FCC PART 15.245

TEST REPORT

For

Takex America, Inc.

151 San Zeno Way,
Sunnyvale, CA 94086, USA

FCC ID: TO5MW50L100AL

Report Type:	Product Type:
Original Report	Microwave Sensor

Prepared By:	Frank Wang Test Engineer
Report Number:	R1704183-FDS
Report Date:	2017-10-16
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1704183-FDS	Original Report	2017-10-16

1 GENERAL DESCRIPTION

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Takex America Inc.* and their product *FCC* ID: TO5MW50L100AL or model: *MW-100AL, MW-50L,* the "EUT" as referred to in this report. It is a microwave sensor and operates in the 24.12GHz band.

1.2 Mechanical Description of EUT

The MW-50 EUT measures approximately 23 cm L x 10 cm W x 10 cm H and weighs approximately 769g
The MW-100A EUT measures approximately 30 cm L x 13 cm W x 13 cm H and weighs approximately 1051g
The test data gathered are from typical production sample, serial number R1704182-1, R1704182-2 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Takex America Inc.* in accordance with Part 2.1091, and Part 15.215 and 15.245 of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 2.1091, Part 15.215, Part 15.245 for RF Exposure, Antenna Requirements, AC Line Conducted Emissions, 20 dB Bandwidth, Fundamental Field Strength, and Radiated Spurious Emissions.

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 C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ℃
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

Type of Measurement: **ANSI C63.4-2014 Radiated Emissions** **(in the BACL 5 m - 3 SAC)** **Note: Measurements up to 1 GHz made using an RandS ESCI EMI Receiver; Measurements from 1 GHz to 40 GHz made using an RandS ESU40 EMI Receiver**	**BACL** **Typical U_{LAB} Value** **(for a k=2 Coverage Factor, equivalent to ~ 95% level of confidence)**	**U_{CISPR} Value** **worst-allowable values of the latest version of CISPR 16-4-2** **(for a k=2 Coverage Factor, equivalent to ~ 95% level of confidence)**
Radiated Electric Field Disturbance – Horizontal Polarization, 30 MHz – 200 MHz (i.e., Radiated Emissions measured at 3 metres distance)	**4.76 dB (No Tilting)**	**5.06 dB (No Tilting)**
Radiated Electric Field Disturbance – Vertical Polarization, 30 MHz – 200 MHz (i.e., Radiated Emissions at 3 metres distance)	**5.13 dB (No Tilting)**	**5.17 dB (No Tilting)**
Radiated Electric Field Disturbance – Horizontal Polarization, 200 MHz – 1000 MHz (i.e., Radiated Emissions measured at 3 metres distance)	**5.29 dB (No Tilting)**	**5.34 (No Tilting)**
Radiated Electric Field Disturbance – Vertical Polarization, 200 MHz – 1000 MHz (i.e., Radiated Emissions measured at 3 metres distance)	**5.53 dB (No Tilting)**	**6.32 dB (No Tilting)**
Radiated Electric Field Disturbance Horizontal and Vertical Polarizations, 1 GHz – 6 GHz (i.e., Radiated Emissions measured at 3 metres distance)	**4.36 dB (No Tilting)**	**5.18 dB (No Tilting)**
Radiated Electric Field Disturbance Horizontal and Vertical Polarizations, 1 GHz – 6 GHz (i.e., Radiated Emissions measured at 3 metres distance)	**4.00 dB (With Boresighting)**	**U_{CISPR} Value is Not Specified**
Radiated Electric Field Disturbance Horizontal and Vertical Polarizations, 6 GHz – 18 GHz (i.e., Radiated Emissions measured at 3 metres distance)	**4.23 dB (With Boresighting)**	**U_{CISPR} Value is Not Specified**
Radiated Electric Field Disturbance Horizontal and Vertical Polarizations, 18 GHz – 26.5 GHz (i.e., Radiated Emissions measured at 1 metres distance)	**4.81 dB (With Boresighting)**	**U_{CISPR} Value is Not Specified**
Radiated Electric Field Disturbance Horizontal and Vertical Polarizations, 26.5 GHz – 40 GHz (i.e., Radiated Emissions at 1 metres distance)	**5.00 dB (With Boresighting)**	**U_{CISPR} Value is Not Specified**

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, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),*** 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 3297.03)*** 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 and Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime and 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 3297.01)*** 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 and 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: (Industry Canada - IC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I and Phase II;

- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - Radio and Teleterminal Equipment (RandTTE) Directive 1995/5/EC
    US -EU EMC and Telecom MRA CAB
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA)
  APEC Tel MRA -Phase I and Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Development Authority - IDA) APEC Tel MRA -Phase I and Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
- Vietnam: APEC Tel MRA -Phase I;

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing in accordance to ANSI C63.10-2013.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

N/A

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
BK Precision	DC Power Supply	1740	26502000233

2.5 Support Equipment

There was no support equipment included, or intended for use with EUT during these tests.

