ELEMENT WASHINGTON DC LLC
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.element.com

Part 96 MEASUREMENT REPORT
Class II Permissive Change

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

Date of Testing:
05/08/2023 – 08/24/2023
Test Report Issue Date:
10/16/2023
Test Site/Location:
Element Lab., Columbia, MD, USA
Test Report Serial No.:
1M2308230095-01.2AS22

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
Class II Permissive Change:	Please see change document

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 Antenna Gain 5
2.6 EMI Suppression Device(s)/Modifications 5
3.0 DESCRIPTION OF TESTS 6
3.1 Measurement 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 CALCULATIONS 9
7.0 TEST RESULTS 10
7.1 Summary 10
7.2 Conducted Output Power / EIRP Data 12
7.3 Conducted Power / EIRP per 10MHz 30
7.4 Conducted Power Spectral Density 49
7.5 Peak-Average Ratio 68
7.6 Spurious and Harmonic Emissions at Antenna Terminal 86
7.7 Band Edge Emissions at Antenna Terminal 103
7.8 Radiated Spurious Emissions Measurements 117
8.0 CONCLUSION 124

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	1.334	31.25	35M5G7D
	16QAM	3570.0 - 3680.0	1.330	31.24	36M4W7D
	64QAM	3570.0 - 3680.0	1.340	31.27	35M0W7D
	256QAM	3570.0 - 3680.0	1.321	31.21	35M6W7D
30 MHz	QPSK	3565.0 - 3685.0	1.236	30.92	28M0G7D
	16QAM	3565.0 - 3685.0	1.225	30.88	28M1W7D
	64QAM	3565.0 - 3685.0	1.216	30.85	28M1W7D
	256QAM	3565.0 - 3685.0	1.219	30.86	28M3W7D
20 MHz	QPSK	3560.0 - 3690.0	1.242	30.94	18M4G7D
	16QAM	3560.0 - 3690.0	1.225	30.88	18M7W7D
	64QAM	3560.0 - 3690.0	1.227	30.89	18M0W7D
	256QAM	3560.0 - 3690.0	1.236	30.92	18M3W7D
10 MHz	QPSK	3555.0 - 3695.0	0.815	29.11	7M91G7D
	16QAM	3555.0 - 3695.0	0.818	29.13	7M80W7D
	64QAM	3555.0 - 3695.0	0.818	29.13	7M89W7D
	256QAM	3555.0 - 3695.0	0.815	29.11	7M85W7D

EUT Overview

Note: EIRP levels shown in the table above are measured over the full channel bandwidth.

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 bandand covers compliance for the integration of seven modules into a single chassis. Per FCC Part 96, this device is evaluated as a Category B CBSD (CBD).

Test Device Serial No.: RF5B000079, RF5B000050, RF5B000001, RF5B000008, RF5B000011, RF5B000083, RF5B000048

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. Seven identical modules are integrated into a host enclosure.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version 2023.07.01 installed on the EUT.

2.5 Antenna Gain

The 14 output ports across the 7 modules integrated in the host unit transmit into 2 orthogonally polarized antennas. The worst case configuration was determined to be the "16 User" case in which beam forming is employed such that the total directional is:

$$\text{Directional Gain} = 10 * \log(n) - 10 * \log(s) + \text{Antenna Gain}$$

n = number of modules = 7
s = number of spatial streams = 16
Antenna Gain = 13.75dBi

$$\text{Directionl Antenna Gain} = 10 * \log(7) - 10 * \log(16) + 13.75\text{dBi} = 10.16 \text{ dBi}$$

2.6 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	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 Band 48 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)
Band(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	*
	Peak-Average Ratio	96.41(g)	≤ 13dB	PASS	Section 7.5
	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 7.6, 7.7
	Frequency Stability	2.1055	Fundamental emissions stay within authorized frequency block	PASS	*
	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	*
	Equivalent Isotropic Radiated Power (EIRP) (Catogory B CBSD)	96.41(b)	47 dBm/10MHz	PASS	Section 7.3
	Power Spectral Density (PSD) (Category B CBSD)	96.41(b)	37 dBm/10MHz	PASS	Section 7.4
Radiated	Radiated Spurious Emissions	96.41(e)	-40 dBm/MHz	PASS	Section 7.8

Table 7-1 Summary of Test Results

The test results identifies with an "*" in the table above were not included in this report because it was determined that the permissive change did not have an impact on these test items.

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

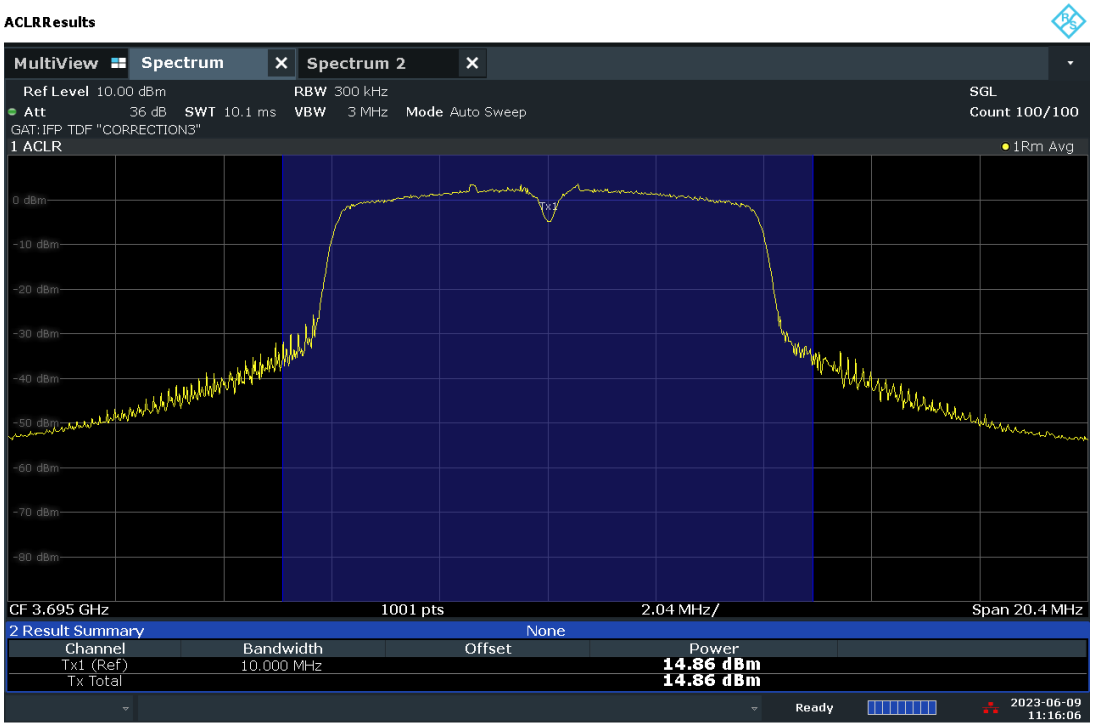
Test Notes

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.
2. A scaling factor of 10log(7) was added to obtain the total output summed across all 7 modules.

Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted Power [dBm]	Ch. B Conducted Power [dBm]	Summed MIMO Conducted Power [dBm]	Summed MIMO Conducted Power [dBm] - All Modules	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]
40 MHz	QPSK	3570.0	11.27	10.56	13.94	22.39	10.16	32.55	1.799
		3625.0	15.28	17.5	19.54	27.99	10.16	38.15	6.534
		3680.0	13.99	13.48	16.75	25.20	10.16	35.36	3.439
	16-QAM	3570.0	11.67	10.52	14.14	22.59	10.16	32.75	1.885
		3625.0	14.99	17.49	19.43	27.88	10.16	38.04	6.366
		3680.0	13.99	13.43	16.73	25.18	10.16	35.34	3.420
	64-QAM	3570.0	11.44	10.53	14.02	22.47	10.16	32.63	1.832
		3625.0	15.37	17.52	19.59	28.04	10.16	38.20	6.604
		3680.0	13.88	13.45	16.68	25.13	10.16	35.29	3.382
	256-QAM	3570.0	11.67	10.49	14.13	22.58	10.16	32.74	1.880
		3625.0	15.36	17.46	19.55	28.00	10.16	38.16	6.542
		3680.0	14.01	13.39	16.72	25.17	10.16	35.33	3.414
30 MHz	QPSK	3565.0	11.20	10.13	13.71	22.16	10.16	32.32	1.706
		3625.0	15.29	17.17	19.34	27.79	10.16	37.95	6.241
		3685.0	14.43	14.66	17.56	26.01	10.16	36.17	4.138
	16-QAM	3565.0	11.20	10.17	13.73	22.18	10.16	32.34	1.713
		3625.0	15.51	17.13	19.41	27.86	10.16	38.02	6.333
		3685.0	14.67	14.64	17.67	26.12	10.16	36.28	4.243
	64-QAM	3565.0	10.85	10.18	13.54	21.99	10.16	32.15	1.640
		3625.0	15.71	17.1	19.47	27.92	10.16	38.08	6.429
		3685.0	14.53	14.68	17.62	26.07	10.16	36.23	4.195
	256-QAM	3565.0	10.68	10.2	13.46	21.91	10.16	32.07	1.610
		3625.0	15.60	17.11	19.43	27.88	10.16	38.04	6.370
		3685.0	14.42	14.67	17.56	26.01	10.16	36.17	4.138
20 MHz	QPSK	3560.0	10.28	9.7	13.01	21.46	10.16	31.62	1.452
		3625.0	16.05	17.19	19.67	28.12	10.16	38.28	6.728
		3690.0	15.30	14.33	17.85	26.30	10.16	36.46	4.429
	16-QAM	3560.0	10.24	9.71	12.99	21.44	10.16	31.60	1.447
		3625.0	15.25	17.13	19.30	27.75	10.16	37.91	6.183
		3690.0	15.04	14.32	17.71	26.16	10.16	36.32	4.282
	64-QAM	3560.0	10.54	9.7	13.15	21.60	10.16	31.76	1.500
		3625.0	15.61	17.14	19.45	27.90	10.16	38.06	6.402
		3690.0	14.95	14.33	17.66	26.11	10.16	36.27	4.239
	256-QAM	3560.0	10.66	9.8	13.26	21.71	10.16	31.87	1.539
		3625.0	15.62	17.17	19.47	27.93	10.16	38.09	6.434
		3690.0	15.07	14.33	17.73	26.18	10.16	36.34	4.302
10 MHz	QPSK	3555.0	10.48	10.16	13.33	21.78	10.16	31.94	1.565
		3625.0	12.22	12.84	15.55	24.00	10.16	34.16	2.608
		3695.0	14.86	15.36	18.13	26.58	10.16	36.74	4.719
	16-QAM	3555.0	10.73	10.2	13.48	21.93	10.16	32.09	1.620
		3625.0	12.14	12.82	15.50	23.95	10.16	34.11	2.579
		3695.0	15.02	15.38	18.21	26.67	10.16	36.83	4.814
	64-QAM	3555.0	11.08	10.19	13.67	22.12	10.16	32.28	1.690
		3625.0	12.26	12.83	15.56	24.02	10.16	34.18	2.616
		3695.0	14.74	15.38	18.08	26.53	10.16	36.69	4.670
	256-QAM	3555.0	11.12	10.20	13.69	22.15	10.16	32.31	1.700
		3625.0	12.42	12.81	15.63	24.08	10.16	34.24	2.655
		3695.0	14.98	15.36	18.18	26.64	10.16	36.80	4.781

