



# FCC PART 95

## TEST REPORT

For

### Commsignia, Inc.

5201 Great America Pkwy, Suite 320  
 Santa Clara, CA 95054, USA

**FCC ID: 2AOZ5-CM-OB4**

|                                        |                                                                                                                                            |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report | <b>Product Type:</b><br>On-Board Unit                                                                                                      |
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| <b>Report Number</b>                   | R1711205-95                                                                                                                                |
| <b>Report Date</b>                     | 2018-05-02                                                                                                                                 |
| <b>Reviewed By</b>                     | Simon Ma<br>RF Engineer <span style="float: right;"><i>Simon Ma</i></span>                                                                 |
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA\*, NIST, or any agency of the Federal Government.

\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" per 2

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### DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|-----------------|---------------|-------------------------|------------------|
| 0               | R1711205-95   | Original Report         | 2018-05-02       |

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## 1 General Description

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### 1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of, *Commsignia, Inc.*, and their product model: *ITS-OB4*; *FCC ID: 2AOZ5-CM-OB4* or the “EUT” as referred to in this report. The EUT is an On-Board Unit operates in 5850-5925 MHz.

### 1.2 Mechanical Description of EUT

The EUT measures 17 cm (L), 11 cm (W), 3.5 cm (H), and weighs 0.5 kg.

*The data gathered are from a production sample provided by the manufacturer, serial number: R1711205-01, assigned by BACL.*

### 1.3 Objective

This report is prepared on behalf of *Commsignia, Inc.* in accordance with Part 2, Part 95. The objective is to determine compliance with FCC Part 95.

### 1.4 Related Submittal(s)/Grant(s)

N/A

### 1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI TIA-603-D and ASTM E2213-03

### 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  $\pm 2.0$  dB for Conducted Emissions tests and  $\pm 4.0$  dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

## 1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

## 1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

**A- An independent, 3<sup>rd</sup>-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02)**, in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (\*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

**B- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)** to certify

- For the USA (Federal Communications Commission):

- 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
- 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
- 3- All Telephone Terminal Equipment within FCC Scope C.

- For the Canada (Industry Canada):

- 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
- 2 All Scope 2-Licensed Personal Mobile Radio Services;
- 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
- 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
- 5 All Scope 5-Licensed Fixed Microwave Radio Services
- 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.

- For Singapore (Info-Communications Development Authority (IDA)):

- 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2

2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
- 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
- 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

**C- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01) to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:**

- 1 Electronics and Office Equipment:
  - for Telephony (ver. 3.0)
  - for Audio/Video (ver. 3.0)
  - for Battery Charging Systems (ver. 1.1)
  - for Set-top Boxes & Cable Boxes (ver. 4.1)
  - for Televisions (ver. 6.1)
  - for Computers (ver. 6.0)
  - for Displays (ver. 6.0)
  - for Imaging Equipment (ver. 2.0)
  - for Computer Servers (ver. 2.0)
- 2 Commercial Food Service Equipment
  - for Commercial Dishwashers (ver. 2.0)
  - for Commercial Ice Machines (ver. 2.0)
  - for Commercial Ovens (ver. 2.1)
  - for Commercial Refrigerators and Freezers
- 3 Lighting Products
  - For Decorative Light Strings (ver. 1.5)
  - For Luminaires (including sub-components) and Lamps (ver. 1.2)
  - For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
  - For Integral LED Lamps (ver. 1.4)
- 4 Heating, Ventilation, and AC Products
  - for Residential Ceiling Fans (ver. 3.0)
  - for Residential Ventilating Fans (ver. 3.2)
- 5 Other
  - For Water Coolers (ver. 3.0)

**D- A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:**

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;

- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC US -EU EMC & Telecom MRA CAB (NB)
  - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - o ENERGY STAR Recognized Test Laboratory – US EPA
  - o Telecommunications Certification Body (TCB) – US FCC;
  - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;



## 2 System Test Configuration

### 2.1 Justification

The EUT was configured for testing according to TIA-603-D and ASTM E2213-03.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

### 2.2 EUT Exercise Software

The test utility used was Terminal.

### 2.3 Special Equipment

| Manufacturer | Description | Model |
|--------------|-------------|-------|
| Lenovo       | Laptop      | T560  |

### 2.4 Equipment Modifications

No modifications were made to the EUT.

### 2.5 Local Support Equipment

N/A

### 2.6 EUT Internal Configuration Details

| Manufacturer | Description                        | Model                        | Crystals (MHz)      |
|--------------|------------------------------------|------------------------------|---------------------|
| Commsignia   | OB4 On-Board Unit base board       | ITS-OB4-M-1.0                | 0.32768, 7.3728, 16 |
| Toradex      | SOM CPU module                     | Apalis iMX6Q 2GB<br>IT V1.1C | 0.32768, 24, 25     |
| muRata       | Dual Channel V2X/DSRC radio module | LBWA1ZZ1LX                   | 40                  |
| uBlox        | GPS module                         | NEO-M8U                      | 30.72, 0.32768      |

**2.7 External I/O Cabling List and Details**

| <b>Cable Descriptions</b> | <b>Length (m)</b> | <b>From</b> | <b>To</b> |
|---------------------------|-------------------|-------------|-----------|
| Console to USB cable      | 1.5               | EUT         | Laptop    |

**2.8 EUT External Power Supply List and Details**

| <b>Manufacturer</b> | <b>Description</b>         | <b>Model</b> | <b>Serial number</b> |
|---------------------|----------------------------|--------------|----------------------|
| Mean Well           | AC/DC SWITCHING<br>ADAPTOR | GS18A12      | N/A                  |

### 3 Summary of Test Results

Results reported relate only to the product tested.

| <b>FCC Rules</b>                      | <b>Description of Test</b>           | <b>Results</b> |
|---------------------------------------|--------------------------------------|----------------|
| FCC §2.1091                           | RF Exposure                          | Compliant      |
| ASTM E2213-03 8.9.1 &<br>FCC §95.3189 | Output Power                         | Compliant      |
| ASTM E2213-03 8.9.1 &<br>FCC §95.3189 | Transmit Spectrum Mask               | Compliant      |
| FCC §2.1049 &<br>FCC §95.3189         | Emission Bandwidth                   | Compliant      |
| ASTM E2213-03 8.9.4 &<br>FCC §95.3189 | Frequency Stability                  | Compliant      |
| ASTM E2213-03 8.9.2 &<br>FCC §2.1051  | Transmit Spurious Emission-Conducted | Compliant      |
| ASTM E2213-03 8.9.2 &<br>FCC §2.1053  | Transmit Spurious Emission-Radiated  | Compliant      |

## 4 FCC §2.1091– RF Exposure

### 4.1 Applicable Standard

According to FCC §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (minutes) |
|-----------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
| 0.3-1.34                                            | 614                           | 1.63                          | * (100)                             | 30                       |
| 1.34-30                                             | 824/f                         | 2.19/f                        | * (180/f <sup>2</sup> )             | 30                       |
| 30-300                                              | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500                                            | /                             | /                             | f/1500                              | 30                       |
| 1500-100,000                                        | /                             | /                             | 1.0                                 | 30                       |

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 MPE Results

#### Single Chain MPE Evaluation

Chain 0

|                                                                                         |              |
|-----------------------------------------------------------------------------------------|--------------|
| <u>Maximum declared output power at antenna input terminal (dBm):</u>                   | <u>20</u>    |
| <u>Maximum declared output power at antenna input terminal (mW):</u>                    | <u>100</u>   |
| <u>Prediction distance (cm):</u>                                                        | <u>20</u>    |
| <u>Prediction frequency (MHz):</u>                                                      | <u>5860</u>  |
| <u>Maximum Antenna Gain, typical (dBi):</u>                                             | <u>13.00</u> |
| <u>Maximum Antenna Gain (numeric):</u>                                                  | <u>19.95</u> |
| <u>Power density of prediction frequency at 20 cm (mW/cm<sup>2</sup>):</u>              | <u>0.397</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1</u>     |

