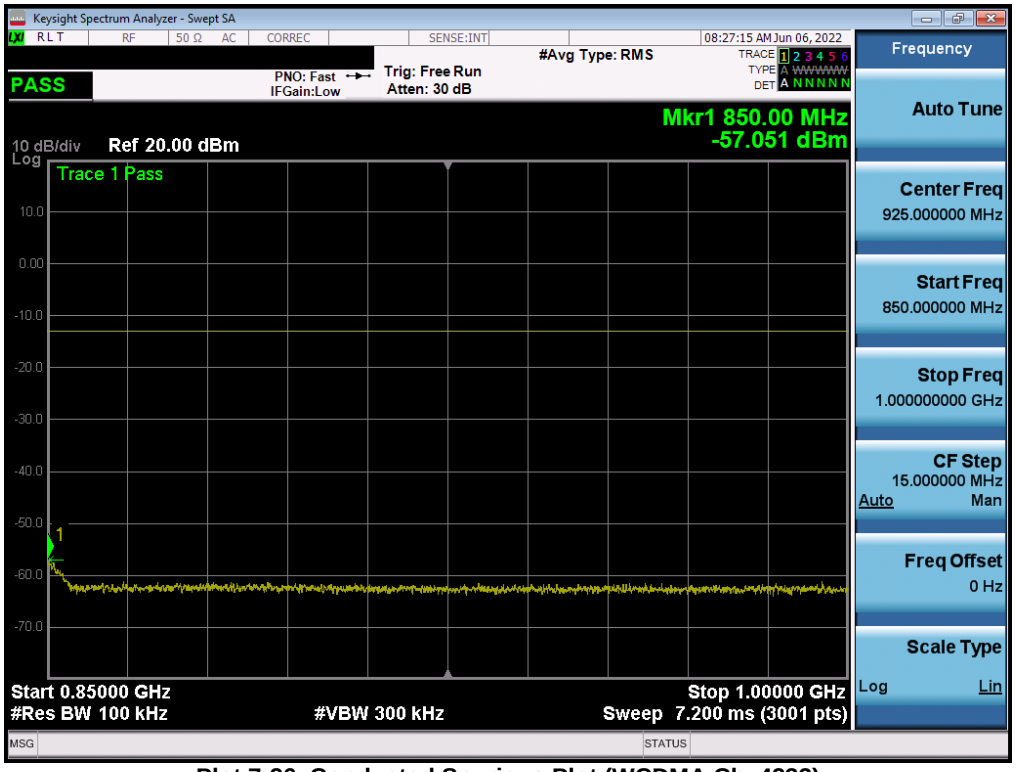


Plot 7-23. Conducted Spurious Plot (WCDMA Ch. 4183)

Plot 7-24. Conducted Spurious Plot (WCDMA Ch. 4183)



Plot 7-25. Conducted Spurious Plot (WCDMA Ch. 4233)



Plot 7-26. Conducted Spurious Plot (WCDMA Ch. 4233)

Plot 7-27. Conducted Spurious Plot (WCDMA Ch. 4233)

7.4 Band Edge Emissions at Antenna Terminal

§2.1051, 22.917(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.

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

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

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

Test Setup

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

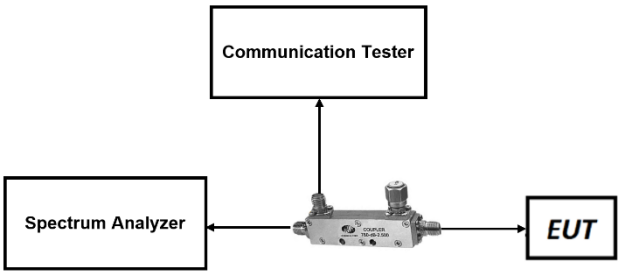
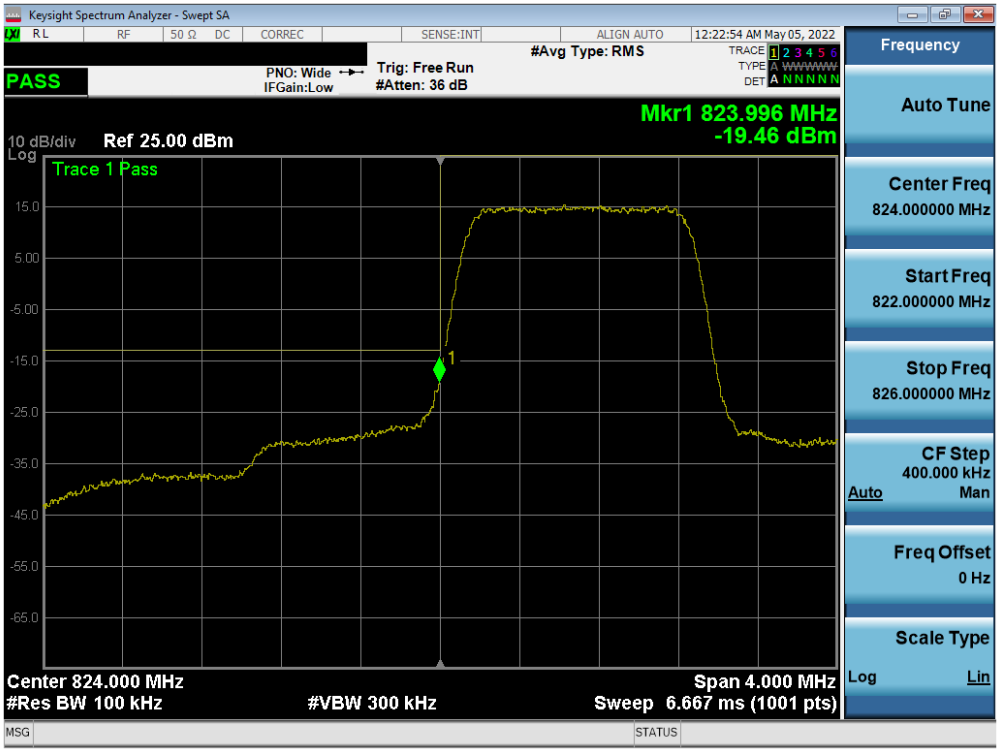


Figure 7-3. Test Instrument & Measurement Setup

Test Notes

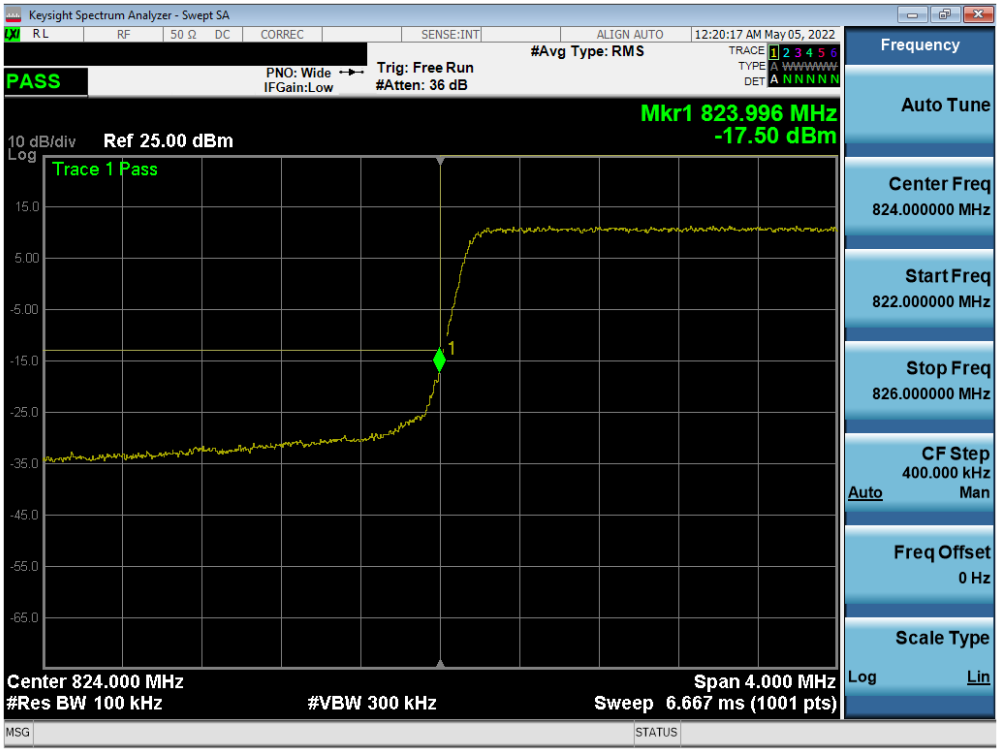
1. Per 22.917(b), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

