74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

# 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:**
August 27, 2020

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

**Report No.:** HCT-RF-2008-FC074

| | |
|---|---|
| **FCC ID:** | **A3LSMG781U** |
| **APPLICANT:** | **SAMSUNG Electronics Co., Ltd.** |

**According to the Evaluation report, all of the data contained herein is reused from the reference FCC ID : A3LSMG781V report.**

| | |
|---|---|
| Model(s): | SM-G781U |
| Additional Model(s): | SM-G781U1/DS, SM-G781W |
| EUT Type: | Mobile Phone |
| FCC Classification: | PCS Licensed Transmitter Held to Ear (PCE) |
| FCC Rule Part(s): | §90, §2 |

| Mode (MHz) | Tx Frequency (MHz) | Emission Designator | Modulation | ERP | |
|---|---|---|---|---|---|
| | | | | Max. Power (W) | Max. Power (dBm) |
| LTE – Band14 (5) | 790.5 –795.5 | 4M52G7D | QPSK | 0.117 | 20.68 |
| | | 4M50W7D | 16QAM | 0.100 | 19.99 |
| | | 4M51W7D | 64QAM | 0.078 | 18.92 |
| LTE – Band14 (10) | 793.0 | 8M97G7D | QPSK | 0.119 | 20.76 |
| | | 8M95W7D | 16QAM | 0.103 | 20.14 |
| | | 8M96W7D | 64QAM | 0.080 | 19.02 |

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.
HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

REVIEWED BY

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

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

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

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

# Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|---|---|---|
| HCT-RF-2008-FC074 | August 27, 2020 | - First Approval Report |

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

# Table of Contents

# MEASUREMENT REPORT

## 1. GENERAL INFORMATION

| | |
|---|---|
| **Applicant Name:** | SAMSUNG Electronics Co., Ltd. |
| **Address:** | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| **FCC ID:** | A3LSMG781U |
| **Application Type:** | Certification |
| **FCC Classification:** | PCS Licensed Transmitter Held to Ear (PCE) |
| **FCC Rule Part(s):** | §90, §2 |
| **EUT Type:** | Mobile Phone |
| **Model(s):** | SM-G781U |
| **Additional Model(s):** | SM-G781U1/DS, SM-G781W |
| **Tx Frequency:** | 790.5 MHz –795.5 MHz (LTE – BAND 14 (5MHz))<br>793.0 MHz (LTE – BAND 14 (10 MHz)) |
| **Date(s) of Tests:** | July 06, 2020 ~ August 12, 2020 |

# 2. INTRODUCTION

## 2.1. DESCRIPTION OF EUT

The EUT was a Mobile Phone with GSM/GPRS/EGPRS/UMTS, CDMA(BC0, 1, 10) and LTE, Sub6.

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

## 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/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. For spurious emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.
   The spurious emissions is calculated by the following formula;

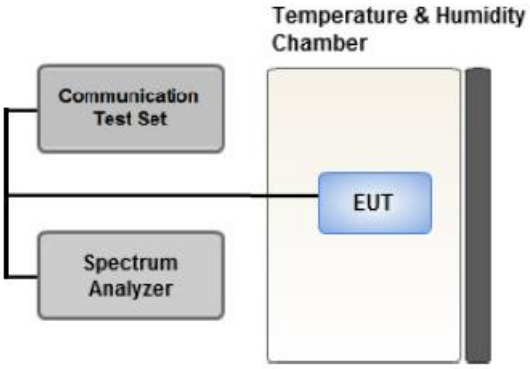
$$Result_{(dBm)} = Pg_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dBi)}$$

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

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

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

### 3.4 OCCUPIED BANDWIDTH.




**Test setup**

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

The EUT makes a call to the communication simulator.

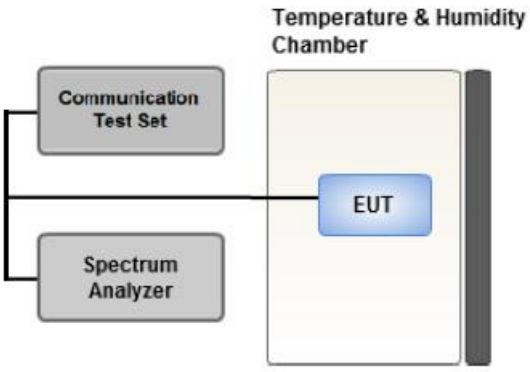
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

**Test Settings**

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

### 3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL




**Test setup**

**Test Overview**

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic.

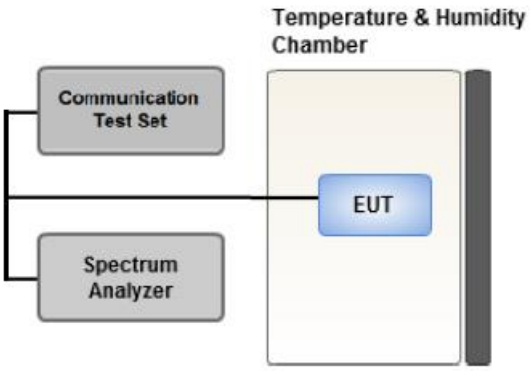
All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

**Test Settings**

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

### 3.6 BAND EDGE




**Test setup**

**Test Overview**

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

**Test Settings**

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

**Test Notes**

§90.543(e)

1. On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.
2. On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.
3. On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.
4. Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.
5. Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater.
   However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

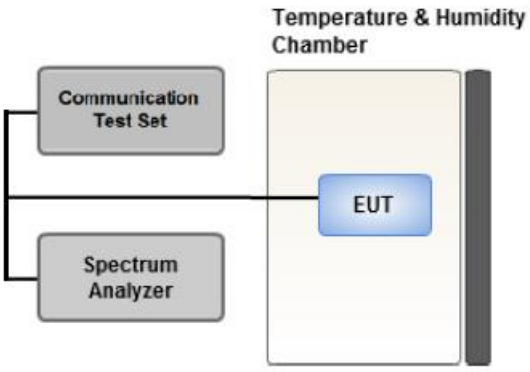
**Test Notes**

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.

-SM-G781U & additional models were tested and the worst case results are reported.

(Worst case : SM-G781U)

[ Worst case ]

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

### 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.

-SM-G781U & additional models were tested and the worst case results are reported.

(Worst case : SM-G781U)

[ Worst case ]

| Test Description | Modulation | Bandwidth (MHz) | Frequency | RB size | RB offset |
|---|---|---|---|---|---|
| **Occupied Bandwidth** | QPSK, 16QAM, 64QAM | 5, 10 | Mid | Full RB | 0 |
| **Band Edge** | QPSK | 5 | Low | 1 | 0 |
| | | | High | 1 | 24 |
| | | 10 | Mid | 1 | 0 |
| | | | | 1 | 49 |
| | | 5 | Low, High | Full RB | 0 |
| | | 10 | Mid | Full RB | 0 |
| **Spurious and Harmonic Emissions at Antenna Terminal** | QPSK | 5 | Low, Mid, High | 1 | 0 |
| | | 10 | Mid | 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 | 03/19/2020 | Annual | 03/19/2021 |
| Hewlett Packard | 11667B / Power Splitter(DC~26.5 GHz) | 11275 | 04/27/2020 | Annual | 04/27/2021 |
| Hewlett Packard | E3632A/DC Power Supply | MY4004427 | 09/27/2019 | Annual | 09/27/2020 |
| 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 | 93008124 | 03/18/2020 | Annual | 03/18/2021 |
| 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 | 02/11/2020 | Biennial | 02/11/2022 |
| Agilent | N9020A/Signal Analyzer(10Hz~26.5GHz) | MY51110063 | 04/27/2020 | Annual | 04/27/2021 |
| Hewlett Packard | 8493C/ATTENUATOR(20dB) | 17280 | 06/04/2020 | Annual | 06/04/2021 |
| 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 | 04/26/2019 | Biennial | 04/26/2021 |
| Schwarzbeck | VULB9160/ Bilog Antenna | 3150 | 03/12/2019 | Biennial | 03/12/2021 |
| Schwarzbeck | VULB9160/ Hybrid Antenna | 760 | 03/22/2019 | Biennial | 03/22/2021 |
| Anritsu Corp. | MT8821C/Wideband Radio Communication Tester | 6262116770 | 07/22/2020 | Annual | 07/22/2021 |
| Anritsu Corp. | MT8820C/Wideband Radio Communication Tester | 6201026545 | 01/22/2020 | Annual | 01/22/2021 |
| REOHDE & SCHWARZ | SMB100A/ SIGNAL GENERATOR (100kHz~40GHz) | 177633 | 07/13/2020 | Annual | 07/13/2021 |
| KEYSIGHT | E7515B / 5G Wireless Tester | MY58300756 | 01/07/2020 | Annual | 01/07/2021 |
| KEYSIGHT | N9030B / Signal Analyzer(5Hz~40.0GHz) | MY55480167 | 06/04/2020 | Annual | 06/04/2021 |
| Mini-Circuits | ZC4PD-K1844+ / 4-Way Divider | 942907 | 09/05/2019 | Annual | 09/05/2020 |
| HCT CO., LTD., | FCC LTE Mobile Conducted RF Automation Test Software | - | - | - | - |

Note:

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

## 5. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014. All measurement uncertainty values are shown with a coverage factor of $k$ = 2 to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded Uncertainty (±dB) |
|---|---|
| Conducted Disturbance (150 kHz ~ 30 MHz) | 1.82 |
| Radiated Disturbance (9 kHz ~ 30 MHz) | 3.40 |
| Radiated Disturbance (30 MHz ~ 1 GHz) | 4.80 |
| Radiated Disturbance (1 GHz ~ 18 GHz) | 5.70 |
| Radiated Disturbance (18 GHz ~ 40 GHz) | 5.05 |

# 6. SUMMARY OF TEST RESULTS

## 6.1 Test Condition : Conducted Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result |
|---|---|---|---|
| Occupied Bandwidth | §2.1049 | N/A | PASS |
| Band Edge / Spurious and Harmonic Emissions at Antenna Terminal. | §2.1051, §90.543(e) | < 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions | PASS |
| On all frequencies between 769-775 MHz and 799-805 MHz. | §90.543(e) | < 65 + 10log10 (P[Watts]) | PASS **(See Note3)** |
| Conducted Output Power | §2.1046 | N/A | **See Note1** |
| Frequency stability / variation of ambient temperature | §2.1055, §90.539(e) | < 2.5 ppm | PASS |

**Note:**

1. See SAR Report
2. The same samples were used for SAR and EMC
3. Since it was not possible to set the resolution bandwidth to 6.25 kHz with the available equipment, a bandwidth of 10 kHz was used instead to show compliance.

## 6.2 Test Condition : Radiated Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result |
|---|---|---|---|
| Effective Radiated Power | §90.542(a)(7) | < 3 Watts max. ERP | PASS |
| Radiated Spurious and Harmonic Emissions | §2.1053, §90.543(e) | < 43 + 10log10 (P[Watts]) for all out-of band emissions | PASS |
| Undesirable Emissions in the 1559 – 1610 MHz band | §2.1053, §90.543(f) | < -70dBW/MHz EIRP (wideband)<br>< -80dBW EIRP (narrowband) | 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

**QAM Modulation**

**Emission Designator = 4M48W7D**

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

# 8. TEST DATA

## 8.1 EFFECTIVE RADIATED POWER

| Freq (MHz) | Mod (Bandwidth) | Modulation | Measured Level (dBm) | Substitute Level (dBm) | Ant. Gain(dBd) | C.L | Pol | Limit | ERP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | W | W | dBm |
| 790.5 | LTE B14 (5 MHz) | QPSK | -30.46 | 32.15 | -10.11 | 1.36 | H | < 3.00 | 0.117 | 20.68 |
| | | 16-QAM | -31.15 | 31.46 | -10.11 | 1.36 | H | | 0.100 | 19.99 |
| | | 64-QAM | -32.22 | 30.39 | -10.11 | 1.36 | H | | 0.078 | 18.92 |
| 793.0 | | QPSK | -30.91 | 31.81 | -10.12 | 1.36 | H | | 0.108 | 20.33 |
| | | 16-QAM | -31.60 | 31.12 | -10.12 | 1.36 | H | | 0.092 | 19.64 |
| | | 64-QAM | -32.70 | 30.02 | -10.12 | 1.36 | H | | 0.071 | 18.54 |
| 795.5 | | QPSK | -31.23 | 31.46 | -10.13 | 1.37 | H | | 0.099 | 19.96 |
| | | 16-QAM | -31.96 | 30.73 | -10.13 | 1.37 | H | | 0.084 | 19.23 |
| | | 64-QAM | -33.87 | 28.82 | -10.13 | 1.37 | H | | 0.054 | 17.32 |

| Freq (MHz) | Mod (Bandwidth) | Modulation | Measured Level (dBm) | Substitute Level (dBm) | Ant. Gain(dBd) | C.L | Pol | Limit | ERP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | W | W | dBm |
| 793.0 | LTE B14 (10 MHz) | QPSK | -30.48 | 32.24 | -10.12 | 1.36 | H | < 3.00 | 0.119 | 20.76 |
| | | 16-QAM | -31.10 | 31.62 | -10.12 | 1.36 | H | | 0.103 | 20.14 |
| | | 64-QAM | -32.22 | 30.50 | -10.12 | 1.36 | H | | 0.080 | 19.02 |