## Chain 1

|                                                                                         |              |
|-----------------------------------------------------------------------------------------|--------------|
| <u>Maximum declared output power at antenna input terminal (dBm):</u>                   | <u>20</u>    |
| <u>Maximum declared output power at antenna input terminal (mW):</u>                    | <u>100</u>   |
| <u>Prediction distance (cm):</u>                                                        | <u>20</u>    |
| <u>Prediction frequency (MHz):</u>                                                      | <u>5860</u>  |
| <u>Maximum Antenna Gain, typical (dBi):</u>                                             | <u>13.00</u> |
| <u>Maximum Antenna Gain (numeric):</u>                                                  | <u>19.95</u> |
| <u>Power density of prediction frequency at 20 cm (mW/cm<sup>2</sup>):</u>              | <u>0.397</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1</u>     |

**Multiple Chains MPE Evaluation**

$$\text{Chain 0} + \text{Chain 1} = 0.397/1 + 0.397/1 = 0.794 \leq 1.0$$

**Conclusion**

The device compliances with FCC MPE limit at 20 cm distance.

## 5 ASTM E2213-03 8.9.1 & FCC §95.3189 – Output Power

### 5.1 Applicable Standard

According to ASTM E2213-03 8.9.1:

Public Safety and Private RSU installations operating in Channels 172, 174, 175, and 176 are used to implement small and medium range operations. RSU installation transmissions in Channels 172, 174, and 176 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP. RSU installation transmissions in Channel 175 shall not exceed 10 dBm antenna input power and 23 dBm EIRP. Public Safety RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 44.8 dBm EIRP. Private RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.

The DSRC Channels 180, 181, and 182 are used to implement small zone operations. Public Safety and Private RSU installation in these channels shall not exceed 10 dBm antenna input power and 23 dBm EIRP. These installations shall also use an antenna with a minimum 6 dBi gain. Public Safety RSU and OBU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 40 dBm EIRP. Private RSU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.

Private OBU operations in Channels 172, 174, 176, 178, and 184 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP. Private OBU operations in Channel 175 shall not exceed 10 dBm antenna input power and 23 dBm EIRP. Private OBU operations in Channels 180, 181, and 182 shall not exceed 20 dBm antenna input power and 23 dBm EIRP.

### 5.2 Test Procedure

According to TIA-603-D

### 5.3 Test Equipment List and Details

| Manufacturer  | Description  | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---------------|--------------|-----------|------------|------------------|----------------------|
| ETS- Lingerin | Power Sensor | 7002-006  | 160097     | 2016-12-05       | 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

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

*The testing was performed by Frank Wang on 2017-12-05 at RF site.*

## 5.5 Test Results

| Channel | Frequency (MHz) | Conducted Output Power |               |             | Antenna Gain <sup>1</sup> (dBi) | E.I.R.P       |               |             |
|---------|-----------------|------------------------|---------------|-------------|---------------------------------|---------------|---------------|-------------|
|         |                 | Chain 0 (dBm)          | Chain 1 (dBm) | Limit (dBm) |                                 | Chain 0 (dBm) | Chain 1 (dBm) | Limit (dBm) |
| 172     | 5860            | 18.99                  | 17.39         | 28.8        | 13.00                           | 31.99         | 30.39         | 33          |
| 178     | 5890            | 18.76                  | 17.32         | 28.8        | 13.00                           | 31.76         | 30.32         | 33          |
| 180     | 5900            | 18.74                  | 17.37         | 20          | 3.00                            | 21.74         | 20.37         | 23          |
| 182     | 5910            | 18.71                  | 17.24         | 20          | 3.00                            | 21.71         | 20.24         | 23          |
| 184     | 5920            | 18.75                  | 17.35         | 28.8        | 13.00                           | 31.75         | 30.35         | 33          |

Note<sup>1</sup>: Based on the manufacturer declares the conducted output power in each port is 20 dBm, in order to meet the EIRP limit, the maximum allowable antenna gain is 3.00 dBi at channel 180 and channel 182 and the maximum allowable antenna gain is 13.00 dBi at other channels.

## 6 ASTM E2213-03 8.9.2 & FCC §95.3189 – Transmit Spectrum Mask

### 6.1 Applicable Standard

**TABLE 9 DSRC Device Classes and Transmit Power Levels<sup>A</sup>**

| Device Class | Maximum Device Output Power, dBm |
|--------------|----------------------------------|
| A            | 0                                |
| B            | 10                               |
| C            | 20                               |
| D            | 28.8 or more                     |

<sup>A</sup> From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

**TABLE 10 DSRC Spectrum Mask<sup>A</sup>**

NOTE—Reduction in Power Spectral Density, dBc.

| Class   | ± 4.5-MHz Offset | ± 5.0-MHz Offset | ± 5.5-MHz Offset | ± 10-MHz Offset | ± 15-MHz Offset |
|---------|------------------|------------------|------------------|-----------------|-----------------|
| Class A | 0                | -10              | -20              | -28             | -40             |
| Class B | 0                | -16              | -20              | -28             | -40             |
| Class C | 0                | -26              | -32              | -40             | -50             |
| Class D | 0                | -35              | -45              | -55             | -65             |

<sup>A</sup> From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

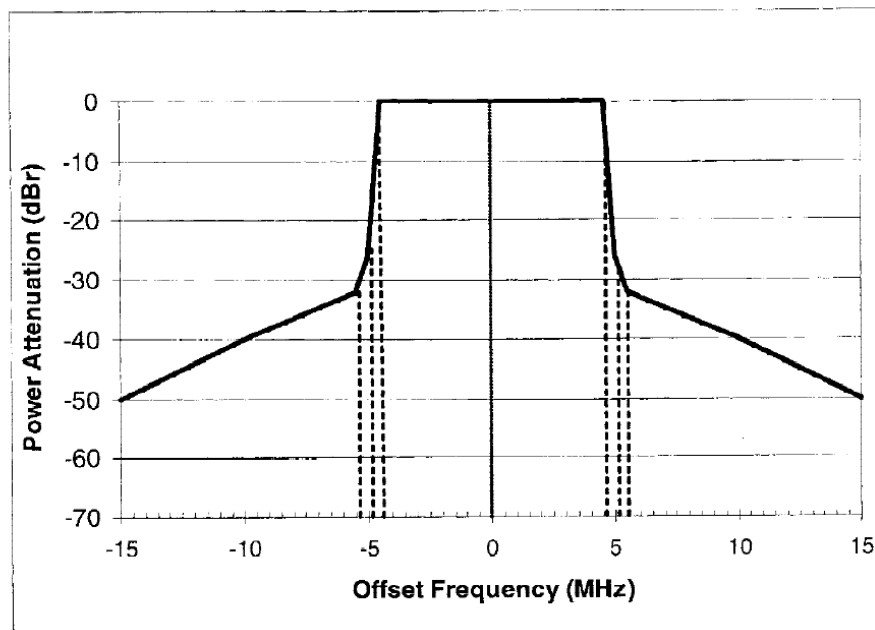


FIG. 14 Class C Transmit Spectrum Mask



## 6.2 Test Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be  $-25$  dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by  $55 + 10\log(P)$  dB, where  $P$  is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

## 6.3 Test Equipment List and Details

| Manufacturer    | Description       | Model No. | Serial No. | Calibration Date | Calibration Interval |
|-----------------|-------------------|-----------|------------|------------------|----------------------|
| Rohde & Schwarz | Spectrum Analyzer | FSQ26     | 200749     | 2017-06-08       | 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