LTE Band 5

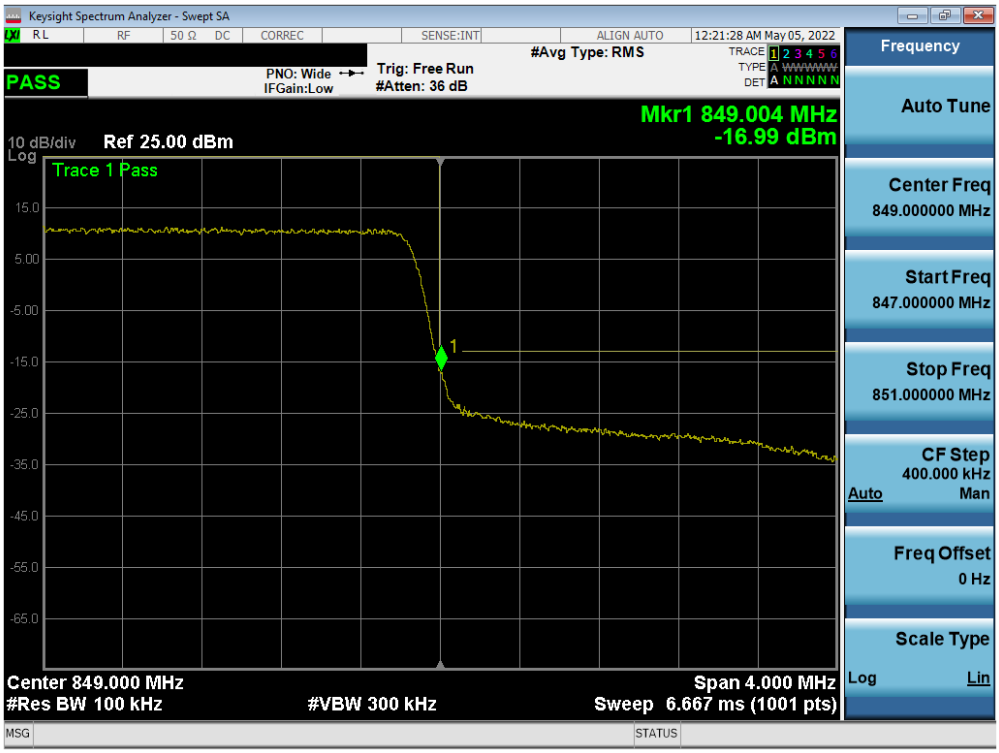


Plot 7-28. Lower BE Plot (LTE Band 5 – 1.4MHz QPSK – Full RB Configuration)

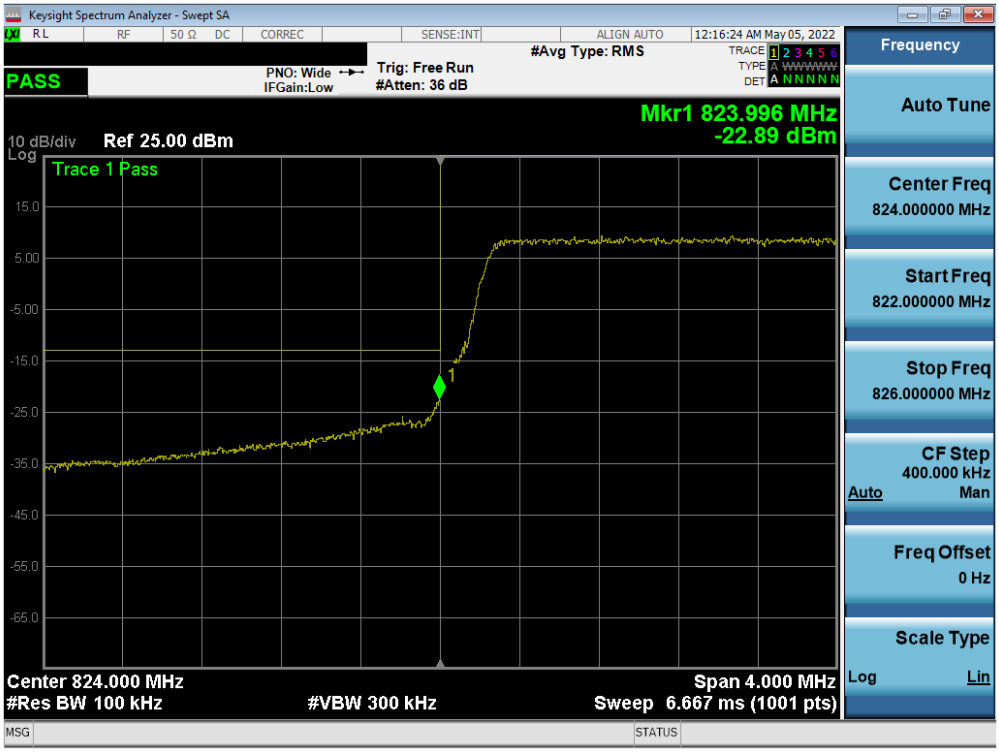
Plot 7-29. Upper BE Plot (LTE Band 5 – 1.4MHz QPSK – Full RB Configuration)



Plot 7-30. Lower BE Plot (LTE Band 5 - 3MHz QPSK – Full RB Configuration)

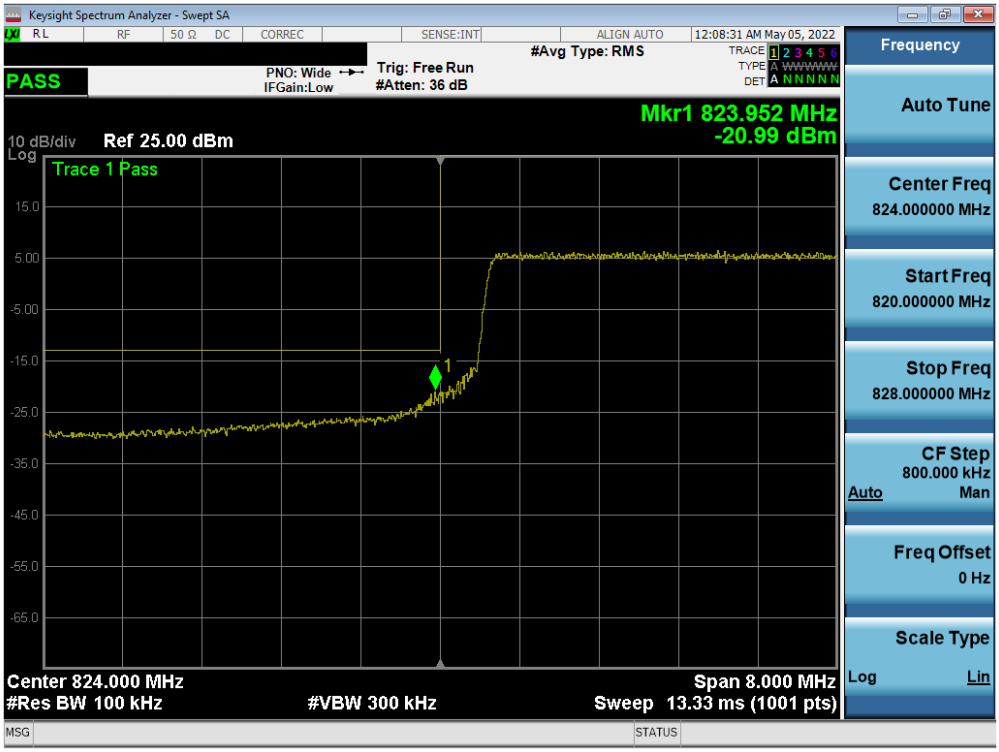


Plot 7-31. Upper BE Plot (LTE Band 5 - 3MHz QPSK – Full RB Configuration)