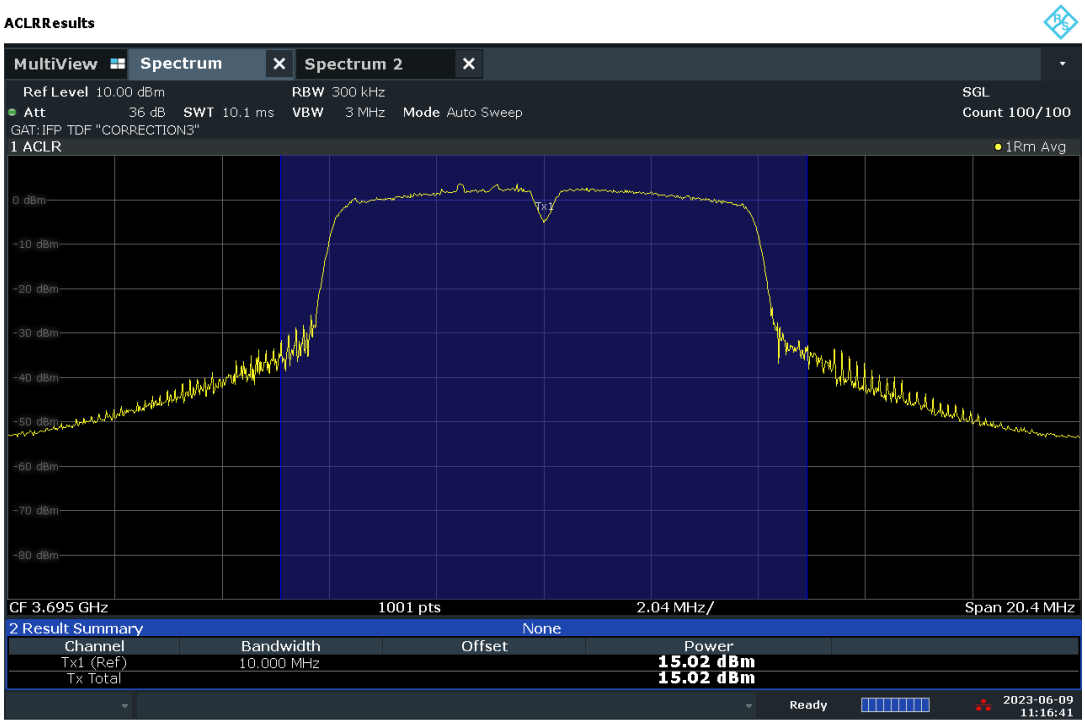
Table 7-2 Conducted Power Measurements

Channel A Conducted Power Measurements



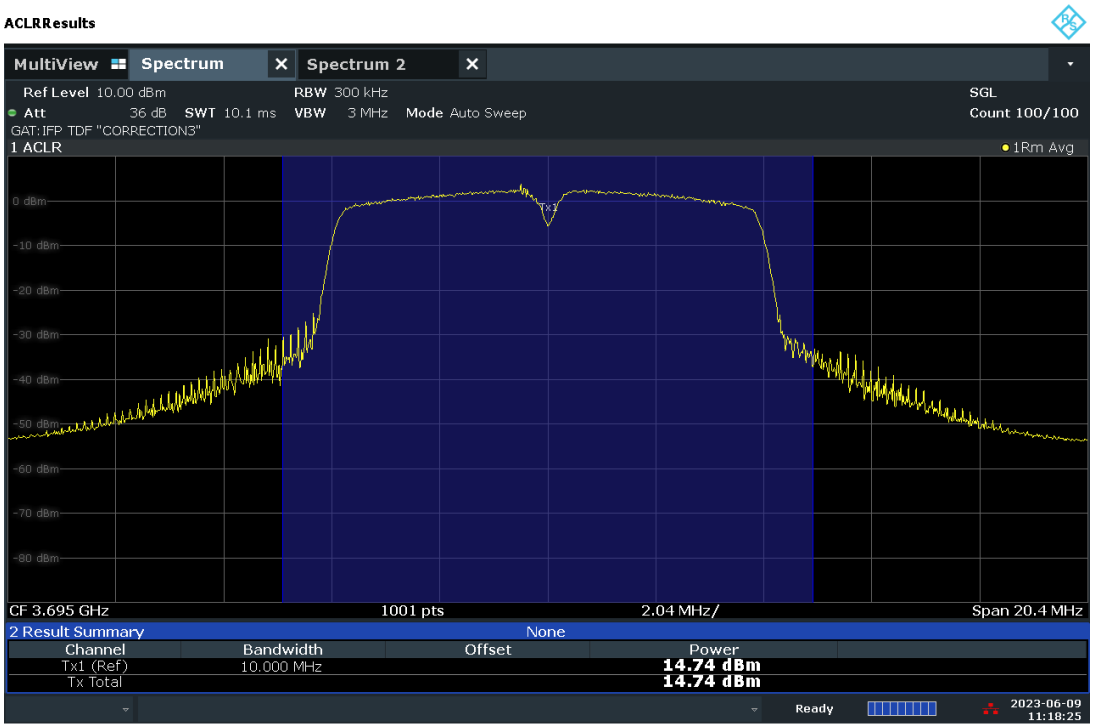
11:16:07 AM 06/09/2023

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



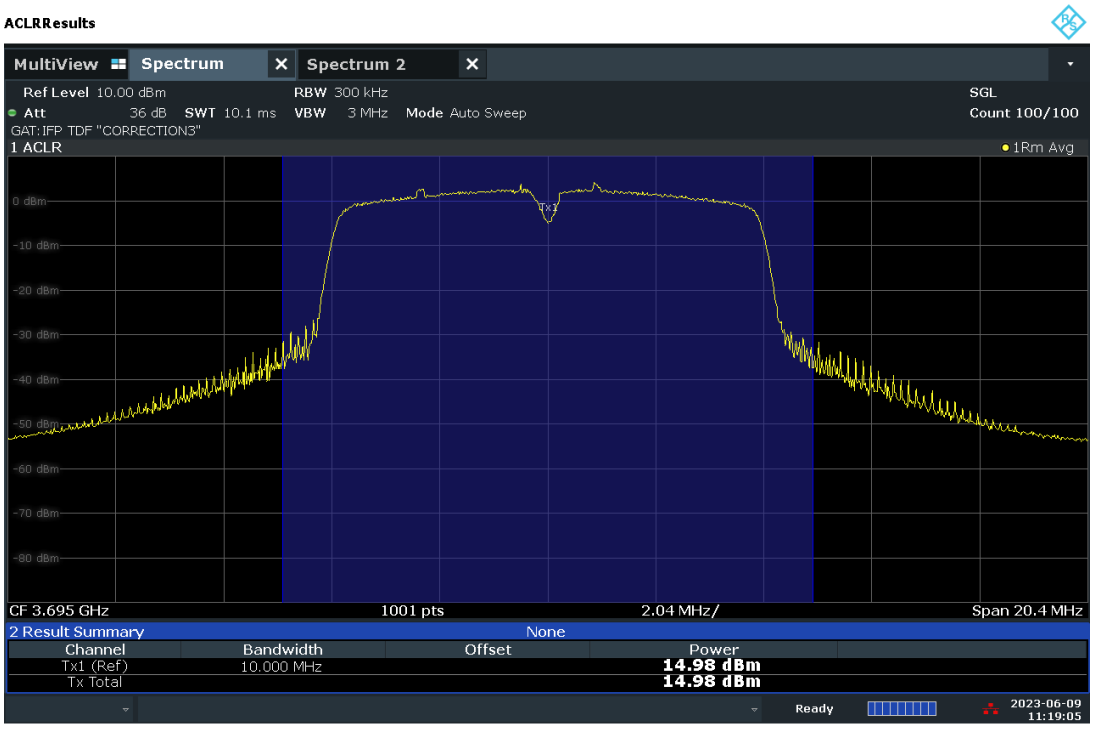
11:16:41 AM 06/09/2023

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



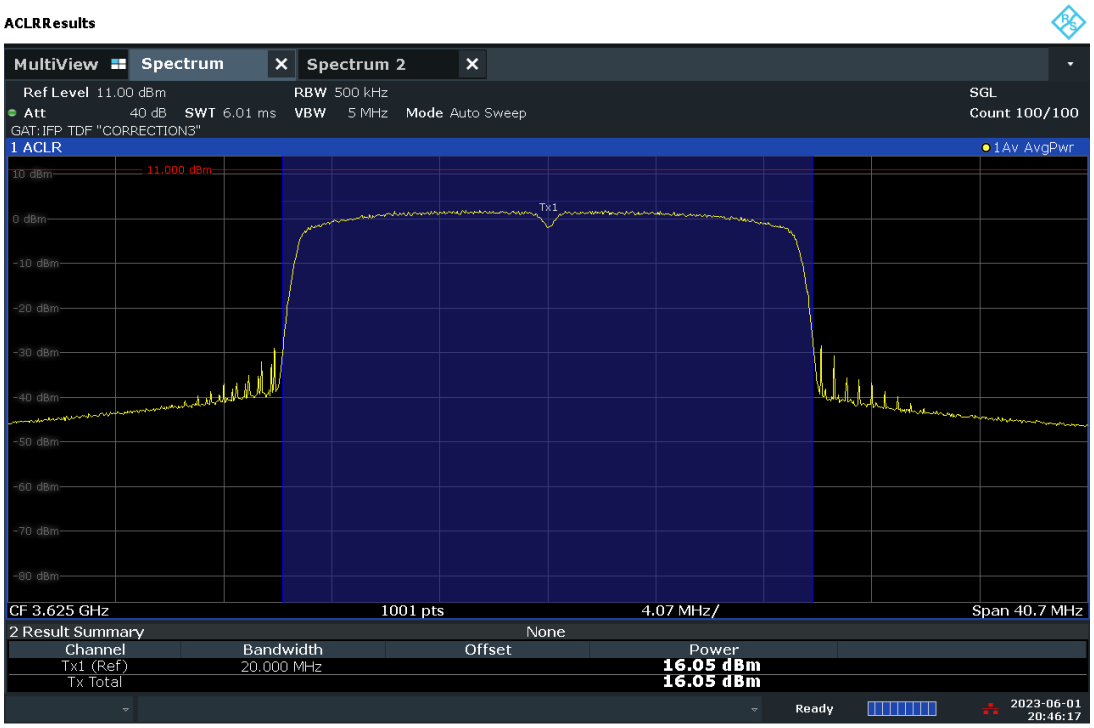
11:18:26 AM 06/09/2023

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



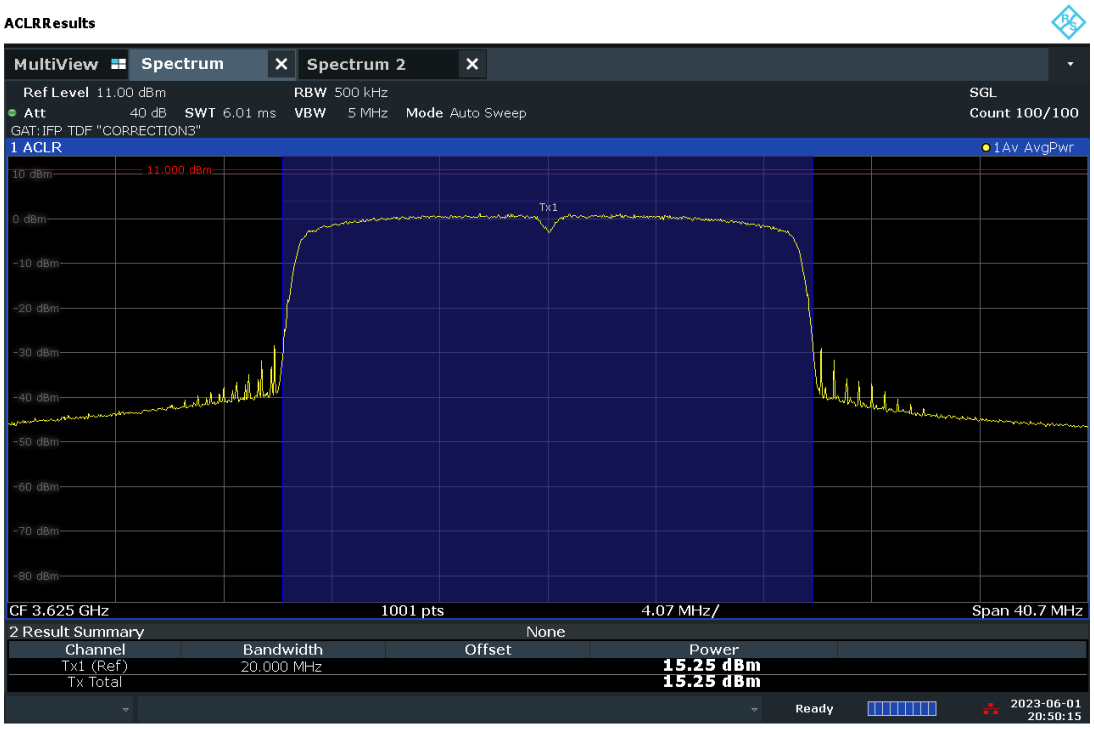
11:19:05 AM 06/09/2023

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



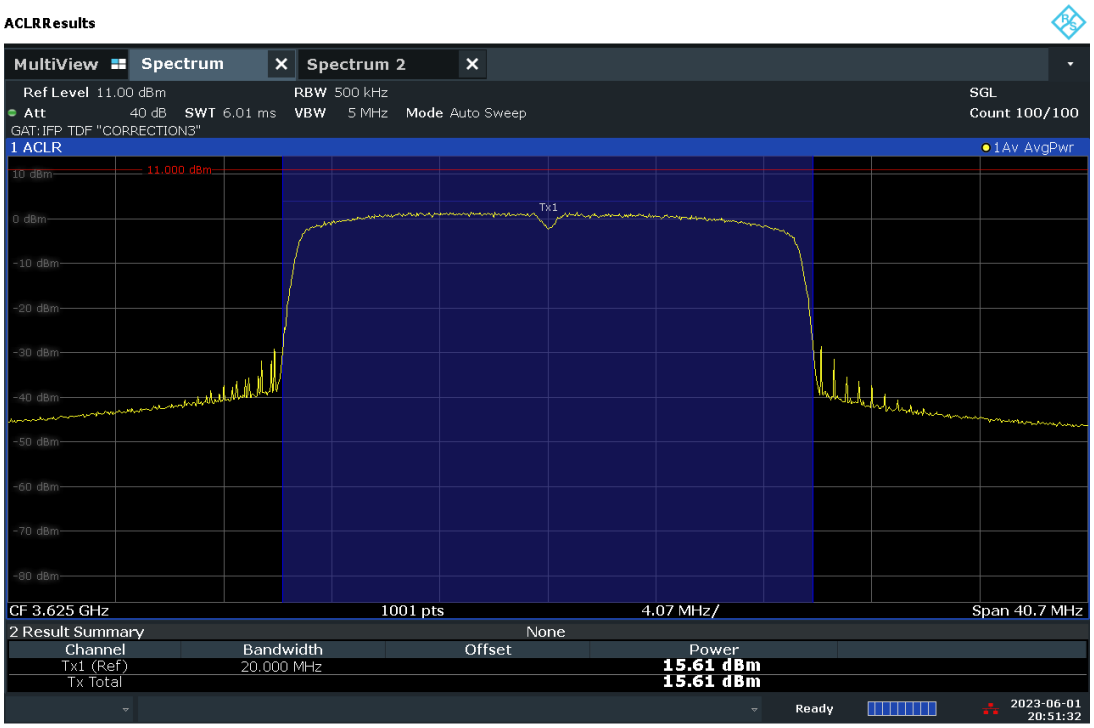
08:46:17 PM 06/01/2023

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



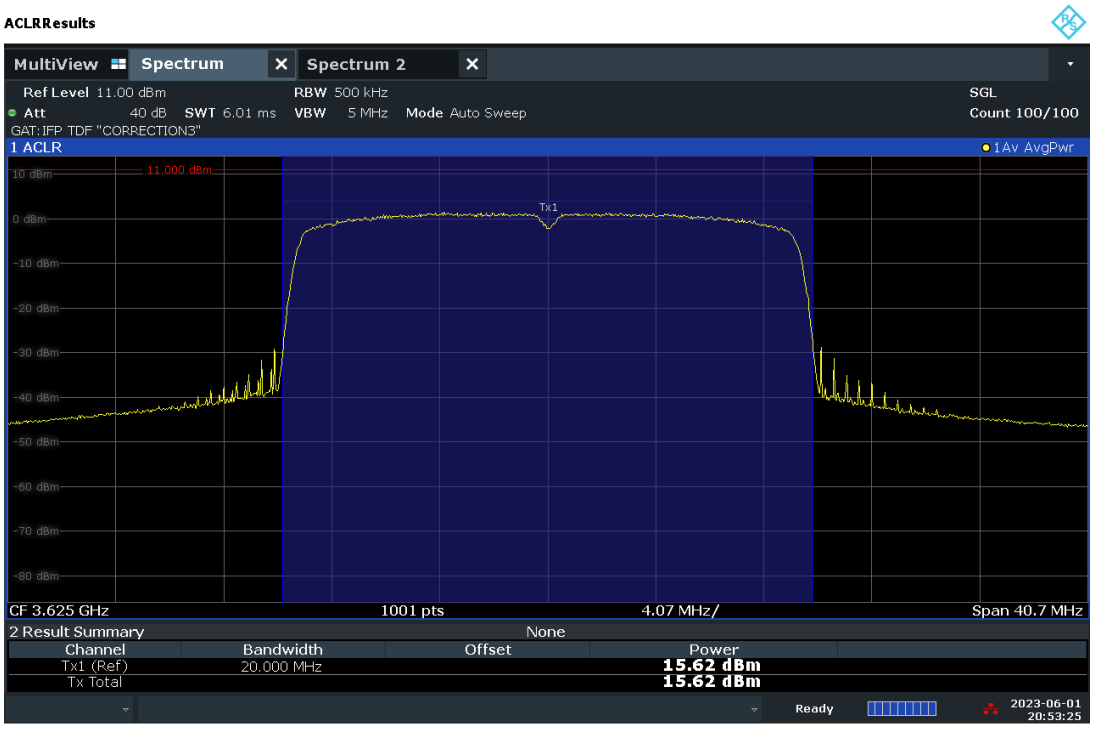
08:50:15 PM 06/01/2023

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



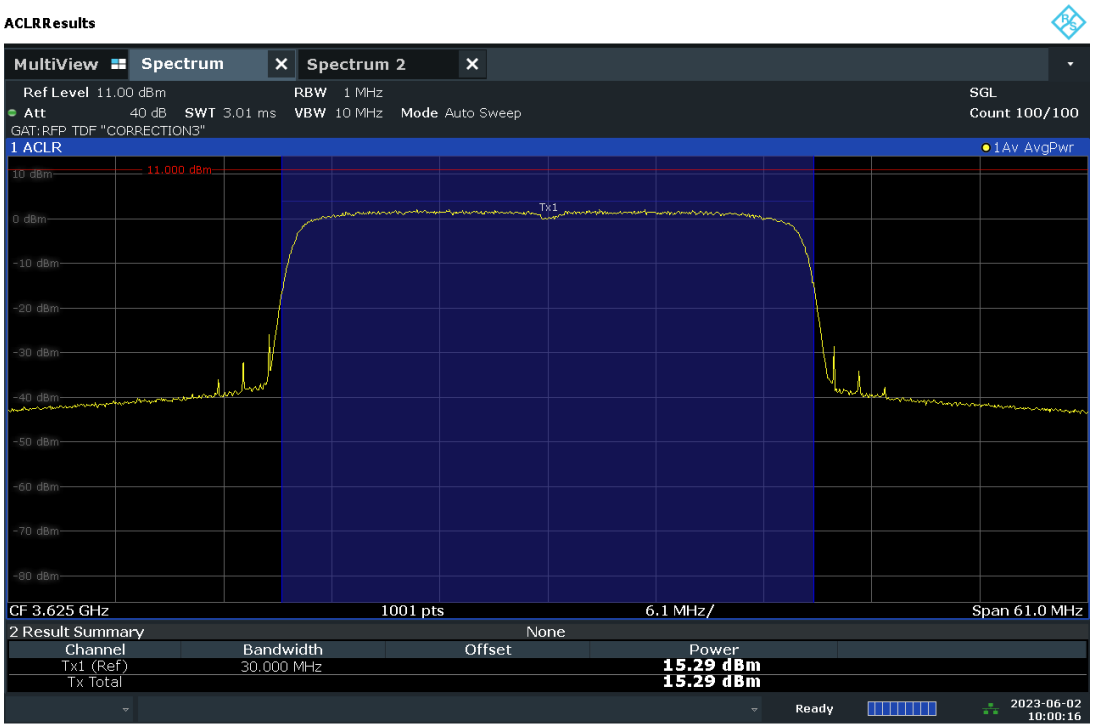
08:51:33 PM 06/01/2023

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



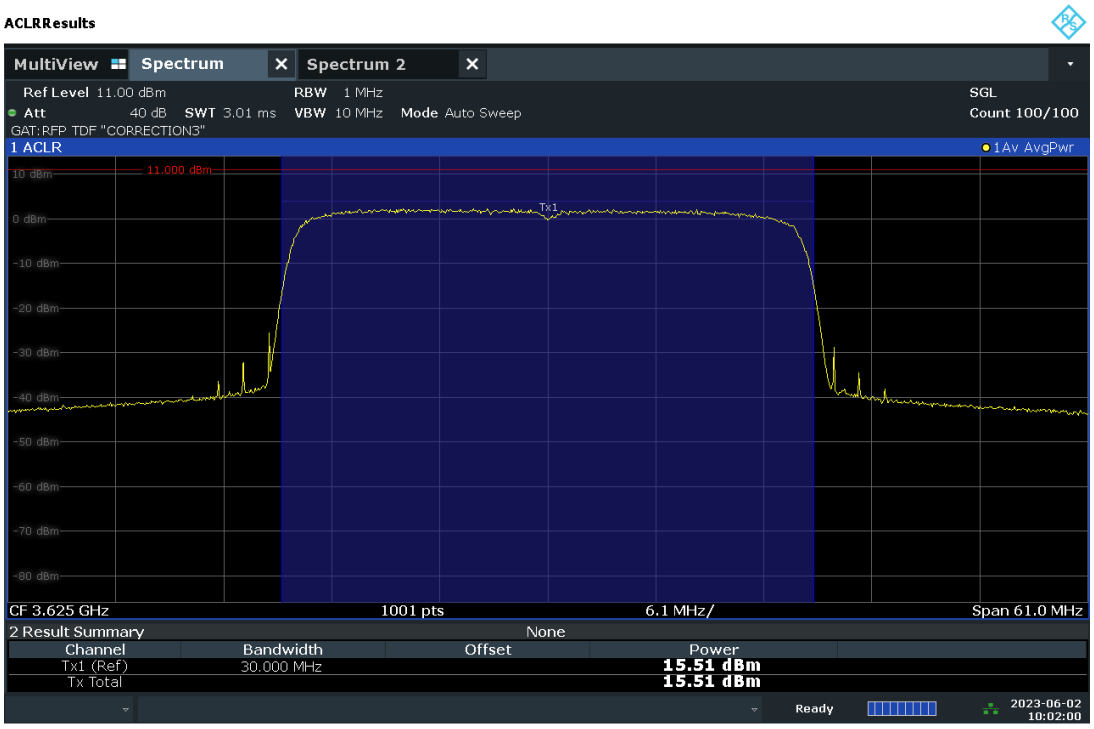
08:53:25 PM 06/01/2023

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



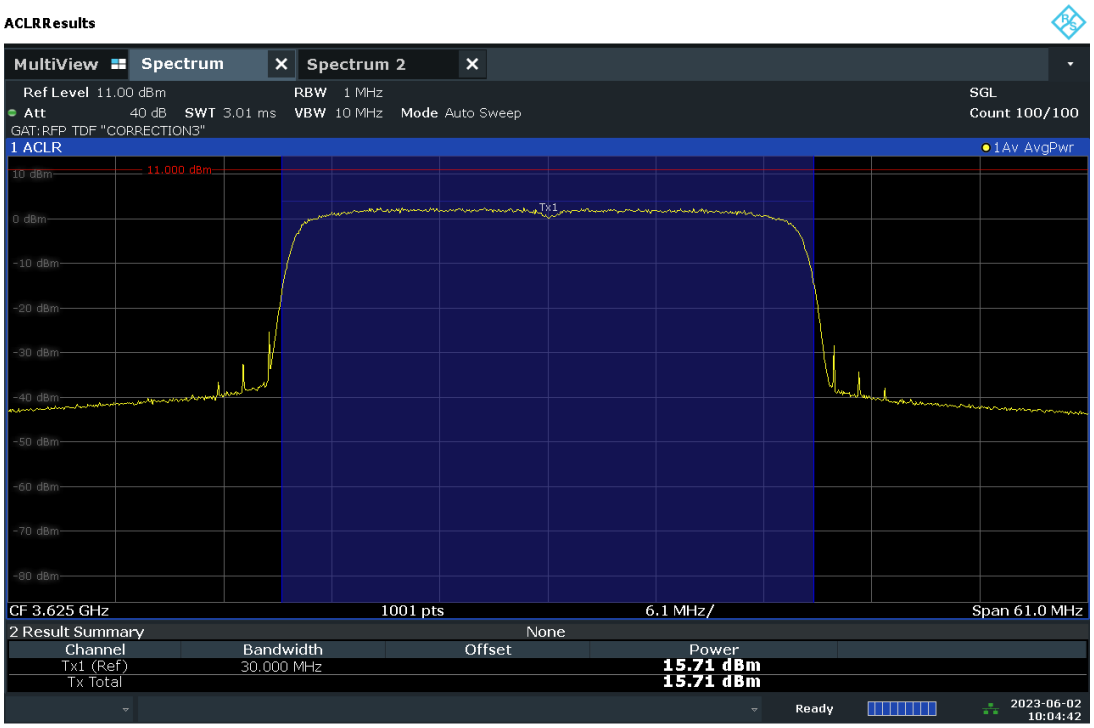
10:00:17 AM 06/02/2023

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



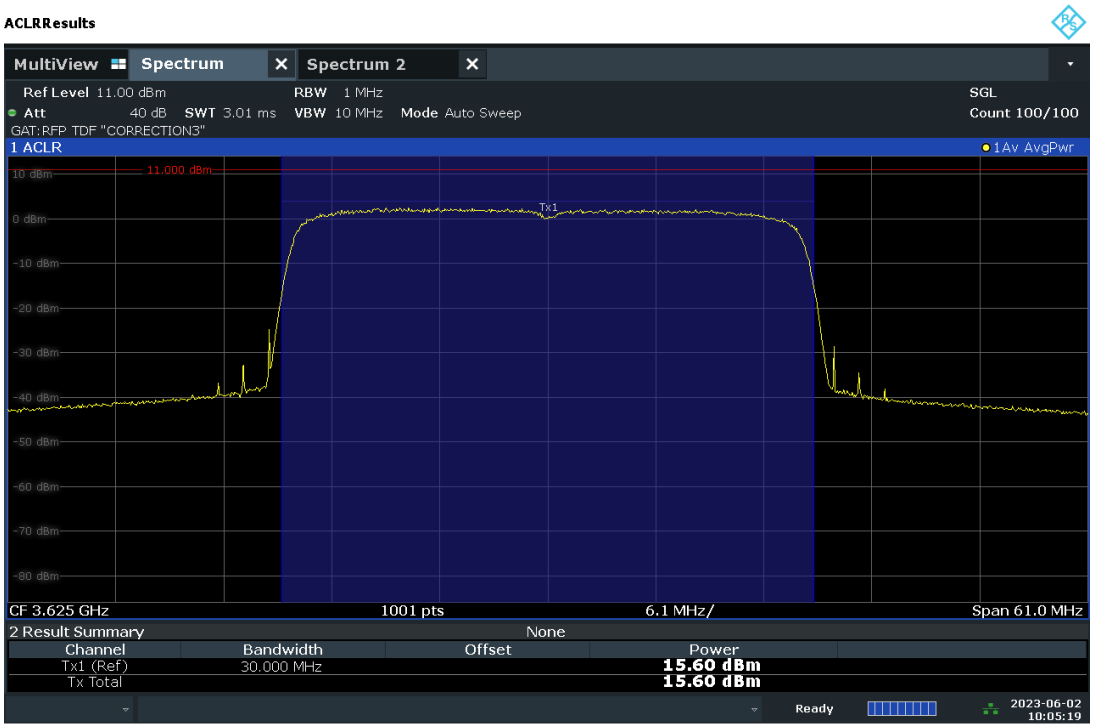
10:02:01 AM 06/02/2023

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



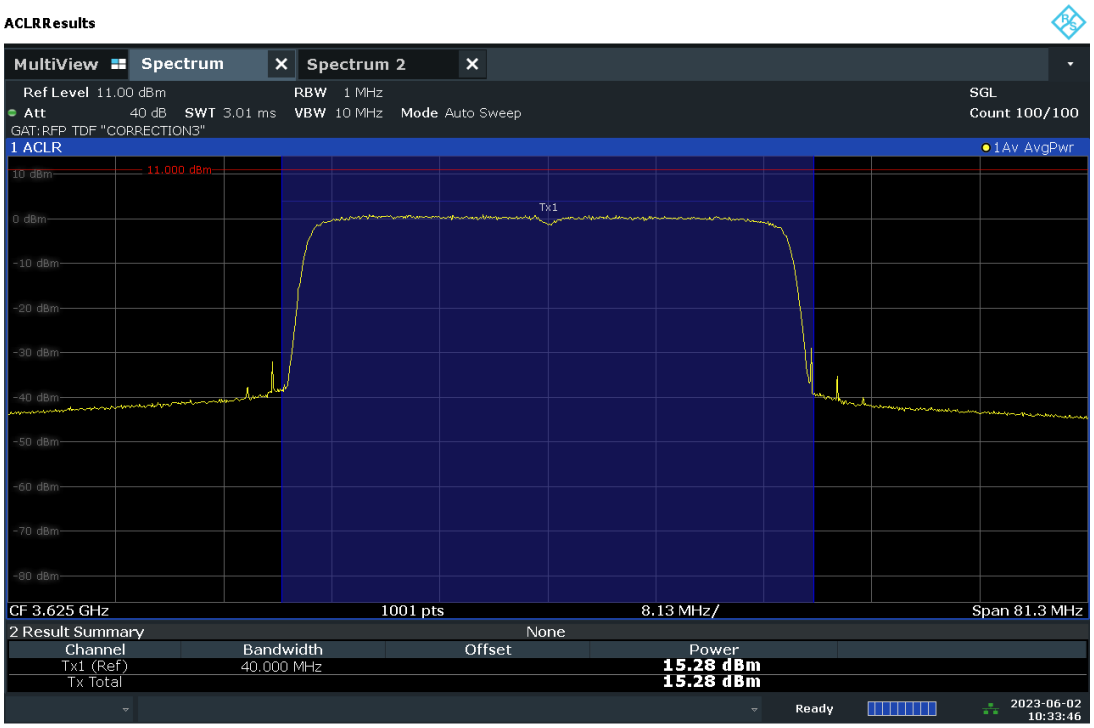
10:04:43 AM 06/02/2023

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



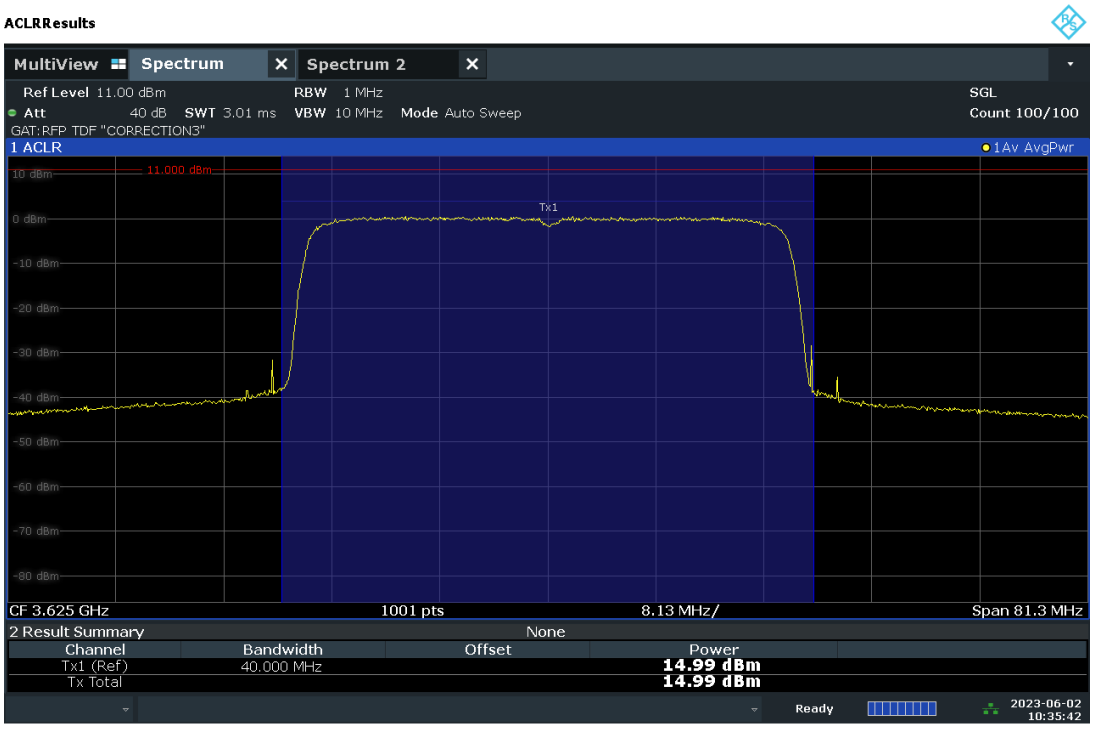
10:05:19 AM 06/02/2023

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



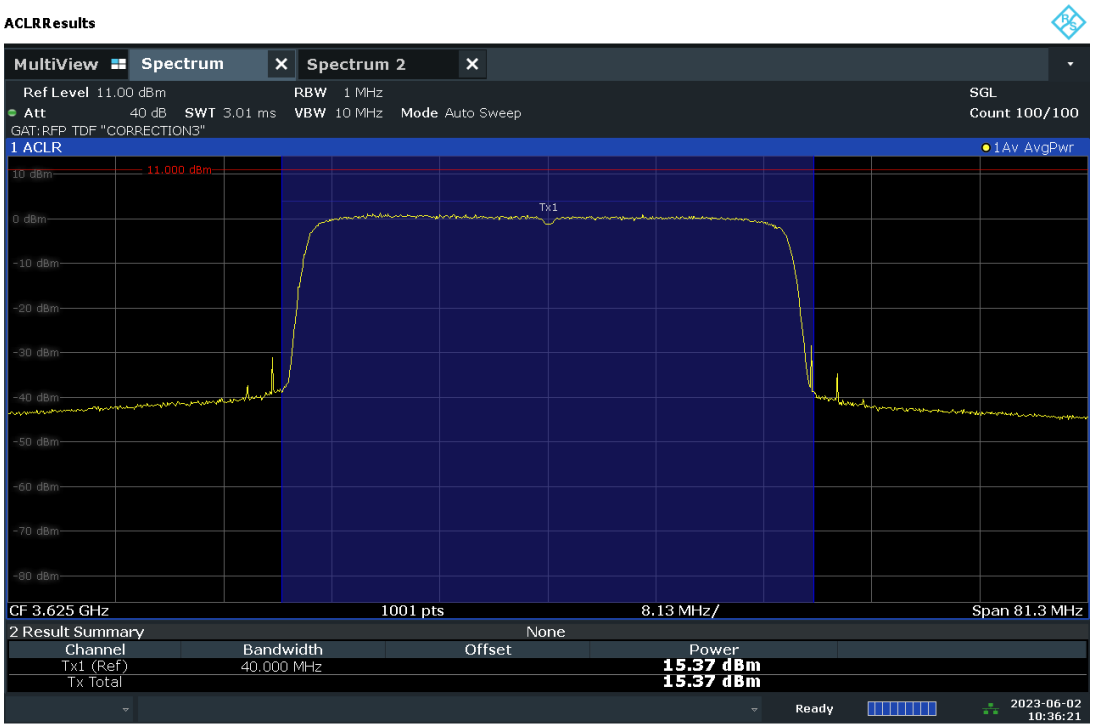
10:33:47 AM 06/02/2023

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



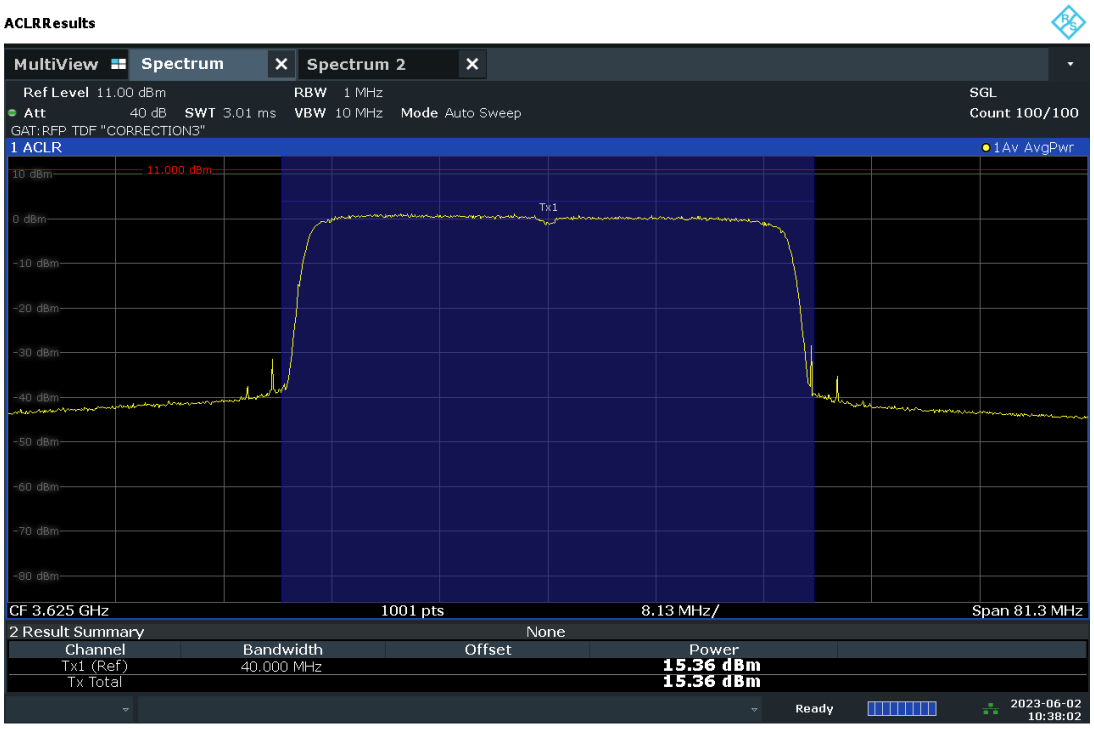
10:35:42 AM 06/02/2023

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



10:36:22 AM 06/02/2023

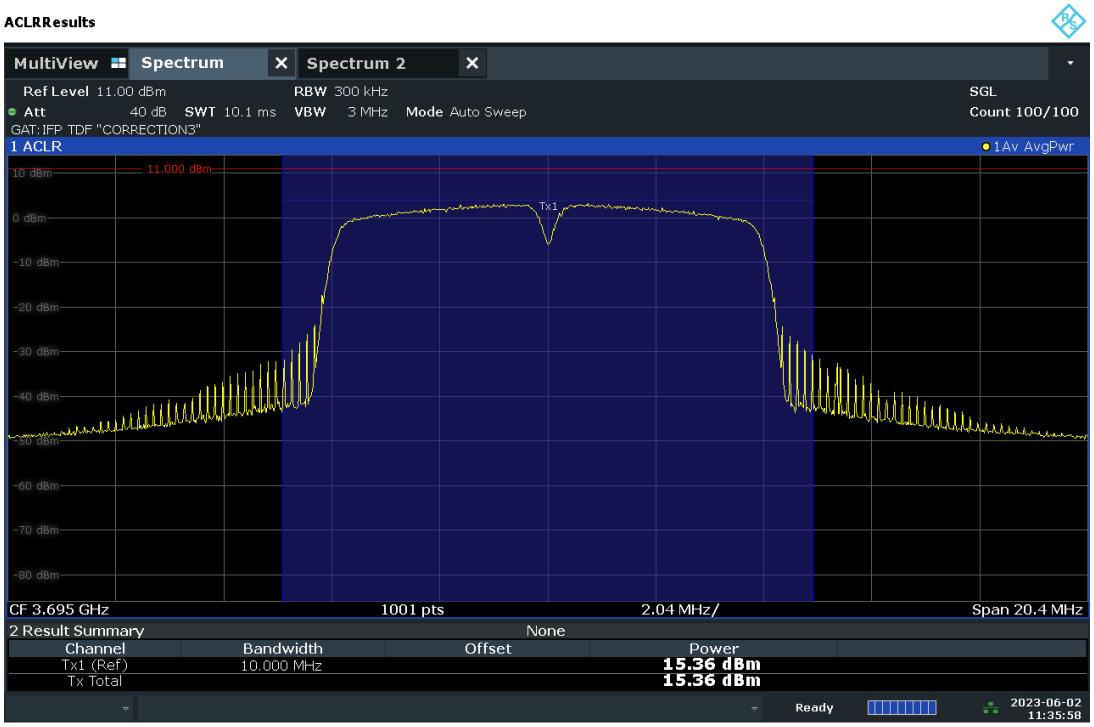
Plot 7.15 – Conducted Power Measurement – 40MHz BW, Mid Channel, 64QAM – Ch.A



10:38:02 AM 06/02/2023

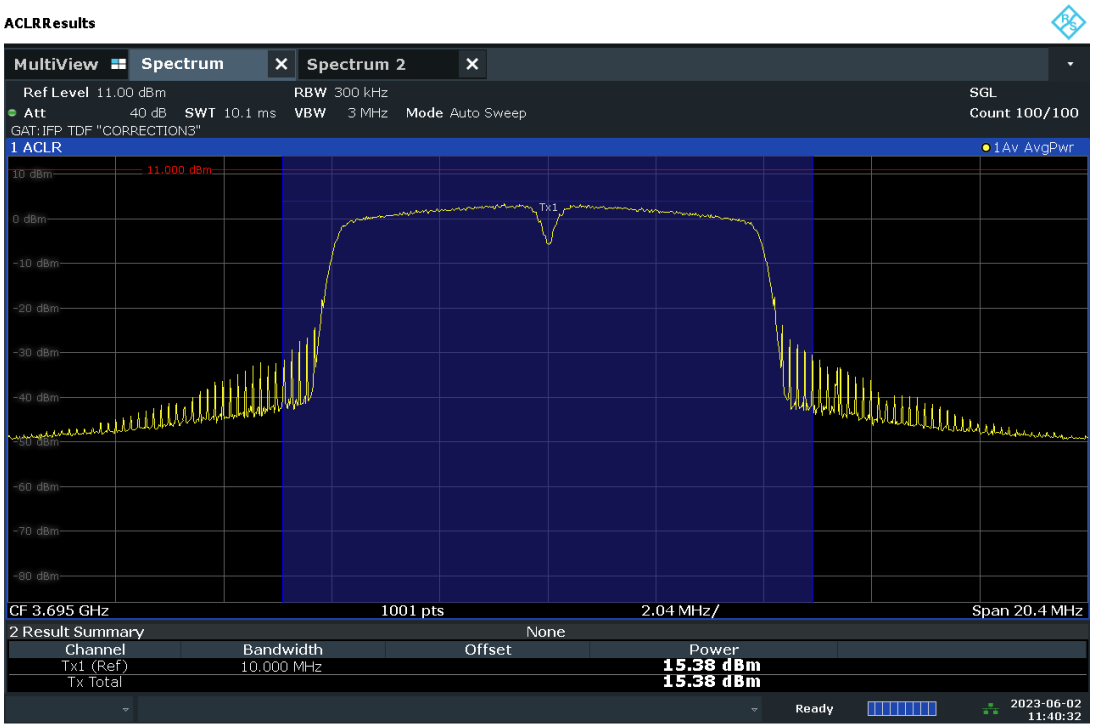
Plot 7.16 – Conducted Power Measurement – 40MHz BW, Mid Channel, 256QAM – Ch.A

Channel B Conducted Power Measurements



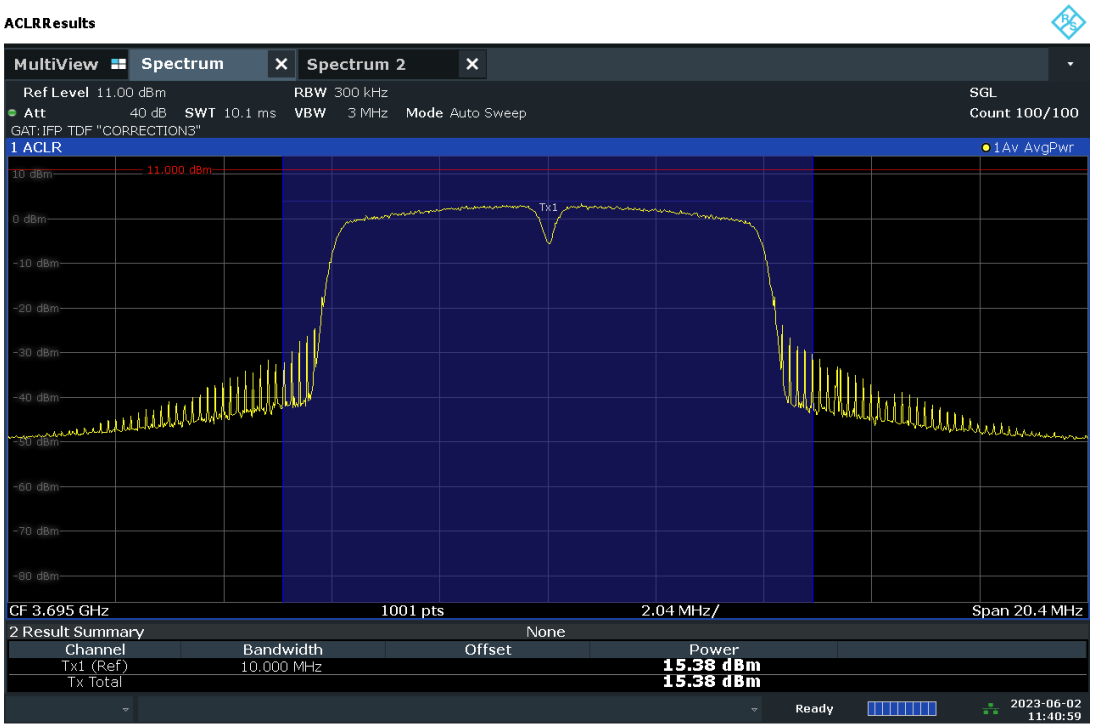
11:35:59 AM 06/02/2023

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

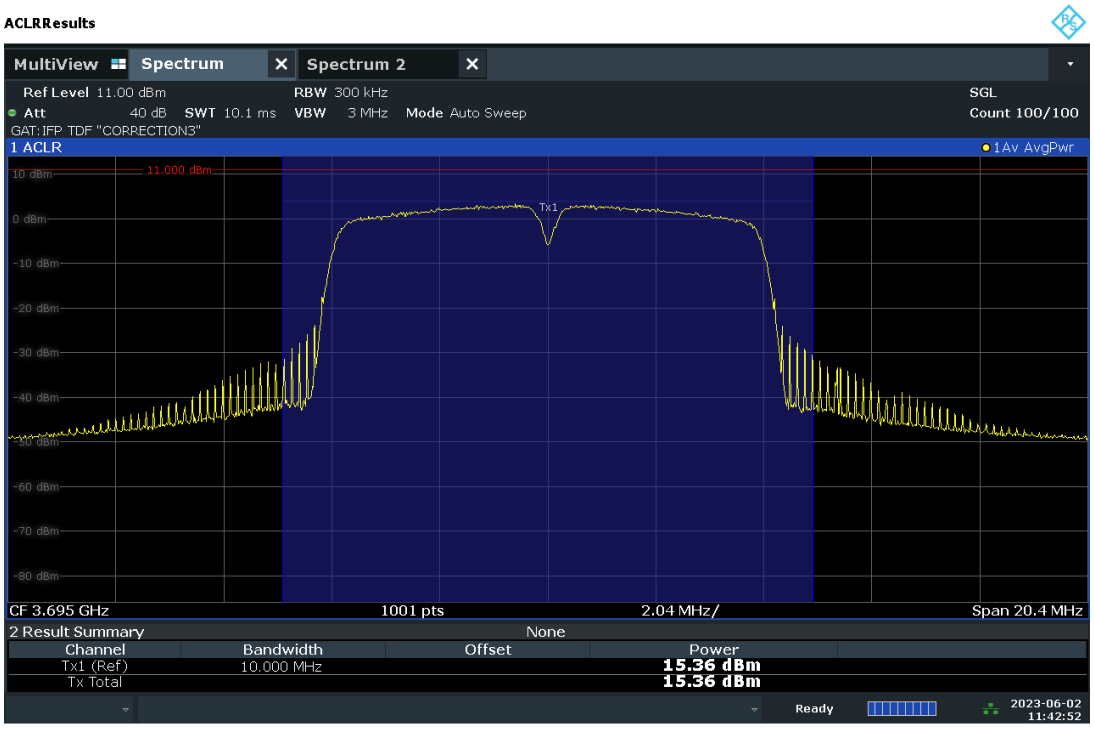


11:40:32 AM 06/02/2023

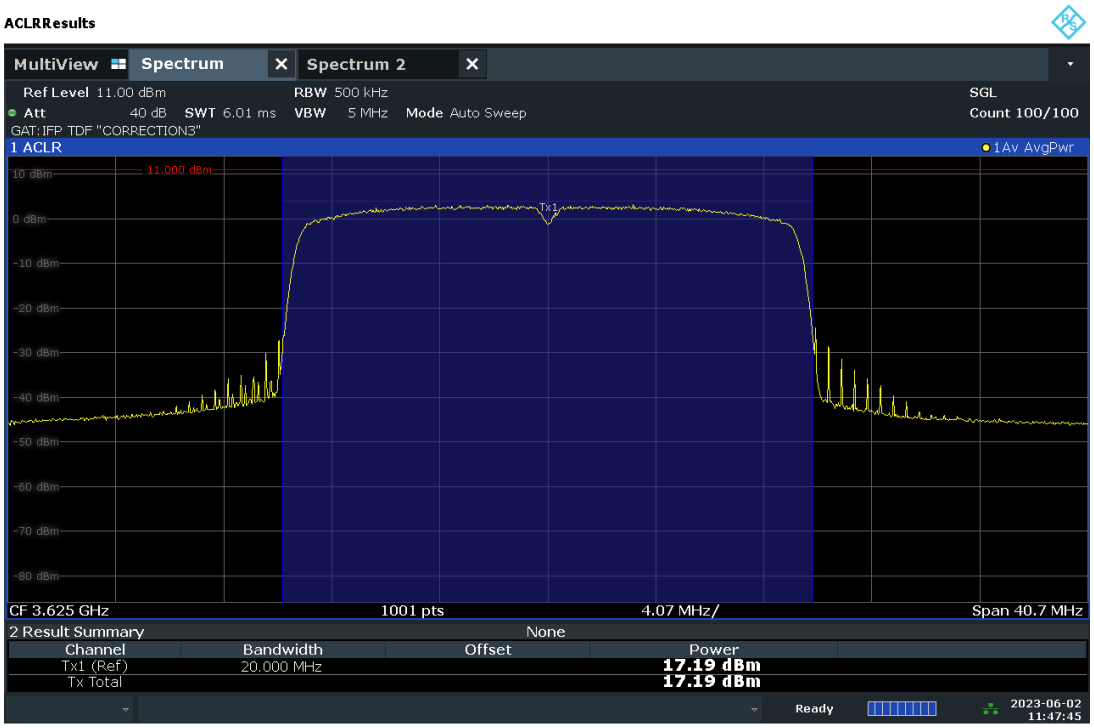
Plot 7.18 – Conducted Power Measurement – 10MHz BW, High Channel, 16QAM – Ch.B