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

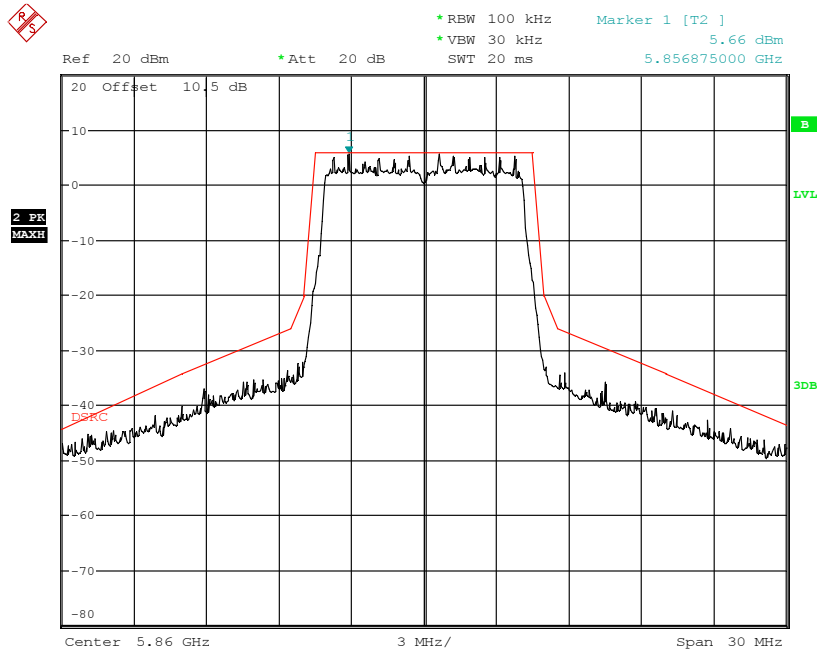
*The testing was performed by Frank Wang on 2017-12-05 at RF site.*

## 6.5 Test Results

Class C mask has been utilized since the conducted output power from each chain was lower than 20 dBm.

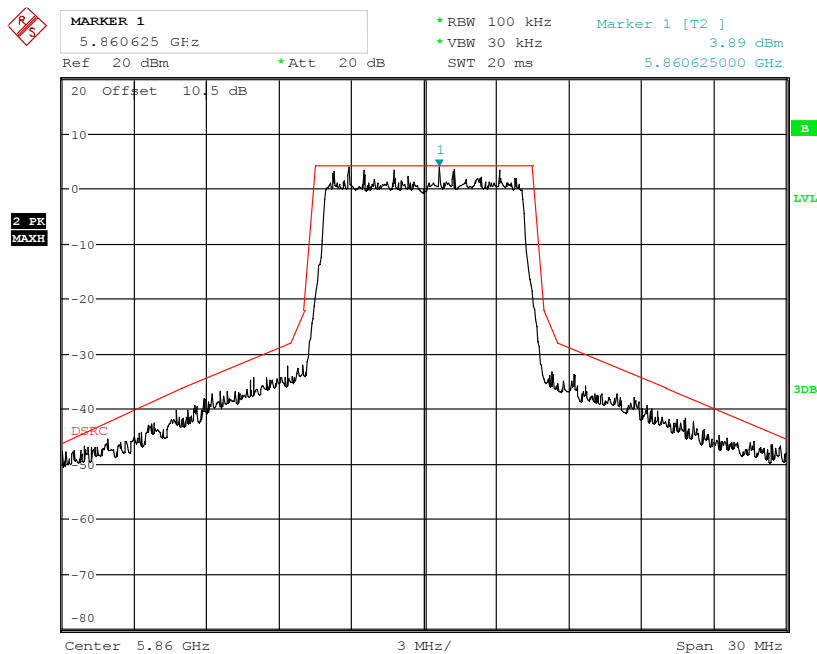
Please refer to the following plots for the test result