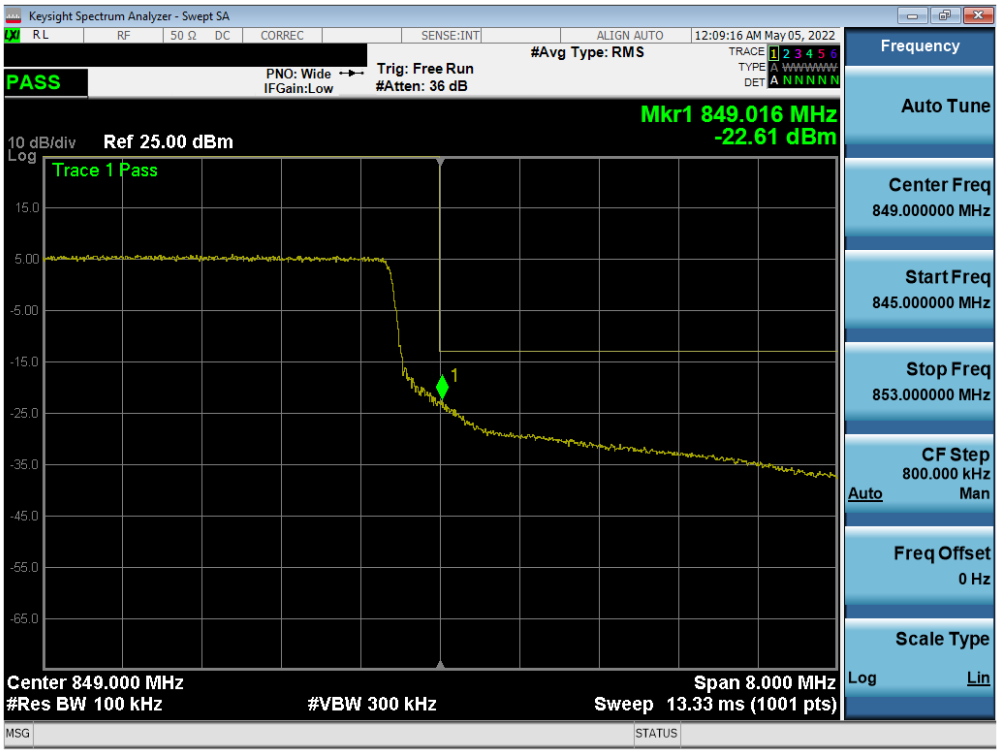


Plot 7-32. Lower BE Plot (LTE Band 5 - 5MHz QPSK – Full RB Configuration)

Plot 7-33. Upper BE Plot (LTE Band 5 - 5MHz QPSK – Full RB Configuration)

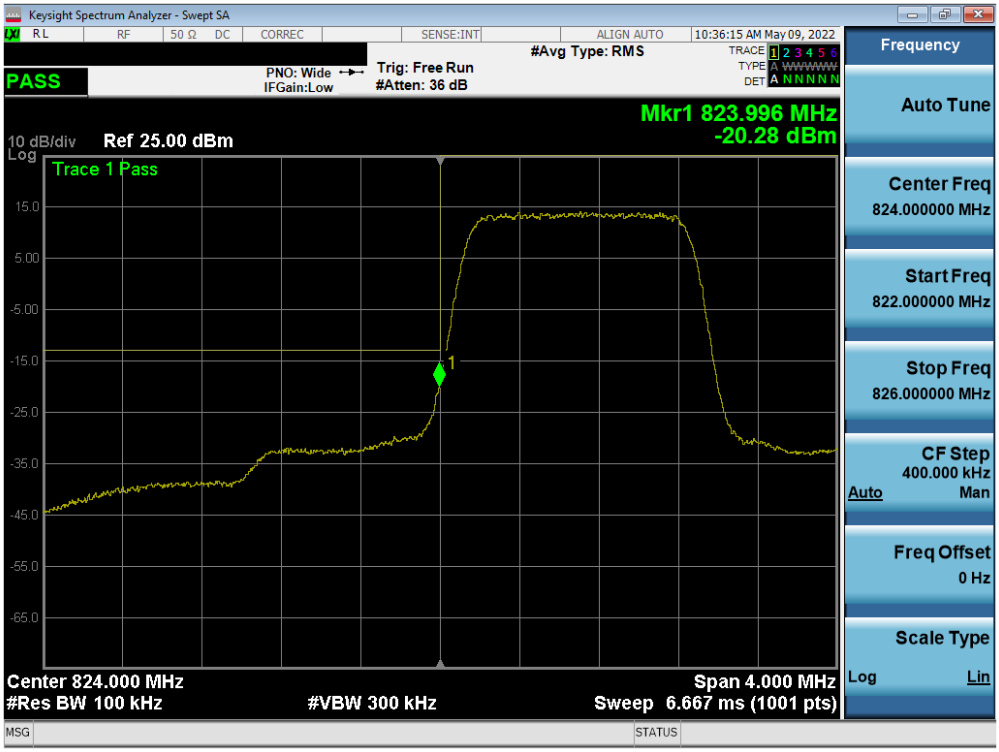


Plot 7-34. Lower BE Plot (LTE Band 5 - 10MHz QPSK – Full RB Configuration)



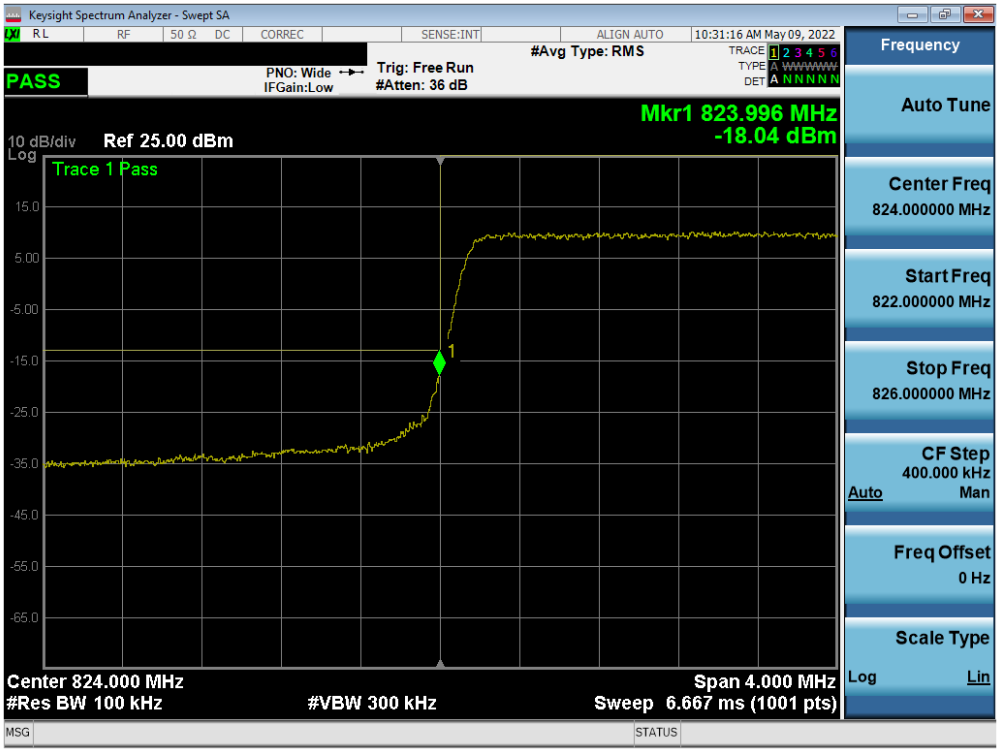
Plot 7-35. Upper BE Plot (LTE Band 5 - 10MHz QPSK – Full RB Configuration)

