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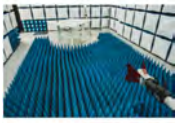

Part 96 MEASUREMENT REPORT

Applicant Name:
Skylark Wireless, LLC
4011 Garrott St.
Houston, TX 77006
USA

Date of Testing:
05/08/2023 – 7/13/2023
Test Report Issue Date:
07/14/2023
Test Site/Location:
Element Lab., Columbia, MD, USA
Test Report Serial No.:
1M2305080068-01.2AS22

FCC ID:	**2AS22-LUMACH2**
APPLICANT:	**Skylark Wireless, LLC**

Application Type:	Certification
Model:	LUMACH2
EUT Type:	CBRS Radio Module
FCC Classification:	Category B Citizens Band Radio Service Devices (CBSD)
FCC Rule Part(s):	96
Test Procedure(s):	ANSI C63.26-2015, KDB 940660 D01 v03

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

MEASUREMENT REPORT
FCC Part 96

Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
			Max. Power [W]	Max. Power [dBm]	
40 MHz	QPSK	3570.0 - 3680.0	2.780	34.44	35M4G7D
	16QAM	3570.0 - 3680.0	2.742	34.38	35M1W7D
	64QAM	3570.0 - 3680.0	2.799	34.47	35M6W7D
	256QAM	3570.0 - 3680.0	2.851	34.55	35M5W7D
30 MHz	QPSK	3565.0 - 3685.0	2.965	34.72	27M9G7D
	16QAM	3565.0 - 3685.0	2.904	34.63	28M0W7D
	64QAM	3565.0 - 3685.0	2.864	34.57	28M0W7D
	256QAM	3565.0 - 3685.0	2.972	34.73	27M4W7D
20 MHz	QPSK	3560.0 - 3690.0	2.698	34.31	18M5G7D
	16QAM	3560.0 - 3690.0	2.630	34.20	18M4W7D
	64QAM	3560.0 - 3690.0	2.636	34.21	18M4W7D
	256QAM	3560.0 - 3690.0	2.667	34.26	18M5W7D
10 MHz	QPSK	3555.0 - 3695.0	2.704	34.32	7M86G7D
	16QAM	3555.0 - 3695.0	2.698	34.31	7M87W7D
	64QAM	3555.0 - 3695.0	2.773	34.43	7M90W7D
	256QAM	3555.0 - 3695.0	2.761	34.41	7M87W7D

EUT Overview

Note: EIRP levels shown in the table above are measured over the full channel bandwidth. These values will appear on the Grant of Authorization.

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.

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 a OnGo Alliance Approved Test Lab (ATL)
- Element Washington DC LLC is a WInnForum Approved Test Lab
- 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.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Skylark Wireless, LLC CBRS Radio Module FCC ID: 2AS22-LUMACH2**. The test data contained in this report pertains only to the emissions due to the EUT's Band 48 operation in the CBRS band. Per FCC Part 96, this device is evaluated as a Category B CBSD (CBE).

Test Device Serial No.: RF5B000050, RF5B000079

2.2 Device Capabilities

This device contains the following capabilities:

Band 48

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 operates with two antenna ports (Channel A and Channel B) which produce two simulatenous, orthogonally polarized transmissions

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version 2023.07.01 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 Measurement 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

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

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

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

4.0 MEASUREMENT UNCERTAINTY

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

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

5.0 TEST EQUIPMENT CALIBRATION DATA

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

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	MVG	EMC Cable and Switch System	1/12/2023	Annual	1/12/2024	MVG-001
-	ETS	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	WL40-1	Licensed Transmitter Cable Set	1/12/2023	Annual	1/12/2024	WL40-1
Agilent	N9030A	50GHz PXA Signal Analyzer	9/9/2022	Annual	9/9/2023	9704-5182
Emco	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	7/20/2021	Triennial	7/20/2023	9203-2178
Keysight Technologies	N9020A	MXA Signal Analyzer	3/15/2023	Annual	3/15/2024	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	9/6/2022	Annual	9/6/2023	MY54490576
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/29/2022	Annual	8/29/2023	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	8/25/2022	Annual	8/25/2023	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	1/13/2023	Annual	1/13/2024	103200
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	8/30/2022	Biennial	8/30/2024	A051107
Sunol	JB6	LB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816
Sunol	DRH-118	Horn Antenna (1-18GHz)	2/14/2022	Biennial	2/14/2024	A082816

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

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

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 8M45W7D

BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – Band 48

Example: Middle Channel 2nd Harmonic (7250 MHz)

The average spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80).

7.0 TEST RESULTS

7.1 Summary

Company Name:	Skylark Wireless, LLC
FCC ID:	2AS22-LUMACH2
FCC Classification:	Category B Citizens Band Radio Service Devices (CBSD)
Mode(s):	Band 48

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
Conducted	Conducted Power	2.1046(a), 2.1046(c)	N/A	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Peak-Average Ratio	96.41(g)	≤ 13dB	PASS	Section 7.6
	Conducted Band Edge / Spurious Emissions (CBSD)	2.1051, 96.41(e)(1)(i)	-13 dBm/MHz at frequencies within 0-10 MHz above the upper SAS-assigned channel edge and within 0-10MHz below the lower SAS-assigned channel edge -25 dBm/MHz at frequencies greater than 10 MHz above and below channel edge -emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz	PASS	Sections 7.7, 7.8
	Frequency Stability	2.1055	Fundamental emissions stay within authorized frequency block	PASS	Section 7.10
	Category B CBSD Device Additional Requirements (CBSD Protocol)	96.45	Category B CBSDs must be professionally installed. In the 3550-3650MHz band, Category B CBSDs must be authorized consistent with information received from an ESC, as described in 96.15. Category B CBSDs are limited to outdoor operations. When registering with a SAS, Category B CBSDs must tranmist all information required under 96.39 plus the following additonal information: antenna gain, beamwidth, azimuth, downtilt angle, and antenna height above ground level.	PASS	SAS Protocol Report
	Equivalent Isotropic Radiated Power (EIRP) (Catogory B CBSD)	96.41(b)	47 dBm/10MHz	PASS	Section 7.4
	Power Spectral Density (PSD) (Category B CBSD)	96.41(b)	37 dBm/10MHz	PASS	Section 7.5
Radiated	Radiated Spurious Emissions	96.41(e)	-40 dBm/MHz	PASS	Section 7.9

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) 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 1.1 and Chamber Control 1.6.4.

7.2 Conducted Output Power/EIRP Data

Test Overview

The EUT is set up to transmit at maximum power for Band 48. All power levels are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Measurement equipment was set up with triggering/gating on the spectrum analyzer such that powers were measured only during the on-time of the signal.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.4.4.1
ANSI C63.26-2015 – Section 6.4.3.2.3

Test Settings

1. Span = 2 x OBW to 3 x OBW
2. RBW = 1% to 5% of the OBW
3. Number of measurement points in sweep ≥ 2 x span / RBW
4. Sweep = auto-couple (less than transmission burst duration)
5. Detector = RMS (power)
6. Trigger was set to enable power measurements only on full power bursts
7. Trace was allowed to stabilize
8. Spectrum analyzer's "Channel Power" function was used to compute the power by integrating the spectrum across the OBW of the signal

Test Setup

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

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

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

Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted Power [dBm]	Ch. B Conducted Power [dBm]	Summed MIMO Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]
40 MHz	QPSK	3570.0	16.02	17.3	19.72	13.75	31.05	1.274
		3625.0	18.35	20.69	22.69	13.75	34.44	2.780
		3680.0	18.60	18.17	21.40	13.75	31.92	1.556
	16-QAM	3570.0	15.50	17.28	19.49	13.75	31.03	1.268
		3625.0	18.41	20.63	22.67	13.75	34.38	2.742
		3680.0	18.54	18.17	21.37	13.75	31.92	1.556
	64-QAM	3570.0	15.76	17.22	19.56	13.75	30.97	1.250
		3625.0	18.41	20.72	22.73	13.75	34.47	2.799
		3680.0	18.53	18.18	21.37	13.75	31.93	1.560
	256-QAM	3570.0	15.53	17.3	19.51	13.75	31.05	1.274
		3625.0	18.43	20.8	22.79	13.75	34.55	2.851
		3680.0	18.54	18.17	21.37	13.75	31.92	1.556
30 MHz	QPSK	3565.0	16.37	18.98	20.88	13.75	32.73	1.875
		3625.0	18.35	20.97	22.86	13.75	34.72	2.965
		3685.0	19.84	17.72	21.92	13.75	31.47	1.403
	16-QAM	3565.0	16.86	19.04	21.10	13.75	32.79	1.901
		3625.0	18.26	20.88	22.77	13.75	34.63	2.904
		3685.0	19.75	17.74	21.87	13.75	31.49	1.409
	64-QAM	3565.0	16.46	19.03	20.94	13.75	32.78	1.897
		3625.0	18.46	20.82	22.81	13.75	34.57	2.864
		3685.0	19.72	17.75	21.86	13.75	31.50	1.413
	256-QAM	3565.0	16.35	19.05	20.92	13.75	32.80	1.905
		3625.0	18.25	20.98	22.84	13.75	34.73	2.972
		3685.0	19.78	17.76	21.90	13.75	31.51	1.416
20 MHz	QPSK	3560.0	16.40	19.23	21.05	13.75	32.98	1.986
		3625.0	18.13	20.56	22.52	13.75	34.31	2.698
		3690.0	19.60	19.38	22.50	13.75	33.13	2.056
	16-QAM	3560.0	17.01	19.12	21.20	13.75	32.87	1.936
		3625.0	18.22	20.45	22.49	13.75	34.20	2.630
		3690.0	19.60	19.3	22.46	13.75	33.05	2.018
	64-QAM	3560.0	16.95	19.17	21.21	13.75	32.92	1.959
		3625.0	18.22	20.46	22.49	13.75	34.21	2.636
		3690.0	19.57	19.35	22.47	13.75	33.10	2.042
	256-QAM	3560.0	17.01	19.27	21.30	13.75	33.02	2.004
		3625.0	18.10	20.51	22.48	13.75	34.26	2.667
		3690.0	19.63	19.37	22.51	13.75	33.12	2.051
10 MHz	QPSK	3555.0	18.15	17.99	21.08	13.75	31.74	1.493
		3625.0	17.68	19.41	21.64	13.75	33.16	2.070
		3695.0	18.96	20.57	22.85	13.75	34.32	2.704
	16-QAM	3555.0	17.60	18.2	20.92	13.75	31.95	1.567
		3625.0	17.67	19.45	21.66	13.75	33.20	2.089
		3695.0	18.93	20.56	22.83	13.75	34.31	2.698
	64-QAM	3555.0	17.99	18.11	21.06	13.75	31.86	1.535
		3625.0	17.86	19.46	21.74	13.75	33.21	2.094
		3695.0	18.95	20.68	22.91	13.75	34.43	2.773
	256-QAM	3555.0	18.08	17.99	21.05	13.75	31.74	1.493
		3625.0	17.64	19.52	21.69	13.75	33.27	2.123
		3695.0	18.91	20.66	22.88	13.75	34.41	2.761

Table 7-2 Conducted Power / EIRP Measurements

Channel A Conducted Power Measurements

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Plot 7.1 – Conducted Power Measurement – 10MHz BW, High Channel, QPSK – Ch.A

04:40:54 PM 05/10/2023

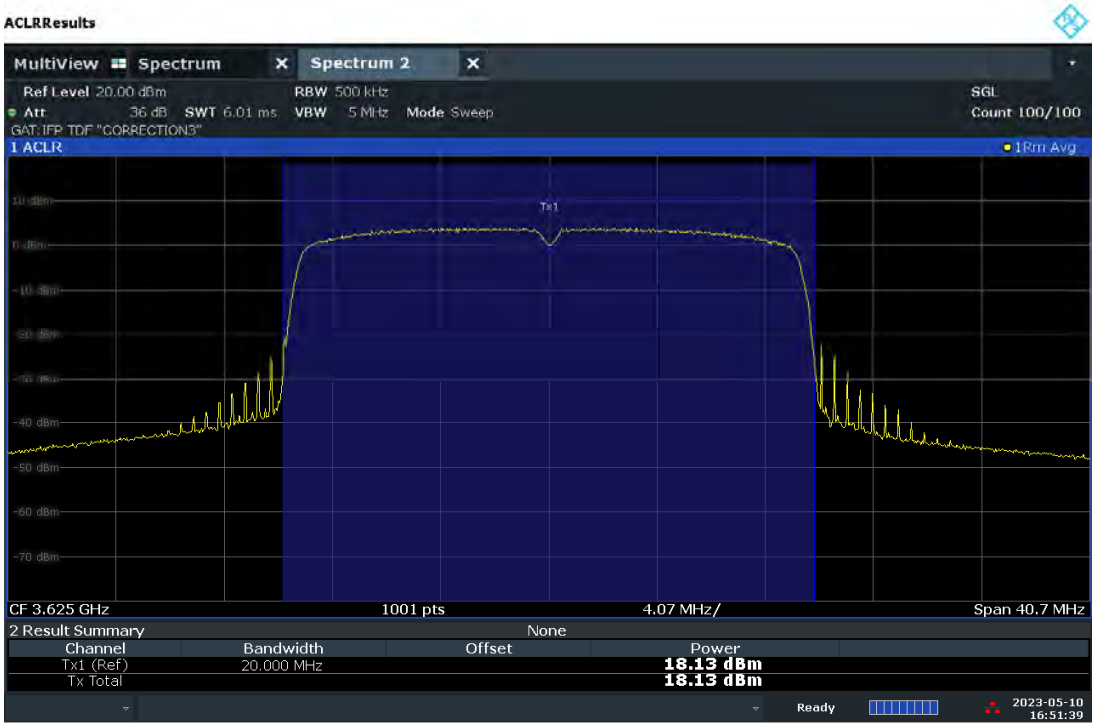
Plot 7.2 – Conducted Power Measurement – 10MHz BW, High Channel, 16QAM – Ch.A

04:41:33 PM 05/10/2023

Plot 7.3 – Conducted Power Measurement – 10MHz BW, High Channel, 64QAM – Ch.A

04:43:39 PM 05/10/2023

Plot 7.4 – Conducted Power Measurement – 10MHz BW, High Channel, 256QAM – Ch.A



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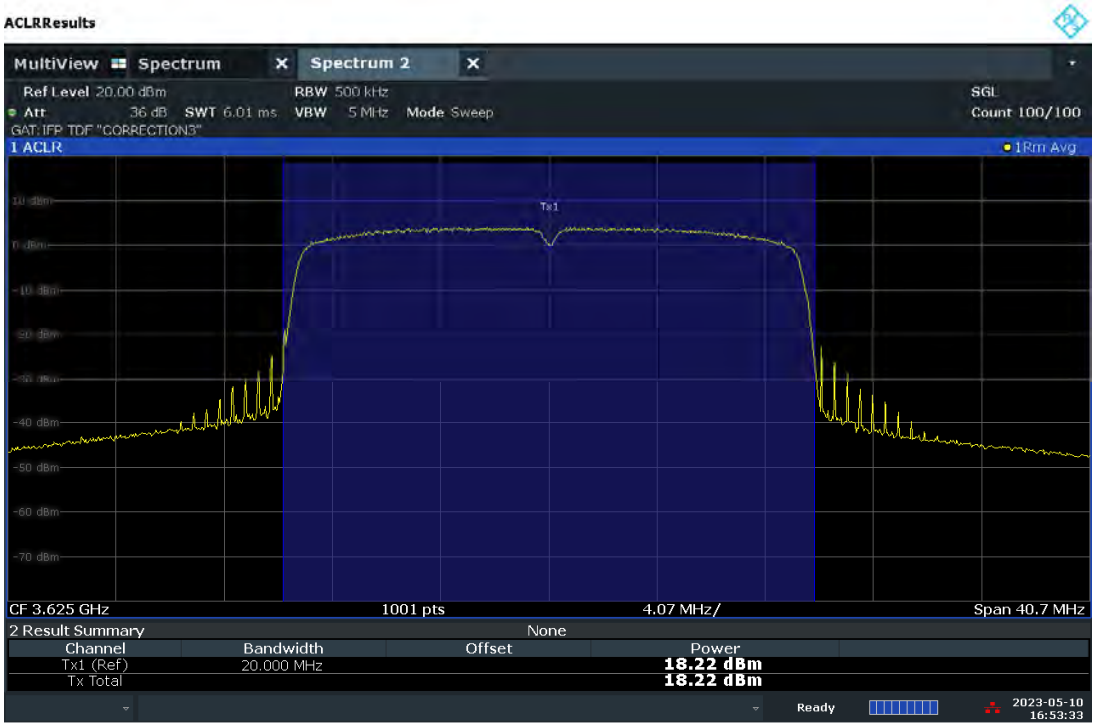
Plot 7.5 – Conducted Power Measurement – 20MHz BW, Mid Channel, QPSK – Ch.A



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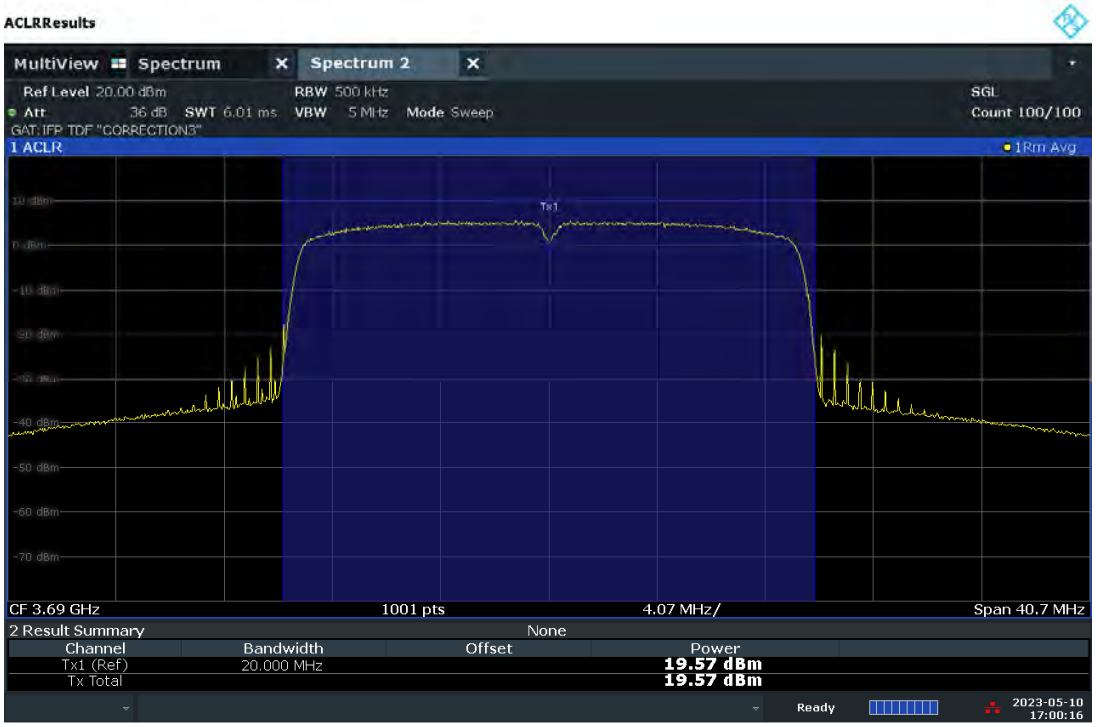
Plot 7.6 – Conducted Power Measurement – 20MHz BW, Mid Channel, 16QAM – Ch.A



05:00:16 PM 05/10/2023

Plot 7.7 – Conducted Power Measurement – 20MHz BW, High Channel, 64QAM – Ch.A

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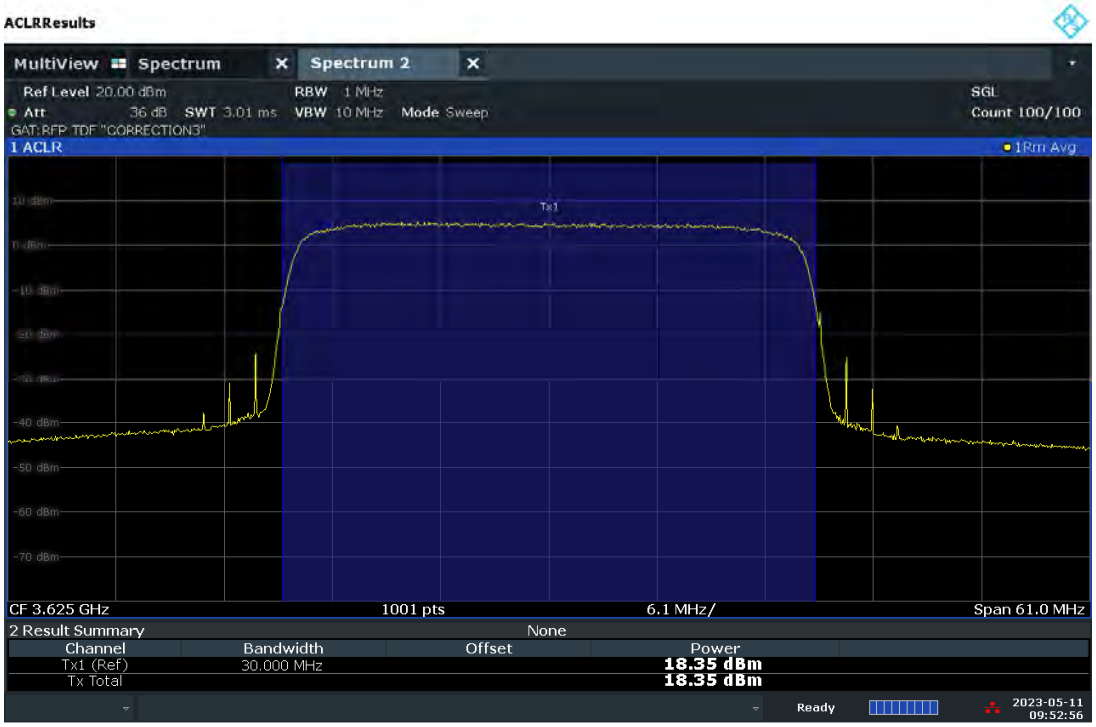
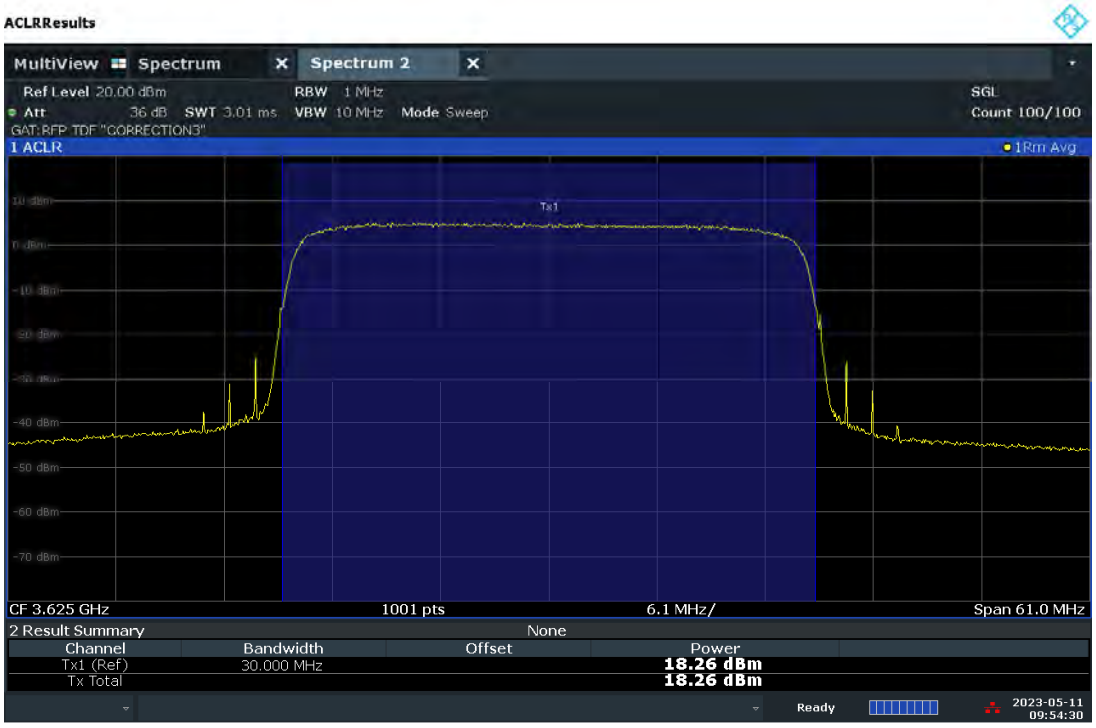
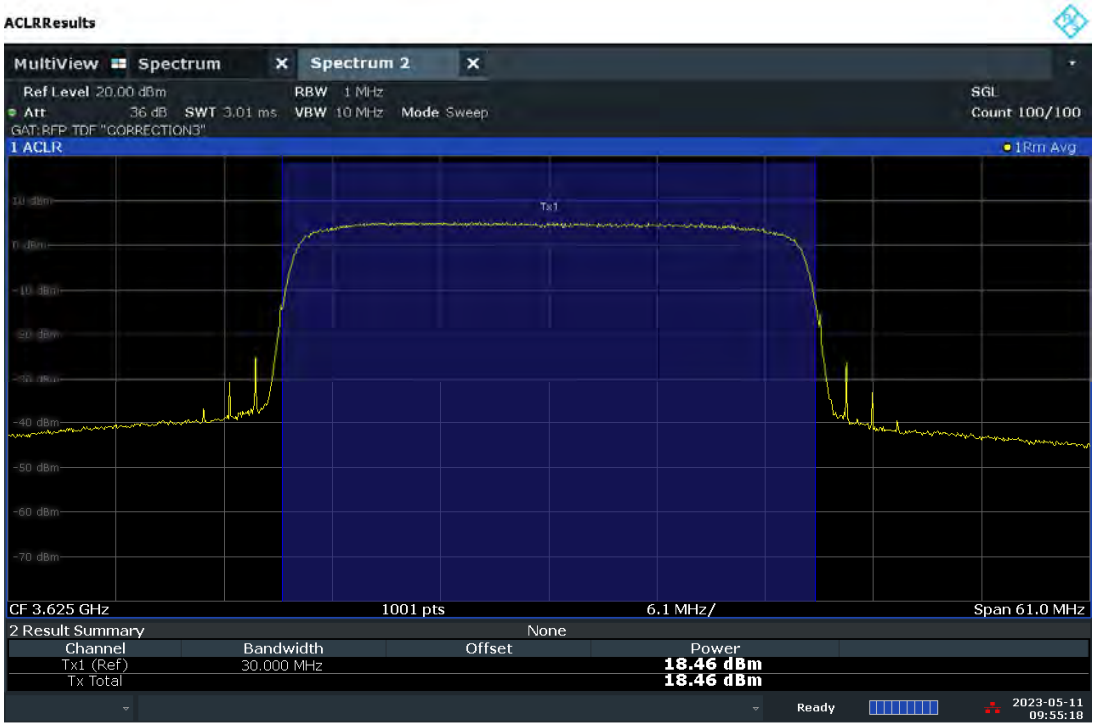
Plot 7.8 – Conducted Power Measurement – 20MHz BW, High Channel, 256QAM – Ch.A



Plot 7.9 – Conducted Power Measurement – 30MHz BW, Mid Channel, QPSK – Ch.A



Plot 7.10 – Conducted Power Measurement – 30MHz BW, Mid Channel, 16QAM – Ch.A



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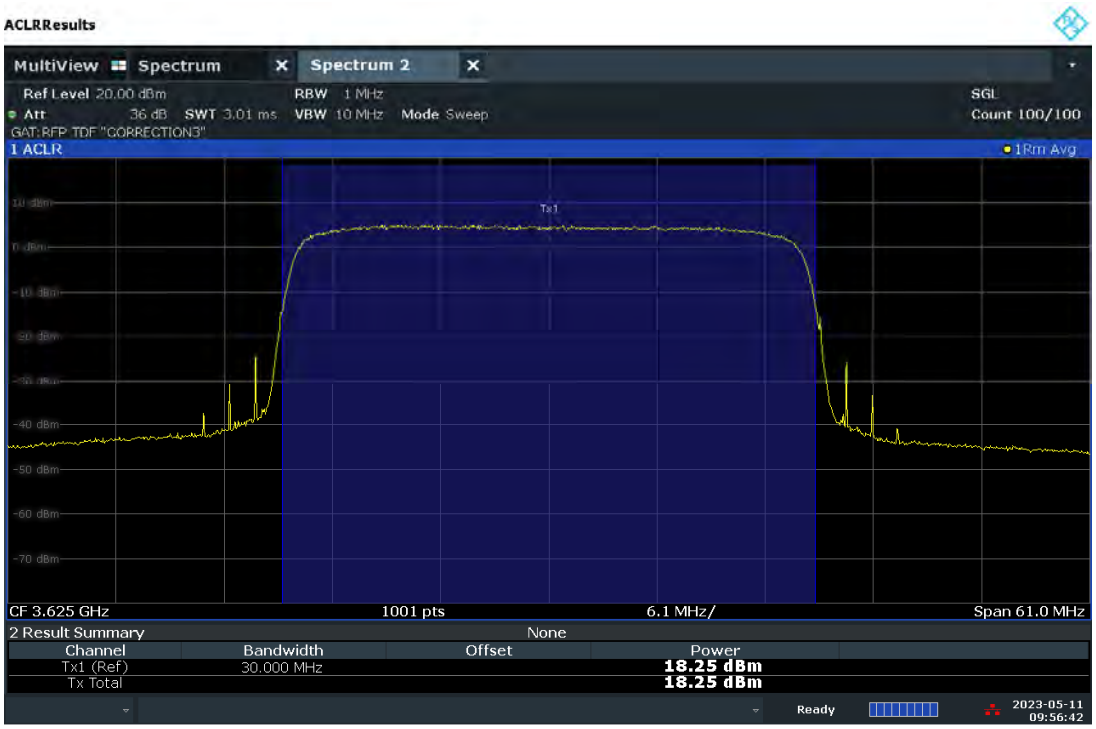
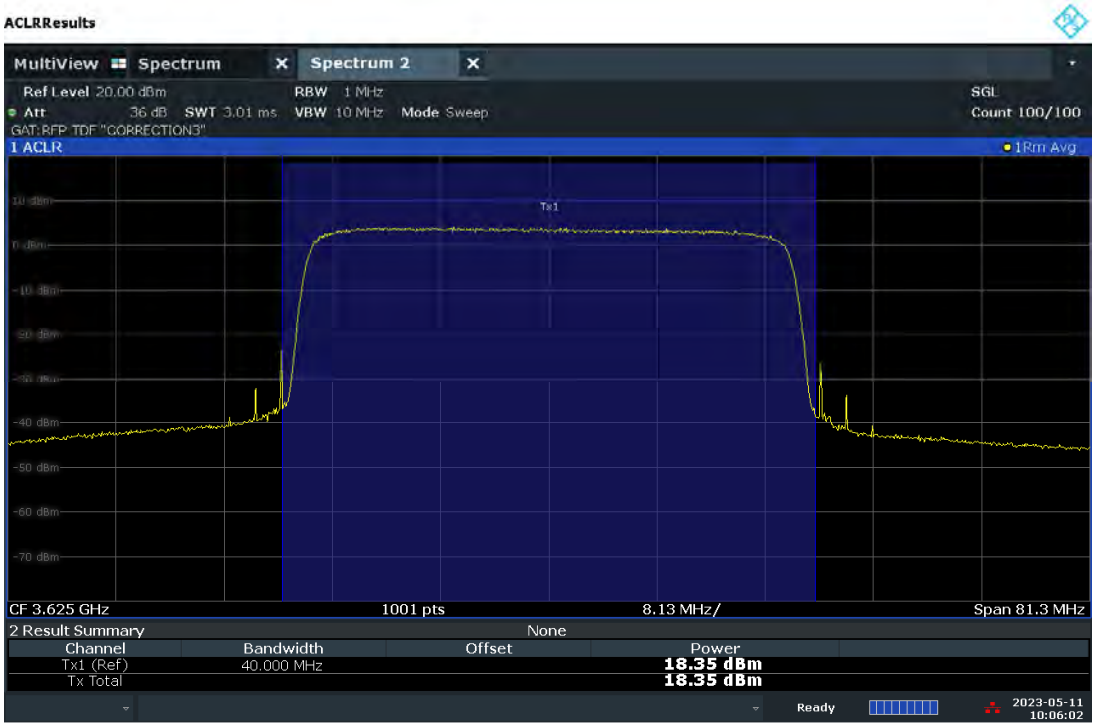
Plot 7.11 – Conducted Power Measurement – 30MHz BW, Mid Channel, 64QAM – Ch.A



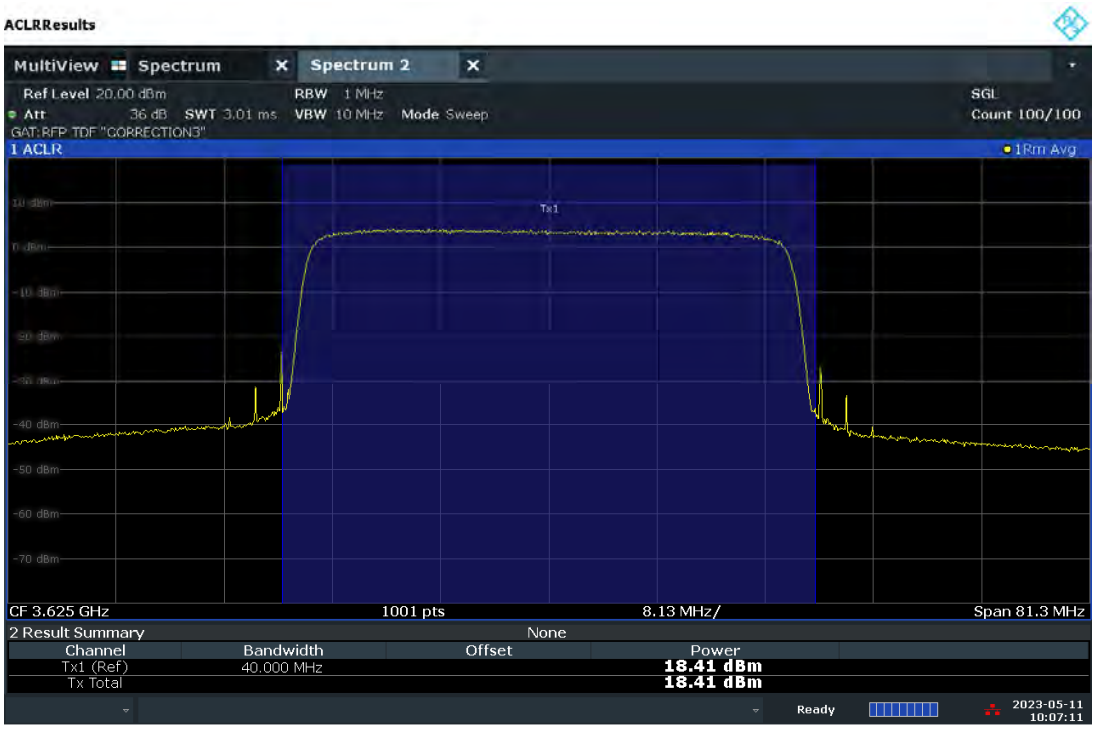
09:56:42 AM 05/11/2023

Plot 7.12 – Conducted Power Measurement – 30MHz BW, Mid Channel, 256QAM – Ch.A



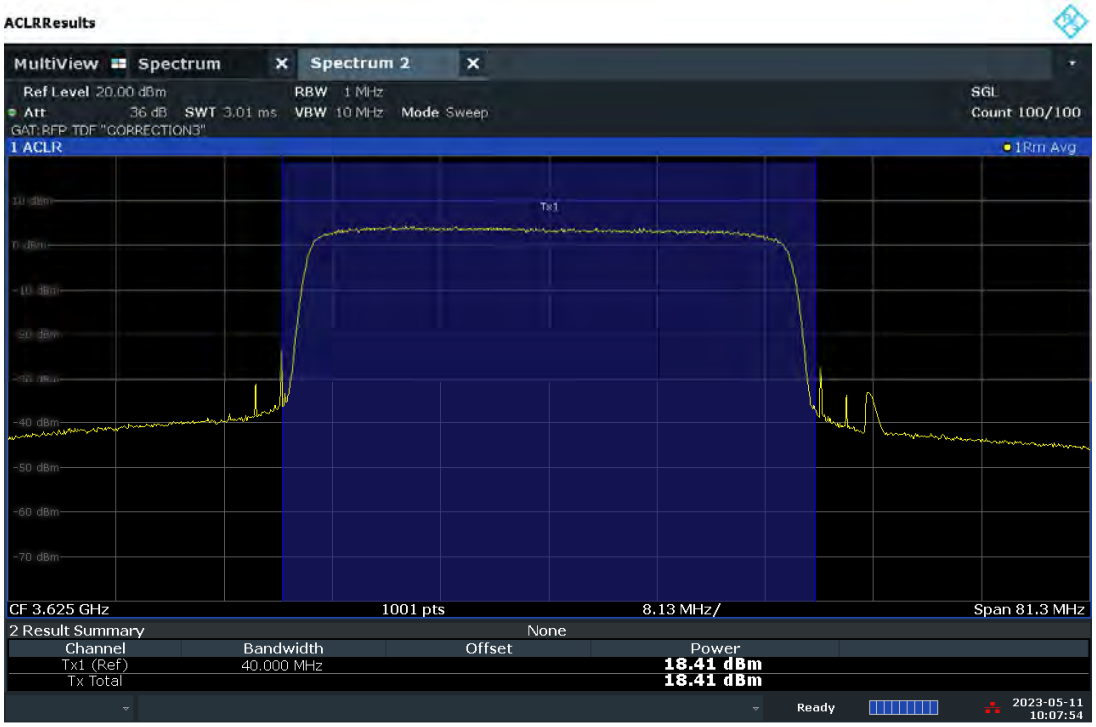
10:06:03 AM 05/11/2023

Plot 7.13 – Conducted Power Measurement – 40MHz BW, Mid Channel, QPSK – Ch.A



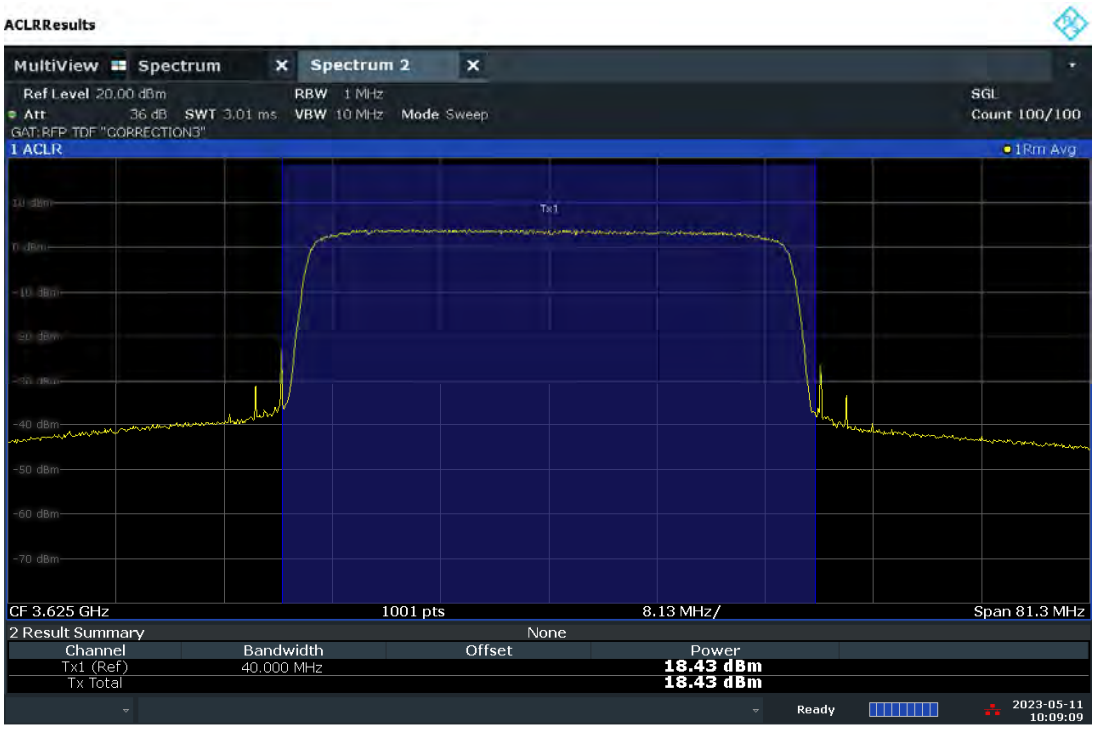
10:07:12 AM 05/11/2023

Plot 7.14 – Conducted Power Measurement – 40MHz BW, Mid Channel, 16QAM – Ch.A



10:07:54 AM 05/11/2023

Plot 7.15 – Conducted Power Measurement – 40MHz BW, Mid Channel, 64QAM – Ch.A



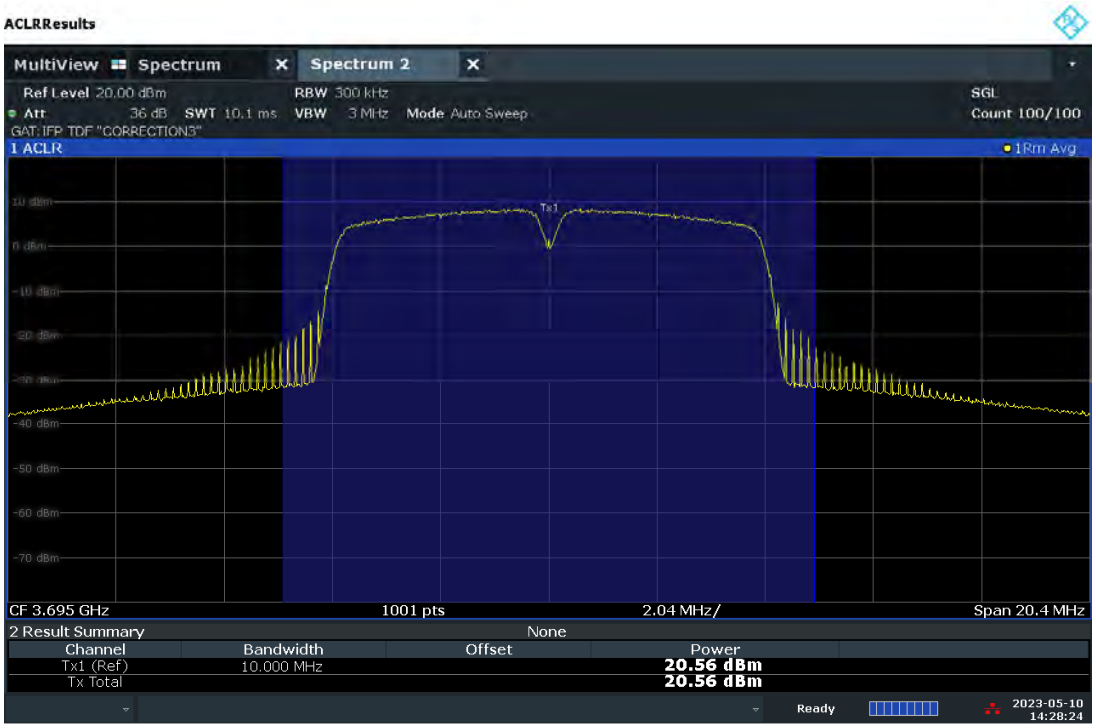
10:09:10 AM 05/11/2023

Plot 7.16 – Conducted Power Measurement – 40MHz BW, Mid Channel, 256QAM – Ch.A

Channel B Conducted Power Measurements

02:25:38 PM 05/10/2023

Plot 7.17 – Conducted Power Measurement – 10MHz BW, High Channel, QPSK – Ch.B



02:28:25 PM 05/10/2023

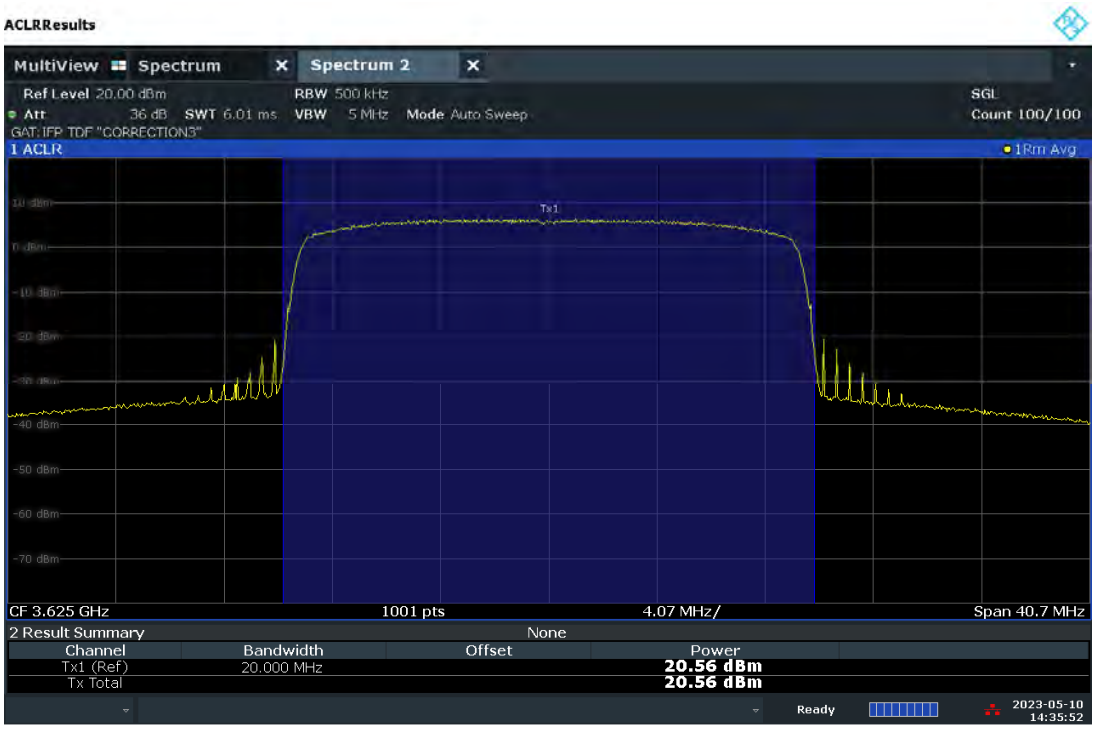
Plot 7.18 – Conducted Power Measurement – 10MHz BW, High Channel, 16QAM – Ch.B