### Low Channel, 5860MHz Chain 0



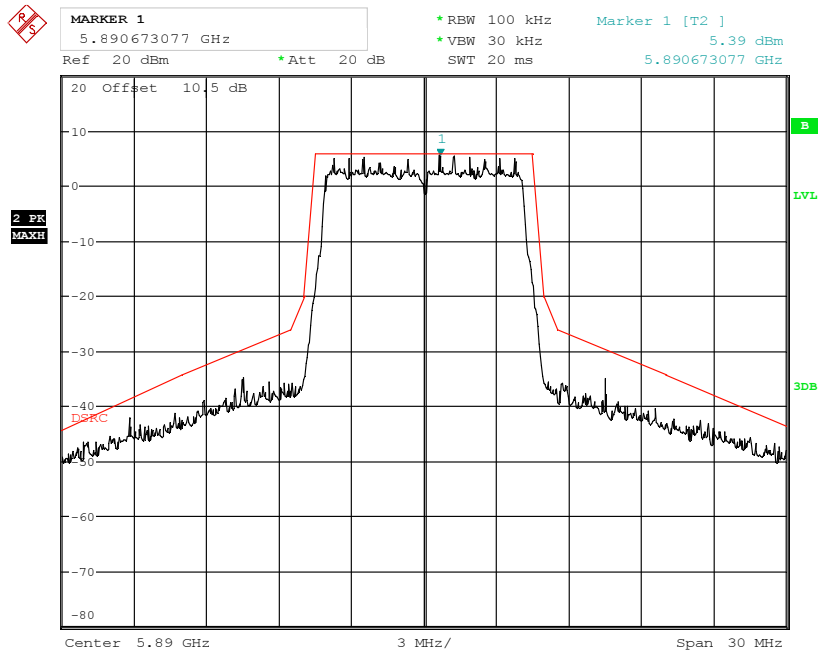
Date: 5.DEC.2017 23:00:04

### Low Channel, 5860MHz Chain 1



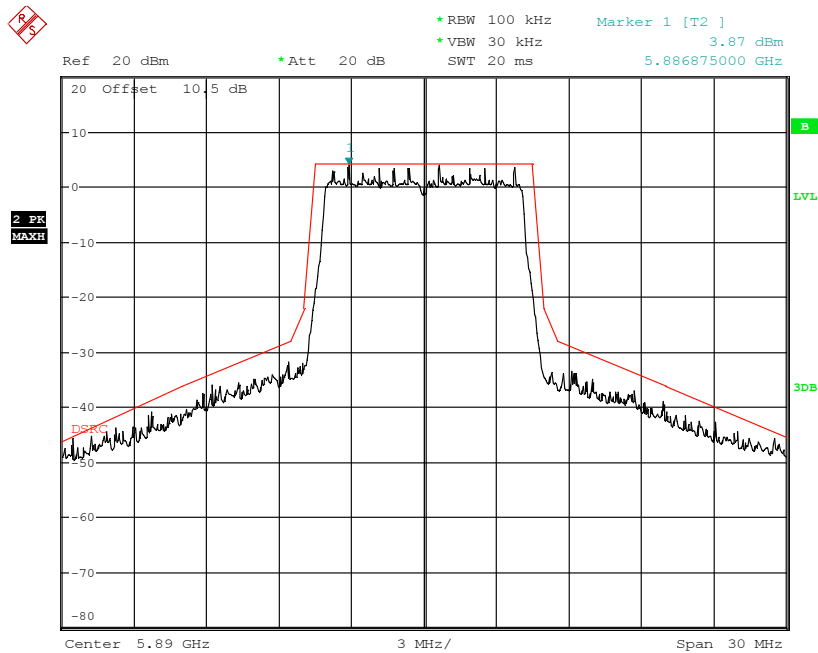
Date: 5.DEC.2017 23:03:58

### Middle Channel, 5890MHz Chain 0



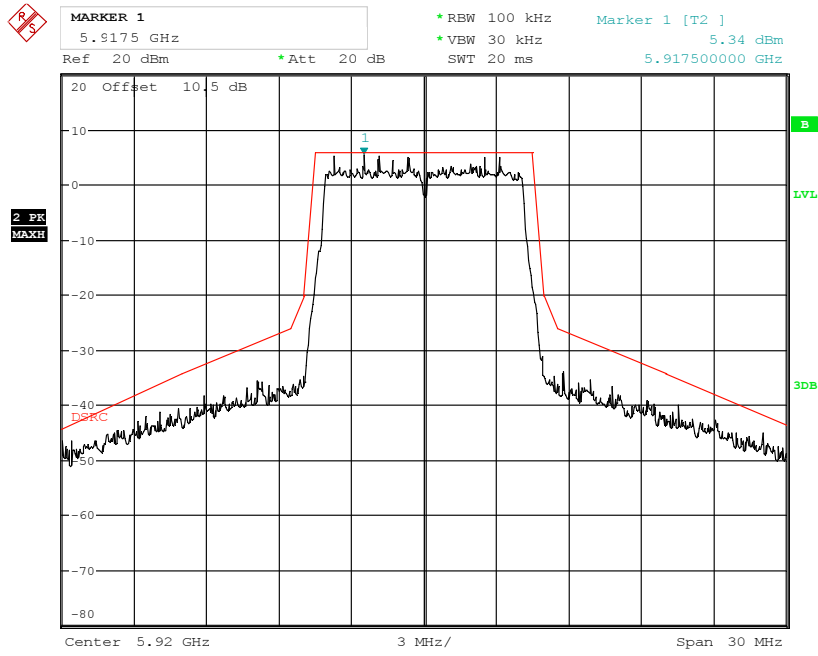
Date: 5.DEC.2017 23:00:45

### Middle Channel, 5890MHz Chain 1



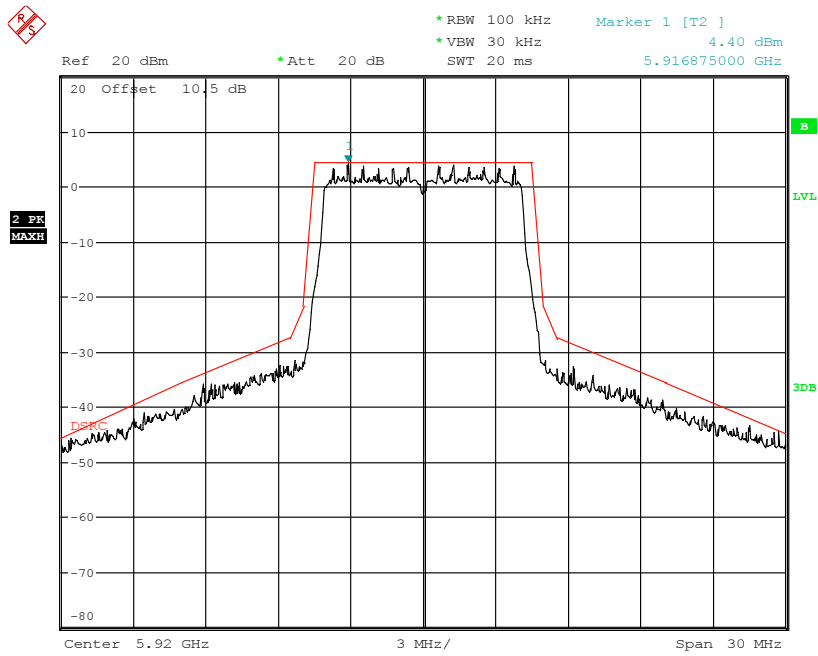
Date: 5.DEC.2017 23:03:22

### High Channel, 5920MHz Chain 0



Date: 5.DEC.2017 23:01:16

### High Channel, 5920MHz Chain 1



Date: 5.DEC.2017 23:02:41

## 7 FCC §95.3189 - Emission Bandwidths

### 7.1 Applicable Standard

According to FCC §95.3189

### 7.2 Test Procedure

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between two recorded frequencies is the occupied bandwidth.

### 7.3 Test Equipment List and Details

| Manufacturer | Description       | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent      | Spectrum Analyzer | E4446A    | US44300386 | 2017-04-20       | 1 year               |

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

### 7.4 Test Environmental Conditions

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

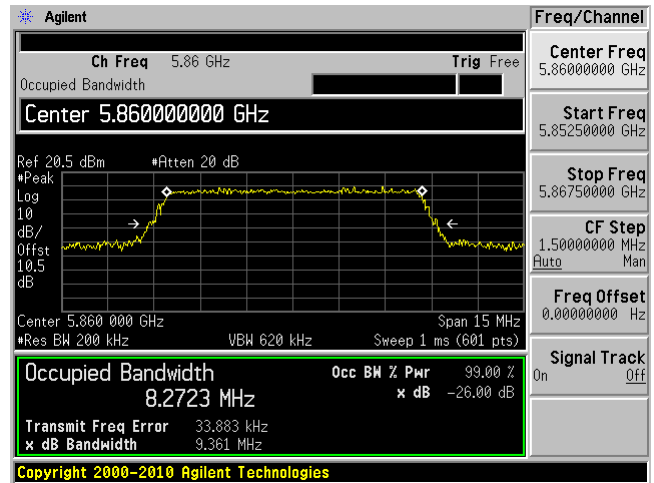
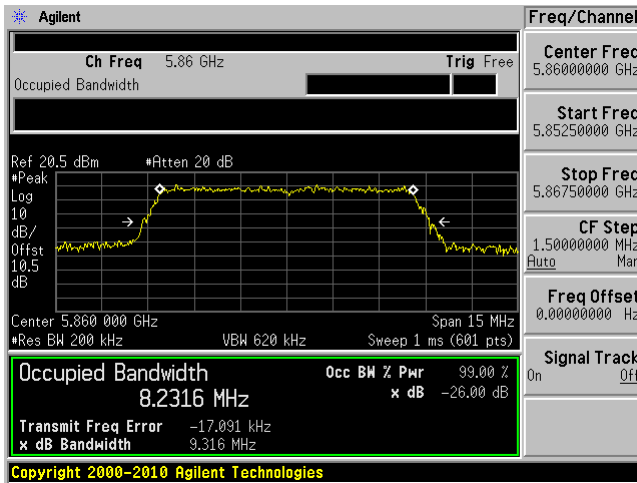
*The testing was performed by Frank Wang on 2017-12-03 at RF site.*

7.5 Test Results

| Channel | Frequency (MHz) | 99% Bandwidth Chain 0 (MHz) | 99% Bandwidth Chain 1 (MHz) |
|---------|-----------------|-----------------------------|-----------------------------|
| Low     | 5860            | 8.2316                      | 8.2723                      |
| Middle  | 5890            | 8.3295                      | 8.2744                      |
| High    | 5920            | 8.2931                      | 8.3072                      |

