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PART 22 MEASUREMENT REPORT

Applicant Name:
Samsung Electronics Co., Ltd.
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Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
6/15/2023 - 7/13/2023
Test Report Issue Date:
7/17/2023
Test Site/Location:
Element lab. Yongin-Si, Gyeonggi-do, South Korea
Test Report Serial No.:
1M2304260059-03.A3L

FCC ID:	**A3LSMF731JPN**
Applicant Name:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SC-54D
Additional Model(s):	SCG23
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, KDB 648474 D03 v01r04

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.

Prepared by

Reviewed by

TABLE OF CONTENTS

PART 22 MEASUREMENT REPORT

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	ERP		EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
GSM/GPRS	N/A	GMSK	824.2 - 848.8	0.327	25.14	0.536	27.29	246KGXW
EDGE	N/A	8-PSK	824.2 - 848.8	0.099	19.94	0.162	22.09	237KG7W
WCDMA	N/A	Spread Spectrum	826.4 - 846.6	0.068	18.33	0.112	20.48	4M16F9W
LTE Band 5	10 MHz	QPSK	829.0 - 844.0	0.072	18.55	0.117	20.70	9M00G7D
		16QAM	829.0 - 844.0	0.056	17.51	0.092	19.66	9M02W7D
	5 MHz	QPSK	826.5 - 846.5	0.072	18.59	0.119	20.74	4M53G7D
		16QAM	826.5 - 846.5	0.055	17.38	0.090	19.53	4M54W7D
	3 MHz	QPSK	825.5 - 847.5	0.073	18.61	0.119	20.76	2M71G7D
		16QAM	825.5 - 847.5	0.056	17.52	0.093	19.67	2M72W7D
	1.4 MHz	QPSK	824.7 - 848.3	0.072	18.56	0.118	20.71	1M10G7D
		16QAM	824.7 - 848.3	0.055	17.41	0.090	19.56	1M12W7D
NR Band n5	20 MHz	π/2 BPSK	834.0 - 839.0	0.067	18.24	0.109	20.39	17M9G7D
		QPSK	834.0 - 839.0	0.067	18.26	0.110	20.41	18M9G7D
		16QAM	834.0 - 839.0	0.054	17.36	0.089	19.51	19M0W7D
	15 MHz	π/2 BPSK	831.5 - 841.5	0.069	18.38	0.113	20.53	13M5G7D
		QPSK	831.5 - 841.5	0.066	18.20	0.108	20.35	14M2G7D
		16QAM	831.5 - 841.5	0.051	17.06	0.083	19.21	14M2W7D
	10 MHz	π/2 BPSK	829.0 - 844.0	0.062	17.90	0.101	20.05	9M03G7D
		QPSK	829.0 - 844.0	0.065	18.11	0.106	20.26	9M40G7D
		16QAM	829.0 - 844.0	0.051	17.04	0.083	19.19	9M35W7D
	5 MHz	π/2 BPSK	826.5 - 846.5	0.068	18.33	0.112	20.48	4M52G7D
		QPSK	826.5 - 846.5	0.065	18.16	0.107	20.31	4M53G7D
		16QAM	826.5 - 846.5	0.059	17.73	0.097	19.88	4M53W7D

EUT Overview

1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Test Location

These measurement tests were conducted at the Element Suwon Laboratory located at 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954, South Korea. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology Suwon, Ltd. located in Yongin-si, Gyeonggi-do, 16954, South Korea.

- Element Materials Technology Suwon, Ltd. is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation(A2LA) with Certificate number 2041.04 for Specific Absorption Rate (SAR), and Electromagnetic Compatibility (EMC) & Telecommunications testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology Suwon, Ltd. facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of ISED: 26168

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF731JPN**. 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.: 0134M, 0165M,0180M, 0214M, 0264M

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), NFC, Wireless Power Transfer

This device uses a tuner circuit that dynamically updates the antenna impedance parameters to optimize antenna performance for certain bands and modes of operation. The tuner for this device was set to simulate a "free space" condition where the transmit antenna is matched to the medium into which it is transmitting and, thus, the power is at its maximum level.

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model: EN-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

This device supports three configurations: one is with screen open, one is where the screen is half open (90 degrees), and one is with screen closed. All configurations are tested, and the worst case radiated emissions data is shown in this report.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version SC54DOMU0AWEQ installed on the EUT.

2.5 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..None

3.2 Radiated Power and Radiated Spurious Emissions

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

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

For radiated power measurements, substitution method is used per the guidance of ANSI C63.26-2015. For emissions below 1GHz, a half-wave dipole is substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

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

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

For radiated spurious emissions measurements, the field strength conversion method is used per the formulas in Section 5.2.7 of ANSI C63.26-2015. Field Strength (EIRP) is calculated using the following formulas:

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

And

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

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.95
Radiated Disturbance (<1GHz)	4.10
Radiated Disturbance (>1GHz)	4.82
Radiated Disturbance (>18GHz)	4.96

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	N9030A	PXA Signal Analyzer	2023-07-04	Annual	2024-07-03	MY49432391
Anritsu	S820E	Cable and Antenna Analyzer	2023-07-05	Annual	2024-07-04	1839097
Anritsu	MA24106A	USB Power Sensor	2023-07-05	Annual	2024-07-04	1244512
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	2022-10-21	Biennial	2024-10-20	10160045
Com-Power	PAM-118A	Preamplifier	2023-07-05	Annual	2024-07-04	551042
Espec	SH-242	Environmental Chamber	2022-08-26	Annual	2023-08-25	93011064
Fairview Microwave	FM2CP1122-10	2.92mm Directional Coupler	2023-07-04	Annual	2024-07-03	1946
Keysight Technologies	N9030B	MXA Signal Analyzer	2023-07-04	Annual	2024-07-03	MY57143276
Mini-Circuits	BW-N10W5+	Attenuator	2023-07-04	Annual	2024-07-03	1607
Mini-Circuits	BW-N10W5+	Attenuator	2023-07-04	Annual	2024-07-03	1607
Rohde & Schwarz	TS-PR18	Preamplifier	2023-07-05	Annual	2024-07-04	102141
Rohde & Schwarz	SMB100A03	Signal Generator	2023-01-17	Annual	2024-01-16	182487
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2023-02-17	Annual	2024-02-16	131453
Rohde & Schwarz	FSW43	Signal and Spectrum Analyzer	2023-01-13	Annual	2024-01-12	101955
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2023-02-17	Annual	2024-02-16	102131
Rohde & Schwarz	TC-TA18	VIVALDI-ANT	2021-10-22	Biennial	2023-10-21	101097
Rohde & Schwarz	TC-TA18	VIVALDI-ANT	2021-10-22	Biennial	2023-10-21	101098
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	2023-06-01	Biennial	2025-05-31	9162-217
Schwarzbeck	UHA9105	Dipole Antenna	2022-07-19	Biennial	2024-07-18	91052522
Sunol	DRH-118	Horn Antenna	2023-01-26	Biennial	2025-01-25	A060215

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.

6.0 SAMPLE CALCULATIONS

GSM Emission Designator

Emission Designator = 250KGXW
GSM BW = 250 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 250KG7W
EDGE BW = 250 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

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: Samsung Electronics Co., Ltd.

FCC ID: A3LSMF731JPN

FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)

Mode(s): GSM/GPRS/WCDMA/NR/LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.2
	Conducted Band Edge / Spurious Emissions	2.1051, 22.917(a)	≥ 43 + 10 log (P[Watts]) dB of attenuation below transmitter power	PASS	Sections 7.3, 7.4
	Frequency Stability	2.1055, 22.355	The carrier frequency of the transmitter must be maintained within the 2.5ppm	PASS	Section 7.7
RADIATED	Effective Radiated Power / Equivalent Isotropic Radiated Power	22.913(a)(5)	< 7 Watts max. ERP	PASS	Section 7.5
	Radiated Spurious Emissions	2.1053, 22.917(a)	> 43 + 10 log10 (P[Watts]) 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.
2) The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.1.

7.2 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

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

Test Setup

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

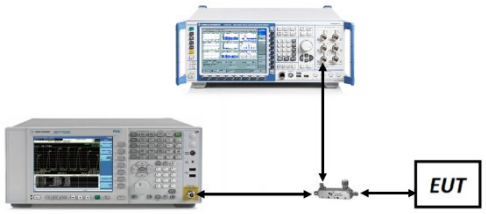


Figure 7-1. Test Instrument & Measurement Setup

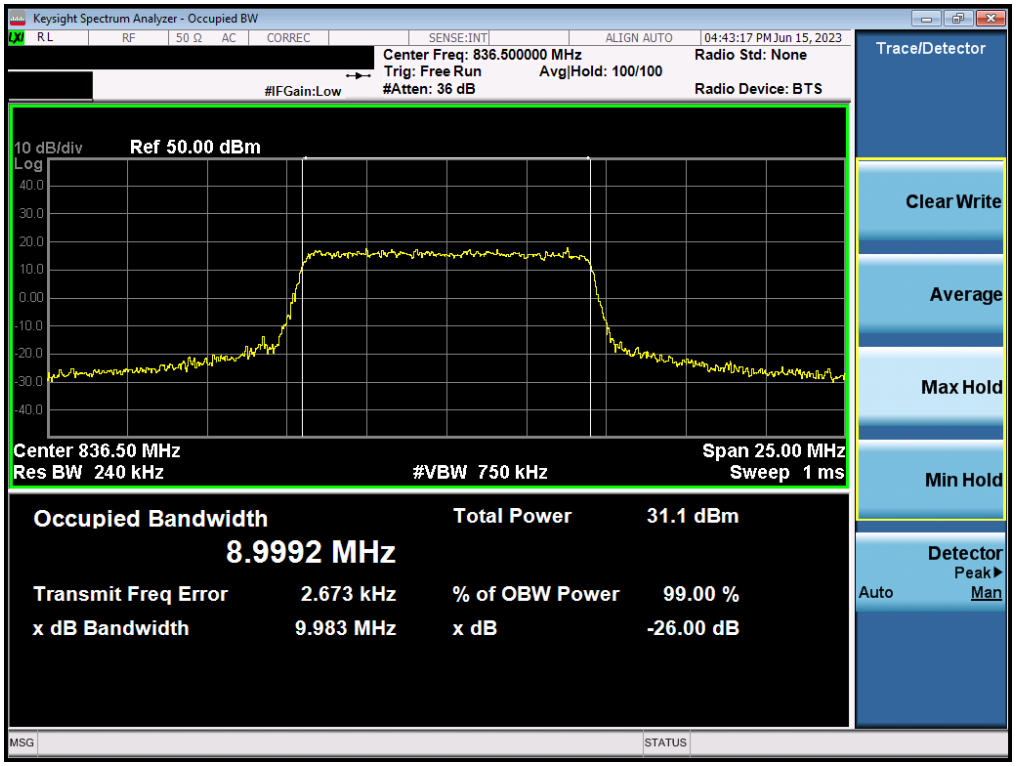
Test Notes

None.

