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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:
March 09, 2020

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

Report No.: HCT-RF-2002-FC021-R1

FCC ID: **A3LSMA415FN**

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

Model(s): SM-A415F/DSN
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	1M10G7D	QPSK	0.090	19.55
		1M09W7D	16QAM	0.077	18.87
		1M09W7D	64QAM	0.061	17.84
LTE – Band5 (3)	825.5 – 847.5	2M70G7D	QPSK	0.092	19.62
		2M69W7D	16QAM	0.078	18.91
		2M70W7D	64QAM	0.061	17.86
LTE – Band5 (5)	826.5 – 846.5	4M51G7D	QPSK	0.090	19.55
		4M50W7D	16QAM	0.076	18.82
		4M50W7D	64QAM	0.060	17.79
LTE – Band5 (10)	829.0 – 844.0	8M98G7D	QPSK	0.095	19.76
		8M99W7D	16QAM	0.079	18.97
		9M00W7D	64QAM	0.062	17.94

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)

Report prepared by : Jae Ryang Do
Engineer of Telecommunication Testing Center

Report approved by : Jong Seok Lee
Manager of Telecommunication Testing Center

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2002-FC021	March 03, 2020	- First Approval Report
HCT-RF-2002-FC021-R1	March 09, 2020	- Revised the Section 8.2

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

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

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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:	A3LSMA415FN
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-A415F/DSN
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:	January 16, 2020 ~ February 21, 2020

2. INTRODUCTION

2.1. DESCRIPTION OF EUT

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

It also supports IEEE 802.11 a/b/g/n/ac (HT20/40/80), 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 1MHz
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 1GHz, 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 = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
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 10th 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 1GHz, 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;

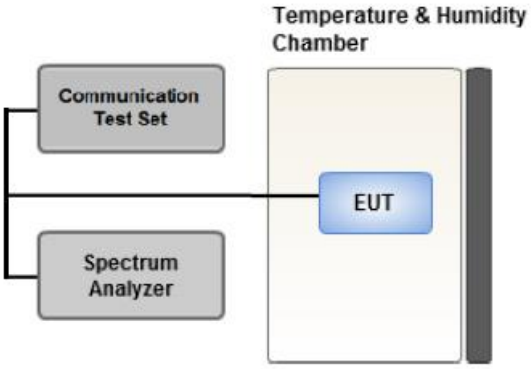
$$Result_{(dBm)} = Pg_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dBi)}$$

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

If the fundalmatal frequency is below 1GHz, 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.

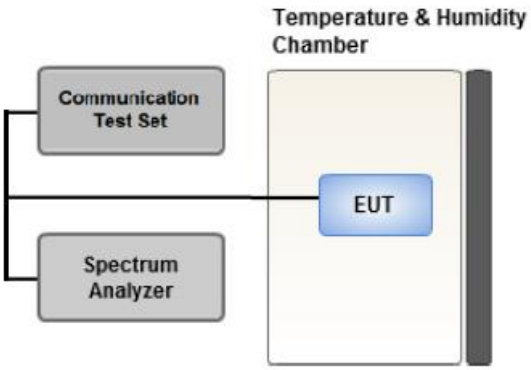
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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

3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

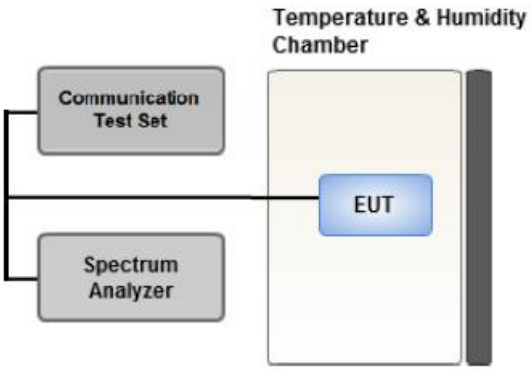
Test Overview

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

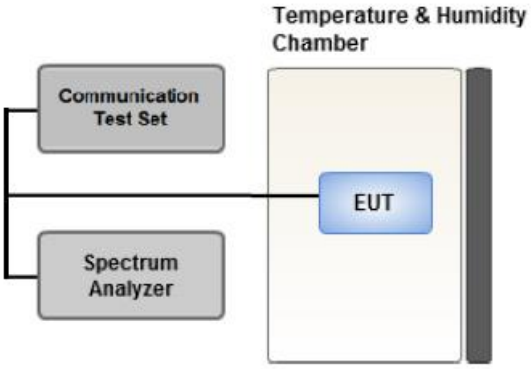
Test Notes

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.
- 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 Radiated Power	QPSK, 16QAM, 64QAM	1	0	X
Radiated Spurious and Harmonic Emissions	QPSK	1	0	X

3.9 WORST CASE(CONDUCTED TEST)

- Worst case : Of all modulation, We have tested modulation of the high Conducted Output Power.
  Conducted Output Power value can be confirmed on the SAR report.

[Worst case]

Test Description	Modulation	Bandwidth (MHz)	Frequency	RB size	RB offset
Occupied Bandwidth	QPSK, 16QAM, 64QAM	1.4, 3, 5, 10, 15	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
		15	Low	1	0
			High	1	74
		1.4, 3, 5, 10, 15	Low, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	QPSK	1.4, 3, 5, 10, 15	Low, Mid, High	1	0

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Date	Calibration Interval	Calibration Due
T&M SYSTEM	FBSR-02B(WHK1.2/15G-10EF)/H.P.F	-	06/10/2019	Annual	06/10/2020
T&M SYSTEM	FBSR-02B(WHK3.3/18G-10EF)/H.P.F	-	06/10/2019	Annual	06/10/2020
WAINWRIGHT INSTRUMENT	WHNX6.0/26.5G-6SS/H.P.F	1	03/20/2019	Annual	03/20/2020
Hewlett Packard	11667B / Power Splitter(DC~26.5 GHz)	11275	05/03/2019	Annual	05/03/2020
Agilent	E3632A/DC Power Supply	MY40004326	07/01/2019	Annual	07/01/2020
Schwarzbeck	UHAP/ Dipole Antenna	557	03/29/2019	Biennial	03/29/2021
Schwarzbeck	UHAP/ Dipole Antenna	558	03/29/2019	Biennial	03/29/2021
ESPEC	SU-642 / Chamber	93000717	08/14/2019	Annual	08/14/2020
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	147	08/29/2019	Biennial	08/29/2021
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	9120D-1298	09/25/2019	Biennial	09/25/2021
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170342	04/29/2019	Biennial	04/29/2021
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170124	01/28/2019	Biennial	01/28/2021
Agilent	N9020A/Signal Analyzer(10Hz~26.5GHz)	MY51110063	05/08/2019	Annual	05/08/2020
Hewlett Packard	8493C/ATTENUATOR(20dB)	17280	06/04/2019	Annual	06/04/2020
REOHDE & SCHWARZ	FSV40/Spectrum Analyzer(10Hz~40GHz)	100931	10/14/2019	Annual	10/14/2020
Agilent	8960 (E5515C)/ Base Station	MY48360800	08/27/2019	Annual	08/27/2020
Schwarzbeck	FMZB1513/ Loop Antenna(9kHz~30MHz)	1513-175	08/23/2018	Biennial	08/23/2020
Schwarzbeck	VULB9160/ Bilog Antenna	9160-3368	08/09/2018	Biennial	08/09/2020
Schwarzbeck	VULB9160/ Hybrid Antenna	760	03/22/2019	Biennial	03/22/2021
Anritsu Corp.	MT8821C/Wideband Radio Communication Tester	6201502997	08/09/2019	Annual	08/09/2020
Anritsu Corp.	MT8820C/Wideband Radio Communication Tester	6201026545	01/30/2019	Annual	01/22/2021
REOHDE & SCHWARZ	SMB100A/ SIGNAL GENERATOR (100kHz~40GHz)	177633	07/15/2019	Annual	07/15/2020
REOHDE & SCHWARZ	ESU40 / EMI TEST RECEIVER	100524	05/17/2019	Annual	05/17/2020
HCT CO., LTD.,	FCC LTE Mobile Conducted RF Automation Test Software	-	-	-	-

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)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05

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
2. The same samples were used for SAR and EMC

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 = 4M48G7D

LTE BW = 4.48 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

16QAM Modulation

Emission Designator = 4M48W7D

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

64QAM 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	-32.87	30.74	-10.24	1.28	H	< 7.00	0.084	19.22
		16-QAM	-33.49	30.12	-10.24	1.28	H		0.072	18.60
		64-QAM	-34.54	29.07	-10.24	1.28	H		0.057	17.55
836.5		QPSK	-33.15	31.03	-10.19	1.29	H		0.090	19.55
		16-QAM	-33.83	30.35	-10.19	1.29	H		0.077	18.87
		64-QAM	-34.86	29.32	-10.19	1.29	H		0.061	17.84
848.3		QPSK	-33.72	30.27	-10.14	1.30	H		0.076	18.83
		16-QAM	-34.39	29.60	-10.14	1.30	H		0.065	18.16
		64-QAM	-35.41	28.58	-10.14	1.30	H		0.052	17.14

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	-32.80	30.84	-10.24	1.28	H	< 7.00	0.086	19.32
		16-QAM	-33.45	30.19	-10.24	1.28	H		0.074	18.67
		64-QAM	-34.51	29.13	-10.24	1.28	H		0.058	17.61
836.5		QPSK	-33.08	31.10	-10.19	1.29	H		0.092	19.62
		16-QAM	-33.79	30.39	-10.19	1.29	H		0.078	18.91
		64-QAM	-34.84	29.34	-10.19	1.29	H		0.061	17.86
847.5		QPSK	-33.63	30.40	-10.15	1.30	H		0.079	18.95
		16-QAM	-34.39	29.64	-10.15	1.30	H		0.066	18.19
		64-QAM	-35.41	28.62	-10.15	1.30	H		0.052	17.17

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	-32.92	30.79	-10.24	1.28	H	< 7.00	0.085	19.28
		16-QAM	-33.54	30.17	-10.24	1.28	H		0.073	18.66
		64-QAM	-34.60	29.11	-10.24	1.28	H		0.057	17.60
836.5		QPSK	-33.15	31.03	-10.19	1.29	H		0.090	19.55
		16-QAM	-33.88	30.30	-10.19	1.29	H		0.076	18.82
		64-QAM	-34.91	29.27	-10.19	1.29	H		0.060	17.79
846.5		QPSK	-33.64	30.59	-10.15	1.30	H		0.082	19.14
		16-QAM	-34.47	29.76	-10.15	1.30	H		0.068	18.31
		64-QAM	-35.46	28.77	-10.15	1.30	H		0.054	17.32

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	-32.84	30.97	-10.22	1.28	H	< 7.00	0.088	19.47
		16-QAM	-33.46	30.35	-10.22	1.28	H		0.077	18.85
		64-QAM	-34.55	29.26	-10.22	1.28	H		0.060	17.76
836.5		QPSK	-32.94	31.24	-10.19	1.29	H		0.095	19.76
		16-QAM	-33.73	30.45	-10.19	1.29	H		0.079	18.97
		64-QAM	-34.76	29.42	-10.19	1.29	H		0.062	17.94
844.0		QPSK	-33.27	30.87	-10.16	1.30	H		0.087	19.41
		16-QAM	-33.90	30.24	-10.16	1.30	H		0.076	18.78
		64-QAM	-34.99	29.15	-10.16	1.30	H		0.059	17.69

8.2 RADIATED SPURIOUS EMISSIONS

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 1.4 MHz QPSK

▣ DISTANCE: 3 meters

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit
20407 (824.7)	1,649.40	-46.66	9.50	-57.42	1.84	H	-49.76	-13.00
	2,474.10	-55.27	10.60	-60.20	2.29	H	-51.89	-13.00
	3,298.80	-57.59	12.30	-59.53	2.69	H	-49.92	-13.00
20525 (836.5)	1,673.00	-41.48	9.65	-52.24	1.86	H	-44.45	-13.00
	2,509.50	-55.62	10.75	-60.73	2.32	H	-52.30	-13.00
	3,346.00	-57.01	12.48	-58.66	2.70	V	-48.89	-13.00
20643 (848.3)	1,696.60	-41.63	9.77	-52.06	1.87	V	-44.17	-13.00
	2,544.90	-55.42	10.88	-59.53	2.32	V	-50.97	-13.00
	3,393.20	-58.45	12.65	-60.40	2.71	H	-50.46	-13.00

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 3 MHz QPSK

▣ DISTANCE: 3 meters

Ch	Freq (MHz)	Measured Level (dBi)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit
20415 (825.5)	1,651.00	-45.24	9.50	-56.00	1.84	H	-48.34	-13.00
	2,476.50	-54.32	10.60	-59.25	2.29	V	-50.94	-13.00
	3,302.00	-57.56	12.30	-59.50	2.69	V	-49.89	-13.00
20525 (836.5)	1,673.00	-40.27	9.65	-51.03	1.86	H	-43.24	-13.00
	2,509.50	-55.04	10.75	-60.15	2.32	V	-51.72	-13.00
	3,346.00	-58.74	12.48	-60.39	2.70	H	-50.62	-13.00
20635 (847.5)	1,695.00	-38.84	9.77	-49.28	1.87	H	-41.38	-13.00
	2,542.50	-55.62	10.85	-59.48	2.32	V	-50.95	-13.00
	3,390.00	-57.78	12.65	-59.73	2.71	H	-49.79	-13.00

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit
20425 (826.5)	1,653.00	-45.33	9.54	-56.13	1.85	H	-48.44	-13.00
	2,479.50	-56.50	10.60	-61.31	2.30	V	-53.01	-13.00
	3,306.00	-59.00	12.33	-60.99	2.69	H	-51.35	-13.00
20525 (836.5)	1,673.00	-40.61	9.65	-51.37	1.86	H	-43.58	-13.00
	2,509.50	-53.62	10.75	-58.73	2.32	V	-50.30	-13.00
	3,346.00	-58.12	12.48	-59.77	2.70	V	-50.00	-13.00
20625 (846.5)	1,693.00	-37.10	9.73	-47.72	1.87	H	-39.86	-13.00
	2,539.50	-55.69	10.85	-59.55	2.32	V	-51.02	-13.00
	3,386.00	-58.34	12.63	-60.34	2.72	V	-50.43	-13.00

▣ 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	-43.68	9.58	-54.52	1.85	H	-46.79	-13.00
	2,487.00	-55.77	10.65	-60.91	2.30	H	-52.56	-13.00
	3,316.00	-58.56	12.38	-60.41	2.68	V	-50.71	-13.00
20525 (836.5)	1,673.00	-40.47	9.65	-51.23	1.86	H	-43.44	-13.00
	2,509.50	-54.87	10.75	-59.98	2.32	V	-51.55	-13.00
	3,346.00	-58.23	12.48	-59.88	2.70	H	-50.11	-13.00
20600 (844.0)	1,688.00	-39.03	9.73	-49.65	1.87	H	-41.79	-13.00
	2,532.00	-56.70	10.80	-61.44	2.33	H	-52.97	-13.00
	3,376.00	-58.39	12.60	-60.40	2.72	H	-50.52	-13.00

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	1.0947
			16-QAM			1.0914
			64-QAM			1.0932
	3 MHz		QPSK	15		2.7026
			16-QAM			2.6866
			64-QAM			2.7012
	5 MHz		QPSK	25		4.5093
			16-QAM			4.4961
			64-QAM			4.4992
	10 MHz		QPSK	50		8.9756
			16-QAM			8.9893
			64-QAM			9.0015

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 33 ~ 44.