### 8.2 RADIATED SPURIOUS EMISSIONS

▣ MODE: LTE B14

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBi) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | Limit |
|---|---|---|---|---|---|---|---|---|
| 23305 (790.5) | 1,581.0 | -50.55 | 9.05 | -58.53 | 1.95 | V | -51.43 | -13.00 |
| | 2,371.5 | -48.00 | 10.05 | -50.50 | 2.42 | V | -42.87 | -13.00 |
| | 3,162.0 | -53.46 | 11.28 | -53.45 | 2.83 | V | -45.00 | -13.00 |
| 23330 (793.0) | 1,586.0 | -50.30 | 9.12 | -58.35 | 1.96 | V | -51.19 | -13.00 |
| | 2,379.0 | -48.17 | 10.05 | -50.75 | 2.44 | V | -43.14 | -13.00 |
| | 3,172.0 | -53.46 | 11.35 | -53.68 | 2.83 | V | -45.16 | -13.00 |
| 23355 (795.5) | 1,591.0 | -50.47 | 9.18 | -58.58 | 1.96 | V | -51.36 | -13.00 |
| | 2,386.5 | -48.33 | 10.09 | -50.92 | 2.45 | V | -43.28 | -13.00 |
| | 3,182.0 | -53.54 | 11.35 | -53.81 | 2.83 | V | -45.29 | -13.00 |

▣ MODE: LTE B14

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

| Ch | Freq (MHz) | Measured Level (dBm) | Ant. Gain (dBi) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | Limit |
|---|---|---|---|---|---|---|---|---|
| 23330 (793.0) | 1,586.0 | -50.13 | 9.12 | -58.18 | 1.96 | V | -51.02 | -13.00 |
| | 2,379.0 | -47.89 | 10.05 | -50.47 | 2.44 | V | -42.86 | -13.00 |
| | 3,172.0 | -53.15 | 11.35 | -53.37 | 2.83 | V | -44.85 | -13.00 |

**1559 MHz ~ 1610 MHz BAND**

▣ OPERATING FREQUENCY: 790.5 MHz, 793.0 MHz, 795.5 MHz

▣ MEASURED OUTPUT POWER: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ WIDEBAND EMISSION LIMIT: -80 dBW/ MHz (= -50 dBm/ MHz)

| Operating Frequency (MHz) | Measured Frequency (MHz) | EMISSION TYPE | Measured Level (dBm) | Ant. Gain (dBi) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 790.5 | 1586.18 | Narrow Band | -58.71 | 9.11 | -66.75 | 1.96 | V | -59.60 | 9.60 |
| 793.0 | 1595.32 | | -59.17 | 9.20 | -67.54 | 1.97 | V | -60.31 | 10.31 |
| 795.5 | 1601.38 | | -58.69 | 9.30 | -67.40 | 1.98 | V | -60.08 | 10.08 |

Note:

The lower narrowband limit was applied because the spurious emission was not found.

▣ OPERATING FREQUENCY: 793.0 MHz

▣ MEASURED OUTPUT POWER: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ WIDEBAND EMISSION LIMIT: -80 dBW/ MHz (= -50 dBm/ MHz)

| Operating Frequency (MHz) | Measured Frequency (MHz) | EMISSION TYPE | Measured Level (dBm) | Ant. Gain (dBi) | Substitute Level (dBm) | C.L | Pol | Result (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 793.0 | 1577.22 | Narrow Band | -58.41 | 9.05 | -66.39 | 1.95 | V | -59.29 | 9.29 |

Note:

The lower narrowband limit was applied because the spurious emission was not found.

### 8.3 OCCUPIED BANDWIDTH

| Band | Band Width | Frequency (MHz) | Modulation | Resource Block Size | Resource Block Offset | Data ( MHz ) |
|---|---|---|---|---|---|---|
| 14 | 5 MHz | 793.0 | QPSK | 25 | 0 | 4.5183 |
| | | | 16-QAM | 25 | 0 | 4.4987 |
| | | | 64-QAM | 25 | 0 | 4.5068 |
| | 10 MHz | | QPSK | 50 | 0 | 8.9660 |
| | | | 16-QAM | 50 | 0 | 8.9453 |
| | | | 64-QAM | 50 | 0 | 8.9623 |

**Note:**

1. Plots of the EUT's Occupied Bandwidth are shown Page 34 ~ 39.

### 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) |
|---|---|---|---|---|---|---|---|
| 14 | 5 | 790.5 | 3.6810 | 27.976 | -67.090 | -39.114 | -13.00 |
| | | 793.0 | 3.6995 | 27.976 | -67.308 | -39.332 | |
| | | 795.5 | 3.7079 | 27.976 | -67.105 | -39.129 | |
| | 10 | 793.0 | 3.6830 | 27.976 | -67.228 | -39.252 | |

**Note:**

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 56 ~ 59.

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 40 ~ 55.

## 8.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: LTE 14

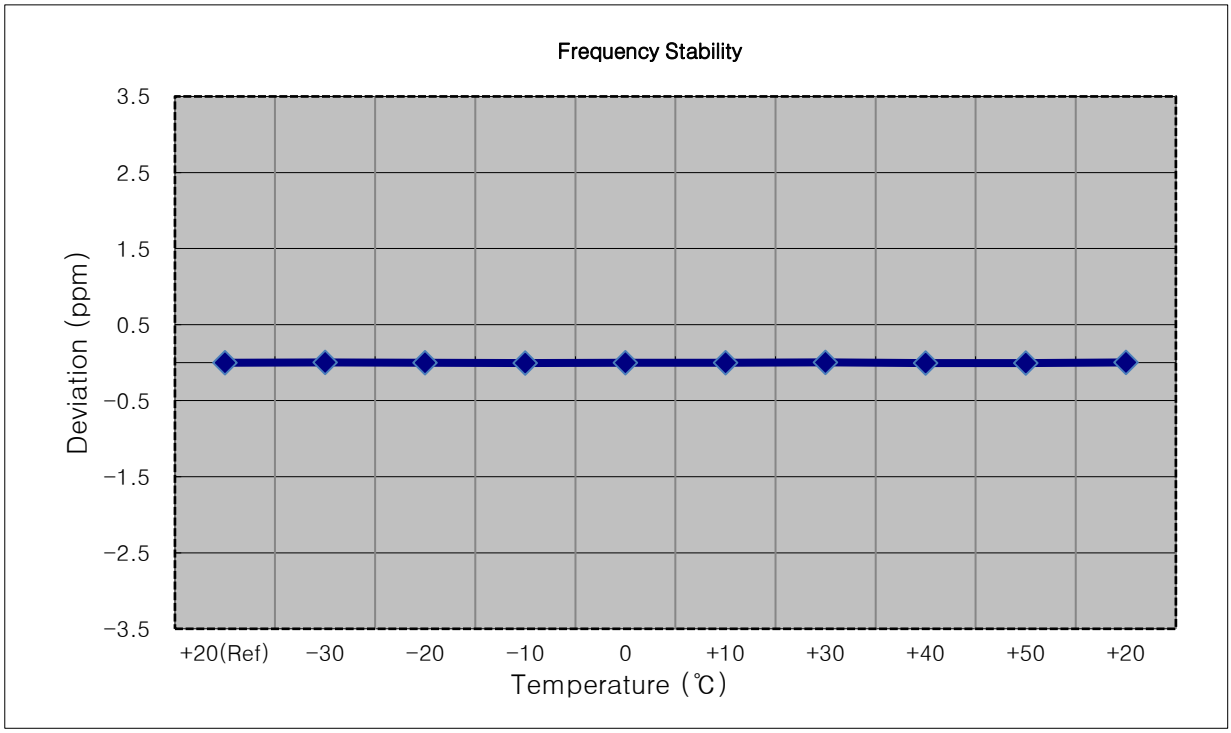
▣ OPERATING FREQUENCY: 790,500,000 Hz

▣ CHANNEL: 23305 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: 2.5ppm

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 790 500 002 | 0.00 | 0.000 000 | 0.0000 |
| 100% | | -30 | 790 500 004 | 2.00 | 0.000 000 | 0.0025 |
| 100% | | -20 | 790 500 000 | -2.00 | 0.000 000 | -0.0025 |
| 100% | | -10 | 790 499 998 | -4.30 | -0.000 001 | -0.0054 |
| 100% | | 0 | 790 500 000 | -2.10 | 0.000 000 | -0.0027 |
| 100% | | +10 | 790 500 000 | -2.70 | 0.000 000 | -0.0034 |
| 100% | | +30 | 790 500 005 | 2.90 | 0.000 000 | 0.0037 |
| 100% | | +40 | 790 499 999 | -3.30 | 0.000 000 | -0.0042 |
| 100% | | +50 | 790 499 999 | -3.50 | 0.000 000 | -0.0044 |
| Batt. Endpoint | 3.400 | +20 | 790 500 005 | 2.50 | 0.000 000 | 0.0032 |



▣ MODE: LTE 14

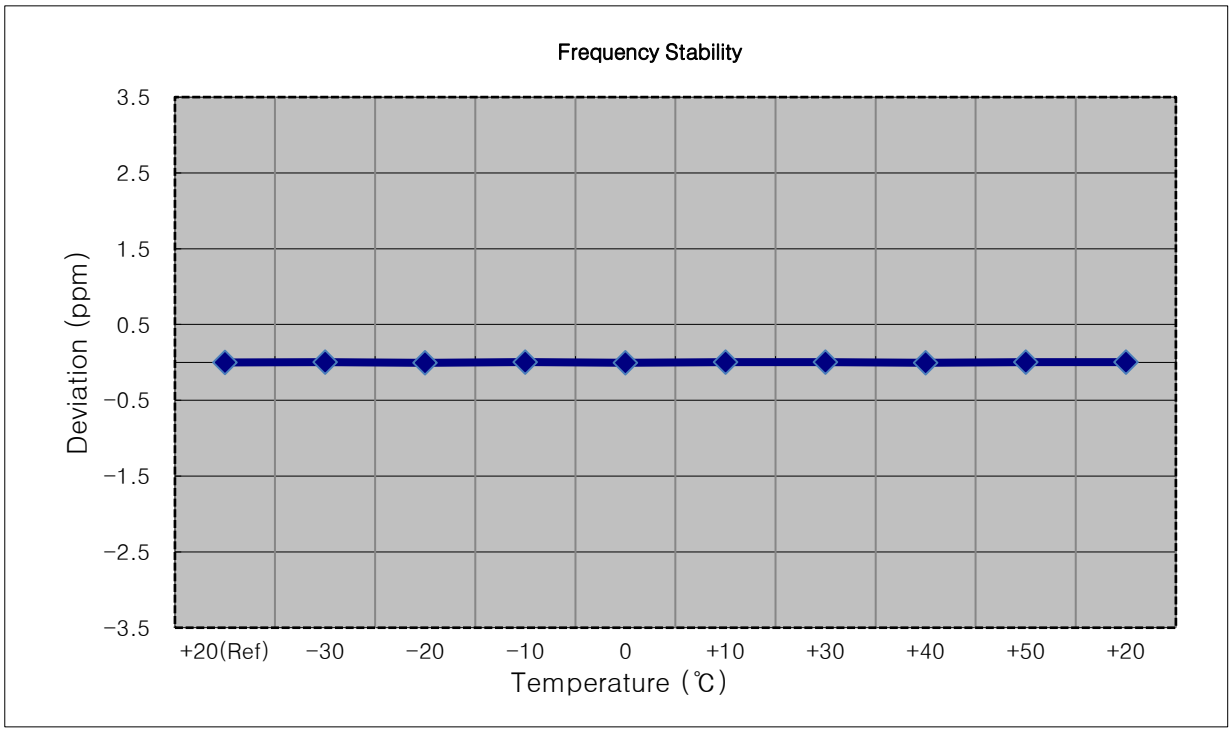
▣ OPERATING FREQUENCY: 793,000,000 Hz

▣ CHANNEL: 23330 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: 2.5ppm

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 792 999 998 | 0.00 | 0.000 000 | 0.0000 |
| 100% | | -30 | 793 000 000 | 2.40 | 0.000 000 | 0.0030 |
| 100% | | -20 | 792 999 993 | -4.20 | -0.000 001 | -0.0053 |
| 100% | | -10 | 793 000 001 | 3.70 | 0.000 000 | 0.0047 |
| 100% | | 0 | 792 999 995 | -2.70 | 0.000 000 | -0.0034 |
| 100% | | +10 | 793 000 000 | 2.60 | 0.000 000 | 0.0033 |
| 100% | | +30 | 793 000 000 | 1.90 | 0.000 000 | 0.0024 |
| 100% | | +40 | 792 999 995 | -2.80 | 0.000 000 | -0.0035 |
| 100% | | +50 | 793 000 001 | 3.60 | 0.000 000 | 0.0045 |
| Batt. Endpoint | 3.400 | +20 | 793 000 000 | 2.50 | 0.000 000 | 0.0032 |



