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FCC 2G, 3G REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

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

Date of Issue:
October 16, 2018

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

Report No.: HCT-RF-1810-FC025

FCC ID: **A3LSMJ415N**

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

According to the Evaluation report, all of the data contained herein is reused from the reference FCC ID : A3LSMJ415GN report.

Model(s): SM-J415N
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)
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 : Jong Seok Lee
Manager of Telecommunication Testing Center

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1810-FC025	October 16, 2018	- First Approval Report

Table of Contents

1. GENERAL INFORMATION 4
2. INTRODUCTION 5
2.1. DESCRIPTION OF EUT 5
2.2. MEASURING INSTRUMENT CALIBRATION 5
2.3. TEST FACILITY 5
3. DESCRIPTION OF TESTS 6
3.1 TEST PROCEDURE 6
3.2 RADIATED POWER 7
3.3 RADIATED SPURIOUS EMISSIONS 8
3.4 PEAK- TO- AVERAGE RATIO 9
3.5 OCCUPIED BANDWIDTH. 11
3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL 12
3.7 BAND EDGE 13
3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE 14
3.9 WORST CASE(CONDUCTED TEST) 15
3.10 WORST CASE(RADIATED TEST) 16
4. LIST OF TEST EQUIPMENT 17
5. MEASUREMENT UNCERTAINTY 18
6. SUMMARY OF TEST RESULTS 19
7. SAMPLE CALCULATION 20
8. TEST DATA 22
8.1 EFFECTIVE RADIATED POWER 22
8.2 EQUIVALENT ISOTROPIC RADIATED POWER 22
8.3 RADIATED SPURIOUS EMISSIONS 23
8.4 PEAK-TO-AVERAGE RATIO 26
8.5 OCCUPIED BANDWIDTH 27
8.6 CONDUCTED SPURIOUS EMISSIONS 28
8.7 BAND EDGE 28
8.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE 29
9. TEST PLOTS 36
10. ANNEX A_ TEST SETUP PHOTO 91

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:	A3LSMJ415N
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-J415N
Tx Frequency:	826.40 - 846.60 MHz (WCDMA850) 1 850.20 - 1 909.80 MHz (GSM1900) 1 852.4 – 1 907.6 MHz (WCDMA1900)
Rx Frequency:	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, & 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 ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points > 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Note

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

   The power is calculated by the following formula;

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

   Where: P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.
3. The maximum value is calculated by adding the forward power to the calibrated source plus its appropriate gain value.

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

3.3 RADIATED SPURIOUS EMISSIONS

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

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

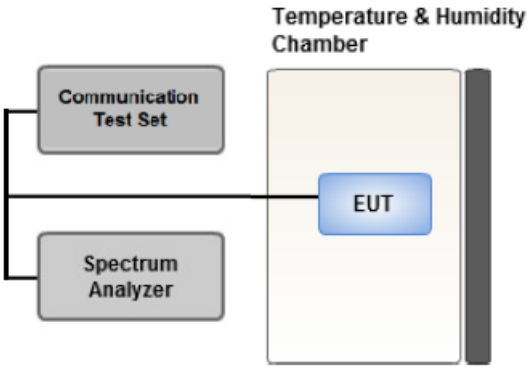
Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points > 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 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 ≥ 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:

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

Test Settings(Peak Power)

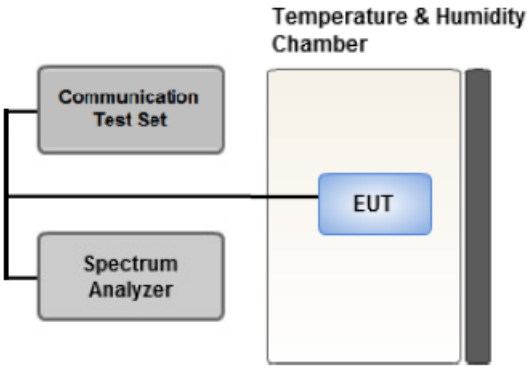
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW ≥ 3 × RBW.

1. Set the RBW ≥ OBW.
2. Set VBW ≥ 3 × RBW.
3. Set span ≥ 2 × OBW.
4. Sweep time ≥ 10 × (number of points in sweep) × (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 × to 3 × the OBW.
2. Set RBW ≥ OBW.
3. Set VBW ≥ 3 × RBW.
4. Set number of measurement points in sweep ≥ 2 × span / RBW.
5. Sweep time:
   Set ≥ [10 × (number of points in sweep) × (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/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.

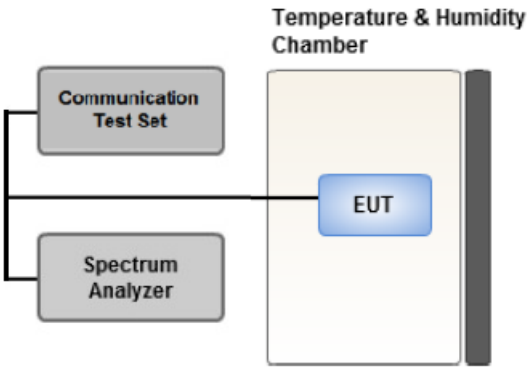
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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 ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

3.6 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.

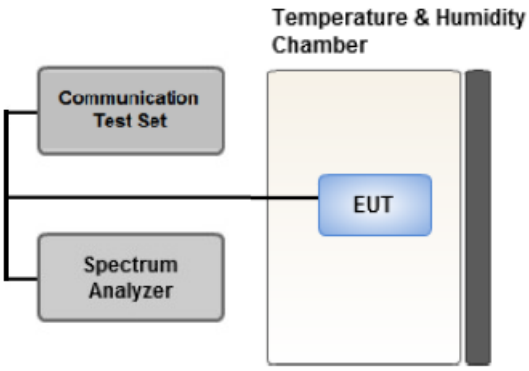
Test Settings(GSM)

1. RBW = 1 MHz
2. VBW ≥ 3 MHz
3. Detector = Peak
4. Trace Mode = max hold
5. Sweep time = auto
6. Number of points in sweep ≥ 2 * Span / RBW

Test Settings(WCDMA)

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

3.7 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 ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

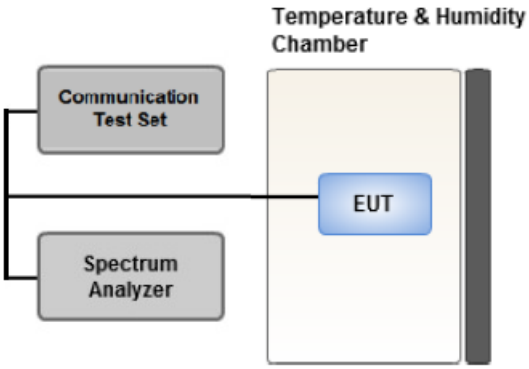
Test Notes

According to FCC 22.917, 24.238, 27.53 specified that power of any emission outside of The authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

All measurements were done at 2 channels(low and high operational frequency range.)

The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

3.8 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 (GSM1900)	3G (WCDMA B2)	3G (WCDMA B5)
Low	512	9262	4132
Mid	661	9400	4183
High	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, Effective Isotropic Radiated Power	QPSK (WCDMA)	12.2 kbps RMC	WCDMA B2 : Z WCDMA B5 : Z	Low, Mid, High
Radiated Spurious and Harmonic Emissions	QPSK (WCDMA)	12.2 kbps RMC	WCDMA B2 : Z WCDMA B5 : Z	Low, Mid, High

[Worst case_2G]

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

[Test Channel]

	UplinkChannel		
	2G (GSM1900)	3G (WCDMA B2)	3G (WCDMA B5)
Low	512	9262	4132
Mid	661	9400	4183
High	810	9538	4233

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:

1. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
2. Model : SU-642
   - Use date of chamber : August 08, 2018 ~ September 04, 2018

5. MEASUREMENT UNCERTAINTY

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

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

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.71

6. SUMMARY OF TEST RESULTS

6.1 Test Condition : Conducted Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Occupied Bandwidth	§2.1049	N/A	PASS
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§2.1051, §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	**See Note1**
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
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	dBm
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	dBm
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: 29.26 dBm = 0.843 W

▣ MODULATION SIGNAL: GSM1900

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 log_{10} (W) = 42.26 dBc

Ch.	Freq.(MHz)	Measured Level [dBm]	Ant. Gain (dBi)	Substitute Level [dBm]	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)	Measured Level [dBm]	Ant. Gain (dBd)	Substitute Level [dBm]	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	71.67
	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	67.69

▣ 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)	Measured Level [dBm]	Ant. Gain (dBi)	Substitute Level [dBm]	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
				Tx_{Total} (ms)	Tx_{On} (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 49 ~ 55.
2. Only GSM(include EDGE) Mode was tested by alternate procedure for PAPR

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

   Duty cycle Factor = 10 log (1/x), x = Tx_{On} / Tx_{Total}

8.5 OCCUPIED BANDWIDTH

Band	Channel	Frequency(MHz)	Data (GSM: kHz / WCDMA : MHz)
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 37 ~ 48.

8.6 CONDUCTED SPURIOUS EMISSIONS

Band	Channel	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result	(dBm)
GSM1900	512	18.91622	29.489	-52.712	-23.223	-13.00
	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 76 ~ 90.
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 56 ~ 75.

8.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: GSM1900

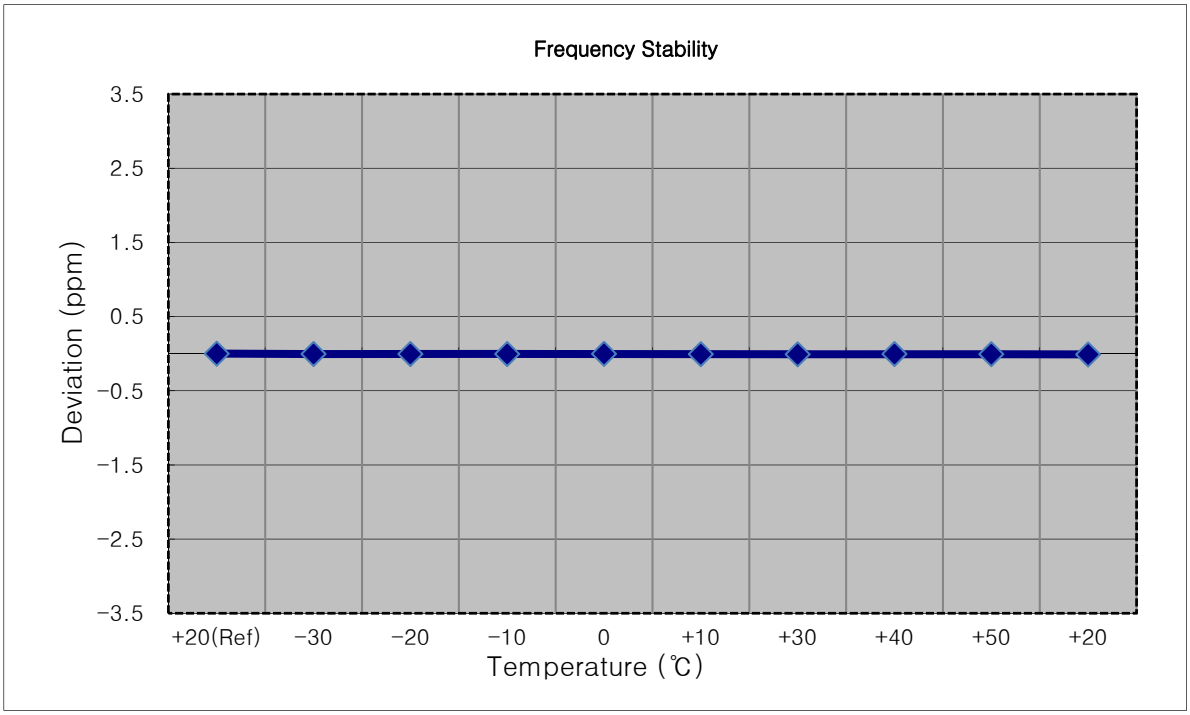
▣ OPERATING FREQUENCY: 1850,200,000 Hz

▣ CHANNEL: 512

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

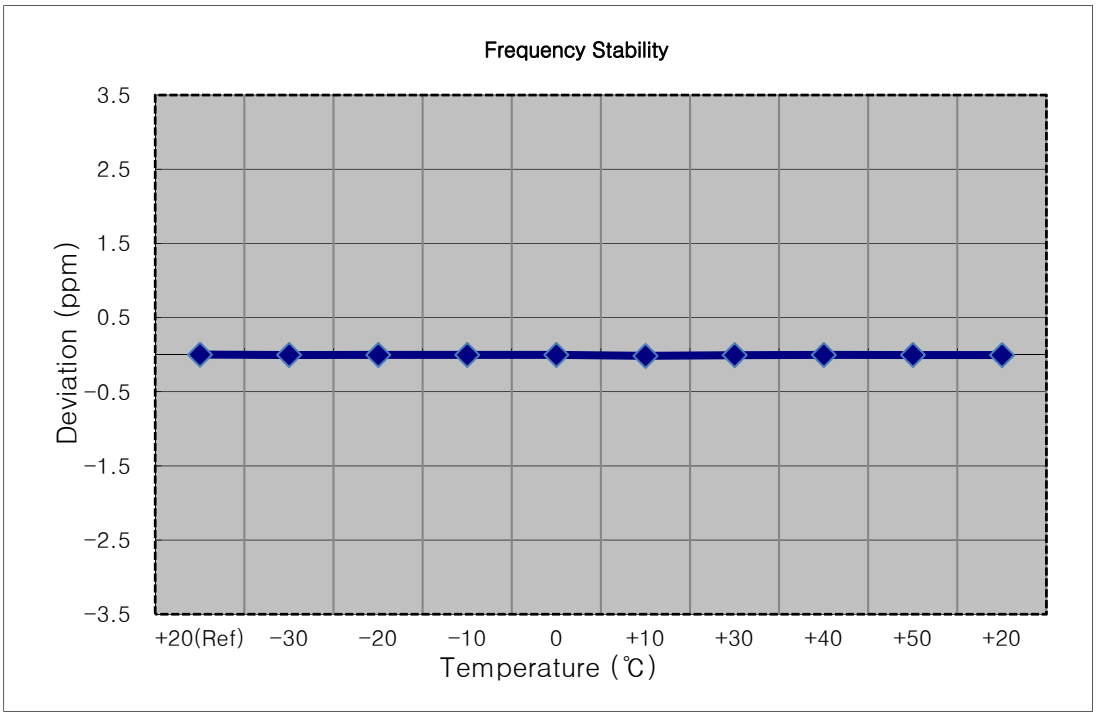
▣ OPERATING FREQUENCY: 1880,000,000 Hz

▣ CHANNEL: 661

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

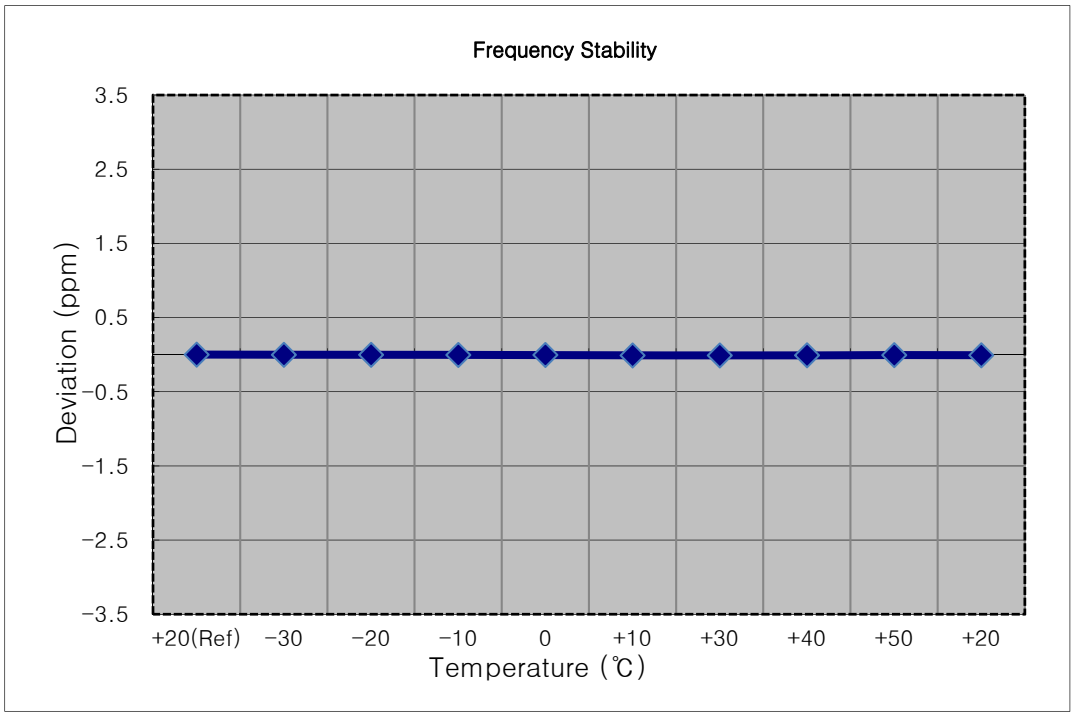
▣ OPERATING FREQUENCY: 1909,800,000 Hz

▣ CHANNEL: 810

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

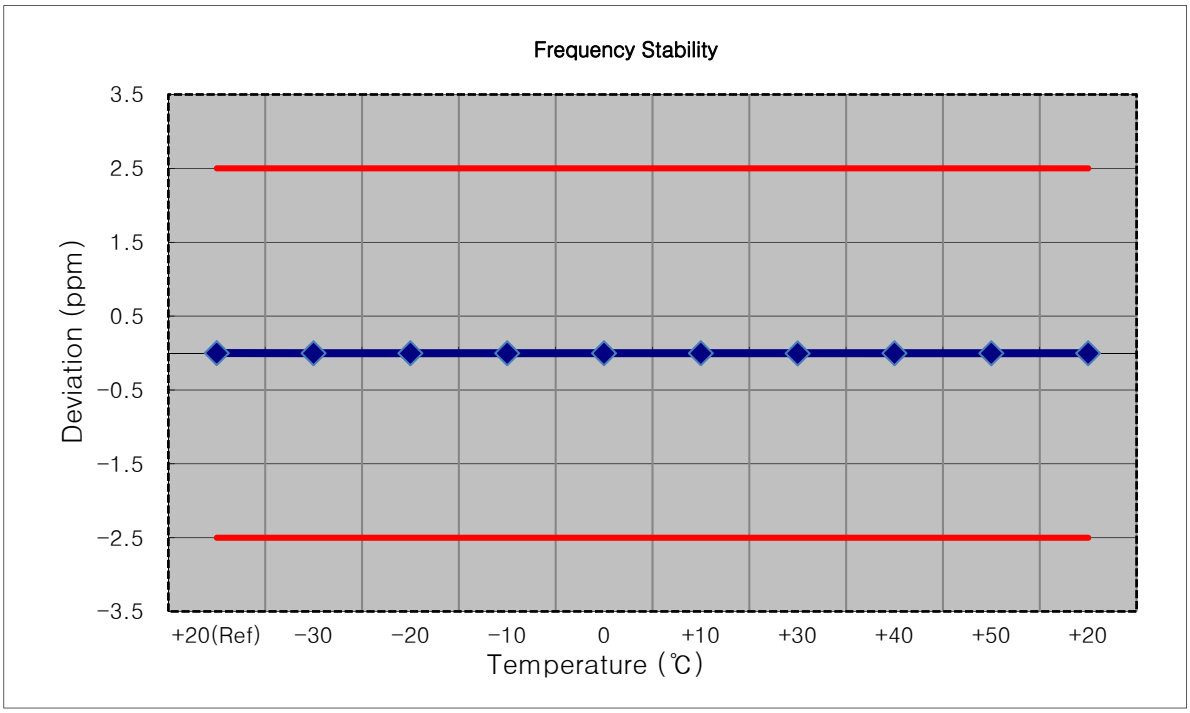
▣ OPERATING FREQUENCY: 836,600,000 Hz

▣ CHANNEL: 4183

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%		+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%	3.80	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