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	3.6785	27.976	-67.368	-39.392	-13.00
		836.5	3.6720	27.976	-67.372	-39.396	
		848.3	3.7199	27.976	-67.355	-39.379	
	3	825.5	3.7015	27.976	-67.434	-39.458	
		836.5	3.6785	27.976	-67.101	-39.125	
		847.5	3.7099	27.976	-66.991	-39.015	
	5	826.5	3.7094	27.976	-67.359	-39.383	
		836.5	3.6875	27.976	-67.257	-39.281	
		846.5	3.1790	27.976	-67.236	-39.260	
	10	829.0	3.6960	27.976	-67.197	-39.221	
		836.5	3.7094	27.976	-66.937	-38.961	
		844.0	3.6965	27.976	-67.179	-39.203	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 69 ~ 80.
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	30.131

8.5 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 45 ~ 68.

8.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: LTE B5

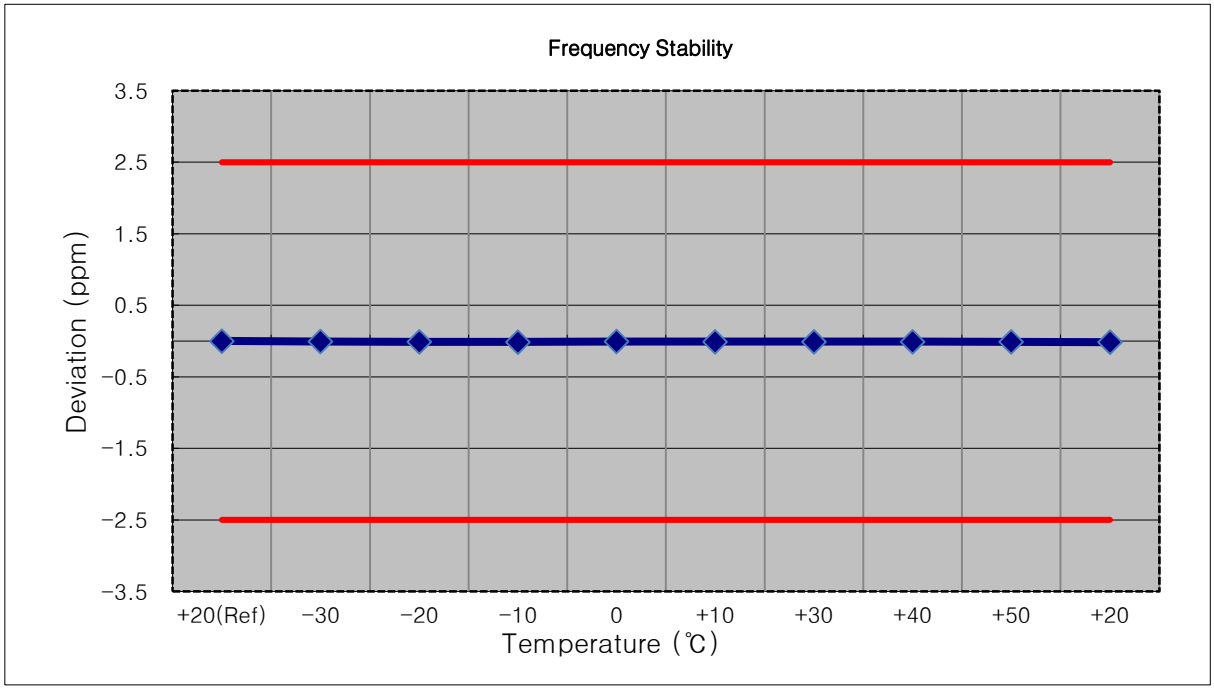
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.850 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 994	0.0	0.000 000	0.000
100%		-30	836 499 990	-4.6	-0.000 001	-0.005
100%		-20	836 499 984	-10.0	-0.000 001	-0.012
100%		-10	836 499 983	-11.7	-0.000 001	-0.014
100%		0	836 499 989	-5.4	-0.000 001	-0.006
100%		+10	836 499 987	-7.9	-0.000 001	-0.009
100%		+30	836 499 987	-7.2	-0.000 001	-0.009
100%		+40	836 499 987	-7.4	-0.000 001	-0.009
100%		+50	836 499 986	-8.4	-0.000 001	-0.010
Batt. Endpoint	3.400	+20	836 499 982	-12.9	-0.000 002	-0.015



▣ MODE: LTE B5

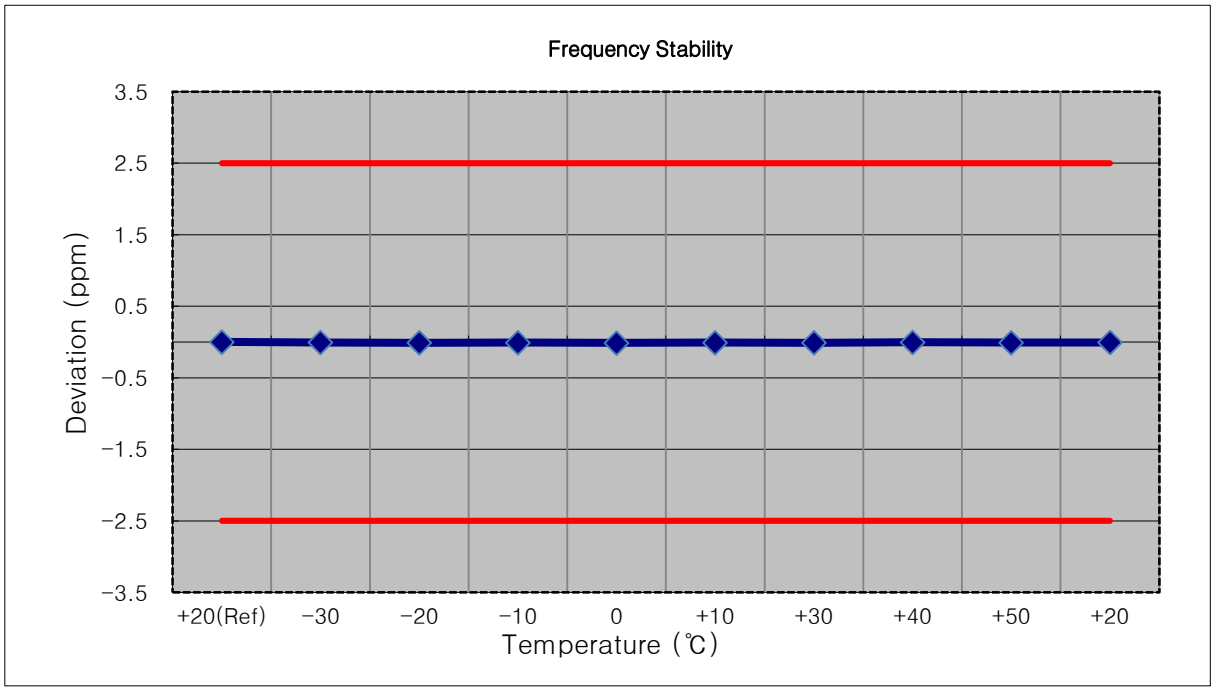
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (3 MHz)

▣ REFERENCE VOLTAGE: 3.850 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 992	0.0	0.000 000	0.000
100%		-30	836 499 987	-5.2	-0.000 001	-0.006
100%		-20	836 499 983	-8.9	-0.000 001	-0.011
100%		-10	836 499 985	-6.3	-0.000 001	-0.008
100%		0	836 499 981	-11.2	-0.000 001	-0.013
100%		+10	836 499 984	-7.5	-0.000 001	-0.009
100%		+30	836 499 983	-8.3	-0.000 001	-0.010
100%		+40	836 499 988	-3.5	0.000 000	-0.004
100%		+50	836 499 984	-7.9	-0.000 001	-0.009
Batt. Endpoint	3.400	+20	836 499 986	-6.2	-0.000 001	-0.007



▣ MODE: LTE B5

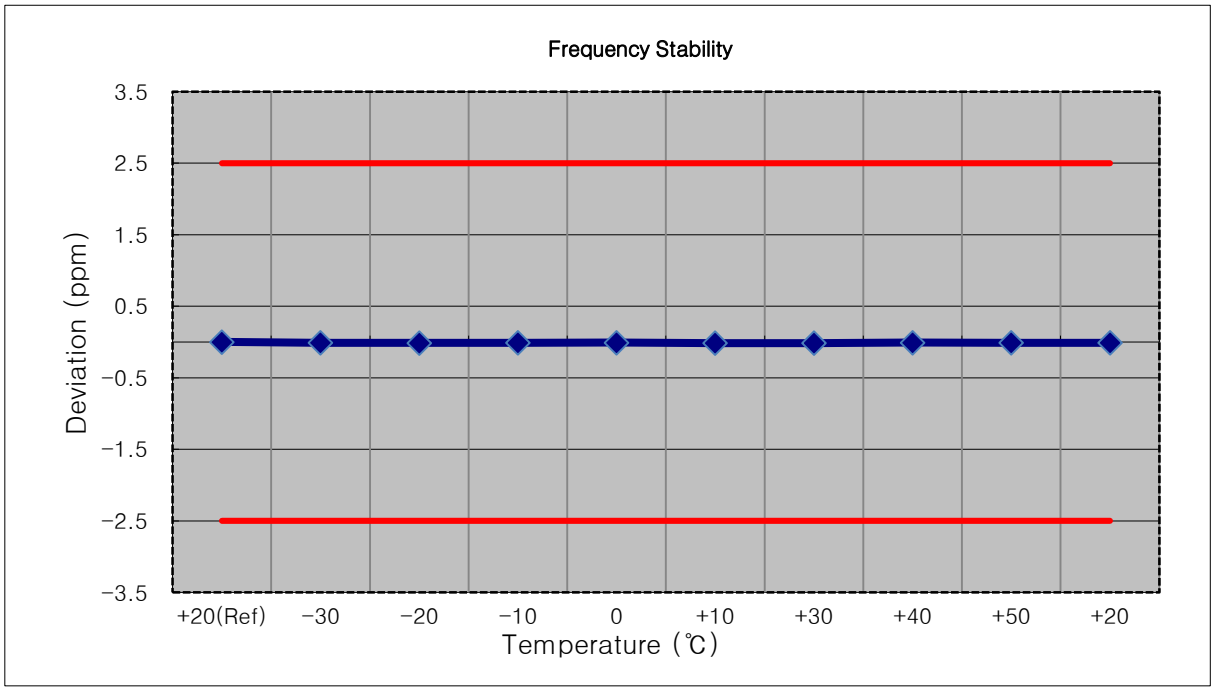
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (5 MHz)

▣ REFERENCE VOLTAGE: 3.850 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 992	0.0	0.000 000	0.000
100%		-30	836 499 983	-8.7	-0.000 001	-0.010
100%		-20	836 499 981	-11.0	-0.000 001	-0.013
100%		-10	836 499 982	-9.4	-0.000 001	-0.011
100%		0	836 499 985	-7.0	-0.000 001	-0.008
100%		+10	836 499 979	-12.3	-0.000 001	-0.015
100%		+30	836 499 978	-13.1	-0.000 002	-0.016
100%		+40	836 499 984	-7.8	-0.000 001	-0.009
100%		+50	836 499 982	-9.8	-0.000 001	-0.012
Batt. Endpoint	3.400	+20	836 499 982	-9.7	-0.000 001	-0.012



▣ MODE: LTE B5

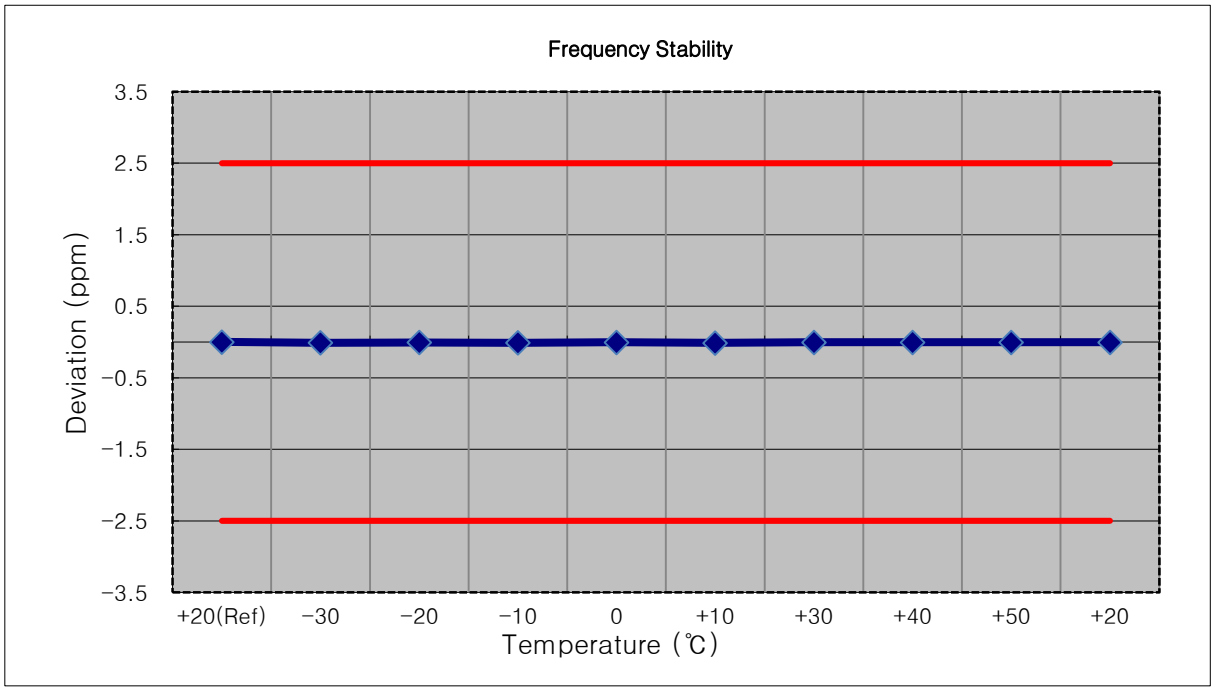
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (10 MHz)