02:29:04 PM 05/10/2023

Plot 7.19 – Conducted Power Measurement – 10MHz BW, High Channel, 64QAM – Ch.B

02:30:26 PM 05/10/2023

Plot 7.20 – Conducted Power Measurement – 10MHz BW, High Channel, 256QAM – Ch.B

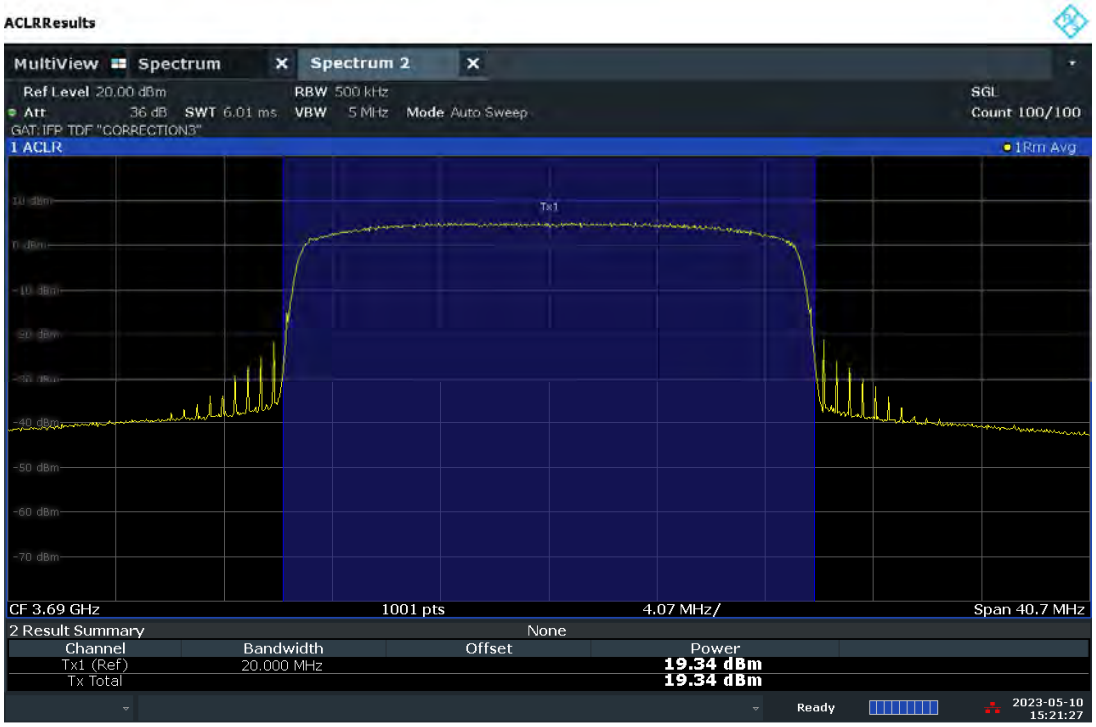


02:35:53 PM 05/10/2023

Plot 7.21 – Conducted Power Measurement – 20MHz BW, Mid Channel, QPSK – Ch.B

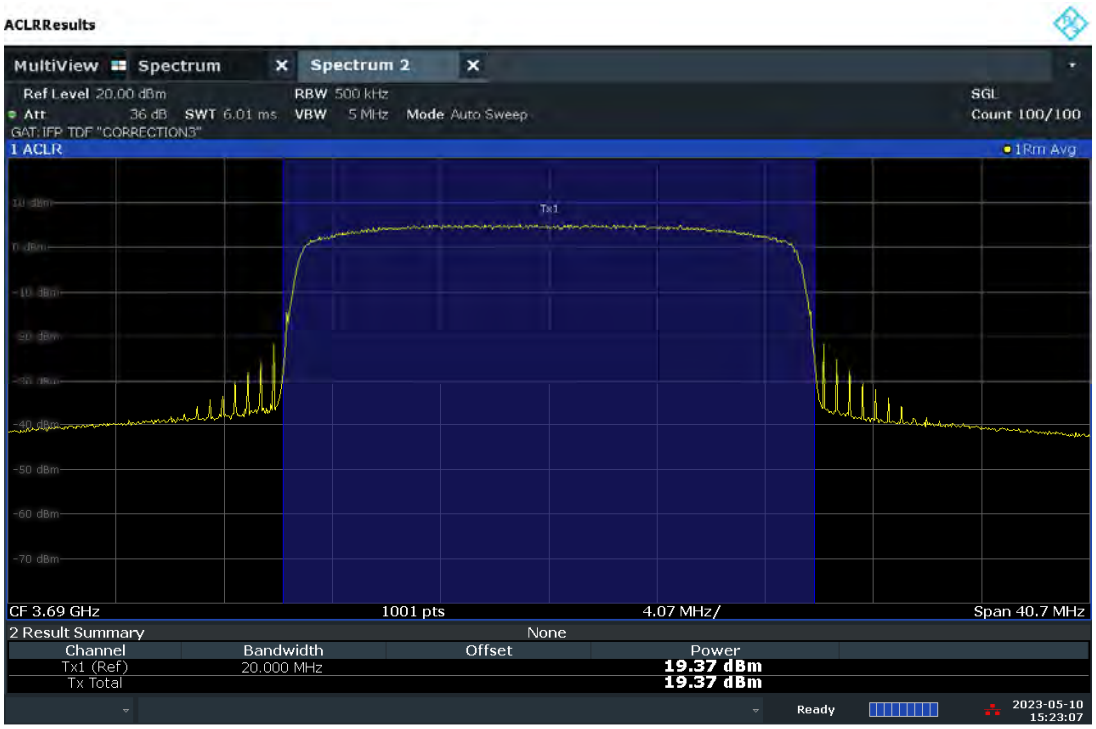
03:15:59 PM 05/10/2023

Plot 7.22 – Conducted Power Measurement – 20MHz BW, Mid Channel, 16QAM – Ch.B



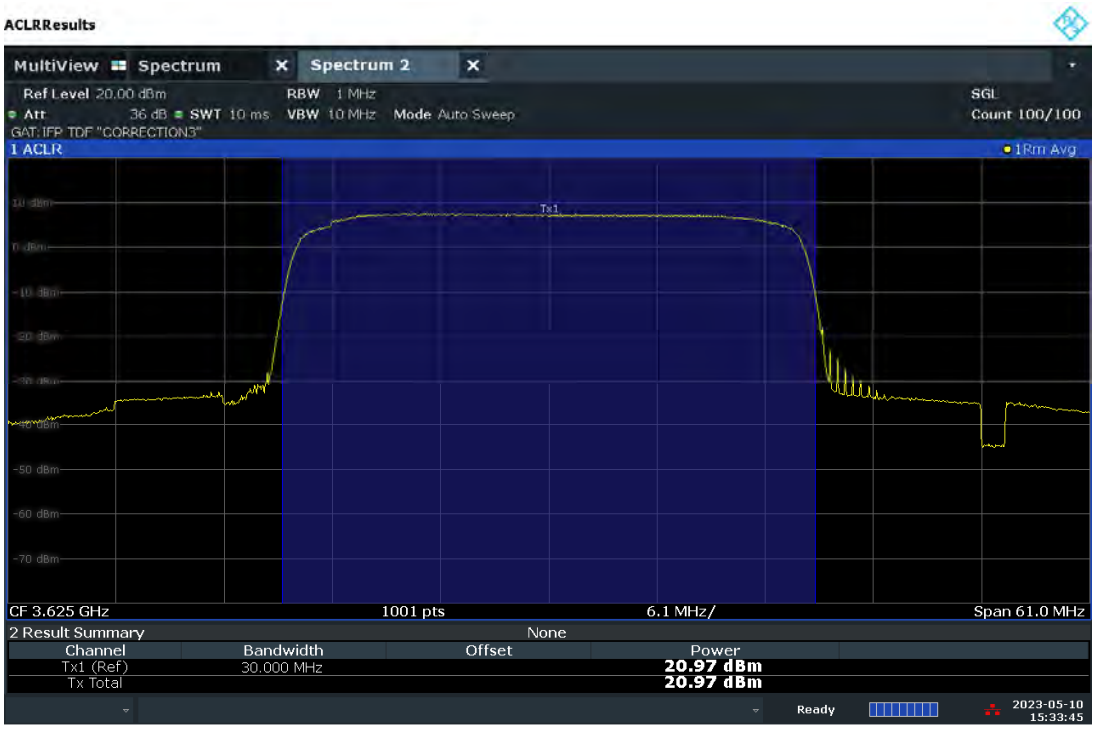
03:21:28 PM 05/10/2023

Plot 7.23 – Conducted Power Measurement – 20MHz BW, High Channel, 64QAM – Ch.B



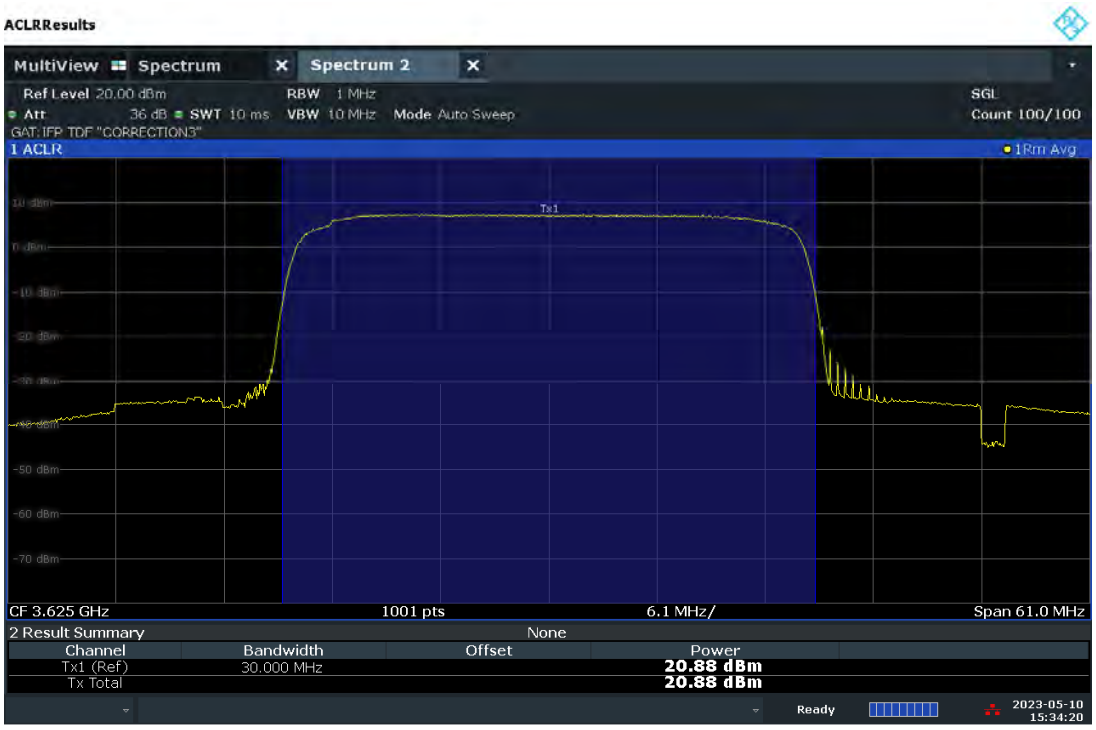
03:23:08 PM 05/10/2023

Plot 7.24 – Conducted Power Measurement – 20MHz BW, High Channel, 256QAM – Ch.B



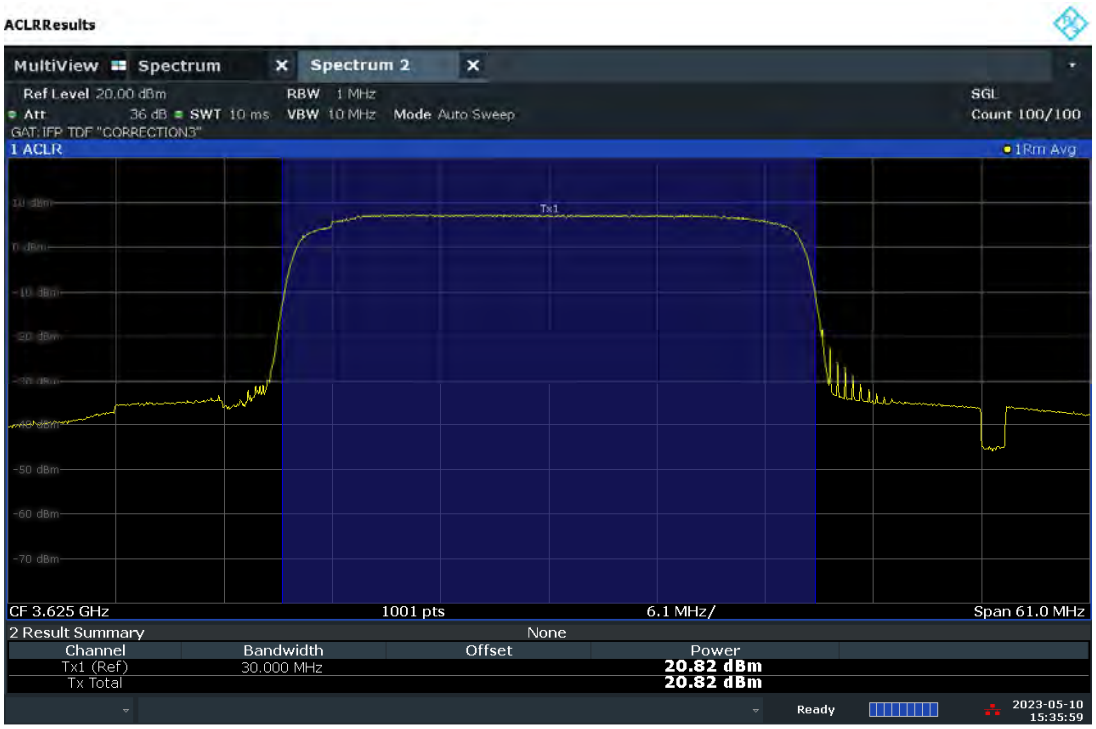
03:33:46 PM 05/10/2023

Plot 7.25 – Conducted Power Measurement – 30MHz BW, Mid Channel, QPSK – Ch.B



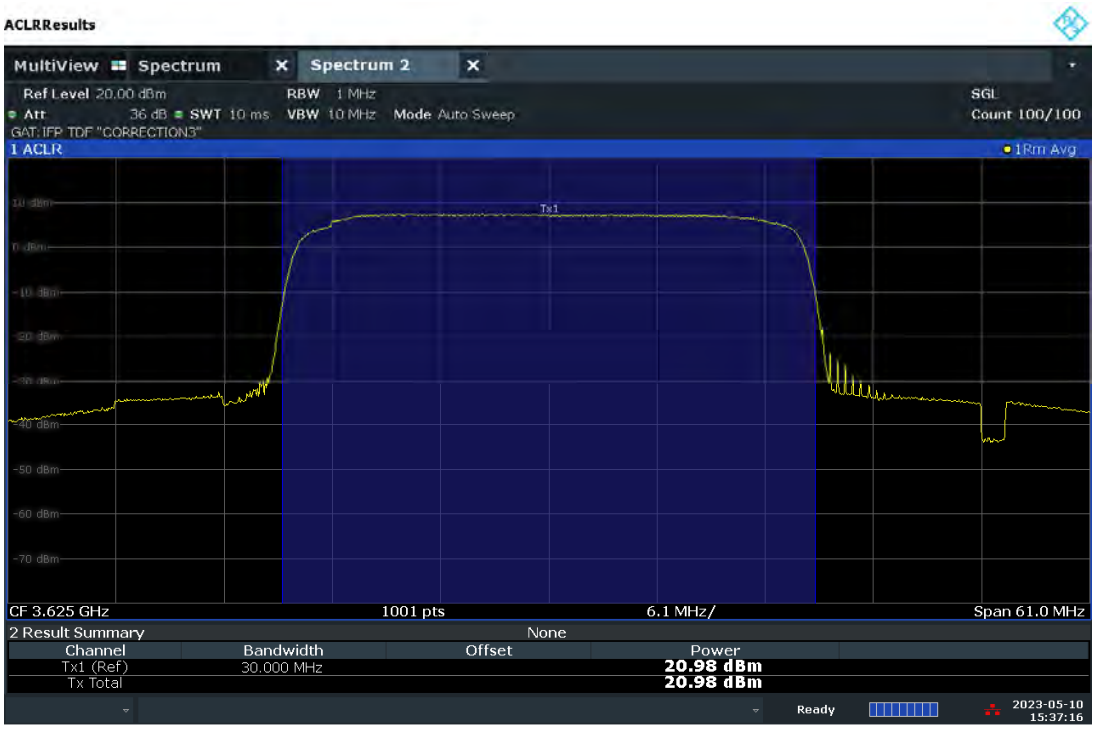
03:34:20 PM 05/10/2023

Plot 7.26 – Conducted Power Measurement – 30MHz BW, Mid Channel, 16QAM – Ch.B



03:36:00 PM 05/10/2023

Plot 7.27 – Conducted Power Measurement – 30MHz BW, Mid Channel, 64QAM – Ch.B



03:37:16 PM 05/10/2023

Plot 7.28 – Conducted Power Measurement – 30MHz BW, Mid Channel, 256QAM – Ch.B

04:06:04 PM 05/10/2023

Plot 7.29 – Conducted Power Measurement – 40MHz BW, Mid Channel, QPSK – Ch.B

04:12:24 PM 05/10/2023

Plot 7.30 – Conducted Power Measurement – 40MHz BW, Mid Channel, 16QAM – Ch.B

04:12:52 PM 05/10/2023

Plot 7.31 – Conducted Power Measurement – 40MHz BW, Mid Channel, 64QAM – Ch.B

04:15:25 PM 05/10/2023

Plot 7.32 – Conducted Power Measurement – 40MHz BW, Mid Channel, 256QAM – Ch.B

7.3 Occupied Bandwidth

Test Overview

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

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

Test Setup

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

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None

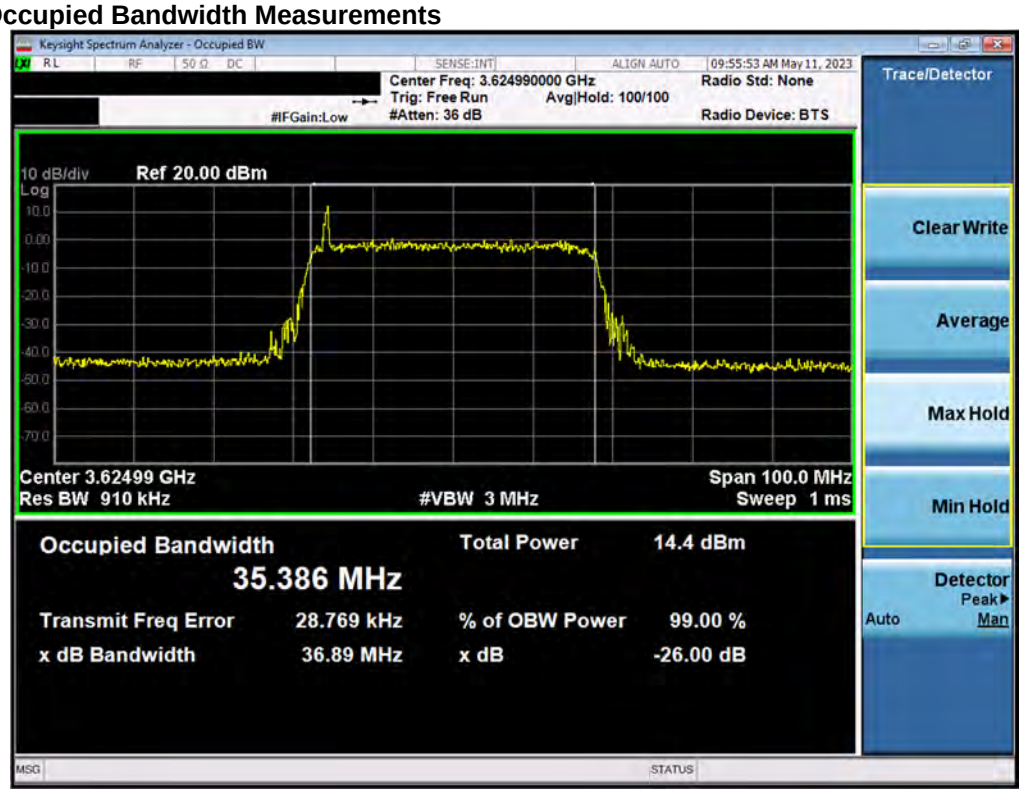
Occupied Bandwidth		
Bandwidth	**Modulation**	**OBW [MHz]**
40 MHz	QPSK	35.4
	16QAM	35.1
	64QAM	35.2
	256QAM	35.5
30 MHz	QPSK	27.5
	16QAM	28.0
	64QAM	28.0
	256QAM	27.4
20 MHz	QPSK	18.4
	16QAM	18.4
	64QAM	18.4
	256QAM	18.5
10 MHz	QPSK	7.9
	16QAM	7.9
	64QAM	7.9
	256QAM	7.8

Table 7-3 Occupied Bandwidth Measurements – Ch.A

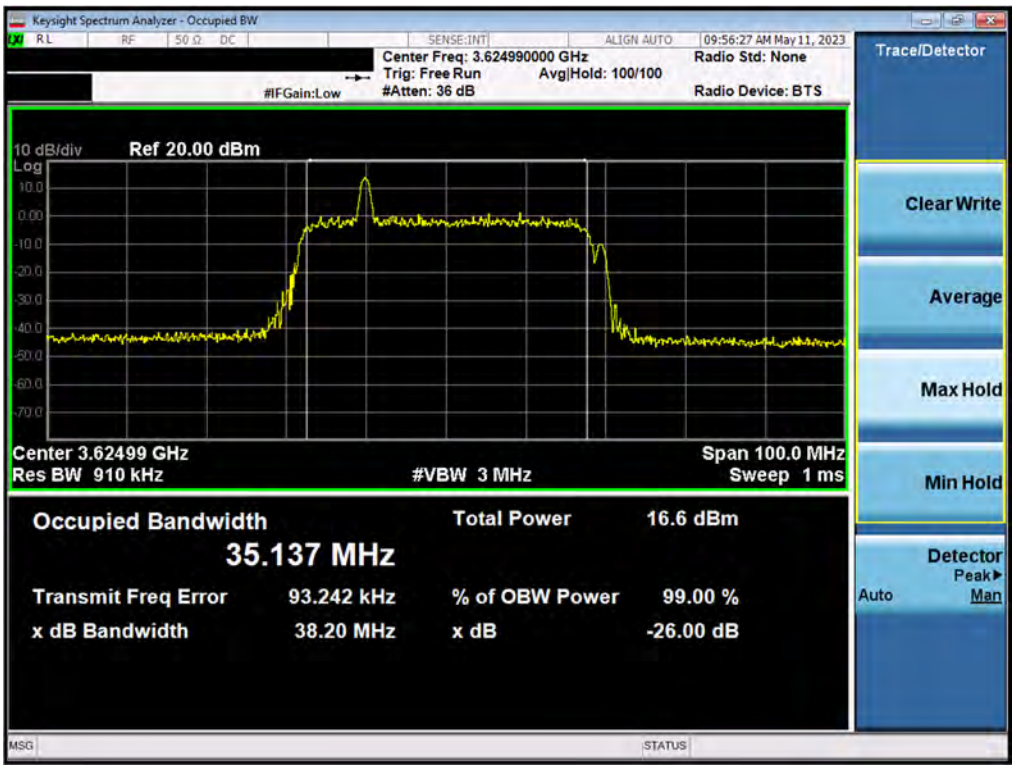
Occupied Bandwidth		
Bandwidth	**Modulation**	**OBW [MHz]**
40 MHz	QPSK	34.9
	16QAM	34.8
	64QAM	35.6
	256QAM	34.3
30 MHz	QPSK	27.9
	16QAM	27.4
	64QAM	27.5
	256QAM	27.6
20 MHz	QPSK	18.5
	16QAM	18.1
	64QAM	18.1
	256QAM	17.6
10 MHz	QPSK	7.8
	16QAM	7.9
	64QAM	7.9
	256QAM	7.9

Table 7-4 Occupied Bandwidth Measurements – Ch.B

Channel A Occupied Bandwidth Measurements

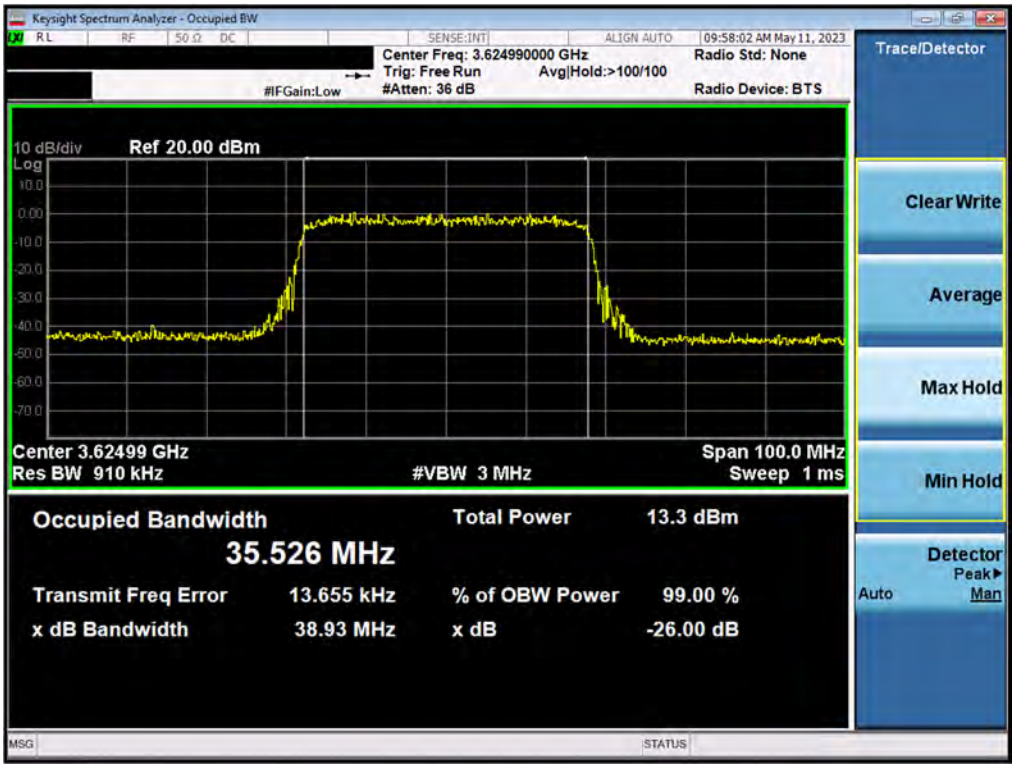


Plot 7.33. Occupied Bandwidth Plot (40MHz QPSK – Ch.A)

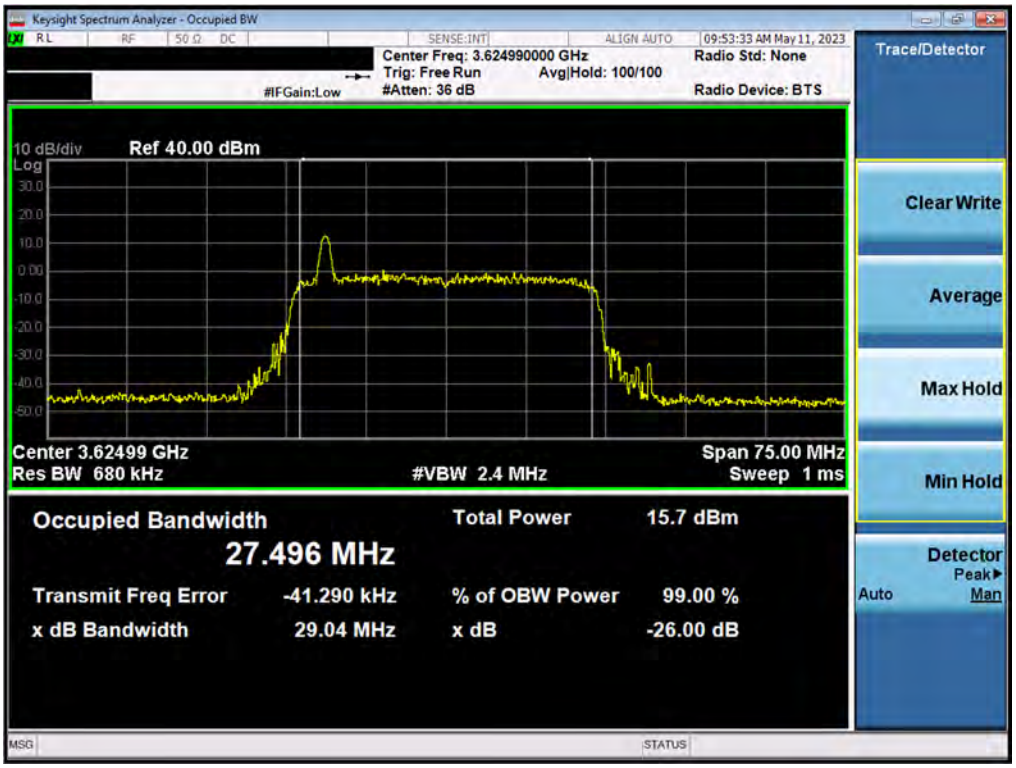


Plot 7.34. Occupied Bandwidth Plot (40MHz 16-QAM – Ch.A)

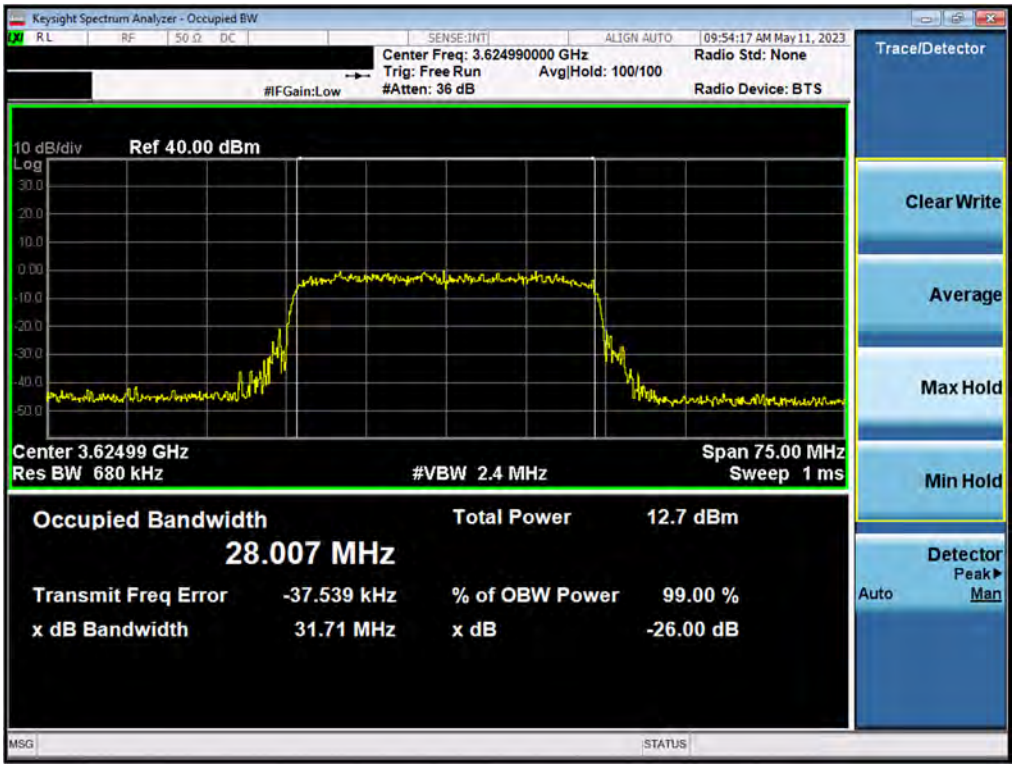
Plot 7.35. Occupied Bandwidth Plot (40MHz 64-QAM – Ch.A)



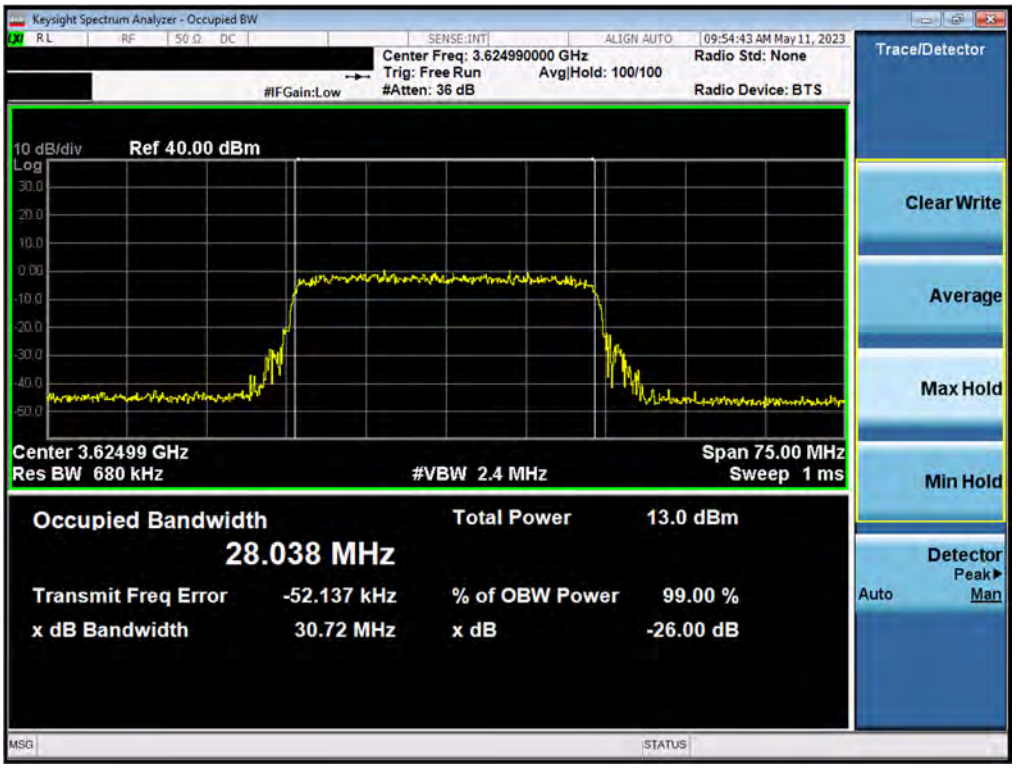
Plot 7.36. Occupied Bandwidth Plot (40MHz 256-QAM – Ch.A)



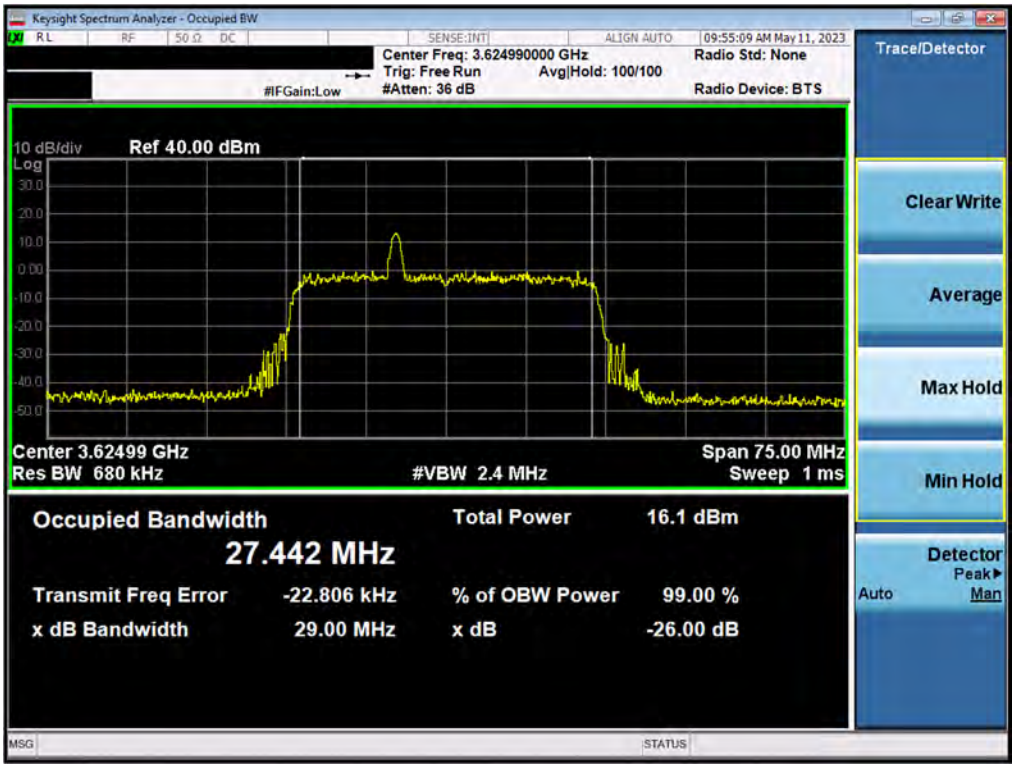
Plot 7.37. Occupied Bandwidth Plot (30MHz QPSK – Ch.A)



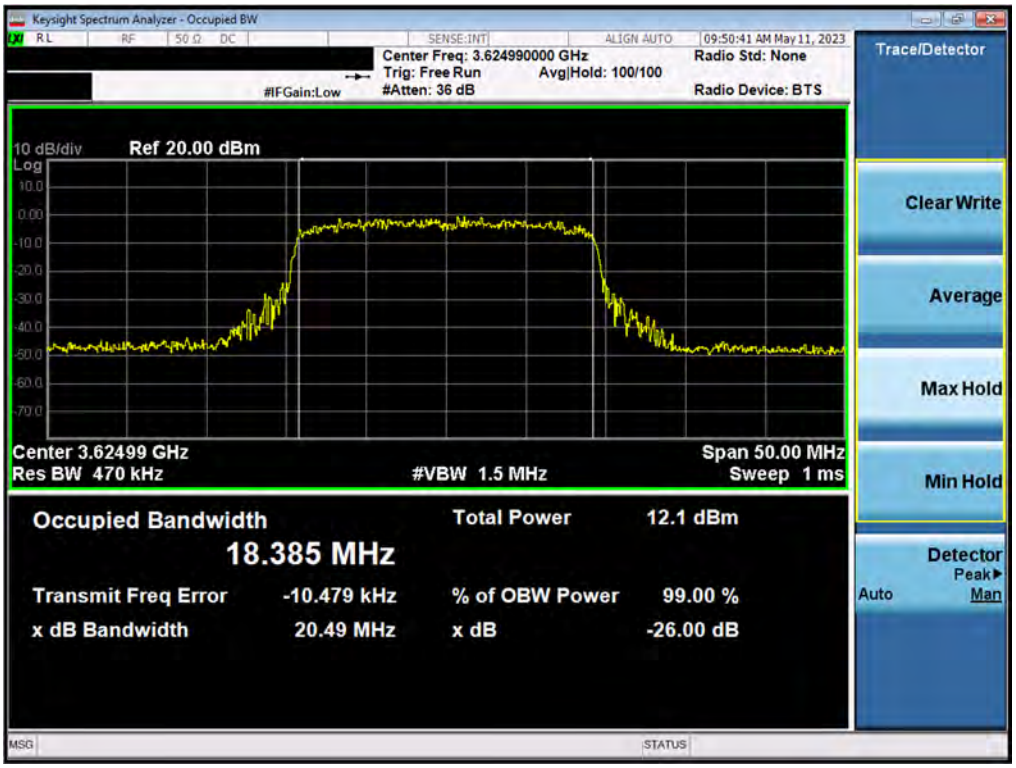
Plot 7.38. Occupied Bandwidth Plot (30MHz 16-QAM – Ch.A)



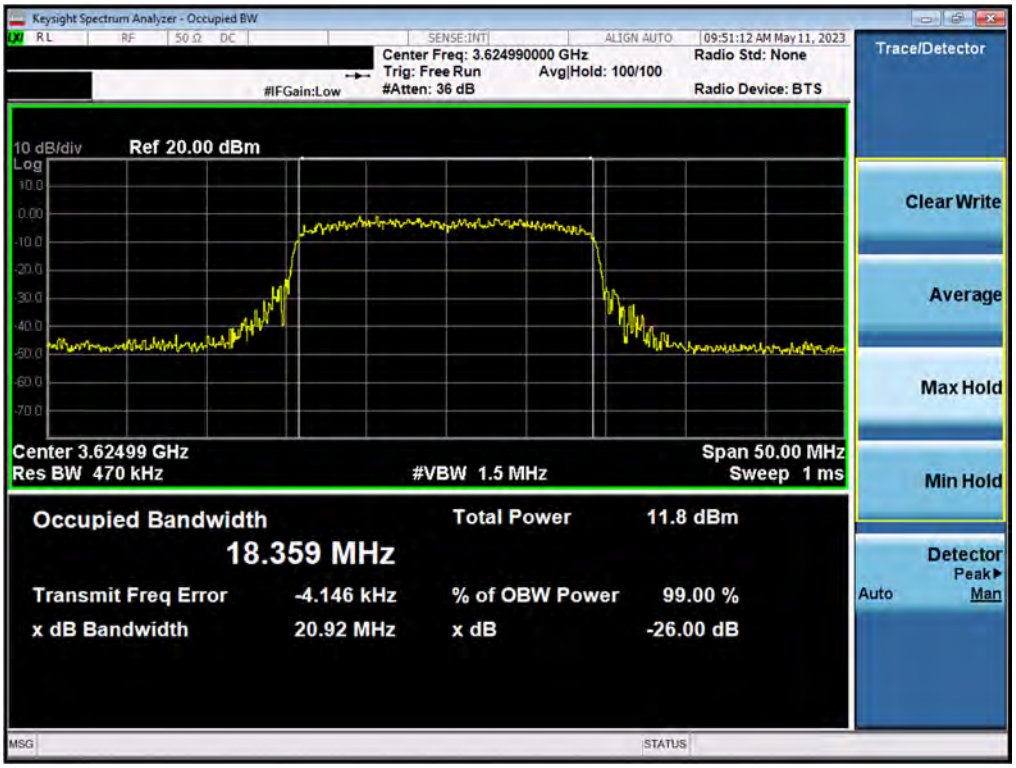
Plot 7.39. Occupied Bandwidth Plot (30MHz 64-QAM – Ch.A)



