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FCC LTE REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

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

Date of Issue:
April 01, 2019

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

Report No.: HCT-RF-1903-FC059-R1

FCC ID: **A3LSMA202F**

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

Model(s): SM-A202F/DS
EUT Type: Mobile Phone
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s): §22, §2

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	ERP	
				Max. Power (W)	Max. Power (dBm)
LTE – Band5 (1.4)	824.7 – 848.3	1M10G7D	QPSK	0.060	17.81
		1M10W7D	16QAM	0.045	16.49
LTE – Band5 (3)	825.5 – 847.5	2M72G7D	QPSK	0.060	17.75
		2M72W7D	16QAM	0.045	16.50
LTE – Band5 (5)	826.5 – 846.5	4M51G7D	QPSK	0.061	17.87
		4M52W7D	16QAM	0.046	16.59
LTE – Band5 (10)	829.0 – 844.0	9M02G7D	QPSK	0.062	17.89
		8M97W7D	16QAM	0.048	16.80

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

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

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

Report approved by : Kwon Jeong
Manager of Telecommunication Testing Center

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1903-FC059	March 29, 2019	- First Approval Report
HCT-RF-1903-FC059-R1	April 01, 2019	- Revised the ANNEX A on page 89. - Added the Output Power B.W 10MHz L & H. - O.B.W 10MHz 64QAM Plot Delete.

Table of Contents

MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	SAMSUNG Electronics Co., Ltd.
Address:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
FCC ID:	A3LSMA202F
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	§22, §2
EUT Type:	Mobile Phone
Model(s):	SM-A202F/DS
Tx Frequency:	824.7 MHz – 848.3 MHz (LTE – Band 5 (1.4 MHz)) 825.5 MHz – 847.5 MHz (LTE – Band 5 (3 MHz)) 826.5 MHz – 846.5 MHz (LTE – Band 5 (5 MHz)) 829.0 MHz – 844.0 MHz (LTE – Band 5 (10 MHz))
Date(s) of Tests:	March 14, 2019 ~ March 26, 2019

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, 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
Transmitter Output Power	- KDB 971168 D01 v03r01 - Section 5.2.4 - ANSI C63.26-2015 - Section 5.2.1 & 5.2.4.2
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.

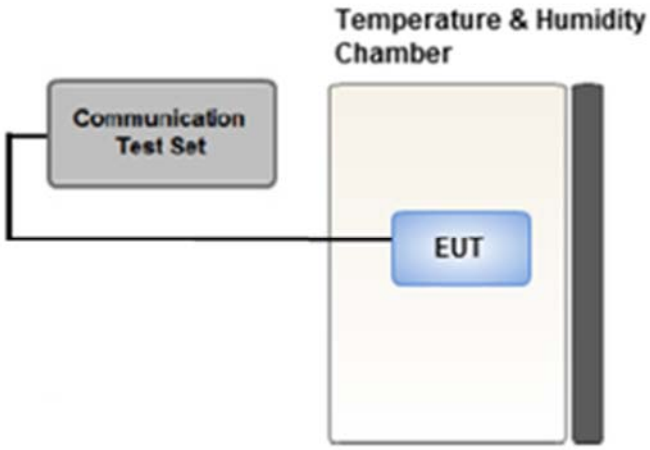
   The power is calculated by the following formula;

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

   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 Transmitter Output Power



Test setup

Test Overview

According to ANSI C63.26-2015 Section 5.2.1 when measuring the maximum RF output power from such devices, control over the EUT must be provided either through special test software (provided by manufacturer specifically for compliance testing, but not accessible by an end user) or through use of a base station emulator, communications test set, call box, or similar instrumentation that is capable of establishing a communications link with the EUT to enable control over variable parameters (e.g., output power, OBW, etc.).

In some cases, these instruments also include basic digital spectrum analyzer and/or power meter capabilities that can be utilized to measure the RF output power if the specified detectors and requirements can be realized and the measurement functions have been calibrated.

Test Settings

1. The RF port of the EUT was connected to the Communication Tester via an RF cable.
2. Conducted average power was measured using a calibrated Radio Communication Tester.

3.4 RADIATED SPURIOUS EMISSIONS

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

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

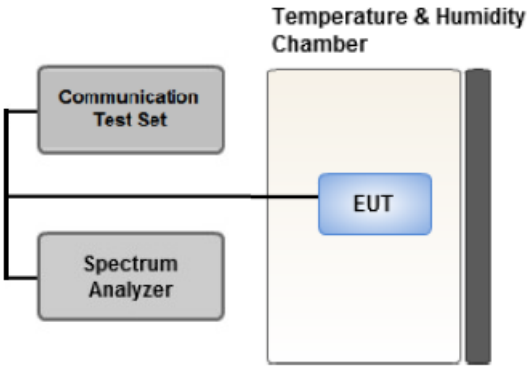
Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points > 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10^{th} harmonics from 9 kHz.

Test Note

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

3.5 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.

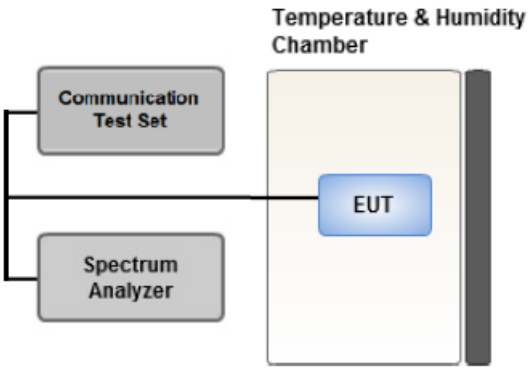
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

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

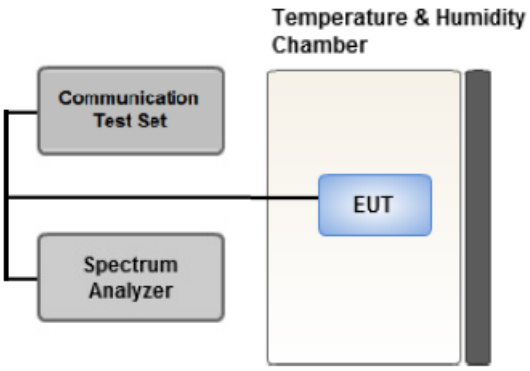
Test Overview

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

1. RBW = 1 MHz
2. VBW ≥ 3 MHz
3. Detector = RMS
4. Trace Mode = 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

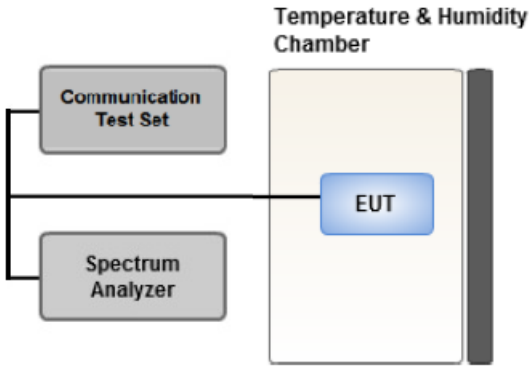
Test Notes

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(RADIATED TEST)

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

[Worst case]

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

3.10 WORST CASE(CONDUCTED TEST)

- Worst case : Of all modulation, We have tested modulation of the high Conducted Output Power.
  Conducted Output Power value can be confirmed on the SAR report.

[Worst case]

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

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Date	Calibration Interval	Calibration Due
REOHDE & SCHWARZ	SCU 18 / AMPLIFIER	10094	04/17/2018	Annual	04/17/2019
Wainwright	WHK1.2/15G-10EF/H.P.F	4	04/04/2018	Annual	04/04/2019
Wainwright	WHK3.3/18G-10EF/H.P.F	2	04/04/2018	Annual	04/04/2019
Hewlett Packard	11667B / Power Splitter(DC~26.5 GHz)	5001	06/07/2018	Annual	06/07/2019
Agilent	E3632A/DC Power Supply	KR75303243	05/09/2018	Annual	05/09/2019
Schwarzbeck	UHAP/ Dipole Antenna	557	03/31/2017	Biennial	03/31/2019
Schwarzbeck	UHAP/ Dipole Antenna	558	03/31/2017	Biennial	03/31/2019
ESPEC	SU-642 / Chamber	93000718	08/07/2018	Annual	08/07/2019
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	147	09/14/2018	Annual	09/14/2019
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	9120D-1298	10/04/2018	Annual	10/04/2019
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170342	04/25/2017	Biennial	04/25/2019
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170124	04/25/2017	Biennial	04/25/2019
Agilent	N9020A/Signal Analyzer(10Hz~26.5GHz)	MY52090906	06/08/2018	Annual	06/08/2019
Hewlett Packard	8493C/ATTENUATOR(20dB)	17280	06/21/2018	Annual	06/21/2019
REOHDE & SCHWARZ	FSV40/Spectrum Analyzer(10Hz~40GHz)	100931	10/22/2018	Annual	10/22/2019
Agilent	8960 (E5515C)/ Base Station	MY48360800	09/27/2018	Annual	09/27/2019
Schwarzbeck	FMZB1513/ Loop Antenna(9kHz~30MHz)	1513-175	08/23/2018	Biennial	08/23/2020
Schwarzbeck	VULB9160/ Bilog Antenna	9160-3368	08/09/2018	Biennial	08/09/2020
Schwarzbeck	VULB9160/ Hybrid Antenna	760	04/06/2017	Biennial	04/06/2019
Anritsu Corp.	MT8821C/Wideband Radio Communication Tester	6201502997	08/13/2018	Annual	08/13/2019
Anritsu Corp.	MT8820C/Wideband Radio Communication Tester	6201026545	01/30/2019	Annual	01/30/2020
REOHDE & SCHWARZ	SMB100A/ SIGNAL GENERATOR (100kHz~40GHz)	177633	07/19/2018	Annual	07/19/2019
REOHDE & SCHWARZ	ESU40 / EMI TEST RECEIVER	100524	07/27/2018	Annual	07/27/2019
HCT CO., LTD.,	FCC LTE Mobile Conducted RF Automation Test Software	-	-	-	-

Note:

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

5. MEASUREMENT UNCERTAINTY

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

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

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

6. SUMMARY OF TEST RESULTS

6.1 Test Condition : Conducted Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Occupied Bandwidth	§2.1049	N/A	PASS
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§2.1051, §22.917(a)	< 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions	PASS
Transmitter Output Power	§2.1046	< 7 Watts max. ERP	PASS
Frequency stability / variation of ambient temperature	§2.1055, §22.355	< 2.5 ppm	PASS

Note:

1. The same samples were used for SAR and EMC

6.2 Test Condition : Radiated Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Effective Radiated Power	§22.913(a)(5)	< 7 Watts max. ERP	PASS
Radiated Spurious and Harmonic Emissions	§2.1053, §22.917(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

64QAM Modulation

Emission Designator = 4M48W7D

LTE BW = 4.48 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data transmission; telemetry; telecommand

8. TEST DATA

8.1 EFFECTIVE RADIATED POWER

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
824.7	LTE B5/ 1.4 MHz	QPSK	-33.45	27.93	-10.26	0.86	H	< 7.00	0.048	16.81
		16-QAM	-34.89	26.49	-10.26	0.86	H		0.034	15.37
836.5		QPSK	-33.52	28.75	-10.21	0.86	H		0.059	17.68
		16-QAM	-34.71	27.56	-10.21	0.86	H		0.045	16.49
848.3		QPSK	-33.61	28.84	-10.16	0.87	H		0.060	17.81
		16-QAM	-34.94	27.51	-10.16	0.87	H		0.044	16.48

