

FCC 2G, 3G REPORT

Certification

| | |
|--|---|
| Applicant Name: SAMSUNG Electronics Co., Ltd. | Date of Issue: September 04, 2018 |
| Address: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea | Location: HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA |
| | Report No.: HCT-RF-1809-FC003 |

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|---|
| FCC ID: A3LSMJ610FN |
| APPLICANT: SAMSUNG Electronics Co., Ltd. |

According to the Evaluation report, all of the data contained herein is reused from the reference FCC ID : A3LSMJ610F report.

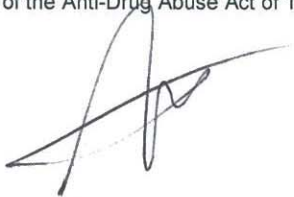

Model(s): SM-J610FN/DS
 Additional Model(s): SM-J610FN, SM-J415FN/DS, SM-J415FN
 EUT Type: Mobile Phone
 FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
 FCC Rule Part(s): §22, §24, §2

| 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 | 245 KGXW | 0.509 | 27.07 |
| GSM850 EDGE | | | 244 KG7W | 0.089 | 19.51 |
| WCDMA850 | 826.4 – 846.6 | 871.4 – 891.6 | 4M16F9W | 0.055 | 17.37 |

| 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 | 247 KGXW | 0.843 | 29.26 |
| GSM1900 EDGE | | | 247 KG7W | 0.068 | 18.33 |
| WCDMA1900 | 1852.4 – 1907.6 | 1932.4 – 1987.6 | 4M16F9W | 0.170 | 22.31 |

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C. 853(a)

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

Report approved by : Yong Hyun Lee
Manager of Telecommunication Testing Center

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

Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|-------------------|--------------------|-------------------------|
| HCT-RF-1809-FC003 | September 04, 2018 | - First Approval Report |
| | | |
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MEASUREMENT REPORT

1. GENERAL INFORMATION

| | |
|-----------------------------|--|
| Applicant Name: | SAMSUNG Electronics Co., Ltd. |
| Address: | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| FCC ID: | A3LSMJ610FN |
| Application Type: | Certification |
| FCC Classification: | PCS Licensed Transmitter Held to Ear (PCE) |
| FCC Rule Part(s): | §22, §24, §2 |
| EUT Type: | Mobile Phone |
| Model(s): | SM-J610FN/DS |
| Additional Model(s): | SM-J610FN, SM-J415FN/DS, SM-J415FN |
| Tx Frequency: | 824.20 - 848.80 MHz (GSM850) 826.40 - 846.60 MHz (WCDMA850) 1 850.20 - 1 909.80 MHz (GSM1900) 1 852.4 - 1 907.6 MHz (WCDMA1900) |
| Rx Frequency: | 869.20 - 893.80 MHz (GSM850) 871.40 - 891.60 MHz (WCDMA850) 1 930.20 - 1 989.80 MHz (GSM1900) 1 932.4 - 1 987.6 MHz (WCDMA1900) |
| Date(s) of Tests: | August 06, 2018 ~ August 28, 2018 |

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/b/g/n (HT20), Bluetooth, BTLE, ANT+ & NFC.

2.2. MEASURING INSTRUMENT CALIBRATION

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

2.3. TEST FACILITY

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

3. DESCRIPTION OF TESTS

3.1 TEST PROCEDURE

| Test Description | Test Procedure Used |
|---|---|
| Occupied Bandwidth | - KDB 971168 D01 v03r01 – Section 4.3 - ANSI C63.26-2015 – Section 5.4.4 |
| Band Edge | - KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7 |
| Spurious and Harmonic Emissions at Antenna Terminal | - KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7 |
| Conducted Output Power | - N/A (See SAR Report) |
| Peak- to- Average Ratio | - KDB 971168 D01 v03r01 – Section 5.7 - ANSI C63.26-2015 – Section 5.2.3.4 - ANSI C63.26-2015 – Section 5.2.6(only GSM) |
| Frequency stability | - ANSI C63.26-2015 – Section 5.6 |
| Effective Radiated Power/ Effective Isotropic Radiated Power | - KDB 971168 D01 v03r01 – Section 5.2 & 5.8 - ANSI C63.26-2015 – Section 5.2 - ANSI/TIA-603-E-2016 – Section 2.2.17 |
| Radiated Spurious and Harmonic Emissions | - KDB 971168 D01 v03r01 – Section 6.2 - ANSI/TIA-603-E-2016 – Section 2.2.12 |

3.2 RADIATED POWER

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-E-2016 Clause 2.2.17.

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW \geq 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;

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

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.

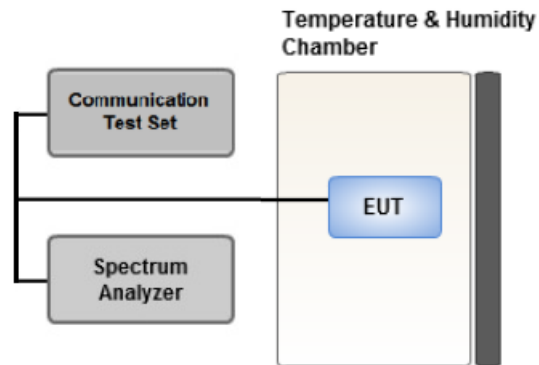
Test Settings

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 10th harmonics from 9 kHz.

Test Note

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

3.4 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)

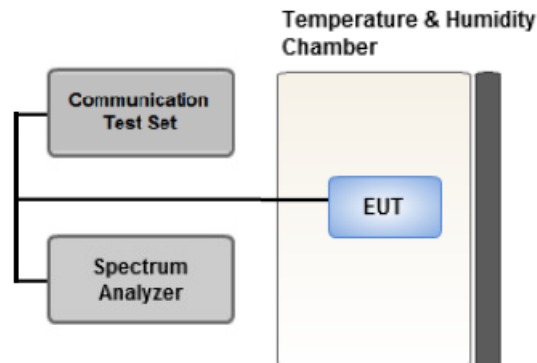
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW $\geq 3 \times$ RBW.

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

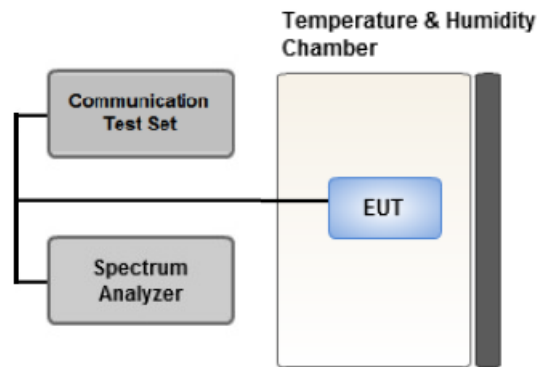
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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.

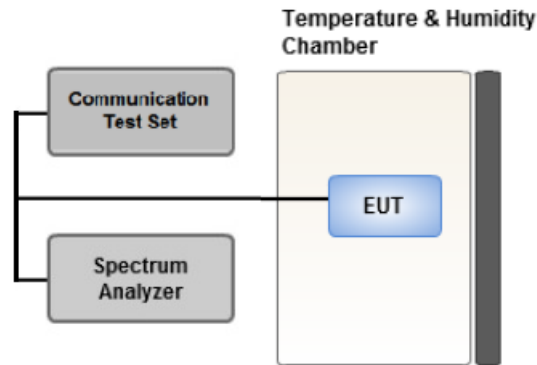
Test Settings(GSM)

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 $\geq 2 * \text{Span} / \text{RBW}$

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 $\geq 2 * \text{Span} / \text{RBW}$

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

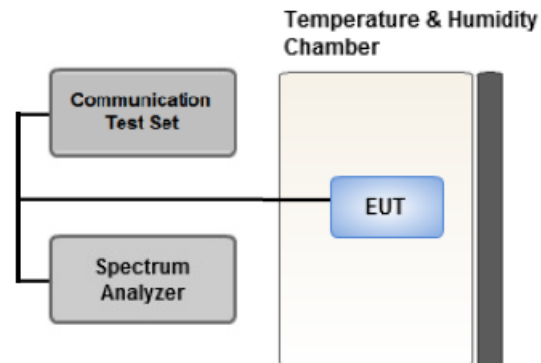
Test Notes

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 $43 + 10 \log(P)$ 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) 3G : QPSK | Low, Mid, High |
| | 2G : EDGE(1 TX Slot) | Low, Mid, High |
| Band Edge | 2G : Voice & EDGE(1 TX Slot) 3G : QPSK | Low, High |
| Spurious and Harmonic Emissions at Antenna Terminal | 2G : Voice 3G : QPSK | Low, Mid, High |

[Test Channel]

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

Note:

- SM-J610FN/DS & Additional Models were tested and the worst case results are reported.

(Worst case : SM-J610FN/DS)

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, Effective Isotropic Radiated Power | QPSK | 12.2 kbps | WCDMA B2 : Z | Low, Mid, High |
| | (WCDMA) | RMC | WCDMA B5 : Z | |
| Radiated Spurious and Harmonic Emissions | QPSK | 12.2 kbps | WCDMA B2 : Z | Low, Mid, High |
| | (WCDMA) | RMC | WCDMA B5 : Z | |

[Worst case_2G]

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

[Test Channel]

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

Note:

- SM-J610FN/DS & Additional Models were tested and the worst case results are reported.
(Worst case : SM-J610FN/DS)

4. LIST OF TEST EQUIPMENT

| Manufacture | Model/ Equipment | Serial Number | Calibration Date | Calibration Interval | Calibration Due |
|------------------|--|---------------|------------------|----------------------|-----------------|
| REOHDE & SCHWARZ | SCU 18 / AMPLIFIER | 10094 | 04/17/2018 | Annual | 04/17/2019 |
| Wainwright | WHK1.2/15G-10EF/H.P.F | 4 | 04/04/2018 | Annual | 04/04/2019 |
| Wainwright | WHK3.3/18G-10EF/H.P.F | 2 | 04/04/2018 | Annual | 04/04/2019 |
| Hewlett Packard | 11667B / Power Splitter(DC~26.5 GHz) | 5001 | 06/07/2018 | Annual | 06/07/2019 |
| Agilent | E3632A/DC Power Supply | KR75303243 | 05/09/2018 | Annual | 05/09/2019 |
| Schwarzbeck | UHAP/ Dipole Antenna | 557 | 03/31/2017 | Biennial | 03/31/2019 |
| Schwarzbeck | UHAP/ Dipole Antenna | 558 | 03/31/2017 | Biennial | 03/31/2019 |
| ESPEC | SU-642 / Chamber | 93000718 | 08/07/2018 | Annual | 08/07/2019 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna(1~18GHz) | 147 | 09/09/2016 | Biennial | 09/09/2018 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna(1~18GHz) | 9120D-1298 | 10/14/2016 | Biennial | 10/14/2018 |
| Schwarzbeck | BBHA 9170/ Horn Antenna(15~40GHz) | BBHA9170342 | 04/25/2017 | Biennial | 04/25/2019 |
| Schwarzbeck | BBHA 9170/ Horn Antenna(15~40GHz) | BBHA9170124 | 04/25/2017 | Biennial | 04/25/2019 |
| Agilent | N9020A/Signal Analyzer(10Hz~26.5GHz) | MY52090906 | 06/08/2018 | Annual | 06/08/2019 |
| Hewlett Packard | 8493C/ATTENUATOR(20dB) | 17280 | 06/21/2018 | Annual | 06/21/2019 |
| REOHDE & SCHWARZ | FSV40/Spectrum Analyzer(10Hz~40GHz) | 100931 | 10/30/2017 | Annual | 10/30/2018 |
| Agilent | 8960 (E5515C)/ Base Station | MY48360800 | 09/26/2017 | Annual | 09/26/2018 |
| Schwarzbeck | FMZB1513/ Loop Antenna(9kHz~30MHz) | 1513-175 | 04/19/2017 | Biennial | 04/19/2019 |
| Schwarzbeck | VULB9160/ Bilog Antenna | 3150 | 09/30/2016 | Biennial | 09/30/2018 |
| Schwarzbeck | VULB9160/ Bilog Antenna | 9360-3368 | 08/09/2018 | Biennial | 08/09/2020 |
| Schwarzbeck | VULB9160/ Hybrid Antenna | 760 | 04/06/2017 | Biennial | 04/06/2019 |
| Anritsu Corp. | MT8820C/Wideband Radio Communication Tester | 6200863156 | 02/13/2018 | Annual | 02/13/2019 |
| Anritsu Corp. | MT8820C/Wideband Radio Communication Tester | 6201026545 | 02/08/2018 | Annual | 02/08/2019 |
| REOHDE & SCHWARZ | SMB100A/ SIGNAL GENERATOR (100kHz~40GHz) | 177633 | 07/19/2018 | Annual | 07/19/2019 |
| REOHDE & SCHWARZ | ESU40 / EMI TEST RECEIVER | 100524 | 07/27/2018 | Annual | 07/27/2019 |
| HCT CO., LTD., | FCC LTE Mobile Conducted RF Automation Test Software | - | - | - | - |

Note:

- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

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

| Parameter | Expanded Uncertainty (\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) | 5.71 |

6. SUMMARY OF TEST RESULTS

6.1 Test Condition : Conducted Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result |
|--|---------------------------------------|---|------------------|
| Occupied Bandwidth | §2.1049 | N/A | PASS |
| Band Edge / Spurious and Harmonic Emissions at Antenna Terminal. | §2.1051, §22.917(a), §24.238(a) | < 43 + 10log10 (P[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 dB | PASS |
| Frequency stability / variation of ambient temperature | §2.1055, § 22.355 | < 2.5 ppm | PASS |
| | §24.235 | Emission must remain in band | PASS |

Note:

1. See SAR Report

6.2 Test Condition : Radiated Test

| Test Description | FCC Part Section(s) | Test Limit | Test Result |
|--|---------------------------------------|--|-------------|
| Effective Radiated Power | §22.913(a)(5) | < 7 Watts max. ERP | PASS |
| Equivalent Isotropic Radiated Power | §24.232(c) | < 2 Watts max. EIRP | PASS |
| Radiated Spurious and Harmonic Emissions | §2.1053, §22.917(a), §24.238(a) | < 43 + 10log10 (P[Watts]) for all out-of band emissions | PASS |

7. SAMPLE CALCULATION

7.1 ERP Sample Calculation

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

ERP = Substitute LEVEL(dBm) + Ant. Gain – CL(Cable Loss)

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

7.2 EIRP Sample Calculation

| Ch./ Freq. | | Measured Level(dBm) | Substitute Level(dBm) | Ant. Gain (dBi) | C.L | Pol. | EIRP | |
|------------|------------|---------------------|-----------------------|-----------------|------|------|-------|-------|
| channel | Freq.(MHz) | | | | | | W | dBm |
| 20175 | 1,732.50 | -15.75 | 18.45 | 9.90 | 1.76 | H | 0.456 | 26.59 |

EIRP = Substitute LEVEL(dBm) + Ant. Gain – CL(Cable Loss)

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

7.3. Emission Designator

GSM Emission Designator

Emission Designator = 249KGXW

GSM BW = 249 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 249KG7W

GSM BW = 249 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M17F9W

WCDMA BW = 4.17 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 4M48G7D

LTE BW = 4.48 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

16QAM Modulation

Emission Designator = 4M48W7D

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

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 | -23.08 | 38.20 | -10.27 | 0.86 | H | < 7.00 | 0.509 | 27.07 |
| | 190 | 836.6 | -24.35 | 37.95 | -10.21 | 0.87 | H | | 0.487 | 26.87 |
| | 251 | 848.8 | -25.48 | 36.99 | -10.16 | 0.87 | H | | 0.395 | 25.96 |
| EDGE | 128 | 824.2 | -30.64 | 30.64 | -10.27 | 0.86 | H | | 0.089 | 19.51 |

| 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 | -33.00 | 28.41 | -10.26 | 0.86 | H | < 7.00 | 0.054 | 17.29 |
| | 4183 | 836.6 | -33.85 | 28.45 | -10.21 | 0.87 | H | | 0.055 | 17.37 |
| | 4233 | 846.6 | -34.23 | 28.11 | -10.17 | 0.87 | H | | 0.051 | 17.07 |

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 |
| GSM1900 | 512 | 1850.2 | -11.71 | 20.33 | 10.27 | 1.34 | H | < 2.00 | 0.843 | 29.26 |
| | 661 | 1880.0 | -12.10 | 20.03 | 10.29 | 1.36 | H | | 0.787 | 28.96 |
| | 810 | 1909.8 | -13.55 | 18.98 | 10.31 | 1.37 | H | | 0.619 | 27.92 |
| EDGE | 512 | 1850.2 | -22.64 | 9.40 | 10.27 | 1.34 | H | | 0.068 | 18.33 |

| Mode | Ch./ Freq. | | Measured Level (dBm) | Substitute LEVEL (dBm) | Ant. Gain (dBi) | C.L | Pol. | Limit | EIRP | |
|-----------|------------|------------|----------------------|------------------------|-----------------|------|------|--------|-------|-------|
| | channel | Freq.(MHz) | | | | | | | W | W |
| WCDMA1900 | 9262 | 1852.4 | -18.66 | 13.38 | 10.27 | 1.34 | V | < 2.00 | 0.170 | 22.31 |
| | 9400 | 1880.0 | -19.56 | 12.57 | 10.29 | 1.36 | V | | 0.141 | 21.50 |
| | 9538 | 1907.6 | -19.53 | 13.00 | 10.31 | 1.37 | V | | 0.156 | 21.94 |

8.3 RADIATED SPURIOUS EMISSIONS

- MEASURED OUTPUT POWER: 27.07 dBm = 0.509 W
- MODULATION SIGNAL: GSM850
- DISTANCE: 3 meters
- LIMIT: $43 + 10 \log_{10} (W) =$ 40.07 dBc

| Ch. | Freq.(MHz) | <u>Measured</u> <u>Level</u> <u>[dBm]</u> | Ant. Gain (dBd) | <u>Substitute</u> <u>Level</u> <u>[dBm]</u> | C.L | Pol. | Result (dBm) | dBc |
|----------------|------------|---|--------------------|---|------|------|-----------------|-------|
| 128 (824.2) | 1,648.40 | -42.58 | 7.46 | -51.47 | 1.27 | V | -47.43 | 74.50 |
| | 2,472.60 | -31.39 | 8.64 | -37.33 | 1.58 | H | -32.42 | 59.49 |
| | 3,296.80 | -55.69 | 10.25 | -61.68 | 1.86 | V | -55.44 | 82.51 |
| 190 (836.6) | 1,673.20 | -42.68 | 7.53 | -51.67 | 1.28 | V | -47.57 | 74.64 |
| | 2,509.80 | -32.08 | 8.83 | -38.40 | 1.62 | V | -33.34 | 60.41 |
| | 3,346.40 | -55.07 | 10.51 | -61.39 | 1.91 | H | -54.94 | 82.01 |
| | 4,183.00 | -49.78 | 10.78 | -53.55 | 2.17 | H | -47.09 | 74.16 |
| 251 (848.8) | 1,697.60 | -47.04 | 7.74 | -56.04 | 1.29 | H | -51.74 | 78.81 |
| | 2,546.40 | -36.76 | 8.86 | -42.79 | 1.62 | H | -37.70 | 64.77 |
| | 3,395.20 | -52.51 | 10.57 | -58.65 | 1.95 | H | -52.18 | 79.25 |
| | 4,244.00 | -49.99 | 10.80 | -53.80 | 2.20 | H | -47.35 | 74.42 |

- MEASURED OUTPUT POWER: 29.26 dBm = 0.843 W
- MODULATION SIGNAL: GSM1900
- DISTANCE: 3 meters
- LIMIT: $43 + 10 \log_{10}(W) =$ 42.26 dBc

| Ch. | Freq.(MHz) | <u>Measured</u> <u>Level</u> <u>[dBm]</u> | Ant. Gain (dBi) | <u>Substitute</u> <u>Level</u> <u>[dBm]</u> | C.L | Pol. | Result (dBm) | dBc |
|-----------------|------------|---|--------------------|---|------|------|-----------------|-------|
| 512 (1850.2) | 3,700.40 | -44.24 | 12.51 | -51.04 | 1.98 | H | -40.51 | 69.77 |
| | 5,550.60 | -48.49 | 13.62 | -49.77 | 2.72 | V | -38.87 | 68.13 |
| | 7,400.80 | -55.46 | 11.50 | -50.45 | 2.92 | H | -41.87 | 71.13 |
| 661 (1880.0) | 3,760.00 | -43.80 | 12.40 | -50.24 | 2.00 | H | -39.84 | 69.10 |
| | 5,640.00 | -49.74 | 13.78 | -50.57 | 2.70 | H | -39.49 | 68.75 |
| | 7,520.00 | -57.84 | 11.57 | -52.63 | 2.93 | H | -43.99 | 73.25 |
| 810 (1909.8) | 3,819.60 | -45.52 | 12.52 | -51.76 | 2.05 | H | -41.29 | 70.55 |
| | 5,729.40 | -51.37 | 13.69 | -51.32 | 2.72 | H | -40.35 | 69.61 |
| | 7,639.20 | -56.92 | 11.99 | -52.12 | 2.93 | V | -43.06 | 72.32 |

- MEASURED OUTPUT POWER: 17.37 dBm = 0.055 W
- MODULATION SIGNAL: WCDMA850
- DISTANCE: 3 meters
- LIMIT: $43 + 10 \log_{10}(W) =$ 30.37 dBc

| Ch. | Freq.(MHz) | <u>Measured</u> <u>Level</u> <u>[dBm]</u> | Ant. Gain (dBd) | <u>Substitute</u> <u>Level</u> <u>[dBm]</u> | C.L | Pol. | Result (dBm) | dBc |
|------------------|------------|---|--------------------|---|------|------|-----------------|-------|
| 4,132 (826.4) | 1,652.80 | -53.59 | 7.46 | -62.48 | 1.27 | V | -58.44 | 75.81 |
| | 2,479.20 | -42.91 | 8.71 | -49.28 | 1.60 | V | -44.32 | 61.69 |
| | 3,305.60 | -55.01 | 10.32 | -61.04 | 1.87 | H | -54.74 | 72.11 |
| 4,183 (836.6) | 1,673.20 | -50.63 | 7.53 | -59.62 | 1.28 | H | -55.52 | 72.89 |
| | 2,509.80 | -47.51 | 8.83 | -53.83 | 1.62 | V | -48.77 | 66.14 |
| | 3,346.40 | -56.40 | 10.51 | -62.72 | 1.91 | H | -56.27 | 73.64 |
| 4,233 (846.6) | 1,693.20 | -49.51 | 7.67 | -58.54 | 1.28 | H | -54.30 | 71.68 |
| | 2,539.80 | -42.98 | 8.85 | -48.76 | 1.61 | V | -43.67 | 61.04 |
| | 3,386.40 | -53.08 | 10.56 | -59.36 | 1.93 | V | -52.88 | 70.25 |
| | 4,233.00 | -53.08 | 10.81 | -56.75 | 2.23 | V | -50.32 | 67.70 |

- MEASURED OUTPUT POWER: 22.31 dBm = 0.170 W
- MODULATION SIGNAL: WCDMA1900
- DISTANCE: 3 meters
- LIMIT: $43 + 10 \log_{10}(W) =$ 35.31 dBc

| Ch. | Freq.(MHz) | <u>Measured</u> <u>Level</u> <u>[dBm]</u> | Ant. Gain (dBi) | <u>Substitute</u> <u>Level</u> <u>[dBm]</u> | C.L | Pol. | Result (dBm) | dBc |
|------------------|------------|---|--------------------|---|------|------|-----------------|-------|
| 9262 (1852.4) | 3,704.80 | -55.26 | 12.50 | -61.89 | 1.99 | V | -51.38 | 73.69 |
| | 5,557.20 | -52.32 | 13.64 | -53.56 | 2.71 | V | -42.63 | 64.94 |
| | 7,409.60 | -55.61 | 11.50 | -50.32 | 2.93 | V | -41.75 | 64.06 |
| 9400 (1880.0) | 3,760.00 | -55.29 | 12.40 | -61.73 | 2.00 | H | -51.33 | 73.64 |
| | 5,640.00 | -51.39 | 13.78 | -52.22 | 2.70 | V | -41.14 | 63.45 |
| | 7,520.00 | -56.39 | 11.57 | -51.18 | 2.93 | H | -42.54 | 64.85 |
| 9538 (1907.6) | 3,815.20 | -54.16 | 12.52 | -60.53 | 2.06 | V | -50.06 | 72.37 |
| | 5,722.80 | -50.39 | 13.70 | -50.08 | 2.72 | V | -39.10 | 61.41 |
| | 7,630.40 | -54.73 | 11.95 | -49.92 | 2.98 | V | -40.95 | 63.26 |

8.4 PEAK-TO-AVERAGE RATIO

| Band | Ch. | Measured P _{Pk} (dBm) | Measured P _{Avg} (dBm) | P _{Avg} (Duty Cycle) | | | P.A.R. = P _{Pk} - P _{Avg} (dB) | Limit (dB) | Pass / Fail |
|-----------------|------|-----------------------------------|------------------------------------|-------------------------------|--------------------------|----------------|--|---------------|----------------|
| | | | | T _{XTotal} (ms) | T _{XOn} (ms) | Factor (dB) | | | |
| GSM1900 | 661 | 29.372 | 19.67 | 4.616 | 0.5475 | 9.26 | 0.44 | 13 | Pass |
| GSM1900 EDGE | 661 | 28.049 | 15.24 | 4.616 | 0.5475 | 9.26 | 3.55 | | |
| WCDMA1900 | 9400 | CCDF Procedure | | | | | 3.03 | | |

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 58 ~ 64.
2. Only GSM(include EDGE) Mode was tested by alternate procedure for PAPR

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

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

8.5 OCCUPIED BANDWIDTH

| Band | Channel | Frequency(MHz) | Data (GSM: kHz / WCDMA : MHz) |
|--------------|---------|----------------|-------------------------------|
| GSM850 | 128 | 824.20 | 243.59 |
| | 190 | 836.60 | 244.71 |
| | 251 | 848.80 | 243.01 |
| GSM850 EDGE | 128 | 824.20 | 243.54 |
| | 190 | 836.60 | 241.74 |
| | 251 | 848.80 | 239.21 |
| GSM1900 | 512 | 1,850.20 | 246.56 |
| | 661 | 1,880.00 | 245.59 |
| | 810 | 1,909.80 | 243.30 |
| GSM1900 EDGE | 512 | 1,850.20 | 246.25 |
| | 661 | 1,880.00 | 246.87 |
| | 810 | 1,909.80 | 243.78 |
| WCDMA850 | 4132 | 826.4 | 4.1636 |
| | 4183 | 836.6 | 4.1420 |
| | 4233 | 846.6 | 4.1497 |
| WCDMA1900 | 9262 | 1852.40 | 4.1320 |
| | 9400 | 1880.00 | 4.1245 |
| | 9538 | 1907.60 | 4.1549 |

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 40 ~ 57.

8.6 CONDUCTED SPURIOUS EMISSIONS

| Band | Channel | Frequency of Maximum Harmonic (GHz) | Factor (dB) | Measurement Maximum Data (dBm) | Result | (dBm) |
|-----------|---------|-------------------------------------|-------------|--------------------------------|---------|--------|
| GSM850 | 128 | 5.6511 | 28.591 | -57.012 | -28.421 | -13.00 |
| | 190 | 2.7269 | 27.976 | -57.203 | -29.227 | |
| | 251 | 3.6945 | 27.976 | -56.509 | -28.533 | |
| GSM1900 | 512 | 18.91622 | 29.489 | -52.712 | -23.223 | |
| | 661 | 18.87947 | 29.489 | -52.335 | -22.846 | |
| | 810 | 17.88895 | 29.489 | -52.313 | -22.824 | |
| WCDMA850 | 4132 | 2.4806 | 27.976 | -77.301 | -49.325 | |
| | 4183 | 2.5135 | 27.976 | -76.743 | -48.767 | |
| | 4233 | 2.5434 | 27.976 | -77.015 | -49.039 | |
| WCDMA1900 | 9262 | 18.94847 | 29.489 | -72.802 | -43.313 | |
| | 9400 | 18.92747 | 29.489 | -72.437 | -42.948 | |
| | 9538 | 18.92172 | 29.489 | -72.441 | -42.952 | |

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 97 ~ 114.
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 |

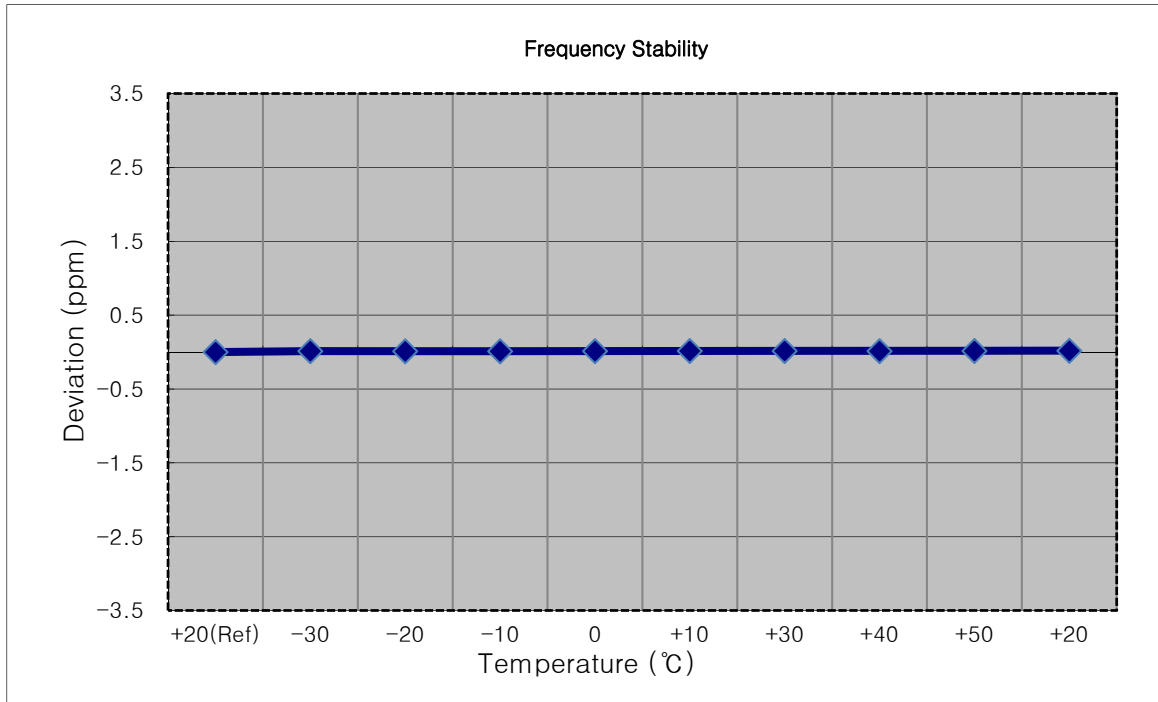
8.7 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 65 ~ 96.

8.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

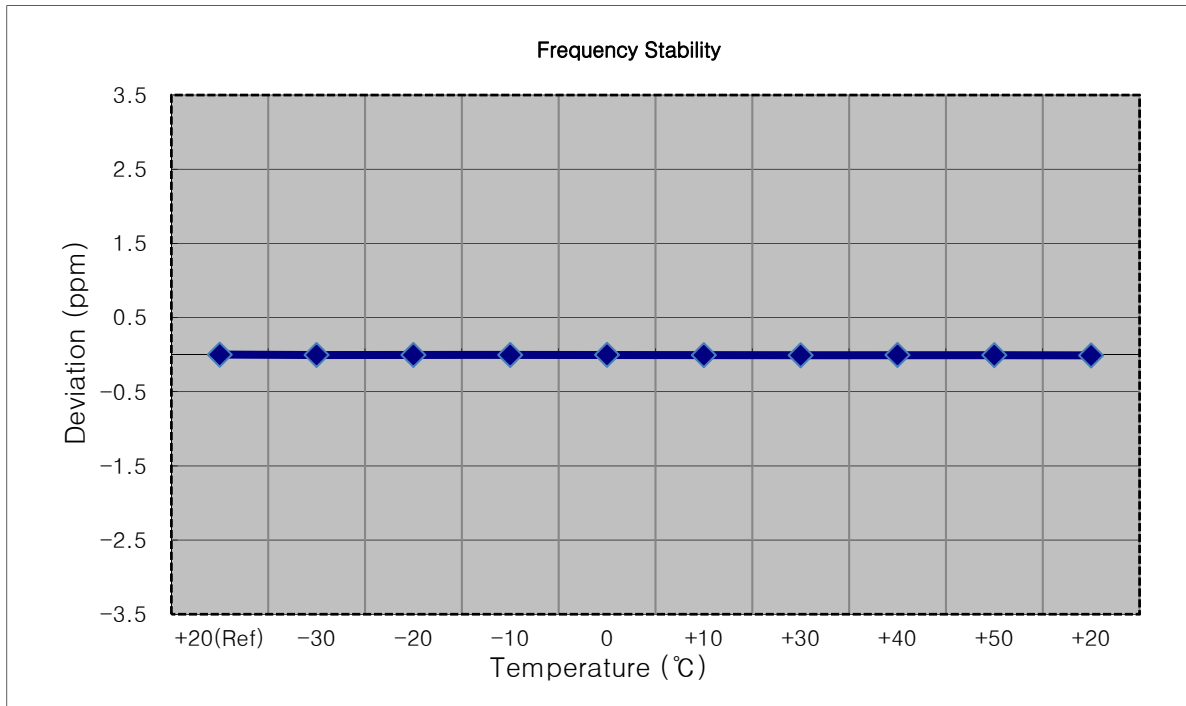
- MODE: GSM850
- OPERATING FREQUENCY: 836.600.000 Hz
- CHANNEL: 190
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|-----------|
| 100% | 3.80 | +20(Ref) | 836 600 013 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 836 600 024 | 11.1 | 0.000 001 | 0.0132 |
| 100% | | -20 | 836 600 023 | 10.5 | 0.000 001 | 0.0125 |
| 100% | | -10 | 836 600 022 | 9.5 | 0.000 001 | 0.0113 |
| 100% | | 0 | 836 600 024 | 11.6 | 0.000 001 | 0.0139 |
| 100% | | +10 | 836 600 026 | 13.0 | 0.000 002 | 0.0155 |
| 100% | | +30 | 836 600 026 | 13.7 | 0.000 002 | 0.0163 |
| 100% | | +40 | 836 600 025 | 12.4 | 0.000 001 | 0.0148 |
| 100% | | +50 | 836 600 027 | 14.5 | 0.000 002 | 0.0173 |
| Batt. Endpoint | | 3.40 | +20 | 836 600 029 | 16.2 | 0.000 002 |



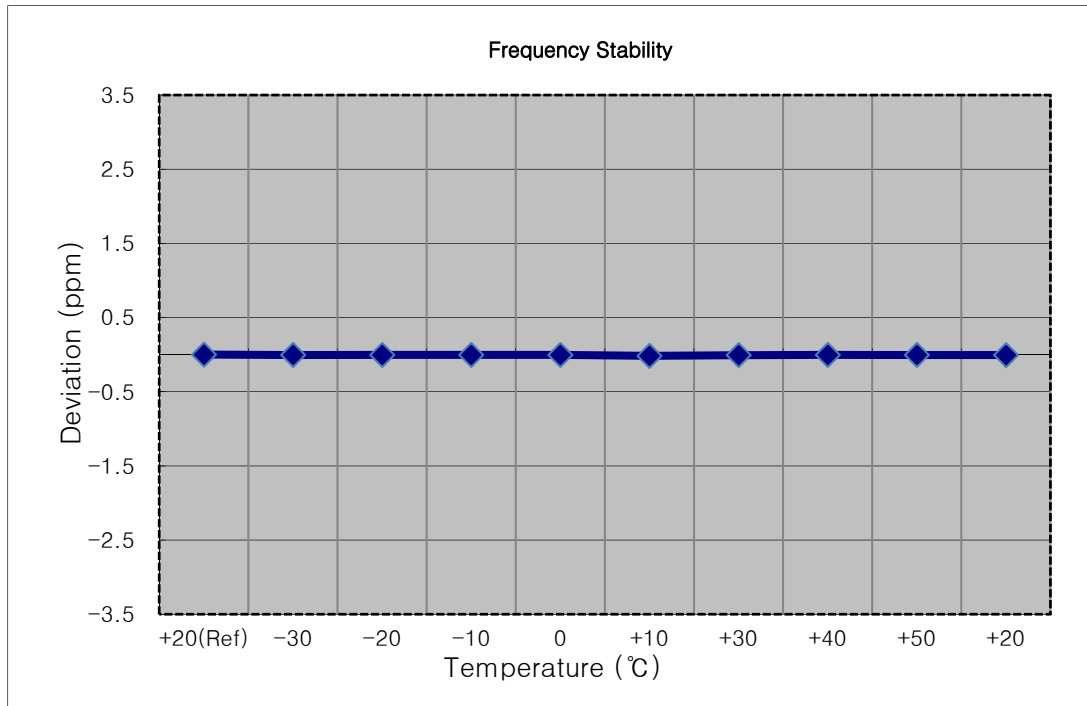
- MODE: GSM1900
- OPERATING FREQUENCY: 1850,200,000 Hz
- CHANNEL: 512
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 1850 199 998 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1850 199 989 | -9.5 | -0.000 001 | -0.0051 |
| 100% | | -20 | 1850 199 989 | -8.8 | 0.000 000 | -0.0048 |
| 100% | | -10 | 1850 199 991 | -7.6 | 0.000 000 | -0.0041 |
| 100% | | 0 | 1850 199 992 | -6.4 | 0.000 000 | -0.0035 |
| 100% | | +10 | 1850 199 986 | -12.5 | -0.000 001 | -0.0068 |
| 100% | | +30 | 1850 199 982 | -16.5 | -0.000 001 | -0.0089 |
| 100% | | +40 | 1850 199 989 | -9.2 | 0.000 000 | -0.0050 |
| 100% | | +50 | 1850 199 985 | -13.1 | -0.000 001 | -0.0071 |
| Batt. Endpoint | 3.40 | +20 | 1850 199 980 | -18.5 | -0.000 001 | -0.0100 |



