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PART 22 MEASUREMENT REPORT

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

Date of Testing:
8/30/2024 – 11/13/2024
Test Report Issue Date:
11/13/2024
Test Site/Location:
Element Lab., Columbia, MD, USA
Element Lab., Morgan Hill, CA, USA
Test Report Serial No.:
1M2408260066-06.A3L

FCC ID:	**A3LSMS936B**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-S936B/DS
Additional Model(s):	SM-S936B
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, KDB 648474 D03 v01r04

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

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

TABLE OF CONTENTS

1.0 INTRODUCTION 4
1.1 Scope 4
1.2 Element Test Location 4
1.3 Test Facility / Accreditations 4
2.0 PRODUCT INFORMATION 5
2.1 Equipment Description 5
2.2 Device Capabilities 5
2.3 Test Configuration 5
2.4 Software and Firmware 5
2.5 EMI Suppression Device(s)/Modifications 5
3.0 DESCRIPTION OF TESTS 6
3.1 Evaluation Procedure 6
3.2 Radiated Power and Radiated Spurious Emissions 6
4.0 MEASUREMENT UNCERTAINTY 7
5.0 TEST EQUIPMENT CALIBRATION DATA 8
6.0 SAMPLE EMISSION DESIGNATORS 9
7.0 TEST RESULTS 10
7.1 Summary 10
7.2 Occupied Bandwidth 13
7.3 Spurious and Harmonic Emissions at Antenna Terminal 42
7.4 Band Edge Emissions at Antenna Terminal 61
7.5 Radiated Power (ERP) 73
7.6 Radiated Spurious Emissions Measurements 79
7.7 Frequency Stability / Temperature Variation 98
8.0 CONCLUSION 103

PART 22 MEASUREMENT REPORT

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]	
GSM/GPRS	N/A	GMSK	824.2 - 848.8	0.555	27.44	0.911	29.59	242KGXW
EDGE	N/A	8-PSK	824.2 - 848.8	0.516	27.12	0.846	29.27	237KG7W
WCDMA	N/A	Spread Spectrum	826.4 - 846.6	0.086	19.34	0.141	21.49	4M15F9W
LTE Band 26/5	15MHz (Band 26 only)	QPSK	831.5 - 841.5	0.067	18.26	0.110	20.41	13M6G7D
		16QAM	831.5 - 841.5	0.054	17.33	0.089	19.48	13M5W7D
	10 MHz	QPSK	829.0 - 844.0	0.071	18.52	0.117	20.67	9M02G7D
		16QAM	829.0 - 844.0	0.059	17.70	0.097	19.85	9M02W7D
	5 MHz	QPSK	826.5 - 846.5	0.069	18.38	0.113	20.53	4M52G7D
		16QAM	826.5 - 846.5	0.062	17.89	0.101	20.04	4M53W7D
	3 MHz	QPSK	825.5 - 847.5	0.071	18.51	0.116	20.66	2M72G7D
		16QAM	825.5 - 847.5	0.059	17.74	0.097	19.89	2M71W7D
	1.4 MHz	QPSK	824.7 - 848.3	0.072	18.57	0.118	20.72	1M10G7D
		16QAM	824.7 - 848.3	0.059	17.71	0.097	19.86	1M10W7D
NR Band n26/5	20 MHz	π/2 BPSK	834.0 - 839.0	0.115	20.60	0.188	22.75	18M0G7D
		QPSK	834.0 - 839.0	0.110	20.43	0.181	22.58	19M0G7D
		16QAM	834.0 - 839.0	0.091	19.57	0.149	21.72	19M1W7D
	15 MHz	π/2 BPSK	831.5 - 841.5	0.112	20.50	0.184	22.65	13M5G7D
		QPSK	831.5 - 841.5	0.107	20.28	0.175	22.43	14M2G7D
		16QAM	831.5 - 841.5	0.084	19.23	0.138	21.38	14M2W7D
	10 MHz	π/2 BPSK	829.0 - 844.0	0.115	20.60	0.188	22.75	9M01G7D
		QPSK	829.0 - 844.0	0.113	20.51	0.185	22.66	9M35G7D
		16QAM	829.0 - 844.0	0.086	19.35	0.141	21.50	9M34W7D
	5 MHz	π/2 BPSK	826.5 - 846.5	0.115	20.60	0.188	22.75	4M50G7D
		QPSK	826.5 - 846.5	0.107	20.31	0.176	22.46	4M52G7D
		16QAM	826.5 - 846.5	0.087	19.40	0.143	21.55	4M51W7D

Antenna-2								
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	ERP		EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
GSM/GPRS	N/A	GMSK	824.2 - 848.8	0.462	26.64	0.757	28.79	249KGXW
EDGE	N/A	8-PSK	824.2 - 848.8	0.113	20.52	0.185	22.67	244KG7W
WCDMA	N/A	Spread Spectrum	826.4 - 846.6	0.065	18.14	0.107	20.29	4M16F9W
LTE Band 26/5	15MHz (Band 26 only)	QPSK	831.5 - 841.5	0.063	17.96	0.103	20.11	13M5G7D
		16QAM	831.5 - 841.5	0.053	17.21	0.086	19.36	13M5W7D
	10 MHz	QPSK	829.0 - 844.0	0.061	17.84	0.100	19.99	9M01G7D
		16QAM	829.0 - 844.0	0.054	17.29	0.088	19.44	9M02W7D
	5 MHz	QPSK	826.5 - 846.5	0.061	17.88	0.101	20.03	4M50G7D
		16QAM	826.5 - 846.5	0.053	17.26	0.087	19.41	4M52W7D
	3 MHz	QPSK	825.5 - 847.5	0.061	17.83	0.100	19.98	2M70G7D
		16QAM	825.5 - 847.5	0.055	17.40	0.090	19.55	2M71W7D
	1.4 MHz	QPSK	824.7 - 848.3	0.060	17.76	0.098	19.91	1M10G7D
		16QAM	824.7 - 848.3	0.051	17.10	0.084	19.25	1M11W7D
NR Band n26/5	20 MHz	π/2 BPSK	834.0 - 839.0	0.075	18.77	0.123	20.92	18M0G7D
		QPSK	834.0 - 839.0	0.077	18.88	0.127	21.03	19M0G7D
		16QAM	834.0 - 839.0	0.059	17.73	0.097	19.88	19M1W7D
	15 MHz	π/2 BPSK	831.5 - 841.5	0.077	18.87	0.127	21.02	13M5G7D
		QPSK	831.5 - 841.5	0.080	19.02	0.131	21.17	14M2G7D
		16QAM	831.5 - 841.5	0.061	17.82	0.099	19.97	14M2W7D
	10 MHz	π/2 BPSK	829.0 - 844.0	0.077	18.86	0.126	21.01	9M01G7D
		QPSK	829.0 - 844.0	0.078	18.92	0.128	21.07	9M36G7D
		16QAM	829.0 - 844.0	0.064	18.04	0.105	20.19	9M35W7D
	5 MHz	π/2 BPSK	826.5 - 846.5	0.075	18.73	0.122	20.88	4M50G7D
		QPSK	826.5 - 846.5	0.079	18.96	0.129	21.11	4M51G7D
		16QAM	826.5 - 846.5	0.066	18.16	0.107	20.31	4M50W7D

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

Measurements were conducted at the Element laboratory(ies) indicated in Section 1.3 below. All measurement facilities are compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element lab located in Columbia, MD 21046, U.S.A. ("MD")

- 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 Agreements (MRAs).

Measurements were performed at Element located in Morgan Hill, CA 95037, U.S.A. ("CA")

- Element is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element facility is a registered (22831) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMS936B**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 22 and RSS-132.

Test Device Serial No.: 2299M, 1268M, 1299M, 1287M, 1385M, 0135M

2.2 Device Capabilities

This device contains the following capabilities:

800/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 5G NR (FR1), 802.11b/g/n/ac/ax/be WLAN, 802.11a/n/ac/ax/be UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), Wireless Power Transfer, UWB

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

2.3 Test Configuration

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

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model: EP-P2400 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

Band	Ant1	Ant2
GSM/GPRS	Ant A	Ant E
WCDMA	Ant A	Ant E
LTE Band 26/5	Ant A	Ant E
NR Band n26/5	Ant A	Ant E

Table 2-1. Antenna Naming Convention

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version S936BXXU0AXJO installed on the EUT.

2.5 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

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

Deviation from Measurement Procedure……..None

3.2 Radiated Power and Radiated Spurious Emissions

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

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

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

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

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

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

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

And

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

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

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

4.0 MEASUREMENT UNCERTAINTY

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

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

Table 4-1. Measurement Uncertainty Budget – MD

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.65
Line Conducted Disturbance	2.71
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz - 1GHz)	4.30
Radiated Disturbance (1 - 18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

Table 4-2. Measurement Uncertainty Budget – CA

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	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	AP2
-	AP1	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	AP1
-	ETS	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	ETS
-	LTx1	Licensed Transmitter Cable Set	4/2/2024	Annual	4/2/2025	LTx1
-	LTx4	Licensed Transmitter Cable Set	4/2/2024	Annual	4/2/2025	LTx4
-	LTx5	LIcensed Transmitter Cable Set	4/2/2024	Annual	4/2/2025	LTx5
Agilent	N9030A	50GHz PXA Signal Analyzer	4/23/2024	Annual	4/23/2025	US51350301
Anritsu	MT8821C	Radio Communication Analyzer	N/A			6201381794
Emco	3116	Horn Antenna (18 - 40GHz)	7/5/2023	Triennial	7/5/2025	9203-2178
Espec	ESX-2CA	Environmental Chamber	9/26/2024	Annual	9/26/2026	17620
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	3/29/2023	Biennial	3/29/2025	128337
ETS Lindgren	3164-10	Quad Ridge Horn 400MHz - 10000MHz	7/13/2023	Biennial	7/13/2025	00166283
Keysight Technologies	N9020A	MXA Signal Analyzer	4/11/2024	Annual	4/11/2025	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer	2/29/2024	Annual	3/1/2025	MY55410501
Mini-Circuits	SSG-4000HP	Synthesized Signal Generator	N/A			11208010032
Mini-Circuits	SSG-4000HP	Synthesized Signal Generator	N/A			11403100002
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			112347
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	10/16/2024	Annual	10/16/2025	100342
Rohde & Schwarz	FSW26	2Hz-26.5GHz Signal and Spectrum Analyzer	3/8/2024	Annual	3/8/2025	103187
Sunol	JB6	LB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816

Table 5-1. Test Equipment Calibration Table – MD

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
ETS Lindgren	ETS 3117	1-18GHz Rx Antenna	8/29/2024	Annual	8/29/2025	205956
Rohde & Schwarz	TS-SFUNIT	1-18GHz Preamp	5/29/2024	Annual	5/29/2025	102141
Rohde & Schwarz	TS-PR8	30M-1GHz Preamp	7/3/2024	Annual	7/3/2025	102356
Rohde & Schwarz	FSW43	EMI Receiver/Analyzer	2/12/2024	Annual	2/12/2025	104092

Table 5-2. Test Equipment Calibration Table – CA

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 EMISSION DESIGNATORS

GSM Emission Designator

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

EDGE Emission Designator

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

WCDMA Emission Designator

Emission Designator = 4M16F9W
WCDMA BW = 4.16 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

QPSK Modulation

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

QAM Modulation

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

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMS936B

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

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

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference	Test Lab Location
CONDUCTED	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.2	MD
	Conducted Band Edge / Spurious Emissions	2.1051, 22.917(a)	≥ 43 + 10 log (P[Watts]) dB of attenuation below transmitter power	PASS	Sections 7.3, 7.4	MD
	Frequency Stability	2.1055, 22.355	The carrier frequency of the transmitter must be maintained within the 2.5ppm	PASS	Section 7.7	MD
RADIATED	Effective Radiated Power / Equivalent Isotropic Radiated Power	22.913(a)(5)	< 7 Watts max. ERP	PASS	Section 7.5	MD
	Radiated Spurious Emissions	2.1053, 22.917(a)	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions	PASS	Section 7.6	CA

Table 7-1. Summary of Test Results

Notes:

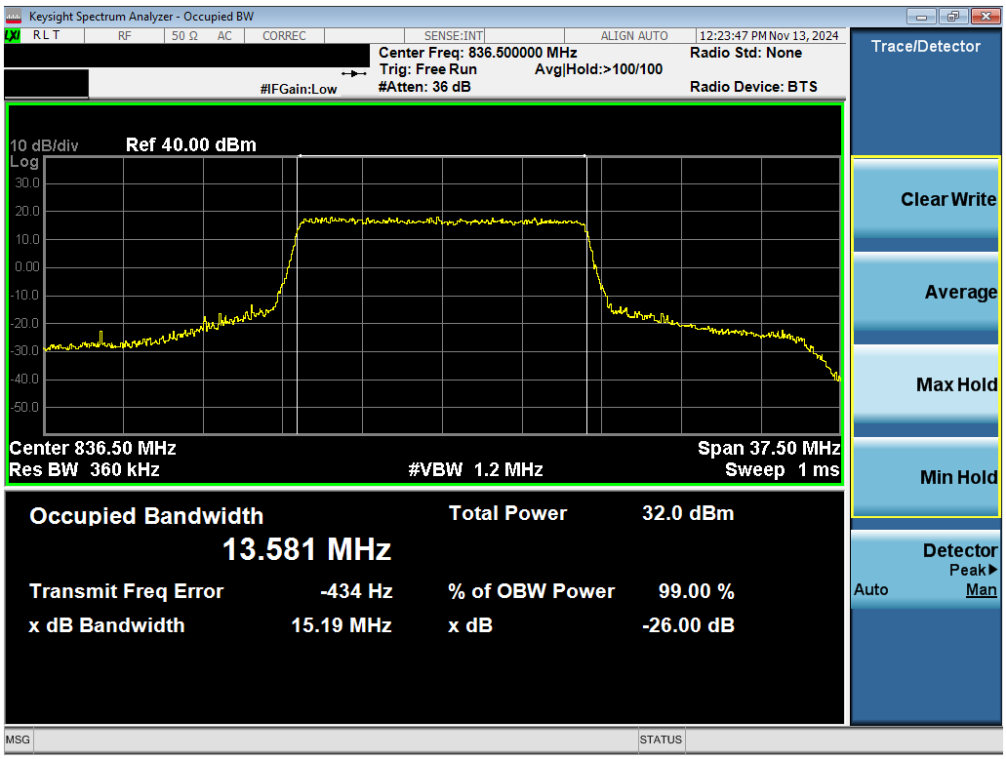
1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.2.2.
5) No conducted powers were included in the report. For the conducted power measurements please see the **RF Exposure Report.**
6) Data was leveraged from model SM-S936U for the certification of SM-S936B/DS. See Table 7-2 for spot-check results.

FCC Rules	Test Item	Test Case	Units	Limit	Reference Model: SM-S936U	Variant Model: SM-S936B/DS	Deviation (dB)	Max Deviation (dB)	Pass/Fail
22	Conducted Output Power	High Ch., 15MHz, QPSK, Ant A	dBm	N/A	24.85	24.03	-0.82	1	PASS
	Occupied Bandwidth	Mid Ch., 15MHz, QPSK, Ant A	dBm	N/A	13.598	13.581	-	N/A	PASS
	ERP	Mid Ch., 15MHz, QPSK, Ant A	dBm	38.45	18.26	17.98	-0.28	3	PASS
	RSE	Mid Ch., 10MHz, 2509.5MHz, Ant A	dBm	-13	-60.94	-60.13	0.81	3	PASS

Table 7-2. Summary of Spot-Checks

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
15I	QPSK	26965	841.5	1 / 0	24.03

Table 7-3. Conducted Output Power Measurements (Spot-check)



Plot 7-1. Occupied Bandwidth (Spot-check)

Bandwidth	Mod.	Frequency [MHz]	Ant. Pol. [H/V]	EUT Pol.	Antenna Height [cm]	Turntable Azimuth [degree]	Ant. Gain [dBi]	RB Size/Offset	Substitute Level [dBm]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
15MHz	QPSK	836.50	H	Y	136	188	1.54	1 / 37	18.59	**17.98**	0.063	38.45	-20.47

Table 7-4. ERP Measurements (Spot-check)

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]
2509.50	H	-	-	-84.04	12.17	35.13	-60.13	-13.00	-47.13

Table 7-5. Radiated Spurious Measurements (Spot-check)

1. Each spot check test on the EUT was performed using the same procedure and setting that were used to perform the test on the corresponding reference device.

2. All test cases were performed to verify the variant EUT is still in compliance with the spot checked results to the reference device and was performed using the guidance of ANSI C63.26-2015.

7.2 Occupied Bandwidth

Test Overview

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

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

Test Setup

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

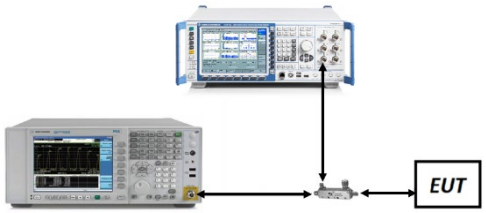


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

Mode	Bandwidth	Modulation	OBW [MHz]
GSM-Cell	N/A	GMSK	0.242
GSM-Cell Edge		8-PSK	0.237
WCDMA-Cell		Spread Spectrum	4.15
LTE-B26-5	15MHz	QPSK	13.60
		16QAM	13.50
	10MHz	QPSK	9.02
		16QAM	9.02
	5 MHz	QPSK	4.52
		16QAM	4.53
	3 MHz	QPSK	2.72
		16QAM	2.71
	1.4 MHz	QPSK	1.10
		16QAM	1.10
NR-n26-5	20 MHz	π/2 BPSK	17.98
		QPSK	18.98
		16QAM	19.10
	15 MHz	π/2 BPSK	13.53
		QPSK	14.19
		16QAM	14.17
	10 MHz	π/2 BPSK	9.01
		QPSK	9.35
		16QAM	9.34
	5 MHz	π/2 BPSK	4.50
		QPSK	4.52
		16QAM	4.51

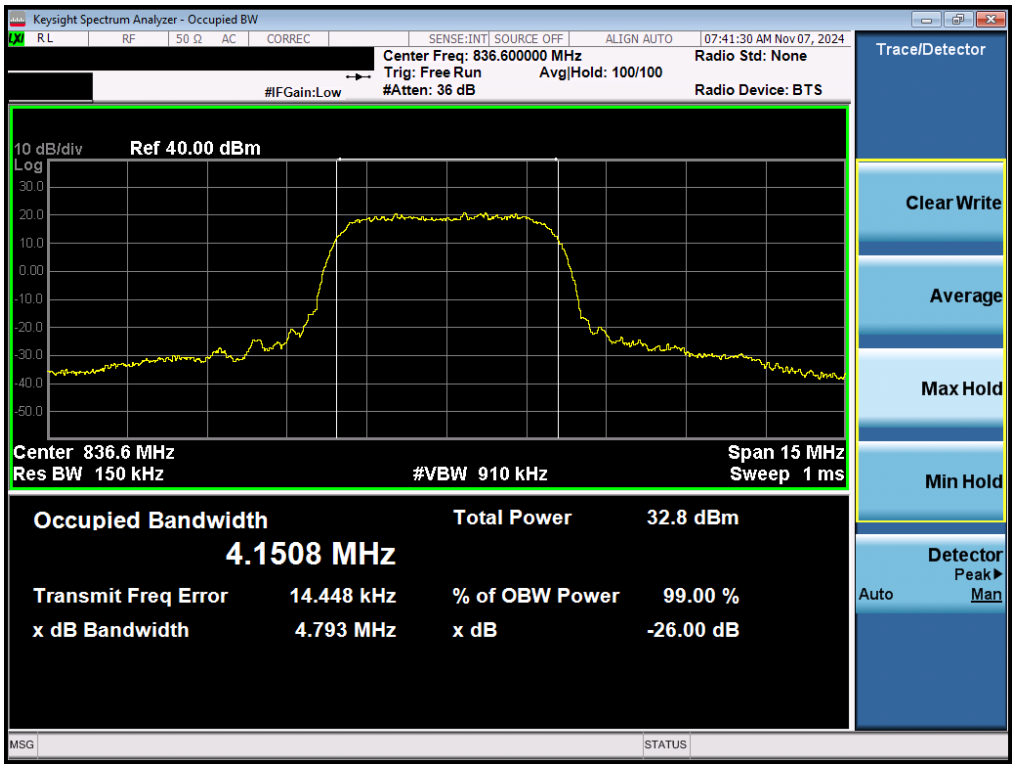
Table 7-6. Occupied Bandwidth Results – Ant1

GPRS Cell – Ant1

Plot 7-2. Occupied Bandwidth Plot (GPRS, Ch. 190 – Ant1)

Plot 7-3. Occupied Bandwidth Plot (EDGE, Ch. 190 – Ant1)

