

## FCC 2G3G REPORT

Certification

**Application Name:**  
SAMSUNG Electronics Co., Ltd.

**Date of Issue:**  
21 April 2020

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

**Test Site/Location:**  
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon,  
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA  
**Report No.:** HCT-RF-2004-FC035

**FCC ID:** A3LSMA516B

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

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

SM-A516B/DS  
Mobile Phone  
PCS Licensed Transmitter Held to Ear (PCE)  
§22, §24, §2

| Mode        | Tx Frequency (MHz) | Rx Frequency (MHz) | Emission Designator | ERP            |                  |
|-------------|--------------------|--------------------|---------------------|----------------|------------------|
|             |                    |                    |                     | Max. Power (W) | Max. Power (dBm) |
| GSM850      | 824.2 - 848.8      | 869.2 - 893.8      | 244 KGXW            | 0.724          | 28.59            |
| GSM850 EDGE | 824.2 - 848.8      | 869.2 - 893.8      | 247 KG7W            | 0.168          | 22.25            |
| WCDMA850    | 826.4 - 846.6      | 871.4 - 891.6      | 4M18F9W             | 0.090          | 19.56            |

| Mode         | Tx Frequency (MHz) | Rx Frequency (MHz) | Emission Designator | EIRP           |                  |
|--------------|--------------------|--------------------|---------------------|----------------|------------------|
|              |                    |                    |                     | Max. Power (W) | Max. Power (dBm) |
| GSM1900      | 1850.2 - 1909.8    | 1930.2 - 1989.8    | 244 KGXW            | 0.451          | 26.55            |
| GSM1900 EDGE | 1850.2 - 1909.8    | 1930.2 - 1989.8    | 247 KG7W            | 0.153          | 21.85            |
| WCDMA1900    | 1852.4 - 1907.6    | 1932.4 - 1987.6    | 4M20F9W             | 0.091          | 19.61            |

**FCC Licensed Remark :**

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




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**Engineer of Telecommunication Testing Center**

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

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## Version

| TEST REPORT NO.   | DATE           | DESCRIPTION             |
|-------------------|----------------|-------------------------|
| HCT-RF-2004-FC035 | April 21, 2020 | - First Approval Report |

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

This laboratory is not accredited for the test results marked \*.

The above Test Report is the accredited test result by KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA.(HCT Accreditation No.: KT197)

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# MEASUREMENT REPORT

## 1. GENERAL INFORMATION

|                            |                                                                                                                                          |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant Name:</b>     | SAMSUNG Electronics Co., Ltd.                                                                                                            |
| <b>Address:</b>            | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea                                                               |
| <b>FCC ID:</b>             | A3LSMA516B                                                                                                                               |
| <b>Application Type:</b>   | Certification                                                                                                                            |
| <b>FCC Classification:</b> | PCS Licensed Transmitter Held to Ear (PCE)                                                                                               |
| <b>FCC Rule Part(s):</b>   | §22, §24, §2                                                                                                                             |
| <b>EUT Type:</b>           | Mobile Phone                                                                                                                             |
| <b>Model(s):</b>           | SM-A516B/DS                                                                                                                              |
| <b>Tx Frequency:</b>       | 824.20 - 848.80 MHz (GSM850)<br>826.40 - 846.60 MHz (WCDMA850)<br>1 850.20 - 1 909.80 MHz (GSM1900)<br>1 852.4 - 1 907.6 MHz (WCDMA1900) |
| <b>Rx Frequency:</b>       | 869.20 - 893.80 MHz (GSM850)<br>871.40 - 891.60 MHz (WCDMA850)<br>1 930.20 - 1 989.80 MHz (GSM1900)<br>1 932.4 - 1 987.6 MHz (WCDMA1900) |
| <b>Date(s) of Tests:</b>   | March 20, 2020 ~ April 10, 2020                                                                                                          |

## **2. INTRODUCTION**

### **2.1. DESCRIPTION OF EUT**

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

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

### **2.2. MEASURING INSTRUMENT CALIBRATION**

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### **2.3. TEST FACILITY**

The Fully-anechoic chamber and conducted measurement facility used to collect the radiated data are located at the **74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.**

### 3. DESCRIPTION OF TESTS

#### 3.1 TEST PROCEDURE

| Test Description                                                | Test Procedure Used                                                                                                           |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Occupied Bandwidth                                              | - KDB 971168 D01 v03r01 – Section 4.3<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)                                                                                                        |
| Peak- to- Average Ratio                                         | - KDB 971168 D01 v03r01 – Section 5.7<br>- ANSI C63.26-2015 – Section 5.2.3.4<br>- ANSI C63.26-2015 – Section 5.2.6(only GSM) |
| 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  $\geq 3 \times$  RBW
4. Span = 1.5 times the OBW
5. No. of sweep points  $> 2 \times$  span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

#### Test Note

1. The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission.
2. A half wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is calculated by the following formula;

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

Where:  $P_d$  is the dipole equivalent power and  $P_g$  is the generator output power into the substitution antenna.

3. The maximum value is calculated by adding the forward power to the calibrated source plus its appropriate gain value.  
These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration
4. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
5. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

### 3.3 RADIATED SPURIOUS EMISSIONS

#### Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA-603-E-2016.

#### Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW  $\geq 3 \times$  RBW
3. Span = 1.5 times the OBW
4. No. of sweep points  $> 2 \times$  span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10<sup>th</sup> 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 dat
3. For spurious emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated. The spurious emissions is calculated by the following formula;

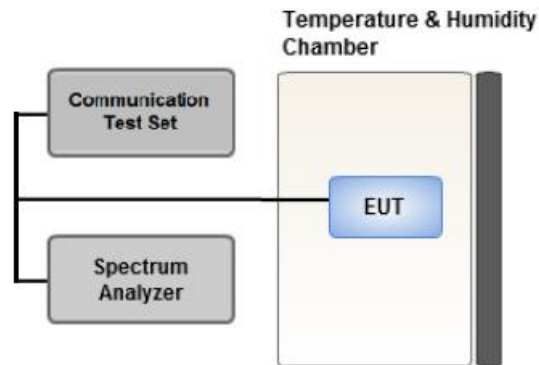
$$\text{Result}_{(\text{dBm})} = P_{g(\text{dBm})} - \text{cable loss}_{(\text{dB})} + \text{antenna gain}_{(\text{dBi})}$$

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

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

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

### 3.4 PEAK- TO- AVERAGE RATIO



**Test setup**

#### ① CCDF Procedure for PAPR

##### **Test Settings**

1. Set resolution/measurement bandwidth  $\geq$  signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Set the measurement interval as follows:
  - .- for continuous transmissions, set to 1 ms,
  - .- or burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1%.

② Alternate Procedure for PAPR

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as  $P_{Pk}$ .

Use one of the applicable procedures presented 5.2(ANSI C63.26-2015) to measure the total average power and record as  $P_{Avg}$ . Determine the P.A.R. from:

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

**Test Settings(Peak Power)**

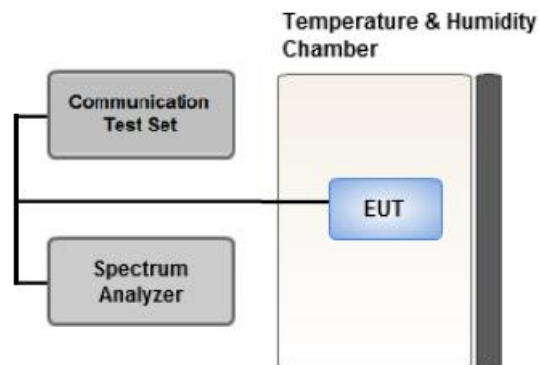
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW  $\geq 3 \times$  RBW.

1. Set the RBW  $\geq$  OBW.
2. Set VBW  $\geq 3 \times$  RBW.
3. Set span  $\geq 2 \times$  OBW.
4. Sweep time  $\geq 10 \times$  (number of points in sweep)  $\times$  (transmission symbol period).
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the peak amplitude level.

**Test Settings(Average Power)**

1. Set span to  $2 \times$  to  $3 \times$  the OBW.
2. Set RBW  $\geq$  OBW.
3. Set VBW  $\geq 3 \times$  RBW.
4. Set number of measurement points in sweep  $\geq 2 \times$  span / RBW.
5. Sweep time:  
Set  $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$  for single sweep (automation-compatible) measurement. The transmission period is the (on + off) time.
6. Detector = power averaging (rms).
7. Set sweep trigger to "free run."
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. (To accurately determine the average power over the on and off period of the transmitter, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.)
9. Use the peak marker function to determine the maximum amplitude level.
10. Add  $[10 \times \log (1/\text{duty cycle})]$  to the measured maximum power level to compute the average power during continuous transmission. For example, add  $[10 \times \log (1/0.25)] = 6$  dB if the duty cycle is a constant 25%.

### 3.5 OCCUPIED BANDWIDTH.



**Test setup**

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

The EUT makes a call to the communication simulator.

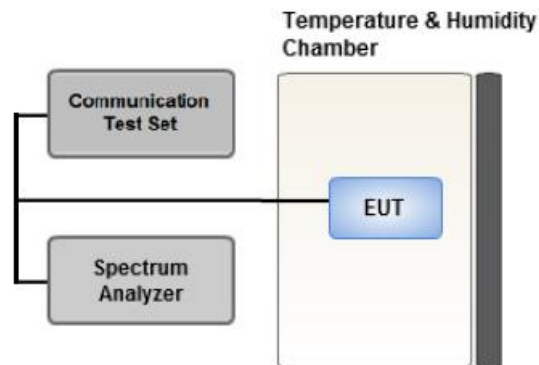
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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

#### **Test Settings**

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

### 3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

#### Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

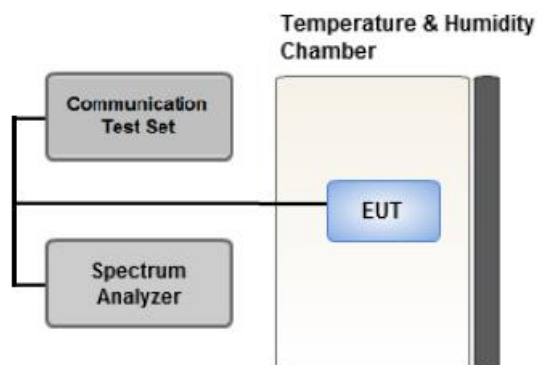
#### Test Settings(GSM)

1. RBW = 1 MHz
2. VBW  $\geq$  3 MHz
3. Detector = Peak
4. Trace Mode = max hold
5. Sweep time = auto
6. Number of points in sweep  $\geq 2 \times \text{Span} / \text{RBW}$

#### Test Settings(WCDMA)

1. RBW = 1 MHz
2. VBW  $\geq$  3 MHz
3. Detector = RMS
4. Trace Mode = trace average
5. Sweep time = auto
6. Number of points in sweep  $\geq 2 \times \text{Span} / \text{RBW}$

### 3.7 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  $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

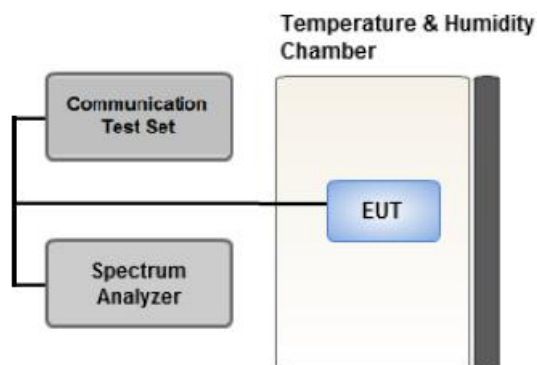
#### Test Notes

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  $43 + 10 \times \log(P)$  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.

### 3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE



**Test setup**

#### **Test Overview**

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015.

The frequency stability of the transmitter is measured by:

1. Temperature:

The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

2. Primary Supply Voltage:

.- Unless otherwise specified, vary primary supply voltage from 85% to 115% of the nominal value for other than hand carried battery equipment.

.- For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

#### **Test Settings**

1. The carrier frequency of the transmitter is measured at room temperature

(20°C to provide a reference).

2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.

3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

### 3.9 WORST CASE(CONDUCTED TEST)

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

[ Worst case ]

| Test Description                                    | Modulation                                | Test Channel   |
|-----------------------------------------------------|-------------------------------------------|----------------|
| Occupied Bandwidth                                  | 2G : Voice & EDGE(1 TX Slot)<br>3G : QPSK | Low, Mid, High |
|                                                     | 2G : EDGE(1 TX Slot)                      | Low, Mid, High |
| Band Edge                                           | 2G : Voice & EDGE(1 TX Slot)<br>3G : QPSK | Low, High      |
| Spurious and Harmonic Emissions at Antenna Terminal | 2G : Voice<br>3G : QPSK                   | Low, Mid, High |

[ Test Channel ]

|      | UplinkChannel  |                 |                  |                  |
|------|----------------|-----------------|------------------|------------------|
|      | 2G<br>(GSM850) | 2G<br>(GSM1900) | 3G<br>(WCDMA B2) | 3G<br>(WCDMA B5) |
| Low  | 128            | 512             | 9262             | 4132             |
| Mid  | 190            | 661             | 9400             | 4183             |
| High | 251            | 810             | 9538             | 4233             |

### 3.10 WORST CASE(RADIATED TEST)

- The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
- All modes of operation were investigated and the worst case configuration results are reported.
- The worst case is reported with the EUT positioning, modulations, and paging service configurations shown in the test data.
- Please refer to the table below.

[ Worst case\_3G ]

| Test Description                                                | Modulation      | Paging Service   | Axis                         | Test Channel   |
|-----------------------------------------------------------------|-----------------|------------------|------------------------------|----------------|
| Effective Radiated Power,<br>Effective Isotropic Radiated Power | QPSK<br>(WCDMA) | 12.2 kbps<br>RMC | WCDMA B2 : X<br>WCDMA B5 : X | Low, Mid, High |
| Radiated Spurious and Harmonic Emissions                        | QPSK<br>(WCDMA) | 12.2 kbps<br>RMC | WCDMA B2 : X<br>WCDMA B5 : Z | Low, Mid, High |

[ Worst case\_2G ]

| Test Description                                                | Mod             | Axis                      | Test Channel                   |
|-----------------------------------------------------------------|-----------------|---------------------------|--------------------------------|
| Effective Radiated Power,<br>Effective Isotropic Radiated Power | Voice           | GSM850 : Y<br>GSM1900 : Z | Low, Mid, High                 |
|                                                                 | EDGE(1 TX Slot) | GSM850 : Y<br>GSM1900 : Z | GSM 850 : Mid<br>GSM1900 : Mid |
| Radiated Spurious and Harmonic Emissions                        | Voice           | GSM850 : X<br>GSM1900 : X | Low, Mid, High                 |

[ Test Channel ]

|      | UplinkChannel  |                 |                  |                  |
|------|----------------|-----------------|------------------|------------------|
|      | 2G<br>(GSM850) | 2G<br>(GSM1900) | 3G<br>(WCDMA B2) | 3G<br>(WCDMA B5) |
| Low  | 128            | 512             | 9262             | 4132             |
| Mid  | 190            | 661             | 9400             | 4183             |
| High | 251            | 810             | 9538             | 4233             |

#### 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         | 05/03/2019       | Annual               | 05/03/2020      |
| Agilent               | E3632A/DC Power Supply                               | MY40004326    | 07/01/2019       | Annual               | 07/01/2020      |
| Schwarzbeck           | UHAP/ Dipole Antenna                                 | 557           | 03/29/2019       | Biennial             | 03/29/2021      |
| Schwarzbeck           | UHAP/ Dipole Antenna                                 | 558           | 03/29/2019       | Biennial             | 03/29/2021      |
| ESPEC                 | SU-642 / Chamber                                     | 93000717      | 08/14/2019       | Annual               | 08/14/2020      |
| Schwarzbeck           | BBHA 9120D/ Horn Antenna(1~18GHz)                    | 147           | 08/29/2019       | Biennial             | 08/29/2021      |
| Schwarzbeck           | BBHA 9120D/ Horn Antenna(1~18GHz)                    | 9120D-1298    | 09/25/2019       | Biennial             | 09/25/2021      |
| Schwarzbeck           | BBHA 9170/ Horn Antenna(15~40GHz)                    | BBHA9170342   | 04/29/2019       | Biennial             | 04/29/2021      |
| Schwarzbeck           | BBHA 9170/ Horn Antenna(15~40GHz)                    | BBHA9170124   | 01/28/2019       | Biennial             | 01/28/2021      |
| Agilent               | N9020A/Signal Analyzer(10Hz~26.5GHz)                 | MY51110063    | 05/08/2019       | Annual               | 05/08/2020      |
| Hewlett Packard       | 8493C/ATTENUATOR(20dB)                               | 17280         | 06/04/2019       | Annual               | 06/04/2020      |
| REOHDE & SCHWARZ      | FSV40/Spectrum Analyzer(10Hz~40GHz)                  | 100931        | 10/14/2019       | Annual               | 10/14/2020      |
| Agilent               | 8960 (E5515C)/ Base Station                          | MY48360800    | 08/27/2019       | Annual               | 08/27/2020      |
| Schwarzbeck           | FMZB1513/ Loop Antenna(9kHz~30MHz)                   | 1513-175      | 08/23/2018       | Biennial             | 08/23/2020      |
| Schwarzbeck           | VULB9160/ Bilog Antenna                              | 9160-3368     | 08/09/2018       | Biennial             | 08/09/2020      |
| Schwarzbeck           | VULB9160/ Hybrid Antenna                             | 760           | 03/22/2019       | Biennial             | 03/22/2021      |
| Anritsu Corp.         | MT8821C/Wideband Radio Communication Tester          | 6201502997    | 08/09/2019       | Annual               | 08/09/2020      |
| Anritsu Corp.         | MT8820C/Wideband Radio Communication Tester          | 6201026545    | 01/30/2019       | Annual               | 01/22/2021      |
| REOHDE & SCHWARZ      | SMB100A/ SIGNAL GENERATOR (100kHz~40GHz)             | 177633        | 07/15/2019       | Annual               | 07/15/2020      |
| REOHDE & SCHWARZ      | ESU40 / EMI TEST RECEIVER                            | 100524        | 05/17/2019       | Annual               | 05/17/2020      |
| HCT CO., LTD.,        | FCC LTE Mobile Conducted RF Automation Test Software | -             | -                | -                    | -               |

Note:

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

## 5. MEASUREMENT UNCERTAINTY

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

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

## 6. SUMMARY OF TEST RESULTS

### 6.1 Test Condition : Conducted Test

| Test Description                                                 | FCC Part Section(s)                   | Test Limit                                                                                    | Test Result      |
|------------------------------------------------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------|------------------|
| Occupied Bandwidth                                               | §2.1049                               | N/A                                                                                           | PASS             |
| Band Edge / Spurious and Harmonic Emissions at Antenna Terminal. | §2.1051,<br>§22.917(a),<br>§24.238(a) | $< 43 + 10 \times \log_{10} (P[\text{Watts}])$ at Band Edge and for all out-of-band emissions | PASS             |
| Conducted Output Power                                           | §2.1046                               | N/A                                                                                           | <u>See Note1</u> |
| Peak- to- Average Ratio                                          | §24.232(d)                            | $< 13 \text{ dB}$                                                                             | PASS             |
| Frequency stability / variation of ambient temperature           | §2.1055,<br>§22.355                   | $< 2.5 \text{ ppm}$                                                                           | PASS             |
|                                                                  | §24.235                               | 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                 | §22.913(a)(5)                          | $< 7 \text{ Watts max. ERP}$                                                 | PASS        |
| Equivalent Isotropic Radiated Power      | §24.232(c),                            | $< 2 \text{ Watts max. EIRP}$                                                | PASS        |
| Radiated Spurious and Harmonic Emissions | §2.1053,<br>§22.917(a),<br>§24.238(a), | $< 43 + 10 \times \log_{10} (P[\text{Watts}])$ for all out-of band emissions | PASS        |

## 7. SAMPLE CALCULATION

### 7.1 ERP Sample Calculation

| Ch./ Freq. |            | Measured<br>Level(dBm) | Substitute<br>Level(dBm) | Ant. Gain<br>(dBd) | C.L  | Pol. | ERP   |       |
|------------|------------|------------------------|--------------------------|--------------------|------|------|-------|-------|
| channel    | Freq.(MHz) |                        |                          |                    |      |      | W     | dBm   |
| 128        | 824.20     | -21.37                 | 38.40                    | -10.61             | 0.95 | H    | 0.483 | 26.84 |

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

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test , the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power.

### 7.2 EIRP Sample Calculation

| Ch./ Freq. |            | Measured<br>Level(dBm) | Substitute<br>Level(dBm) | Ant. Gain<br>(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 |

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

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test , the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of equivalent isotropic radiated power.

### 7.3. Emission Designator

#### GSM Emission Designator

Emission Designator = 249KGXW

GSM BW = 249 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

#### EDGE Emission Designator

Emission Designator = 249KG7W

GSM BW = 249 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

#### WCDMA Emission Designator

Emission Designator = 4M17F9W

WCDMA BW = 4.17 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

#### QPSK Modulation

Emission Designator = 4M48G7D

LTE BW = 4.48 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

#### 16QAM Modulation

Emission Designator = 4M48W7D

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

## 8. TEST DATA

### 8.1 EFFECTIVE RADIATED POWER

| Mode   | Ch./ Freq. |            | Measured Level (dBm) | Substitute LEVEL (dBm) | Ant. Gain (dBd) | C.L  | Pol. | Limit  | ERP   |       |
|--------|------------|------------|----------------------|------------------------|-----------------|------|------|--------|-------|-------|
|        | channel    | Freq.(MHz) |                      |                        |                 |      |      | W      | W     | dBm   |
| GSM850 | 128        | 824.2      | -24.31               | 39.30                  | -10.25          | 1.28 | V    | < 7.00 | 0.599 | 27.77 |
|        | 190        | 836.6      | -24.11               | 40.07                  | -10.19          | 1.29 | V    |        | 0.724 | 28.59 |
|        | 251        | 848.8      | -24.09               | 39.93                  | -10.14          | 1.30 | V    |        | 0.706 | 28.49 |
| EDGE   | 190        | 836.6      | -30.45               | 33.73                  | -10.19          | 1.29 | V    |        | 0.168 | 22.25 |

| Mode     | Ch./ Freq. |            | Measured Level (dBm) | Substitute LEVEL (dBm) | Ant. Gain (dBd) | C.L  | Pol. | Limit  | ERP   |       |
|----------|------------|------------|----------------------|------------------------|-----------------|------|------|--------|-------|-------|
|          | channel    | Freq.(MHz) |                      |                        |                 |      |      | W      | W     | dBm   |
| WCDMA850 | 4132       | 826.4      | -32.80               | 30.81                  | -10.25          | 1.28 | H    | < 7.00 | 0.085 | 19.28 |
|          | 4183       | 836.6      | -33.14               | 31.04                  | -10.19          | 1.29 | H    |        | 0.090 | 19.56 |
|          | 4233       | 846.6      | -33.96               | 30.09                  | -10.15          | 1.30 | H    |        | 0.073 | 18.64 |

## 8.2 EQUIVALENT ISOTROPIC RADIATED POWER

| Mode    | Ch./ Freq. |            | Measured Level (dBm) | Substitute LEVEL (dBm) | Ant. Gain (dBi) | C.L  | Pol. | Limit  | EIRP  |       |
|---------|------------|------------|----------------------|------------------------|-----------------|------|------|--------|-------|-------|
|         | channel    | Freq.(MHz) |                      |                        |                 |      |      | W      | W     | dBm   |
| GSM1900 | 512        | 1850.2     | -16.20               | 17.44                  | 10.10           | 1.94 | V    | < 2.00 | 0.363 | 25.60 |
|         | 661        | 1880.0     | -15.51               | 18.38                  | 10.15           | 1.98 | V    |        | 0.451 | 26.55 |
|         | 810        | 1909.8     | -16.18               | 18.16                  | 10.23           | 2.00 | V    |        | 0.435 | 26.39 |
| EDGE    | 661        | 1880.0     | -20.21               | 13.68                  | 10.15           | 1.98 | V    |        | 0.153 | 21.85 |

| Mode      | Ch./ Freq. |            | Measured Level (dBm) | Substitute LEVEL (dBm) | Ant. Gain (dBi) | C.L  | Pol. | Limit  | EIRP  |       |
|-----------|------------|------------|----------------------|------------------------|-----------------|------|------|--------|-------|-------|
|           | channel    | Freq.(MHz) |                      |                        |                 |      |      | W      | W     | dBm   |
| WCDMA1900 | 9262       | 1852.4     | -23.62               | 10.02                  | 10.10           | 1.94 | H    | < 2.00 | 0.066 | 18.18 |
|           | 9400       | 1880.0     | -23.14               | 10.75                  | 10.15           | 1.98 | H    |        | 0.078 | 18.92 |
|           | 9538       | 1907.6     | -22.96               | 11.38                  | 10.23           | 2.00 | H    |        | 0.091 | 19.61 |

### 8.3 RADIATED SPURIOUS EMISSIONS

▣ MODULATION SIGNAL: GSM850

▣ DISTANCE: 3 meters

| Ch.            | Freq.(MHz) | <u>Measured</u><br><u>Level</u><br><u>[dBm]</u> | Ant. Gain<br>(dBi) | <u>Substitute</u><br><u>Level</u><br><u>[dBm]</u> | C.L  | Pol. | Result<br>(dBm) | dBc   |
|----------------|------------|-------------------------------------------------|--------------------|---------------------------------------------------|------|------|-----------------|-------|
| 128<br>(824.2) | 1,648.40   | -45.61                                          | 9.50               | -56.37                                            | 1.84 | H    | -48.71          | 79.46 |
|                | 2,472.60   | -45.87                                          | 10.60              | -50.91                                            | 2.28 | H    | -42.59          | 73.34 |
|                | 3,296.80   | -55.89                                          | 12.25              | -57.71                                            | 2.69 | V    | -48.15          | 78.90 |
| 190<br>(836.6) | 1,673.20   | -48.14                                          | 9.65               | -58.90                                            | 1.86 | H    | -51.11          | 81.85 |
|                | 2,509.80   | -46.22                                          | 10.75              | -51.33                                            | 2.32 | V    | -42.90          | 73.65 |
|                | 3,346.40   | -56.81                                          | 12.48              | -58.46                                            | 2.70 | H    | -48.69          | 79.43 |
| 251<br>(848.8) | 1,697.60   | -49.00                                          | 9.80               | -59.47                                            | 1.87 | H    | -51.54          | 82.28 |
|                | 2,546.40   | -45.84                                          | 10.88              | -49.95                                            | 2.32 | H    | -41.39          | 72.14 |
|                | 3,395.20   | -55.95                                          | 12.68              | -57.93                                            | 2.72 | V    | -47.97          | 78.71 |

▣ MODULATION SIGNAL: GSM1900

▣ DISTANCE: 3 meters

| Ch.             | Freq.(MHz) | <u>Measured</u><br><u>Level</u><br><u>[dBm]</u> | Ant. Gain<br>(dBi) | <u>Substitute</u><br><u>Level</u><br><u>[dBm]</u> | C.L  | Pol. | Result<br>(dBm) | dBc   |
|-----------------|------------|-------------------------------------------------|--------------------|---------------------------------------------------|------|------|-----------------|-------|
| 512<br>(1850.2) | 3,700.40   | -54.57                                          | 12.40              | -59.54                                            | 2.86 | H    | -50.00          | 76.54 |
|                 | 5,550.60   | -49.70                                          | 13.10              | -48.15                                            | 3.58 | H    | -38.63          | 65.17 |
|                 | 7,400.80   | -56.57                                          | 11.10              | -46.78                                            | 4.26 | V    | -39.94          | 66.48 |
| 661<br>(1880.0) | 3,760.00   | -53.83                                          | 12.48              | -58.81                                            | 2.88 | V    | -49.21          | 75.75 |
|                 | 5,640.00   | -53.20                                          | 13.30              | -51.82                                            | 3.62 | V    | -42.14          | 68.69 |
|                 | 7,520.00   | -57.99                                          | 11.30              | -47.82                                            | 4.30 | H    | -40.82          | 67.36 |
| 810<br>(1909.8) | 3,819.60   | -53.55                                          | 12.40              | -58.52                                            | 2.90 | H    | -49.02          | 75.57 |
|                 | 5,729.40   | -56.65                                          | 13.35              | -54.55                                            | 3.63 | H    | -44.83          | 71.38 |
|                 | 7,639.20   | -57.05                                          | 11.65              | -46.92                                            | 4.34 | V    | -39.61          | 66.16 |

▣ MODULATION SIGNAL: WCDMA850

▣ DISTANCE: 3 meters

| Ch.              | Freq.(MHz) | <u>Measured</u><br><u>Level</u><br><u>[dBm]</u> | Ant. Gain<br>(dBi) | <u>Substitute</u><br><u>Level</u><br><u>[dBm]</u> | C.L  | Pol. | Result<br>(dBm) | dBc   |
|------------------|------------|-------------------------------------------------|--------------------|---------------------------------------------------|------|------|-----------------|-------|
| 4,132<br>(826.4) | 1,652.80   | -52.65                                          | 9.50               | -63.41                                            | 1.84 | V    | -55.75          | 77.47 |
|                  | 2,479.20   | -33.01                                          | 10.60              | -37.82                                            | 2.30 | H    | -29.52          | 51.23 |
|                  | 3,305.60   | -58.20                                          | 12.33              | -60.19                                            | 2.69 | V    | -50.55          | 72.27 |
| 4,183<br>(836.6) | 1,673.20   | -52.24                                          | 9.65               | -63.00                                            | 1.86 | V    | -55.21          | 76.92 |
|                  | 2,509.80   | -32.65                                          | 10.75              | -37.76                                            | 2.32 | H    | -29.33          | 51.05 |
|                  | 3,346.40   | -57.79                                          | 12.48              | -59.44                                            | 2.70 | H    | -49.67          | 71.38 |
| 4,233<br>(846.6) | 1,693.20   | -52.97                                          | 9.73               | -63.59                                            | 1.87 | V    | -55.73          | 77.45 |
|                  | 2,539.80   | -30.93                                          | 10.85              | -34.79                                            | 2.32 | V    | -26.26          | 47.98 |
|                  | 3,386.40   | -57.92                                          | 12.63              | -59.92                                            | 2.72 | V    | -50.01          | 71.72 |

▣ MODULATION SIGNAL: WCDMA1900

▣ DISTANCE: 3 meters

| Ch.              | Freq.(MHz) | <u>Measured</u><br><u>Level</u><br><u>[dBm]</u> | Ant. Gain<br>(dBi) | <u>Substitute</u><br><u>Level</u><br><u>[dBm]</u> | C.L  | Pol. | Result<br>(dBm) | dBc   |
|------------------|------------|-------------------------------------------------|--------------------|---------------------------------------------------|------|------|-----------------|-------|
| 9262<br>(1852.4) | 3,704.80   | -54.40                                          | 12.42              | -59.39                                            | 2.86 | H    | -49.83          | 69.43 |
|                  | 5,557.20   | -56.61                                          | 13.15              | -55.07                                            | 3.58 | V    | -45.50          | 65.11 |
|                  | 7,409.60   | -55.80                                          | 11.13              | -45.89                                            | 4.25 | V    | -39.01          | 58.61 |
| 9400<br>(1880.0) | 3,760.00   | -54.40                                          | 12.48              | -59.38                                            | 2.88 | V    | -49.78          | 69.38 |
|                  | 5,640.00   | -56.63                                          | 13.30              | -55.25                                            | 3.62 | H    | -45.57          | 65.18 |
|                  | 7,520.00   | -57.09                                          | 11.30              | -46.92                                            | 4.30 | V    | -39.92          | 59.52 |
| 9538<br>(1907.6) | 3,815.20   | -53.29                                          | 12.40              | -58.30                                            | 2.90 | V    | -48.80          | 68.40 |
|                  | 5,722.80   | -55.89                                          | 13.35              | -53.75                                            | 3.63 | H    | -44.03          | 63.64 |
|                  | 7,630.40   | -57.65                                          | 11.60              | -47.60                                            | 4.34 | H    | -40.34          | 59.94 |

#### 8.4 PEAK-TO-AVERAGE RATIO

| Band            | Ch.  | Measured<br>P <sub>PK</sub> (dBm) | Measured<br>P <sub>Avg</sub> (dBm) | P <sub>Avg</sub> (Duty Cycle) |                          |                | P.A.R.<br>= P <sub>PK</sub> -<br>P <sub>Avg</sub><br>(dB) | Limit<br>(dB) | Pass /<br>Fail |
|-----------------|------|-----------------------------------|------------------------------------|-------------------------------|--------------------------|----------------|-----------------------------------------------------------|---------------|----------------|
|                 |      |                                   |                                    | Tx <sub>Total</sub><br>(ms)   | Tx <sub>On</sub><br>(ms) | Factor<br>(dB) |                                                           |               |                |
| GSM1900         | 661  | 30.232                            | 20.81                              | 4.6160                        | 0.5475                   | 9.26           | 0.16                                                      | 13            | Pass           |
| GSM1900<br>EDGE | 661  | 29.188                            | 16.50                              | 4.616                         | 0.5475                   | 9.26           | 3.42                                                      |               |                |
| WCDMA1900       | 9400 | CCDF Procedure                    |                                    |                               |                          |                | 2.57                                                      |               |                |

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 54 ~ 60.
2. Only GSM(include EDGE) Mode was tested by alternate procedure for PAPR

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

$$\text{Duty cycle Factor} = 10 \times \log (1/X), \quad X = T_{XOn} / T_{XTotal}$$

## 8.5 OCCUPIED BANDWIDTH

| Band         | Channel | Frequency(MHz) | Data (GSM: kHz /<br>WCDMA : MHz) |
|--------------|---------|----------------|----------------------------------|
| GSM850       | 128     | 824.20         | 241.82                           |
|              | 190     | 836.60         | 243.94                           |
|              | 251     | 848.80         | 242.99                           |
| GSM850 EDGE  | 128     | 824.20         | 247.43                           |
|              | 190     | 836.60         | 239.91                           |
|              | 251     | 848.80         | 245.94                           |
| GSM1900      | 512     | 1,850.20       | 239.29                           |
|              | 661     | 1,880.00       | 243.60                           |
|              | 810     | 1,909.80       | 241.77                           |
| GSM1900 EDGE | 512     | 1,850.20       | 236.12                           |
|              | 661     | 1,880.00       | 246.95                           |
|              | 810     | 1,909.80       | 245.94                           |
| WCDMA850     | 4132    | 826.40         | 4.1663                           |
|              | 4183    | 836.60         | 4.1747                           |
|              | 4233    | 846.60         | 4.1812                           |
| WCDMA1900    | 9262    | 1852.40        | 4.1747                           |
|              | 9400    | 1880.00        | 4.1783                           |
|              | 9538    | 1907.60        | 4.2025                           |

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 40 ~ 53.