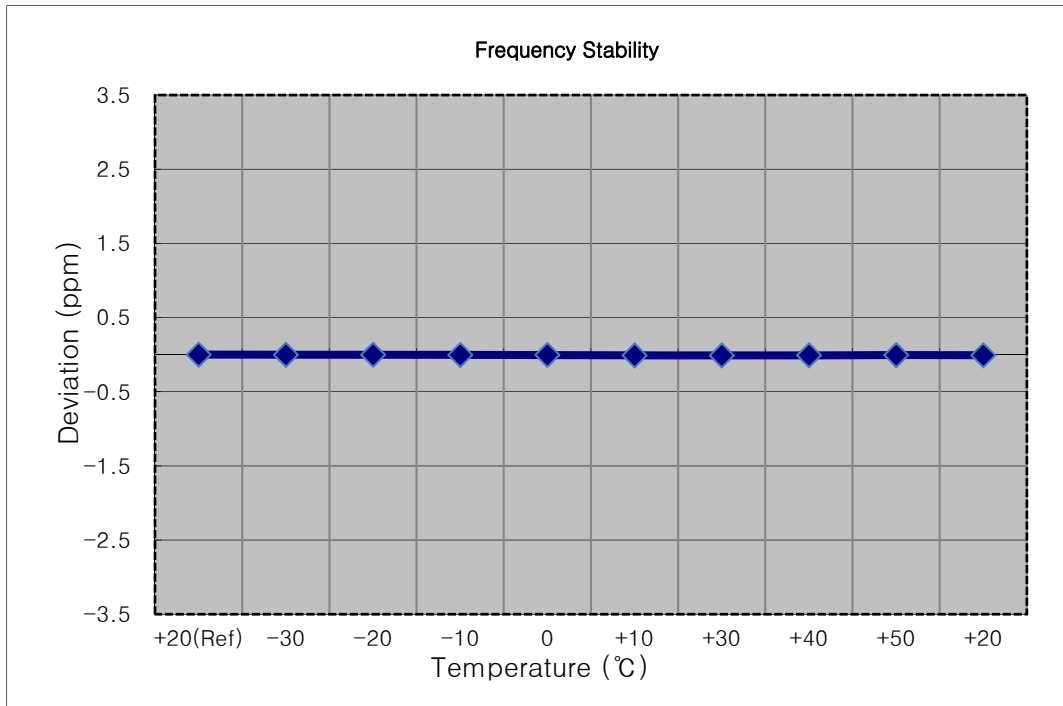
- MODE: GSM1900
- OPERATING FREQUENCY: 1880,000,000 Hz
- CHANNEL: 661
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 1879 999 989 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1879 999 979 | -9.8 | -0.000 001 | -0.0052 |
| 100% | | -20 | 1879 999 981 | -8.2 | 0.000 000 | -0.0044 |
| 100% | | -10 | 1879 999 981 | -8.0 | 0.000 000 | -0.0043 |
| 100% | | 0 | 1879 999 981 | -7.8 | 0.000 000 | -0.0041 |
| 100% | | +10 | 1879 999 957 | -32.2 | -0.000 002 | -0.0171 |
| 100% | | +30 | 1879 999 976 | -13.6 | -0.000 001 | -0.0072 |
| 100% | | +40 | 1879 999 981 | -8.1 | 0.000 000 | -0.0043 |
| 100% | | +50 | 1879 999 979 | -10.2 | -0.000 001 | -0.0054 |
| Batt. Endpoint | 3.40 | +20 | 1879 999 978 | -11.4 | -0.000 001 | -0.0060 |



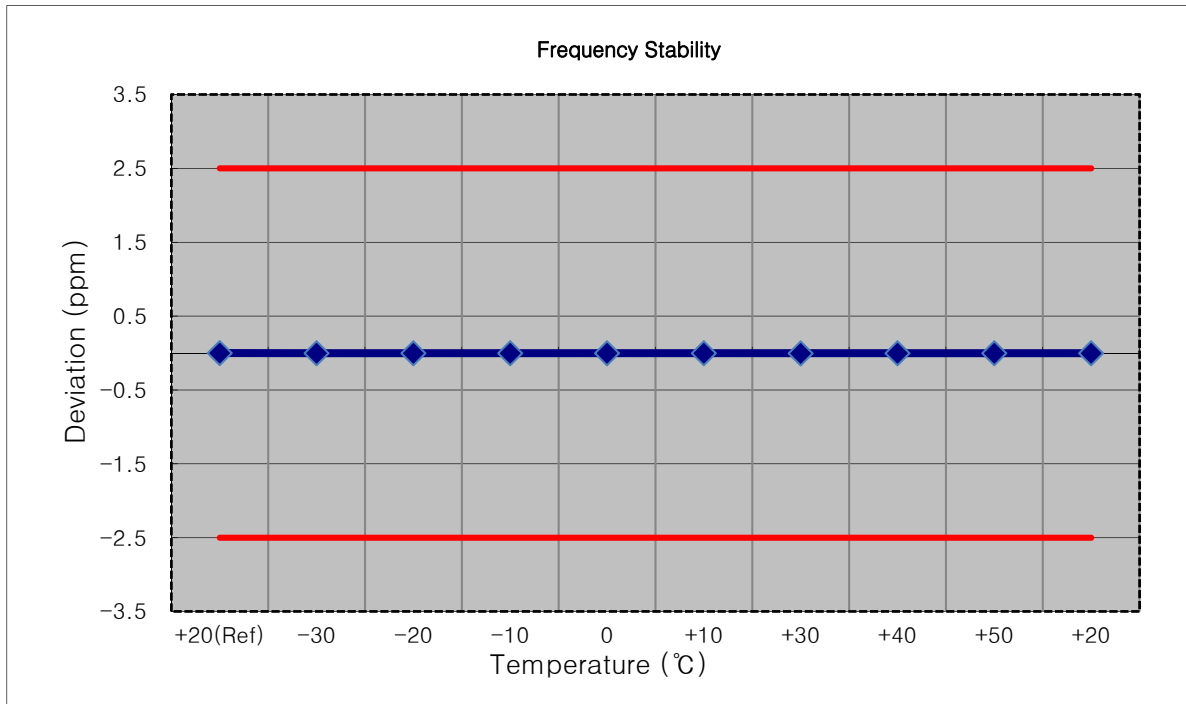
- MODE: GSM1900
- OPERATING FREQUENCY: 1909,800,000 Hz
- CHANNEL: 810
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 1909 799 989 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1909 799 984 | -4.6 | 0.000 000 | -0.0024 |
| 100% | | -20 | 1909 799 982 | -6.2 | 0.000 000 | -0.0032 |
| 100% | | -10 | 1909 799 981 | -7.7 | 0.000 000 | -0.0040 |
| 100% | | 0 | 1909 799 980 | -8.2 | 0.000 000 | -0.0043 |
| 100% | | +10 | 1909 799 966 | -22.3 | -0.000 001 | -0.0117 |
| 100% | | +30 | 1909 799 967 | -21.6 | -0.000 001 | -0.0113 |
| 100% | | +40 | 1909 799 973 | -15.4 | -0.000 001 | -0.0081 |
| 100% | | +50 | 1909 799 977 | -11.6 | -0.000 001 | -0.0061 |
| Batt. Endpoint | 3.40 | +20 | 1909 799 973 | -15.3 | -0.000 001 | -0.0080 |



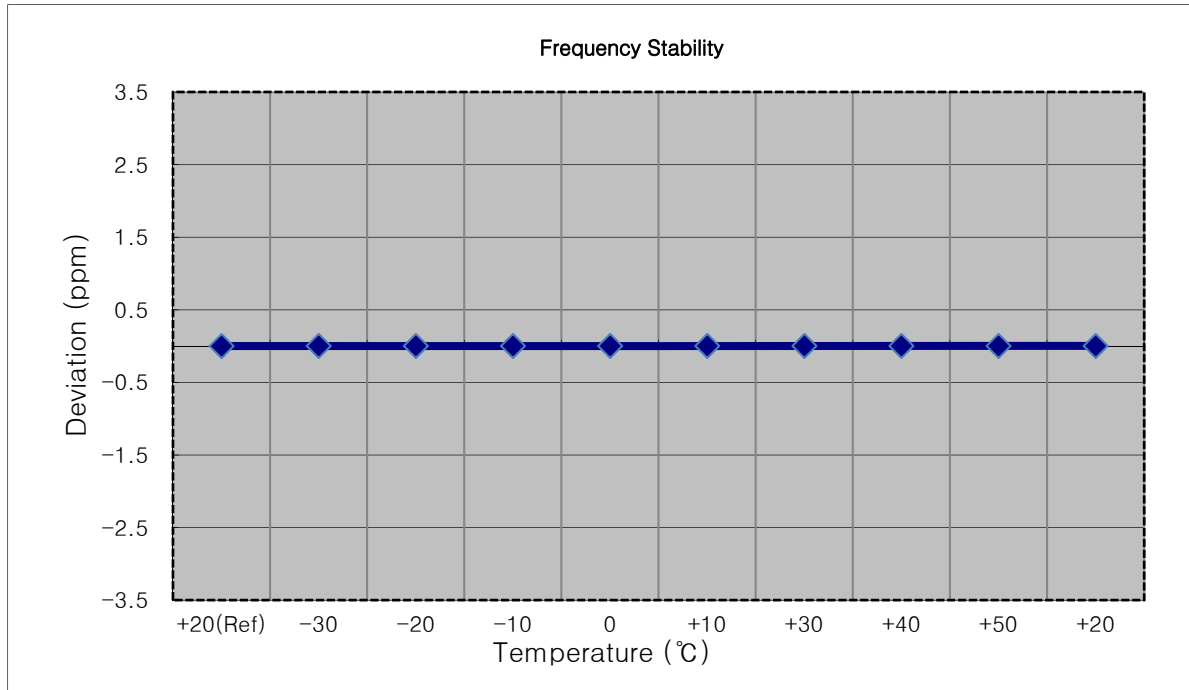
- MODE: WCDMA850
- OPERATING FREQUENCY: 836,600,000 Hz
- CHANNEL: 4183
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 836 599 998 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 836 599 997 | -1.0 | 0.000 000 | -0.0011 |
| 100% | | -20 | 836 599 996 | -1.3 | 0.000 000 | -0.0016 |
| 100% | | -10 | 836 599 996 | -1.5 | 0.000 000 | -0.0018 |
| 100% | | 0 | 836 599 996 | -1.5 | 0.000 000 | -0.0018 |
| 100% | | +10 | 836 599 997 | -1.3 | 0.000 000 | -0.0015 |
| 100% | | +30 | 836 599 996 | -1.9 | 0.000 000 | -0.0022 |
| 100% | | +40 | 836 599 997 | -0.9 | 0.000 000 | -0.0011 |
| 100% | | +50 | 836 599 997 | -1.2 | 0.000 000 | -0.0015 |
| Batt. Endpoint | 3.40 | +20 | 836 599 997 | -0.9 | 0.000 000 | -0.0011 |



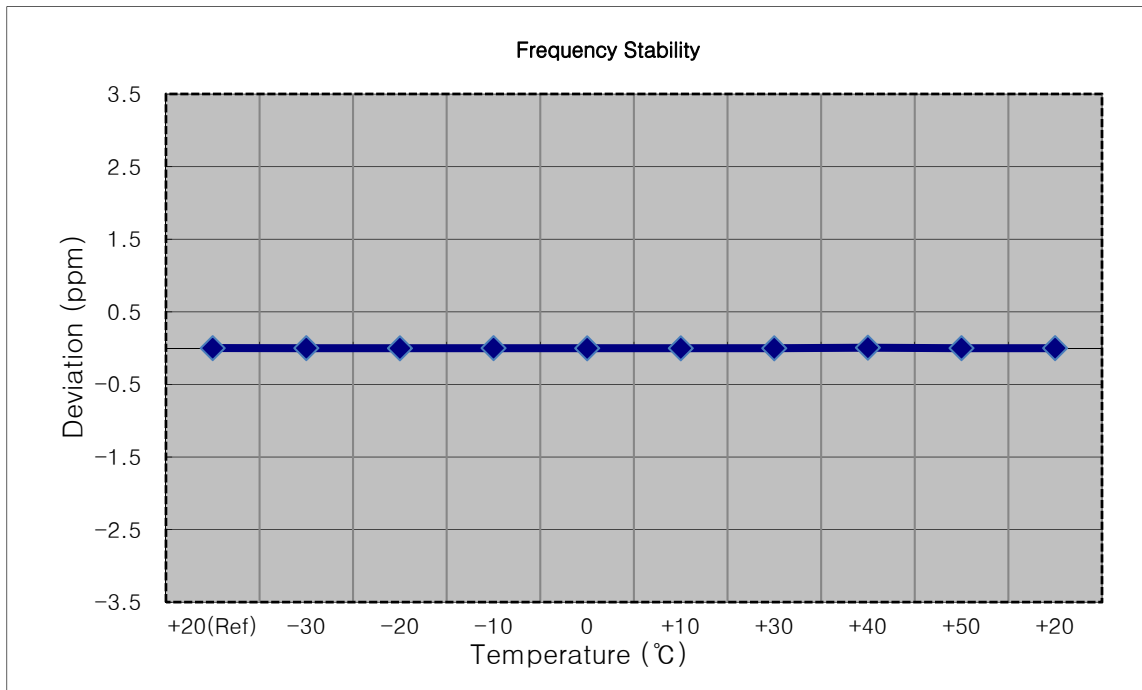
- MODE: WCDMA1900
- OPERATING FREQUENCY: 1,852,400,000 Hz
- CHANNEL: 9262
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|--------|
| 100% | 3.80 | +20(Ref) | 1852 400 003 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1852 400 005 | 2.1 | 0.000 000 | 0.0011 |
| 100% | | -20 | 1852 400 005 | 2.1 | 0.000 000 | 0.0011 |
| 100% | | -10 | 1852 400 006 | 2.5 | 0.000 000 | 0.0014 |
| 100% | | 0 | 1852 400 005 | 1.7 | 0.000 000 | 0.0009 |
| 100% | | +10 | 1852 400 005 | 2.1 | 0.000 000 | 0.0011 |
| 100% | | +30 | 1852 400 006 | 2.3 | 0.000 000 | 0.0012 |
| 100% | | +40 | 1852 400 006 | 2.7 | 0.000 000 | 0.0015 |
| 100% | | +50 | 1852 400 007 | 4.2 | 0.000 000 | 0.0023 |
| Batt. Endpoint | 3.40 | +20 | 1852 400 007 | 4.1 | 0.000 000 | 0.0022 |



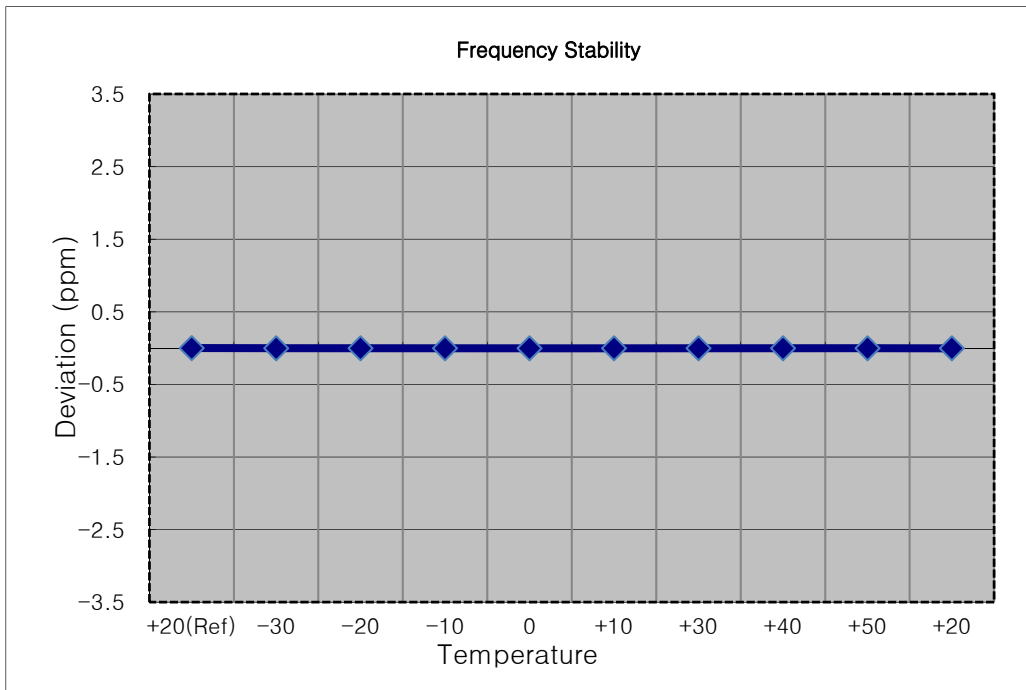
- MODE: WCDMA1900
- OPERATING FREQUENCY: 1,880,000,000 Hz
- CHANNEL: 9400
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 1879 999 998 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1879 999 996 | -2.1 | 0.000 000 | -0.0011 |
| 100% | | -20 | 1879 999 995 | -2.5 | 0.000 000 | -0.0013 |
| 100% | | -10 | 1879 999 996 | -1.8 | 0.000 000 | -0.0010 |
| 100% | | 0 | 1879 999 995 | -2.6 | 0.000 000 | -0.0014 |
| 100% | | +10 | 1879 999 994 | -3.4 | 0.000 000 | -0.0018 |
| 100% | | +30 | 1879 999 994 | -3.5 | 0.000 000 | -0.0019 |
| 100% | | +40 | 1880 000 009 | 11.1 | 0.000 001 | 0.0059 |
| 100% | | +50 | 1879 999 995 | -2.4 | 0.000 000 | -0.0013 |
| Batt. Endpoint | 3.40 | +20 | 1879 999 995 | -2.2 | 0.000 000 | -0.0012 |



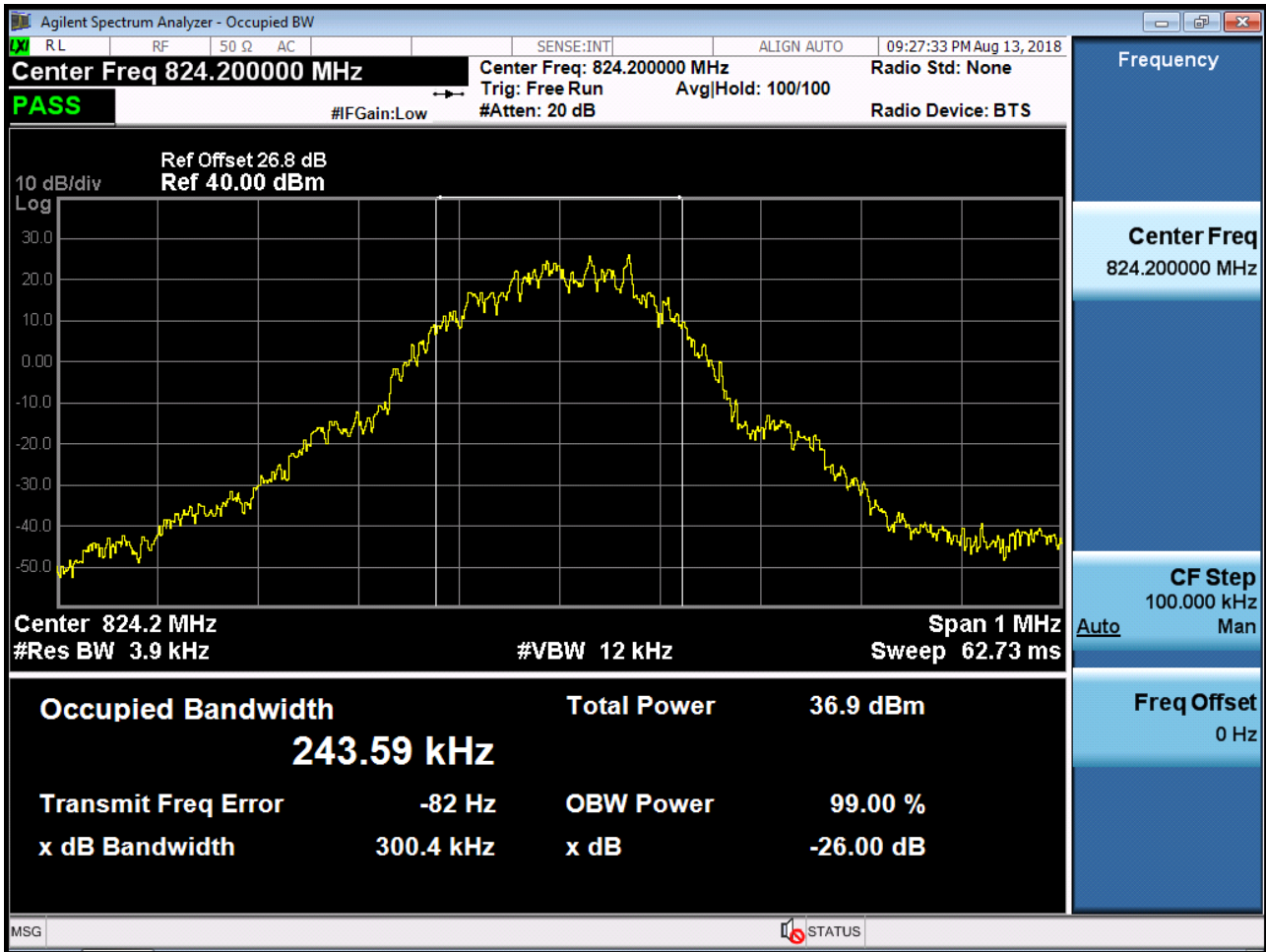
- MODE: WCDMA1900
- OPERATING FREQUENCY: 1,907,600,000 Hz
- CHANNEL: 9538
- REFERENCE VOLTAGE: 3.80 VDC
- DEVIATION LIMIT: Emission must remain in band

| Voltage (%) | Power (VDC) | Temp. (°C) | Frequency (Hz) | Frequency Error (Hz) | Deviation (%) | ppm |
|----------------|-------------|------------|----------------|----------------------|---------------|---------|
| 100% | 3.80 | +20(Ref) | 1907 599 995 | 0.0 | 0.000 000 | 0.0000 |
| 100% | | -30 | 1907 599 990 | -4.2 | 0.000 000 | -0.0022 |
| 100% | | -20 | 1907 599 991 | -4.1 | 0.000 000 | -0.0022 |
| 100% | | -10 | 1907 599 990 | -4.9 | 0.000 000 | -0.0026 |
| 100% | | 0 | 1907 599 990 | -4.7 | 0.000 000 | -0.0025 |
| 100% | | +10 | 1907 599 991 | -4.0 | 0.000 000 | -0.0021 |
| 100% | | +30 | 1907 599 991 | -3.7 | 0.000 000 | -0.0020 |
| 100% | | +40 | 1907 599 990 | -4.8 | 0.000 000 | -0.0025 |
| 100% | | +50 | 1907 599 991 | -4.0 | 0.000 000 | -0.0021 |
| Batt. Endpoint | 3.40 | +20 | 1907 599 989 | -5.2 | 0.000 000 | -0.0027 |

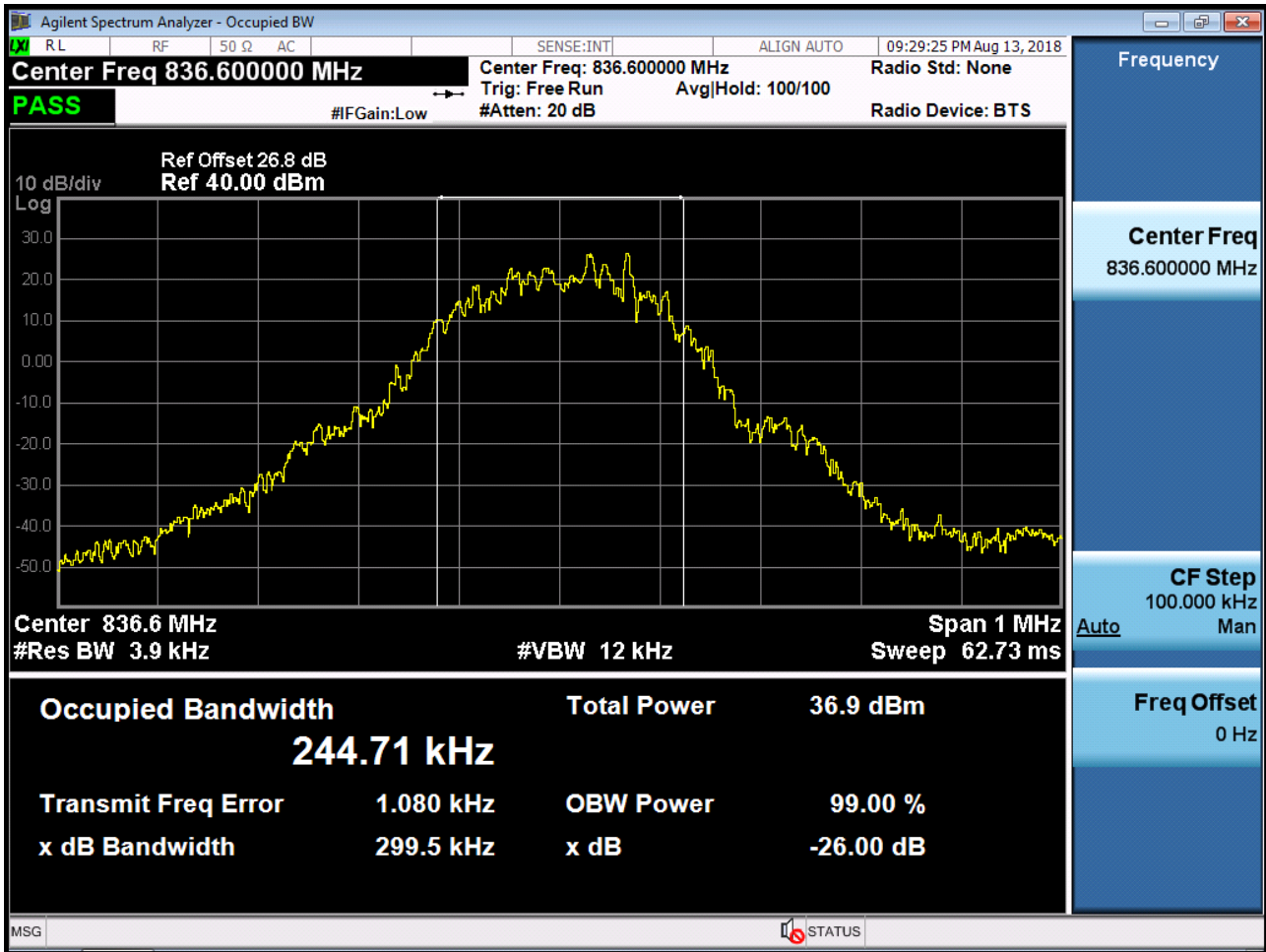


9. TEST PLOTS

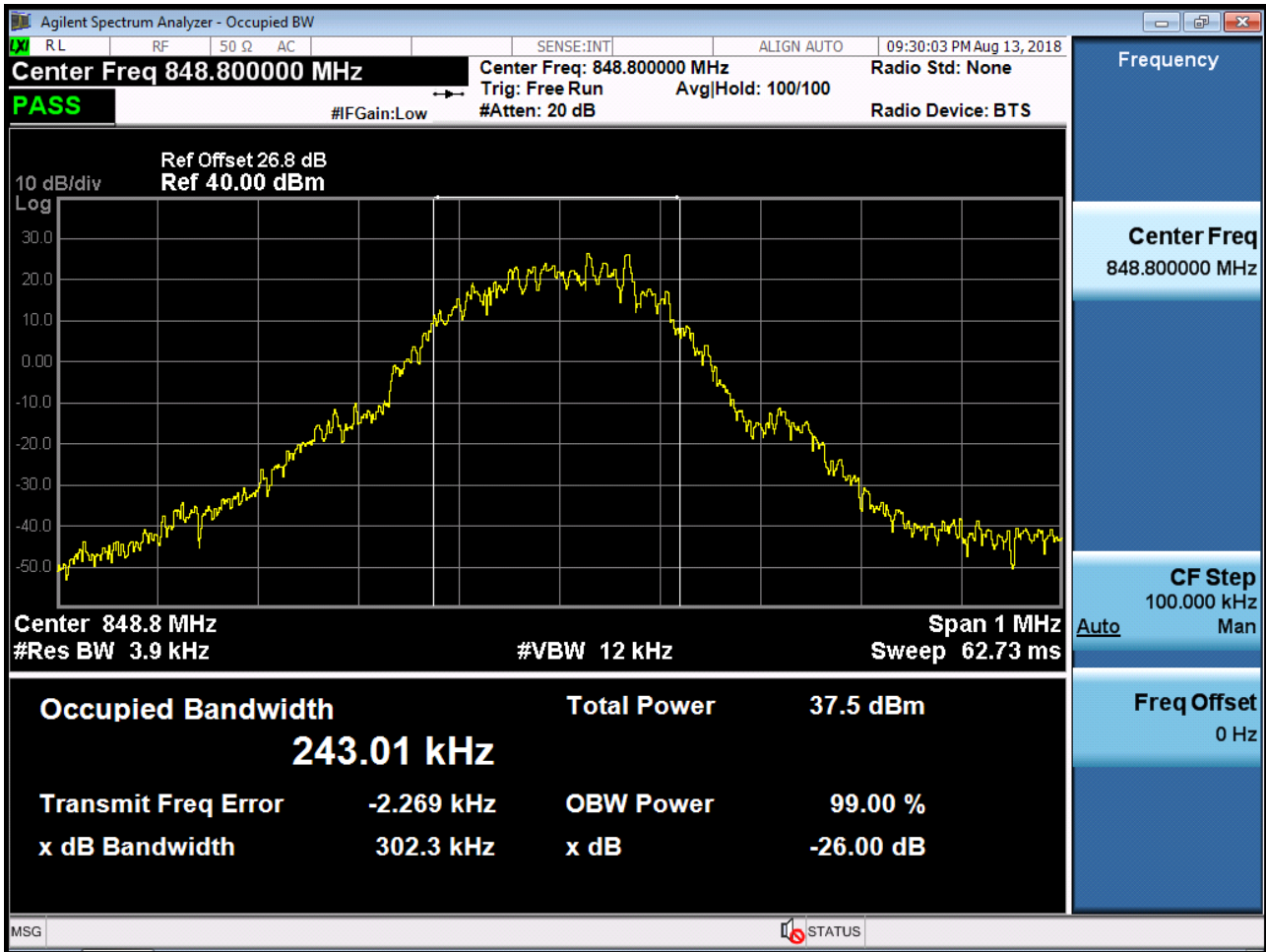
■ GSM850 MODE (128 CH.) Occupied Bandwidth



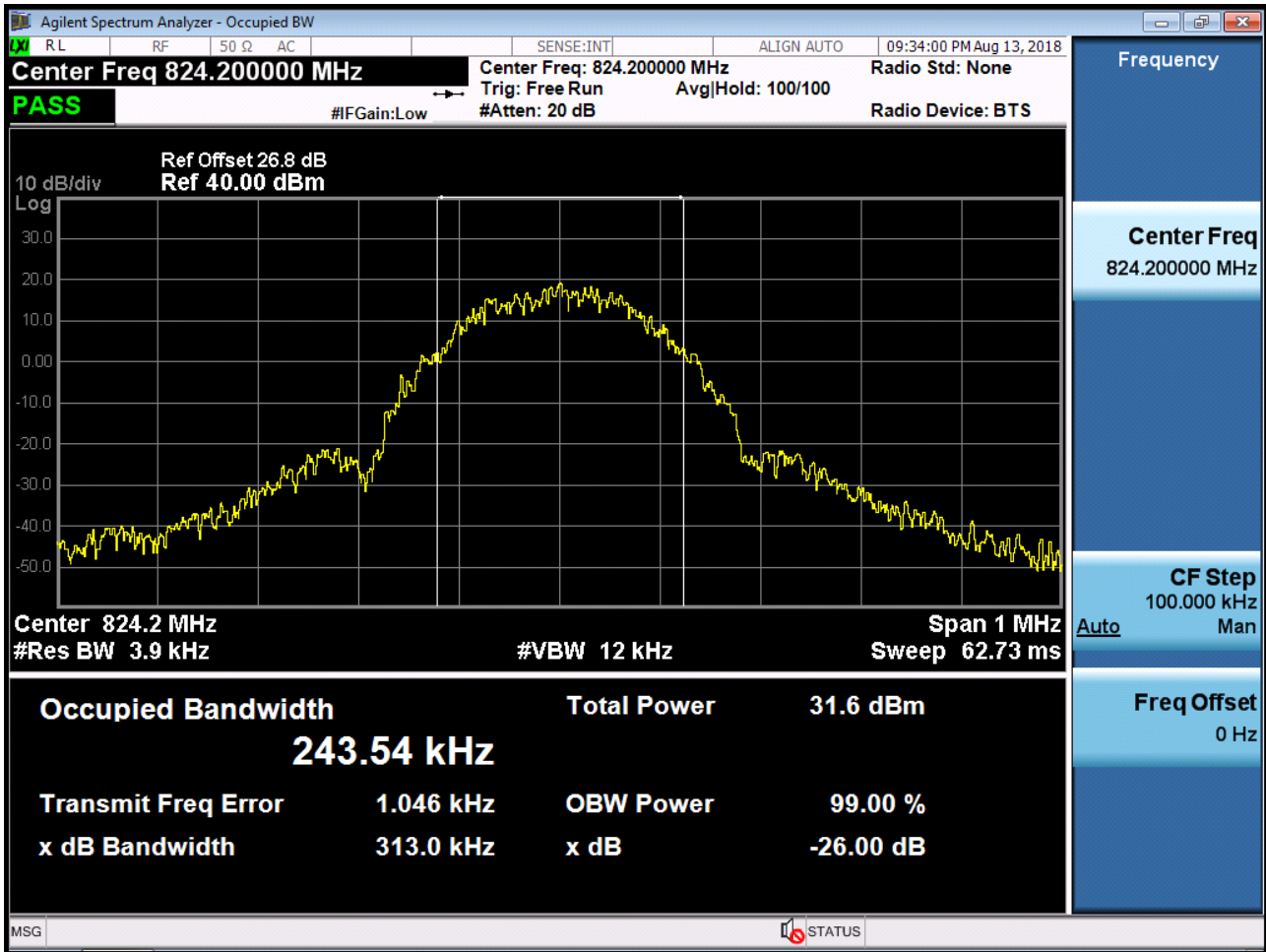
■ GSM850 MODE (190 CH.) Occupied Bandwidth



