FCC LTE REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
129, Samsung-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
January 26, 2022

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-RF-2201-FC098

FCC ID: **A3LSMM236B**

APPLICANT: **SAMSUNG Electronics Co., Ltd.**

Model(s):	SM-M236B/DS
EUT Type:	Mobile Phone
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§22, §2

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	ERP	
				Max. Power (W)	Max. Power (dBm)
LTE – Band5 (1.4)	824.7 – 848.3	1M09G7D	QPSK	0.097	19.88
		1M09W7D	16QAM	0.084	19.23
		1M09W7D	64QAM	0.065	18.11
LTE – Band5 (3)	825.5 – 847.5	2M71G7D	QPSK	0.098	19.92
		2M70W7D	16QAM	0.083	19.21
		2M71W7D	64QAM	0.066	18.18
LTE – Band5 (5)	826.5 – 846.5	4M50G7D	QPSK	0.098	19.93
		4M49W7D	16QAM	0.084	19.23
		4M51W7D	64QAM	0.066	18.18
LTE – Band5 (10)	829.0 – 844.0	9M01G7D	QPSK	0.104	20.17
		8M99W7D	16QAM	0.089	19.50
		9M00W7D	64QAM	0.069	18.36

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)

REVIEWED BY

Report prepared by : Jae Mun Do **Engineer of Telecommunication Testing Center**	**Report approved by : Jong Seok Lee** **Manager of Telecommunication Testing Center**

This test results were applied only to the test methods required by the standard.

This laboratory is not accredited for the test results marked *.
The above Test Report is the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (HCT Accreditation No.: KT197)

* The report shall not be reproduced except in full(only partly) without approval of the laboratory.

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2201-FC098	January 26, 2022	- First Approval Report

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.

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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:	A3LSMM236B
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§22, §2
EUT Type:	Mobile Phone
Model(s):	SM-M236B/DS
Tx Frequency:	824.7 MHz – 848.3 MHz (LTE – Band 5 (1.4 MHz)) 825.5 MHz – 847.5 MHz (LTE – Band 5 (3 MHz)) 826.5 MHz – 846.5 MHz (LTE – Band 5 (5 MHz)) 829.0 MHz – 844.0 MHz (LTE – Band 5 (10 MHz))
Date(s) of Tests:	December 23, 2021 ~ January 25, 2022
Serial number:	Radiated: R3CRB0JMDVJ Conducted: R3CRB0HM09R

2. INTRODUCTION

2.1. DESCRIPTION OF EUT

The EUT was a Mobile Phone with GSM/GPRS/EGPRS/UMTS and LTE, Sub6.

It also supports IEEE 802.11 a/b/g/n/ac (20/40/80), Bluetooth, BT LE, NFC.

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)
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;

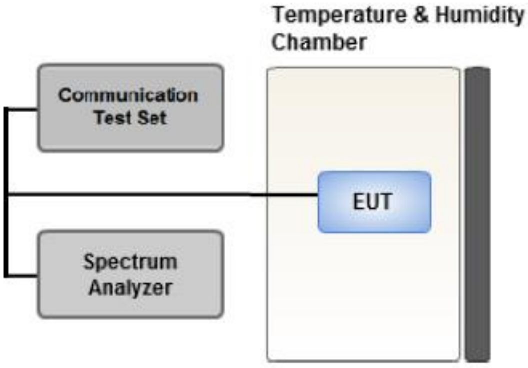
$$Result_{(dBm)} = Pg_{(dBm)} - cable\ loss_{(dB)} + antenna\ gain_{(dBi)}$$

   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.

$$EIRP_{(dBm)} = ERP_{(dBm)} + 2.15$$

3.4 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.

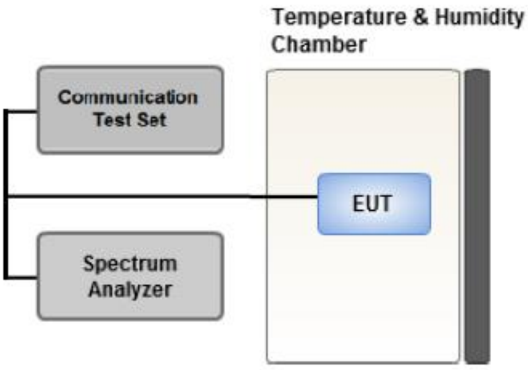
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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

3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

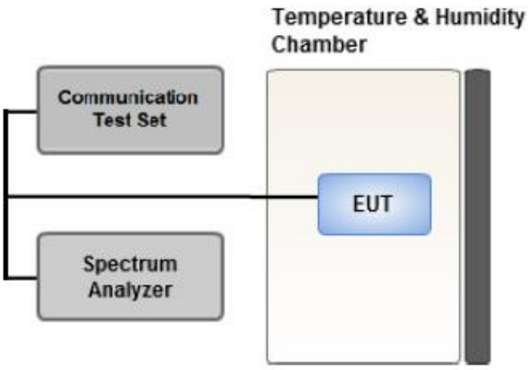
Test Overview

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

3.6 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

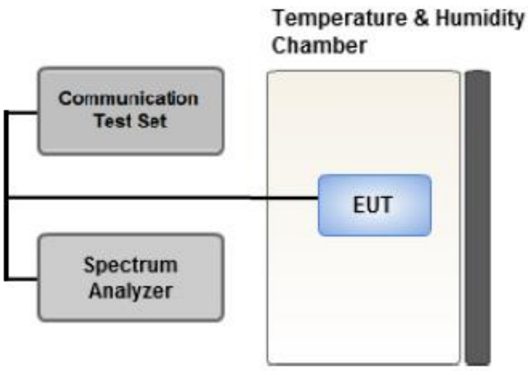
Test Notes

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.

3.7 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.

3.8 WORST CASE(RADIATED TEST)

- 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 : Stand alone, Stand alone + External accessories (Earphone, AC adapter, etc)
  Worst case : Stand alone
- We were performed the RSE test in condition of co-location. There has no significant emission raised.
- WWAN + WLAN 5 GHz + BT (Worst case : Stand alone)
- In the case of radiated spurious emissions, all bandwidth of operation were investigated and the worst case bandwidth results are reported. (Worst case : 10 MHz)
- The worst case is reported with the EUT positioning, modulations, and paging service configurations shown in the test data.

[Worst case]

Test Description	Modulation	RB size	RB offset	Axis
Effective Isotropic Radiated Power	QPSK, 16QAM, 64QAM,	1	0	X
Radiated Spurious and Harmonic Emissions	QPSK	1	0	Y

3.9 WORST CASE(CONDUCTED TEST)

- All modes of operation were investigated and the worst case configuration results are reported.

[Worst case]

Test Description	Modulation	Bandwidth (MHz)	Frequency	RB size	RB offset
Occupied Bandwidth	QPSK, 16QAM, 64QAM,	1.4, 3, 5, 10	Mid	Full RB	0
Band Edge	QPSK	1.4	Low	1	0
			High	1	5
		3	Low	1	0
			High	1	14
		5	Low	1	0
			High	1	24
		10	Low	1	0
			High	1	49
		1.4, 3, 5, 10	Low, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	QPSK	1.4, 3, 5, 10	Low, Mid, High	1	0

4. LIST OF TEST EQUIPMENT

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
H.P.F	FBSR-02B(WHK1.2/15 G-10EF)	T&M SYSTEM	-	03/02/2022	Annual
H.P.F	FBSR-02B(WHK3.3/18 G-10EF)	T&M SYSTEM	-	03/02/2022	Annual
Power Splitter(DC ~ 26.5 GHz)	11667B	Hewlett Packard	11275	04/07/2022	Annual
DC Power Supply	E3632A	Agilent	MY40010147	06/28/2022	Annual
Dipole Antenna	UHAP	Schwarzbeck	557	04/05/2023	Biennial
Dipole Antenna	UHAP	Schwarzbeck	558	04/05/2023	Biennial
Chamber	SU-642	ESPEC	93008124	03/15/2022	Annual
Horn Antenna(1 ~ 18 GHz)	BBHA 9120D	Schwarzbeck	147	08/30/2022	Biennial
Horn Antenna(1 ~ 18 GHz)	BBHA 9120D	Schwarzbeck	9120D-1298	09/15/2023	Biennial
Horn Antenna(15 ~ 40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170342	10/13/2022	Biennial
Horn Antenna(15 ~ 40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170124	04/12/2023	Biennial
Signal Analyzer(10 Hz ~ 26.5 GHz)	N9020A	Agilent	MY52090906	05/18/2022	Annual
ATTENUATOR(20 dB)	8493C	Hewlett Packard	17280	06/01/2022	Annual
Spectrum Analyzer(10 Hz ~ 40 GHz)	FSV40	REOHDE & SCHWARZ	100931	09/29/2022	Annual
Base Station	8960 (E5515C)	Agilent	MY48360800	08/18/2022	Annual
Loop Antenna(9 kHz ~ 30 MHz)	FMZB1513	Schwarzbeck	1513-333	03/19/2022	Biennial
Bilog Antenna	VULB9160	Schwarzbeck	3150	03/03/2023	Biennial
Hybrid Antenna	VULB9168	Schwarzbeck	760	02/22/2023	Biennial
Wideband Radio Communication Tester	MT8821C	Anritsu Corp.	6262116770	07/12/2022	Annual
Wideband Radio Communication Tester	MT8820C	Anritsu Corp.	6200863156	12/29/2022	Annual
SIGNAL GENERATOR (100 kHz ~ 40 GHz)	SMB100A	REOHDE & SCHWARZ	177633	07/05/2022	Annual
Signal Analyzer(5 Hz ~ 40.0 GHz)	N9030B	KEYSIGHT	MY55480167	06/02/2022	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. Espectially, 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)	1.82 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70 (Confidence level about 95 %, *k*=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05 (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, §22.917(a)	< 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions	PASS
Conducted Output Power	§2.1046	N/A	See Note1
Frequency stability / variation of ambient temperature	§2.1055, §22.355	< 2.5 ppm	PASS

Note:

1. See SAR Report

6.2 Test Condition : Radiated Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Effective Radiated Power	§22.913(a)(5)	< 7 Watts max. ERP	PASS
Radiated Spurious and Harmonic Emissions	§2.1053, §22.917(a)	< 43 + 10log10 (P[Watts]) for all out-of band emissions	PASS

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 = 4M48 G7D

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 EFFECTIVE RADIATED POWER

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
824.7	LTE B5/ 1.4 MHz	QPSK	-31.53	31.52	-10.24	1.40	H	< 7.00	0.097	19.88
		16-QAM	-32.18	30.87	-10.24	1.40	H		0.084	19.23
		64-QAM	-33.30	29.75	-10.24	1.40	H		0.065	18.11
836.5		QPSK	-31.85	31.19	-10.19	1.41	H		0.091	19.59
		16-QAM	-32.46	30.58	-10.19	1.41	H		0.079	18.98
		64-QAM	-33.55	29.49	-10.19	1.41	H		0.062	17.89
848.3		QPSK	-32.16	31.00	-10.14	1.42	H		0.088	19.44
		16-QAM	-32.81	30.35	-10.14	1.42	H		0.076	18.79
		64-QAM	-33.90	29.26	-10.14	1.42	H		0.059	17.70

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
825.5	LTE B5/ 3 MHz	QPSK	-31.46	31.56	-10.24	1.40	H	< 7.00	0.098	19.92
		16-QAM	-32.17	30.85	-10.24	1.40	H		0.083	19.21
		64-QAM	-33.20	29.82	-10.24	1.40	H		0.066	18.18
836.5		QPSK	-31.71	31.33	-10.19	1.41	H		0.094	19.73
		16-QAM	-32.37	30.67	-10.19	1.41	H		0.081	19.07
		64-QAM	-33.47	29.57	-10.19	1.41	H		0.063	17.97
847.5		QPSK	-31.95	31.24	-10.15	1.42	H		0.093	19.68
		16-QAM	-32.63	30.56	-10.15	1.42	H		0.079	19.00
		64-QAM	-33.70	29.49	-10.15	1.42	H		0.062	17.93

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
826.5	LTE B5/ 5 MHz	QPSK	-31.44	31.56	-10.24	1.40	H	< 7.00	0.098	19.93
		16-QAM	-32.15	30.85	-10.24	1.40	H		0.084	19.22
		64-QAM	-33.19	29.81	-10.24	1.40	H		0.066	18.18
836.5		QPSK	-31.77	31.27	-10.19	1.41	H		0.093	19.67
		16-QAM	-32.46	30.58	-10.19	1.41	H		0.079	18.98
		64-QAM	-33.53	29.51	-10.19	1.41	H		0.062	17.91
846.5		QPSK	-31.72	31.46	-10.15	1.42	H		0.098	19.89
		16-QAM	-32.38	30.80	-10.15	1.42	H		0.084	19.23
		64-QAM	-33.54	29.64	-10.15	1.42	H		0.064	18.07

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
829.0	LTE B5/ 10 MHz	QPSK	-31.33	31.79	-10.22	1.40	H	< 7.00	0.104	20.17
		16-QAM	-32.00	31.12	-10.22	1.40	H		0.089	19.50
		64-QAM	-33.14	29.98	-10.22	1.40	H		0.069	18.36
836.5		QPSK	-31.71	31.33	-10.19	1.41	H		0.094	19.73
		16-QAM	-32.39	30.65	-10.19	1.41	H		0.080	19.05
		64-QAM	-33.54	29.50	-10.19	1.41	H		0.062	17.90
844.0		QPSK	-31.56	31.50	-10.14	1.41	H		0.099	19.95
		16-QAM	-32.28	30.78	-10.14	1.41	H		0.084	19.23
		64-QAM	-33.33	29.73	-10.14	1.41	H		0.066	18.18

8.2 RADIATED SPURIOUS EMISSIONS

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit
20450 (829.0)	1 658.00	-51.97	9.76	-62.49	2.01	H	-54.74	77.06
	2 487.00	-52.83	10.62	-57.33	2.49	H	-49.20	71.52
	3 316.00	-57.98	12.19	-59.35	2.91	H	-50.06	72.38
20525 (836.5)	1 673.00	-53.60	9.82	-64.11	2.01	V	-56.30	78.32
	2 509.50	-52.02	10.70	-56.32	2.50	V	-48.12	70.15
	3 346.00	-58.41	12.37	-60.07	2.92	H	-50.62	72.65
20600 (844.0)	1 688.00	-51.49	9.94	-61.90	2.03	H	-53.99	76.31
	2 532.00	-55.79	10.70	-59.54	2.50	V	-51.34	73.66
	3 376.00	-57.99	12.50	-59.65	2.93	V	-50.07	72.39

8.3 OCCUPIED BANDWIDTH

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
5	1.4 MHz	836.5	QPSK	6	0	1.0921
			16-QAM			1.0895
			64-QAM			1.0941
	3 MHz		QPSK	15		2.7118
			16-QAM			2.7028
			64-QAM			2.7069
	5 MHz		QPSK	25		4.5028
			16-QAM			4.4936
			64-QAM			4.5113
	10 MHz		QPSK	50		9.0067
			16-QAM			8.9929
			64-QAM			9.0020

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 55 ~ 66.

8.4 CONDUCTED SPURIOUS EMISSIONS

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
5	1.4	824.7	3.7039	27.976	-67.018	-39.042	-13.00
		836.5	3.7179	27.976	-67.274	-39.298	
		848.3	3.7139	27.976	-67.414	-39.438	
	3	825.5	3.7124	27.976	-66.959	-38.983	
		836.5	3.7064	27.976	-67.270	-39.294	
		847.5	3.7104	27.976	-66.642	-38.666	
	5	826.5	3.6980	27.976	-67.281	-39.305	
		836.5	3.6870	27.976	-67.129	-39.153	
		846.5	3.7010	27.976	-67.306	-39.330	
	10	829.0	3.7039	27.976	-67.035	-39.059	
		836.5	3.6985	27.976	-67.158	-39.182	
		844.0	3.7005	27.976	-67.268	-39.292	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 67 ~ 78.
2. Conducted Spurious Emissions was Tested QPSK Modulation, Resource Block Size 1 and Resource Block Offset 0
3. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
4. Factor (dB) = Cable Loss + Attenuator + Power Splitter

Frequency Range (GHz)	Factor [dB]
0.03 – 1	25.270
1 – 5	27.976
5 – 10	28.591
10 – 15	29.116
15 – 20	29.489
Above 20(26.5)	30.131

8.5 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 31 ~ 54.