## 8.6 CONDUCTED SPURIOUS EMISSIONS

| Band      | Channel | Frequency of Maximum Harmonic (GHz) | Factor (dB) | Measurement Maximum Data (dBm) | Result  | (dBm)  |
|-----------|---------|-------------------------------------|-------------|--------------------------------|---------|--------|
| GSM850    | 128     | 6.5509                              | 28.591      | -57.68                         | -29.084 | -13.00 |
|           | 190     | 3.6990                              | 27.976      | -57.27                         | -29.292 |        |
|           | 251     | 3.7099                              | 27.976      | -57.14                         | -29.167 |        |
| GSM1900   | 512     | 16.76592                            | 29.489      | -52.734                        | -23.245 |        |
|           | 661     | 16.04240                            | 29.489      | -53.234                        | -23.745 |        |
|           | 810     | 16.63592                            | 29.489      | -53.375                        | -23.886 |        |
| WCDMA850  | 4132    | 2.4771                              | 27.976      | -77.224                        | -49.248 |        |
|           | 4183    | 2.5115                              | 27.976      | -77.124                        | -49.148 |        |
|           | 4233    | 2.5380                              | 27.976      | -77.142                        | -49.166 |        |
| WCDMA1900 | 9262    | 18.9272                             | 29.489      | -72.789                        | -43.300 |        |
|           | 9400    | 18.8622                             | 29.489      | -73.087                        | -43.598 |        |
|           | 9538    | 18.9565                             | 29.489      | -72.826                        | -43.337 |        |

### Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 93 ~ 110.
2. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
3. 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      |

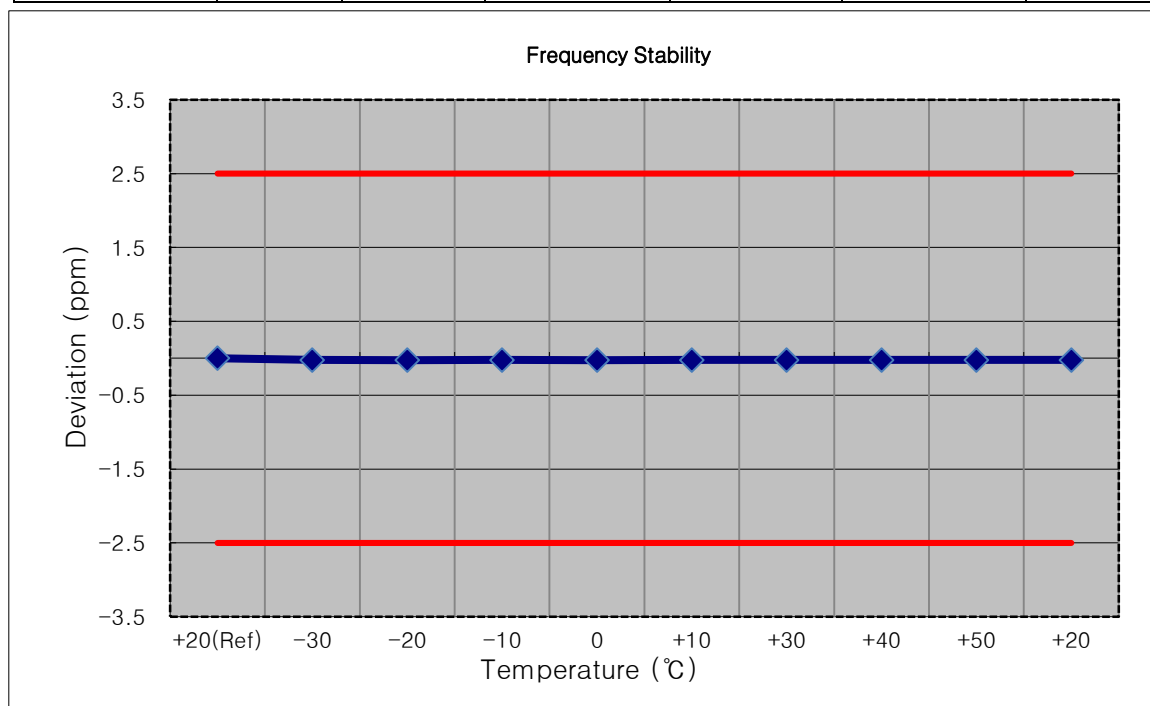
## 8.7 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 61 ~ 92.

## 8.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

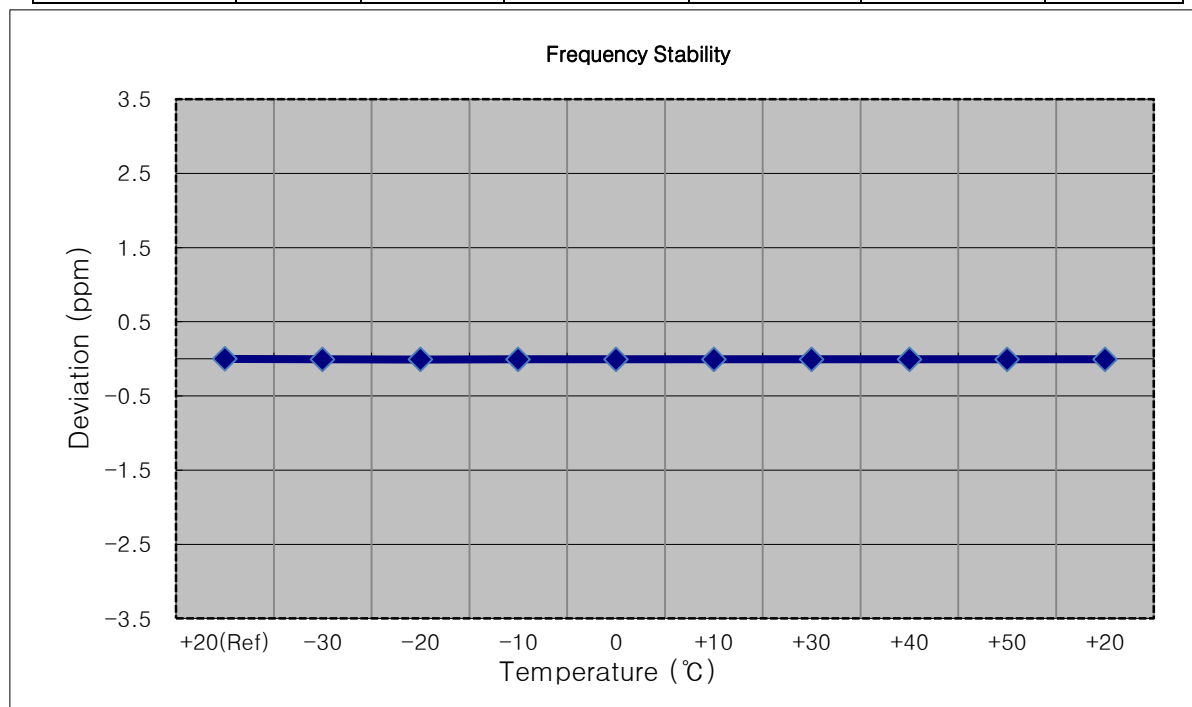
- ☐ MODE: GSM850  
☐ OPERATING FREQUENCY: 836,600,000 Hz  
☐ CHANNEL: 190  
☐ REFERENCE VOLTAGE: 3.86 VDC  
☐ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm     |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100%           | 3.860       | +20(Ref)   | 836 599 981    | 0.0                  | 0.000 000     | 0.0000  |
| 100%           |             | -30        | 836 599 961    | -19.2                | -0.000 002    | -0.0229 |
| 100%           |             | -20        | 836 599 961    | -20.0                | -0.000 002    | -0.0239 |
| 100%           |             | -10        | 836 599 961    | -19.1                | -0.000 002    | -0.0229 |
| 100%           |             | 0          | 836 599 961    | -20.0                | -0.000 002    | -0.0239 |
| 100%           |             | +10        | 836 599 961    | -19.2                | -0.000 002    | -0.0229 |
| 100%           |             | +30        | 836 599 962    | -18.9                | -0.000 002    | -0.0226 |
| 100%           |             | +40        | 836 599 961    | -19.2                | -0.000 002    | -0.0230 |
| 100%           |             | +50        | 836 599 961    | -19.8                | -0.000 002    | -0.0236 |
| Batt. Endpoint | 3.400       | +20        | 836 599 961    | -19.5                | -0.000 002    | -0.0233 |



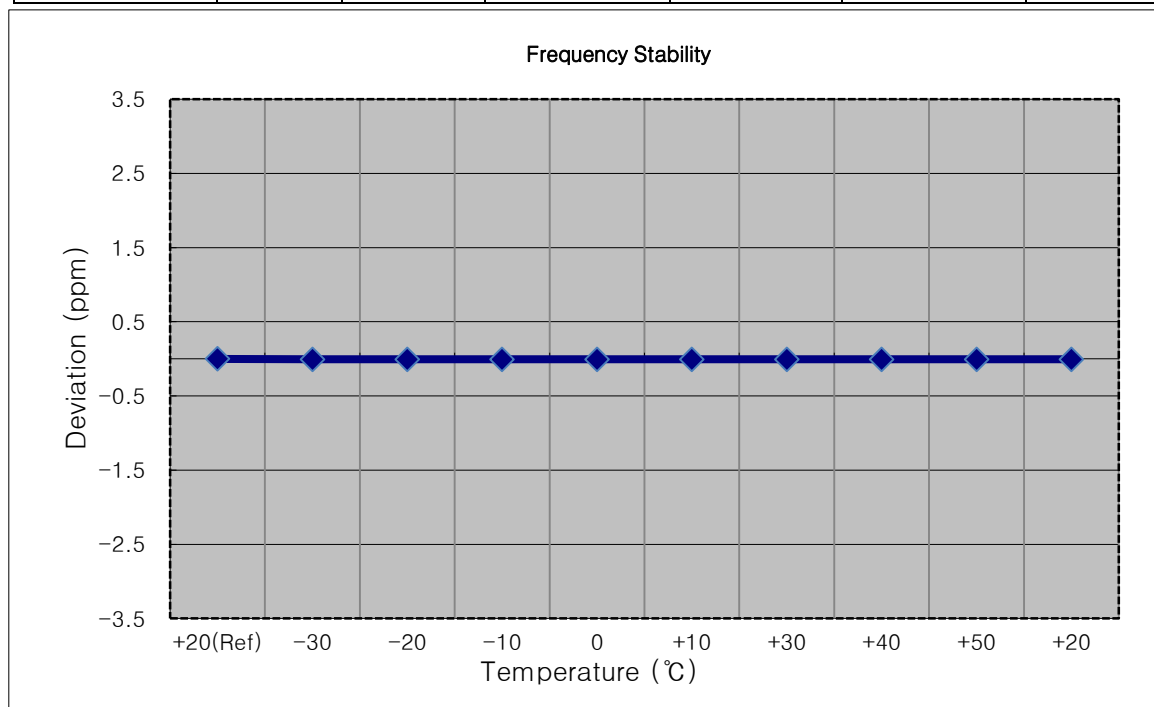
- ▣ Mode: GSM1900
- ▣ OPERATING FREQUENCY: 1850,200,000 Hz
- ▣ CHANNEL: 512
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm     |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100%           | 3.860       | +20(Ref)   | 1850 199 987   | 0.0                  | 0.000 000     | 0.0000  |
| 100%           |             | -30        | 1850 199 973   | -13.9                | -0.000 001    | -0.0075 |
| 100%           |             | -20        | 1850 199 972   | -14.9                | -0.000 001    | -0.0080 |
| 100%           |             | -10        | 1850 199 973   | -13.2                | -0.000 001    | -0.0072 |
| 100%           |             | 0          | 1850 199 974   | -12.9                | -0.000 001    | -0.0070 |
| 100%           |             | +10        | 1850 199 974   | -12.9                | -0.000 001    | -0.0070 |
| 100%           |             | +30        | 1850 199 973   | -13.9                | -0.000 001    | -0.0075 |
| 100%           |             | +40        | 1850 199 973   | -13.9                | -0.000 001    | -0.0075 |
| 100%           |             | +50        | 1850 199 974   | -13.0                | -0.000 001    | -0.0070 |
| Batt. Endpoint | 3.400       | +20        | 1850 199 974   | -13.0                | -0.000 001    | -0.0070 |



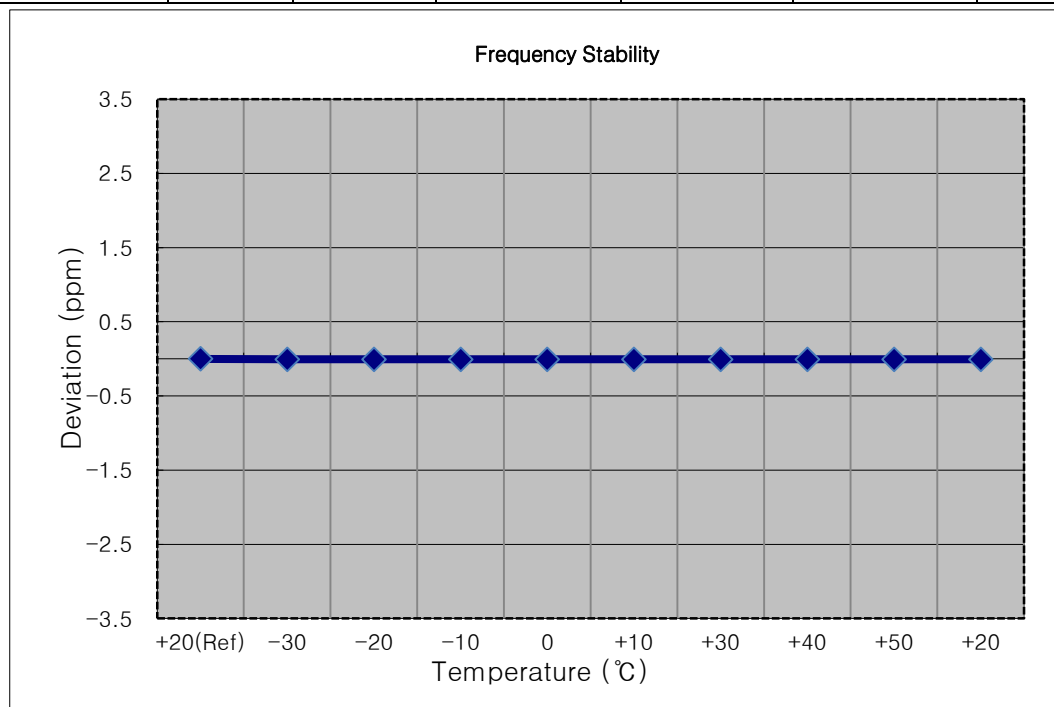
- ▣ Mode: GSM1900
- ▣ OPERATING FREQUENCY: 1880,000,000 Hz
- ▣ CHANNEL: 661
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm    |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100%           | 3.860       | +20(Ref)   | 1879 999 987   | 0.0                  | 0.000 000     | 0.000  |
| 100%           |             | -30        | 1879 999 973   | -14.2                | -0.000 001    | -0.008 |
| 100%           |             | -20        | 1879 999 974   | -13.4                | -0.000 001    | -0.007 |
| 100%           |             | -10        | 1879 999 973   | -13.6                | -0.000 001    | -0.007 |
| 100%           |             | 0          | 1879 999 973   | -14.0                | -0.000 001    | -0.007 |
| 100%           |             | +10        | 1879 999 974   | -13.4                | -0.000 001    | -0.007 |
| 100%           |             | +30        | 1879 999 974   | -13.4                | -0.000 001    | -0.007 |
| 100%           |             | +40        | 1879 999 974   | -12.9                | -0.000 001    | -0.007 |
| 100%           |             | +50        | 1879 999 974   | -13.1                | -0.000 001    | -0.007 |
| Batt. Endpoint | 3.400       | +20        | 1879 999 974   | -13.1                | -0.000 001    | -0.007 |



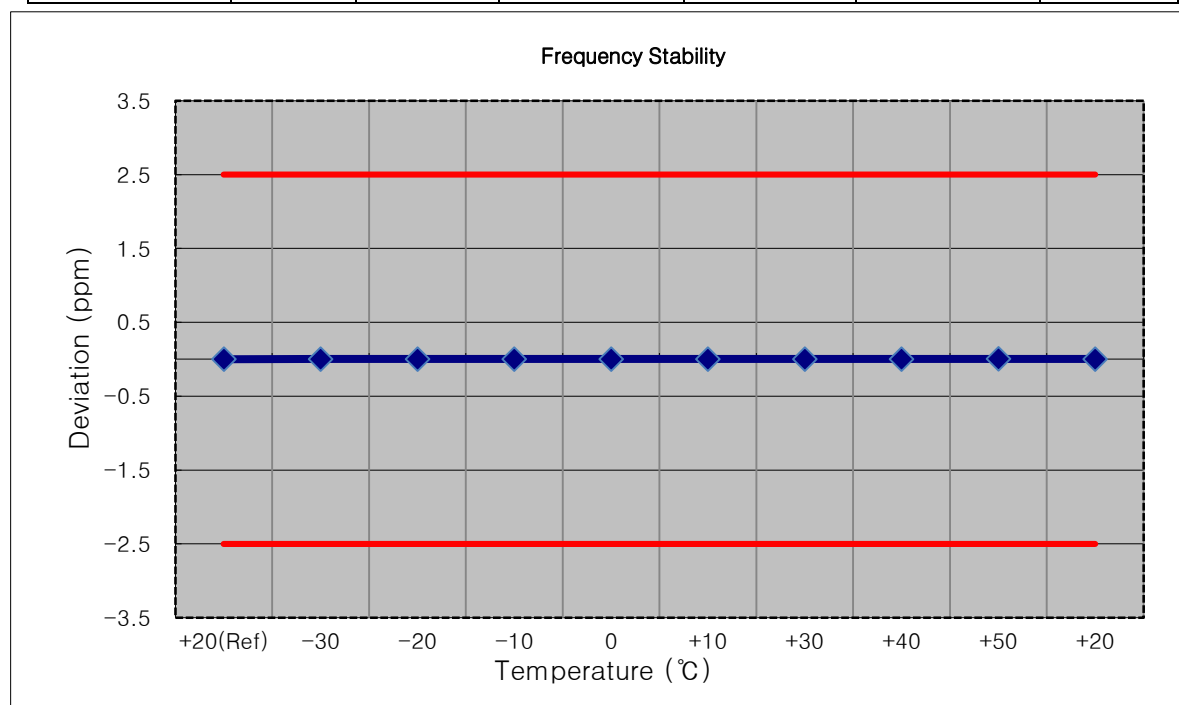
- ▣ Mode: GSM1900
- ▣ OPERATING FREQUENCY: 1909,800,000 Hz
- ▣ CHANNEL: 810
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm    |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100%           | 3.860       | +20(Ref)   | 1909 799 987   | 0.0                  | 0.000 000     | 0.000  |
| 100%           |             | -30        | 1909 799 974   | -13.4                | -0.000 001    | -0.007 |
| 100%           |             | -20        | 1909 799 974   | -13.1                | -0.000 001    | -0.007 |
| 100%           |             | -10        | 1909 799 975   | -12.5                | -0.000 001    | -0.007 |
| 100%           |             | 0          | 1909 799 974   | -12.6                | -0.000 001    | -0.007 |
| 100%           |             | +10        | 1909 799 975   | -11.8                | -0.000 001    | -0.006 |
| 100%           |             | +30        | 1909 799 975   | -11.7                | -0.000 001    | -0.006 |
| 100%           |             | +40        | 1909 799 975   | -12.3                | -0.000 001    | -0.006 |
| 100%           |             | +50        | 1909 799 974   | -12.7                | -0.000 001    | -0.007 |
| Batt. Endpoint | 3.400       | +20        | 1909 799 975   | -12.3                | -0.000 001    | -0.006 |



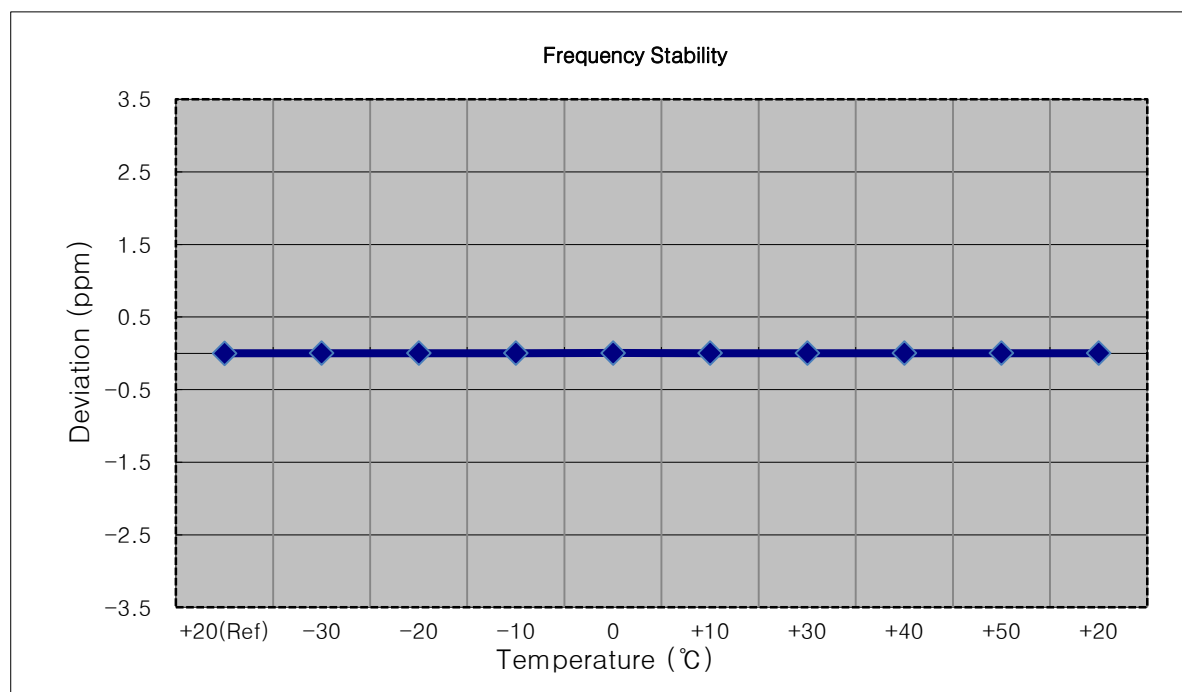
☐ Mode: WCDMA850  
☐ OPERATING FREQUENCY: 836,600,000 Hz  
☐ CHANNEL: 4183  
☐ REFERENCE VOLTAGE: 3.86 VDC  
☐ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm    |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100%           | 3.860       | +20(Ref)   | 836 600 003    | 0.0                  | 0.000 000     | 0.0000 |
| 100%           |             | -30        | 836 600 005    | 2.6                  | 0.000 000     | 0.0031 |
| 100%           |             | -20        | 836 600 005    | 2.1                  | 0.000 000     | 0.0025 |
| 100%           |             | -10        | 836 600 006    | 3.3                  | 0.000 000     | 0.0039 |
| 100%           |             | 0          | 836 600 005    | 2.3                  | 0.000 000     | 0.0027 |
| 100%           |             | +10        | 836 600 006    | 2.8                  | 0.000 000     | 0.0034 |
| 100%           |             | +30        | 836 600 006    | 3.0                  | 0.000 000     | 0.0035 |
| 100%           |             | +40        | 836 600 006    | 3.2                  | 0.000 000     | 0.0038 |
| 100%           |             | +50        | 836 600 007    | 3.9                  | 0.000 000     | 0.0046 |
| Batt. Endpoint | 3.400       | +20        | 836 600 006    | 2.7                  | 0.000 000     | 0.0033 |



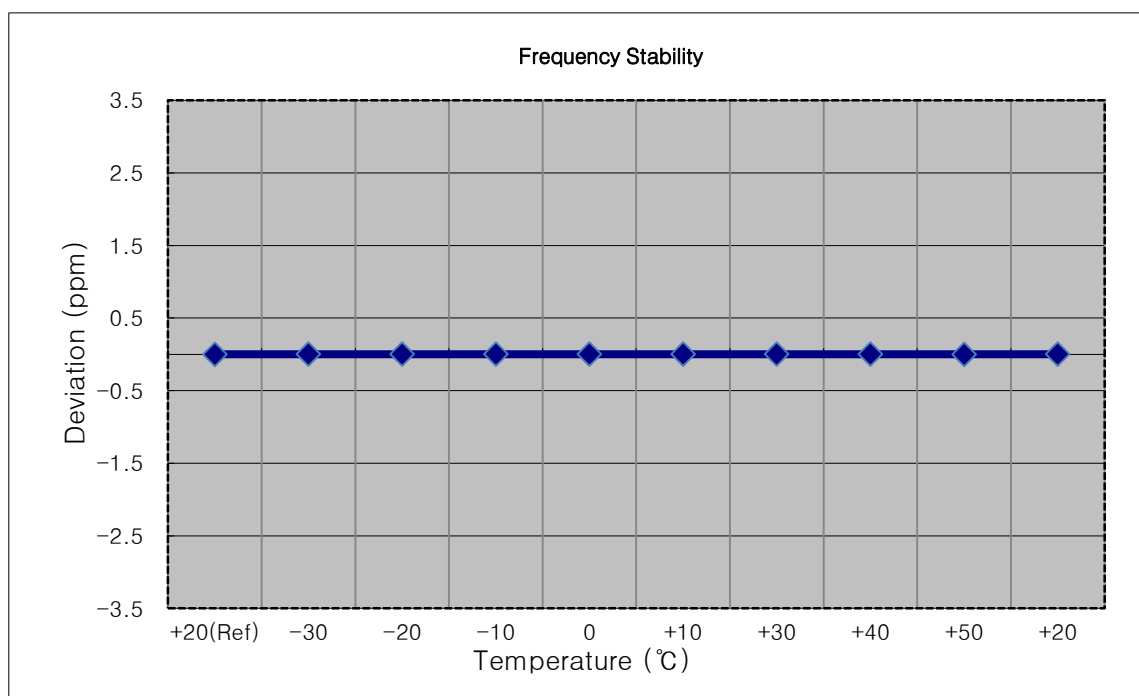
- ☐ Mode: WCDMA1900  
☐ OPERATING FREQUENCY: 1,852,400,000 Hz  
☐ CHANNEL: 9262  
☐ REFERENCE VOLTAGE: 3.86 VDC  
☐ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm    |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100%           | 3.860       | +20(Ref)   | 1852 400 005   | 0.0                  | 0.000 000     | 0.0000 |
| 100%           |             | -30        | 1852 400 009   | 4.1                  | 0.000 000     | 0.0022 |
| 100%           |             | -20        | 1852 400 010   | 4.2                  | 0.000 000     | 0.0023 |
| 100%           |             | -10        | 1852 400 010   | 4.3                  | 0.000 000     | 0.0023 |
| 100%           |             | 0          | 1852 400 011   | 5.9                  | 0.000 000     | 0.0032 |
| 100%           |             | +10        | 1852 400 010   | 4.4                  | 0.000 000     | 0.0024 |
| 100%           |             | +30        | 1852 400 010   | 4.4                  | 0.000 000     | 0.0024 |
| 100%           |             | +40        | 1852 400 010   | 4.3                  | 0.000 000     | 0.0023 |
| 100%           |             | +50        | 1852 400 010   | 4.3                  | 0.000 000     | 0.0023 |
| Batt. Endpoint | 3.400       | +20        | 1852 400 010   | 4.1                  | 0.000 000     | 0.0022 |



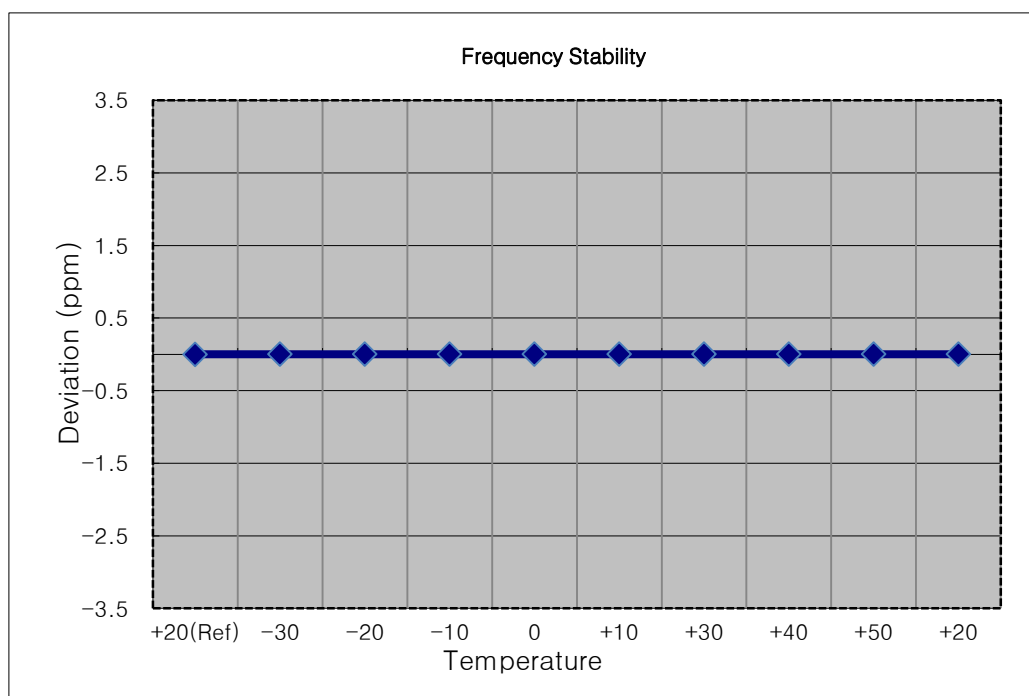
- ▣ Mode: WCDMA1900
- ▣ OPERATING FREQUENCY: 1,880,000,000 Hz
- ▣ CHANNEL: 9400
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm     |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100%           | 3.860       | +20(Ref)   | 1880 000 002   | 0.0                  | 0.000 000     | 0.0000  |
| 100%           |             | -30        | 1880 000 004   | 2.4                  | 0.000 000     | 0.0013  |
| 100%           |             | -20        | 1880 000 004   | 2.3                  | 0.000 000     | 0.0012  |
| 100%           |             | -10        | 1880 000 005   | 2.6                  | 0.000 000     | 0.0014  |
| 100%           |             | 0          | 1880 000 004   | 2.0                  | 0.000 000     | 0.0011  |
| 100%           |             | +10        | 1880 000 004   | 1.7                  | 0.000 000     | 0.0009  |
| 100%           |             | +30        | 1880 000 004   | 2.2                  | 0.000 000     | 0.0012  |
| 100%           |             | +40        | 1880 000 004   | 2.3                  | 0.000 000     | 0.0012  |
| 100%           |             | +50        | 1880 000 000   | -2.2                 | 0.000 000     | -0.0012 |
| Batt. Endpoint | 3.400       | +20        | 1880 000 004   | 1.7                  | 0.000 000     | 0.0009  |



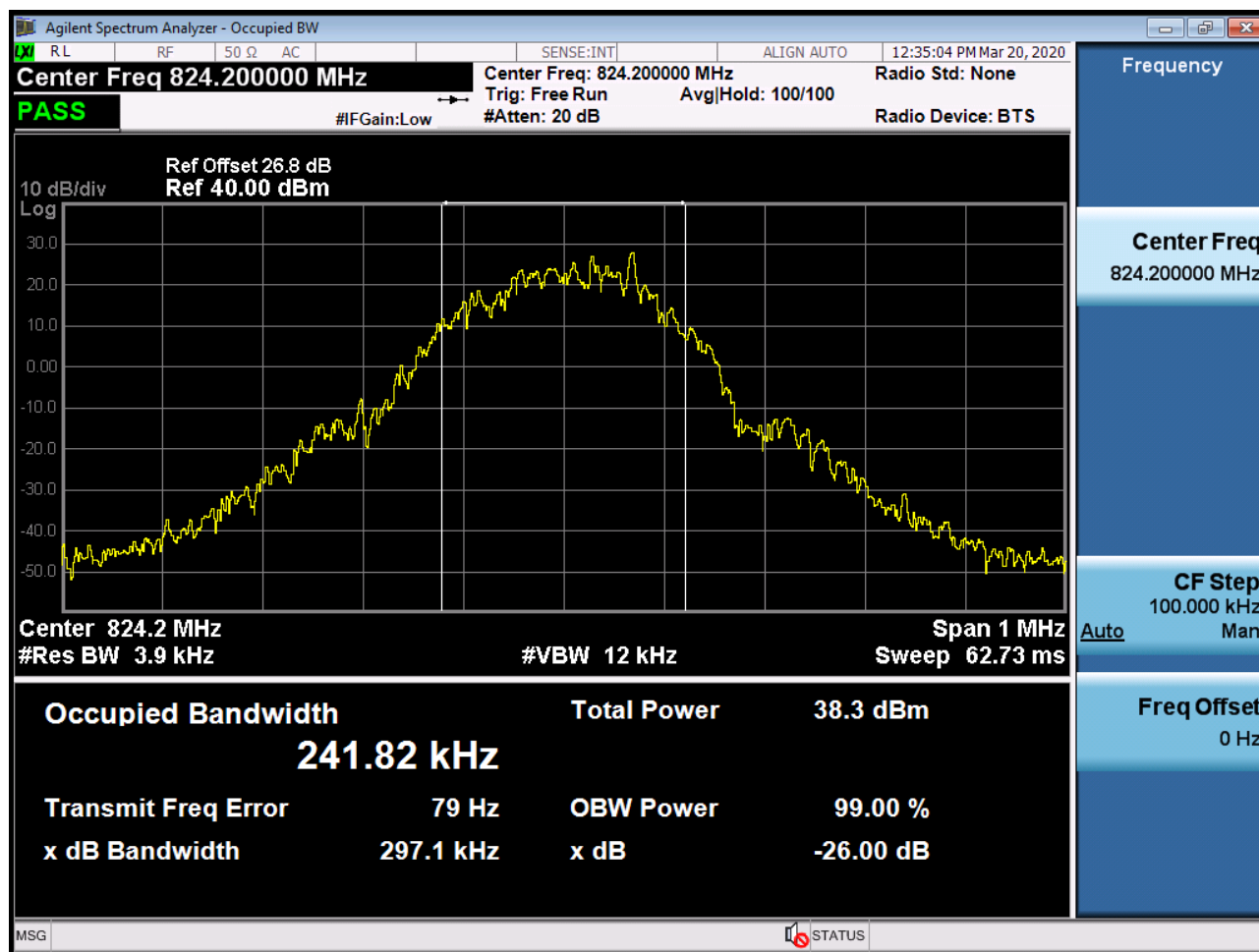
- ▣ Mode: WCDMA1900
- ▣ OPERATING FREQUENCY: 1,907,600,000 Hz
- ▣ CHANNEL: 9538
- ▣ REFERENCE VOLTAGE: 3.86 VDC
- ▣ DEVIATION LIMIT: Emission must remain in band

| Voltage (%)    | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm    |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100%           | 3.860       | +20(Ref)   | 1907 600 003   | 0.0                  | 0.000 000     | 0.0000 |
| 100%           |             | -30        | 1907 600 006   | 3.4                  | 0.000 000     | 0.0018 |
| 100%           |             | -20        | 1907 600 006   | 3.3                  | 0.000 000     | 0.0017 |
| 100%           |             | -10        | 1907 600 007   | 3.9                  | 0.000 000     | 0.0020 |
| 100%           |             | 0          | 1907 600 006   | 2.8                  | 0.000 000     | 0.0015 |
| 100%           |             | +10        | 1907 600 006   | 3.0                  | 0.000 000     | 0.0016 |
| 100%           |             | +30        | 1907 600 007   | 3.8                  | 0.000 000     | 0.0020 |
| 100%           |             | +40        | 1907 600 005   | 2.5                  | 0.000 000     | 0.0013 |
| 100%           |             | +50        | 1907 600 006   | 3.3                  | 0.000 000     | 0.0017 |
| Batt. Endpoint | 3.400       | +20        | 1907 600 005   | 2.4                  | 0.000 000     | 0.0013 |

