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PART 27 MEASUREMENT REPORT

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

Date of Testing:
9/8/2023 - 11/2/2023
Test Report Issue Date:
11/8/2023
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2309070105-03.A3L

FCC ID:	A3LSMA156E
APPLICANT:	Samsung Electronics Co., Ltd.

Application Type:	Certification
Model:	SM-A156E/DS
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part:	27
Test Procedure(s):	ANSI C63.26-2015

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

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

RJ Ortanez
Executive Vice President



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FCC Part 27

Antenna-1								
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	ERP		EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
LTE Band 12/17	10 MHz	QPSK	704.0 - 711.0	0.066	18.22	0.109	20.37	8M98G7D
		16QAM	704.0 - 711.0	0.053	17.23	0.087	19.38	8M95W7D
	5 MHz	QPSK	701.5 - 713.5	0.067	18.25	0.110	20.40	4M51G7D
		16QAM	701.5 - 713.5	0.053	17.23	0.087	19.38	4M51W7D
	3 MHz	QPSK	700.5 - 714.5	0.068	18.30	0.111	20.45	2M70G7D
		16QAM	700.5 - 714.5	0.054	17.32	0.088	19.47	2M70W7D
	1.4 MHz	QPSK	699.7 - 715.3	0.067	18.26	0.110	20.41	1M10G7D
		16QAM	699.7 - 715.3	0.053	17.26	0.087	19.41	1M11W7D

Overview Table (<1GHz Bands)

Antenna-1						
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
WCDMA1700	N/A	Spread Spectrum	1712.4 - 1752.6	0.141	21.50	4M19F9W
LTE Band 66/4	20 MHz	QPSK	1720.0 - 1770.0	0.323	25.09	17M9G7D
		16QAM	1720.0 - 1770.0	0.252	24.01	17M9W7D
	15 MHz	QPSK	1717.5 - 1772.5	0.322	25.08	13M5G7D
		16QAM	1717.5 - 1772.5	0.241	23.82	13M5W7D
	10 MHz	QPSK	1715.0 - 1775.0	0.324	25.11	9M03G7D
		16QAM	1715.0 - 1775.0	0.244	23.88	8M97W7D
	5 MHz	QPSK	1712.5 - 1777.5	0.319	25.04	4M51G7D
		16QAM	1712.5 - 1777.5	0.235	23.71	4M50W7D
	3 MHz	QPSK	1711.5 - 1778.5	0.335	25.25	2M70G7D
		16QAM	1711.5 - 1778.5	0.240	23.81	2M71W7D
1.4 MHz	QPSK	1710.7 - 1779.3	0.310	24.91	1M10G7D	
	16QAM	1710.7 - 1779.3	0.232	23.65	1M10W7D	
NR Band n66	40 MHz	$\pi/2$ BPSK	1730.0 - 1760.0	0.159	22.02	38M6G7D
		QPSK	1730.0 - 1760.0	0.156	21.94	38M6G7D
		16QAM	1730.0 - 1760.0	0.129	21.10	38M6W7D
	30 MHz	$\pi/2$ BPSK	1725.0 - 1765.0	0.162	22.08	28M6G7D
		QPSK	1725.0 - 1765.0	0.156	21.92	28M6G7D
		16QAM	1725.0 - 1765.0	0.123	20.89	28M6W7D
	20 MHz	$\pi/2$ BPSK	1720.0 - 1770.0	0.152	21.82	18M0G7D
		QPSK	1720.0 - 1770.0	0.150	21.75	19M0G7D
		16QAM	1720.0 - 1770.0	0.133	21.24	19M0W7D
	15 MHz	$\pi/2$ BPSK	1717.5 - 1772.5	0.148	21.70	13M5G7D
		QPSK	1717.5 - 1772.5	0.153	21.85	14M2G7D
		16QAM	1717.5 - 1772.5	0.120	20.79	14M2W7D
	10 MHz	$\pi/2$ BPSK	1715.0 - 1775.0	0.152	21.83	9M02G7D
		QPSK	1715.0 - 1775.0	0.153	21.86	9M34G7D
		16QAM	1715.0 - 1775.0	0.118	20.70	9M34W7D
	5 MHz	$\pi/2$ BPSK	1712.5 - 1777.5	0.170	22.30	4M49G7D
		QPSK	1712.5 - 1777.5	0.163	22.12	4M50G7D
		16QAM	1712.5 - 1777.5	0.136	21.33	4M51W7D

Overview Table (>1GHz Bands)

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Antenna-2						
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 4	20 MHz	QPSK	1720.0 - 1745.0	0.123	20.91	18M0G7D
		16QAM	1720.0 - 1745.0	0.097	19.88	18M0W7D
	15 MHz	QPSK	1717.5 - 1747.5	0.124	20.94	13M4G7D
		16QAM	1717.5 - 1747.5	0.102	20.10	13M5W7D
	10 MHz	QPSK	1715.0 - 1750.0	0.125	20.98	9M01G7D
		16QAM	1715.0 - 1750.0	0.100	20.00	8M98W7D
	5 MHz	QPSK	1712.5 - 1752.5	0.122	20.86	4M52G7D
		16QAM	1712.5 - 1752.5	0.095	19.78	4M51W7D
	3 MHz	QPSK	1711.5 - 1753.5	0.119	20.75	2M70G7D
		16QAM	1711.5 - 1753.5	0.095	19.77	2M70W7D
	1.4 MHz	QPSK	1710.7 - 1754.3	0.116	20.64	1M10G7D
		16QAM	1710.7 - 1754.3	0.091	19.59	1M10W7D
NR Band n66	40 MHz	$\pi/2$ BPSK	1730.0 - 1760.0	0.107	20.31	38M7G7D
		QPSK	1730.0 - 1760.0	0.105	20.22	38M8G7D
		16QAM	1730.0 - 1760.0	0.086	19.36	38M8W7D
	30 MHz	$\pi/2$ BPSK	1725.0 - 1765.0	0.105	20.23	28M7G7D
		QPSK	1725.0 - 1765.0	0.103	20.12	28M7G7D
		16QAM	1725.0 - 1765.0	0.094	19.73	28M7W7D
	20 MHz	$\pi/2$ BPSK	1720.0 - 1770.0	0.104	20.15	23M0G7D
		QPSK	1720.0 - 1770.0	0.102	20.08	23M9G7D
		16QAM	1720.0 - 1770.0	0.088	19.44	23M9W7D
	15 MHz	$\pi/2$ BPSK	1717.5 - 1772.5	0.104	20.17	18M0G7D
		QPSK	1717.5 - 1772.5	0.105	20.21	19M0G7D
		16QAM	1717.5 - 1772.5	0.088	19.45	19M0W7D
	10 MHz	$\pi/2$ BPSK	1715.0 - 1775.0	0.102	20.10	13M5G7D
		QPSK	1715.0 - 1775.0	0.110	20.42	14M2G7D
		16QAM	1715.0 - 1775.0	0.088	19.44	14M2W7D
	5 MHz	$\pi/2$ BPSK	1712.5 - 1777.5	0.102	20.11	9M05G7D
		QPSK	1712.5 - 1777.5	0.107	20.28	9M37G7D
		16QAM	1712.5 - 1777.5	0.092	19.65	9M32W7D

Overview Table (>1GHz Bands)

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1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Test Location

These measurement tests were conducted at the Element laboratory 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 Element lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 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.
- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.
- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMA156E**. 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.: 1932M, 1958M, 0441M, 0432M, 0421M

2.2 Device Capabilities

This device contains the following capabilities:

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

Band	Ant1	Ant2
WCDMA AWS	Ant B	N/A
LTE B12/17	Ant A	N/A
LTE B66/4	Ant B	N/A
LTE B4	N/A	Ant C
NR n66	Ant B	Ant C

Table 2-1. Antenna Naming Convention

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.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version A156EDXU0AWI4 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.

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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 $P_g [dBm] - \text{cable loss} [dB]$.

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

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

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

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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 (\pm dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	AP2-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-001
-	AP2-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-002
-	ETS-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	ETS-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-002
-	LTX4	Licensed Transmitter Cable Set	1/12/2023	Annual	1/12/2024	LTX4
-	LTX5	Licensed Transmitter Cable Set	1/12/2023	Annual	1/12/2024	LTX5
Anritsu	MT8821C	Radio Communication Analyzer	N/A			620152694
Com-Power	AL-130R	9kHz - 30MHz Loop Antenna	1/18/2022	Biennial	1/19/2024	121085
EMCO	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9704-5182
EMCO	3116	Horn Antenna (18-40GHz)	7/5/2023	Biennial	7/5/2025	9203-2178
Keysight Technologies	N9030A	PXA Signal Analyzer (3Hz-26.5GHz)	8/7/2023	Annual	8/7/2024	MYS4490576
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	3/15/2023	Annual	3/15/2024	MYS2350166
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			112347
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Test Antenna	9/28/2022	Biennial	9/28/2024	101058
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	9/25/2023	Annual	9/25/2024	100342
Rohde & Schwarz	ESW44	EMI Test Receiver (2Hz-44GHz)	3/1/2023	Annual	3/1/2024	101716
Rohde & Schwarz	VULB9162	Bi-Log Antenna	2/21/2023	Biennial	2/21/2025	00301
Sunol	DRH-118	Horn Antenna (1-18GHz)	2/14/2022	Biennial	2/14/2024	A050307
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	8/30/2022	Biennial	8/30/2024	A051107

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.
2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

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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 analyzer. 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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.
 FCC ID: A3LSMA156E
 FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
 Mode(s): WCDMA/LTE/NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power*	2.1046(a), 2.1046(c)	N/A	PASS	See RF Exposure Report
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (LTE Band 12, 17)	2.1051, 27.53(g)	$\geq 43 + 10 \log (P[\text{Watts}])$ dB of attenuation below transmitter power	PASS	Sections 7.4, 7.5
	Conducted Band Edge / Spurious Emissions (WCDMA AWS; LTE Band 4, 66; NR Band n66)	2.1051, 27.53(h)	$\geq 43 + 10 \log (P[\text{Watts}])$ dB of attenuation below transmitter power	PASS	Sections 7.4, 7.5
	Peak-to-Average Ratio (WCDMA AWS; LTE Band 4, 66; NR Band n66)	27.50(d)(5)	≤ 13 dB	PASS	Section 7.6
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block	PASS	Section 7.9
RADIATED	Effective Radiated Power (LTE Band 12, 17)	27.50(c)(10)	≤ 3 Watts max. ERP	PASS	Section 7.7
	Equivalent Isotropic Radiated Power (WCDMA AWS; LTE Band 4, 66; NR Band n66)	27.50(d)(4)	≤ 1 Watt max. EIRP	PASS	Section 7.7
	Radiated Spurious Emissions (LTE Band 12, 17)	2.1053, 27.53(g)	$\geq 43 + 10 \log (P[\text{Watts}])$ dB of attenuation below transmitter power	PASS	Section 7.8
	Radiated Spurious Emissions (WCDMA AWS; LTE Band 4, 66; NR Band n66)	2.1053, 27.53(h)(1)	$\geq 43 + 10 \log (P[\text{Watts}])$ dB of attenuation below transmitter power	PASS	Section 7.8

* 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 (FCC)

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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 v1.2.2.

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7.2 Occupied Bandwidth

Test Overview

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

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

Test Setup

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

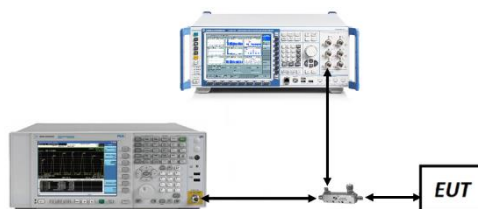


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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Mode	Bandwidth	Modulation	OBW [MHz]	
WCDMA-AWS	5 MHz	Spread Spectrum	4.19	
LTE-B66/4	20 MHz	QPSK	17.92	
		16QAM	17.94	
	15 MHz	QPSK	13.48	
		16QAM	13.52	
	10 MHz	QPSK	9.03	
		16QAM	8.97	
	5 MHz	QPSK	4.51	
		16QAM	4.50	
	3 MHz	QPSK	2.70	
		16QAM	2.71	
	1.4 MHz	QPSK	1.10	
		16QAM	1.10	
	LTE-B12/17	10 MHz	QPSK	8.98
			16QAM	8.95
5 MHz		16QAM	4.51	
		QPSK	2.70	
3 MHz		16QAM	2.70	
		QPSK	1.10	
1.4 MHz	16QAM	1.11		
	NR-n66	40MHz	BPSK	38.62
QPSK			38.62	
16QAM			38.56	
30MHz		BPSK	28.65	
		QPSK	28.64	
		16QAM	28.61	
25MHz		BPSK	23.04	
		QPSK	23.83	
		16QAM	23.84	
20MHz		BPSK	17.99	
		QPSK	19.01	
		16QAM	19.01	
15MHz		BPSK	13.49	
		QPSK	14.19	
		16QAM	14.21	
10MHz		BPSK	9.02	
		QPSK	9.34	
		16QAM	9.34	
5MHz	BPSK	4.49		
	QPSK	4.50		
	16QAM	4.51		

Table 7-2. Summary of Occupied Bandwidth Test Results – Ant1

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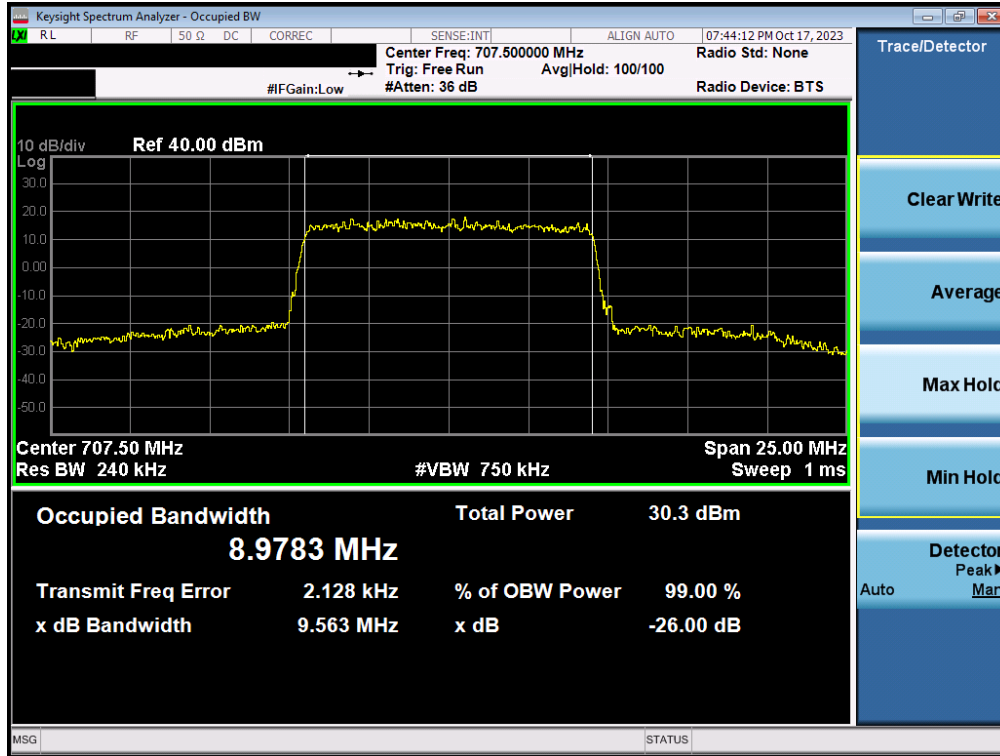


Mode	Bandwidth	Modulation	OBW [MHz]
LTE-B4	20 MHz	QPSK	17.98
		16QAM	17.98
	15 MHz	QPSK	13.43
		16QAM	13.51
	10 MHz	QPSK	9.01
		16QAM	8.98
	5 MHz	QPSK	4.52
		16QAM	4.51
	3 MHz	QPSK	2.70
		16QAM	2.70
	1.4 MHz	QPSK	1.10
		16QAM	1.10
NR-n66	40MHz	BPSK	38.72
		QPSK	38.79
		16QAM	38.78
	30MHz	BPSK	28.67
		QPSK	28.67
		16QAM	28.67
	25MHz	BPSK	22.96
		QPSK	23.86
		16QAM	23.88
	20MHz	BPSK	17.95
		QPSK	19.03
		16QAM	18.98
	15MHz	BPSK	13.49
		QPSK	14.16
		16QAM	14.23
	10MHz	BPSK	9.05
		QPSK	9.37
		16QAM	9.32
5MHz	BPSK	4.48	
	QPSK	4.50	
	16QAM	4.51	

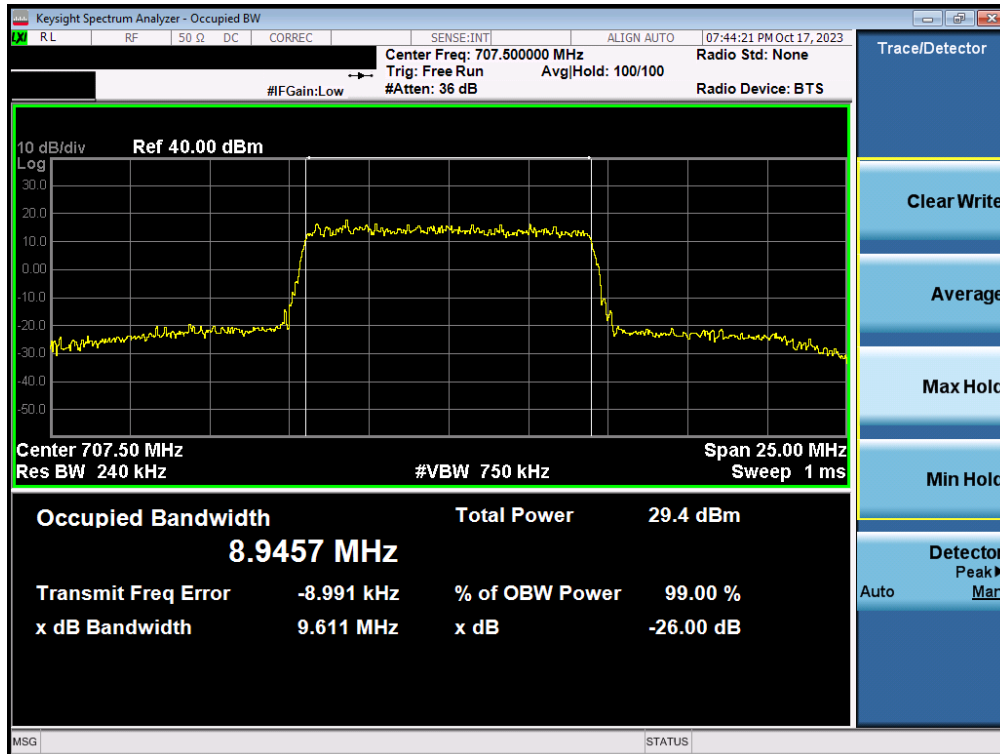
Table 7-3. Summary of Occupied Bandwidth Test Results – Ant2

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 12/17 – Ant1

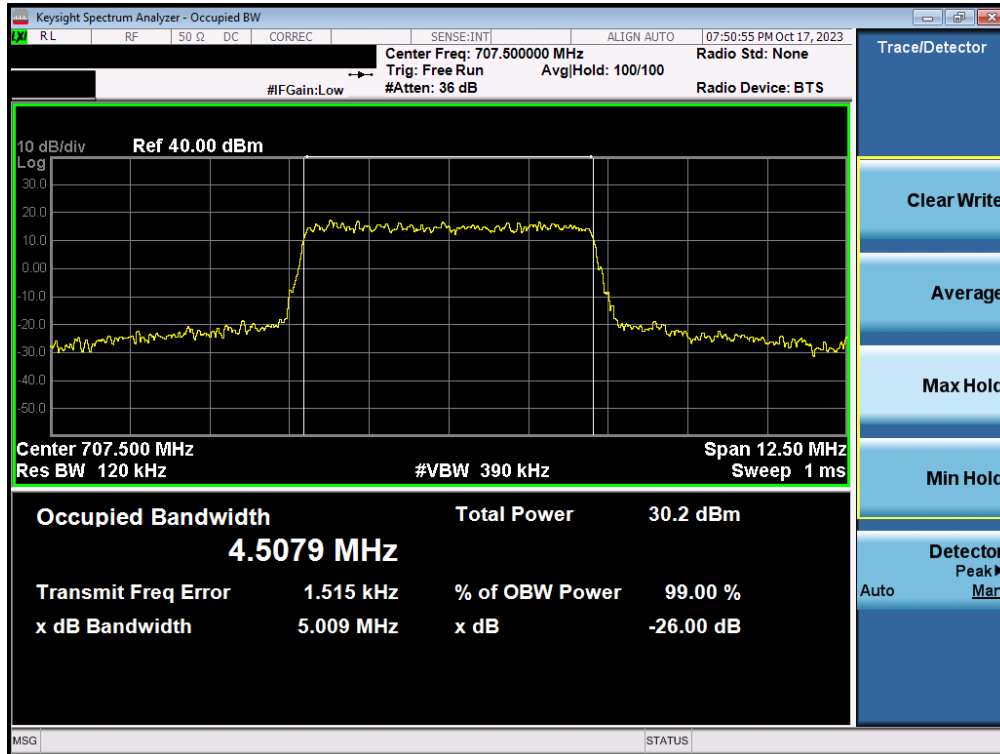


Plot 7-1. Occupied Bandwidth Plot (LTE Band 12/17 - 10MHz QPSK - Full RB – Ant1)

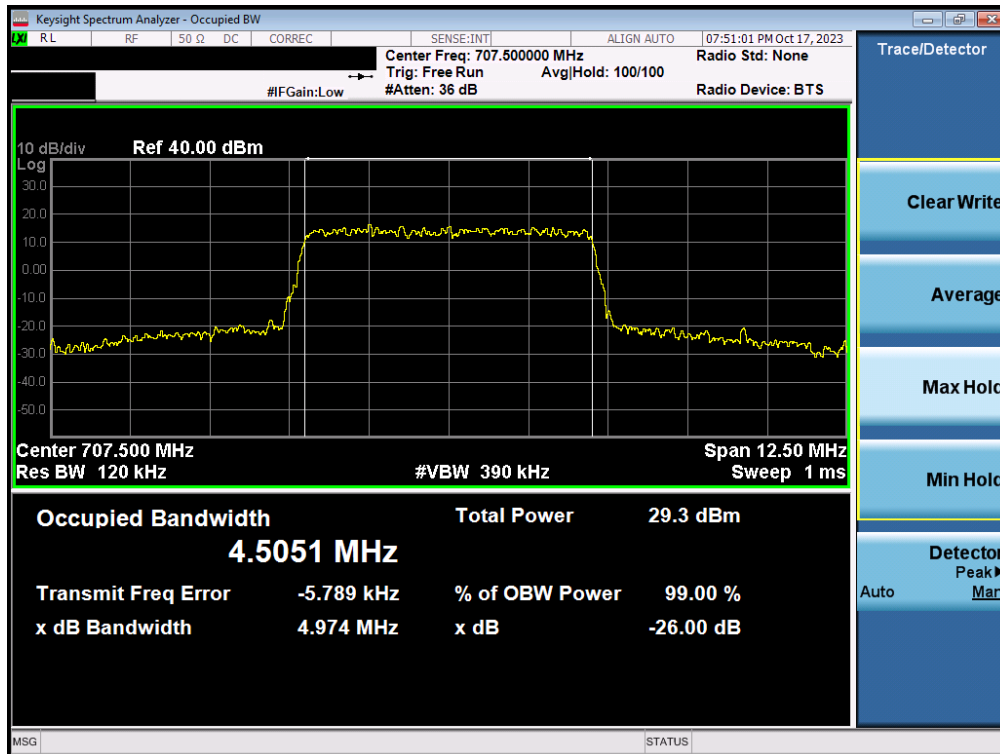


Plot 7-2. Occupied Bandwidth Plot (LTE Band 12/17 - 10MHz 16-QAM - Full RB – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-3. Occupied Bandwidth Plot (LTE Band 12/17 - 5MHz QPSK - Full RB – Ant1)