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
825.5	LTE B5/ 3 MHz	QPSK	-33.46	27.93	-10.26	0.86	H	< 7.00	0.048	16.81
		16-QAM	-34.66	26.73	-10.26	0.86	H		0.036	15.61
836.5		QPSK	-33.45	28.82	-10.21	0.86	H		0.060	17.75
		16-QAM	-34.70	27.57	-10.21	0.86	H		0.045	16.50
847.5		QPSK	-33.61	28.79	-10.17	0.87	H		0.060	17.75
		16-QAM	-34.93	27.47	-10.17	0.87	H		0.044	16.43

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
826.5	LTE B5/ 5 MHz	QPSK	-33.43	28.04	-10.26	0.86	H	< 7.00	0.049	16.92
		16-QAM	-34.71	26.76	-10.26	0.86	H		0.037	15.64
836.5		QPSK	-33.33	28.94	-10.21	0.86	H		0.061	17.87
		16-QAM	-34.61	27.66	-10.21	0.86	H		0.046	16.59
846.5		QPSK	-33.61	28.71	-10.17	0.87	H		0.058	17.67
		16-QAM	-34.84	27.48	-10.17	0.87	H		0.044	16.44

Freq (MHz)	Mod/ Bandwidth	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain(dBd)	C.L	Pol	Limit	ERP	
								W	W	dBm
829.0	LTE B5/ 10 MHz	QPSK	-33.40	28.27	-10.24	0.86	H	< 7.00	0.052	17.17
		16-QAM	-34.55	27.12	-10.24	0.86	H		0.040	16.02
836.5		QPSK	-33.31	28.96	-10.21	0.86	H		0.062	17.89
		16-QAM	-34.40	27.87	-10.21	0.86	H		0.048	16.80
844.0		QPSK	-33.61	28.67	-10.18	0.87	H		0.058	17.62
		16-QAM	-34.75	27.53	-10.18	0.87	H		0.044	16.48

8.2 Transmitter Output Power

Modulation	RB Size	RB Offset	Conducted Average Power (dBm)		
			20407	20525	20643
			824.7 MHz	836.5 MHz	848.3 MHz
QPSK	1	0	23.64	23.48	23.84
	1	3	23.62	23.53	23.87
	1	5	23.63	23.52	23.81
	3	0	23.63	23.54	23.79
	3	1	23.64	23.57	23.77
	3	3	23.62	23.50	23.80
	6	0	22.64	22.49	22.79
16QAM	1	0	22.55	22.23	22.50
	1	3	22.55	22.46	22.46
	1	5	22.62	22.33	22.53
	3	0	22.64	22.48	22.68
	3	1	22.49	22.44	22.76
	3	3	22.49	22.41	22.79
	6	0	21.65	21.52	21.74

Note:

1. Limit: 7 W(=38.45dBm)
2. Bandwidth : 1.4 MHz

Modulation	RB Size	RB Offset	Conducted Average Power (dBm)		
			20415	20525	20635
			825.5 MHz	836.5 MHz	847.5 MHz
QPSK	1	0	23.68	23.60	23.91
	1	7	23.68	23.59	23.75
	1	14	23.56	23.51	23.83
	8	0	22.60	22.53	22.77
	8	3	22.59	22.54	22.76
	8	7	22.59	22.53	22.75
	15	0	22.60	22.58	22.76
16QAM	1	0	22.54	22.35	22.63
	1	7	22.37	22.11	22.64
	1	14	22.37	22.08	22.44
	8	0	21.57	21.47	21.75
	8	3	21.57	21.48	21.73
	8	7	21.52	21.40	21.70
	15	0	21.61	21.51	21.77

Note:

1. Limit: 7 W(=38.45dBm)
2. Bandwidth : 3 MHz

Modulation	RB Size	RB Offset	Conducted Average Power (dBm)		
			20425	20525	20625
			826.5 MHz	836.5 MHz	846.5 MHz
QPSK	1	0	23.77	23.60	23.84
	1	12	23.66	23.53	23.79
	1	24	23.55	23.61	23.86
	12	0	22.63	22.53	22.78
	12	6	22.55	22.52	22.79
	12	11	22.58	22.53	22.79
	25	0	22.57	22.53	22.76
16QAM	1	0	22.45	22.35	22.60
	1	12	22.28	22.26	22.55
	1	24	22.23	22.13	22.39
	12	0	21.51	21.49	21.73
	12	6	21.54	21.49	21.76
	12	11	21.51	21.47	21.81
	25	0	21.57	21.50	21.77

Note:

1. Limit: 7 W(=38.45dBm)
2. Bandwidth : 5 MHz

Modulation	RB Size	RB Offset	Conducted Average Power (dBm)		
			20450	20525	20600
			829.0 MHz	836.5 MHz	844.0 MHz
QPSK	1	0	23.56	23.59	23.58
	1	24	23.52	23.60	23.51
	1	49	23.42	23.56	23.47
	25	0	22.47	22.57	22.50
	25	12	22.50	22.53	22.42
	25	24	22.46	22.52	22.43
	50	0	22.46	22.59	22.55
16QAM	1	0	22.25	22.26	22.24
	1	24	22.40	22.47	22.46
	1	49	22.19	22.27	22.25
	25	0	21.48	21.58	21.46
	25	12	21.54	21.58	21.55
	25	24	21.51	21.56	21.55
	50	0	21.47	21.52	21.50

Note:

1. Limit: 7 W(=38.45dBm)
2. Bandwidth : 10 MHz

8.3 RADIATED SPURIOUS EMISSIONS

▣ OPERATING FREQUENTY: 848.30 MHz

▣ MEASURED OUTPUT POWER: 17.81 dBm = 0.060 W

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 1.4 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 30.81 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	dBc
20407 (824.7)	1,649.40	-53.60	7.46	-62.49	1.27	H	-58.45	76.26
	2,474.10	-42.77	8.64	-48.90	1.58	V	-43.99	61.80
	3,298.80	-57.63	10.30	-63.68	1.86	V	-57.39	75.20
20525 (836.5)	1,673.00	-53.93	7.53	-62.92	1.28	H	-58.82	76.62
	2,509.50	-41.47	8.83	-47.79	1.62	H	-42.73	60.54
	3,346.00	-56.96	10.51	-63.28	1.91	H	-56.83	74.64
20643 (848.3)	1,696.60	-54.21	7.76	-63.29	1.29	H	-58.97	76.78
	2,544.90	-40.92	8.86	-46.95	1.62	H	-41.86	59.67
	3,393.20	-57.49	10.56	-63.75	1.95	H	-57.29	75.09

▣ OPERATING FREQUENTY: 847.50 MHz

▣ MEASURED OUTPUT POWER: 17.75 dBm = 0.060 W

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 3 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 30.75 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	dBc
20415 (825.5)	1,651.00	-53.64	7.46	-62.53	1.27	H	-58.49	76.24
	2,476.50	-42.03	8.64	-48.16	1.58	H	-43.25	61.00
	3,302.00	-58.02	10.30	-64.07	1.86	H	-57.78	75.53
20525 (836.5)	1,673.00	-54.70	7.53	-63.69	1.28	H	-59.59	77.34
	2,509.50	-41.97	8.83	-48.29	1.62	H	-43.23	60.98
	3,346.00	-58.54	10.51	-64.86	1.91	V	-58.41	76.16
20635 (847.5)	1,695.00	-52.87	7.76	-61.95	1.29	H	-57.63	75.38
	2,542.50	-41.10	8.86	-47.13	1.62	H	-42.04	59.79
	3,390.00	-58.14	10.56	-64.40	1.95	H	-57.94	75.69

▣ OPERATING FREQUENTY: 836.50 MHz

▣ MEASURED OUTPUT POWER: 17.87 dBm = 0.061 W

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 5 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 30.87 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	dBc
20425 (826.5)	1,653.00	-53.33	7.46	-62.22	1.27	V	-58.18	76.05
	2,479.50	-41.40	8.71	-47.77	1.60	H	-42.81	60.68
	3,306.00	-58.33	10.32	-64.35	1.87	V	-58.05	75.92
20525 (836.5)	1,673.00	-53.61	7.53	-62.60	1.28	H	-58.50	76.37
	2,509.50	-41.95	8.83	-48.27	1.62	H	-43.21	61.08
	3,346.00	-58.26	10.51	-64.58	1.91	H	-58.13	76.00
20625 (846.5)	1,693.00	-54.48	7.67	-63.51	1.28	H	-59.27	77.14
	2,539.50	-40.28	8.86	-46.31	1.62	H	-41.22	59.09
	3,386.00	-56.94	10.56	-63.22	1.93	V	-56.74	74.61

▣ OPERATING FREQUENTY: 836.50 MHz

▣ MEASURED OUTPUT POWER: 17.89 dBm = 0.062 W

▣ MODE: LTE B5

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 30.89 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	dBc
20450 (829.0)	1,658.00	-54.02	7.50	-63.08	1.27	H	-59.00	76.88
	2,487.00	-42.85	8.77	-48.92	1.60	H	-43.90	61.79
	3,316.00	-58.44	10.35	-64.55	1.88	V	-58.23	76.12
20525 (836.5)	1,673.00	-55.58	7.53	-64.57	1.28	H	-60.47	78.36
	2,509.50	-42.62	8.83	-48.94	1.62	H	-43.88	61.77
	3,346.00	-57.91	10.51	-64.23	1.91	H	-57.78	75.67
20600 (844.0)	1,688.00	-53.96	7.67	-62.99	1.28	H	-58.75	76.64
	2,532.00	-39.30	8.85	-45.66	1.61	H	-40.57	58.46
	3,376.00	-58.54	10.56	-64.89	1.89	H	-58.37	76.26
	4,220.00	-52.80	10.81	-56.70	2.22	H	-50.26	68.15

8.4 OCCUPIED BANDWIDTH

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
5	1.4 MHz	836.5	QPSK	6	0	1.0972
			16-QAM			1.0979
	3 MHz		QPSK	15		2.7170
			16-QAM			2.7239
	5 MHz		QPSK	25		4.5137
			16-QAM			4.5193
	10 MHz		QPSK	50		9.0192
			16-QAM			8.9670

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 45 ~ 52.

8.5 CONDUCTED SPURIOUS EMISSIONS

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
5	1.4	824.7	3.6805	27.976	-66.747	-38.771	-13.00
		836.5	3.6835	27.976	-67.194	-39.218	
		848.3	3.6810	27.976	-67.270	-39.294	
	3	825.5	3.7094	27.976	-66.422	-38.446	
		836.5	3.6925	27.976	-67.162	-39.186	
		847.5	3.7010	27.976	-67.348	-39.372	
	5	826.5	3.6860	27.976	-67.443	-39.467	
		836.5	3.7020	27.976	-67.097	-39.121	
		846.5	3.6790	27.976	-67.473	-39.497	
	10	829.0	3.6730	27.976	-67.294	-39.318	
		836.5	3.6965	27.976	-67.069	-39.093	
		844.0	3.7049	27.976	-67.093	-39.117	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 77 ~ 88.
2. Conducted Spurious Emissions was Tested QPSK Modulation, Resource Block Size 1 and Resource Block Offset 0
3. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
4. Factor(dB) = Cable Loss + Attenuator + Power Splitter

Frequency Range (GHz)	Factor [dB]
0.03 – 1	25.270
1 – 5	27.976
5 – 10	28.591
10 – 15	29.116
15 – 20	29.489
Above 20	30.131

8.6 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 53 ~ 76.