8.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: LTE B5

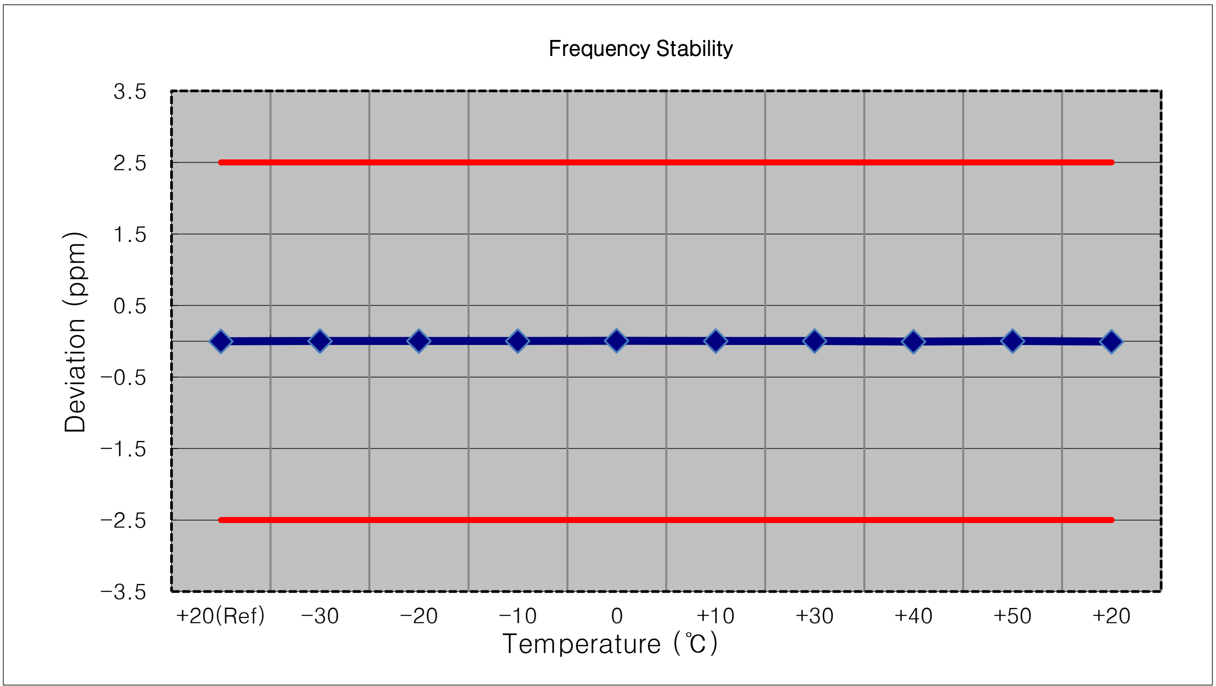
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.860 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	3.860	+20(Ref)	836 499 994	0.0	0.000 000	0.000
100 %		-30	836 499 998	4.0	0.000 000	0.005
100 %		-20	836 499 997	3.7	0.000 000	0.004
100 %		-10	836 499 999	4.9	0.000 001	0.006
100 %		0	836 499 999	5.0	0.000 001	0.006
100 %		+10	836 499 998	4.4	0.000 001	0.005
100 %		+30	836 499 997	3.8	0.000 000	0.005
100 %		+40	836 499 990	-3.2	0.000 000	-0.004
100 %		+50	836 499 998	4.0	0.000 000	0.005
Batt. Endpoint	3.650	+20	836 499 990	-4.0	0.000 000	-0.005



▣ MODE: LTE B5

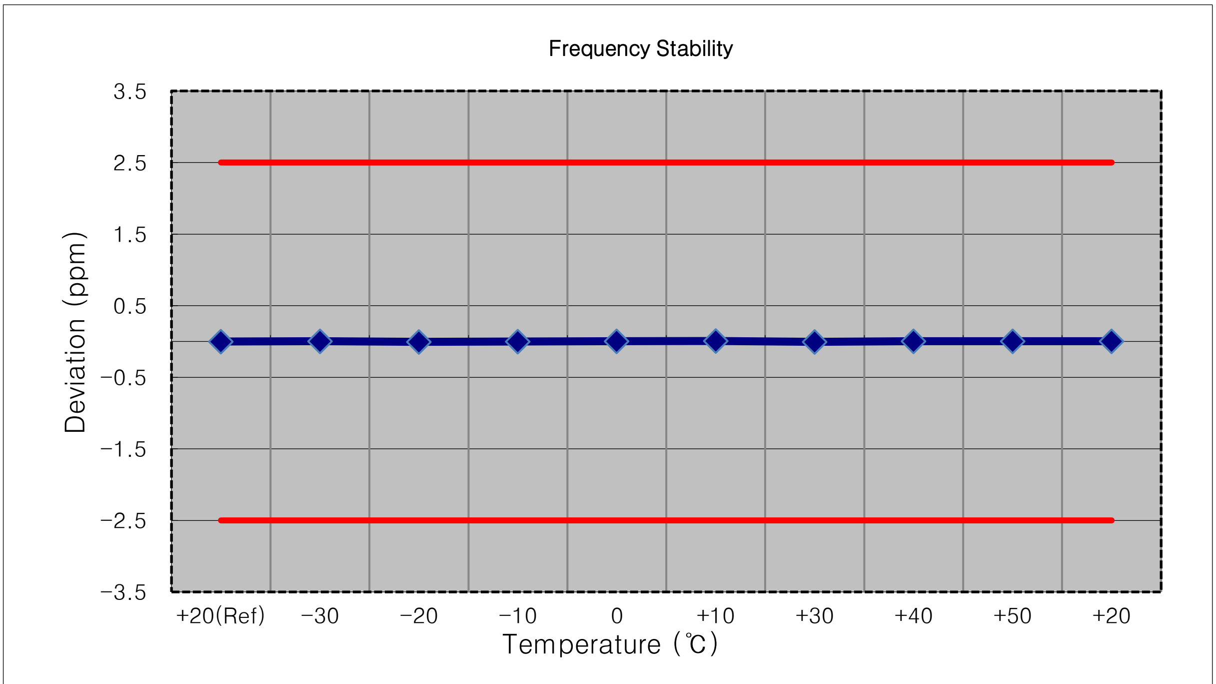
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525(3 MHz)

▣ REFERENCE VOLTAGE: 3.860 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	3.860	+20(Ref)	836 500 002	0.0	0.000 000	0.000
100 %		-30	836 500 006	3.8	0.000 000	0.005
100 %		-20	836 499 999	-3.4	0.000 000	-0.004
100 %		-10	836 500 000	-2.4	0.000 000	-0.003
100 %		0	836 500 006	4.0	0.000 000	0.005
100 %		+10	836 500 008	5.4	0.000 001	0.006
100 %		+30	836 499 998	-4.3	-0.000 001	-0.005
100 %		+40	836 500 007	4.1	0.000 000	0.005
100 %		+50	836 500 005	2.2	0.000 000	0.003
Batt. Endpoint	3.650	+20	836 500 007	4.1	0.000 000	0.005



▣ MODE: LTE B5

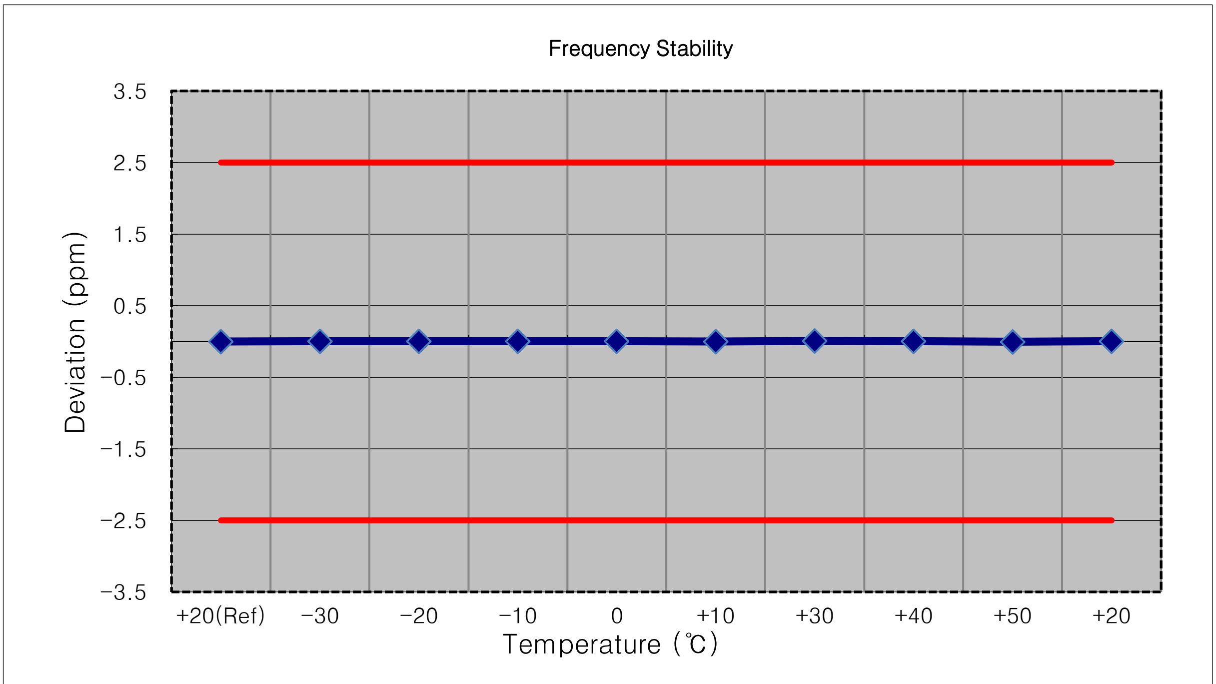
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525(5 MHz)

▣ REFERENCE VOLTAGE: 3.860 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	3.860	+20(Ref)	836 500 004	0.0	0.000 000	0.000
100 %		-30	836 500 006	2.0	0.000 000	0.002
100 %		-20	836 500 007	2.6	0.000 000	0.003
100 %		-10	836 500 007	2.4	0.000 000	0.003
100 %		0	836 500 006	2.1	0.000 000	0.003
100 %		+10	836 500 003	-1.6	0.000 000	-0.002
100 %		+30	836 500 010	5.8	0.000 001	0.007
100 %		+40	836 500 008	4.3	0.000 001	0.005
100 %		+50	836 500 001	-2.9	0.000 000	-0.003
Batt. Endpoint	3.650	+20	836 500 007	2.6	0.000 000	0.003



▣ MODE: LTE B5

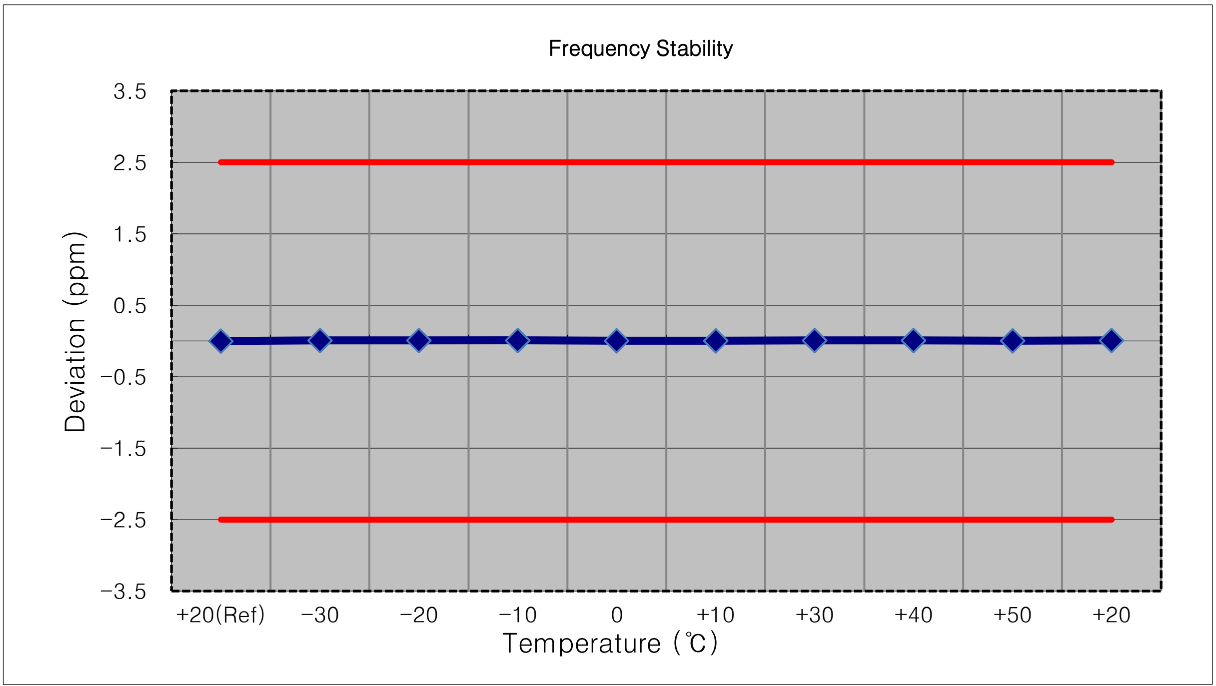
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525(10 MHz)

▣ REFERENCE VOLTAGE: 3.860 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	3.860	+20(Ref)	836 500 003	0.0	0.000 000	0.000
100 %		-30	836 500 010	6.9	0.000 001	0.008
100 %		-20	836 500 009	5.6	0.000 001	0.007
100 %		-10	836 500 011	7.7	0.000 001	0.009
100 %		0	836 500 007	3.2	0.000 000	0.004
100 %		+10	836 500 008	4.5	0.000 001	0.005
100 %		+30	836 500 010	7.1	0.000 001	0.008
100 %		+40	836 500 010	6.2	0.000 001	0.007
100 %		+50	836 500 008	4.7	0.000 001	0.006
Batt. Endpoint	3.650	+20	836 500 011	7.2	0.000 001	0.009



9. TEST PLOTS

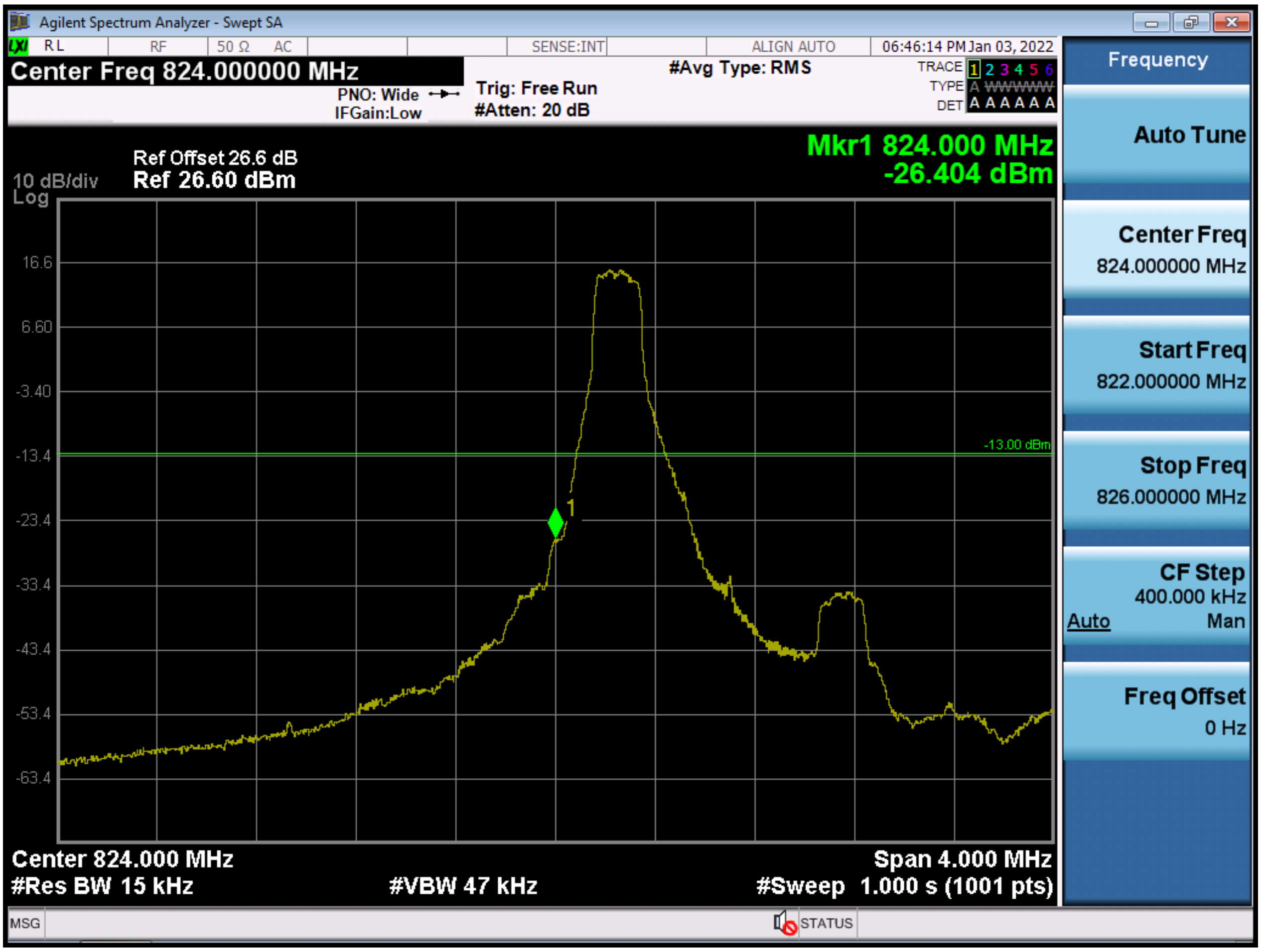
1.4 M_BandEdge_Lowest Channel_QPSK_FullRB(1)