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

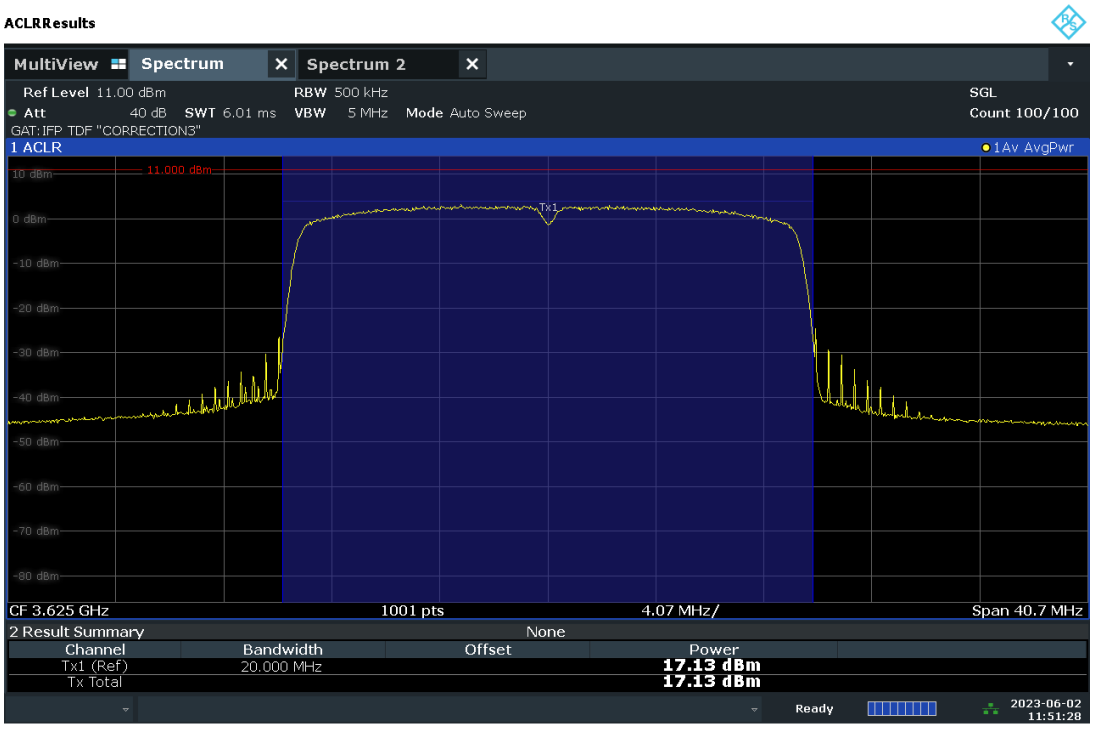


Plot 7.20 – Conducted Power Measurement – 10MHz BW, High Channel, 256QAM – Ch.B



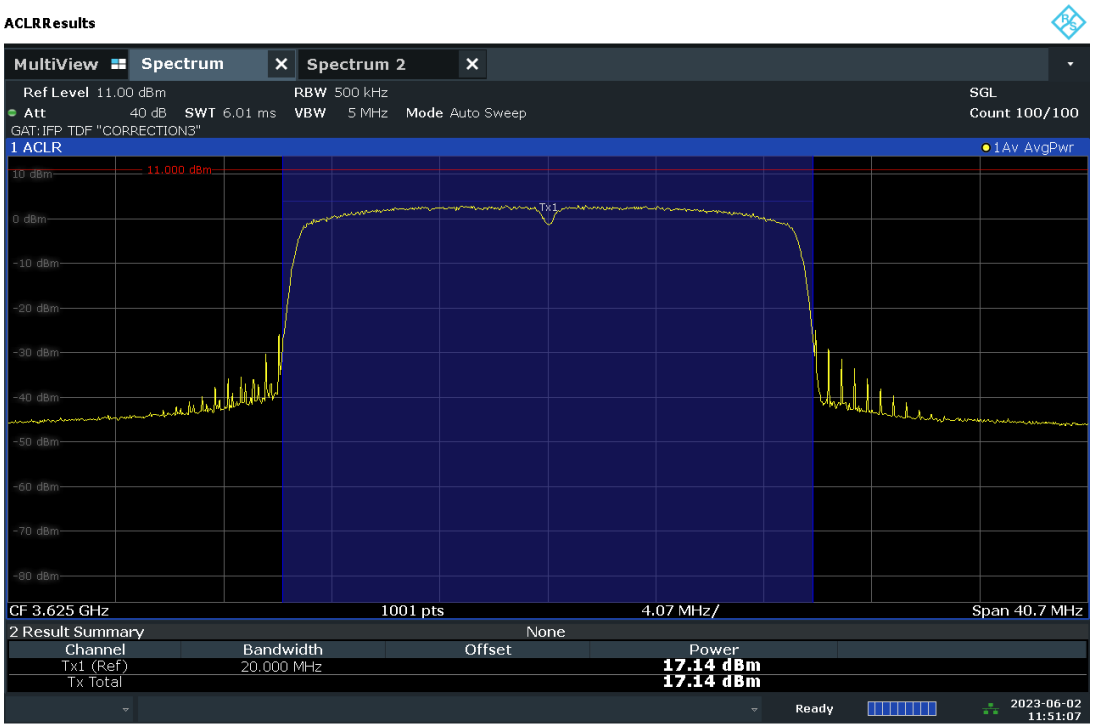
11:47:45 AM 06/02/2023

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



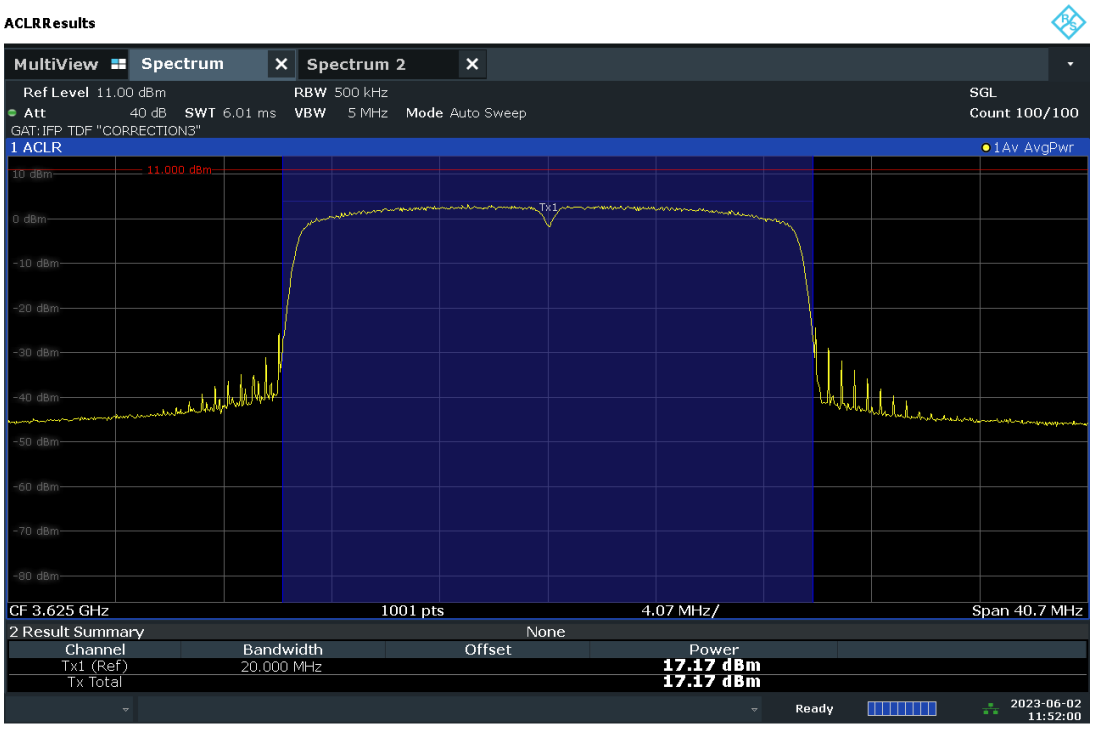
11:51:28 AM 06/02/2023

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



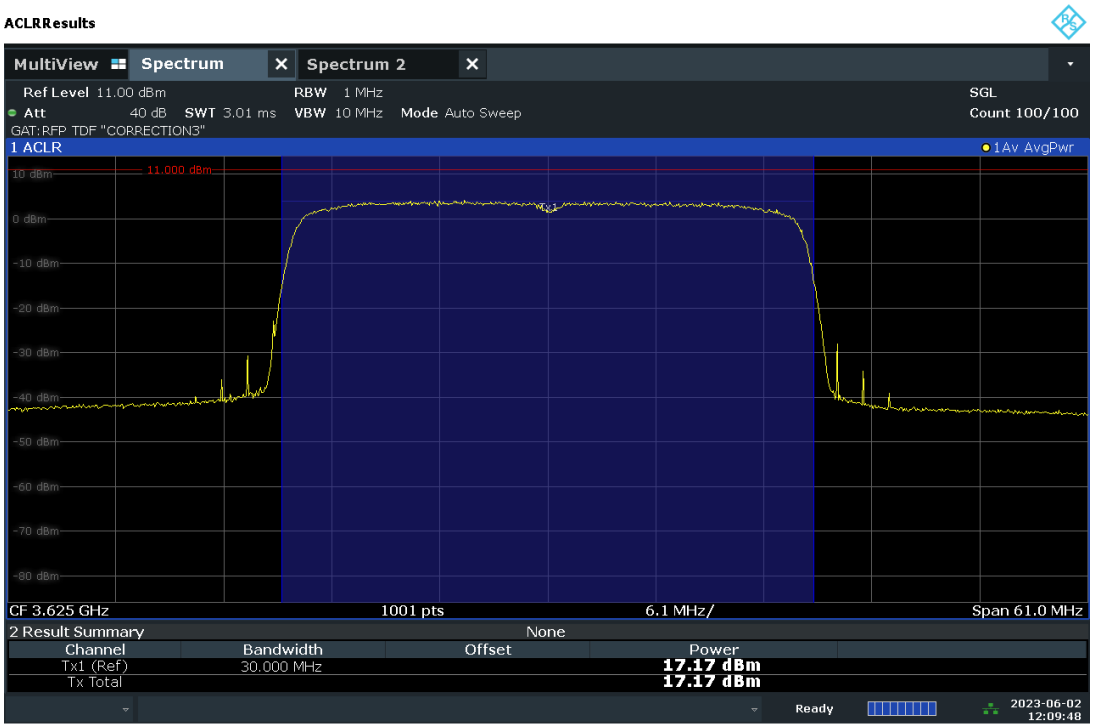
11:51:08 AM 06/02/2023

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



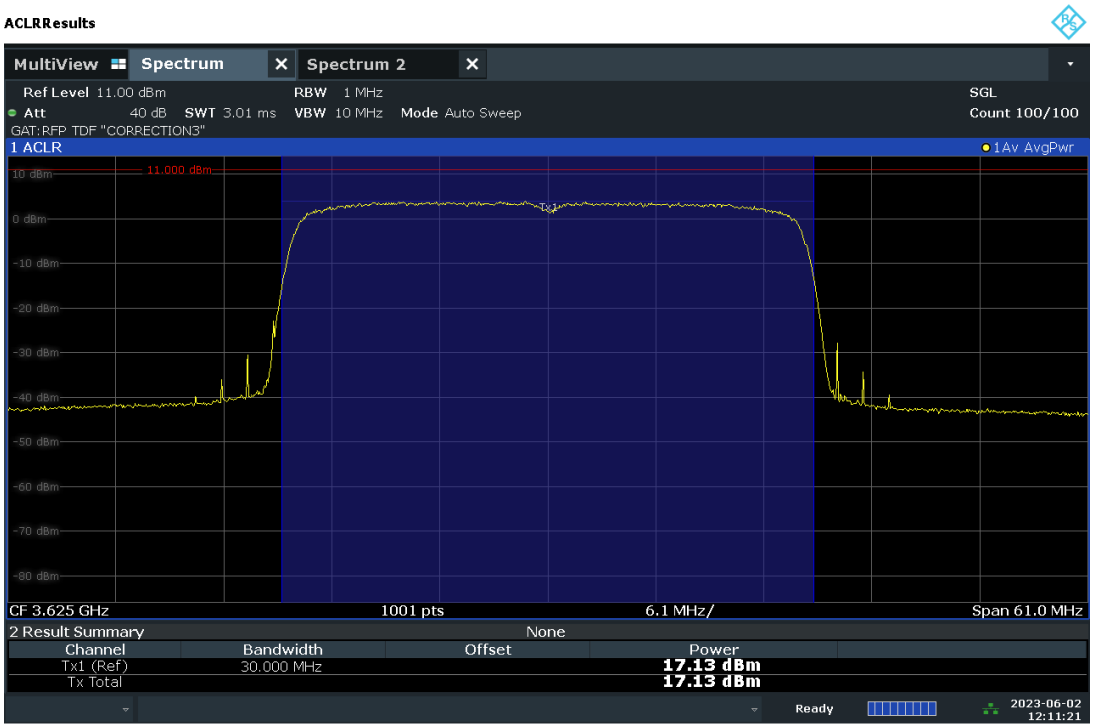
11:52:01 AM 06/02/2023

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



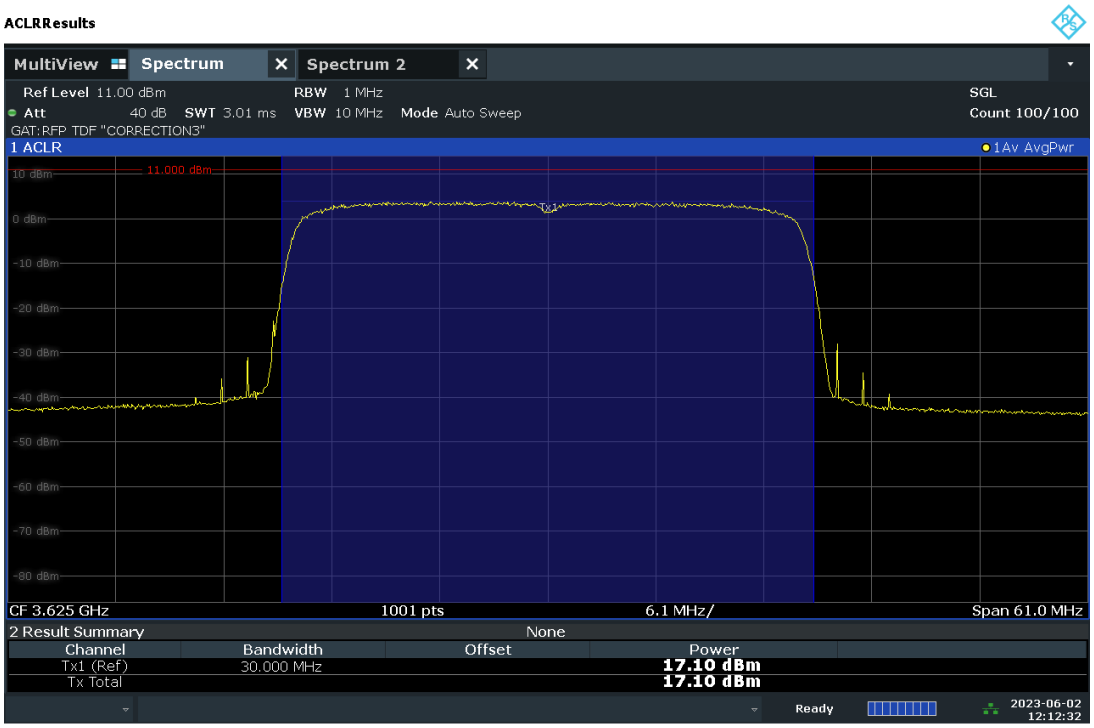
12:09:48 PM 06/02/2023

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

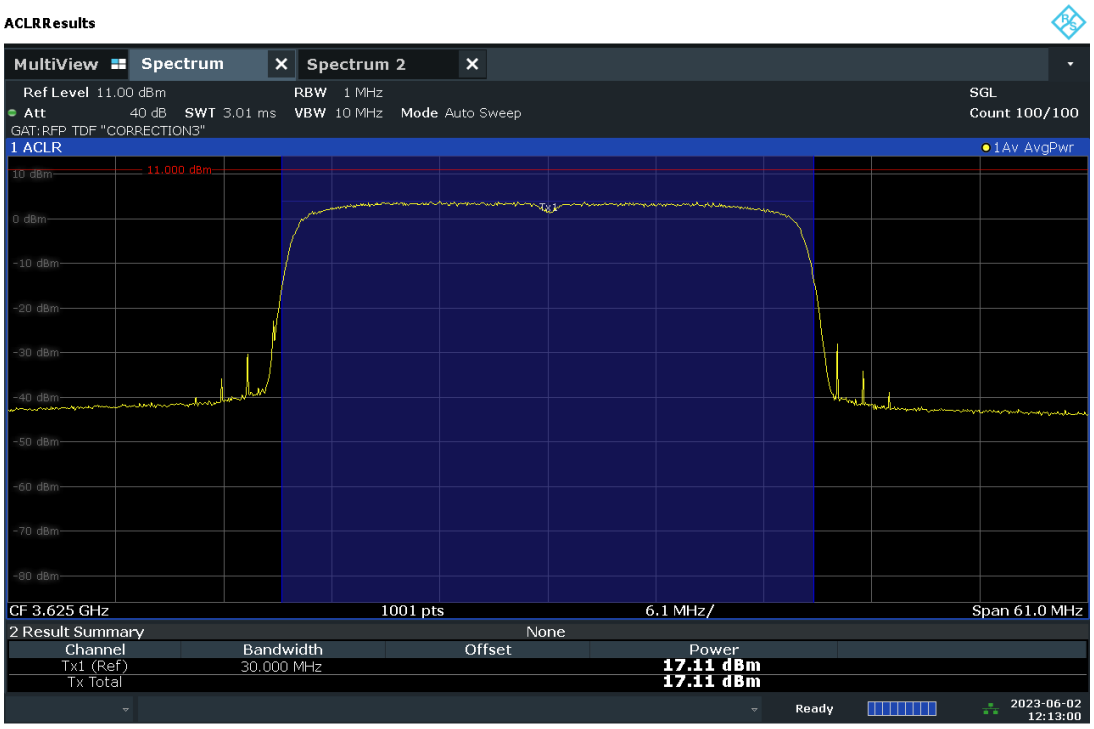


12:11:21 PM 06/02/2023

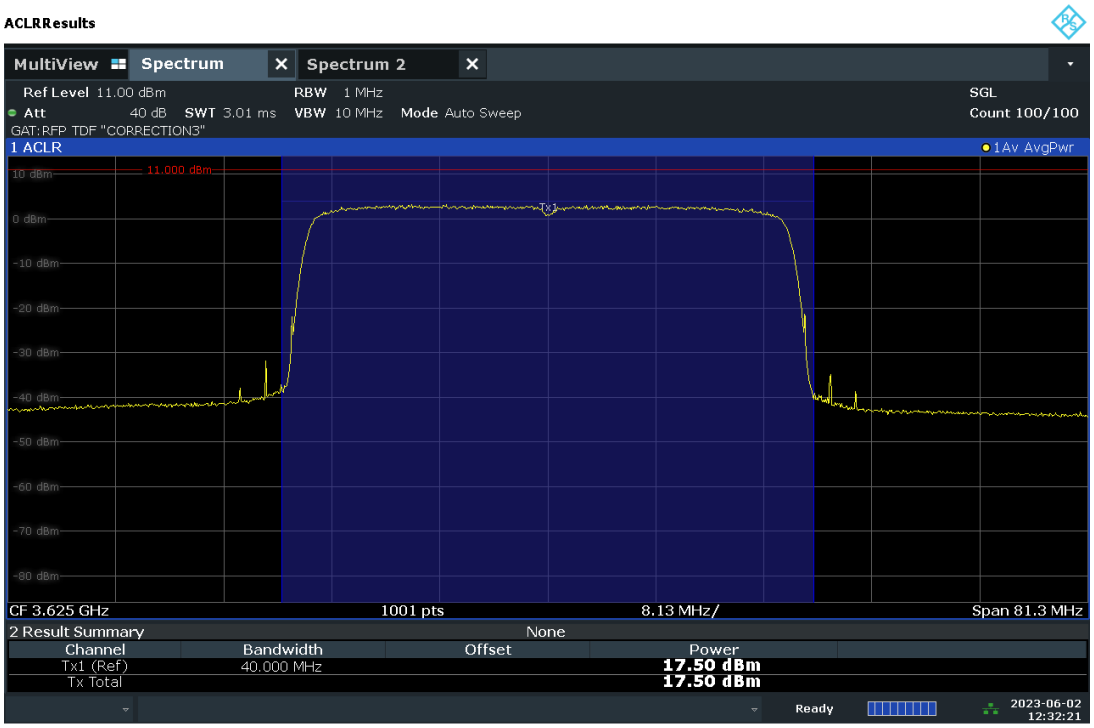
Plot 7.26 – Conducted Power Measurement – 30MHz BW, Mid Channel, 16QAM – Ch.B



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

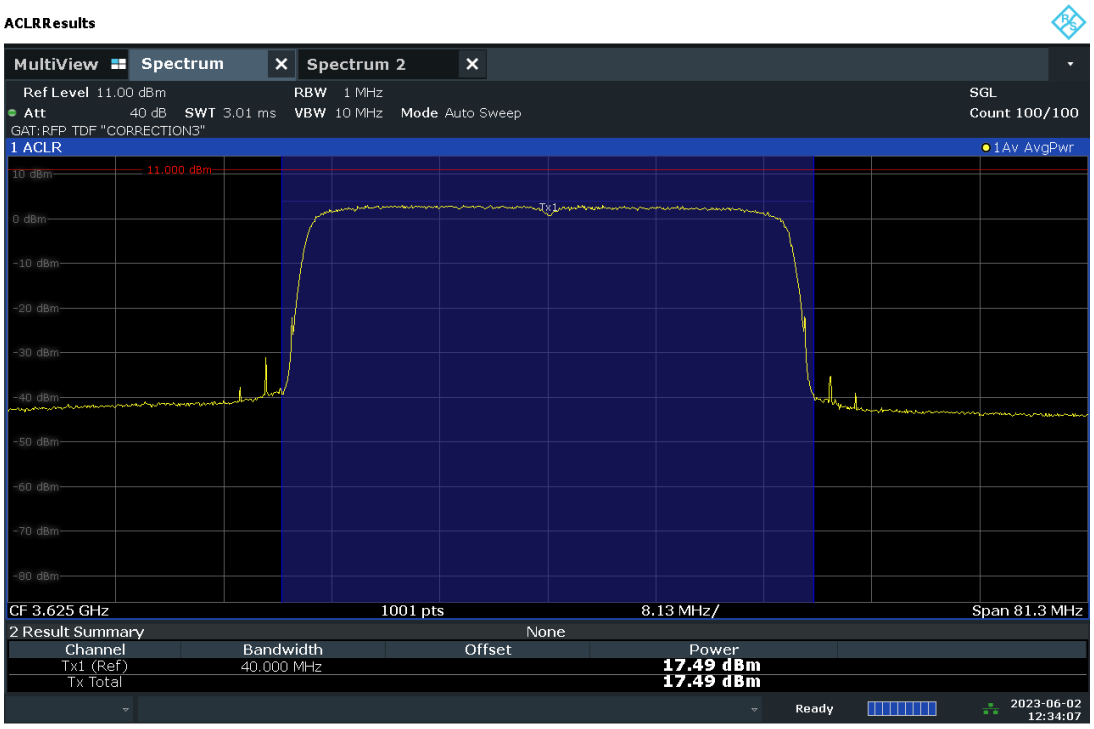


Plot 7.28 – Conducted Power Measurement – 30MHz BW, Mid Channel, 256QAM – Ch.B



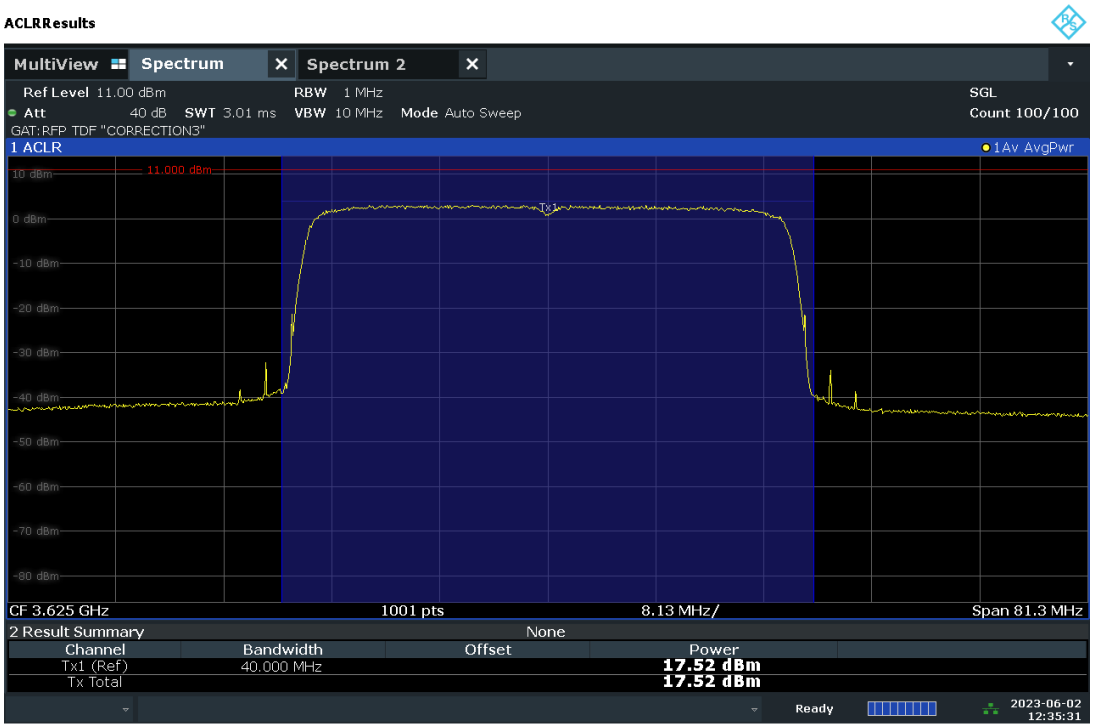
12:32:21 PM 06/02/2023

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



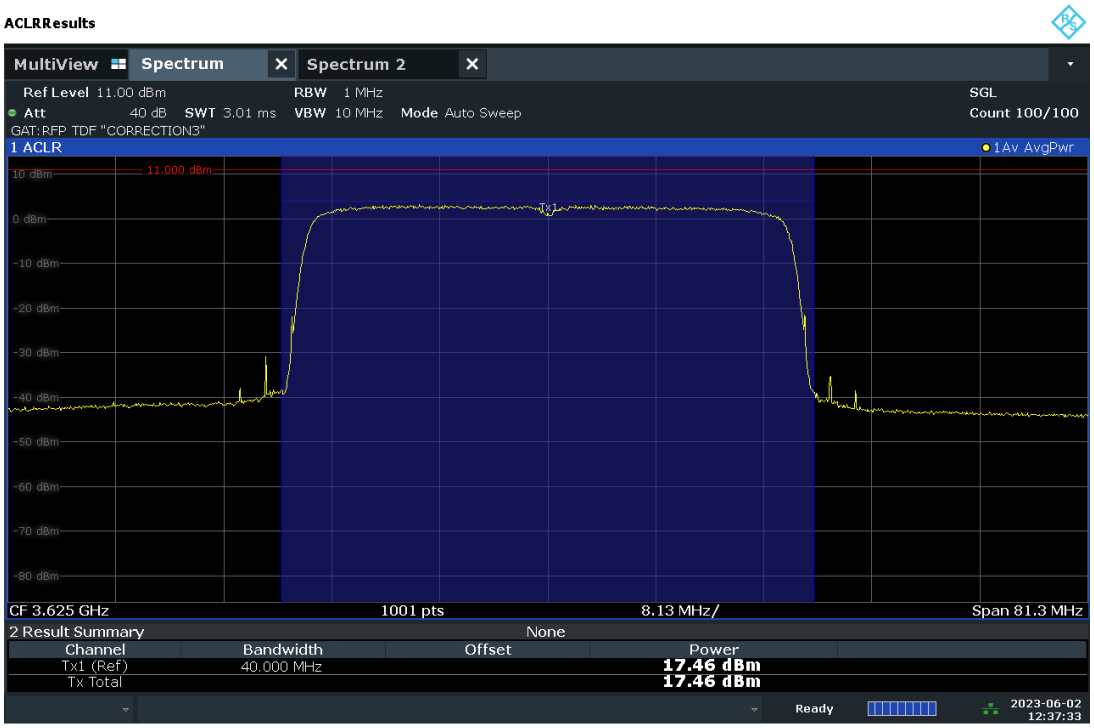
12:34:08 PM 06/02/2023

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



12:35:32 PM 06/02/2023

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



12:37:34 PM 06/02/2023

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

7.3 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 gated as to only measure during on periods.

The e.i.r.p. per 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 7-2. Test Instrument & Measurement Setup

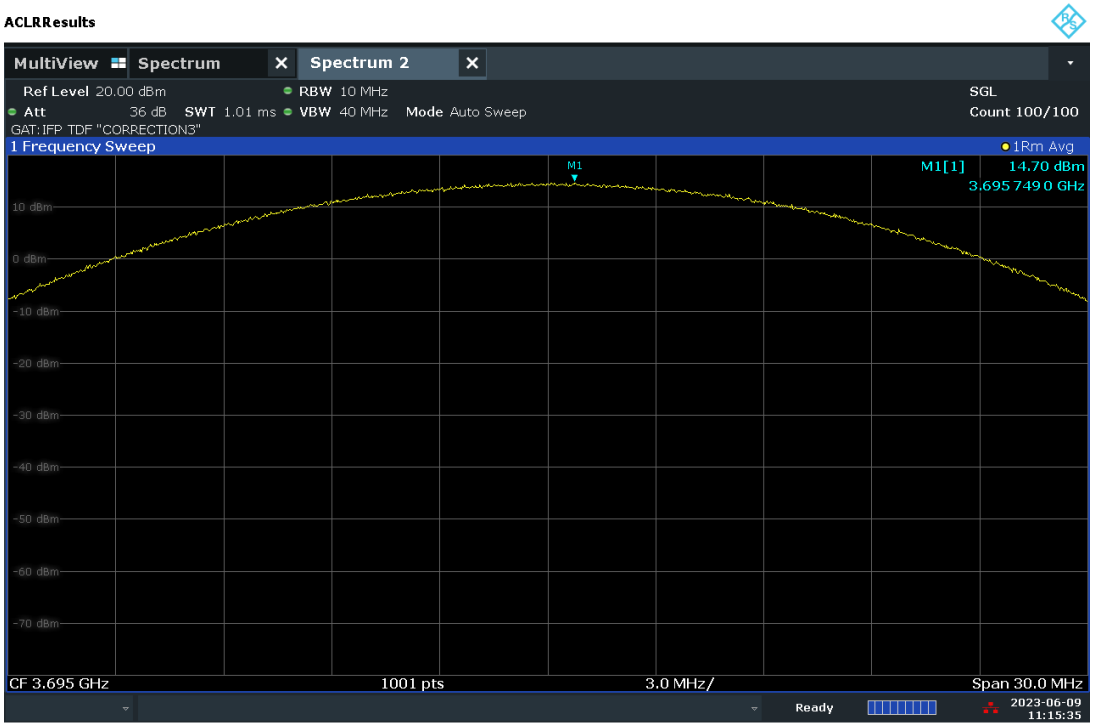
Test Notes

A scaling factor of 10log(7) was added to obtain the total output summed across all 7 modules.

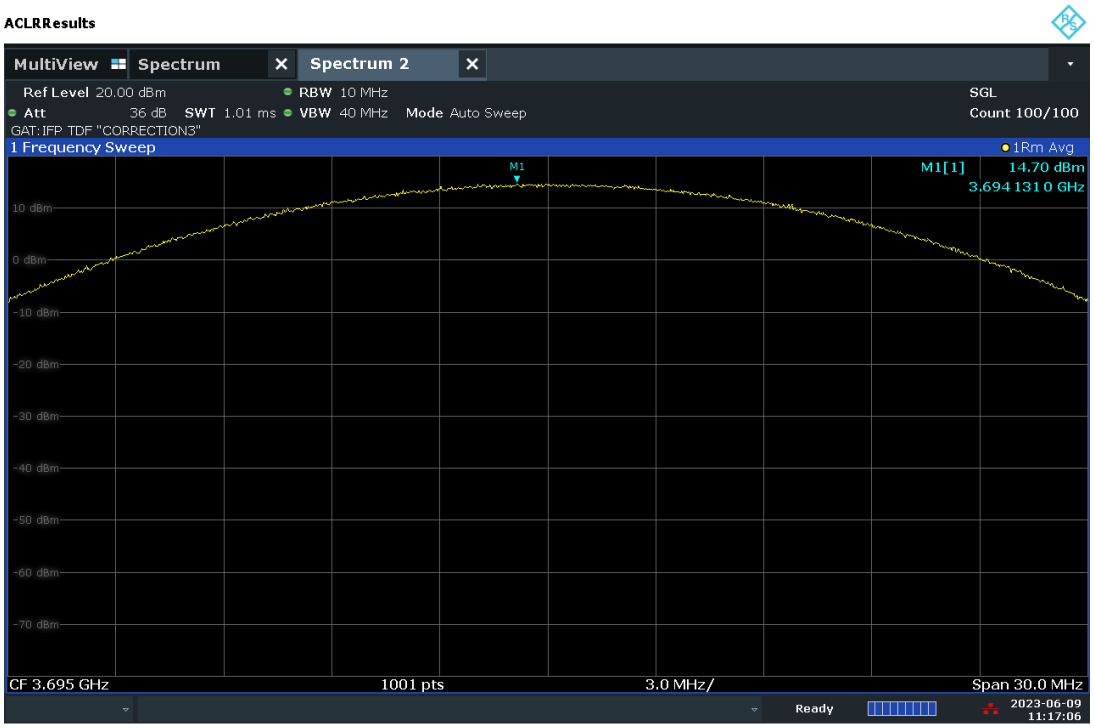
Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted PSD [dBm/10MHz]	Ch. B Conducted PSD [dBm/10MHz]	Summed MIMO Conducted PSD [dBm/10MHz]	Summed MIMO Conducted PSD [dBm/10MHz] - All Modules	Ant Gain [dBi]	EIRP PSD [dBm/10MHz]	EIRP PSD [Watts/10MHz]	EIRP PSD Limit [dBm/10MHz]	Margin [dB]
40 MHz	QPSK	3570.0	6.86	5.59	9.28	17.73	10.16	27.89	0.616	47.00	-19.11
		3625.0	10.40	12.48	14.57	23.02	10.16	33.18	2.082	47.00	-13.82
		3680.0	9.02	8.54	11.80	20.25	10.16	30.41	1.098	47.00	-16.59
	16-QAM	3570.0	7.15	5.60	9.45	17.91	10.16	28.07	0.640	47.00	-18.93
		3625.0	9.99	12.68	14.55	23.00	10.16	33.16	2.071	47.00	-13.84
		3680.0	9.01	8.47	11.76	20.21	10.16	30.37	1.089	47.00	-16.63
	64-QAM	3570.0	6.80	5.66	9.28	17.73	10.16	27.89	0.615	47.00	-19.11
		3625.0	10.39	12.55	14.61	23.06	10.16	33.22	2.101	47.00	-13.78
		3680.0	9.10	8.48	11.81	20.26	10.16	30.42	1.102	47.00	-16.58
	256-QAM	3570.0	7.31	5.65	9.57	18.02	10.16	28.18	0.658	47.00	-18.82
		3625.0	10.48	12.53	14.64	23.09	10.16	33.25	2.112	47.00	-13.75
		3680.0	9.06	8.41	11.76	20.21	10.16	30.37	1.089	47.00	-16.63
30 MHz	QPSK	3565.0	7.38	6.23	9.85	18.30	10.16	28.46	0.702	47.00	-18.54
		3625.0	11.42	13.24	15.43	23.89	10.16	34.05	2.539	47.00	-12.95
		3685.0	10.49	10.70	13.61	22.06	10.16	32.22	1.666	47.00	-14.78
	16-QAM	3565.0	7.31	6.32	9.85	18.30	10.16	28.46	0.702	47.00	-18.54
		3625.0	11.65	13.32	15.58	24.03	10.16	34.19	2.622	47.00	-12.81
		3685.0	10.77	10.67	13.73	22.18	10.16	32.34	1.715	47.00	-14.66
	64-QAM	3565.0	6.98	6.26	9.65	18.10	10.16	28.26	0.669	47.00	-18.74
		3625.0	11.73	13.17	15.52	23.97	10.16	34.13	2.589	47.00	-12.87
		3685.0	10.63	10.74	13.70	22.15	10.16	32.31	1.701	47.00	-14.69
	256-QAM	3565.0	6.76	6.29	9.54	17.99	10.16	28.15	0.654	47.00	-18.85
		3625.0	11.71	13.18	15.52	23.97	10.16	34.13	2.587	47.00	-12.87
		3685.0	10.56	10.71	13.65	22.10	10.16	32.26	1.681	47.00	-14.74
20 MHz	QPSK	3560.0	8.57	7.61	11.13	19.58	10.16	29.74	0.941	47.00	-17.26
		3625.0	13.97	15.13	17.60	26.05	10.16	36.21	4.178	47.00	-10.79
		3690.0	13.12	12.32	15.75	24.20	10.16	34.36	2.729	47.00	-12.64
	16-QAM	3560.0	8.22	7.61	10.94	19.39	10.16	29.55	0.901	47.00	-17.45
		3625.0	13.16	15.13	17.27	25.72	10.16	35.88	3.870	47.00	-11.12
		3690.0	12.91	12.32	15.64	24.09	10.16	34.25	2.658	47.00	-12.75
	64-QAM	3560.0	8.56	7.57	11.10	19.55	10.16	29.71	0.936	47.00	-17.29
		3625.0	13.46	15.07	17.35	25.80	10.16	35.96	3.945	47.00	-11.04
		3690.0	12.83	12.32	15.59	24.04	10.16	34.20	2.633	47.00	-12.80
	256-QAM	3560.0	8.79	7.72	11.30	19.75	10.16	29.91	0.979	47.00	-17.09
		3625.0	13.48	15.15	17.41	25.86	10.16	36.02	3.996	47.00	-10.98
		3690.0	12.92	12.25	15.61	24.06	10.16	34.22	2.642	47.00	-12.78
10 MHz	QPSK	3555.0	10.44	10.21	13.34	21.79	10.16	31.95	1.566	47.00	-15.05
		3625.0	11.94	12.61	15.30	23.75	10.16	33.91	2.460	47.00	-13.09
		3695.0	14.70	15.20	17.97	26.42	10.16	36.58	4.548	47.00	-10.42
	16-QAM	3555.0	10.57	10.00	13.30	21.76	10.16	31.92	1.554	47.00	-15.08
		3625.0	11.90	12.62	15.29	23.74	10.16	33.90	2.453	47.00	-13.10
		3695.0	14.70	15.20	17.97	26.42	10.16	36.58	4.548	47.00	-10.42
	64-QAM	3555.0	10.83	10.05	13.47	21.92	10.16	32.08	1.614	47.00	-14.92
		3625.0	12.00	12.52	15.28	23.73	10.16	33.89	2.449	47.00	-13.11
		3695.0	14.55	15.14	17.87	26.32	10.16	36.48	4.443	47.00	-10.52
	256-QAM	3555.0	10.95	10.02	13.52	21.97	10.16	32.13	1.633	47.00	-14.87
		3625.0	12.28	12.50	15.40	23.85	10.16	34.01	2.519	47.00	-12.99
		3695.0	14.84	15.54	18.21	26.67	10.16	36.83	4.814	47.00	-10.17

Table 7-3 E.I.R.P. Per 10MHz Measurements

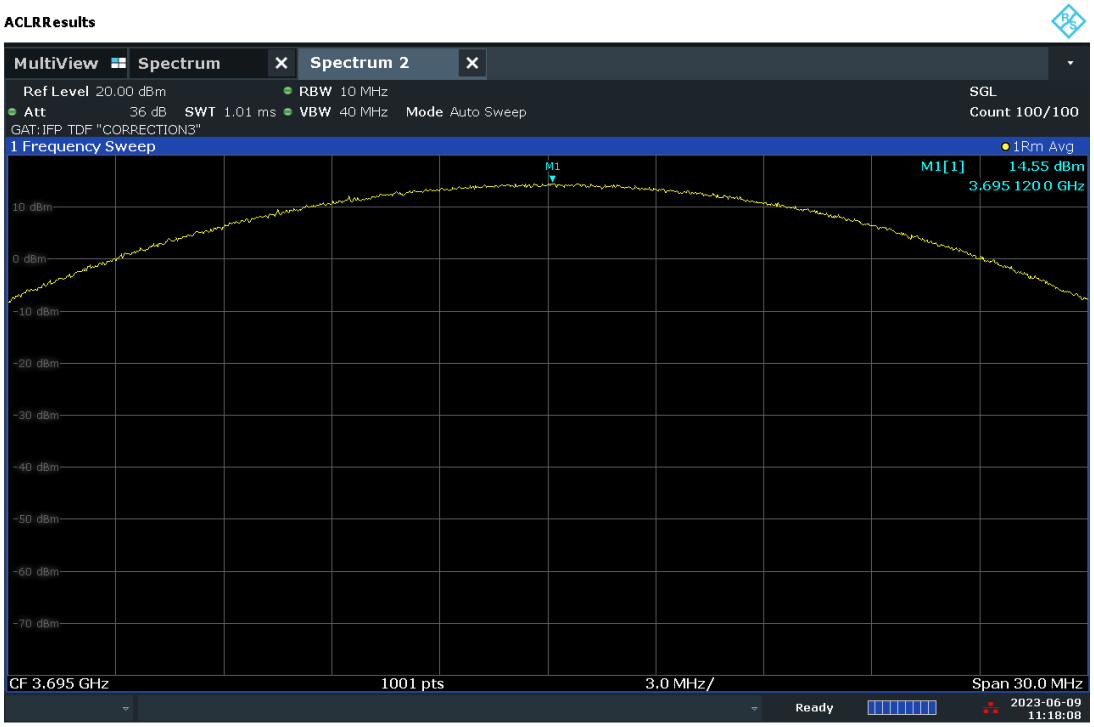
Channel A Conducted Power / 10MHz Measurement



