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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 17, 2019
**Location:**
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
**Report No.:** HCT-RF-1903-FC025-R1

**FCC ID:** **A3LSMT725**

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

**Model(s):** SM-T725
**Additional Model(s):** T725N, T727
**EUT Type:** Tablet
**FCC Classification:** PCS Licensed Transmitter (PCB)
**FCC Rule Part(s):** §27, §2

| Mode (MHz) | Tx Frequency (MHz) | Emission Designator | Modulation | ERP | |
|---|---|---|---|---|---|
| | | | | Max. Power (W) | Max. Power (dBm) |
| LTE – Band12 (1.4) | 699.7 – 715.3 | 1M09G7D | QPSK | 0.037 | 15.73 |
| | | 1M09W7D | 16QAM | 0.031 | 14.97 |
| | | 1M09W7D | 64QAM | 0.025 | 13.99 |
| LTE – Band12 (3) | 700.5 – 714.5 | 2M71G7D | QPSK | 0.038 | 15.78 |
| | | 2M70W7D | 16QAM | 0.032 | 15.03 |
| | | 2M71W7D | 64QAM | 0.025 | 14.05 |
| LTE – Band12 / 17 (5) | 701.5 – 713.5 | 4M51G7D | QPSK | 0.038 | 15.77 |
| | | 4M50W7D | 16QAM | 0.032 | 15.02 |
| | | 4M50W7D | 64QAM | 0.025 | 14.04 |
| LTE – Band12 / 17 (10) | 704.0 – 711.0 | 8M98G7D | QPSK | 0.036 | 15.53 |
| | | 8M99W7D | 16QAM | 0.030 | 14.84 |
| | | 9M00W7D | 64QAM | 0.024 | 13.81 |

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 : Kwon Jeong**
**Manager of Telecommunication Testing Center**

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# Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|---|---|---|
| HCT-RF-1903-FC025 | March 14, 2019 | - First Approval Report |
| HCT-RF-1903-FC025-R1 | March 17, 2019 | - Revised the worst case configuration on page 14.<br>- Added the note on page 17. |
| | | |
| | | |

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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:** | A3LSMT725 |
| **Application Type:** | Certification |
| **FCC Classification:** | PCS Licensed Transmitter (PCB) |
| **FCC Rule Part(s):** | §27, §2 |
| **EUT Type:** | Tablet |
| **Model(s):** | SM-T725 |
| **Additional Model(s):** | T725N, T727 |
| **Tx Frequency:** | 699.7 MHz – 715.3 MHz (LTE – Band 12 (1.4 MHz))<br>700.5 MHz – 714.5 MHz (LTE – Band 12 (3 MHz))<br>701.5 MHz – 713.5 MHz (LTE – Band 12/17 (5 MHz))<br>704.0 MHz – 711.0 MHz (LTE – Band 12/17 (10 MHz)) |
| **Date(s) of Tests:** | March 04, 2019 ~ March 13, 2019 |

# 2. INTRODUCTION

### 2.1. DESCRIPTION OF EUT

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

It also supports IEEE 802.11 a/b/g/n/ac (HT20/40/80), ANT+, Bluetooth, BT LE.

The EUT was a Tablet with Accessories(Keyboard and Charging pad).

(Keyboard - Model : SAMSUNG, Manufacture : EH-FT720)

(Charging Doc – Model: SAMSUNG, Manufacture : EE-D3200)

### 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<br>- ANSI C63.26-2015 – Section 5.4.4 |
| Band Edge | - KDB 971168 D01 v03r01 – Section 6.0<br>- ANSI C63.26-2015 – Section 5.7 |
| Spurious and Harmonic Emissions at Antenna Terminal | - KDB 971168 D01 v03r01 – Section 6.0<br>- 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/<br>Effective Isotropic Radiated Power | - KDB 971168 D01 v03r01 – Section 5.2 & 5.8<br>- ANSI C63.26-2015 – Section 5.2<br>- ANSI/TIA-603-E-2016 – Section 2.2.17 |
| Radiated Spurious and Harmonic Emissions | - KDB 971168 D01 v03r01 – Section 6.2<br>- 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.

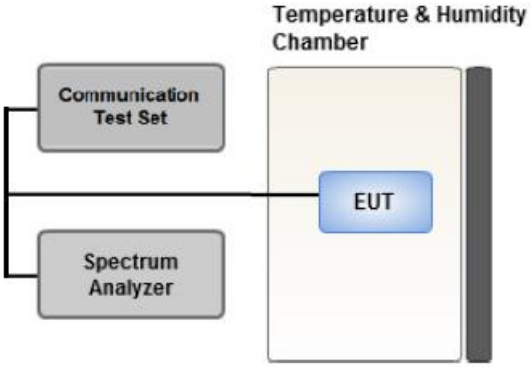
**Test Settings**

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 $10^{th}$ harmonics from 9 kHz.

**Test Note**

1. Measurements value show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
2. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
   The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the test data

### 3.4 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.

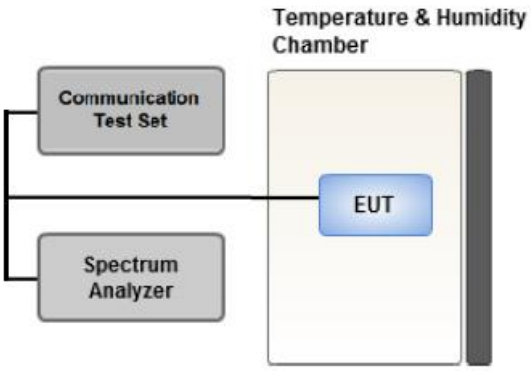
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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**

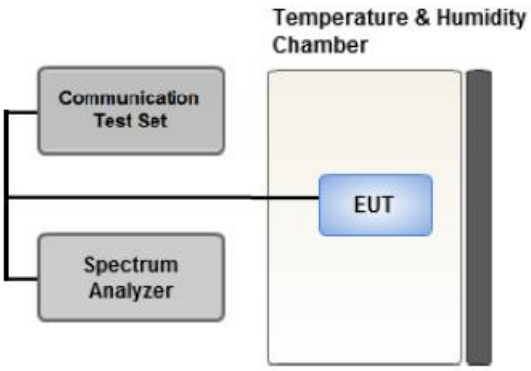
**Test Overview**

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 * 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

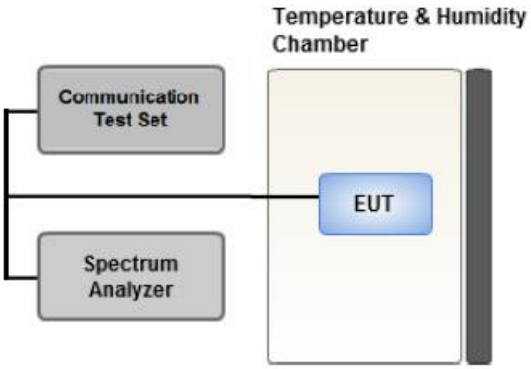
**Test Notes**

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, RB sizes and offsets, and channel bandwidth configurations shown in the test data.
- Please refer to the table below.
- LTE Band 12 (698 – 716 MHz, 5/10MHzbandwidth) overlaps the entire frequency range of LTE Band 17 (704 - 716 MHz) and they have the same Tune-up power.
  Therefore, test data provided in this report covers Band 17 as well as Band 12.

[ Worst case ]

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

**Note:**

- SM-T725 & additional models were tested and the worst case results are reported.

(Worst case : SM-T725)

- SM-T725 with Stand alone&Keyboard&Charging pad were tested and the worst case results are reported.

(Worst case : Stand alone)

### 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.
- LTE Band 12 (698 – 716 MHz, 5/10MHzbandwidth) overlaps the entire frequency range of LTE Band 17 (704 - 716 MHz) and they have the same Tune-up power.
  Therefore, test data provided in this report covers Band 17 as well as Band 12.

[ Worst case ]

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

**Note:**

- SM-T725 & additional models were tested and the worst case results are reported.

(Worst case : SM-T725)

- SM-T725 with Stand alone&Keyboard&Charging pad were tested and the worst case results are reported.

(Worst case : Stand alone)

# 4. LIST OF TEST EQUIPMENT

| Manufacture | Model/ Equipment | Serial Number | Calibration Date | Calibration Interval | Calibration Due |
|---|---|---|---|---|---|
| REOHDE & SCHWARZ | SCU 18 / AMPLIFIER | 10094 | 04/17/2018 | Annual | 04/17/2019 |
| Wainwright | WHK1.2/15G-10EF/H.P.F | 4 | 04/04/2018 | Annual | 04/04/2019 |
| Wainwright | WHK3.3/18G-10EF/H.P.F | 2 | 04/04/2018 | Annual | 04/04/2019 |
| Hewlett Packard | 11667B / Power Splitter(DC~26.5 GHz) | 5001 | 06/07/2018 | Annual | 06/07/2019 |
| Agilent | E3632A/DC Power Supply | KR75303243 | 05/09/2018 | Annual | 05/09/2019 |
| Schwarzbeck | UHAP/ Dipole Antenna | 557 | 03/31/2017 | Biennial | 03/31/2019 |
| Schwarzbeck | UHAP/ Dipole Antenna | 558 | 03/31/2017 | Biennial | 03/31/2019 |
| ESPEC | SU-642 / Chamber | 93000718 | 08/07/2018 | Annual | 08/07/2019 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna(1~18GHz) | 147 | 09/14/2018 | Annual | 09/14/2019 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna(1~18GHz) | 9120D-1298 | 10/04/2018 | Annual | 10/04/2019 |
| Schwarzbeck | BBHA 9170/ Horn Antenna(15~40GHz) | BBHA9170342 | 04/25/2017 | Biennial | 04/25/2019 |
| Schwarzbeck | BBHA 9170/ Horn Antenna(15~40GHz) | BBHA9170124 | 04/25/2017 | Biennial | 04/25/2019 |
| Agilent | N9020A/Signal Analyzer(10Hz~26.5GHz) | MY52090906 | 06/08/2018 | Annual | 06/08/2019 |
| Hewlett Packard | 8493C/ATTENUATOR(20dB) | 17280 | 06/21/2018 | Annual | 06/21/2019 |
| REOHDE & SCHWARZ | FSV40/Spectrum Analyzer(10Hz~40GHz) | 100931 | 10/22/2018 | Annual | 10/22/2019 |
| Agilent | 8960 (E5515C)/ Base Station | MY48360800 | 09/27/2018 | Annual | 09/27/2019 |
| 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 | 04/06/2017 | Biennial | 04/06/2019 |
| Anritsu Corp. | MT8821C/Wideband Radio Communication Tester | 6201502997 | 08/13/2018 | Annual | 08/13/2019 |
| Anritsu Corp. | MT8820C/Wideband Radio Communication Tester | 6201026545 | 01/30/2019 | Annual | 01/30/2020 |
| REOHDE & SCHWARZ | SMB100A/ SIGNAL GENERATOR (100kHz~40GHz) | 177633 | 07/19/2018 | Annual | 07/19/2019 |
| REOHDE & SCHWARZ | ESU40 / EMI TEST RECEIVER | 100524 | 07/27/2018 | Annual | 07/27/2019 |
| 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.

# 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) | 5.71 |

# 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(g) | < 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, §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 |
|---|---|---|---|
| Effective Radiated Power | §27.50(c)(10) | < 3 Watts max. ERP | PASS |
| Radiated Spurious and Harmonic Emissions | §2.1053, §27.53(g) | < 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 |
| 699.7 | LTE B12 (1.4 MHz) | QPSK | -31.44 | 25.91 | -10.16 | 0.78 | V | < 3.00 | 0.031 | 14.97 |
| | | 16-QAM | -32.19 | 25.16 | -10.16 | 0.78 | V | | 0.026 | 14.22 |
| | | 64-QAM | -33.17 | 24.18 | -10.16 | 0.78 | H | | 0.021 | 13.24 |
| 707.5 | | QPSK | -30.74 | 26.55 | -10.17 | 0.78 | V | | 0.036 | 15.60 |
| | | 16-QAM | -31.47 | 25.82 | -10.17 | 0.78 | V | | 0.031 | 14.87 |
| | | 64-QAM | -32.45 | 24.84 | -10.17 | 0.78 | H | | 0.024 | 13.89 |
| 715.3 | | QPSK | -30.52 | 26.69 | -10.18 | 0.78 | V | | 0.037 | 15.73 |
| | | 16-QAM | -31.28 | 25.93 | -10.18 | 0.78 | V | | 0.031 | 14.97 |
| | | 64-QAM | -32.26 | 24.95 | -10.18 | 0.78 | H | | 0.025 | 13.99 |

| Freq (MHz) | Mod (Bandwidth) | Modulation | Measured Level (dBm) | Substitute Level (dBm) | Ant. Gain(dBd) | C.L | Pol | Limit | ERP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | W | W | dBm |
| 700.5 | LTE B12 (3 MHz) | QPSK | -31.37 | 26.00 | -10.16 | 0.78 | V | < 3.00 | 0.032 | 15.06 |
| | | 16-QAM | -32.13 | 25.24 | -10.16 | 0.78 | V | | 0.027 | 14.30 |
| | | 64-QAM | -33.12 | 24.25 | -10.16 | 0.78 | H | | 0.021 | 13.31 |
| 707.5 | | QPSK | -30.75 | 26.54 | -10.17 | 0.78 | V | | 0.036 | 15.59 |
| | | 16-QAM | -31.45 | 25.84 | -10.17 | 0.78 | V | | 0.031 | 14.89 |
| | | 64-QAM | -32.45 | 24.84 | -10.17 | 0.78 | H | | 0.024 | 13.89 |
| 714.5 | | QPSK | -30.45 | 26.74 | -10.18 | 0.78 | V | | 0.038 | 15.78 |
| | | 16-QAM | -31.20 | 25.99 | -10.18 | 0.78 | V | | 0.032 | 15.03 |
| | | 64-QAM | -32.18 | 25.01 | -10.18 | 0.78 | H | | 0.025 | 14.05 |

| Freq (MHz) | Mod (Bandwidth) | Modulation | Measured Level (dBm) | Substitute Level (dBm) | Ant. Gain(dBd) | C.L | Pol | Limit | ERP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | W | W | dBm |
| 701.5 | LTE B12/17 (5 MHz) | QPSK | -31.34 | 26.06 | -10.16 | 0.78 | V | < 3.00 | 0.033 | 15.12 |
| | | 16-QAM | -32.10 | 25.30 | -10.16 | 0.78 | V | | 0.027 | 14.36 |
| | | 64-QAM | -33.08 | 24.32 | -10.16 | 0.78 | H | | 0.022 | 13.38 |
| 707.5 | | QPSK | -30.72 | 26.57 | -10.17 | 0.78 | V | | 0.036 | 15.62 |
| | | 16-QAM | -31.43 | 25.86 | -10.17 | 0.78 | V | | 0.031 | 14.91 |
| | | 64-QAM | -32.41 | 24.88 | -10.17 | 0.78 | H | | 0.025 | 13.93 |
| 713.5 | | QPSK | -30.45 | 26.73 | -10.18 | 0.78 | V | | 0.038 | 15.77 |
| | | 16-QAM | -31.20 | 25.98 | -10.18 | 0.78 | V | | 0.032 | 15.02 |
| | | 64-QAM | -32.18 | 25.00 | -10.18 | 0.78 | H | | 0.025 | 14.04 |

| Freq (MHz) | Mod (Bandwidth) | Modulation | Measured Level (dBm) | Substitute Level (dBm) | Ant. Gain(dBd) | C.L | Pol | Limit | ERP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | W | W | dBm |
| 704.0 | LTE B12/17 (10 MHz) | QPSK | -31.35 | 26.05 | -10.16 | 0.78 | V | < 3.00 | 0.032 | 15.11 |
| | | 16-QAM | -32.10 | 25.30 | -10.16 | 0.78 | V | | 0.027 | 14.36 |
| | | 64-QAM | -33.09 | 24.31 | -10.16 | 0.78 | H | | 0.022 | 13.37 |
| 707.5 | | QPSK | -30.94 | 26.35 | -10.17 | 0.78 | V | | 0.035 | 15.40 |
| | | 16-QAM | -31.70 | 25.59 | -10.17 | 0.78 | V | | 0.029 | 14.64 |
| | | 64-QAM | -32.69 | 24.60 | -10.17 | 0.78 | H | | 0.023 | 13.65 |
| 711.0 | | QPSK | -30.73 | 26.49 | -10.18 | 0.78 | V | | 0.036 | 15.53 |
| | | 16-QAM | -31.42 | 25.80 | -10.18 | 0.78 | V | | 0.030 | 14.84 |
| | | 64-QAM | -32.45 | 24.77 | -10.18 | 0.78 | H | | 0.024 | 13.81 |

### 8.3 RADIATED SPURIOUS EMISSIONS

▣ OPERATING FREQUENTY: 715.30 MHz

▣ MEASURED OUTPUT POWER: 15.73 dBm = 0.037 W

▣ MODE: LTE B12

▣ MODULATION SIGNAL: 1.4 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 $\log_{10}$ (W) = 28.73 dBc

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBd) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | dBc |
|---|---|---|---|---|---|---|---|---|
| 23017 (699.7) | 1,399.40 | -57.80 | 5.32 | -64.36 | 1.16 | H | -62.35 | 78.08 |
| | 2,099.10 | -57.86 | 7.68 | -64.35 | 1.44 | H | -60.26 | 75.99 |
| | 2,798.80 | -55.56 | 9.00 | -60.64 | 1.72 | H | -55.51 | 71.24 |
| 23095 (707.5) | 1,415.00 | -57.84 | 5.41 | -64.26 | 1.17 | V | -62.17 | 77.89 |
| | 2,122.50 | -57.34 | 7.58 | -63.25 | 1.46 | V | -59.28 | 75.00 |
| | 2,830.00 | -54.61 | 9.08 | -59.82 | 1.72 | H | -54.61 | 70.33 |
| 23173 (715.3) | 1,430.60 | -58.07 | 5.55 | -64.96 | 1.17 | V | -62.73 | 78.46 |
| | 2,145.90 | -58.08 | 7.32 | -63.34 | 1.47 | H | -59.64 | 75.37 |
| | 2,861.20 | -55.29 | 9.16 | -60.28 | 1.74 | H | -55.01 | 70.74 |

▣ OPERATING FREQUENTY: 714.50 MHz

▣ MEASURED OUTPUT POWER: 15.78 dBm = 0.038 W

▣ MODE: LTE B12

▣ MODULATION SIGNAL: 3 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 $lo_{g10}$ (W) = 28.78 dBc

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBd) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | dBc |
|---|---|---|---|---|---|---|---|---|
| 23025 (700.5) | 1,401.00 | -58.27 | 5.32 | -64.83 | 1.16 | H | -62.82 | 78.60 |
| | 2,101.50 | -57.36 | 7.68 | -63.85 | 1.44 | H | -59.76 | 75.54 |
| | 2,802.00 | -55.34 | 9.00 | -60.42 | 1.72 | H | -55.29 | 71.07 |
| 23095 (707.5) | 1,415.00 | -57.99 | 5.41 | -64.41 | 1.17 | H | -62.32 | 78.09 |
| | 2,122.50 | -57.56 | 7.58 | -63.47 | 1.46 | H | -59.50 | 75.28 |
| | 2,830.00 | -56.64 | 9.08 | -61.85 | 1.72 | H | -56.64 | 72.41 |
| 23165 (714.5) | 1,429.00 | -58.45 | 5.55 | -65.34 | 1.17 | H | -63.11 | 78.89 |
| | 2,143.50 | -57.57 | 7.32 | -62.83 | 1.47 | H | -59.13 | 74.91 |
| | 2,858.00 | -55.10 | 9.16 | -60.09 | 1.74 | H | -54.82 | 70.60 |

▣ OPERATING FREQUENTY: 713.50 MHz

▣ MEASURED OUTPUT POWER: 15.77 dBm = 0.038 W

▣ MODE: LTE B12 / B17

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 $\log_{10}$ (W) = 28.77 dBc

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBd) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | dBc |
|---|---|---|---|---|---|---|---|---|
| 23035 (701.5) | 1,403.00 | -57.48 | 5.32 | -64.04 | 1.16 | H | -62.03 | 77.80 |
| | 2,104.50 | -57.37 | 7.66 | -63.60 | 1.45 | H | -59.54 | 75.31 |
| | 2,806.00 | -56.41 | 9.01 | -61.49 | 1.70 | H | -56.33 | 72.10 |
| 23095 (707.5) | 1,415.00 | -57.33 | 5.41 | -63.75 | 1.17 | H | -61.66 | 77.42 |
| | 2,122.50 | -58.16 | 7.58 | -64.07 | 1.46 | H | -60.10 | 75.87 |
| | 2,830.00 | -56.69 | 9.08 | -61.90 | 1.72 | H | -56.69 | 72.46 |
| 23155 (713.5) | ㄹ | -58.64 | 5.55 | -65.53 | 1.17 | H | -63.30 | 79.07 |
| | 2,140.50 | -56.93 | 7.37 | -62.18 | 1.47 | H | -58.43 | 74.20 |
| | 2,854.00 | -53.70 | 9.16 | -58.77 | 1.73 | H | -53.49 | 69.26 |

