

FCC LTE REPORT

Certification

Application Name:
SAMSUNG Electronics Co., Ltd.

Date of Issue:
21 April 2020

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

Test Site/Location:
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
Report No.: HCT-RF-2004-FC037

FCC ID: A3LSMA516B

APPLICANT: SAMSUNG Electronics Co., Ltd.

Model(s):
EUT Type:
FCC Classification:
FCC Rule Part(s):

SM-A516B/DS
Mobile Phone
PCS Licensed Transmitter Held to Ear (PCE)
§27, §2

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	EIRP	
				Max. Power (W)	Max. Power (dBm)
LTE-Band41 (5)	2498.5 – 2687.5	4M54G7D	QPSK	0.149	21.74
-	-	4M51W7D	16QAM	0.123	20.90
-	-	4M52W7D	64QAM	0.097	19.87
LTE-Band41 (10)	2501.0 – 2685.0	9M05G7D	QPSK	0.144	21.58
-	-	8M99W7D	16QAM	0.119	20.77
-	-	9M00W7D	64QAM	0.093	19.70
LTE-Band41 (15)	2503.5 – 2682.5	13M5G7D	QPSK	0.143	21.54
-	-	13M5W7D	16QAM	0.119	20.74
-	-	13M5W7D	64QAM	0.092	19.65
LTE-Band41 (20)	2506.0 – 2680.0	18M0G7D	QPSK	0.137	21.37
-	-	18M0W7D	16QAM	0.114	20.55
-	-	17M9W7D	64QAM	0.093	19.67

FCC Licensed Remark :

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-2004-FC037	April 21, 2020	- First Approval Report

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)

Table of Contents

1. GENERAL INFORMATION	4
2. INTRODUCTION	5
2.1. DESCRIPTION OF EUT.....	5
2.2. MEASURING INSTRUMENT CALIBRATION	5
2.3. TEST FACILITY	5
3. DESCRIPTION OF TESTS.....	6
3.1 TEST PROCEDURE	6
3.2 RADIATED POWER.....	7
3.3 RADIATED SPURIOUS EMISSIONS	8
3.4 PEAK- TO- AVERAGE RATIO.....	9
3.5 OCCUPIED BANDWIDTH.	11
3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL	12
3.7 CHANNEL EDGE	13
3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE	15
3.9 WORST CASE(RADIATED TEST)	16
3.10 WORST CASE(CONDUCTED TEST)	17
4. LIST OF TEST EQUIPMENT	18
5. MEASUREMENT UNCERTAINTY	19
6. SUMMARY OF TEST RESULTS	20
7. SAMPLE CALCULATION	21
8. TEST DATA	23
8.1 EQUIVALENT ISOTROPIC RADIATED POWER.....	23
8.2 RADIATED SPURIOUS EMISSIONS	25
8.3 PEAK-TO-AVERAGE RATIO.....	29
8.4 OCCUPIED BANDWIDTH	30
8.5 CONDUCTED SPURIOUS EMISSIONS	31
8.6 CHANNEL EDGE.....	32
8.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE	33
8.8 GEO-LOCATION MECHANISM	45
9. TEST PLOTS.....	50
10. ANNEX A_ TEST SETUP PHOTO.....	131

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:	A3LSMA516B
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§27, §2
EUT Type:	Mobile Phone
Model(s):	SM-A516B/DS
Tx Frequency:	2498.5 – 2687.5 : 5 MHz 2501.0 – 2685.0 : 10 MHz 2503.5 – 2682.5 : 15 MHz 2506.0 – 2680.0 : 20 MHz
Date(s) of Tests:	March 20, 2020 ~ April 10, 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, ANT+.

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
Channel 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 NormalHz
3. VBW $\geq 3 \times$ RBW
4. Span = 1.5 times the OBW
5. No. of sweep points $> 2 \times$ 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;

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

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 NormalHz for emissions above 1GHz
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $> 2 \times$ 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;

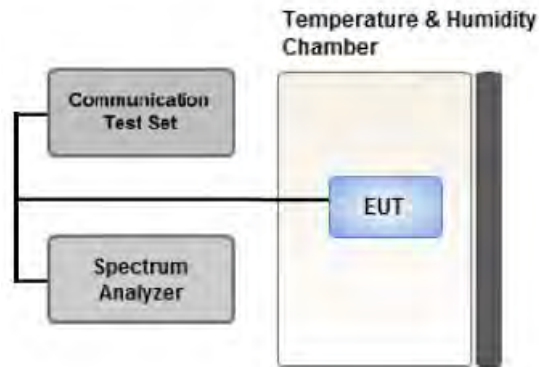
$$\text{Result}_{(\text{dBm})} = P_{g(\text{dBm})} - \text{cable loss}_{(\text{dB})} + \text{antenna gain}_{(\text{dBi})}$$

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

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

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

3.4 PEAK- TO- AVERAGE RATIO



Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth $\geq$ 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:

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

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 $\geq 3 \times$ RBW.

1. Set the RBW $\geq$ OBW.
2. Set VBW $\geq 3 \times$ RBW.
3. Set span $\geq 2 \times$ OBW.
4. Sweep time $\geq 10 \times$ (number of points in sweep) $\times$ (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)

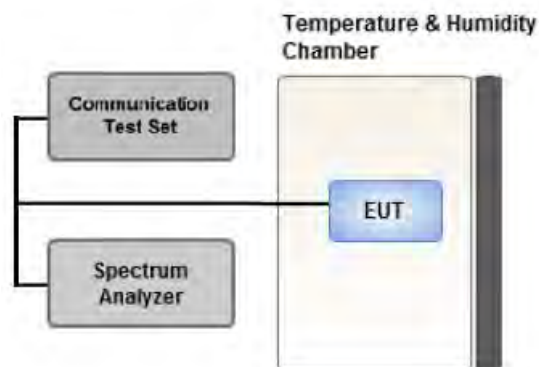
1. Set span to $2 \times$ to $3 \times$ the OBW.
2. Set RBW $\geq$ OBW.
3. Set VBW $\geq 3 \times$ RBW.
4. Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
5. Sweep time:

Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$ 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 $[10 \log (1/\text{duty cycle})]$ to the measured maximum power level to compute the average power during continuous transmission. For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ 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.

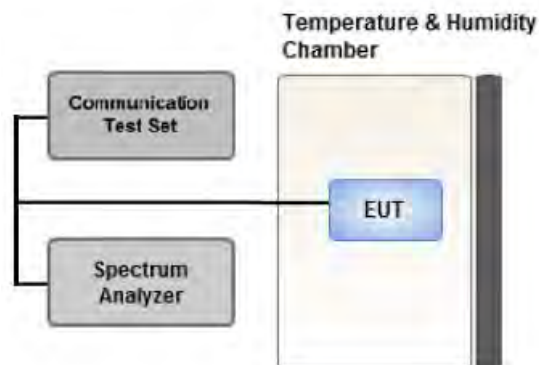
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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 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 $\geq 3 \times$ 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

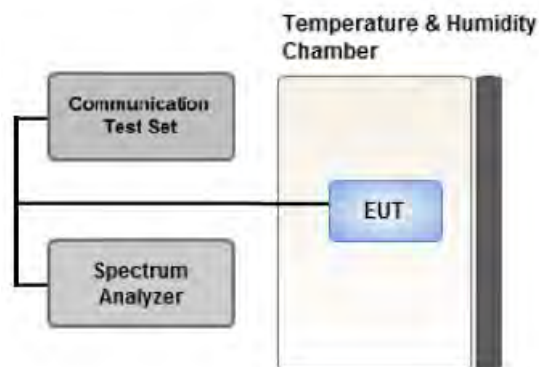
Test Overview

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 $\geq$ 3 MHz
3. Detector = Peak
4. Trace Mode = max hold
5. Sweep time = auto
6. Number of points in sweep $\geq 2 \times \text{Span} / \text{RBW}$

3.7 CHANNEL 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.

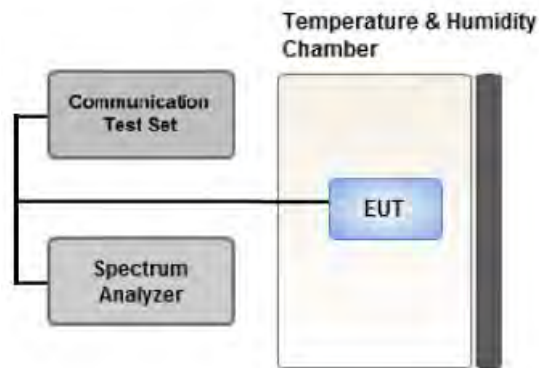
Test Settings

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. Within 1MHz of the channel edge the RBW should be 2% of EBW, then 1 MHz after that.
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

1. The attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge,
2. $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge.
3. $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge.
4. The attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz.
5. $55 + 10 \log (P)$ dB at or below 2490.5 MHz.
6. X is the greater of 6MHz or the actual emission bandwidth
7. The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer

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)

- 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, RB sizes and offsets, and channel bandwidth configurations shown in the test data.
- Please refer to the table below.
- All modes of operation were investigated and the worst case configuration results are reported.
- Please refer to the table below.

[Worst case]

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

3.10 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	5, 10, 15, 20	Mid	Full RB	0
Peak-To-Average Ratio	QPSK, 16QAM, 64QAM	5, 10, 15, 20	Mid	Full RB	0
Channel Edge	QPSK	5	Low	1	0
			High	1	24
		10	Low	1	0
			High	1	49
		15	Low	1	0
			High	1	74
		20	Low	1	0
			High	1	99
		5, 10, 15, 20	Low, Mid, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	QPSK	5, 10, 15, 20	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	-	03/09/2020	Annual	03/09/2021
T&M SYSTEM	FBSR-02B(WHK3.3/18G-10EF)/H.P.F	-	03/09/2020	Annual	03/09/2021
WAINWRIGHT INSTRUMENT	WHNX6.0/26.5G-6SS/H.P.F	1	03/19/2010	Annual	03/19/2021
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
Keysight	E7515B / UXM5G	MY583000756	01/07/2020	Annual	01/07/2021
HCT CO., LTD.,	FCC LTE Mobile Conducted RF Automation Test Software	-	-	-	-

Note:

- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
- 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 ($\pm$ 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, §27.53(m)(4)	■ $< 40 + 10\log_{10} (P[\text{Watts}])$ at Channel edges ■ $< 43 + 10\log_{10} (P[\text{Watts}])$ between 5 and X MHz from Channel edges ■ $< 55 + 10\log_{10} (P[\text{Watts}])$ beyond X MHz beyond from Channel edges ■ $< 43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz	PASS
Conducted Output Power	§2.1046	N/A	<u>See Note1</u>
Frequency stability / variation of ambient temperature	§2.1055, §27.54	Emission must remain in band	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
Equivalent Isotropic Radiated Power	§27.50(h)(2)	< 2 Watts max. EIRP	PASS
Radiated Spurious and Harmonic Emissions	§2.1053, §27.53(m)(4)	$< 55 + 10\log_{10} (P[\text{Watts}])$	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

$$\text{ERP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 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
40620	2593.0	-15.75	18.45	9.90	1.76	H	0.456	26.59

$$\text{EIRP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 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 EQUIVALENT ISOTROPIC RADIATED POWER

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBi)	C.L	Pol	Limit	EIRP	
								W	W	dBm
2498.5	LTE B41/ 5 MHz	QPSK	-25.11	11.64	10.70	2.31	H	< 2.00	0.101	20.03
		16-QAM	-25.93	10.82	10.70	2.31	H		0.083	19.21
		64-QAM	-26.95	9.80	10.70	2.31	H		0.066	18.19
2593.0		QPSK	-23.68	13.11	10.98	2.35	H		0.149	21.74
		16-QAM	-24.52	12.27	10.98	2.35	H		0.123	20.90
		64-QAM	-25.55	11.24	10.98	2.35	H		0.097	19.87
2687.5		QPSK	-25.02	12.14	11.10	2.39	H		0.122	20.85
		16-QAM	-25.77	11.39	11.10	2.39	H		0.102	20.10
		64-QAM	-26.73	10.43	11.10	2.39	H		0.082	19.14

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBi)	C.L	Pol	Limit	EIRP	
								W	W	dBm
2501.0	LTE B41/ 10 MHz	QPSK	-25.04	11.71	10.70	2.31	H	< 2.00	0.102	20.10
		16-QAM	-25.81	10.94	10.70	2.31	H		0.086	19.33
		64-QAM	-26.95	9.80	10.70	2.31	H		0.066	18.19
2593.0		QPSK	-23.84	12.95	10.98	2.35	H		0.144	21.58
		16-QAM	-24.65	12.14	10.98	2.35	H		0.119	20.77
		64-QAM	-25.72	11.07	10.98	2.35	H		0.093	19.70
2685.0		QPSK	-24.72	12.36	11.10	2.39	H		0.128	21.07
		16-QAM	-25.39	11.69	11.10	2.39	H		0.110	20.40
		64-QAM	-26.50	10.58	11.10	2.39	H		0.085	19.29

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBi)	C.L	Pol	Limit	EIRP	
								W	W	dBm
2503.5	LTE B41/ 15 MHz	QPSK	-25.05	11.70	10.70	2.31	H	< 2.00	0.102	20.09
		16-QAM	-25.89	10.86	10.70	2.31	H		0.084	19.25
		64-QAM	-26.94	9.81	10.70	2.31	H		0.066	18.20
2593.0		QPSK	-23.88	12.91	10.98	2.35	H		0.143	21.54
		16-QAM	-24.68	12.11	10.98	2.35	H		0.119	20.74
		64-QAM	-25.77	11.02	10.98	2.35	H		0.092	19.65
2682.5		QPSK	-24.99	11.99	11.10	2.38	H		0.118	20.71
		16-QAM	-25.70	11.28	11.10	2.38	H		0.100	20.00
		64-QAM	-26.72	10.26	11.10	2.38	H		0.079	18.98

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBi)	C.L	Pol	Limit	EIRP	
								W	W	dBm
2506.0	LTE B41/ 20 MHz	QPSK	-25.04	11.63	10.73	2.32	H	< 2.00	0.101	20.04
		16-QAM	-25.93	10.74	10.73	2.32	H		0.082	19.15
		64-QAM	-26.87	9.80	10.73	2.32	H		0.066	18.21
2593.0		QPSK	-24.24	12.55	10.98	2.35	H		0.131	21.18
		16-QAM	-25.14	11.65	10.98	2.35	H		0.107	20.28
		64-QAM	-26.03	10.76	10.98	2.35	H		0.087	19.39
2680.0		QPSK	-24.33	12.65	11.10	2.38	H		0.137	21.37
		16-QAM	-25.15	11.83	11.10	2.38	H		0.114	20.55
		64-QAM	-26.03	10.95	11.10	2.38	H		0.093	19.67

8.2 RADIATED SPURIOUS EMISSIONS

- ▣ OPERATING FREQUENCY : 2593.0 MHz
- ▣ MEASURED OUTPUT POWER: 21.74 dBm = 0.149 W
- ▣ MODE: LTE B41
- ▣ MODULATION SIGNAL: 5 MHz QPSK
- ▣ DISTANCE: 1 meters
- ▣ LIMIT: $55 + 10 \log_{10}(W) =$ 46.74 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	EIRP (dBm)	dBc
39675 (2498.5)	4,997.00	-52.19	12.70	-63.98	3.35	V	-54.63	76.37
	7,495.50	-48.87	11.20	-50.55	4.29	V	-43.64	65.38
	9,994.00	-50.40	11.89	-48.71	5.04	V	-41.86	63.60
40620 (2593.0)	5,186.00	-54.27	12.75	-66.04	3.44	V	-56.73	78.47
	7,779.00	-45.49	11.65	-48.13	4.36	V	-40.84	62.58
	10,372.00	-45.54	10.75	-42.28	5.16	H	-36.69	58.43
41565 (2687.5)	5,375.00	-53.50	13.52	-64.77	3.52	H	-54.77	76.52
	8,062.50	-46.47	10.93	-47.08	4.45	V	-40.60	62.34
	10,750.00	-49.22	10.90	-45.64	5.31	V	-40.05	61.79

- OPERATING FREQUENCY : 2593.0 MHz
 ■ MEASURED OUTPUT POWER: 21.58 dBm = 0.144 W
 ■ MODE: LTE B41
 ■ MODULATION SIGNAL: 10 MHz QPSK
 ■ DISTANCE: 1 meters
 ■ LIMIT: $55 + 10 \log_{10} (W) =$ 46.58 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	EIRP (dBm)	dBc
39700 (2501.0)	5,002.00	-56.43	12.70	-68.22	3.35	V	-58.87	80.45
	7,503.00	-48.88	11.20	-50.45	4.29	H	-43.54	65.12
	10,004.00	-50.61	10.84	-47.90	5.03	V	-42.09	63.67
40620 (2593.0)	5,186.00	-57.42	12.75	-69.19	3.44	V	-59.88	81.46
	7,779.00	-45.84	11.65	-48.48	4.36	V	-41.19	62.77
	10,372.00	-51.58	10.75	-48.32	5.16	H	-42.73	64.31
41540 (2685.0)	5,370.00	-56.30	13.25	-67.38	3.52	V	-57.65	79.23
	8,055.00	-46.79	10.92	-47.39	4.46	H	-40.93	62.51
	10,740.00	-50.22	10.90	-46.92	5.29	V	-41.31	62.89

- ▣ OPERATING FREQUENCY : 2593.0 MHz
- ▣ MEASURED OUTPUT POWER: 21.54 dBm = 0.143 W
- ▣ MODE: LTE B41
- ▣ MODULATION SIGNAL: 15 MHz QPSK
- ▣ DISTANCE: 1 meters
- ▣ LIMIT: $55 + 10 \log_{10} (W) =$ 46.54 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	EIRP (dBm)	dBc
39725 (2503.5)	5,007.00	-55.85	12.65	-66.90	3.35	V	-57.60	79.14
	7,510.50	-47.35	11.25	-49.12	4.29	V	-42.16	63.70
	10,014.00	-50.06	11.02	-47.28	5.03	V	-41.29	62.83
40620 (2593.0)	5,186.00	-57.68	12.75	-69.45	3.44	H	-60.14	81.68
	7,779.00	-46.05	11.65	-48.69	4.36	V	-41.40	62.94
	10,372.00	-47.67	10.75	-44.41	5.16	H	-38.82	60.36
41515 (2682.5)	5,365.00	-53.48	13.27	-64.58	3.52	H	-54.83	76.37
	8,047.50	-45.98	10.90	-46.56	4.46	V	-40.12	61.66
	10,730.00	-49.64	10.90	-46.46	5.25	V	-40.81	62.35

- ▣ OPERATING FREQUENCY : 2680.0 MHz
- ▣ MEASURED OUTPUT POWER: 21.37 dBm = 0.137 W
- ▣ MODE: LTE B41
- ▣ MODULATION SIGNAL: 20 MHz QPSK
- ▣ DISTANCE: 1 meters
- ▣ LIMIT: $55 + 10 \log_{10} (W) =$ 46.37 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	EIRP (dBm)	dBc
39750 (2506.0)	5,012.00	-56.77	12.65	-67.82	3.35	H	-58.52	79.89
	7,518.00	-47.86	11.30	-49.85	4.30	V	-42.85	64.22
	10,024.00	-52.01	11.05	-49.15	5.02	H	-43.12	64.49
40620 (2593.0)	5,186.00	-53.59	12.75	-65.36	3.44	H	-56.05	77.42
	7,779.00	-48.06	11.65	-50.70	4.36	V	-43.41	64.78
	10,372.00	-47.78	10.75	-44.52	5.16	H	-38.93	60.30
41490 (2680.0)	5,360.00	-53.44	13.28	-64.56	3.51	H	-54.79	76.16
	8,040.00	-44.24	10.93	-44.89	4.48	V	-38.44	59.81
	10,720.00	-49.99	10.90	-47.20	5.24	V	-41.54	62.91

8.3 PEAK-TO-AVERAGE RATIO

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (dB)
41	5 MHz	2593.0	QPSK	25	0	5.54
			16-QAM			6.09
			64-QAM			6.22
	10 MHz		QPSK	50		5.55
			16-QAM			6.07
			64-QAM			6.19
	15 MHz		QPSK	75		5.39
			16-QAM			6.07
			64-QAM			6.05
	20 MHz		QPSK	100		5.53
			16-QAM			6.09
			64-QAM			6.12

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 63 ~ 74.

8.4 OCCUPIED BANDWIDTH

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
41	5 MHz	2593.0	QPSK	25	0	4.5403
			16-QAM			4.5129
			64-QAM			4.5186
	10 MHz		QPSK	50		9.0541
			16-QAM			8.9883
			64-QAM			8.9968
	15 MHz		QPSK	75		13.454
			16-QAM			13.465
			64-QAM			13.475
	20 MHz		QPSK	100		18.021
			16-QAM			17.984
			64-QAM			17.923

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 51 ~ 62.

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)
41	5	2498.5	26.1362	34.111	-76.836	-42.725	-25.00
		2593.0	26.1048	34.111	-76.765	-42.654	
		2687.5	26.4018	34.111	-76.894	-42.783	
	10	2501.0	26.1498	34.111	-77.031	-42.920	
		2593.0	26.1935	34.111	-76.344	-42.233	
		2685.0	26.0896	34.111	-76.706	-42.595	
	15	2503.5	26.1469	34.111	-76.801	-42.690	
		2593.0	26.1287	34.111	-76.858	-42.747	
		2682.5	26.4451	34.111	-76.918	-42.807	
	20	2506.0	26.1638	34.111	-76.712	-42.601	
		2593.0	26.1304	34.111	-76.680	-42.569	
		2680.0	25.8012	34.111	-76.789	-42.678	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 103 ~ 130.
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. Duty Cycle factor already applied on the factor.
 - Duty Cycle factor(dB) = 3.98
 - Factor(dB) = Duty Cycle factor + Cable Loss + Ext. Attenuator + Power Splitter
 - Result(dBm) = Reading + Factor

Frequency Range (GHz)	Factor [dB]
0.03 – 1	29.250
1 – 5	31.956
5 – 10	32.571
10 – 15	33.096
15 – 20	33.469
Above 20(26.5)	34.111

Note: Factor(dB) = Duty Cycle factor + Cable Loss + Ext. Attenuator + Power Splitter

8.6 CHANNEL EDGE

Band Width	Frequency (MHz)	Modulation	RB (Size/Offset)	2 495 MHz ~ 2 496 MHz	C.E ~ (C.E +1MHz)	2 490.5 MHz ~ 2 495 MHz	(C.E + 1 MHz) ~ (C.E + 5 MHz)	Below 2 490.5 MHz	(C.E + 5 MHz) ~ (C.E + X MHz)	Above (C.E + X MHz)
				Lower	Upper	Lower	Upper	Lower	Upper	Upper
5 MHz	2498.5	QPSK	25/0	-23.29	-21.66	-24.36	-17.89	-32.95	-30.20	-31.24
10 MHz	2501.0	QPSK	50/0	-27.77	-22.64	-27.05	-18.34	-31.28	-23.44	-34.56
15 MHz	2503.5	QPSK	75/0	-28.61	-23.48	-27.84	-20.39	-32.09	-22.99	-37.01
20 MHz	2506.0	QPSK	100/0	-29.57	-22.94	-28.51	-20.36	-31.26	-22.51	-37.55
Limit				-13.0	-10.0	-13.0	-10.0	-25.0	-13.0	-25.0

Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	C.E ~ (C.E ± 1MHz)		(C.E ± 1 MHz) ~ (C.E ± 5 MHz)	
					Lower	Upper	Lower	Upper
5 MHz	2593.0	QPSK	25	0	-23.83	-21.94	-24.23	-22.54
	2687.5	QPSK	25	0	-22.29	-21.11	-19.22	-18.45
10 MHz	2593.0	QPSK	50	0	-25.29	-23.75	-26.71	-23.46
	2685.0	QPSK	50	0	-24.92	-23.71	-23.62	-20.89
15 MHz	2593.0	QPSK	75	0	-28.70	-27.04	-28.58	-24.46
	2682.5	QPSK	75	0	-29.07	-24.69	-26.32	-21.65
20 MHz	2593.0	QPSK	100	0	-27.91	-27.63	-29.00	-25.17
	2680.0	QPSK	100	0	-27.86	-24.98	-27.80	-22.29
Limit					-10.0		-10.0	

Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	(C.E ± 5 MHz) ~ (C.E ± X MHz)		Above (C.E ± X MHz)	
					Lower	Upper	Lower	Upper
5 MHz	2593.0	QPSK	25	0	-30.07	-29.77	-32.28	-32.05
	2687.5	QPSK	25	0	-28.39	-28.71	-31.27	-31.33
10 MHz	2593.0	QPSK	50	0	-30.10	-27.58	-34.22	-33.58
	2685.0	QPSK	50	0	-26.23	-24.02	-31.66	-31.95
15 MHz	2593.0	QPSK	75	0	-30.49	-26.77	-36.33	-35.03
	2682.5	QPSK	75	0	-28.62	-24.12	-35.11	-37.28
20 MHz	2593.0	QPSK	100	0	-29.39	-27.14	-36.48	-35.00
	2680.0	QPSK	100	0	-28.65	-23.99	-34.36	-41.56
Limit					-13.0		-25.0	

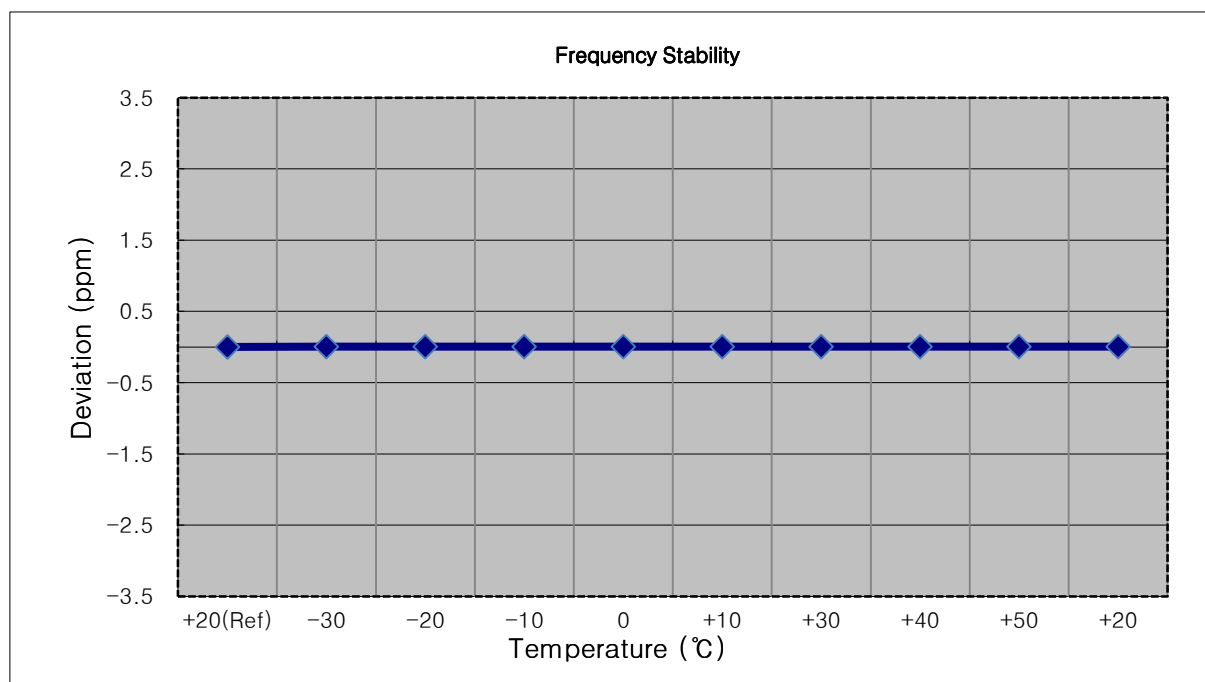
Note:

1. C.E = Channel Edge
2. X = X is the greater of 6MHz or the actual emission bandwidth.
3. X = 6MHz(5MHz Bandwidth), 10MHz(10MHz Bandwidth), 15MHz(15MHz Bandwidth), 20MHz(20MHz Bandwidth)
4. Plots of the EUT's Channel Edge are shown Page 75 ~ 102. (1RB & Full RB)

8.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

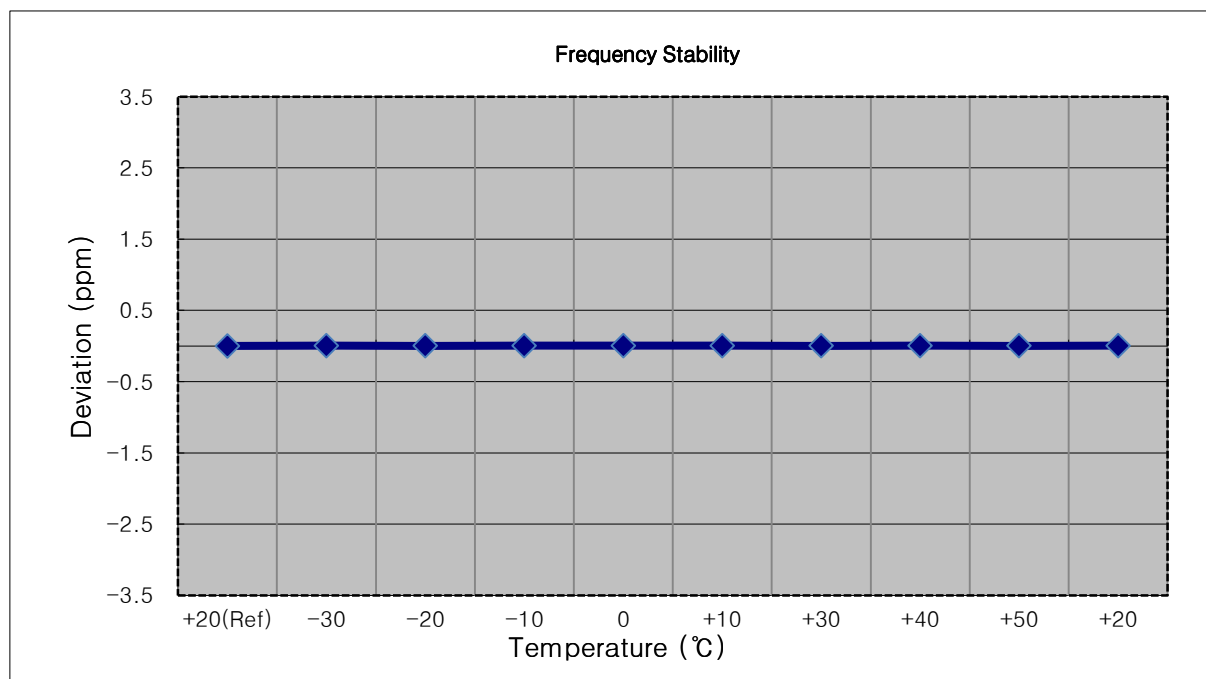
- MODE: LTE 41
- OPERATING FREQUENCY: 2498,500,000 Hz
- BANDWIDTH: 39675 (5 MHz)
- REFERENCE VOLTAGE: 3.86 VDC
- DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2498 500 010	0.0	0.000 000	0.000
100%		-30	2498 500 021	10.7	0.000 000	0.004
100%		-20	2498 500 021	11.3	0.000 000	0.005
100%		-10	2498 500 018	8.3	0.000 000	0.003
100%		0	2498 500 018	8.4	0.000 000	0.003
100%		+10	2498 500 019	9.3	0.000 000	0.004
100%		+30	2498 500 020	10.3	0.000 000	0.004
100%		+40	2498 500 018	8.6	0.000 000	0.003
100%		+50	2498 500 020	10.5	0.000 000	0.004
85%	3.400	+20	2498 500 020	9.7	0.000 000	0.004



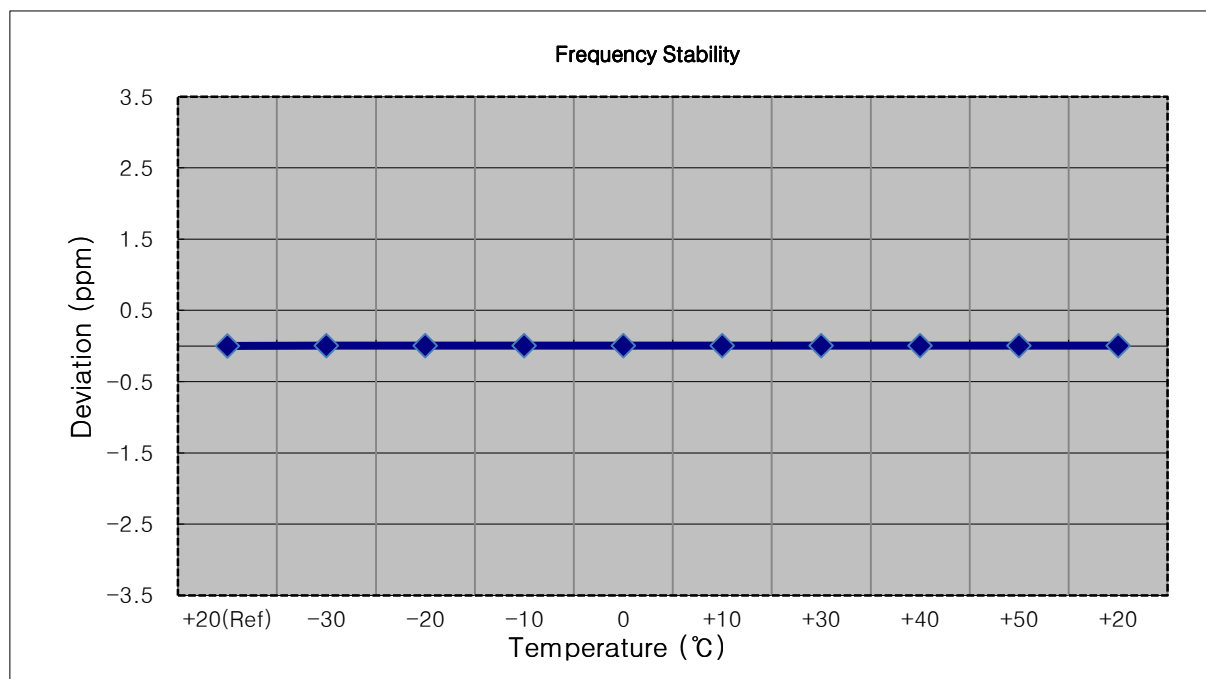
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2501,000,000 Hz
☐ BANDWIDTH: 39700 (10 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2501 000 008	0.0	0.000 000	0.000
100%		-30	2501 000 017	8.5	0.000 000	0.003
100%		-20	2501 000 014	6.2	0.000 000	0.002
100%		-10	2501 000 016	7.8	0.000 000	0.003
100%		0	2501 000 018	9.3	0.000 000	0.004
100%		+10	2501 000 016	7.6	0.000 000	0.003
100%		+30	2501 000 013	5.2	0.000 000	0.002
100%		+40	2501 000 018	9.6	0.000 000	0.004
100%		+50	2501 000 016	7.4	0.000 000	0.003
85%	3.400	+20	2501 000 018	9.8	0.000 000	0.004



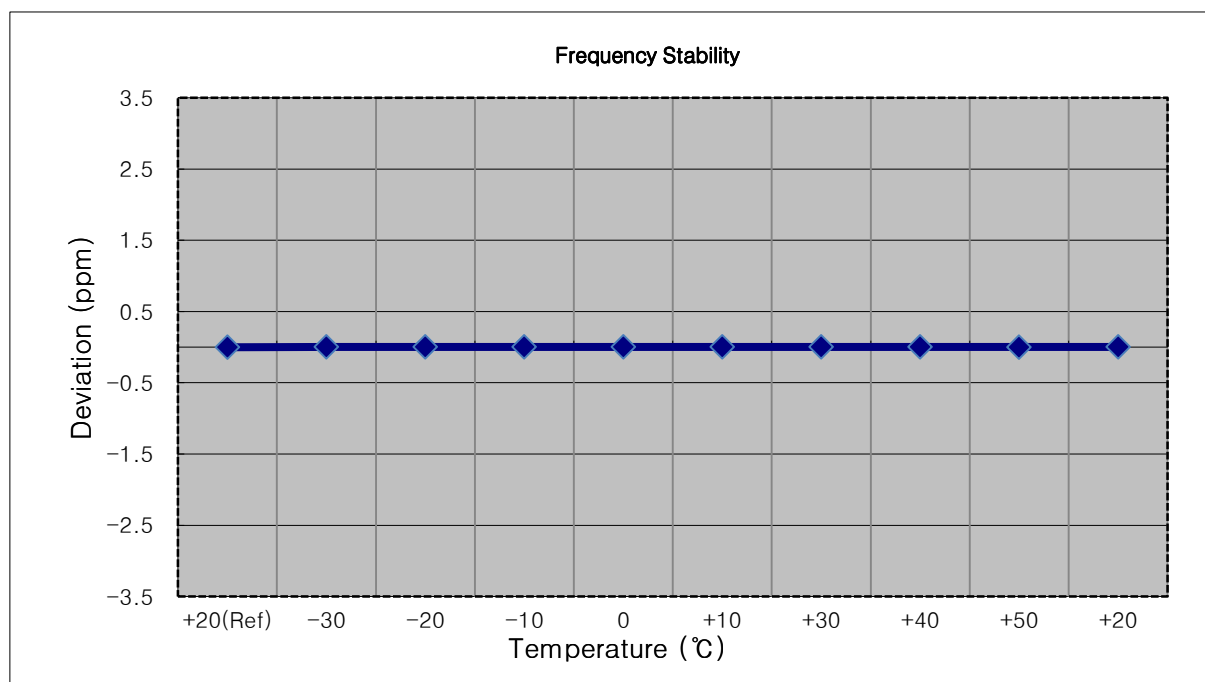
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2503,500,000 Hz
☐ BANDWIDTH: 39725 (15 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2503 500 010	0.0	0.000 000	0.000
100%		-30	2503 500 020	9.6	0.000 000	0.004
100%		-20	2503 500 020	9.6	0.000 000	0.004
100%		-10	2503 500 019	8.6	0.000 000	0.003
100%		0	2503 500 021	10.9	0.000 000	0.004
100%		+10	2503 500 021	10.8	0.000 000	0.004
100%		+30	2503 500 019	8.8	0.000 000	0.004
100%		+40	2503 500 021	10.4	0.000 000	0.004
100%		+50	2503 500 020	9.3	0.000 000	0.004
85%	3.400	+20	2503 500 018	7.9	0.000 000	0.003



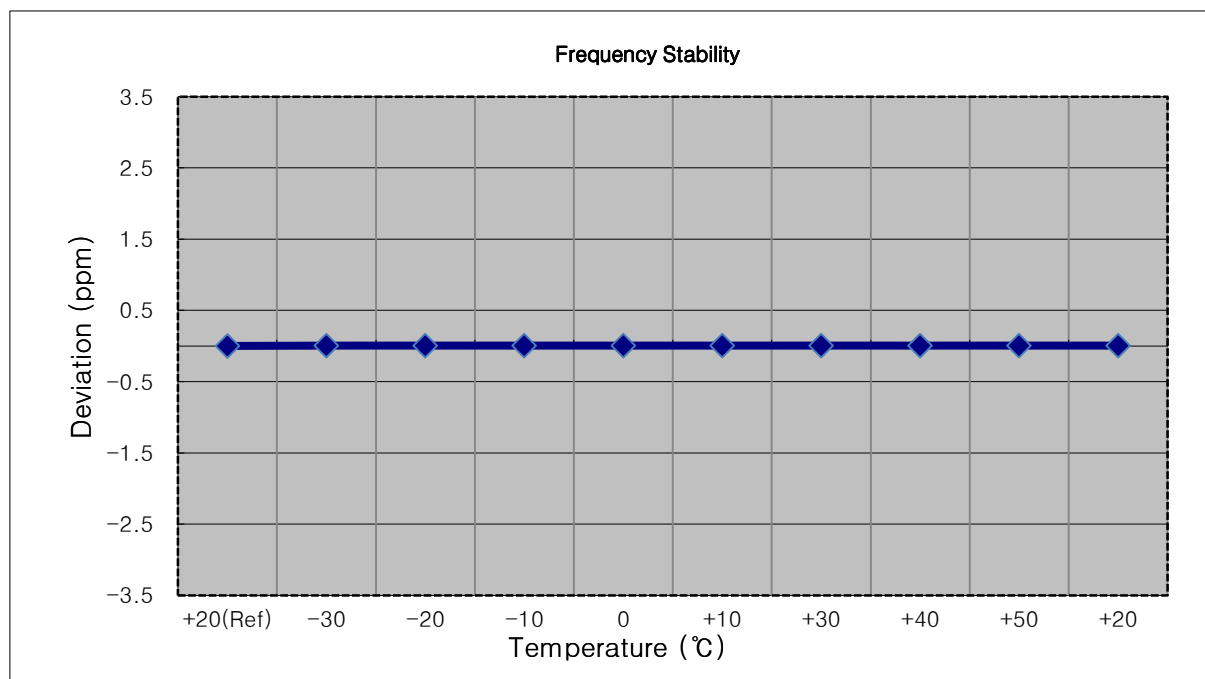
MODE: LTE 41
 OPERATING FREQUENCY: 2506,000,000 Hz
 BANDWIDTH: 39750 (20 MHz)
 REFERENCE VOLTAGE: 3.86 VDC
 DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2506 000 008	0.0	0.000 000	0.000
100%		-30	2506 000 015	7.2	0.000 000	0.003
100%		-20	2506 000 017	8.9	0.000 000	0.004
100%		-10	2506 000 017	9.0	0.000 000	0.004
100%		0	2506 000 015	7.1	0.000 000	0.003
100%		+10	2506 000 017	9.3	0.000 000	0.004
100%		+30	2506 000 016	8.0	0.000 000	0.003
100%		+40	2506 000 017	8.8	0.000 000	0.004
100%		+50	2506 000 015	6.5	0.000 000	0.003
85%	3.400	+20	2506 000 018	10.1	0.000 000	0.004