▣ MODE: LTE 14

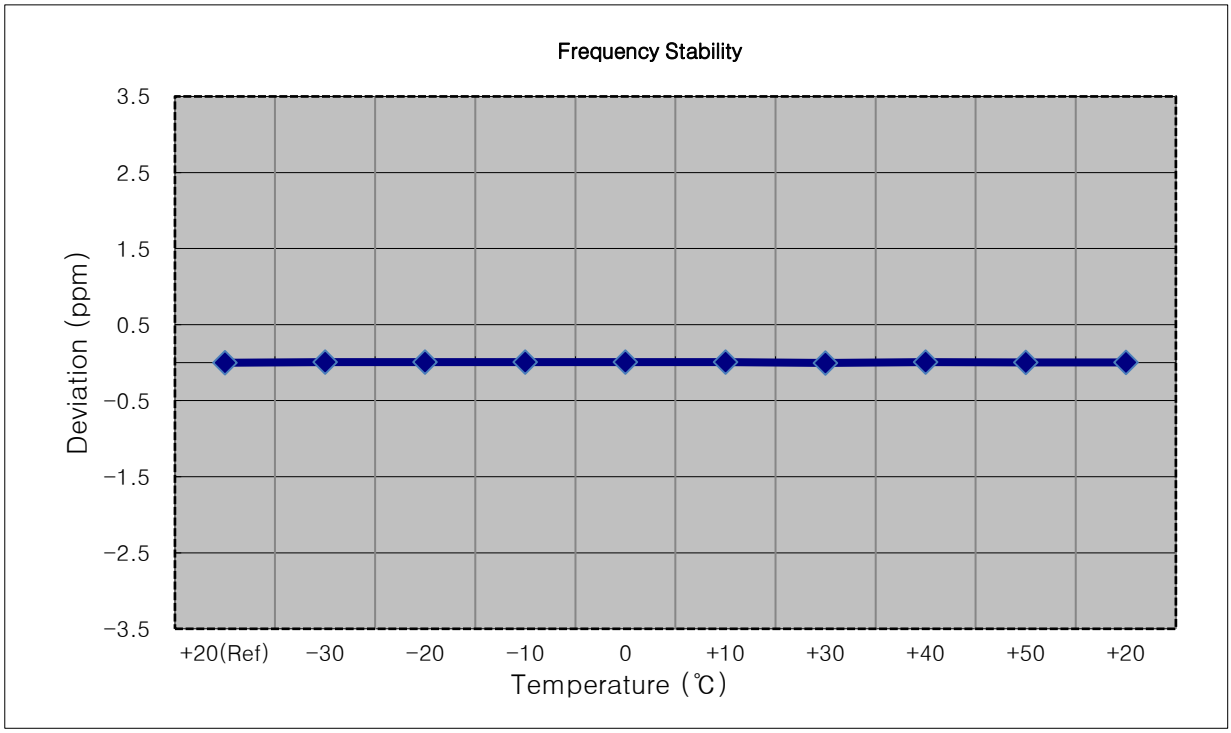
▣ OPERATING FREQUENCY: 795,500,000 Hz

▣ CHANNEL: 23355 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: 2.5ppm

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 795 500 002 | 0.00 | 0.000 000 | 0.0000 |
| 100% | | -30 | 795 500 007 | 4.60 | 0.000 001 | 0.0058 |
| 100% | | -20 | 795 500 007 | 5.40 | 0.000 001 | 0.0068 |
| 100% | | -10 | 795 500 007 | 5.30 | 0.000 001 | 0.0067 |
| 100% | | 0 | 795 500 007 | 5.00 | 0.000 001 | 0.0063 |
| 100% | | +10 | 795 500 007 | 4.80 | 0.000 001 | 0.0060 |
| 100% | | +30 | 795 499 999 | -3.40 | 0.000 000 | -0.0043 |
| 100% | | +40 | 795 500 006 | 4.40 | 0.000 001 | 0.0055 |
| 100% | | +50 | 795 500 006 | 3.60 | 0.000 000 | 0.0045 |
| Batt. Endpoint | 3.400 | +20 | 795 500 004 | 2.40 | 0.000 000 | 0.0030 |



▣ MODE: LTE 14

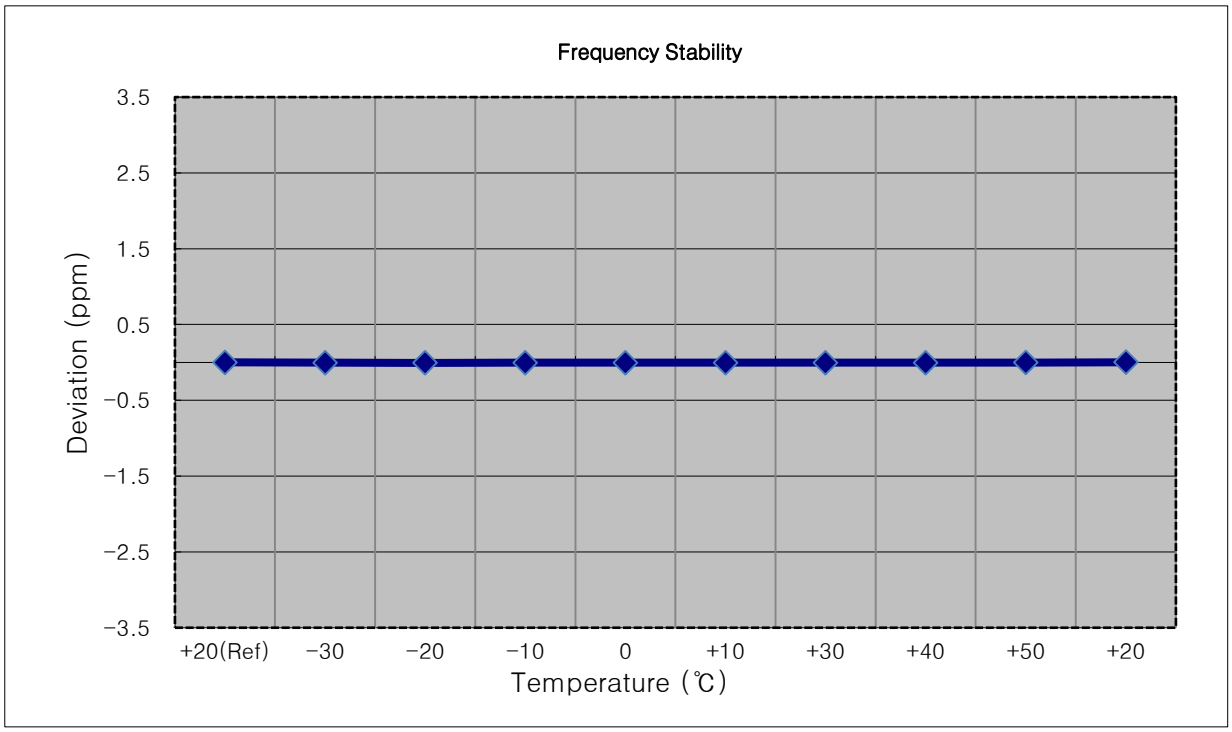
▣ OPERATING FREQUENCY: 793,000,000 Hz

▣ CHANNEL: 23330 (10 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

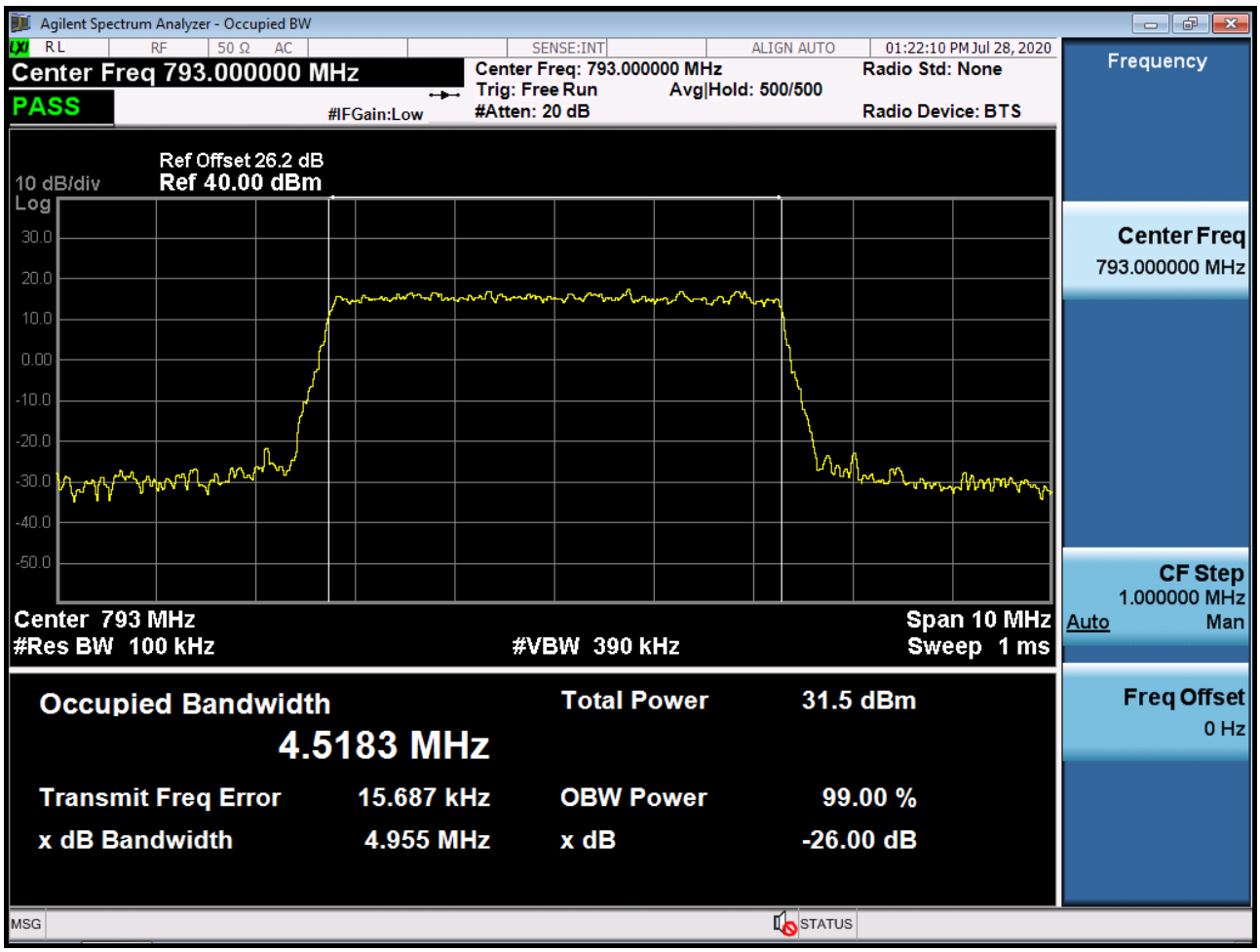
▣ DEVIATION LIMIT: 2.5ppm

| Voltage (%) | Power (VDC) | Temp. (℃) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|---|---|---|---|---|---|---|
| 100% | 3.850 | +20(Ref) | 792 999 997 | 0.00 | 0.000 000 | 0.0000 |
| 100% | | -30 | 792 999 995 | -2.20 | 0.000 000 | -0.0028 |
| 100% | | -20 | 792 999 993 | -3.80 | 0.000 000 | -0.0048 |
| 100% | | -10 | 792 999 995 | -2.70 | 0.000 000 | -0.0034 |
| 100% | | 0 | 792 999 994 | -3.50 | 0.000 000 | -0.0044 |
| 100% | | +10 | 792 999 995 | -2.50 | 0.000 000 | -0.0032 |
| 100% | | +30 | 792 999 994 | -2.80 | 0.000 000 | -0.0035 |
| 100% | | +40 | 792 999 994 | -2.80 | 0.000 000 | -0.0035 |
| 100% | | +50 | 792 999 995 | -2.00 | 0.000 000 | -0.0025 |
| Batt. Endpoint | 3.400 | +20 | 793 000 000 | 2.60 | 0.000 000 | 0.0033 |

