TEST REPORT

FCC Sub6 n70 Test for SM-S721U
Certification

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-RF-2407-FC032

DATE OF ISSUE
July 19, 2024

Tested by
Jin Woo Yu

Technical Manager
Jong Seok Lee

HCT CO., LTD.
BongJai Huh / CEO

HCT CO., LTD. 2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA Tel. +82 31 645 6300 Fax. +82 31 645 6401

HCT CO.,LTD.
2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 645 6300 Fax. +82 31 645 6401

TEST REPORT

REPORT NO.
HCT-RF-2407-FC032

DATE OF ISSUE
July 19, 2024

Additional Model
SM-S721U1

Applicant	**SAMSUNG Electronics Co., Ltd.** 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Product Name Model Name	Mobile Phone SM-S721U
Date of Test	May 21, 2024 ~ July 19, 2024
FCC ID	A3LSMS721U
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 Republic of Korea)
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
Test Standard Used	FCC Rule Part: § 27
Test Results	PASS

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	July 19, 2024	Initial Release

Notice

Content
The measurements shown in this report were made in accordance with the procedures specified in CFR47 section § 2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)
The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated. The test results have only been applied with the test methods required by the standard(s).
The laboratory is not accredited for the test results marked *. Information provided by the applicant is marked **. Test results provided by external providers are marked ***.
When confirmation of authenticity of this test report is required, please contact www.hct.co.kr
The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

CONTENTS

MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	SAMSUNG Electronics Co., Ltd.
Address:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
FCC ID:	A3LSMS721U
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§ 27
EUT Type:	Mobile phone
Model(s):	SM-S721U
Additional Model(s)	SM-S721U1
SCS(kHz):	15
Bandwidth(MHz):	5, 10, 15
Waveform:	CP-OFDM, DFT-S-OFDM
Modulation:	DFT-S-OFDM: PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: QPSK, 16QAM, 64QAM, 256QAM
Tx Frequency:	1697.5 MHz – 1707.5 MHz (Sub6 n70(5 MHz)) 1700.0 MHz – 1705.0 MHz (Sub6 n70(10 MHz)) 1705.5 MHz (Sub6 n70(15 MHz))
Date(s) of Tests:	May 20, 2024 ~ July 19, 2024
Serial number:	Radiated : 67d50ecc63197ece Conducted : R3CX40SV7PD

1.1 MAXIMUM OUTPUT POWER

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	EIRP	
				Max. Power (W)	Max. Power (dBm)
Sub6 n70 (5)	1697.5 – 1707.5	4M60G7D	PI/2 BPSK	0.120	20.78
		4M63G7D	QPSK	0.118	20.73
		4M58W7D	16QAM	0.095	19.77
		4M65W7D	64QAM	0.066	18.19
		4M57W7D	256QAM	0.044	16.39
Sub6 n70 (10)	1700.0 – 1705.0	8M98G7D	PI/2 BPSK	0.119	20.74
		9M02G7D	QPSK	0.117	20.70
		8M99W7D	16QAM	0.092	19.65
		8M98W7D	64QAM	0.067	18.26
		8M97W7D	256QAM	0.042	16.27
Sub6 n70 (15)	1702.5	13M4G7D	PI/2 BPSK	0.114	20.55
		13M5G7D	QPSK	0.112	20.51
		13M5W7D	16QAM	0.088	19.44
		13M5W7D	64QAM	0.064	18.05
		13M4W7D	256QAM	0.041	16.17

2. INTRODUCTION

2.1 DESCRIPTION OF EUT

The EUT was a Mobile Phone with GSM/GPRS/EGPRS/UMTS and LTE, Sub 6, mmWave.
It also supports IEEE 802.11 a/b/g/n/ac/ax (20/40/80/160 MHz), Bluetooth(iPA, ePA), BT LE(iPA, ePA), NFC, WPT, WIFI 6E.

2.2 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.3 TEST FACILITY

The Fully-anechoic chamber and conducted measurement facility used to collect the radiated data are located at the **74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.**

3. DESCRIPTION OF TESTS

3.1 TEST PROCEDURE

Test Description	Test Procedure Used
Occupied Bandwidth	- KDB 971168 D01 v03r01 – Section 4.3 - ANSI C63.26-2015 – Section 5.4.4
Band Edge	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Spurious and Harmonic Emissions at Antenna Terminal	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Conducted Output Power	- N/A (See SAR Report)
Peak- to- Average Ratio	- KDB 971168 D01 v03r01 – Section 5.7 - ANSI C63.26-2015 – Section 5.2.3.4 - ANSI C63.26-2015 – Section 5.2.6(only GSM)
Frequency stability	- ANSI C63.26-2015 – Section 5.6
Effective Radiated Power/ Effective Isotropic Radiated Power	- KDB 971168 D01 v03r01 – Section 5.2 & 5.8 - ANSI/TIA-603-E-2016 – Section 2.2.17
Radiated Spurious and Harmonic Emissions	- KDB 971168 D01 v03r01 – Section 6.2 - ANSI/TIA-603-E-2016 – Section 2.2.12

3.2 RADIATED POWER

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.
The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-E-2016 Clause 2.2.17.

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5 % of the expected OBW, not to exceed 1 MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points > 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Note

1. The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission.
2. A half wave dipole is then substituted in place of the EUT. For emissions above 1 GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.
   The power is calculated by the following formula;

$$P_{d\ (dBm)} = Pg_{\ (dBm)} - \text{cable loss}_{\ (dB)} + \text{antenna gain}_{\ (dB)}$$

   Where: P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.
3. The maximum value is calculated by adding the forward power to the calibrated source plus its appropriate gain value.
   These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration
4. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
5. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

3.3 RADIATED SPURIOUS EMISSIONS

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA-603-E-2016.

Test Settings

1. RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1 GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points > 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10^{th} harmonics from 9 kHz.

Test Note

1. Measurements value show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
2. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the test data
3. For spurious emissions above 1 GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.
   The spurious emissions is calculated by the following formula;

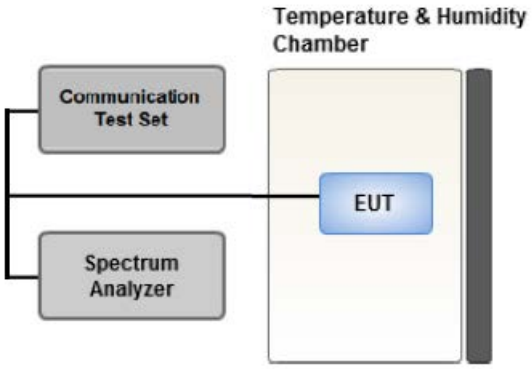
$$\text{Result}_{(dBm)} = \text{Pg}_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dBi)}$$

   Where: P_g is the generator output power into the substitution antenna.

   If the fundamental frequency is below 1 GHz, RF output power has been converted to EIRP.

$$\text{EIRP}_{(dBm)} = \text{ERP}_{(dBm)} + 2.15$$

3.4 PEAK- TO- AVERAGE RATIO



Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Set the measurement interval as follows:
   .- for continuous transmissions, set to 1 ms,
   .- or burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1 %.

② Alternate Procedure for PAPR

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as P_{Pk}. Use one of the applicable procedures presented 5.2(ANSI C63.26-2015) to measure the total average power and record as P_{Avg}. Determine the P.A.R. from:

$$P.A.R_{(dB)} = P_{Pk\ (dBm)} - P_{Avg\ (dBm)}\ (P_{Avg} = \text{Average Power} + \text{Duty cycle Factor})$$

Test Settings(Peak Power)

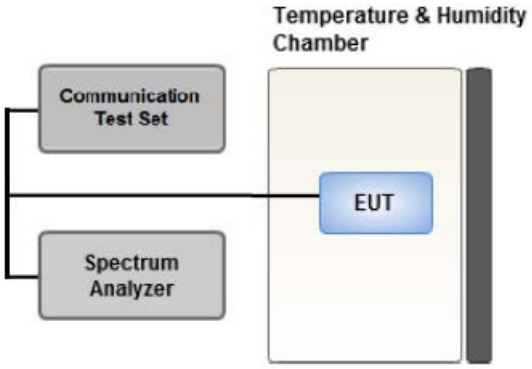
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW ≥ 3 × RBW.

1. Set the RBW ≥ OBW.
2. Set VBW ≥ 3 × RBW.
3. Set span ≥ 2 × OBW.
4. Sweep time ≥ 10 × (number of points in sweep) × (transmission symbol period).
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the peak amplitude level.

Test Settings(Average Power)

1. Set span to 2 × to 3 × the OBW.
2. Set RBW ≥ OBW.
3. Set VBW ≥ 3 × RBW.
4. Set number of measurement points in sweep ≥ 2 × span / RBW.
5. Sweep time:
   Set ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. The transmission period is the (on + off) time.
6. Detector = power averaging (rms).
7. Set sweep trigger to "free run."
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. (To accurately determine the average power over the on and off period of the transmitter, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.)
9. Use the peak marker function to determine the maximum amplitude level.
10. Add [10 log (1/duty cycle)] to the measured maximum power level to compute the average power during continuous transmission. For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is a constant 25 %.

3.5 OCCUPIED BANDWIDTH.



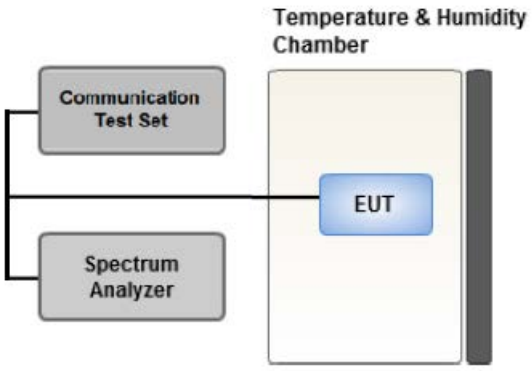
Test setup

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.
The EUT makes a call to the communication simulator.
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99 % occupied bandwidth and the 26 dB 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

3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

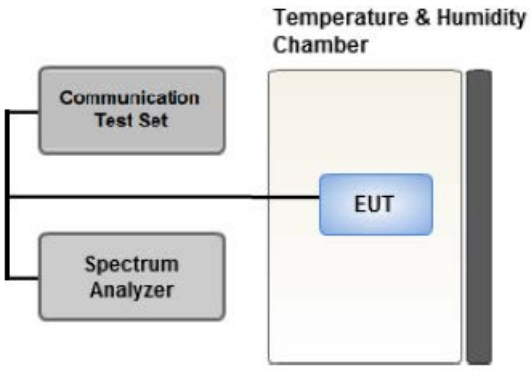
Test Overview

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

Test Settings

1. RBW = 1 MHz
2. VBW ≥ 3 MHz
3. Detector = RMS
4. Trace Mode = trace average
5. Sweep time = auto
6. Number of points in sweep ≥ 2 x Span / RBW

3.7 BAND EDGE



Test setup

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Settings

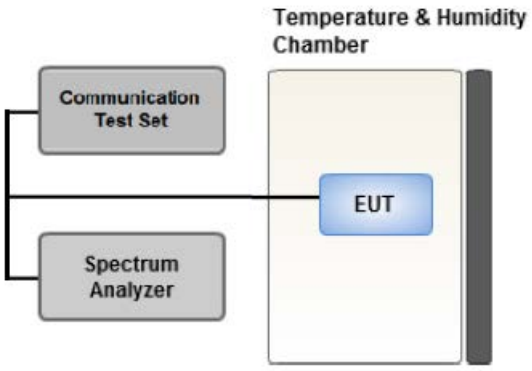
1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW > 1 % of the emission bandwidth
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

According to FCC 22.917, 24.238, 27.53 specified that power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.
All measurements were done at 2 channels(low and high operational frequency range.)
The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

Where Margin < 1 dB the emission level is either corrected by 10 log(1 MHz/ RB) or the emission is integrated over a 1 MHz bandwidth to determine the final result. When using the integration method the integration window is either centered on the emission or, for emissions at the band edge, centered by an offset of 500 kHz from the block edge so that the integration window is the 1 MHz adjacent to the block edge.

3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE



Test setup

Test Overview

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015.
The frequency stability of the transmitter is measured by:

1. Temperature:
   The temperature is varied from -30 °C to +50 °C in 10 °C increments using an environmental chamber.
2. Primary Supply Voltage:
   .- Unless otherwise specified, vary primary supply voltage from 85 % to 115 % of the nominal value for other than hand carried battery equipment.
   .- For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20 °C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter.
   Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10 °C intervals ranging from -30 °C to +50 °C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

3.9 WORST CASE(RADIATED TEST)

- Waveform : All Waveform of operation were investigated and the worst case configuration results are reported.
  (Worst case: DFT-S-OFDM)
- The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
- All modes of operation were investigated and the worst case configuration results are reported.
  Mode: SA Only
  Mode : Stand alone, Stand alone + External accessories (Earphone, AC adapter, etc)
  Worst case : Stand alone
- All simultaneous transmission scenarios of operation were investigated, and the test results showed no additional significant emissions relative to the least restrictive limit were observed.
  Therefore, only the worst case(stand-alone) results were reported.
- All RB sizes, offsets of operation were investigated and the worst case configuration results are reported.
  Please refer to the table below.
- In the case of radiated spurious emissions, all bandwidth of operation was investigated and the worst case bandwidth results are reported. (Worst case : 5 MHz)
- SM-S721U & additional models were tested and the worst case results are reported.
  (Worst case : SM-S721U)

[Worst case]

Test Description	Modulation	RB size	RB offset	Axis
Effective Isotropic Radiated Power	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	See Section 8.1		Z
Radiated Spurious and Harmonic Emissions	PI/2 BPSK	See Section 8.2		Z

3.10 WORST CASE(CONDUCTED TEST)

- Waveform : All Waveform of operation were investigated and the worst case configuration results are reported.
  (Worst case: DFT-S-OFDM)
- Modulation : All Modulation of operation were investigated and the worst case configuration results are reported.
  (Worst case: PI/2 BPSK)
- All modes of operation were investigated and the worst case configuration results are reported.
  Mode: SA Only
- All RB sizes, offsets of operation were investigated and the worst case configuration results are reported.
  Please refer to the table below.
- SM-S721U & additional models were tested and the worst case results are reported.
  (Worst case : SM-S721U)

[Worst case]

Test Description	Modulation	Bandwidth (MHz)	Frequency	RB size	RB offset
Occupied Bandwidth, Peak-To-Average Ratio	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5, 10, 15	Mid	Full RB	0
Band Edge	PI/2 BPSK	5	Low	1	0
			High	1	24
		10	Low	1	0
			High	1	51
		15	Low	1	0
			High	1	78
		5, 10, 15	Low, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	PI/2 BPSK	5, 10, 15	Low, Mid, High	1	1

4. LIST OF TEST EQUIPMENT

Equipment	Model	Manufacture	Serial No.	Due to Calibration	Calibration Interval
Precision Dipole Antenna	UHAP	Schwarzbeck	01273	03/10/2026	Biennial
Precision Dipole Antenna	UHAP	Schwarzbeck	01274	03/10/2026	Biennial
Horn Antenna(1~18 GHz)	BBHA 9120D	Schwarzbeck	02289	02/14/2026	Biennial
Horn Antenna(1~18 GHz)	BBHA 9120D	Schwarzbeck	9120D-1299	04/27/2025	Biennial
Horn Antenna(15~40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170342	09/29/2024	Biennial
Horn Antenna(15~40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
Loop Antenna(9 kHz~30 MHz)	FMZB1513	Rohde & Schwarz	1513-175	01/16/2025	Biennial
Bilog Antenna	VULB9160	Schwarzbeck	3150	03/09/2025	Biennial
Hybrid Antenna	VULB9160	Schwarzbeck	760	02/24/2025	Biennial
RF Switching System	FBSR-06B (1G HPF + LNA)	T&M SYSTEM	F3L1	05/14/2025	Annual
RF Switching System	FBSR-06B (3G HPF + LNA)	T&M SYSTEM	F3L2	05/14/2025	Annual
RF Switching System	FBSR-06B (6G HPF + LNA)	T&M SYSTEM	F3L3	05/14/2025	Annual
RF Switching System	FBSR-06B (LNA)	T&M SYSTEM	F3L4	05/14/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/17/2024	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/26/2025	Annual
DC Power Supply	E3632A	Hewlett Packard	MY40004427	08/25/2024	Annual
Power Splitter(DC~26.5 GHz)	11667B	Hewlett Packard	11275	02/29/2025	Annual
Chamber	SU-642	ESPEC	93008124	02/19/2025	Annual
Signal Analyzer(10 Hz~26.5 GHz)	N9020A	Agilent	MY51110063	04/04/2025	Annual
ATTENUATOR(20 dB)	8493C	Hewlett Packard	17280	04/17/2025	Annual
Spectrum Analyzer(10 Hz~40 GHz)	FSV40	REOHDE & SCHWARZ	101436	02/13/2025	Annual
Base Station	8960 (E5515C)	Agilent	MY48360800	08/10/2024	Annual
Wideband Radio Communication Tester	MT8821C	Anritsu Corp.	6262287701	05/16/2025	Annual
Wideband Radio Communication Tester	MT8000A	Anritsu Corp.	6262302511	05/14/2025	Annual
Signal Analyzer(5 Hz~40.0 GHz)	N9030B	KEYSIGHT	MY55480167	05/17/2025	Annual
4-Way Divider	ZC4PD-K1844+	Mini-Circuits	942907	09/19/2024	Annual
FCC LTE Mobile Conducted RF Automation Test Software	-	HCT CO., LTD.,	-	-	-

Note:

1. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
2. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. 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 data shown herein 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.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.98 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.58 (Confidence level about 95 %, k=2)

6. SUMMARY OF TEST RESULTS

6.1 Test Condition: Conducted Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Occupied Bandwidth	§ 2.1049	N/A	PASS
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§ 2.1051, § 27.53(h)	< 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions	PASS
Conducted Output Power	§ 2.1046	N/A	See Note1
Peak- to- Average Ratio	§ 27.50(d)(5)	< 13 dB	PASS
Frequency stability / variation of ambient temperature	§ 2.1055, § 27.54	Emission must remain in band	PASS

Note:

1. See SAR Report
2. All conducted tests were tested using 5G Wireless Tester.

6.2 Test Condition: Radiated Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Equivalent Isotropic Radiated Power	§ 27.50(d)(4)	< 1 Watts max. EIRP	PASS
Radiated Spurious and Harmonic Emissions	§ 2.1053, § 27.53(h)	< 43 + 10log10 (P[Watts]) for all out-of band emissions	PASS

Note:

1. Radiated tests were tested using 5G Wireless Tester.

7. SAMPLE CALCULATION

7.1 ERP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
channel	Freq.(MHz)						W	dBm
128	824.20	-21.37	38.40	-10.61	0.95	H	0.483	26.84

ERP = Substitute LEVEL(dBm) + Ant. Gain – CL(Cable Loss)

1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
2) During the test, the turn table is rotated until the maximum signal is found.
3) Record the field strength meter's level.
4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power.

7.2 EIRP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol.	EIRP	
channel	Freq.(MHz)						W	dBm
20175	1,732.50	-15.75	18.45	9.90	1.76	H	0.456	26.59

EIRP = Substitute LEVEL(dBm) + Ant. Gain – CL(Cable Loss)

1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
2) During the test, the turn table is rotated until the maximum signal is found.
3) Record the field strength meter's level.
4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
6) The signal generator output level with Ant. Gain and cable loss are the rating of equivalent isotropic radiated power.

7.3. Emission Designator

GSM Emission Designator

Emission Designator = 249KGXW
GSM BW = 249 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 249KG7W
GSM BW = 249 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M17F9W
WCDMA BW = 4.17 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 4M48G7D
LTE BW = 4.48 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

QAM Modulation

Emission Designator = 4M48W7D
LTE BW = 4.48 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

8. TEST DATA

8.1 EQUIVALENT ISOTROPIC RADIATED POWER

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1697.5	Sub6 n70/ 5 MHz [15 kHz]	PI/2 BPSK	-20.46	13.17	9.60	1.99	V	< 1.00	0.120	20.78	1	12
		QPSK	-20.51	13.12	9.60	1.99	V		0.118	20.73		
		16-QAM	-21.47	12.16	9.60	1.99	V		0.095	19.77		
		64-QAM	-23.05	10.58	9.60	1.99	V		0.066	18.19		
		256-QAM	-24.85	8.78	9.60	1.99	V		0.044	16.39		
1702.5		PI/2 BPSK	-20.70	12.93	9.60	1.99	V		0.113	20.54	1	23
		QPSK	-20.76	12.87	9.60	1.99	V		0.112	20.48		
		16-QAM	-21.70	11.93	9.60	1.99	V		0.090	19.54		
		64-QAM	-23.22	10.41	9.60	1.99	V		0.063	18.02		
		256-QAM	-25.08	8.55	9.60	1.99	V		0.041	16.16		
1707.5		PI/2 BPSK	-20.63	12.57	9.60	1.99	V		0.104	20.18	1	12
		QPSK	-20.67	12.53	9.60	1.99	V		0.103	20.14		
		16-QAM	-21.57	11.63	9.60	1.99	V		0.084	19.24		
		64-QAM	-23.14	10.06	9.60	1.99	V		0.059	17.67		
		256-QAM	-24.99	8.21	9.60	1.99	V		0.038	15.82		

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1700.0	Sub6 n70/ 10 MHz [15 kHz]	PI/2 BPSK	-20.50	13.13	9.60	1.99	V	< 1.00	0.119	20.74	1	26
		QPSK	-20.54	13.09	9.60	1.99	V		0.117	20.70		
		16-QAM	-21.59	12.04	9.60	1.99	V		0.092	19.65		
		64-QAM	-22.98	10.65	9.60	1.99	V		0.067	18.26		
		256-QAM	-24.97	8.66	9.60	1.99	V		0.042	16.27		
1702.5		PI/2 BPSK	-20.54	13.09	9.60	1.99	V		0.117	20.70	1	1
		QPSK	-20.56	13.07	9.60	1.99	V		0.117	20.68		
		16-QAM	-21.60	12.03	9.60	1.99	V		0.092	19.64		
		64-QAM	-23.07	10.56	9.60	1.99	V		0.066	18.17		
		256-QAM	-24.99	8.64	9.60	1.99	V		0.042	16.25		
1705.0		PI/2 BPSK	-20.55	12.87	9.60	1.99	V		0.112	20.48	1	26
		QPSK	-20.60	12.82	9.60	1.99	V		0.110	20.43		
		16-QAM	-21.53	11.89	9.60	1.99	V		0.089	19.50		
		64-QAM	-22.96	10.46	9.60	1.99	V		0.064	18.07		
		256-QAM	-24.92	8.50	9.60	1.99	V		0.041	16.11		

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1702.5	Sub6 n70/ 15 MHz [15 kHz]	PI/2 BPSK	-20.69	12.94	9.60	1.99	V	< 1.00	0.114	20.55	1	77
		QPSK	-20.73	12.90	9.60	1.99	V		0.112	20.51		
		16-QAM	-21.80	11.83	9.60	1.99	V		0.088	19.44		
		64-QAM	-23.19	10.44	9.60	1.99	V		0.064	18.05		
		256-QAM	-25.07	8.56	9.60	1.99	V		0.041	16.17		

8.2 RADIATED SPURIOUS EMISSIONS

▣ NR Band: N70
▣ Bandwidth: 5 MHz
▣ Modulation: PI/2 BPSK
▣ Distance: 3 meters
▣ SCS: 15 kHz

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit (dBm)	RB	
									Size	Offset
339500 (1697.5)	3395.00	-59.70	11.05	-61.88	2.93	V	-53.75	-13.00	1	12
	5092.50	-60.52	10.70	-55.89	3.64	V	-48.83	-13.00		
	6790.00	-62.77	10.60	-51.79	4.25	V	-45.44	-13.00		
340500 (1702.5)	3405.00	-60.09	11.10	-62.20	2.91	V	-54.01	-13.00	1	23
	5107.50	-61.12	10.80	-55.63	3.67	V	-48.50	-13.00		
	6810.00	-62.85	10.70	-51.86	4.24	V	-45.40	-13.00		
341500 (1707.5)	3415.00	-60.00	11.10	-61.58	2.93	V	-53.41	-13.00	1	12
	5122.50	-61.01	10.80	-55.39	3.64	V	-48.23	-13.00		
	6830.00	-64.49	10.70	-53.55	4.28	V	-47.13	-13.00		

8.3 PEAK-TO-AVERAGE RATIO

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (dB)
Sub6 n70	5 MHz	1702.5	BPSK	25	0	4.96
			QPSK			5.68
			16-QAM			6.30
			64-QAM			6.37
			256-QAM			6.24
	10 MHz		BPSK	50		5.59
			QPSK			5.82
			16-QAM			6.36
			64-QAM			6.64
			256-QAM			6.55
	15 MHz		BPSK	75		4.40
			QPSK			5.64
			16-QAM			6.34
			64-QAM			6.55
			256-QAM			6.66

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 36 ~ 50.

8.4 OCCUPIED BANDWIDTH

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
Sub6 n70	5 MHz	1702.5	BPSK	25	0	4.6020
			QPSK			4.6257
			16-QAM			4.5808
			64-QAM			4.6457
			256-QAM			4.5679
	10 MHz		BPSK	50		8.9829
			QPSK			9.0195
			16-QAM			8.9918
			64-QAM			8.9830
			256-QAM			8.9655
	15 MHz		BPSK	75		13.441
			QPSK			13.450
			16-QAM			13.465
			64-QAM			13.496
			256-QAM			13.443

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 51 ~ 65.