▣ OPERATING FREQUENTY: 711.00 MHz

▣ MEASURED OUTPUT POWER: 15.53 dBm = 0.036 W

▣ MODE: LTE B12 / B17

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 $lo_{g10}$ (W) = 28.53 dBc

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBd) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | dBc |
|---|---|---|---|---|---|---|---|---|
| 23060 (704.0) | 1,408.00 | -58.51 | 5.38 | -64.84 | 1.17 | H | -62.78 | 78.31 |
| | 2,112.00 | -57.99 | 7.63 | -63.96 | 1.45 | H | -59.93 | 75.46 |
| | 2,816.00 | -55.38 | 9.03 | -60.58 | 1.70 | H | -55.40 | 70.92 |
| 23095 (707.5) | 1,415.00 | -58.03 | 5.41 | -64.45 | 1.17 | H | -62.36 | 77.88 |
| | 2,122.50 | -57.52 | 7.58 | -63.43 | 1.46 | H | -59.46 | 74.99 |
| | 2,830.00 | -56.74 | 9.08 | -61.95 | 1.72 | H | -56.74 | 72.26 |
| 23130 (711.0) | 1,422.00 | -58.23 | 5.44 | -64.73 | 1.17 | H | -62.61 | 78.13 |
| | 2,133.00 | -57.32 | 7.47 | -63.07 | 1.47 | H | -59.22 | 74.74 |
| | 2,844.00 | -56.29 | 9.13 | -61.43 | 1.71 | H | -56.16 | 71.69 |

### 8.3 OCCUPIED BANDWIDTH

| Band | Band Width | Frequency (MHz) | Modulation | Resource Block Size | Resource Block Offset | Data ( MHz ) |
|---|---|---|---|---|---|---|
| 12 | 1.4 MHz | 707.5 | QPSK | 6 | 0 | 1.0929 |
| | | | 16-QAM | | | 1.0909 |
| | | | 64-QAM | | | 1.0913 |
| | 3 MHz | | QPSK | 15 | | 2.7127 |
| | | | 16-QAM | | | 2.6969 |
| | | | 64-QAM | | | 2.7130 |
| 12/ 17 | 5 MHz | | QPSK | 25 | | 4.5123 |
| | | | 16-QAM | | | 4.5035 |
| | | | 64-QAM | | | 4.4960 |
| | 10 MHz | | QPSK | 50 | | 8.9831 |
| | | | 16-QAM | | | 8.9915 |
| | | | 64-QAM | | | 8.9957 |

**Note:**

1. Plots of the EUT's Occupied Bandwidth are shown Page 41 ~ 52.

## 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) |
|---|---|---|---|---|---|---|---|
| 12 | 1.4 | 699.7 | 3.6970 | 27.976 | -67.371 | -39.395 | -13.00 |
| | | 707.5 | 3.6780 | 27.976 | -67.183 | -39.207 | |
| | | 715.3 | 3.7000 | 27.976 | -67.247 | -39.271 | |
| | 3 | 700.5 | 3.7015 | 27.976 | -67.244 | -39.268 | |
| | | 707.5 | 3.7034 | 27.976 | -67.044 | -39.068 | |
| | | 714.5 | 3.7069 | 27.976 | -67.396 | -39.420 | |
| 12/17 | 5 | 701.5 | 3.7049 | 27.976 | -67.075 | -39.099 | |
| | | 707.5 | 3.7219 | 27.976 | -67.022 | -39.046 | |
| | | 713.5 | 3.6975 | 27.976 | -67.260 | -39.284 | |
| | 10 | 704.0 | 3.7149 | 27.976 | -67.160 | -39.184 | |
| | | 707.5 | 3.6935 | 27.976 | -67.286 | -39.310 | |
| | | 711.0 | 3.7119 | 27.976 | -66.927 | -38.951 | |

**Note:**

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 78 ~ 89.
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 53 ~ 77.

## 8.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: LTE B12

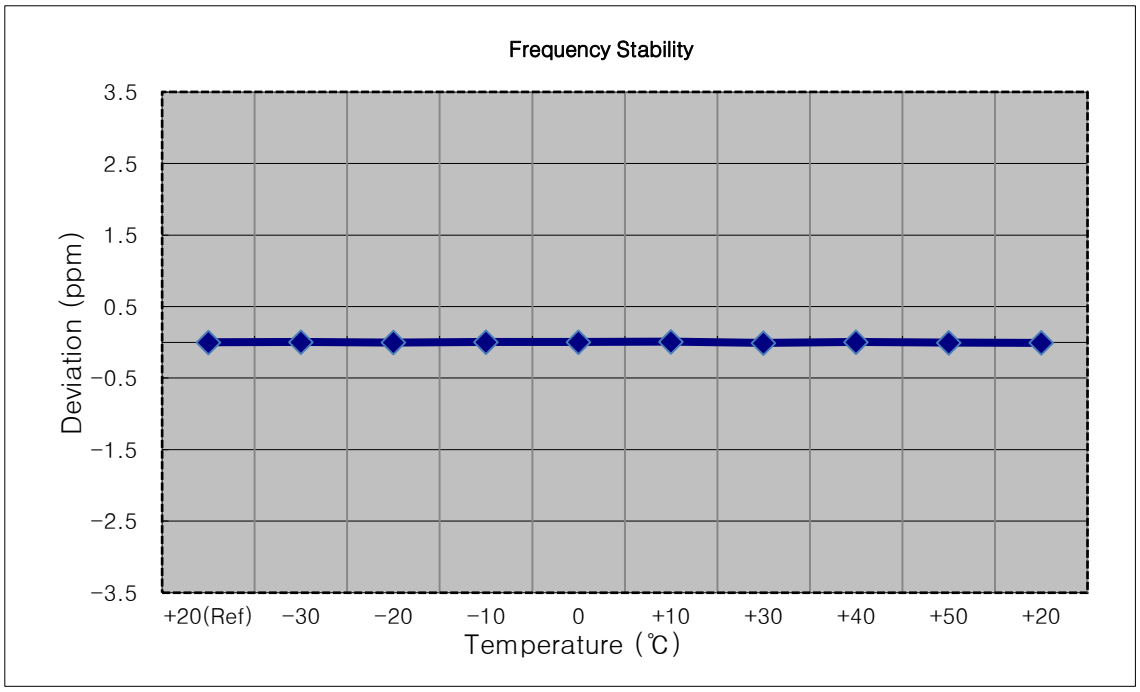
▣ OPERATING FREQUENCY: 699,700,000 Hz

▣ CHANNEL: 23017 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 699 699 994 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 699 699 997 | 3.0 | 0.000 000 | 0.004 |
| 100% | | -20 | 699 699 992 | -1.8 | 0.000 000 | -0.003 |
| 100% | | -10 | 699 699 997 | 2.9 | 0.000 000 | 0.004 |
| 100% | | 0 | 699 699 997 | 3.1 | 0.000 000 | 0.004 |
| 100% | | +10 | 699 700 000 | 5.6 | 0.000 001 | 0.008 |
| 100% | | +30 | 699 699 987 | -6.8 | -0.000 001 | -0.010 |
| 100% | | +40 | 699 699 997 | 2.6 | 0.000 000 | 0.004 |
| 100% | | +50 | 699 699 991 | -2.9 | 0.000 000 | -0.004 |
| Batt. Endpoint | 3.400 | +20 | 699 699 989 | -5.3 | -0.000 001 | -0.008 |



▣ MODE: LTE B12

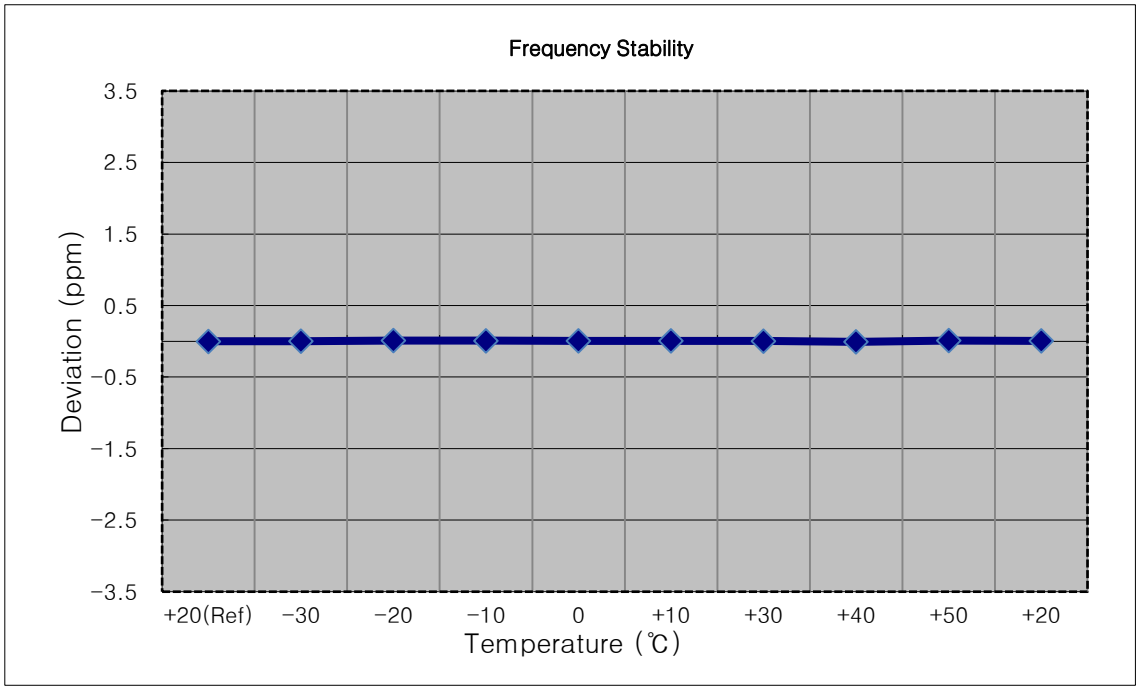
▣ OPERATING FREQUENCY: 700,500,000 Hz

▣ CHANNEL: 23025 (3 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 700 500 004 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 700 500 006 | 1.7 | 0.000 000 | 0.002 |
| 100% | | -20 | 700 500 011 | 7.5 | 0.000 001 | 0.011 |
| 100% | | -10 | 700 500 010 | 5.9 | 0.000 001 | 0.008 |
| 100% | | 0 | 700 500 009 | 5.2 | 0.000 001 | 0.007 |
| 100% | | +10 | 700 500 008 | 4.5 | 0.000 001 | 0.006 |
| 100% | | +30 | 700 500 007 | 2.7 | 0.000 000 | 0.004 |
| 100% | | +40 | 700 500 000 | -4.3 | -0.000 001 | -0.006 |
| 100% | | +50 | 700 500 011 | 7.3 | 0.000 001 | 0.010 |
| Batt. Endpoint | 3.400 | +20 | 700 500 009 | 4.7 | 0.000 001 | 0.007 |



▣ MODE: LTE B12/17

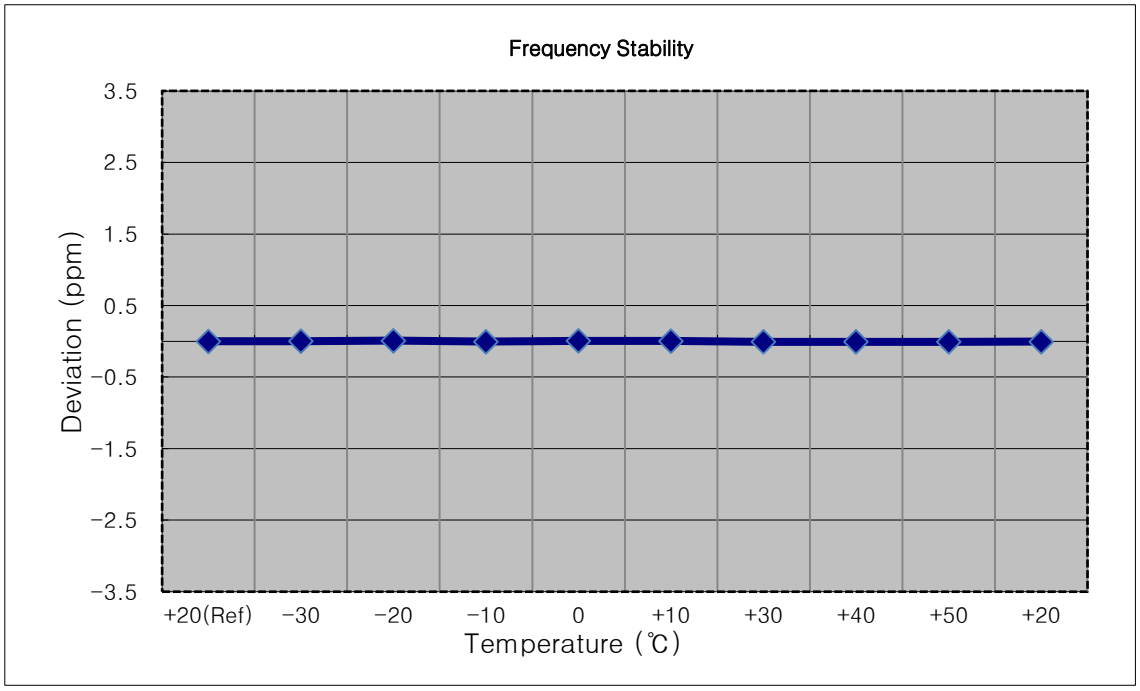
▣ OPERATING FREQUENCY: 701,500,000 Hz

▣ CHANNEL: 23035 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 701 500 005 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 701 500 007 | 1.7 | 0.000 000 | 0.002 |
| 100% | | -20 | 701 500 012 | 6.4 | 0.000 001 | 0.009 |
| 100% | | -10 | 701 500 001 | -3.7 | -0.000 001 | -0.005 |
| 100% | | 0 | 701 500 010 | 4.8 | 0.000 001 | 0.007 |
| 100% | | +10 | 701 500 008 | 2.7 | 0.000 000 | 0.004 |
| 100% | | +30 | 701 500 001 | -4.4 | -0.000 001 | -0.006 |
| 100% | | +40 | 701 500 001 | -4.6 | -0.000 001 | -0.007 |
| 100% | | +50 | 701 500 000 | -4.7 | -0.000 001 | -0.007 |
| Batt. Endpoint | 3.400 | +20 | 701 500 001 | -3.7 | -0.000 001 | -0.005 |



▣ MODE: LTE B12/17

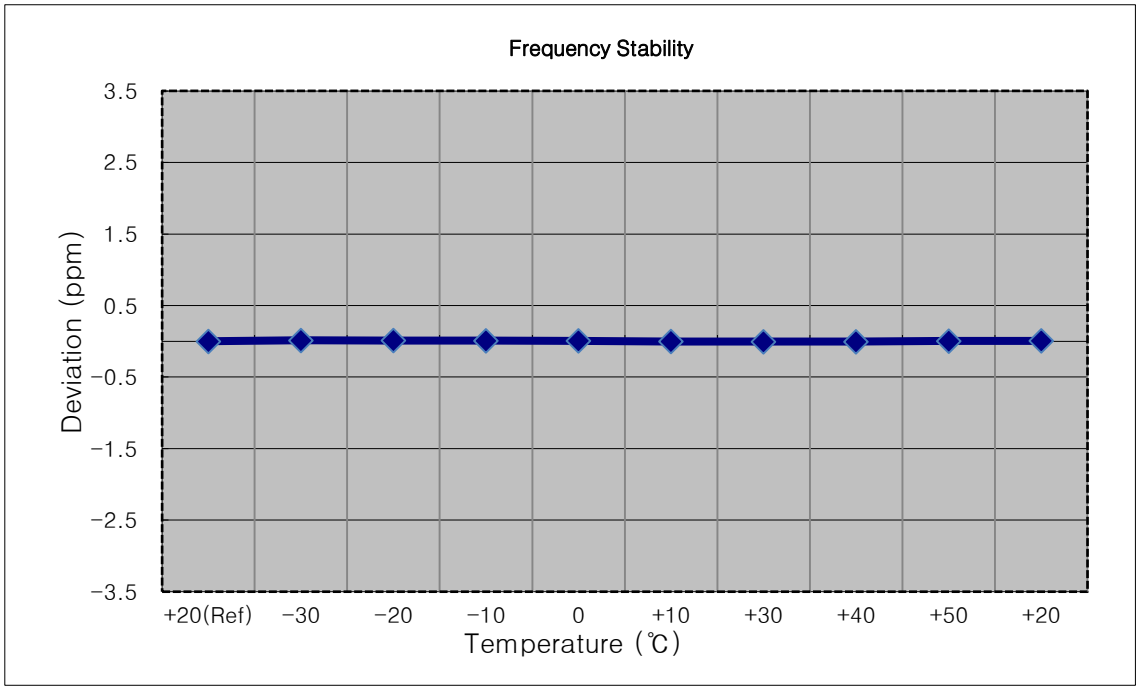
▣ OPERATING FREQUENCY: 704,000,000 Hz

▣ CHANNEL: 23060 (10 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 704 000 010 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 704 000 020 | 9.6 | 0.000 001 | 0.014 |
| 100% | | -20 | 704 000 019 | 8.6 | 0.000 001 | 0.012 |
| 100% | | -10 | 704 000 016 | 5.8 | 0.000 001 | 0.008 |
| 100% | | 0 | 704 000 015 | 4.7 | 0.000 001 | 0.007 |
| 100% | | +10 | 704 000 008 | -2.0 | 0.000 000 | -0.003 |
| 100% | | +30 | 704 000 007 | -2.9 | 0.000 000 | -0.004 |
| 100% | | +40 | 704 000 008 | -2.6 | 0.000 000 | -0.004 |
| 100% | | +50 | 704 000 014 | 3.4 | 0.000 000 | 0.005 |
| Batt. Endpoint | 3.400 | +20 | 704 000 015 | 4.3 | 0.000 001 | 0.006 |



▣ MODE: LTE B12

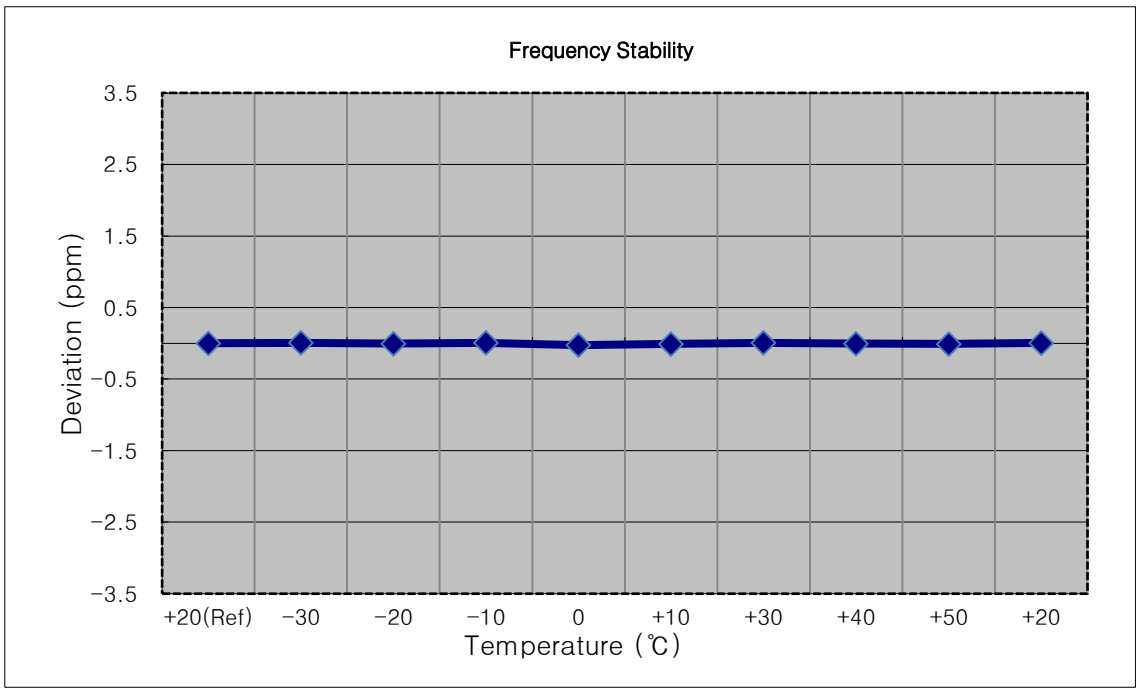
▣ OPERATING FREQUENCY: 707,500,000 Hz

▣ CHANNEL: 23095 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 707 500 002 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 707 500 008 | 5.1 | 0.000 001 | 0.007 |
| 100% | | -20 | 707 499 999 | -3.7 | -0.000 001 | -0.005 |
| 100% | | -10 | 707 500 007 | 4.5 | 0.000 001 | 0.006 |
| 100% | | 0 | 707 499 985 | -17.0 | -0.000 002 | -0.024 |
| 100% | | +10 | 707 499 995 | -7.0 | -0.000 001 | -0.010 |
| 100% | | +30 | 707 500 006 | 4.0 | 0.000 001 | 0.006 |
| 100% | | +40 | 707 500 000 | -2.8 | 0.000 000 | -0.004 |
| 100% | | +50 | 707 499 996 | -6.9 | -0.000 001 | -0.010 |
| Batt. Endpoint | 3.400 | +20 | 707 500 005 | 2.8 | 0.000 000 | 0.004 |