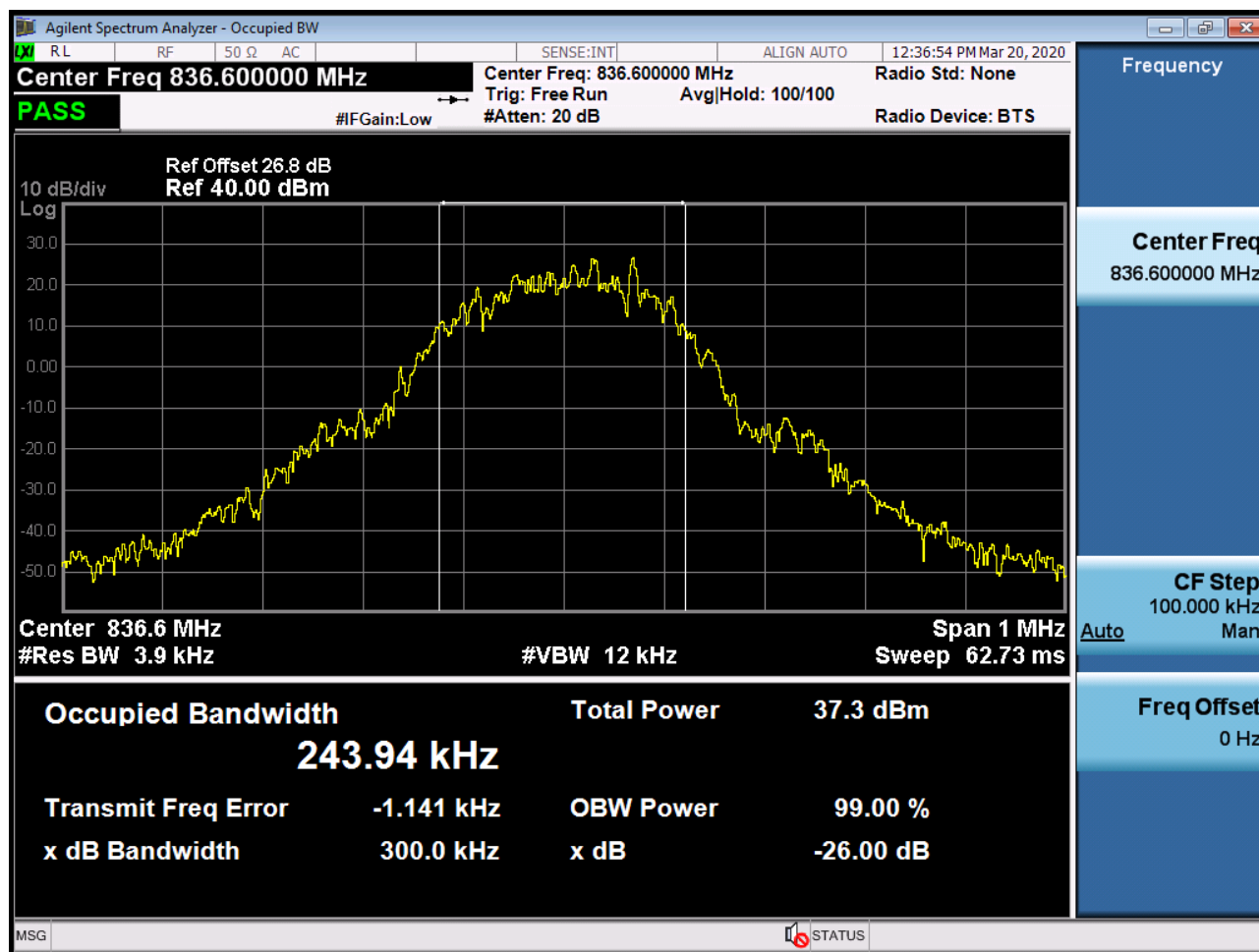


## 9. TEST PLOTS

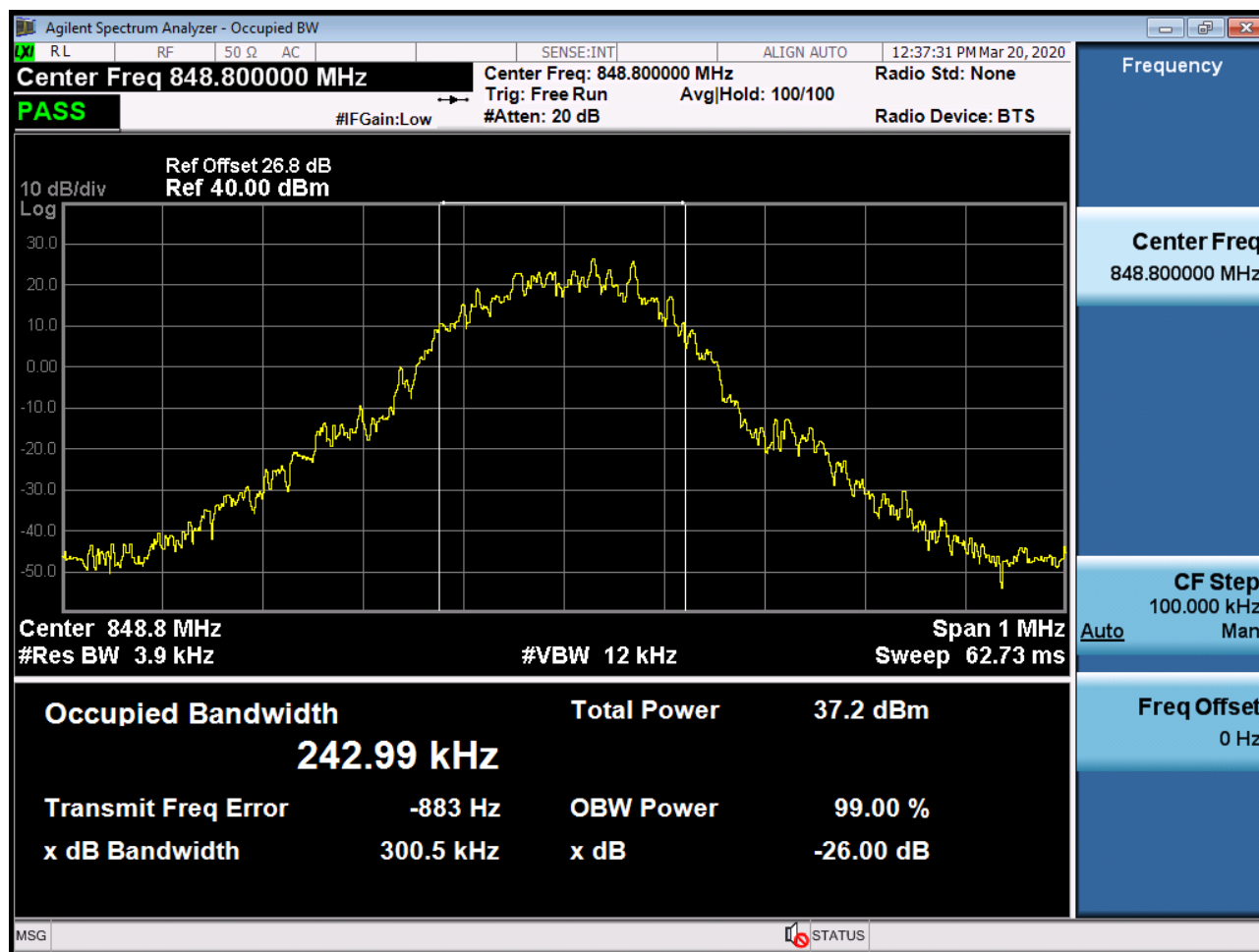
■ GSM850 MODE (128 CH.) Occupied Bandwidth



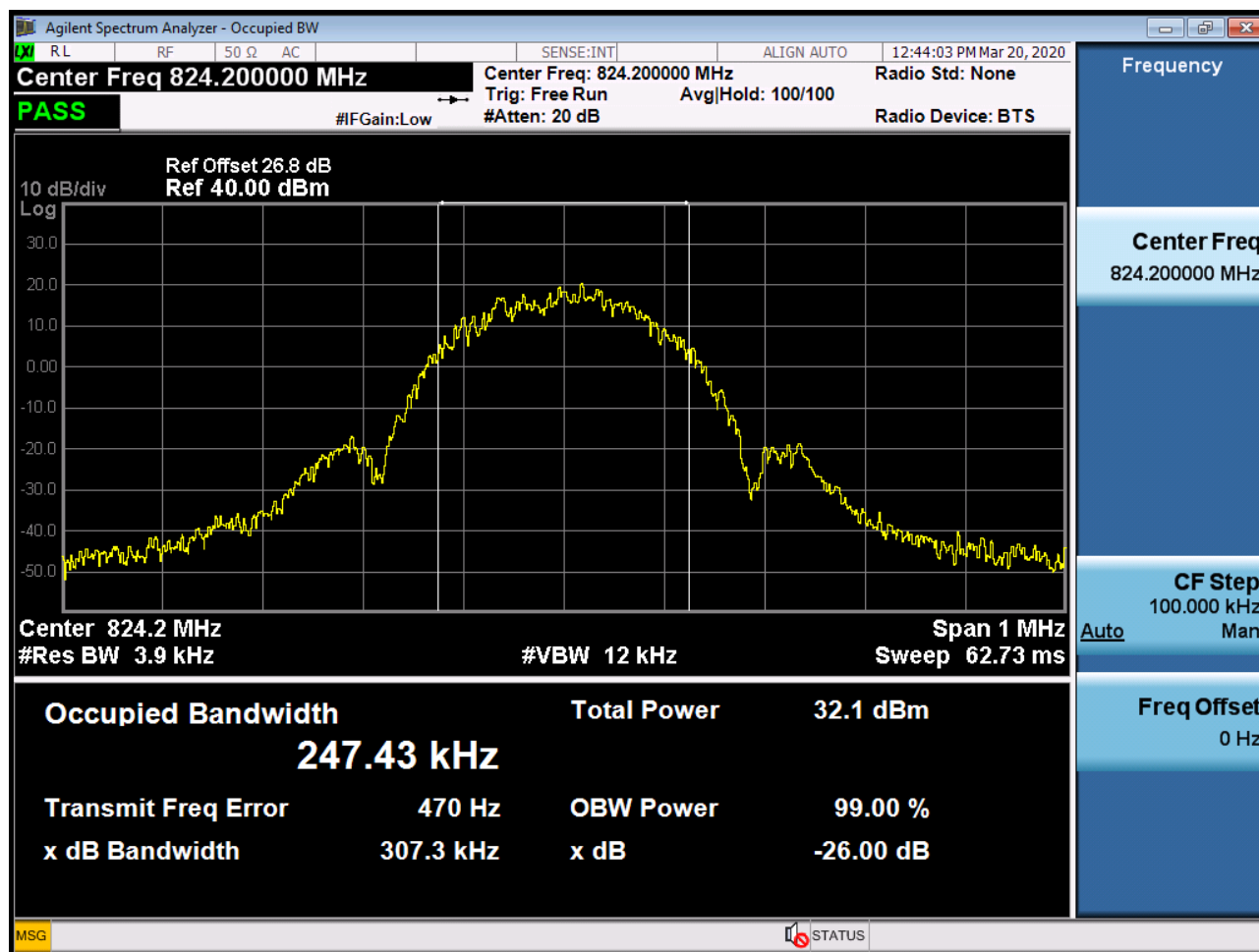
■ GSM850 MODE (190 CH.) Occupied Bandwidth



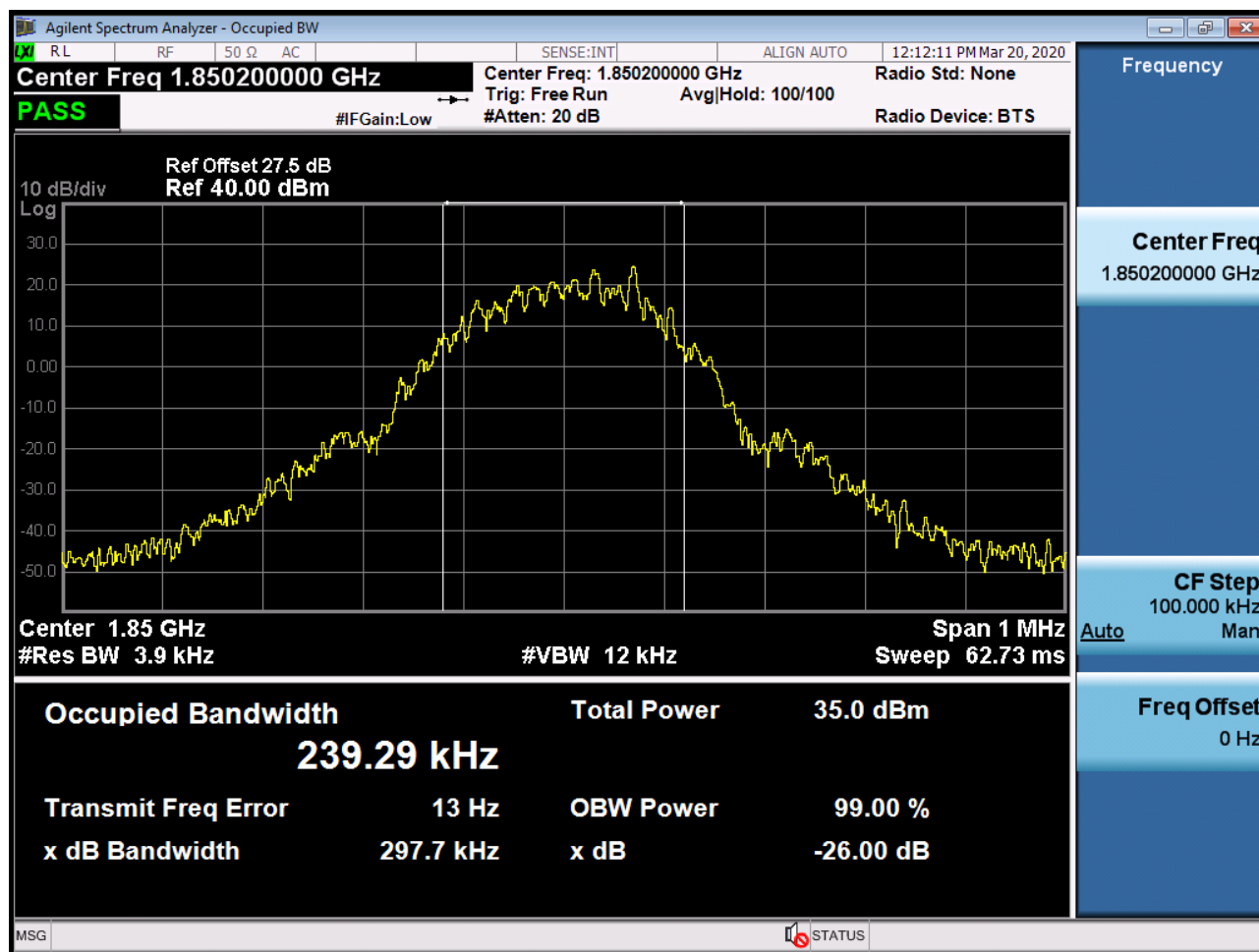
■ GSM850 MODE (251 CH.) Occupied Bandwidth



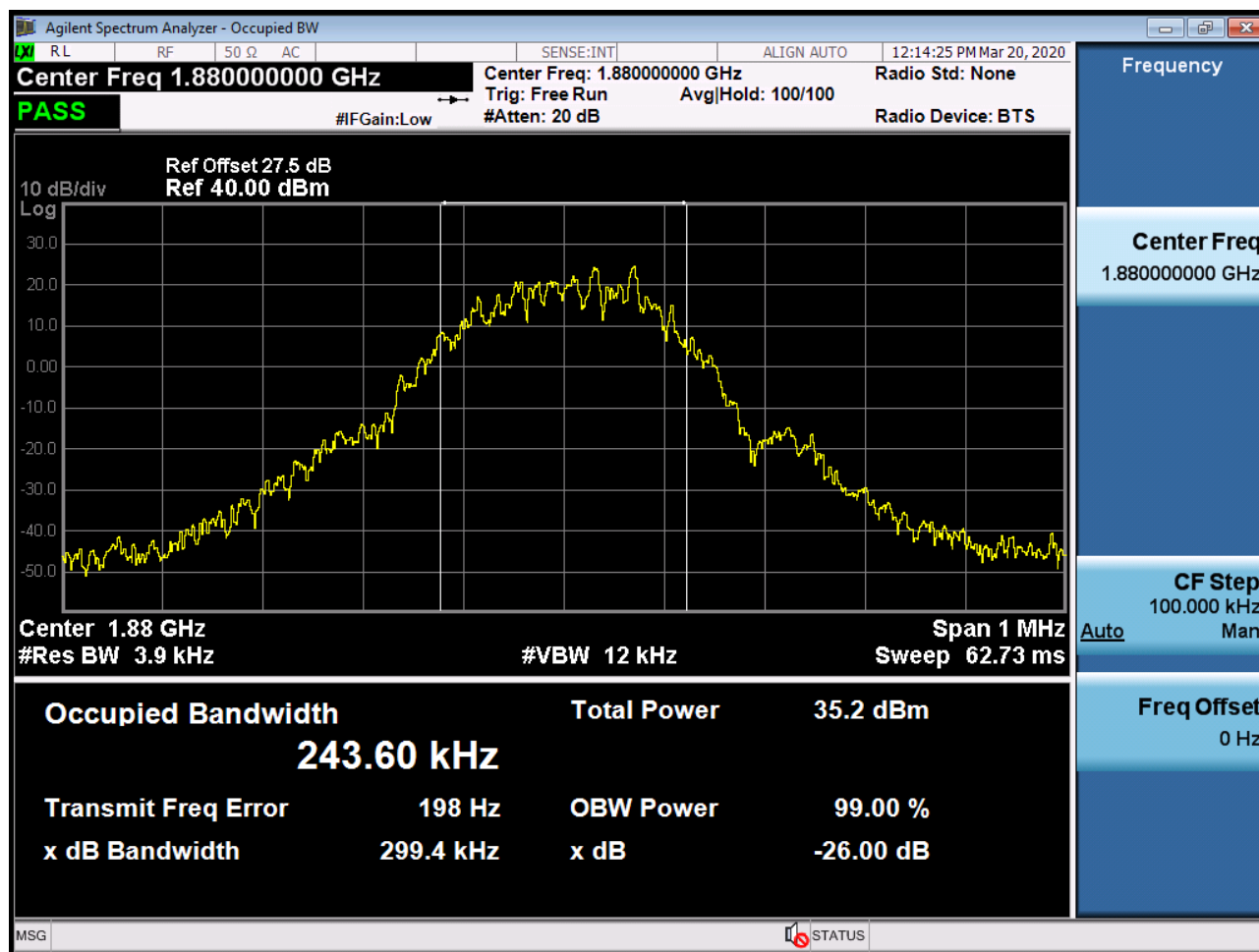
■ GSM850 EDGE (128 CH.) Occupied Bandwidth



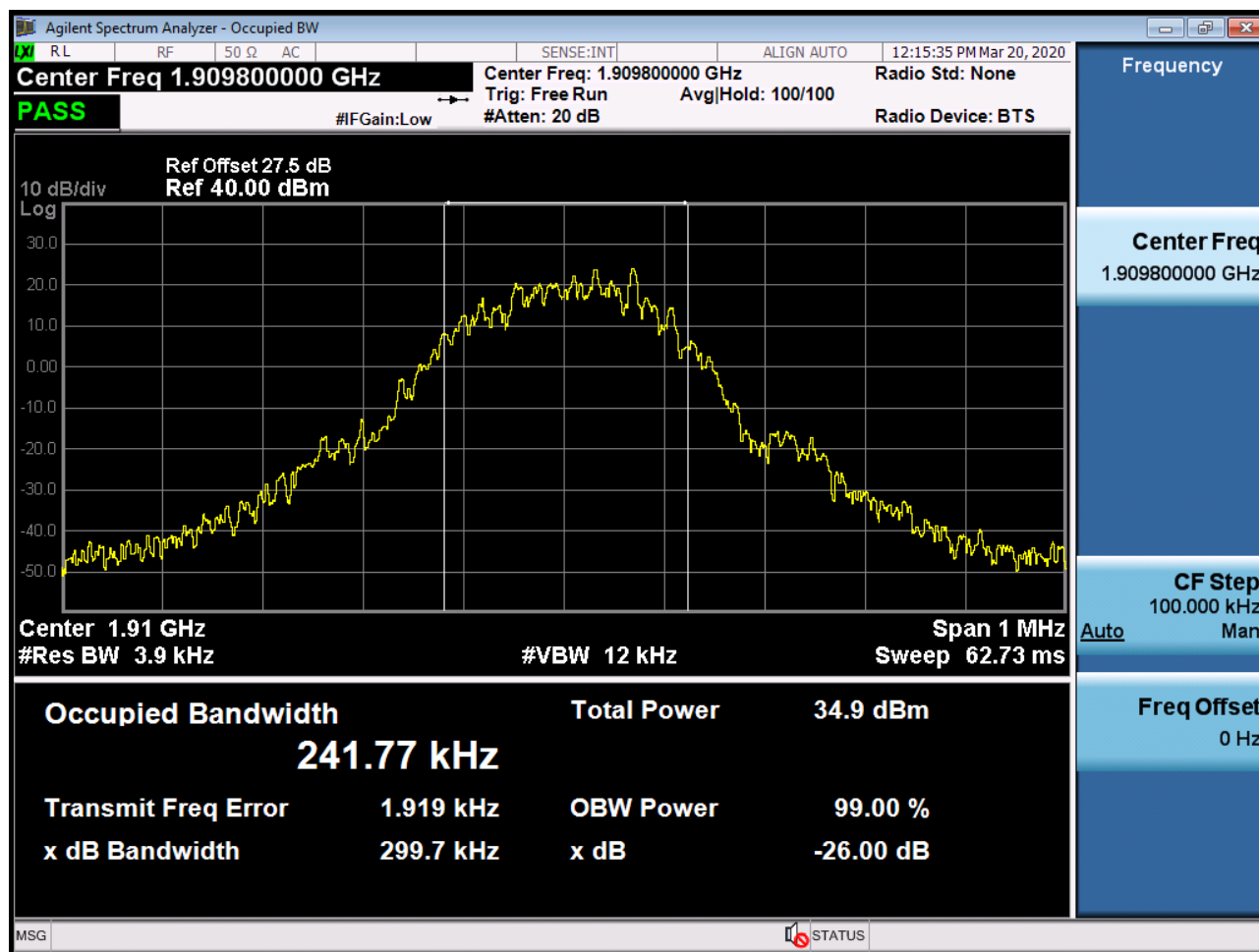
■ GSM1900 MODE (512 CH.) Occupied Bandwidth



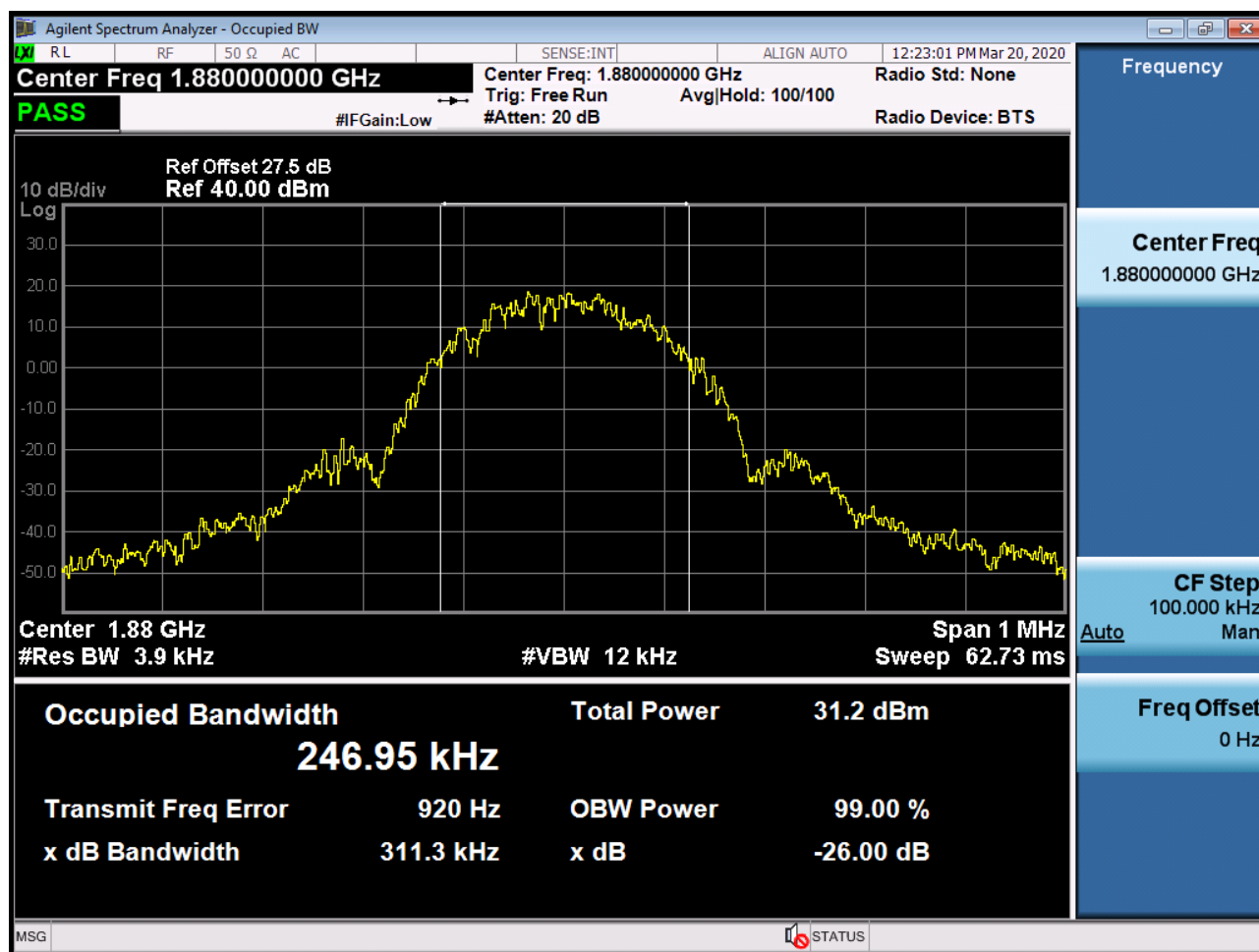
■ GSM1900 MODE (661 CH.) Occupied Bandwidth



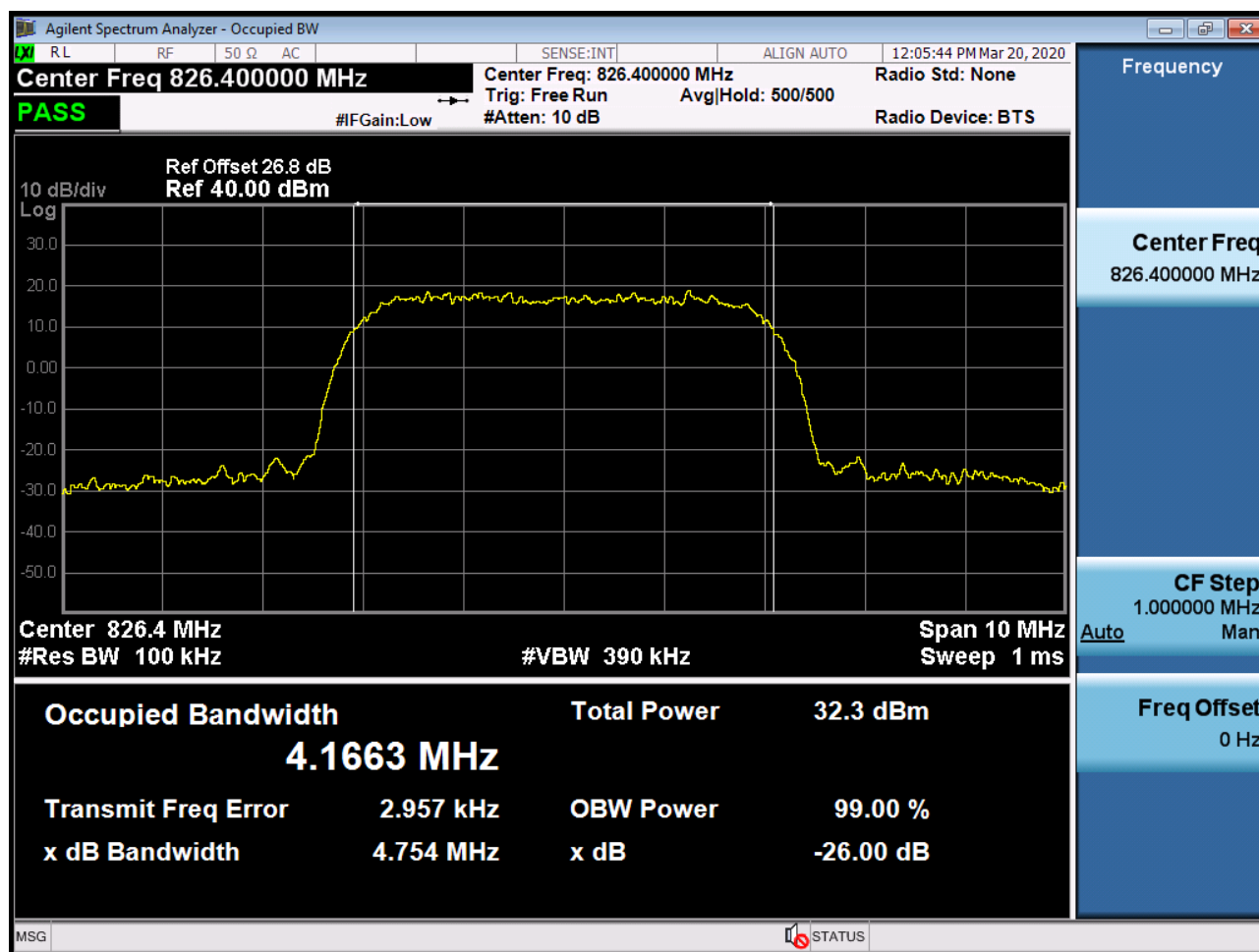
■ GSM1900 MODE (810 CH.) Occupied Bandwidth



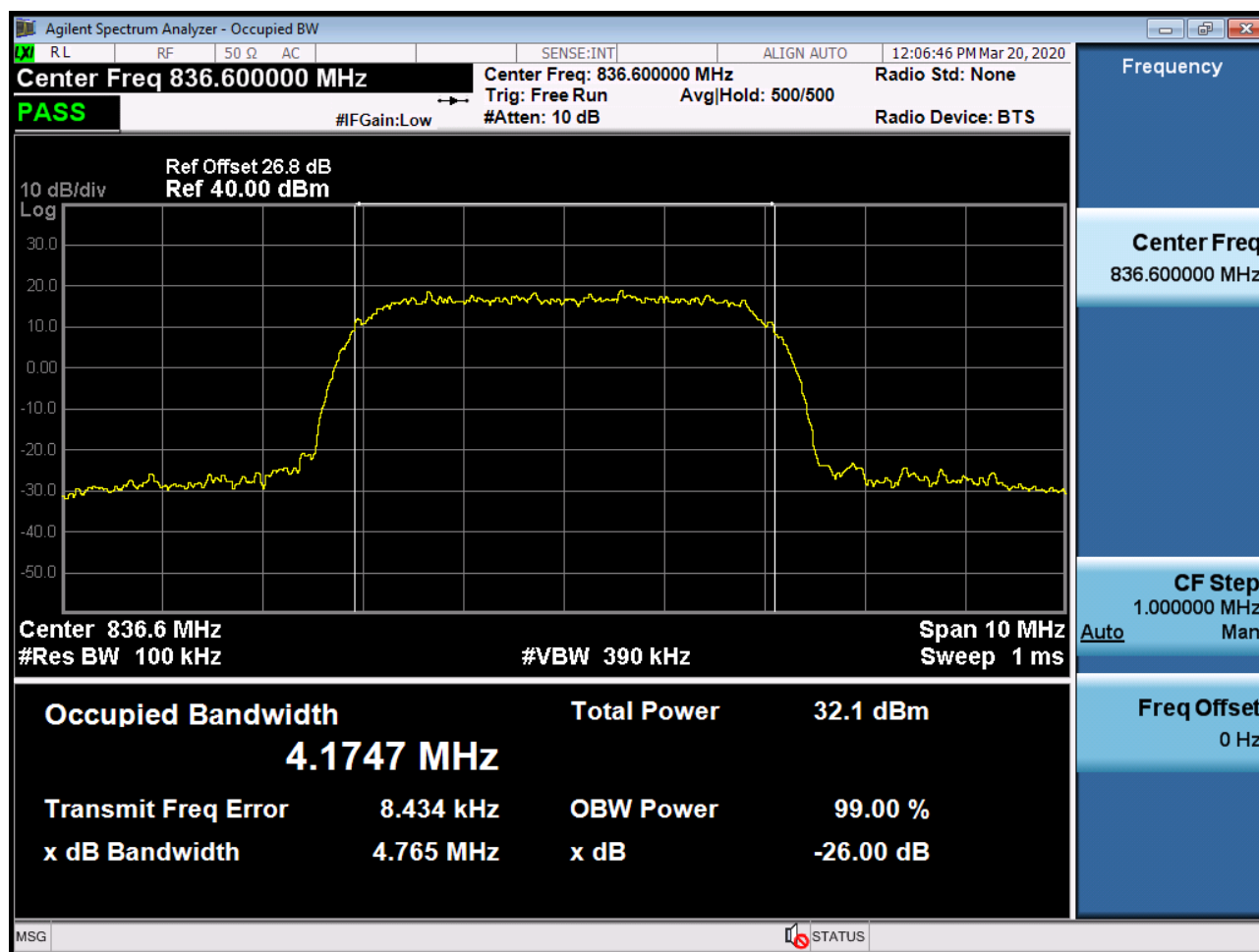
■ GSM1900 EDGE (661 CH.) Occupied Bandwidth



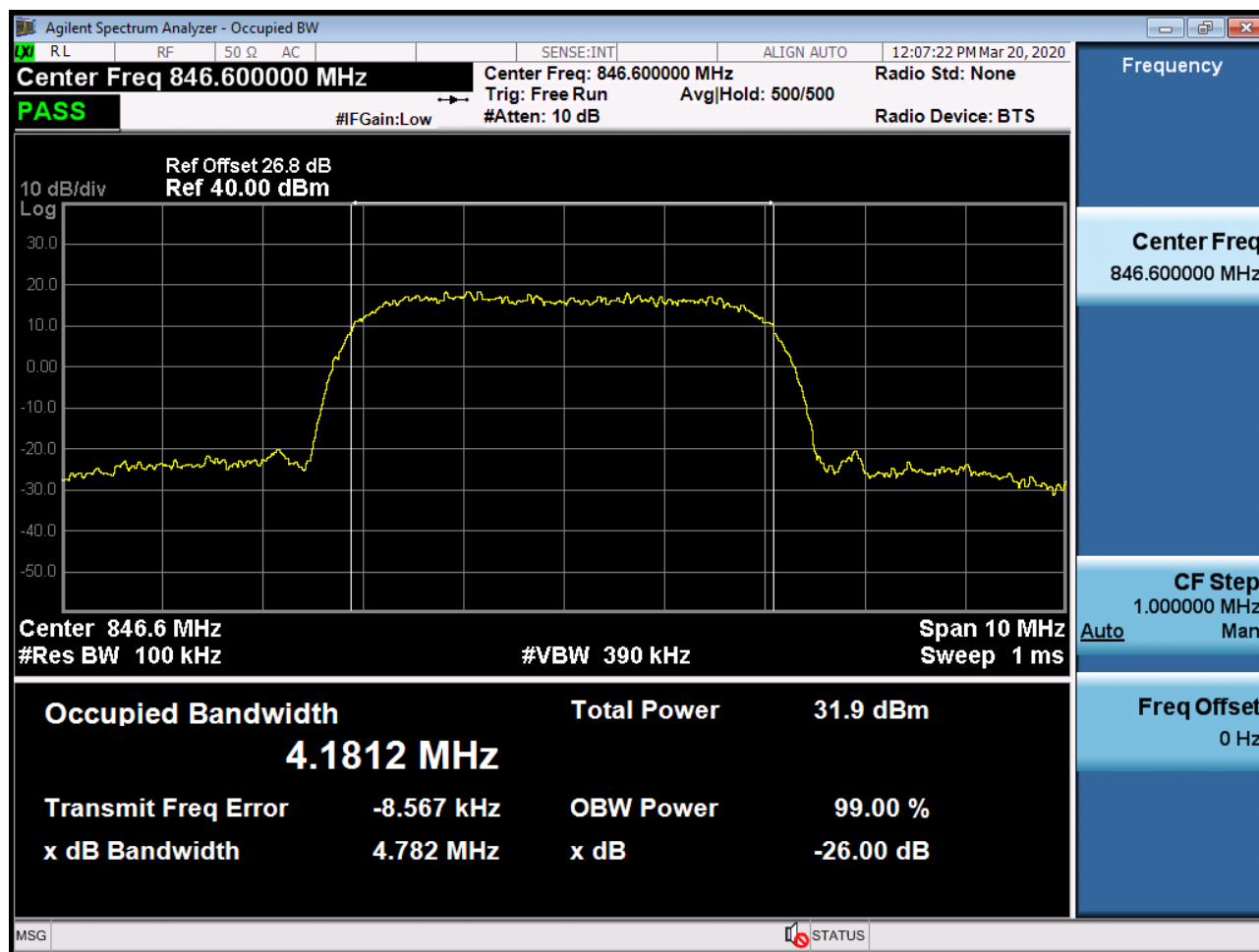
■ WCDMA850 MODE (4132 CH.) Occupied Bandwidth