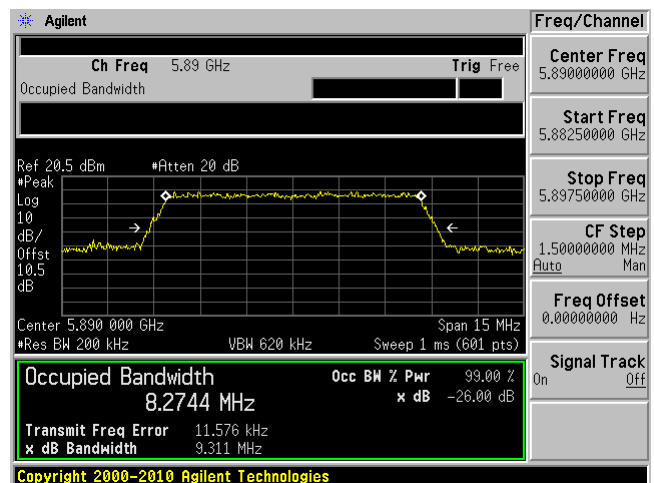
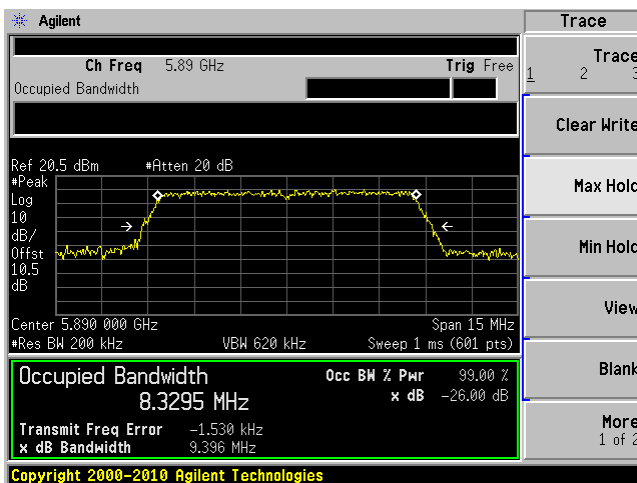
Low Channel, 5860MHz Chain 0

Low Channel, 5860MHz Chain 1

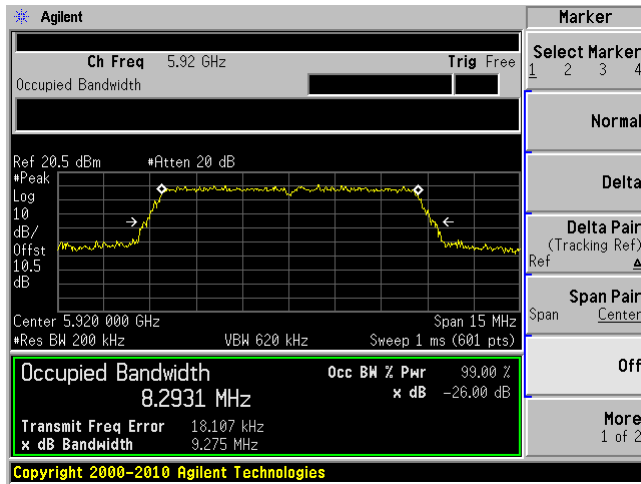


Middle Channel, 5890MHz Chain 0

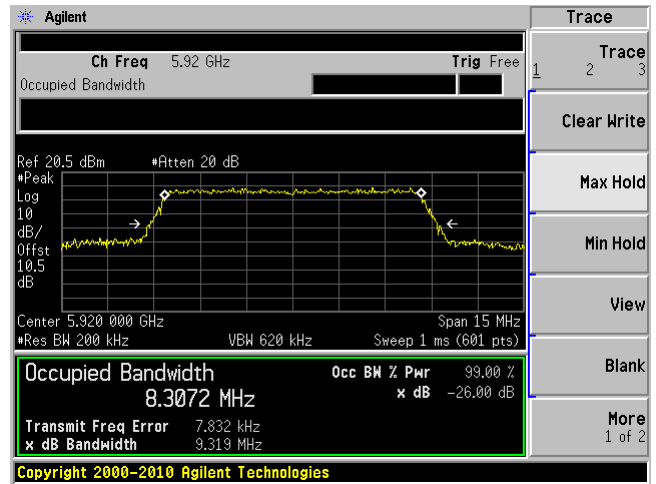
Middle Channel, 5890MHz Chain 1



### High Channel, 5920MHz Chain 0



### High Channel, 5920MHz Chain 1



## 8 ASTM E2213-03 8.9.4 & FCC §95.3189 - Frequency Tolerance

### 8.1 Applicable Standard

According to FCC §95.3189 and ASTM E2213-03 8.9.4

### 8.2 Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.2, the carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The measurement method is as following:

- Operate the equipment in standby conditions for 15 minutes before proceeding.
- Record the carrier frequency of the transmitter as MCF MHz.
- Calculate the ppm frequency error by the following:

$$\text{Ppm error} = ((\text{MCF}/\text{ACF}) - 1) * 10^6$$

Where

MCF is the Measured Carrier Frequency in MHz  
ACF is the Assigned Carrier Frequency in MHz

- The value recorded above is the carrier frequency stability.

### 8.3 Test Equipment List and Details

| Manufacturer | Description         | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|---------------------|-----------|------------|------------------|----------------------|
| Agilent      | Spectrum Analyzer   | E4446A    | US44300386 | 2017-04-20       | 1 year               |
| Tenney       | Temperature Chamber | TUJR      | 27445-06   | 2017-10-02       | 1 year               |

**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

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

The testing was performed by Frank Wang on 2017-12-05 at RF site.

## 8.5 Test Results

Middle Channel, 5890MHz:

| Temperature (°C) | Voltage (V) | Frequency (MHz) | Result (ppm) | Limit (ppm) |
|------------------|-------------|-----------------|--------------|-------------|
| -30              | 12          | 5890.00         | 0.00         | +/- 10      |
| -20              | 12          | 5890.00         | 0.00         | +/- 10      |
| -10              | 12          | 5890.00         | 0.00         | +/- 10      |
| 0                | 12          | 5890.02         | 4.08         | +/- 10      |
| 10               | 12          | 5890.00         | 0.00         | +/- 10      |
| 20               | 12          | 5890.00         | 0.00         | +/- 10      |
| 30               | 12          | 5890.02         | 4.08         | +/- 10      |
| 40               | 12          | 5889.98         | -4.08        | +/- 10      |
| 50               | 12          | 5890.00         | 0.00         | +/- 10      |

## 9 ASTM E2213-03 8.9.2 & FCC §2.1051 - Transmit Conducted Spurious Emission

### 9.1 Applicable Standard

According to ASTM EN2213-03 8.9.2:

8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to  $-25$  dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

### 9.2 Measurement Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be  $-25$  dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by  $55 + 10\log(P)$  dB, where  $P$  is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

### 9.3 Test Equipment List and Details

| Manufacturer | Description       | Model No. | Serial No. | Calibration Date | Calibration Interval |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| Agilent      | Spectrum Analyzer | E4446A    | US44300386 | 2017-04-20       | 1 year               |

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

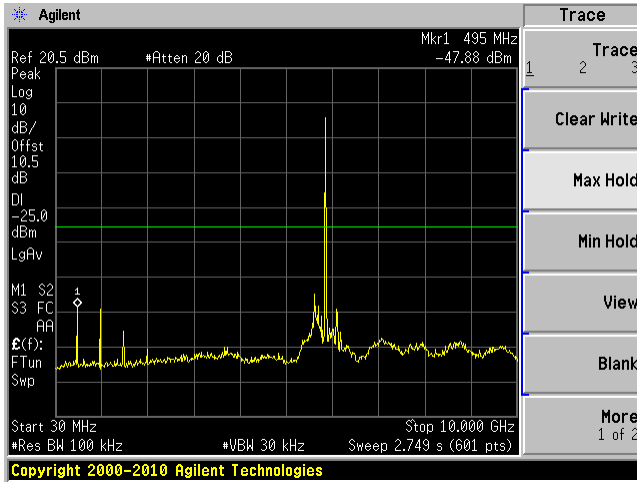
### 9.4 Test Environmental Conditions

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

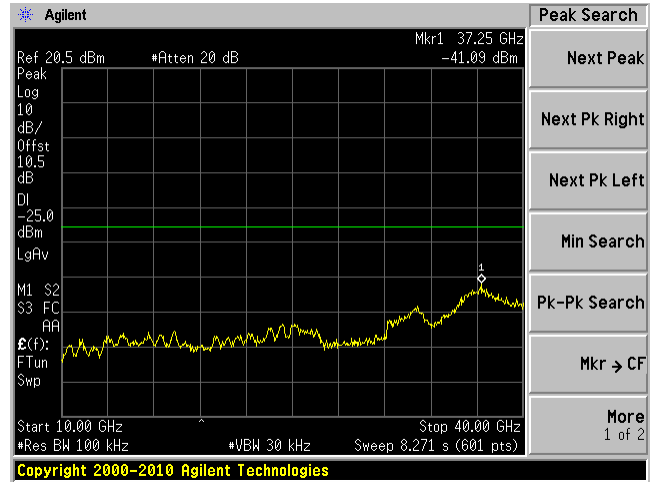
*The testing was performed by Frank Wang from 2017-12-03 at RF site.*

