PCTEST
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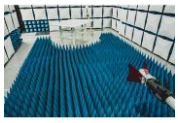

PART 27 MEASUREMENT REPORT

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

Date of Testing:
2/8/2021 - 2/11/2021
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2102050006-06.A3L

FCC ID:	**A3LSMG998U**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Class II Permissive Change
Model:	SM-G998U
Additional Model(s):	SM-G998U1
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part:	27
Test Procedure(s):	ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01
Class II Permissive Change:	Please see FCC change document
Original Grant Date:	12/22/2020

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

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

Randy Ortanez
President

ACCREDITED
CERT #2041.01

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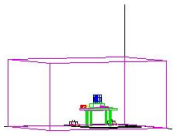
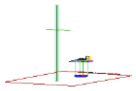


MEASUREMENT REPORT
FCC Part 27



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 66	20 MHz	QPSK	1720.0 - 1770.0	0.103	20.15	17M9G7D
		16QAM	1720.0 - 1770.0	0.083	19.18	18M0W7D
		64QAM	1720.0 - 1770.0	0.068	18.34	18M0W7D
		256QAM	1720.0 - 1770.0	0.029	14.64	18M0W7D
	15 MHz	QPSK	1717.5 - 1772.5	0.106	20.25	13M5G7D
		16QAM	1717.5 - 1772.5	0.076	18.83	13M5W7D
		64QAM	1717.5 - 1772.5	0.064	18.09	13M5W7D
		256QAM	1717.5 - 1772.5	0.031	14.95	13M5W7D
	10 MHz	QPSK	1715.0 - 1775.0	0.102	20.08	8M98G7D
		16QAM	1715.0 - 1775.0	0.074	18.70	8M98W7D
		64QAM	1715.0 - 1775.0	0.063	18.00	8M99W7D
		256QAM	1715.0 - 1775.0	0.032	15.00	9M03W7D
	5 MHz	QPSK	1712.5 - 1777.5	0.066	18.20	4M51G7D
		16QAM	1712.5 - 1777.5	0.061	17.89	4M50W7D
		64QAM	1712.5 - 1777.5	0.064	18.08	4M50W7D
		256QAM	1712.5 - 1777.5	0.029	14.66	4M52W7D
	3 MHz	QPSK	1711.5 - 1778.5	0.066	18.19	2M70G7D
		16QAM	1711.5 - 1778.5	0.061	17.85	2M71W7D
		64QAM	1711.5 - 1778.5	0.064	18.07	2M70W7D
		256QAM	1711.5 - 1778.5	0.032	15.10	2M71W7D
	1.4 MHz	QPSK	1710.7 - 1779.3	0.101	20.06	1M09G7D
		16QAM	1710.7 - 1779.3	0.080	19.05	1M10W7D
		64QAM	1710.7 - 1779.3	0.064	18.09	1M09W7D
		256QAM	1710.7 - 1779.3	0.031	14.98	1M09W7D

Overview Table (>1GHz Bands)

1.0 INTRODUCTION

1.1 Scope

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

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. 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 PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) 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 **Samsung Portable Handset FCC ID: A3LSMG998U**. 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 27.

Test Device Serial No.: 32609, 33524

2.2 Device Capabilities

This device contains the following capabilities:

800/850/1900 CDMA/EvDO Rev0/A, 1x Advanced (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (n5, n71, n41, n66, n2, n12, n25, n30, n77, n260, n261), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), NFC, Wireless Power Transfer, UWB

This EUT supports 2 antennas (Antenna A and Antenna E) for band 66 operations. This report includes supplemental conducted and radiated data to ensure compliance for Antenna E, which was not covered in the original filing.

2.3 Test Configuration

The EUT was tested per the guidance of ANSI/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.

2.4 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 document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/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 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 wooden turntable 80cm above the ground plane and 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. Radiated power levels are also investigated with the receive antenna horizontally and vertically polarized. The maximized power level is recorded using the spectrum analyzer "Channel Power" function with the integration band set to the emissions' occupied bandwidth, a RMS detector, RBW = 100kHz, VBW = 300kHz, and a 1 second sweep time over a minimum of 10 sweeps, per the guidelines of KDB 971168 D01 v03r01.

Per the guidance of ANSI/TIA-603-E-2016, a half-wave dipole is then 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 fundamental radiated power measurements, the guidance of KDB 971168 D01 v03r01 is used to record the EUT power level that is subsequently matched via the aforementioned substitution method given in ANSI/TIA-603-E-2016.

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 474788 D01.

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
-	LTx4	Licensed Transmitter Cable Set	9/16/2020	Annual	9/16/2021	LTx4
Agilent	E5515C	Wireless Communications Test Set	N/A			GB45360985
Anritsu	MT8821C	Radio Communication Analyzer	N/A			6200901190
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	2/22/2019	Biennial	2/22/2021	128338
Keysight Technologies	N9020A	MXA Signal Analyzer	9/22/2020	Annual	9/22/2021	MY54500644
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	9/17/2020	Annual	9/17/2021	MY57141001
Mini-Circuits	SSG-4000HP	Synthesized Signal Generator	N/A			11208010032
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			112347
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	7/15/2020	Annual	7/15/2021	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/21/2020	Annual	2/21/2021	102133
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	7/27/2020	Biennial	7/27/2022	A051107

Table 5-1. Summary of Test Results

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.

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

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).

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMG998U

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

Mode(s): LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power	2.1046	N/A	PASS	Section 7.2
	Occupied Bandwidth	2.1049	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions	2.1051, 27.53	> 43 + 10log10(P[Watts]) at Band Edge and for all out-of-band emissions	PASS	Sections 7.4, 7.5
RADIATED	Equivalent Isotropic Radiated Power (LTE Band 66)	27.50(d)(4)	< 1 Watts max. EIRP	PASS	Section 7.7
	Radiated Spurious Emissions	2.1053, 27.53	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions	PASS	Section 7.8

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 PCTEST **EMC Software Tool Beta 8**.
5) For radiated spurious emissions, automated test software was used to maximize emissions. The measurement software utilized is Chamber Control v1.3.1.

7.2 Conducted Power Output Data

Test Overview

The EUT is set up to transmit two contiguous LTE channels. The power level of both carriers is measured by means of a calibrated spectrum analyzer. 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

KDB 971168 D01 v03r01 – Section 6.0

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.

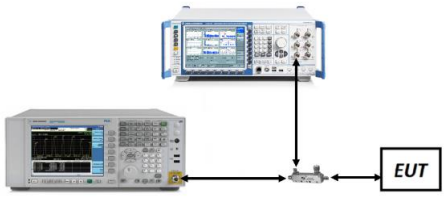


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
20 MHz	QPSK	132072	1720.0	1/50	23.00
		132322	1745.0	1/50	23.27
		132572	1770.0	1/0	**23.39**
	16-QAM	132322	1745.0	1/50	22.63
	64-QAM	132322	1745.0	1/50	21.58
	256-QAM	132572	1770.0	1/0	18.49
15 MHz	QPSK	132047	1717.5	1/37	23.25
		132322	1745.0	1/37	**23.37**
		132597	1772.5	1/0	23.15
	16-QAM	132322	1745.0	1/37	22.28
	64-QAM	132322	1745.0	1/37	21.33
	256-QAM	132597	1772.5	1/0	18.80
10 MHz	QPSK	132022	1715.0	1/25	22.96
		132322	1745.0	1/25	**23.20**
		132622	1775.0	1/25	23.08
	16-QAM	132622	1775.0	1/25	22.42
	64-QAM	132322	1745.0	1/25	21.24
	256-QAM	132622	1775.0	1/25	18.85
5 MHz	QPSK	131997	1712.5	1/24	**21.54**
		132322	1745.0	1/0	21.32
		132647	1777.5	1/0	21.41
	16-QAM	132322	1745.0	1/0	21.34
	64-QAM	132322	1745.0	1/0	21.32
	256-QAM	132647	1777.5	1/0	18.51
3 MHz	QPSK	131987	1711.5	1/0	**21.52**
		132322	1745.0	1/7	21.31
		132657	1778.5	1/0	21.29
	16-QAM	132322	1745.0	1/7	21.30
	64-QAM	132322	1745.0	1/7	21.31
	256-QAM	132657	1778.5	1/0	18.95
1.4 MHz	QPSK	131979	1710.7	1/5	23.10
		132322	1745.0	1/2	23.18
		132665	1779.3	1/0	**23.19**
	16-QAM	132322	1745.0	1/2	22.50
	64-QAM	132322	1745.0	1/2	21.33
	256-QAM	132665	1779.3	1/0	18.83

Table 7-2. Conducted Power Band 66

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

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.

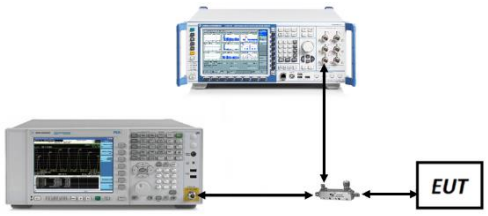
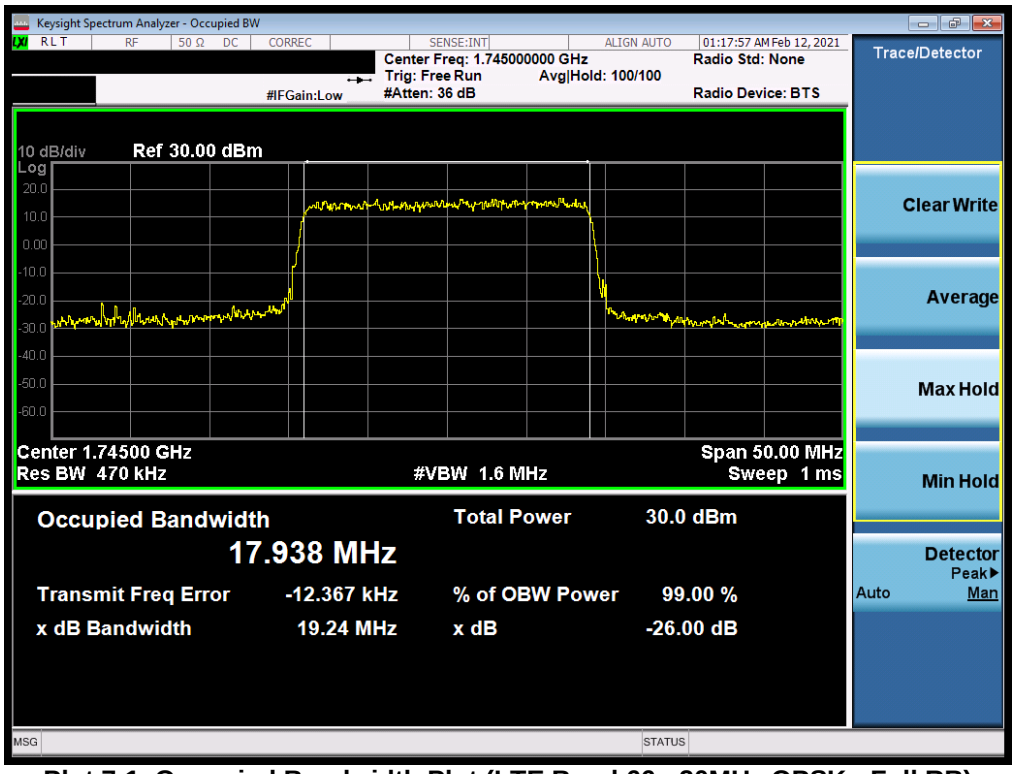


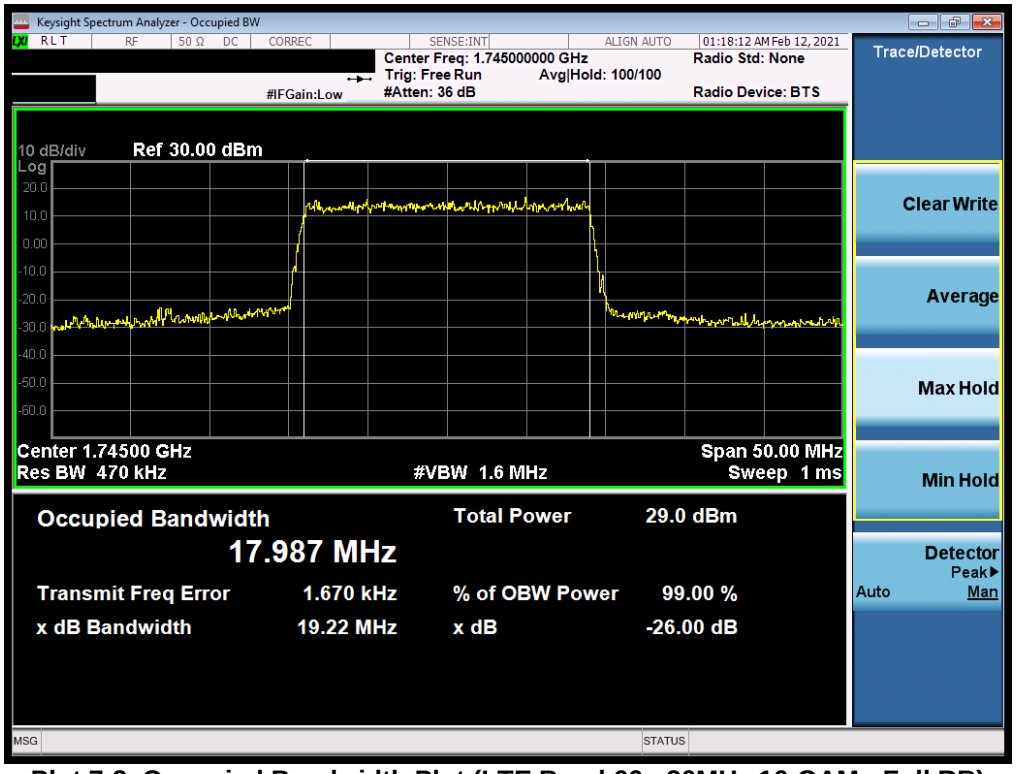
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

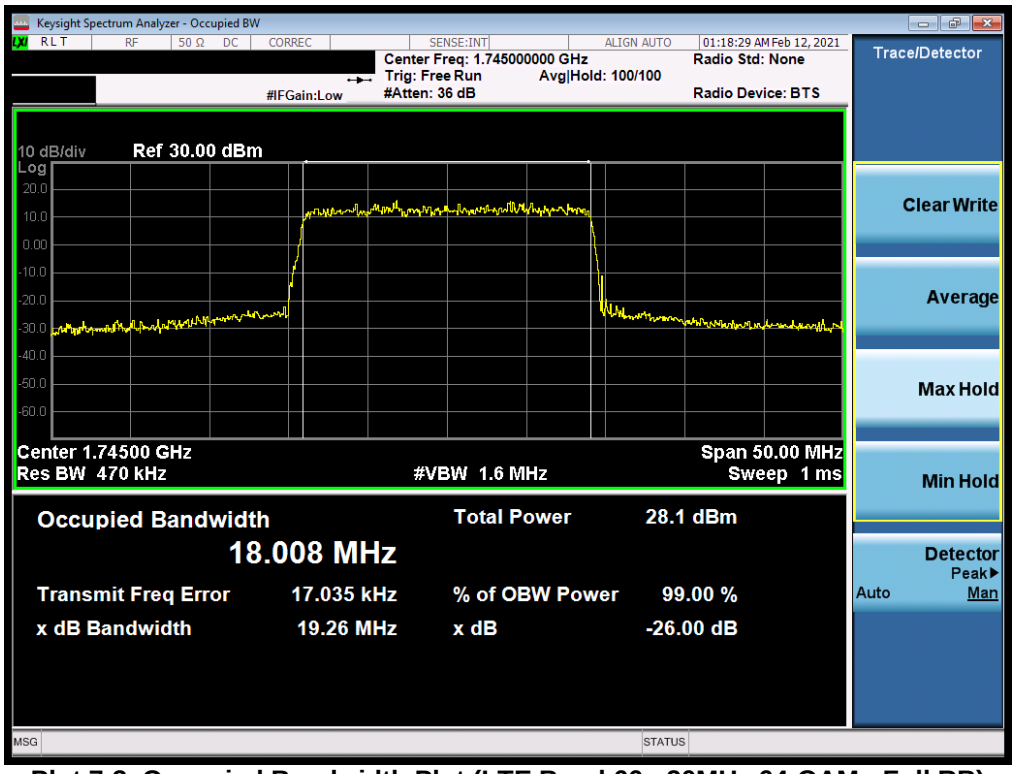
None.



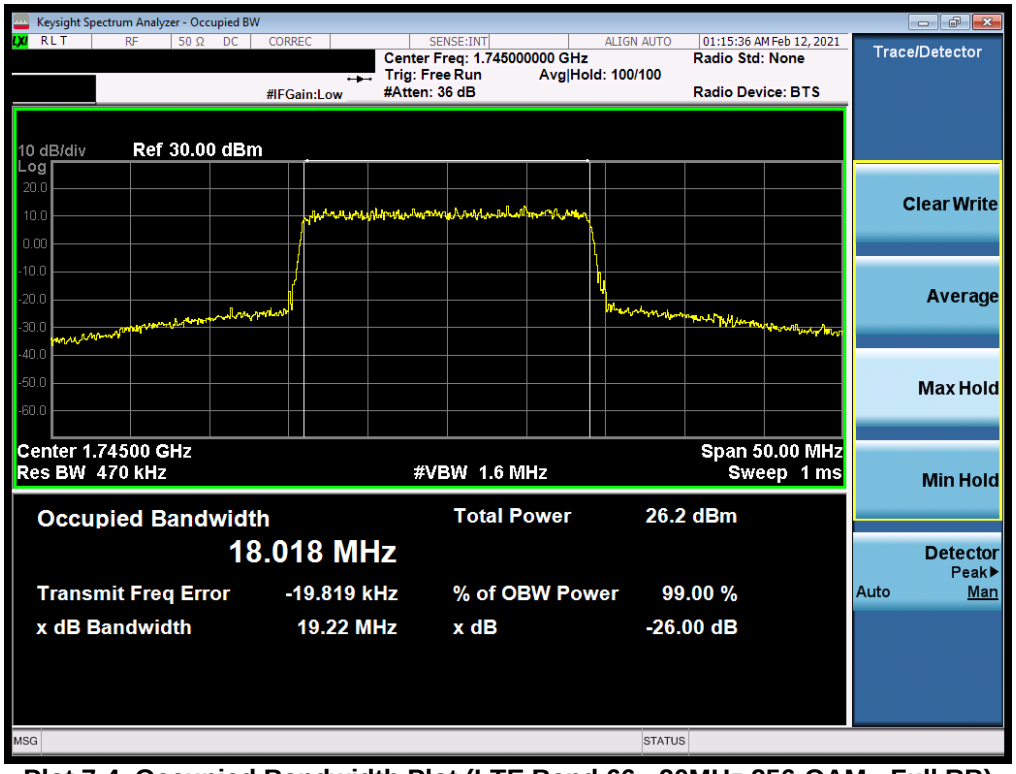
Plot 7-1. Occupied Bandwidth Plot (LTE Band 66 - 20MHz QPSK - Full RB)



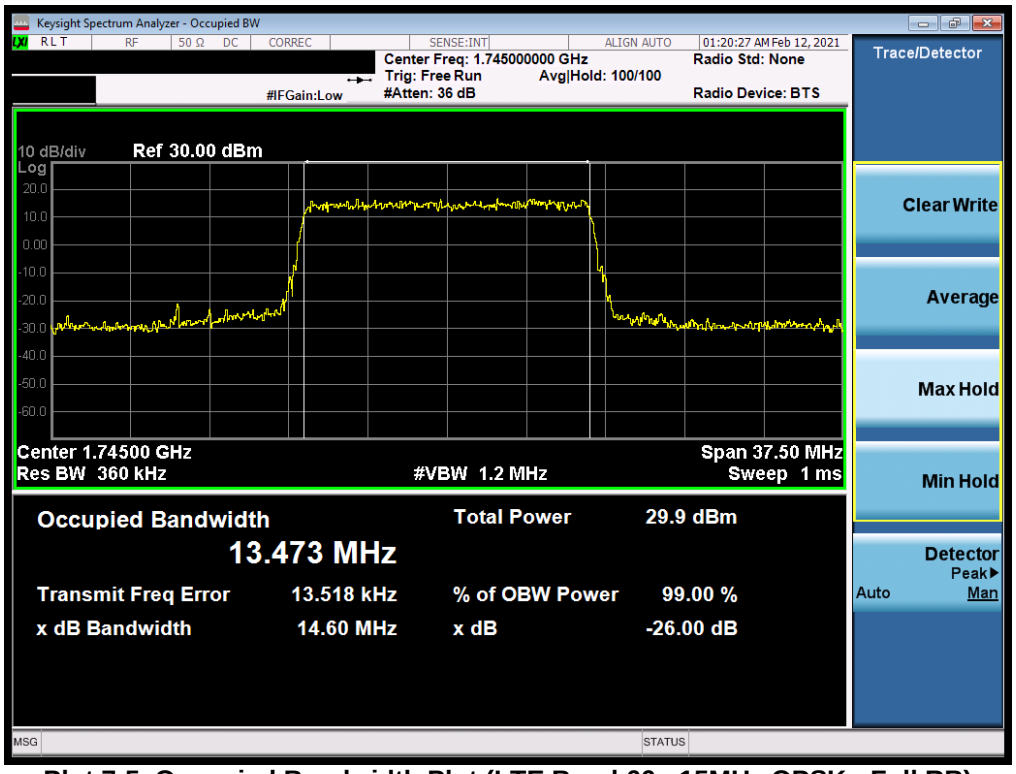
Plot 7-2. Occupied Bandwidth Plot (LTE Band 66 - 20MHz 16-QAM - Full RB)



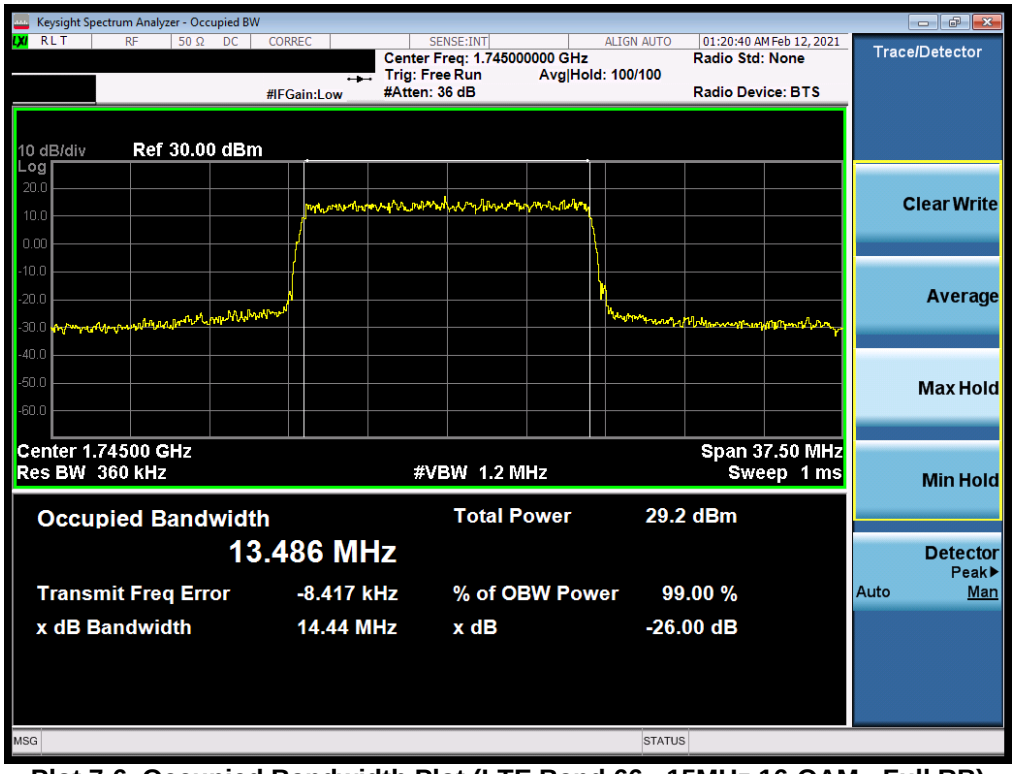
Plot 7-3. Occupied Bandwidth Plot (LTE Band 66 - 20MHz 64-QAM - Full RB)



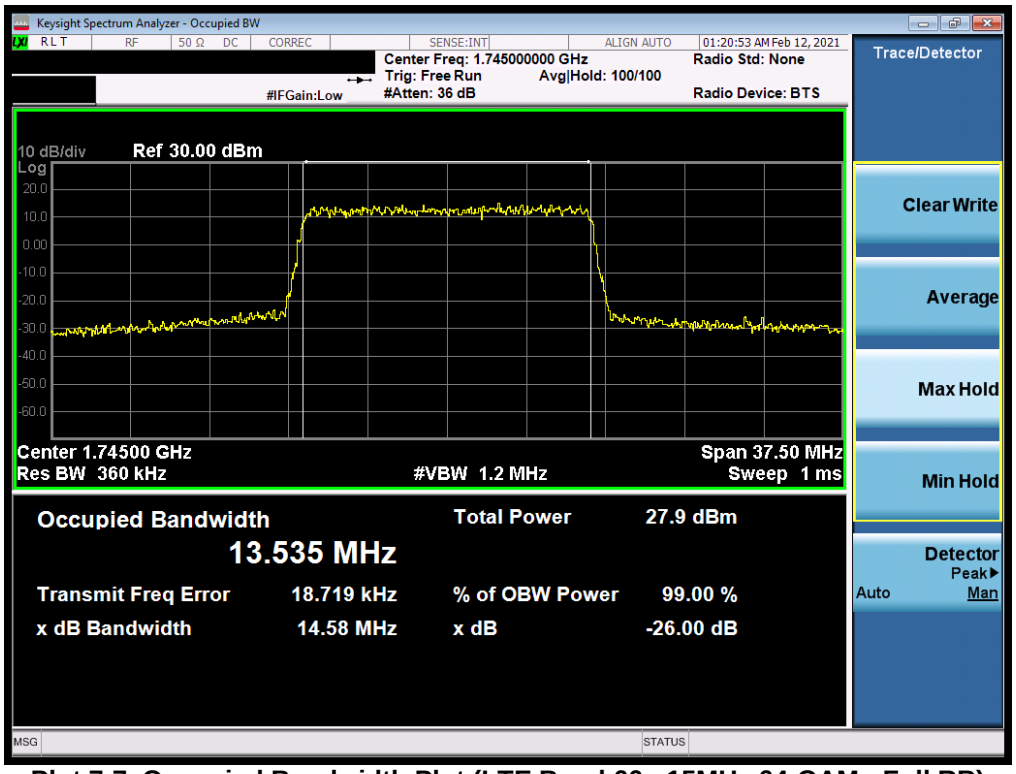
Plot 7-4. Occupied Bandwidth Plot (LTE Band 66 - 20MHz 256-QAM - Full RB)