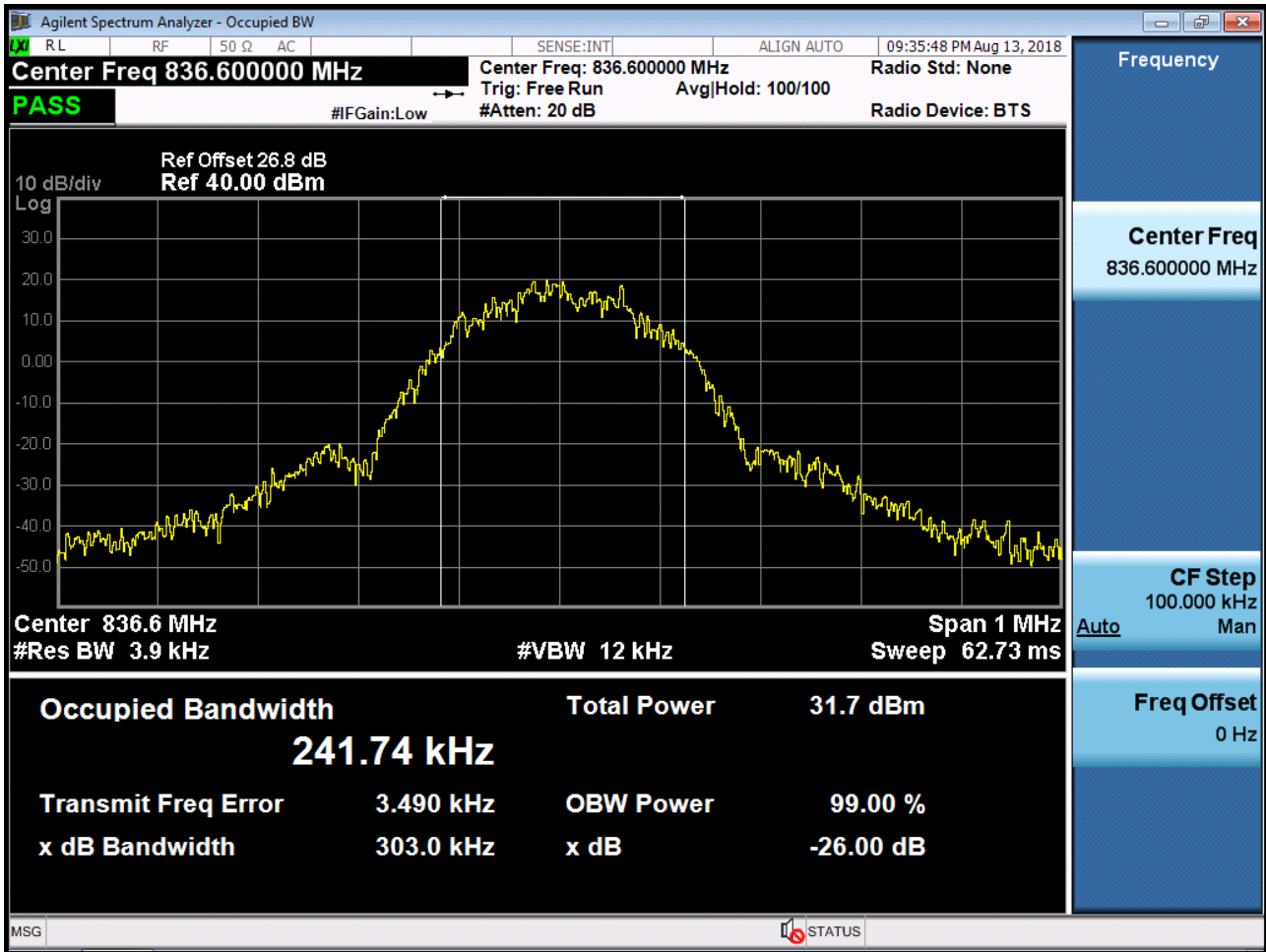
■ GSM850 MODE (251 CH.) Occupied Bandwidth



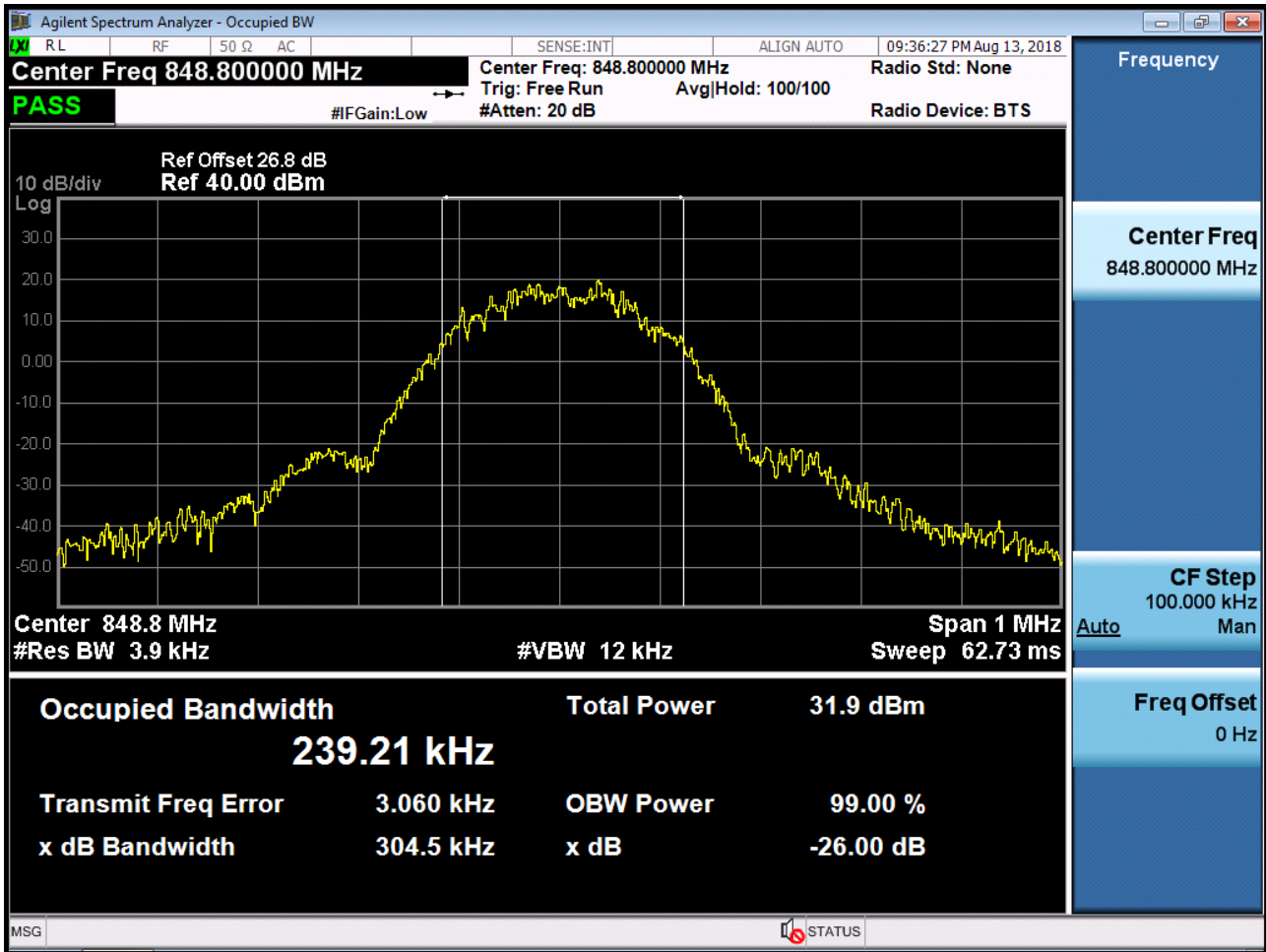
■ GSM850 EDGE (128 CH.) Occupied Bandwidth



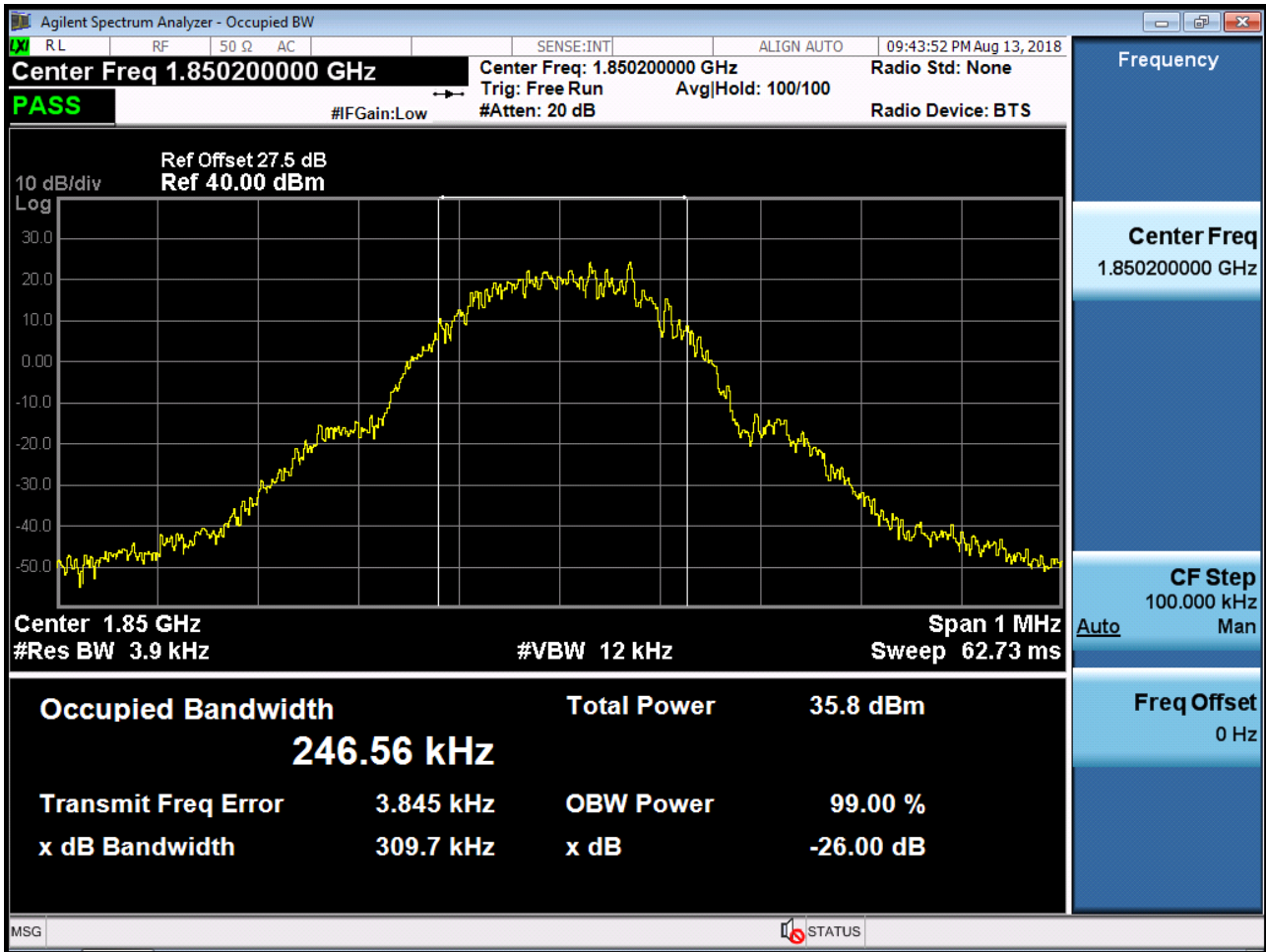
■ GSM850 EDGE (190 CH.) Occupied Bandwidth



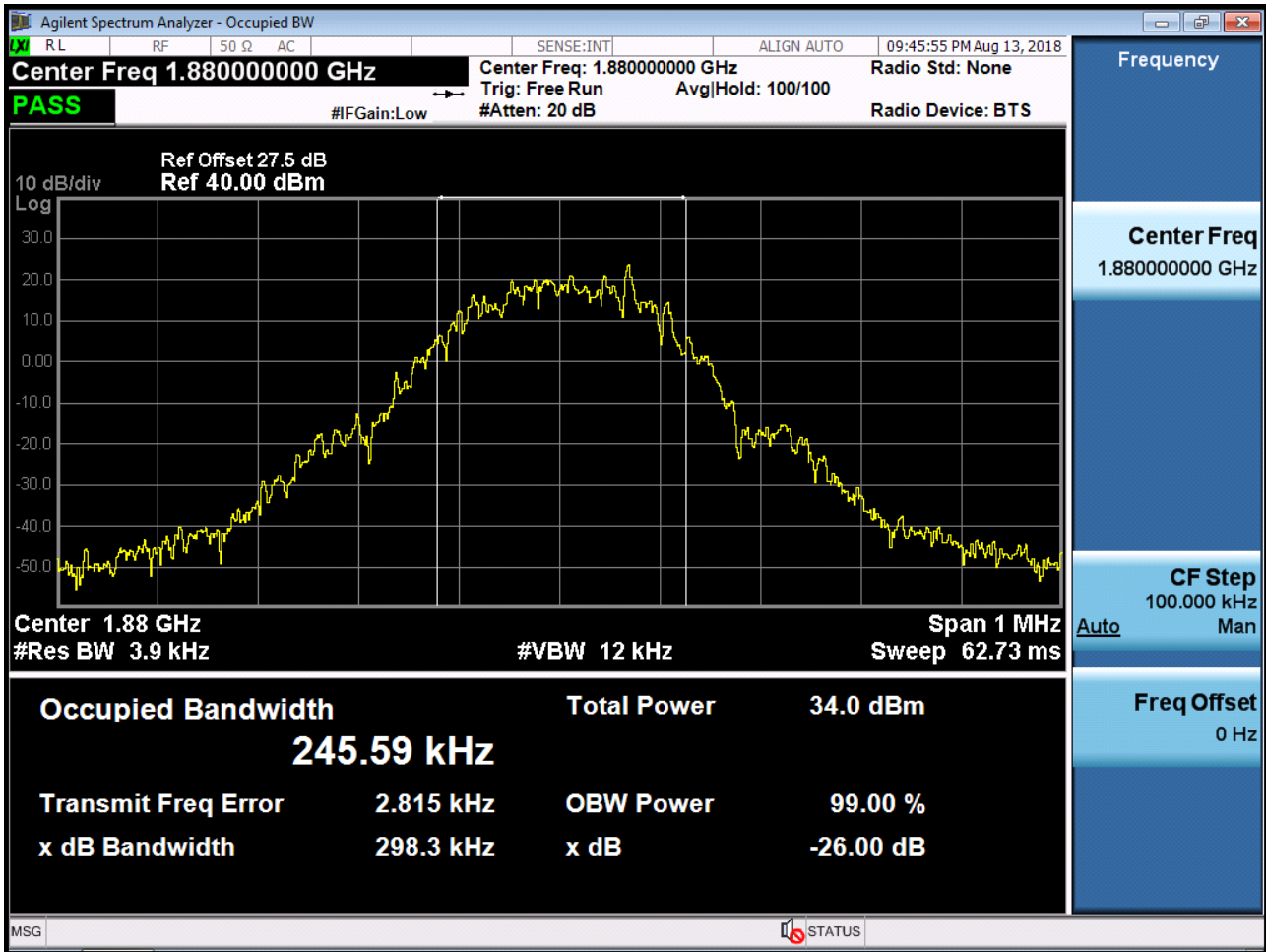
■ GSM850 EDGE (251 CH.) Occupied Bandwidth



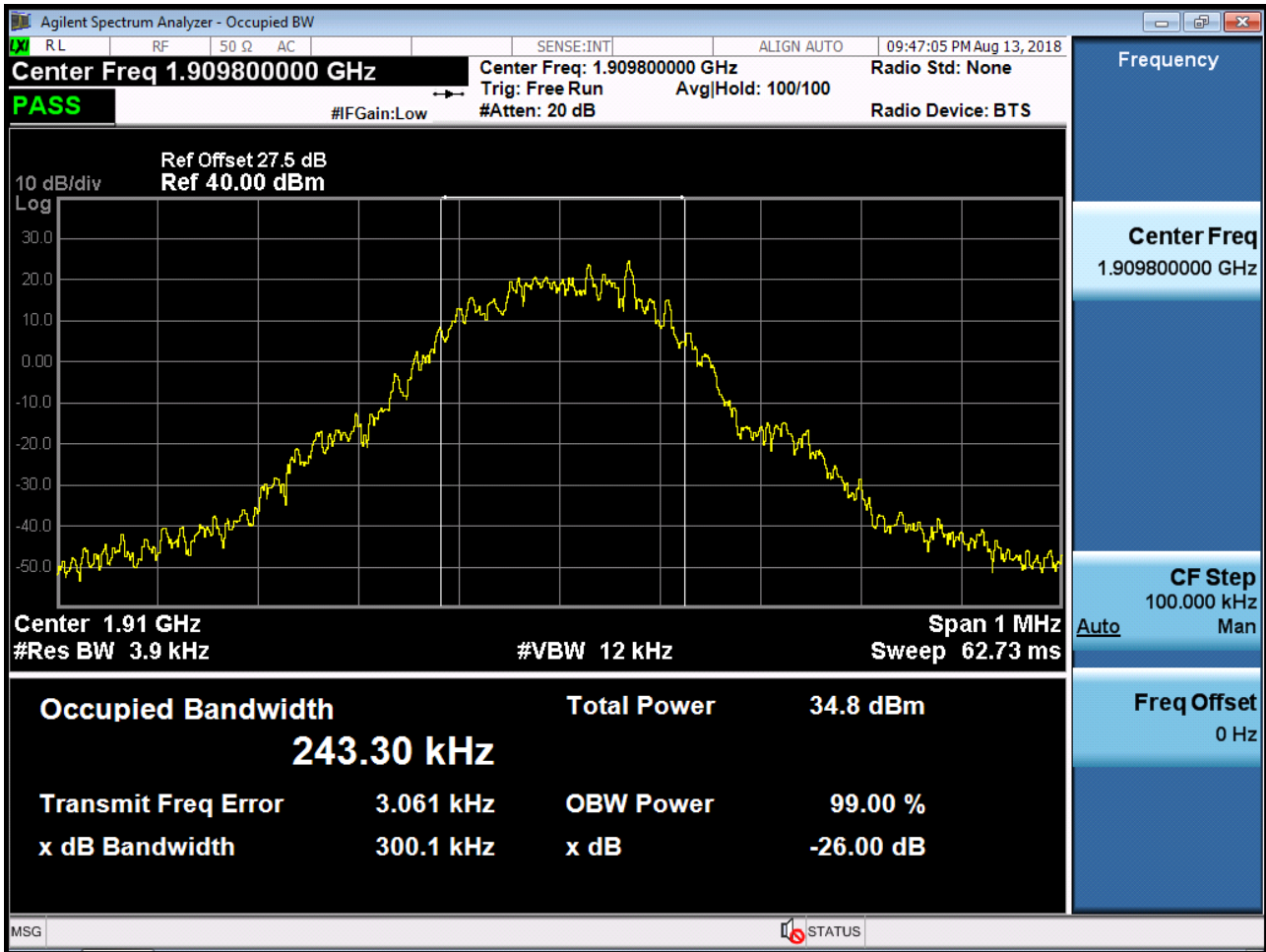
■ GSM1900 MODE (512 CH.) Occupied Bandwidth



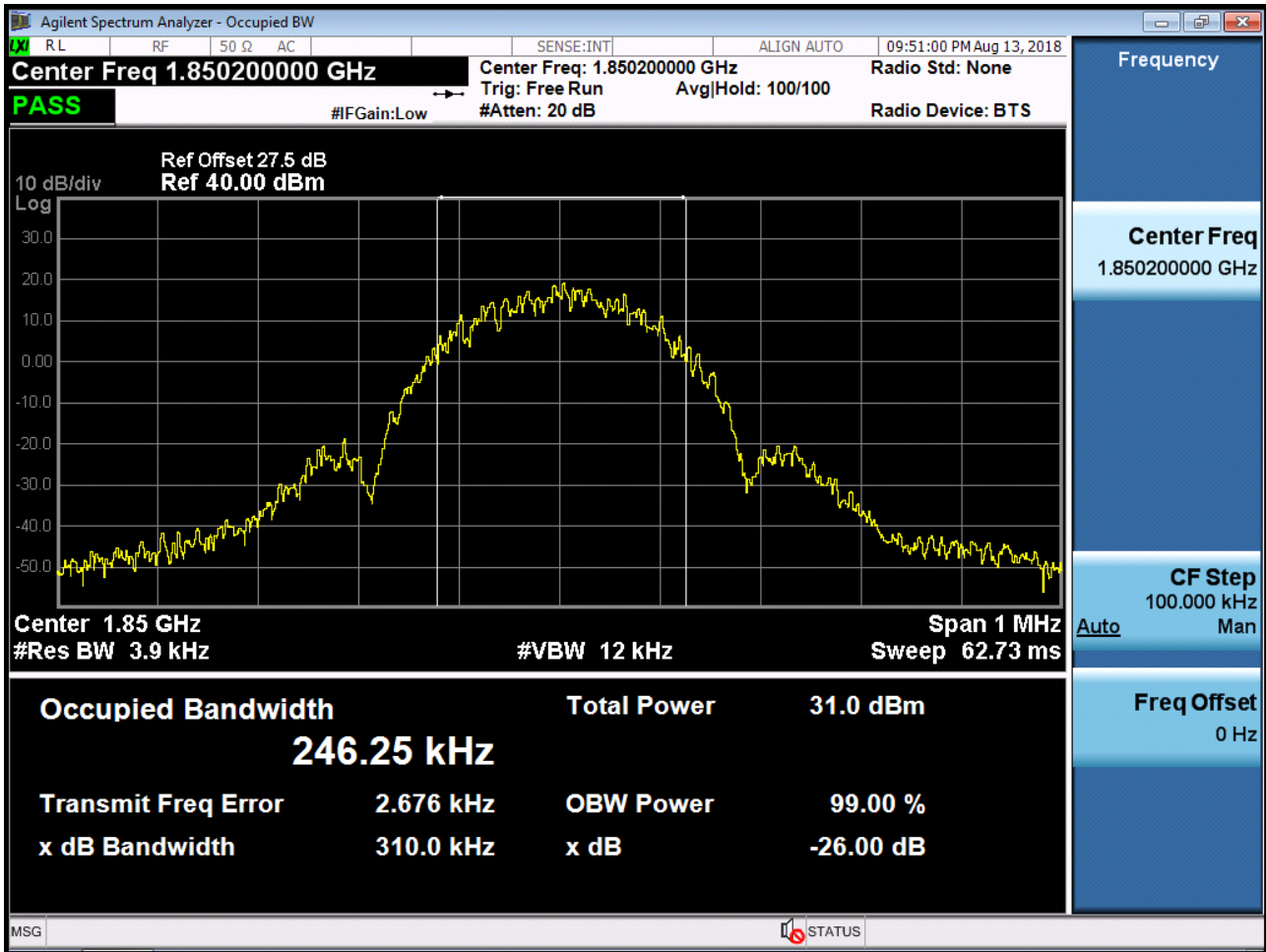
■ GSM1900 MODE (661 CH.) Occupied Bandwidth



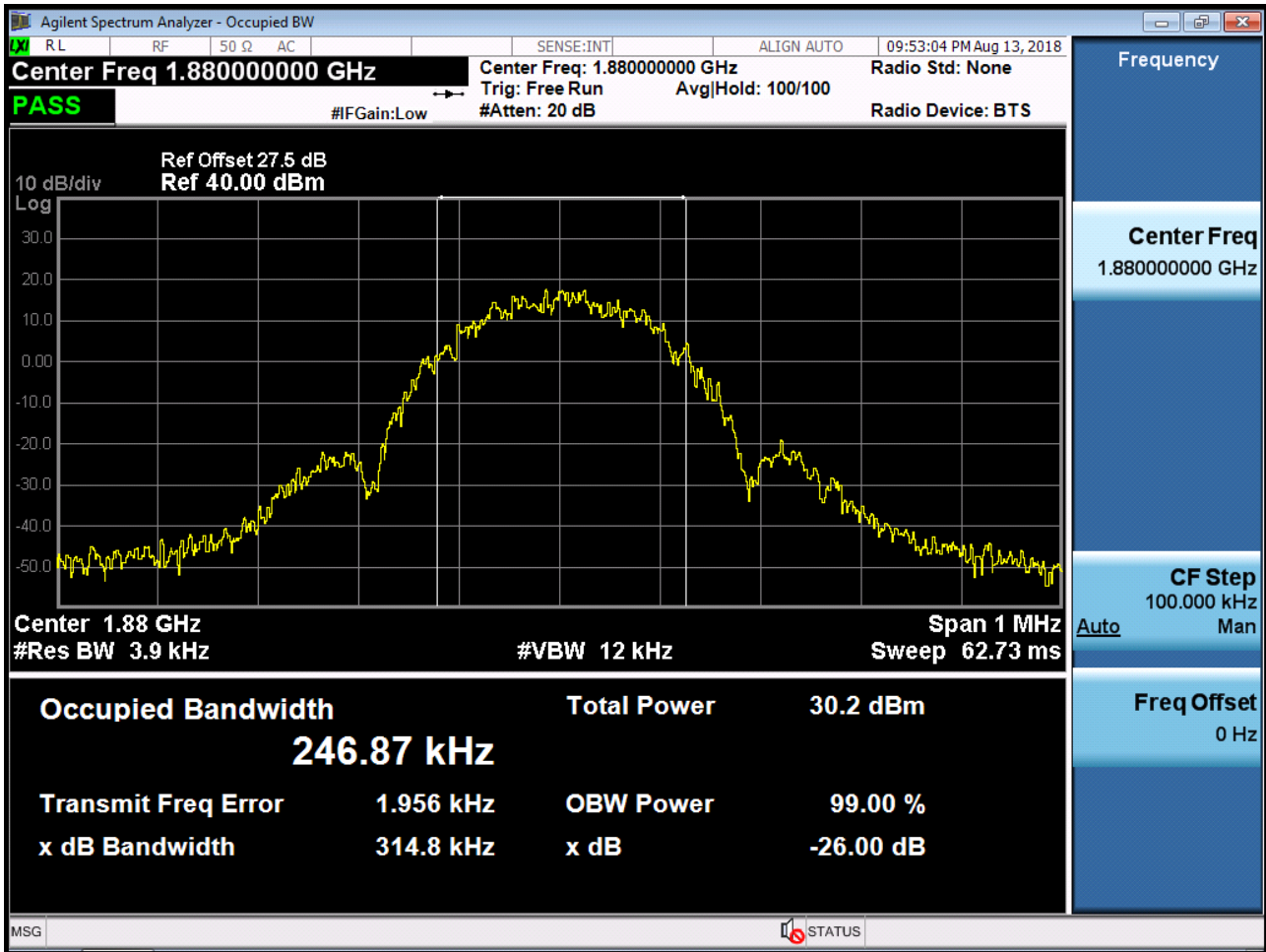
■ GSM1900 MODE (810 CH.) Occupied Bandwidth



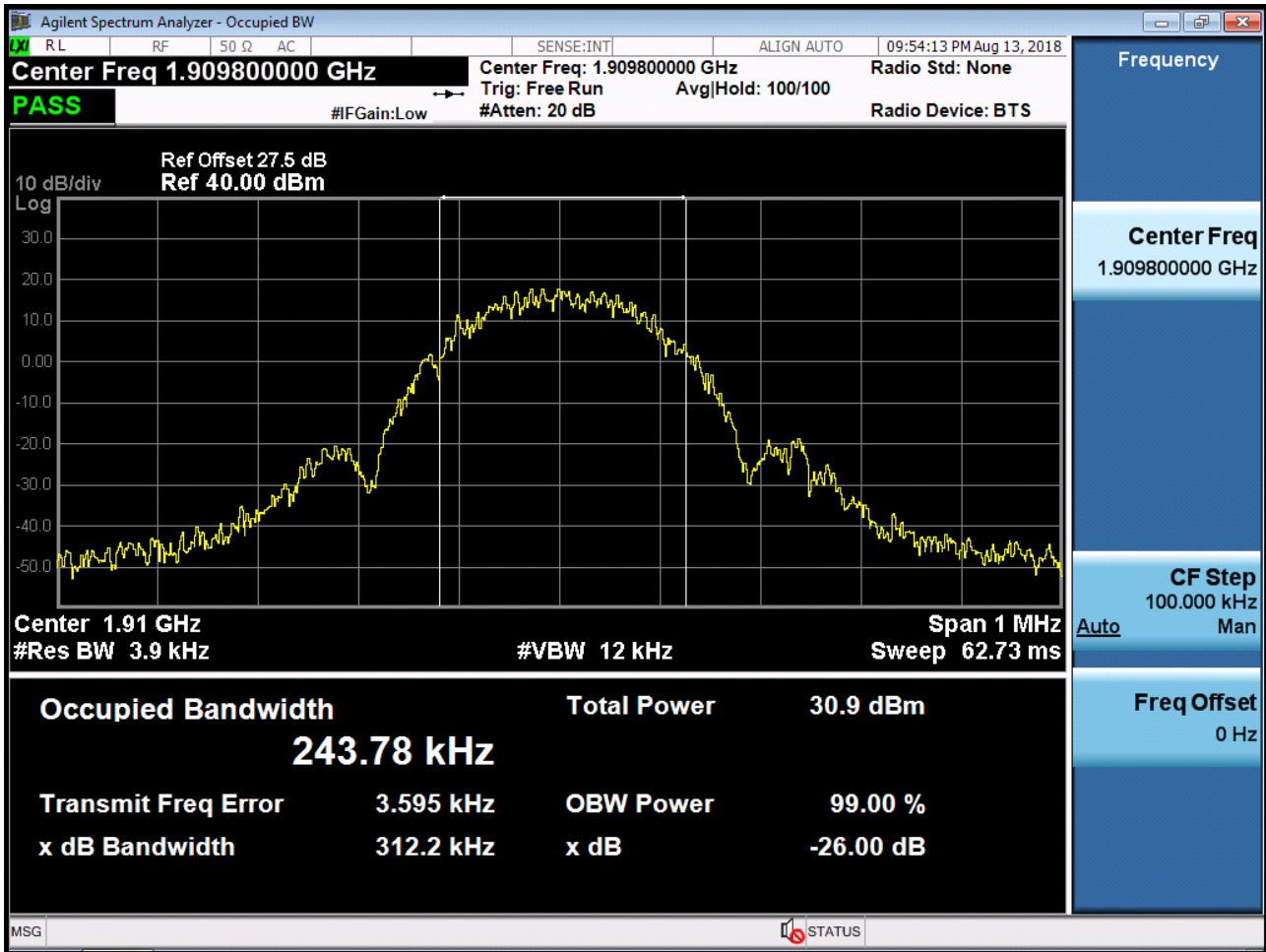
■ GSM1900 EDGE (512 CH.) Occupied Bandwidth



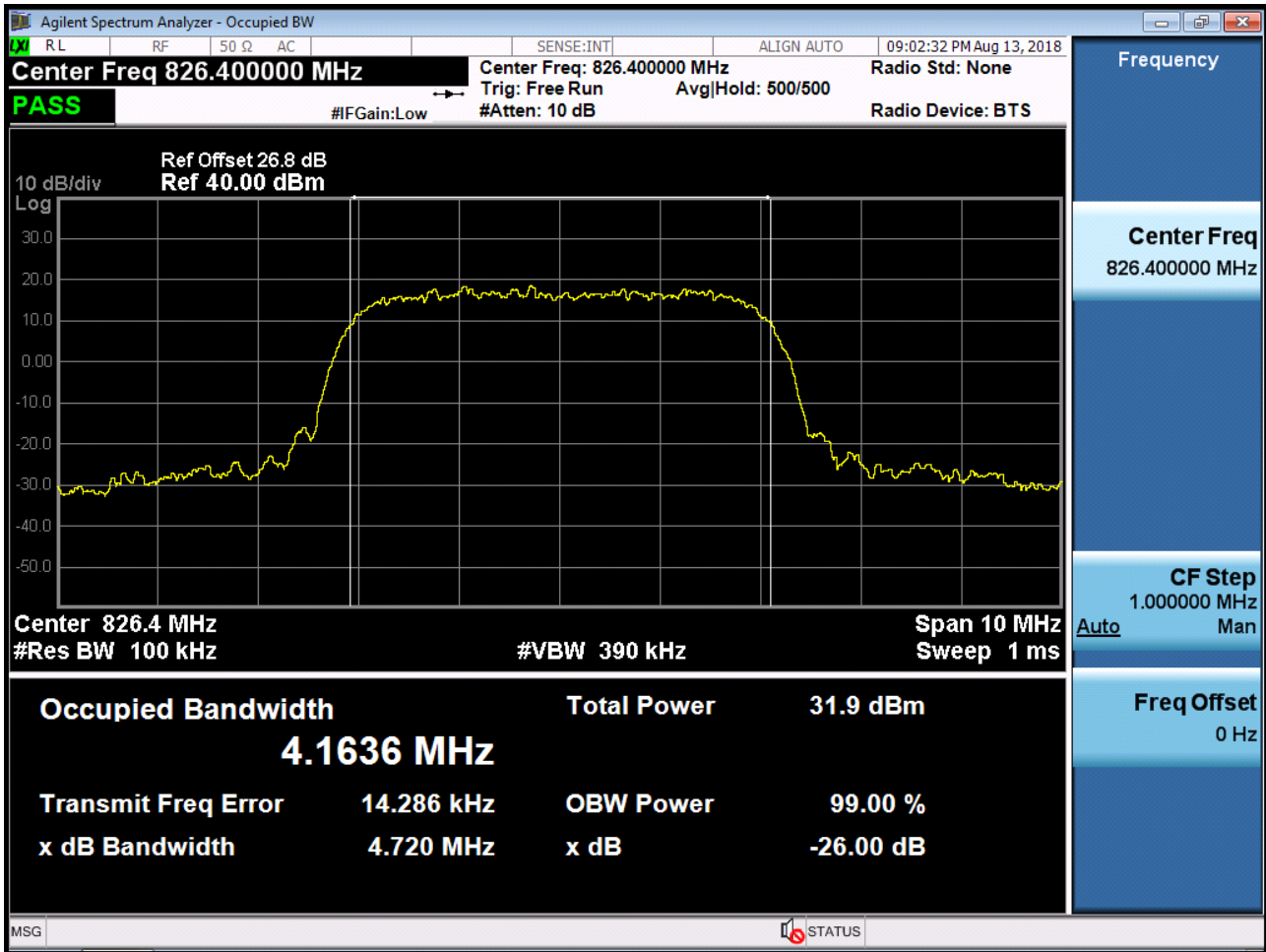
■ GSM1900 EDGE (661 CH.) Occupied Bandwidth



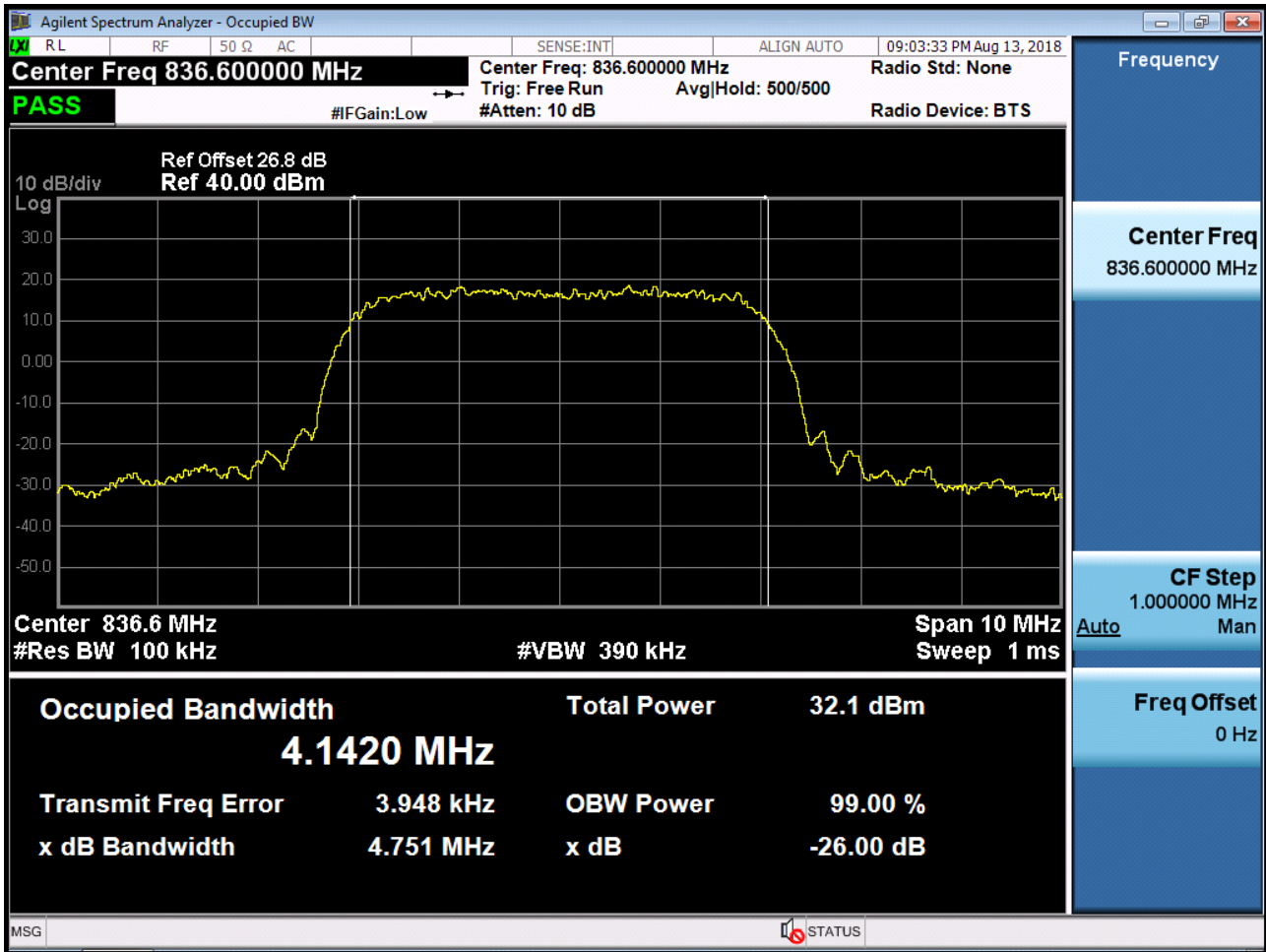
■ GSM1900 EDGE (810 CH.) Occupied Bandwidth



