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PART 22 & 90 MEASUREMENT REPORT

Applicant Name:
Samsung Electronics Co., Ltd.
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Gyeonggi-do, 16677, Korea

Date of Testing:
9/5/2022 – 11/6/2022
Test Report Issue Date:
11/24/2022
Test Site/Location:
Element Lab. Yongin-Si, Gyeonggi-do, South Korea
Test Report Serial No.:
1M2209010096-06.A3L

FCC ID:	**A3LSMS911U**
Applicant Name:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-S911U
Additional Model(s):	SM-S911U1
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part:	§22(H), §90(S), §90(R)
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

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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	Measurement	Max. Power [W]	Max. Power [dBm]	Emission Designator
LTE Band 14	10 MHz	QPSK	793.0	ERP	0.104	20.18	9M07G7D
		16QAM	793.0	ERP	0.084	19.27	9M05W7D
	5 MHz	QPSK	790.5 - 795.5	ERP	0.104	20.15	4M55G7D
		16QAM	790.5 - 795.5	ERP	0.086	19.32	4M56W7D
LTE Band 26	15 MHz	QPSK	821.5	ERP	0.126	20.99	13M6G7D
		16QAM	821.5	ERP	0.104	20.19	13M6W7D
	15 MHz	QPSK	821.5	Conducted	0.289	24.61	13M6G7D
		16QAM	821.5	Conducted	0.233	23.68	13M6W7D
	10 MHz	QPSK	819.0	Conducted	0.303	24.81	9M04G7D
		16QAM	819.0	Conducted	0.249	23.96	9M05W7D
	5 MHz	QPSK	816.5 - 821.5	Conducted	0.300	24.77	4M56G7D
		16QAM	816.5 - 821.5	Conducted	0.233	23.68	4M56W7D
	3 MHz	QPSK	815.5 - 822.5	Conducted	0.287	24.57	2M73G7D
		16QAM	815.5 - 822.5	Conducted	0.245	23.89	2M74W7D
	1.4 MHz	QPSK	814.7 - 823.3	Conducted	0.291	24.64	1M11G7D
		16QAM	814.7 - 823.3	Conducted	0.235	23.72	1M12W7D
NR Band n26	20 MHz	π/2 BPSK	824	ERP	0.097	19.88	17M9G7D
		QPSK	824	ERP	0.091	19.61	19M0G7D
		16QAM	824	ERP	0.076	18.80	19M0W7D
	15 MHz	π/2 BPSK	821.5	ERP	0.096	19.82	13M5G7D
		QPSK	821.5	ERP	0.091	19.57	14M2G7D
		16QAM	821.5	ERP	0.078	18.93	14M2W7D
	20 MHz	π/2 BPSK	824	Conducted	0.283	24.52	17M9G7D
		QPSK	824	Conducted	0.288	24.59	19M0G7D
		16QAM	824	Conducted	0.208	23.17	19M0W7D
	15 MHz	π/2 BPSK	821.5	Conducted	0.280	24.47	13M5G7D
		QPSK	821.5	Conducted	0.285	24.55	14M2G7D
		16QAM	821.5	Conducted	0.214	23.30	14M2W7D
	10 MHz	π/2 BPSK	819	Conducted	0.265	24.23	9M01G7D
		QPSK	819	Conducted	0.281	24.49	9M34G7D
		16QAM	819	Conducted	0.216	23.35	9M33W7D
	5 MHz	π/2 BPSK	816.5 - 821.5	Conducted	0.283	24.52	4M52G7D
		QPSK	816.5 - 821.5	Conducted	0.285	24.55	4M49G7D
		16QAM	816.5 - 821.5	Conducted	0.218	23.38	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: A3LSMS911U**. 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 90 and 22H.

Test Device Serial No.: 0285M, 0281M, 0221M, 0308M, 0368M, 0374M

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 and FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), NFC, Wireless Power Transfer

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: EP-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.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version S911USQU0AVJM 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	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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
AAMCS	UDC	Directional Coupler	2022-07-05	Annual	2023-07-04	N/A
Agilent	N9030A	PXA Signal Analyzer	2022-07-04	Annual	2023-07-03	MY49432391
Anritsu	S820E	Cable and Antenna Analyzer	2022-07-06	Annual	2023-07-05	1839097
Anritsu	MA24106A	USB Power Sensor	2022-07-06	Annual	2023-07-05	1244512
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	2022-10-21	Biennial	2024-10-20	10160045
Com-Power	PAM-118A	Preamplifier	2022-07-06	Annual	2023-07-05	551042
Espec	SH-242	Environmental Chamber	2022-08-26	Annual	2023-08-25	93011064
Fairview Microwave	FM2CP1122-10	Coupler	2022-07-06	Annual	2023-07-05	1946
Keysight Technologies	N9030B	MXA Signal Analyzer	2022-05-10	Annual	2023-05-19	MY57142018
Mini-Circuits	BW-N10W5+	Attenuator	2022-05-09	Annual	2023-05-08	1607
Mini-Circuits	BW-N10W5+	Attenuator	2022-05-09	Annual	2023-05-08	1607
Rohde & Schwarz	TS-PR18	Preamplifier	2022-07-06	Annual	2023-07-05	102141
Rohde & Schwarz	SMB100A03	Signal Generator	2022-01-18	Annual	2023-01-17	182487
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2022-02-18	Annual	2023-02-17	131453
Rohde & Schwarz	ESW	EMI Test Receiver	2022-07-04	Annual	2023-07-03	101761
Rohde & Schwarz	FSW43	Signal & Spectrum Analyzer	2022-01-18	Annual	2023-01-17	101250
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2022-02-18	Annual	2023-02-17	102131
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2022-03-28	Annual	2023-03-27	102151
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	2021-07-13	Biennial	2023-07-12	9162-217
Schwarzbeck	UHA9105	Dipole Antenna	2022-07-19	Biennial	2024-07-18	91052522
Sunol	DRH-118	Horn Antenna	2021-07-14	Biennial	2023-07-13	A102416-1
Sunol	DRH-118	Horn Antenna	2021-01-12	Biennial	2023-01-11	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

Emission Designator

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 – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (1564 MHz)

The average 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 analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMS911U

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

Mode(s): LTE/NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power*	2.1046(a), 90.635(b)	< 100 Watts	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (LTE Band 14)	2.1051, 90.543(c)(e)	On all frequencies between 769-775 MHz and 799-805 MHz, attenuation by a factor not less than 65 + 10 log(P) dB in a 6.25 kHz band segment, for mobile and portable stations. On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, attenuation by at least 43 + 10 log(P) dB > 43 + 10log10(P[Watts]) for all out-of-band emissions outside of those specified in 90.543(e)	PASS	Sections 7.4, 7.5
	Conducted Band Edge / Spurious Emissions (LTE Band 26; NR Band n26)	2.1051, 90.691(a)	> 43 + 10 log10(P[Watts]) for all out-of-band emissions except emissions beyond 37.5kHz from the block edge > 50 + 10 log10(P[Watts]) at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge	PASS	Sections 7.4, 7.5
	Frequency Stability	2.1055, 90.213	< 2.5 ppm **Fundamental emissions stay within authorized frequency block	PASS	Section 7.8
RADIATED	Effective Radiated Power (LTE Band 14)	90.542(a)(7)	< 3 Watts max. ERP	PASS	Section 7.6
	Effective Radiated Power (LTE Band 26; NR Band n26)	22.913(a)(2)	< 7 Watts max. ERP	PASS	Section 7.6
	Radiated Spurious Emissions (LTE Band 14)	2.1053, 90.543(e)(f)	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions except emissions in the 1559 - 1610MHz band are subject to a limit of -40dBm/MHz for wideband signals	PASS	Section 7.7
	Radiated Spurious Emissions (LTE Band 26; NR Band n26)	2.1053, 90.691(a)	> 43 + 10 log10(P[Watts]) for all out-of-band emissions except emissions beyond 37.5kHz from the block edge > 50 + 10 log10(P[Watts]) at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge	PASS	Section 7.7

* The only transmitter output conducted powers included in this report are those where the Pmax value, per the tune-up document, is higher than any of the DSI power levels. For the remaining conducted power measurements, see the **RF Exposure Report**.

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 shown in Section 7.0 were 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) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool V1.0.

7.2 Conducted Output Power Data

Test Overview

All emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, 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.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2

Test Settings

1. Span = 2 x OBW to 3 x OBW
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.

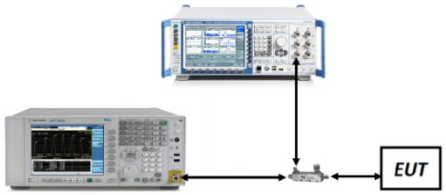


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. For LTE mode, the device was tested under all modulations, RB sizes and offsets, and channel bandwidth configurations and the worst case emissions are reported with 1 RB.

2. This unit was tested with its standard battery.

3. Conducted power measurements were evaluated using various combinations of RB size, RB offset, modulation, and channel bandwidth. Channel bandwidth data is shown in the tables below based only on the channel bandwidths that were supported in this device.

4. All other conducted power measurements are contained in the RF exposure report for this filing.

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Conducted Power [Watts]	Conducted Power Limit [dBm]	Margin [dB]
15 MHz	QPSK	26765	821.5	1 / 0	24.61	0.289	50.00	-25.39
	16-QAM	26765	821.5	1 / 0	23.68	0.233	50.00	-26.32
10 MHz	QPSK	26740	819.0	1 / 0	24.81	0.303	50.00	-25.19
	16-QAM	26740	819.0	1 / 0	23.96	0.249	50.00	-26.04
5 MHz	QPSK	26715	816.5	1 / 0	24.77	0.300	50.00	-25.23
		26765	821.5	1 / 12	24.63	0.290	50.00	-25.37
	16-QAM	26715	816.5	1 / 0	23.63	0.231	50.00	-26.37
		26765	821.5	1 / 12	23.68	0.233	50.00	-26.32
3 MHz	QPSK	26705	815.5	1 / 14	24.49	0.281	50.00	-25.51
		26775	822.5	1 / 7	24.57	0.287	50.00	-25.43
	16-QAM	26705	815.5	1 / 14	23.64	0.231	50.00	-26.36
		26775	822.5	1 / 7	23.89	0.245	50.00	-26.11
1.4 MHz	QPSK	26697	814.7	1 / 3	24.60	0.288	50.00	-25.40
		26783	823.3	1 / 3	24.64	0.291	50.00	-25.36
	16-QAM	26697	814.7	1 / 3	23.72	0.235	50.00	-26.28
		26783	823.3	1 / 3	23.64	0.231	50.00	-26.36

Table 7-2. Conducted Power Output Data (LTE Band 26)

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
20 MHz	π/2 BPSK	164800	824.0	1 / 26	24.52	0.283	50.00	-25.48
	QPSK	164800	824.0	1 / 53	24.59	0.288	50.00	-25.41
	16-QAM	164800	824.0	1 / 26	23.17	0.208	50.00	-26.83
15 MHz	π/2 BPSK	164300	821.5	1 / 39	24.47	0.280	50.00	-25.53
	QPSK	164300	821.5	1 / 58	24.55	0.285	50.00	-25.45
	16-QAM	164300	821.5	1 / 58	23.30	0.214	50.00	-26.70
10 MHz	π/2 BPSK	163800	819.0	1 / 38	24.23	0.265	50.00	-25.77
	QPSK	163800	819.0	1 / 13	24.49	0.281	50.00	-25.51
	16-QAM	163800	819.0	1 / 38	23.35	0.216	50.00	-26.65
5 MHz	π/2 BPSK	165300	816.5	1 / 12	24.38	0.274	50.00	-25.62
		169300	821.5	1 / 6	24.52	0.283	50.00	-25.48
	QPSK	165300	816.5	1 / 18	24.46	0.279	50.00	-25.54
		169300	821.5	1 / 12	24.55	0.285	50.00	-25.45
	16-QAM	165300	816.5	1 / 18	23.25	0.212	50.00	-26.75
		169300	821.5	1 / 12	23.38	0.218	50.00	-26.62

Table 7-3. Conducted Power Output Data (NR Band n26)

7.3 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.

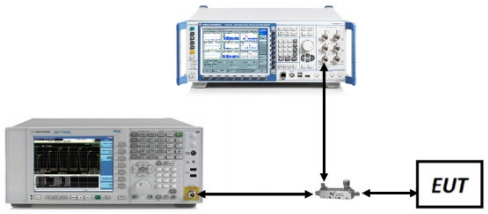


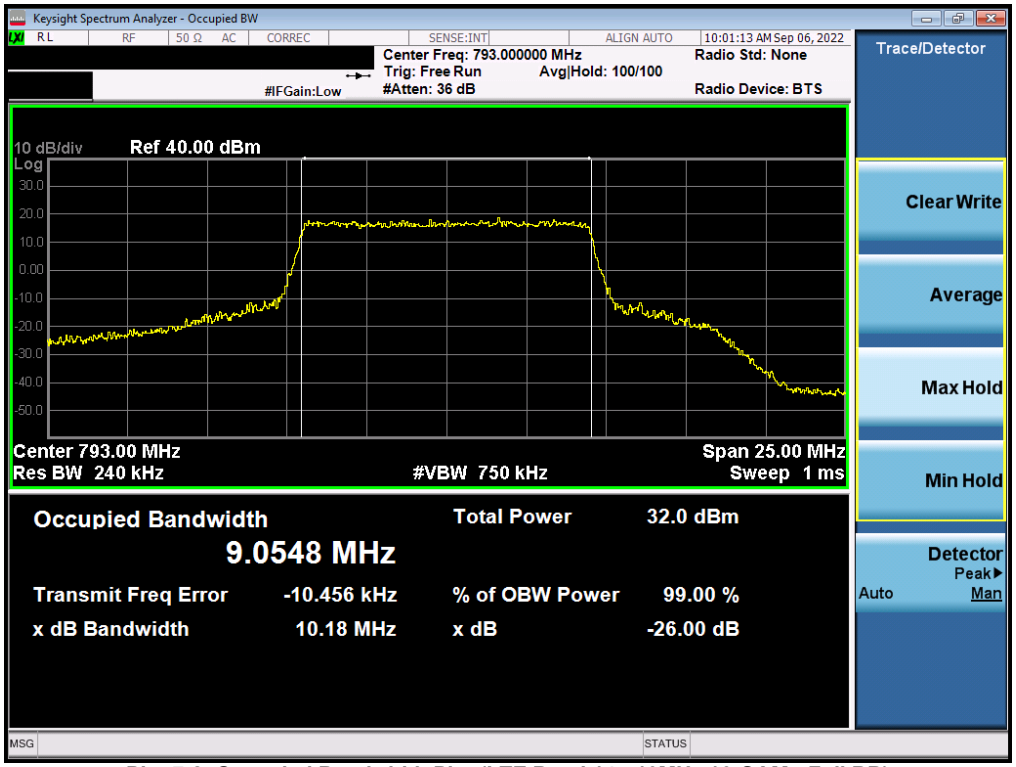
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