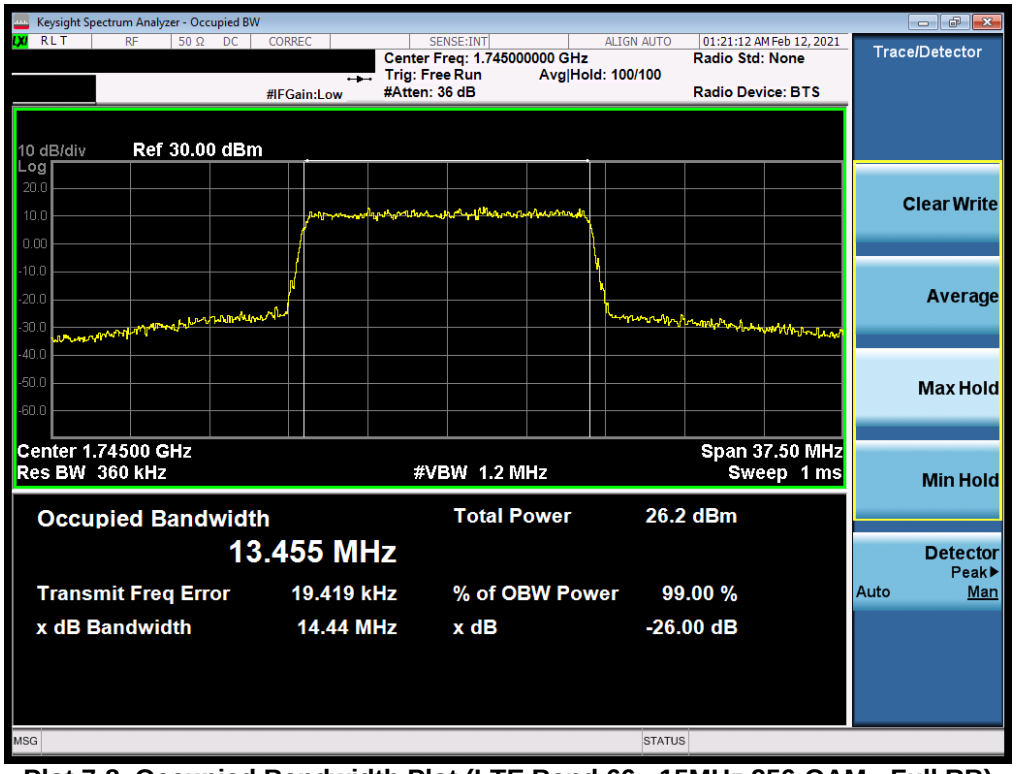
Plot 7-5. Occupied Bandwidth Plot (LTE Band 66 - 15MHz QPSK - Full RB)



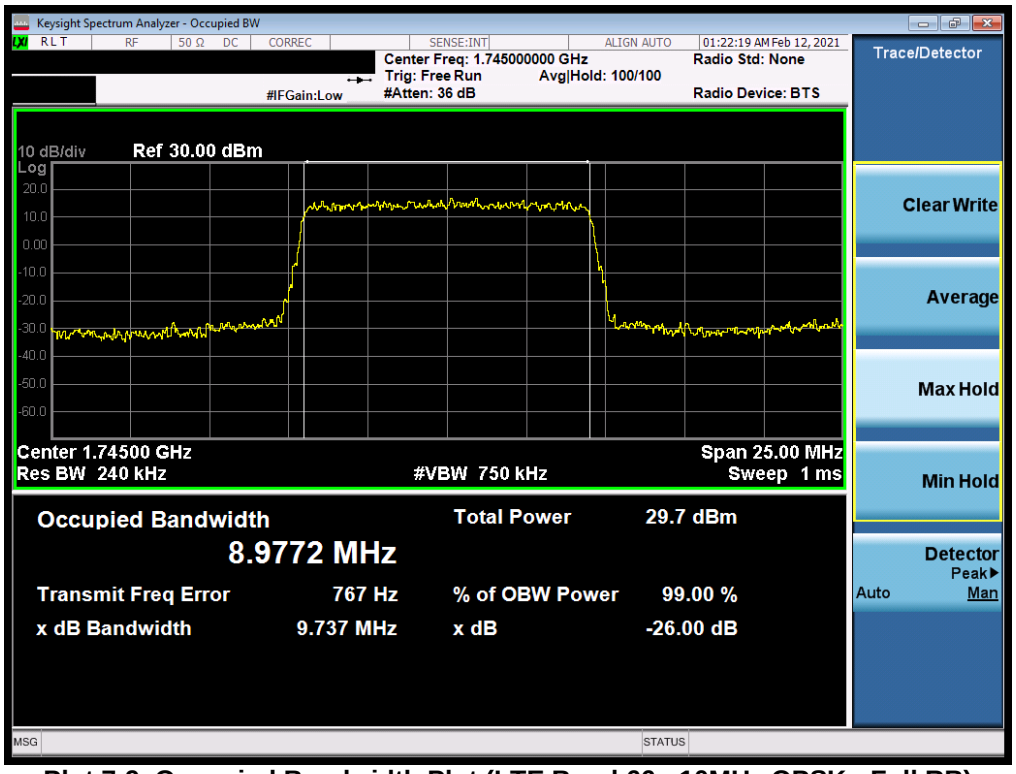
Plot 7-6. Occupied Bandwidth Plot (LTE Band 66 - 15MHz 16-QAM - Full RB)



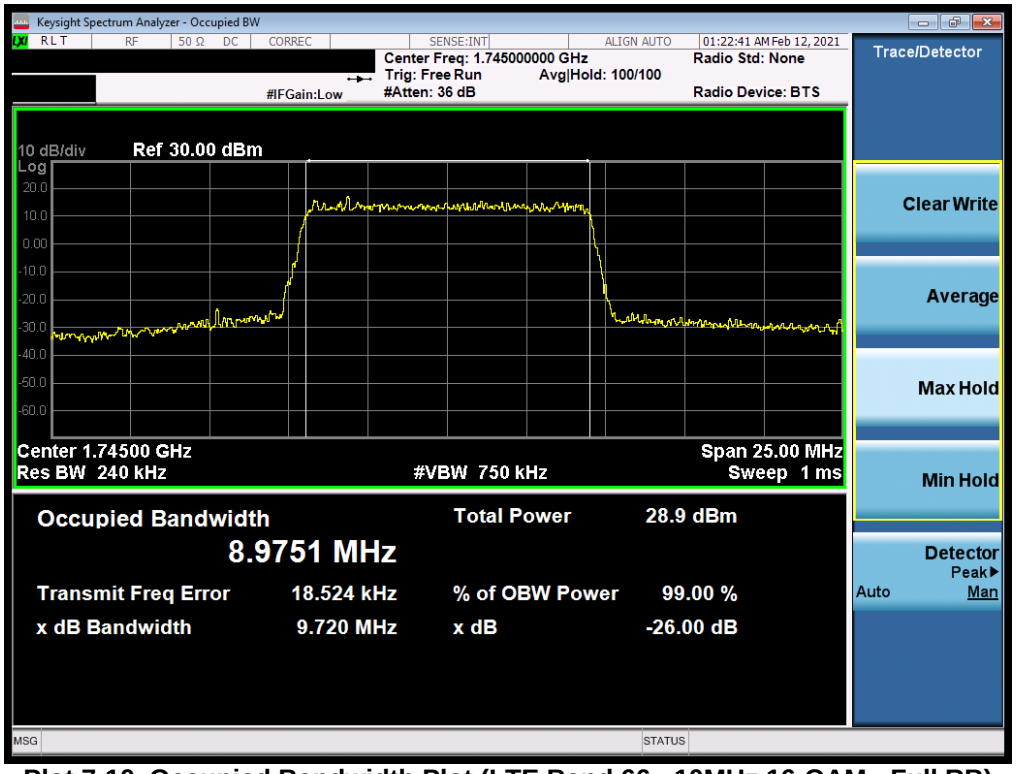
Plot 7-7. Occupied Bandwidth Plot (LTE Band 66 - 15MHz 64-QAM - Full RB)



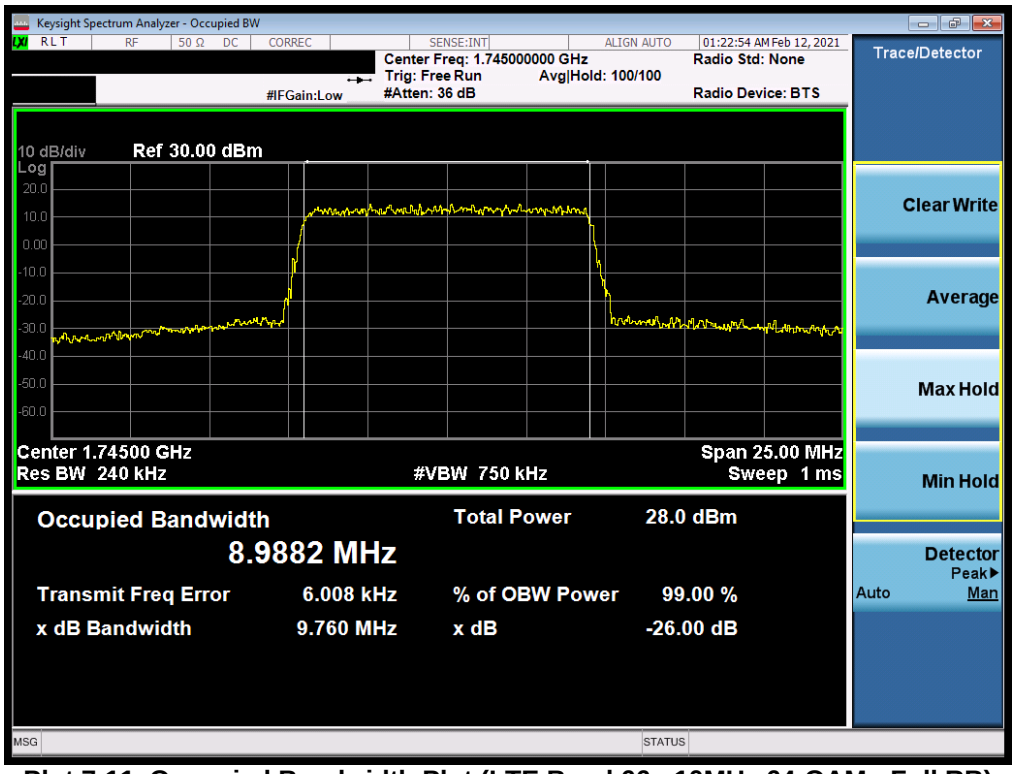
Plot 7-8. Occupied Bandwidth Plot (LTE Band 66 - 15MHz 256-QAM - Full RB)



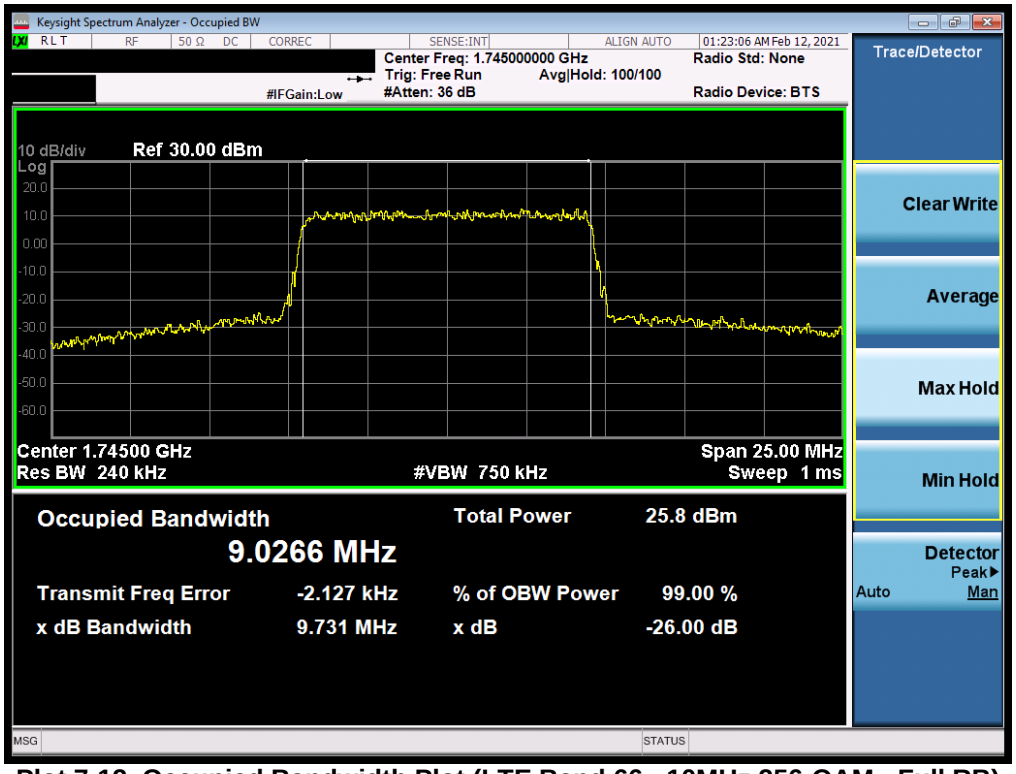
Plot 7-9. Occupied Bandwidth Plot (LTE Band 66 - 10MHz QPSK - Full RB)



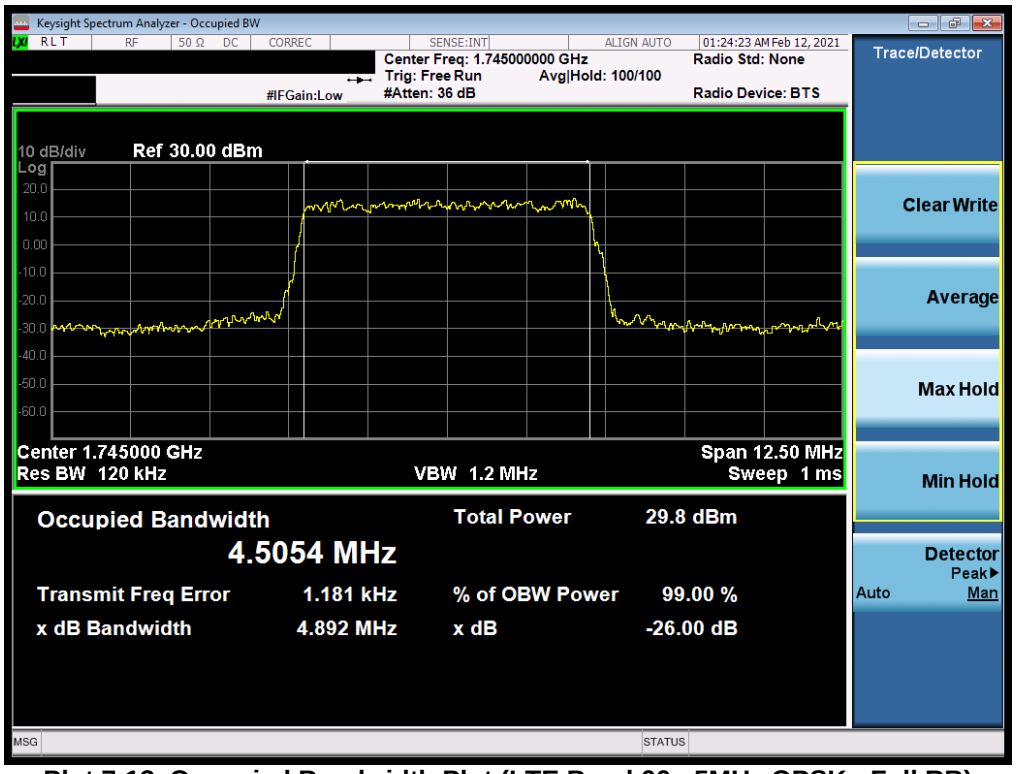
Plot 7-10. Occupied Bandwidth Plot (LTE Band 66 - 10MHz 16-QAM - Full RB)



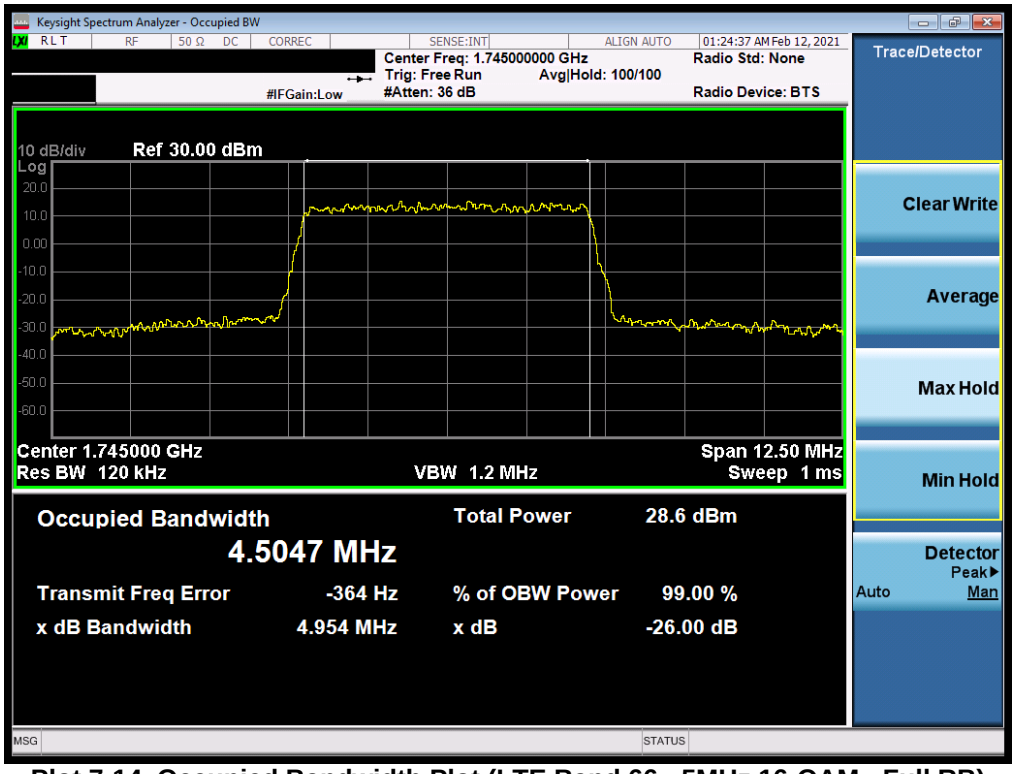
Plot 7-11. Occupied Bandwidth Plot (LTE Band 66 - 10MHz 64-QAM - Full RB)



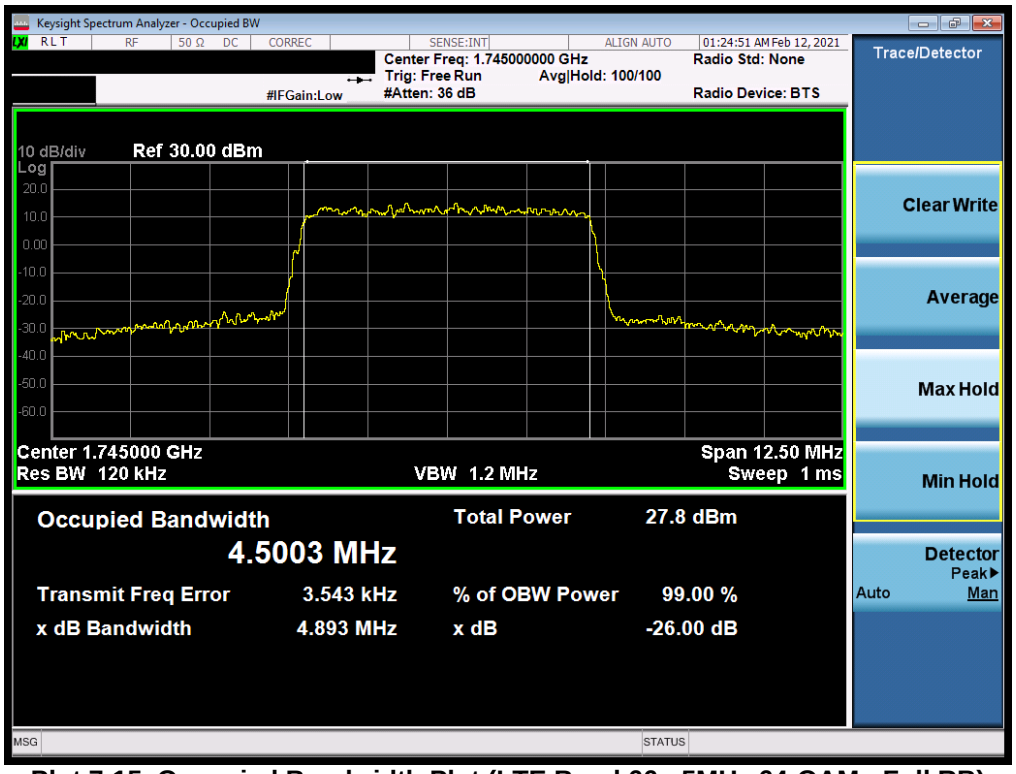
Plot 7-12. Occupied Bandwidth Plot (LTE Band 66 - 10MHz 256-QAM - Full RB)



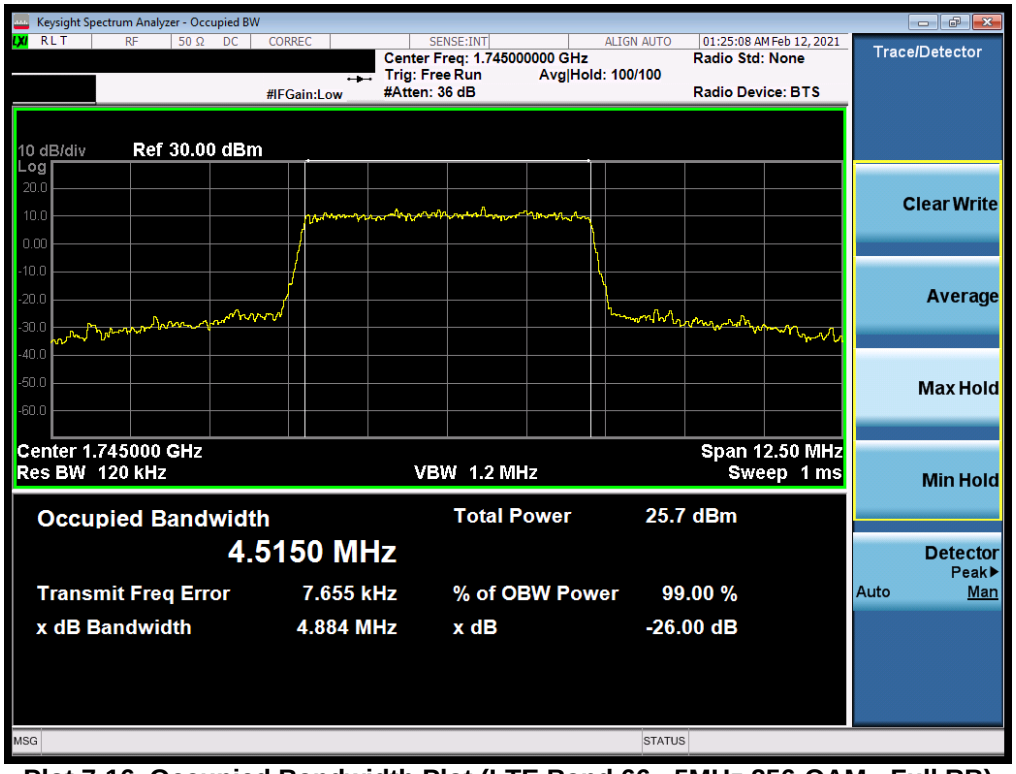
Plot 7-13. Occupied Bandwidth Plot (LTE Band 66 - 5MHz QPSK - Full RB)



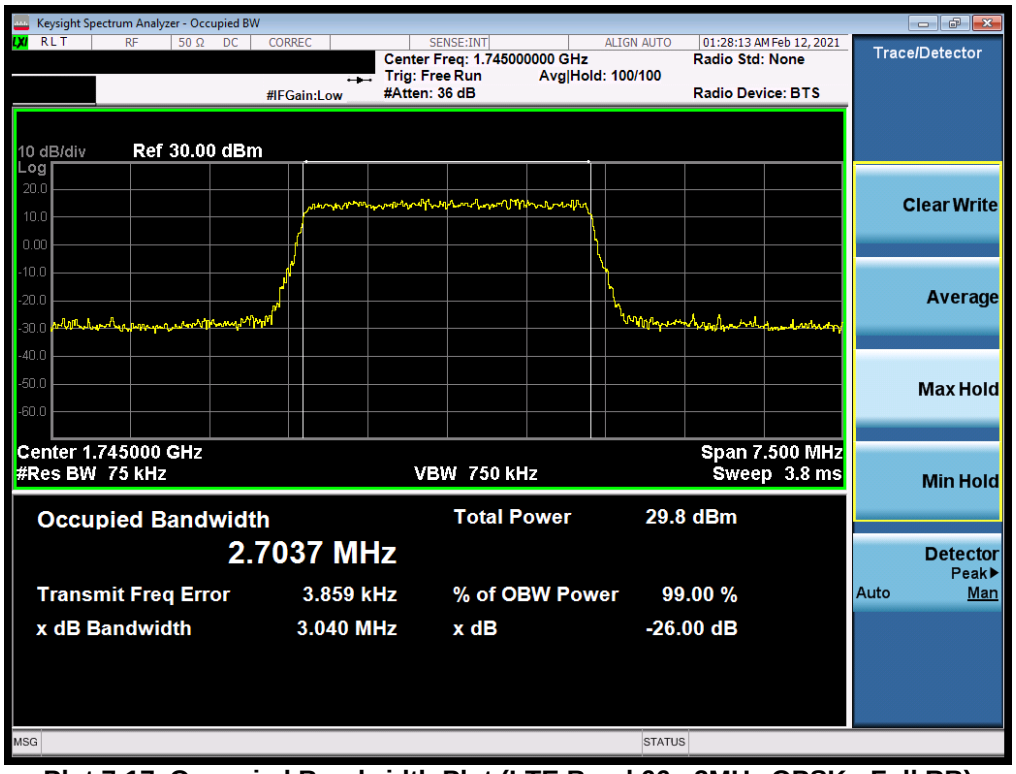
Plot 7-14. Occupied Bandwidth Plot (LTE Band 66 - 5MHz 16-QAM - Full RB)



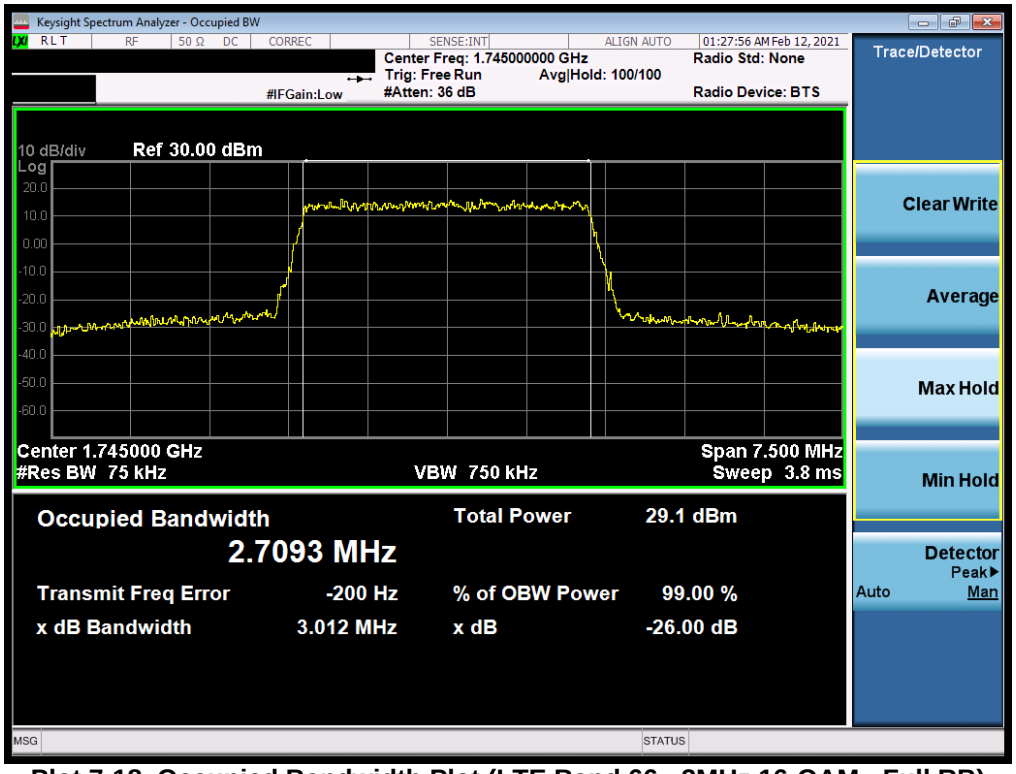
Plot 7-15. Occupied Bandwidth Plot (LTE Band 66 - 5MHz 64-QAM - Full RB)