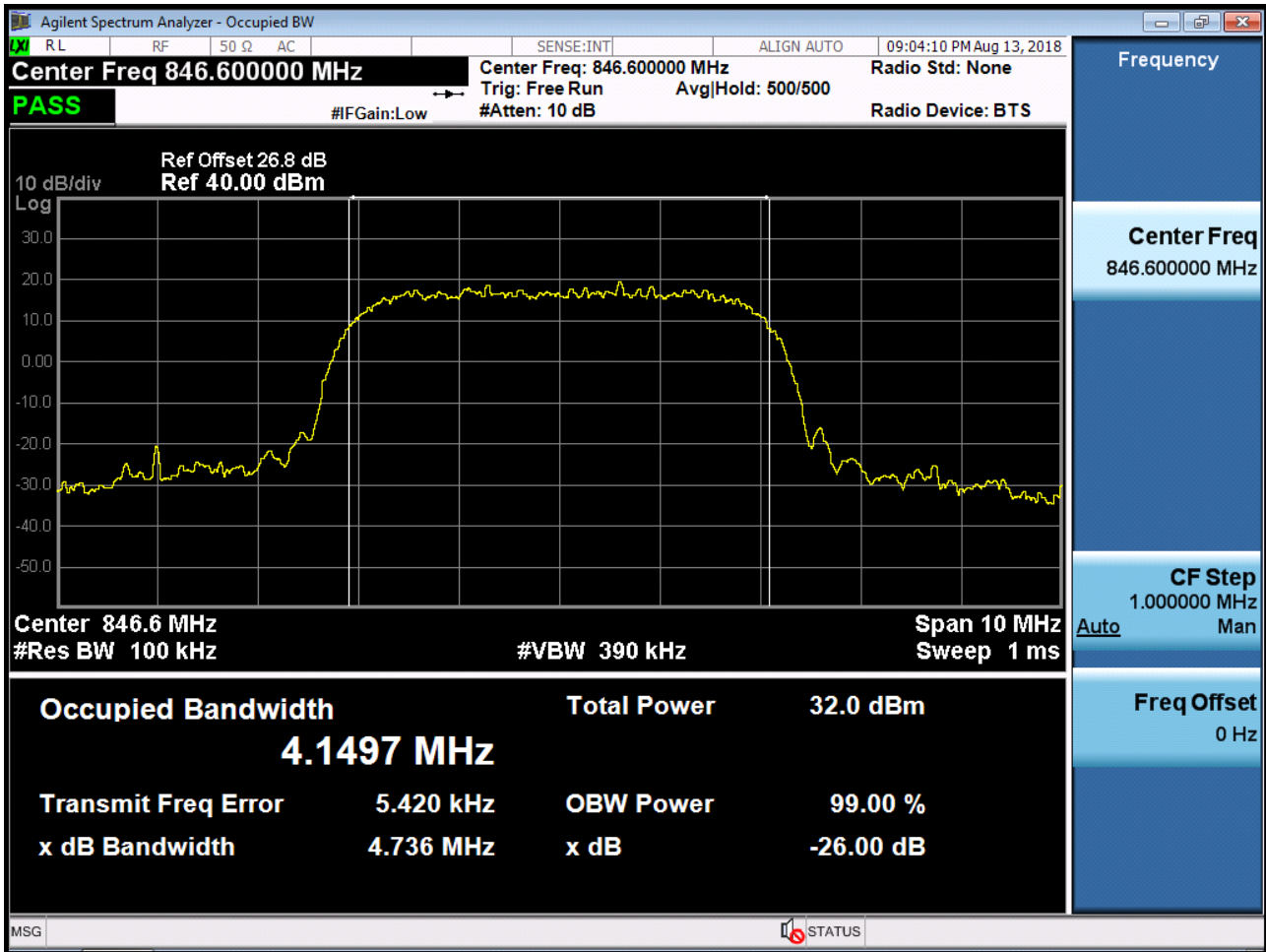
■ WCDMA850 MODE (4132 CH.) Occupied Bandwidth



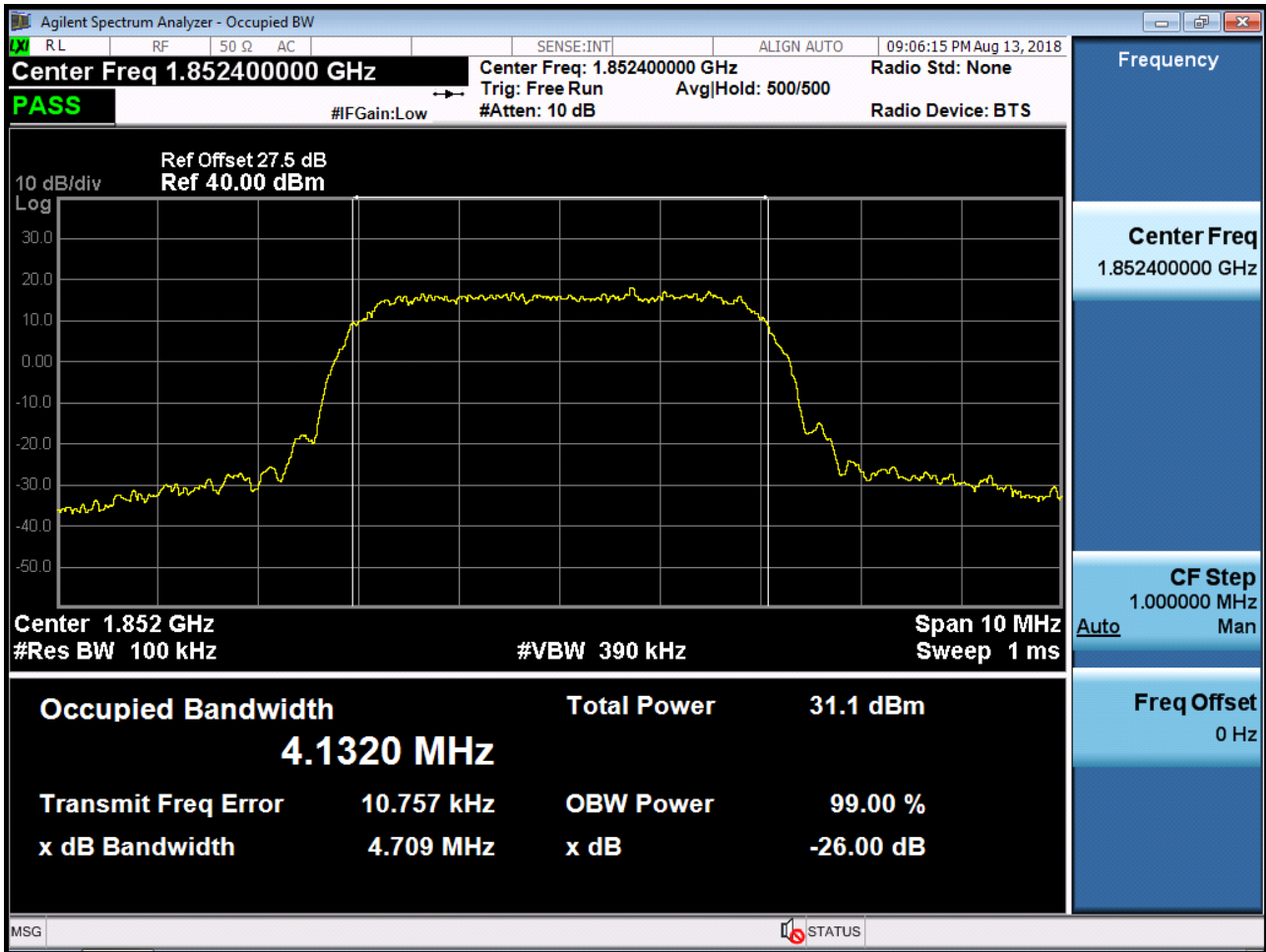
■ WCDMA850 MODE (4183 CH.) Occupied Bandwidth



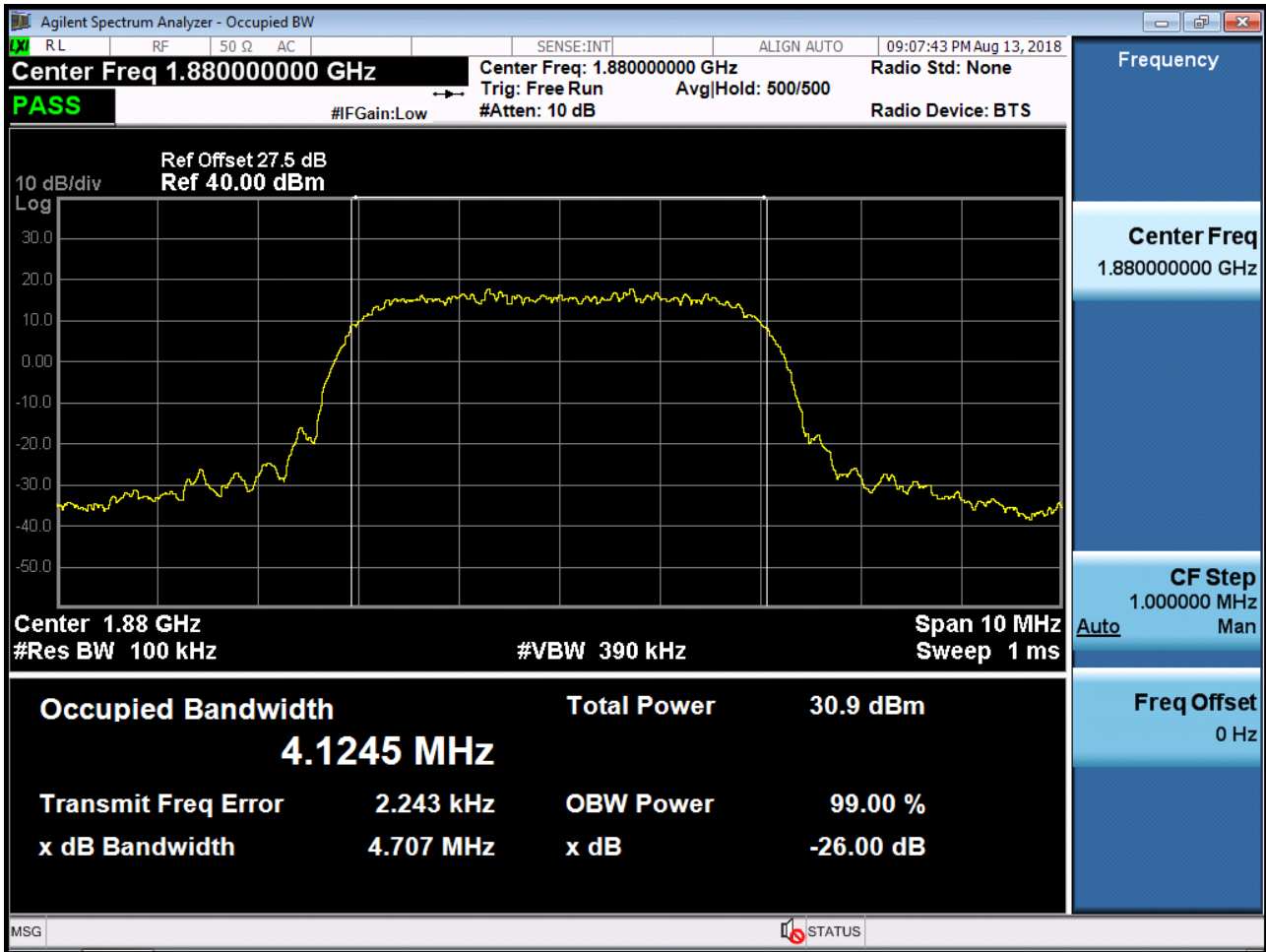
■ WCDMA850MODE (4233 CH.) Occupied Bandwidth



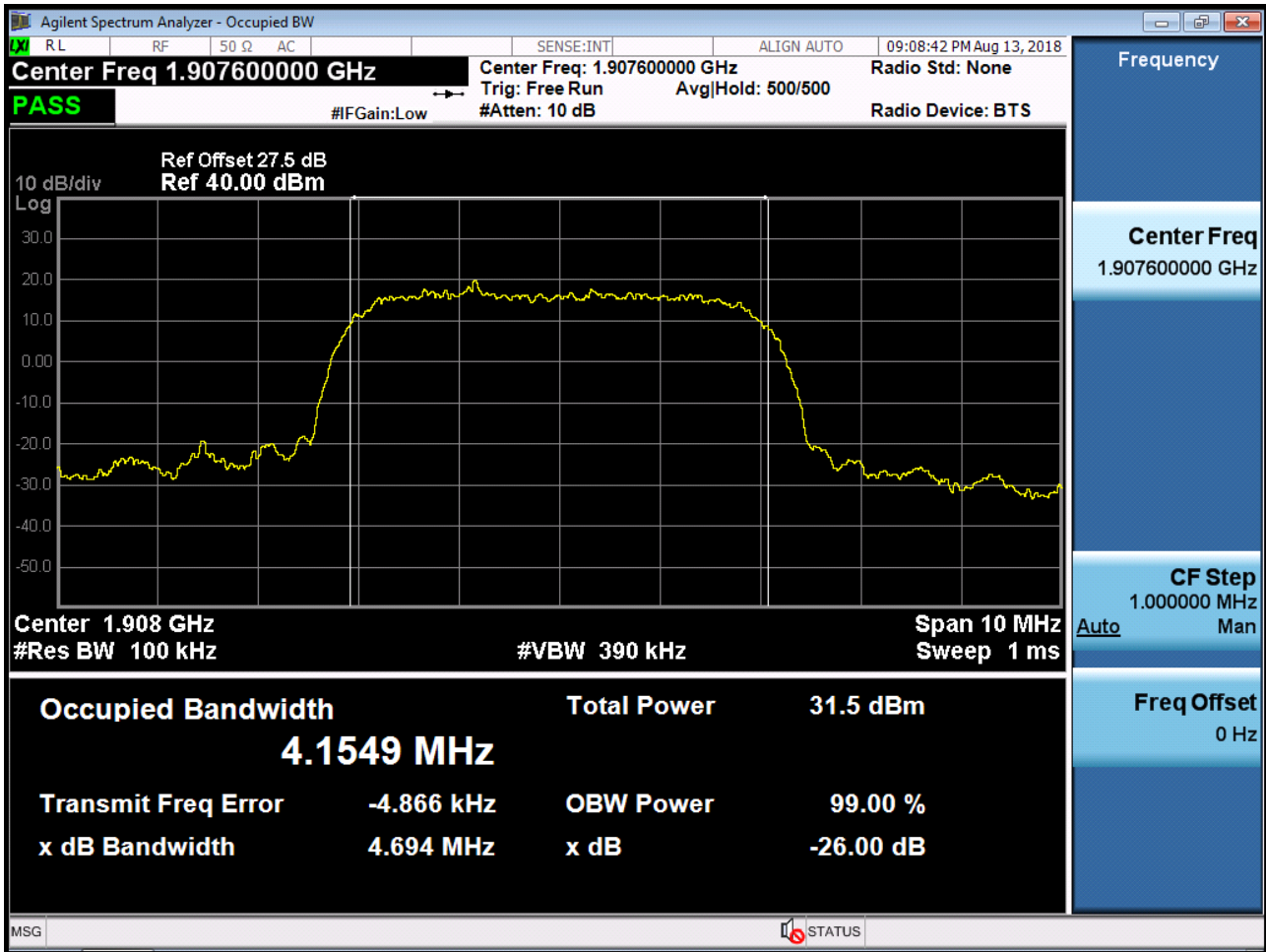
■ WCDMA1900 MODE (9262 CH.) Occupied Bandwidth



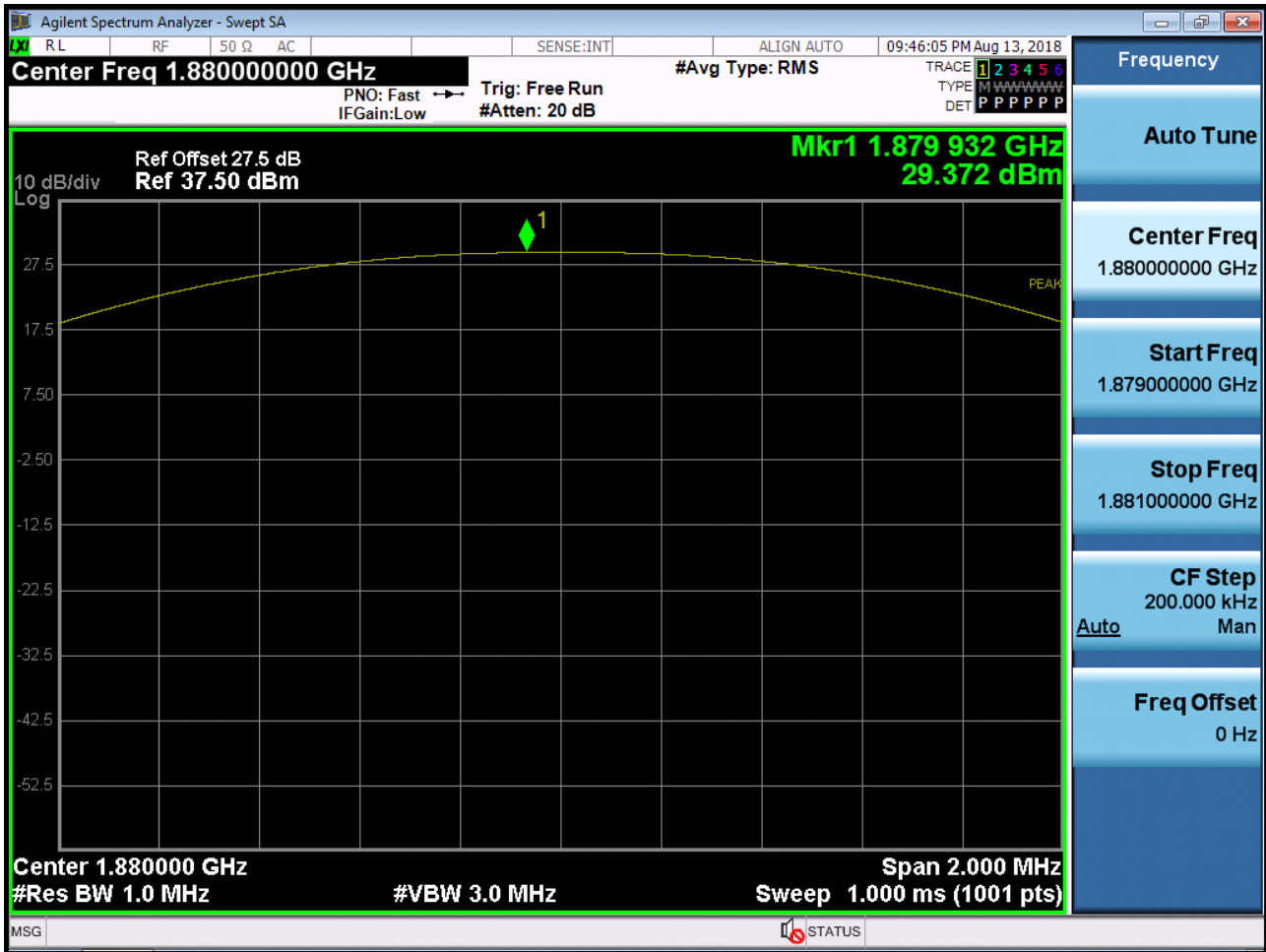
■ WCDMA1900 MODE (9400 CH.) Occupied Bandwidth



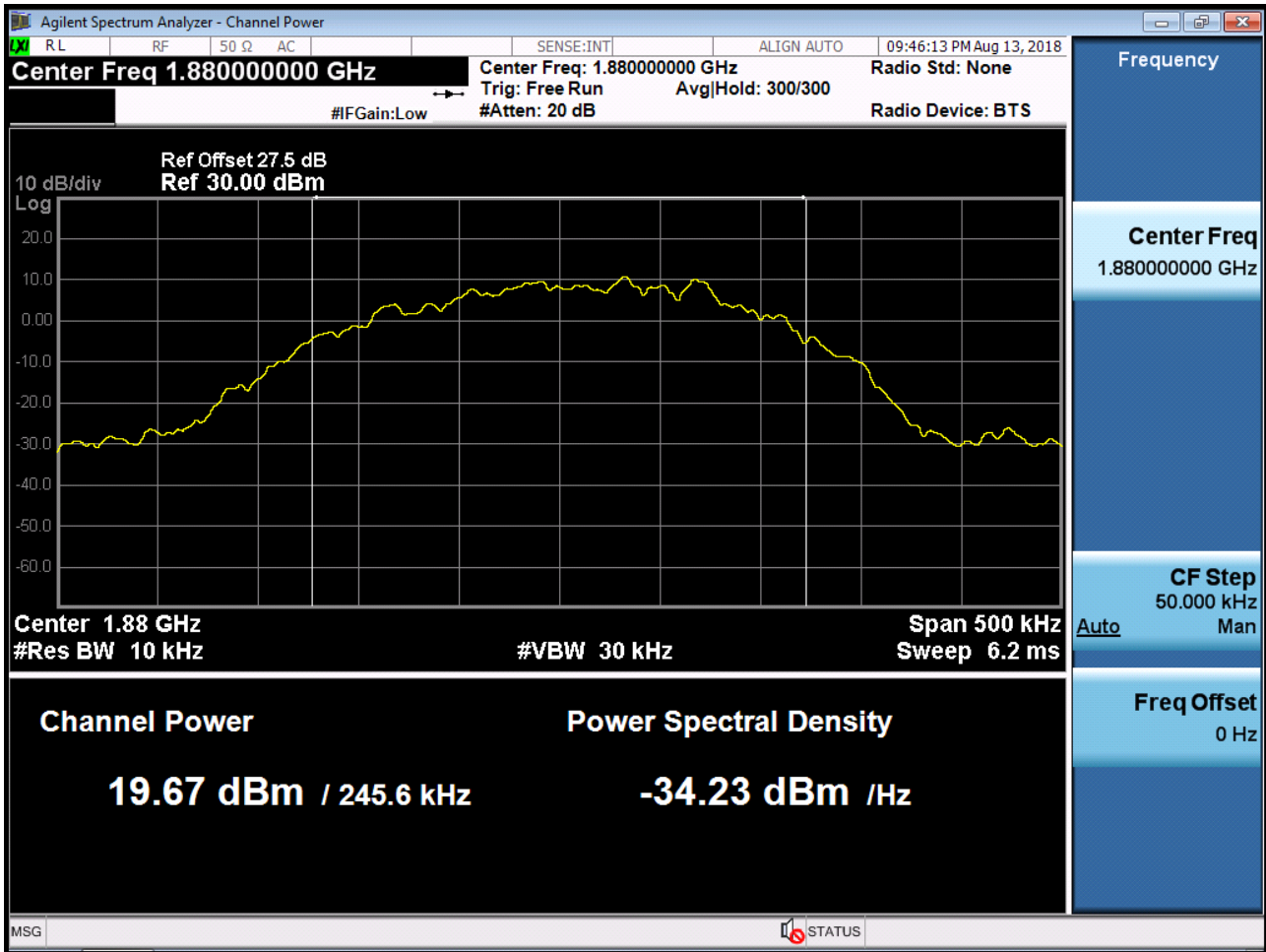
■ WCDMA1900 MODE (9538 CH.) Occupied Bandwidth



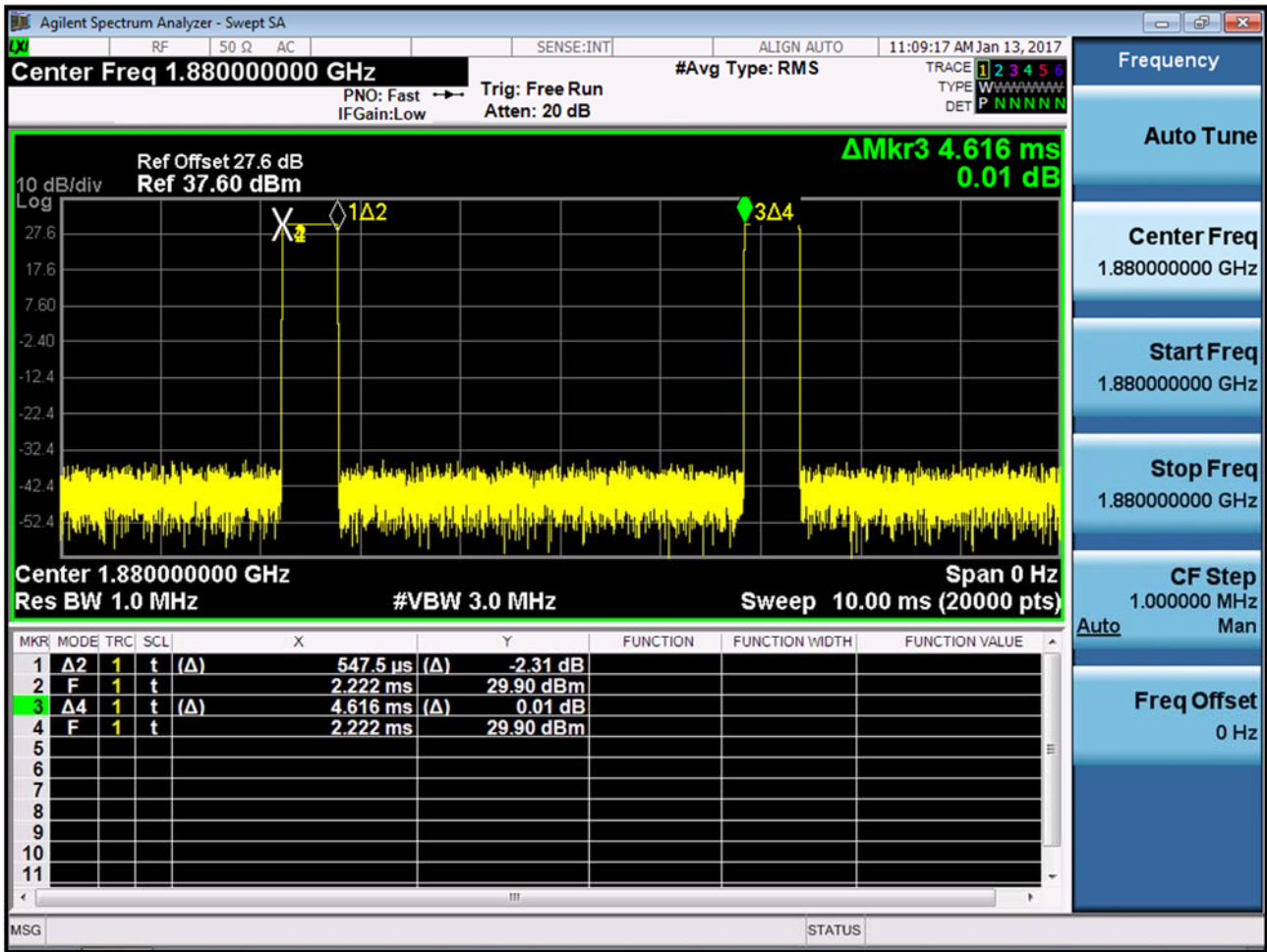
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{pk}



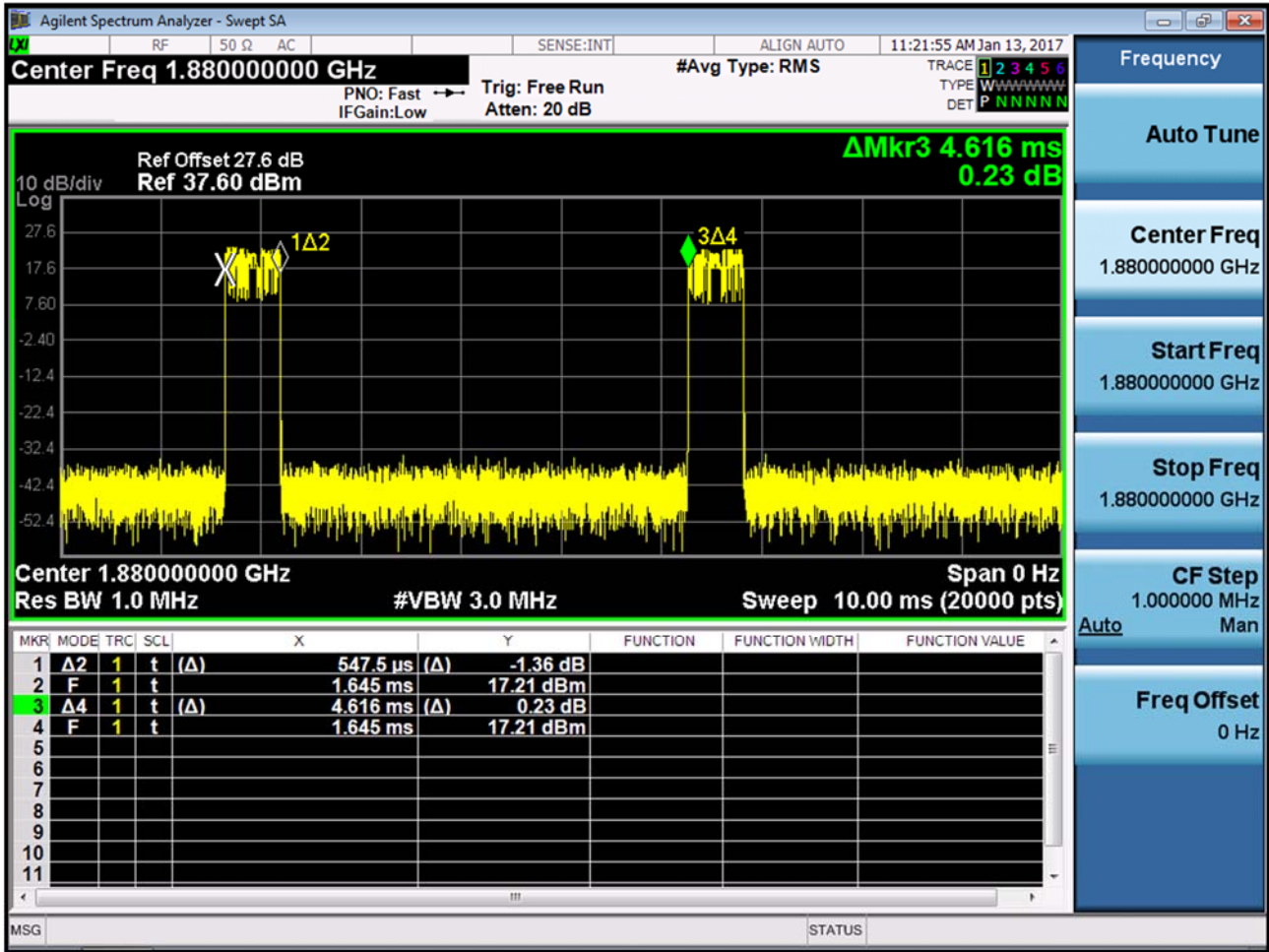
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Avg}



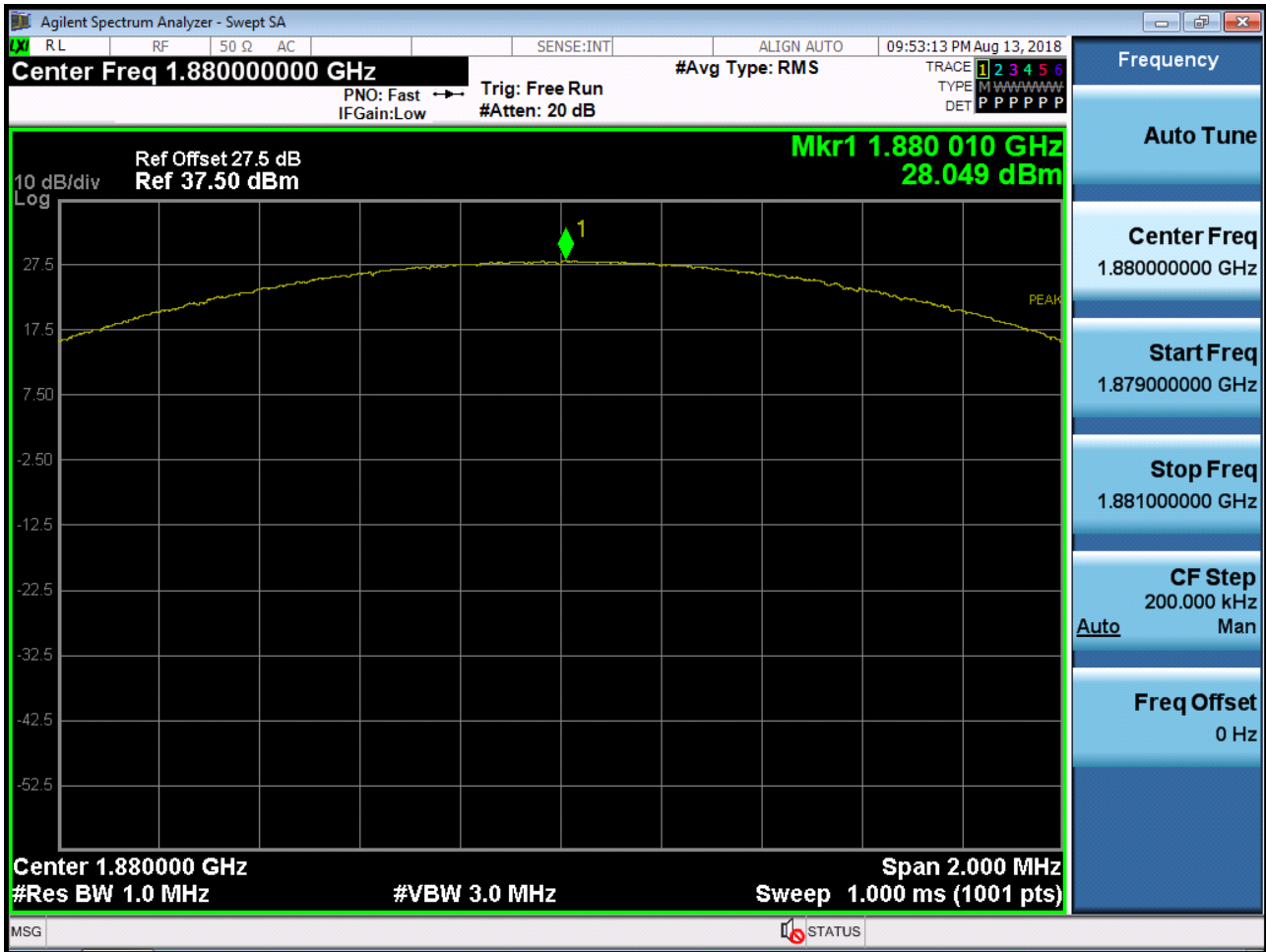
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio Duty



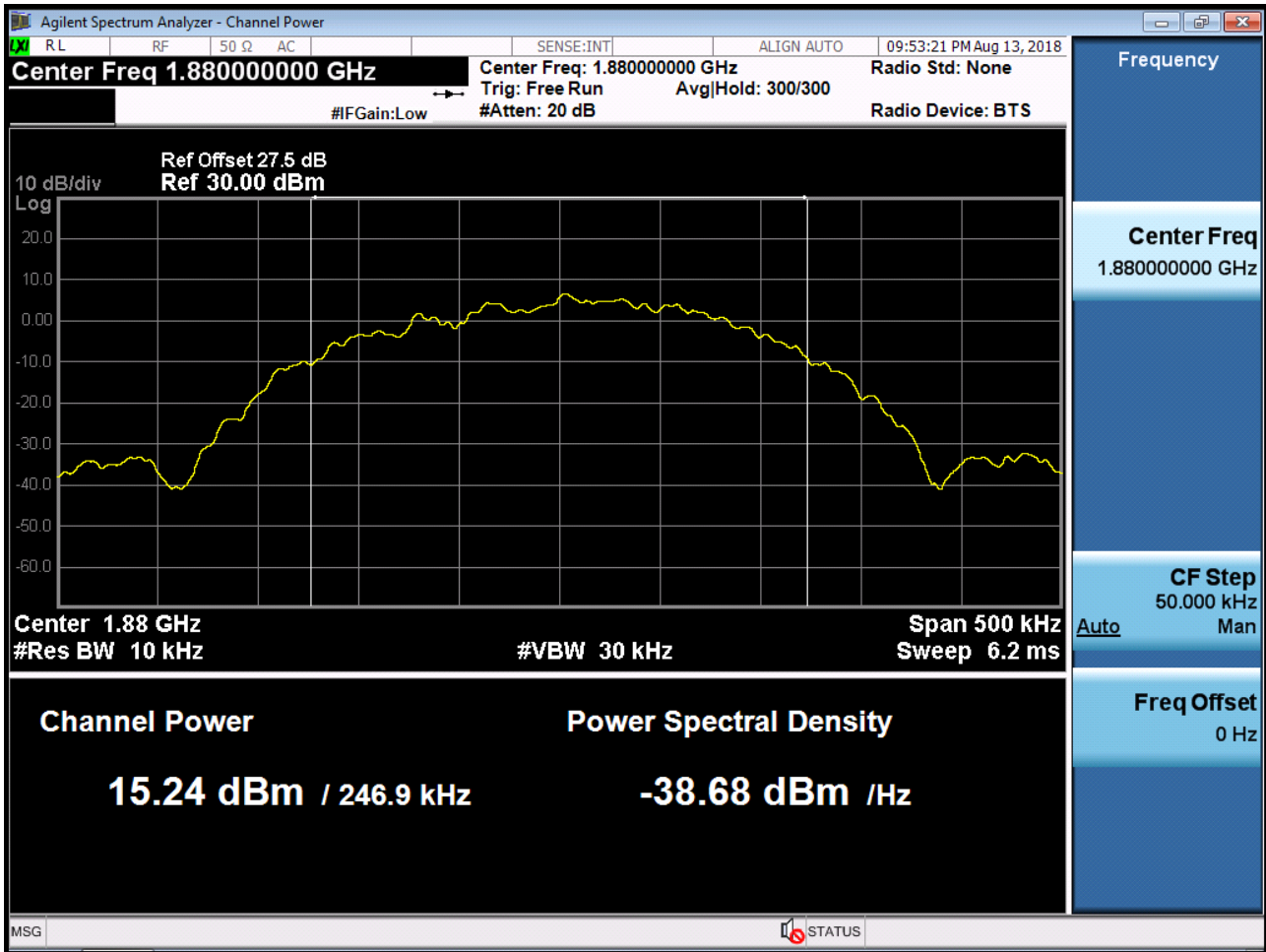
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio Duty