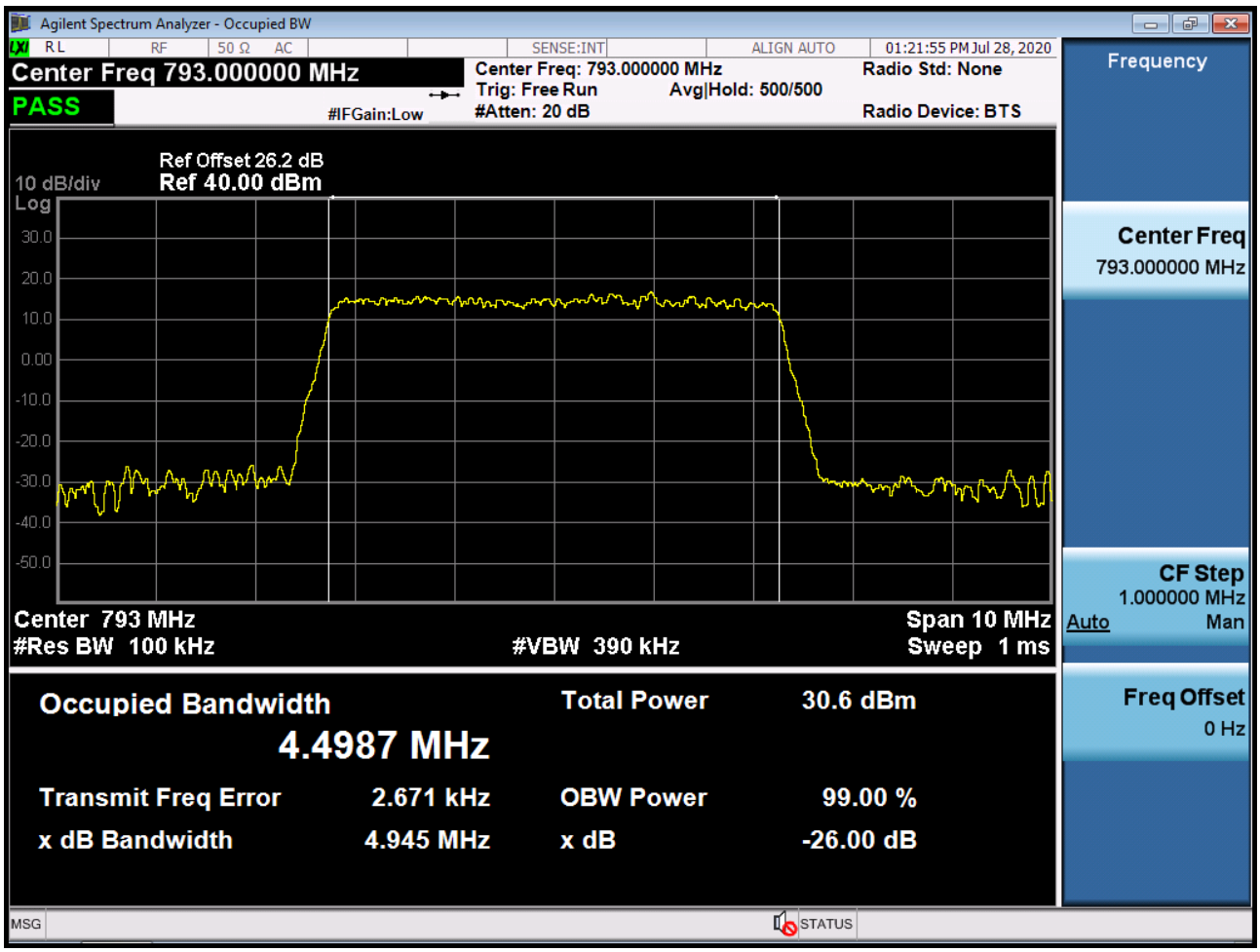


## 9. TEST PLOTS

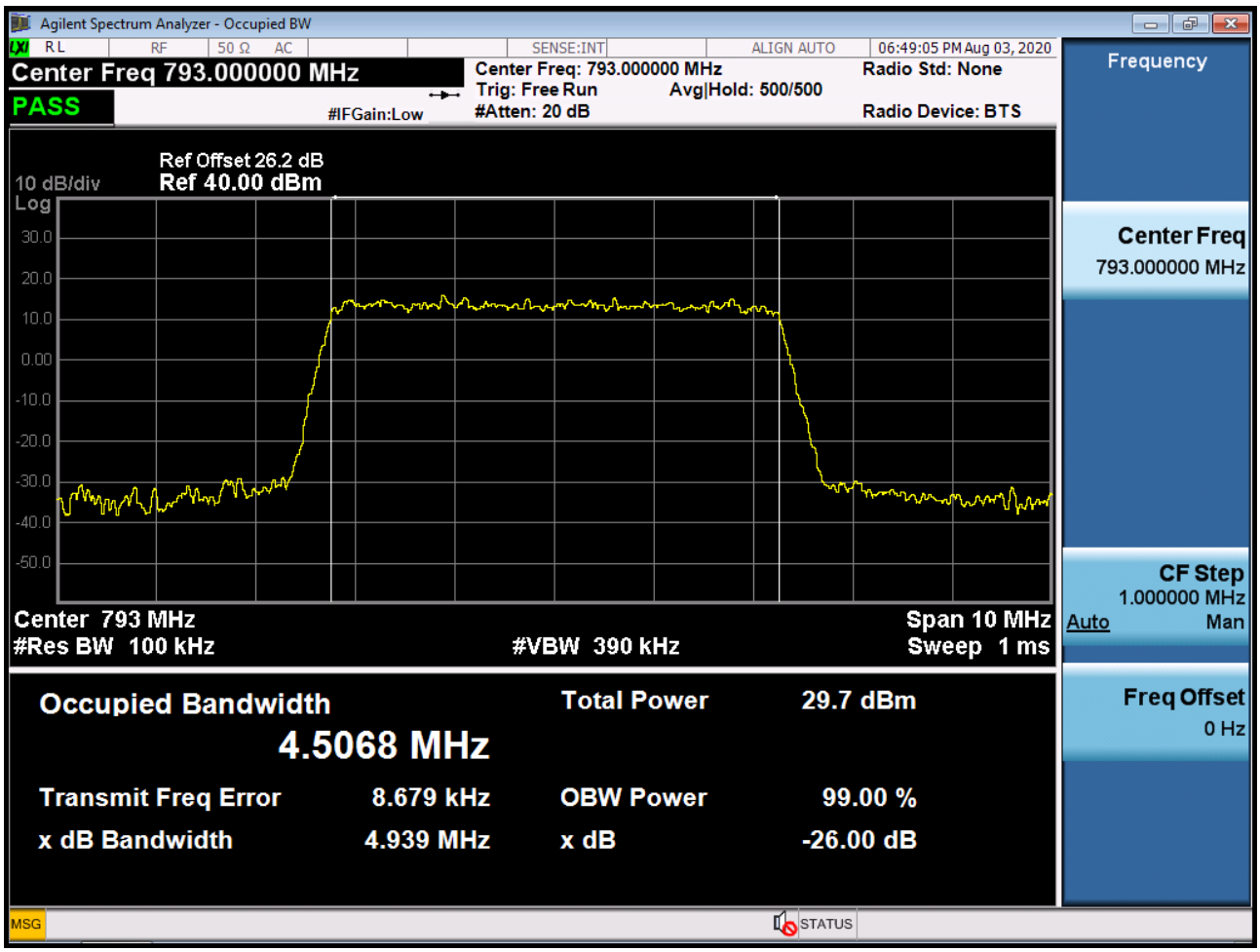
BAND 14. Occupied Bandwidth Plot (Ch.23330 QPSK RB 25) 5 MHz



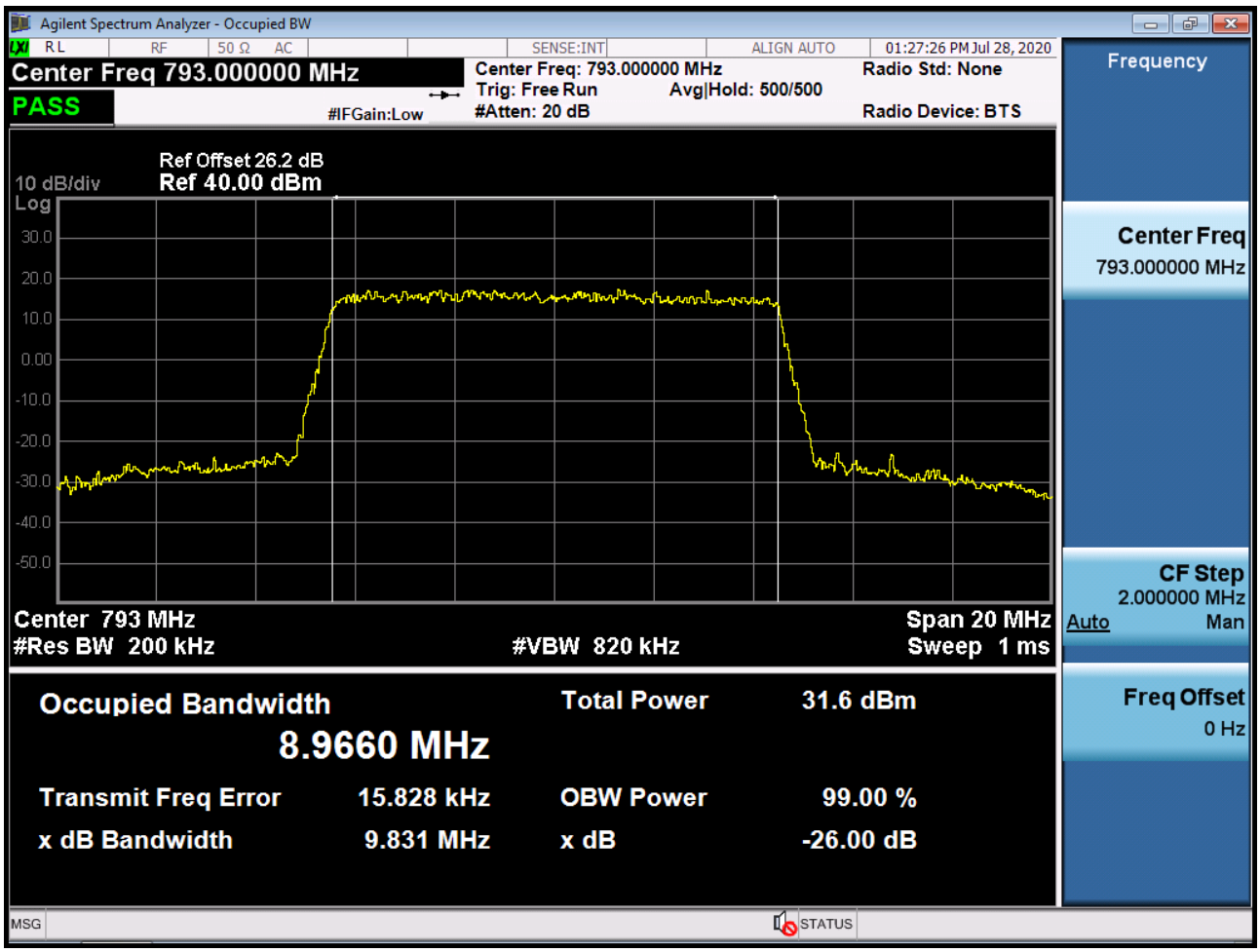
BAND 14. Occupied Bandwidth Plot (Ch.23330 16-QAM RB 25) 5 MHz