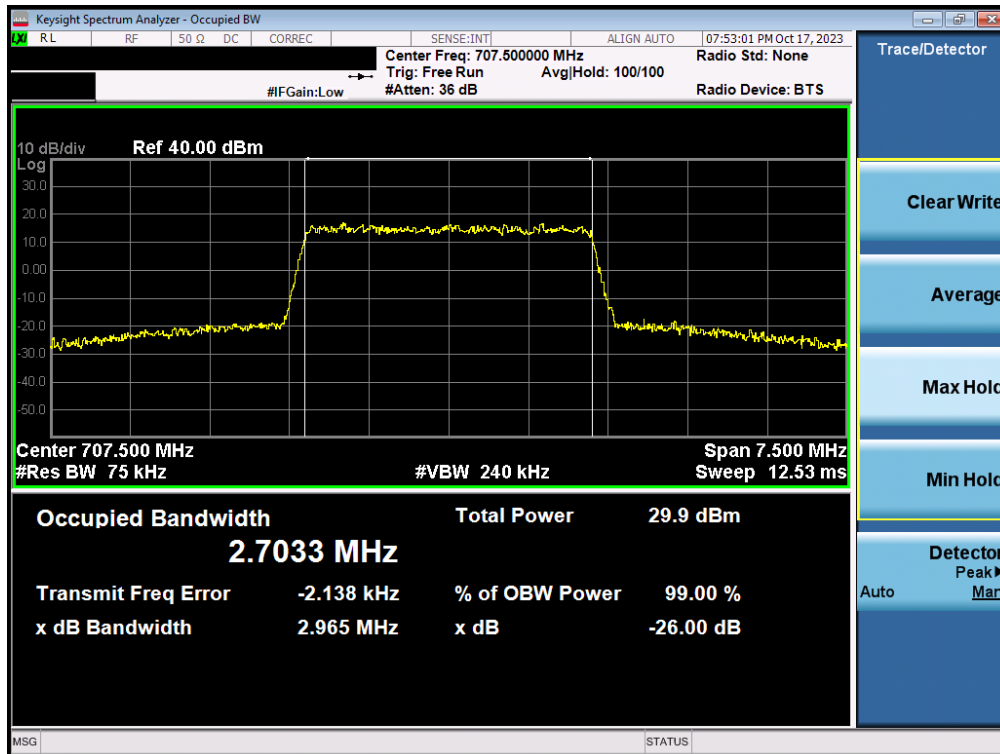


Plot 7-4. Occupied Bandwidth Plot (LTE Band 12/17 - 5MHz 16-QAM - Full RB – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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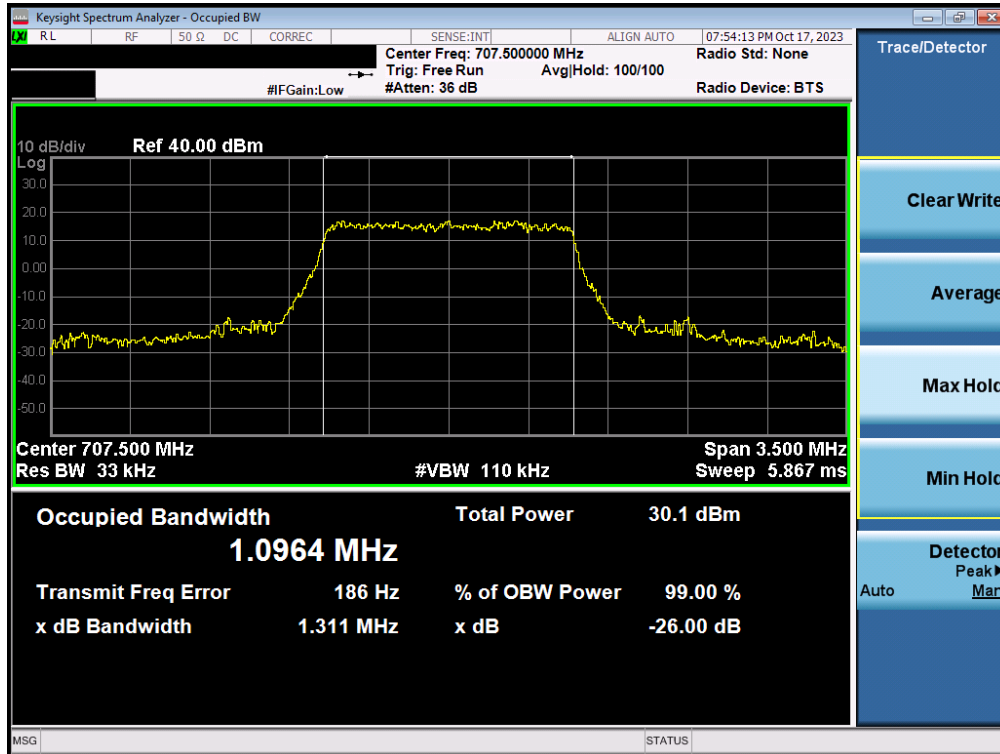


Plot 7-5. Occupied Bandwidth Plot (LTE Band 12 - 3MHz QPSK - Full RB - Ant1)

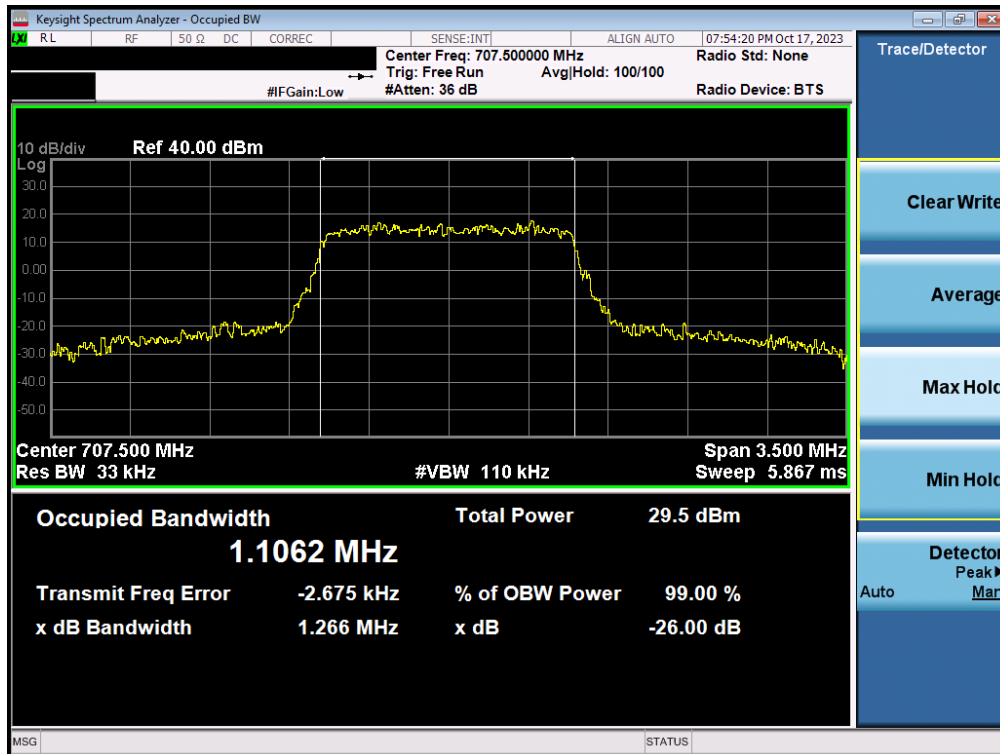


Plot 7-6. Occupied Bandwidth Plot (LTE Band 12 - 3MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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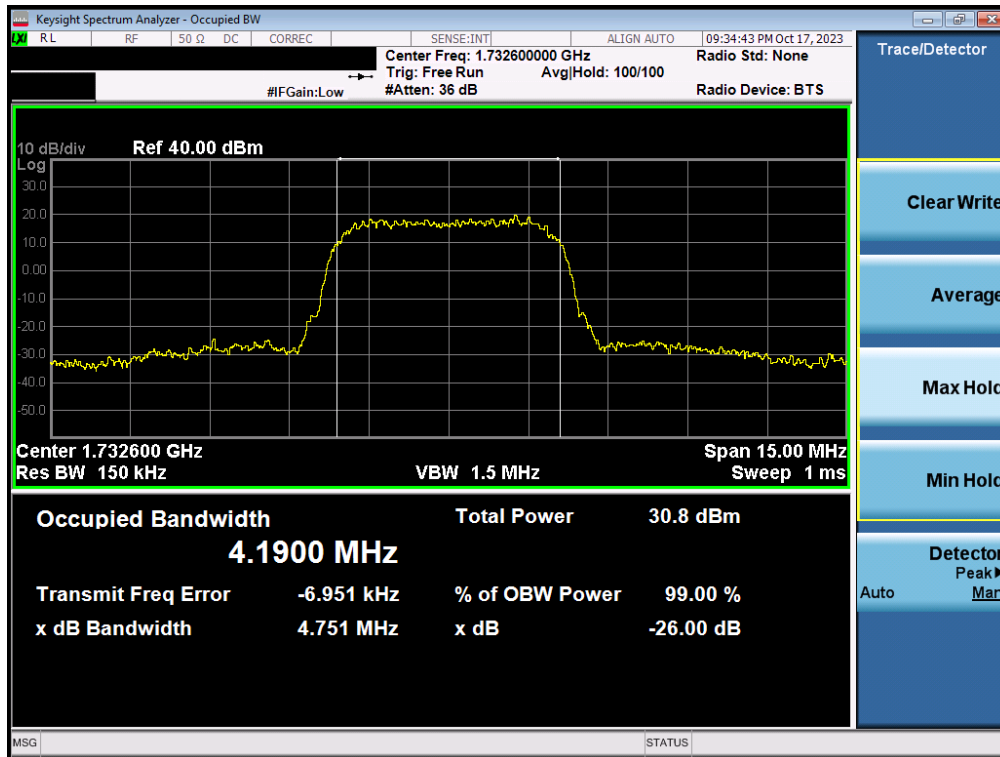
Plot 7-7. Occupied Bandwidth Plot (LTE Band 12 – 1.4MHz QPSK - Full RB – Ant1)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 12 – 1.4MHz 16-QAM - Full RB – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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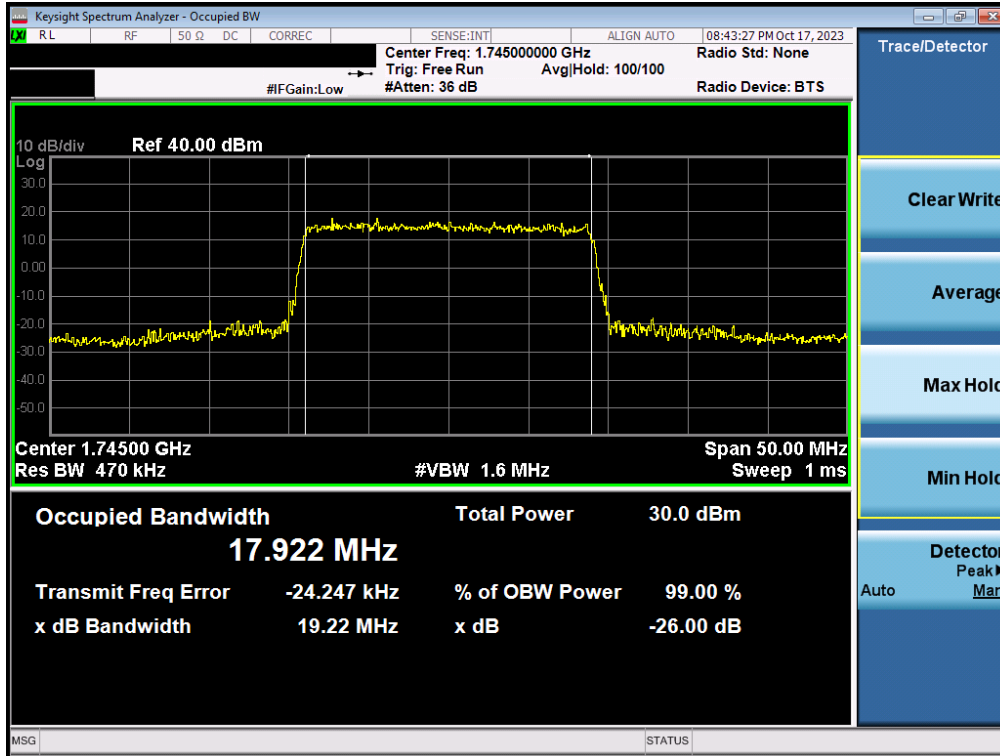
WCDMA AWS – Ant1



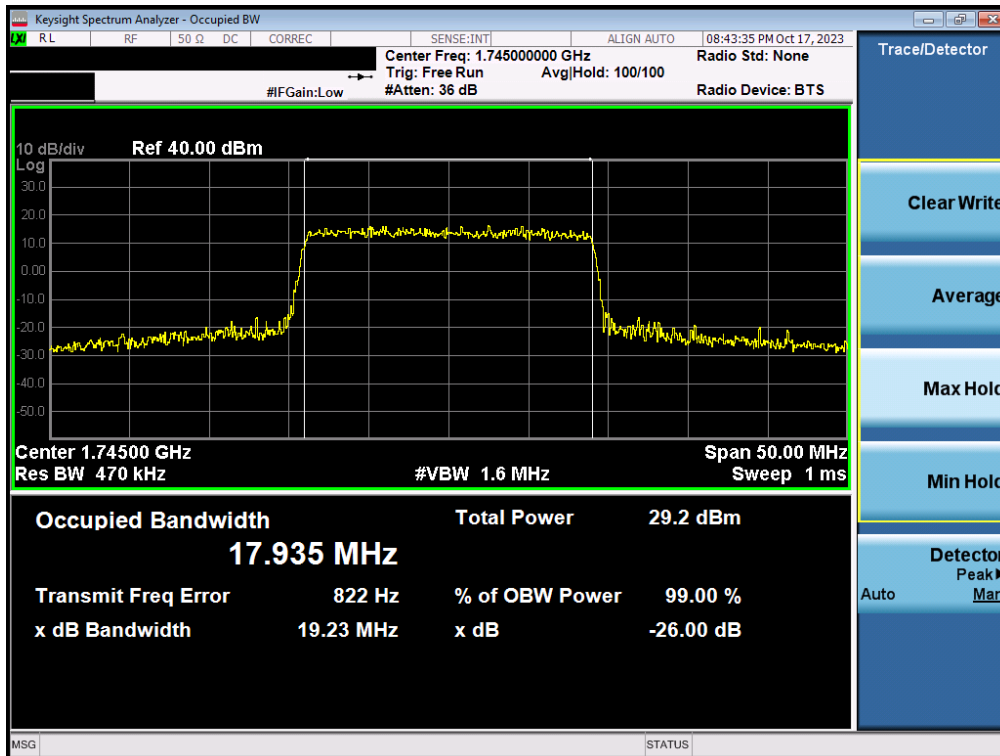
Plot 7-9. Occupied Bandwidth Plot (WCDMA, Ch. 1413 – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 66/4 - Ant1

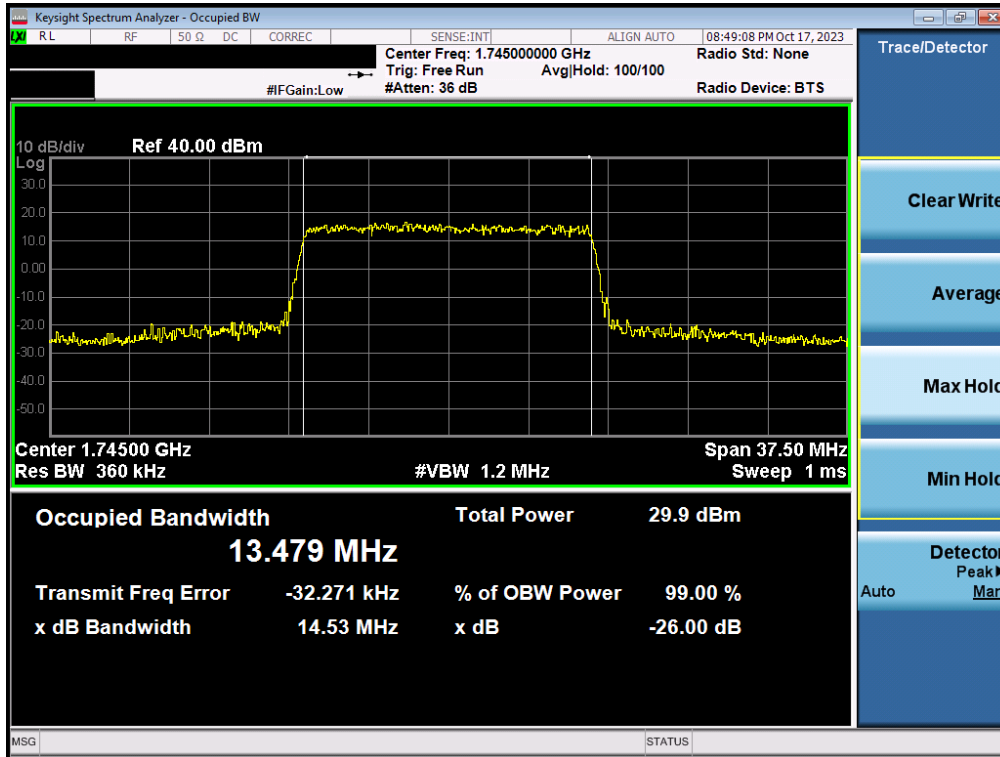


Plot 7-10. Occupied Bandwidth Plot (LTE Band 66/4 - 20MHz QPSK - Full RB - Ant1)

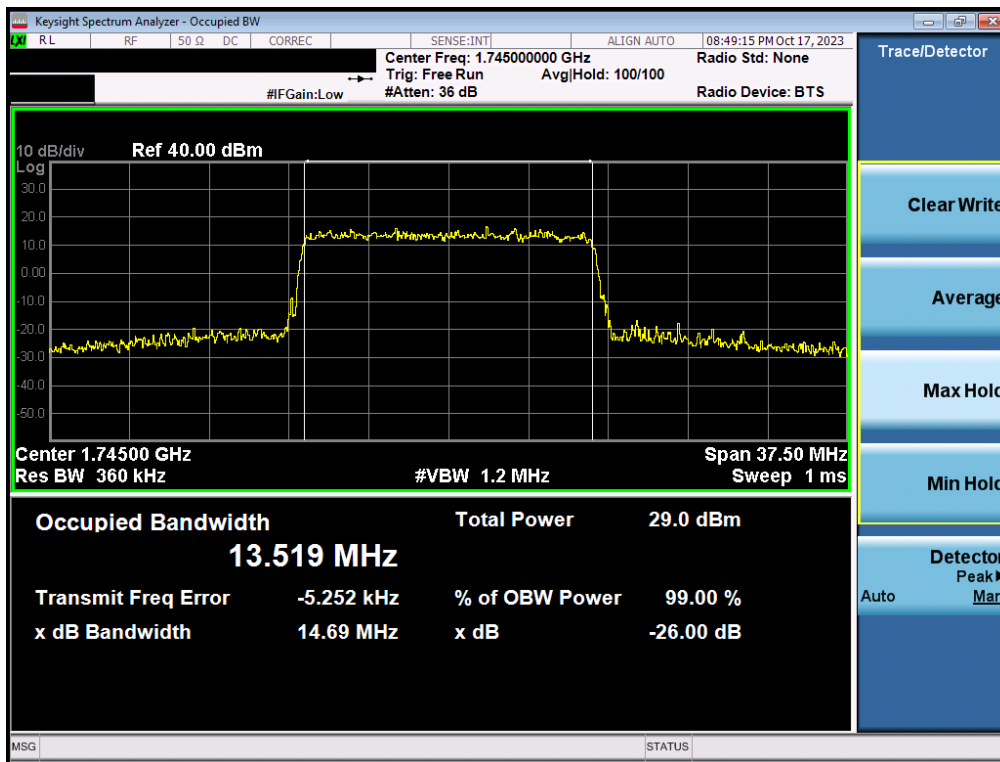


Plot 7-11. Occupied Bandwidth Plot (LTE Band 66/4 - 20MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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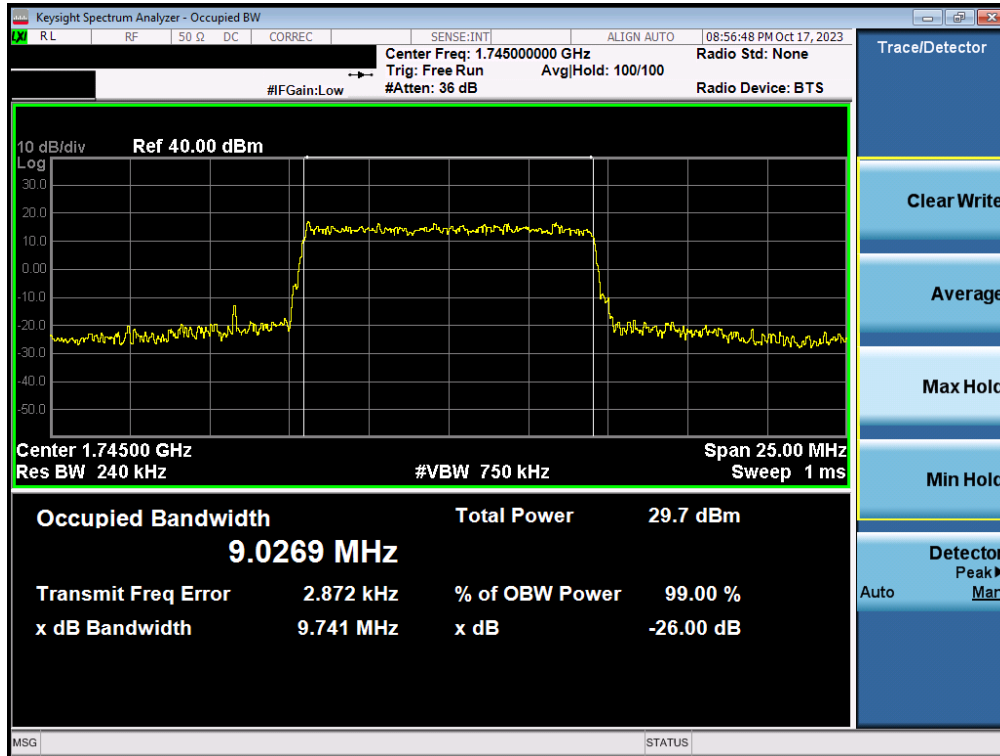


Plot 7-12. Occupied Bandwidth Plot (LTE Band 66/4 - 15MHz QPSK - Full RB - Ant1)