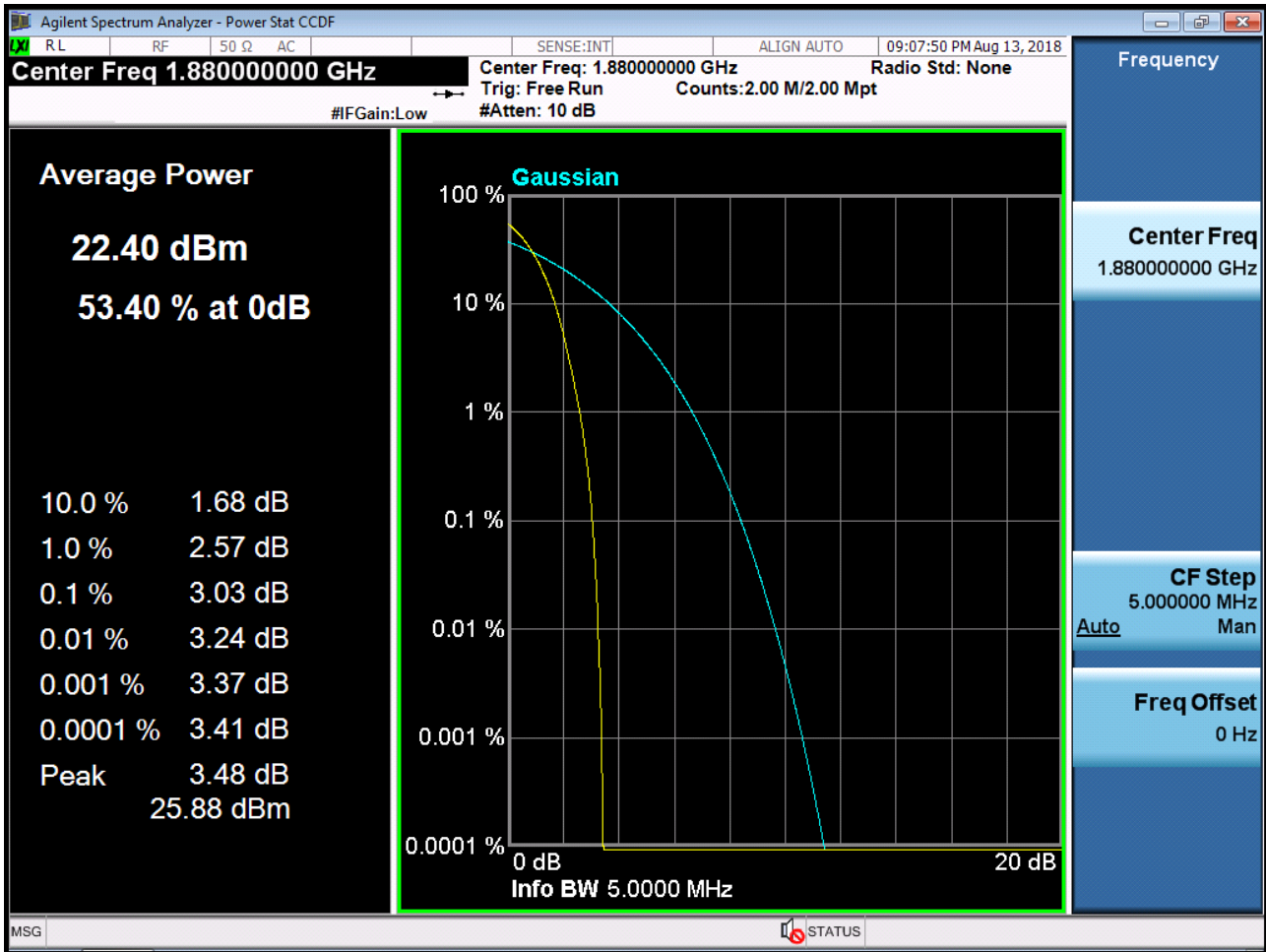
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{PK}



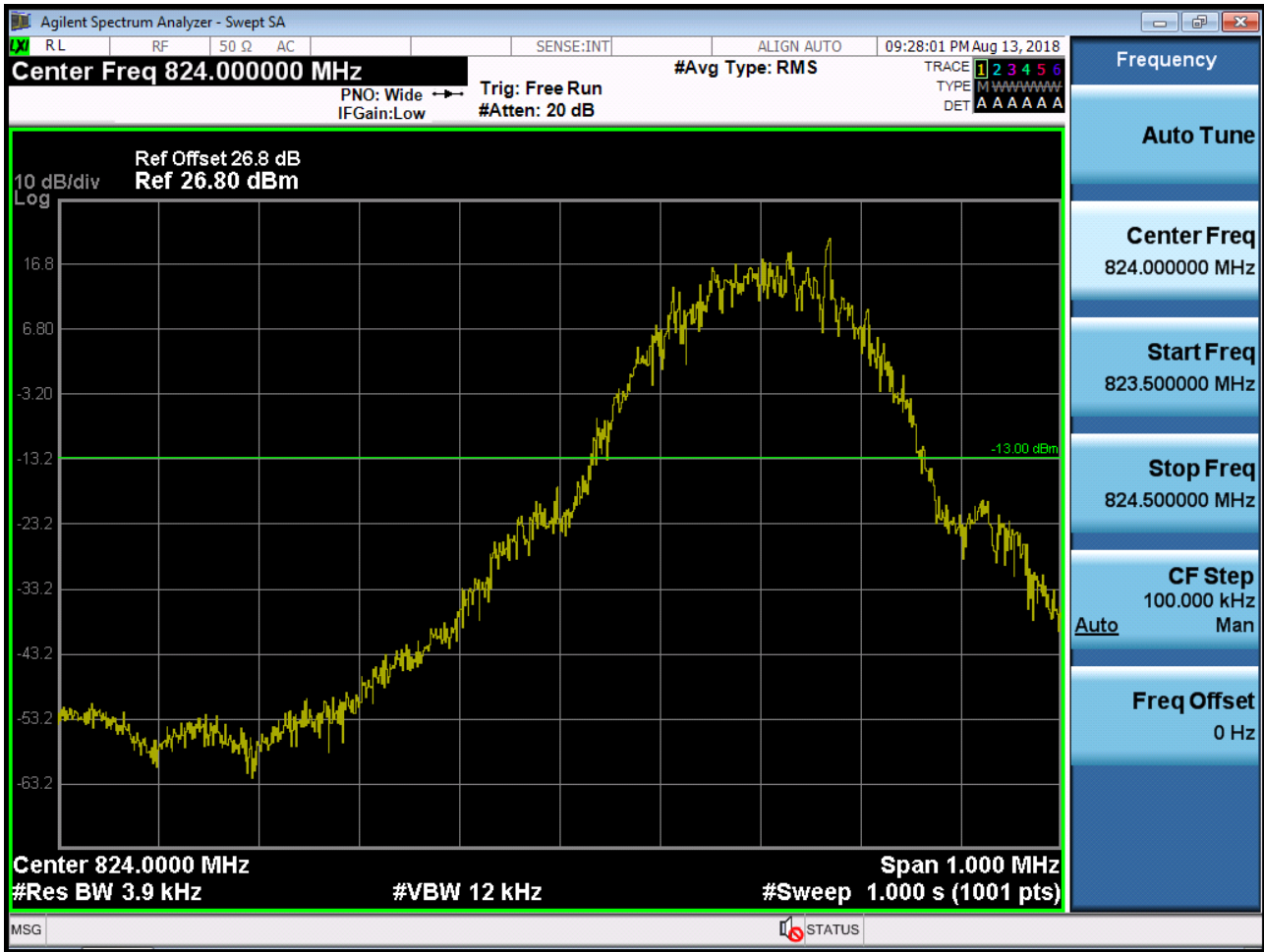
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{AVG}