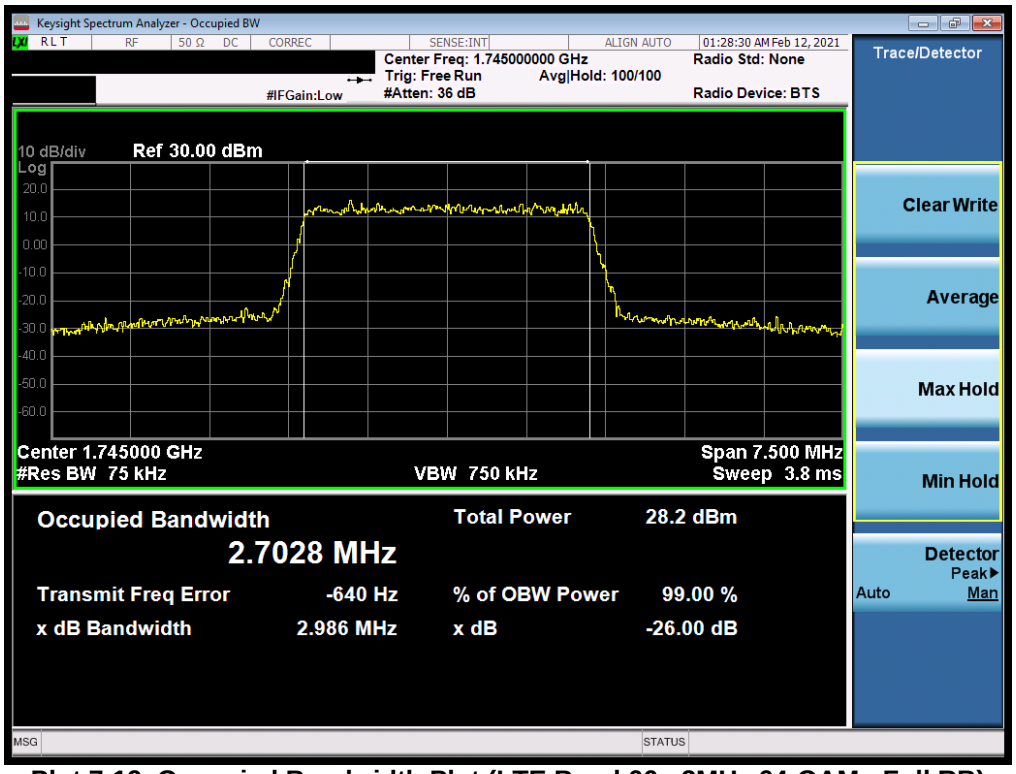
Plot 7-16. Occupied Bandwidth Plot (LTE Band 66 - 5MHz 256-QAM - Full RB)



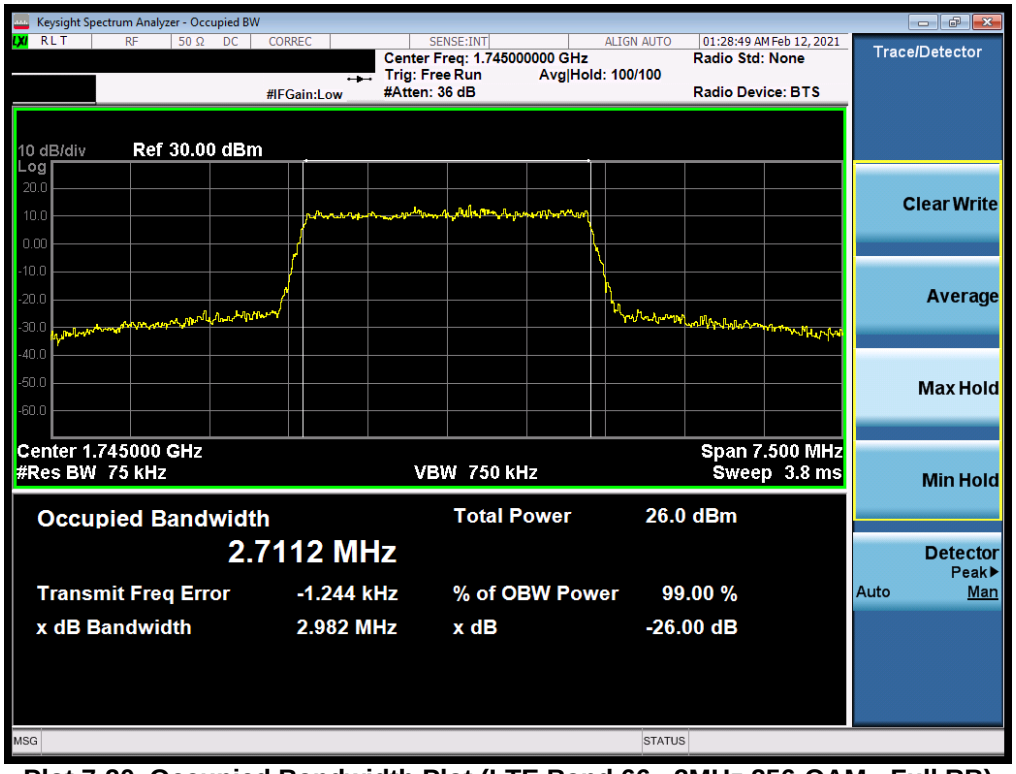
Plot 7-17. Occupied Bandwidth Plot (LTE Band 66 - 3MHz QPSK - Full RB)



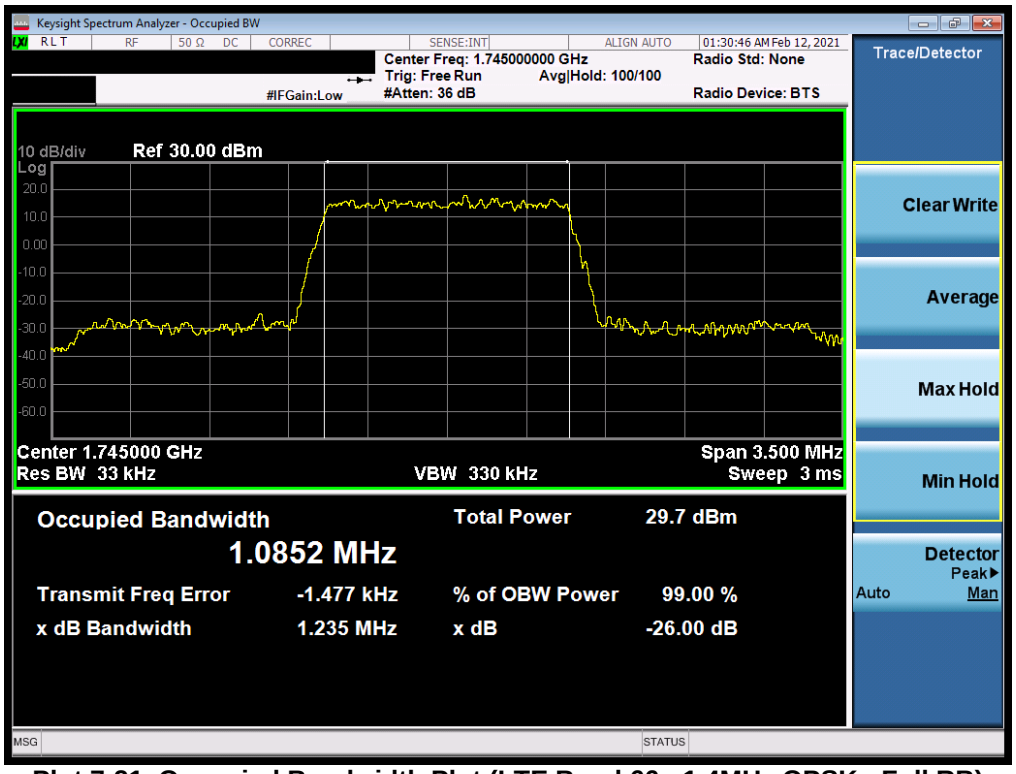
Plot 7-18. Occupied Bandwidth Plot (LTE Band 66 - 3MHz 16-QAM - Full RB)



Plot 7-19. Occupied Bandwidth Plot (LTE Band 66 - 3MHz 64-QAM - Full RB)



Plot 7-20. Occupied Bandwidth Plot (LTE Band 66 - 3MHz 256-QAM - Full RB)



Plot 7-21. Occupied Bandwidth Plot (LTE Band 66 - 1.4MHz QPSK - Full RB)

Plot 7-22. Occupied Bandwidth Plot (LTE Band 66 - 1.4MHz 16-QAM - Full RB)

Plot 7-23. Occupied Bandwidth Plot (LTE Band 66 - 1.4MHz 64-QAM - Full RB)

Plot 7-24. Occupied Bandwidth Plot (LTE Band 66 - 1.4MHz 256-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

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 18GHz (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.

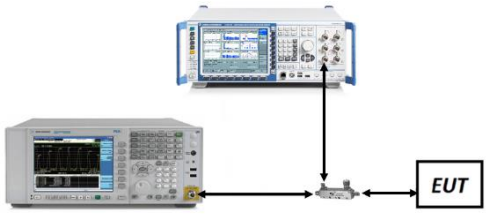
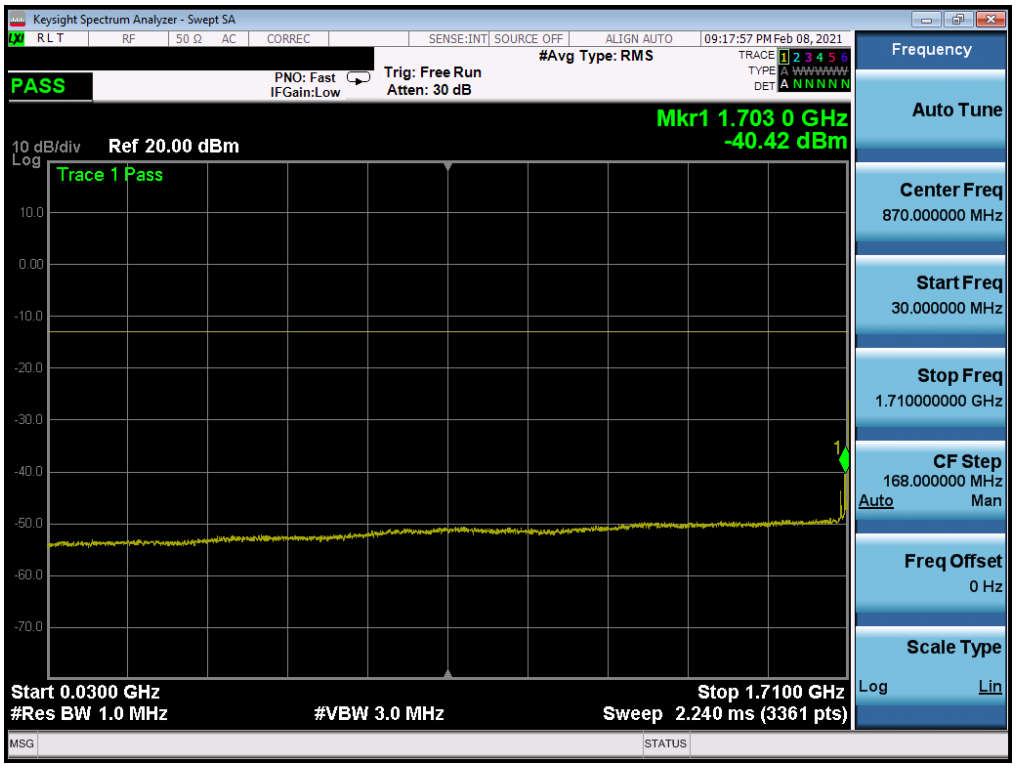


Figure 7-3. Test Instrument & Measurement Setup

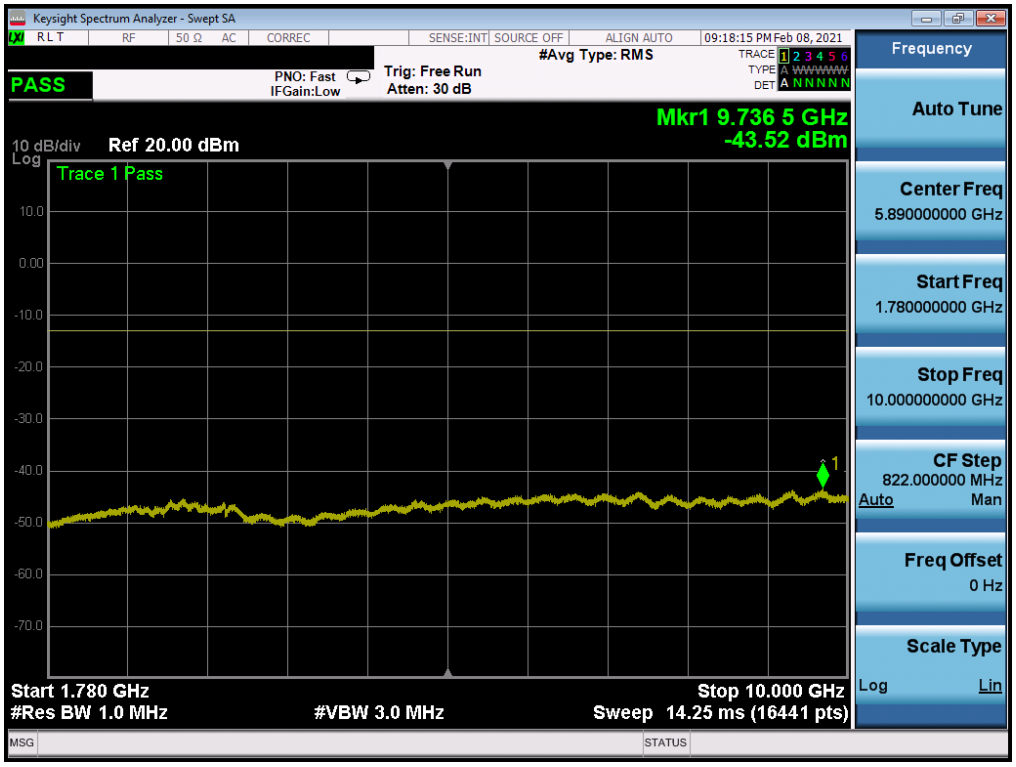
Test Notes

Per Part 27, 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 66

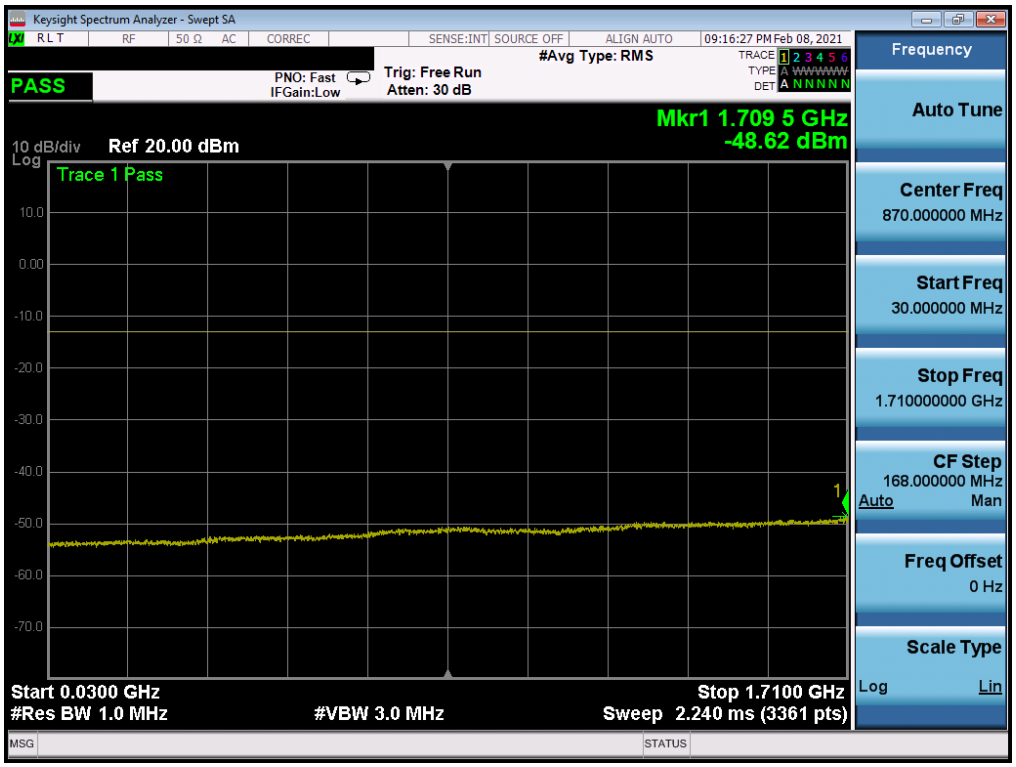


Plot 7-25. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

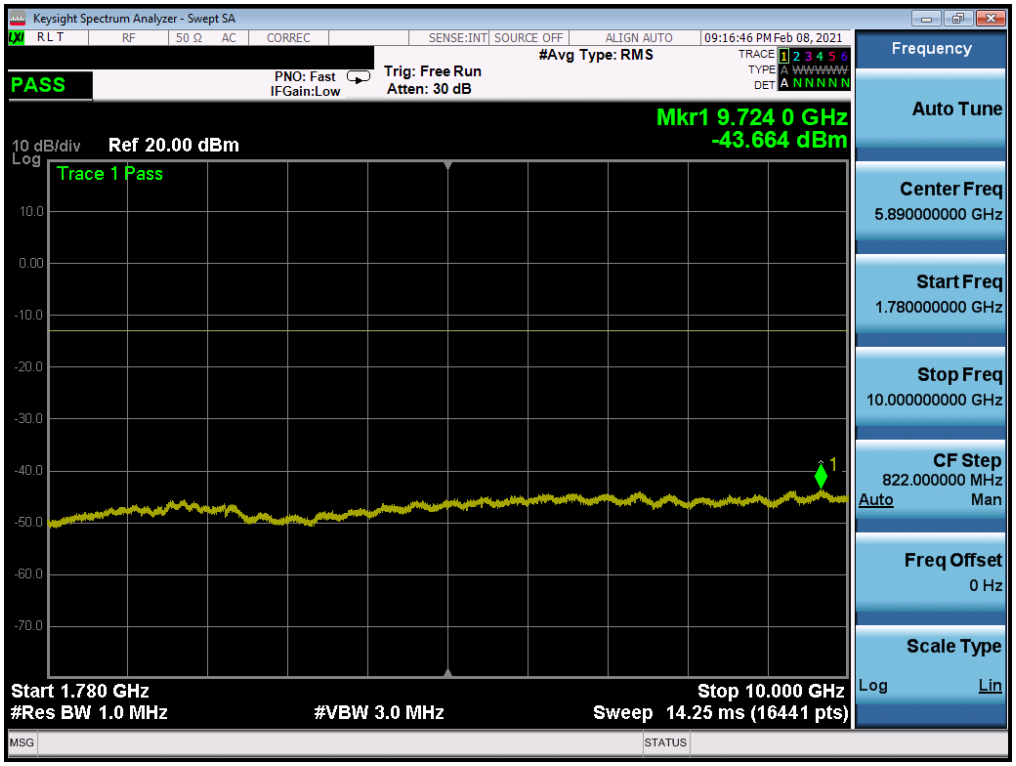


Plot 7-26. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

Plot 7-27. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

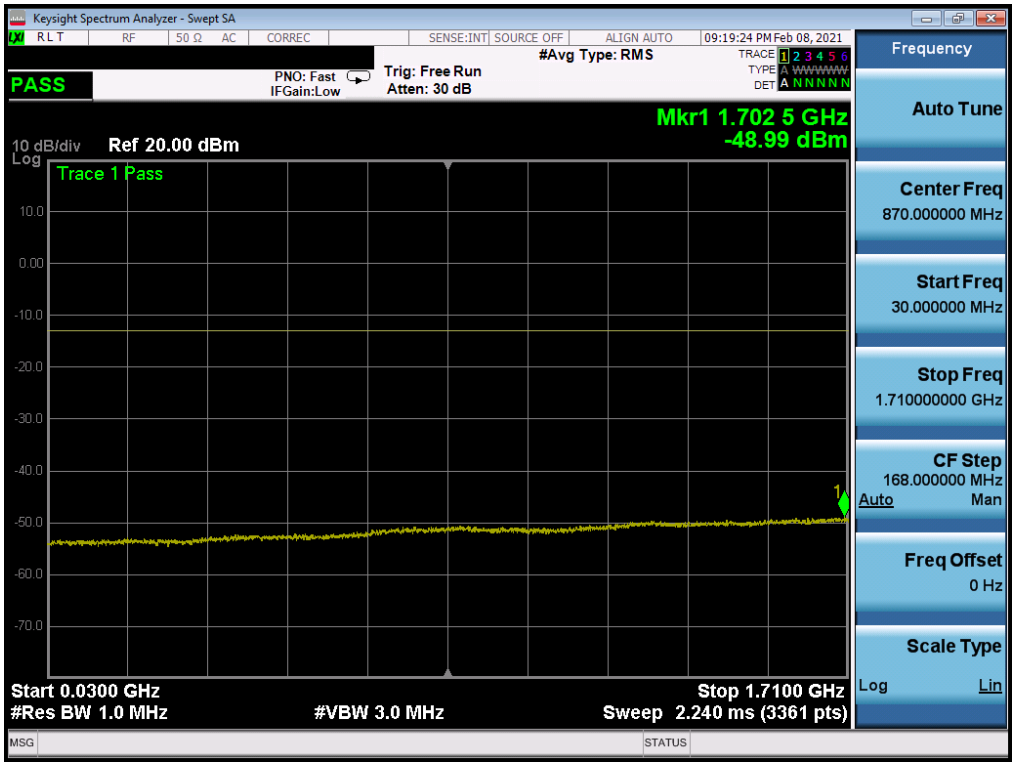


Plot 7-28. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

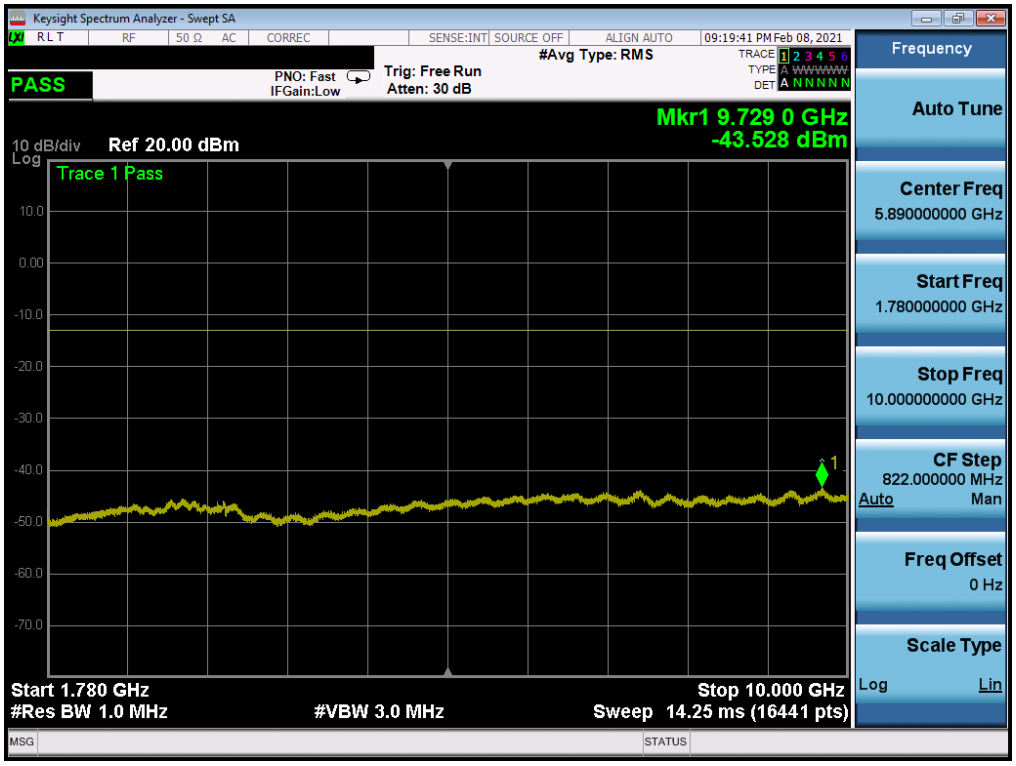


Plot 7-29. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

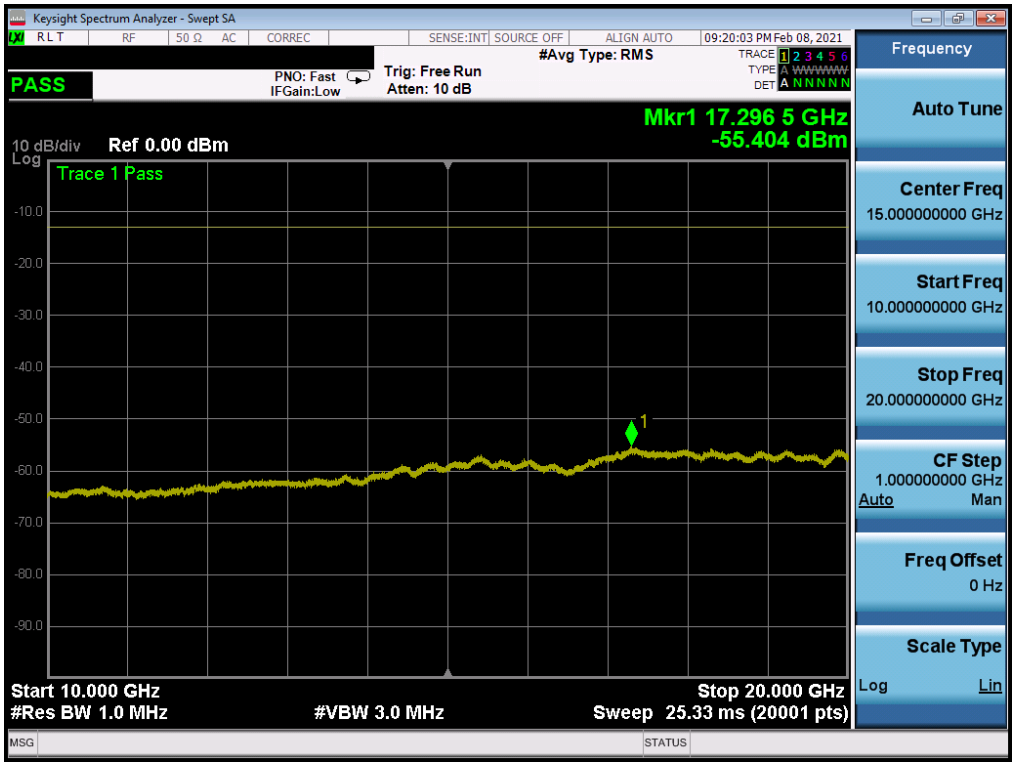
Plot 7-30. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



Plot 7-31. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-32. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-33. Conducted Spurious Plot (LTE Band 66 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

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 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.

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.