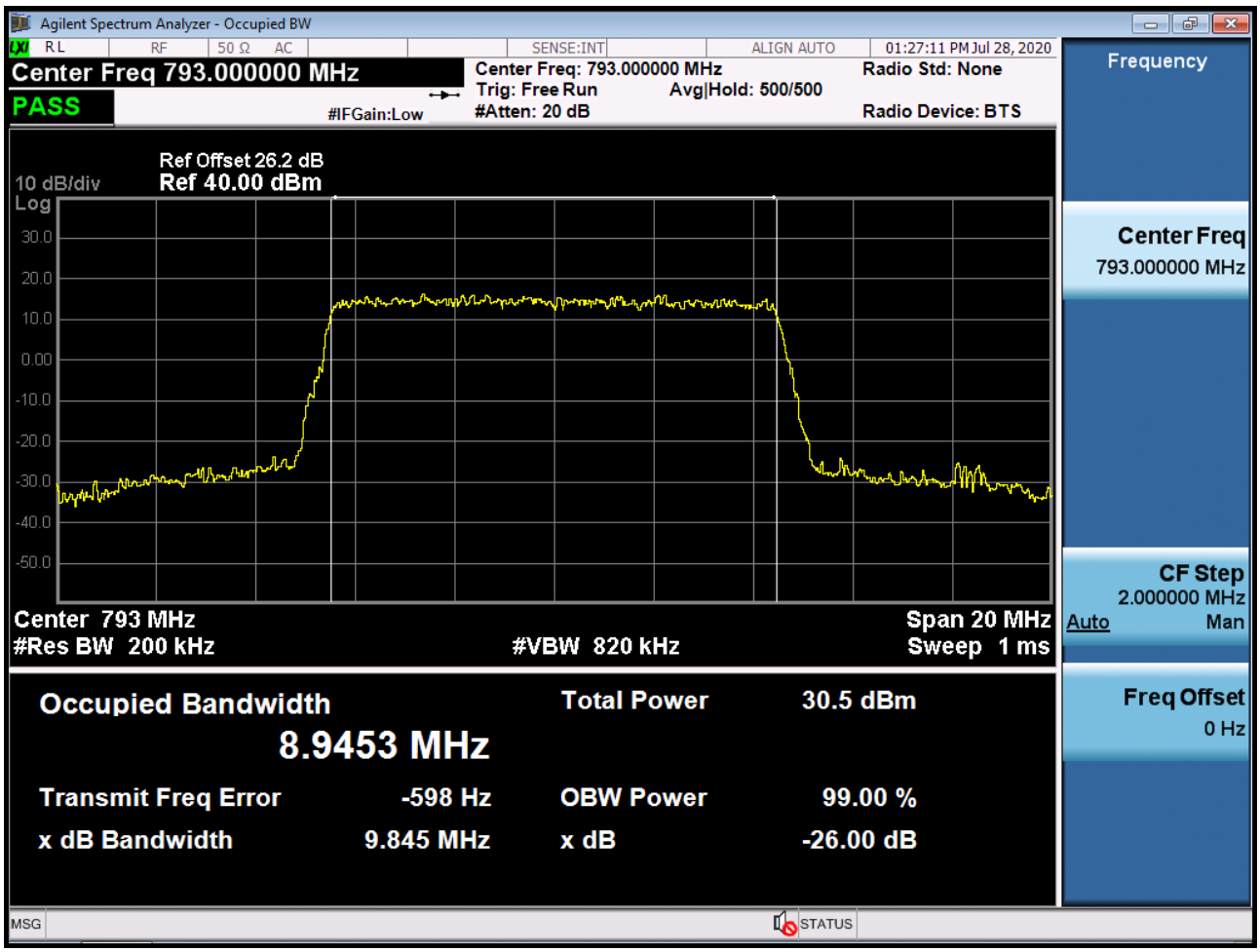
BAND 14. Occupied Bandwidth Plot (Ch.23330 64-QAM RB 25) 5 MHz



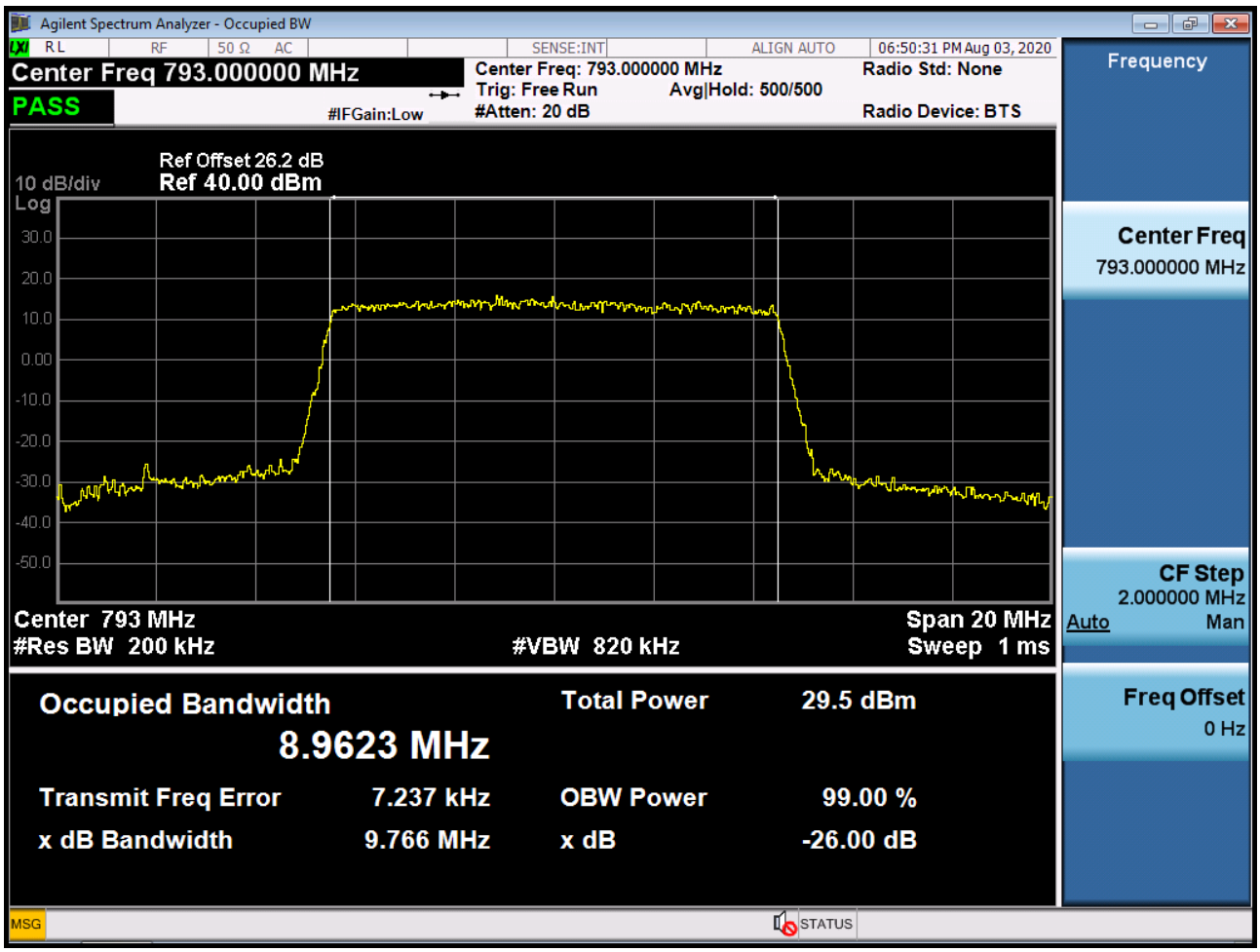
BAND 14. Occupied Bandwidth Plot (Ch.23330 QPSK RB 50) 10 MHz



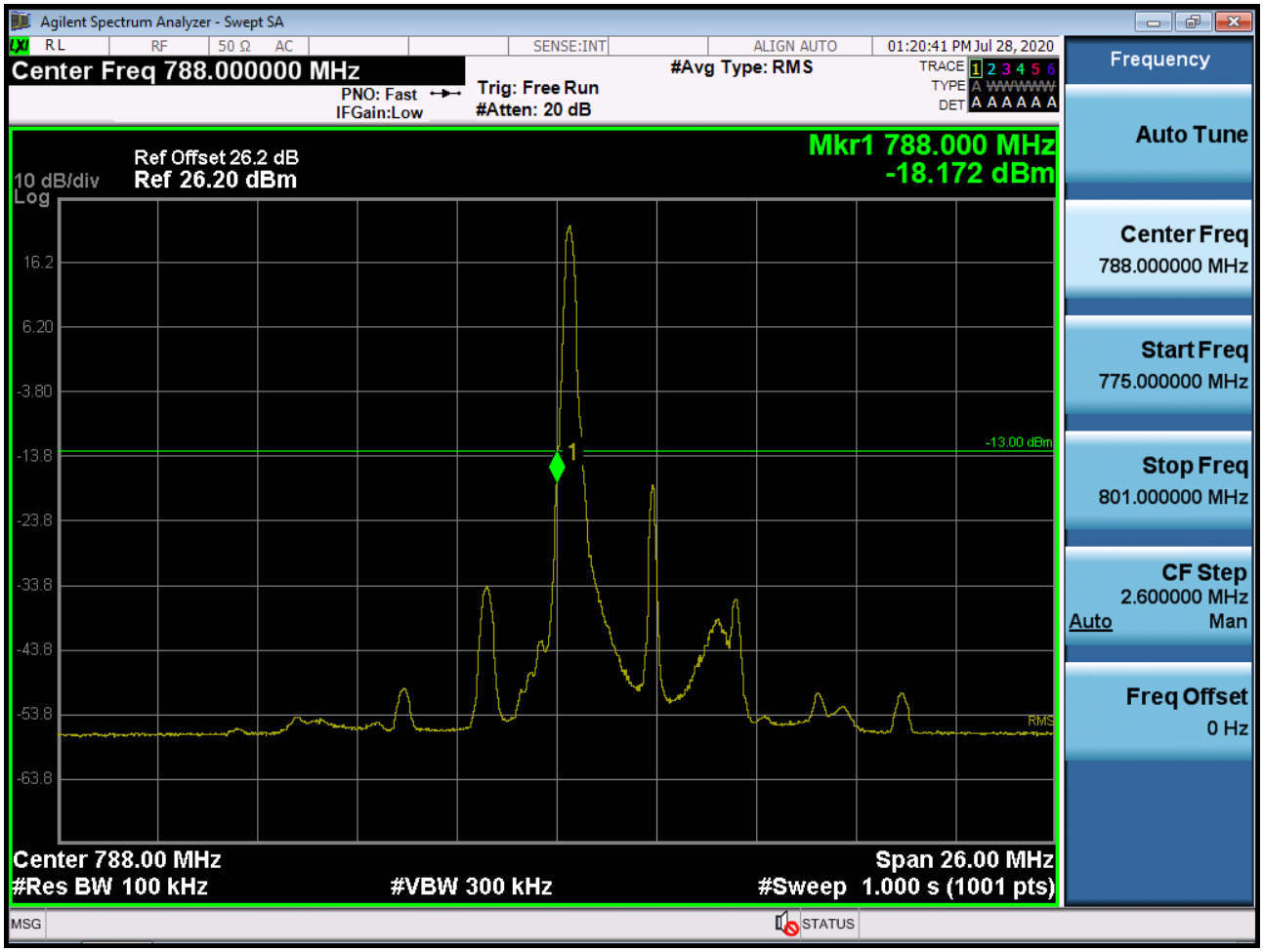
BAND 14. Occupied Bandwidth Plot (Ch.23330 16-QAM RB 50) 10 MHz



BAND 14. Occupied Bandwidth Plot (Ch.23330 64-QAM RB 50) 10 MHz



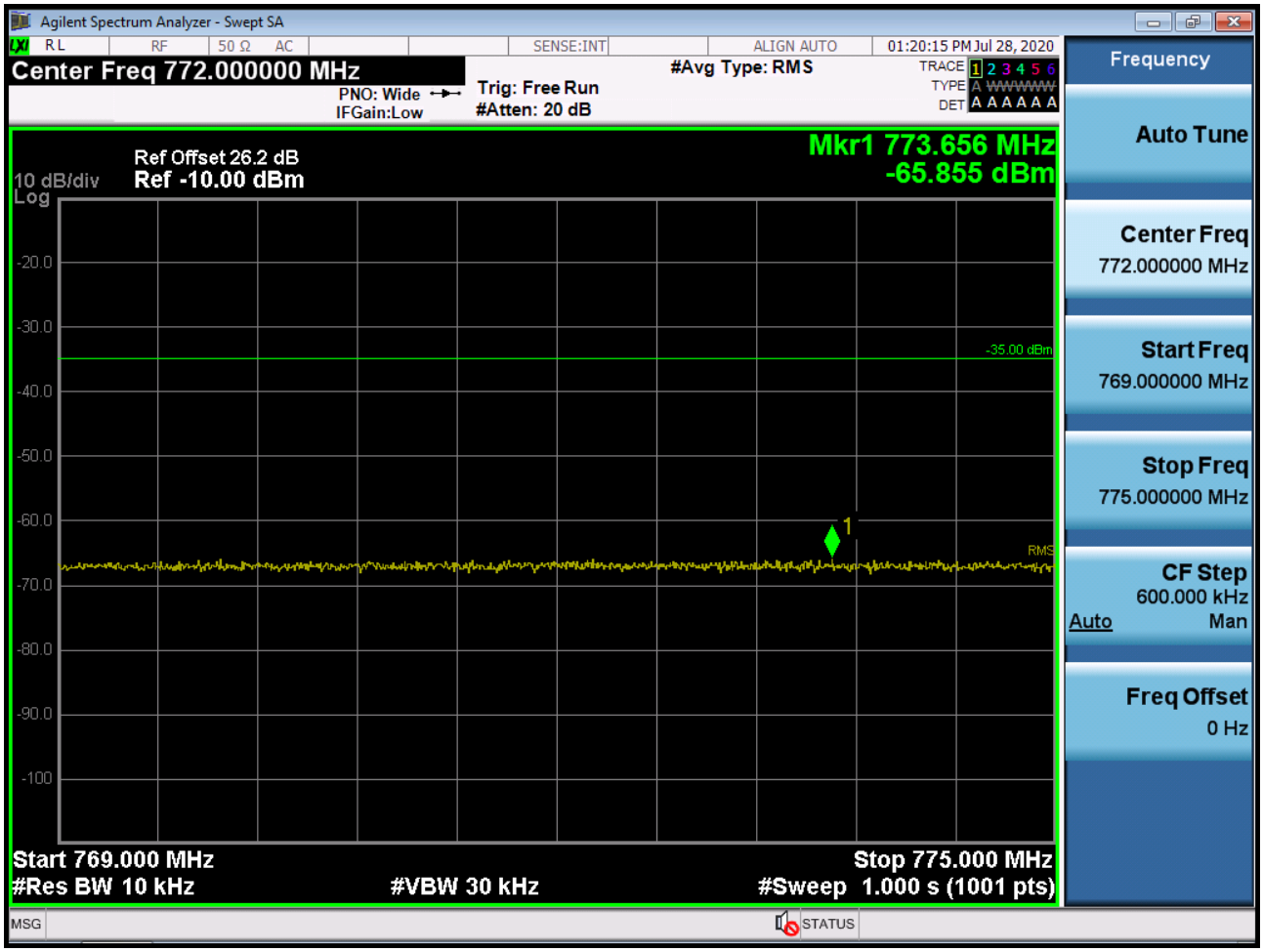
BAND 14 Lower Band Edge Plot (5M BW Ch.23305 QPSK_RB1 OFFSET_0)