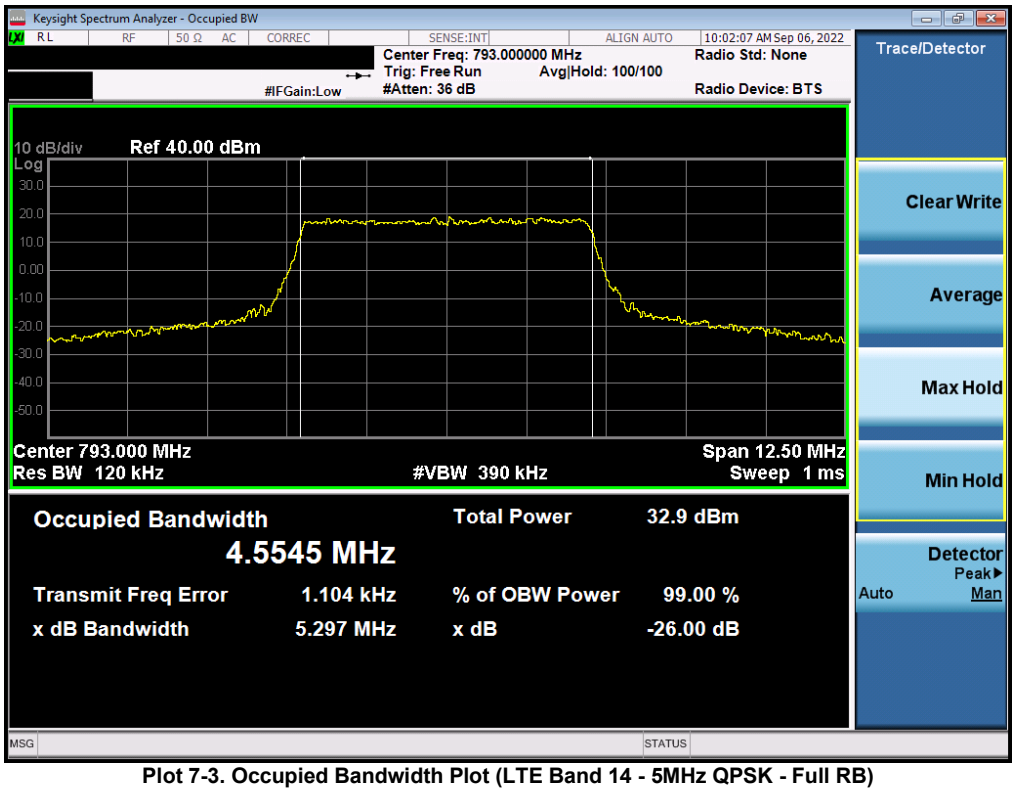
None

LTE Band 14

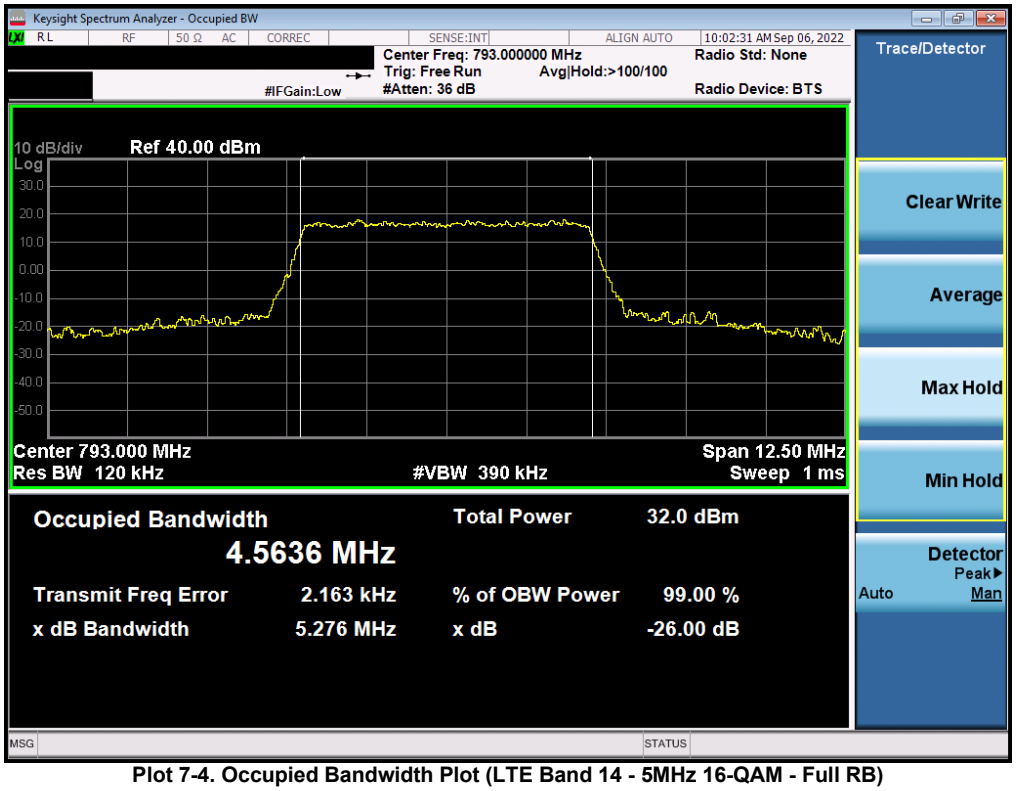
Plot 7-1. Occupied Bandwidth Plot (LTE Band 14 - 10MHz QPSK - Full RB)



Plot 7-2. Occupied Bandwidth Plot (LTE Band 14 - 10MHz 16-QAM - Full RB)



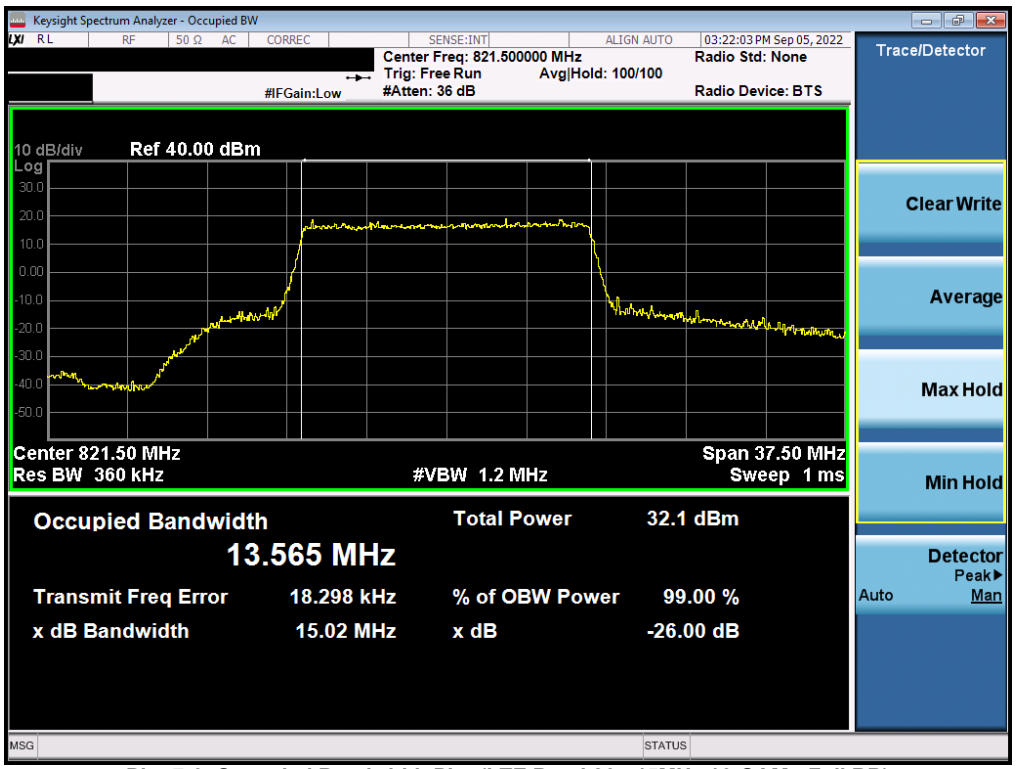
Plot 7-3. Occupied Bandwidth Plot (LTE Band 14 - 5MHz QPSK - Full RB)



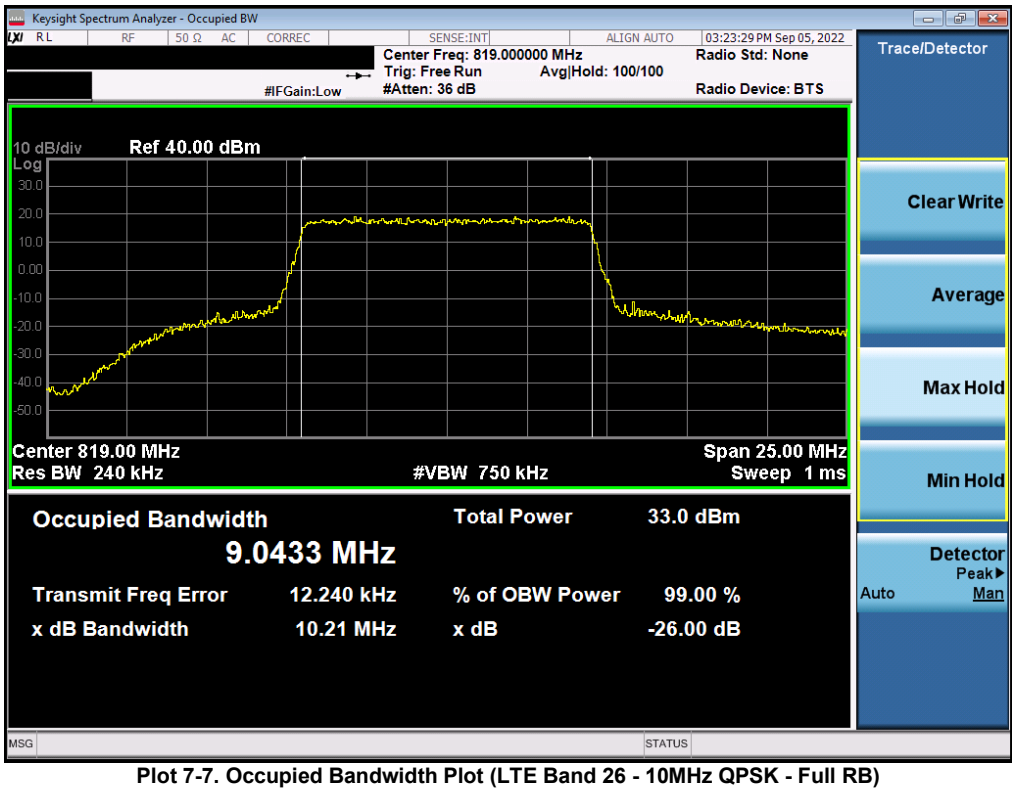
Plot 7-4. Occupied Bandwidth Plot (LTE Band 14 - 5MHz 16-QAM - Full RB)

LTE Band 26

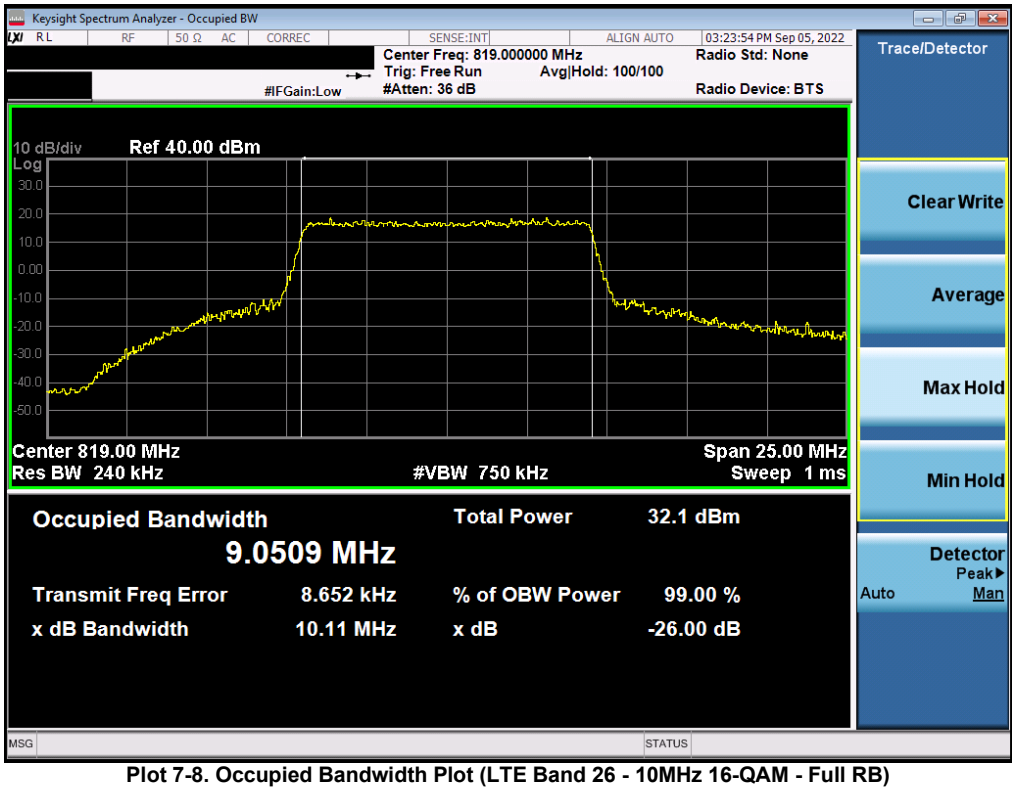
Plot 7-5. Occupied Bandwidth Plot (LTE Band 26 - 15MHz QPSK - Full RB)



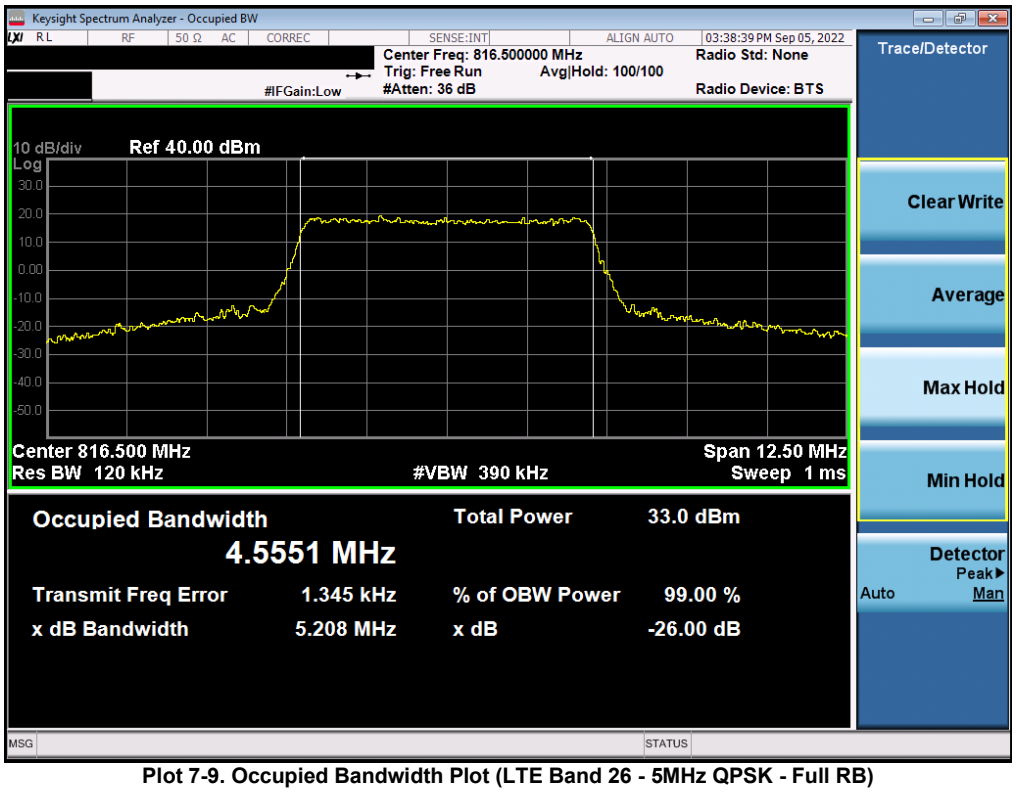
Plot 7-6. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 16-QAM - Full RB)



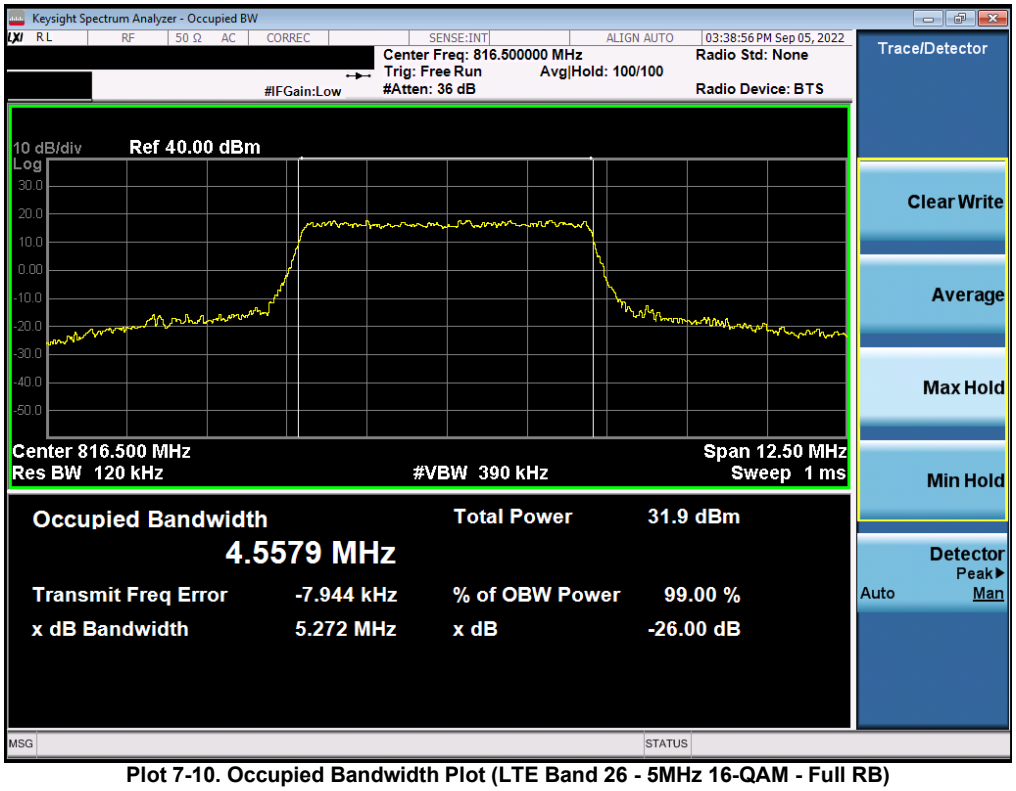
Plot 7-7. Occupied Bandwidth Plot (LTE Band 26 - 10MHz QPSK - Full RB)