▣ MODE: LTE B12

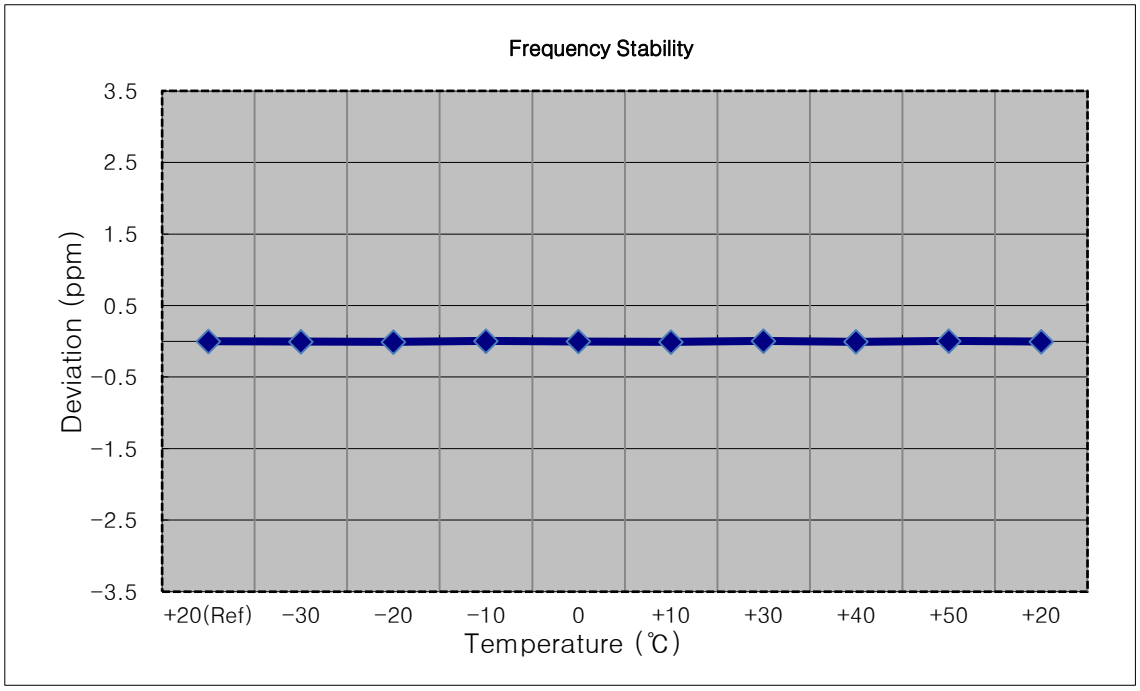
▣ OPERATING FREQUENCY: 707,500,000 Hz

▣ CHANNEL: 23095 (3 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 707 499 995 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 707 499 992 | -2.5 | 0.000 000 | -0.004 |
| 100% | | -20 | 707 499 989 | -5.8 | -0.000 001 | -0.008 |
| 100% | | -10 | 707 499 998 | 3.7 | 0.000 001 | 0.005 |
| 100% | | 0 | 707 499 993 | -2.1 | 0.000 000 | -0.003 |
| 100% | | +10 | 707 499 989 | -5.8 | -0.000 001 | -0.008 |
| 100% | | +30 | 707 499 998 | 3.0 | 0.000 000 | 0.004 |
| 100% | | +40 | 707 499 990 | -4.8 | -0.000 001 | -0.007 |
| 100% | | +50 | 707 499 997 | 2.5 | 0.000 000 | 0.004 |
| Batt. Endpoint | 3.400 | +20 | 707 499 991 | -3.5 | 0.000 000 | -0.005 |



▣ MODE: LTE B12/17

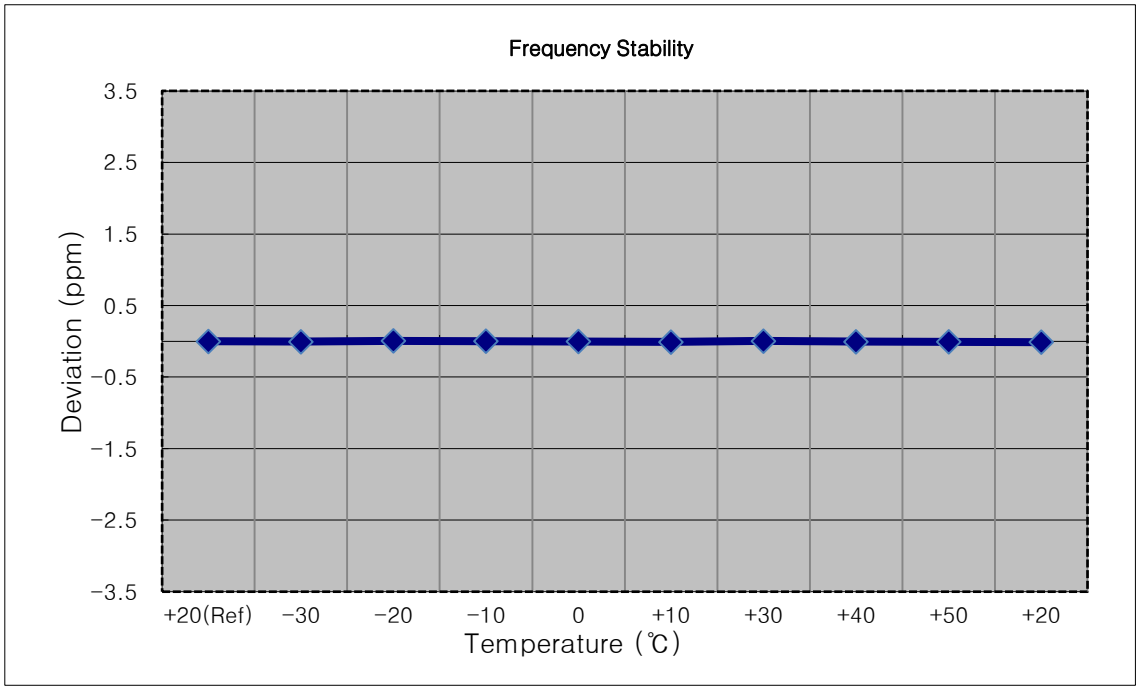
▣ OPERATING FREQUENCY: 707,500,000 Hz

▣ CHANNEL: 23095 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 707 499 995 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 707 499 991 | -3.7 | -0.000 001 | -0.005 |
| 100% | | -20 | 707 499 999 | 4.1 | 0.000 001 | 0.006 |
| 100% | | -10 | 707 499 997 | 1.7 | 0.000 000 | 0.002 |
| 100% | | 0 | 707 499 993 | -2.1 | 0.000 000 | -0.003 |
| 100% | | +10 | 707 499 989 | -6.2 | -0.000 001 | -0.009 |
| 100% | | +30 | 707 499 997 | 2.5 | 0.000 000 | 0.004 |
| 100% | | +40 | 707 499 992 | -2.8 | 0.000 000 | -0.004 |
| 100% | | +50 | 707 499 990 | -5.3 | -0.000 001 | -0.007 |
| Batt. Endpoint | 3.400 | +20 | 707 499 988 | -7.2 | -0.000 001 | -0.010 |



▣ MODE: LTE B12/17

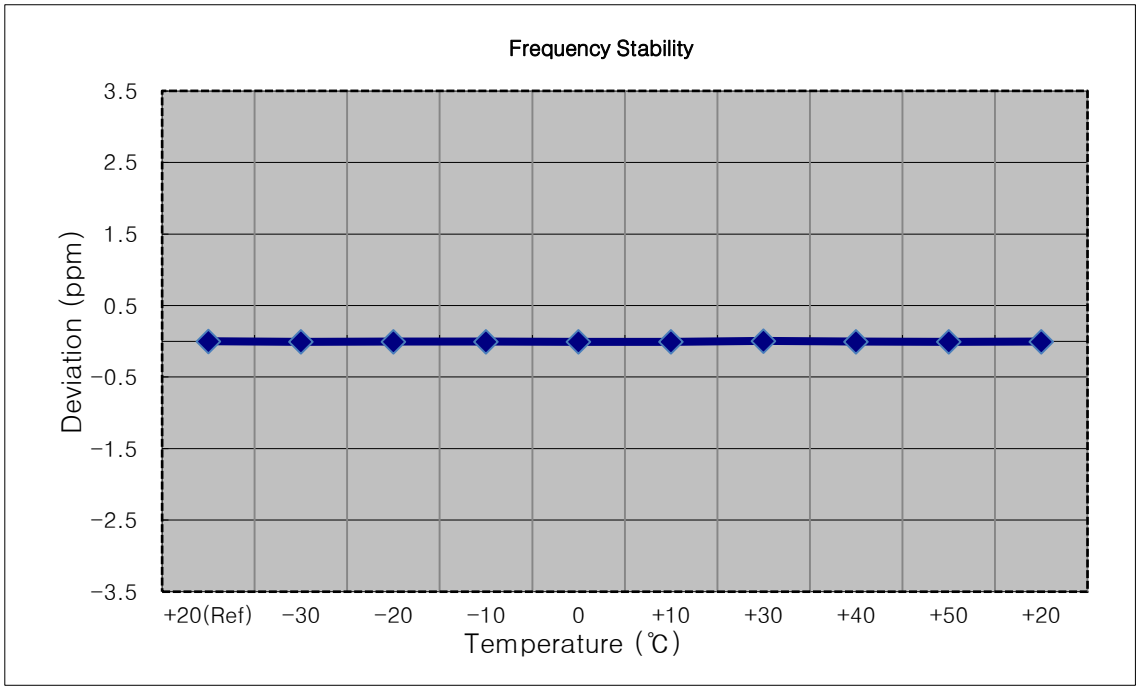
▣ OPERATING FREQUENCY: 707,500,000 Hz

▣ CHANNEL: 23095 (10 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 707 499 994 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 707 499 990 | -4.0 | -0.000 001 | -0.006 |
| 100% | | -20 | 707 499 991 | -3.1 | 0.000 000 | -0.004 |
| 100% | | -10 | 707 499 991 | -3.1 | 0.000 000 | -0.004 |
| 100% | | 0 | 707 499 990 | -4.6 | -0.000 001 | -0.007 |
| 100% | | +10 | 707 499 990 | -4.6 | -0.000 001 | -0.007 |
| 100% | | +30 | 707 499 998 | 3.5 | 0.000 000 | 0.005 |
| 100% | | +40 | 707 499 991 | -3.5 | 0.000 000 | -0.005 |
| 100% | | +50 | 707 499 989 | -4.8 | -0.000 001 | -0.007 |
| Batt. Endpoint | 3.400 | +20 | 707 499 991 | -2.9 | 0.000 000 | -0.004 |



▣ MODE: LTE B12

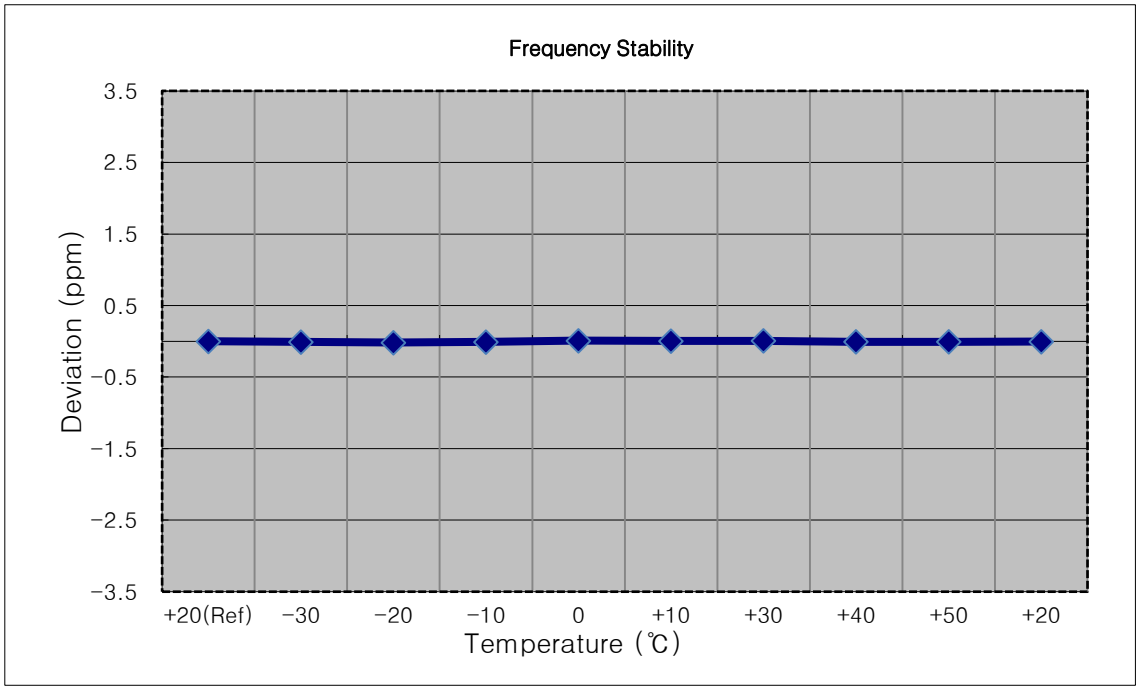
▣ OPERATING FREQUENCY: 715,300,000 Hz

▣ CHANNEL: 23173 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 715 299 993 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 715 299 986 | -6.8 | -0.000 001 | -0.010 |
| 100% | | -20 | 715 299 980 | -13.2 | -0.000 002 | -0.018 |
| 100% | | -10 | 715 299 986 | -7.0 | -0.000 001 | -0.010 |
| 100% | | 0 | 715 300 000 | 6.9 | 0.000 001 | 0.010 |
| 100% | | +10 | 715 299 997 | 3.9 | 0.000 001 | 0.005 |
| 100% | | +30 | 715 299 998 | 4.4 | 0.000 001 | 0.006 |
| 100% | | +40 | 715 299 988 | -5.6 | -0.000 001 | -0.008 |
| 100% | | +50 | 715 299 988 | -4.9 | -0.000 001 | -0.007 |
| Batt. Endpoint | 3.400 | +20 | 715 299 990 | -3.6 | -0.000 001 | -0.005 |



▣ MODE: LTE B12

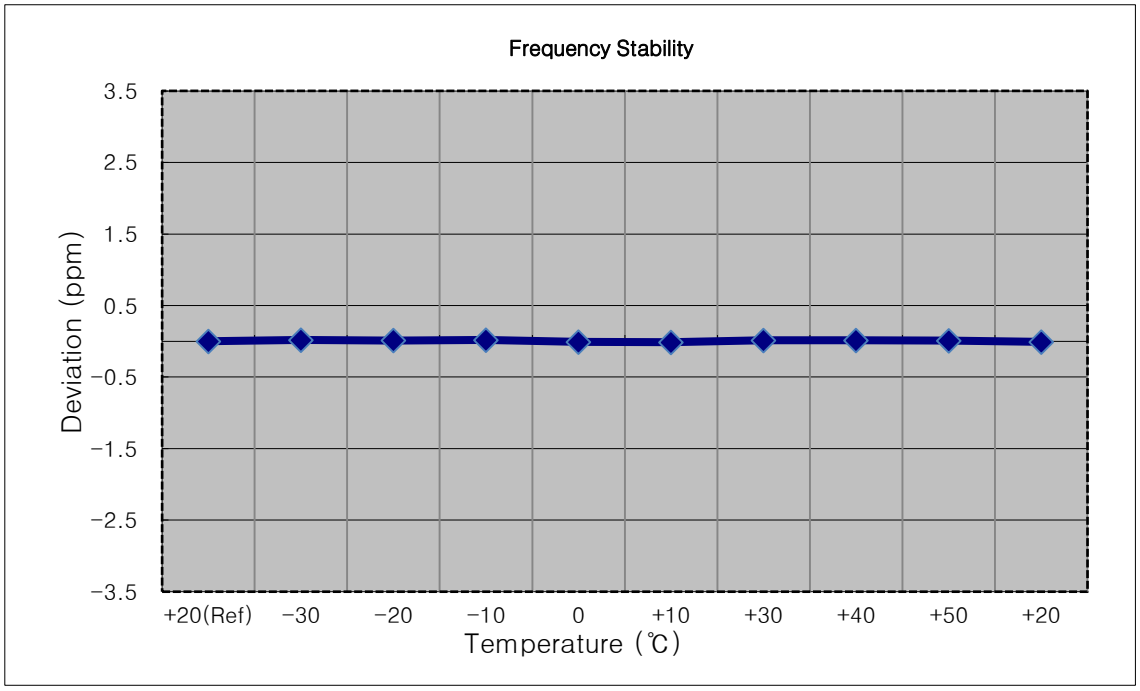
▣ OPERATING FREQUENCY: 714,500,000 Hz

▣ CHANNEL: 23165 (3 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 714 500 017 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 714 500 030 | 13.3 | 0.000 002 | 0.019 |
| 100% | | -20 | 714 500 025 | 7.9 | 0.000 001 | 0.011 |
| 100% | | -10 | 714 500 030 | 13.3 | 0.000 002 | 0.019 |
| 100% | | 0 | 714 500 010 | -7.1 | -0.000 001 | -0.010 |
| 100% | | +10 | 714 500 007 | -9.3 | -0.000 001 | -0.013 |
| 100% | | +30 | 714 500 026 | 9.2 | 0.000 001 | 0.013 |
| 100% | | +40 | 714 500 026 | 9.7 | 0.000 001 | 0.014 |
| 100% | | +50 | 714 500 023 | 6.6 | 0.000 001 | 0.009 |
| Batt. Endpoint | 3.400 | +20 | 714 500 010 | -7.1 | -0.000 001 | -0.010 |



▣ MODE: LTE B12/17

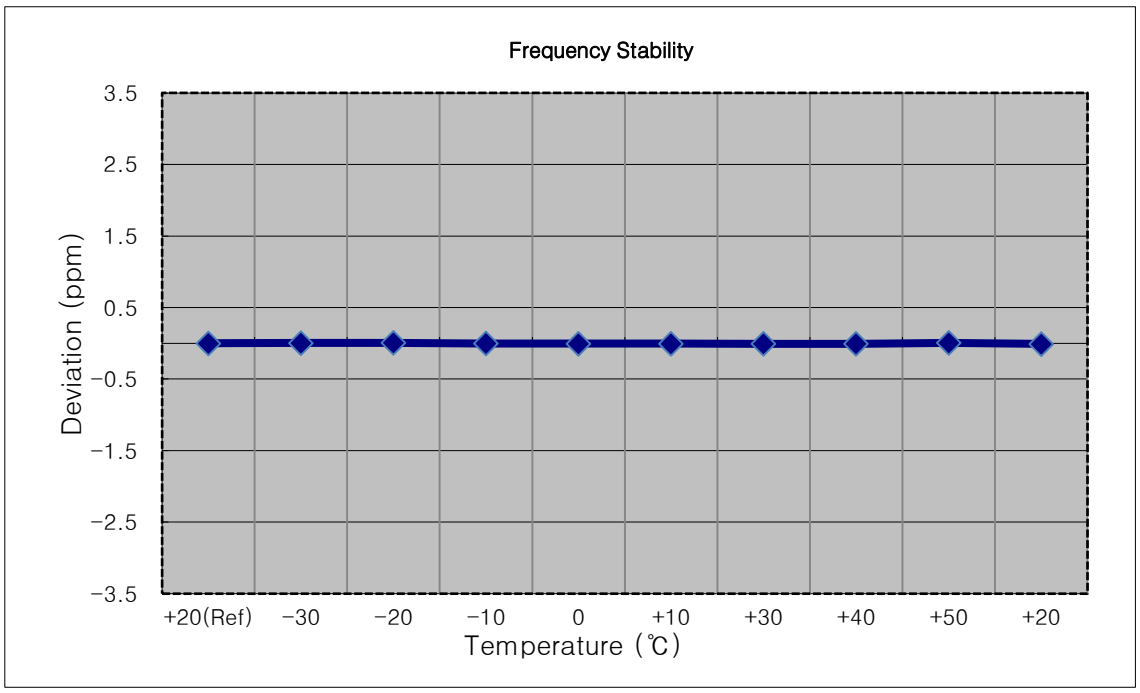
▣ OPERATING FREQUENCY: 713,500,000 Hz

▣ CHANNEL: 23155 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 713 499 992 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 713 499 994 | 2.7 | 0.000 000 | 0.004 |
| 100% | | -20 | 713 499 996 | 4.1 | 0.000 001 | 0.006 |
| 100% | | -10 | 713 499 990 | -1.4 | 0.000 000 | -0.002 |
| 100% | | 0 | 713 499 989 | -2.5 | 0.000 000 | -0.004 |
| 100% | | +10 | 713 499 989 | -2.7 | 0.000 000 | -0.004 |
| 100% | | +30 | 713 499 987 | -4.3 | -0.000 001 | -0.006 |
| 100% | | +40 | 713 499 986 | -5.3 | -0.000 001 | -0.007 |
| 100% | | +50 | 713 499 996 | 4.0 | 0.000 001 | 0.006 |
| Batt. Endpoint | 3.400 | +20 | 713 499 985 | -6.6 | -0.000 001 | -0.009 |