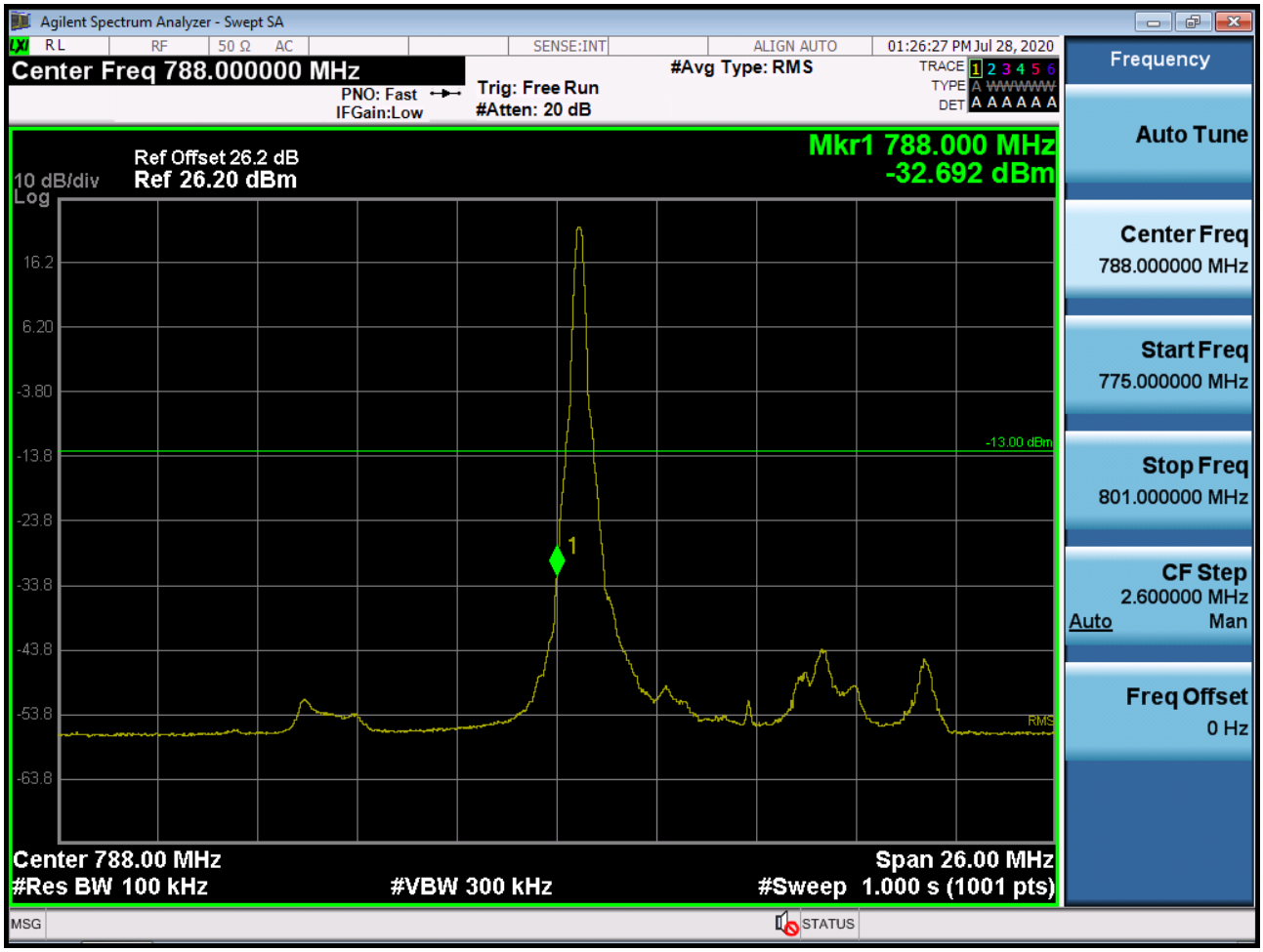
BAND 14 Lower Band Edge Plot (5M BW Ch.23305 QPSK_RB_25)

BAND 14 Lower Emission Mask (769 MHz ~ 775 MHz) Plot (5M BW Ch.23305 QPSK_RB1_0)-1

BAND 14 Lower Emission Mask (769 MHz ~ 775 MHz) Plot (5M BW Ch.23305 QPSK_RB25_0)-2

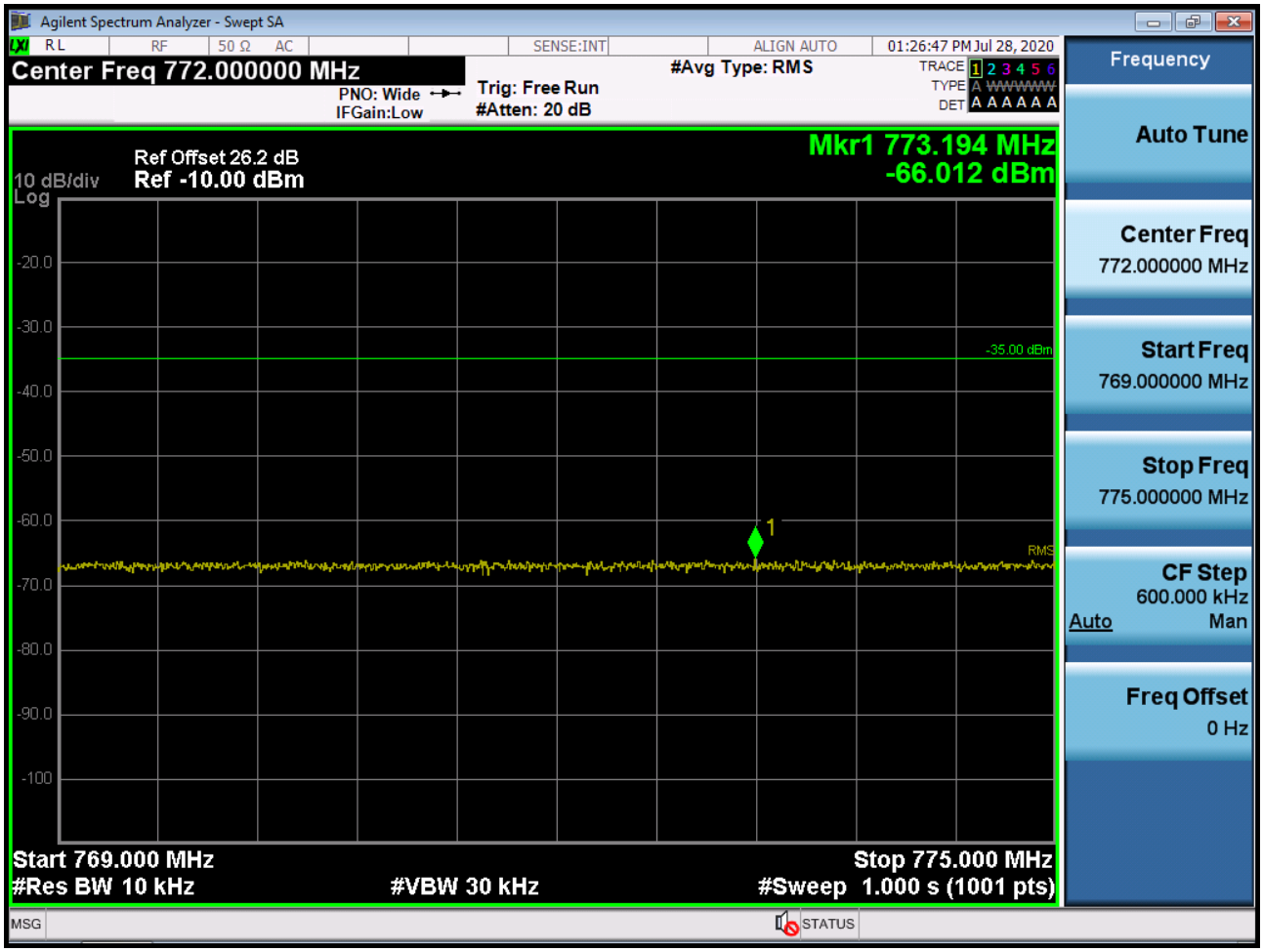


BAND 14 Lower Band Edge Plot (10M BW Ch.23330 QPSK_RB1 OFFSET_0)

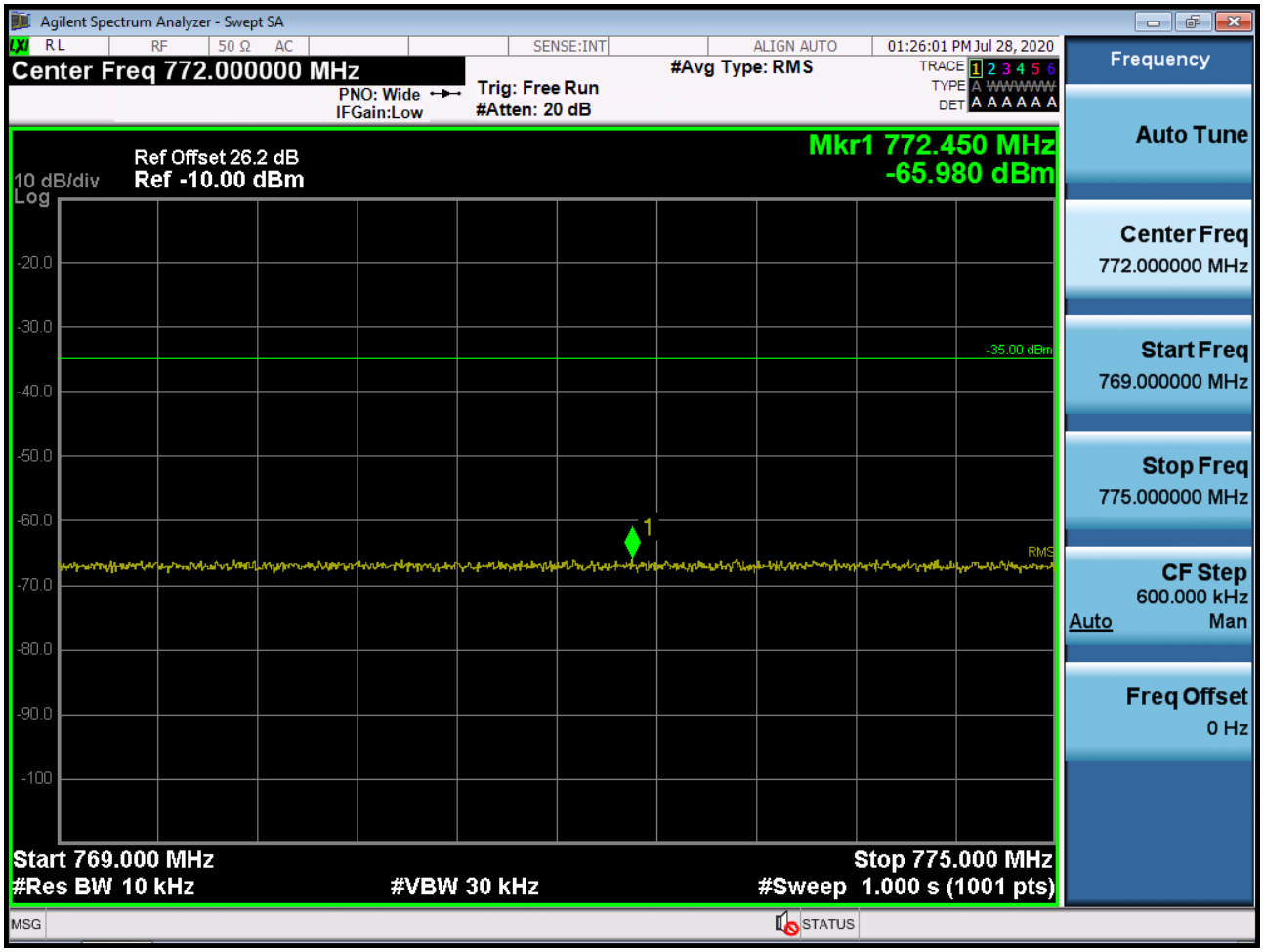


BAND 14. Lower & Upper Band Edge Plot (10M BW Ch.23330 QPSK RB_50)

