



FCC PART 27

TEST AND MEASUREMENT REPORT

For

Whoop Wireless, Inc.

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1509101-27	Initial	2015-11-03

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Whoop Wireless, Inc.* and their product model: HE4-001, FCC ID: 2AEQJ-HE4-001 which will henceforth be referred to as the EUT (Equipment under Test). The EUT was a dual-directional industrial amplifier. The EUT operated in the frequency bands of 2100 MHz and 1700 MHz for CDMA, WCDMA and LTE downlink & uplink, 700 MHz for LTE downlink and uplink, respectively.

1.2 Mechanical Description

The EUT measured approximately 25.4 cm (L) x 21 cm (W) x 5.1 cm (H) and weighs 1.25 kg.

The test data gathered are from typical production sample, serial number: R1509101-1, assigned by BACL.

1.3 Objective

This type approval report was prepared on behalf of *Whoop Wireless, Inc.* in accordance with Part 2, Subpart J, Part 20.21, and Part 27 of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC rules for RF output power, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation and band edge.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 20.21 – Signal Boosters Part 27 - Miscellineous Wireless Communication Services

Applicable Standards: TIA/EIA603-D, FCC KDB 935210.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ± 2.0 dB for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:

1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to ISO Guide 65:1996 by A2LA to certify:

1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.

2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.

3. Radio Communication Equipment for Singapore.

4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.

5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).

6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

 $\frac{http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286\&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b}{\label{eq:abs}}$

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-D. The final qualification test was performed with the EUT operating at normal mode.

2.2 EUT Exercise Software

There was no exercise software with the EUT; signal was sent through EUT using a signal generator.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 EUT Internal Configuration

Manufacturer	Description	Model	Serial Number
Zore Access Tech	-	HE4-001 REV A	-

2.5 Local Support Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Dell	Laptop	Latitude D600	CN-0X2034-48643-3A6-8307

2.6 **Power Supply and Line Filters**

Manufacturers	Descriptions	Models	Serial Numbers
-	AC/DC Adapter	KWT-0605000	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	То
RF cable	< 1	Signal Generator	Input/EUT
RF cable	< 1	Output/EUT	Spectrum Analyzer

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§2.1046, §27.50(b)(c)(d)	RF Output Power	Compliant
§2.1049	26 dB Occupied Bandwidth	Compliant
§2.1053, §27.53	Spurious Radiated Emissions	Compliant
§2.1053, §27.53	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §27.53	Band Edge & Intermodulation	Compliant
§2.1055, §27.54	Frequency Stability	N/A ¹
§20.21	Out of Band Rejection	Compliant

¹ The EUT was a signal booster.

Whoop Wireless Inc.

4 FCC §1.1307(b) (1) & §2.1091 - RF Exposure

4.1 Applicable Standards

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
	Limits for Gene	eral Population/Uncon	trolled Exposure	
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Limits for General Population/Uncontrolled Exposure

Note: f = frequency in MHz

* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

- G = power gain of the antenna in the direction of interest relative to an isotropic radiator
- R = distance to the center of radiation of the antenna

4.3 Test Results

AWS Band

Downlink

- Maximum peak output power at antenna input terminal (dBm): 14.59
- Maximum peak output power at antenna input terminal (mW): 28.77
 - Prediction distance (cm): 30

Prediction frequency (MHz): 2107

- Antenna Gain, typical (dBi): 10
- Maximum Antenna Gain (numeric): 10
- Power density at predication frequency and distance (mW/cm²): 0.0254
- MPE limit for uncontrolled exposure at predication frequency (mW/cm²): <u>1.0</u>

Uplink

<u>19.24</u>	Maximum peak output power at antenna input terminal (dBm):
83.95	Maximum peak output power at antenna input terminal (mW):
<u>30</u>	Prediction distance (cm):
<u>1722.75</u>	Prediction frequency (MHz):
<u>10</u>	Antenna Gain, typical (dBi):
<u>10</u>	Maximum Antenna Gain (numeric):

Power density at predication frequency and distance (mW/cm²): 0.0742

MPE limit for uncontrolled exposure at predication frequency (mW/cm^2) : 1.0

LTE Band 13

Downlink

Maximum peak output power at antenna input terminal (dBm):	<u>14.82</u>
Maximum peak output power at antenna input terminal (mW):	30.34

- Prediction distance (cm): 30
- Prediction frequency (MHz): 747.42
- Antenna Gain, typical (dBi): 8.5
- Maximum Antenna Gain (numeric): 7.0795
- Power density at predication frequency and distance (mW/cm²): 0.0190
- MPE limit for uncontrolled exposure at predication frequency (mW/cm²): 0.4983

Uplink

Maximum peak output power at antenna input terminal (dBm):					
Maximum peak output power at antenna input terminal (mW):	<u>199.99</u>				
Prediction distance (cm):	<u>30</u>				
Prediction frequency (MHz):	<u>777.56</u>				
Antenna Gain, typical (dBi):	<u>8.5</u>				
Maximum Antenna Gain (numeric):	<u>7.0795</u>				
Power density at predication frequency and distance (mW/cm^2) :	0.1252				

MPE limit for uncontrolled exposure at predication frequency (mW/cm²): 0.5184

LTE Band 17

Downlink

Maximum peak output power at antenna input terminal (dBm):	<u>14.82</u>
Maximum peak output power at antenna input terminal (mW):	<u>30.34</u>
Prediction distance (cm):	<u>30</u>
Prediction frequency (MHz):	<u>745.5</u>
Antenna Gain, typical (dBi):	<u>8.5</u>
Maximum Antenna Gain (numeric):	<u>7.0795</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.0190</u>
2	

MPE limit for uncontrolled exposure at predication frequency (mW/cm²): 0.4970

Uplink

Maximum peak output power at antenna input terminal (dBm):	<u>19.72</u>
Maximum peak output power at antenna input terminal (mW):	<u>93.76</u>
Prediction distance (cm):	<u>30</u>
Prediction frequency (MHz):	705.65
Antenna Gain, typical (dBi):	<u>8.5</u>
Maximum Antenna Gain (numeric):	<u>7.0795</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.0587</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>0.4704</u>

Results

For uplink and downlink, the highest power density levels at 30 cm are below the MPE uncontrolled exposure limit.