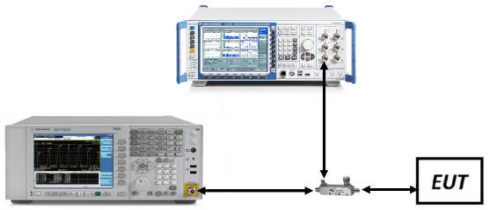
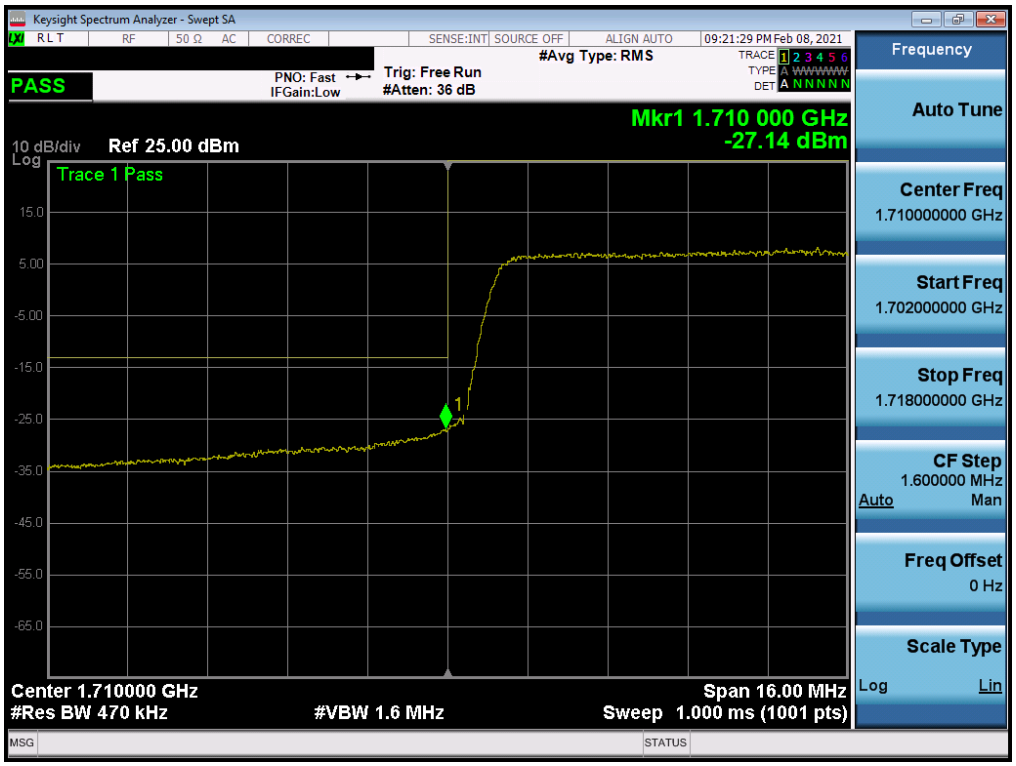


Figure 7-4. Test Instrument & Measurement Setup

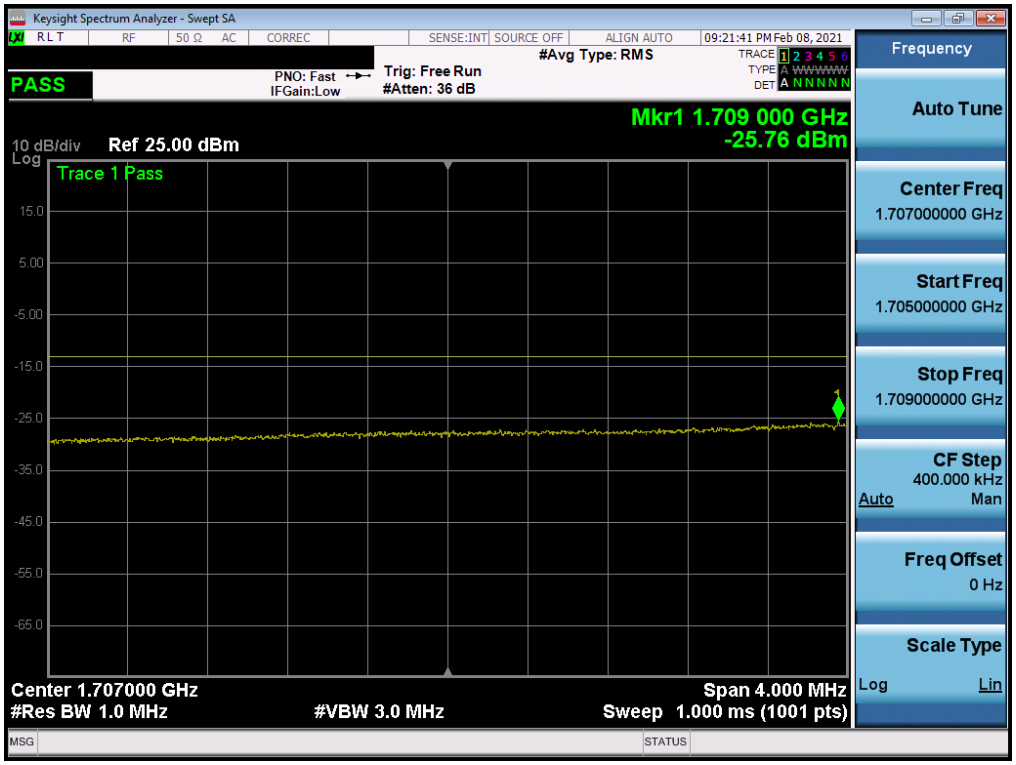
Test Notes

Per 27.53(h) 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.

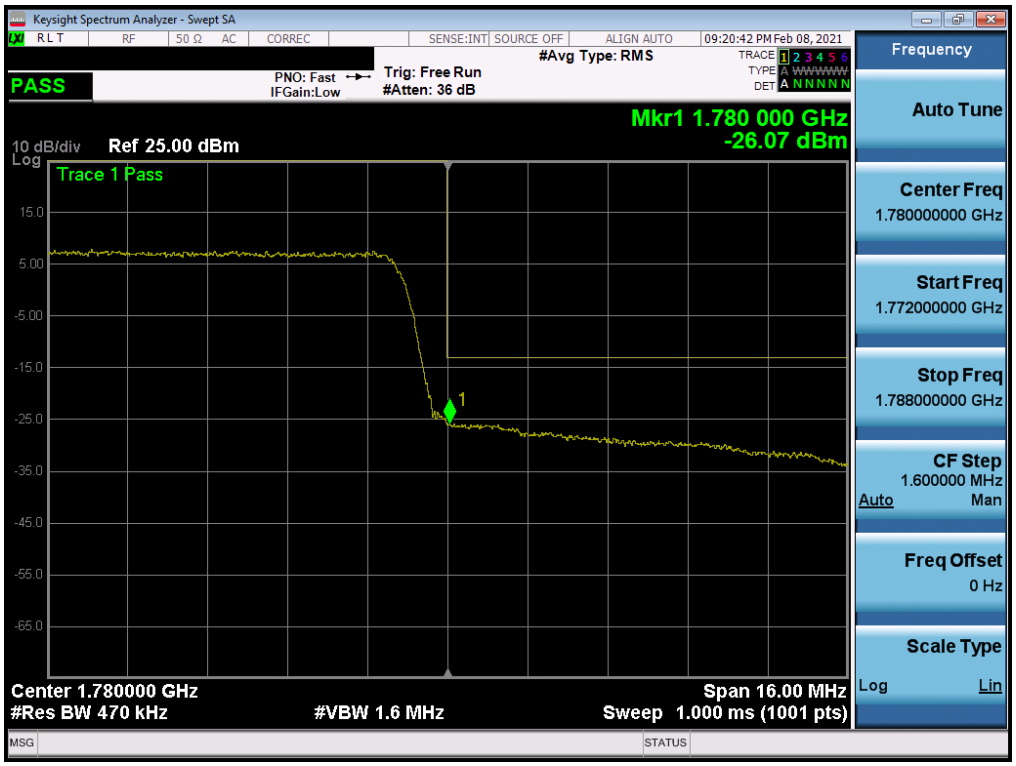
LTE Band 66



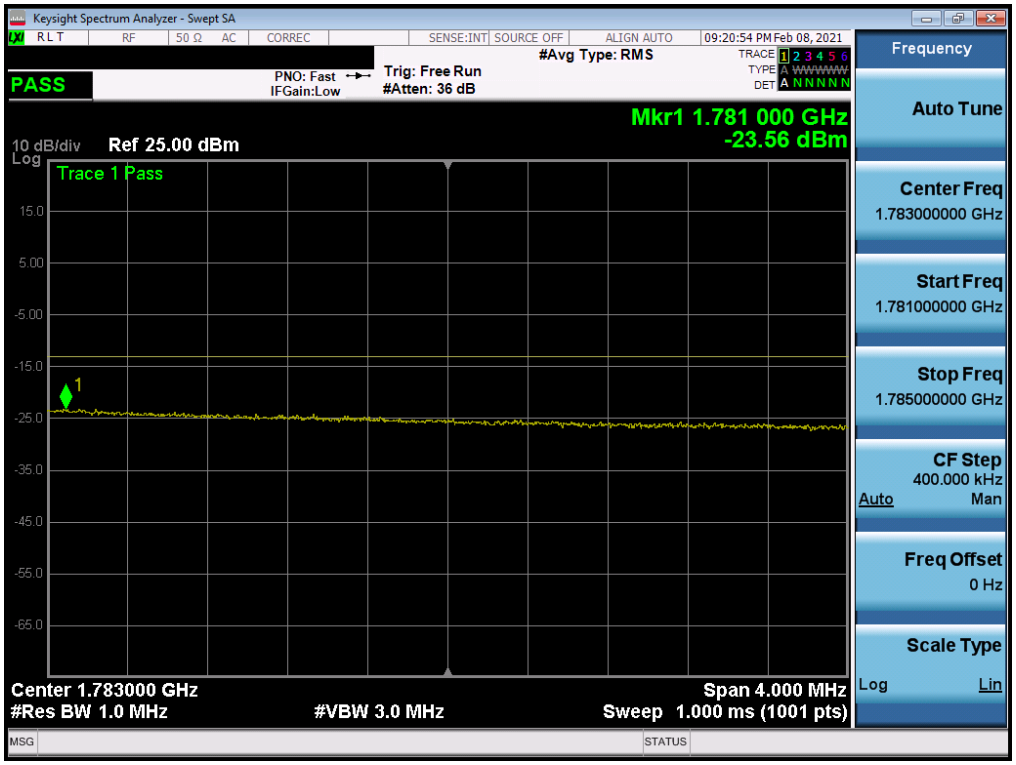
Plot 7-34. Lower Band Edge Plot (LTE Band 66 - 20MHz QPSK – Full RB)



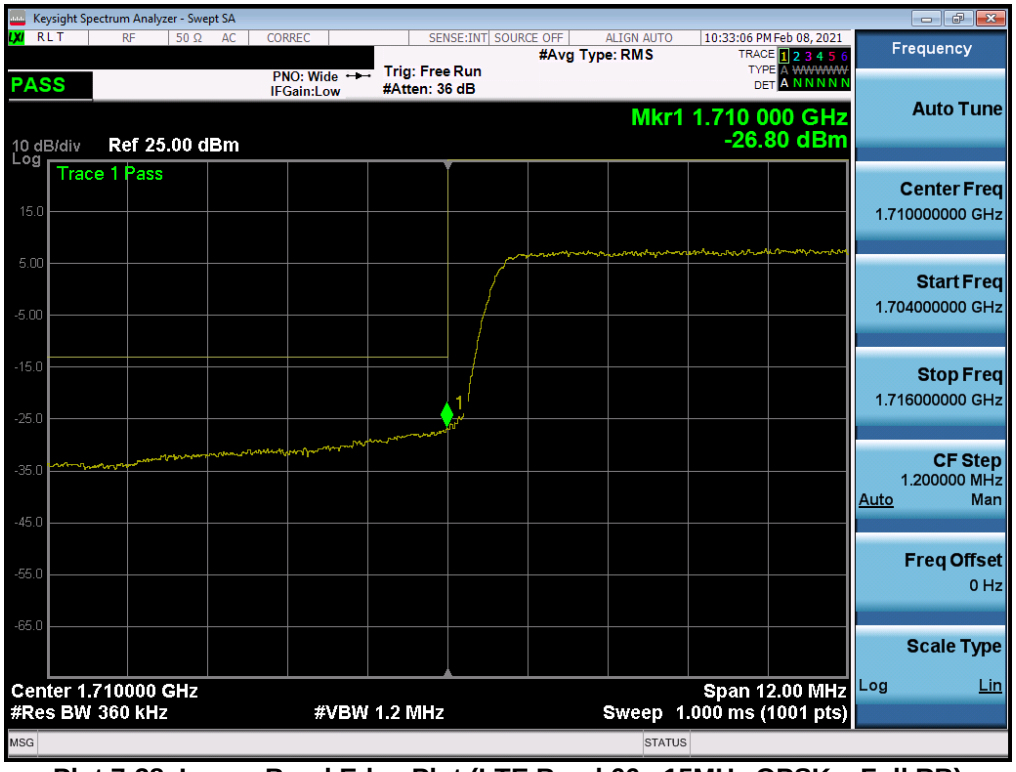
Plot 7-35. Lower Extended Band Edge Plot (LTE Band 66 - 20MHz QPSK – Full RB)



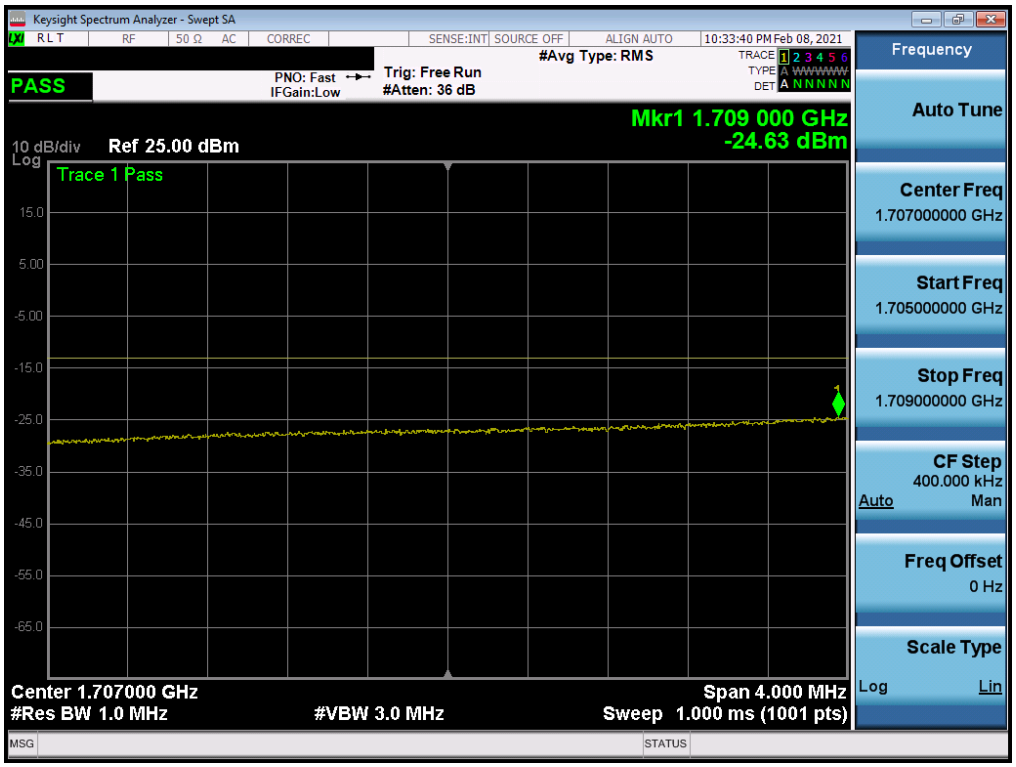
Plot 7-36. Upper Band Edge Plot (LTE Band 66 - 20MHz QPSK – Full RB)



Plot 7-37. Channel Edge Plot (LTE Band 66 - 20MHz QPSK – Full RB)

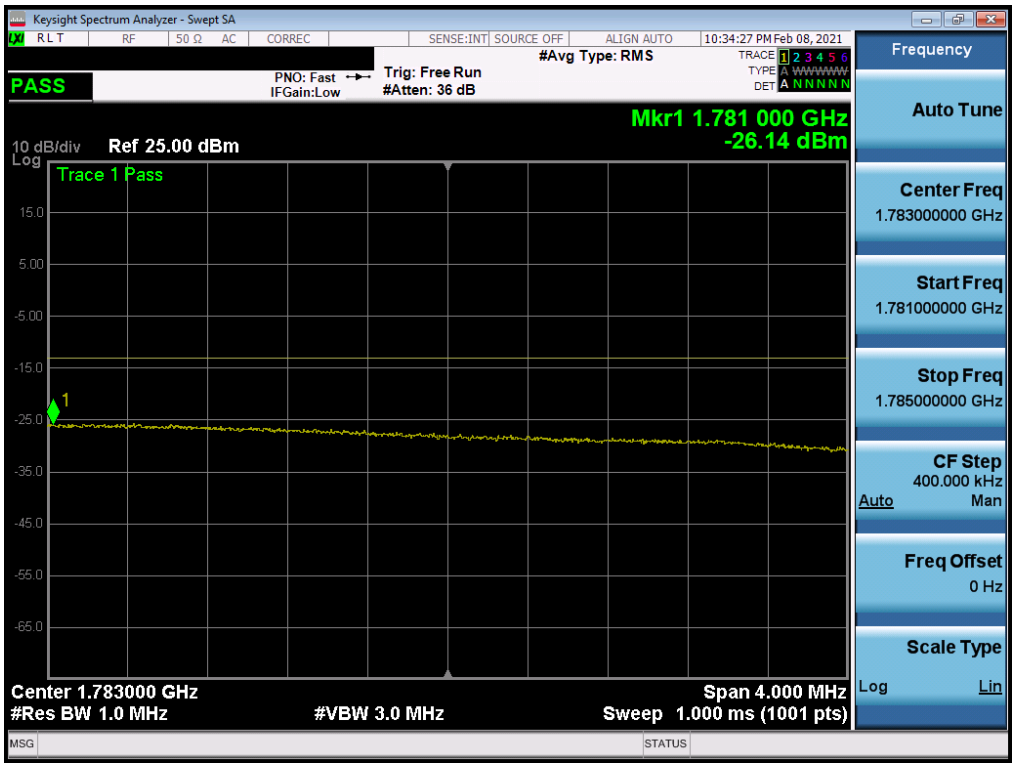


Plot 7-38. Lower Band Edge Plot (LTE Band 66 - 15MHz QPSK – Full RB)

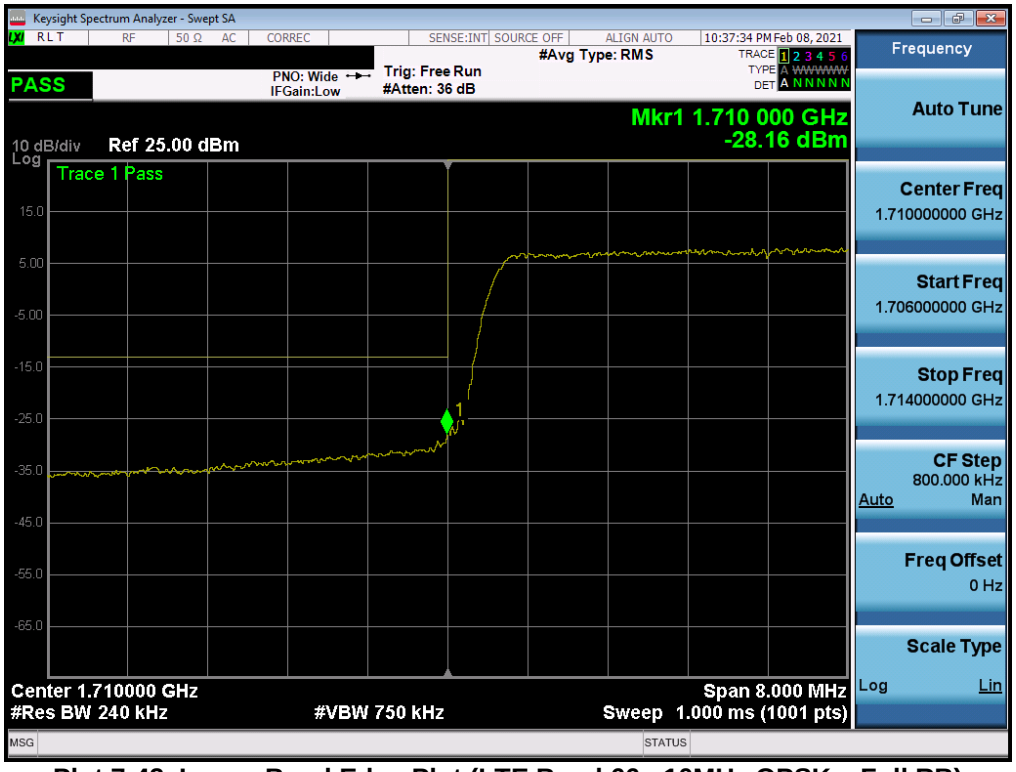


Plot 7-39. Lower Extended Band Edge Plot (LTE Band 66 - 15MHz QPSK – Full RB)

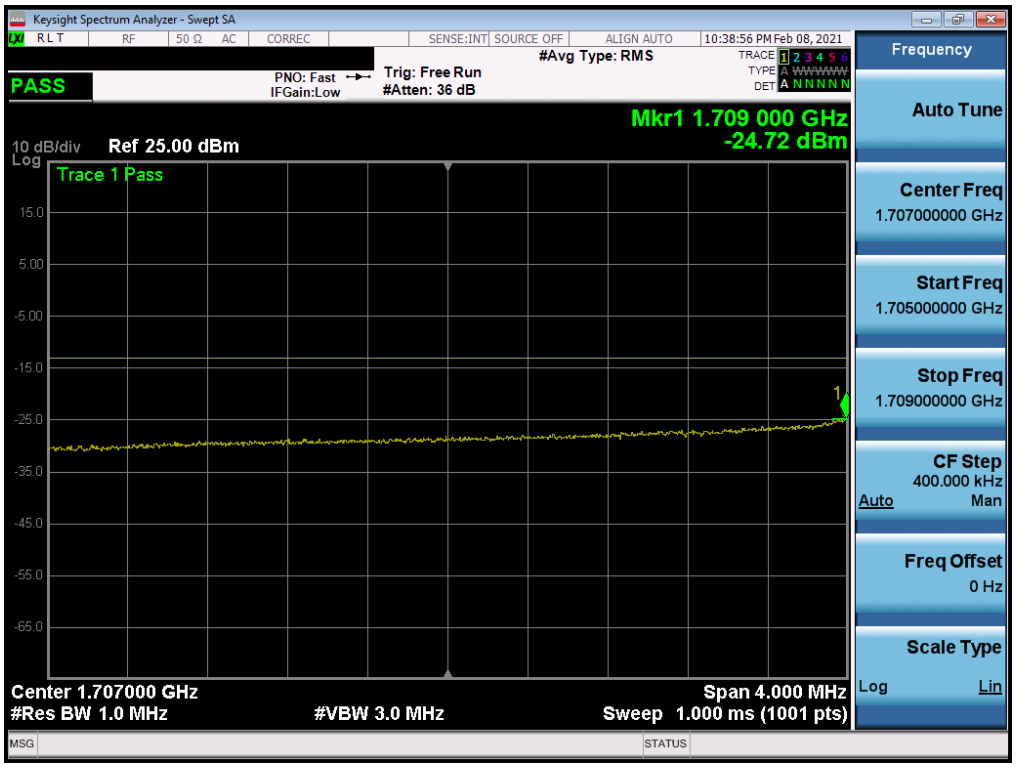
Plot 7-40. Upper Band Edge Plot (LTE Band 66 - 15MHz QPSK – Full RB)



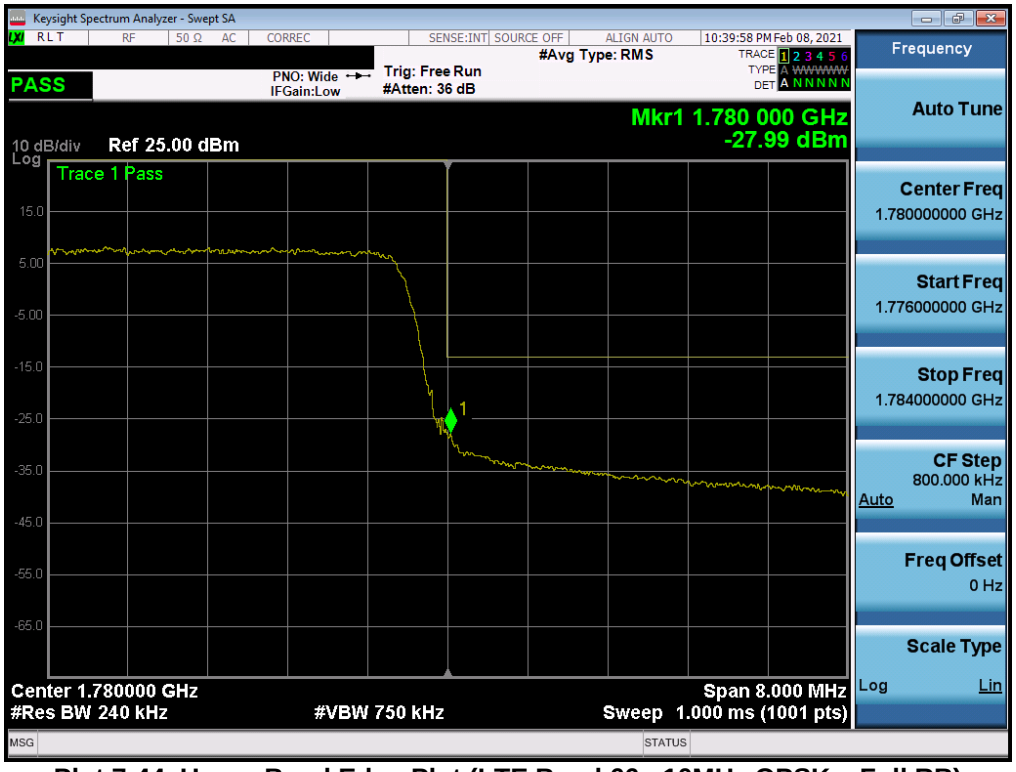
Plot 7-41. Upper Extended Band Edge Plot (LTE Band 66 - 15MHz QPSK – Full RB)



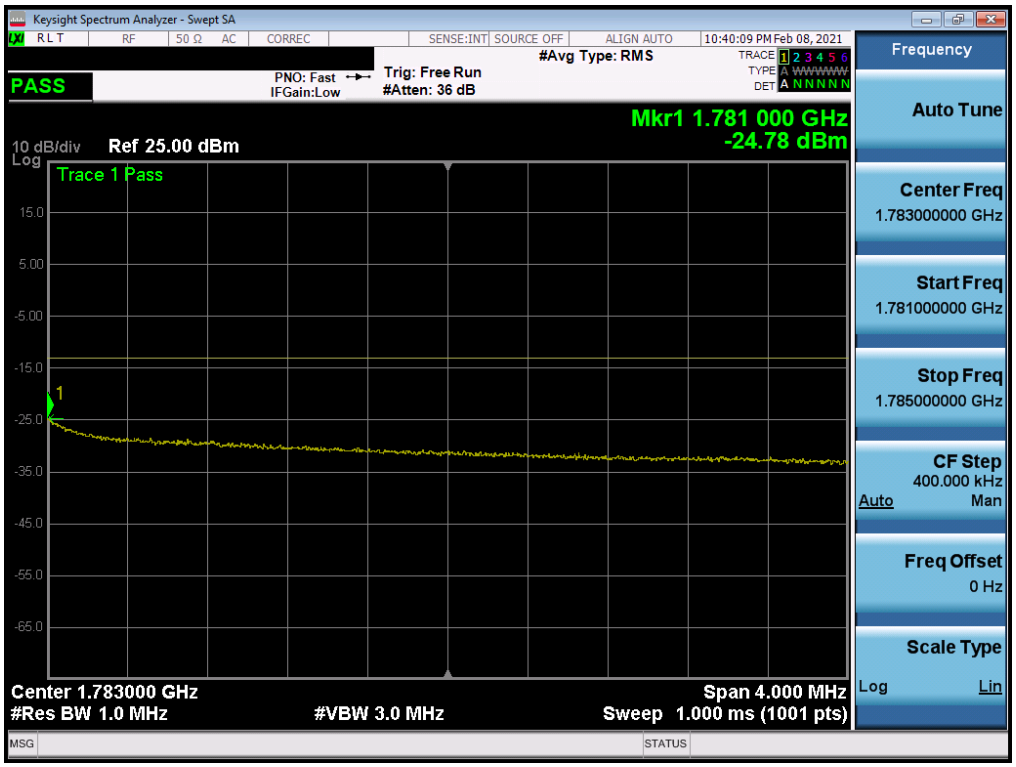
Plot 7-42. Lower Band Edge Plot (LTE Band 66 - 10MHz QPSK – Full RB)