LTE Band 26

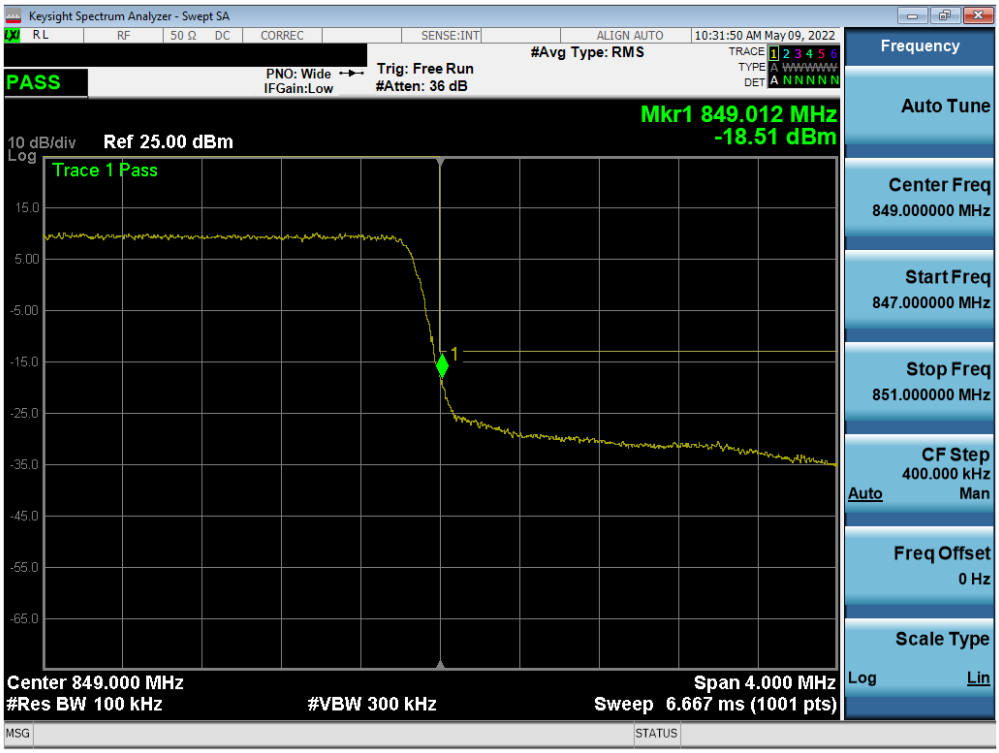


Plot 7-36. Lower BE Plot (LTE Band 26 – 1.4MHz QPSK – Full RB Configuration)

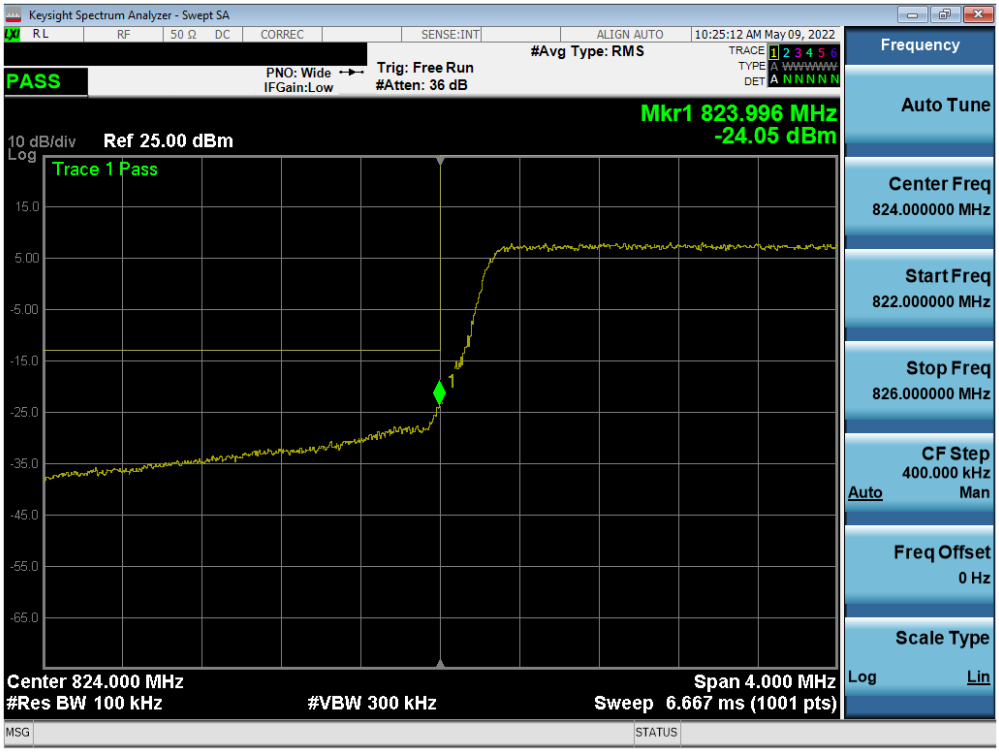
Plot 7-37. Upper BE Plot (LTE Band 26 – 1.4MHz QPSK – Full RB Configuration)



Plot 7-38. Lower BE Plot (LTE Band 26 - 3MHz QPSK – Full RB Configuration)

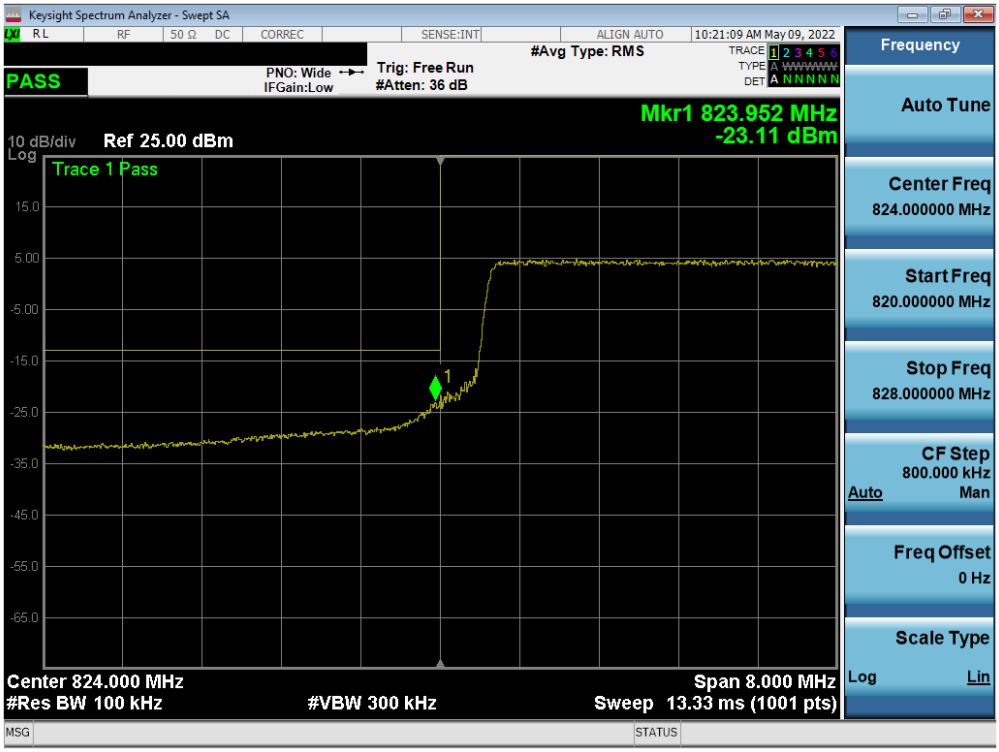


Plot 7-39. Upper BE Plot (LTE Band 26 - 3MHz QPSK – Full RB Configuration)