8.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

▣ MODE: LTE B5

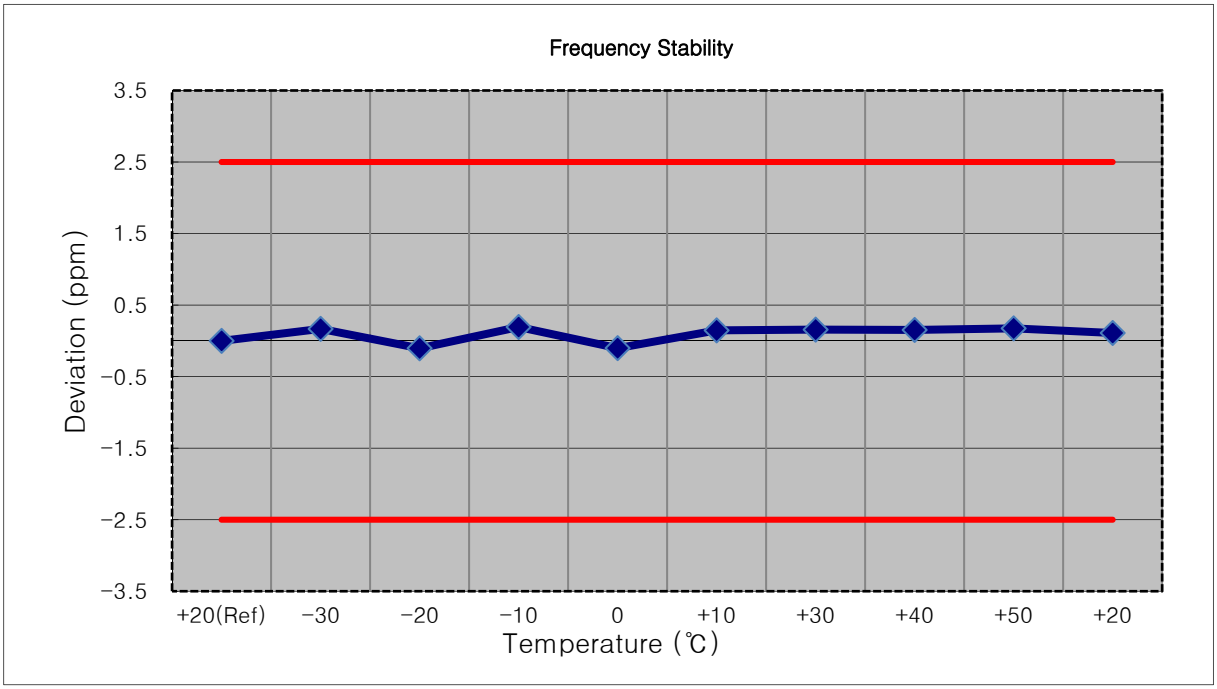
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (1.4 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 500 114	0.0	0.000 000	0.000
100%		-30	836 500 254	140.3	0.000 017	0.168
100%		-20	836 500 027	-86.9	-0.000 010	-0.104
100%		-10	836 500 276	162.0	0.000 019	0.194
100%		0	836 500 029	-85.0	-0.000 010	-0.102
100%		+10	836 500 236	122.9	0.000 015	0.147
100%		+30	836 500 245	131.6	0.000 016	0.157
100%		+40	836 500 241	127.8	0.000 015	0.153
100%		+50	836 500 260	146.2	0.000 017	0.175
Batt. Endpoint	3.400	+20	836 500 206	92.5	0.000 011	0.111



▣ MODE: LTE B5

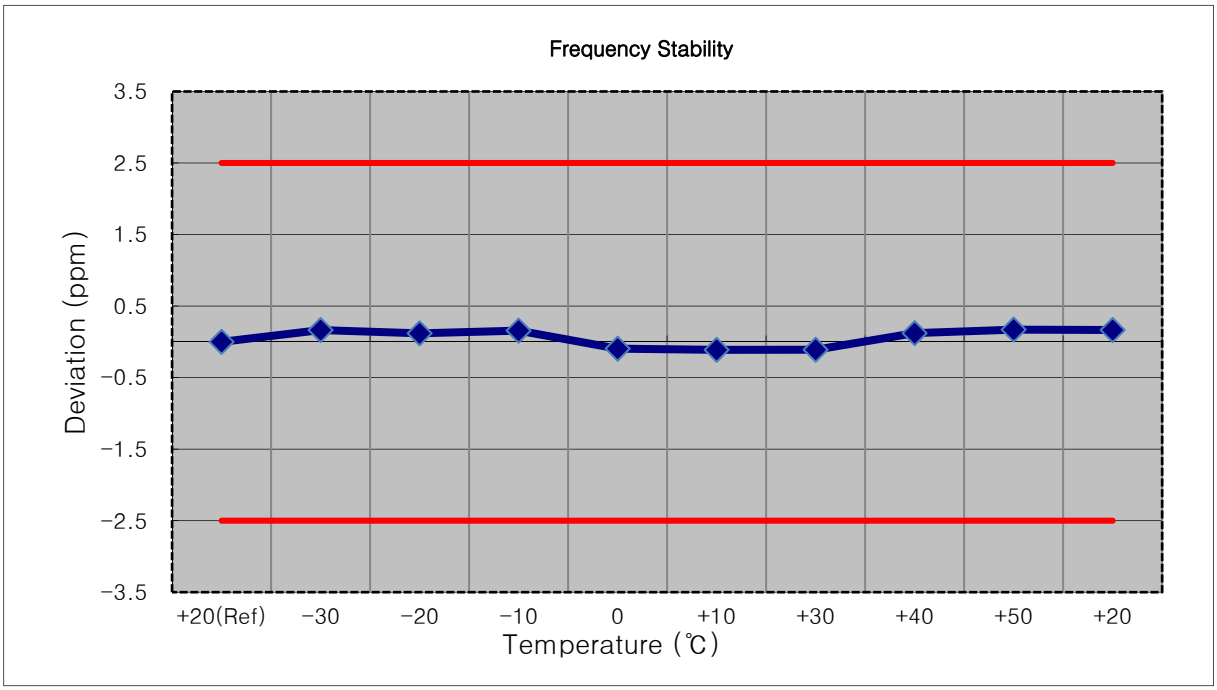
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (3 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 922	0.0	0.000 000	0.000
100%		-30	836 500 060	138.1	0.000 017	0.165
100%		-20	836 500 022	99.5	0.000 012	0.119
100%		-10	836 500 053	130.8	0.000 016	0.156
100%		0	836 499 842	-80.0	-0.000 010	-0.096
100%		+10	836 499 829	-93.5	-0.000 011	-0.112
100%		+30	836 499 830	-92.1	-0.000 011	-0.110
100%		+40	836 500 024	101.6	0.000 012	0.121
100%		+50	836 500 065	142.7	0.000 017	0.171
Batt. Endpoint	3.400	+20	836 500 061	138.5	0.000 017	0.166



▣ MODE: LTE B5

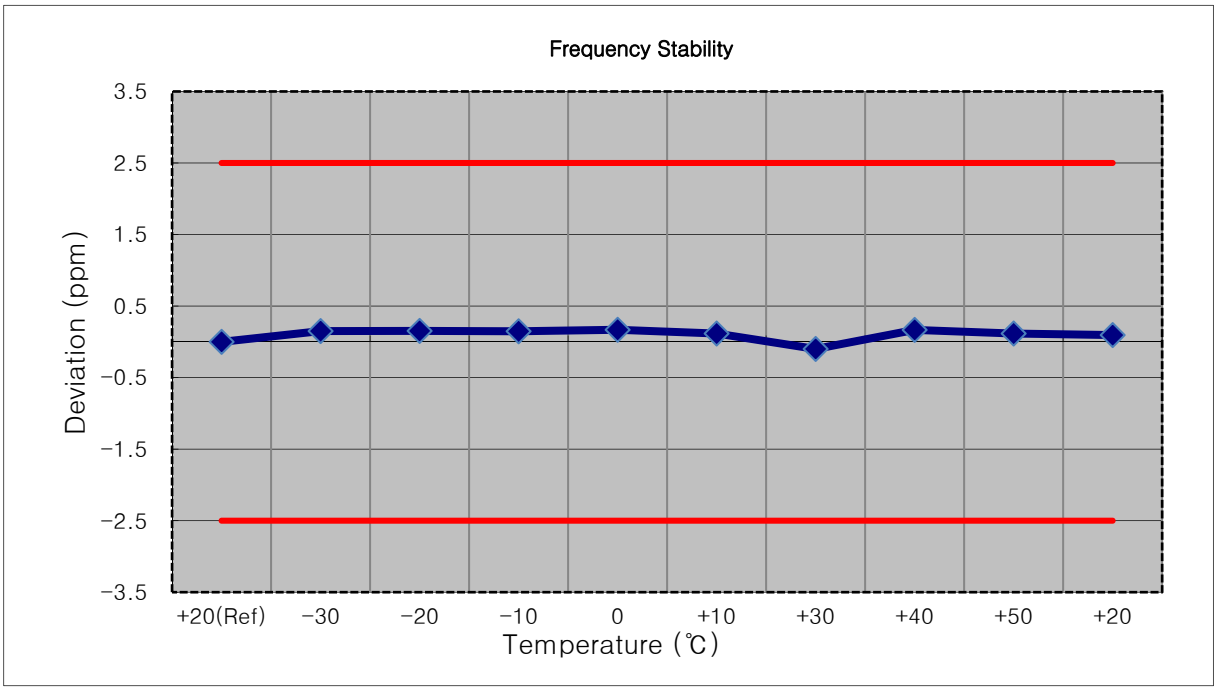
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (5 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 499 926	0.0	0.000 000	0.000
100%		-30	836 500 052	126.1	0.000 015	0.151
100%		-20	836 500 053	127.8	0.000 015	0.153
100%		-10	836 500 049	123.8	0.000 015	0.148
100%		0	836 500 067	140.9	0.000 017	0.168
100%		+10	836 500 023	97.5	0.000 012	0.117
100%		+30	836 499 843	-82.9	-0.000 010	-0.099
100%		+40	836 500 065	139.4	0.000 017	0.167
100%		+50	836 500 023	97.1	0.000 012	0.116
Batt. Endpoint	3.400	+20	836 500 005	79.1	0.000 009	0.095



▣ MODE: LTE B5

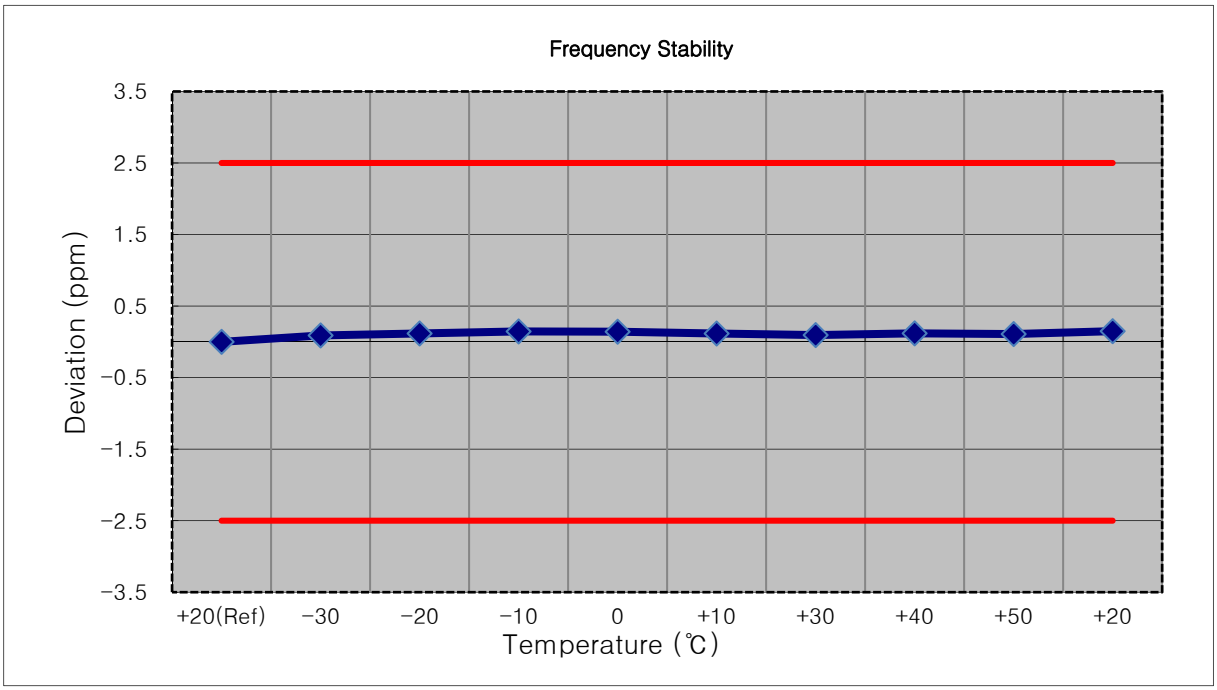
▣ OPERATING FREQUENCY: 836,500,000 Hz

▣ CHANNEL: 20525 (10 MHz)