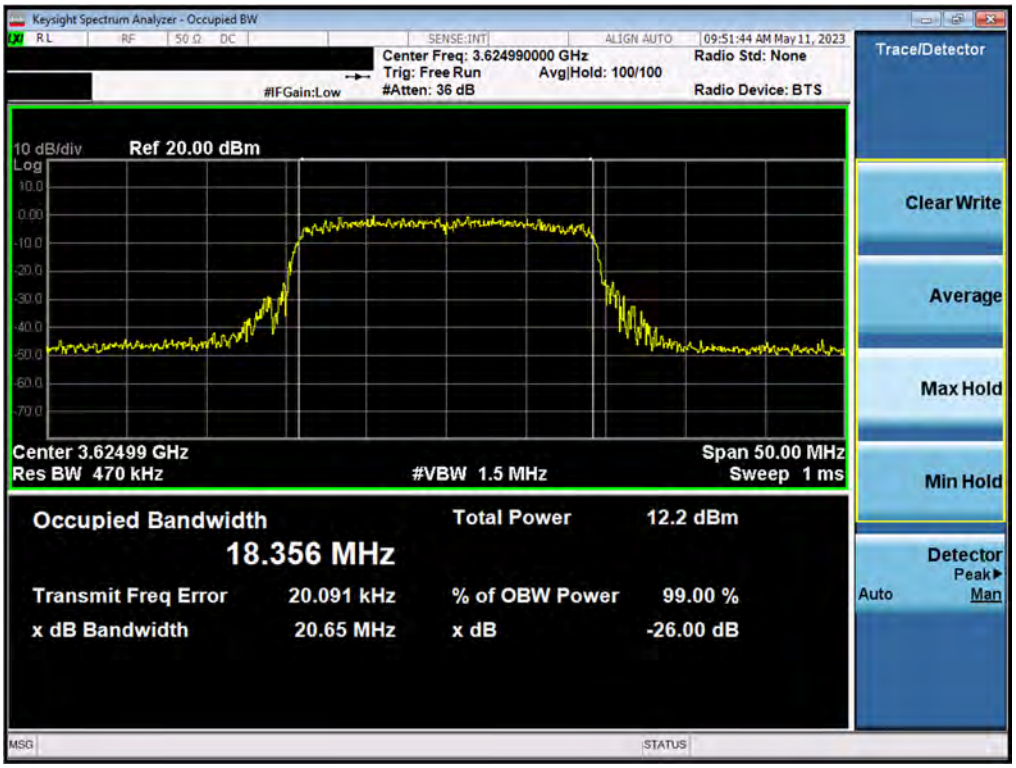
Plot 7.40. Occupied Bandwidth Plot (30MHz 256-QAM – Ch.A)



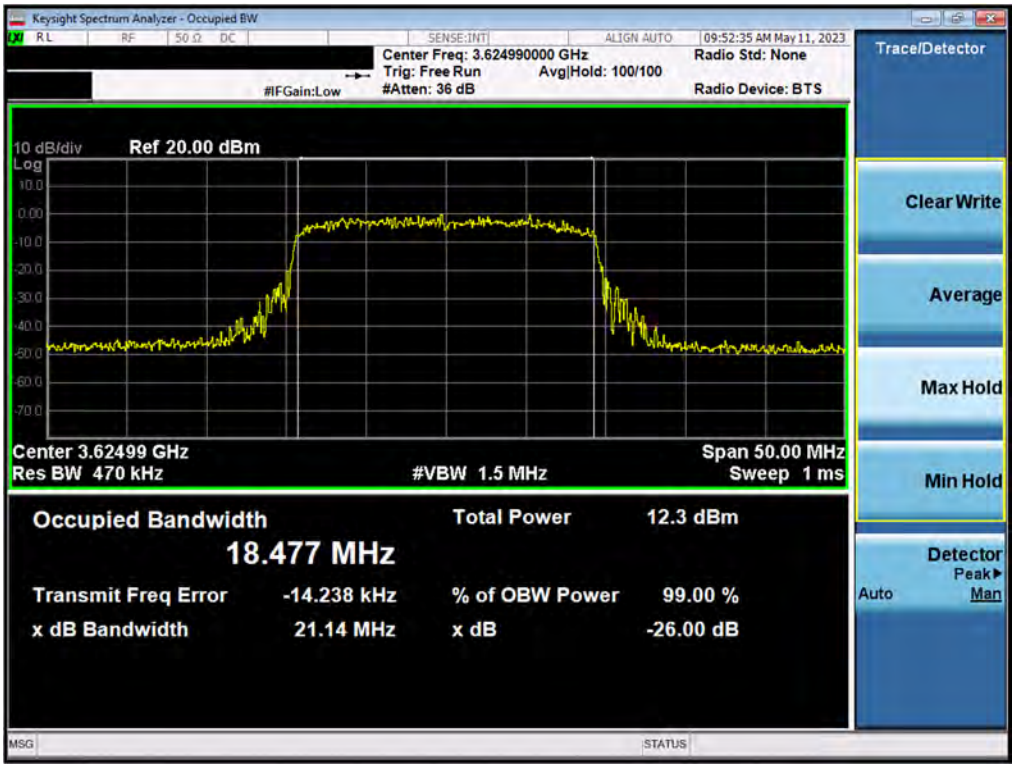
Plot 7.41. Occupied Bandwidth Plot (20MHz QPSK – Ch.A)



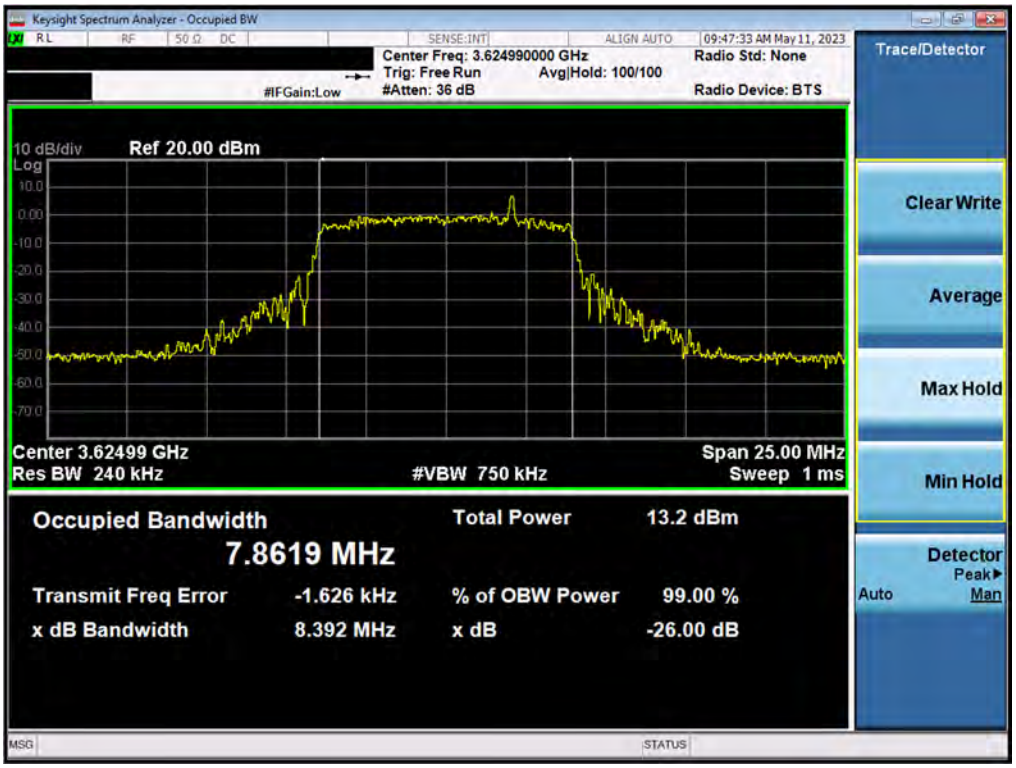
Plot 7.42. Occupied Bandwidth Plot (20MHz 16-QAM – Ch.A)



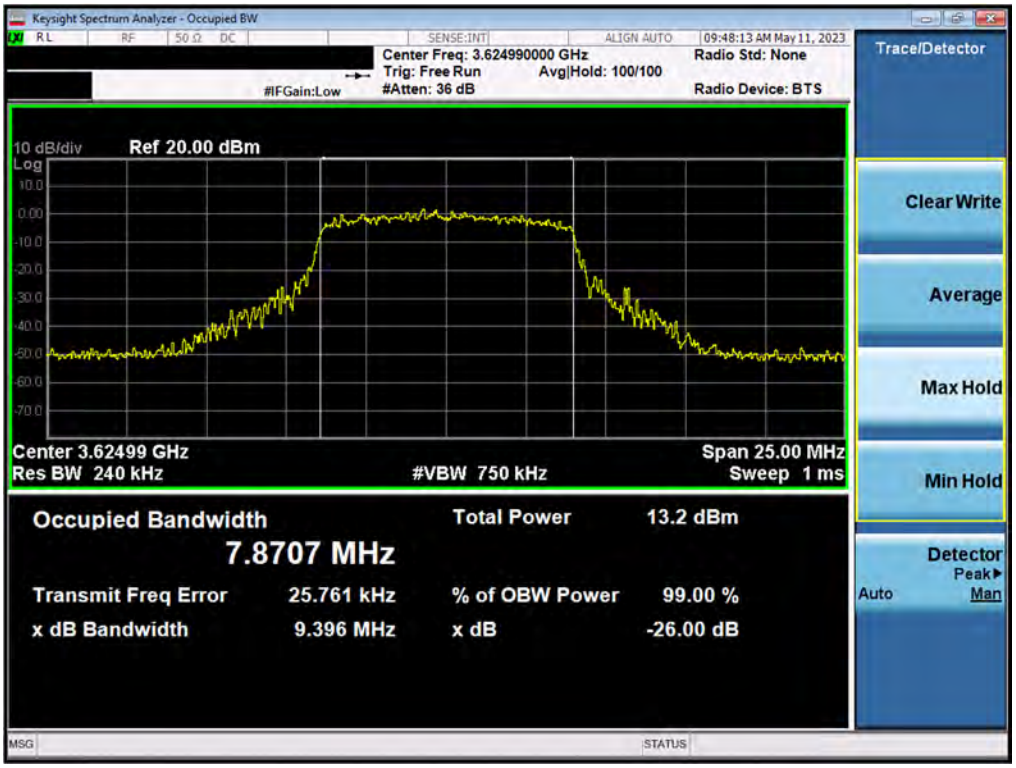
Plot 7.43. Occupied Bandwidth Plot (20MHz 64-QAM – Ch.A)



Plot 7.44. Occupied Bandwidth Plot (20MHz 256-QAM – Ch.A)



Plot 7.45. Occupied Bandwidth Plot (10MHz QPSK – Ch.A)

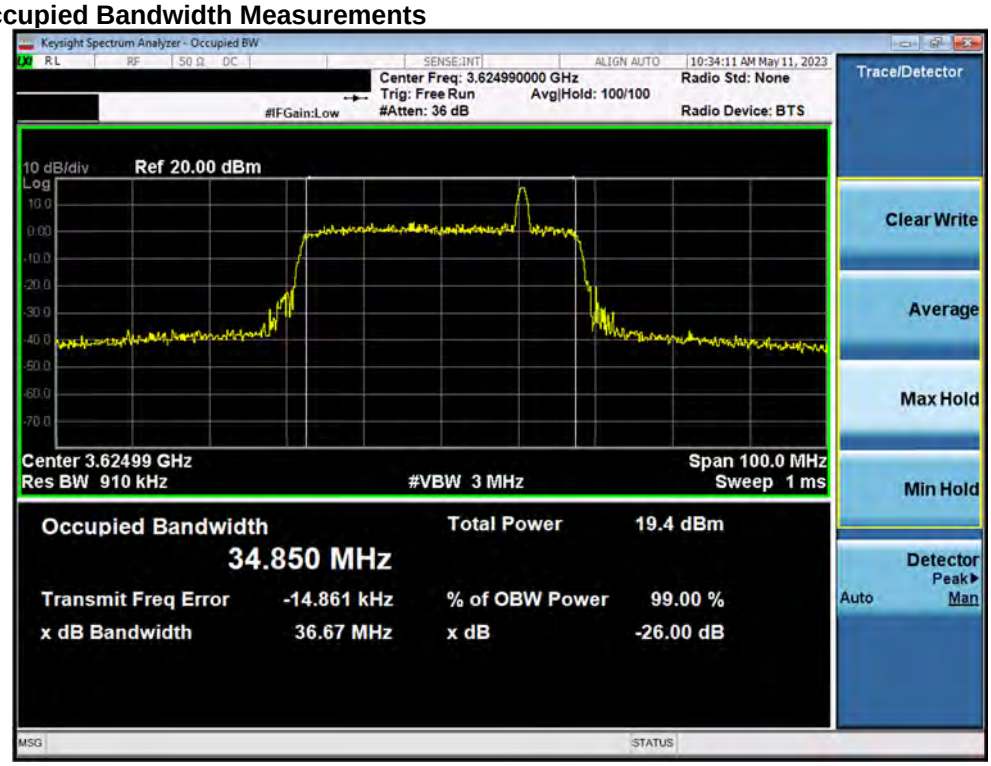


Plot 7.46. Occupied Bandwidth Plot (10MHz 16-QAM – Ch.A)

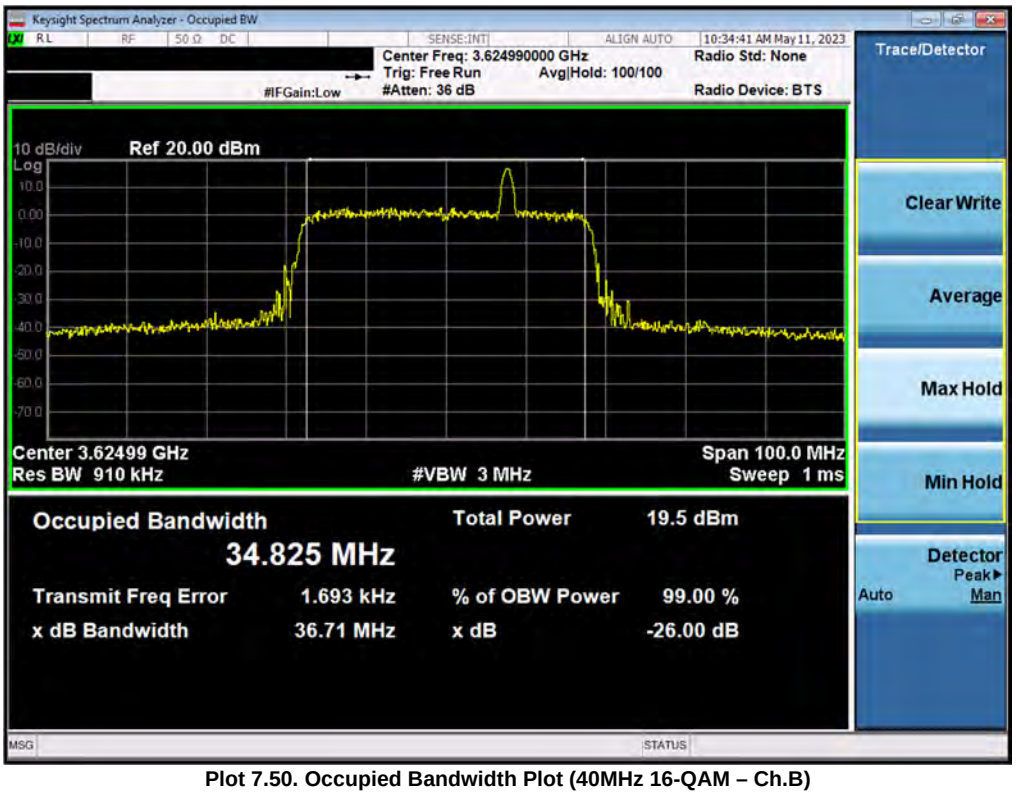
Plot 7.47. Occupied Bandwidth Plot (10MHz 64-QAM – Ch.A)

Plot 7.48. Occupied Bandwidth Plot (10MHz 256-QAM – Ch.A)

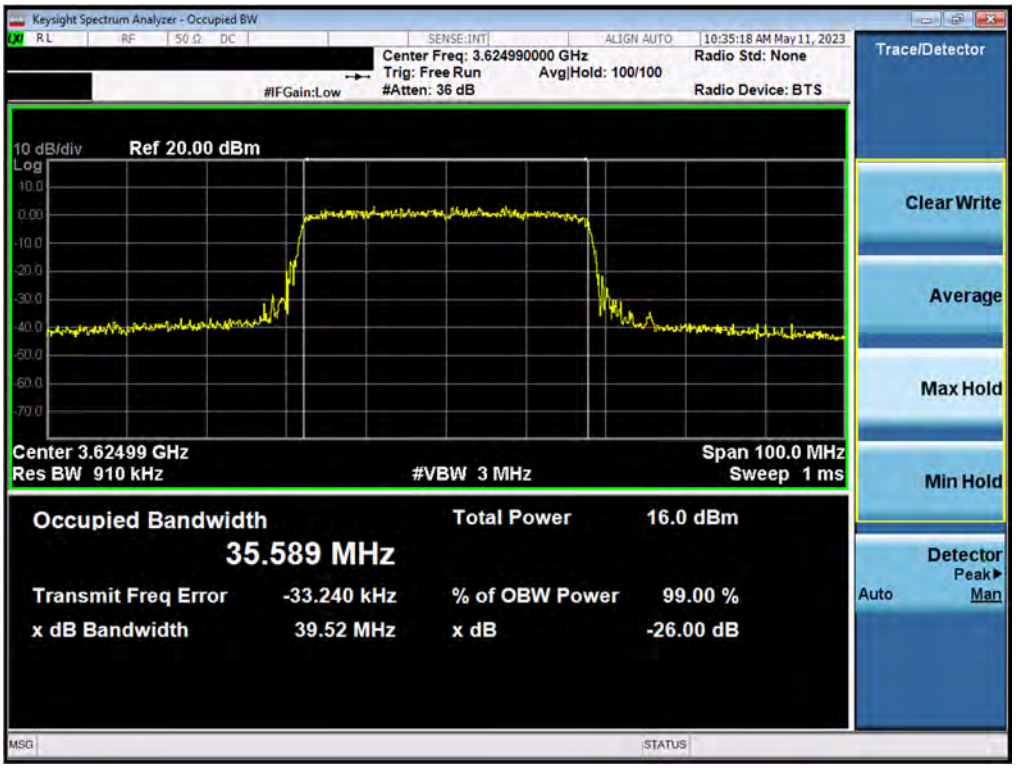
Channel B Occupied Bandwidth Measurements



Plot 7.49. Occupied Bandwidth Plot (40MHz QPSK – Ch.B)

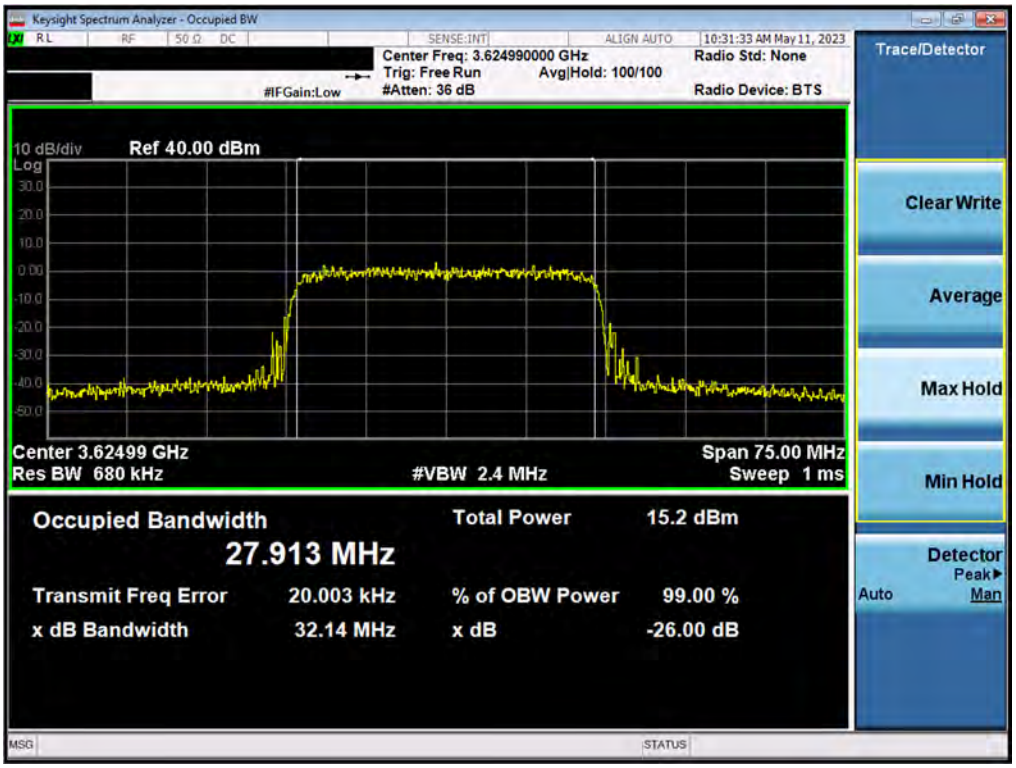


Plot 7.50. Occupied Bandwidth Plot (40MHz 16-QAM – Ch.B)

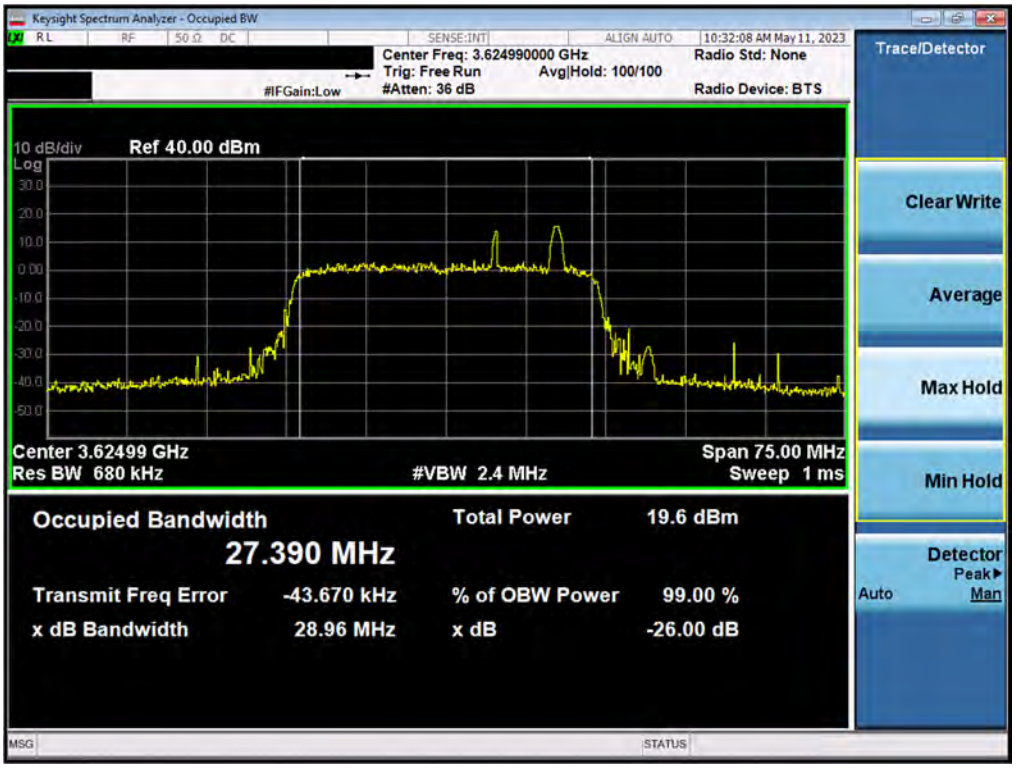


Plot 7.51. Occupied Bandwidth Plot (40MHz 64-QAM – Ch.B)

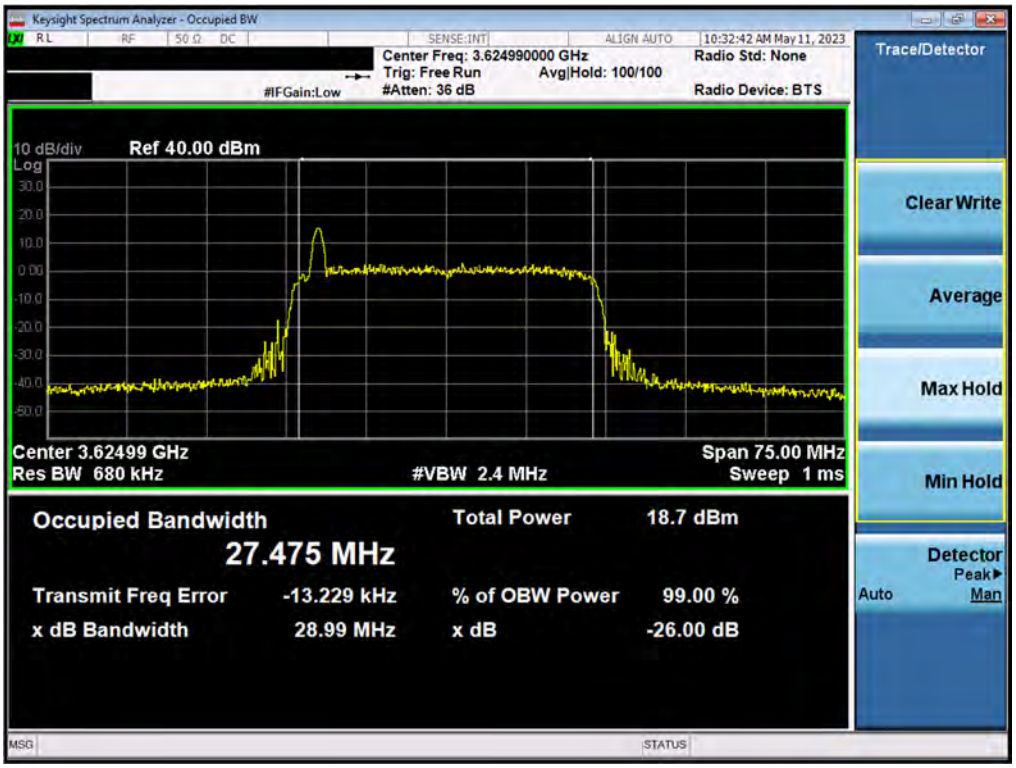
Plot 7.52. Occupied Bandwidth Plot (40MHz 256-QAM – Ch.B)



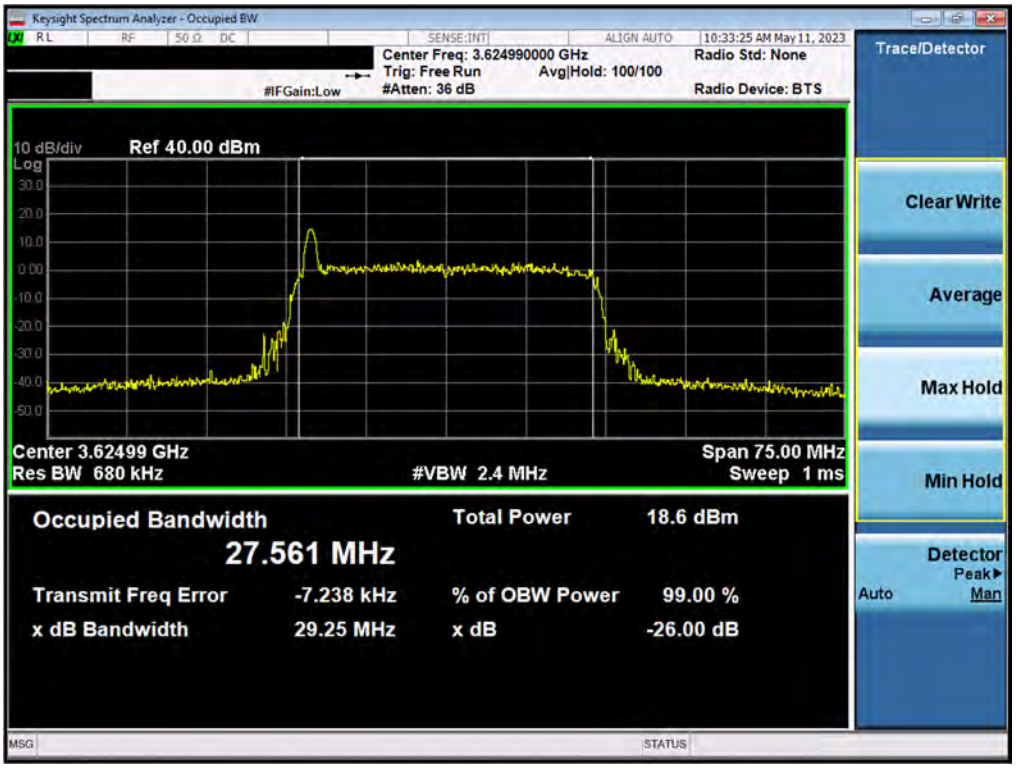
Plot 7.53. Occupied Bandwidth Plot (30MHz QPSK – Ch.B)



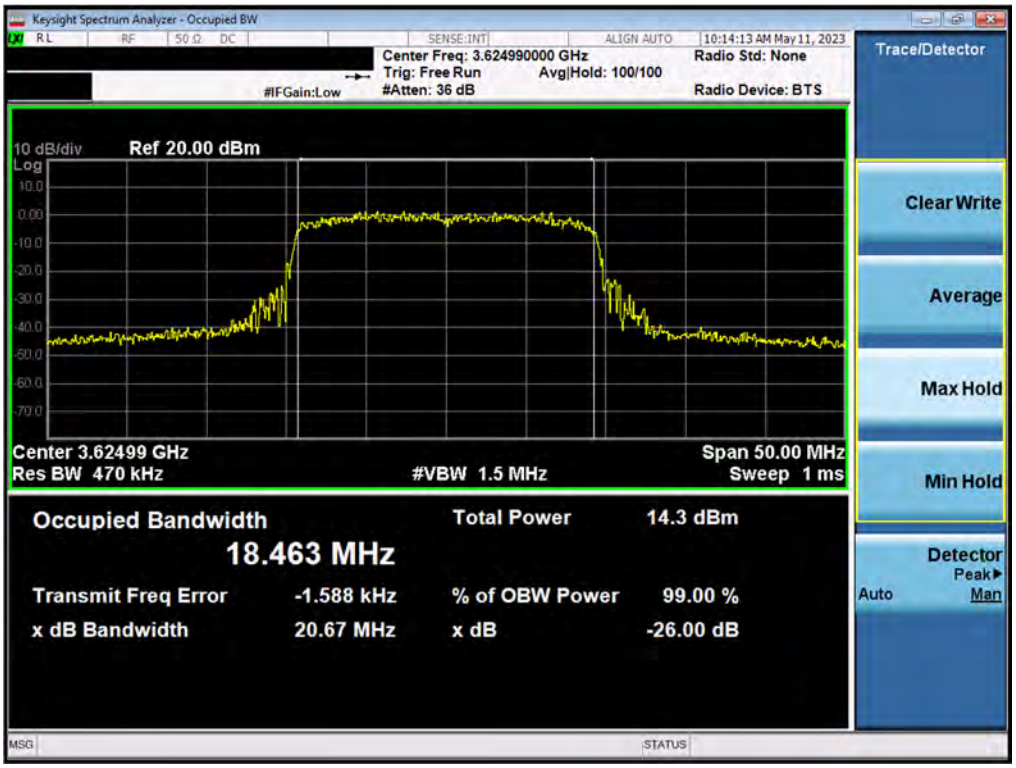
Plot 7.54. Occupied Bandwidth Plot (30MHz 16-QAM – Ch.B)



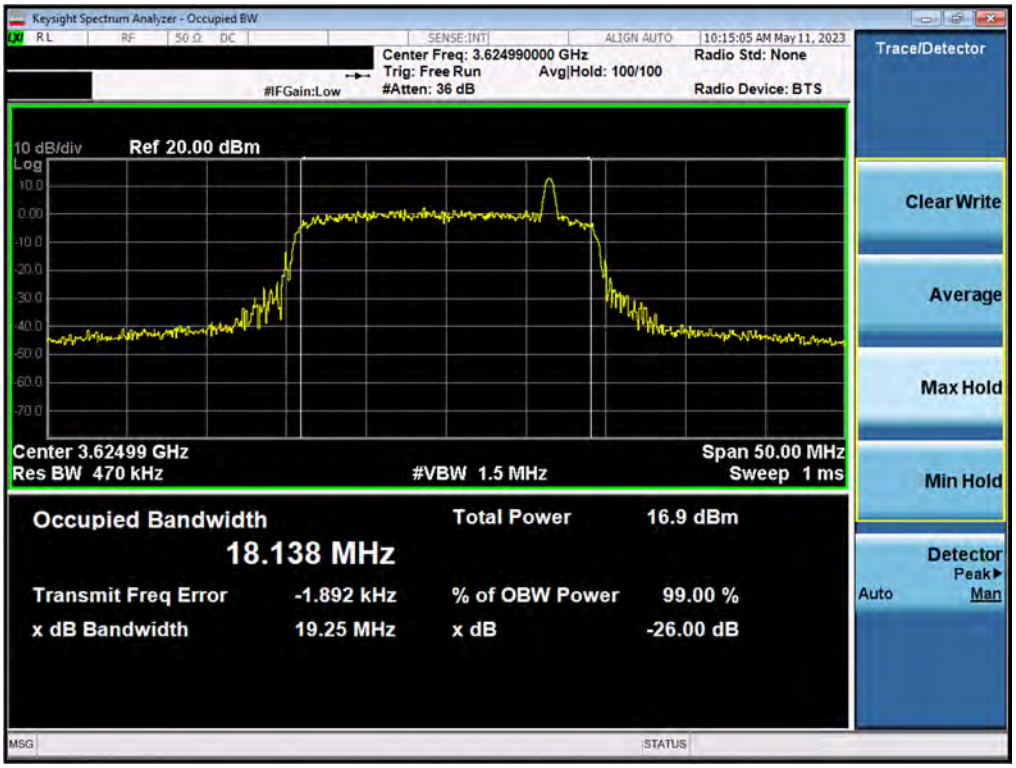
Plot 7.55. Occupied Bandwidth Plot (30MHz 64-QAM – Ch.B)



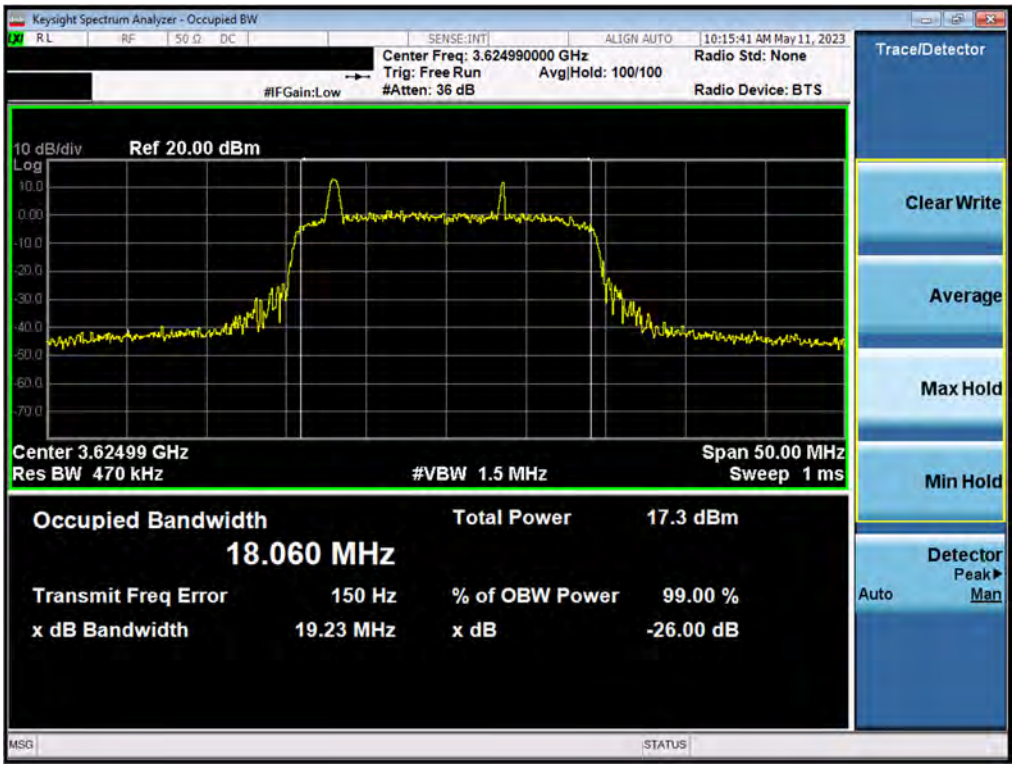
Plot 7.56. Occupied Bandwidth Plot (30MHz 256-QAM – Ch.B)



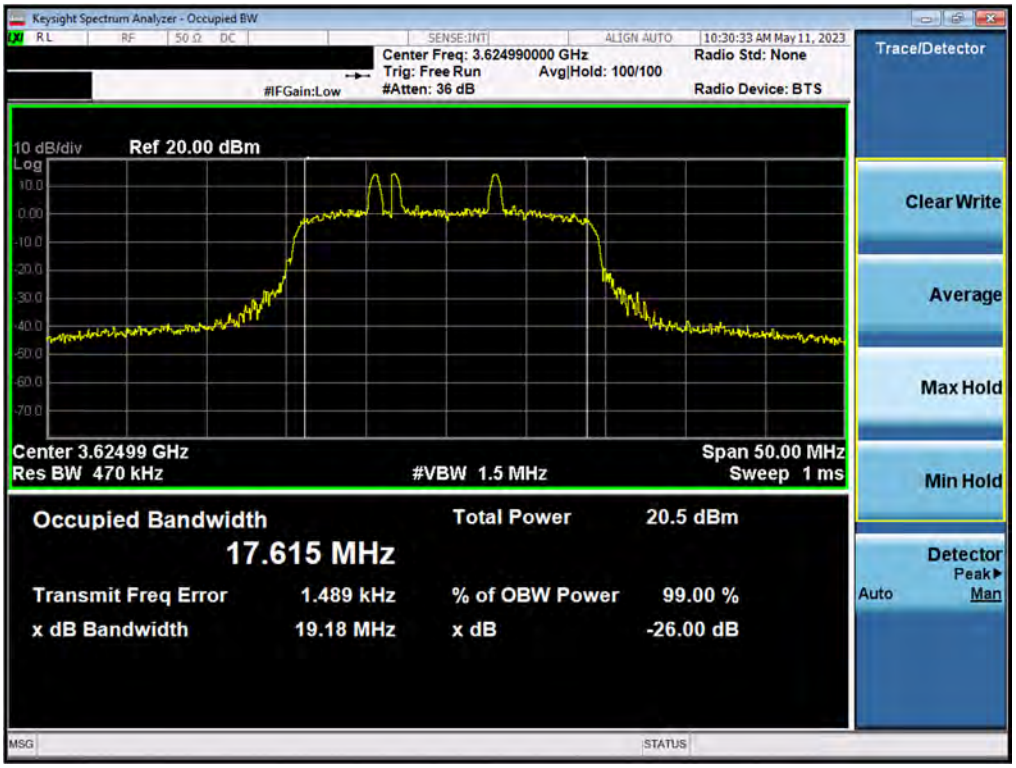
Plot 7.57. Occupied Bandwidth Plot (20MHz QPSK – Ch.B)



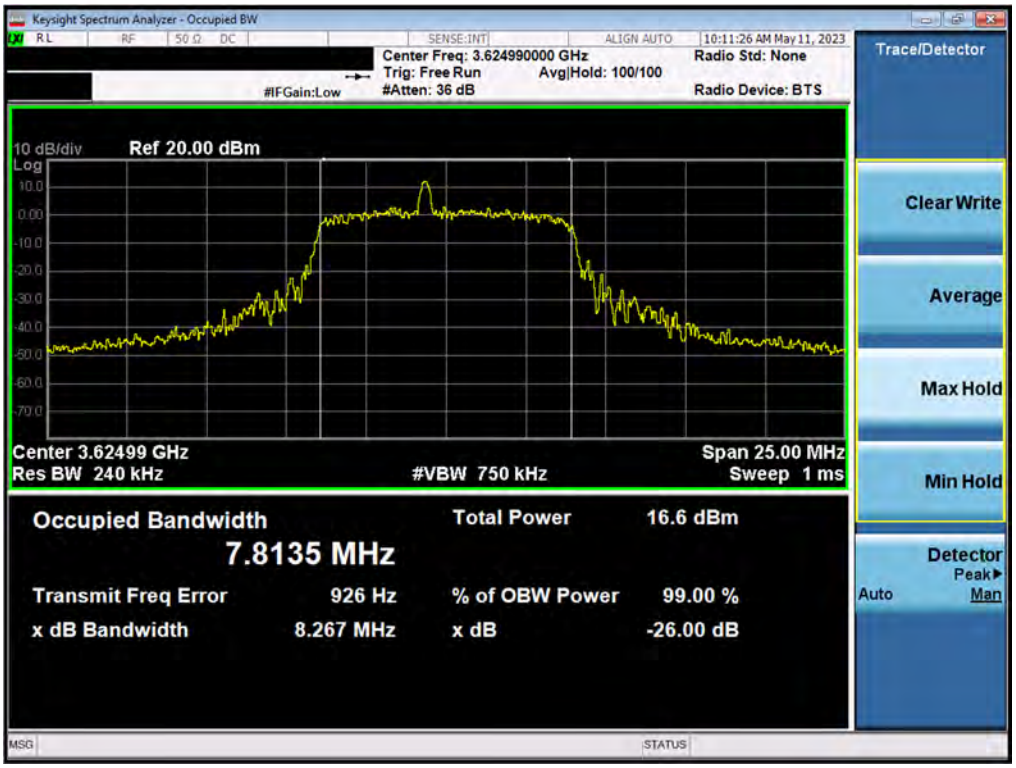
Plot 7.58. Occupied Bandwidth Plot (20MHz 16-QAM – Ch.B)



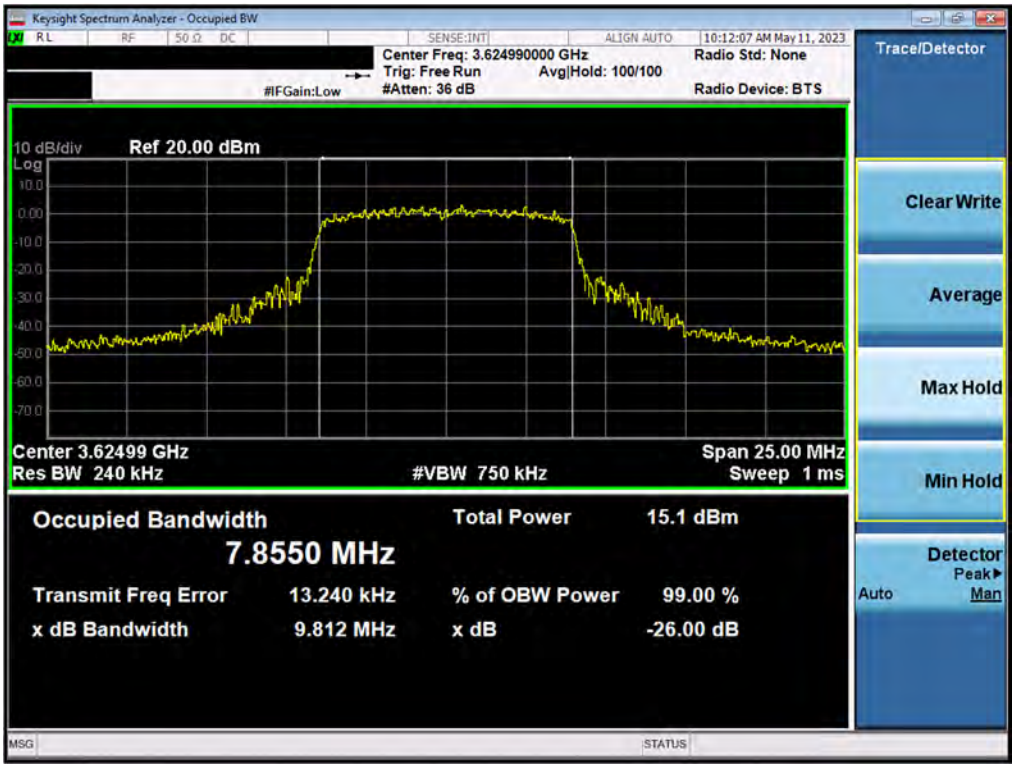
Plot 7.59. Occupied Bandwidth Plot (20MHz 64-QAM – Ch.B)



Plot 7.60. Occupied Bandwidth Plot (20MHz 256-QAM – Ch.B)

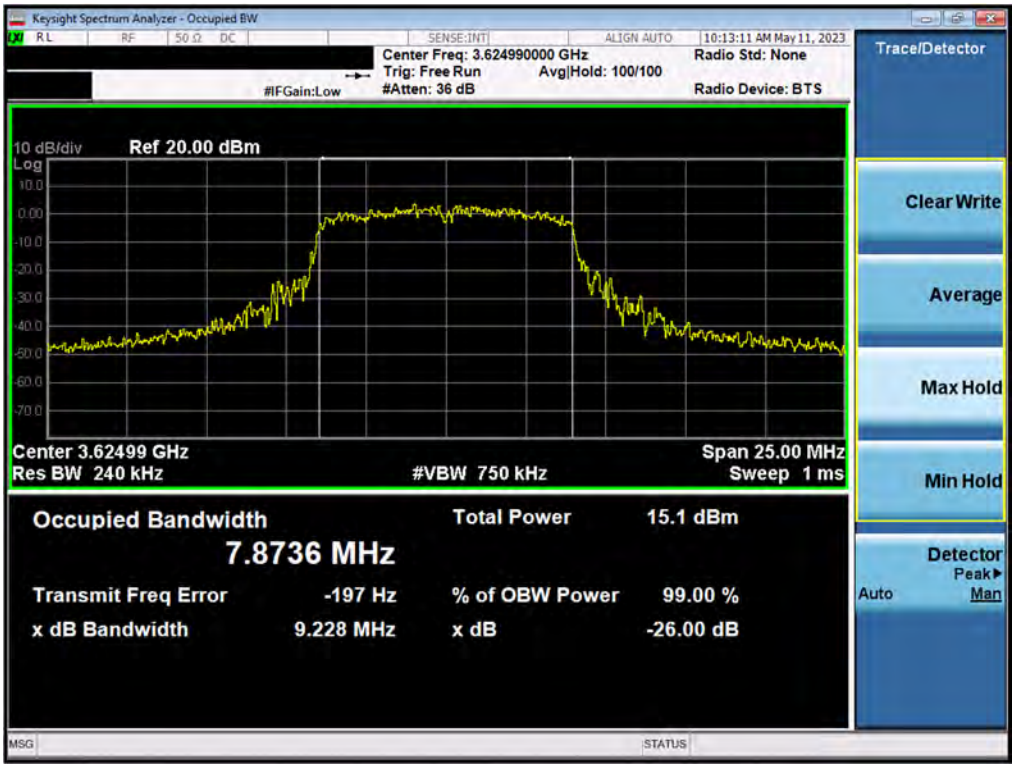


Plot 7.61. Occupied Bandwidth Plot (10MHz QPSK – Ch.B)



Plot 7.62. Occupied Bandwidth Plot (10MHz 16-QAM – Ch.B)

Plot 7.63. Occupied Bandwidth Plot (10MHz 64-QAM – Ch.B)



Plot 7.64. Occupied Bandwidth Plot (10MHz 256-QAM – Ch.B)

7.4 Conducted Power / EIRP Per 10MHz

Test Overview

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum power control level, as defined in ANSI C63.26-2015,and at the appropriate frequencies. The EUT transmits with a duty cycle of approximately 71.95%; the spectrum analyzer was gate as to only measure during on periods.