BAND 14 Lower Emission Mask (769 MHz ~ 775 MHz) Plot (10M BW Ch.23330 QPSK_RB51_0)-1



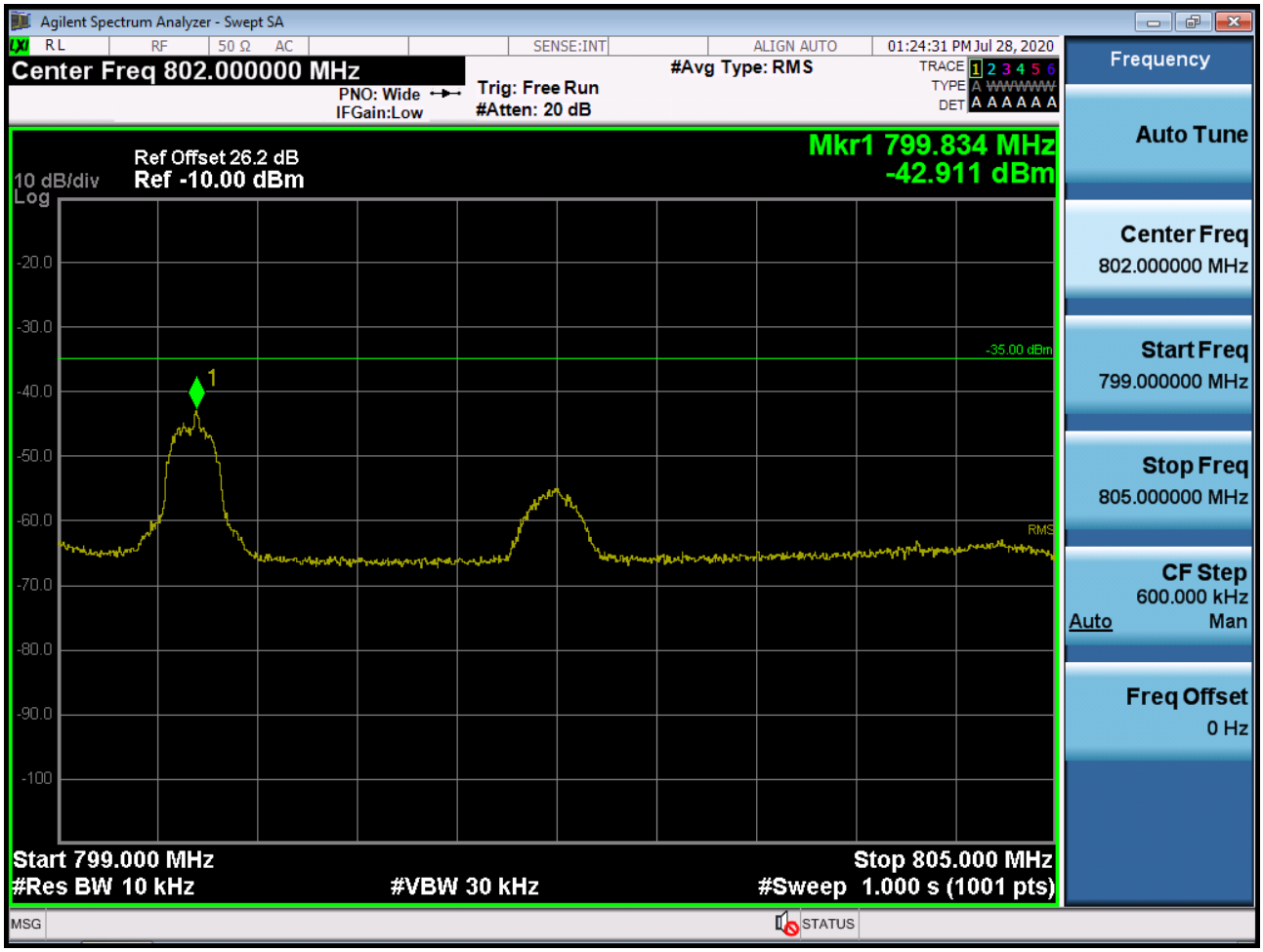
BAND 14 Lower Emission Mask (769 MHz ~ 775 MHz) Plot (10M BW Ch.23330 QPSK_RB50_0)-2



BAND 14 Upper Band Edge Plot (5M BW Ch.23355 QPSK_RB1_Offset 24)

BAND 14 Upper Band Edge Plot (5M BW Ch.23355 QPSK_RB_25)

BAND 14 Upper Emission Mask (799 MHz ~805 MHz) Plot (5M BW Ch.23355 QPSK_RB1_24)



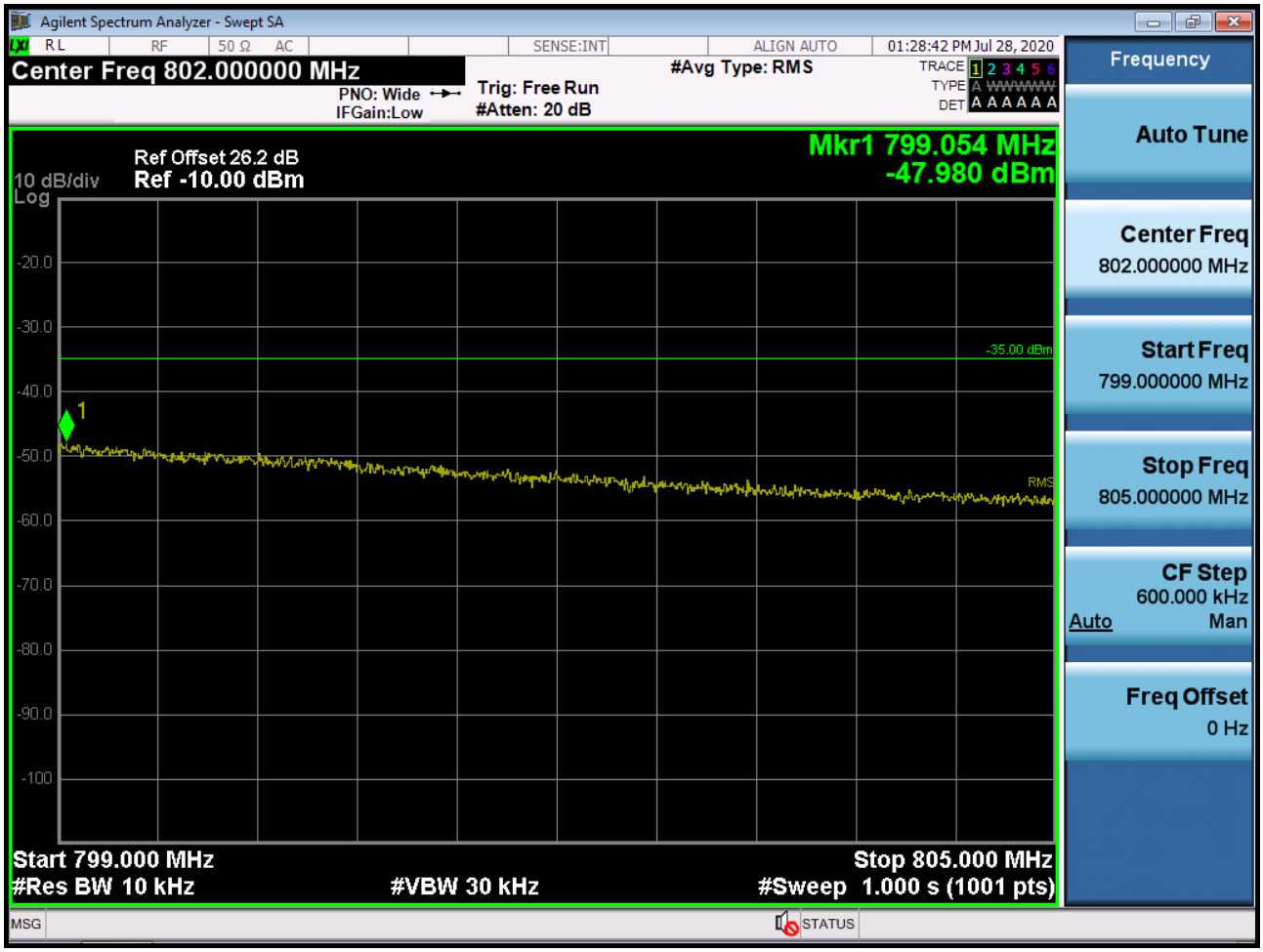
BAND 14 Upper Emission Mask (799 MHz ~805 MHz) Plot (5M BW Ch.23355 QPSK_RB25_0)-2

BAND 14 Upper Band Edge Plot (10M BW Ch.23330 QPSK_RB1_Offset_49)

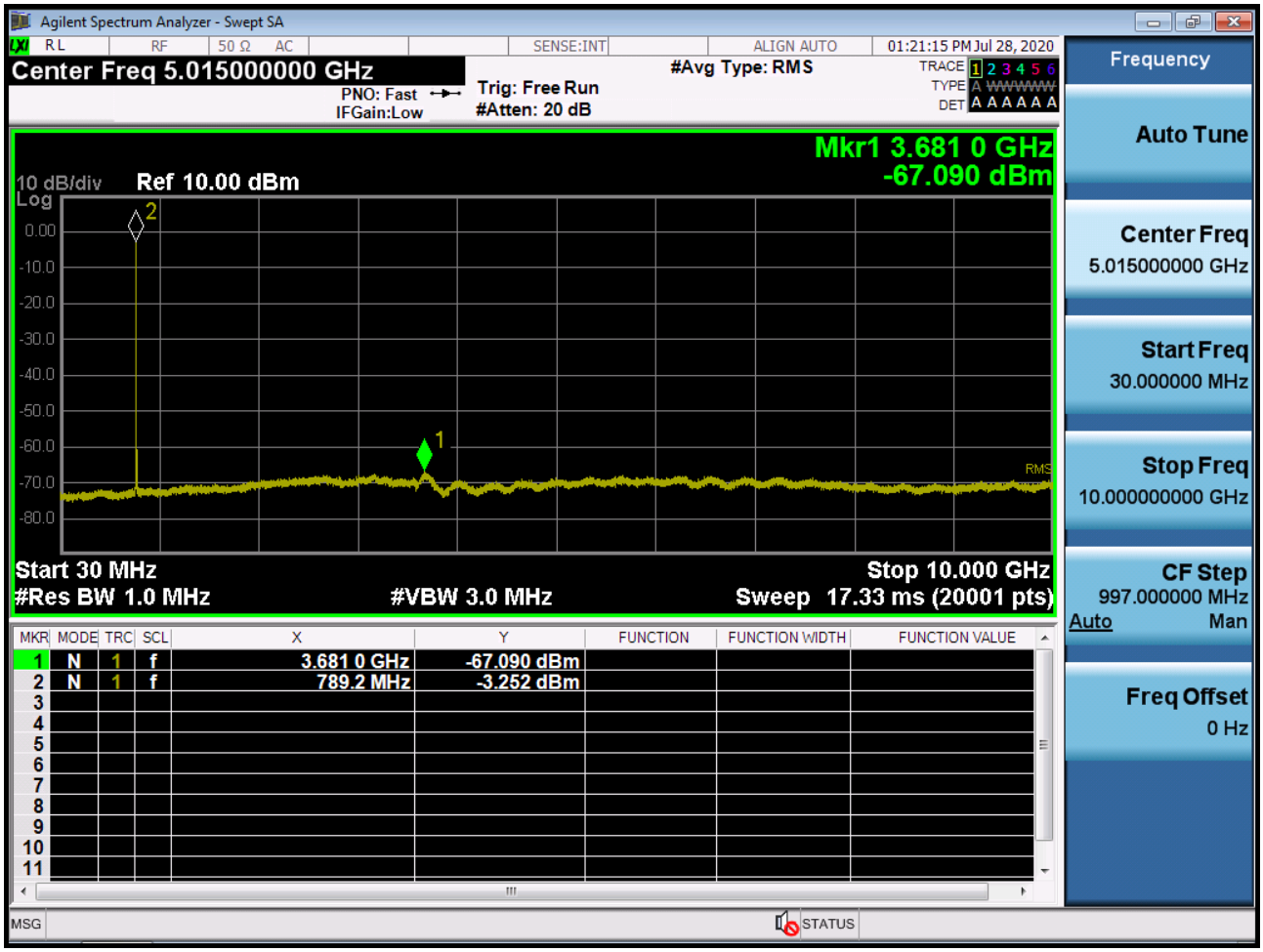
BAND 14 Upper Band Edge Plot (10M BW Ch.23330 QPSK_ QPSK_RB_50)