### 9.5 Test Results

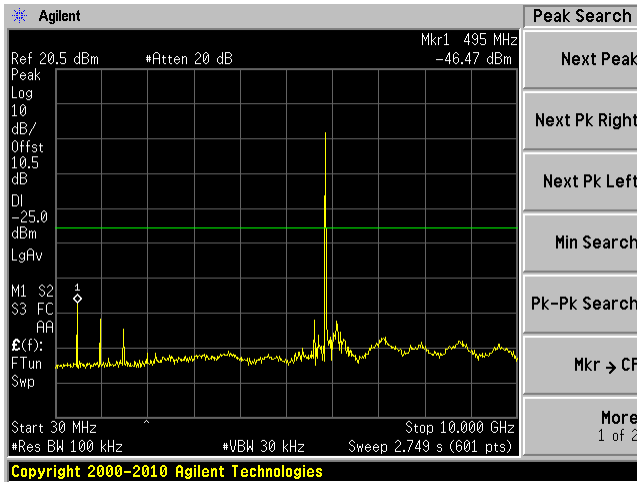
Low Channel 5860 MHz Chain 0, 30MHz – 10GHz



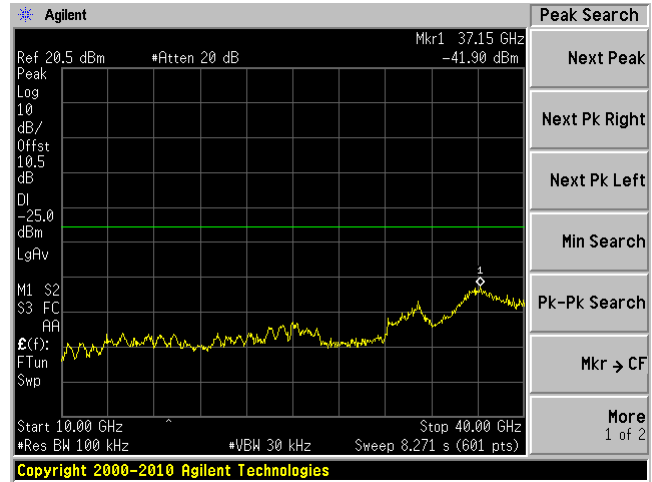
Low Channel 5860 MHz Chain 0, 10GHz – 40GHz



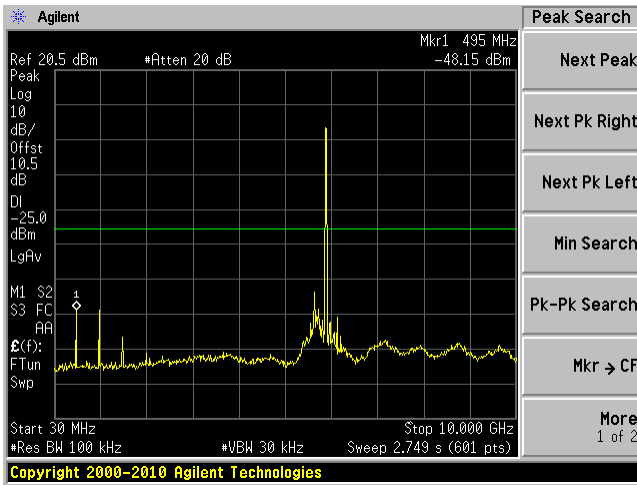
Low Channel 5860 MHz Chain 1, 30MHz – 10GHz



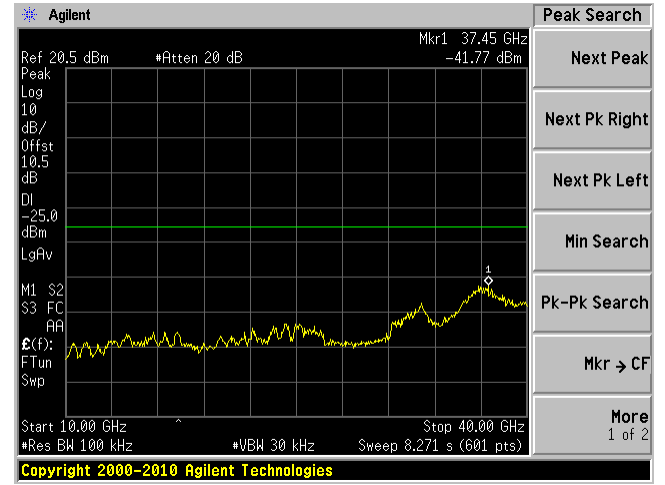
Low Channel 5860 MHz Chain 1, 10 GHz – 40GHz



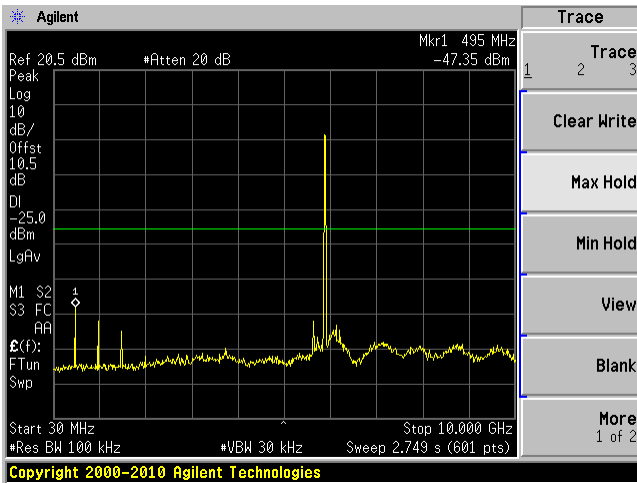
Middle Channel 5890 MHz Chain 0, 30MHz – 10GHz



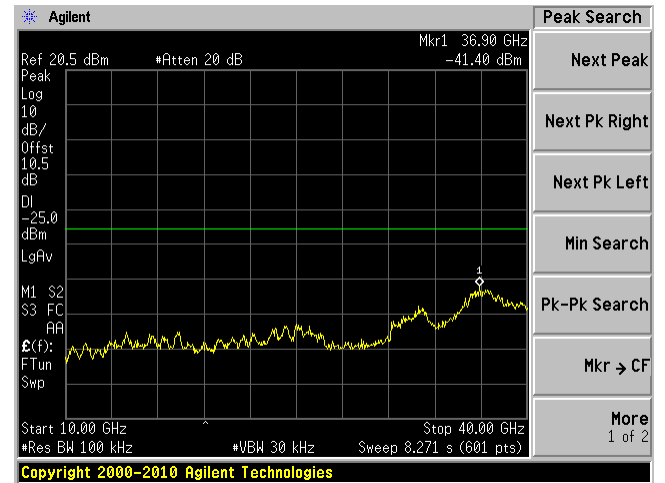
Middle Channel 5890 MHz Chain 0, 10GHz – 40GHz