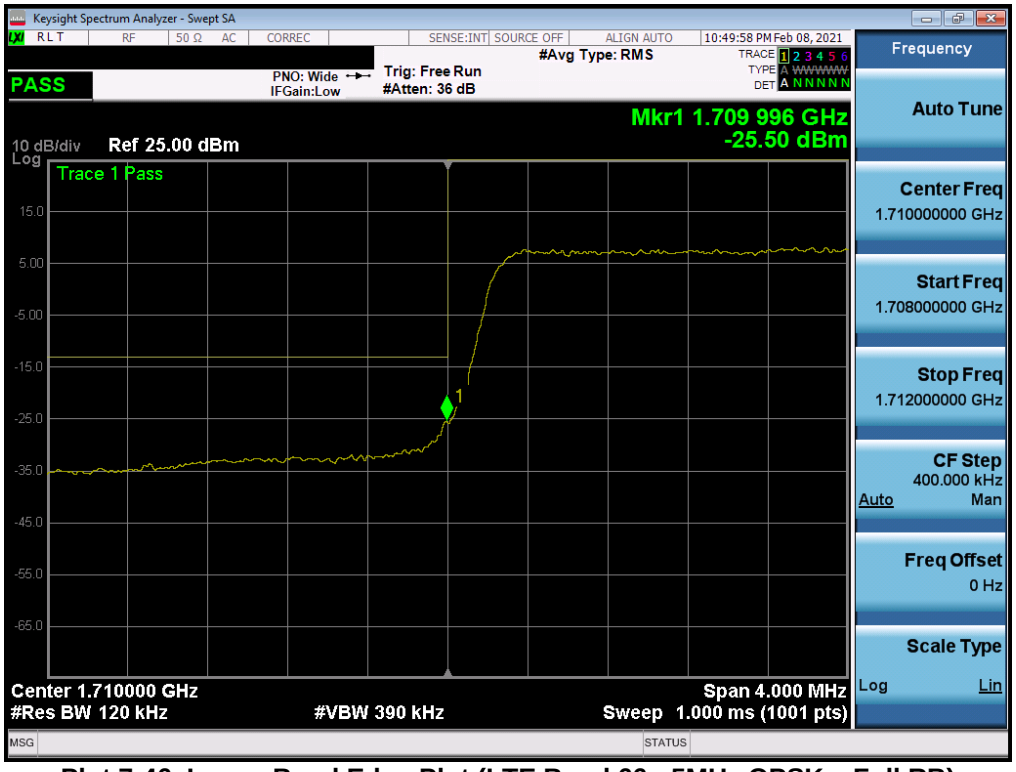
Plot 7-43. Lower Extended Band Edge Plot (LTE Band 66 - 10MHz QPSK – Full RB)



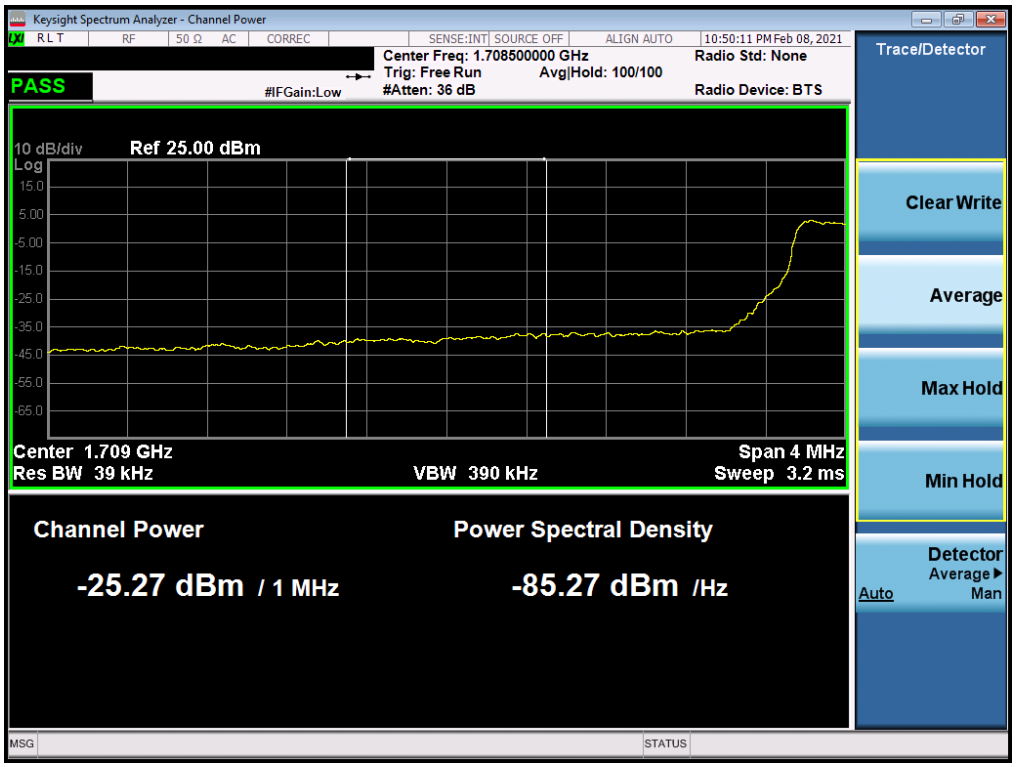
Plot 7-44. Upper Band Edge Plot (LTE Band 66 - 10MHz QPSK – Full RB)



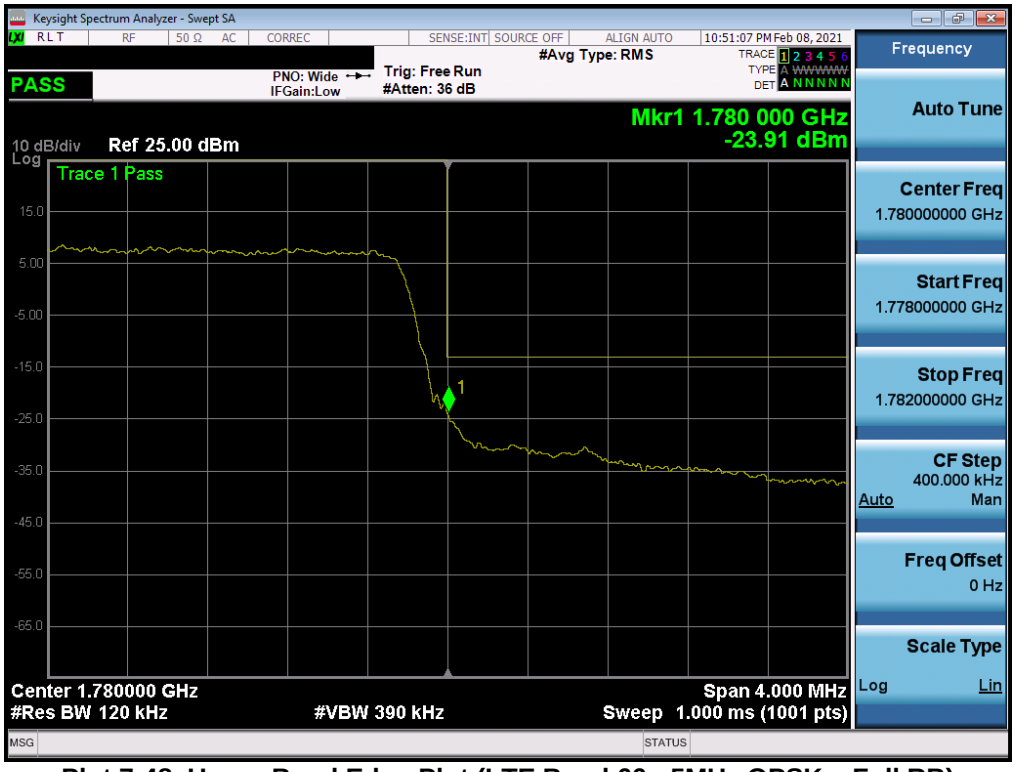
Plot 7-45. Upper Extended Band Edge Plot (LTE Band 66 - 10MHz QPSK – Full RB)



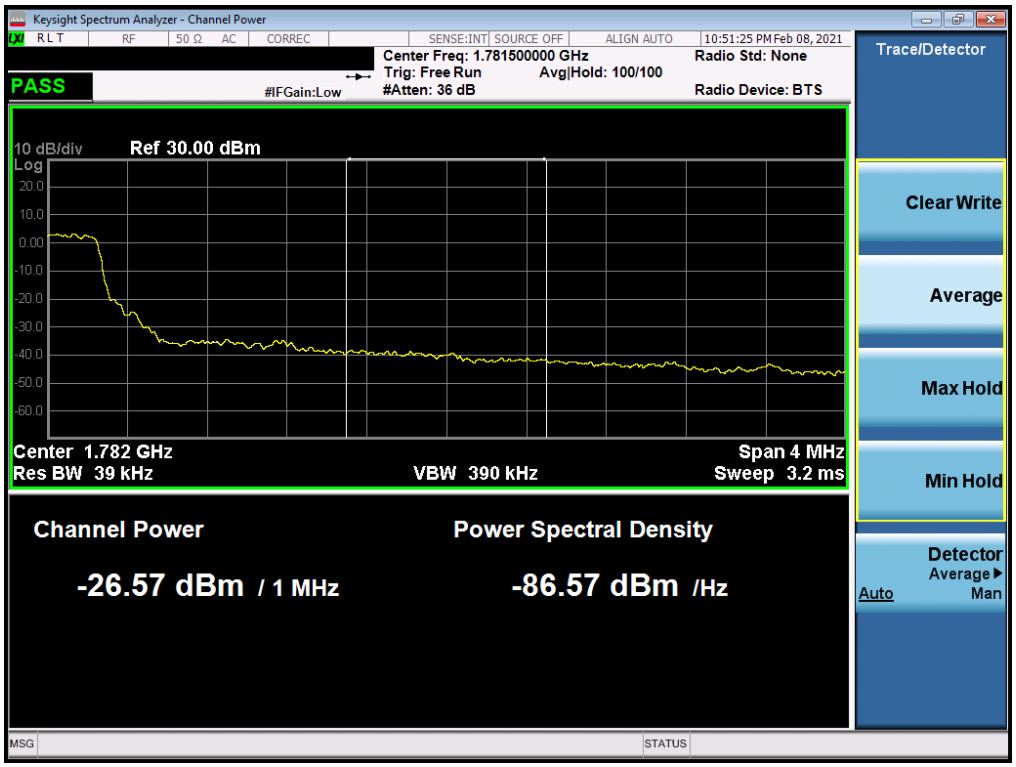
Plot 7-46. Lower Band Edge Plot (LTE Band 66 - 5MHz QPSK – Full RB)



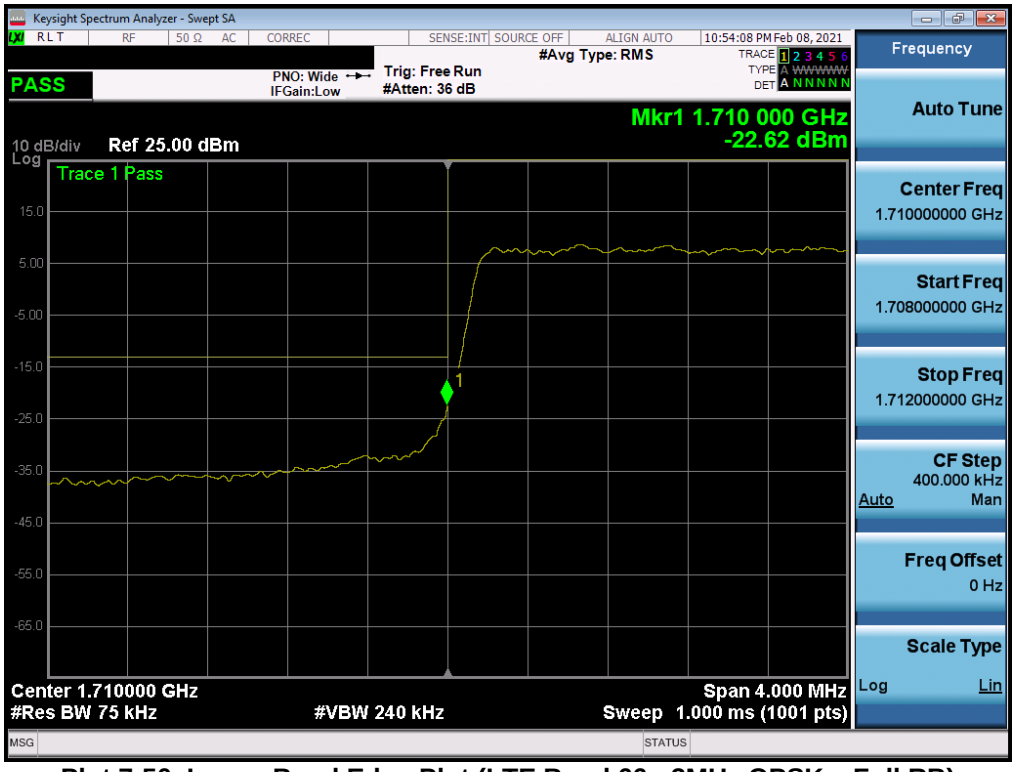
Plot 7-47. Lower Extended Band Edge Plot (LTE Band 66 - 5MHz QPSK – Full RB)



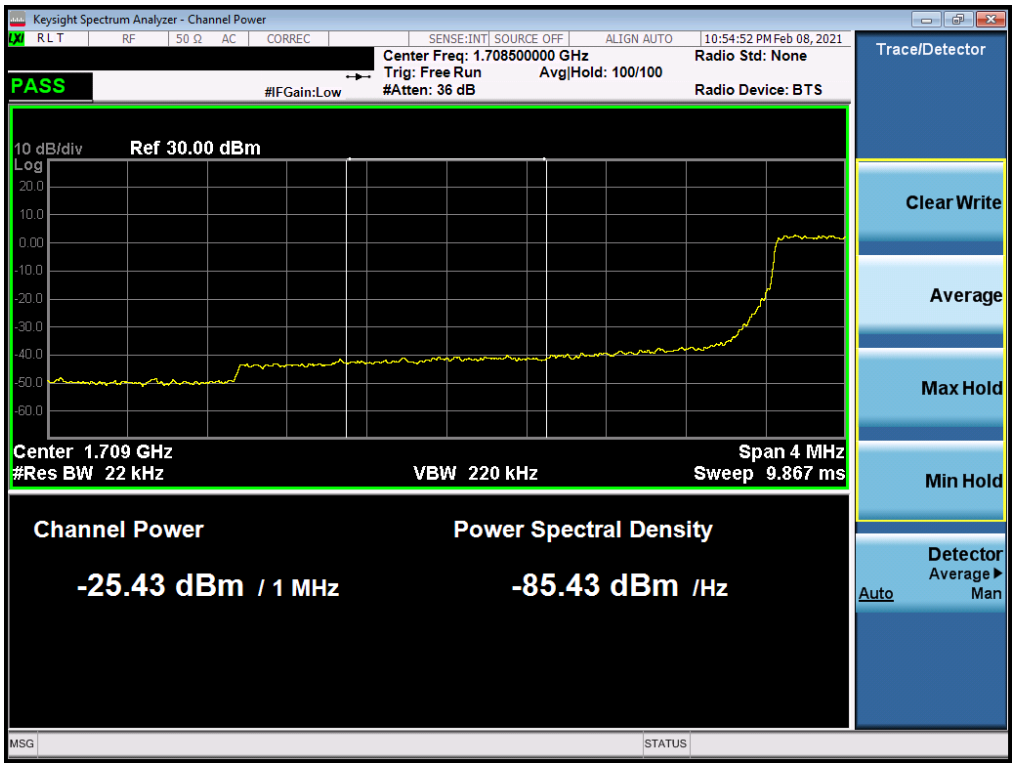
Plot 7-48. Upper Band Edge Plot (LTE Band 66 - 5MHz QPSK – Full RB)



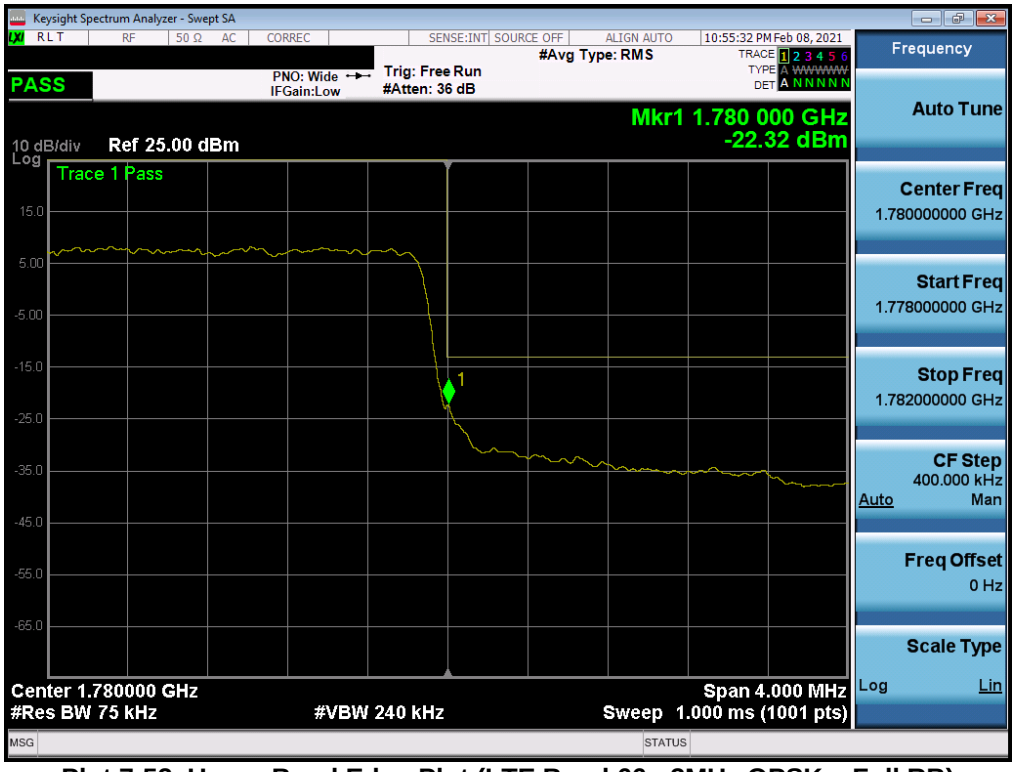
Plot 7-49. Upper Extended Band Edge Plot (LTE Band 66 - 5MHz QPSK – Full RB)



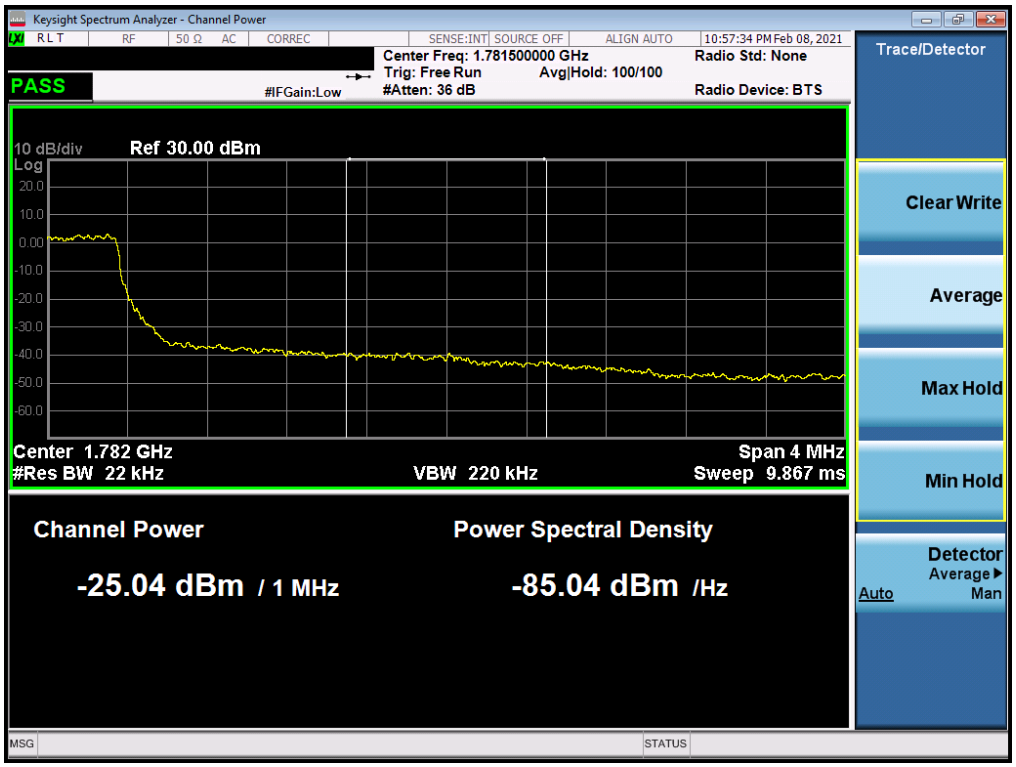
Plot 7-50. Lower Band Edge Plot (LTE Band 66 - 3MHz QPSK – Full RB)



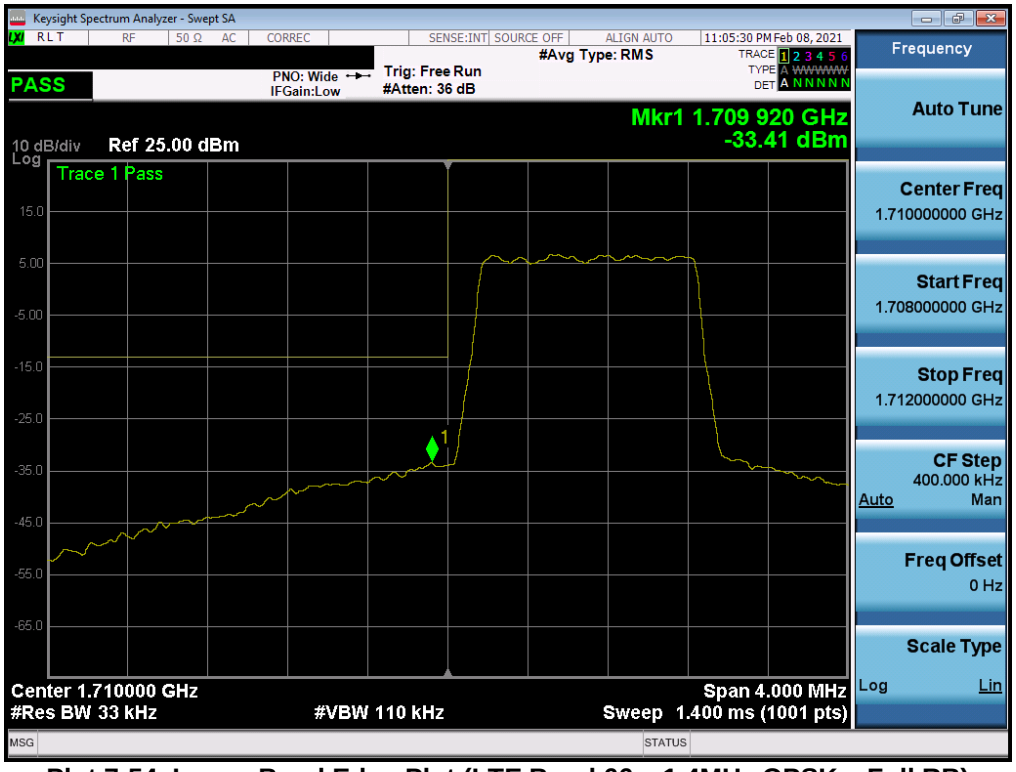
Plot 7-51. Lower Extended Band Edge Plot (LTE Band 66 - 3MHz QPSK – Full RB)



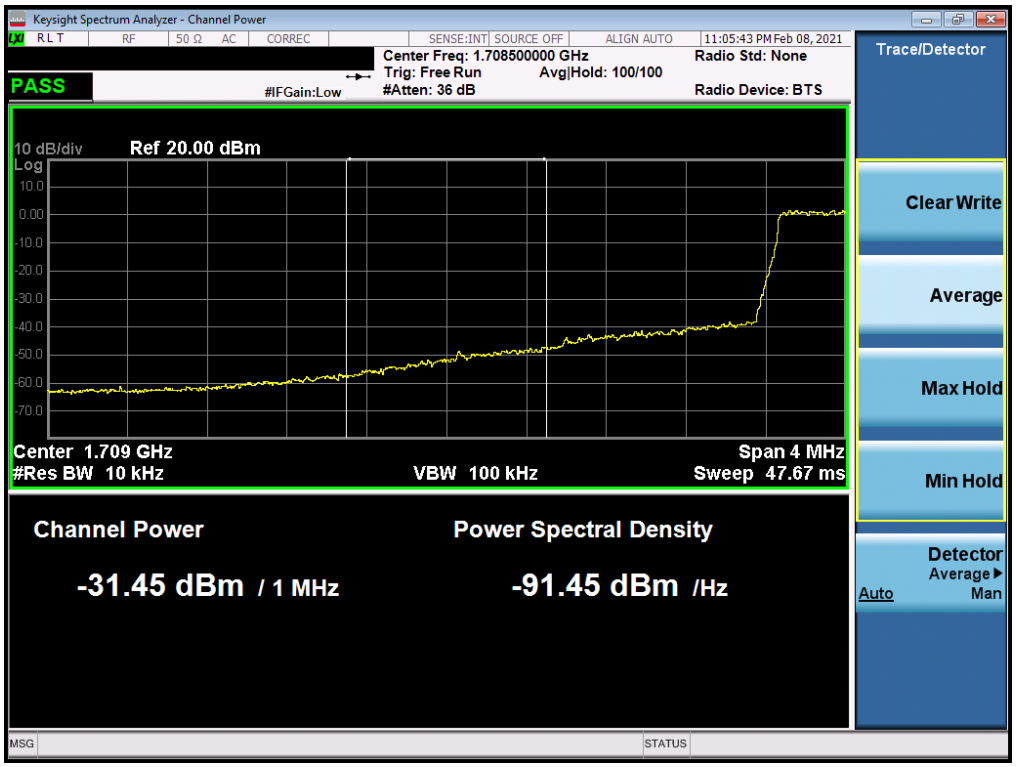
Plot 7-52. Upper Band Edge Plot (LTE Band 66 - 3MHz QPSK – Full RB)