▣ MODE: LTE B12/17

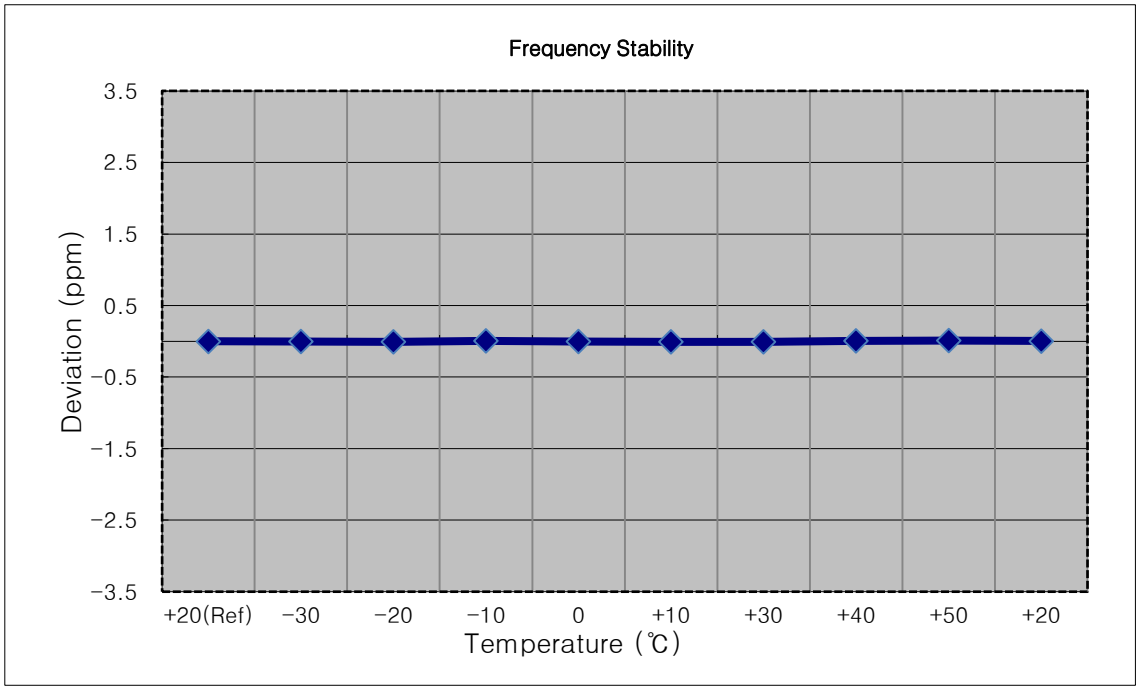
▣ OPERATING FREQUENCY: 711,000,000 Hz

▣ CHANNEL: 23130 (10 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

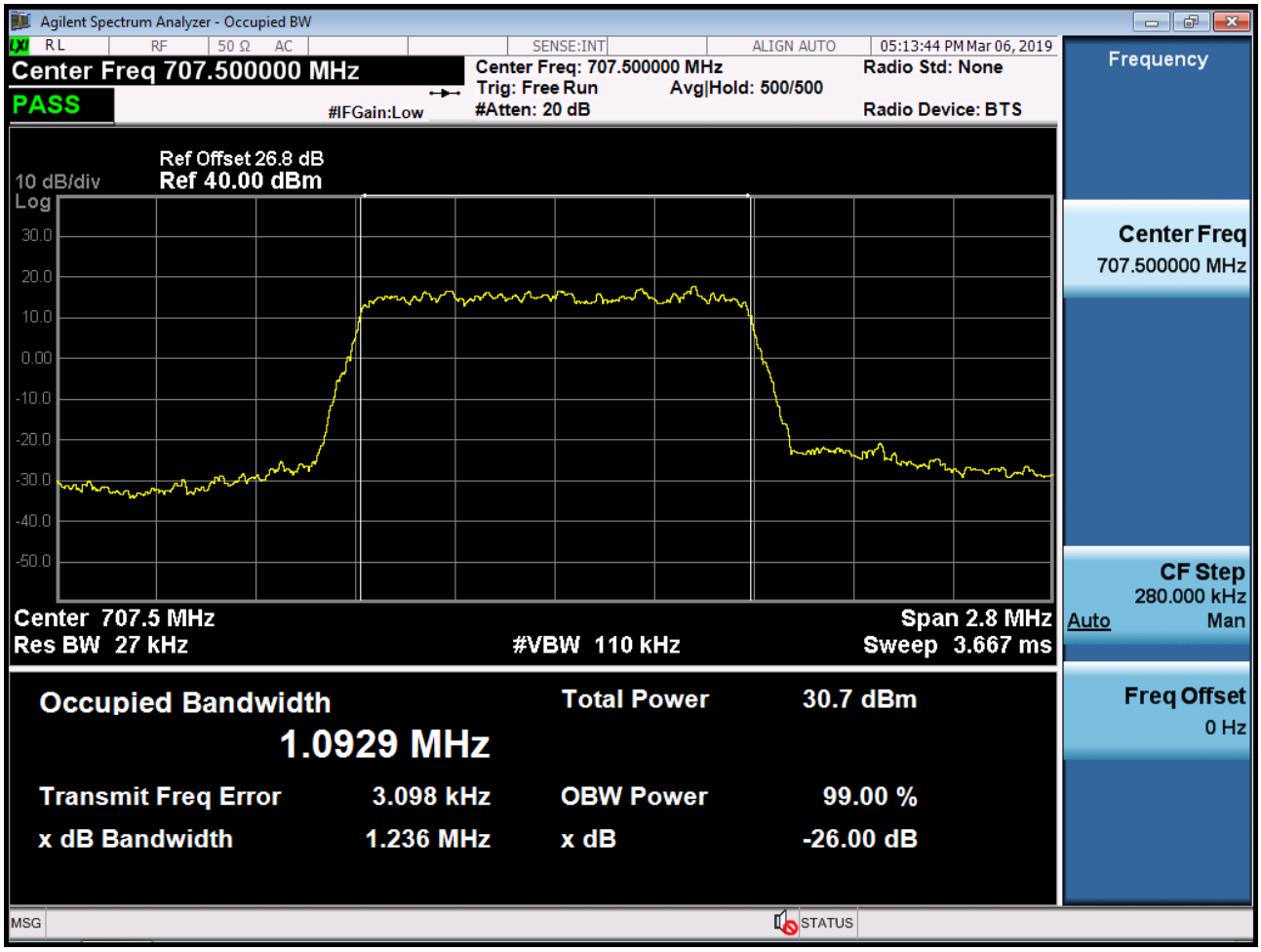
▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 711 000 003 | 0.0 | 0.000 000 | 0.000 |
| 100% | | -30 | 711 000 002 | -1.8 | 0.000 000 | -0.003 |
| 100% | | -20 | 710 999 998 | -5.5 | -0.000 001 | -0.008 |
| 100% | | -10 | 711 000 008 | 4.3 | 0.000 001 | 0.006 |
| 100% | | 0 | 711 000 001 | -2.3 | 0.000 000 | -0.003 |
| 100% | | +10 | 710 999 999 | -4.1 | -0.000 001 | -0.006 |
| 100% | | +30 | 710 999 999 | -4.6 | -0.000 001 | -0.006 |
| 100% | | +40 | 711 000 009 | 5.2 | 0.000 001 | 0.007 |
| 100% | | +50 | 711 000 012 | 8.7 | 0.000 001 | 0.012 |
| Batt. Endpoint | 3.400 | +20 | 711 000 007 | 3.2 | 0.000 000 | 0.005 |

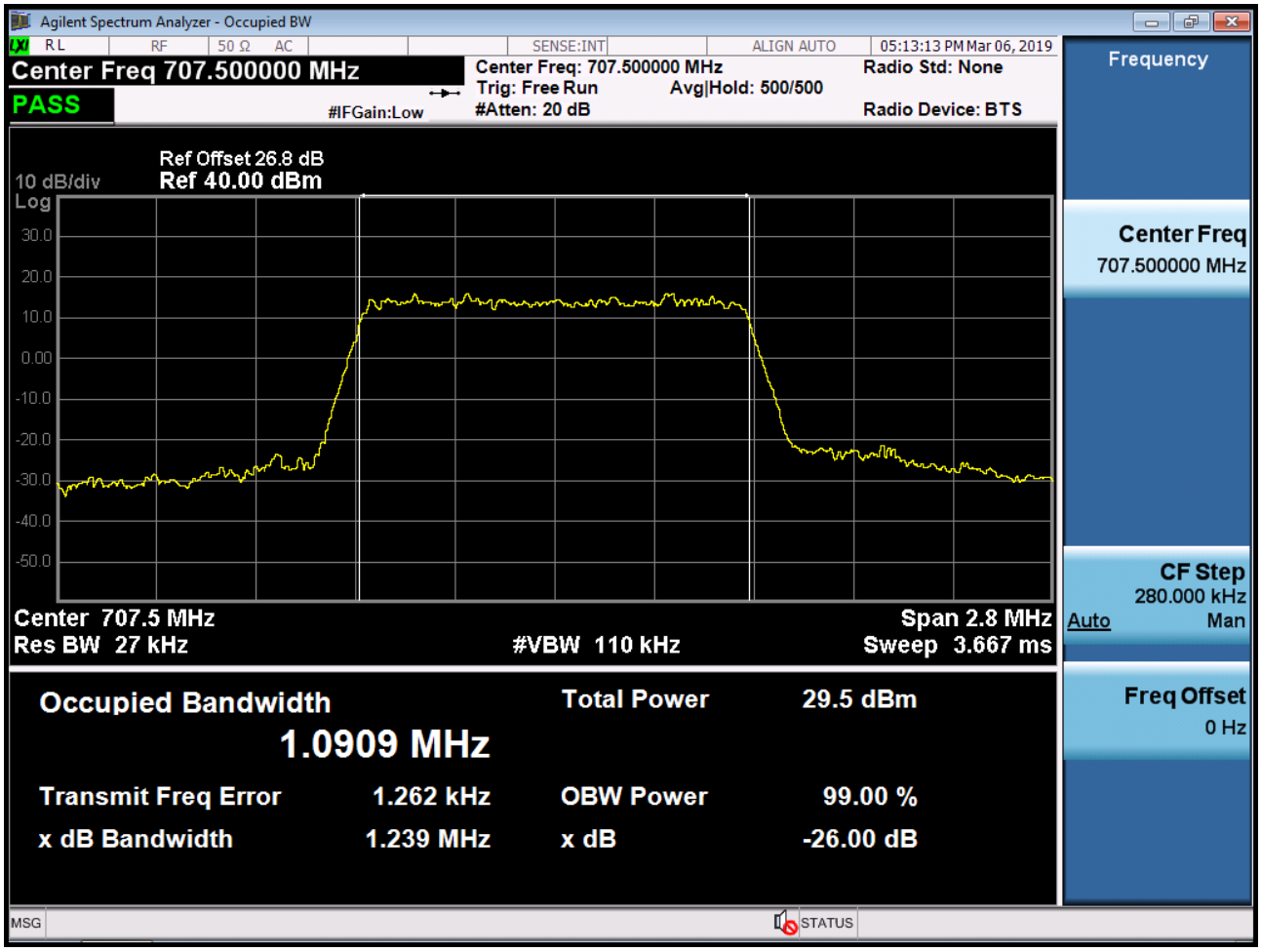


# 9. TEST PLOTS

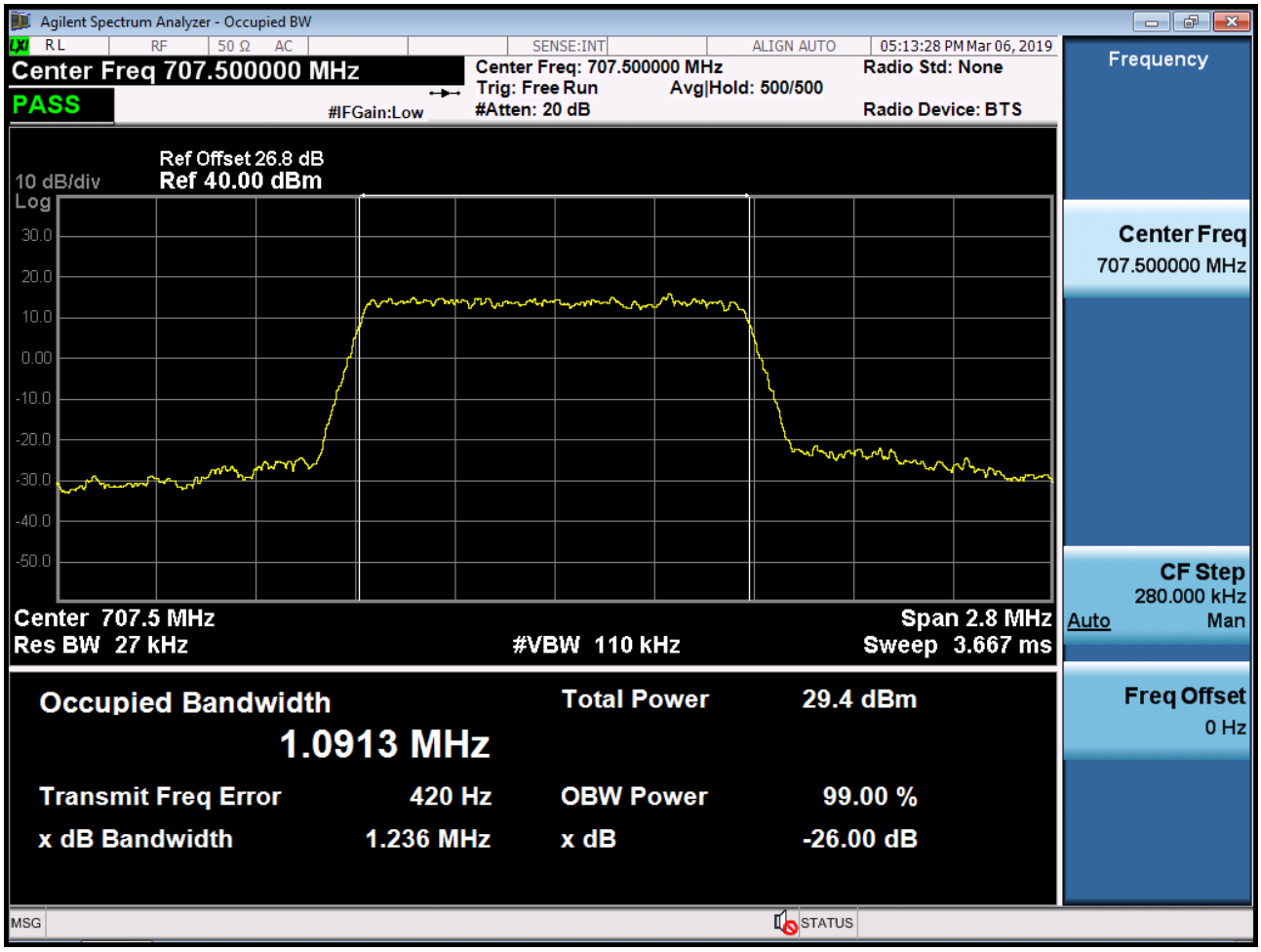
BAND 12. Occupied Bandwidth Plot (1.4M BW Ch.23095 QPSK_RB6_0)



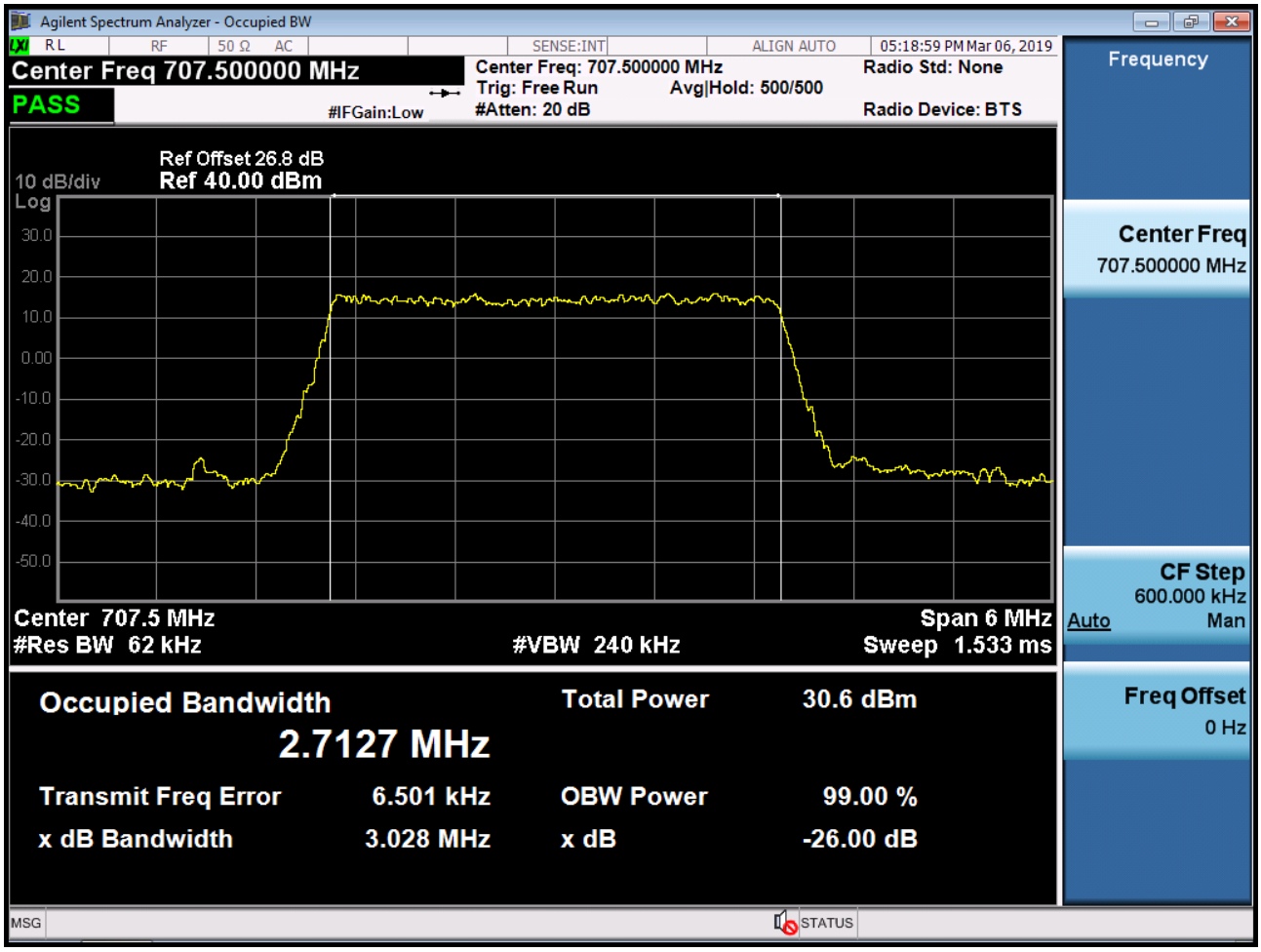
BAND 12. Occupied Bandwidth Plot (1.4M BW Ch.23095 16QAM_RB6_0)



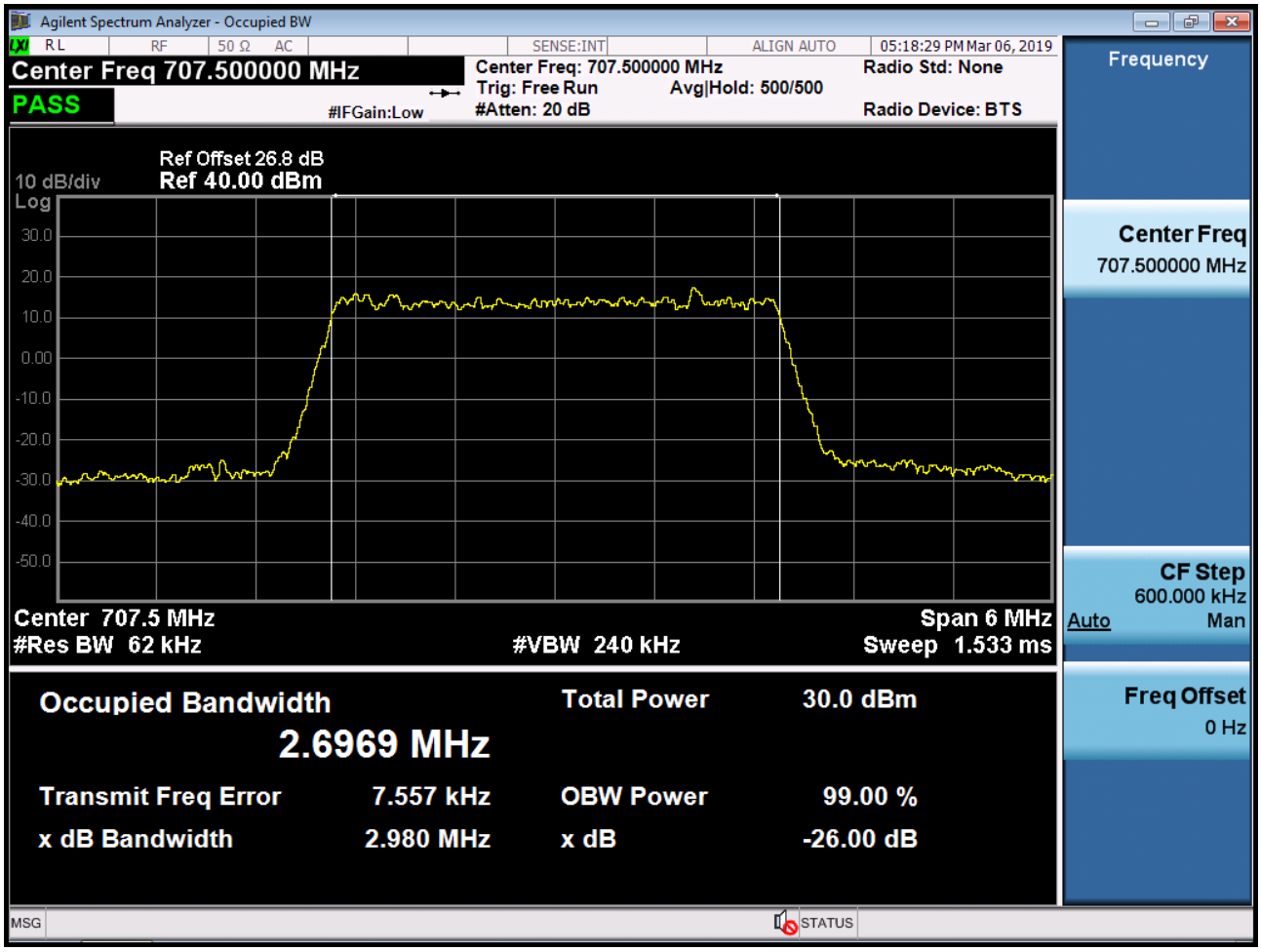
BAND 12. Occupied Bandwidth Plot (1.4M BW Ch.23095 64QAM_RB6_0)