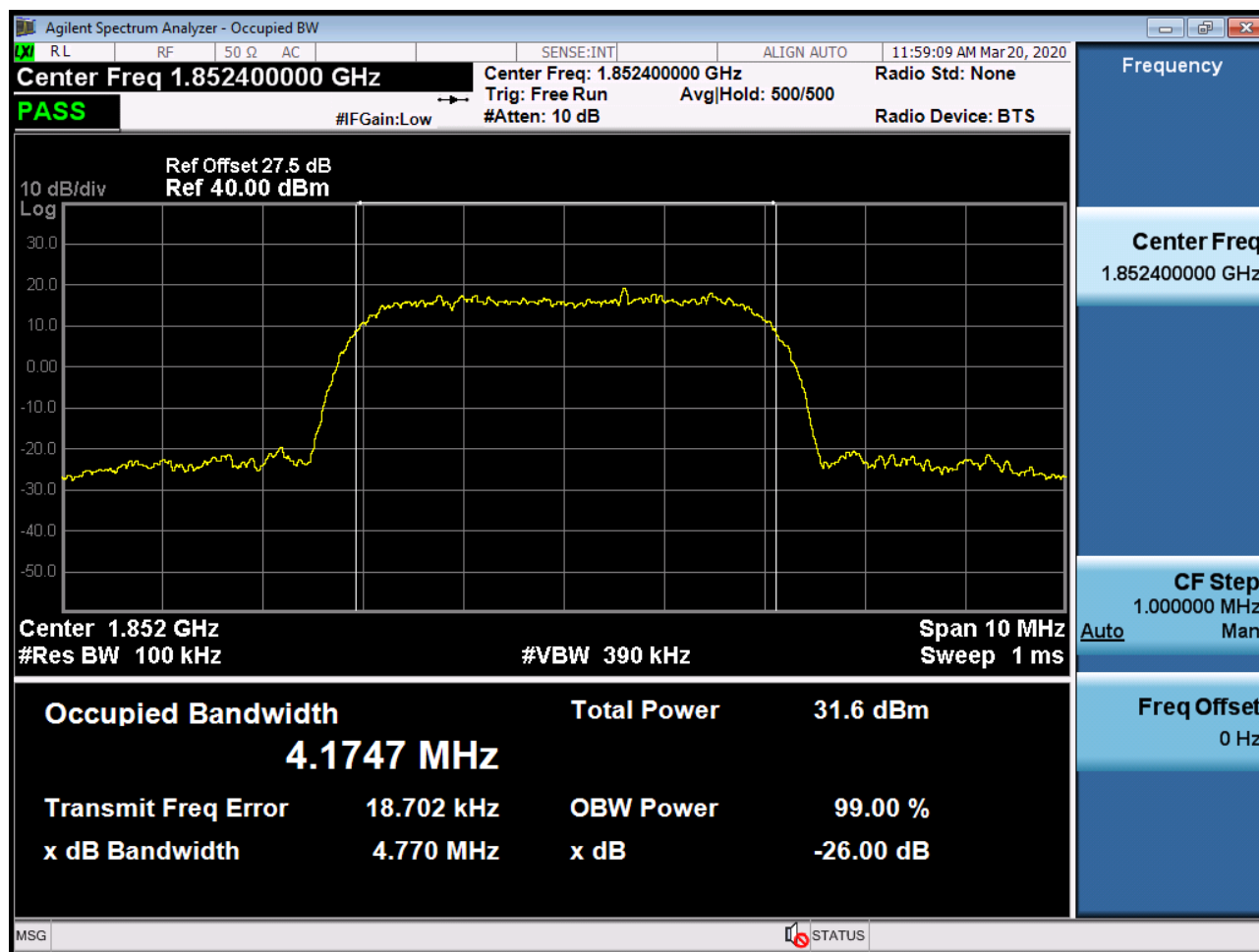
■ WCDMA850 MODE (4183 CH.) Occupied Bandwidth



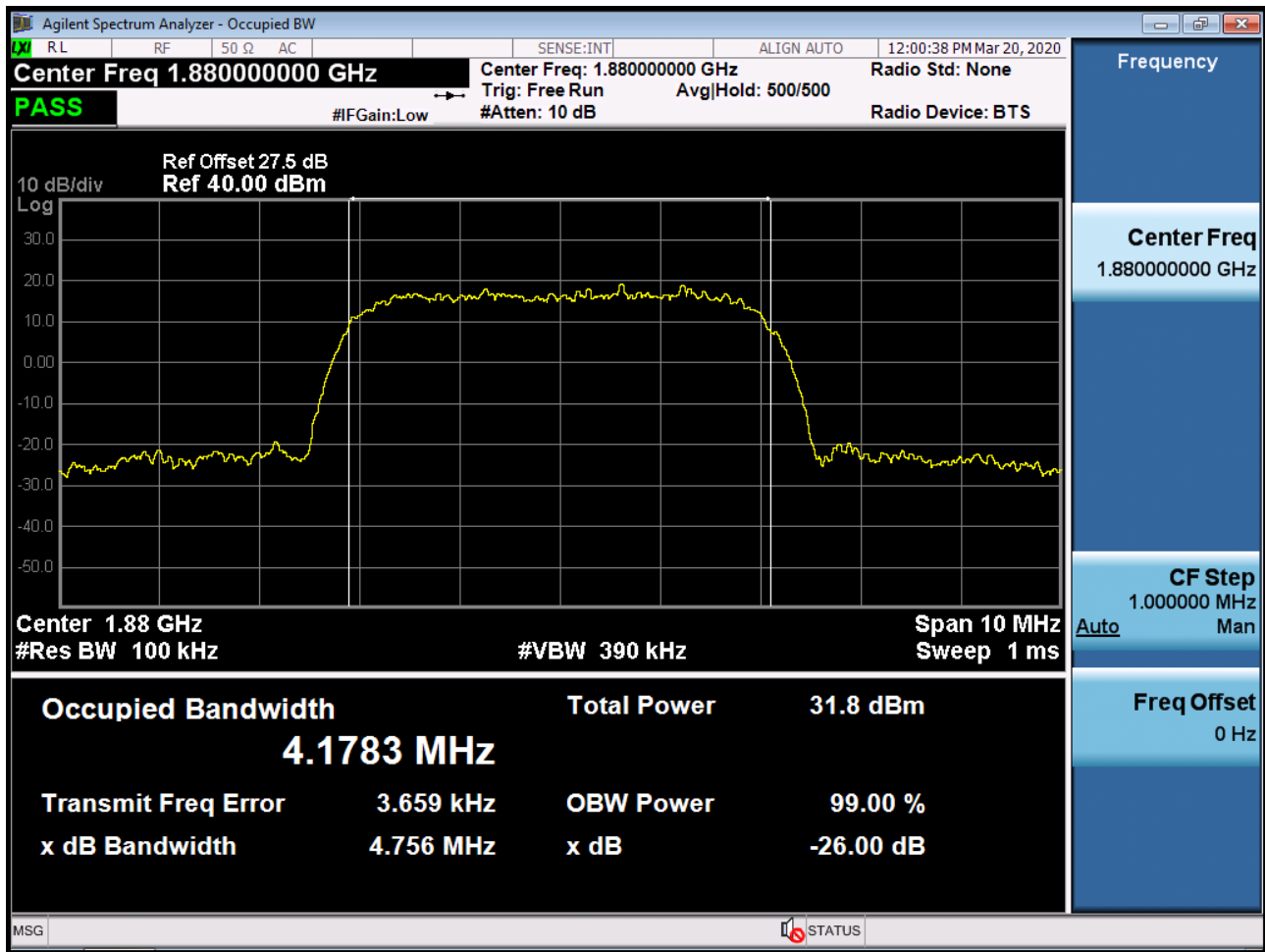
■ WCDMA850MODE (4233 CH.) Occupied Bandwidth



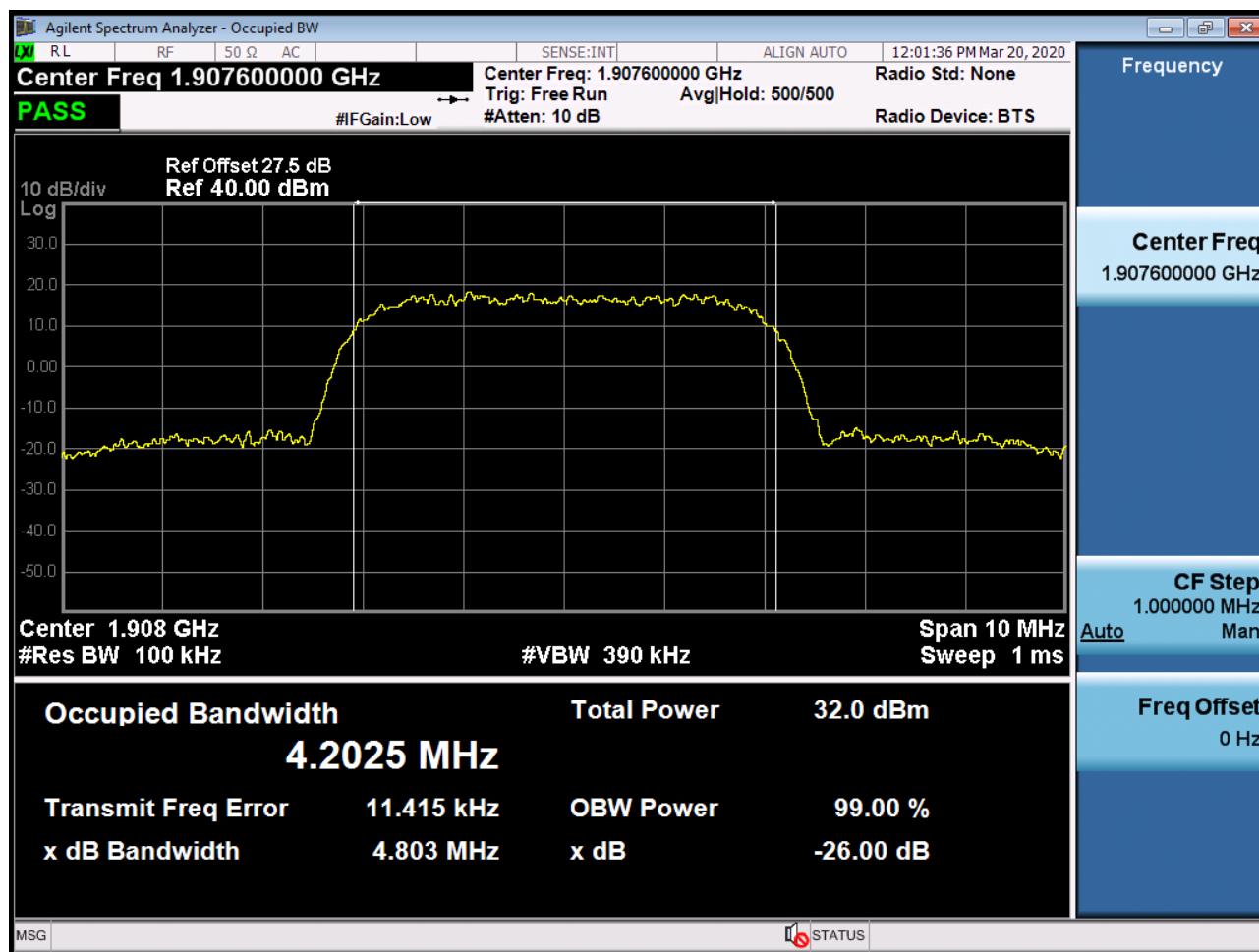
■ WCDMA1900 MODE (9262 CH.) Occupied Bandwidth



■ WCDMA1900 MODE (9400 CH.) Occupied Bandwidth



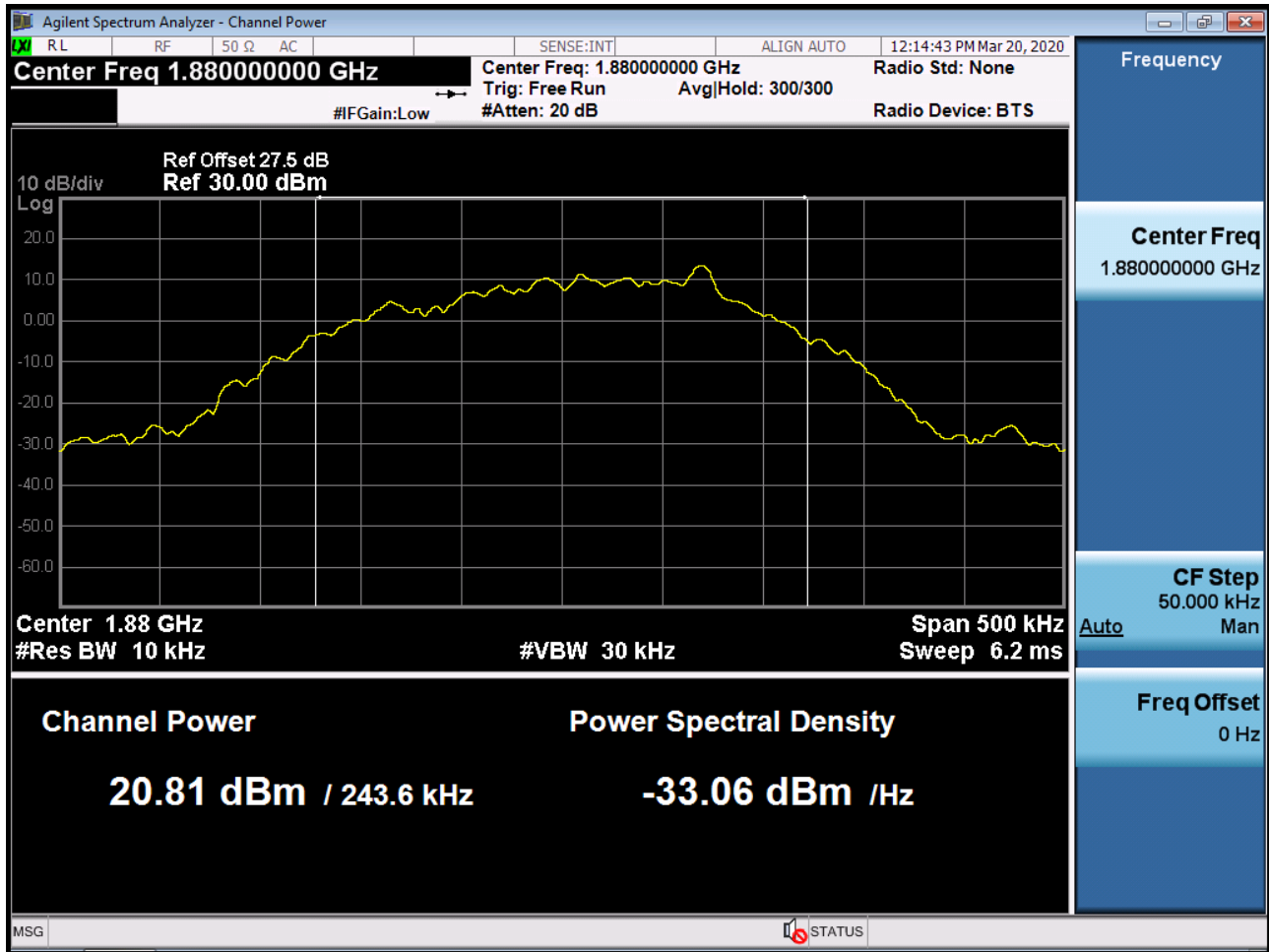
■ WCDMA1900 MODE (9538 CH.) Occupied Bandwidth



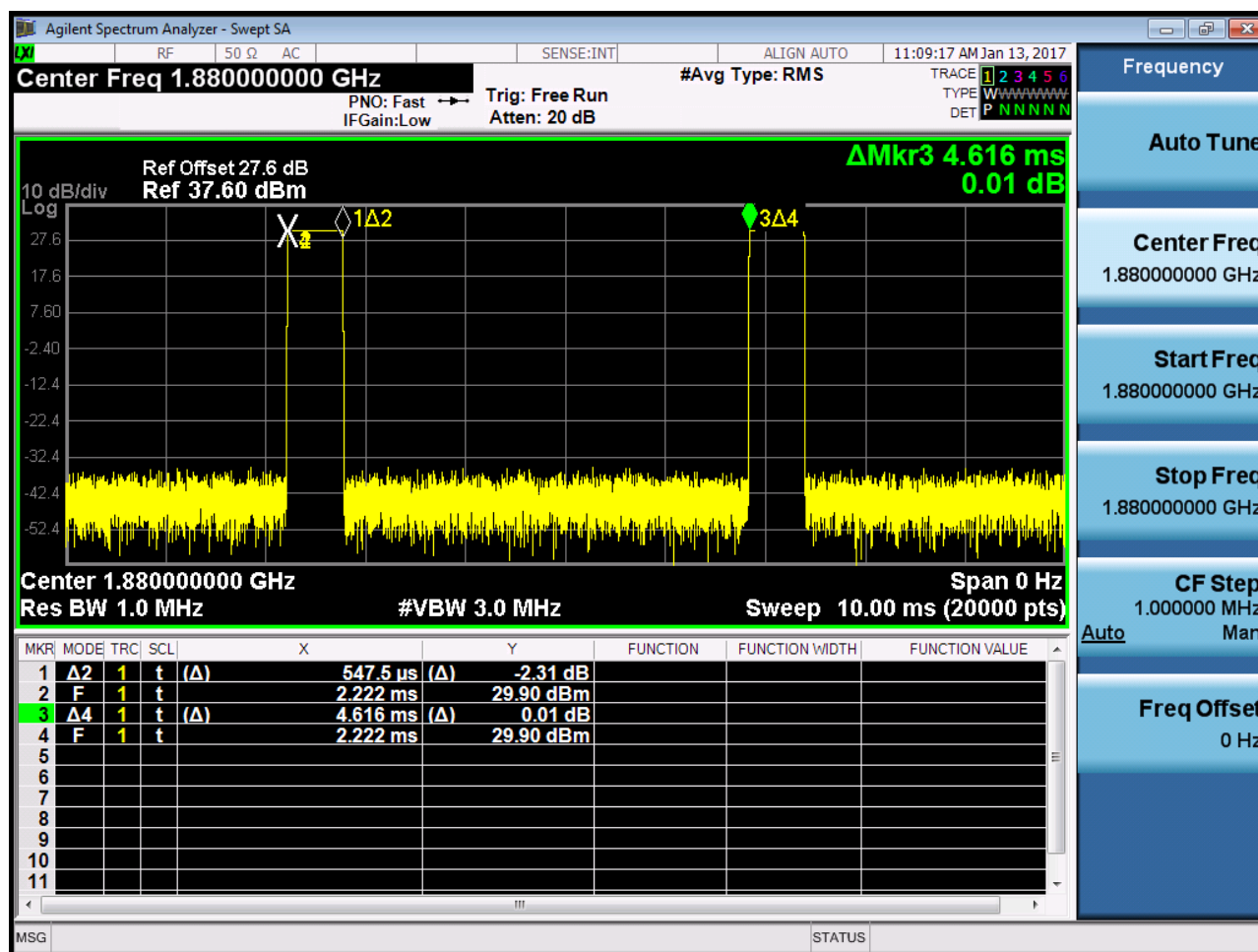
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P<sub>PK</sub>



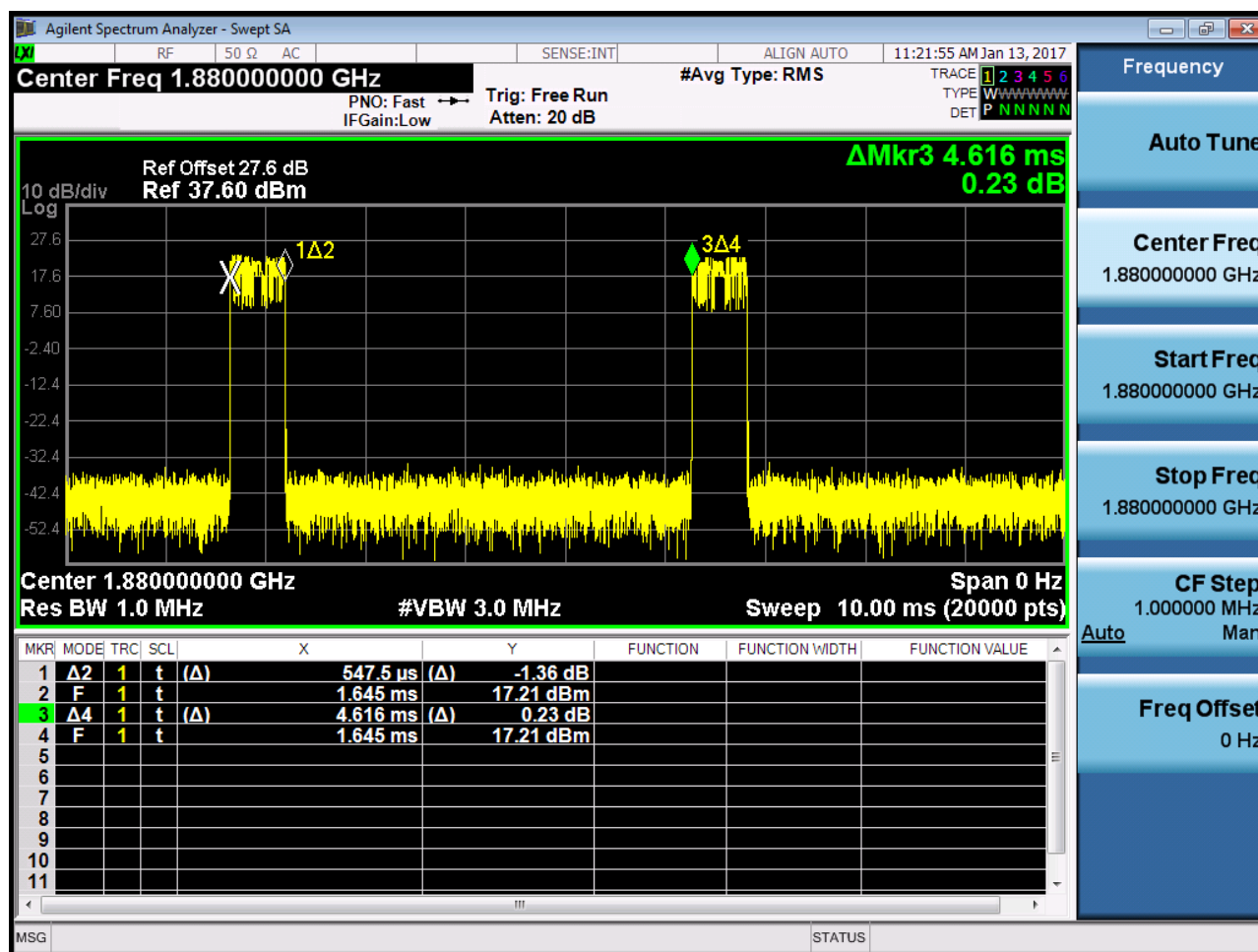
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio  $P_{Avg}$



■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio Duty



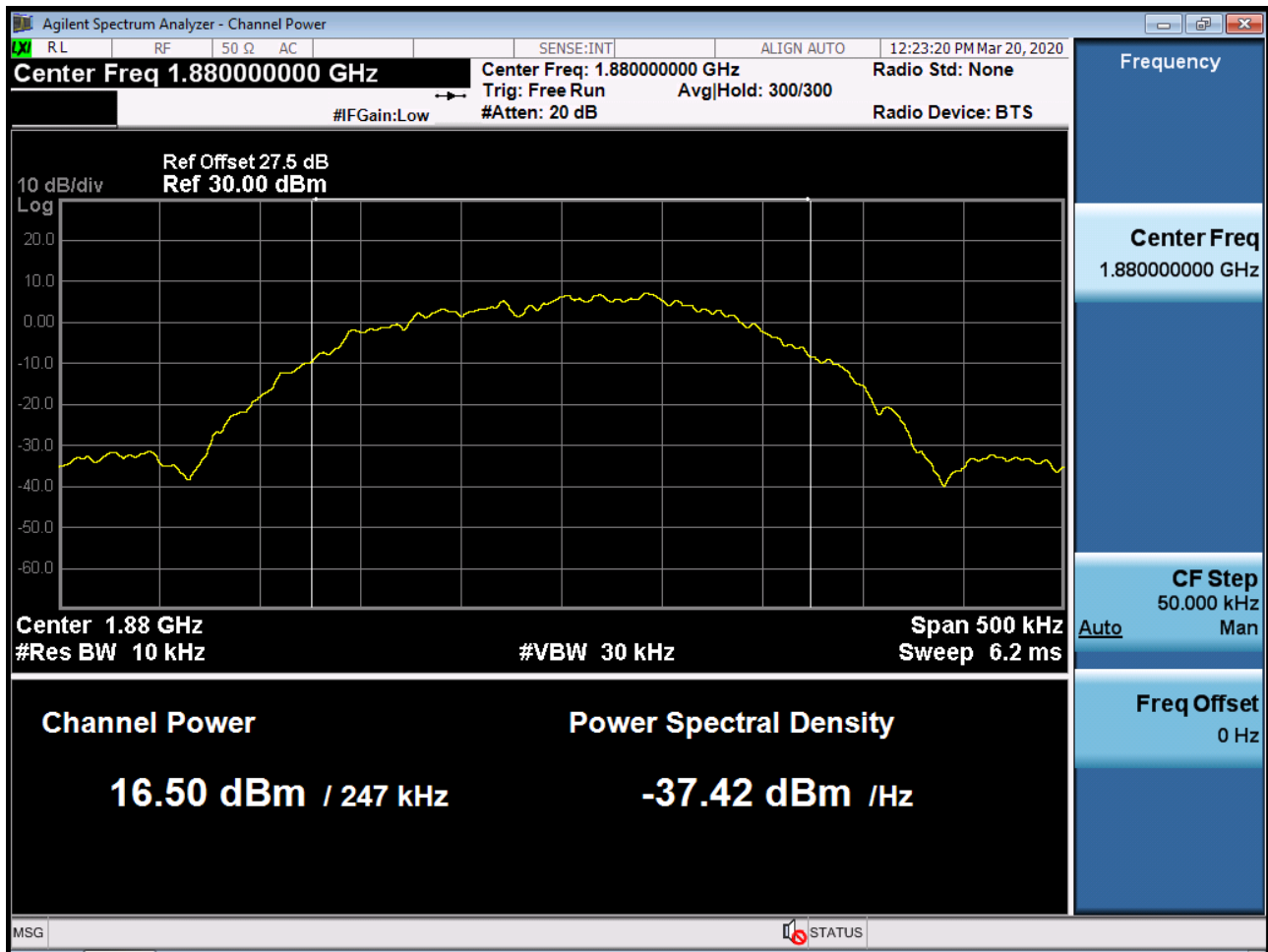
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio Duty



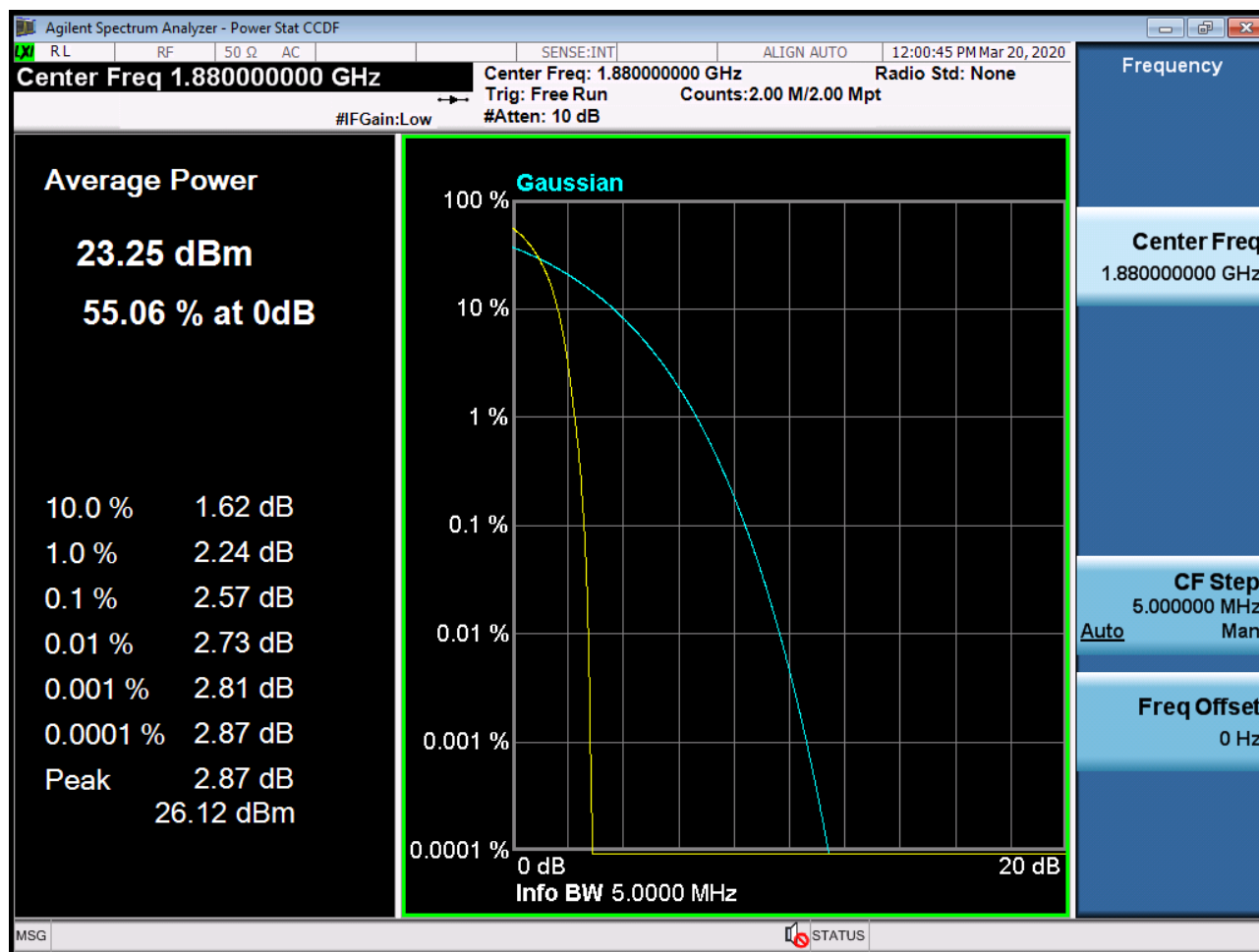
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P<sub>PK</sub>



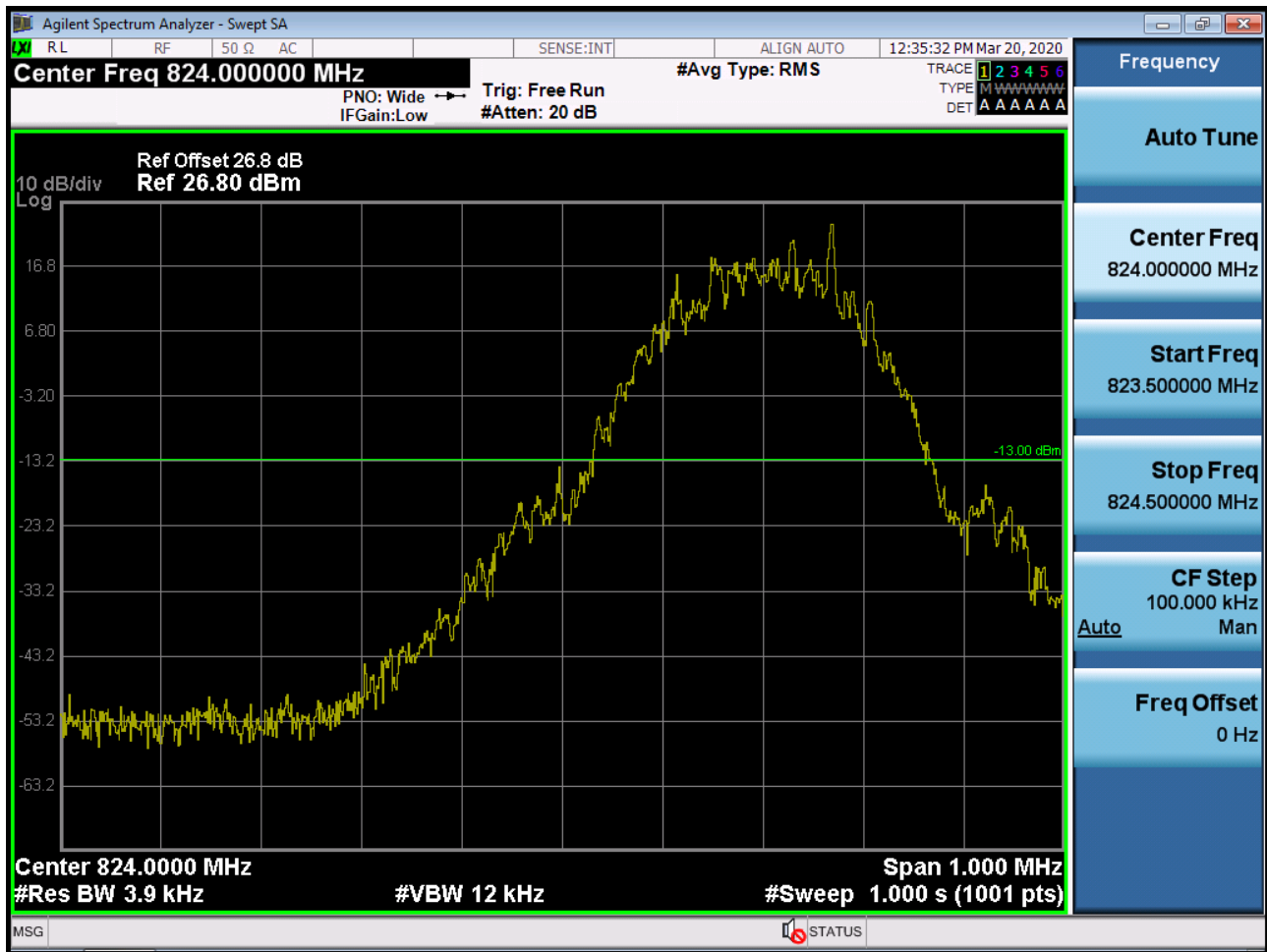
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio  $P_{Avg}$



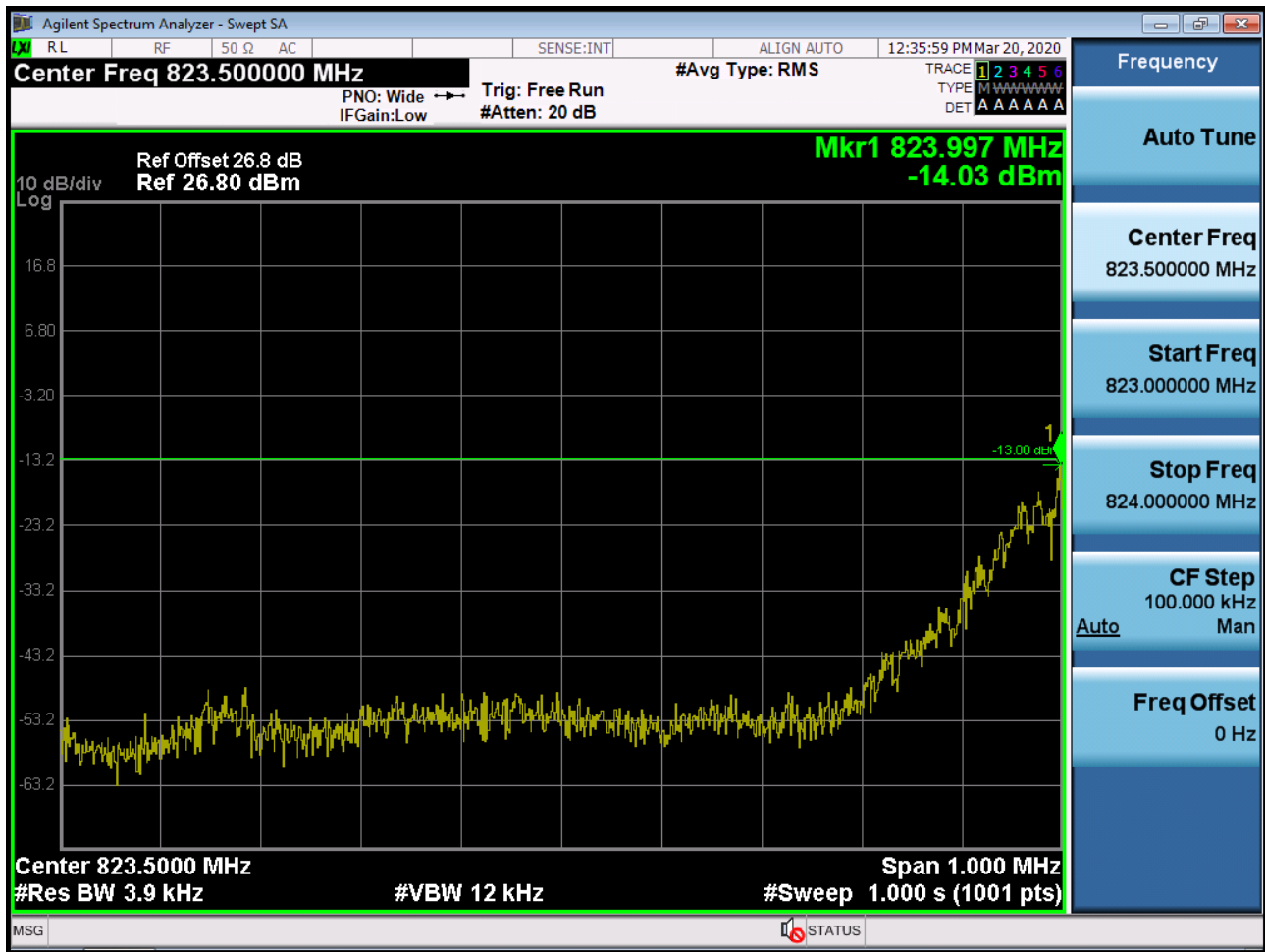
■ WCDMA1900 MODE (9400 CH.) Peak-to-Average Ratio