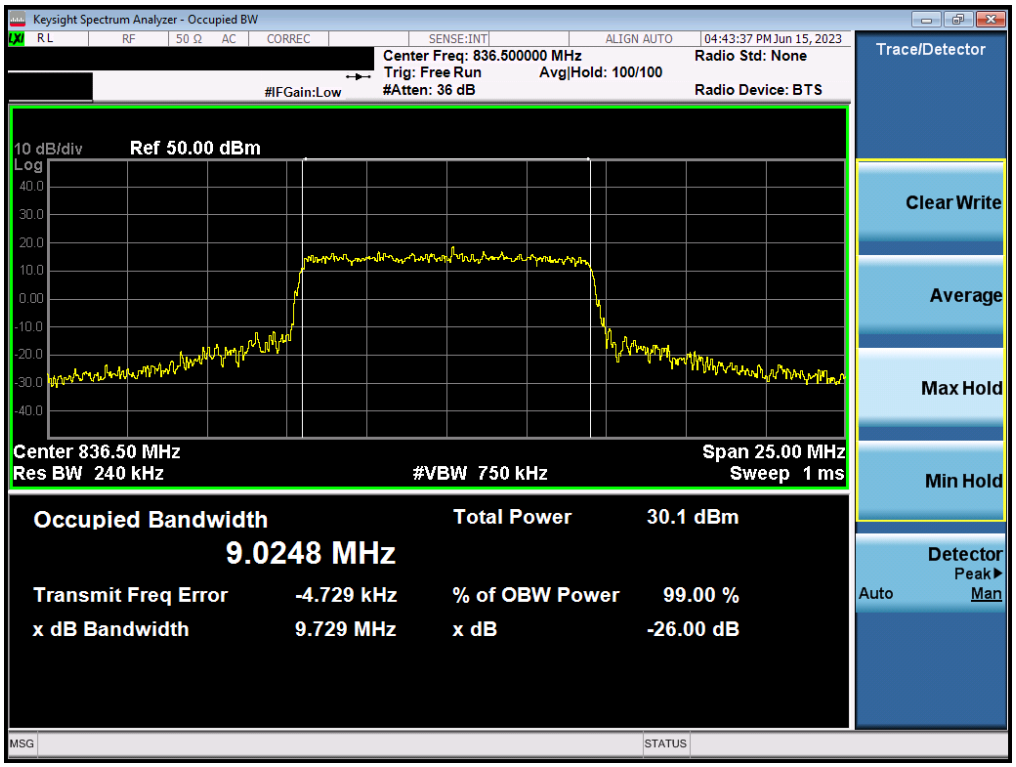
Mode	Bandwidth	Modulation	OBW [MHz]
GSM850	N/A	N/A	0.246
EDGE850			0.237
WCDMA850			4.155
LTE Band 5	10 MHz	QPSK	8.999
		16QAM	9.025
	5 MHz	QPSK	4.528
		16QAM	4.540
	3 MHz	QPSK	2.714
		16QAM	2.721
	1.4 MHz	QPSK	1.097
		16QAM	1.116
NR Band n5	20 MHz	π/2 BPSK	17.917
		QPSK	18.942
		16QAM	18.986
	15 MHz	π/2 BPSK	13.487
		QPSK	14.188
		16QAM	14.172
	10 MHz	π/2 BPSK	9.033
		QPSK	9.396
		16QAM	9.351
	5 MHz	π/2 BPSK	4.525
		QPSK	4.527
		16QAM	4.534

Table 7-2. Occupied Bandwidth Test Results

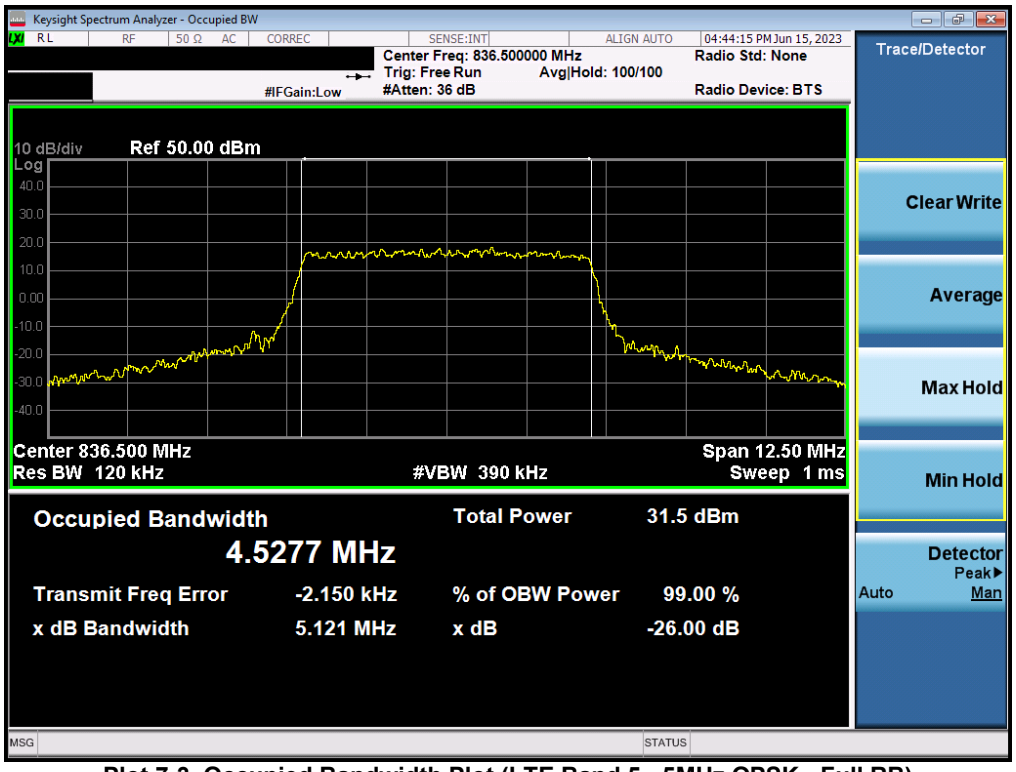
LTE Band 5



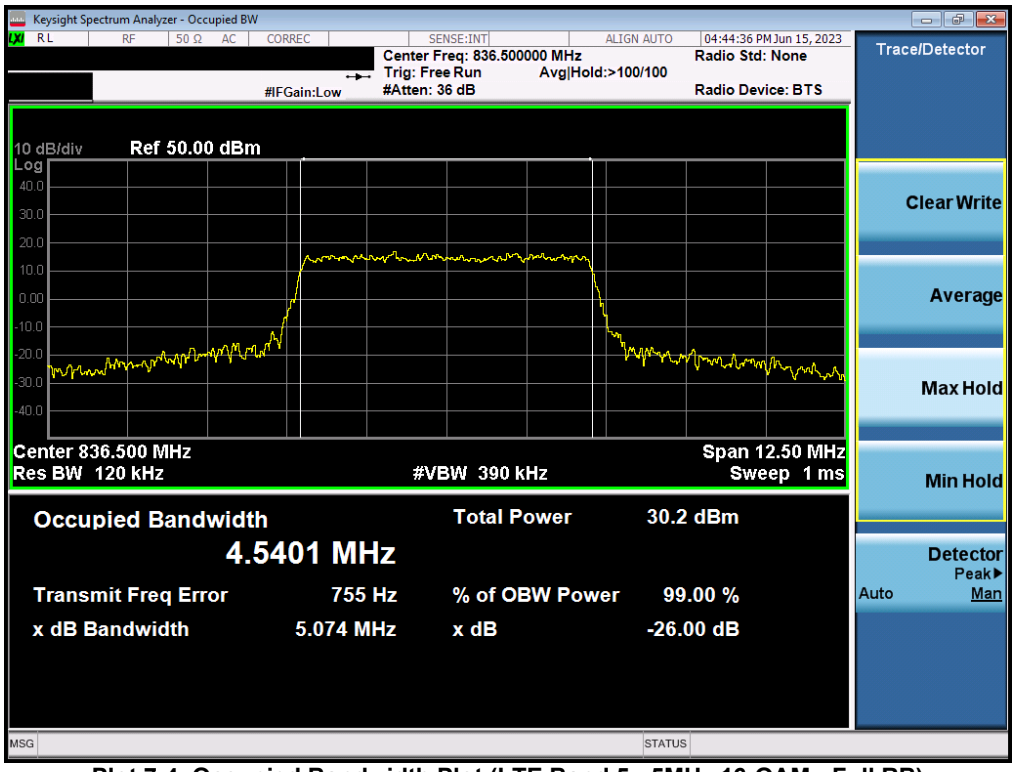
Plot 7-1. Occupied Bandwidth Plot (LTE Band 5 - 10MHz QPSK - Full RB)



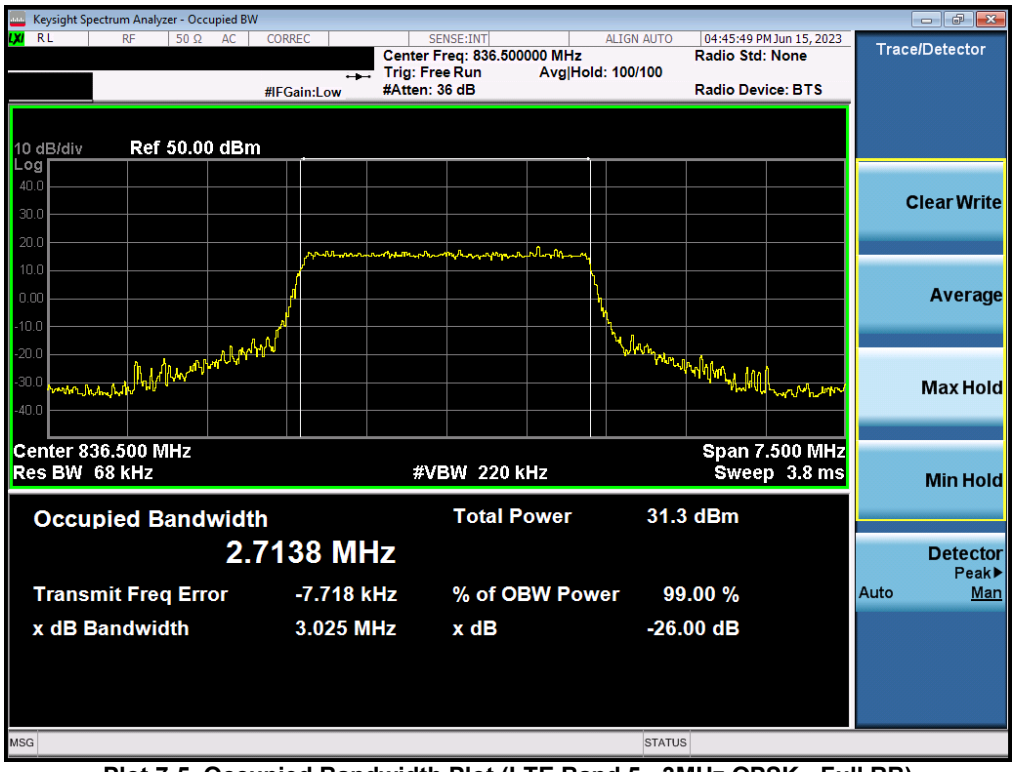
Plot 7-2. Occupied Bandwidth Plot (LTE Band 5 - 10MHz 16-QAM - Full RB)



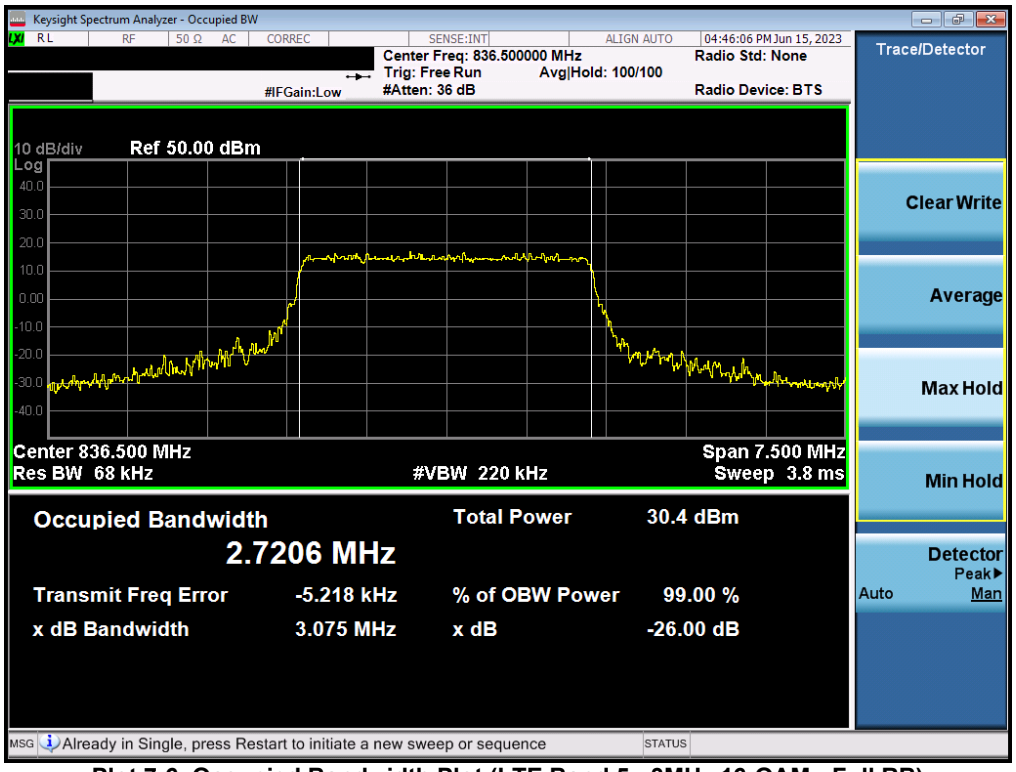
Plot 7-3. Occupied Bandwidth Plot (LTE Band 5 - 5MHz QPSK - Full RB)