2.6 Interface Ports and Cabling

N/A

3 SUMMARY OF TEST RESULTS

Results reported relate only to the product tested.

FCC and ISED Rules	Description of Test	Results
FCC §2.1091	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207	AC Line Conducted Emissions	Note
FCC §15.215	Emission Bandwidth	Compliant
FCC §15.245	Fundamental Field Strength	Compliant
FCC §15.205, §15.209, §15.245	Radiated Spurious Emissions	Compliant

Note: Device is DC powered, so the AC Line Conducted emission is not required.

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^2)	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	* ($180/f^2$)	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

MW-50L

Maximum peak output power at antenna input terminal (dBm):	-18.06
Maximum peak output power at antenna input terminal (mW):	0.016
Prediction distance (cm):	20
Prediction frequency (MHz):	24121
Maximum Antenna Gain, typical (dBi):	21
Maximum Antenna Gain (numeric):	125.89
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00039
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

MW-100AL

Maximum peak output power at antenna input terminal (dBm):	-17.71
Maximum peak output power at antenna input terminal (mW):	0.017
Prediction distance (cm):	20
Prediction frequency (MHz):	24123
Maximum Antenna Gain, typical (dBi):	24
Maximum Antenna Gain (numeric):	251.19
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.000847
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Note: The maximum peak output power at antenna is adjusted for tune-up tolerance and the tune-up tolerance is ±1dBm

5 FCC §15.203 - ANTENNA REQUIREMENTS

5.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.2 Antenna Description

The antennas used by the EUT are permanently attached antennas.

Radio Antenna	Frequency Range (MHz)	Maximum Antenna Gain (dBi)	External/Integral/Integral	Antenma Type/Pattern
MW- 50L	24.12 GHz	21	Internal	Horn reflector antenna
MW100AL	24.12 GHz	24	Internal	Offset parabolic antenna

6 FCC §15.215 – EMISSION BANDWIDTH

6.1 Applicable Standards

According to FCC §15.215(c), Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

6.2 Measurement Procedure

Span = approximately 2 to 5 times the 99% occupied bandwidth, centered on a hopping channel

RBW = 1% to 5 % of the 99% occupied bandwidth

VBW = 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the minimum emission or emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2017-04-10	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Wisewave	Antenna, Horn	ARH-4223	10555-01	2015-09-01	2 years
IW	Armored High Frequency Cable	DC 1531	KPS-1501A3960KPS	2016-08-05	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
Agilent	Pre-Amplifier	8449B	3008A01978	2017-03-23	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

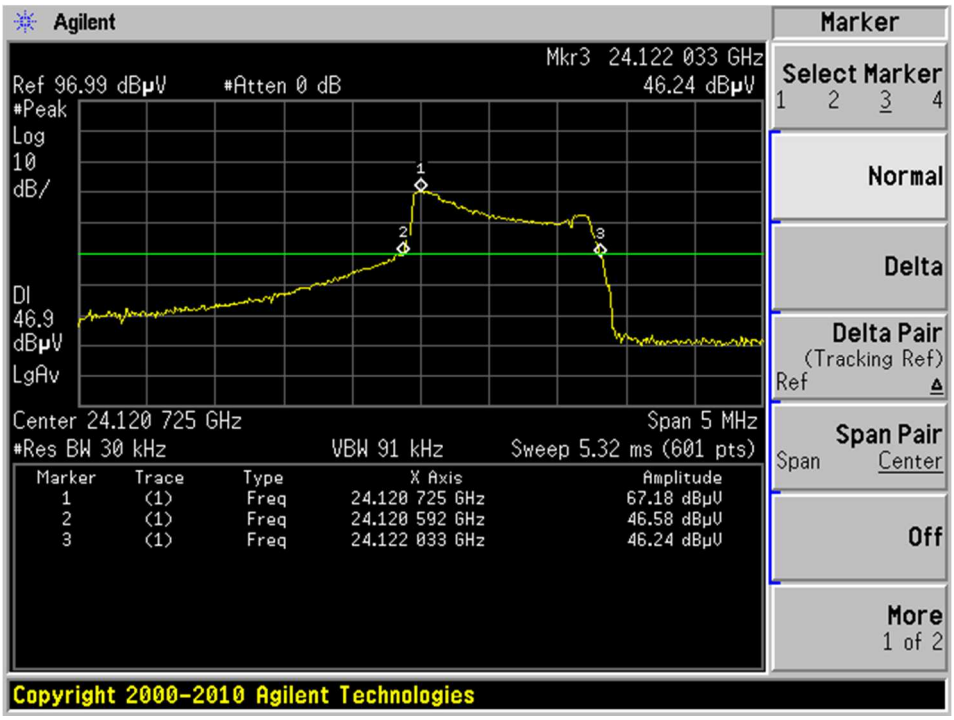
The testing was performed by Frank Wang on 2017-06-21 in RF site.