5 FCC §2.1046 & §27.50(b) (c) (d) - RF Output Power

5.1 Applicable Standards

According to FCC §27.50 (b) (9), control stations and mobile stations transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands and fixed stations transmitting in the 787-788 MHz and 805-806 MHz bands are limited to 30 Watts ERP.

According to FCC §27.50 (c) (9), control and mobile stations in the 698-746 MHz band are limited to 30 watts ERP.

According to FCC §27.50 (d) (2), the power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to an EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

According to FCC §27.50 (d) (4), fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP.

5.2 Test Procedure

Conducted:

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω - 75Ω matching pad.



5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

5.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-12 in the RF Site.

5.5 Test Results

AWS Band

Downlink

Signal Type	AGC	Input Power (dBm)	Output Power (dBm)	Gain (dB)	EIRP (dBm)
Broadband	Off	-49.21	14.59	63.8	24.59
	On	-46.12	14.9	61.02	24.9
Narrowband	Off	-50.95	13.12	64.07	23.12
	On	-47.57	12.65	60.22	22.65

Uplink

Signal Type	AGC	Input Power (dBm)	Output Power (dBm)	Gain (dB)	EIRP (dBm)
Broadband	Off	-51.17	15.86	67.03	25.86
	On	-47.84	15.81	63.65	25.81
Narrowband	Off	-47.36	19.24	66.6	29.24
	On	-45.19	18.13	63.32	28.13

Band	Signal Type	AGC	Input Power (dBm)	Output Power (dBm)	Gain (dB)	ERP (dBm)			
	Downlink								
	Droodbond	Off	-48.14	14.82	62.96	44.77			
	Dioadoand	On	-44.97	14.02	58.99	44.77			
	Norrowhond	Off	-50.12	12.29	62.41	44.77			
Dand 12	Inallowballu	On	-46.78	10.75	57.53	44.77			
Dalla 15			Up	link					
	Droodbond	Off	-42.76	21.92	64.68	28.27			
	Broadband	On	-39.5	23.47	62.97	29.82			
	Narrowband	Off	-42.42	22.37	64.79	28.72			
		On	-39.55	23.01	62.56	29.36			
	Downlink								
	Broadband	Off	-48.14	14.82	62.96	21.17			
		On	-44.97	14.02	58.99	20.37			
	Narrowhand	Off	-50.12	12.29	62.41	18.64			
Band 17	Nanowballu	On	-46.78	10.75	57.53	17.10			
Band 17	Uplink								
	Broadband	Off	-37.78	19.72	57.5	26.07			
	Divadualid	On	-34.5	19.24	53.74	25.59			
	Narrowhand	Off	-39.5	18.85	58.35	25.2			
	Narrowband	On	-36.71	17.47	54.18	23.82			

LTE Band 13 & 17

Note: ERP=Conducted Output Power (dBm) + Antenna Gain (dBi) -2.15 dB EIRP=Conducted Output Power (dBm) + Antenna Gain (dBi)

6 FCC §2.1049 – Occupied Bandwidth

6.1 Applicable Standards

Requirements: FCC §2.1049

6.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω -75 Ω matching pad.

The resolution bandwidth of the spectrum analyzer was set to at least 1 to 5% of the anticipated OBW and the 26 dB & 99% bandwidth was recorded.



6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2014-10-16	1 year
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2015-03-09	1 year
Agilent	Signal Generator	E4438C	MY45091309	2014-07-15	2 years

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

6.4 Test Environmental Conditions

Temperature:	21-23 °C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-9 in the RF Site.

6.5 Test Results

Please refer to the following table and plots.

	Signal Type	·	Inj	put	Output	
DL/UP		AGC	99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
	Droadband	off	4165.2	4628	4185	4668
Downlink	Broadband	on	4165.2	4628	4195.4	4693
	Narrowband	off	240.79	319.16	244.03	317.12
		on	240.79	319.16	241.25	317.36
Broadba Uplink Narrowba	Due e dhe u d	off	4170.2	4639	4168.4	4647
	Broadband	on	4170.2	4640	4164.7	4650
	NT 1 1	off	242.42	318.96	244.51	320.22
	Narrowband	on	242.42	318.96	243.12	319.12

AWS Band

LTE Band 13

DL/UP	Signal Type	·	Inj	put	Output	
		AGC	99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
	Dreadband	off	4169.4	4664	4152.9	4604
Downlink N	Broadband	on	4169.4	4664	4147.7	4683
	Narrowband	off	241.45	318.86	242.90	318.73
		on	241.45	318.86	241.70	321.89
Broadband Uplink Narrowband	Ducedheard	off	4182.6	4651	4204.6	4822
	Broadband	on	4182.6	4651	4481.1	4941
	NT 1 1	off	243.10	317.55	241.03	316.23
	Narrowband	on	243.10	317.55	244.19	319.10

LTE Band 17

DL/UP	Signal Type	AGC	Input		Output	
			99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Downlink	Broadband	off	4187.3	4632	4152.9	4604
		on	4187.3	4632	4147.7	4683
	Narrowband	off	240.84	317.37	245.54	317.95
		on	240.84	317.37	239.12	320.81
Uplink	Broadband	off	4174.1	4654	4113.1	4510
		on	4174.1	4654	4126.3	4941
	Narrowband	off	244.72	323.45	241.03	316.23
		on	244.72	323.45	244.19	319.10

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AWS Band, Downlink: Broadband Signal

