7. Band Edge Spectrum AWS

7.1 Test Specification

FCC Part 27, Subpart C, Section 27.53 (h)

7.2 Test Procedure

Enclosed are spectrum analyzer plots for the lowest operation frequency and the highest operation frequency in which the E.U.T. is planned to be used.

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (loss = 41.0 dB).

7.3 Limit

The 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 + log (P) dB, yielding –13dBm.

7.4 Test Results

Modulation	Operation Frequency	Band Edge Frequency	Reading	Specification	Margin
	(MHz)	(MHz)	(dBm)	(dBm)	(dB)
LTE 64QAM	2115.0	2110.00	-28.2	-13.0	-15.2
LTE 64QAM	2175.0	2180.00	-24.9	-13.0	-11.9
GSM	2111.2	2110.00	-24.4	-13.0	-11.4
GSM	2178.8	2180.00	-18.2	-13.0	-5.2
W-CDMA	2112.5	2110.00	-15.3	-13.0	-2.3
W-CDMA	2177.5	2180.00	-15.3	-13.0	-2.3

Figure 49 Band Edge Spectrum Results AWS

See additional information in *Figure 50* to *Figure 55.*

JUDGEMENT: Passed by 2.3 dB

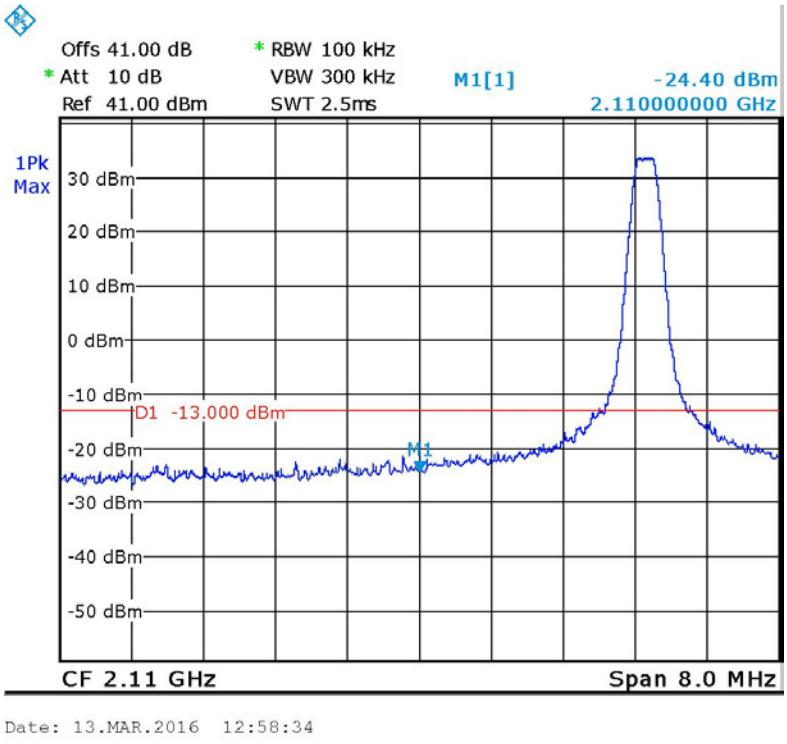