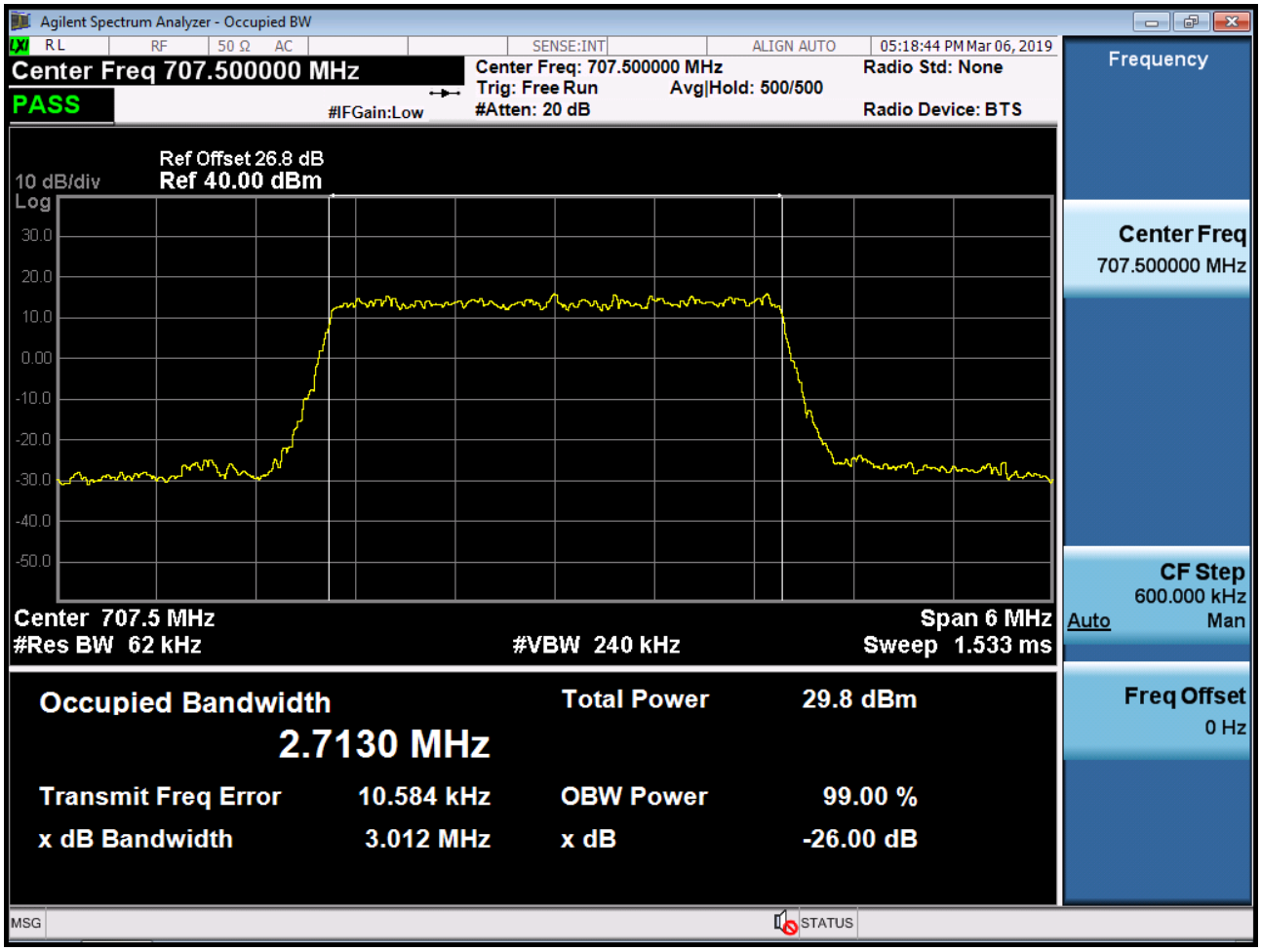
BAND 12. Occupied Bandwidth Plot (3M BW Ch.23095 QPSK_RB15_0)



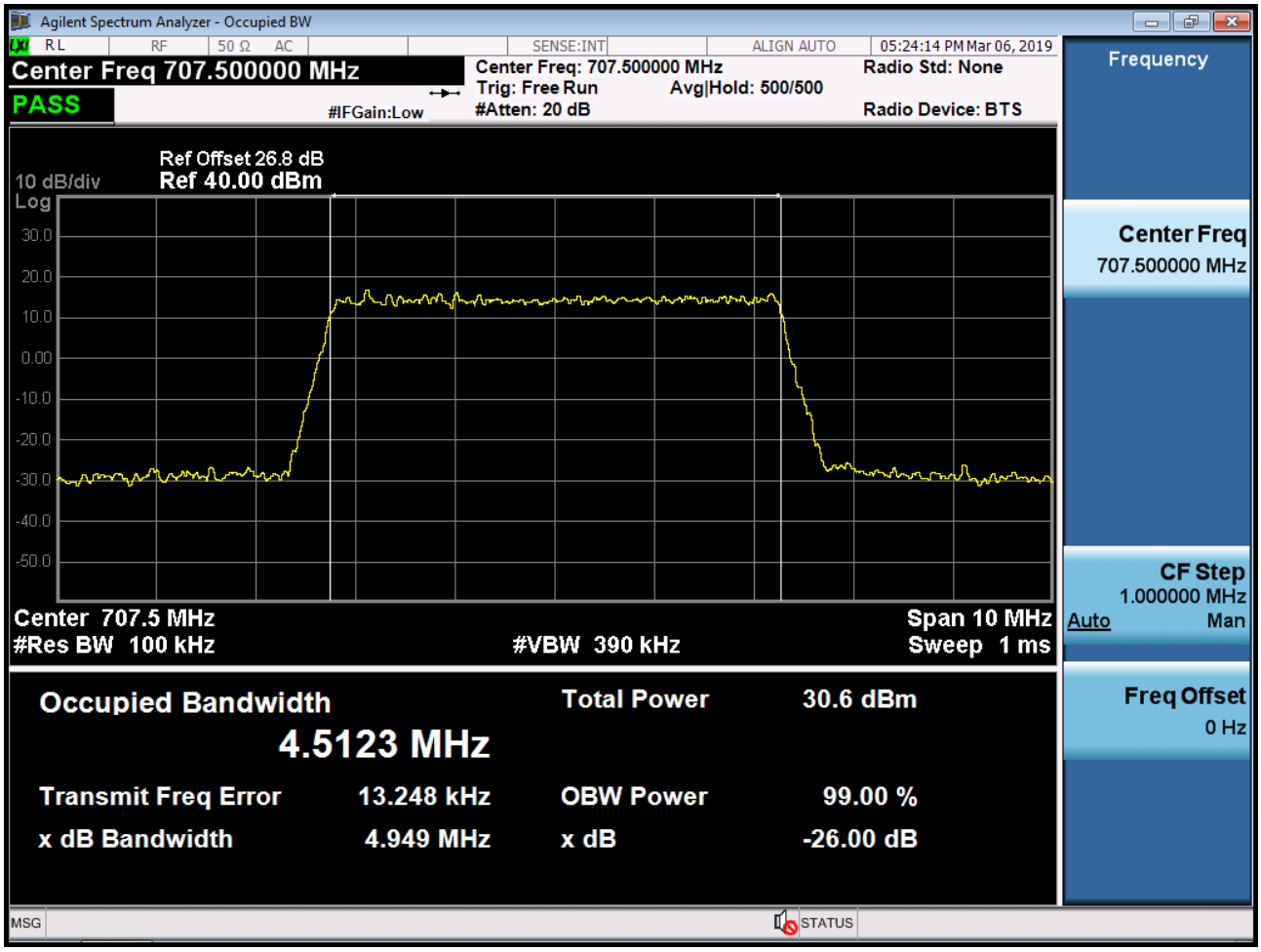
BAND 12. Occupied Bandwidth Plot (3M BW Ch.23095 16QAM_RB15_0)



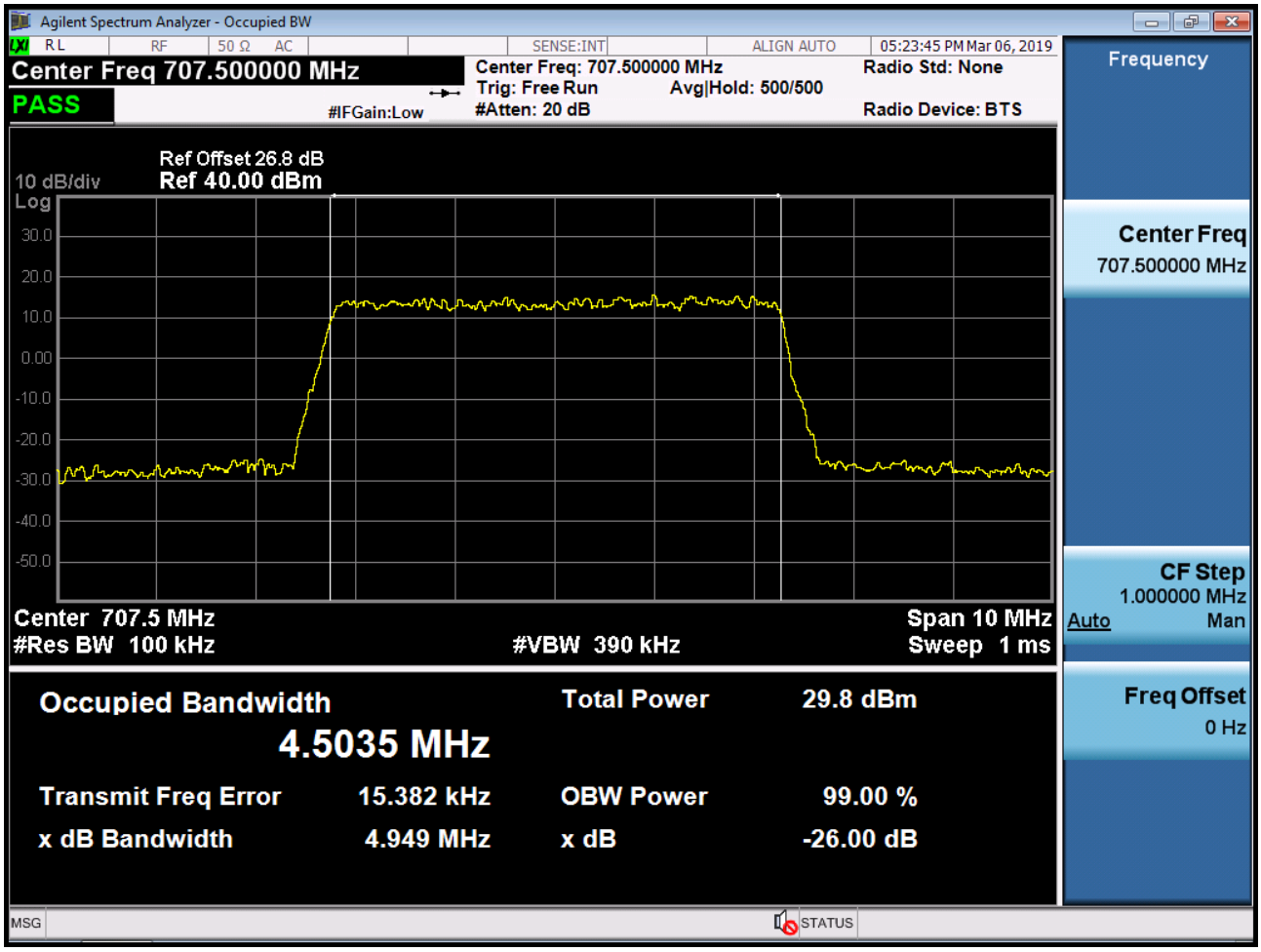
BAND 12. Occupied Bandwidth Plot (3M BW Ch.23095 64QAM_RB15_0)



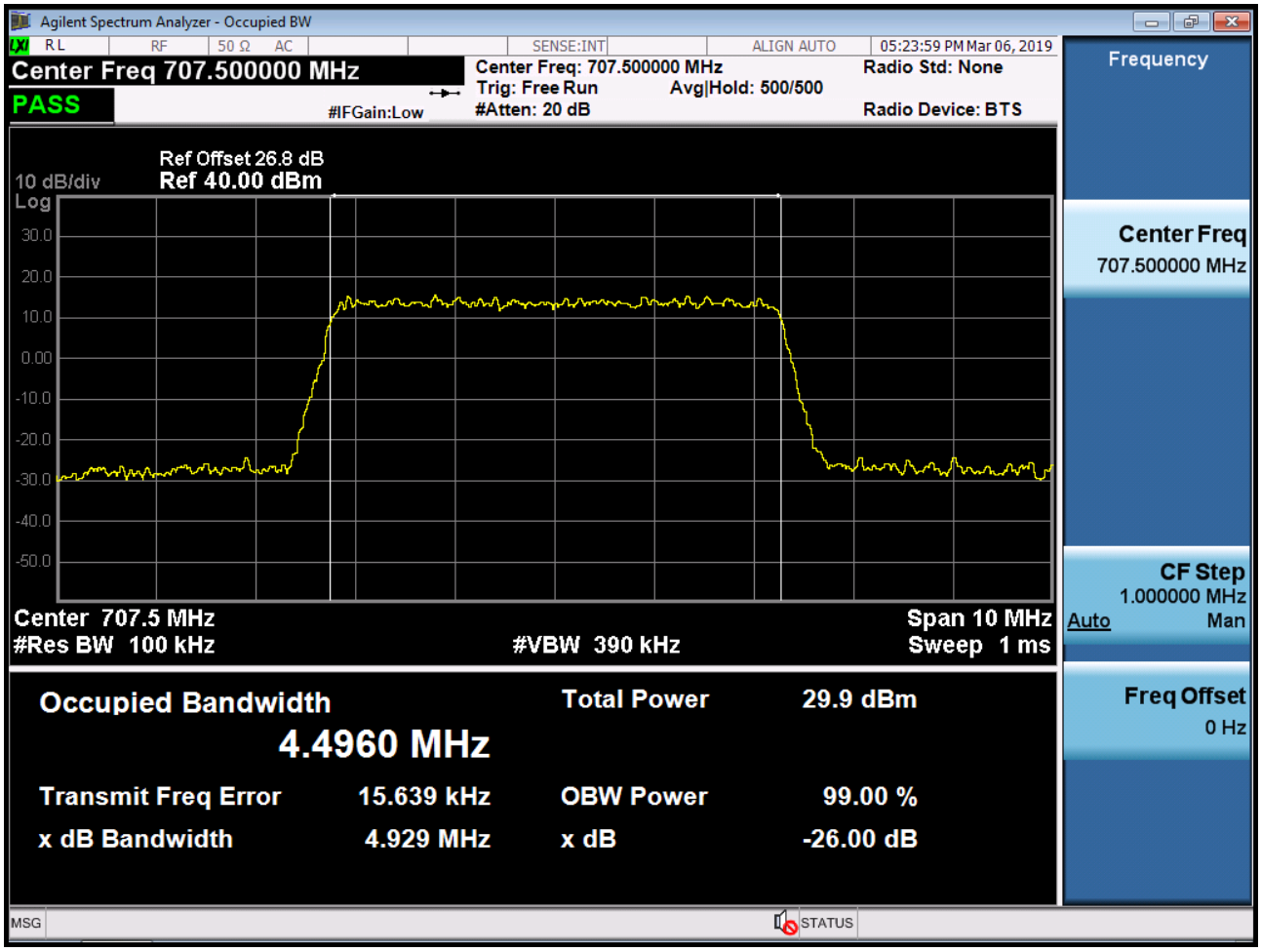
BAND 12 / 17. Occupied Bandwidth Plot (5M BW Ch.23095 QPSK_RB25_0)



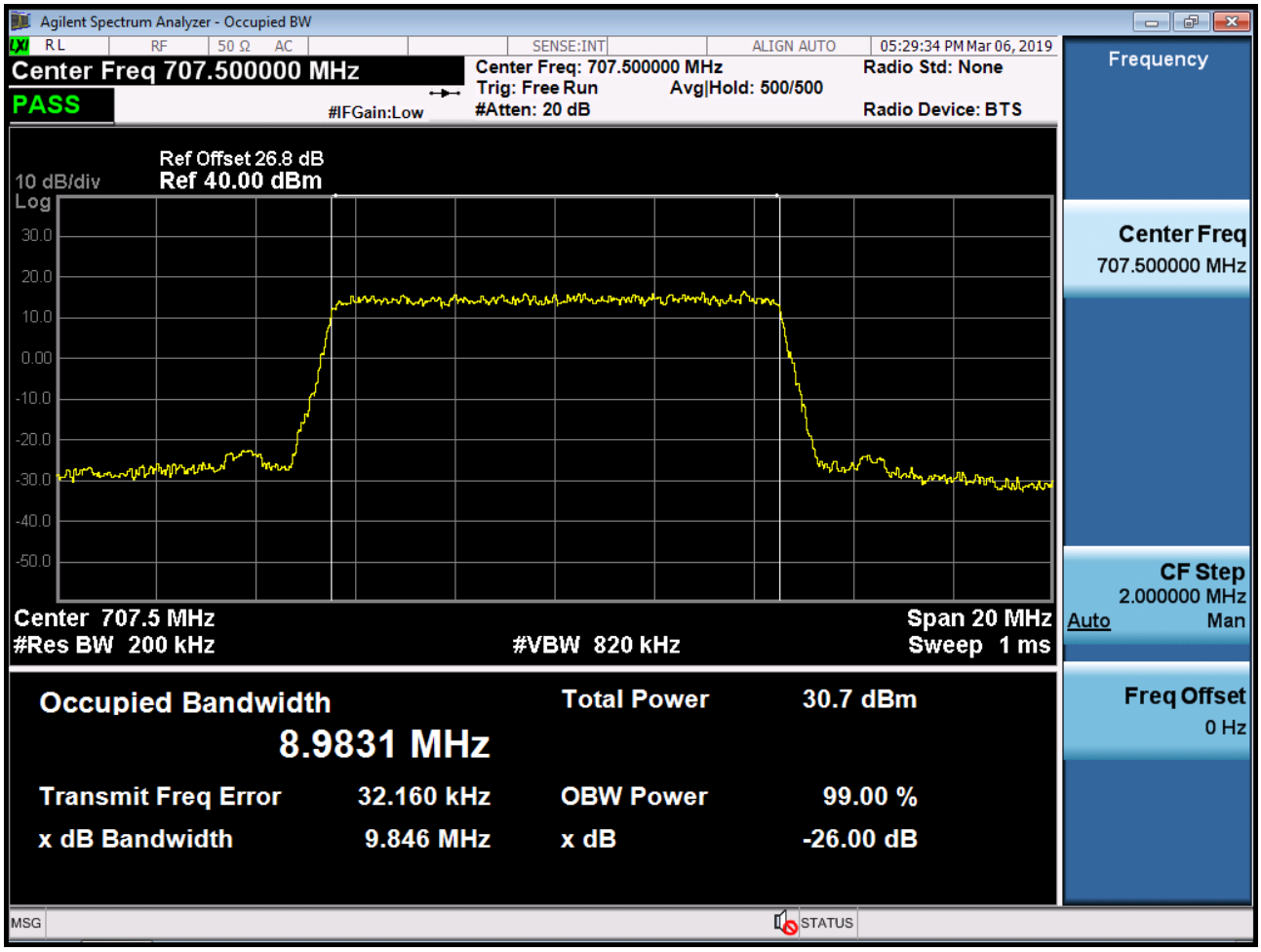
BAND 12 / 17. Occupied Bandwidth Plot (5M BW Ch.23095 16QAM_RB25_0)