AGC off

Input



Output







Output



AWS Band, Downlink: Narrowband Signal

AGC off

Input



Output







Output



AWS Band, Uplink: Broadband Signal

AGC off

Input



Output



Input



Output



AWS Band, Uplink: Narrowband Signal

AGC off

Input



Output







Output



LTE Band 13, Downlink: Broadband Signal

AGC off

Input



Output







Output



LTE Band 13, Downlink: Narrowband Signal

AGC off

Input



Output







Output



LTE Band 13, Uplink: Broadband Signal

AGC off

Input



Output







Output



Date: 22.0CT.2015 10:20:30

Date: 22.0CT.2015 10:21:19

LTE Band 13, Uplink: Narrowband Signal

AGC off





Output







Output



LTE Band 17, Downlink: Broadband Signal

AGC off

Input



Output



Input



Output



LTE Band 17, Downlink: Narrowband Signal

AGC off





Output


AGC on





Output



Report Number: R1509101-27

LTE Band 17, Uplink: Broadband Signal

AGC off







Output

Date: 22.0CT.2015 09:44:08

Report Number: R1509101-27

AGC on





Output



Date: 22.0CT.2015 09:44:40

Date: 22.0CT.2015 10:21:19

LTE Band 17, Uplink: Narrowband Signal

AGC off

Input



Output



Report Number: R1509101-27

AGC on

Input



Output



Report Number: R1509101-27

7 FCC §2.1053 & §27.53 (c) (g) (h) - Spurious Radiated Emissions

7.1 Applicable Standards

According to FCC §27.53,

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log (P)$ dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P) dB$. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

7.2 Test Procedure

The transmitter was placed on the turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \log (TX \text{ Power in Watts}/0.001)$ – the absolute level Spurious attenuation limit in dB = $43 + 10 \log_{10}$ (power out in Watts)

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
Hewlett Packard	Pre-amplifier	8447D	2944A10187	3/20/2015	1 year
HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A0113	3/11/2015	1 year
ЕМСО	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
COM-POWER	Antenna, Dipole	AD-100	721033DB1, 2, 3, 4	2014-11-03	2 years
Agilent	Analyzer, Communications	E5515C	GB44051221	2015-09-10	1 year

7.3 Test Equipment List and Details

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

7.4 Test Setup Block Diagram

Radiated Emissions Testing



7.5 Test Environmental Conditions

Temperature:	20-21°C
Relative Humidity:	47-49 %
ATM Pressure:	101.4-101.6 kPa

The testing was performed by Todd Moy on 2015-10-23 in 5 Meter Chamber 3.

7.6 Test Results

Carrier Wave Signal

AWS Band

Downlink

Indica	ated		Test Antenna		Substituted						
Frequency (MHz)	S.A. Amp. (dBuV)	Azimuth (degree)	Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
47.8	43.59	0	100	V	47.8	-41.97	0	0.05	-42.02	-13	-29.02
300	31.33	175	177	Н	300	-70.69	0	0.07	-70.76	-13	-57.76
300	30.28	112	100	V	300	-71.74	0	0.07	-71.81	-13	-58.81
374.4	27.35	254	119	Н	374.4	-71.58	0	0.08	-71.66	-13	-58.66
374.4	27.38	119	120	V	374.4	-71.55	0	0.08	-71.63	-13	-58.63
1039	52.73	0	100	Н	1039	-57.38	6.122	0.49	-51.748	-13	-38.748
1039	48.9	0	100	V	1039	-62.82	6.279	0.49	-57.031	-13	-44.031
2253	47.97	0	100	Н	2253	-59.56	9.205	0.69	-51.045	-13	-38.045
2253	52.88	0	100	V	2253	-55.09	9.506	0.69	-46.274	-13	-33.274

Uplink

Indic	ated		Test Antenna		Substituted						-
Frequency (MHz)	S.A. Amp. (dBuV)	Azimuth (degree)	Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
47.8	42.45	0	100	V	47.8	-43.11	0	0.05	-43.16	-13	-30.16
300	28.36	87	100	Н	300	-73.66	0	0.07	-73.73	-13	-60.73
300	29.62	267	100	V	300	-72.4	0	0.07	-72.47	-13	-59.47
374.4	28.26	115	100	Н	374.4	-70.67	0	0.08	-70.75	-13	-57.75
374.4	29.76	323	100	V	374.4	-69.17	0	0.08	-69.25	-13	-56.25
1039	48.55	0	100	Н	1039	-61.56	6.122	0.49	-55.928	-13	-42.928
1039	47.37	0	100	V	1039	-64.35	6.279	0.49	-58.561	-13	-45.561
2253	47.7	0	100	Н	2253	-59.83	9.205	0.69	-51.315	-13	-38.315
2253	50.52	0	100	V	2253	-57.45	9.506	0.69	-48.634	-13	-35.634

LTE Band 13

Indicated **Test Antenna** Substituted Azimuth Limit Margin Cable Absolute S.A. Ant. Gain Frequency Height Polarity Frequency Level (degree) (dBm) (**dB**) Correction Amp. Loss Level (MHz) (**cm**) (H/V) (MHz) (dBm) (dBuV) (\mathbf{dB}) (\mathbf{dB}) (dBm) 47.8 43.51 0 100 V 47.8 -42.05 0 0.05 -42.1 -13 -29.1 0.07 300 30.94 178 195 Η 300 -71.08 0 -71.15 -13 -58.15 300 31.24 127 100 V 300 -70.78 0 0.07 -70.85 -13 -57.85 -72.09 0.08 -72.17 374.4 26.84 273 152 Η 374.4 0 -13 -59.17 374.4 102 V 0 0.08 -71.34 27.67 100 374.4 -71.26 -13 -58.34 1039 49.42 0 100 Η 1039 -60.69 6.122 0.49 -55.058 -13 -42.058 1039 48.57 0 100 V 1039 -63.15 6.279 0.49 -57.361 -13 -44.361 2253 2253 47.12 0 100 Н -60.41 9.205 0.69 -51.895 -13 -38.895 V -49.794 2253 49.36 0 100 2253 -58.61 9.506 0.69 -13 -36.794