▣ REFERENCE VOLTAGE: 3.85 VDC

▣ DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.850	+20(Ref)	836 500 081	0.0	0.000 000	0.000
100%		-30	836 500 156	74.8	0.000 009	0.089
100%		-20	836 500 180	98.2	0.000 012	0.117
100%		-10	836 500 203	121.4	0.000 015	0.145
100%		0	836 500 200	118.7	0.000 014	0.142
100%		+10	836 500 179	97.4	0.000 012	0.116
100%		+30	836 500 160	79.0	0.000 009	0.094
100%		+40	836 500 181	99.1	0.000 012	0.118
100%		+50	836 500 172	90.9	0.000 011	0.109
Batt. Endpoint	3.400	+20	836 500 206	124.7	0.000 015	0.149



8.8 GEO-LOCATION MECHANISM

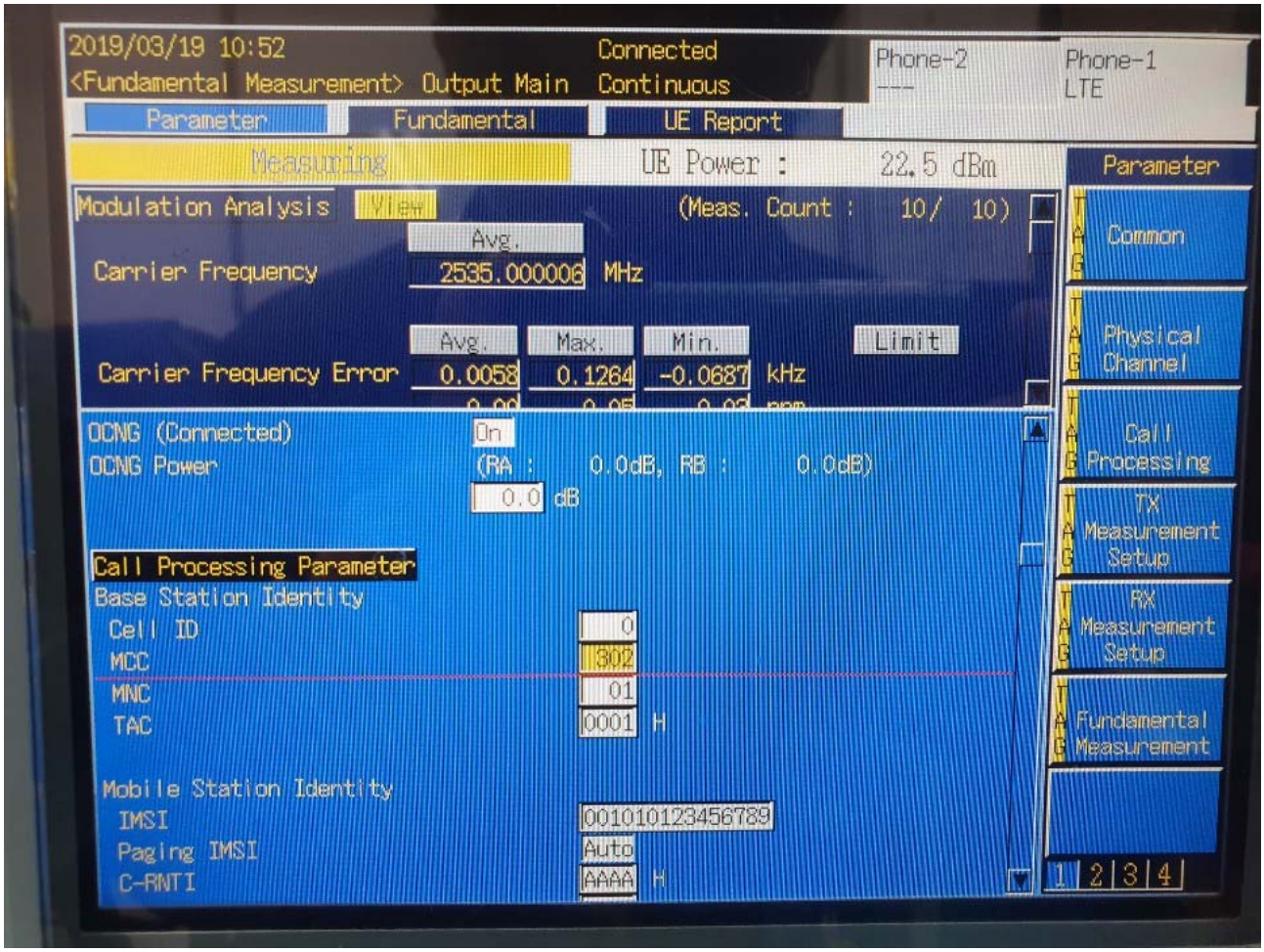
The device uses a geo-location mechanism based on the cellular MCC codes in order to only enable certain LTE bands when the device is not in the USA.

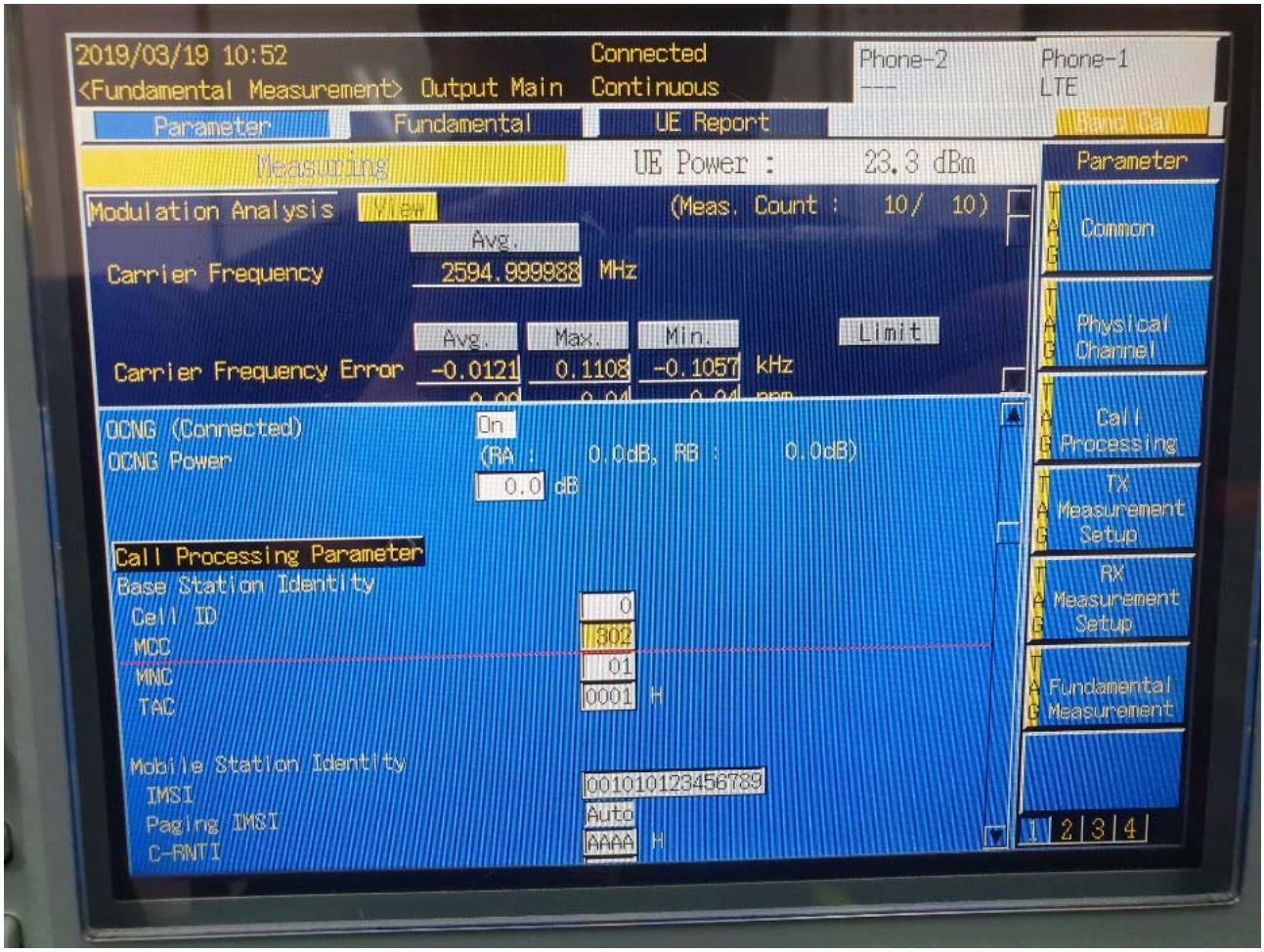
The validation of this mechanism is provided below. The device was configured for cellular communications to a test set and the MCC code was adjusted on the test set between the US MCC and then an MCC code valid for a country where the LTE band is supported.

Band	MCC = USA	MCC = non US
7	Did not connect	Connected (Canada)
38	Did not connect	Connected (Canada)
40	Did not connect	Connected (Canada)

The verification tests confirmed the operational of the geo-location mechanism.