8.5 CONDUCTED SPURIOUS EMISSIONS

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
Sub6 n70	5	1697.5	3.3914	29.400	-75.227	-45.827	-13.00
		1702.5	3.4019	29.400	-74.949	-45.549	
		1707.5	3.4118	29.400	-75.075	-45.675	
	10	1700.0	3.3919	29.400	-74.596	-45.196	
		1702.5	3.3969	29.400	-74.821	-45.421	
		1705.0	3.4019	29.400	-74.235	-44.835	
	15	1702.5	3.3919	29.400	-75.119	-45.719	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 66 ~ 79.
2. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
3. Factor(dB) = Cable Loss + Ext. Attenuator + Power Splitter

Frequency Range (GHz)	Factor [dB]
0.03 – 1	26.694
1 – 5	29.400
5 – 10	30.015
10 – 15	30.540
15 – 20	30.913
Above 20	31.555

8.6 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 80 ~ 97.

8.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ BandWidth: 5 MHz

▣ Voltage(100 %): 3.880 VDC

▣ Batt. Endpoint: 3.300 VDC

▣ LIMIT: Emission must remain in band

Test. Frequncy	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(°C)	(Hz)	Error (Hz)	(%)	
1697.5	100 %	+20(Ref)	1697 500 000	0.0	0.000 000	0.000
	100 %	-30	1697 500 000	-0.3	0.000 000	0.000
	100 %	-20	1697 500 001	1.2	0.000 000	0.001
	100 %	-10	1697 500 000	-0.3	0.000 000	0.000
	100 %	0	1697 500 000	0.0	0.000 000	0.000
	100 %	+10	1697 500 001	0.6	0.000 000	0.000
	100 %	+30	1697 500 000	0.3	0.000 000	0.000
	100 %	+40	1697 499 999	-0.9	0.000 000	-0.001
	100 %	+50	1697 499 999	-0.8	0.000 000	0.000
	Batt. Endpoint	+20	1697 500 000	0.3	0.000 000	0.000
1707.5	100 %	+20(Ref)	1707 500 001	0.0	0.000 000	0.000
	100 %	-30	1707 500 001	-0.1	0.000 000	0.000
	100 %	-20	1707 500 001	0.3	0.000 000	0.000
	100 %	-10	1707 500 002	1.3	0.000 000	0.001
	100 %	0	1707 500 001	0.6	0.000 000	0.000
	100 %	+10	1707 500 001	0.4	0.000 000	0.000
	100 %	+30	1707 500 001	0.5	0.000 000	0.000
	100 %	+40	1707 500 002	1.1	0.000 000	0.001
	100 %	+50	1707 500 001	0.3	0.000 000	0.000
	Batt. Endpoint	+20	1707 500 001	0.4	0.000 000	0.000

▣ BandWidth: 10 MHz

▣ Voltage(100 %): 3.880 VDC

▣ Batt. Endpoint: 3.300 VDC

▣ LIMIT: Emission must remain in band

Test. Frequncy	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(℃)	(Hz)	Error (Hz)	(%)	
1700.0	100 %	+20(Ref)	1699 999 999	0.0	0.000 000	0.000
	100 %	-30	1699 999 999	0.1	0.000 000	0.000
	100 %	-20	1699 999 999	0.4	0.000 000	0.000
	100 %	-10	1700 000 000	0.5	0.000 000	0.000
	100 %	0	1699 999 999	0.0	0.000 000	0.000
	100 %	+10	1700 000 000	0.7	0.000 000	0.000
	100 %	+30	1699 999 998	-0.8	0.000 000	0.000
	100 %	+40	1700 000 000	0.8	0.000 000	0.000
	100 %	+50	1699 999 999	0.2	0.000 000	0.000
	Batt. Endpoint	+20	1699 999 999	0.4	0.000 000	0.000
1705.0	100 %	+20(Ref)	1705 000 000	0.0	0.000 000	0.000
	100 %	-30	1704 999 999	-0.9	0.000 000	0.000
	100 %	-20	1704 999 999	-0.8	0.000 000	0.000
	100 %	-10	1704 999 999	-0.8	0.000 000	0.000
	100 %	0	1704 999 999	-0.7	0.000 000	0.000
	100 %	+10	1705 000 000	-0.1	0.000 000	0.000
	100 %	+30	1705 000 000	0.2	0.000 000	0.000
	100 %	+40	1705 000 000	-0.4	0.000 000	0.000
	100 %	+50	1705 000 001	0.4	0.000 000	0.000
	Batt. Endpoint	+20	1705 000 000	-0.2	0.000 000	0.000

▣ BandWidth: 15 MHz

▣ Voltage(100 %): 3.880 VDC

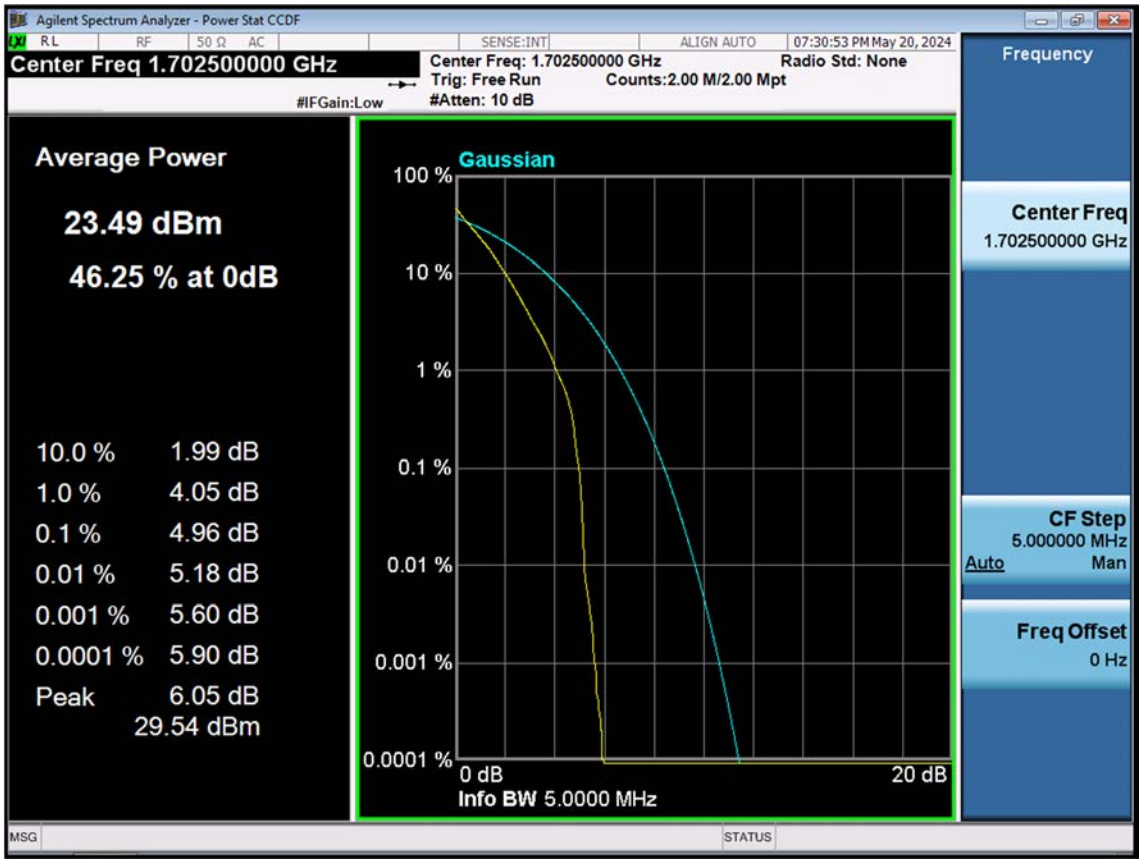
▣ Batt. Endpoint: 3.300 VDC

▣ LIMIT: Emission must remain in band

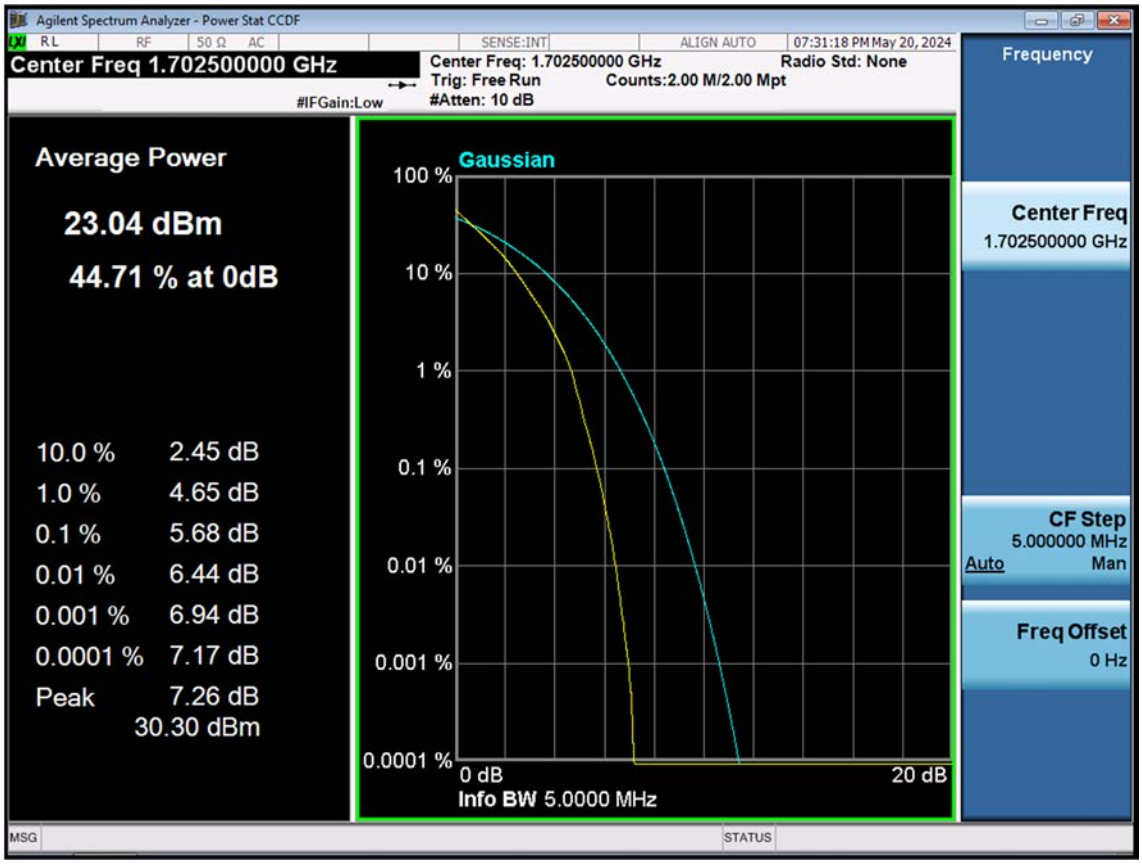
Test. Frequncy	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(°C)	(Hz)	Error (Hz)	(%)	
1702.5	100 %	+20(Ref)	1702 500 000	0.0	0.000 000	0.000
	100 %	-30	1702 500 000	-0.3	0.000 000	0.000
	100 %	-20	1702 500 000	-0.6	0.000 000	0.000
	100 %	-10	1702 500 000	-0.7	0.000 000	0.000
	100 %	0	1702 500 000	0.1	0.000 000	0.000
	100 %	+10	1702 500 001	0.7	0.000 000	0.000
	100 %	+30	1702 500 000	0.0	0.000 000	0.000
	100 %	+40	1702 500 000	-0.6	0.000 000	0.000
	100 %	+50	1702 500 001	1.2	0.000 000	0.001
	Batt. Endpoint	+20	1702 500 000	-0.7	0.000 000	0.000