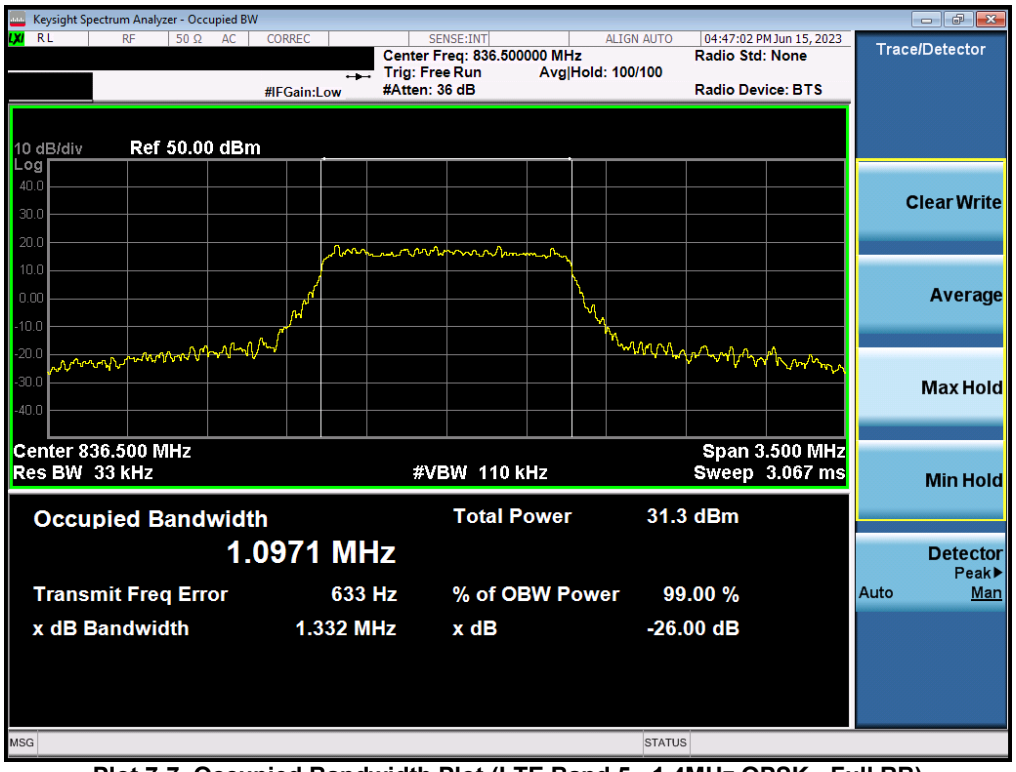
Plot 7-4. Occupied Bandwidth Plot (LTE Band 5 - 5MHz 16-QAM - Full RB)



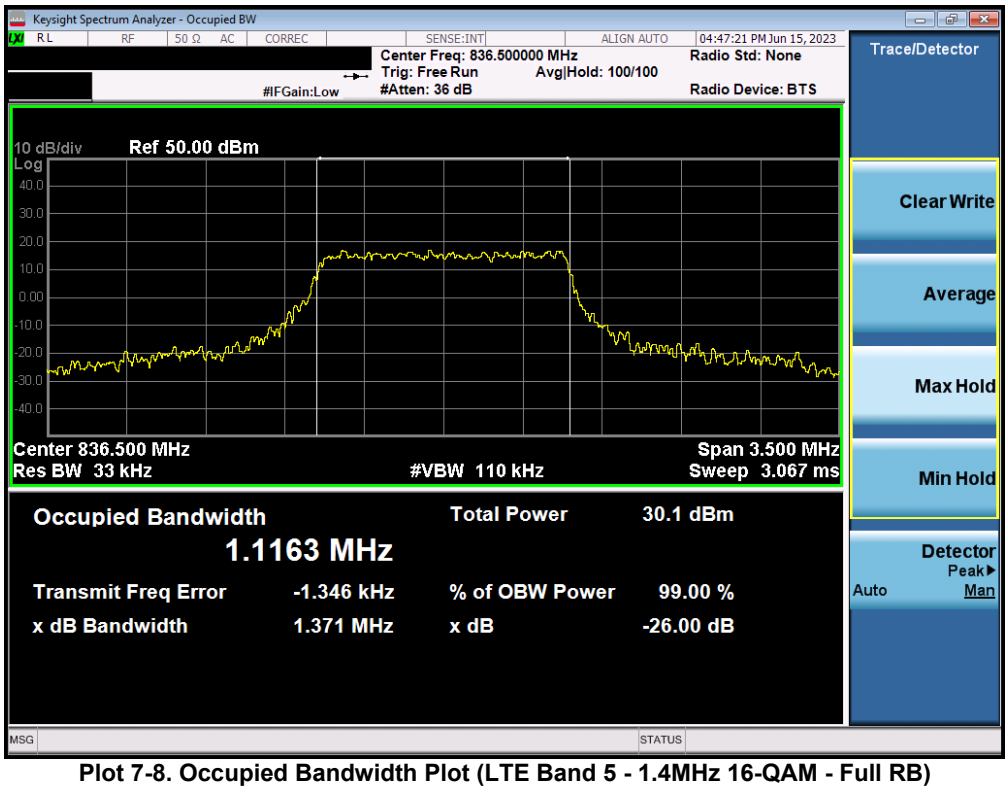
Plot 7-5. Occupied Bandwidth Plot (LTE Band 5 - 3MHz QPSK - Full RB)



Plot 7-6. Occupied Bandwidth Plot (LTE Band 5 - 3MHz 16-QAM - Full RB)



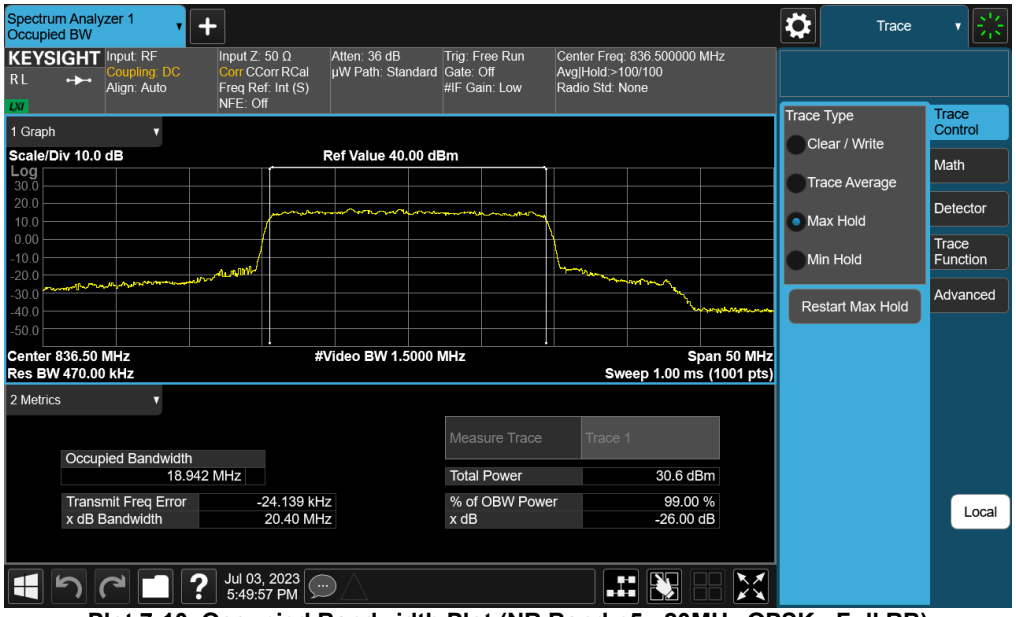
Plot 7-7. Occupied Bandwidth Plot (LTE Band 5 - 1.4MHz QPSK - Full RB)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 5 - 1.4MHz 16-QAM - Full RB)

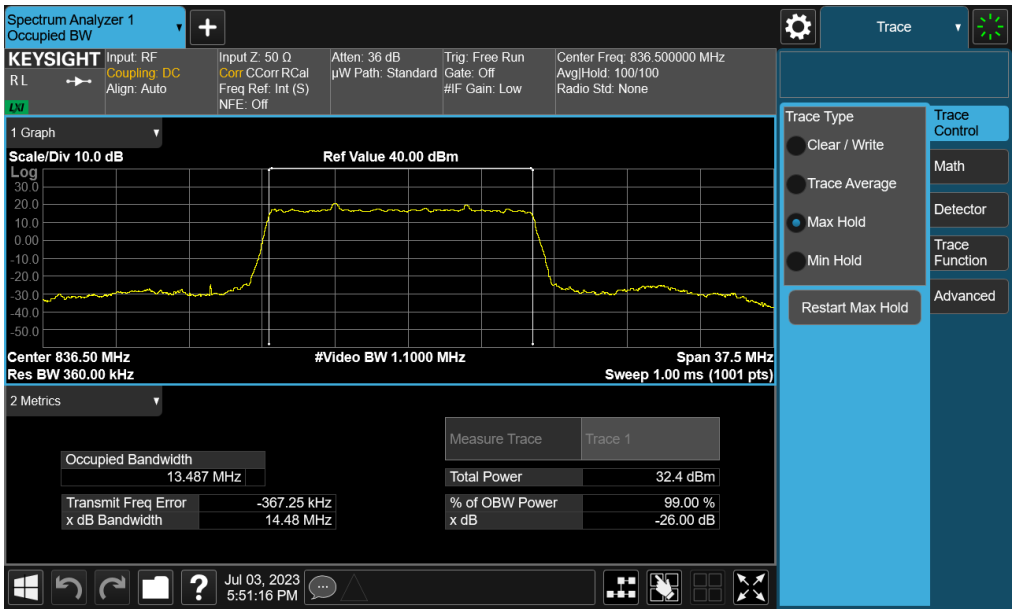
NR Band n5

Plot 7-9. Occupied Bandwidth Plot (NR Band n5 - 20MHz π/2 BPSK - Full RB)



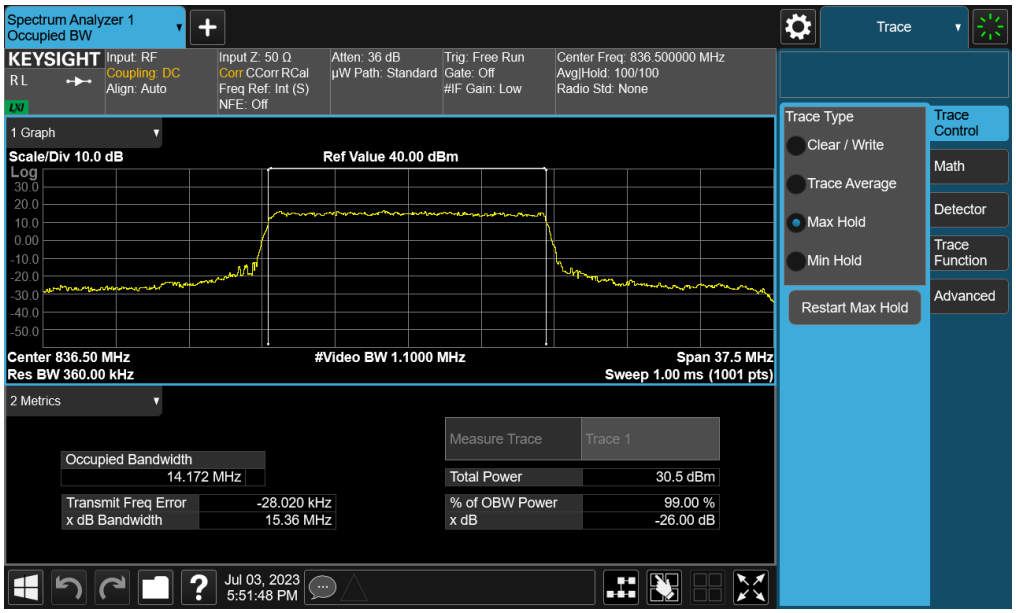
Plot 7-10. Occupied Bandwidth Plot (NR Band n5 - 20MHz QPSK - Full RB)