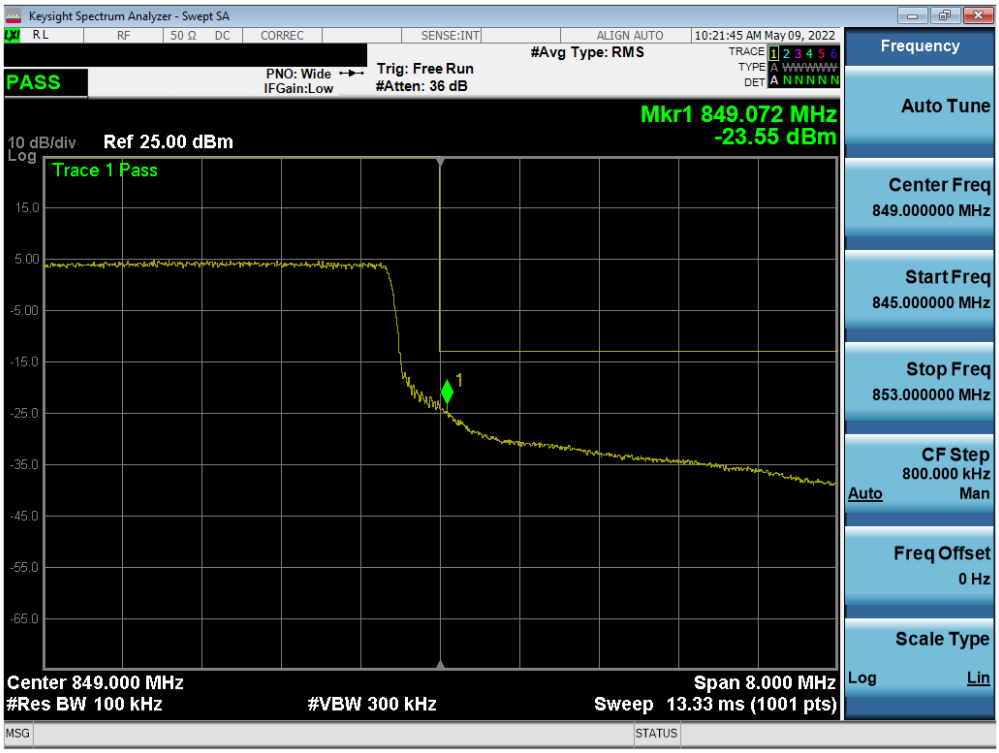


Plot 7-40. Lower BE Plot (LTE Band 26 - 5MHz QPSK – Full RB Configuration)

Plot 7-41. Upper BE Plot (LTE Band 26 - 5MHz QPSK – Full RB Configuration)

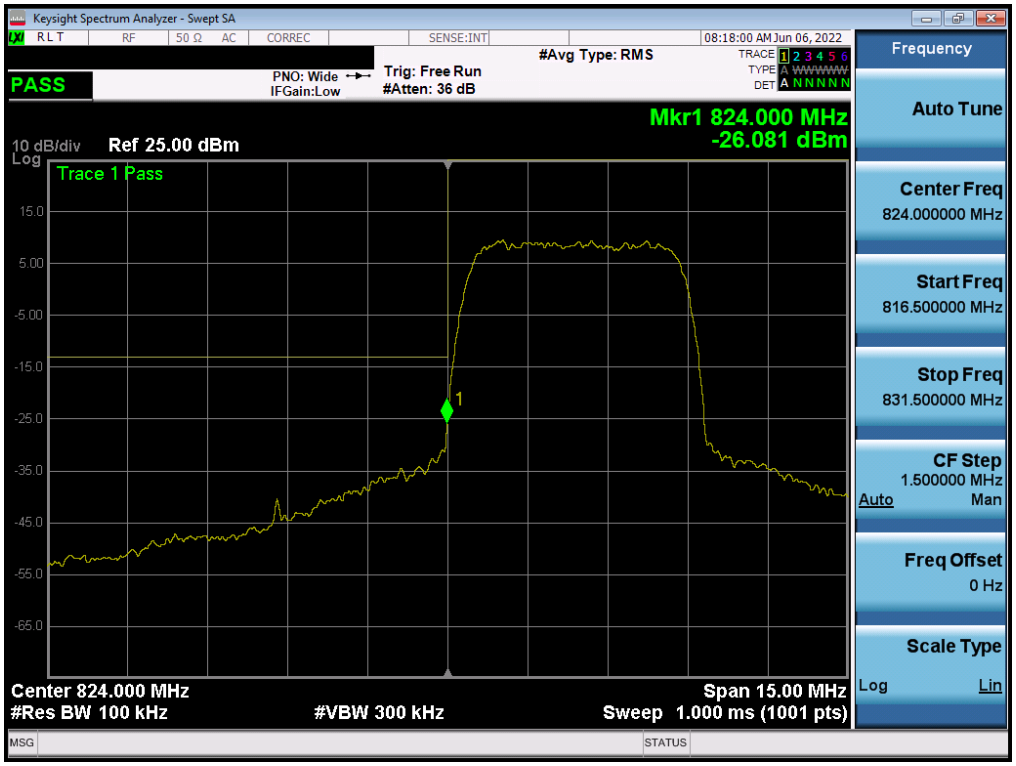


Plot 7-42. Lower BE Plot (LTE Band 26 - 10MHz QPSK – Full RB Configuration)



Plot 7-43. Upper BE Plot (LTE Band 26 - 10MHz QPSK – Full RB Configuration)

WCDMA Cell



Plot 7-44. Lower BE Plot (WCDMA Cell – Ch. 4132)

Plot 7-45. Upper BE Plot (WCDMA Cell – Ch. 4233)

7.5 Radiated Power (ERP/EIRP)

§22.913(a)(5)

Test Overview

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

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1
ANSI C63.26-2015 – Section 5.2.5.5

Test Settings

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

ERP/EIRP = PMeas – LC + GT

Where:

ERP/EIRP = Effective or Equivalent Isotropic Radiated Power, respectively (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 dBd (ERP) or dBi (EIRP)

Test Setup

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

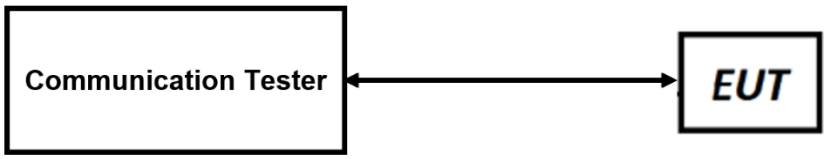


Figure 7-4. ERP/EIRP Measurement Setup

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.

7.5.1 Port BCM – ERP/EIRP

LTE Band 26

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	824.7	-25.70	1 / 24	25.28	**-2.57**	0.553	38.45	-41.02	**-0.42**	0.908	40.61	-41.03
		836.5	-25.70	1 / 0	25.02	-2.83	0.521	38.45	-41.28	-0.68	0.855	40.61	-41.29
		848.3	-25.70	1 / 0	25.20	-2.65	0.543	38.45	-41.10	-0.50	0.891	40.61	-41.11
	16-QAM	824.7	-25.70	1 / 12	24.62	**-3.23**	0.475	38.45	-41.68	**-1.08**	0.780	40.61	-41.69
3 MHz	QPSK	825.5	-25.70	1 / 12	25.31	**-2.54**	0.557	38.45	-40.99	**-0.39**	0.914	40.61	-41.00
		836.5	-25.70	1 / 12	25.04	-2.81	0.524	38.45	-41.26	-0.66	0.859	40.61	-41.27
		847.5	-25.70	1 / 12	25.11	-2.74	0.532	38.45	-41.19	-0.59	0.873	40.61	-41.20
	16-QAM	825.5	-25.70	1 / 24	24.52	**-3.33**	0.465	38.45	-41.78	**-1.18**	0.762	40.61	-41.79
5 MHz	QPSK	826.5	-25.70	1 / 24	25.32	**-2.53**	0.558	38.45	-40.98	**-0.38**	0.916	40.61	-40.99
		836.5	-25.70	1 / 0	25.19	-2.66	0.542	38.45	-41.11	-0.51	0.889	40.61	-41.12
		846.5	-25.70	1 / 0	25.17	-2.68	0.540	38.45	-41.13	-0.53	0.885	40.61	-41.14
	16-QAM	826.5	-25.70	1 / 12	24.79	**-3.06**	0.494	38.45	-41.51	**-0.91**	0.811	40.61	-41.52
10 MHz	QPSK	829.0	-25.70	1 / 12	25.23	**-2.62**	0.547	38.45	-41.07	**-0.47**	0.897	40.61	-41.08
		836.5	-25.70	1 / 0	25.21	-2.64	0.545	38.45	-41.09	-0.49	0.893	40.61	-41.10
		844.0	-25.70	1 / 12	25.15	-2.70	0.537	38.45	-41.15	-0.55	0.881	40.61	-41.16
	16-QAM	829.0	-25.70	1 / 12	24.74	**-3.11**	0.489	38.45	-41.56	**-0.96**	0.802	40.61	-41.57