1.4 M_BandEdge_Lowest Channel_QPSK_FullRB(2)

1.4 M_BandEdge_Highest Channel_QPSK_FullRB(1)

1.4 M_BandEdge_Highest Channel_QPSK_FullRB(2)

1.4 M_BandEdge_Lowest Channel_QPSK_1RB



1.4 M_BandEdge_Highest Channel_QPSK_1RB

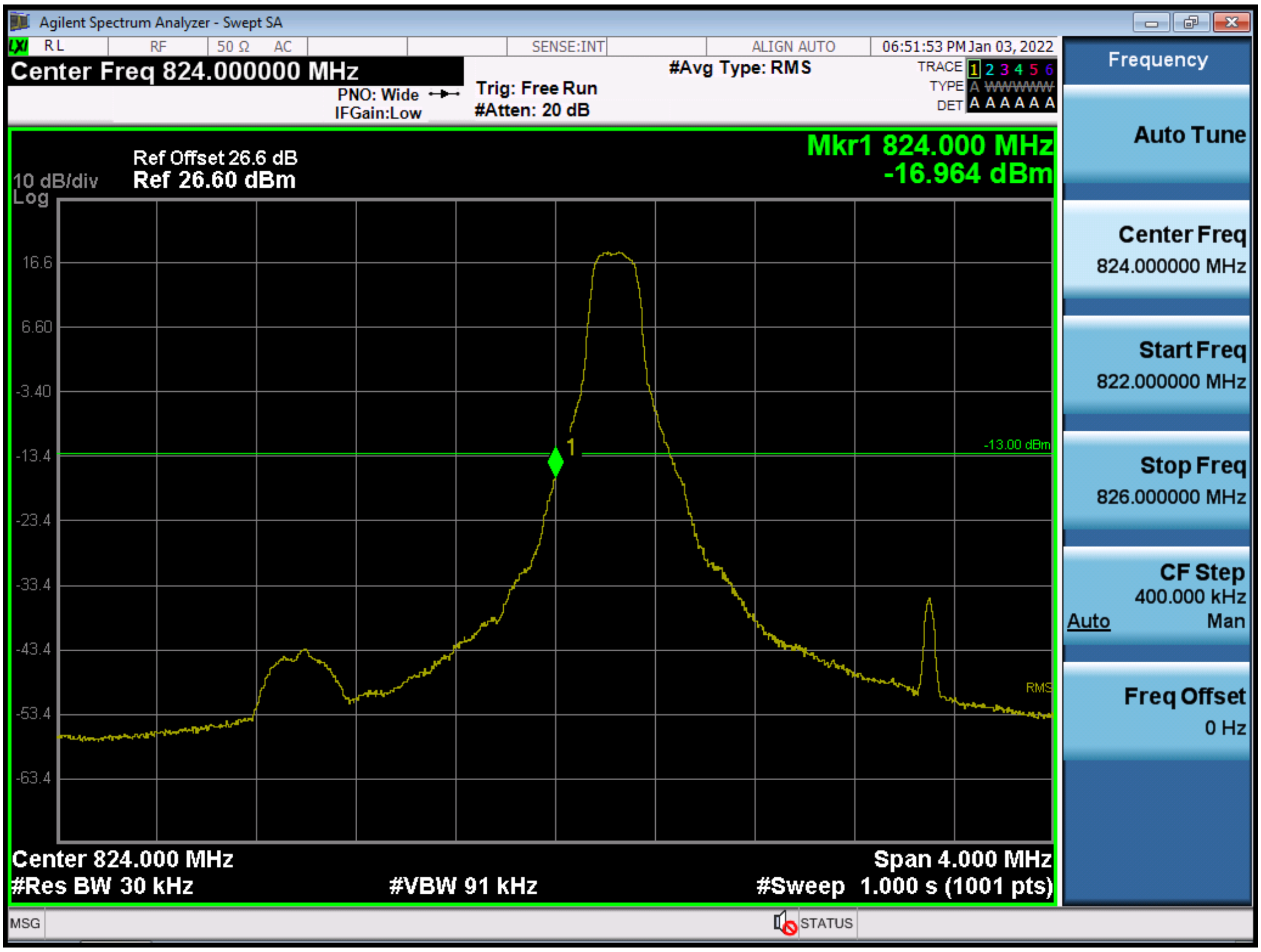
3 M_BandEdge_Lowest Channel_QPSK_FullRB(1)

3 M_BandEdge_Lowest Channel_QPSK_FullRB(2)

3 M_BandEdge_Highest Channel_QPSK_FullRB(1)

3 M_BandEdge_Highest Channel_QPSK_FullRB(2)

3 M_BandEdge_Lowest Channel_QPSK_1RB



3 M_BandEdge_Highest Channel_QPSK_1RB

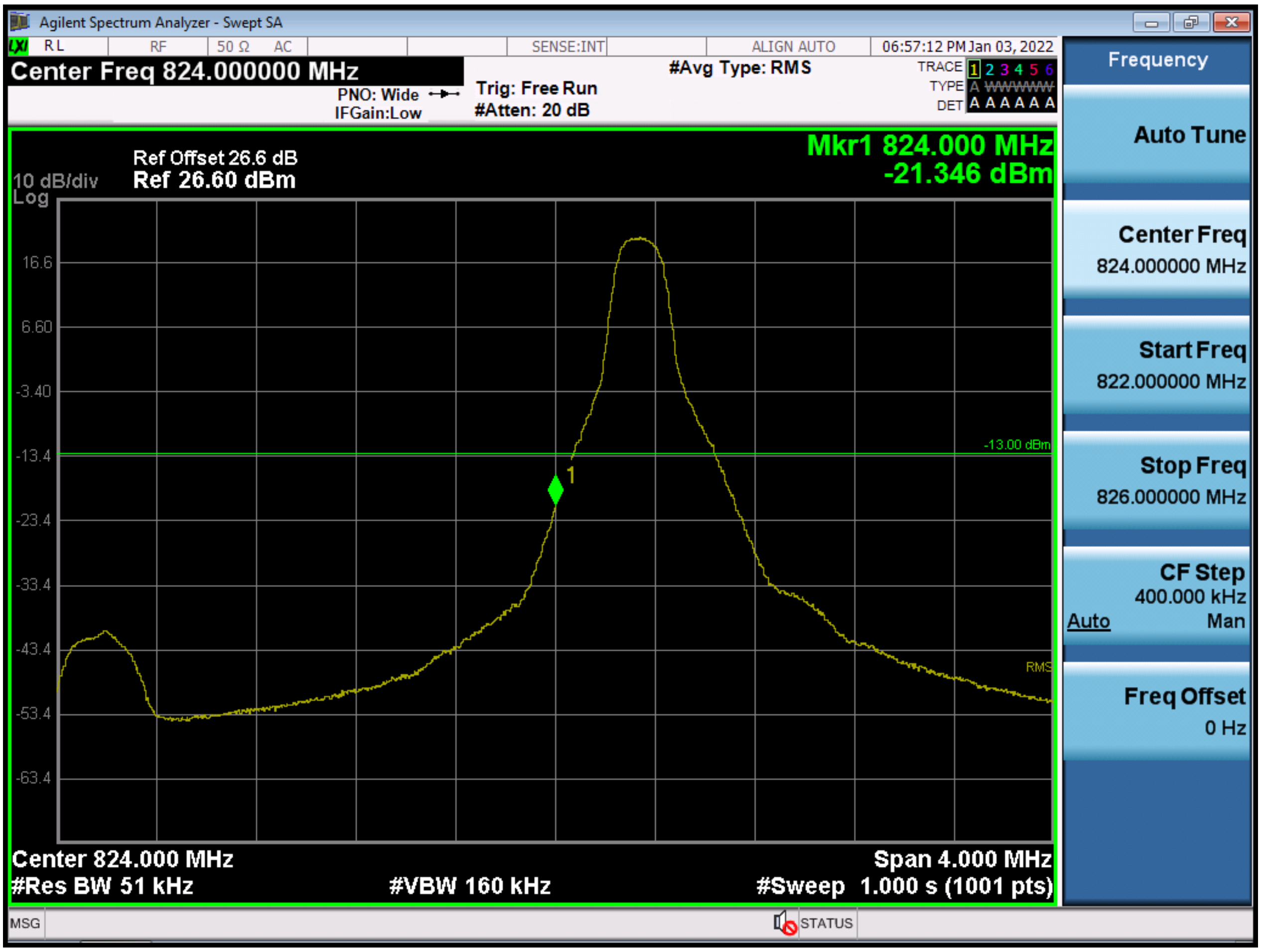
5 M_BandEdge_Lowest Channel_QPSK_FullRB(1)

5 M_BandEdge_Lowest Channel_QPSK_FullRB(2)

5 M_BandEdge_Highest Channel_QPSK_FullRB(1)

5 M_BandEdge_Highest Channel_QPSK_FullRB(2)

5 M_BandEdge_Lowest Channel_QPSK_1RB



5 M_BandEdge_Highest Channel_QPSK_1RB

10 M_BandEdge_Lowest Channel_QPSK_FullRB(1)

10 M_BandEdge_Lowest Channel_QPSK_FullRB(2)

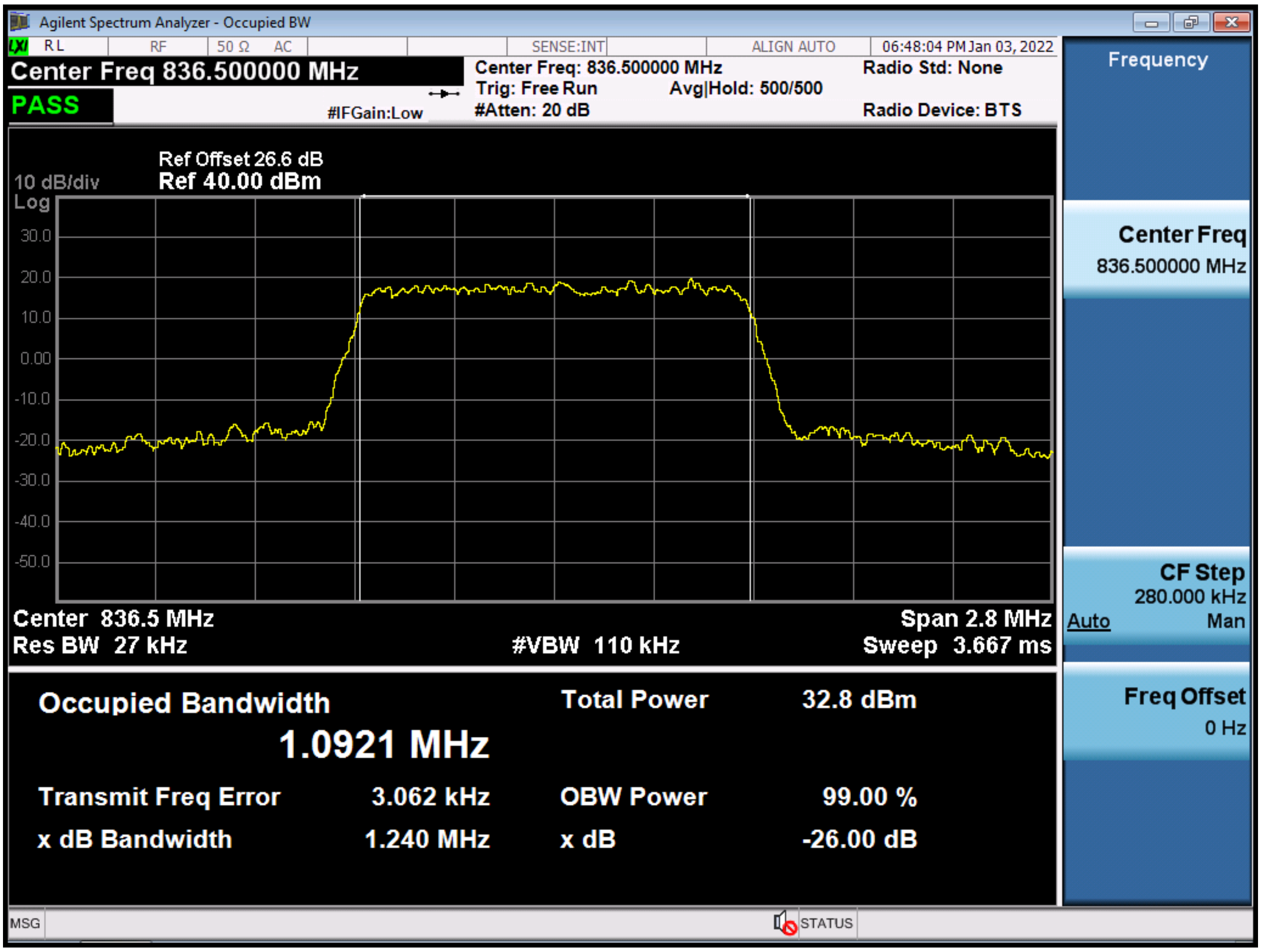
10 M_BandEdge_Highest Channel_QPSK_FullRB(1)