Plot 7-11. Occupied Bandwidth Plot (NR Band n5 - 20MHz 16-QAM - Full RB)



Plot 7-12. Occupied Bandwidth Plot (NR Band n5 - 15MHz π/2 BPSK - Full RB)

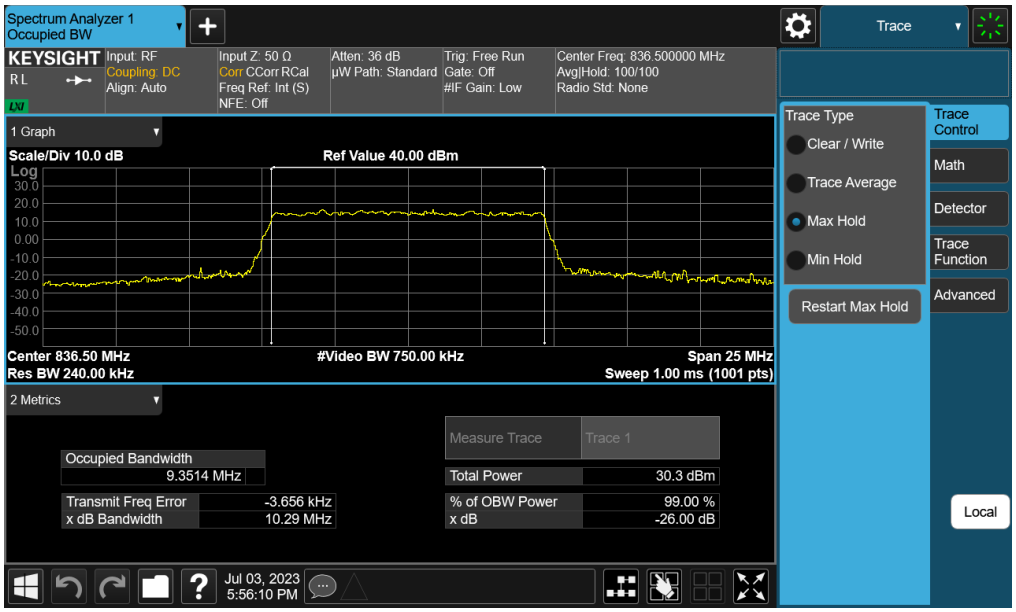
Plot 7-13. Occupied Bandwidth Plot (NR Band n5 - 15MHz QPSK - Full RB)



Plot 7-14. Occupied Bandwidth Plot (NR Band n5 - 15MHz 16-QAM - Full RB)

Plot 7-15. Occupied Bandwidth Plot (NR Band n5 - 10MHz π/2 BPSK - Full RB)

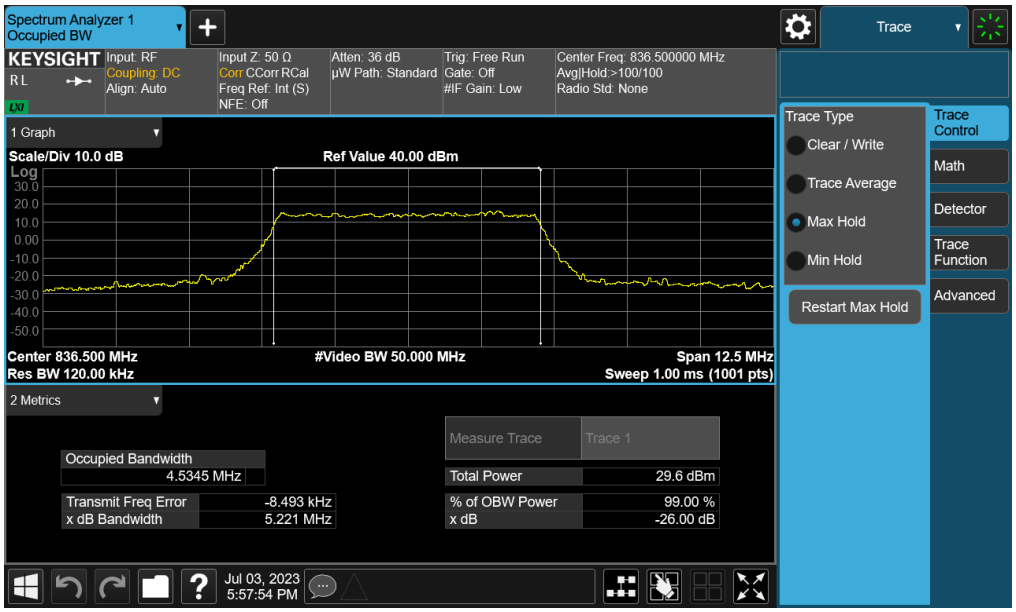
Plot 7-16. Occupied Bandwidth Plot (NR Band n5 - 10MHz QPSK - Full RB)



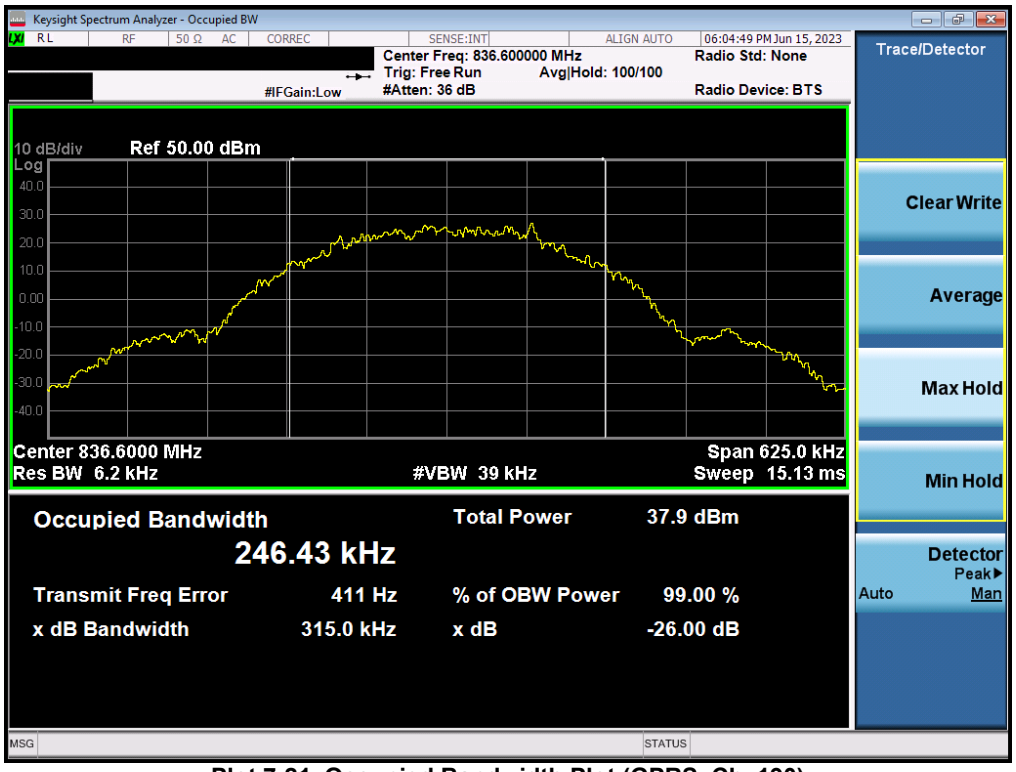
Plot 7-17. Occupied Bandwidth Plot (NR Band n5 - 10MHz 16-QAM - Full RB)

Plot 7-18. Occupied Bandwidth Plot (NR Band n5 - 5MHz π/2 BPSK - Full RB)

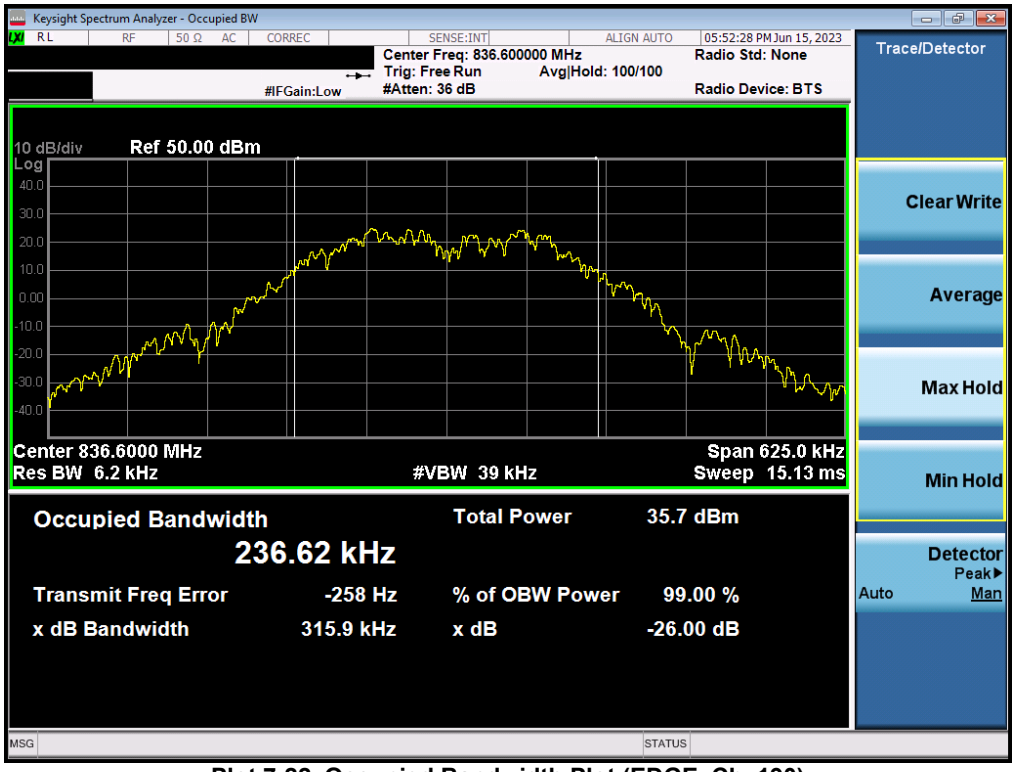
Plot 7-19. Occupied Bandwidth Plot (NR Band n5 - 5MHz QPSK - Full RB)



Plot 7-20. Occupied Bandwidth Plot (NR Band n5 - 5MHz 16-QAM - Full RB)

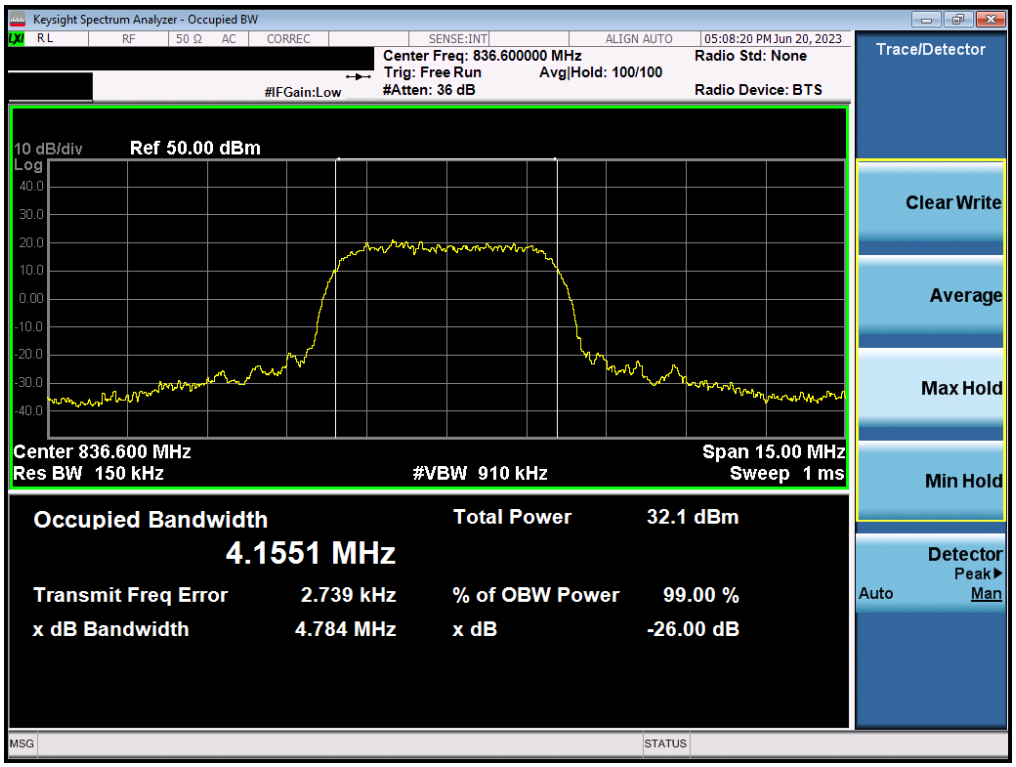


Plot 7-21. Occupied Bandwidth Plot (GPRS, Ch. 190)



Plot 7-22. Occupied Bandwidth Plot (EDGE, Ch. 190)

WCDMA Cell



Plot 7-23. Occupied Bandwidth Plot (WCDMA, Ch. 4183)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 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.