Downlink

Uplink

Indica	ated		Test Antenna		Substituted						
Frequency (MHz)	S.A. Amp. (dBuV)	Azimuth (degree)	Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
47.8	42.78	0	100	V	47.8	-42.78	0	0.05	-42.83	-13	-29.83
300	28.92	82	100	Н	300	-73.1	0	0.07	-73.17	-13	-60.17
300	28.82	246	100	V	300	-73.2	0	0.07	-73.27	-13	-60.27
374.4	27.73	105	100	Н	374.4	-71.2	0	0.08	-71.28	-13	-58.28
374.4	29.53	333	100	V	374.4	-69.4	0	0.08	-69.48	-13	-56.48
1039	46.96	0	100	Н	1039	-63.15	6.122	0.49	-57.518	-13	-44.518
1039	48.29	0	100	V	1039	-63.43	6.279	0.49	-57.641	-13	-44.641
2253	45.56	0	100	Н	2253	-61.97	9.205	0.69	-53.455	-13	-40.455
2253	46.59	0	100	V	2253	-61.38	9.506	0.69	-52.564	-13	-39.564

LTE Band 17

Indicated **Test Antenna** Substituted Azimuth Limit Margin Cable Absolute S.A. Ant. Gain Frequency Height Polarity Frequency Level (degree) (dBm) (**dB**) Correction Amp. Loss Level (MHz) (**cm**) (H/V) (MHz) (dBm) (dBuV) (\mathbf{dB}) (\mathbf{dB}) (dBm) -41.89 47.8 43.72 0 100 V 47.8 -41.84 0 0.05 -13 -28.89 0.07 300 30.88 178 191 Η 300 -71.14 0 -71.21 -13 -58.21 300 31.39 121 100 V 300 -70.63 0 0.07 -70.7 -13 -57.7 -72.06 0.08 -72.14 374.4 26.87 290 184 Η 374.4 0 -13 -59.14 374.4 V -72.33 0 0.08 -72.41 -59.41 26.6 108 100 374.4 -13 1039 49.63 0 100 Η 1039 -60.48 6.122 0.49 -54.848 -13 -41.848 1039 51.87 0 100 V 1039 -59.85 6.279 0.49 -54.061 -13 -41.061 2253 2253 -59.96 47.57 0 100 Н 9.205 0.69 -51.445 -13 -38.445 V -52.284 2253 46.87 0 100 2253 -61.1 9.506 0.69 -13 -39.284

Downlink

Uplink

Indic	ated		Test Antenna		Substituted						
Frequency (MHz)	S.A. Amp. (dBuV)	Azimuth (degree)	Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
47.8	42.75	0	100	V	47.8	-42.81	0	0.05	-42.86	-13	-29.86
300	28.64	85	102	Н	300	-73.38	0	0.07	-73.45	-13	-60.45
300	29.39	274	100	V	300	-72.63	0	0.07	-72.7	-13	-59.7
374.4	28.99	112	100	Н	374.4	-69.94	0	0.08	-70.02	-13	-57.02
374.4	29.42	326	100	V	374.4	-69.51	0	0.08	-69.59	-13	-56.59
1039	47.42	0	100	Н	1039	-62.69	6.122	0.49	-57.058	-13	-44.058
1039	47.35	0	100	V	1039	-64.37	6.279	0.49	-58.581	-13	-45.581
2253	46.18	0	100	Н	2253	-61.35	9.205	0.69	-52.835	-13	-39.835
2253	47.54	0	100	V	2253	-60.43	9.506	0.69	-51.614	-13	-38.614

8 FCC §2.1051 & §27.53 (c)(g)(h) - Spurious Emissions at Antenna Terminals

8.1 Applicable Standards

According to FCC §27.53,

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log (P)$ dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P) dB$. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω -75 Ω matching pad

The resolution bandwidth of the spectrum analyzer was set 100 KHz or greater for frequency band 746MHz-788MHz and greater than 1MHz for 2100 and 1700 band. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval	
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year	
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years	
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years	

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-10 in the RF Site.

8.5 Test Results

Please refer to the following plots,

AWS Band, Downlink: Broadband Signal

AGC Off

Low Channel: 2112.5 MHz



Middle Channel: 2132.5 MHz



🔆 Agilent Freq/Channel Mkr1 2.15 GHz Center Freq Ref 26.4 dBm #Peak 1 15.95 dBm #Atten 20 dB 11.0150000 GHz 1 Log 10 Start Freq 30.0000000 MHz dB/ Offst 16.4 ~3 8 Stop Freq 22.0000000 GHz dB DI estre. –13.0 dBm CF Step 2.19700000 GHz LgAv <u>Auto</u> Man Start 30 MHz Stop 22.00 GHz FreqOffset 0.0000000 Hz #Res BW 1 MHz VBW 3 MHz Sweep 109.9 ms (601 pts) Trace (1) (1) (1) (1) (1) Amplitude 15.95 dBm -30.67 dBm -28.88 dBm -27.03 dBm Type Freq Freq Freq Freq X Axis 2.15 GHz 760 MHz 870 MHz 1.97 GHz Marker 1234 Signal Track 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

High Channel: 2152.5 MHz

AGC On

Agilent Freg/Channel 24 Mkr4 1.97 GHz Center Freq -25.91 dBm Ref 26.4 dBm #Atten 20 dB 11.0150000 GHz #Peak Log 10 Start Freq dB/ 30.0000000 MHz Offst 16.4 ,3 8 Stop Freq dB 22.0000000 GHz DI . -13.0 **CF** Step dBm 2.19700000 GHz LgAv Man <u>Auto</u> Start 30 MHz Stop 22.00 GHz Freq Offset #Res BW 1 MHz Sweep 109.9 ms (601 pts) VBW 3 MHz 0.00000000 Hz Amplitude 14.90 dBm -30.64 dBm -28.14 dBm -25.91 dBm X Axis 2.12 GHz 760 MHz 870 MHz 1.97 GHz Trace (1) (1) Type Freq Freq Freq Marker 23 Signal Track (1) (1) 0n <u>0ff</u> 4 Freq Copyright 2000-2012 Agilent Technologies