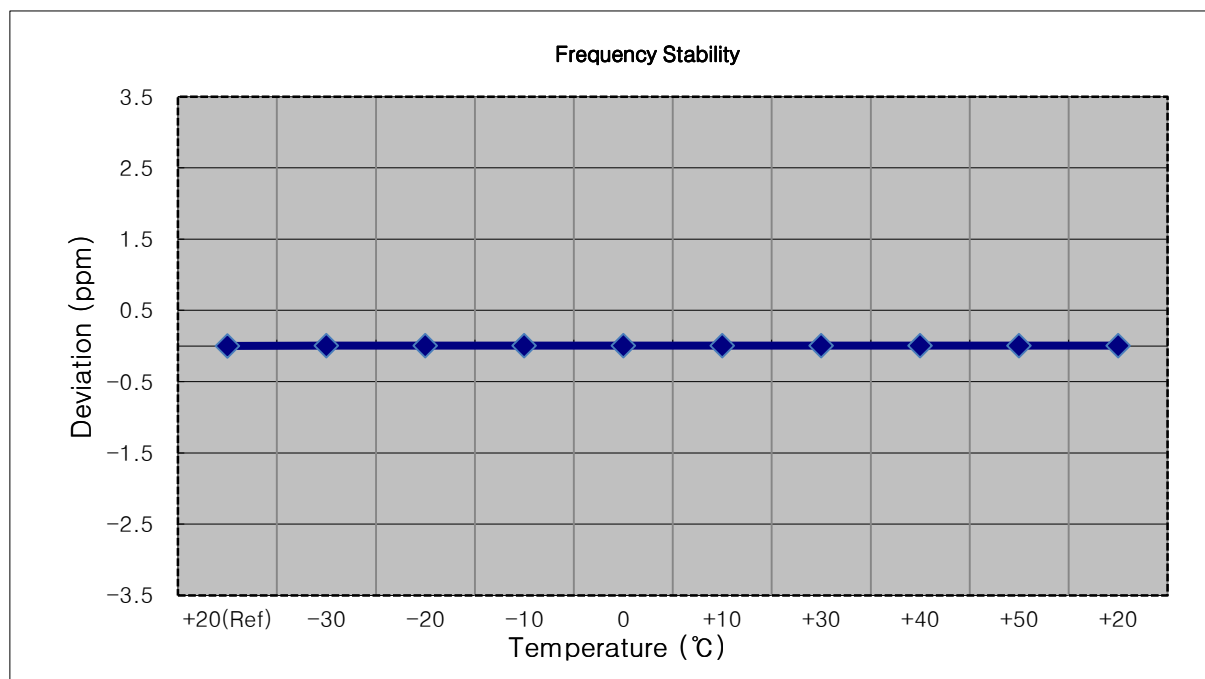
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2593,000,000 Hz
☐ BANDWIDTH: 40620 (5 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2593 000 011	0.0	0.000 000	0.000
100%		-30	2593 000 021	9.6	0.000 000	0.004
100%		-20	2593 000 023	11.4	0.000 000	0.004
100%		-10	2593 000 020	8.7	0.000 000	0.003
100%		0	2593 000 022	10.4	0.000 000	0.004
100%		+10	2593 000 022	10.6	0.000 000	0.004
100%		+30	2593 000 024	12.9	0.000 000	0.005
100%		+40	2593 000 024	12.9	0.000 000	0.005
100%		+50	2593 000 020	8.6	0.000 000	0.003
85%	3.400	+20	2593 000 022	10.2	0.000 000	0.004



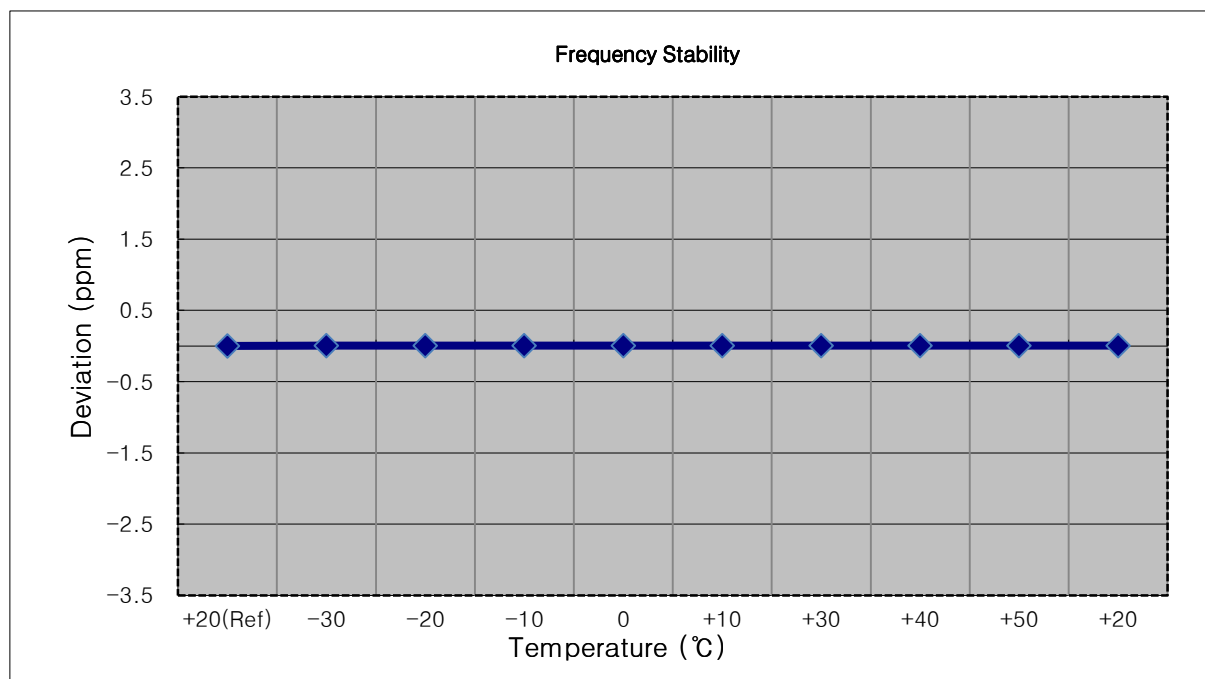
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2593,000,000 Hz
☐ BANDWIDTH: 40620 (10 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2593 000 008	0.0	0.000 000	0.000
100%		-30	2593 000 021	13.3	0.000 001	0.005
100%		-20	2593 000 020	12.1	0.000 000	0.005
100%		-10	2593 000 018	9.8	0.000 000	0.004
100%		0	2593 000 018	9.7	0.000 000	0.004
100%		+10	2593 000 017	8.7	0.000 000	0.003
100%		+30	2593 000 017	8.7	0.000 000	0.003
100%		+40	2593 000 017	9.1	0.000 000	0.004
100%		+50	2593 000 019	10.8	0.000 000	0.004
85%	3.400	+20	2593 000 018	9.7	0.000 000	0.004



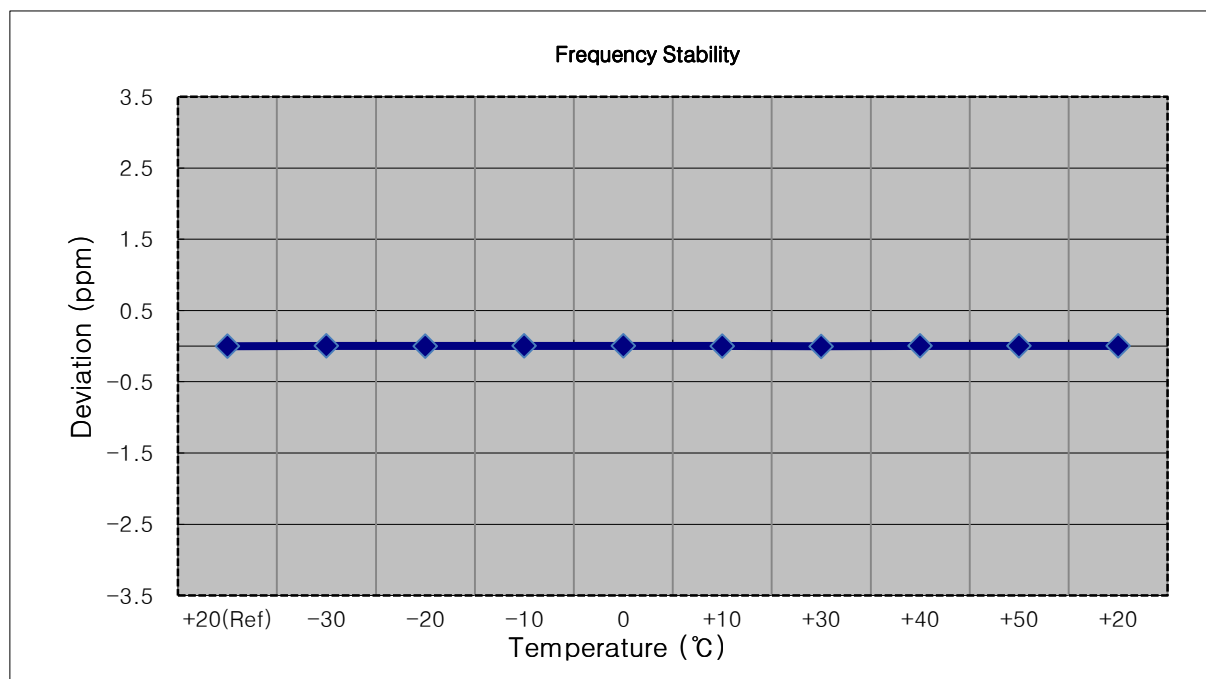
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2593,000,000 Hz
☐ BANDWIDTH: 40620 (15 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2593 000 008	0.0	0.000 000	0.000
100%		-30	2593 000 021	13.2	0.000 001	0.005
100%		-20	2593 000 018	10.7	0.000 000	0.004
100%		-10	2593 000 020	12.7	0.000 000	0.005
100%		0	2593 000 017	8.9	0.000 000	0.003
100%		+10	2593 000 017	9.2	0.000 000	0.004
100%		+30	2593 000 019	11.0	0.000 000	0.004
100%		+40	2593 000 019	11.7	0.000 000	0.005
100%		+50	2593 000 020	12.2	0.000 000	0.005
85%	3.400	+20	2593 000 019	11.3	0.000 000	0.004



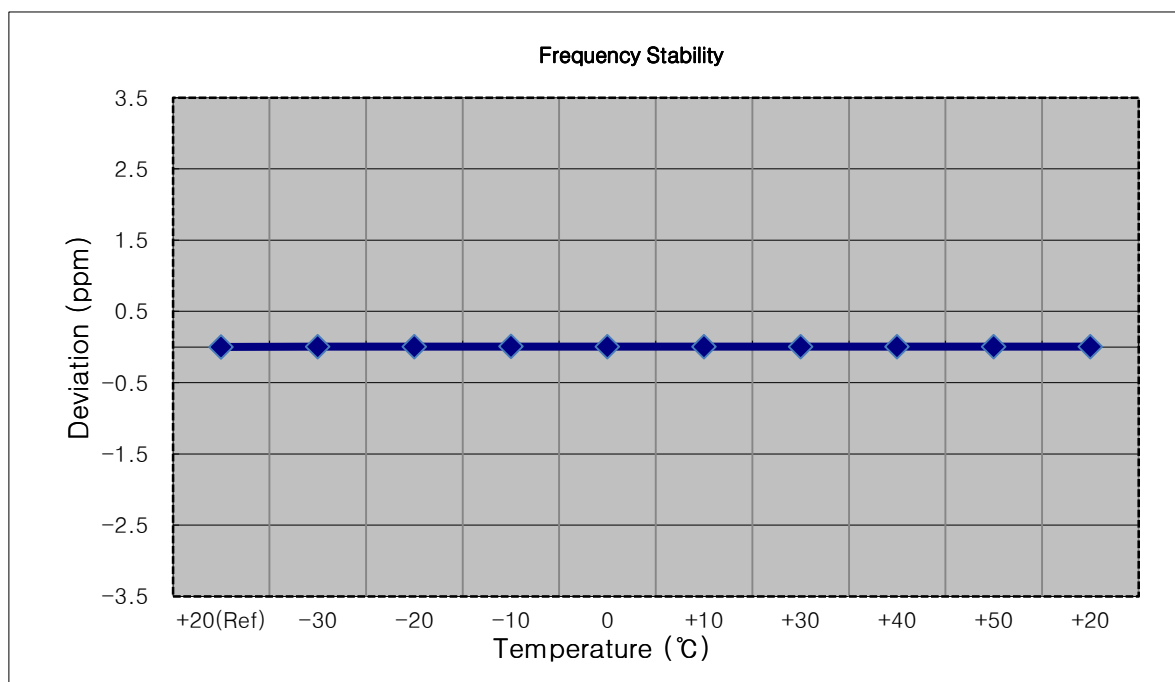
- ▣ MODE: LTE 41
- ▣ OPERATING FREQUENCY: 2593,000,000 Hz
- ▣ BANDWIDTH: 40620 (20 MHz)
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2593 000 009	0.0	0.000 000	0.000
100%		-30	2593 000 016	7.8	0.000 000	0.003
100%		-20	2593 000 015	6.7	0.000 000	0.003
100%		-10	2593 000 017	8.8	0.000 000	0.003
100%		0	2593 000 016	7.1	0.000 000	0.003
100%		+10	2593 000 015	6.1	0.000 000	0.002
100%		+30	2593 000 002	-7.0	0.000 000	-0.003
100%		+40	2593 000 018	9.0	0.000 000	0.003
100%		+50	2593 000 016	7.4	0.000 000	0.003
85%	3.400	+20	2593 000 016	7.4	0.000 000	0.003



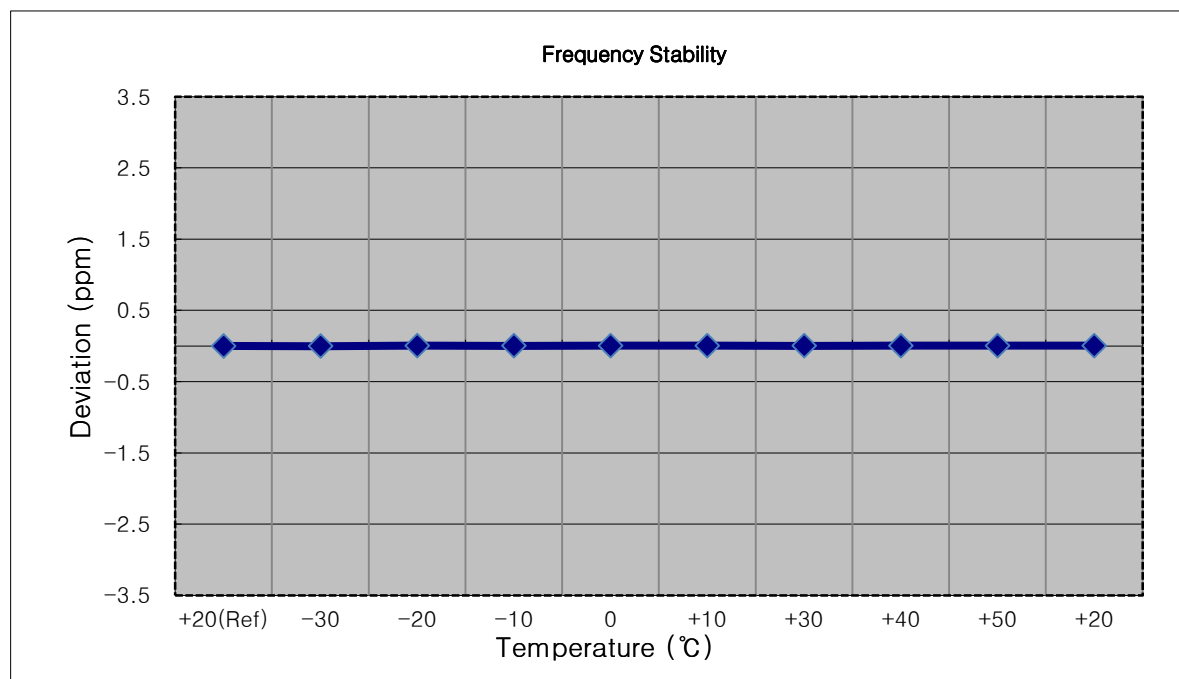
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2687,500,000 Hz
☐ BANDWIDTH: 41565 (5 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2687 500 013	0.0	0.000 000	0.000
100%		-30	2687 500 025	12.5	0.000 000	0.005
100%		-20	2687 500 025	11.6	0.000 000	0.004
100%		-10	2687 500 027	14.2	0.000 001	0.005
100%		0	2687 500 025	12.5	0.000 000	0.005
100%		+10	2687 500 025	11.9	0.000 000	0.004
100%		+30	2687 500 024	10.8	0.000 000	0.004
100%		+40	2687 500 023	10.1	0.000 000	0.004
100%		+50	2687 500 026	13.1	0.000 000	0.005
85%	3.400	+20	2687 500 025	11.7	0.000 000	0.004



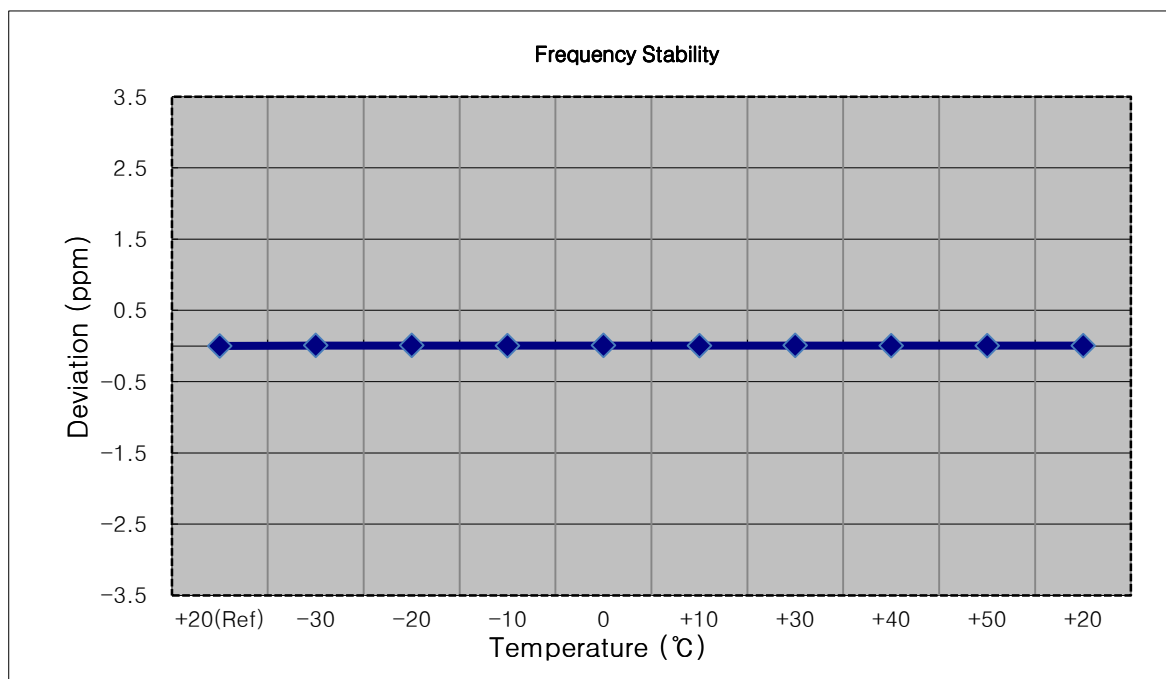
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2685,000,000 Hz
☐ BANDWIDTH: 41540 (10 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2685 000 010	0.0	0.000 000	0.000
100%		-30	2685 000 001	-8.9	0.000 000	-0.003
100%		-20	2685 000 020	9.8	0.000 000	0.004
100%		-10	2685 000 017	7.5	0.000 000	0.003
100%		0	2685 000 020	10.0	0.000 000	0.004
100%		+10	2685 000 019	9.7	0.000 000	0.004
100%		+30	2685 000 017	7.6	0.000 000	0.003
100%		+40	2685 000 018	8.2	0.000 000	0.003
100%		+50	2685 000 019	9.4	0.000 000	0.004
85%	3.400	+20	2685 000 024	13.9	0.000 001	0.005



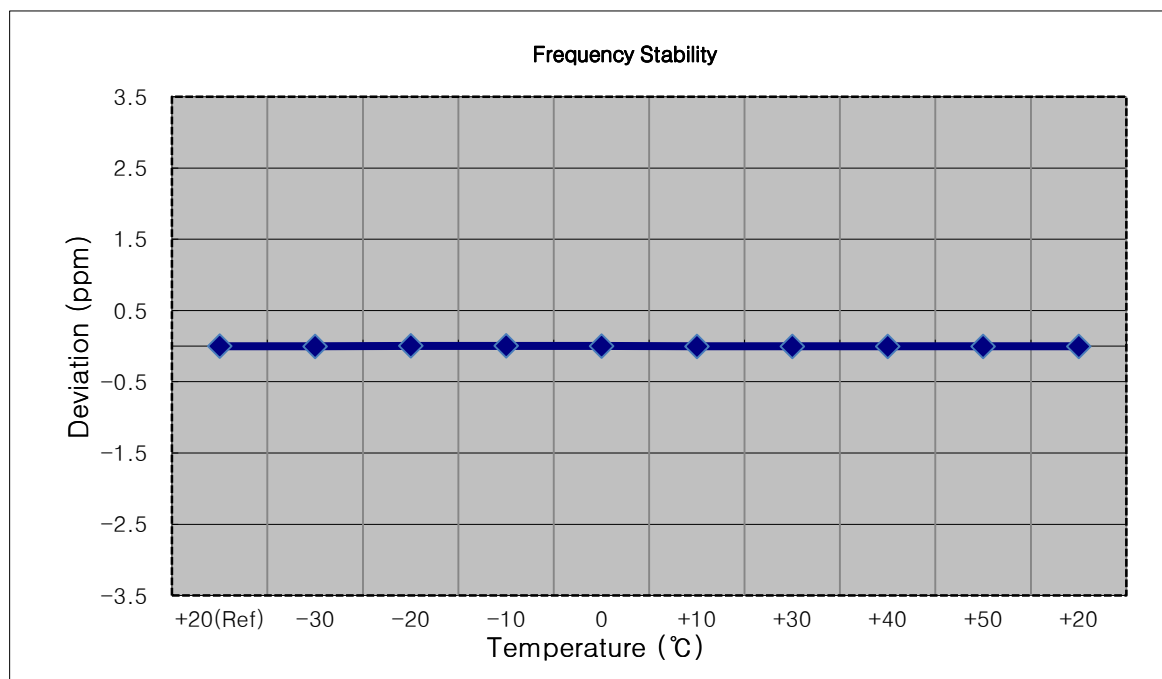
- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2682,500,000 Hz
☐ BANDWIDTH: 41515 (15 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2682 500 014	0.0	0.000 000	0.000
100%		-30	2682 500 028	14.1	0.000 001	0.005
100%		-20	2682 500 029	14.7	0.000 001	0.005
100%		-10	2682 500 027	12.8	0.000 000	0.005
100%		0	2682 500 030	16.2	0.000 001	0.006
100%		+10	2682 500 028	13.7	0.000 001	0.005
100%		+30	2682 500 031	16.6	0.000 001	0.006
100%		+40	2682 500 028	13.8	0.000 001	0.005
100%		+50	2682 500 025	11.1	0.000 000	0.004
85%	3.400	+20	2682 500 027	12.6	0.000 000	0.005



- ☐ MODE: LTE 41
☐ OPERATING FREQUENCY: 2680,000,000 Hz
☐ BANDWIDTH: 41490 (20 MHz)
☐ REFERENCE VOLTAGE: 3.86 VDC
☐ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.860	+20(Ref)	2680 000 008	0.0	0.000 000	0.000
100%		-30	2679 999 999	-8.8	0.000 000	-0.003
100%		-20	2680 000 015	7.1	0.000 000	0.003
100%		-10	2680 000 016	8.6	0.000 000	0.003
100%		0	2680 000 015	7.0	0.000 000	0.003
100%		+10	2680 000 000	-7.6	0.000 000	-0.003
100%		+30	2680 000 002	-6.1	0.000 000	-0.002
100%		+40	2680 000 000	-8.1	0.000 000	-0.003
100%		+50	2679 999 999	-8.2	0.000 000	-0.003
85%	3.400	+20	2680 000 000	-7.7	0.000 000	-0.003



8.8 GEO-LOCATION MECHANISM

The device uses a geo-location mechanism based on the cellular MCC codes in order to only enable certain LTE bands when the device is not in the USA.

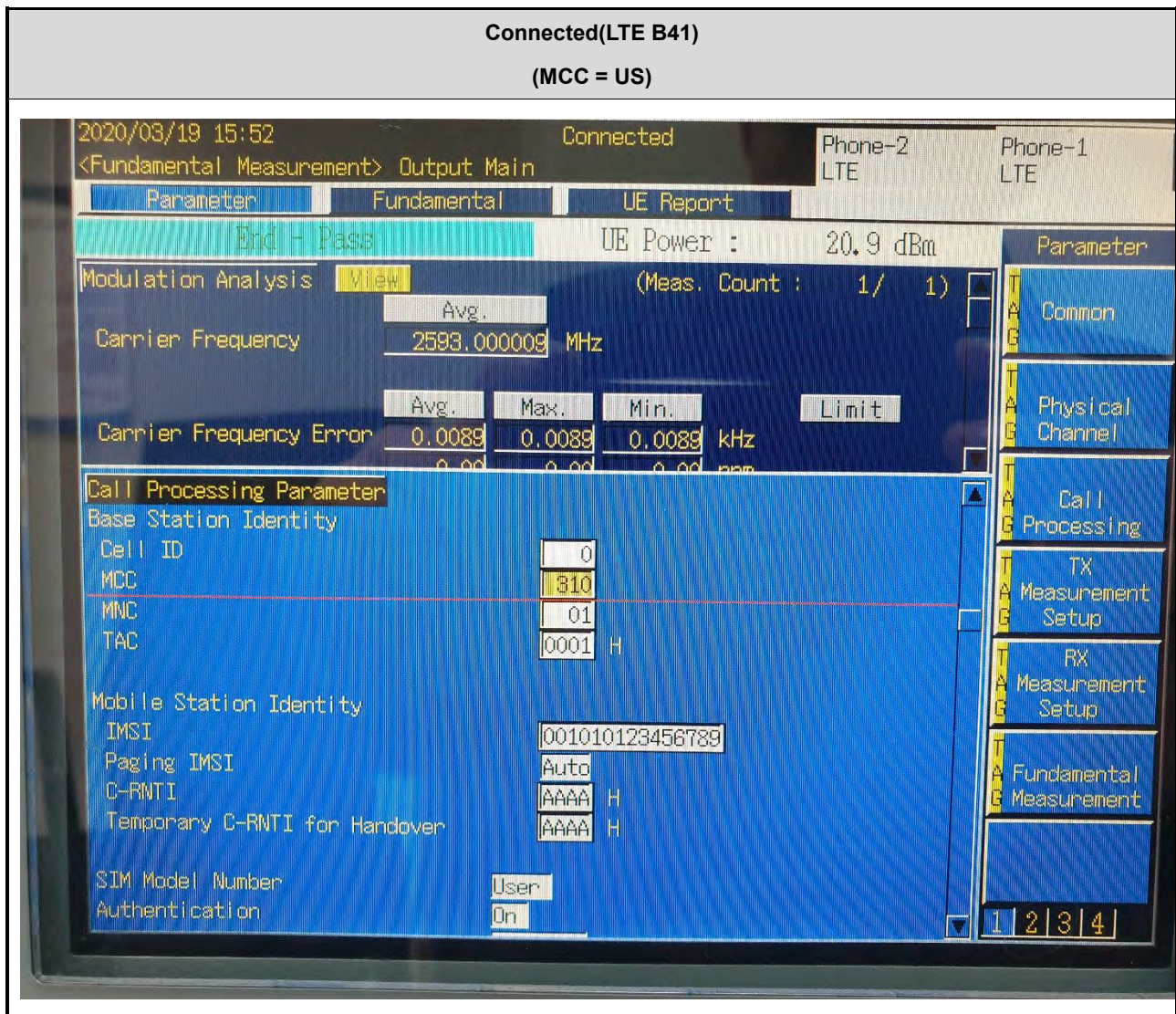
The validation of this mechanism is provided below. The device was configured for cellular communications to a test set and the MCC code was adjusted on the test set between the US MCC and then an MCC code valid for a country where the LTE band is supported.

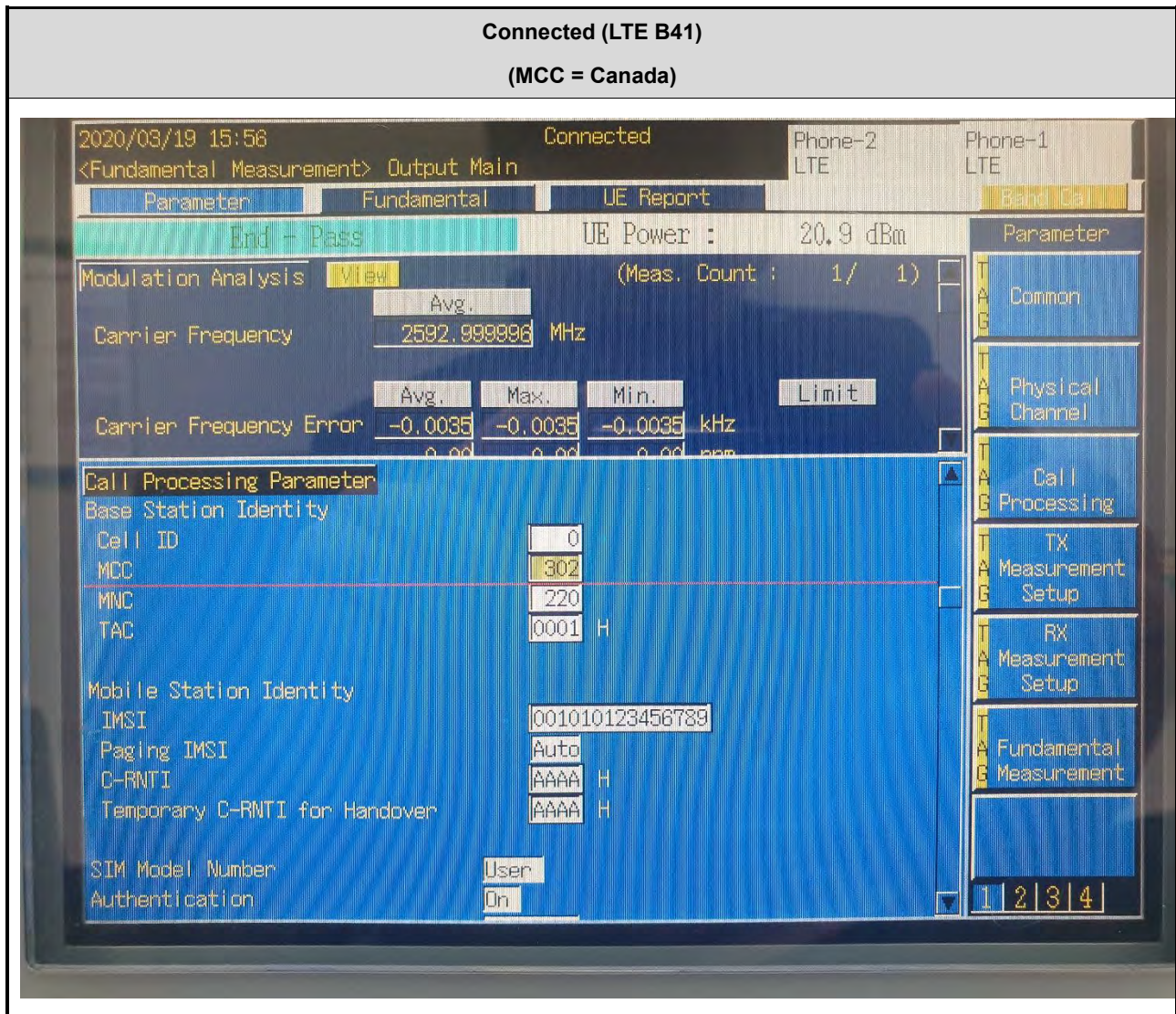
Band	MCC = USA	MCC = non US
41	Connected	Connected (Canada)

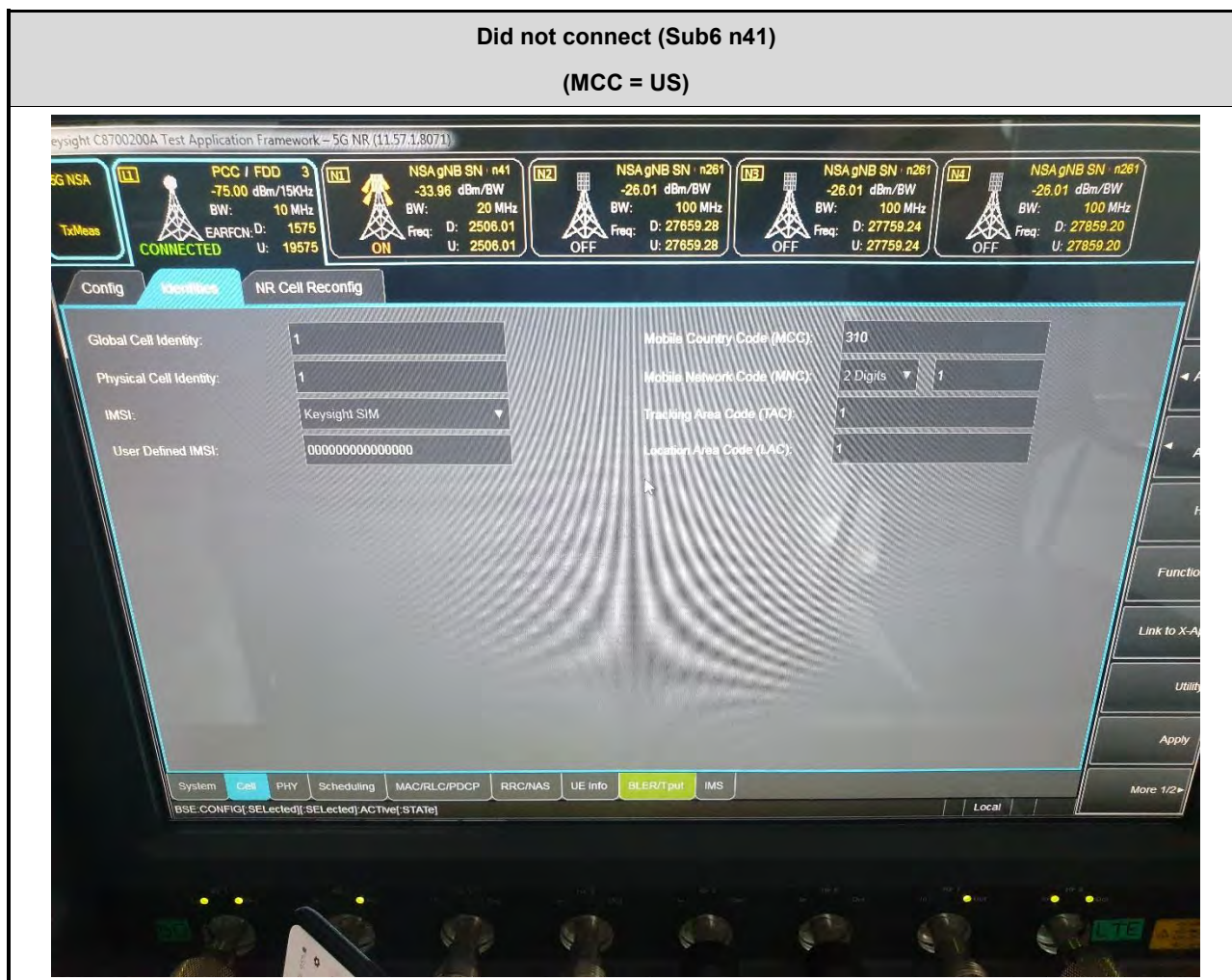
Band	MCC = USA
Sub6 n41	Did not connect
Sub6 n78	Did not connect

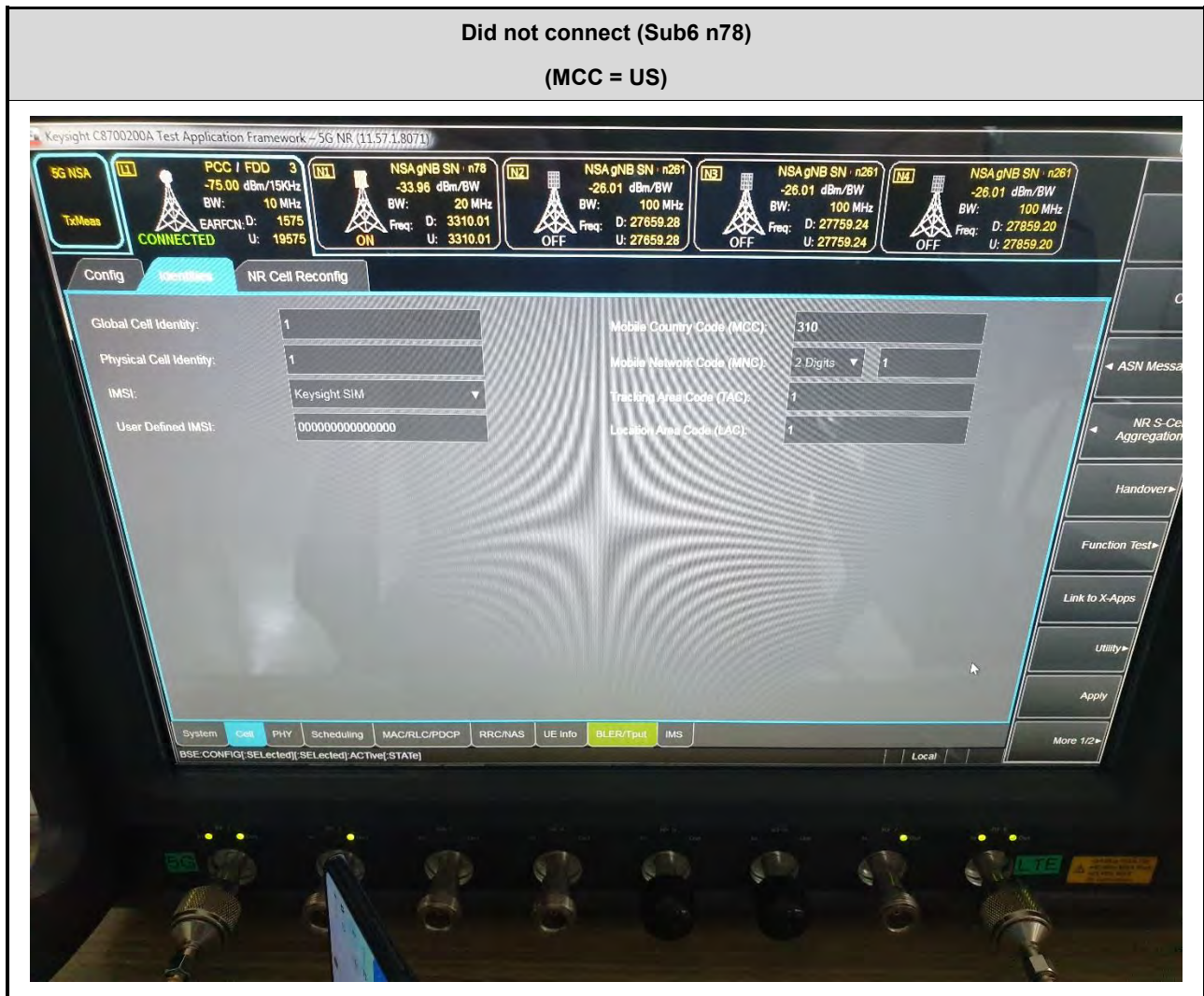
The verification tests confirmed the operational of the geo-location mechanism.