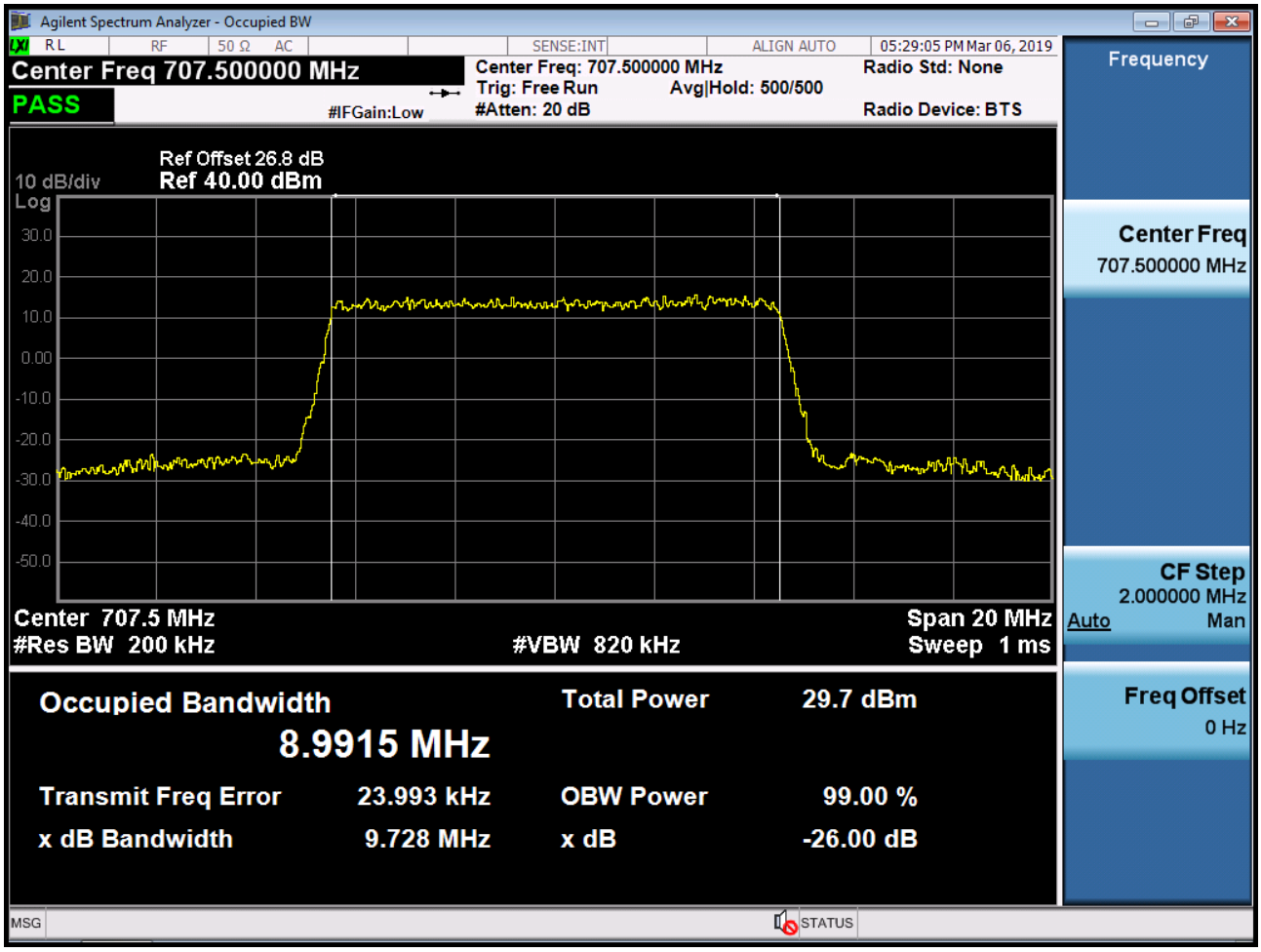
BAND 12 / 17. Occupied Bandwidth Plot (5M BW Ch.23095 64QAM_RB25_0)



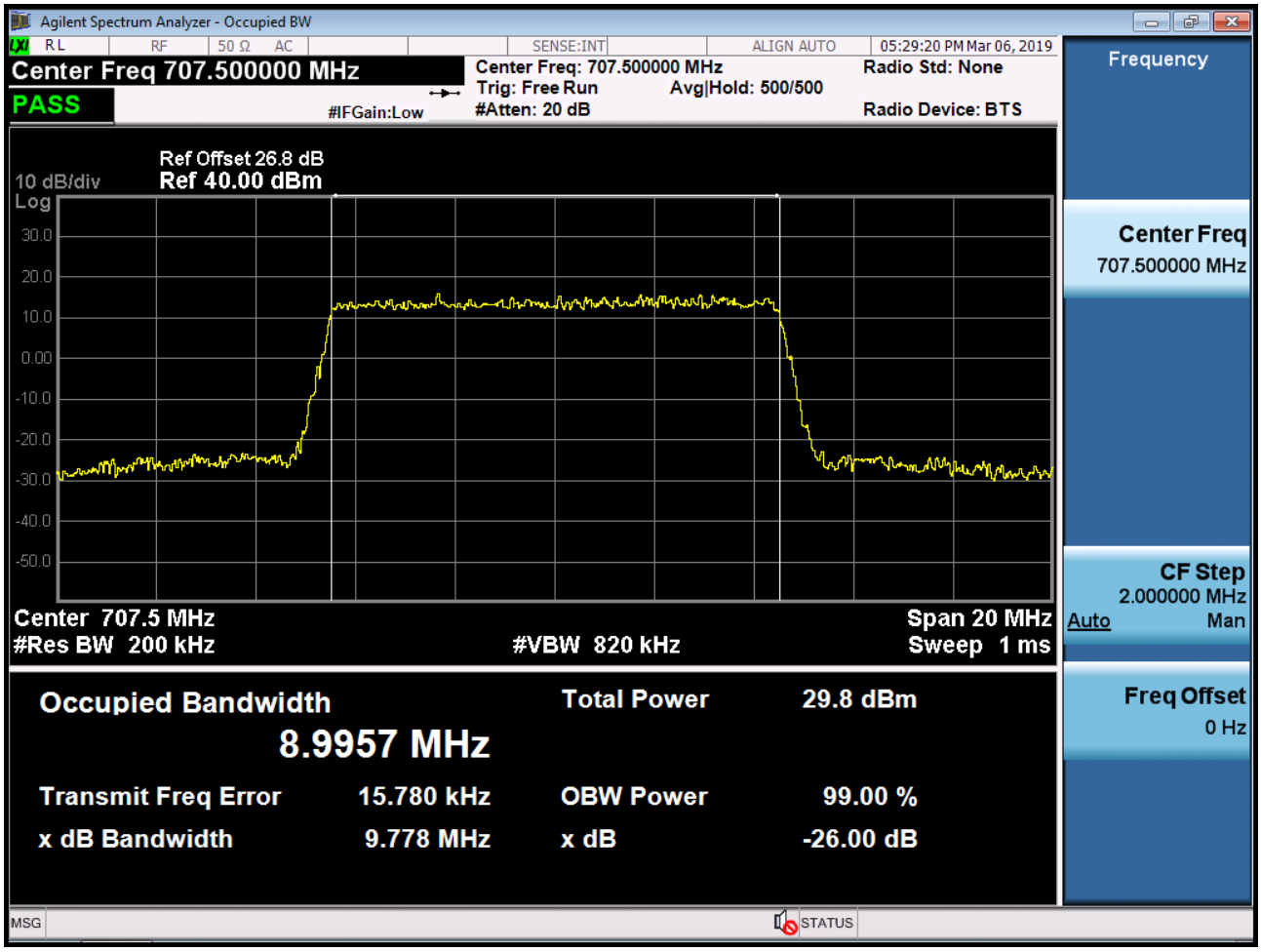
BAND 12 / 17. Occupied Bandwidth Plot (10M BW Ch.23095 QPSK_RB50_0)



BAND 12 / 17. Occupied Bandwidth Plot (10M BW Ch.23095 16QAM_RB50_0)



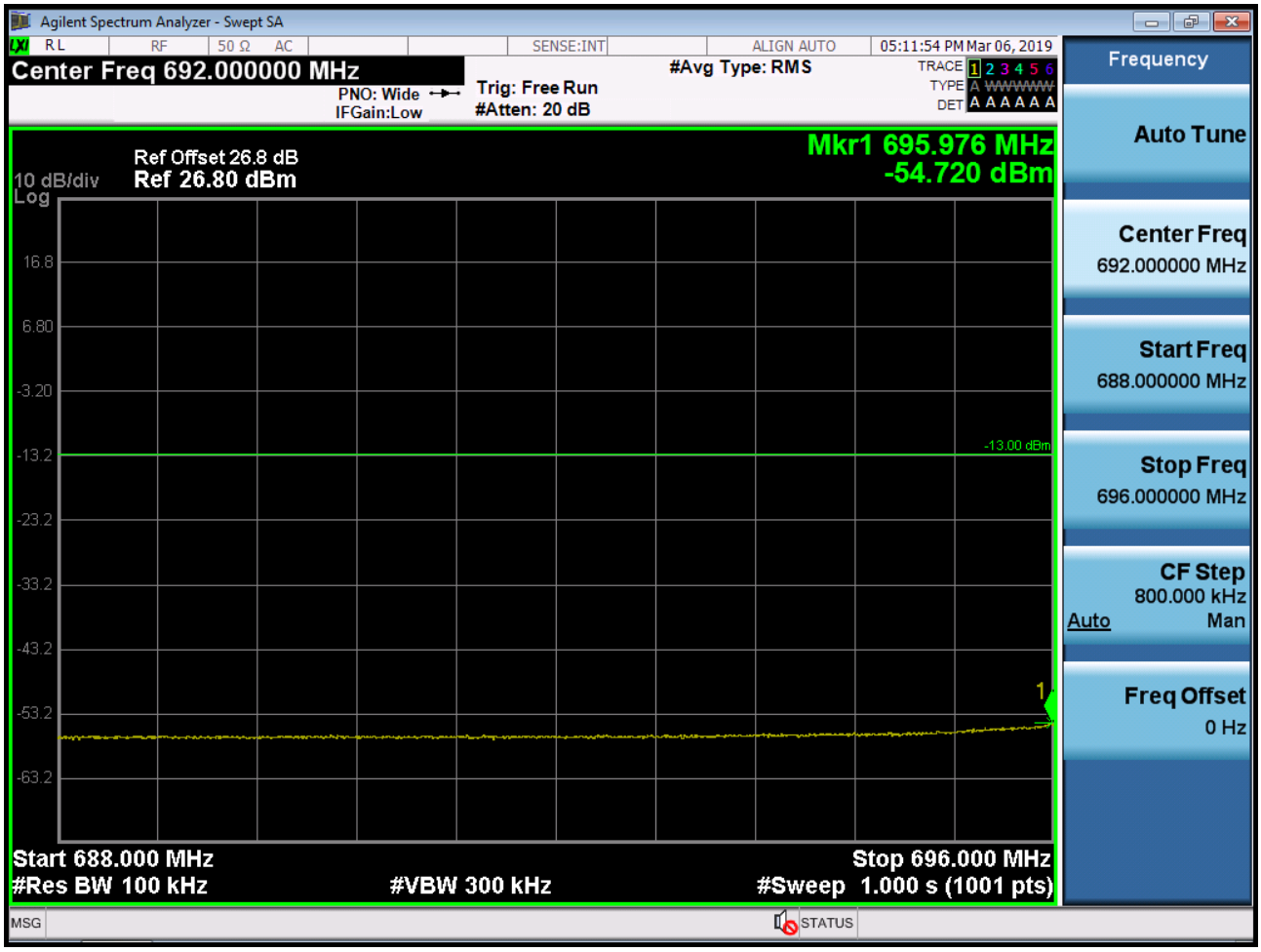
BAND 12 / 17. Occupied Bandwidth Plot (10M BW Ch.23095 64QAM_RB50_0)



BAND 12. Lower Band Edge Plot (1.4M BW Ch.23017 QPSK_RB1_Offset 0)

BAND 12. Lower Band Edge Plot (1.4M BW Ch.23017 QPSK_RB6_Offset 0)

BAND 12. Lower Extended Band Edge Plot (1.4M BW Ch.23017 QPSK_RB6_0)



BAND 12. Lower Band Edge Plot (3M BW Ch.23025 QPSK_RB1_Offset 0)

BAND 12. Lower Band Edge Plot (3M BW Ch.23025 QPSK_RB15_Offset 0)

BAND 12. Lower Extended Band Edge Plot (3M BW Ch.23025 QPSK_RB15_0)

BAND 12 / 17. Lower Band Edge Plot (5M BW Ch.23035 QPSK_RB1_Offset 0)

BAND 12 / 17. Lower Band Edge Plot (5M BW Ch.23035 QPSK_RB25_Offset 0)

BAND 12 / 17. Lower Extended Band Edge Plot (5M BW Ch.23035 QPSK_RB25_0)

BAND 12 / 17. Lower Band Edge Plot (10M BW Ch.23060 QPSK_RB1_Offset 0)

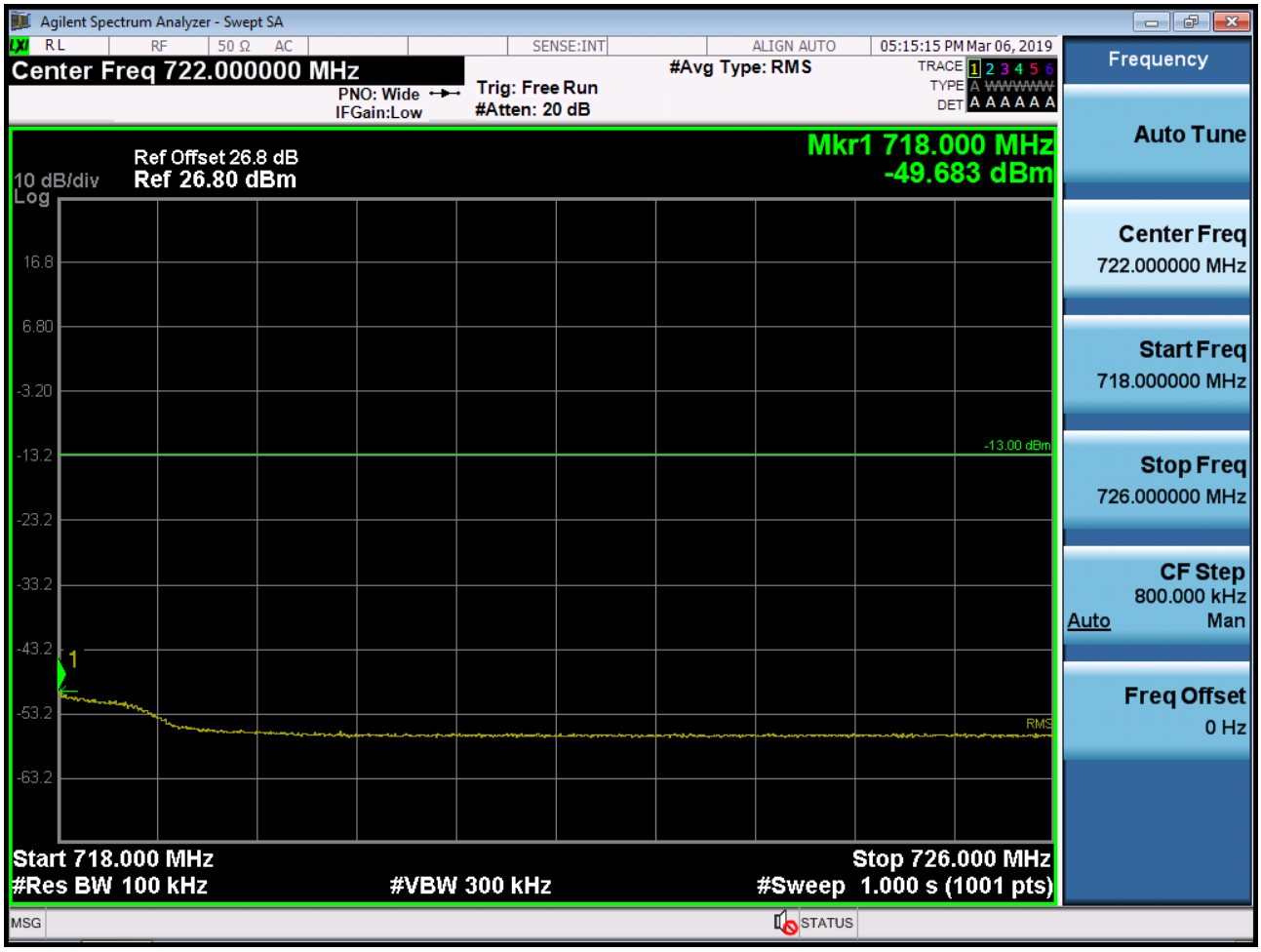
BAND 12 / 17. Lower Band Edge Plot (10M BW Ch.23060 QPSK_RB50_Offset 0)

BAND 12 / 17. Lower Extended Band Edge Plot (10M BW Ch.23060 QPSK_RB50_0)

BAND 12. Upper Band Edge Plot (1.4M BW Ch.23173 QPSK_RB1_Offset 5)

BAND 12. Upper Band Edge Plot (1.4M BW Ch.23173 QPSK_RB6_Offset 0)

BAND 12. Upper Extended Band Edge Plot (1.4M BW Ch.23173 QPSK_RB6_0)



BAND 12. Upper Band Edge Plot (3M BW Ch.23165 QPSK_RB1_Offset 14)-1

BAND 12. Upper Band Edge Plot (3M BW Ch.23165 QPSK_RB1_Offset 14)-2

BAND 12. Upper Band Edge Plot (3M BW Ch.23165 QPSK_RB15_Offset 0)

BAND 12. Upper Extended Band Edge Plot (3M BW Ch.23165 QPSK_RB15_0)

BAND 12 / 17. Upper Band Edge Plot (5M BW Ch.23155 QPSK_RB1_Offset 24)

BAND 12 / 17. Upper Band Edge Plot (5M BW Ch.23155 QPSK_RB25_Offset 0)

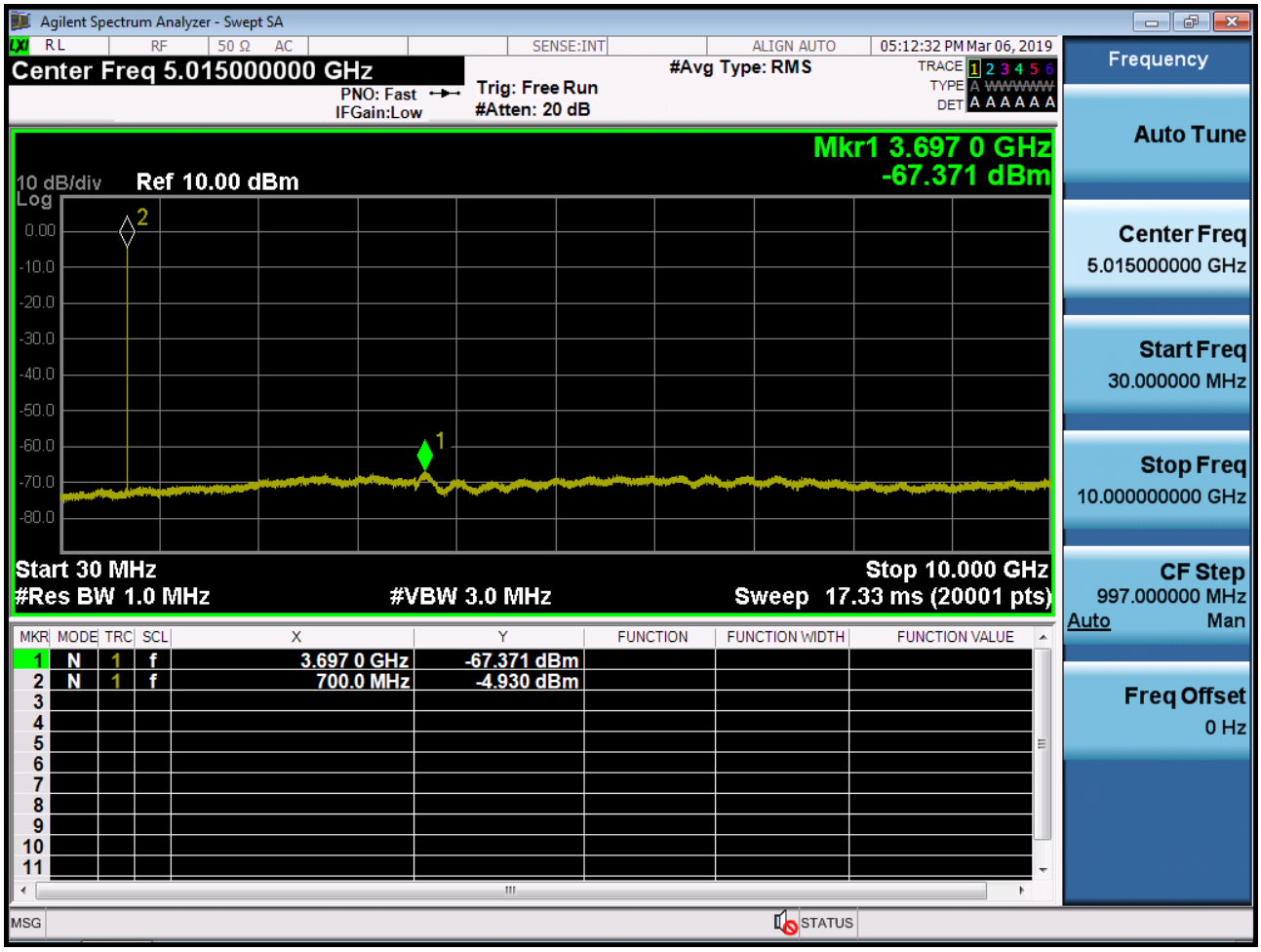
BAND 12 / 17. Upper Extended Band Edge Plot (5M BW Ch.23155 QPSK_RB25_0)

BAND 12 / 17. Upper Band Edge Plot (10M BW Ch.23130 QPSK_RB1_Offset 49)