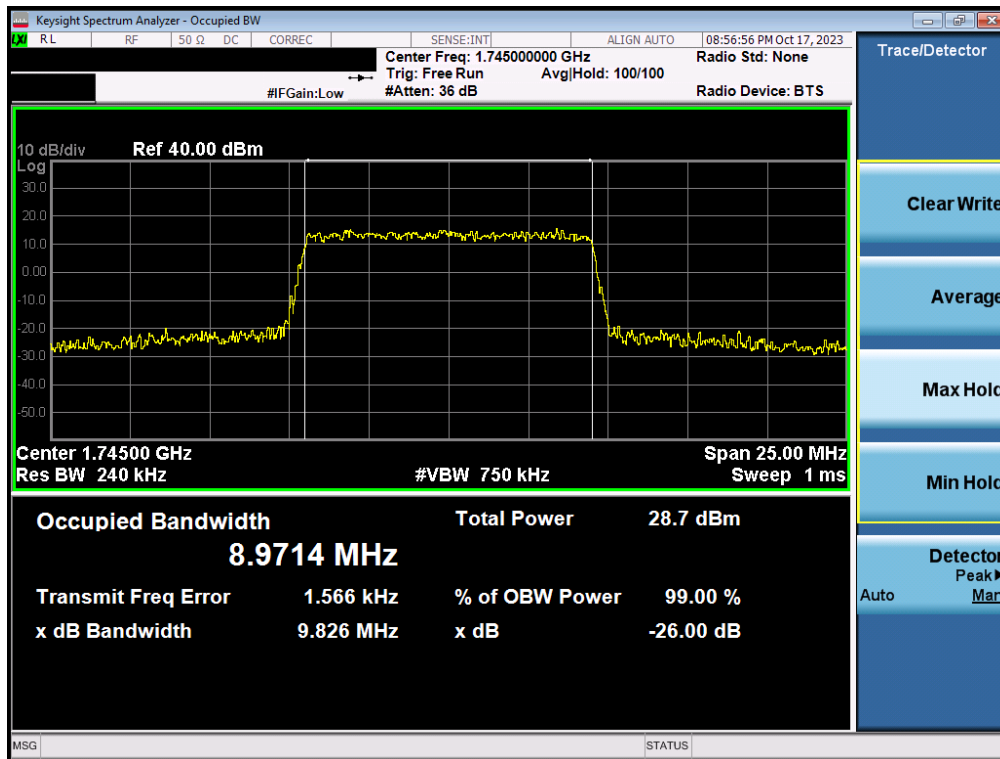


Plot 7-13. Occupied Bandwidth Plot (LTE Band 66/4 - 15MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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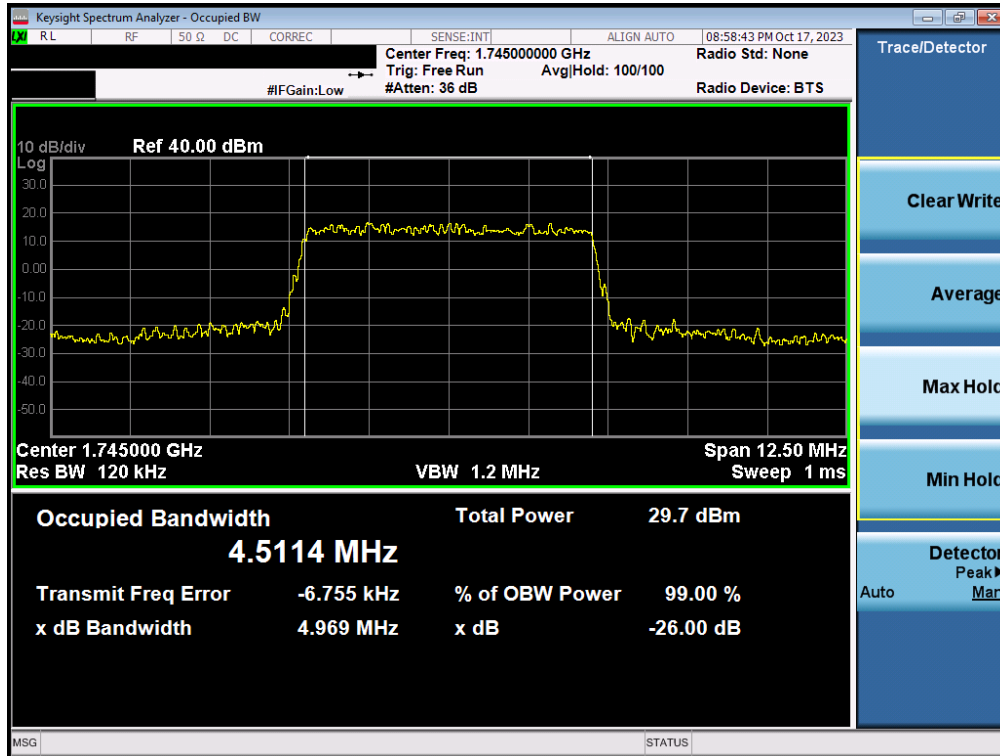


Plot 7-14. Occupied Bandwidth Plot (LTE Band 66/4 - 10MHz QPSK - Full RB - Ant1)

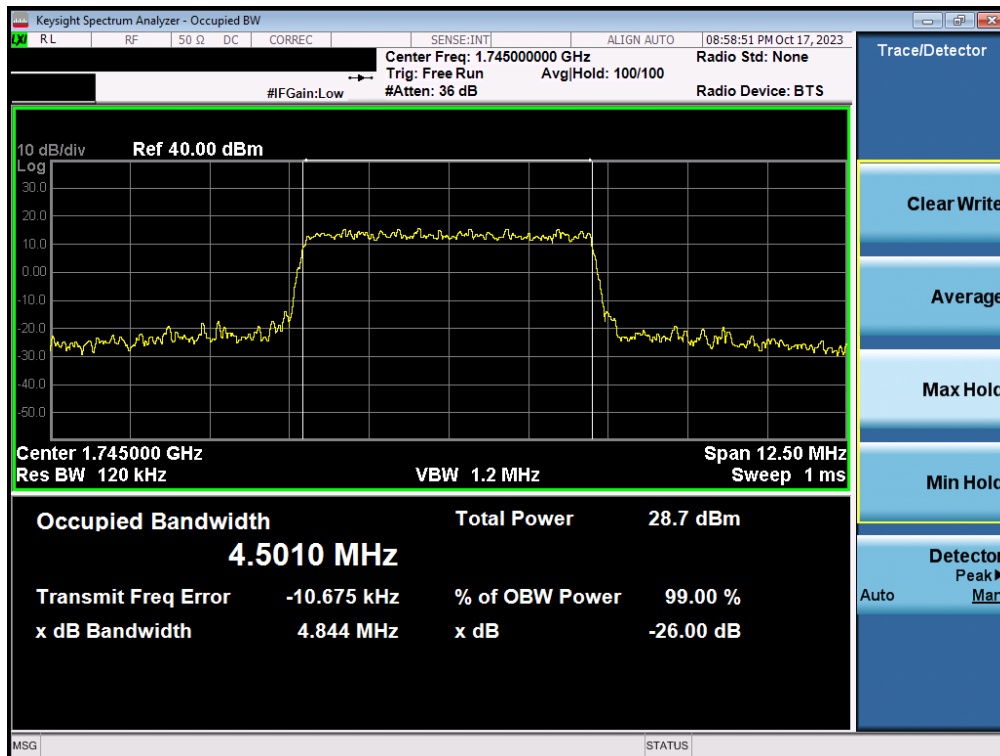


Plot 7-15. Occupied Bandwidth Plot (LTE Band 66/4 - 10MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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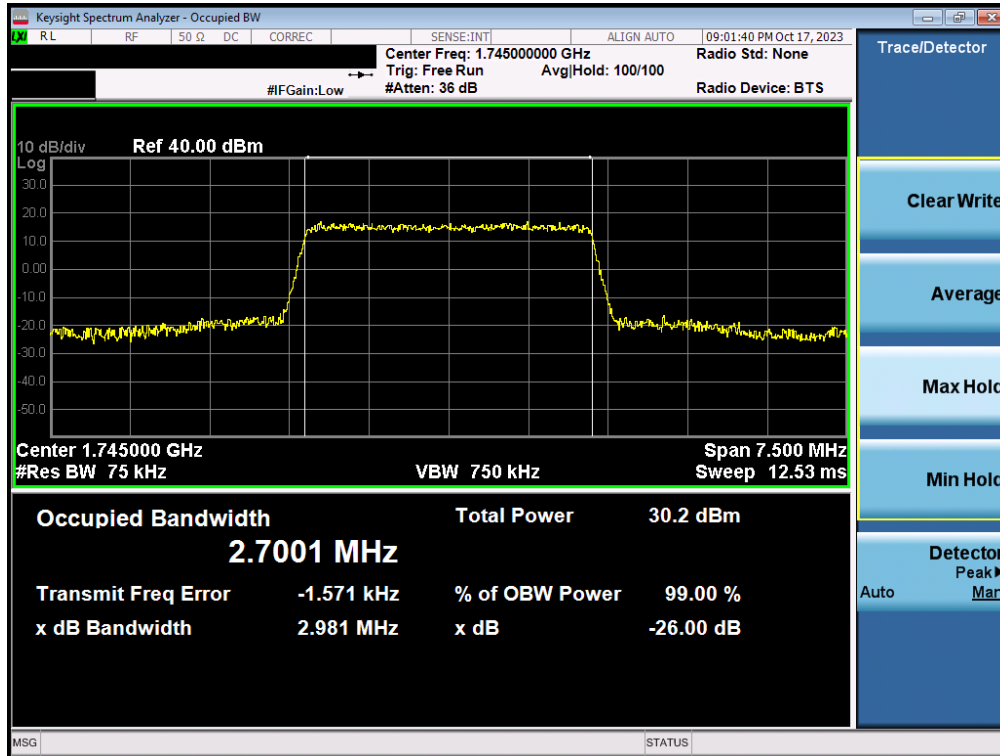


Plot 7-16. Occupied Bandwidth Plot (LTE Band 66/4 - 5MHz QPSK - Full RB - Ant1)

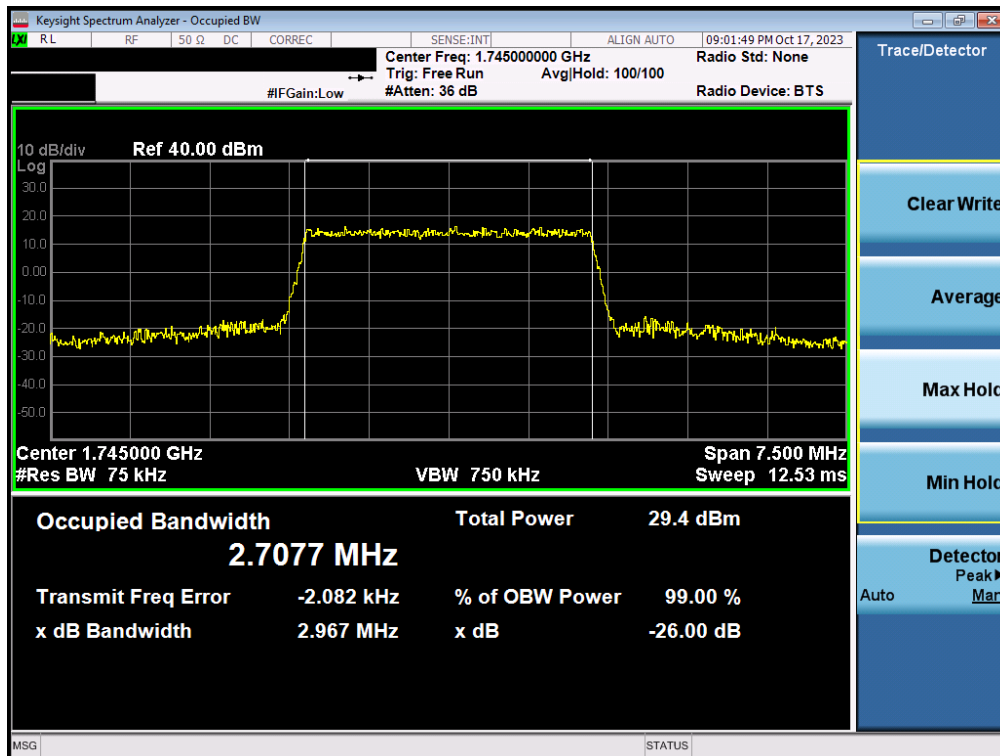


Plot 7-17. Occupied Bandwidth Plot (LTE Band 66/4 - 5MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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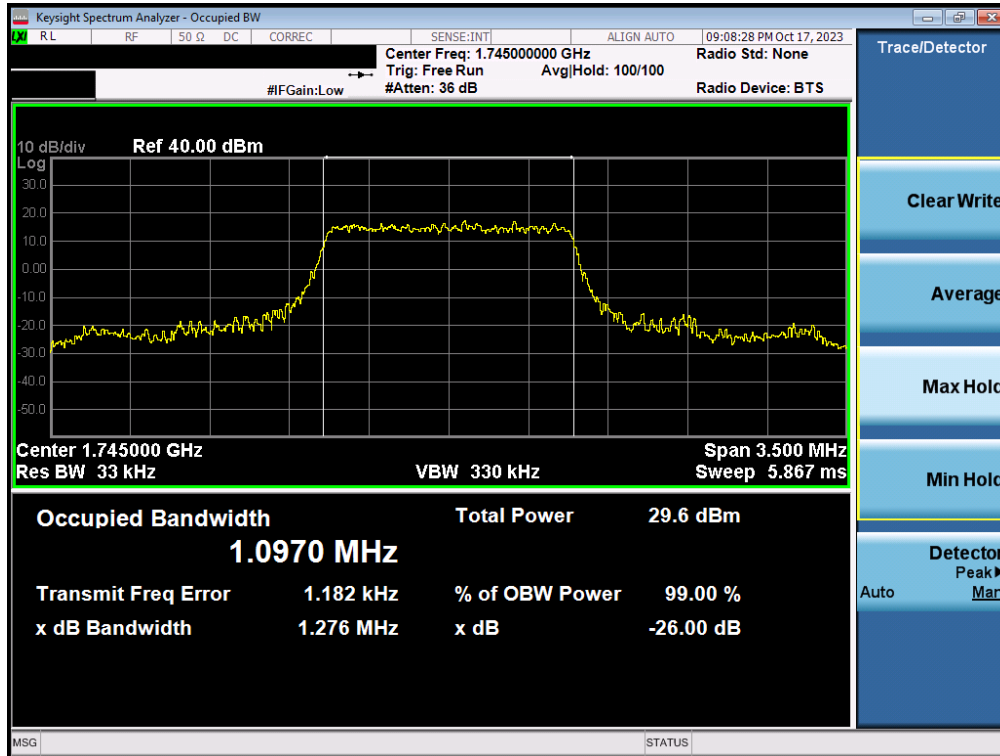


Plot 7-18. Occupied Bandwidth Plot (LTE Band 66/4 - 3MHz QPSK - Full RB - Ant1)

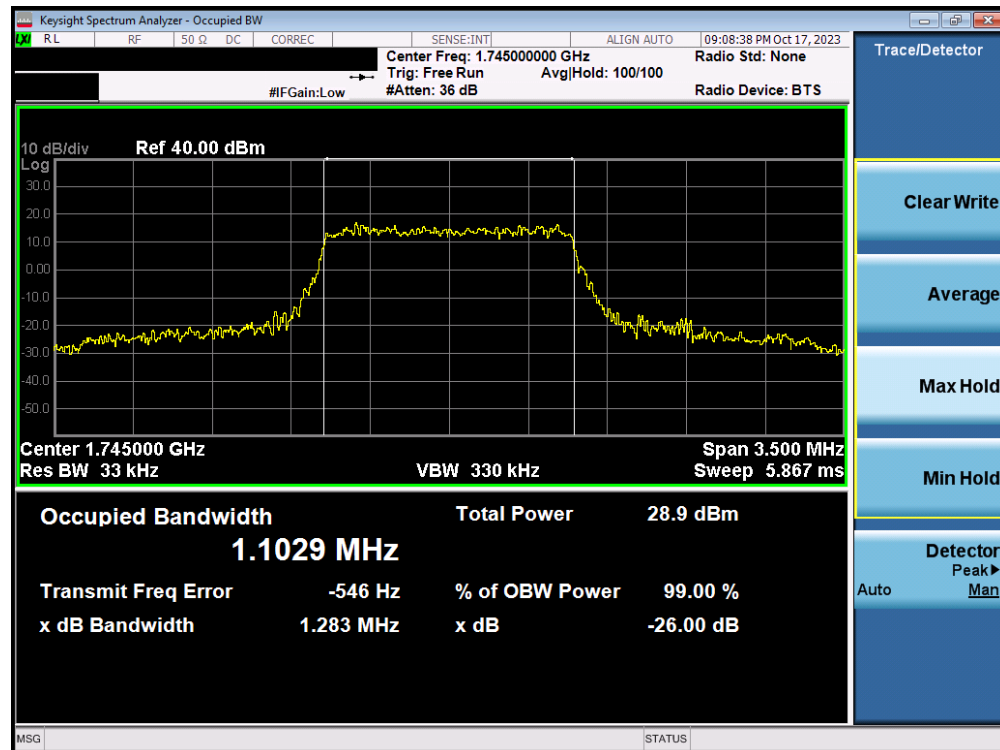


Plot 7-19. Occupied Bandwidth Plot (LTE Band 66/4 - 3MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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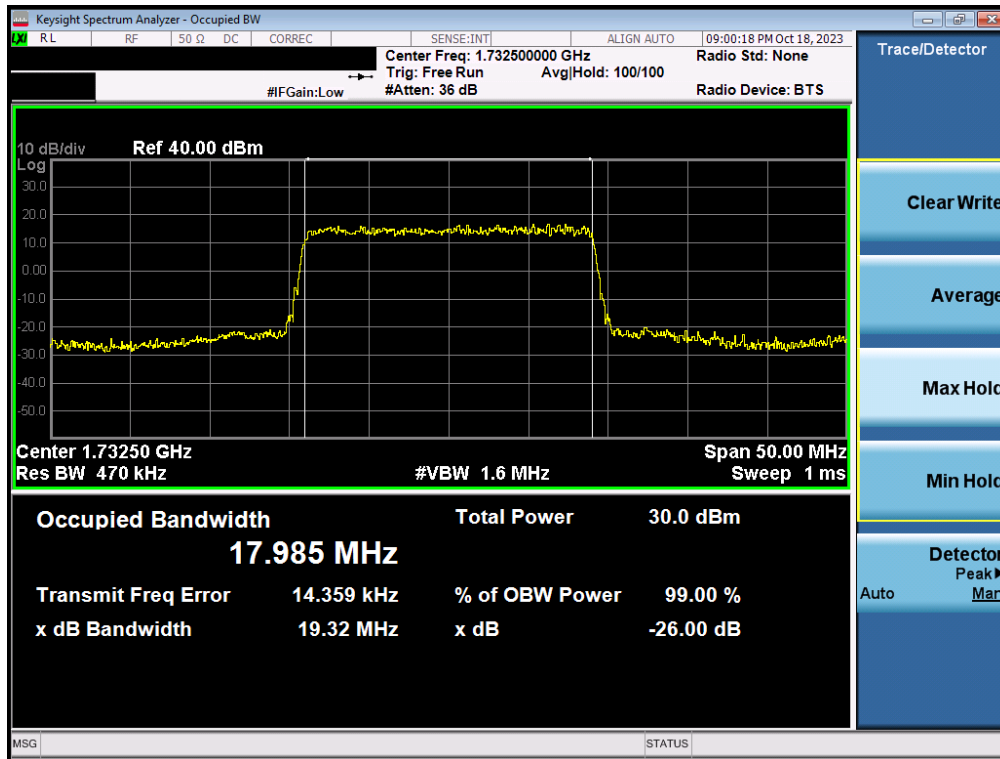
Plot 7-20. Occupied Bandwidth Plot (LTE Band 66/4 - 1.4MHz QPSK - Full RB - Ant1)



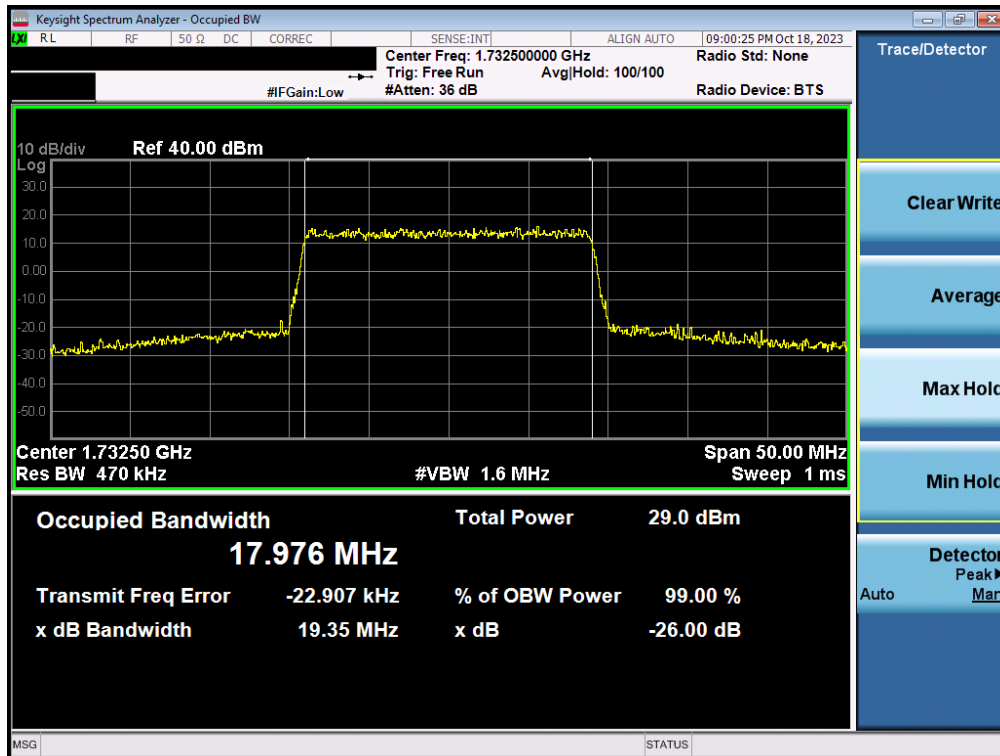
Plot 7-21. Occupied Bandwidth Plot (LTE Band 66/4 - 1.4MHz 16-QAM - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 4 – Ant2

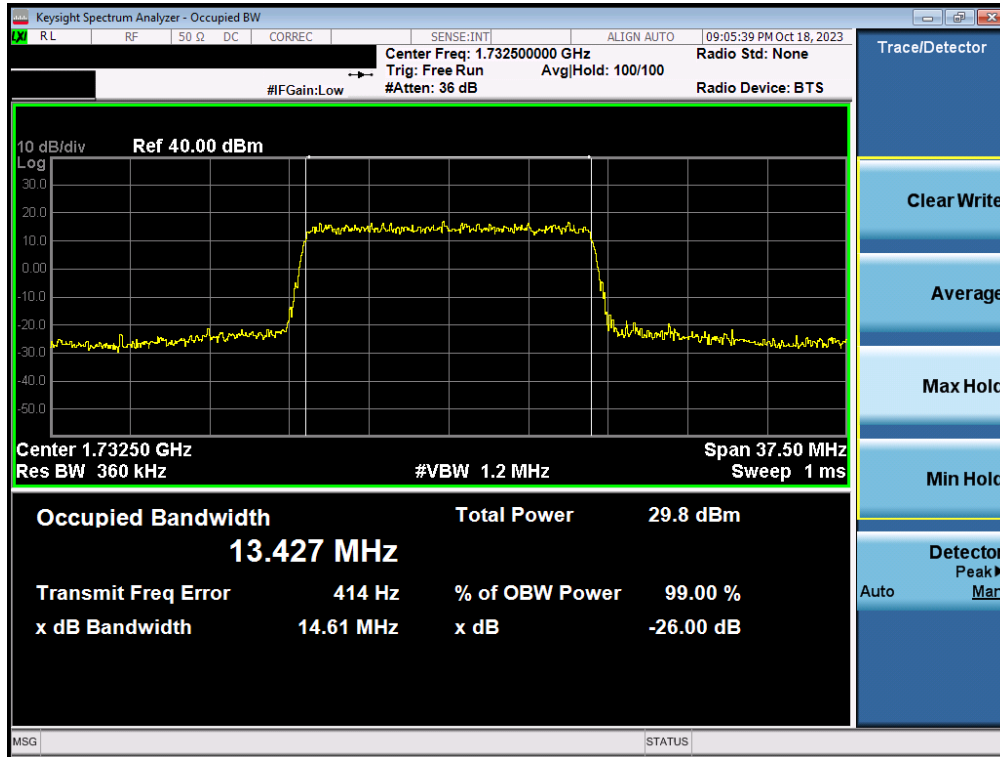


Plot 7-22. Occupied Bandwidth Plot (LTE Band 4 - 20MHz QPSK - Full RB - Ant2)