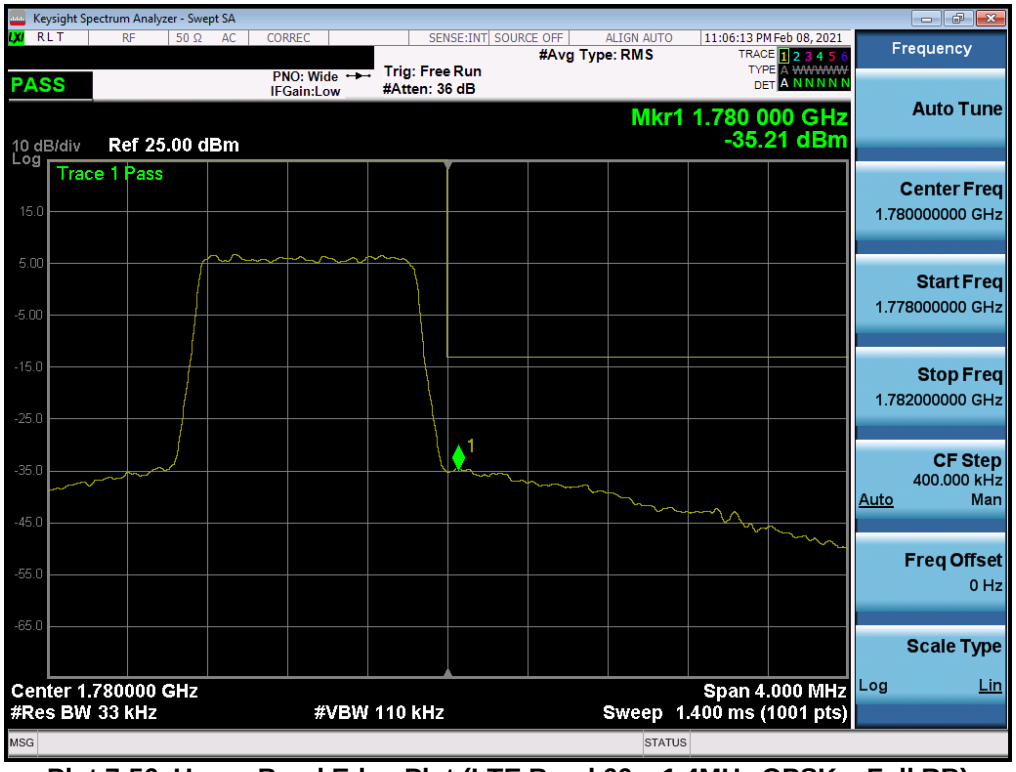
Plot 7-53. Upper Extended Band Edge Plot (LTE Band 66 - 3MHz QPSK – Full RB)



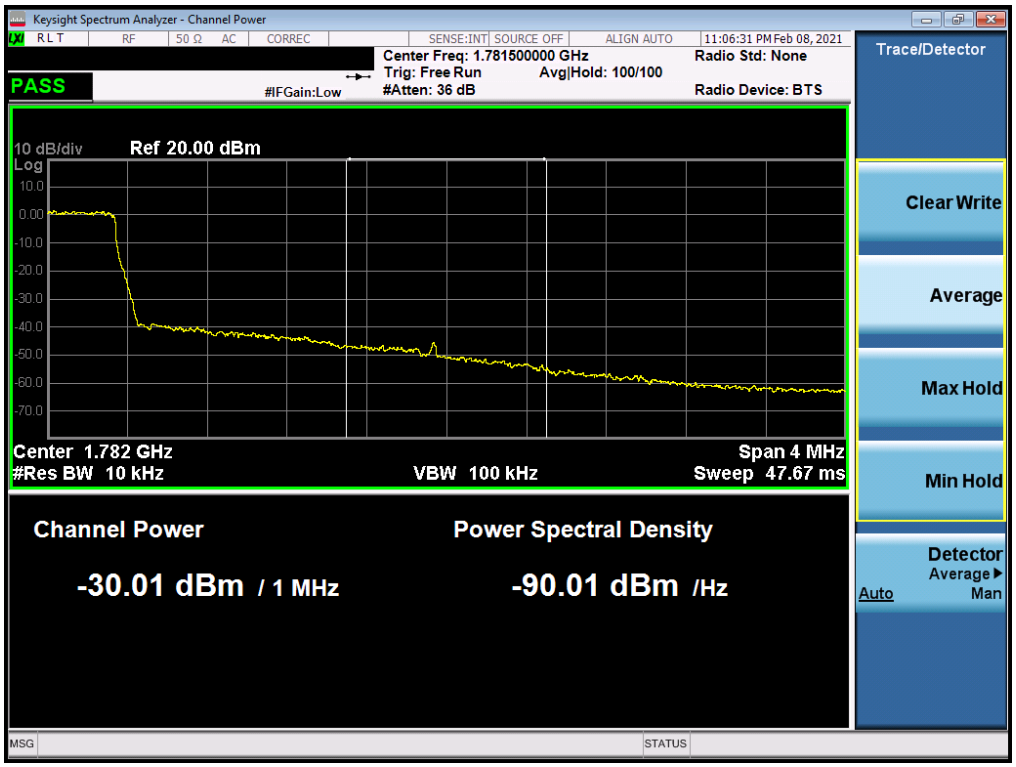
Plot 7-54. Lower Band Edge Plot (LTE Band 66 – 1.4MHz QPSK – Full RB)



Plot 7-55. Lower Extended Band Edge Plot (LTE Band 66 – 1.4MHz QPSK – Full RB)



Plot 7-56. Upper Band Edge Plot (LTE Band 66 – 1.4MHz QPSK – Full RB)



Plot 7-57. Upper Extended Band Edge Plot (LTE Band 66 – 1.4MHz QPSK – Full RB)

7.6 Peak-Average Ratio

Test Overview

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

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.7.1

Test Settings

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

Test Setup

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

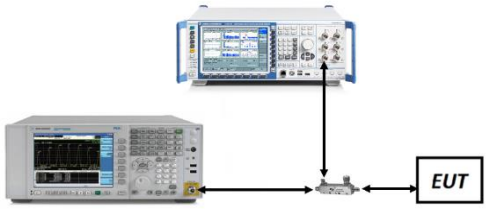
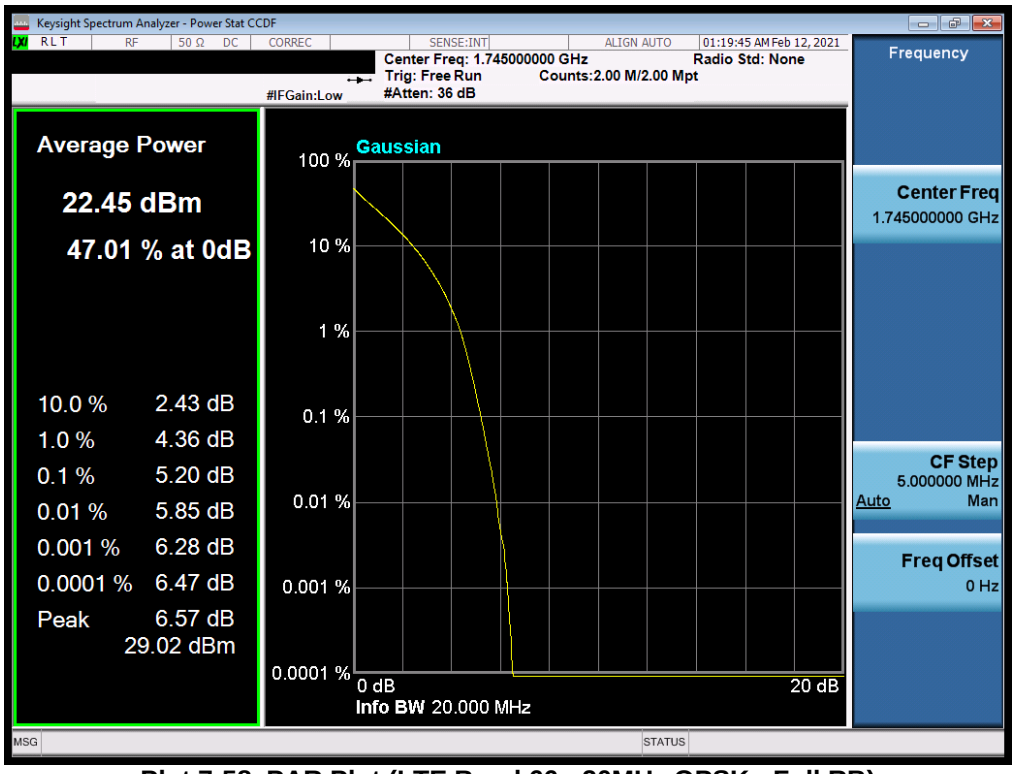


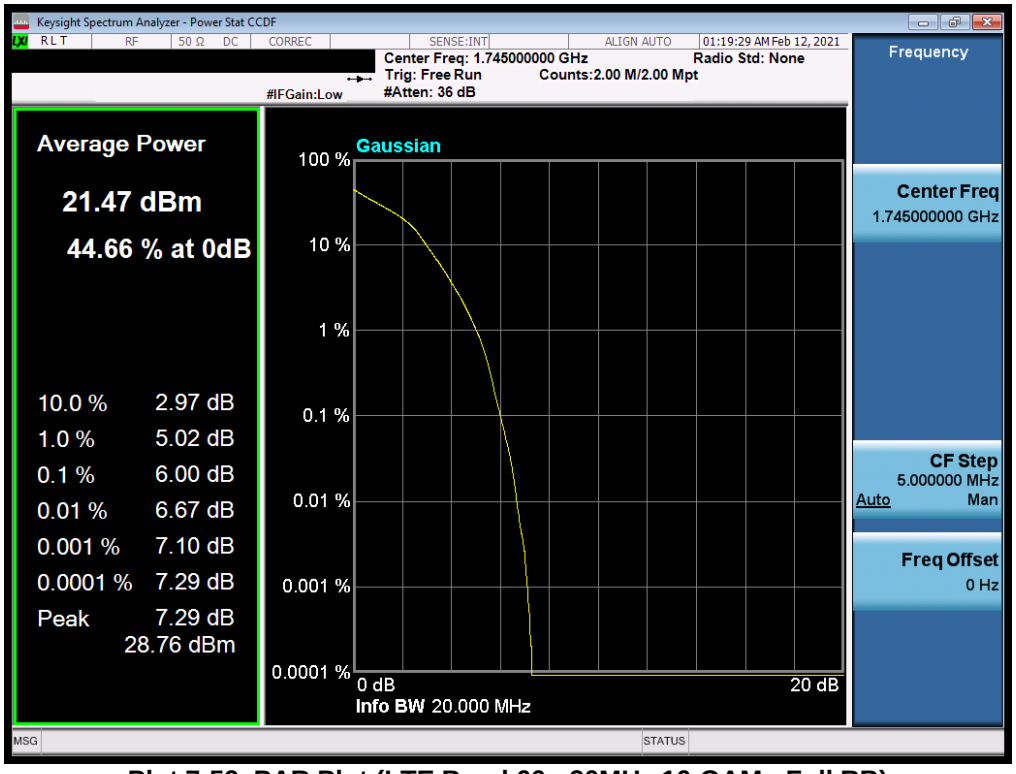
Figure 7-5. Test Instrument & Measurement Setup

Test Notes

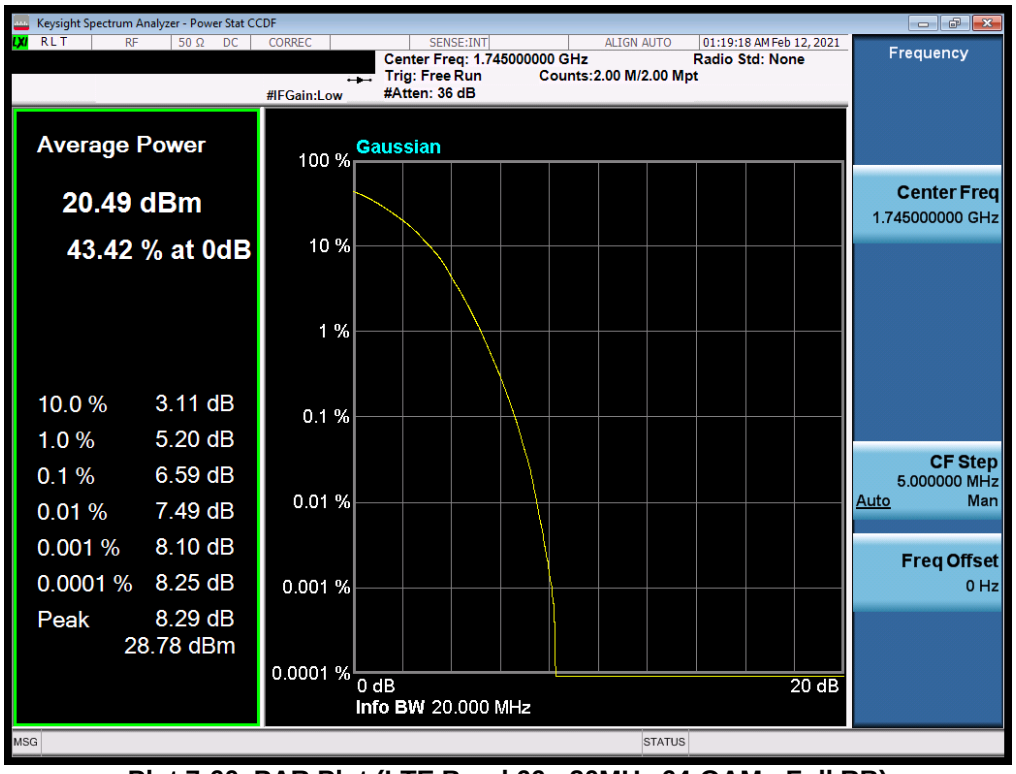
None.



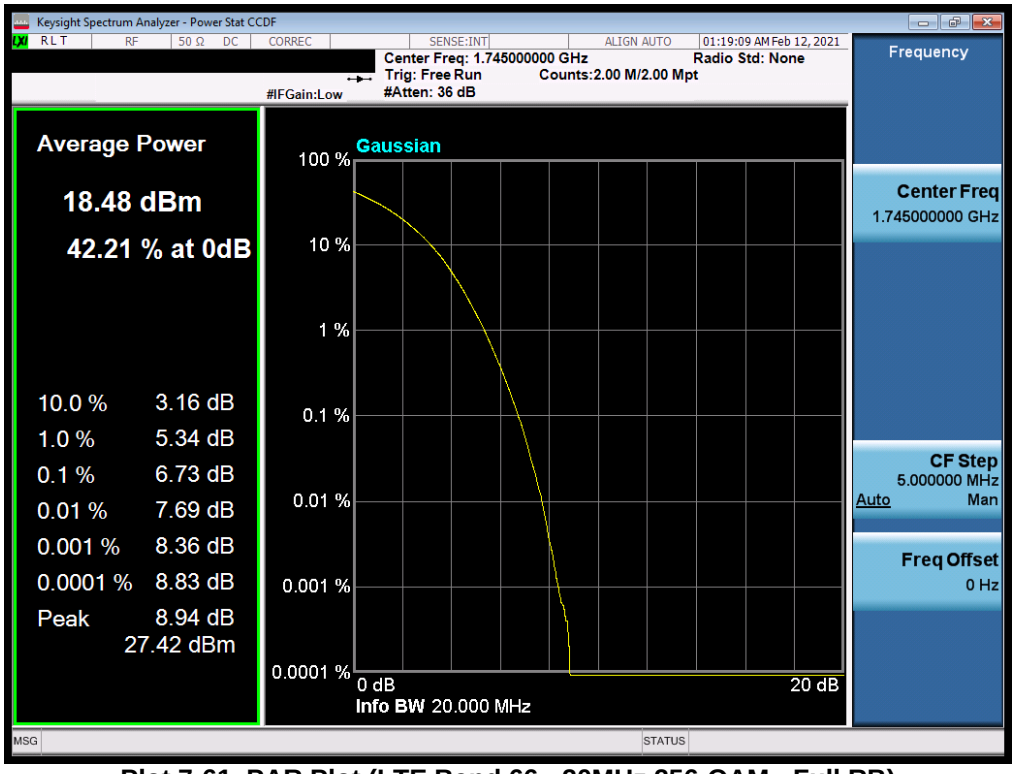
Plot 7-58. PAR Plot (LTE Band 66 - 20MHz QPSK - Full RB)



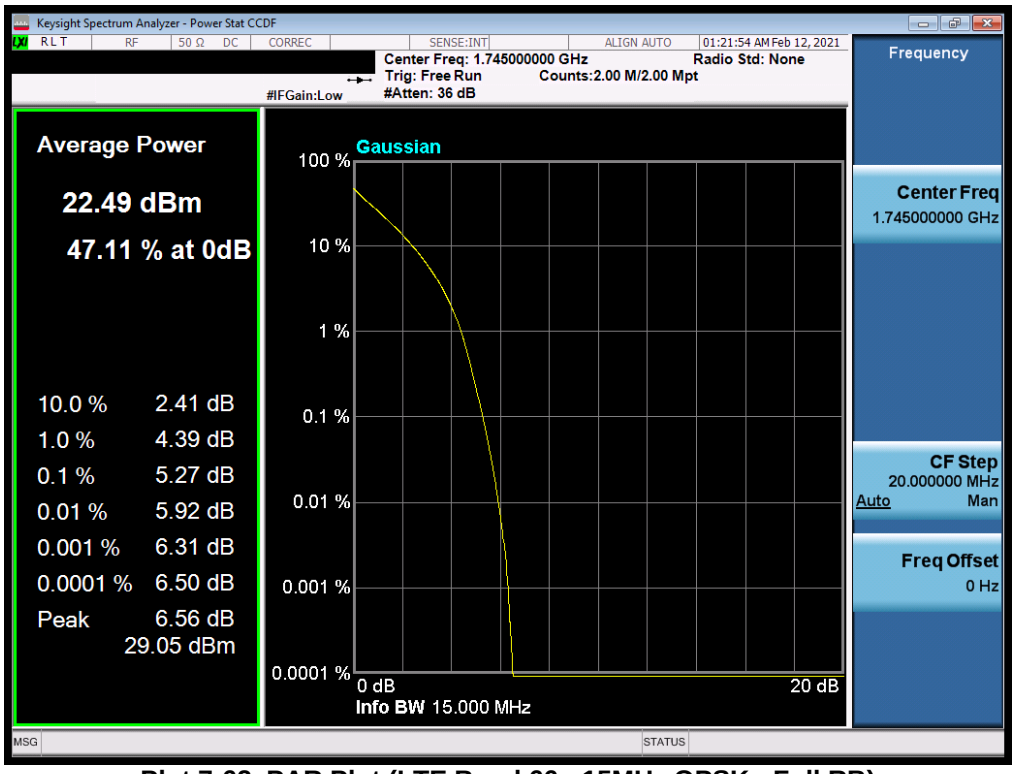
Plot 7-59. PAR Plot (LTE Band 66 - 20MHz 16-QAM - Full RB)



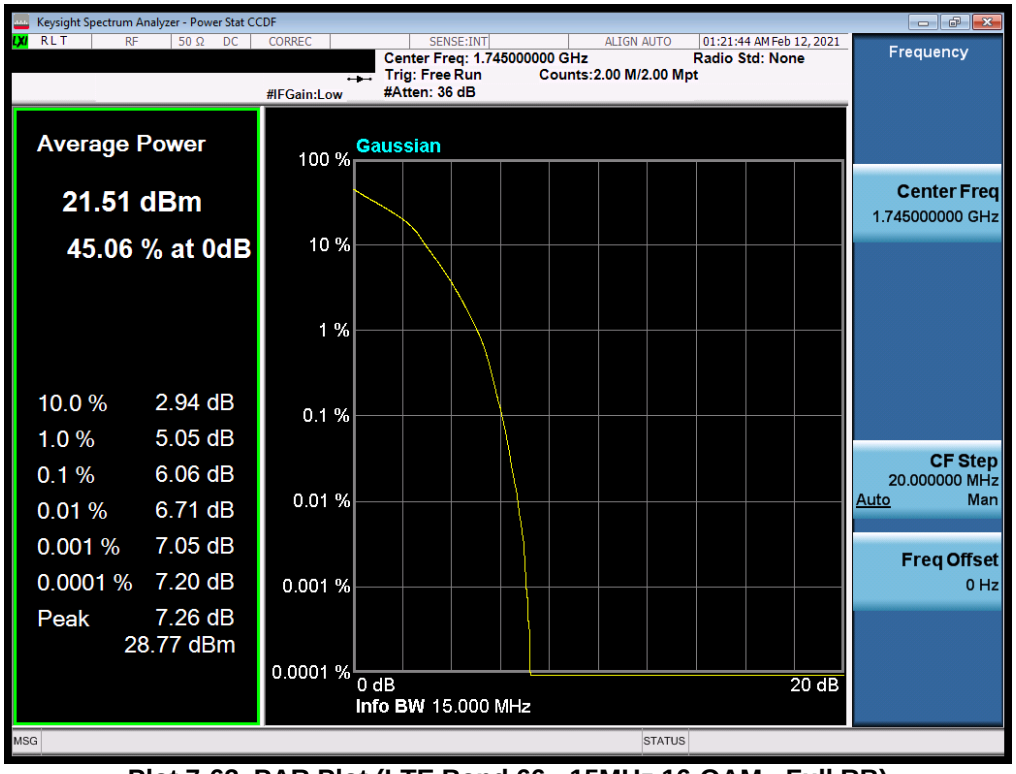
Plot 7-60. PAR Plot (LTE Band 66 - 20MHz 64-QAM - Full RB)



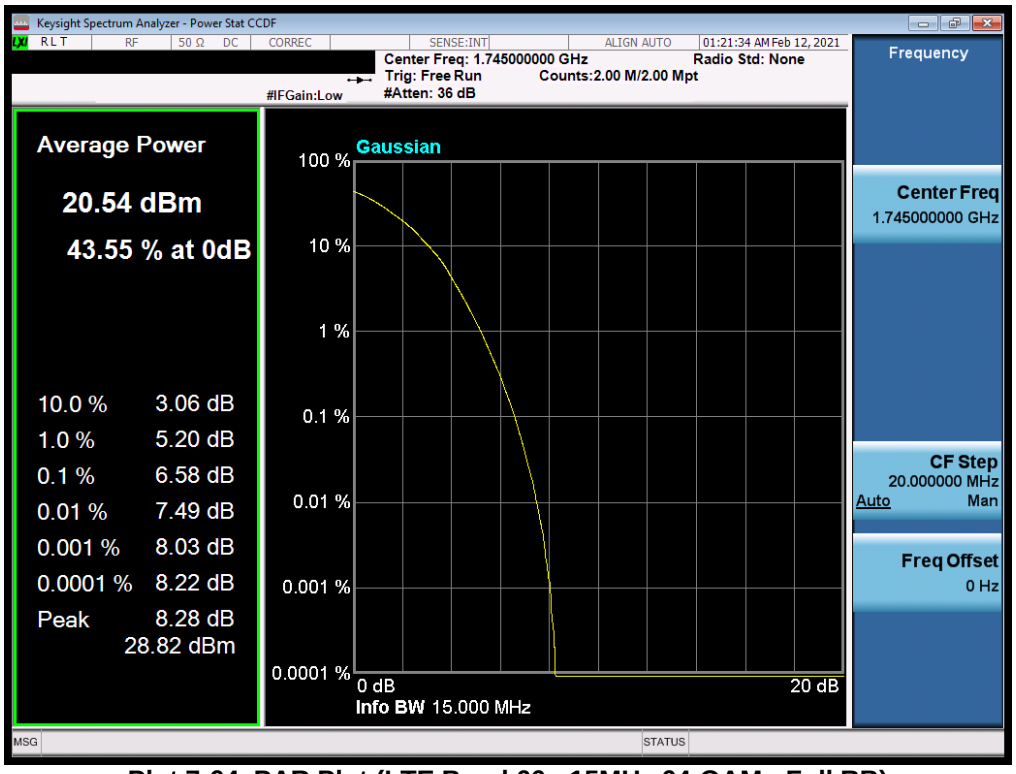
Plot 7-61. PAR Plot (LTE Band 66 - 20MHz 256-QAM - Full RB)



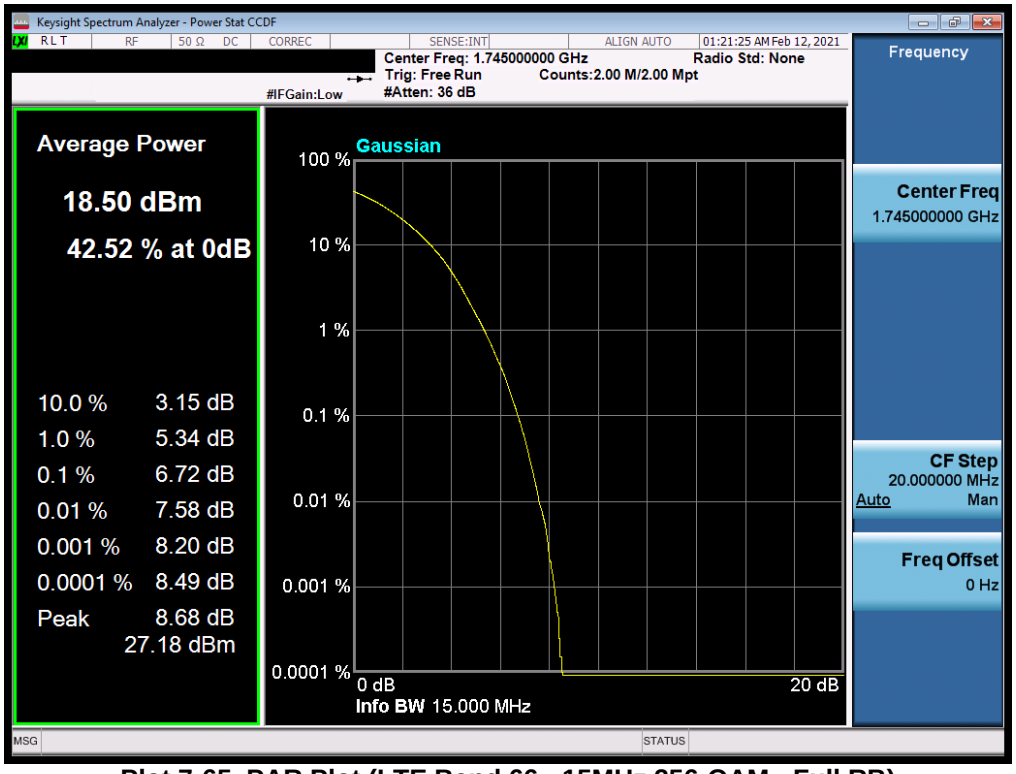
Plot 7-62. PAR Plot (LTE Band 66 - 15MHz QPSK - Full RB)



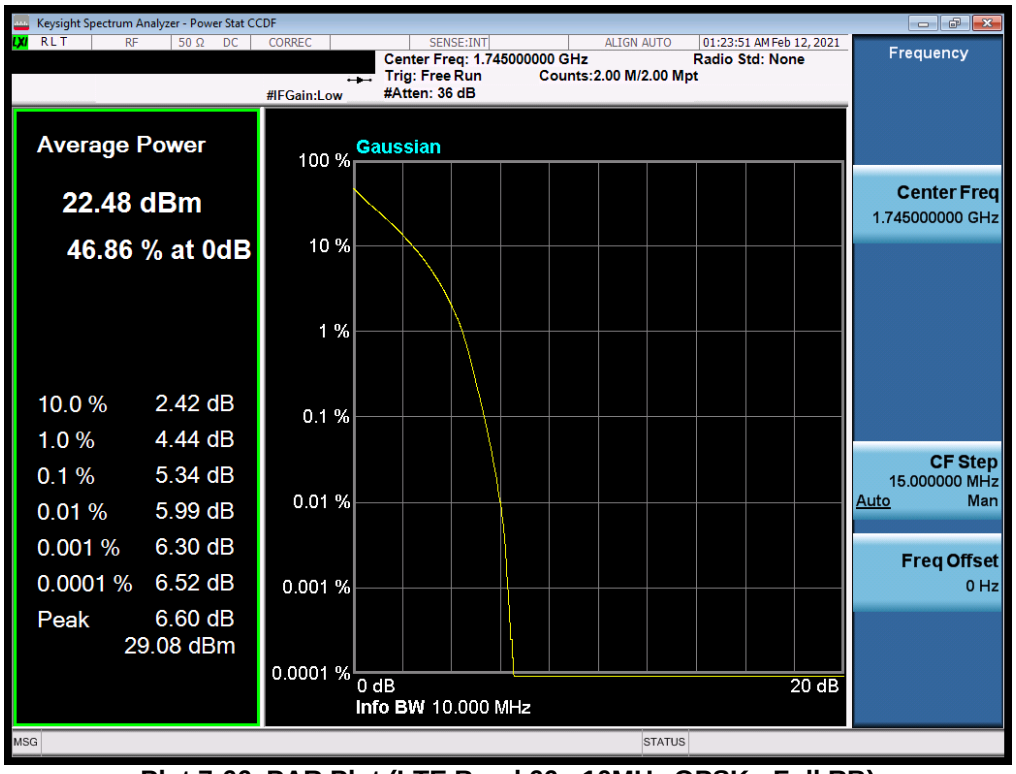
Plot 7-63. PAR Plot (LTE Band 66 - 15MHz 16-QAM - Full RB)