▣ REFERENCE VOLTAGE: 3.850 VDC

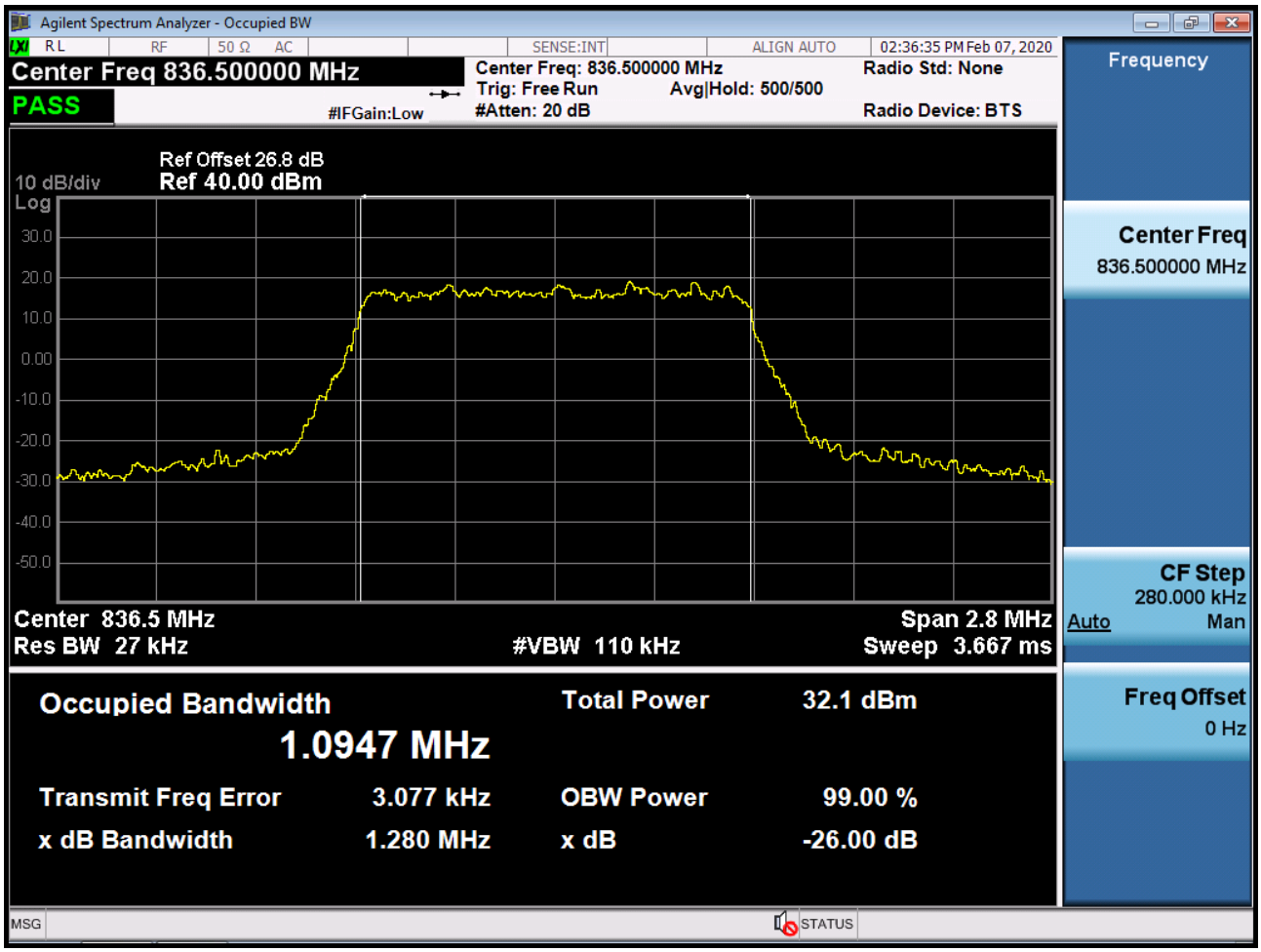
▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 991	0.0	0.000 000	0.000
100%		-30	836 499 983	-8.5	-0.000 001	-0.010
100%		-20	836 499 986	-4.8	-0.000 001	-0.006
100%		-10	836 499 982	-9.1	-0.000 001	-0.011
100%		0	836 499 987	-3.8	0.000 000	-0.005
100%		+10	836 499 980	-10.9	-0.000 001	-0.013
100%		+30	836 499 988	-3.1	0.000 000	-0.004
100%		+40	836 499 988	-2.7	0.000 000	-0.003
100%		+50	836 499 987	-4.0	0.000 000	-0.005
Batt. Endpoint	3.400	+20	836 499 987	-3.8	0.000 000	-0.005

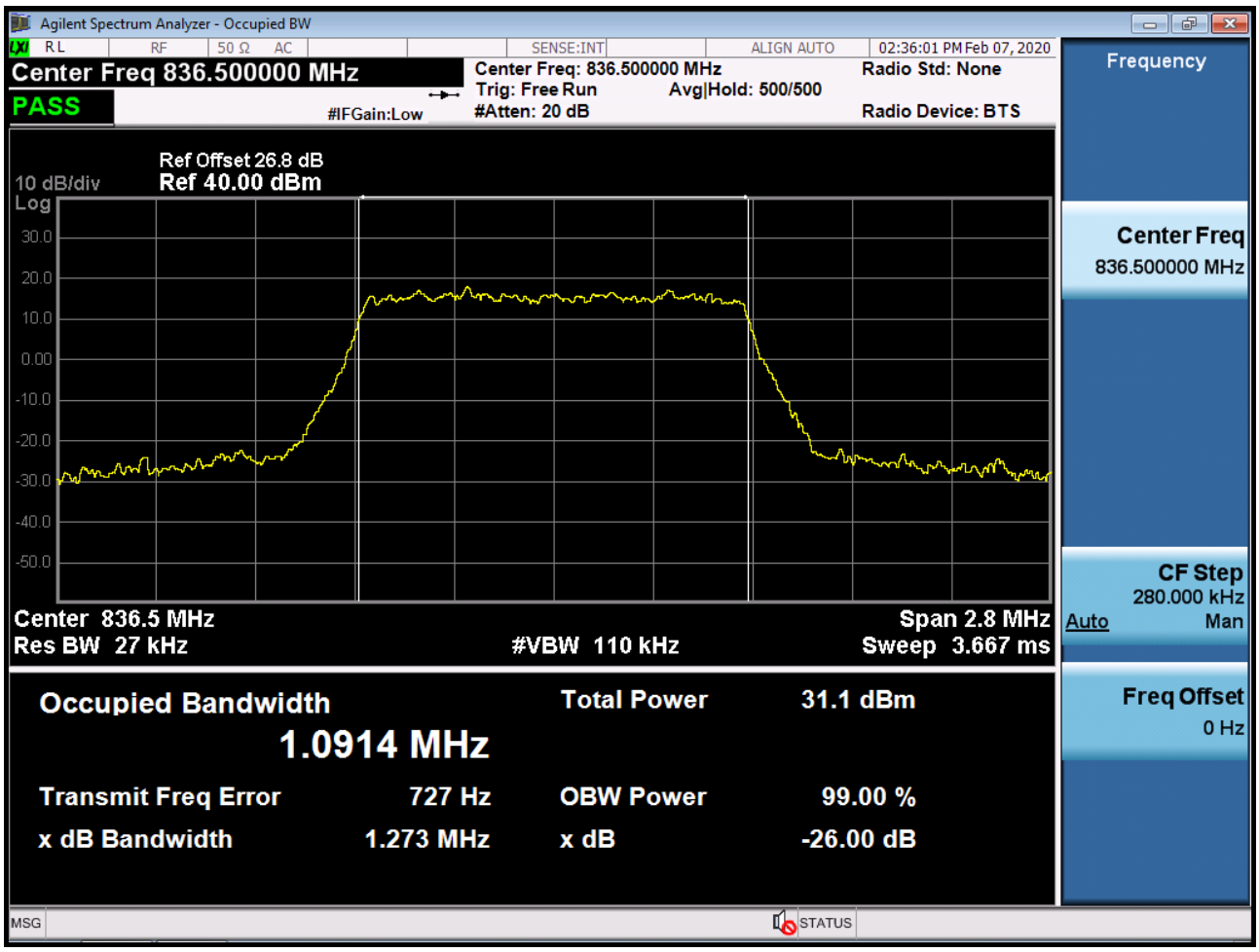


9. TEST PLOTS

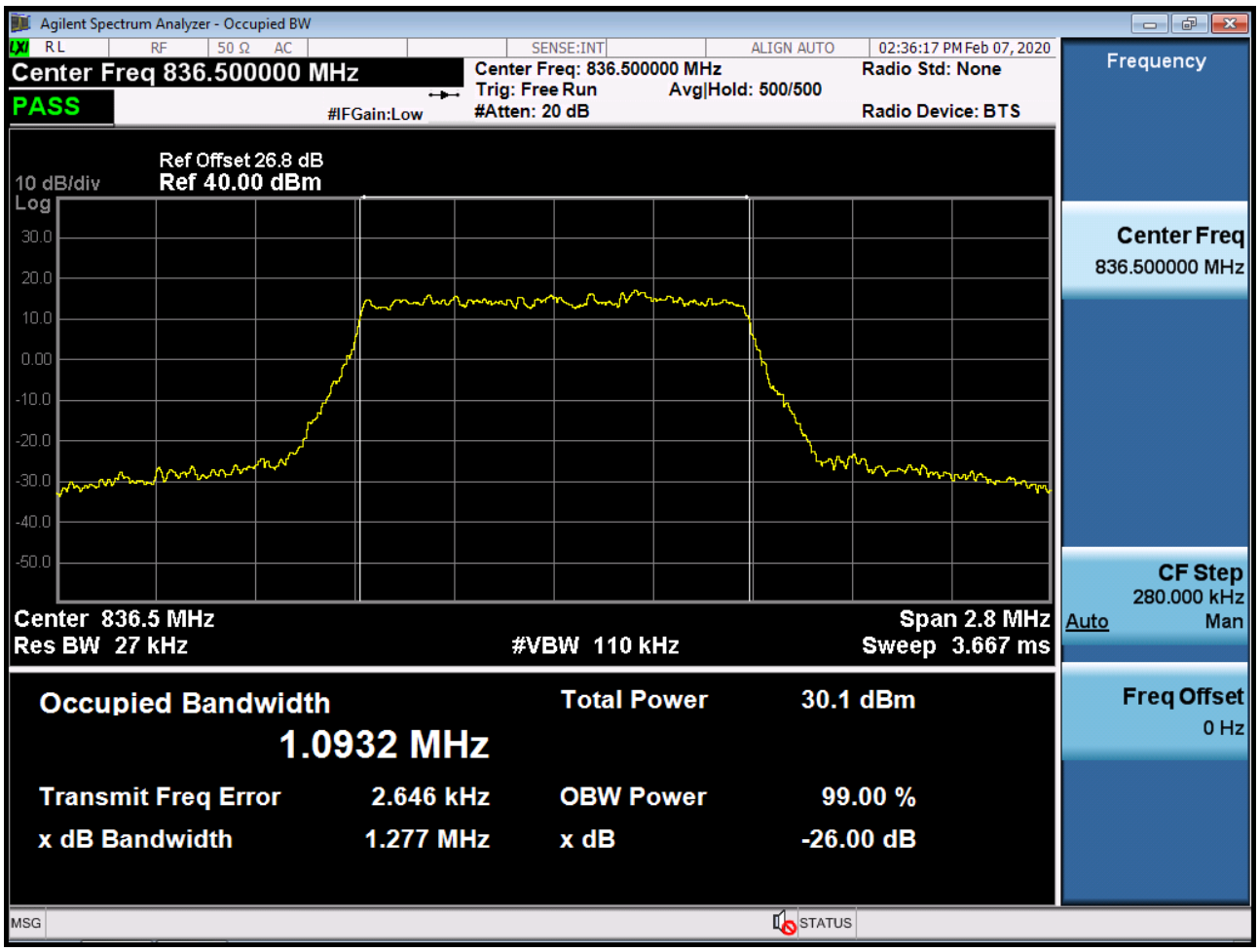
BAND 5. Occupied Bandwidth Plot (1.4M BW Ch.20525 QPSK_RB6_0)



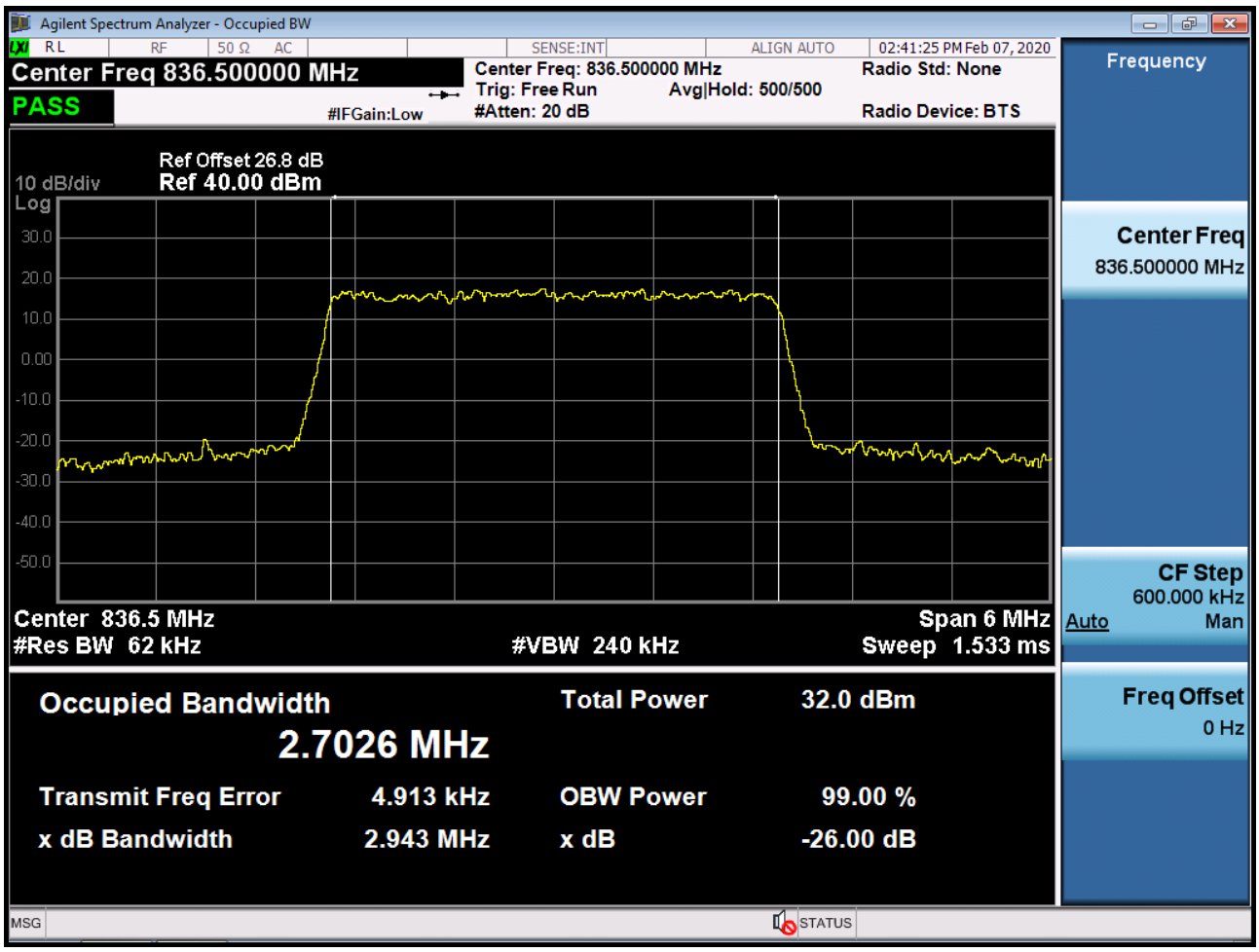
BAND 5. Occupied Bandwidth Plot (1.4M BW Ch.20525 16QAM_RB6_0)