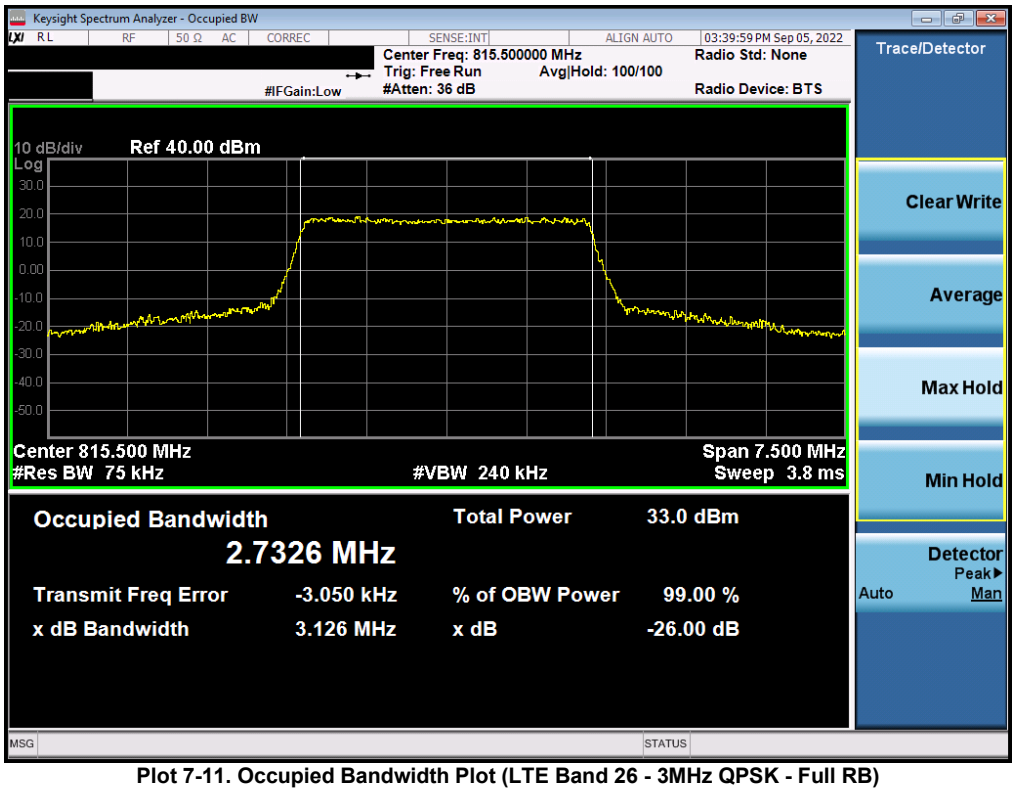
Plot 7-8. Occupied Bandwidth Plot (LTE Band 26 - 10MHz 16-QAM - Full RB)



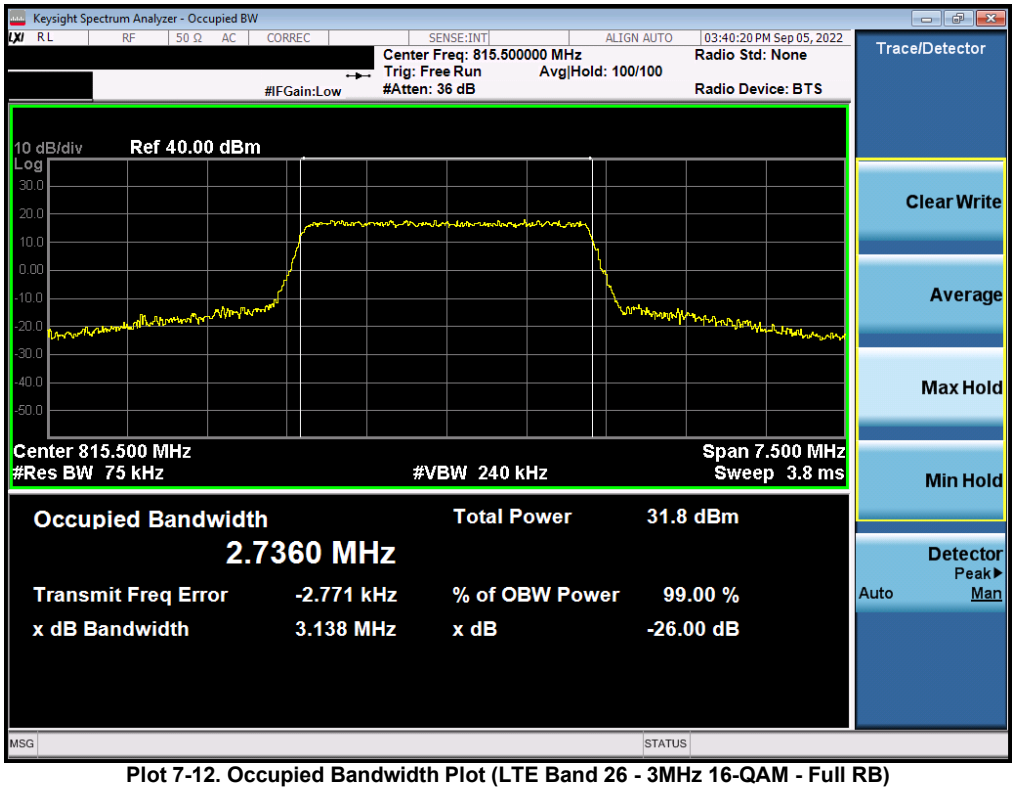
Plot 7-9. Occupied Bandwidth Plot (LTE Band 26 - 5MHz QPSK - Full RB)



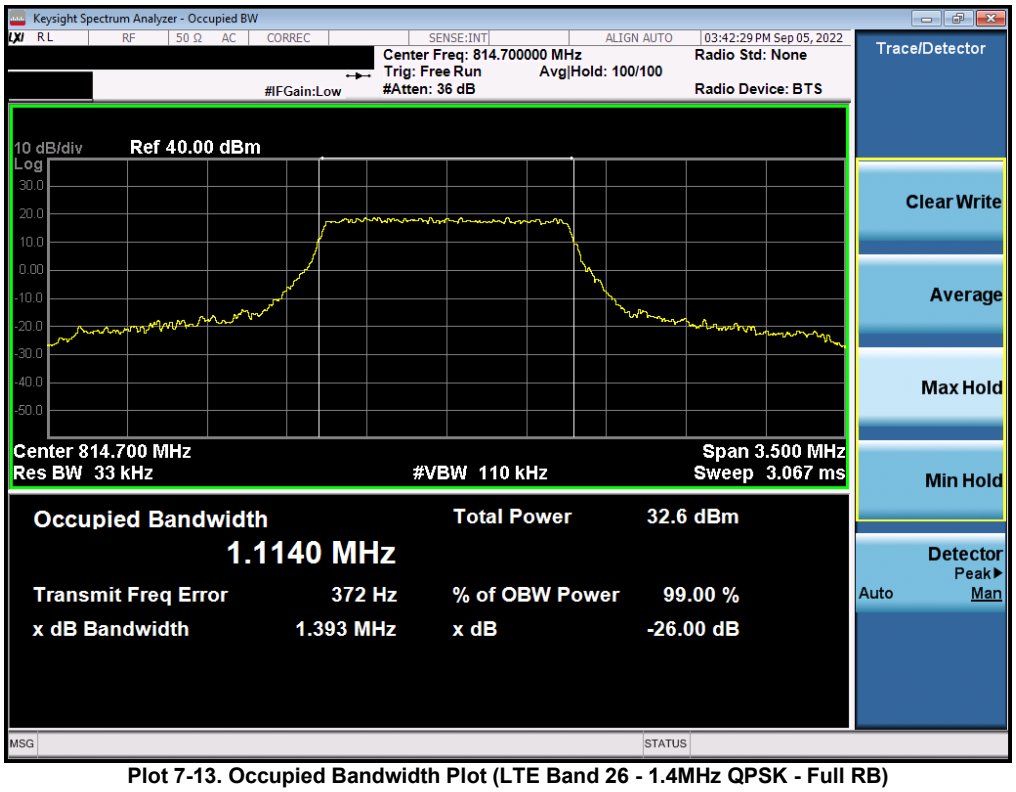
Plot 7-10. Occupied Bandwidth Plot (LTE Band 26 - 5MHz 16-QAM - Full RB)



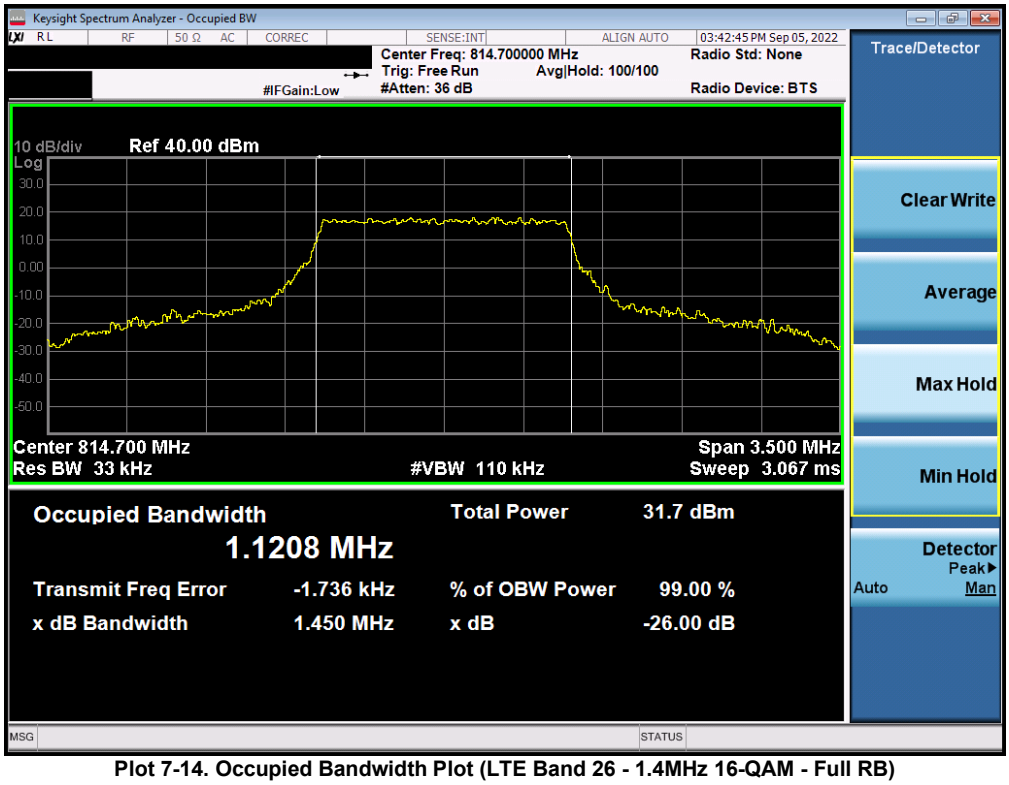
Plot 7-11. Occupied Bandwidth Plot (LTE Band 26 - 3MHz QPSK - Full RB)



Plot 7-12. Occupied Bandwidth Plot (LTE Band 26 - 3MHz 16-QAM - Full RB)

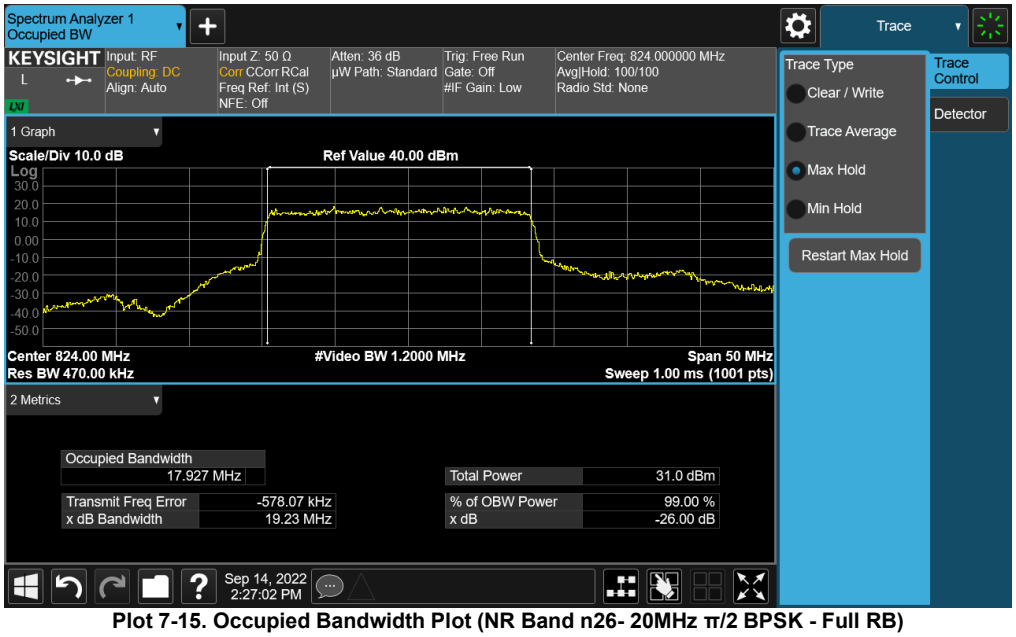


Plot 7-13. Occupied Bandwidth Plot (LTE Band 26 - 1.4MHz QPSK - Full RB)



Plot 7-14. Occupied Bandwidth Plot (LTE Band 26 - 1.4MHz 16-QAM - Full RB)

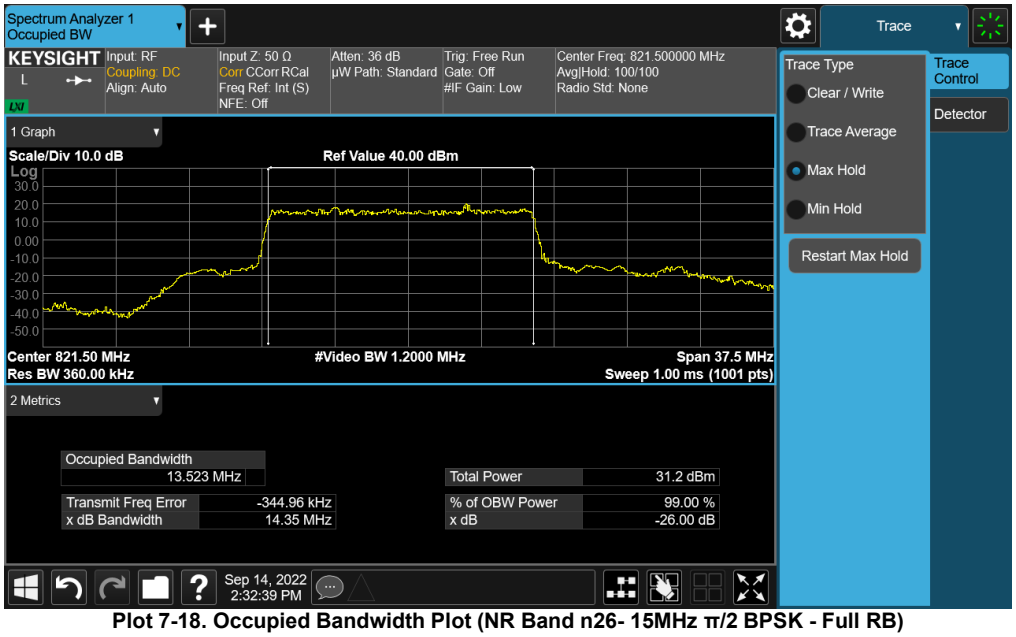
NR Band n26



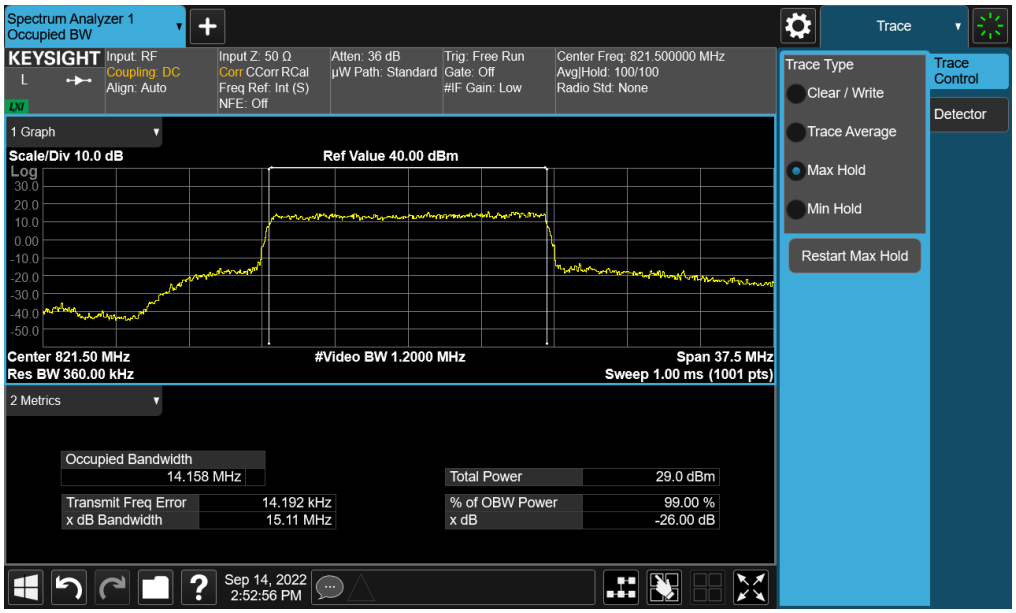
Plot 7-15. Occupied Bandwidth Plot (NR Band n26- 20MHz π/2 BPSK - Full RB)