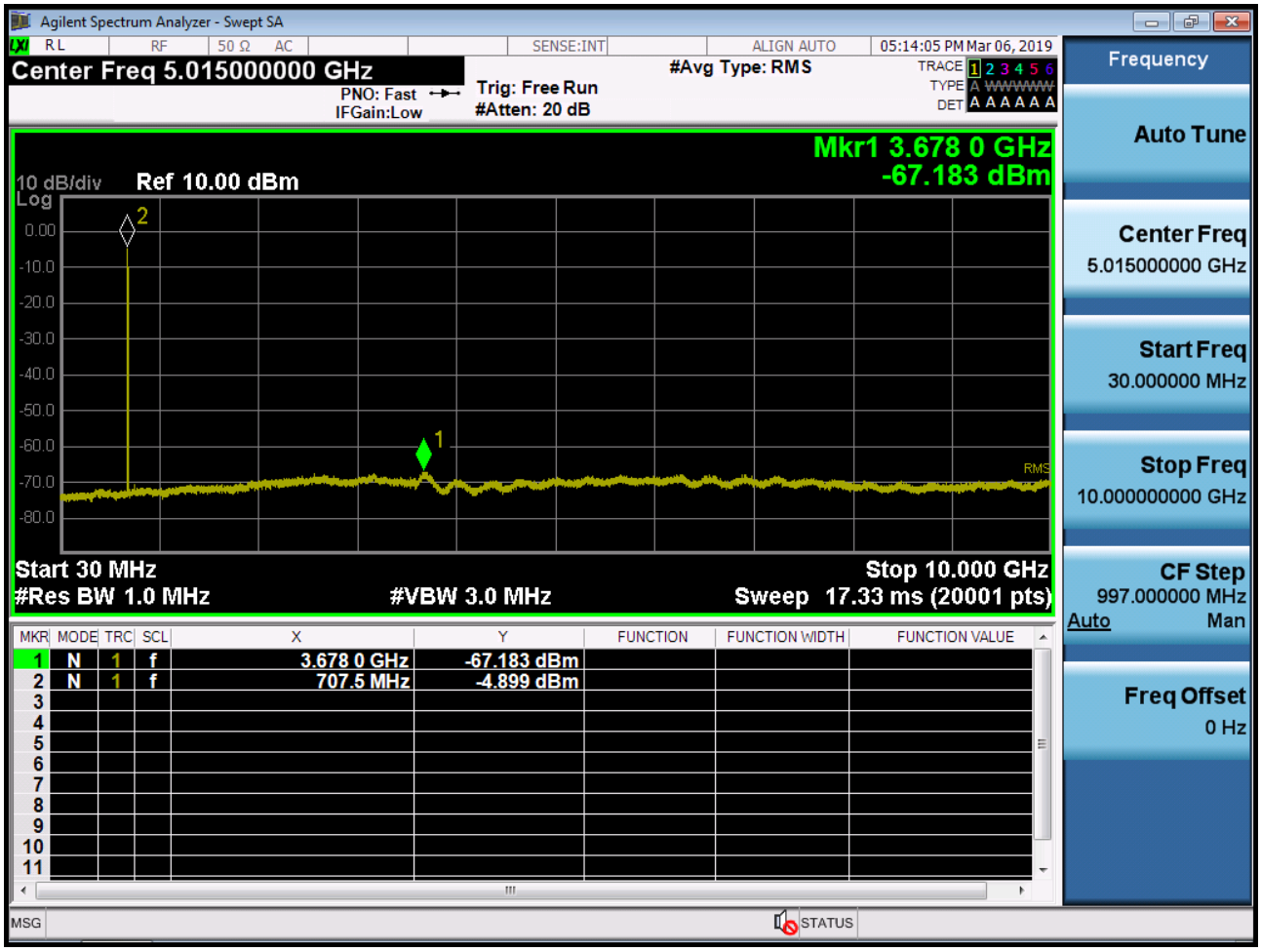
BAND 12 / 17. Upper Band Edge Plot (10M BW Ch.23130 QPSK_RB50_Offset 0)

BAND 12 / 17. Upper Extended Band Edge Plot (10M BW Ch.23130 QPSK_RB50_0)

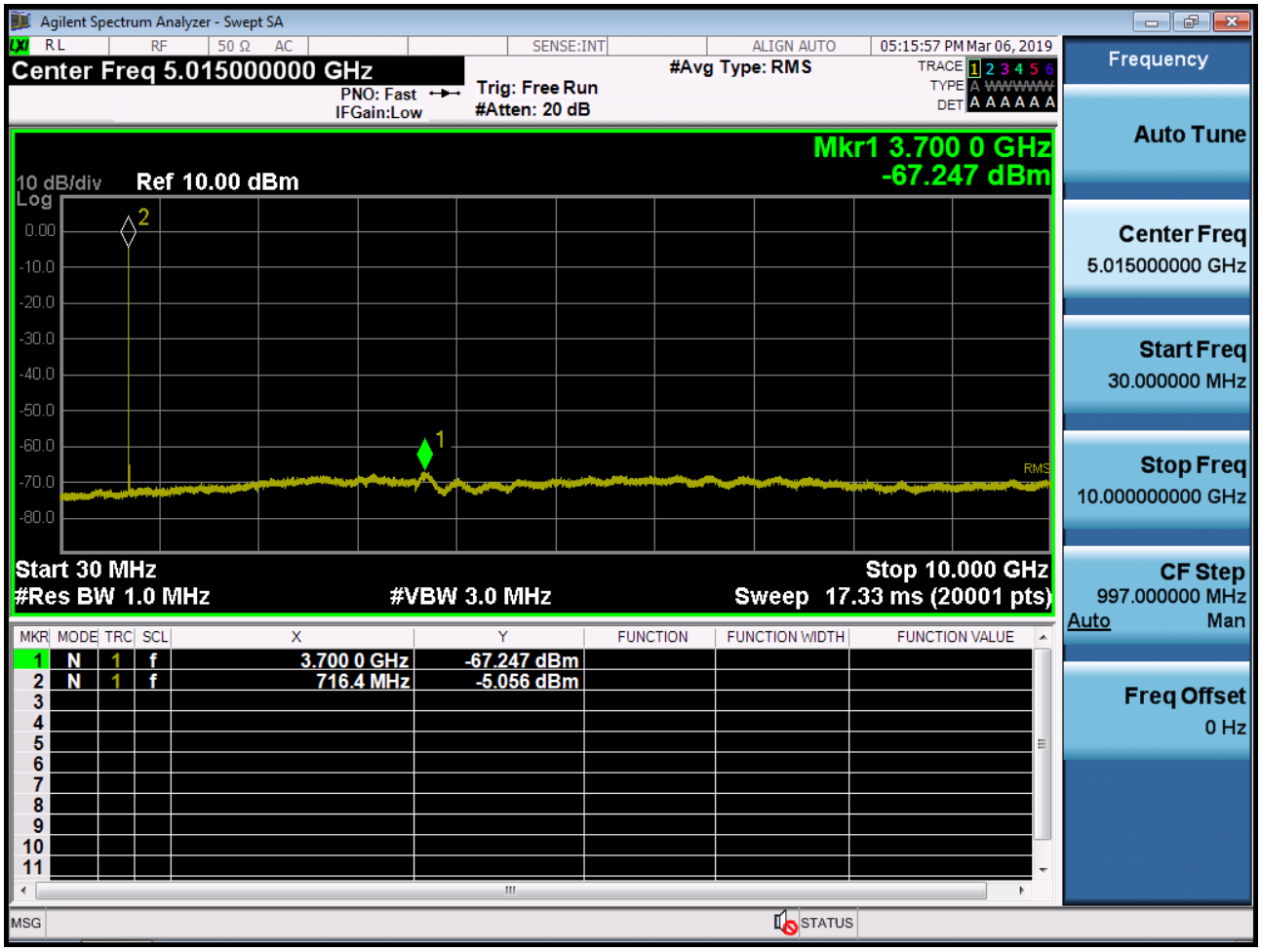
BAND 12. Conducted Spurious Plot _ (23017ch_1.4MHz_QPSK_RB 1_0)



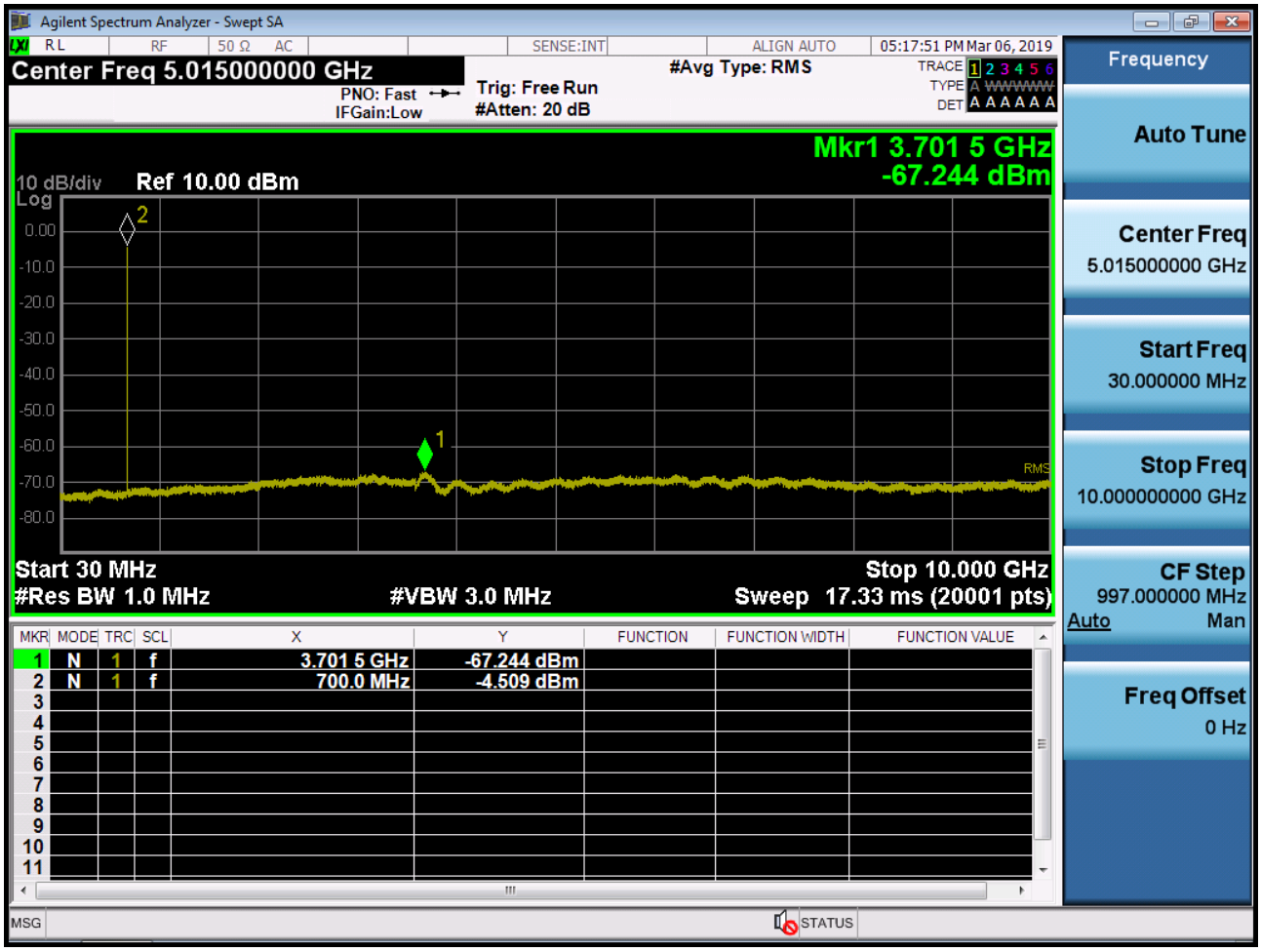
BAND 12. Conducted Spurious Plot _ (23095ch_1.4MHz_QPSK_RB 1_0)



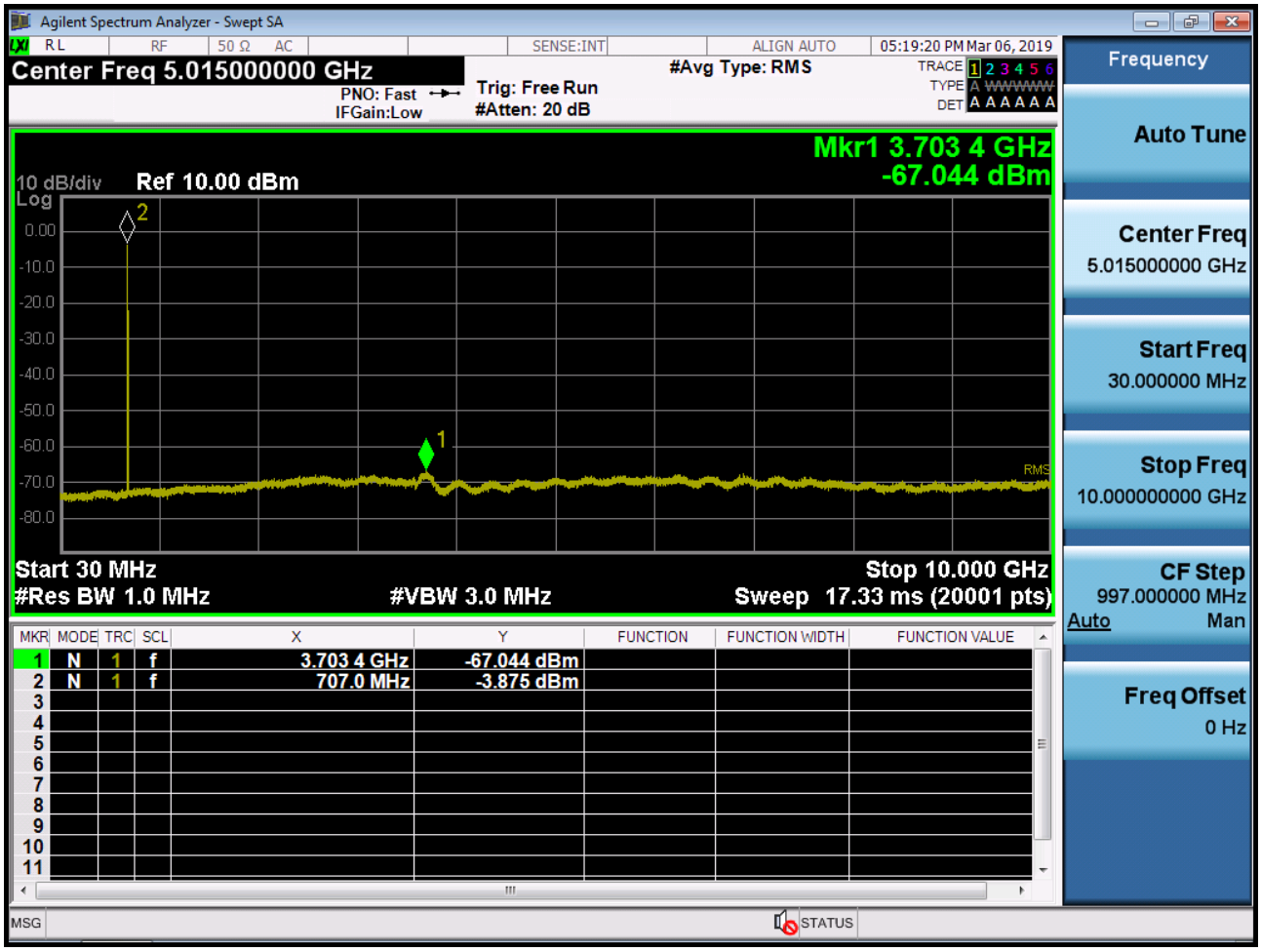
BAND 12. Conducted Spurious Plot _ (23173ch_1.4MHz_QPSK_RB 1_0)



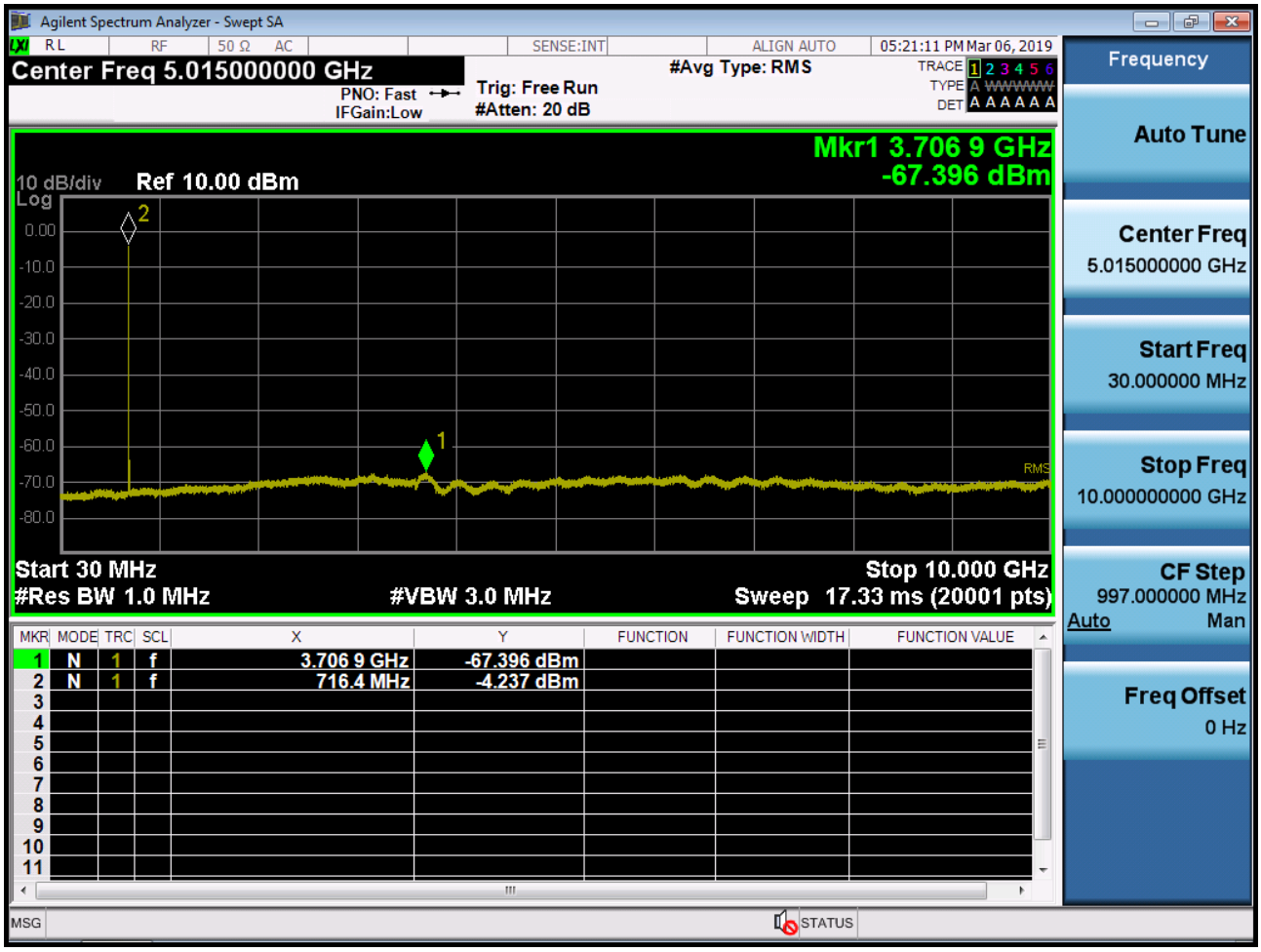
BAND 12. Conducted Spurious Plot _ (23025ch_3MHz_QPSK_RB 1_0)



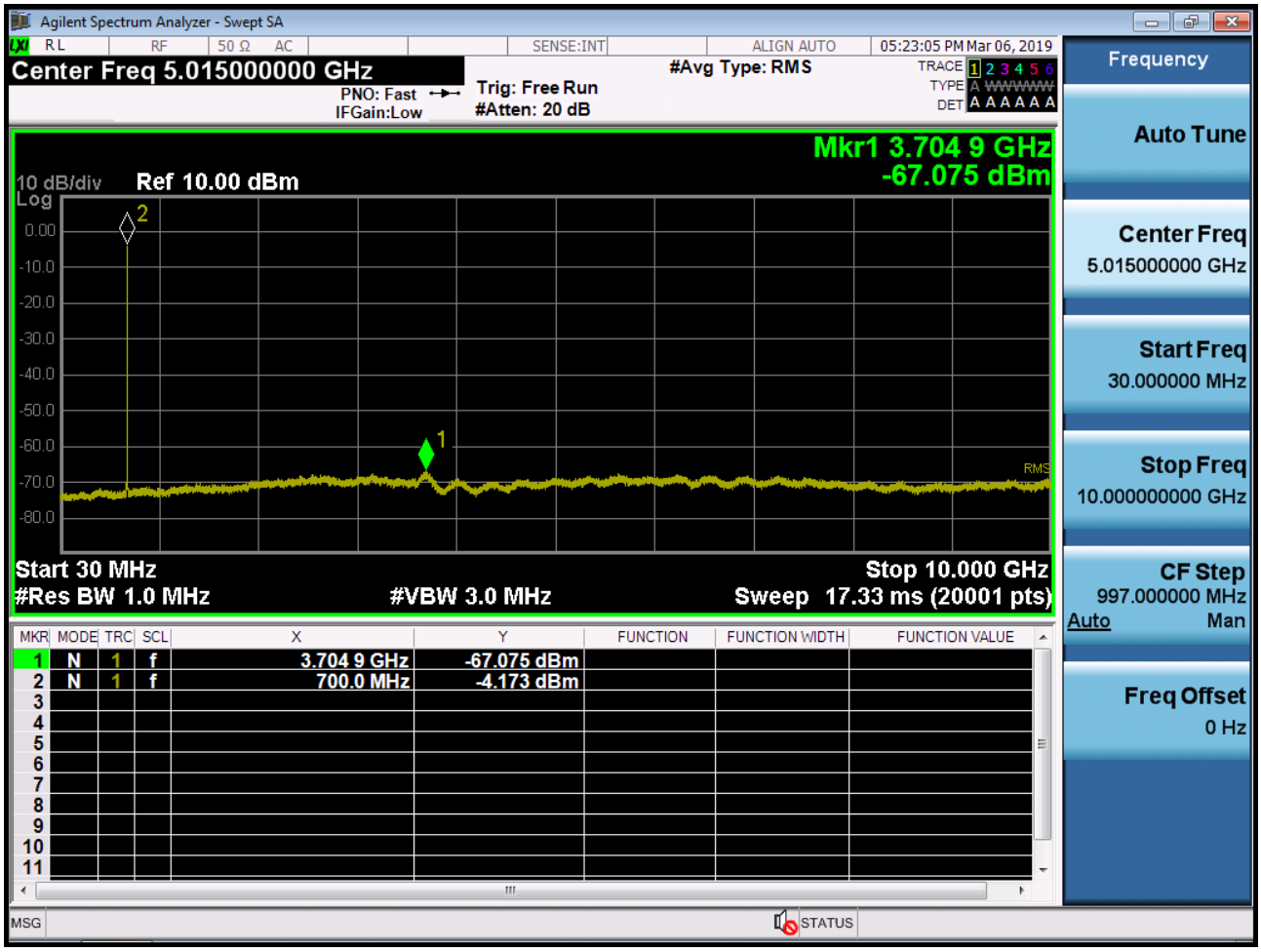
BAND 12. Conducted Spurious Plot _ (23095ch_3MHz_QPSK_RB 1_0)