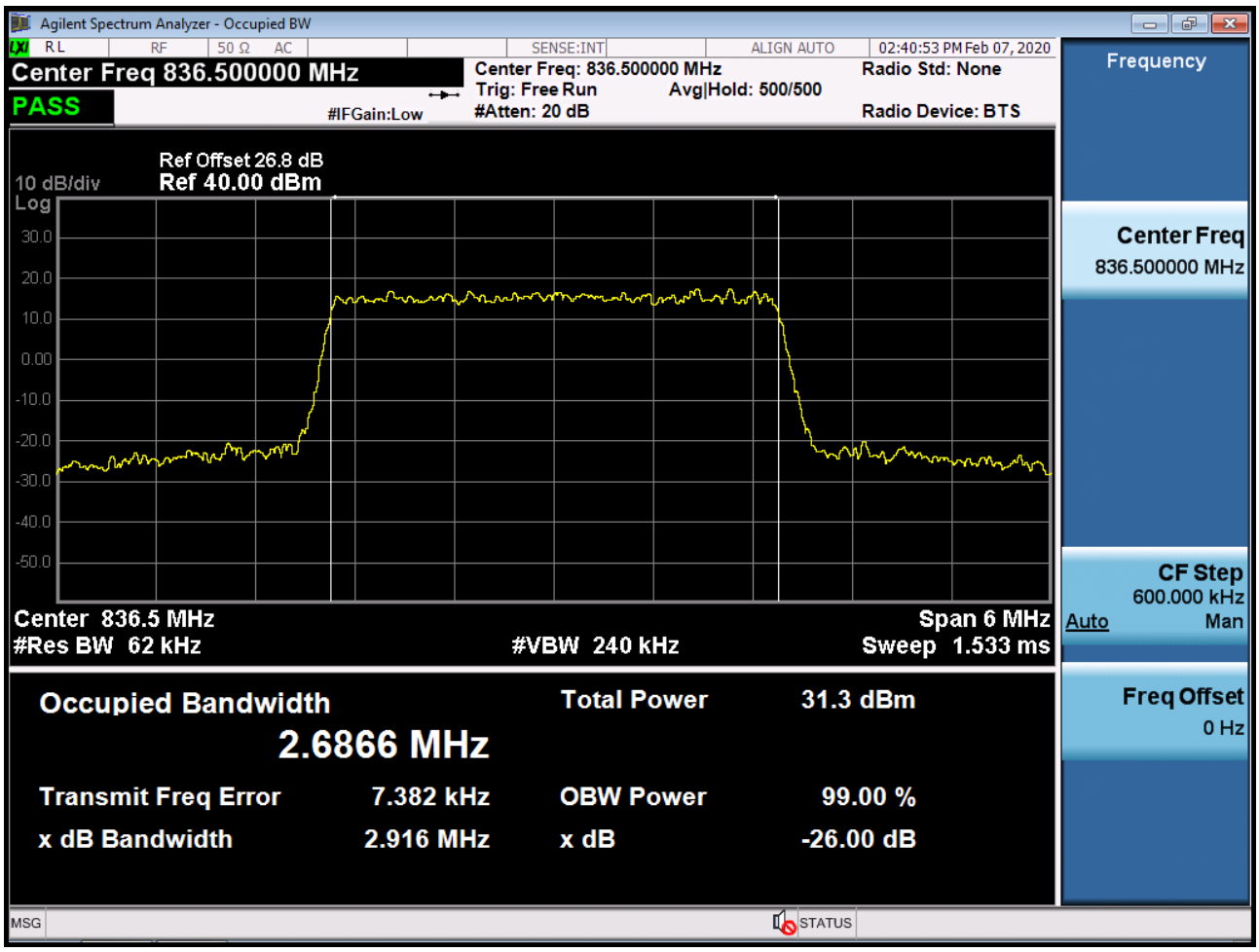
BAND 5. Occupied Bandwidth Plot (1.4M BW Ch.20525 64QAM_RB6_0)



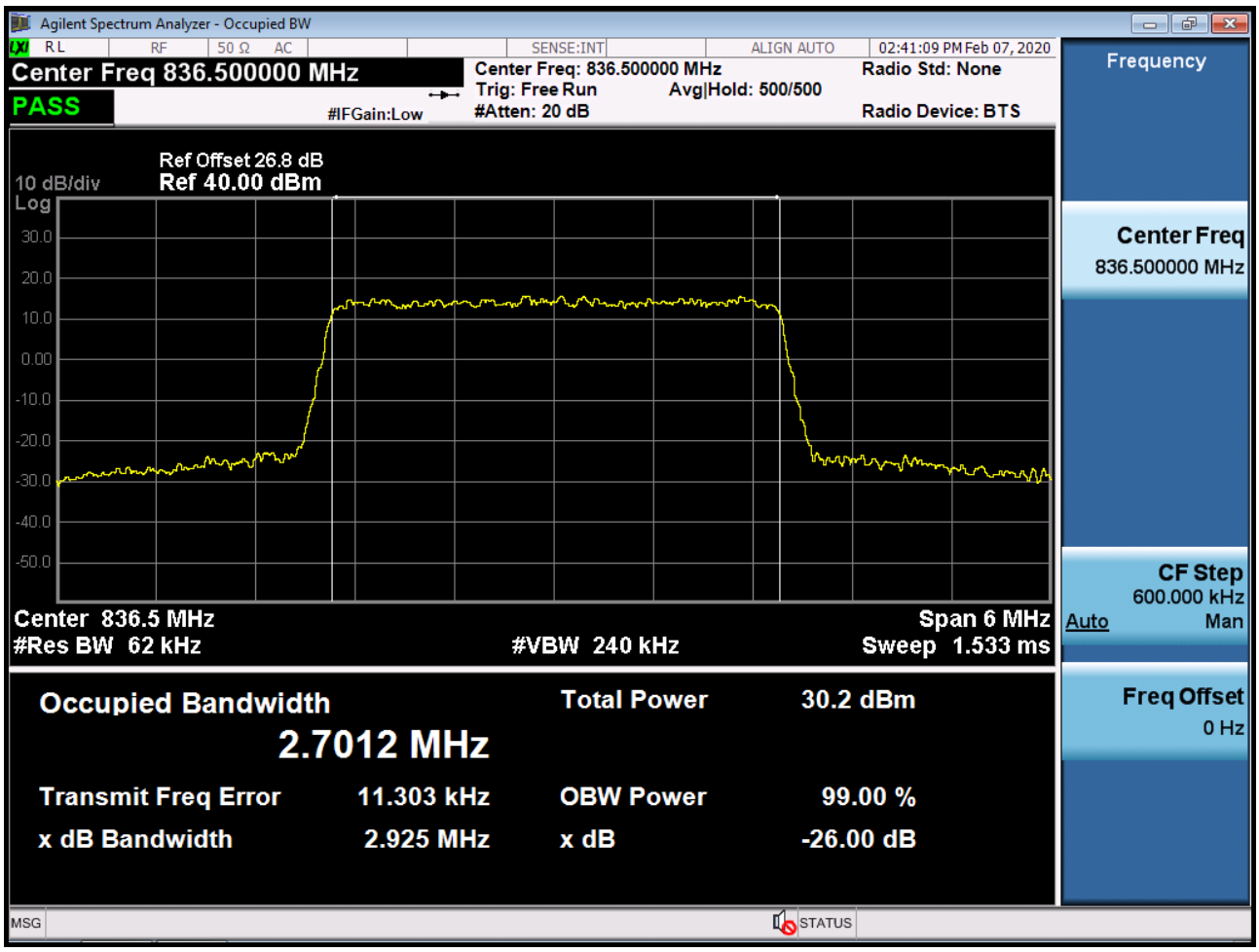
BAND 5. Occupied Bandwidth Plot (3M BW Ch.20525 QPSK_RB15_0)



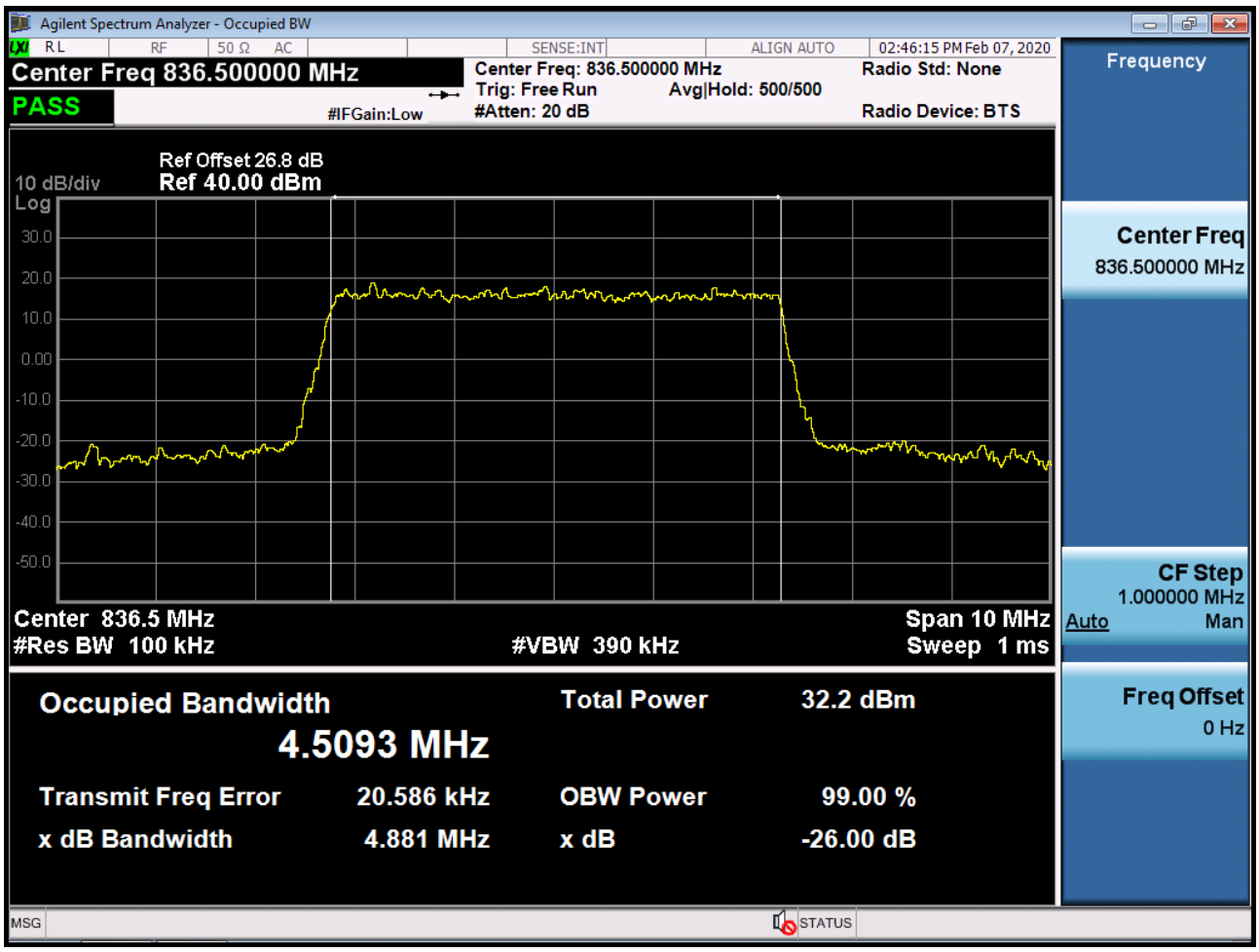
BAND 5. Occupied Bandwidth Plot (3M BW Ch.20525 16QAM_RB15_0)



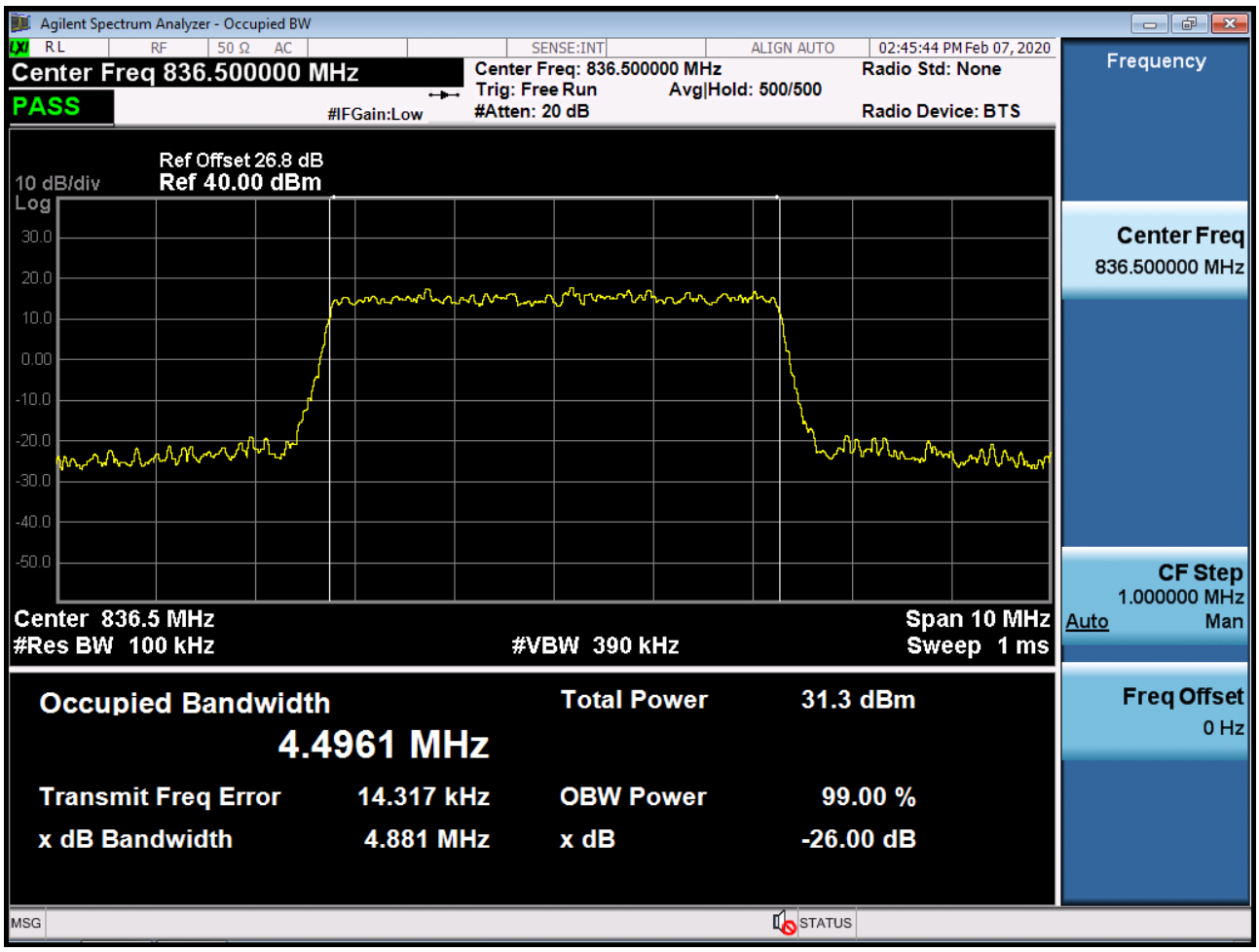
BAND 5. Occupied Bandwidth Plot (3M BW Ch.20525 64QAM_RB15_0)