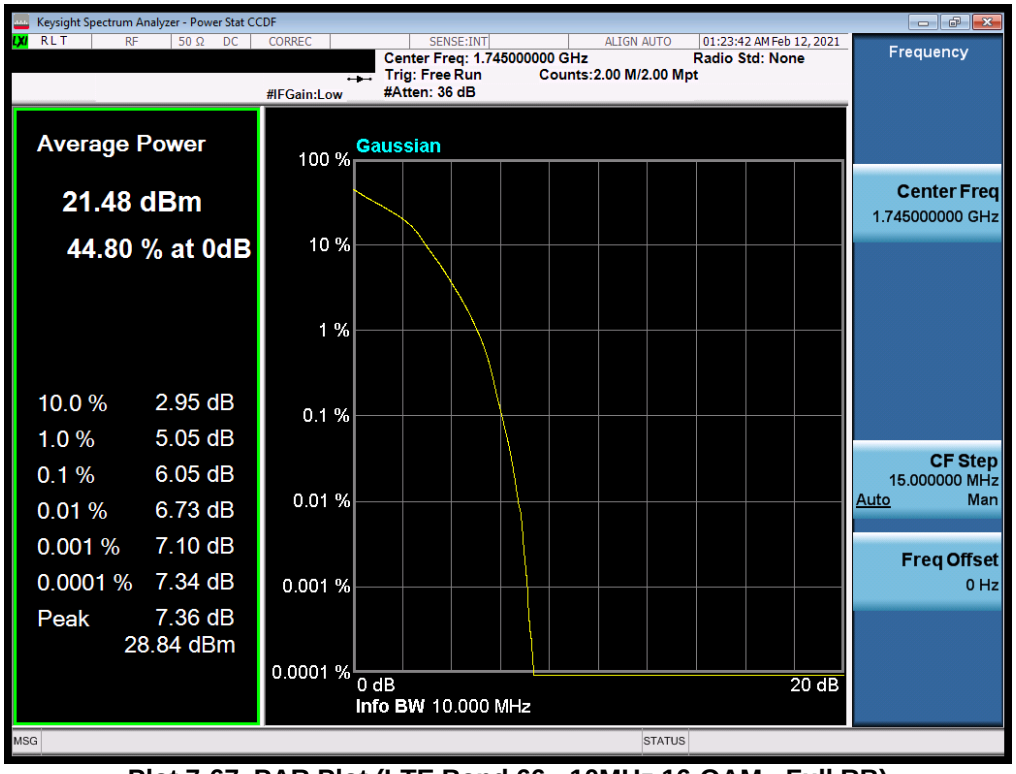
Plot 7-64. PAR Plot (LTE Band 66 - 15MHz 64-QAM - Full RB)



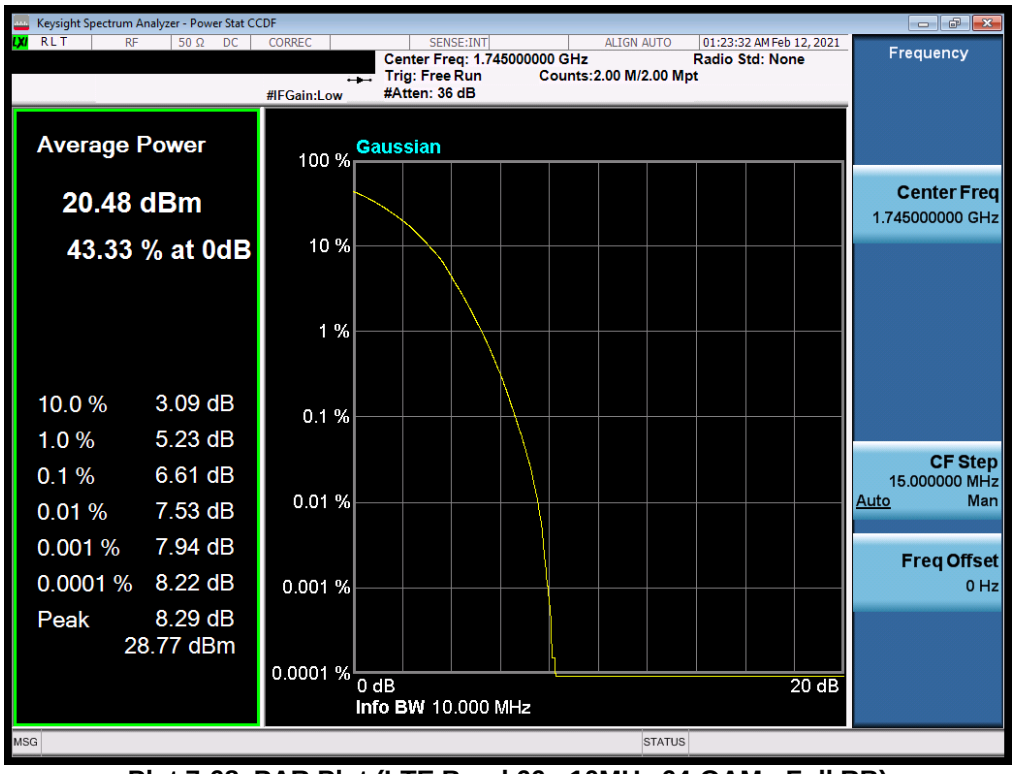
Plot 7-65. PAR Plot (LTE Band 66 - 15MHz 256-QAM - Full RB)



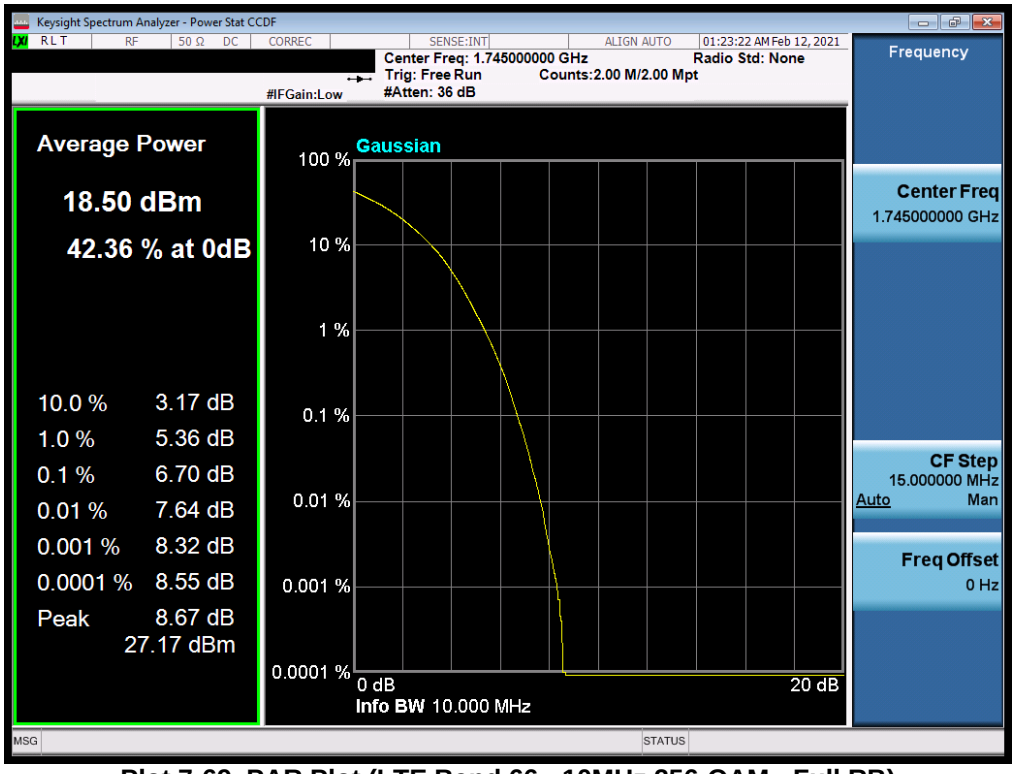
Plot 7-66. PAR Plot (LTE Band 66 - 10MHz QPSK - Full RB)



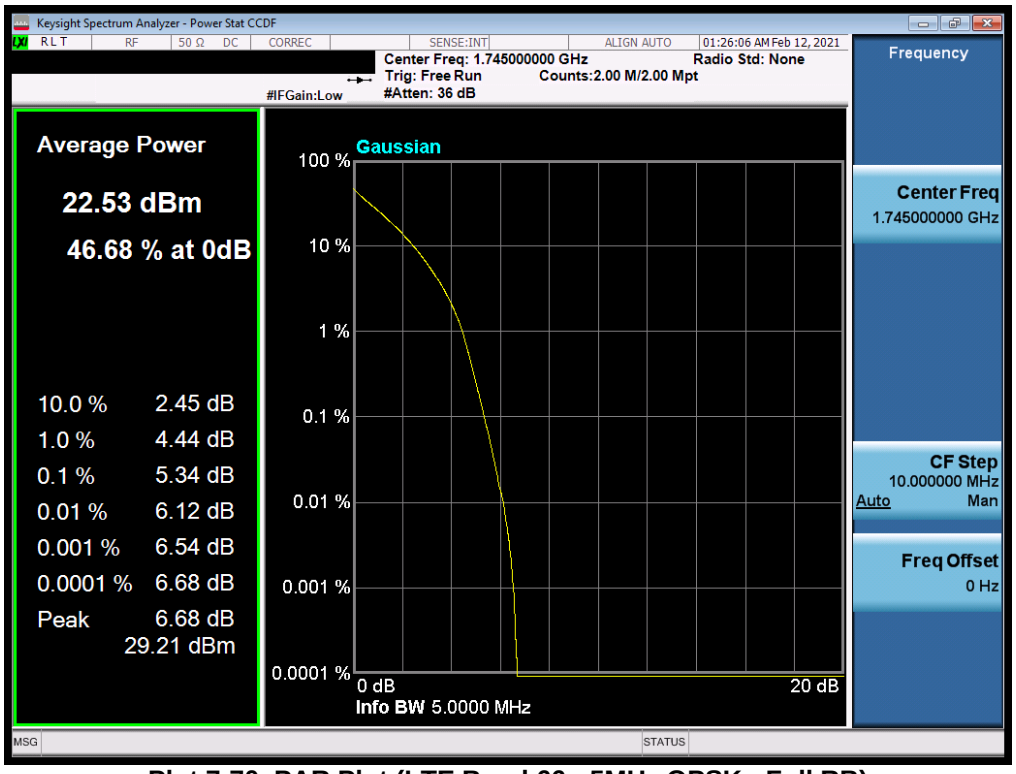
Plot 7-67. PAR Plot (LTE Band 66 - 10MHz 16-QAM - Full RB)



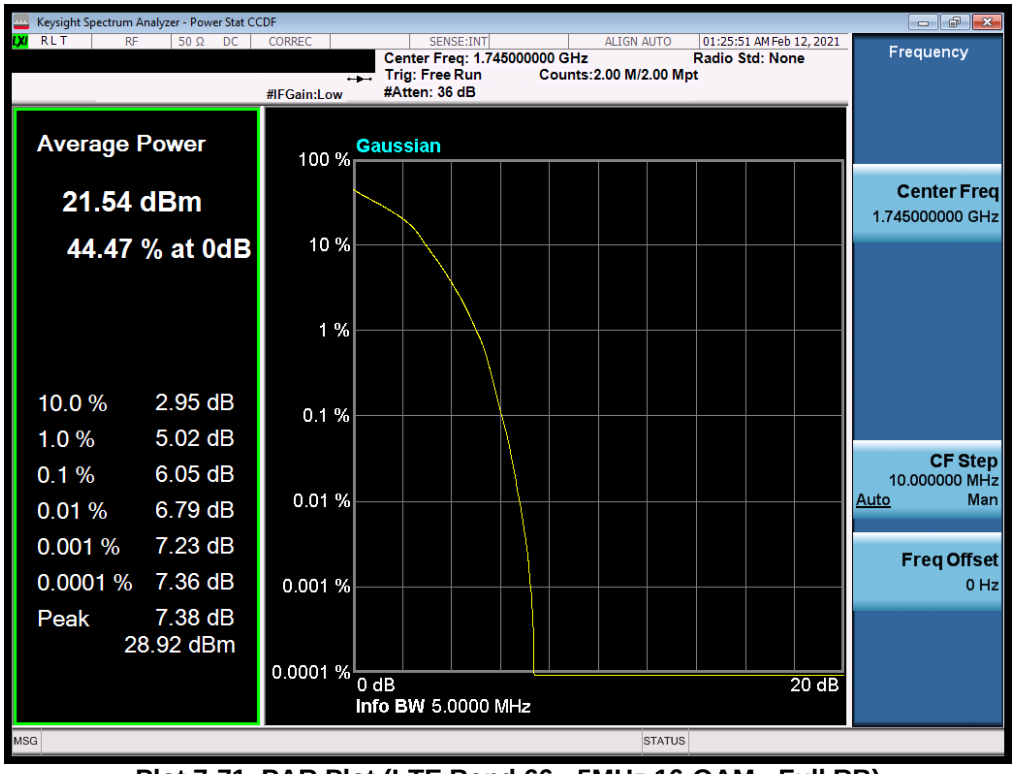
Plot 7-68. PAR Plot (LTE Band 66 - 10MHz 64-QAM - Full RB)



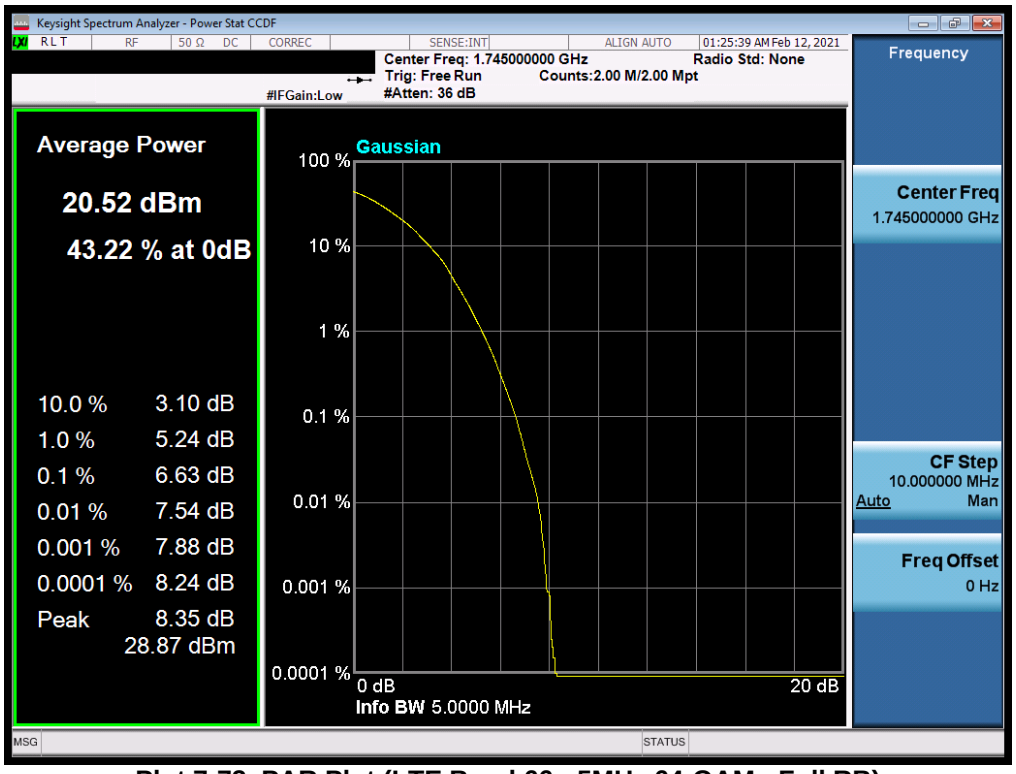
Plot 7-69. PAR Plot (LTE Band 66 - 10MHz 256-QAM - Full RB)



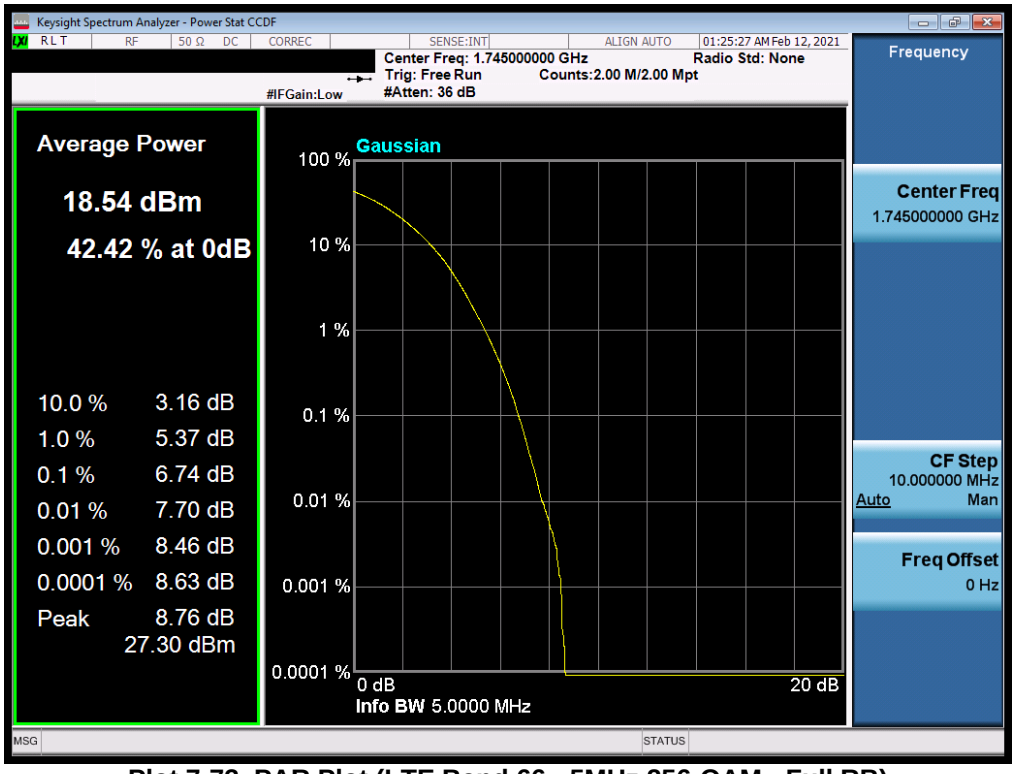
Plot 7-70. PAR Plot (LTE Band 66 - 5MHz QPSK - Full RB)



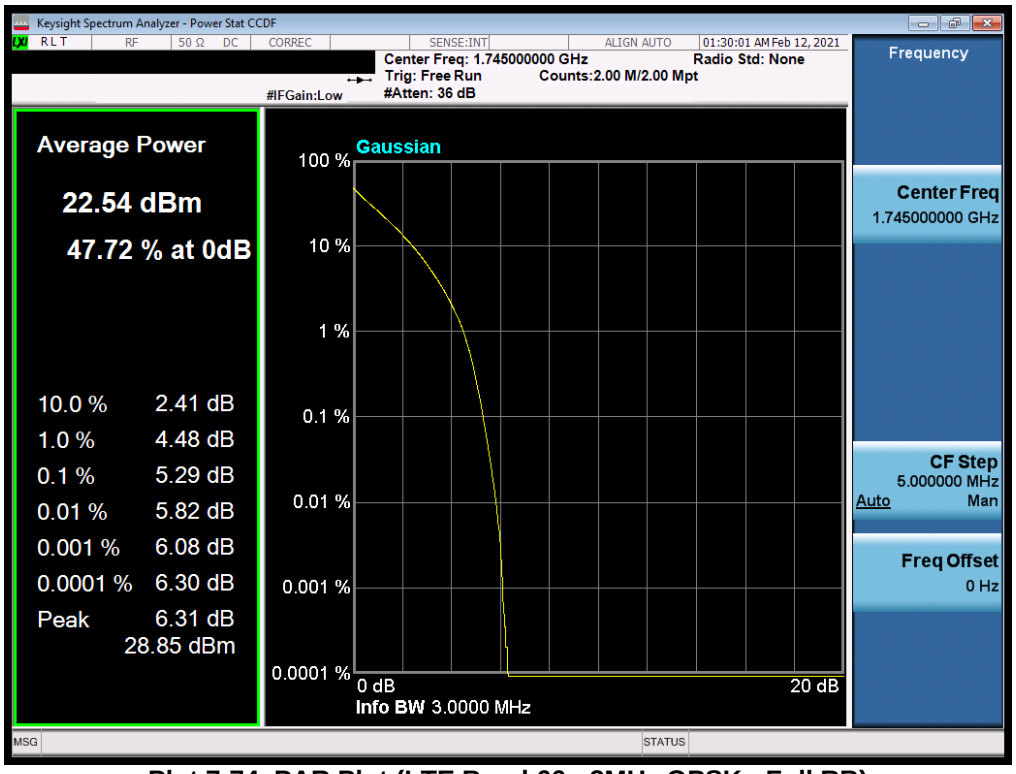
Plot 7-71. PAR Plot (LTE Band 66 - 5MHz 16-QAM - Full RB)



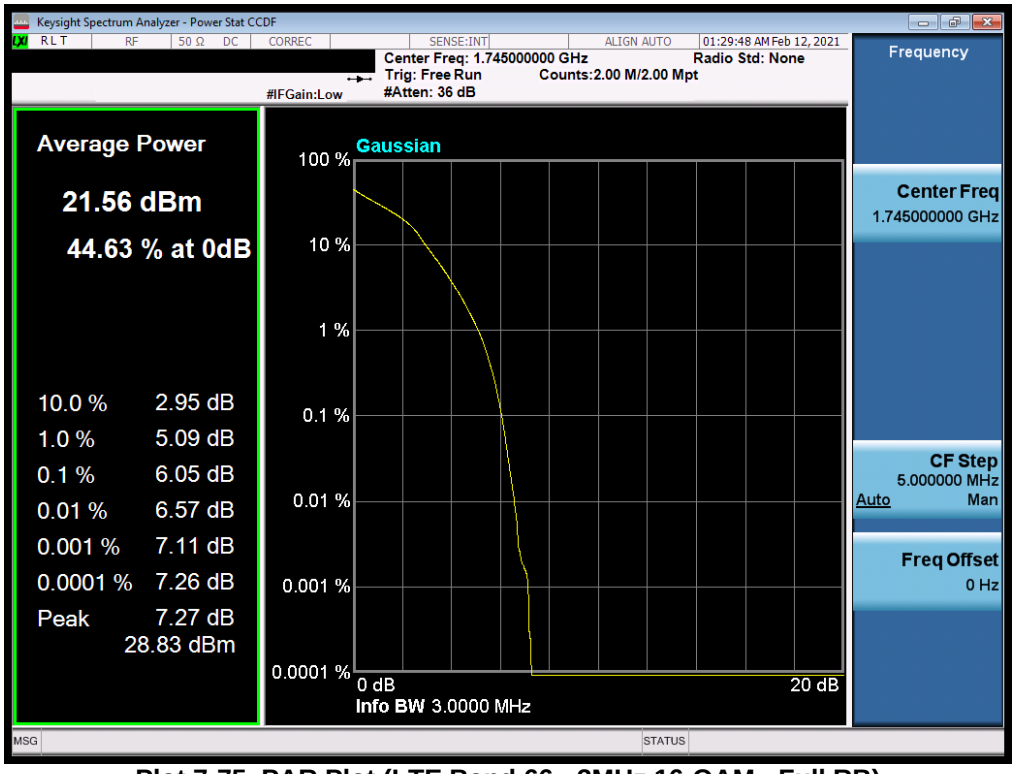
Plot 7-72. PAR Plot (LTE Band 66 - 5MHz 64-QAM - Full RB)



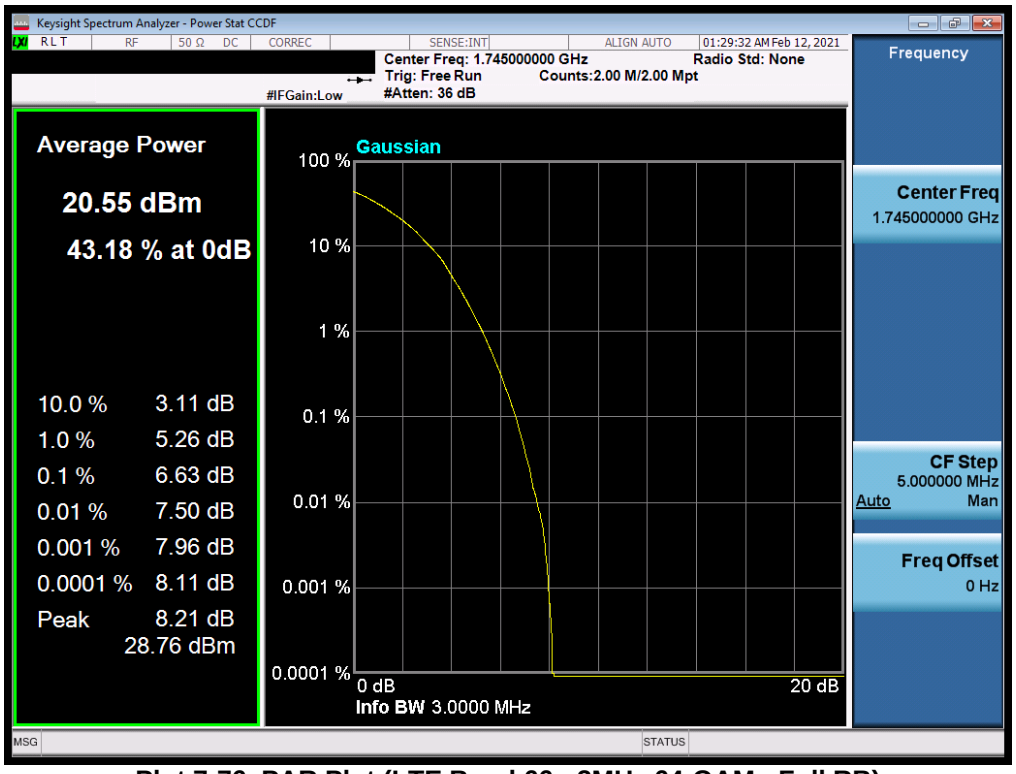
Plot 7-73. PAR Plot (LTE Band 66 - 5MHz 256-QAM - Full RB)