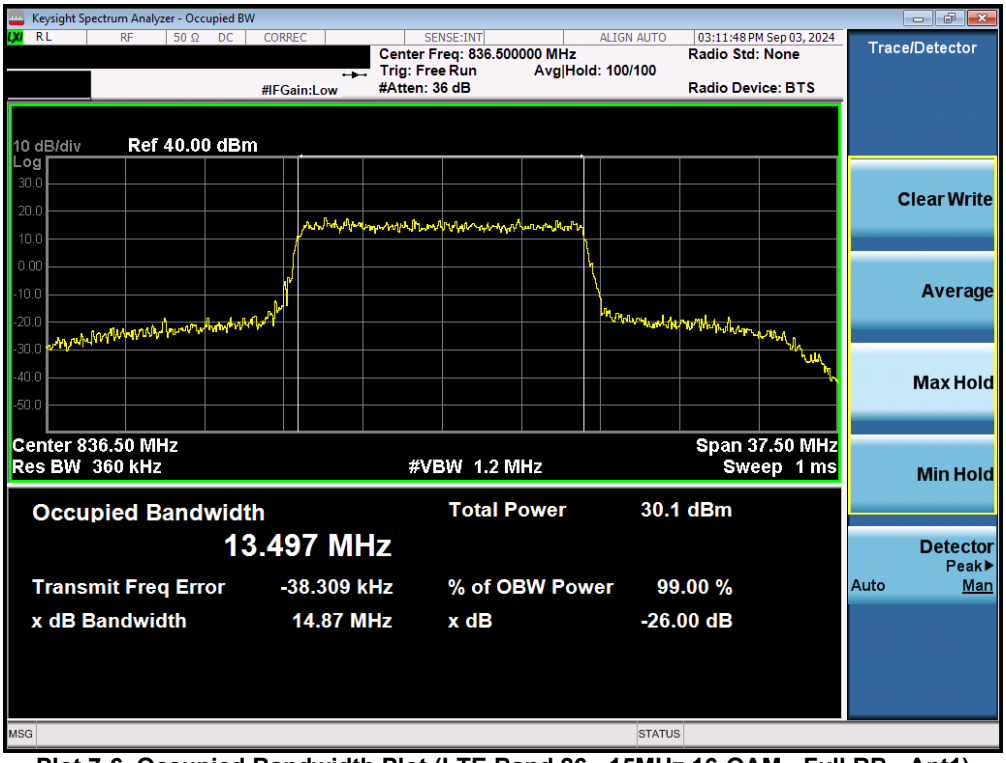
WCDMA Cell – Ant1



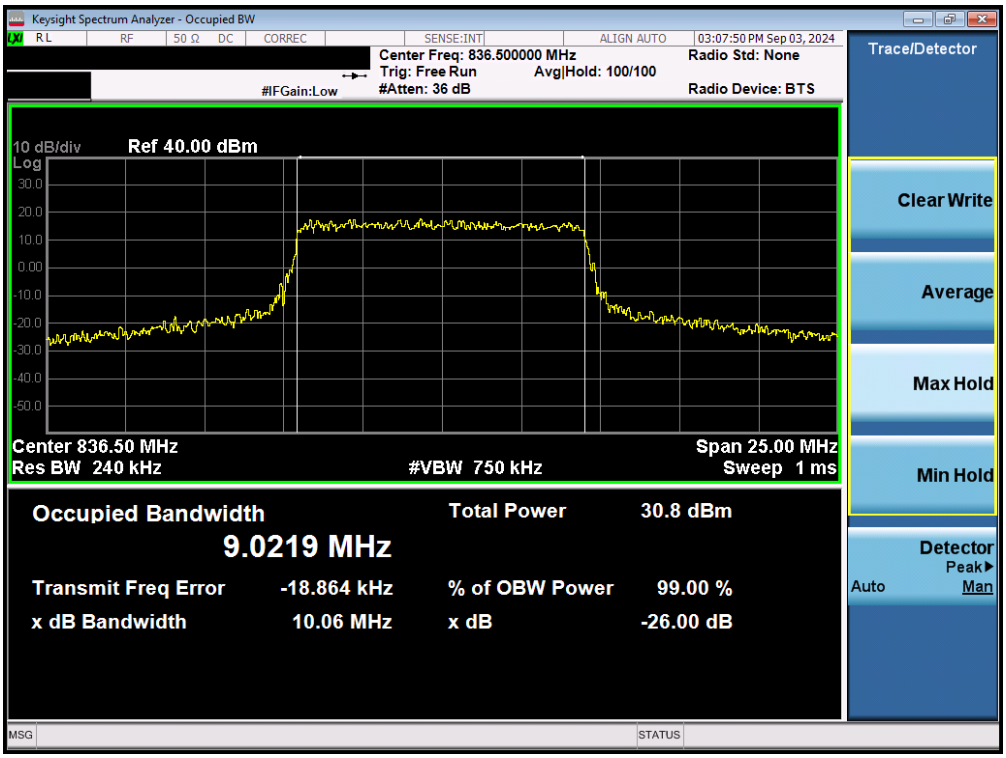
Plot 7-4. Occupied Bandwidth Plot (WCDMA, Ch. 4183 – Ant1)

LTE Band 26/5 – Ant1

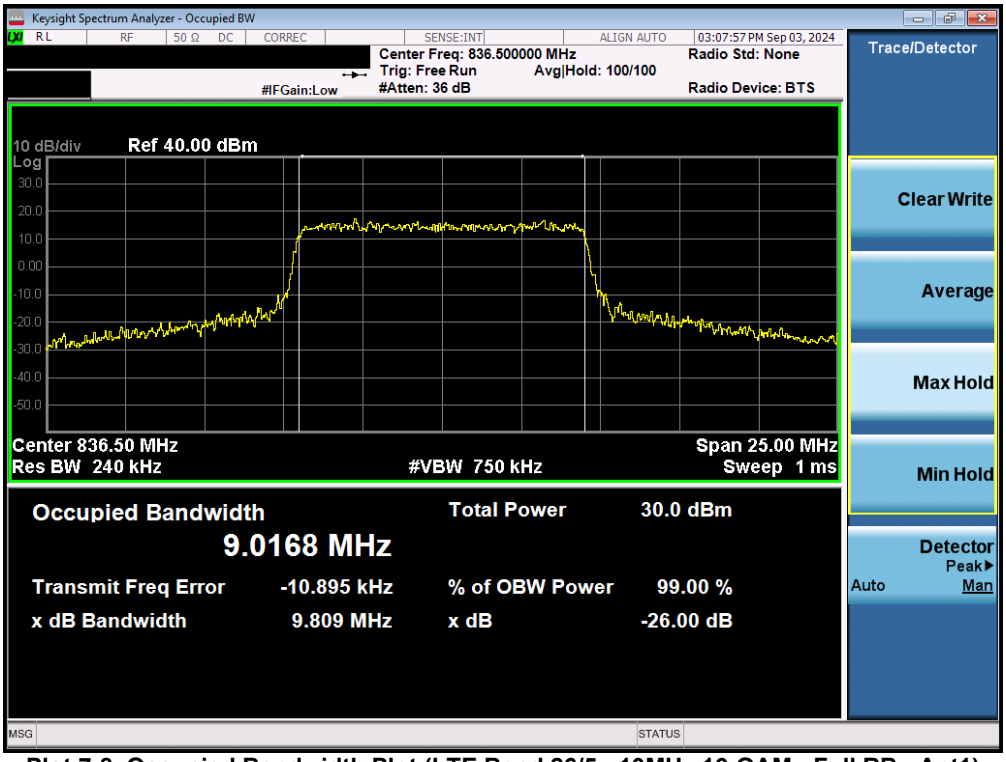
Plot 7-5. Occupied Bandwidth Plot (LTE Band 26 - 15MHz QPSK - Full RB - Ant1)



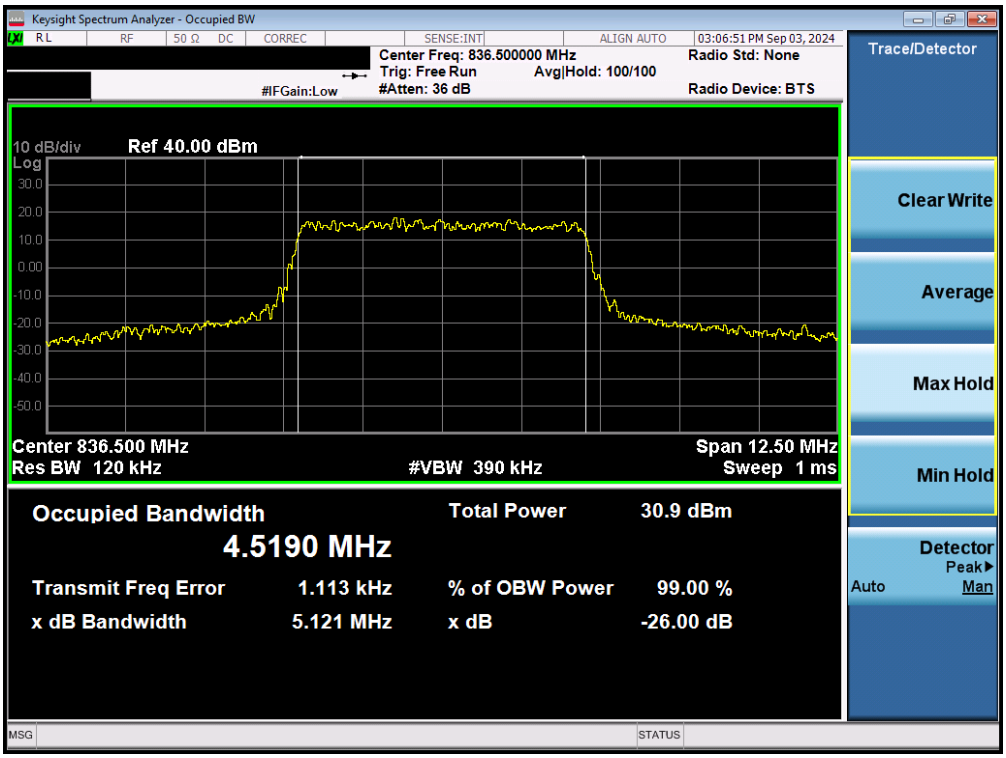
Plot 7-6. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 16-QAM - Full RB - Ant1)



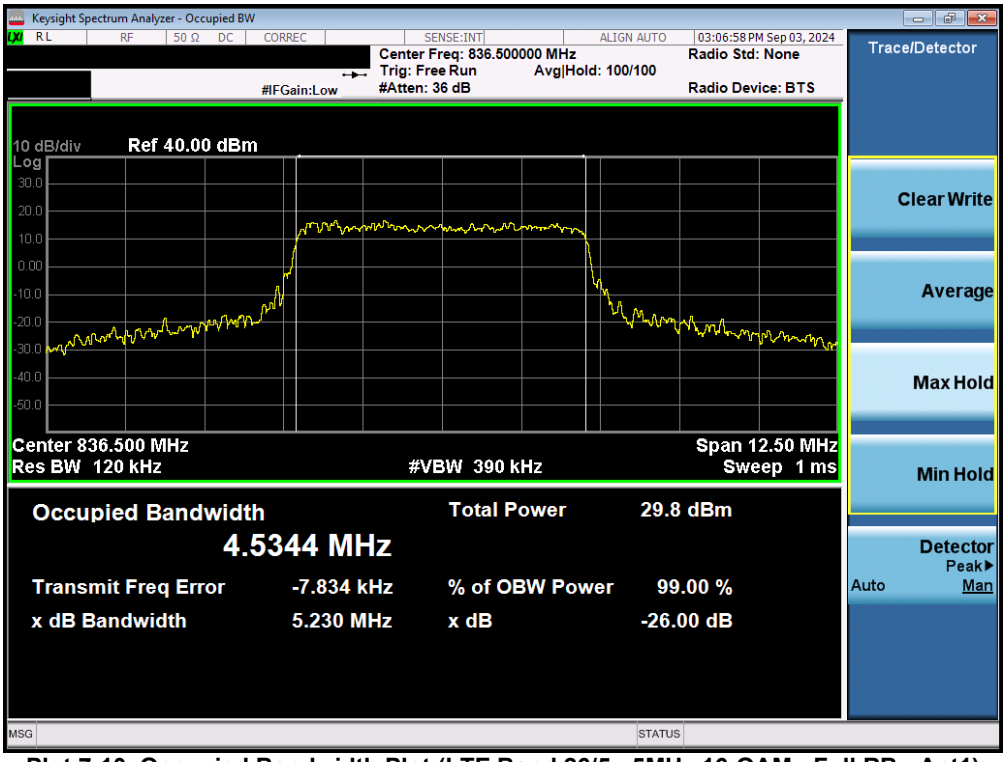
Plot 7-7. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Ant1)



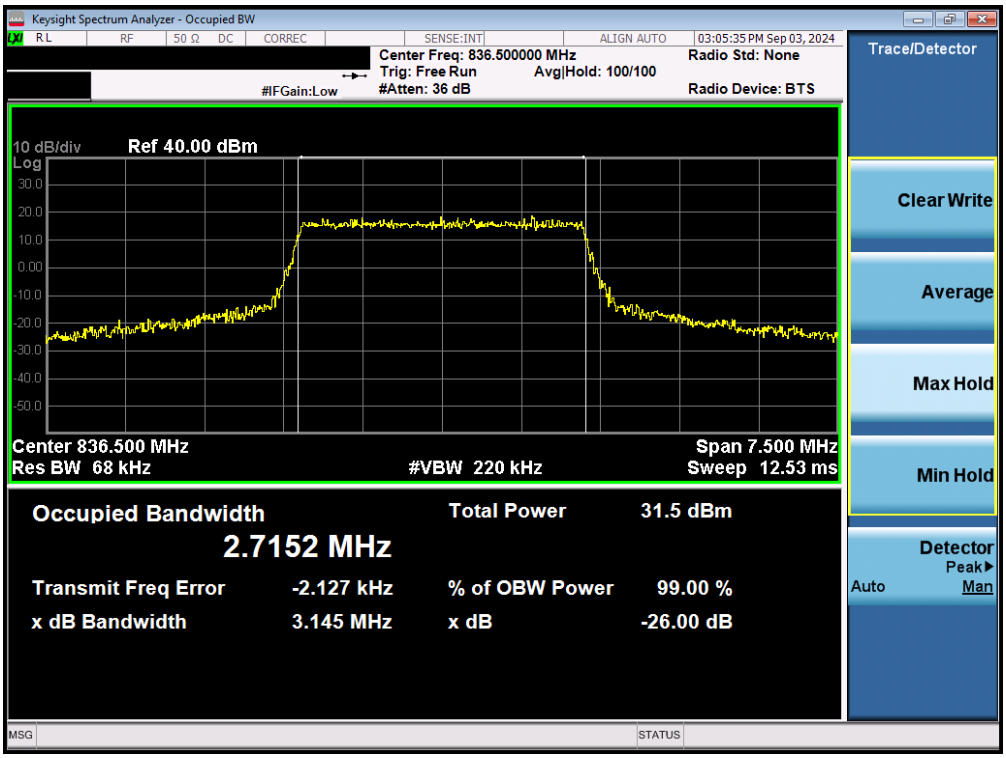
Plot 7-8. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB - Ant1)



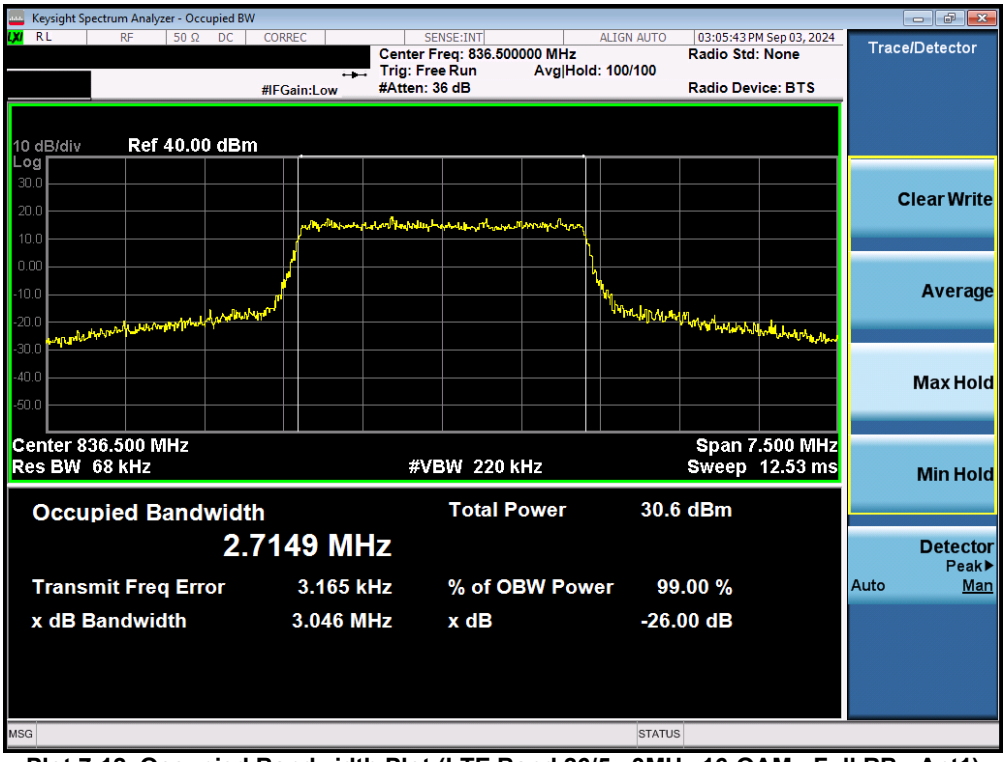
Plot 7-9. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB - Ant1)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB - Ant1)

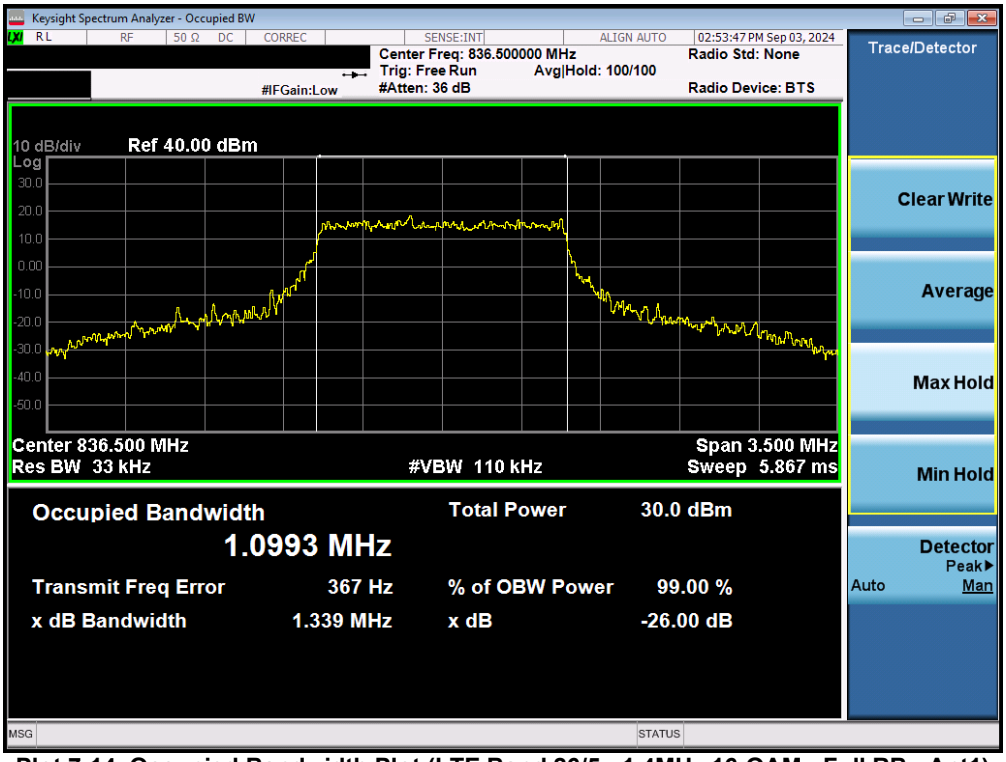


Plot 7-11. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz QPSK - Full RB - Ant1)



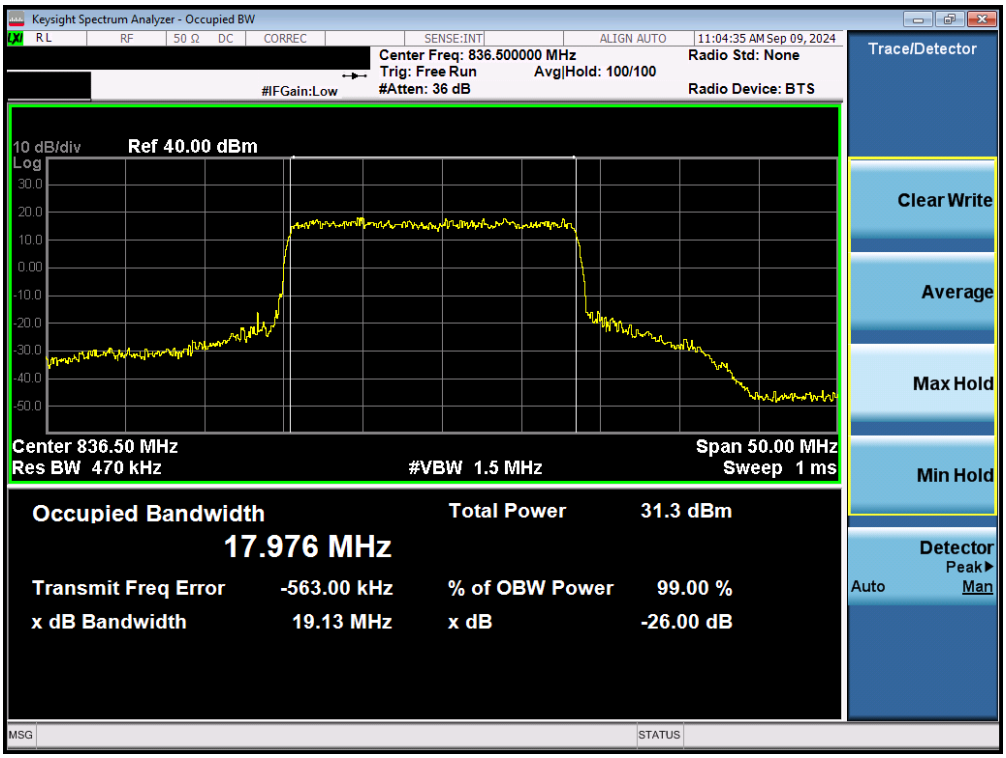
Plot 7-12. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 16-QAM - Full RB - Ant1)

Plot 7-13. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz QPSK - Full RB - Ant1)