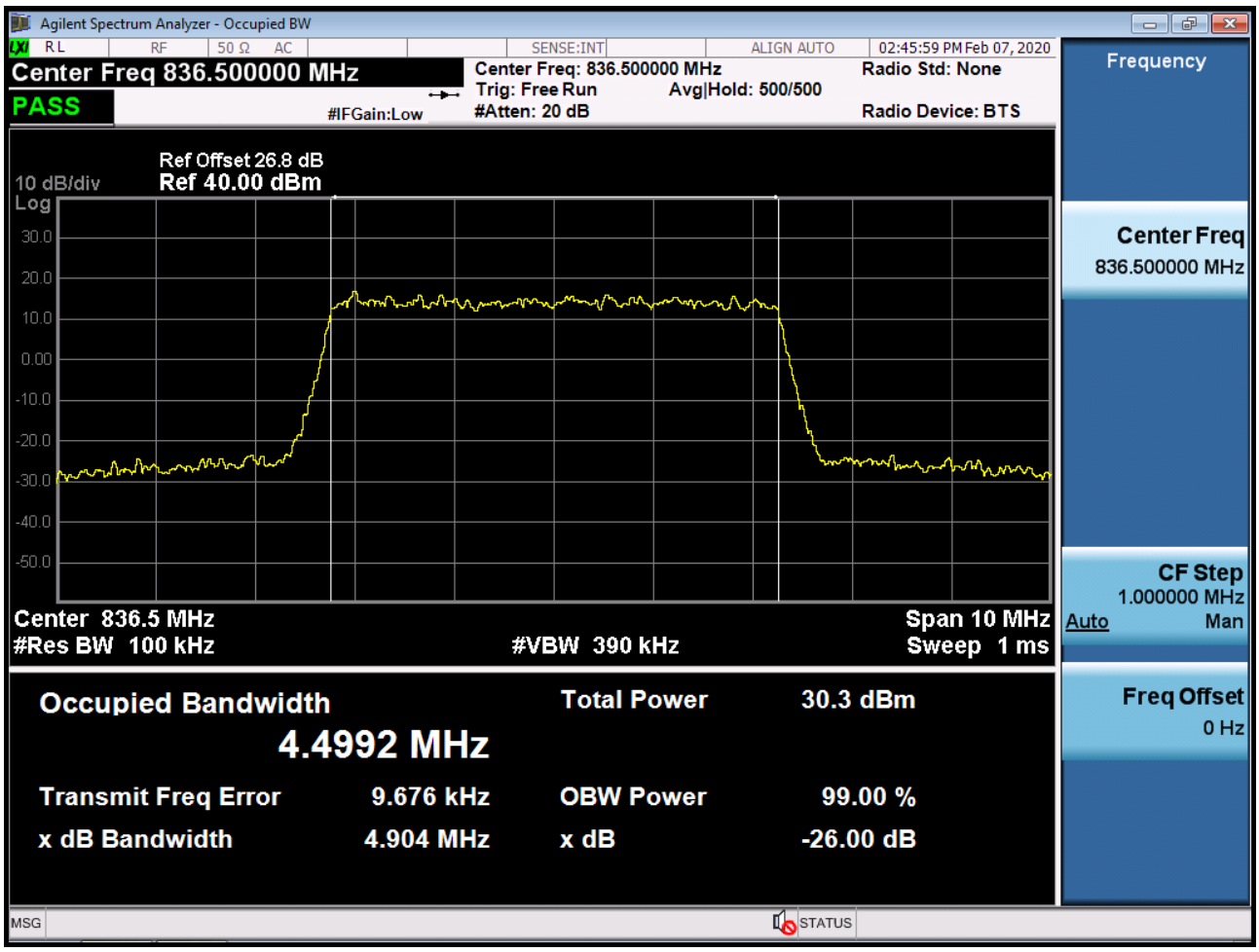
BAND 5. Occupied Bandwidth Plot (5M BW Ch.20525 QPSK_RB25_0)



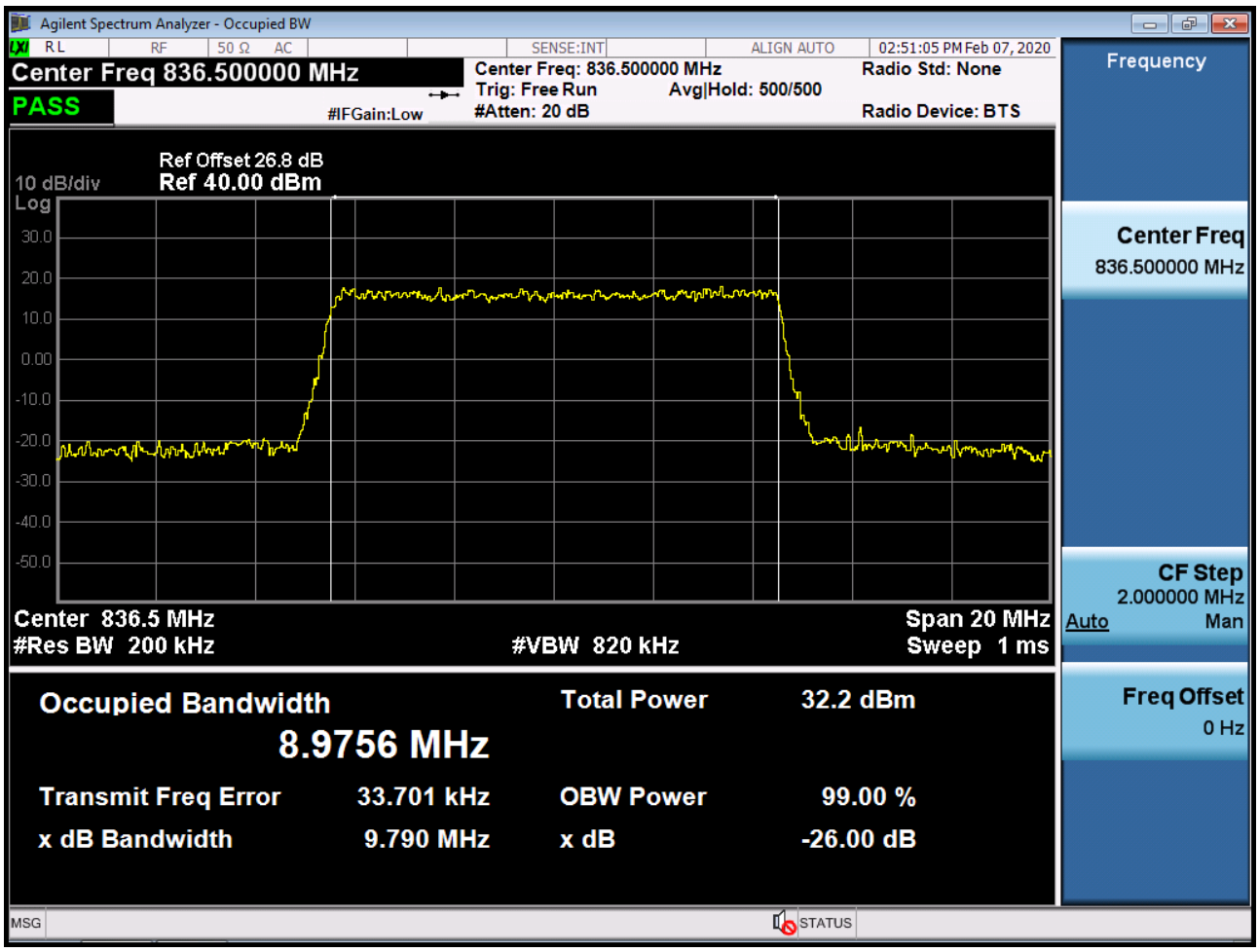
BAND 5. Occupied Bandwidth Plot (5M BW Ch.20525 16QAM_RB25_0)



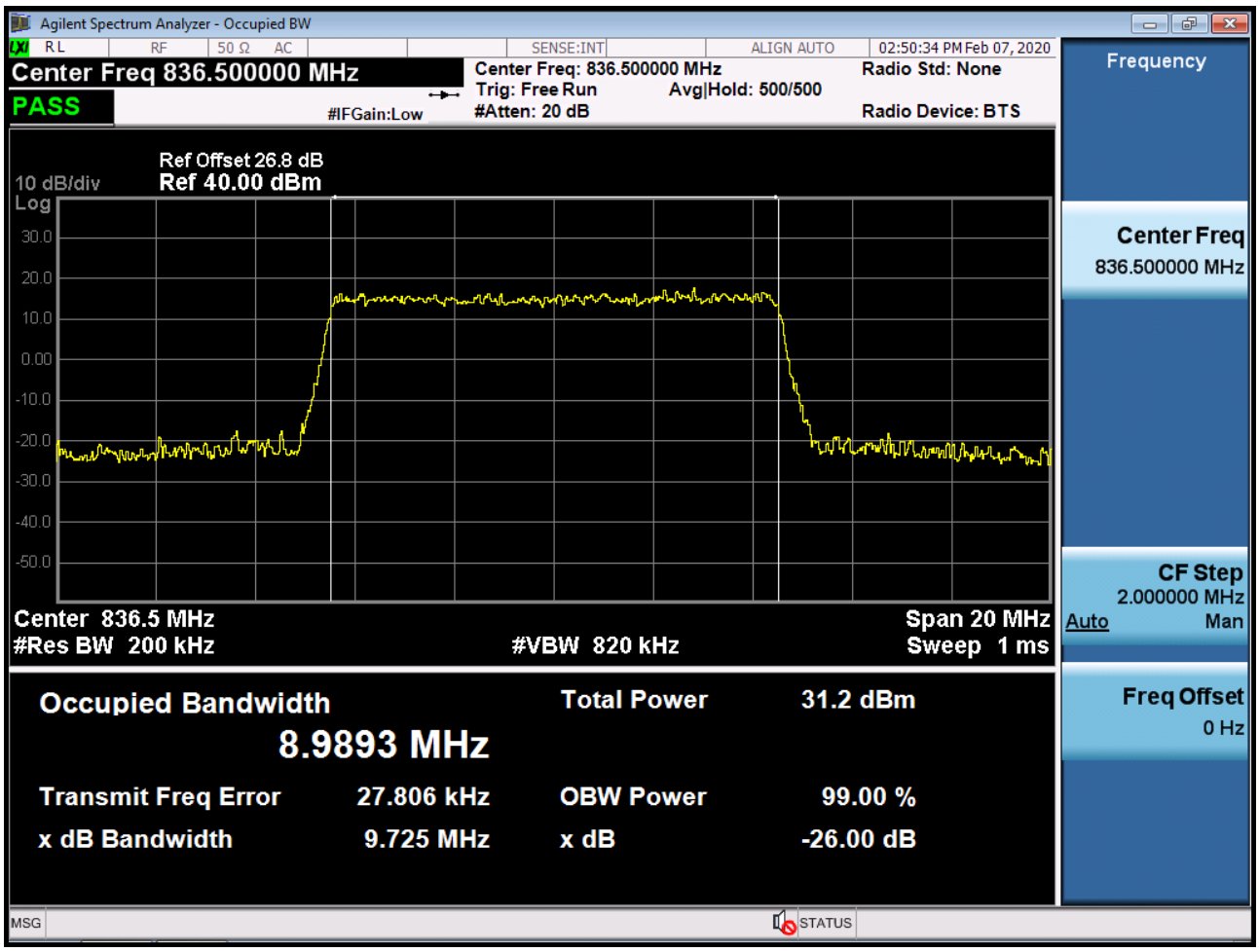
BAND 5. Occupied Bandwidth Plot (5M BW Ch.20525 64QAM_RB25_0)



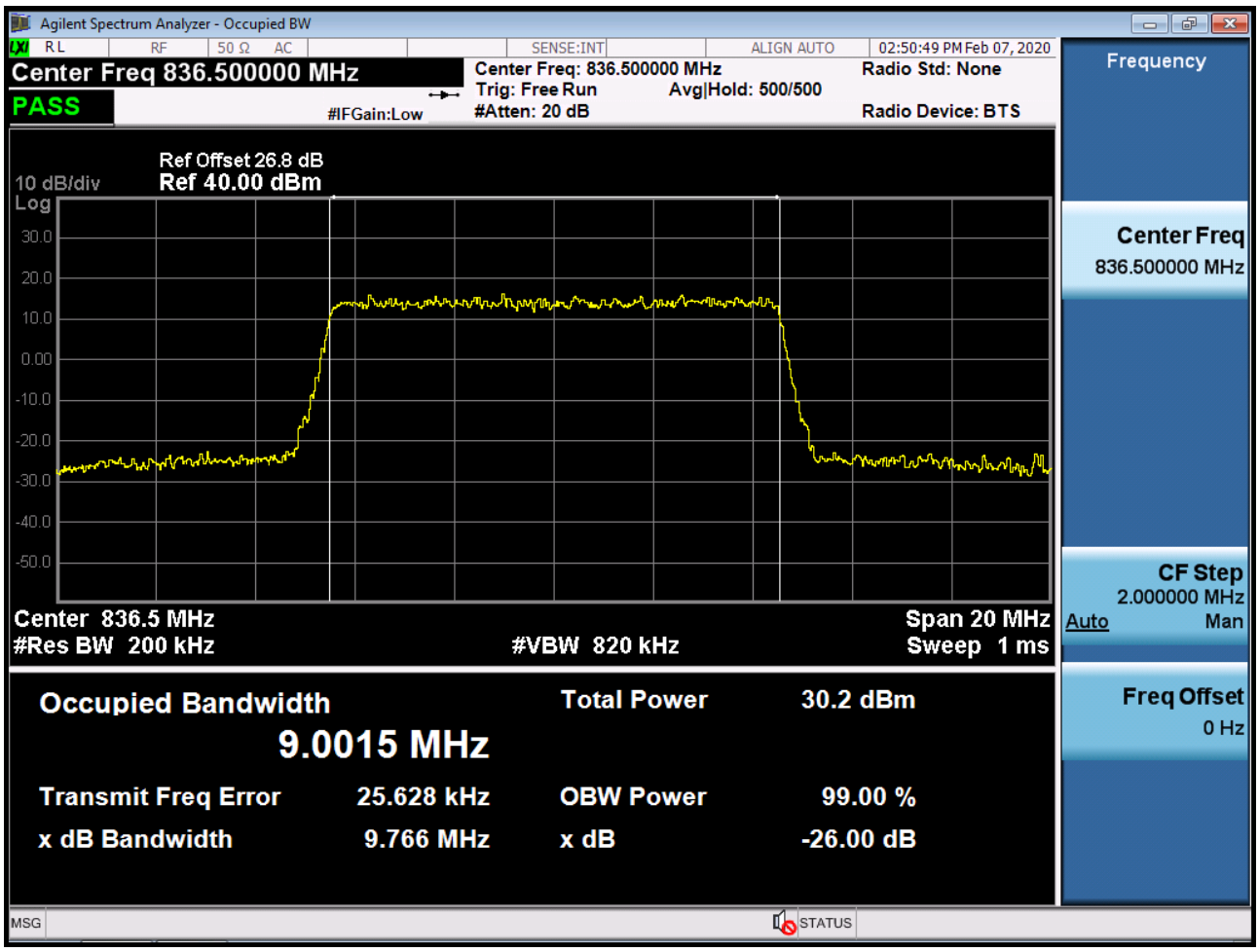
BAND 5. Occupied Bandwidth Plot (10M BW Ch.20525 QPSK_RB50_0)



BAND 5. Occupied Bandwidth Plot (10M BW Ch.20525 16QAM_RB50_0)



BAND 5. Occupied Bandwidth Plot (10M BW Ch.20525 64QAM_RB50_0)



BAND 5. Lower Band Edge Plot (1.4M BW Ch.20407 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (1.4M BW Ch.20407 QPSK_RB6_Offset 0)

BAND 5. Lower Extended Band Edge Plot (1.4M BW Ch.20407 QPSK_RB6_0)

BAND 5. Lower Band Edge Plot (3M BW Ch.20415 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (3M BW Ch.20415 QPSK_RB15_Offset 0)

BAND 5. Lower Extended Band Edge Plot (3M BW Ch.20415 QPSK_RB15_0)

BAND 5. Lower Band Edge Plot (5M BW Ch.20425 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (5M BW Ch.20425 QPSK_RB25_Offset 0)

BAND 5. Lower Extended Band Edge Plot (5M BW Ch.20425 QPSK_RB25_0)

BAND 5. Lower Band Edge Plot (10M BW Ch.20450 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (10M BW Ch.20450 QPSK_RB50_Offset 0)

BAND 5. Lower Extended Band Edge Plot (10M BW Ch.20450 QPSK_RB50_0)

BAND 5. Upper Band Edge Plot (1.4M BW Ch.20643 QPSK_RB1_Offset 5)

BAND 5. Upper Band Edge Plot (1.4M BW Ch.20643 QPSK_RB6_Offset 0)

BAND 5. Upper Extended Band Edge Plot (1.4M BW Ch.20643 QPSK_RB6_0)

BAND 5. Upper Band Edge Plot (3M BW Ch.20635 QPSK_RB1_Offset 14)

BAND 5. Upper Band Edge Plot (3M BW Ch.20635 QPSK_RB15_Offset 0)