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



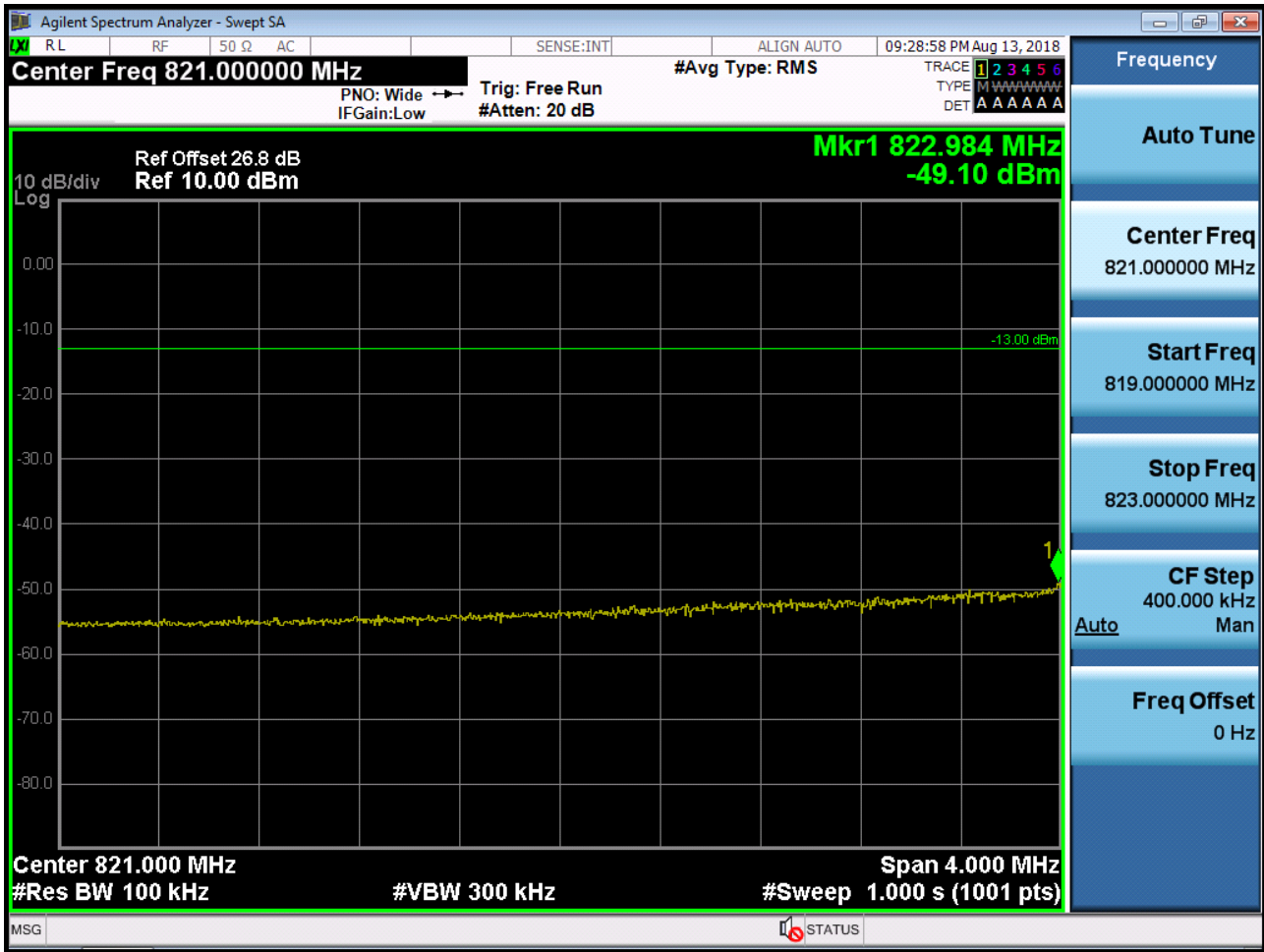
■ GSM850 MODE (128 CH.) Block Edge 1



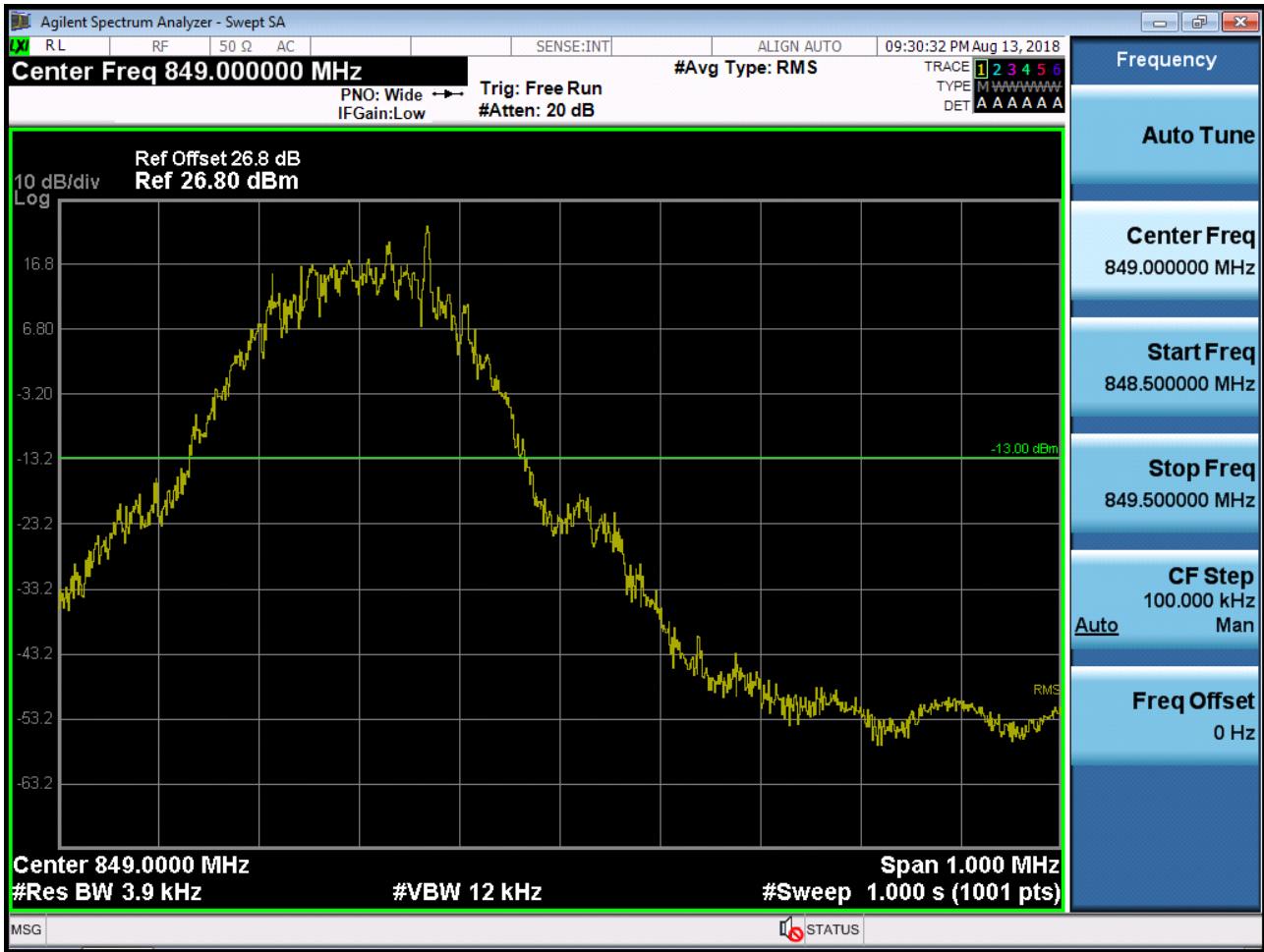
■ GSM850 MODE (128 CH.) Block Edge 2



■ GSM850 MODE (128 CH.) Block Edge 3



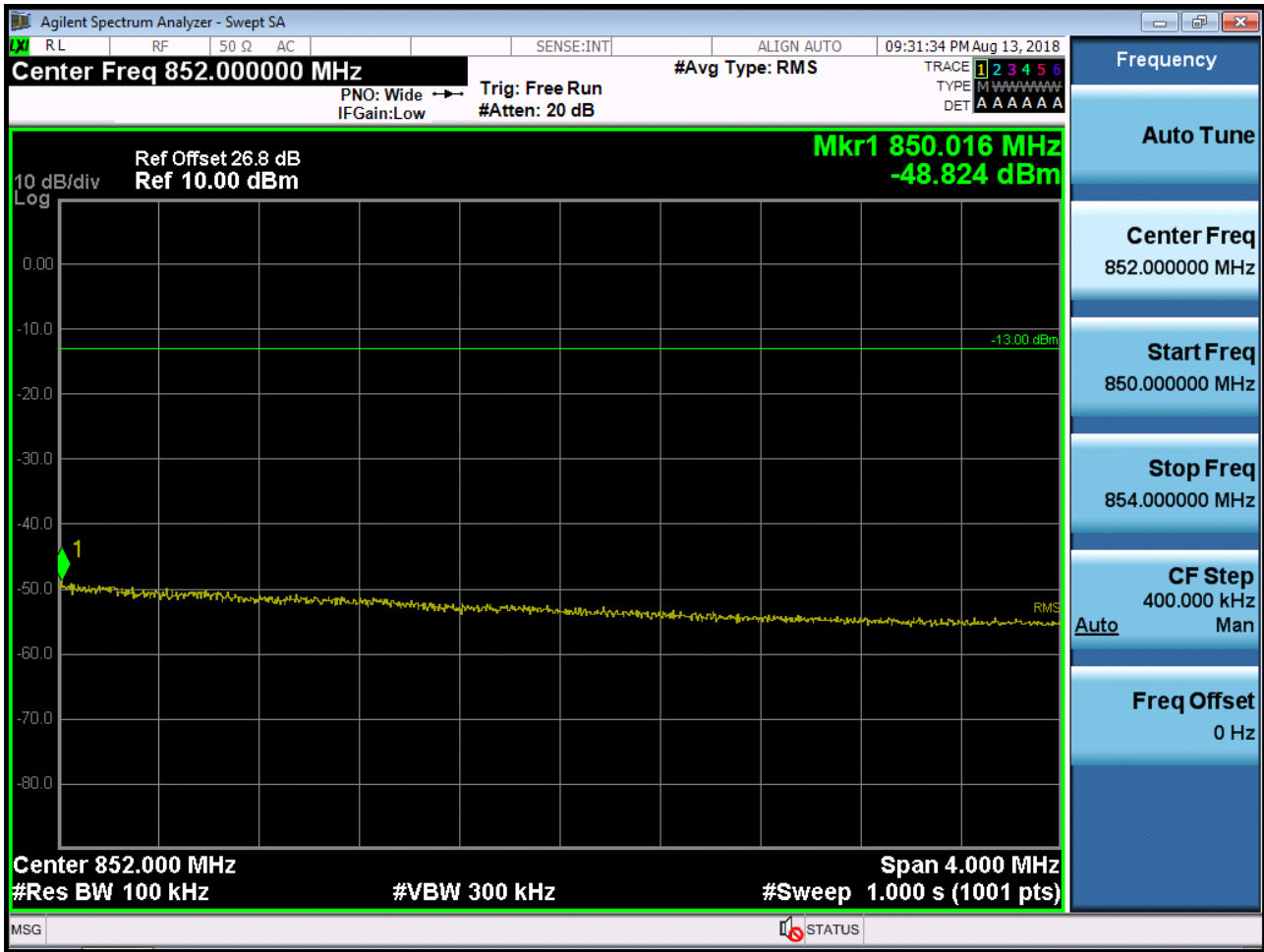
■ GSM850 MODE (251 CH.) Block Edge 1



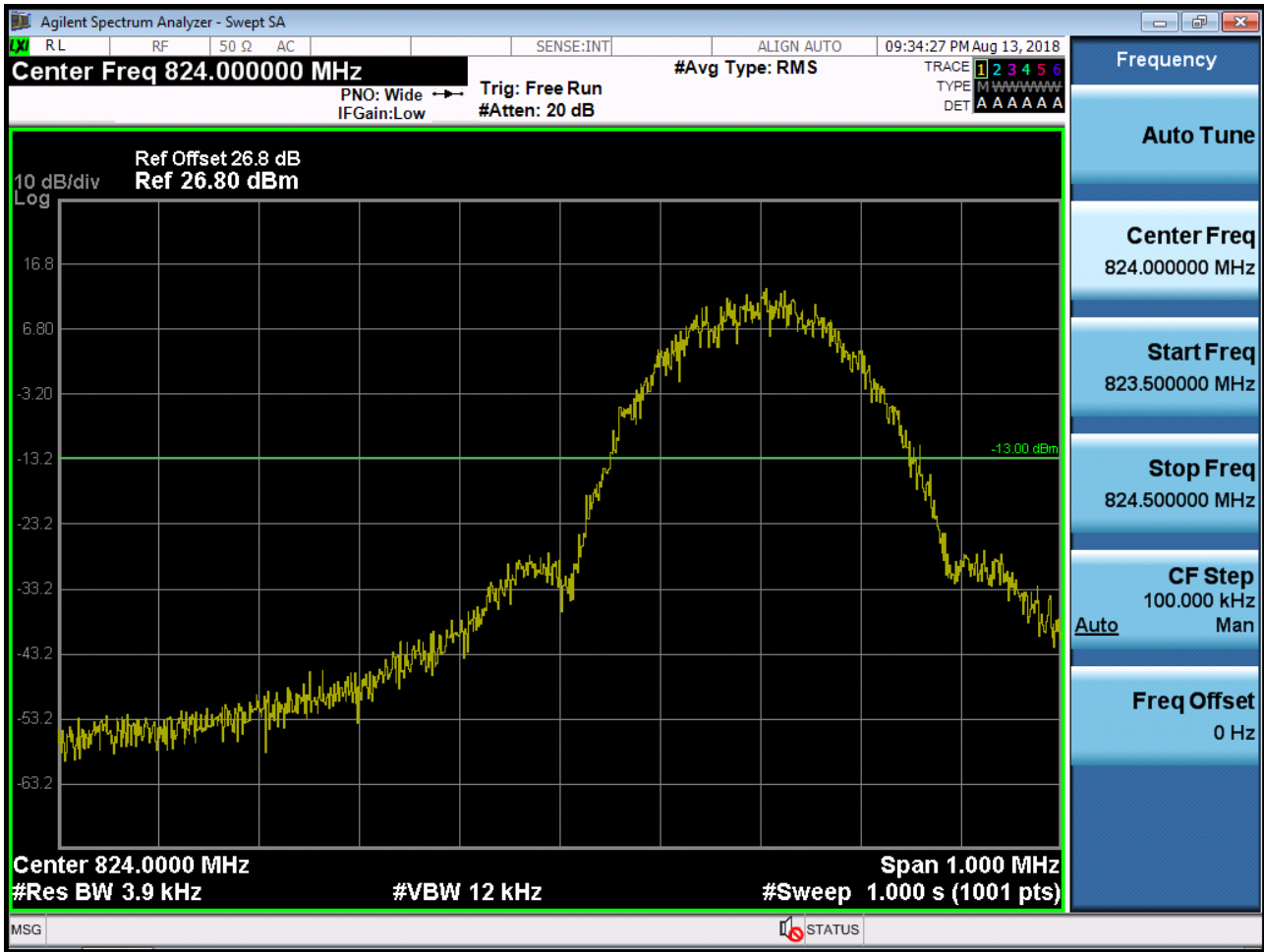
■ GSM850 MODE (251 CH.) Block Edge 2



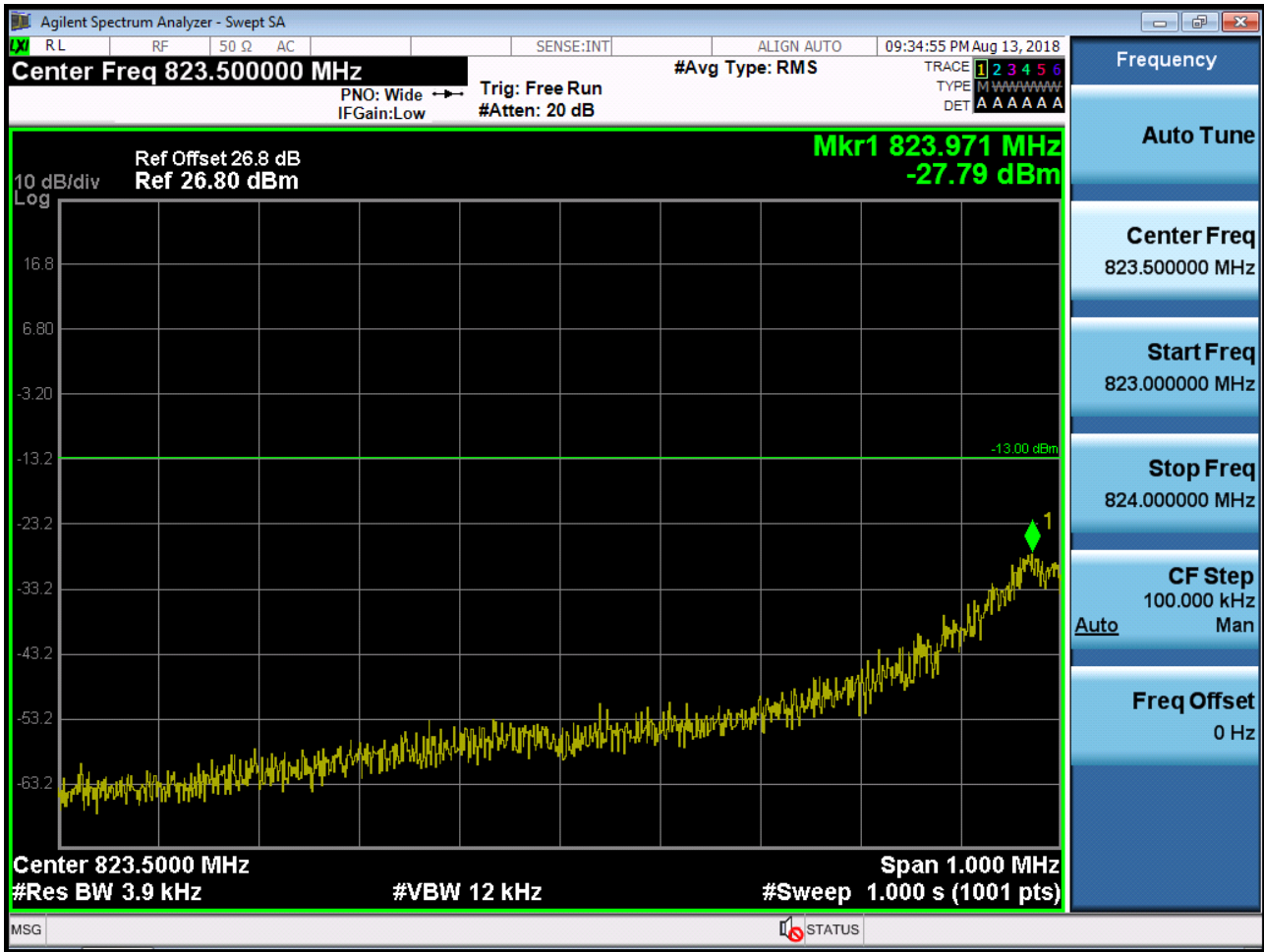
■ GSM850 MODE (251 CH.) Block Edge 3



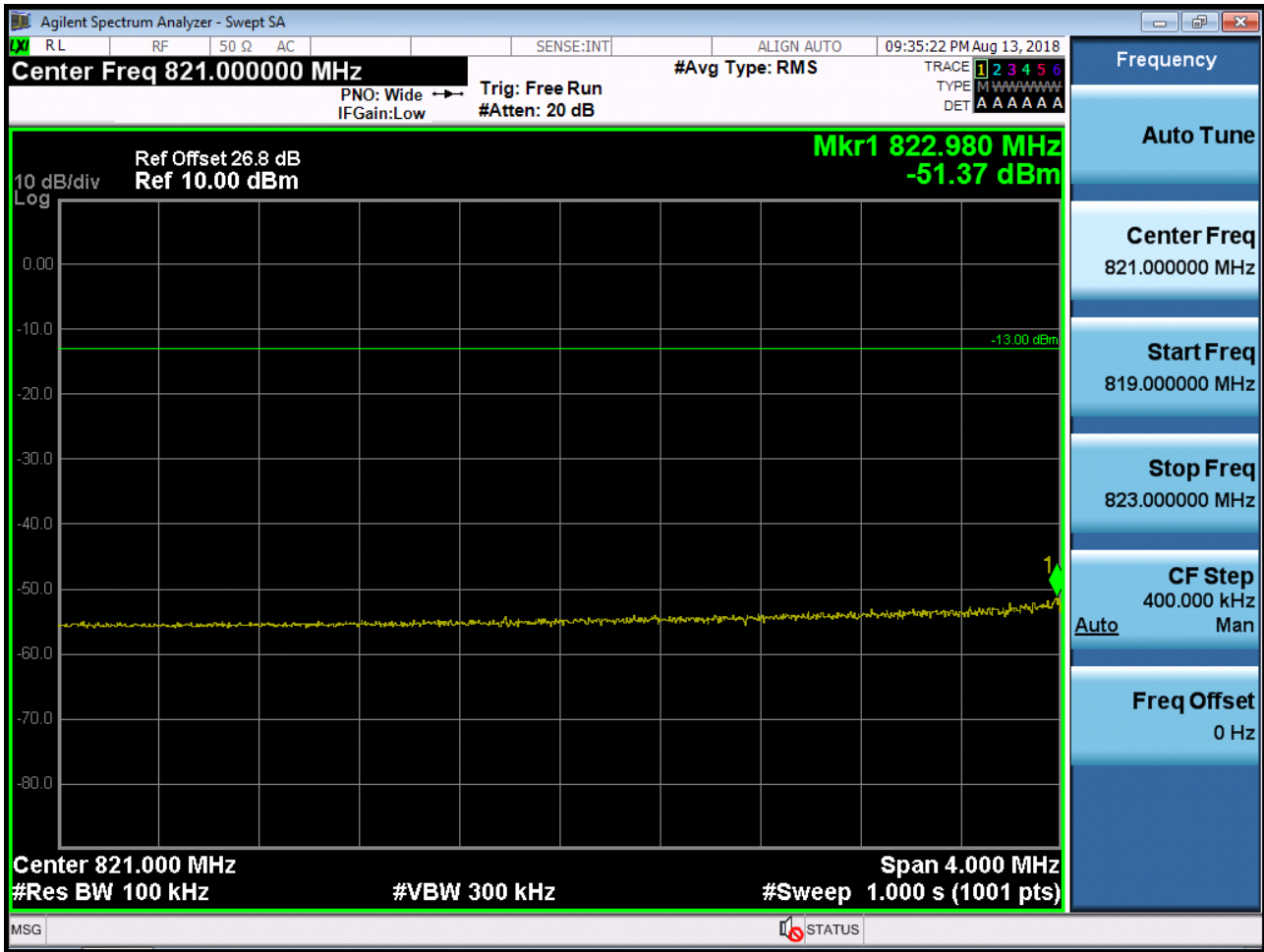
■ EDGE MODE (128 CH.) Block Edge 1



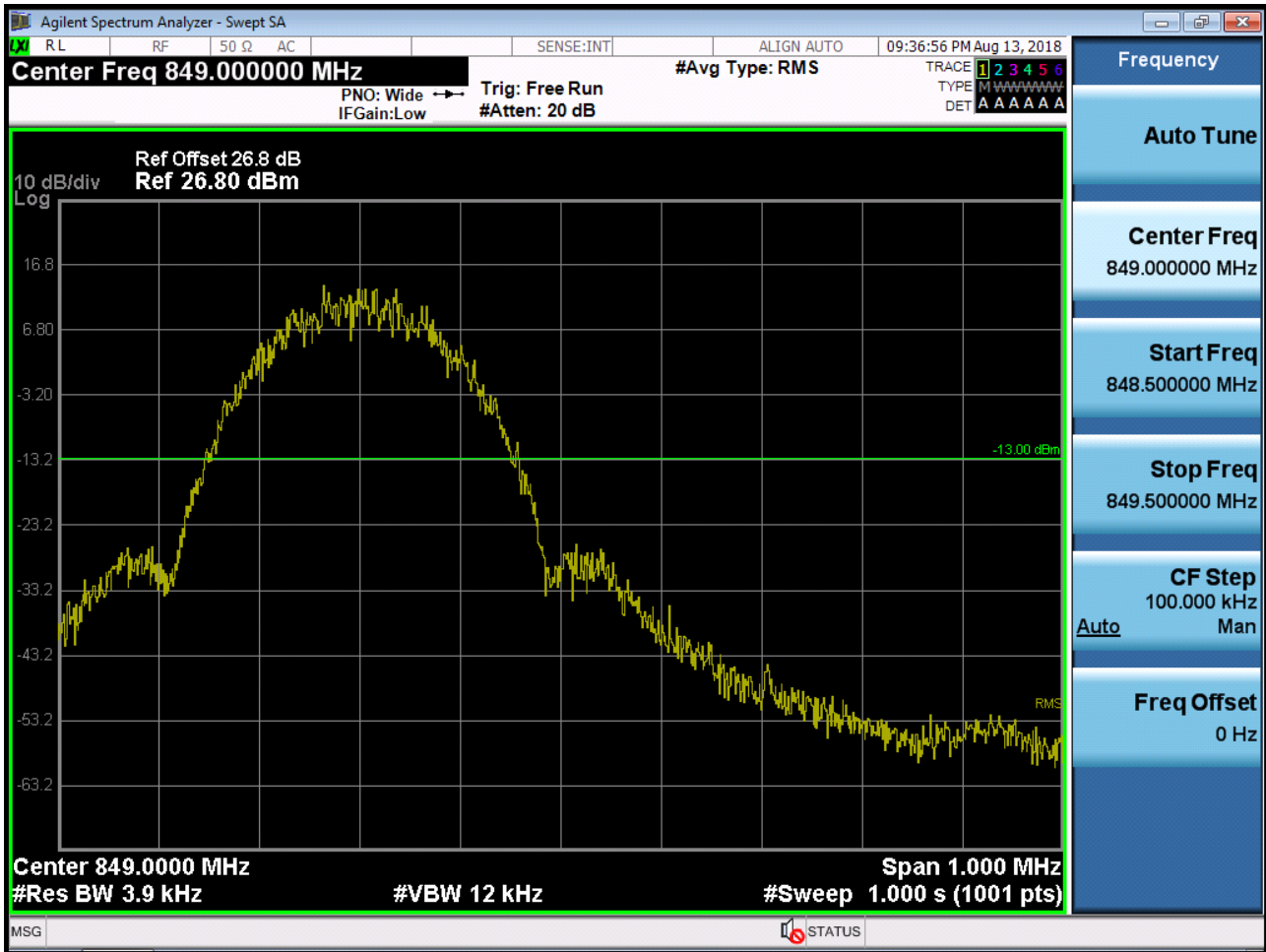
■ EDGE MODE (128 CH.) Block Edge 2



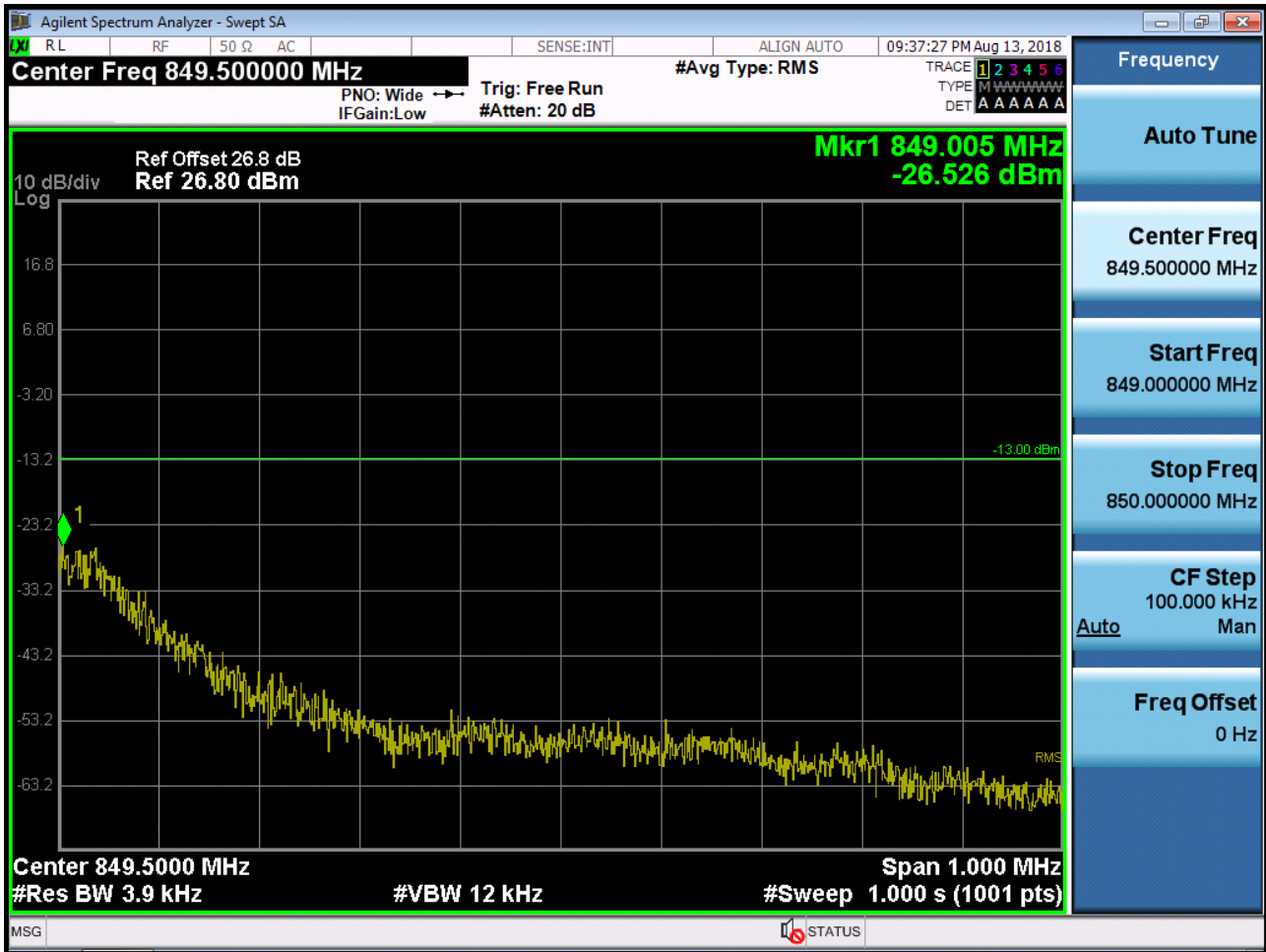
■ EDGE MODE (128 CH.) Block Edge 3



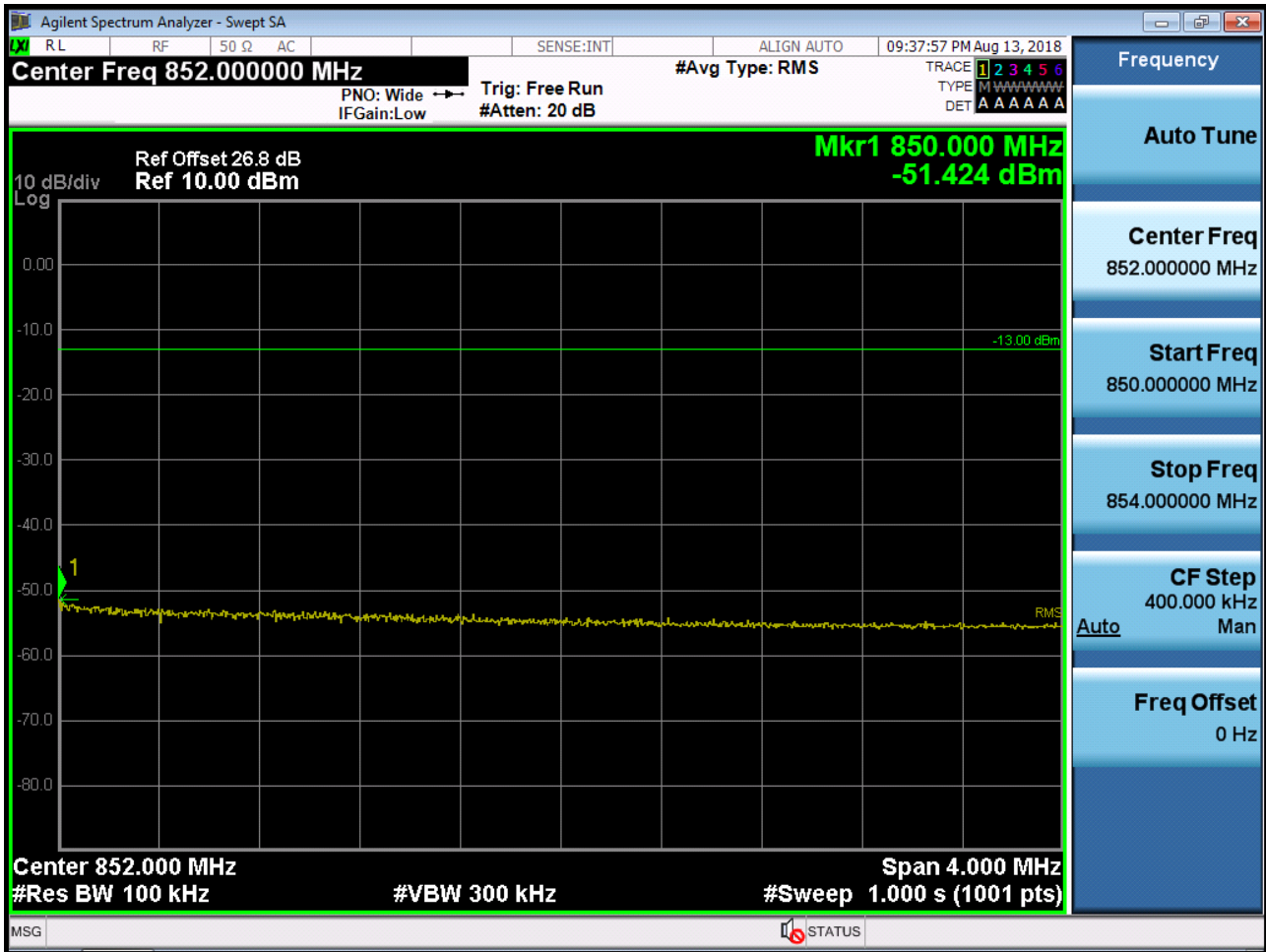
■ EDGE MODE (251 CH.) Block Edge 1



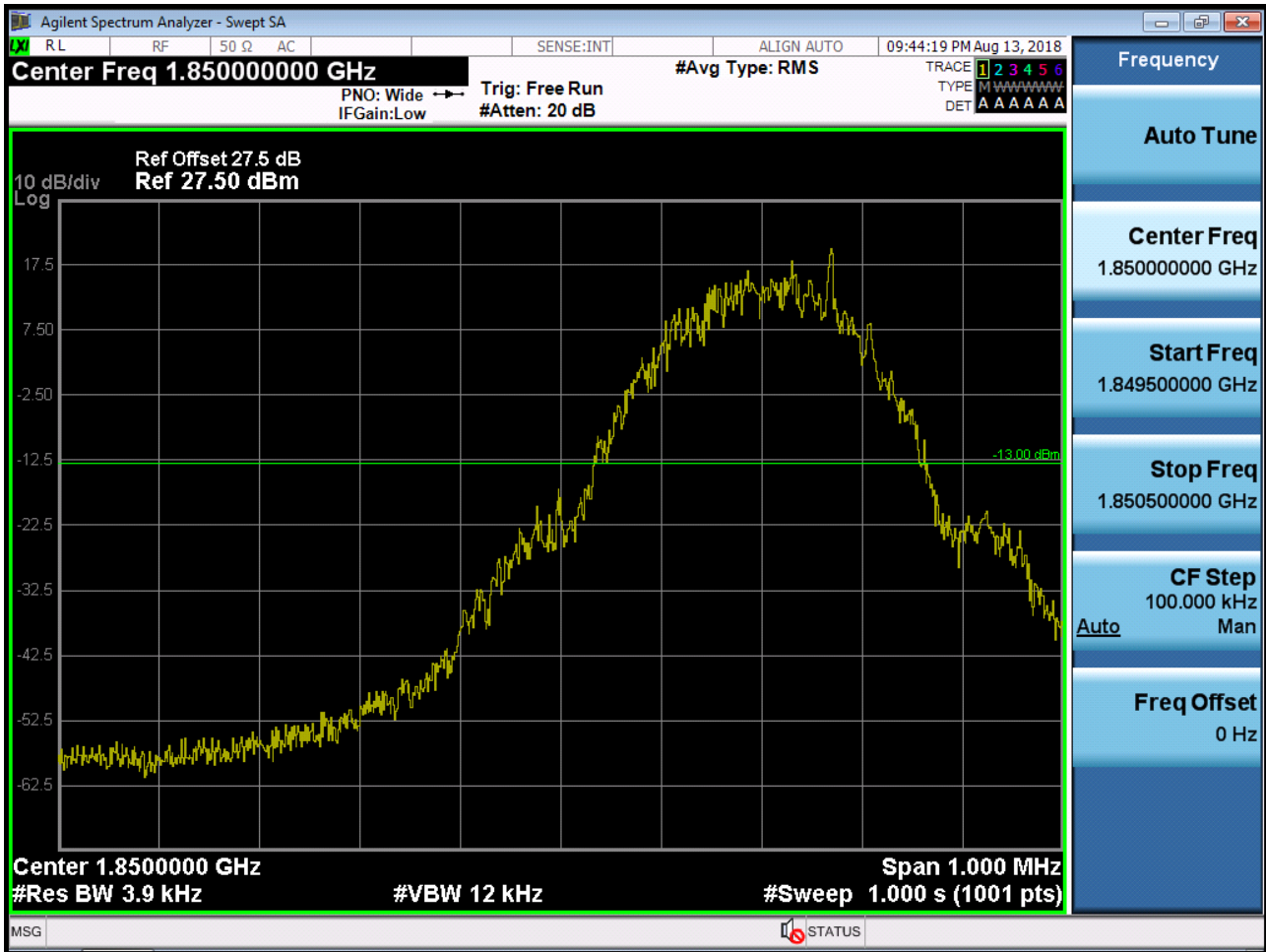
■ EDGE MODE (251 CH.) Block Edge 2



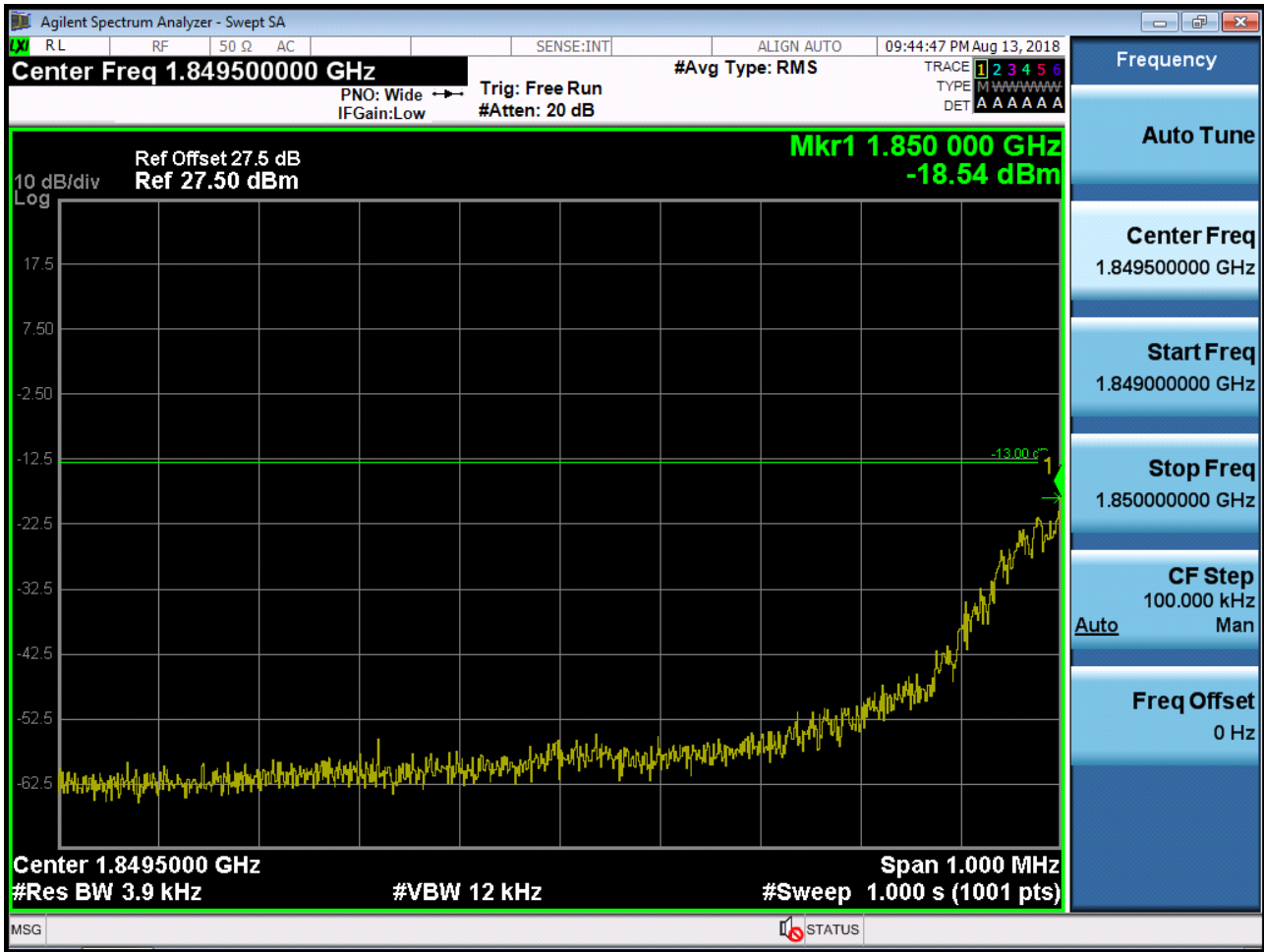
■ EDGE MODE (251 CH.) Block Edge 3



■ GSM1900 MODE (512 CH.) Block Edge 1



■ GSM1900 MODE (512 CH.) Block Edge 2



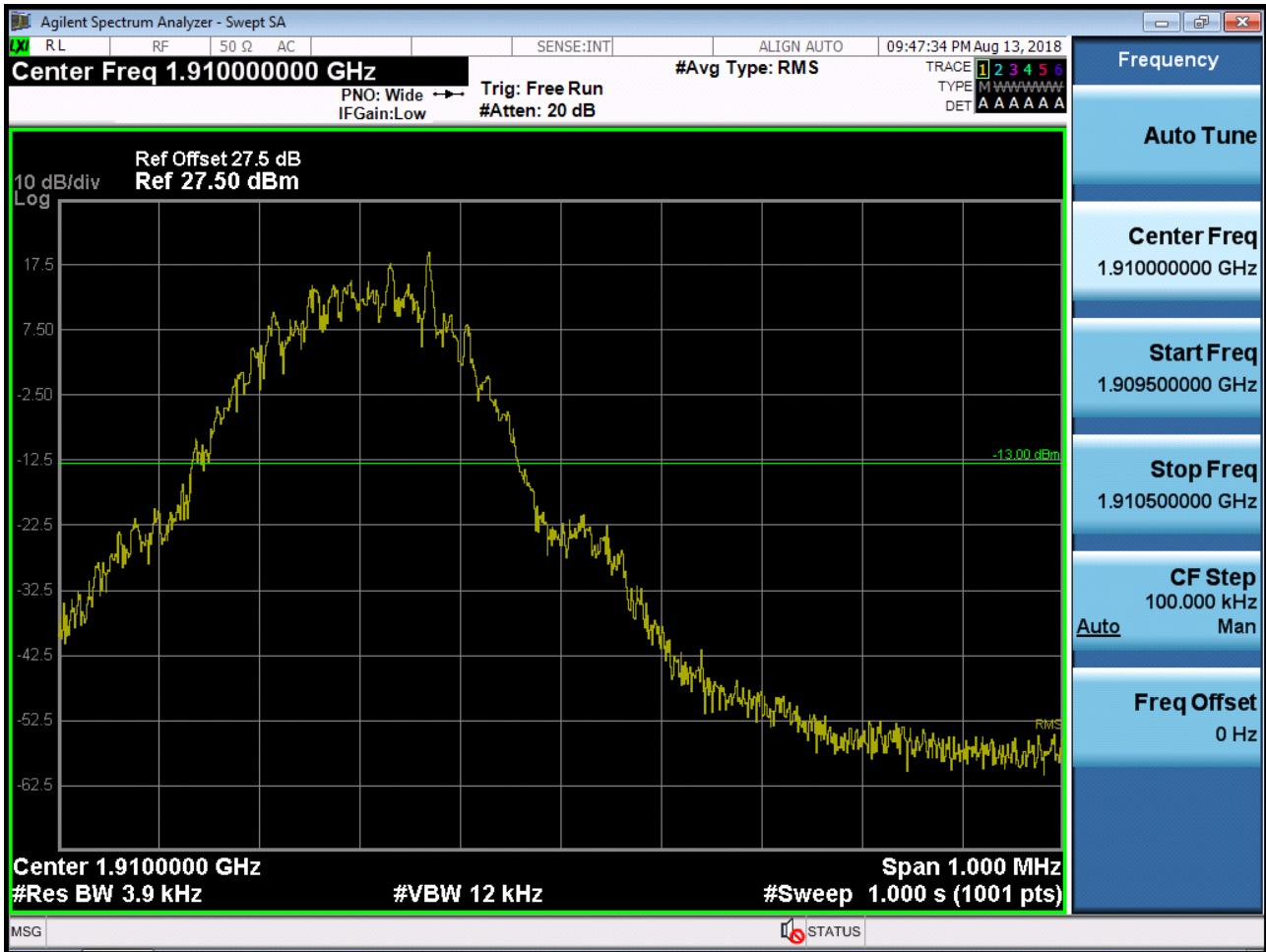
■ GSM1900 MODE (512 CH.) Block Edge 3



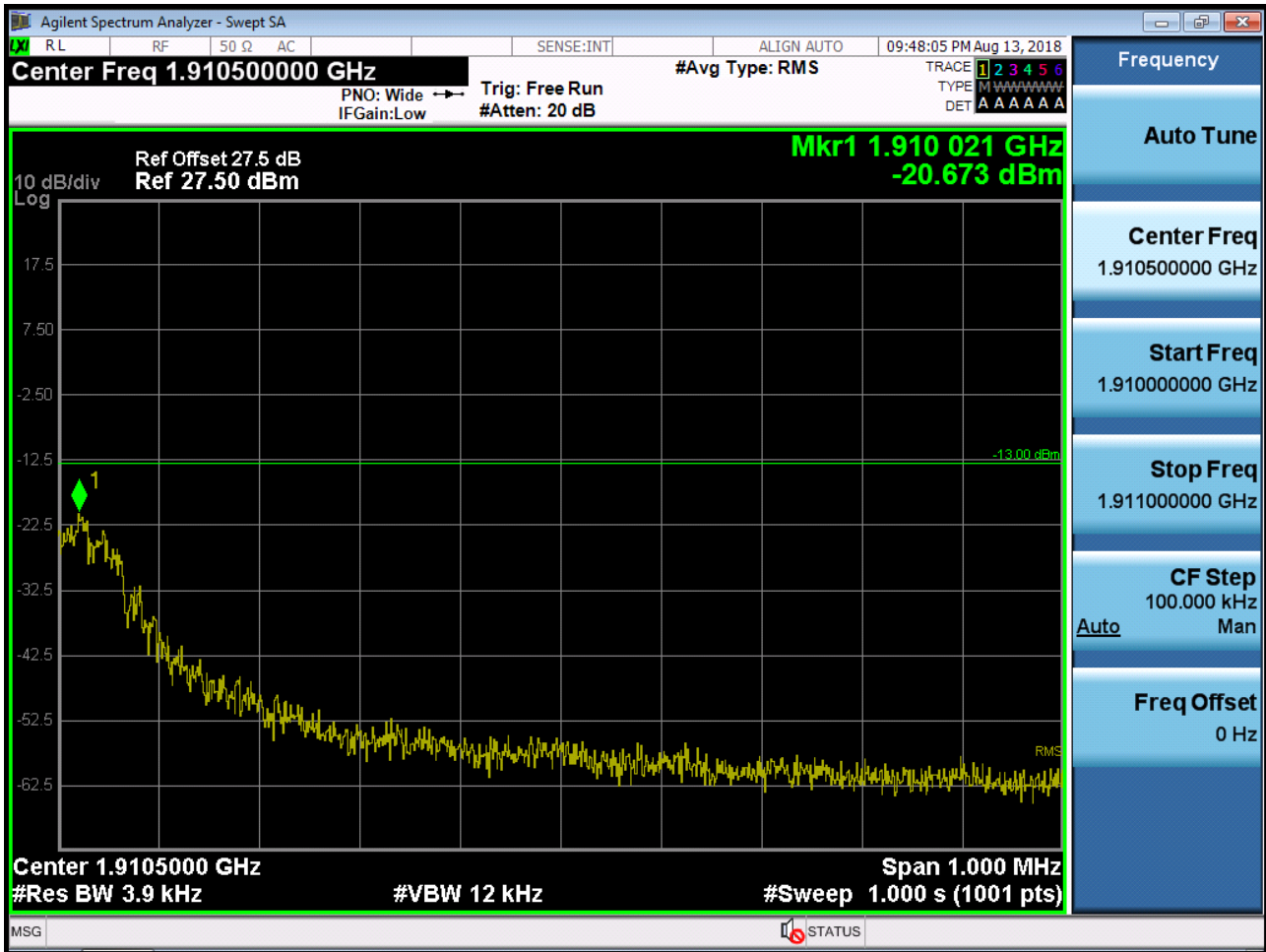
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + $10 \cdot \log(1 \text{ MHz}/100 \text{ kHz}) \text{ dB} = -49.06 \text{ dBm} + 10 \text{ dB} = -39.06 \text{ dBm}$

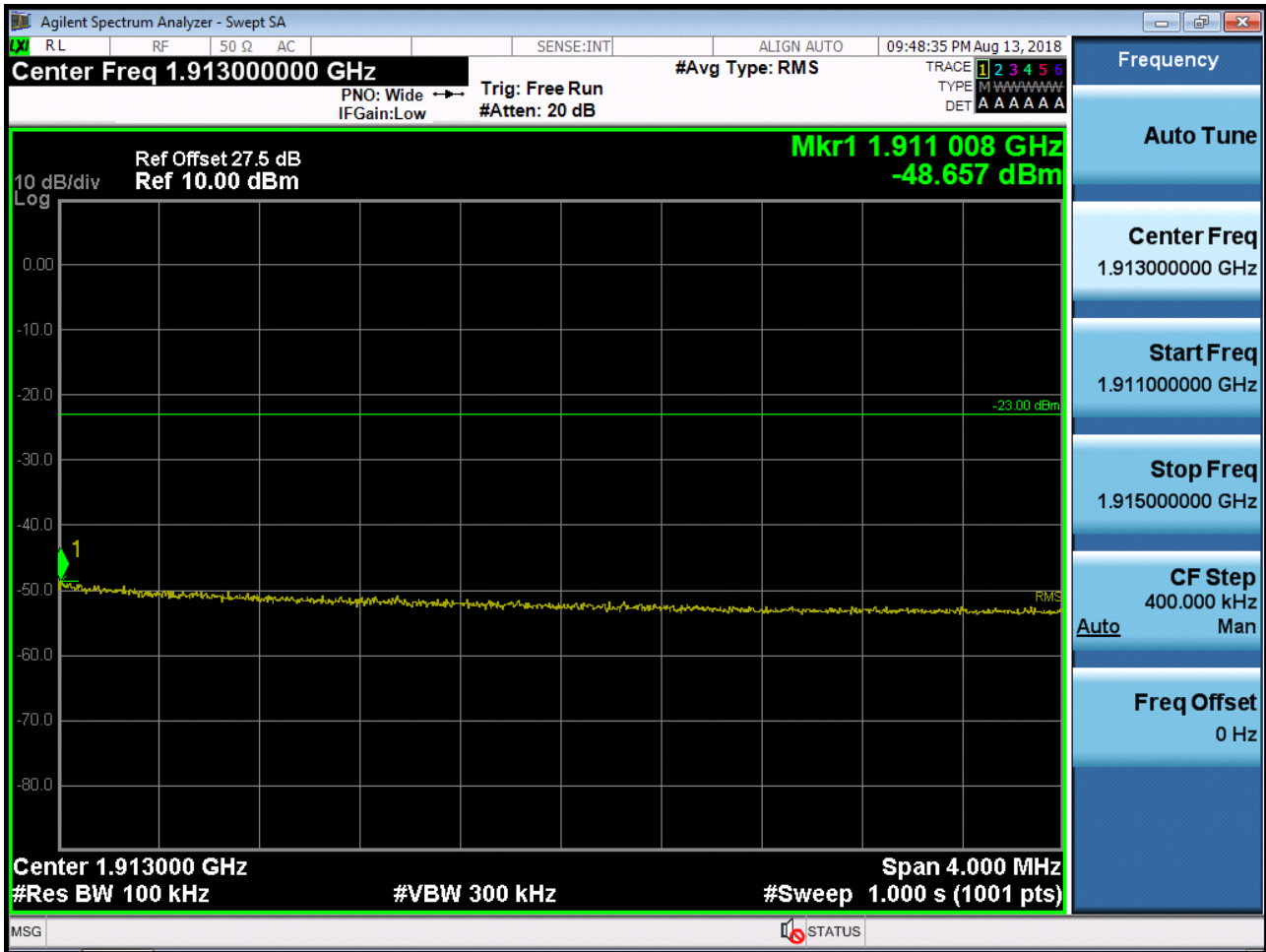
■ GSM1900 MODE (810 CH.) Block Edge 1



■ GSM1900 MODE (810 CH.) Block Edge 2



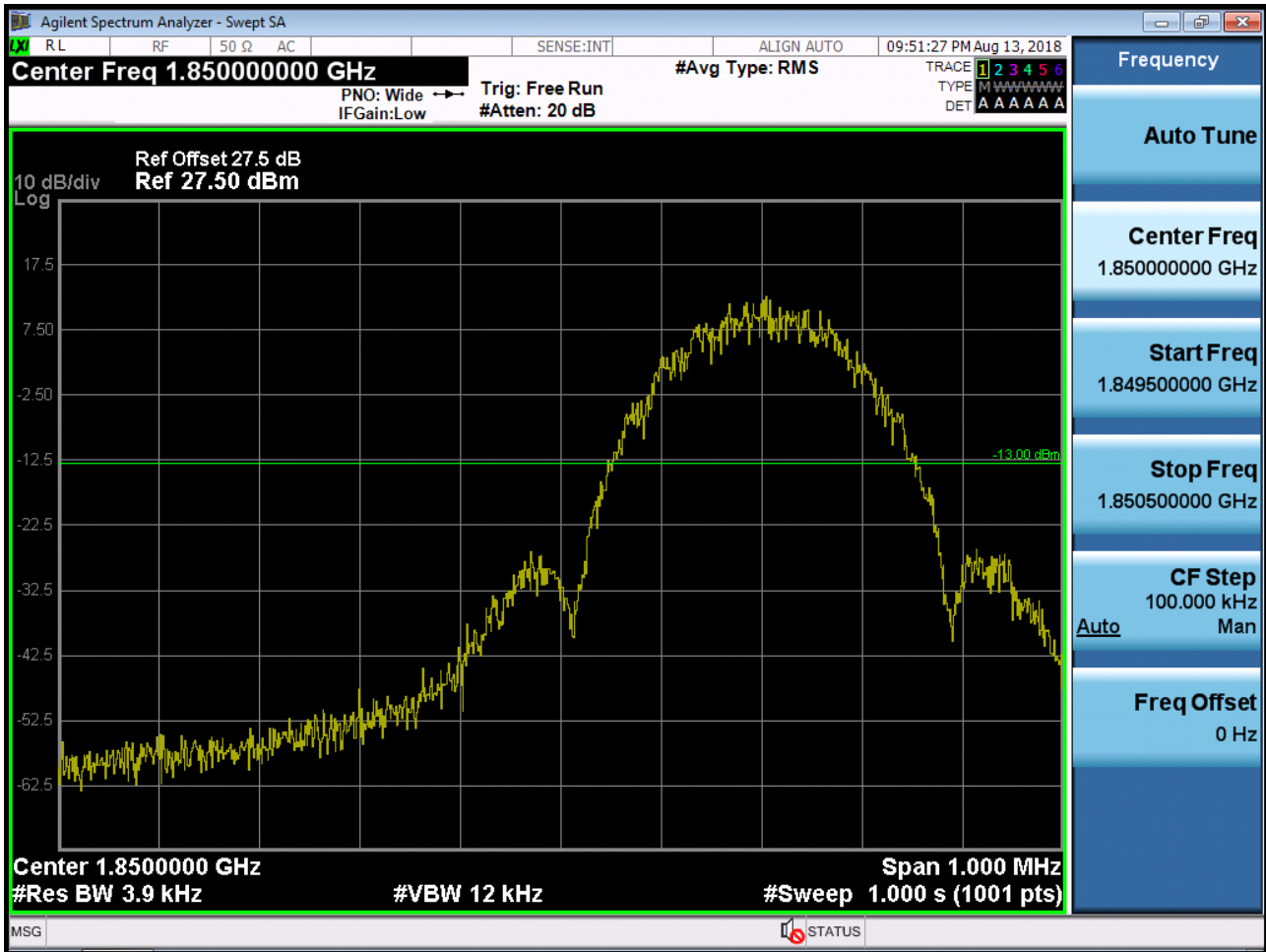
■ GSM1900 MODE (810 CH.) Block Edge 3



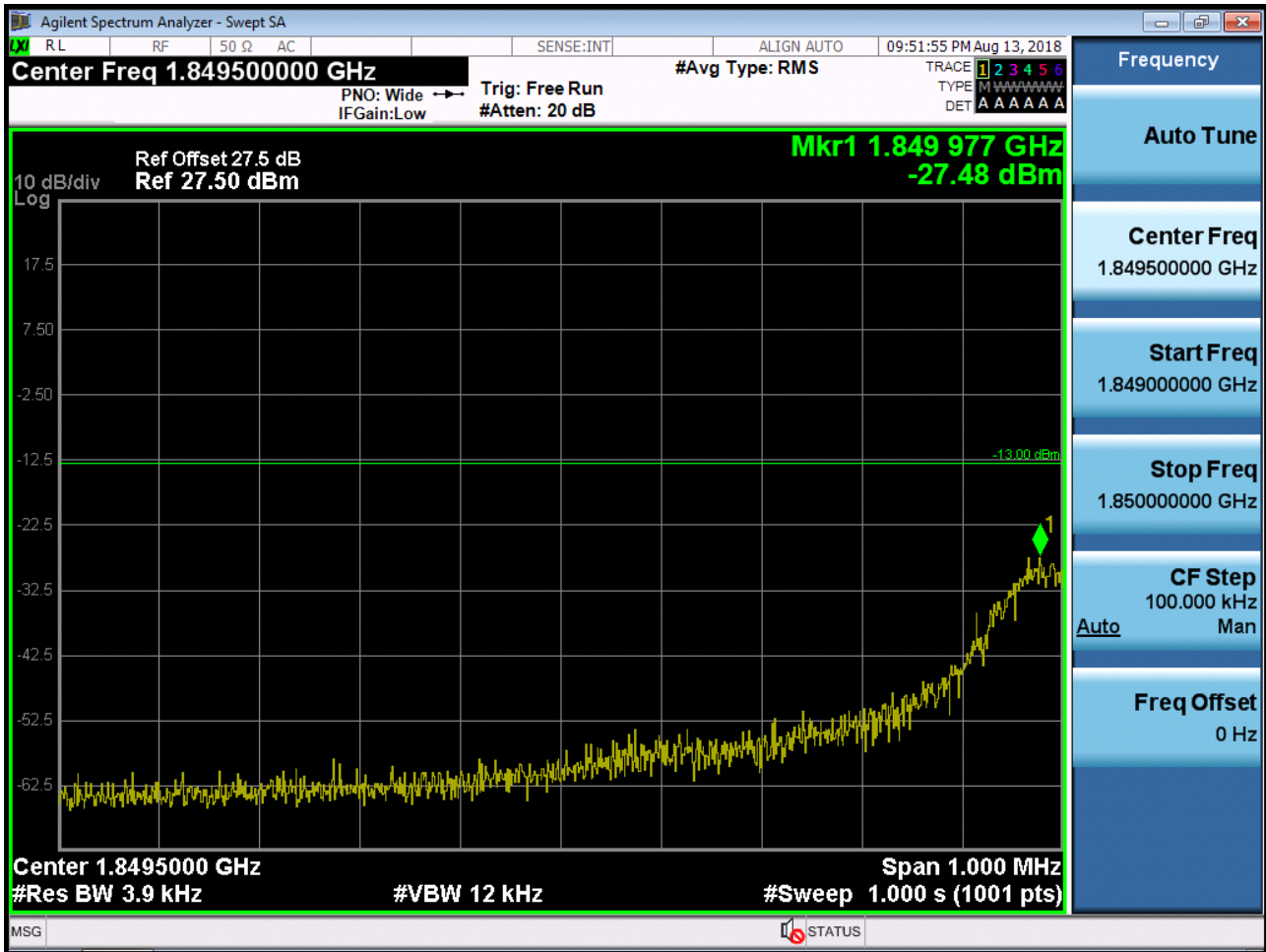
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10*log(1 MHz/100 kHz) dB = -48.657 dBm + 10 dB = **-38.657 dBm**