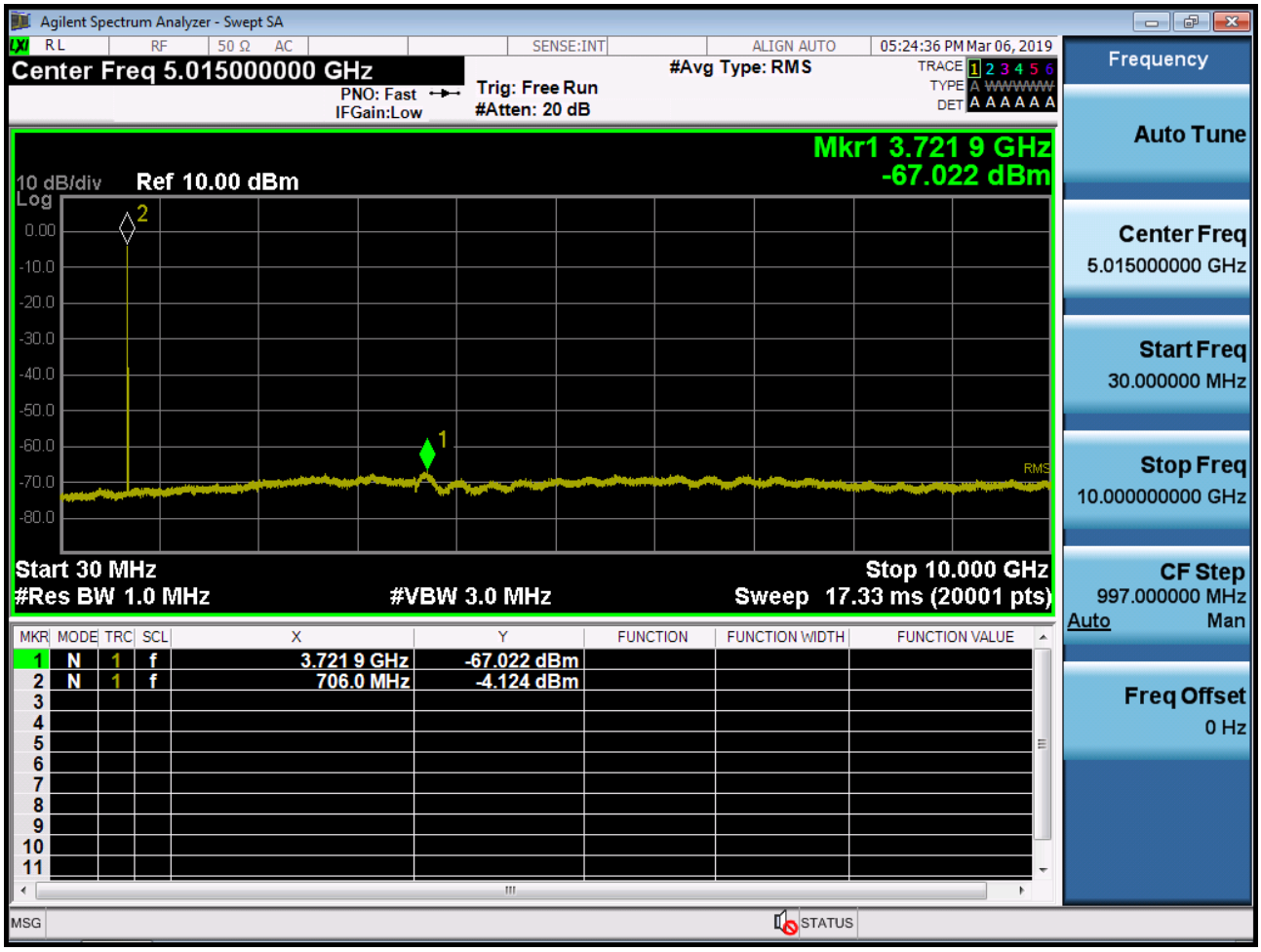
BAND 12. Conducted Spurious Plot _ (23165ch_3MHz_QPSK_RB 1_0)



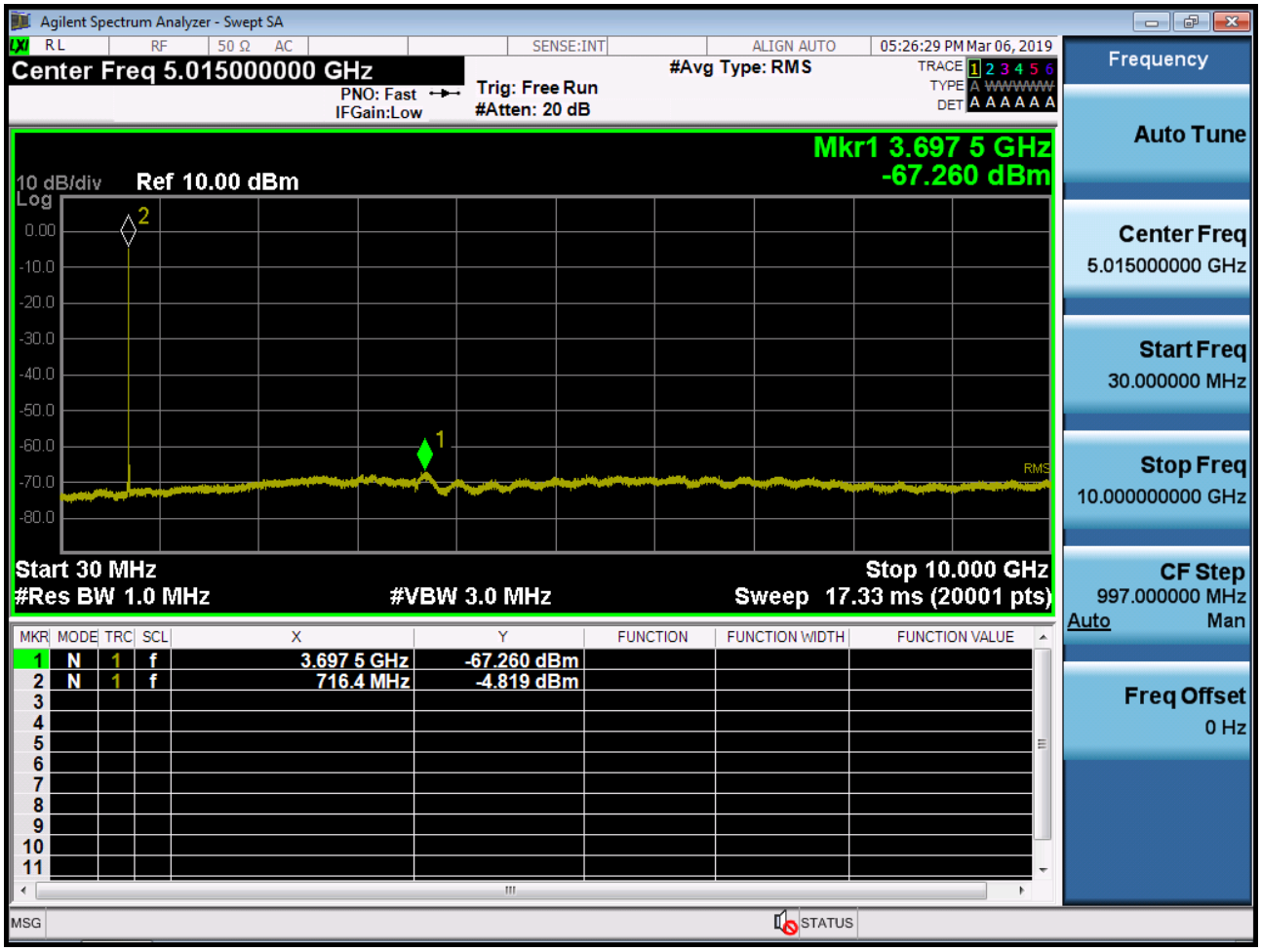
BAND 12 / 17. Conducted Spurious Plot _ (23035ch_5MHz_QPSK_RB 1_0)



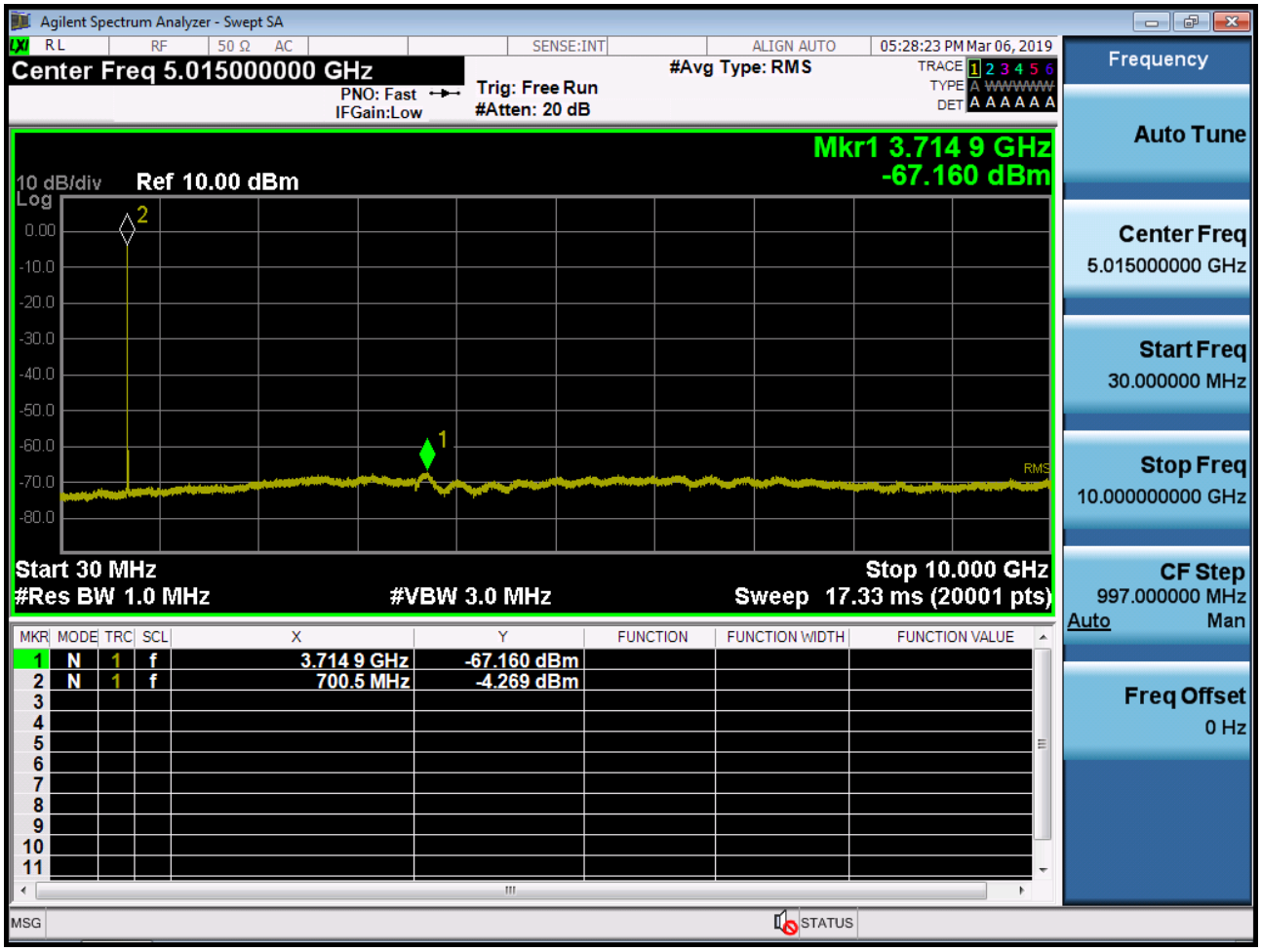
BAND 12 / 17. Conducted Spurious Plot _ (23095ch_5MHz_QPSK_RB 1_0)



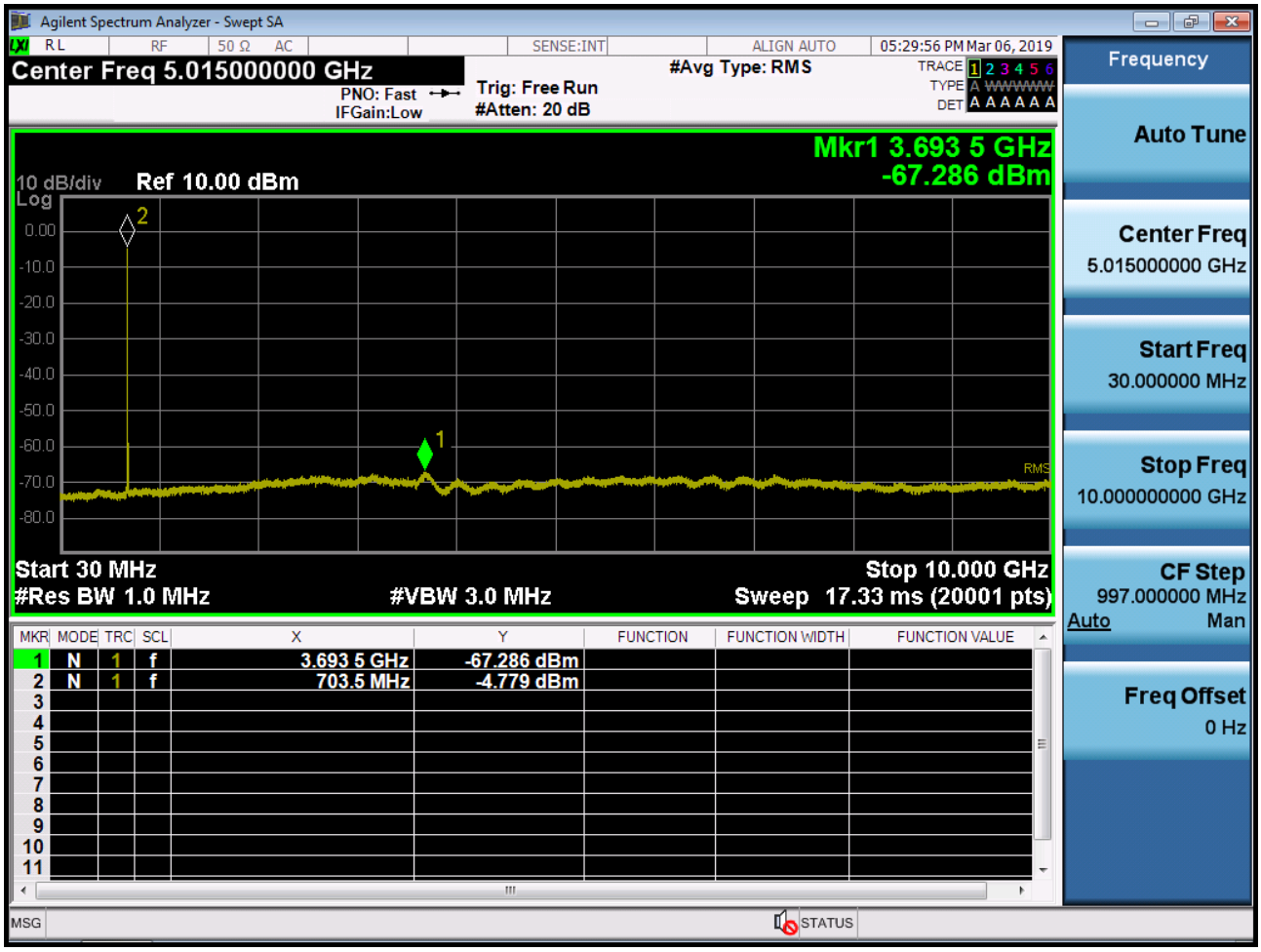
BAND 12 / 17. Conducted Spurious Plot _ (23155ch_5MHz_QPSK_RB 1_0)



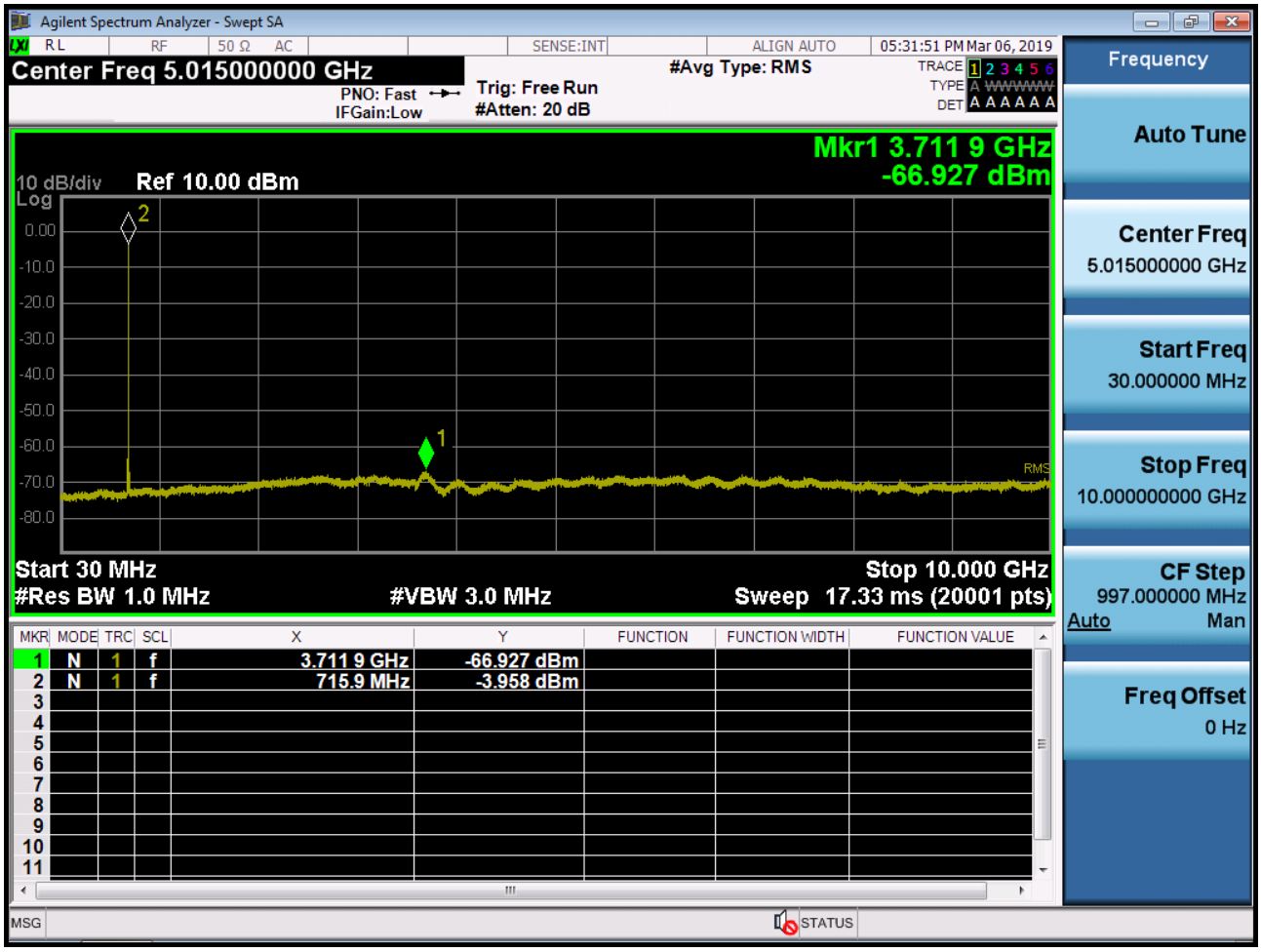
BAND 12 / 17. Conducted Spurious Plot _ (23060ch_10MHz_QPSK_RB 1_0)



BAND 12 / 17. Conducted Spurious Plot _ (23095ch_10MHz_QPSK_RB 1_0)



BAND 12 / 17. Conducted Spurious Plot _ (23130ch_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-1903-FC020-P |
| 2 | HCT-RF-1903-FC021-P |
| 3 | HCT-RF-1903-FC022-P |
| 4 | HCT-RF-1903-FC023-P |
| 5 | HCT-RF-1903-FC024-P |
| 6 | HCT-RF-1903-FC025-P |
| 7 | HCT-RF-1903-FC026-P |