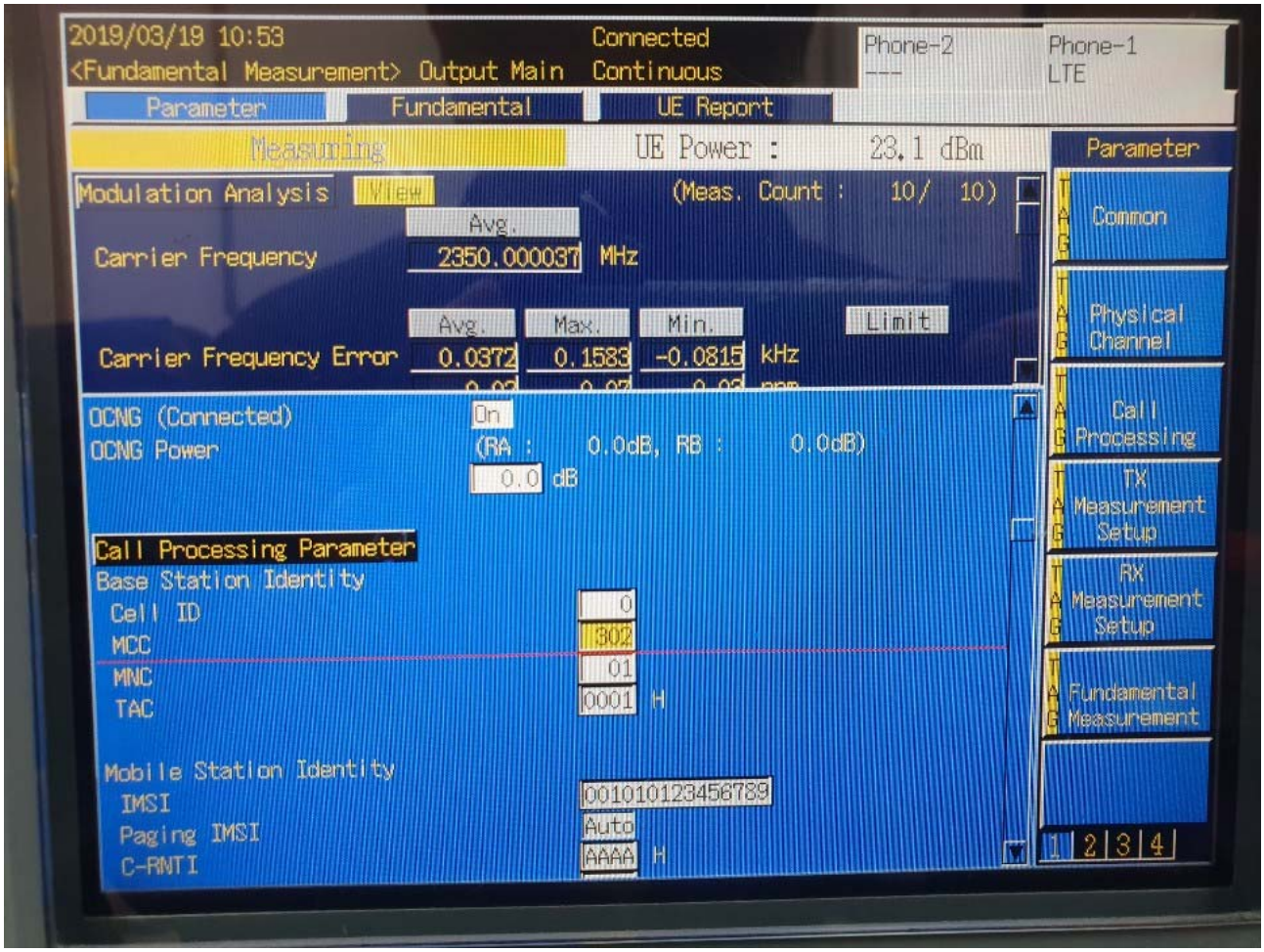
Verification test

Connected(LTE B7) (MCC = Canada)


Connected(LTE B38) (MCC = Canada)


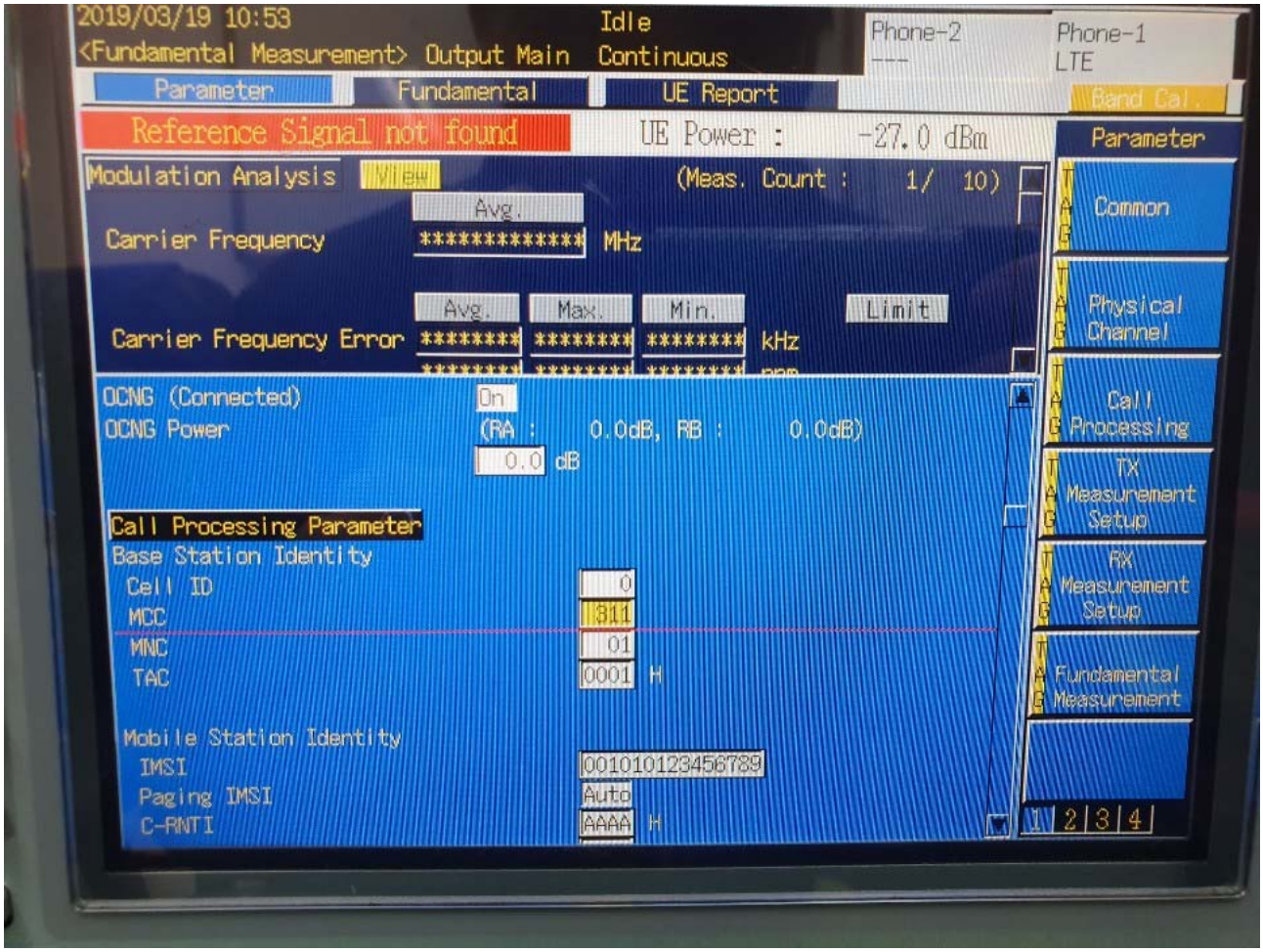
Connected(LTE B40)

(MCC = Canada)



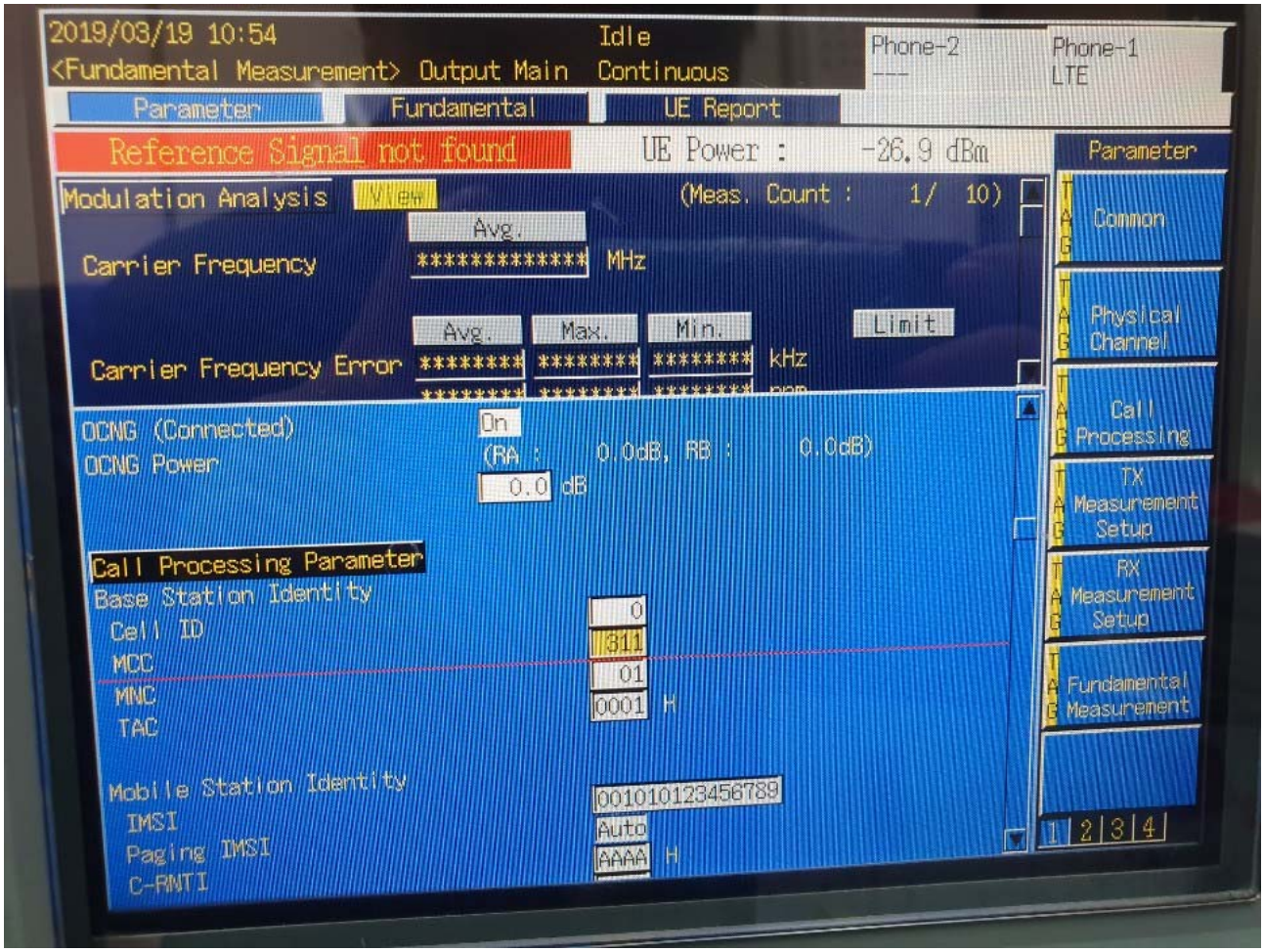
Did not connect (LTE B7)

(MCC = US)