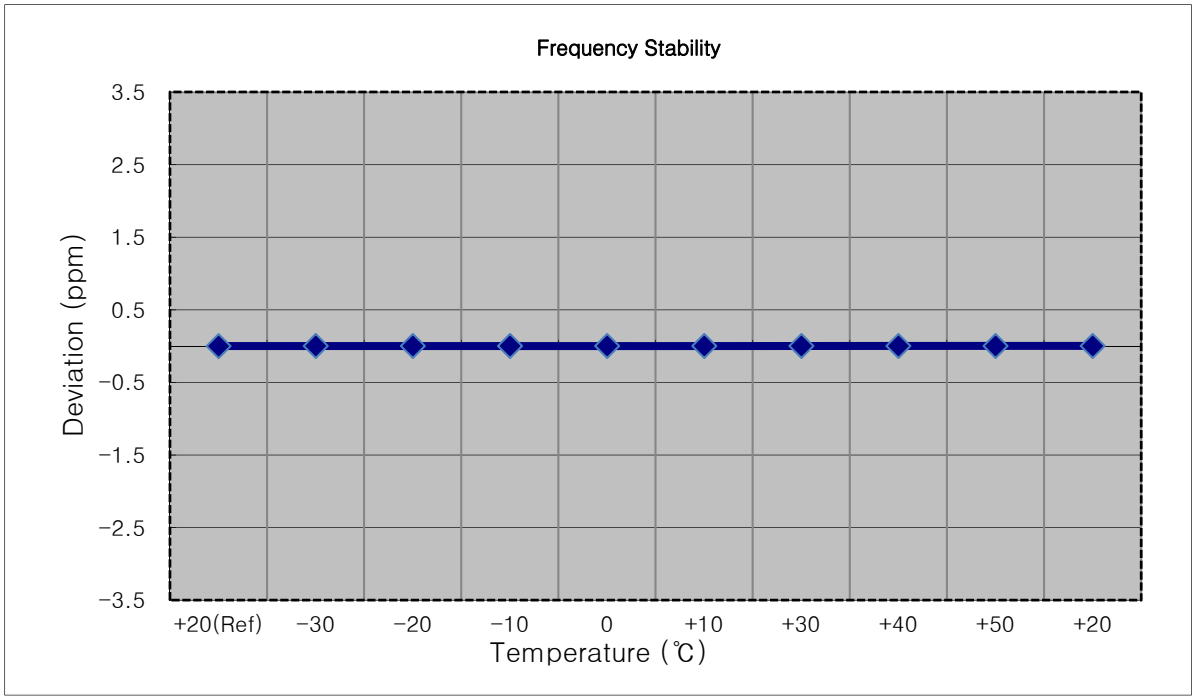
▣ OPERATING FREQUENCY: 1,852,400,000 Hz

▣ CHANNEL: 9262

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

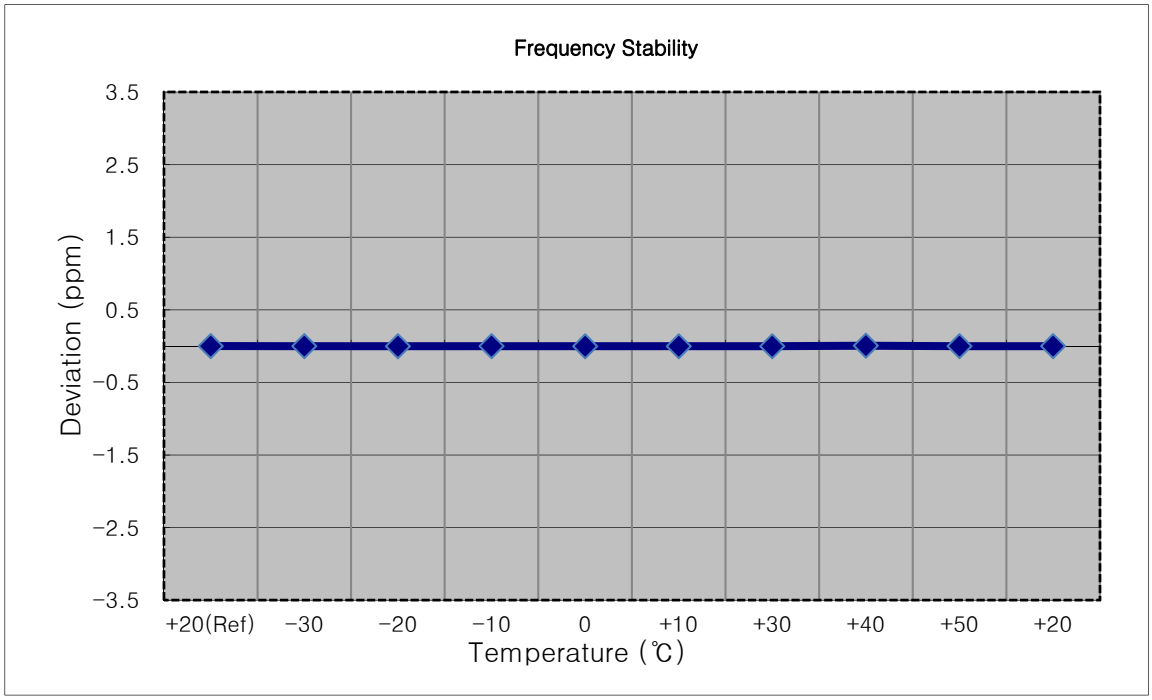
▣ OPERATING FREQUENCY: 1,880,000,000 Hz

▣ CHANNEL: 9400

▣ REFERENCE VOLTAGE: 3.80 VDC

▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

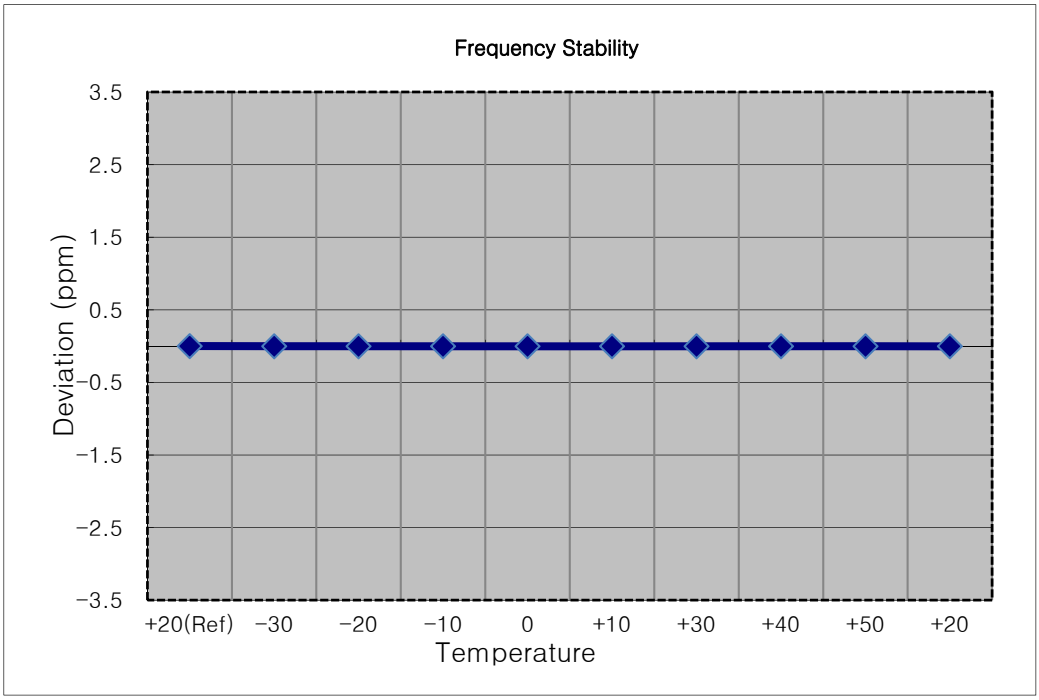
▣ OPERATING FREQUENCY: 1,907,600,000 Hz

▣ CHANNEL: 9538

▣ REFERENCE VOLTAGE: 3.80 VDC

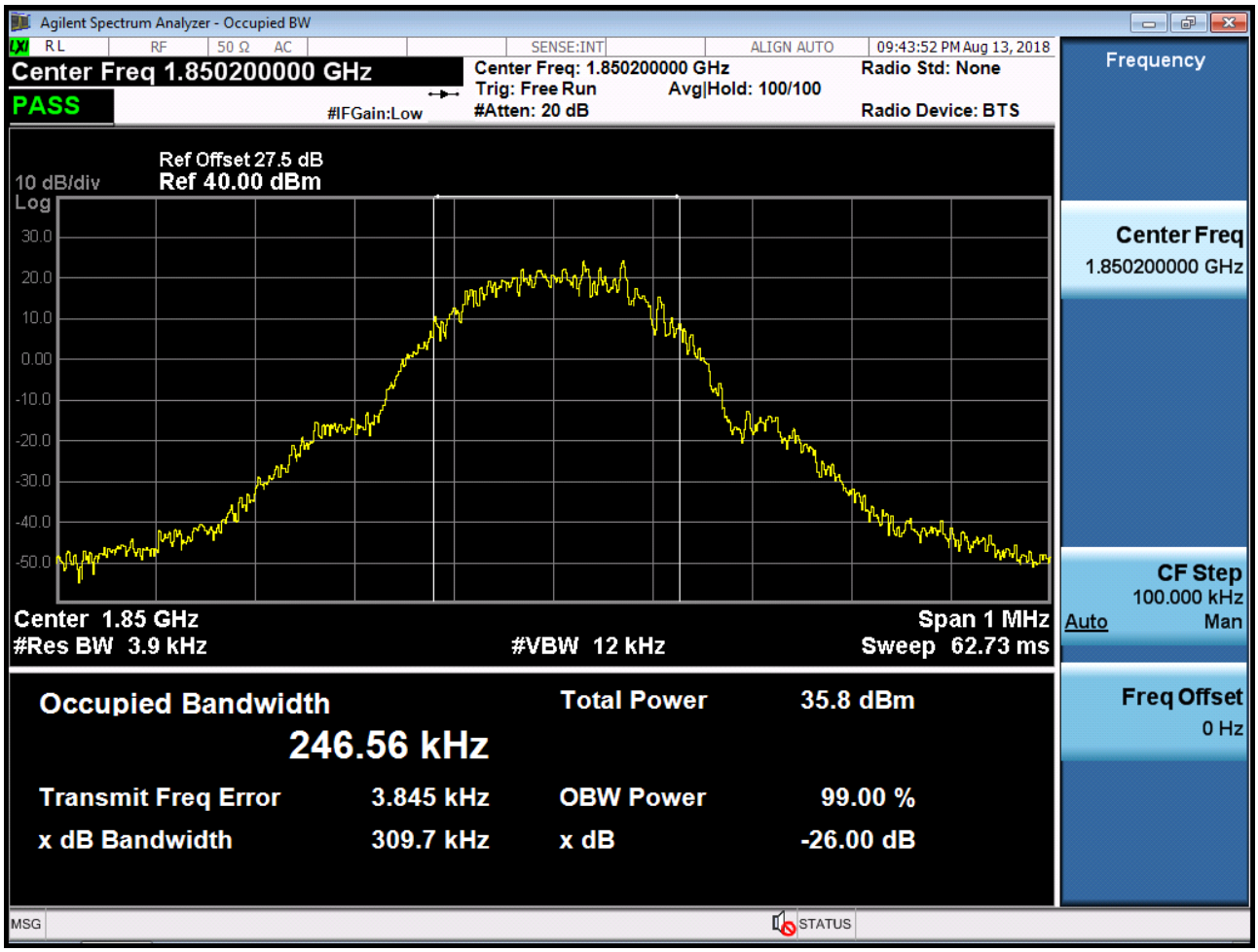
▣ DEVIATION LIMIT: Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (℃)	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

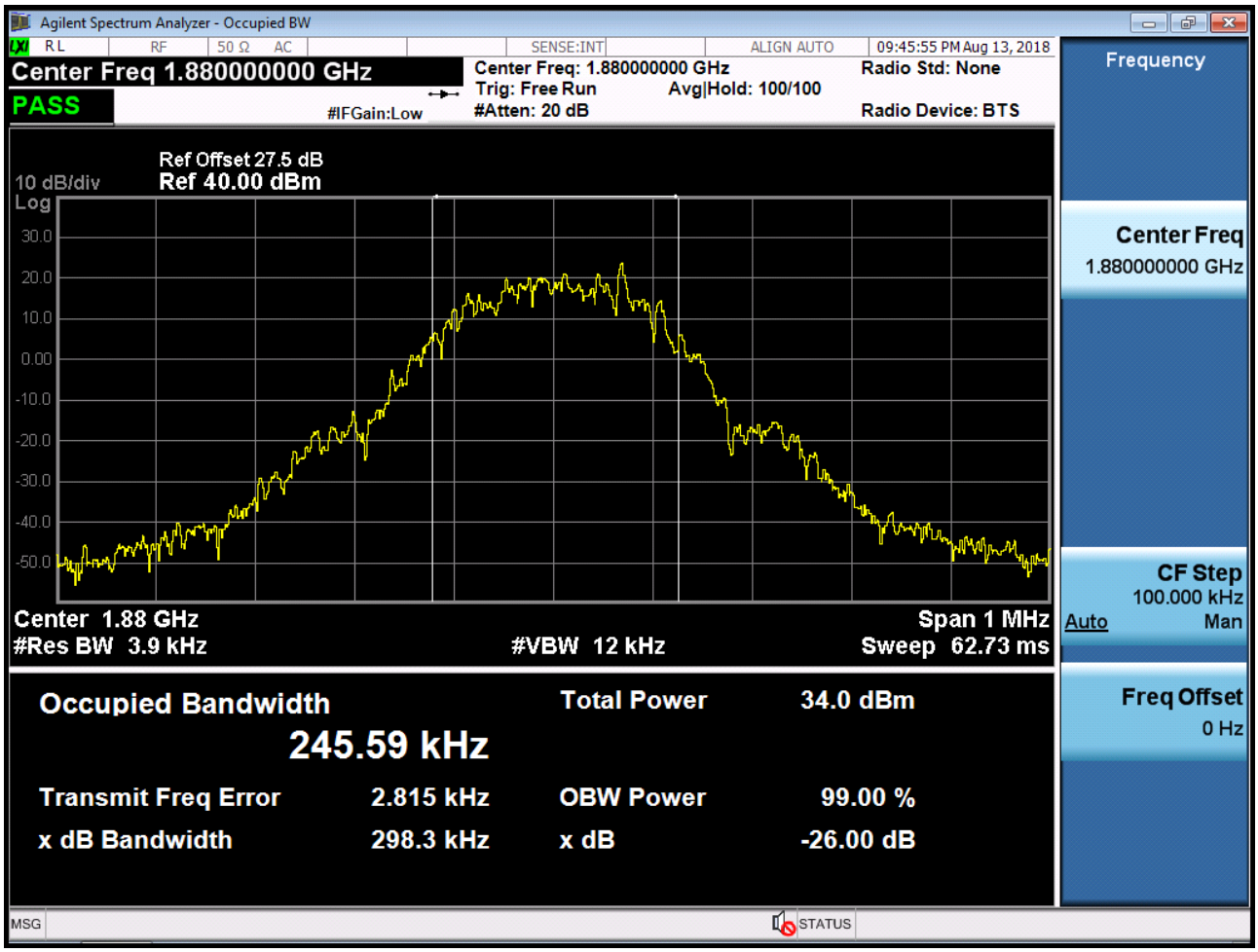


9. TEST PLOTS

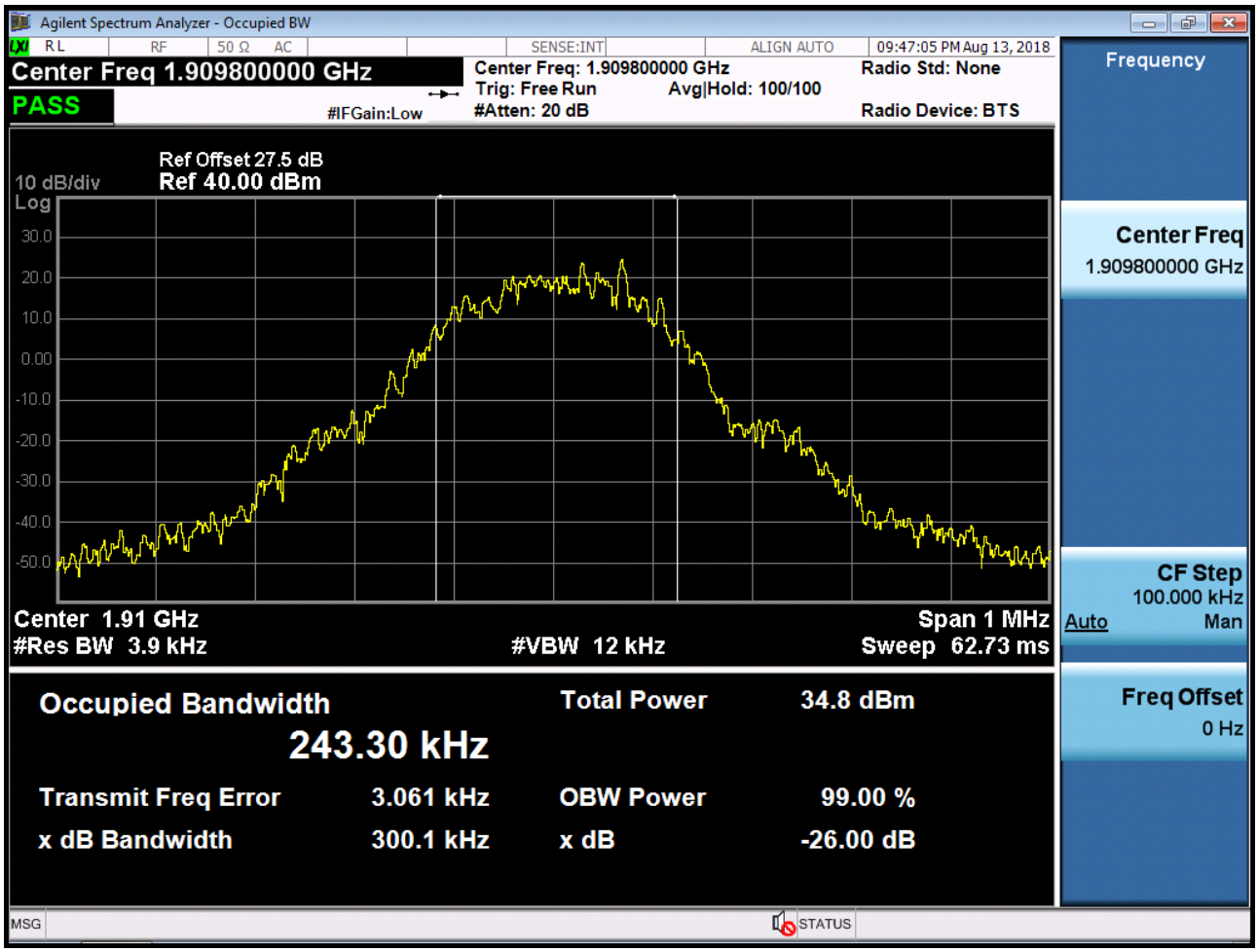
■ GSM1900 MODE (512 CH.) Occupied Bandwidth



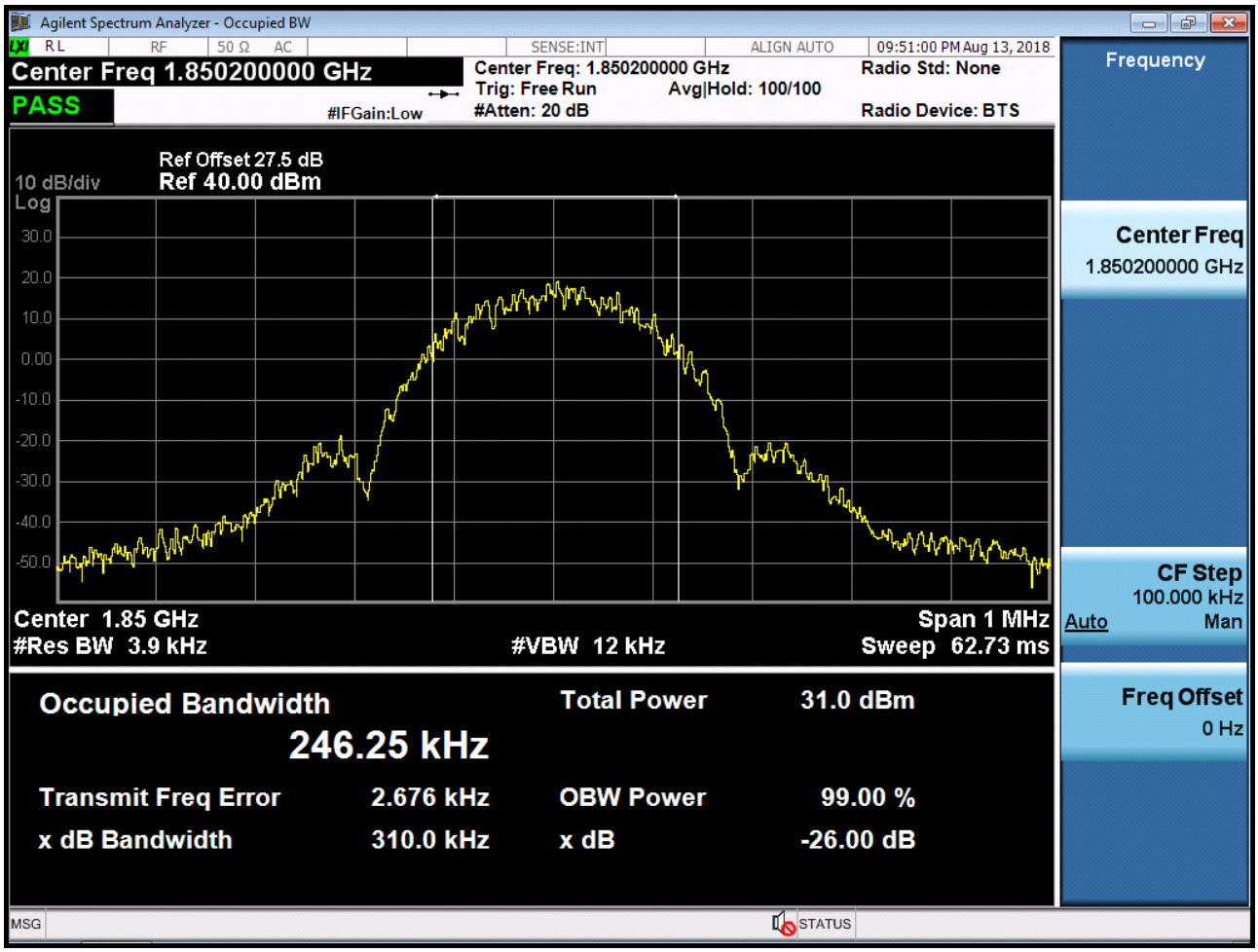
■ GSM1900 MODE (661 CH.) Occupied Bandwidth



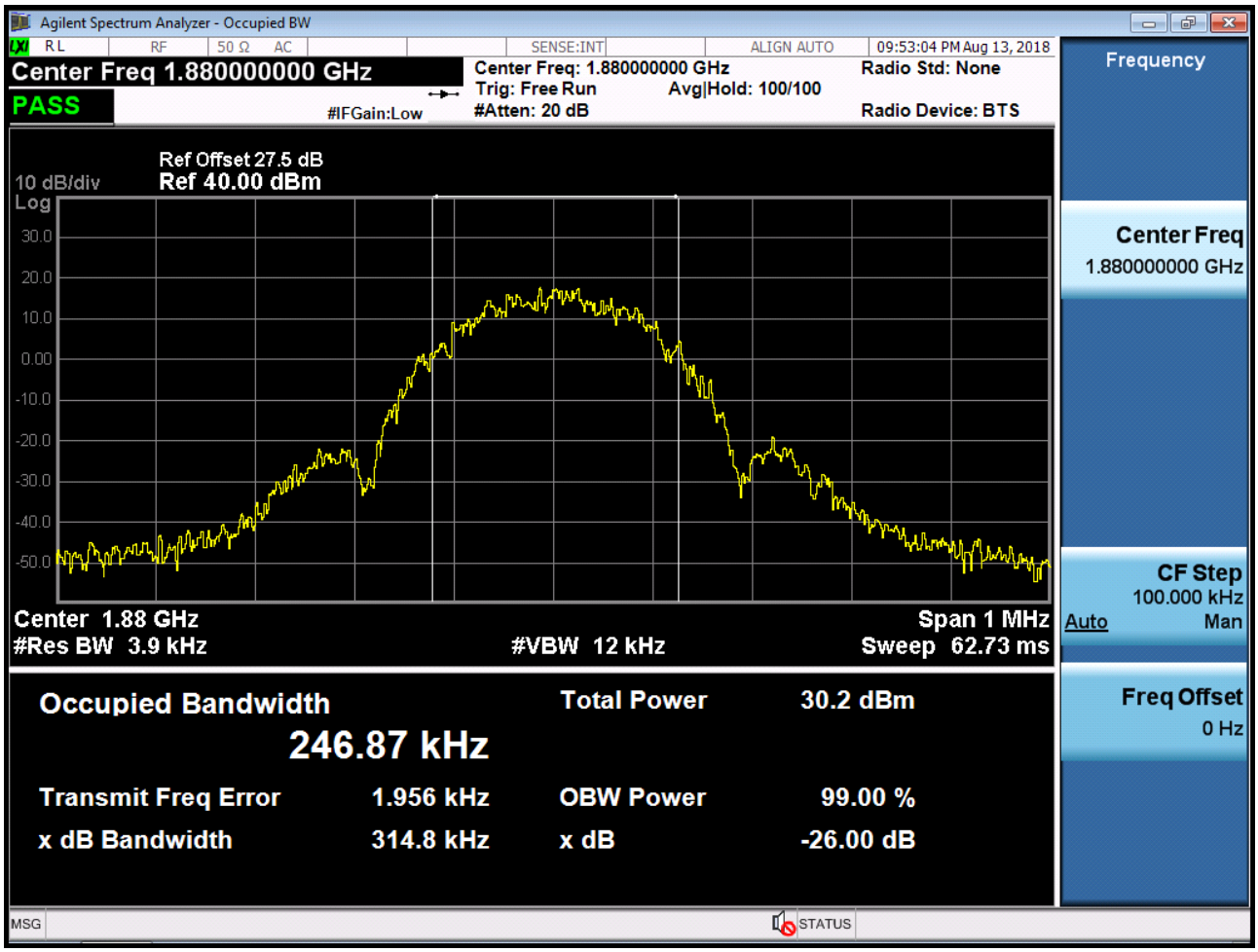
■ GSM1900 MODE (810 CH.) Occupied Bandwidth



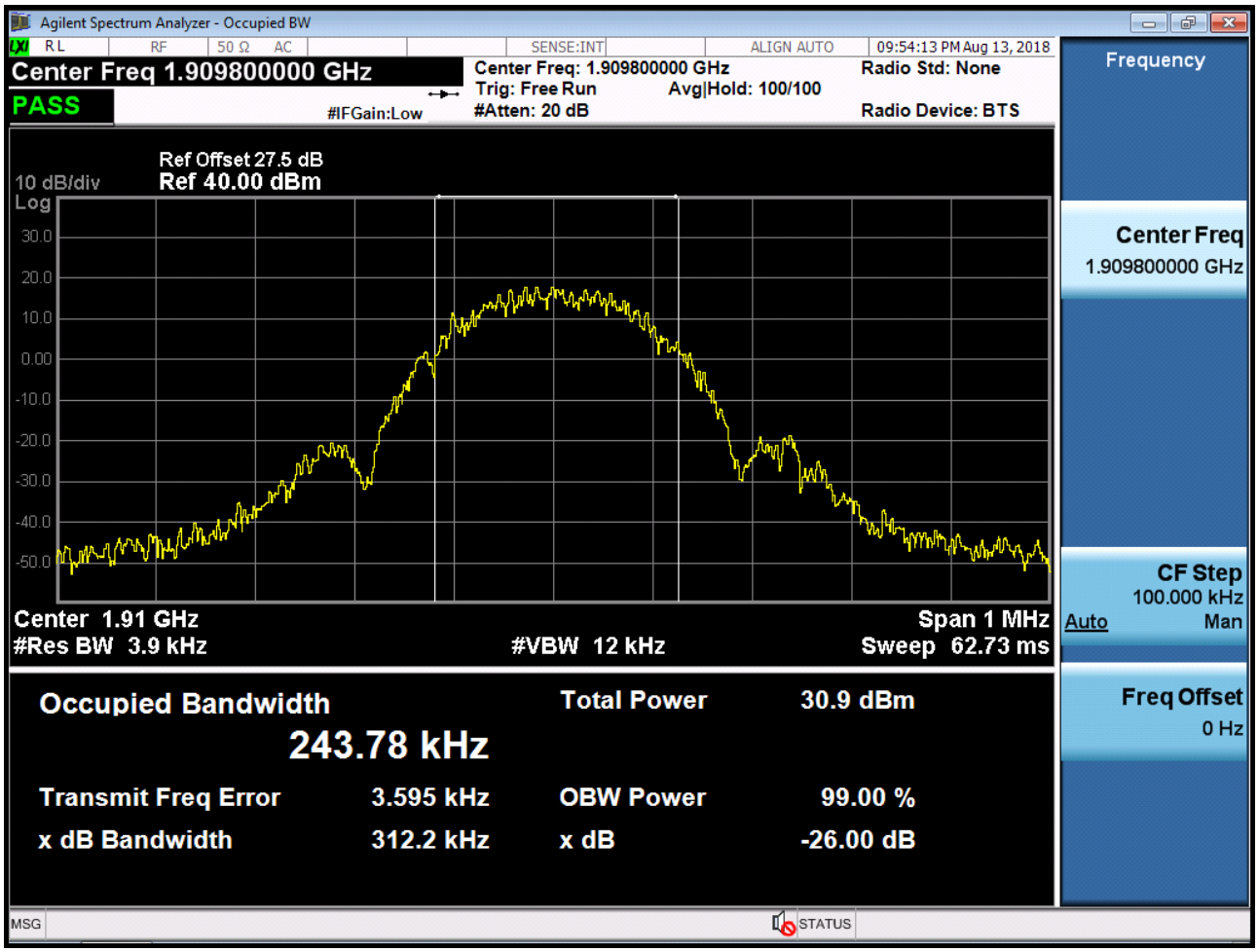
■ GSM1900 EDGE (512 CH.) Occupied Bandwidth