Plot 7-16. Occupied Bandwidth Plot (NR Band n26- 20MHz QPSK - Full RB)

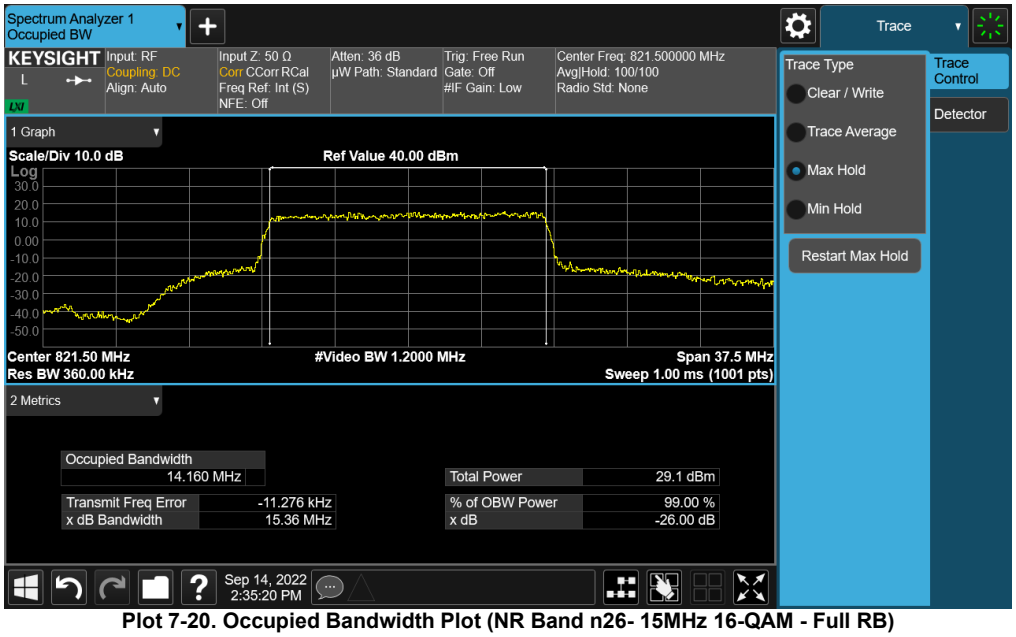
Plot 7-17. Occupied Bandwidth Plot (NR Band n26- 20MHz 16-QAM - Full RB)



Plot 7-18. Occupied Bandwidth Plot (NR Band n26- 15MHz π/2 BPSK - Full RB)

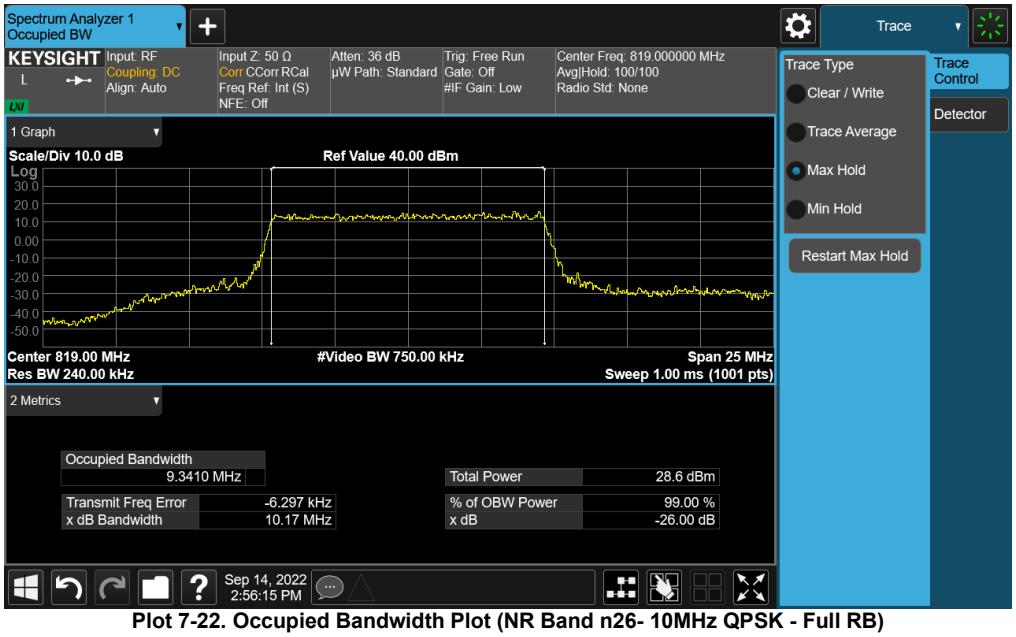


Plot 7-19. Occupied Bandwidth Plot (NR Band n26- 15MHz QPSK - Full RB)

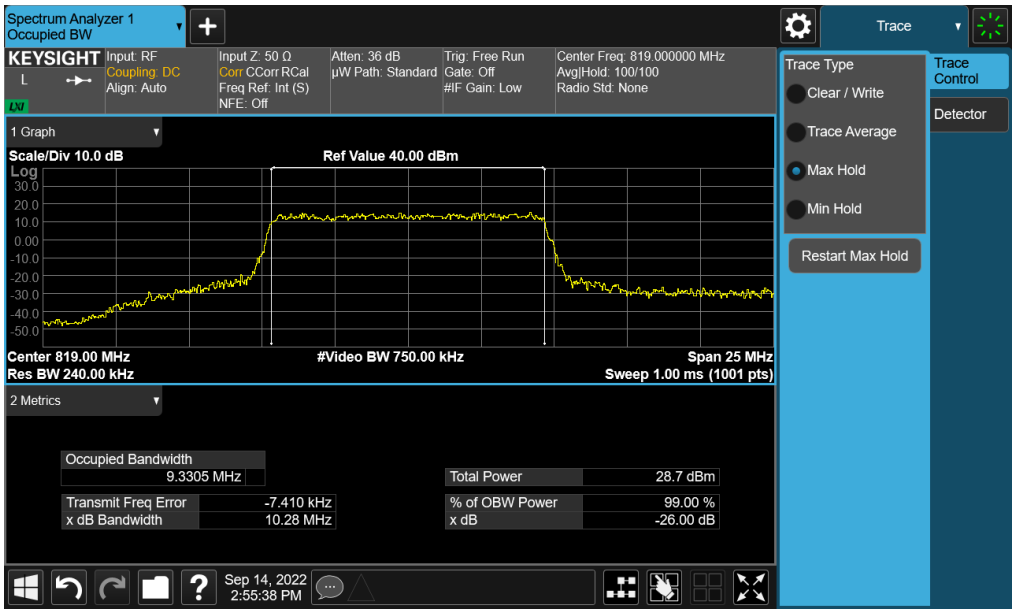


Plot 7-20. Occupied Bandwidth Plot (NR Band n26- 15MHz 16-QAM - Full RB)

Plot 7-21. Occupied Bandwidth Plot (NR Band n26- 10MHz π/2 BPSK - Full RB)

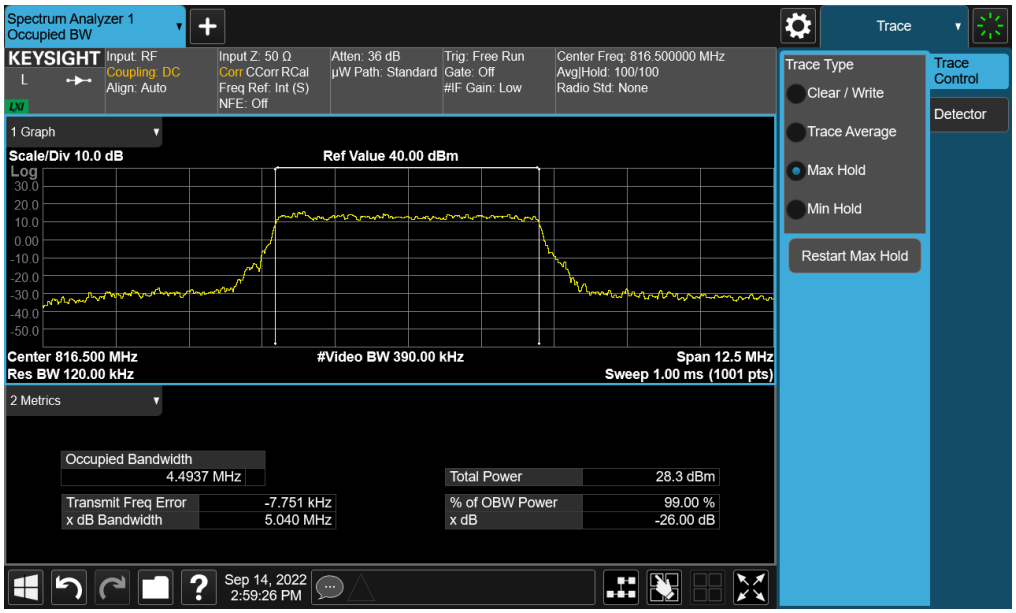


Plot 7-22. Occupied Bandwidth Plot (NR Band n26- 10MHz QPSK - Full RB)

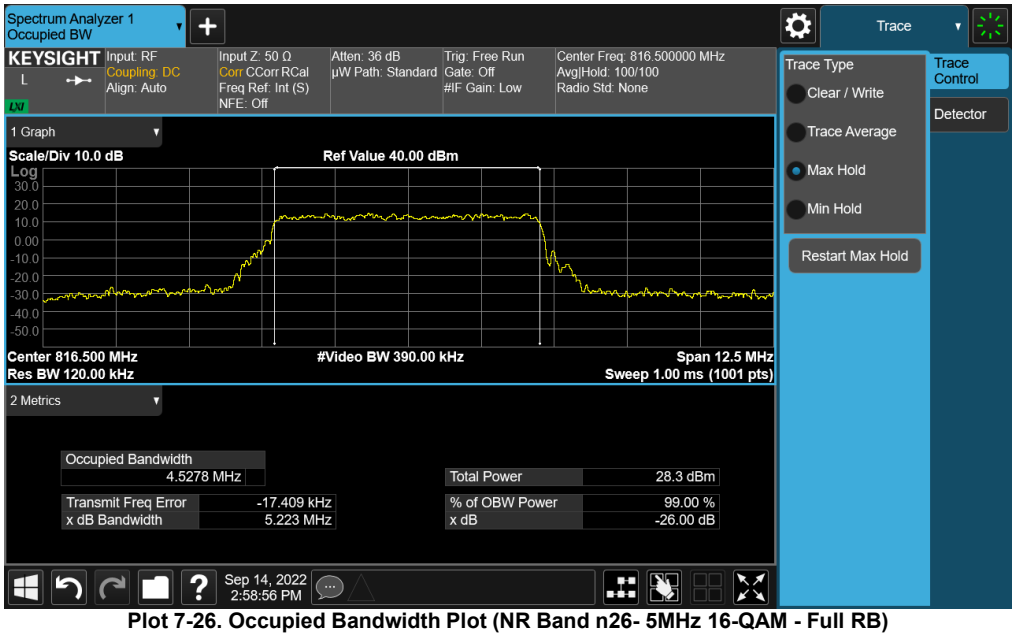


Plot 7-23. Occupied Bandwidth Plot (NR Band n26- 10MHz 16-QAM - Full RB)

Plot 7-24. Occupied Bandwidth Plot (NR Band n26- 5MHz π/2 BPSK - Full RB)



Plot 7-25. Occupied Bandwidth Plot (NR Band n26- 5MHz QPSK - Full RB)



Plot 7-26. Occupied Bandwidth Plot (NR Band n26- 5MHz 16-QAM - Full RB)

7.4 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. RBW ≥ 100kHz
3. VBW ≥ 3 x RBW
4. Detector = RMS
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

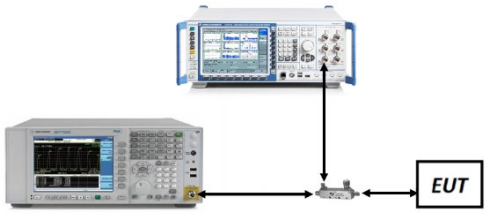


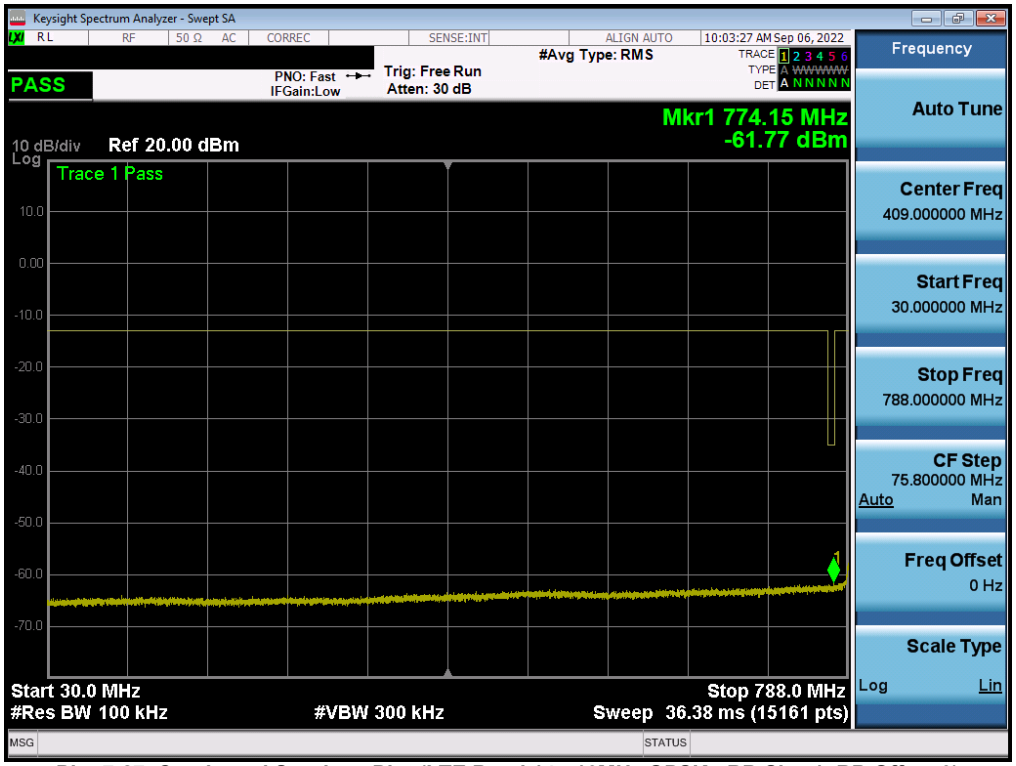
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

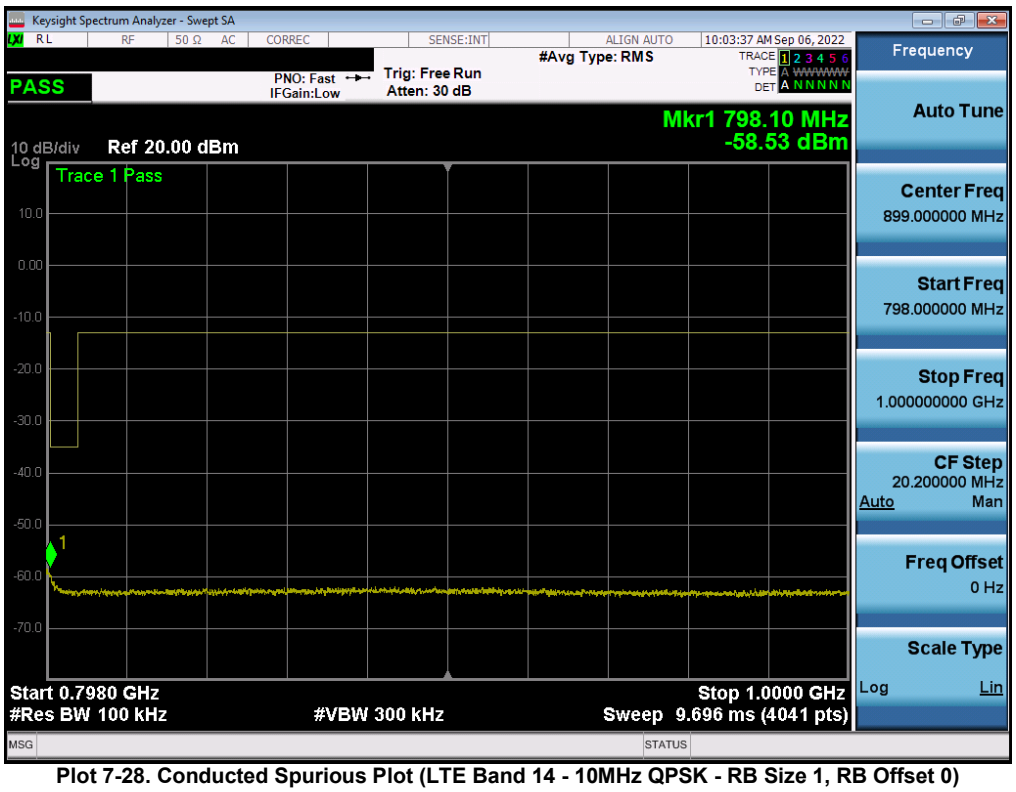
1. Per Part 22H and 90, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater.