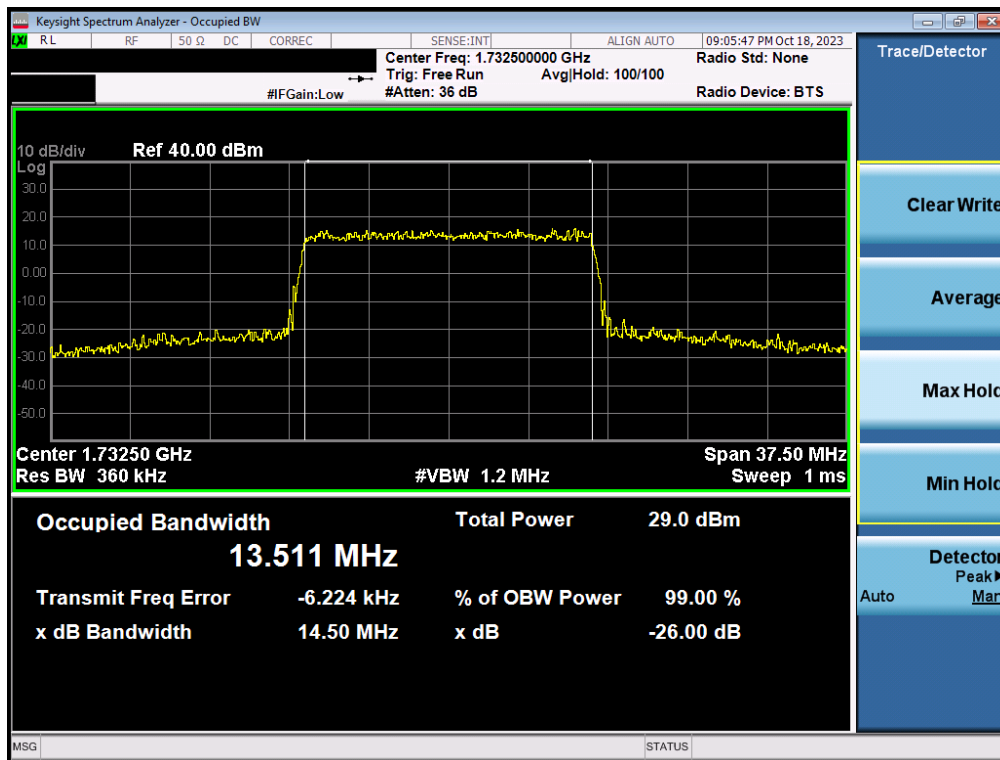


Plot 7-23. Occupied Bandwidth Plot (LTE Band 4 - 20MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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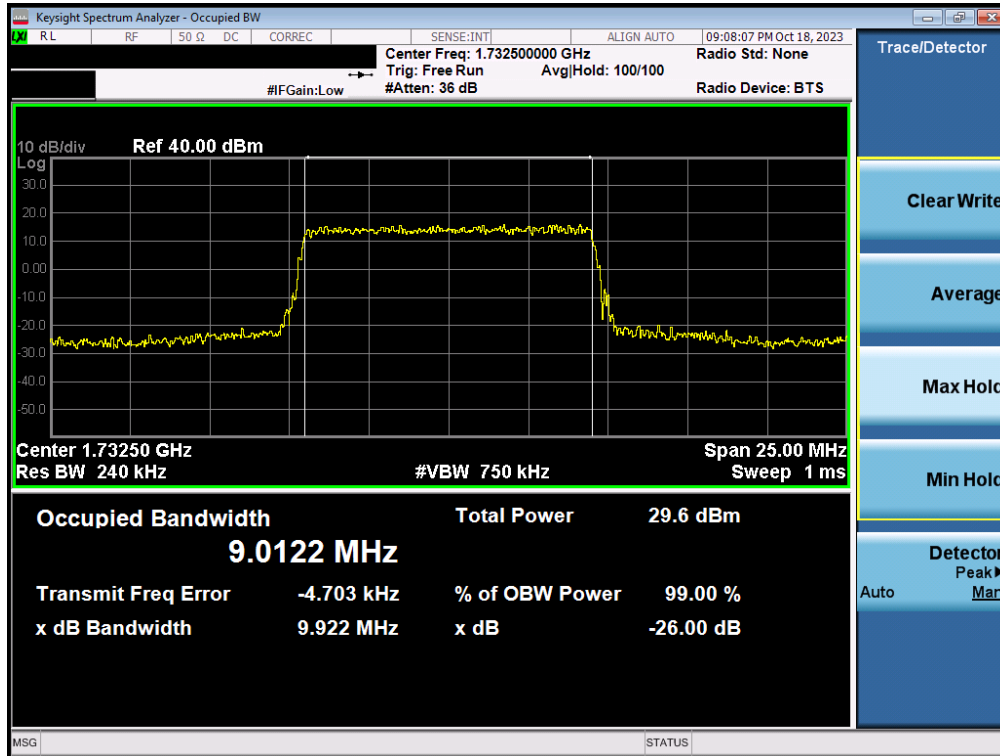


Plot 7-24. Occupied Bandwidth Plot (LTE Band 4 - 15MHz QPSK - Full RB - Ant2)

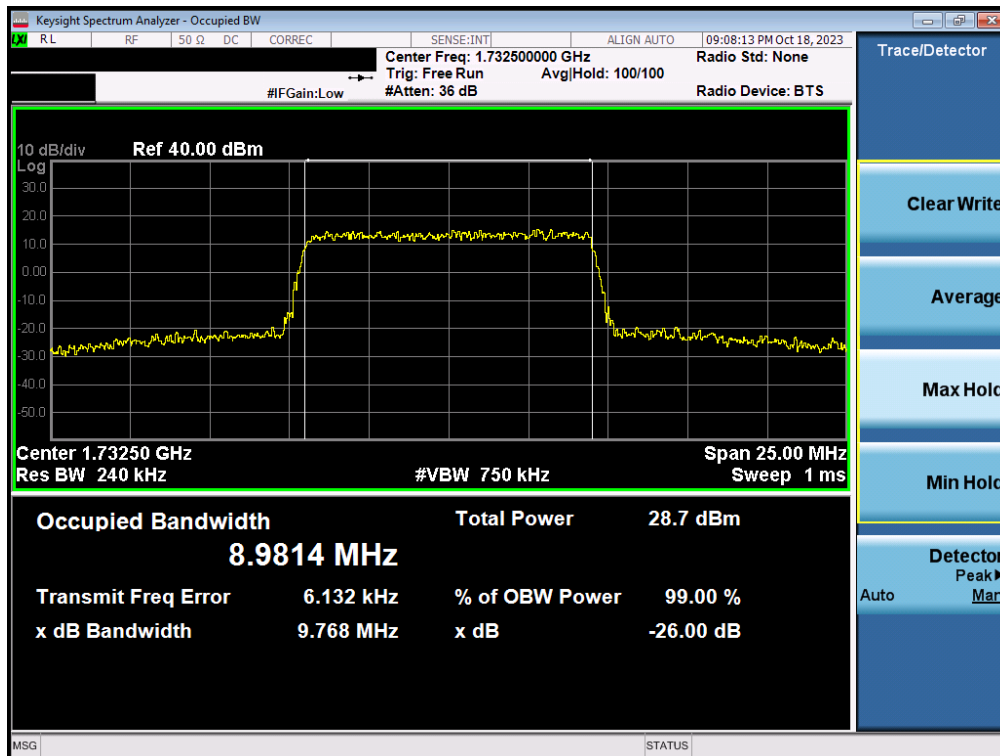


Plot 7-25. Occupied Bandwidth Plot (LTE Band 4 - 15MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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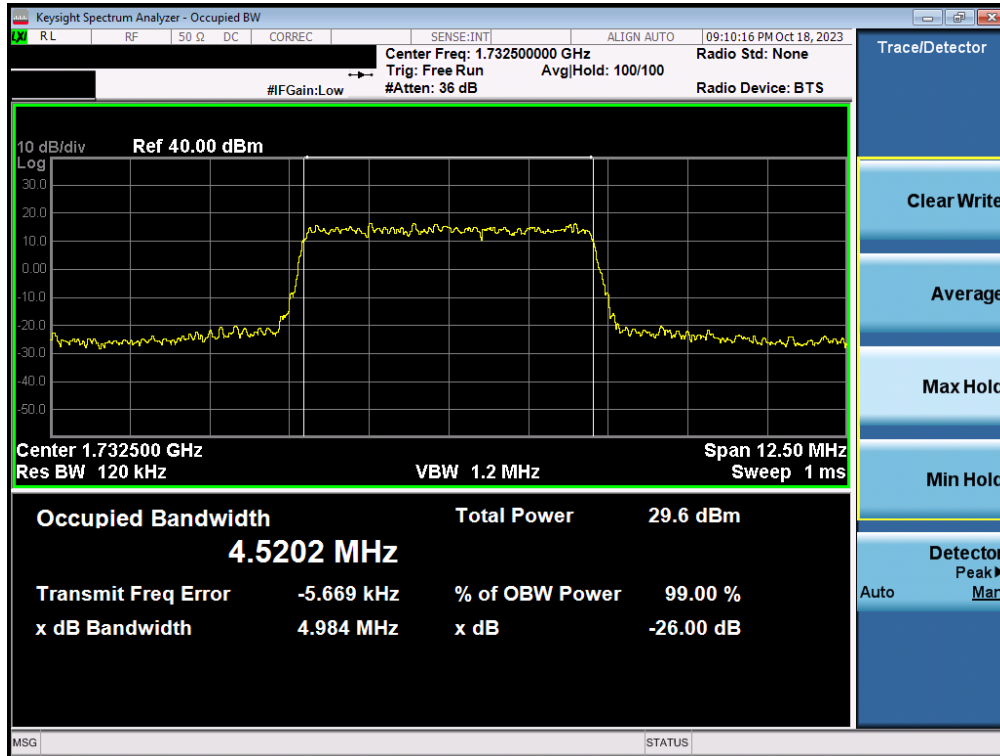


Plot 7-26. Occupied Bandwidth Plot (LTE Band 4 - 10MHz QPSK - Full RB - Ant2)

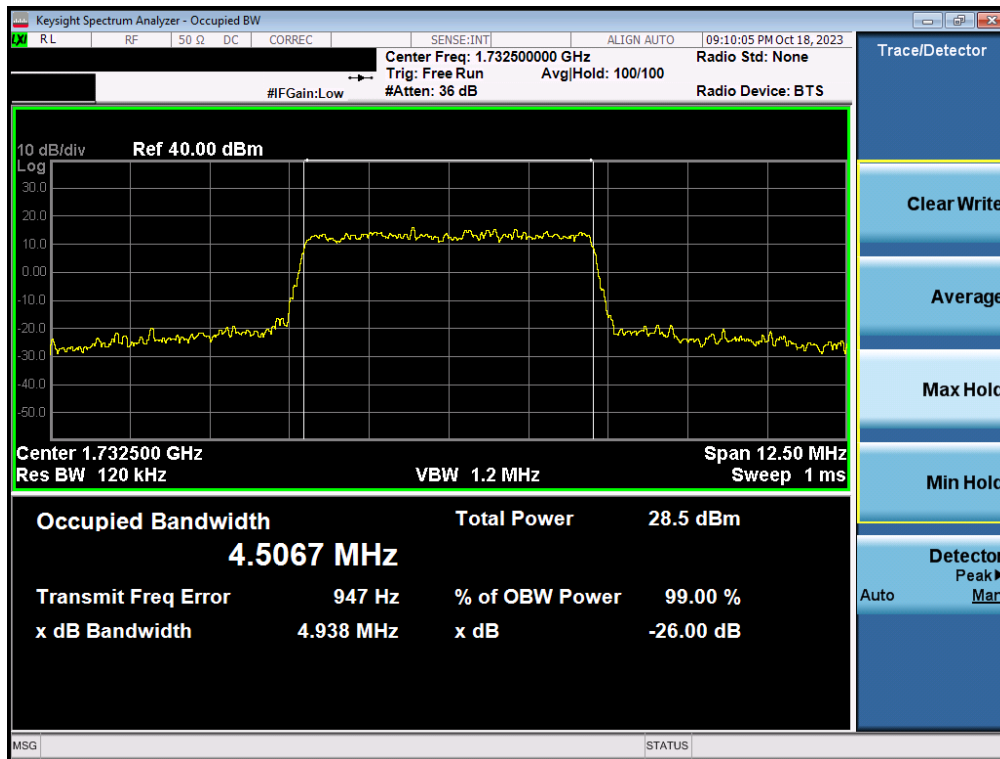


Plot 7-27. Occupied Bandwidth Plot (LTE Band 4 - 10MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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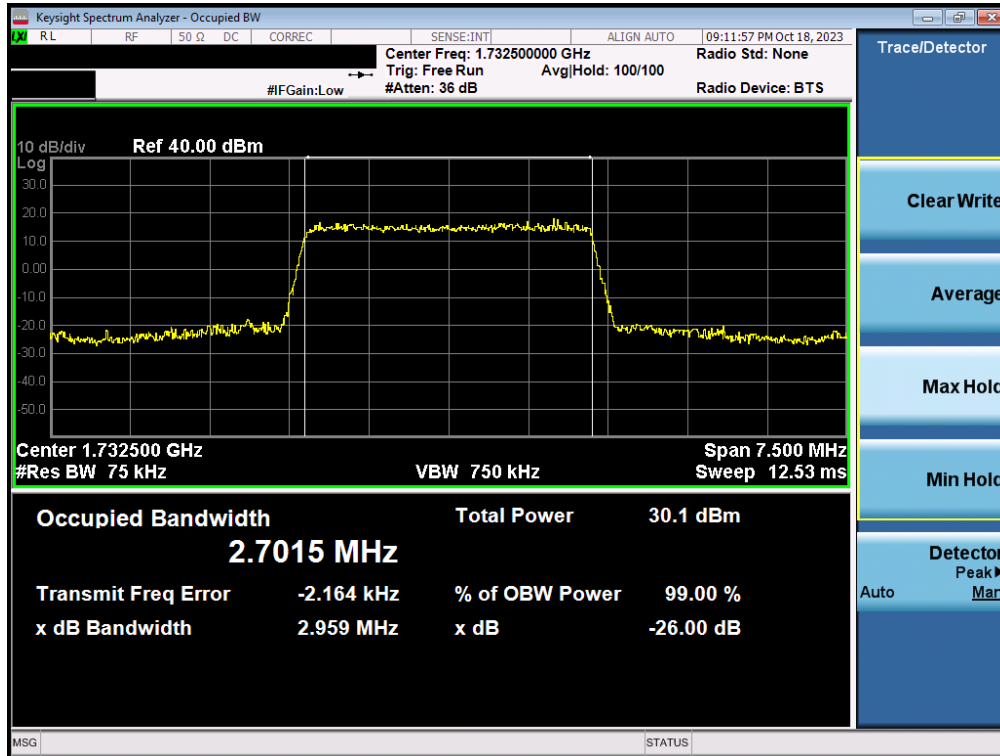


Plot 7-28. Occupied Bandwidth Plot (LTE Band 4 - 5MHz QPSK - Full RB - Ant2)

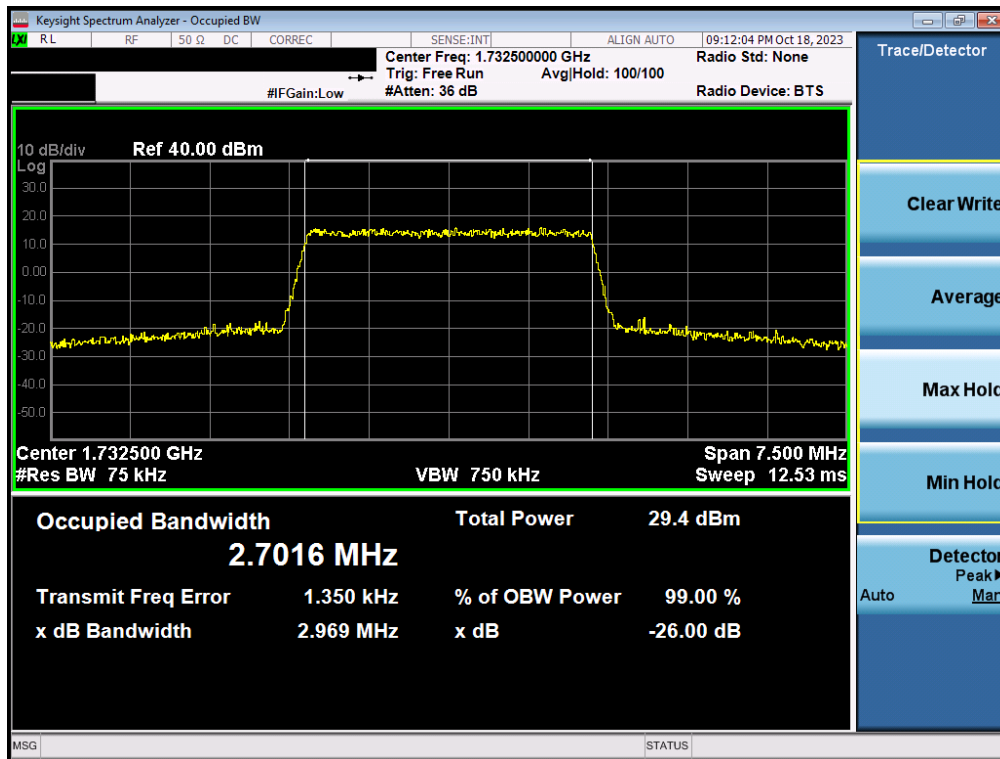


Plot 7-29. Occupied Bandwidth Plot (LTE Band 4 - 5MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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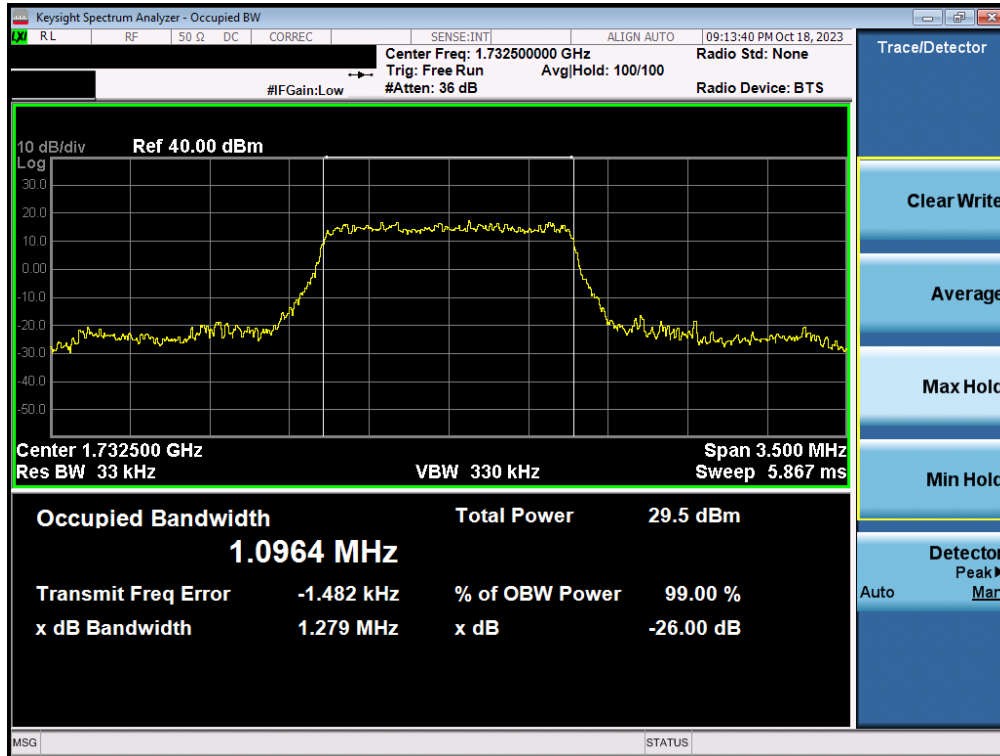


Plot 7-30. Occupied Bandwidth Plot (LTE Band 4 - 3MHz QPSK - Full RB - Ant2)

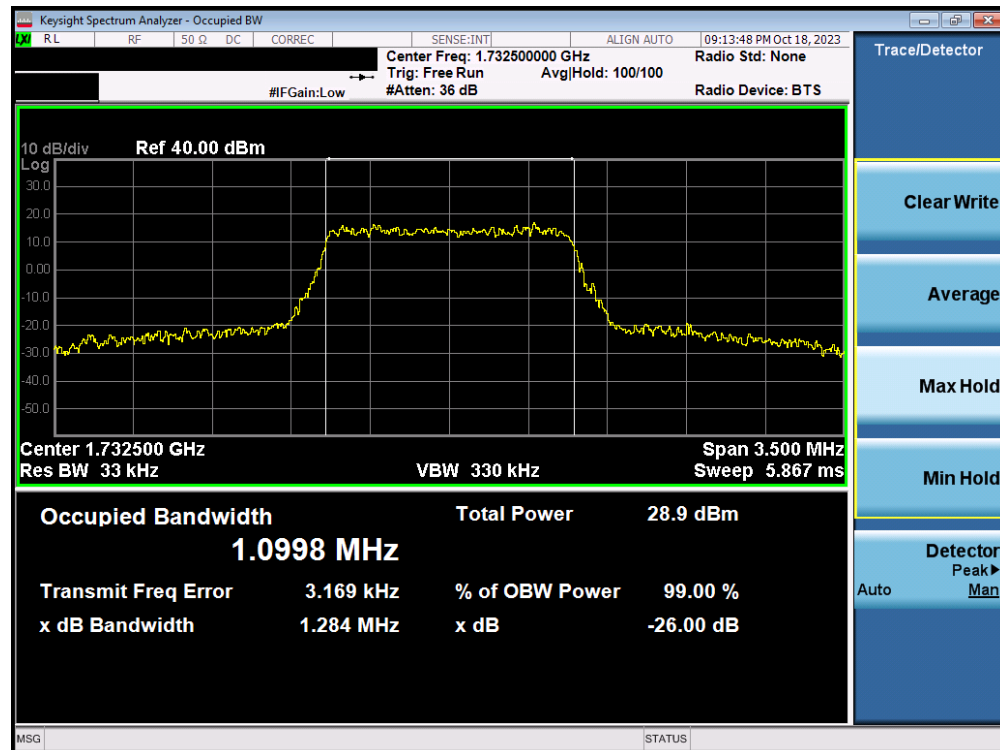


Plot 7-31. Occupied Bandwidth Plot (LTE Band 4 - 3MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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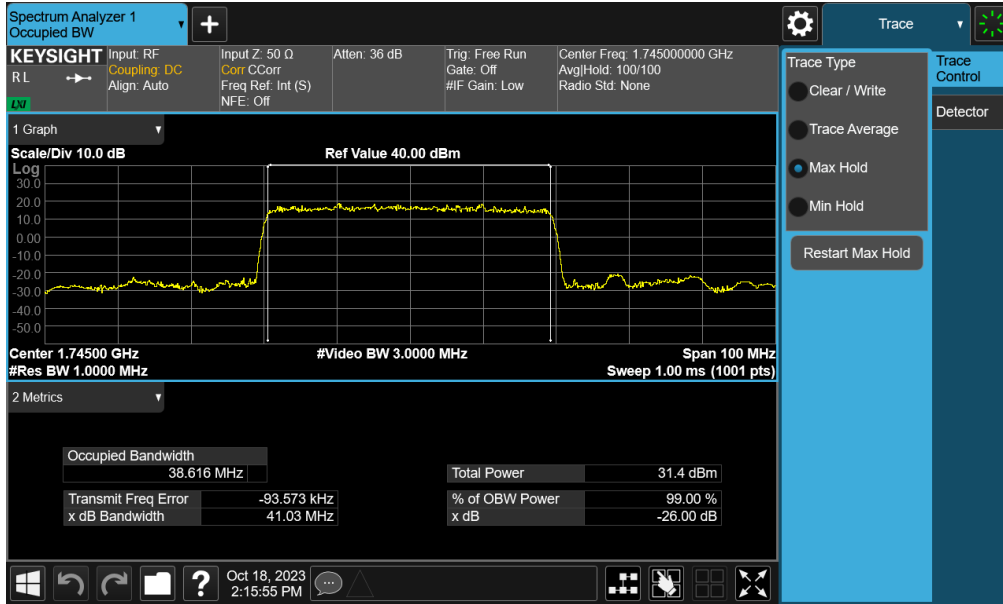
Plot 7-32. Occupied Bandwidth Plot (LTE Band 4 - 1.4MHz QPSK - Full RB - Ant2)