10 M_BandEdge_Highest Channel_QPSK_FullRB(2)

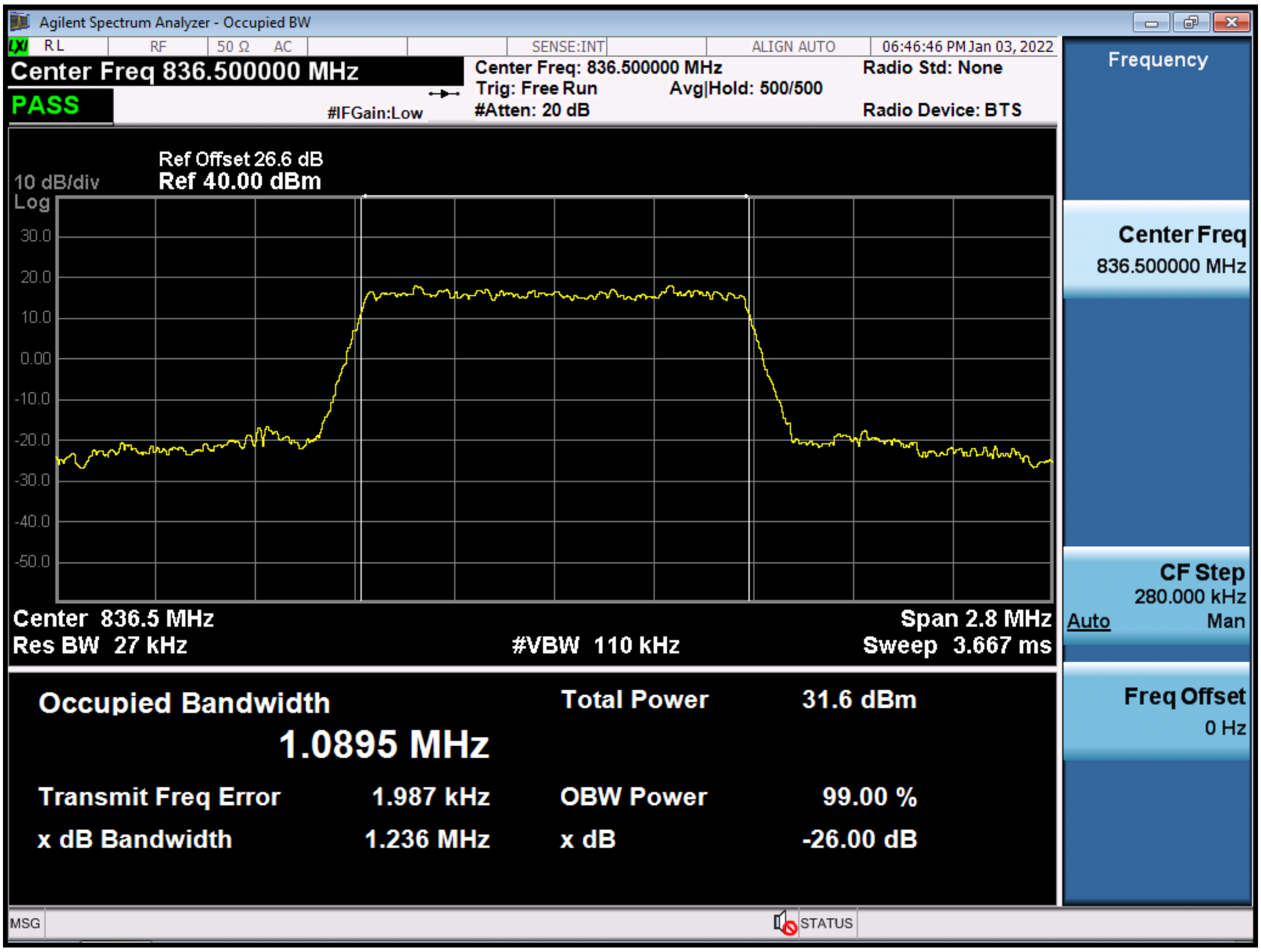
10 M_BandEdge_Lowest Channel_QPSK_1RB

10 M_BandEdge_Highest Channel_QPSK_1RB

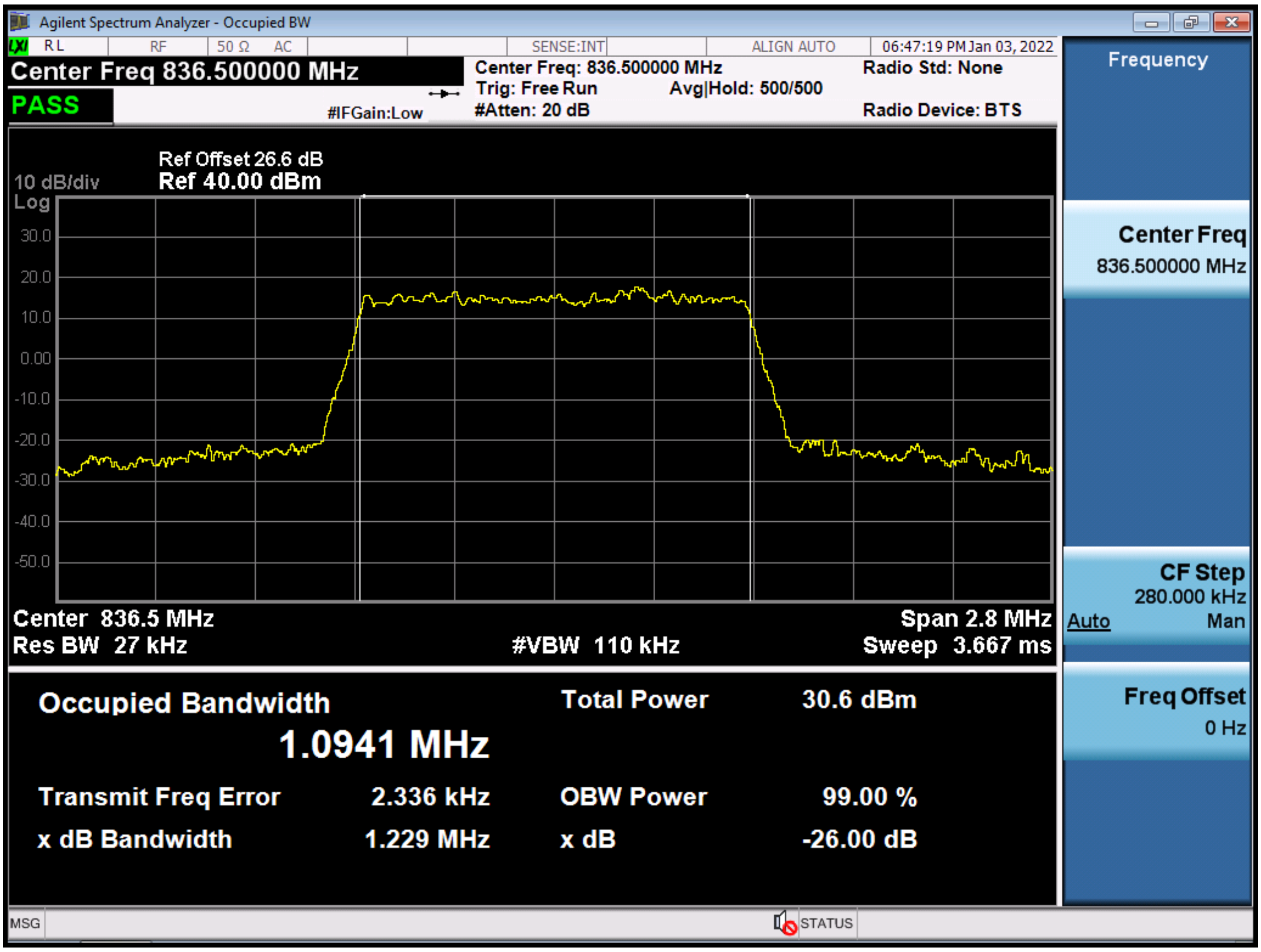
1.4 M_OBW_Mid Channel_QPSK_FullRB



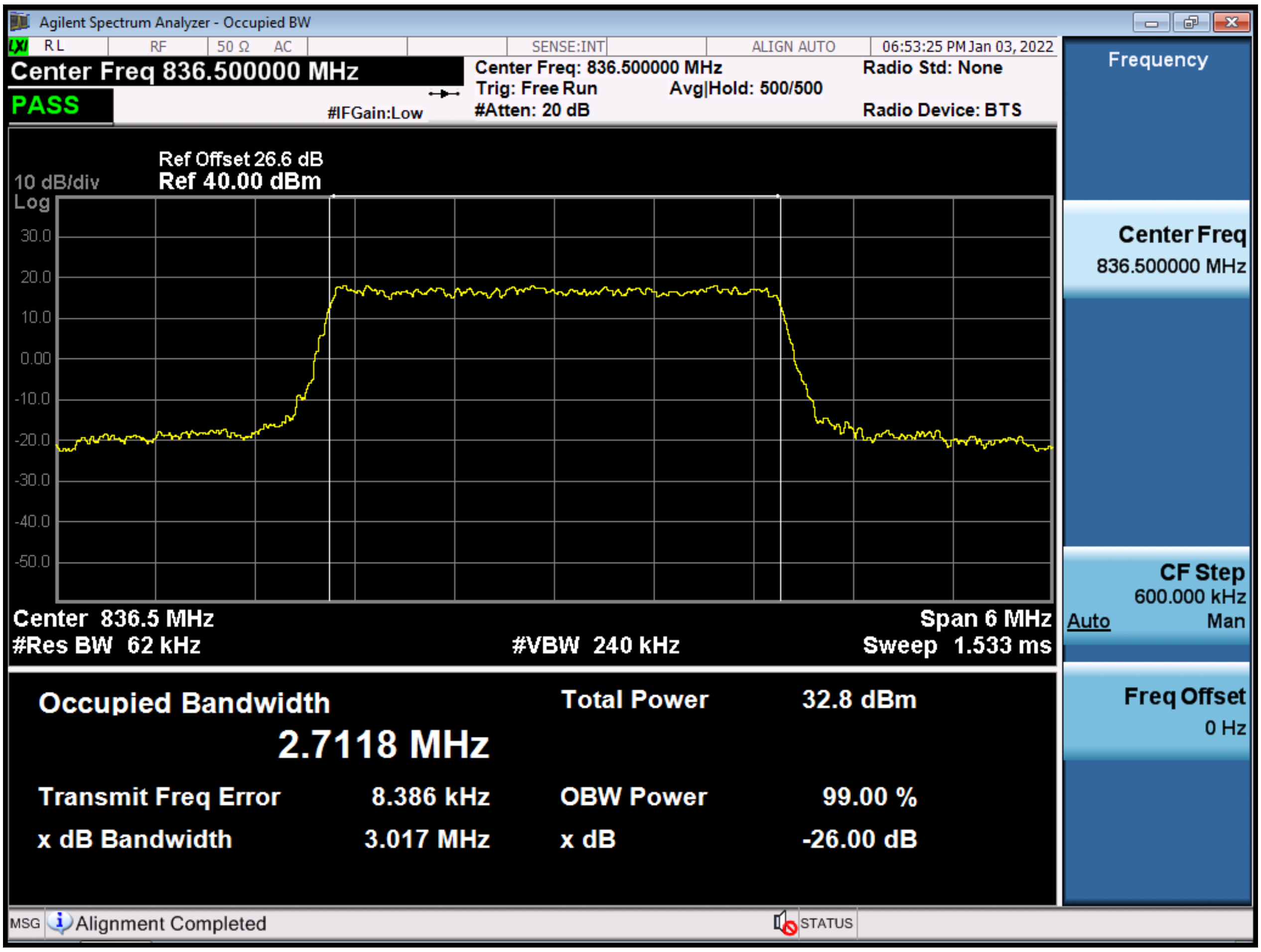
1.4 M_OBW_Mid Channel_16QAM_FullRB



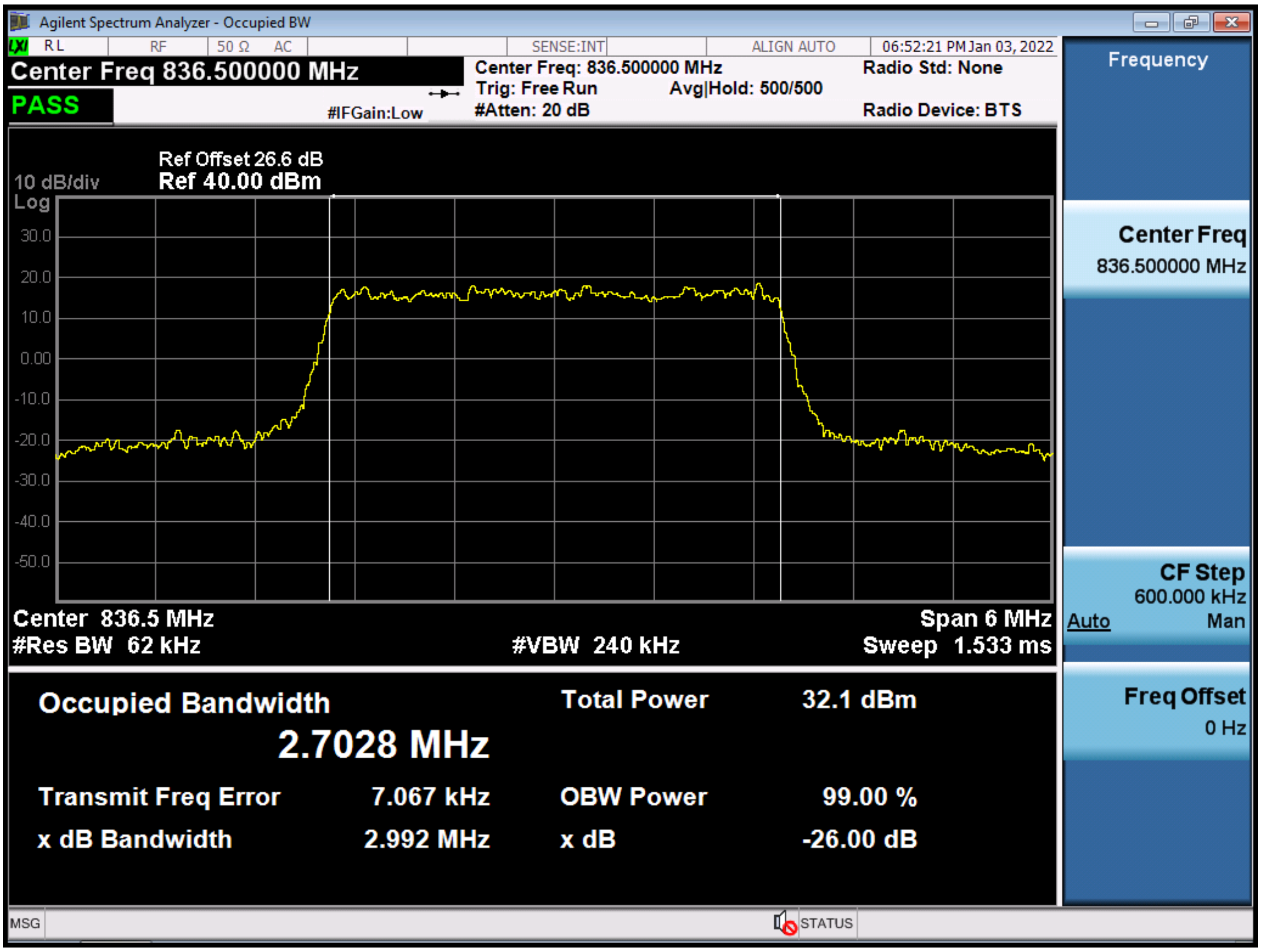
1.4 M_OBW_Mid Channel_64QAM_FullRB