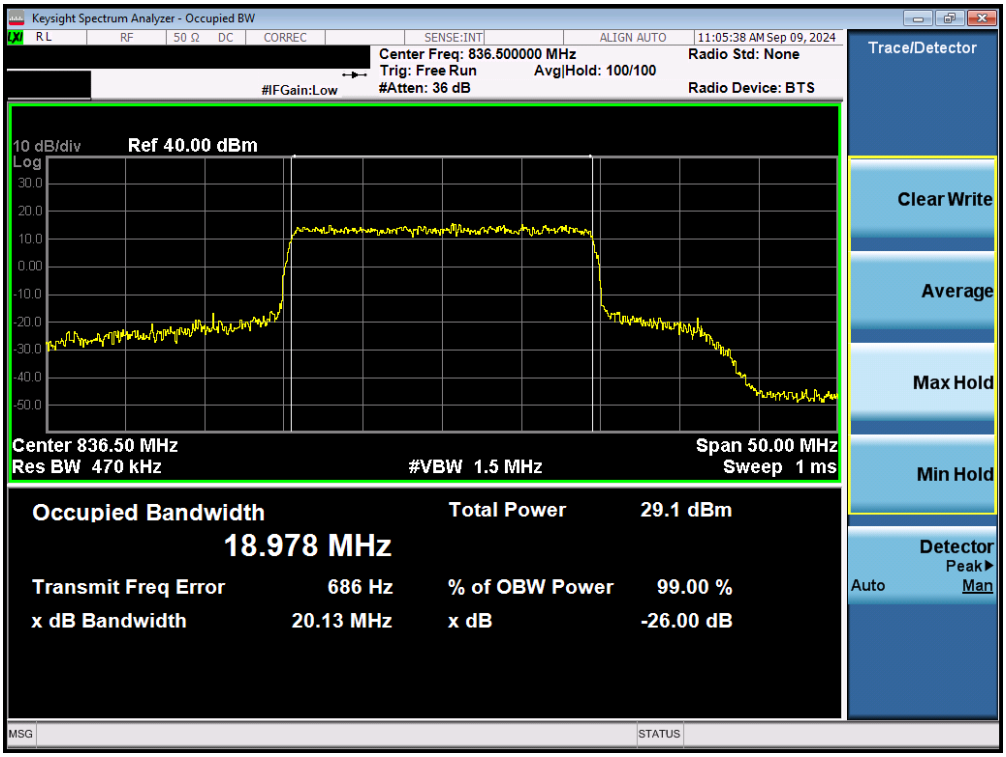


Plot 7-14. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 16-QAM - Full RB - Ant1)

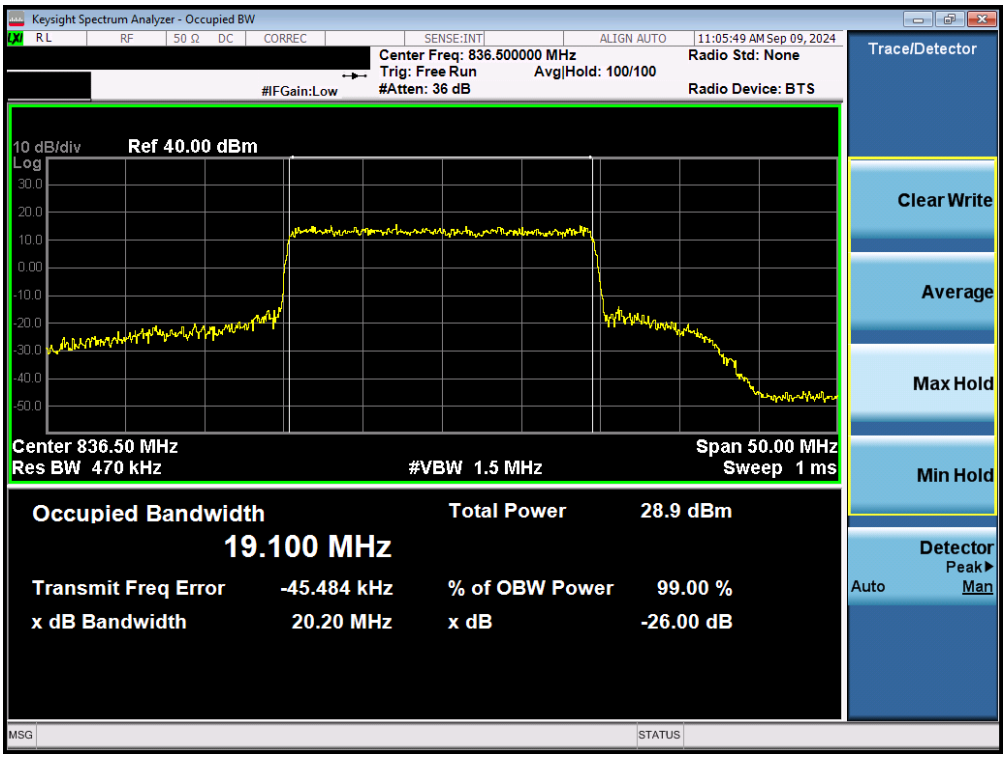
NR Band n26/5 – Ant1



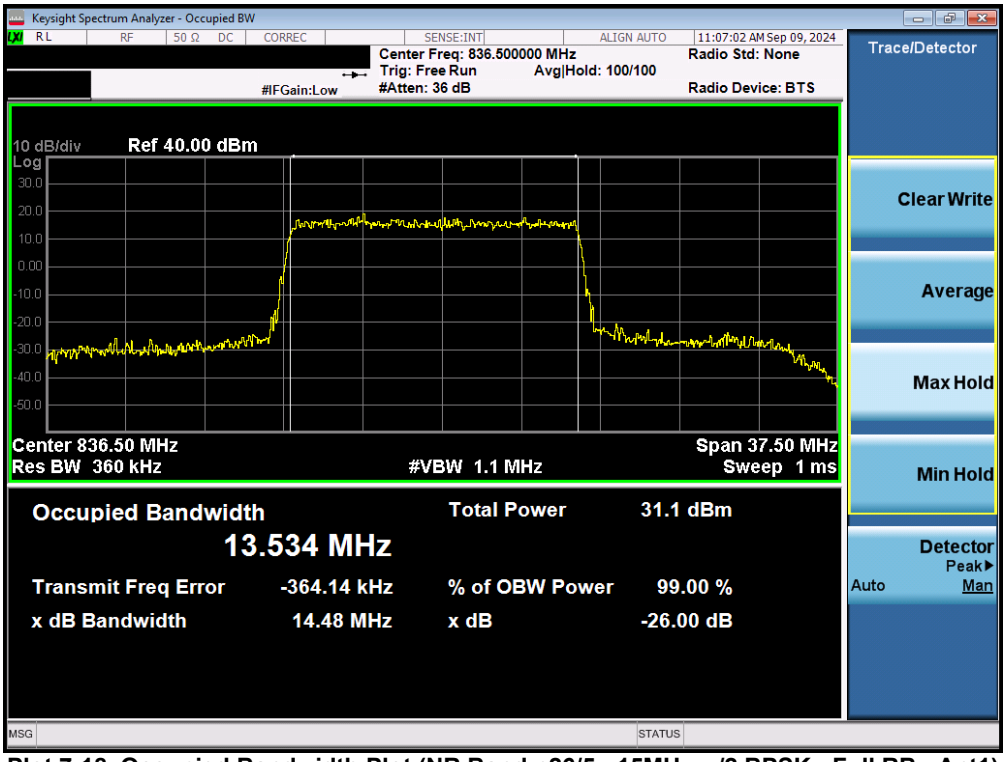
Plot 7-15. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz π/2 BPSK - Full RB - Ant1)



Plot 7-16. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz QPSK - Full RB - Ant1)

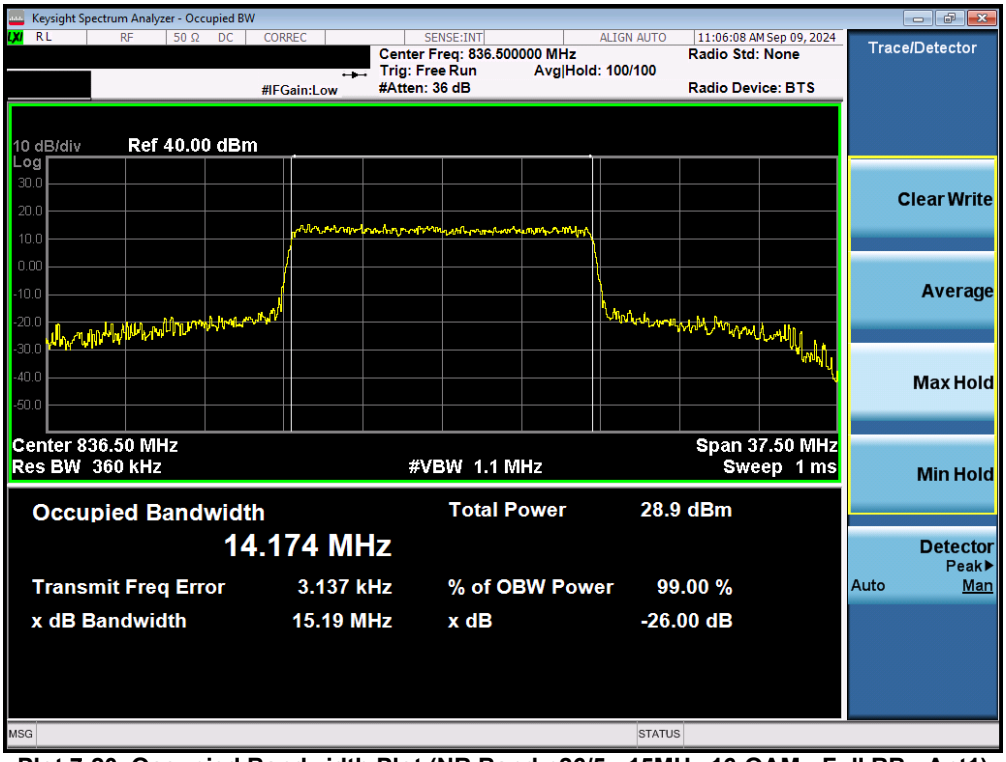


Plot 7-17. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz 16-QAM - Full RB - Ant1)

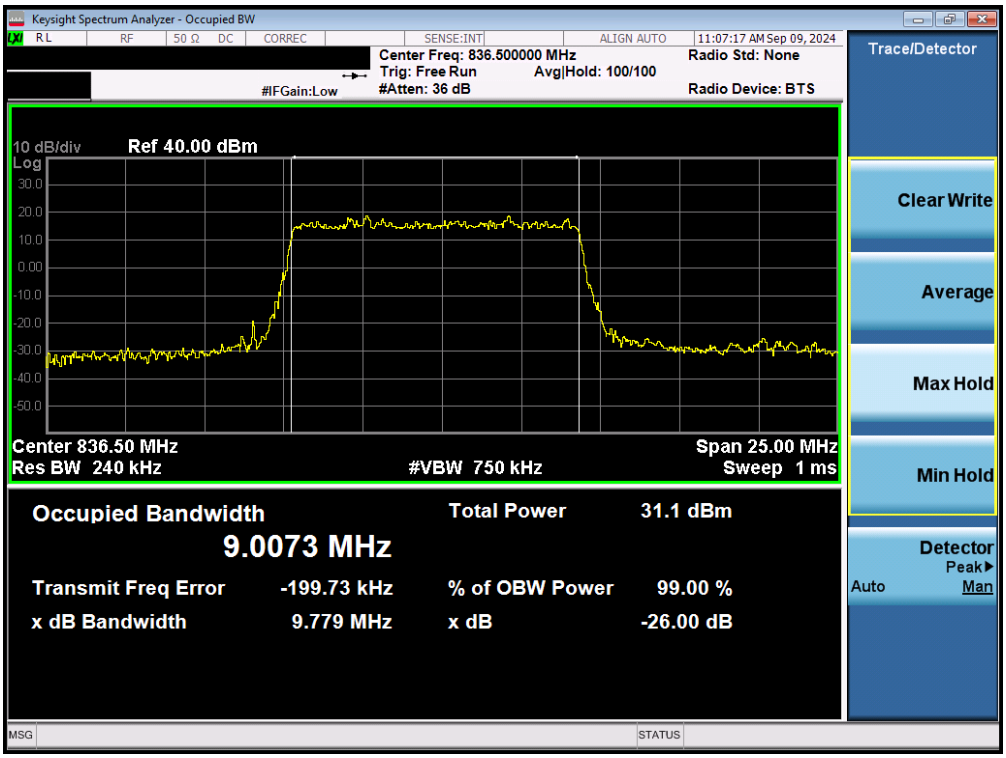


Plot 7-18. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz π/2 BPSK - Full RB - Ant1)

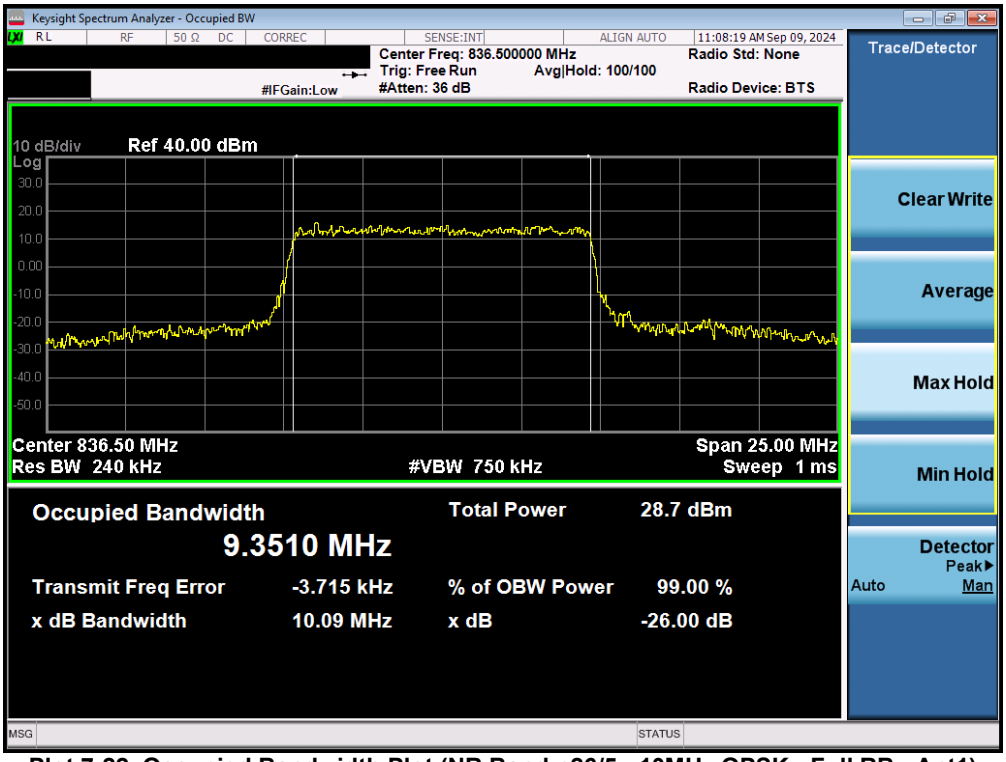
Plot 7-19. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz QPSK - Full RB - Ant1)



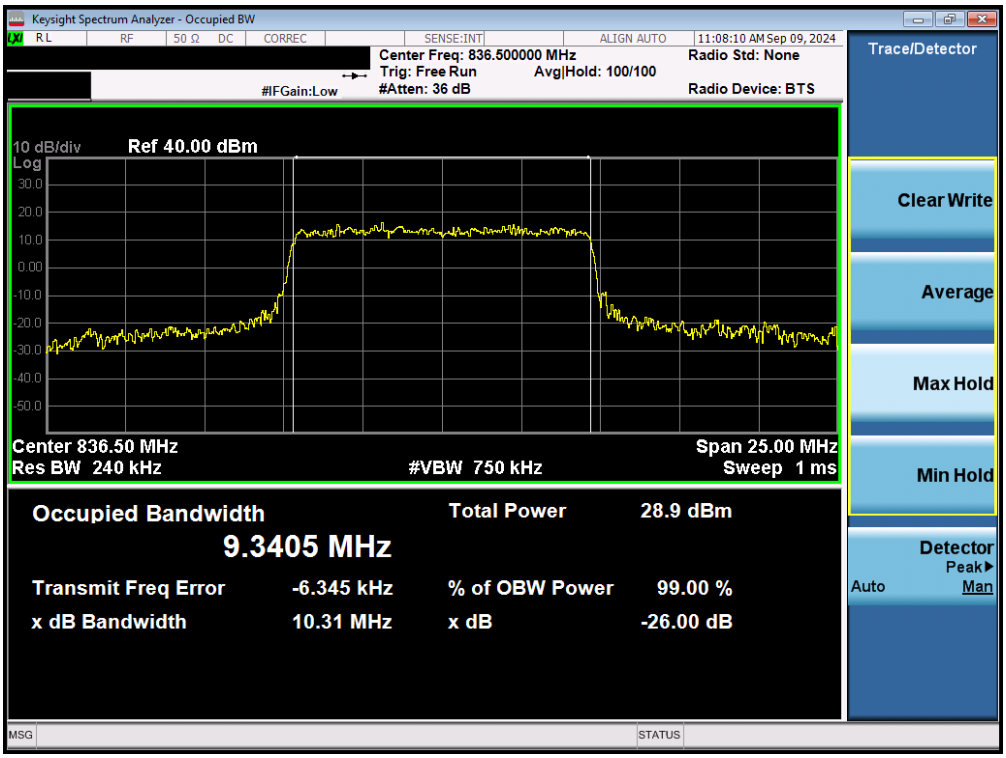
Plot 7-20. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz 16-QAM - Full RB - Ant1)



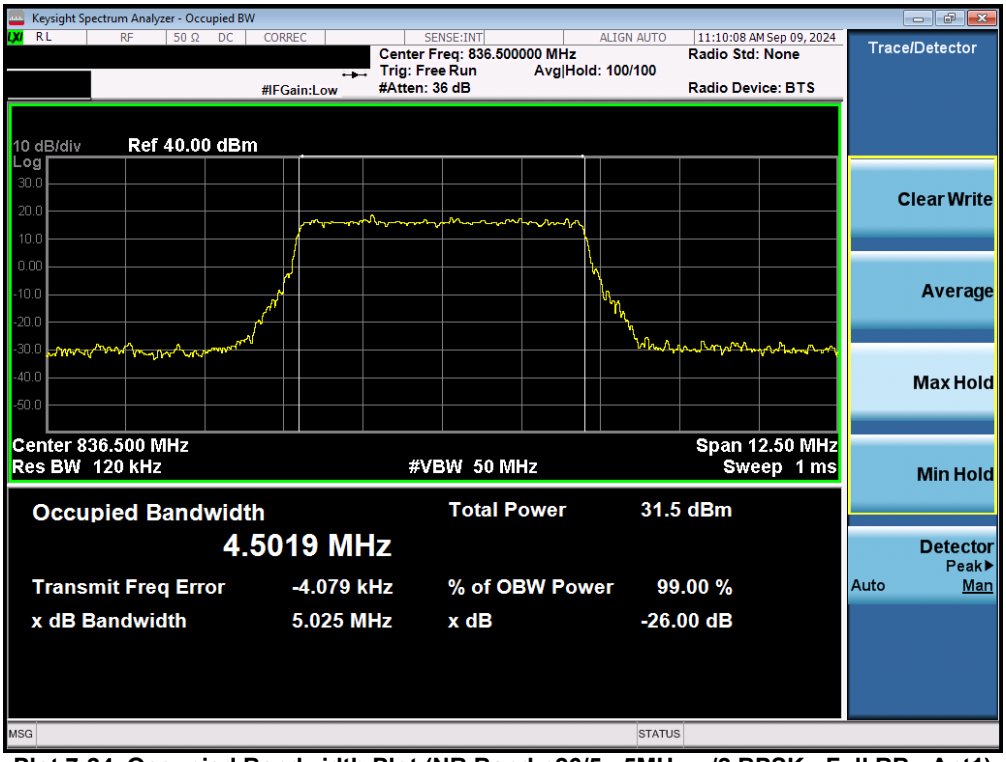
Plot 7-21. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz π/2 BPSK - Full RB - Ant1)



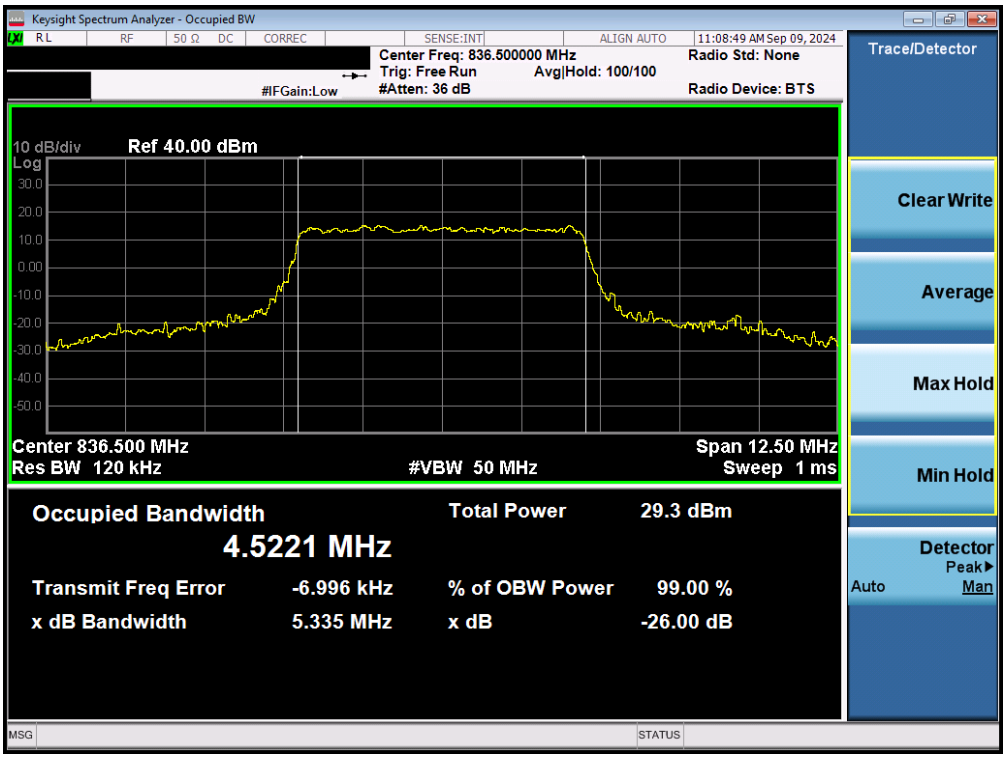
Plot 7-22. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz QPSK - Full RB - Ant1)