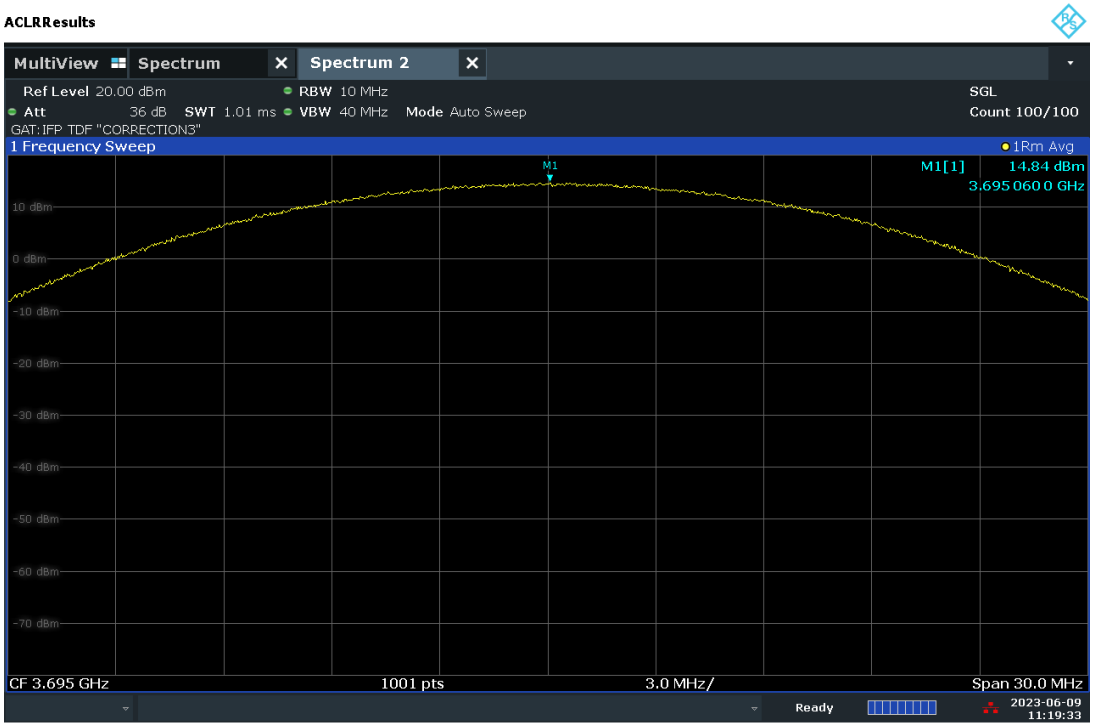
Plot 7.33. Conducted Power / 10MHz Plot (10MHz QPSK, High Channel – Ch.A)



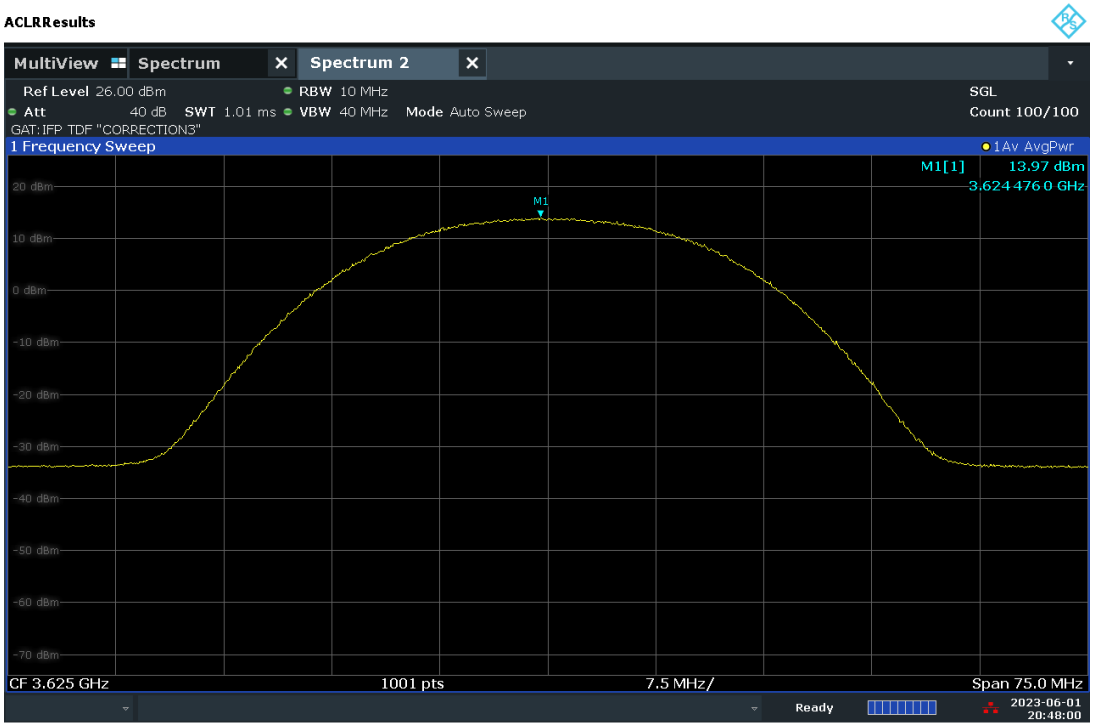
Plot 7.34. Conducted Power / 10MHz Plot (10MHz 16QAM, High Channel – Ch.A)



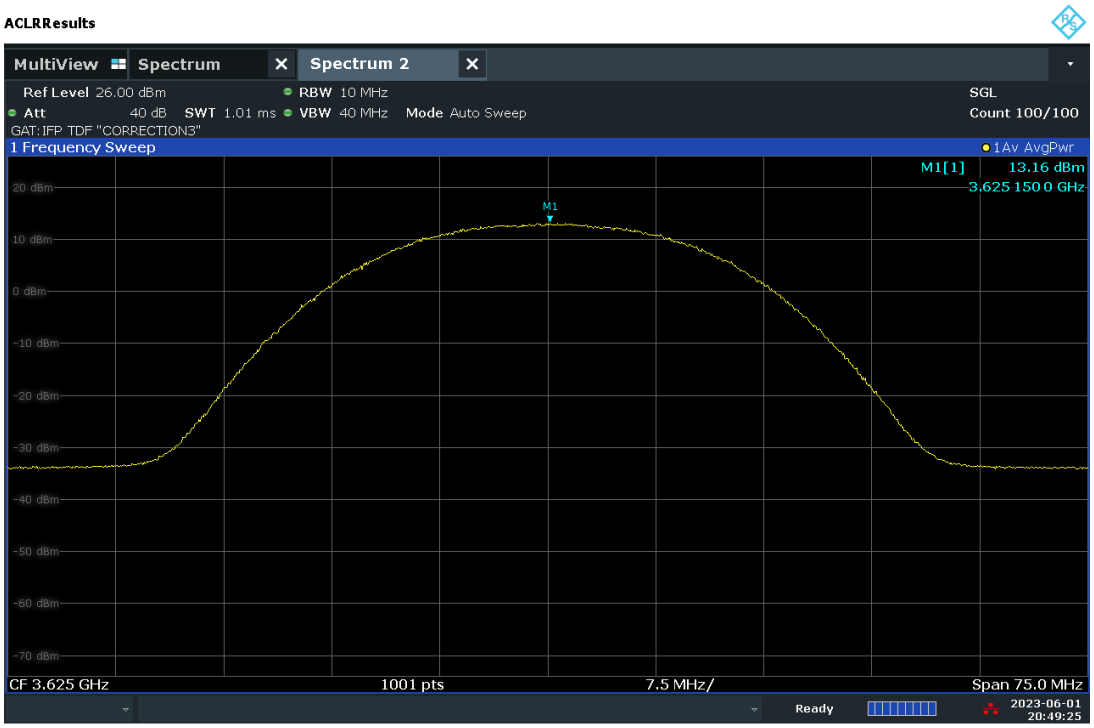
Plot 7.35. Conducted Power / 10MHz Plot (10MHz 64QAM, High Channel – Ch.A)



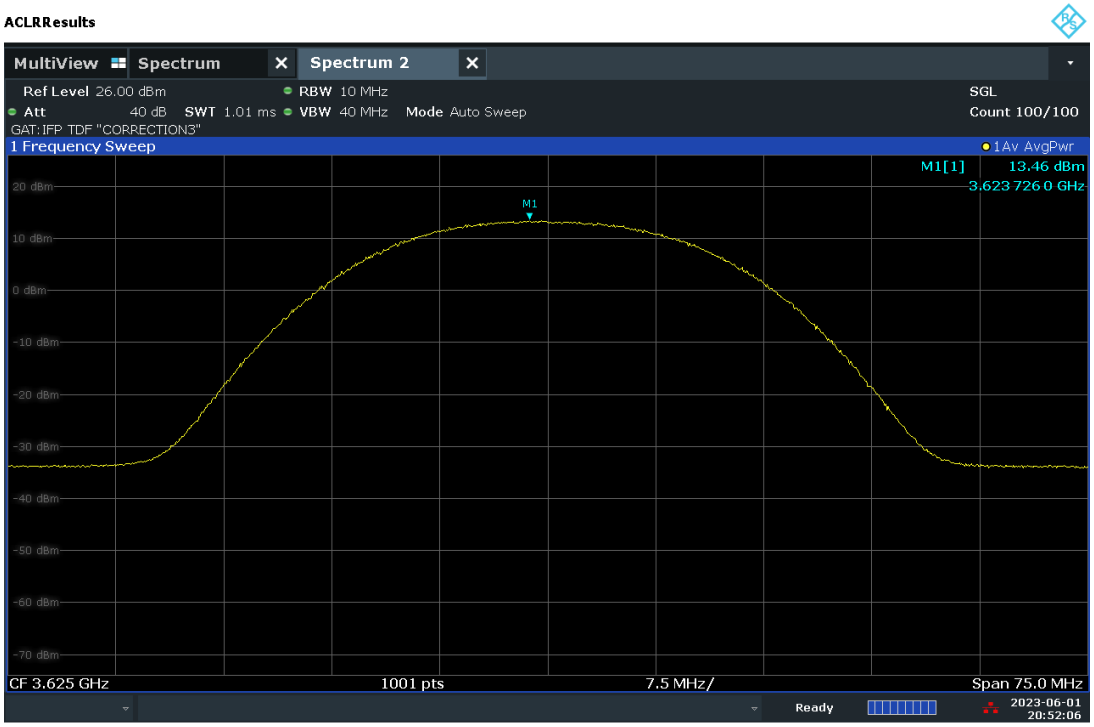
Plot 7.36. Conducted Power / 10MHz Plot (10MHz 256QAM, High Channel – Ch.A)



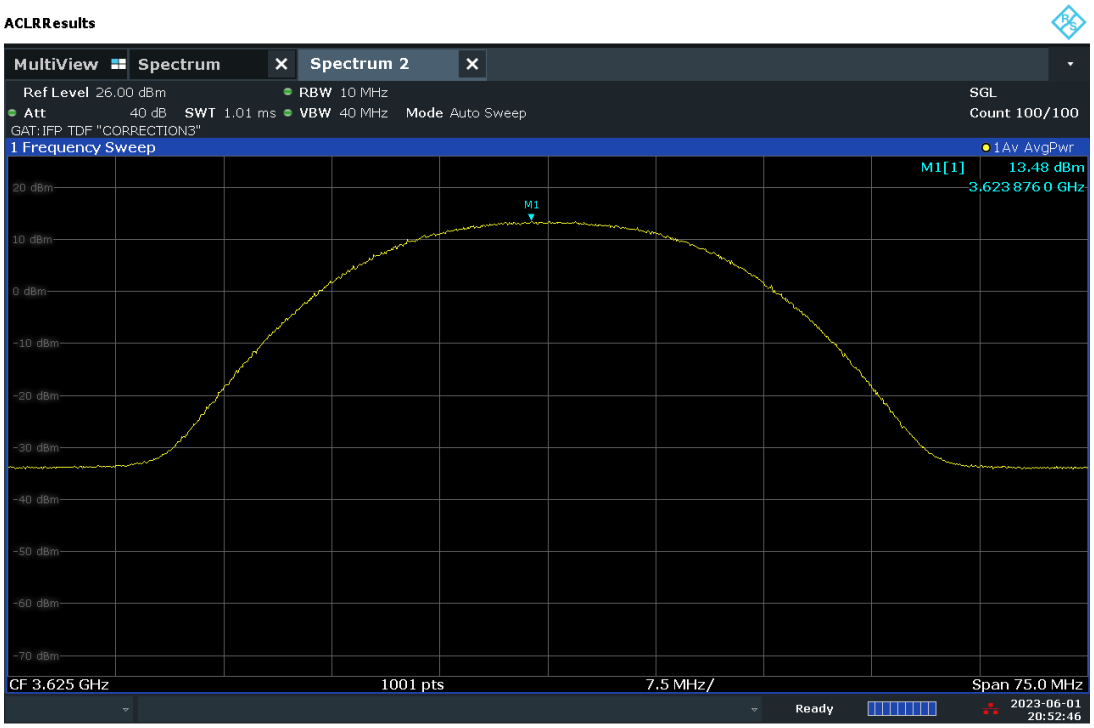
Plot 7.37. Conducted Power / 10MHz Plot (20MHz QPSK, Mid Channel – Ch.A)



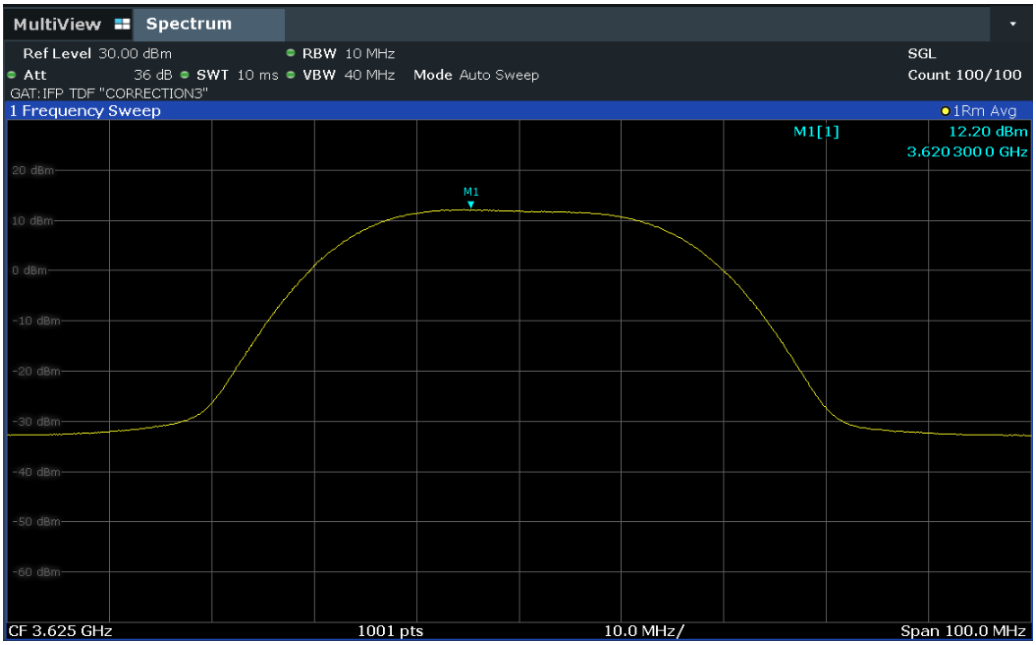
Plot 7.38. Conducted Power / 10MHz Plot (20MHz 16QAM, Mid Channel – Ch.A)



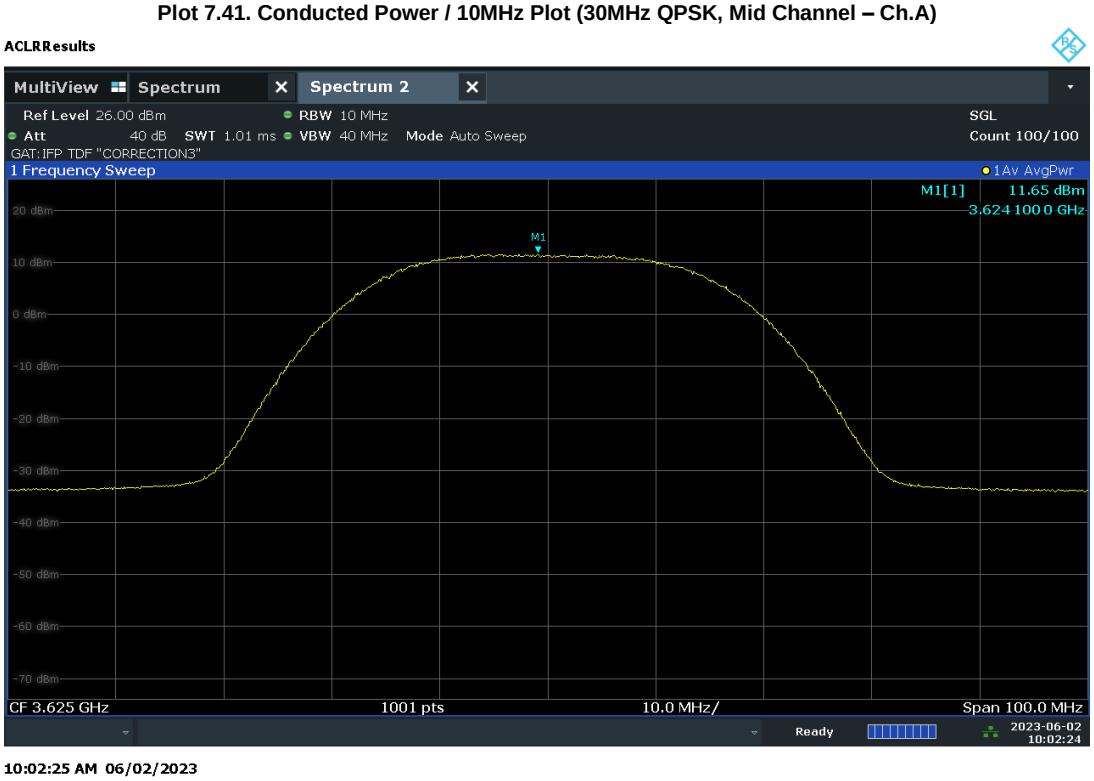
Plot 7.39. Conducted Power / 10MHz Plot (20MHz 64QAM, Mid Channel – Ch.A)



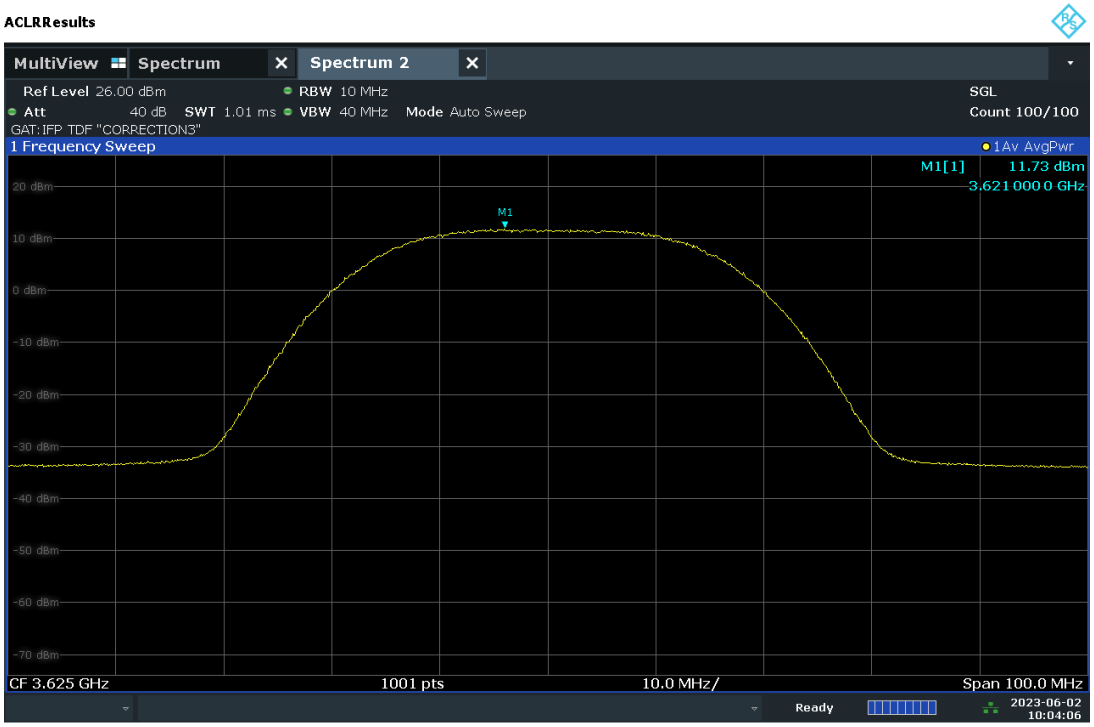
Plot 7.40. Conducted Power / 10MHz Plot (20MHz 256QAM, Mid Channel – Ch.A)



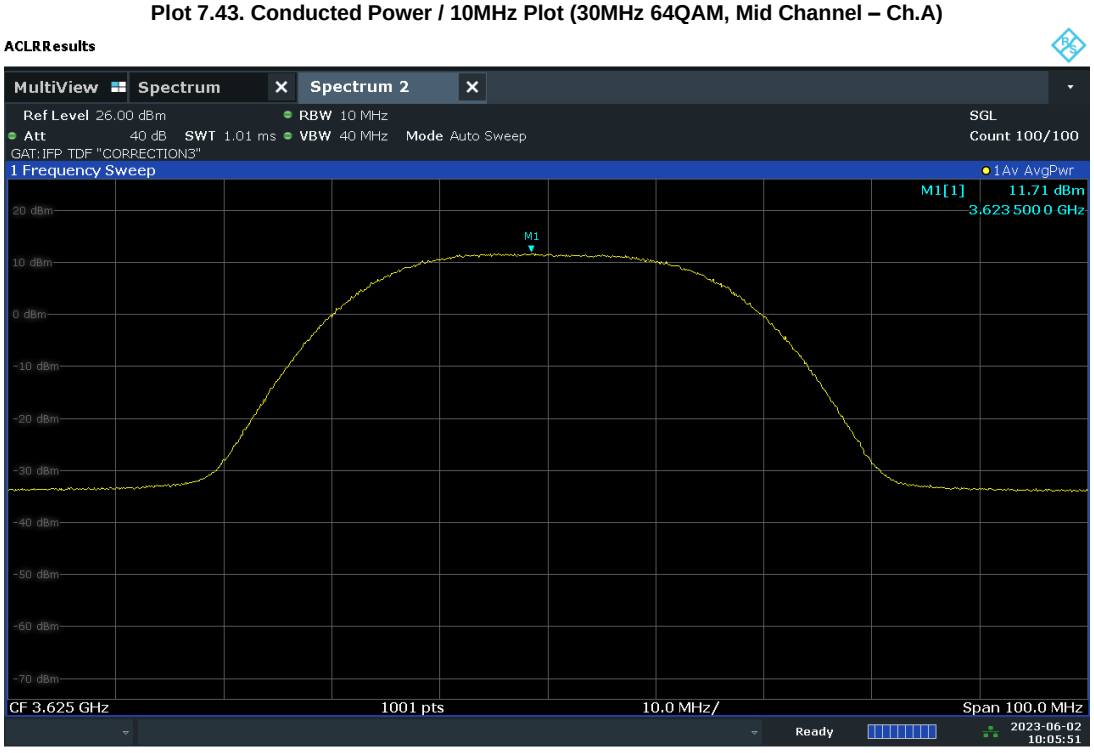
Plot 7.41. Conducted Power / 10MHz Plot (30MHz QPSK, Mid Channel – Ch.A)



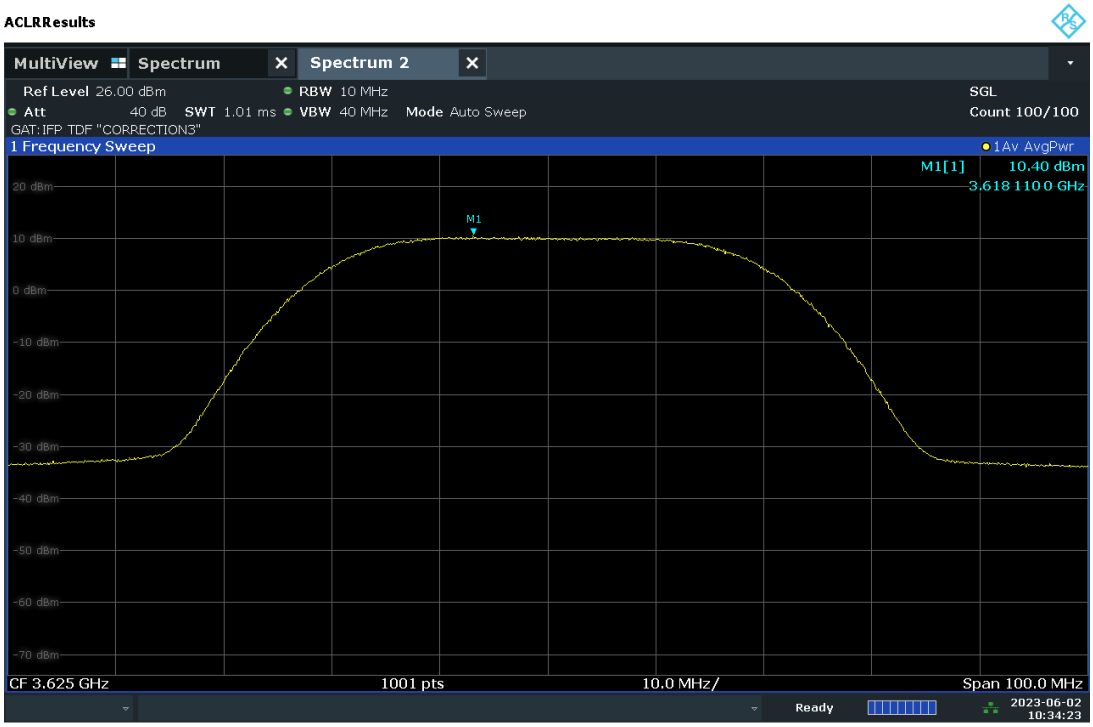
Plot 7.42. Conducted Power / 10MHz Plot (30MHz 16QAM, Mid Channel – Ch.A)



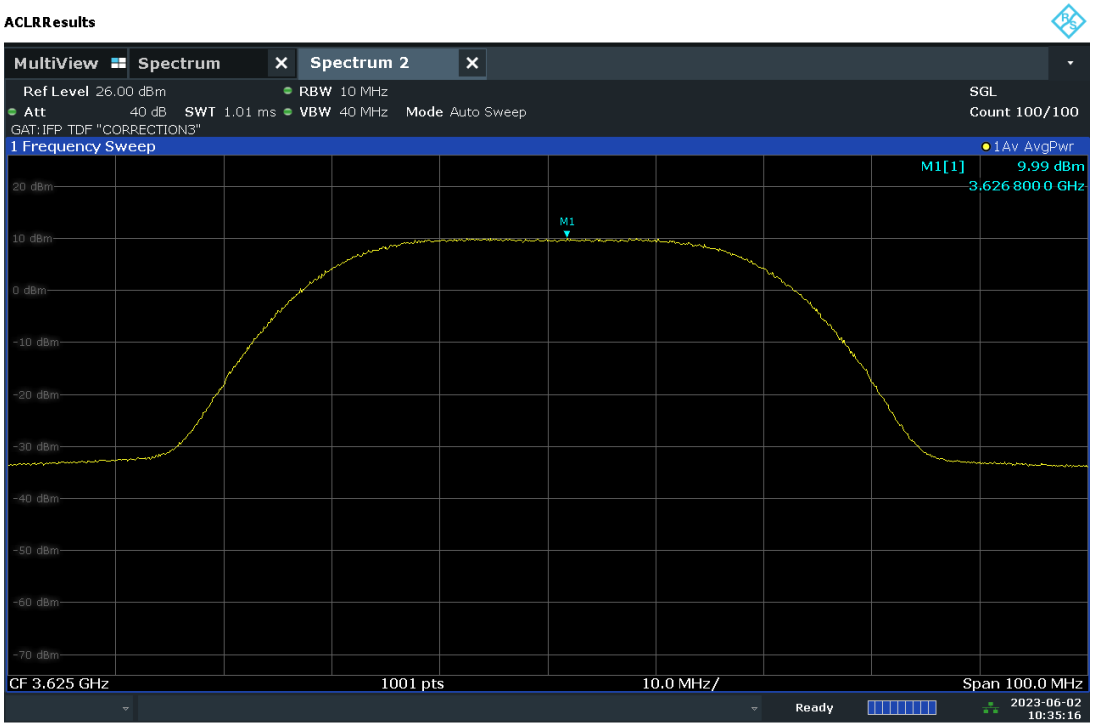
Plot 7.43. Conducted Power / 10MHz Plot (30MHz 64QAM, Mid Channel – Ch.A)



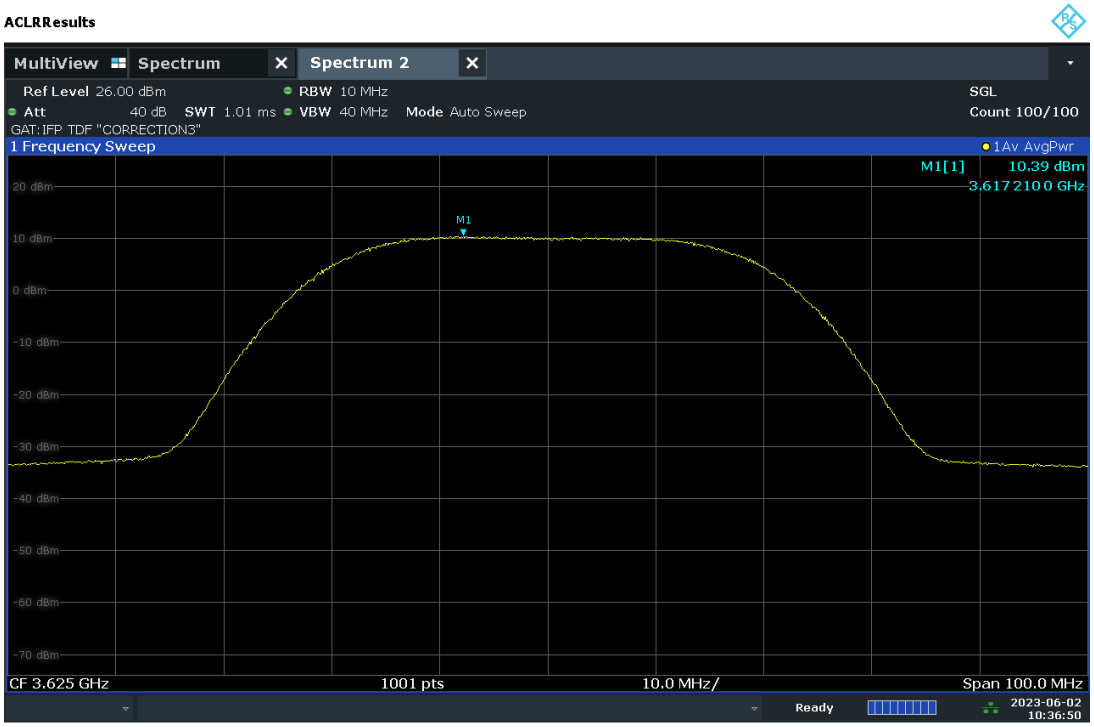
Plot 7.44. Conducted Power / 10MHz Plot (30MHz 256QAM, Mid Channel – Ch.A)



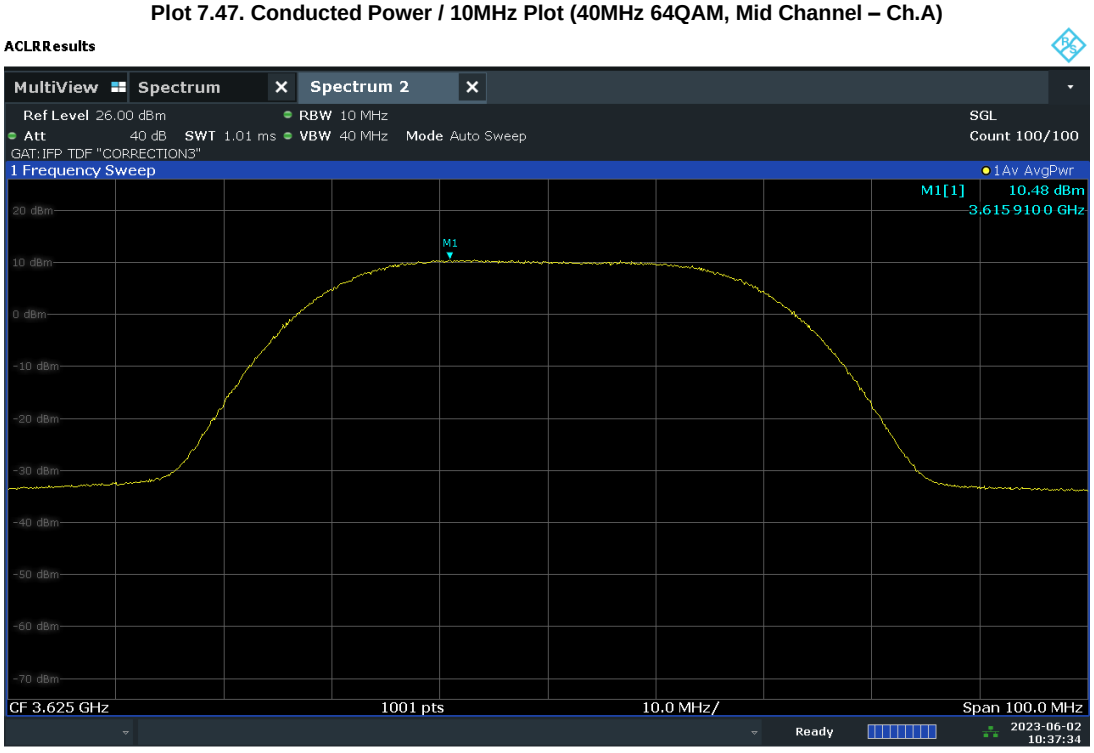
Plot 7.45. Conducted Power / 10MHz Plot (40MHz QPSK, Mid Channel – Ch.A)



Plot 7.46. Conducted Power / 10MHz Plot (40MHz 16QAM, Mid Channel – Ch.A)

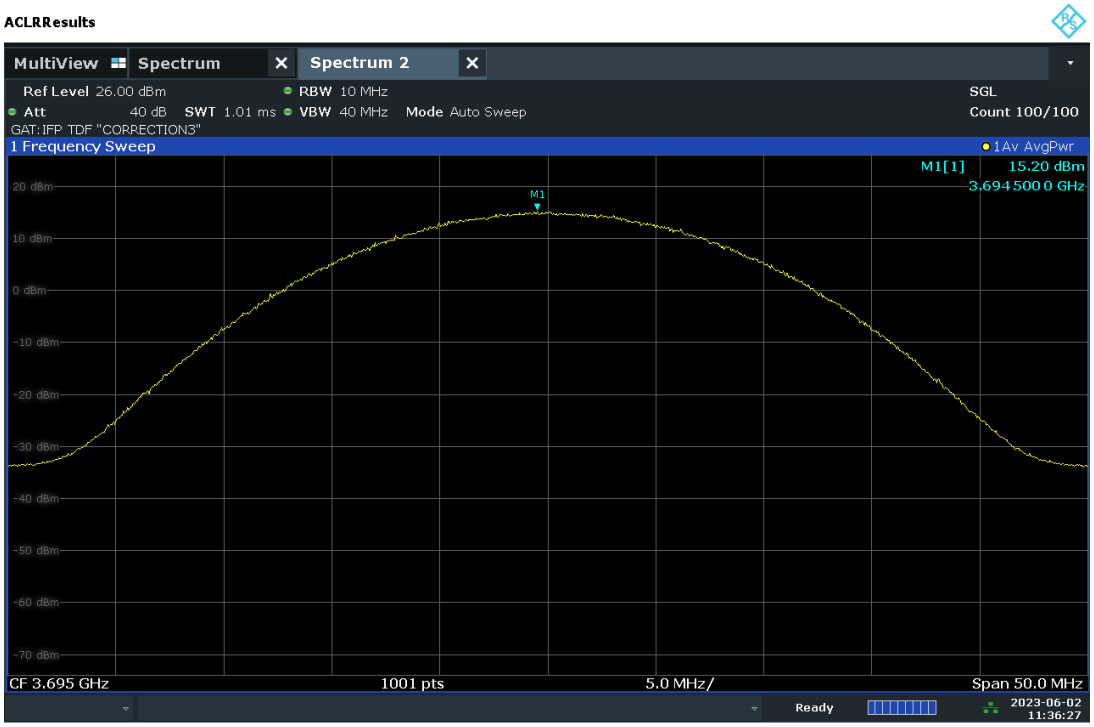


Plot 7.47. Conducted Power / 10MHz Plot (40MHz 64QAM, Mid Channel – Ch.A)