The e.i.r.p./10MHz for a Category B CBSD must be less than 47dBm/10MHz.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.4.4.1
ANSI C63.26-2015 – Section 5.2.4.5
ANSI C63.26-2015 – Section 6.4.3.2.3

Test Settings

1. Span = 2x to 3X the OBW
2. RBW = 10MHz
3. VBW ≥ 3 x RBW
4. Set number of sweep points ≥ 2 x span / RBW
5. Sweep Time = auto couple
6. Detector = RMS
7. Trace mode = average
8. Trigger = Level

Test Setup

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

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

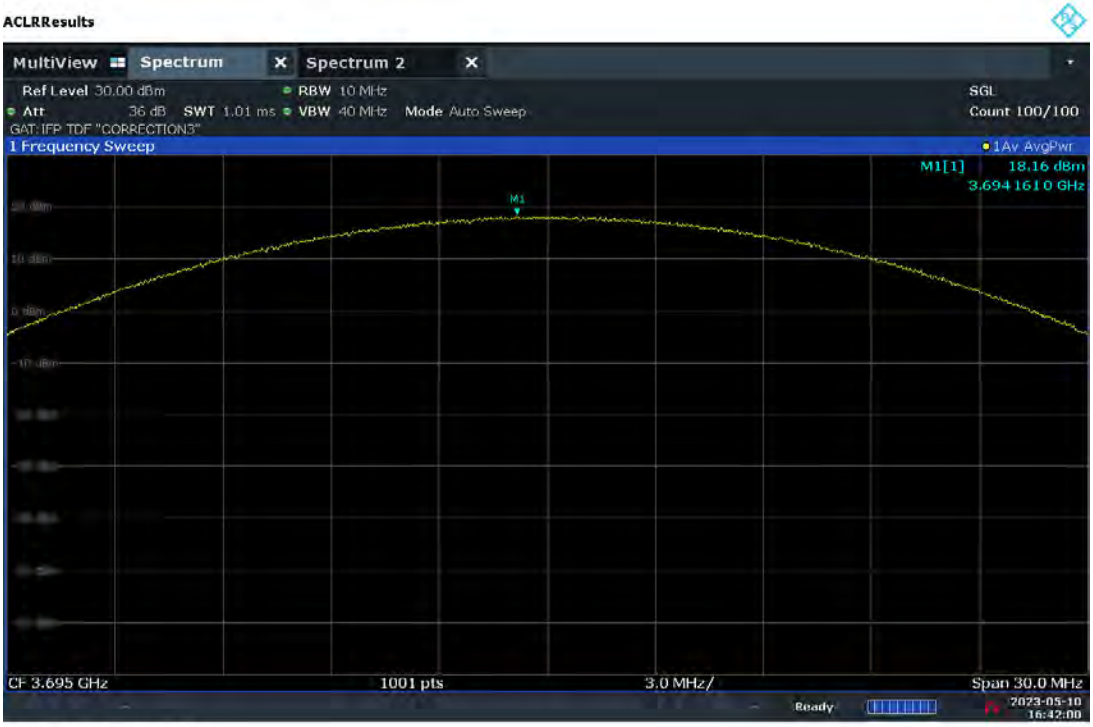
Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted Power [dBm/10MHz]	Ch. B Conducted Power [dBm/10MHz]	Summed MIMO Conducted Power [dBm/10MHz]	Ant Gain [dBi]	EIRP [dBm/10MHz]	EIRP [Watts/10MHz]	EIRP Limit [dBm/10MHz]	Margin [dB]
40 MHz	QPSK	3570.0	10.17	11.51	13.90	13.75	27.65	0.58	47.00	-19.35
		3625.0	12.74	15.02	17.04	13.75	30.79	1.20	47.00	-16.21
		3680.0	12.69	12.42	15.57	13.75	29.32	0.85	47.00	-17.68
	16-QAM	3570.0	9.83	11.52	13.77	13.75	27.52	0.56	47.00	-19.48
		3625.0	12.63	14.86	16.90	13.75	30.65	1.16	47.00	-16.35
		3680.0	12.75	12.45	15.61	13.75	29.36	0.86	47.00	-17.64
	64-QAM	3570.0	10.10	11.48	13.85	13.75	27.60	0.58	47.00	-19.40
		3625.0	12.80	15.02	17.06	13.75	30.81	1.21	47.00	-16.19
		3680.0	12.14	12.46	15.31	13.75	29.06	0.81	47.00	-17.94
	256-QAM	3570.0	9.78	11.62	13.81	13.75	27.56	0.57	47.00	-19.44
		3625.0	12.81	15.00	17.05	13.75	30.80	1.20	47.00	-16.20
		3680.0	12.71	12.45	15.59	13.75	29.34	0.86	47.00	-17.66
30 MHz	QPSK	3565.0	12.08	14.52	16.48	13.75	30.23	1.05	47.00	-16.77
		3625.0	13.79	16.44	18.32	13.75	32.07	1.61	47.00	-14.93
		3685.0	15.23	13.07	17.29	13.75	31.04	1.27	47.00	-15.96
	16-QAM	3565.0	12.39	14.49	16.58	13.75	30.33	1.08	47.00	-16.67
		3625.0	13.69	16.35	18.23	13.75	31.98	1.58	47.00	-15.02
		3685.0	15.05	13.13	17.21	13.75	30.96	1.25	47.00	-16.04
	64-QAM	3565.0	11.79	14.49	16.36	13.75	30.11	1.02	47.00	-16.89
		3625.0	13.91	16.27	18.26	13.75	32.01	1.59	47.00	-14.99
		3685.0	15.13	13.18	17.27	13.75	31.02	1.27	47.00	-15.98
	256-QAM	3565.0	11.83	14.44	16.34	13.75	30.09	1.02	47.00	-16.91
		3625.0	13.52	16.47	18.25	13.75	32.00	1.59	47.00	-15.00
		3685.0	15.10	13.15	17.24	13.75	30.99	1.26	47.00	-16.01
20 MHz	QPSK	3560.0	13.56	16.32	18.17	13.75	31.92	1.55	47.00	-15.08
		3625.0	15.36	17.68	19.68	13.75	33.43	2.20	47.00	-13.57
		3690.0	16.91	16.55	19.74	13.75	33.49	2.24	47.00	-13.51
	16-QAM	3560.0	14.28	16.30	18.42	13.75	32.17	1.65	47.00	-14.83
		3625.0	15.40	17.51	19.59	13.75	33.34	2.16	47.00	-13.66
		3690.0	16.87	16.43	19.67	13.75	33.42	2.20	47.00	-13.58
	64-QAM	3560.0	14.27	16.25	18.38	13.75	32.13	1.63	47.00	-14.87
		3625.0	15.61	17.61	19.73	13.75	33.48	2.23	47.00	-13.52
		3690.0	16.76	16.49	19.64	13.75	33.39	2.18	47.00	-13.61
	256-QAM	3560.0	14.38	16.42	18.53	13.75	32.28	1.69	47.00	-14.72
		3625.0	15.31	17.78	19.73	13.75	33.48	2.23	47.00	-13.52
		3690.0	16.79	16.53	19.67	13.75	33.42	2.20	47.00	-13.58
10 MHz	QPSK	3555.0	17.30	17.23	20.28	13.75	34.03	2.53	47.00	-12.97
		3625.0	16.91	18.46	20.76	13.75	34.51	2.83	47.00	-12.49
		3695.0	18.29	19.69	22.06	13.75	35.81	3.81	47.00	-11.19
	16-QAM	3555.0	16.93	17.48	20.22	13.75	33.97	2.50	47.00	-13.03
		3625.0	16.97	18.58	20.86	13.75	34.61	2.89	47.00	-12.39
		3695.0	18.15	19.73	22.02	13.75	35.77	3.78	47.00	-11.23
	64-QAM	3555.0	17.70	17.26	20.50	13.75	34.25	2.66	47.00	-12.75
		3625.0	17.06	18.67	20.95	13.75	34.70	2.95	47.00	-12.30
		3695.0	18.16	19.95	22.16	13.75	35.91	3.90	47.00	-11.09
	256-QAM	3555.0	17.45	17.25	20.36	13.75	34.11	2.58	47.00	-12.89
		3625.0	17.09	18.64	20.94	13.75	34.69	2.95	47.00	-12.31
		3695.0	18.35	19.81	22.15	13.75	35.90	3.89	47.00	-11.10

Table 7-5 E.I.R.P. / 10MHz Measurements

Channel A Conducted Power / 10MHz

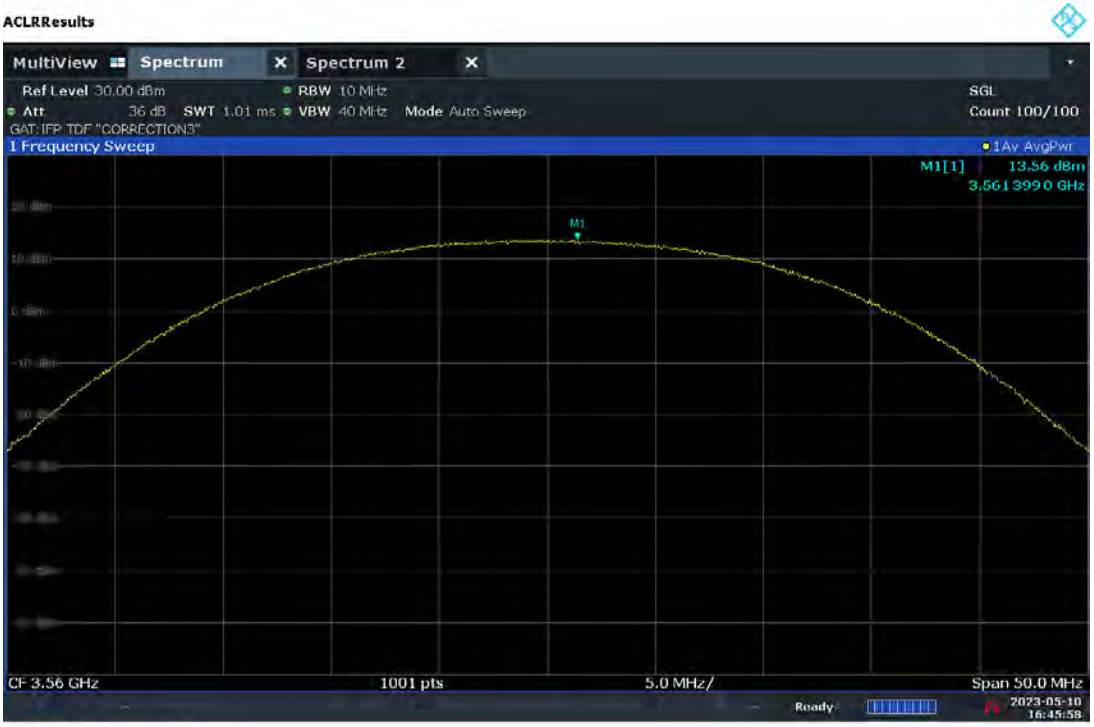
Plot 7.65. Conducted Power / 10MHz (10MHz QPSK, High Channel – Ch.A)

Plot 7.66. Conducted Power / 10MHz (10MHz 16QAM, High Channel – Ch.A)



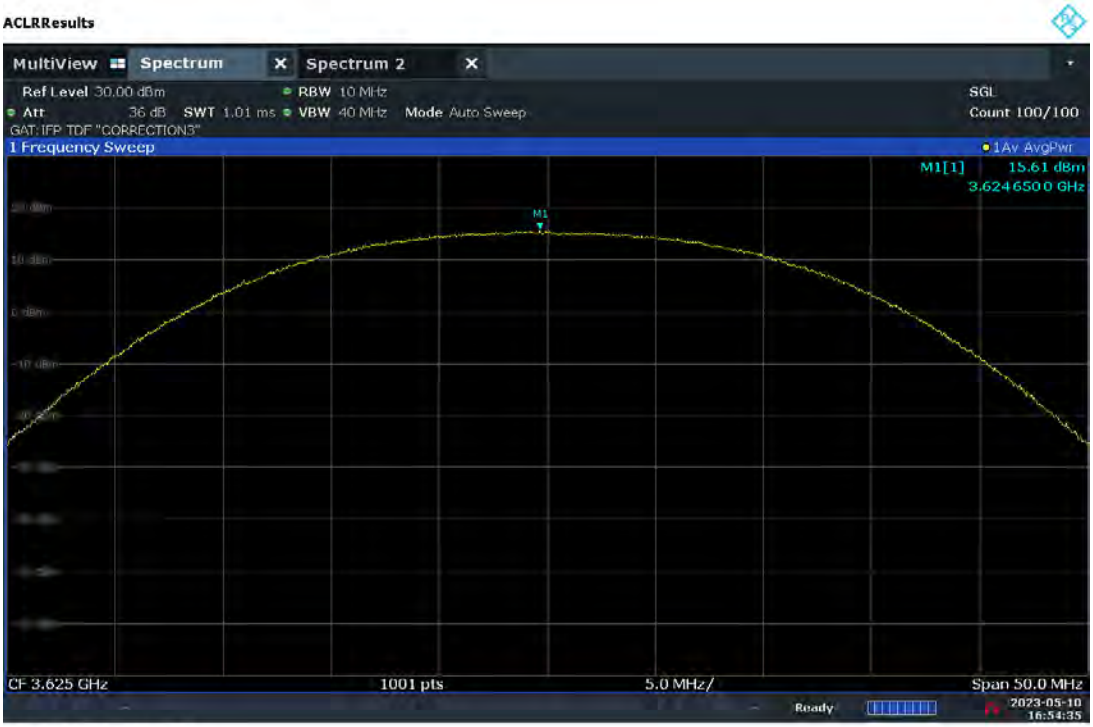
Plot 7.67. Conducted Power / 10MHz (10MHz 64QAM, High Channel – Ch.A)

Plot 7.68. Conducted Power / 10MHz (10MHz 256QAM, High Channel – Ch.A)

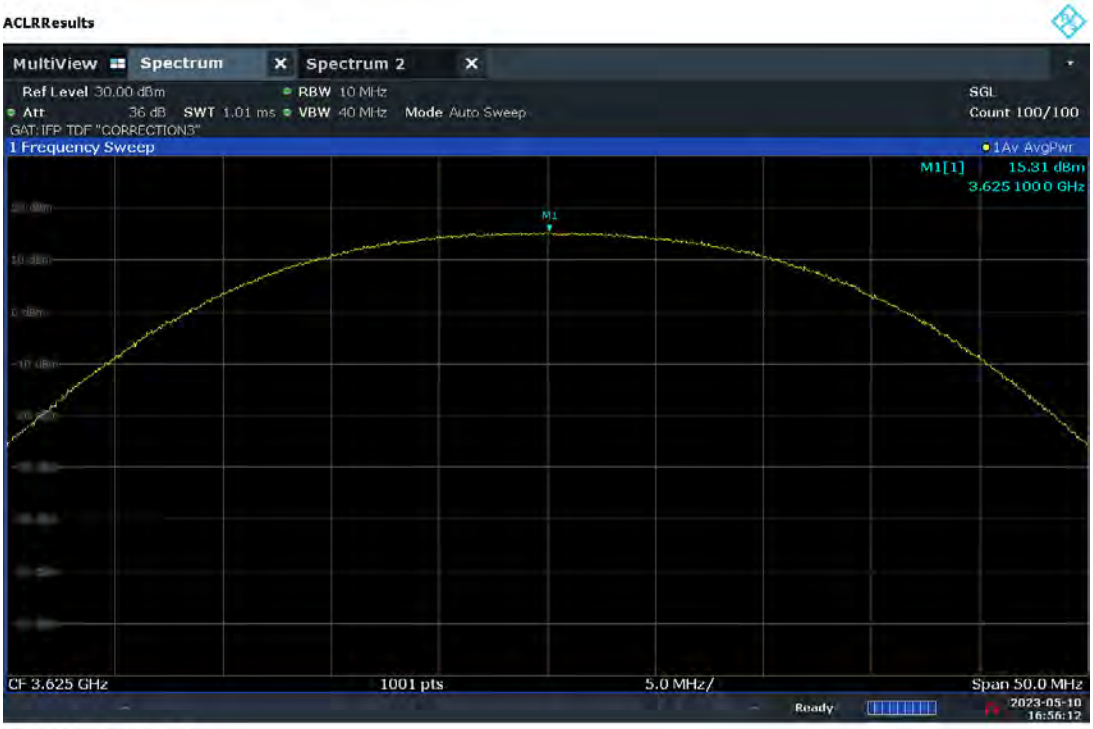


Plot 7.69. Conducted Power / 10MHz (20MHz QPSK, Low Channel – Ch.A)

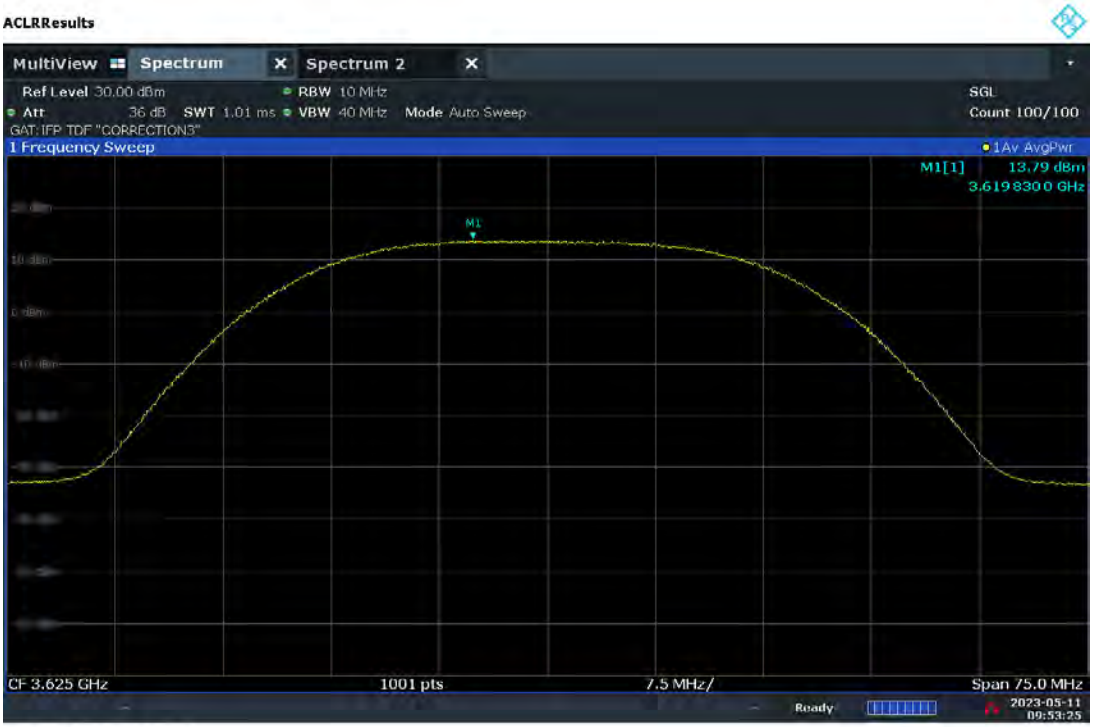
Plot 7.70. Conducted Power / 10MHz (20MHz 16QAM, Low Channel – Ch.A)



Plot 7.71. Conducted Power / 10MHz (20MHz 64QAM, Mid Channel – Ch.A)



Plot 7.72. Conducted Power / 10MHz (20MHz 256QAM, Mid Channel – Ch.A)



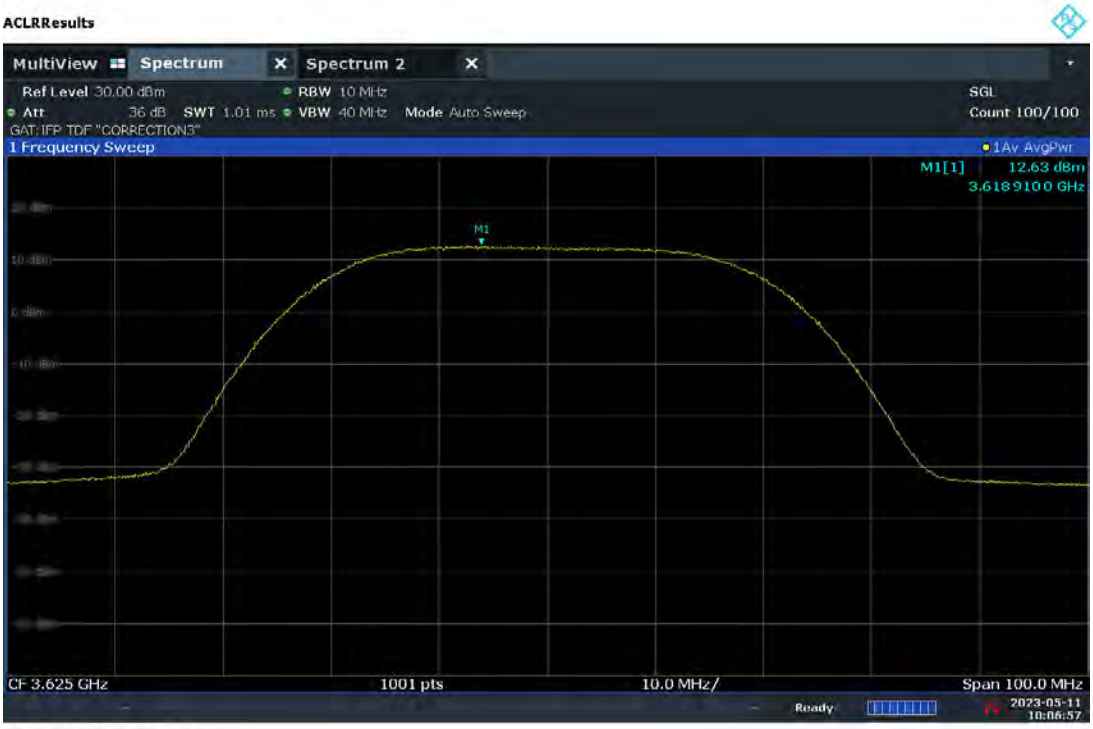
Plot 7.73. Conducted Power / 10MHz (30MHz QPSK, Mid Channel – Ch.A)

Plot 7.74. Conducted Power / 10MHz (30MHz 16QAM, Mid Channel – Ch.A)

Plot 7.75. Conducted Power / 10MHz (30MHz 64QAM, Mid Channel – Ch.A)

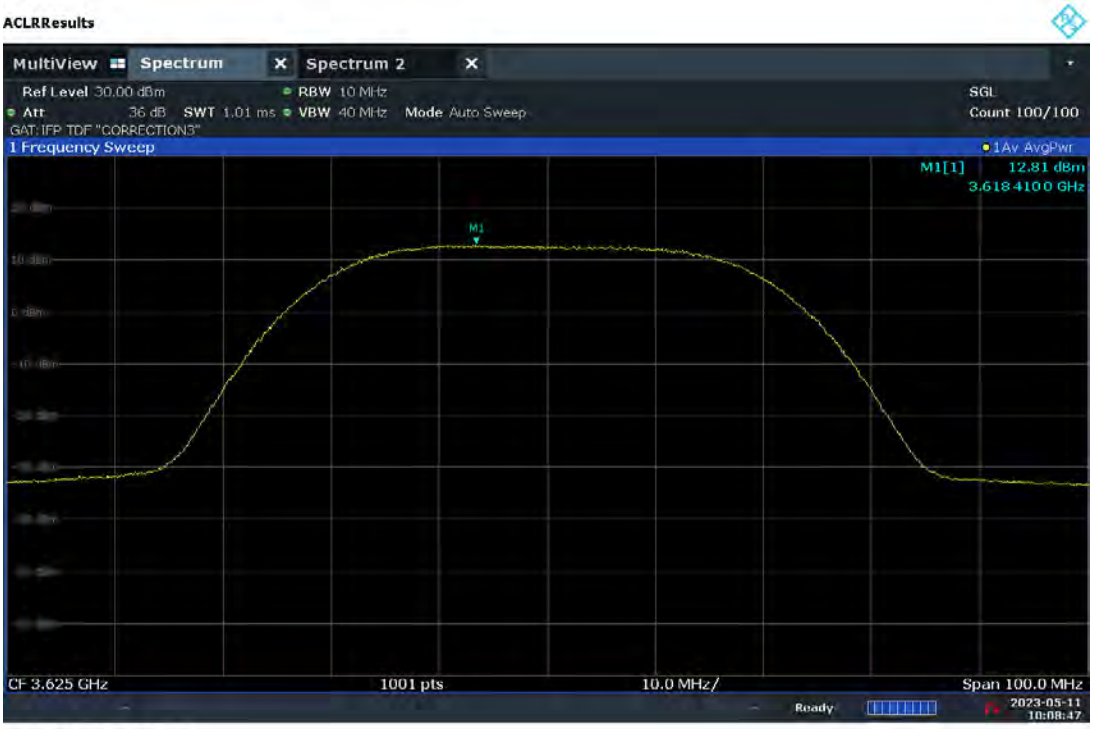
Plot 7.76. Conducted Power / 10MHz (30MHz 256QAM, Mid Channel – Ch.A)

Plot 7.77. Conducted Power / 10MHz (40MHz QPSK, Mid Channel – Ch.A)



Plot 7.78. Conducted Power / 10MHz (40MHz 16QAM, Mid Channel – Ch.A)

Plot 7.79. Conducted Power / 10MHz (40MHz 64QAM, Mid Channel – Ch.A)

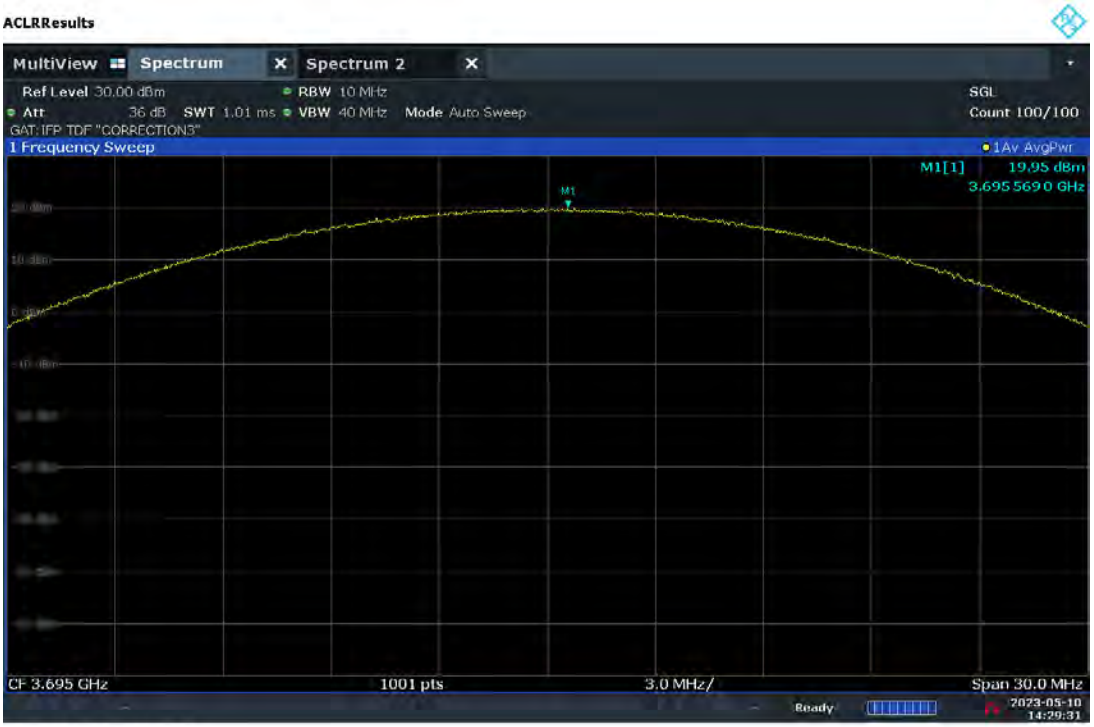


Plot 7.80. Conducted Power / 10MHz (40MHz 256QAM, Mid Channel – Ch.A)

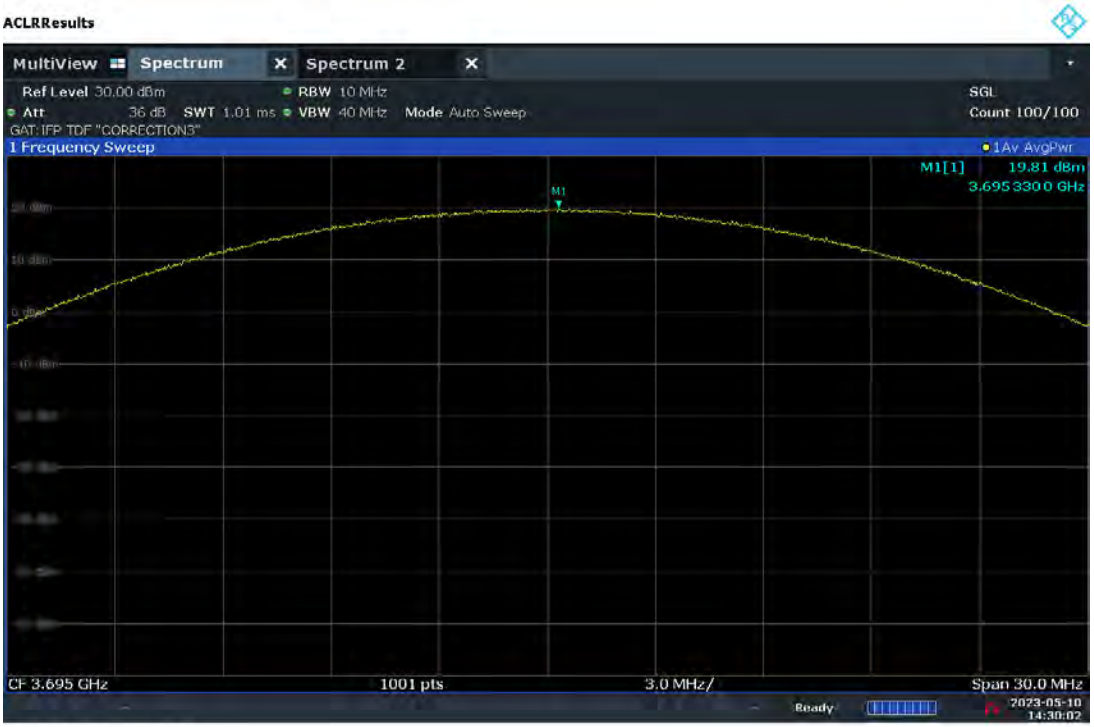
Channel B Conducted Power / 10MHz

Plot 7.81. Conducted Power / 10MHz (10MHz QPSK, High Channel – Ch.B)

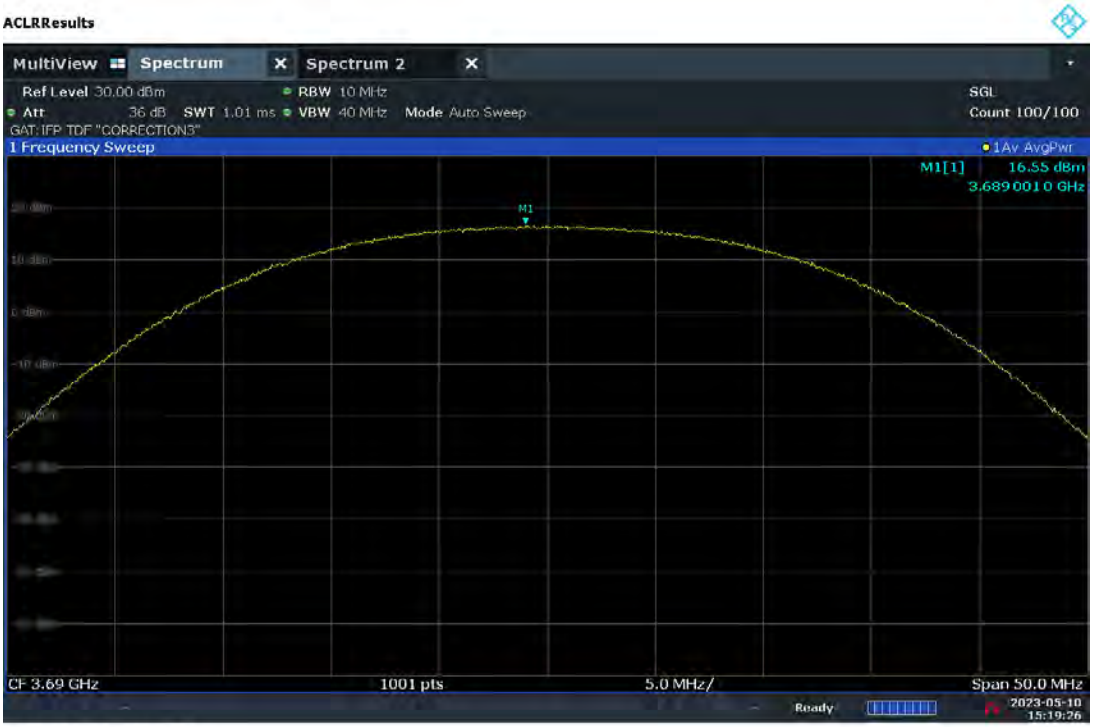
Plot 7.82. Conducted Power / 10MHz (10MHz 16QAM, High Channel – Ch.B)



Plot 7.83. Conducted Power / 10MHz (10MHz 64QAM, High Channel – Ch.B)

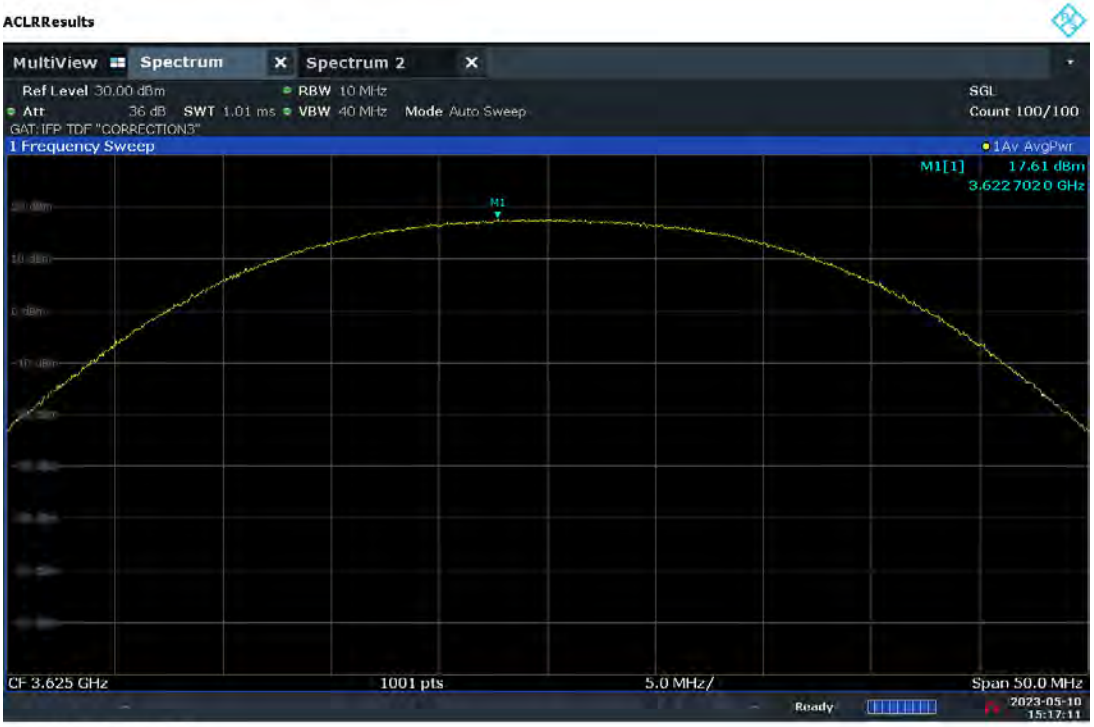


Plot 7.84. Conducted Power / 10MHz (10MHz 256QAM, High Channel – Ch.B)

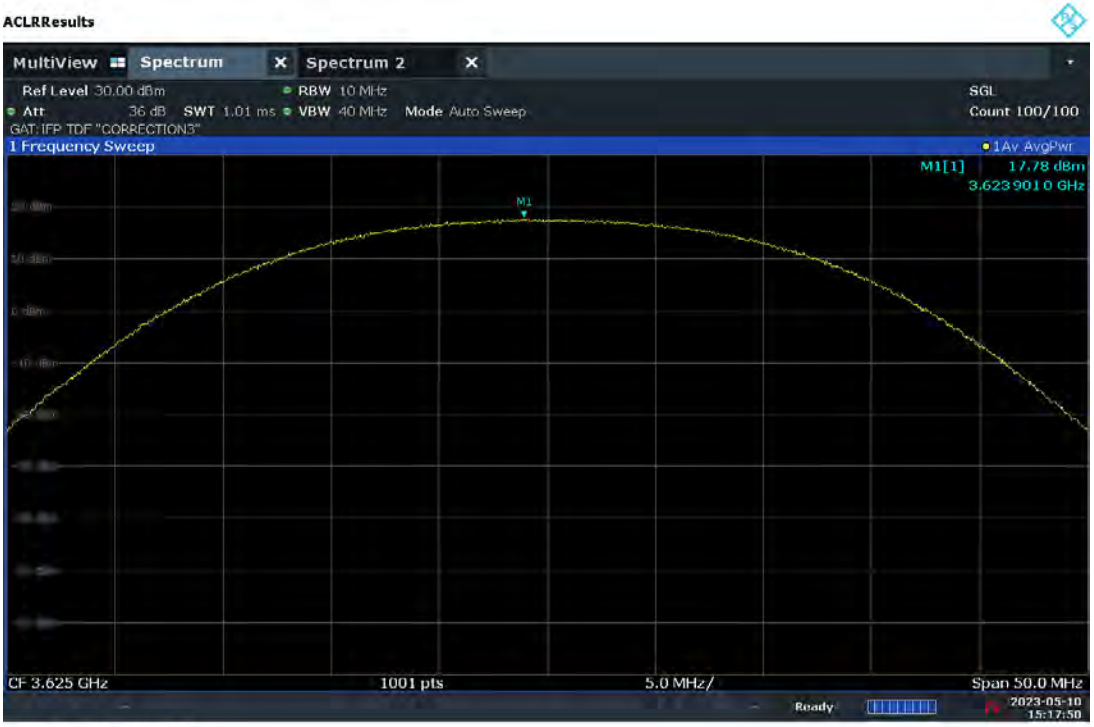


Plot 7.85. Conducted Power / 10MHz (20MHz QPSK, High Channel – Ch.B)