9. TEST PLOTS

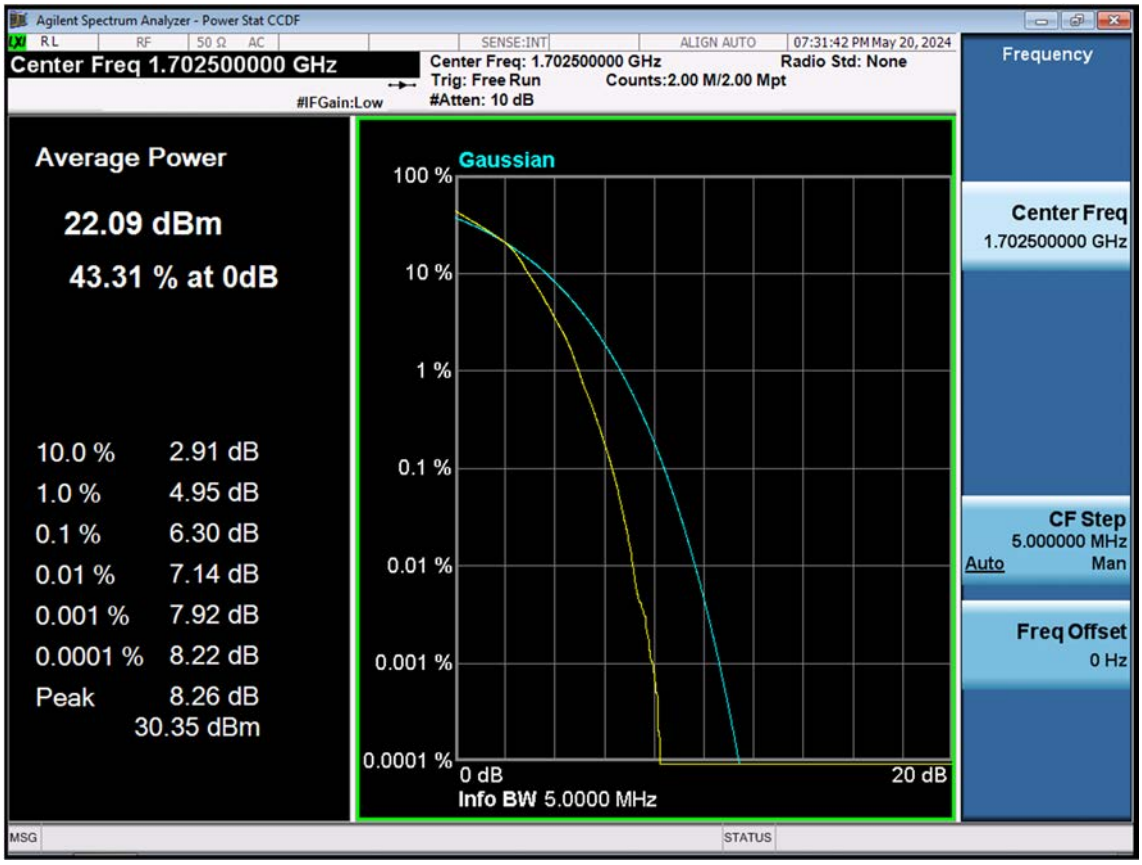
5 M_PAR_Mid_BPSK_FullRB



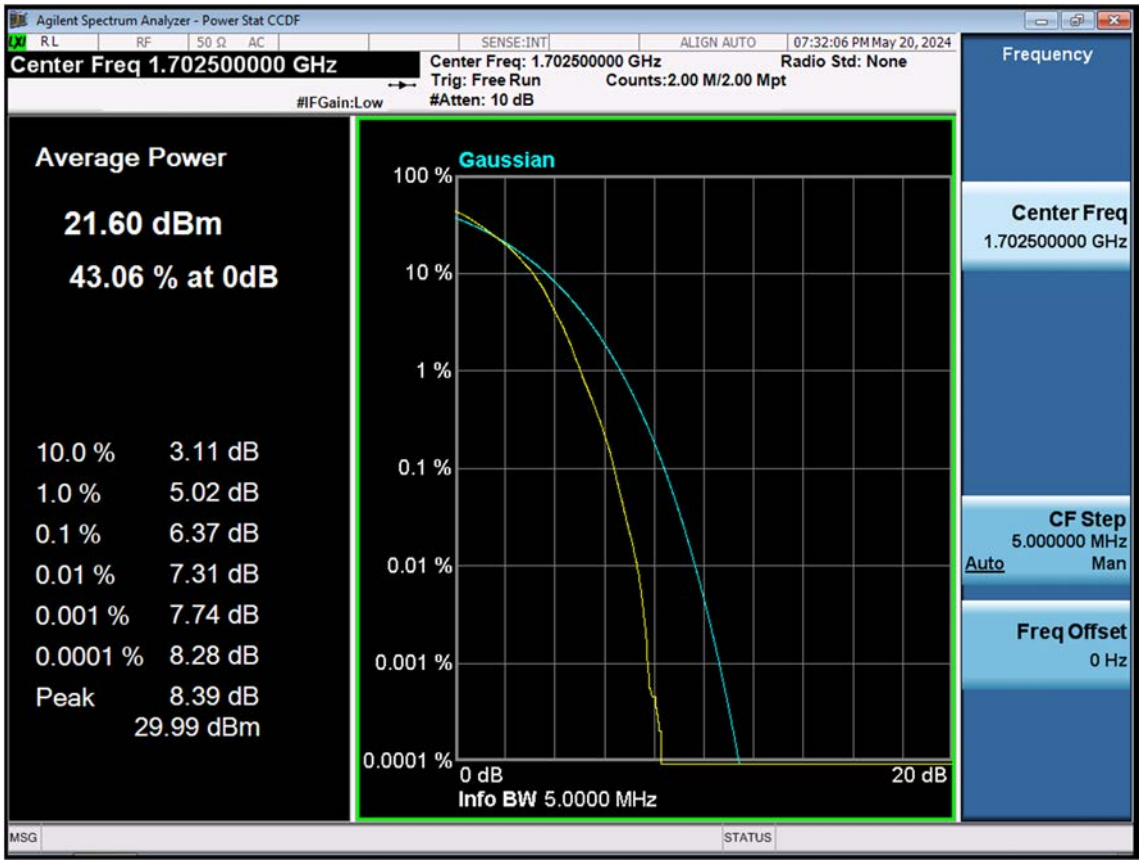
5 M_PAR_Mid_QPSK_FullRB



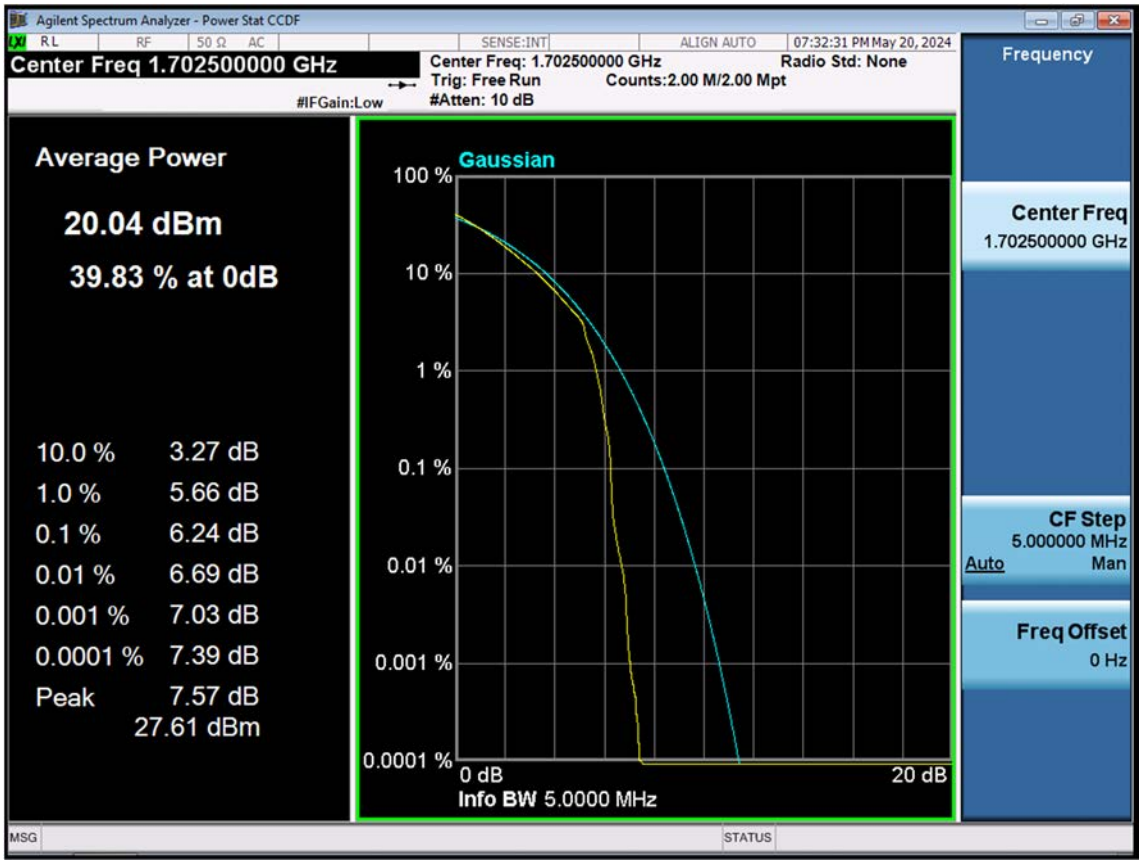
5 M_PAR_Mid_16QAM_FullRB



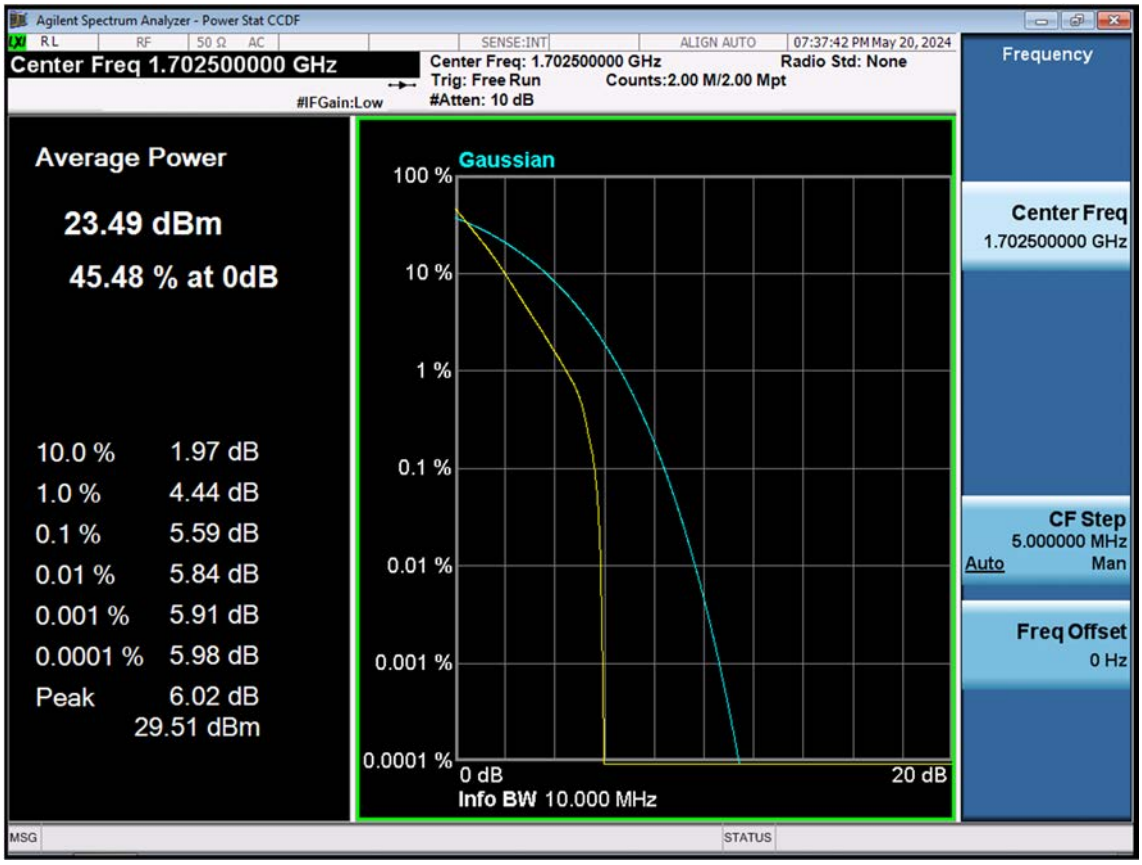
5 M_PAR_Mid_64QAM_FullRB



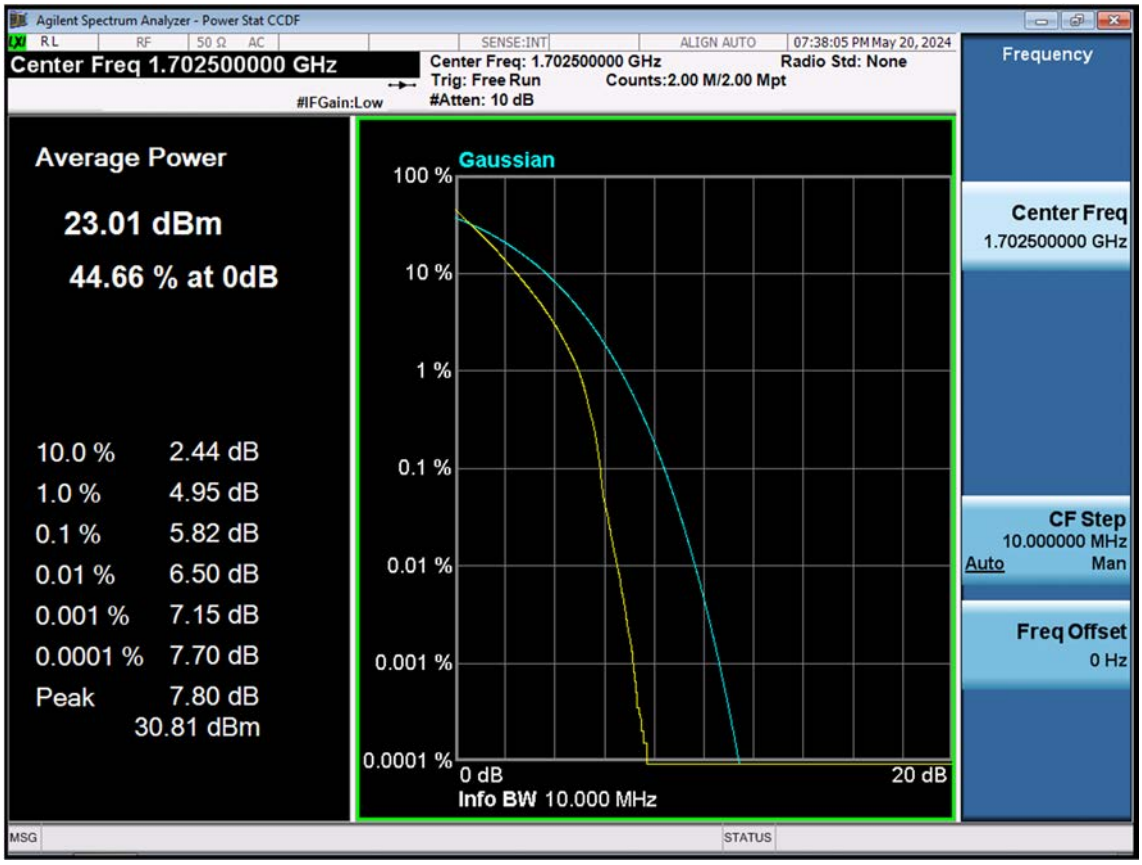
5 M_PAR_Mid_256QAM_FullRB



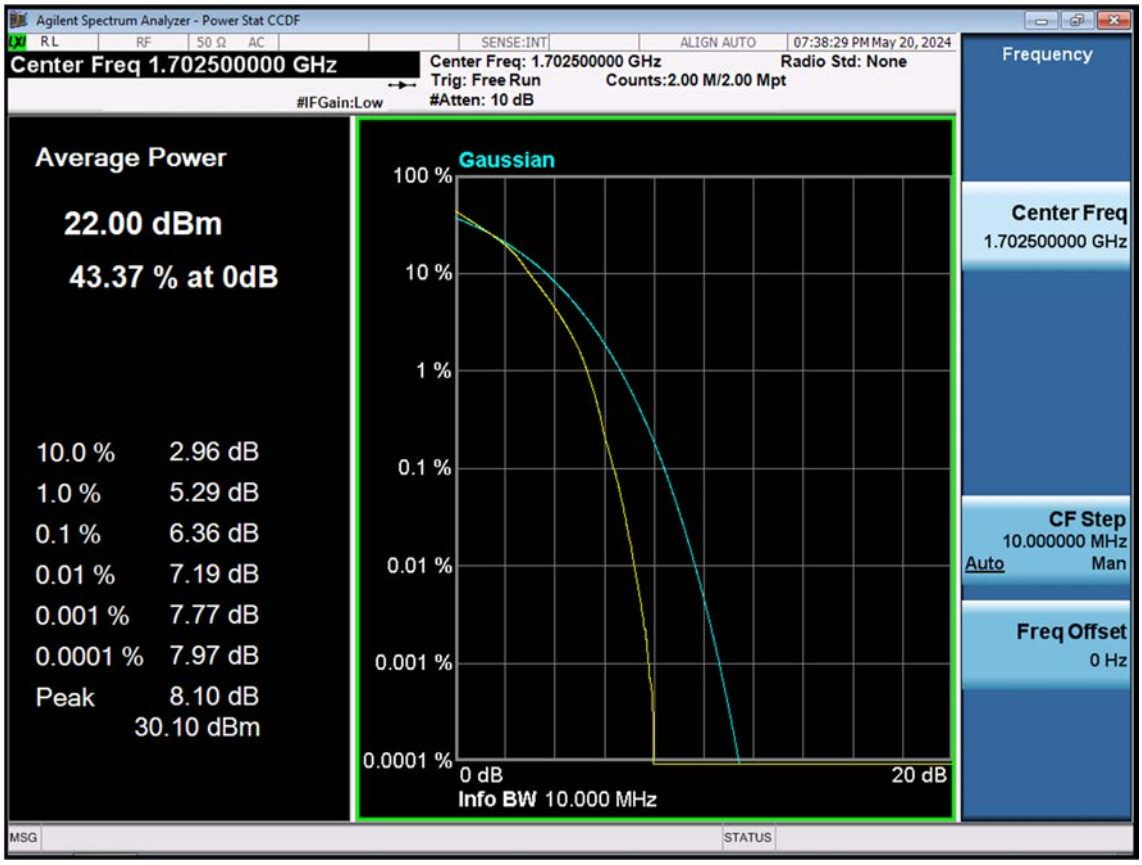
10 M_PAR_Mid_BPSK_FullRB



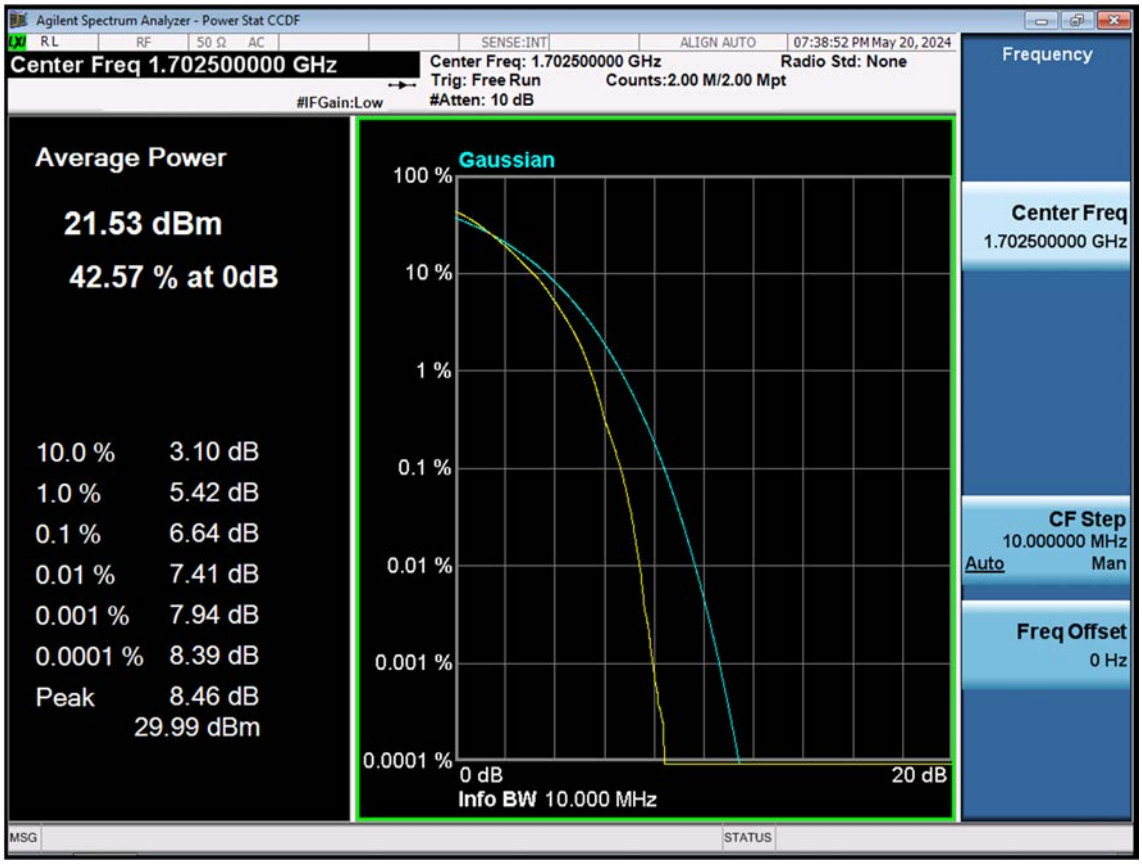
10 M_PAR_Mid_QPSK_FullRB



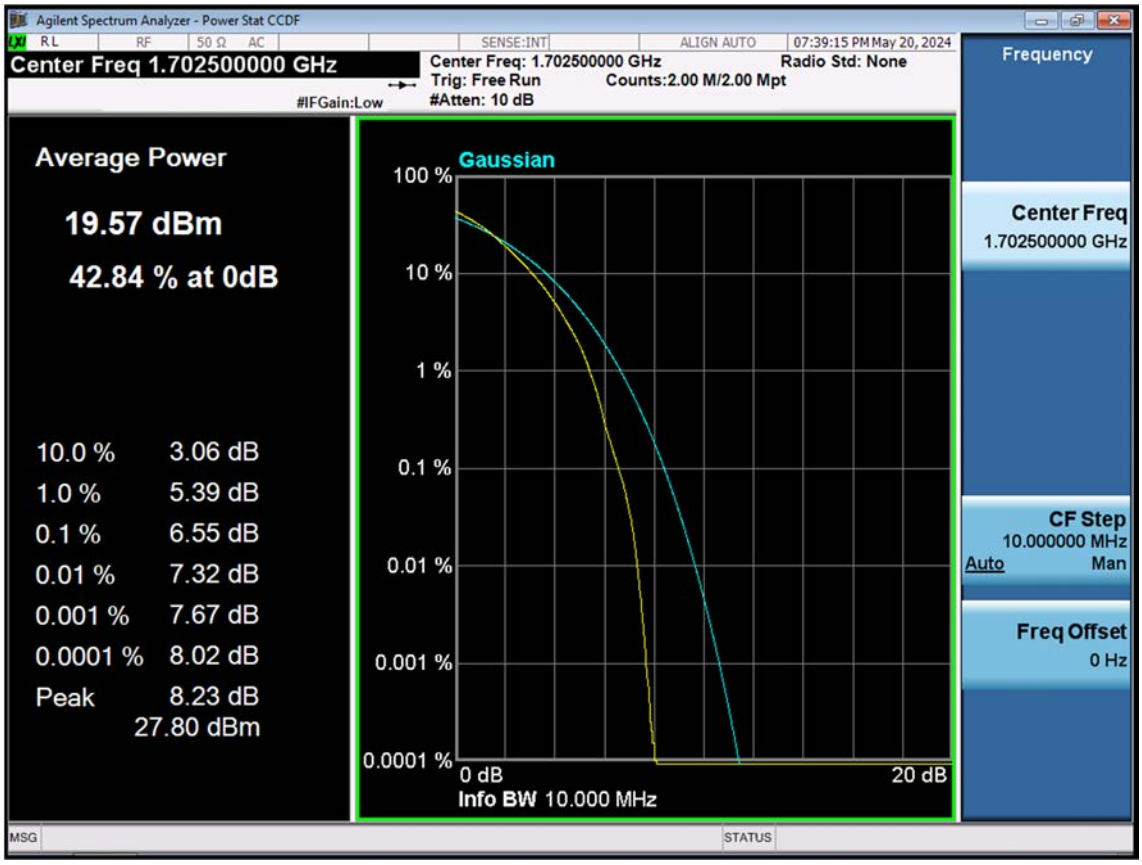
10 M_PAR_Mid_16QAM_FullRB



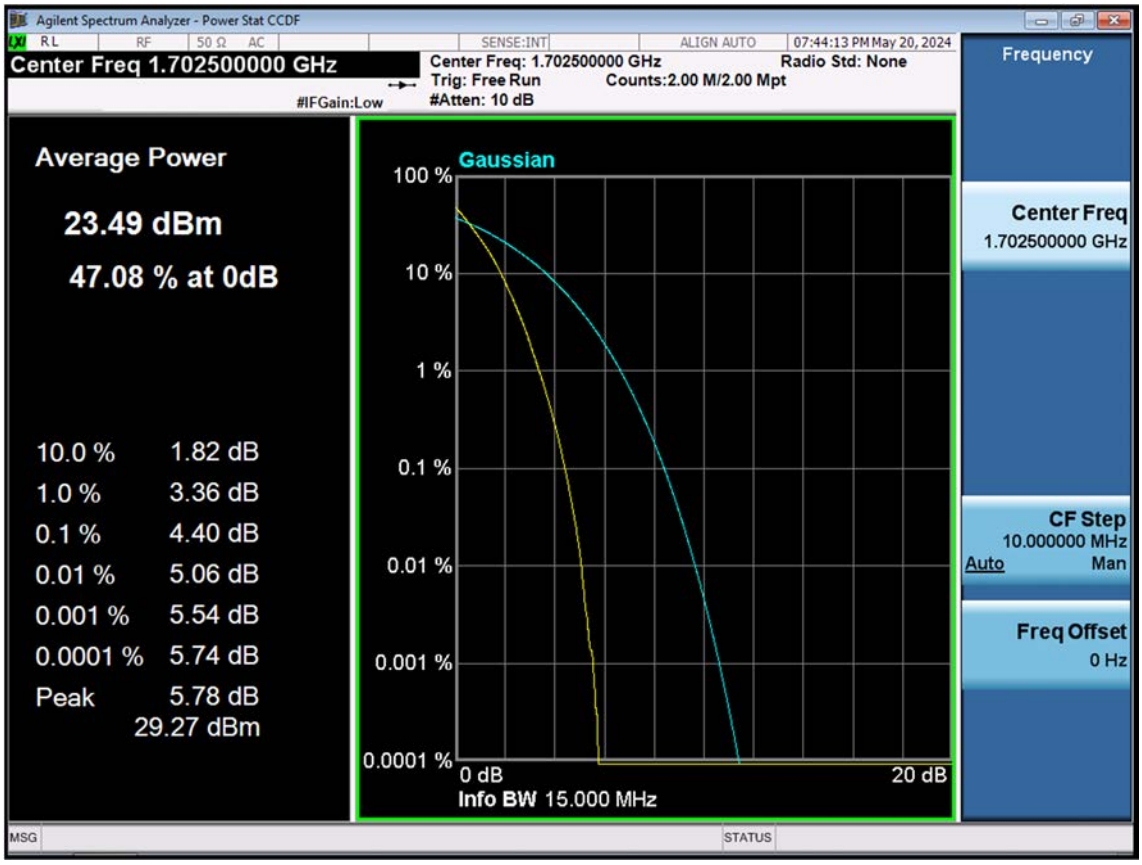
10 M_PAR_Mid_64QAM_FullRB



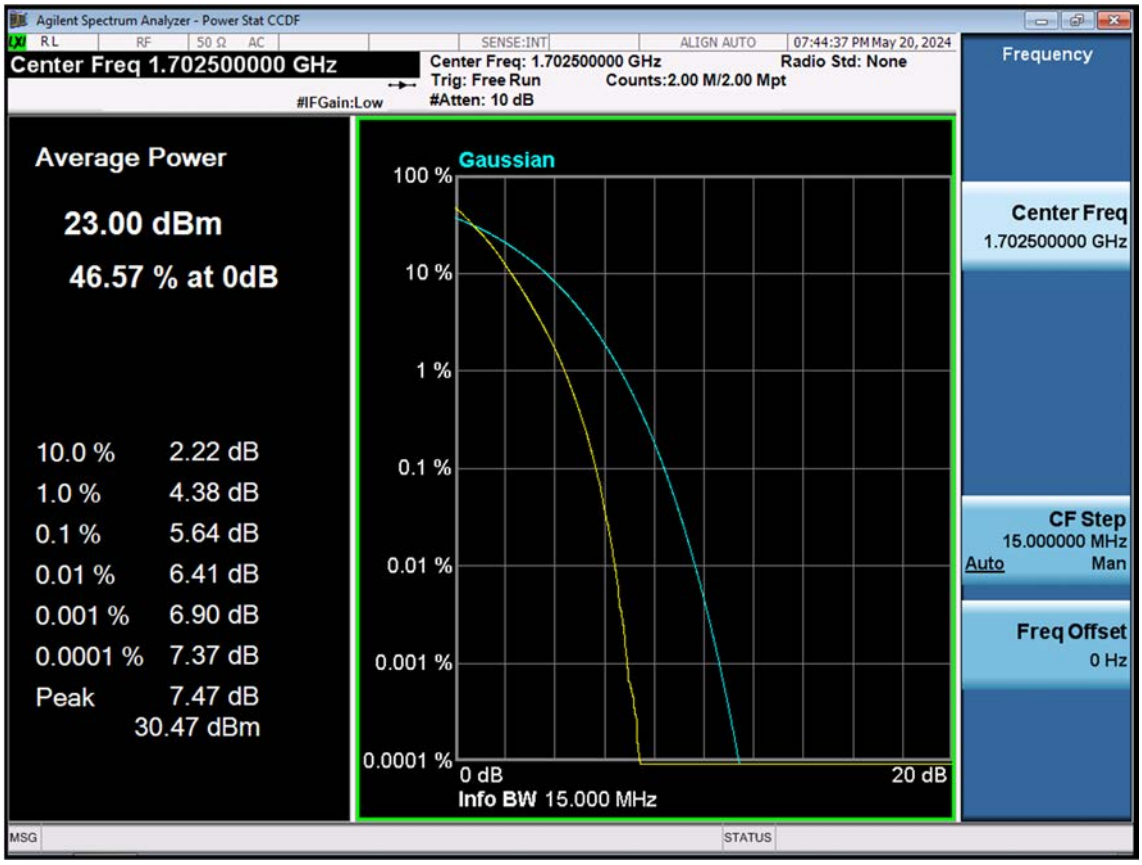
10 M_PAR_Mid_256QAM_FullRB