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.

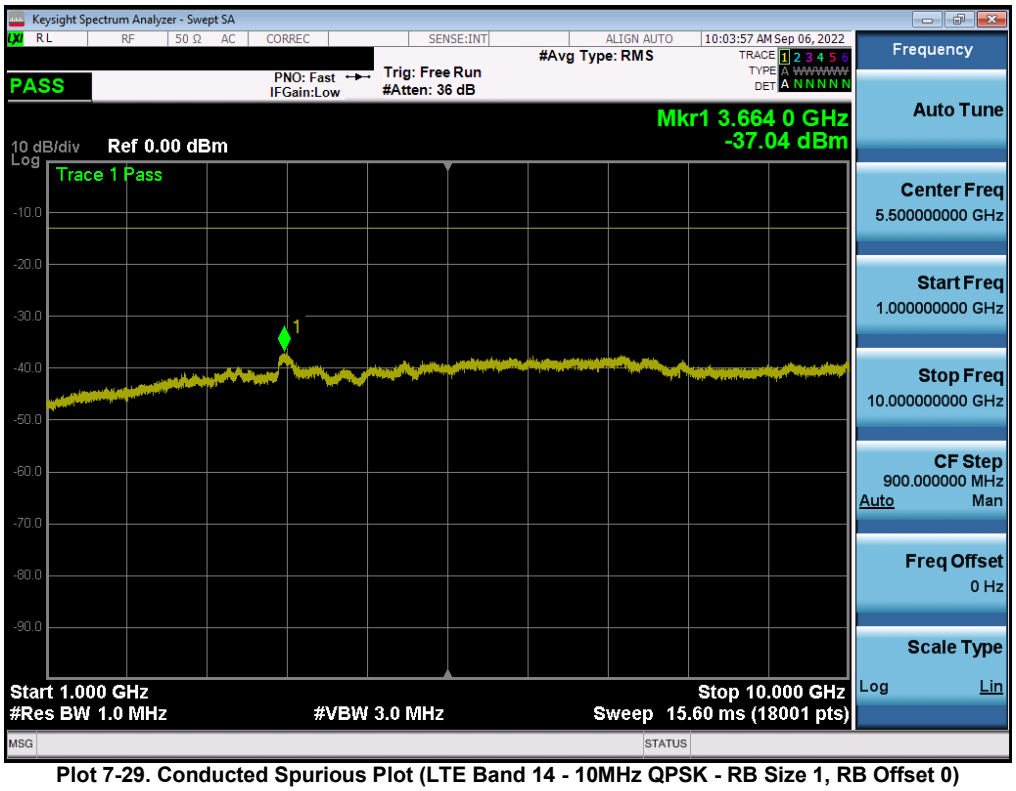
LTE Band 14



Plot 7-27. Conducted Spurious Plot (LTE Band 14 - 10MHz QPSK - RB Size 1, RB Offset 0)

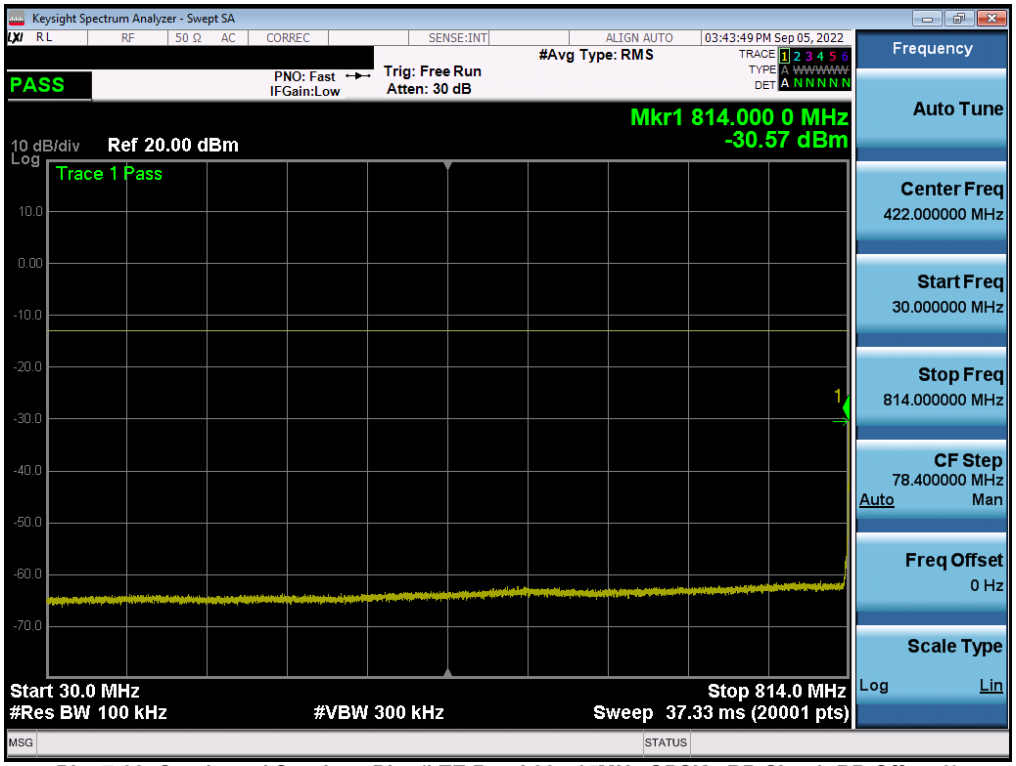


Plot 7-28. Conducted Spurious Plot (LTE Band 14 - 10MHz QPSK - RB Size 1, RB Offset 0)

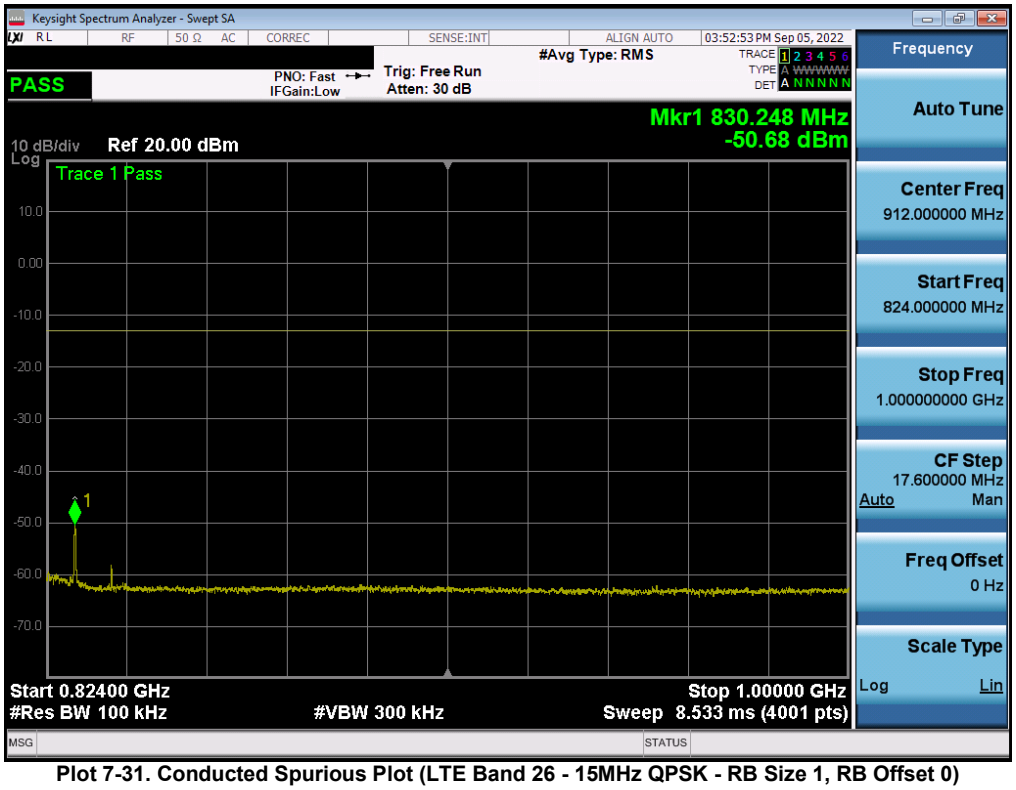


Plot 7-29. Conducted Spurious Plot (LTE Band 14 - 10MHz QPSK - RB Size 1, RB Offset 0)

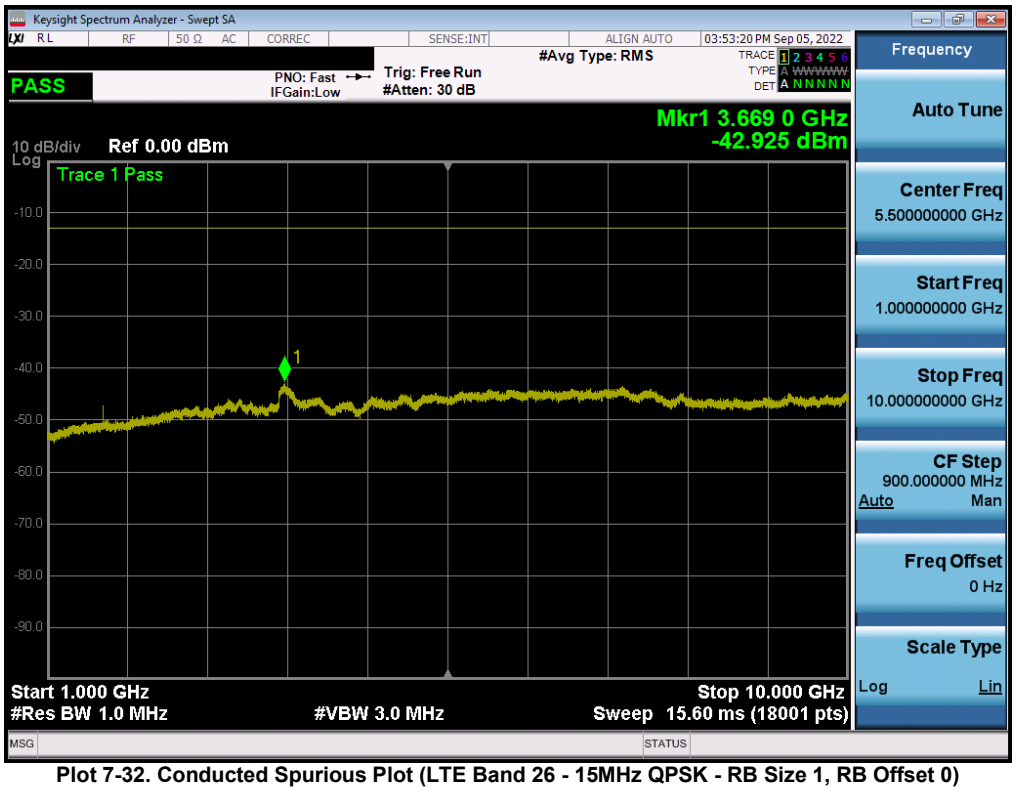
LTE Band 26



Plot 7-30. Conducted Spurious Plot (LTE Band 26 - 15MHz QPSK - RB Size 1, RB Offset 0)

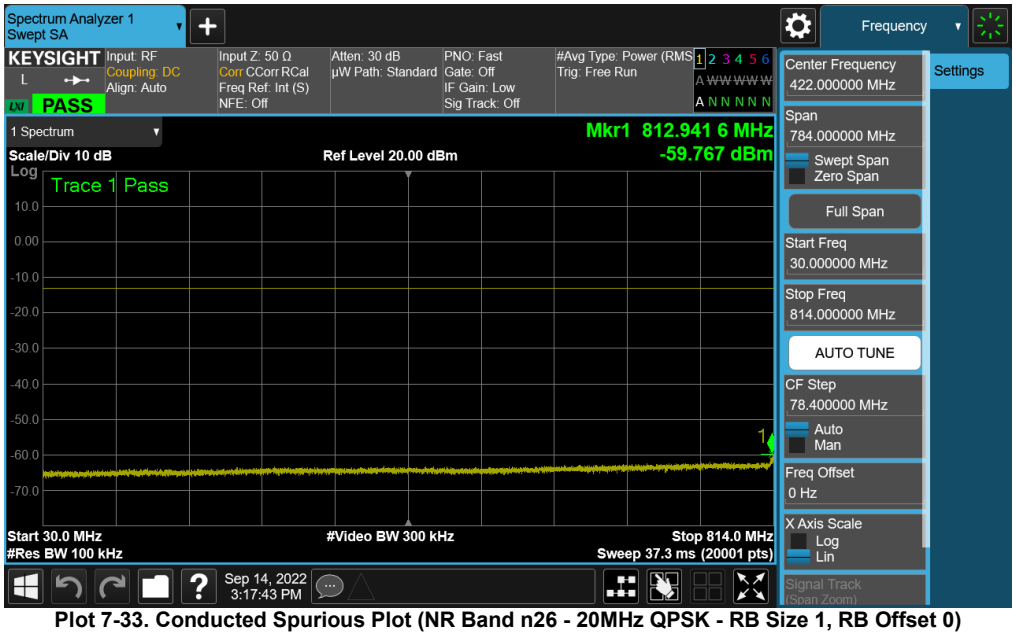


Plot 7-31. Conducted Spurious Plot (LTE Band 26 - 15MHz QPSK - RB Size 1, RB Offset 0)

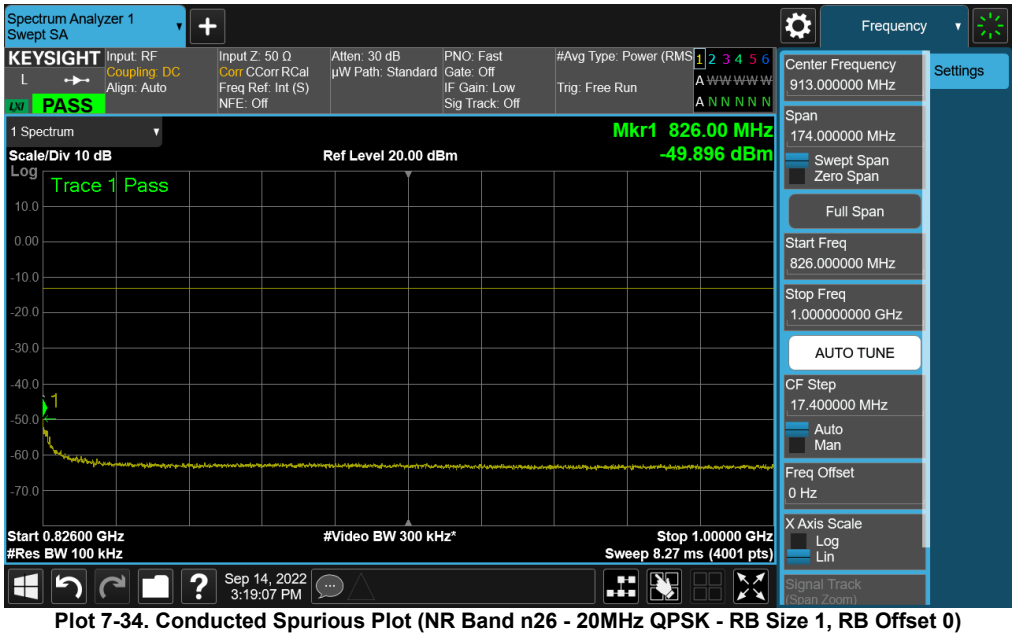


Plot 7-32. Conducted Spurious Plot (LTE Band 26 - 15MHz QPSK - RB Size 1, RB Offset 0)

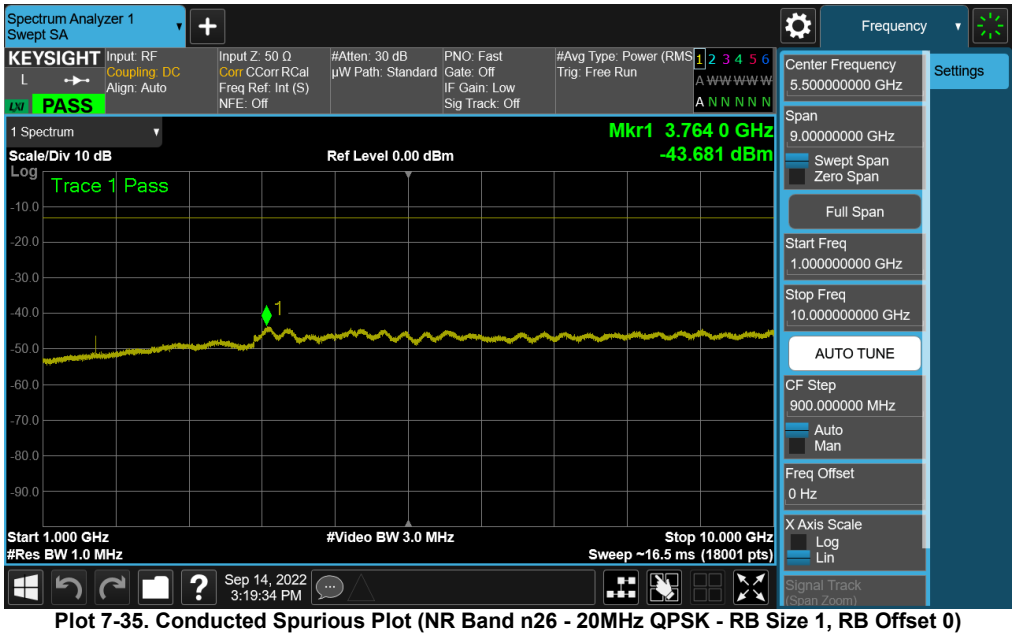
NR Band n26



Plot 7-33. Conducted Spurious Plot (NR Band n26 - 20MHz QPSK - RB Size 1, RB Offset 0)



Plot 7-34. Conducted Spurious Plot (NR Band n26 - 20MHz QPSK - RB Size 1, RB Offset 0)



Plot 7-35. Conducted Spurious Plot (NR Band n26 - 20MHz QPSK - RB Size 1, RB Offset 0)

7.5 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.