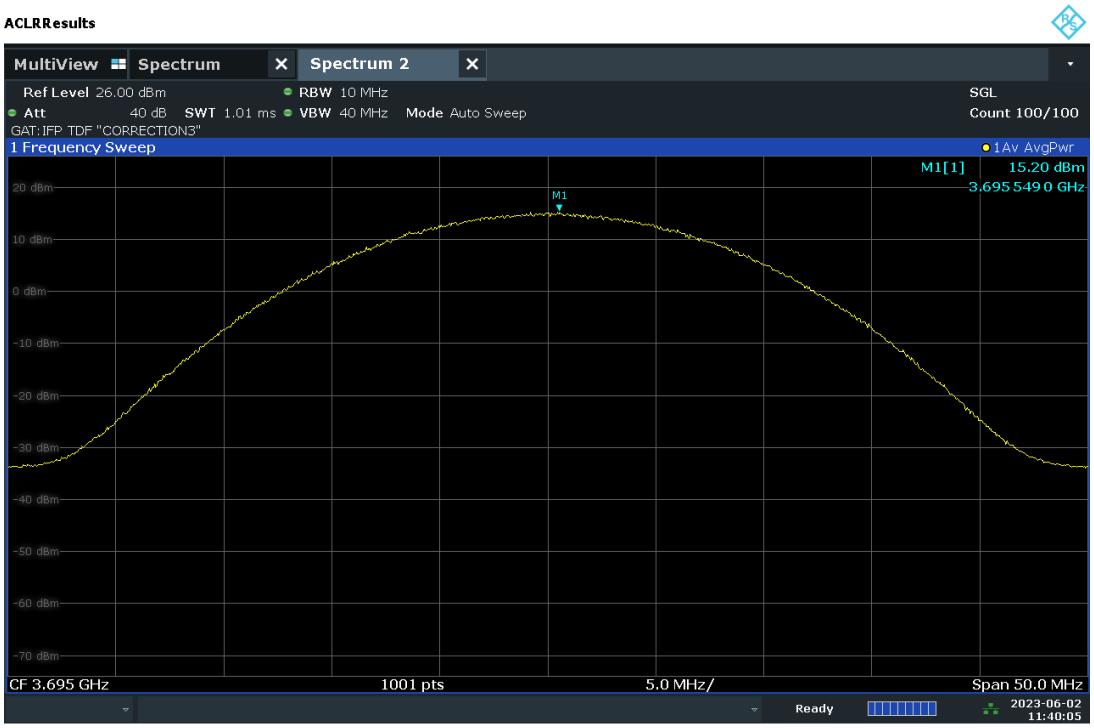


Plot 7.48. Conducted Power / 10MHz Plot (40MHz 256QAM, Mid Channel – Ch.A)

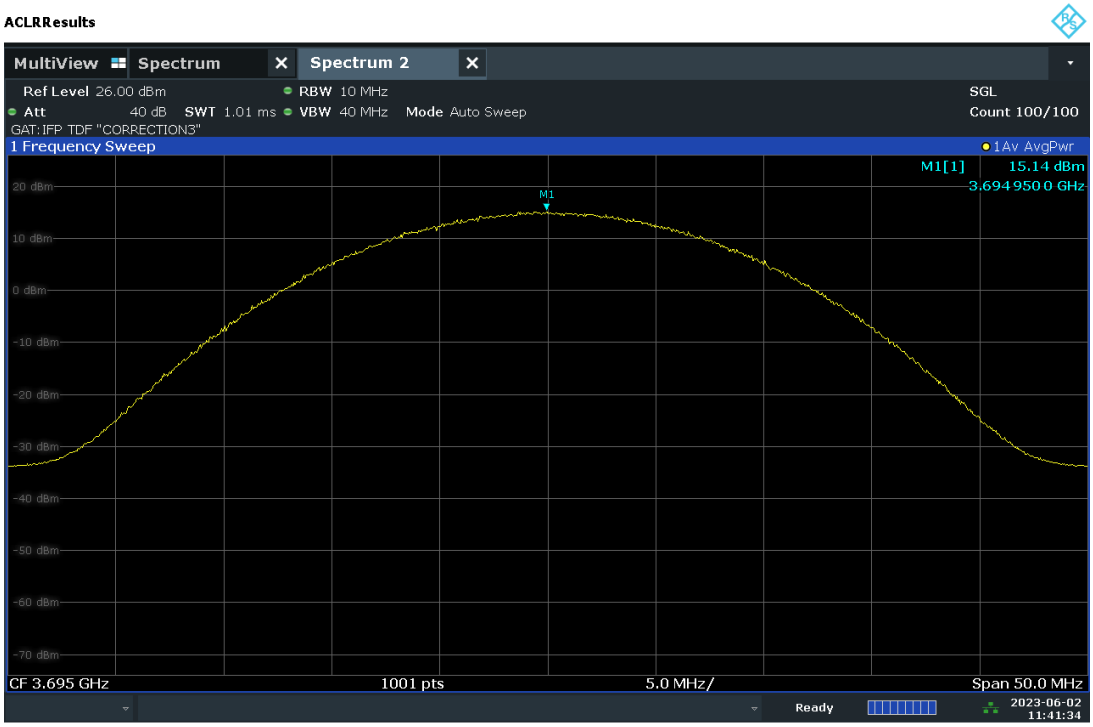
Channel B Conducted Power / 10MHz Measurements



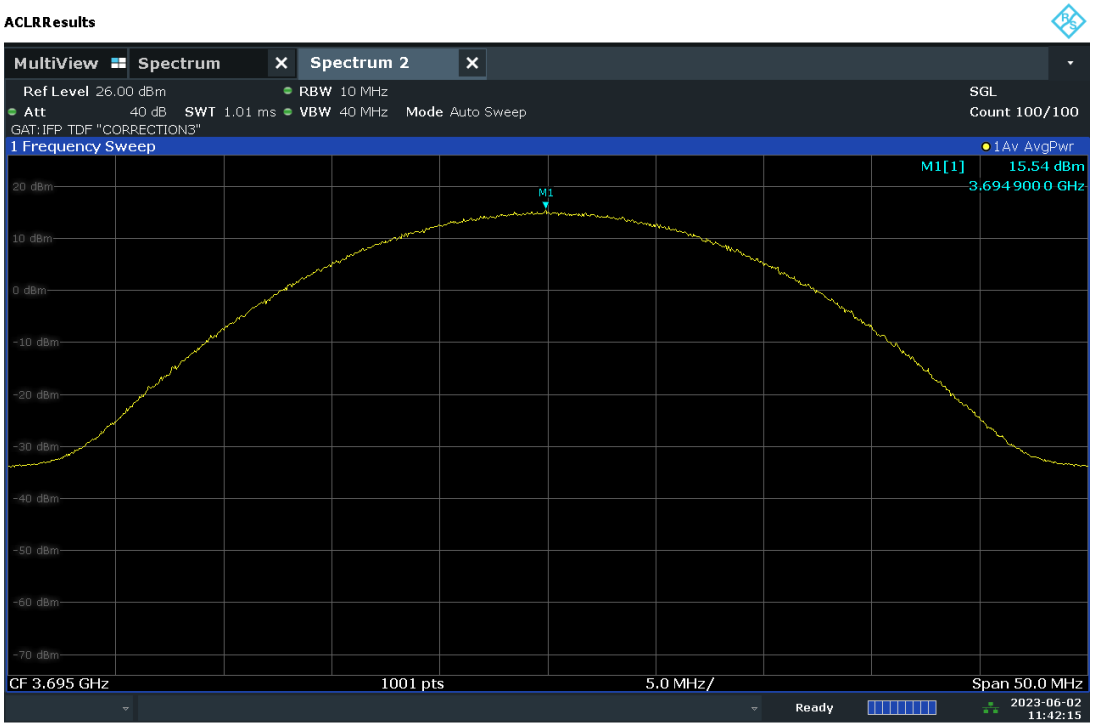
Plot 7.49. Conducted Power / 10MHz Plot (10MHz QPSK, High Channel – Ch.B)



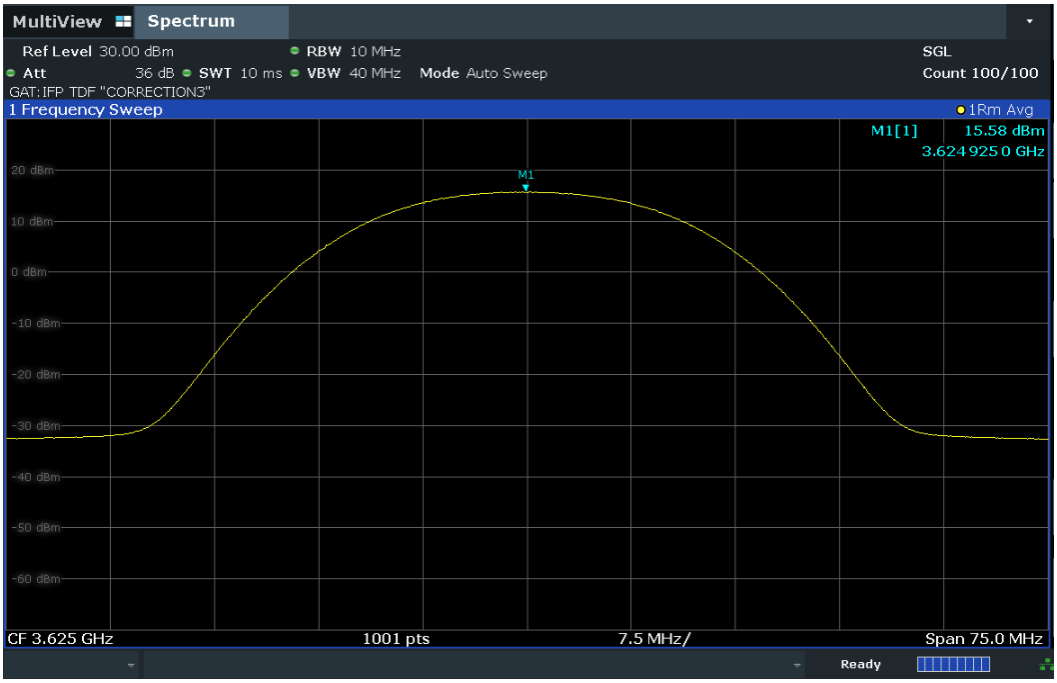
Plot 7.50. Conducted Power / 10MHz Plot (10MHz 16QAM, High Channel – Ch.B)



Plot 7.51. Conducted Power / 10MHz Plot (10MHz 64QAM, High Channel – Ch.B)

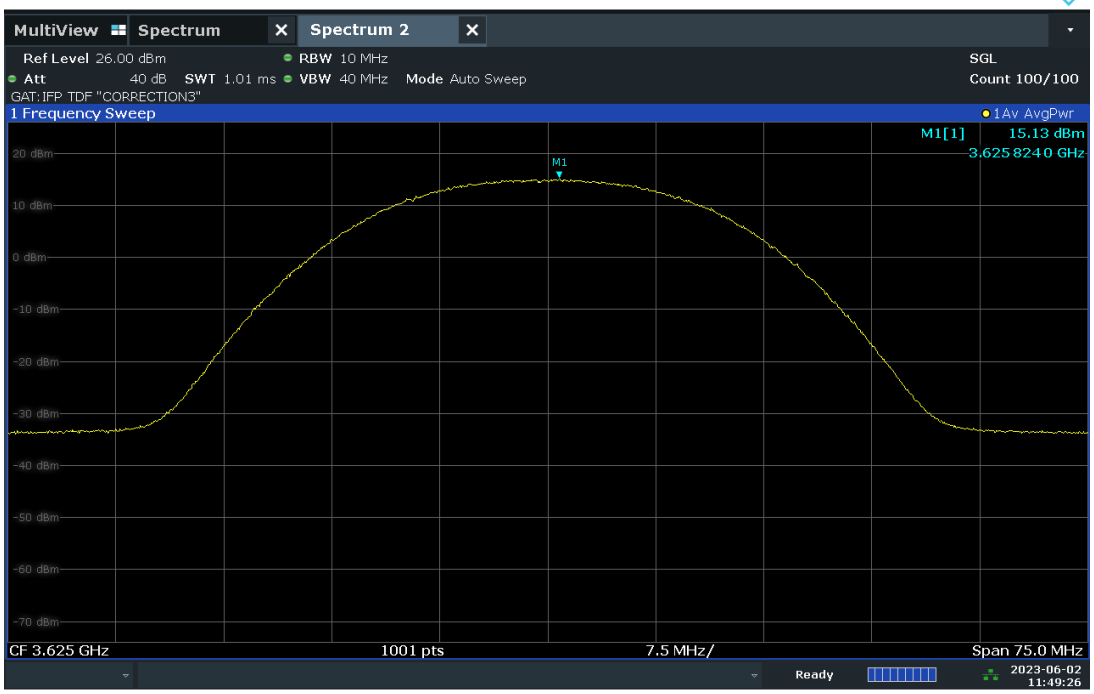


Plot 7.52. Conducted Power / 10MHz Plot (10MHz 256QAM, High Channel – Ch.B)



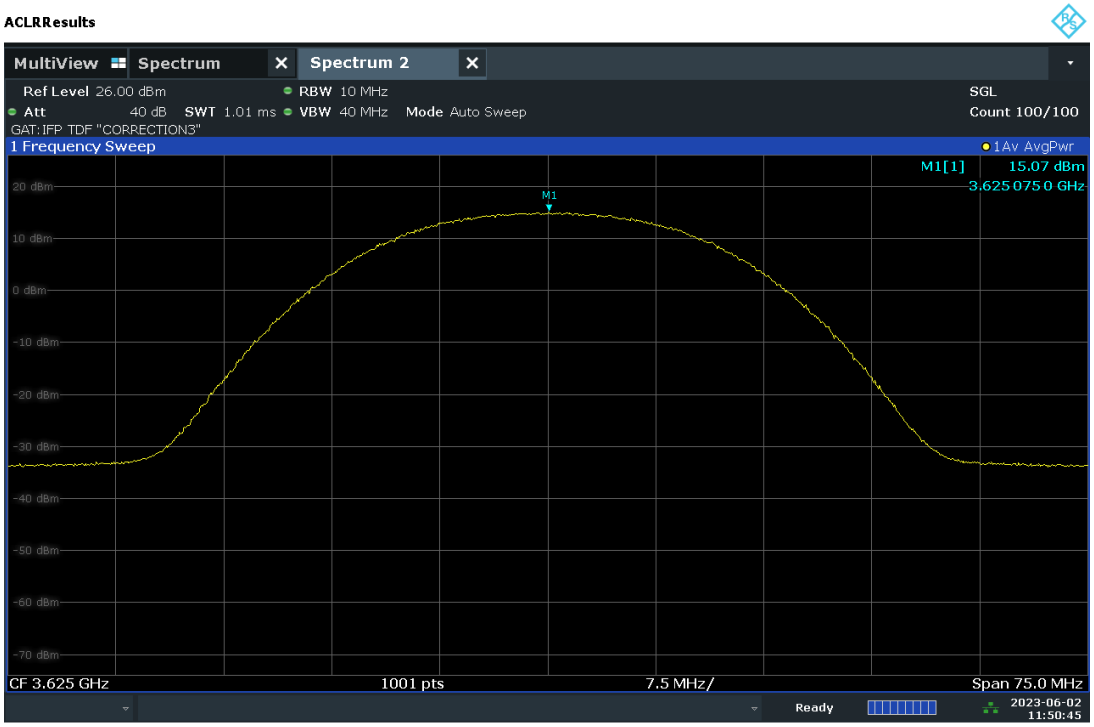
Plot 7.53. Conducted Power / 10MHz Plot (20MHz QPSK, Mid Channel – Ch.B)

ACLRResults

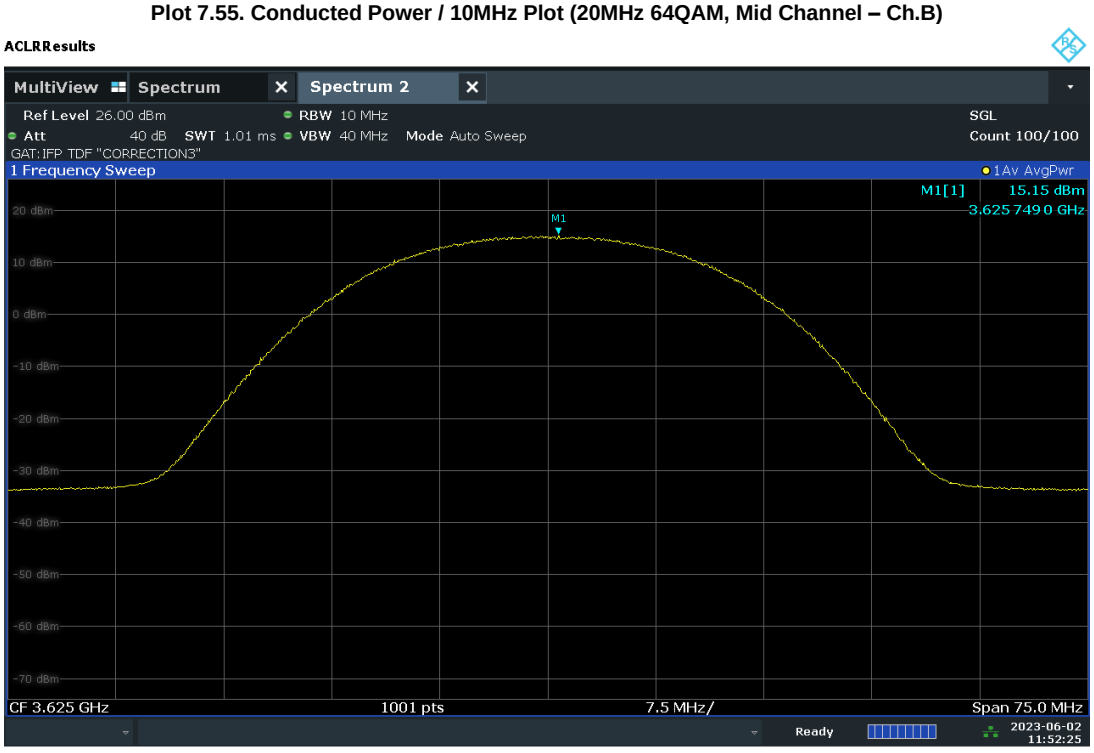


11:49:27 AM 06/02/2023

Plot 7.54. Conducted Power / 10MHz Plot (20MHz 16QAM, Mid Channel – Ch.B)

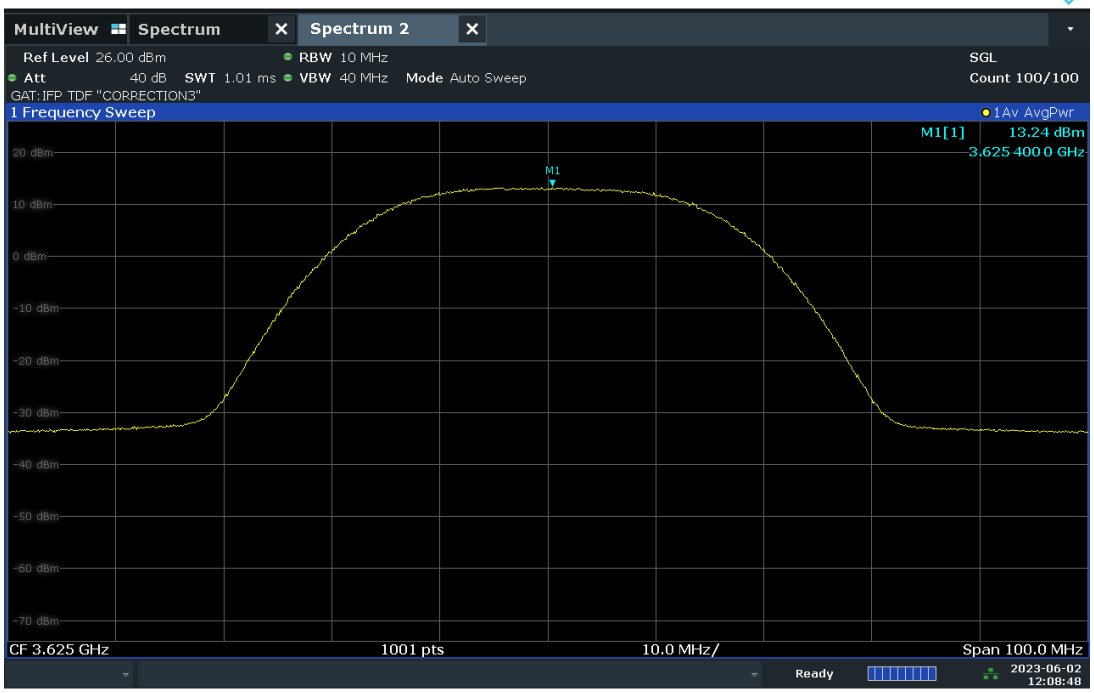


Plot 7.55. Conducted Power / 10MHz Plot (20MHz 64QAM, Mid Channel – Ch.B)



Plot 7.56. Conducted Power / 10MHz Plot (20MHz 256QAM, Mid Channel – Ch.B)

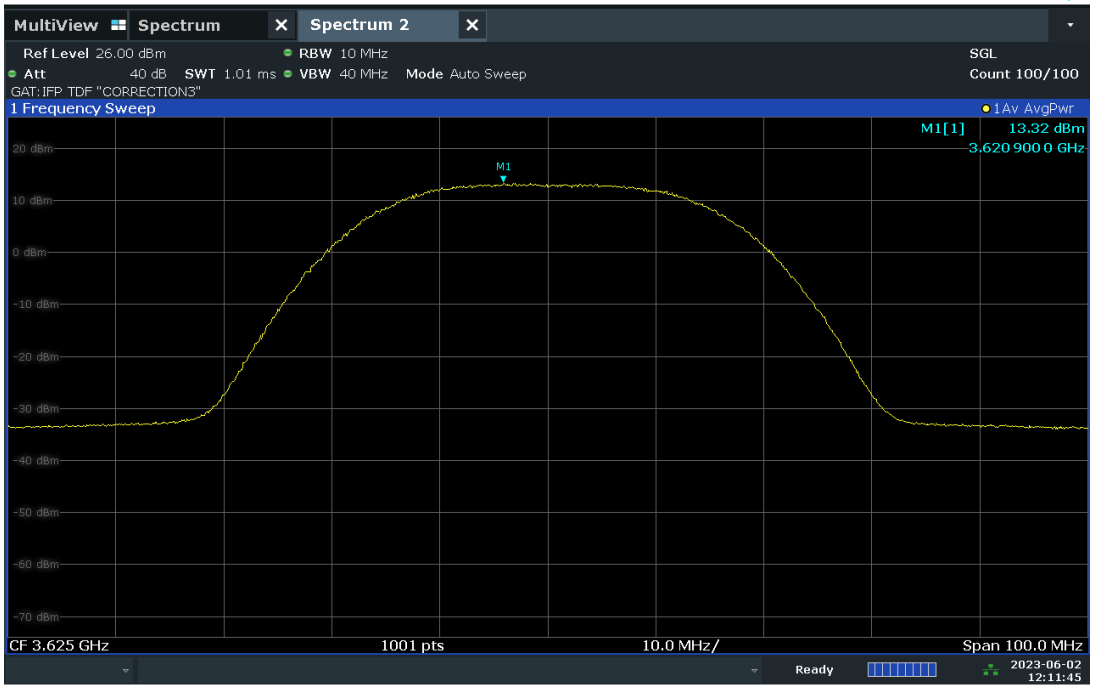
ACLRResults



12:08:48 PM 06/02/2023

Plot 7.57. Conducted Power / 10MHz Plot (30MHz QPSK, Mid Channel – Ch.B)

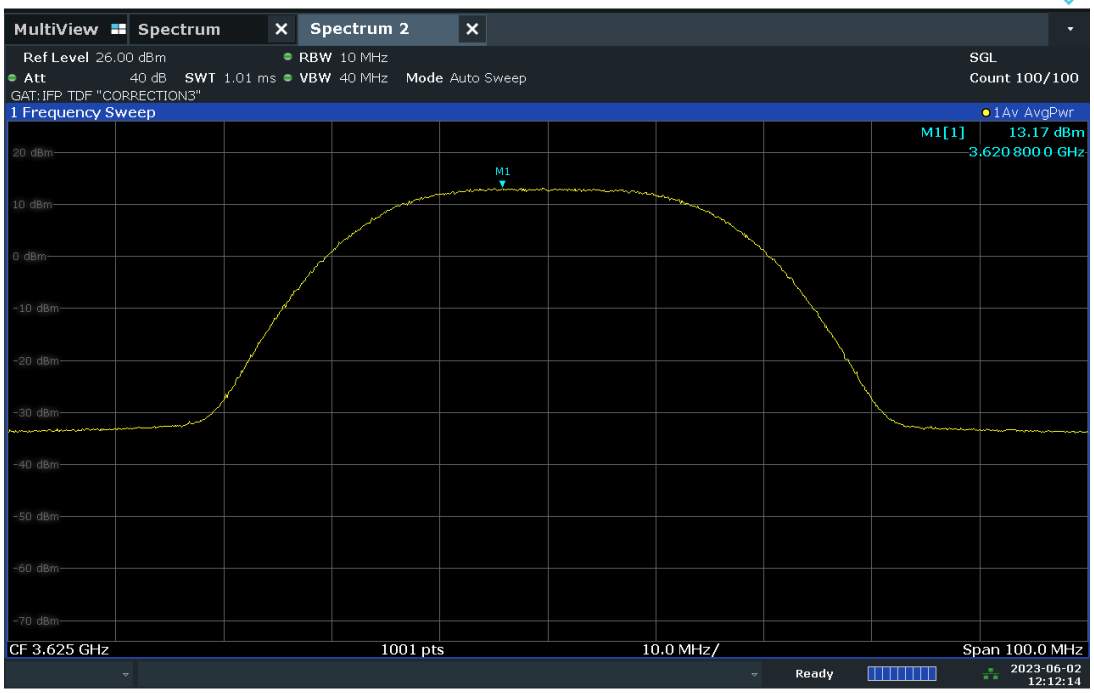
ACLRResults



12:11:46 PM 06/02/2023

Plot 7.58. Conducted Power / 10MHz Plot (30MHz 16QAM, Mid Channel – Ch.B)

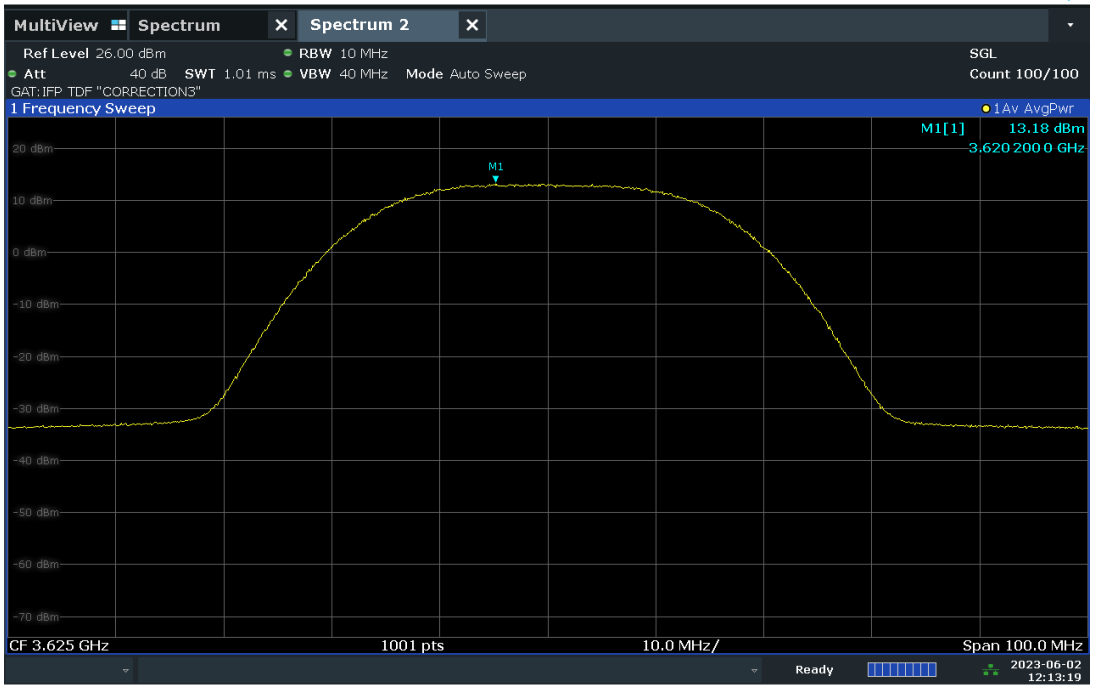
ACLRResults



12:12:15 PM 06/02/2023

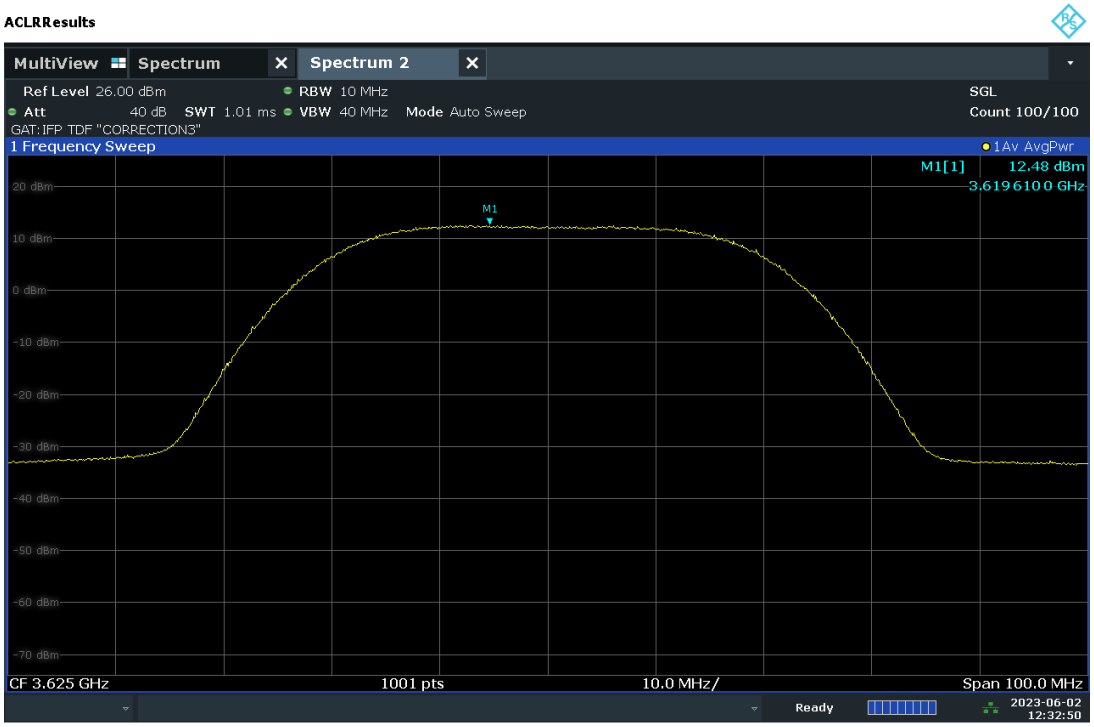
Plot 7.59. Conducted Power / 10MHz Plot (30MHz 64QAM, Mid Channel – Ch.B)

ACLRResults



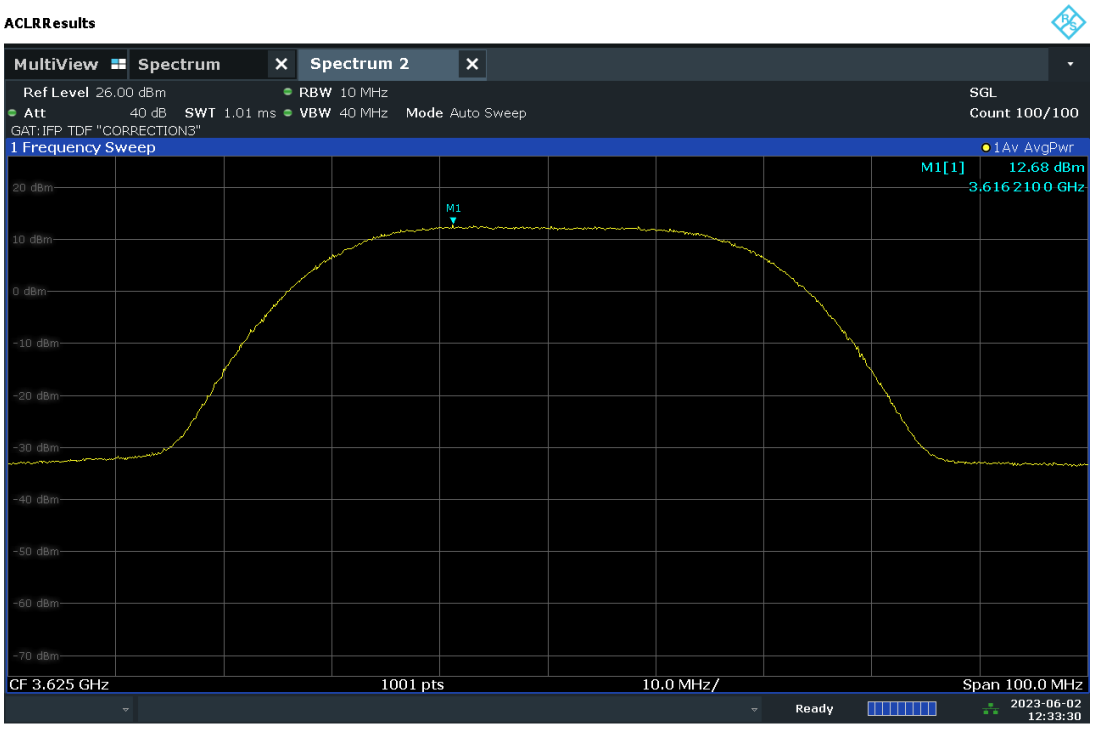
12:13:19 PM 06/02/2023

Plot 7.60. Conducted Power / 10MHz Plot (30MHz 256QAM, Mid Channel – Ch.B)



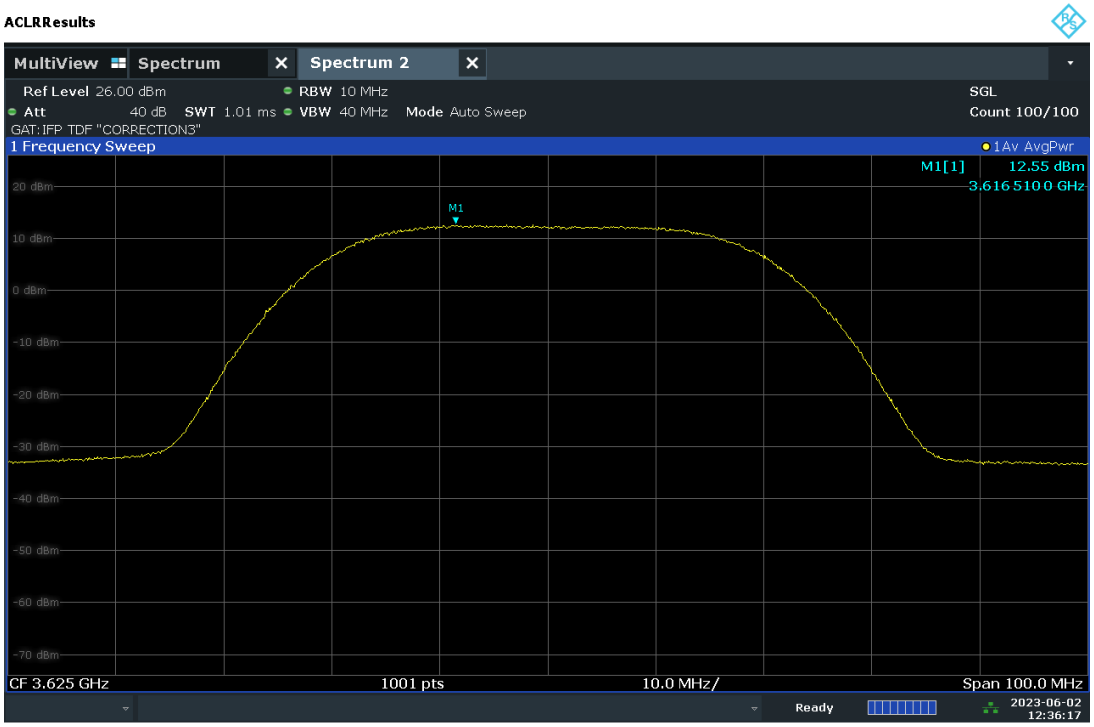
12:32:50 PM 06/02/2023

Plot 7.61. Conducted Power / 10MHz Plot (40MHz QPSK, Mid Channel – Ch.B)

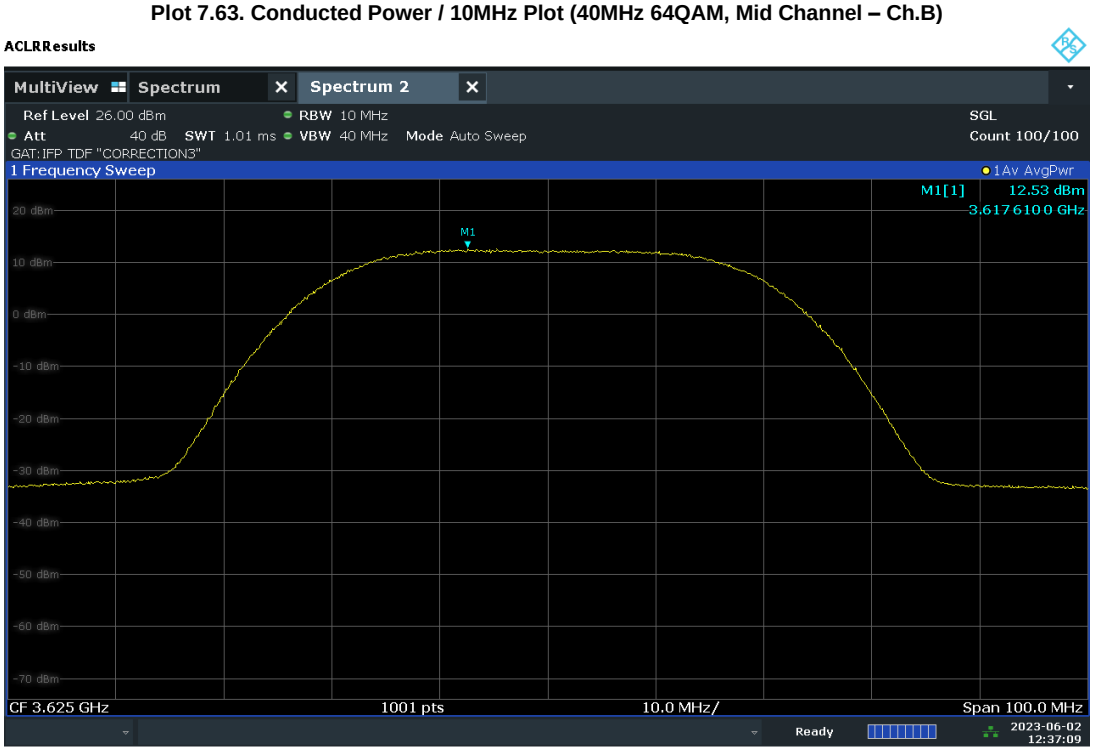


12:33:31 PM 06/02/2023

Plot 7.62. Conducted Power / 10MHz Plot (40MHz 16QAM, Mid Channel – Ch.B)



Plot 7.63. Conducted Power / 10MHz Plot (40MHz 64QAM, Mid Channel – Ch.B)



Plot 7.64. Conducted Power / 10MHz Plot (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 Antenna 1 and Antenna 2 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 orthognally polarized and with beamforming applies, the directional gain is 18.61dBi.