6.5 Test Results

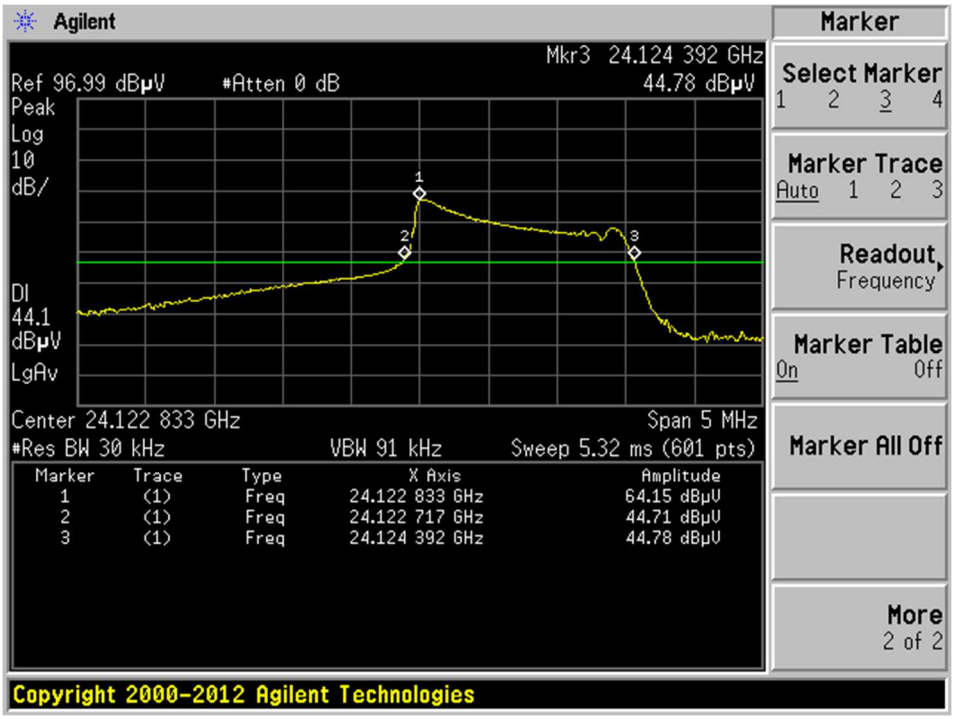
Unit	Frequency (MHz)	20 dB Bandwidth range (MHz)	Range Limit (MHz)	Result
MW-50L	24120.725	24120.592-24122.033	24075-24175	Compliance
MW-100AL	24122.833	24122.717-24124.392		Compliance

Please refer to the following plots for detailed test results.

MW-50L



MW-100AL



7 FCC 15.245(B) – FUNDAMENTAL FIELD STRENGTH

7.1 Application Standards

According to FCC § 15.245.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902–928	500	1.6
2435–2465	500	1.6
5785–5815	500	1.6
10500–10550	2500	25.0
24075–24175	2500	25.0

(2) Field strength limits are specified at a distance of 3 meters.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

7.2 Test Setup

The radiated emissions tests were performed in the 3-meter semi-anechoic chamber test site, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C limits.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2017-04-10	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Wisewave	Antenna, Horn	ARH-4223	10555-01	2015-09-01	2 years
IW	Armored High Frequency Cable	DC 1531	KPS-1501A3960KPS	2016-08-05	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
Agilent	Pre-Amplifier	8449B	3008A01978	2017-03-23	1 year

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

7.4 Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-46 %
ATM Pressure:	102 kPa

The testing was performed by Frank Wang from 2017-06-19 to 2017-06-23 in 5m chamber 3.