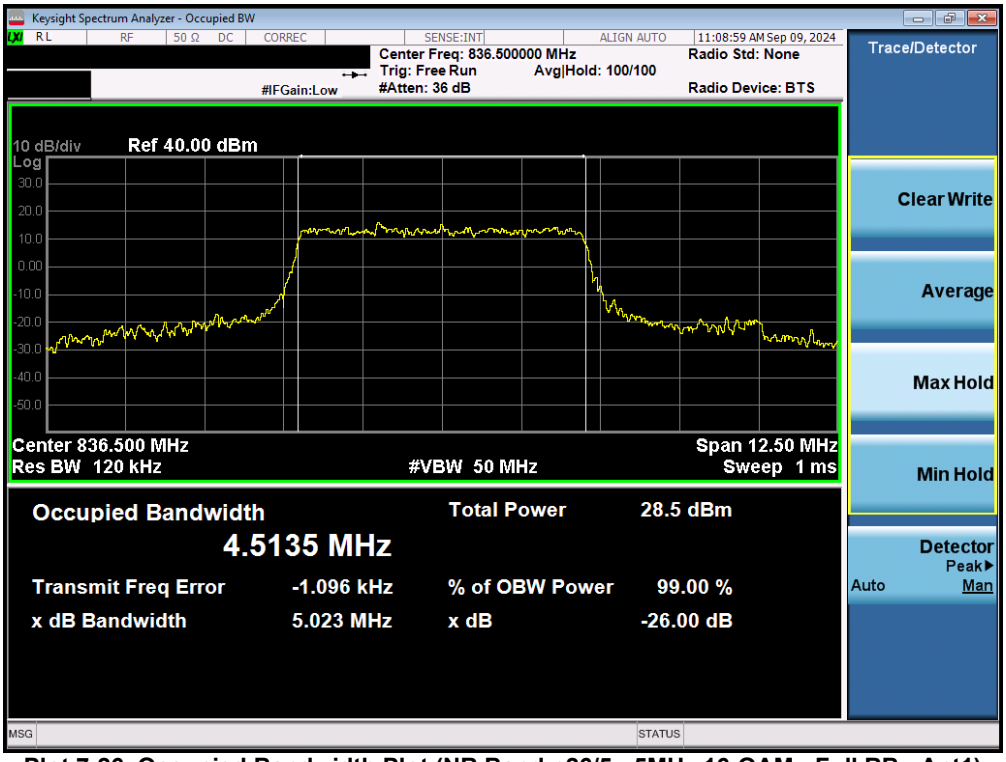
Plot 7-23. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz 16-QAM - Full RB - Ant1)



Plot 7-24. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz π/2 BPSK - Full RB - Ant1)



Plot 7-25. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz QPSK - Full RB - Ant1)



Plot 7-26. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz 16-QAM - Full RB - Ant1)

Mode	Bandwidth	Modulation	OBW [MHz]
GSM-Cell	N/A	GMSK	0.249
GSM-Cell Edge		8-PSK	0.244
WCDMA-Cell		Spread Spectrum	4.16
LTE-B26-5	15MHz	QPSK	13.52
		16QAM	13.51
	10MHz	QPSK	9.01
		16QAM	9.02
	5 MHz	QPSK	4.50
		16QAM	4.52
	3 MHz	QPSK	2.70
		16QAM	2.71
	1.4 MHz	QPSK	1.10
		16QAM	1.11
NR-n26-5	20 MHz	π/2 BPSK	18.03
		QPSK	19.03
		16QAM	19.07
	15 MHz	π/2 BPSK	13.53
		QPSK	14.23
		16QAM	14.16
	10 MHz	π/2 BPSK	9.01
		QPSK	9.36
		16QAM	9.35
	5 MHz	π/2 BPSK	4.50
		QPSK	4.51
		16QAM	4.50

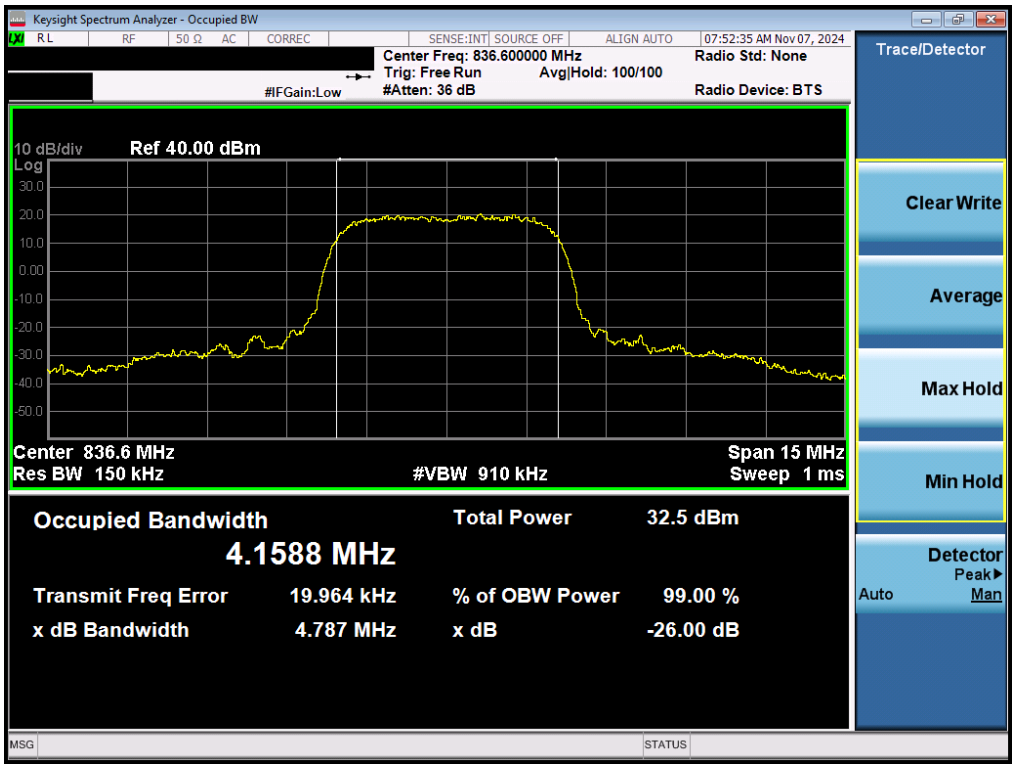
Table 7-7. Occupied Bandwidth Results – Ant2

GPRS Cell – Ant2

Plot 7-27. Occupied Bandwidth Plot (GPRS, Ch. 190 – Ant2)

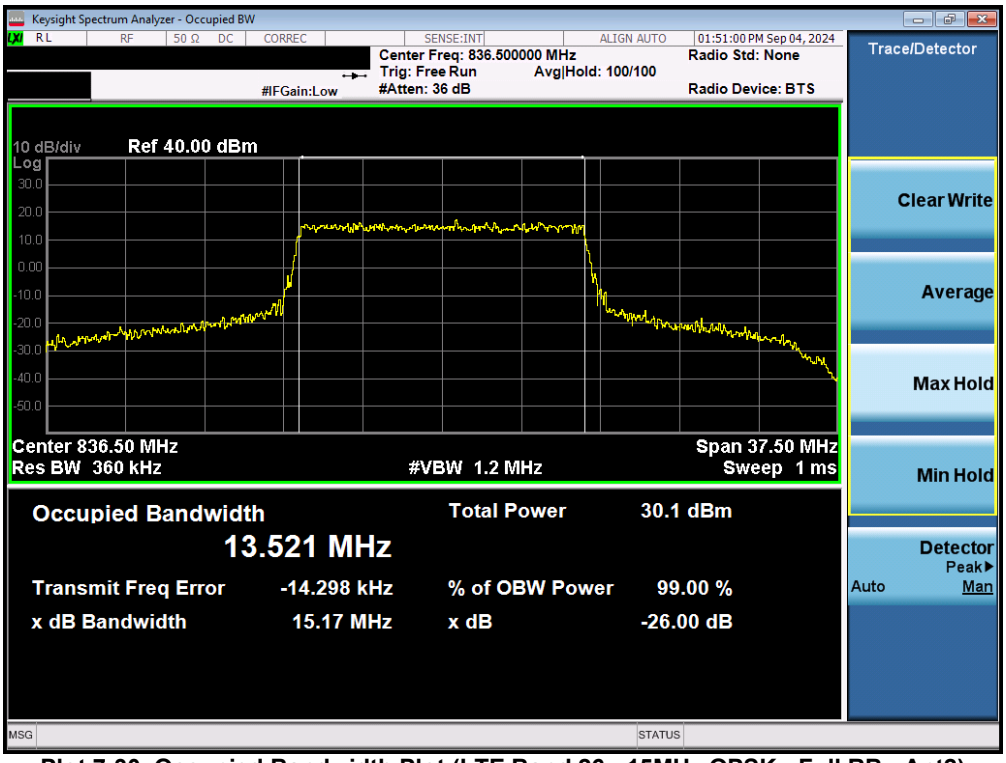
Plot 7-28. Occupied Bandwidth Plot (EDGE, Ch. 190 – Ant2)

WCDMA Cell – Ant2

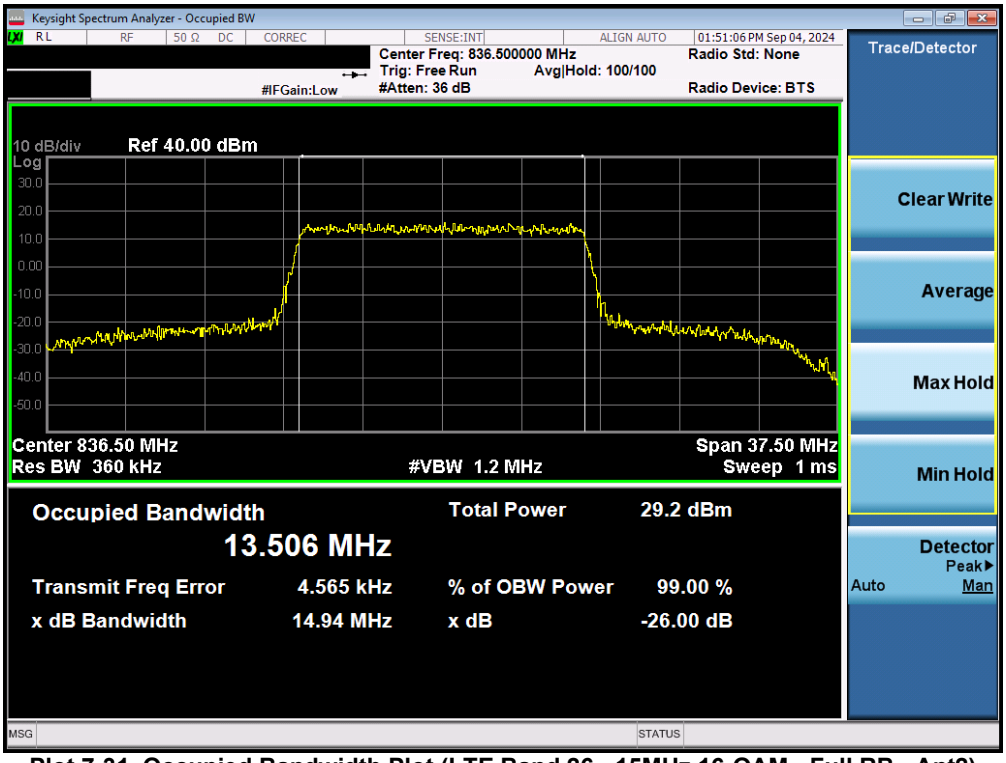


Plot 7-29. Occupied Bandwidth Plot (WCDMA, Ch. 4183 – Ant2)

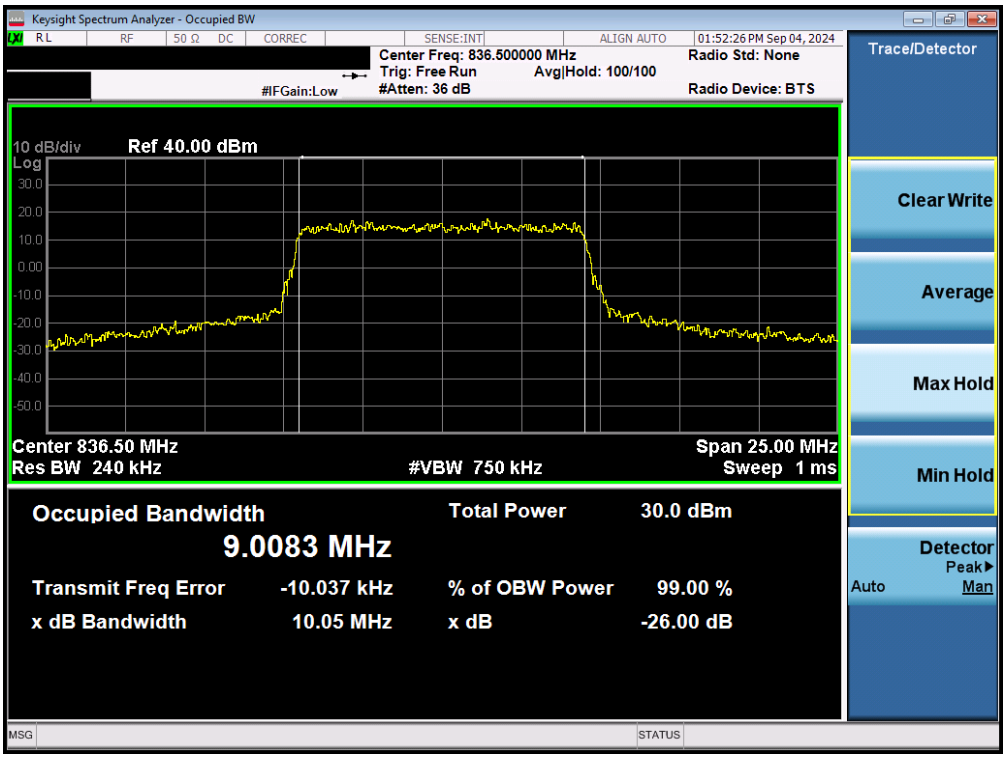
LTE Band 26/5 – Ant2



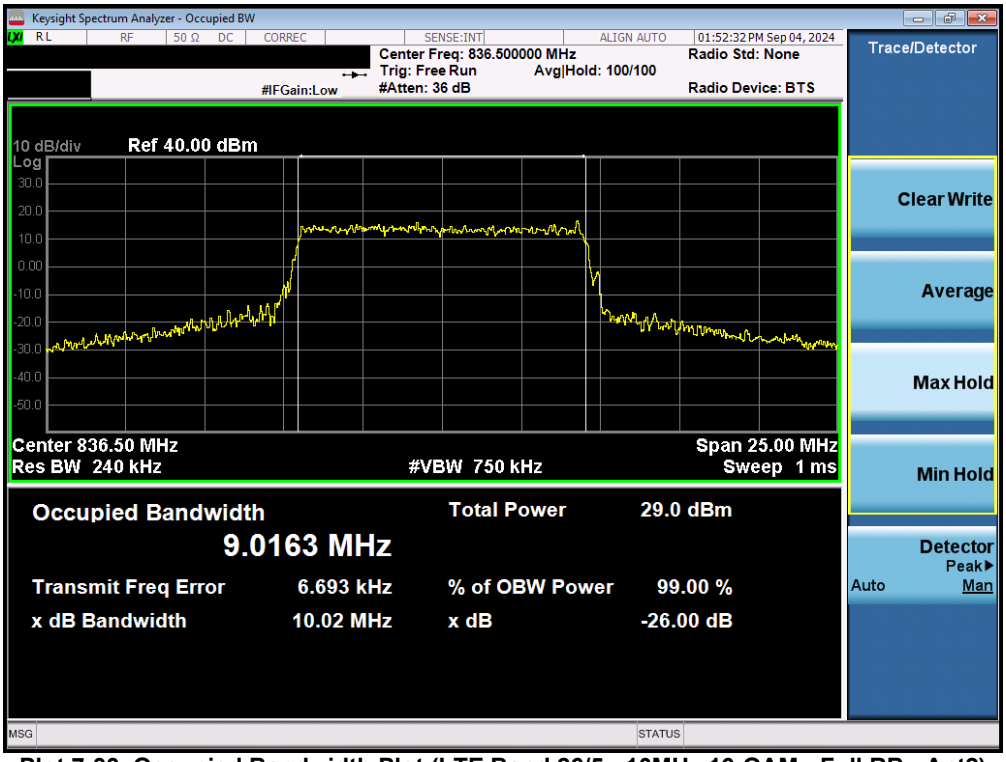
Plot 7-30. Occupied Bandwidth Plot (LTE Band 26 - 15MHz QPSK - Full RB - Ant2)



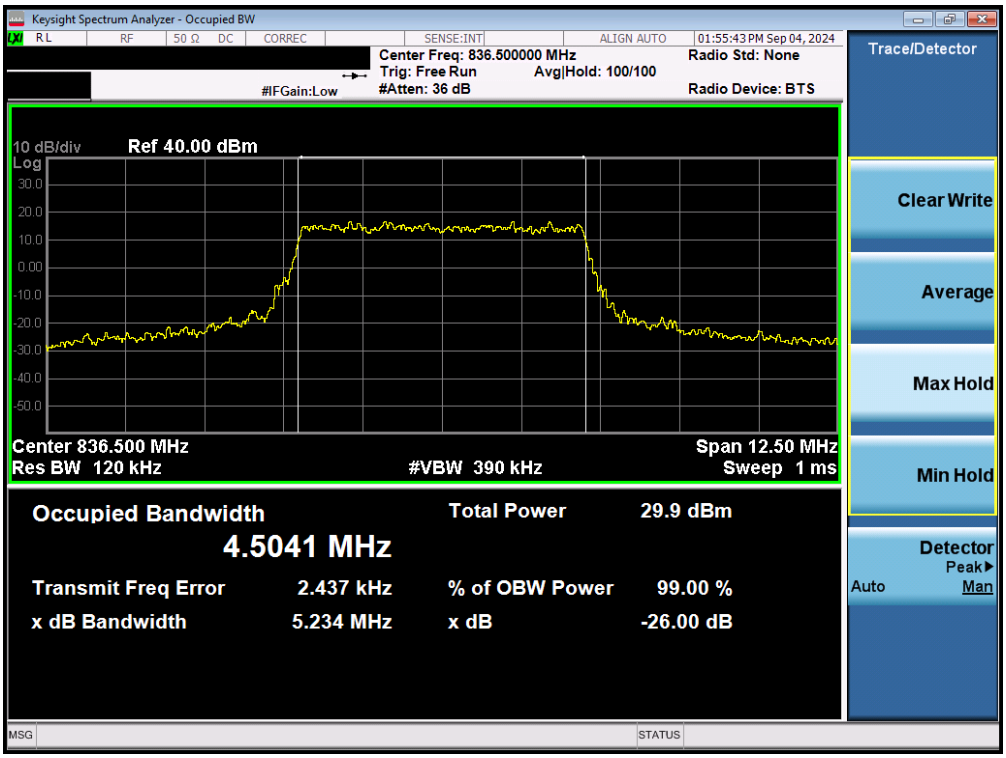
Plot 7-31. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 16-QAM - Full RB - Ant2)



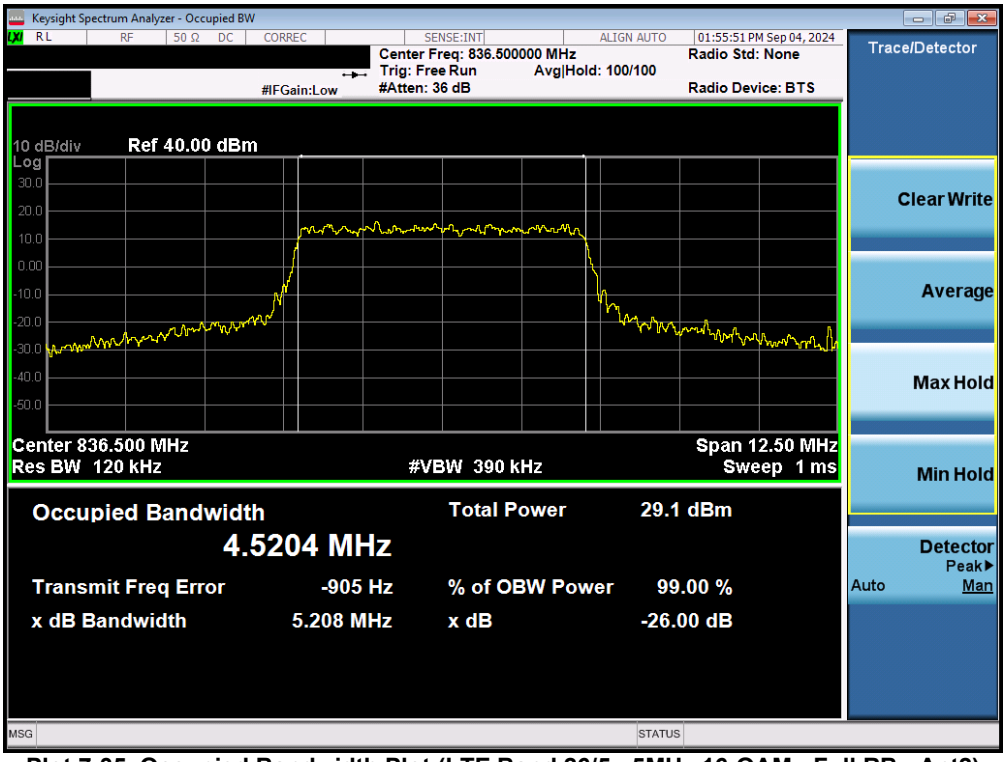
Plot 7-32. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB - Ant2)