Sample MIMO Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average conducted power spectral density was measured to be 13.97 dBm/10MHz for Channel A and 15.13 dBm/10MHz for Channel B.

Antenna 1 + Antenna 2 = MIMO

(13.97 dBm/10MHz + 15.13 dBm/10MHz) = (24.946 mW/10MHz + 32.584 mW/10MHz) = 57.530 mW/10MHz = 17.60 dBm/10MHz

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 19.68 dBm with directional gain of 18.61 dBi.

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

17.60 dBm/10MHz + 10.16 dBi = 27.76 dBm/10MHz

7.4 Conducted 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 gated as to only measure during on periods.

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

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 = 10MHz
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 7-3. Test Instrument & Measurement Setup

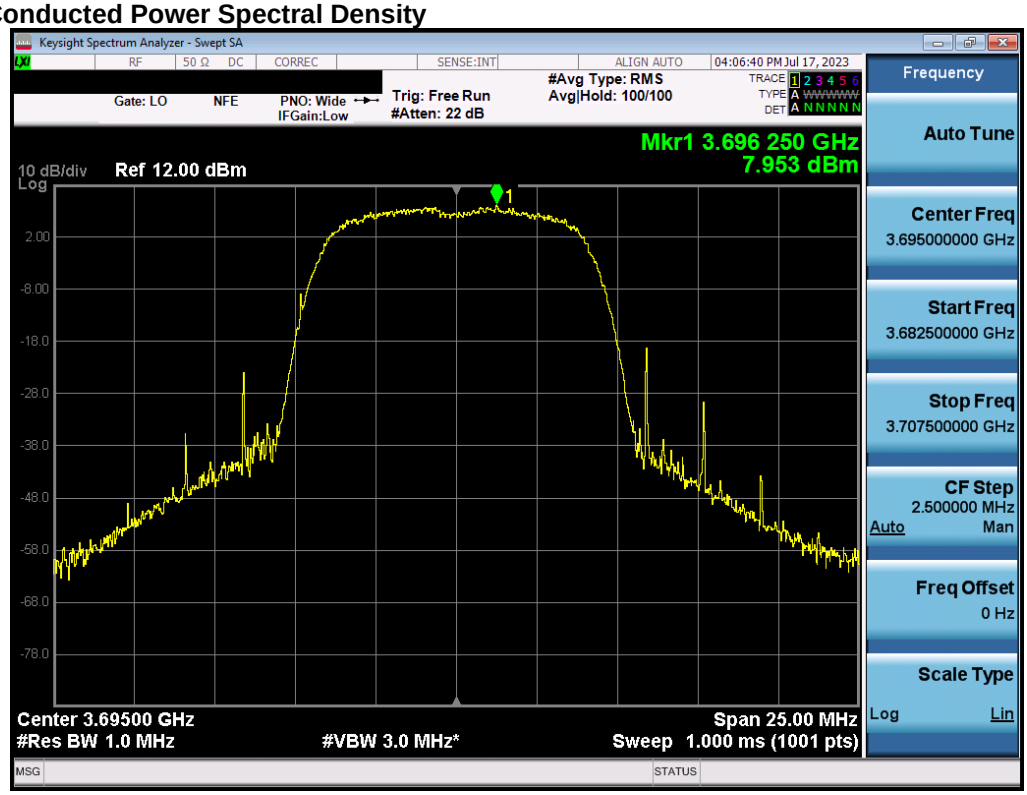
Test Notes

A scaling factor of 10log(7) was added to obtain the total output summed across all 7 modules.

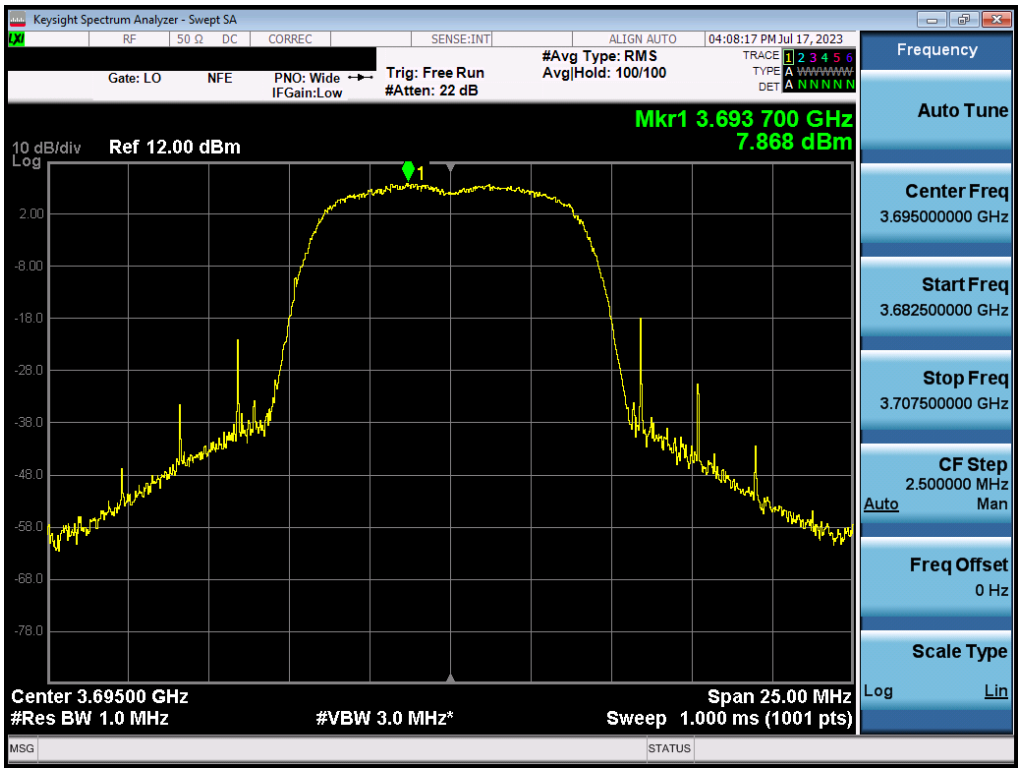
Bandwidth	Modulation	Frequency [MHz]	Ch. A Conducted PSD [dBm/MHz]	Ch. B Conducted PSD [dBm/MHz]	Summed MIMO Conducted PSD [dBm/MHz]	Summed MIMO Conducted PSD [dBm] - All Modules	Ant Gain [dBi]	EIRP PSD [dBm/MHz]	EIRP PSD [Watts/MHz]	EIRP PSD Limit [dBm/MHz]	Margin [dB]
40 MHz	QPSK	3570.0	-2.25	-2.88	0.45	8.90	10.16	19.06	0.081	37.00	-17.94
		3625.0	3.13	4.18	6.69	15.14	10.16	25.30	0.339	37.00	-11.70
		3680.0	0.10	-0.51	2.82	11.27	10.16	21.43	0.139	37.00	-15.57
	16-QAM	3570.0	-2.99	-2.75	0.15	8.60	10.16	18.76	0.075	37.00	-18.24
		3625.0	3.38	4.05	6.74	15.19	10.16	25.35	0.343	37.00	-11.65
		3680.0	0.04	-0.54	2.77	11.22	10.16	21.38	0.137	37.00	-15.62
	64-QAM	3570.0	-2.56	-2.88	0.29	8.74	10.16	18.90	0.078	37.00	-18.10
		3625.0	2.67	3.93	6.36	14.81	10.16	24.97	0.314	37.00	-12.03
		3680.0	0.31	-0.49	2.94	11.39	10.16	21.55	0.143	37.00	-15.45
	256-QAM	3570.0	-3.04	-2.70	0.15	8.60	10.16	18.76	0.075	37.00	-18.24
		3625.0	2.61	4.17	6.47	14.92	10.16	25.08	0.322	37.00	-11.92
		3680.0	-0.11	-0.57	2.68	11.13	10.16	21.29	0.135	37.00	-15.71
30 MHz	QPSK	3565.0	-1.54	-2.95	0.82	9.27	10.16	19.43	0.088	37.00	-17.57
		3625.0	4.47	4.65	7.57	16.02	10.16	26.18	0.415	37.00	-10.82
		3685.0	1.91	2.03	4.98	13.43	10.16	23.59	0.229	37.00	-13.41
	16-QAM	3565.0	-1.02	-2.25	1.42	9.87	10.16	20.03	0.101	37.00	-16.97
		3625.0	4.64	4.61	7.63	16.09	10.16	26.25	0.421	37.00	-10.75
		3685.0	1.98	2.03	5.02	13.47	10.16	23.63	0.231	37.00	-13.37
	64-QAM	3565.0	-1.60	-2.21	1.12	9.57	10.16	19.73	0.094	37.00	-17.27
		3625.0	4.69	4.62	7.66	16.11	10.16	26.27	0.424	37.00	-10.73
		3685.0	2.02	2.01	5.03	13.48	10.16	23.64	0.231	37.00	-13.36
	256-QAM	3565.0	-1.05	-2.26	1.40	9.85	10.16	20.01	0.100	37.00	-16.99
		3625.0	3.63	4.59	7.15	15.60	10.16	25.76	0.376	37.00	-11.24
		3685.0	2.16	2.01	5.10	13.55	10.16	23.71	0.235	37.00	-13.29
20 MHz	QPSK	3560.0	-0.63	-0.42	2.49	10.94	10.16	21.10	0.129	37.00	-15.90
		3625.0	6.06	6.83	9.47	17.92	10.16	28.08	0.643	37.00	-8.92
		3690.0	2.99	3.84	6.44	14.90	10.16	25.06	0.320	37.00	-11.94
	16-QAM	3560.0	0.29	-0.43	2.95	11.40	10.16	21.56	0.143	37.00	-15.44
		3625.0	6.04	6.92	9.52	17.97	10.16	28.13	0.650	37.00	-8.87
		3690.0	2.83	3.80	6.35	14.80	10.16	24.96	0.313	37.00	-12.04
	64-QAM	3560.0	0.24	-0.41	2.94	11.39	10.16	21.55	0.143	37.00	-15.45
		3625.0	5.71	6.78	9.29	17.74	10.16	27.90	0.617	37.00	-9.10
		3690.0	2.65	3.83	6.29	14.74	10.16	24.90	0.309	37.00	-12.10
	256-QAM	3560.0	0.32	-0.28	3.04	11.49	10.16	21.65	0.146	3.00	18.65
		3625.0	5.98	6.74	9.39	17.84	10.16	28.00	0.630	37.00	-9.00
		3690.0	2.79	3.63	6.24	14.69	10.16	24.85	0.305	37.00	-12.15
10 MHz	QPSK	3555.0	5.25	3.86	7.62	16.07	10.16	26.23	0.420	37.00	-10.77
		3625.0	6.77	6.70	9.74	18.19	10.16	28.35	0.685	37.00	-8.65
		3695.0	7.95	8.88	11.45	19.90	10.16	30.06	1.014	37.00	-6.94
	16-QAM	3555.0	5.53	3.91	7.81	16.26	10.16	26.42	0.439	37.00	-10.58
		3625.0	6.58	6.80	9.70	18.15	10.16	28.31	0.677	37.00	-8.69
		3695.0	7.87	8.90	11.43	19.88	10.16	30.04	1.008	37.00	-6.96
	64-QAM	3555.0	4.69	4.00	7.37	15.82	10.16	25.98	0.396	37.00	-11.02
		3625.0	7.15	6.85	10.01	18.46	10.16	28.62	0.728	37.00	-8.38
		3695.0	8.08	8.91	11.53	19.98	10.16	30.14	1.032	37.00	-6.86
	256-QAM	3555.0	4.57	4.06	7.34	15.79	10.16	25.95	0.393	37.00	-11.05
		3625.0	7.41	6.71	10.08	18.53	10.16	28.69	0.740	37.00	-8.31
		3695.0	7.86	8.76	11.35	19.80	10.16	29.96	0.990	37.00	-7.04

Table 7-4 E.I.R.P. Power Spectral Density Measurements

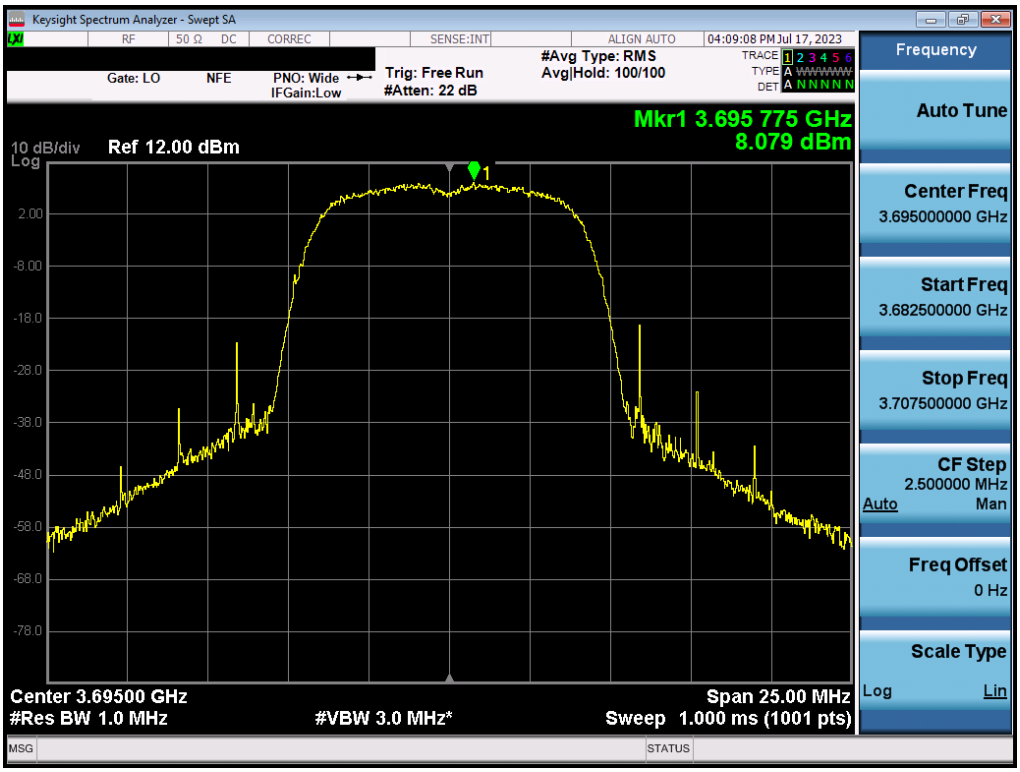
Channel A Conducted Power Spectral Density



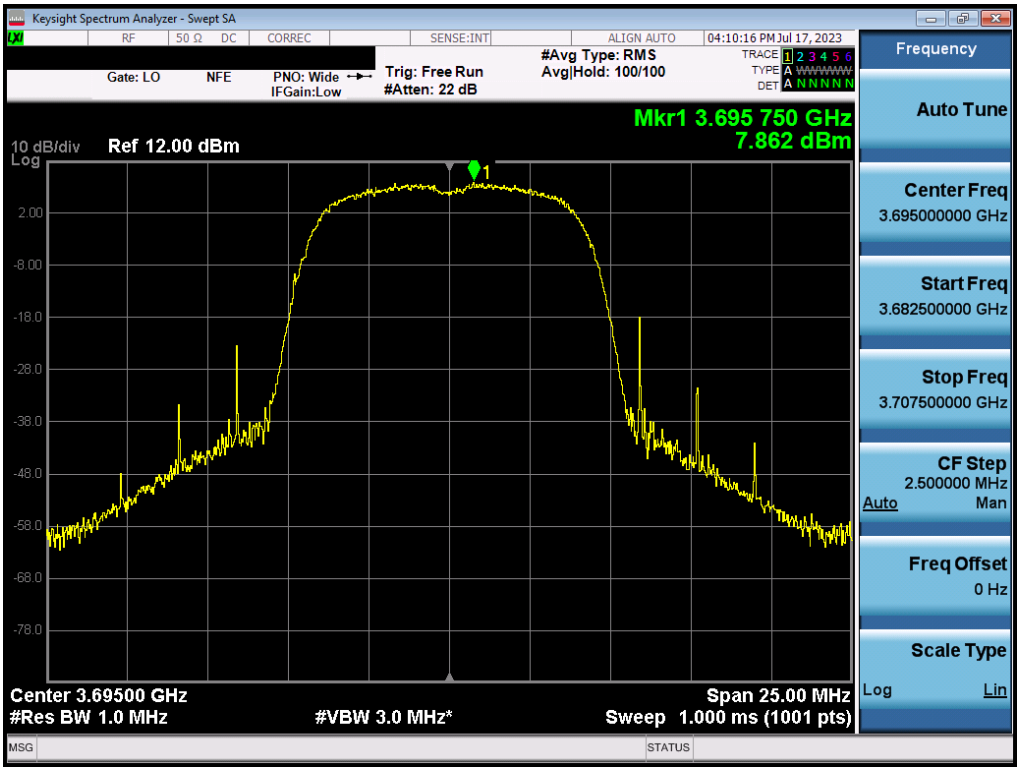
Plot 7.65. Conducted Power Spectral Density Plot (10MHz QPSK, High Channel – Ch.A)



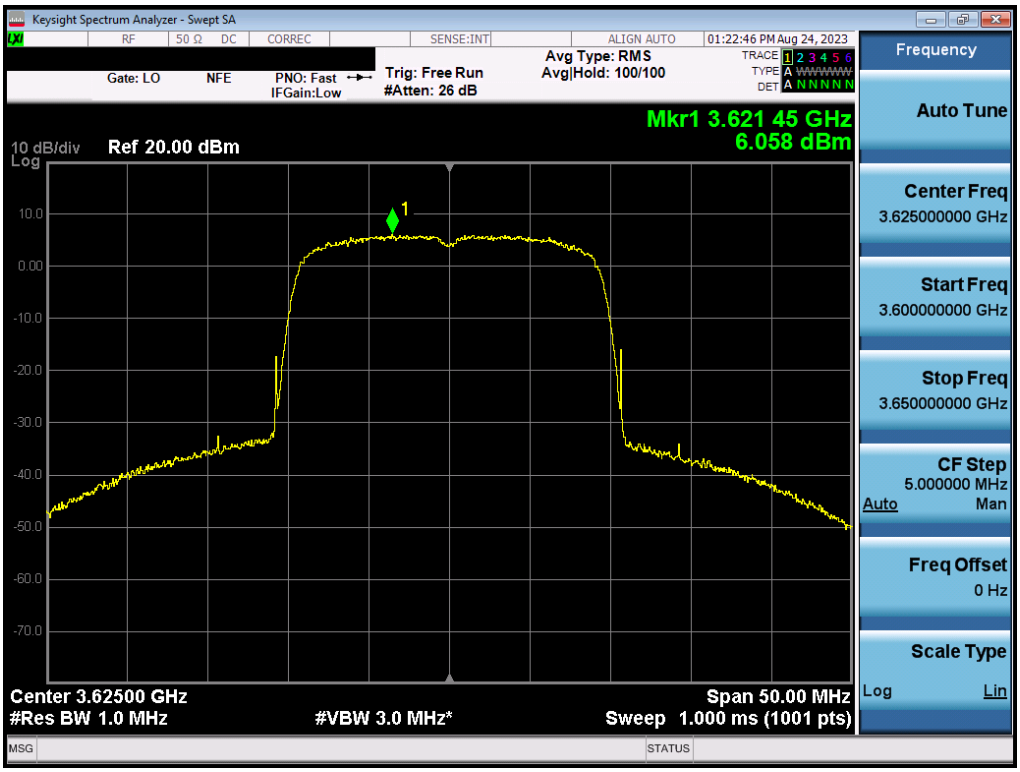
Plot 7.66. Conducted Power Spectral Density Plot (10MHz 16QAM, High Channel – Ch.A)



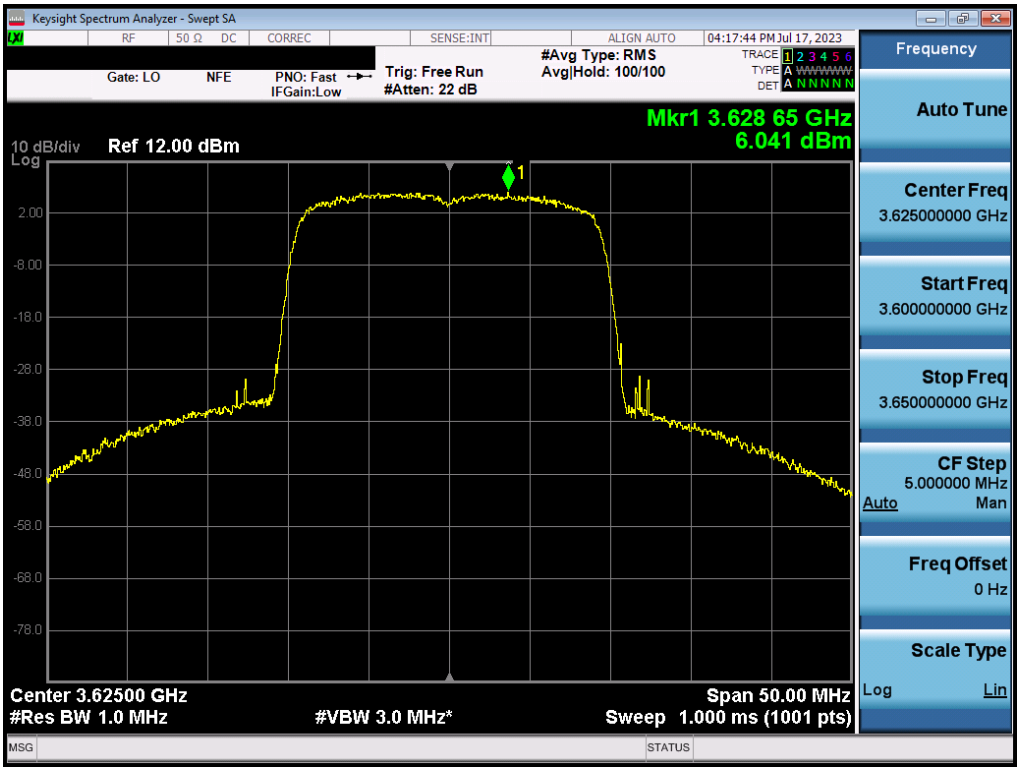
Plot 7.67. Conducted Power Spectral Density Plot (10MHz 64QAM, High Channel – Ch.A)



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

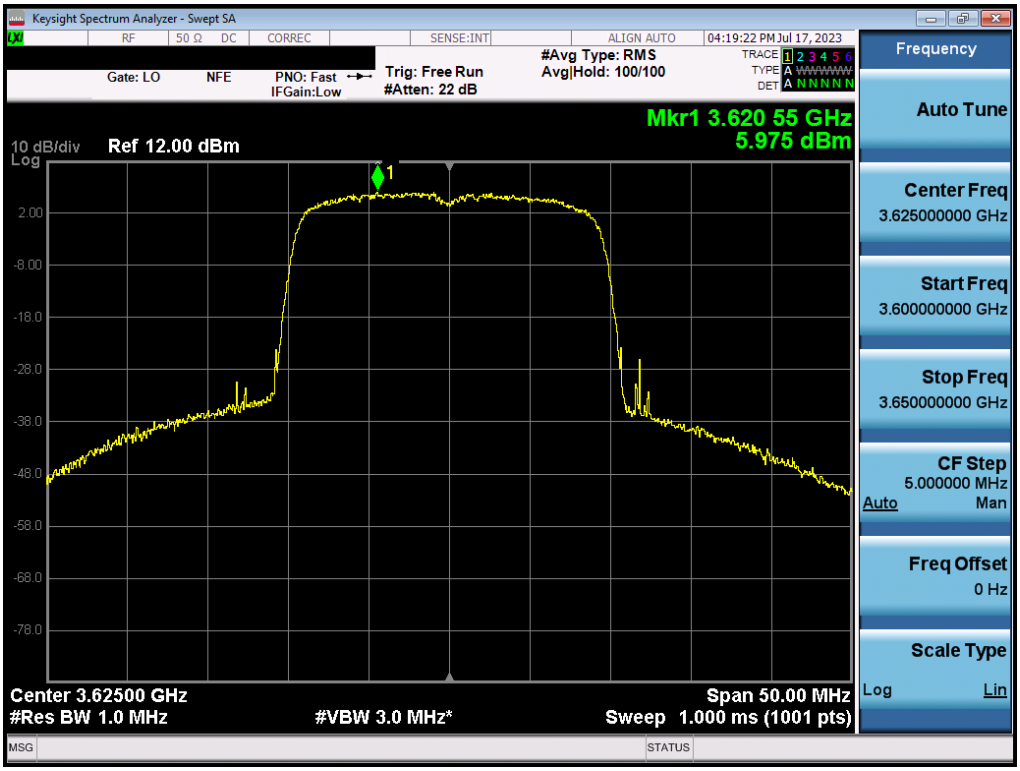


Plot 7.69. Conducted Power Spectral Density Plot (20MHz QPSK, Mid Channel – Ch.A)



Plot 7.70. Conducted Power Spectral Density Plot (20MHz 16QAM, Mid Channel – Ch.A)

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

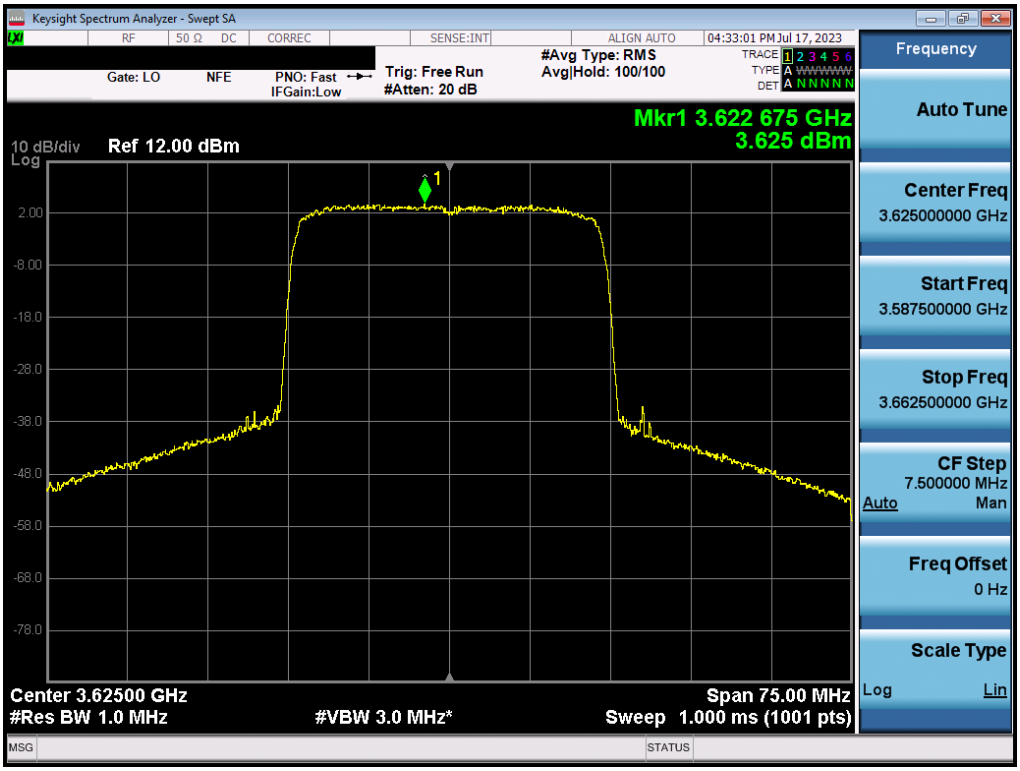


Plot 7.72. Conducted Power Spectral Density Plot (20MHz 256QAM, Mid Channel – Ch.A)

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

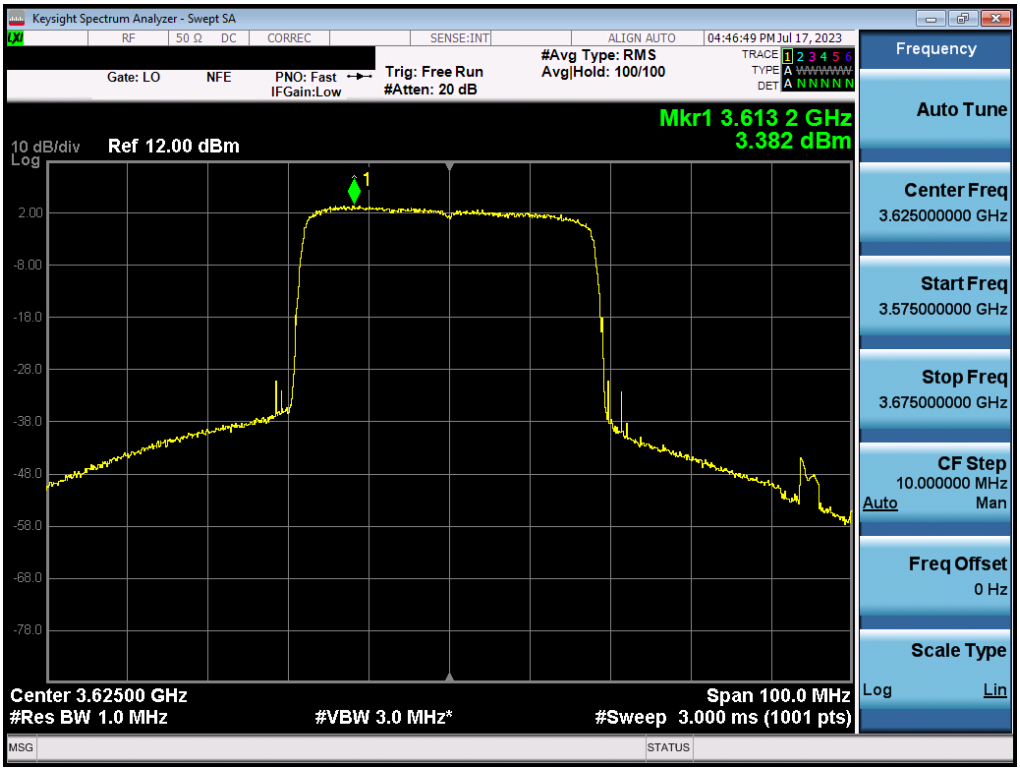
Plot 7.74. Conducted Power Spectral Density Plot (30MHz 16QAM, Mid Channel – Ch.A)