Table 7-2. Port BCM ERP/EIRP Data (LTE Band 26)

LTE Band 5

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	829.0	-25.70	1 / 5	25.19	**-2.66**	0.542	38.45	-41.11	**-0.51**	0.889	40.61	-41.12
		836.5	-25.70	1 / 0	24.74	-3.11	0.489	38.45	-41.56	-0.96	0.802	40.61	-41.57
		844.0	-25.70	1 / 0	24.94	-2.91	0.512	38.45	-41.36	-0.76	0.839	40.61	-41.37
	16-QAM	829.0	-25.70	1 / 5	24.39	**-3.46**	0.451	38.45	-41.91	**-1.31**	0.740	40.61	-41.92
3 MHz	QPSK	829.0	-25.70	1 / 7	25.03	**-2.82**	0.522	38.45	-41.27	**-0.67**	0.857	40.61	-41.28
		836.5	-25.70	1 / 7	24.76	-3.09	0.491	38.45	-41.54	-0.94	0.805	40.61	-41.55
		844.0	-25.70	1 / 7	24.85	-3.00	0.501	38.45	-41.45	-0.85	0.822	40.61	-41.46
	16-QAM	829.0	-25.70	1 / 7	24.45	**-3.40**	0.457	38.45	-41.85	**-1.25**	0.750	40.61	-41.86
5 MHz	QPSK	829.0	-25.70	1 / 24	25.09	**-2.76**	0.530	38.45	-41.21	**-0.61**	0.869	40.61	-41.22
		836.5	-25.70	1 / 0	24.98	-2.87	0.516	38.45	-41.32	-0.72	0.847	40.61	-41.33
		844.0	-25.70	1 / 0	24.91	-2.94	0.508	38.45	-41.39	-0.79	0.834	40.61	-41.40
	16-QAM	829.0	-25.70	1 / 24	24.58	**-3.27**	0.471	38.45	-41.72	**-1.12**	0.773	40.61	-41.73
10 MHz	QPSK	829.0	-25.70	1 / 25	25.04	**-2.81**	0.524	38.45	-41.26	**-0.66**	0.859	40.61	-41.27
		836.5	-25.70	1 / 0	24.96	-2.89	0.514	38.45	-41.34	-0.74	0.843	40.61	-41.35
		844.0	-25.70	1 / 25	24.91	-2.94	0.508	38.45	-41.39	-0.79	0.834	40.61	-41.40
	16-QAM	829.0	-25.70	1 / 25	24.47	**-3.38**	0.459	38.45	-41.83	**-1.23**	0.753	40.61	-41.84

Table 7-3. Port BCM ERP/EIRP Data (LTE Band 5)

WCDMA Cell

Frequency [MHz]	Mode	Conducted Power [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP [mW]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
826.40	WCDMA850	24.83	-25.70	**-3.02**	**0.499**	38.45	-41.47	**-0.87**	**0.818**	40.61	-41.48
836.60	WCDMA850	24.69	-25.70	-3.16	0.483	38.45	-41.61	-1.01	0.793	40.61	-41.62
846.60	WCDMA850	24.54	-25.70	-3.31	0.467	38.45	-41.76	-1.16	0.766	40.61	-41.77

Table 7-4. Port BCM ERP/EIRP Data (WCDMA Cell)

7.6 Radiated Spurious Emissions

§2.1053, 22.917(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 ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

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

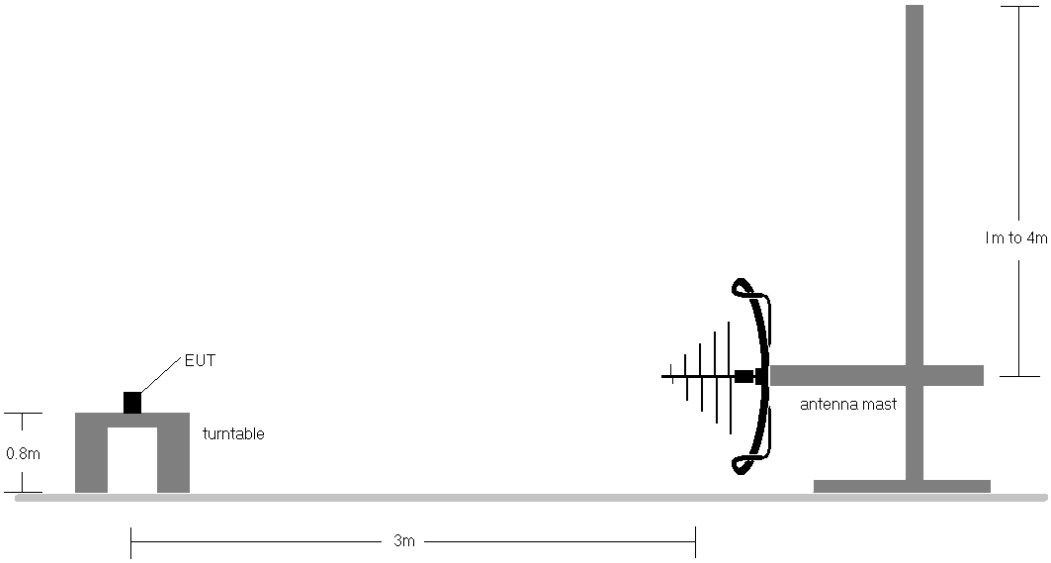


Figure 7-5. Test Instrument & Measurement Setup < 1GHz

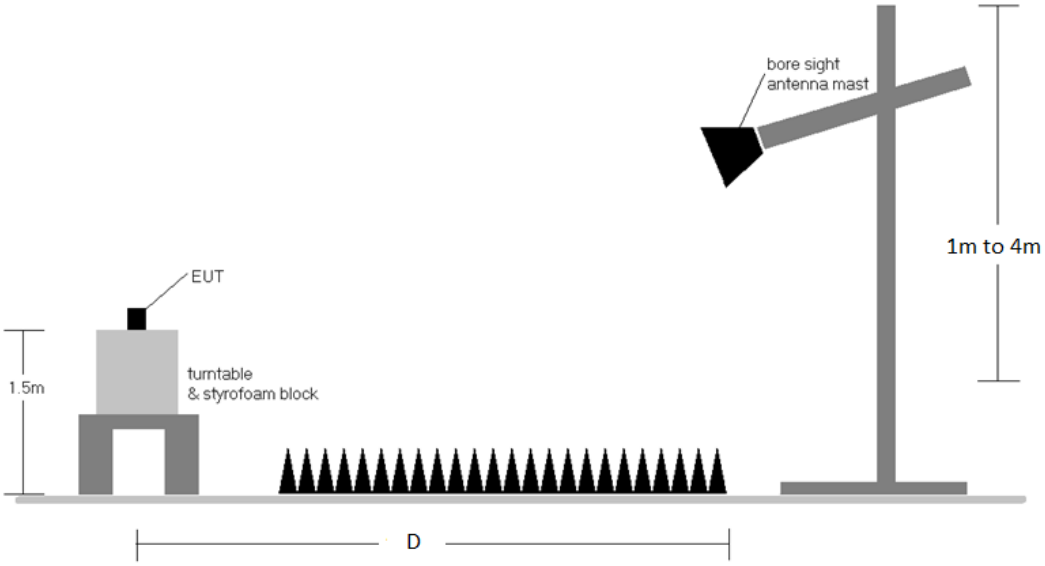


Figure 7-6. Test Instrument & Measurement Setup >1 GHz

Test Notes

1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
    a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
    b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2. 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.