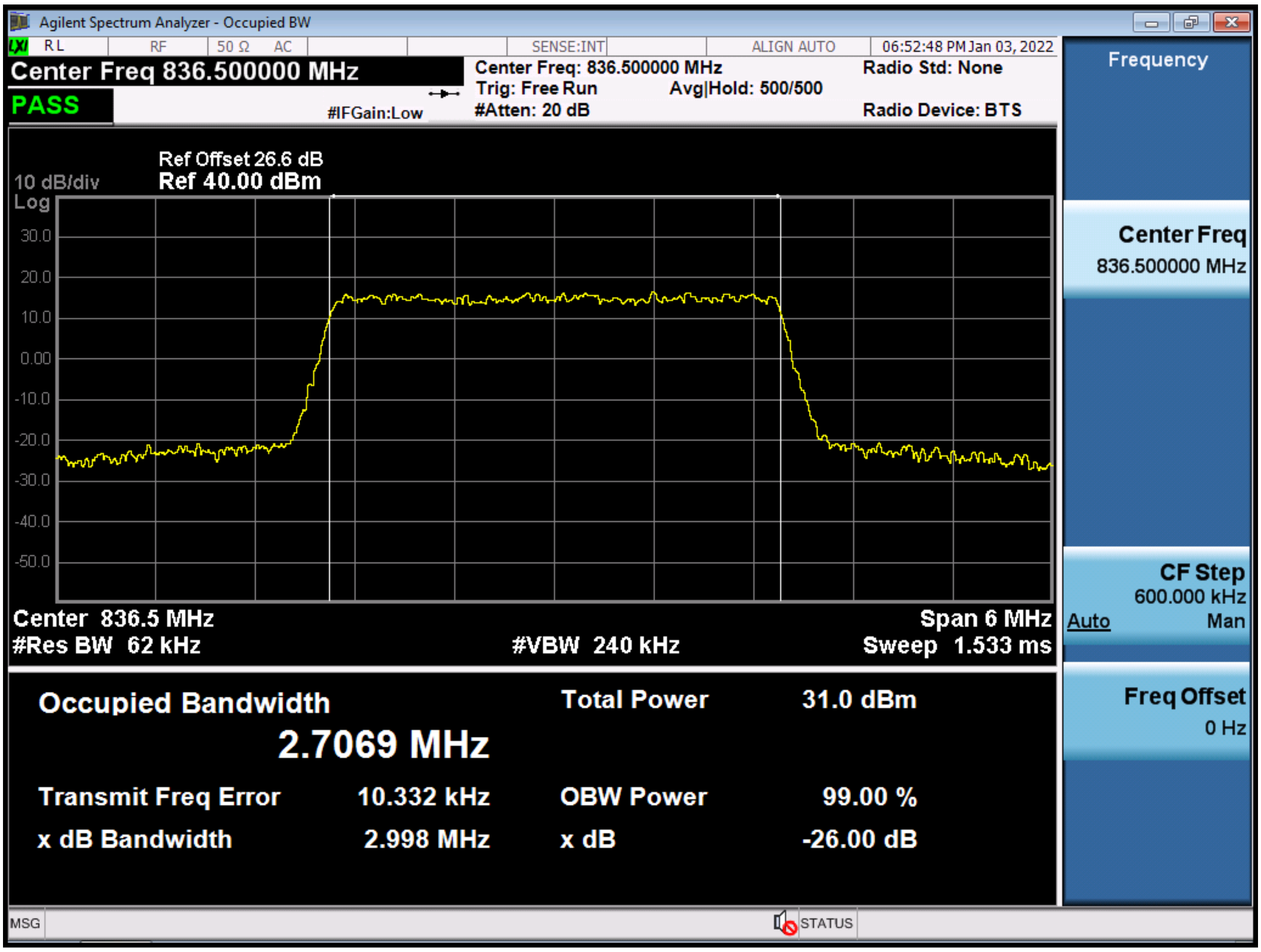
3 M_OBW_Mid Channel_QPSK_FullRB



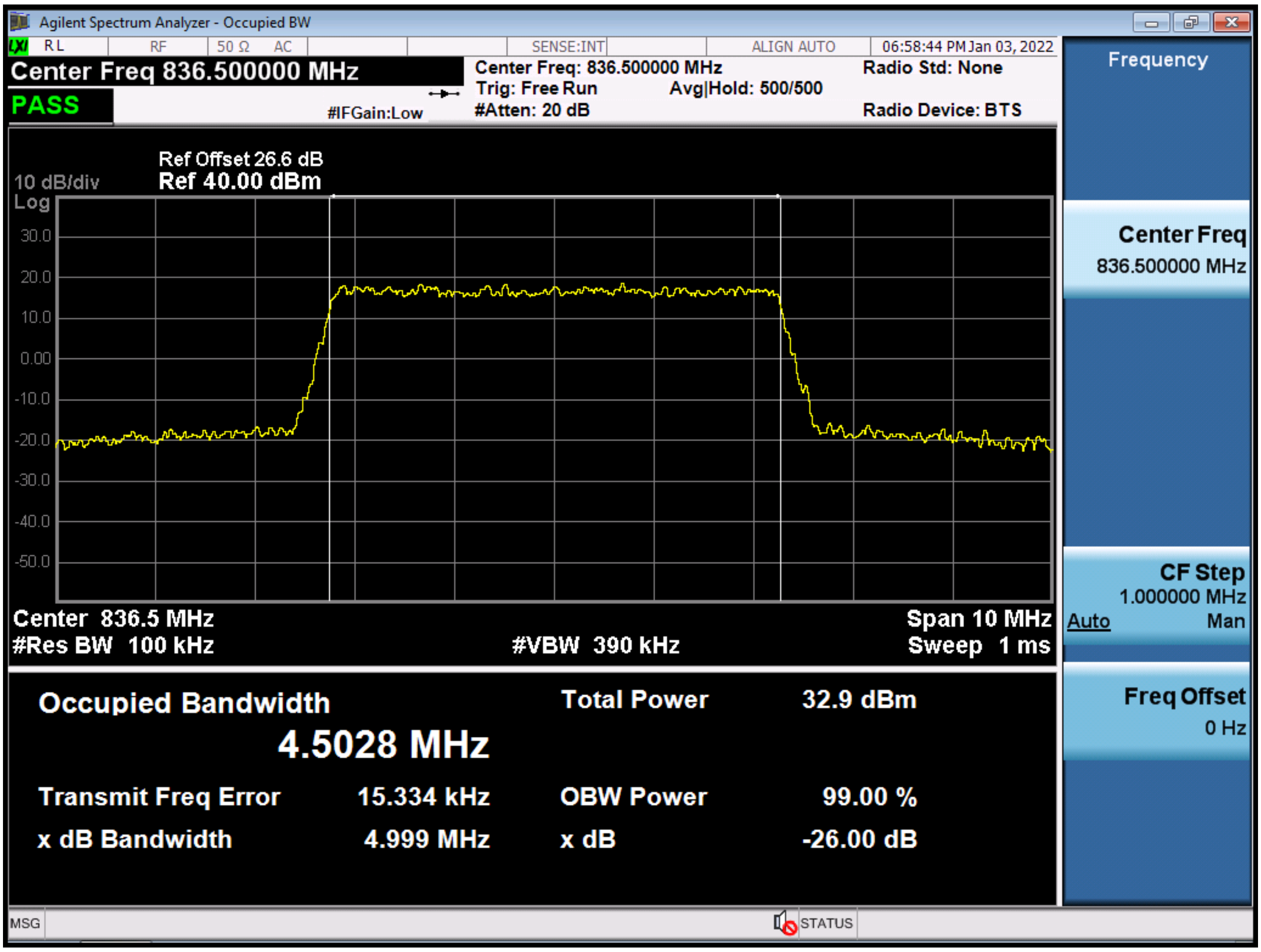
3 M_OBW_Mid Channel_16QAM_FullRB



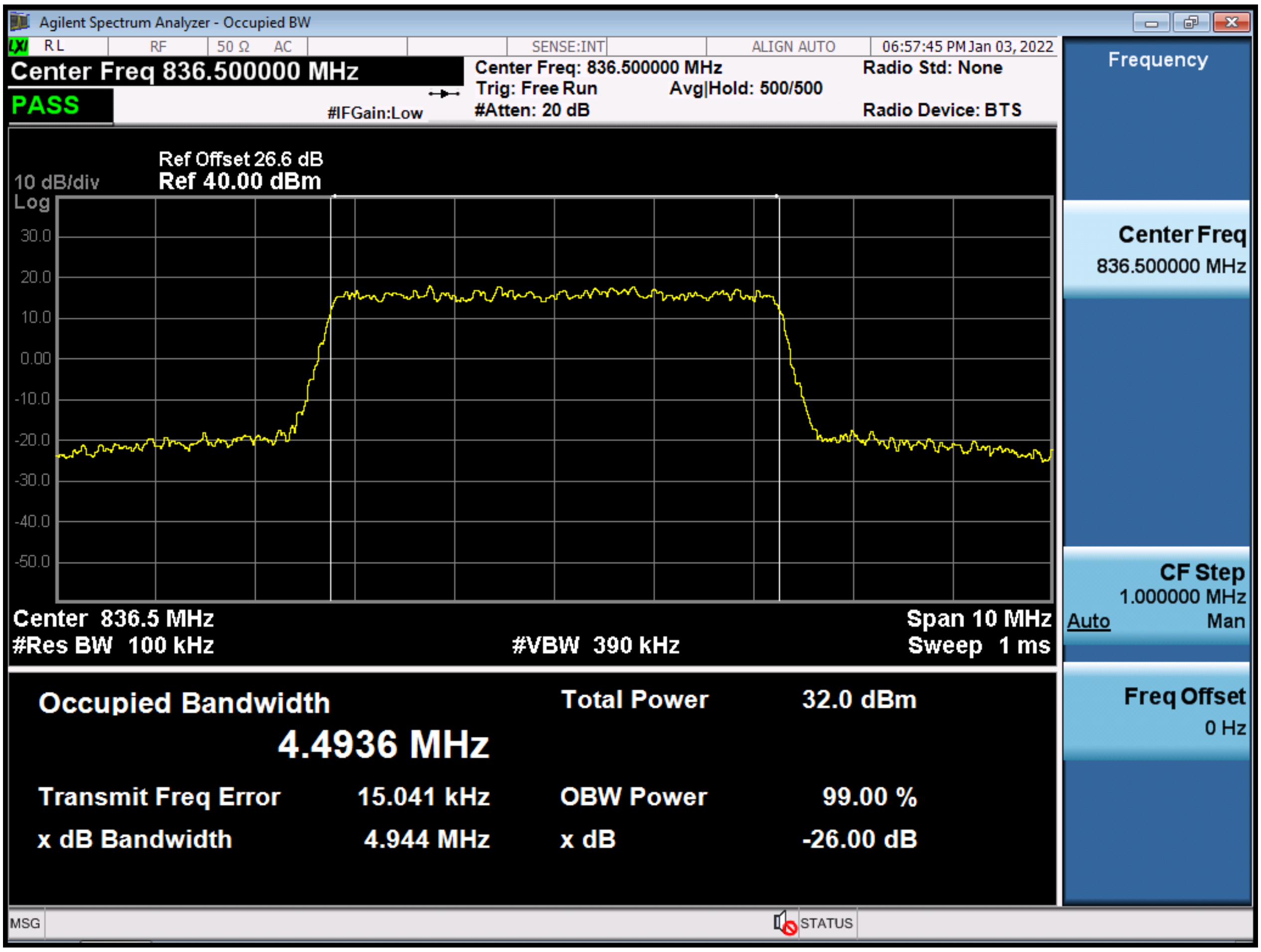
3 M_OBW_Mid Channel_64QAM_FullRB



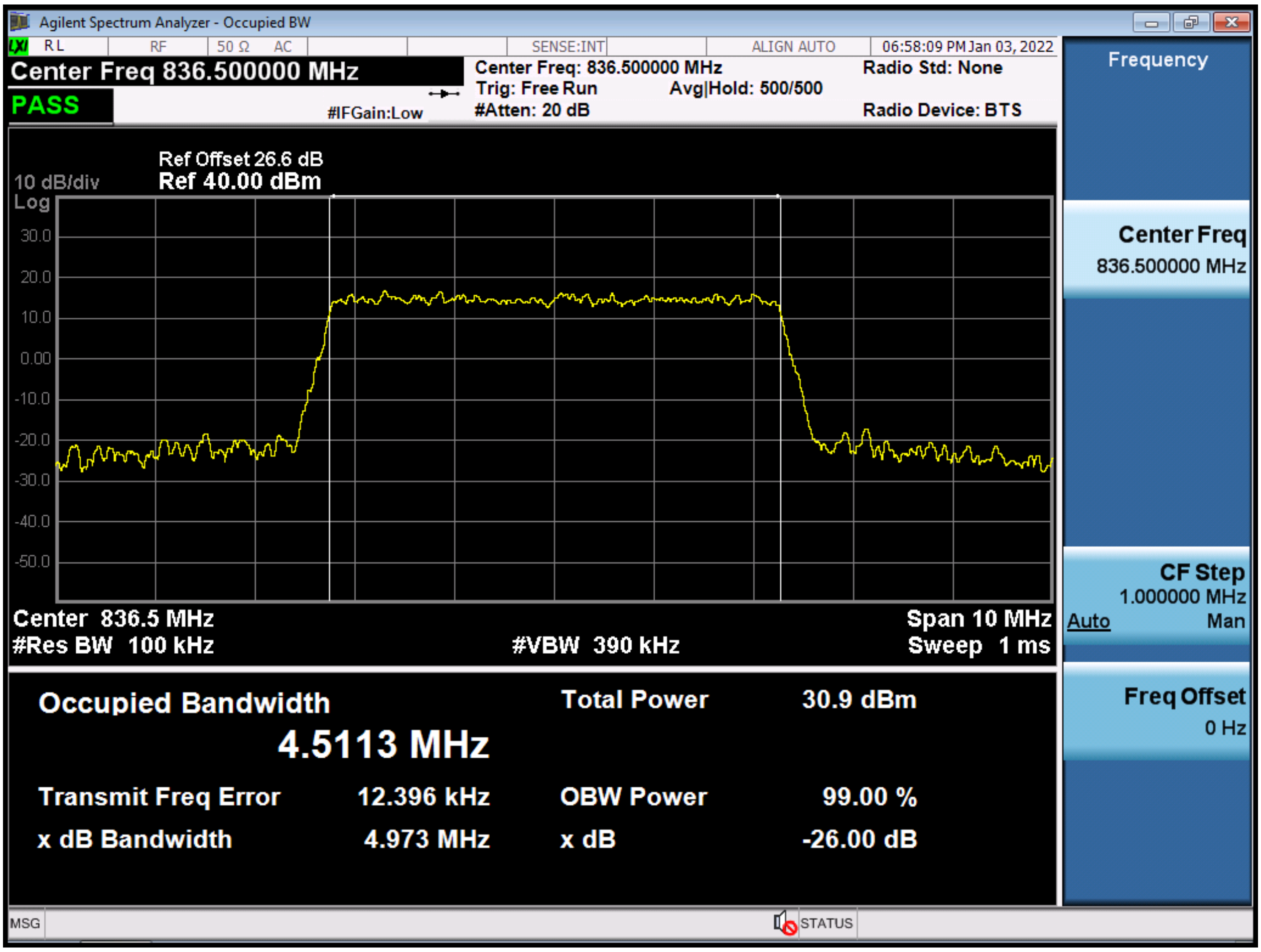
5 M_OBW_Mid Channel_QPSK_FullRB



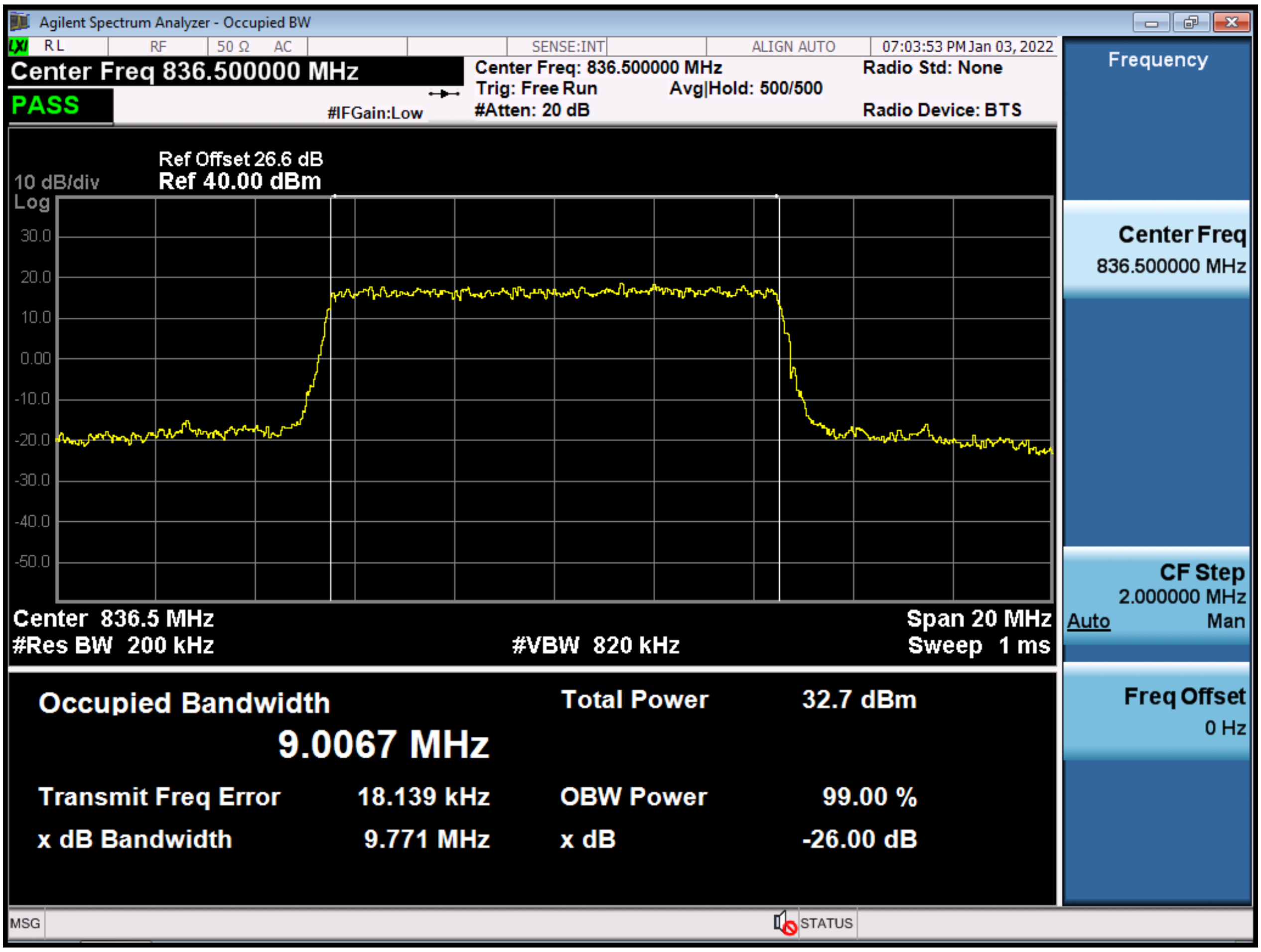
5 M_OBW_Mid Channel_16QAM_FullRB