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



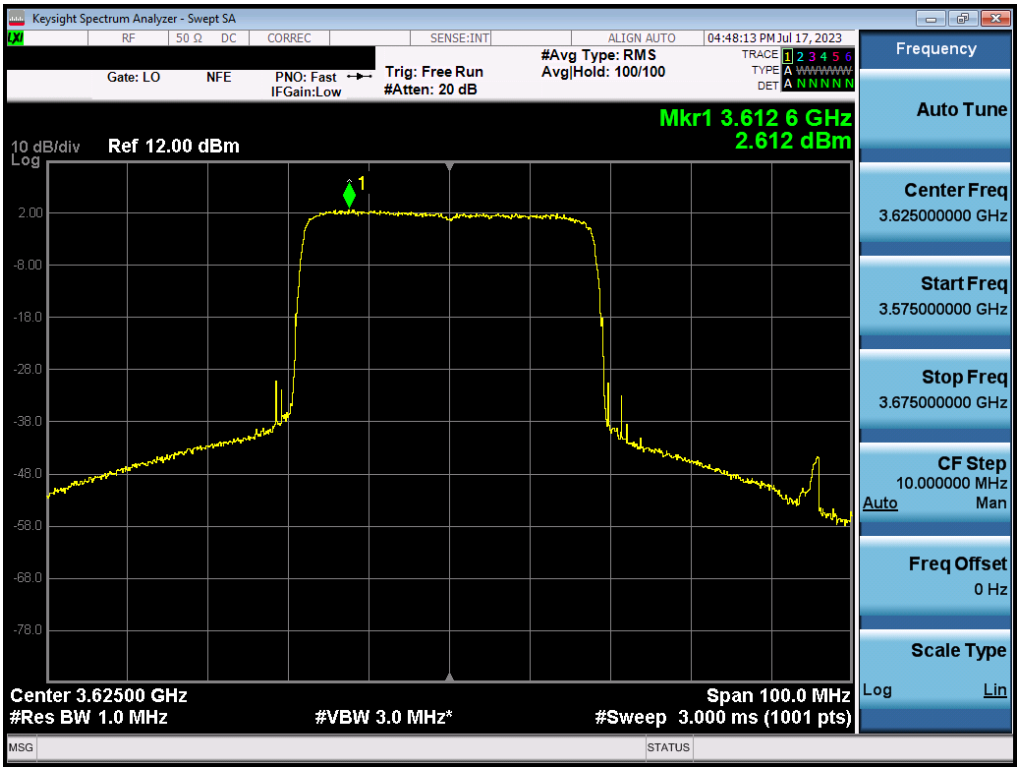
Plot 7.76. Conducted Power Spectral Density Plot (30MHz 256QAM, Mid Channel – Ch.A)

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



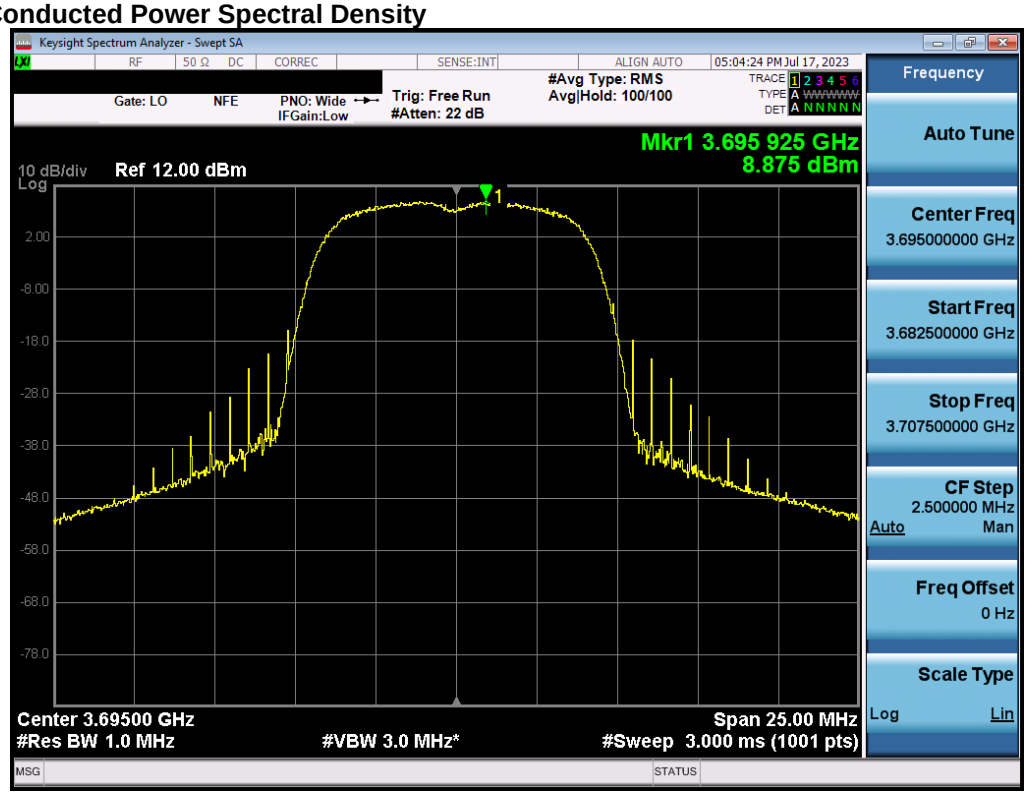
Plot 7.78. Conducted Power Spectral Density Plot (40MHz 16QAM, Mid Channel – Ch.A)

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

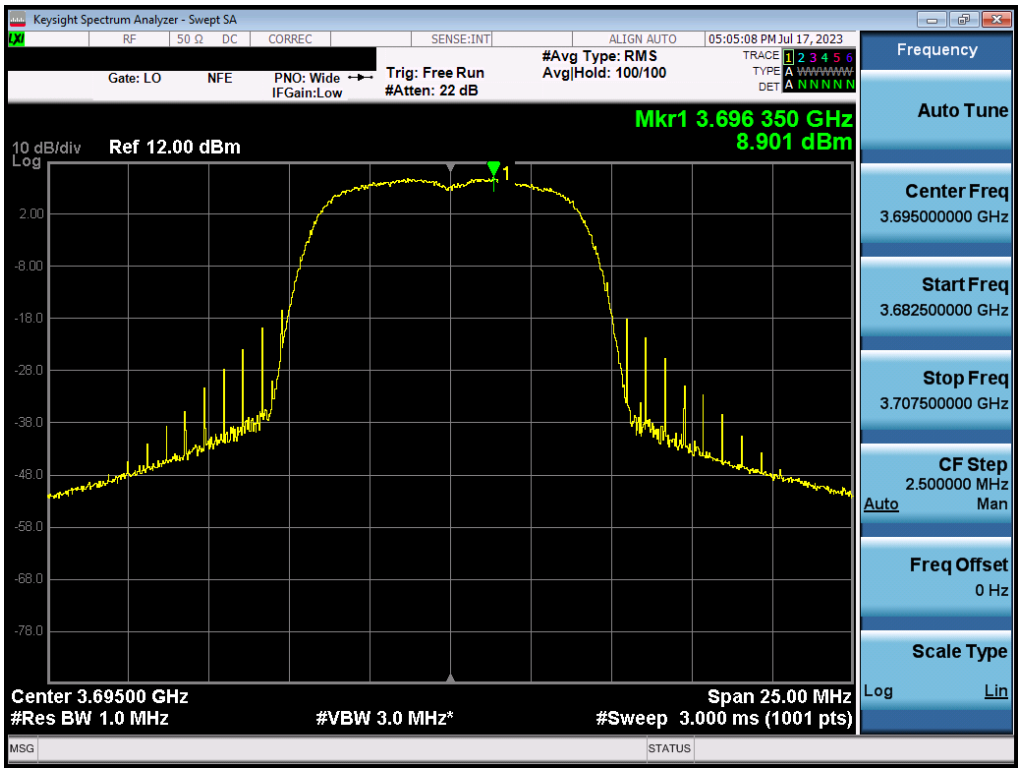


Plot 7.80. Conducted Power Spectral Density Plot (40MHz 256QAM, Mid Channel – Ch.A)

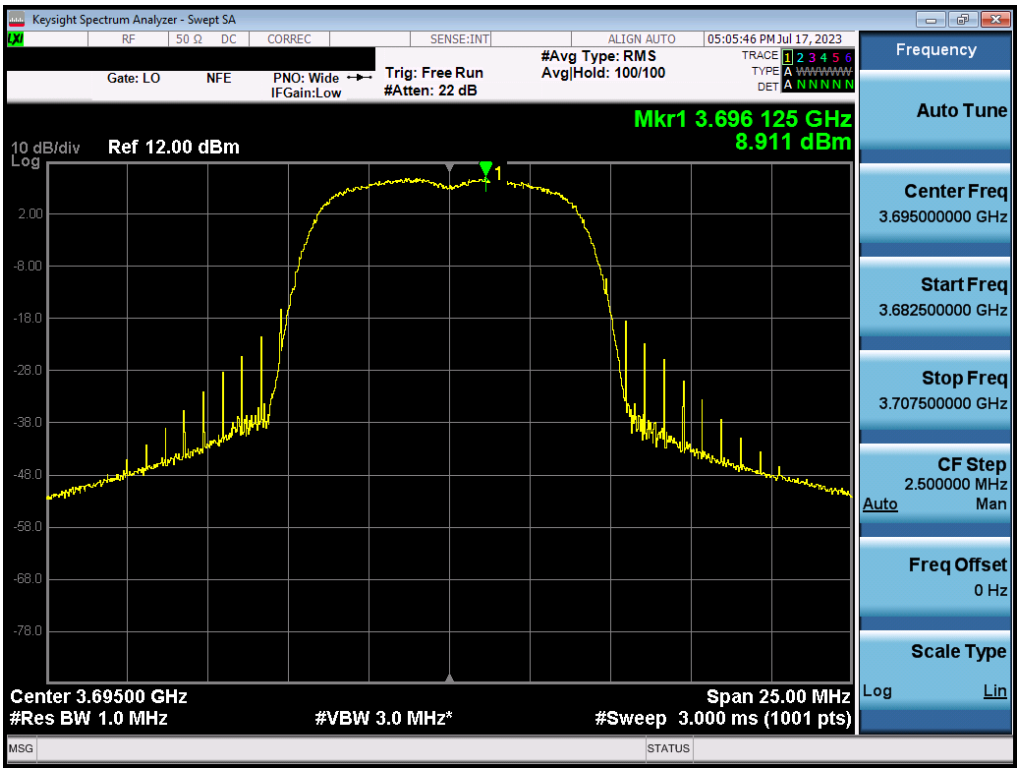
Channel B Conducted Power Spectral Density



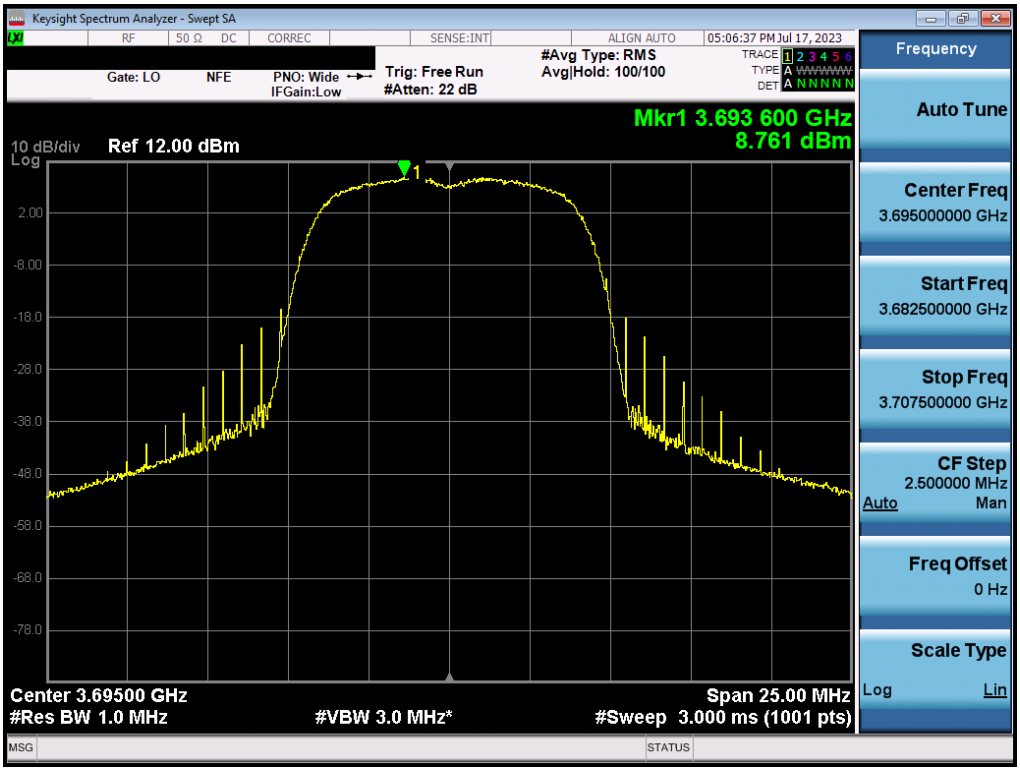
Plot 7.81. Conducted Power Spectral Density Plot (10MHz QPSK, High Channel – Ch.B)



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

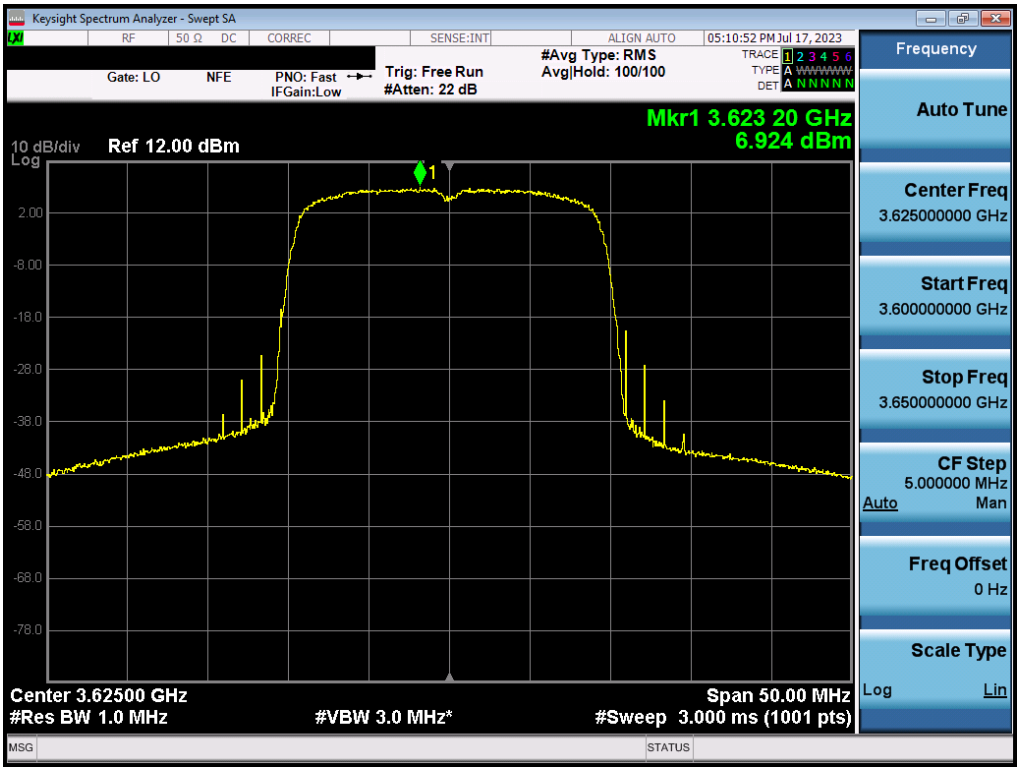


Plot 7.83. Conducted Power Spectral Density Plot (10MHz 64QAM, High Channel – Ch.B)



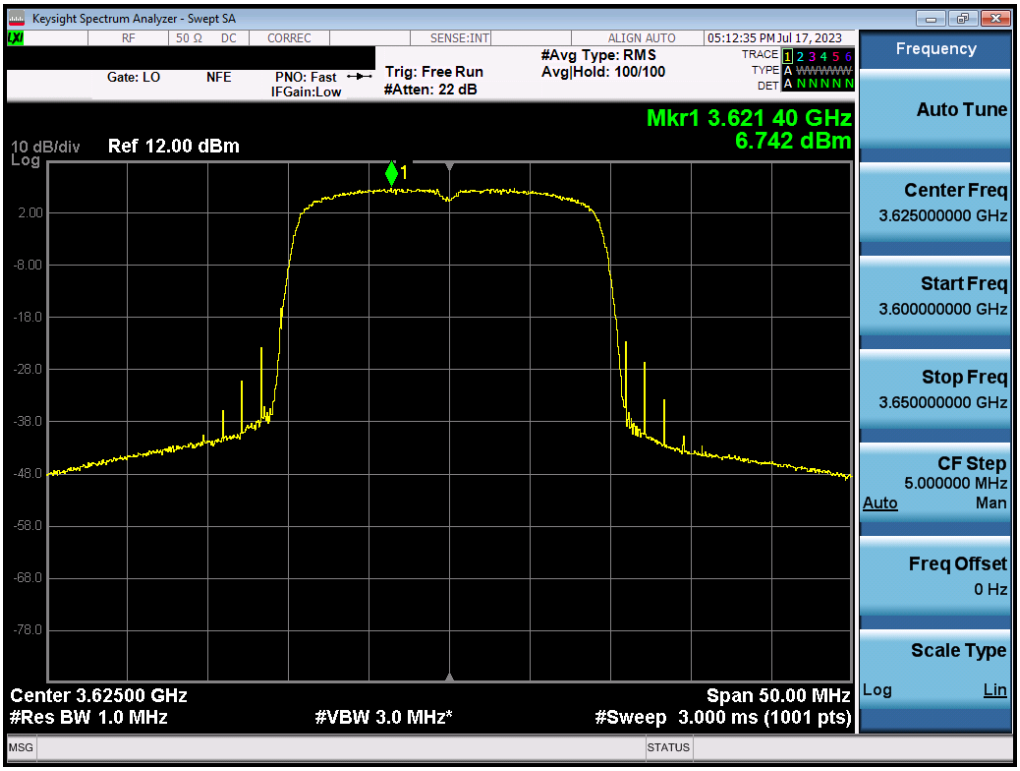
Plot 7.84. Conducted Power Spectral Density Plot (10MHz 256QAM, High Channel – Ch.B)

Plot 7.85. Conducted Power Spectral Density Plot (20MHz QPSK, Mid Channel – Ch.B)

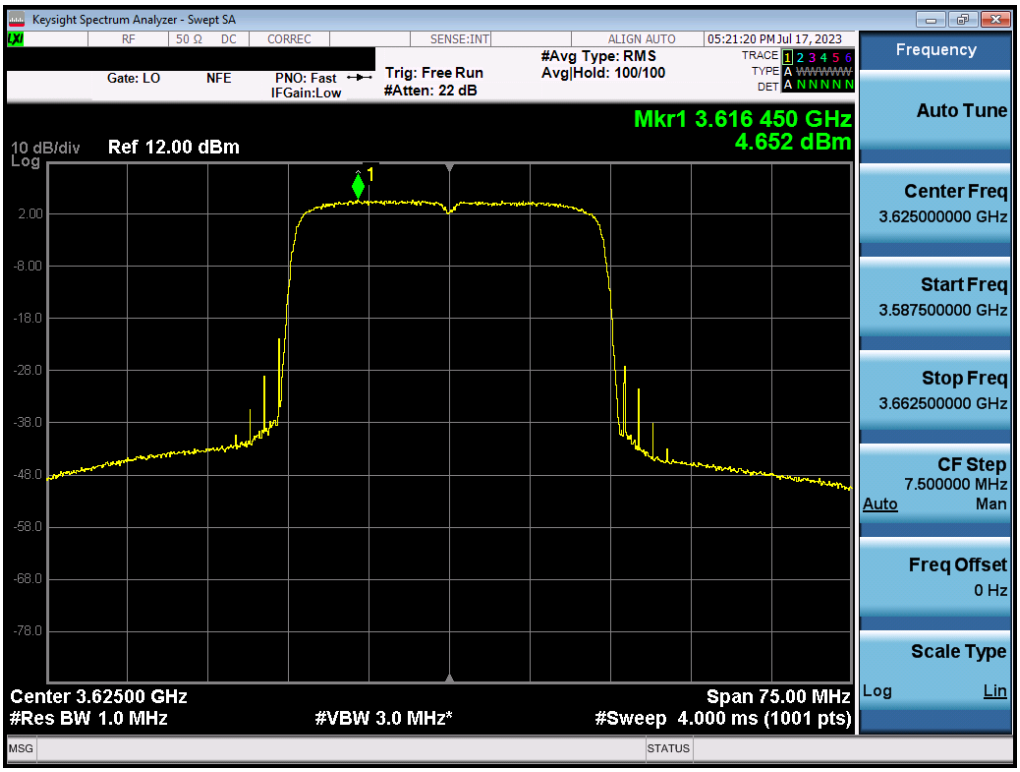


Plot 7.86. Conducted Power Spectral Density Plot (20MHz 16QAM, Mid Channel – Ch.B)

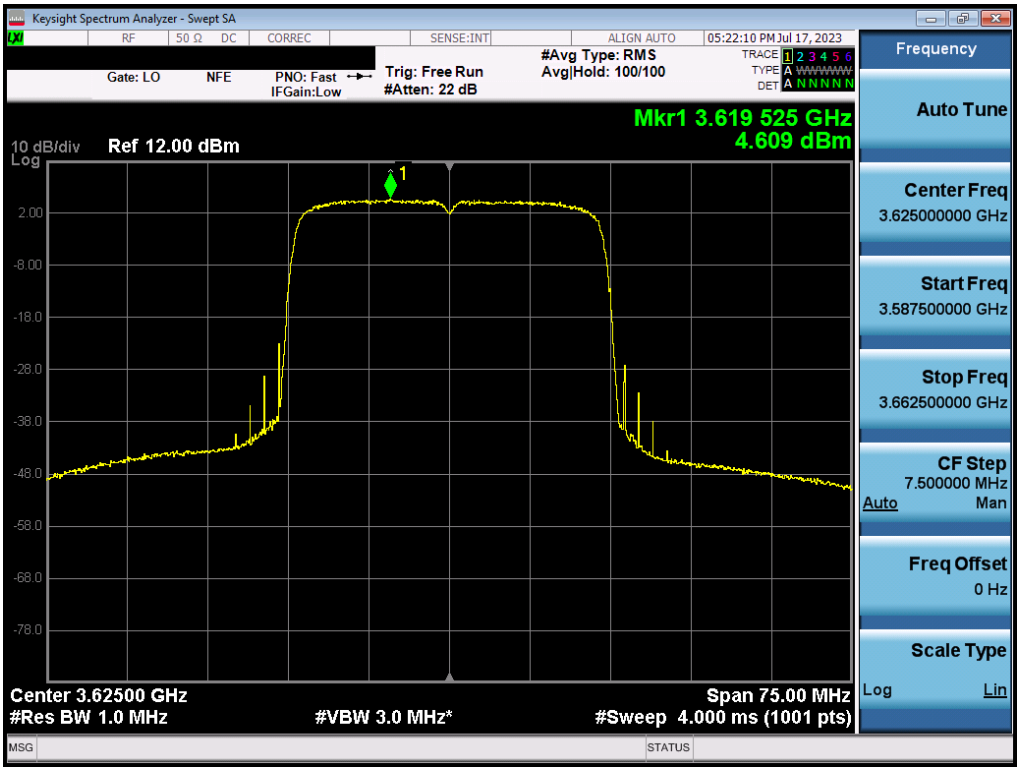
Plot 7.87. Conducted Power Spectral Density Plot (20MHz 64QAM, Mid Channel – Ch.B)



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



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



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

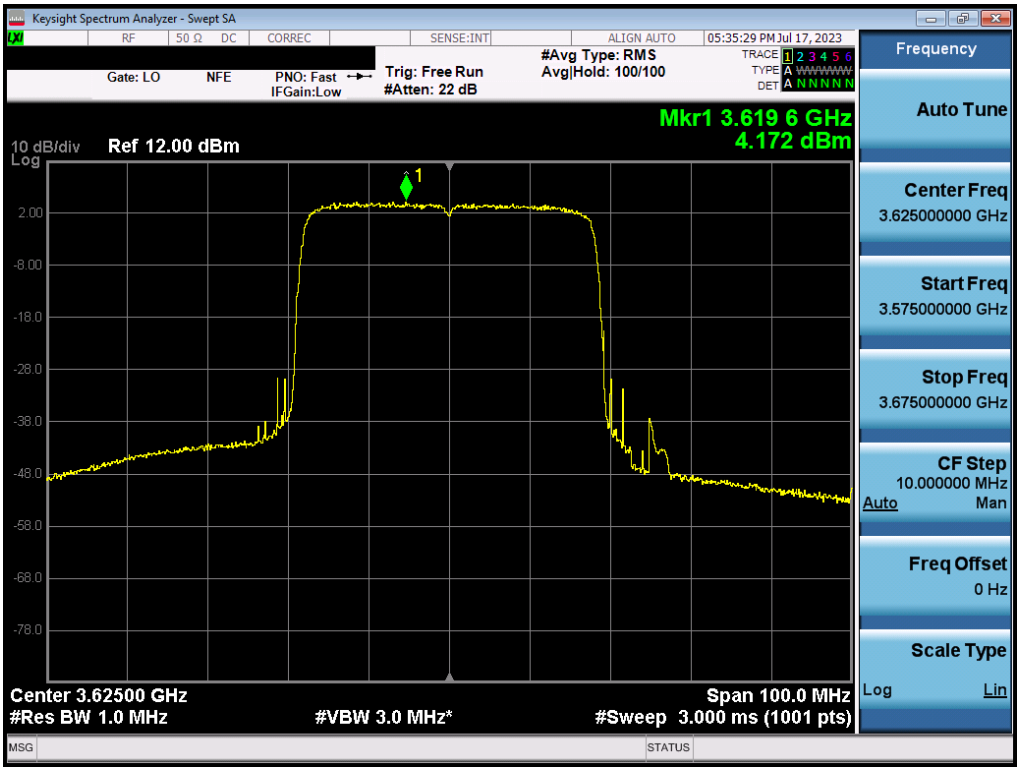
Plot 7.91. Conducted Power Spectral Density Plot (30MHz 64QAM, Mid Channel – Ch.B)

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

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

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

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



Plot 7.96. Conducted Power Spectral Density Plot (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 Antenna 1 and Antenna 2 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 orthognally polarized and with beamforming applies, the directional gain is 18.61dBi.

Sample MIMO Calculation:

At 3625 MHz in QPSK, 20MHz BW mode, the average conducted power spectral density was measured to be 5.76 dBm for Channel A and 6.83 dBm for Channel B.

Antenna 1 + Antenna 2 = MIMO

(6.06 dBm + 6.83 dBm) = (4.036 mW + 4.819 mW) = 8.855 mW = 9.47 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 9.34 dBm with directional gain of 18.61 dBi.

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

9.47 dBm + 10.16dBi =19.63 dBm

7.5 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 7-4. Test Instrument & Measurement Setup

Test Notes

None.

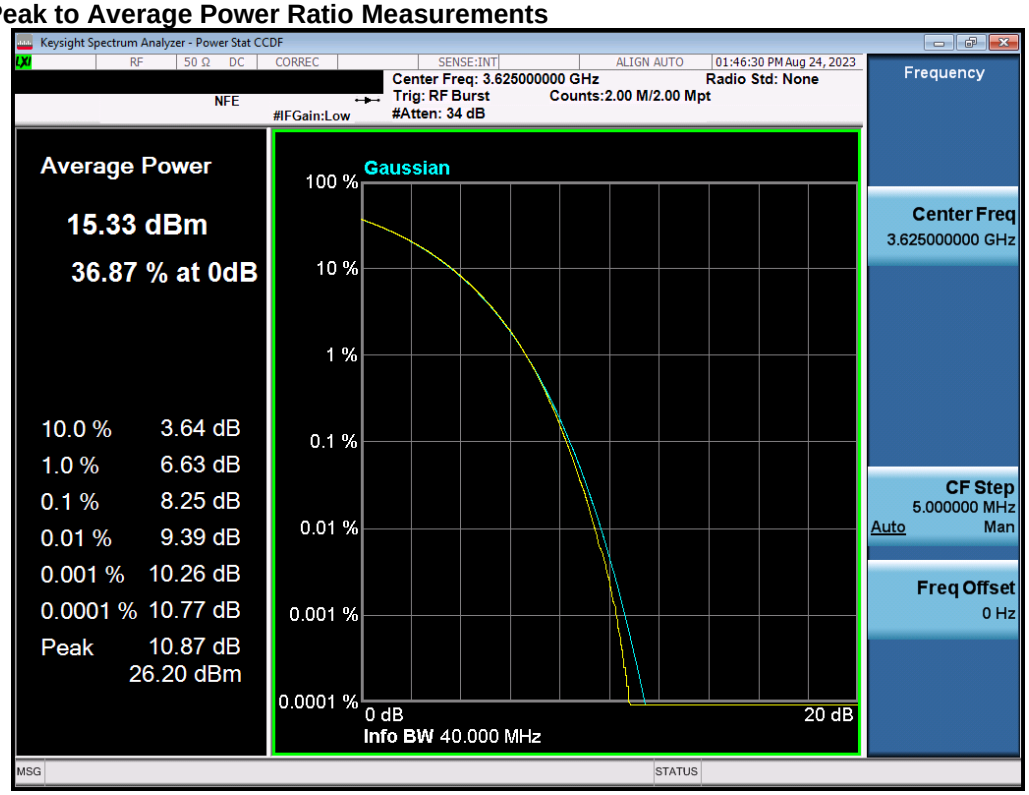
PAR				
Bandwidth	**Modulation**	**PAR at 0.1% [dB]**	**PAR Limit [dB]**	**Margin [dB]**
40 MHz	QPSK	8.25	13.0	-4.75
	16QAM	8.3	13.0	-4.7
	64QAM	8.29	13.0	-4.71
	256QAM	8.26	13.0	-4.74
30 MHz	QPSK	8.23	13.0	-4.77
	16QAM	8.13	13.0	-4.87
	64QAM	8.01	13.0	-4.99
	256QAM	8.15	13.0	-4.85
20 MHz	QPSK	8.25	13.0	-4.75
	16QAM	8.26	13.0	-4.74
	64QAM	8.32	13.0	-4.68
	256QAM	8.34	13.0	-4.66
10 MHz	QPSK	8.07	13.0	-4.93
	16QAM	8.09	13.0	-4.91
	64QAM	8.17	13.0	-4.83
	256QAM	8.1	13.0	-4.9

Table 7-5 Peak to Average Power Ratio Measurements – Ch.A

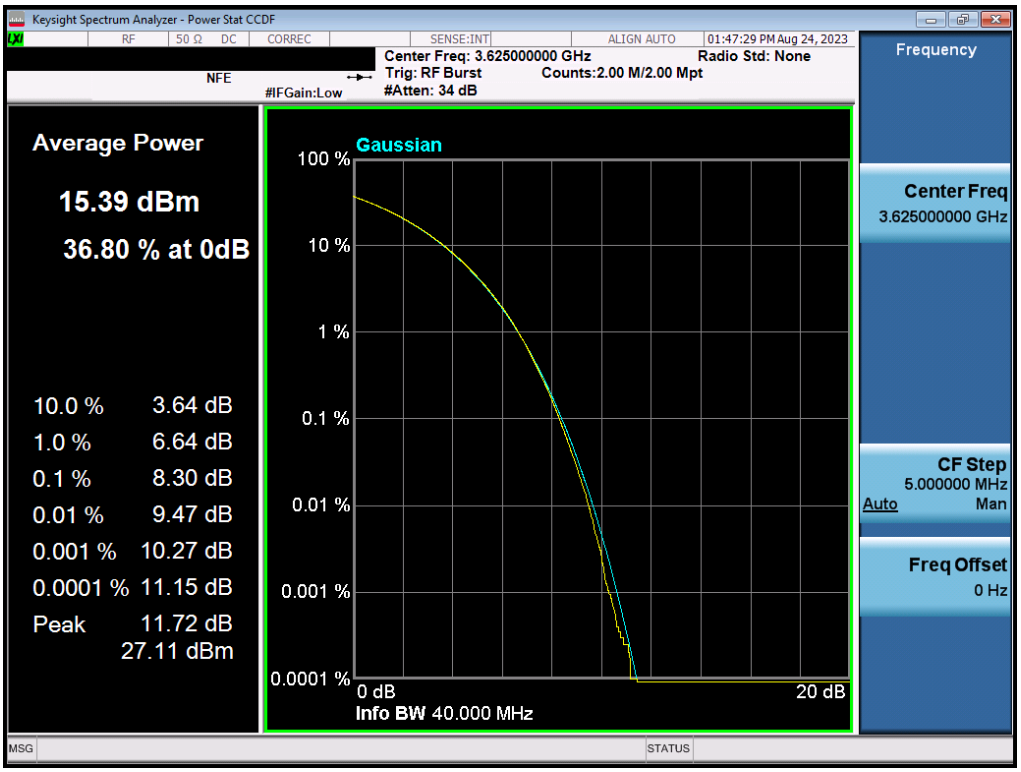
PAR				
Bandwidth	**Modulation**	**PAR at 0.1% [dB]**	**PAR Limit [dB]**	**Margin [dB]**
40 MHz	QPSK	8.60	13.0	-4.40
	16QAM	8.06	13.0	-4.94
	64QAM	8.07	13.0	-4.93
	256QAM	8.09	13.0	-4.91
30 MHz	QPSK	8.16	13.0	-4.84
	16QAM	8.01	13.0	-4.99
	64QAM	8.00	13.0	-5.00
	256QAM	8.15	13.0	-4.85
20 MHz	QPSK	8.06	13.0	-4.94
	16QAM	8.20	13.0	-4.80
	64QAM	8.06	13.0	-4.94
	256QAM	8.28	13.0	-4.72
10 MHz	QPSK	7.96	13.0	-5.04
	16QAM	7.93	13.0	-5.07
	64QAM	7.96	13.0	-5.04
	256QAM	7.96	13.0	-5.04

Table 7-6 Peak to Average Power Ratio Measurements – Ch.B

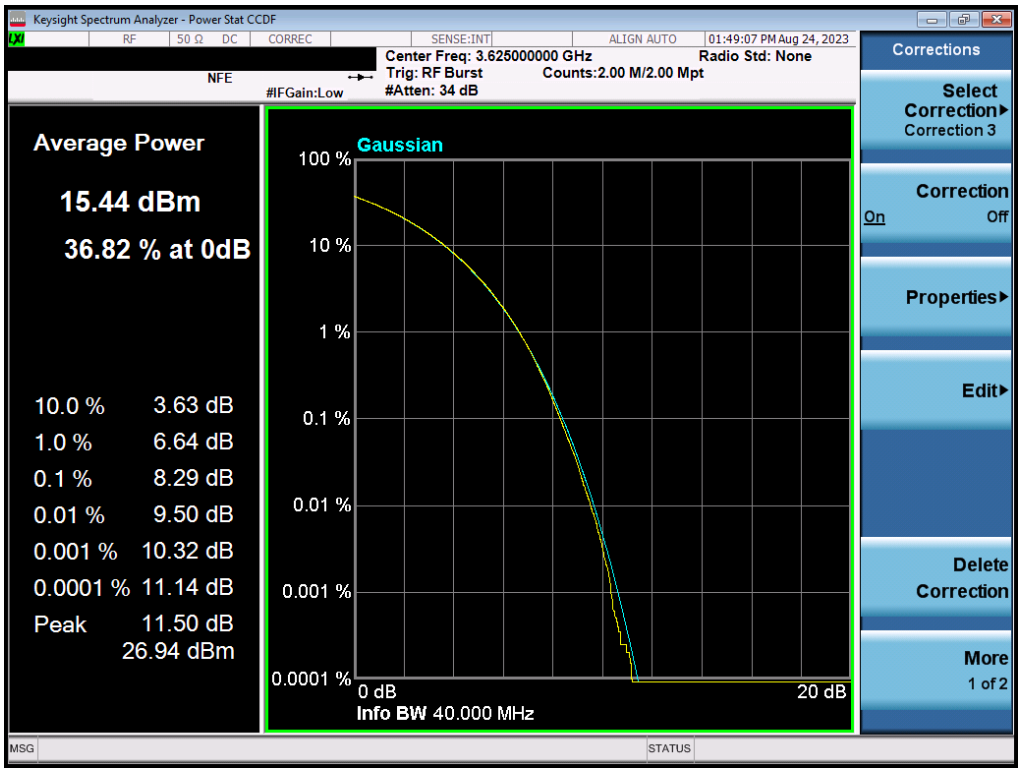
Channel A Peak to Average Power Ratio Measurements