7.5 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW > 1/*T* Hz / Sweep = Auto

Where *T* is the period of the transmitting signal

7.6 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

7.7 Test Result

Measured at 3 meter

MW-50L (Fundamental Frequency = 24.121 GHz)

Frequency (GHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
24.121	61.72	347	116	H	35.202	19.119	35.541	80.5	148	-67.5	PK
24.121	58.07	347	116	H	35.202	19.119	35.541	76.85	128	-51.15	AV
24.121	78.39	0	151	V	35.202	19.119	35.541	97.17	148	-50.83	PK
24.121	75.33	0	151	V	35.202	19.119	35.541	94.11	128	-33.89	AV

MW-100AL (Fundamental Frequency = 24.123 GHz)

Frequency (GHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
24.123	66.19	9	177	H	35.202	19.119	35.541	84.97	148	-63.03	PK
24.123	61.61	9	177	H	35.202	19.119	35.541	80.39	128	-47.61	AV
24.123	81.74	0	153	V	35.202	19.119	35.541	100.52	148	-47.48	PK
24.123	73.88	0	153	V	35.202	19.119	35.541	92.66	128	-35.34	AV

8 FCC §15.205, §15.209, §15.245 – RADIATED SPURIOUS EMISSIONS

8.1 Application Standards

According to FCC § 15.245 Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500–10550 MHz, and 24075–24175 MHz.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902–928	500	1.6
2435–2465	500	1.6
5785–5815	500	1.6
10500–10550	2500	25.0
24075–24175	2500	25.0

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423		
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	4. 5 – 5. 15
2.1735 – 2.1905	25.5 – 25.67	1300 – 1427	5. 35 – 5. 46
4.125 – 4.128	37.5 – 38.25	1435 – 1626.5	7.25 – 7.75
4.17725 – 4.17775	73 – 74.6	1645.5 – 1646.5	8.025 – 8.5
4.20725 – 4.20775	74.8 – 75.2	1660 – 1710	9.0 – 9.2
6.215 – 6.218	108 – 121.94	1718.8 – 1722.2	9.3 – 9.5
6.26775 – 6.26825	123 – 138	2200 – 2300	10.6 – 12.7
6.31175 – 6.31225	149.9 – 150.05	2310 – 2390	13.25 – 13.4
8.291 – 8.294	156.52475 – 156.52525	2483.5 – 2500	14.47 – 14.5
8.362 – 8.366	156.7 – 156.9	2690 – 2900	15.35 – 16.2
8.37625 – 8.38675	162.0125 –167.17	3260 – 3267	17.7 – 21.4
8.41425 – 8.41475	167.72 – 173.2	3.332 – 3.339	22.01 – 23.12
12.29 – 12.293	240 – 285	3 3458 – 3 358	23.6 – 24.0
12.51975 – 12.52025	322 – 335.4	3.600 – 4.400	31.2 – 31.8
12.57675 – 12.57725	399.9 – 410		36.43 – 36.5
13.36 – 13.41	608 – 614		Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

8.2 Test Setup

The radiated emissions tests were performed in the 3-meter semi-anechoic chamber test site, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C limits.

8.3 Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-46 %
ATM Pressure:	102 kPa

The testing was performed by Frank Wang from 2017-06-19 to 2017-06-23 in 5m chamber 3.

8.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 year
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2017-04-10	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Wisewave	Antenna, Horn	ARH-2823	10555-01	2015-09-01	2 years
Wisewave	Antenna, Horn	ARH-4223	10555-01	2015-09-01	2 years
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/R
IW	Armored High Frequency Cable	DC 1531	KPS-1501A3960KPS	2016-08-05	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
Agilent	Amplifier, Pre	8447D	2944A10187	2016-06-28	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2017-03-23	1 year
A.H.Systems	Pre-Amplifier	PAM-1840VH	2696	2017-02-28	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R
Wisewave	Antenna, Horn	M19RH	17061501	2017-06-15	3 years
Wisewave	Antenna, Horn	M12RH	17061501	2017-06-15	3 years
Wisewave	Antenna, Horn	M08RH	17061501	2017-06-15	3 years

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

8.5 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.
The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW > 1/*T* Hz / Sweep = Auto

Where *T* is the period of the transmitting signal

8.6 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

8.7 Summary of Test Results

MW-50L

Worst case reading as follows measured at 3 meters:

30 MHz to 1 GHz: -9.51 dB at 100.34 MHz in the **Vertical** polarization

1 GHz – 26.5 GHz: -3.097 dB at 1115 MHz in the **Vertical** polarization

Worst case reading as follows measured at 1 meter:

26.5 GHz – 110 GHz: **-**0.15 dB at 95.58 GHz in the **Vertical** polarization

MW-100AL

Worst case reading as follows measured at 3 meters:

30 MHz to 1 GHz: -12.91 dB at 106.55 MHz in the **Vertical** polarization

1GHz – 26.5 GHz: -3.207 dB at 1143 MHz in the **Vertical** polarization

Worst case reading as follows measured at 1 meter:

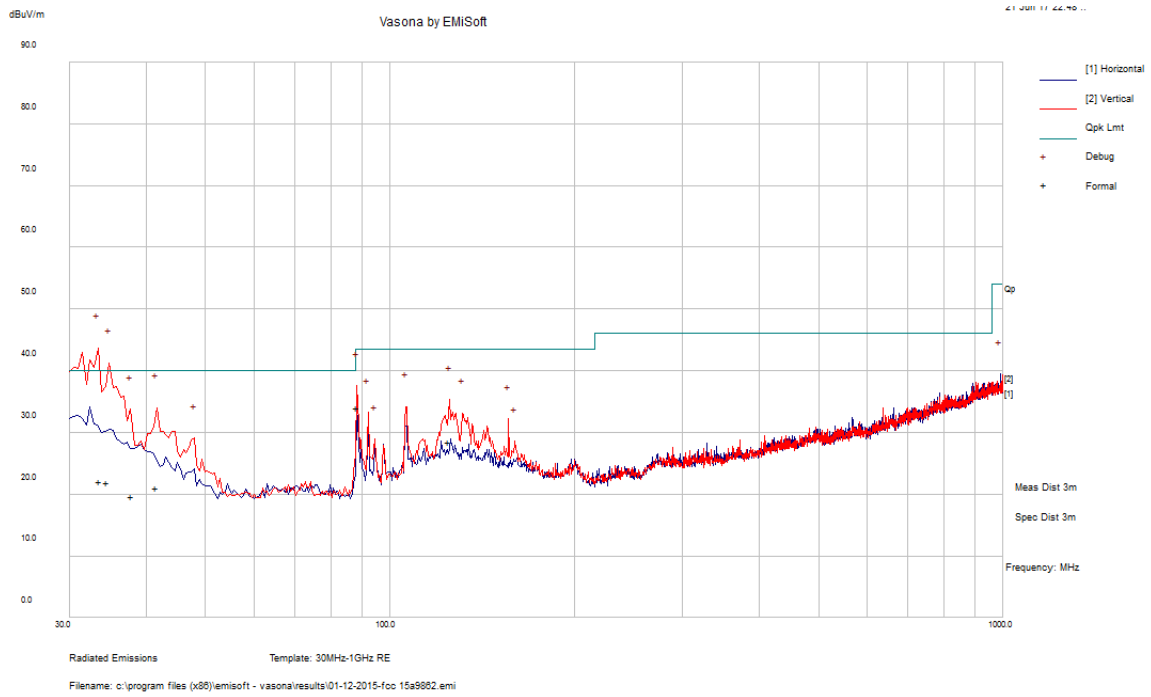
26.5 GHz – 110 GHz: **-**0.31 dB at 90 GHz in the **Vertical** polarization