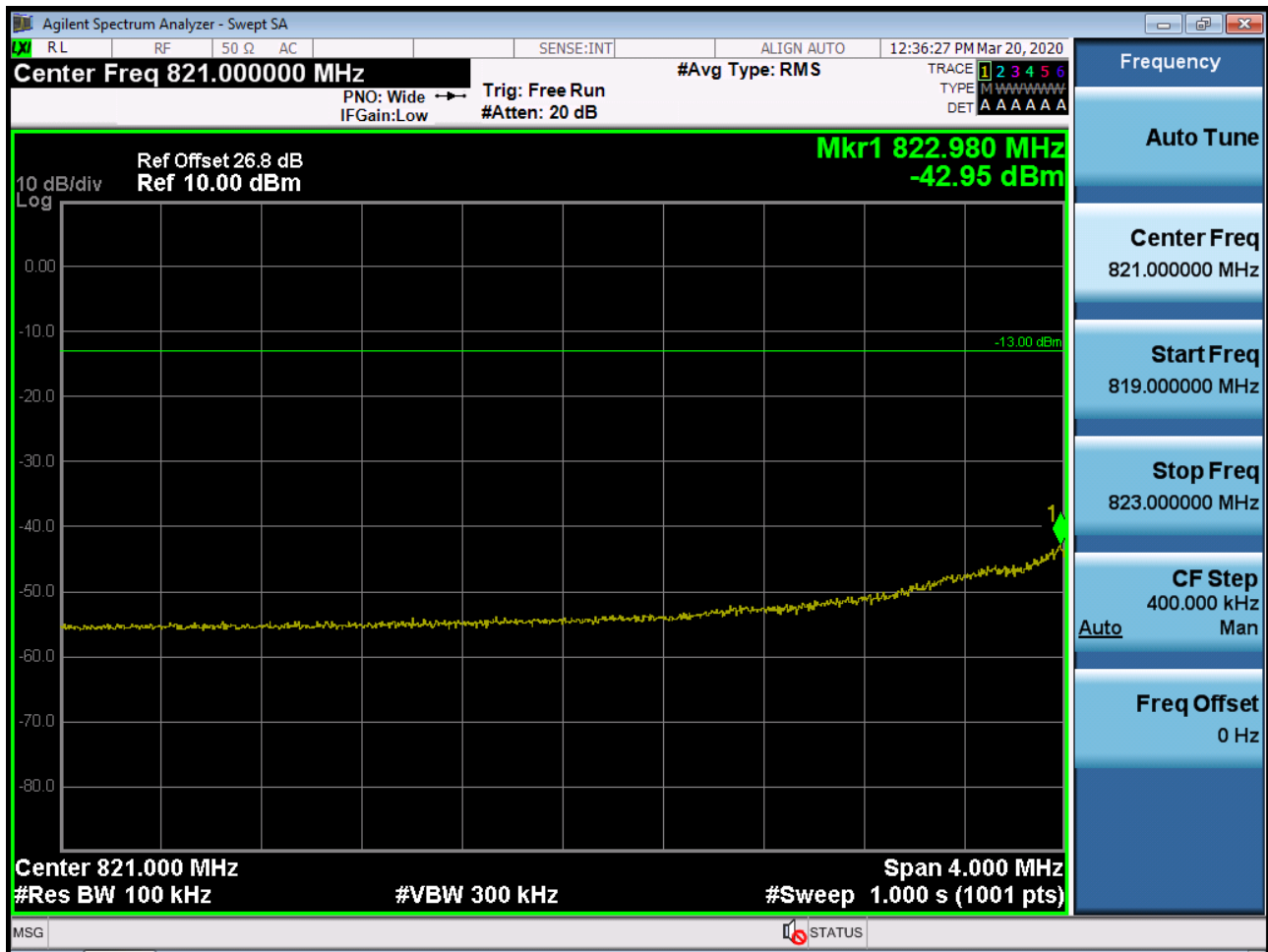
■ GSM850 MODE (128 CH.) Block Edge 1



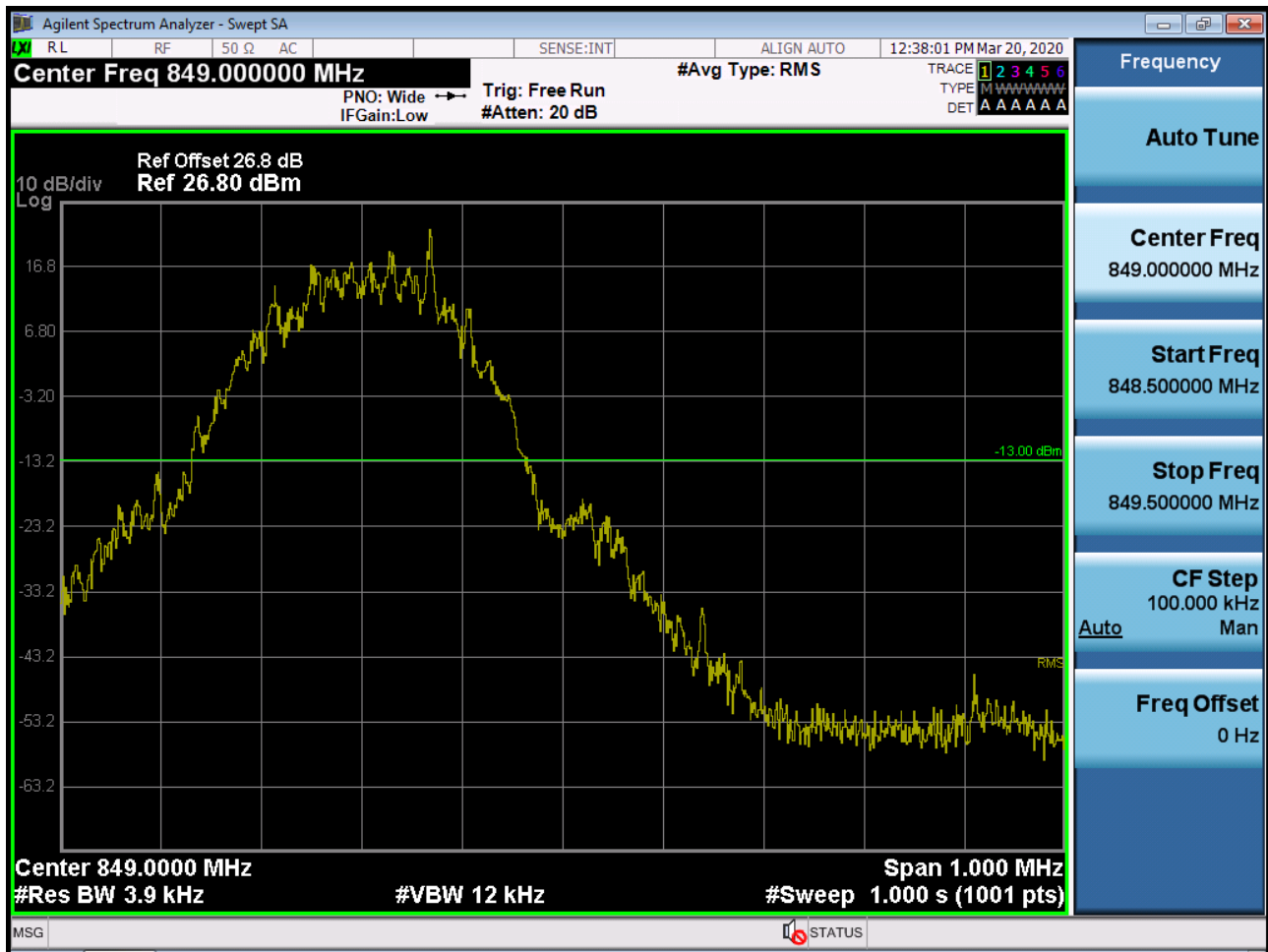
■ GSM850 MODE (128 CH.) Block Edge 2



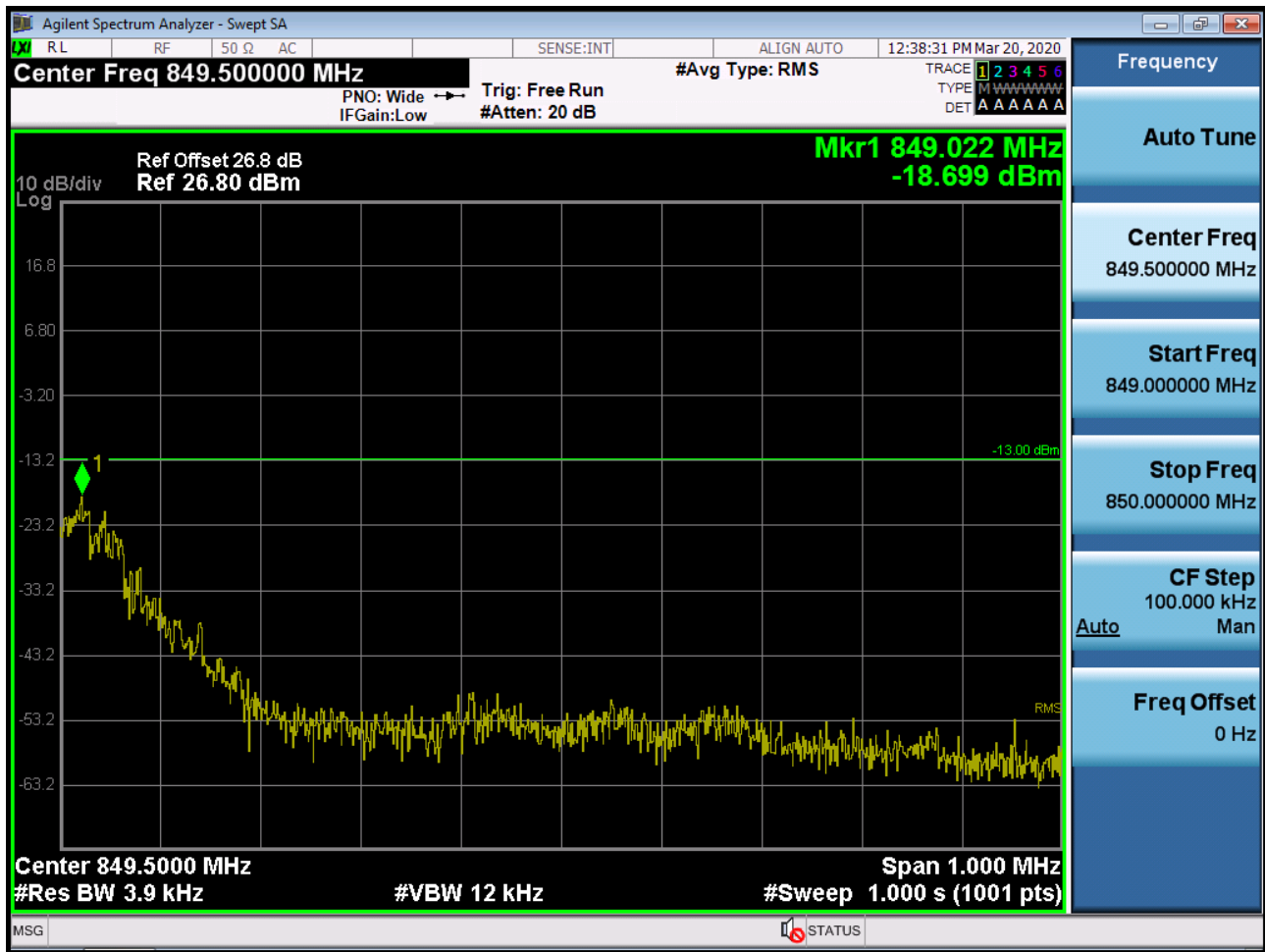
■ GSM850 MODE (128 CH.) Block Edge 3



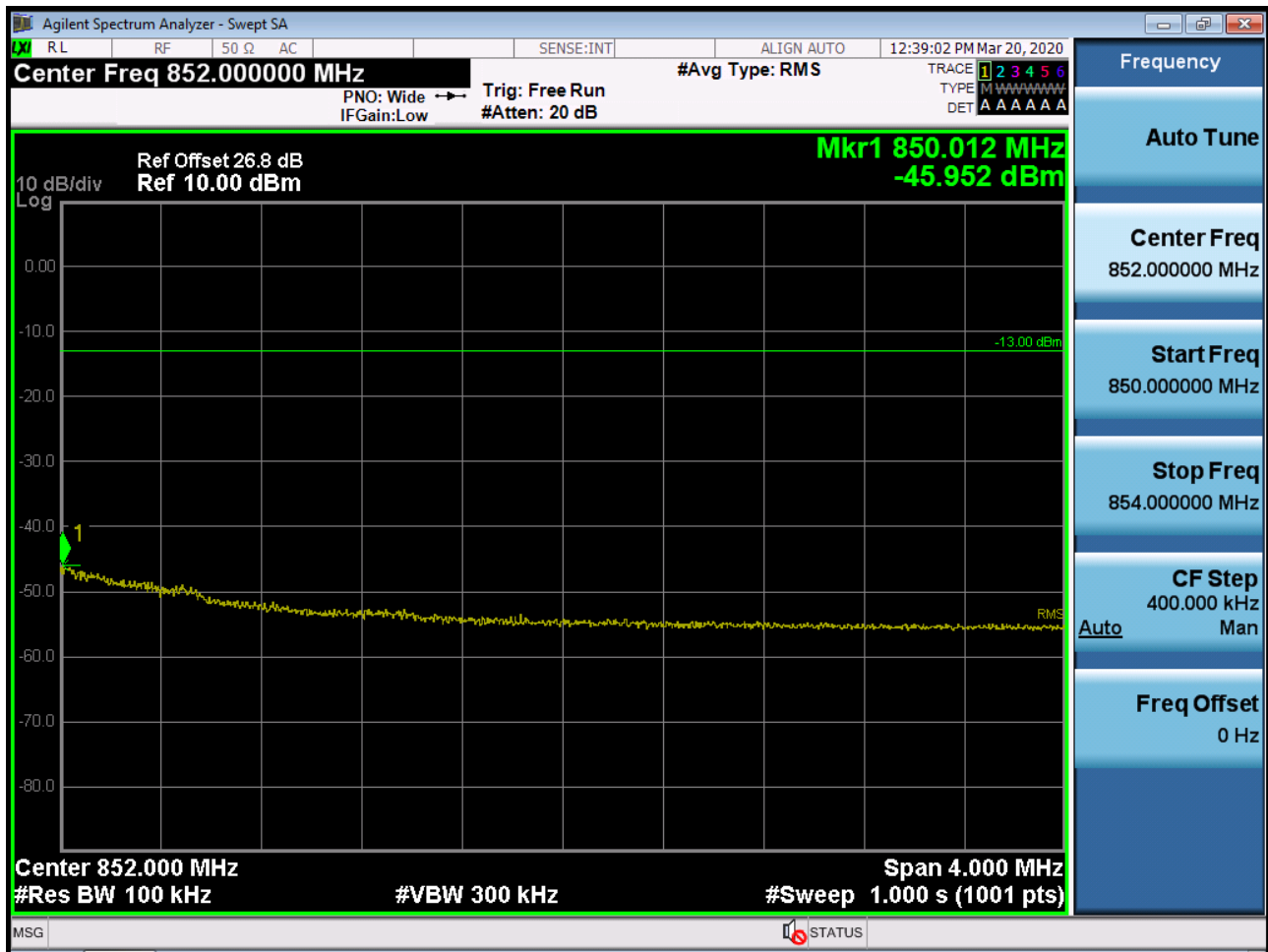
■ GSM850 MODE (251 CH.) Block Edge 1



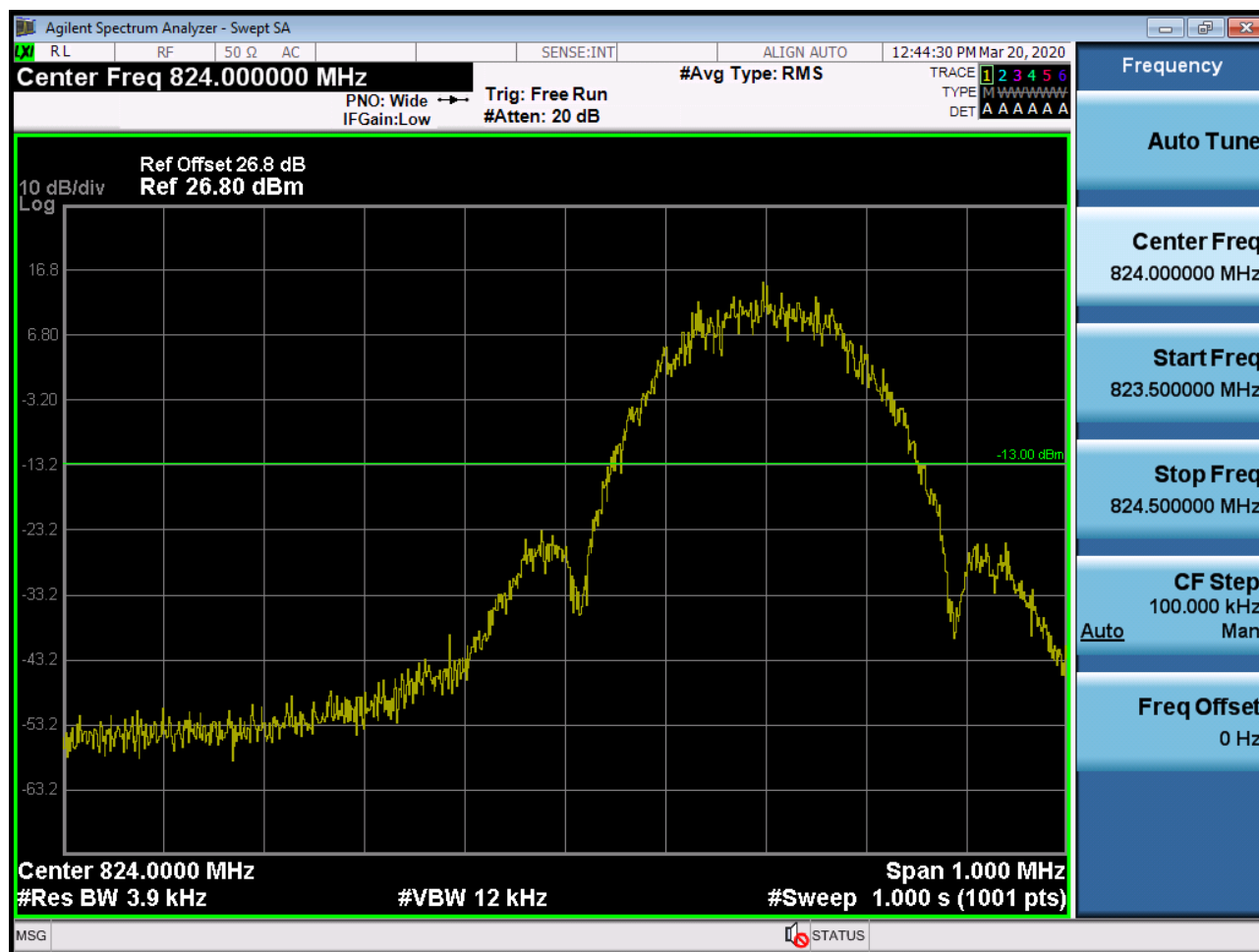
■ GSM850 MODE (251 CH.) Block Edge 2



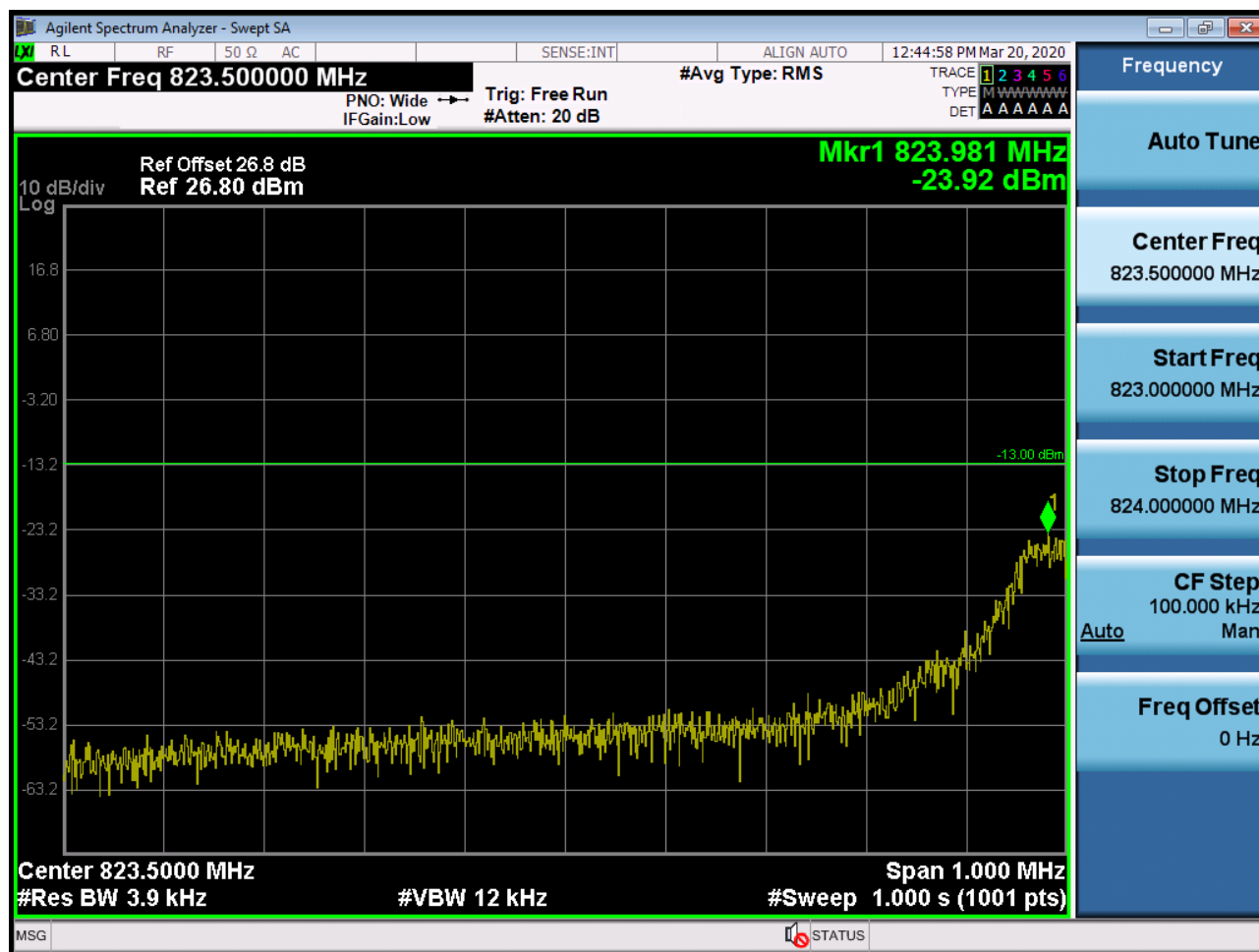
■ GSM850 MODE (251 CH.) Block Edge 3



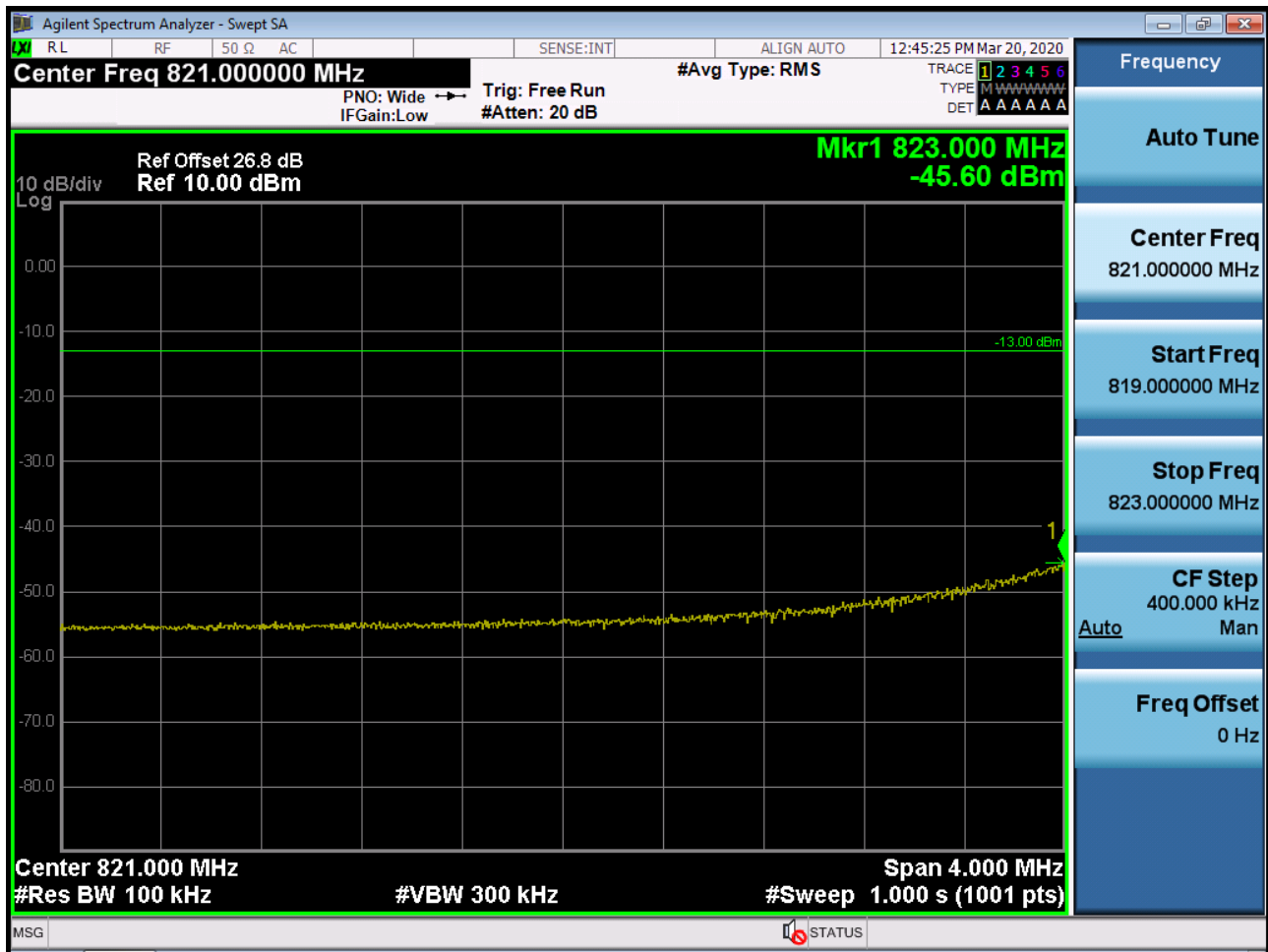
■ EDGE MODE (128 CH.) Block Edge 1



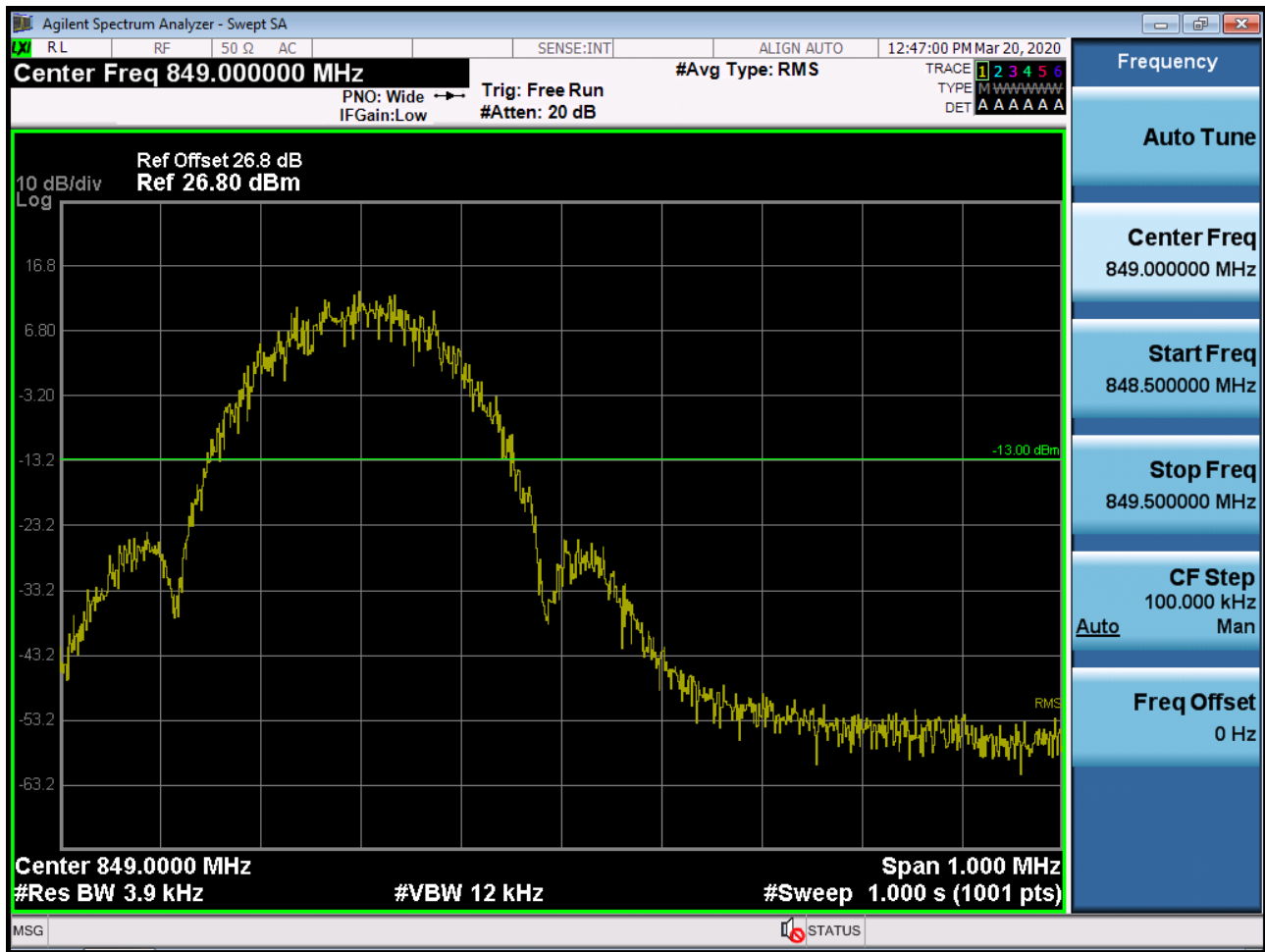
■ EDGE MODE (128 CH.) Block Edge 2



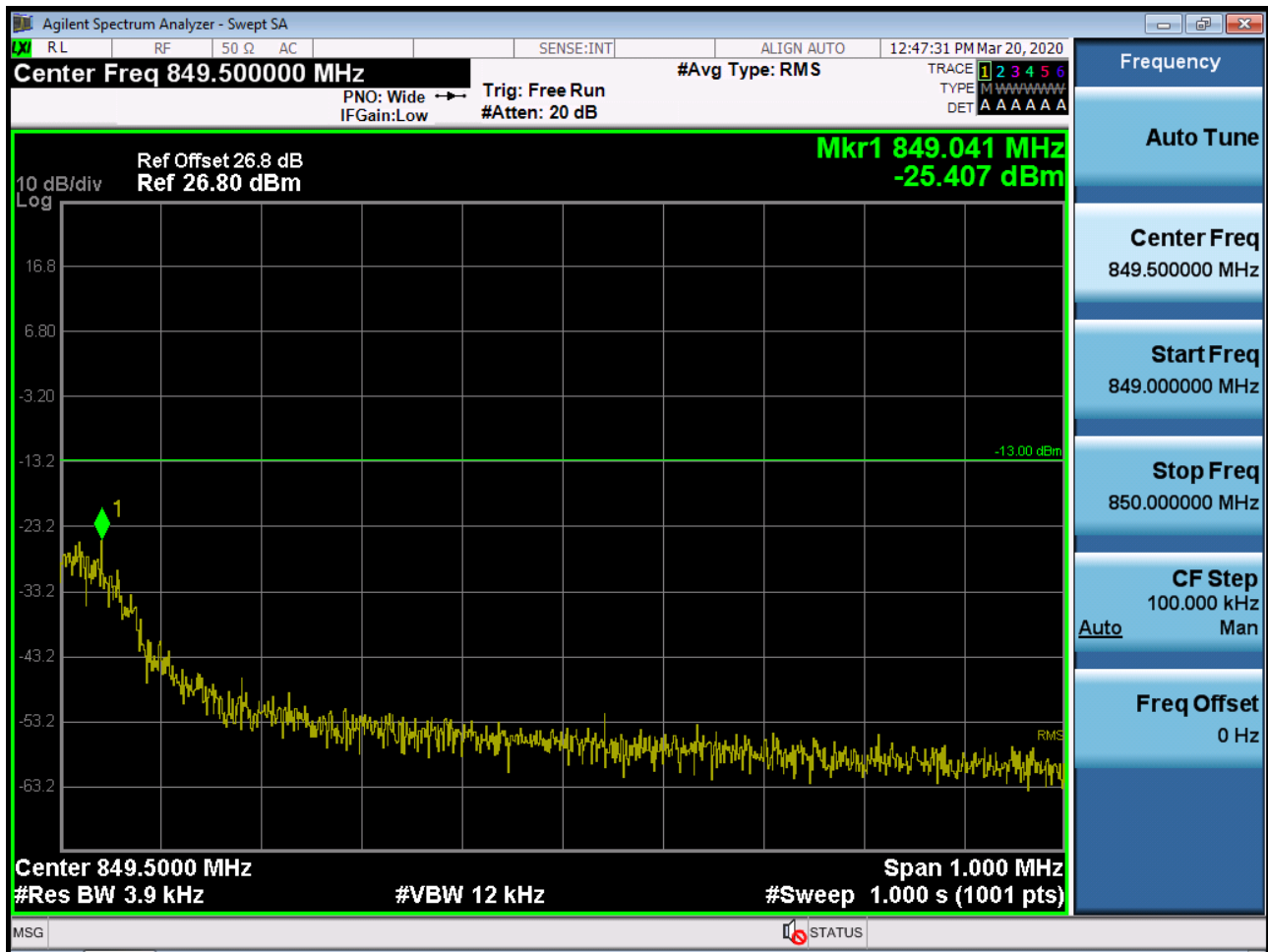
■ EDGE MODE (128 CH.) Block Edge 3



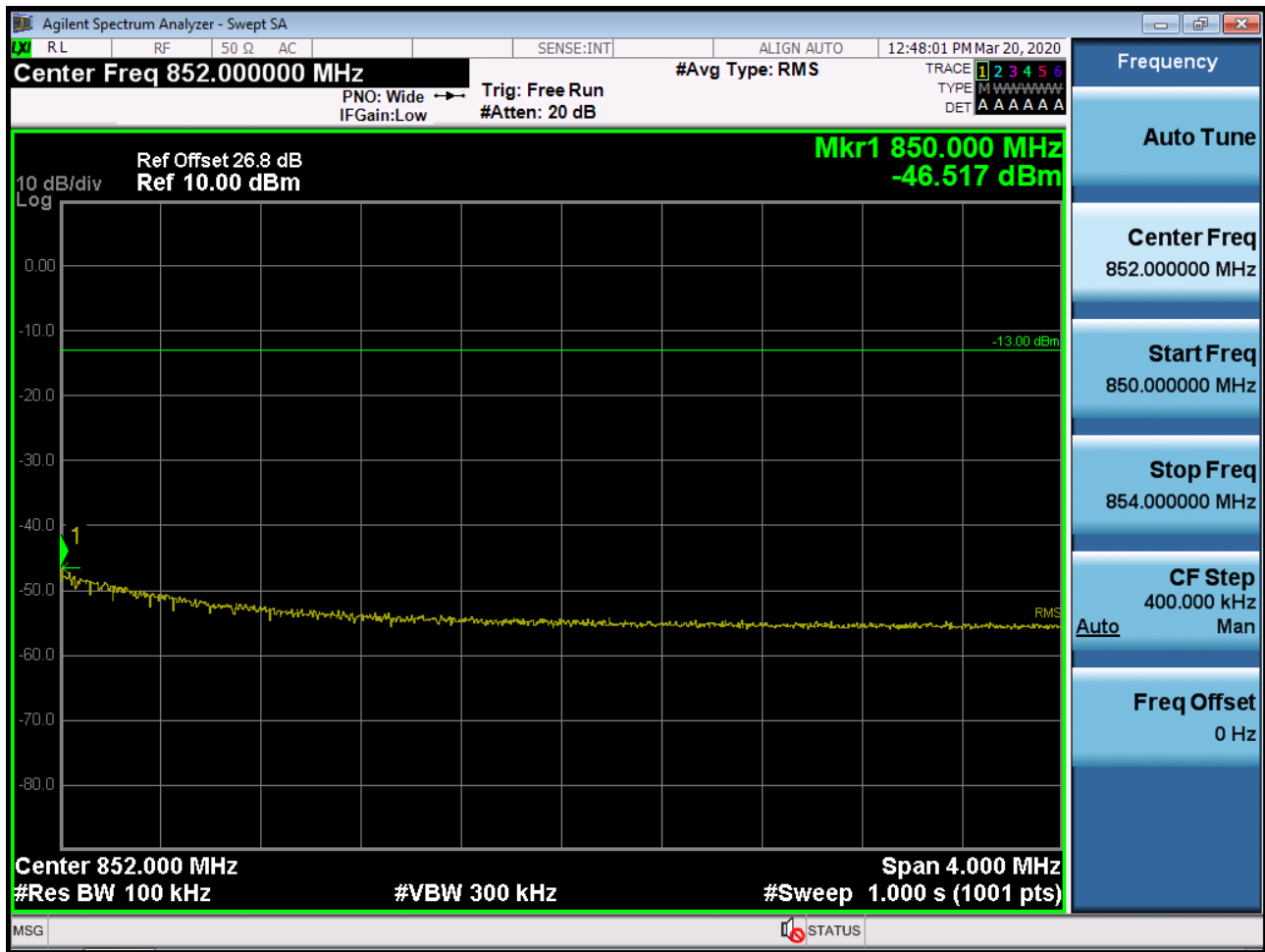
■ EDGE MODE (251 CH.) Block Edge 1



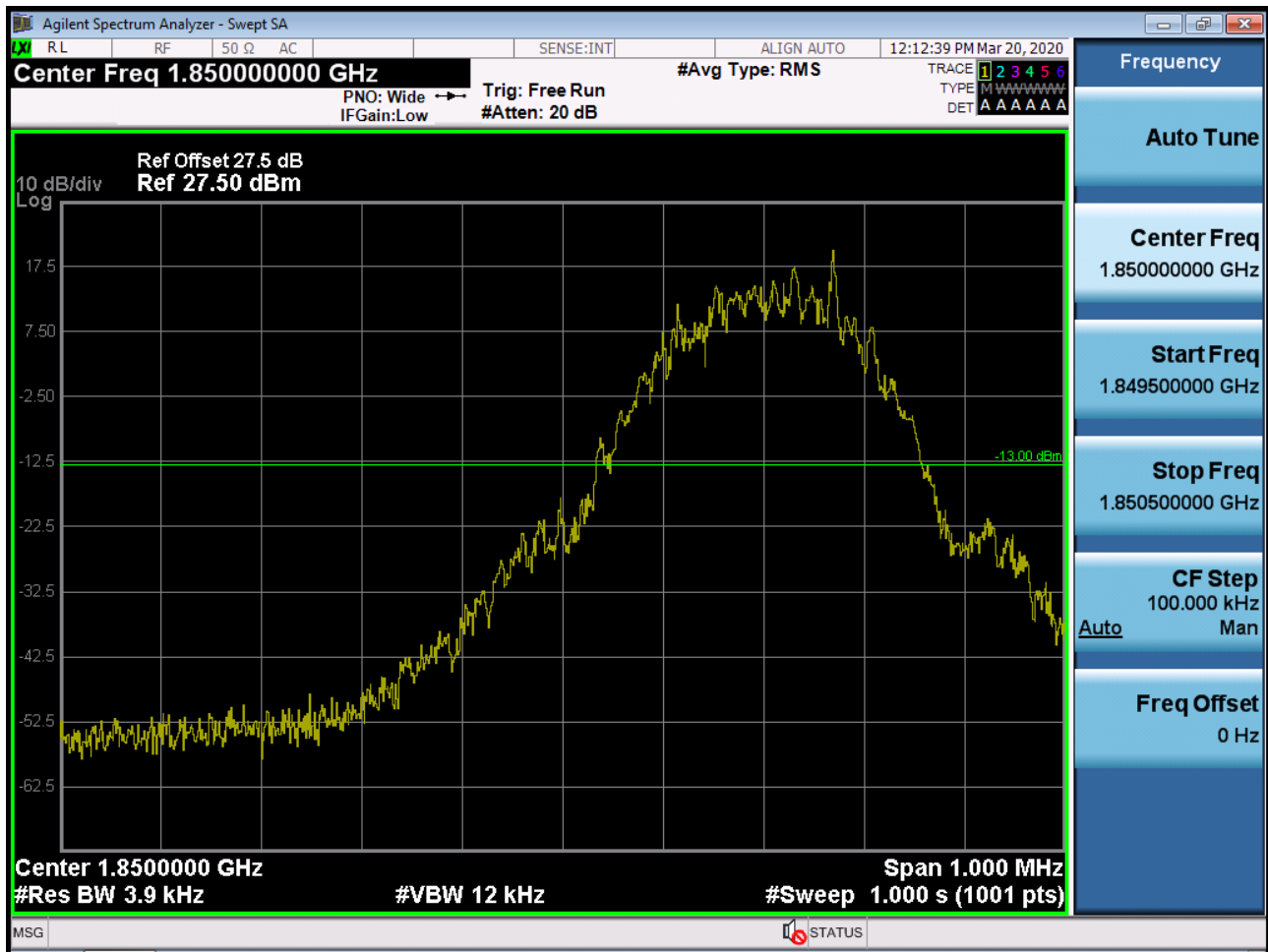
■ EDGE MODE (251 CH.) Block Edge 2



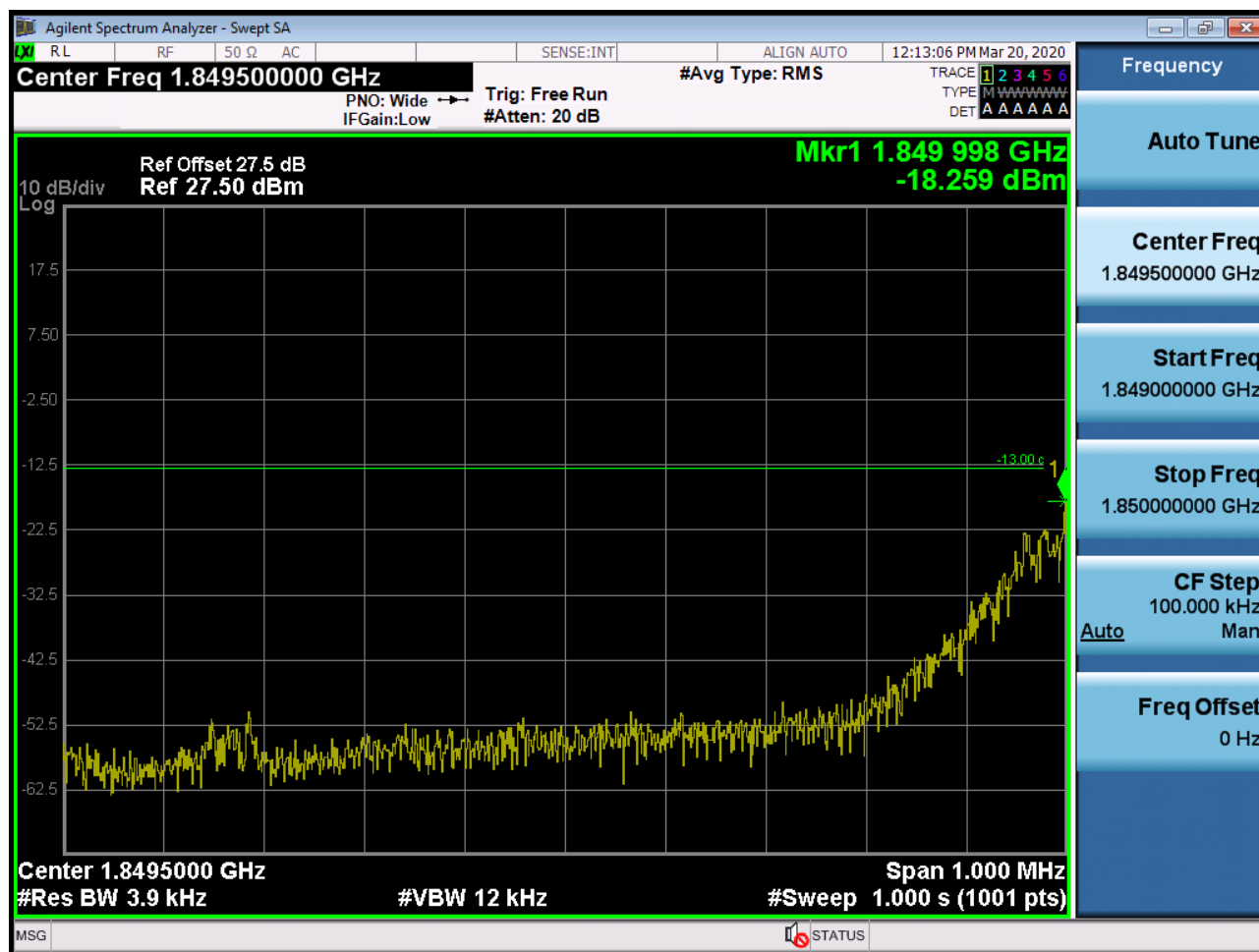