BAND 5. Upper Extended Band Edge Plot (3M BW Ch.20635 QPSK_RB15_0)

BAND 5. Upper Band Edge Plot (5M BW Ch.20625 QPSK_RB1_Offset 24)

BAND 5. Upper Band Edge Plot (5M BW Ch.20625 QPSK_RB25_Offset 0)

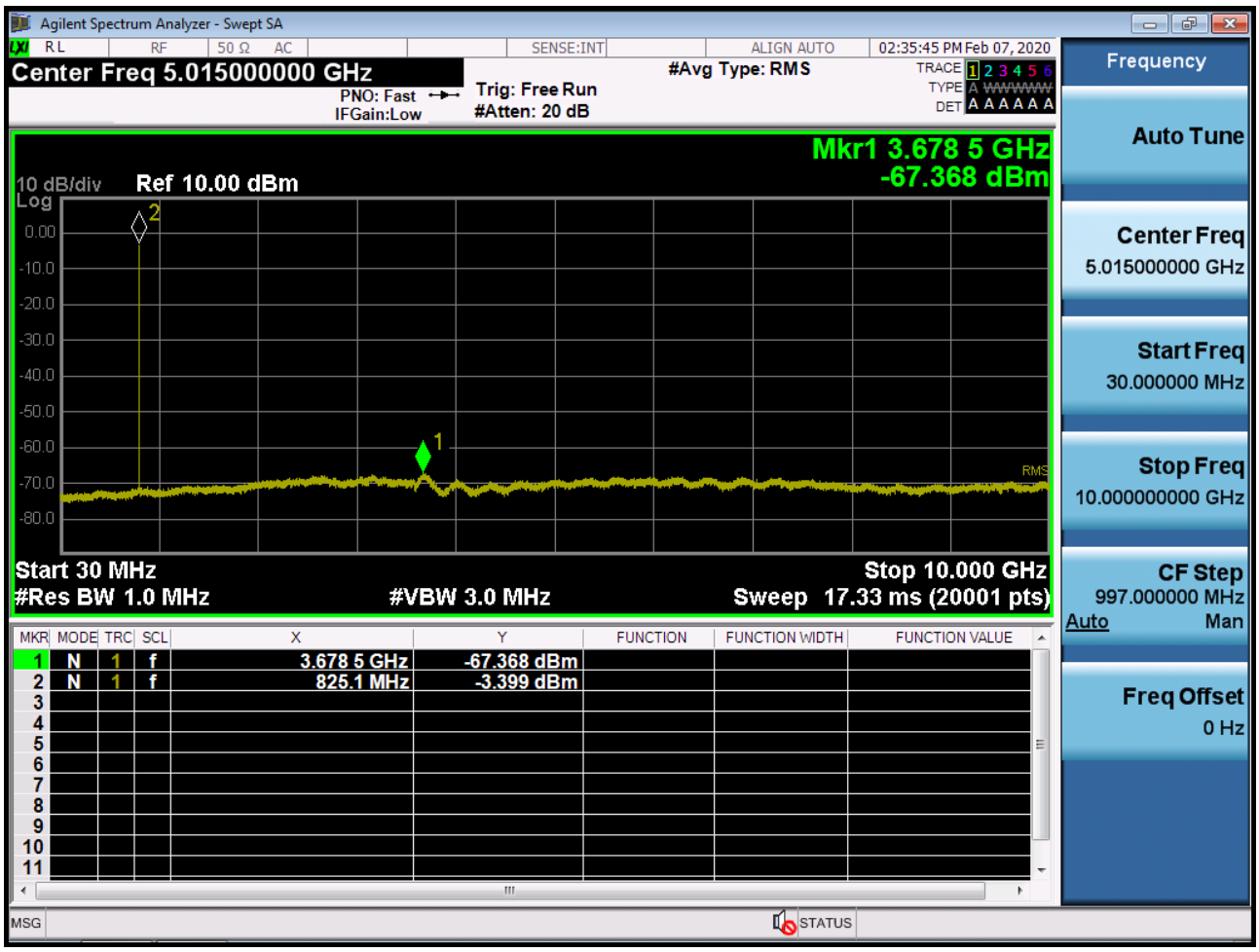
BAND 5. Upper Extended Band Edge Plot (5M BW Ch.20625 QPSK_RB25_0)

BAND 5. Upper Band Edge Plot (10M BW Ch.20600 QPSK_RB1_Offset 49)

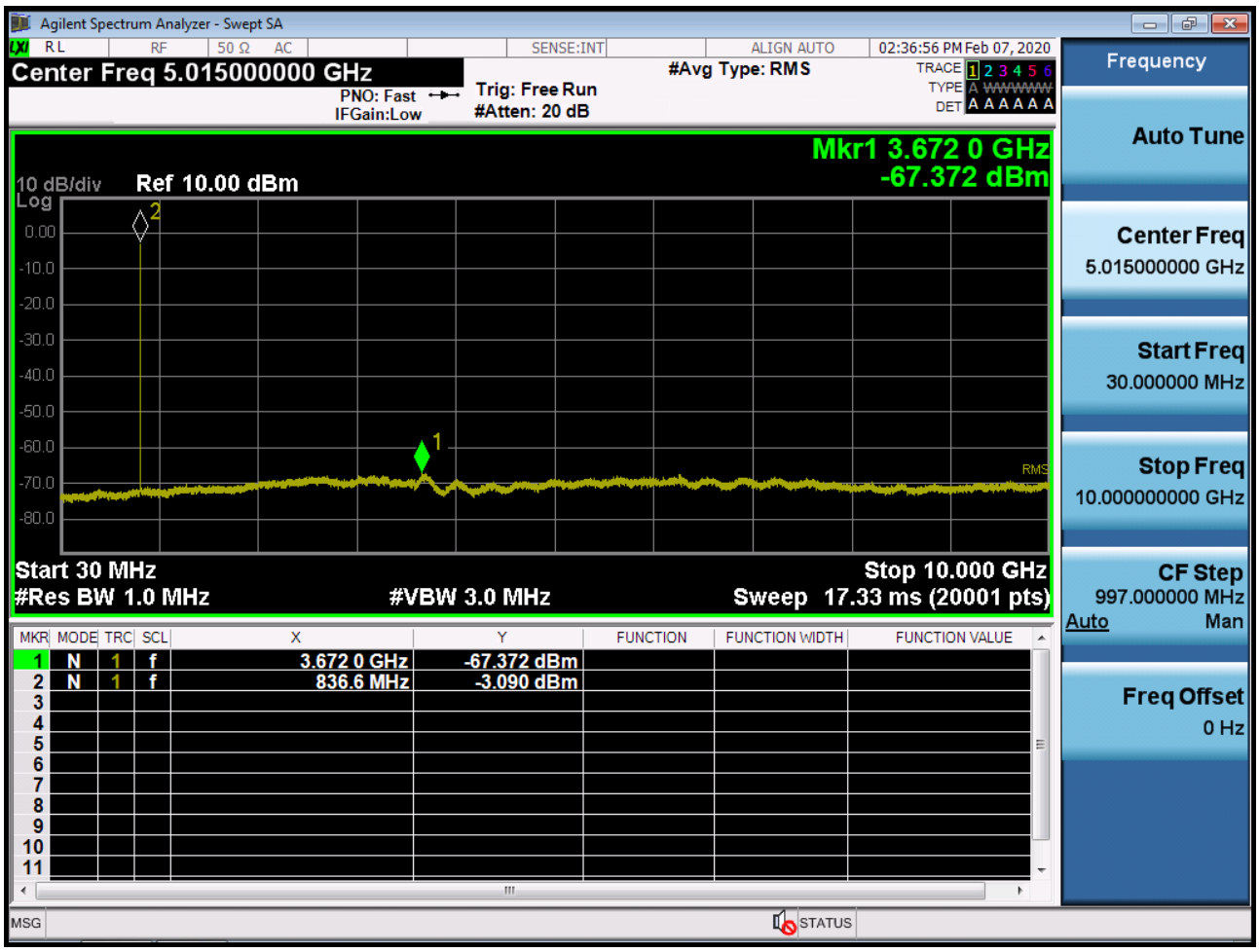
BAND 5. Upper Band Edge Plot (10M BW Ch.20600 QPSK_RB50_Offset 0)

BAND 5. Upper Extended Band Edge Plot (10M BW Ch.20600 QPSK_RB50_0)

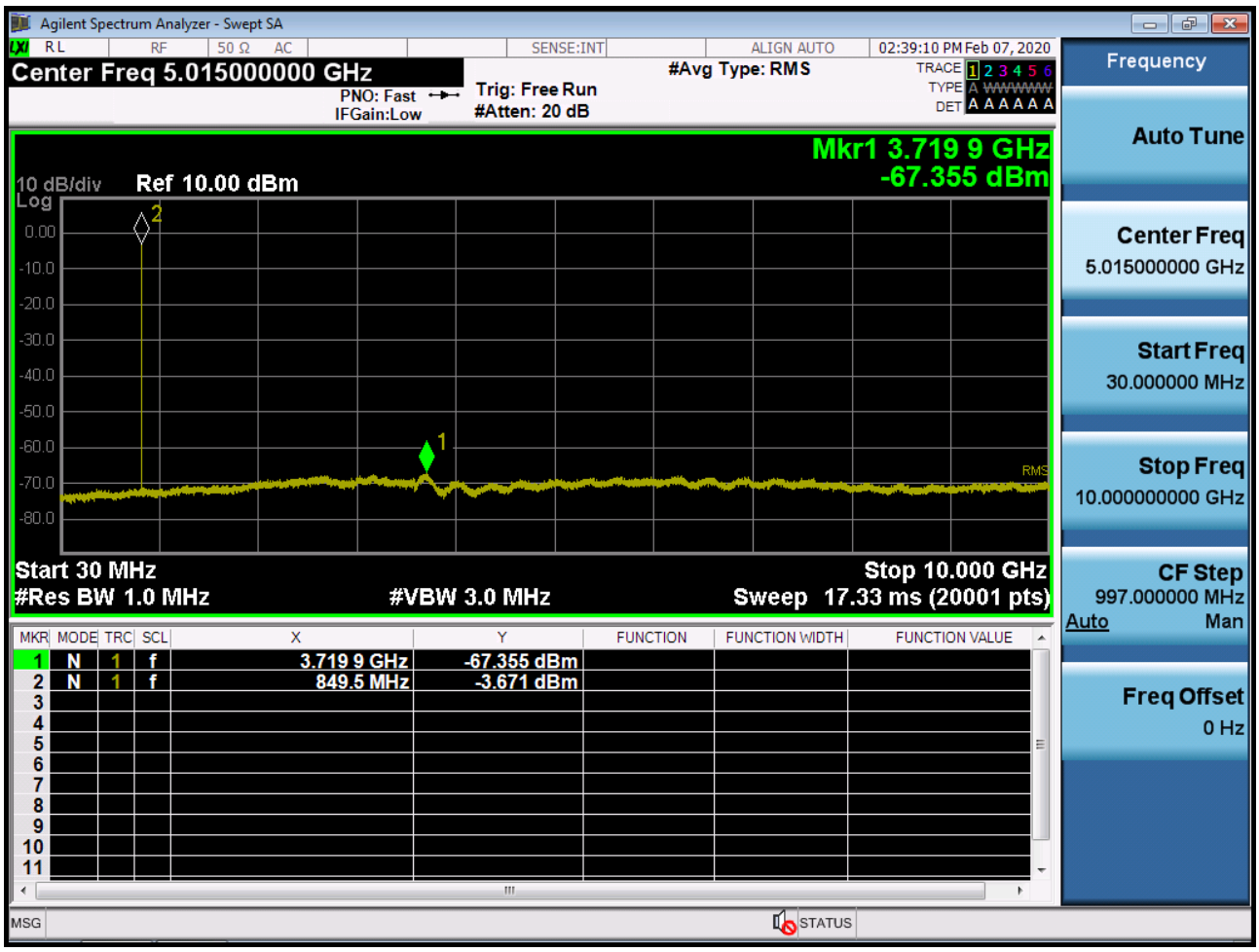
BAND 5. Conducted Spurious Plot (20407ch_1.4MHz_QPSK_RB 1_0)



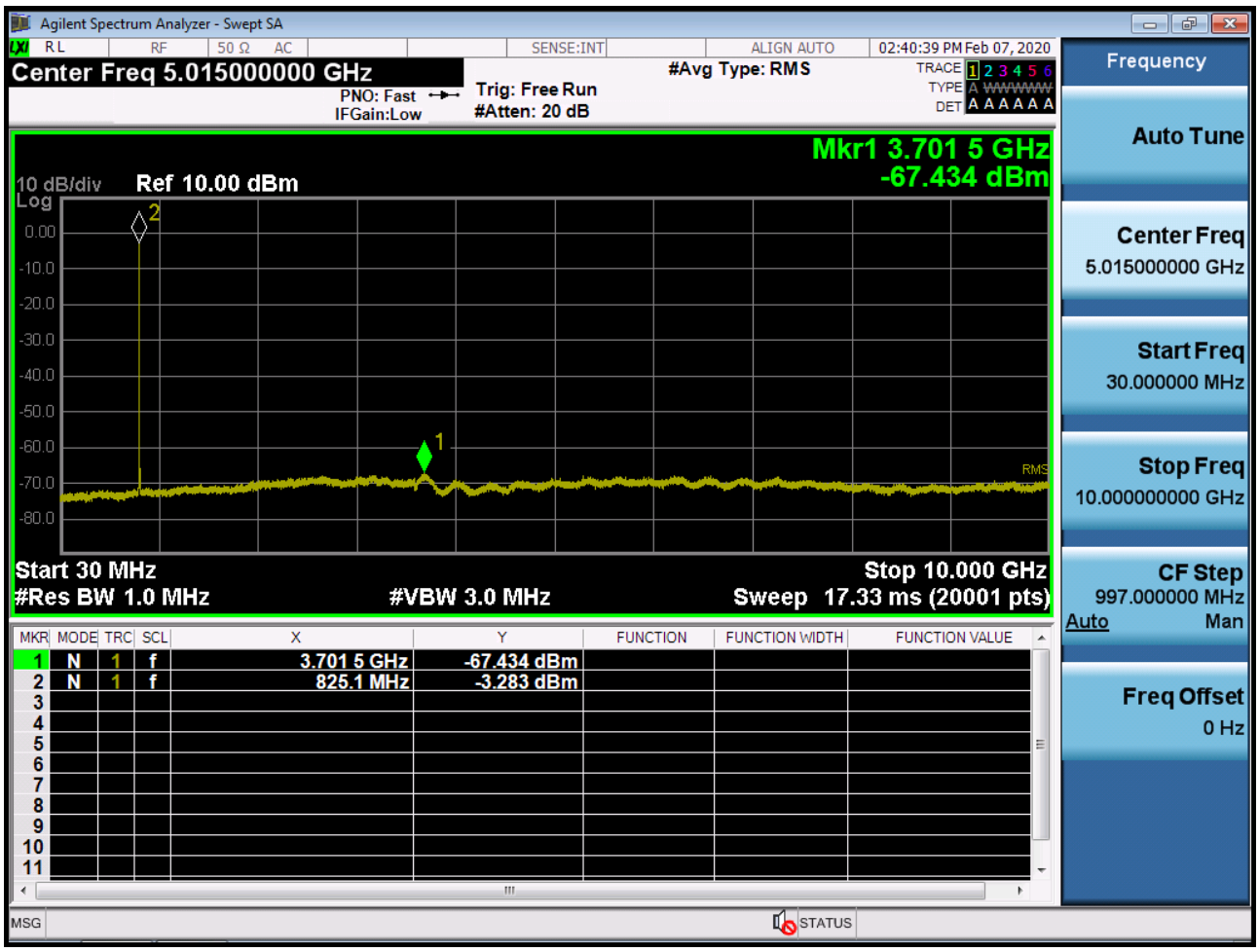
BAND 5. Conducted Spurious Plot (20525ch_1.4MHz_QPSK_RB 1_0)