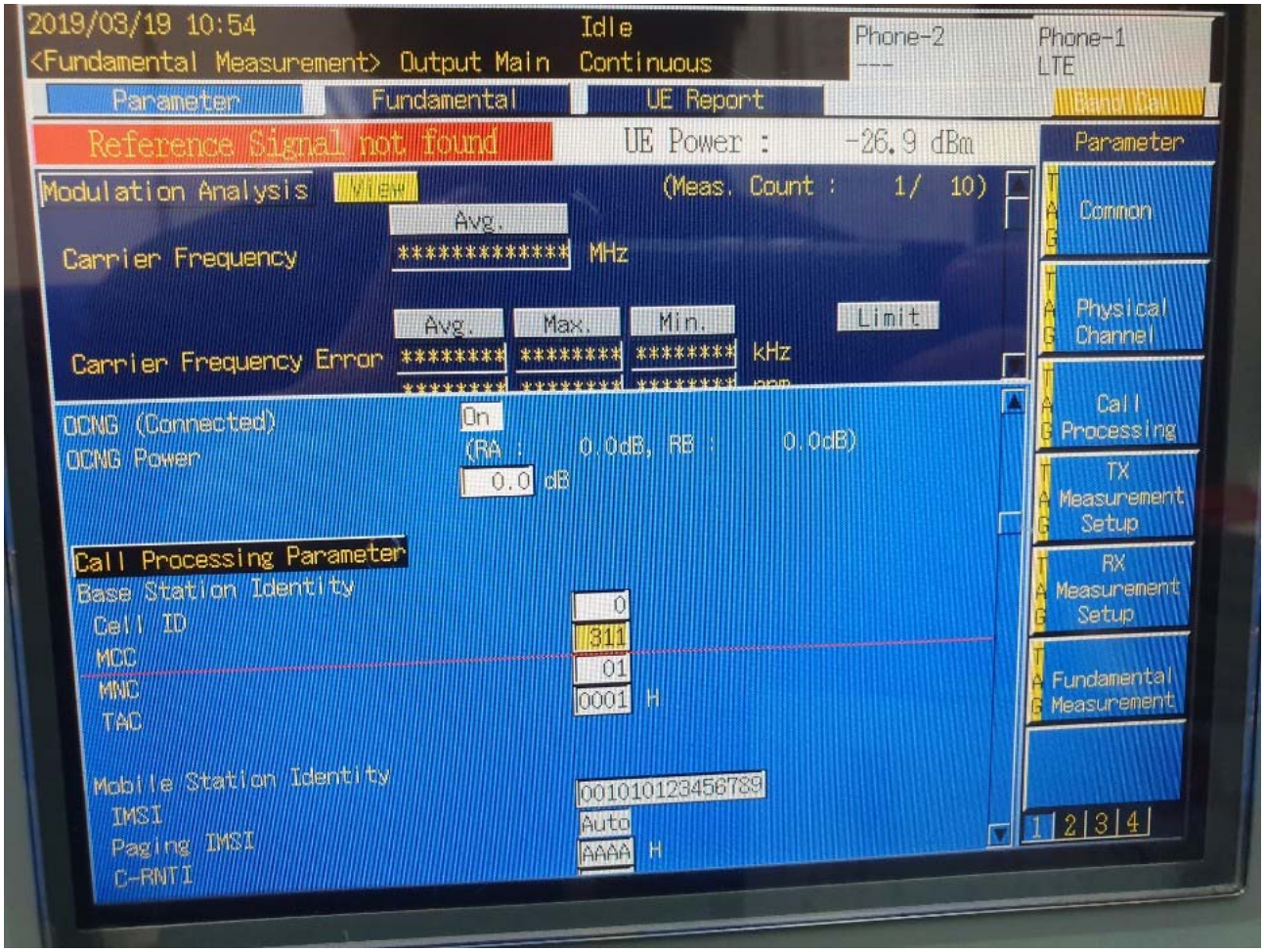
Did not connect (LTE B38)

(MCC = US)



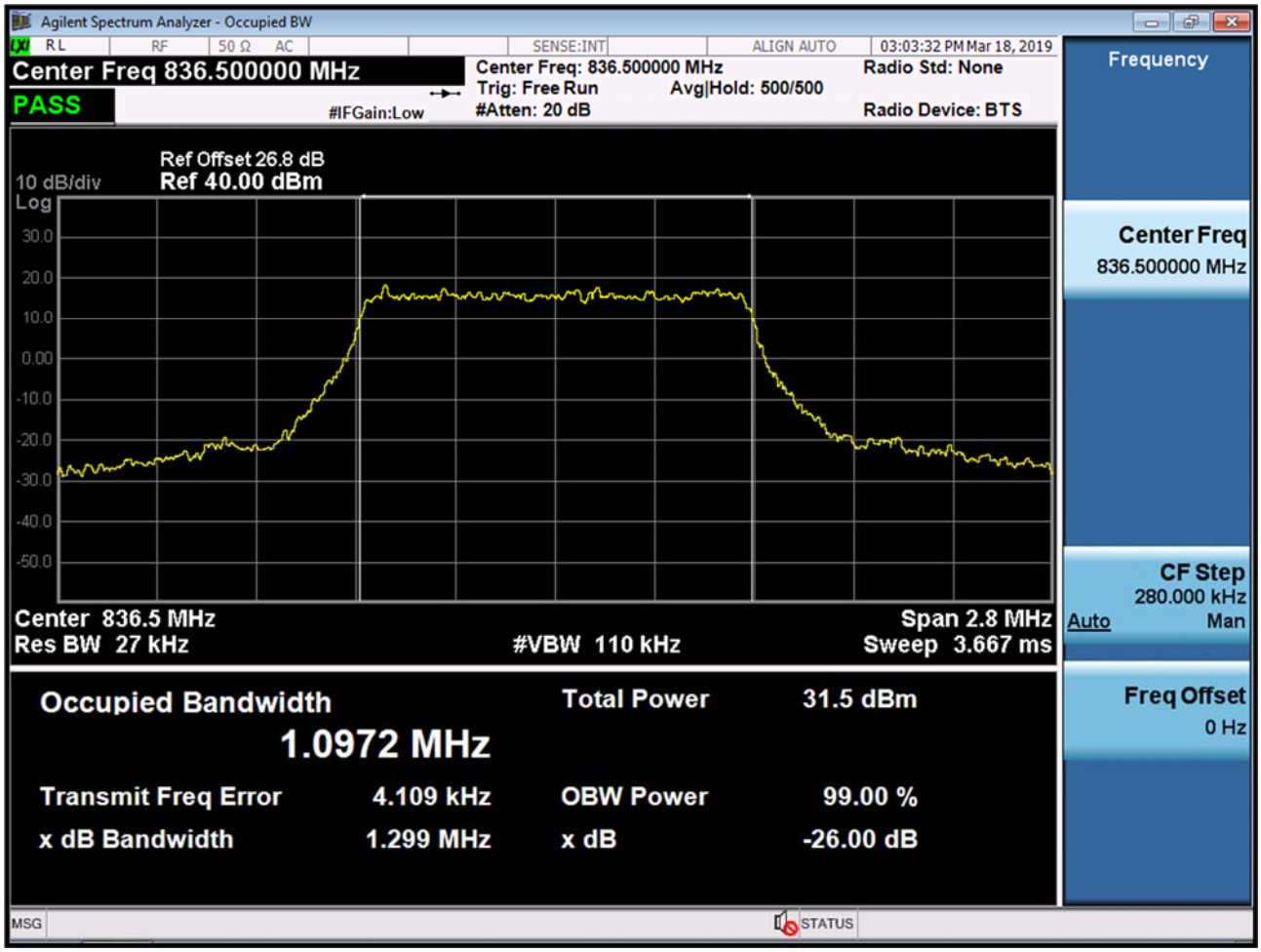
Did not connect (LTE B40)

(MCC = US)

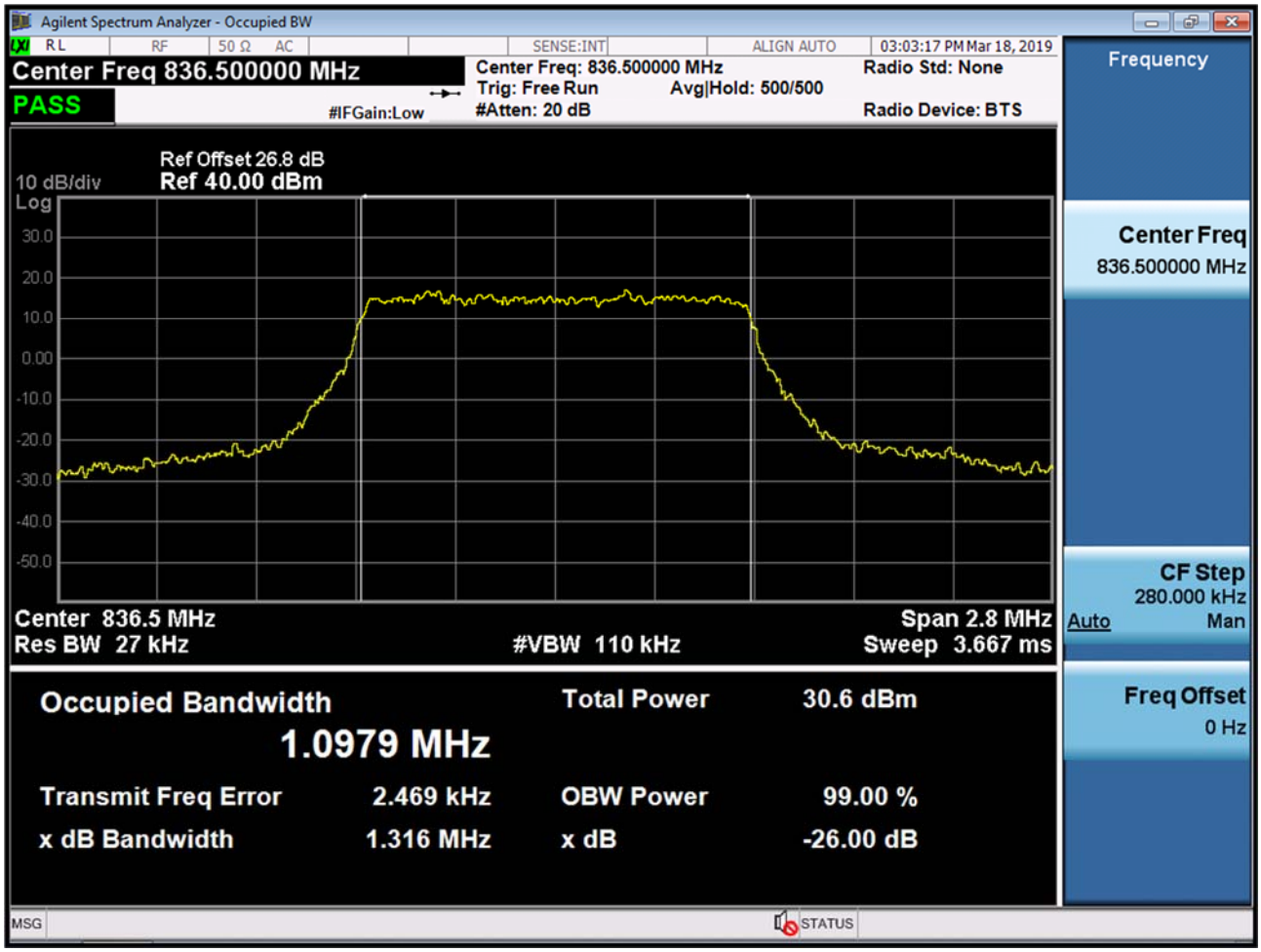


9. TEST PLOTS

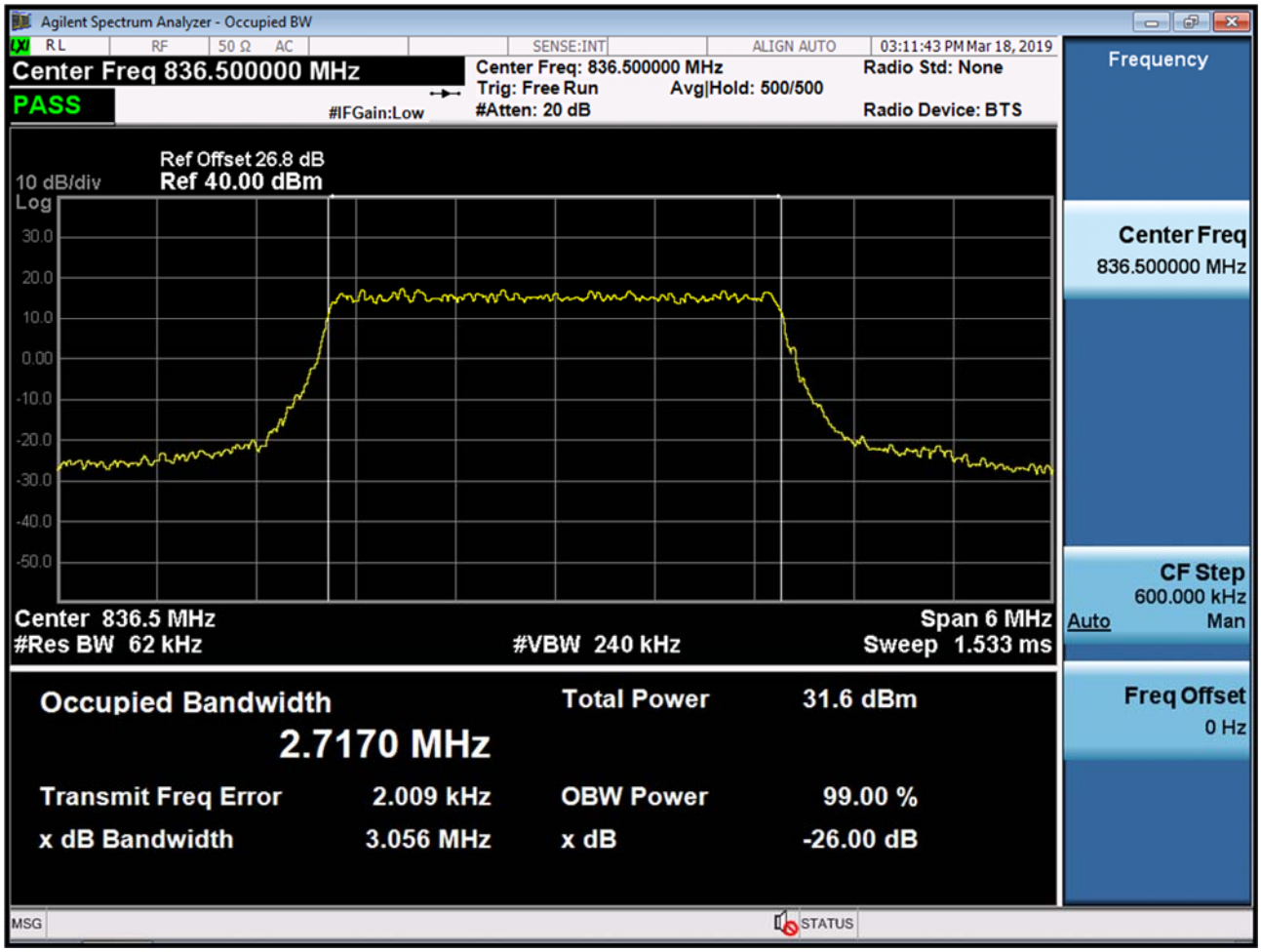
BAND 5. Occupied Bandwidth Plot (1.4M BW Ch.20525 QPSK_RB6_0)