Verification test



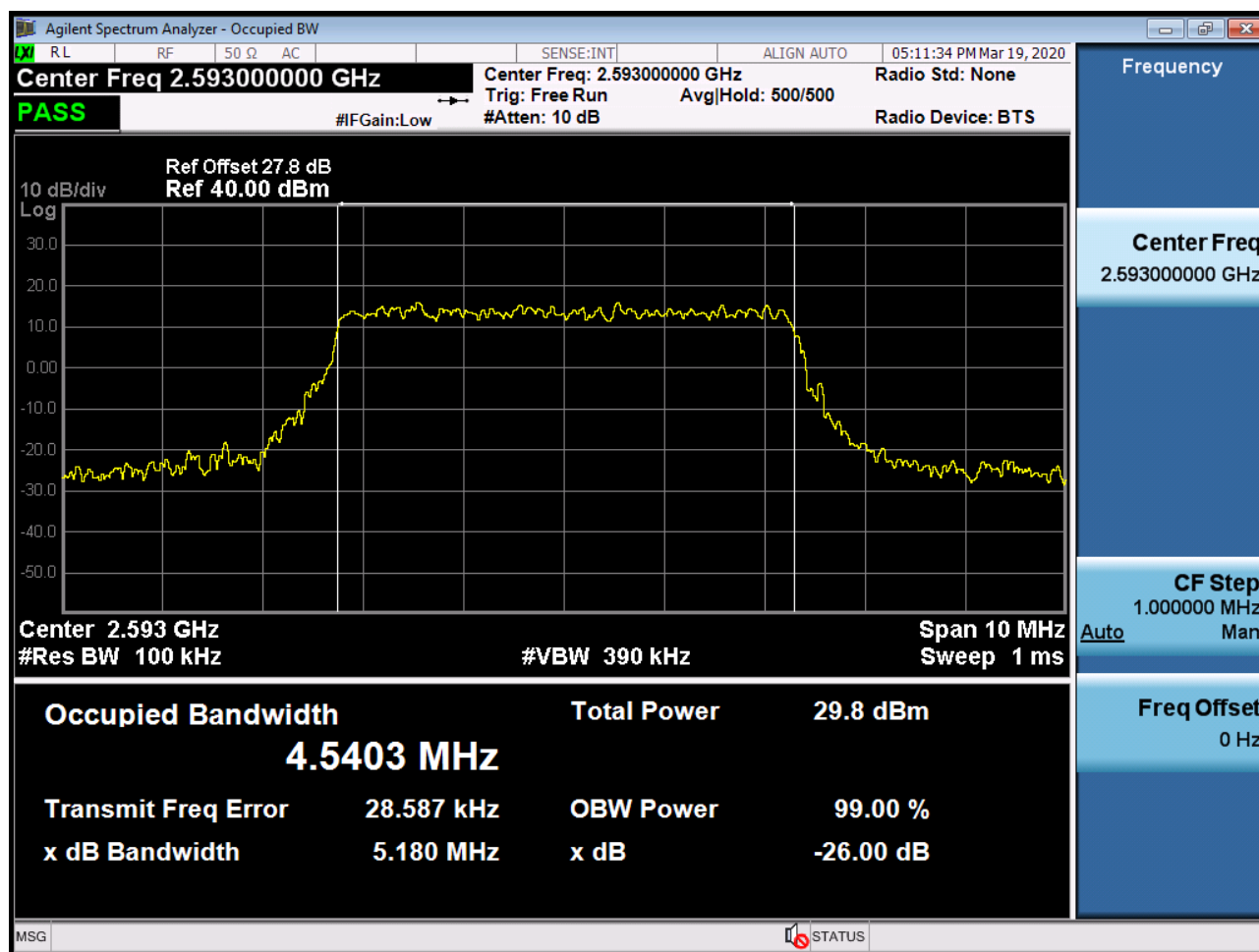




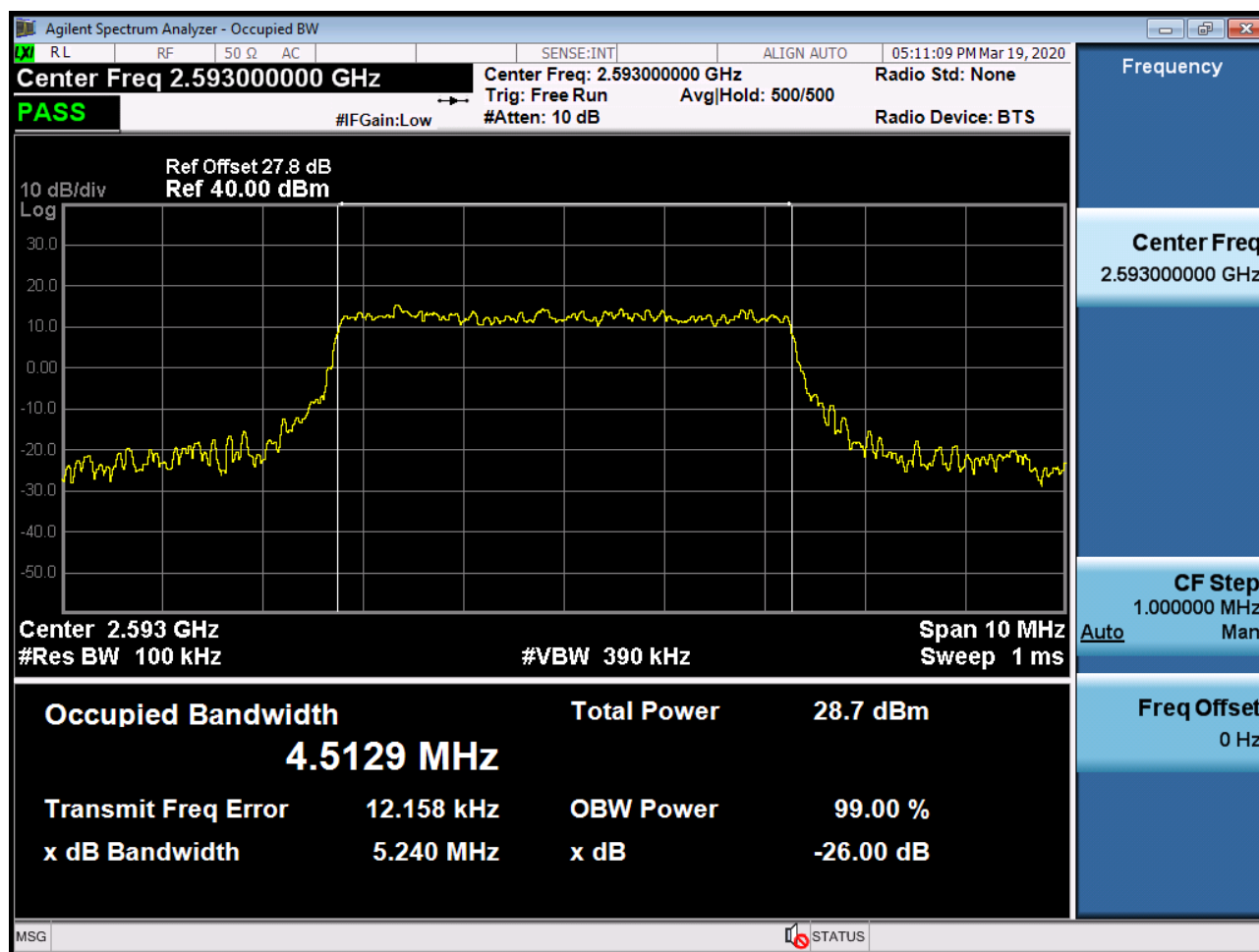


9. TEST PLOTS

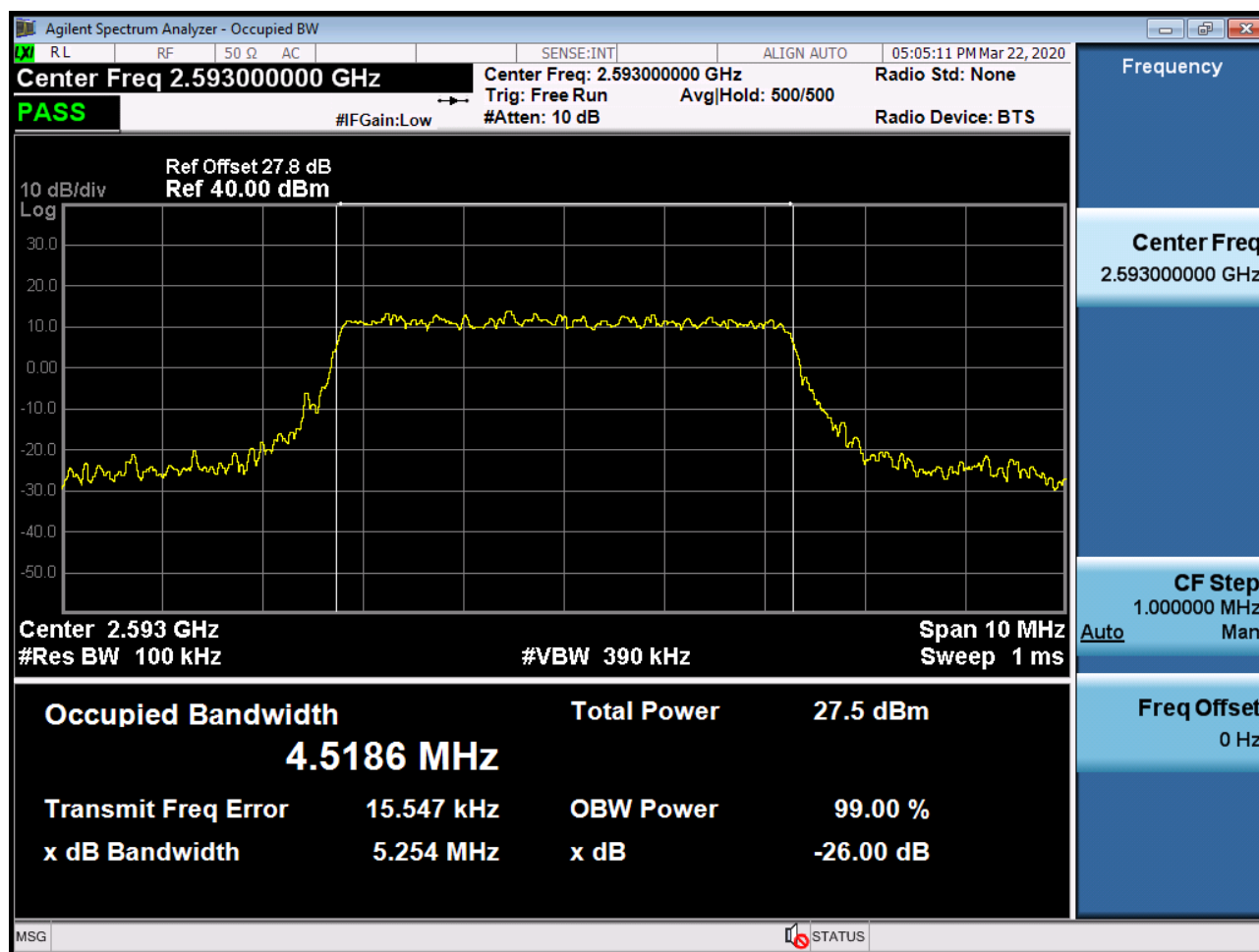
BAND 41. Occupied Bandwidth Plot (5 MHz Ch.40620 QPSK RB 25)



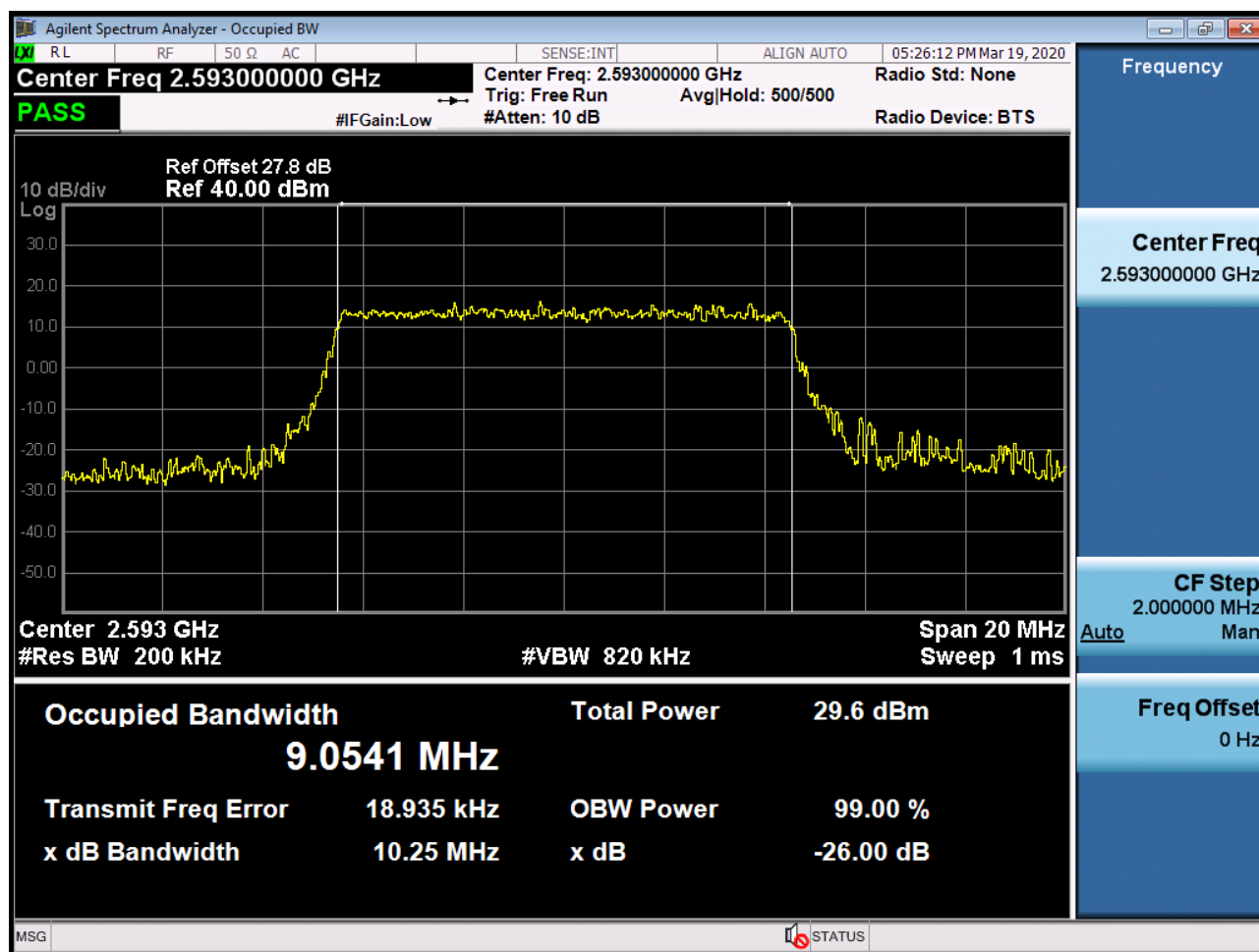
BAND 41. Occupied Bandwidth Plot (5 MHz Ch.40620 16-QAM RB 25)



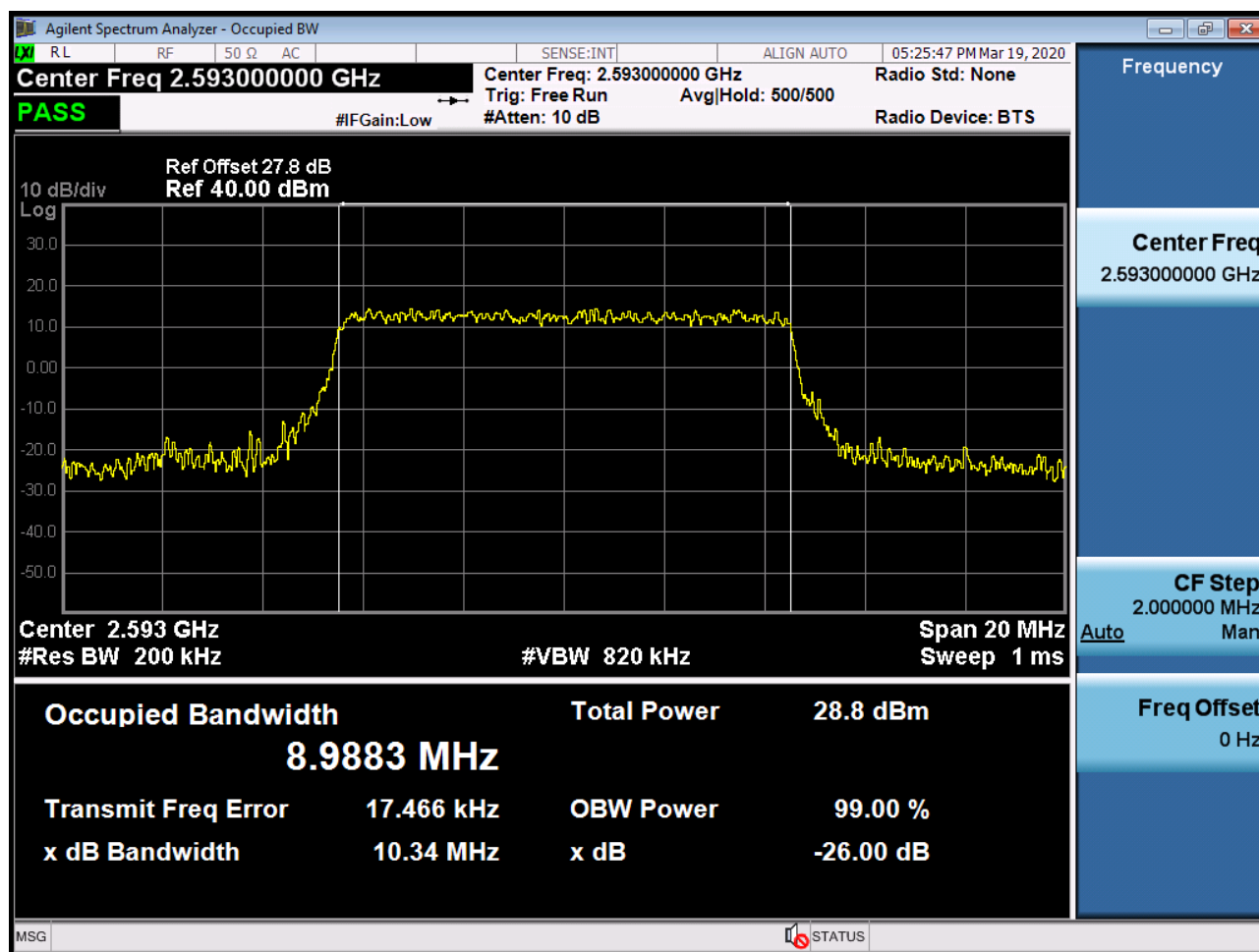
BAND 41. Occupied Bandwidth Plot (5 MHz Ch.40620 64-QAM RB 25)



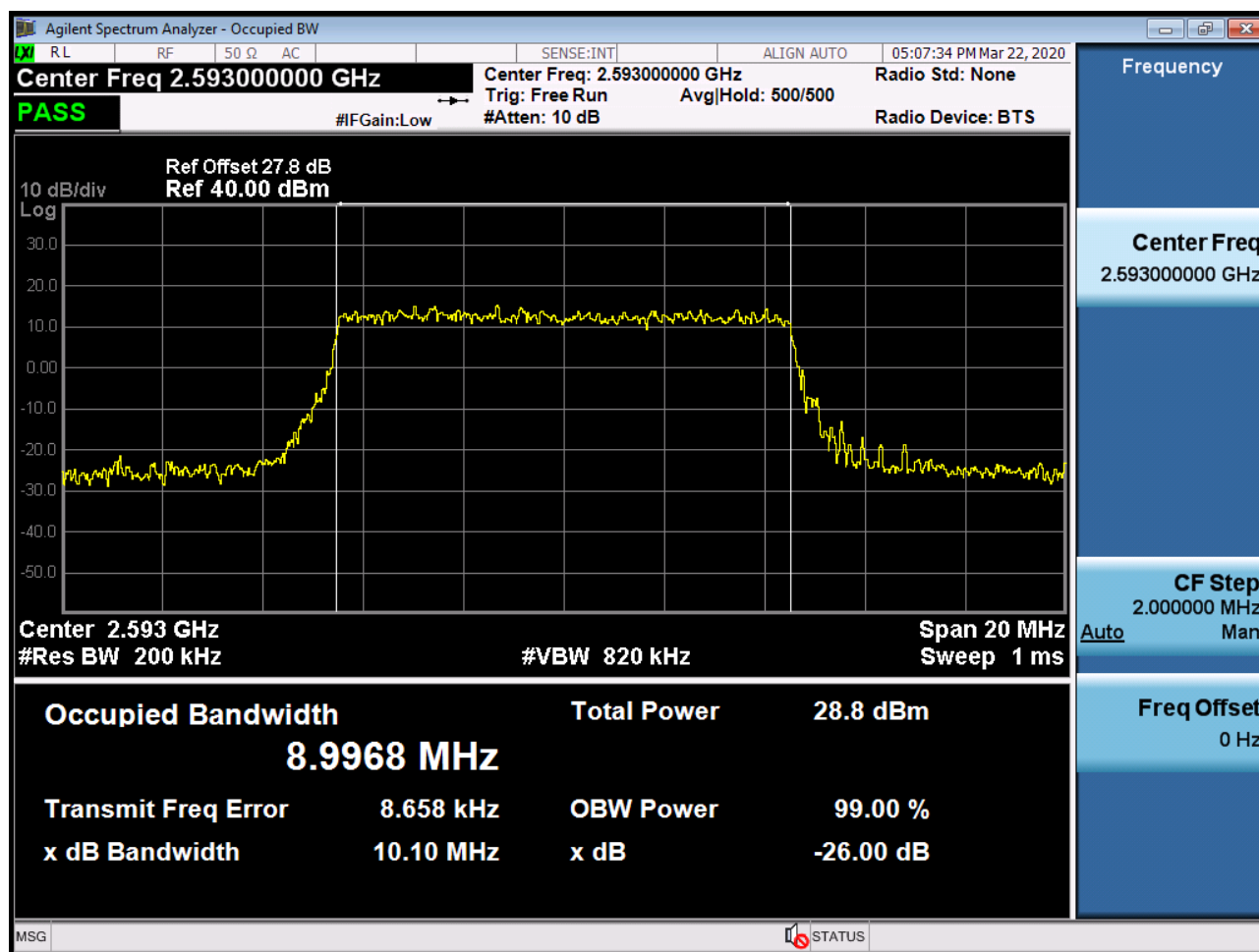
BAND 41. Occupied Bandwidth Plot (10 MHz Ch.40620 QPSK RB 50)



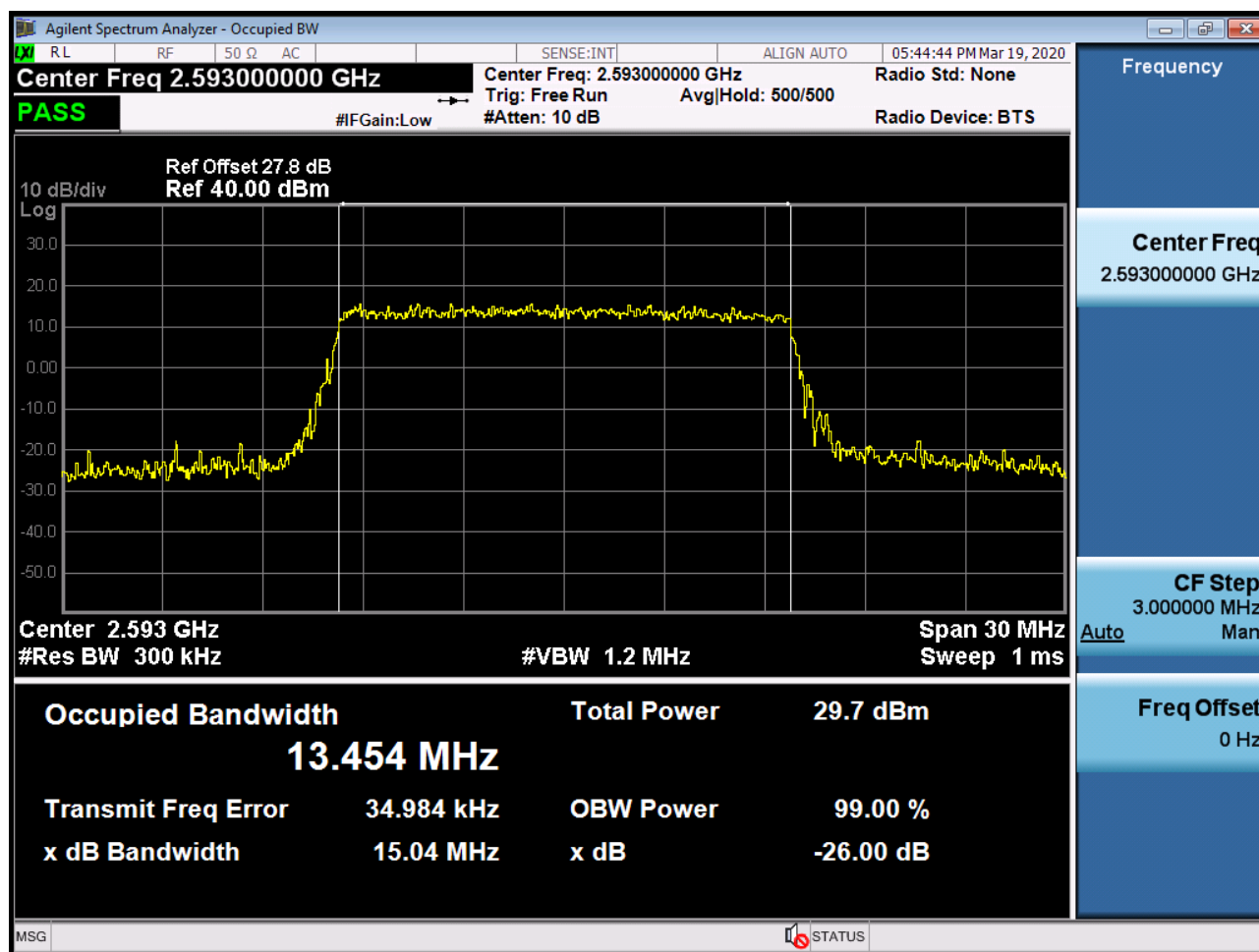
BAND 41. Occupied Bandwidth Plot (10 MHz Ch.40620 16-QAM RB 50)



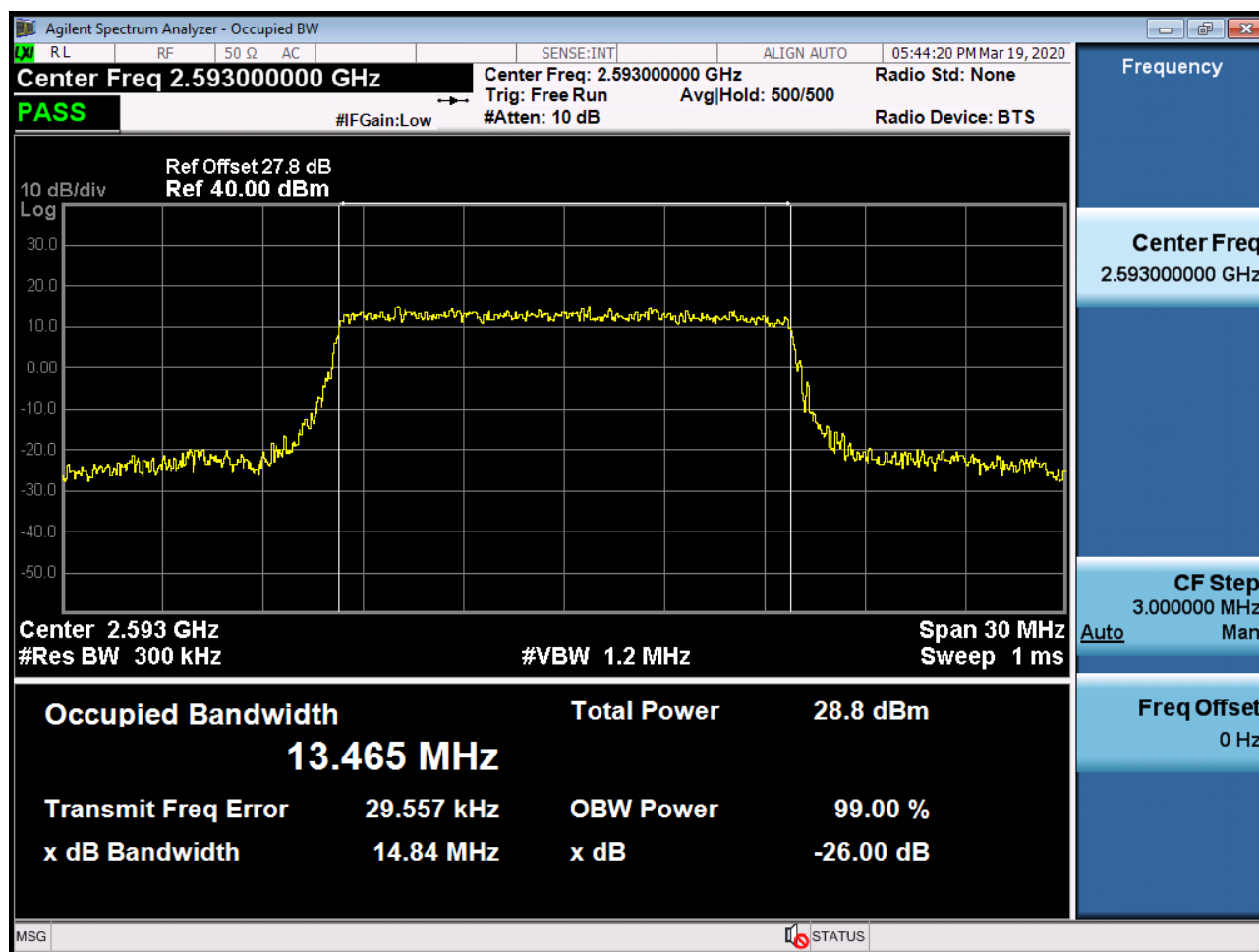
BAND 41. Occupied Bandwidth Plot (10 MHz Ch.40620 64-QAM RB 50)



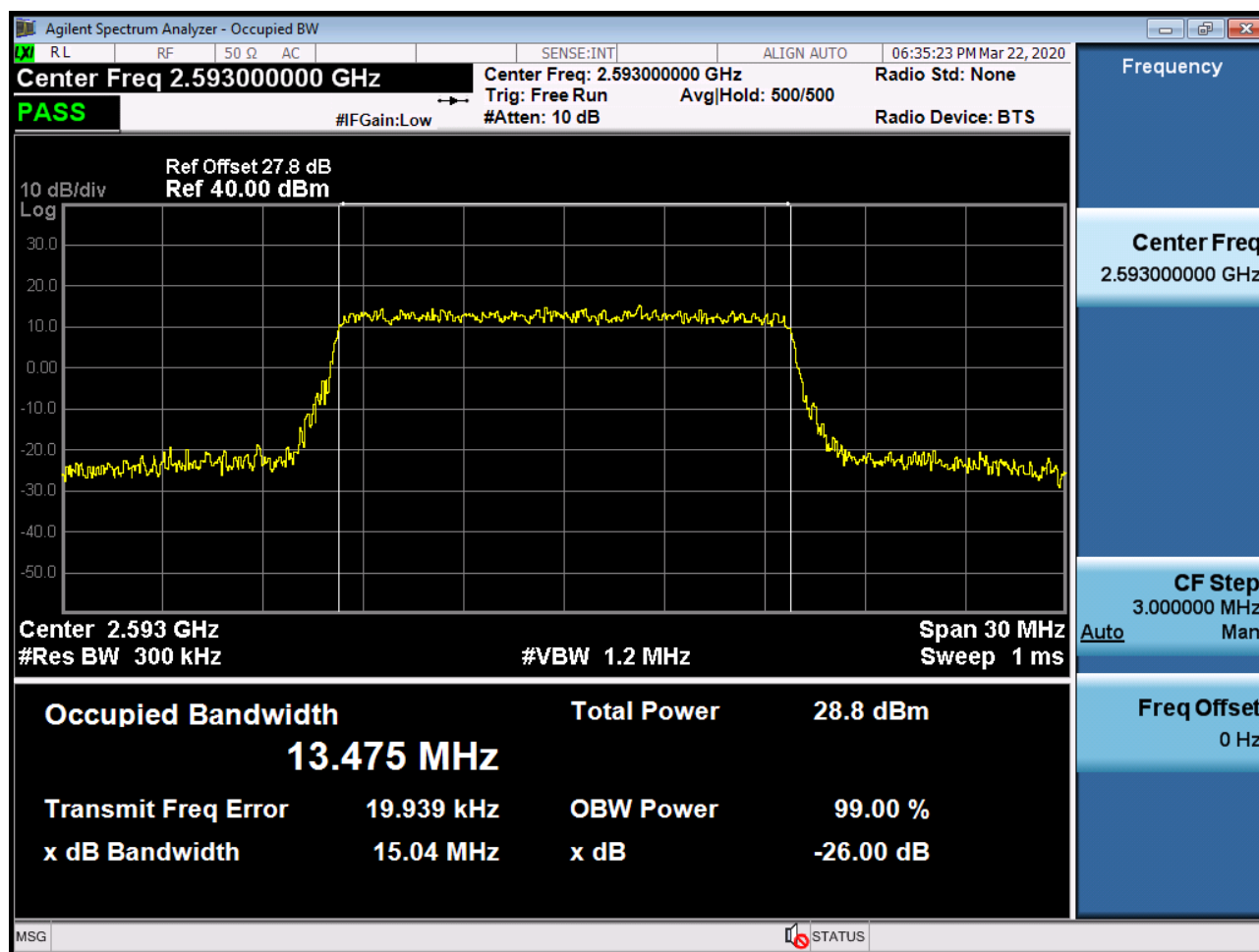
BAND 41. Occupied Bandwidth Plot (15 MHz Ch.40620 QPSK RB 75)



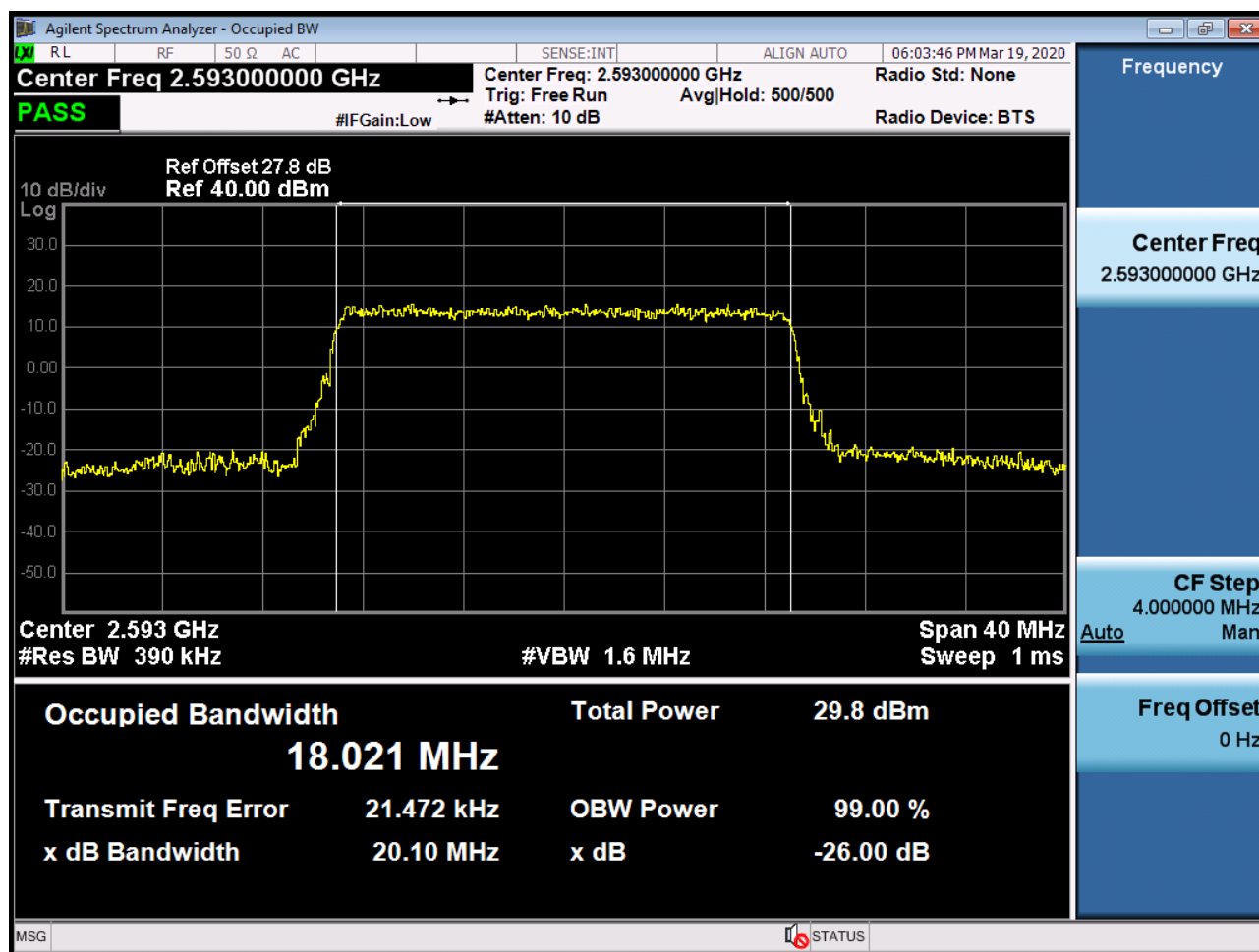
BAND 41. Occupied Bandwidth Plot (15 MHz Ch.40620 16-QAM RB 75)



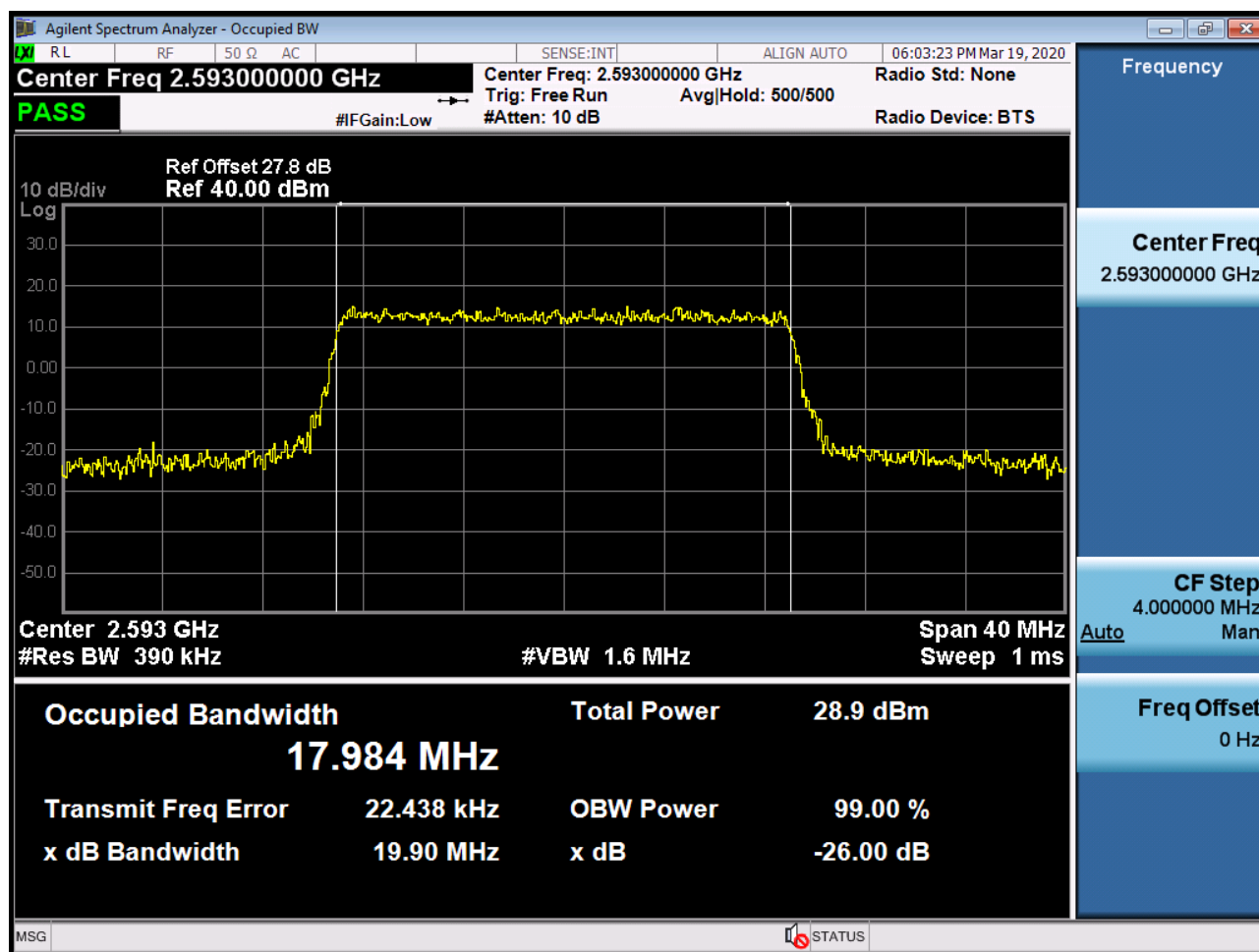
BAND 41. Occupied Bandwidth Plot (15 MHz Ch.40620 64-QAM RB 75)