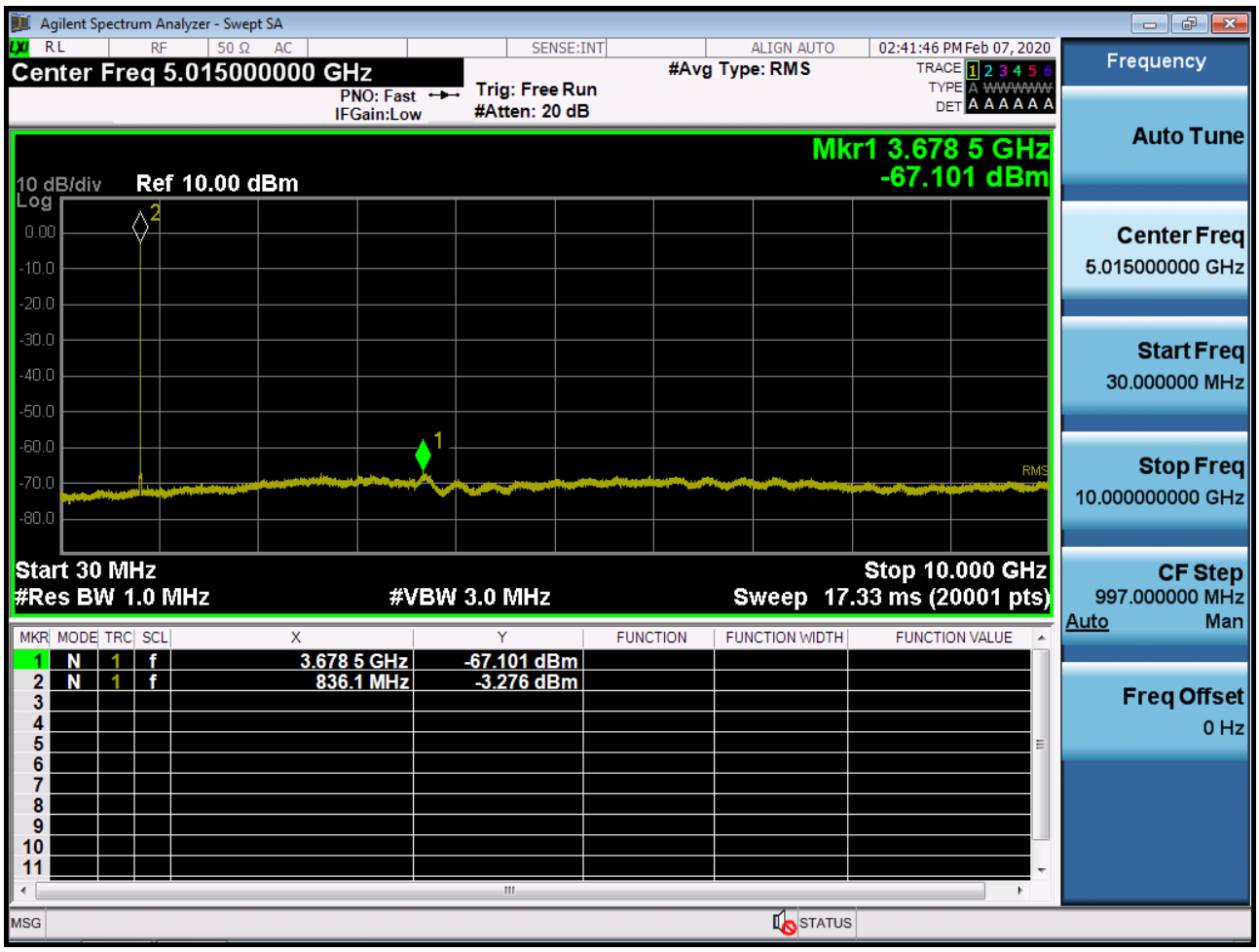
BAND 5. Conducted Spurious Plot (20643ch_1.4MHz_QPSK_RB 1_0)



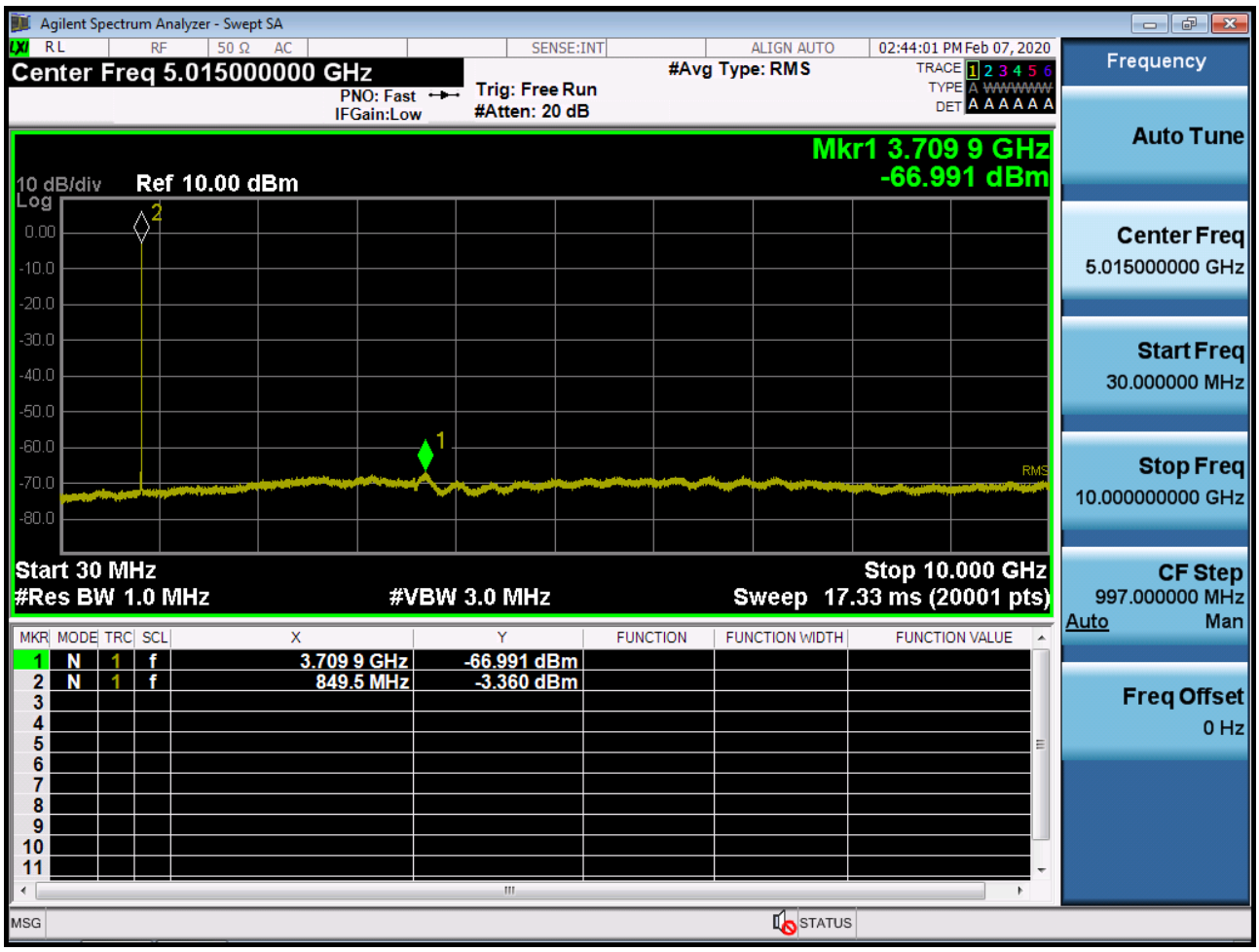
BAND 5. Conducted Spurious Plot (20415ch_3MHz_QPSK_RB 1_0)



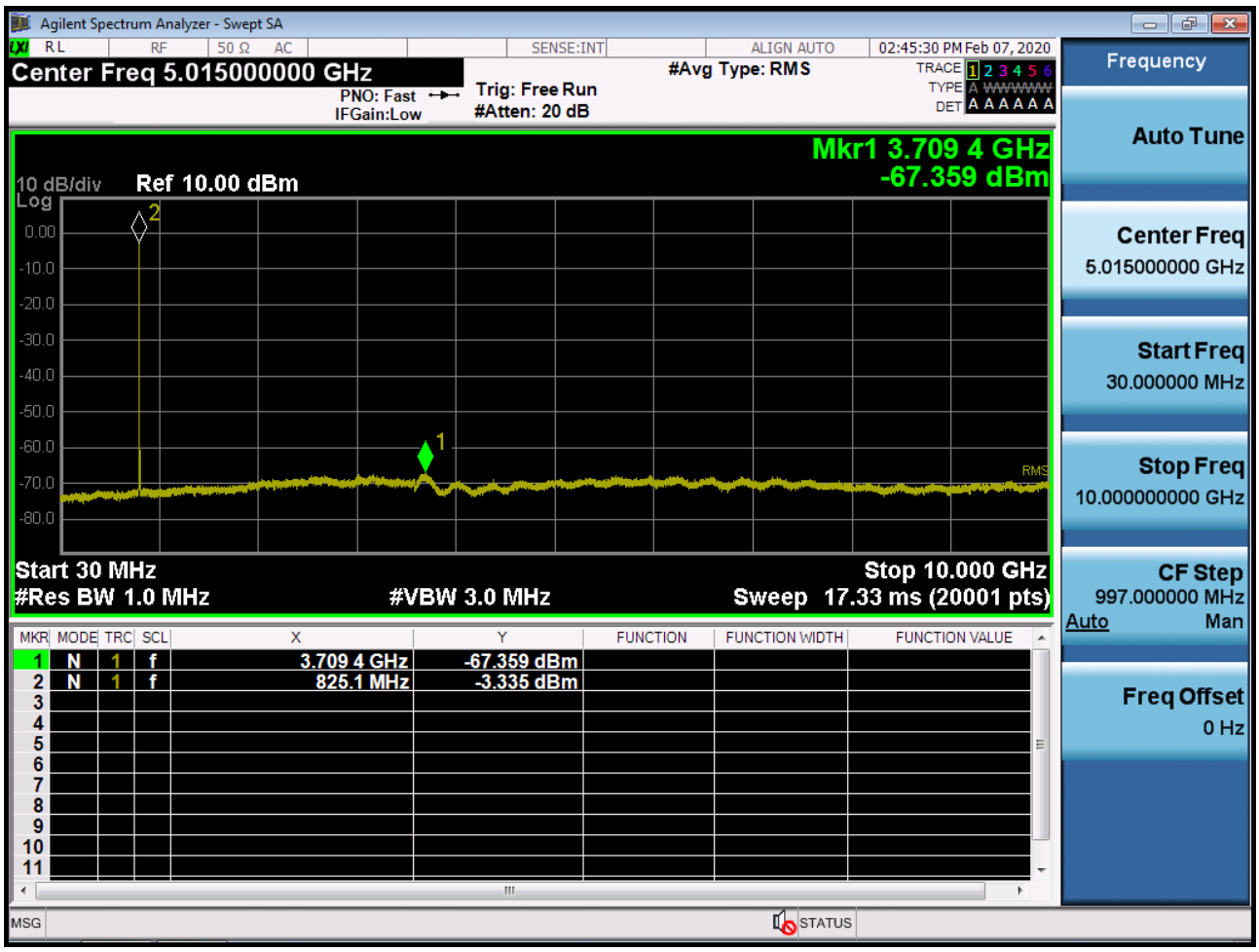
BAND 5. Conducted Spurious Plot (20525ch_3MHz_QPSK_RB 1_0)



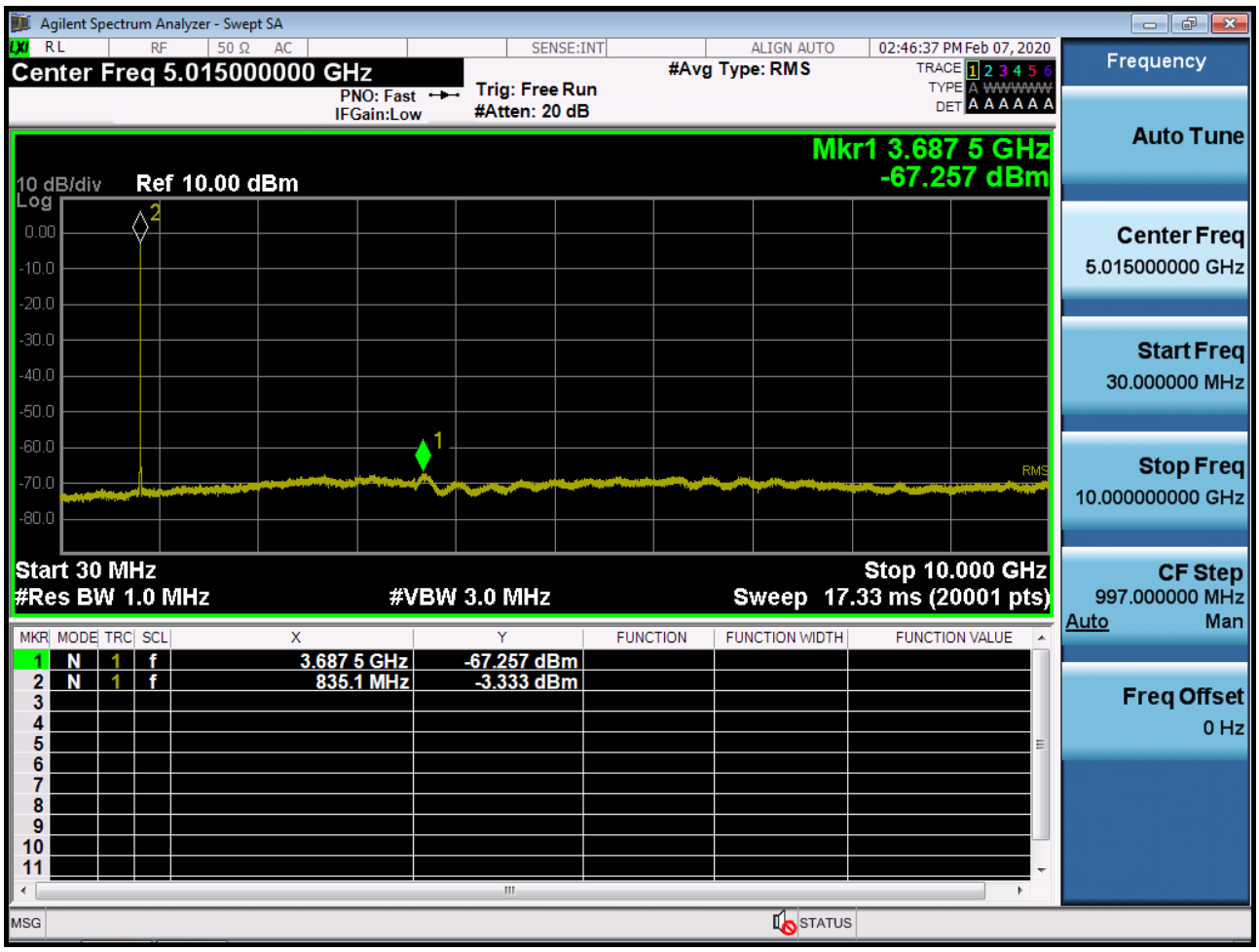
BAND 5. Conducted Spurious Plot (20635ch_3MHz_QPSK_RB 1_0)