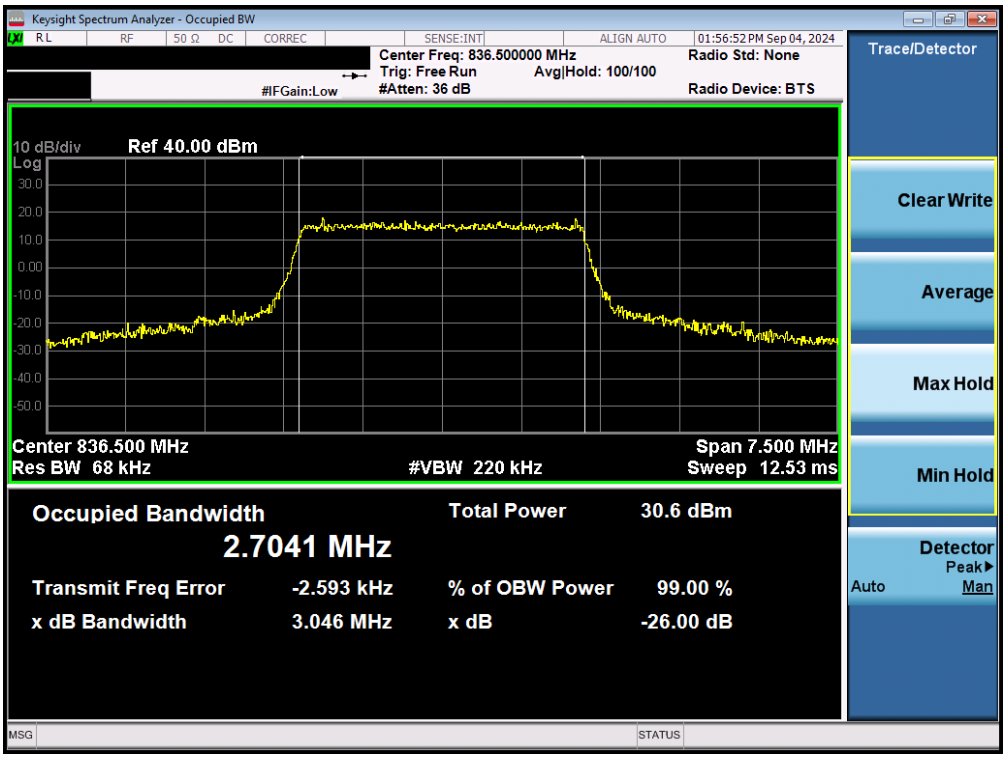
Plot 7-33. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB - Ant2)



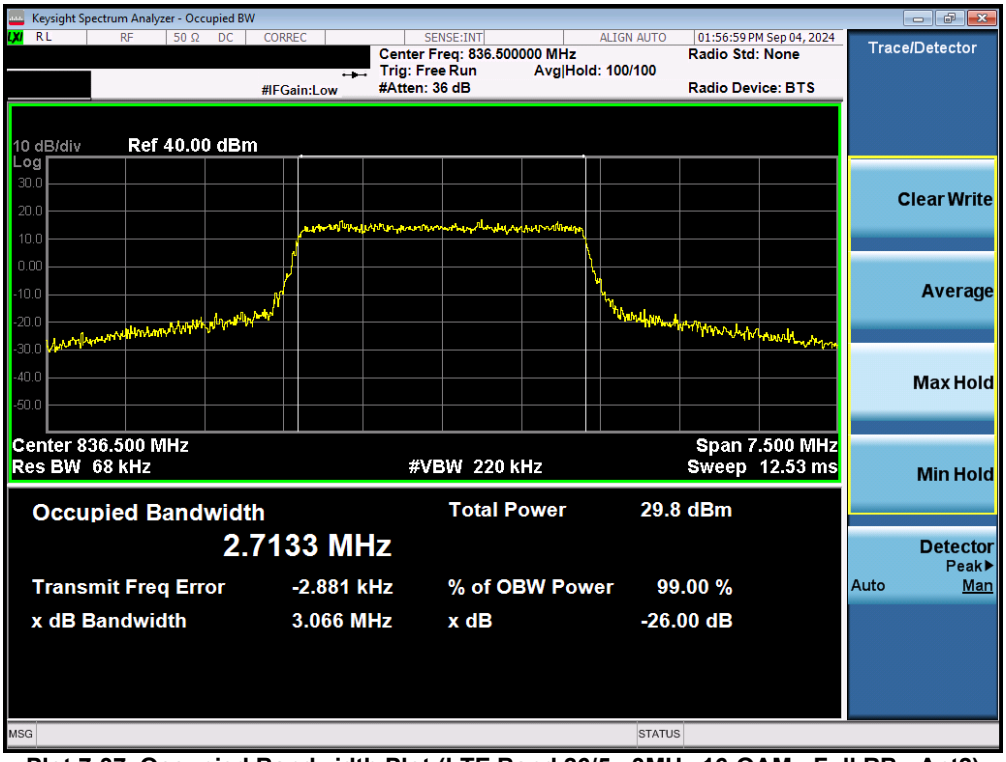
Plot 7-34. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB - Ant2)



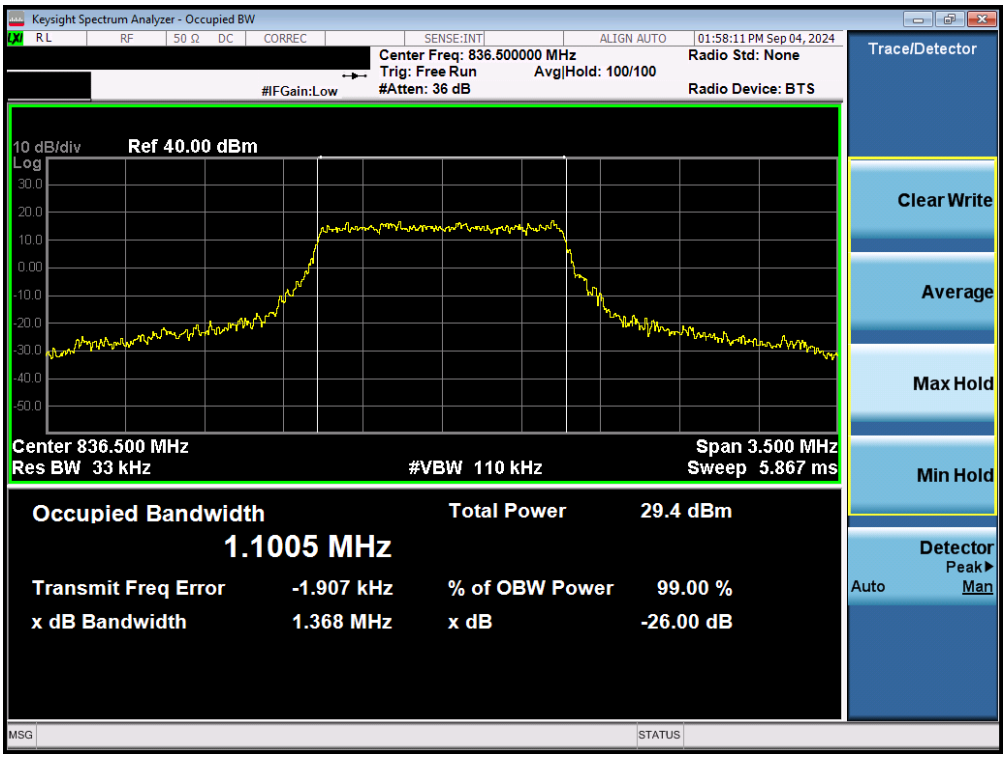
Plot 7-35. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB - Ant2)



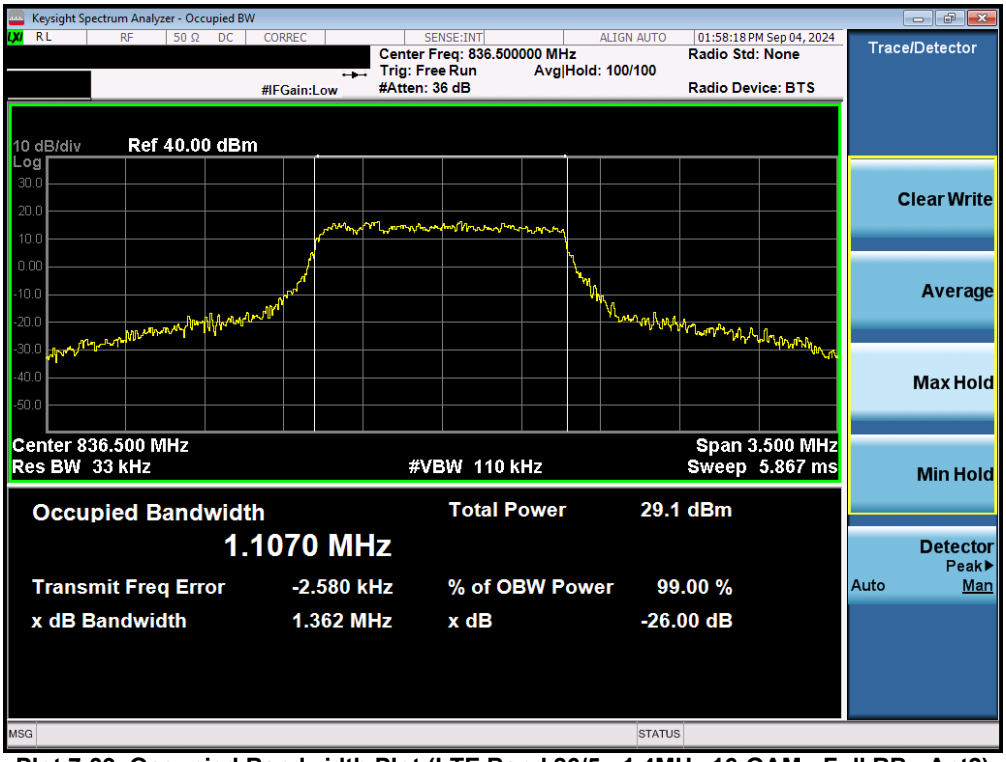
Plot 7-36. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz QPSK - Full RB - Ant2)



Plot 7-37. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 16-QAM - Full RB - Ant2)

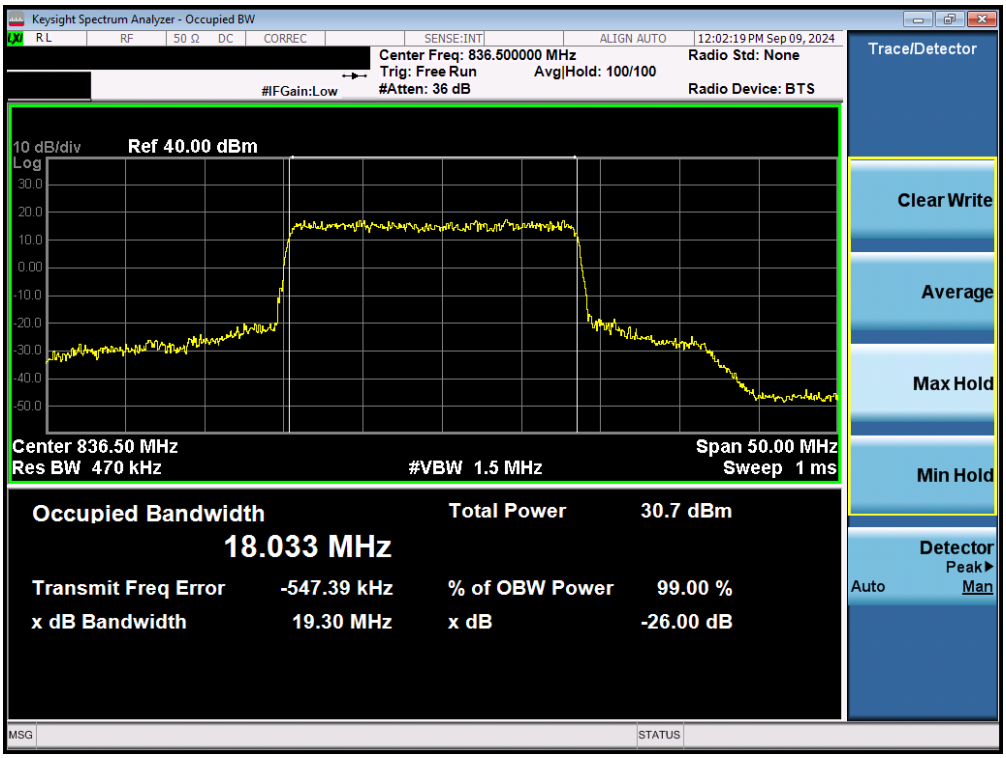


Plot 7-38. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz QPSK - Full RB - Ant2)

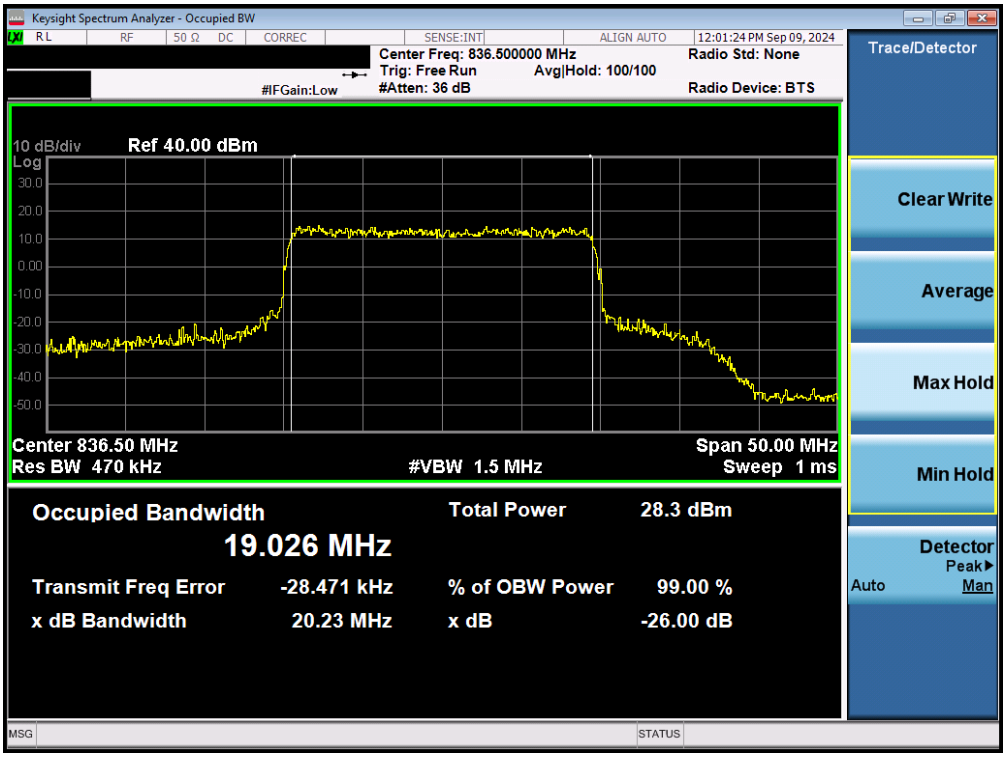


Plot 7-39. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 16-QAM - Full RB - Ant2)

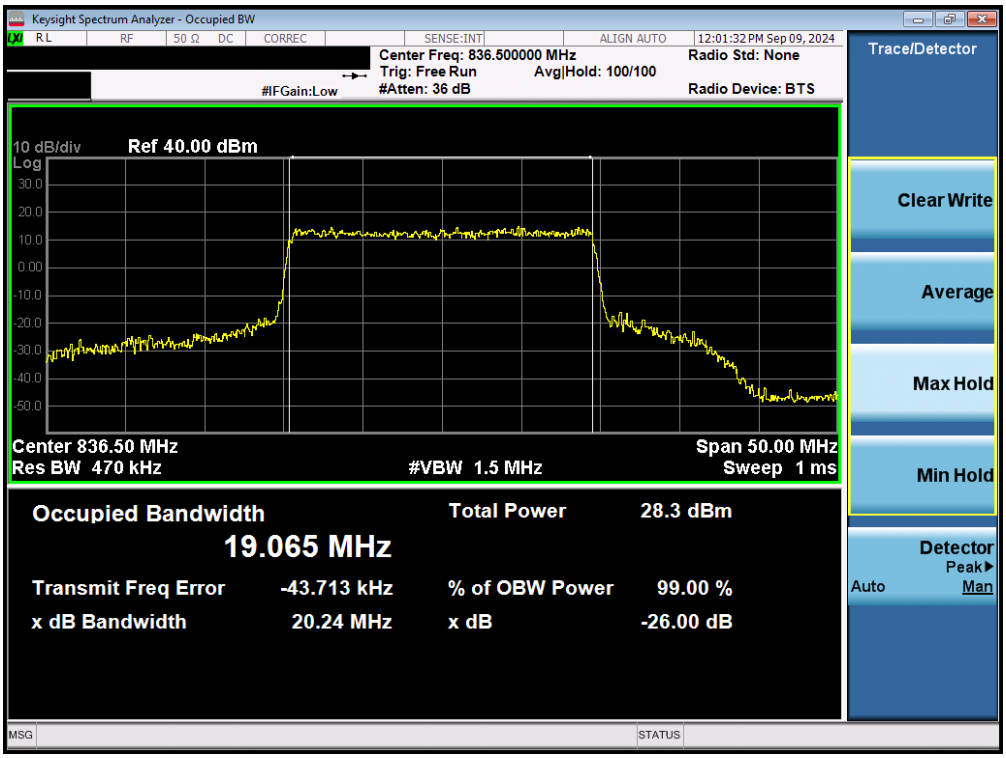
NR Band n26/5 – Ant2



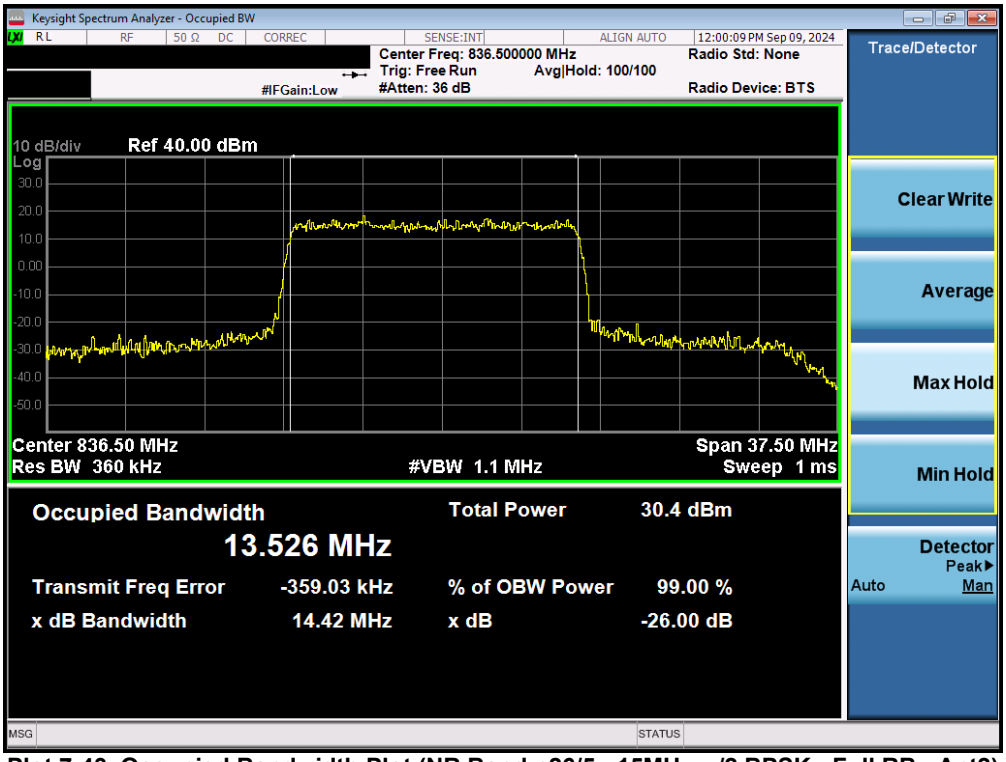
Plot 7-40. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz π/2 BPSK - Full RB - Ant2)



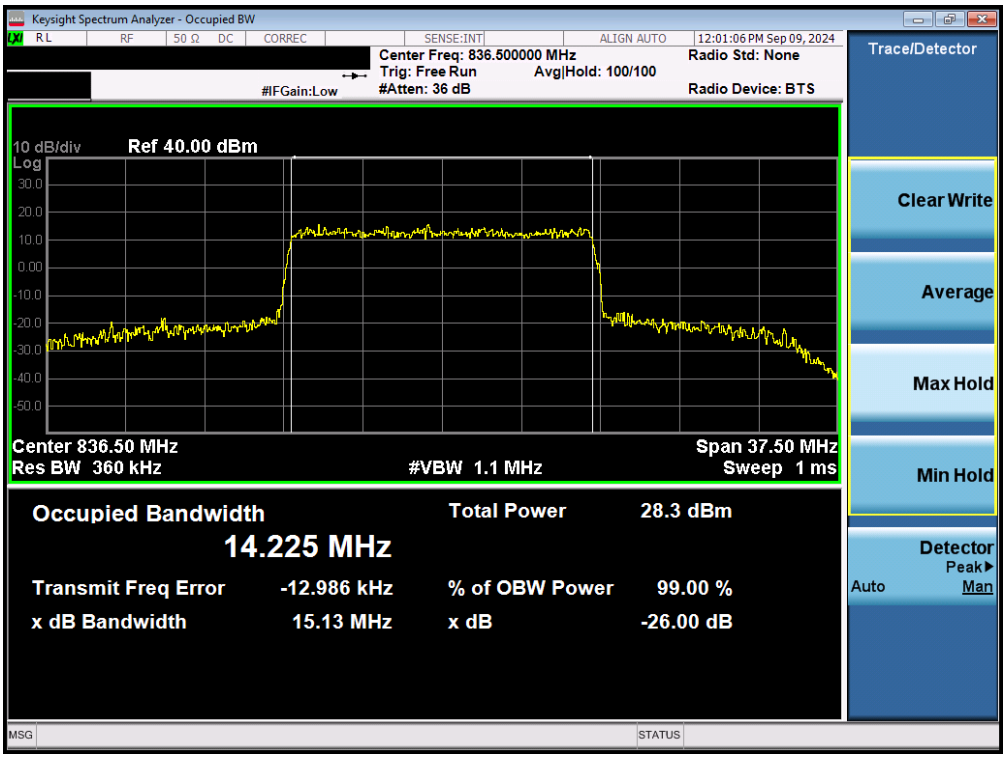
Plot 7-41. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz QPSK - Full RB - Ant2)