■ EDGE MODE (251 CH.) Block Edge 3



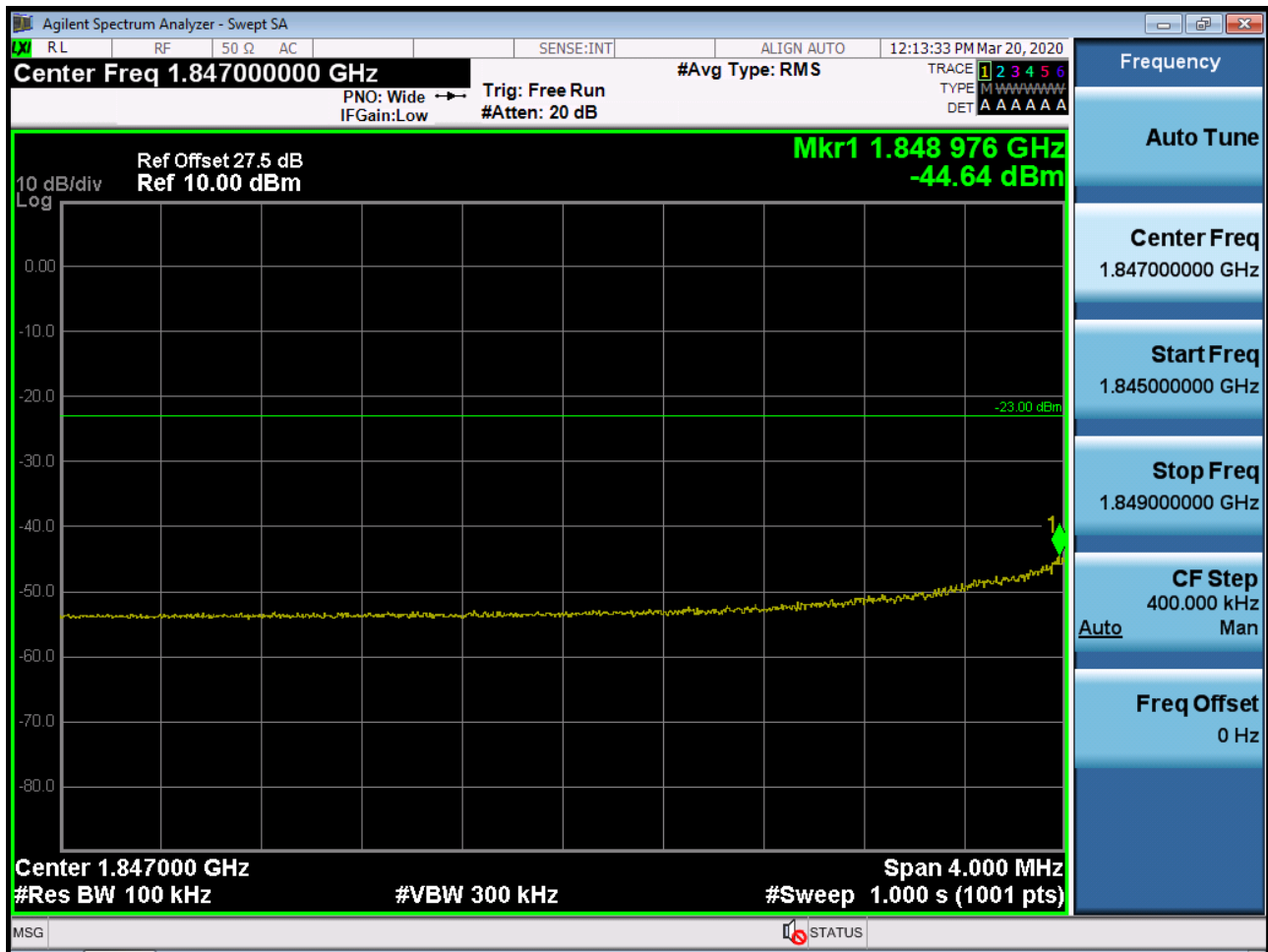
■ GSM1900 MODE (512 CH.) Block Edge 1



■ GSM1900 MODE (512 CH.) Block Edge 2



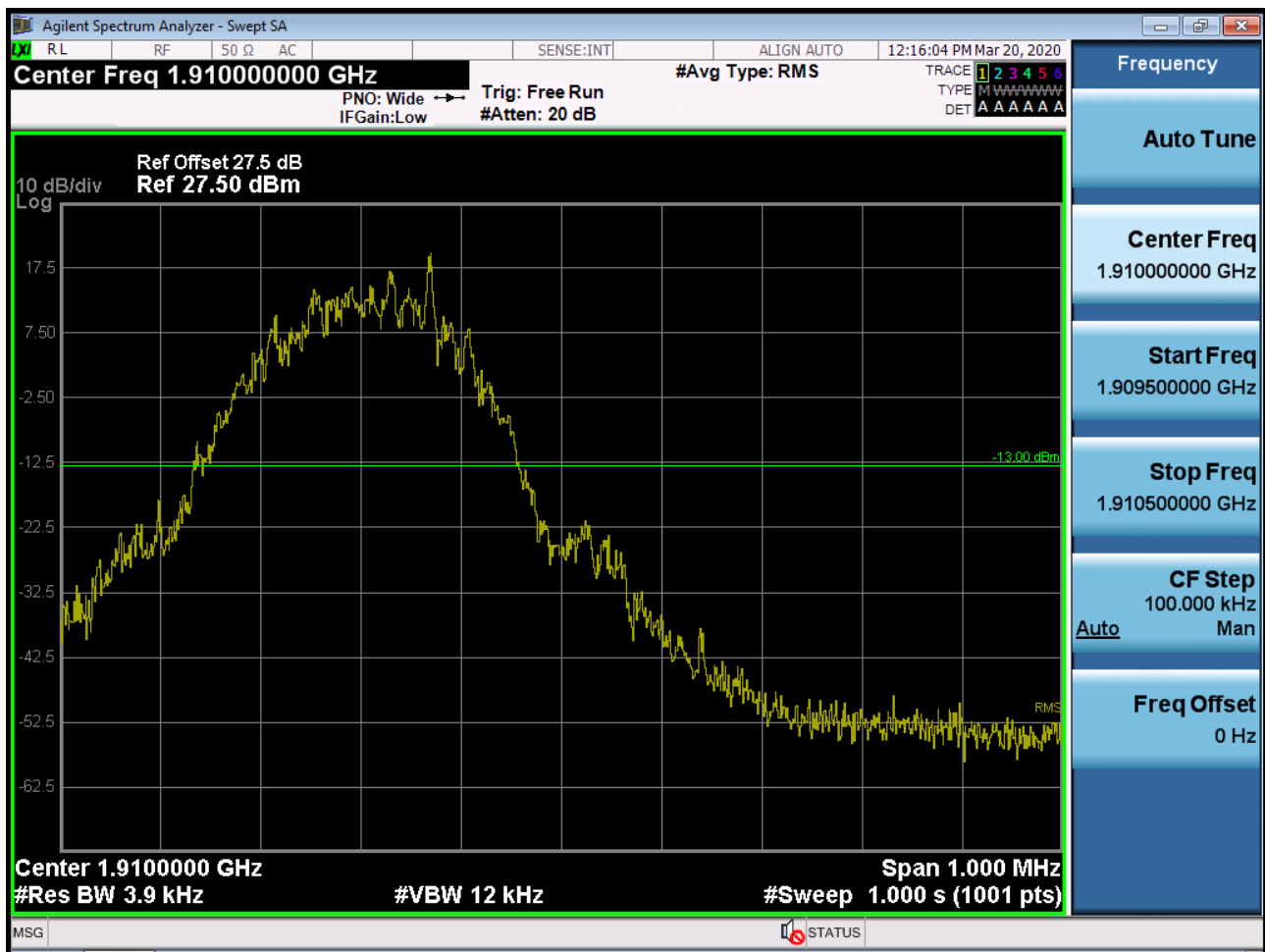
■ GSM1900 MODE (512 CH.) Block Edge 3



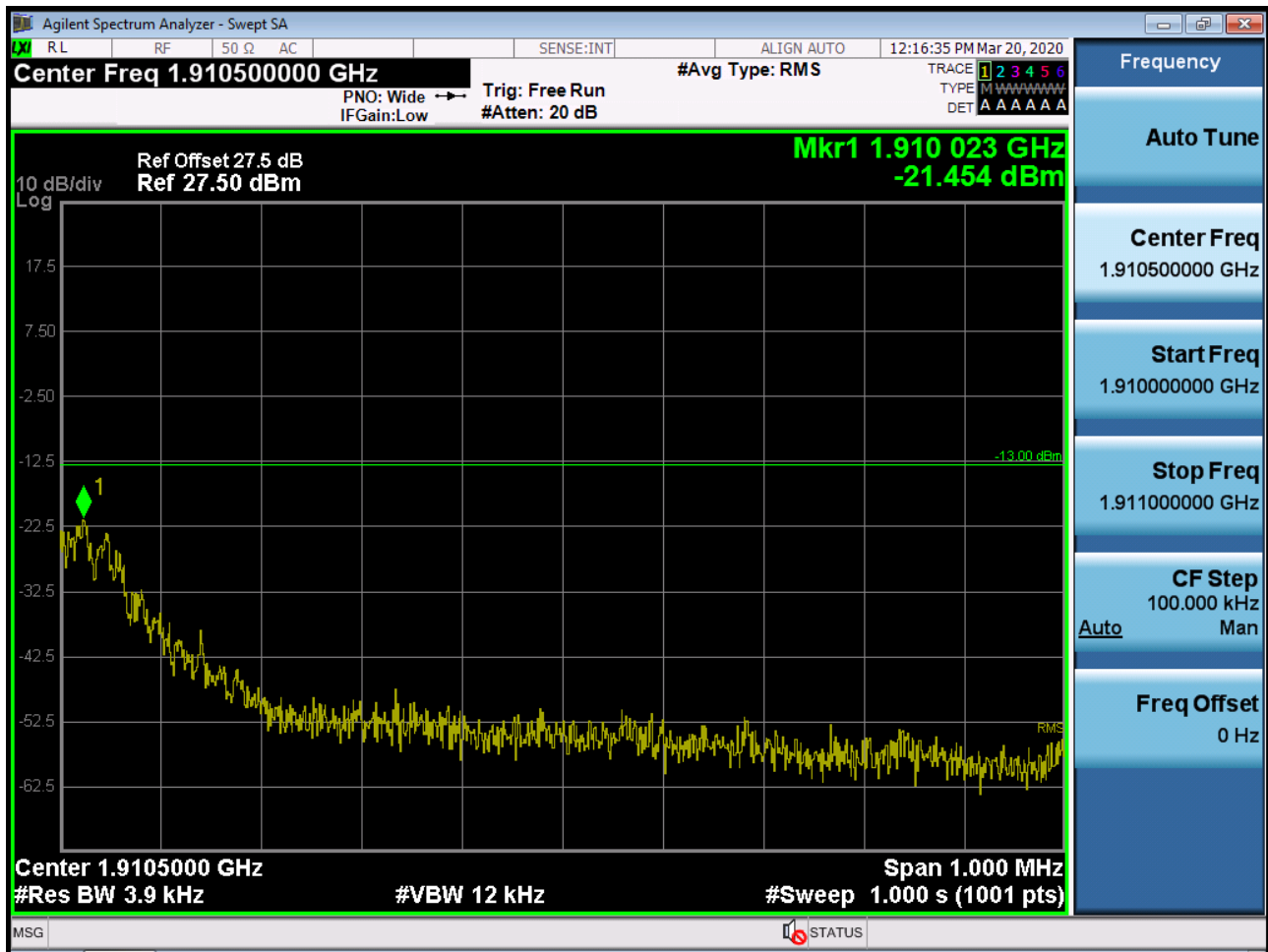
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = -44.64 dBm + 10 dB = -34.64 dBm

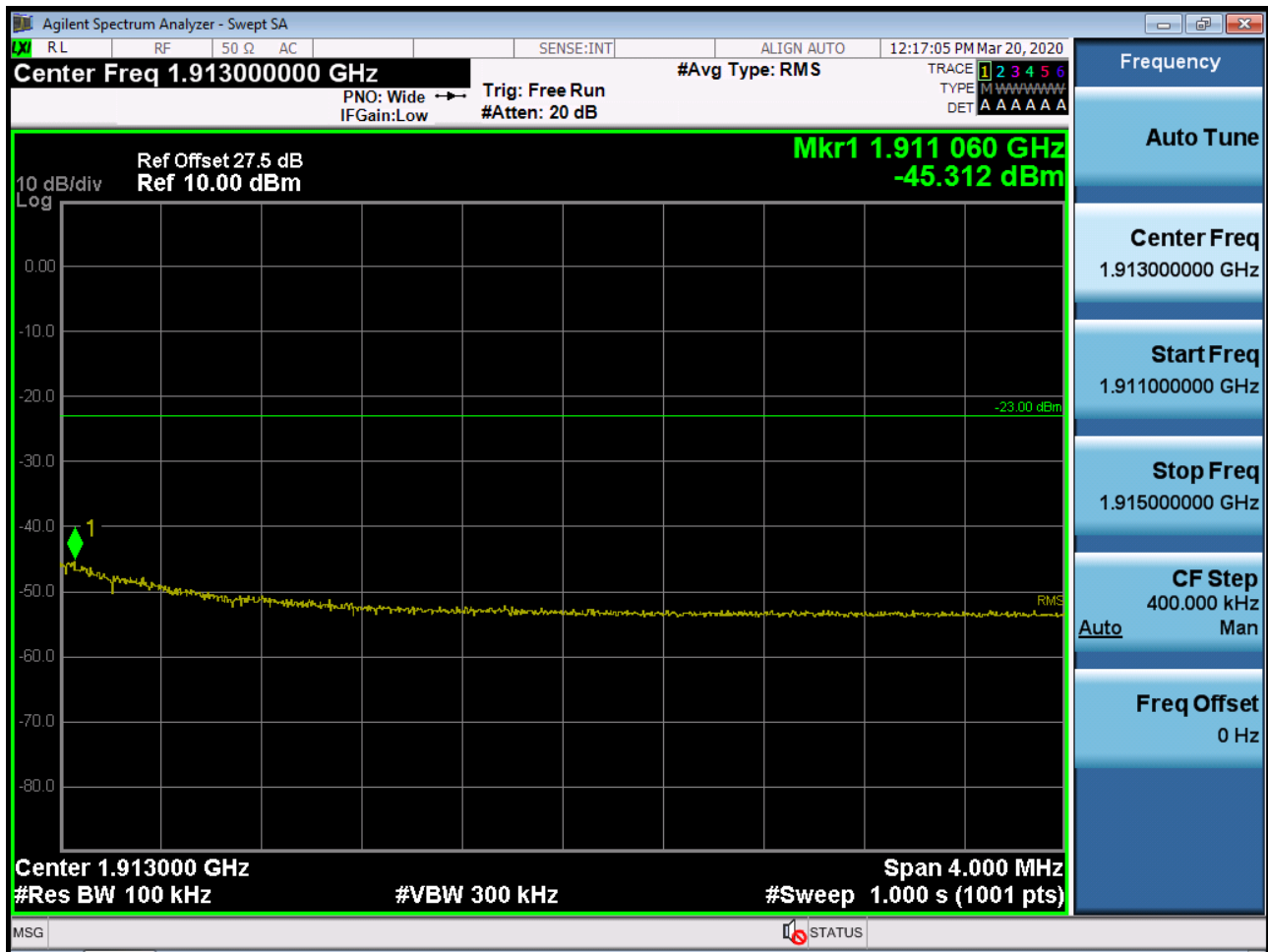
■ GSM1900 MODE (810 CH.) Block Edge 1



■ GSM1900 MODE (810 CH.) Block Edge 2



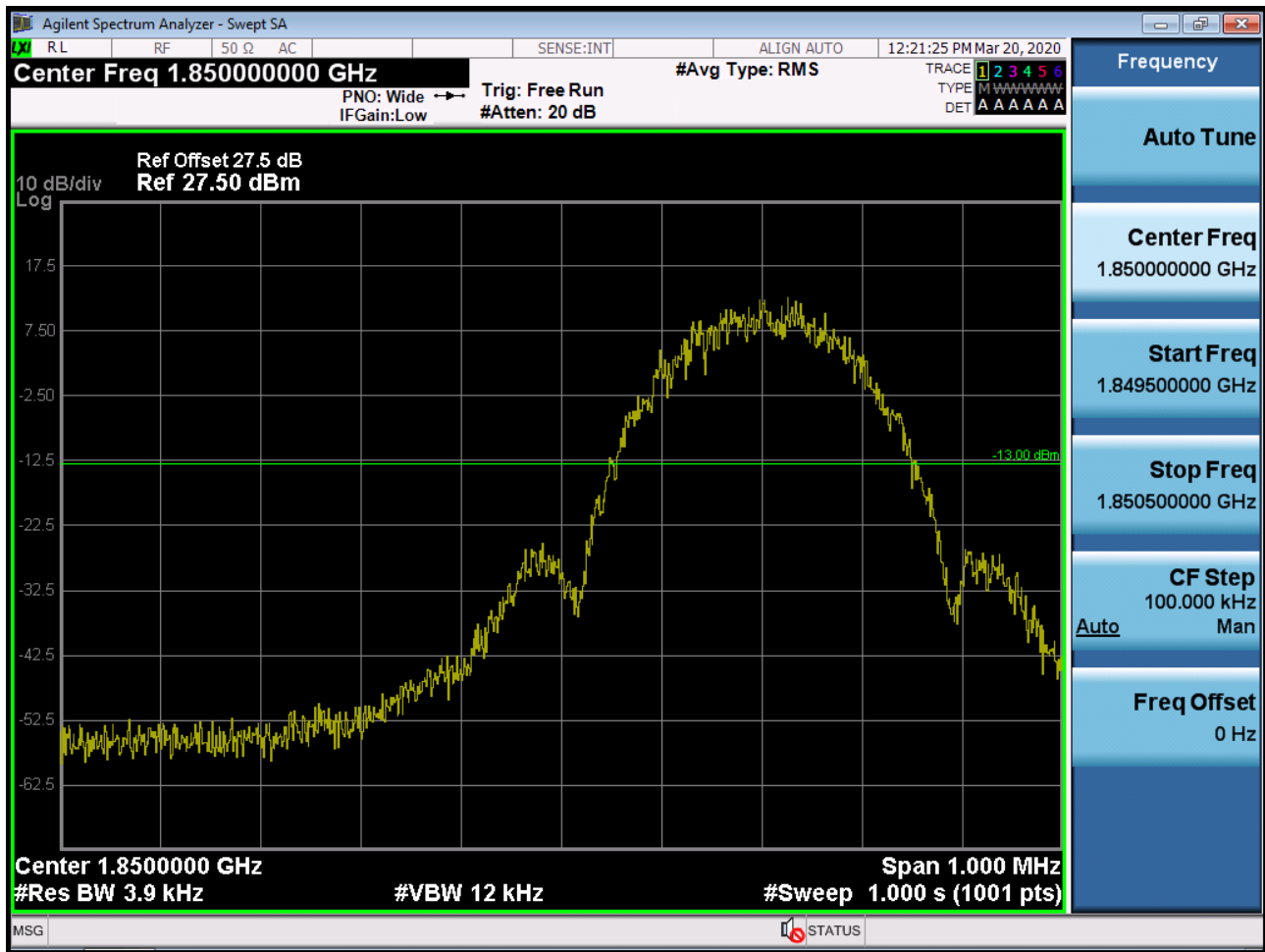
■ GSM1900 MODE (810 CH.) Block Edge 3



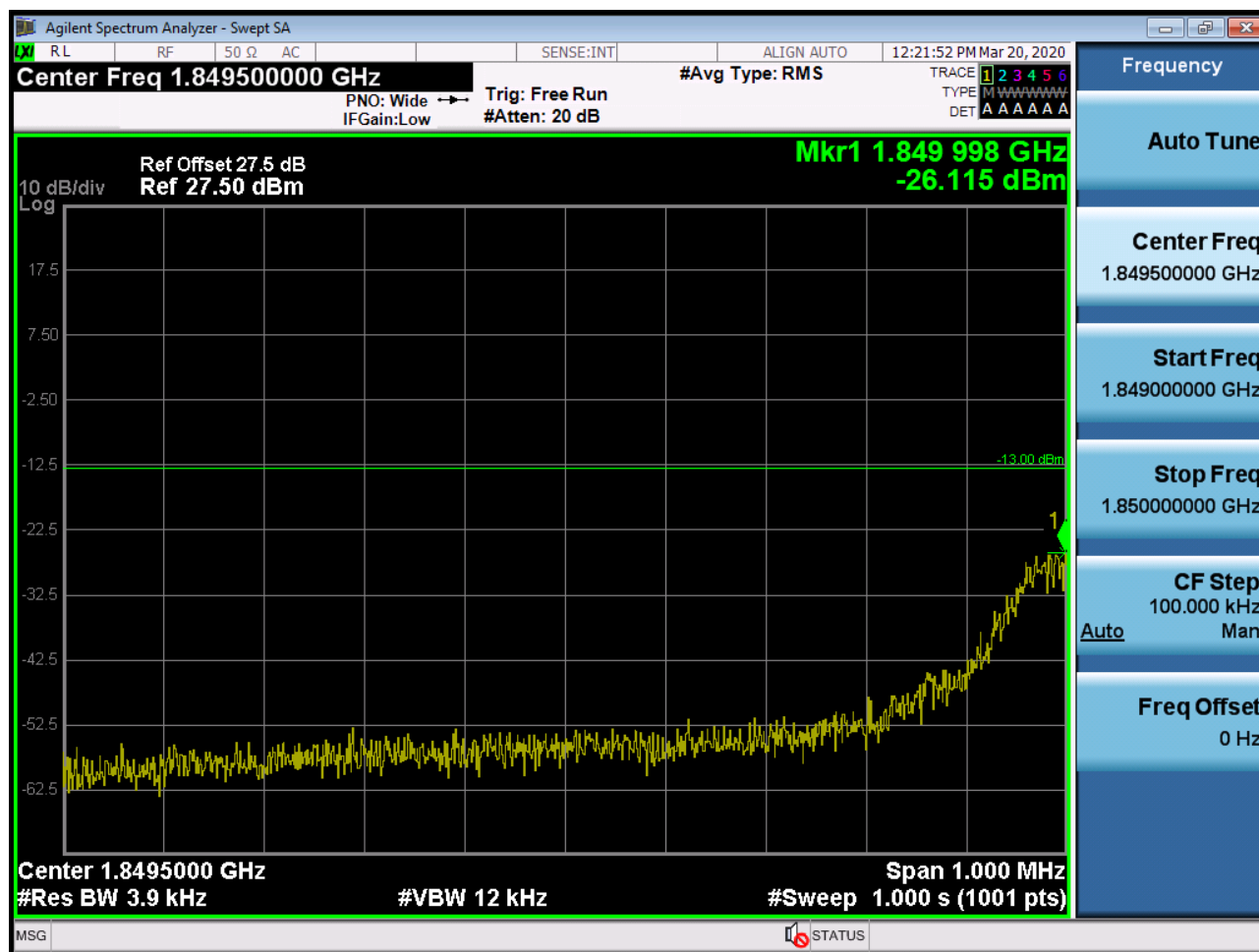
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = -45.312 dBm + 10 dB = -35.312 dBm

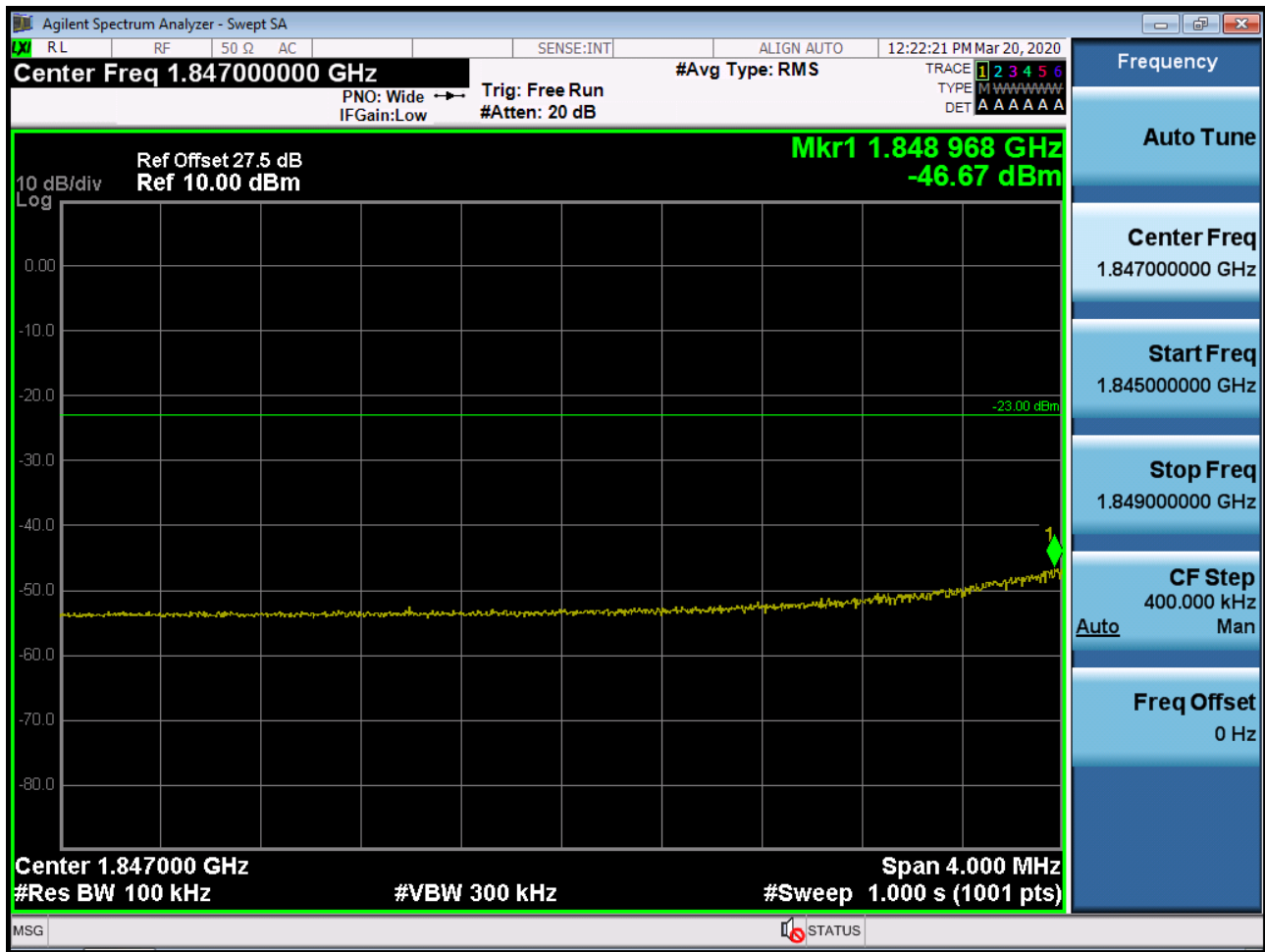
■ EDGE MODE (512 CH.) Block Edge 1



■ EDGE MODE (512 CH.) Block Edge 2



■ EDGE MODE (512 CH.) Block Edge 3



Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = -46.67 dBm + 10 dB = -36.67 dBm