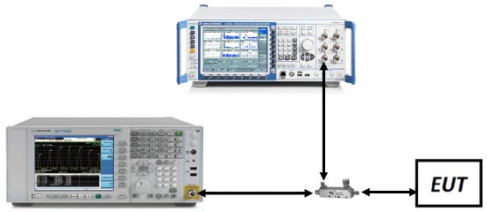


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

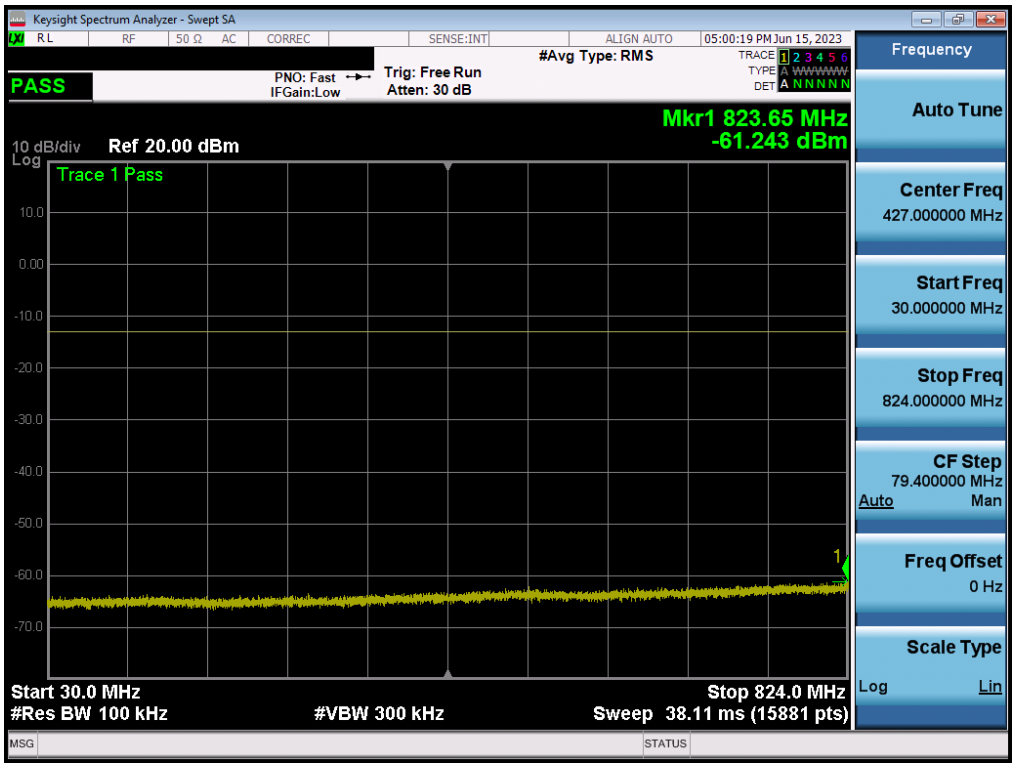
1. Per Part 22 and RSS-132, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth 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.

2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) 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.

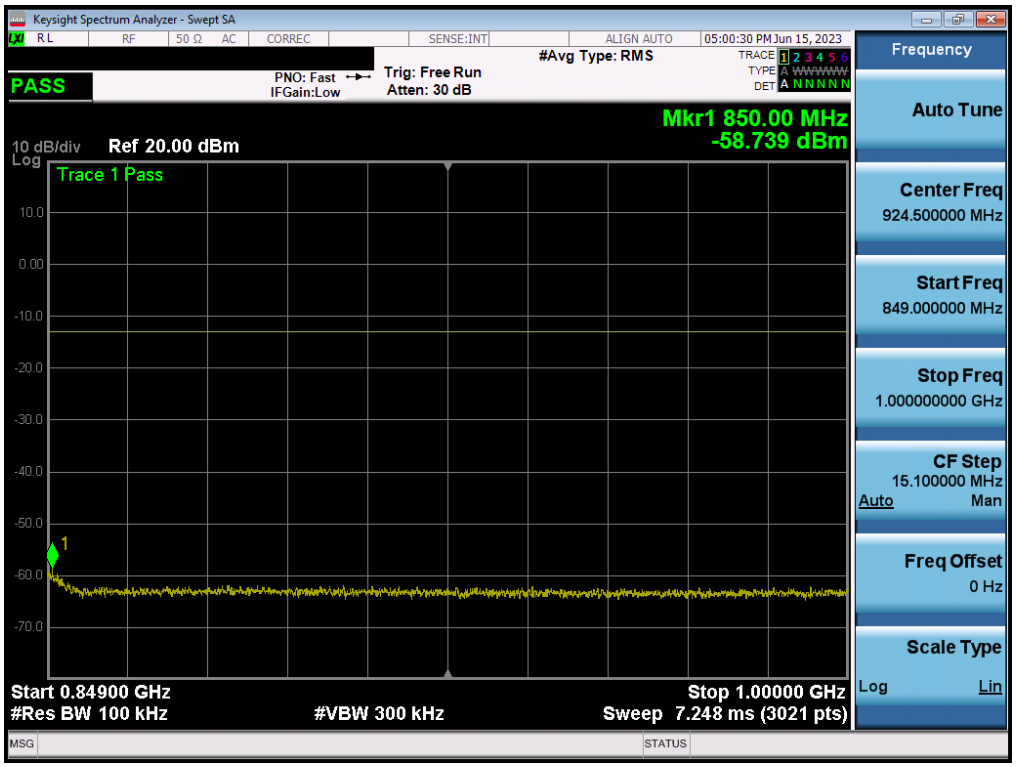
Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
GSM850	N/A	Low	30.0 - 823.0	-42.95	-13	-29.95
		Low	849.0 - 10000.0	-51.83	-13	-38.83
		Low	10000.0 - 100000.0	-35.05	-13	-22.05
		Mid	30.0 - 824.0	-51.81	-13	-38.81
		Mid	849.0 - 10000.0	-53.24	-13	-40.24
		Mid	10000.0 - 100000.0	-34.62	-13	-21.62
		High	30.0 - 824.0	-52.47	-13	-39.47
		High	850.0 - 10000.0	-39.63	-13	-26.63
		High	10000.0 - 100000.0	-33.54	-13	-20.54
WCDMA850	N/A	Low	30.0 - 823.0	-34.09	-13	-21.09
		Low	849.0 - 10000.0	-61.92	-13	-48.92
		Low	10000.0 - 100000.0	-43.70	-13	-30.70
		Mid	30.0 - 824.0	-55.33	-13	-42.33
		Mid	849.0 - 10000.0	-56.09	-13	-43.09
		Mid	10000.0 - 100000.0	-43.56	-13	-30.56
		High	30.0 - 824.0	-61.47	-13	-48.47
		High	850.0 - 10000.0	-33.27	-13	-20.27
		High	10000.0 - 100000.0	-43.27	-13	-30.27
LTE Band 5	20 MHz	Low	30.0 - 823.0	-60.46	-13	-47.46
		Low	849.0 - 10000.0	-61.78	-13	-48.78
		Low	10000.0 - 100000.0	-43.80	-13	-30.80
		Mid	30.0 - 824.0	-61.24	-13	-48.24
		Mid	849.0 - 10000.0	-58.74	-13	-45.74
		Mid	10000.0 - 100000.0	-43.44	-13	-30.44
		High	30.0 - 824.0	-61.29	-13	-48.29
		High	850.0 - 10000.0	-46.23	-13	-33.23
		High	10000.0 - 100000.0	-43.59	-13	-30.59
NR Band n5	20 MHz	Low	30.0 - 824.0	-58.74	-13	-45.74
		Low	849.0 - 10000.0	-60.86	-13	-47.86
		Low	10000.0 - 100000.0	-41.25	-13	-28.25
		Mid	30.0 - 824.0	-59.17	-13	-46.17
		Mid	849.0 - 10000.0	-60.00	-13	-47.00
		Mid	10000.0 - 100000.0	-41.38	-13	-28.38
		High	30.0 - 824.0	-59.20	-13	-46.20
		High	849.0 - 10000.0	-60.33	-13	-47.33
		High	10000.0 - 100000.0	-41.61	-13	-28.61

Table 7-3. Conducted Spurious Emission Results

LTE Band 5



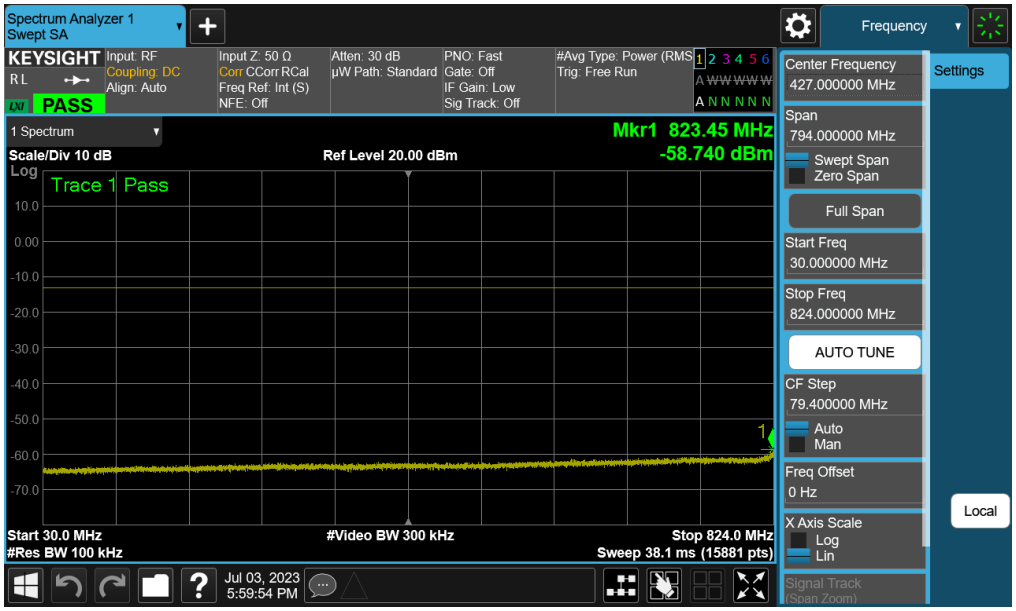
Plot 7-24. Conducted Spurious Plot (LTE Band 5 - 10MHz QPSK - 1 RB - Mid Channel)