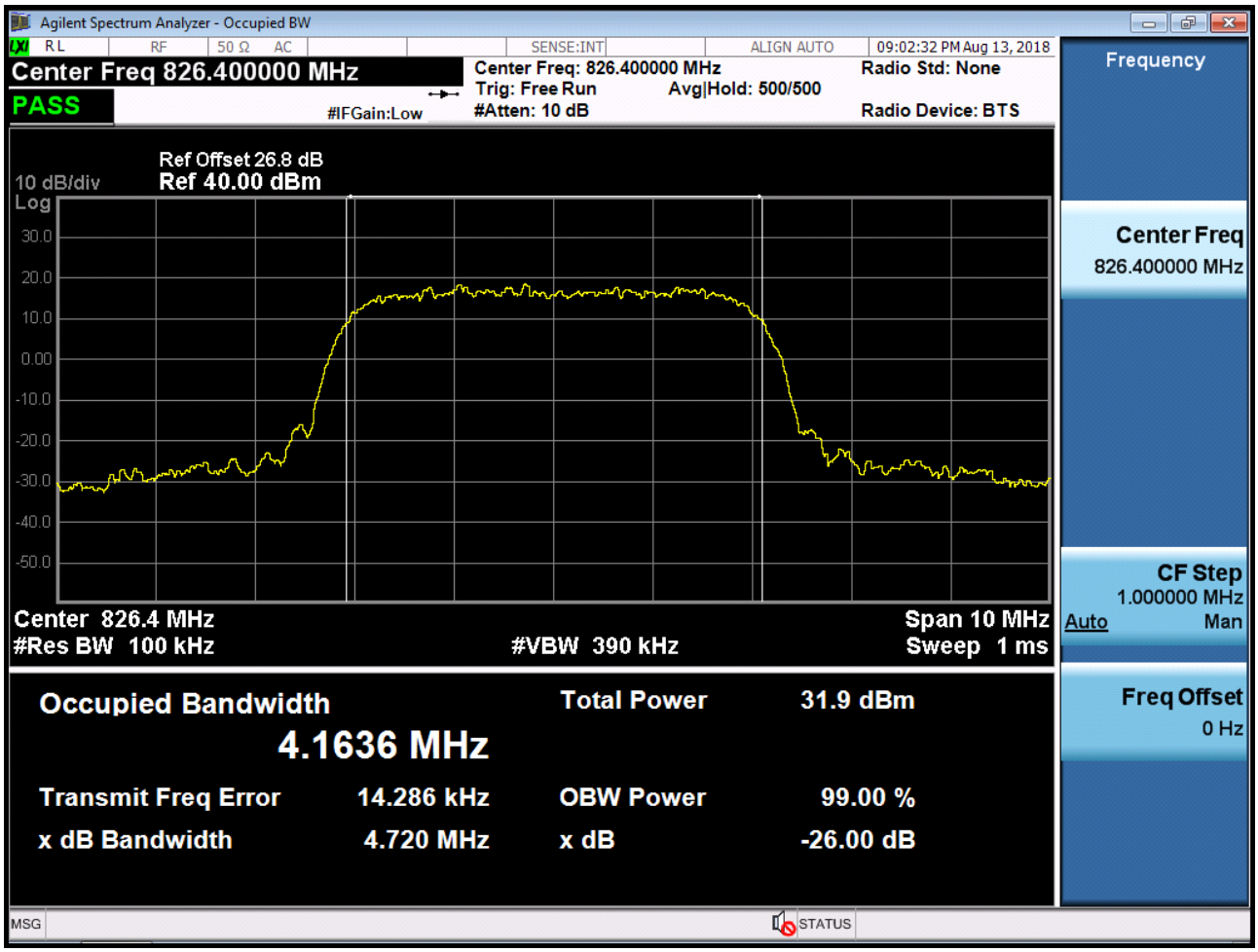
■ GSM1900 EDGE (661 CH.) Occupied Bandwidth



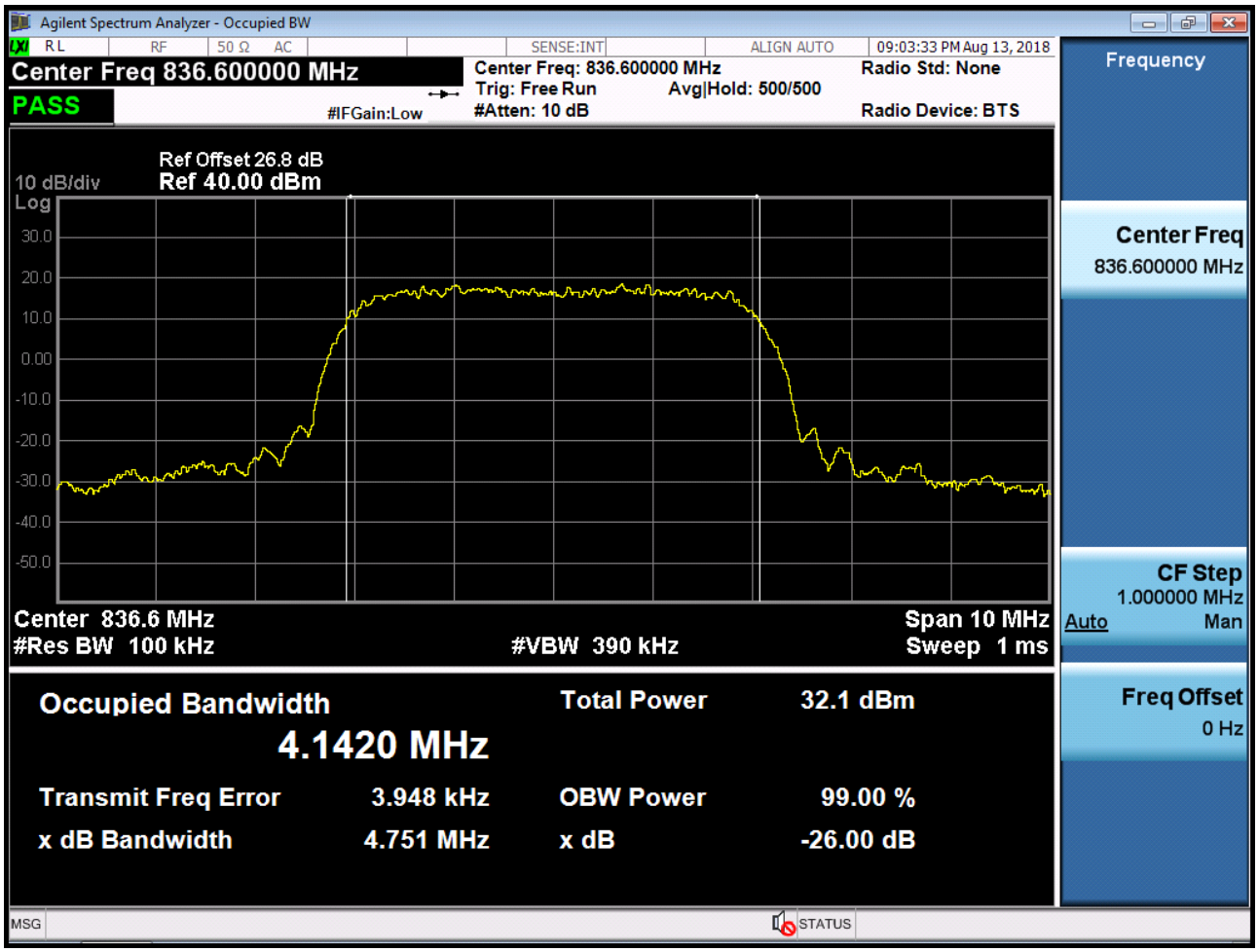
■ GSM1900 EDGE (810 CH.) Occupied Bandwidth



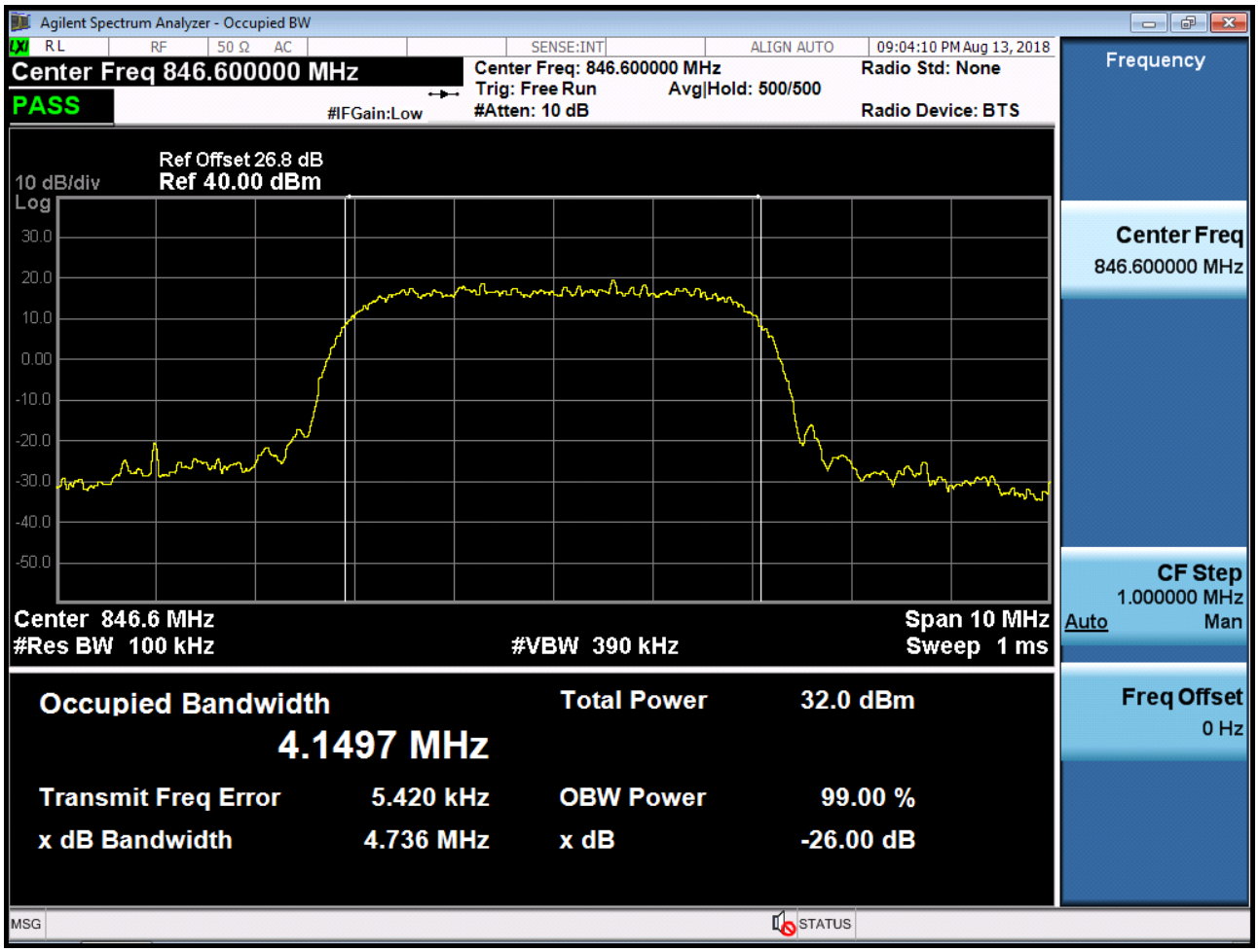
■ WCDMA850 MODE (4132 CH.) Occupied Bandwidth



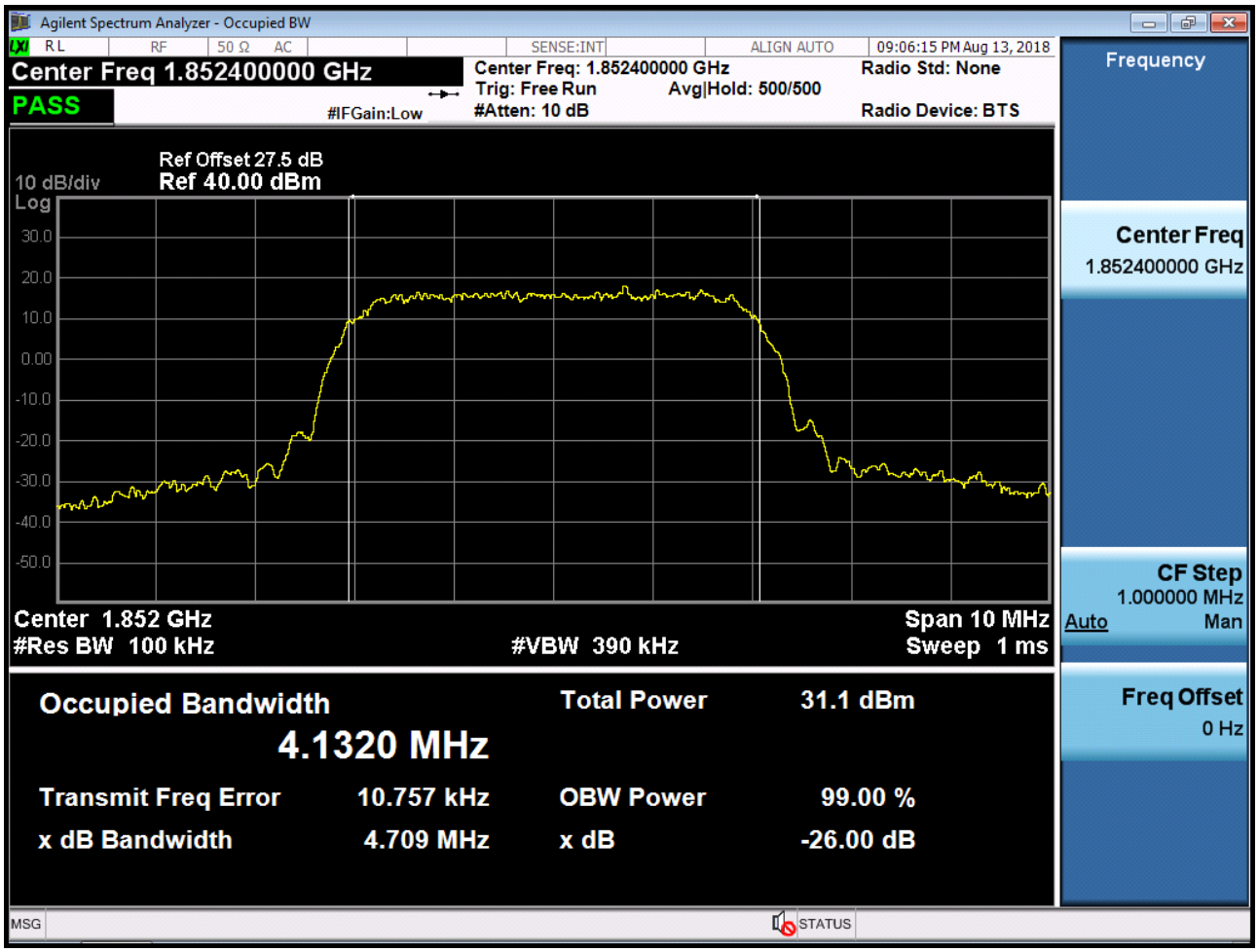
■ WCDMA850 MODE (4183 CH.) Occupied Bandwidth



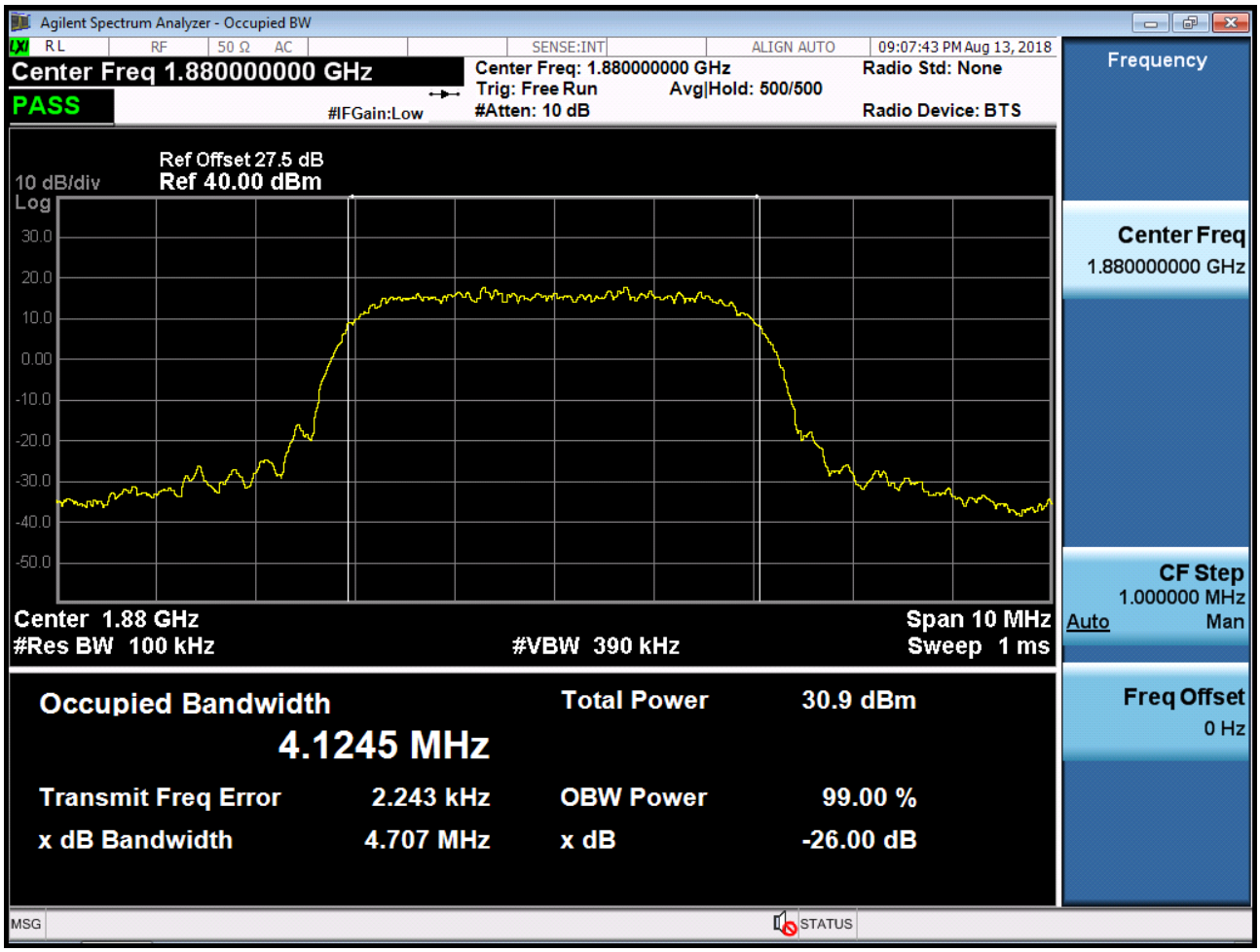
■ WCDMA850MODE (4233 CH.) Occupied Bandwidth



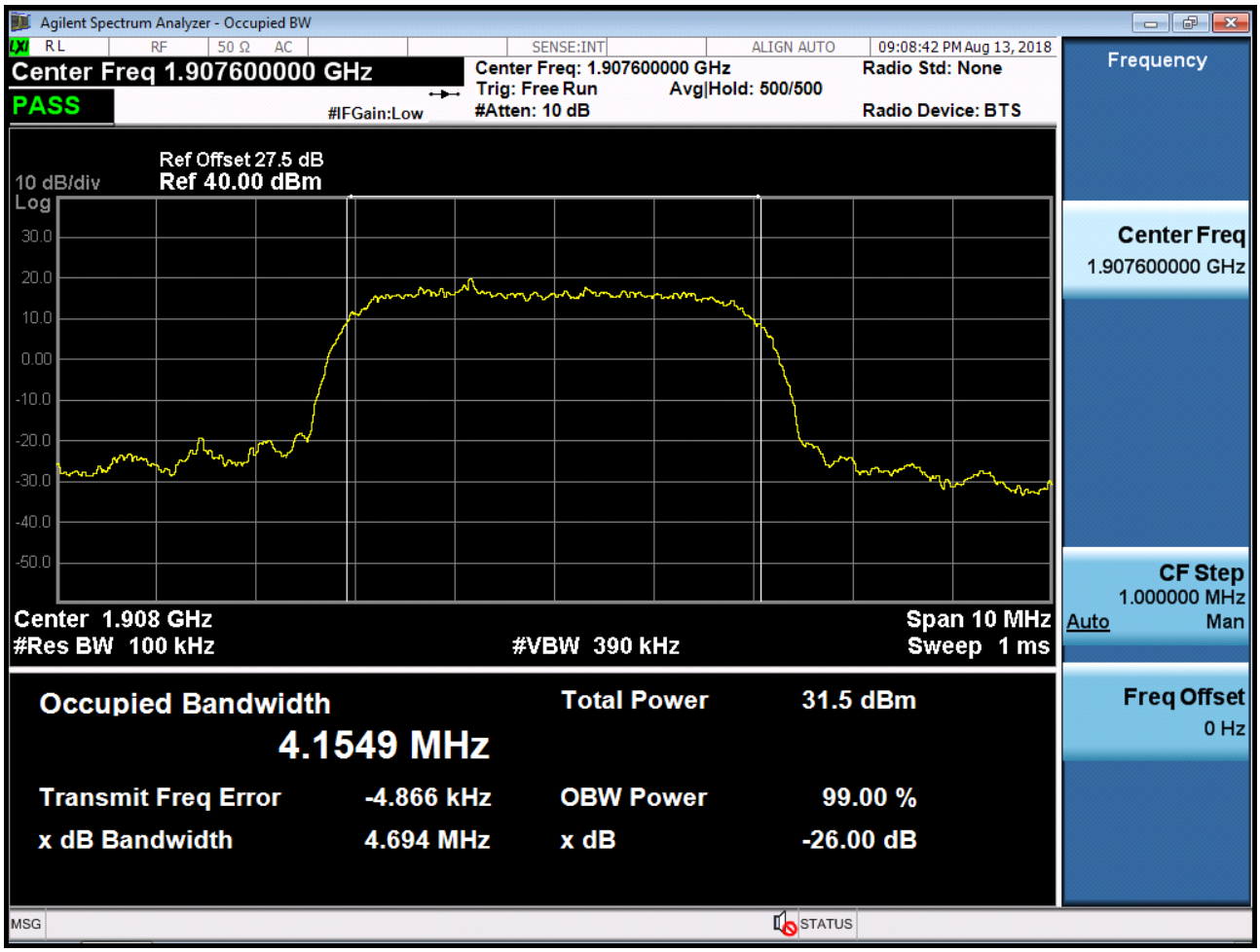
■ WCDMA1900 MODE (9262 CH.) Occupied Bandwidth