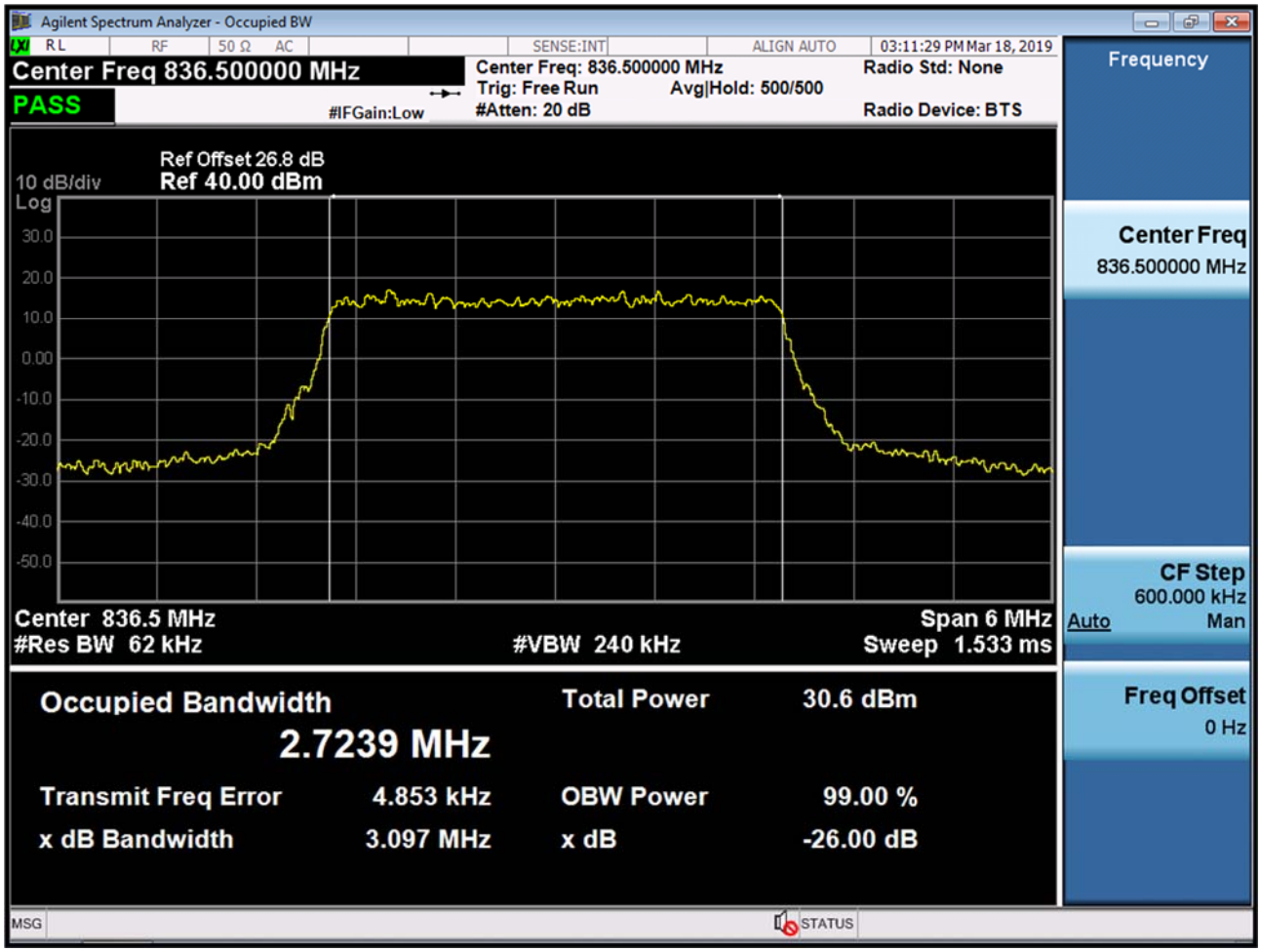
BAND 5. Occupied Bandwidth Plot (1.4M BW Ch.20525 16QAM_RB6_0)



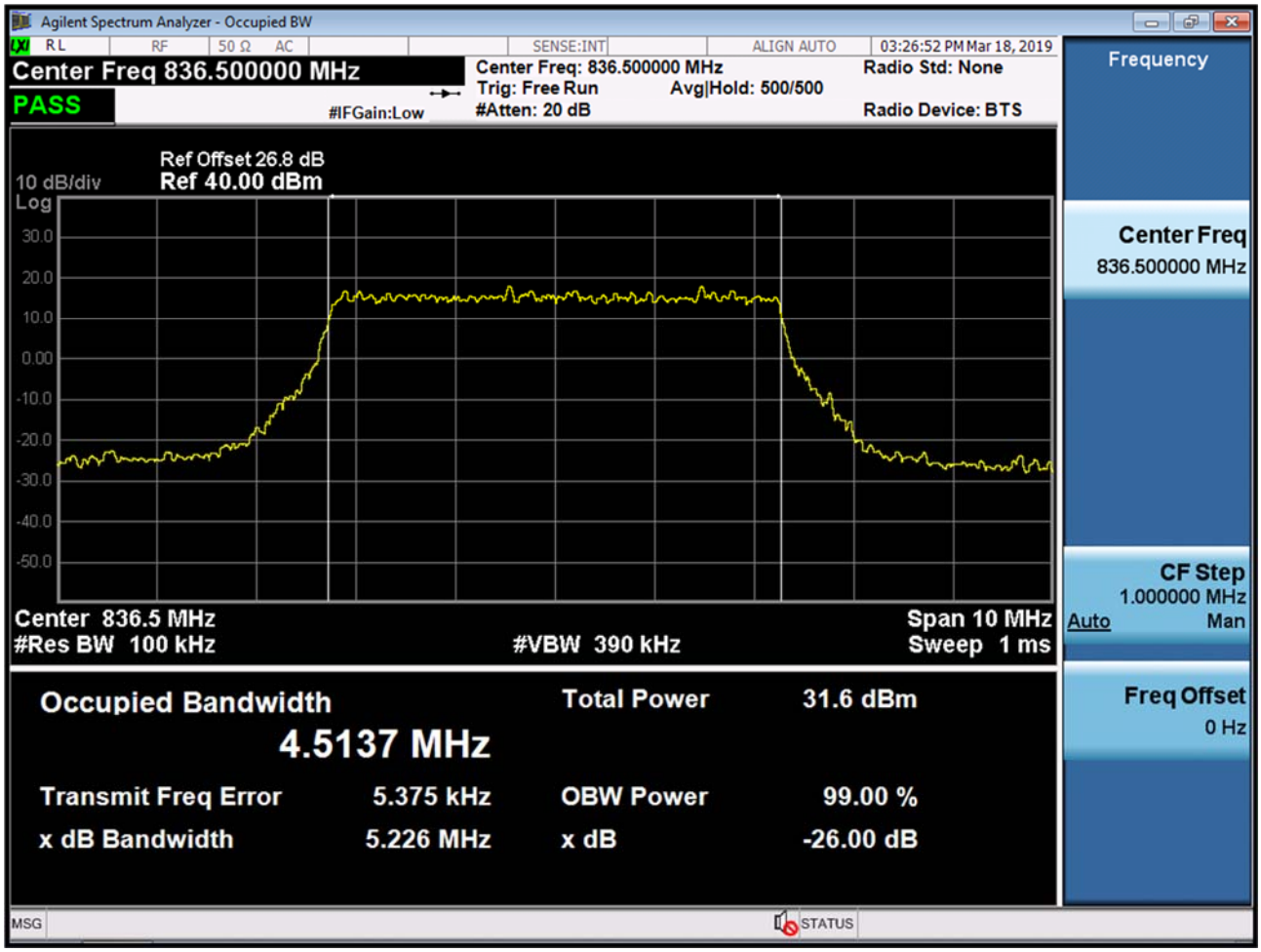
BAND 5. Occupied Bandwidth Plot (3M BW Ch.20525 QPSK_RB15_0)