Plot 7-42. Occupied Bandwidth Plot (NR Band n26/5 - 20MHz 16-QAM - Full RB - Ant2)

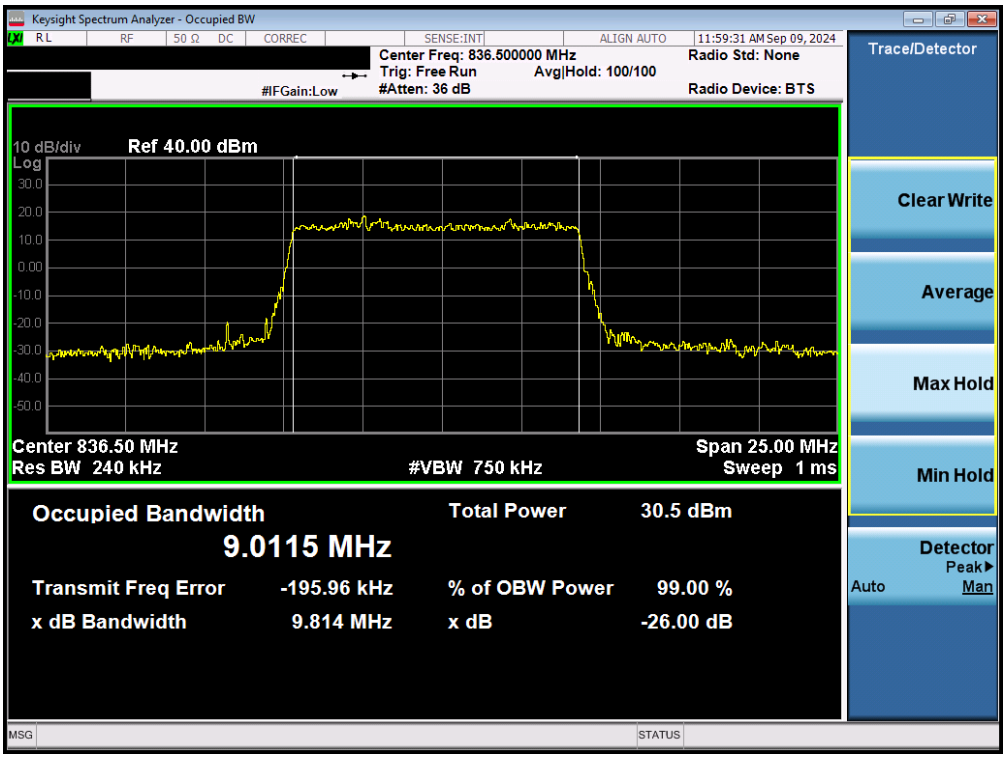


Plot 7-43. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz π/2 BPSK - Full RB - Ant2)

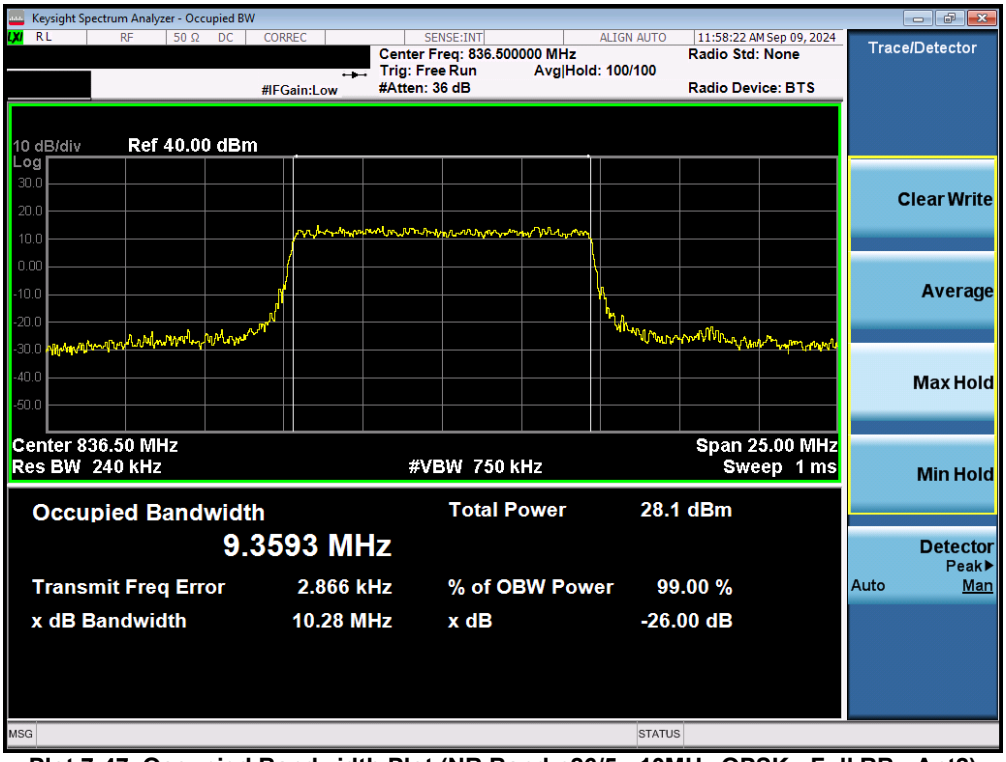


Plot 7-44. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz QPSK - Full RB - Ant2)

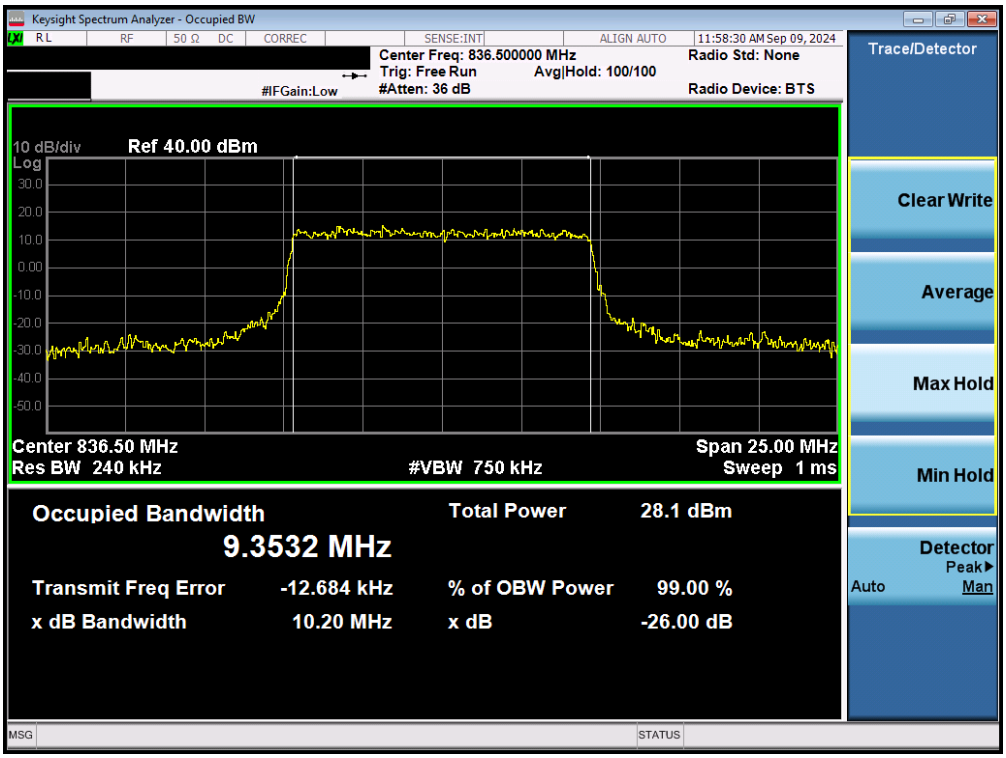
Plot 7-45. Occupied Bandwidth Plot (NR Band n26/5 - 15MHz 16-QAM - Full RB - Ant2)



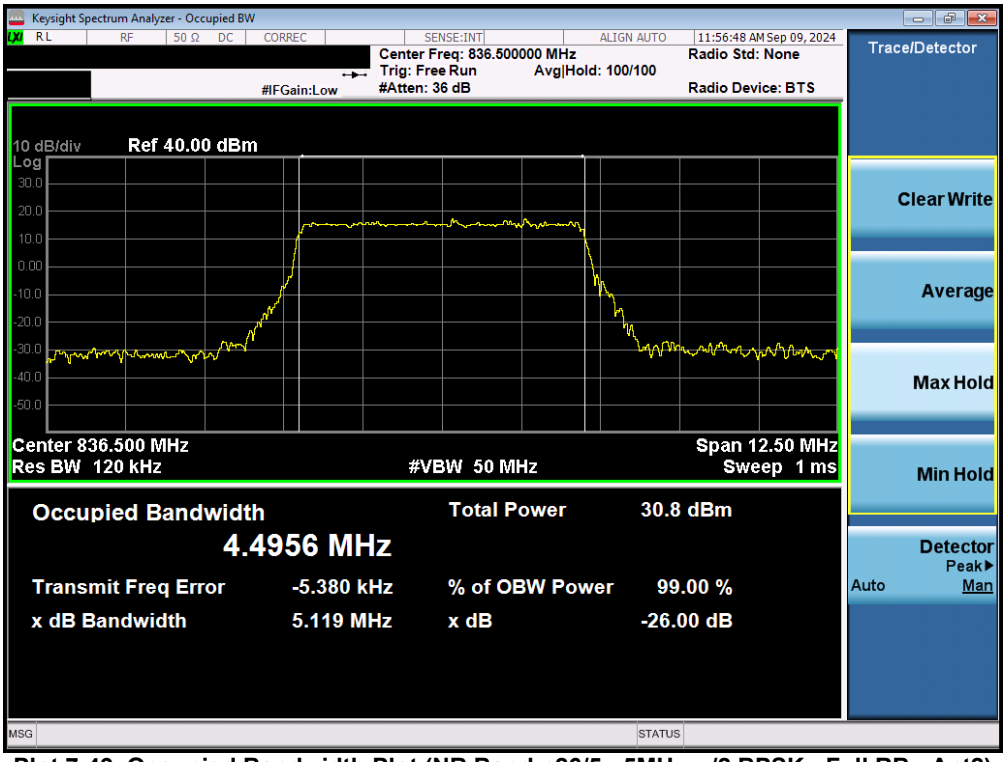
Plot 7-46. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz π/2 BPSK - Full RB - Ant2)



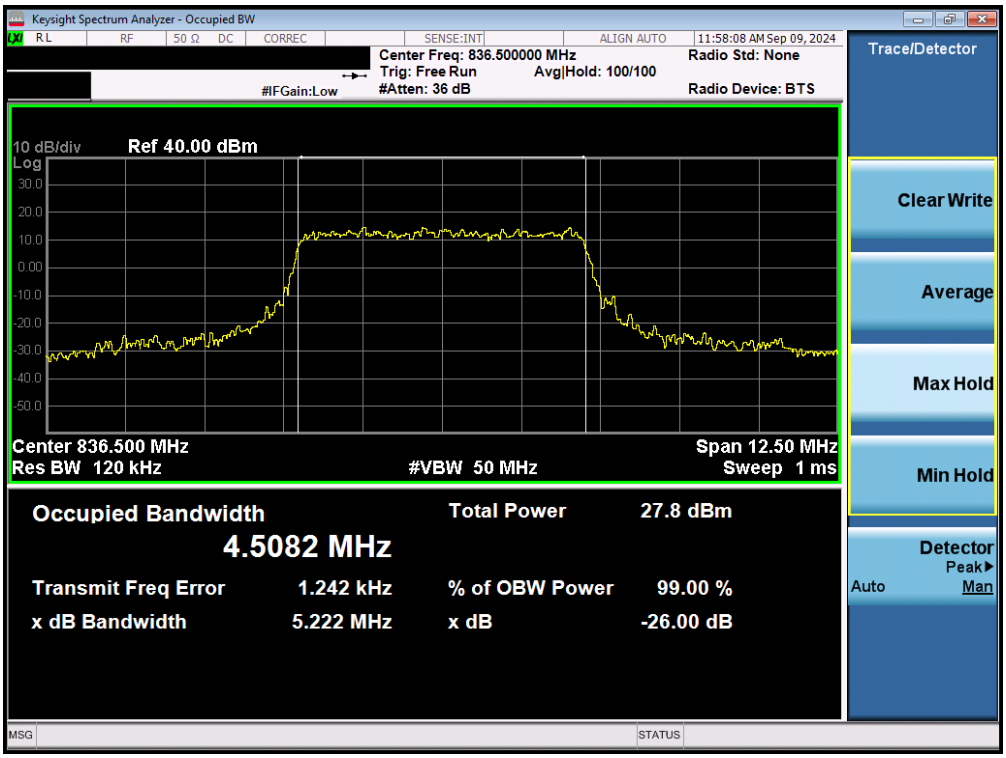
Plot 7-47. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz QPSK - Full RB - Ant2)



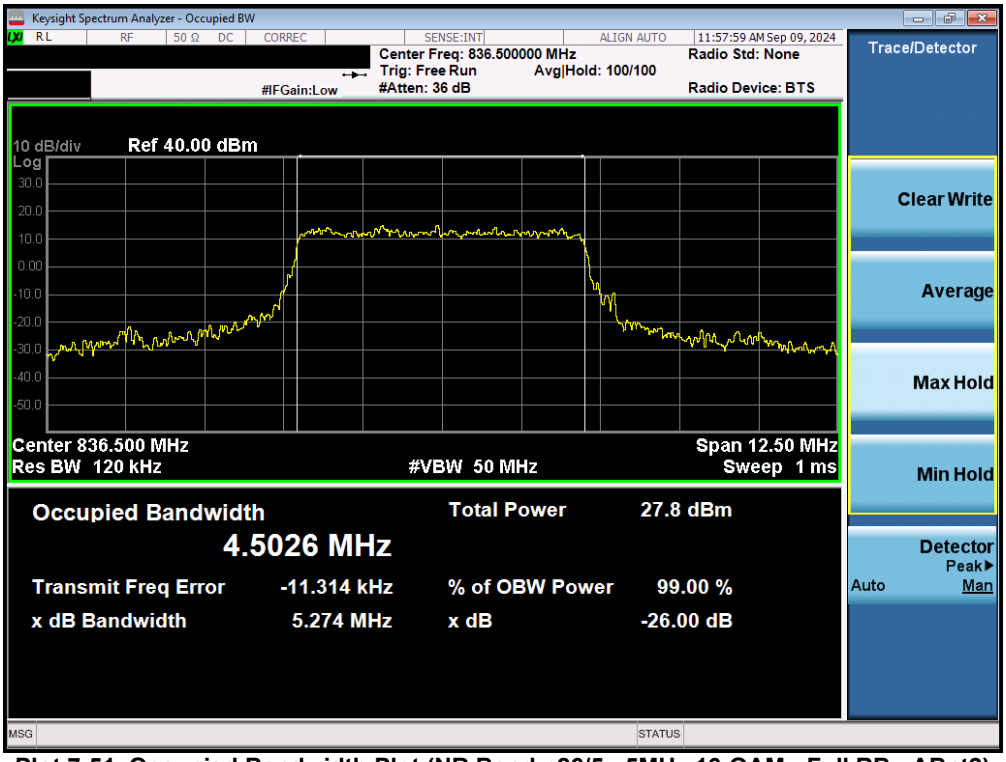
Plot 7-48. Occupied Bandwidth Plot (NR Band n26/5 - 10MHz 16-QAM - Full RB - Ant2)



Plot 7-49. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz π/2 BPSK - Full RB - Ant2)



Plot 7-50. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz QPSK - Full RB - Ant2)



Plot 7-51. Occupied Bandwidth Plot (NR Band n26/5 - 5MHz 16-QAM - Full RB - ABnt2)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

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

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

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

Test Setup

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

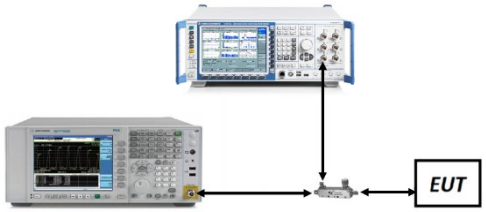


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

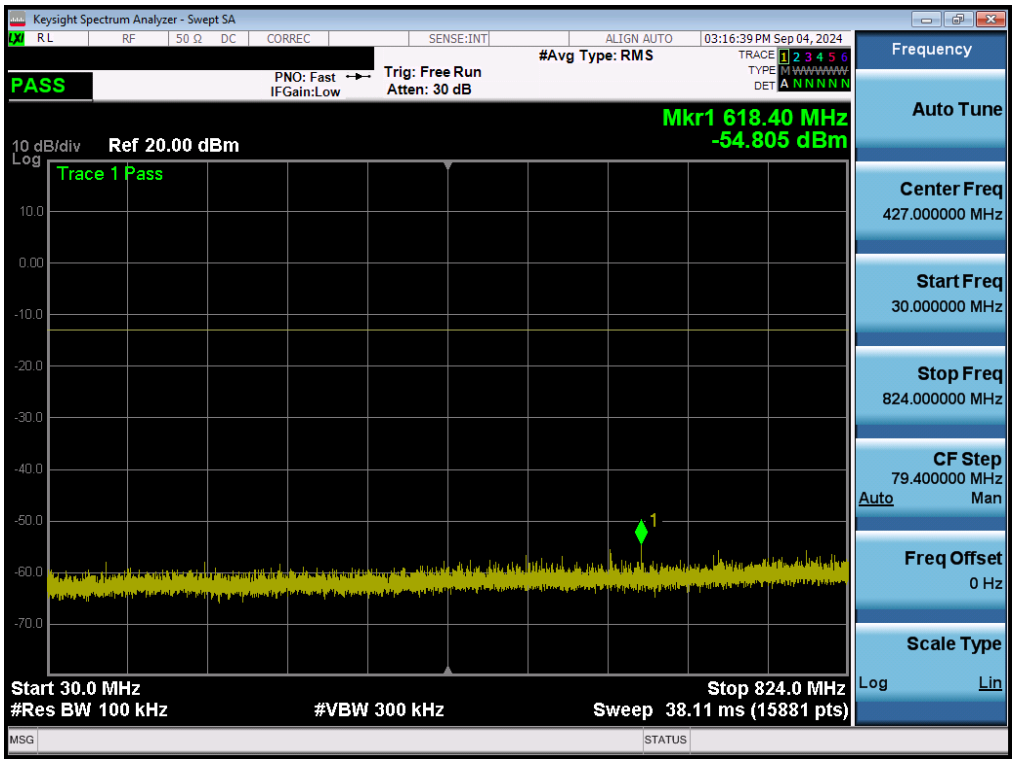
1. Per Part 22 and RSS-132, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

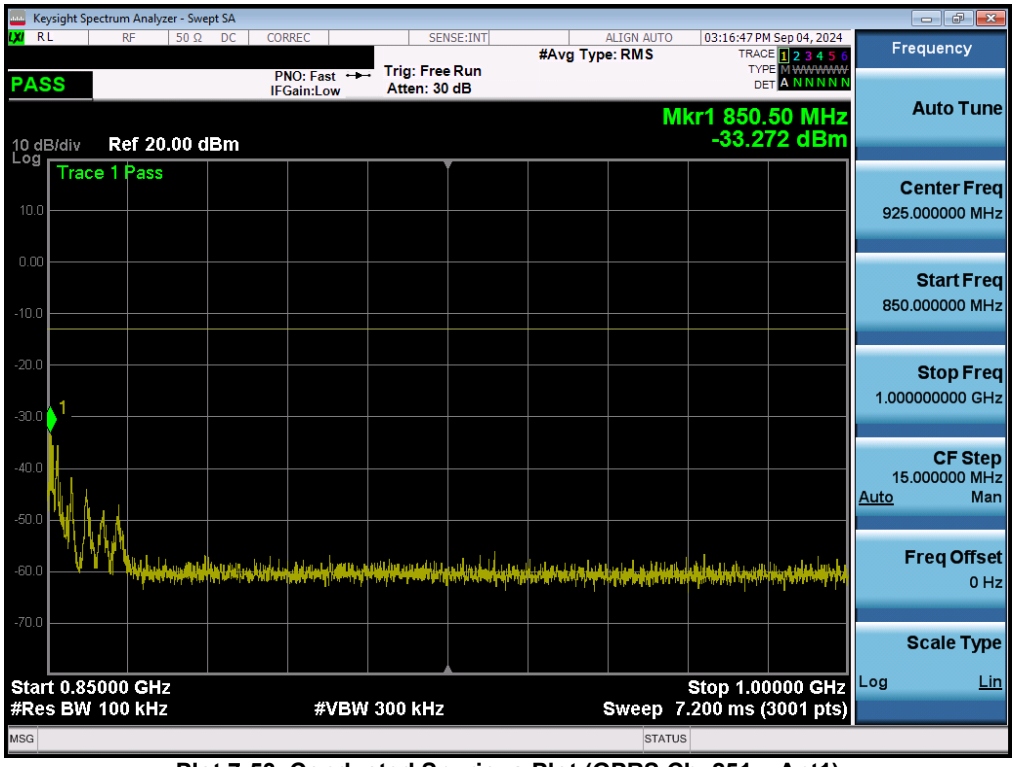
Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
GSM-Cell	-37.477	Low	30.0 - 823.0	-37.48	-13.0	-24.48
		Low	849.0 - 1000.0	-57.12	-13.0	-44.12
		Low	1000.0 - 10000.0	-32.79	-13.0	-19.79
		Mid	30.0 - 824.0	-50.77	-13.0	-37.77
		Mid	849.0 - 1000.0	-49.96	-13.0	-36.96
		Mid	1000.0 - 10000.0	-32.38	-13.0	-19.38
		High	30.0 - 824.0	-54.81	-13.0	-41.81
		High	850.0 - 1000.0	-33.27	-13.0	-20.27
		High	1000.0 - 10000.0	-31.51	-13.0	-18.51
WCDMA-Cell	-34.487	Low	30.0 - 823.0	-35.91	-13.0	-22.91
		Low	849.0 - 1000.0	-56.90	-13.0	-43.90
		Low	1000.0 - 10000.0	-22.22	-13.0	-9.21
		Mid	30.0 - 824.0	-54.86	-13.0	-41.86
		Mid	849.0 - 1000.0	-56.17	-13.0	-43.17
		Mid	1000.0 - 10000.0	-23.39	-13.0	-10.39
		High	30.0 - 824.0	-54.49	-13.0	-41.49
		High	850.0 - 1000.0	-34.78	-13.0	-21.78
		High	1000.0 - 10000.0	-22.68	-13.0	-9.68
LTE-B26-5	-61.34	Low	30.0 - 823.0	-61.34	-13.0	-48.34
		Low	849.0 - 1000.0	-65.45	-13.0	-52.45
		Low	1000.0 - 10000.0	-47.26	-13.0	-34.26
		Mid	30.0 - 824.0	-64.32	-13.0	-51.32
		Mid	849.0 - 1000.0	-65.12	-13.0	-52.12
		Mid	1000.0 - 10000.0	-46.56	-13.0	-33.56
		High	30.0 - 824.0	-64.46	-13.0	-51.46
		High	850.0 - 1000.0	-61.64	-13.0	-48.64
		High	1000.0 - 10000.0	-46.75	-13.0	-33.74
NR-n26-5	-60.157	Low	30.0 - 824.0	-60.16	-13.0	-47.16
		Low	849.0 - 1000.0	-63.91	-13.0	-50.91
		Low	1000.0 - 10000.0	-47.47	-13.0	-34.47
		Mid	30.0 - 824.0	-61.89	-13.0	-48.89
		Mid	849.0 - 1000.0	-63.15	-13.0	-50.15
		Mid	1000.0 - 10000.0	-46.98	-13.0	-33.98
		High	30.0 - 824.0	-63.15	-13.0	-50.15
		High	849.0 - 1000.0	-62.36	-13.0	-49.36
		High	1000.0 - 10000.0	-47.52	-13.0	-34.52