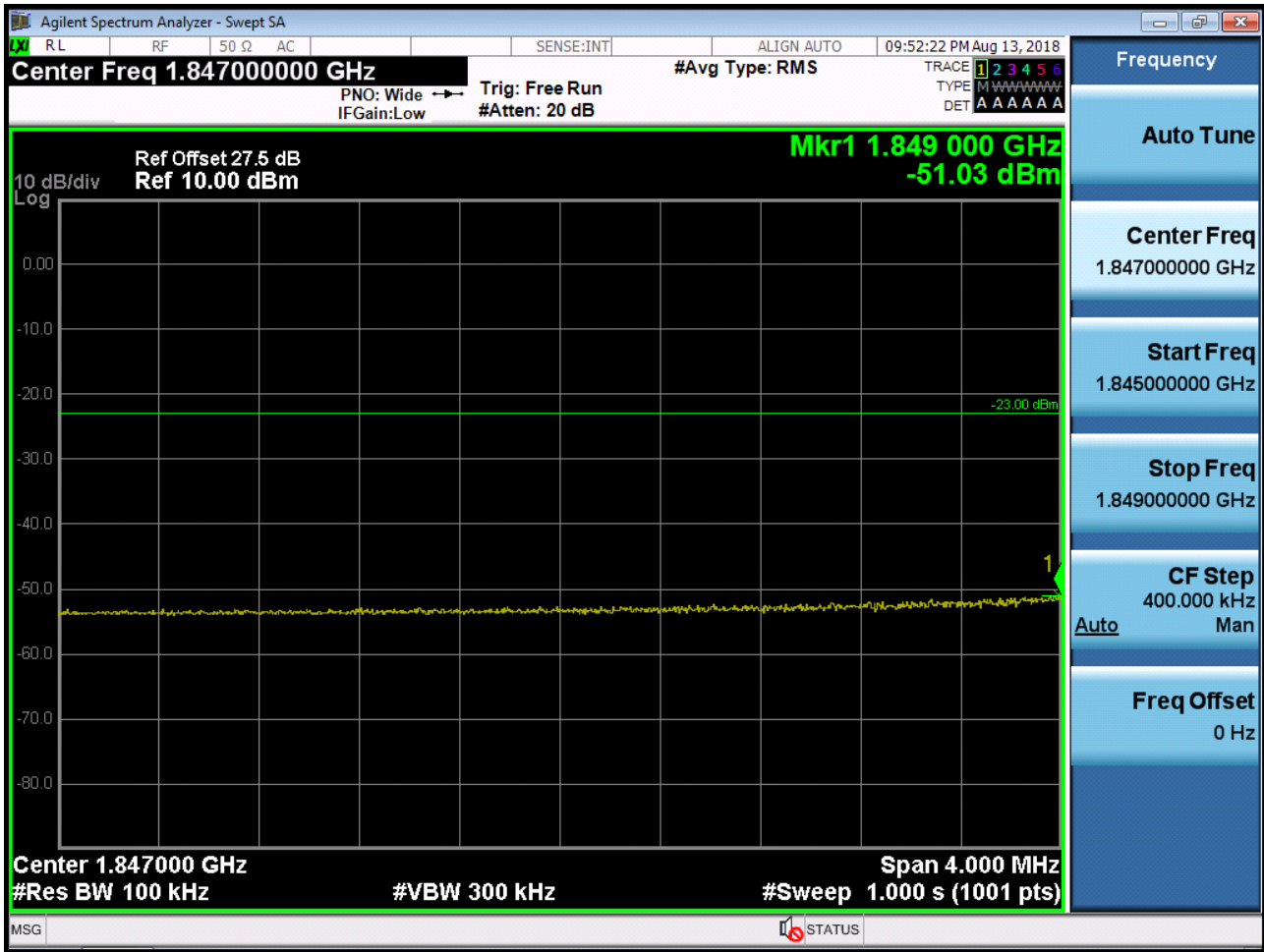
■ EDGE MODE (512 CH.) Block Edge 1



■ EDGE MODE (512 CH.) Block Edge 2



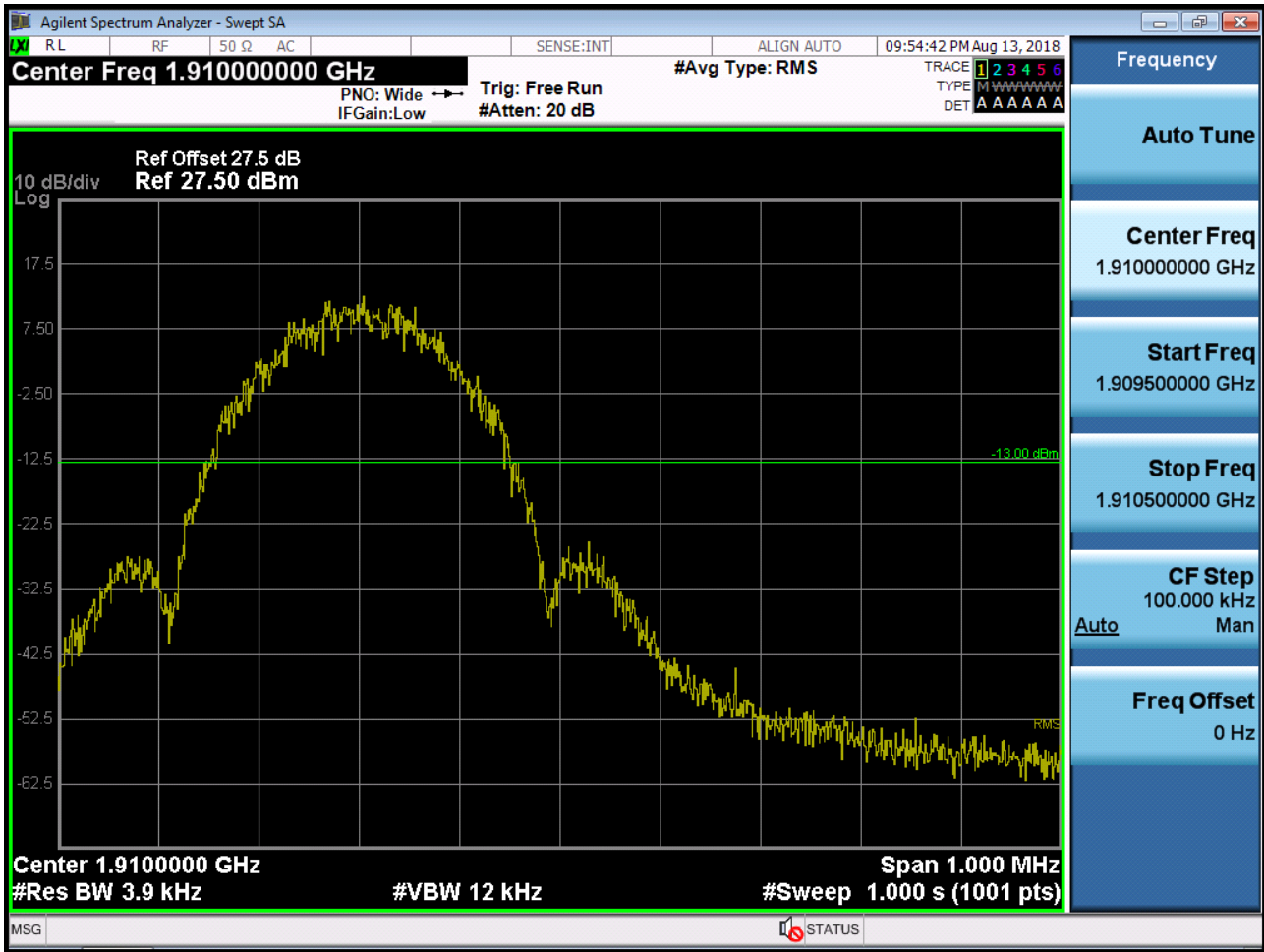
■ EDGE MODE (512 CH.) Block Edge 3



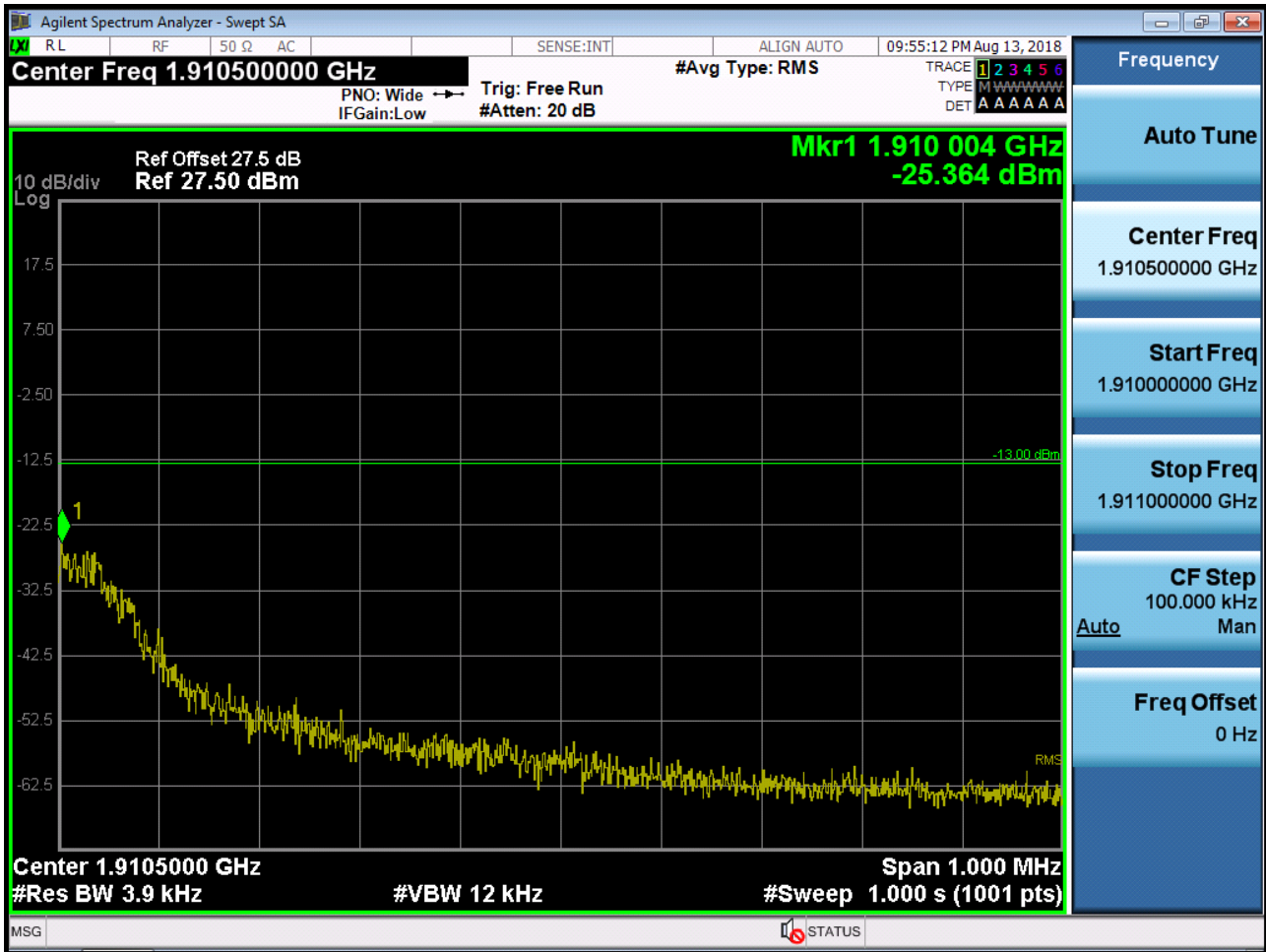
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + $10 \cdot \log(1 \text{ MHz}/100 \text{ kHz}) \text{ dB} = -51.03 \text{ dBm} + 10 \text{ dB} = -41.03 \text{ dBm}$

■ EDGE MODE (810 CH.) Block Edge 1



■ 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*log(1 MHz/100 kHz) dB = -50.549 dBm + 10 dB = **-40.549 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



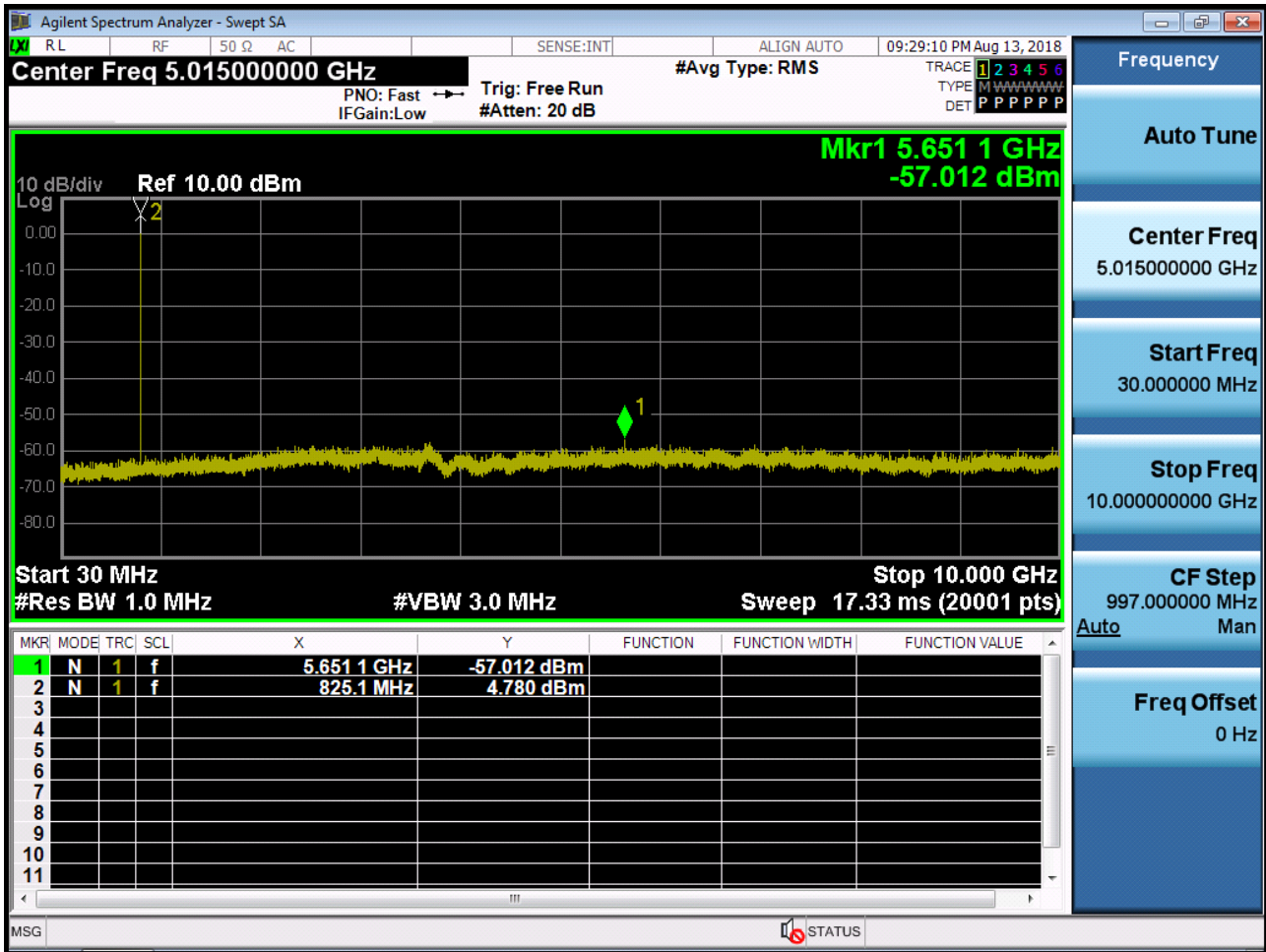
■ WCDMA1900 MODE (9538 CH.) Block Edge



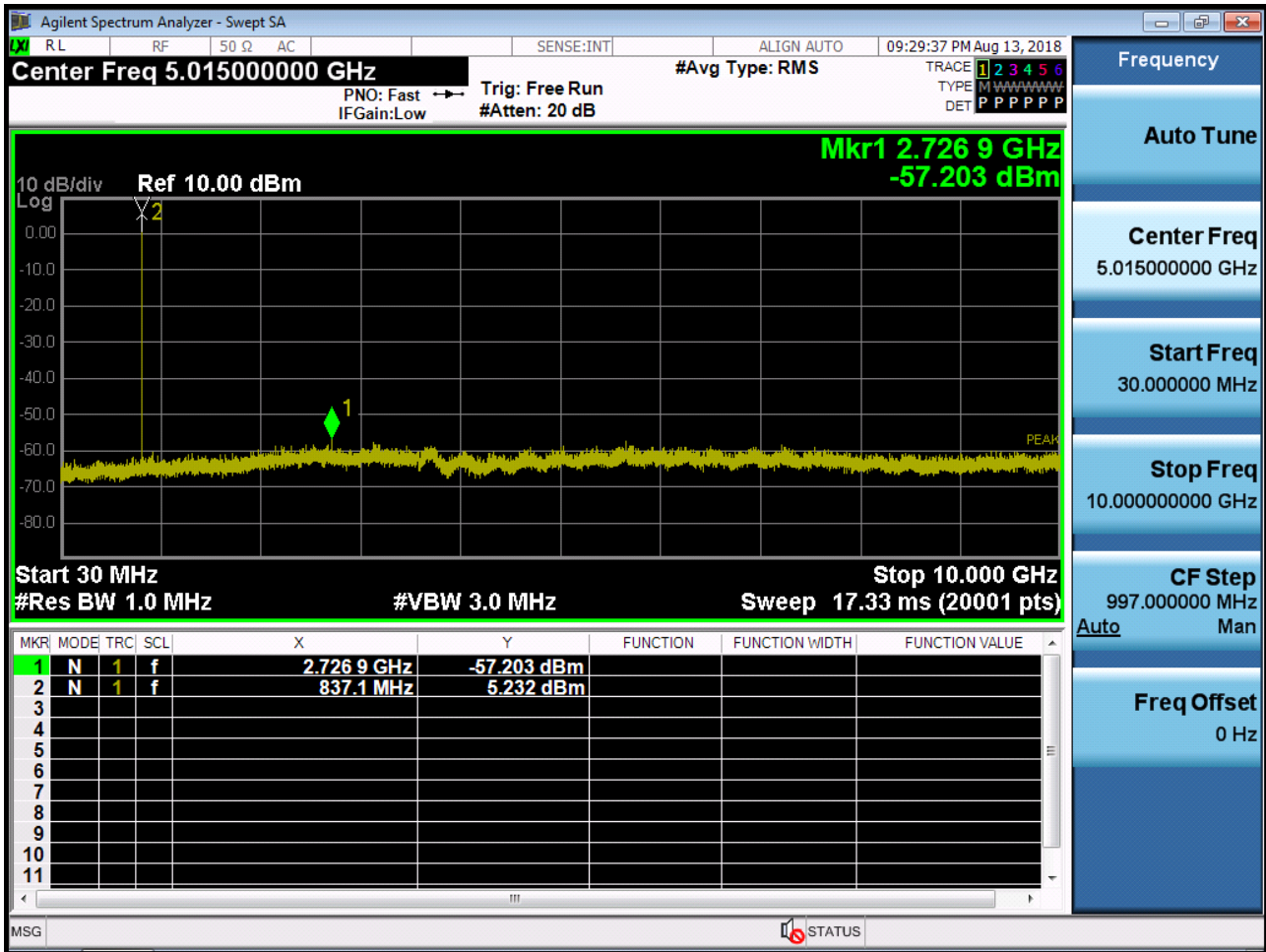
■ WCDMA1900 MODE (9538 CH.) – 4 MHz Span



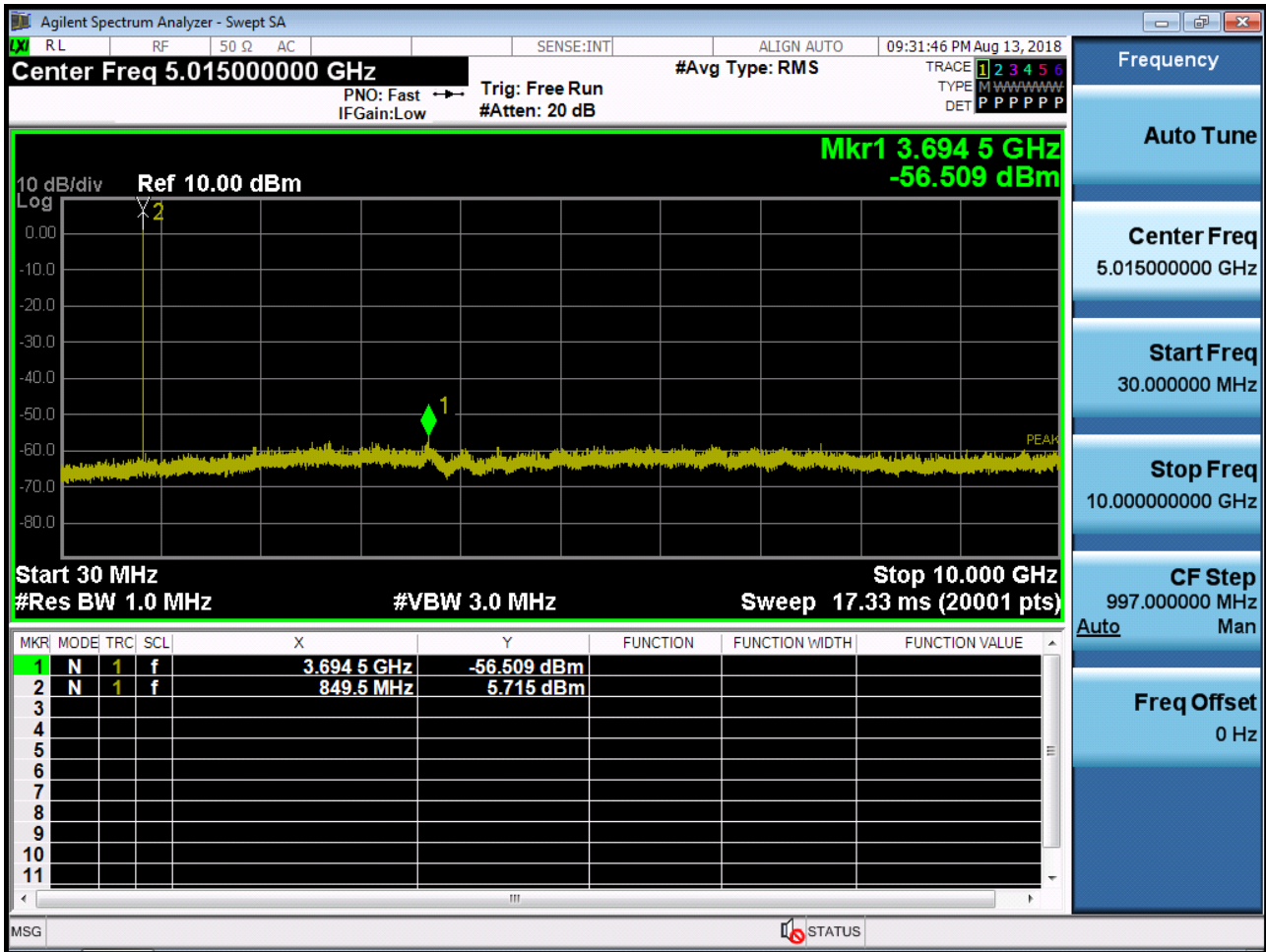
■ GSM850 MODE (128 CH.) Conducted Spurious Emissions



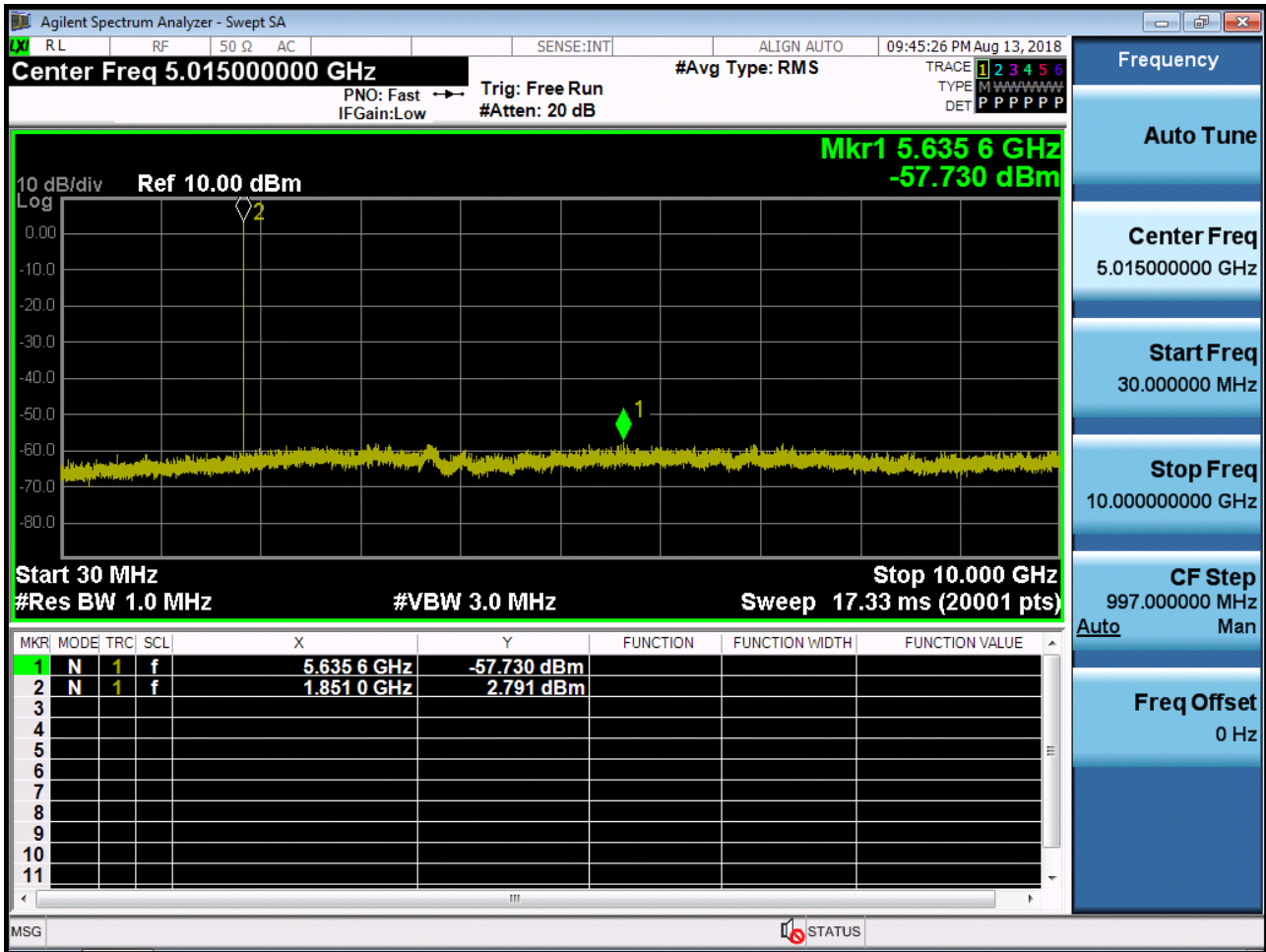
■ GSM850 MODE (190 CH.) Conducted Spurious Emissions



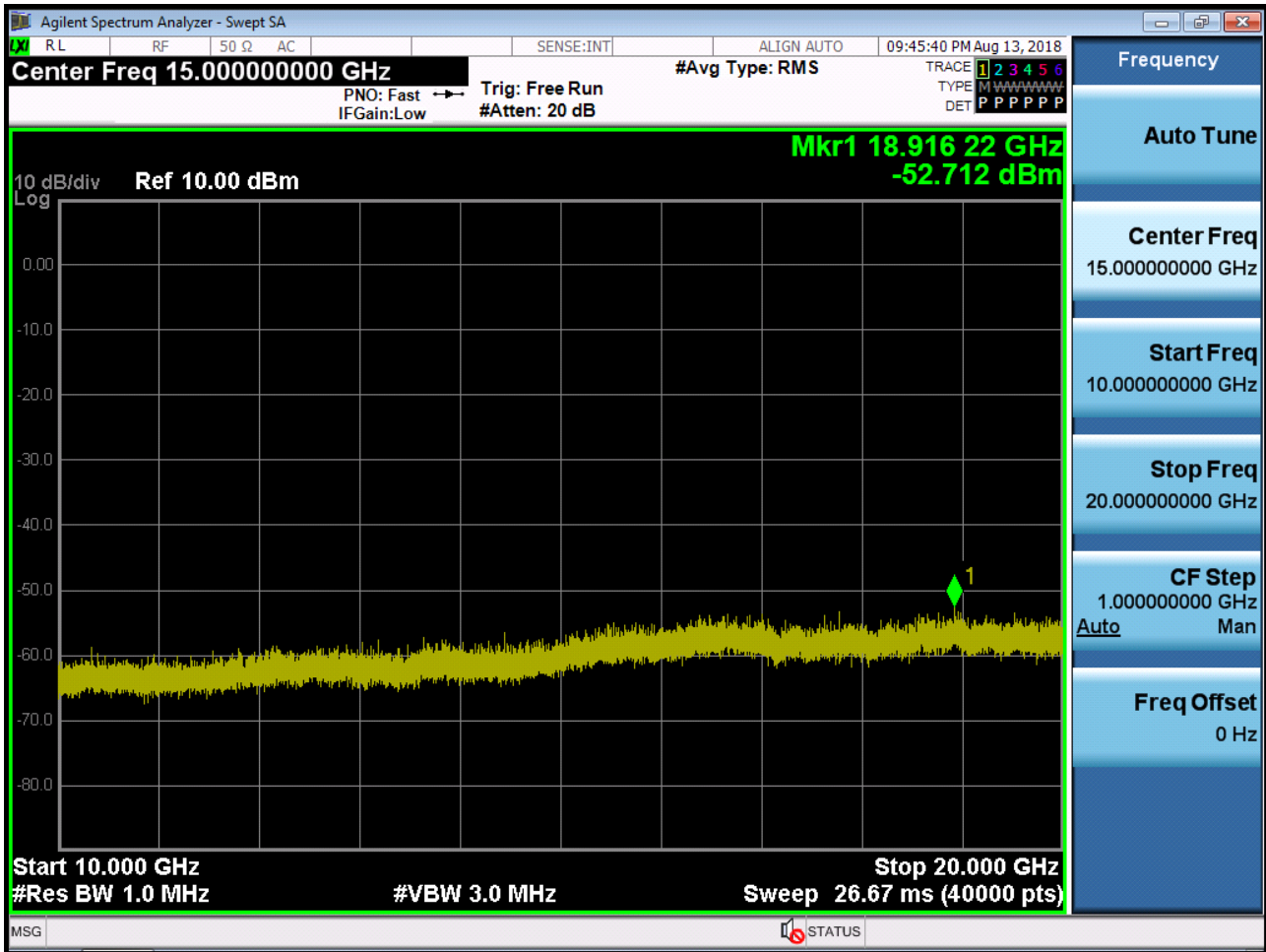
■ GSM850 MODE (251 CH.) Conducted Spurious Emissions



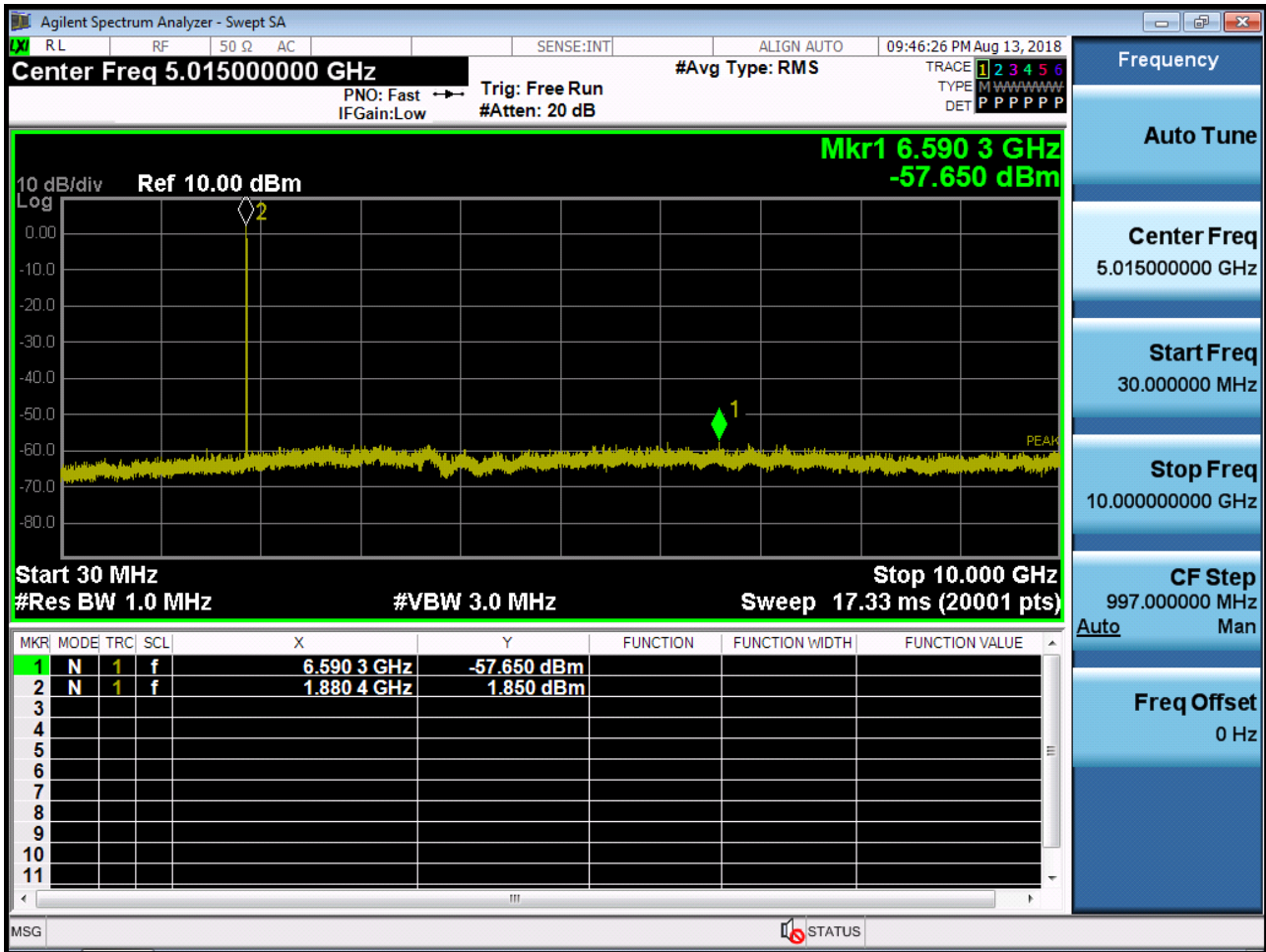
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions1



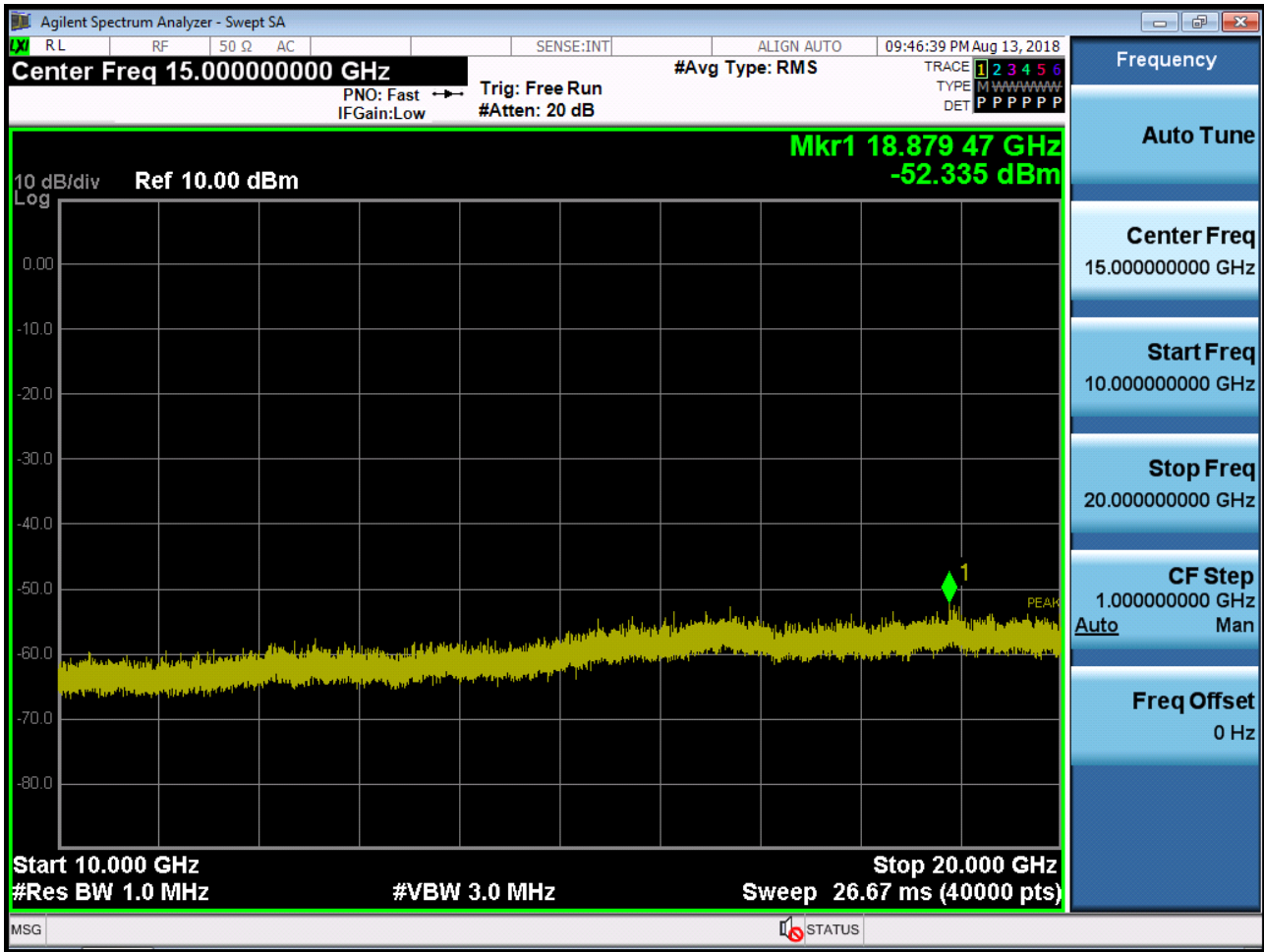
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions2