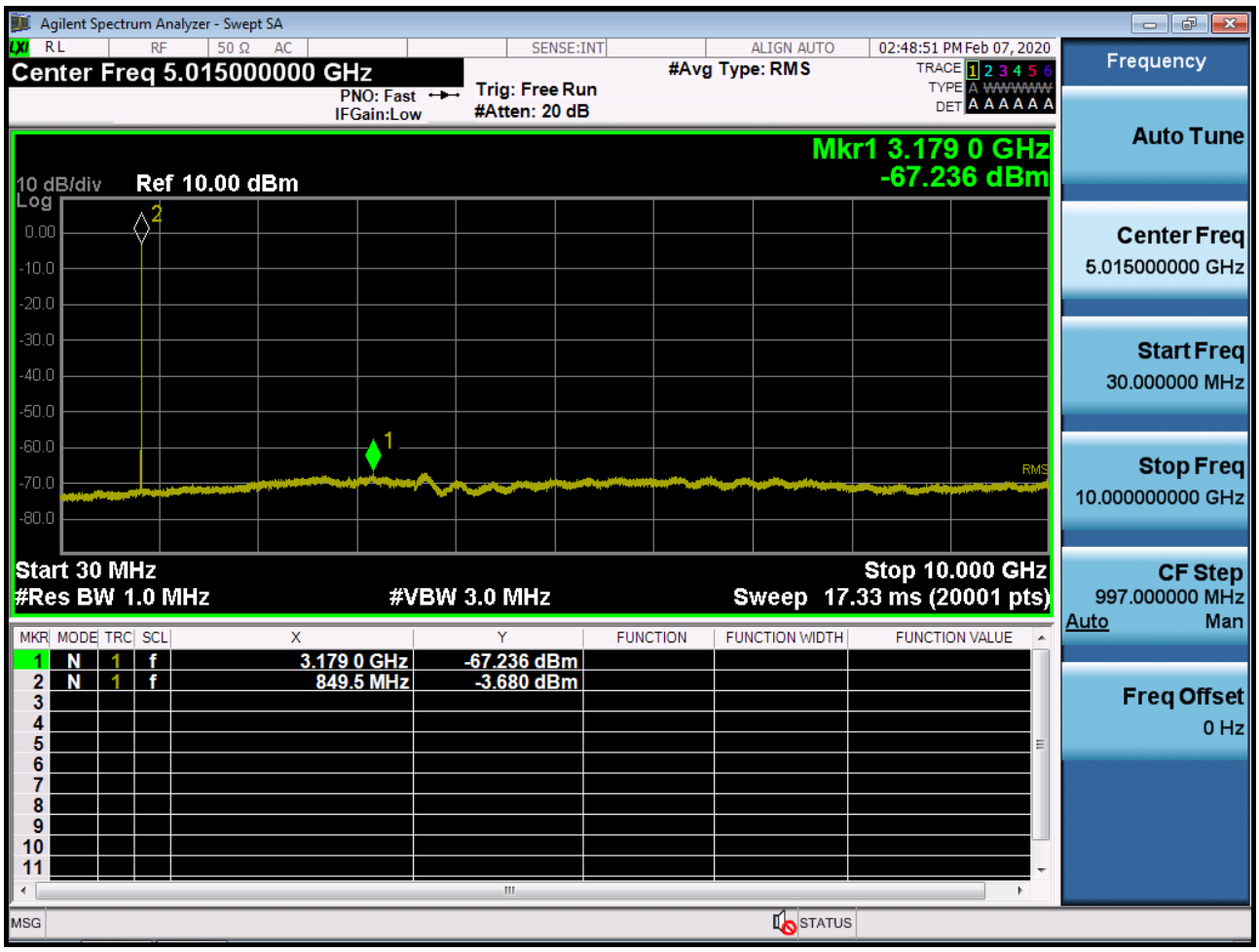
BAND 5. Conducted Spurious Plot (20425ch_5MHz_QPSK_RB 1_0)



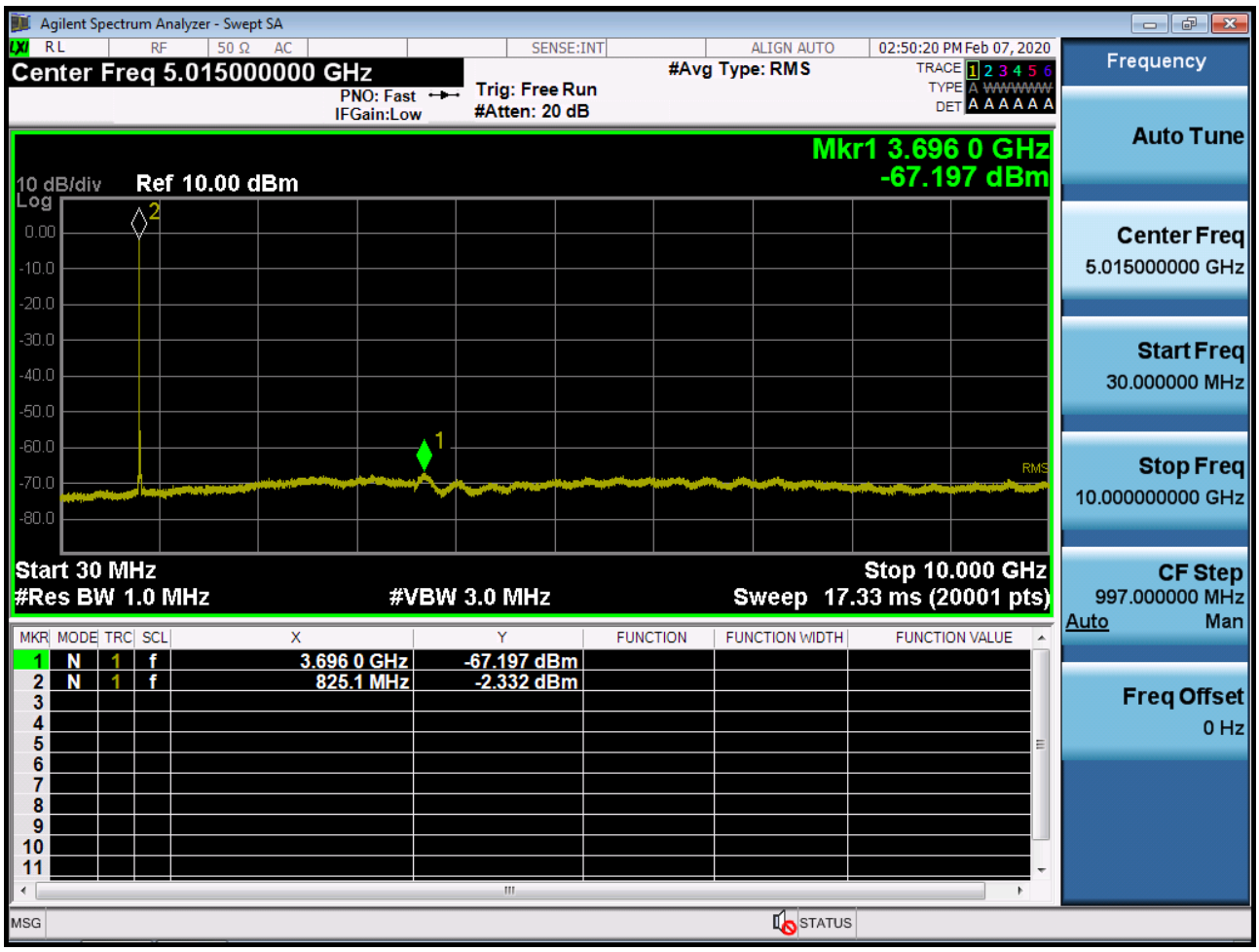
BAND 5. Conducted Spurious Plot (20525ch_5MHz_QPSK_RB 1_0)



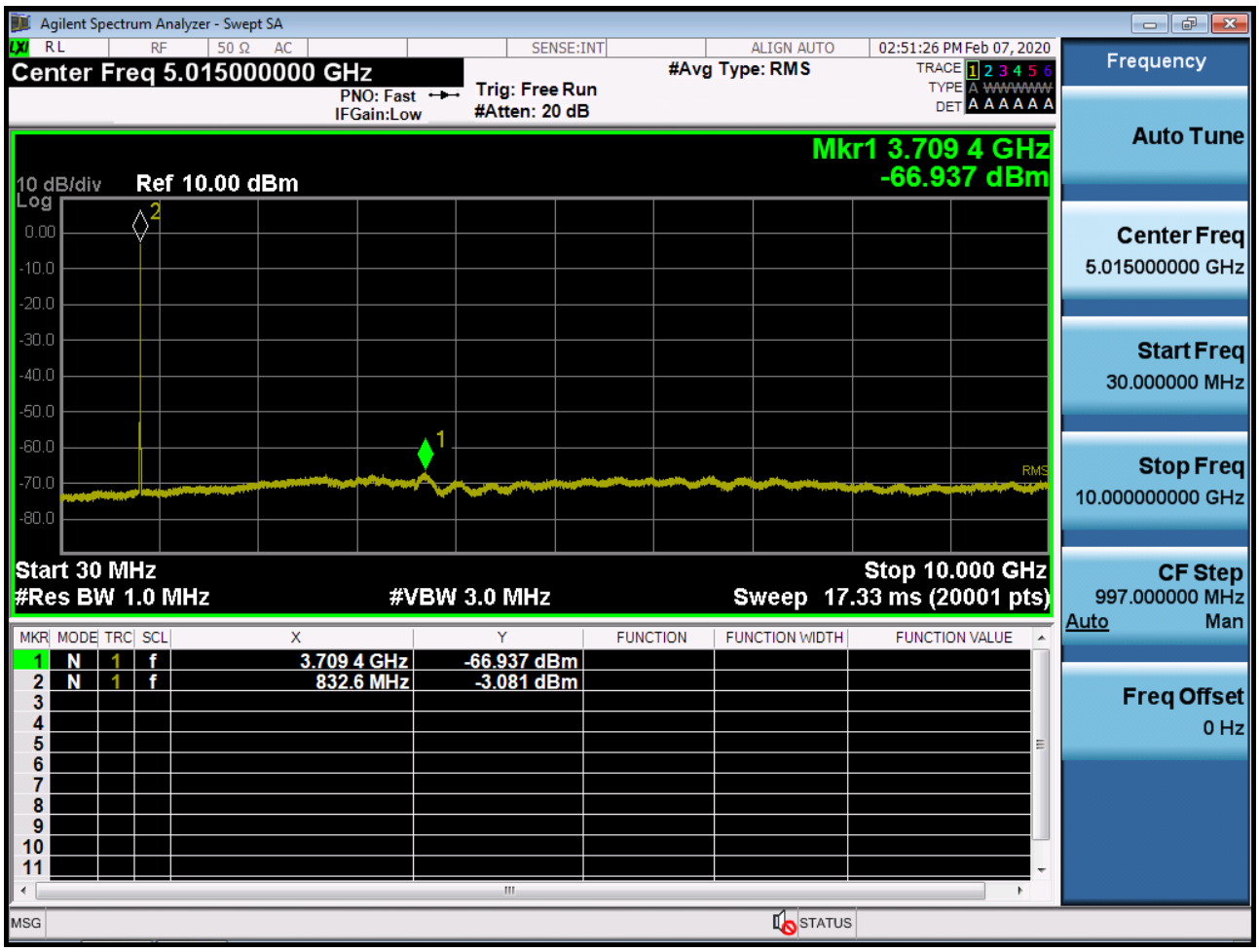
BAND 5. Conducted Spurious Plot (20625ch_5MHz_QPSK_RB 1_0)



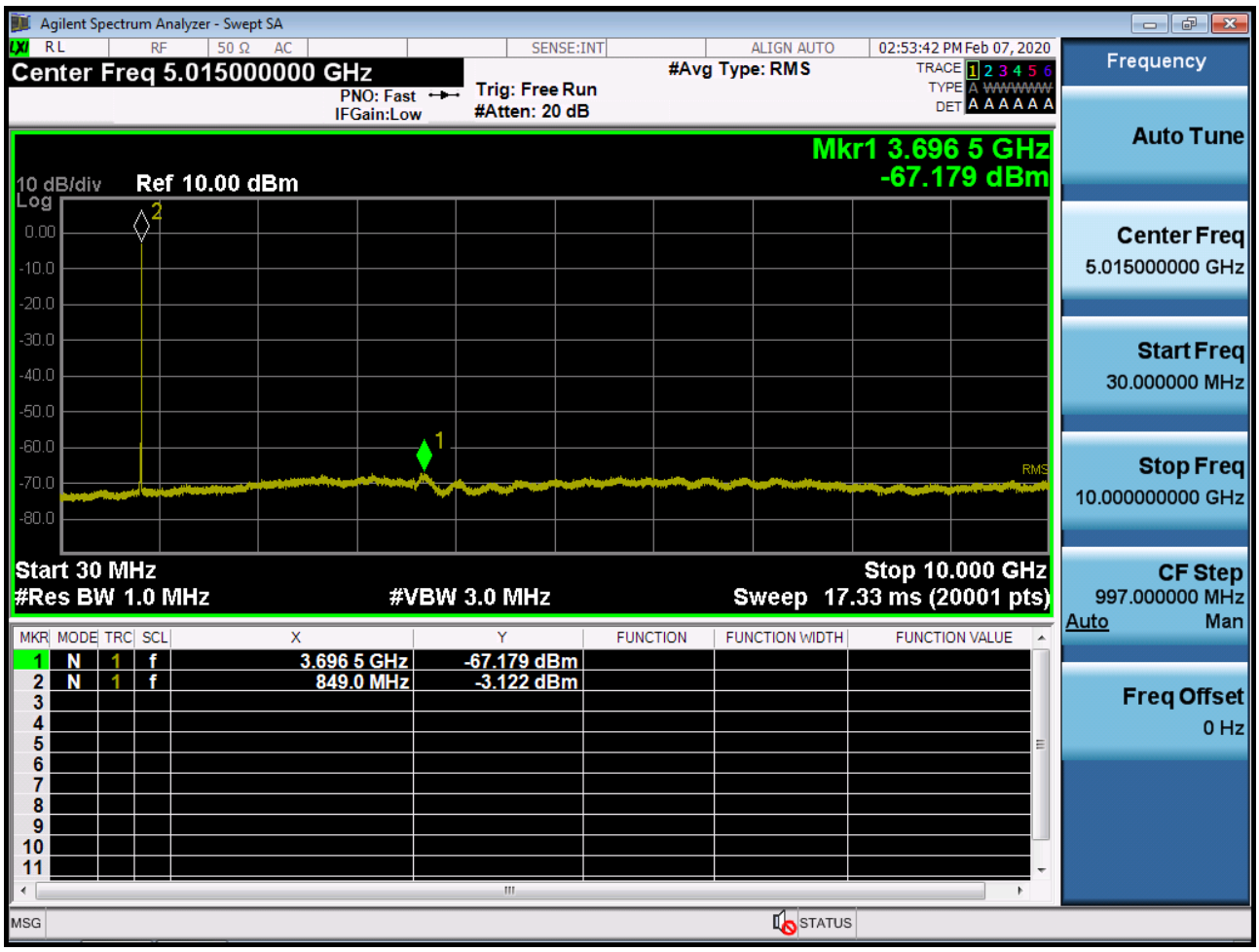
BAND 5. Conducted Spurious Plot (20450ch_10MHz_QPSK_RB 1_0)



BAND 5. Conducted Spurious Plot (20525ch_10MHz_QPSK_RB 1_0)



BAND 5. Conducted Spurious Plot (20600ch_10MHz_QPSK_RB 1_0)



10. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2002-FC021-P