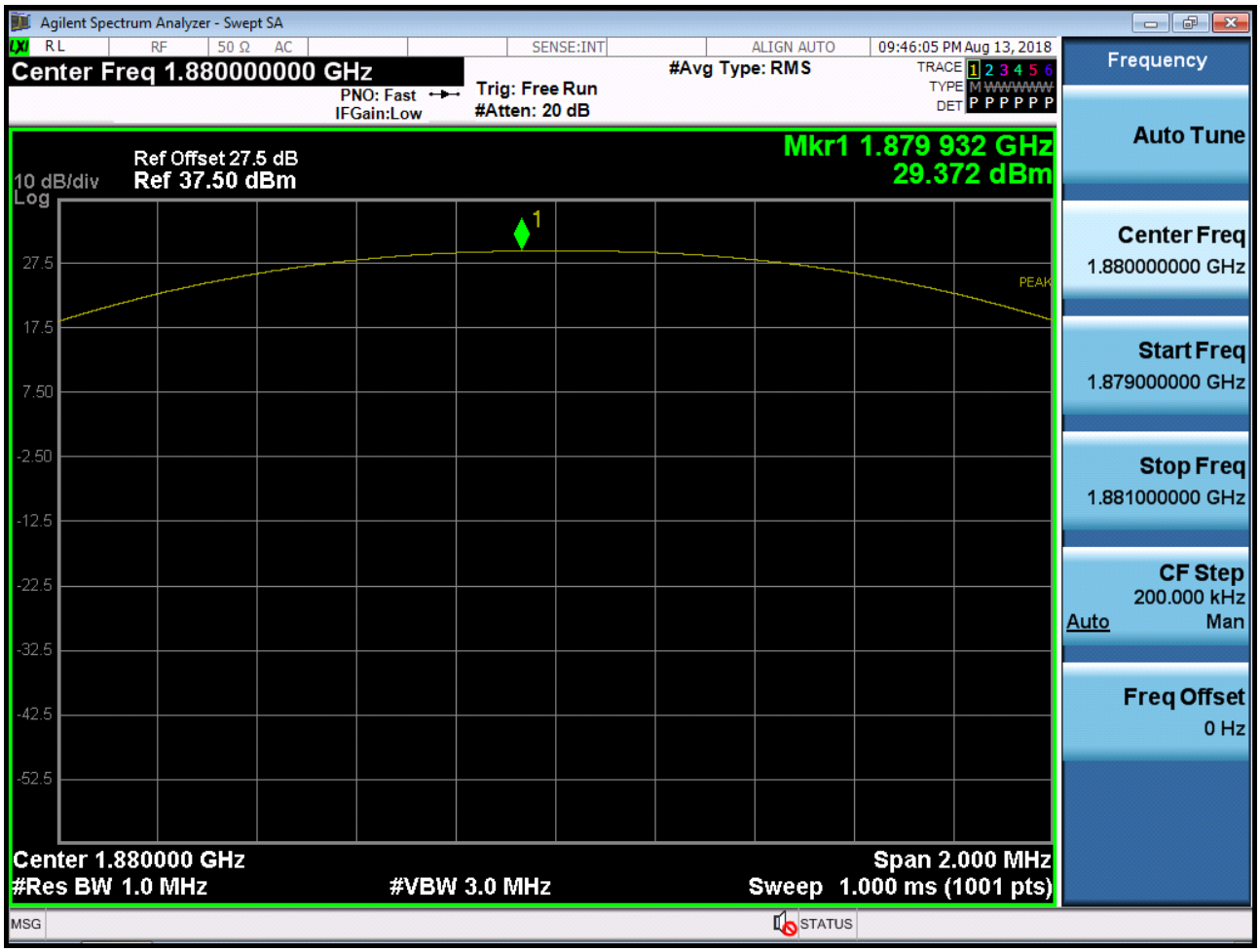
■ WCDMA1900 MODE (9400 CH.) Occupied Bandwidth



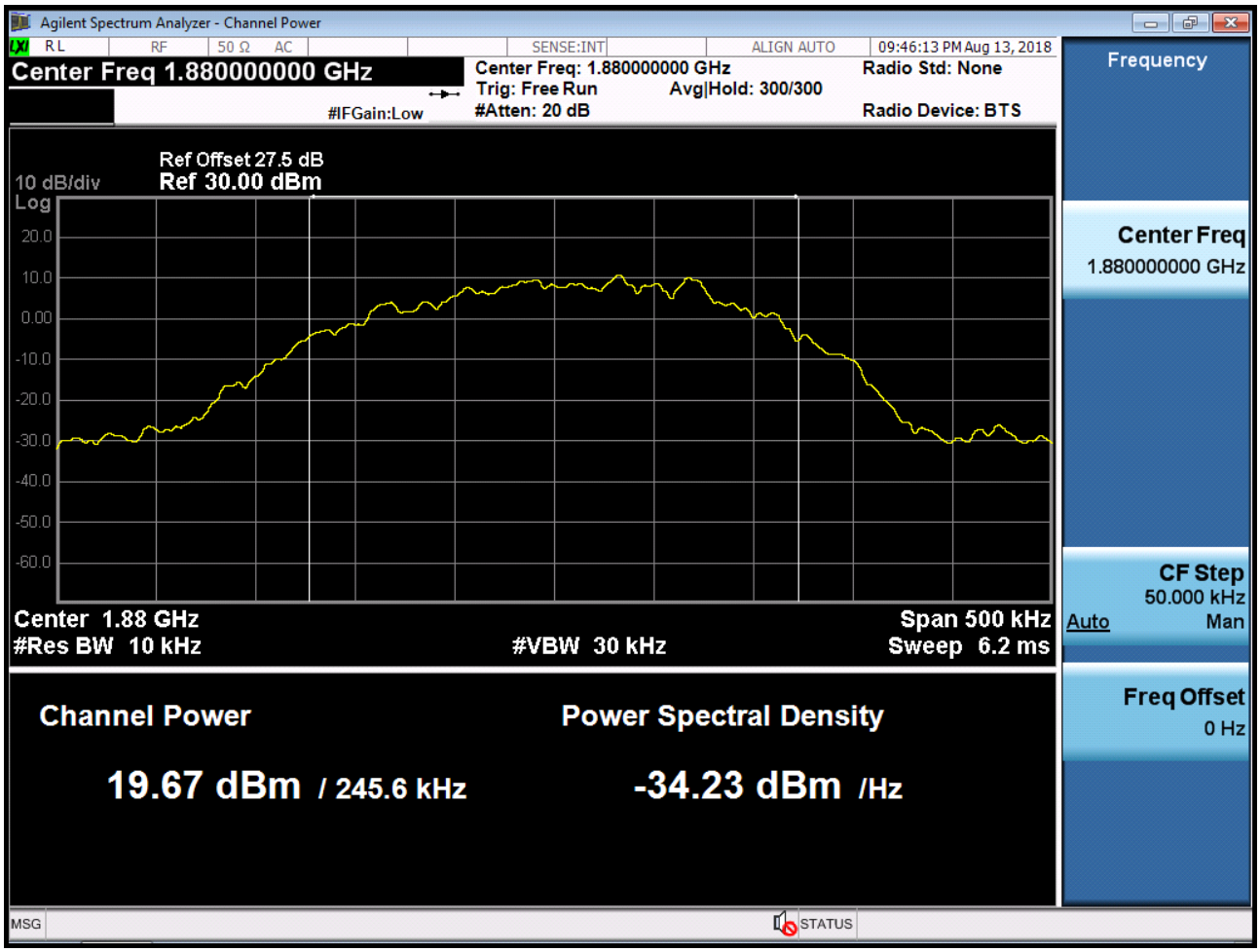
■ WCDMA1900 MODE (9538 CH.) Occupied Bandwidth



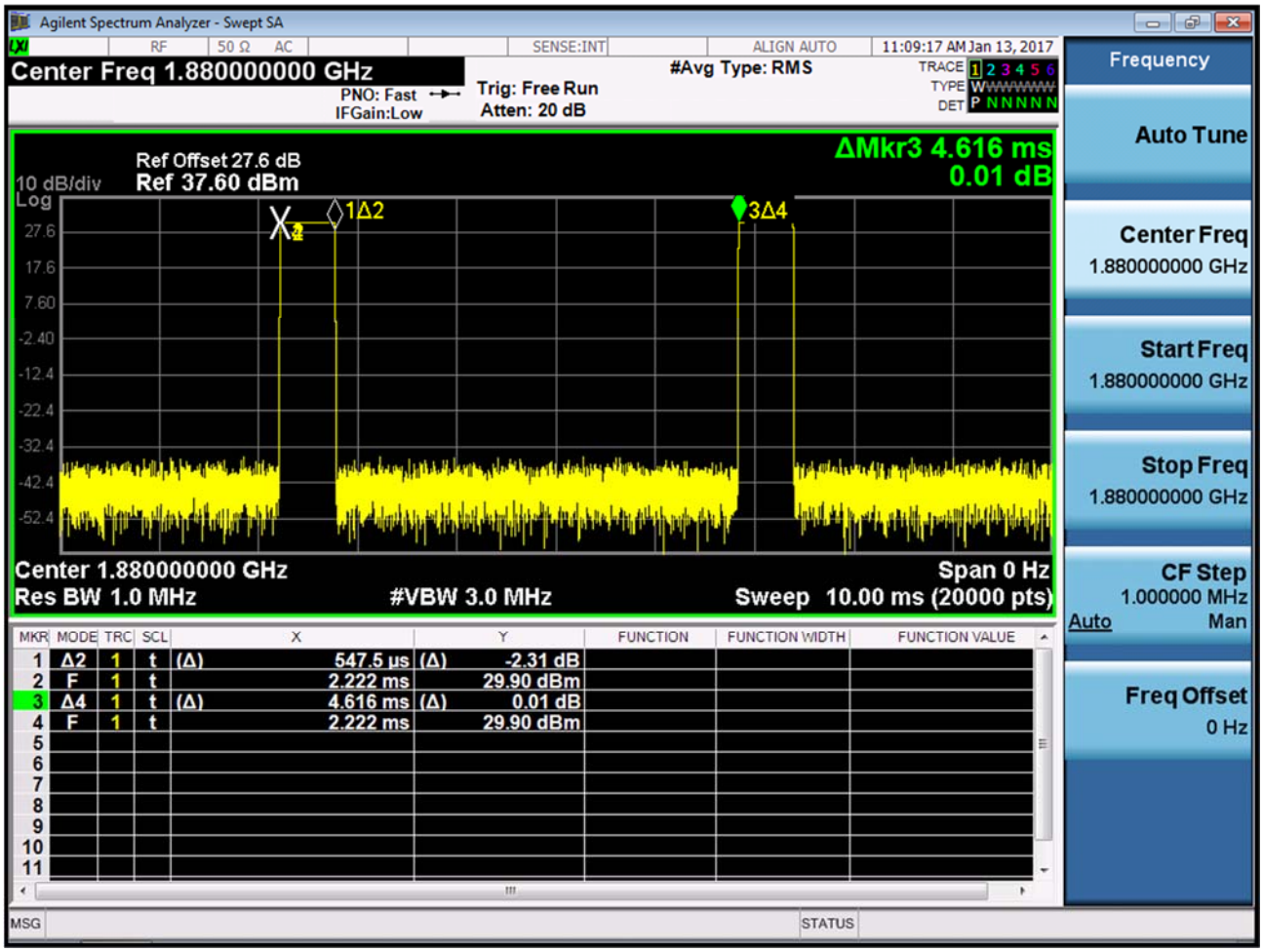
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Pk}



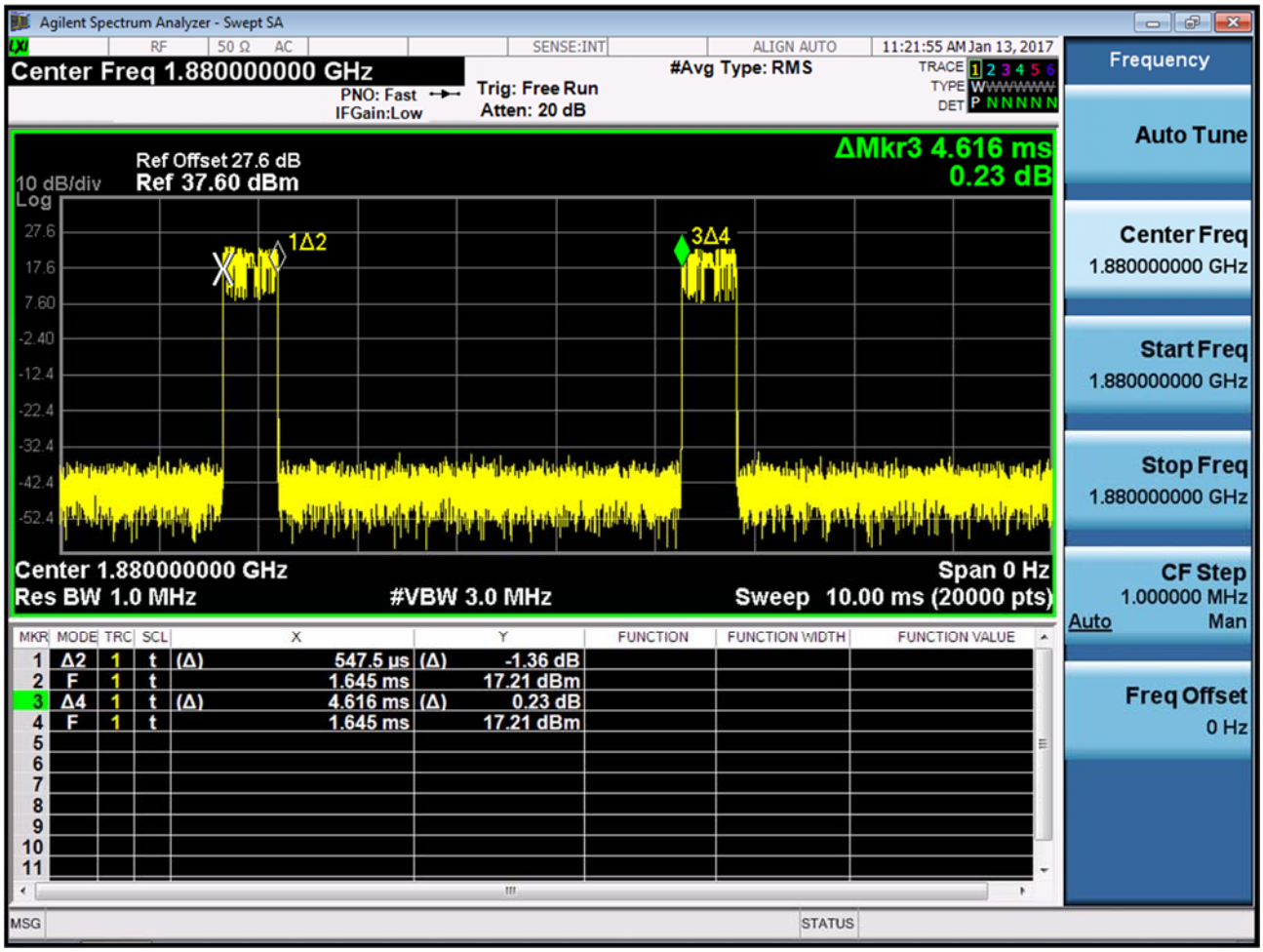
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Avg}



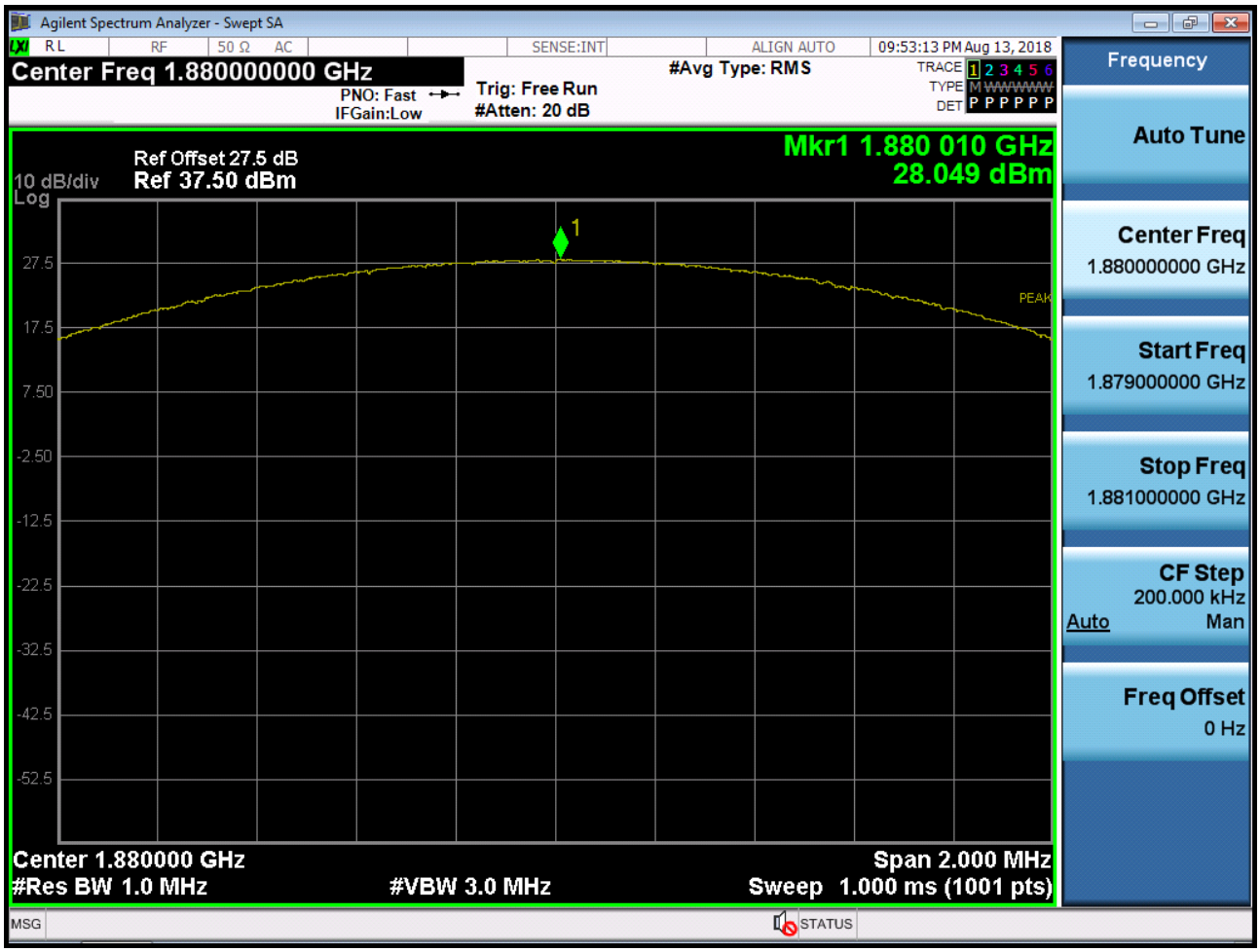
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio Duty



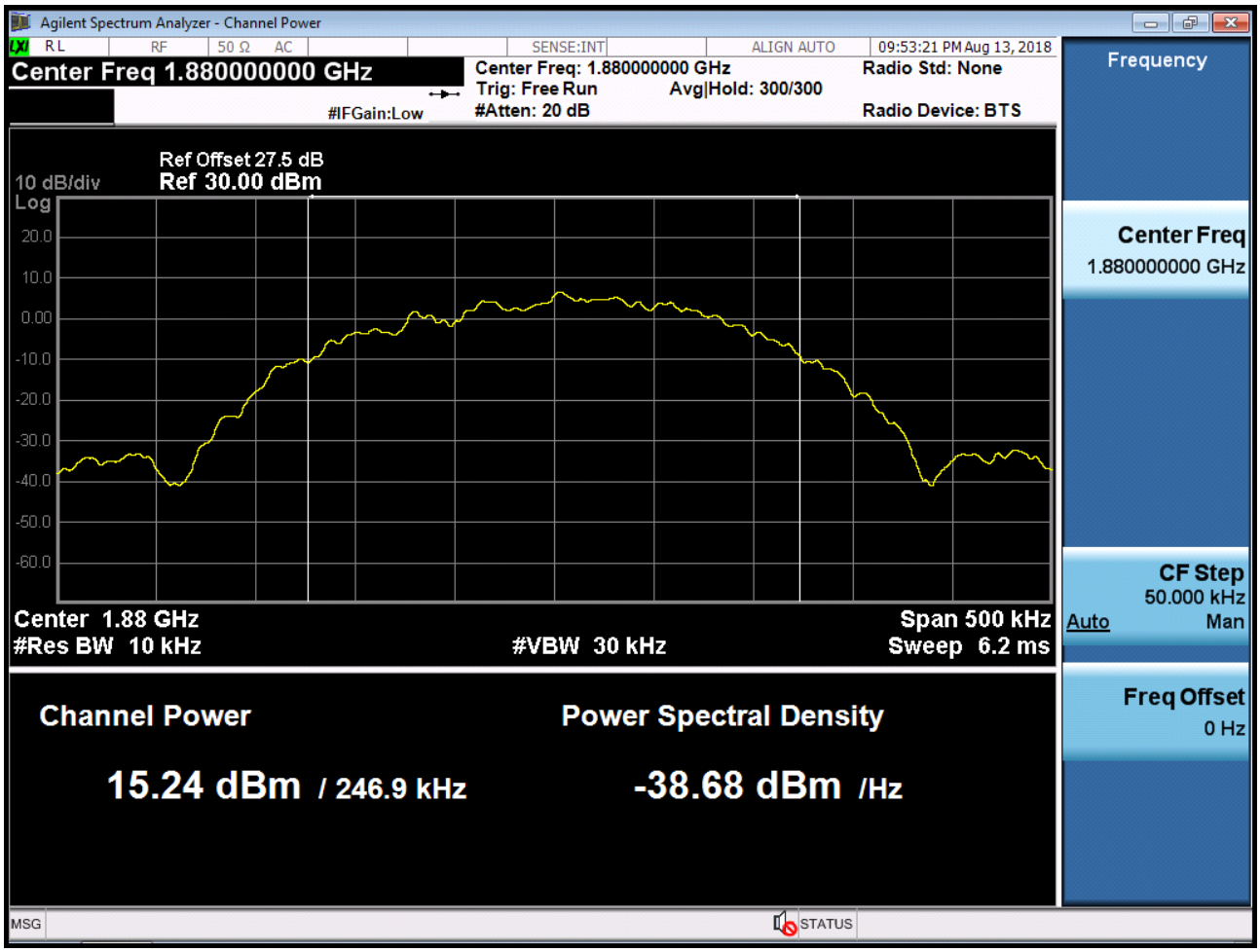
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio Duty



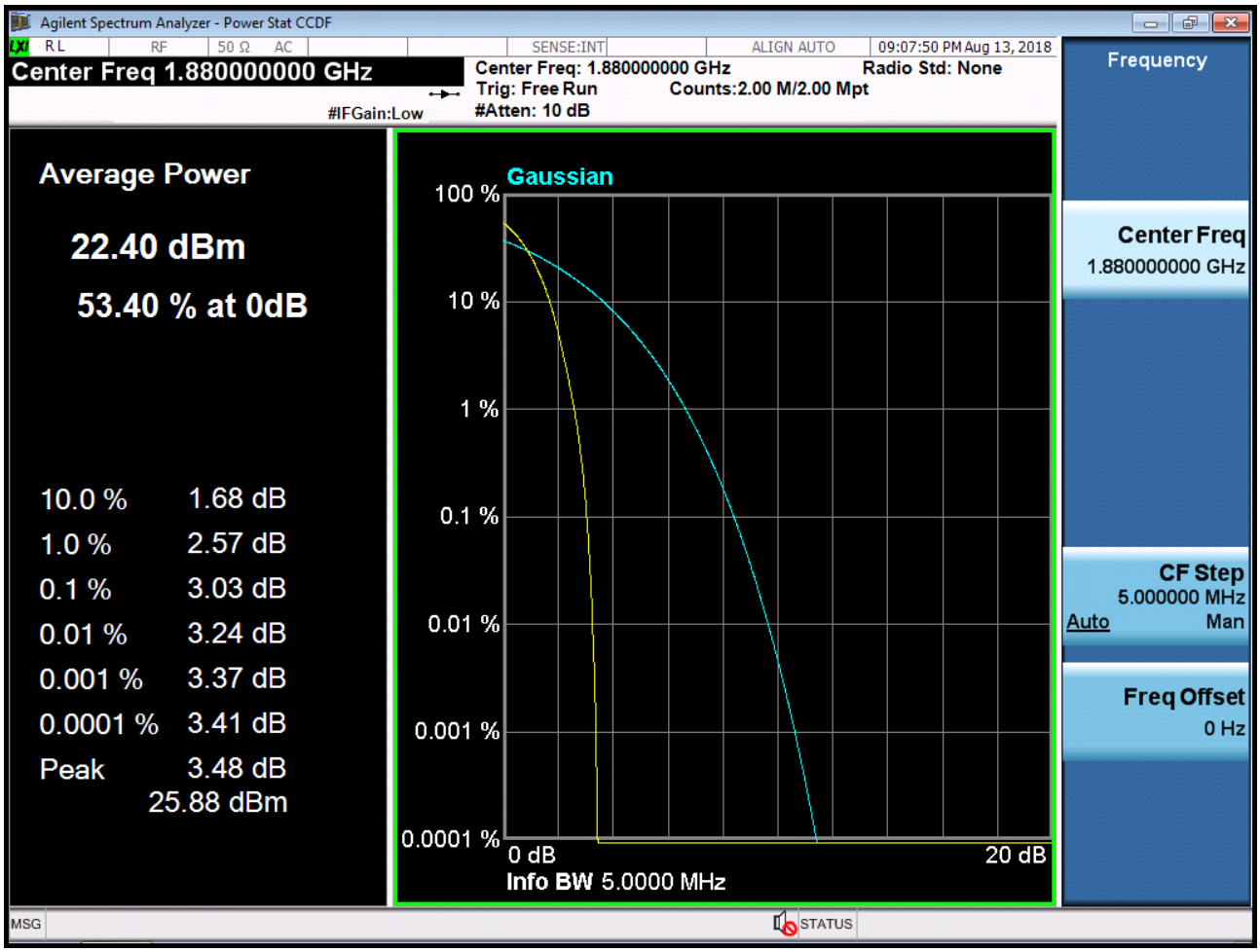
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{Pk}