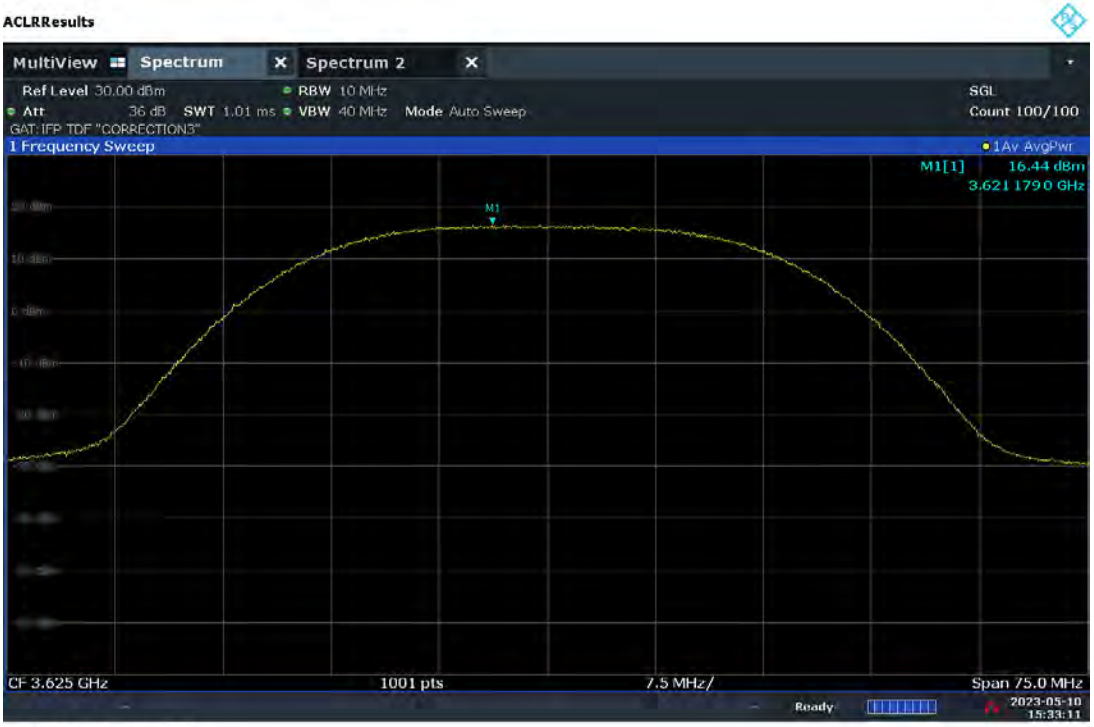
Plot 7.86. Conducted Power / 10MHz (20MHz 16QAM, High Channel – Ch.B)



Plot 7.87. Conducted Power / 10MHz (20MHz 64QAM, Mid Channel – Ch.B)

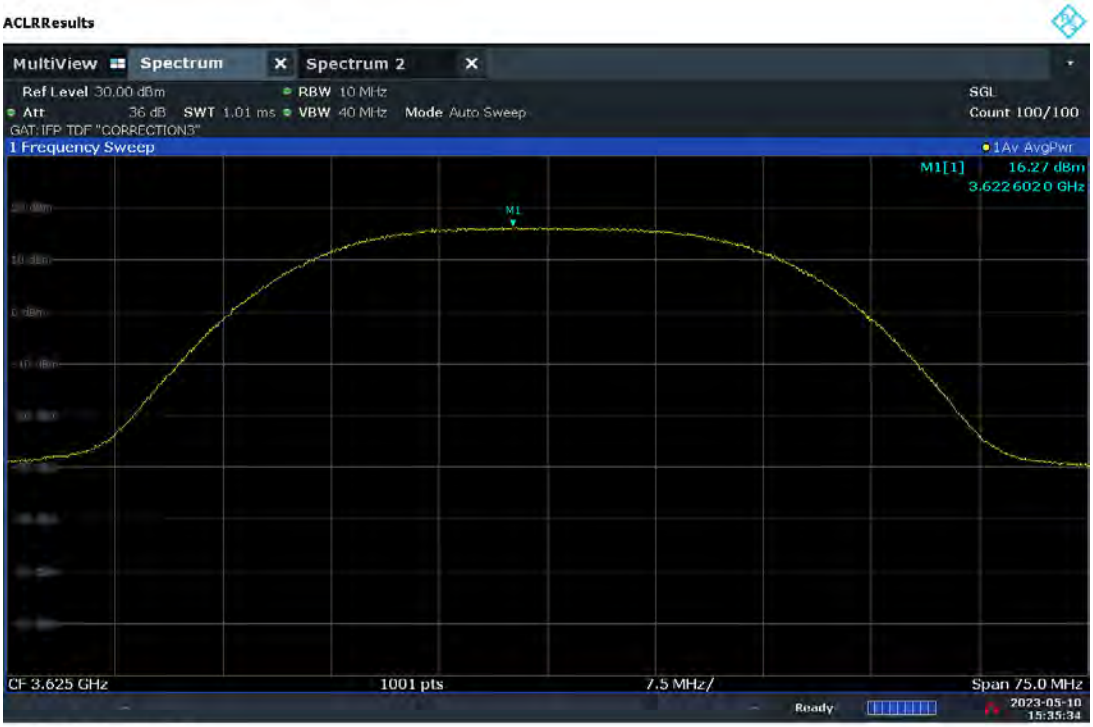


Plot 7.88. Conducted Power / 10MHz (20MHz 256QAM, Mid Channel – Ch.B)

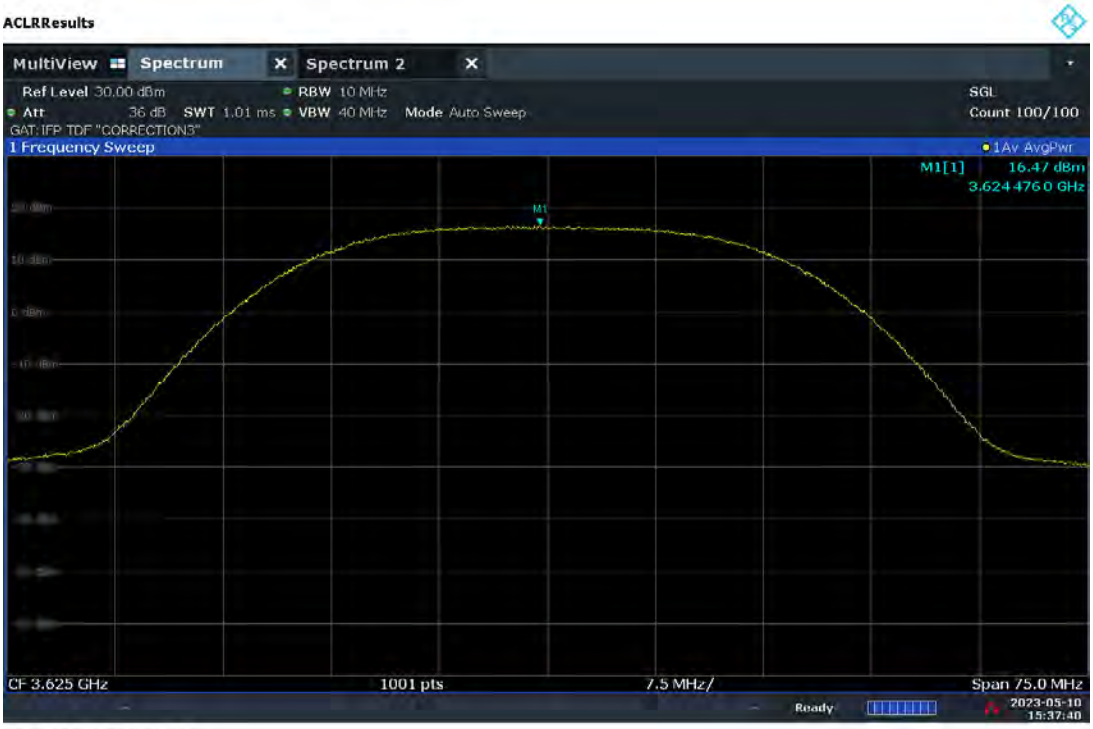


Plot 7.89. Conducted Power / 10MHz (30MHz QPSK, Mid Channel – Ch.B)

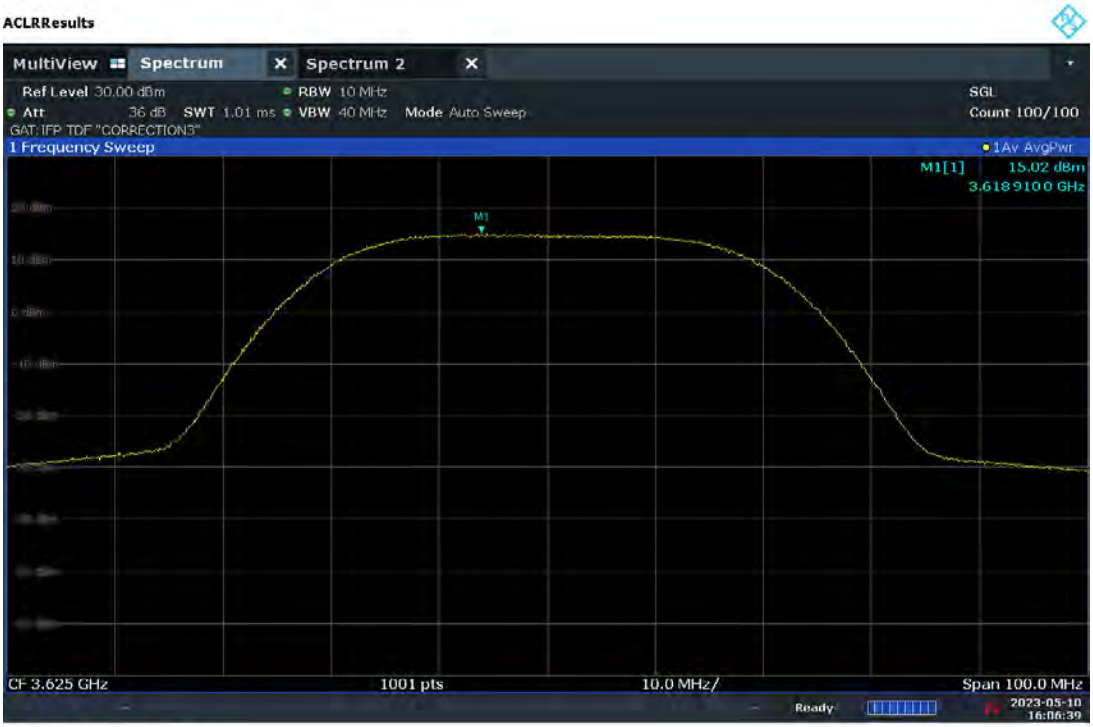
Plot 7.90. Conducted Power / 10MHz (30MHz 16QAM, Mid Channel – Ch.B)



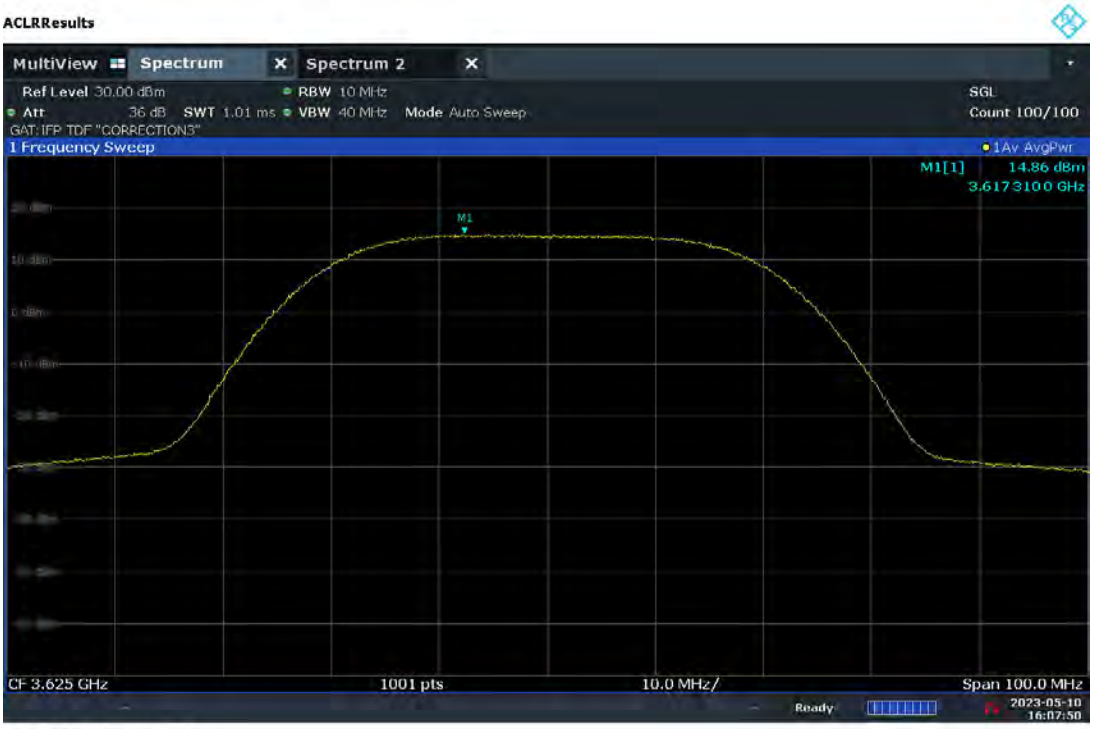
Plot 7.91. Conducted Power / 10MHz (30MHz 64QAM, Mid Channel – Ch.B)



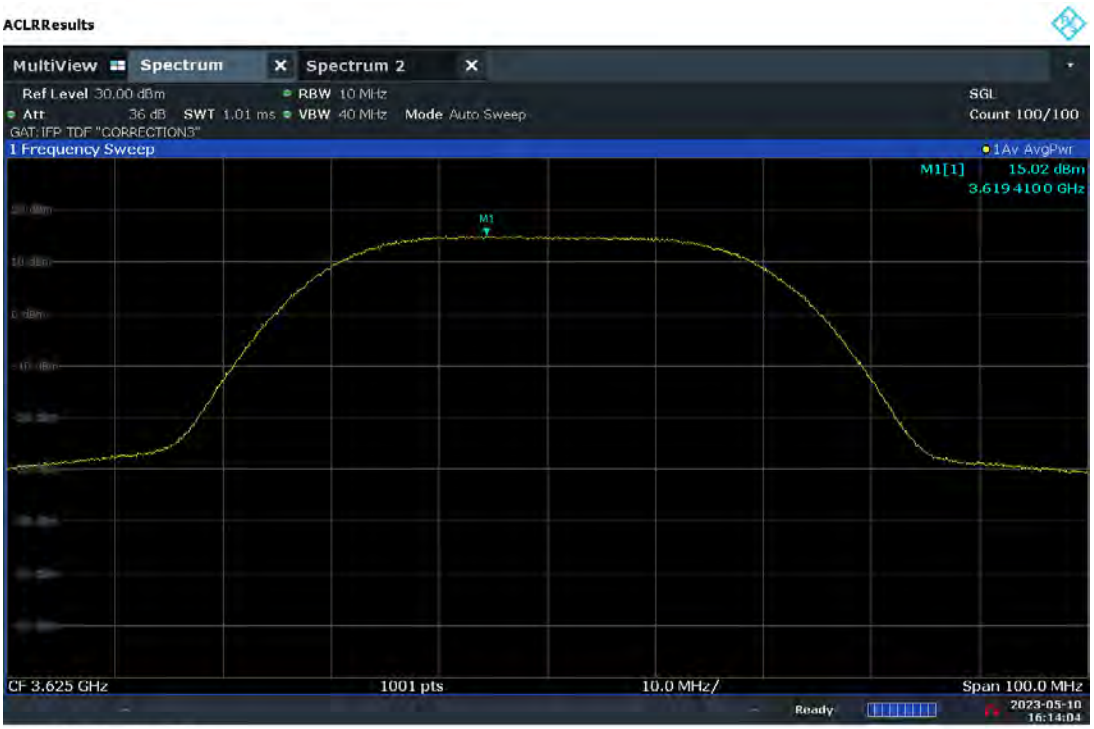
Plot 7.92. Conducted Power / 10MHz (30MHz 256QAM, Mid Channel – Ch.B)



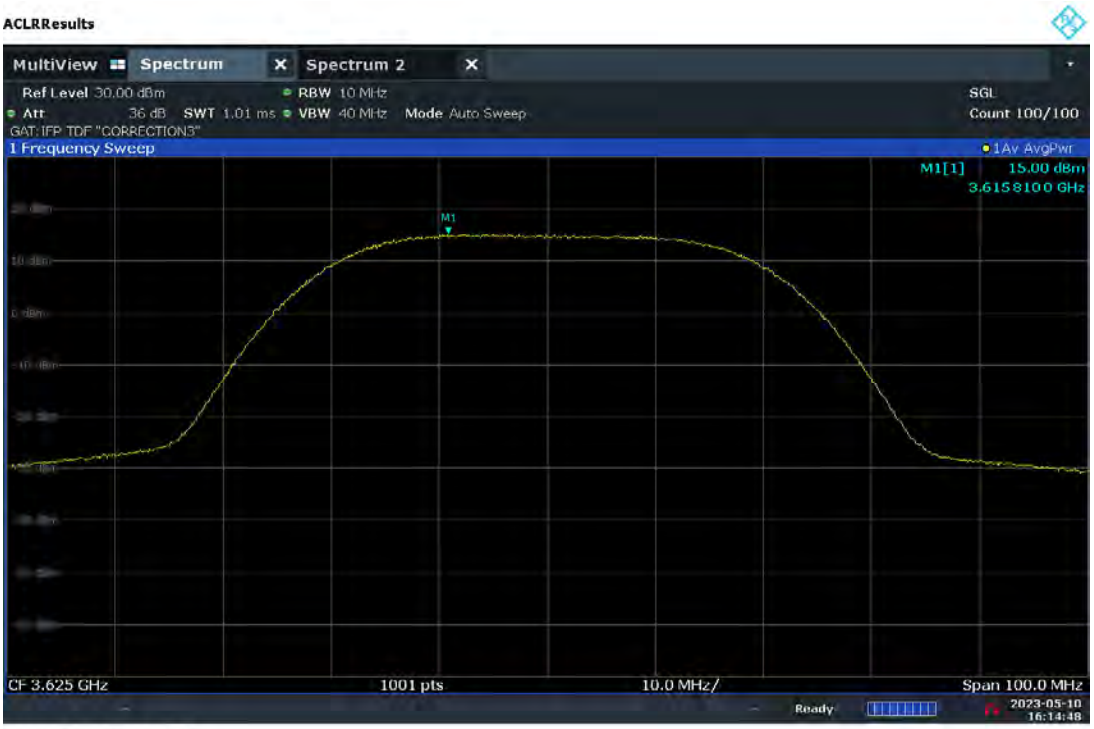
Plot 7.93. Conducted Power / 10MHz (40MHz QPSK, Mid Channel – Ch.B)



Plot 7.94. Conducted Power / 10MHz (40MHz 16QAM, Mid Channel – Ch.B)



Plot 7.95. Conducted Power / 10MHz (40MHz 64QAM, Mid Channel – Ch.B)



Plot 7.96. Conducted Power / 10MHz (40MHz 256QAM, Mid Channel – Ch.B)

Note:

Per ANSI C63.26-2015 Section 5.2.5.3 and KDB 662911 v02r01 Section E)2), the power spectral density at Channel A and Channel B were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.26-2015 Section 6.4.6 and KDB 662911 v02r01 Section F.2.c, since the transmissions are otherognally polarized, the directional gain is equal to the single transmission gain of 13.75dBi

Sample MIMO Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average conducted power per 10MHz was measured to be 15.36 dBm/10MHz for Channel A and 17.68 dBm/10MHz for Channel B.

Channel A + Channel B = MIMO

(15.36 dBm/10MHz + 17.68 dBm/10MHz) = (34.356 mW/10MHz + 58.614 mW/10MHz) = 92.970 mW/10MHz = 19.68 dBm/10MHz

Sample e.i.r.p / 10MHz Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average MIMO power density was calculated to be 19.68 dBm with directional gain of 13.75 dBi.

e.i.r.p. Power Spectral Density(dBm) = Power Spectral Density (dBm) + Ant gain (dBi)

19.68 dBm/10MHz + 13.75dBi = 33.43 dBm/10MHz

7.5 Power Spectral Density

Test Overview

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum power control level, as defined in ANSI C63.26-2015,and at the appropriate frequencies. The EUT transmits with a duty cycle of approximately 71.95%; the spectrum analyzer was gate as to only measure during on periods.

The power spectral density for a Category B CBSD must be less than 37dBm/1MHz e.i.r.p.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.4.4.1
ANSI C63.26-2015 – Section 5.2.4.5
ANSI C63.26-2015 – Section 6.4.3.2.3

Test Settings

9. Span = 2x to 3X the OBW
10. RBW = 1MHz
11. VBW ≥ 3 x RBW
12. Set number of sweep points ≥ 2 x span / RBW
13. Sweep Time = auto couple
14. Detector = RMS
15. Trace mode = average
16. Trigger = Level

Test Setup

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

Figure 7-4. Test Instrument & Measurement Setup

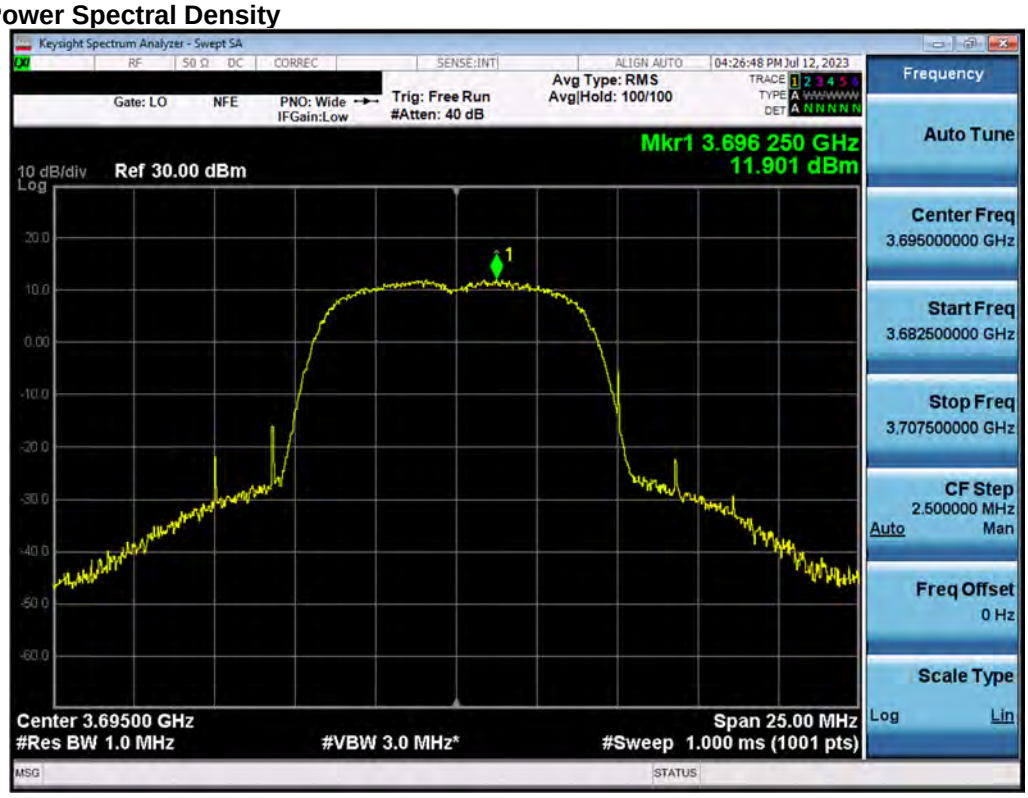
Test Notes

None

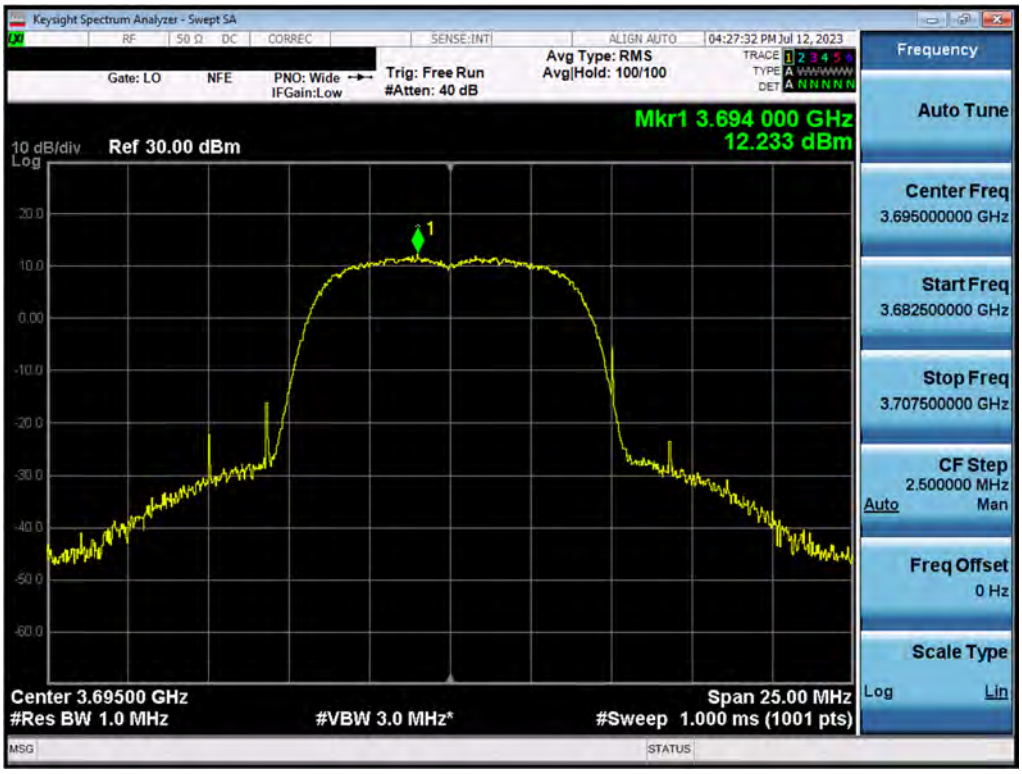
Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted PSD [dBm/MHz]	Ch. B Conducted PSD [dBm/MHz]	Summed MIMO Conducted PSD [dBm/MHz]	Ant Gain [dBi]	EIRP PSD [dBm/MHz]	EIRP PSD [Watts/MHz]	EIRP PSD Limit [dBm/MHz]	Margin [dB]
40 MHz	QPSK	3570.0	3.86	2.42	6.21	13.75	19.96	0.099	37.00	-17.04
		3625.0	5.55	5.84	8.70	13.75	22.45	0.176	37.00	-14.55
		3680.0	4.30	3.08	6.74	13.75	20.49	0.112	37.00	-16.51
	16-QAM	3570.0	1.98	2.60	5.31	13.75	19.06	0.081	37.00	-17.94
		3625.0	1.65	5.81	7.22	13.75	20.97	0.125	37.00	-16.03
		3680.0	4.26	3.20	6.77	13.75	20.52	0.113	37.00	-16.48
	64-QAM	3570.0	1.90	2.71	5.33	13.75	19.08	0.081	37.00	-17.92
		3625.0	3.06	5.69	7.58	13.75	21.33	0.136	37.00	-15.67
		3680.0	3.32	3.10	6.22	13.75	19.97	0.099	37.00	-17.03
	256-QAM	3570.0	3.62	2.68	6.18	13.75	19.93	0.098	37.00	-17.07
		3625.0	4.94	5.66	8.32	13.75	22.07	0.161	37.00	-14.93
		3680.0	4.10	3.20	6.69	13.75	20.44	0.111	37.00	-16.56
30 MHz	QPSK	3565.0	2.29	5.42	7.14	13.75	20.89	0.123	37.00	-16.11
		3625.0	6.33	7.05	9.72	13.75	23.47	0.222	37.00	-13.53
		3685.0	6.43	3.44	8.20	13.75	21.95	0.157	37.00	-15.05
	16-QAM	3565.0	4.80	5.30	8.06	13.75	21.81	0.152	37.00	-15.19
		3625.0	5.77	7.13	9.51	13.75	23.26	0.212	37.00	-13.74
		3685.0	5.29	3.10	7.34	13.75	21.09	0.129	37.00	-15.91
	64-QAM	3565.0	6.16	5.15	8.69	13.75	22.44	0.175	37.00	-14.56
		3625.0	5.88	7.11	9.55	13.75	23.30	0.214	37.00	-13.70
		3685.0	6.48	3.38	8.21	13.75	21.96	0.157	37.00	-15.04
	256-QAM	3565.0	2.13	5.01	6.81	13.75	20.56	0.114	37.00	-16.44
		3625.0	4.21	7.30	9.03	13.75	22.78	0.190	37.00	-14.22
		3685.0	5.52	3.18	7.51	13.75	21.26	0.134	37.00	-15.74
20 MHz	QPSK	3560.0	6.17	8.17	10.30	13.75	24.05	0.254	37.00	-12.95
		3625.0	6.81	8.19	10.57	13.75	24.32	0.270	37.00	-12.68
		3690.0	6.63	6.06	9.36	13.75	23.11	0.205	37.00	-13.89
	16-QAM	3560.0	7.28	8.27	10.81	13.75	24.56	0.286	37.00	-12.44
		3625.0	7.59	8.22	10.93	13.75	24.68	0.294	37.00	-12.32
		3690.0	5.81	6.13	8.98	13.75	22.73	0.188	37.00	-14.27
	64-QAM	3560.0	8.00	8.19	11.10	13.75	24.85	0.306	37.00	-12.15
		3625.0	8.06	8.29	11.19	13.75	24.94	0.312	37.00	-12.06
		3690.0	6.01	6.15	9.09	13.75	22.84	0.192	37.00	-14.16
	256-QAM	3560.0	7.72	8.30	11.03	13.75	24.78	0.301	37.00	-12.22
		3625.0	7.95	8.34	11.16	13.75	24.91	0.310	37.00	-12.09
		3690.0	6.91	6.13	9.55	13.75	23.30	0.214	37.00	-13.70
10 MHz	QPSK	3555.0	13.37	11.39	15.50	13.75	29.25	0.841	37.00	-7.75
		3625.0	11.03	12.20	14.66	13.75	28.41	0.694	37.00	-8.59
		3695.0	11.90	13.33	15.68	13.75	29.43	0.878	37.00	-7.57
	16-QAM	3555.0	11.90	11.47	14.70	13.75	28.45	0.700	37.00	-8.55
		3625.0	10.95	12.10	14.57	13.75	28.32	0.679	37.00	-8.68
		3695.0	12.23	13.13	15.71	13.75	29.46	0.884	37.00	-7.54
	64-QAM	3555.0	11.37	11.34	14.37	13.75	28.12	0.648	37.00	-8.88
		3625.0	9.10	12.33	14.02	13.75	27.77	0.598	37.00	-9.23
		3695.0	12.00	13.38	15.76	13.75	29.51	0.893	37.00	-7.49
	256-QAM	3555.0	10.93	11.35	14.15	13.75	27.90	0.617	37.00	-9.10
		3625.0	12.15	12.25	15.21	13.75	28.96	0.787	37.00	-8.04
		3695.0	12.01	13.24	15.68	13.75	29.43	0.877	37.00	-7.57

Table 7-6 Power Spectral Density Measurements

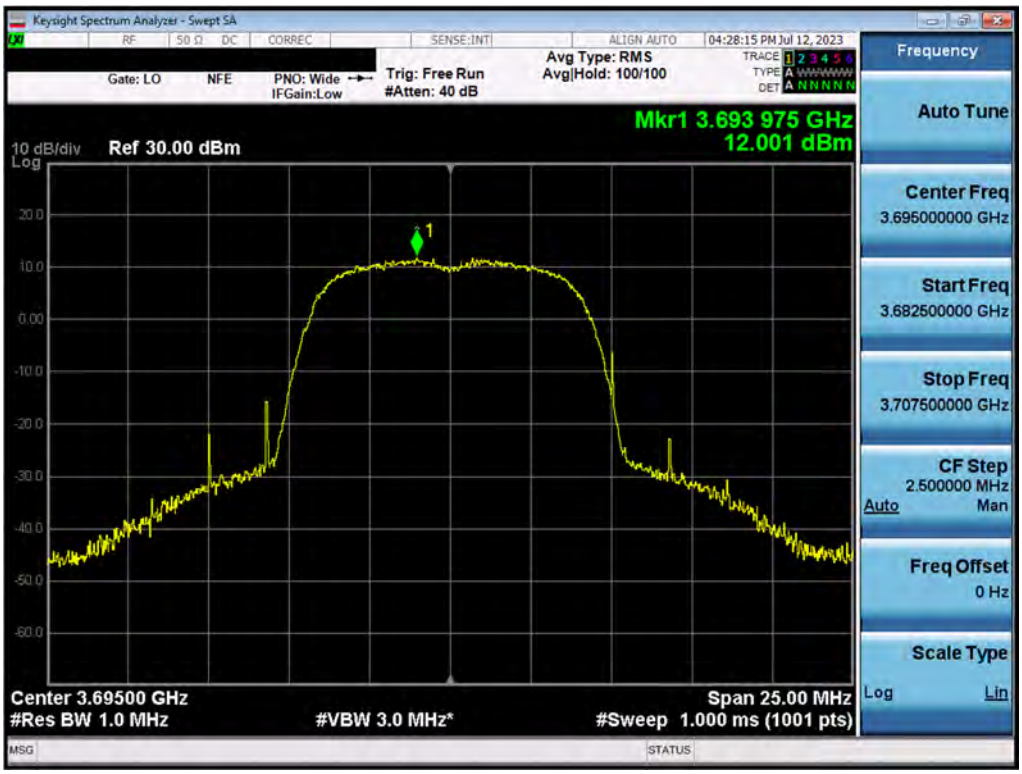
Channel A Power Spectral Density



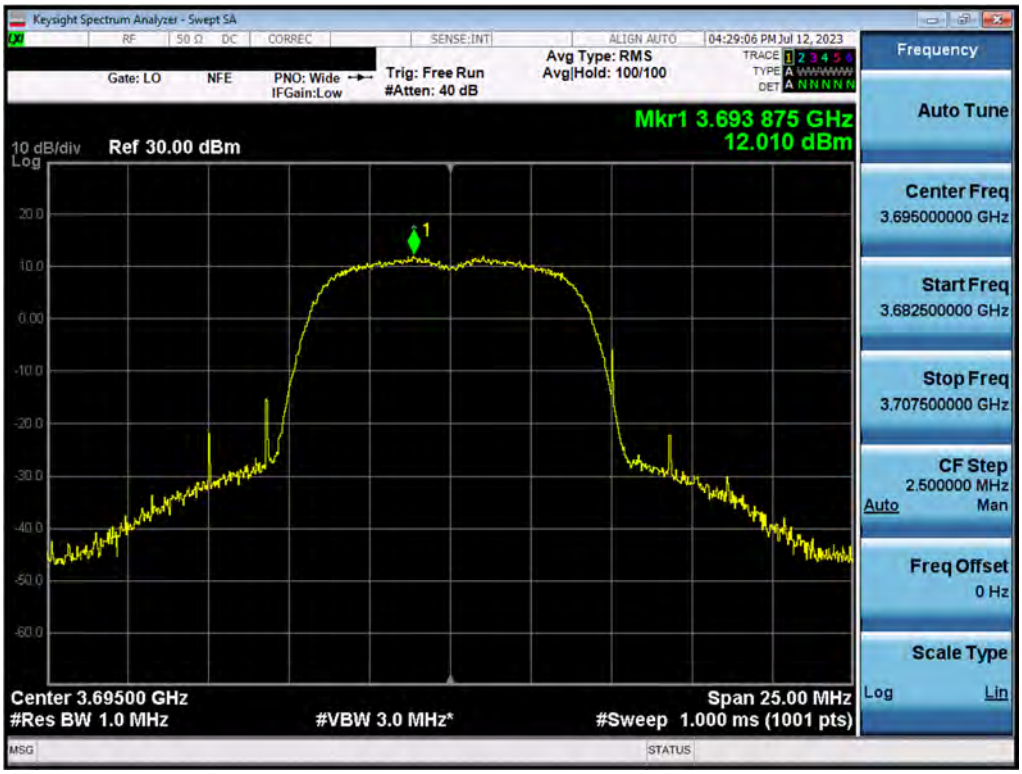
Plot 7.97. Power Spectral Density (10MHz QPSK, High Channel – Ch.A)



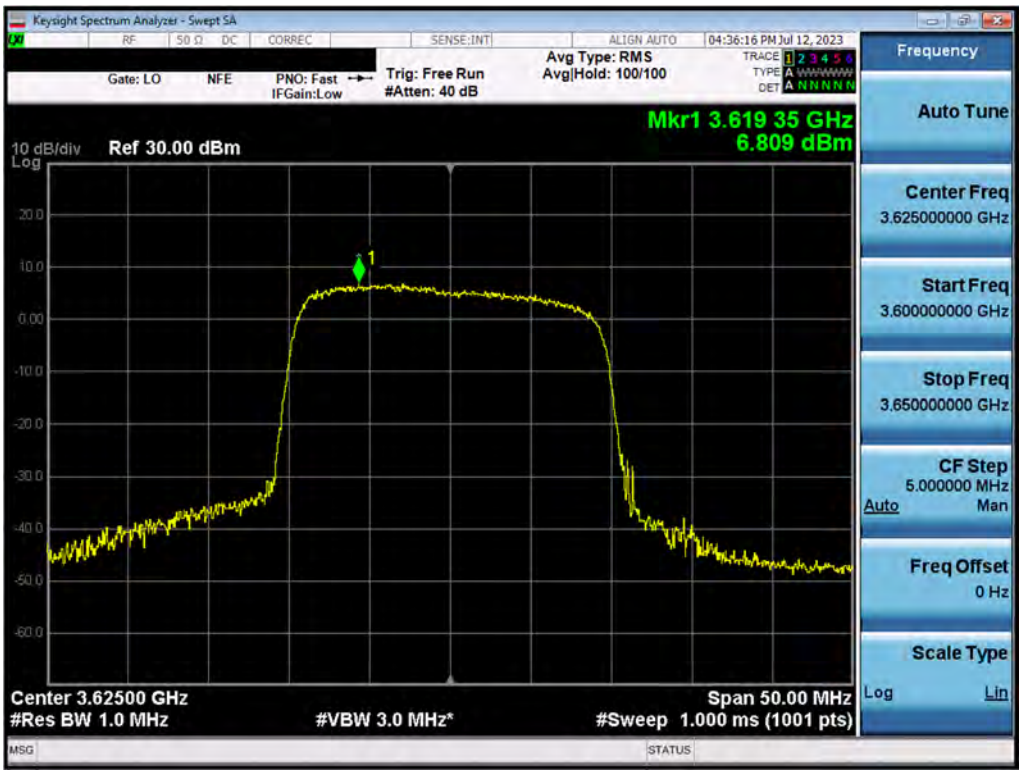
Plot 7.98. Power Spectral Density (10MHz 16QAM, High Channel – Ch.A)



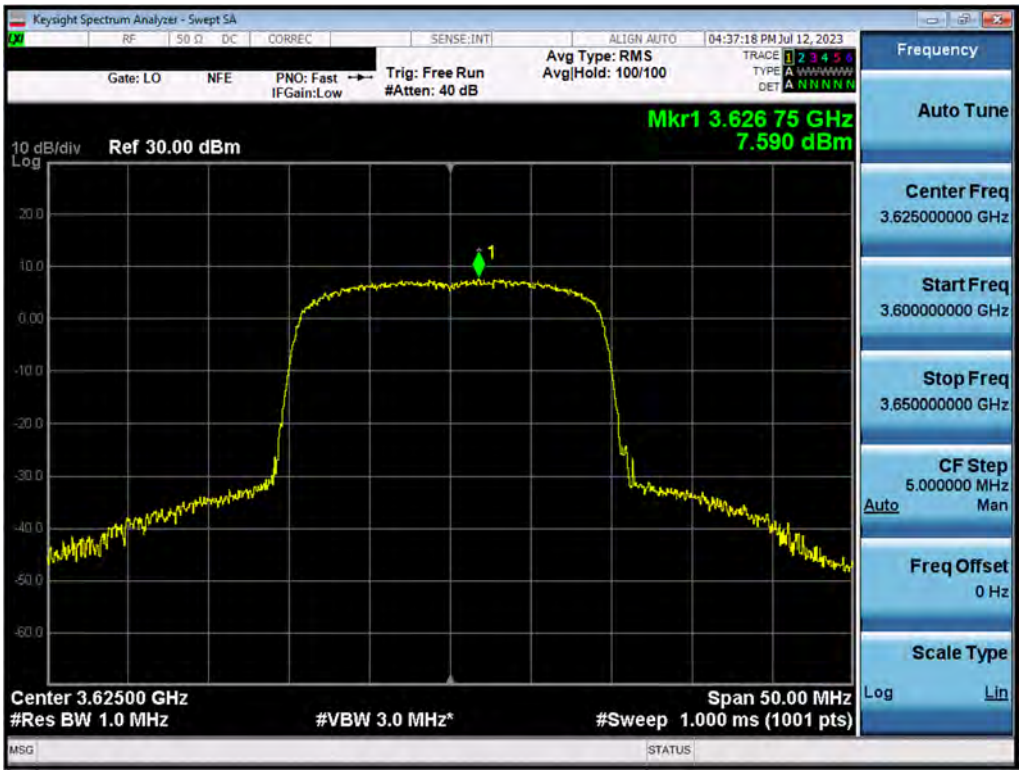
Plot 7.99. Power Spectral Density (10MHz 64QAM, High Channel – Ch.A)



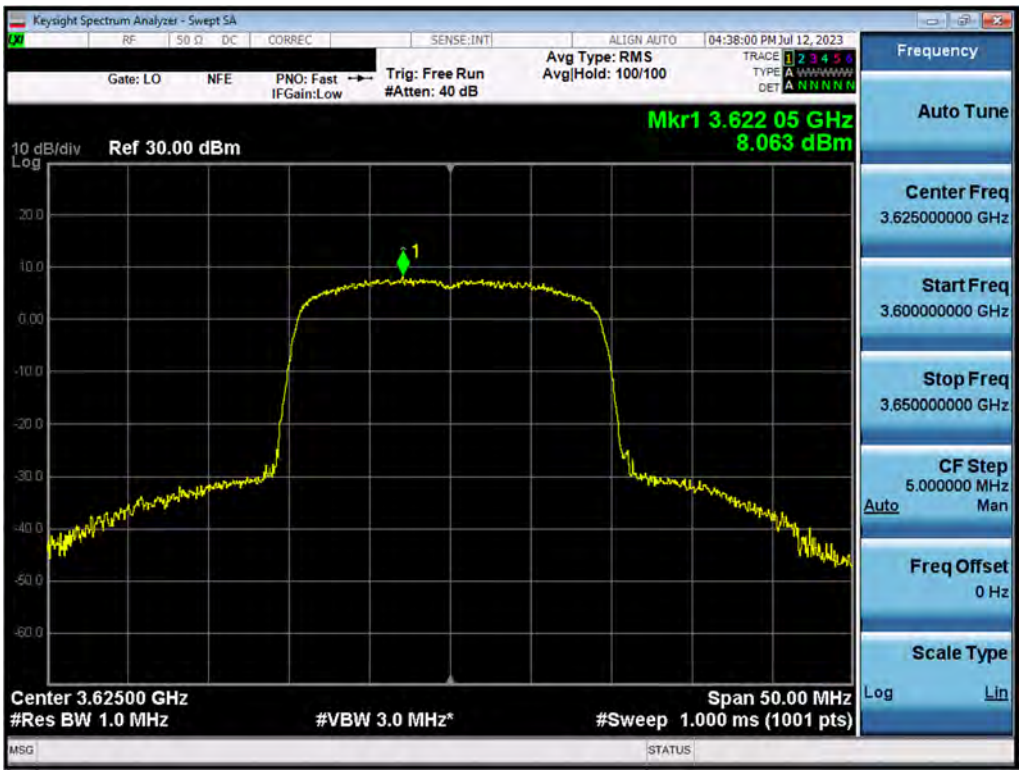
Plot 7.100. Power Spectral Density (10MHz 256QAM, High Channel – Ch.A)