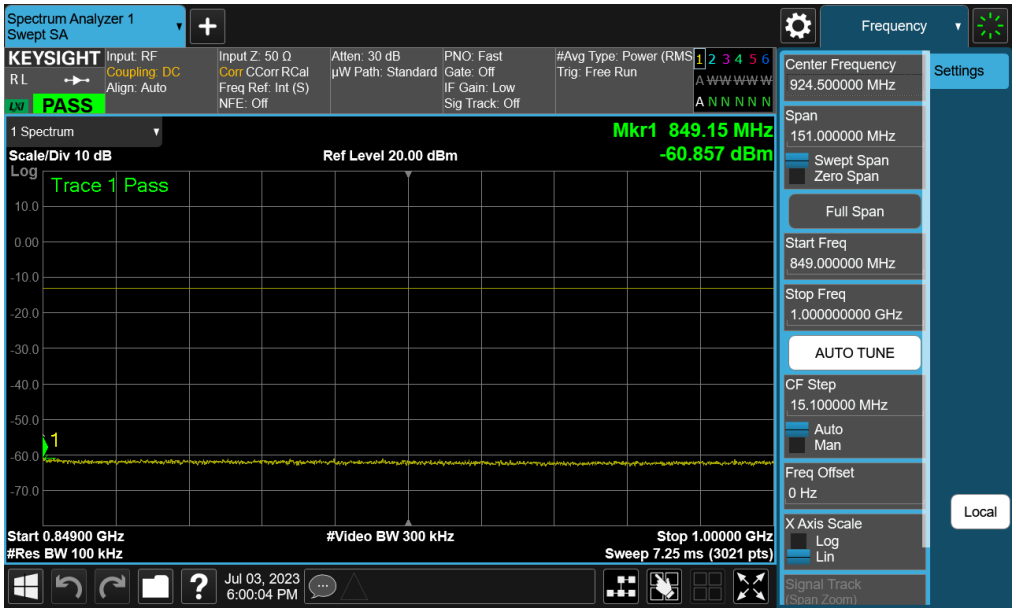
Plot 7-25. Conducted Spurious Plot (LTE Band 5 - 10MHz QPSK - 1 RB - Mid Channel)

Plot 7-26. Conducted Spurious Plot (LTE Band 5 - 10MHz QPSK - 1 RB - Mid Channel)

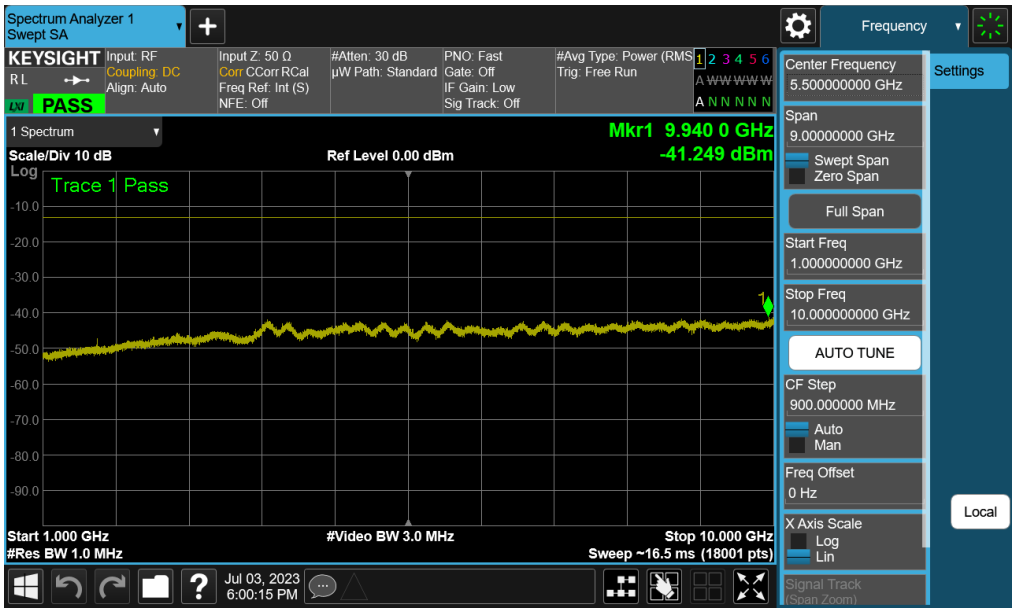
NR Band n5



Plot 7-27. Conducted Spurious Plot (NR Band n5 - 20.0MHz - 1 RB - Low Channel)

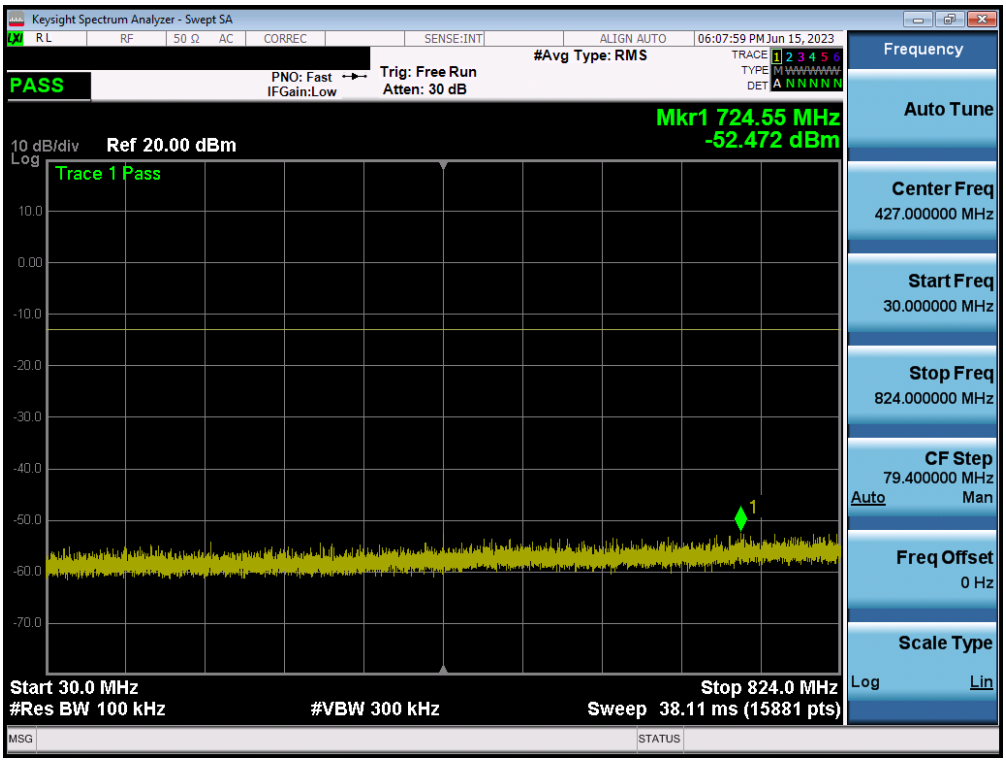


Plot 7-28. Conducted Spurious Plot (NR Band n5 - 20.0MHz - 1 RB - Low Channel)

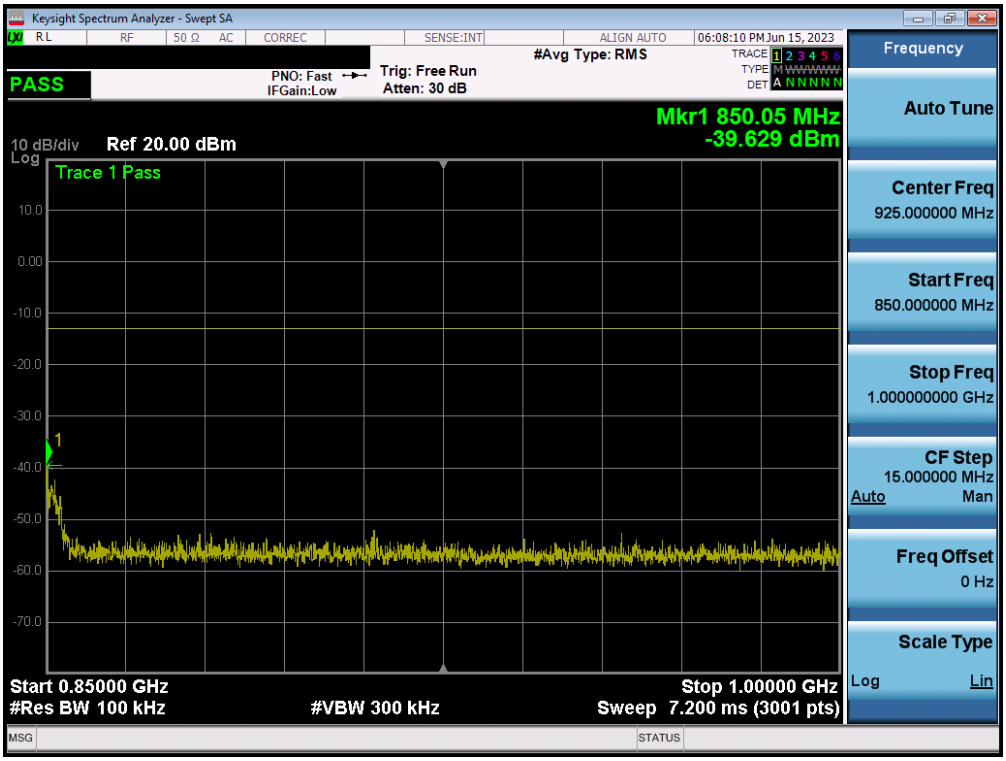


Plot 7-29. Conducted Spurious Plot (NR Band n5 - 20.0MHz - 1 RB - Low Channel)

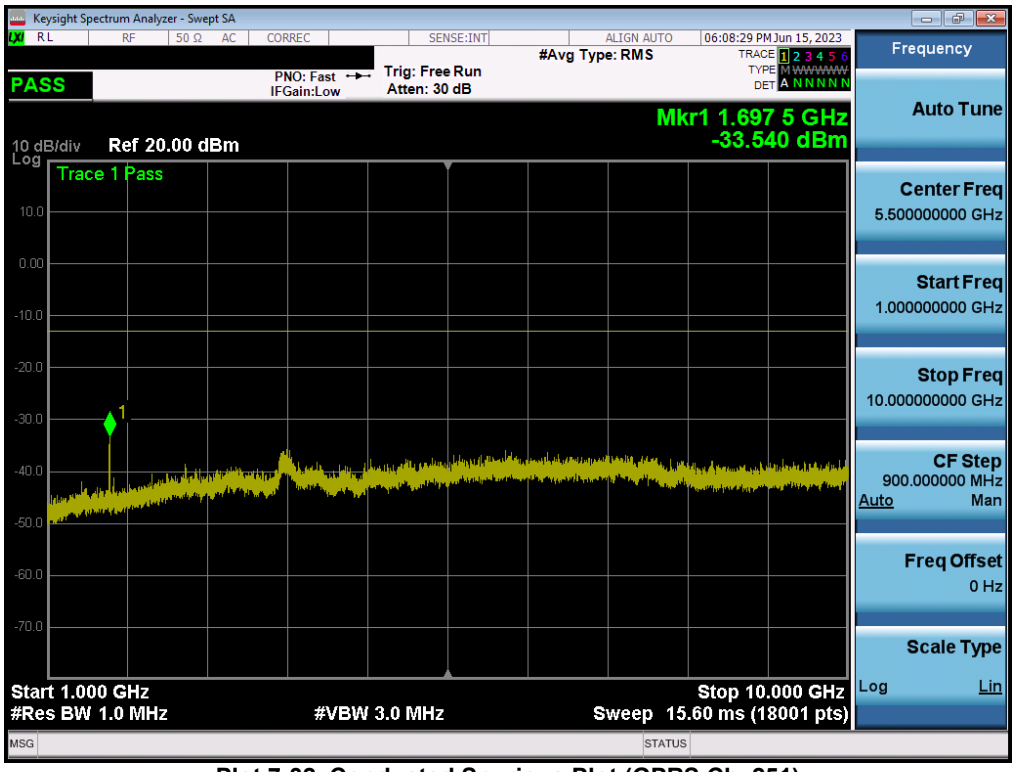
GSM/GPRS Cell



Plot 7-30. Conducted Spurious Plot (GPRS Ch. 251)