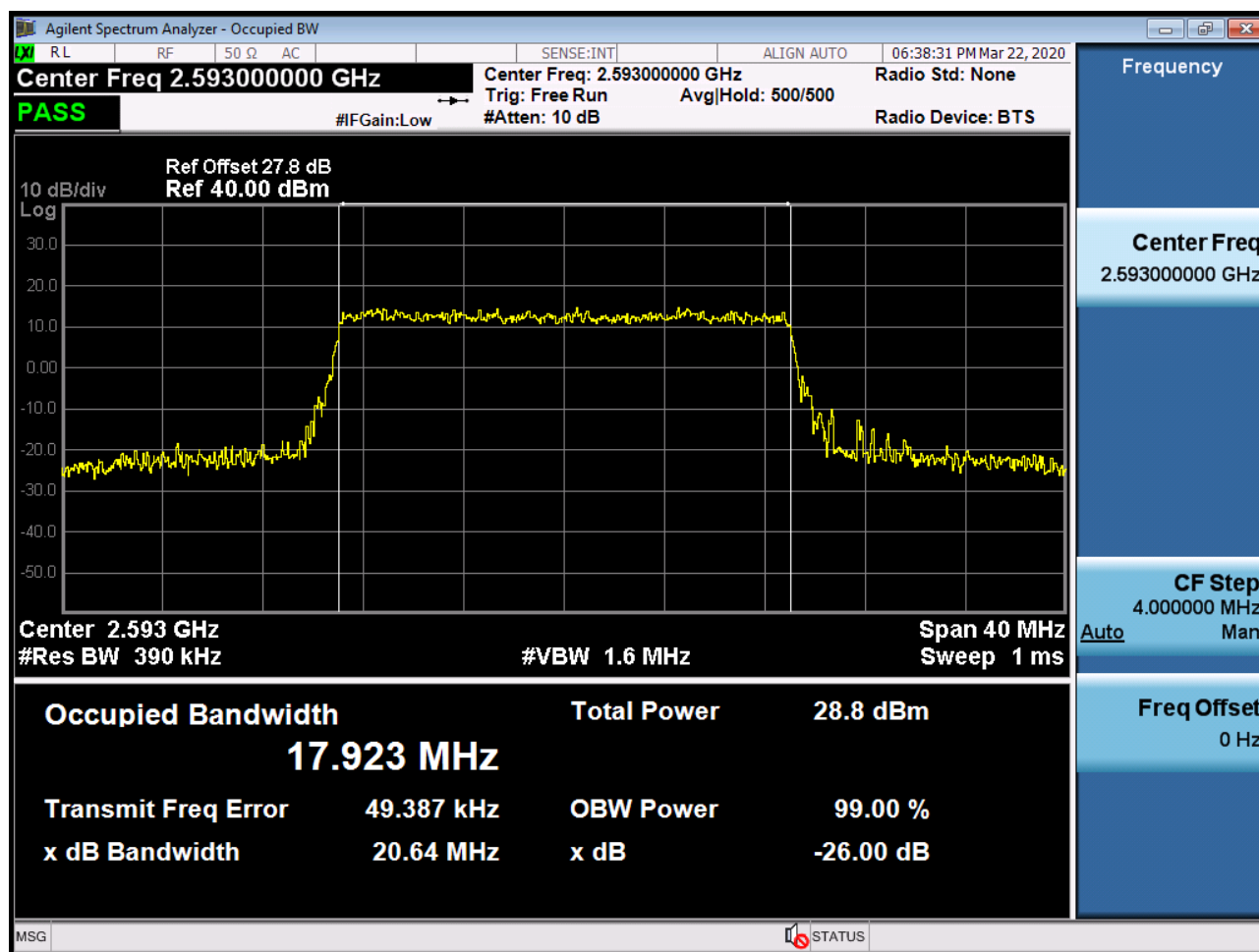
BAND 41. Occupied Bandwidth Plot (20 MHz Ch.40620 QPSK RB 100)



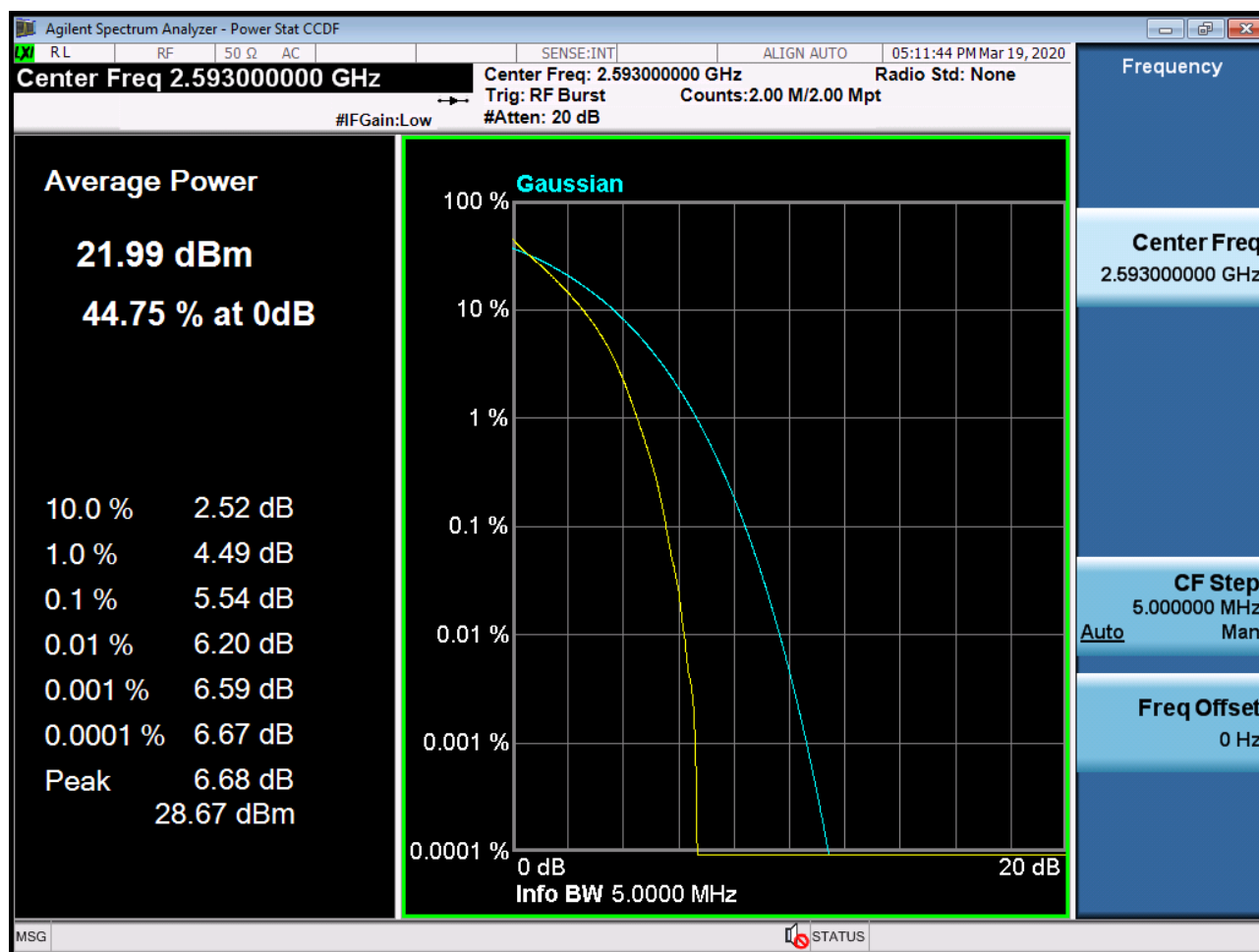
BAND 41. Occupied Bandwidth Plot (20 MHz Ch.40620 16-QAM RB 100)



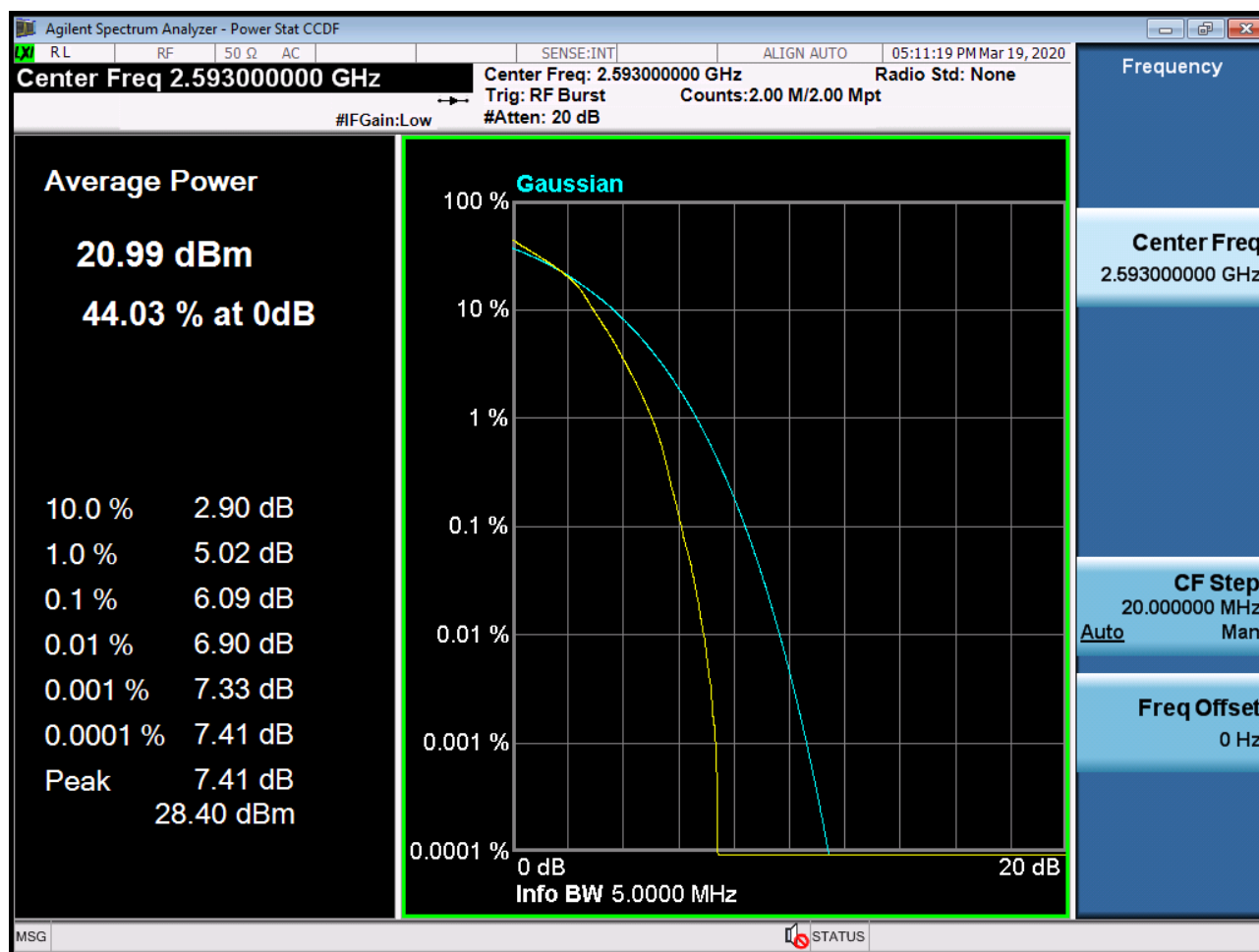
BAND 41. Occupied Bandwidth Plot (20 MHz Ch.40620 64-QAM RB 100)



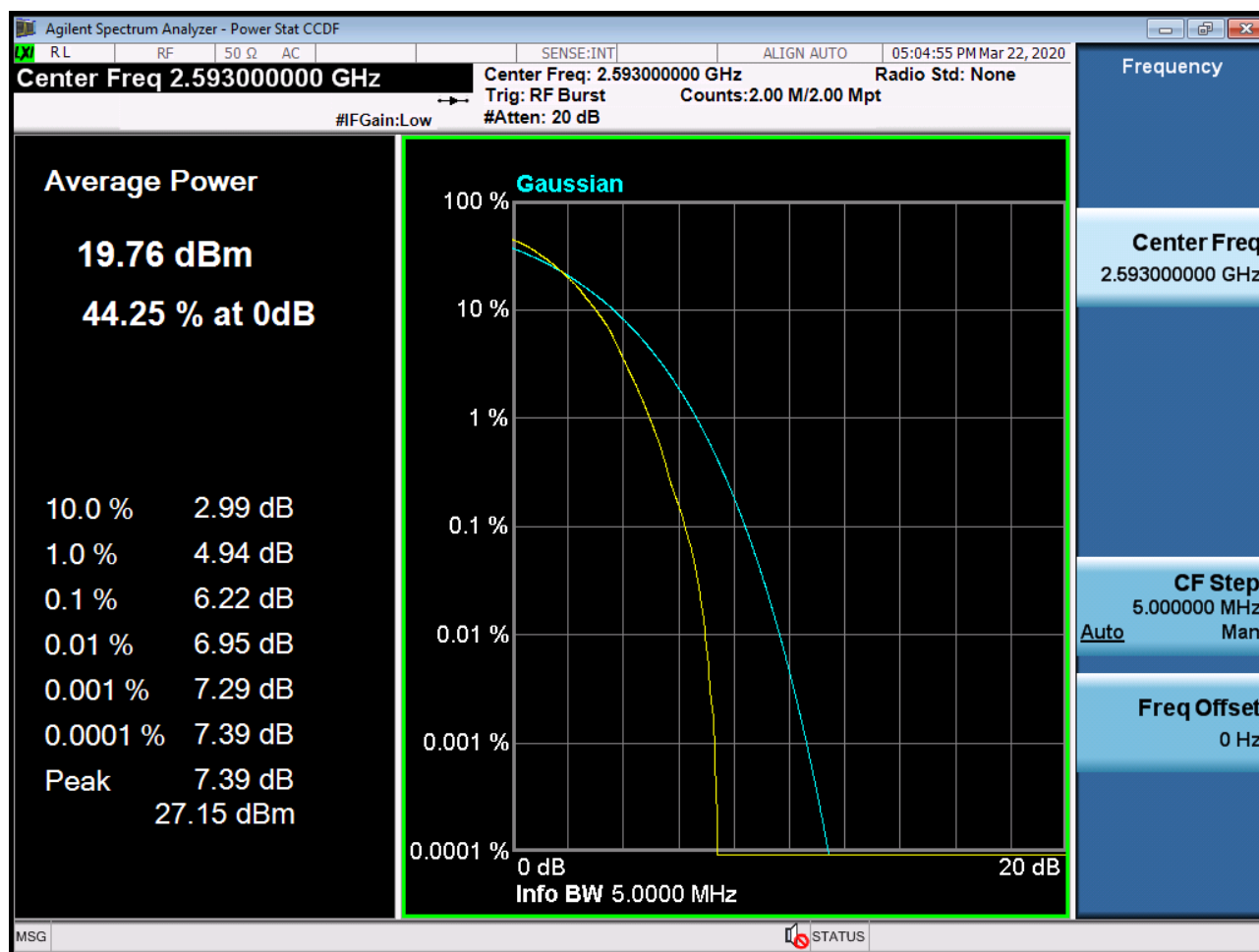
BAND 41. PAR Plot (5M BW_Ch.40620_QPSK_RB25_0)



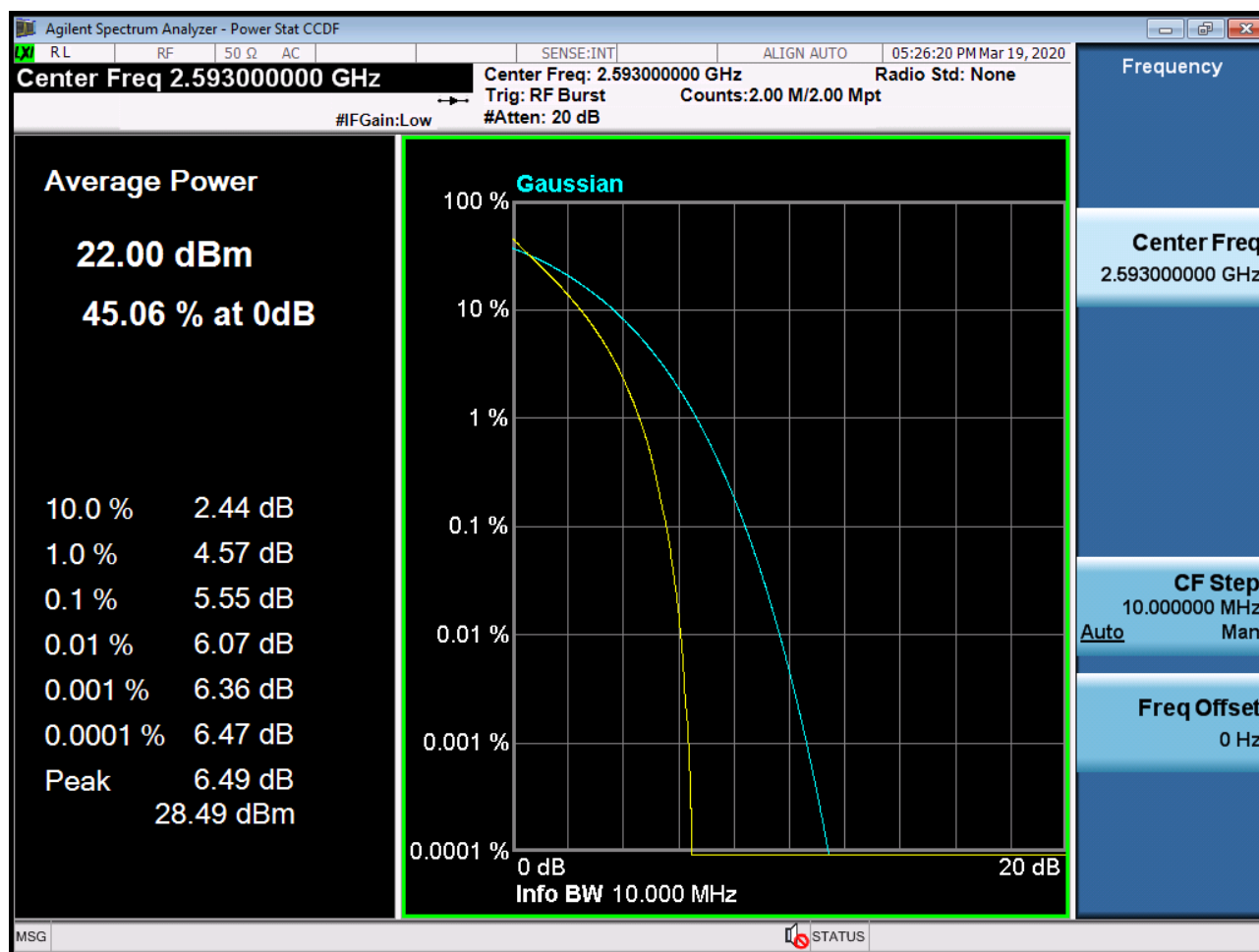
BAND 41. PAR Plot (5M BW_Ch.40620_16QAM_RB25_0)



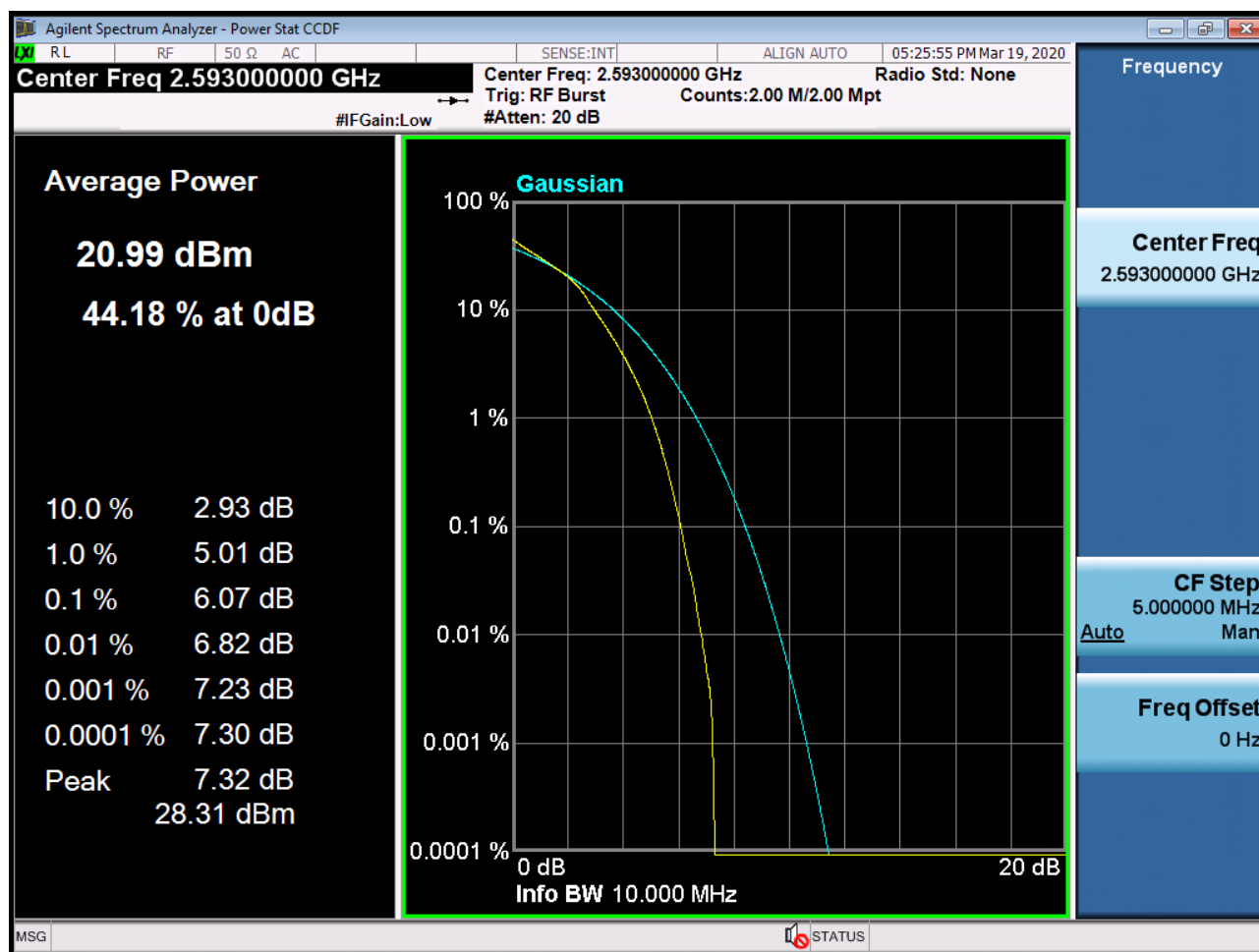
BAND 41. PAR Plot (5M BW_Ch.40620_64QAM_RB25_0)



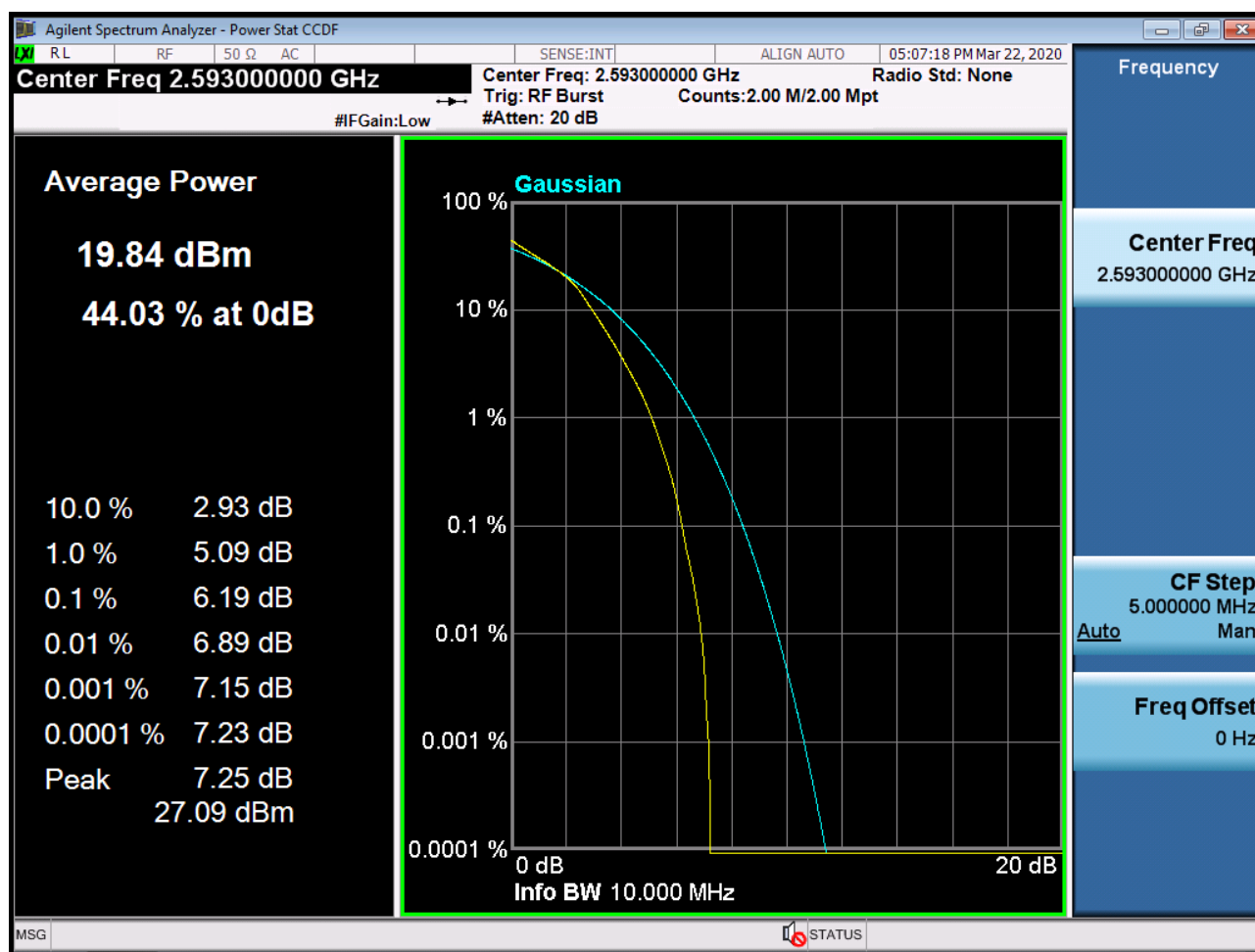
BAND 41. PAR Plot (10M BW_Ch.40620_QPSK_RB50_0)



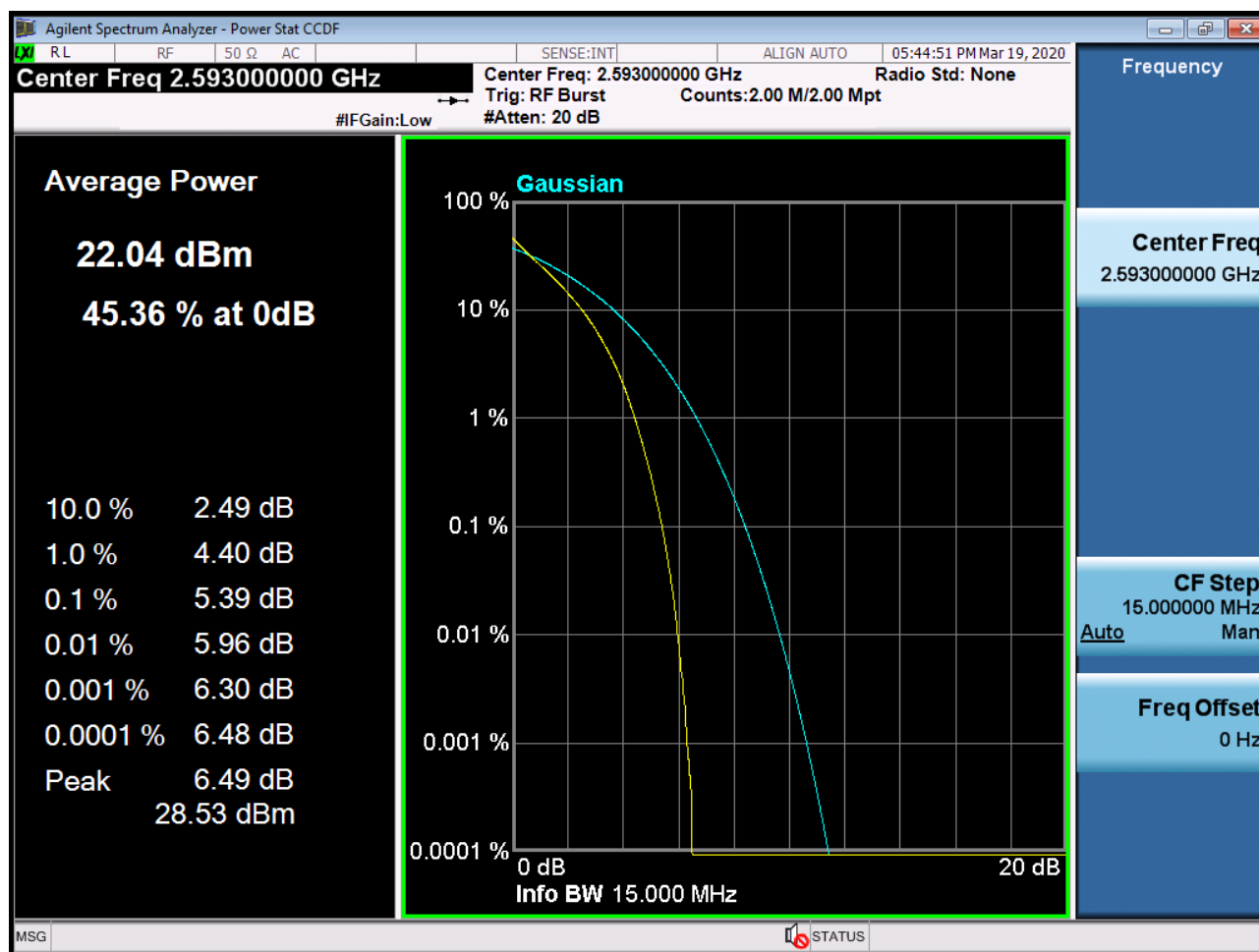
BAND 41. PAR Plot (10M BW_Ch.40620_16QAM_RB50_0)



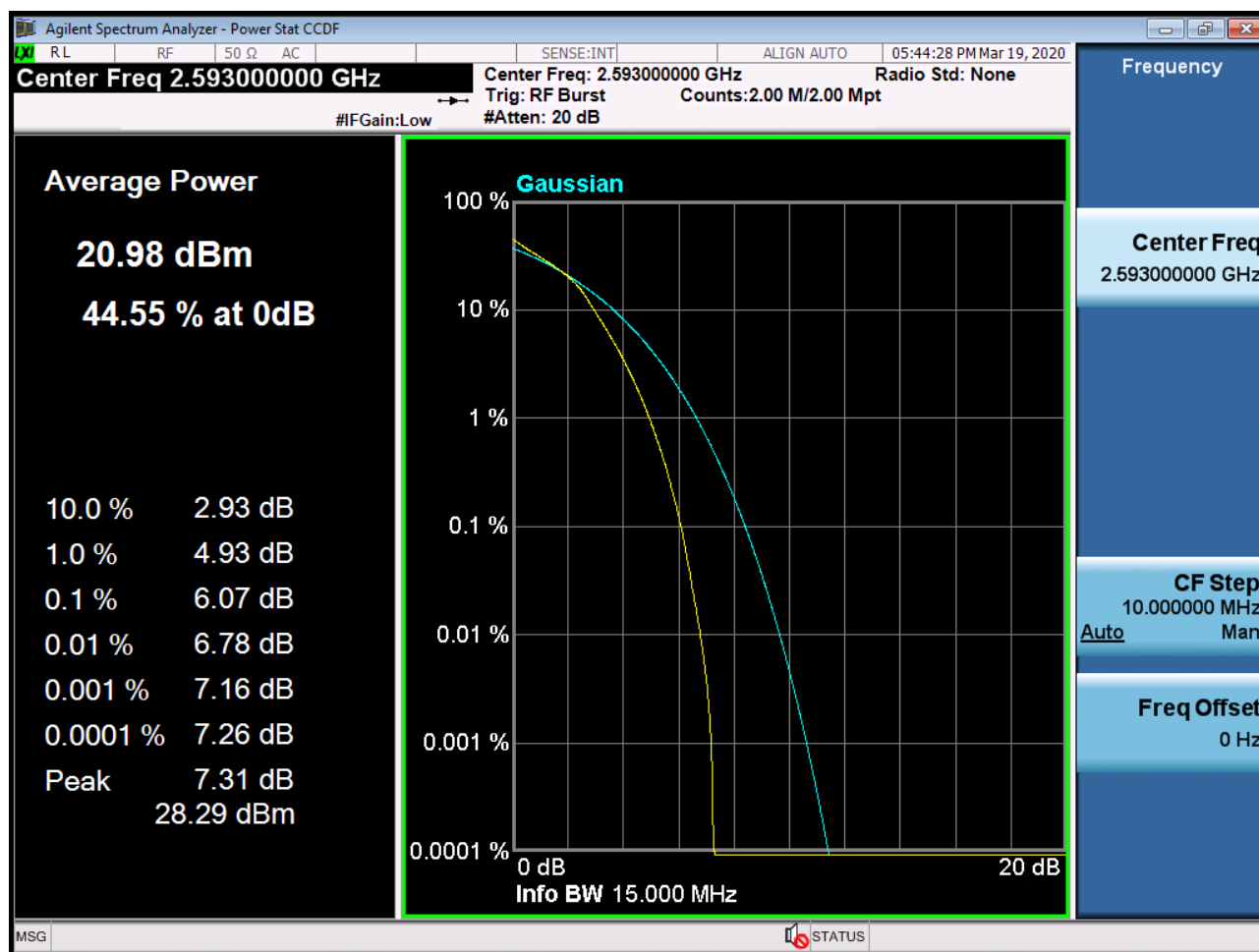
BAND 41. PAR Plot (10M BW_Ch.40620_64QAM_RB50_0)



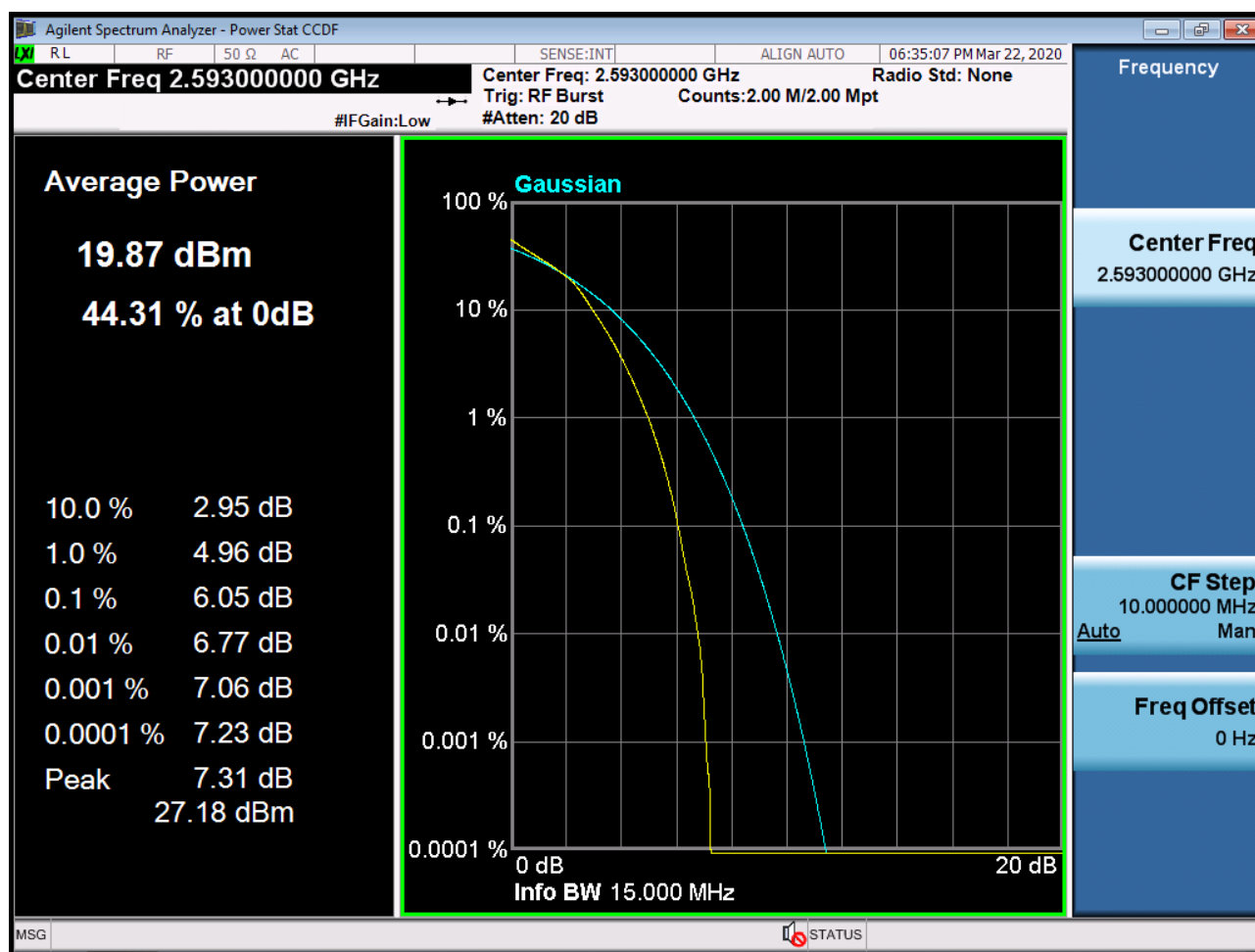
BAND 41. PAR Plot (15M BW_Ch.40620_QPSK_RB75_0)



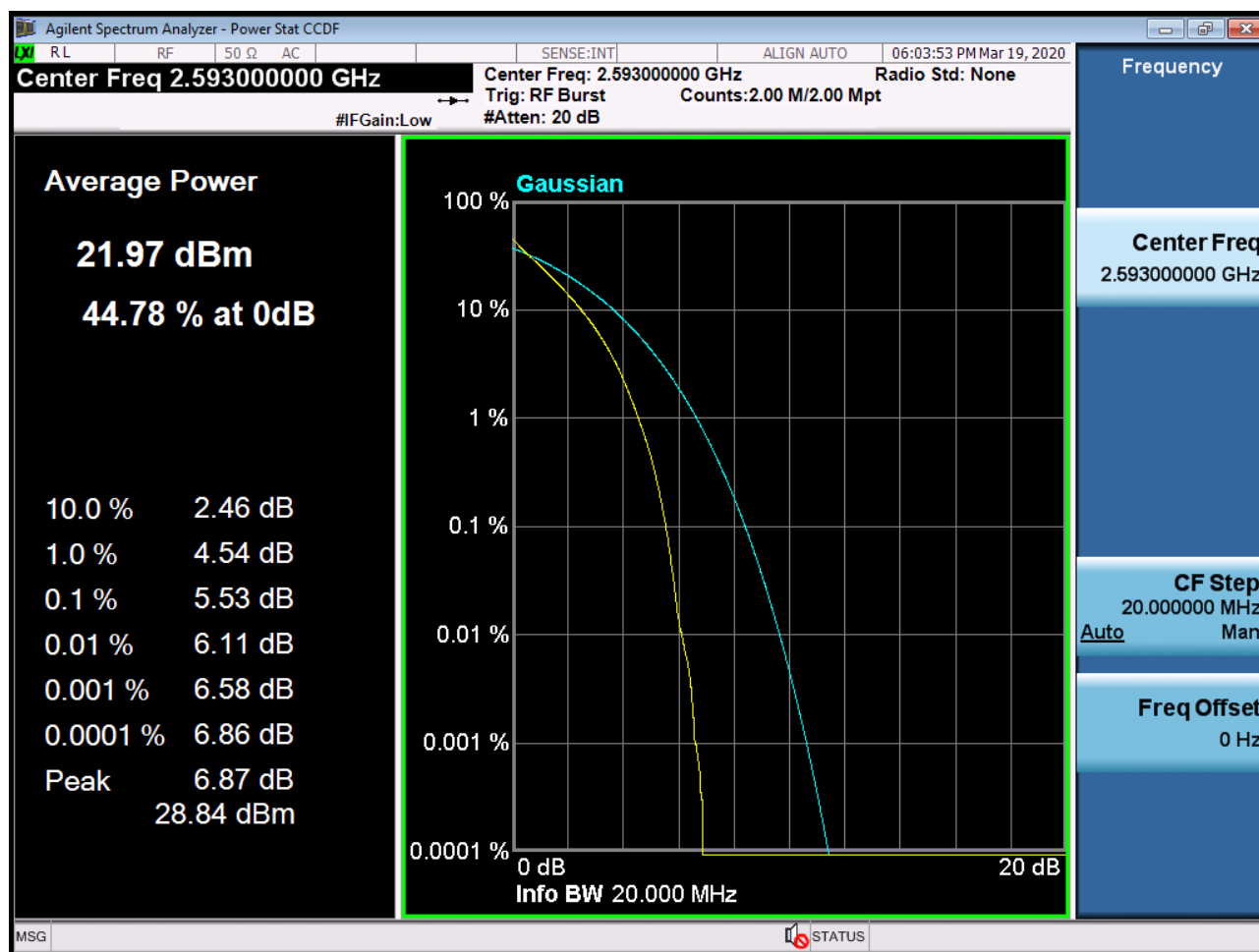
BAND 41. PAR Plot (15M BW_Ch.40620_16QAM_RB75_0)