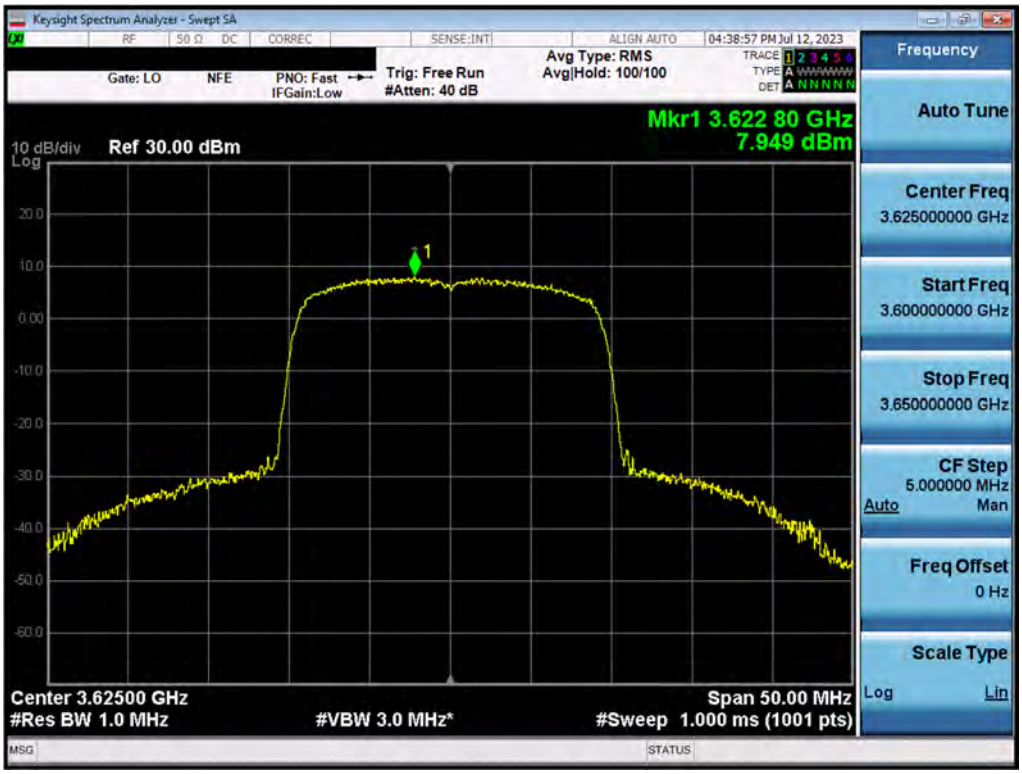
Plot 7.101. Power Spectral Density (20MHz QPSK, Mid Channel – Ch.A)



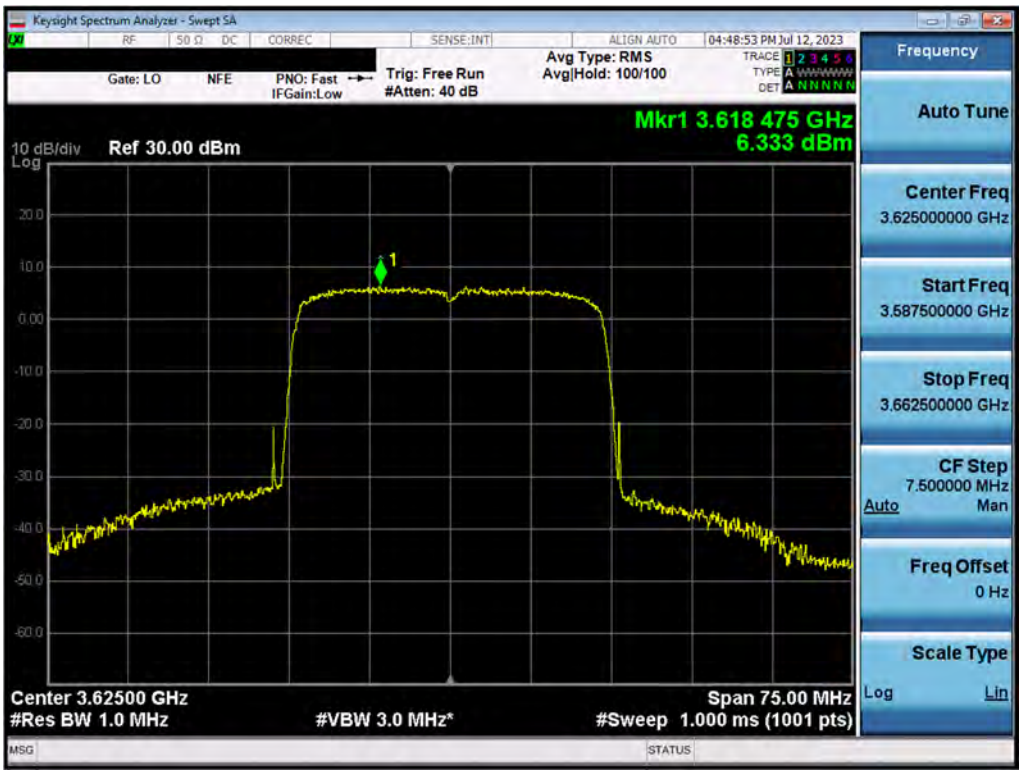
Plot 7.102. Power Spectral Density (20MHz 16QAM, Mid Channel – Ch.A)



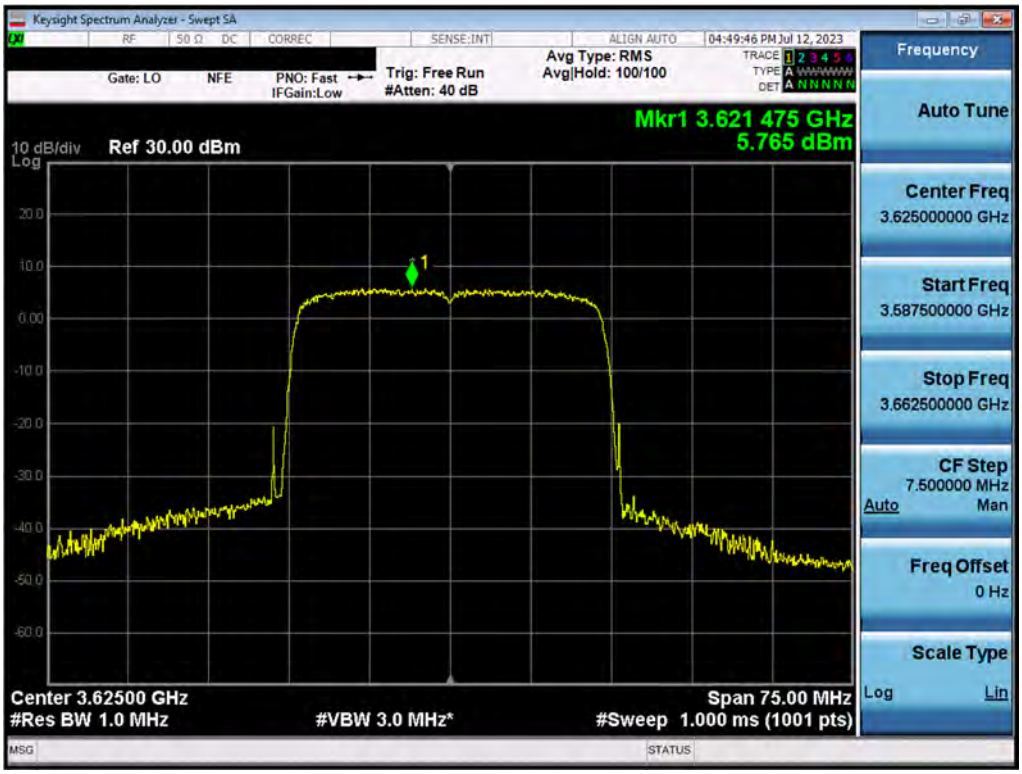
Plot 7.103. Power Spectral Density (20MHz 64QAM, Mid Channel – Ch.A)



Plot 7.104. Power Spectral Density (20MHz 256QAM, Mid Channel – Ch.A)

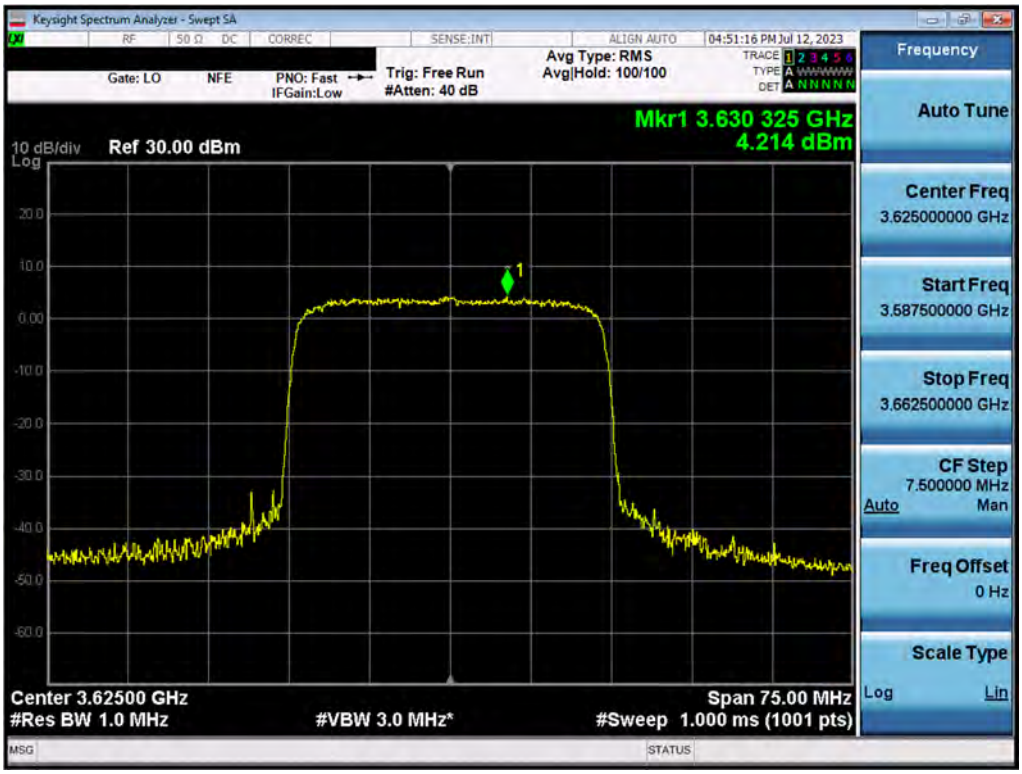


Plot 7.105. Power Spectral Density (30MHz QPSK, Mid Channel – Ch.A)



Plot 7.106. Power Spectral Density (30MHz 16QAM, Mid Channel – Ch.A)

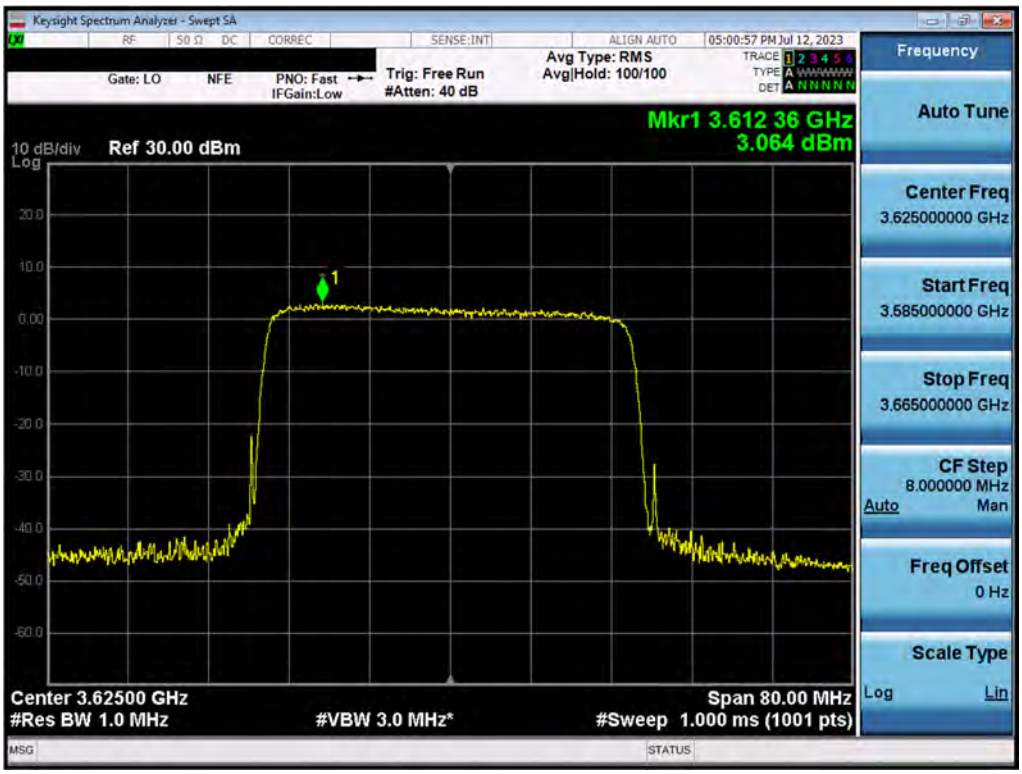
Plot 7.107. Power Spectral Density (30MHz 64QAM, Mid Channel – Ch.A)



Plot 7.108. Power Spectral Density (30MHz 256QAM, Mid Channel – Ch.A)

Plot 7.109. Power Spectral Density (40MHz QPSK, Mid Channel – Ch.A)

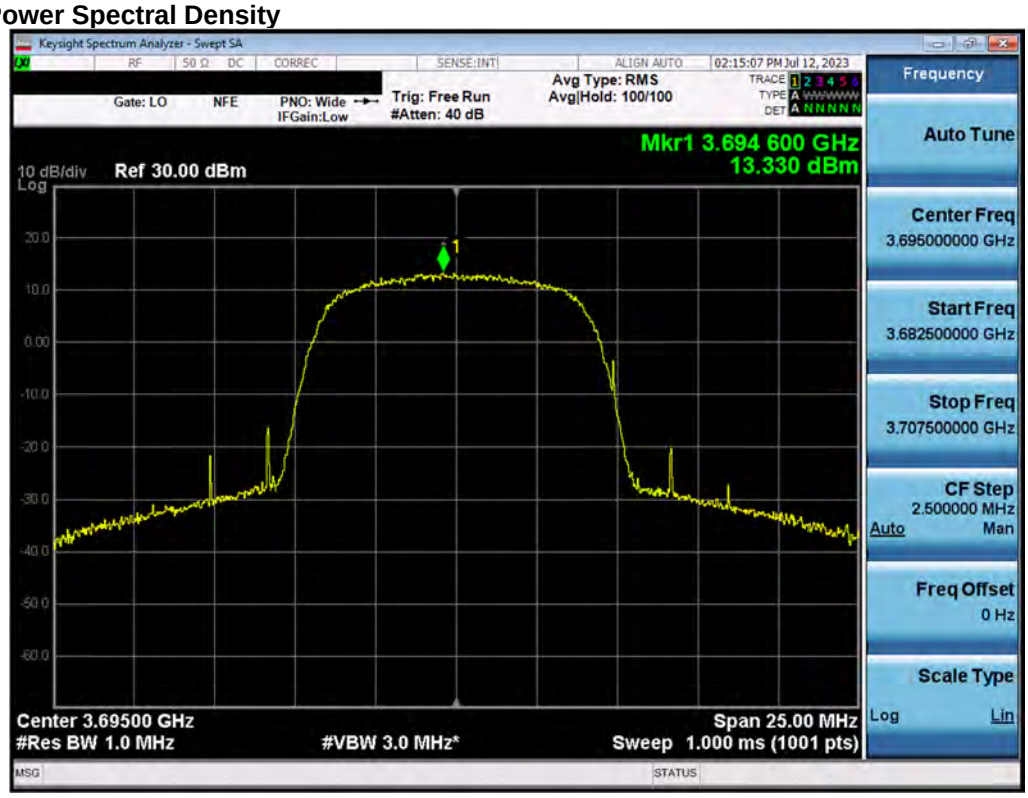
Plot 7.110. Power Spectral Density (40MHz 16QAM, Mid Channel – Ch.A)



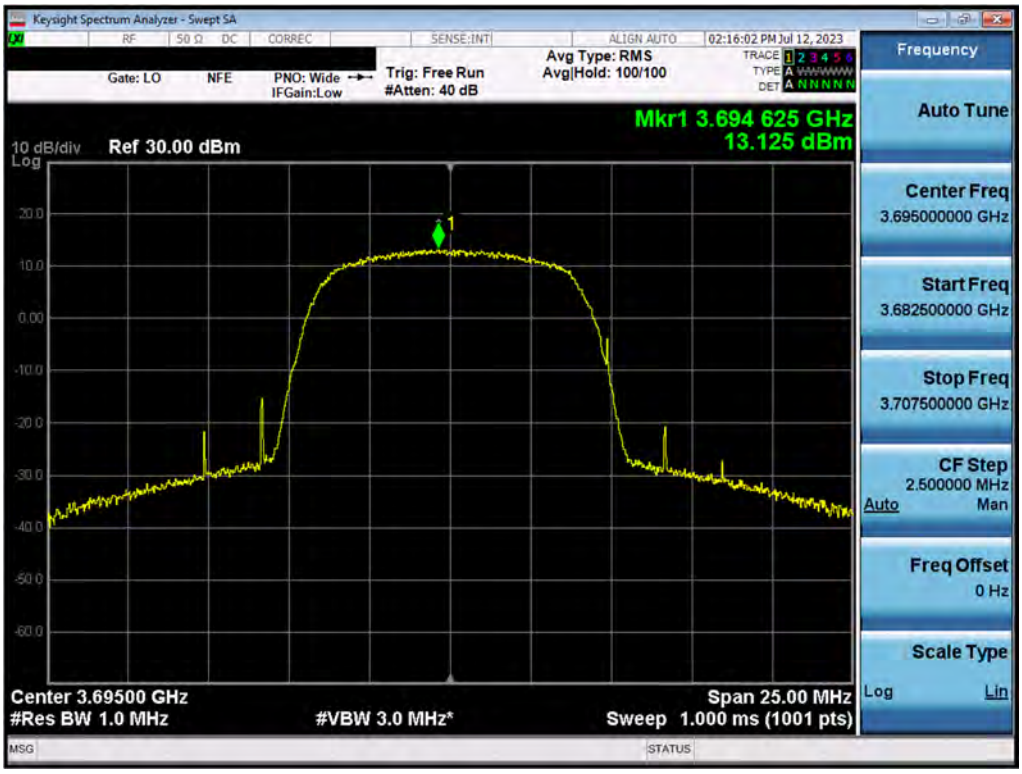
Plot 7.111. Power Spectral Density (40MHz 64QAM, Mid Channel – Ch.A)

Plot 7.112. Power Spectral Density (40MHz 256QAM, Mid Channel – Ch.A)

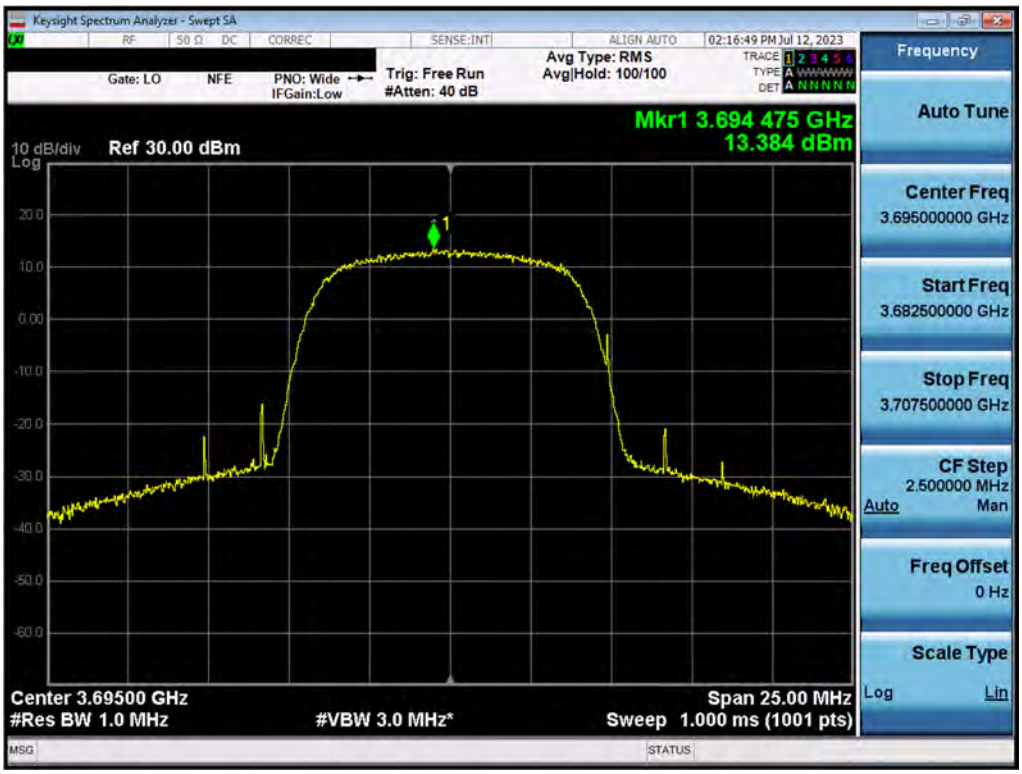
Channel B Power Spectral Density



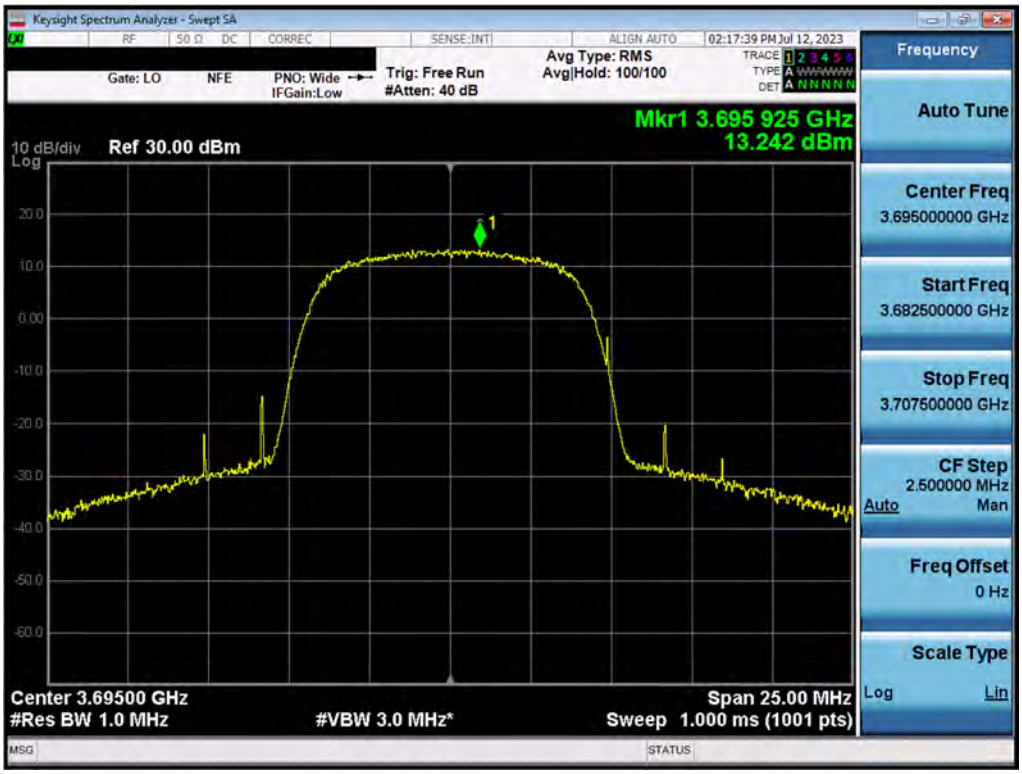
Plot 7.113. Power Spectral Density (10MHz QPSK, High Channel – Ch.B)



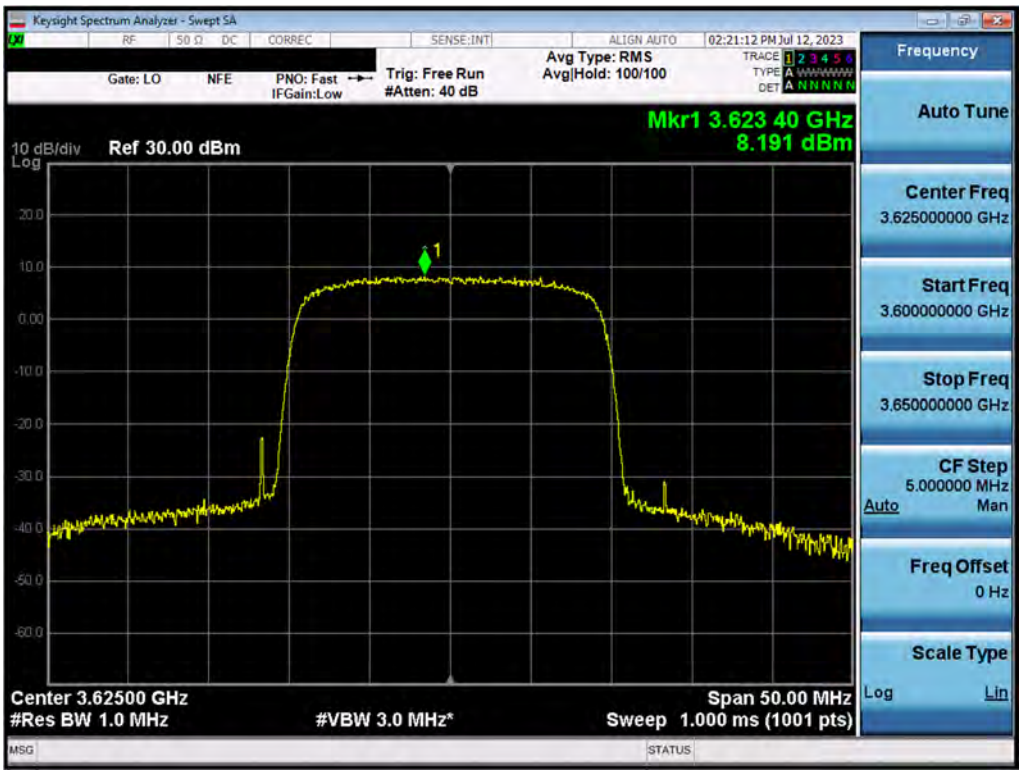
Plot 7.114. Power Spectral Density (10MHz 16QAM, High Channel – Ch.B)



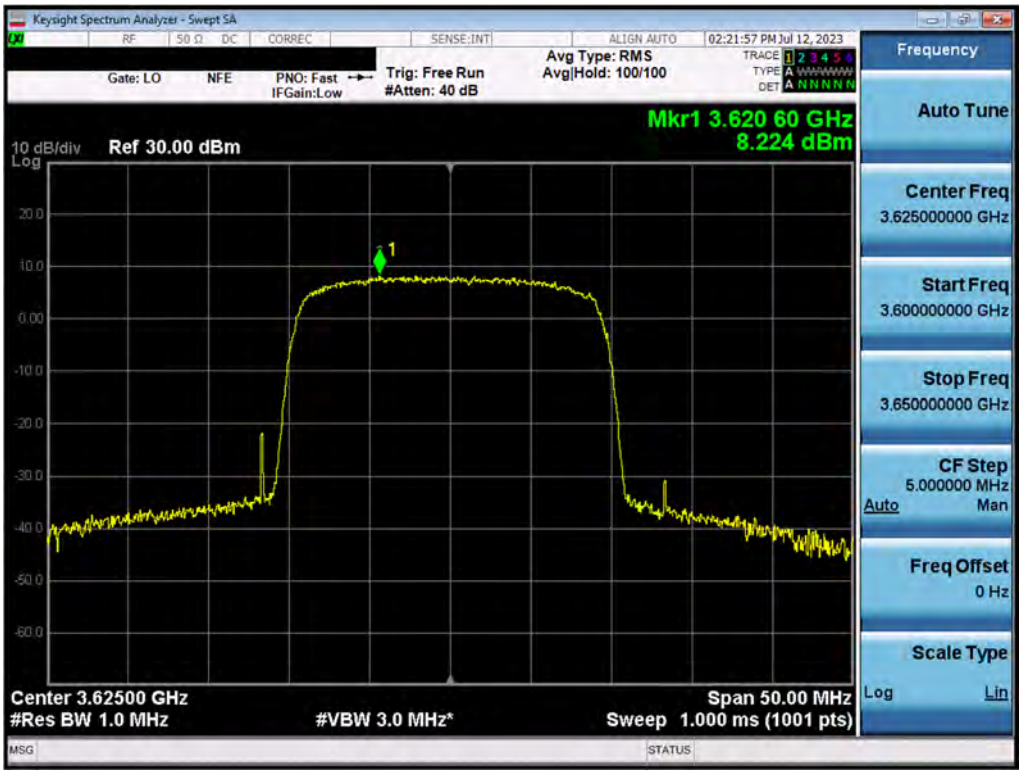
Plot 7.115. Power Spectral Density (10MHz 64QAM, High Channel – Ch.B)



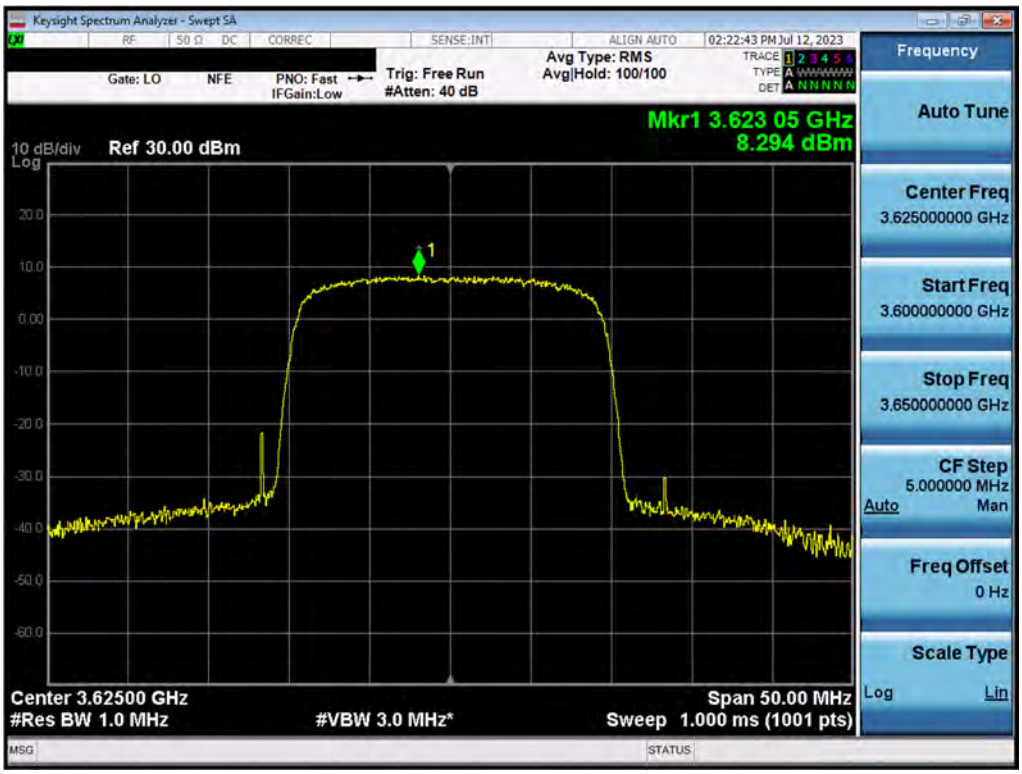
Plot 7.116. Power Spectral Density (10MHz 256QAM, High Channel – Ch.B)



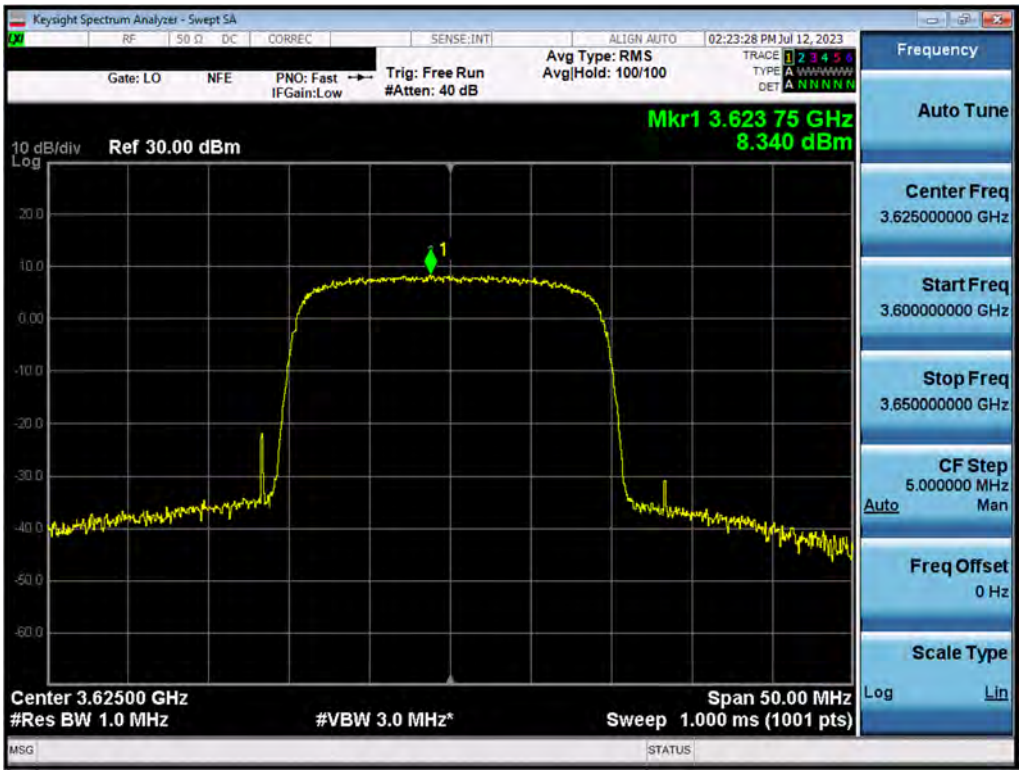
Plot 7.117. Power Spectral Density (20MHz QPSK, Mid Channel – Ch.B)



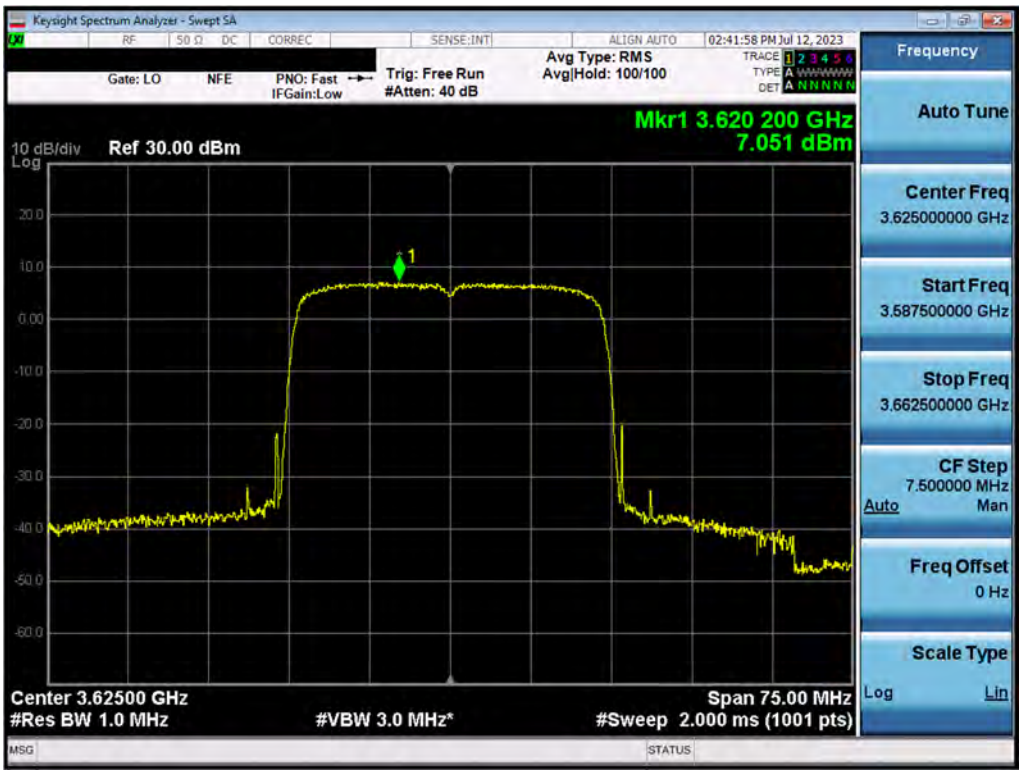
Plot 7.118. Power Spectral Density (20MHz 16QAM, Mid Channel – Ch.B)



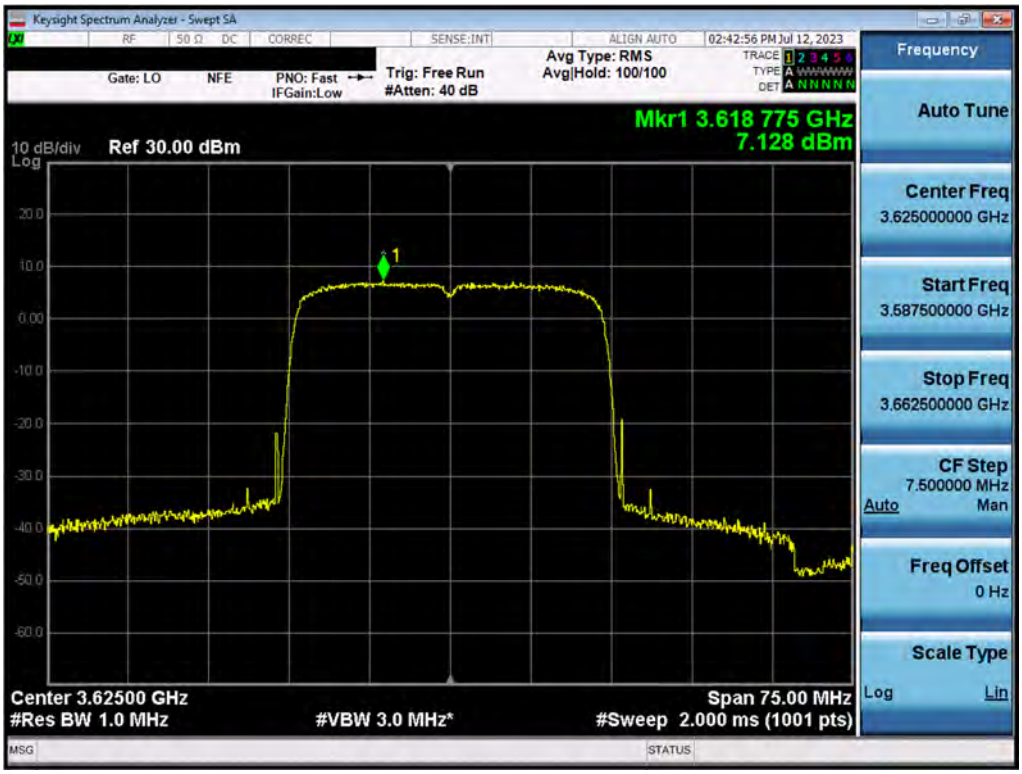
Plot 7.119. Power Spectral Density (20MHz 64QAM, Mid Channel – Ch.B)



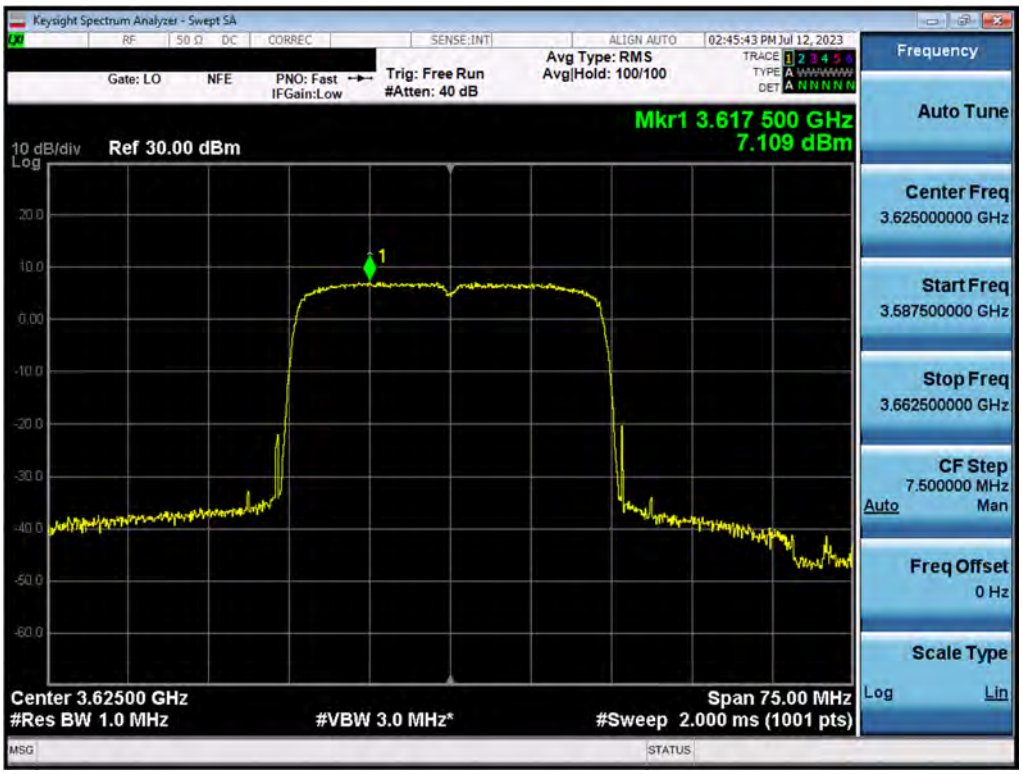
Plot 7.120. Power Spectral Density (20MHz 256QAM, Mid Channel – Ch.B)



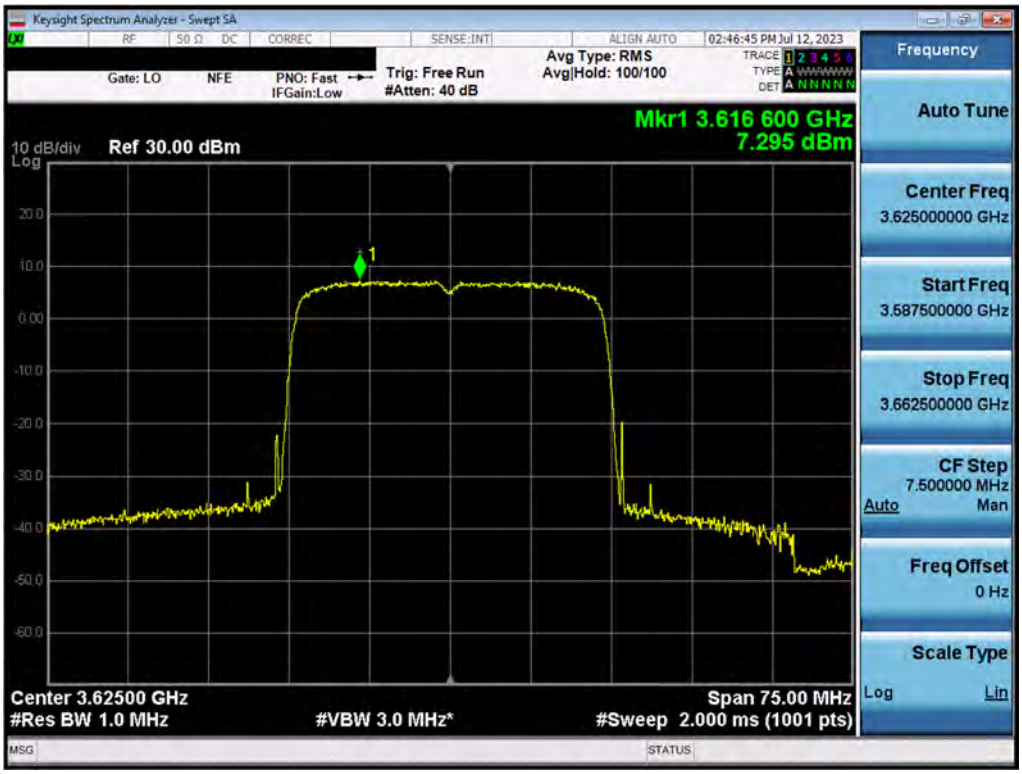
Plot 7.121. Power Spectral Density (30MHz QPSK, Mid Channel – Ch.B)