For LTE B26, NR Band n26 operation under Part 90.691, the minimum permissible attenuation level of any spurious emission removed from the EA licensee's frequency block by greater than 37.5 kHz is 43 + 10log$_{10}$(P$_{[Watts]}$), where P is the transmitter power in Watts. The minimum permissible attenuation level of any spurious emission removed from the EA licensee's frequency block by up to and including 37.5 kHz is 50 + 10log$_{10}$(P$_{[Watts]}$), where P is the transmitter power in Watts.

For LTE Band 14 operation under Part 90.543, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

Additionally, for LTE Band 14 operation, on all frequencies between 769-775 MHz and 799-805 MHz, the power of any emission shall be attenuated by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.3

Test Settings

1. Span was set large enough so as to capture all out of band emissions near the band edge
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Detector = RMS
5. Trace mode = trace average
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

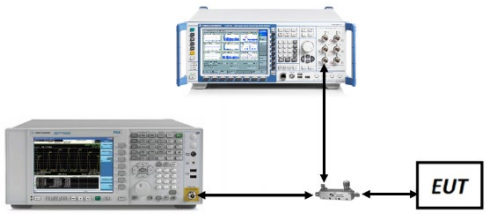


Figure 7-4. Test Instrument & Measurement Setup

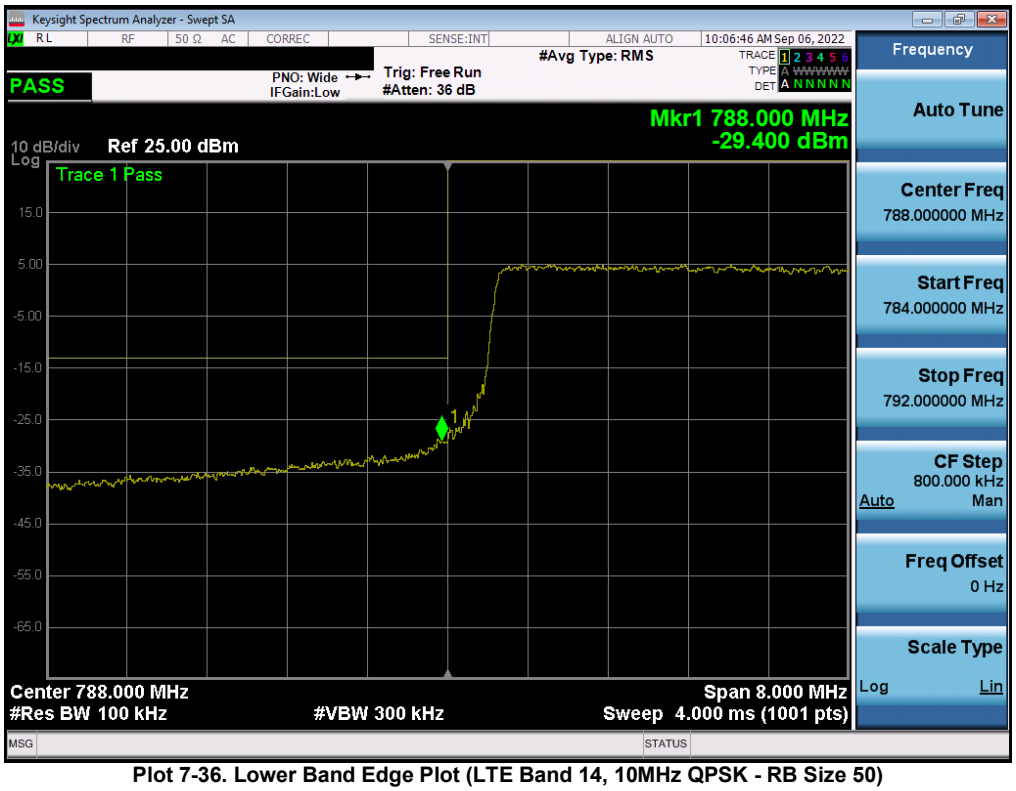
Test Notes

1. For channel edge emission, the signal analyzer's "ACP" measurement capability is used.

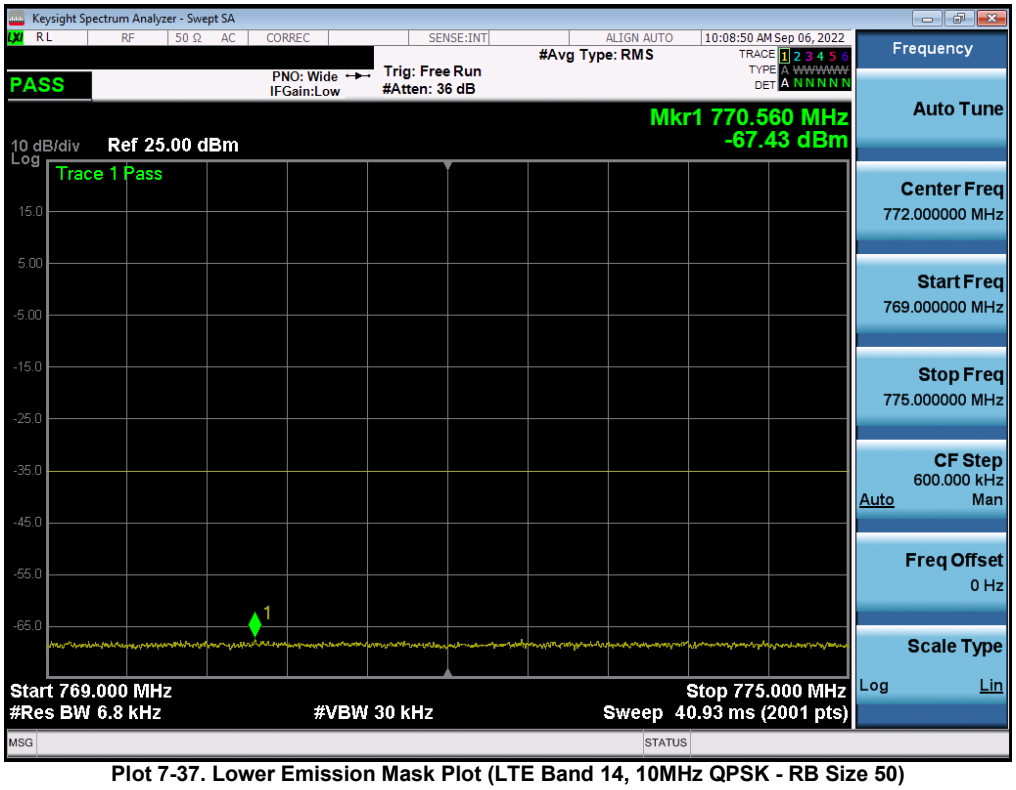
2. Per 22.917(b) in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission 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.

3. 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.

LTE Band 14



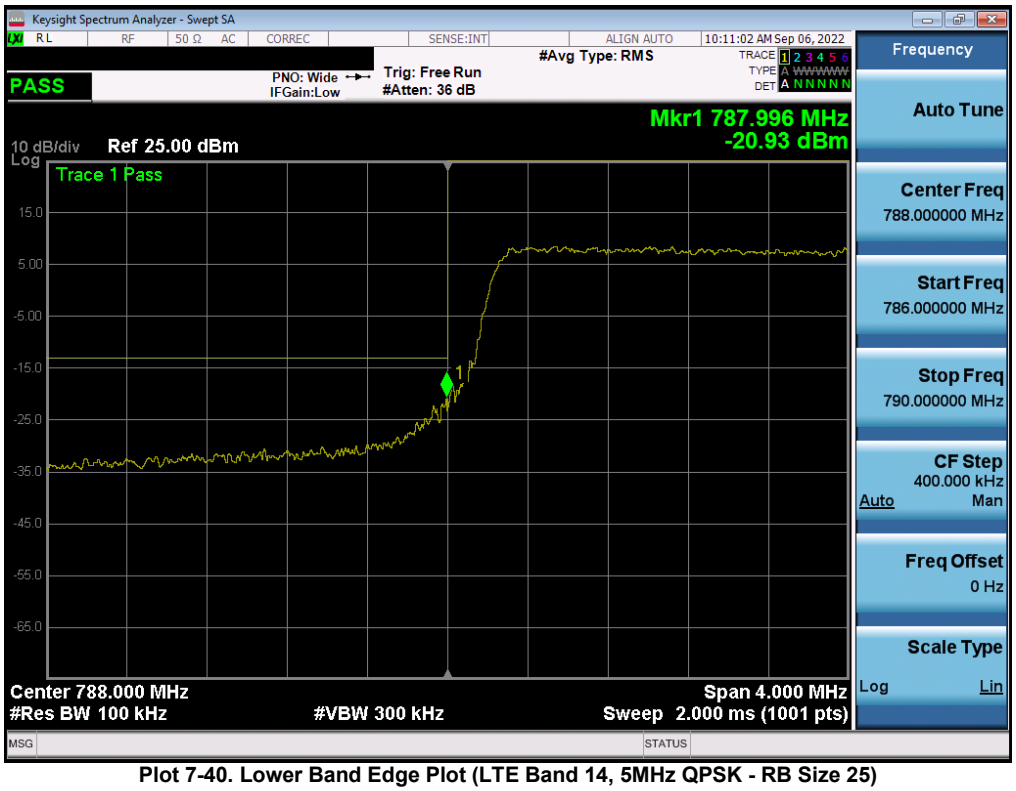
Plot 7-36. Lower Band Edge Plot (LTE Band 14, 10MHz QPSK - RB Size 50)



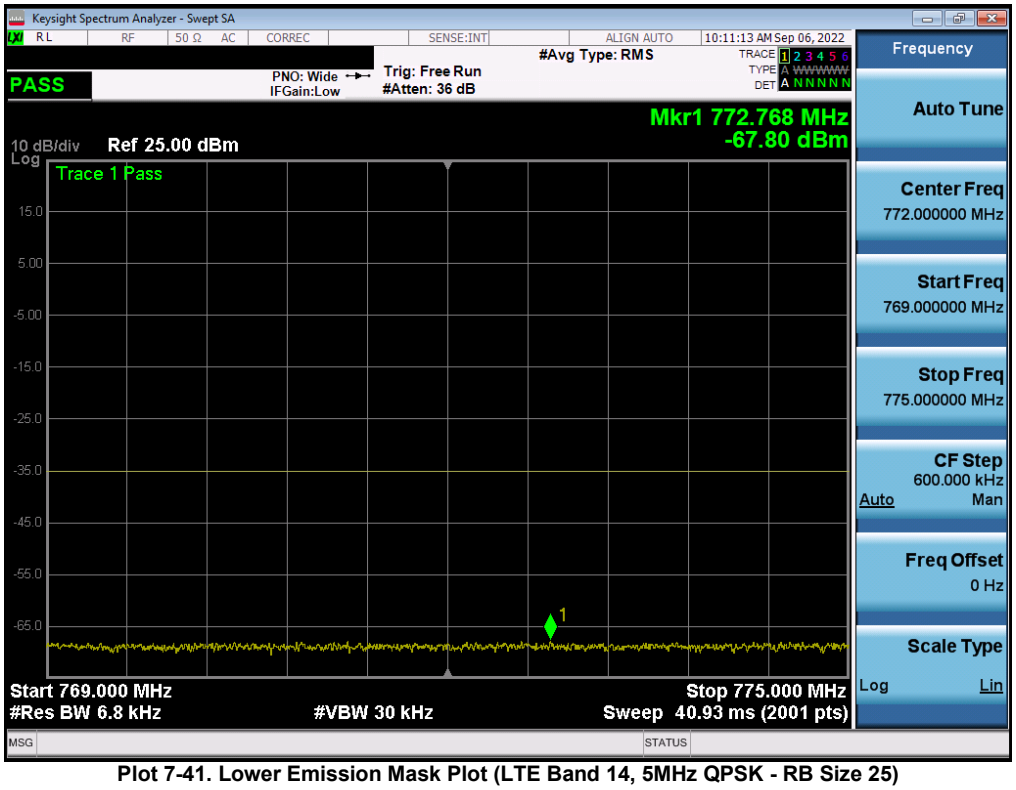
Plot 7-37. Lower Emission Mask Plot (LTE Band 14, 10MHz QPSK - RB Size 50)

Plot 7-38. Upper Band Edge Plot (LTE Band 14, 10MHz QPSK - RB Size 50)

Plot 7-39. Upper Emission Mask Plot (LTE Band 14, 10MHz QPSK - RB Size 50)



Plot 7-40. Lower Band Edge Plot (LTE Band 14, 5MHz QPSK - RB Size 25)

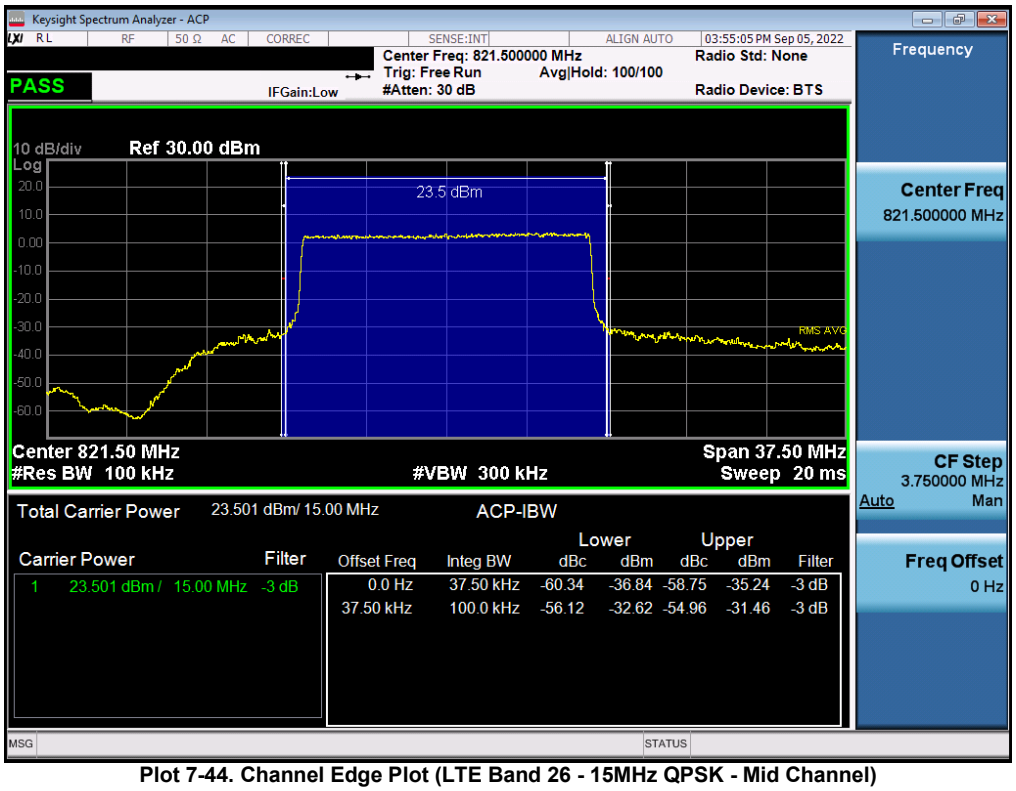


Plot 7-41. Lower Emission Mask Plot (LTE Band 14, 5MHz QPSK - RB Size 25)