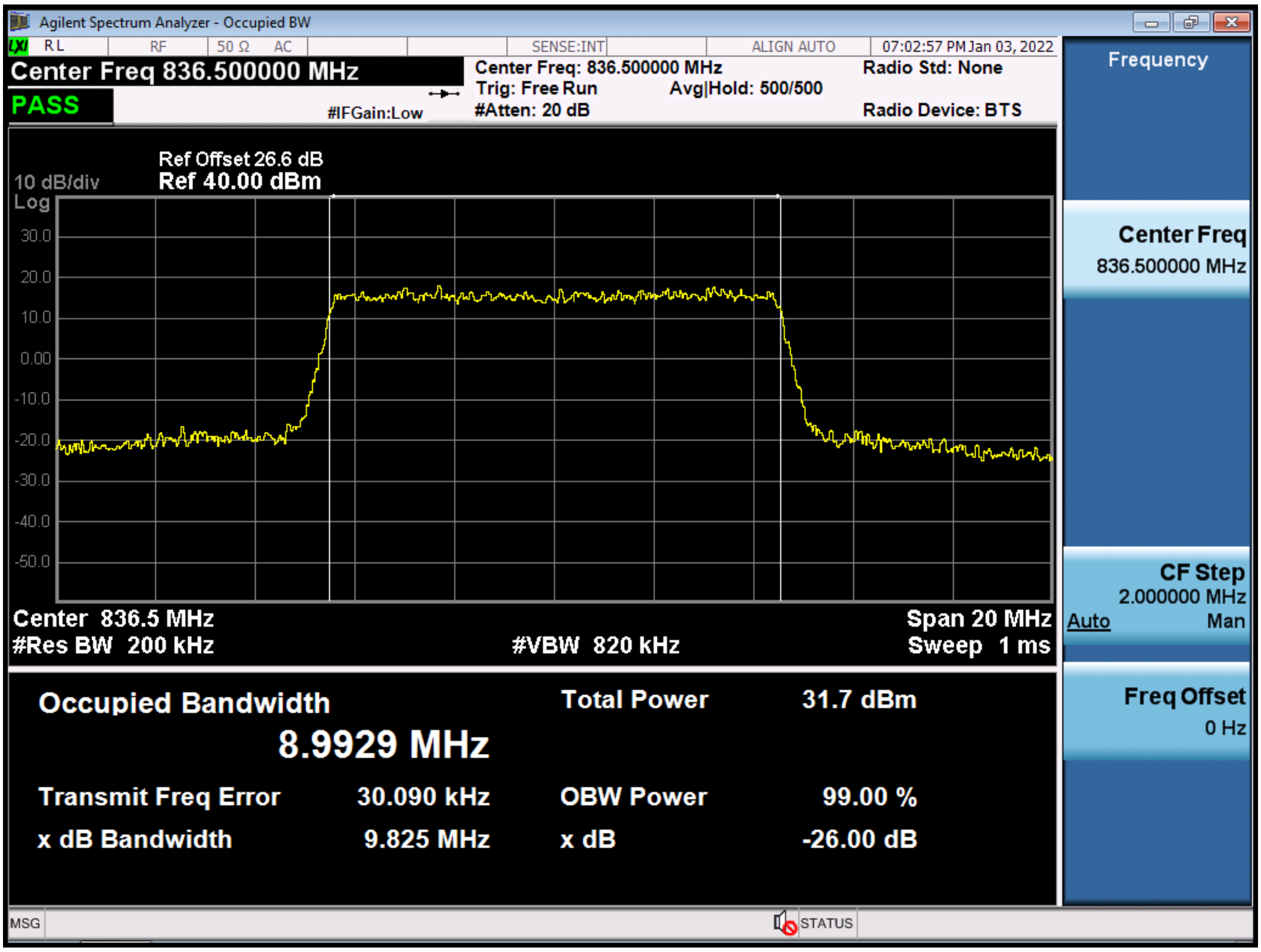
5 M_OBW_Mid Channel_64QAM_FullRB



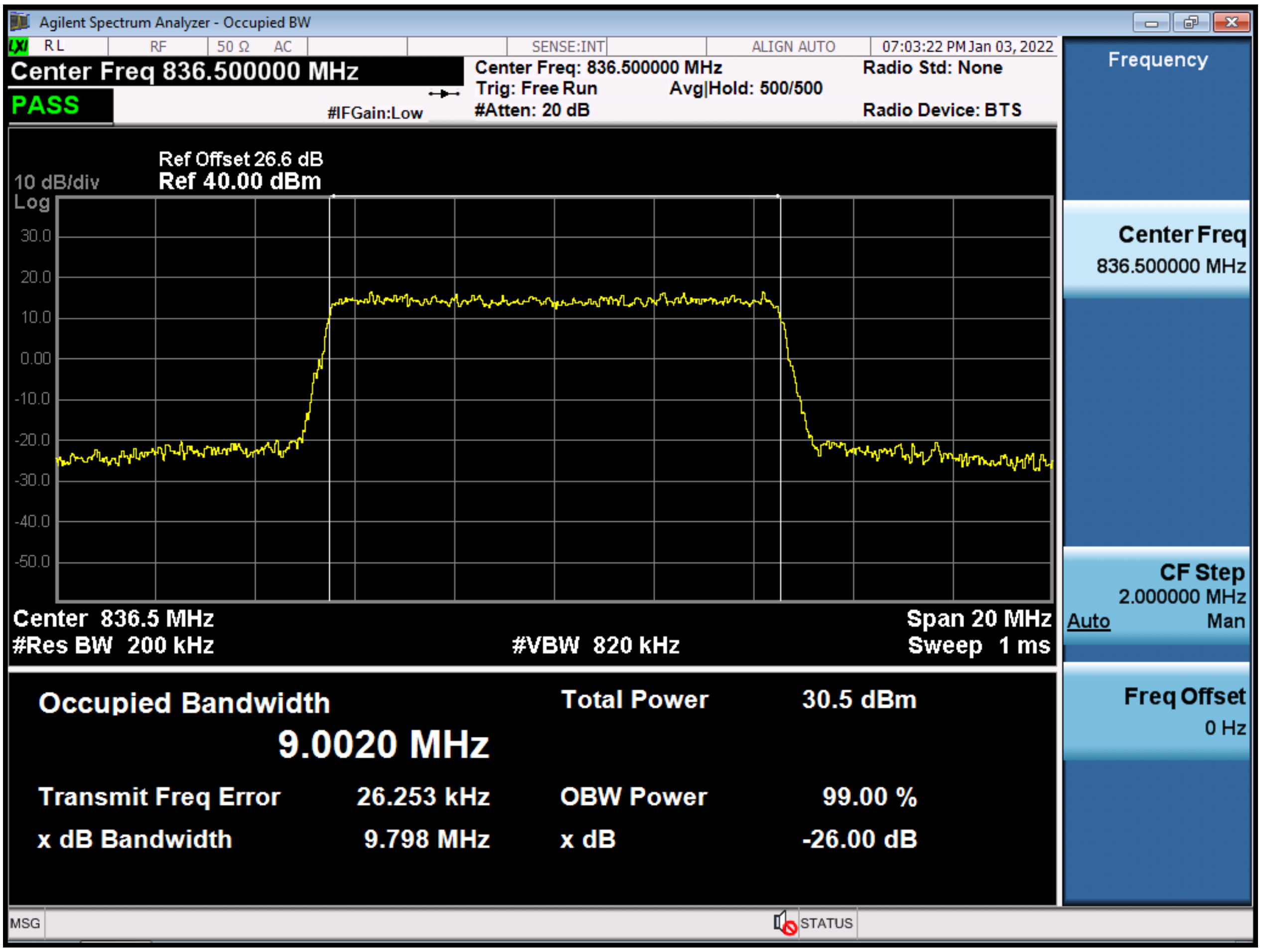
10 M_OBW_Mid Channel_QPSK_FullRB



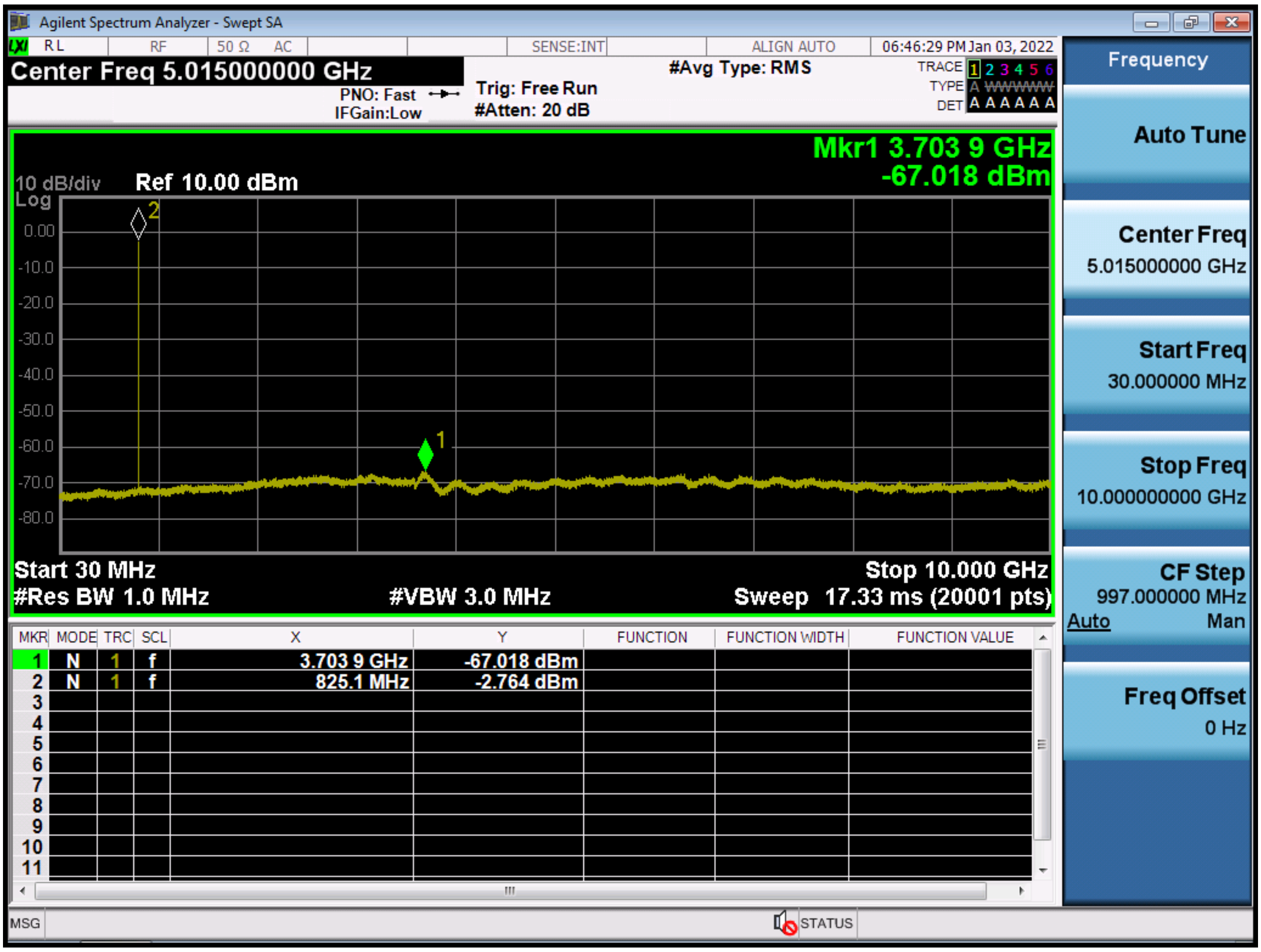
10 M_OBW_Mid Channel_16QAM_FullRB



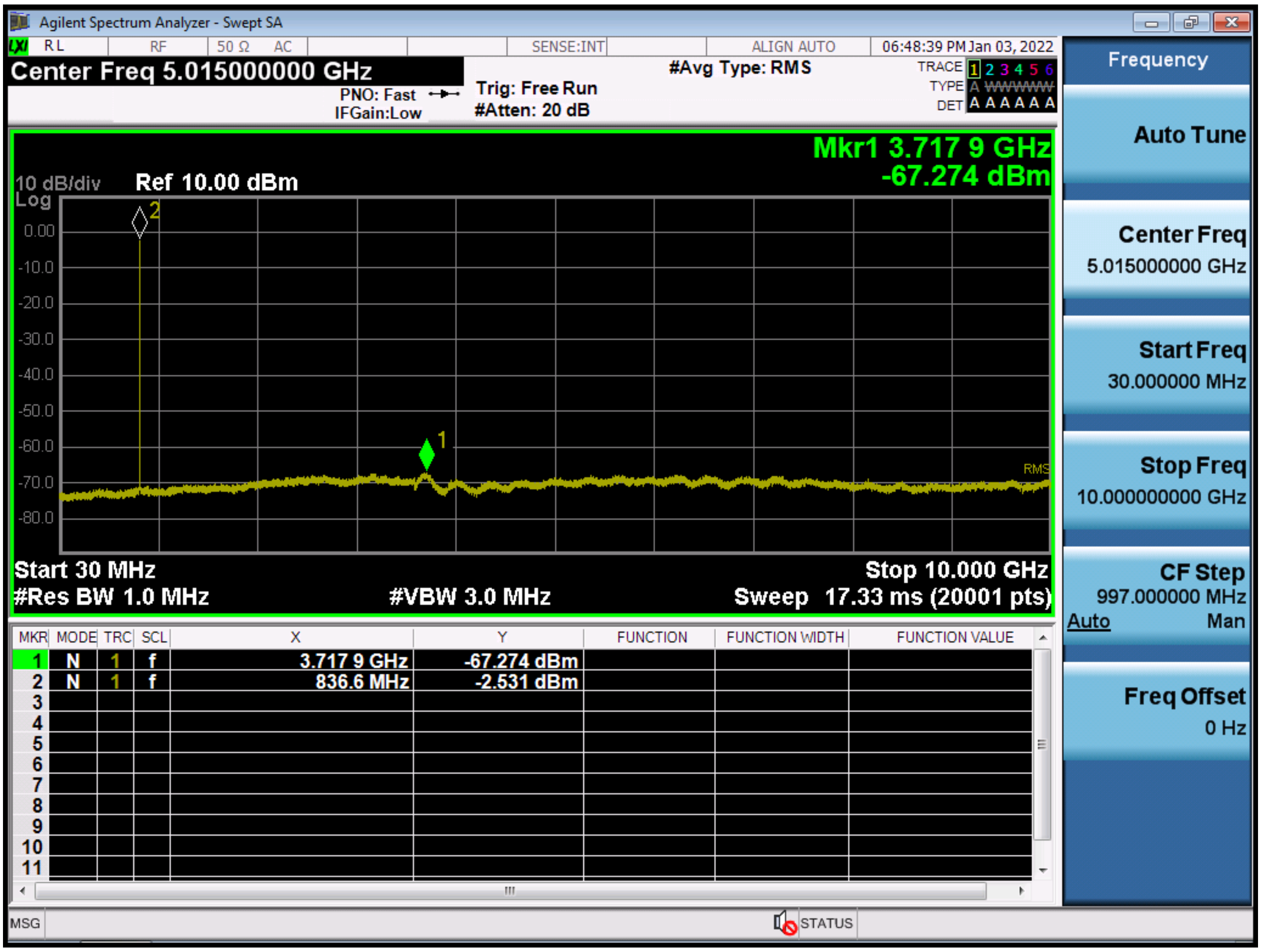
10 M_OBW_Mid Channel_64QAM_FullRB



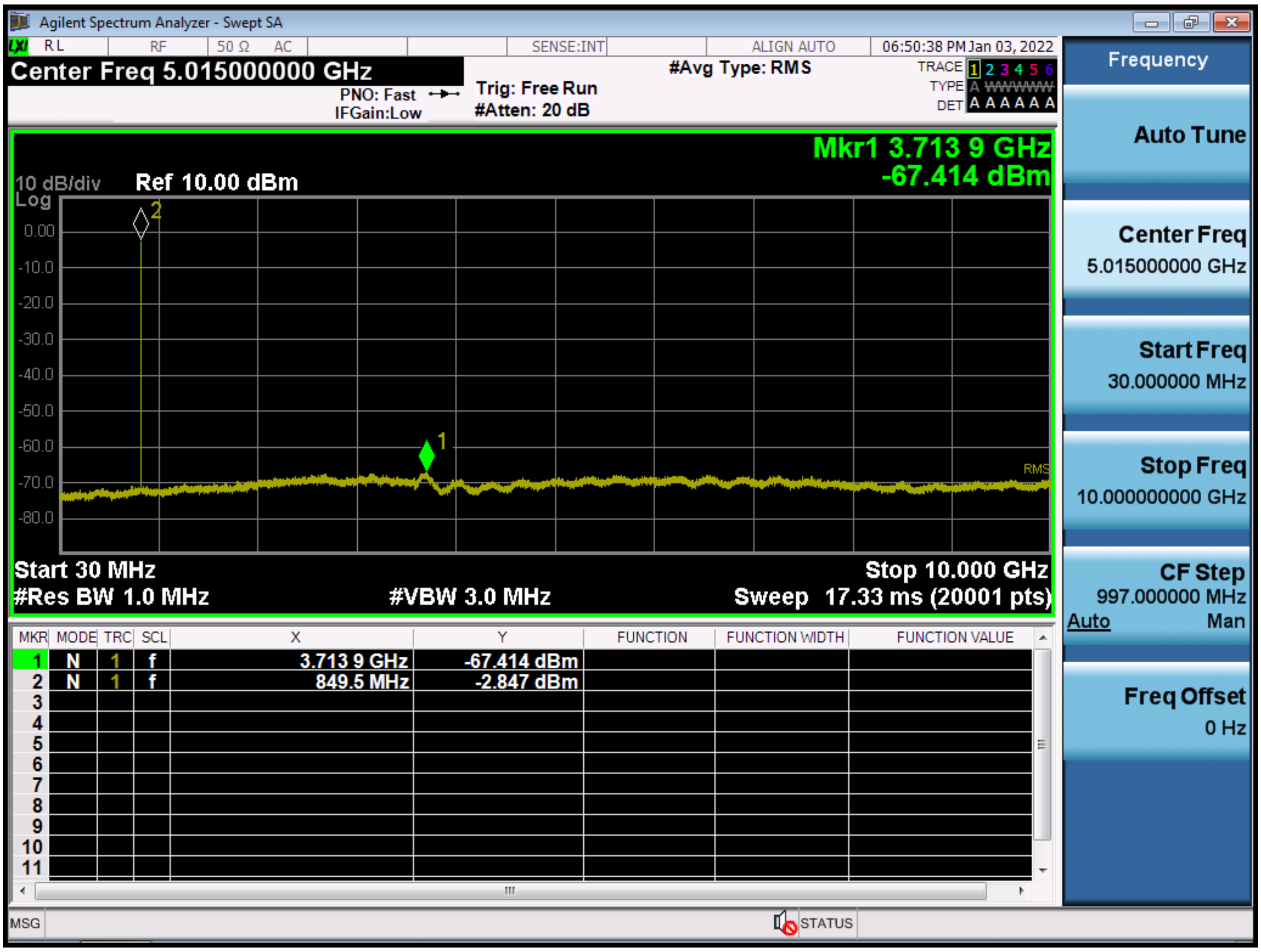
1.4 M_CSE(30 M-10 G)_Lowest Channel_QPSK_1RB