Figure 50. — GSM 2111.2 MHz

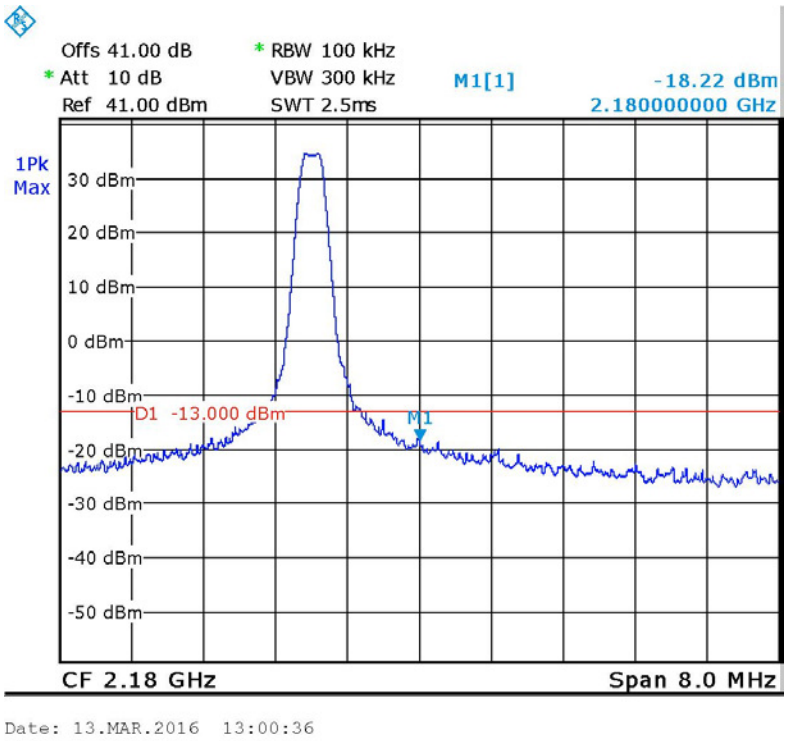

Figure 51. — GSM 2178.8 MHz

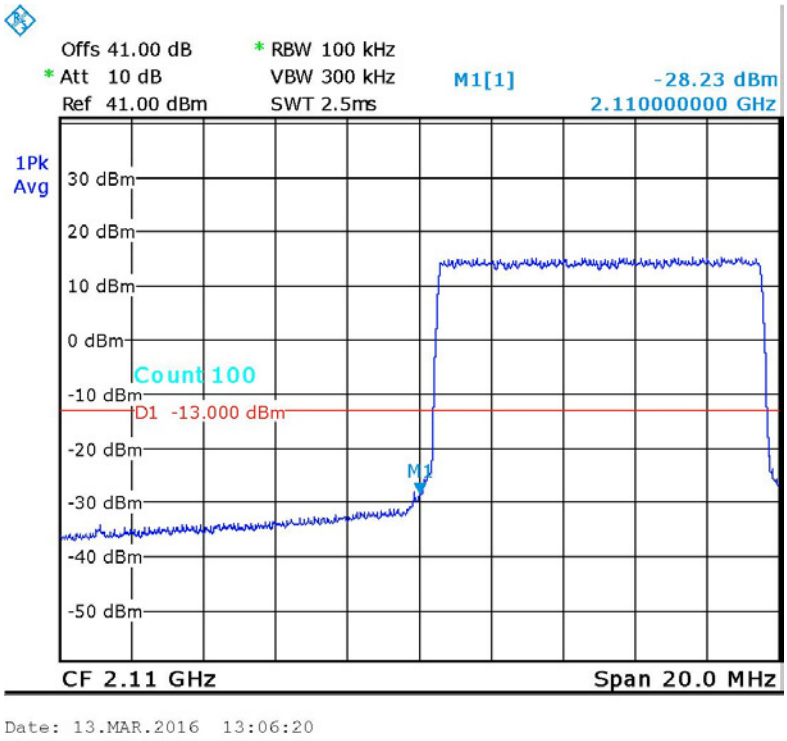

Figure 52. — LTE 64QAM 2115.0 MHz

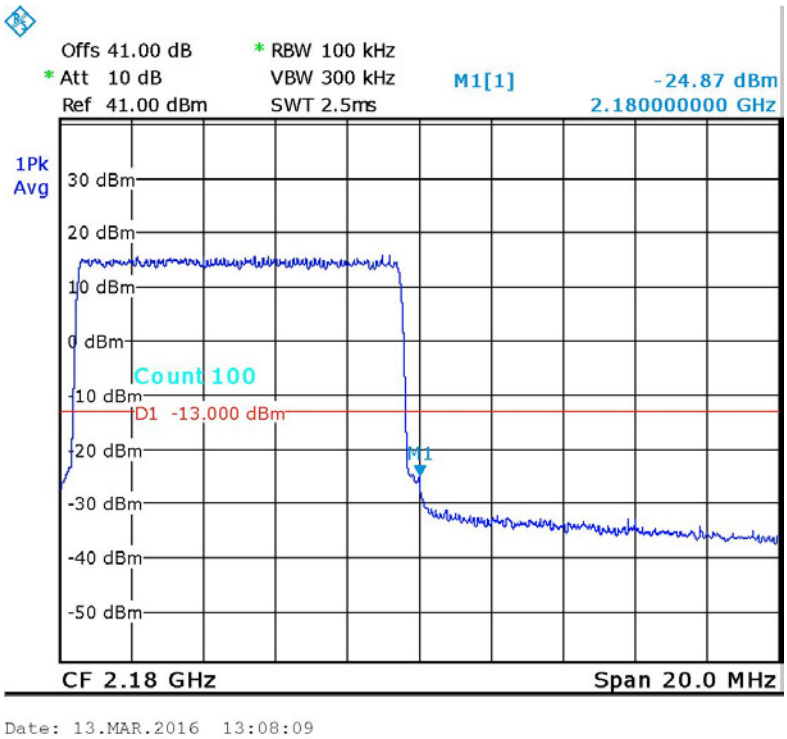

Figure 53. — LTE 64QAM 2175.0 MHz

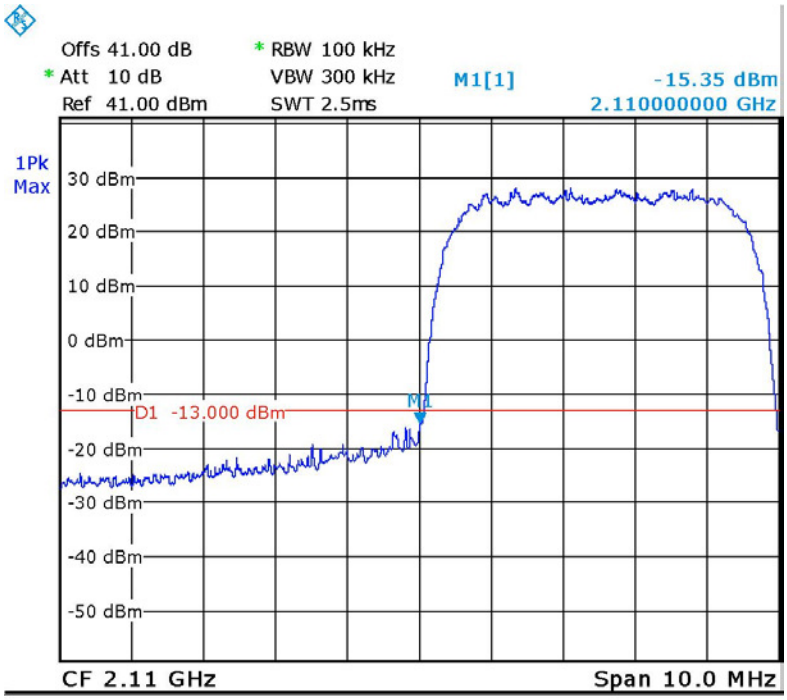

Figure 54. — W-CDMA 2112.5 MHz

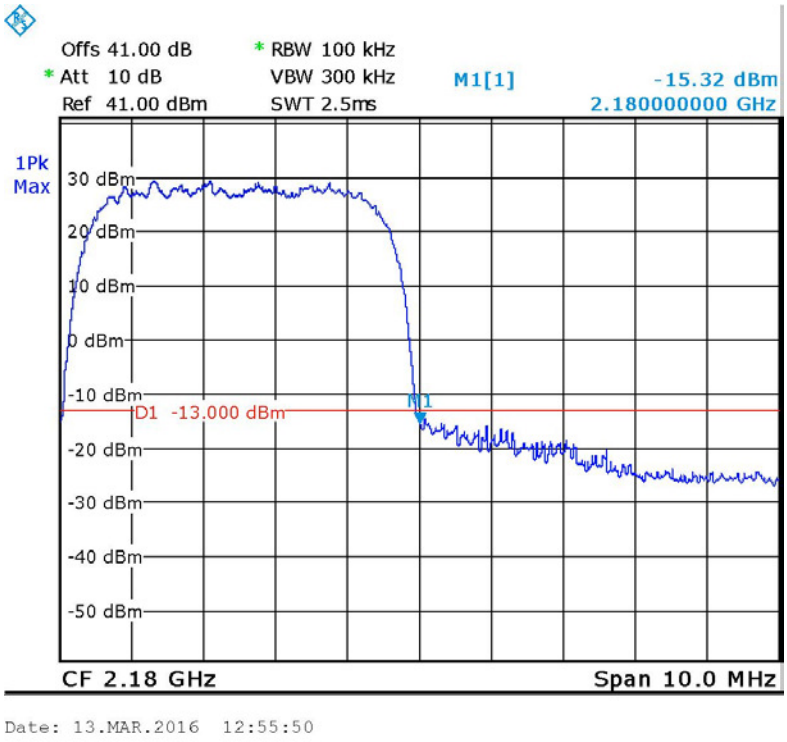

Figure 55. — W-CDMA 2177.5 MHz

7.5 Test Equipment Used; Band Edge Spectrum AWS

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration	Period
EXG Vector signal generator	Agilent	N5172B	MY51350518	May 3, 2013	May 3, 2016
Spectrum Analyzer	R&S	FSL6	100194	February 29, 2016	February 28, 2017
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	March 1, 2015	March 31, 2016

Figure 56 Test Equipment Used

8. Spurious Radiated Emission AWS

8.1 Test Specification

FCC, Part 27, Subpart C, Section 27.53 (h)

8.2 Test Procedure

The test method was based on ANSI/TIA-603-D: 2010, Section 2.2.12 Unwanted Emissions: Radiated Spurious.