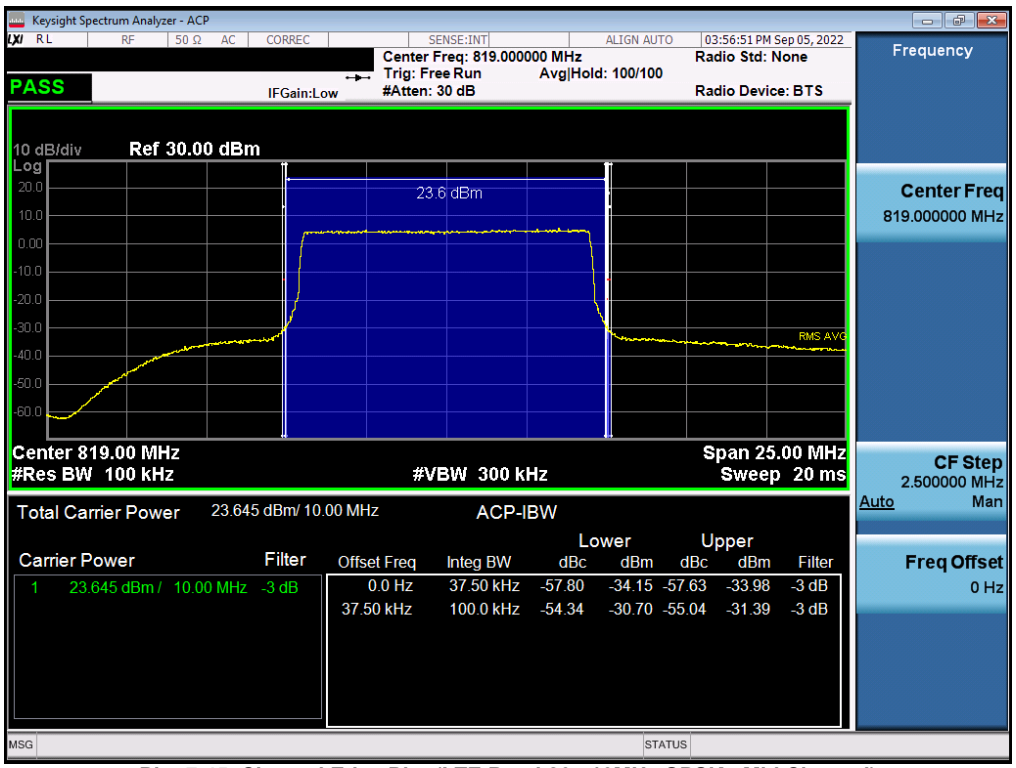
Plot 7-42. Upper Band Edge Plot (LTE Band 14, 5MHz QPSK - RB Size 25)

Plot 7-43. Upper Emission Mask Plot (LTE Band 14, 5MHz QPSK - RB Size 25)

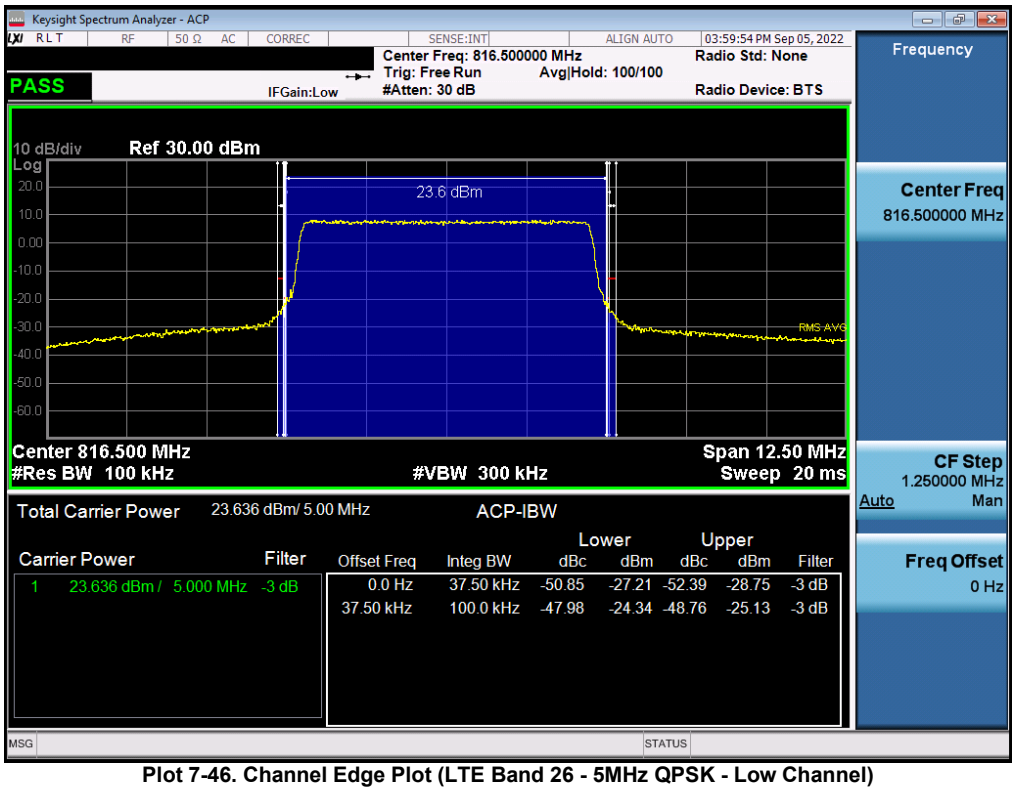
LTE Band 26



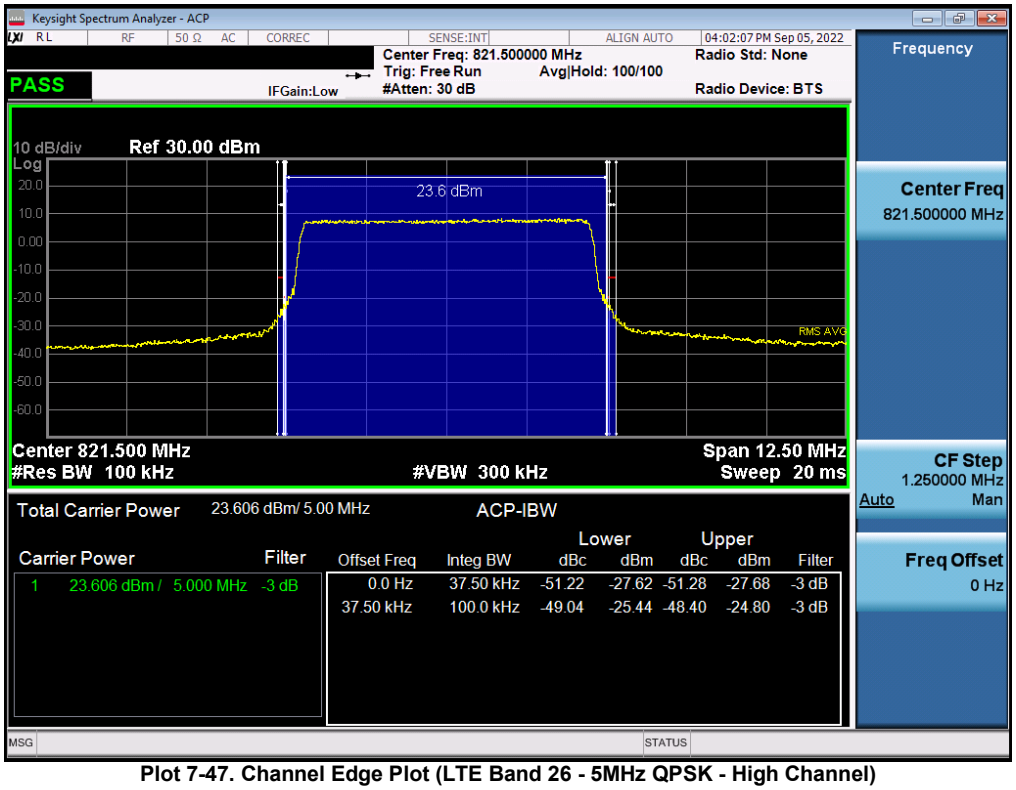
Plot 7-44. Channel Edge Plot (LTE Band 26 - 15MHz QPSK - Mid Channel)



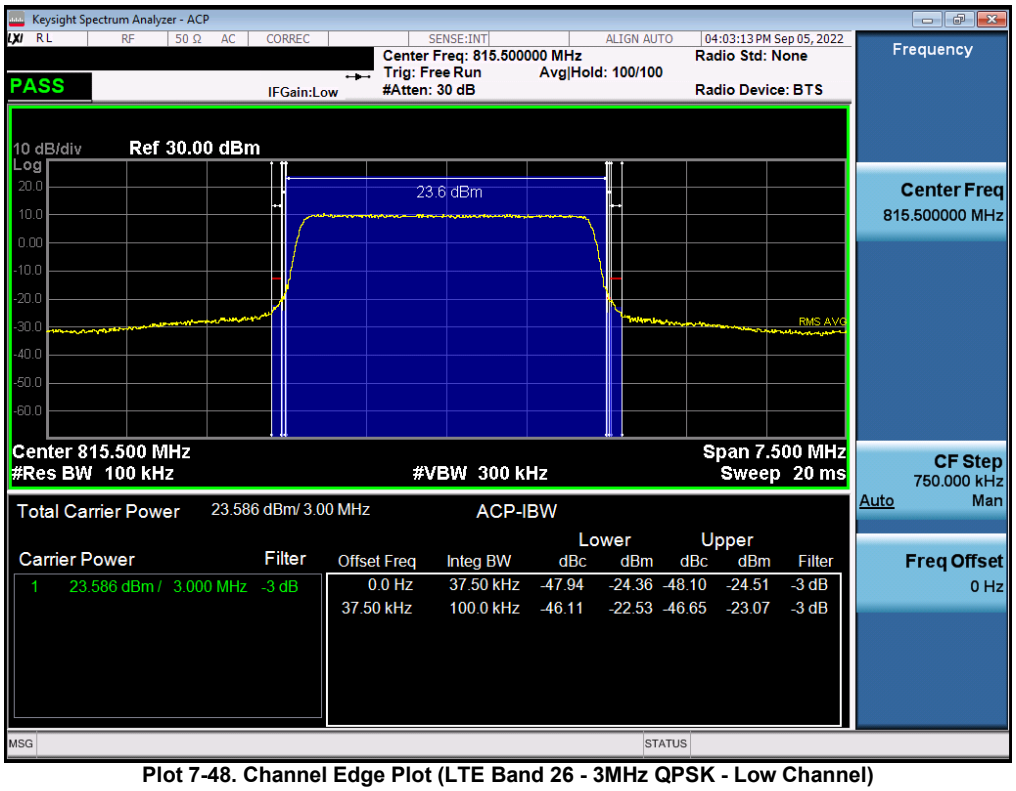
Plot 7-45. Channel Edge Plot (LTE Band 26 - 10MHz QPSK - Mid Channel)



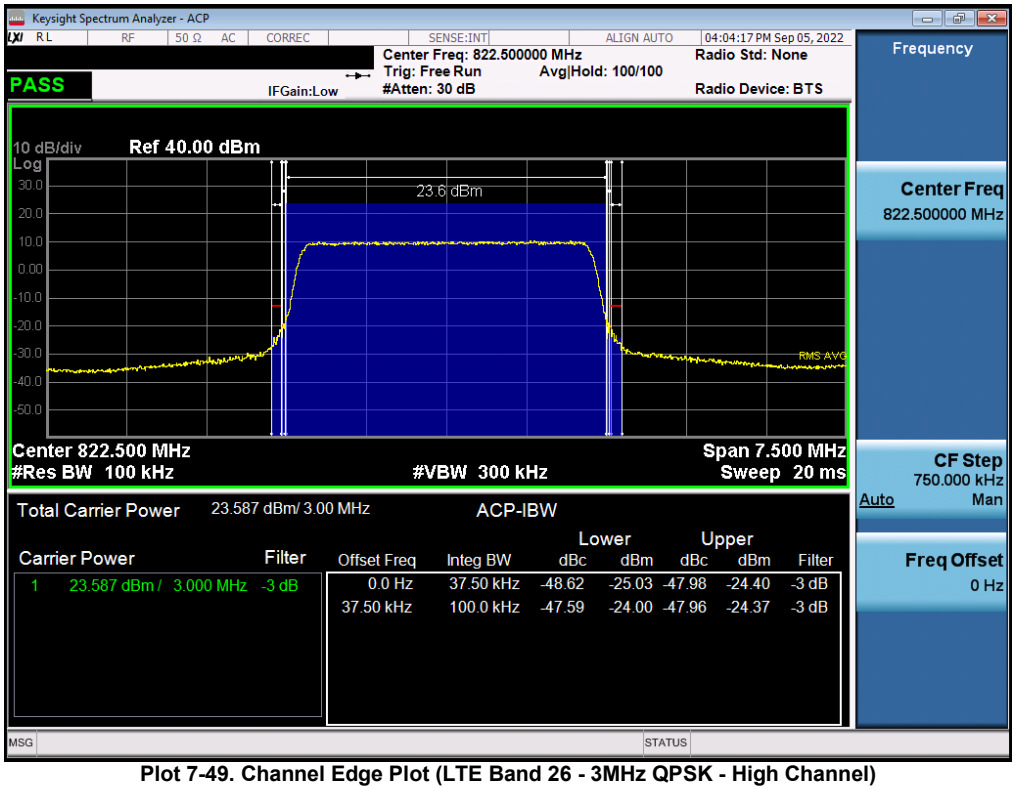
Plot 7-46. Channel Edge Plot (LTE Band 26 - 5MHz QPSK - Low Channel)



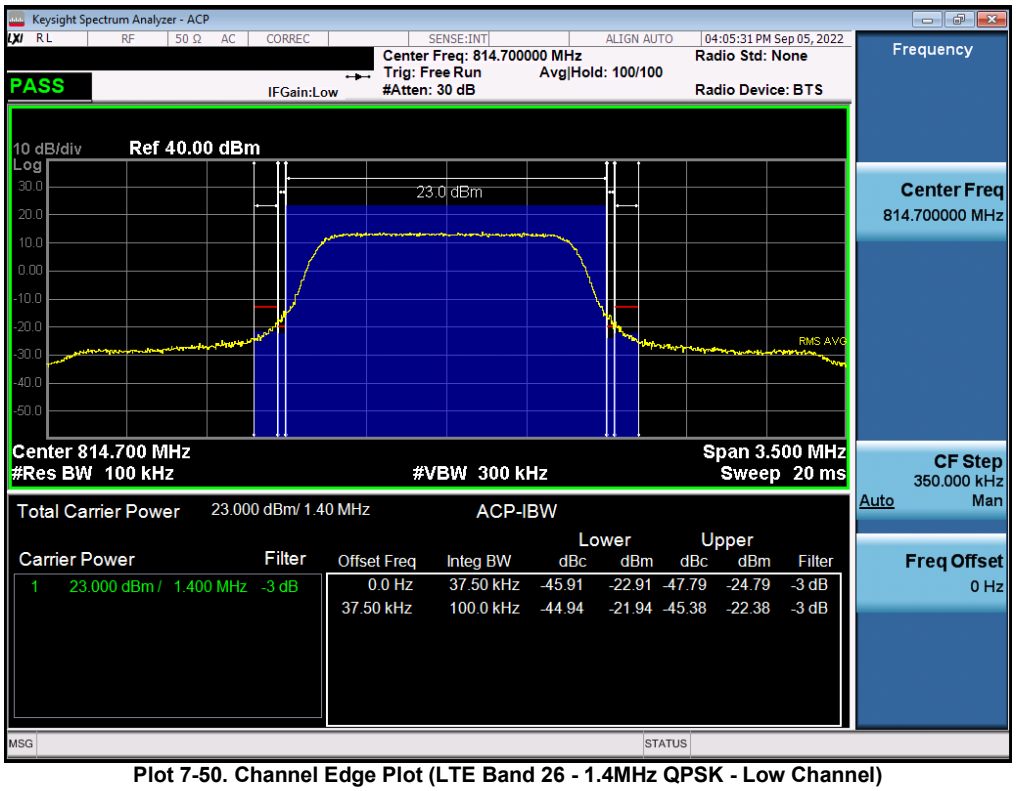
Plot 7-47. Channel Edge Plot (LTE Band 26 - 5MHz QPSK - High Channel)