Table 7-8. Conducted Spurious Emissions Results – Ant1

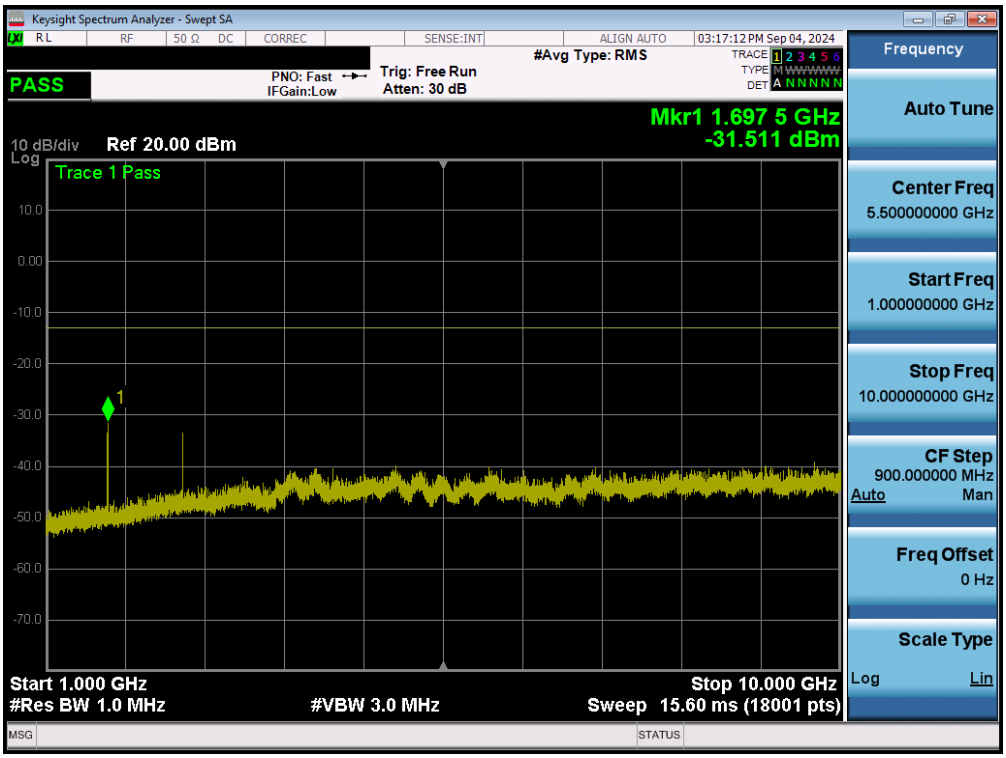
GSM/GPRS Cell – Ant1



Plot 7-52. Conducted Spurious Plot (GPRS Ch. 251 – Ant1)

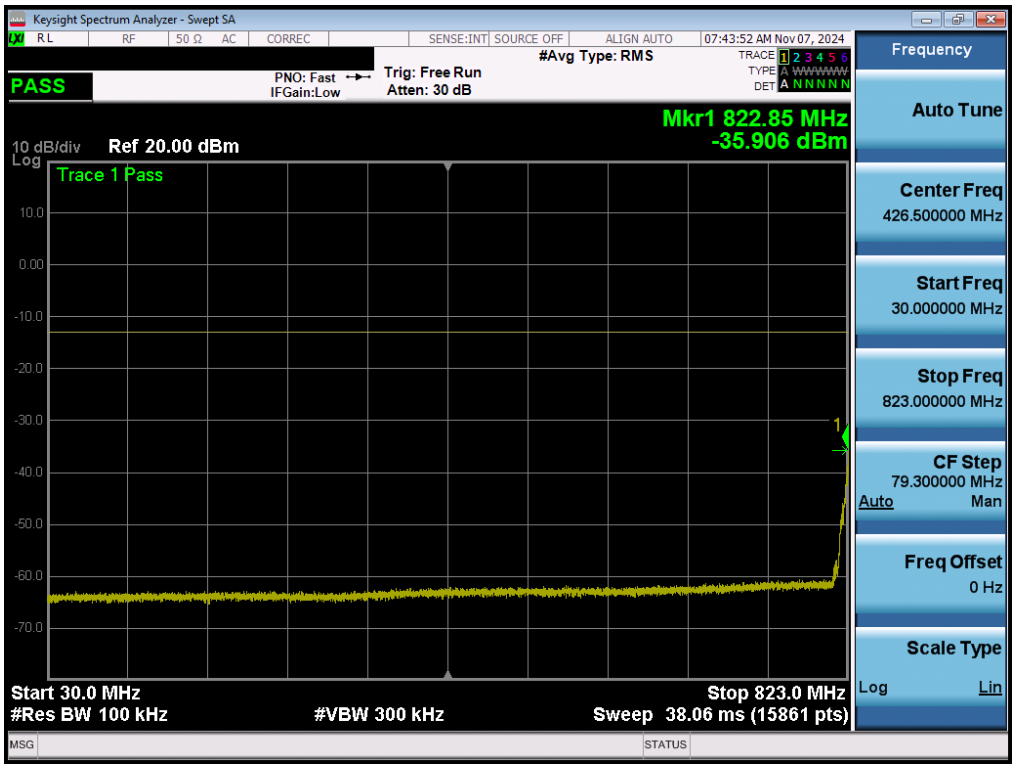


Plot 7-53. Conducted Spurious Plot (GPRS Ch. 251 – Ant1)

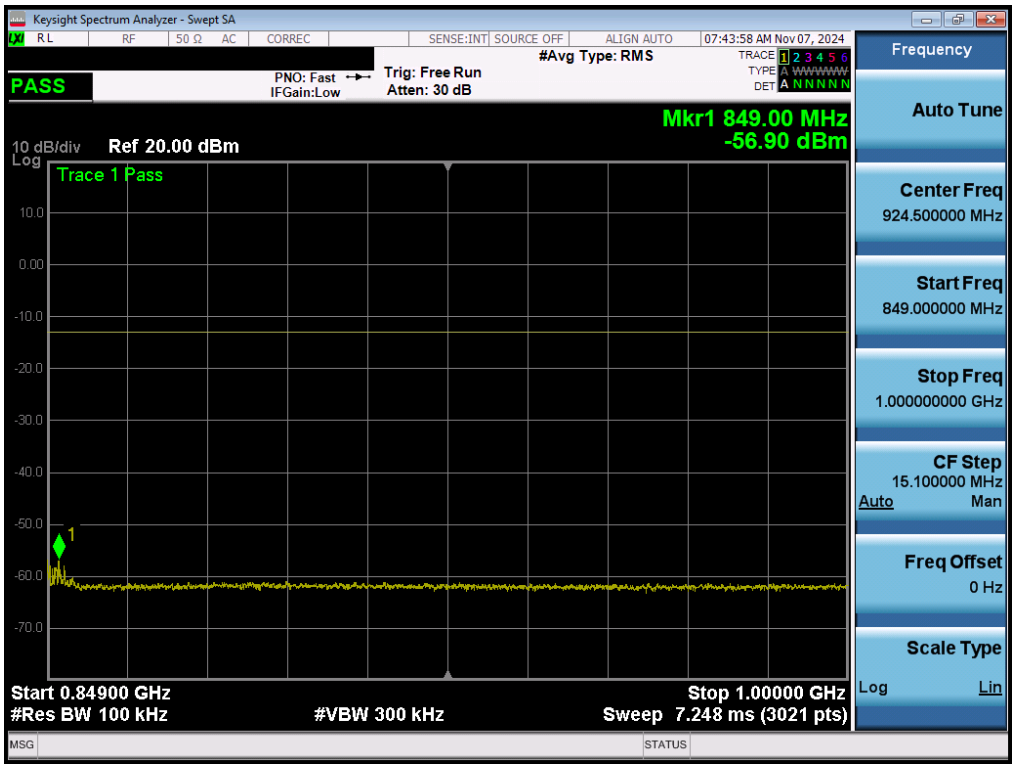


Plot 7-54. Conducted Spurious Plot (GPRS Ch. 251 – Ant1)

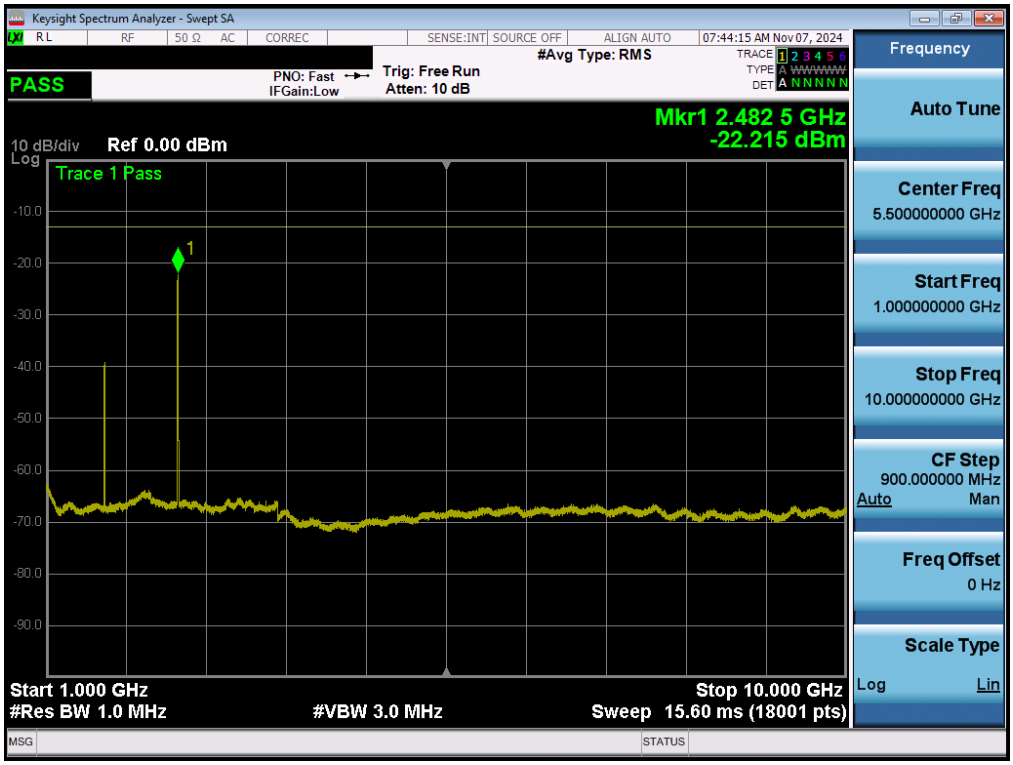
WCDMA Cell – Ant1



Plot 7-55. Conducted Spurious Plot (WCDMA Ch. 4132 – Ant1)

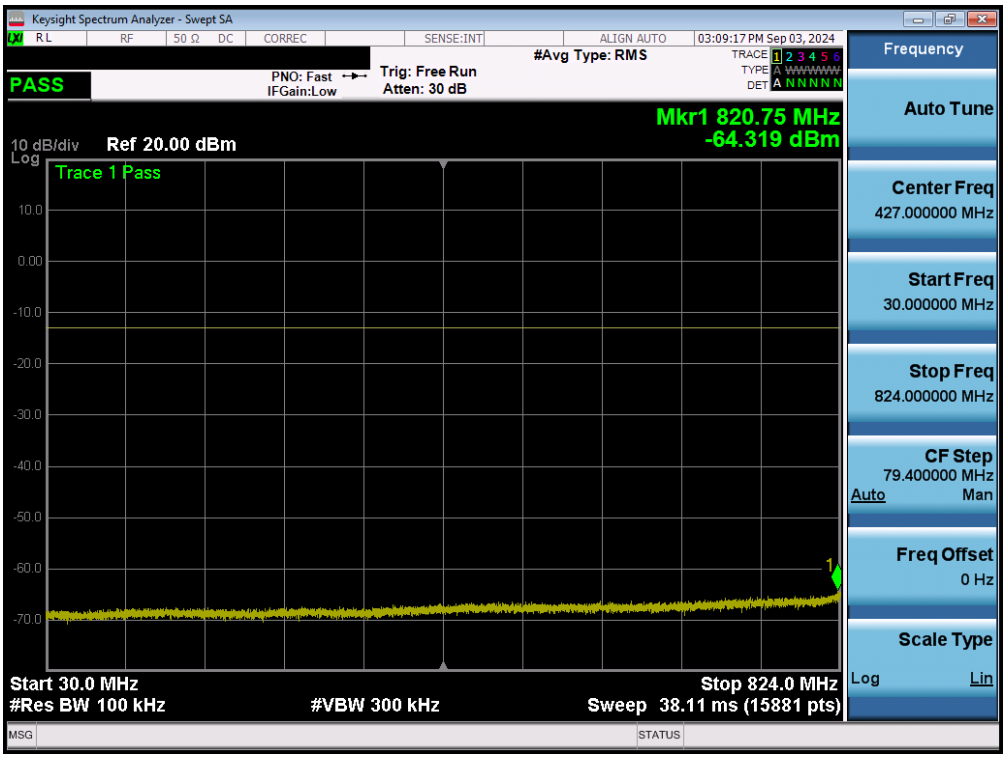


Plot 7-56. Conducted Spurious Plot (WCDMA Ch. 4132 – Ant1)

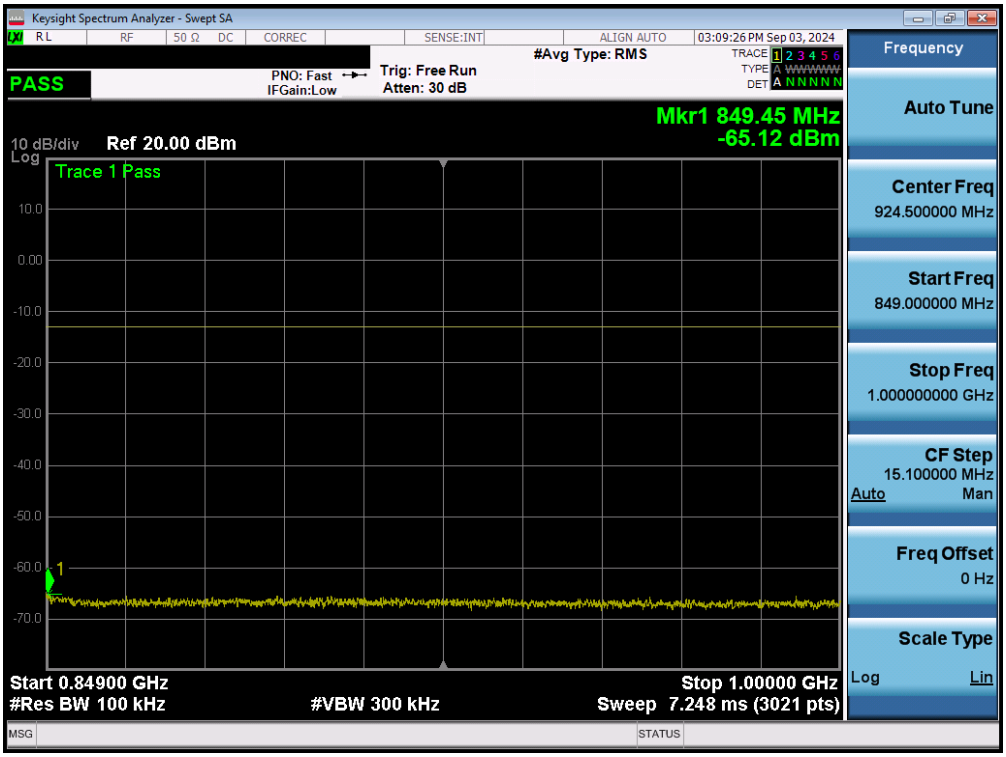


Plot 7-57. Conducted Spurious Plot (WCDMA Ch. 4132 – Ant1)

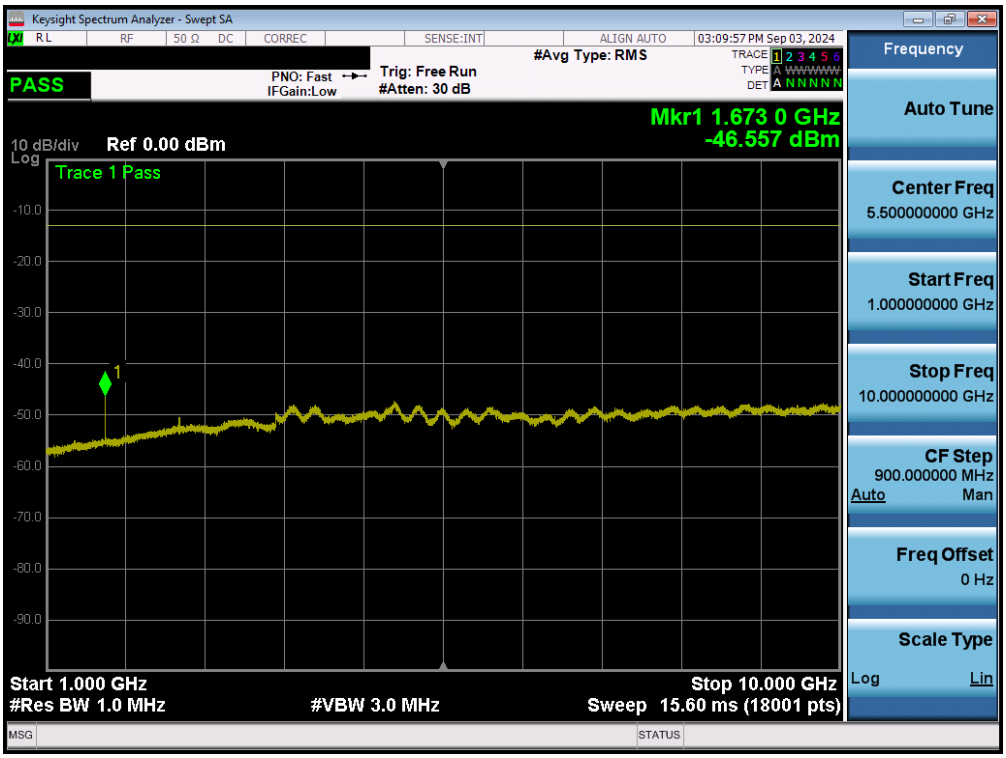
LTE Band 26/5 – Ant1



Plot 7-58. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - 1 RB - Mid Channel – Ant1)

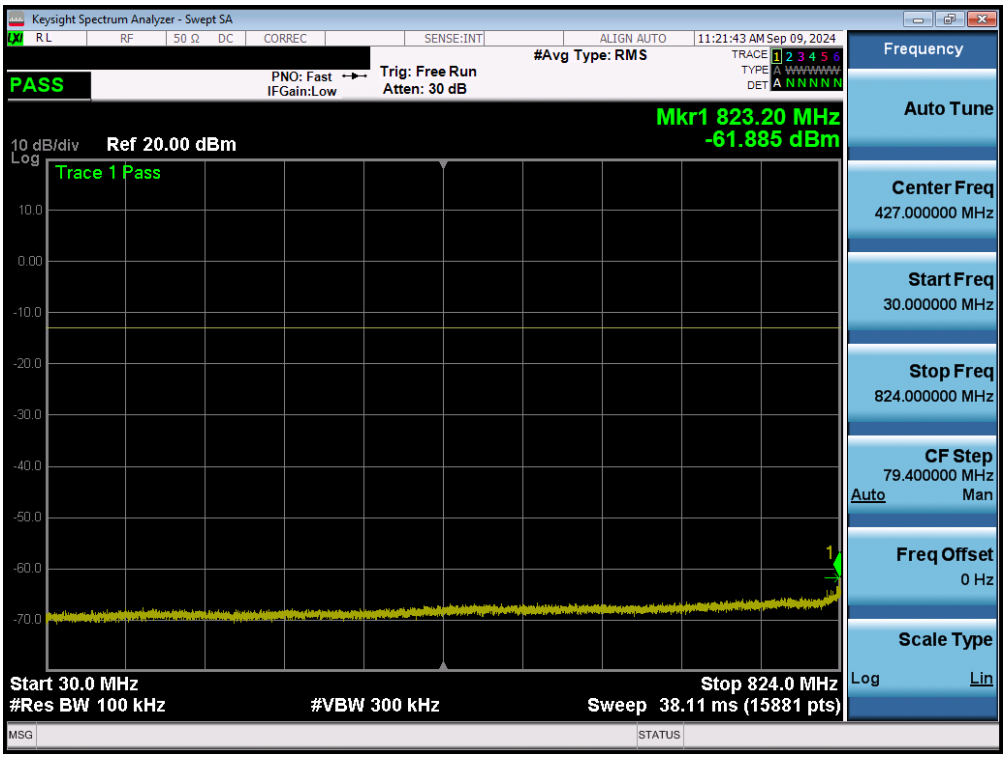


Plot 7-59. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - 1 RB - Mid Channel – Ant1)