Agilent Spectrum Analyzer - Swept SA

RL RF 50  $\Omega$  AC SENSE:INT ALIGN AUTO 12:24:41 PM Mar 20, 2020

**Center Freq 1.91000000 GHz** #Avg Type: RMS

PNO: Wide Trg: Free Run  
IFGain:Low #Atten: 20 dB

TRACE 1 2 3 4 5 6  
TYPE M W W W W W W W  
DET A A A A A A

Ref Offset 27.5 dB  
Ref 27.50 dBm

10 dB/div  
Log

-13.00 dBm

RMS

**Center 1.910000 GHz** **Span 1.000 MHz**  
**#Res BW 3.9 kHz** **#VBW 12 kHz** **#Sweep 1.000 s (1001 pts)**

MSG STATUS

Frequency

Auto Tune

**Center Freq**  
1.91000000 GHz

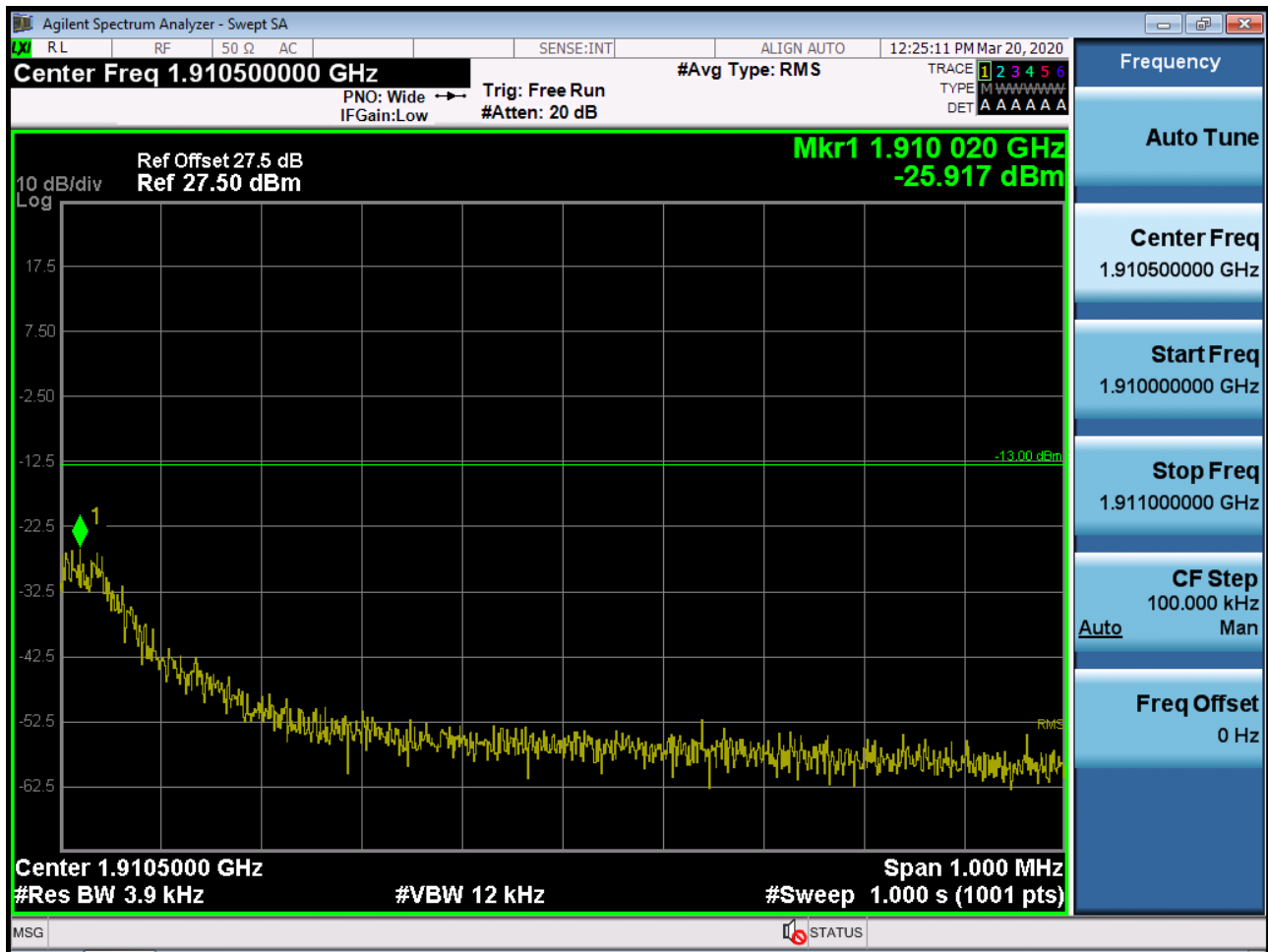
**Start Freq**  
1.90950000 GHz

**Stop Freq**  
1.91050000 GHz

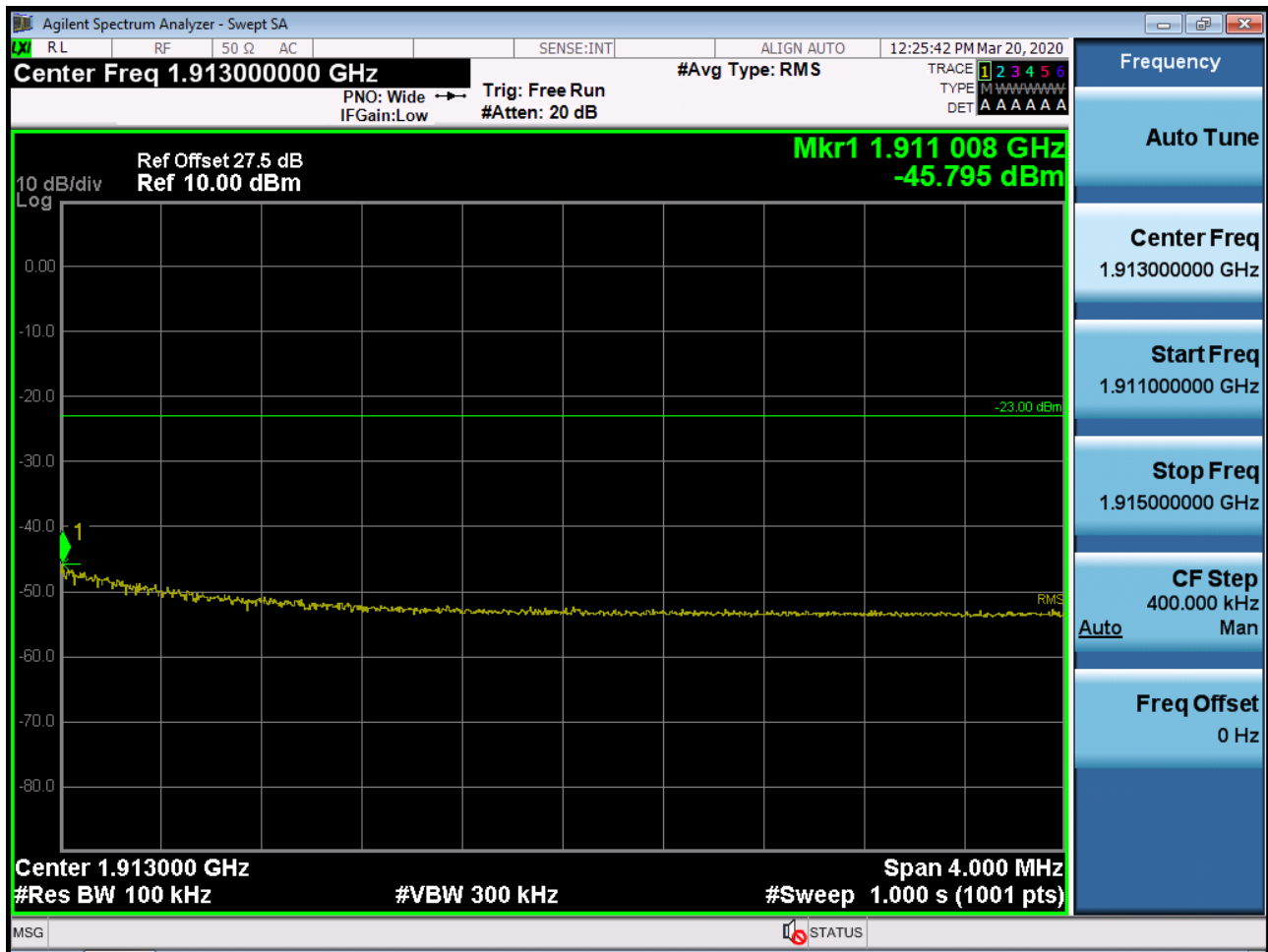
**CF Step**  
100.000 kHz  
Auto Man

**Freq Offset**  
0 Hz

■ EDGE MODE (810 CH.) Block Edge 2



■ EDGE MODE (810 CH.) Block Edge 3



Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = -45.795 dBm + 10 dB = -35.795 dBm

■ WCDMA850 MODE (4132 CH.) Block Edge



■ WCDMA850 MODE (4132 CH.) – 4 MHz Span



■ WCDMA850MODE (4233 CH.) Block Edge



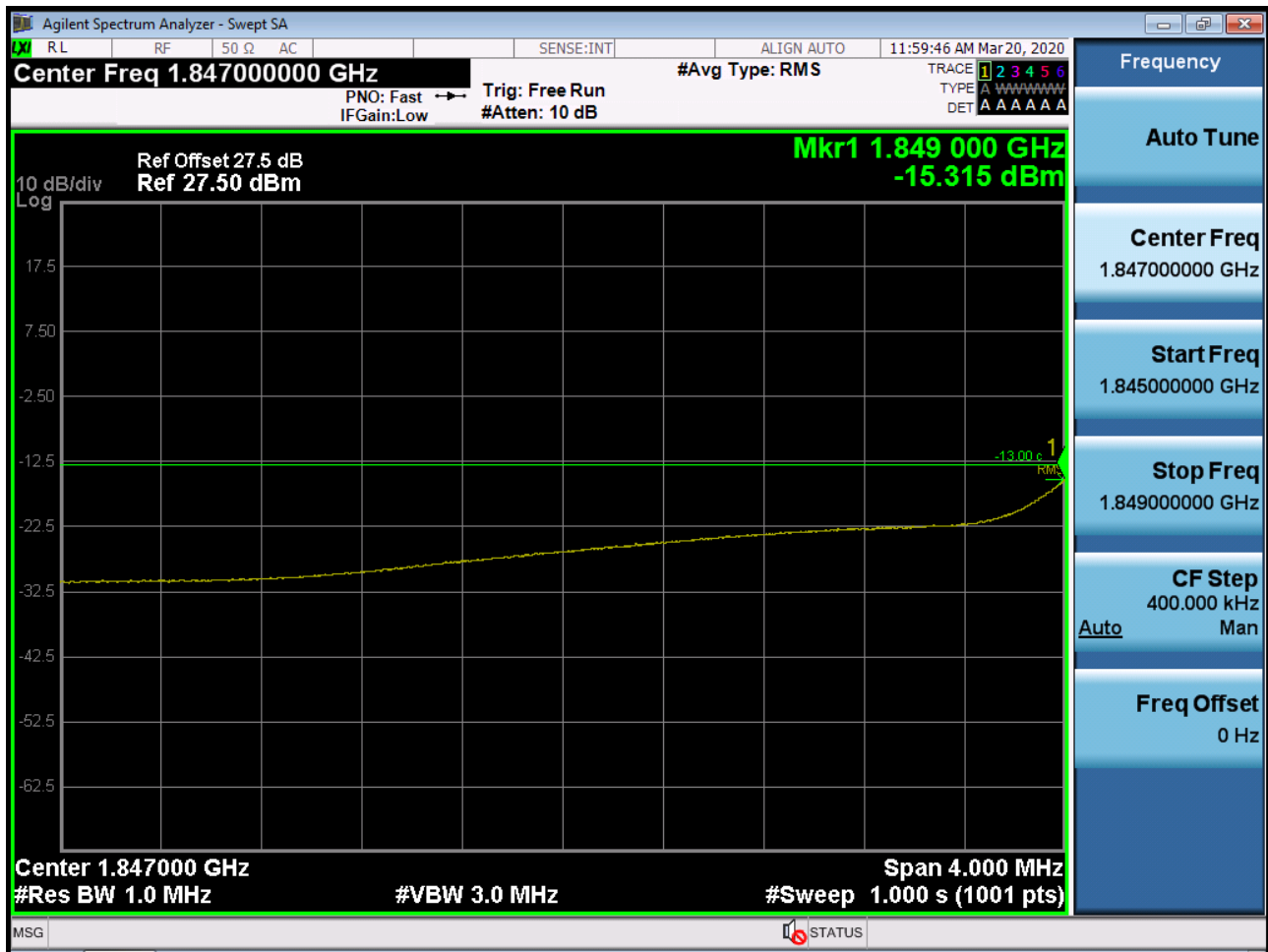
■ WCDMA850MODE (4233 CH.) – 4 MHz Span



■ WCDMA1900 MODE (9262 CH.) Block Edge



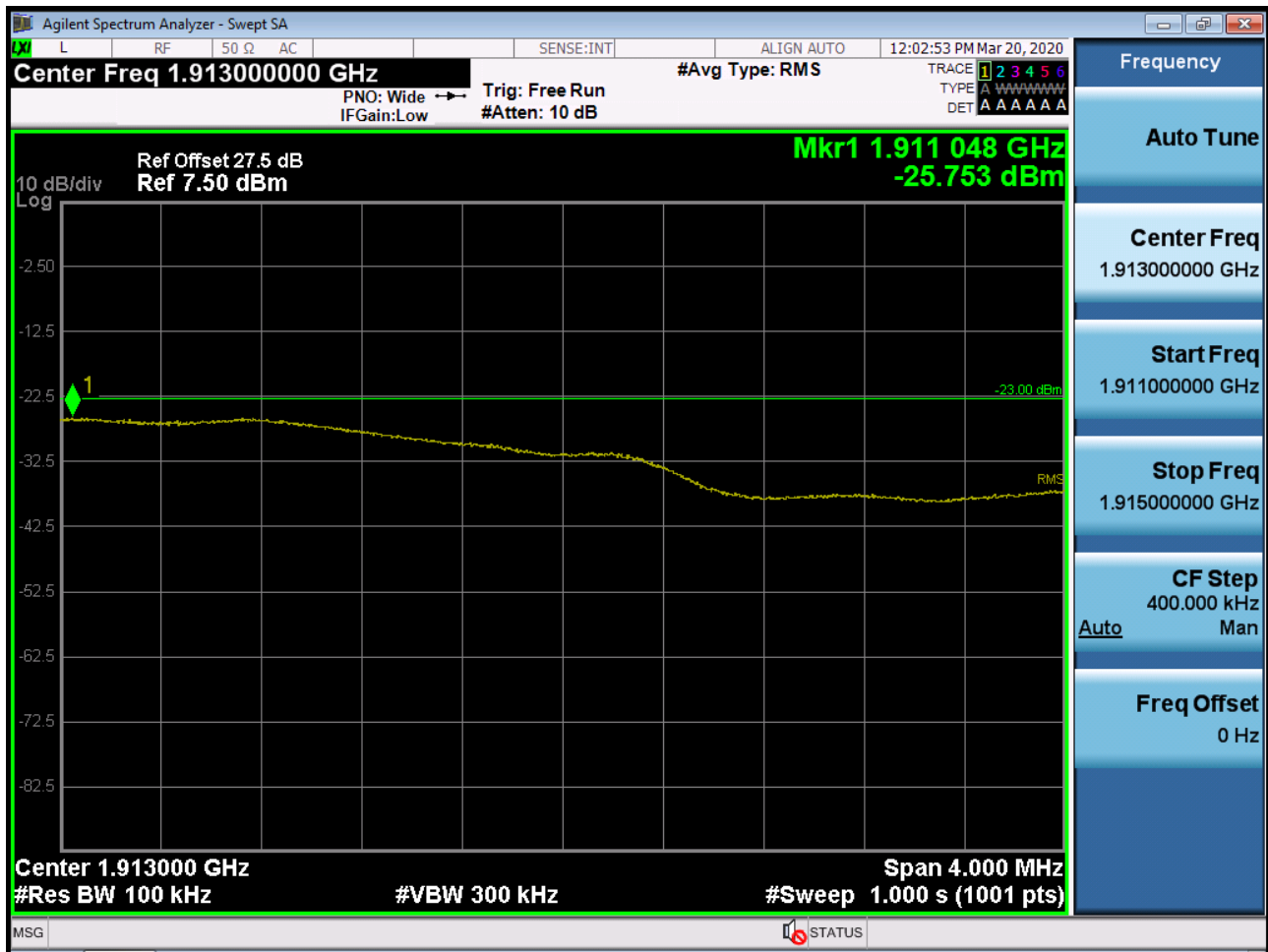
■ WCDMA1900 MODE (9262 CH.) – 4 MHz Span



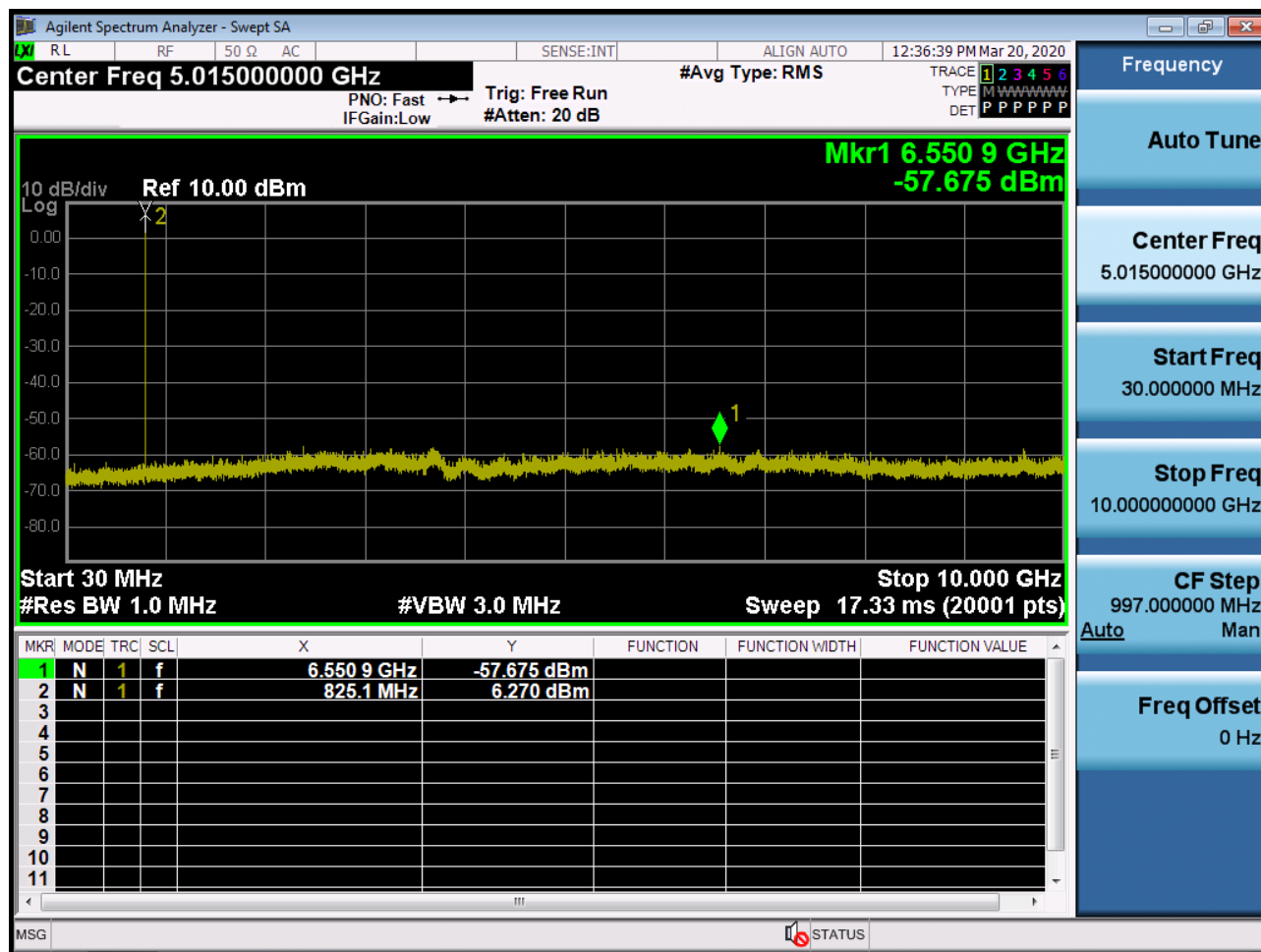
■ WCDMA1900 MODE (9538 CH.) Block Edge



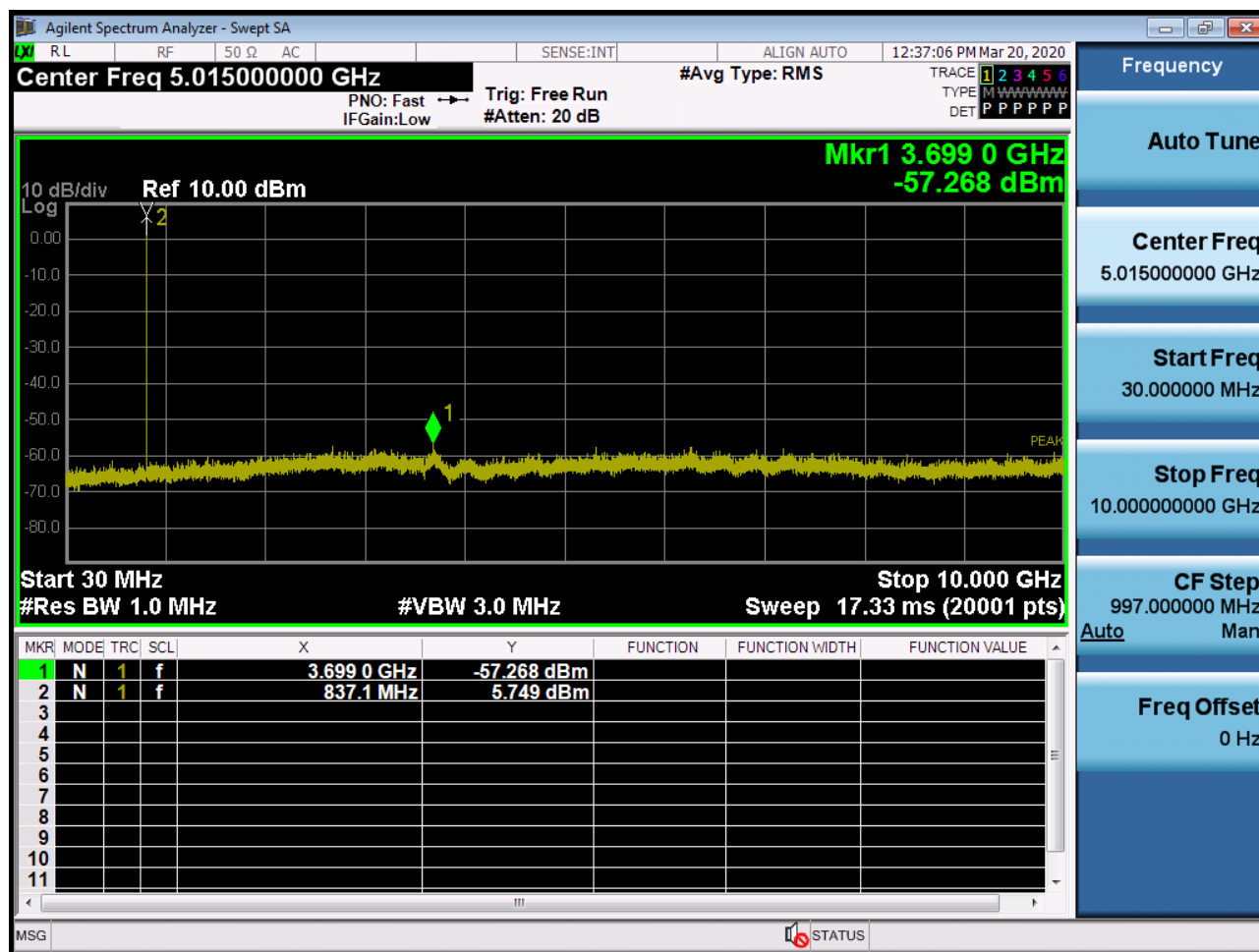
■ WCDMA1900 MODE (9538 CH.) – 4 MHz Span



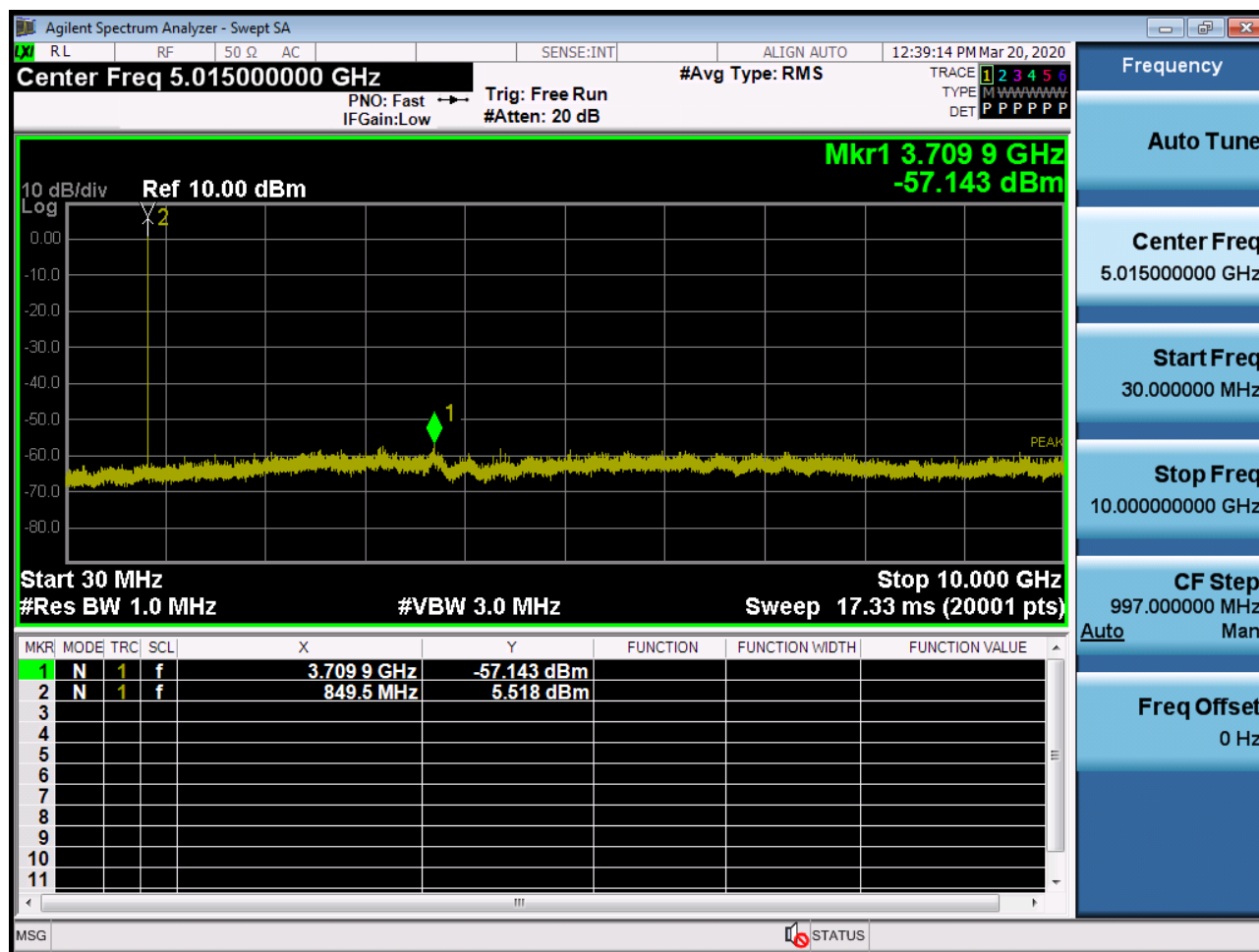
■ GSM850 MODE (128 CH.) Conducted Spurious Emissions



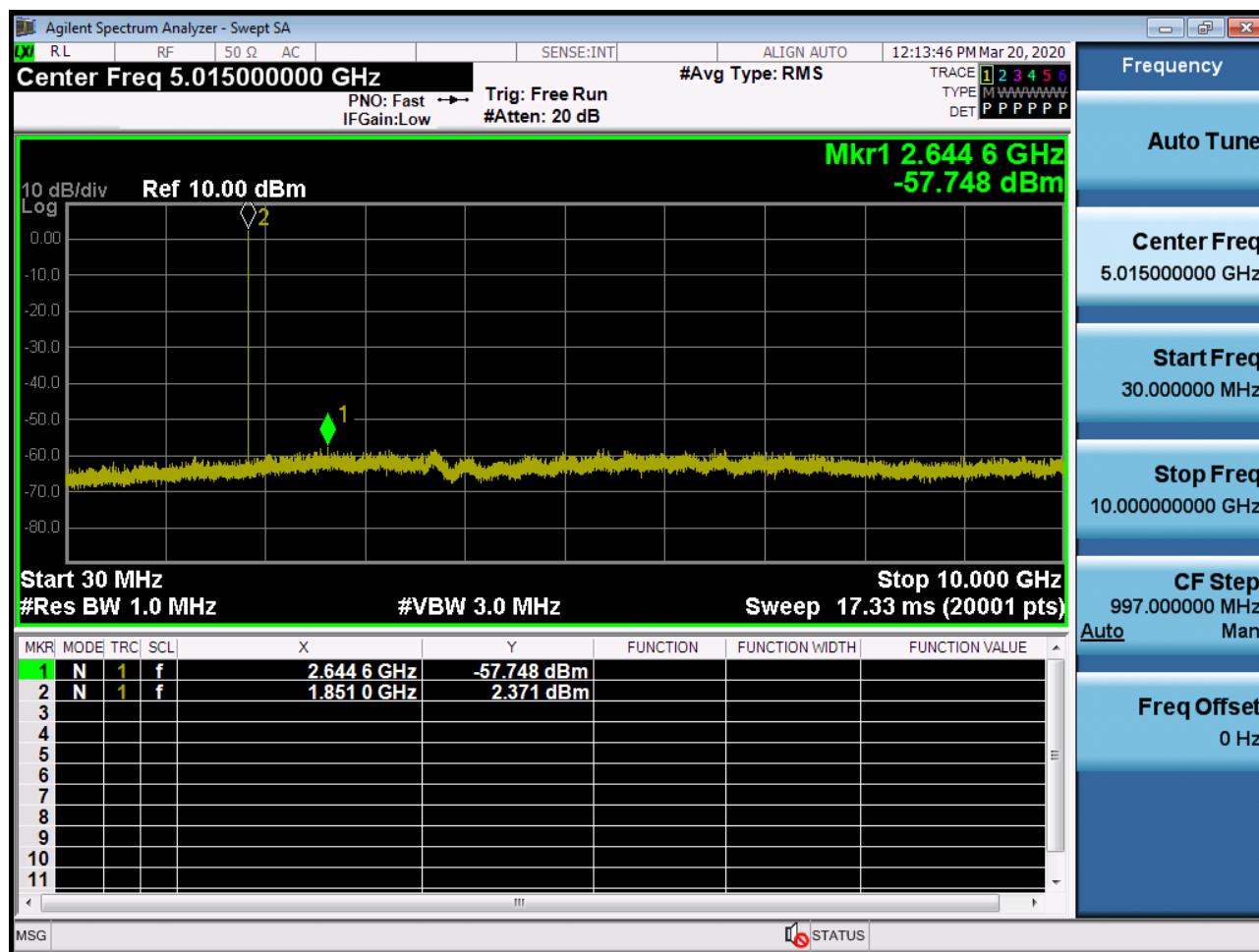
■ GSM850 MODE (190 CH.) Conducted Spurious Emissions



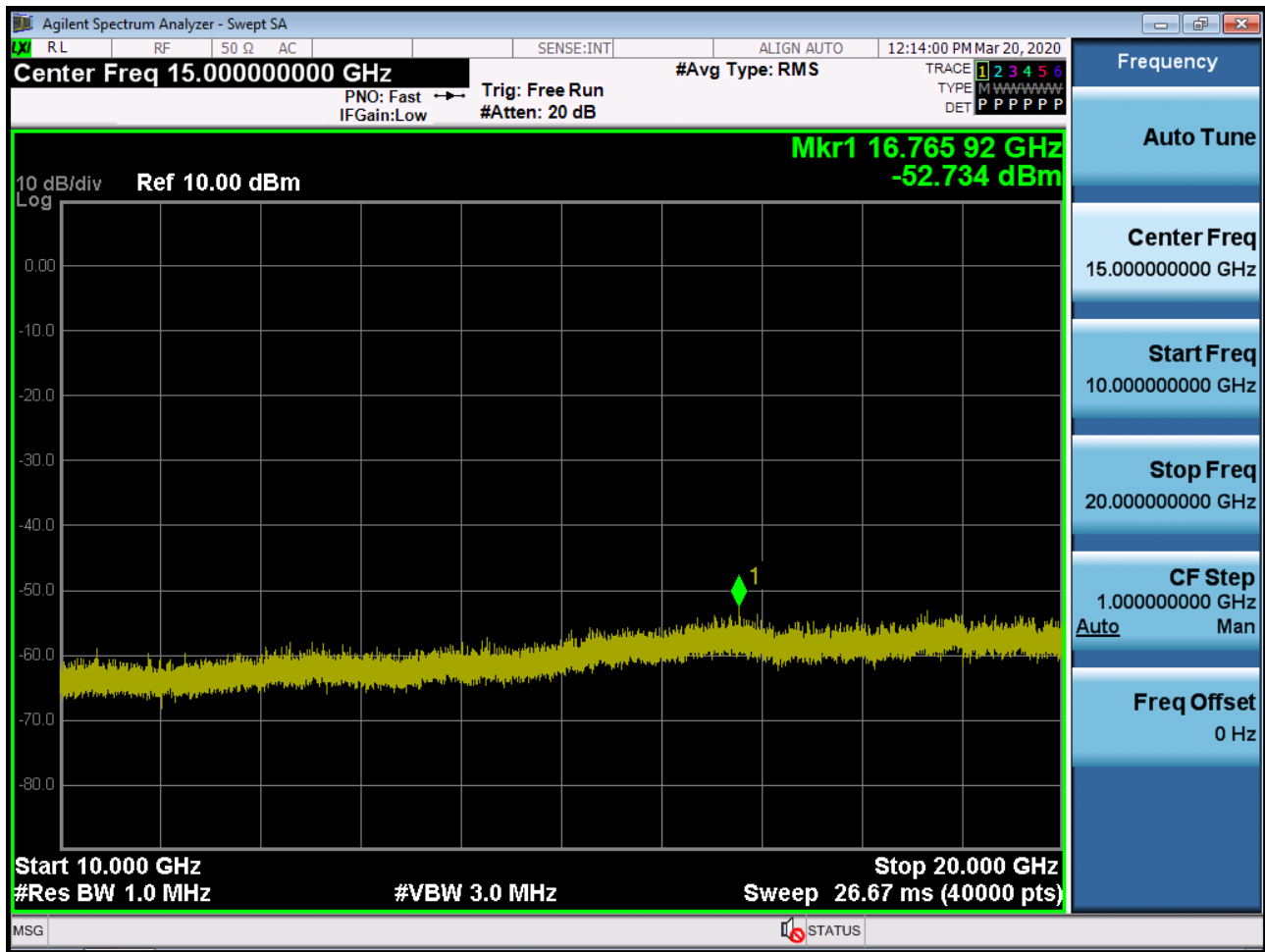
■ GSM850 MODE (251 CH.) Conducted Spurious Emissions