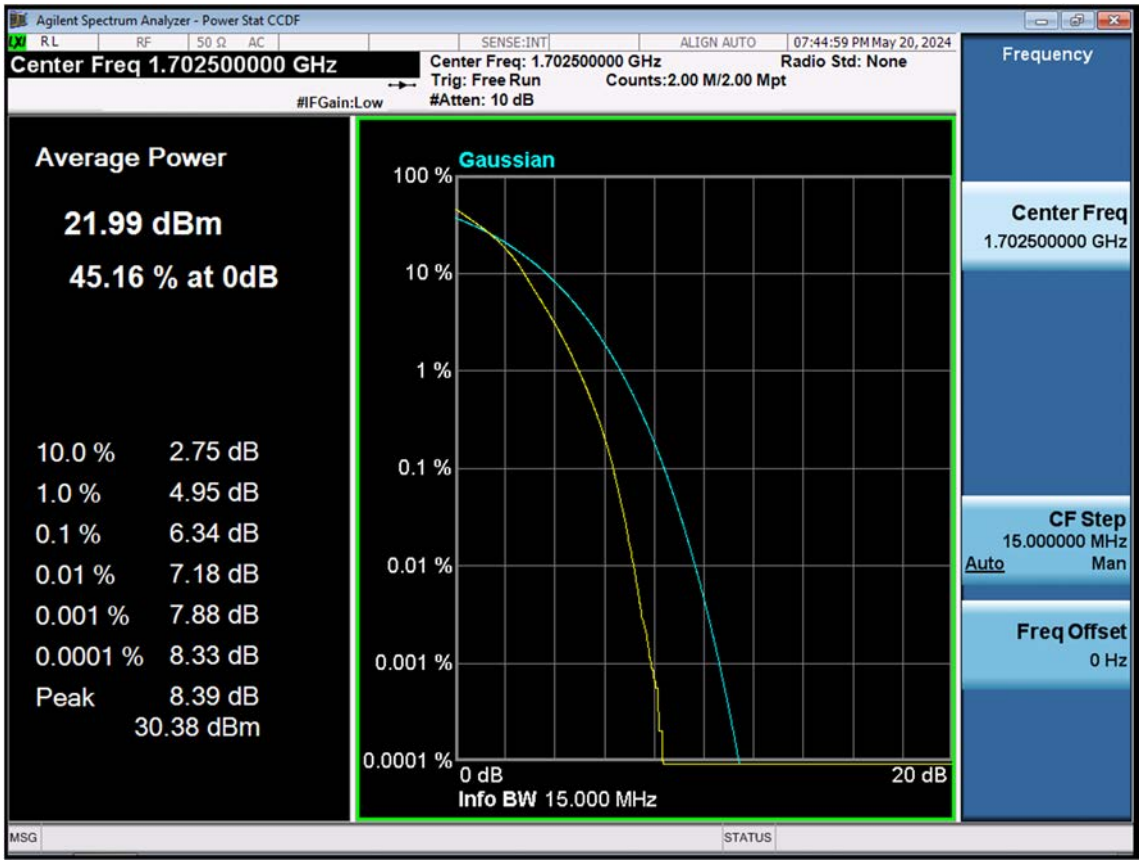
15 M_PAR_Mid_BPSK_FullRB



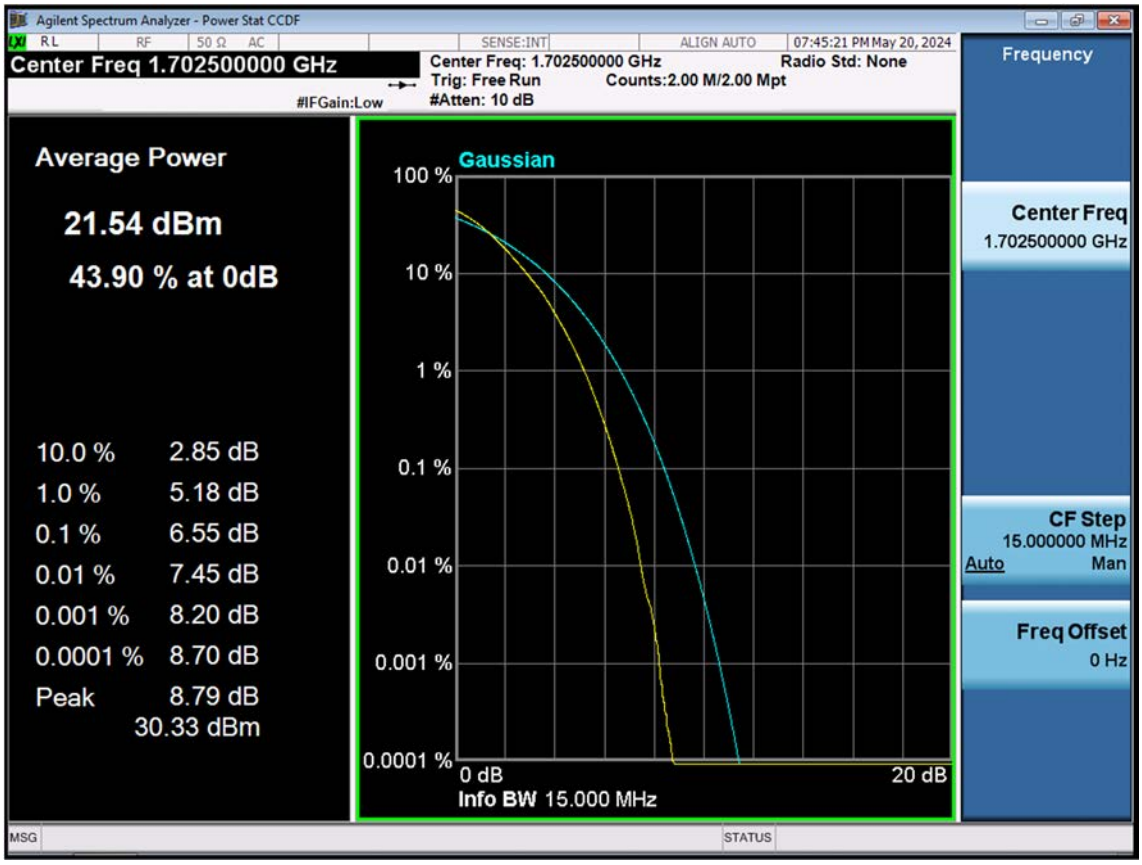
15 M_PAR_Mid_QPSK_FullRB



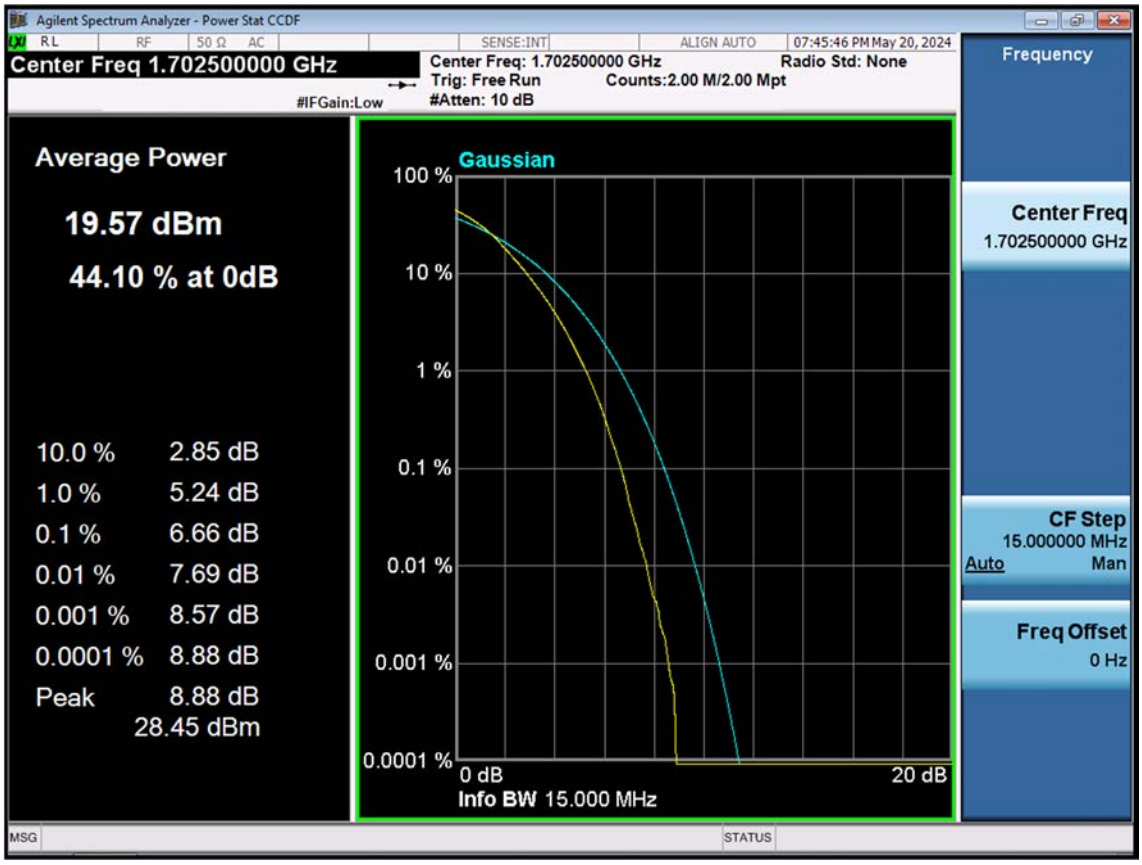
15 M_PAR_Mid_16QAM_FullRB



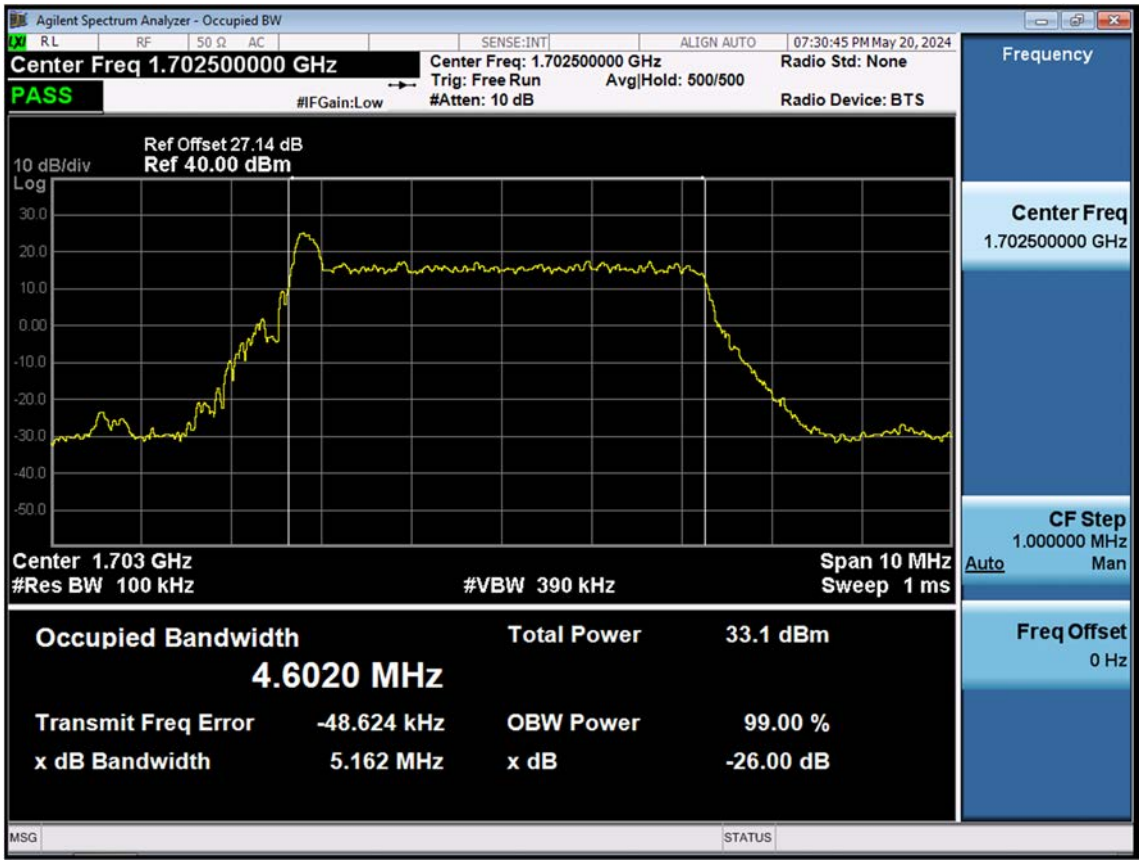
15 M_PAR_Mid_64QAM_FullRB



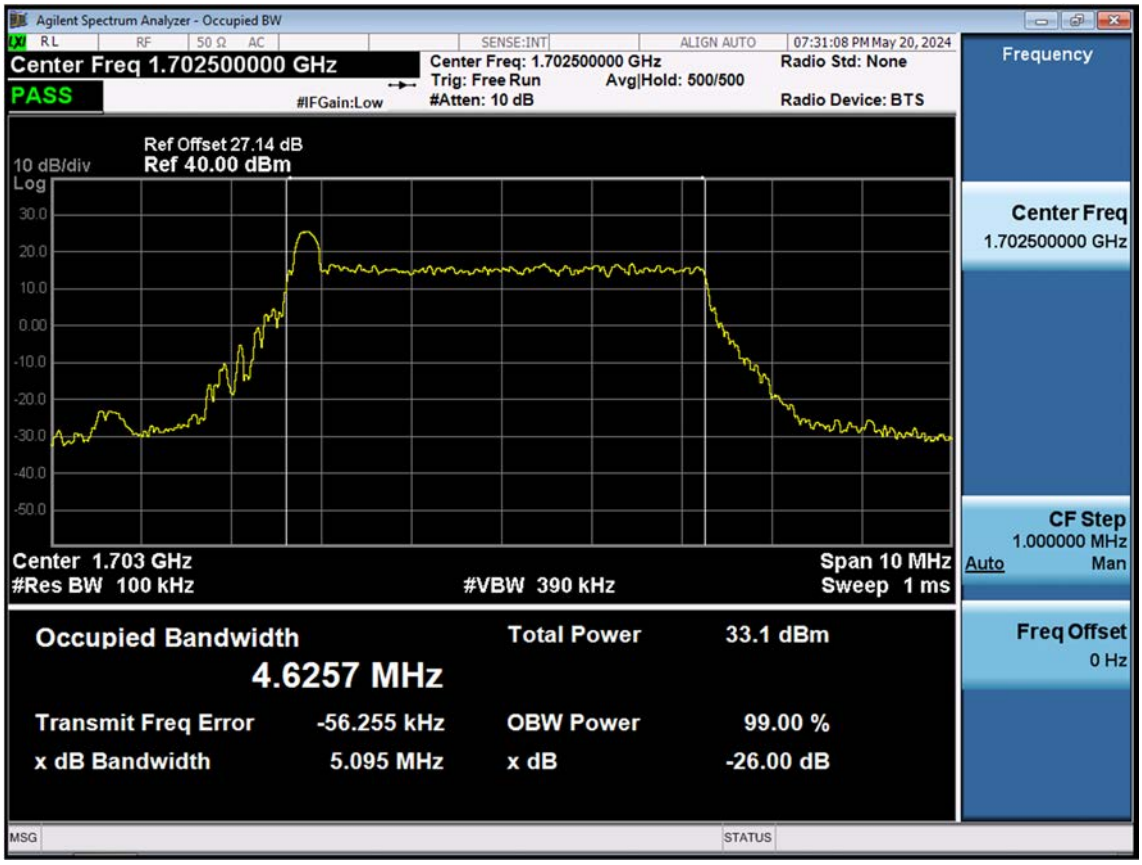
15 M_PAR_Mid_256QAM_FullRB



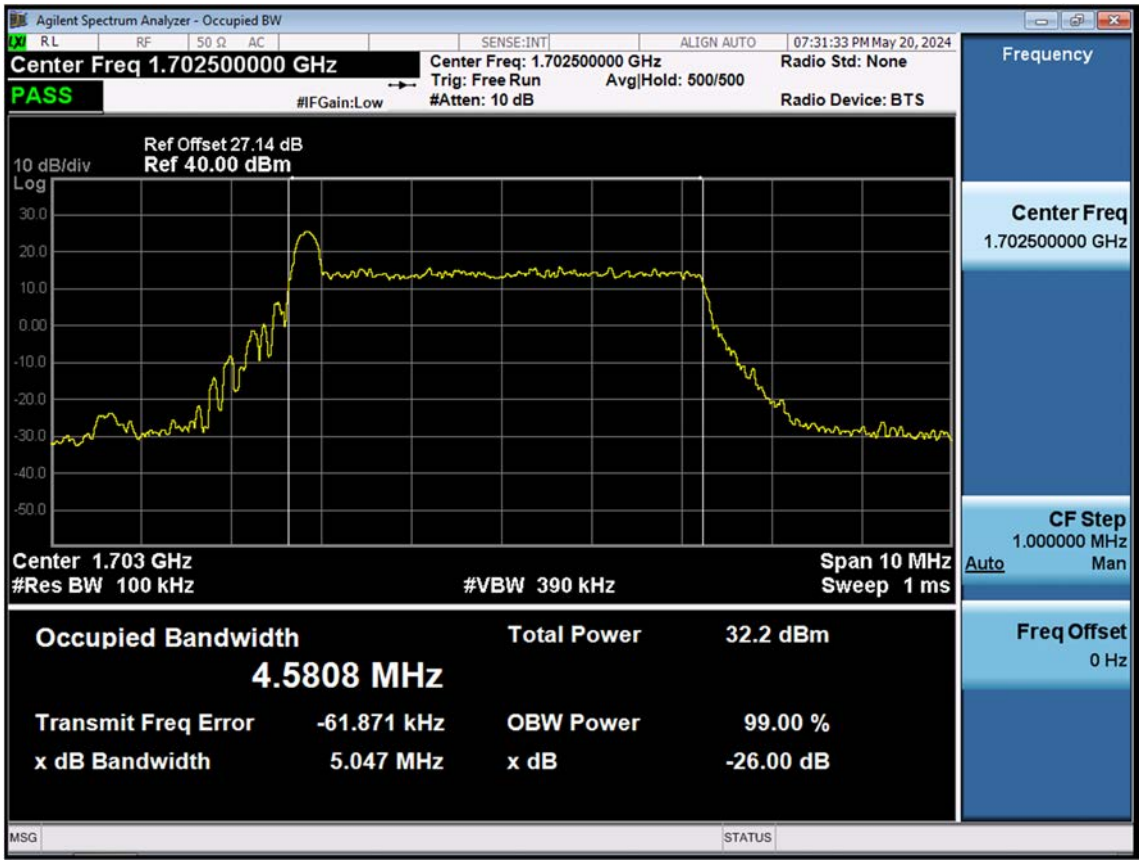
5 M_OBW_Mid_BPSK_FullRB



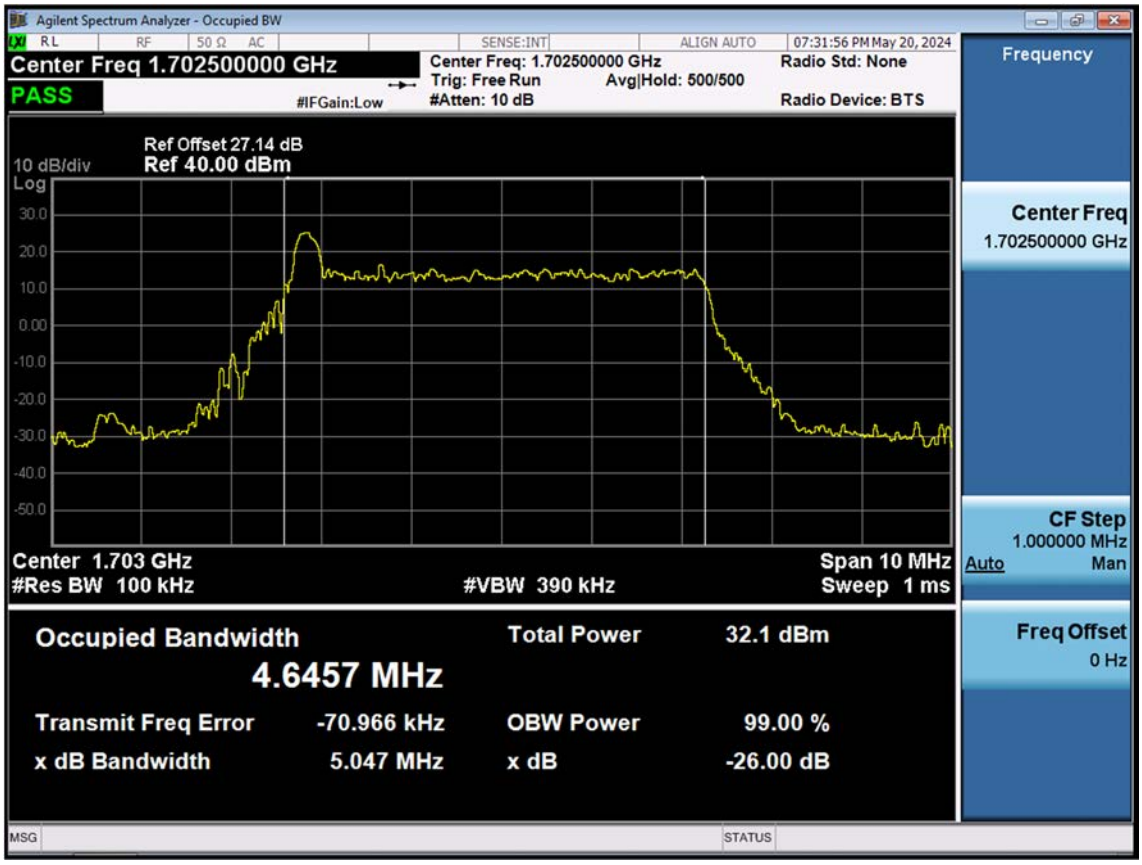
5 M_OBW_Mid_QPSK_FullRB



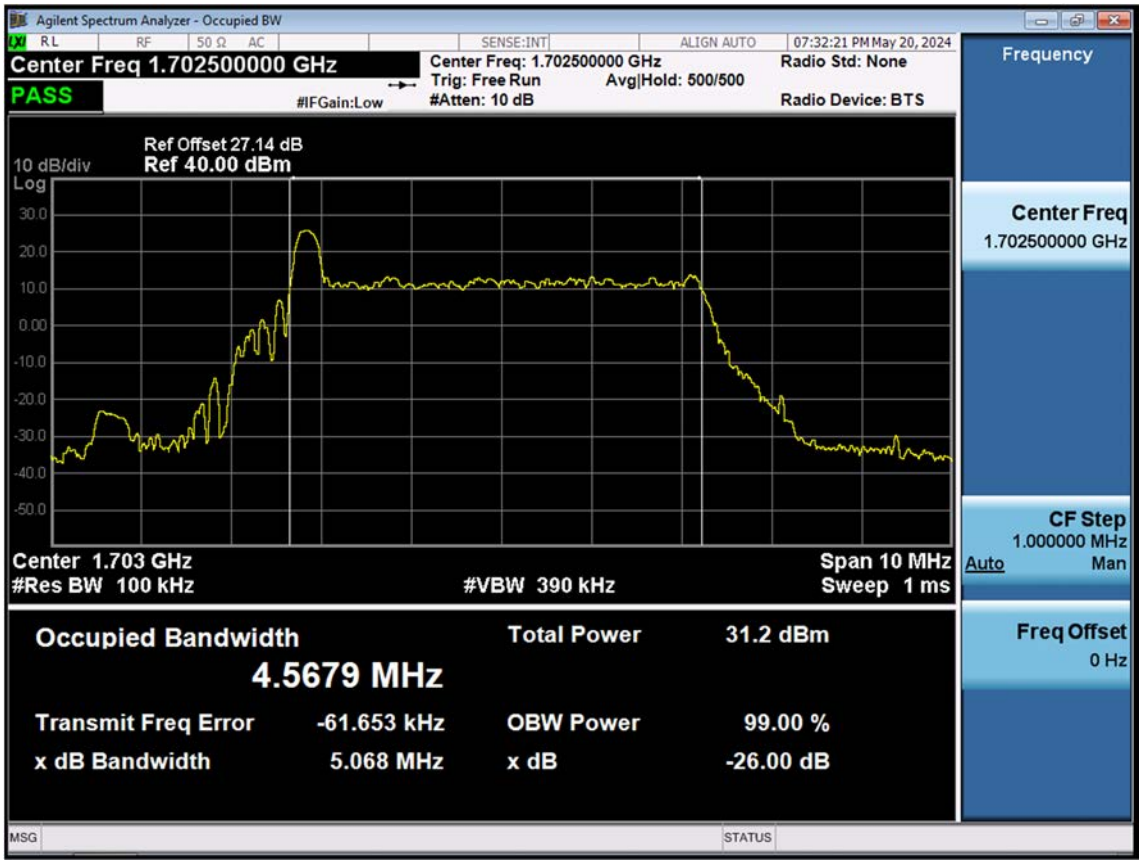
5 M_OBW_Mid_16QAM_FullRB



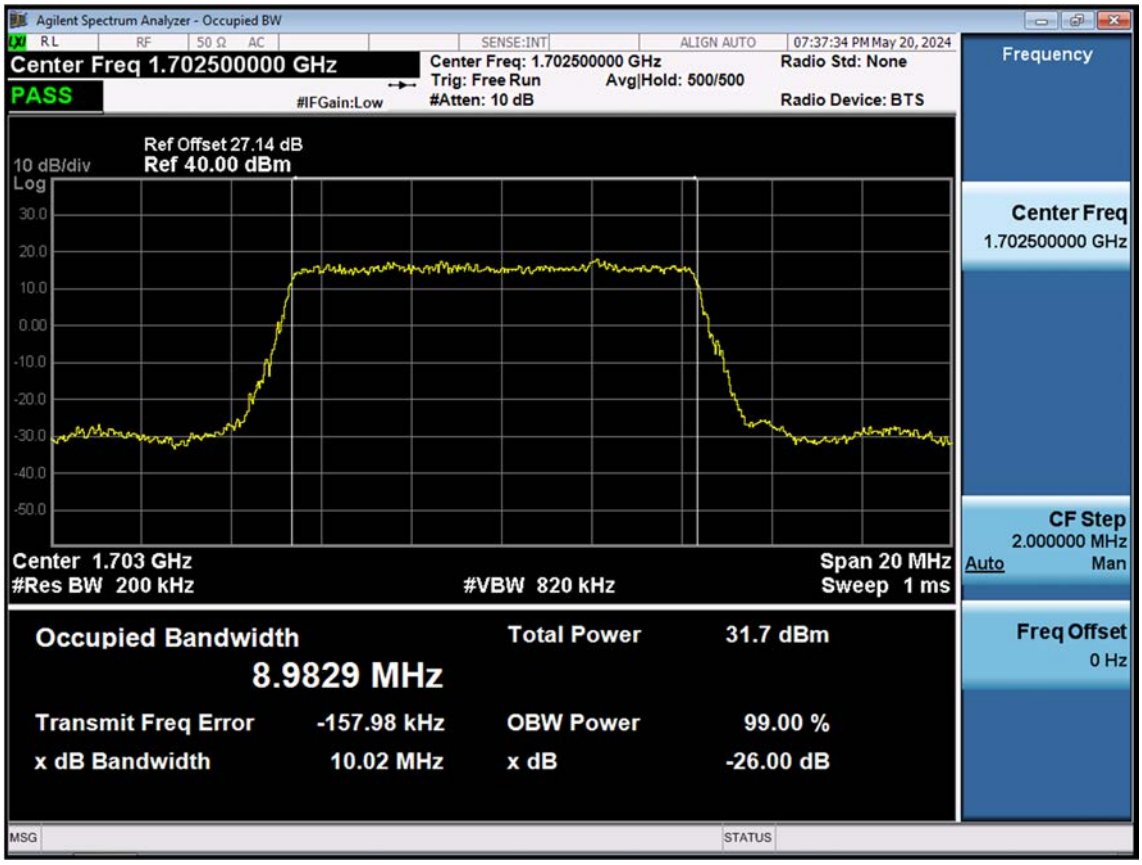
5 M_OBW_Mid_64QAM_FullRB



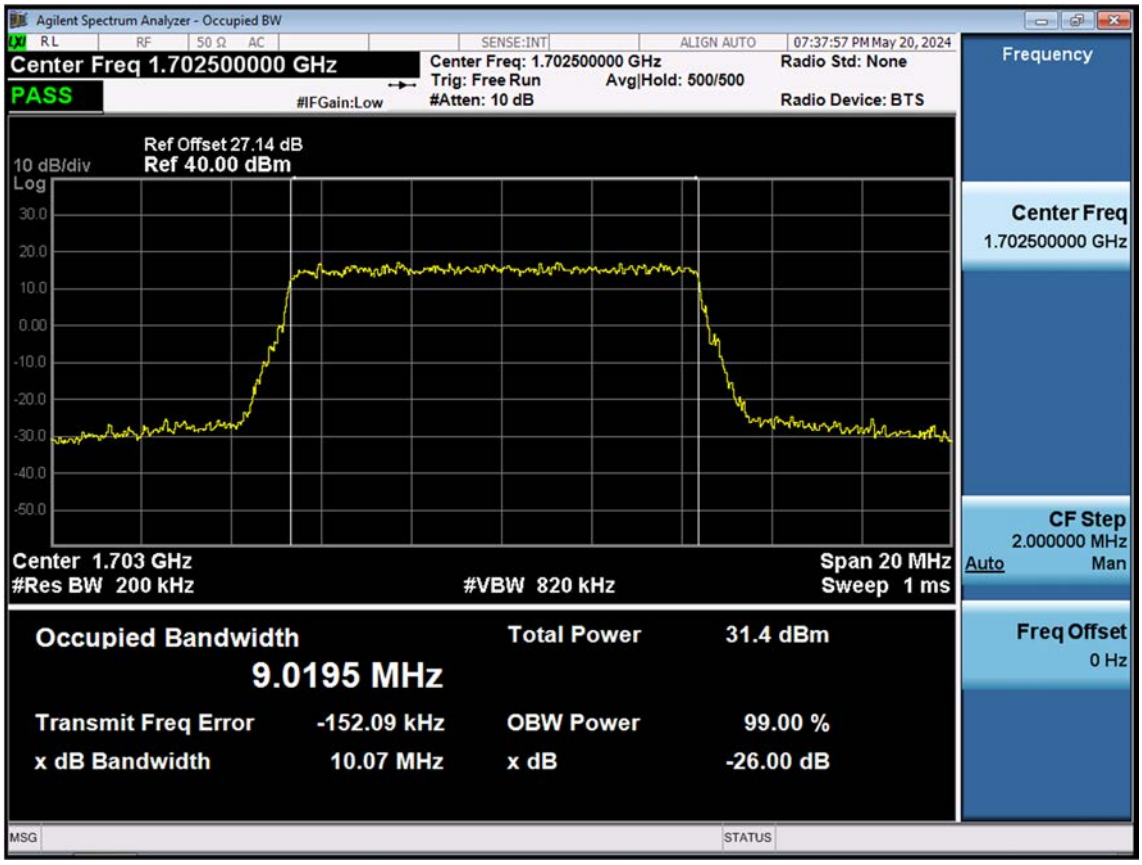
5 M_OBW_Mid_256QAM_FullRB



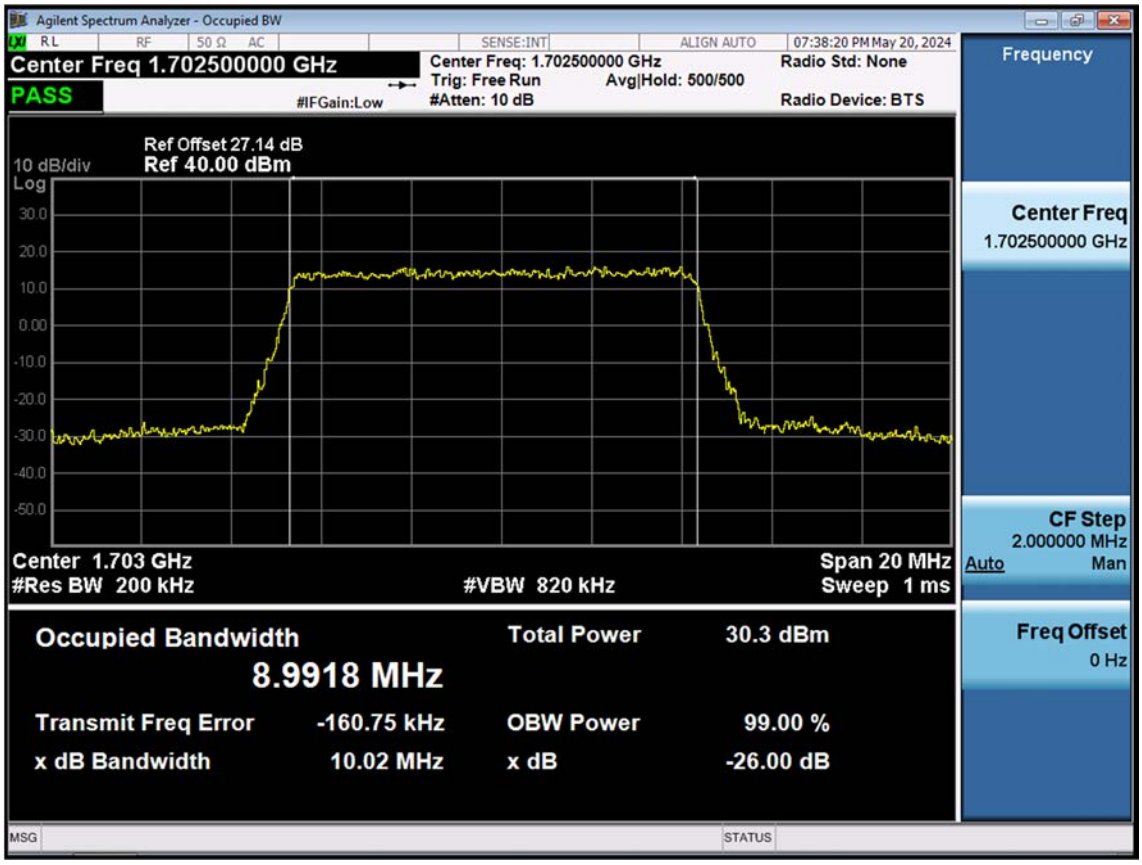