Plot 7-33. Occupied Bandwidth Plot (LTE Band 4 - 1.4MHz 16-QAM - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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NR Band n66 – Ant1

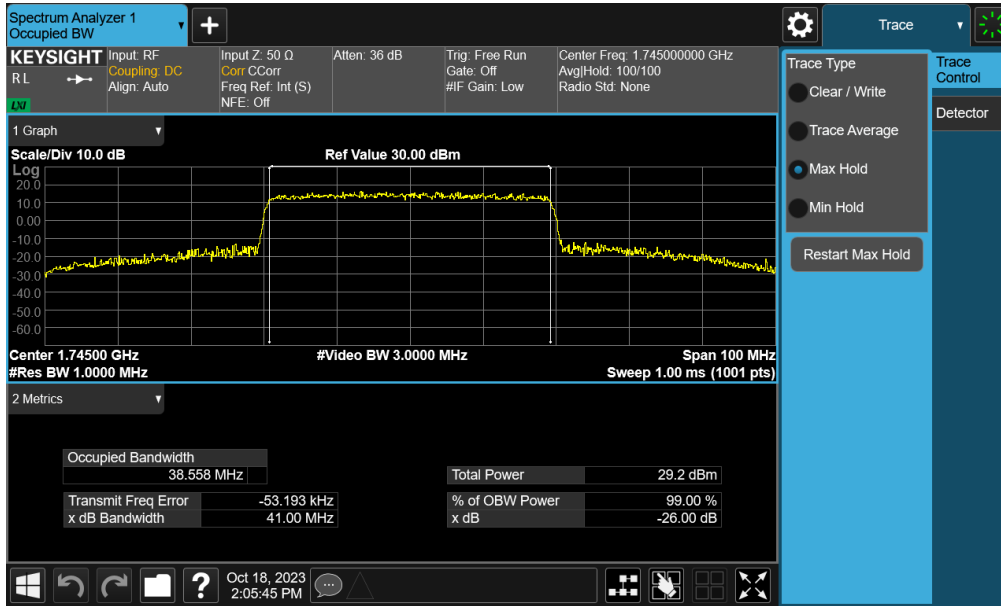


Plot 7-34. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz $\pi/2$ BPSK - Full RB – Ant1)

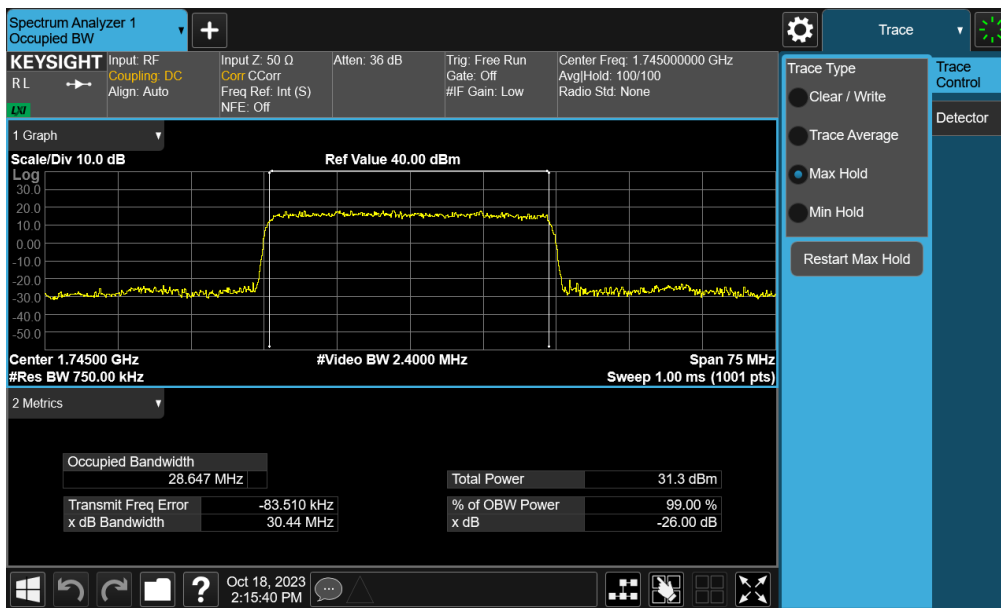


Plot 7-35. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz QPSK - Full RB – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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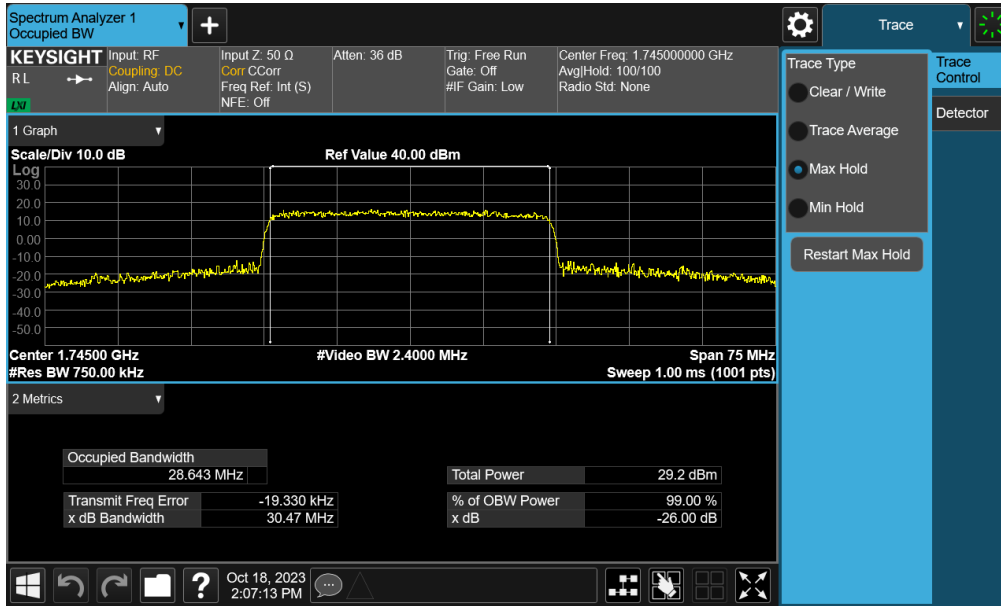


Plot 7-36. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz 16QAM - Full RB - Ant1)

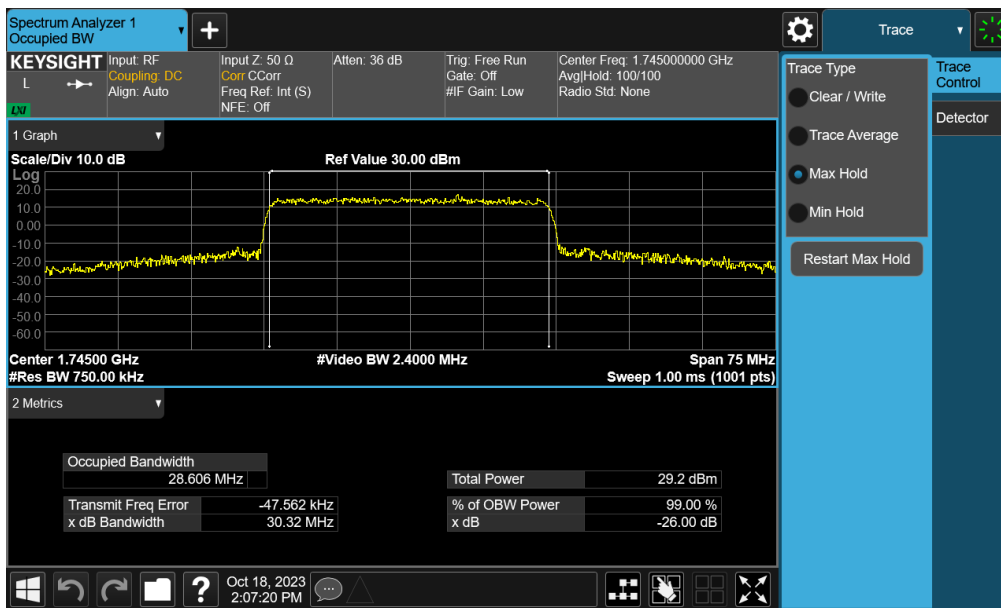


Plot 7-37. Occupied Bandwidth Plot (NR Band n66 - 30.0MHz $\pi/2$ BPSK - Full RB - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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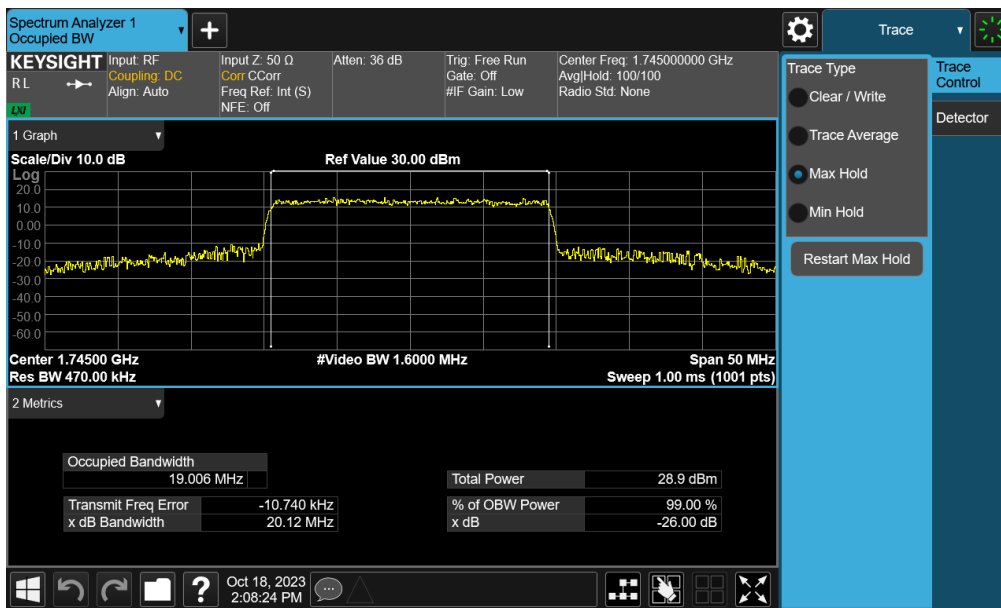
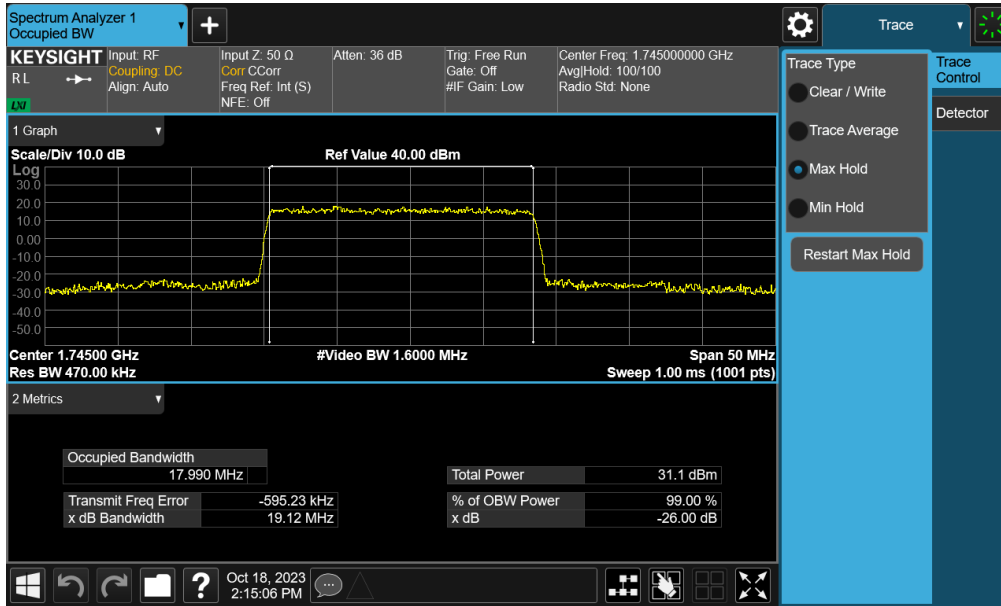


Plot 7-38. Occupied Bandwidth Plot (NR Band n66 - 30.0MHz 16QAM - Full RB – Ant1)

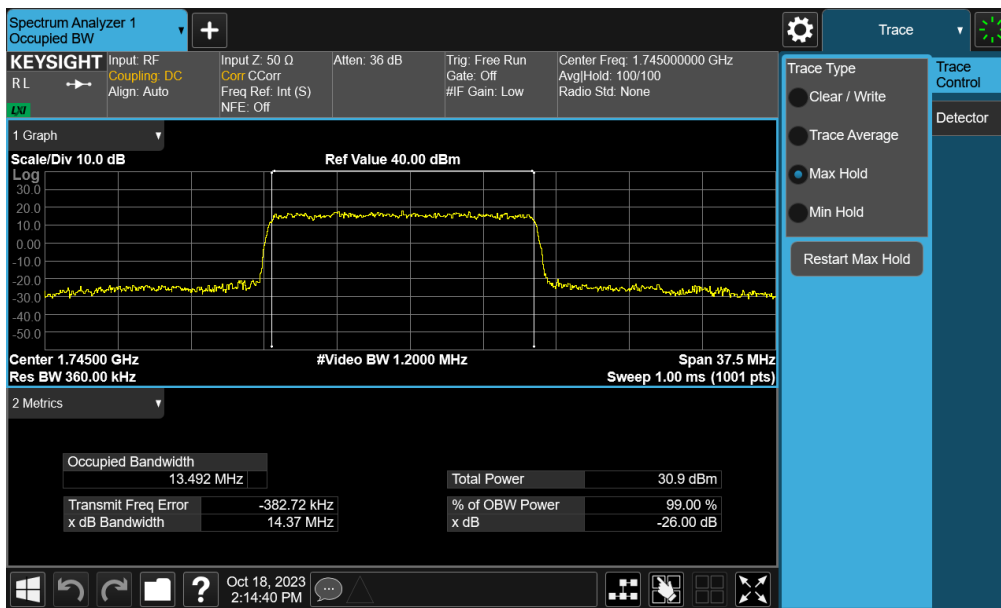
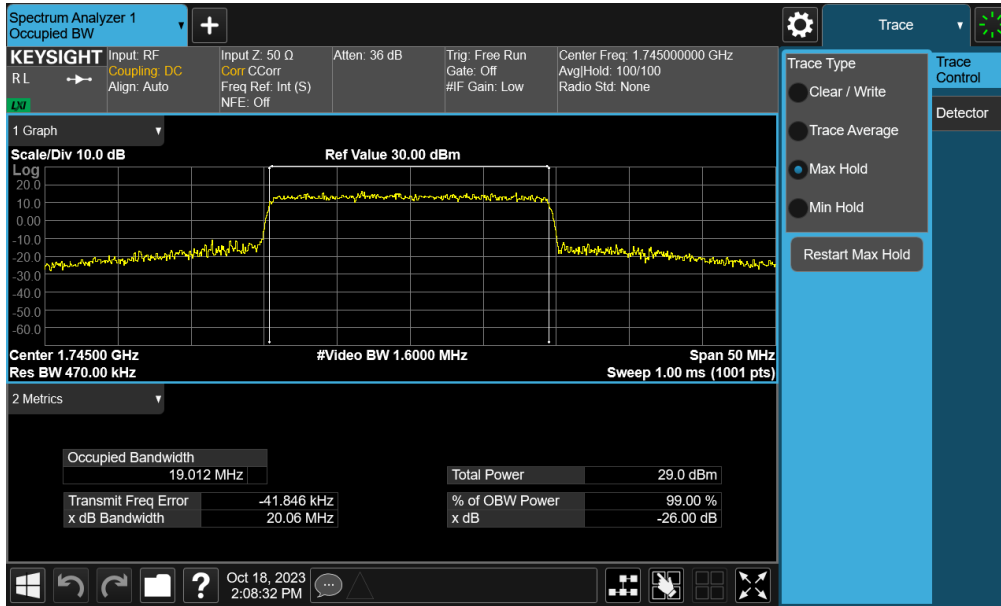


Plot 7-39. Occupied Bandwidth Plot (NR Band n66 - 30.0MHz 16QAM - Full RB – Ant1)

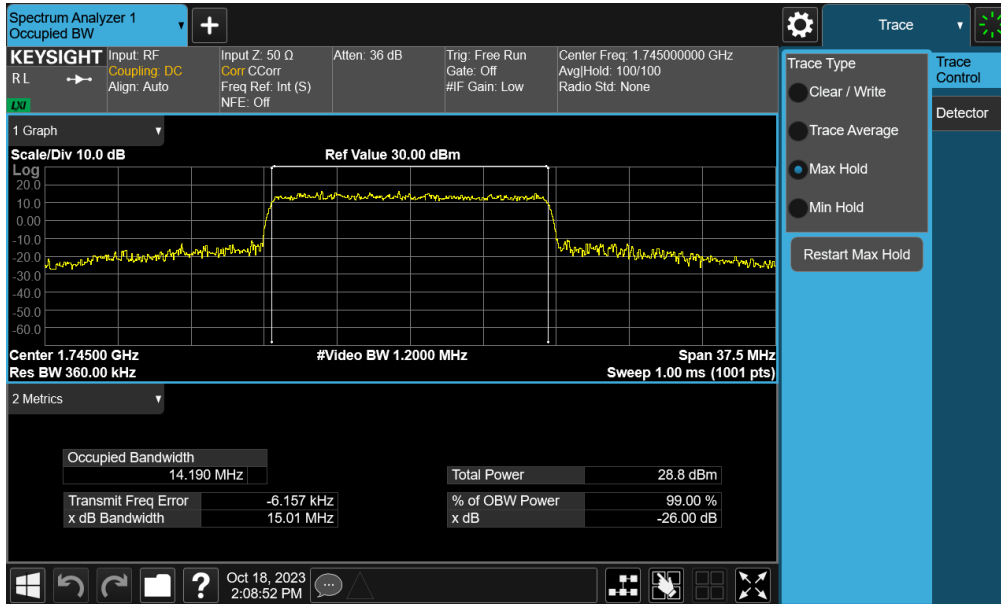
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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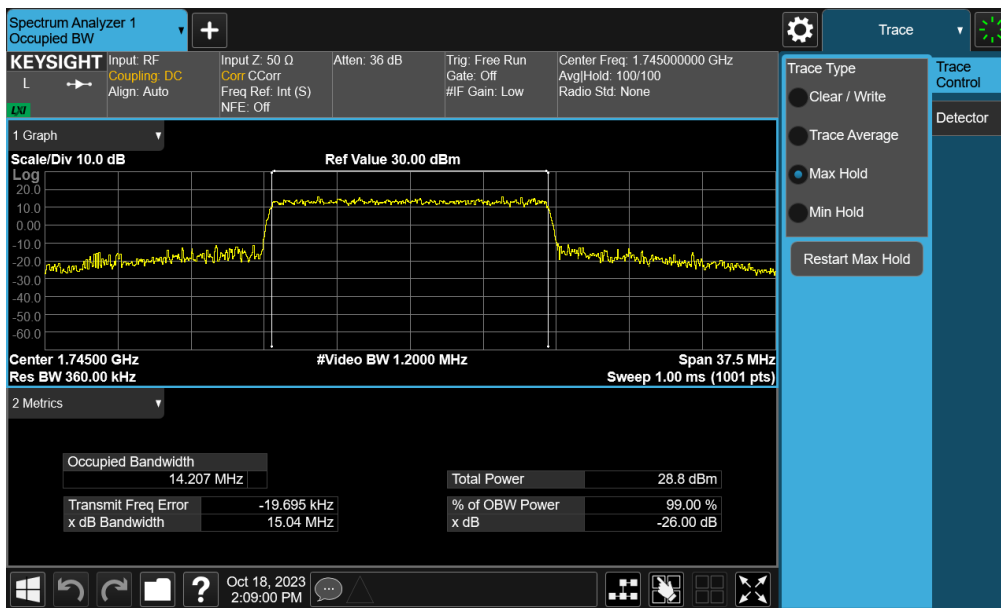
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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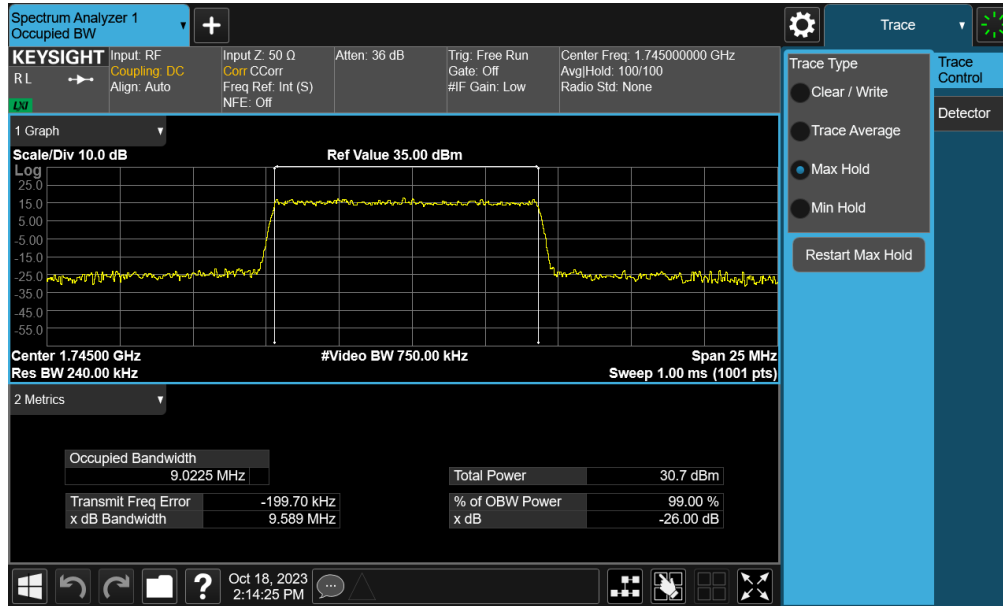