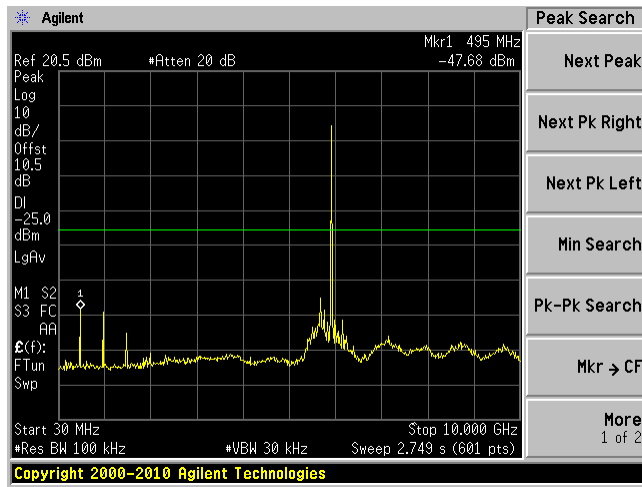
Middle Channel 5890 MHz Chain 1, 30MHz – 10GHz



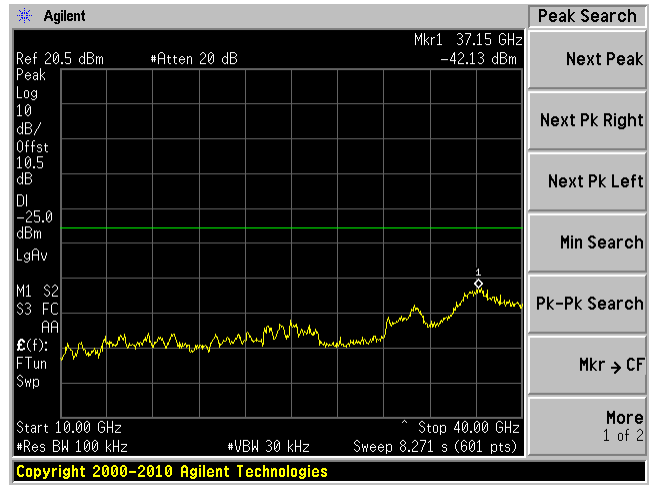
Middle Channel 5890 MHz Chain 1, 10GHz – 40GHz



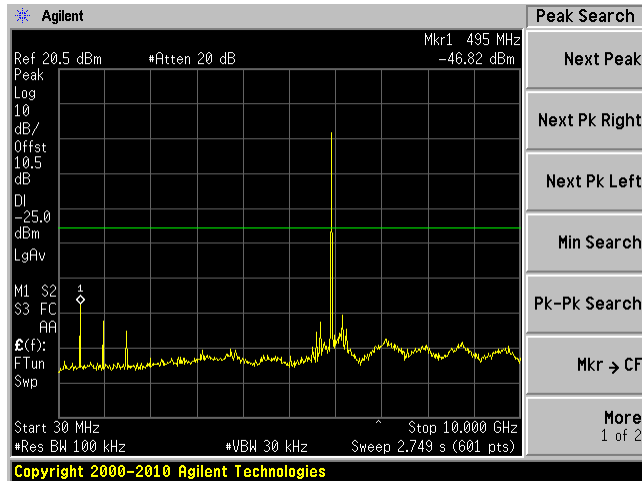
### High Channel 5920 MHz Chain 0, 30MHz – 10GHz



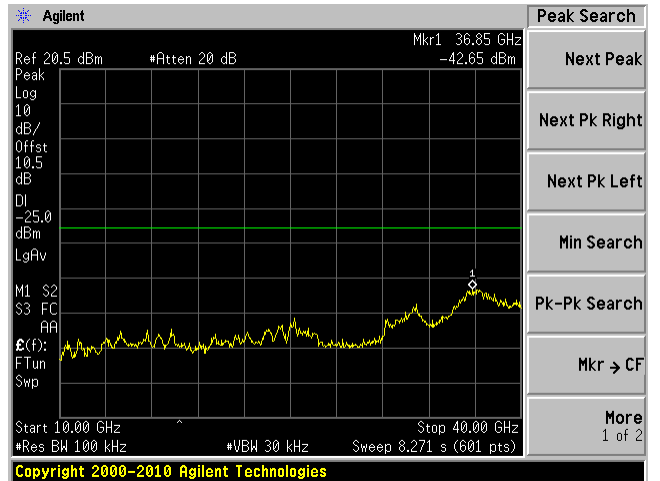
### High Channel 5920 MHz Chain 0, 10GHz – 40GHz



### High Channel 5920 MHz Chain 1, 30MHz – 10GHz



### High Channel 5920 MHz Chain 1, 10GHz – 40GHz



## 10 ASTM E2213-03 8.9.2 & FCC §2.1053 – Field Strength of Spurious Emission

### 10.1 Applicable Standard

According to ASTM EN2213-03 8.9.2:

8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to  $-25$  dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

### 10.2 Measurement Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be  $-25$  dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by  $55 + 10\log(P)$  dB, where  $P$  is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

### 10.3 Test Equipment List and Details

| Manufacturer       | Description         | Model No.   | Serial No.          | Calibration Date | Calibration Interval |
|--------------------|---------------------|-------------|---------------------|------------------|----------------------|
| Sunol Science Corp | System Controller   | SC99V       | 122303-1            | N/R              | N/R                  |
| Sunol Sciences     | Antenna, Biconi-Log | JB1         | A013105-3           | 2015-07-11       | 31 months            |
| Agilent            | Amplifier, Pre      | 8447D       | 2944A10187          | 2017-03-13       | 1 year               |
| Agilent            | Spectrum Analyzer   | E4446A      | US44300386          | 2017-04-20       | 1 year               |
| EMCO               | Horn Antenna        | 3315        | 9511-4627           | 2016-01-28       | 2 year               |
| A.R.A.             | Antenna, Horn       | DRG-118/A   | 1132                | 2015-09-21       | 27 months            |
| Wisewave           | Antenna, Horn       | ARH-2823-02 | 10555-01            | 2015-09-01       | 28 months            |
| Wisewave           | Antenna, Horn       | ARH-4223-02 | 10555-01            | 2015-10-22       | 25 months            |
| Agilent            | Amplifier, Pre      | 8447D       | 2944A07030          | 2017-05-17       | 1 year               |
| HP                 | Generator, Signal   | 8648C       | 3847M00143          | 2016-12-21       | 1 year               |
| COM-POWER          | Antenna, Dipole     | AD-100      | 721033DB1/<br>2/3/4 | 2017-02-13       | 2 year               |

**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

|                           |             |
|---------------------------|-------------|
| <b>Temperature:</b>       | 22-26° C    |
| <b>Relative Humidity:</b> | 42-46 %     |
| <b>ATM Pressure:</b>      | 101-102 kPa |

The testing was performed by Frank Wang on 2017-12-08 at 5 meter chamber 3.

## 10.5 Test Results

Note: Both chains are transmitting simultaneously at the same channel for testing which is the worst case.