10 M_OBW_Mid_BPSK_FullRB



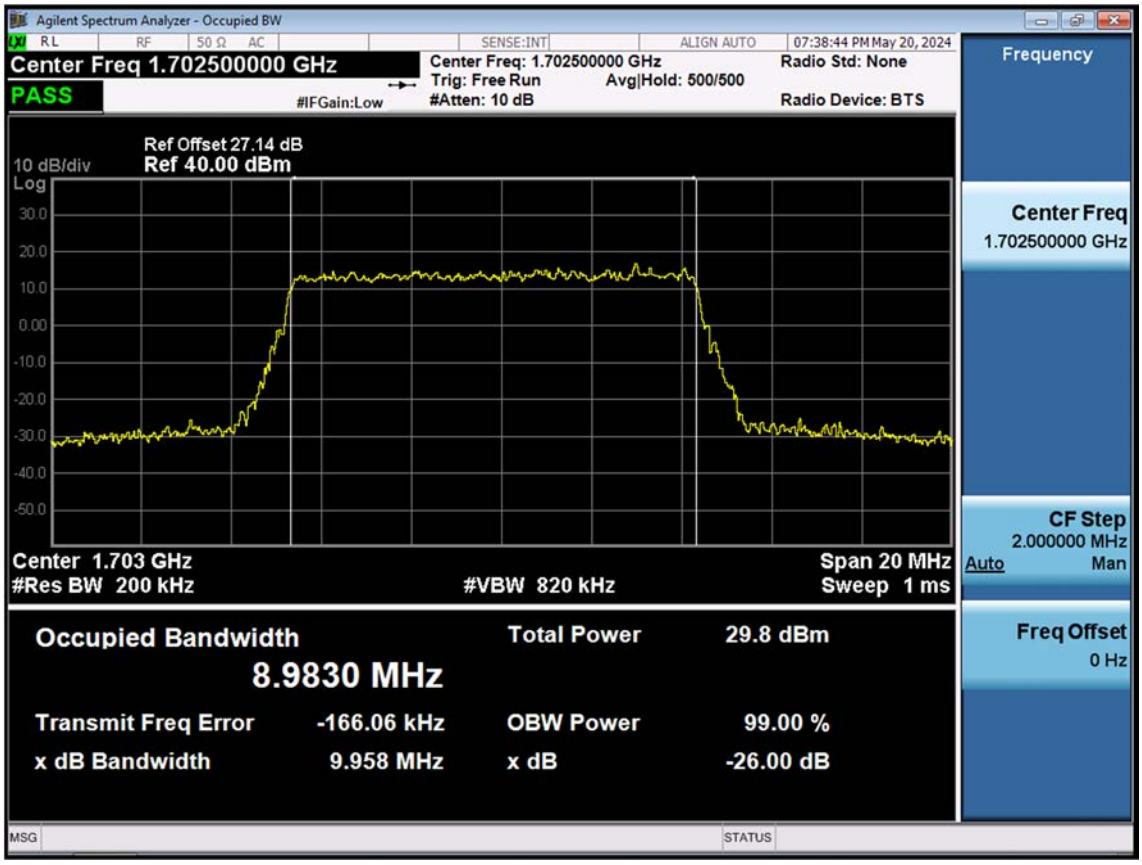
10 M_OBW_Mid_QPSK_FullRB



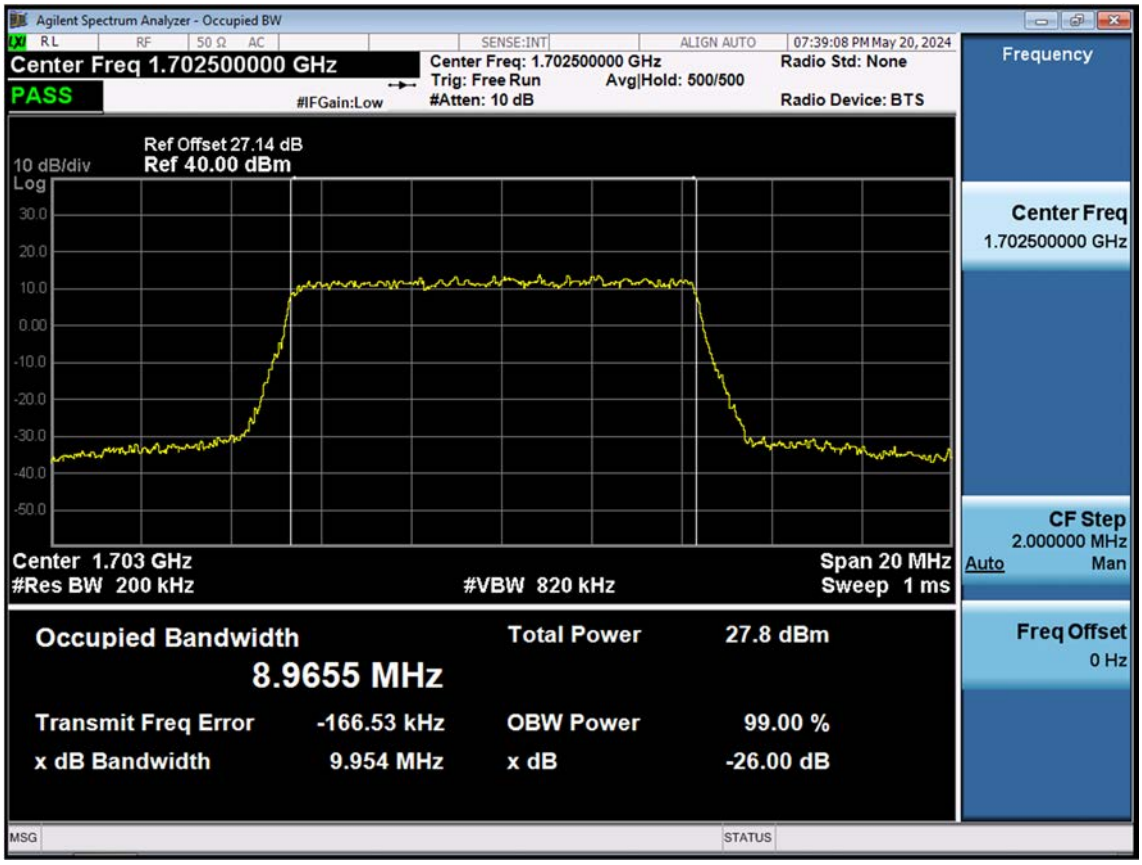
10 M_OBW_Mid_16QAM_FullRB



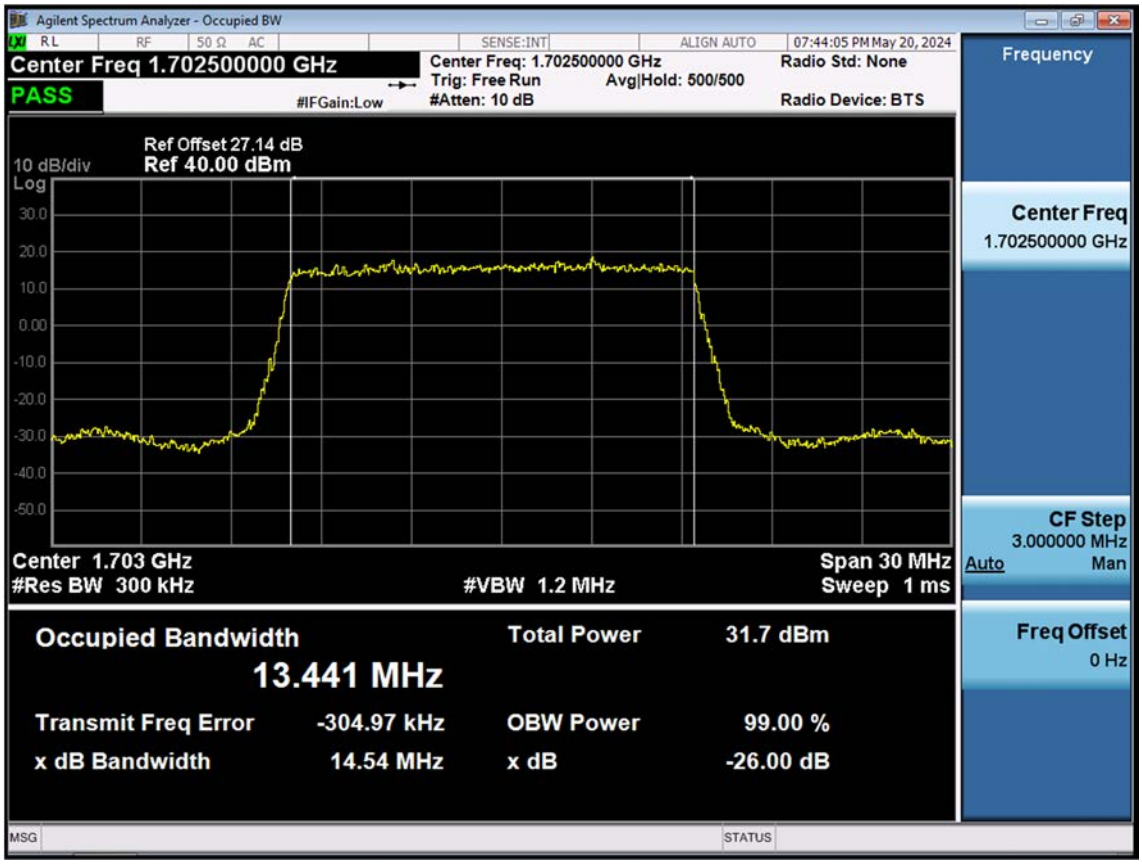
10 M_OBW_Mid_64QAM_FullRB



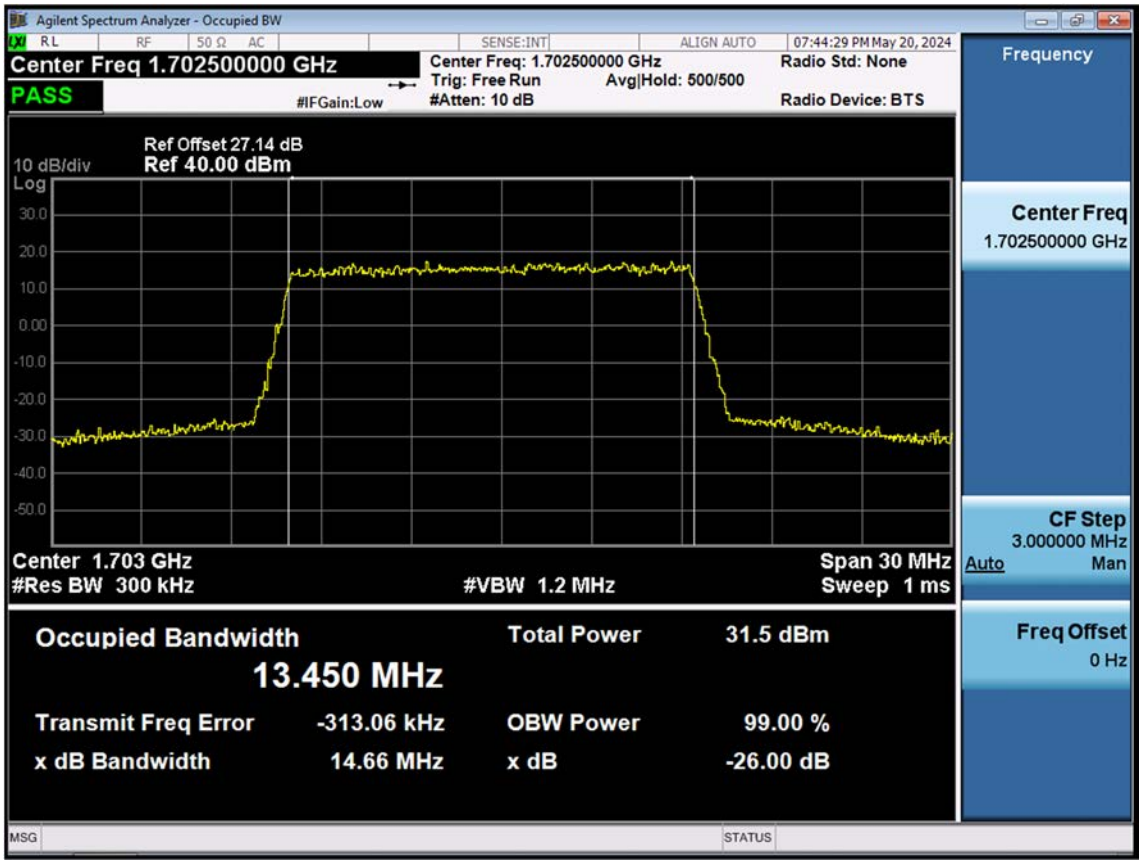
10 M_OBW_Mid_256QAM_FullRB



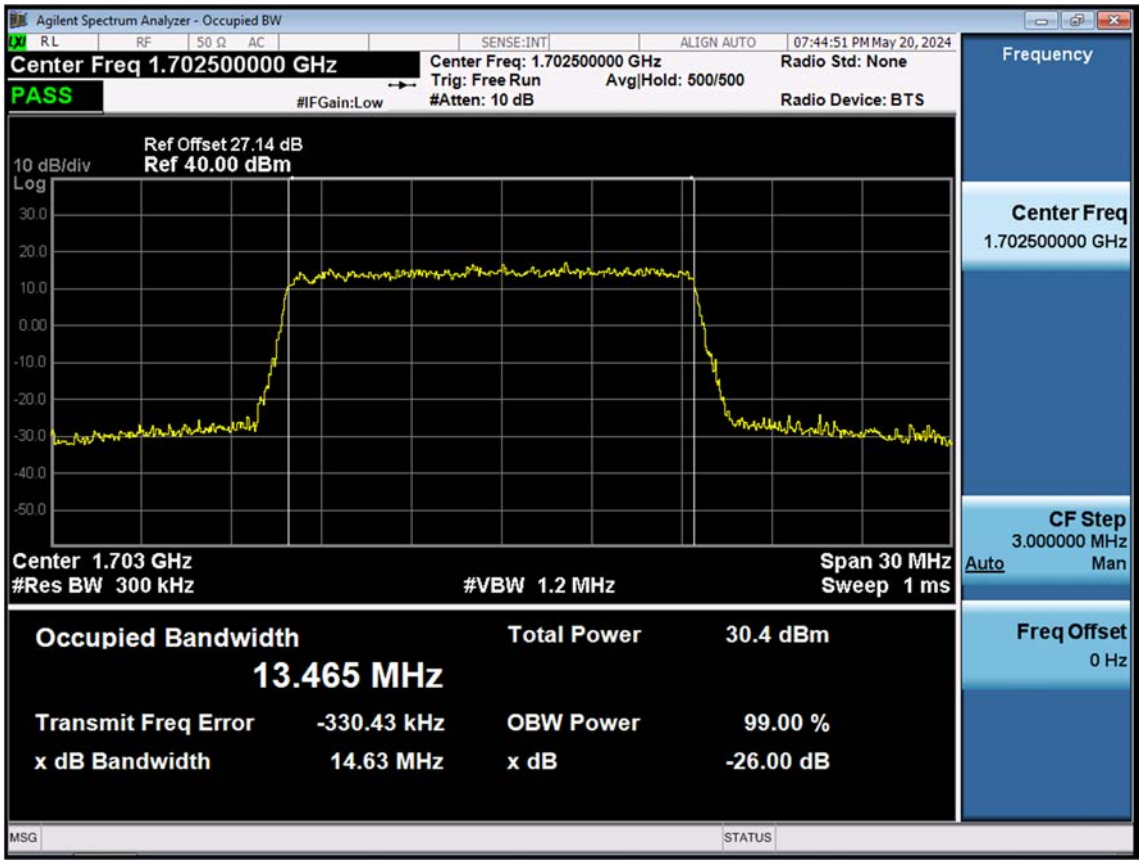
15 M_OBW_Mid_BPSK_FullRB



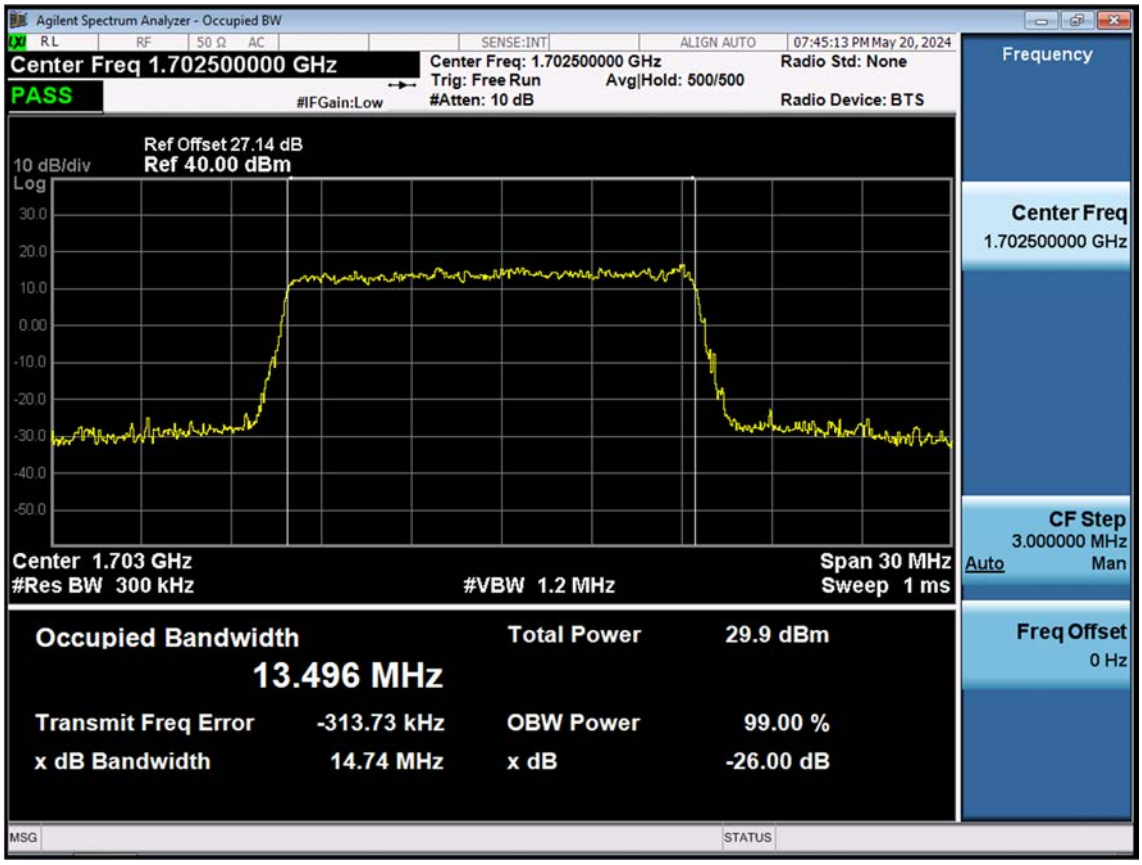
15 M_OBW_Mid_QPSK_FullRB



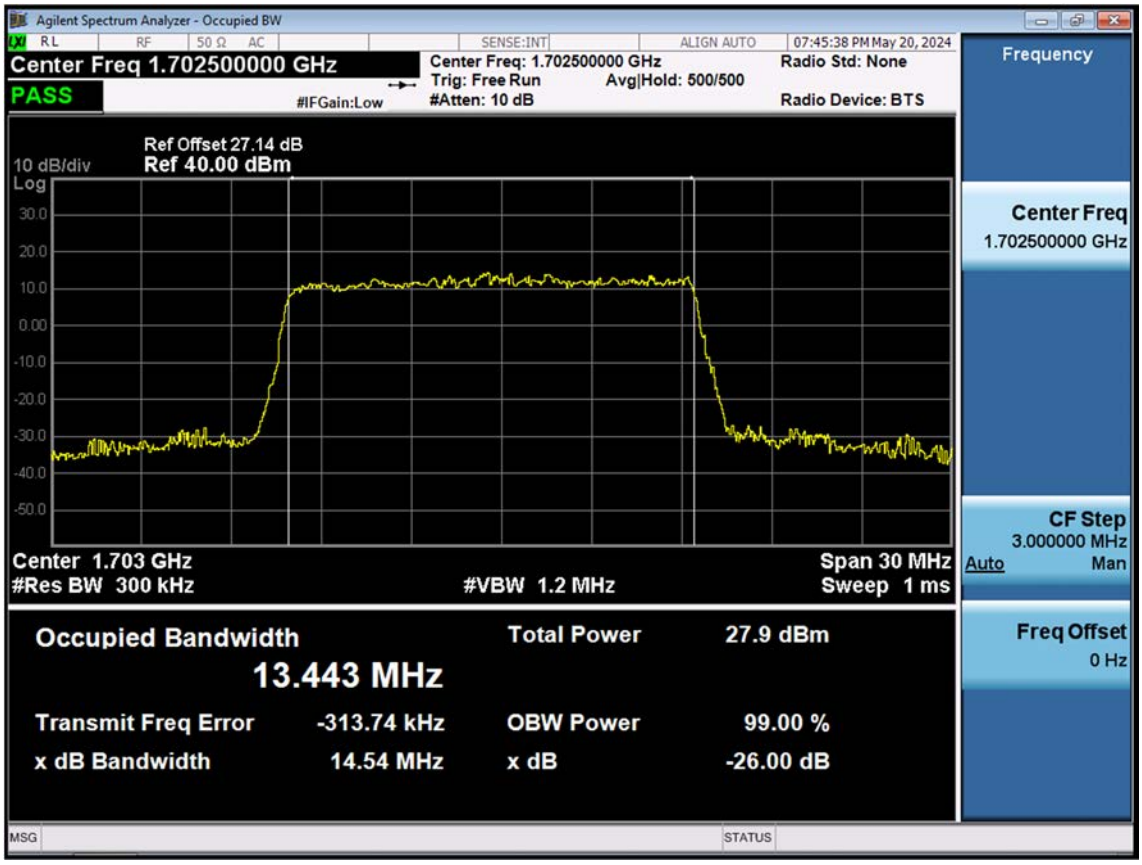
15 M_OBW_Mid_16QAM_FullRB



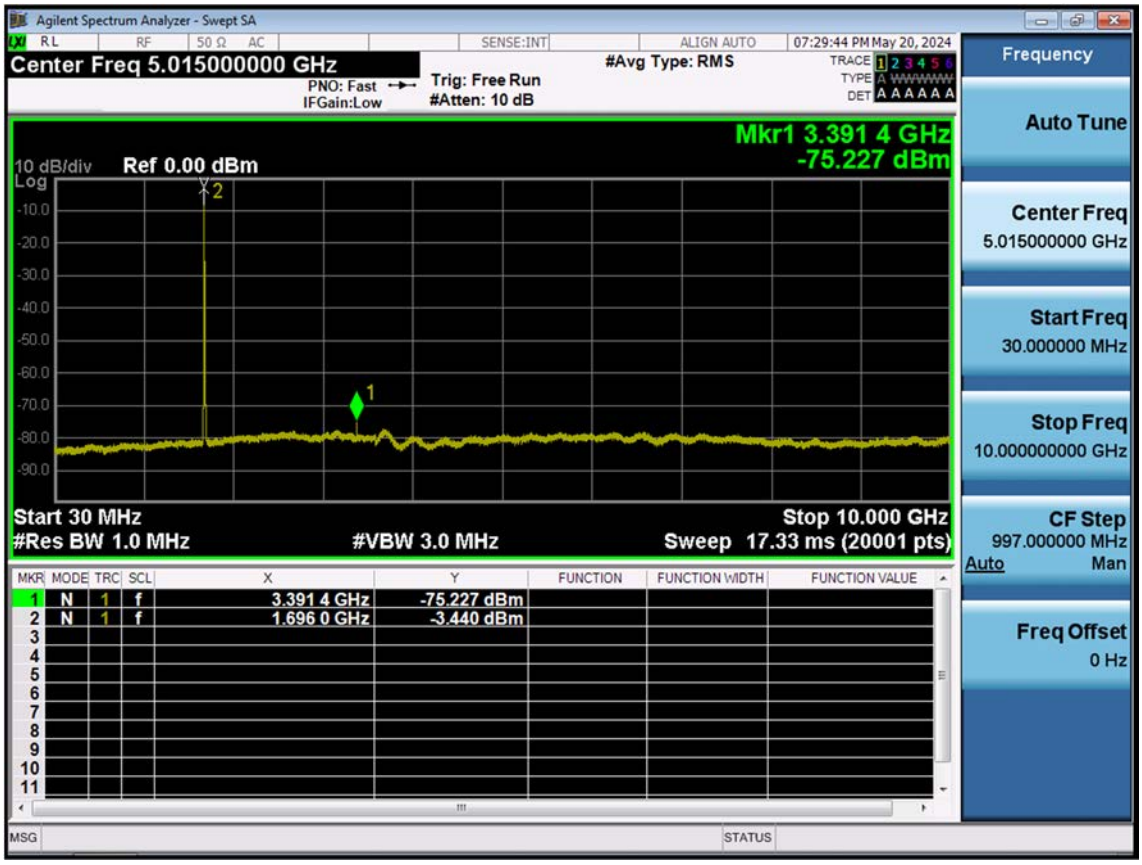
15 M_OBW_Mid_64QAM_FullRB



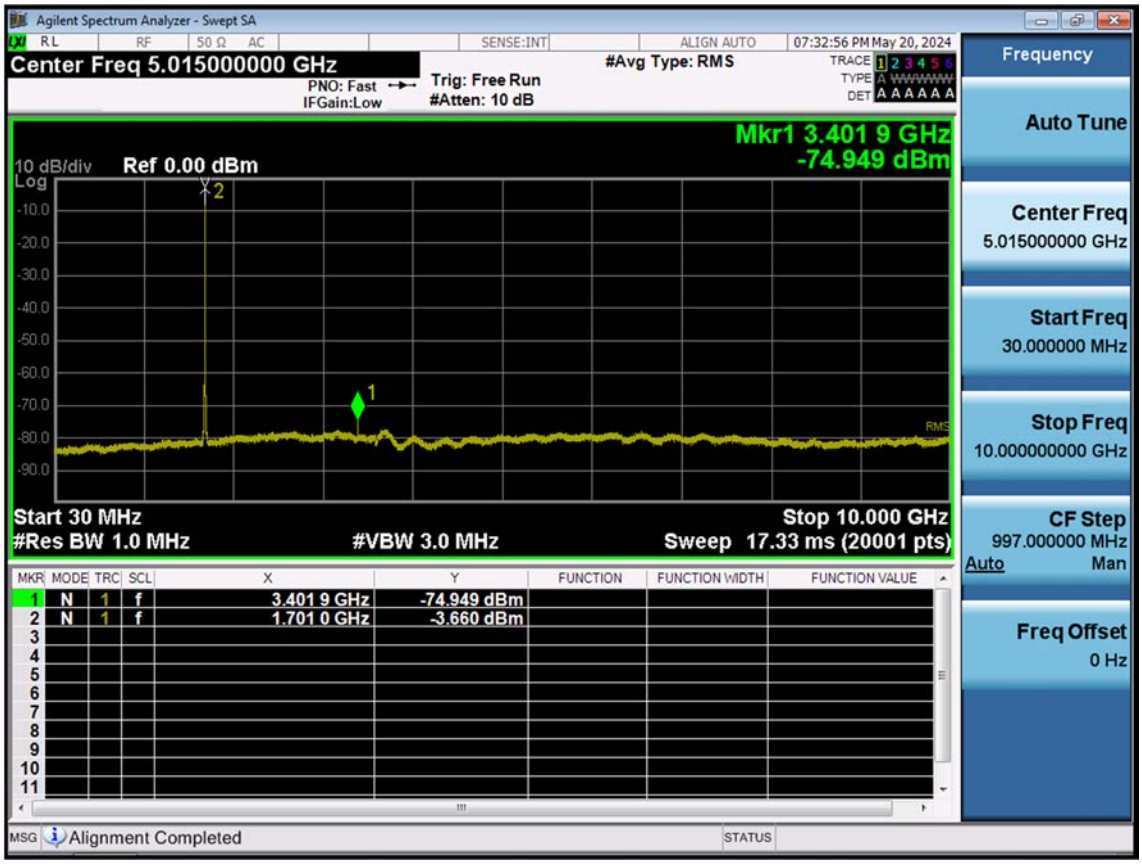
15 M_OBW_Mid_256QAM_FullRB



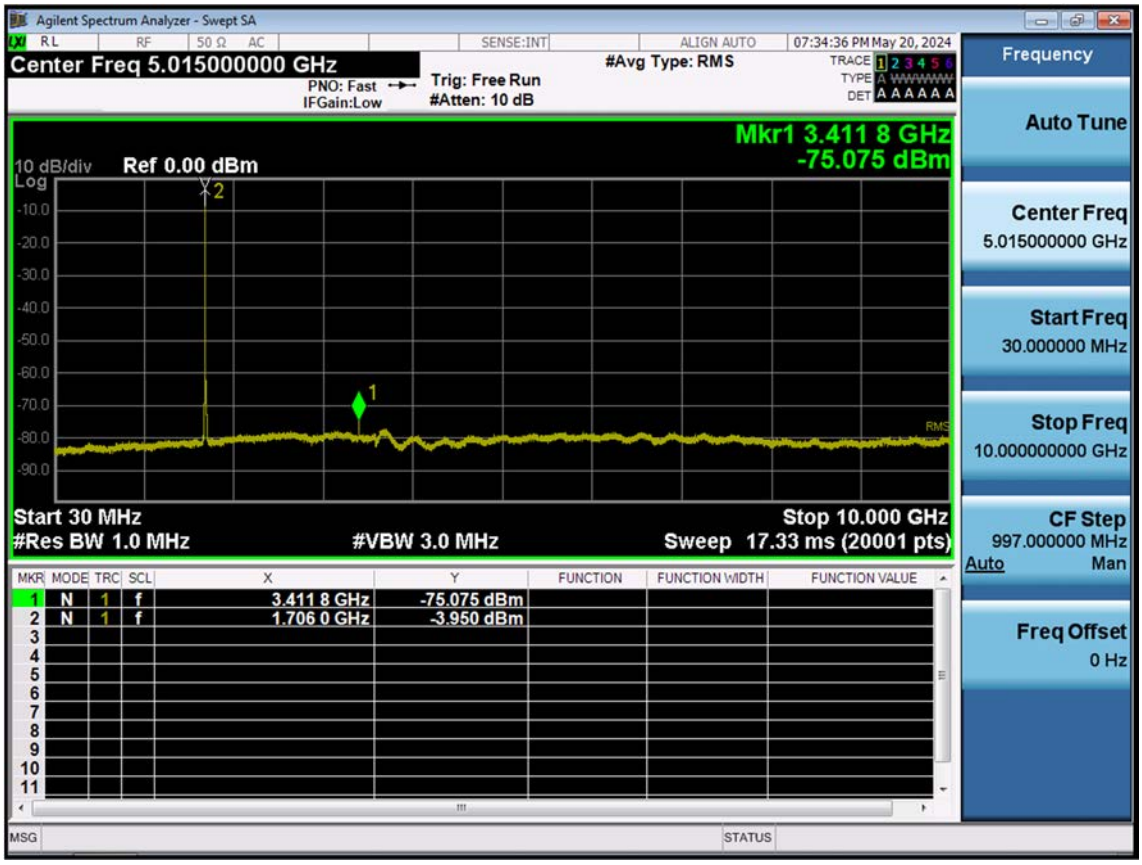