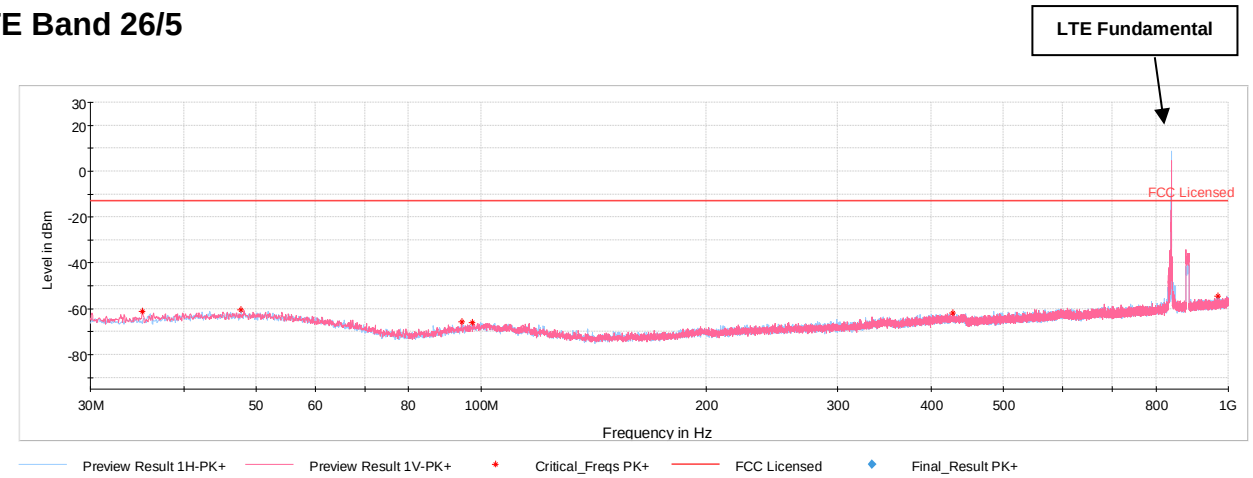
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

6. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance.

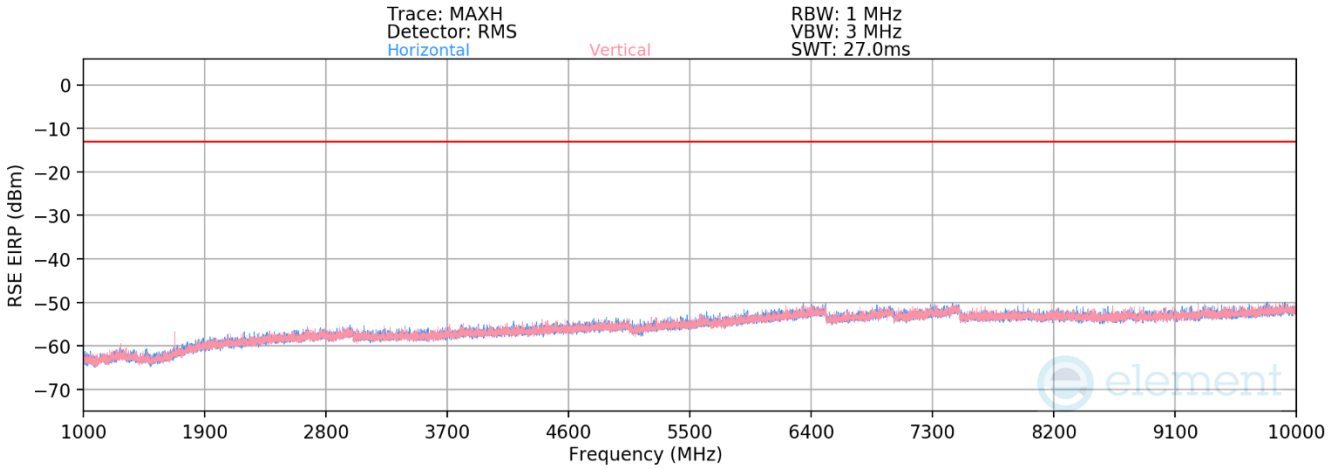
7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

7.6.1 Antenna BCM – Radiated Spurious Emission Measurements

LTE Band 26/5



Plot 7-46. Antenna BCM Radiated Spurious Plot below 1GHz (LTE Band 26/5)



Plot 7-47. Antenna BCM Radiated Spurious Plot above 1GHz (LTE Band 26/5)

Bandwidth (MHz):	10
Frequency (MHz):	829.0
RB / Offset:	1 / 37

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]
1658.0	V	109	182	-74.35	-4.41	28.24	-67.02	-13.00	-54.02
2487.0	V	347	112	-76.86	-0.24	29.90	-65.36	-13.00	-52.36
3316.0	V	-	-	-77.88	1.52	30.64	-64.61	-13.00	-51.61
4145.0	V	-	-	-78.49	2.77	31.28	-63.98	-13.00	-50.98
4974.0	V	-	-	-79.11	4.48	32.37	-62.88	-13.00	-49.88

Table 7-5. Antenna BCM Radiated Spurious Data (LTE Band 26/5 – Low Channel)

Bandwidth (MHz):	10
Frequency (MHz):	836.5
RB / Offset:	1 / 37

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]
1673.0	V	221	274	-73.35	-4.15	29.50	-65.76	-13.00	-52.76
2509.5	V	160	219	-75.72	-0.24	31.04	-64.22	-13.00	-51.22
3346.0	V	-	-	-78.20	1.74	30.54	-64.72	-13.00	-51.72
4182.5	V	-	-	-78.63	2.81	31.18	-64.08	-13.00	-51.08
5019.0	V	-	-	-79.05	4.32	32.27	-62.99	-13.00	-49.99

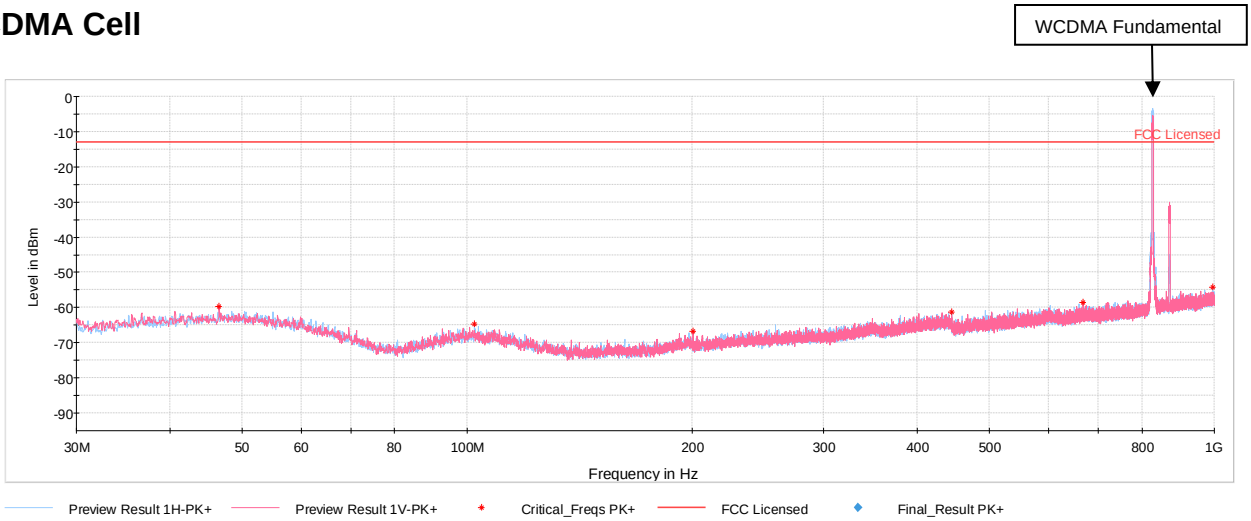
Table 7-6. Antenna BCM Radiated Spurious Data (LTE Band 26/5 – Mid Channel)