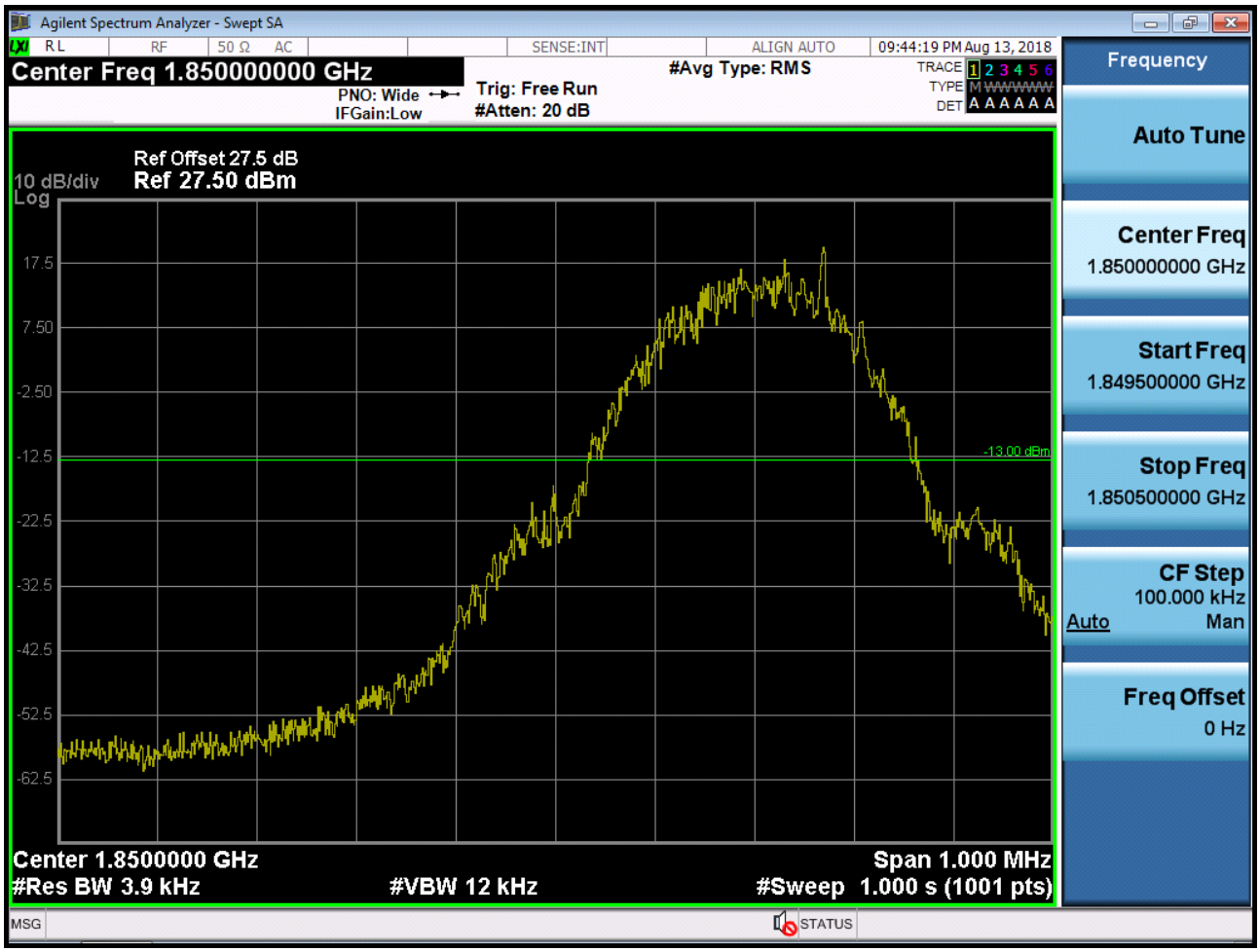
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{Avg}



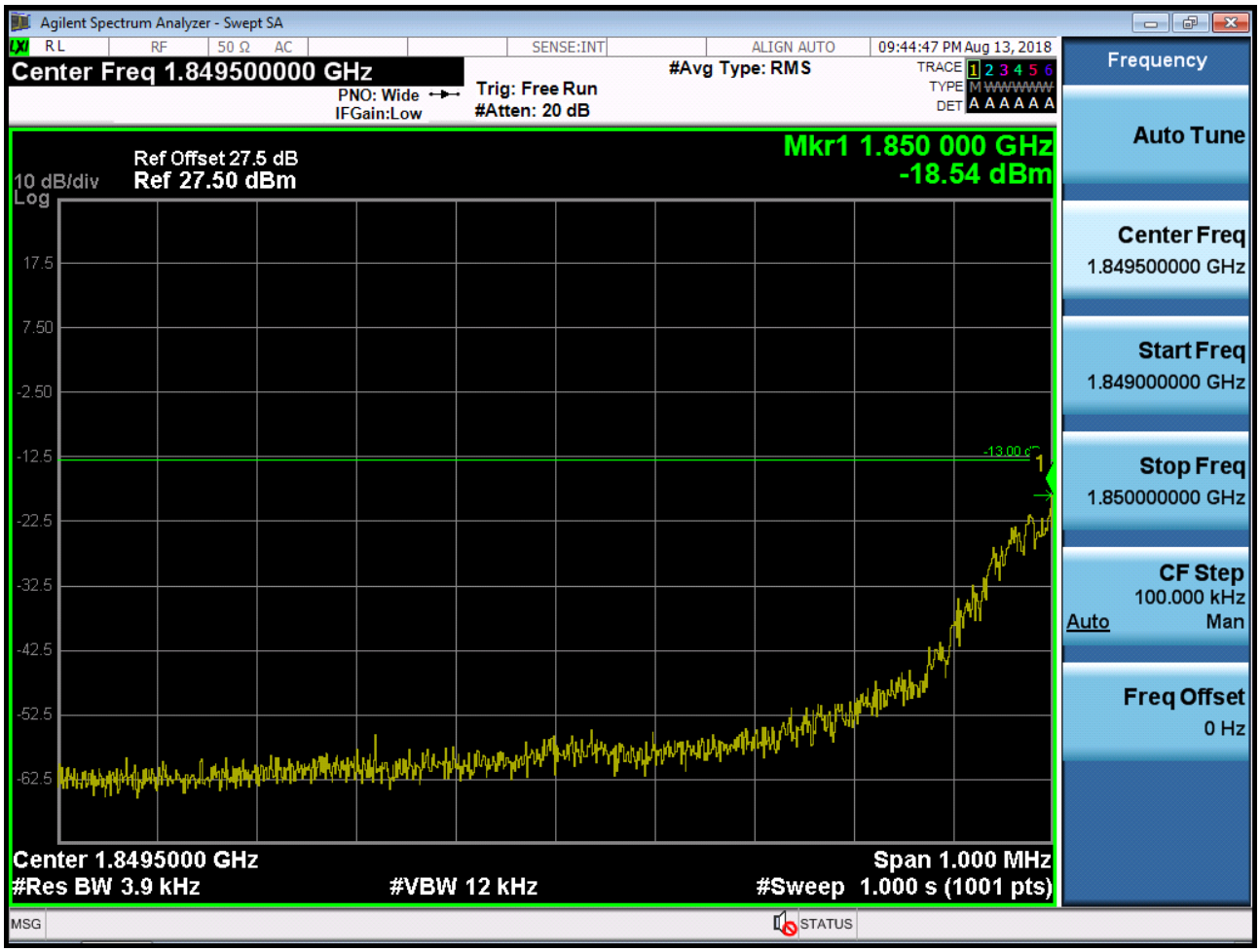
■ WCDMA1900 MODE (9400 CH.) Peak-to-Average Ratio



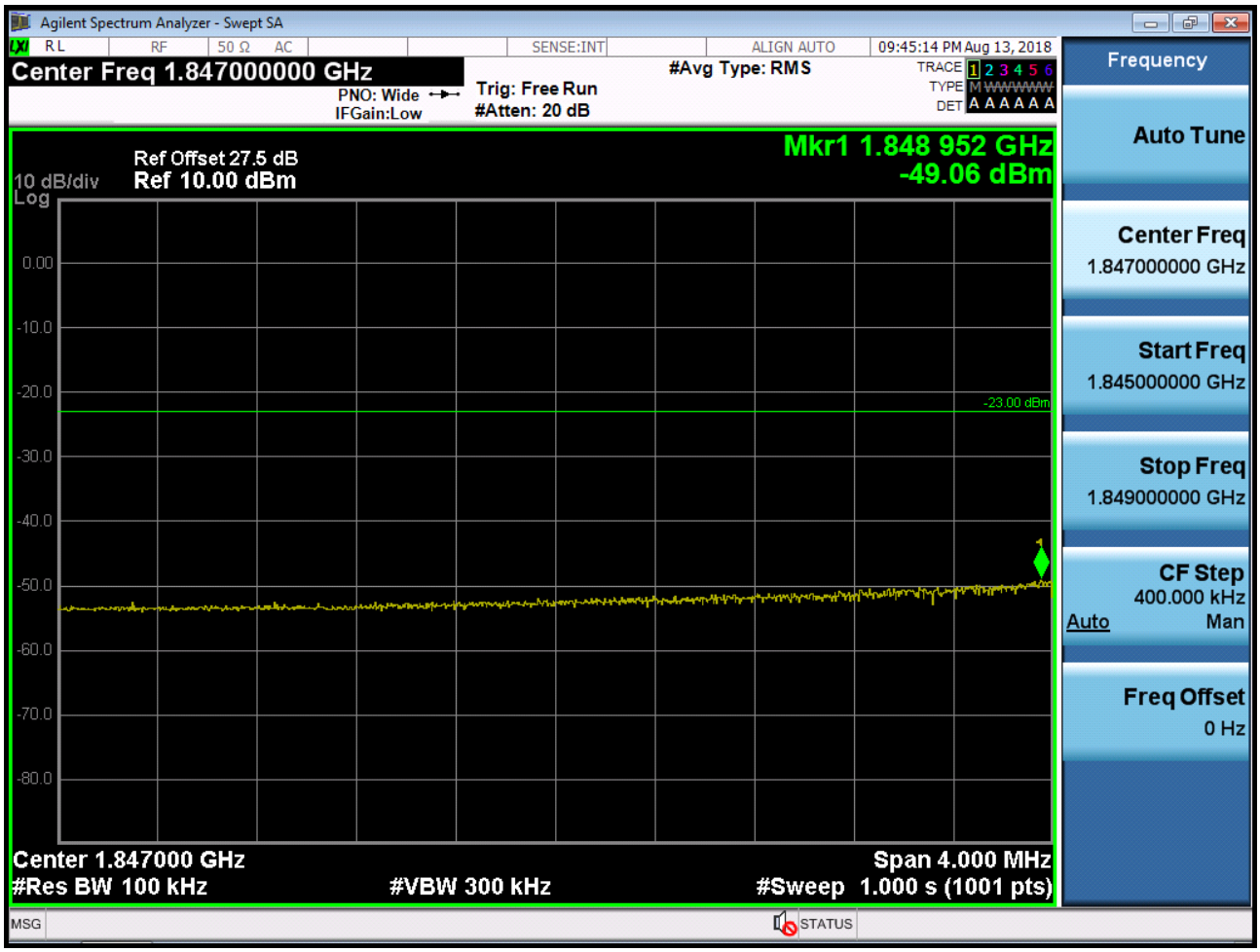
■ GSM1900 MODE (512 CH.) Block Edge 1



■ GSM1900 MODE (512 CH.) Block Edge 2



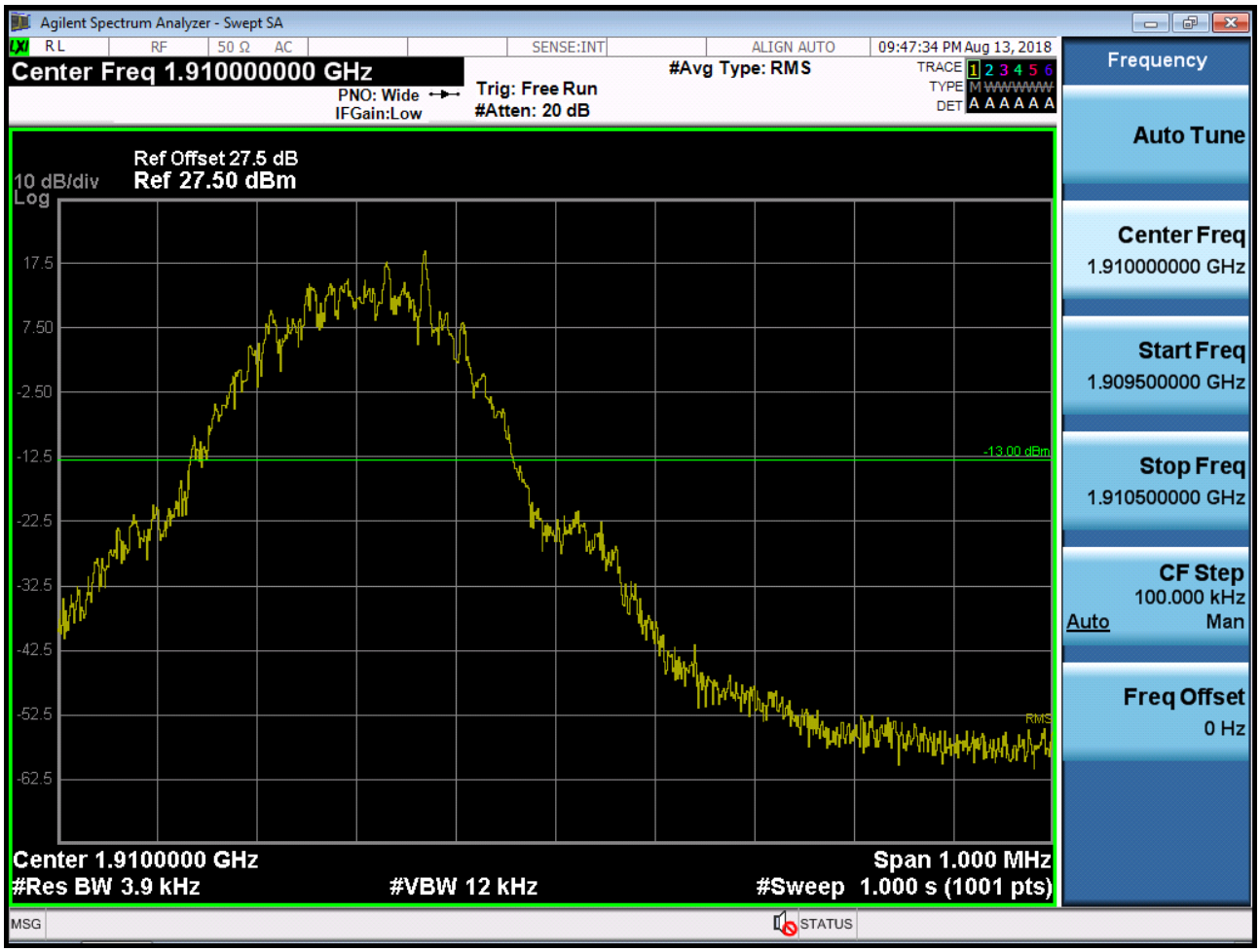
■ GSM1900 MODE (512 CH.) Block Edge 3



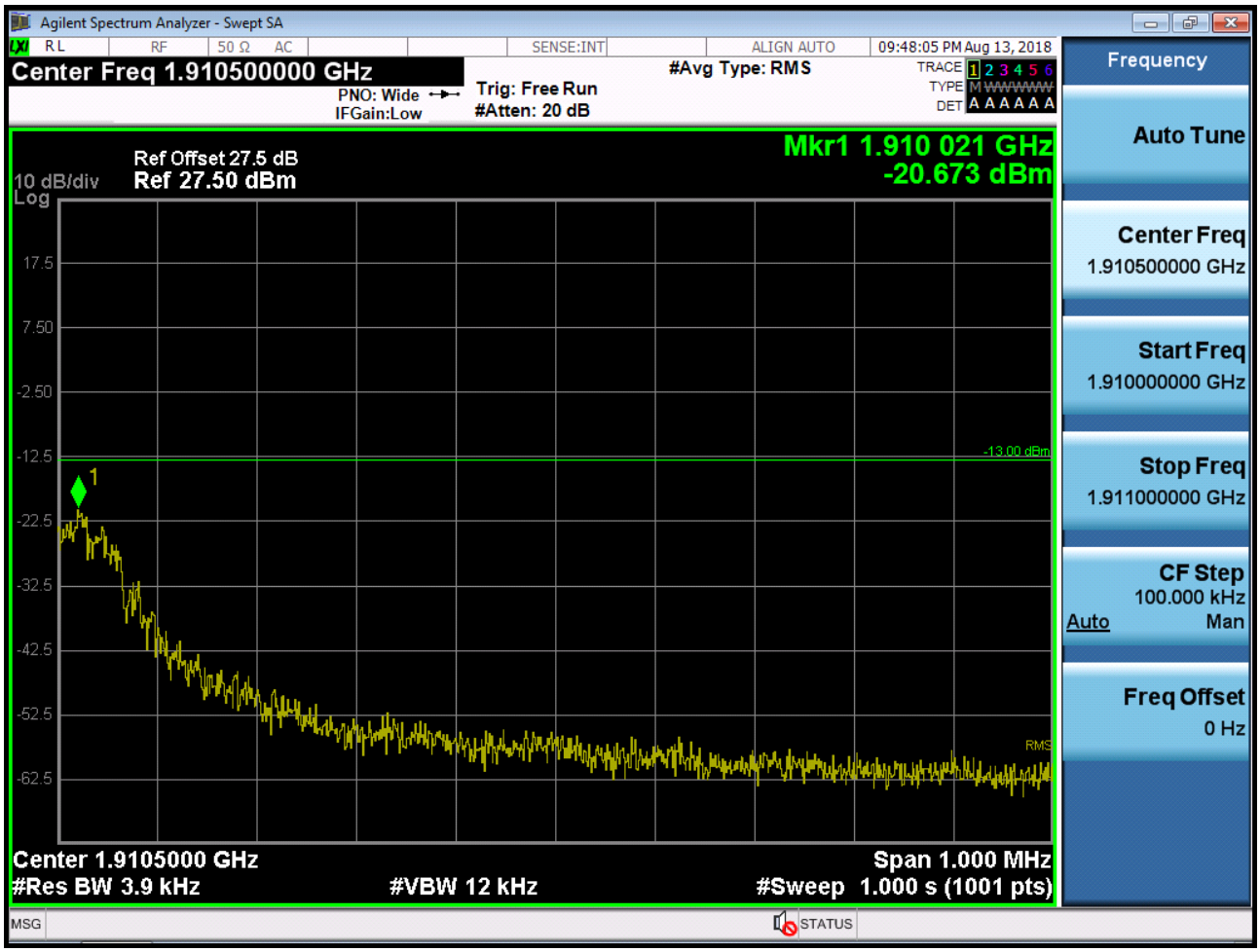
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10*log(1 MHz/100 kHz) dB = -49.06 dBm + 10 dB = **-39.06 dBm**

■ GSM1900 MODE (810 CH.) Block Edge 1



■ GSM1900 MODE (810 CH.) Block Edge 2

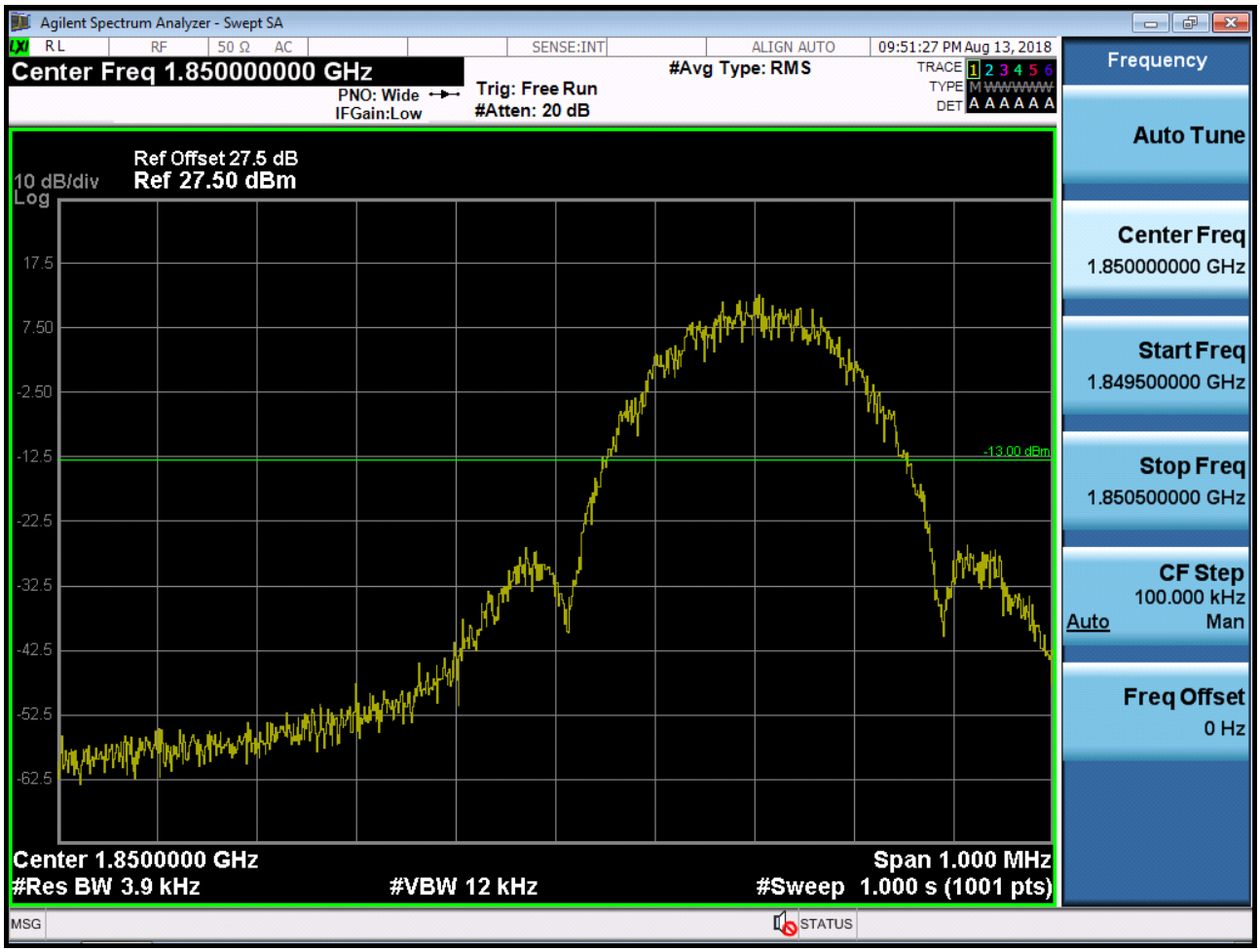


■ GSM1900 MODE (810 CH.) Block Edge 3

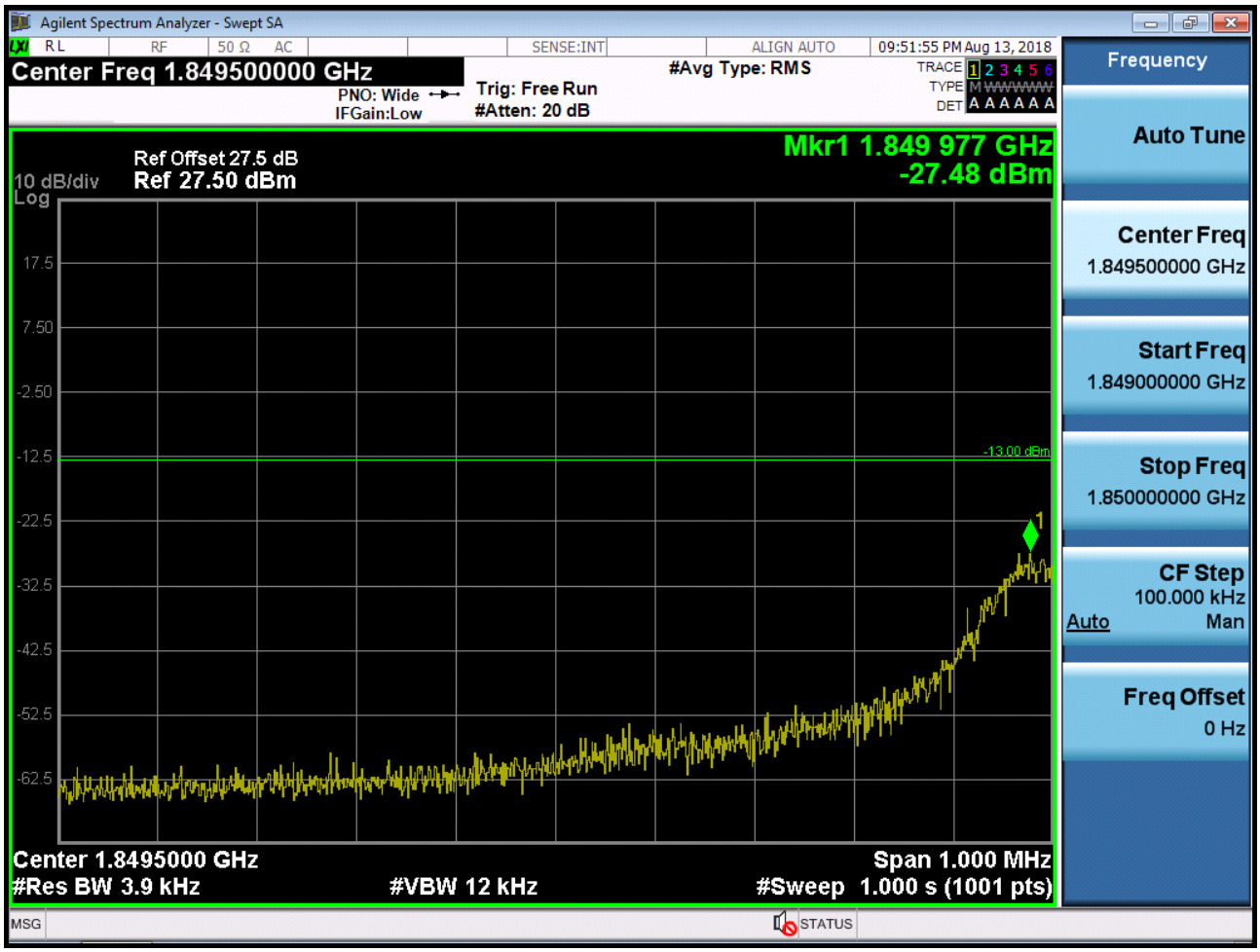
Note : We used a narrower RBW in order to increase accuracy.