Plot 7-44. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz QPSK - Full RB – Ant1)

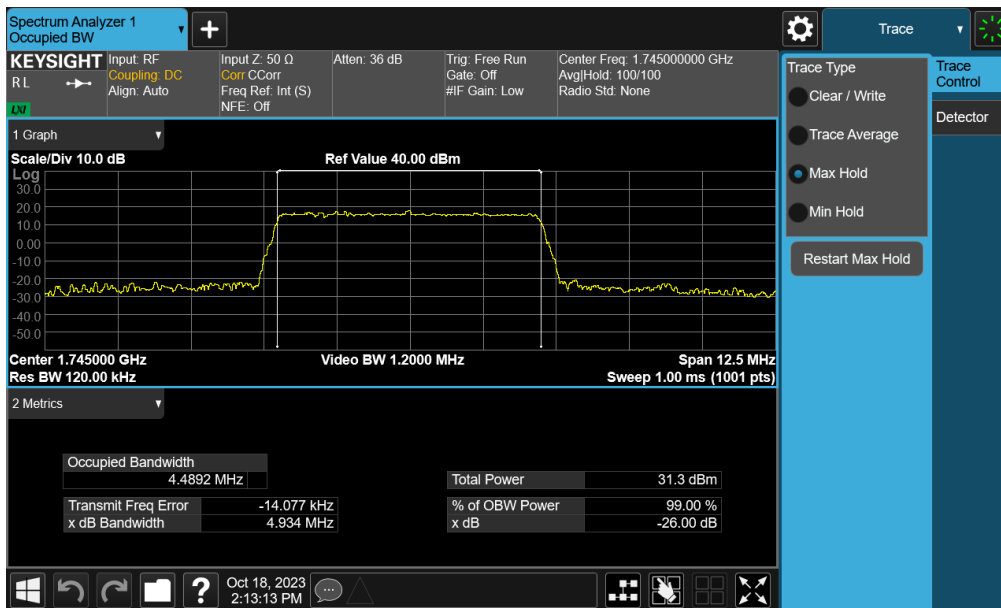
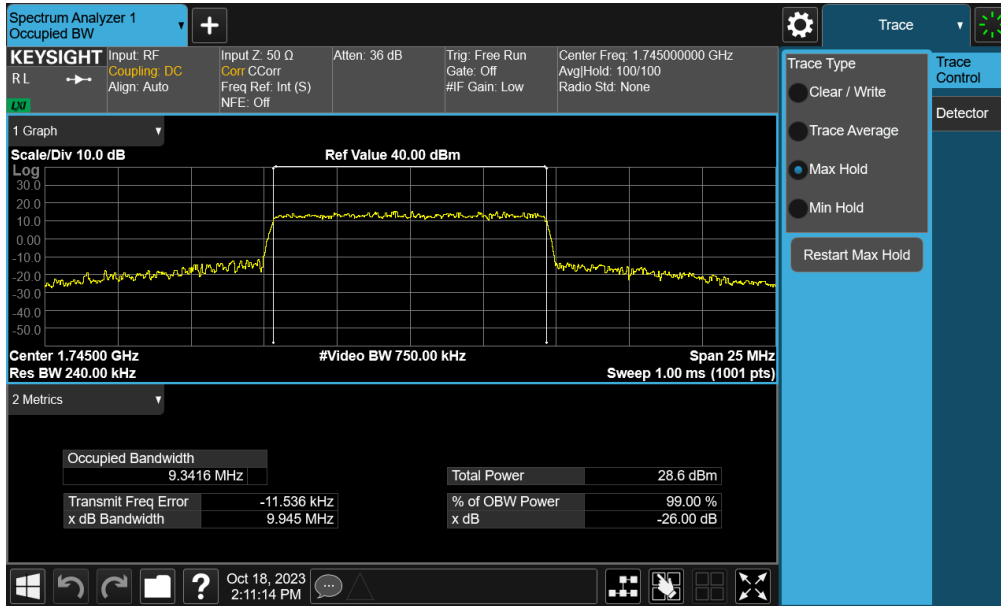


Plot 7-45. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz 16QAM - Full RB – Ant1)

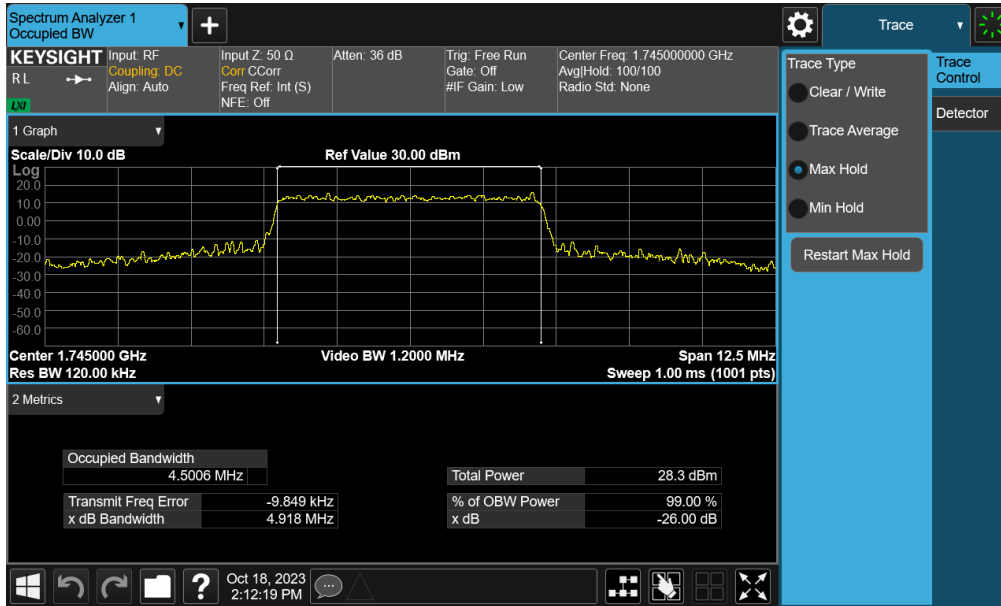
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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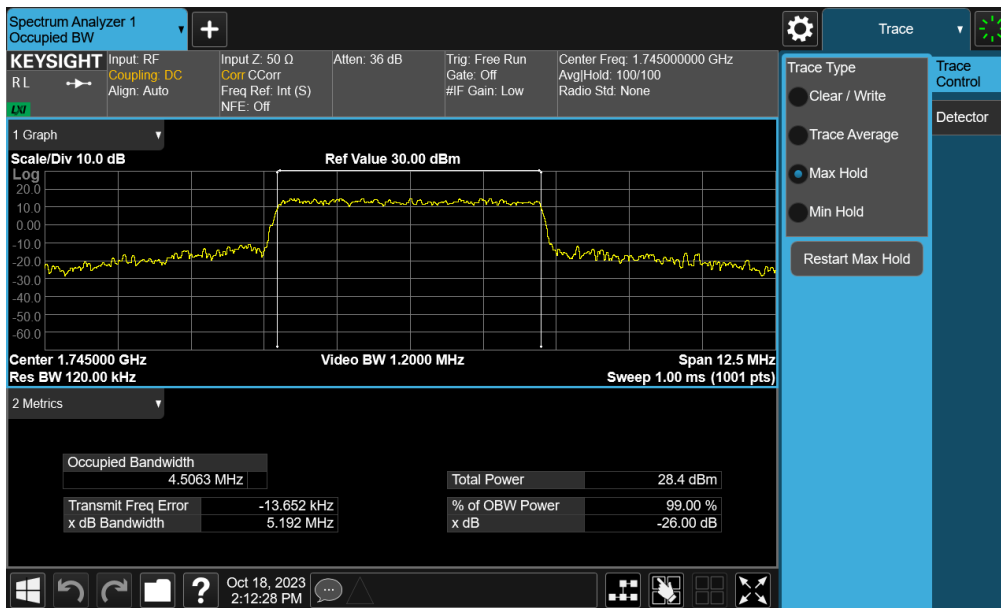
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-50. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz QPSK - Full RB – Ant1)

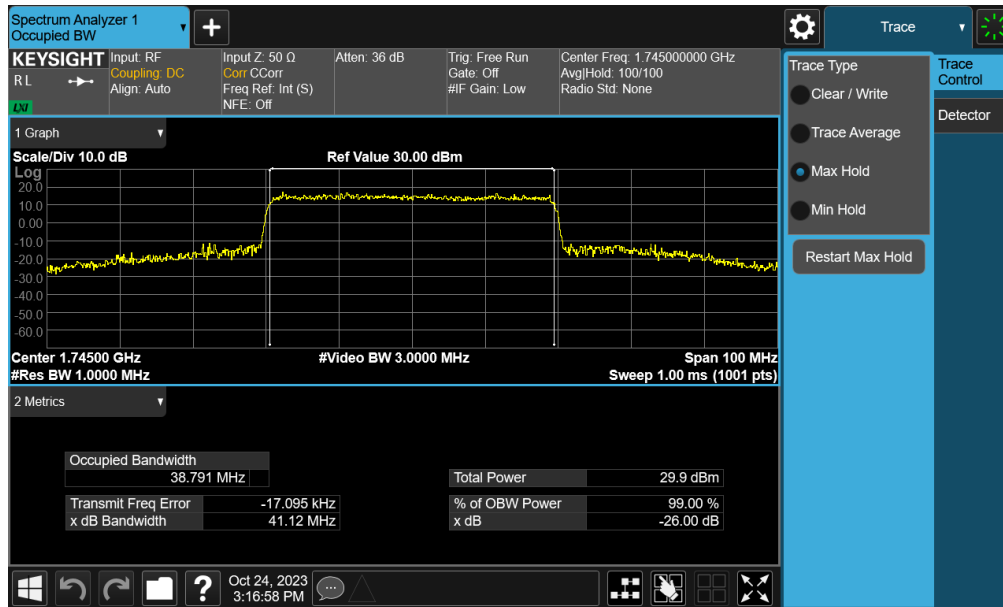


Plot 7-51. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz 16QAM - Full RB – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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NR Band n66 – Ant2

Plot 7-52. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz $\pi/2$ BPSK - Full RB – Ant2)

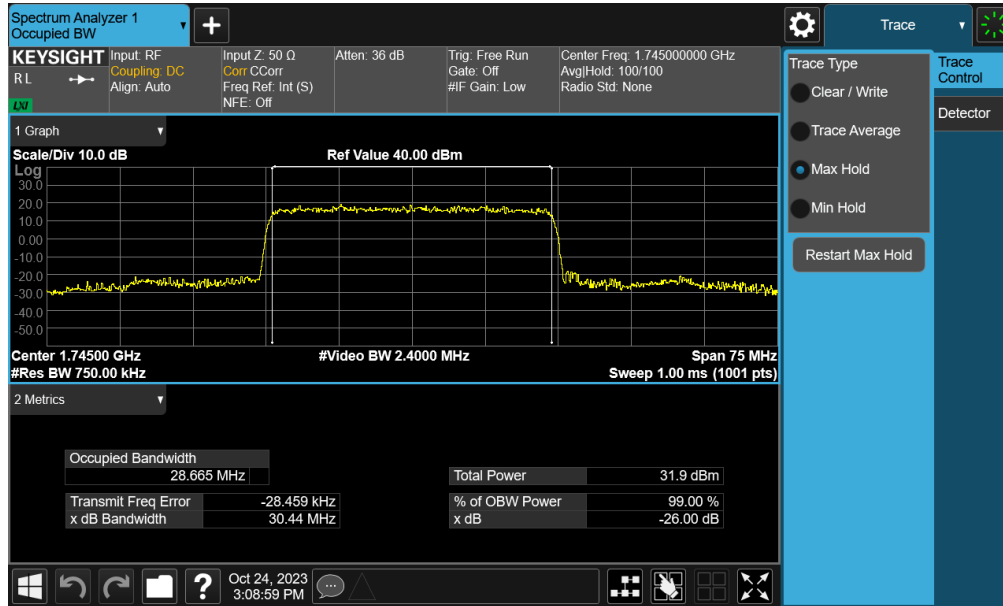


Plot 7-53. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz QPSK - Full RB – Ant2)

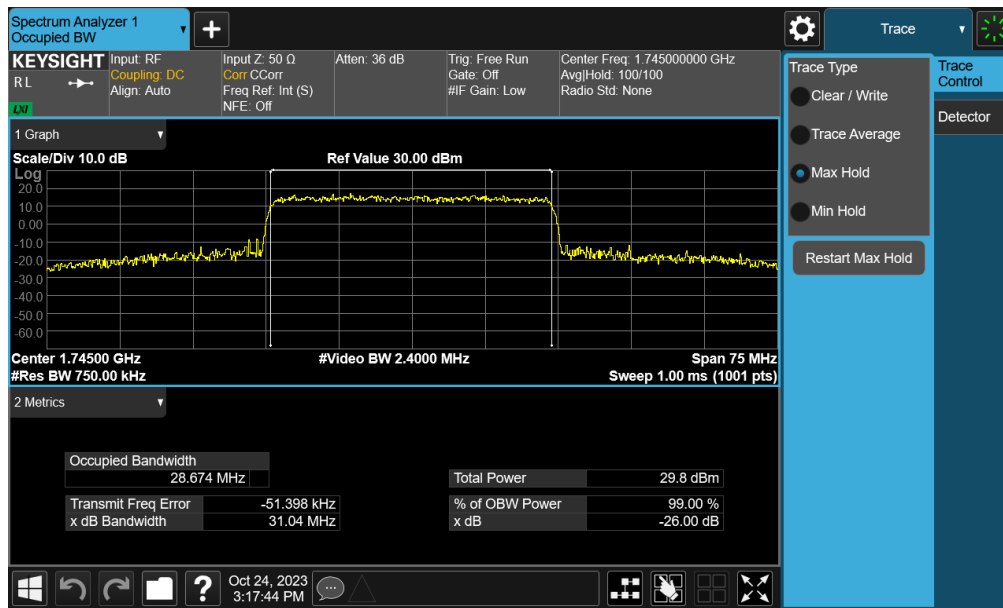


Plot 7-54. Occupied Bandwidth Plot (NR Band n66 - 40.0MHz 16QAM - Full RB – Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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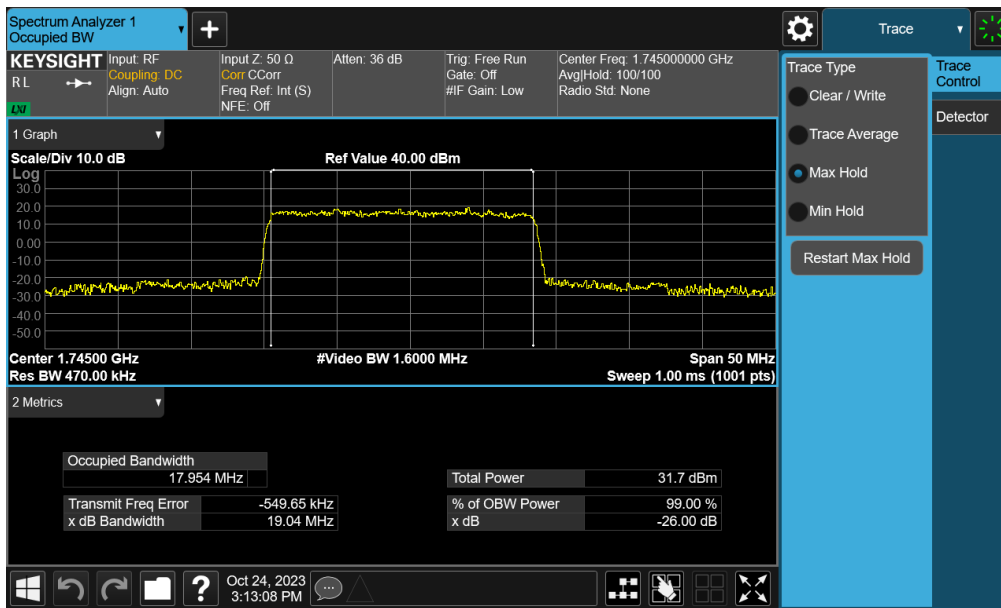
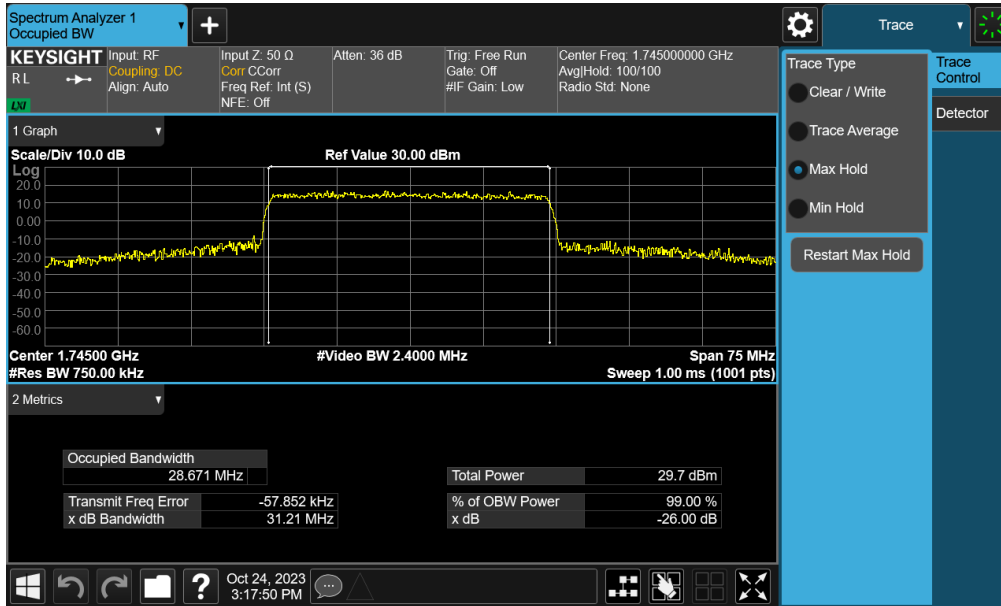


Plot 7-55. Occupied Bandwidth Plot (NR Band n66 - 30.0MHz $\pi/2$ BPSK - Full RB - Ant2)

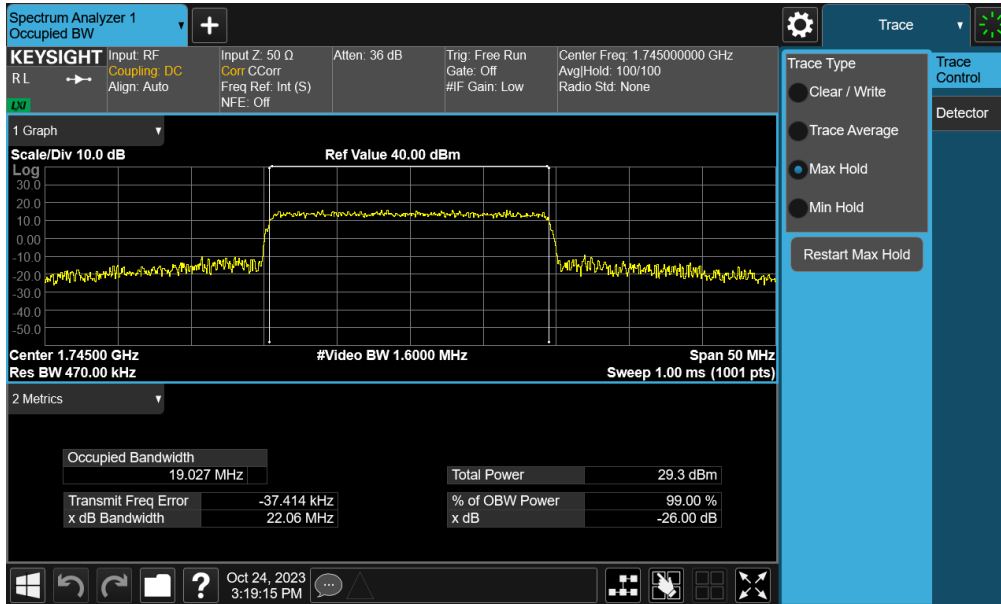


Plot 7-56. Occupied Bandwidth Plot (NR Band n66 - 30.0MHz 16QAM - Full RB - Ant2)

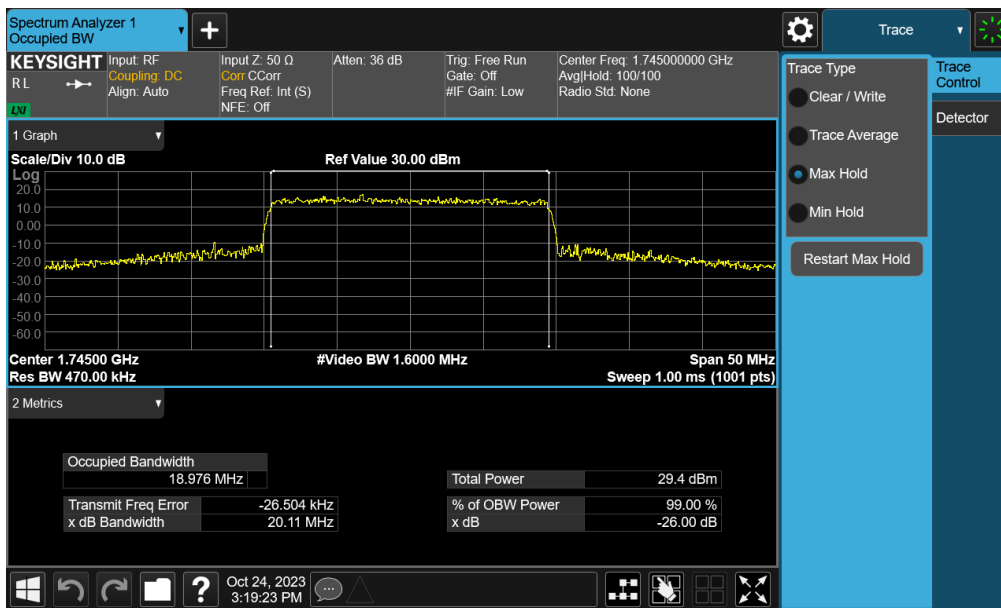
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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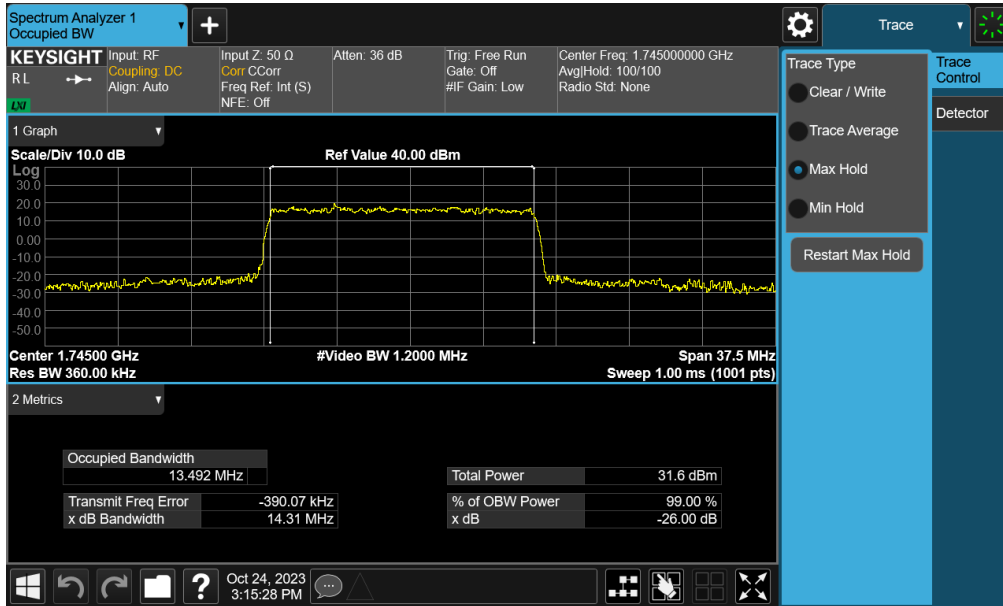