Bandwidth (MHz):	10
Frequency (MHz):	844.0
RB / Offset:	1 / 37

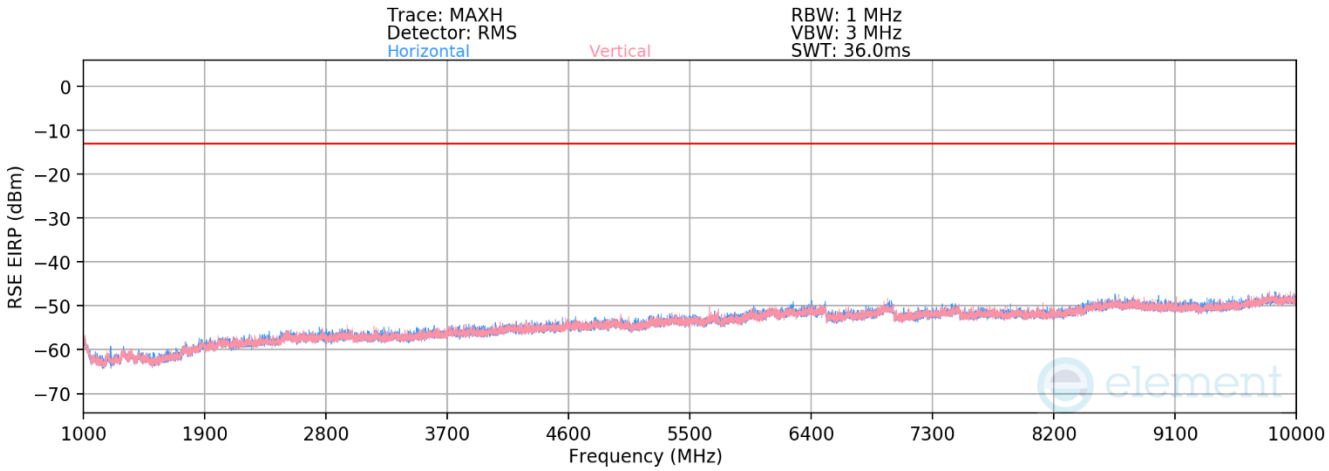
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1688.0	V	326	247	-75.12	-3.91	27.97	-67.28	-13.00	-54.28
2532.0	V	-	-	-76.99	-0.11	29.90	-65.36	-13.00	-52.36
3376.0	V	-	-	-78.69	1.71	30.02	-65.24	-13.00	-52.24
4220.0	V	-	-	-78.94	2.82	30.88	-64.37	-13.00	-51.37

Table 7-7. Antenna BCM Radiated Spurious Data (LTE Band 26/5 – High Channel)

WCDMA Cell



Plot 7-48. Antenna BCM Radiated Spurious Plot below 1GHz (WCDMA Cell)



Plot 7-49. Antenna BCM Radiated Spurious Plot above 1GHz (WCDMA Cell)

Mode:	WCDMA RMC
Channel:	4132
Frequency (MHz):	826.4

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]
1652.8	V	-	-	-77.44	-2.38	27.18	-68.08	-13.00	-55.08
2479.2	V	-	-	-78.62	2.44	30.82	-64.44	-13.00	-51.44
3305.6	V	-	-	-79.13	3.68	31.55	-63.71	-13.00	-50.71

Table 7-8. Antenna BCM Radiated Spurious Data (WCDMA Cell – Low Channel)

Mode:	WCDMA RMC
Channel:	4183
Frequency (MHz):	836.6

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]
1673.2	V	-	-	-77.53	-2.46	27.01	-68.25	-13.00	-55.25
2509.8	V	-	-	-78.49	2.88	31.39	-63.87	-13.00	-50.87
3346.4	V	-	-	-79.51	3.52	31.01	-64.24	-13.00	-51.24

Table 7-9. Antenna BCM Radiated Spurious Data (WCDMA Cell – Mid Channel)

Mode:	WCDMA RMC
Channel:	4233
Frequency (MHz):	846.6

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]
1693.2	V	-	-	-77.58	-2.18	27.24	-68.01	-13.00	-55.01
2539.8	V	-	-	-78.32	2.67	31.35	-63.91	-13.00	-50.91
3386.4	V	-	-	-78.78	3.08	31.30	-63.95	-13.00	-50.95

Table 7-10. Antenna BCM Radiated Spurious Data (WCDMA Cell – High Channel)

7.7 Frequency Stability / Temperature Variation

§2.1055, 22.355

Test Overview and Limit

Frequency Tolerance testing is performed in accordance with the guidelines of ANSI C63.26-2015 and TIA-603-E-2016. The Frequency Tolerance 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 22, the Frequency Tolerance of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency.

Test Procedure Used

ANSI C63.26-2015

TIA-603-E-2016

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

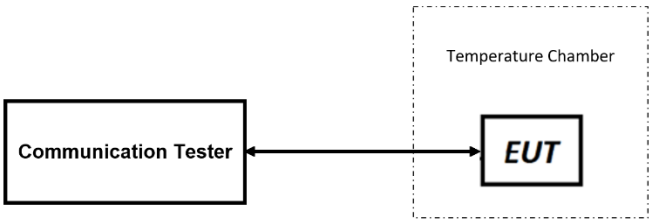


Figure 7-7. Test Instrument & Measurement Setup

Test Notes

None

Frequency Tolerance / Temperature Variation

LTE Band 26/5

Operating Frequency (Hz):	836,500,000
Ref. Voltage (VDC):	3.80
Deviation Limit:	± 0.00025% or 2.5 ppm

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	836,500,001	0.54	0.0000001
		- 20	836,500,000	0.28	0.0000000
		- 10	836,500,001	0.57	0.0000001
		0	836,500,000	0.32	0.0000000
		+ 10	836,500,000	-0.39	0.0000000
		+ 20 (Ref)	836,500,000	0.00	0.0000000
		+ 30	836,500,000	0.41	0.0000000
		+ 40	836,500,001	0.75	0.0000001
		+ 50	836,500,001	0.68	0.0000001
Battery Endpoint	3.40	+ 20	836,500,000	0.49	0.0000001

Table 7-11. LTE Band 26/5 Frequency Tolerance Data

Frequency Tolerance / Temperature Variation

WCDMA Cellular

Operating Frequency (Hz):	836,600,000
Ref. Voltage (VDC):	3.80
Deviation Limit:	± 0.00025% or 2.5 ppm

Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	- 30	836,600,001	0.75	0.0000001
		- 20	836,600,000	0.44	0.0000001
		- 10	836,600,000	-0.32	0.0000000
		0	836,600,000	-0.40	0.0000000
		+ 10	836,600,000	-0.19	0.0000000
		+ 20 (Ref)	836,600,000	0.00	0.0000000
		+ 30	836,599,999	-0.52	-0.0000001
		+ 40	836,600,000	-0.49	-0.0000001
		+ 50	836,599,999	-0.57	-0.0000001
Battery Endpoint	3.40	+ 20	836,600,000	0.36	0.0000000

Table 7-12. WCDMA Cell Frequency Tolerance Data

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the Apple **Watch FCC ID: BCG-A2622** complies with all the requirements of Part 22 of the FCC rules.

9.0 APPENDIX A

Antenna gains provided by manufacturer:

Cellular Antenna Gain (BCM), Type: LDS			
Band	**Frequency (MHz)**	**Horizontal (dBi)**	**Vertical (dBi)**
12	700.0	-33.5	-30.3
12	707.4	-33.3	-29.7
12	715.0	-33.8	-29.8
13	778.6	-29.2	-26.4
13	782.0	-29.5	-26.5
13	785.4	-28.7	-26.1
26	815.0	-29.6	-26.8
26	831.4	-29.3	-26.1
26	848.0	-29.1	-25.7
40	2397.4	-11.7	-11.5

Table 9-1. Antenna Gains