5 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



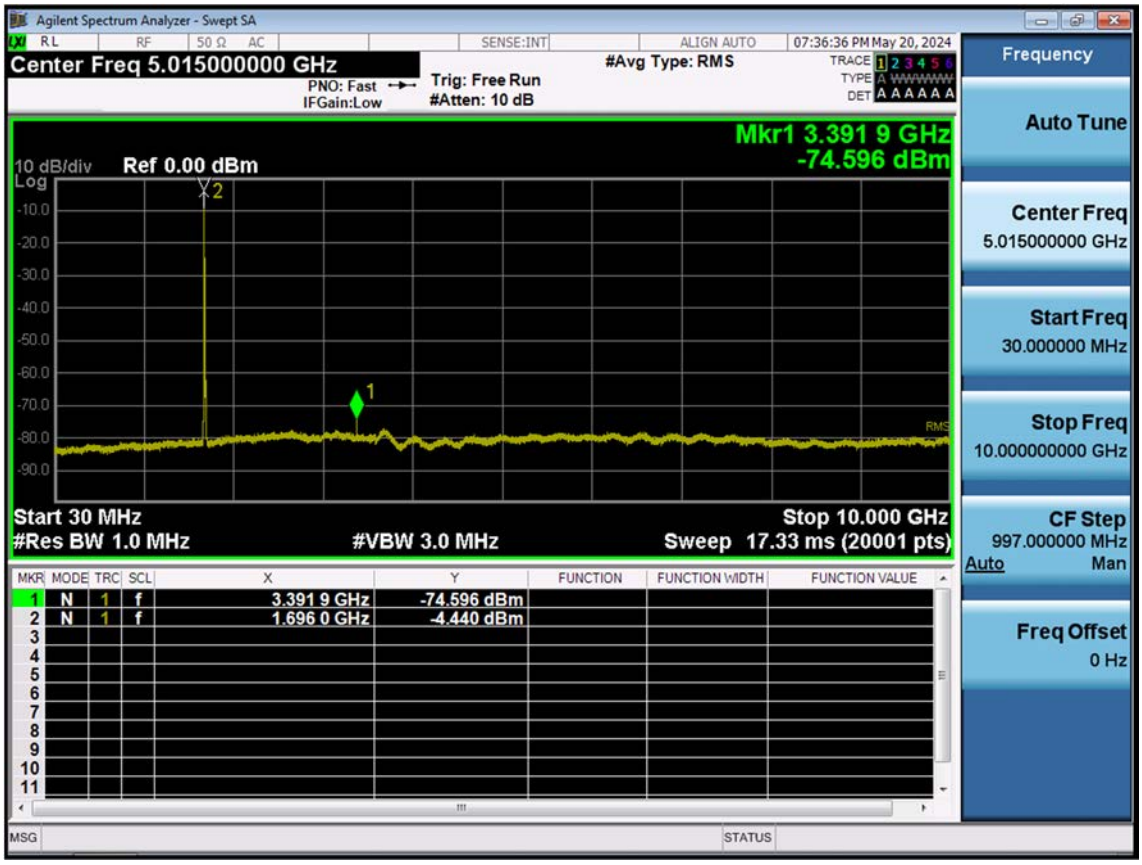
5 M_Conducted Spurious(30 M-10 G)_Mid_BPSK_FullRB



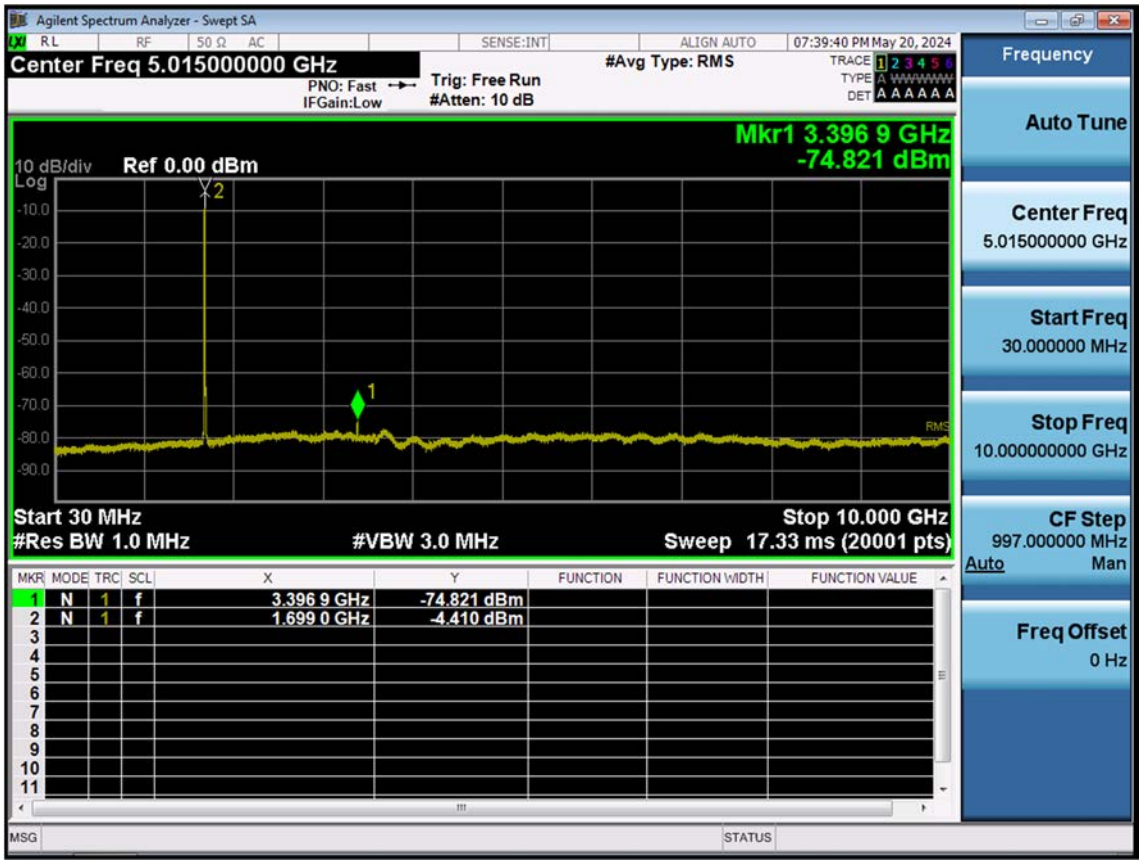
5 M_Conducted Spurious(30 M-10 G)_High_BPSK_1RB



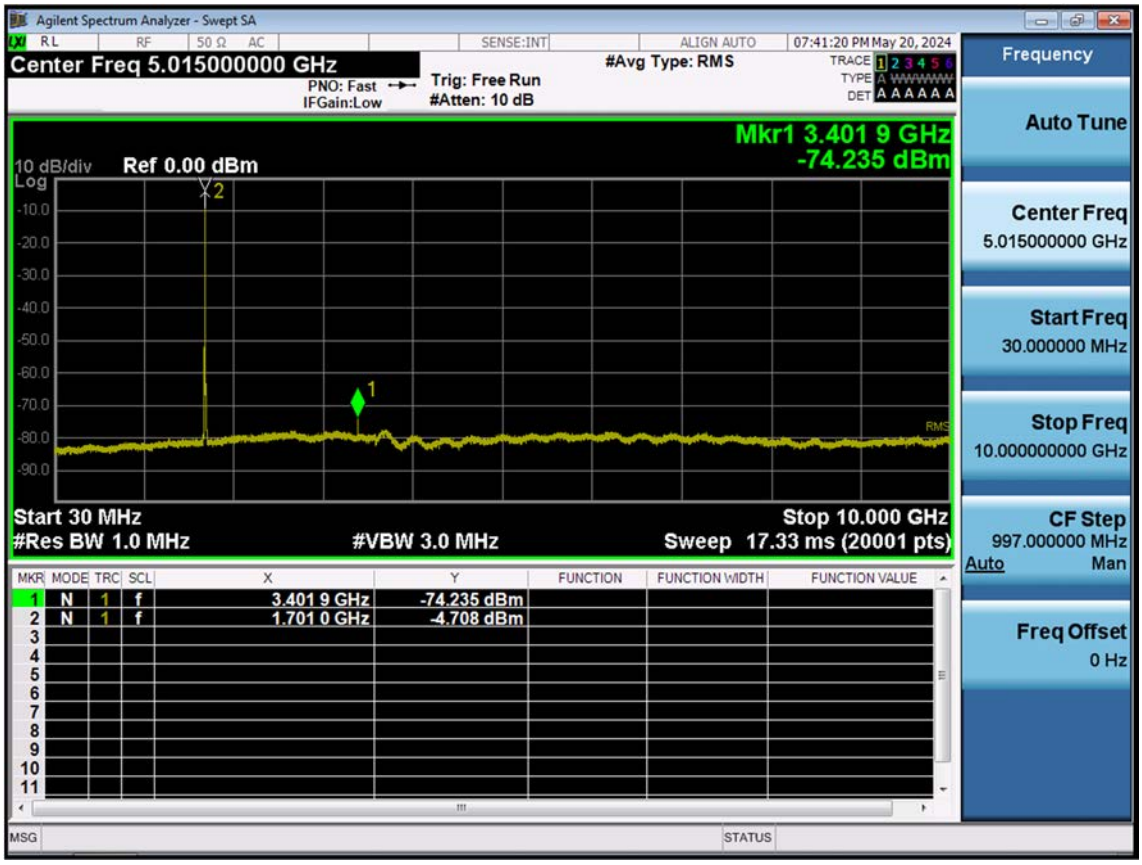
10 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



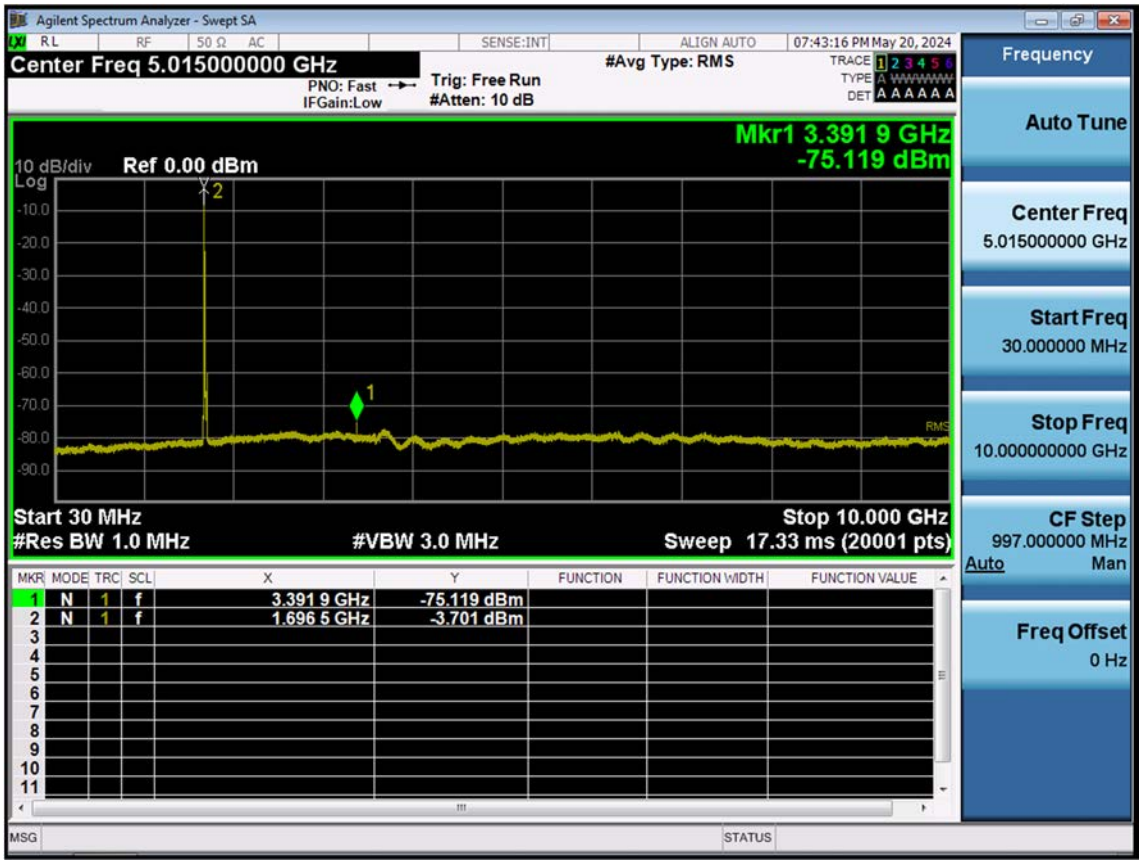
10 M_Conducted Spurious(30 M-10 G)_Mid_BPSK_FullRB



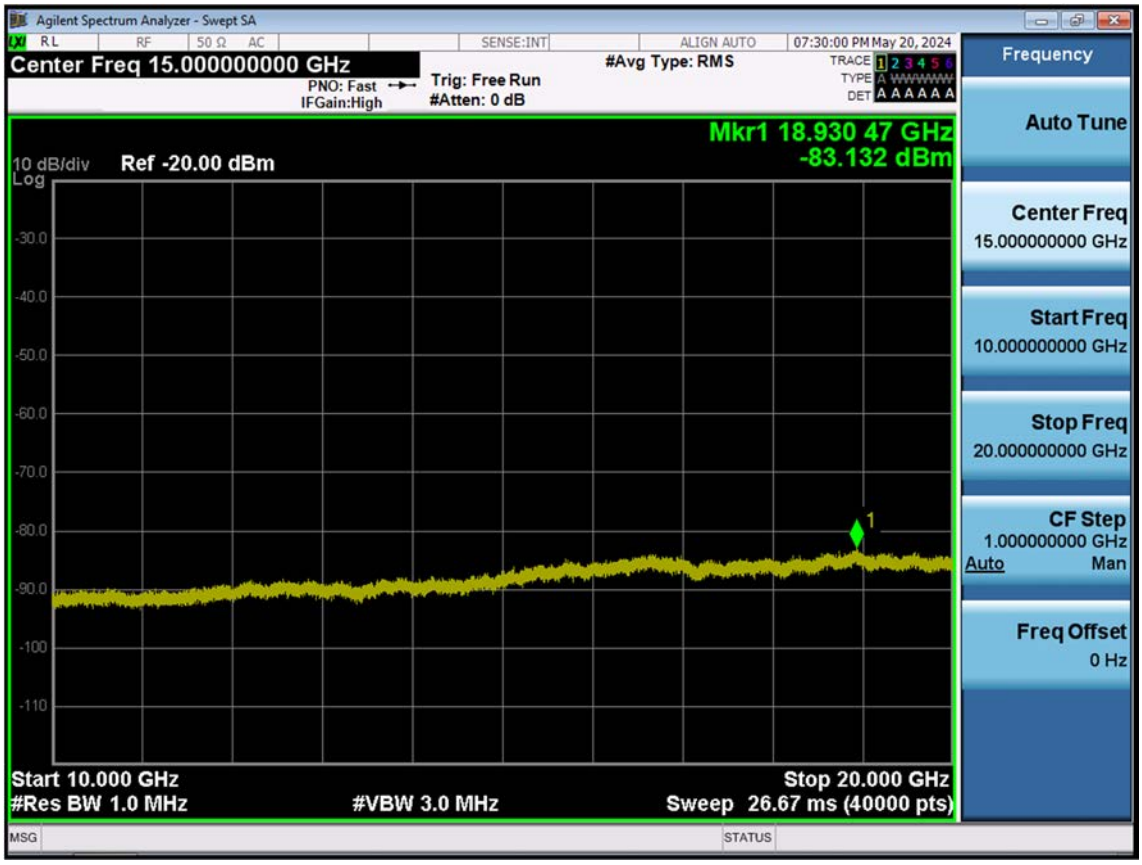
10 M_Conducted Spurious(30 M-10 G)_High_BPSK_1RB



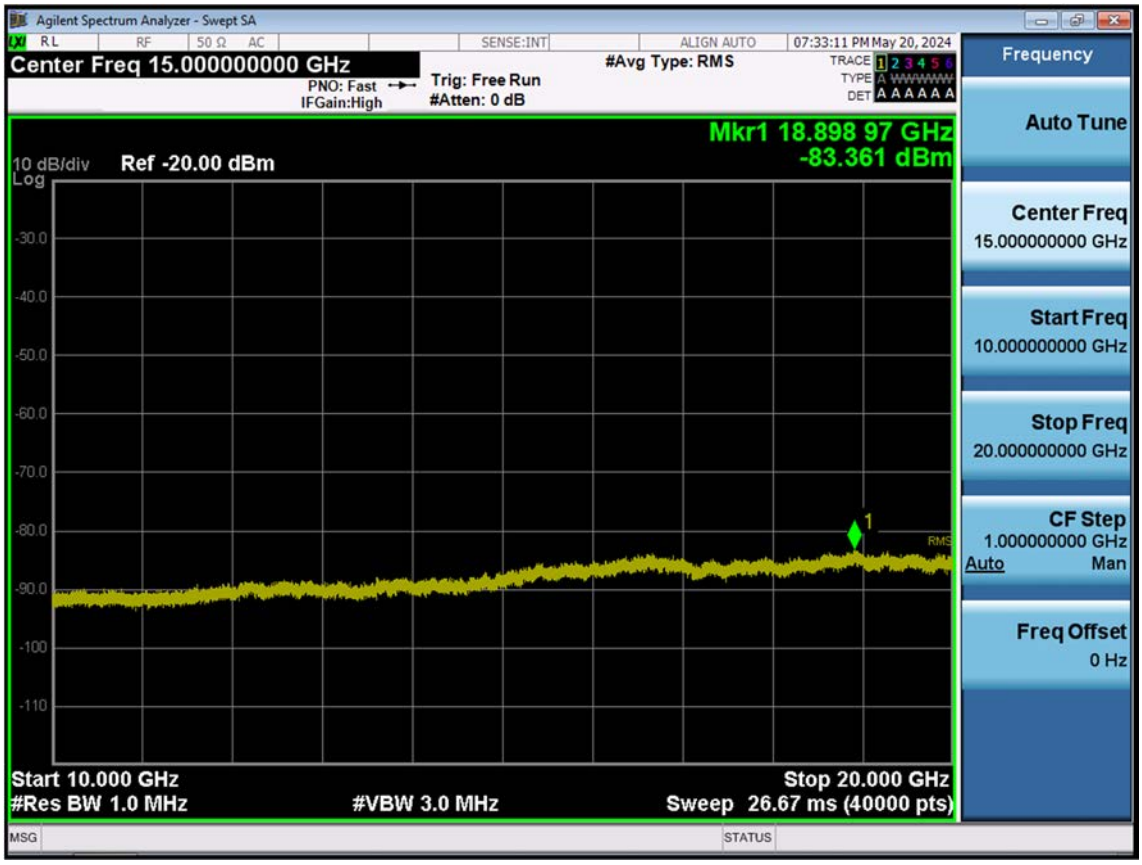
15 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



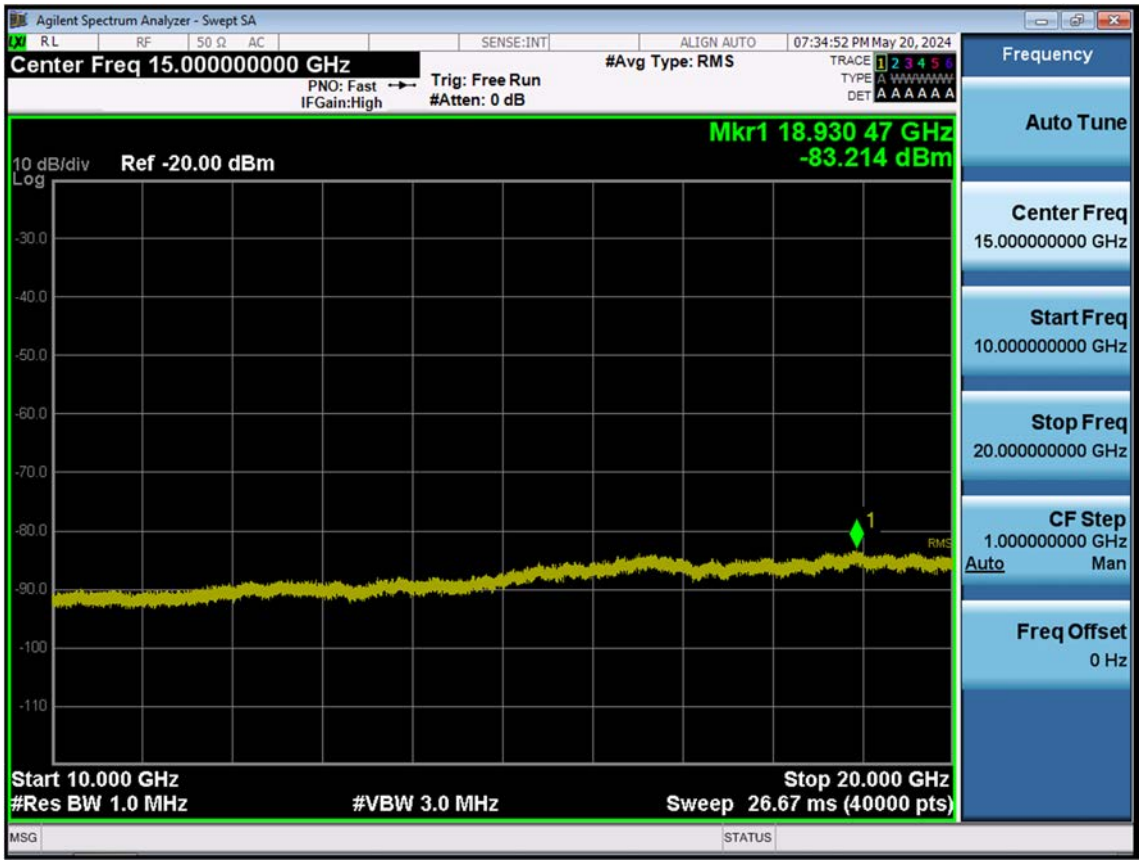
5 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