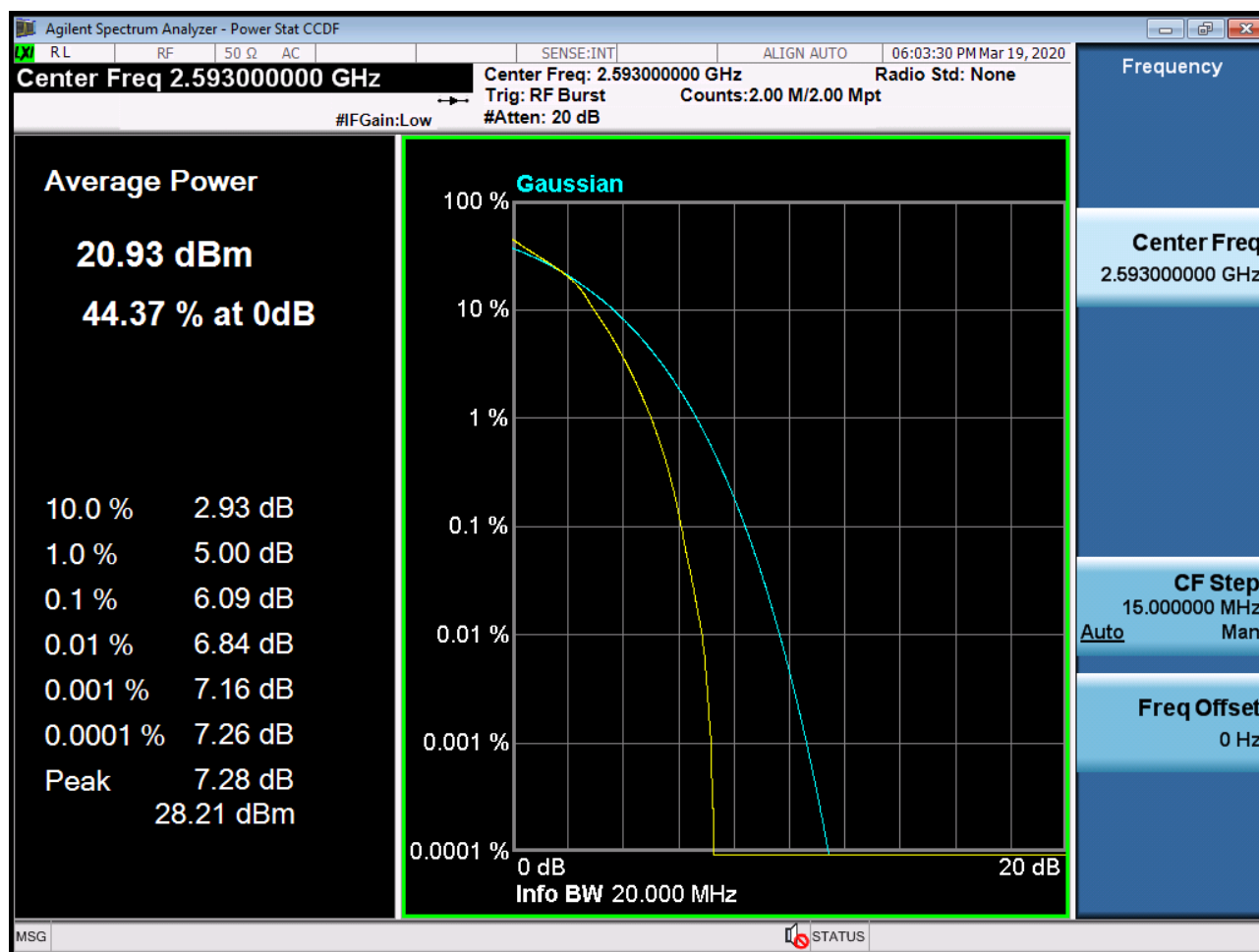
BAND 41. PAR Plot (15M BW_Ch.40620_64QAM_RB75_0)



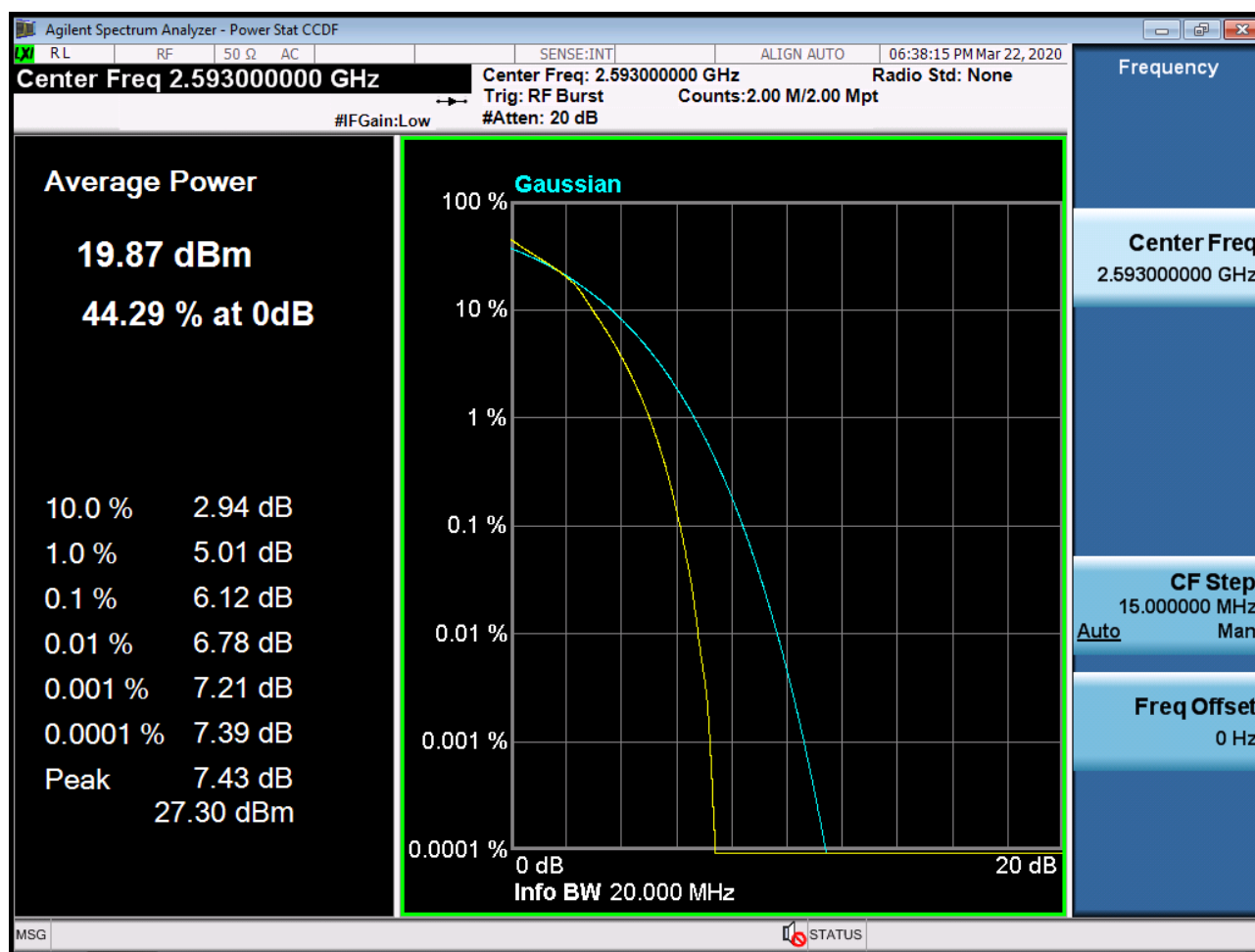
BAND 41. PAR Plot (20M BW_Ch.40620_QPSK_RB100_0)



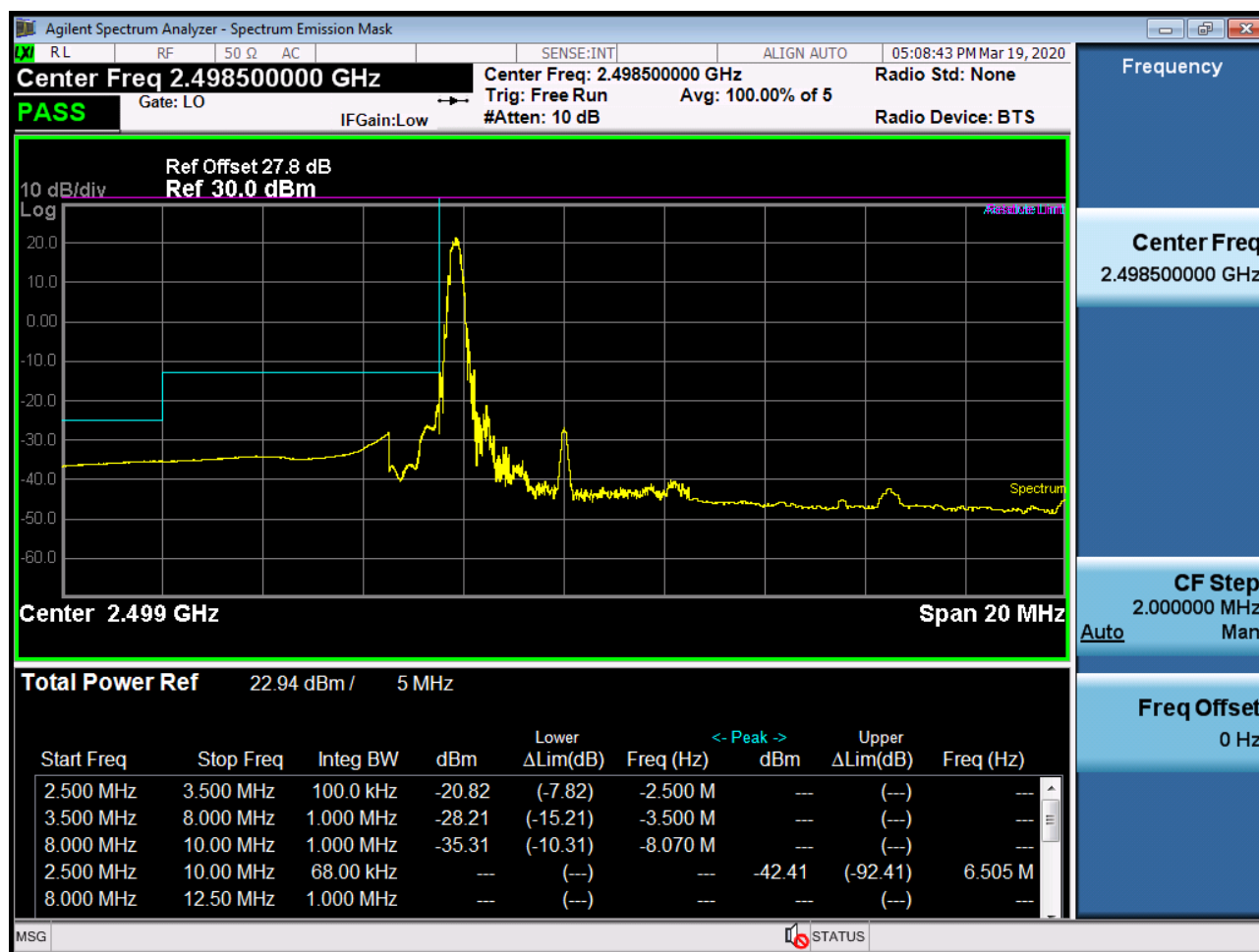
BAND 41. PAR Plot (20M BW_Ch.40620_16QAM_RB100_0)



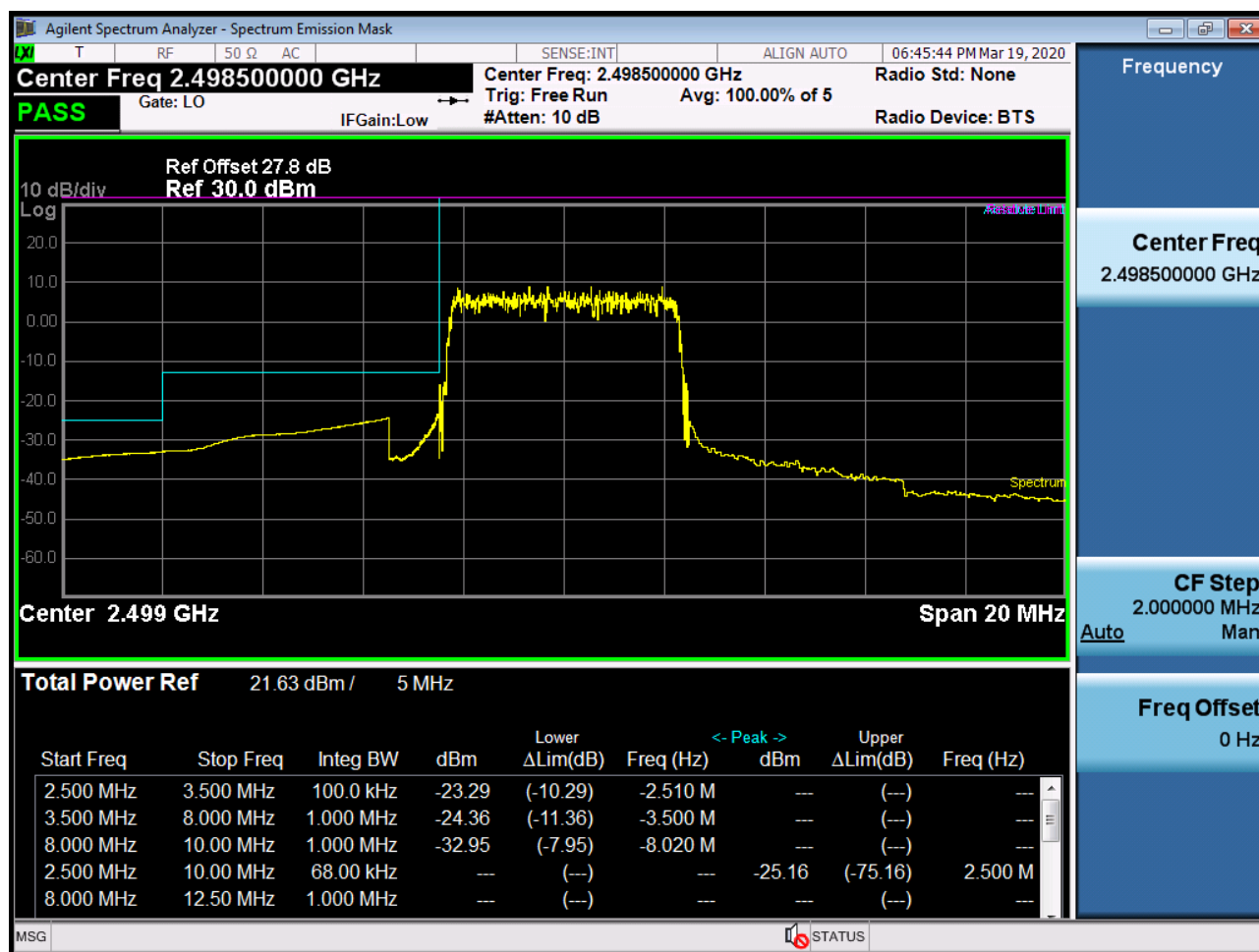
BAND 41. PAR Plot (20M BW_Ch.40620_64QAM_RB100_0)



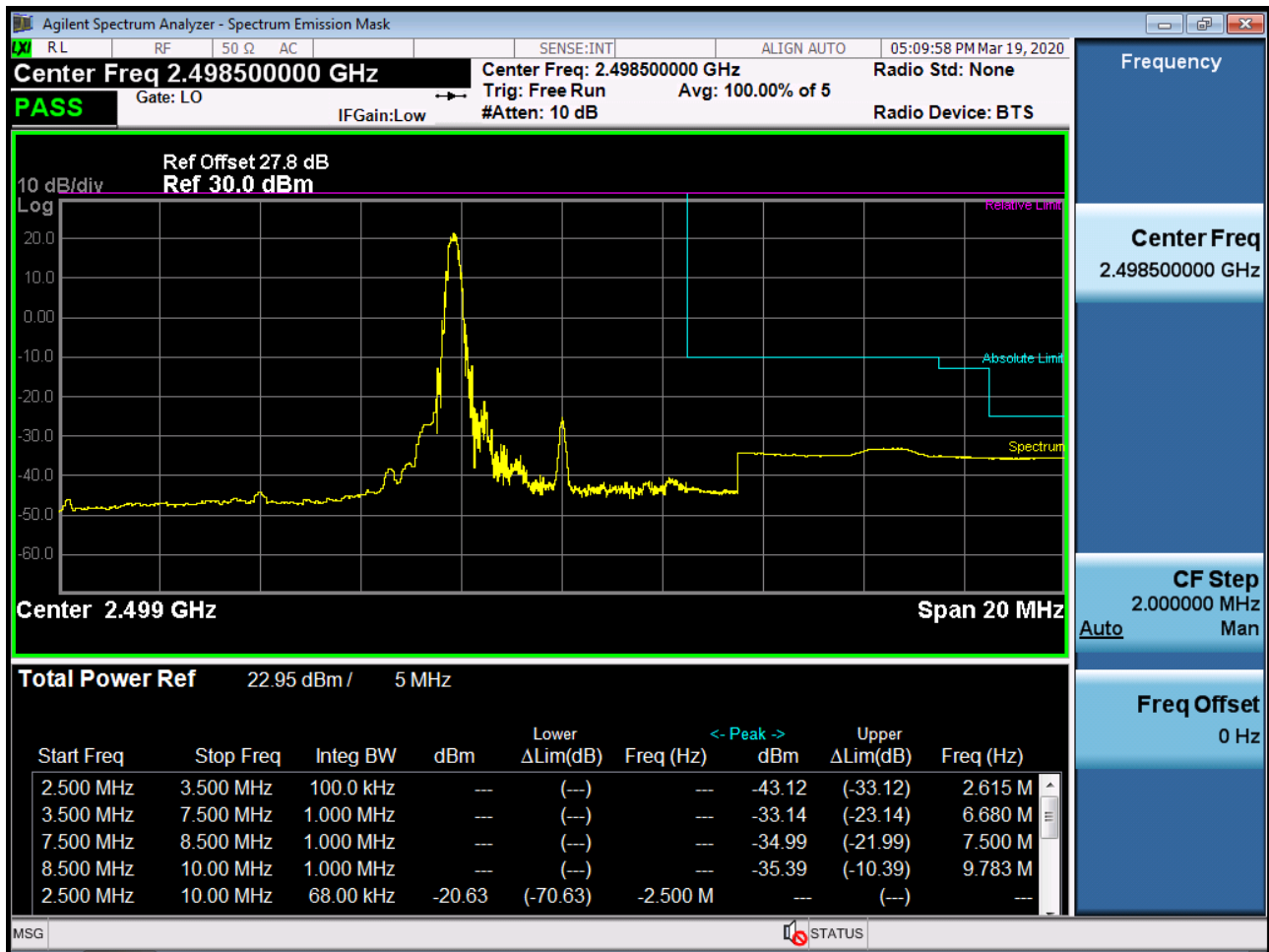
BAND 41. Low Channel Edge Plot (5 MHz Ch.39675 QPSK RB 1, Offset 0)-1



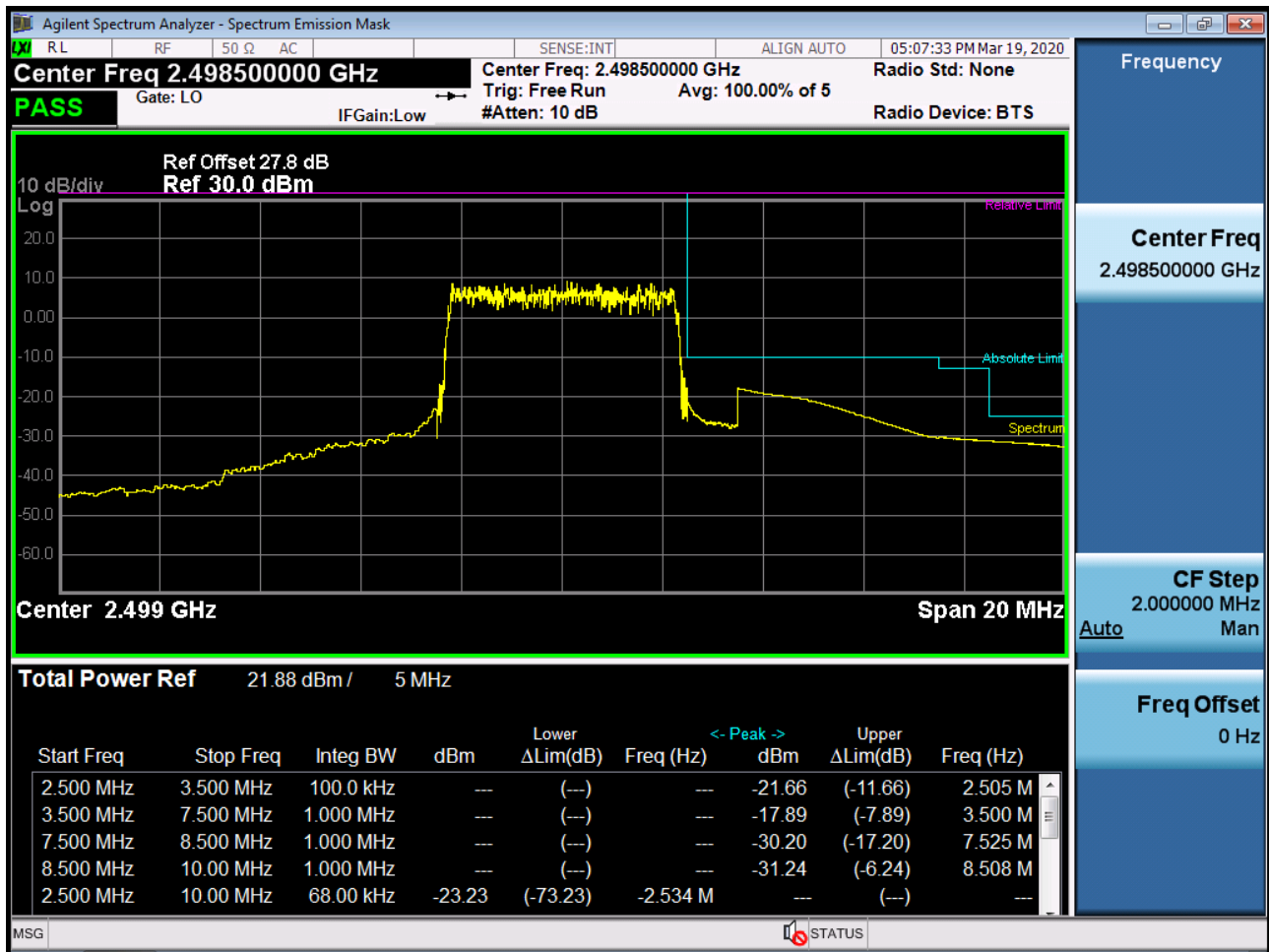
BAND 41. Low Channel Edge Plot (5 MHz Ch.39675 QPSK RB 25, Offset 0)-1



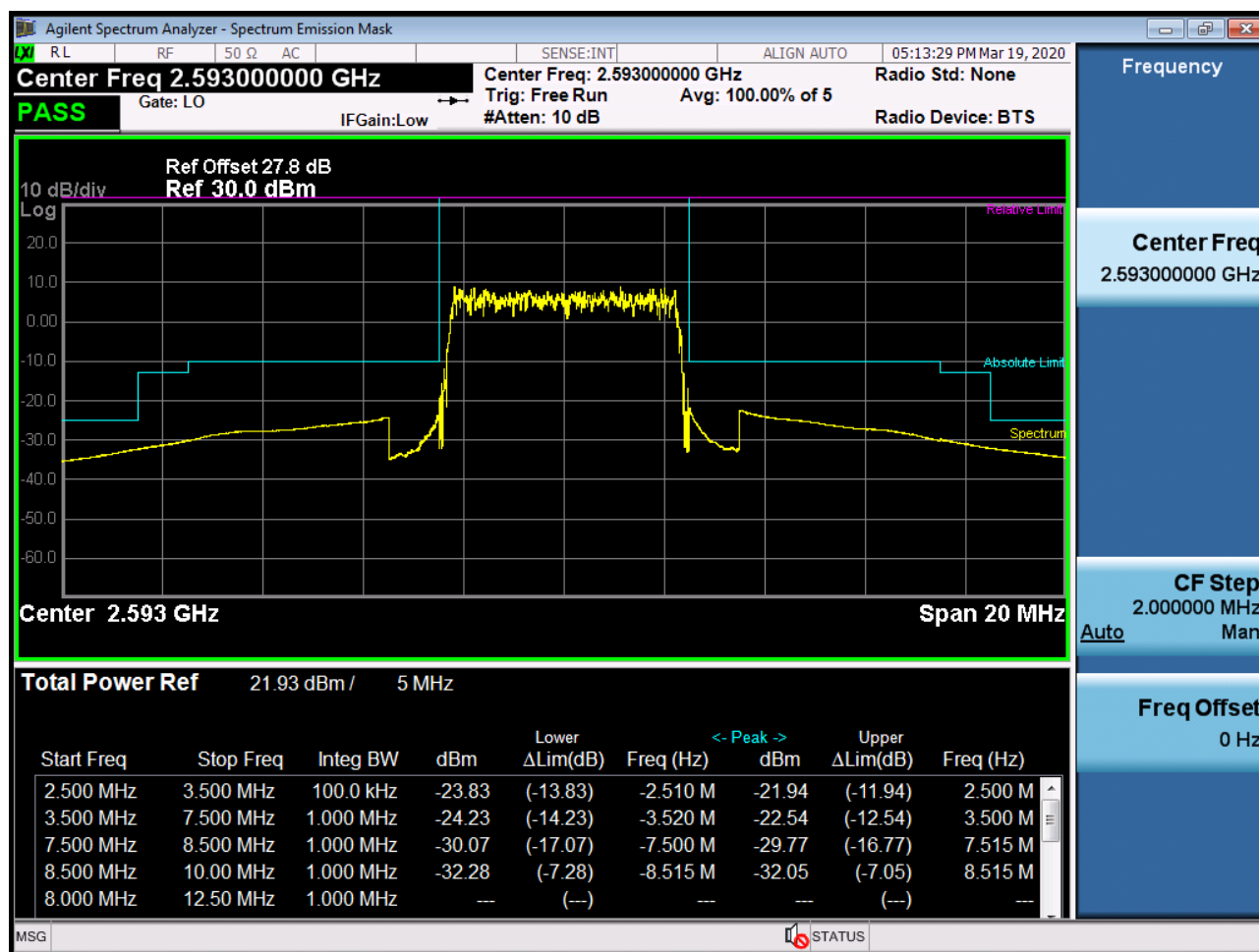
BAND 41. Low Channel Edge Plot (5 MHz Ch.39675 QPSK_RB1_Offset 0)-2



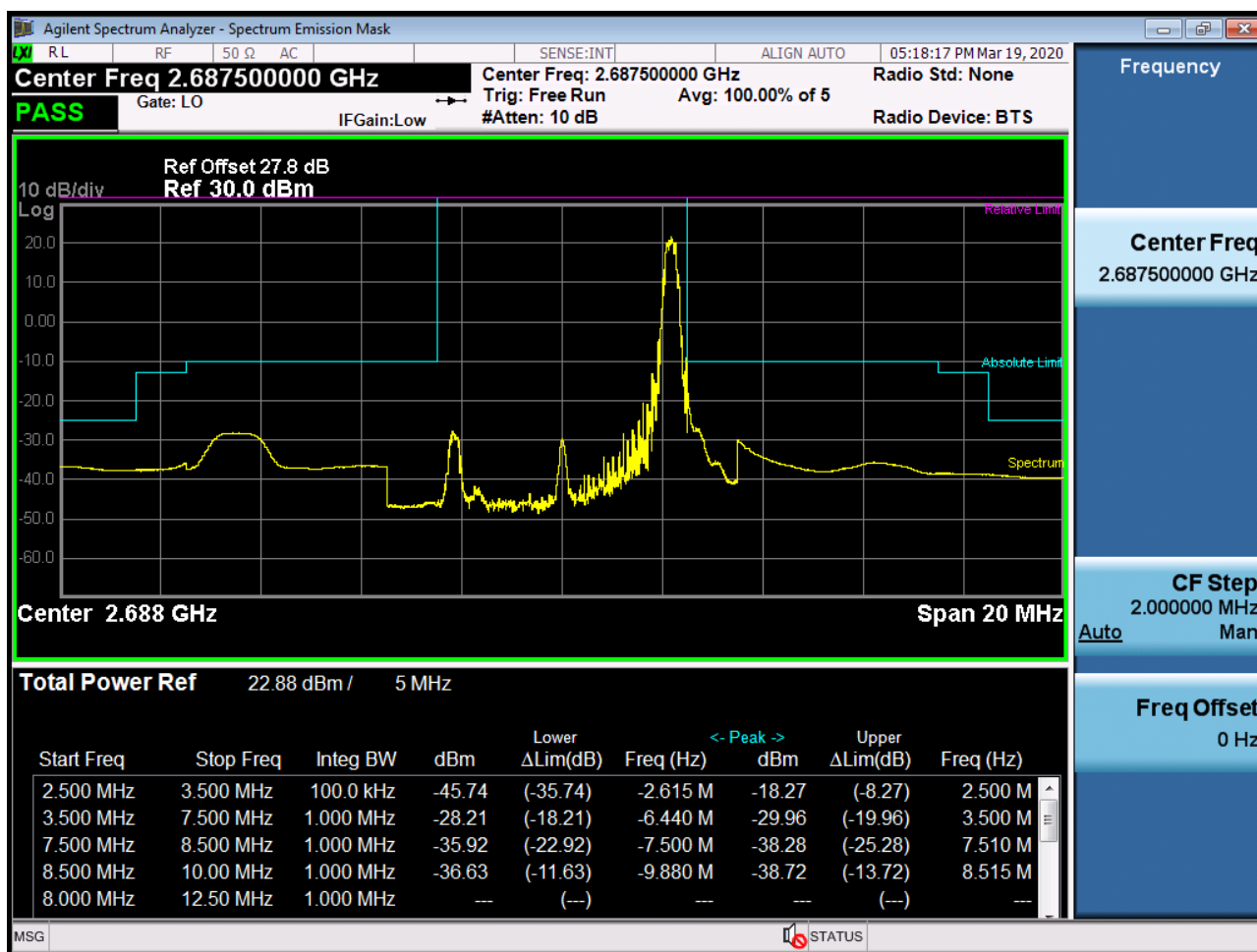
BAND 41. Low Channel Edge Plot (5 MHz Ch.39675 QPSK_RB25_Offset 0)-2



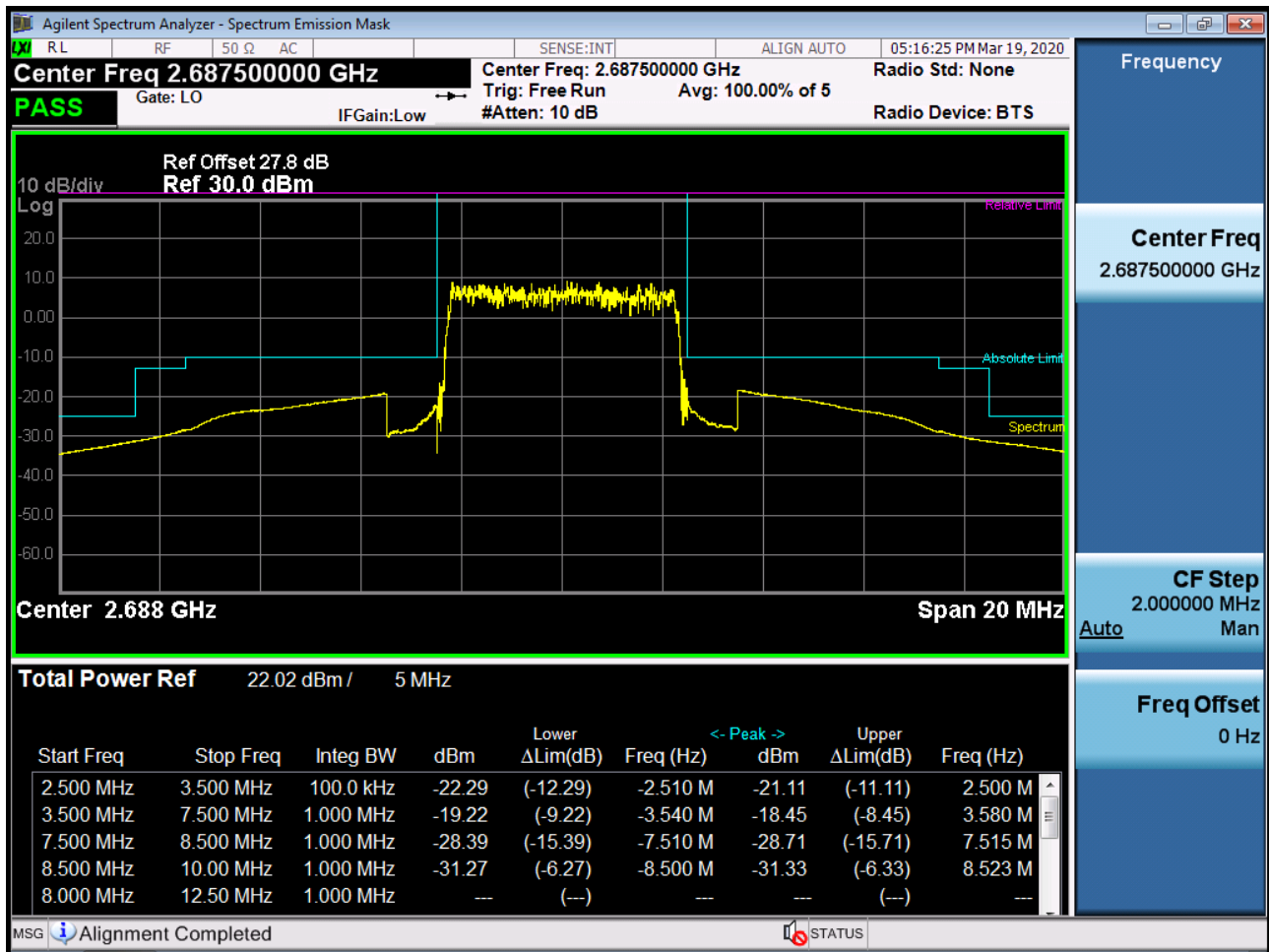
BAND 41. Mid Channel Edge Plot (5 MHz Ch.40620 QPSK RB 25)



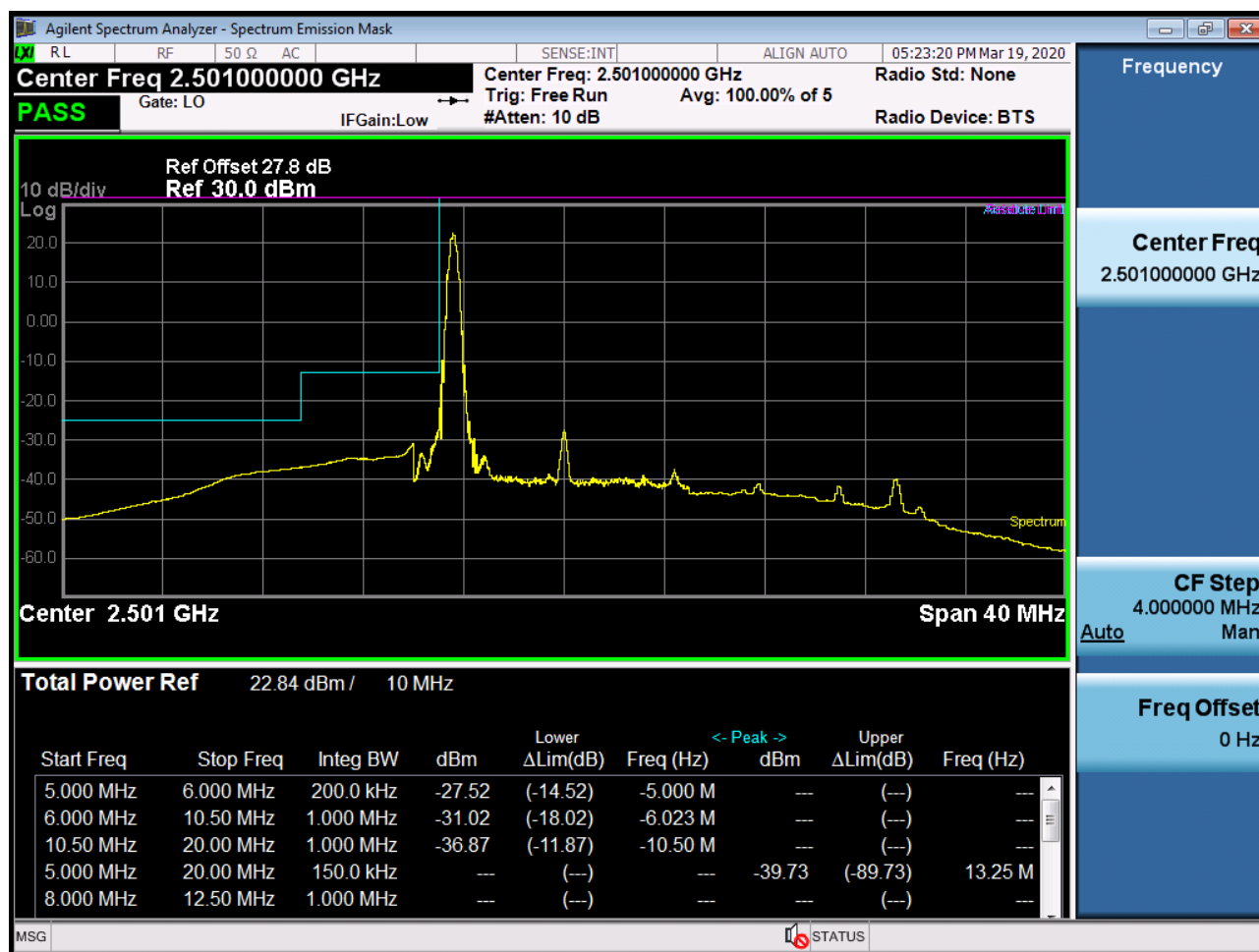
BAND 41. High Channel Edge Plot (5 MHz Ch.41565 QPSK RB 1, Offset 24)



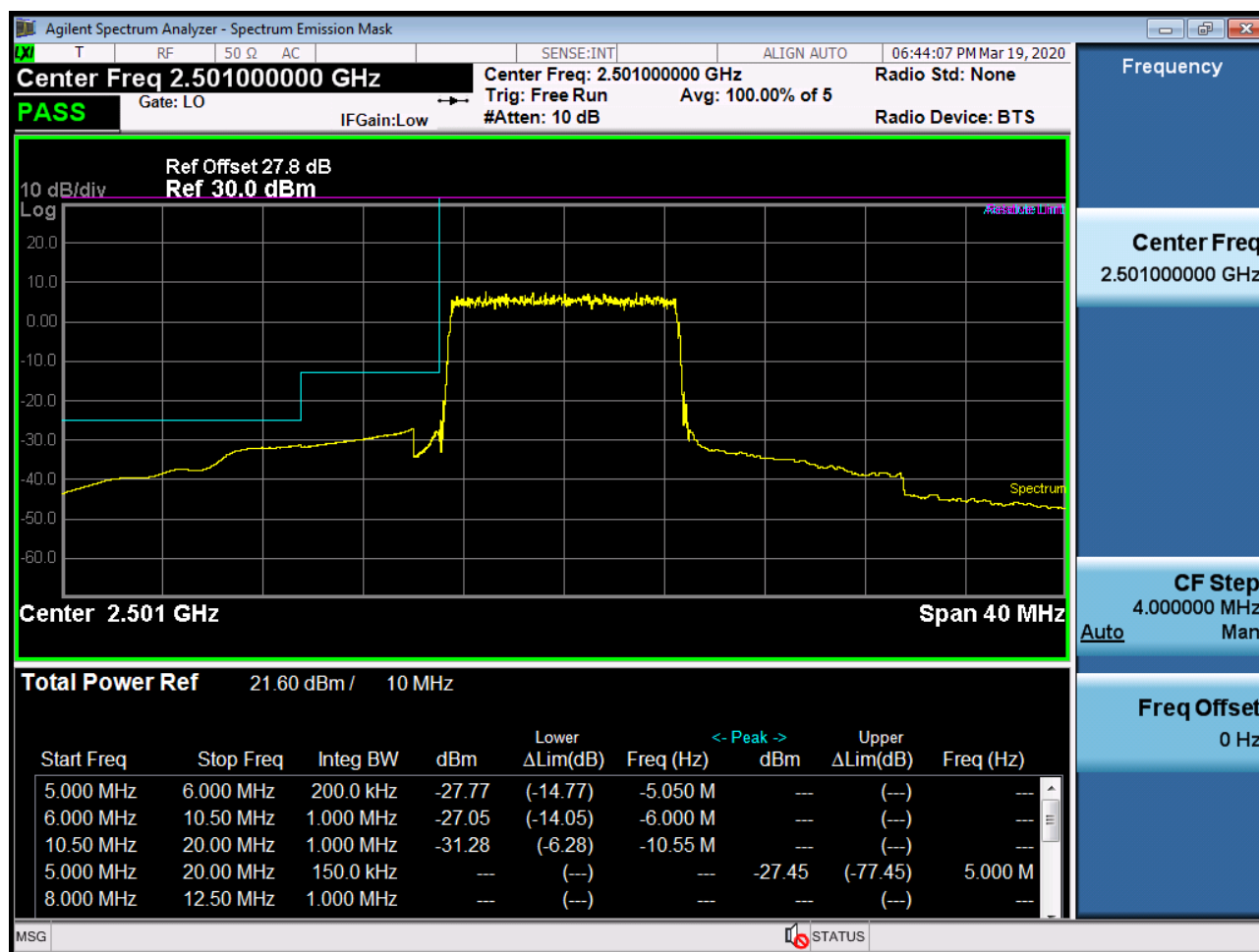
BAND 41. High Channel Edge Plot (5 MHz Ch.41565 QPSK_RB25_Offset 0)