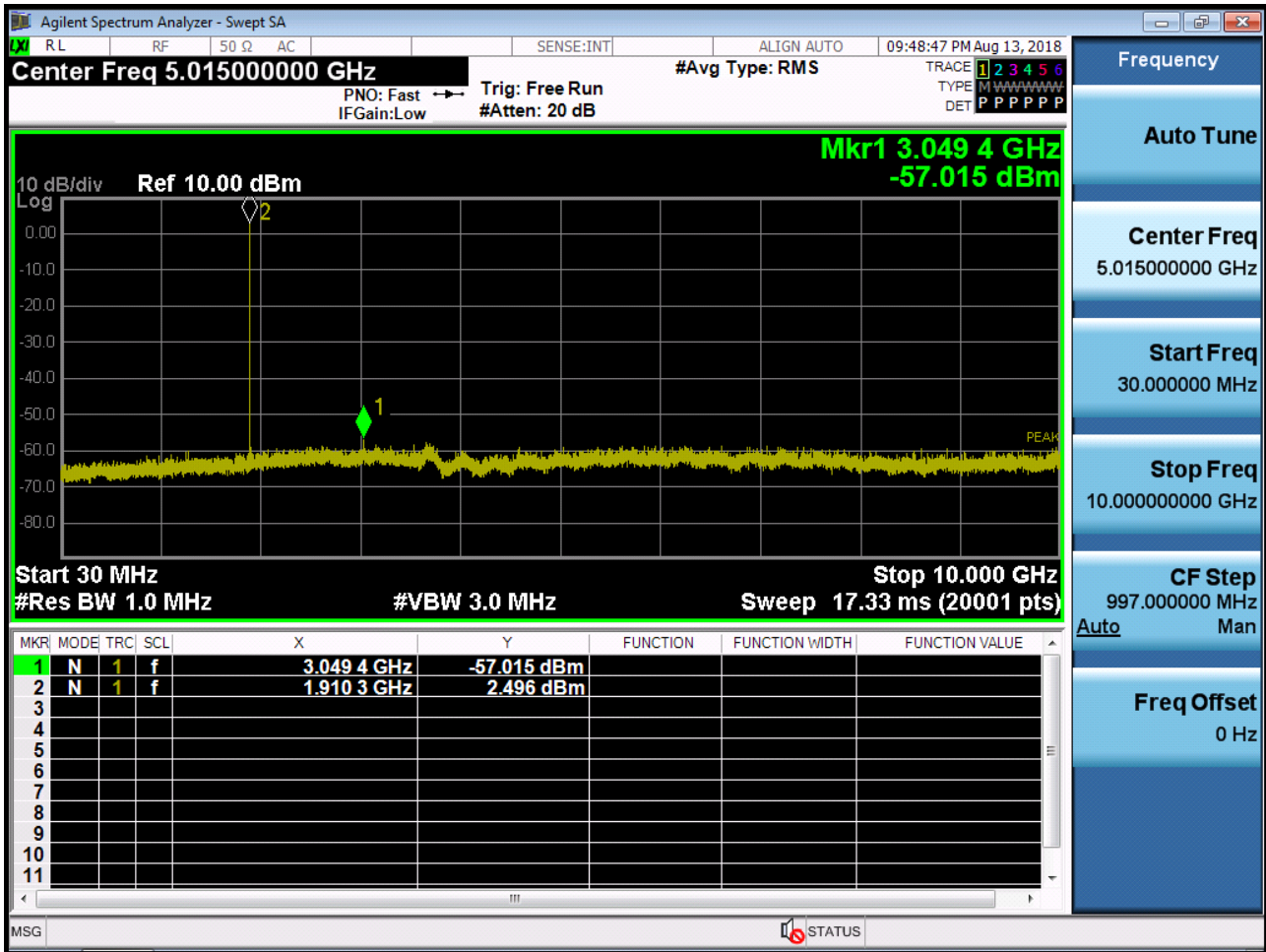
■ GSM1900 MODE (661 CH) Conducted Spurious Emissions1



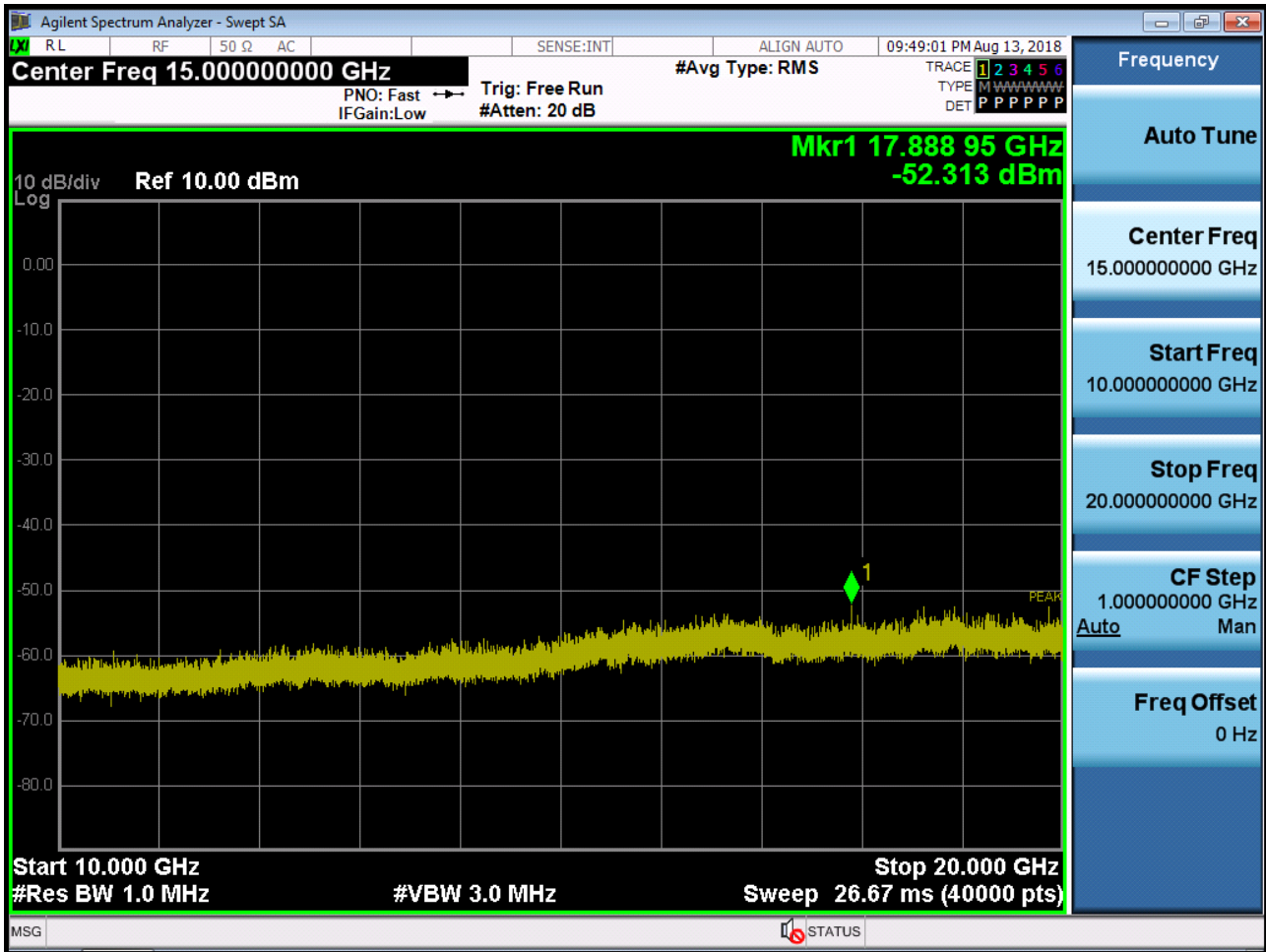
■ GSM1900 MODE (661 CH.) Conducted Spurious Emissions2



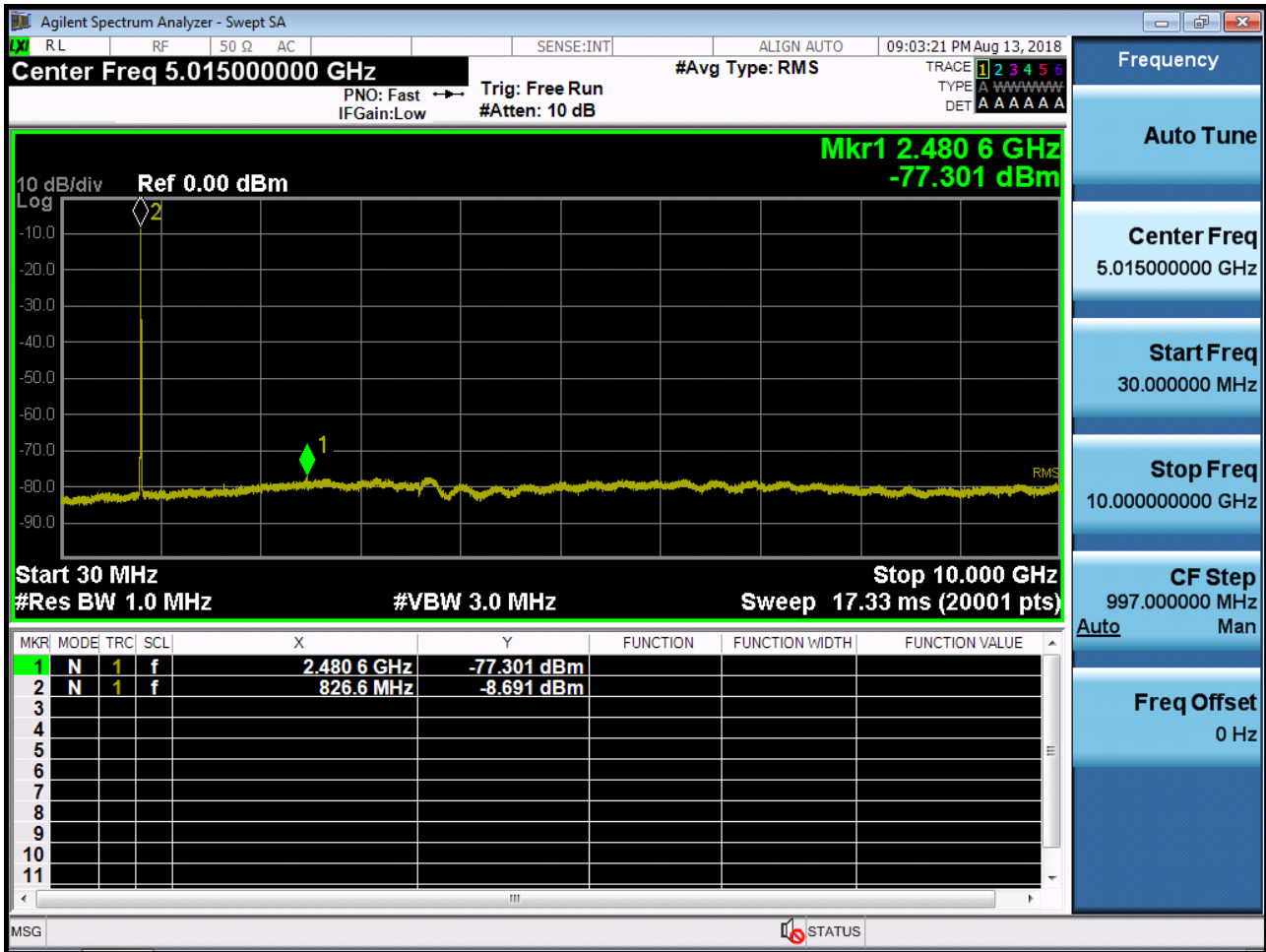
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions1



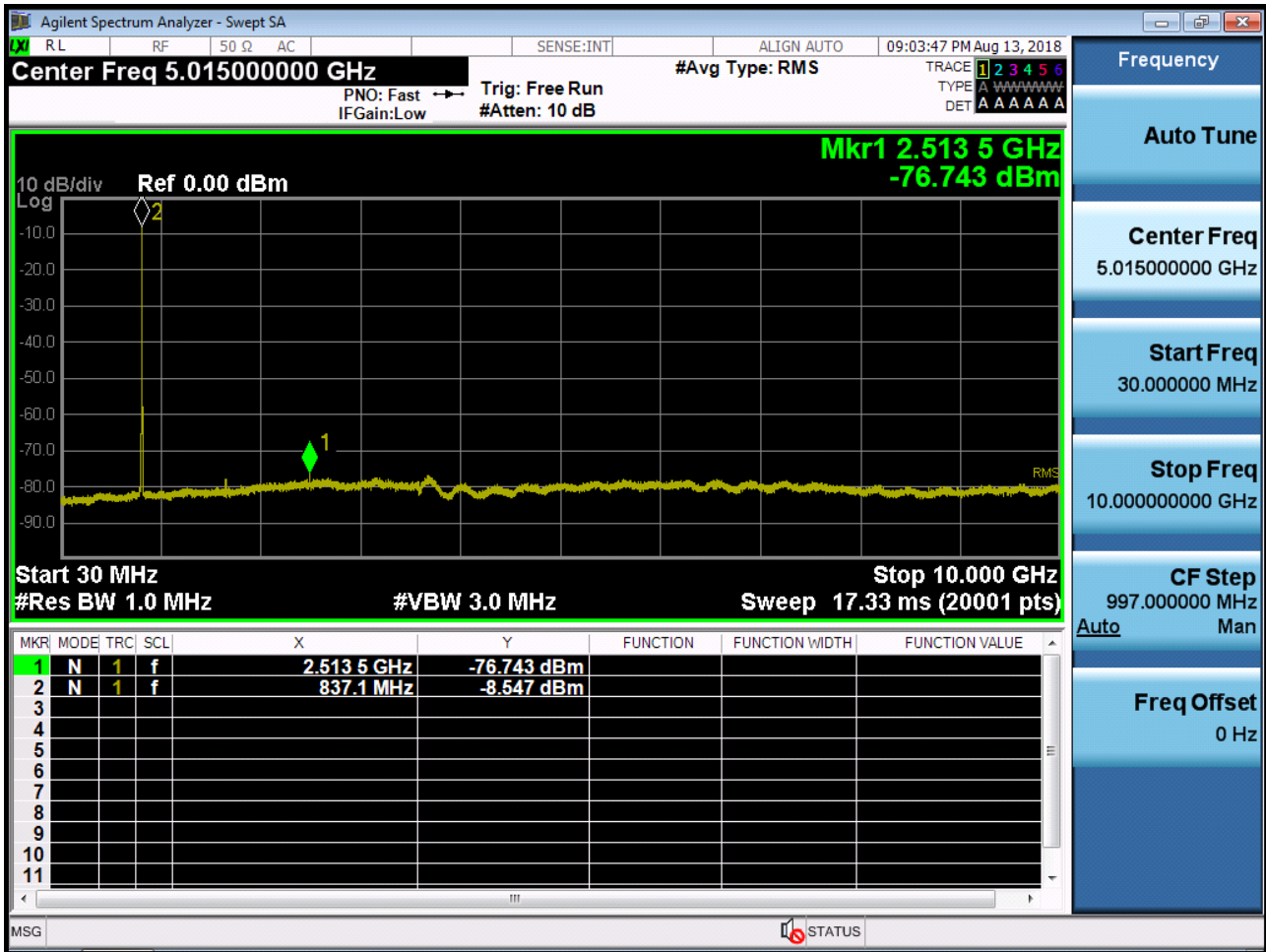
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions2



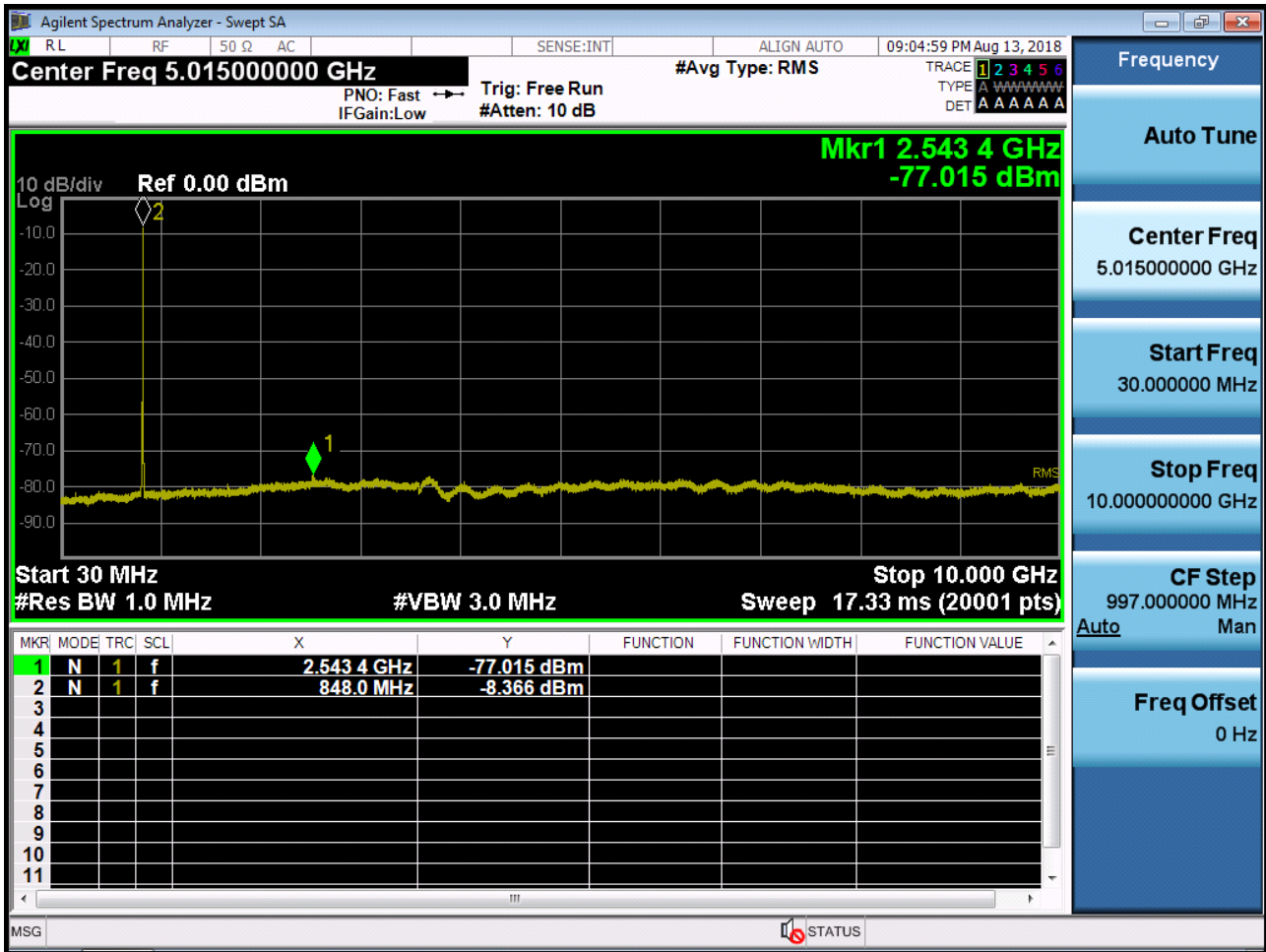
■ WCDMA850 MODE (4132 CH.) Conducted Spurious Emissions



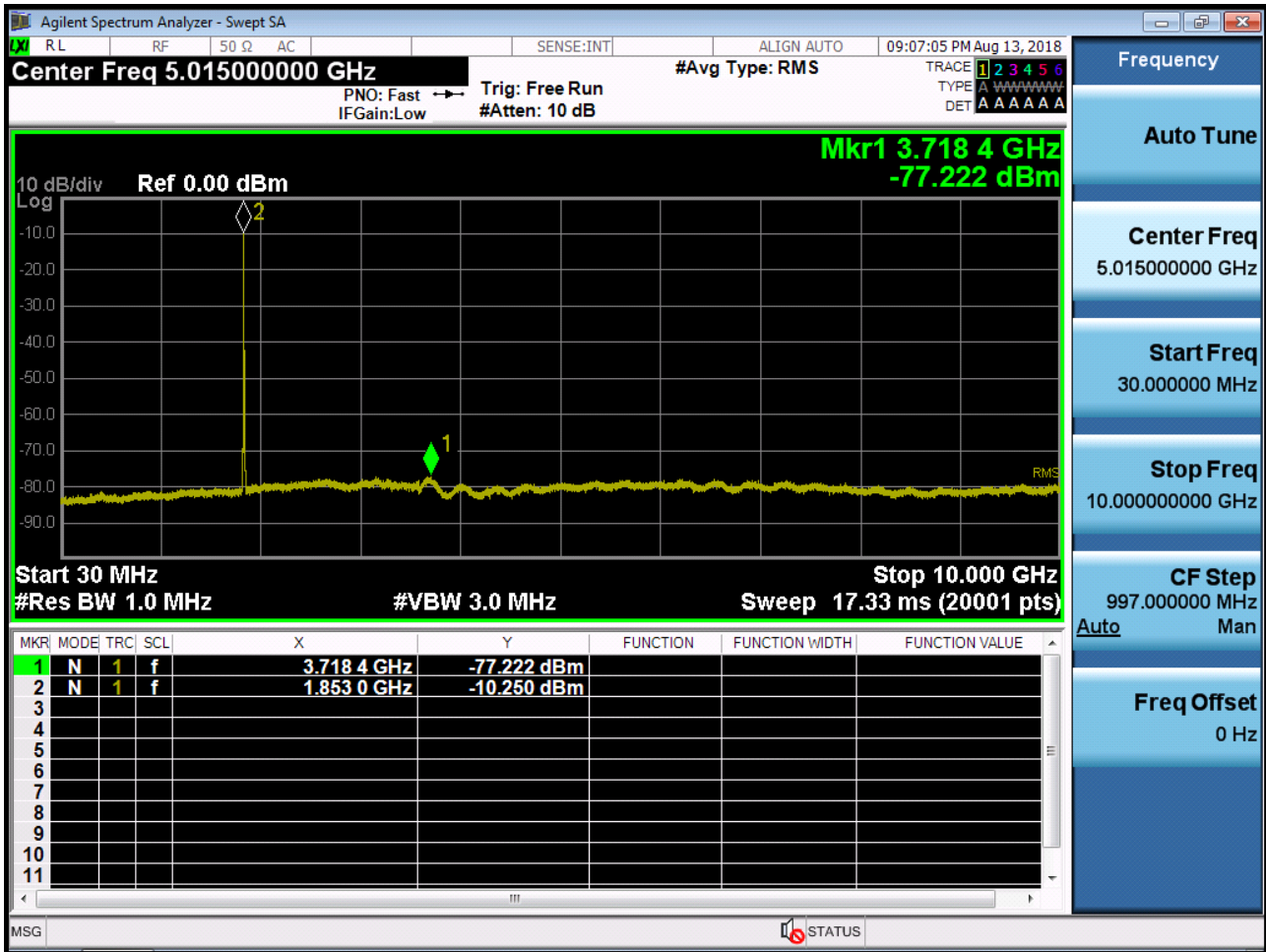
■ WCDMA850 MODE (4183 CH.) Conducted Spurious Emissions



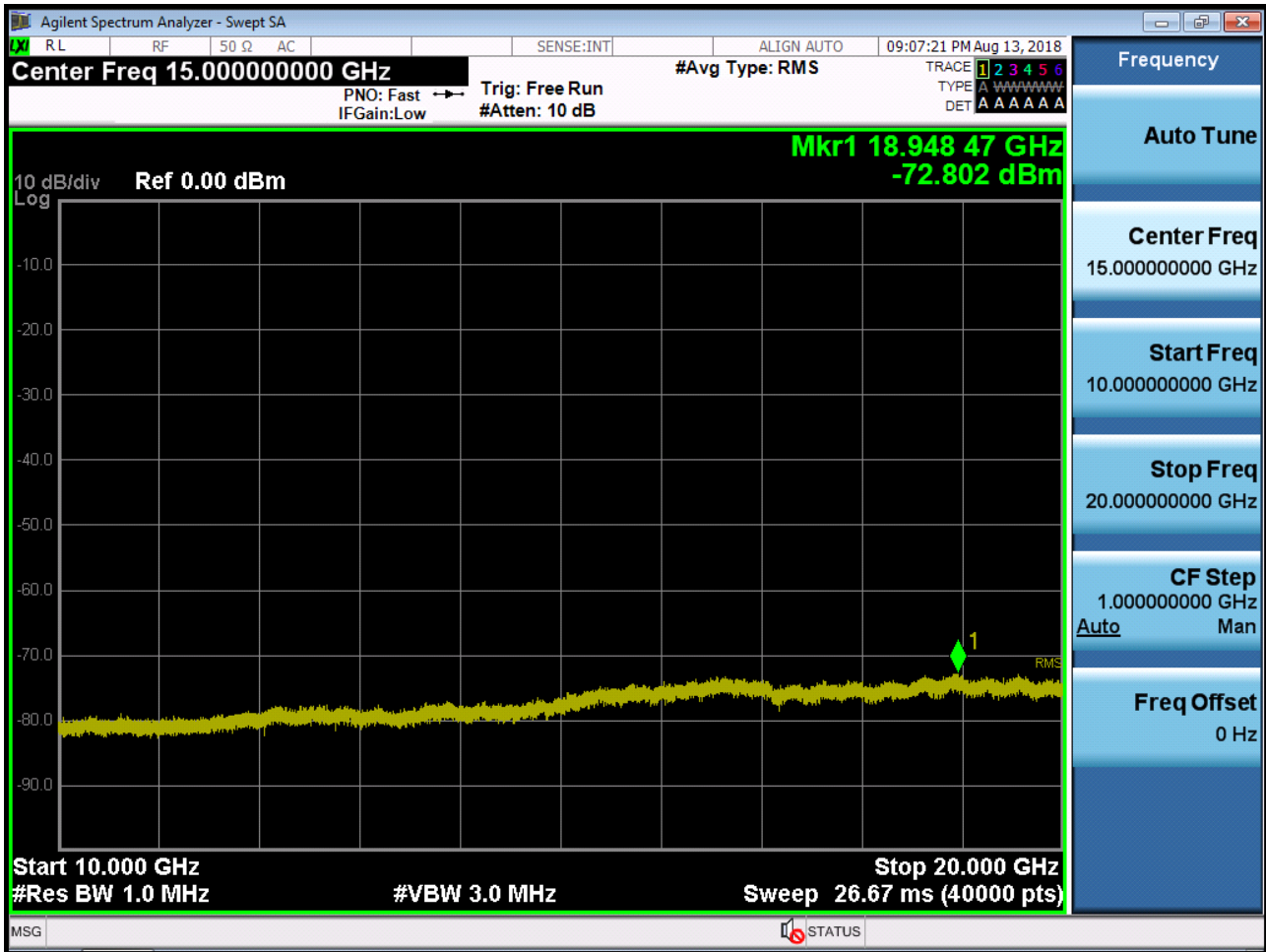
■ WCDMA850MODE (4233 CH.) Conducted Spurious Emissions



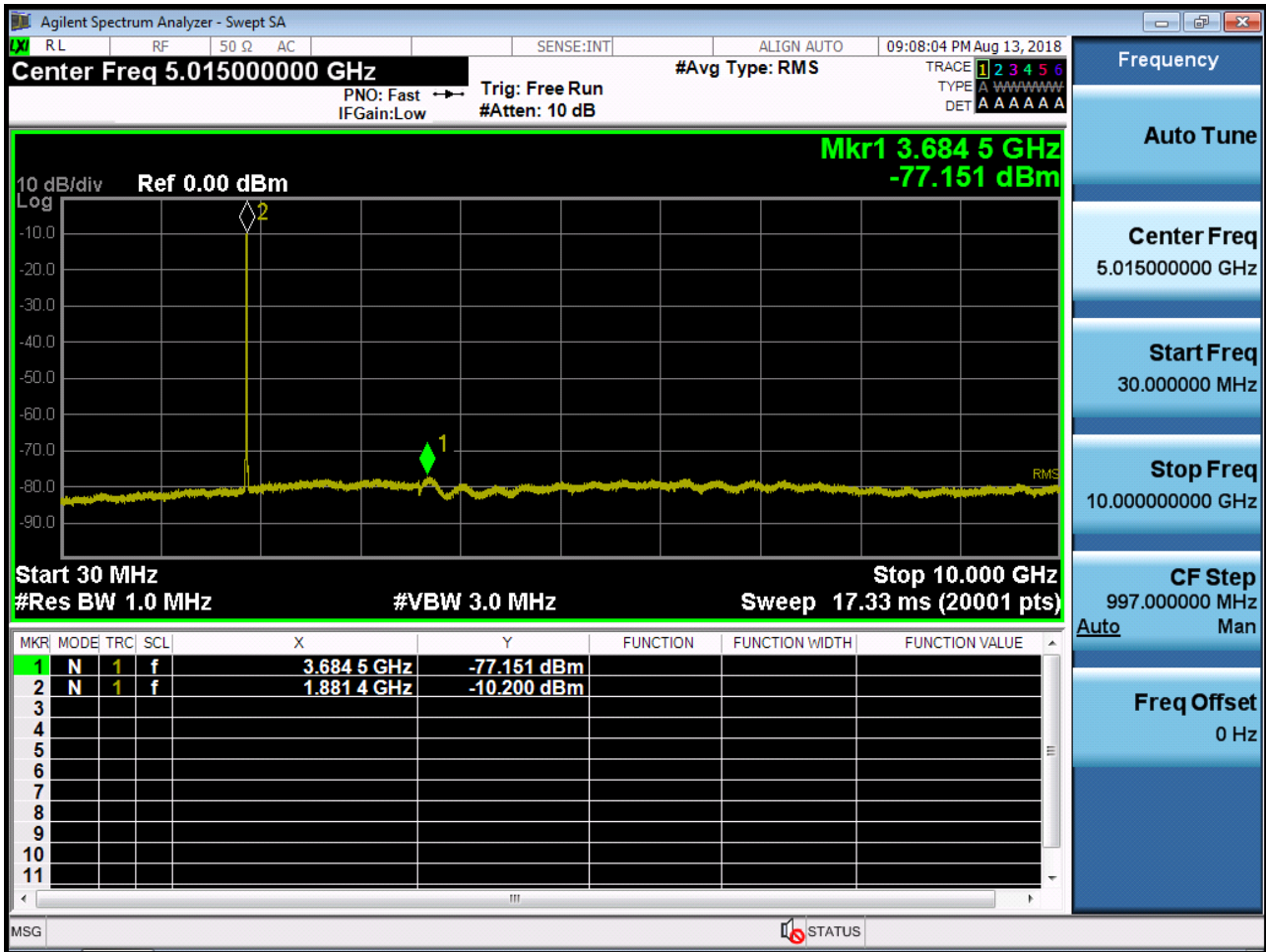
■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions1



■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions2



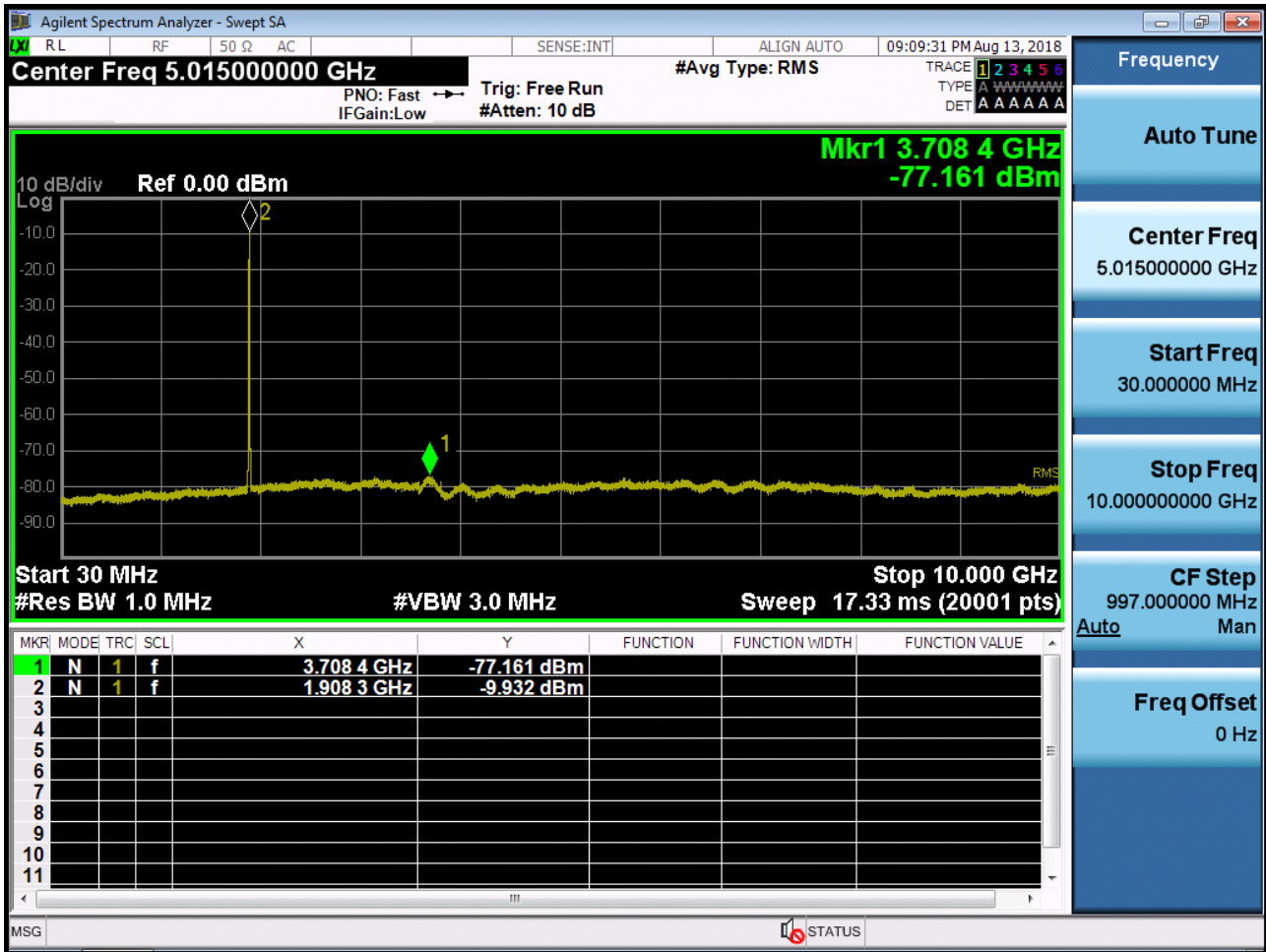
■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions1



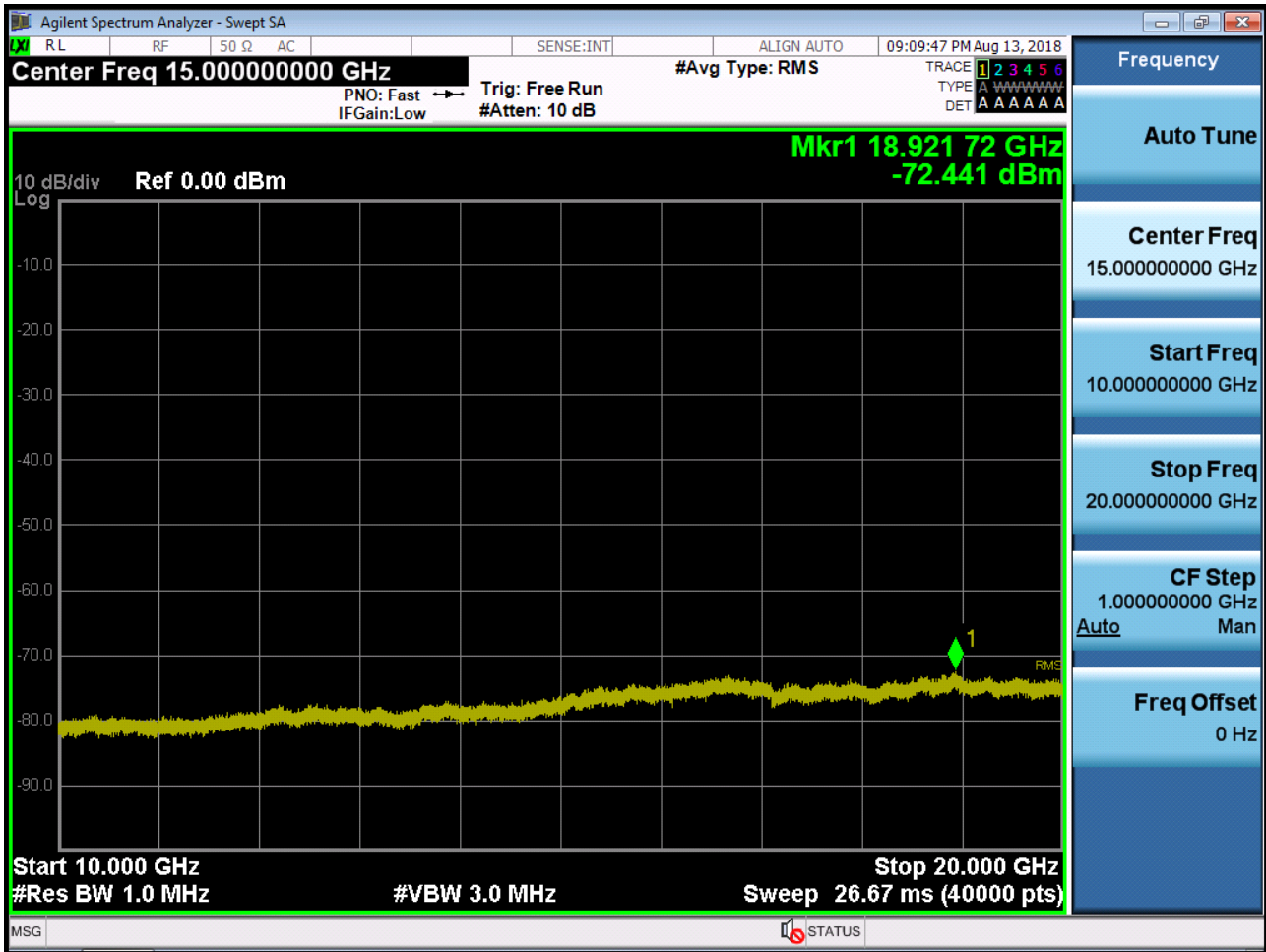
■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions2



■ 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-1809-FC001-P |
| 2 | HCT-RF-1809-FC002-P |
| 3 | HCT-RF-1809-FC003-P |