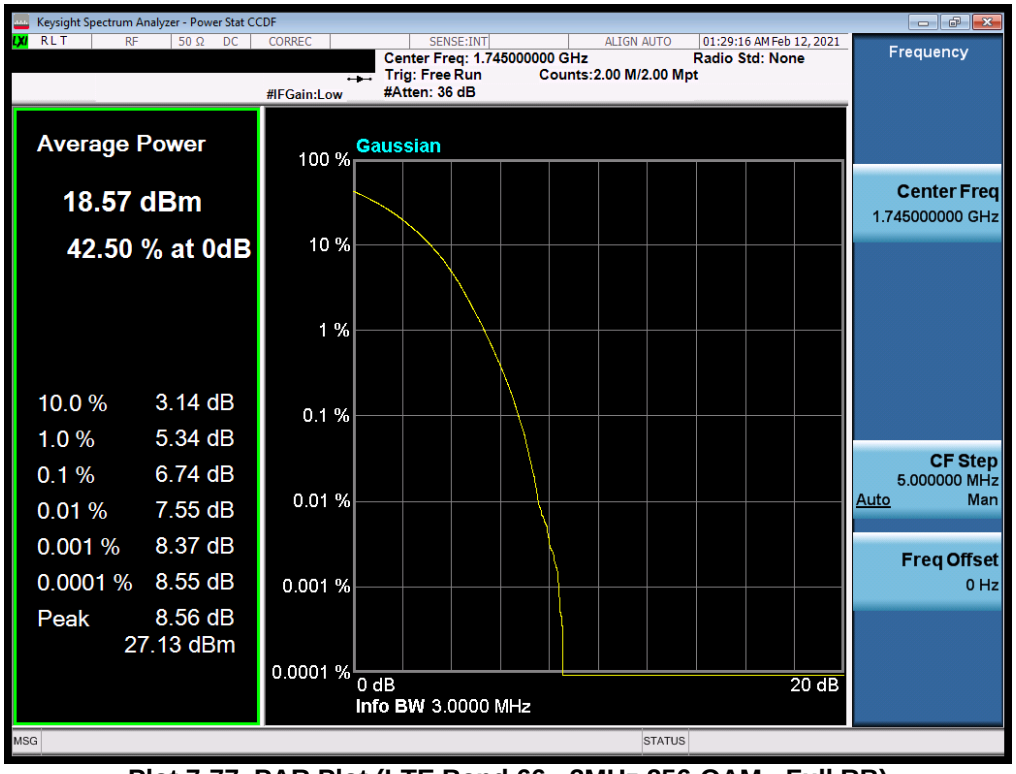
Plot 7-74. PAR Plot (LTE Band 66 - 3MHz QPSK - Full RB)



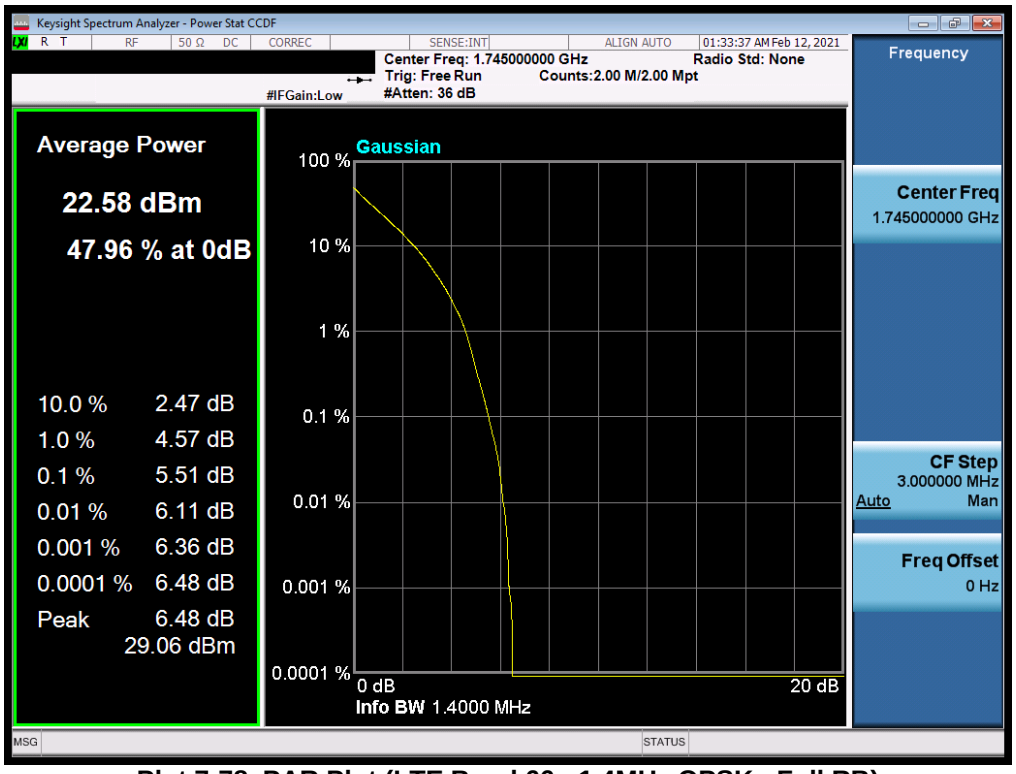
Plot 7-75. PAR Plot (LTE Band 66 - 3MHz 16-QAM - Full RB)



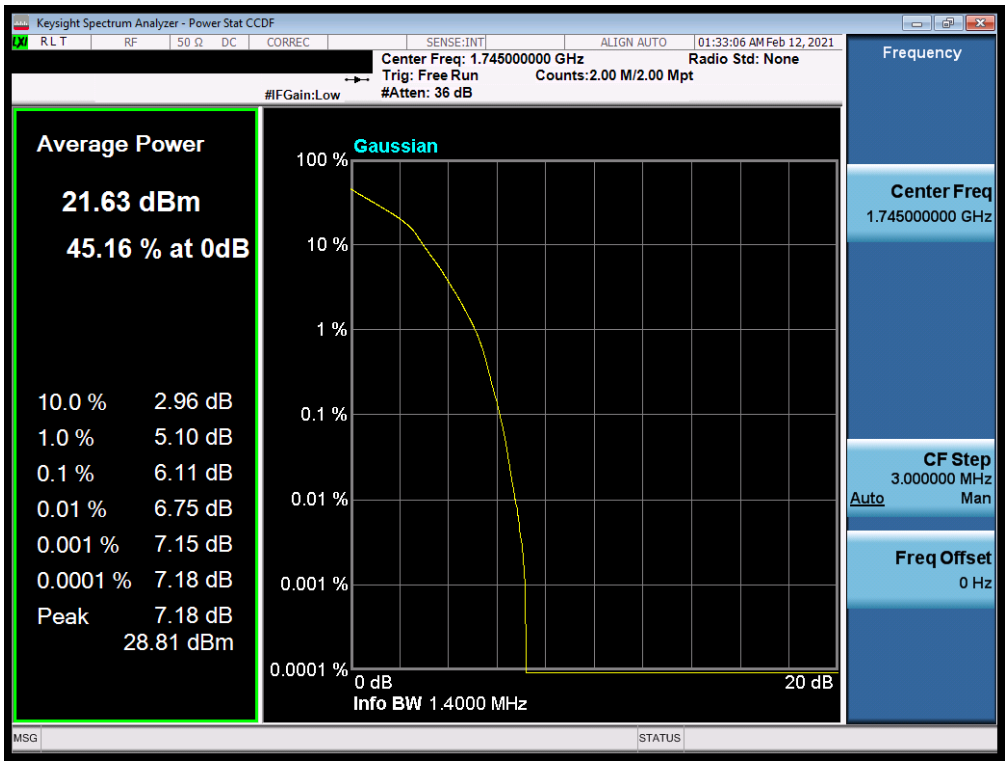
Plot 7-76. PAR Plot (LTE Band 66 - 3MHz 64-QAM - Full RB)



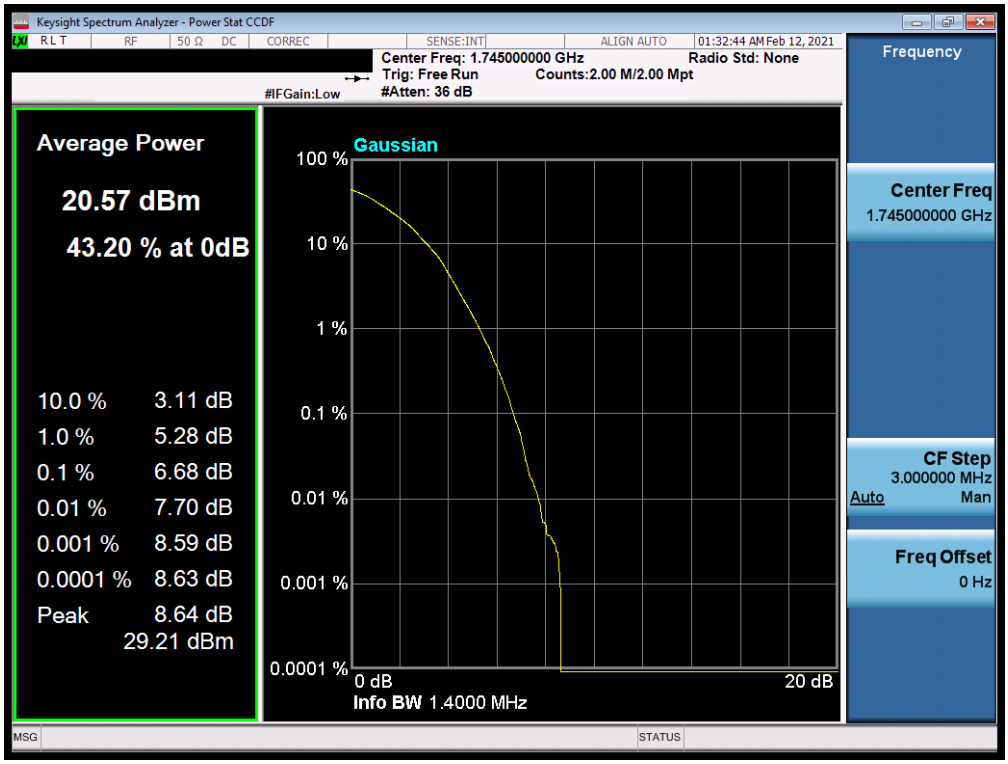
Plot 7-77. PAR Plot (LTE Band 66 - 3MHz 256-QAM - Full RB)



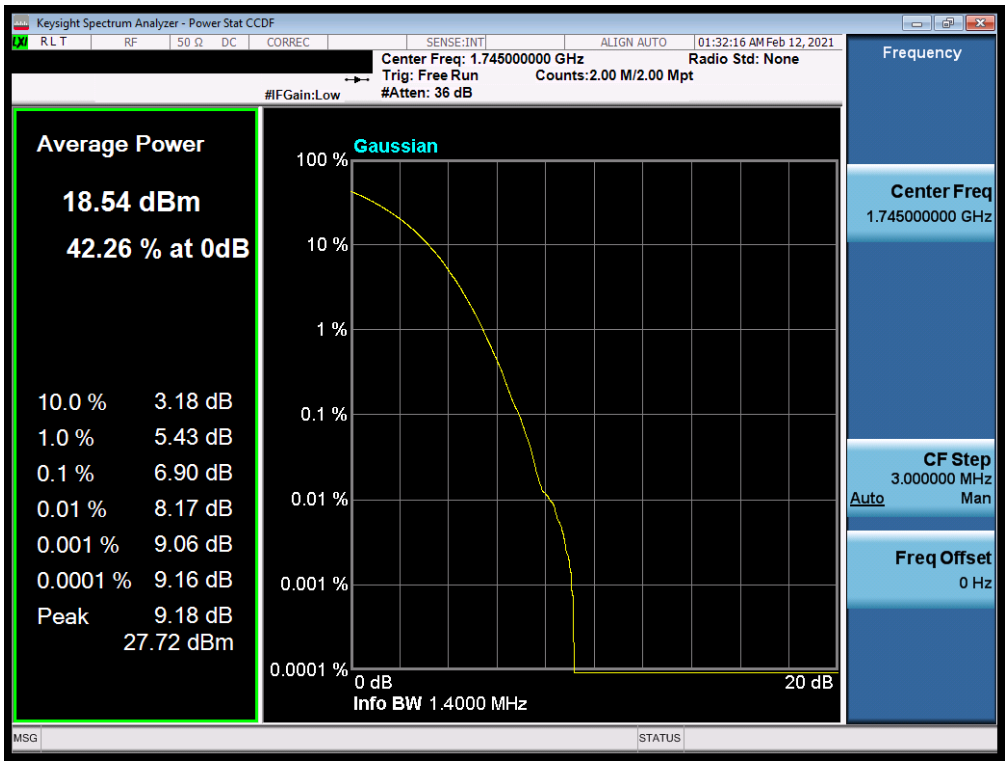
Plot 7-78. PAR Plot (LTE Band 66 - 1.4MHz QPSK - Full RB)



Plot 7-79. PAR Plot (LTE Band 66 - 1.4MHz 16-QAM - Full RB)



Plot 7-80. PAR Plot (LTE Band 66 - 1.4MHz 64-QAM - Full RB)



Plot 7-81. PAR Plot (LTE Band 66 - 1.4MHz 256-QAM - Full RB)

7.7 Radiated Power (ERP/EIRP)

Test Overview

Effective Radiated Power (ERP) and Equivalent Isotropic Radiated Power (EIRP) measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally 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 RMS average measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI/TIA-603-E-2016 – Section 2.2.17

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, 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".
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.

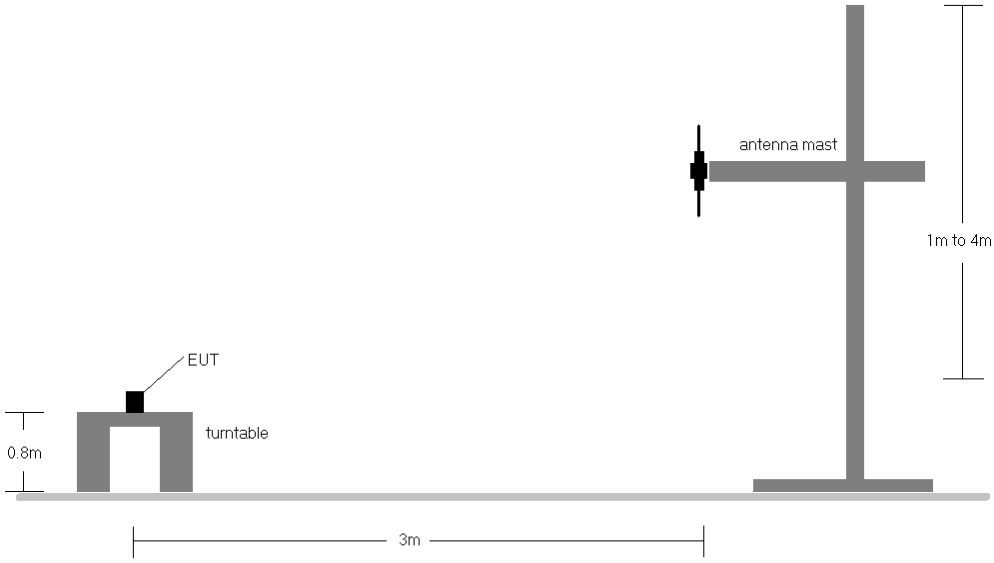


Figure 7-6. Radiated Test Setup <1GHz

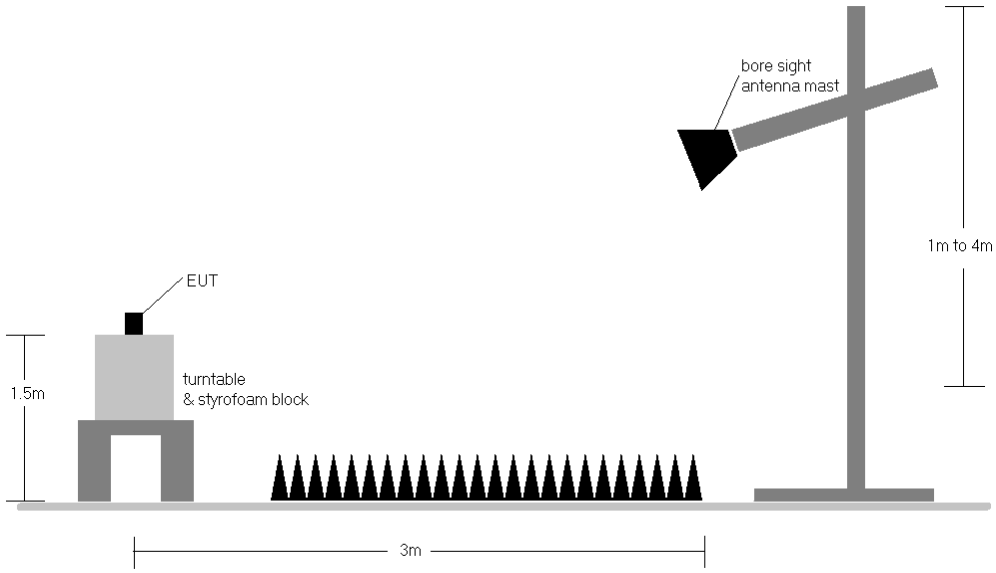


Figure 7-7. Radiated Test Setup >1GHz

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) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.

Bandwidth	Mod.	Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Ant. Gain [dBi]	RB Size/Offset	Substitute Level [dBm]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
20 MHz	QPSK	1720.0	V	129.0	305.0	9.31	1 / 99	9.04	18.35	0.068	30.00	-11.65
		1745.0	V	113.0	300.0	9.14	1 / 50	11.01	**20.15**	0.103	30.00	-9.85
		1770.0	V	149.0	311.0	9.17	1 / 50	10.76	19.93	0.098	30.00	-10.07
	16-QAM	1745.0	V	113.0	300.0	9.14	1 / 50	10.04	19.18	0.083	30.00	-10.82
	64-QAM	1745.0	V	113.0	300.0	9.14	1 / 50	9.20	18.34	0.068	30.00	-11.66
	256-QAM	1770.0	V	149.0	311.0	9.17	1 / 50	5.47	14.64	0.029	30.00	-15.36
15 MHz	QPSK	1717.5	V	129.0	305.0	9.33	1/37	9.27	18.60	0.072	30.00	-11.40
		1745.0	V	113.0	300.0	9.14	1/37	11.11	**20.25**	0.106	30.00	-9.75
		1772.5	V	149.0	311.0	9.18	1/0	10.51	19.69	0.093	30.00	-10.31
	16-QAM	1745.0	V	113.0	300.0	9.14	1/37	9.69	18.83	0.076	30.00	-11.17
	64-QAM	1745.0	V	113.0	300.0	9.14	1/37	8.95	18.09	0.064	30.00	-11.91
	256-QAM	1772.5	V	149.0	311.0	9.18	1/0	5.77	14.95	0.031	30.00	-15.05
10 MHz	QPSK	1715.0	V	129.0	305.0	9.35	1/25	8.96	18.31	0.068	30.00	-11.69
		1745.0	V	113.0	300.0	9.14	1/25	10.94	**20.08**	0.102	30.00	-9.92
		1775.0	V	149.0	311.0	9.18	1/25	10.43	19.62	0.092	30.00	-10.38
	16-QAM	1775.0	V	149.0	311.0	9.18	1/25	9.51	18.70	0.074	30.00	-11.30
	64-QAM	1745.0	V	113.0	300.0	9.14	1/25	8.86	18.00	0.063	30.00	-12.00
	256-QAM	1775.0	V	149.0	311.0	9.18	1/25	5.81	15.00	0.032	30.00	-15.00
5 MHz	QPSK	1712.5	V	129.0	305.0	9.37	1/24	7.53	16.89	0.049	30.00	-13.11
		1745.0	V	113.0	300.0	9.14	1/0	9.06	**18.20**	0.066	30.00	-11.80
		1777.5	V	149.0	311.0	9.19	1/0	8.76	17.95	0.062	30.00	-12.05
	16-QAM	1745.0	V	113.0	300.0	9.14	1/0	8.75	17.89	0.061	30.00	-12.11
	64-QAM	1745.0	V	113.0	300.0	9.14	1/0	8.94	18.08	0.064	30.00	-11.92
	256-QAM	1777.5	V	149.0	311.0	9.19	1/0	5.47	14.66	0.029	30.00	-15.34
3 MHz	QPSK	1711.5	V	129.0	305.0	9.37	1/0	7.50	16.87	0.049	30.00	-13.13
		1745.0	V	113.0	300.0	9.14	1/7	9.05	**18.19**	0.066	30.00	-11.81
		1778.5	V	149.0	311.0	9.20	1/0	8.63	17.83	0.061	30.00	-12.17
	16-QAM	1745.0	V	113.0	300.0	9.14	1/7	8.71	17.85	0.061	30.00	-12.15
	64-QAM	1745.0	V	113.0	300.0	9.14	1/7	8.93	18.07	0.064	30.00	-11.93
	256-QAM	1778.5	V	149.0	311.0	9.20	1/0	5.90	15.10	0.032	30.00	-14.90
1.4 MHz	QPSK	1710.7	V	129.0	305.0	9.38	1/5	9.07	18.45	0.070	30.00	-11.55
		1745.0	V	113.0	300.0	9.14	1/2	10.92	**20.06**	0.101	30.00	-9.94
		1779.3	V	149.0	311.0	9.20	1/0	10.53	19.73	0.094	30.00	-10.27
	16-QAM	1745.0	V	113.0	300.0	9.14	1/2	9.91	19.05	0.080	30.00	-10.95
	64-QAM	1745.0	V	113.0	300.0	9.14	1/2	8.95	18.09	0.064	30.00	-11.91
	256-QAM	1779.3	V	149.0	311.0	9.20	1/0	5.78	14.98	0.031	30.00	-15.02
20 MHz	Opposite Pol.	1745.0	H	106.0	170.0	9.26	1/50	9.90	19.16	0.082	30.00	-10.84

Table 7-3. EIRP Data (LTE Band 66)

7.8 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 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

ANSI/TIA-603-E-2016 – Section 2.2.12

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.

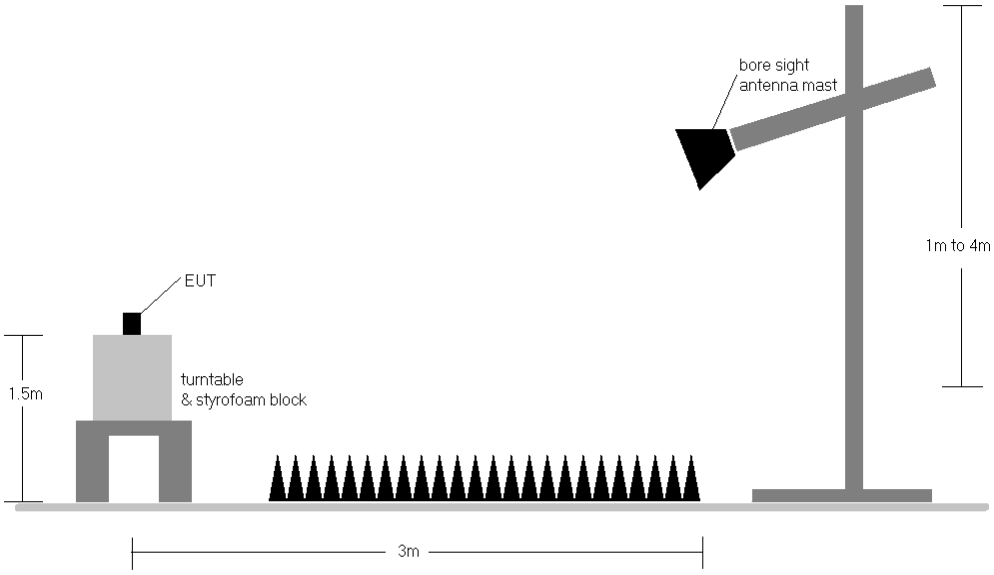


Figure 7-8. Test Instrument & Measurement Setup >1 GHz

Test Notes

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

2) 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.

3) This unit was tested with its standard battery.

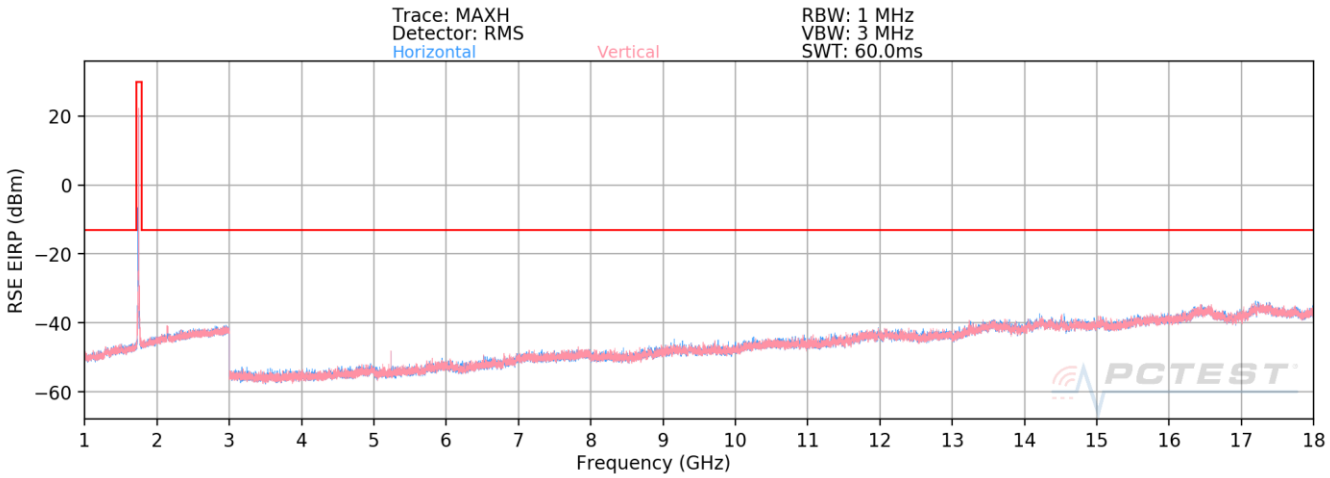
4) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.

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) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

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

LTE Band 66



Plot 7-82. Radiated Spurious Plot (LTE Band 66)

Bandwidth (MHz):	20
Frequency (MHz):	1720.0
RB / Offset:	1 / 50
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

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]
3440.0	H	-	-	-80.24	7.73	34.49	-60.77	-13.00	-47.77
5160.0	H	113	311	-75.85	10.51	41.66	-53.60	-13.00	-40.60
6880.0	H	-	-	-82.73	14.12	38.39	-56.87	-13.00	-43.87
8600.0	H	-	-	-83.94	17.14	40.20	-55.06	-13.00	-42.06
10320.0	H	-	-	-83.71	20.15	43.44	-51.82	-13.00	-38.82

Table 7-4. Radiated Spurious Data (LTE Band 66 – Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1745.0
RB / Offset:	1 / 50
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

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]
3490.0	H	-	-	-80.59	7.58	33.99	-61.27	-13.00	-48.27
5235.0	H	137	303	-75.03	10.31	42.28	-52.98	-13.00	-39.98
6980.0	H	-	-	-82.52	14.68	39.16	-56.10	-13.00	-43.10
8725.0	H	-	-	-83.51	17.57	41.06	-54.20	-13.00	-41.20
10470.0	H	-	-	-83.98	20.53	43.55	-51.71	-13.00	-38.71

Table 7-5. Radiated Spurious Data (LTE Band 66 – Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1770.0
RB / Offset:	1 / 50
Detector / Trace Mode:	RMS / Average
RBW / VBW:	1MHz / 3MHz

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]
3540.00	H	-	-	-80.46	7.91	34.45	-60.81	-13.00	-47.81
5310.00	H	135	353	-75.34	11.13	42.79	-52.47	-13.00	-39.47
7080.00	H	-	-	-82.87	15.03	39.16	-56.10	-13.00	-43.10
8850.00	H	-	-	-83.69	17.07	40.38	-54.88	-13.00	-41.88
10620.00	H	-	-	-83.86	20.35	43.49	-51.77	-13.00	-38.77

Table 7-6. Radiated Spurious Data (LTE Band 66 – High Channel)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMG998U** complies with all the requirements of Part 27 of the FCC rules.