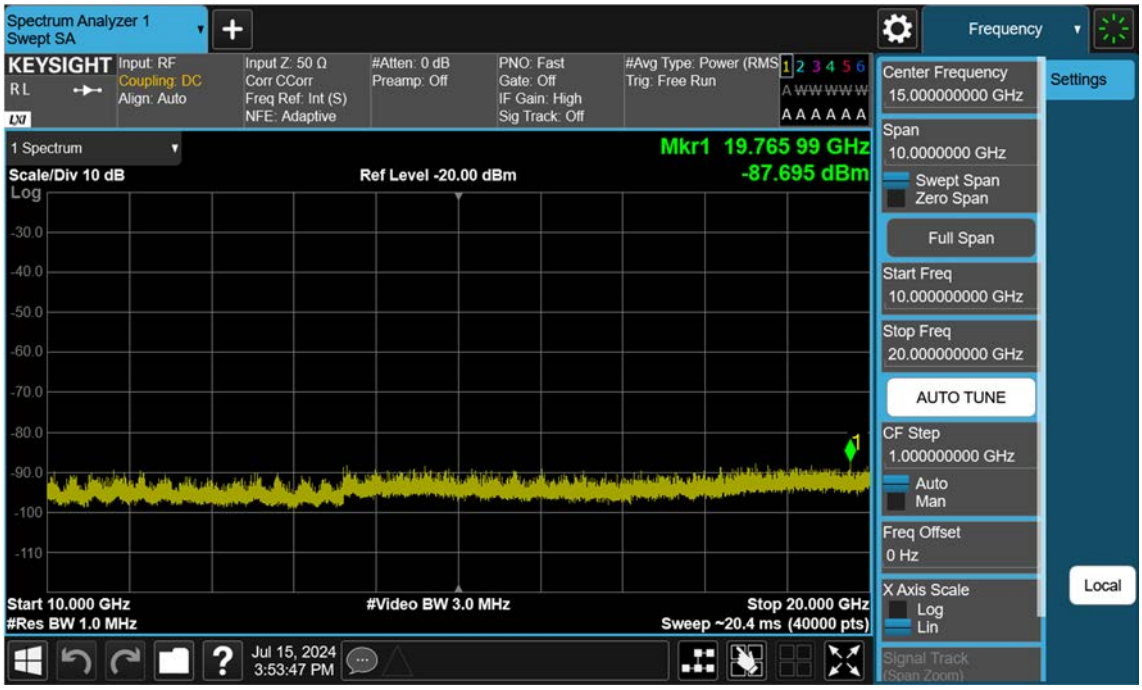
5 M_Conducted Spurious(Above10 G)_Mid_BPSK_FullRB



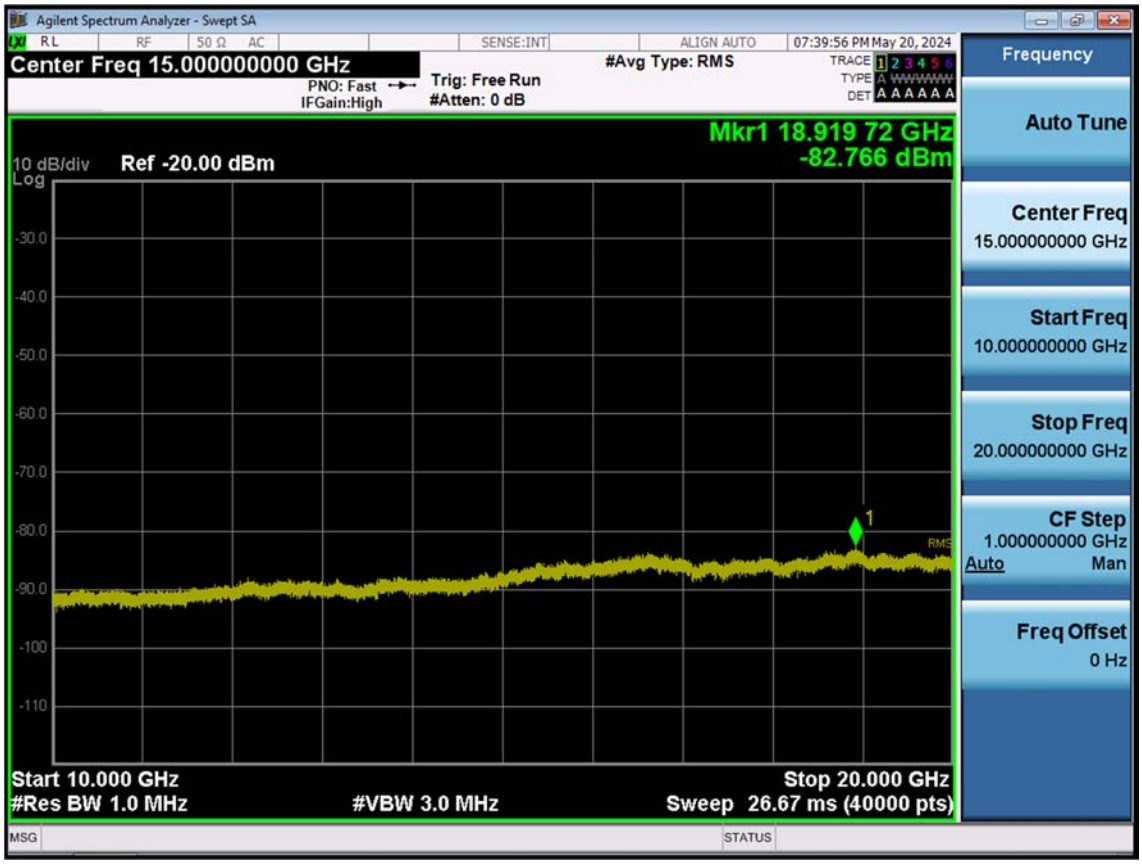
5 M_Conducted Spurious(Above10 G)_High_BPSK_1RB



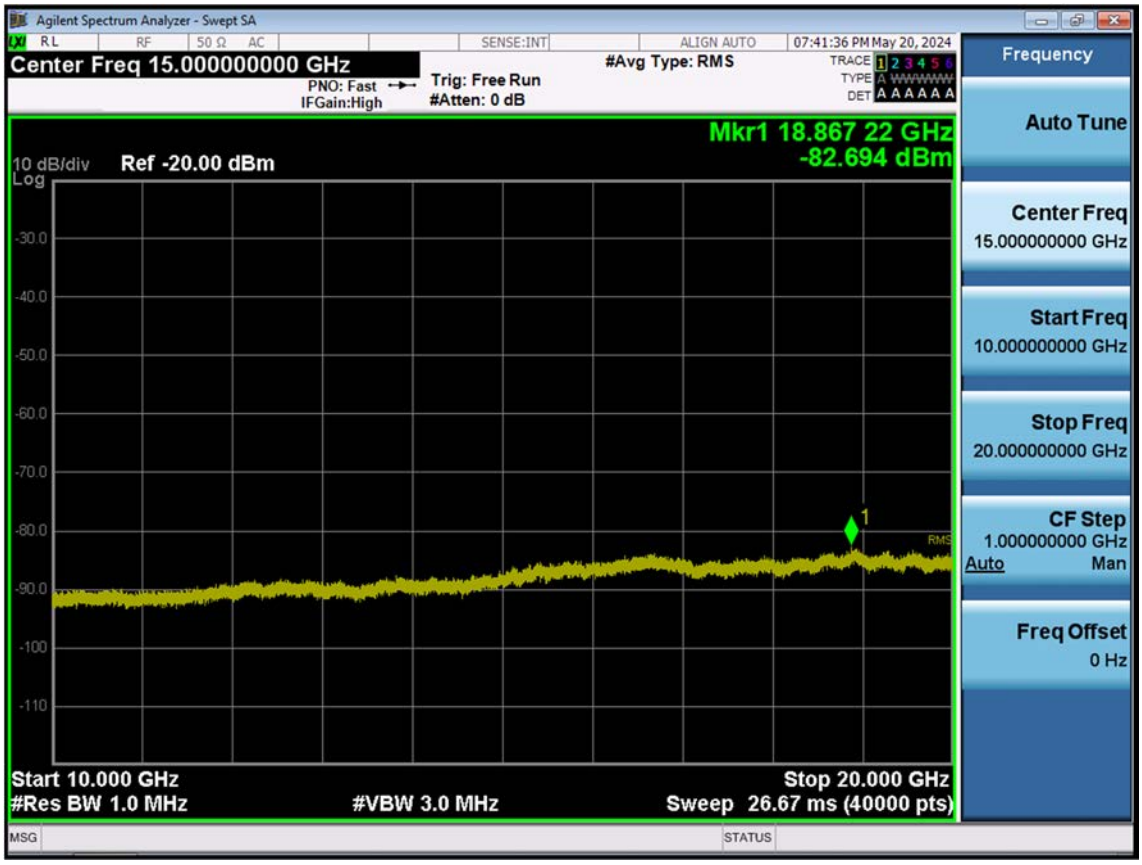
10 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



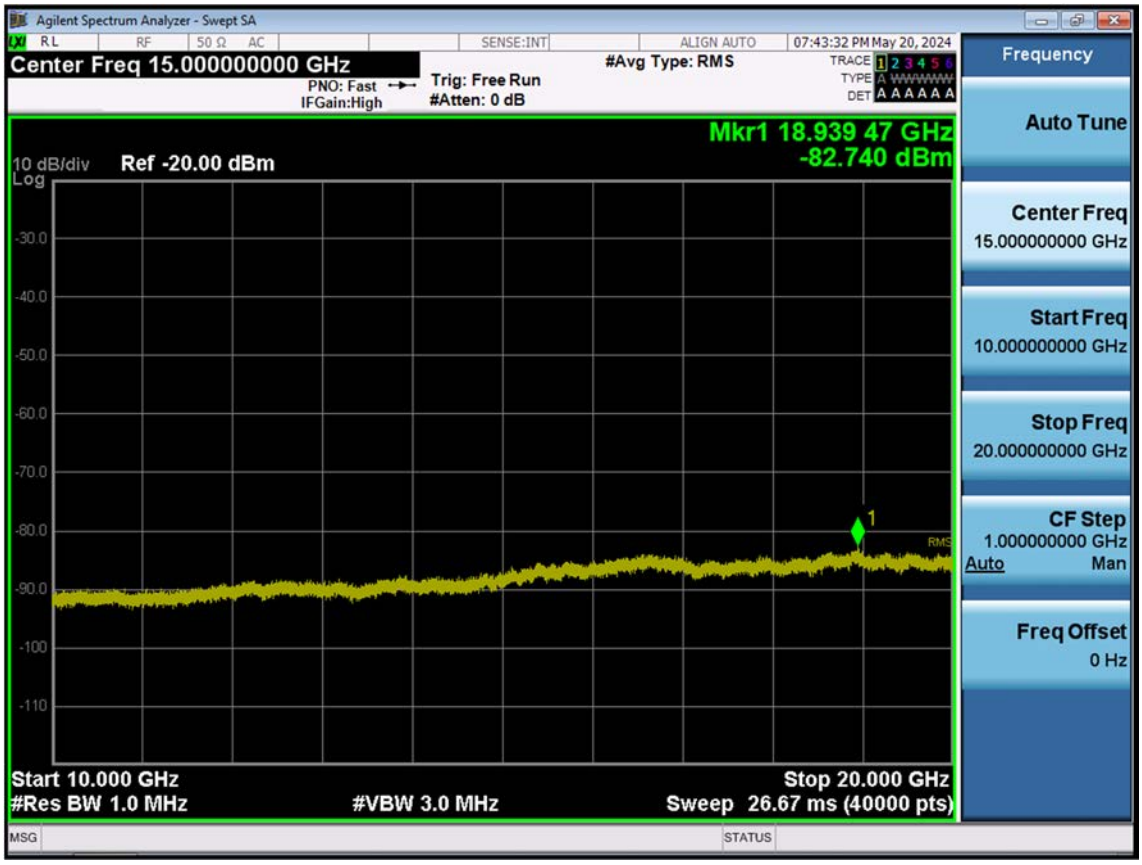
10 M_Conducted Spurious(Above10 G)_Mid_BPSK_FullRB



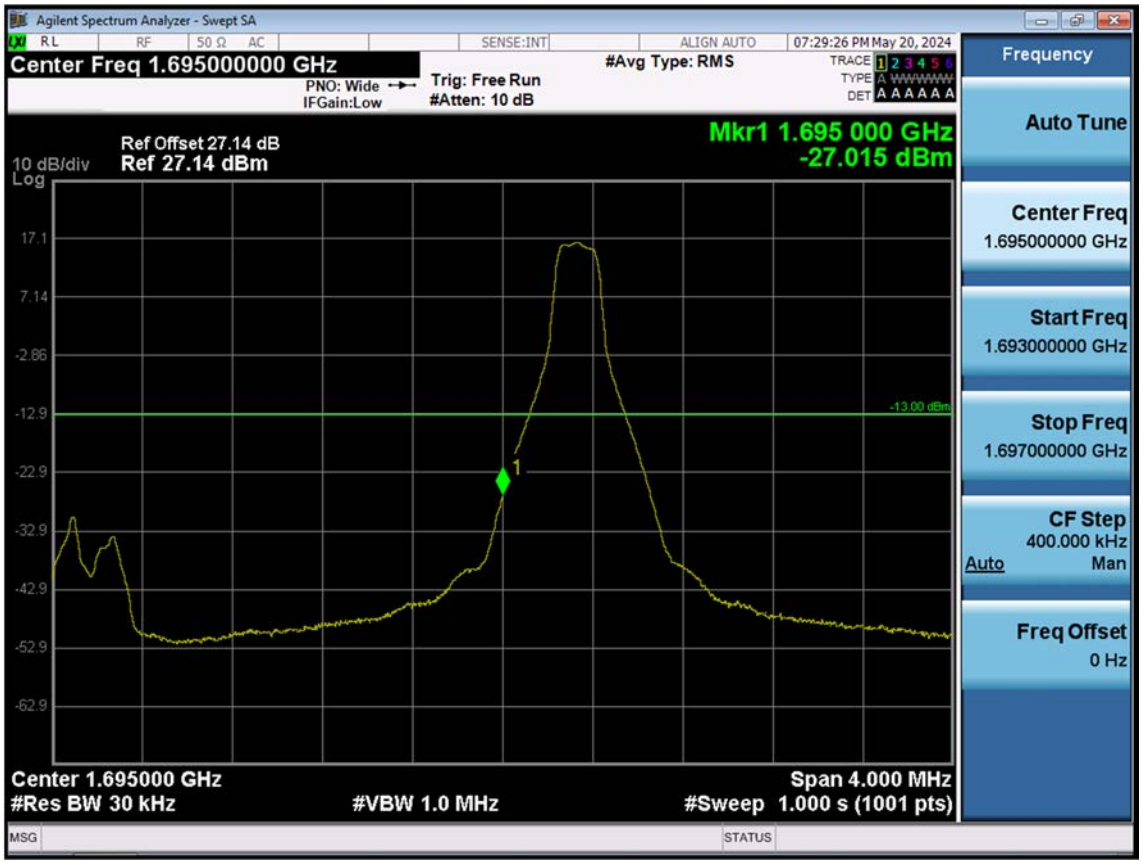
10 M_Conducted Spurious(Above10 G)_High_BPSK_1RB



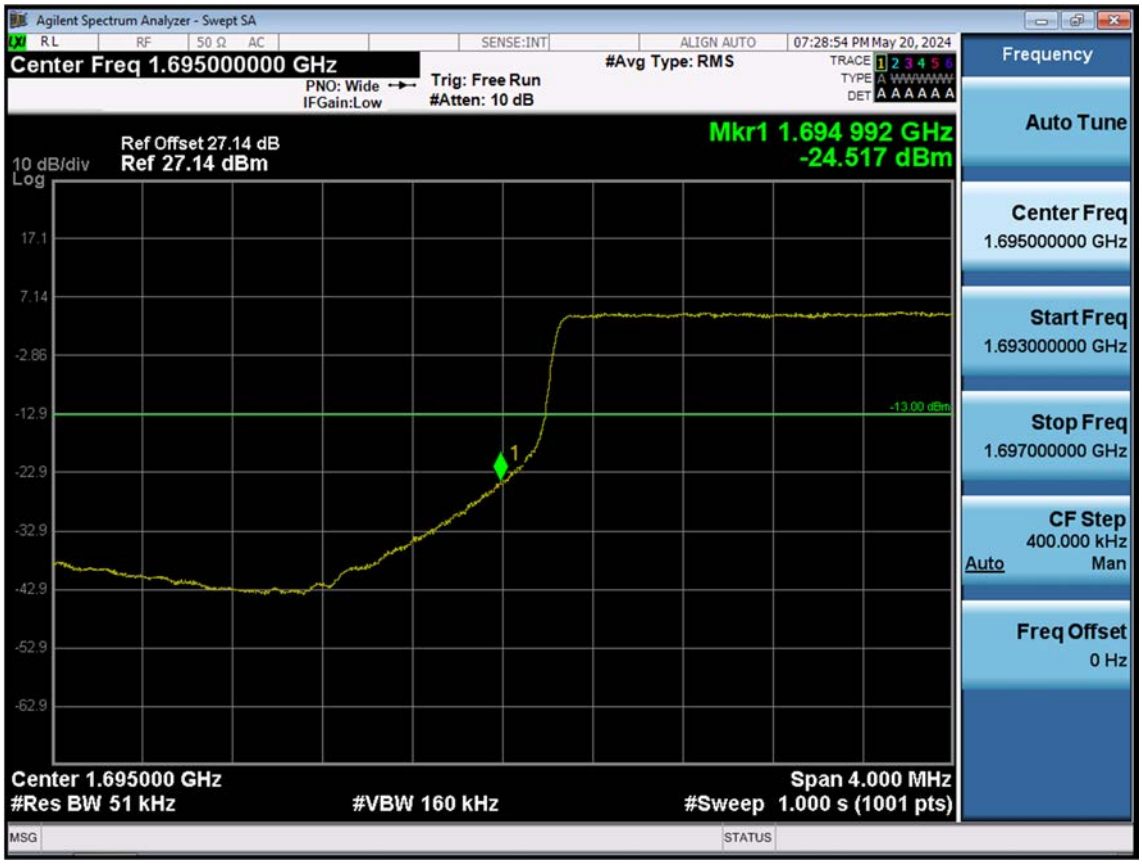
15 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