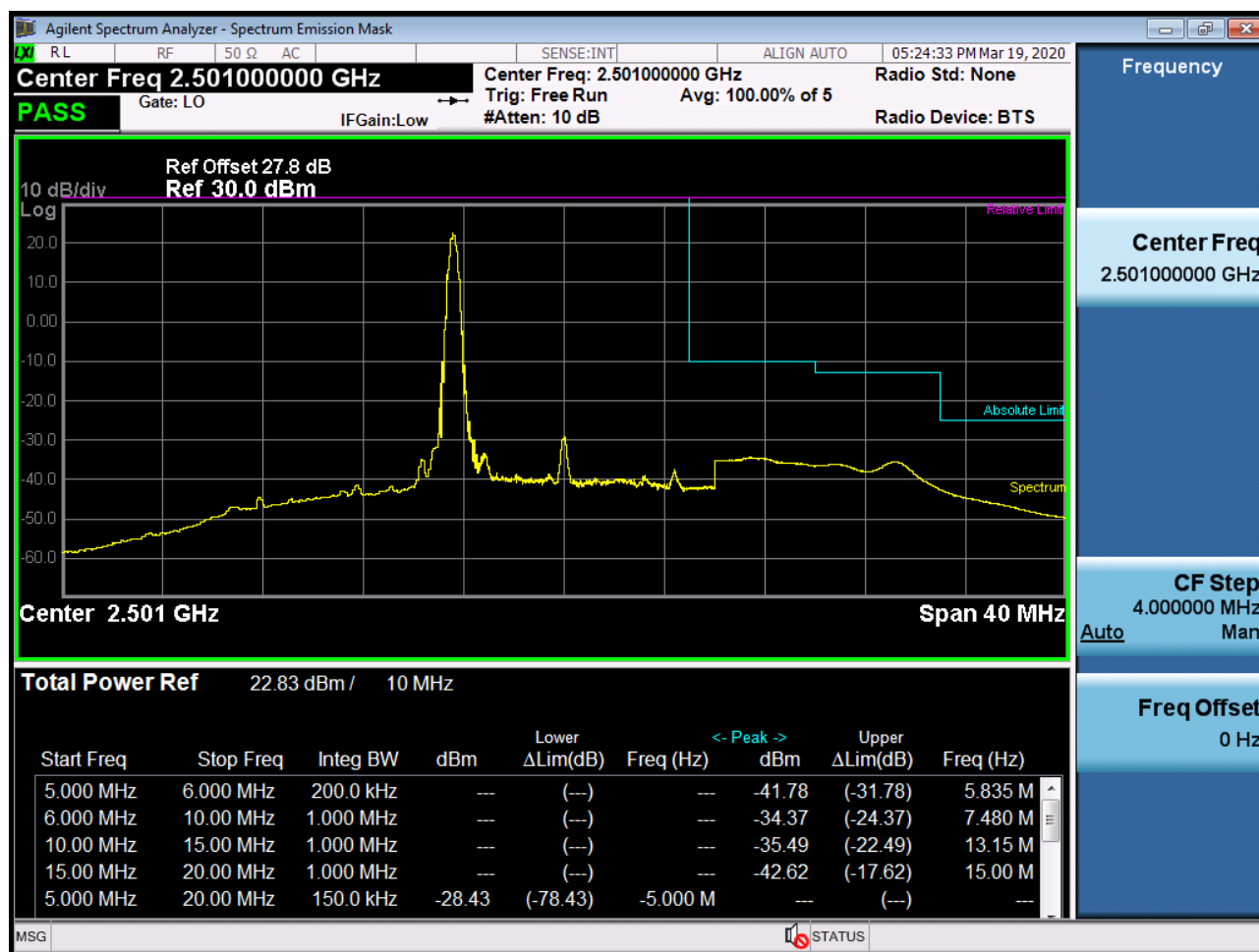
BAND 41. Low Channel Edge Plot (10 MHz Ch.39700 QPSK RB 1, Offset 0)-1



BAND 41. Low Channel Edge Plot (10 MHz Ch.39700 QPSK RB 25, Offset 0)-1



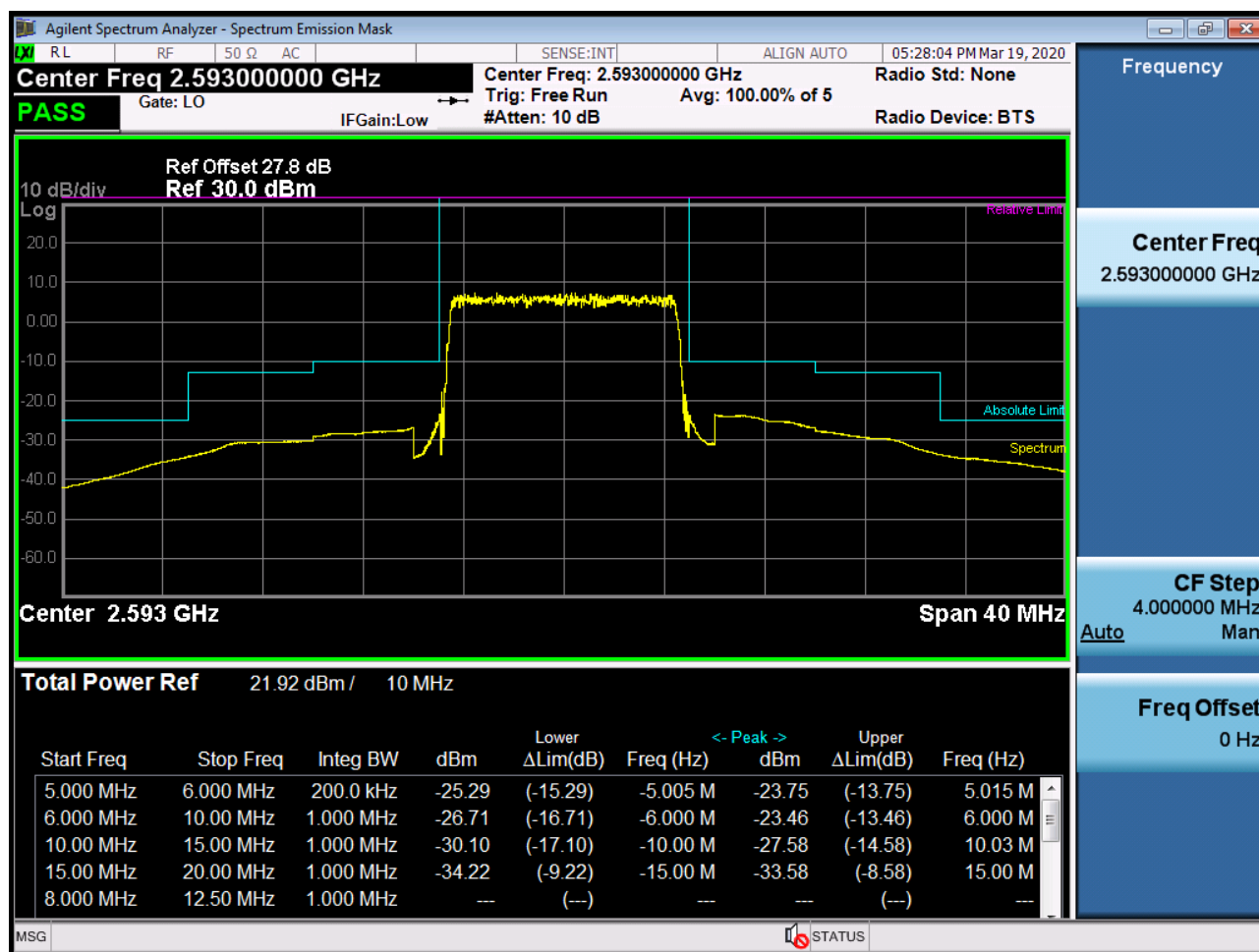
BAND 41. Low Channel Edge Plot (10 MHz Ch.39700 QPSK_RB1_Offset 0)-2



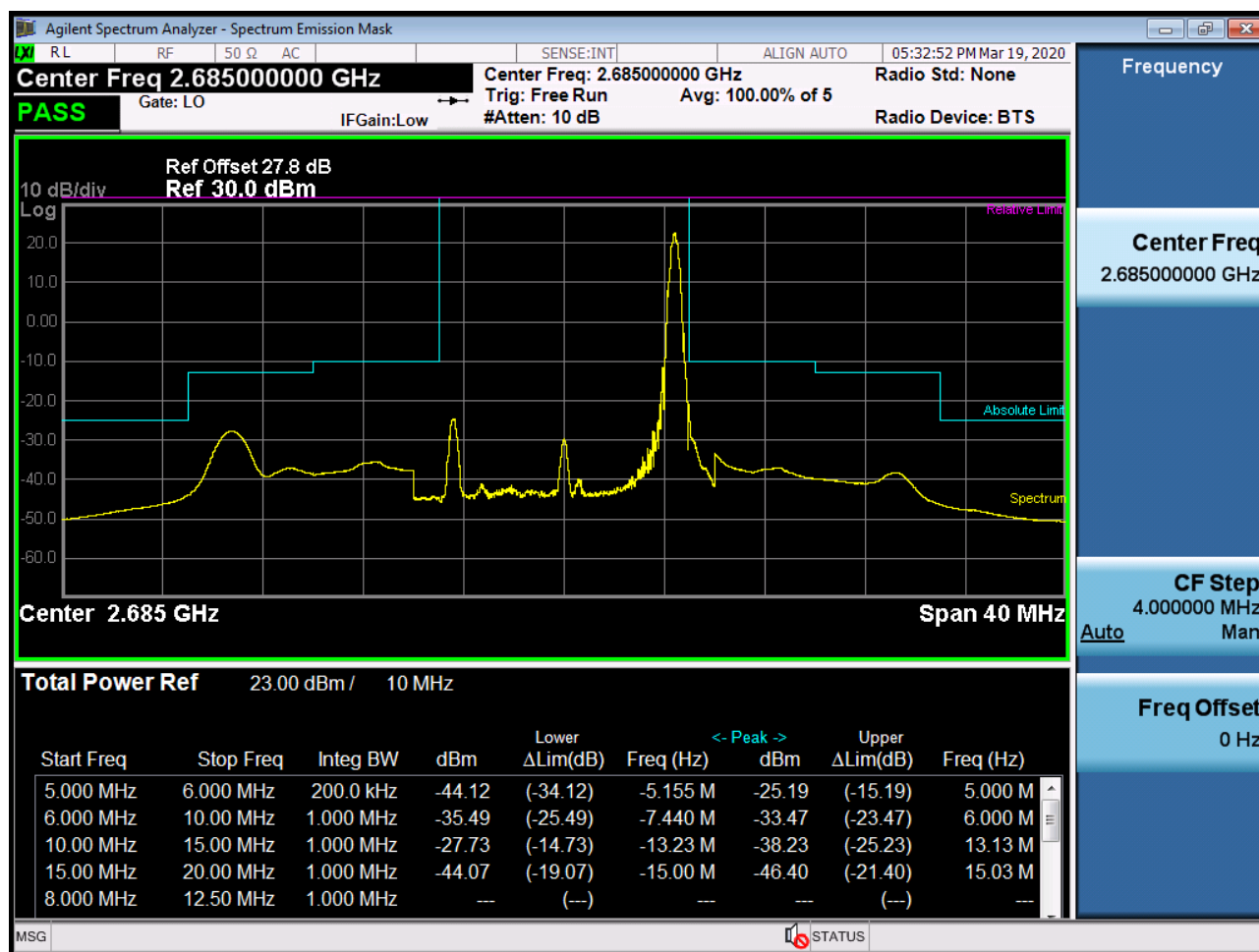
BAND 41. Low Channel Edge Plot (10 MHz Ch.39700 QPSK_RB50_Offset 0)-2



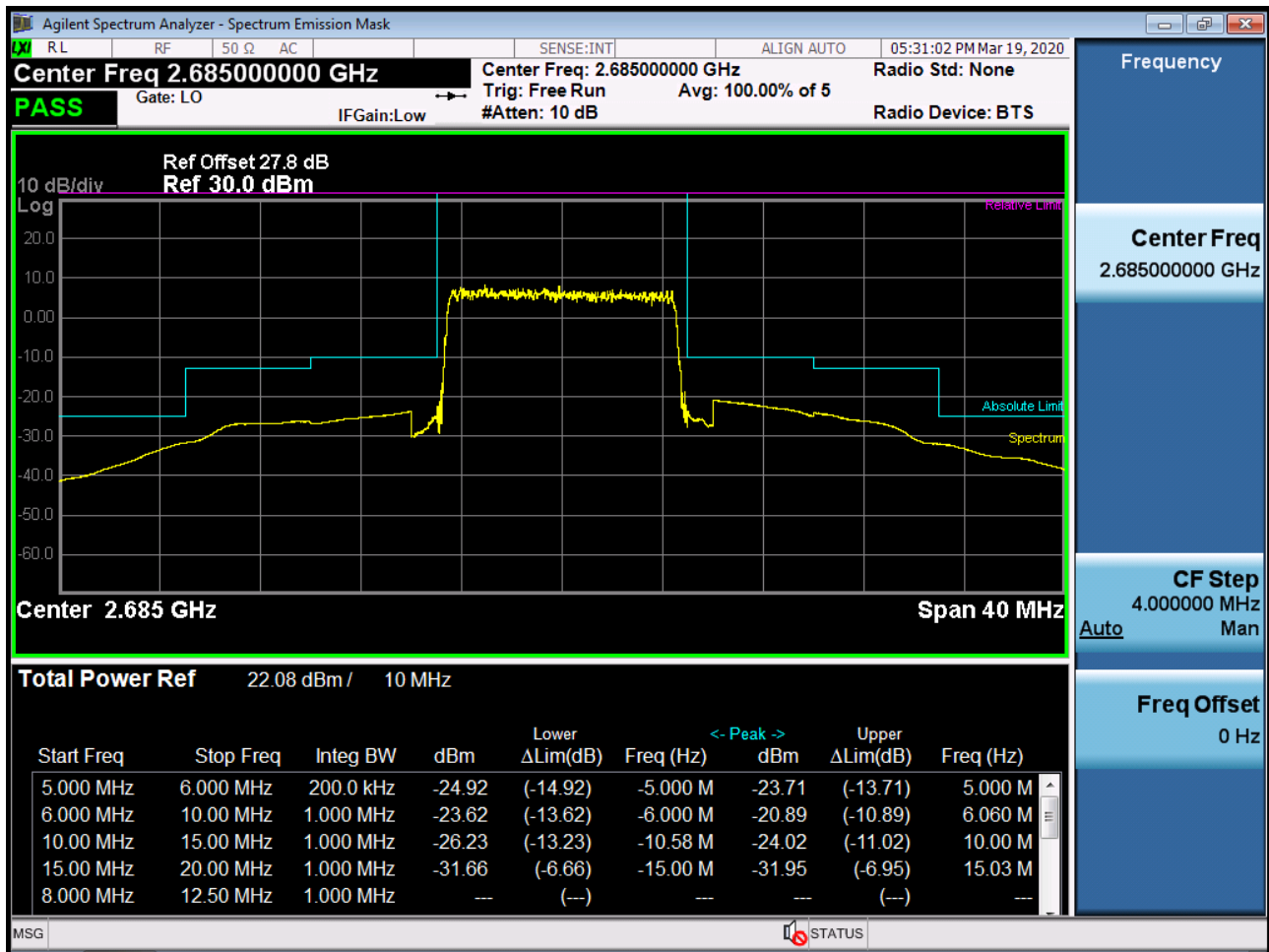
BAND 41. Mid Channel Edge Plot (10 MHz Ch.40620 QPSK RB 50)



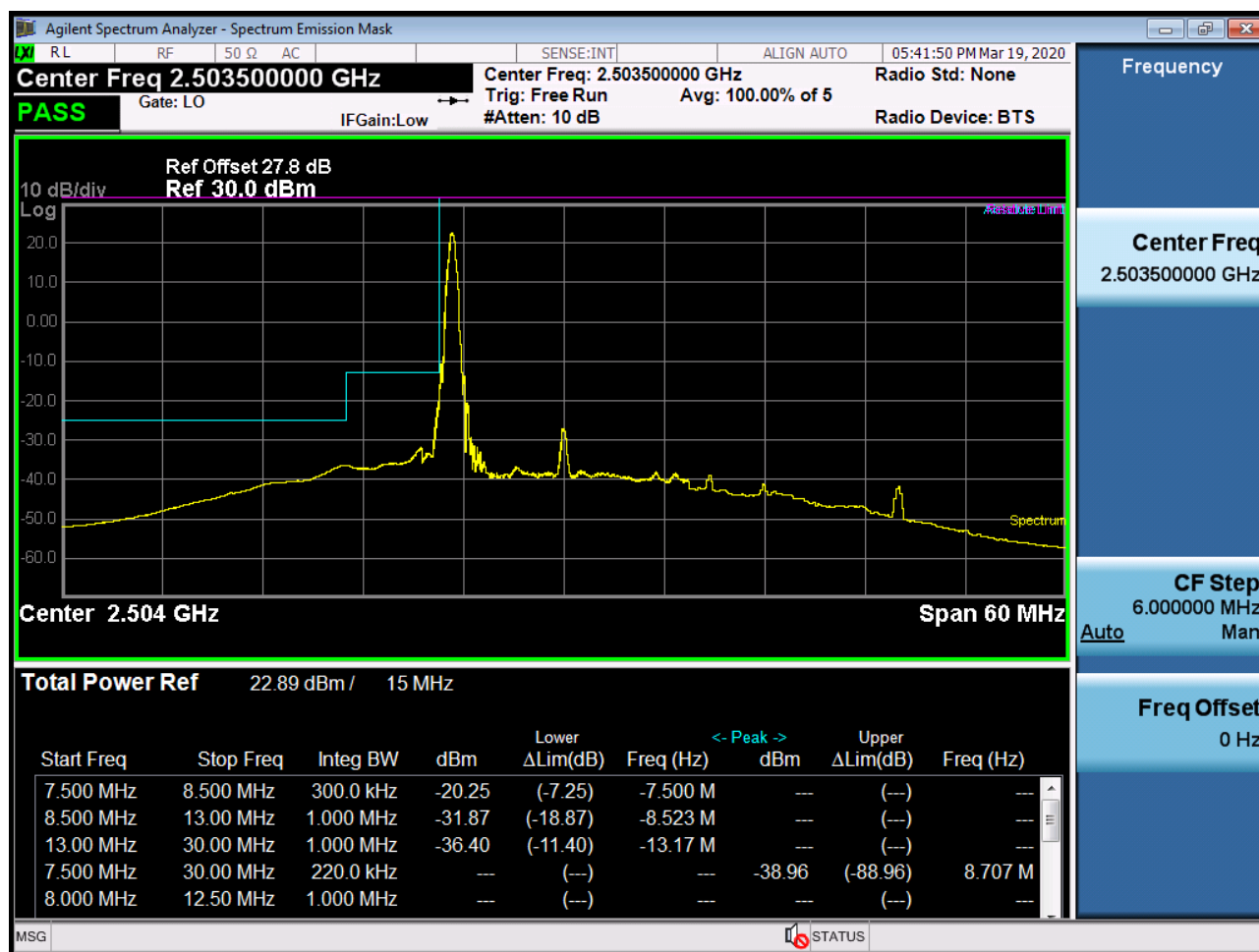
BAND 41. High Channel Edge Plot (10 MHz Ch.41540 QPSK RB 1, Offset 49)



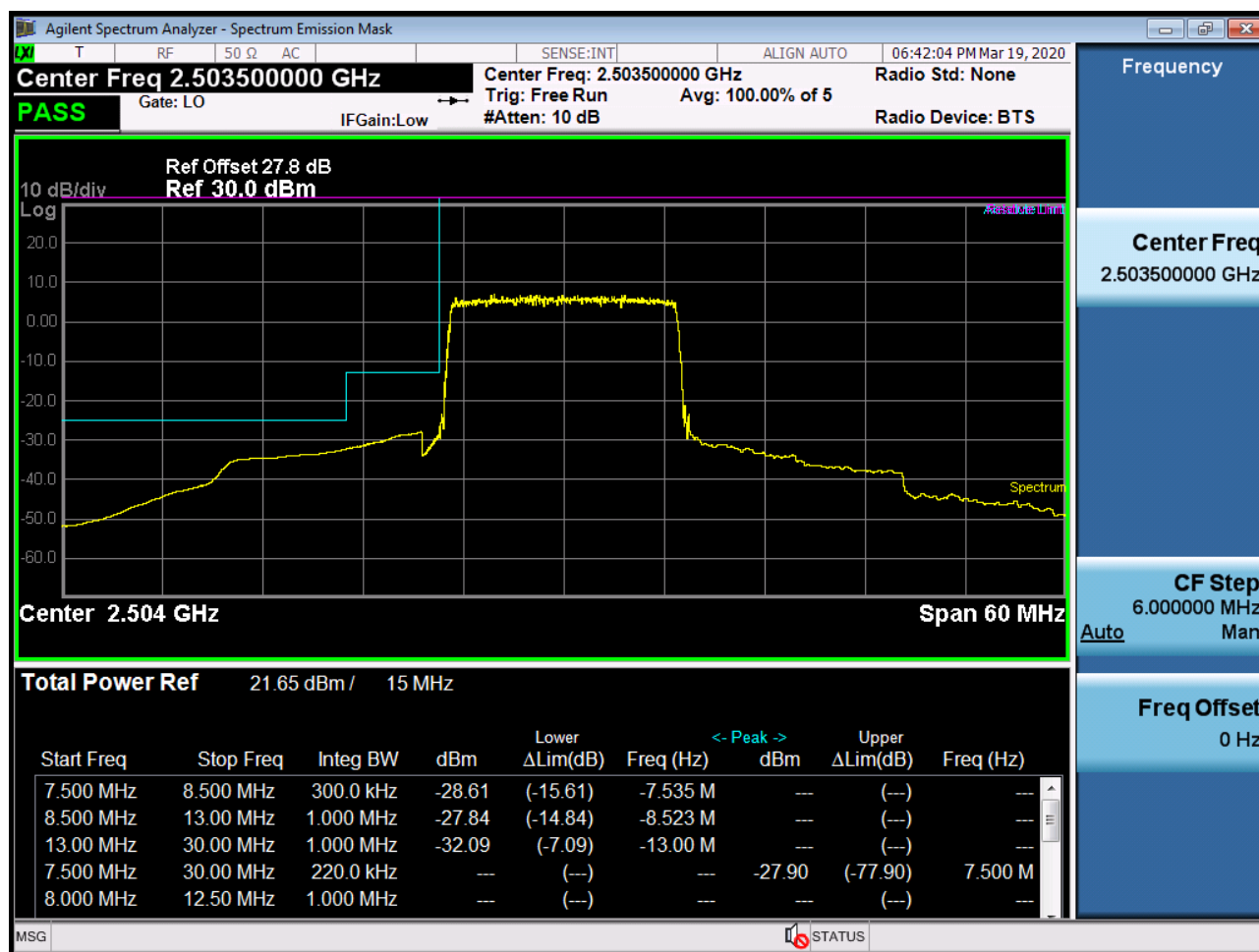
BAND 41. High Channel Edge Plot (10 MHz Ch.41540 QPSK_RB50_Offset 0)



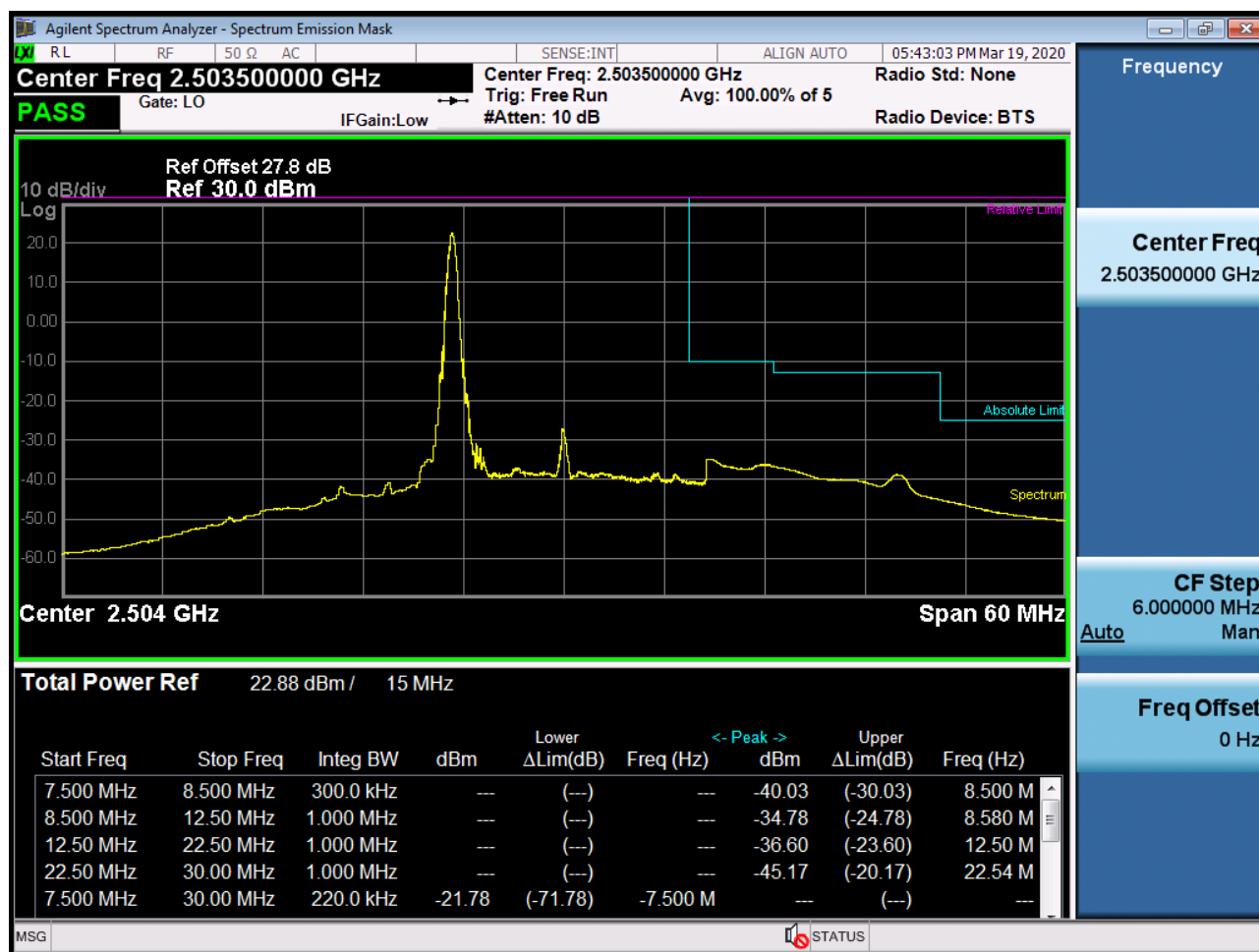
BAND 41. Low Channel Edge Plot (15 MHz Ch.39725 QPSK RB 1, Offset 0)-1



BAND 41. Low Channel Edge Plot (15 MHz Ch.39725 QPSK RB 75, Offset 0)-1



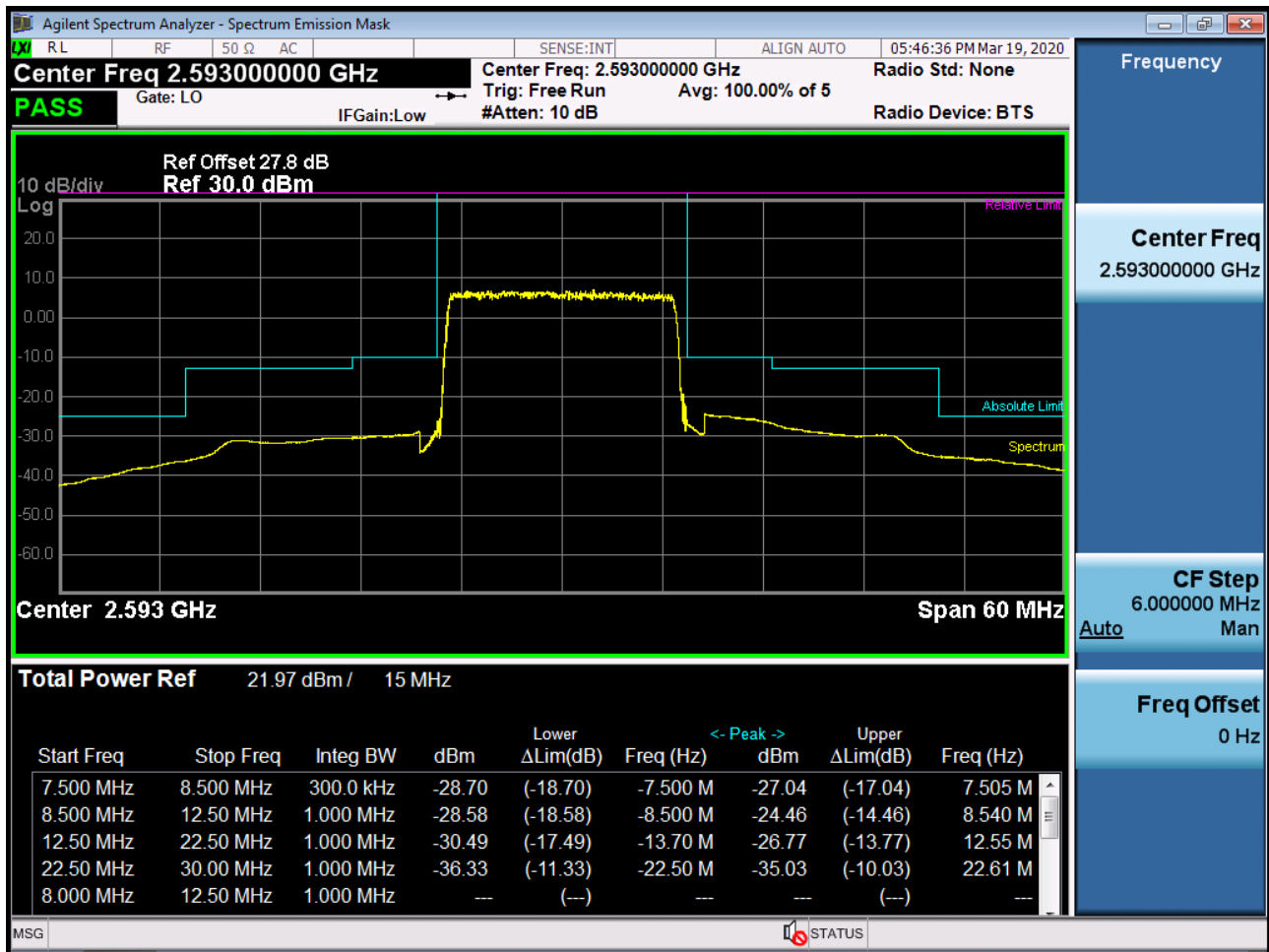
BAND 41. Low Channel Edge Plot (15 MHz Ch.39725 QPSK_RB1_Offset 0)-2



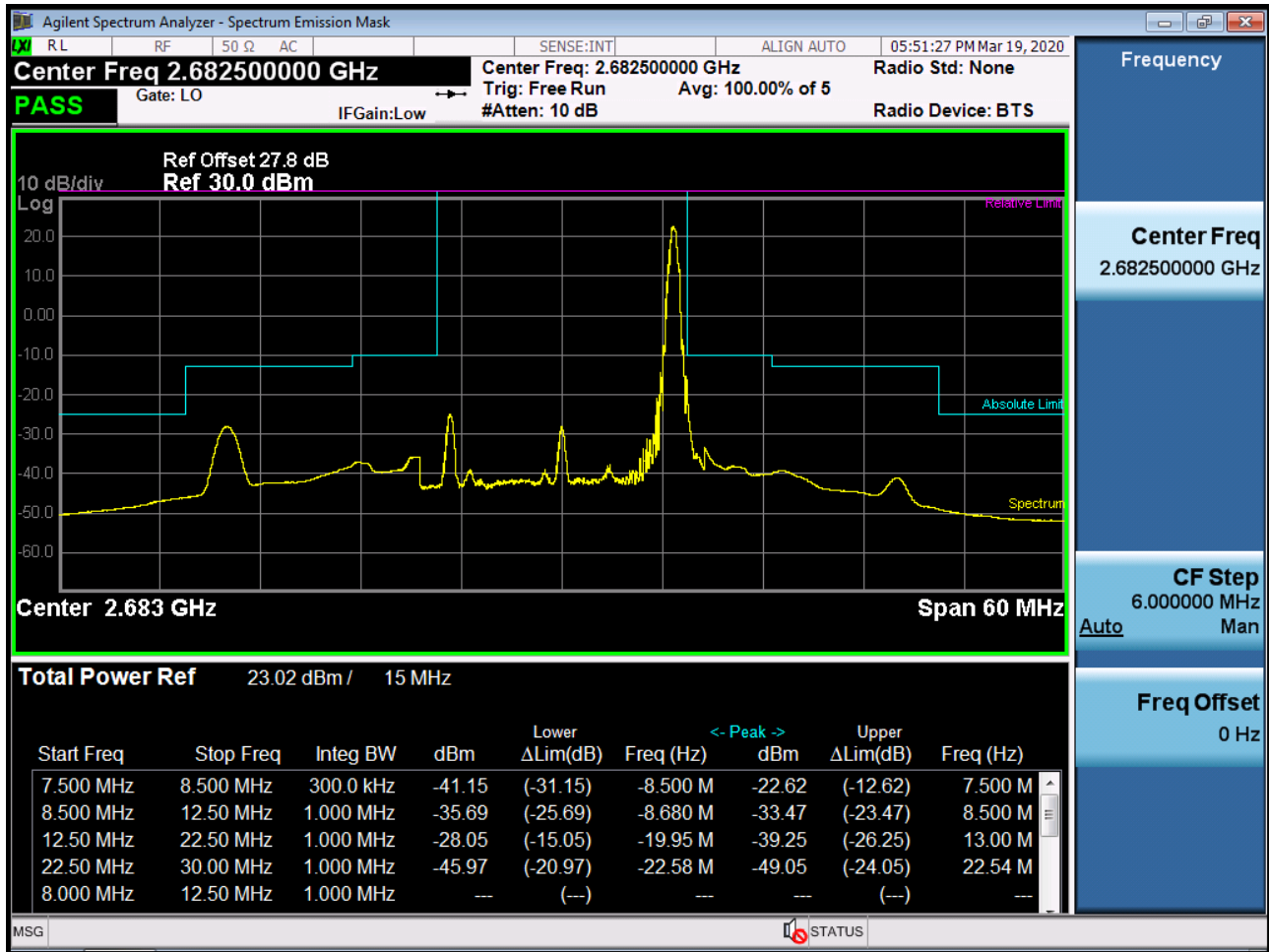
BAND 41. Low Channel Edge Plot (15 MHz Ch.39725 QPSK_RB75_Offset 0)-2



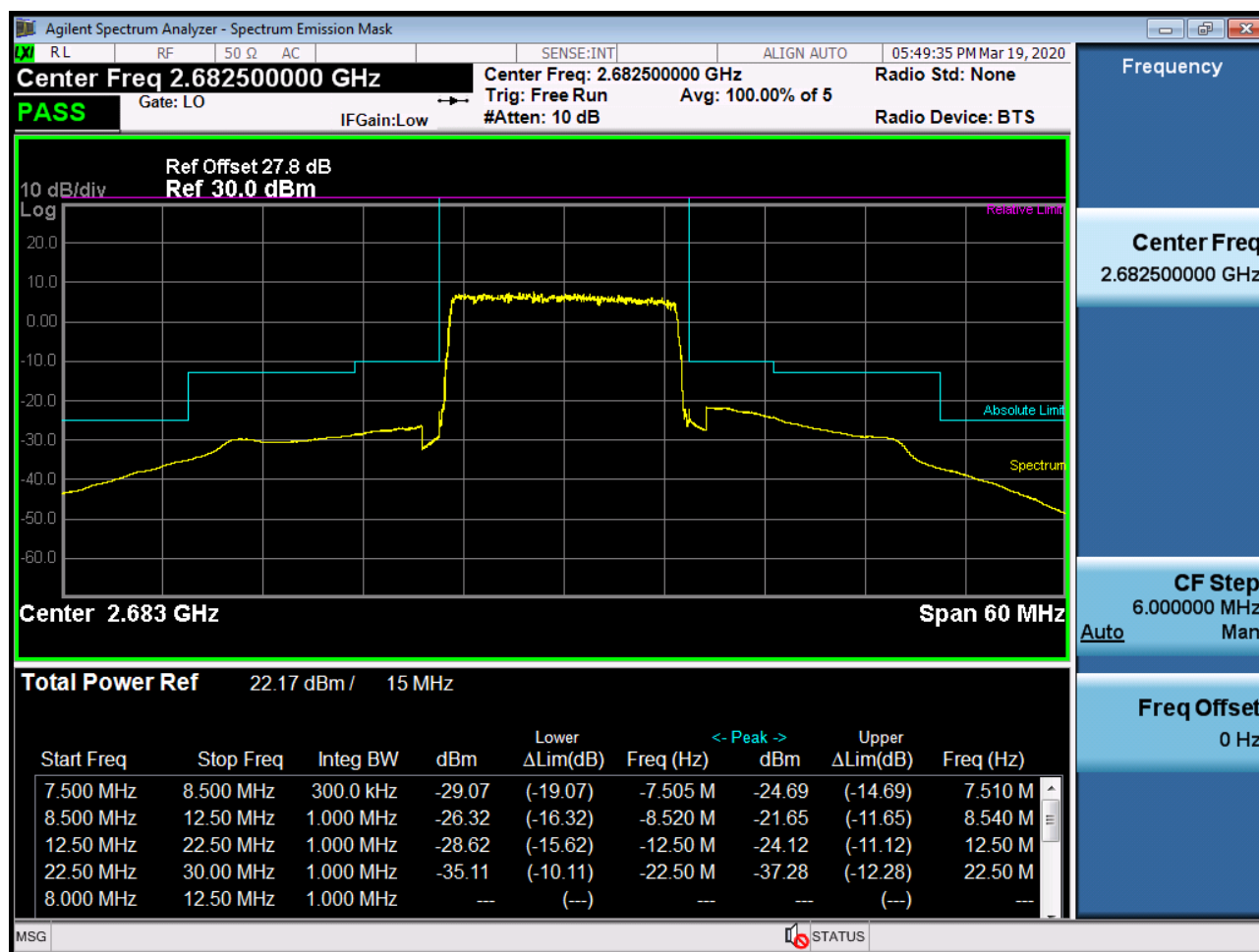
BAND 41. Mid Channel Edge Plot (15 MHz Ch.40620 QPSK RB 75)



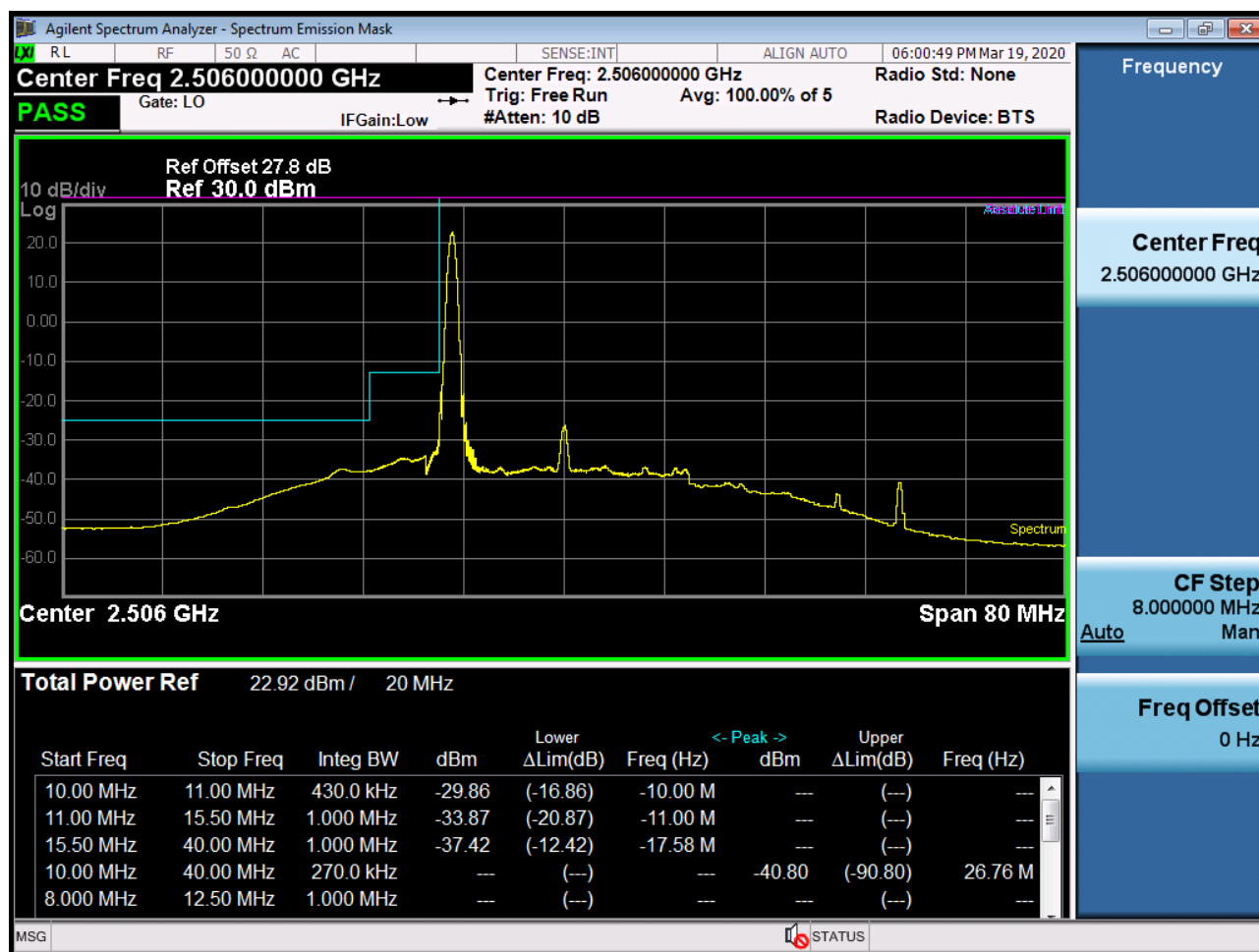
BAND 41. High Channel Edge Plot (15 MHz Ch.41515 QPSK RB 1, Offset 74)