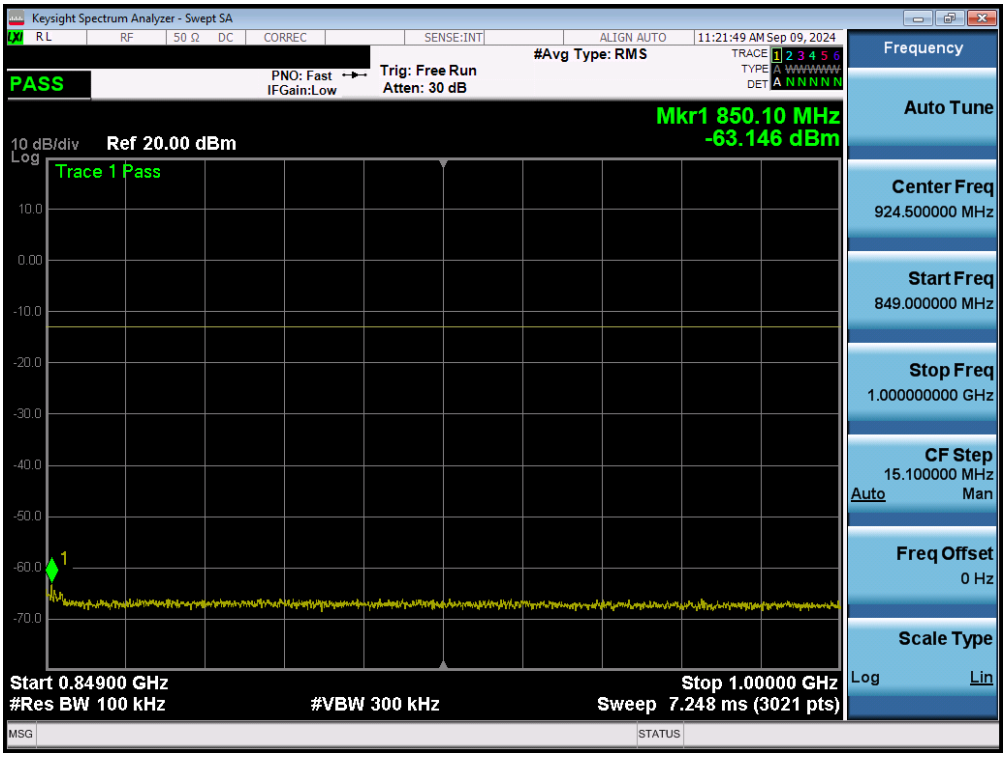


Plot 7-60. Conducted Spurious Plot (LTE Band 26/5 - 10MHz QPSK - 1 RB - Mid Channel – Ant1)

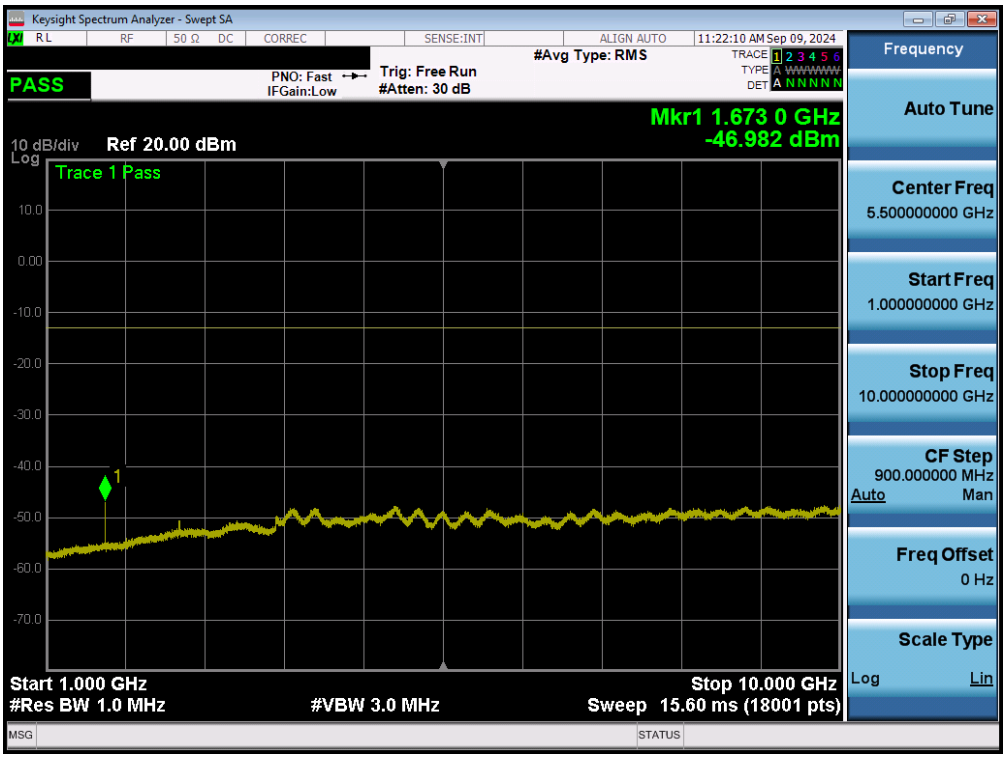
NR Band n26/5 – Ant1



Plot 7-61. Conducted Spurious Plot (NR Band n26/5 - 20.0MHz - 1 RB - Mid Channel - Ant1)



Plot 7-62. Conducted Spurious Plot (NR Band n26/5 - 20.0MHz - 1 RB - Mid Channel - Ant1)

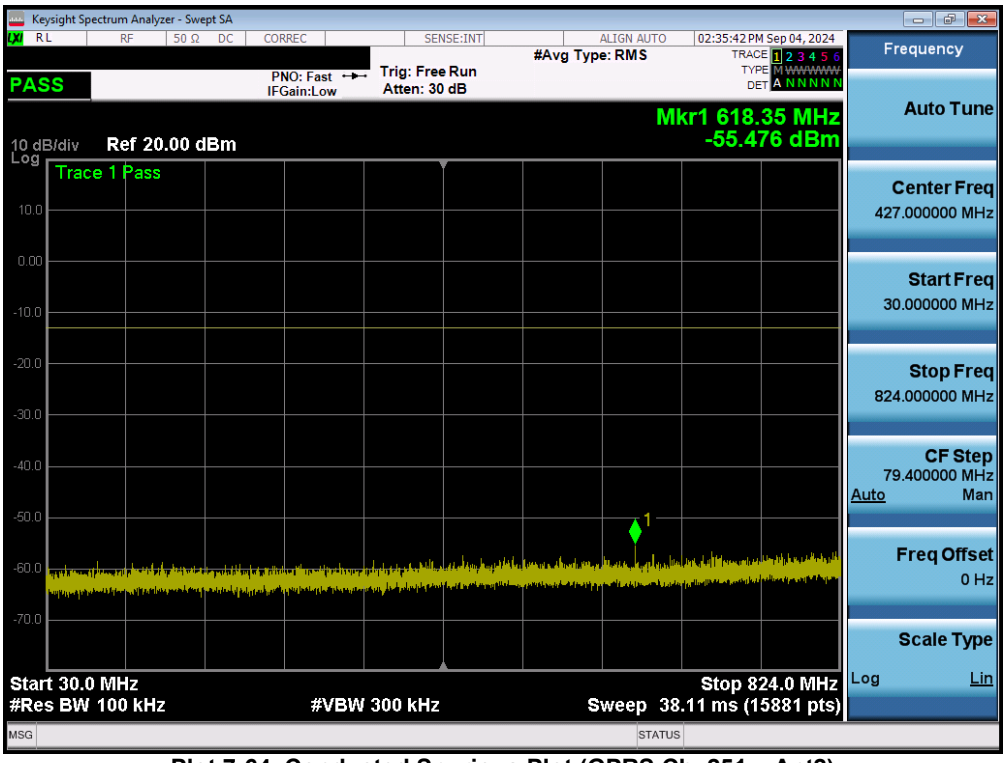


Plot 7-63. Conducted Spurious Plot (NR Band n26/5 - 20.0MHz - 1 RB - Mid Channel - Ant1)

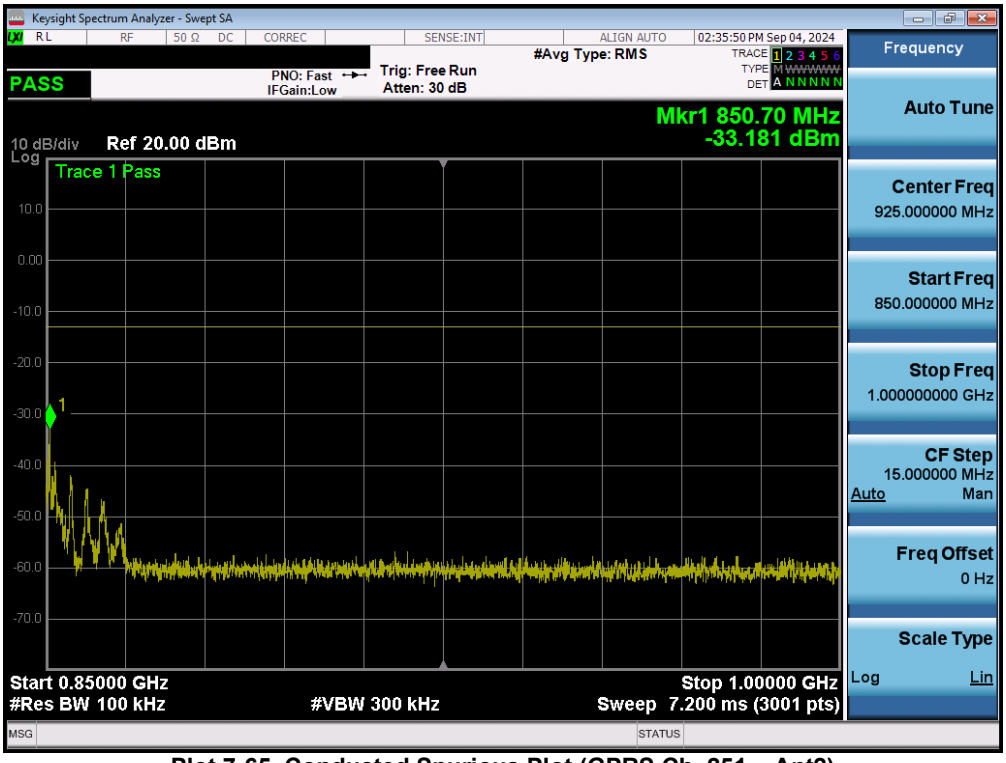
Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
GSM-Cell	250kHz	Low	30.0 - 823.0	-36.28	-13.0	-23.28
		Low	849.0 - 1000.0	-56.51	-13.0	-43.51
		Low	1000.0 - 10000.0	-33.59	-13.0	-20.59
		Mid	30.0 - 824.0	-50.76	-13.0	-37.76
		Mid	849.0 - 1000.0	-50.36	-13.0	-37.36
		Mid	1000.0 - 10000.0	-33.70	-13.0	-20.70
		High	30.0 - 824.0	-55.48	-13.0	-42.48
		High	850.0 - 1000.0	-33.18	-13.0	-20.18
		High	1000.0 - 10000.0	-32.27	-13.0	-19.27
WCDMA-Cell	5MHz	Low	30.0 - 823.0	-36.37	-13.0	-23.37
		Low	849.0 - 1000.0	-57.03	-13.0	-44.03
		Low	1000.0 - 10000.0	-23.05	-13.0	-10.05
		Mid	30.0 - 824.0	-54.73	-13.0	-41.73
		Mid	849.0 - 1000.0	-55.86	-13.0	-42.86
		Mid	1000.0 - 10000.0	-23.29	-13.0	-10.29
		High	30.0 - 824.0	-53.70	-13.0	-40.70
		High	850.0 - 1000.0	-34.91	-13.0	-21.91
		High	1000.0 - 10000.0	-22.92	-13.0	-9.92
LTE-B26-5	10MHz	Low	30.0 - 823.0	-62.78	-13.0	-49.78
		Low	849.0 - 1000.0	-65.85	-13.0	-52.85
		Low	1000.0 - 10000.0	-47.32	-13.0	-34.32
		Mid	30.0 - 824.0	-65.70	-13.0	-52.70
		Mid	849.0 - 1000.0	-65.10	-13.0	-52.10
		Mid	1000.0 - 10000.0	-47.08	-13.0	-34.08
		High	30.0 - 824.0	-65.10	-13.0	-52.10
		High	850.0 - 1000.0	-63.00	-13.0	-50.00
		High	1000.0 - 10000.0	-47.30	-13.0	-34.30
NR-n26-5	20MHz	Low	30.0 - 824.0	-60.49	-13.0	-47.49
		Low	849.0 - 1000.0	-63.66	-13.0	-50.66
		Low	1000.0 - 10000.0	-47.27	-13.0	-34.27
		Mid	30.0 - 824.0	-61.32	-13.0	-48.32
		Mid	849.0 - 1000.0	-62.72	-13.0	-49.71
		Mid	1000.0 - 10000.0	-47.34	-13.0	-34.34
		High	30.0 - 824.0	-63.48	-13.0	-50.48
		High	849.0 - 1000.0	-62.96	-13.0	-49.96
		High	1000.0 - 10000.0	-47.34	-13.0	-34.34

Table 7-9. Conducted Spurious Emissions Results – Ant2

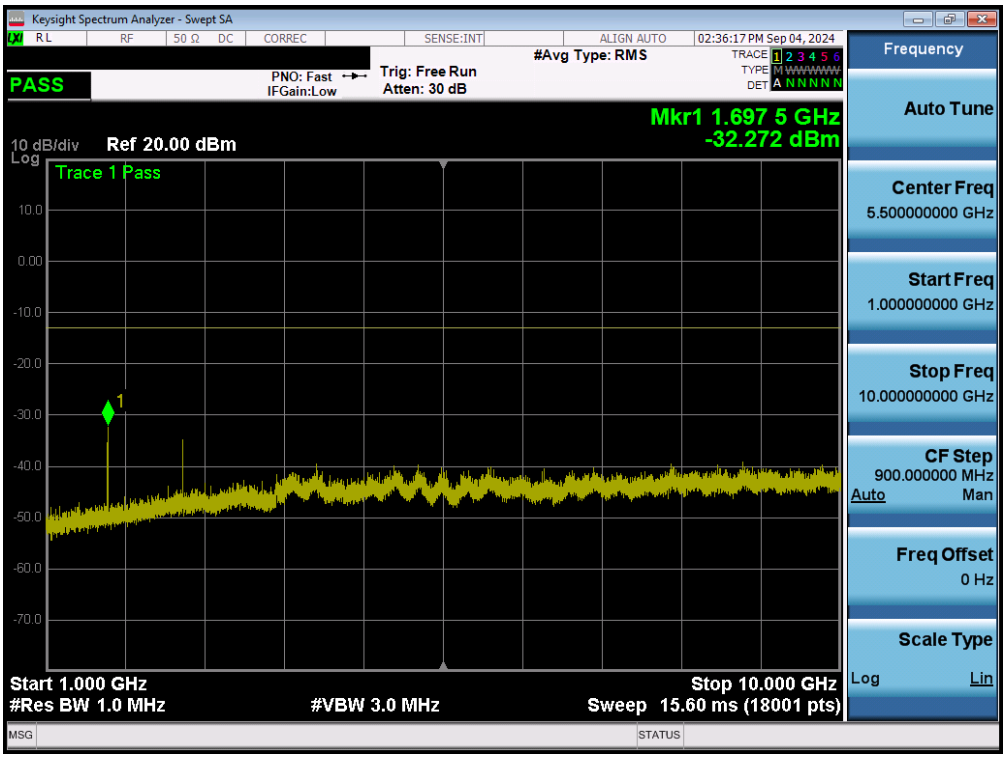
GSM/GPRS Cell – Ant2



Plot 7-64. Conducted Spurious Plot (GPRS Ch. 251 – Ant2)

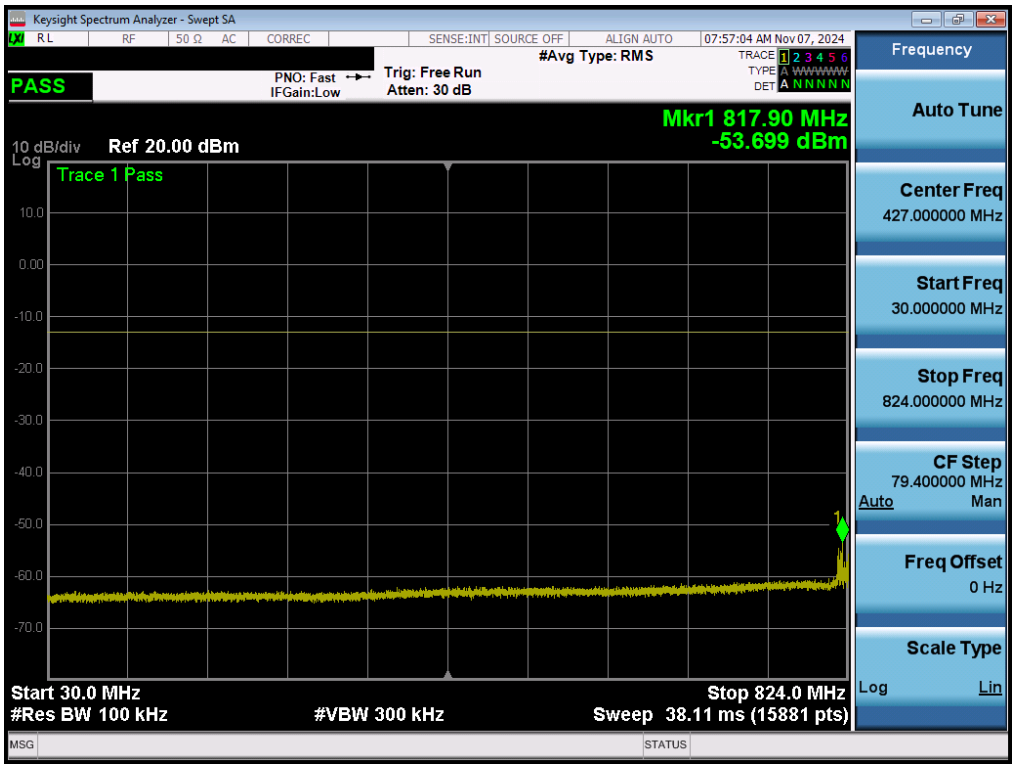


Plot 7-65. Conducted Spurious Plot (GPRS Ch. 251 – Ant2)

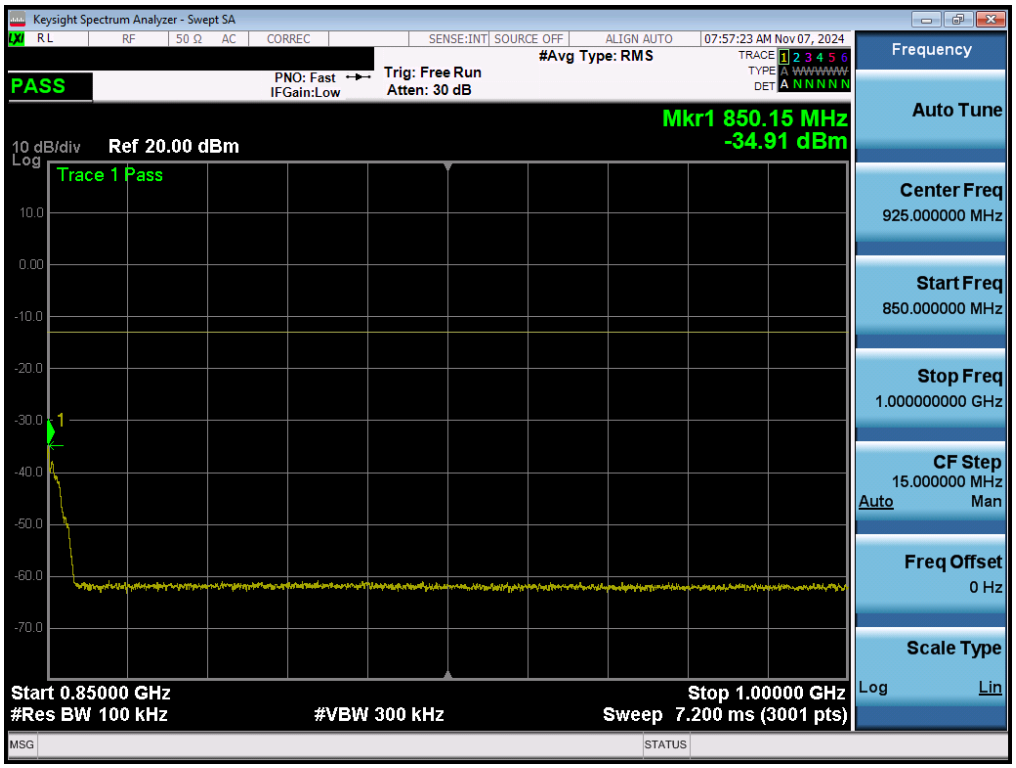


Plot 7-66. Conducted Spurious Plot (GPRS Ch. 251 – Ant2)

WCDMA Cell – Ant2



Plot 7-67. Conducted Spurious Plot (WCDMA Ch. 4233 – Ant2)



Plot 7-68. Conducted Spurious Plot (WCDMA Ch. 4233 – Ant2)