Low Channel: 2112.5 MHz

Middle Channel: 2132.5 MHz



🔆 Agilent Freq/Channel Mkr1 2.15 GHz 17.34 dBm Center Freq Ref 26.4 dBm #Peak #Atten 20 dB 11.0150000 GHz ¢ Log 10 Start Freq dB/ 30.0000000 MHz Offst 16.4 ;3 © Stop Freq 22.0000000 GHz ¢ dB DL An –13.0 dBm **CF** Step 2.19700000 GHz LgAv Man Auto Start 30 MHz #Res BW 1 MHz Stop 22.00 GHz Sweep 109.9 ms (601 pts) Freq Offset 0.00000000 Hz VBW 3 MHz Trace (1) (1) (1) (1) (1) Amplitude 17.34 dBm -28.86 dBm -28.70 dBm -25.47 dBm Type Freq Freq Freq Freq X Axis 2.15 GHz 760 MHz 870 MHz 1.97 GHz Marker 1234 Signal Track 0n Off Copyright 2000-2012 Agilent Technologies

High Channel: 2152.5 MHz

AWS Band, Downlink: Narrowband signal

AGC Off

Low Channel: 2110.7 MHz



Middle Channel: 2132.5 MHz



🔆 Agilent Freq/Channel Mkr1 2.15 GHz Center Freq 11.0150000 GHz Ref 18.4 dBm #Peak _____ 10.98 dBm #Atten 12 dB ¢ Log 10 Start Freq 30.0000000 MHz dB/ Offst 16.4 Stop Freq 22.0000000 GHz dB DI –13.0 dBm CF Step 2.19700000 GHz LgAv Man <u>Auto</u> M1 S2 S3 FC Freq Offset 0.00000000 Hz sth. when r λu. M-WWW AA **£**(f): Signal Track FTun 0n <u>0ff</u> Swp Start 30 MHz #Res BW 1 MHz Stop 22.00 GHz VBW 3 MHz Sweep 109.9 ms (601 pts) Copyright 2000-2012 Agilent Technologies

High Channel: 2154.3 MHz

AGC On



Low Channel: 2110.7 MHz

Middle Channel: 2132.5 MHz





High Channel: 2154.3 MHz

AWS Band, Uplink: Broadband Signal

AGC Off

Low Channel: 1712.5 MHz



Middle Channel: 1732.5 MHz





High Channel: 1752.5 MHz

AGC On

Agilent Freq/Channel Mkr1 760 MHz Center Freq Ref 33 dBm #Peak _____ #Atten 22 dB -31.49 dBm 11.0150000 GHz 20 Log 10 Start Freq dB/ 30.0000000 MHz Offst 21 Stop Freq dB 22.0000000 GHz Ŷ DI -13.0 CF Step dBm 2.19700000 GHz Auto Man LgAv <u>Auto</u> Stop 22.00 GHz Start 30 MHz Freq Offset 0.00000000 Hz #Res BW 1 MHz VBW 3 MHz Sweep 109.9 ms (601 pts) X Axis 760 MHz 1.71 GHz 1.86 GHz Marker Trace Type Freq Freq Amplitude (1) (1) -31.49 dBm 19.80 dBm 23 Signal Track (1)Freq -27.76 dBm 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

Low Channel: 1712.5 MHz

Middle Channel: 1732.5 MHz



Agilent Freq/Channel 쑕 Mkr3 1.86 GHz Center Freq Ref 33 dBm #Peak -27.24 dBm #Atten 22 dB 11.0150000 GHz 2 Log 10 Start Freq dB/ 30.0000000 MHz Offst 21 Stop Freq 22.0000000 GHz dB 1 ð DI -13.0 dBm **CF Step** 2.19700000 GHz Auto Man LgAv <u>Auto</u> Start 30 MHz Stop 22.00 GHz Freq Offset 0.00000000 Hz #Res BW 1 MHz VBW 3 MHz Sweep 109.9 ms (601 pts) Trace (1) (1) (1) Amplitude -30.09 dBm 18.37 dBm -27.24 dBm X Axis 760 MHz 1.75 GHz 1.86 GHz Type Freq Freq Freq Marker Signal Track 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

High Channel: 1752.5 MHz

AWS Band, Uplink: Narrowband Signal

AGC Off

Low Channel: 1710.7 MHz



Middle Channel: 1732.5 MHz





High Channel: 1754.3 MHz

AGC On

Low Channel: 1710.7 MHz



Middle Channel: 1732.5 MHz





High Channel: 1754.3 MHz

LTE Band 13, Downlink: Broadband signal

AGC Off

Low Channel: 748.5 MHz



Middle Channel: 751.5 MHz



🔆 Agilent Freq/Channel Mkr1 747 MHz Center Freq Ref 26.4 dBm #Peak 3.20 dBm #Atten 20 dB 4.01500000 GHz Log 10 Start Freq dB/ 30.0000000 MHz Offst 16.4 Stop Freq 8.00000000 GHz dB 34 ₩ 2 \$ DI –13.0 dBm **CF Step** 797.000000 MHz Auto Man LgAv <u>Auto</u> Start 30 MHz #Res BW 100 kHz Stop 8.000 GHz Freq Offset 0.00000000 Hz VBW 300 kHz Sweep 761.7 ms (601 pts) Type Freq Freq Freq Freq X Axis 747 MHz 893 MHz 1.969 GHz 2.102 GHz Amplitude 3.20 dBm -36.89 dBm -36.39 dBm -36.23 dBm Marker Trace (1) (1) (1) (1) 1 234 Signal Track 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