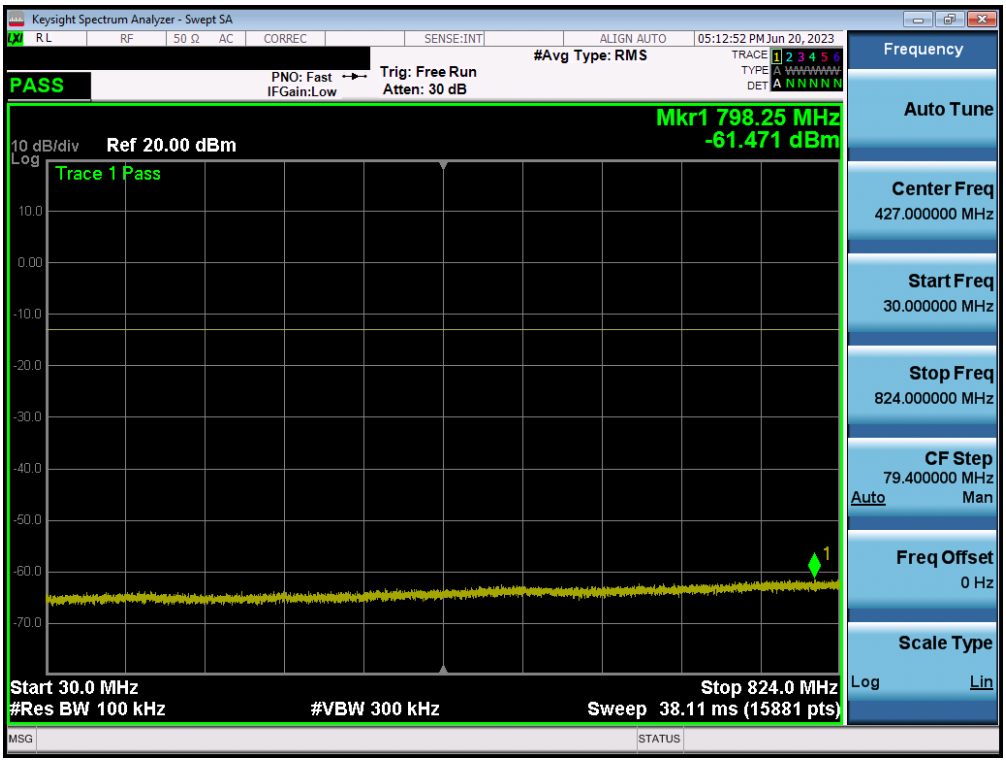


Plot 7-31. Conducted Spurious Plot (GPRS Ch. 251)

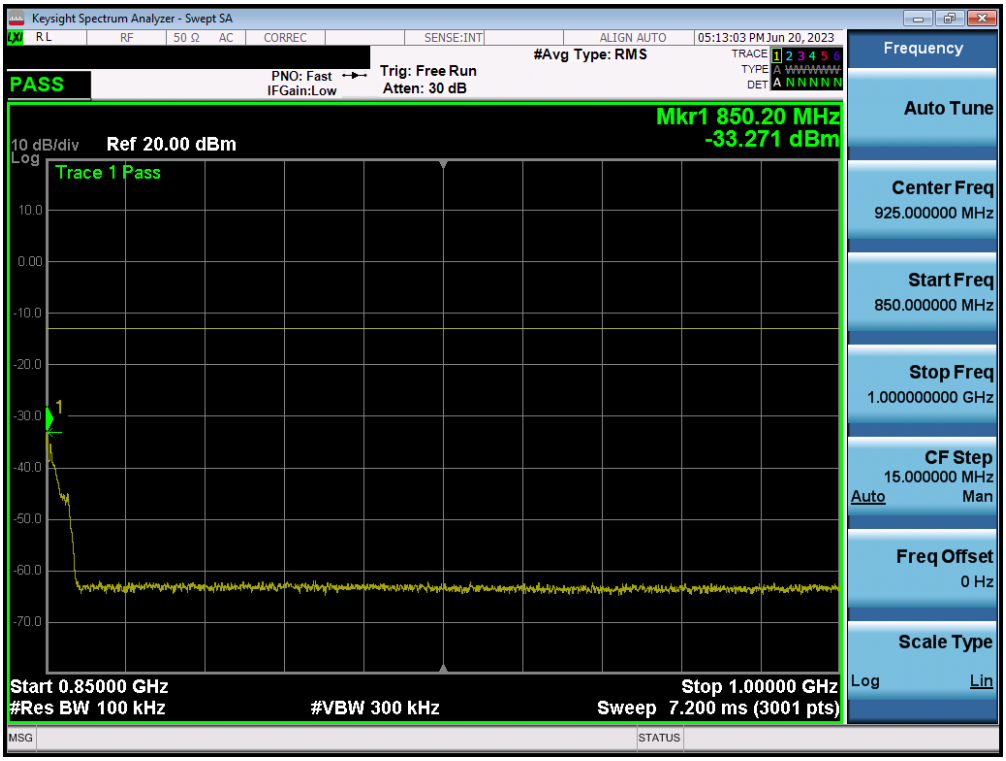


Plot 7-32. Conducted Spurious Plot (GPRS Ch. 251)

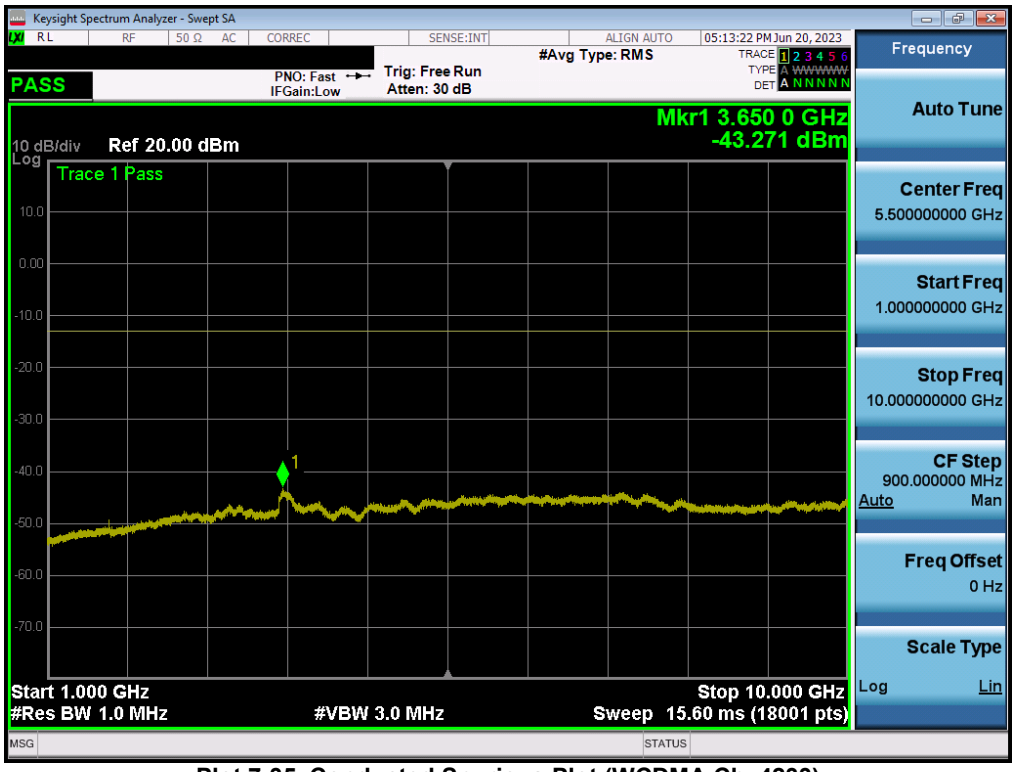
WCDMA Cell



Plot 7-33. Conducted Spurious Plot (WCDMA Ch. 4233)



Plot 7-34. Conducted Spurious Plot (WCDMA Ch. 4233)



Plot 7-35. Conducted Spurious Plot (WCDMA Ch. 4233)

7.4 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.3

Test Settings

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

Test Setup

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

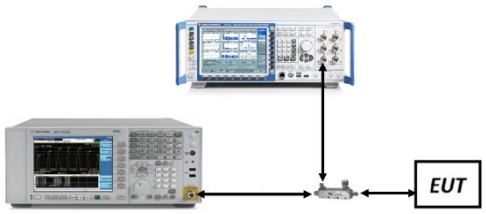


Figure 7-3. Test Instrument & Measurement Setup

Test Notes

1. Per 22.917(b) and RSS-132(5.5), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) 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.

Mode	Channel	Test Case	Level [dBm]	Limit [dBm]	Margin [dB]
GSM850	Low	Band Edge	-15.84	-13	-2.84
	High	Band Edge	-15.82	-13	-2.82

Table 7-4. Band Edge Test Results – GSM/GPRS

Mode	Channel	Test Case	Level [dBm]	Limit [dBm]	Margin [dB]
WCDMA850	Low	Band Edge	-21.01	-13	-8.01
	High	Band Edge	-19.59	-13	-6.59

Table 7-5. Band Edge Test Results – WCDMA

Mode	Bandwidth	Channel	Test Case	Level [dBm]	Limit [dBm]	Margin [dB]
LTE Band 5	10 MHz	Low	Band Edge	-30.59	-13	-17.59
		High	Band Edge	-31.63	-13	-18.63
	5 MHz	Low	Band Edge	-21.92	-13	-8.92
		High	Band Edge	-20.16	-13	-7.16
	3 MHz	Low	Band Edge	-18.3	-13	-5.30
		High	Band Edge	-17.12	-13	-4.12
	1.4 MHz	Low	Band Edge	-15.59	-13	-2.59
		High	Band Edge	-15.76	-13	-2.76

Table 7-6. Band Edge Test Results – LTE B5

Mode	Bandwidth	Channel	Test Case	Level [dBm]	Limit [dBm]	Margin [dB]
NR Band n5	20 MHz	Low	Band Edge	-31.92	-13	-18.92
		High	Band Edge	-32.33	-13	-19.33
	15 MHz	Low	Band Edge	-29.41	-13	-16.41
		High	Band Edge	-29.07	-13	-16.07
	10 MHz	Low	Band Edge	-27.57	-13	-14.57
		High	Band Edge	-25.71	-13	-12.71
	5 MHz	Low	Band Edge	-22.53	-13	-9.53
		High	Band Edge	-19.04	-13	-6.04

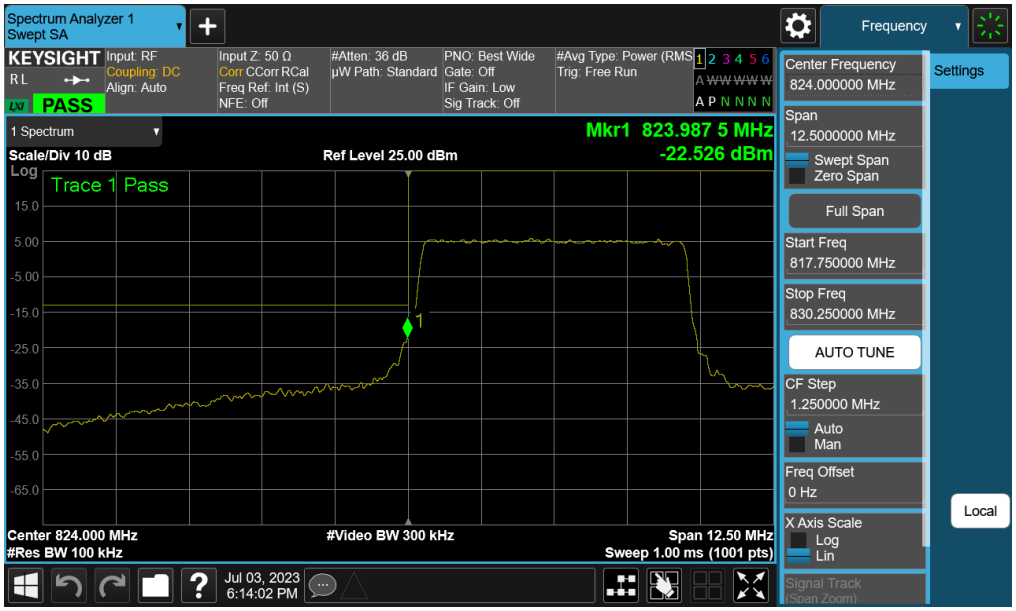
Table 7-7. Band Edge Test Results – NR n5