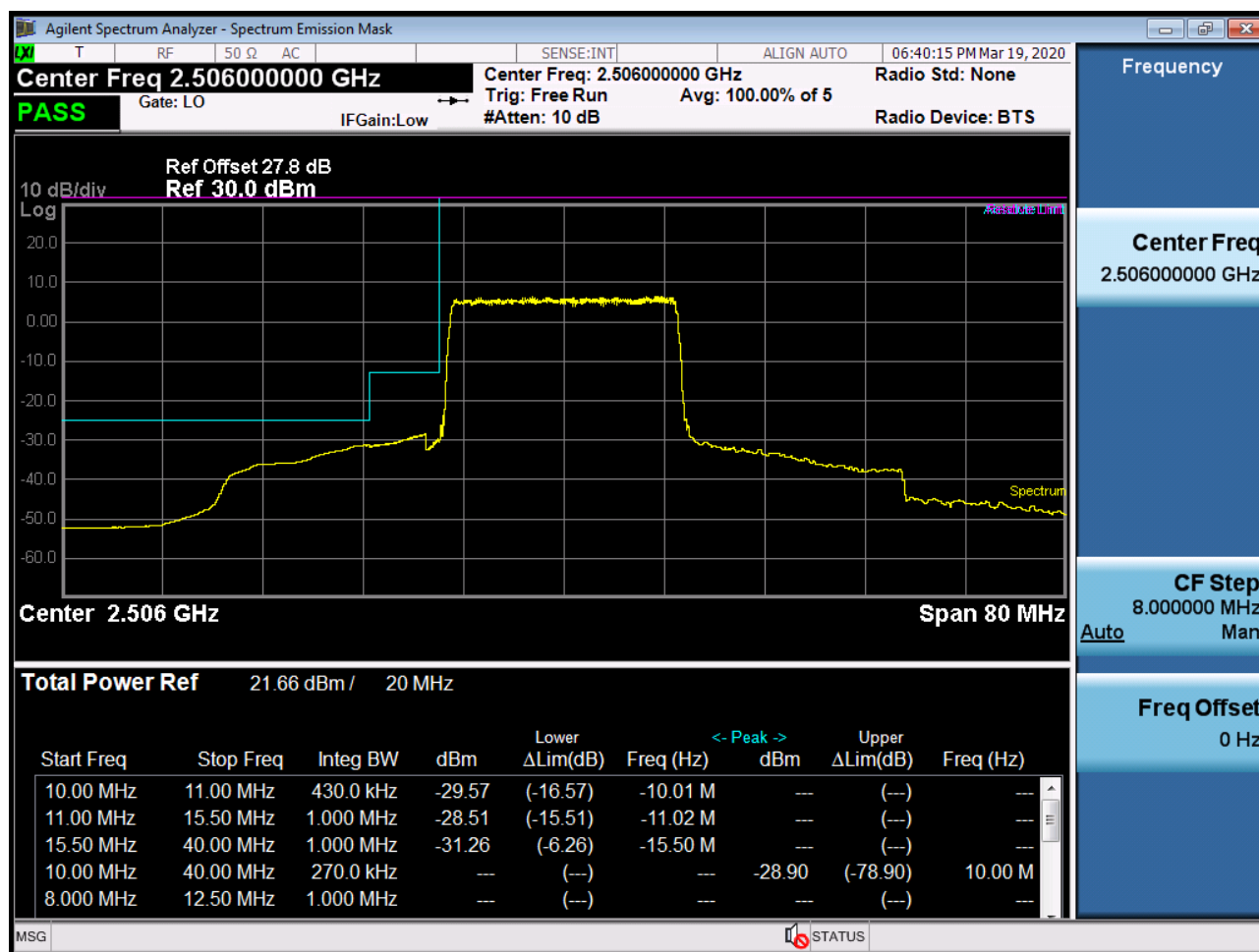
BAND 41. High Channel Edge Plot (15 MHz Ch.41515 QPSK_RB75_Offset 0)



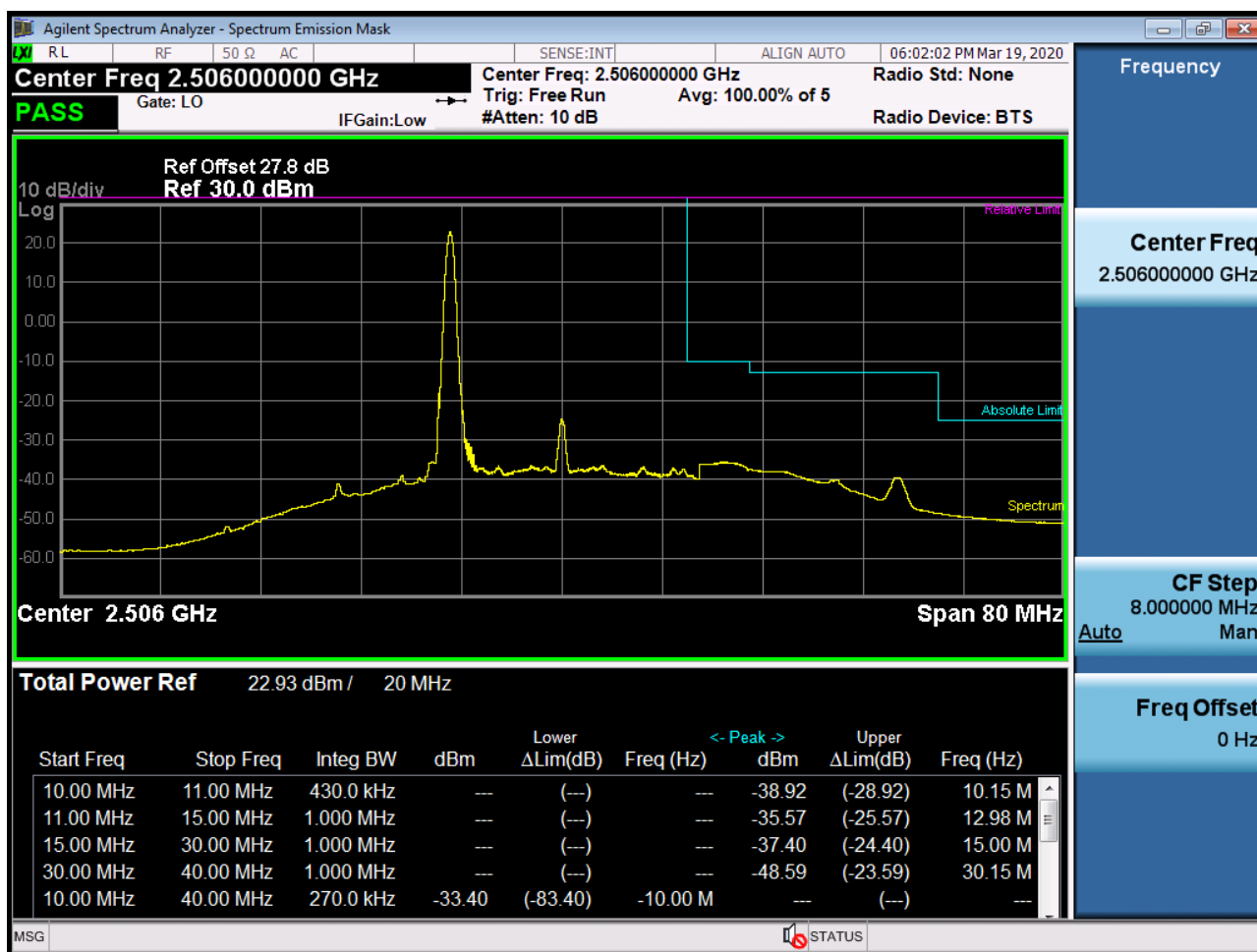
BAND 41. Low Channel Edge Plot (20 MHz Ch.39750 QPSK RB 1, Offset 0)-1



BAND 41. Low Channel Edge Plot (20 MHz Ch.39750 QPSK RB 100, Offset 0)-1



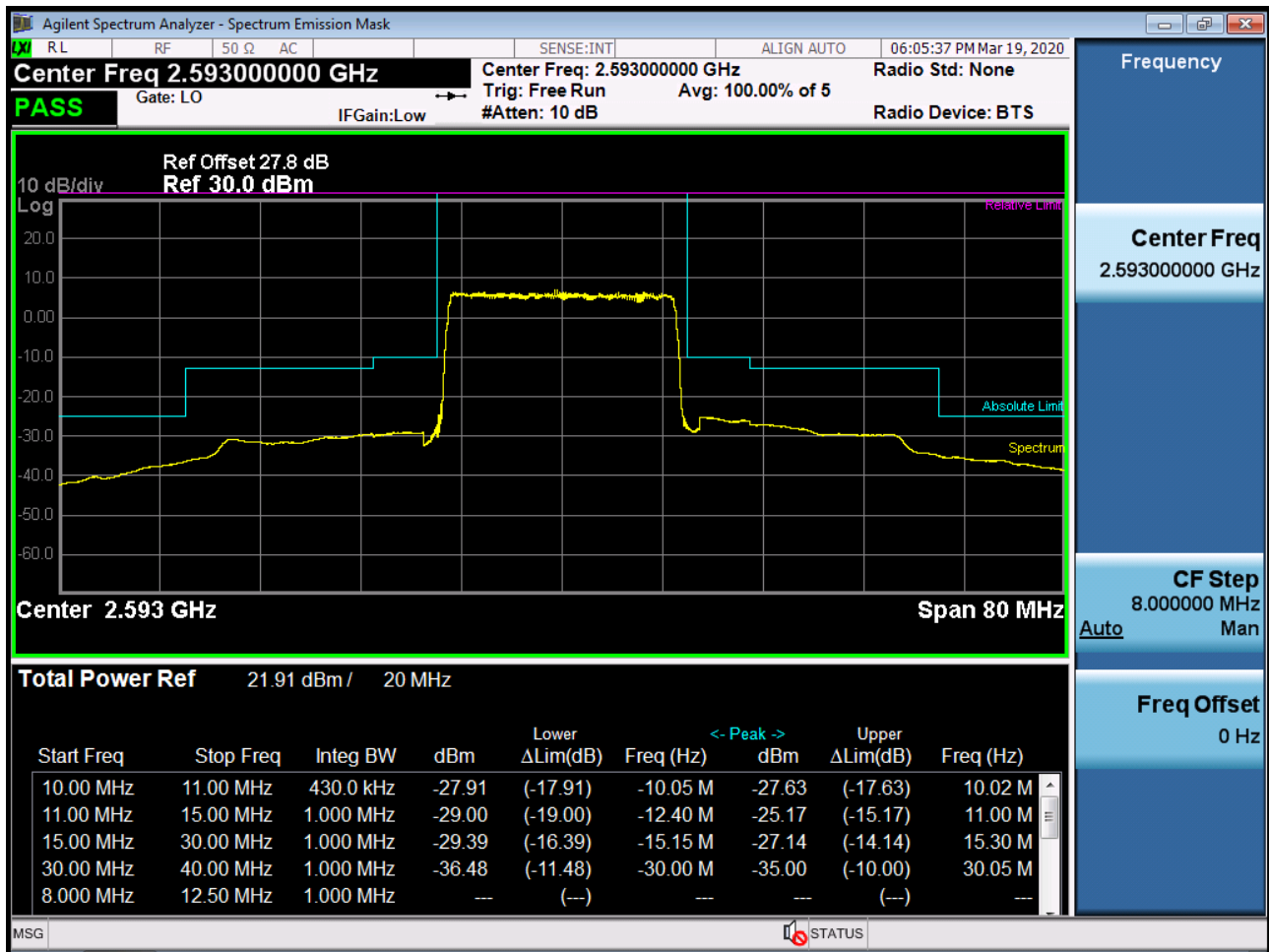
BAND 41. Low Channel Edge Plot (20 MHz Ch.39750 QPSK_RB1_Offset 0)-2



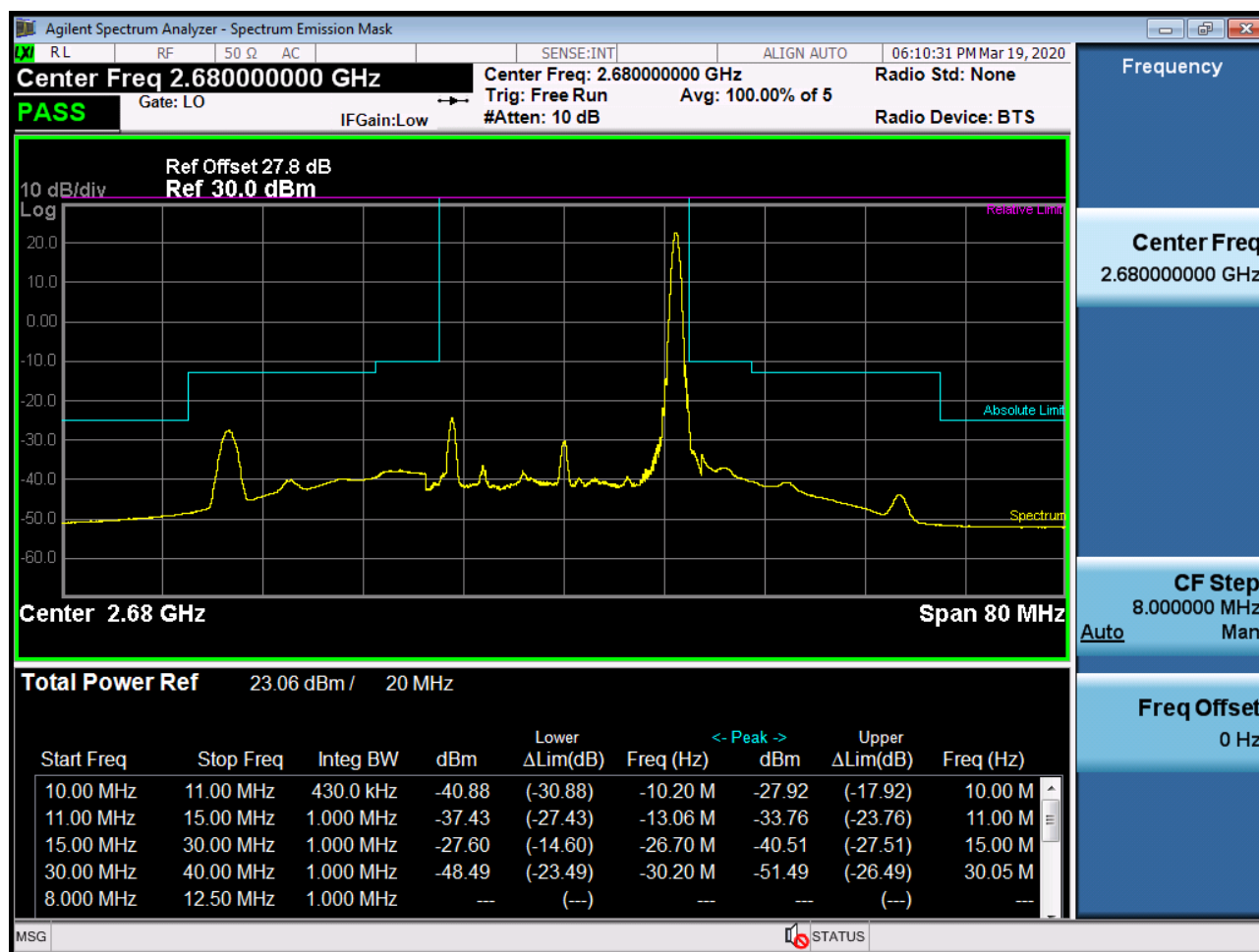
BAND 41. Low Channel Edge Plot (20 MHz Ch.39750 QPSK_RB100_Offset 0)-2



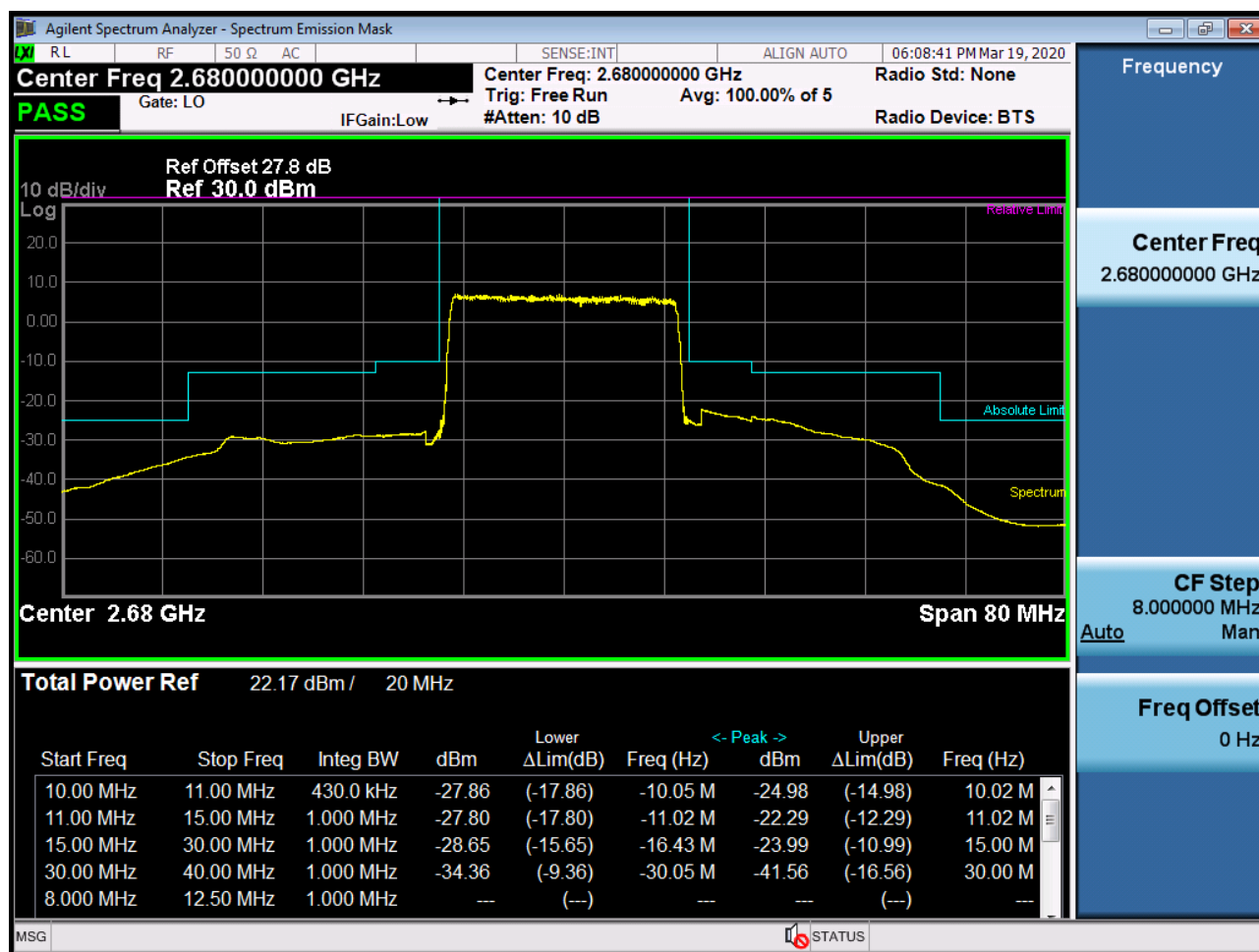
BAND 41. Mid Channel Edge Plot (20 MHz Ch.40620 QPSK RB 100)



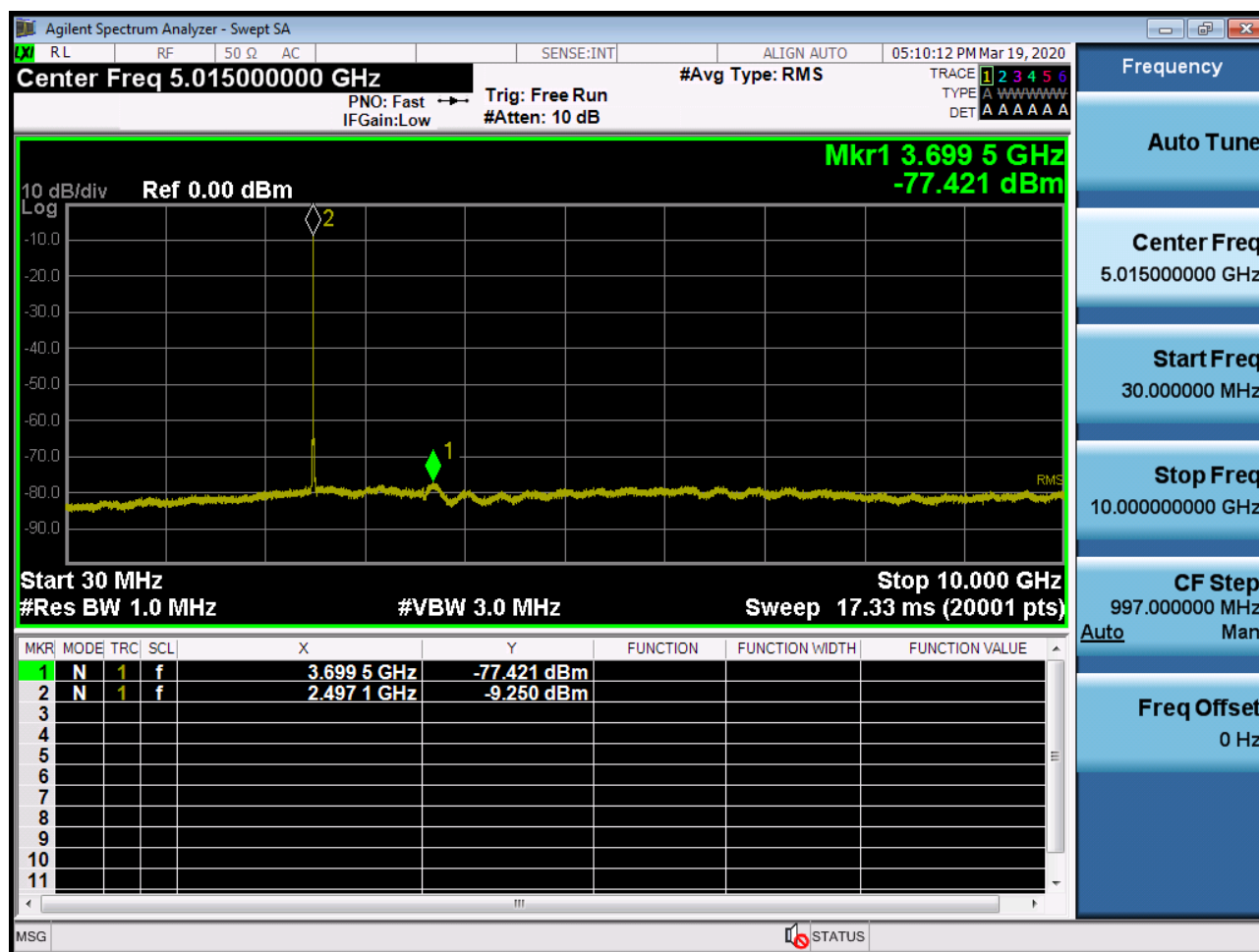
BAND 41. High Channel Edge Plot (20 MHz Ch.41490 QPSK RB 1, Offset 99)



BAND 41. High Channel Edge Plot (20 MHz Ch.41490 QPSK_RB100_Offset 0)



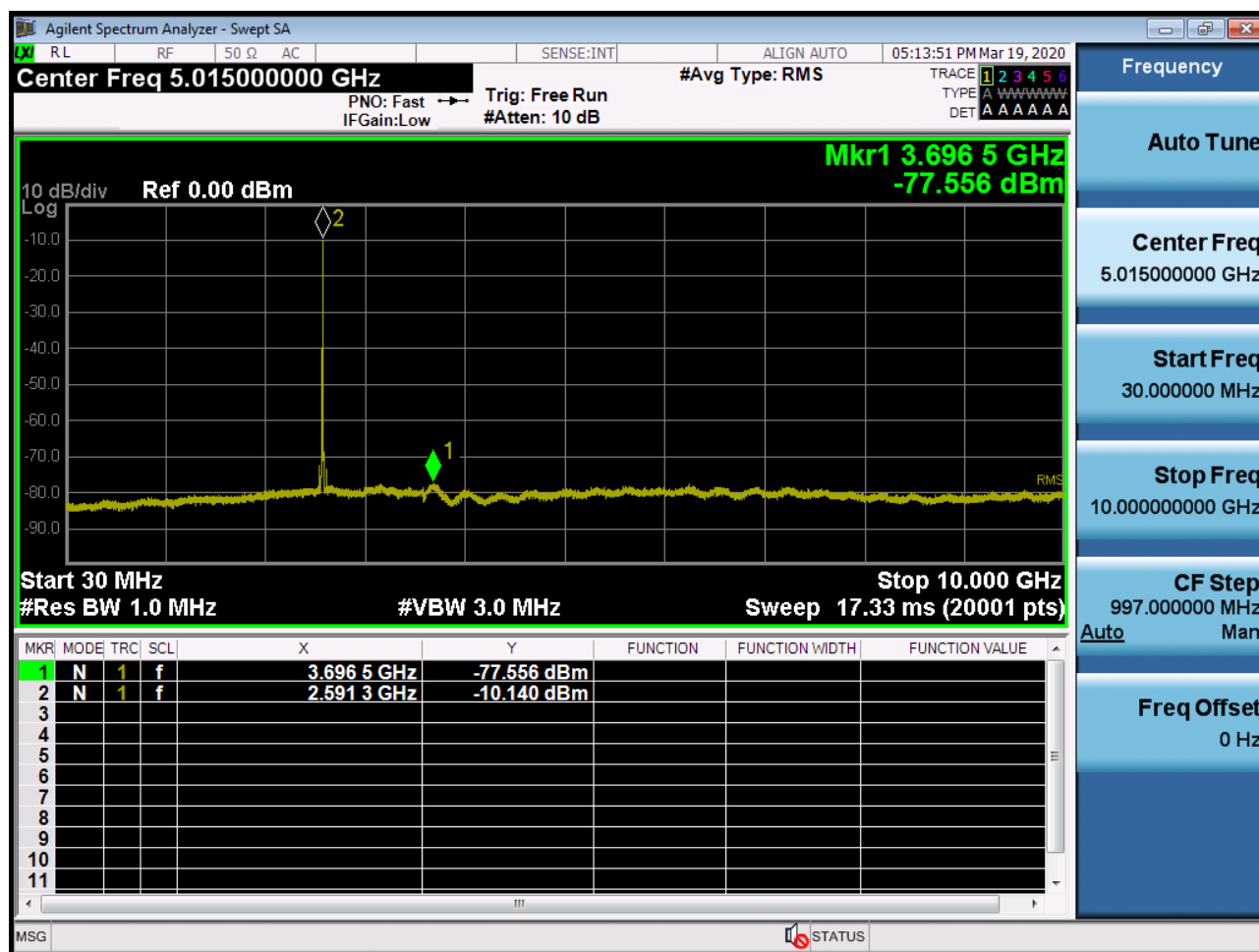
BAND 41. Conducted Spurious Plot 1 (5 MHz Ch.39675 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (5 MHz Ch. 39675 QPSK RB 1, Offset 0)



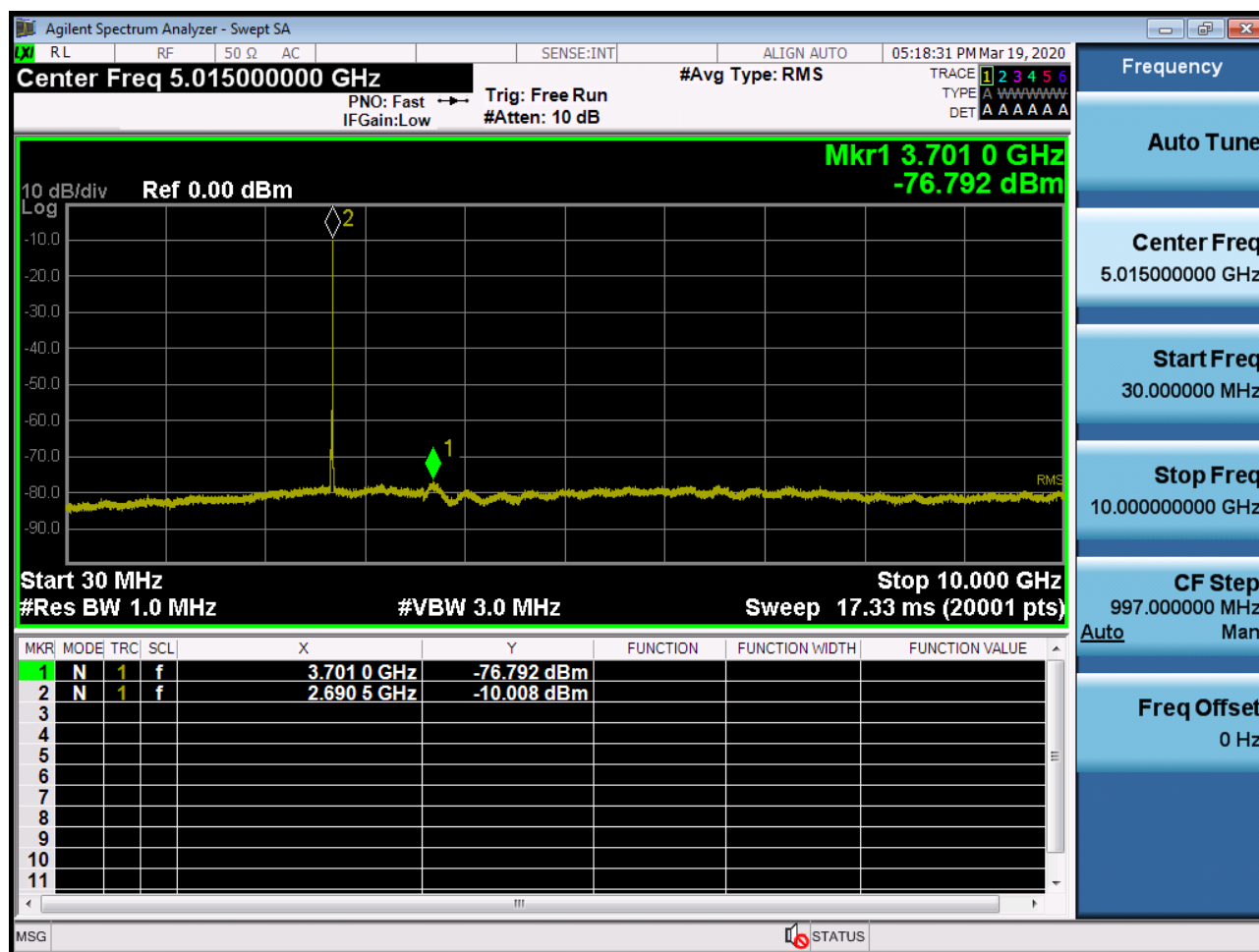
BAND 41. Conducted Spurious Plot 1 (5 MHz Ch.40620 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (5 MHz Ch. 40620 QPSK RB 1, Offset 0)



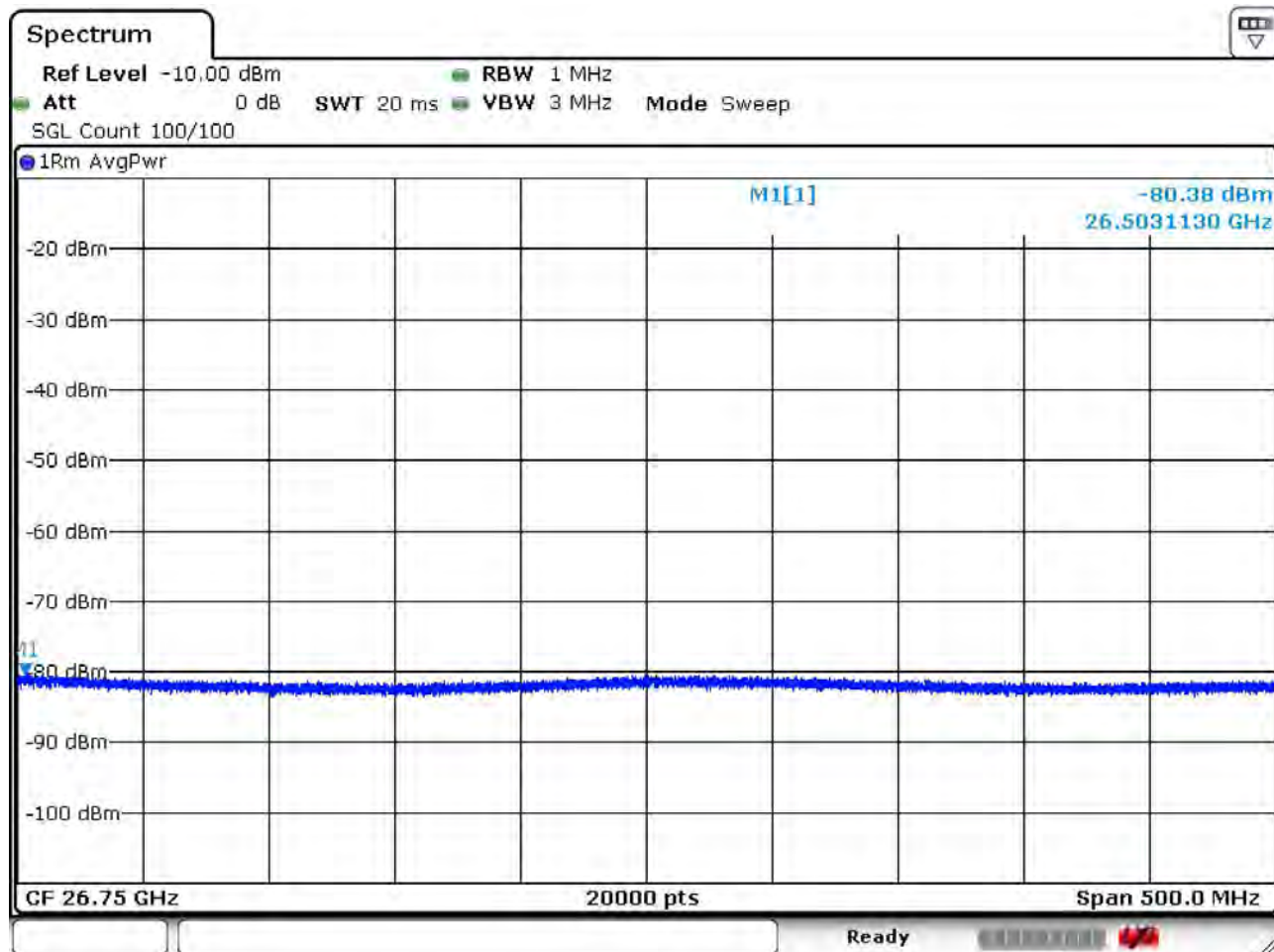
BAND 41. Conducted Spurious Plot 1 (5 MHz Ch.41565 QPSK RB 1, Offset 0)



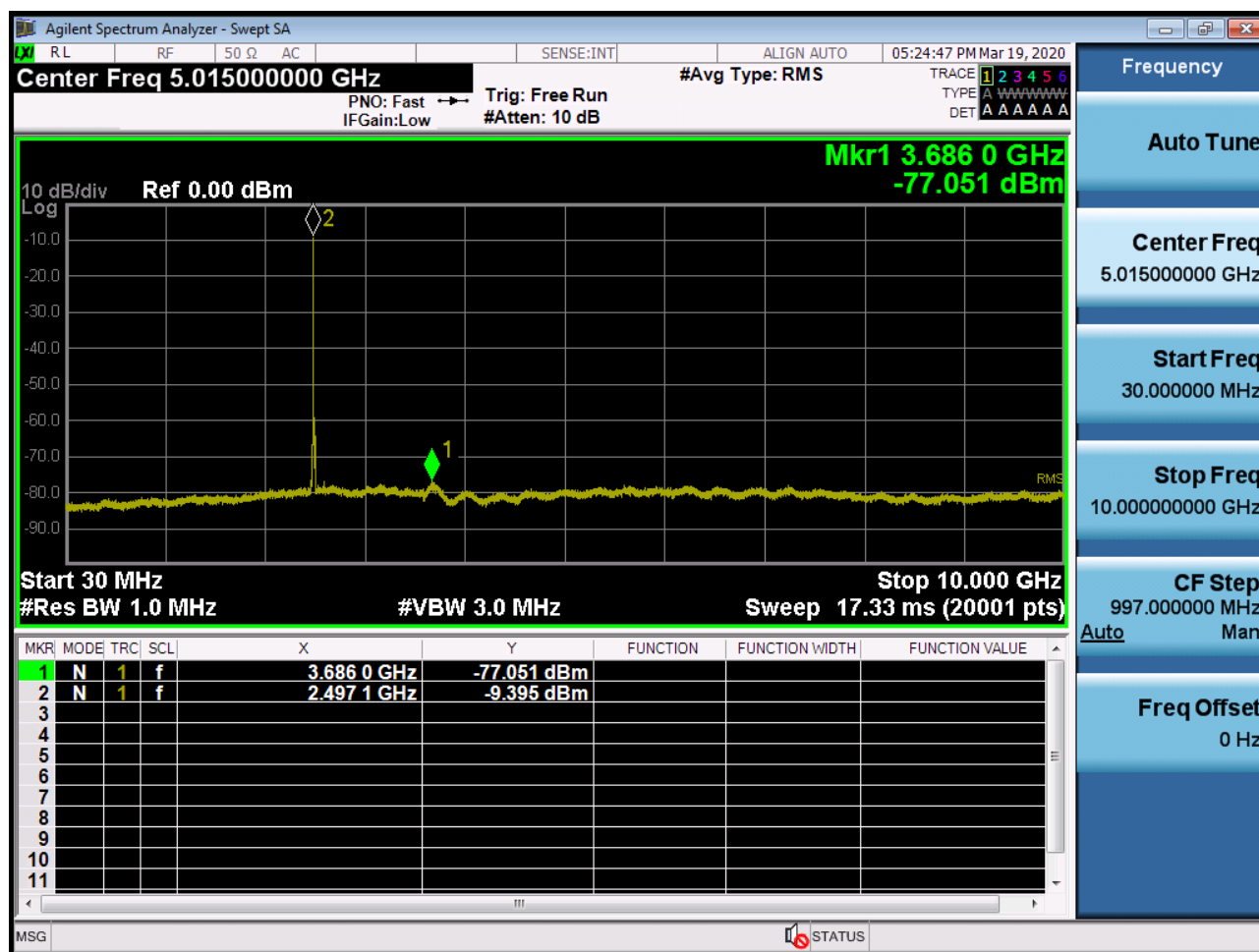
BAND 41. Conducted Spurious Plot 2 (5 MHz Ch. 41565 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 3 (5 MHz Ch. 41565 QPSK RB 1, Offset 0)