Low Channel Frequency: 5860 MHz

| Freq. (MHz) | S.A. Amp. (dBμV) | Table Azimuth Degrees | Test Antenna |              | Substitution    |                 |                |                 | Absolute Level (dBm) | FCC         |             |
|-------------|------------------|-----------------------|--------------|--------------|-----------------|-----------------|----------------|-----------------|----------------------|-------------|-------------|
|             |                  |                       | Height (m)   | Polar (H/ V) | S.G Freq. (MHz) | S.G Level (dBm) | Ant. Gain (dB) | Cable Loss (dB) |                      | Limit (dBm) | Margin (dB) |
| 500         | 49.92            | 0                     | 200          | V            | 500             | -52.02          | 0              | 0.076           | -52.096              | -25         | -27.10      |
| 500         | 50.83            | 65                    | 162          | H            | 500             | -52.19          | 0              | 0.076           | -52.266              | -25         | -27.27      |
| 375         | 46.3             | 0                     | 173          | V            | 375             | -41.6           | 0              | 0.076           | -41.676              | -25         | -16.68      |
| 375         | 47.12            | 92                    | 113          | H            | 375             | -59.91          | 0              | 0.076           | -59.986              | -25         | -34.99      |
| 1500        | 53.69            | 0                     | 100          | V            | 1500            | -58.16          | 9.845          | 0.695           | -49.01               | -25         | -24.01      |
| 1500        | 51.07            | 0                     | 100          | H            | 1500            | -60.31          | 9.845          | 0.695           | -51.16               | -25         | -26.16      |
| 1988        | 48.17            | 0                     | 100          | V            | 1988            | -60.43          | 6.871          | 0.335           | -53.894              | -25         | -28.89      |
| 2000        | 49.65            | 0                     | 100          | H            | 2000            | -58.94          | 6.871          | 0.335           | -52.404              | -25         | -27.40      |

## Middle Channel Frequency: 5890 MHz

| Freq. (MHz) | S.A. Amp. (dBμV) | Table Azimuth Degrees | Test Antenna |              | Substitution    |                 |                |                 | Absolute Level (dBm) | FCC         |             |
|-------------|------------------|-----------------------|--------------|--------------|-----------------|-----------------|----------------|-----------------|----------------------|-------------|-------------|
|             |                  |                       | Height (m)   | Polar (H/ V) | S.G Freq. (MHz) | S.G Level (dBm) | Ant. Gain (dB) | Cable Loss (dB) |                      | Limit (dBm) | Margin (dB) |
| 500         | 49.92            | 0                     | 200          | V            | 500             | -48.04          | 0              | 0.076           | -48.116              | -25         | -23.12      |
| 500         | 50.83            | 65                    | 162          | H            | 500             | -49.72          | 0              | 0.076           | -49.796              | -25         | -24.80      |
| 375         | 46.3             | 0                     | 173          | V            | 375             | -55.18          | 0              | 0.076           | -55.256              | -25         | -30.26      |
| 375         | 46.86            | 92                    | 113          | H            | 375             | -57.75          | 0              | 0.076           | -57.826              | -25         | -32.83      |
| 1500        | 53.02            | 0                     | 100          | V            | 1500            | -58.83          | 9.845          | 0.695           | -49.68               | -25         | -24.68      |
| 1500        | 49.47            | 0                     | 100          | H            | 1500            | -61.91          | 9.845          | 0.695           | -52.76               | -25         | -27.76      |
| 1988        | 48.19            | 0                     | 100          | V            | 1988            | -60.41          | 6.871          | 0.335           | -53.874              | -25         | -28.874     |
| 1987        | 48.88            | 0                     | 100          | H            | 1987            | -59.71          | 6.871          | 0.335           | -53.174              | -25         | -28.174     |

## High Channel Frequency: 5920 MHz

| Freq. (MHz) | S.A. Amp. (dBμV) | Table Azimuth Degrees | Test Antenna |              | Substitution    |                 |                |                 | Absolute Level (dBm) | FCC         |             |
|-------------|------------------|-----------------------|--------------|--------------|-----------------|-----------------|----------------|-----------------|----------------------|-------------|-------------|
|             |                  |                       | Height (m)   | Polar (H/ V) | S.G Freq. (MHz) | S.G Level (dBm) | Ant. Gain (dB) | Cable Loss (dB) |                      | Limit (dBm) | Margin (dB) |
| 501         | 48.62            | 0                     | 200          | V            | 501             | -49.34          | 0              | 0.076           | -49.416              | -25         | -24.42      |
| 501         | 49.83            | 65                    | 162          | H            | 501             | -50.72          | 0              | 0.076           | -50.796              | -25         | -25.80      |
| 375         | 46.98            | 0                     | 173          | V            | 375             | -54.5           | 0              | 0.076           | -54.576              | -25         | -29.58      |
| 375         | 46.86            | 92                    | 113          | H            | 375             | -57.75          | 0              | 0.076           | -57.826              | -25         | -32.83      |
| 1500        | 53               | 0                     | 141          | V            | 1500            | -58.85          | 9.845          | 0.335           | -49.34               | -25         | -24.34      |
| 1500        | 50.02            | 0                     | 300          | H            | 1500            | -61.36          | 9.845          | 0.335           | -51.85               | -25         | -26.85      |
| 1990        | 49.13            | 0                     | 100          | V            | 1990            | -59.47          | 9.041          | 0.695           | -51.124              | -25         | -26.12      |
| 1987        | 49.1             | 0                     | 100          | H            | 1987            | -59.49          | 9.041          | 0.695           | -51.144              | -25         | -26.14      |



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## **11 Annex A (Normative)– FCC Equipment Labeling Requirements**

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### **11.1 FCC ID Label Requirements**

#### **As per FCC §2.925,**

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID: XXX123

Where: XXX—Grantee Code, 123—Equipment Product Code

#### **As per FCC §15.19,**

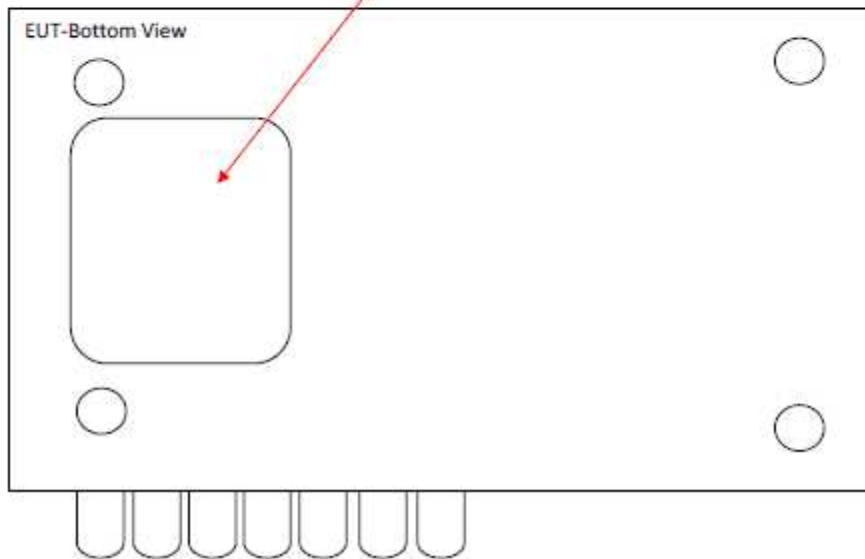
(a) In addition to the requirements in part 2 of this chapter, a device subject to certification, or verification shall be labeled as follows:

(3) All other devices shall bear the following statement in a conspicuous location on the device:  
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified above is required to be affixed only to the main control unit. If the EUT is integrated within another device then a label affixed to the host shall also state, “Contains FCC ID: XXXXXX”

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

### 11.2 EUT Label Contents and Location



## 12 Annex D (Informative) - A2LA Electrical Testing Certificate



### Accredited Laboratory

A2LA has accredited

## BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

### Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of any additional program requirements in the Electrical field. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 30<sup>th</sup> day of August 2016.

A handwritten signature in black ink, appearing to be 'L. L. L.', written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 3297.02  
Valid to September 30, 2018  
Revised November 14, 2016

*For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

---END OF REPORT ---