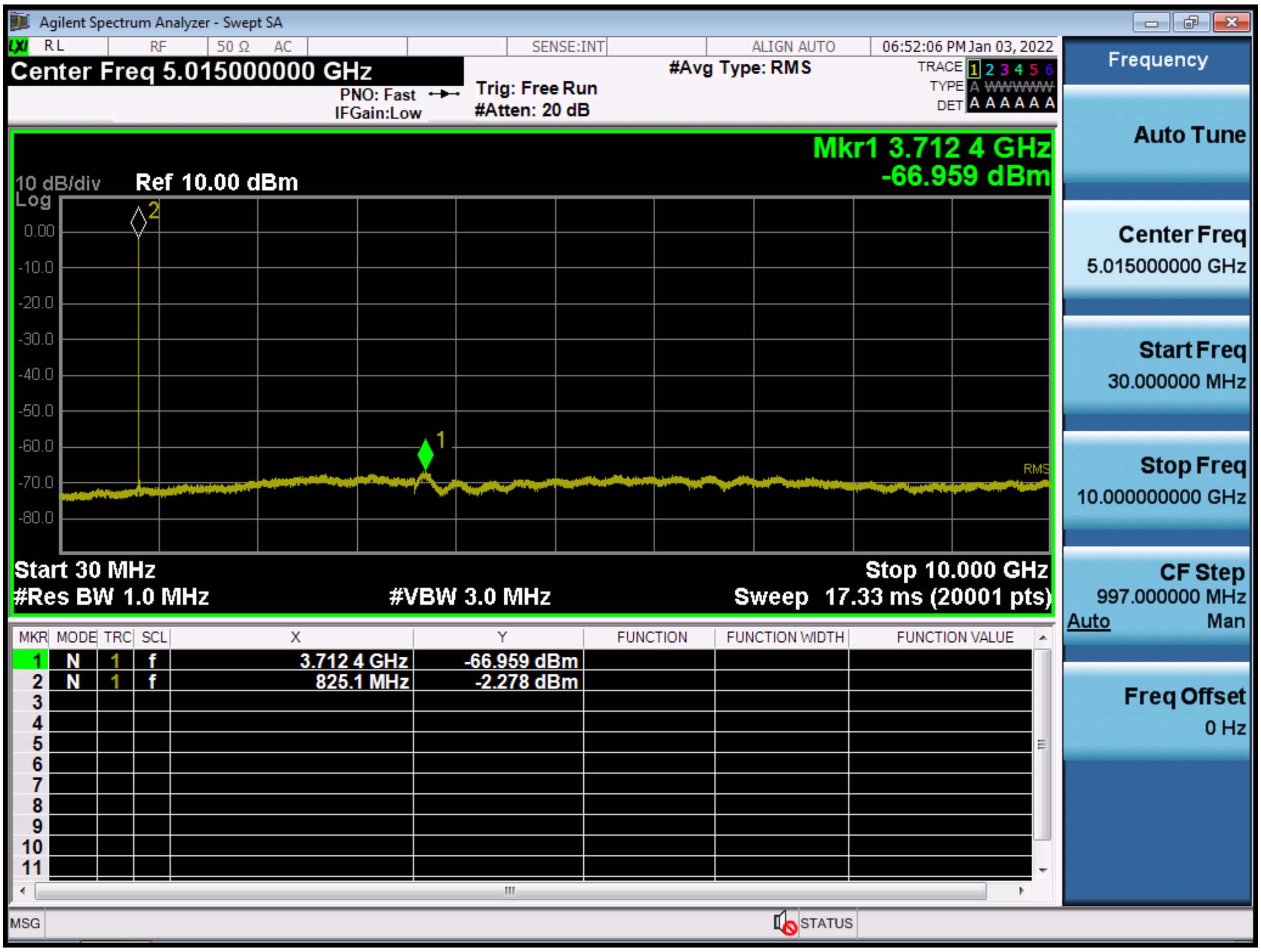
1.4 M_CSE(30 M-10 G)_Mid Channel_QPSK_1RB



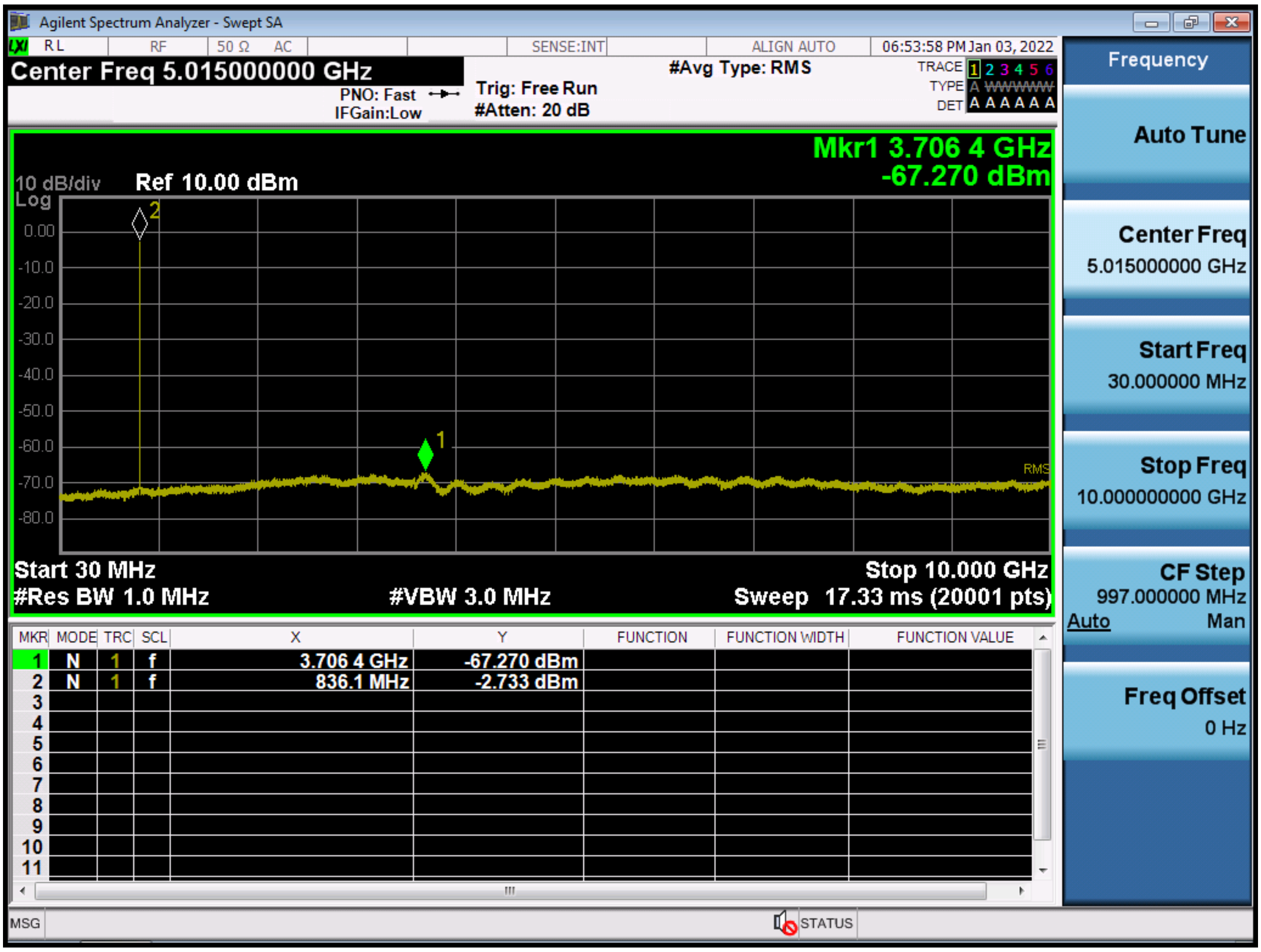
1.4 M_CSE(30 M-10 G)_Highest Channel_QPSK_1RB



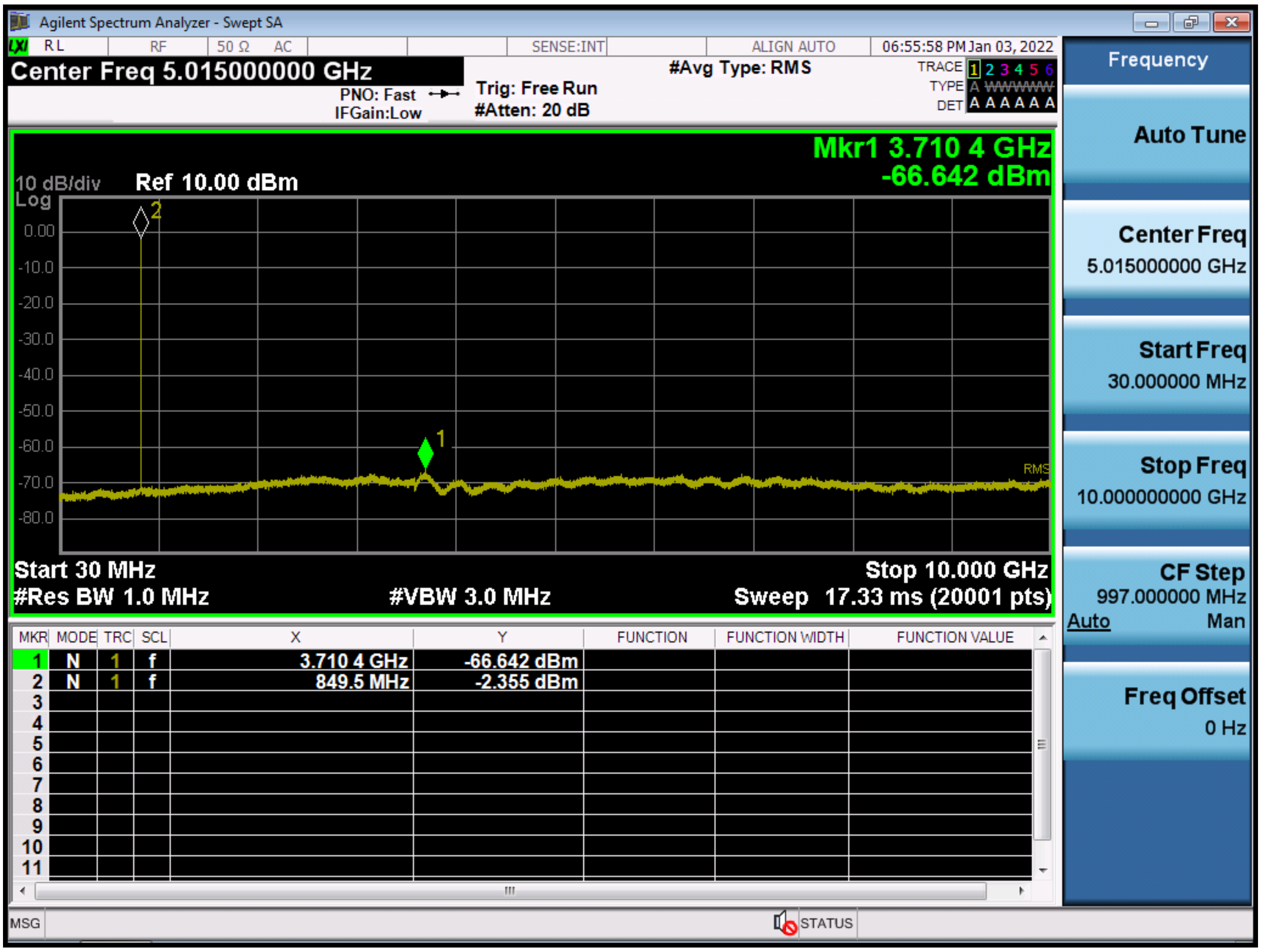
3 M_CSE(30 M-10 G)_Lowest Channel_QPSK_1RB



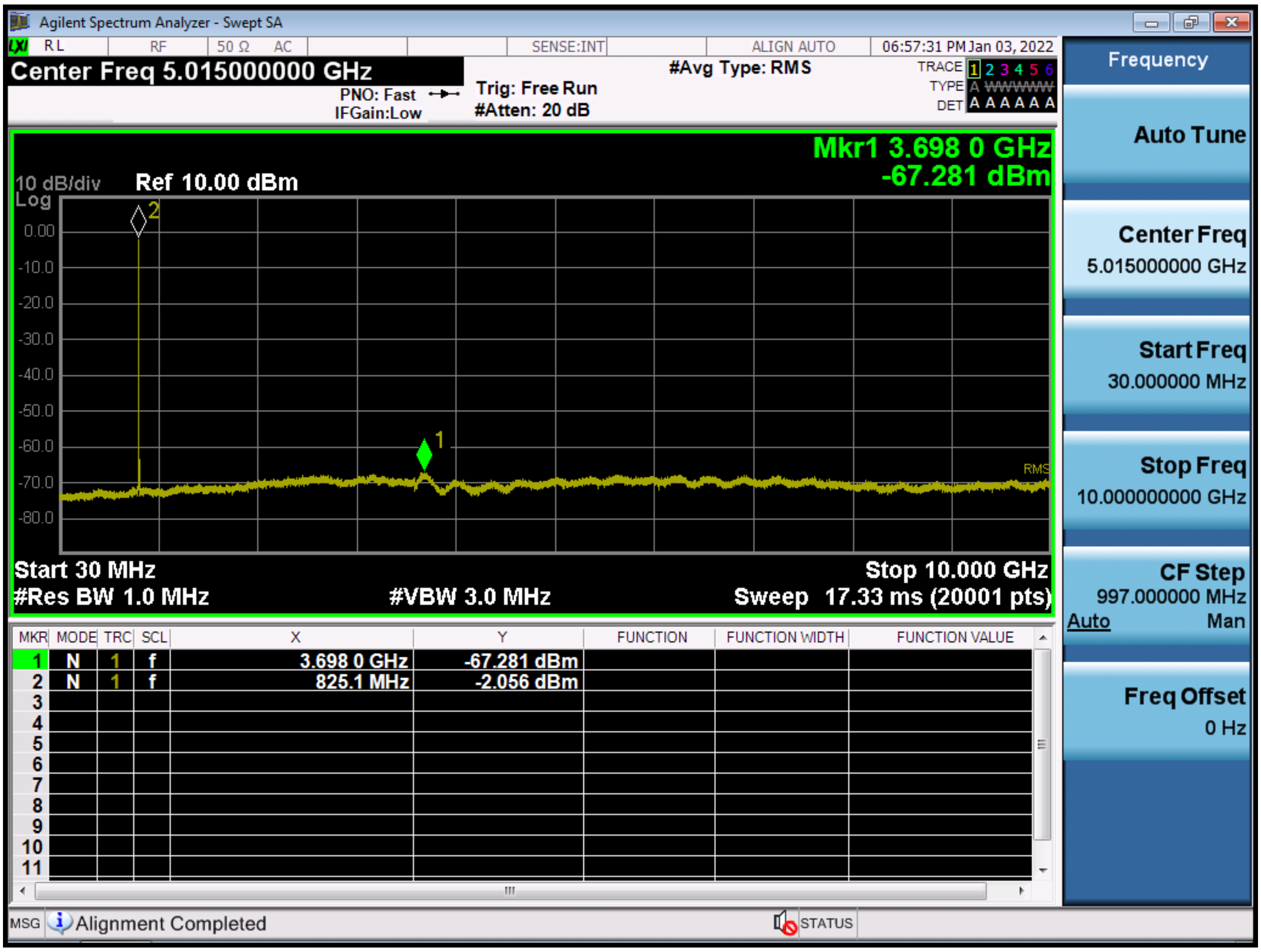
3 M_CSE(30 M-10 G)_Mid Channel_QPSK_1RB



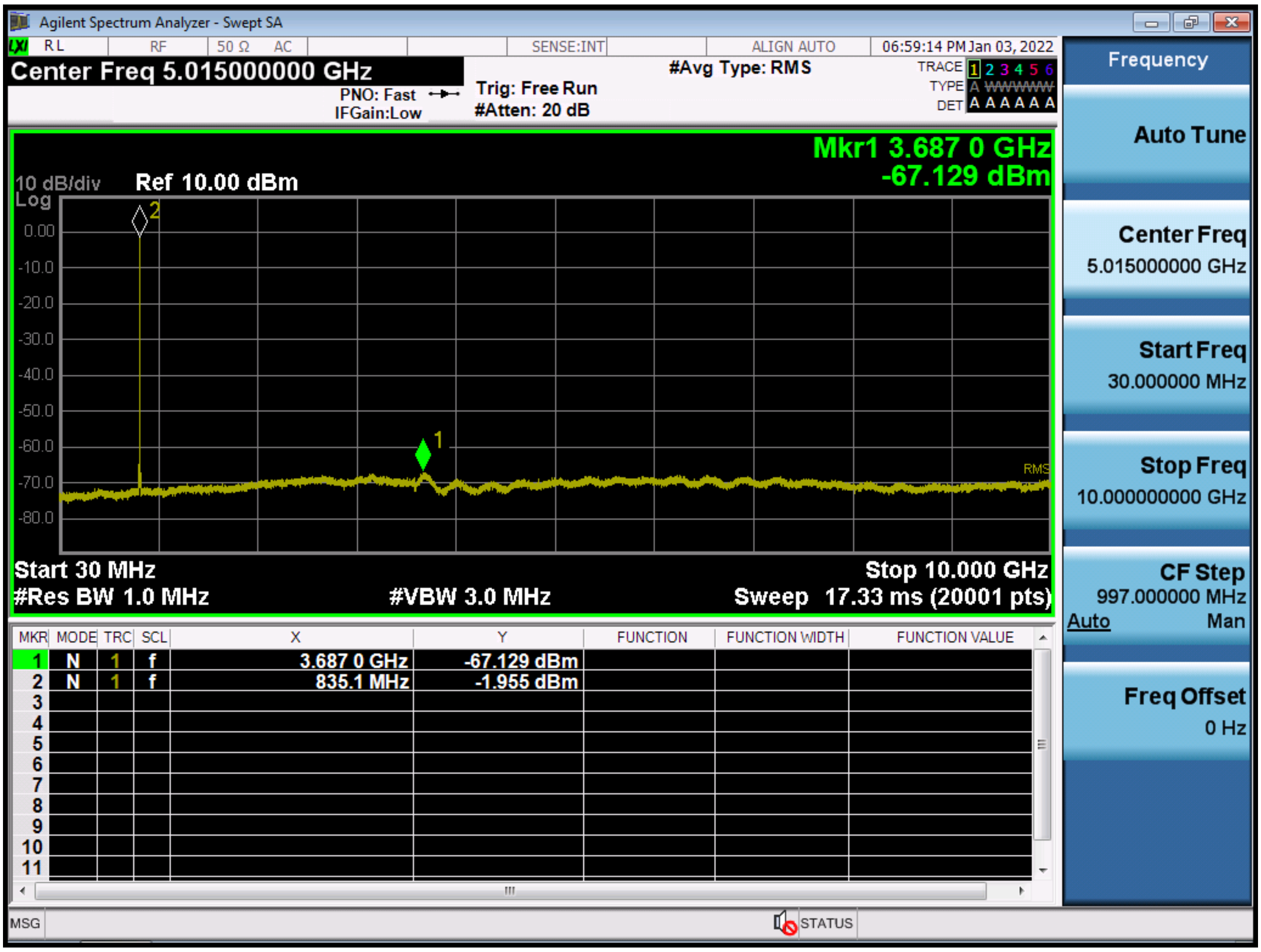
3 M_CSE(30 M-10 G)_Highest Channel_QPSK_1RB