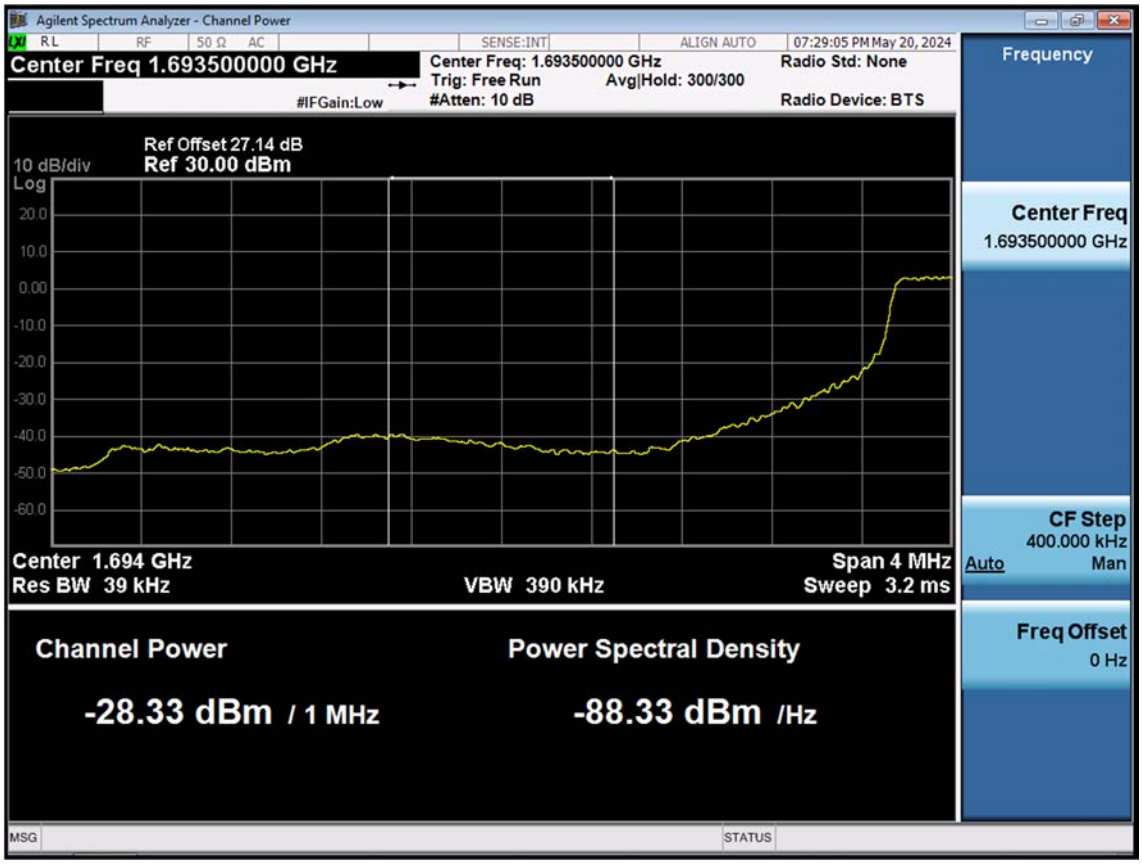
5 M_Band Edge_Low_BPSK_1RB



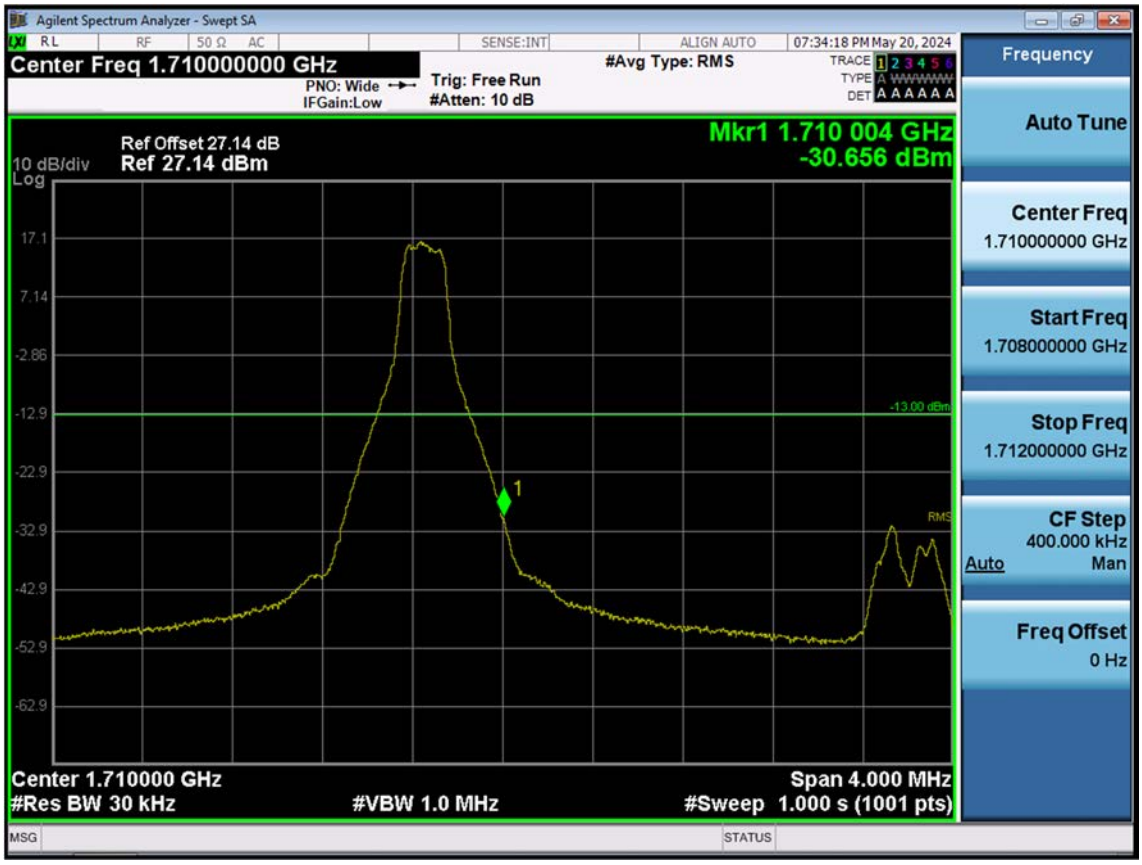
5 M_Band Edge_Low_BPSK_FullRB



5 M_Extended Band Edge_Low_BPSK_FullRB

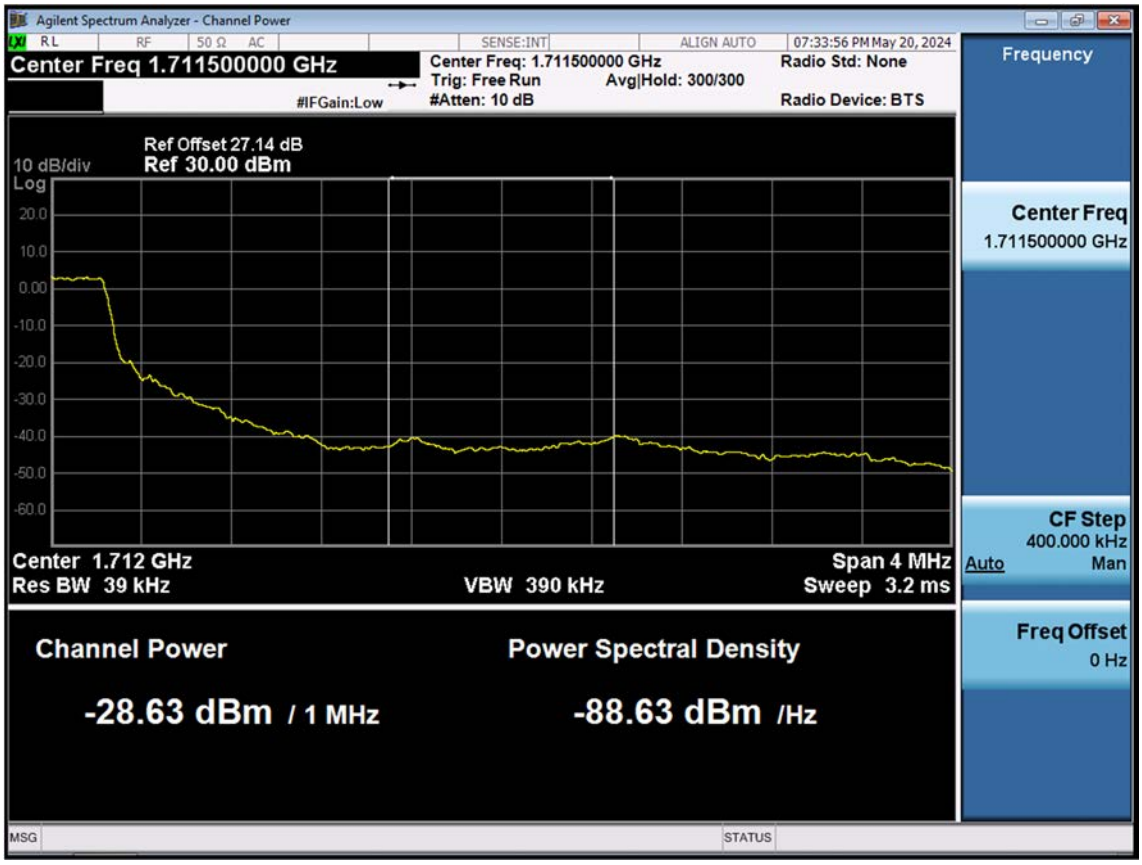


5 M_Band Edge_High_BPSK_1RB

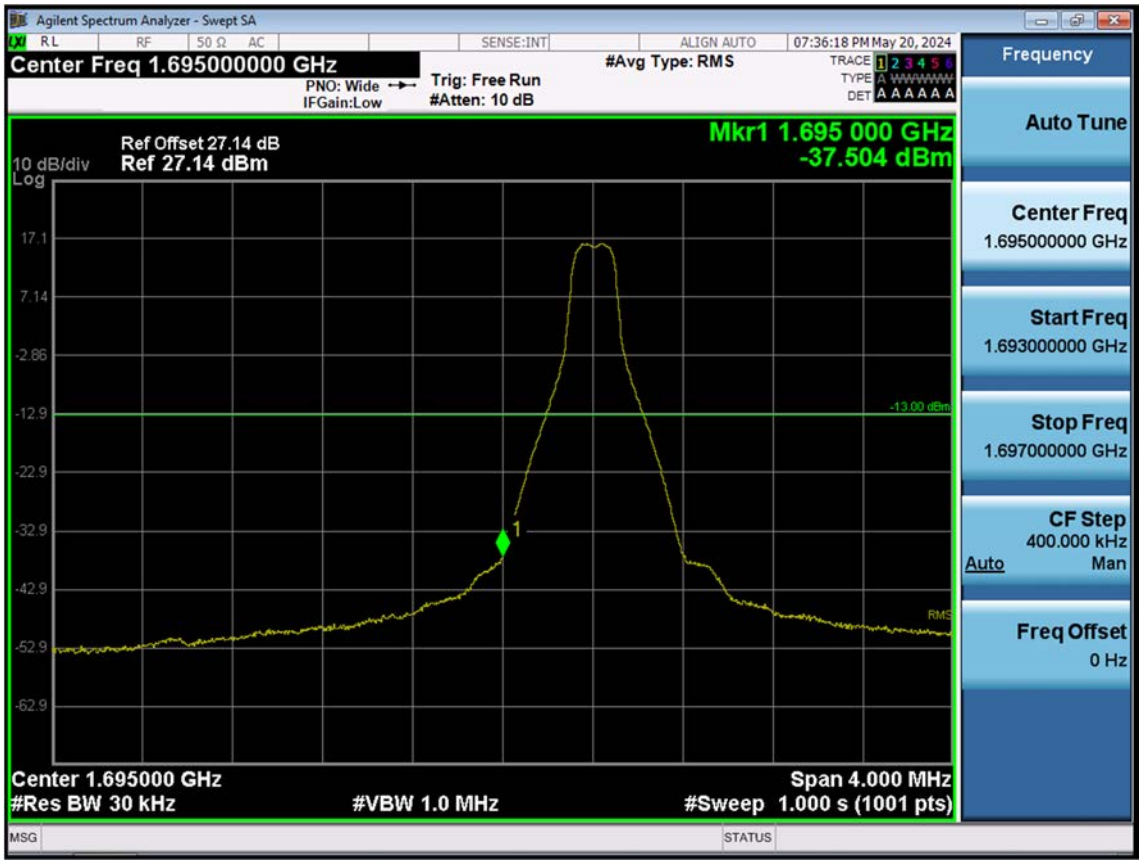


5 M_Band Edge_High_BPSK_FullRB

5 M_Extended Band Edge_High_BPSK_FullRB

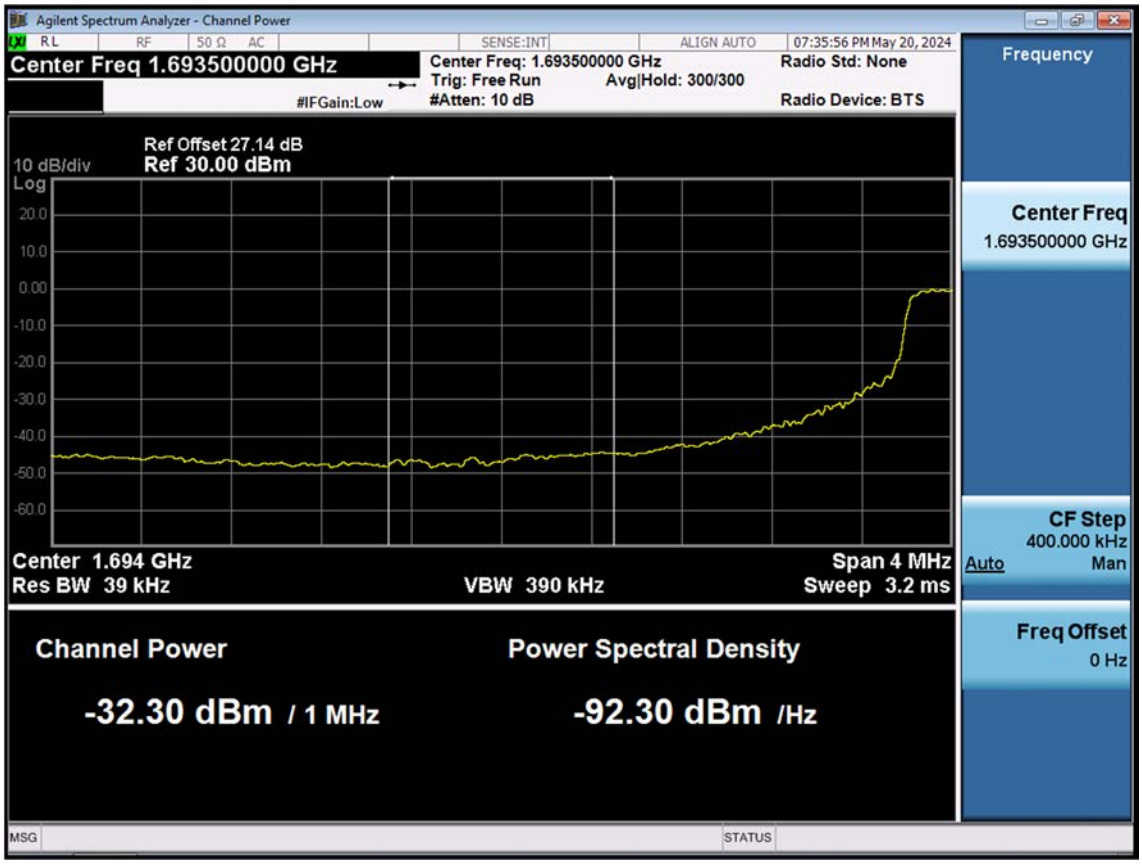


10 M_Band Edge_Low_BPSK_1RB

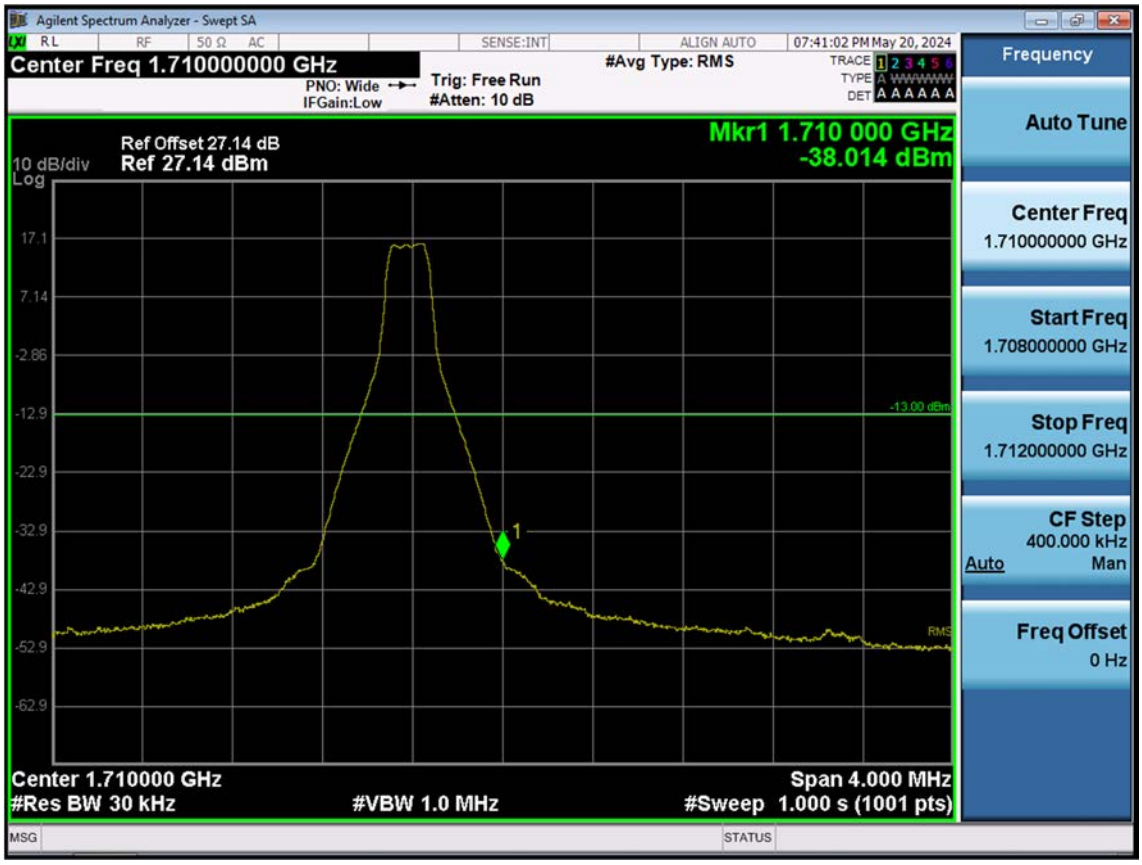


10 M_Band Edge_Low_BPSK_FullRB

10 M_Extended Band Edge_Low_BPSK_FullRB

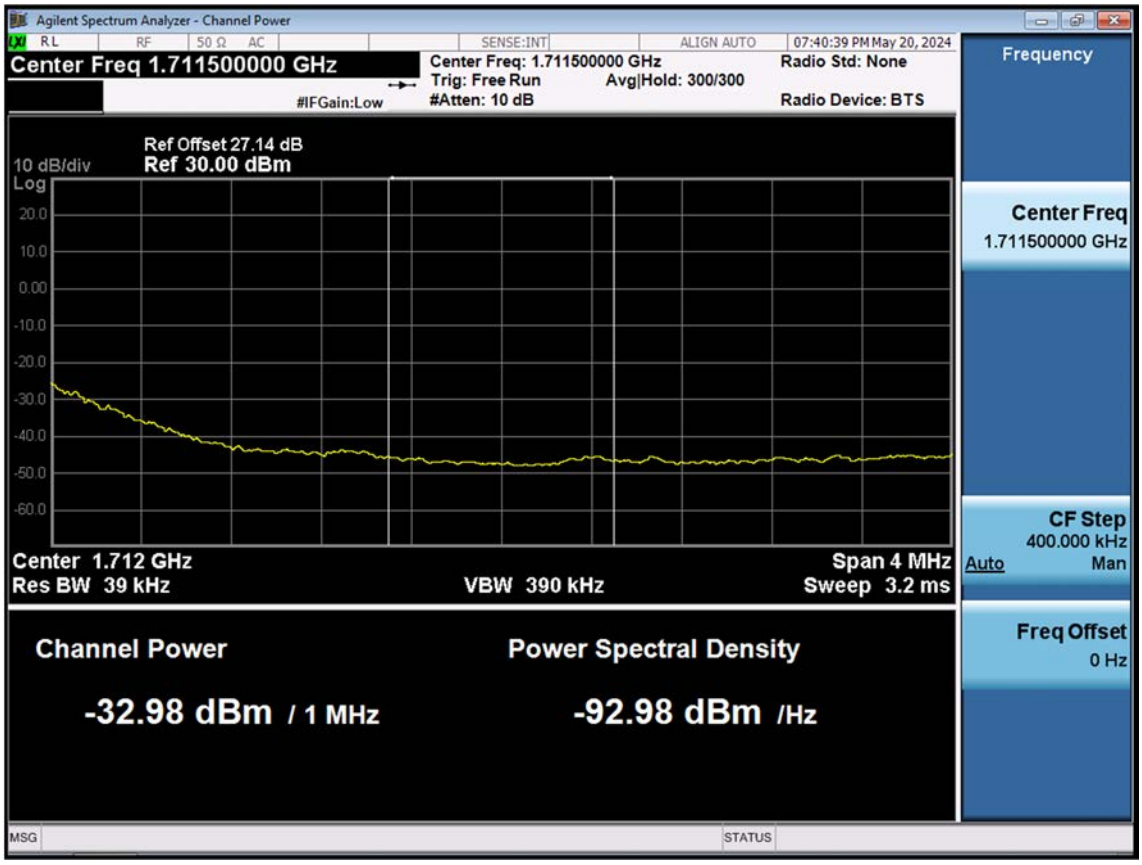


10 M_Band Edge_High_BPSK_1RB

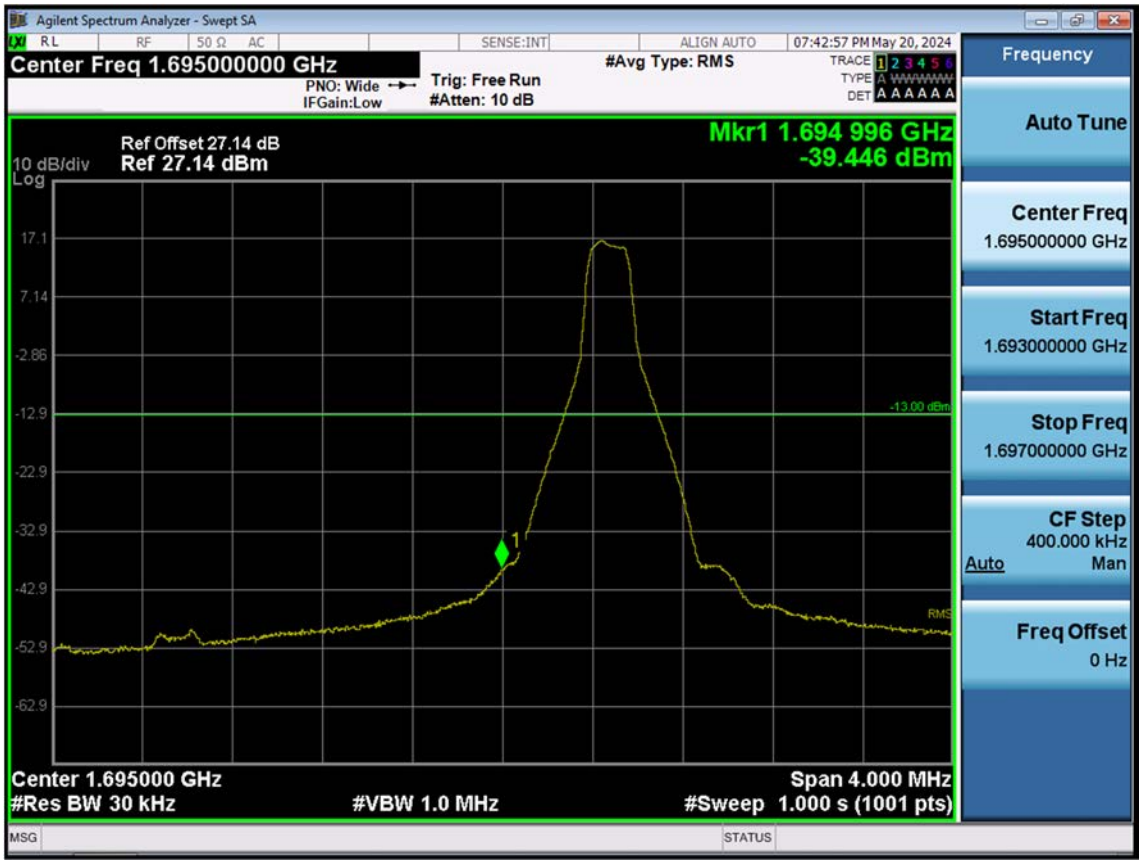


10 M_Band Edge_High_BPSK_FullRB

10 M_Extended Band Edge_High_BPSK_FullRB



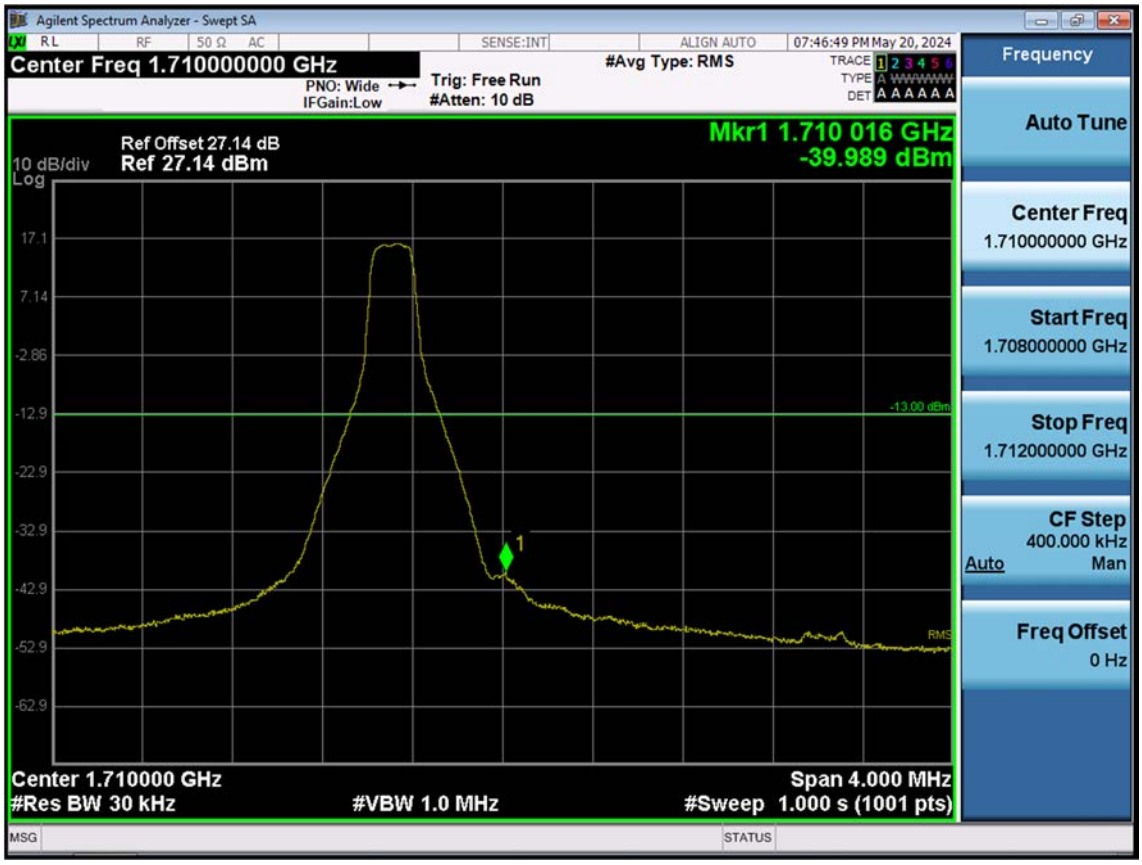
15 M_Band Edge_Low_BPSK_1RB



15 M_Band Edge_Low_BPSK_FullRB

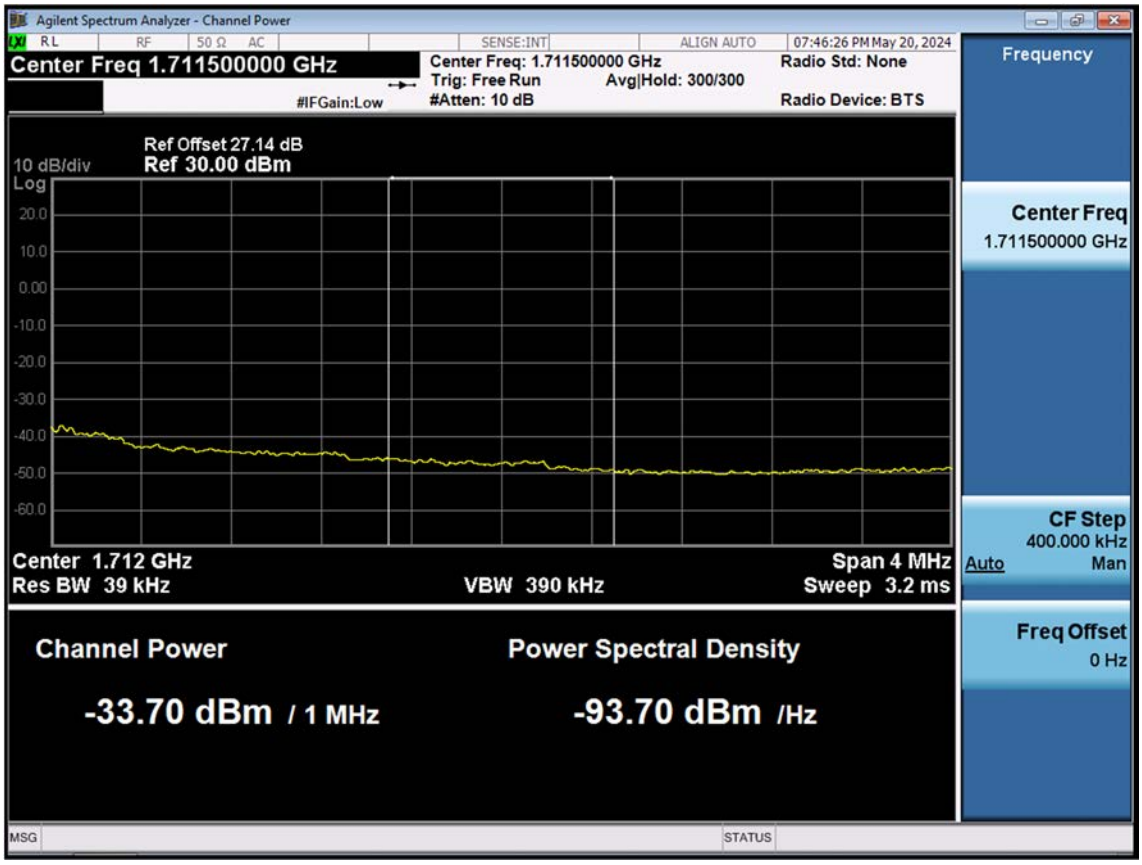
15 M_Extended Band Edge_Low_BPSK_FullRB

15 M_Band Edge_High_BPSK_1RB



15 M_Band Edge_High_BPSK_FullRB

15 M_Extended Band Edge_High_BPSK_FullRB



10. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2407-FC032-P