(a) The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009MHz-30MHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.0 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-22.0GHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -22.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

(b) The E.U.T. was replaced by a substitution antenna (dipole 30MHz-1GHz, Horn Antenna above 1GHz) driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).
The signals observed in step (a) were converted to radiated power using:
$P_d(dBm) = P_g(dBm) – Cable\ Loss\ (dB) + Substitution\ Antenna\ Gain\ (dBd)$
P_d = Dipole equivalent power (result).
P_g = Signal generator output level.

A Peak detector was using for this test.

The test was performed in 3 operation frequencies: bottom, middle and top.

Testing was performed when the RF port was connected to 50 Ω termination.

All modulations (GSM, WCDMA and LTE-64QAM) were tested. The GSM modulation had the highest radiation and its results are listed below.

8.3 Limit

The power of any emission outside of the authorized operating frequency ranges (2110-2180 MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB, yielding –13dBm

8.4 Test Results

Carrier Channel	Freq.	Antenna Pol.	Maximum Peak Level	Signal Generator RF Output	Cable Loss	Antenna Gain	Effective Radiated Power Level	Limit	Margin
(MHz)	(MHz)	(V/H)	(dBµV/m)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)	(dB)
2111.2	4222.4	V	43.5	-55.7	0.5	7.4	-48.8	-13.0	-35.8
	4222.4	H	43.6	-55.2	0.5	7.4	-48.3	-13.0	-35.3
2145.0	4290.0	V	42.6	-56.5	0.5	7.4	-49.6	-13.0	-36.6
	4290.0	H	43.0	-55.7	0.5	7.4	-48.8	-13.0	-35.8
2178.8	4357.6	V	45.1	-54	0.5	7.4	-47.1	-13.0	-34.1
	4357.6	H	44.5	-54.6	0.5	7.4	-47.7	-13.0	-34.7

Figure 57 Spurious Radiated Emission AWS – GSM Modulation

The E.U.T met the requirements of the FCC, Part 27, Subpart C, Section 27.53 (h) specifications.