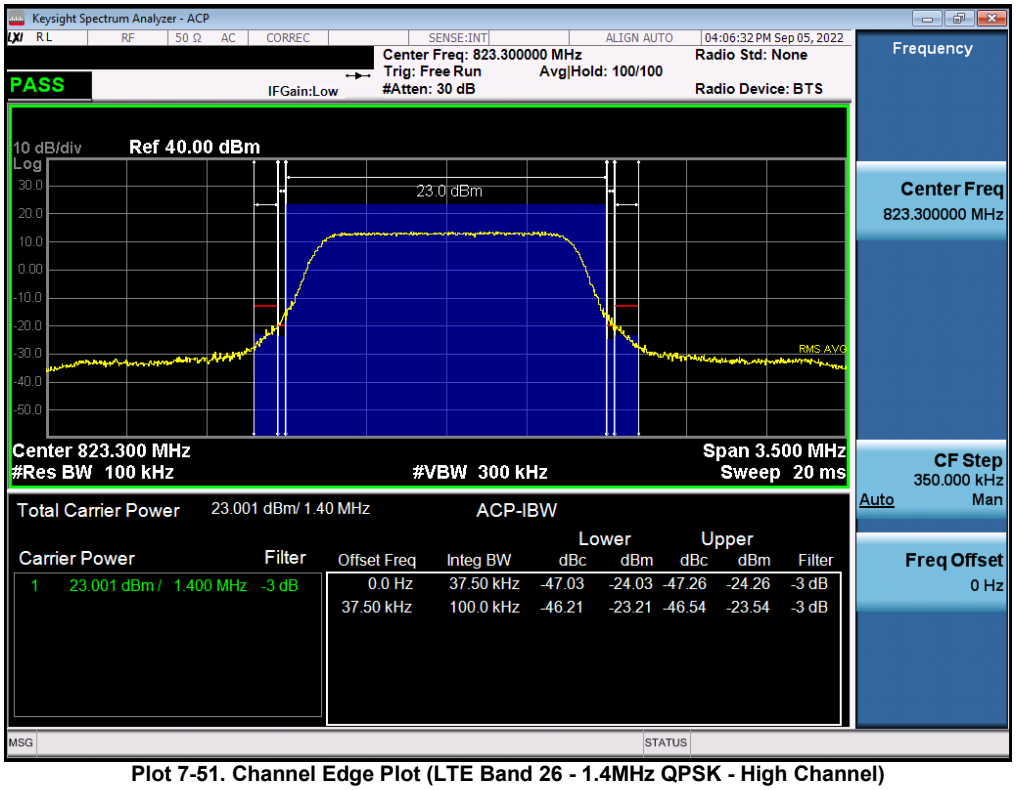
Plot 7-48. Channel Edge Plot (LTE Band 26 - 3MHz QPSK - Low Channel)



Plot 7-49. Channel Edge Plot (LTE Band 26 - 3MHz QPSK - High Channel)

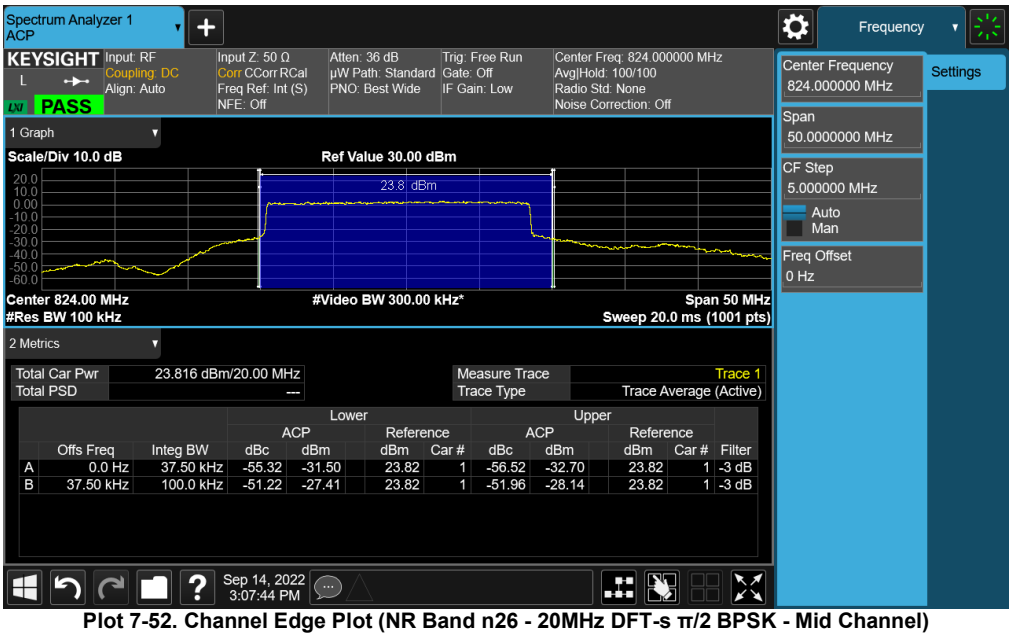


Plot 7-50. Channel Edge Plot (LTE Band 26 - 1.4MHz QPSK - Low Channel)

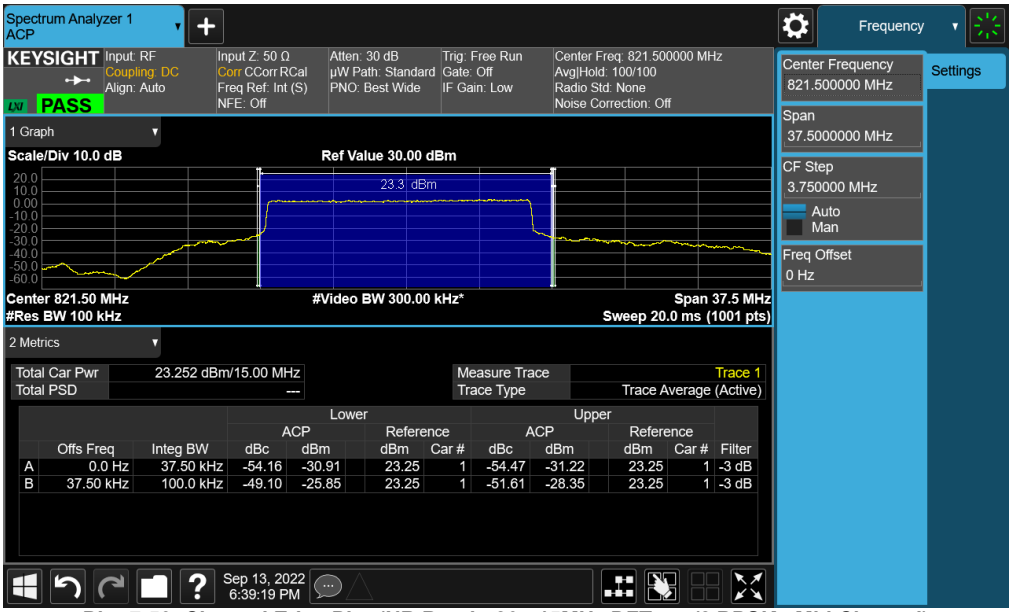


Plot 7-51. Channel Edge Plot (LTE Band 26 - 1.4MHz QPSK - High Channel)

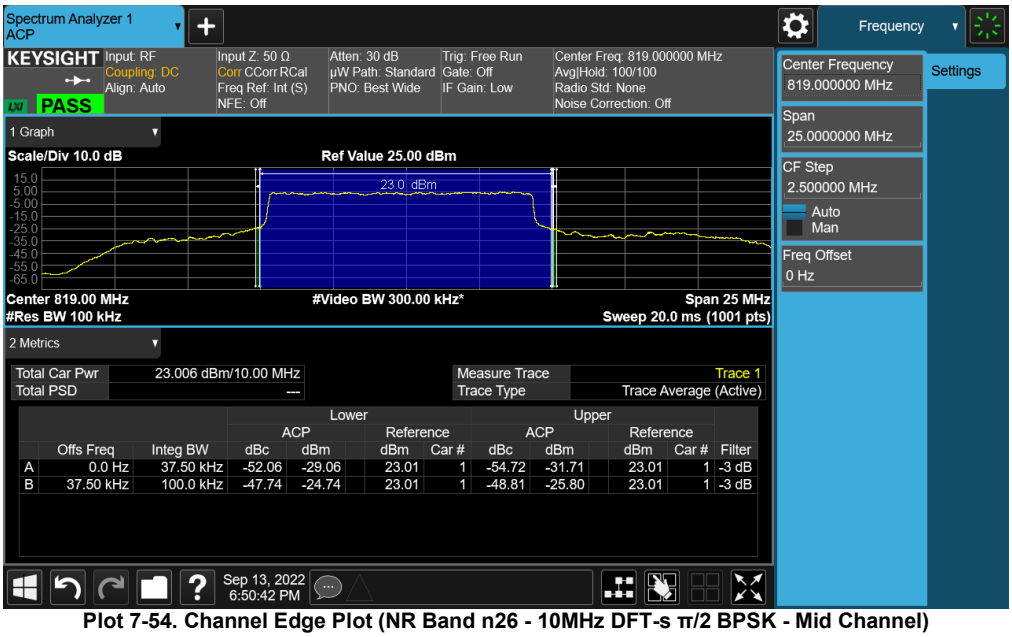
NR Band n26



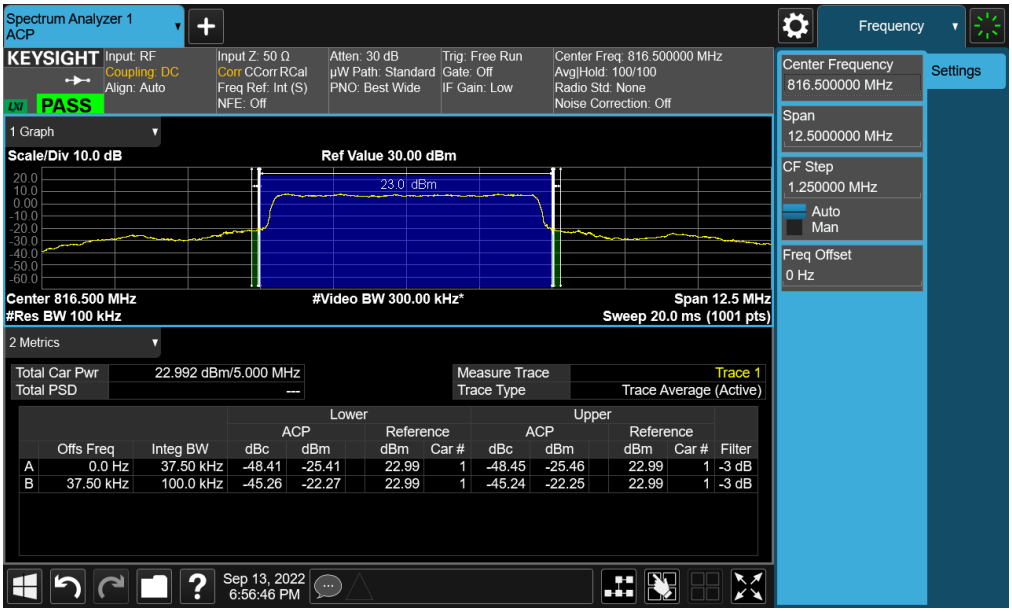
Plot 7-52. Channel Edge Plot (NR Band n26 - 20MHz DFT-s π/2 BPSK - Mid Channel)



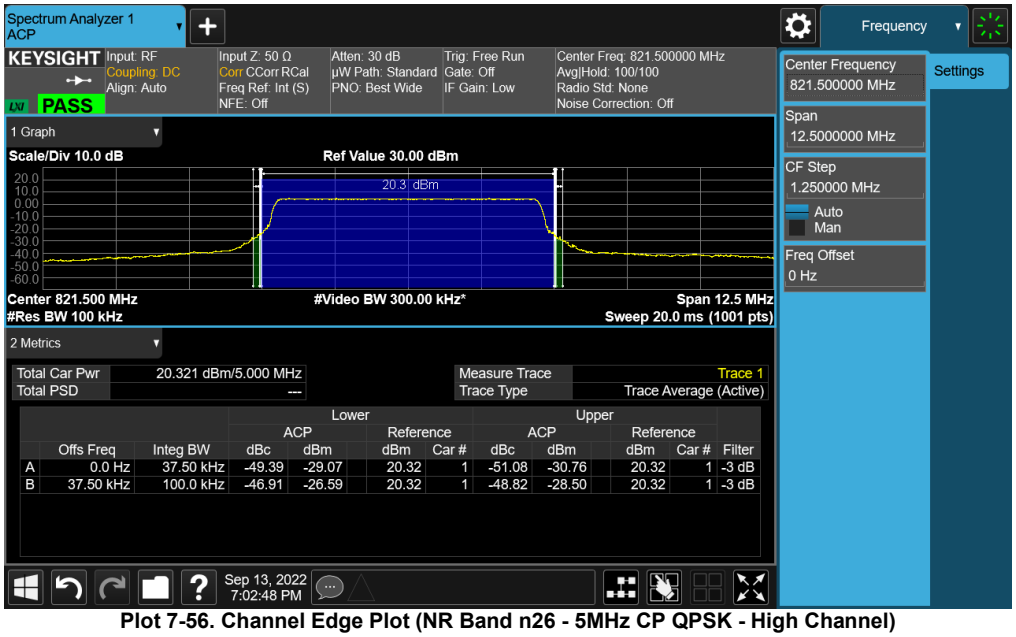
Plot 7-53. Channel Edge Plot (NR Band n26 - 15MHz DFT-s π/2 BPSK - Mid Channel)



Plot 7-54. Channel Edge Plot (NR Band n26 - 10MHz DFT-s π/2 BPSK - Mid Channel)



Plot 7-55. Channel Edge Plot (NR Band n26 - 5MHz DFT-s π/2 BPSK - Low Channel)



Plot 7-56. Channel Edge Plot (NR Band n26 - 5MHz CP QPSK - High Channel)

7.6 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.
2. RBW = 1 – 5% of the expected OBW
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".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
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.

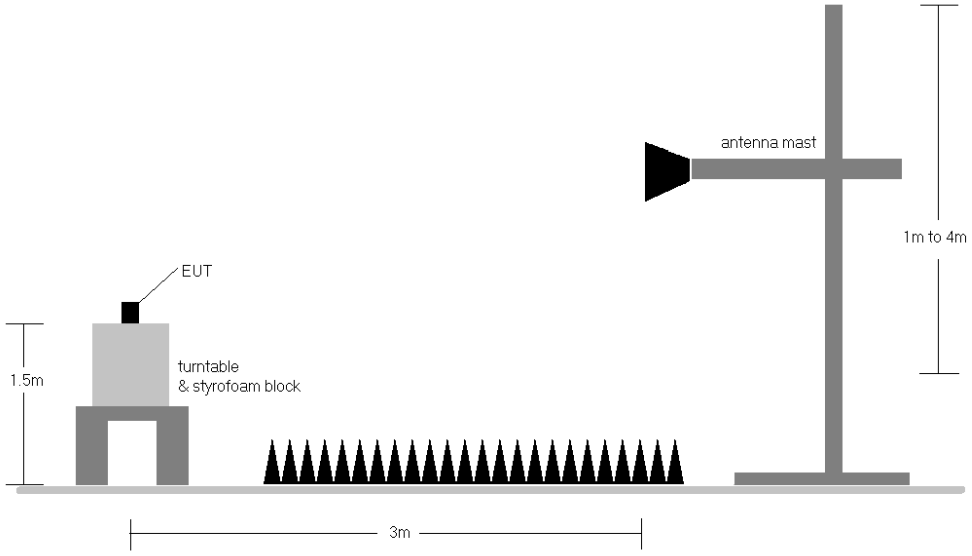


Figure 7-5. Radiated Test Setup <1GHz

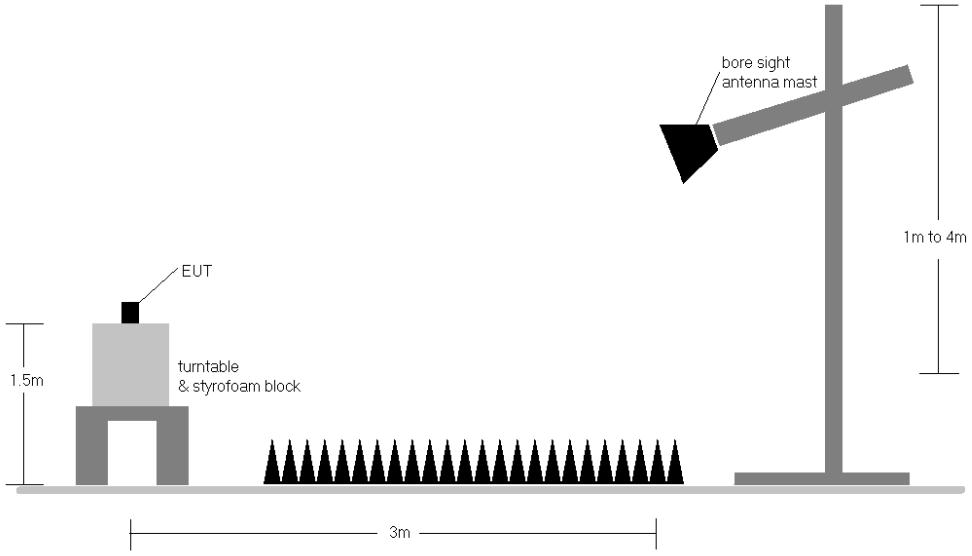


Figure 7-6. Radiated Test Setup > 1GHz

Test Notes

1) 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.

2) This unit was tested with its standard battery.

3) 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.