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

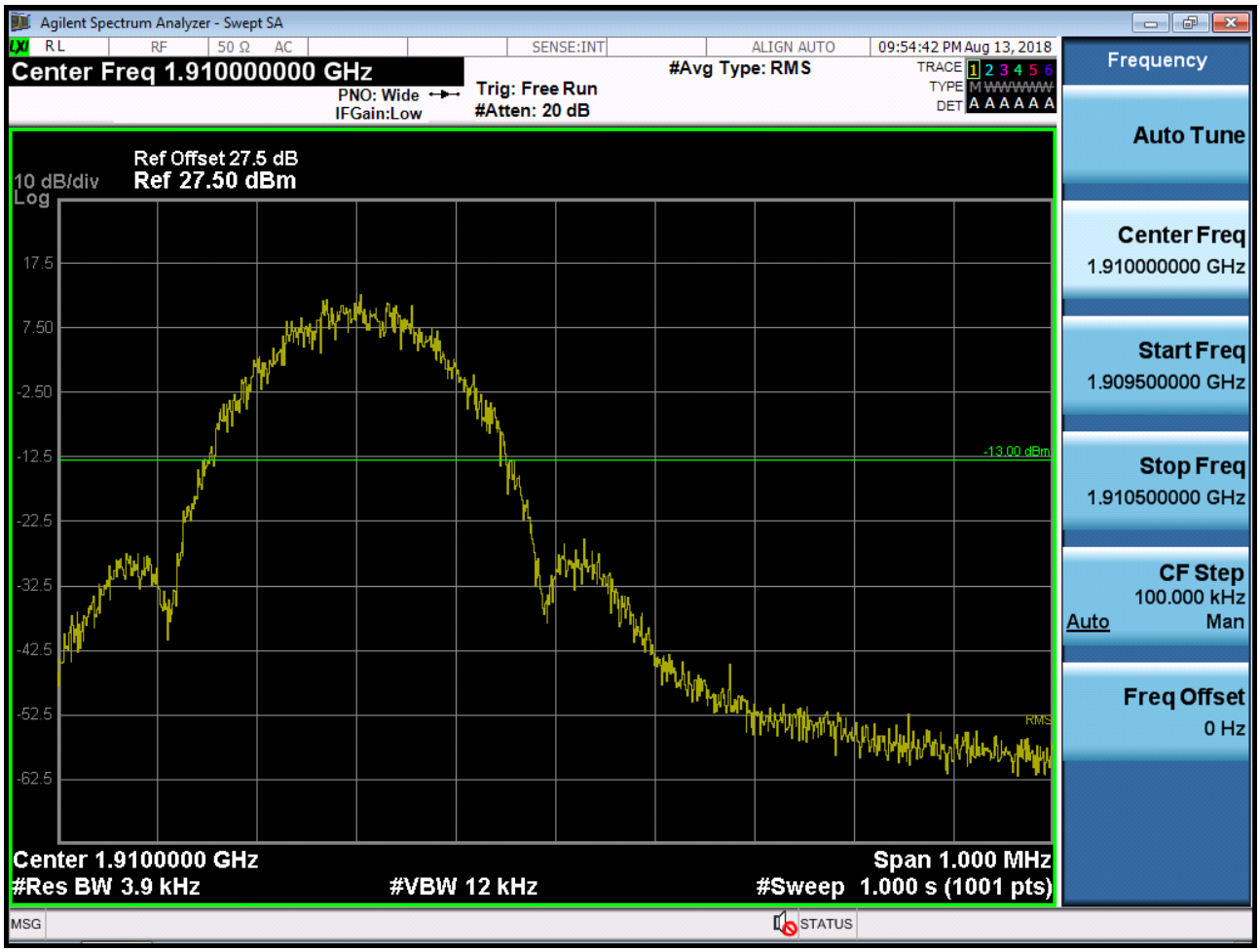


■ EDGE MODE (512 CH.) Block Edge 3

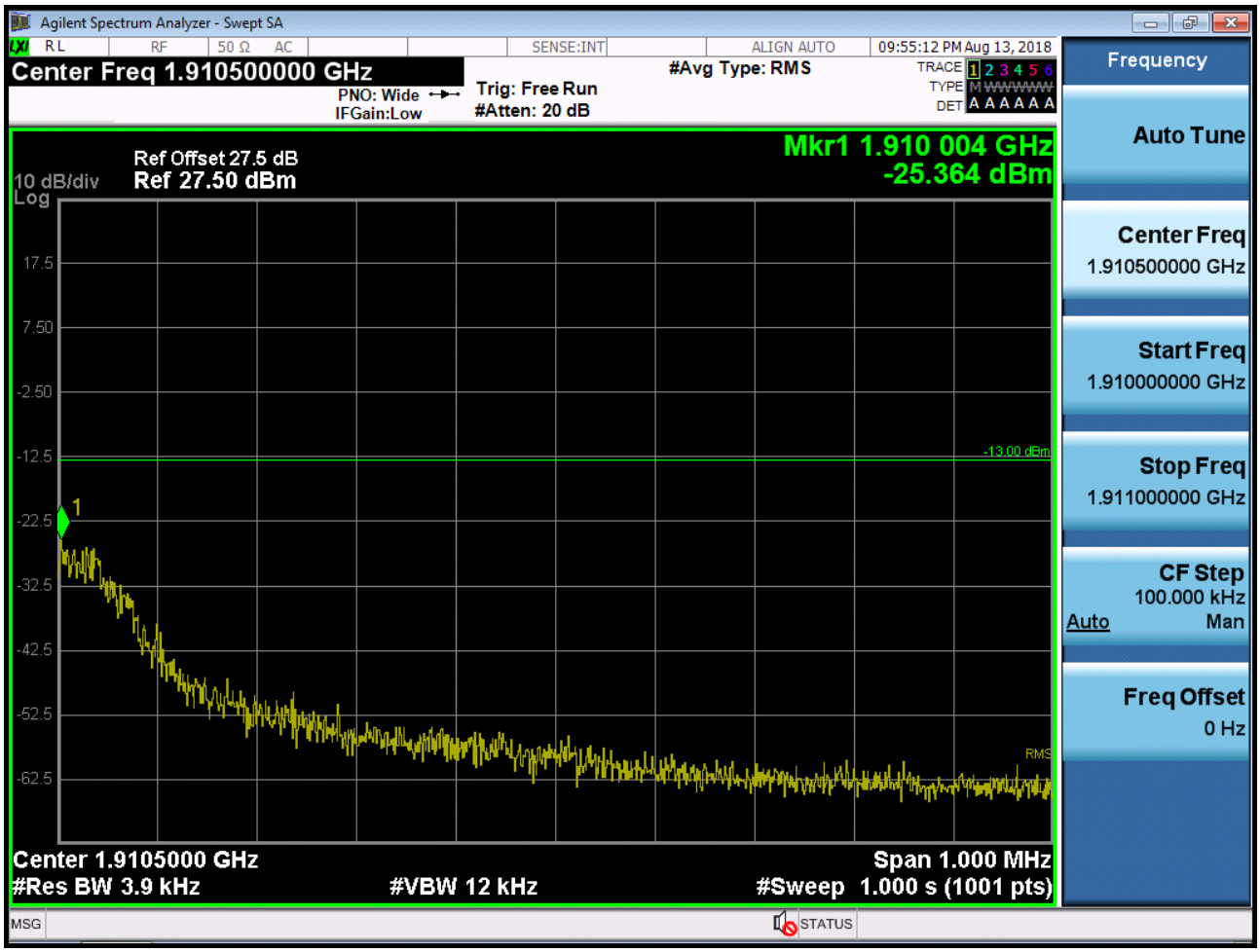
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10*log(1 MHz/100 kHz) dB = -51.03 dBm + 10 dB = **-41.03 dBm**