BAND 14 Upper Emission Mask (793 MHz ~805 MHz) Plot (10M BW Ch.23330 QPSK_RB1_49)-1

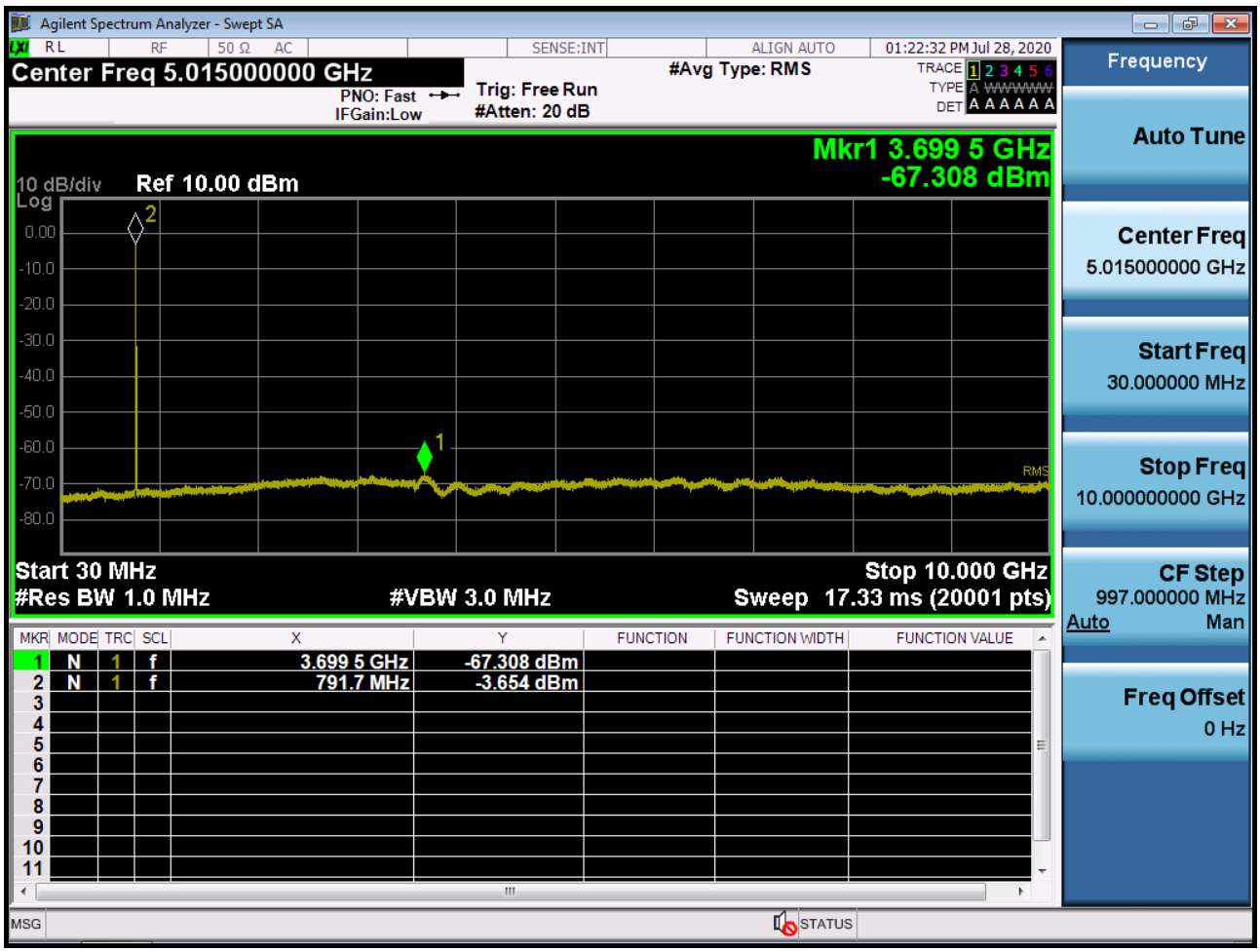
BAND 14 Upper Emission Mask (793 MHz ~805 MHz) Plot (10M BW Ch.23330 QPSK_RB50_0)-2



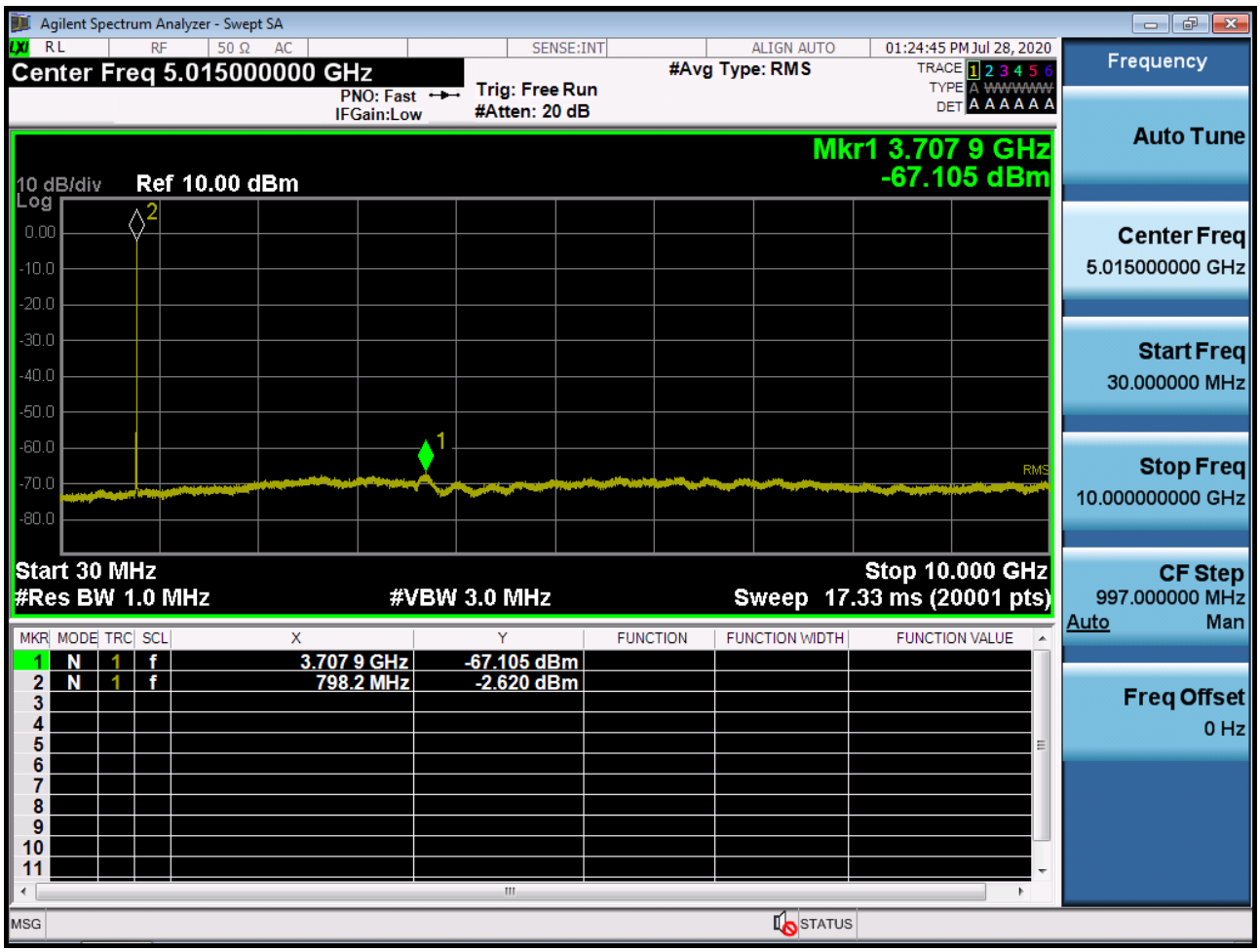
BAND 14. Conducted Spurious Plot (23305ch_5MHz_QPSK_RB 1_0)



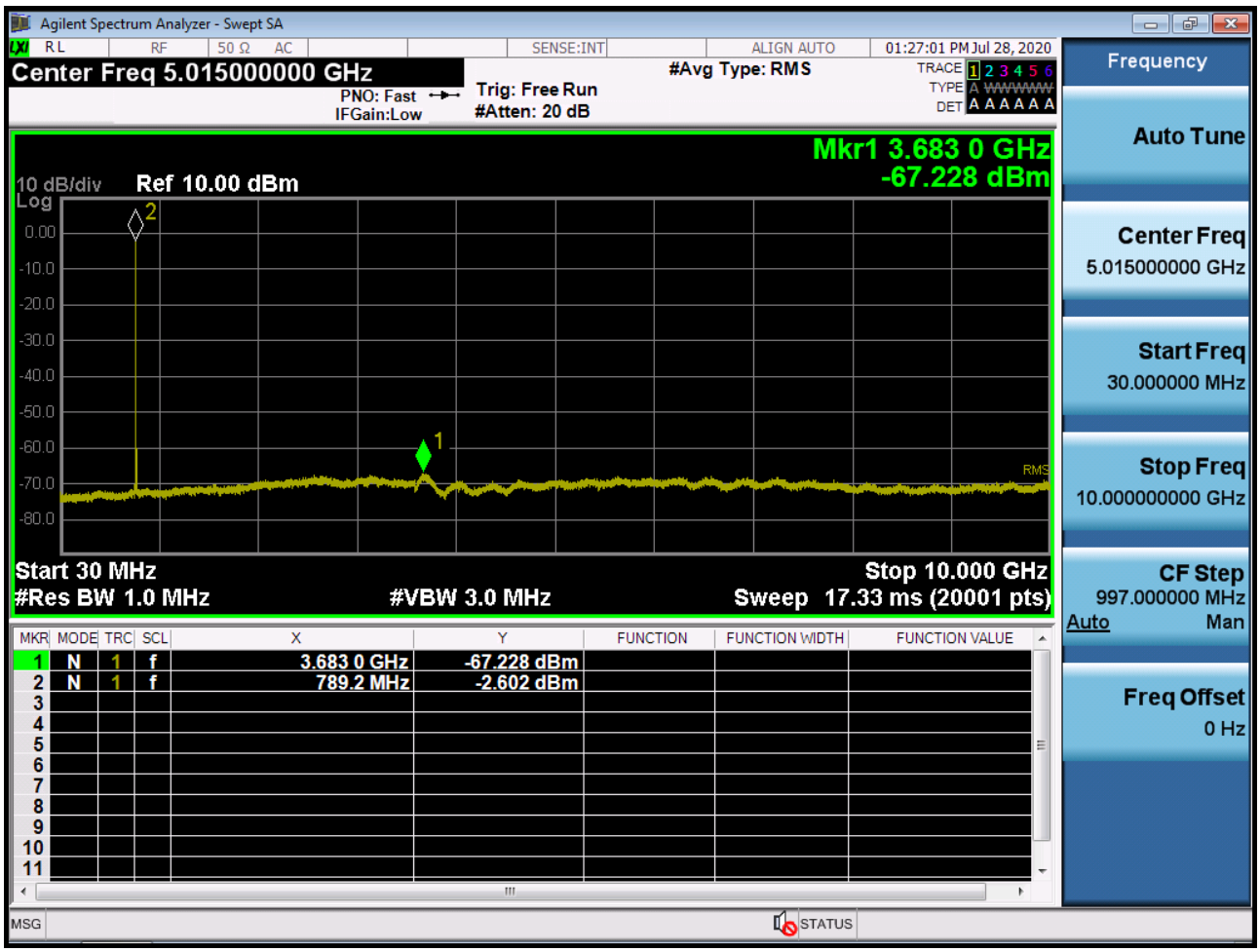
BAND 14. Conducted Spurious Plot (23330ch_5MHz_QPSK_RB 1_0)



BAND 14. Conducted Spurious Plot (23355ch_5MHz_QPSK_ RB 1_0)



BAND 14. Conducted Spurious Plot (Ch.23330 10 MHz QPSK RB 1, Offset 0)



## 10. APPENDIX A_ TEST SETUP PHOTO

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

| No. | Description |
|---|---|
| 1 | HCT-RF-2008-FC074-P |