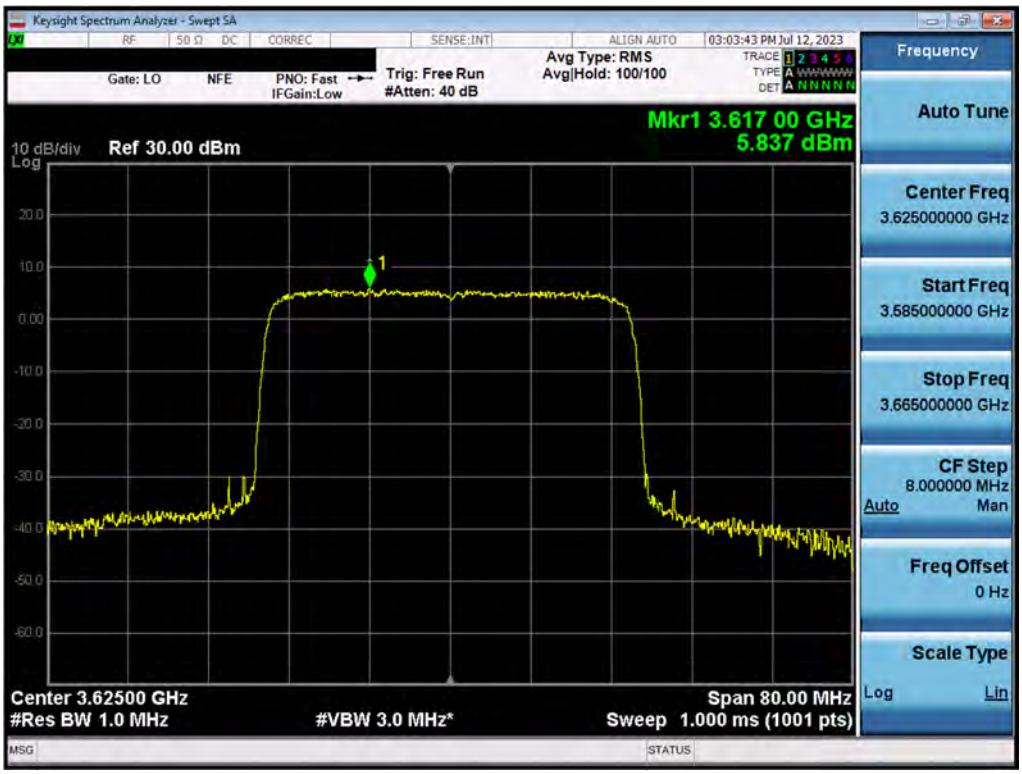
Plot 7.122. Power Spectral Density (30MHz 16QAM, Mid Channel – Ch.B)



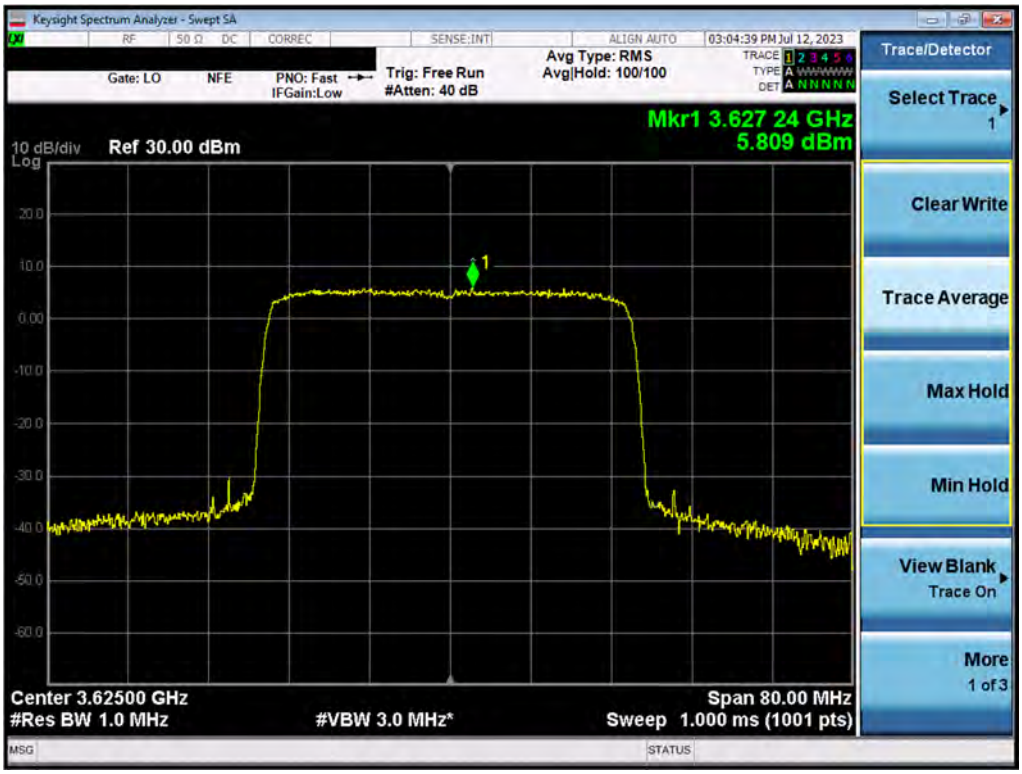
Plot 7.123. Power Spectral Density (30MHz 64QAM, Mid Channel – Ch.B)



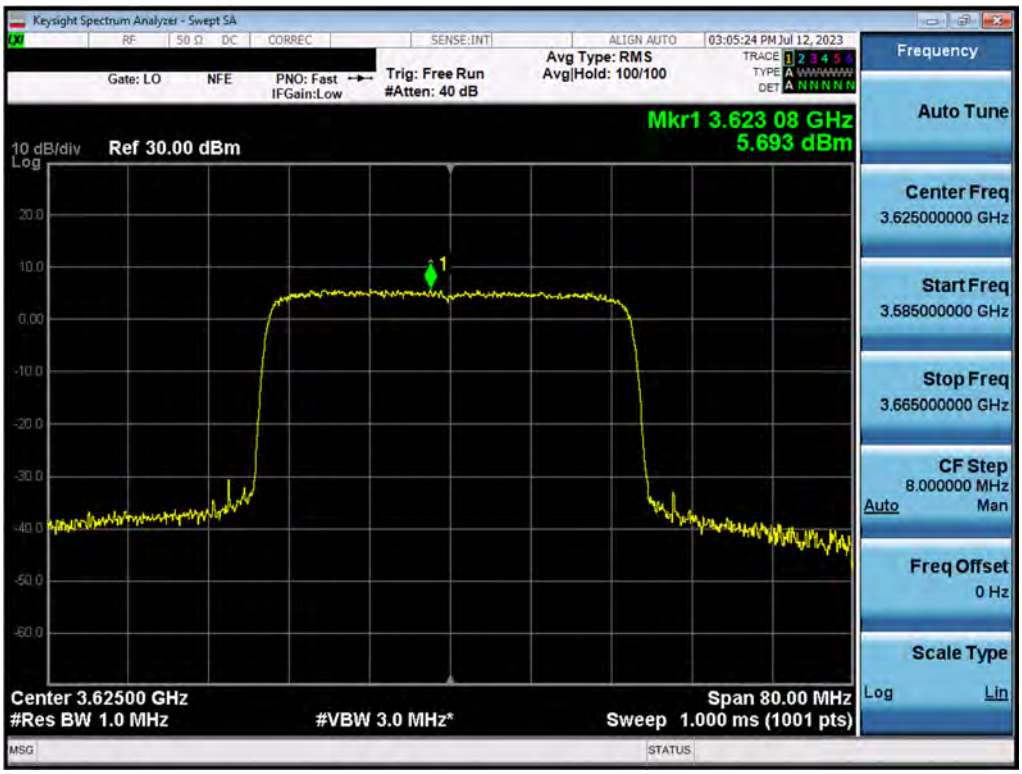
Plot 7.124. Power Spectral Density (30MHz 256QAM, Mid Channel – Ch.B)



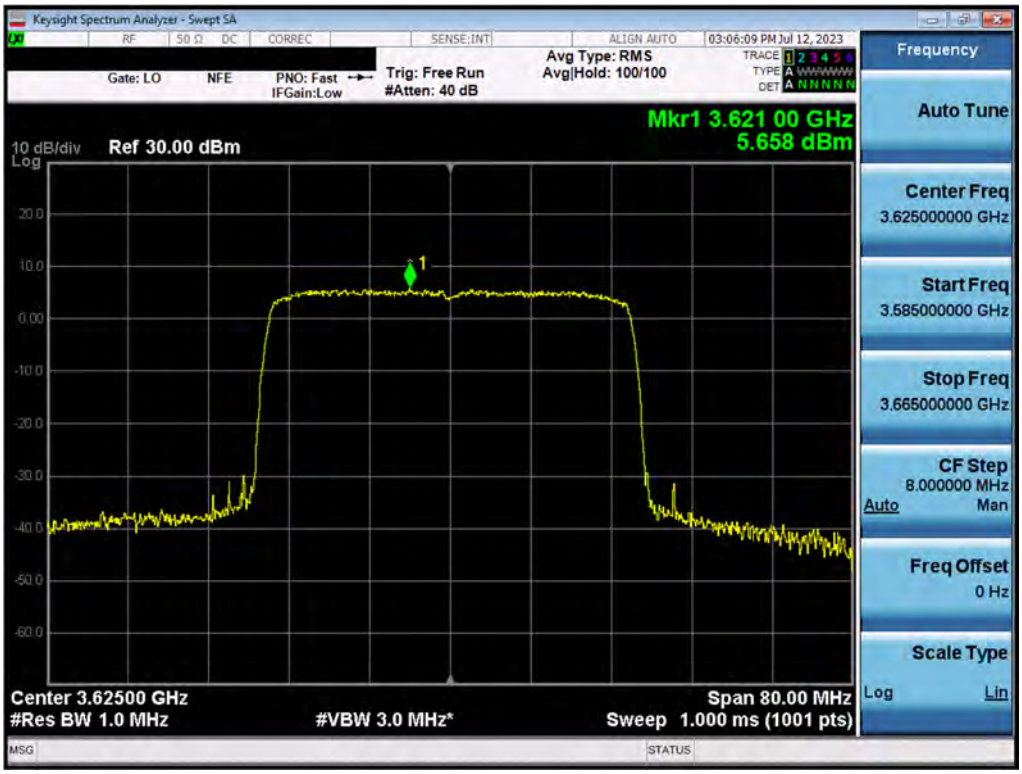
Plot 7.125. Power Spectral Density (40MHz QPSK, Mid Channel – Ch.B)



Plot 7.126. Power Spectral Density (40MHz 16QAM, Mid Channel – Ch.B)



Plot 7.127. Power Spectral Density (40MHz 64QAM, Mid Channel – Ch.B)



Plot 7.128. Power Spectral Density (40MHz 256QAM, Mid Channel – Ch.B)

Note:

Per ANSI C63.26-2015 Section 5.2.5.3 and KDB 662911 v02r01 Section E)2), the power spectral density at Channel A and Channel B were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.26-2015 Section 6.4.6 and KDB 662911 v02r01 Section F.2.c, since the transmissions are otherognally polarized, the directional gain is equal to the single transmission gain of 13.75dBi

Sample MIMO Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average conducted power spectral density was measured to be 6.81 dBm/MHz for Channel A and 8.19 dBm/MHz for Channel B.

Channel A + Channel B = MIMO

(6.81 dBm + 8.19 dBm) = (4.797 mW + 6.592 mW) = 11.389 mW = 10.57 dBm

Sample e.i.r.p Power Spectral Density Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average MIMO power density was calculated to be 10.57 dBm with directional gain of 13.75 dBi.

e.i.r.p. Power Spectral Density(dBm) = Power Spectral Density (dBm) + Ant gain (dBi)

10.57 dBm + 13.75dBi = 24.32 dBm

7.6 Peak-Average Ratio

Test Overview

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

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.3.4

Test Settings

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

Test Setup

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

Figure 7-5. Test Instrument & Measurement Setup

Test Notes

None.

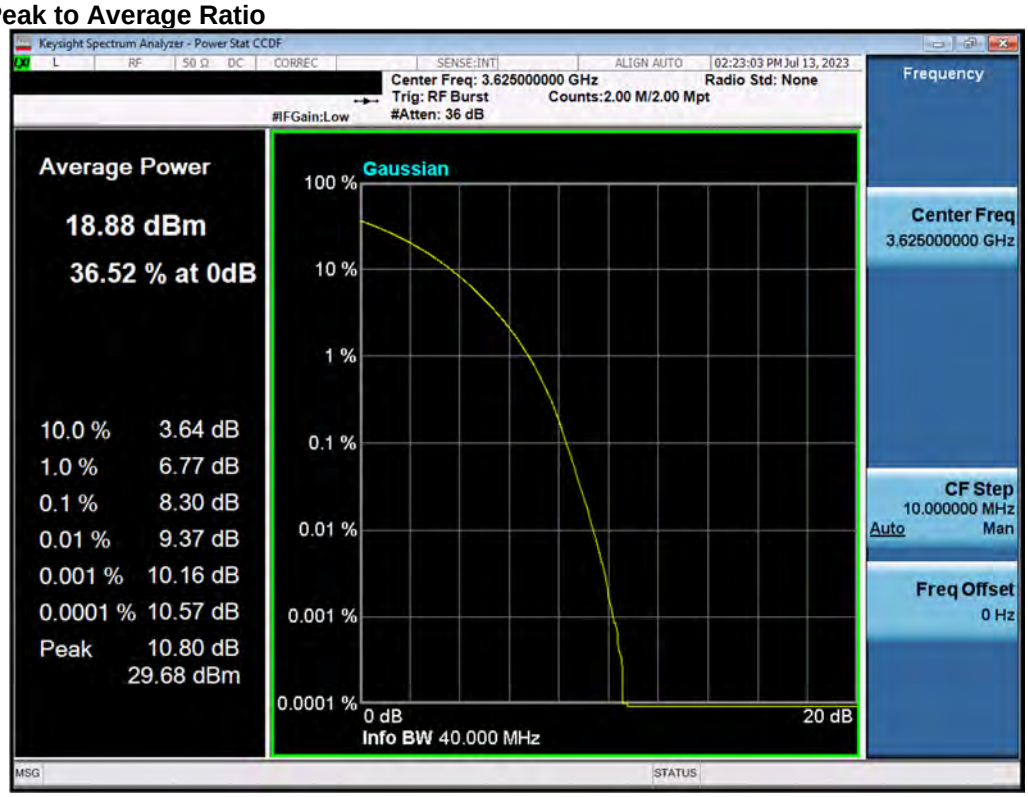
Bandwidth	Modulation	PAR at 0.1% [dB]	PAR Limit [dB]	Margin [dB]
40 MHz	QPSK	8.3	13.0	-4.7
	16QAM	8.26	13.0	-4.74
	64QAM	8.09	13.0	-4.91
	256QAM	8.13	13.0	-4.87
30 MHz	QPSK	8.08	13.0	-4.92
	16QAM	7.99	13.0	-5.01
	64QAM	8.17	13.0	-4.83
	256QAM	7.97	13.0	-5.03
20 MHz	QPSK	8.21	13.0	-4.79
	16QAM	8.24	13.0	-4.76
	64QAM	8.08	13.0	-4.92
	256QAM	8.04	13.0	-4.96
10 MHz	QPSK	8.16	13.0	-4.84
	16QAM	8.12	13.0	-4.88
	64QAM	8.3	13.0	-4.7
	256QAM	8.06	13.0	-4.94

Table 7-7 Peak to Average Power Ratio Measurements – Ch.A

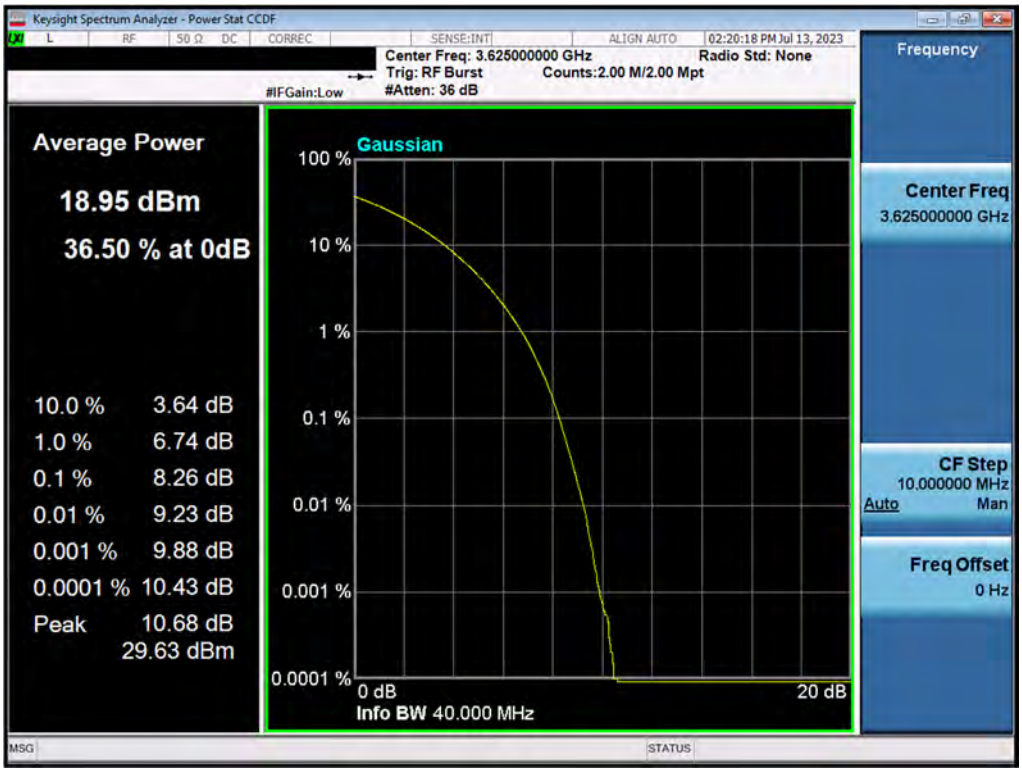
Bandwidth	Modulation	PAR at 0.1% [dB]	PAR Limit [dB]	Margin [dB]
40 MHz	QPSK	8.16	13.0	-4.84
	16QAM	8.14	13.0	-4.86
	64QAM	8.14	13.0	-4.86
	256QAM	8.09	13.0	-4.91
30 MHz	QPSK	8.1	13.0	-4.9
	16QAM	8.12	13.0	-4.88
	64QAM	8.09	13.0	-4.91
	256QAM	8.16	13.0	-4.84
20 MHz	QPSK	8.11	13.0	-4.89
	16QAM	8.13	13.0	-4.87
	64QAM	8.14	13.0	-4.86
	256QAM	8.14	13.0	-4.86
10 MHz	QPSK	8.13	13.0	-4.87
	16QAM	8.09	13.0	-4.91
	64QAM	8.09	13.0	-4.91
	256QAM	8.09	13.0	-4.91

Table 7-8 Peak to Average Power Ratio Measurements – Ch.B

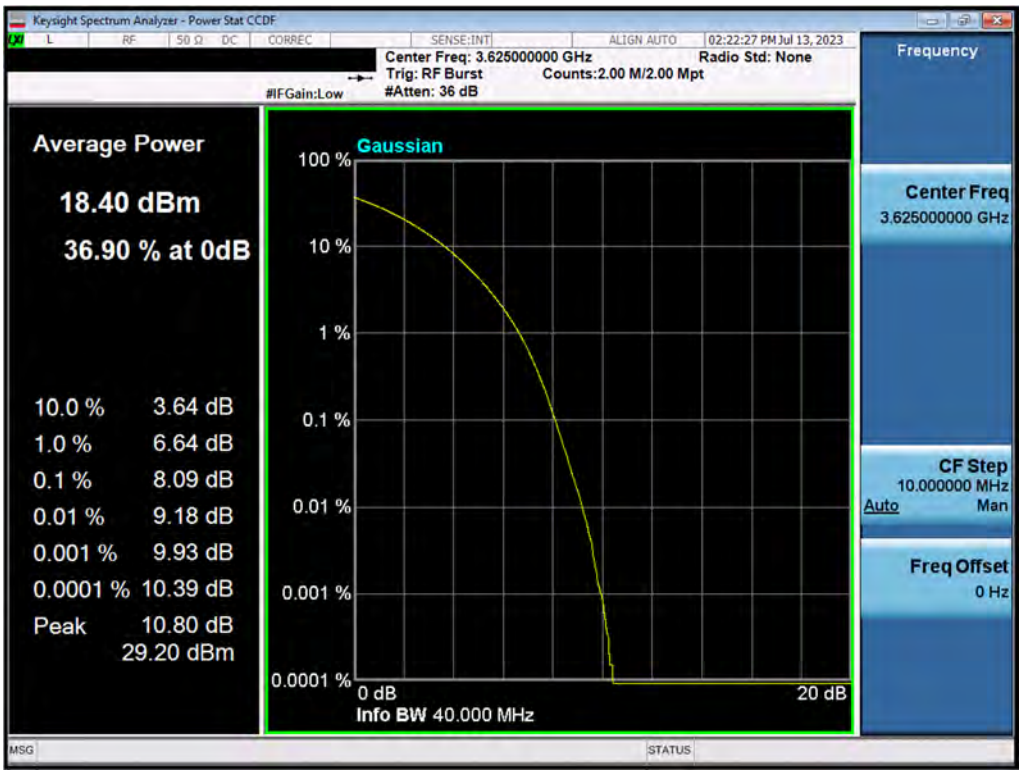
Channel A Peak to Average Ratio



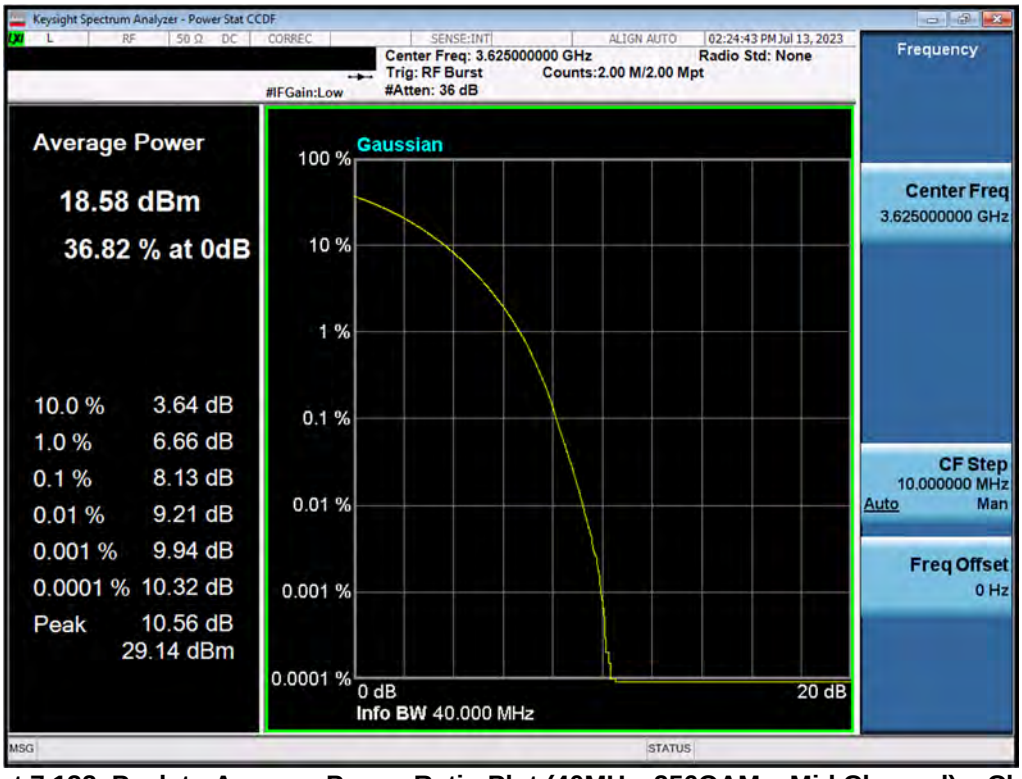
Plot 7.129. Peak to Average Power Ratio Plot (40MHz, QPSK – Mid Channel) – Ch.A



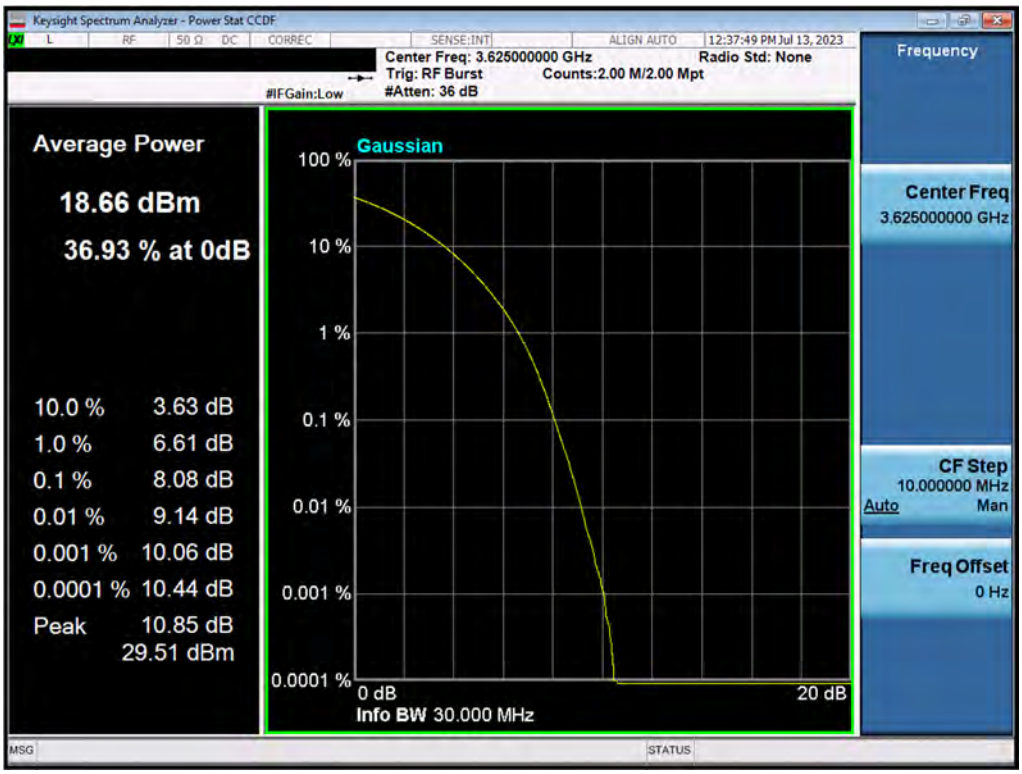
Plot 7.130. Peak to Average Power Ratio Plot (40MHz, 16QAM – Mid Channel) – Ch.A



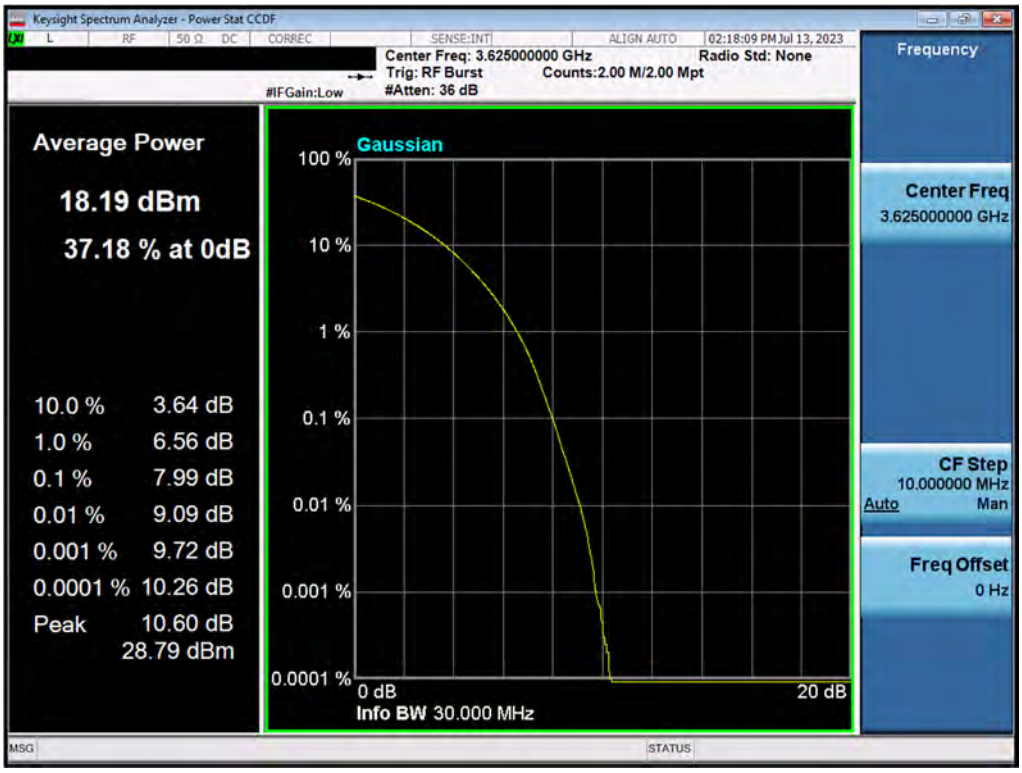
Plot 7.131. Peak to Average Power Ratio Plot (40MHz, 64QAM – Mid Channel) – Ch.A



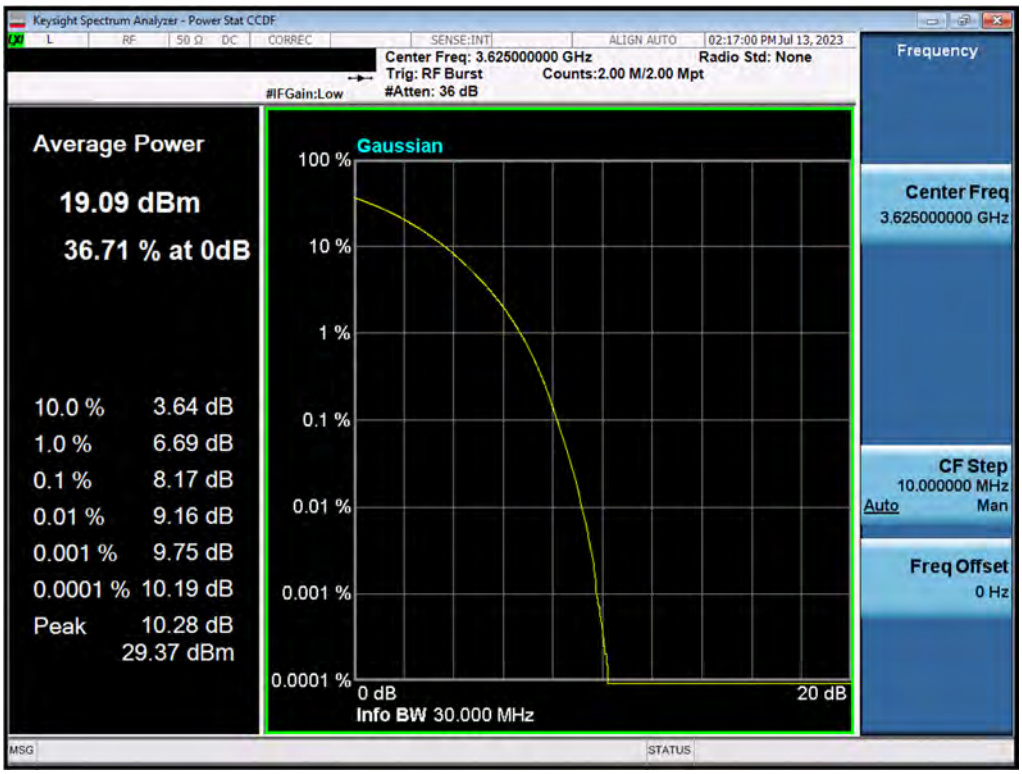
Plot 7.132. Peak to Average Power Ratio Plot (40MHz, 256QAM – Mid Channel) – Ch.A



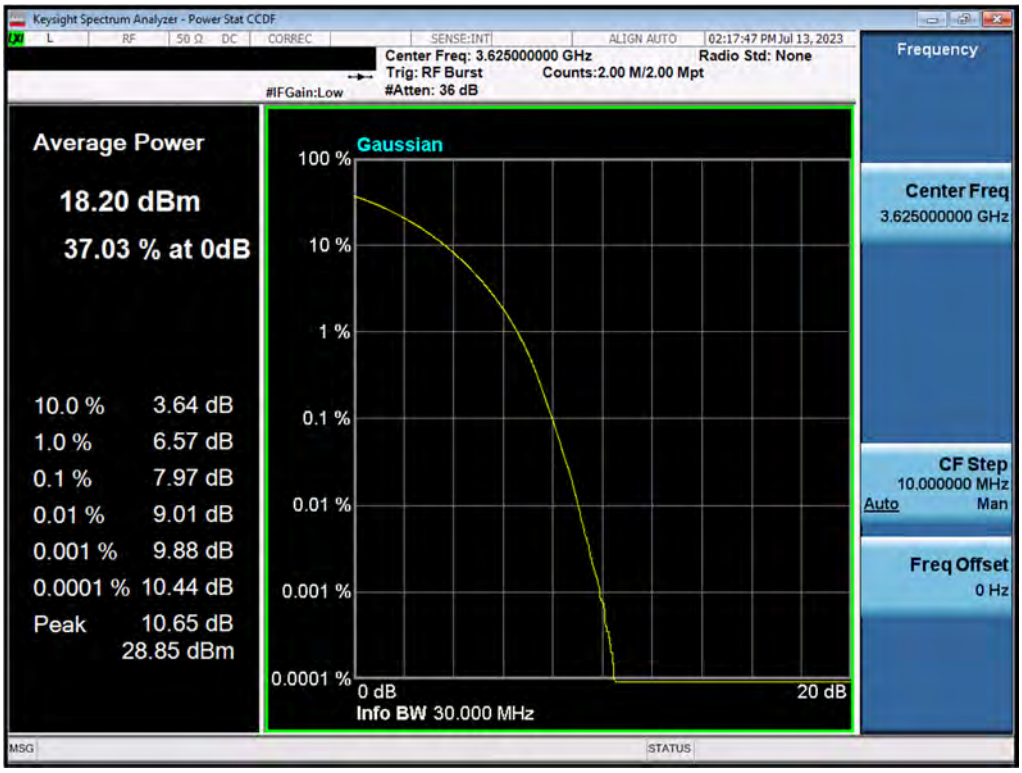
Plot 7.133. Peak to Average Power Ratio Plot (30MHz, QPSK – Mid Channel) – Ch.A



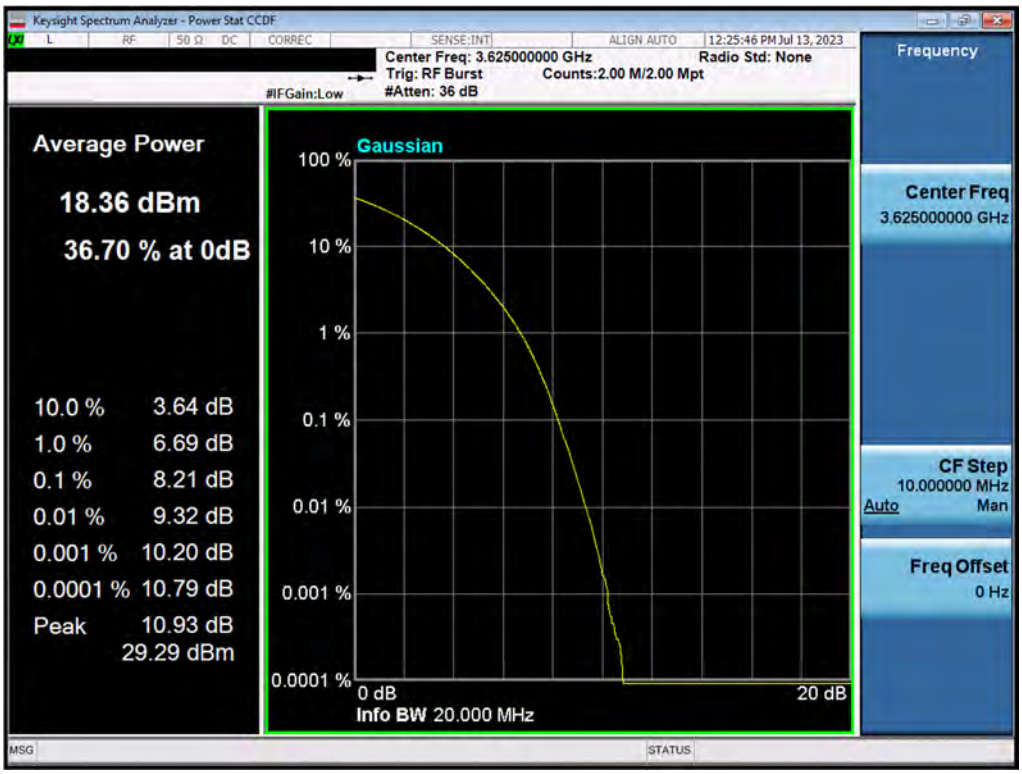
Plot 7.134. Peak to Average Power Ratio Plot (30MHz, 16QAM – Mid Channel) – Ch.A



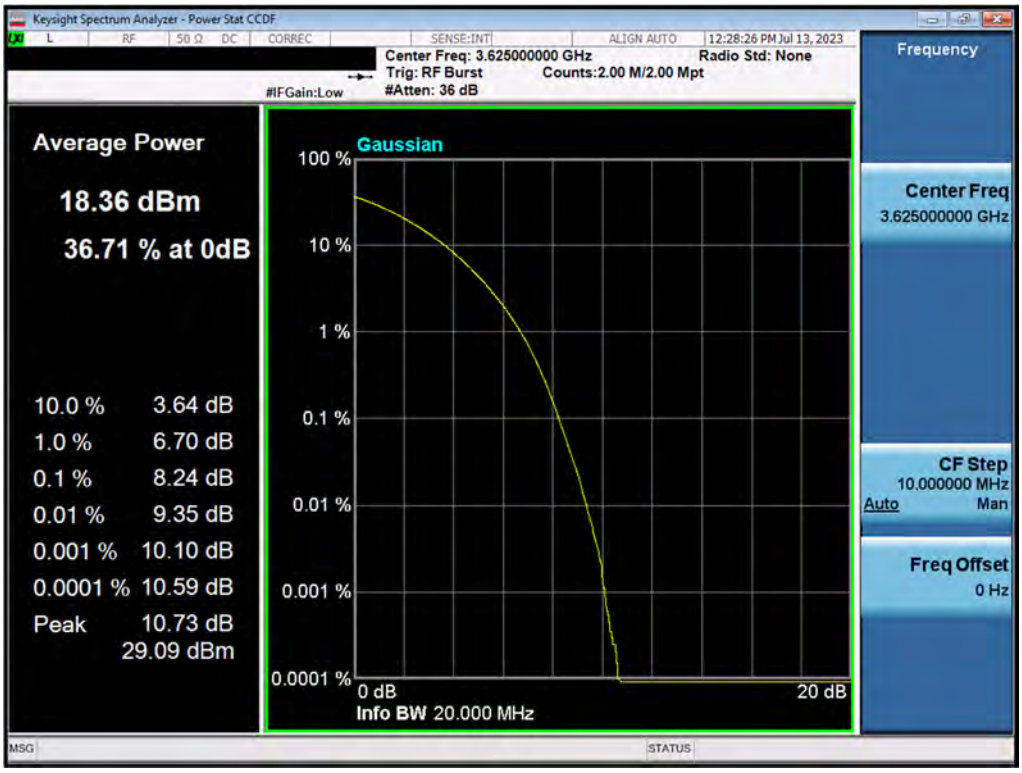
Plot 7.135. Peak to Average Power Ratio Plot (30MHz, 64QAM – Mid Channel) – Ch.A



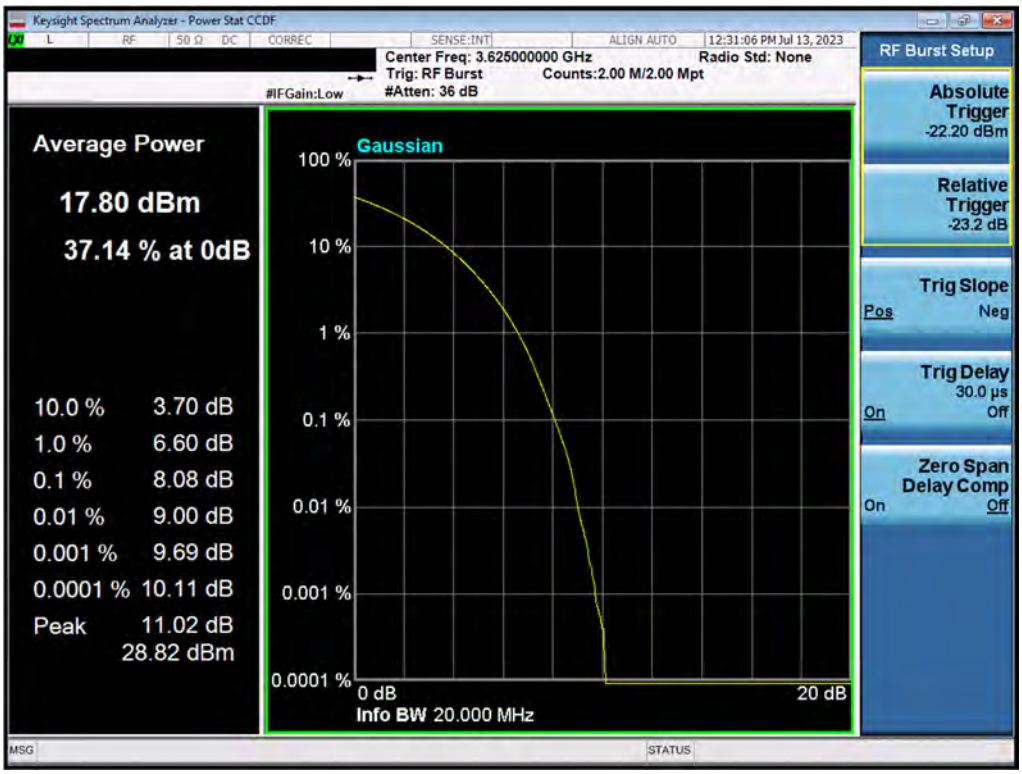
Plot 7.136. Peak to Average Power Ratio Plot (30MHz, 256QAM – Mid Channel) – Ch.A