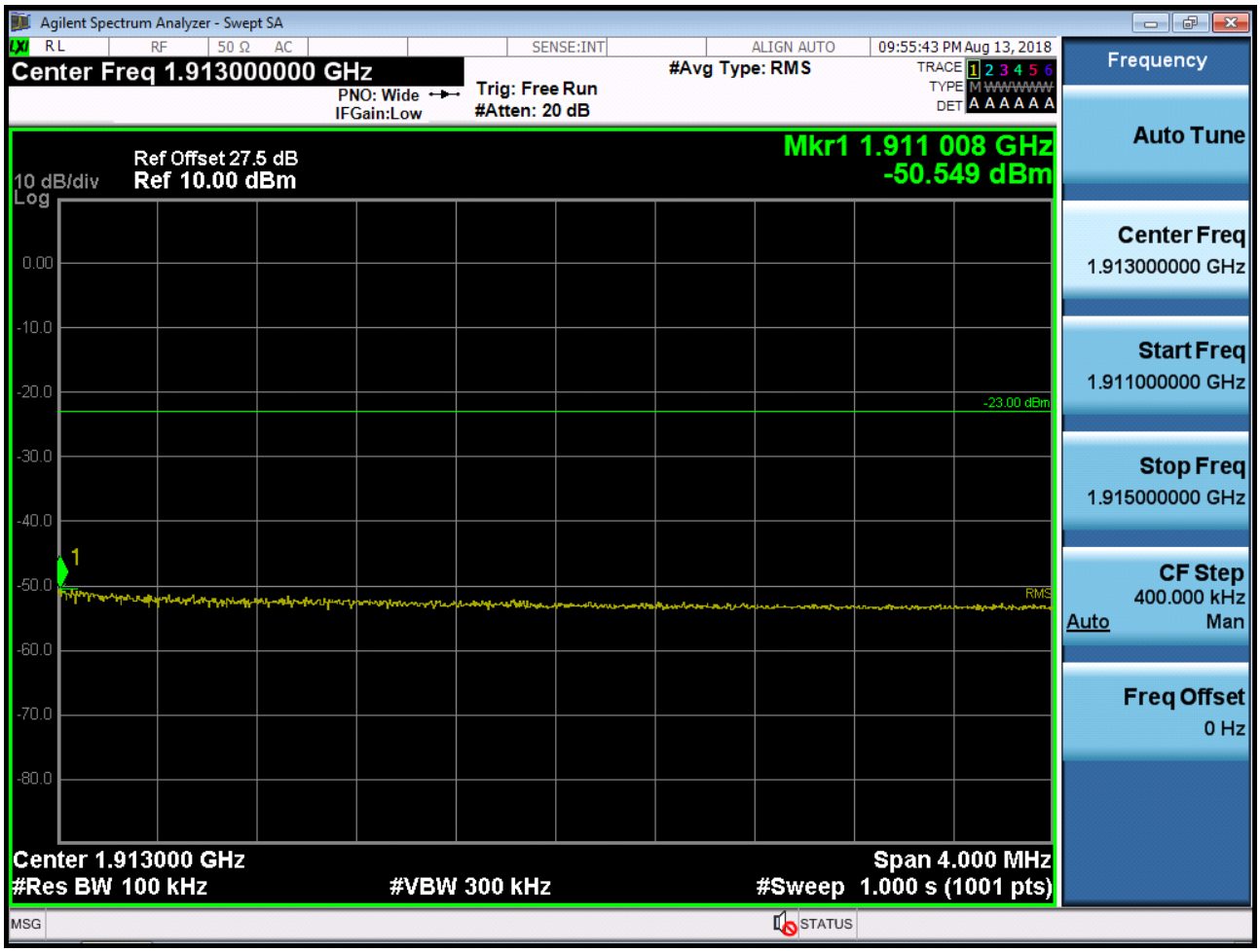
■ EDGE MODE (810 CH.) Block Edge 1



■ EDGE MODE (810 CH.) Block Edge 2



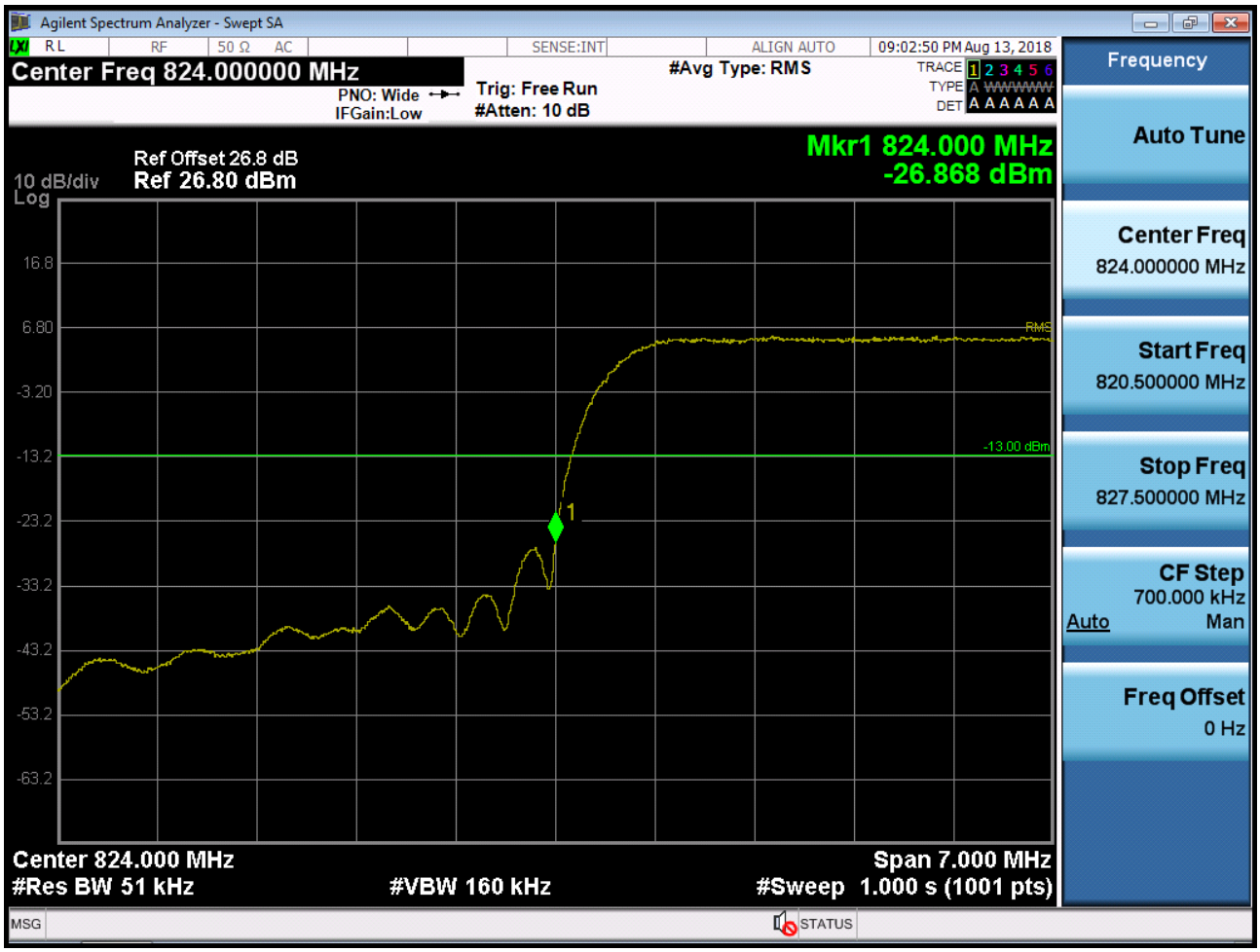
■ EDGE MODE (810 CH.) Block Edge 3



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

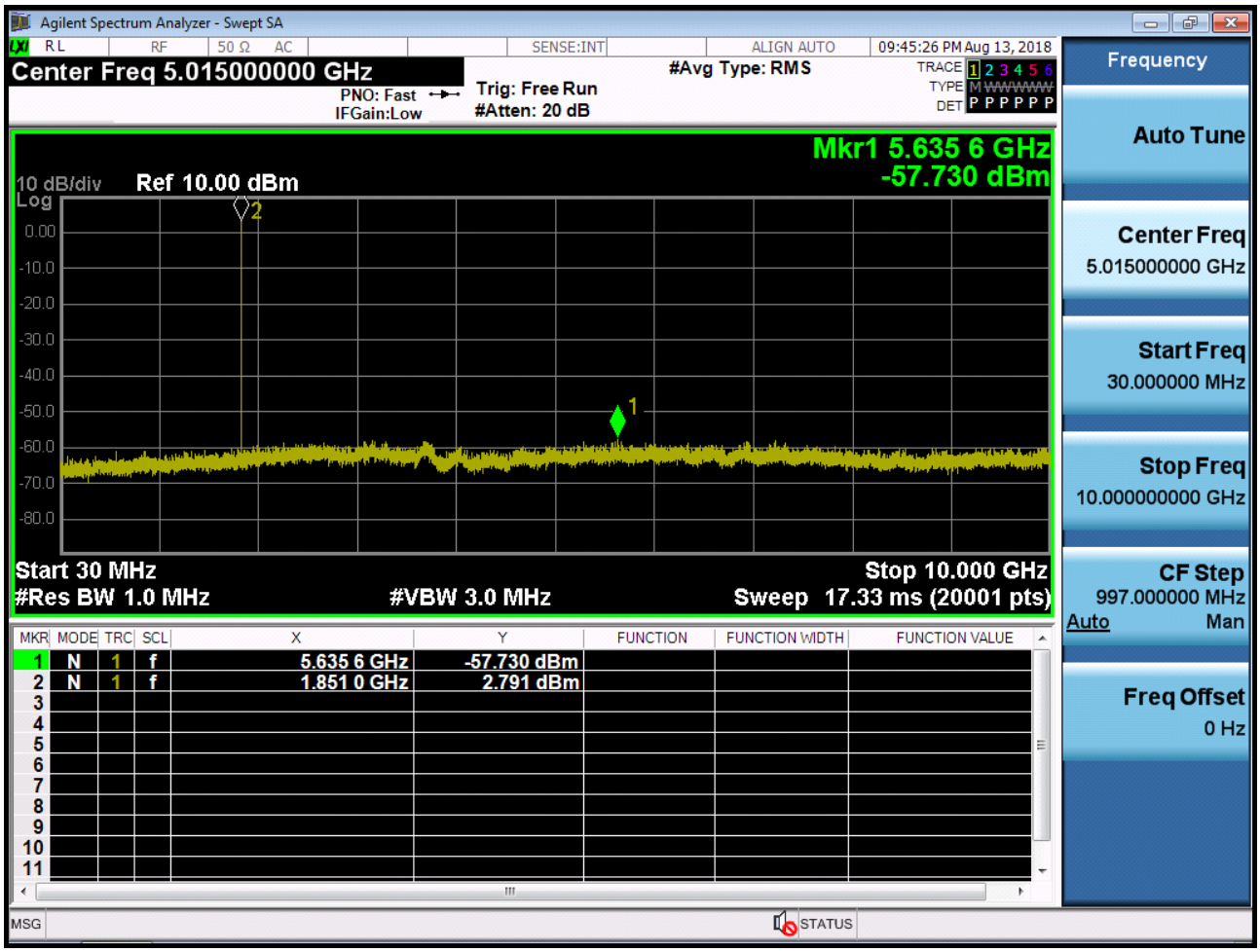
■ WCDMA1900 MODE (9262 CH.) Block Edge

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

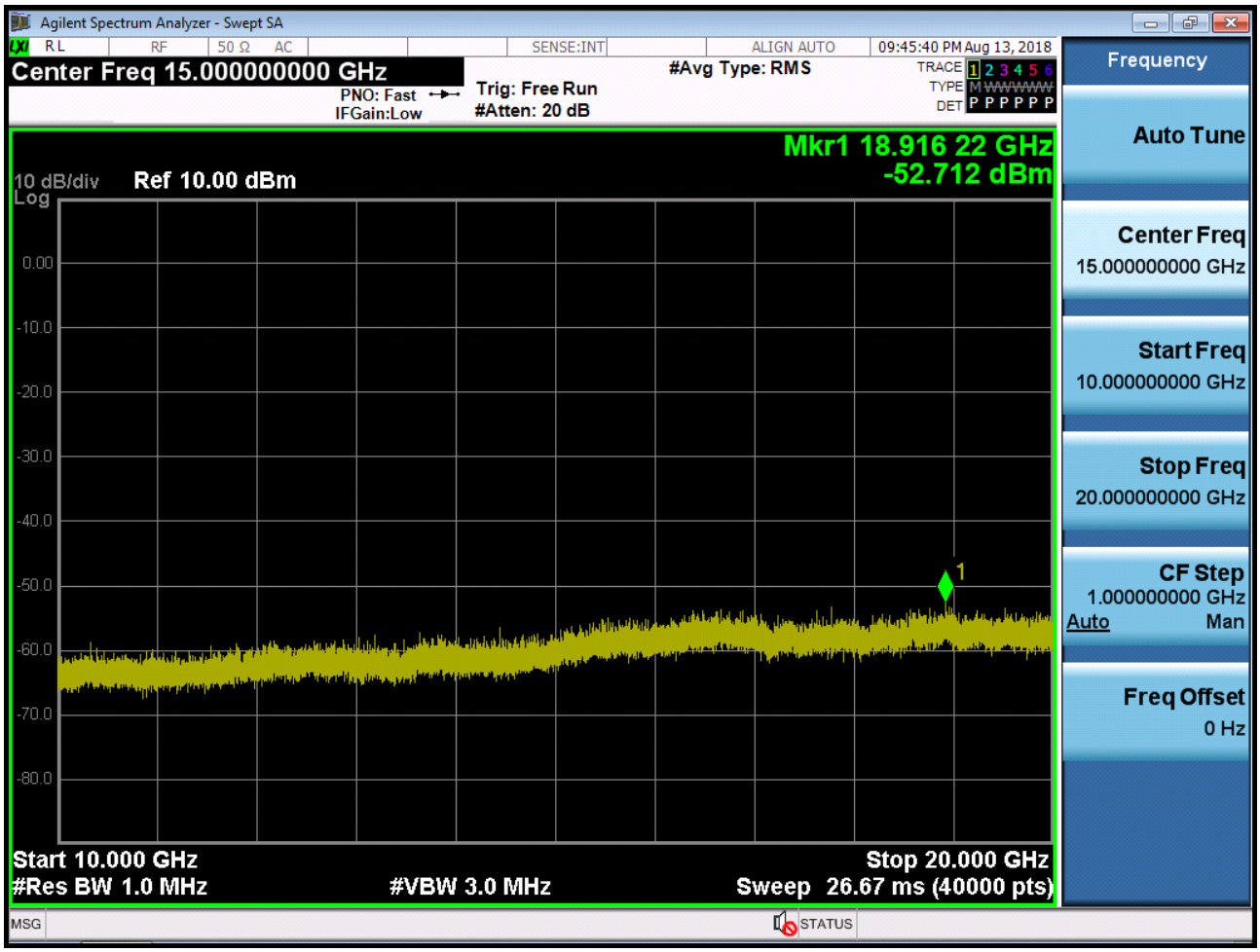
■ WCDMA1900 MODE (9538 CH.) Block Edge

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

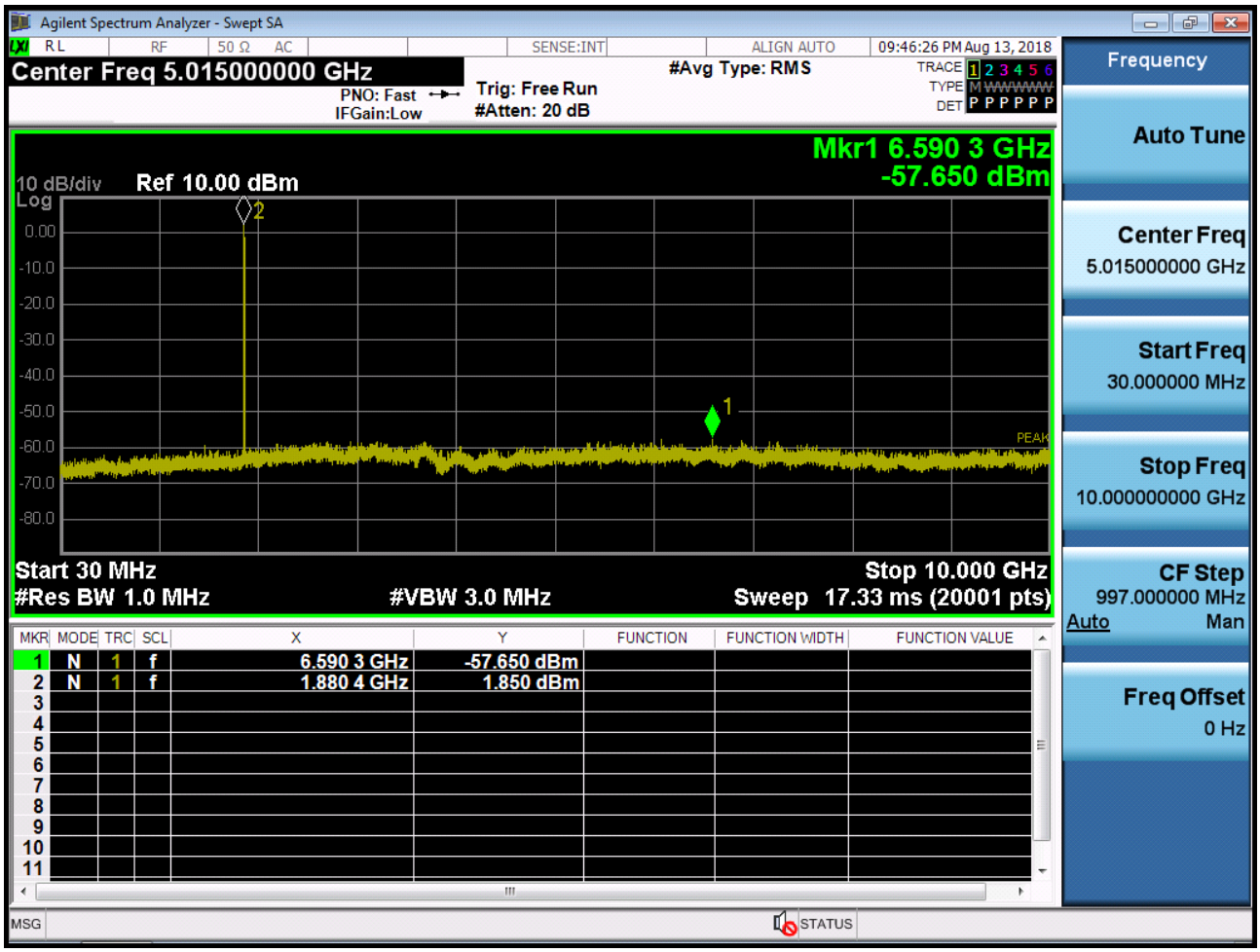
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions1



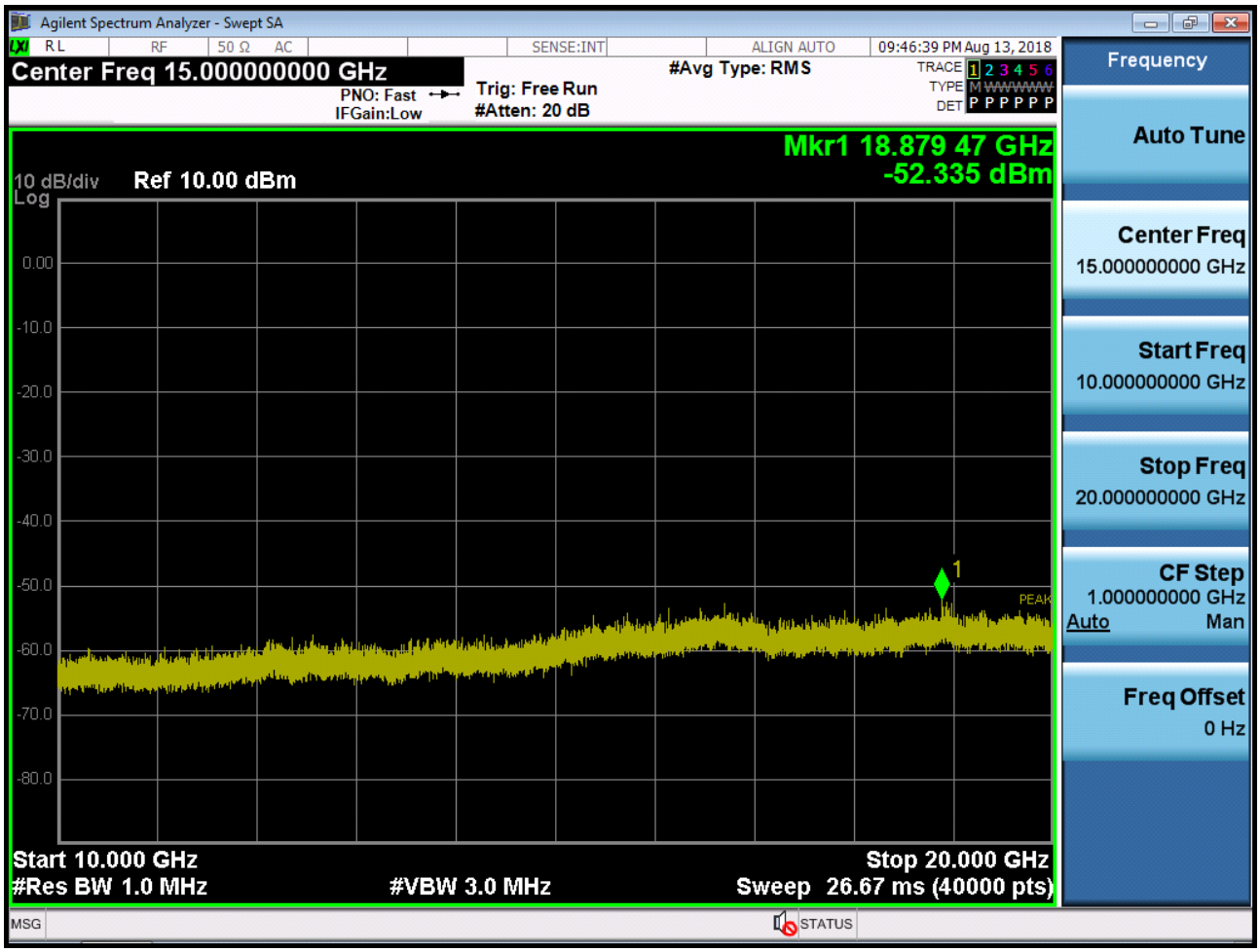
■ GSM1900 MODE (512 CH.) Conducted Spurious Emissions2



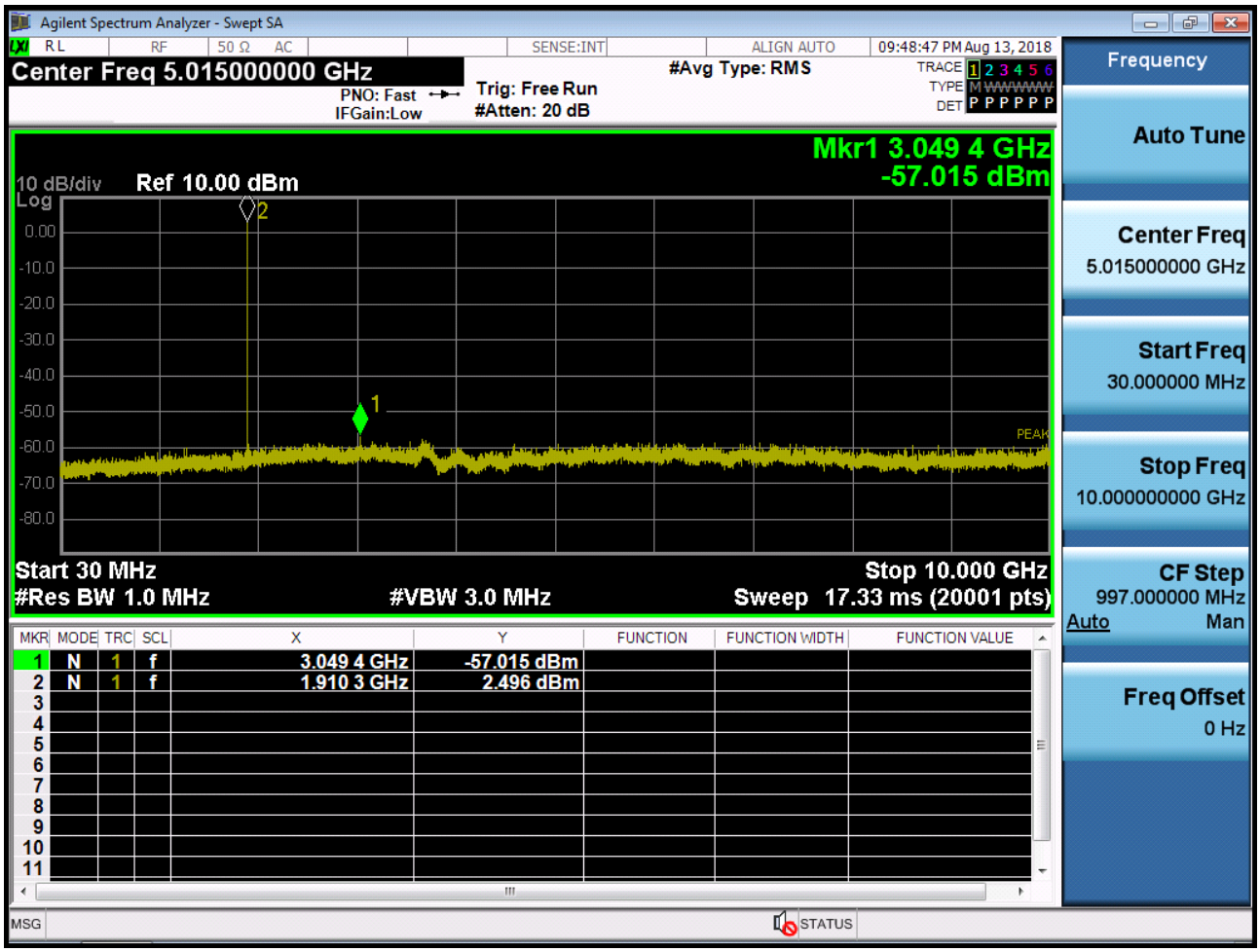
■ GSM1900 MODE (661 CH) Conducted Spurious Emissions1



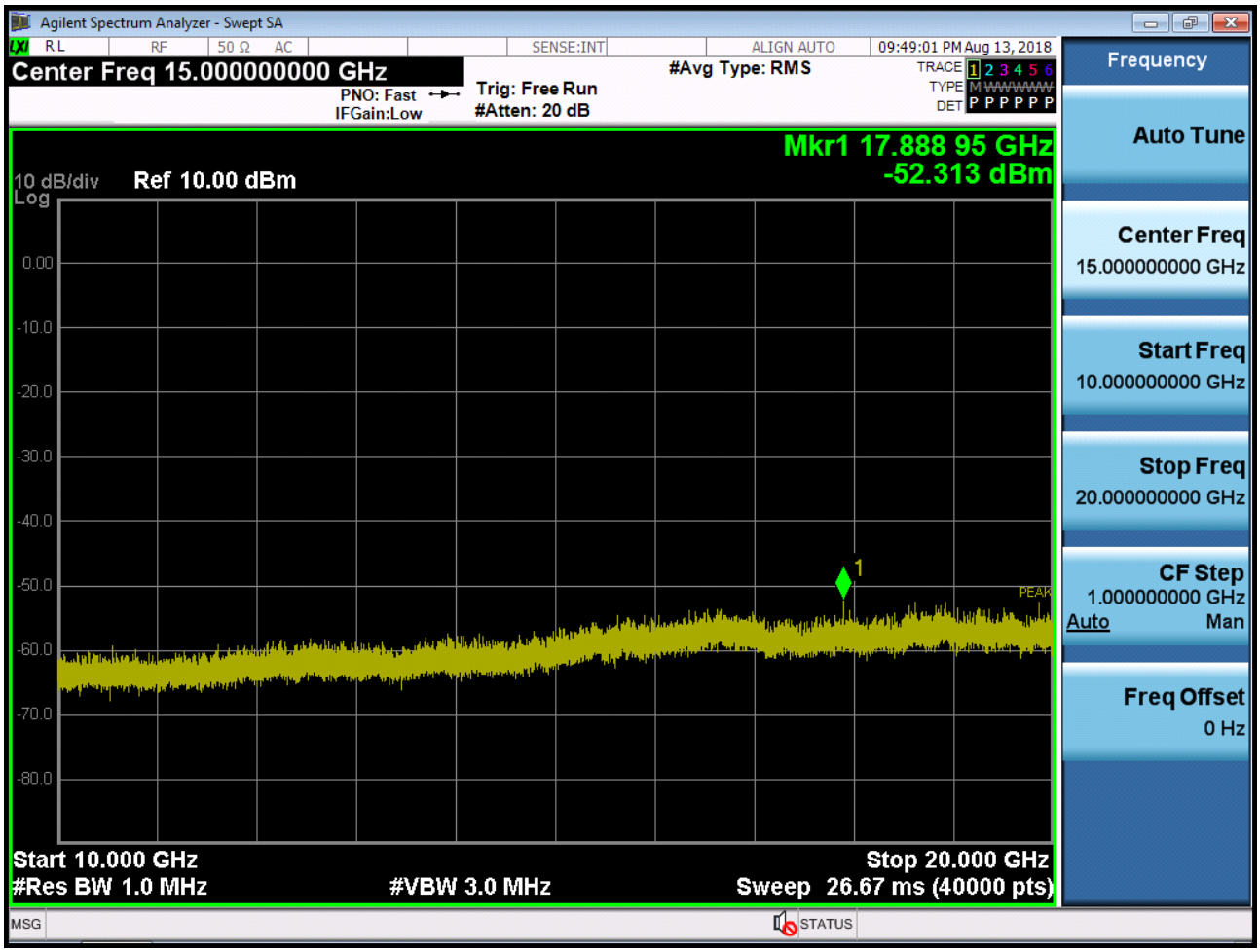
■ GSM1900 MODE (661 CH.) Conducted Spurious Emissions2



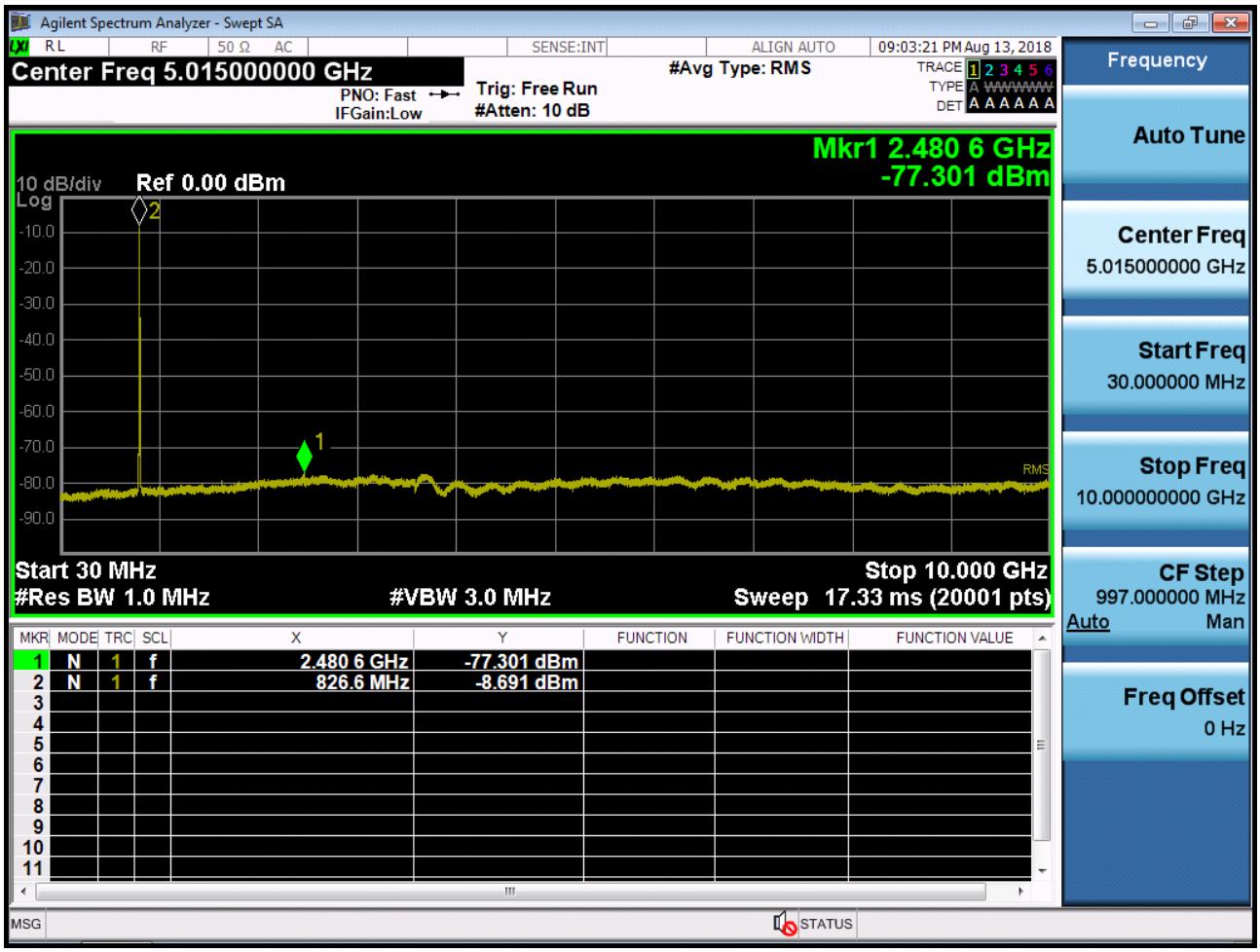
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions1



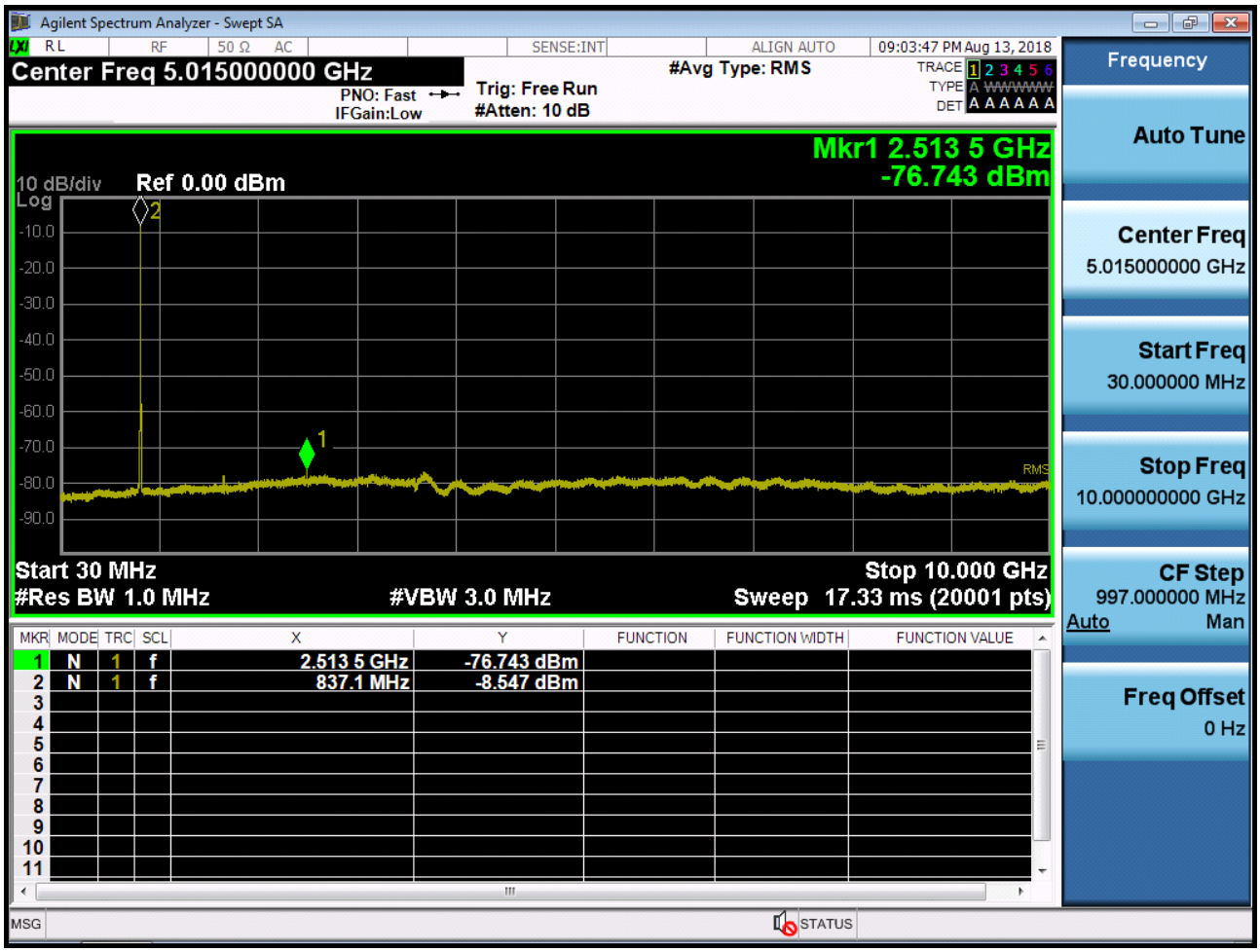
■ GSM1900 MODE (810 CH.) Conducted Spurious Emissions2