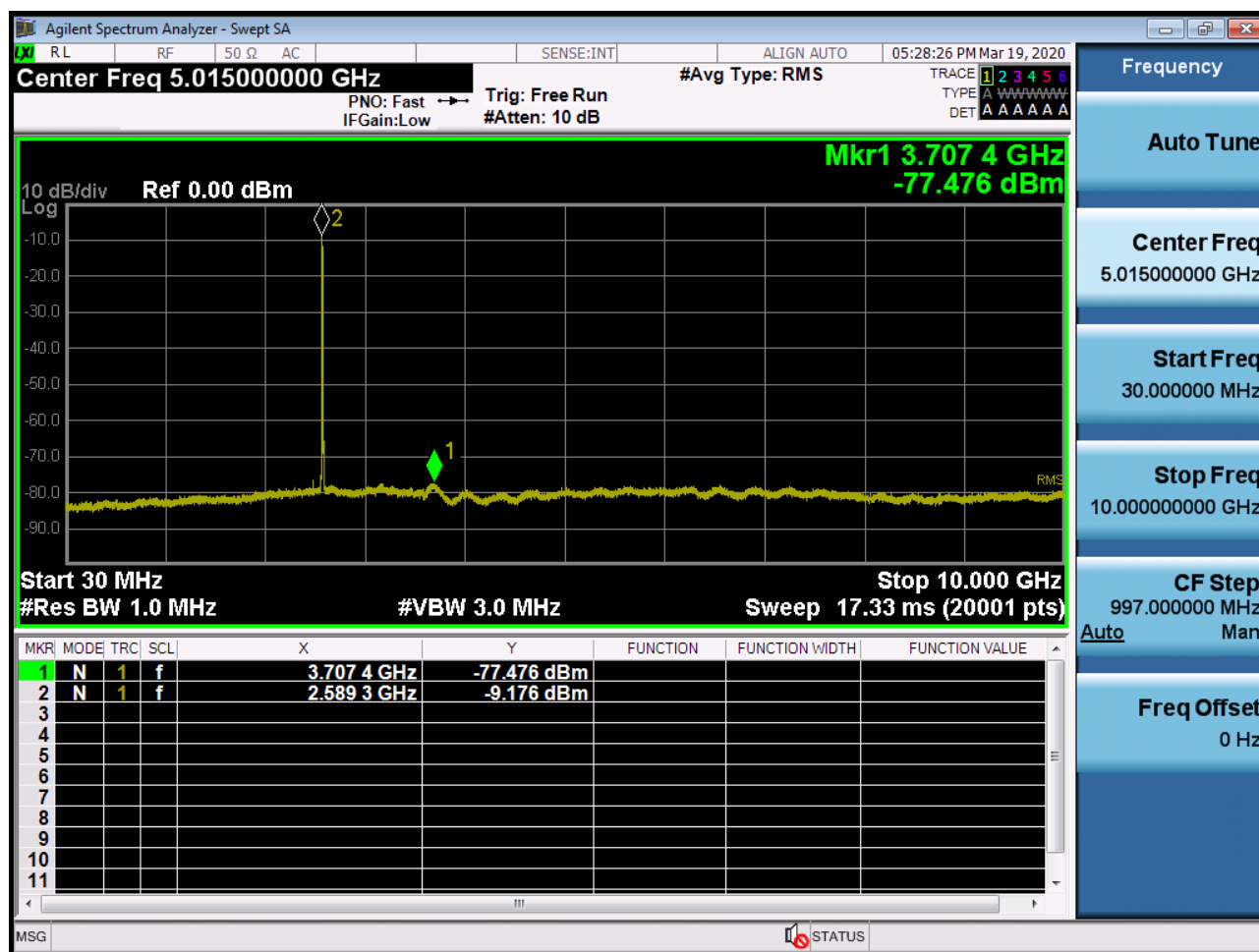
BAND 41. Conducted Spurious Plot 1 (10 MHz Ch.39700 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (10 MHz Ch. 39700 QPSK RB 1, Offset 0)



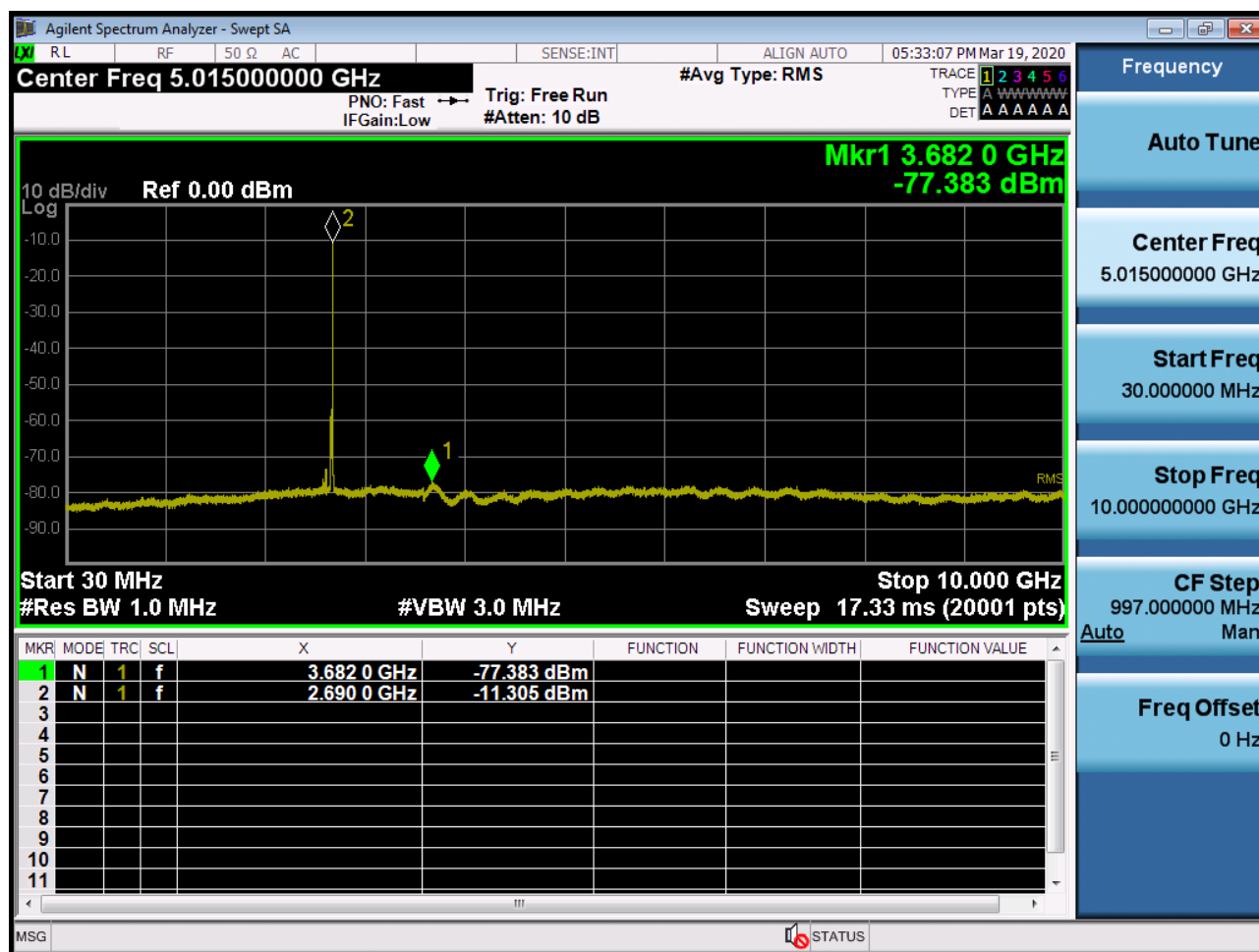
BAND 41. Conducted Spurious Plot 1 (10 MHz Ch.40620 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (10 MHz Ch. 40620 QPSK RB 1, Offset 0)



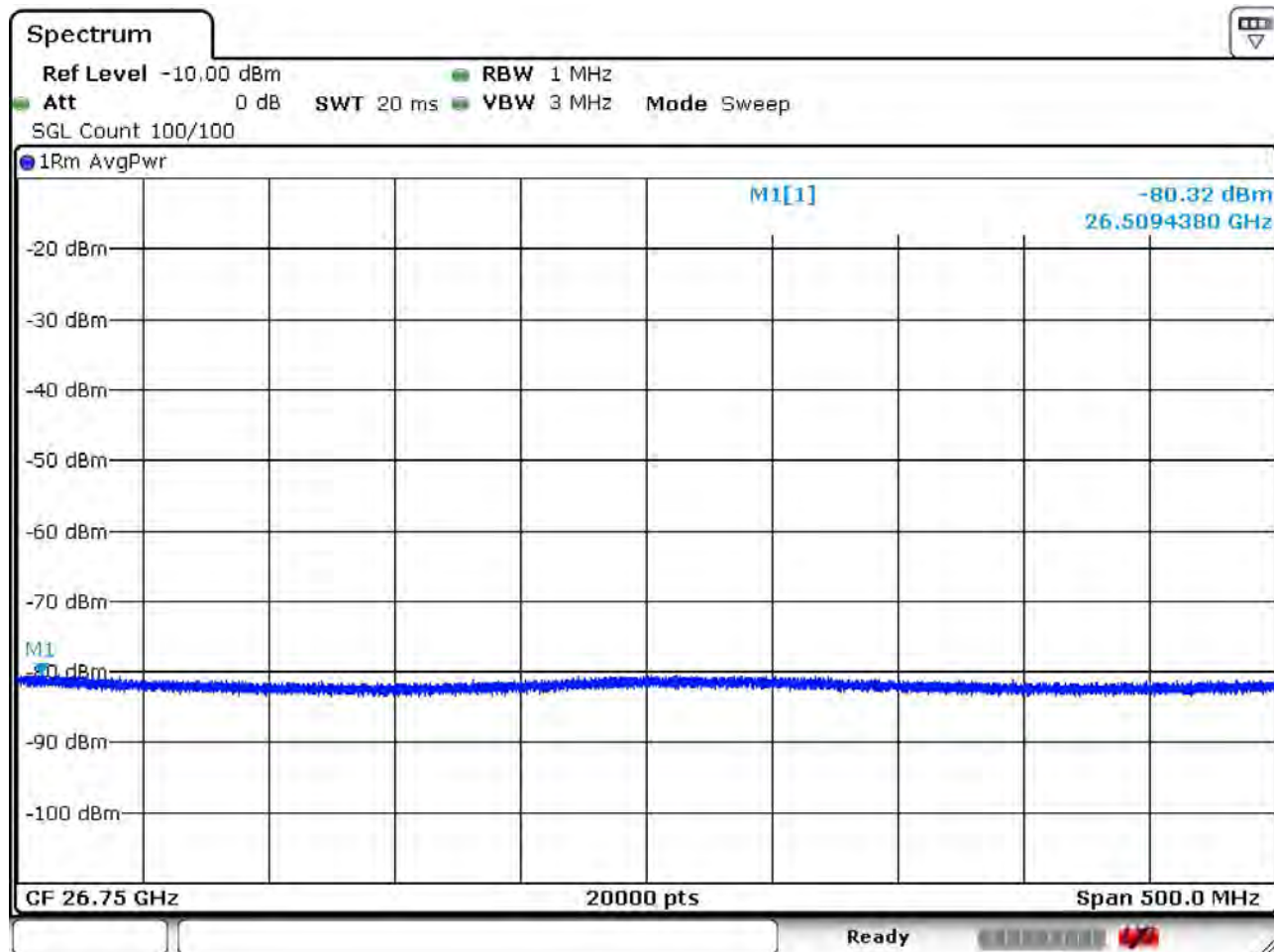
BAND 41. Conducted Spurious Plot 1 (10 MHz Ch. 41540 QPSK RB 1, Offset 0)



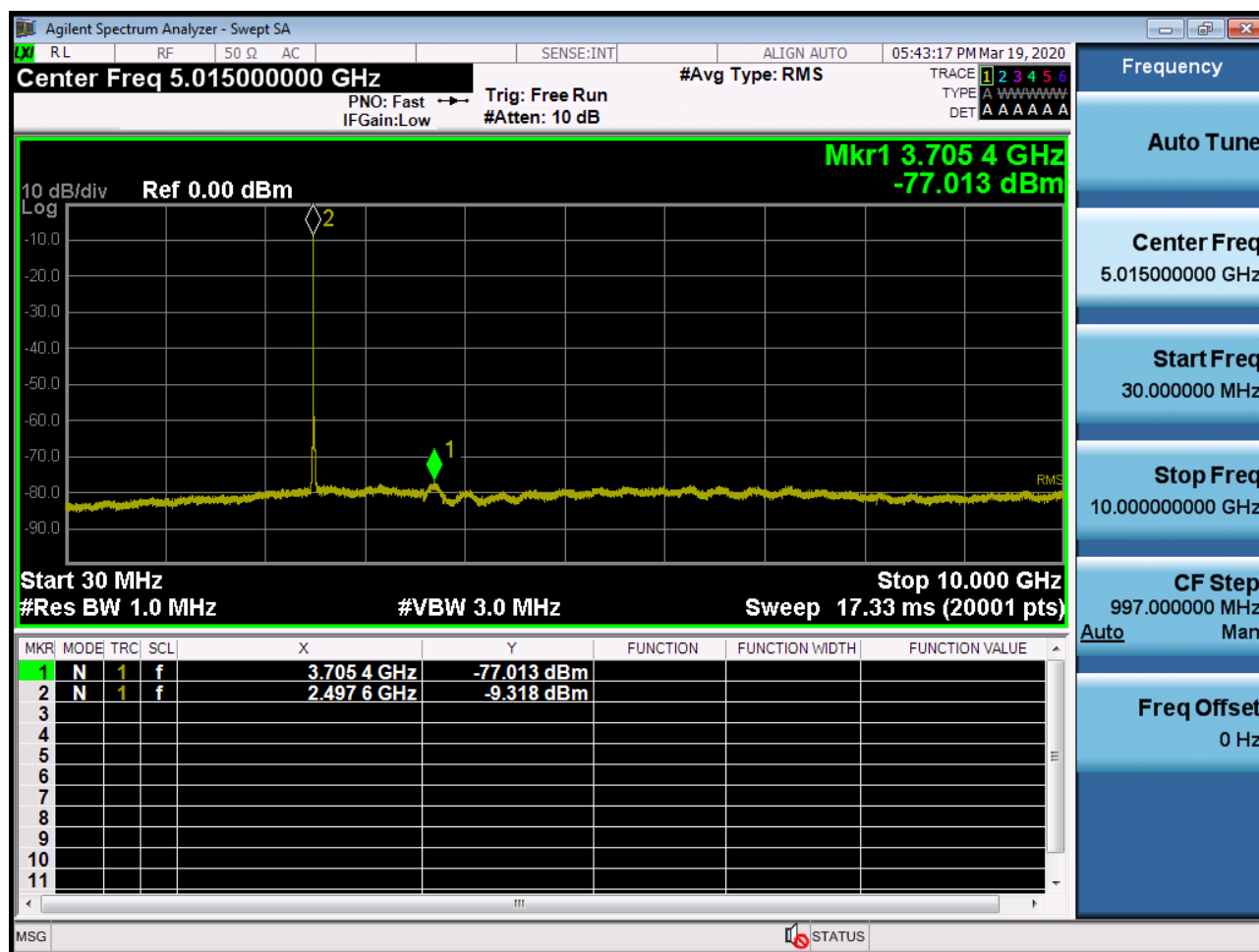
BAND 41. Conducted Spurious Plot 2 (10 MHz Ch. 41540 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 3 (10 MHz Ch. 41540 QPSK RB 1, Offset 0)



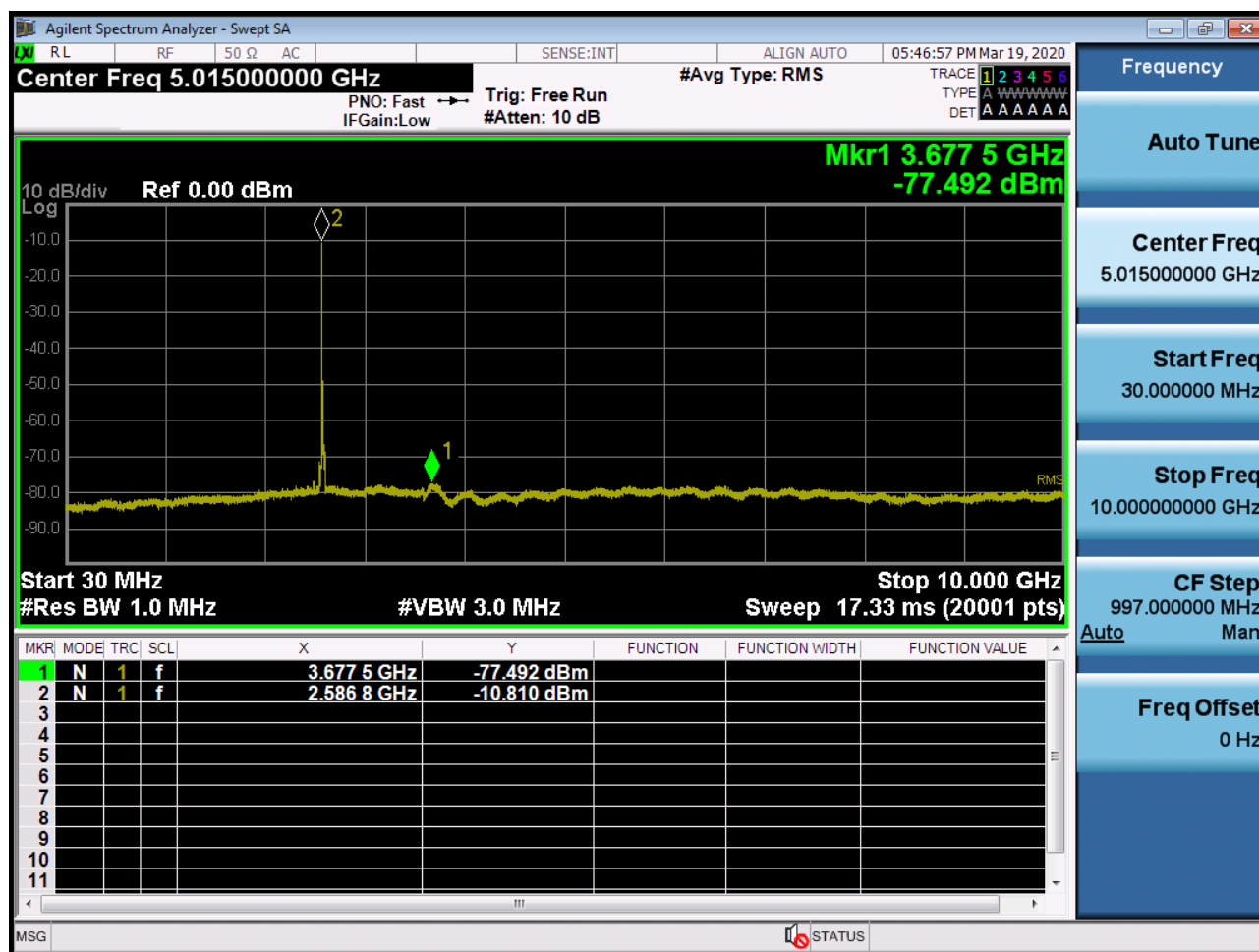
BAND 41. Conducted Spurious Plot 1 (15 MHz Ch.39725 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (15 MHz Ch. 39725 QPSK RB 1, Offset 0)



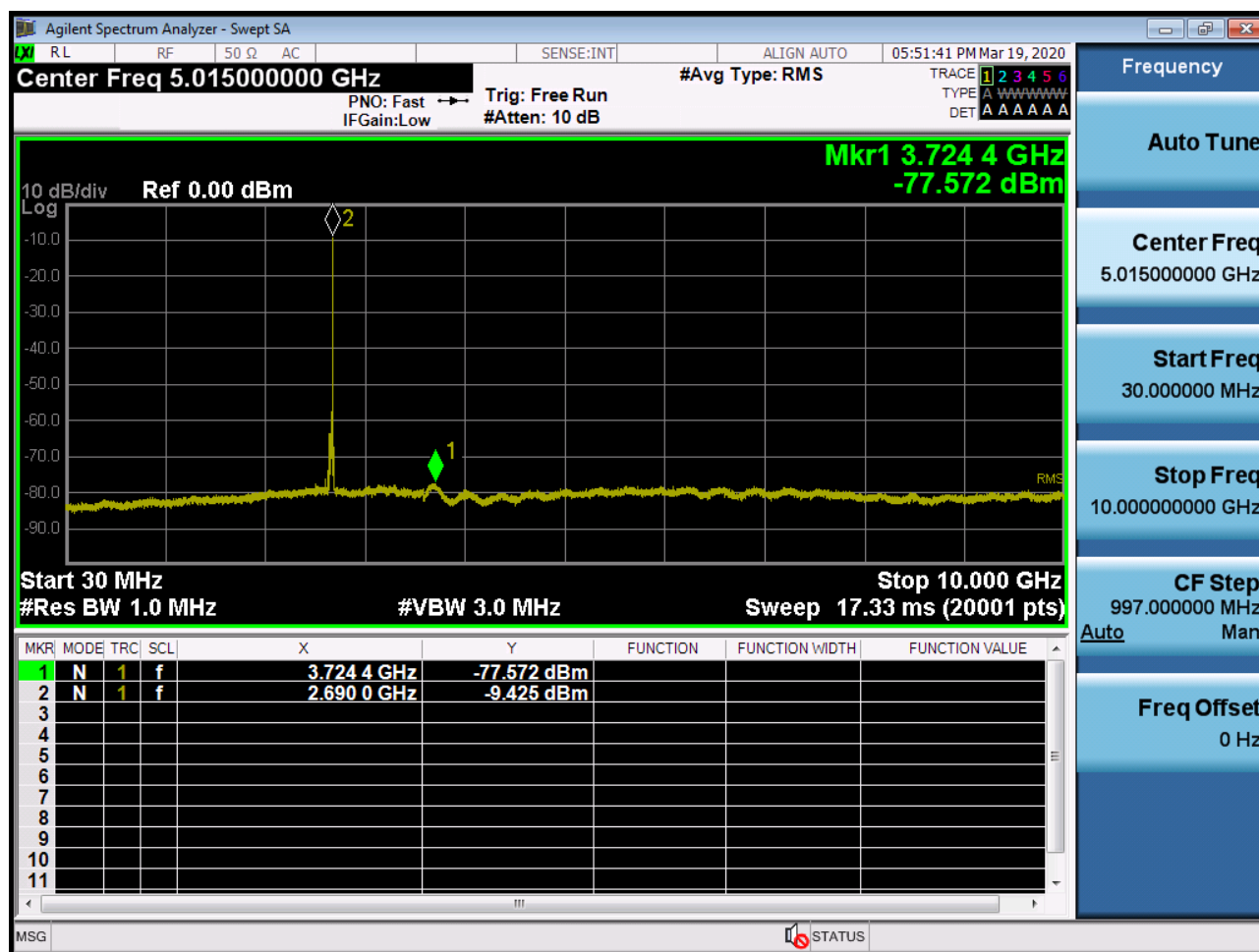
BAND 41. Conducted Spurious Plot 1 (15 MHz Ch.40620 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (15 MHz Ch. 40620 QPSK RB 1, Offset 0)



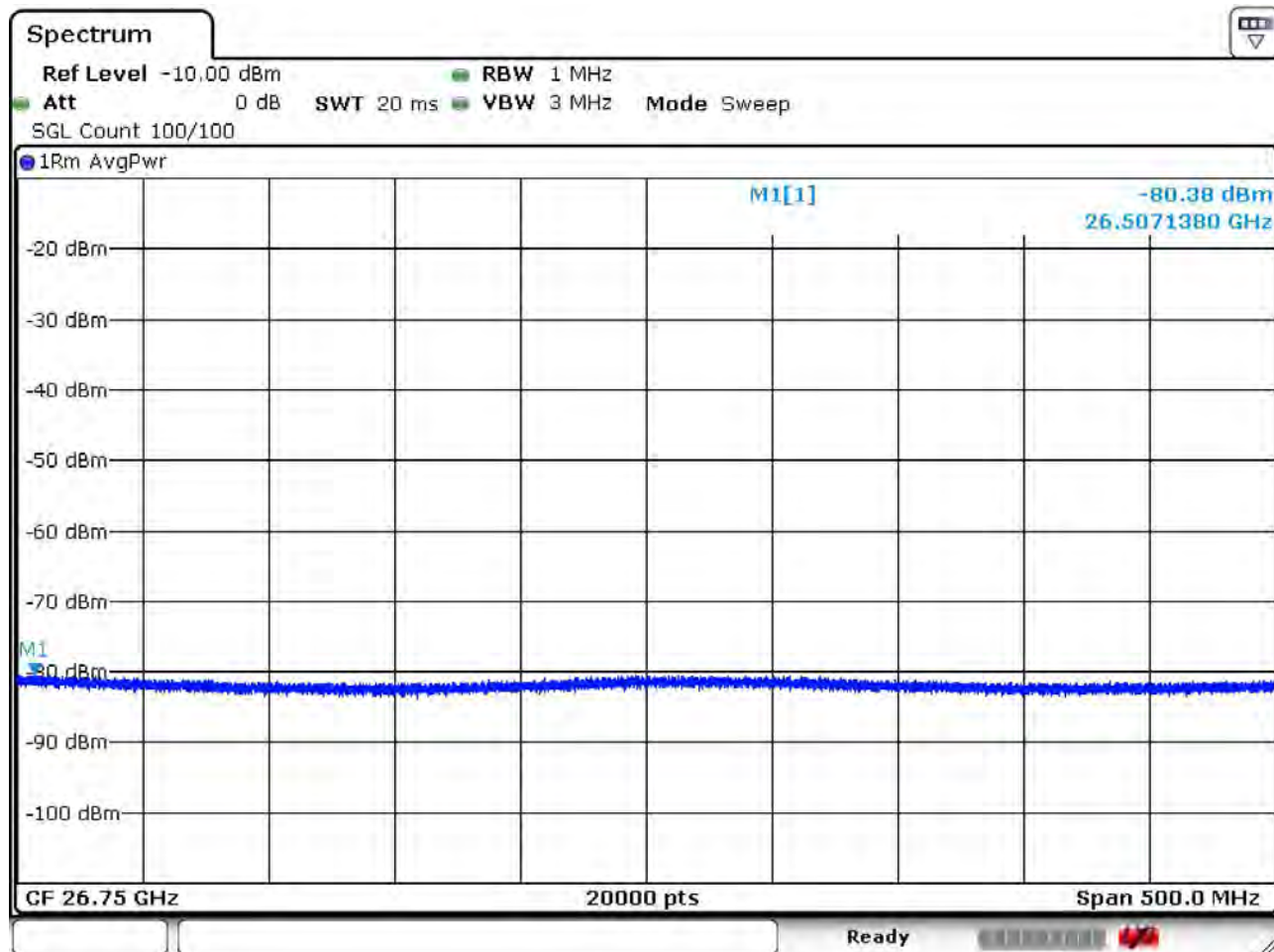
BAND 41. Conducted Spurious Plot 1 (15 MHz Ch.41515 QPSK RB 1, Offset 0)



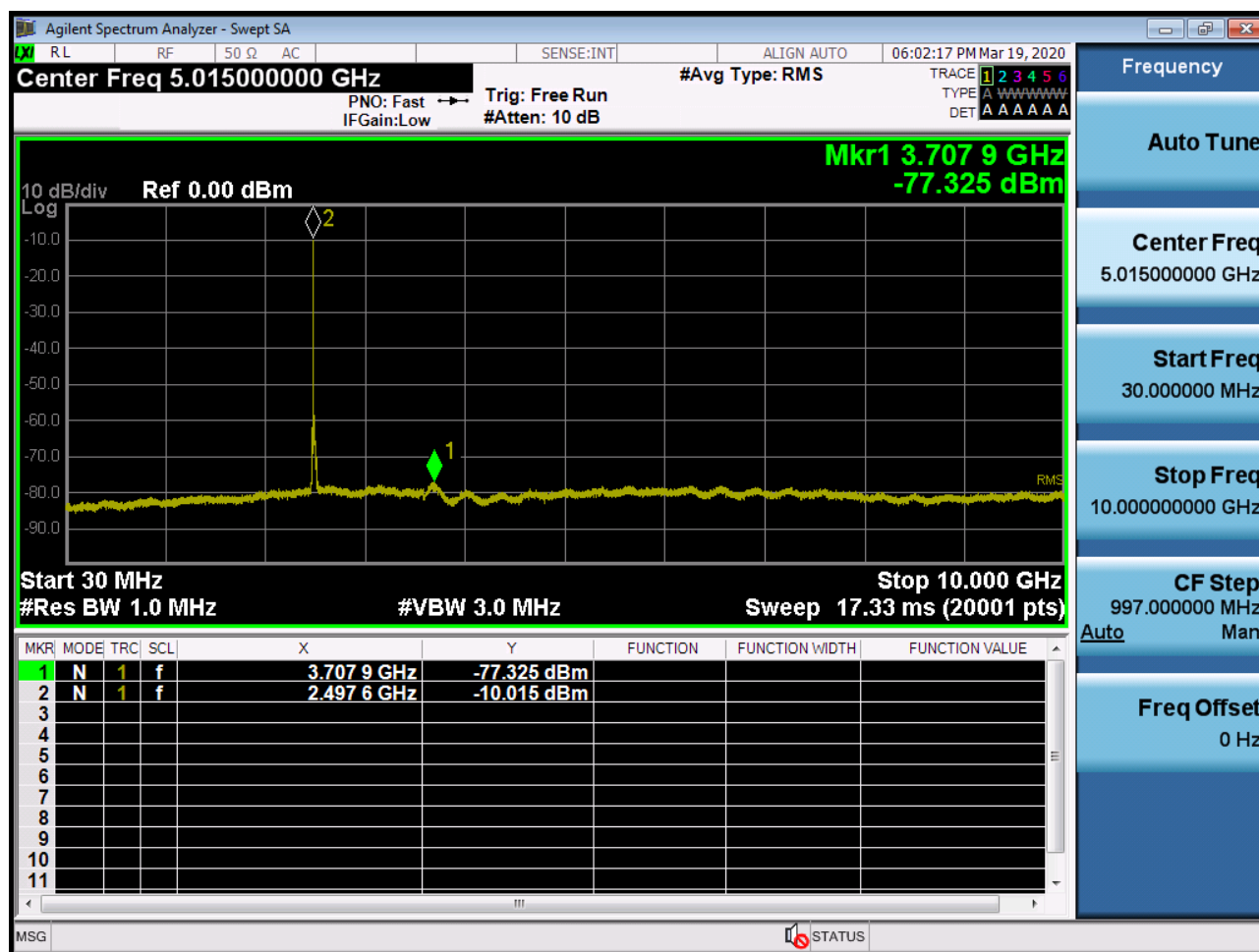
BAND 41. Conducted Spurious Plot 2 (15 MHz Ch. 41515 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 3 (15 MHz Ch. 41515 QPSK RB 1, Offset 0)



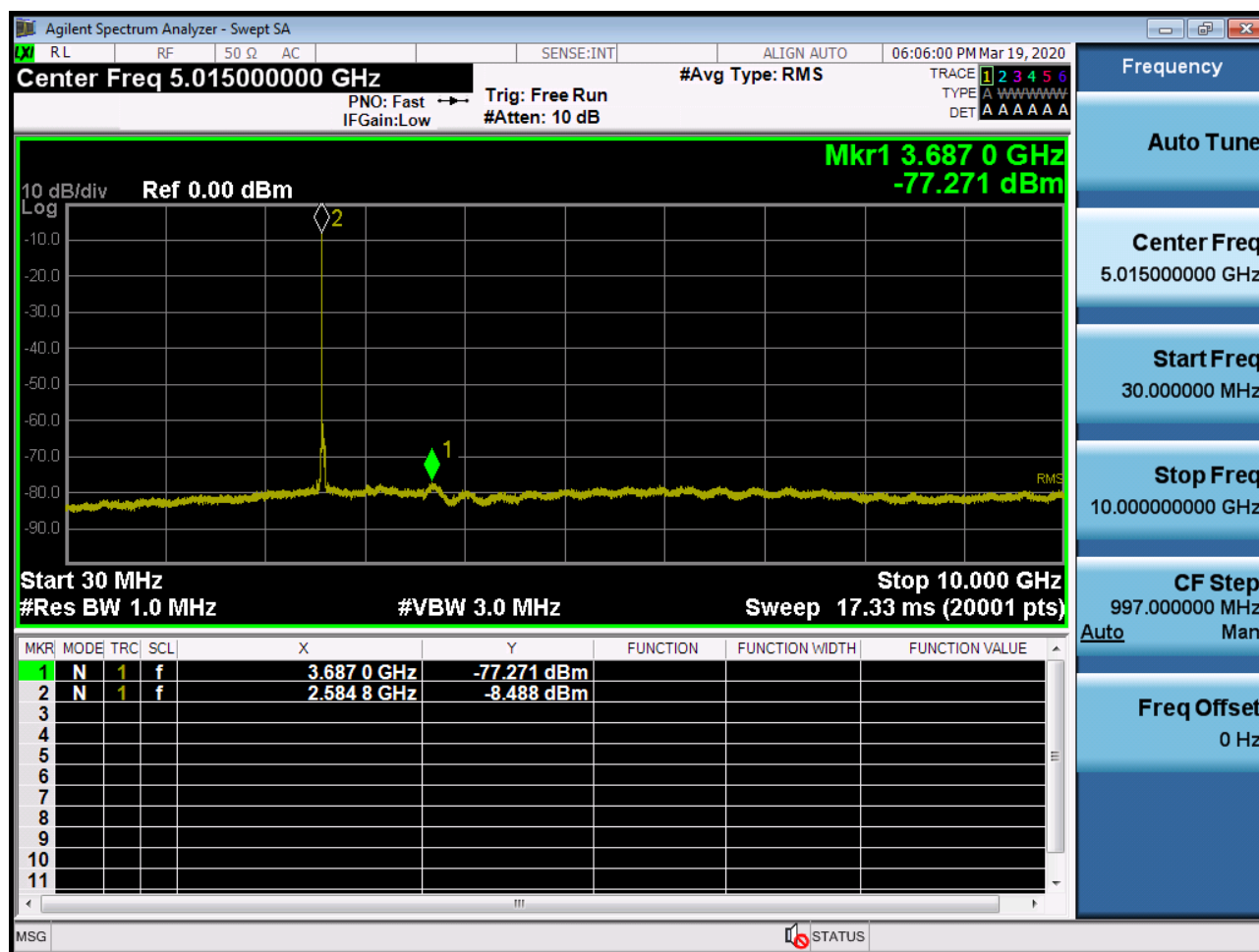
BAND 41. Conducted Spurious Plot 1 (20 MHz Ch.39750 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (20 MHz Ch. 39750 QPSK RB 1, Offset 0)



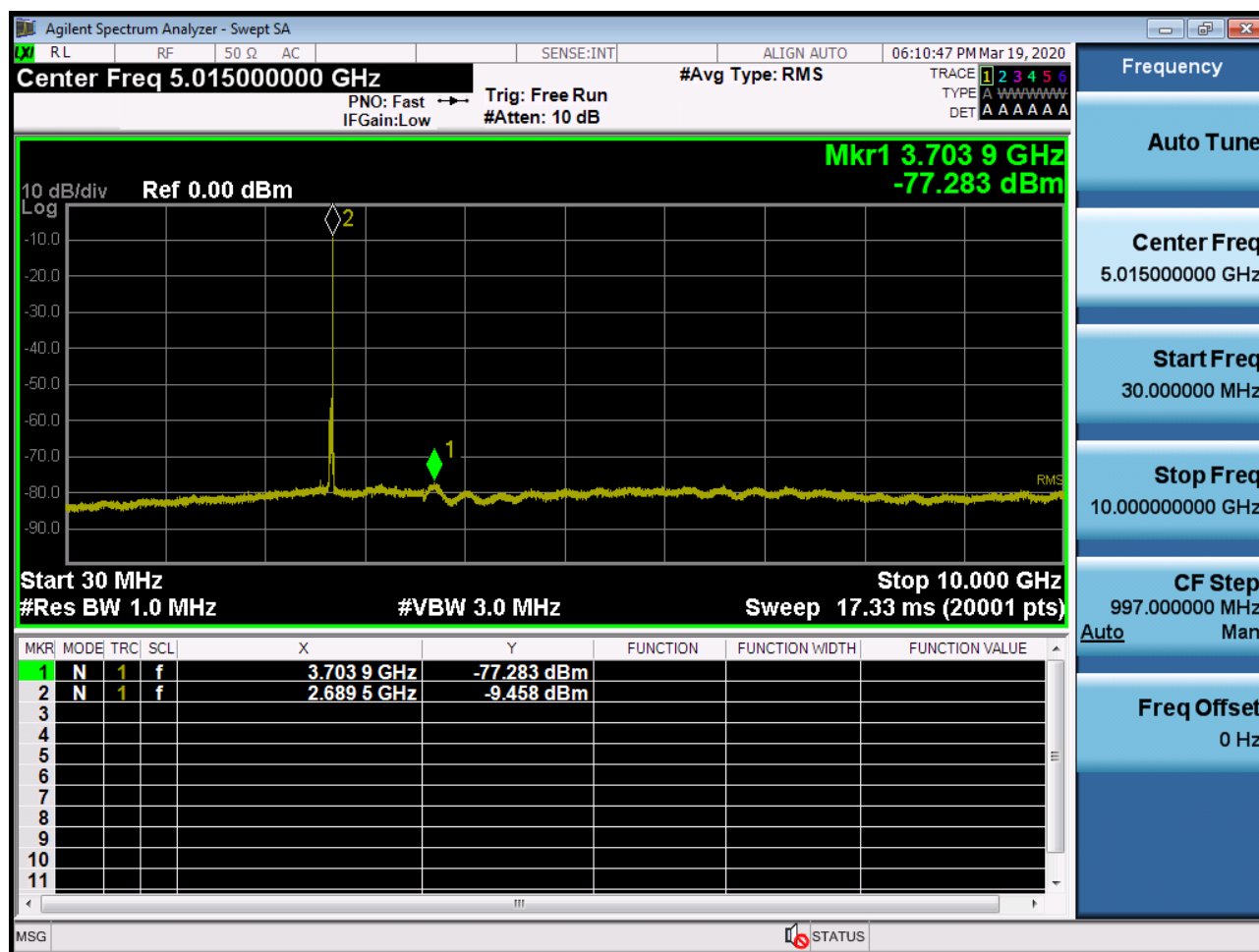
BAND 41. Conducted Spurious Plot 1 (20 MHz Ch.40620 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (20 MHz Ch. 40620 QPSK RB 1, Offset 0)



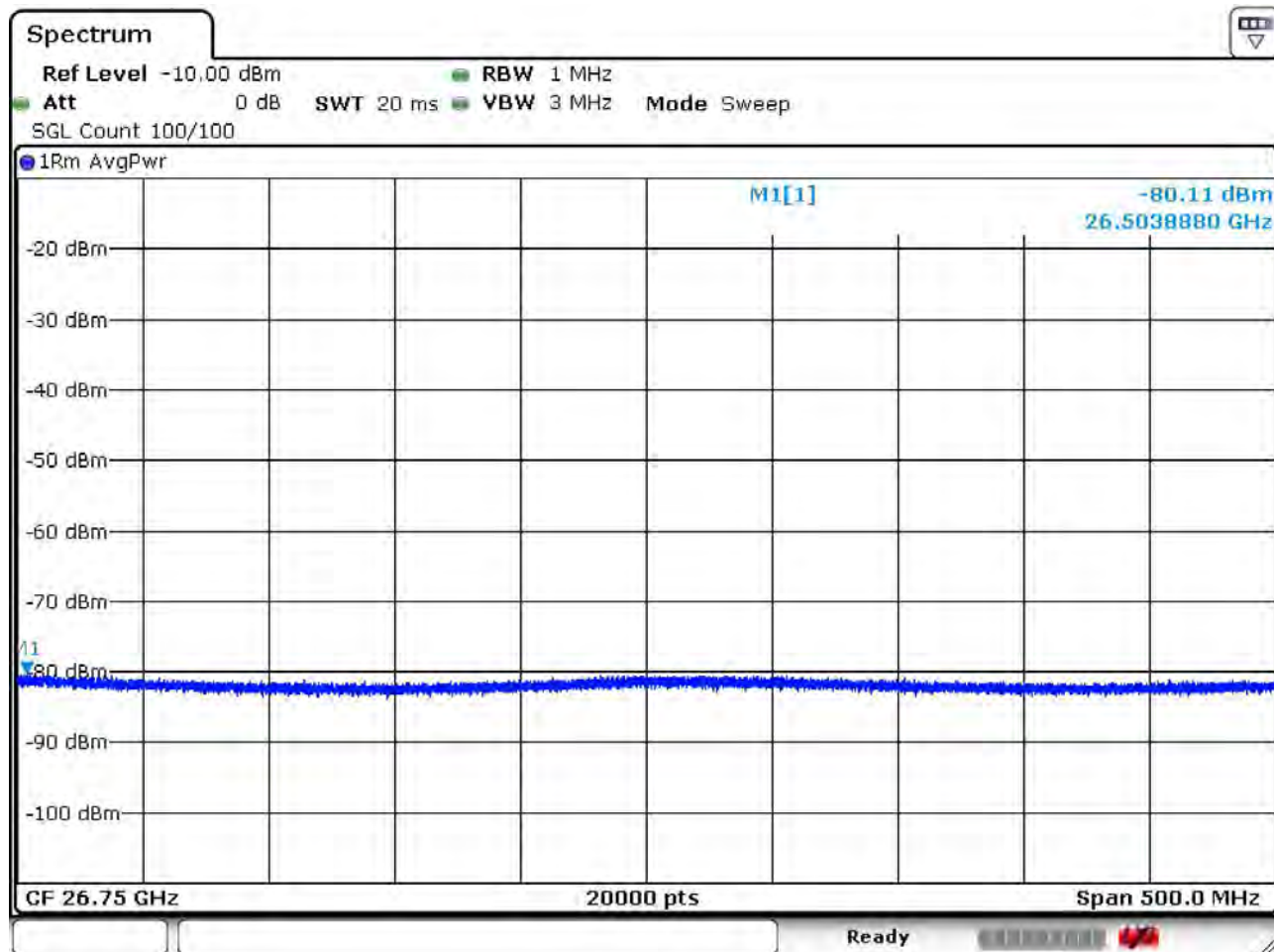
BAND 41. Conducted Spurious Plot 1 (20 MHz Ch.41490 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 2 (20 MHz Ch. 41490 QPSK RB 1, Offset 0)



BAND 41. Conducted Spurious Plot 3 (20 MHz Ch. 41490 QPSK RB 1, Offset 0)



10. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2004-FC037-P