High Channel: 753.5 MHz

AGC On

Agilent Freq/Channel Mkr1 747 MHz Center Freq Ref 26.4 dBm #Peak #Atten 20 dB 6.01 dBm 4.01500000 GHz Log å 10 Start Freq dB/ 30.0000000 MHz Offst 16.4 Stop Freq dB 34 **↔** 8.00000000 GHz Ā DI –13.0 dBm **CF** Step 797.000000 MHz LgAv Man <u>Auto</u> Start 30 MHz Stop 8.000 GHz FreqOffset 0.00000000 Hz #Res BW 100 kHz VBW 300 kHz Sweep 761.7 ms (601 pts) X Axis 747 MHz 893 MHz 1.969 GHz 2.102 GHz Type Freq Freq Freq Marker Trace Amplitude 6.01 dBm -36.10 dBm -37.73 dBm -36.72 dBm 123 Signal Track (1)(1)0n <u>0ff</u> Freq А Copyright 2000-2012 Agilent Technologies

Low Channel: 748.5 MHz

Middle Channel: 751.5 MHz





High Channel: 753.5.MHz

LTE Band 13, Downlink: Narrowband Signal

AGC Off

Low Channel: 748.5 MHz



Middle Channel: 751.5 MHz



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High Channel: 753.5 MHz

AGC On



Low Channel: 748.5 MHz

Middle Channel: 751.5 MHz




High Channel: 753.5 MHz

LTE Band 13, Uplink: Broadband Signal

AGC Off

Low Channel: 779.5 MHz



Middle Channel: 781.5 MHz



Freq/Channel 🔆 Agilent Mkr1 787 MHz 13.83 dBm Center Freq Ref 33 dBm #Peak #Atten 22 dB 4.01500000 GHz Log ô 10 Start Freq dB/ 30.0000000 MHz Offst 21 dB Stop Freq 8.00000000 GHz DI 23 🔗 -13.0 dBm CF Step 797.000000 MHz LgAv Man <u>Auto</u> Start 30 MHz #Res BW 100 kHz Stop 8.000 GHz Freq Offset 0.00000000 Hz Sweep 761.7 ms (601 pts) VBW 300 kHz Trace (1) (1) (1) Type Freq Freq Freq X Axis 787 MHz 1.717 GHz 1.863 GHz Amplitude 13.83 dBm -37.62 dBm -37.28 dBm Marker 1 123 Signal Track 0n <u>0ff</u> Copyright 2000–2012 Agilent Technologies

High Channel: 784.5 MHz



Low Channel: 779.5 MHz

Middle Channel: 781.5 MHz





High Channel: 784.5 MHz

LTE Band 13, Uplink: Narrowband signal

AGC Off

Low Channel: 779.5 MHz



Middle Channel: 781.5 MHz





High Channel: 784.5 MHz

🔆 Agilent Freq/Channel Mkr4 1.863 GHz Center Freq Ref 31 dBm #Peak #Atten 20 dB -37.24 dBm 4.01500000 GHz ō Log 10 Start Freq dB/ 30.0000000 MHz Offst 21 Stop Freq dB 8.00000000 GHz 34 ∞ DI -13.0 dBm **CF** Step al he 797.000000 MHz LgAv Man <u>Auto</u> Start 30 MHz Stop 8.000 GHz FreqOffset 0.00000000 Hz #Res BW 100 kHz VBW 300 kHz Sweep 761.7 ms (601 pts) X Axis 774 MHz 840 MHz 1.717 GHz 1.863 GHz Type Freq Freq Freq Marker Trace Amplitude 20.47 dBm -39.20 dBm -37.83 dBm -37.24 dBm (1) (1) 23 Signal Track (1)0n <u>0ff</u> Δ (1)Freq Copyright 2000-2012 Agilent Technologies

Low Channel: 779.5 MHz

Middle Channel: 781.5 MHz



High Channel: 784.5 MHz



LTE Band 17, Downlink: Broadband Signal

AGC Off

Low Channel: 736.5 MHz



Middle Channel: 740 MHz



🔆 Agilent Freq/Channel Mkr1 747 MHz Center Freq Ref 26.4 dBm #Peak 6.29 dBm #Atten 20 dB 4.01500000 GHz Log 10 Start Freq dB/ 30.0000000 MHz Offst 16.4 Stop Freq 8.00000000 GHz 3.4 \$¢ dB 2 \$ DL CF Step 797.000000 MHz Puto Man –13.0 dBm LgAv <u>Auto</u> Start 30 MHz #Res BW 100 kHz Stop 8.000 GHz Freq Offset 0.00000000 Hz VBW 300 kHz Sweep 761.7 ms (601 pts) Amplitude 6.29 dBm -36.71 dBm -31.75 dBm -33.06 dBm Type Freq Freq Freq Freq X Axis 747 MHz 893 MHz 1.969 GHz 2.142 GHz Marker Trace (1) (1) (1) (1) 1 234 Signal Track 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

High Channel: 743.5 MHz

Low Channel: 736.5 MHz



Middle Channel: 740 MHz



High Channel: 743.5 MHz



LTE Band 17, Downlink: Narrowband Signal

AGC Off



Low Channel: 736.5 MHz

Middle Channel: 740 MHz



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High Channel: 743.5 MHz



Low Channel: 736.5 MHz

Middle Channel: 740 MHz





High Channel: 743.5 MHz

LTE Band 17, Uplink: Broadband Signal

AGC Off

Low Channel: 706.5 MHz



Middle Channel: 710 MHz



🔆 Agilent Freq/Channel Mkr4 1.863 GHz Center Freq Ref 33 dBm #Peak -37.36 dBm #Atten 22 dB 4.01500000 GHz Log 1 10 Start Freq dB/ 30.0000000 MHz Offst 21 dB Stop Freq 8.00000000 GHz DI ³⁴ **CF Step** 797.000000 MHz Auto Man –13.0 dBm LgAv <u>Auto</u> Start 30 MHz #Res BW 100 kHz Stop 8.000 GHz Freq Offset 0.00000000 Hz VBW 300 kHz Sweep 761.7 ms (601 pts) Amplitude 11.75 dBm -40.56 dBm -39.24 dBm -37.36 dBm Type Freq Freq Freq Freq X Axis 707 MHz 774 MHz 1.704 GHz 1.863 GHz Marker Trace (1) (1) (1) (1) 1 234 Signal Track 0n <u>0ff</u> Copyright 2000-2012 Agilent Technologies