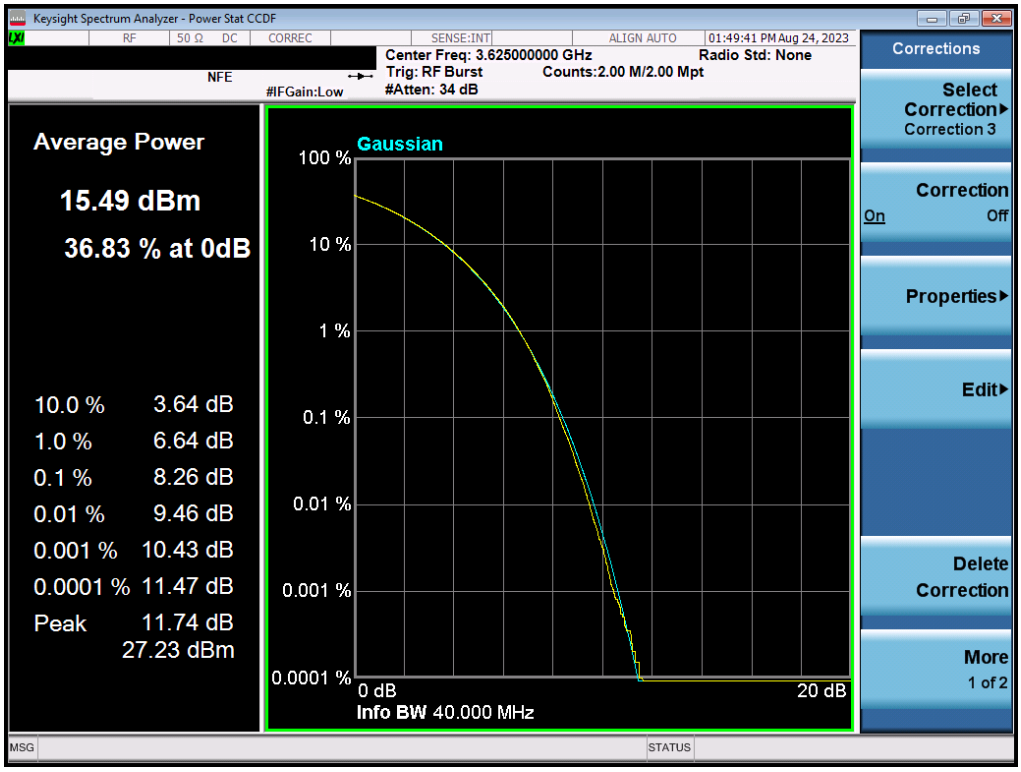
Plot 7.97. Peak to Average Power Ratio Plot (40MHz, QPSK – Mid Channel) – Ch.A



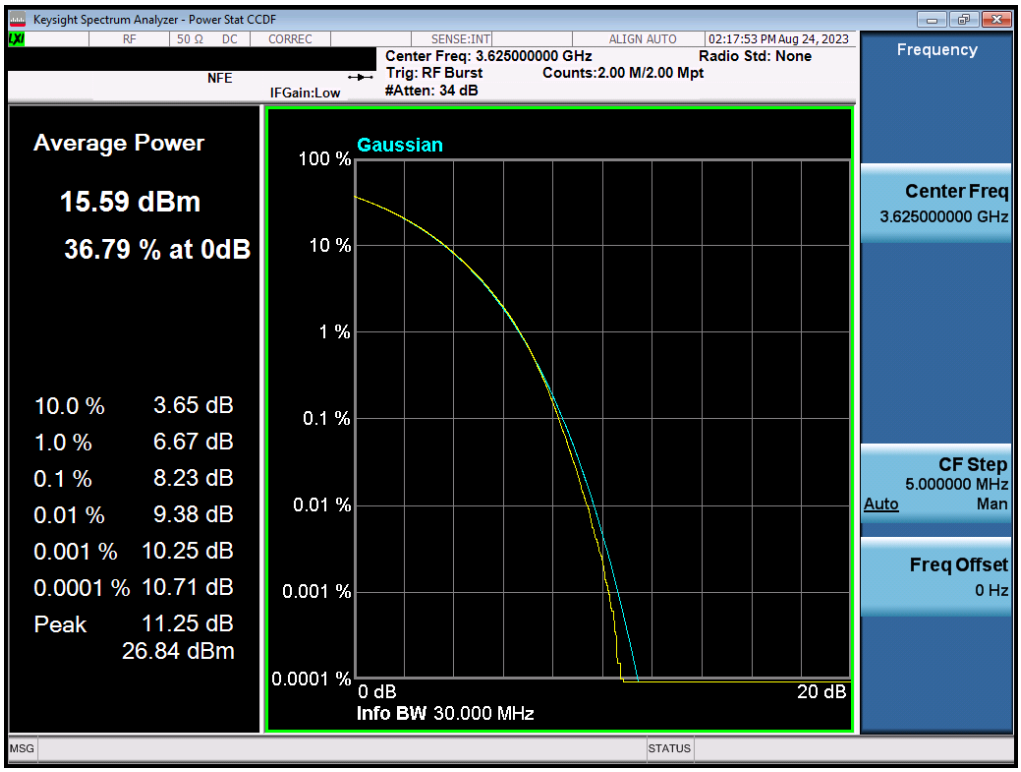
Plot 7.98. Peak to Average Power Ratio Plot (40MHz, 16QAM – Mid Channel) – Ch.A



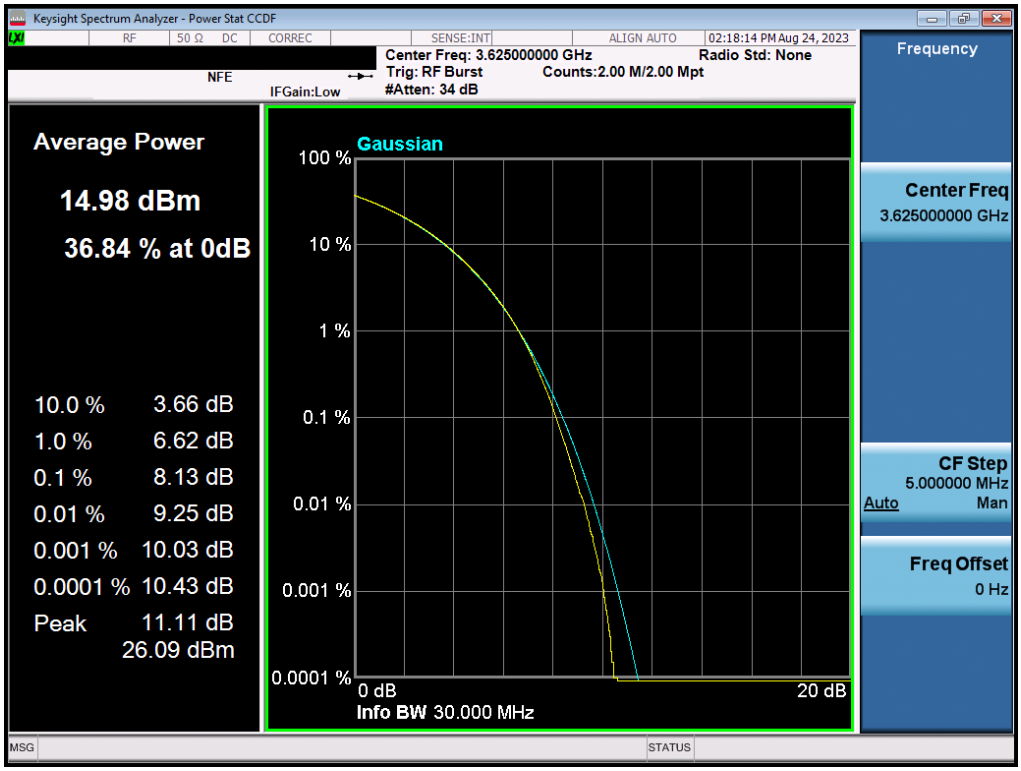
Plot 7.99. Peak to Average Power Ratio Plot (40MHz, 64QAM – Mid Channel) – Ch.A



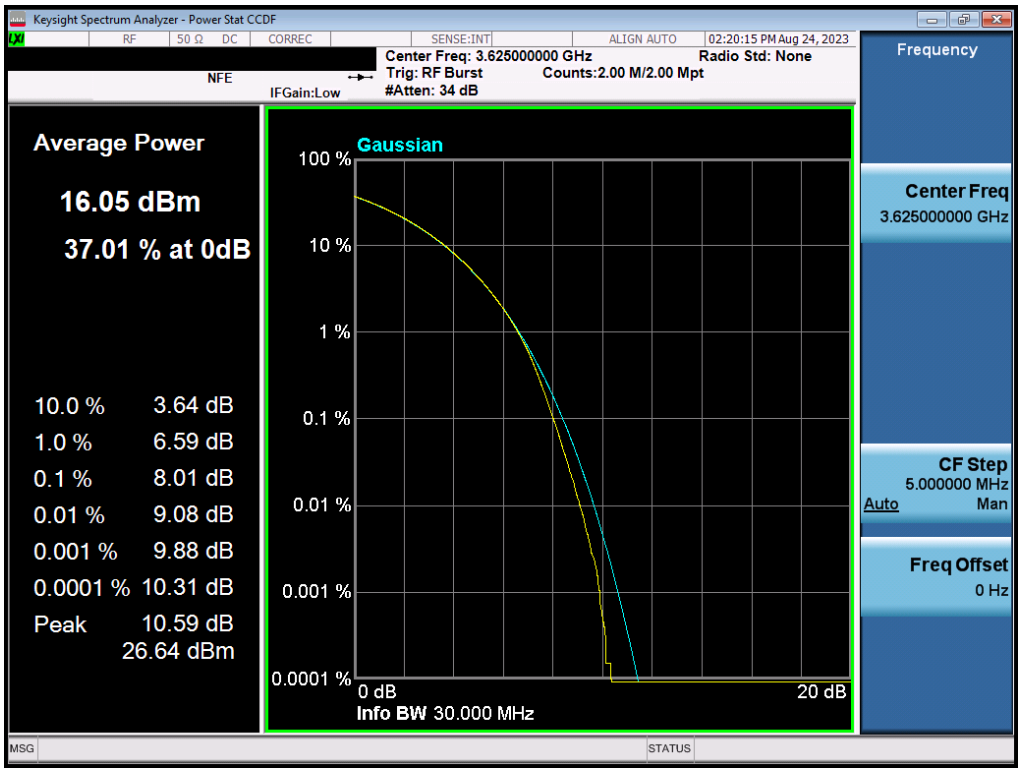
Plot 7.100. Peak to Average Power Ratio Plot (40MHz, 256QAM – Mid Channel) – Ch.A



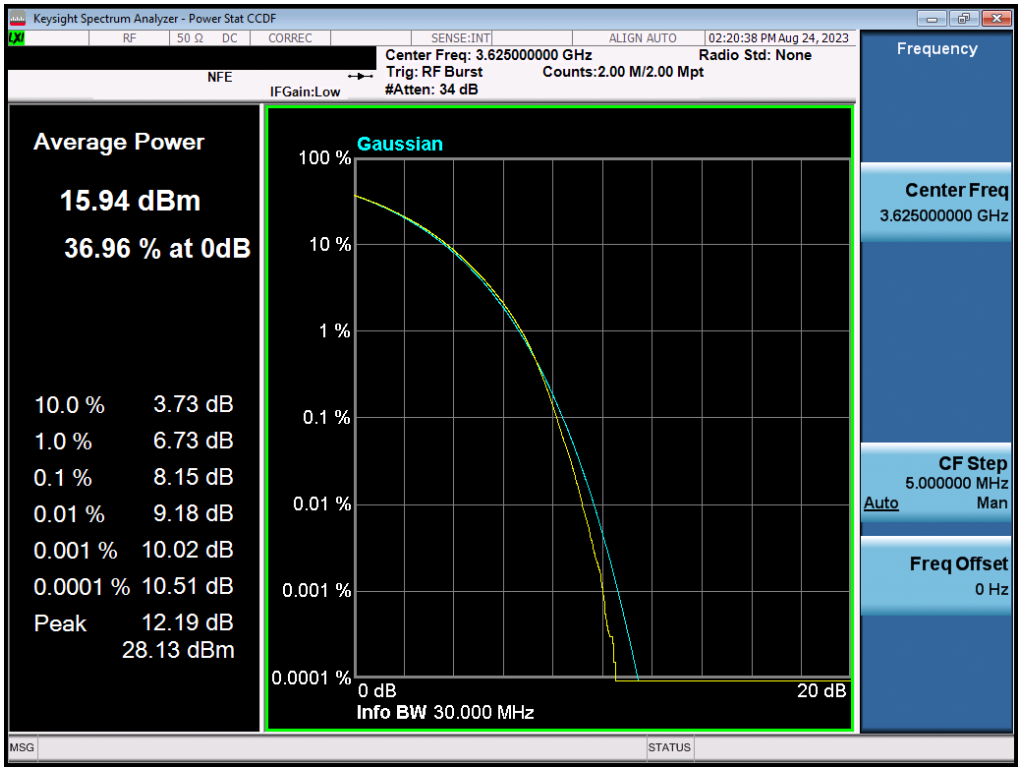
Plot 7.101. Peak to Average Power Ratio Plot (30MHz, QPSK – Mid Channel) – Ch.A



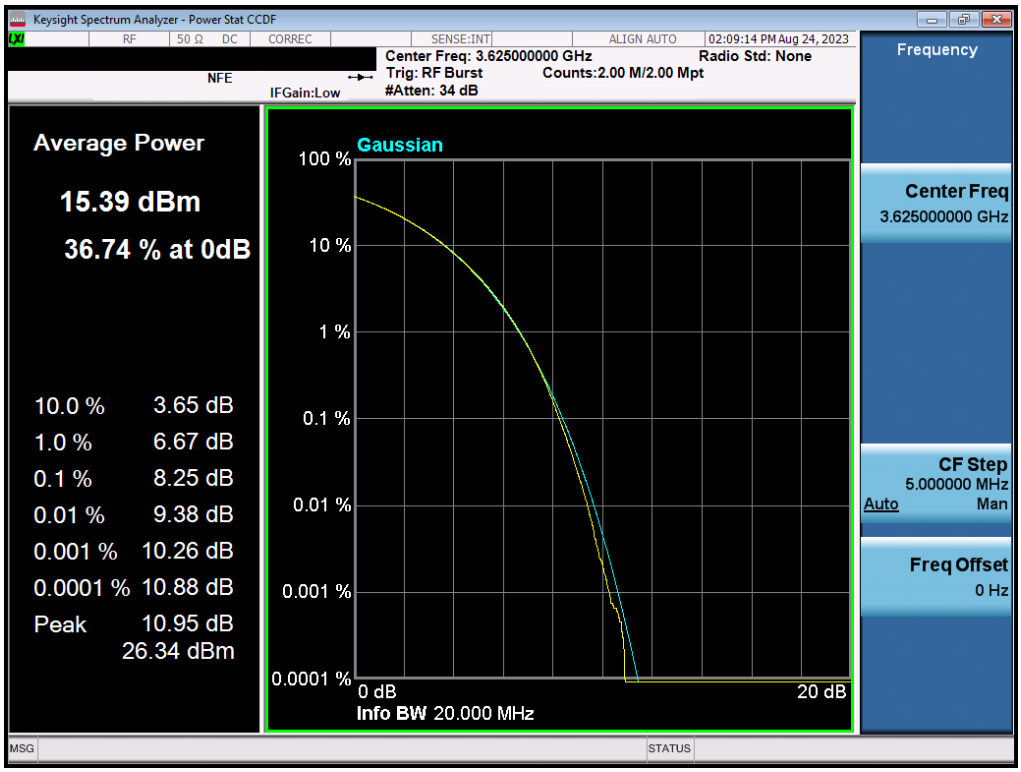
Plot 7.102. Peak to Average Power Ratio Plot (30MHz, 16QAM – Mid Channel) – Ch.A



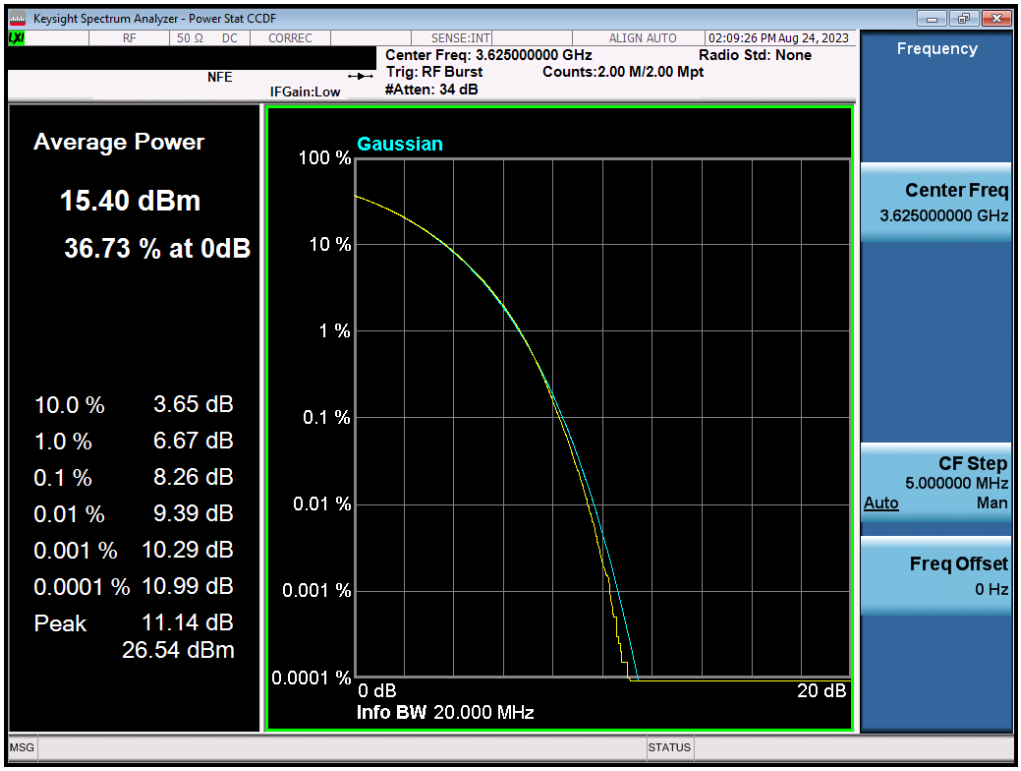
Plot 7.103. Peak to Average Power Ratio Plot (30MHz, 64QAM – Mid Channel) – Ch.A



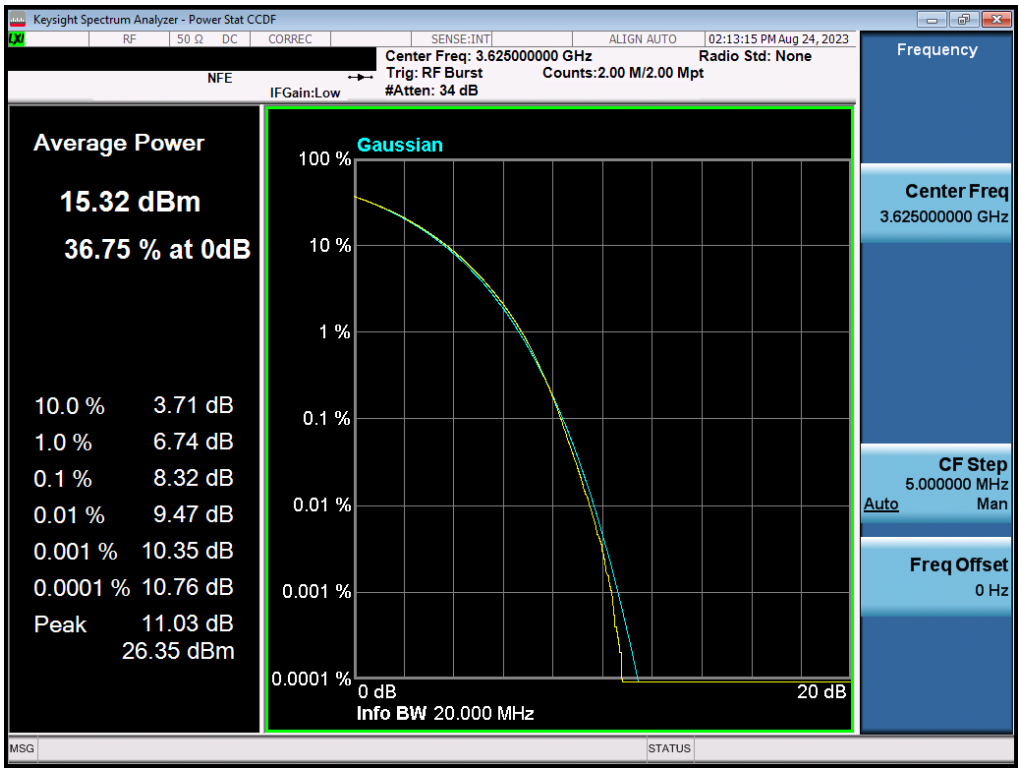
Plot 7.104. Peak to Average Power Ratio Plot (30MHz, 256QAM – Mid Channel) – Ch.A



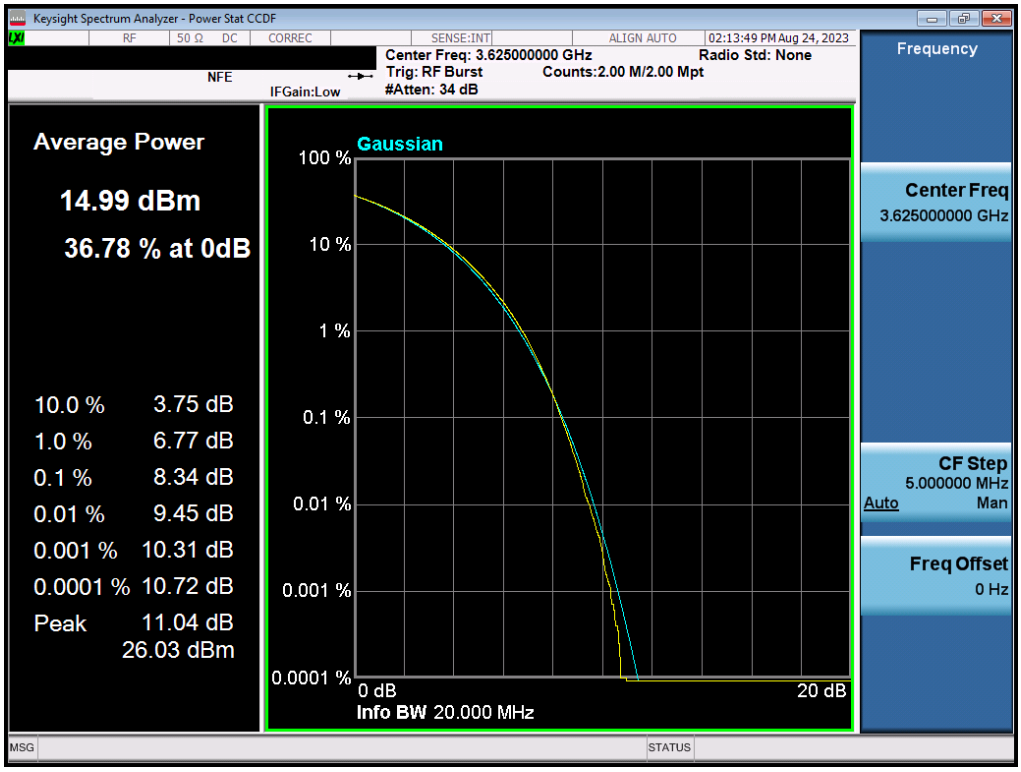
Plot 7.105. Peak to Average Power Ratio Plot (20MHz, QPSK – Mid Channel) – Ch.A



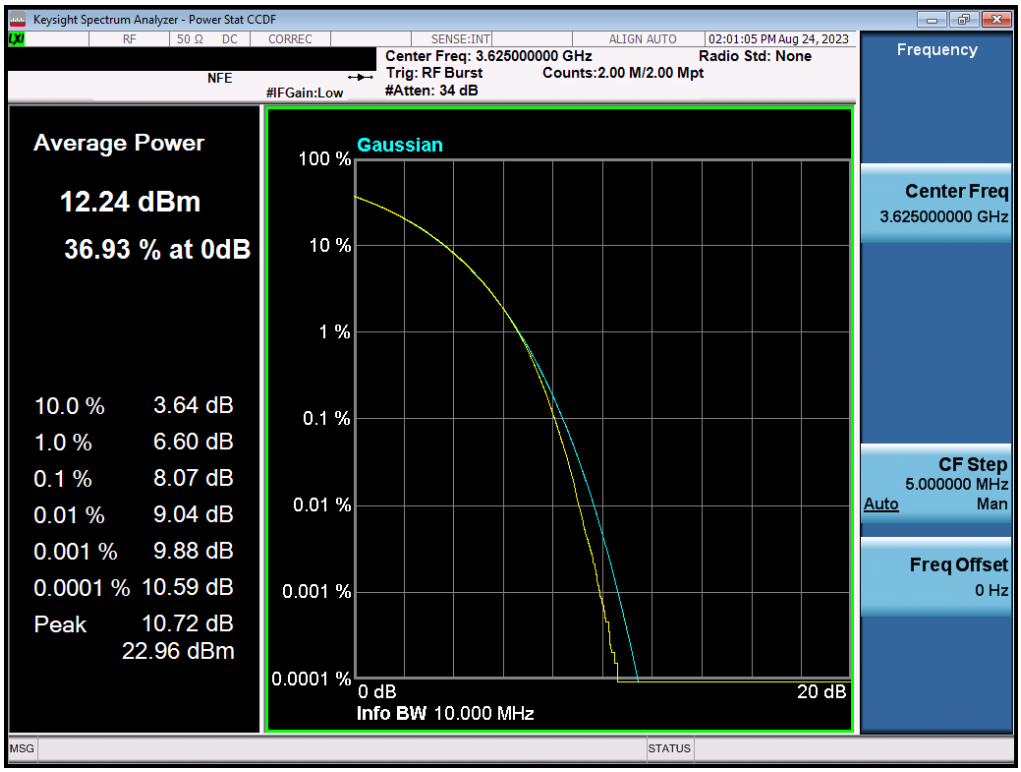
Plot 7.106. Peak to Average Power Ratio Plot (20MHz, 16QAM – Mid Channel) – Ch.A



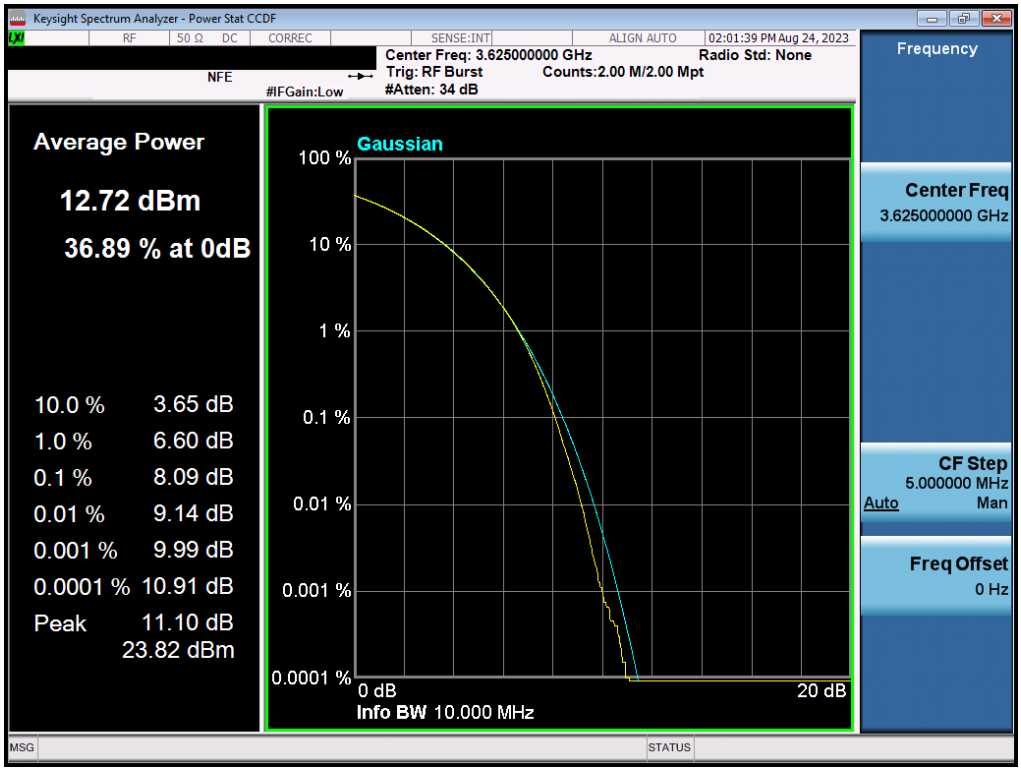
Plot 7.107. Peak to Average Power Ratio Plot (20MHz, 64QAM – Mid Channel) – Ch.A



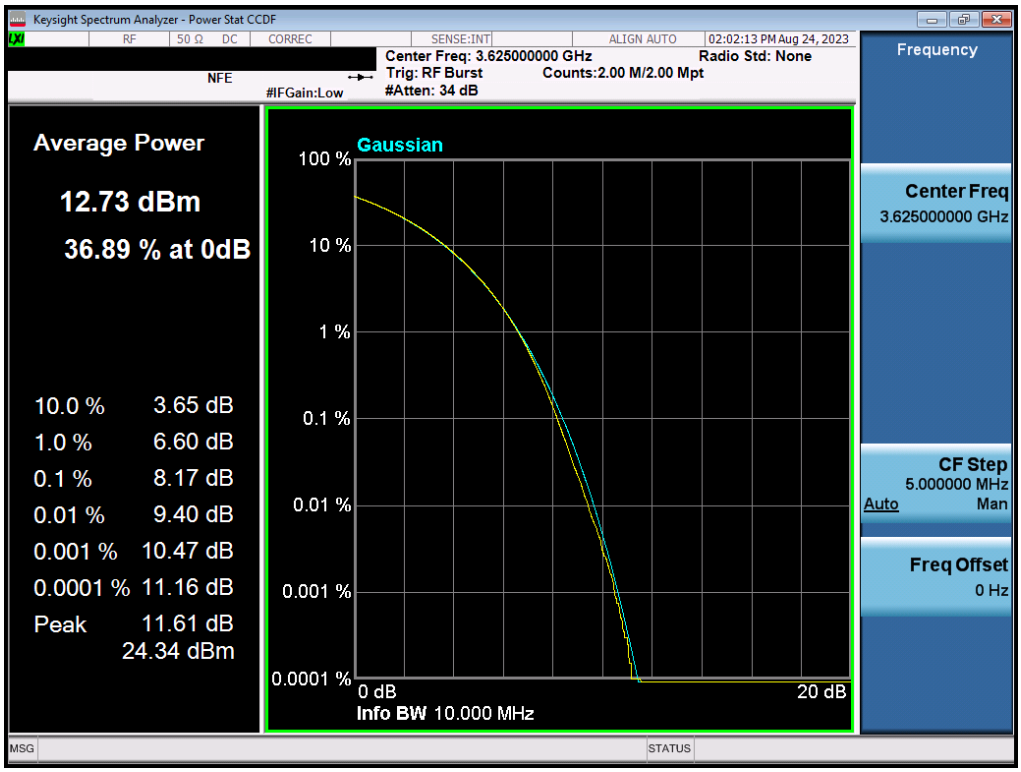
Plot 7.108. Peak to Average Power Ratio Plot (20MHz, 256QAM – Mid Channel) – Ch.A



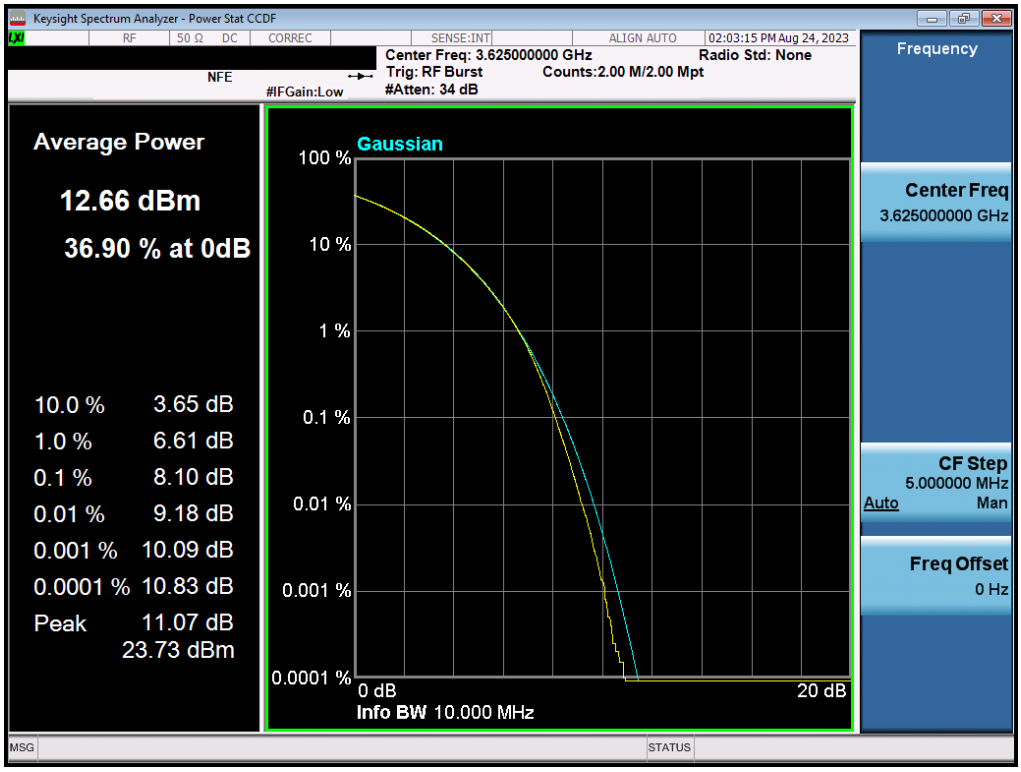
Plot 7.109. Peak to Average Power Ratio Plot (10MHz, QPSK – Mid Channel) – Ch.A



Plot 7.110. Peak to Average Power Ratio Plot (10MHz, 16QAM – Mid Channel) – Ch.A



Plot 7.111. Peak to Average Power Ratio Plot (10MHz, 64QAM – Mid Channel) – Ch.A



Plot 7.112. Peak to Average Power Ratio Plot (10MHz, 256QAM – Mid Channel) – Ch.A