Plot 7-59. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz QPSK - Full RB – Ant2)

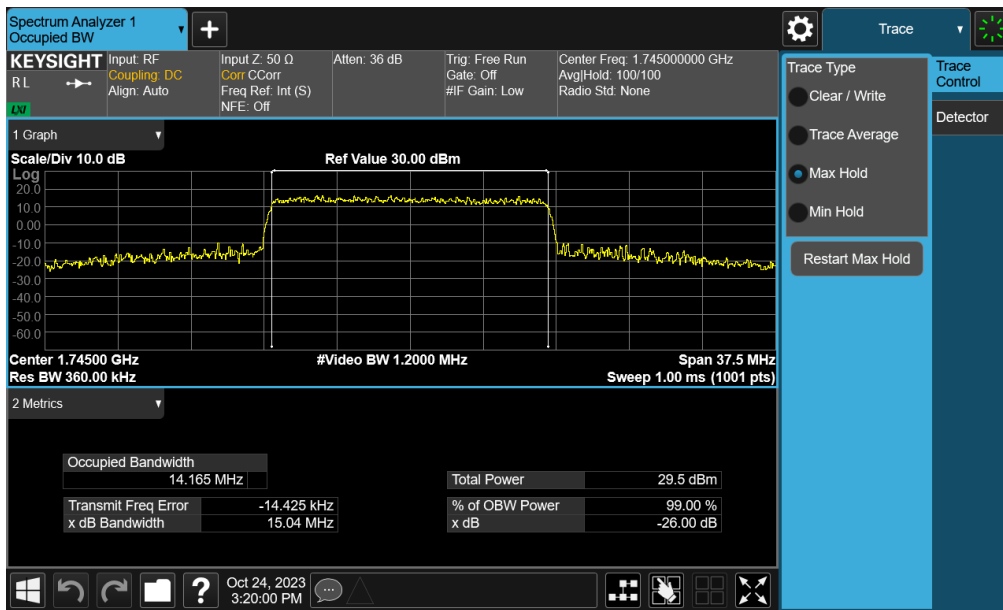


Plot 7-60. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz 16QAM - Full RB – Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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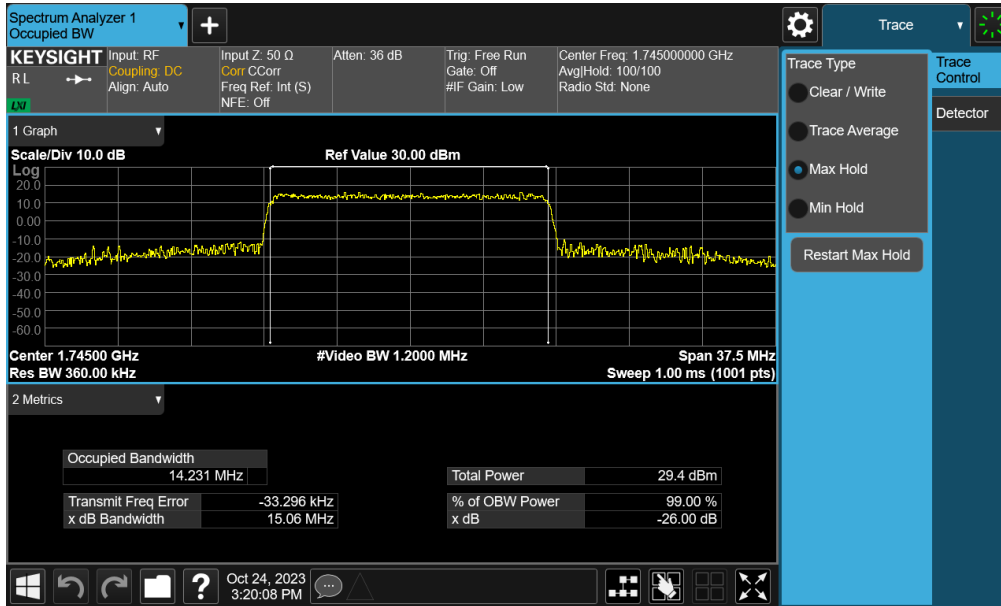


Plot 7-61. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz $\pi/2$ BPSK - Full RB - Ant2)

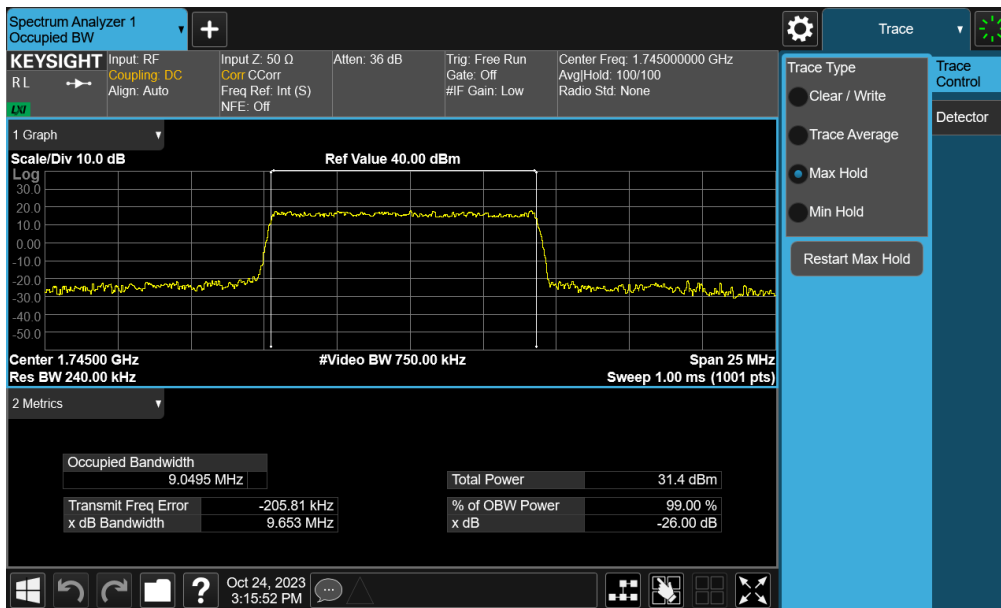


Plot 7-62. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz QPSK - Full RB - Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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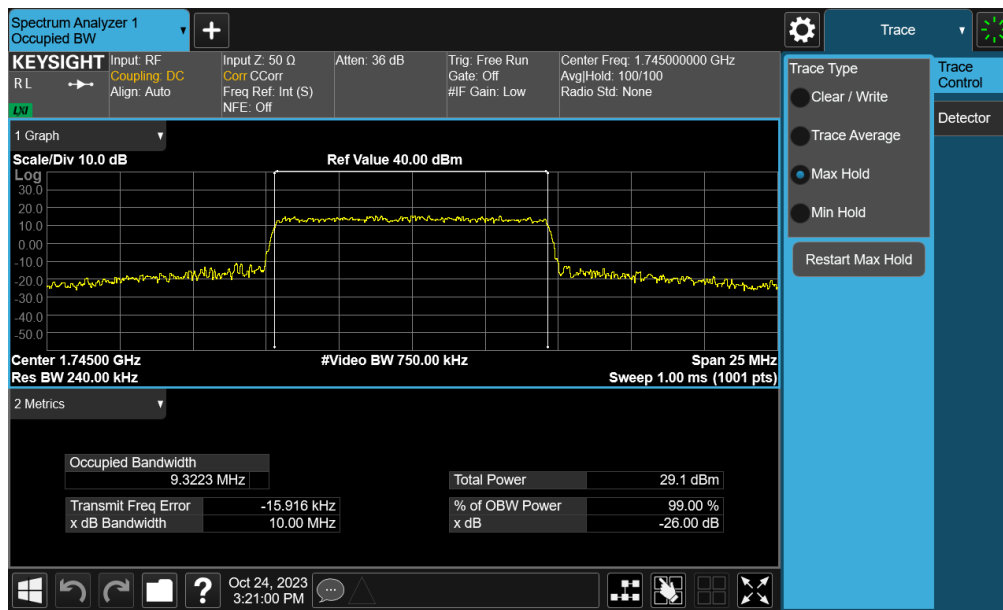
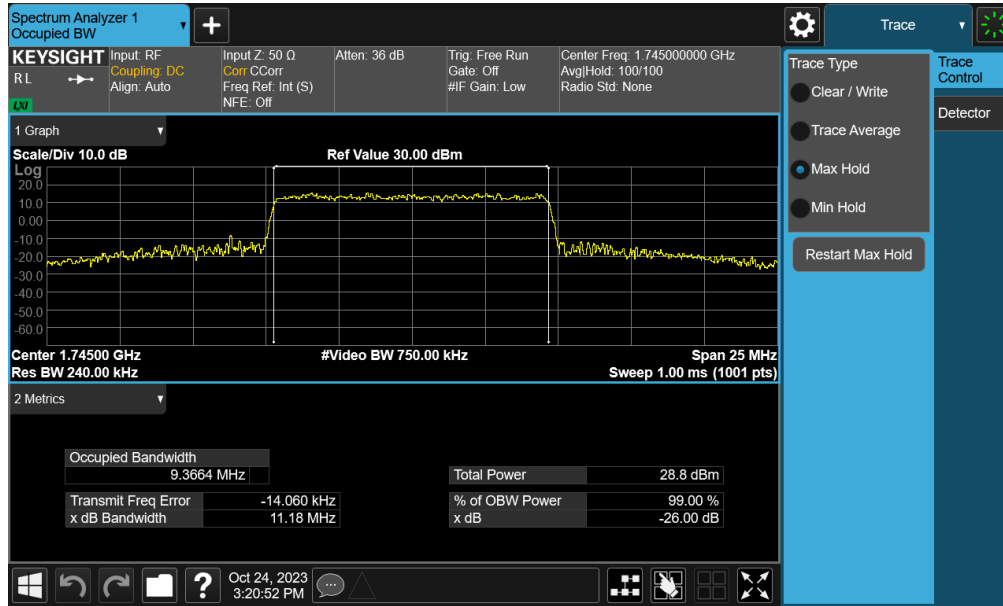


Plot 7-63. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz 16QAM - Full RB – Ant2)

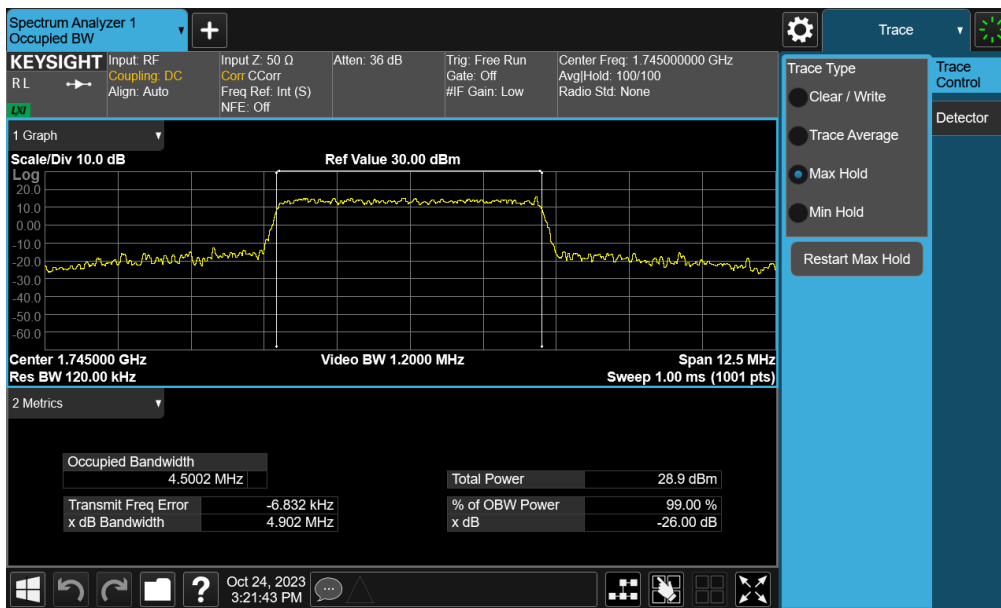
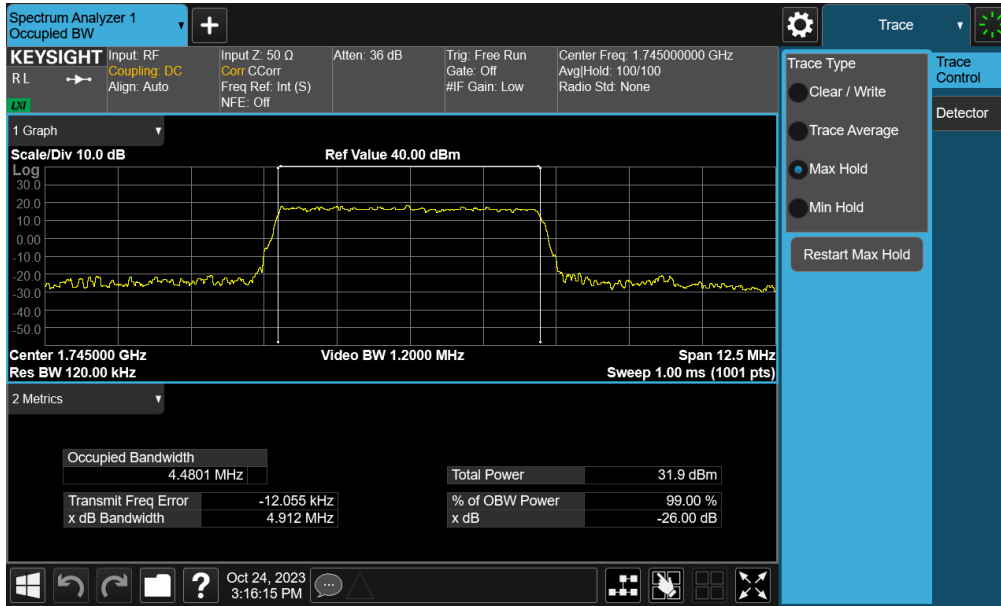


Plot 7-64. Occupied Bandwidth Plot (NR Band n66 - 10.0MHz π/2 BPSK - Full RB – Ant2)

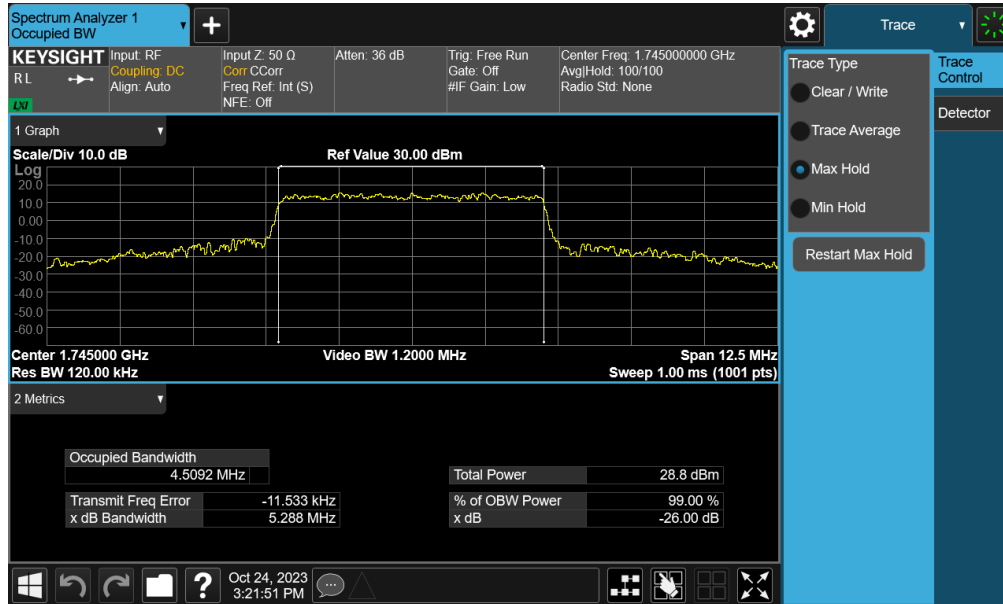
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-69. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz 16QAM - Full RB – Ant2)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

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

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 18GHz (separated into at least two plots per channel)
2. RBW \geq 100kHz
3. VBW \geq 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.

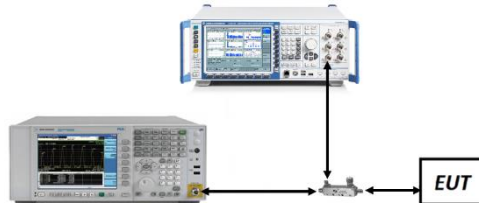


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

1. 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.
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.

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Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
LTE-B12/17	10 MHz	Low	30.0 - 679.9	-49.42	-13.00	-36.42
			716.0 - 1000.0	-59.32	-13.00	-46.32
			1000.0 - 10000.0	-45.32	-13.00	-32.32
		Mid	30.0 - 680.0	-55.67	-13.00	-42.67
			716.0 - 1000.0	-56.02	-13.00	-43.02
			1000.0 - 10000.0	-45.32	-13.00	-32.32
		High	30.0 - 679.9	-58.78	-13.00	-45.78
			716.0 - 1000.0	-47.86	-13.00	-34.86
			1000.0 - 10000.0	-45.22	-13.00	-32.22
WCDMA-AWS	5MHz	Low	30.0 - 1705.0	-33.17	-13.00	-20.17
			1755.0 - 10000.0	-47.40	-13.00	-34.40
			10000.0 - 20000.0	-62.96	-13.00	-49.96
		Mid	30.0 - 1710.0	-53.85	-13.00	-40.85
			1755.0 - 10000.0	-47.37	-13.00	-34.37
			10000.0 - 20000.0	-62.76	-13.00	-49.76
		High	30.0 - 1710.0	-53.84	-13.00	-40.84
			1760.0 - 10000.0	-35.44	-13.00	-22.44
			10000.0 - 20000.0	-62.63	-13.00	-49.63
LTE-B66/4	20MHz	Low	30.0 - 1709.0	-42.61	-13.00	-29.61
			1780.0 - 10000.0	-47.00	-13.00	-34.00
			10000.0 - 20000.0	-62.61	-13.00	-49.61
		Mid	30.0 - 1710.0	-53.92	-13.00	-40.92
			1780.0 - 10000.0	-47.35	-13.00	-34.35
			10000.0 - 20000.0	-62.46	-13.00	-49.46
		High	30.0 - 1710.0	-53.81	-13.00	-40.81
			1781.0 - 10000.0	-42.36	-13.00	-29.36
			10000.0 - 20000.0	-62.46	-13.00	-49.46
NR-n66	20MHz	Low	30.0 - 1709.0	-45.17	-13.00	-32.17
			1780.0 - 10000.0	-47.33	-13.00	-34.33
			10000.0 - 20000.0	-63.66	-13.00	-50.66
		Mid	30.0 - 1710.0	-52.64	-13.00	-39.64
			1780.0 - 10000.0	-47.46	-13.00	-34.46
			10000.0 - 20000.0	-63.48	-13.00	-50.48
		High	30.0 - 1710.0	-53.56	-13.00	-40.56
			1781.0 - 10000.0	-45.52	-13.00	-32.52
			10000.0 - 20000.0	-63.60	-13.00	-50.60

Table 7-4. Summary of Conducted Spurious Emission Test Results – Ant1

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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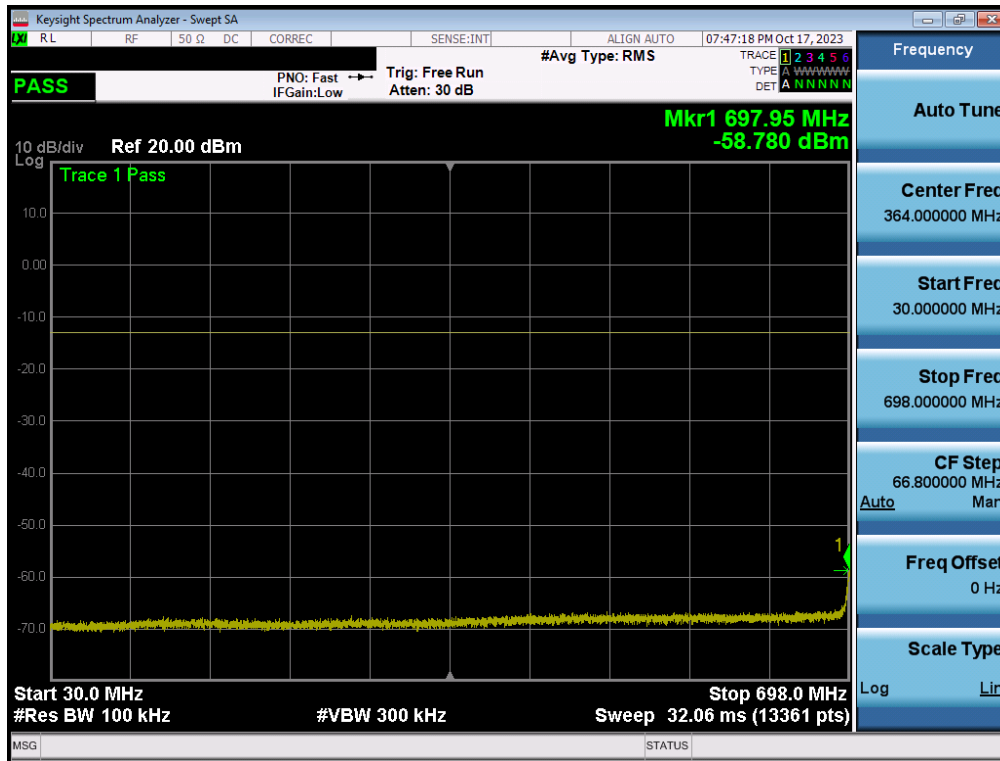


Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
LTE-B4	20MHz	Low	30.0 - 1709.0	-43.72	-13.00	-30.72
			1780.0 - 10000.0	-39.55	-13.00	-26.55
			10000.0 - 20000.0	-62.10	-13.00	-49.10
		Mid	30.0 - 1710.0	-50.80	-13.00	-37.80
			1780.0 - 10000.0	-42.03	-13.00	-29.03
			10000.0 - 20000.0	-62.07	-13.00	-49.07
		High	30.0 - 1710.0	-53.44	-13.00	-40.44
			1781.0 - 10000.0	-40.19	-13.00	-27.19
			10000.0 - 20000.0	-62.31	-13.00	-49.31
NR-n66	20MHz	Low	30.0 - 1709.0	-45.81	-13.00	-32.81
			1780.0 - 10000.0	-42.59	-13.00	-29.59
			10000.0 - 20000.0	-63.16	-13.00	-50.16
		Mid	30.0 - 1710.0	-52.64	-13.00	-39.64
			1780.0 - 10000.0	-39.63	-13.00	-26.63
			10000.0 - 20000.0	-62.87	-13.00	-49.87
		High	30.0 - 1710.0	-53.31	-13.00	-40.31
			1781.0 - 10000.0	-37.30	-13.00	-24.30
			10000.0 - 20000.0	-62.82	-13.00	-49.82