LTE Band 5

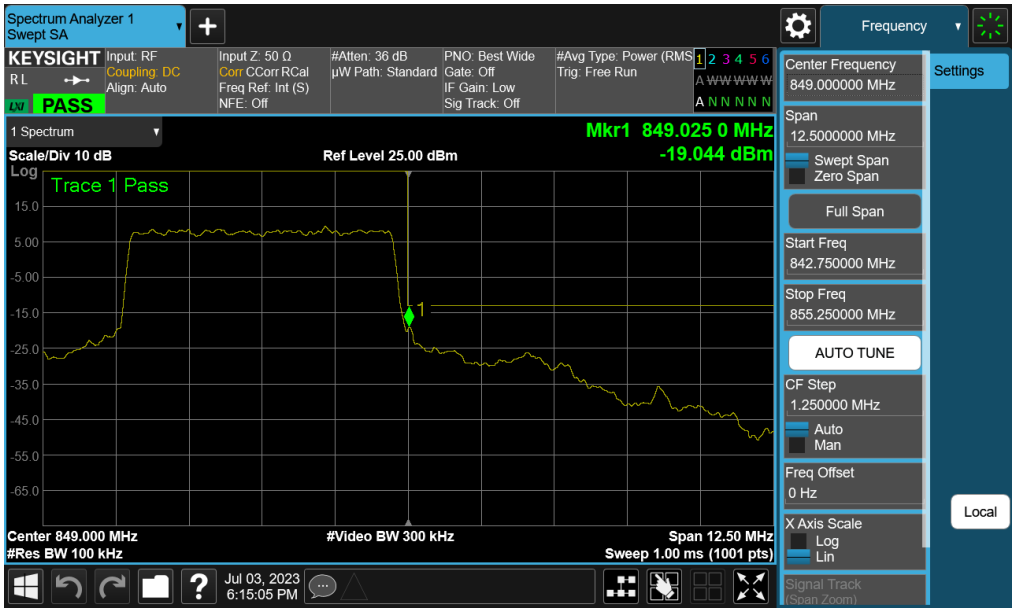
Plot 7-36. Lower Band Edge Plot (LTE Band 5 – 1.4MHz QPSK – Full RB)

Plot 7-37. Upper Band Edge Plot (LTE Band 5 – 1.4MHz QPSK – Full RB)

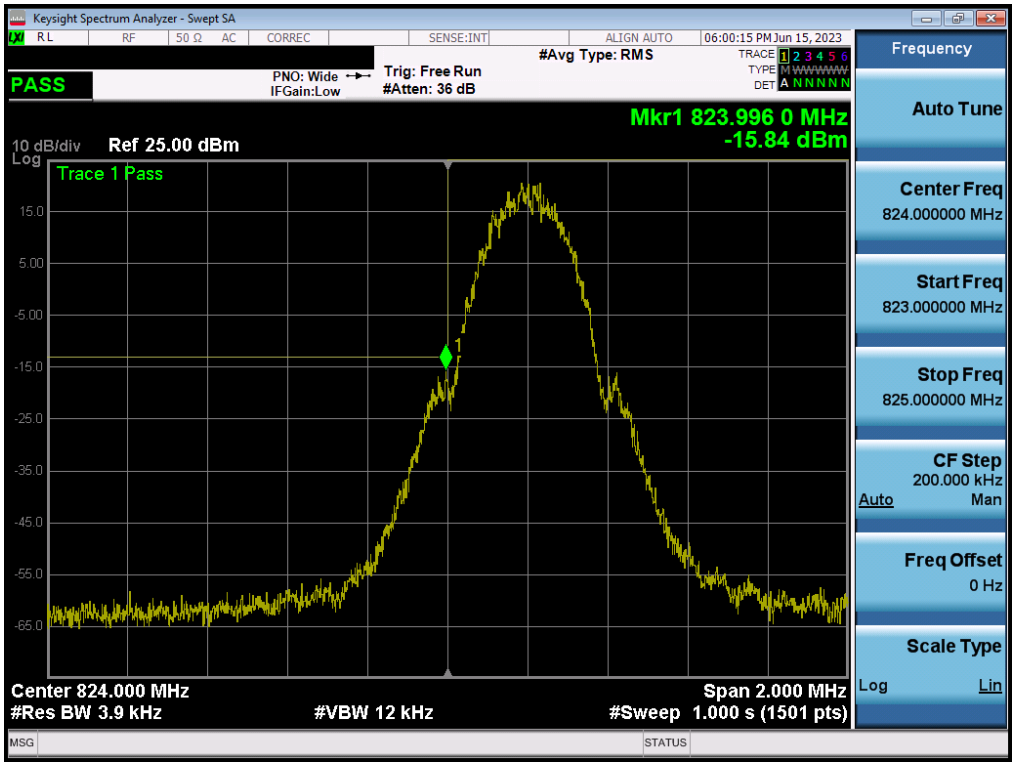
NR Band n5



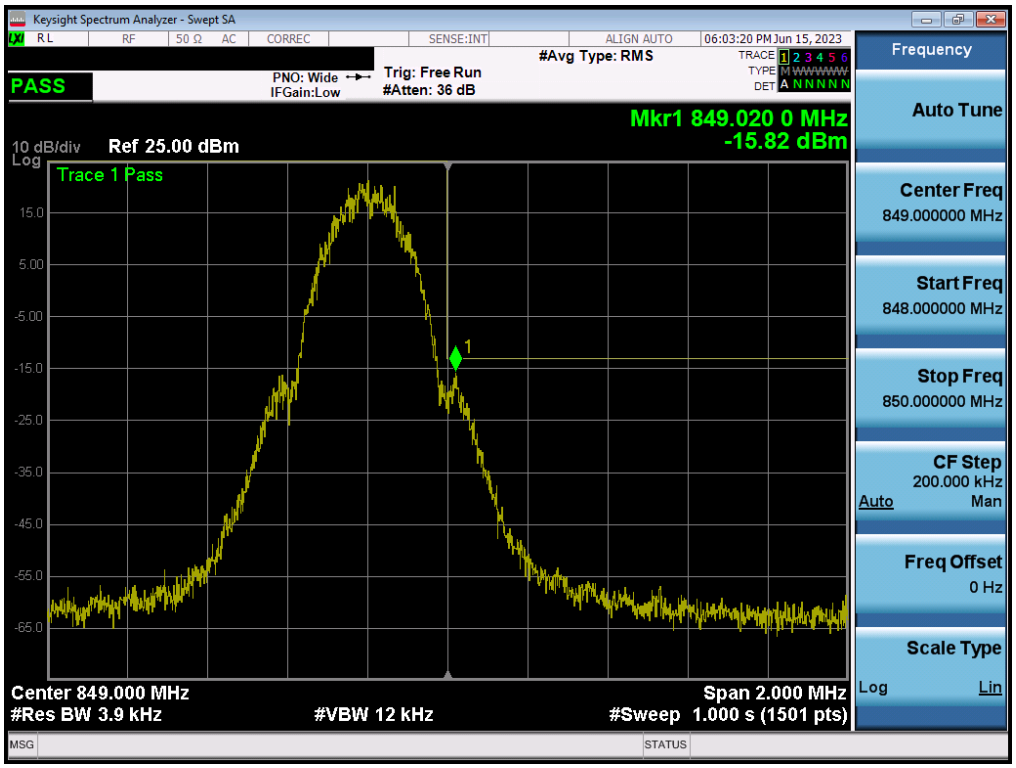
Plot 7-38. Lower Band Edge Plot (NR Band n5 – 5.0MHz - Full RB)



Plot 7-39. Upper Band Edge Plot (NR Band n5 – 5.0MHz - Full RB)



Plot 7-40. Lower Band Edge Plot (GPRS Cell – Ch. 128)



Plot 7-41. Upper Band Edge Plot (GPRS Cell – Ch. 251)

WCDMA Cell

Plot 7-42. Lower Band Edge Plot (WCDMA Cell – Ch. 4132)

Plot 7-43. Upper Band Edge Plot (WCDMA Cell – Ch. 4233)

7.5 Radiated Power (ERP)

Test Overview

Effective Radiated Power (ERP) measurements are performed using the substitution method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

ANSI C63.26-2015 – Section 5.2.4.4

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation. For signals with burst transmission, the signal analyzer's "time domain power" measurement capability is used.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto". Trigger is set to enable triggering only on full power bursts with the sweep time set less than or equal to the transmission burst duration.
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the "gating" function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize.

Test Setup

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

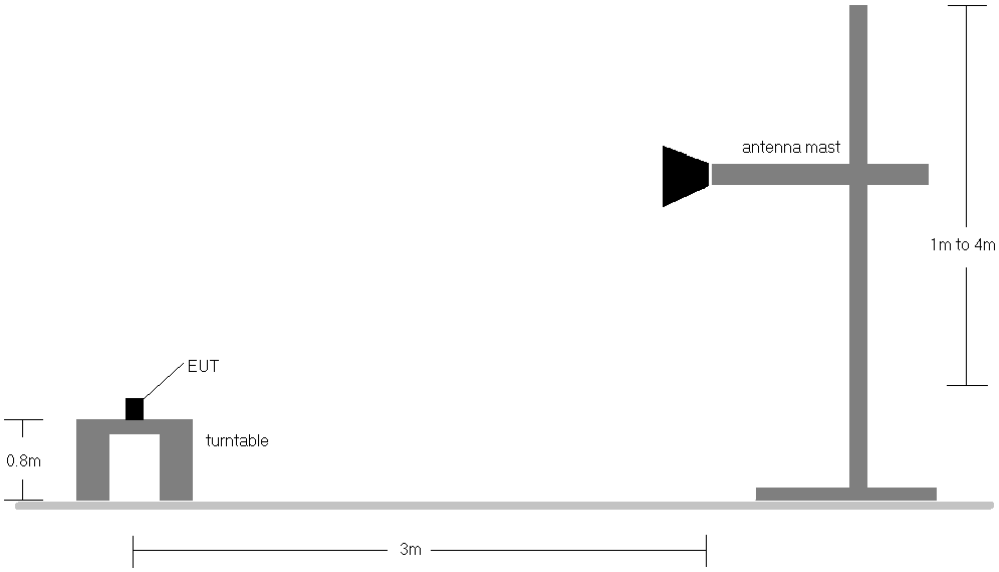


Figure 7-4. Radiated Test Setup < 1GHz

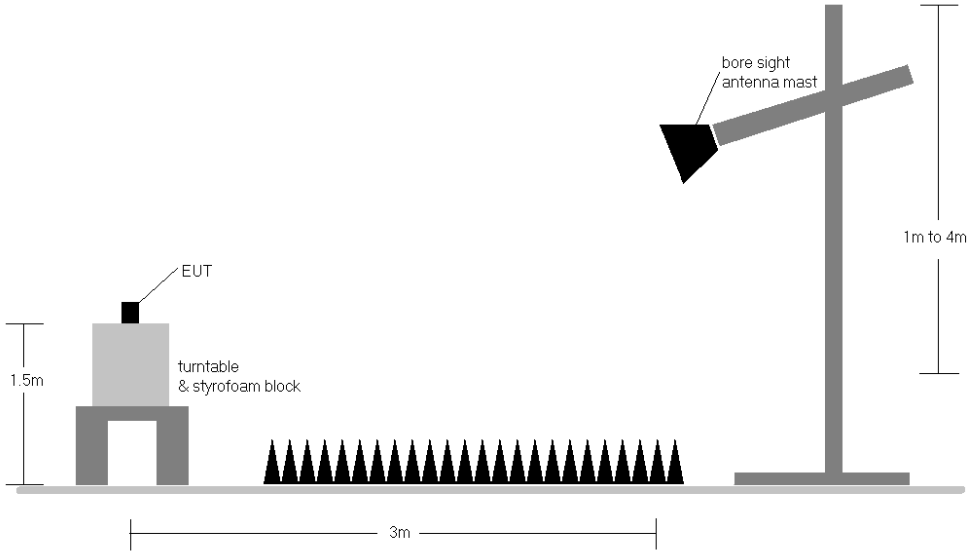


Figure 7-5. Radiated Test Setup > 1GHz

Test Notes

1) This device employs GSM, GPRS, and EDGE capabilities. The EUT was tested under all configurations and the highest powers are reported in GPRS mode while transmitting with one slot active.

2) This device employs UMTS technology with WCDMA (AMR/RMC) and HSDPA capabilities. The EUT was tested under all configurations and the highest powers are 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) For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) 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.