JUDGEMENT: Passed by 34.1 dB

8.5 *Test Instrumentation Used, Radiated Measurements AWS*

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EMI Receiver	HP	85422E	3906A00276	March 3, 2016	March 3, 2017
RF Filter Section	HP	85420E	3705A00248	March 3, 2016	March 3, 2017
EMI Receiver	R&S	ESCI7	100724	February 29, 2016	March 1, 2017
Spectrum Analyzer	HP	8593EM	3536A00120ADI	March 10, 2016	March 10, 2017
Active Loop Antenna	EMCO	6502	9506-2950	November 5, 2015	November 30, 2016
Antenna Biconical	EMCO	3104	2606	December 28, 2014	December 28, 2016
Antenna Log Periodic	EMCO #1349	3146	9505-4081	December 28, 2014	December 28, 2016
Horn Antenna 1G-18G	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna 18G-26G	ARA	SWH-28	1007	March 30, 2014	March 30, 2016
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	March 1, 2015	March 31, 2016
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	March 1, 2015	March 3 1, 2016
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A
Antenna Mast	ETS	2070-2	-	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 58 Test Equipment Used

9. APPENDIX A - CORRECTION FACTORS

9.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)	Frequency (MHz)	Cable Loss (dB)
0.010	0.4	50.00	1.2
0.015	0.2	100.00	0.7
0.020	0.2	150.00	2.1
0.030	0.3	200.00	2.3
0.050	0.3	300.00	2.9
0.075	0.3	500.00	3.8
0.100	0.2	750.00	4.8
0.150	0.2	1000.00	5.4
0.200	0.3	1500.00	6.7
0.500	0.4	2000.00	9.0
1.00	0.4	2500.00	9.4
1.50	0.5	3000.00	9.9
2.00	0.5	3500.00	10.2
5.00	0.6	4000.00	11.2
10.00	0.8	4500.00	12.1
15.00	0.9	5000.00	13.1
20.00	0.8	5500.00	13.5
		6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

9.2 Correction factors for RF cable for Semi Anechoic Chamber

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

9.3 Correction factors for Horn ANTENNA

Model: 3115
Antenna serial number: 29845
10 meter range

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (dB/m)
1000	22.4	10000	36.1
2000	25.2	11000	37.0
3000	31.1	12000	41.3
4000	30.2	13000	38.1
5000	34.2	14000	41.7
6000	31.6	15000	39.0
7000	34.7	16000	38.8
8000	34.8	17000	43.2
9000	36.2	18000	43.7

9.4 Correction factors for Horn ANTENNA

Model: SWH-28
Antenna serial number: 1007
1 meter range

FREQUENCY	Antenna Factor
(MHz)	(dB/m)
18000	33.0
18500	32.9
19000	33.1
19500	33.3
20000	33.6
20500	33.6
21000	33.4
21500	33.8
22000	33.7
22500	33.9
23000	34.8
23500	34.5
24000	34.2
24500	34.8
25000	34.4
25500	35.2
26000	35.9
26500	36.0

9.5 Correction factors forACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2

9.6 Correction factors forBiconical Antenna EMCO Model 3104 serial 2606

CALIBRATION DATA

Frequency, MHz	Near free space antenna factor, dB/m	Geometry specific correction factor, dB	Free space antenna factor, dB/m [1)]
30	12.97	0.13	12.84
35	12.34	0.09	12.25
40	12.03	0.06	11.97
45	11.42	0.02	11.40
50	11.91	0.03	11.88
60	11.92	0.37	11.55
70	9.60	0.25	9.35
80	6.99	-0.45	7.44
90	10.87	-0.34	11.21
100	11.51	-0.06	11.57
120	13.30	0.20	13.10
140	12.56	-0.01	12.57
160	14.49	-0.12	14.61
180	16.53	0.05	16.48
200	15.30	0.15	15.15

[1)] The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

9.7 Correction factors forLog Periodic Antenna EMCO Model 3146 serial 9505-4081

CALIBRATION DATA

Frequency, MHz	Antenna factor, dB/m [1]
200	11.55
250	11.60
300	14.43
400	15.38
500	17.98
600	18.78
700	21.17
800	21.16
900	22.67
1000	24.09

[1] The antenna factor shall be added to receiver reading in dBµV to obtain field strength in dBµV/m.