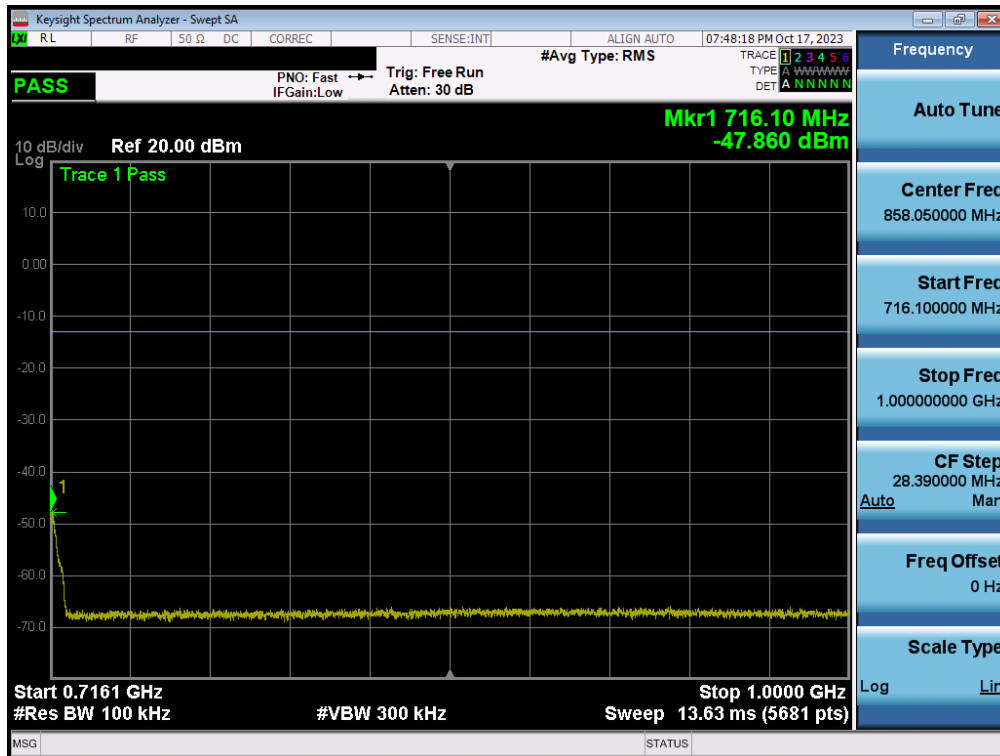
Table 7-5. Summary of Conducted Spurious Emission Test Results – Ant2

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 12/17 – Ant1



Plot 7-70. Conducted Spurious Plot (LTE Band 12/17 - 10MHz QPSK - 1 RB - High Channel - Ant1)



Plot 7-71. Conducted Spurious Plot (LTE Band 12/17 - 10MHz QPSK - 1 RB - High Channel - Ant1)

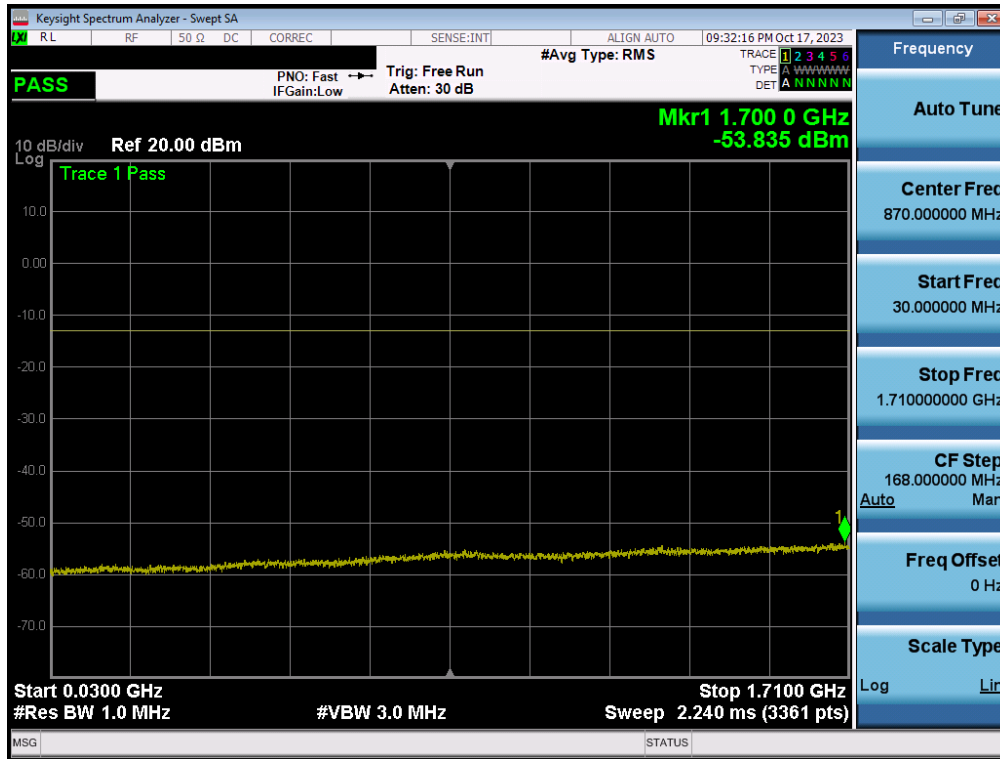
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2309070105-03.A3L	Test Dates: 9/8/2023 - 11/2/2023	EUT Type: Portable Handset	Page 54 of 119



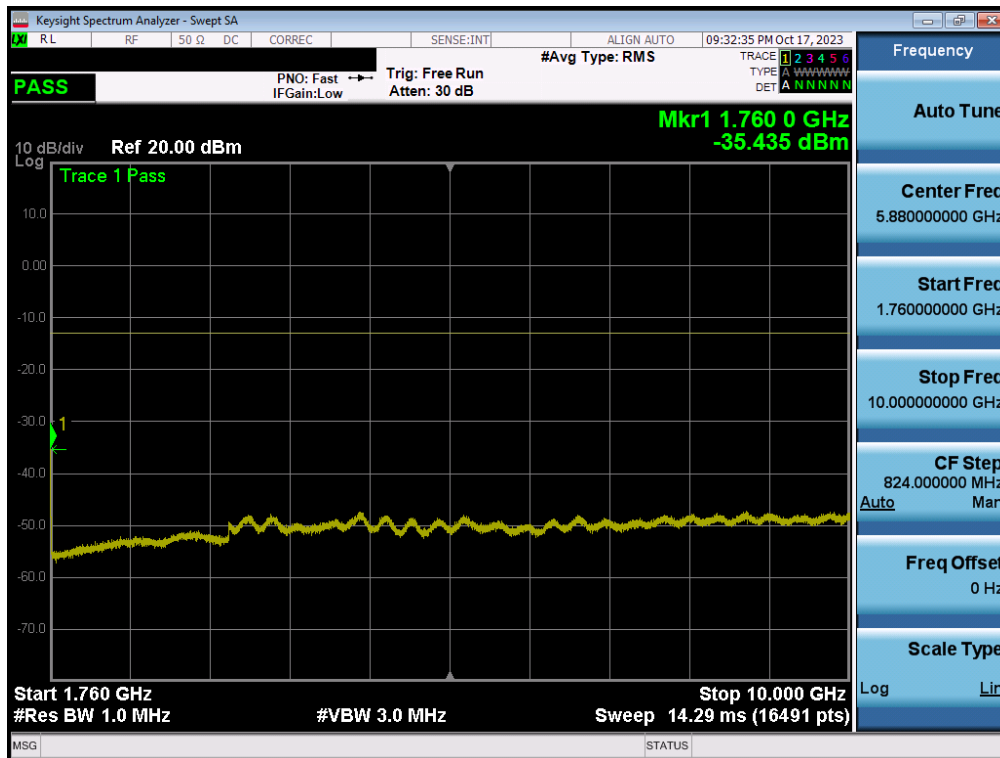
Plot 7-72. Conducted Spurious Plot (LTE Band 12/17 - 10MHz QPSK - 1 RB - High Channel - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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WCDMA AWS – Ant1

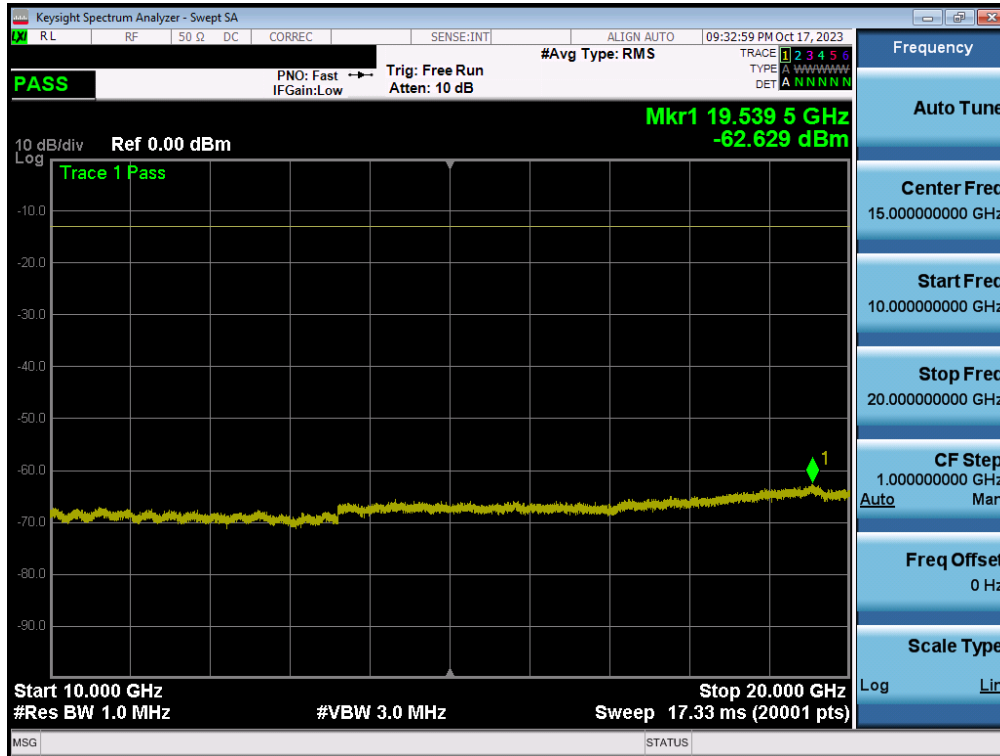


Plot 7-73. Conducted Spurious Plot (WCDMA Ch. 1513- High Channel - Ant1)



Plot 7-74. Conducted Spurious Plot (WCDMA Ch. 1513- High Channel - Ant1)

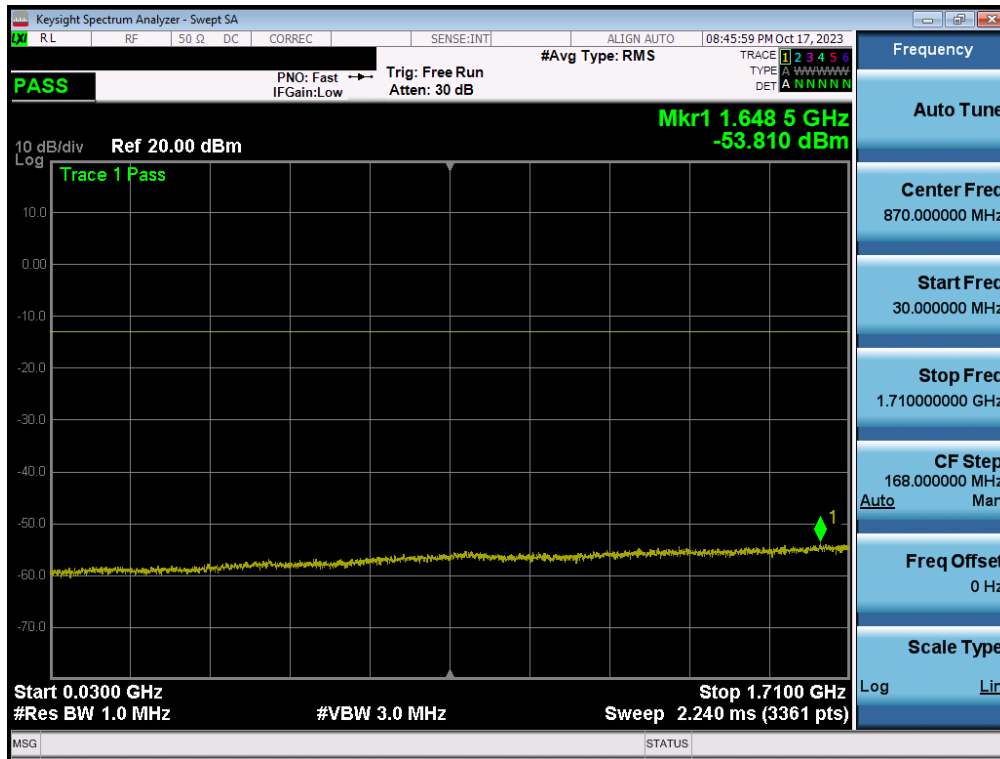
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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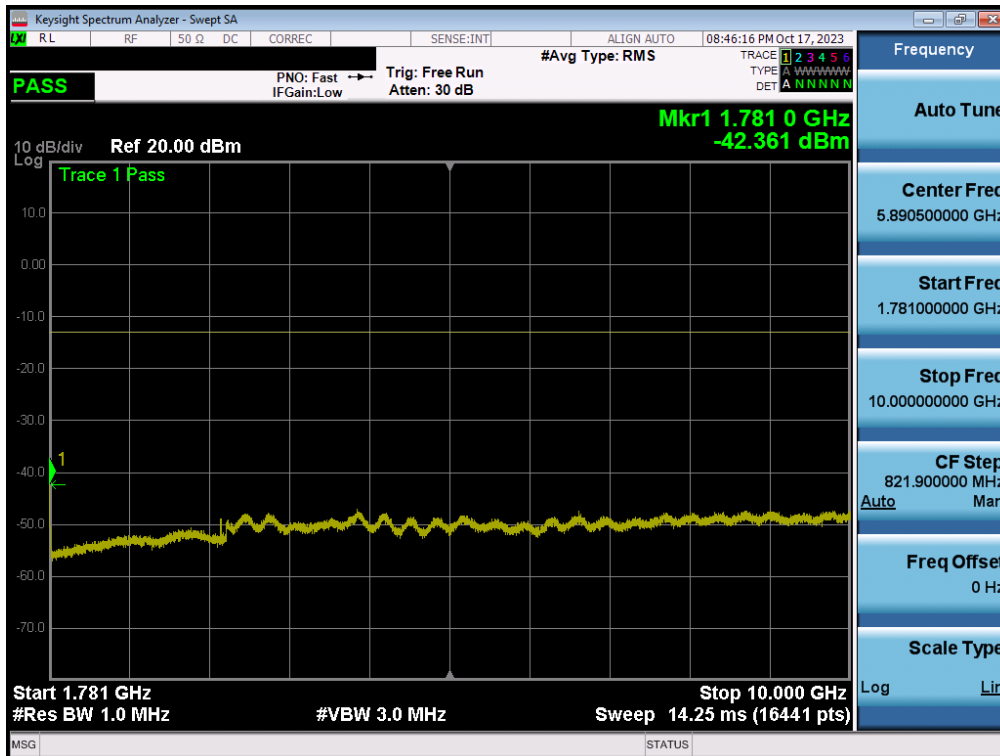
Plot 7-75. Conducted Spurious Plot (WCDMA Ch. 1513- High Channel - Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 66/4 – Ant1

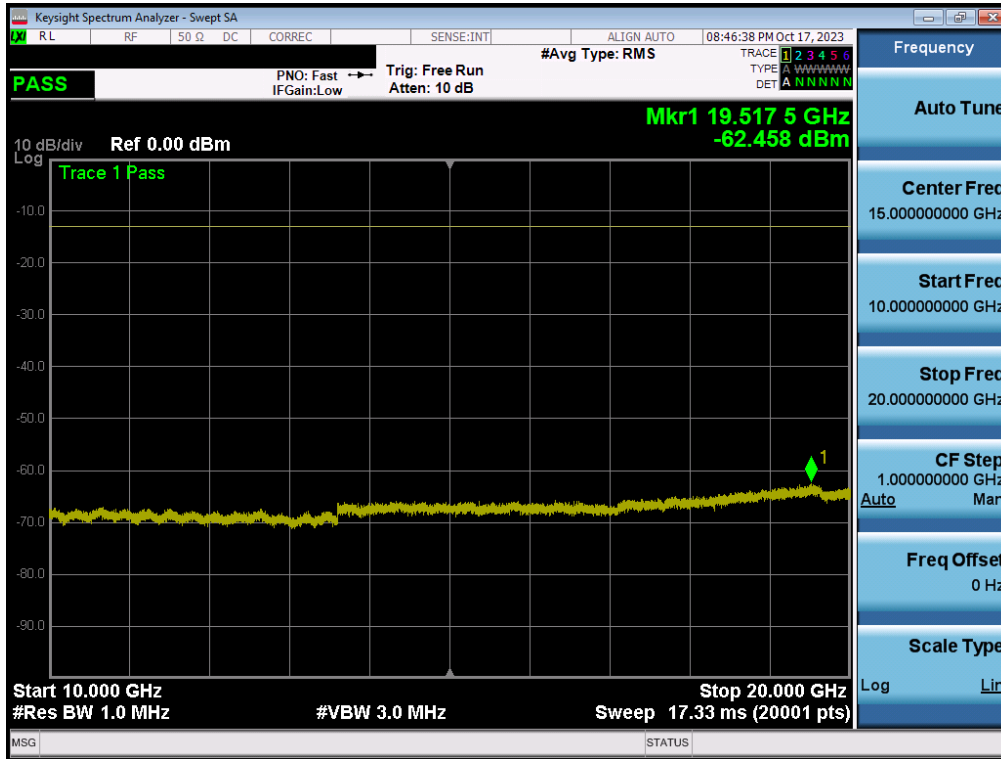


Plot 7-76. Conducted Spurious Plot (LTE Band 66/4 - 20MHz QPSK - 1 RB - High Channel – Ant1)



Plot 7-77. Conducted Spurious Plot (LTE Band 66/4 - 20MHz QPSK - 1 RB - High Channel – Ant1)

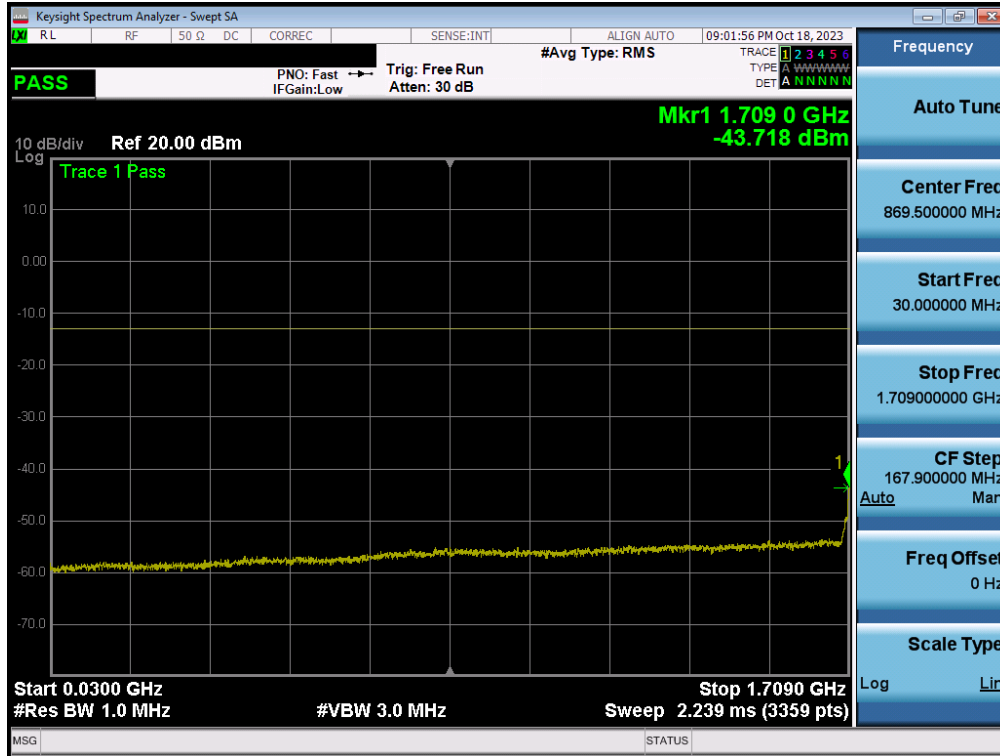
FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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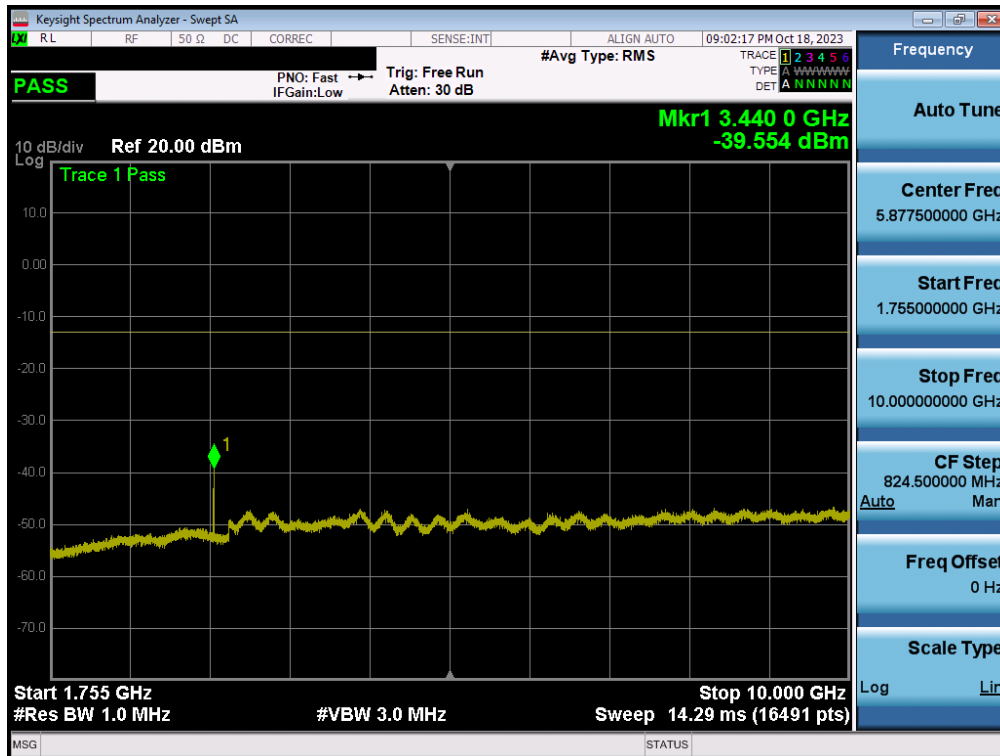
Plot 7-78. Conducted Spurious Plot (LTE Band 66/4 - 20MHz QPSK - 1 RB - High Channel – Ant1)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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LTE Band 4 – Ant2



Plot 7-79. Conducted Spurious Plot (LTE Band 4 - 20MHz QPSK - 1 RB - Low Channel – Ant2)



Plot 7-80. Conducted Spurious Plot (LTE Band 4 - 20MHz QPSK - 1 RB - Low Channel – Ant2)

FCC ID: A3LSMA156E	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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