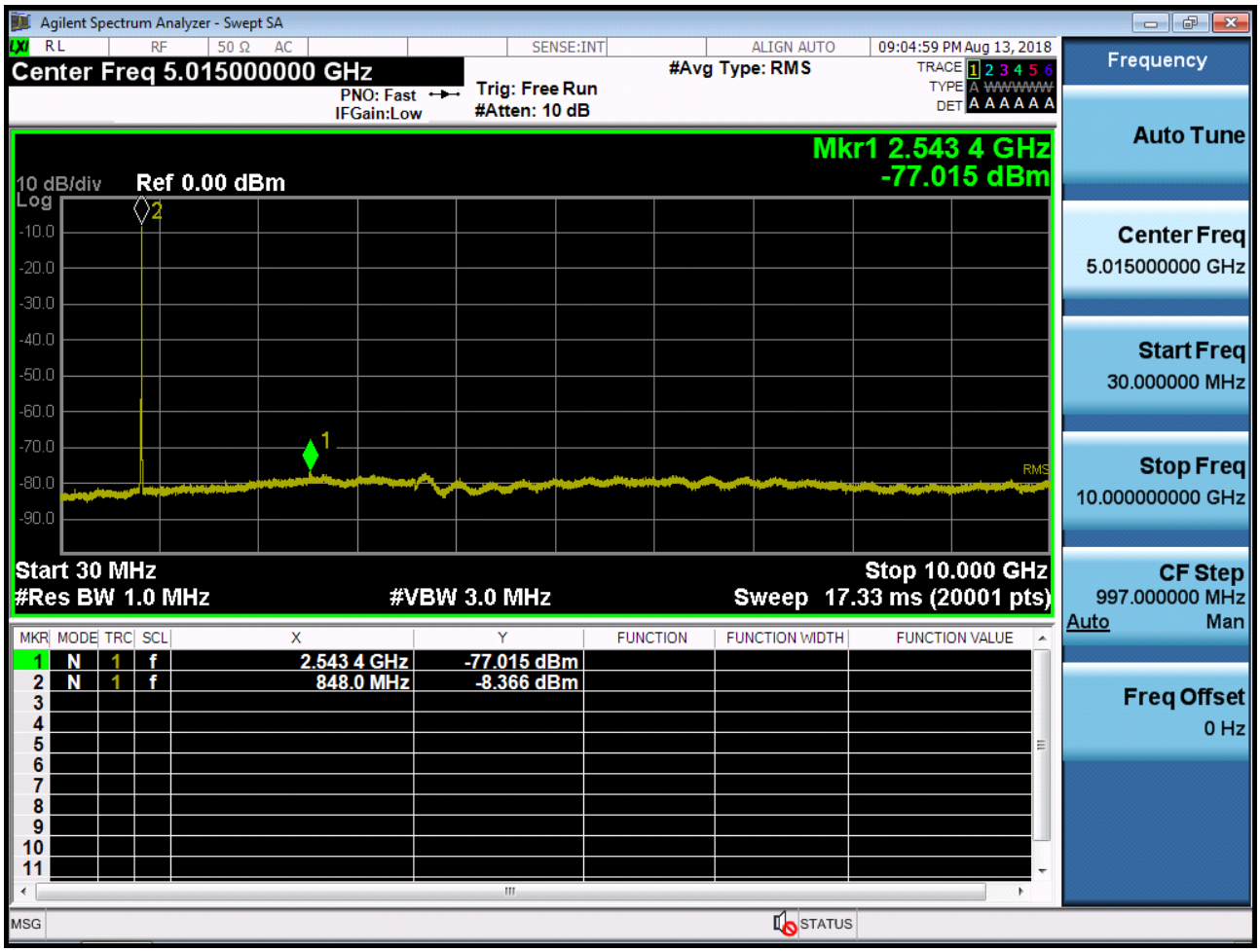
■ WCDMA850 MODE (4132 CH.) Conducted Spurious Emissions



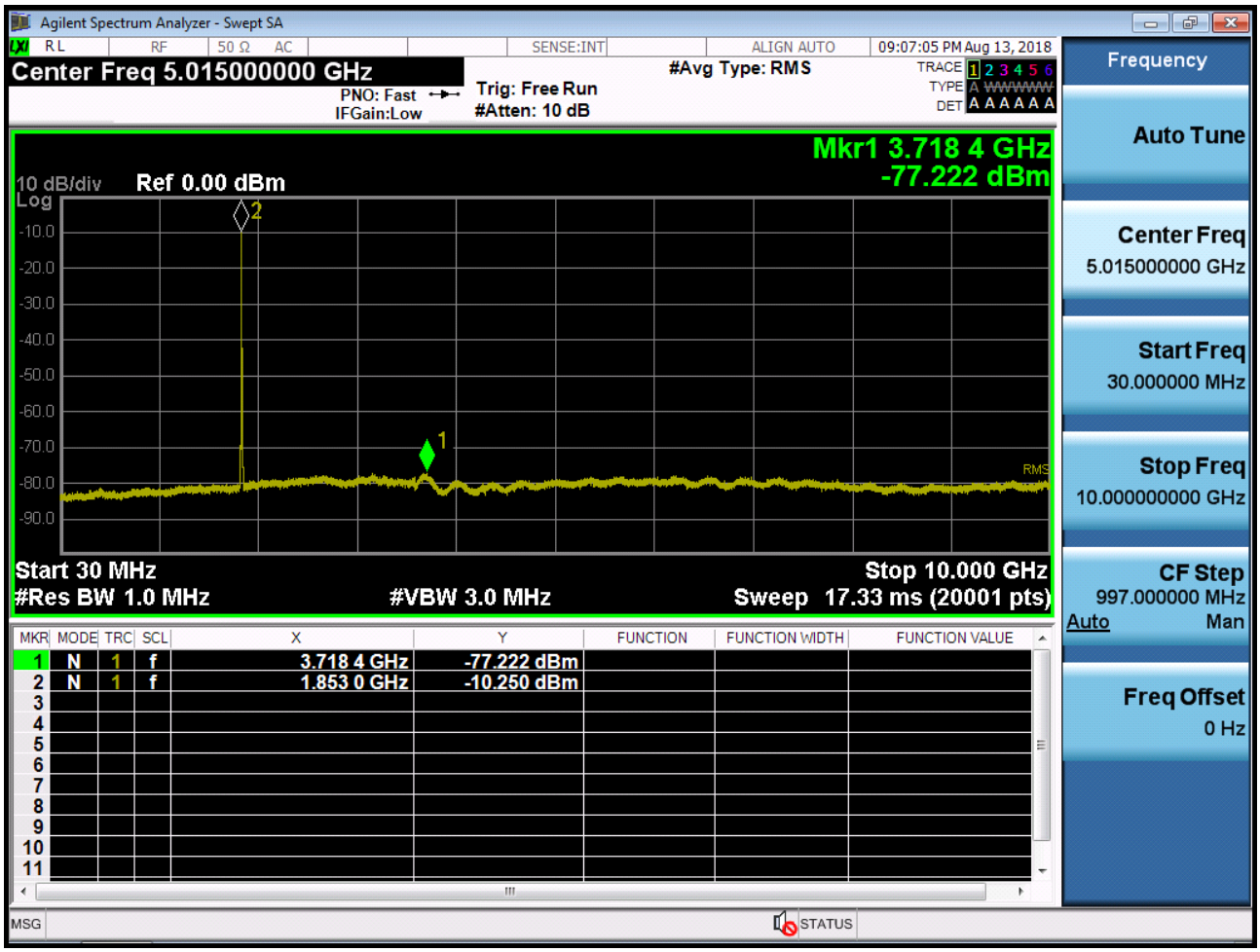
■ WCDMA850 MODE (4183 CH.) Conducted Spurious Emissions



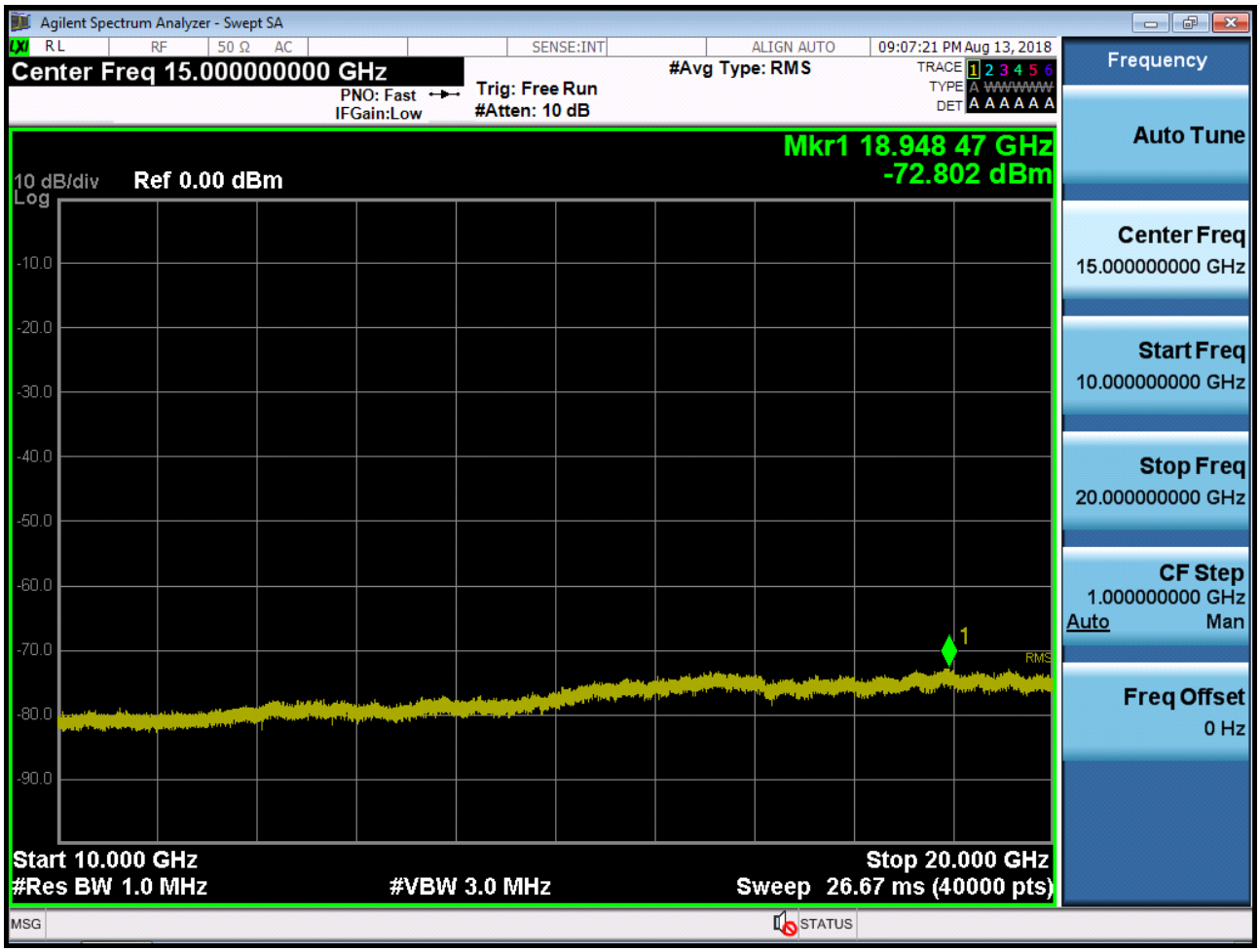
■ WCDMA850MODE (4233 CH.) Conducted Spurious Emissions



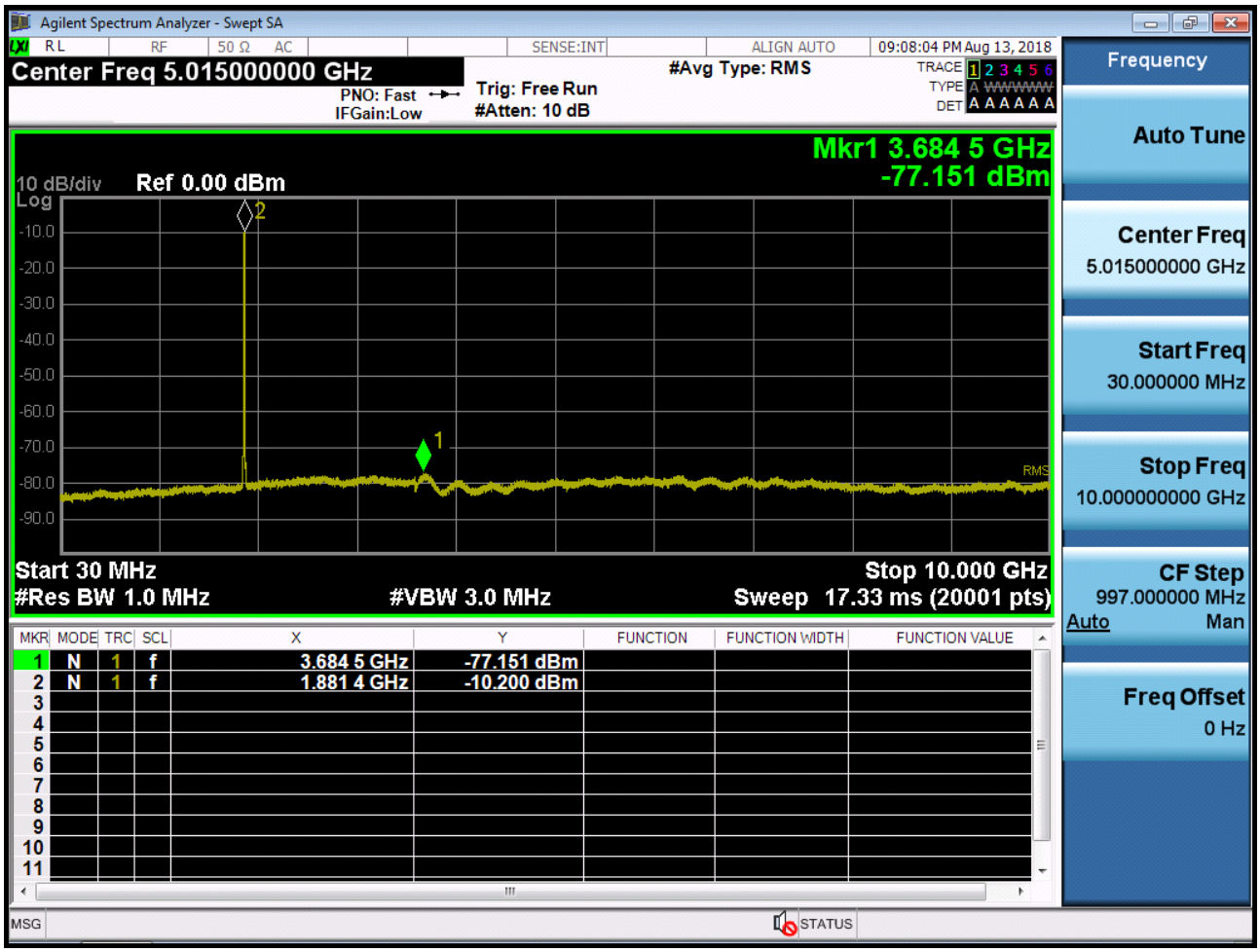
■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions1



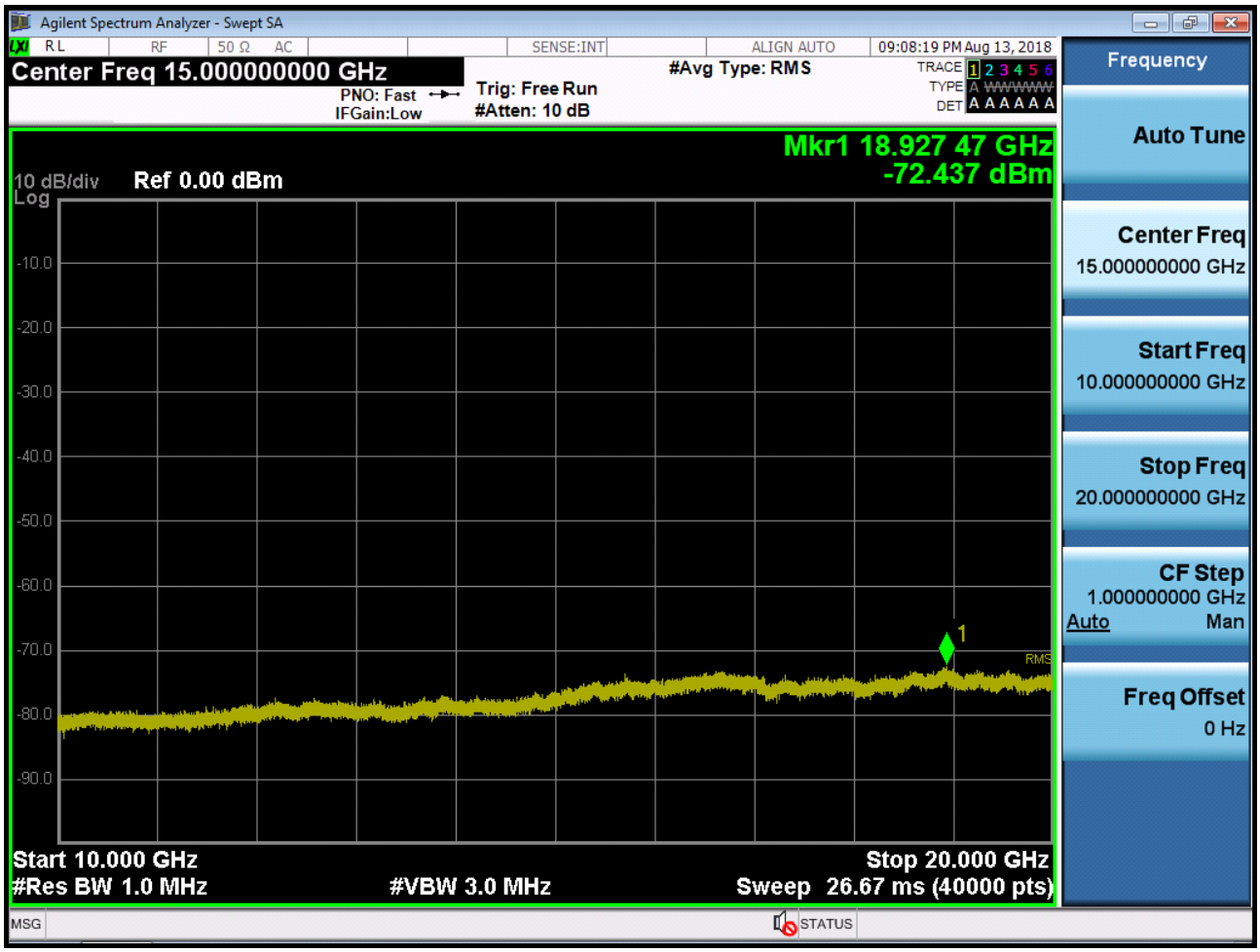
■ WCDMA1900 MODE (9262 CH.) Conducted Spurious Emissions2



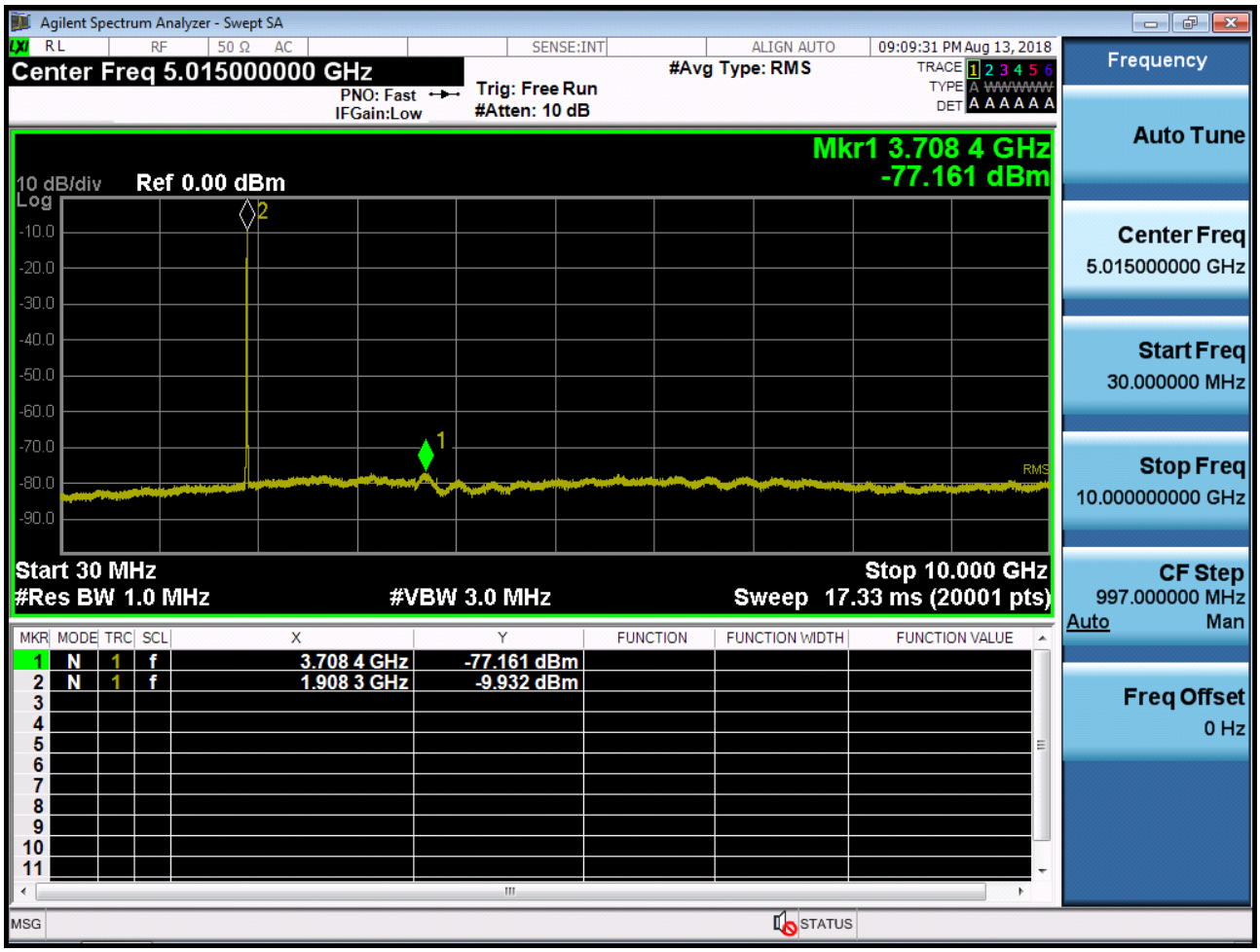
■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions1



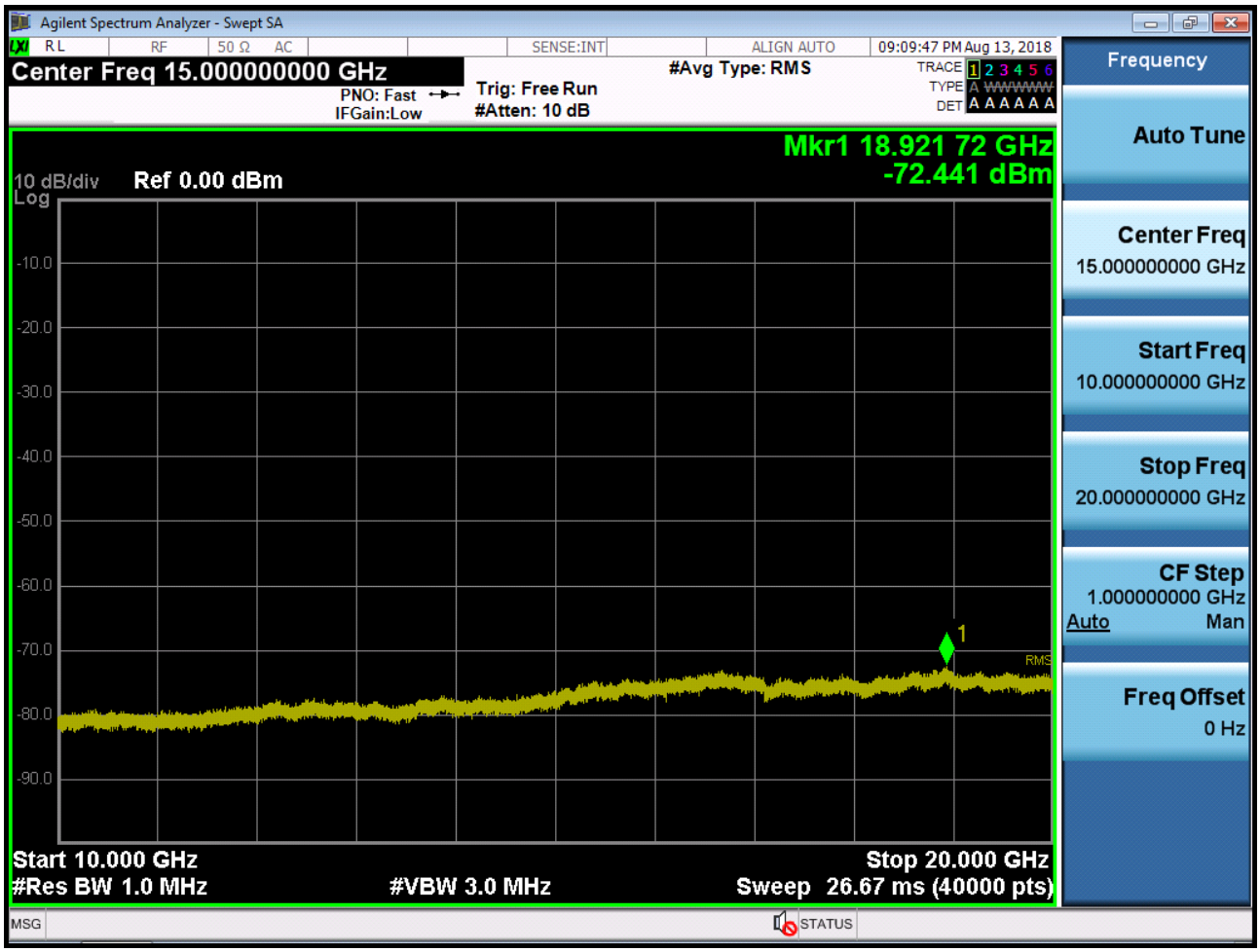
■ WCDMA1900 MODE (9400 CH.) Conducted Spurious Emissions2



■ 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-1810-FC023-P
2	HCT-RF-1810-FC024-P
3	HCT-RF-1810-FC025-P
4	HCT-RF-1810-FC026-P