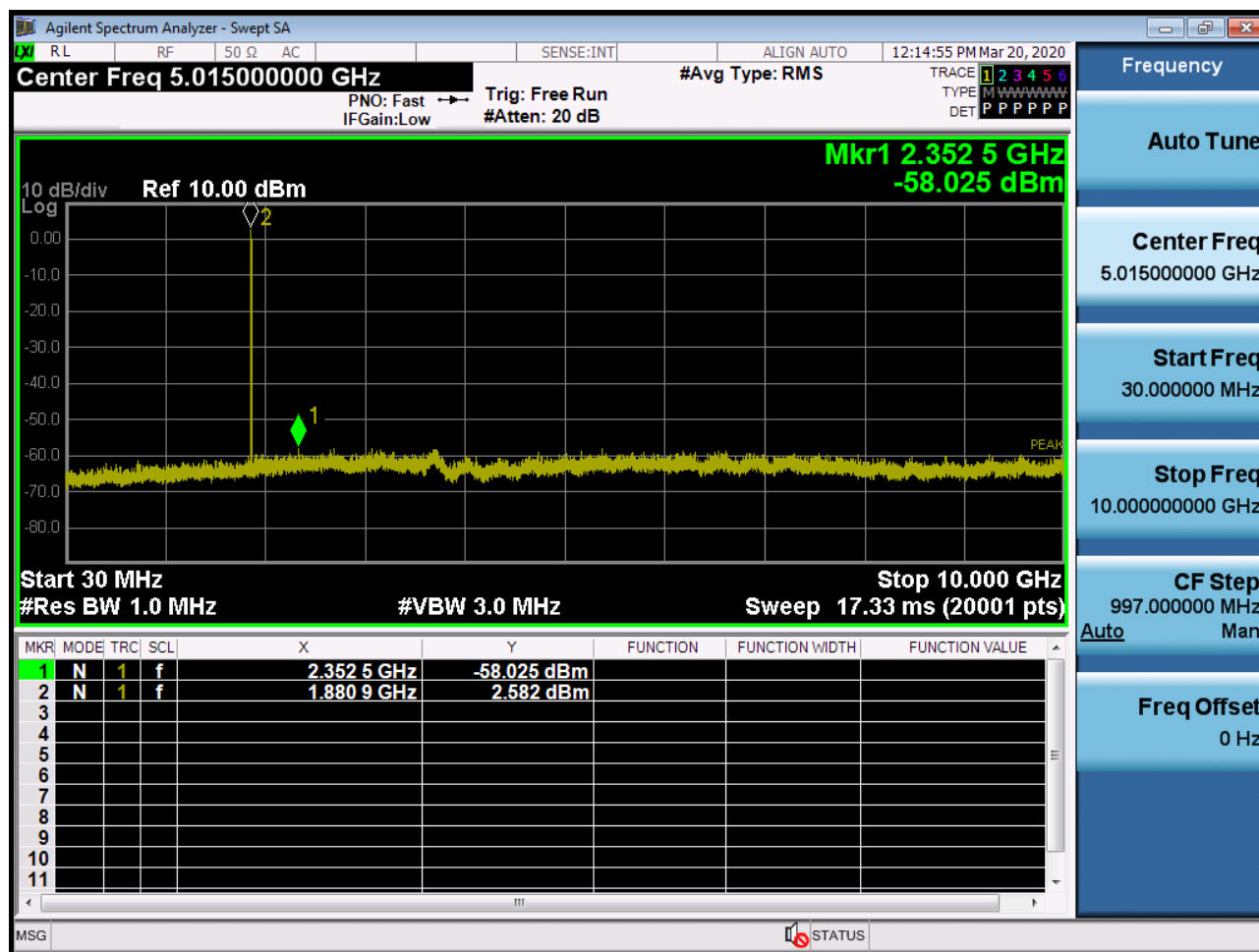
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions1



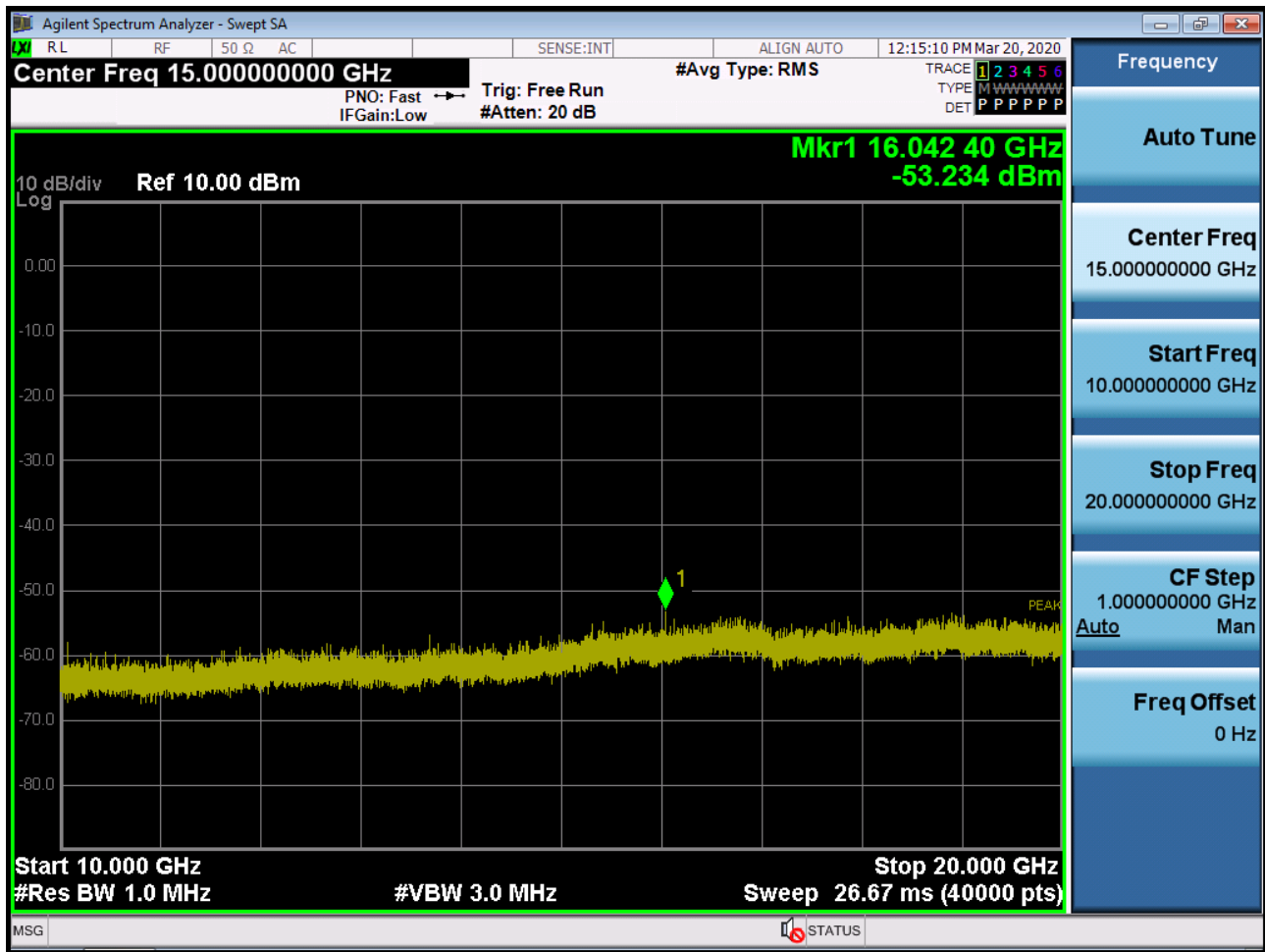
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions2



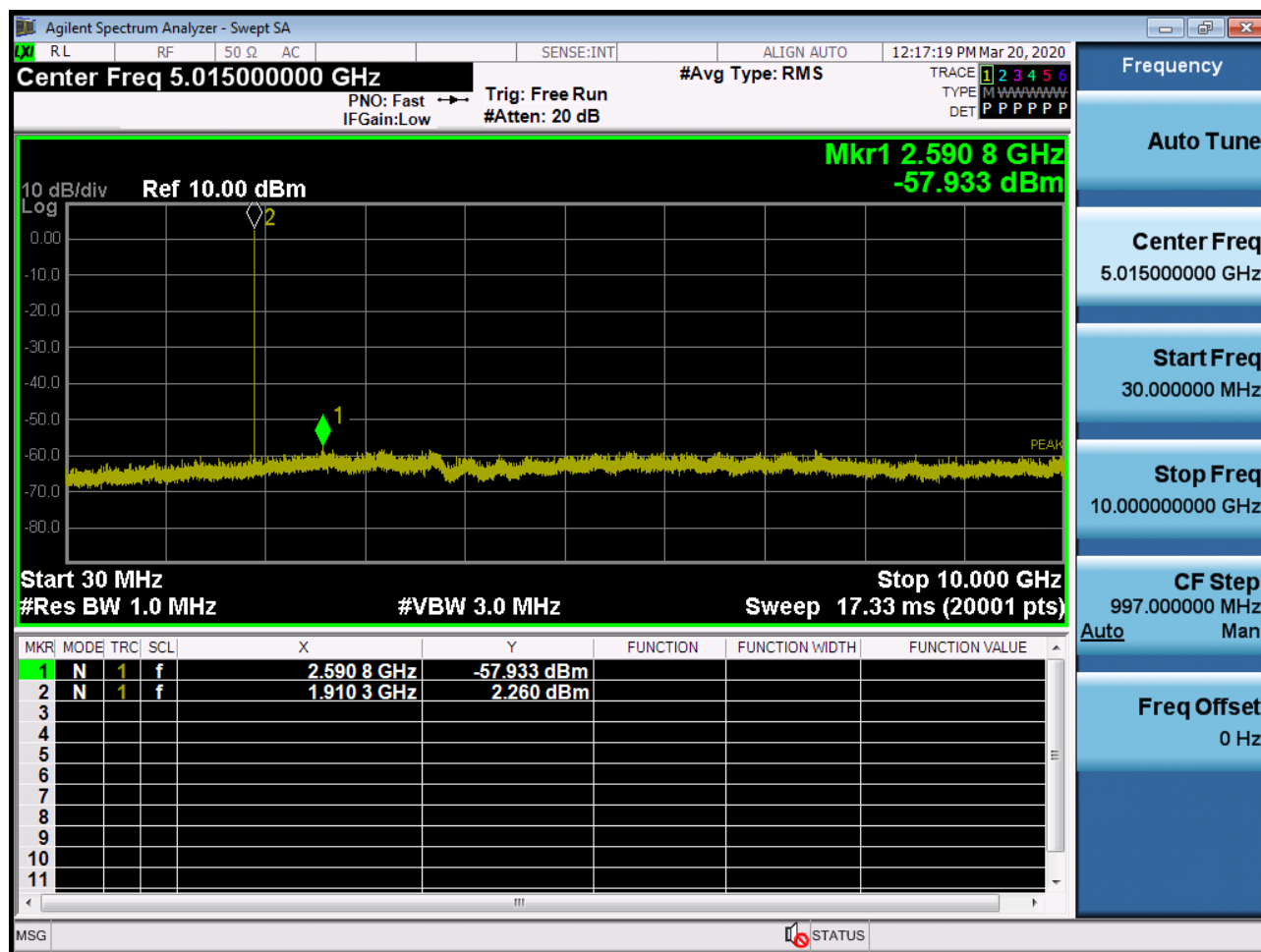
■ GSM1900 MODE (661 CH) Conducted Spurious Emissions1



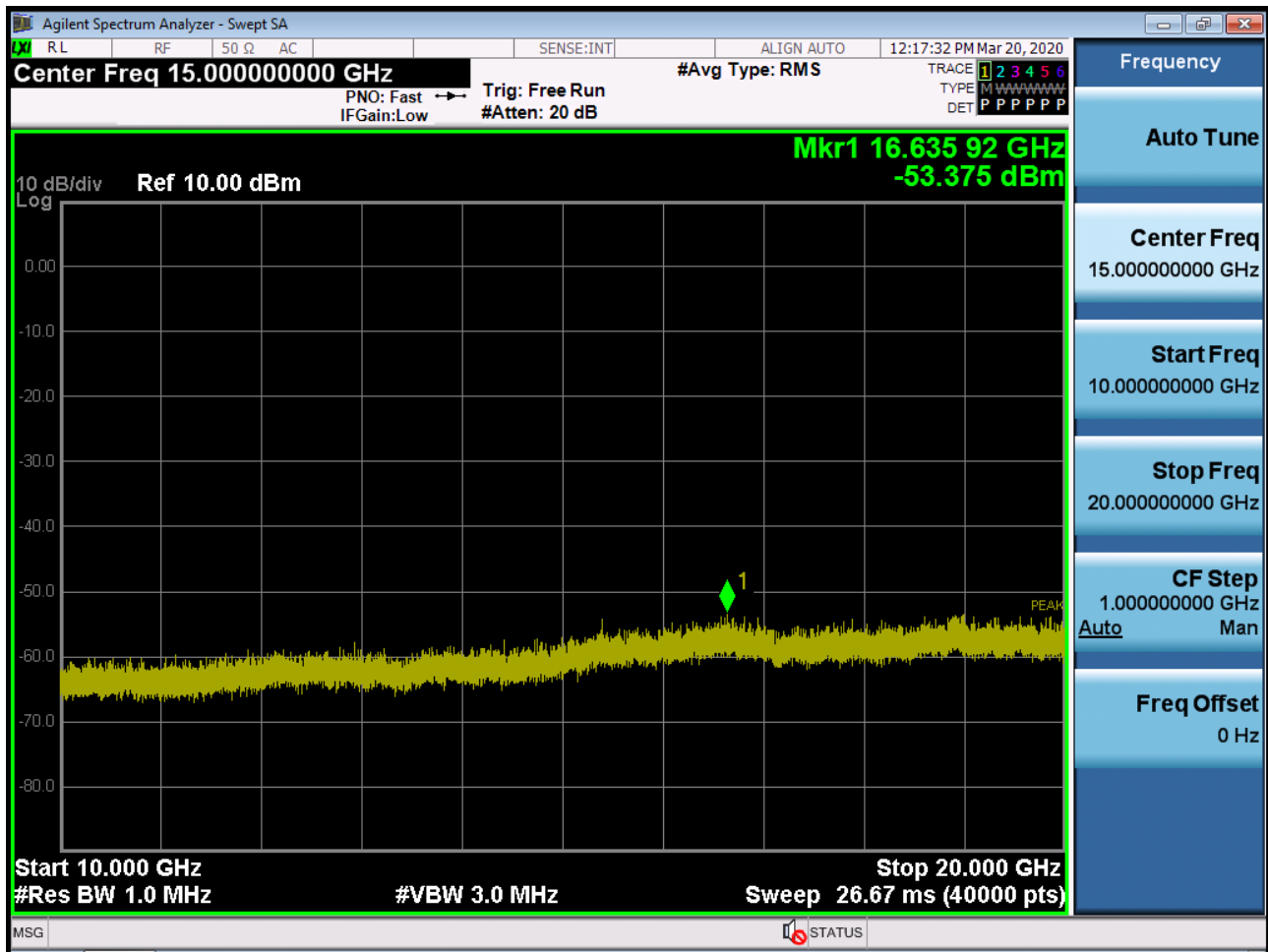
■ GSM1900 MODE (661 CH.) Conducted Spurious Emissions2



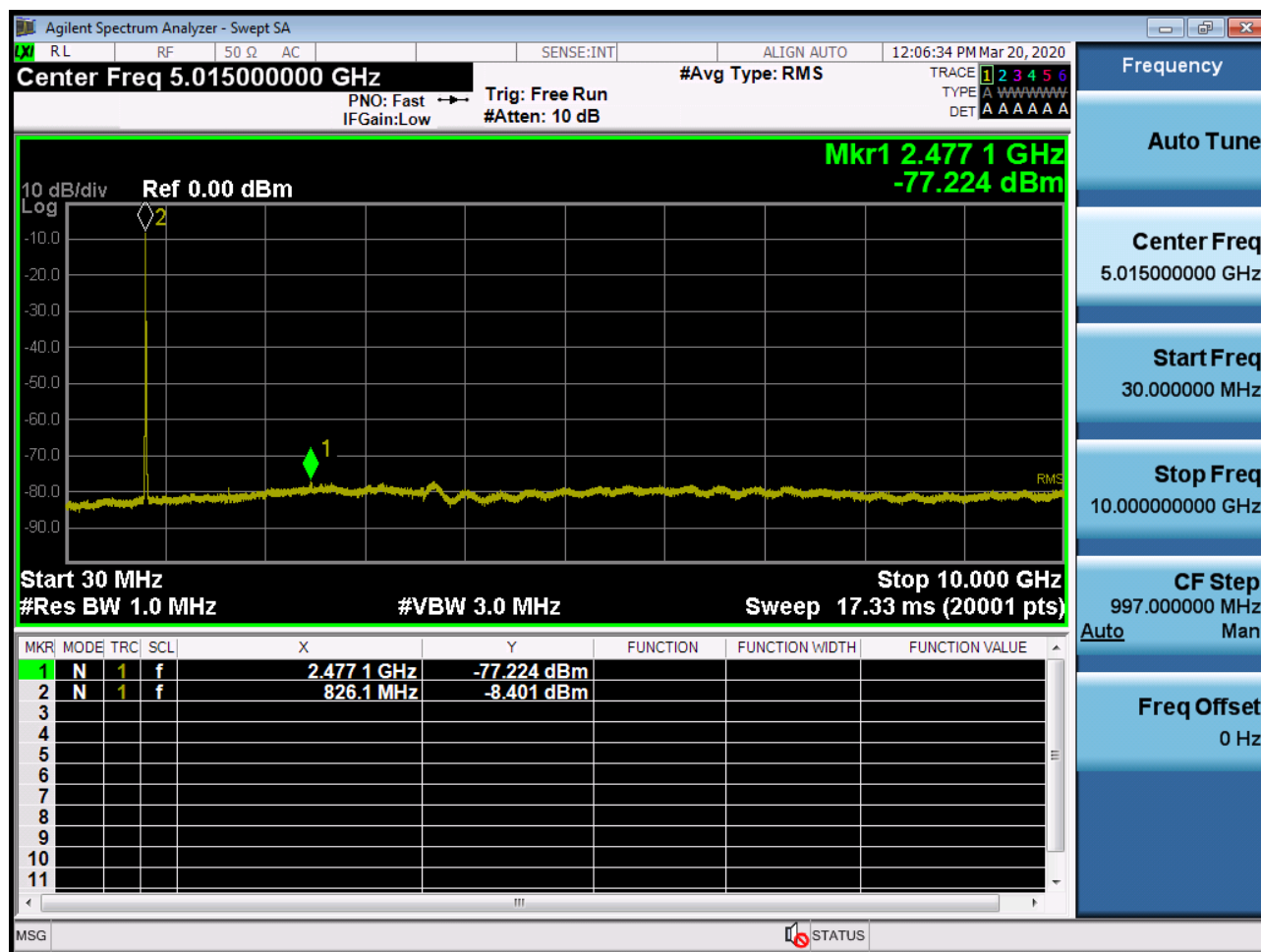
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions1



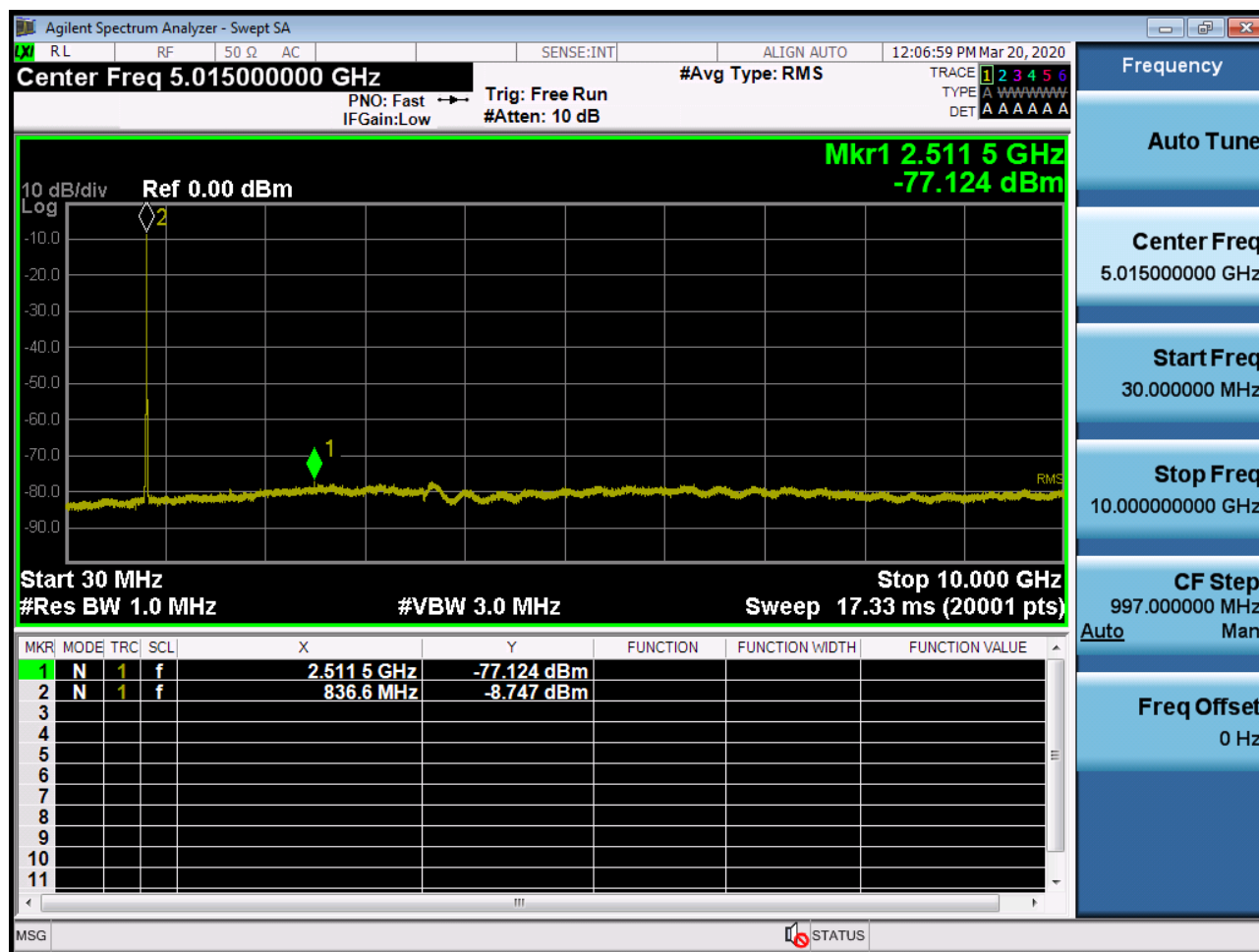
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions2



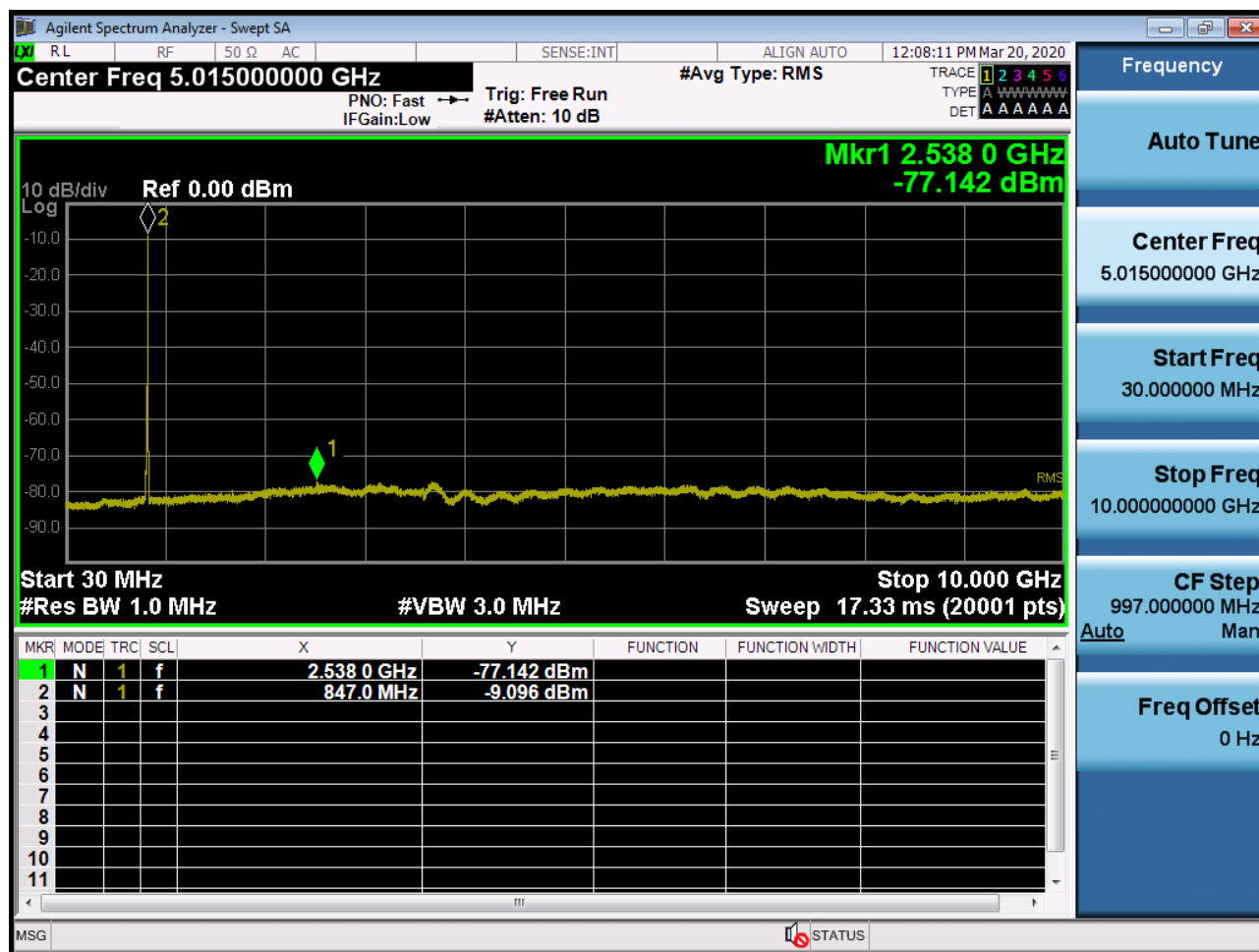
■ WCDMA850 MODE (4132 CH.) Conducted Spurious Emissions



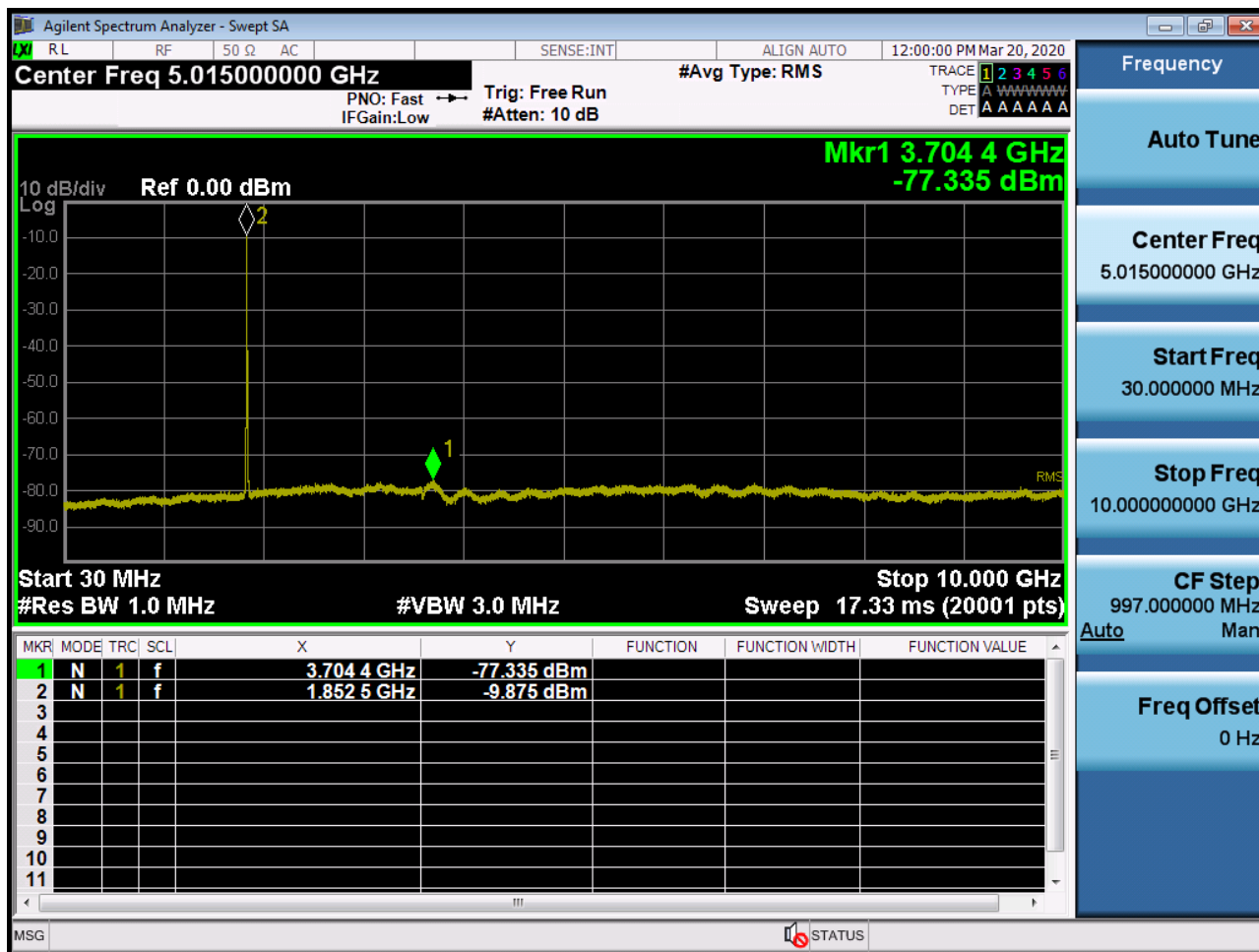
■ WCDMA850 MODE (4183 CH.) Conducted Spurious Emissions



■ WCDMA850MODE (4233 CH.) Conducted Spurious Emissions



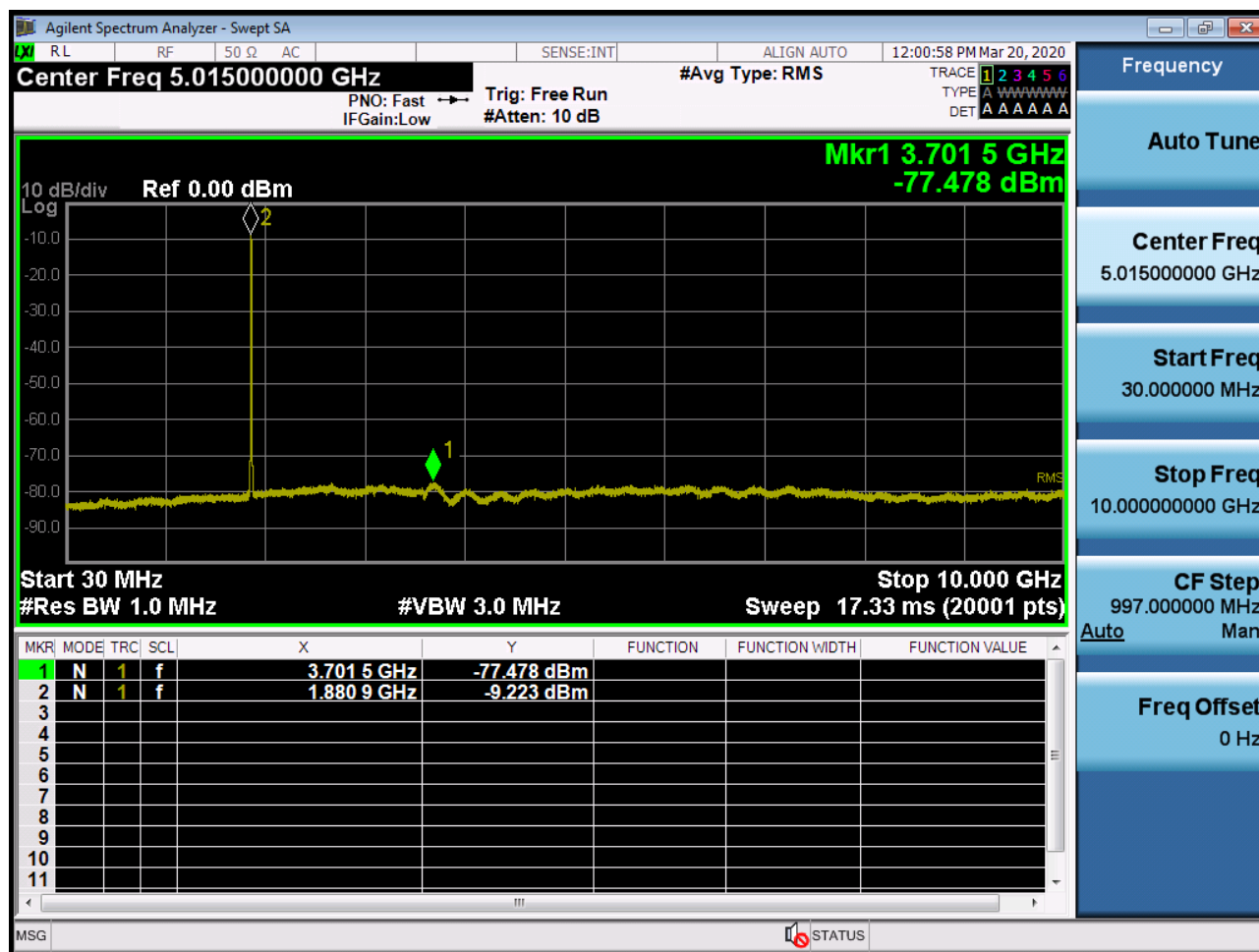
■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions1



■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions2



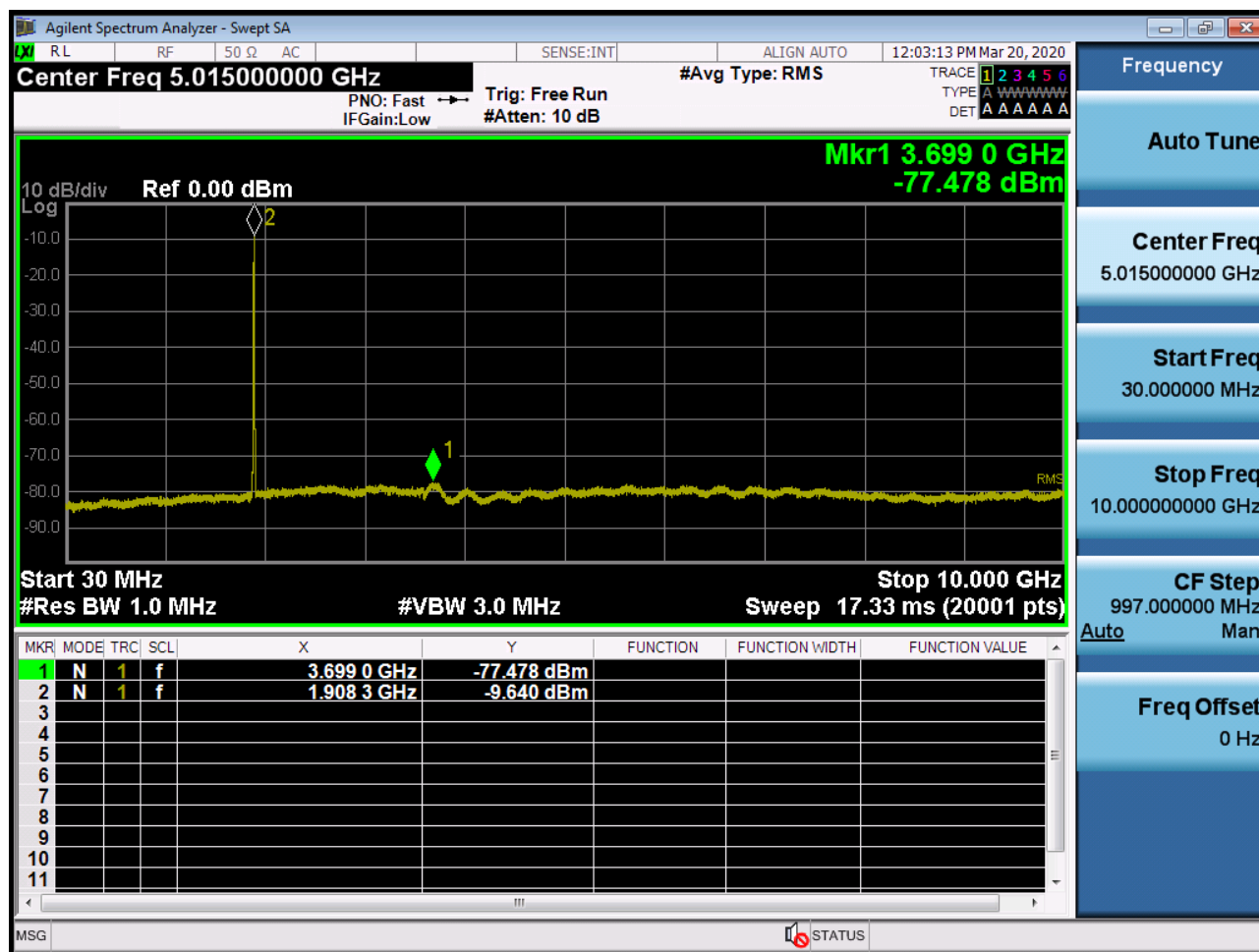
■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions1



■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions2



■ WCDMA1900 MODE (9538 CH.) Conducted Spurious Emissions1



■ WCDMA1900 MODE (9538 CH.) Conducted Spurious Emissions2



## 10. ANNEX A\_ TEST SETUP PHOTO

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

| No. | Description         |
|-----|---------------------|
| 1   | HCT-RF-2004-FC035-P |