High Channel: 713.5 MHz



Low Channel: 706.5 MHz

Middle Channel: 710 MHz



Freq/Channel 🔆 Agilent Mkr4 1.863 GHz Center Freq 4.01500000 GHz Ref 33 dBm #Peak -36.10 dBm #Atten 22 dB Log 10 Start Freq dB/ 30.0000000 MHz Offst Stop Freq 8.00000000 GHz dB DI 34 0∕ -13.0 dBm CF Step 797.000000 MHz LgAv <u>Auto</u> Man Start 30 MHz Stop 8.000 GHz FreqOffset 0.00000000 Hz #Res BW 100 kHz VBW 300 kHz Sweep 761.7 ms (601 pts) Amplitude 11.38 dBm -38.12 dBm -37.96 dBm -36.10 dBm Trace (1) (1) (1) (1) (1) X Axis 707 MHz 774 MHz 1.704 GHz 1.863 GHz Type Freq Freq Freq Freq Marker 1 234 Signal Track 0n <u>0ff</u> Copyright 2000–2012 Agilent Technologies

High Channel: 713.5 MHz

LTE Band 17, Uplink: Narrowband Signal

AGC Off

Low Channel: 706.5 MHz



Middle Channel: 710 MHz





High Channel: 713.5 MHz



Low Channel: 706.5 MHz

Middle Channel: 710 MHz



🔆 Agilent Freq/Channel Mkr1 707 MHz Center Freq Ref 31 dBm #Peak 19.82 dBm #Atten 20 dB 4.01500000 GHz 1 \$ Log 10 Start Freq dB/ 30.0000000 MHz Offst 21 dB Stop Freq 8.00000000 GHz ³¢ DI $\hat{\diamond}$ –13.0 dBm **CF Step** 797.000000 MHz <u>Auto</u> Man ŕ١ LgAv <u>Auto</u> Start 30 MHz Stop 8.000 GHz Freq Offset 0.00000000 Hz #Res BW 100 kHz VBW 300 kHz Sweep 761.7 ms (601 pts) Amplitude 19.82 dBm -38.20 dBm -39.69 dBm -36.94 dBm Type Freq Freq Freq Freq X Axis 707 MHz 840 MHz 1.717 GHz 1.863 GHz Marker Trace (1) (1) (1) (1) 23 Signal Track 0n <u>0ff</u> Δ Copyright 2000-2012 Agilent Technologies

High Channel: 713.5 MHz

9 FCC §27.53 (c)(g)(h) - Band Edge & Intermodulation

9.1 Applicable Standards

According to FCC §27.53,

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P) dB$;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log (P)$ dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P) dB$. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

9.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω -75 Ω matching pad.

The center frequency of the spectrum analyzer was set according to center frequency of the EUT to be transmitted. The RBW was set to greater than 30 KHz for 700 bands and greater than 1% of emission bandwidth for AWS band LTE.



9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval	
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year	
Agilent	Generator, Signal	E4438C	MY45091309	2015-08-21	1 year	
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years	
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years	

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-10 in the RF Site.

9.5 Test Results

Please refer to the following plots.

Band Edge:

AWS Band, Downlink: Broadband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Report Number: R1509101-27

Lower Band Edge



🔆 Ag	ilent										Freq/Channel
Ref 18 #Ava	.4 dBm		#Atten	12 dB			Mk	r1 2.	154 989 -35.76	9 5 GHz 33 dBm	Center Freq 2.15550000 GHz
Log 10 dB/											Start Freq 2.15500000 GHz
Offst 16.4 dB											Stop Freq
DI -13.0 dBm	1										CF Step 100.000000 kHz
PHVg 9 100 W1 S2	m	~~~~			~~~~	·····		<u> </u>			Auto Man
AA €(f):											Signal Track
Swp											On <u>Off</u>
Start 2 #Res B	2.155 0 W 47 ki iaht 20	00 0 G Hz 100-20	Hz 112 Ad	VB ilent T	W 150 echnol	kHz ngies	St Swe	top 2.: ep 1.4	156 000 ms (60	0 GHz 01 pts)	
	copyright 2000 2012 fighting reciminingies										

AWS Band, Downlink: Narrowband Signal

AGC Off

Lower Band Edge



Upper Band Edge



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Lower Band Edge



🔆 Ag	jilent											Freq/Channel
Ref 18 #Avg	.4 dBm		#Atten	12 dB			Mk	r1	2.155 -6	342 9.52	5 GHz 7 dBm	Center Freq 2.15550000 GHz
Log 10 dB/												Start Freq 2.15500000 GHz
16.4 dB DI												Stop Freq 2.15600000 GHz
-13.0 dBm PAvg												CF Step 100.000000 kHz Auto Man
100 W1 S2 S3 FC												Freq Offset 0.00000000 Hz
HH £(f): f>50k Sum								gentag ta	~~~~~			Signal Track
Swp Start 2	2.155 0	00 0 G	Hz				St	top	2.156	000	0 GHz	
#Res B	3W 3.3 I	(Hz		VE	3W 10 k	Hz	Sweep	27	7.3 ms	(60	1 pts)	
Copyr	ight 20	JUU-2	012 Ag	ilent T	echnol	ogies						

AWS Band, Uplink: Broadband Signal

AGC Off

Lower Band Edge





Lower Band Edge





AWS Band, Uplink: Narrowband signal

AGC Off

Lower Band Edge



Upper Band Edge



Report Number: R1509101-27

Lower Band Edge





Intermodulation:

AWS Band, Downlink: Broadband signal

AGC Off

Low Channel



High Channel


Low Channel





AWS Band, Downlink: Narrowband Signal

AGC Off

Low Channel



High Channel



Low Channel





AWS Band, Uplink: Broadband Signal

AGC Off

Low Channel



High Channel



Low Channel





AWS Band, Uplink: Narrowband Signal

AGC Off

Low Channel



High Channel



Low Channel





Band Edge:

LTE Band 13, Downlink: Broadband signal

AGC Off

Lower Band Edge





Lower Band Edge



Upper Band Edge



LTE Band 13, Downlink: Narrowband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge



* Agilent											Freq/Channel
Ref 18 #Ava	.4 dBm		#Atten	12 dB			М	kr1 7	57.025 -62.69	96 MHz 4 dBm	Center Freq 757.050000 MHz
Log 10 dB/											Start Freq
Offst 16.4 dB											Stop Freq
DI -13.0 dBm											CF Step
PAvg 100 W1 S2											Auto Man
S3 FC AA			1								0.00000000 Hz
f>50k Swp			¥								Signal Track ^{On <u>Off</u>}
Start 7 #Res_B	/57.000 W 30 k	00 MH Hz	z	UF	3W 91_k	Hz	Su	itop 75 een 1	57.100 ms (60	00 MHz 1 nts)	
Copyright 2000–2012 Agilent Technologies											

LTE Band 13, Uplink: Broadband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge





LTE Band 13, Uplink: Narrowband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge



* Agilent											Freq/Channel
Ref 23 d #Ava	¦Bm		⊭Atten	12 dB			М	kr1 7	87.022 -59.88	95 MHz 1 dBm	Center Freq 787.050000 MHz
Log 10 dB/											Start Freq
0ffst 21 dB											Stop Freq
DI -13.0 dBm											787.100000 MHz CF Step
PAvg 100											10.0000000 kHz <u>Auto</u> Man
WI 52 S3 FC_ AA											Freq Offset 0.00000000 Hz
€(f): f>50k Swp			1 Q					~			Signal Track On <u>Off</u>
Start 78	7.000	00 MH	z					Stop 78	37.100	00 MHz	
#Res BW 30 kHz VBW 91 kHz Sweep 1 ms (601 pts) Copyright 2000–2012 Agilent Technologies											

Intermodulation:

LTE Band 13, Downlink: Broadband Signal

AGC Off



Low Channel



Low Channel





LTE Band 13, Downlink: Narrowband Signal

AGC Off

Low Channel



High Channel



Low Channel





LTE Band 13, Uplink: Broadband Signal

AGC Off

Low Channel



High Channel



Low Channel





LTE Band 13, Uplink: Narrowband Signal

AGC Off

Low Channel



High Channel



Low Channel





Band Edge:

LTE Band 17, Downlink: Broadband signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge





LTE Band 17, Downlink: Narrowband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge



🔆 👫 Ag	jilent										Freq/Channel
Ref 18	.4 dBm		#Atten	12 dB			М	kr1 7	46.001 -57.05	54 MHz 0 dBm	Center Freq
#Hvg											740.030000 1112
10 dB/ Offst											Start Freq 746.000000 MHz
16.4 dB DI											Stop Freq 746.100000 MHz
-13.0 dBm PAvg											CF Step 10.0000000 kHz <u>Auto</u> Man
W1 S2 S3 FC AA							~				FreqOffset 0.00000000 Hz
£ (f): f>50k Swp											Signal Track ^{On <u>Off</u>}
Start 7 #Res P	746.000 W 30 k	00 MH 17	z			H7	Sw	itop 74 Jeen 1	46.100 ms (60	00 MHz 1 nts)	
Copyright 2000-2012 Agilent Technologies											

LTE Band 17, Uplink: Broadband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge





LTE Band 17, Uplink: Narrowband Signal

AGC Off

Lower Band Edge



Upper Band Edge



Lower Band Edge





Intermodulation:

LTE Band 17, Downlink: Broadband Signal

AGC Off

Low Channel



High Channel



Low Channel





LTE Band 17, Downlink: Narrowband Signal

AGC Off

Low Channel



High Channel



Low Channel





LTE Band 17, Uplink: Broadband Signal

AGC Off

Low Channel



High Channel


AGC On

Low Channel



High Channel



LTE Band 17, Uplink: Narrowband Signal

AGC Off

Low Channel



High Channel



Report Number: R1509101-27

AGC On

Low Channel



High Channel

🔆 Agilen	nt							Freq/Channel
Ref 23 dE #Avg	3m	#Atten 12 dB			Mkr1 7:	16.072 -59.14	68 MHz 3 dBm	Center Freq 716.050000 MHz
Log 10 dB/								Start Freq 716.000000 MHz
21 dB DI								Stop Freq 716.100000 MHz
-13.0 dBm PAvg								CF Step 10.0000000 kHz Auto Man
100 W1 S2 S3 FC								FreqOffset 0.00000000 Hz
€(f): f>50k Swp					1 \$			Signal Track On <u>Off</u>
Start 716.000 00 MHz Stop 716 #Res BW 30 kHz VBW 91 kHz Sween 1 r				6.100 (ms (60	00 MHz 1 pts)			
Copyright 2000-2012 Agilent Technologies								

10 FCC §20.21 - Out of Band Rejection

10.1 Applicable Standard

According to FCC Part 20.21, a frequency selective booster shall have -20 dB at the band edge referenced to the gain in the center of the pass band of the booster, where band edge is the end of the licensee's allocated spectrum.

10.2 Test Procedure

KDB 935210 D05, Section 3.3.

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The span of the spectrum analyzer was set to be wide enough in order to capture the spectrum of entire operating band.

10.3 Test Equipment List and Details

Manufacturer	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

Temperature:	21-23° C		
Relative Humidity:	42-48 %		
ATM Pressure:	101.4-102 kPa		

The testing was performed by Ronak Patel on 2015-09-21 in the RF Site.

10.5 Test Results

Please refer to the following plot,

AWS Band

Downlink, 2110-2155 MHz



Uplink, 1710-1755 MHz



LTE Band

Downlink, 734-757 MHz



Uplink, 776-787 MHz