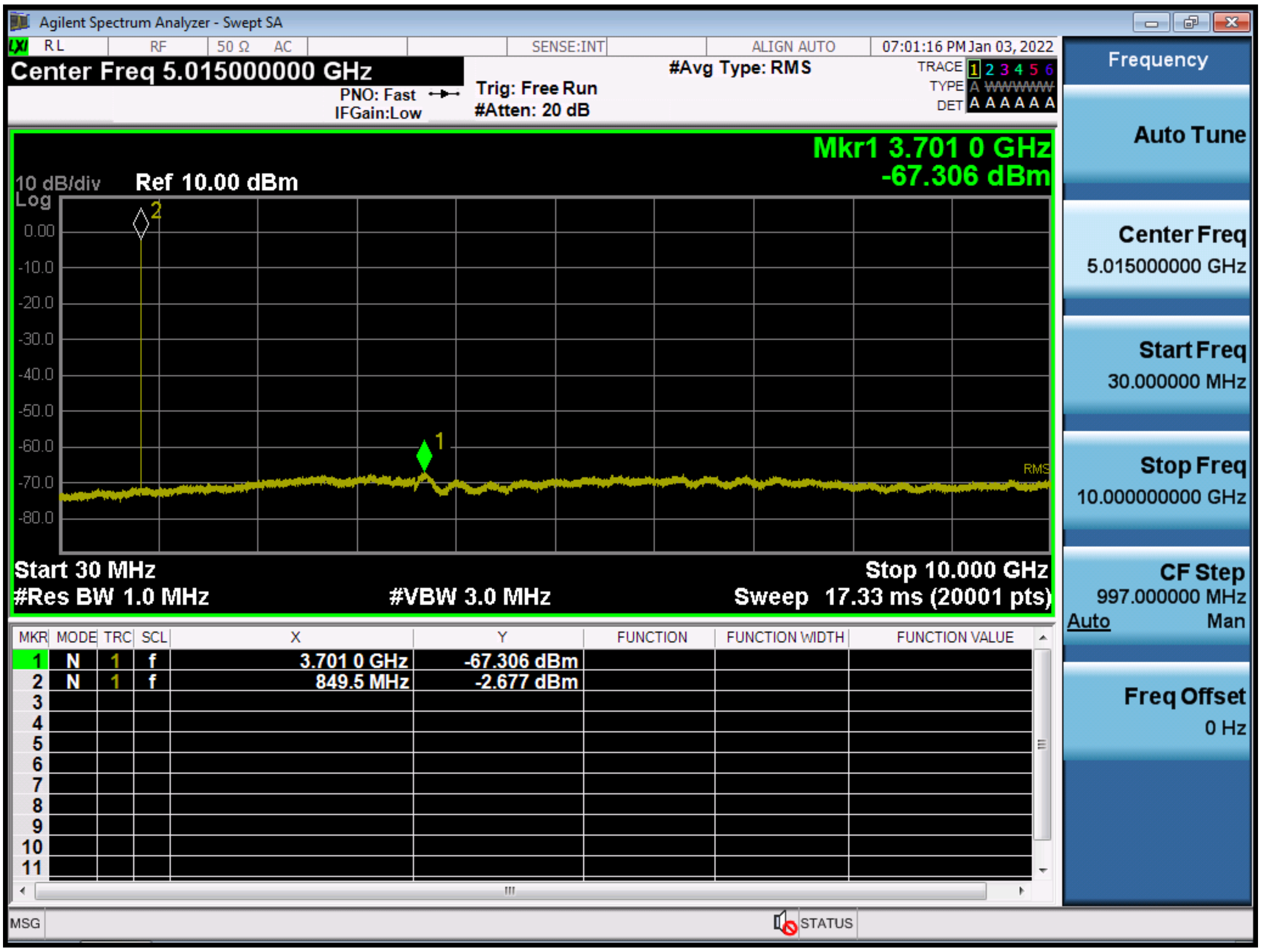
5 M_CSE(30 M-10 G)_Lowest Channel_QPSK_1RB



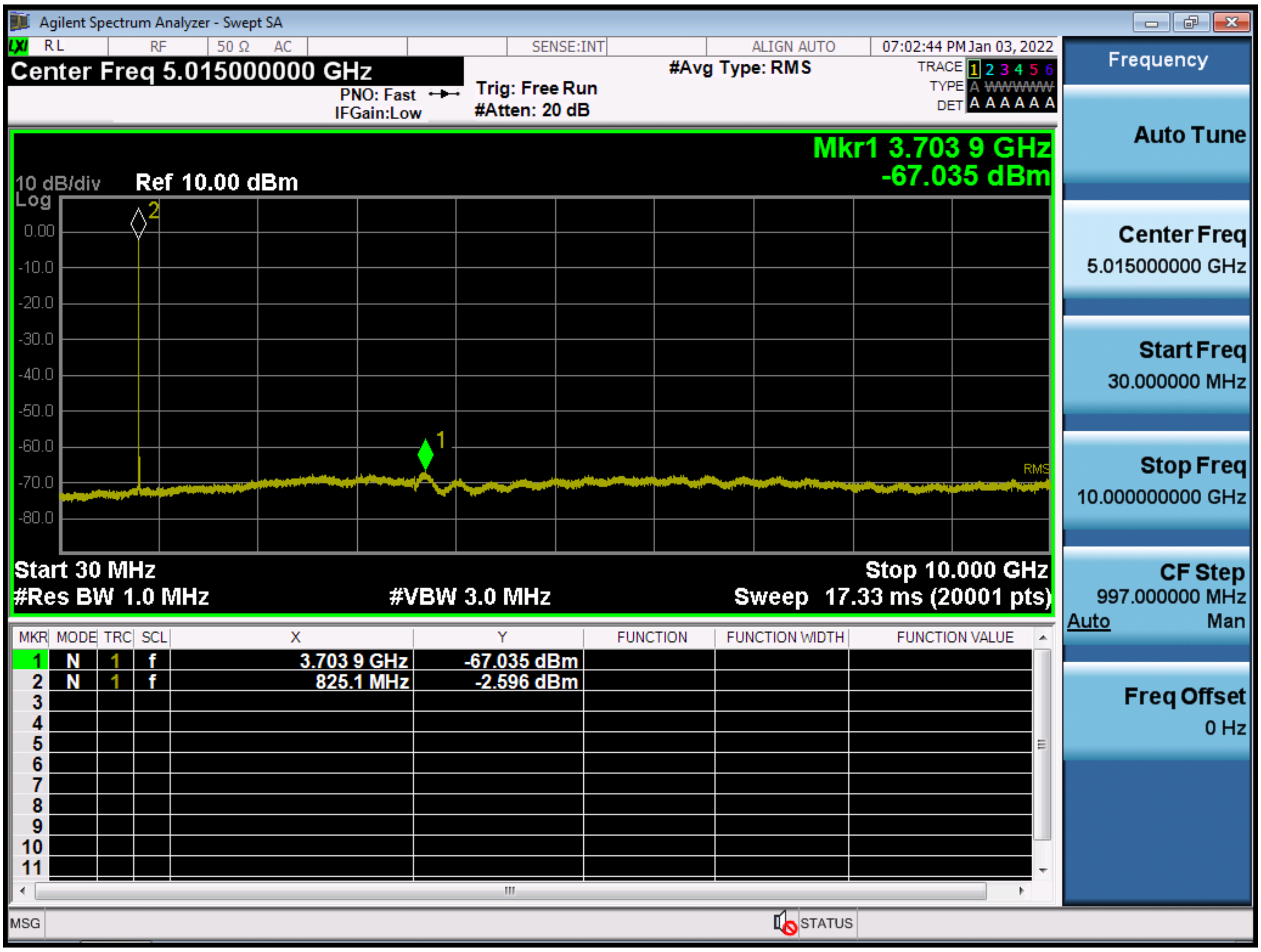
5 M_CSE(30 M-10 G)_Mid Channel_QPSK_1RB



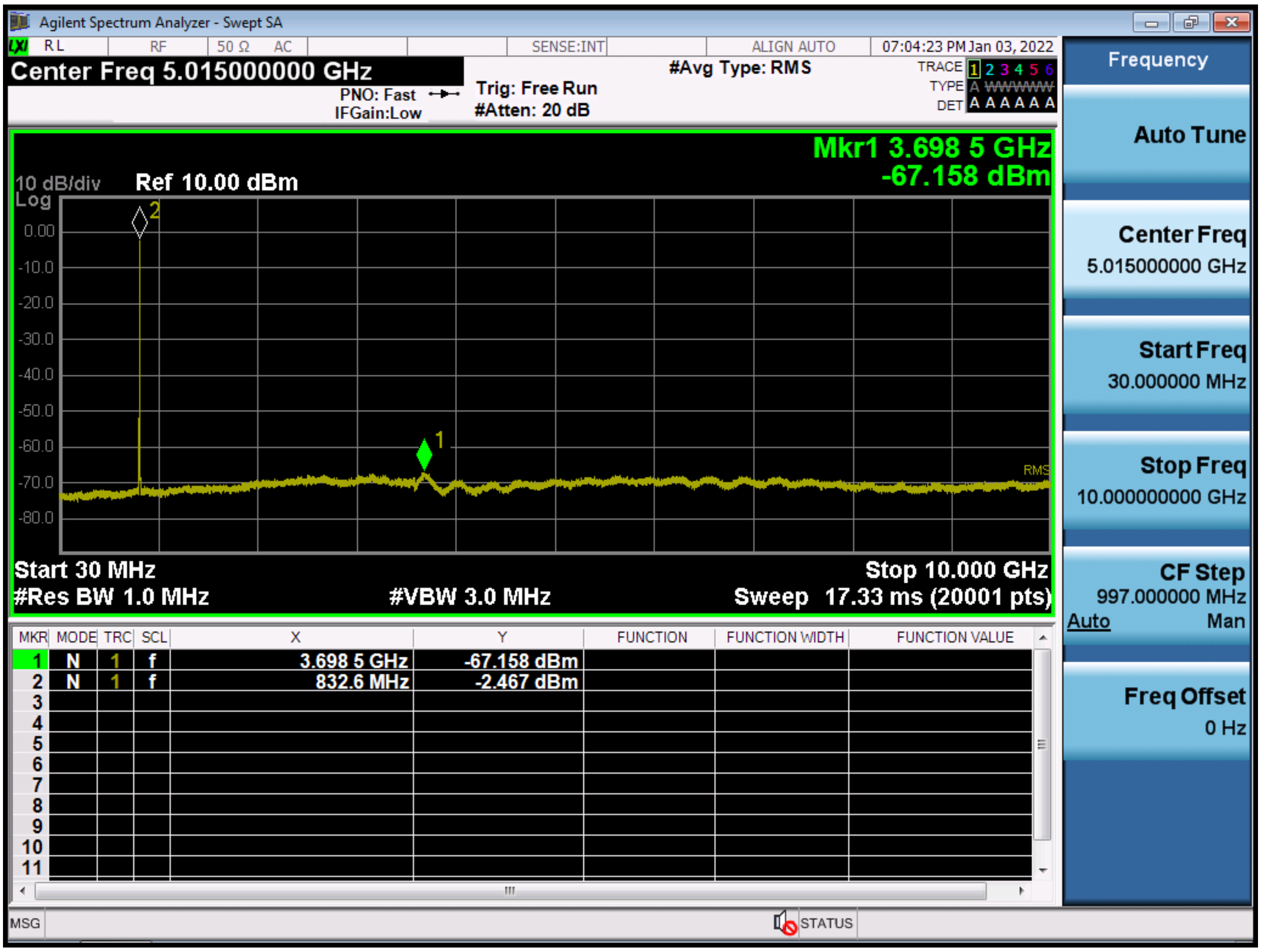
5 M_CSE(30 M-10 G)_Highest Channel_QPSK_1RB



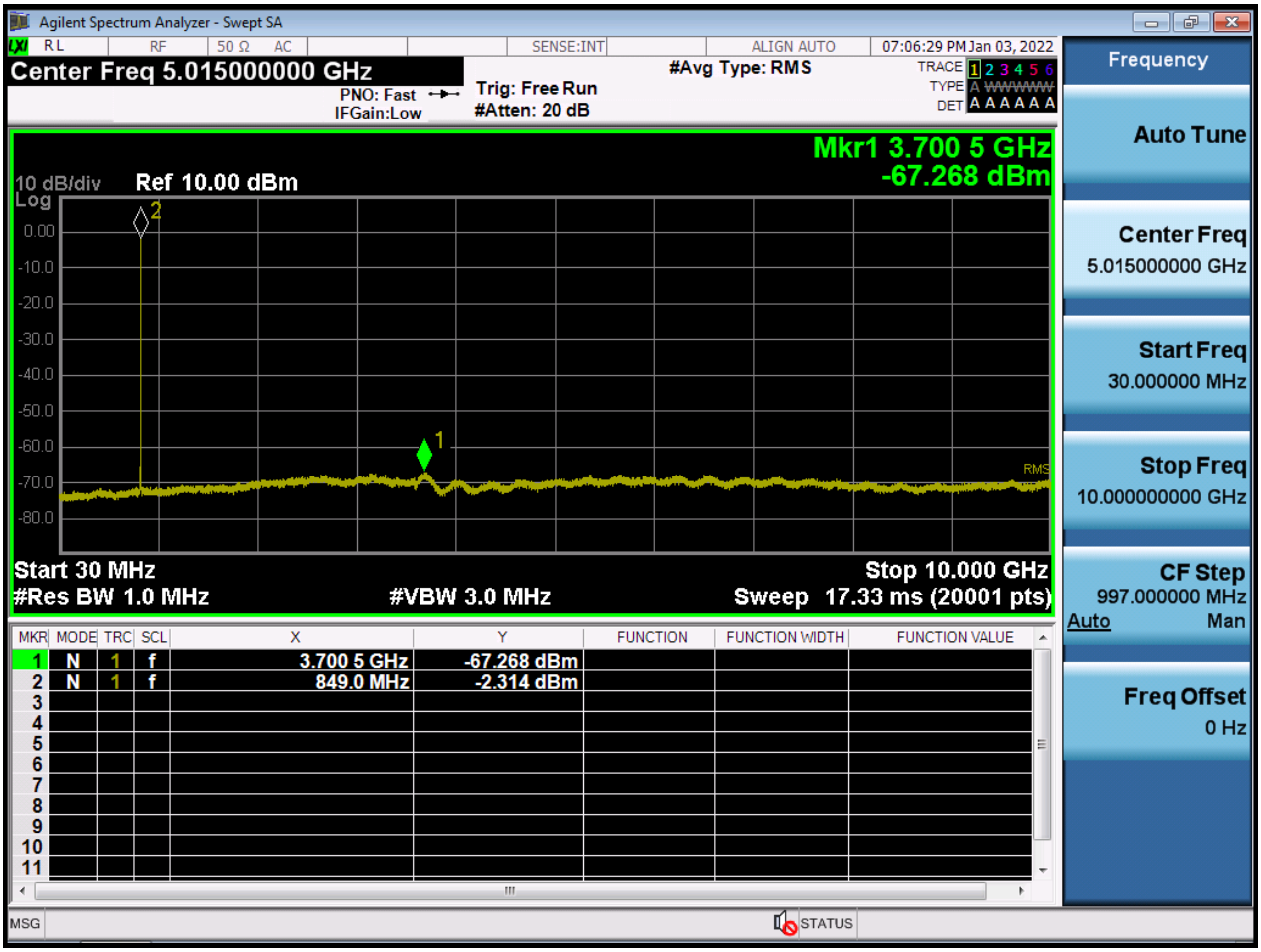
10 M_CSE(30 M-10 G)_Lowest Channel_QPSK_1RB



10 M_CSE(30 M-10 G)_Mid Channel_QPSK_1RB



10 M_CSE(30 M-10 G)_Highest Channel_QPSK_1RB



10. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2201-FC098-P