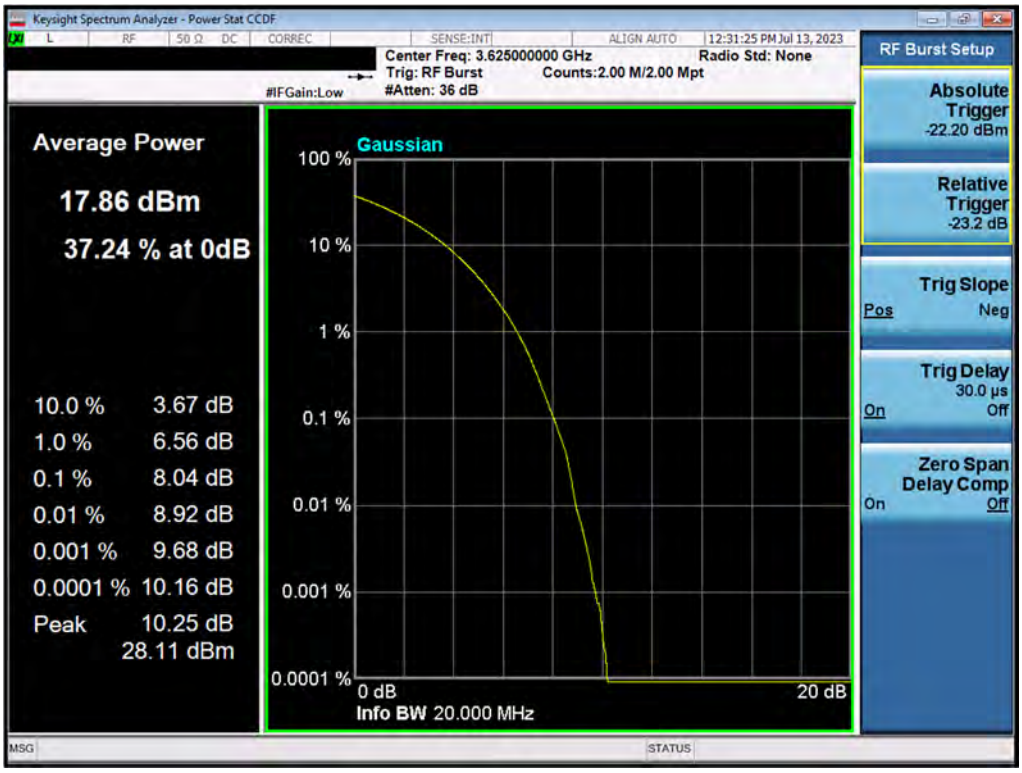
Plot 7.137. Peak to Average Power Ratio Plot (20MHz, QPSK – Mid Channel) – Ch.A



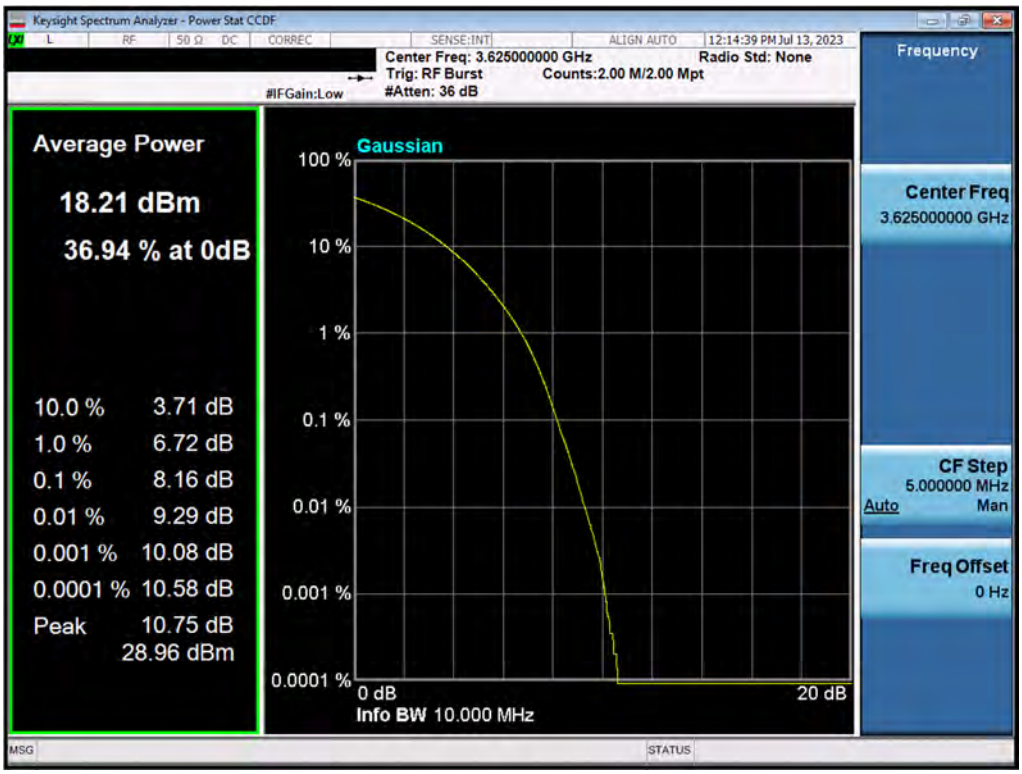
Plot 7.138. Peak to Average Power Ratio Plot (20MHz, 16QAM – Mid Channel) – Ch.A



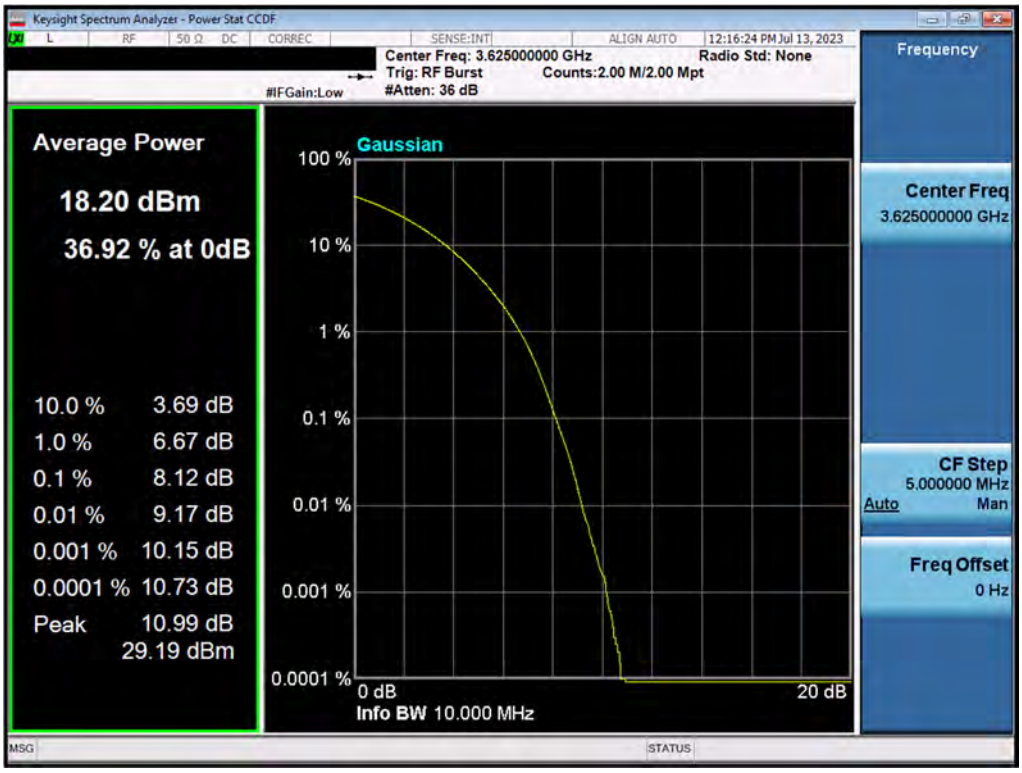
Plot 7.139. Peak to Average Power Ratio Plot (20MHz, 64QAM – Mid Channel) – Ch.A



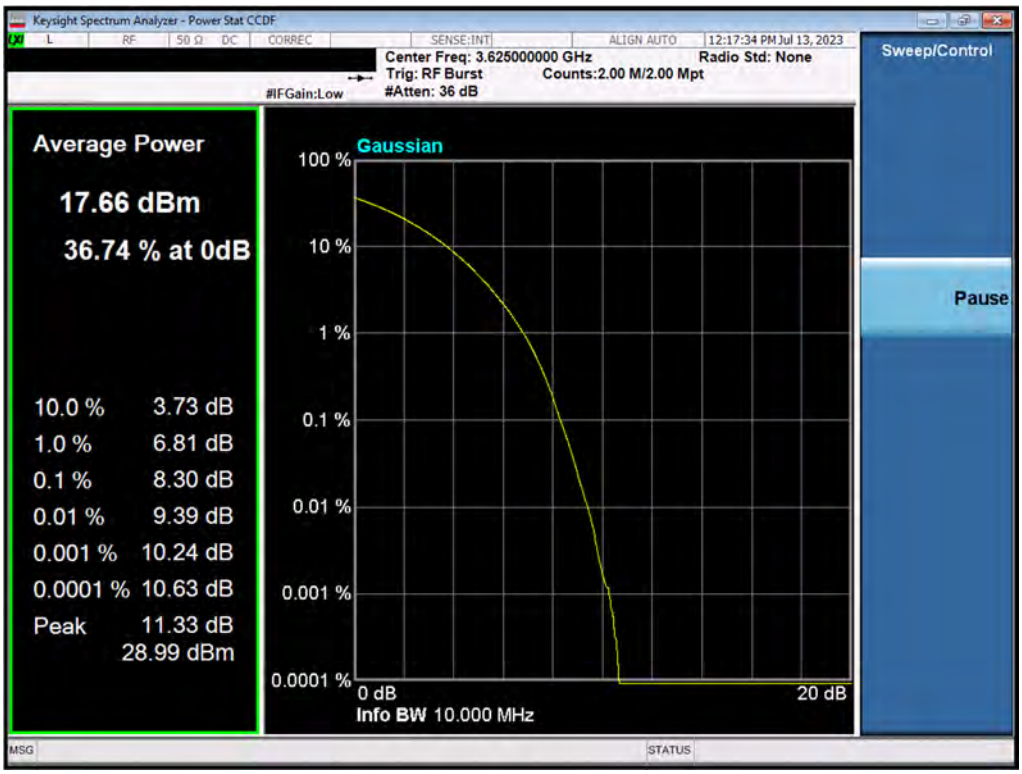
Plot 7.140. Peak to Average Power Ratio Plot (20MHz, 256QAM – Mid Channel) – Ch.A



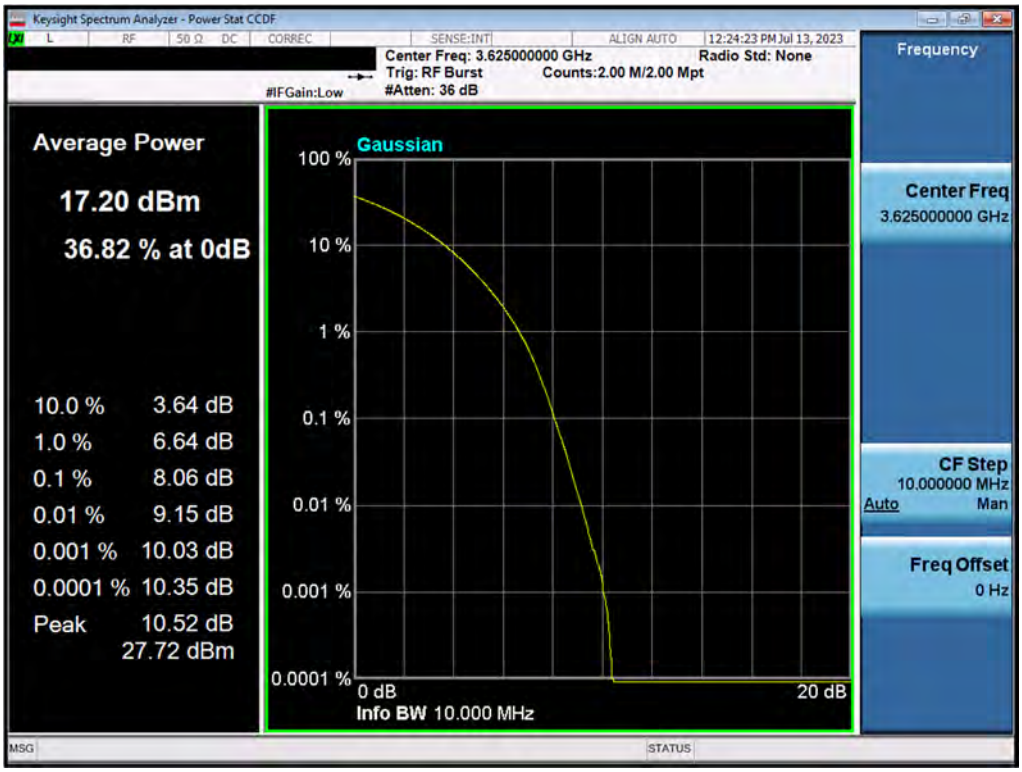
Plot 7.141. Peak to Average Power Ratio Plot (10MHz, QPSK – Mid Channel) – Ch.A



Plot 7.142. Peak to Average Power Ratio Plot (10MHz, 16QAM – Mid Channel) – Ch.A

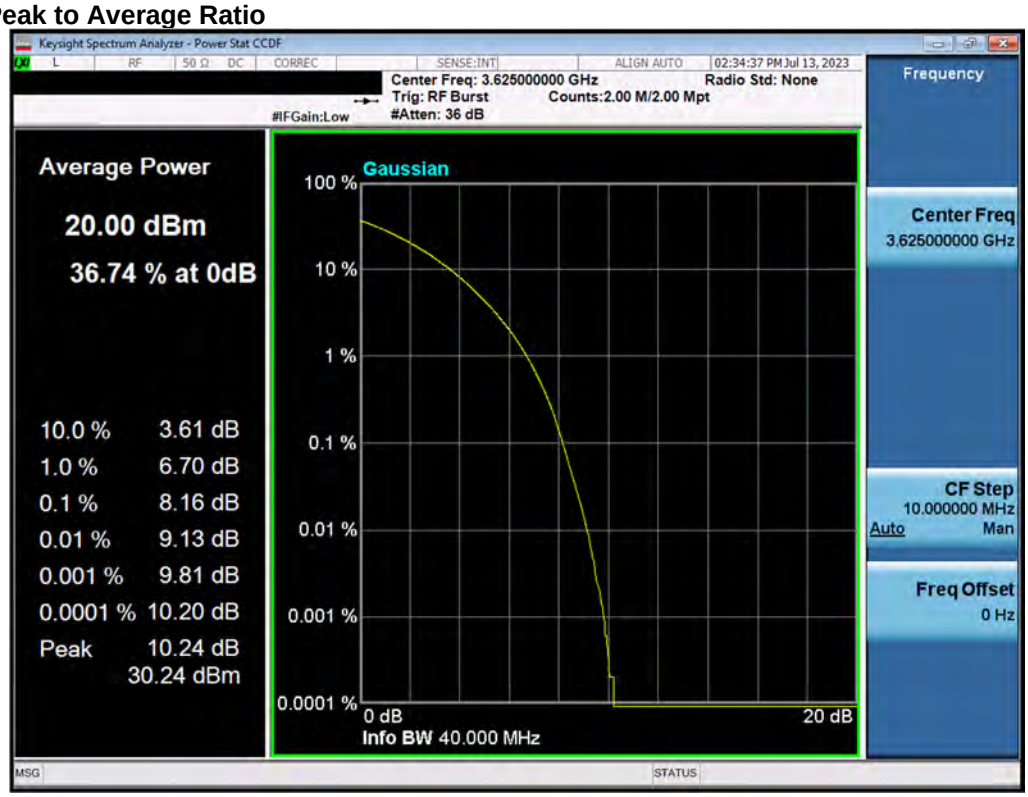


Plot 7.143. Peak to Average Power Ratio Plot (10MHz, 64QAM – Mid Channel) – Ch.A

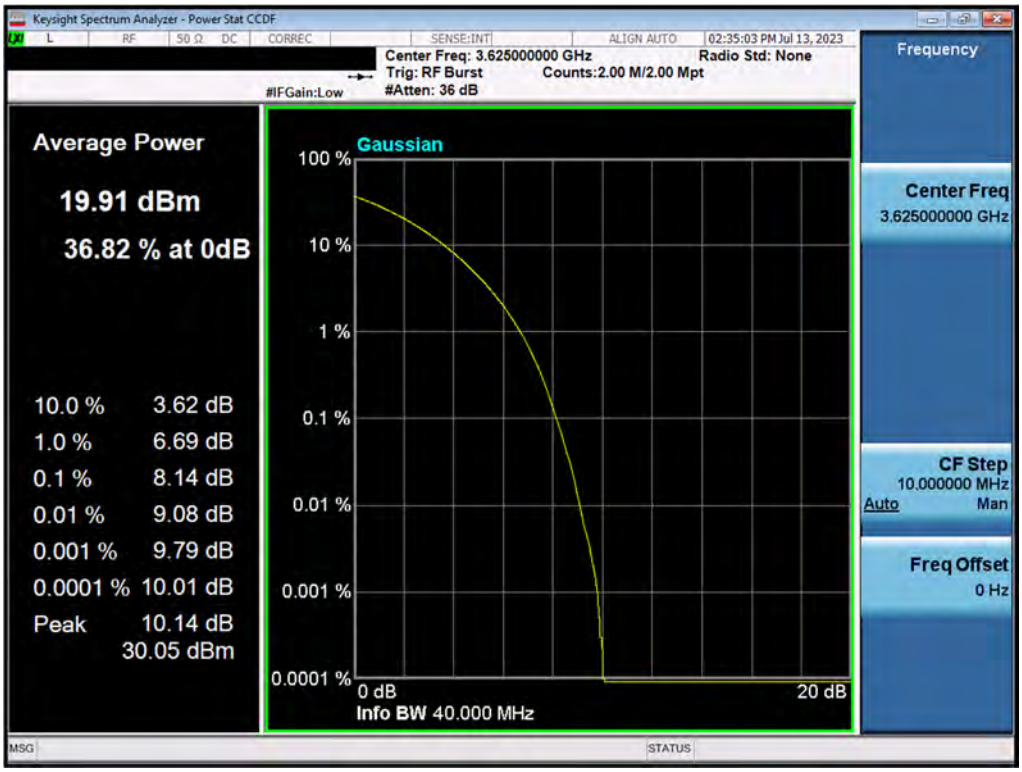


Plot 7.144. Peak to Average Power Ratio Plot (10MHz, 256QAM – Mid Channel) – Ch.A

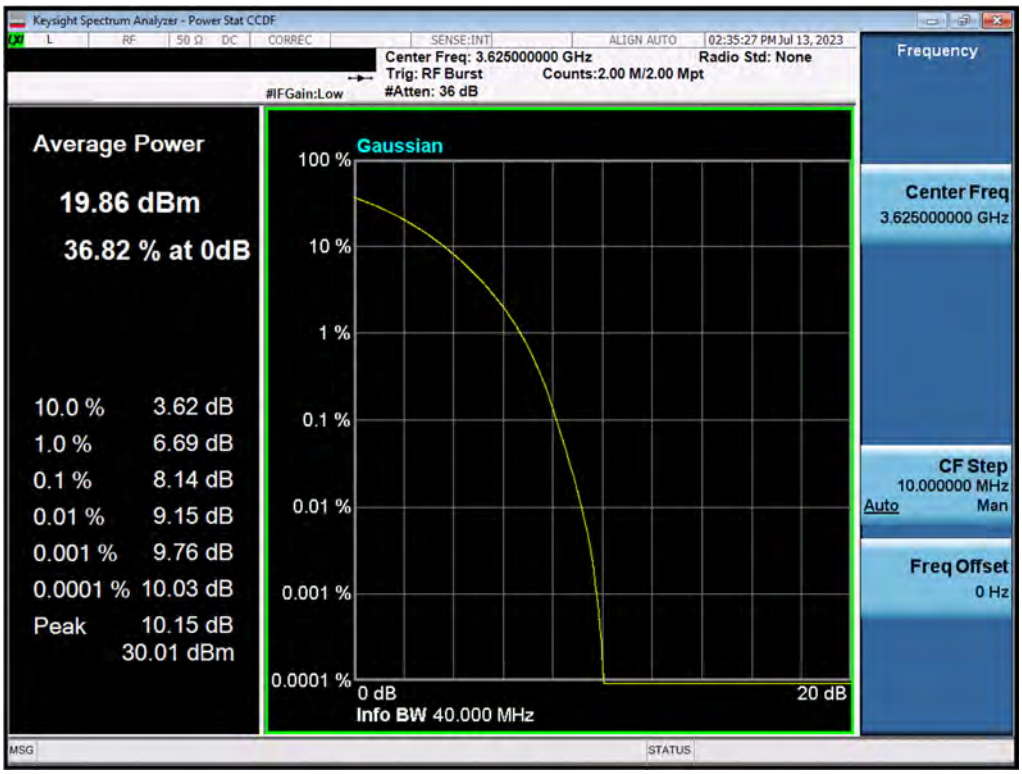
Channel B Peak to Average Ratio



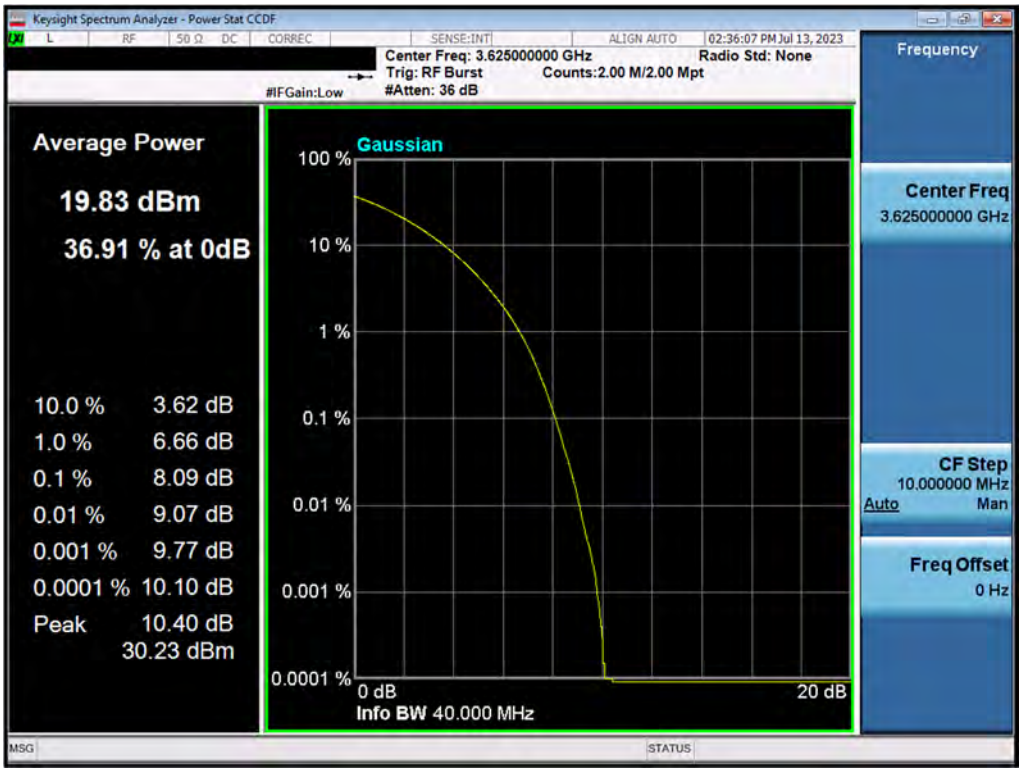
Plot 7.145. Peak to Average Power Ratio Plot (40MHz, QPSK – Mid Channel) – Ch.B



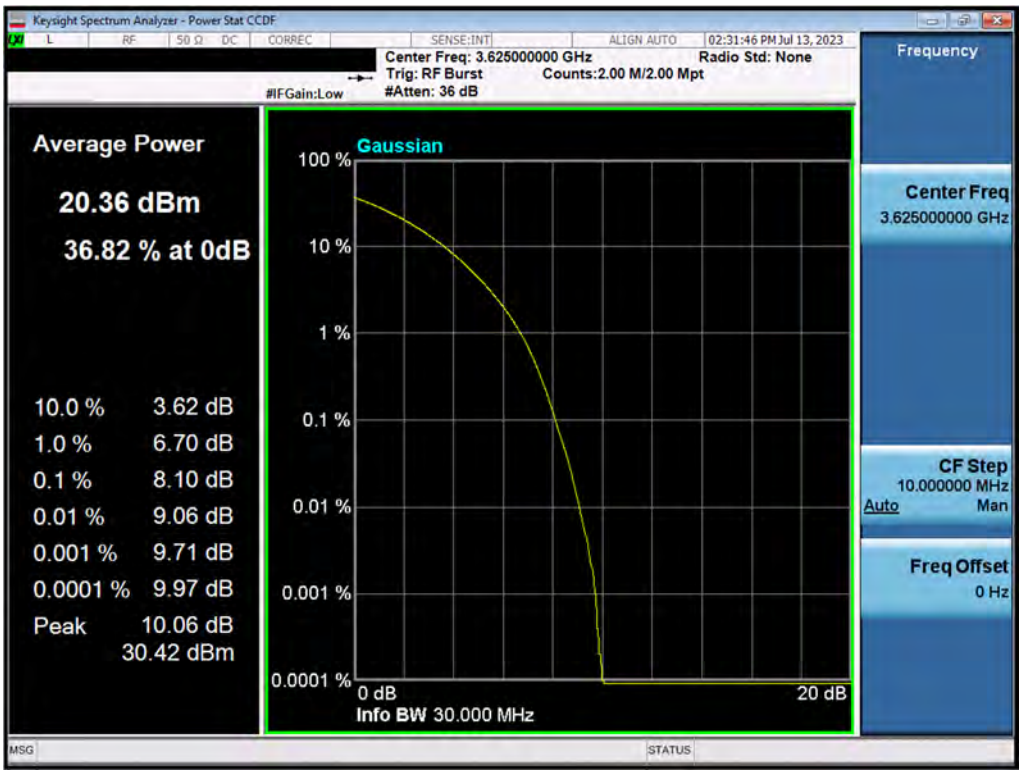
Plot 7.146. Peak to Average Power Ratio Plot (40MHz, 16QAM – Mid Channel) – Ch.B



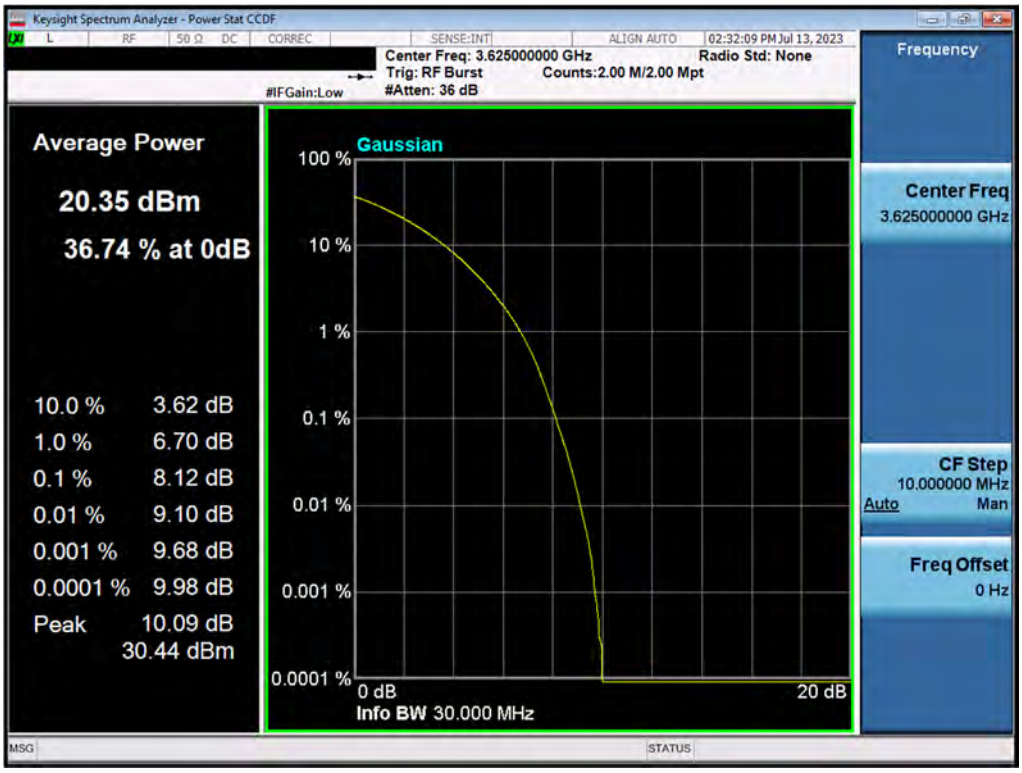
Plot 7.147. Peak to Average Power Ratio Plot (40MHz, 64QAM – Mid Channel) – Ch.B



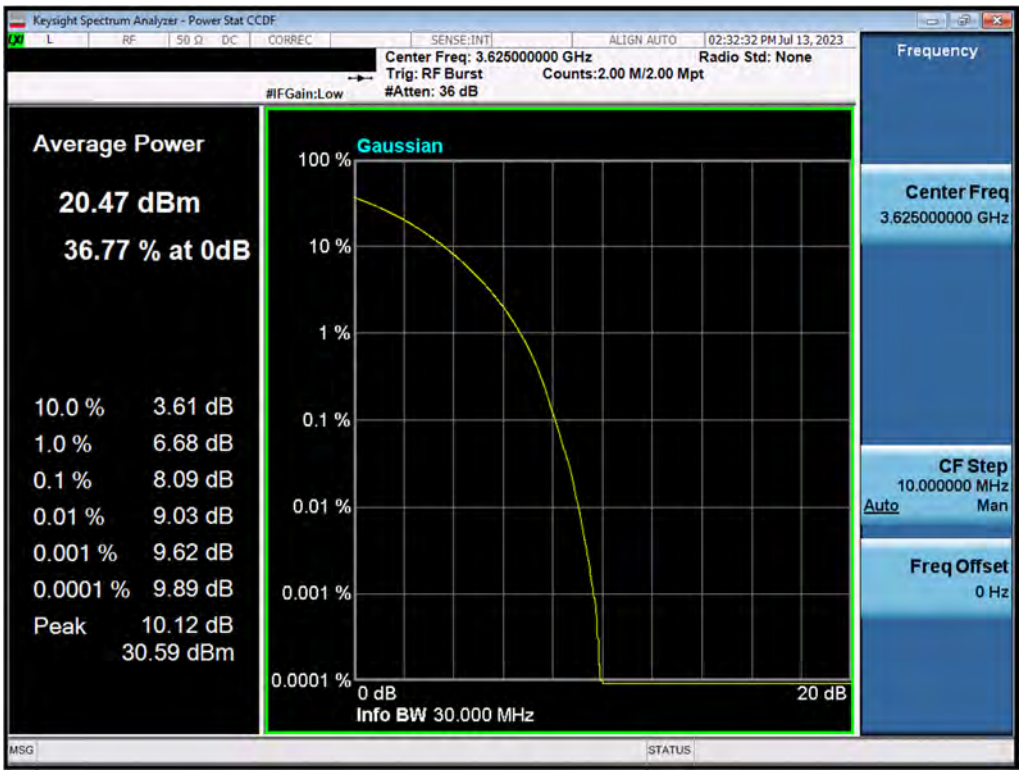
Plot 7.148. Peak to Average Power Ratio Plot (40MHz, 256QAM – Mid Channel) – Ch.B



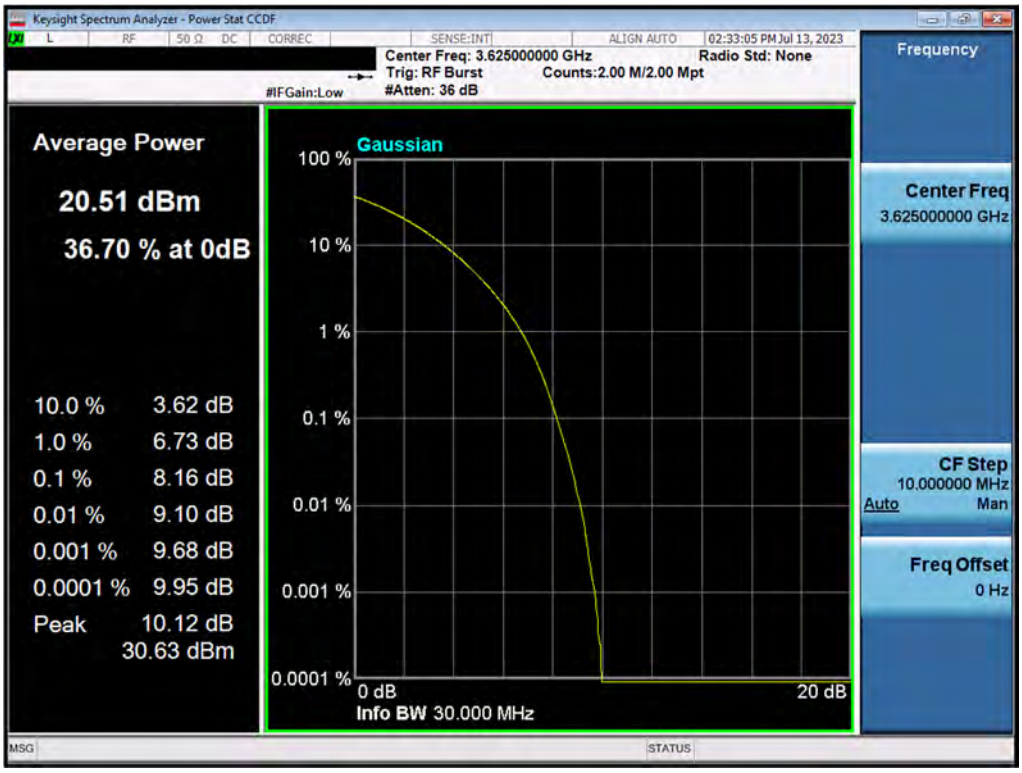
Plot 7.149. Peak to Average Power Ratio Plot (30MHz, QPSK – Mid Channel) – Ch.B



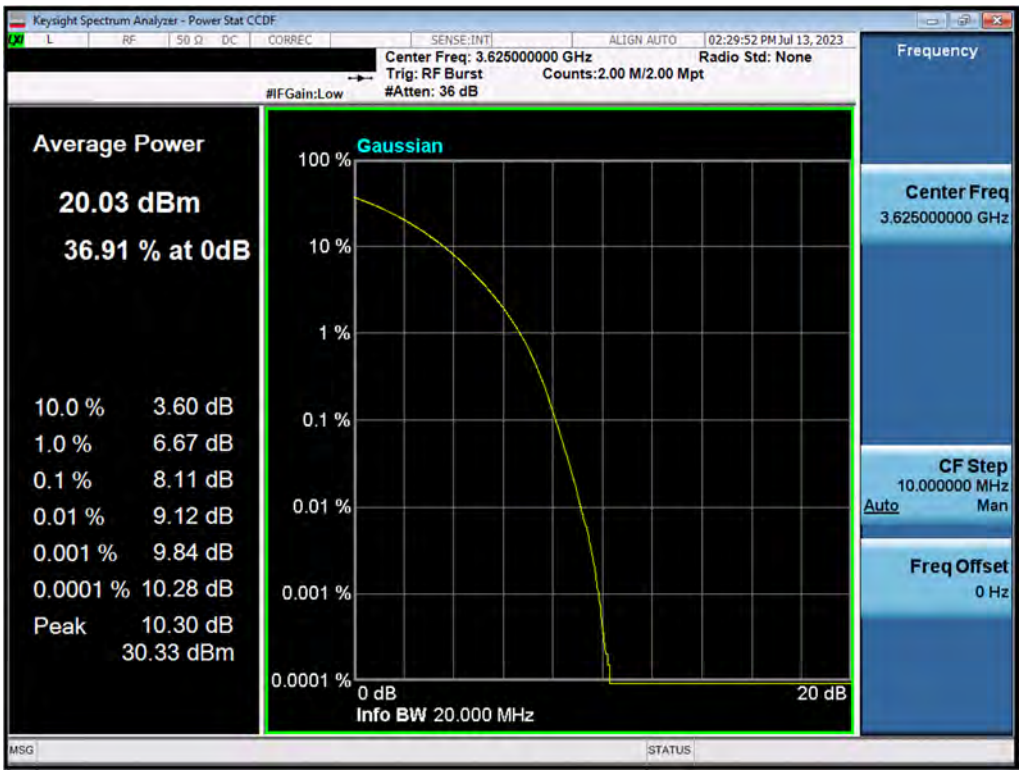
Plot 7.150. Peak to Average Power Ratio Plot (30MHz, 16QAM – Mid Channel) – Ch.B



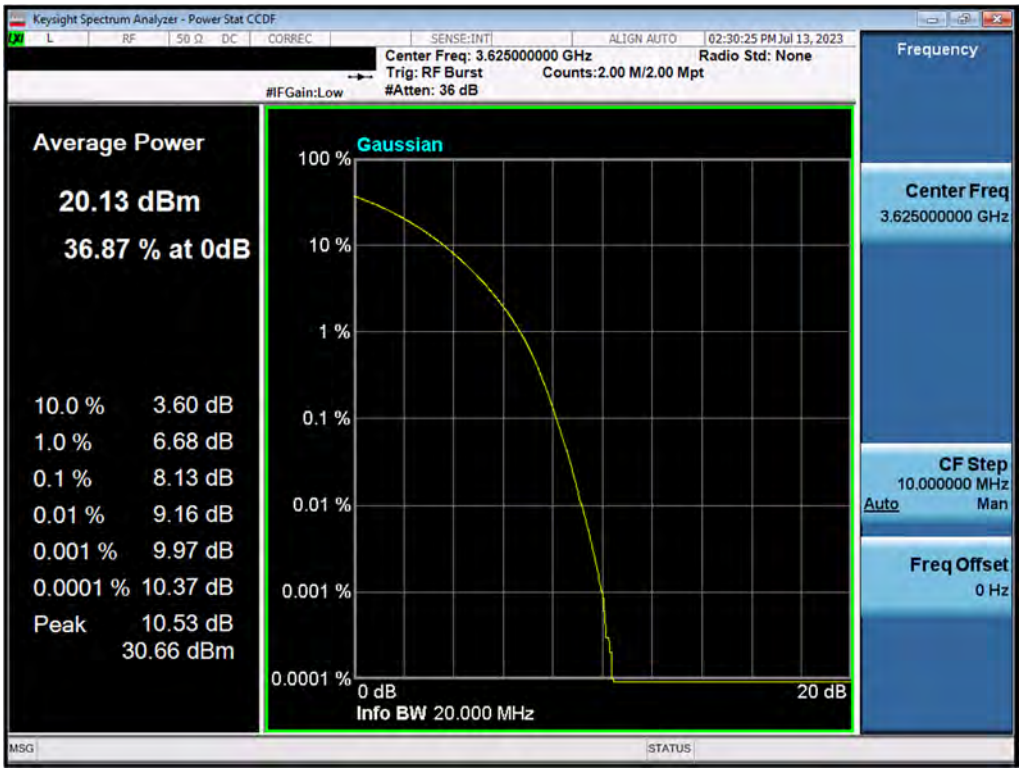
Plot 7.151. Peak to Average Power Ratio Plot (30MHz, 64QAM – Mid Channel) – Ch.B



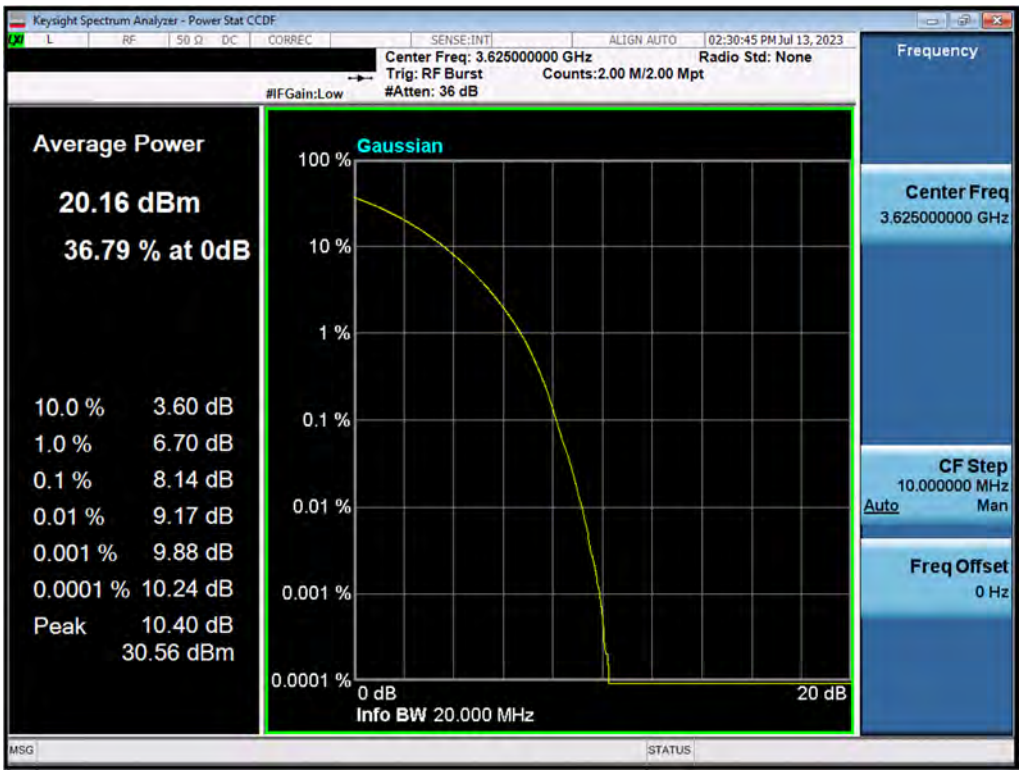
Plot 7.152. Peak to Average Power Ratio Plot (30MHz, 256QAM – Mid Channel) – Ch.B



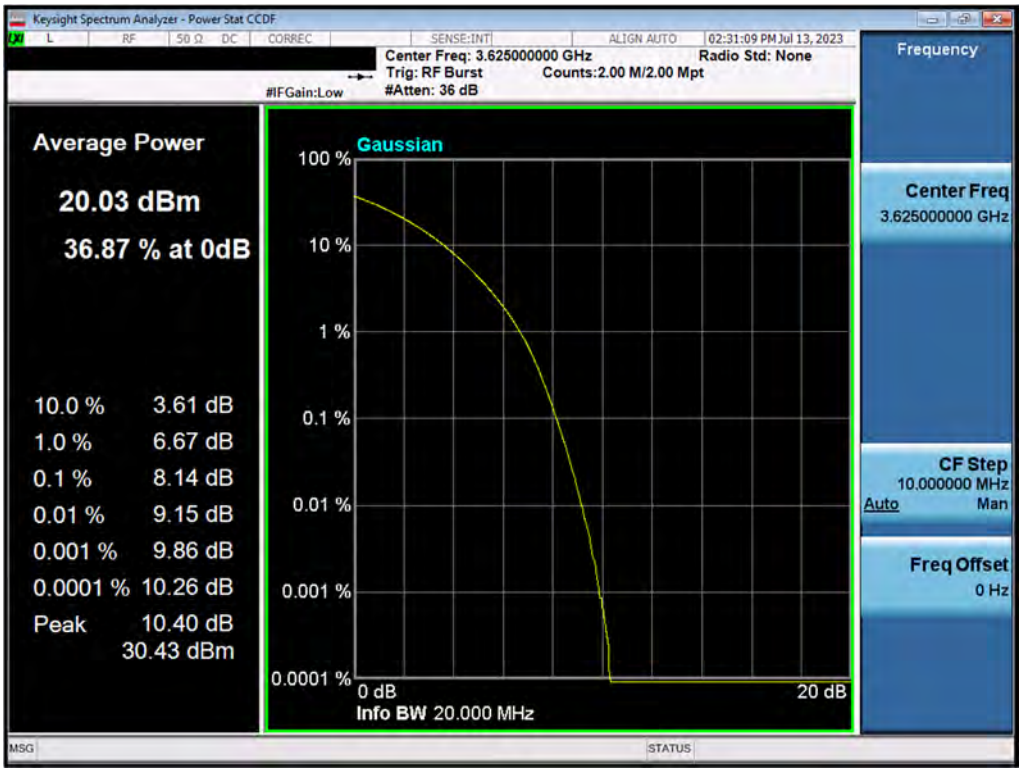
Plot 7.153. Peak to Average Power Ratio Plot (20MHz, QPSK – Mid Channel) – Ch.B



Plot 7.154. Peak to Average Power Ratio Plot (20MHz, 16QAM – Mid Channel) – Ch.B



Plot 7.155. Peak to Average Power Ratio Plot (20MHz, 64QAM – Mid Channel) – Ch.B



Plot 7.156. Peak to Average Power Ratio Plot (20MHz, 256QAM – Mid Channel) – Ch.B