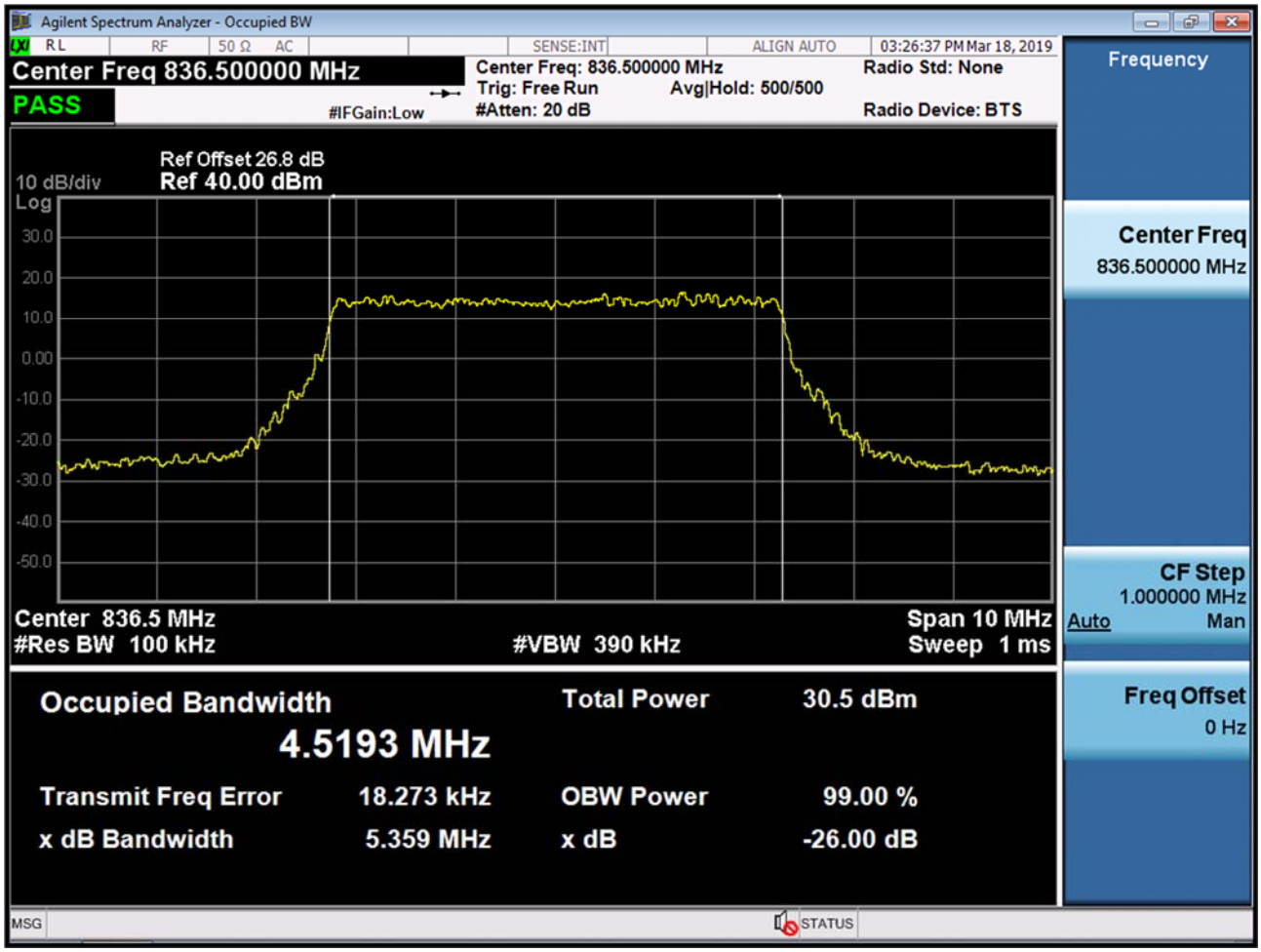
BAND 5. Occupied Bandwidth Plot (3M BW Ch.20525 16QAM_RB15_0)



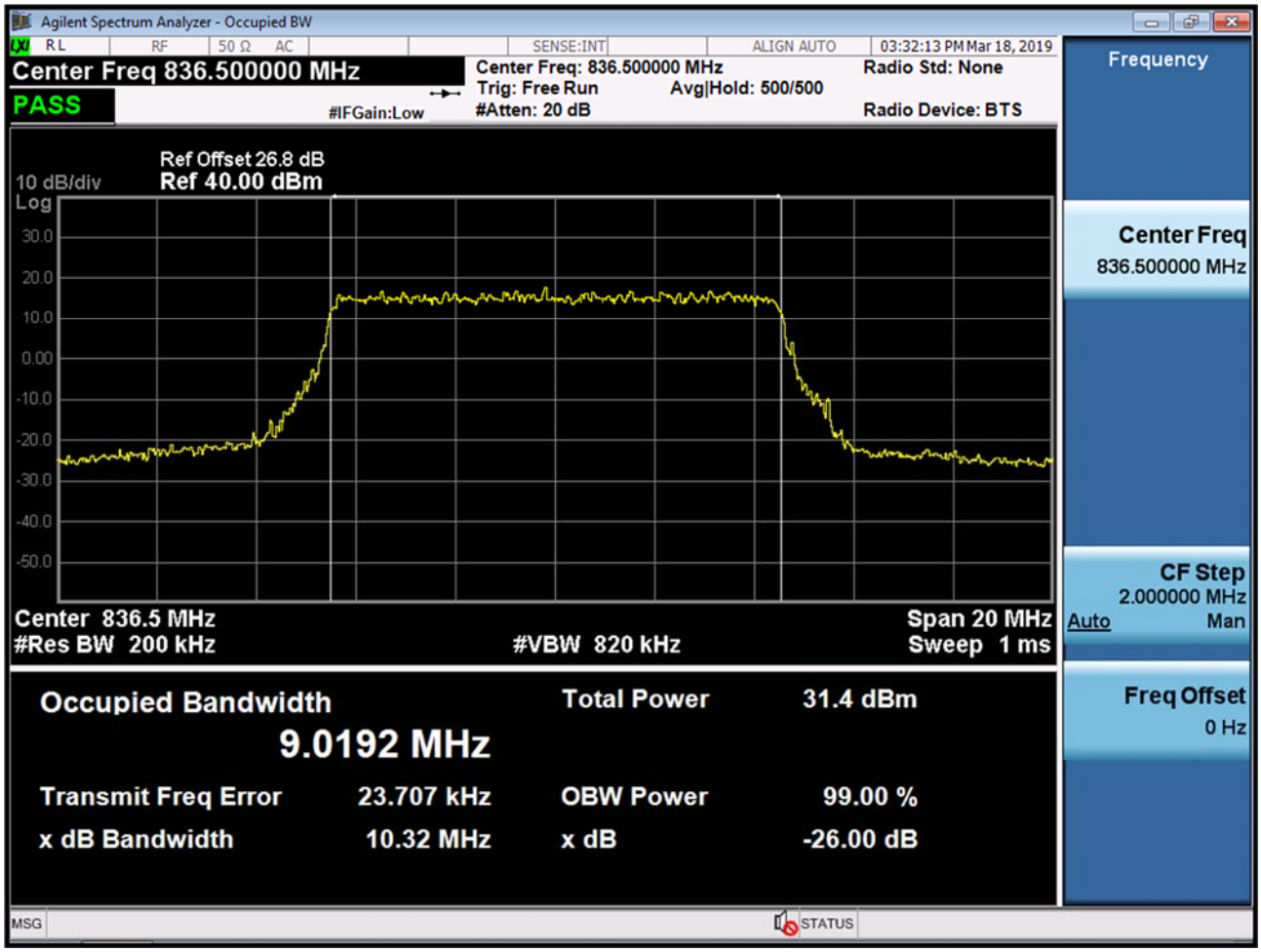
BAND 5. Occupied Bandwidth Plot (5M BW Ch.20525 QPSK_RB25_0)



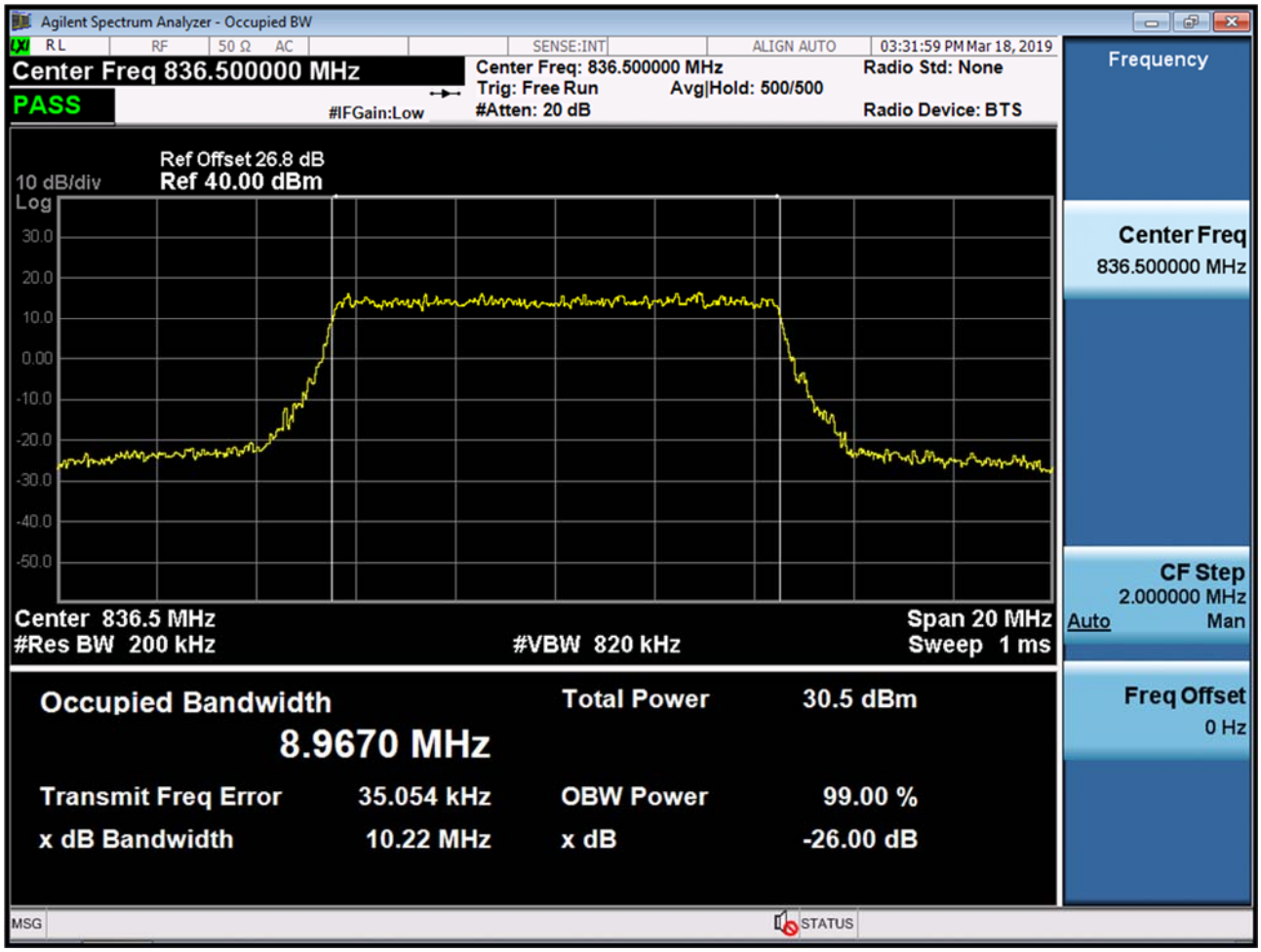
BAND 5. Occupied Bandwidth Plot (5M BW Ch.20525 16QAM_RB25_0)



BAND 5. Occupied Bandwidth Plot (10M BW Ch.20525 QPSK_RB50_0)



BAND 5. Occupied Bandwidth Plot (10M BW Ch.20525 16QAM_RB50_0)



BAND 5. Lower Band Edge Plot (1.4M BW Ch.20407 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (1.4M BW Ch.20407 QPSK_RB6_Offset 0)

BAND 5. Lower Extended Band Edge Plot (1.4M BW Ch.20407 QPSK_RB6_0)

BAND 5. Lower Band Edge Plot (3M BW Ch.20415 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (3M BW Ch.20415 QPSK_RB15_Offset 0)

BAND 5. Lower Extended Band Edge Plot (3M BW Ch.20415 QPSK_RB15_0)

BAND 5. Lower Band Edge Plot (5M BW Ch.20425 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (5M BW Ch.20425 QPSK_RB25_Offset 0)

BAND 5. Lower Extended Band Edge Plot (5M BW Ch.20425 QPSK_RB25_0)

BAND 5. Lower Band Edge Plot (10M BW Ch.20450 QPSK_RB1_Offset 0)

BAND 5. Lower Band Edge Plot (10M BW Ch.20450 QPSK_RB50_Offset 0)

BAND 5. Lower Extended Band Edge Plot (10M BW Ch.20450 QPSK_RB50_0)

BAND 5. Upper Band Edge Plot (1.4M BW Ch.20643 QPSK_RB1_Offset 5)

BAND 5. Upper Band Edge Plot (1.4M BW Ch.20643 QPSK_RB6_Offset 0)

BAND 5. Upper Extended Band Edge Plot (1.4M BW Ch.20643 QPSK_RB6_0)

BAND 5. Upper Band Edge Plot (3M BW Ch.20635 QPSK_RB1_Offset 14)