Please refer to the following tables for full test results

8.8 Radiated Spurious Emission (30 MHz to 1 GHz)

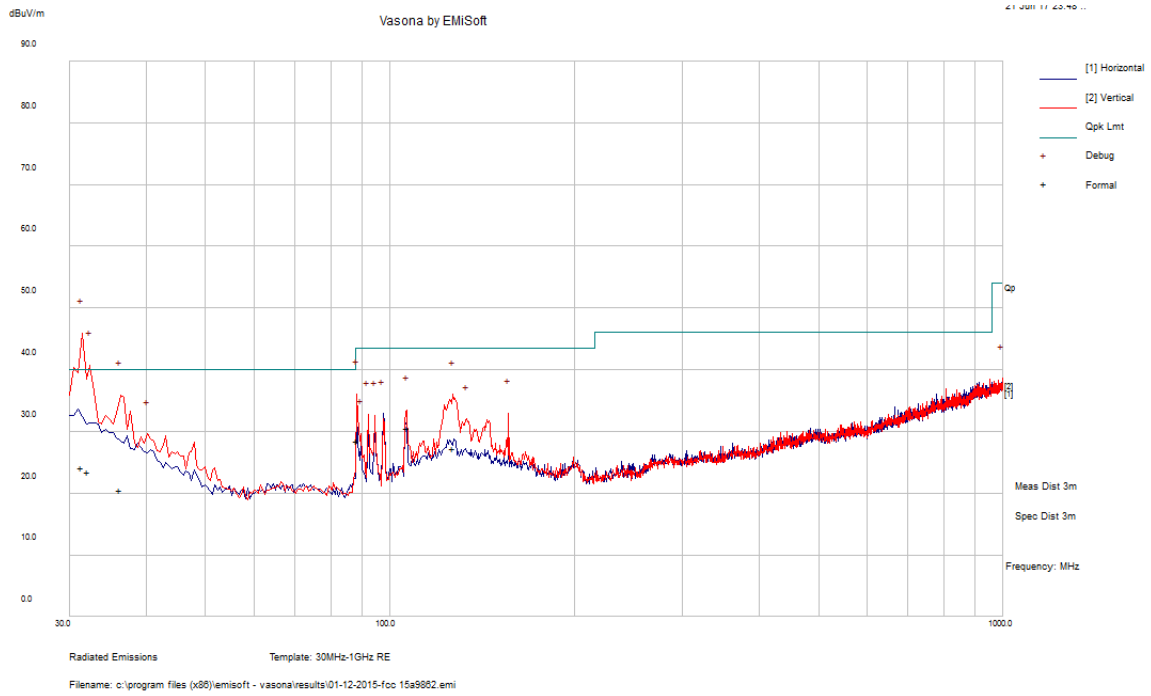
Measured at 3 meters

MW-50L



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
33.655	22.12	377	V	181	40	-17.88	QP
34.62675	21.96	164	V	98	40	-18.04	QP
41.651	21.03	135	V	186	40	-18.97	QP
88.44925	33.99	106	V	154	43.5	**-9.51**	QP
37.923	19.66	388	V	323	40	-20.34	QP
124.967	28.53	114	V	36	43.5	-14.97	QP

MW-100AL



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
31.432	24.2	312	V	13	40	-15.8	QP
32.2185	23.46	162	V	335	40	-16.54	QP
36.2155	20.6	347	V	82	40	-19.4	QP
88.449	28.44	108	V	175	43.5	-15.06	QP
126.676	27.28	101	V	204	43.5	-16.22	QP
106.554	30.59	104	V	143	43.5	**-12.91**	QP

8.9 Radiated Spurious Emission (1 GHz to 26.5 GHz)

Measured at 3 meters

MW-50L

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Fundamental Signal 24.121 GHz											
1311	50.29	0	100	H	23.901	7.56	17.838	63.913	74	-10.087	PK
1311	36.86	0	100	H	23.901	7.56	17.838	50.483	54	-3.517	AV
1115	51.05	0	100	V	23.901	7.56	17.838	64.673	74	-9.327	PK
1115	37.28	0	100	V	23.901	7.56	17.838	50.903	54	-3.097	AV
24075	36.32	0	100	H	35.202	19.119	35.541	55.1	74	-18.9	PK
24075	23.09	0	100	H	35.202	19.119	35.541	41.87	54	-12.13	AV
24075	36.57	0	100	V	35.202	19.119	35.541	55.35	74	-18.65	PK
24075	23.53	0	100	V	35.202	19.119	35.541	42.31	54	-11.69	AV

MW-100AL

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Fundamental Signal 24.123 GHz											
1055	50.64	0	100	H	23.901	7.56	17.838	64.263	74	-9.737	PK
1055	37.09	0	100	H	23.901	7.56	17.838	50.713	54	-3.287	AV
1143	50.57	0	100	V	23.901	7.56	17.838	64.193	74	-9.807	PK
1143	37.17	0	100	V	23.901	7.56	17.838	50.793	54	-3.207	AV
24075	37	347	116	H	35.202	19.119	35.541	55.78	74	-18.22	PK
24075	22.91	347	116	H	35.202	19.119	35.541	41.69	54	-12.31	AV
24075	37.89	0	100	V	35.202	19.119	35.541	56.67	74	-17.33	PK
24075	23.94	0	100	V	35.202	19.119	35.541	42.72	54	-11.28	AV

8.10 Radiated Spurious Emission (26.5 GHz to 110 GHz)

Worst case Vertical Polarity was Measured at 1 meter,

MW-50L

Frequency (GHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Fundamental Signal 24.121 GHz											
48.22	25.32	0	100	V	34.5	0	0	59.82	83.54	-23.72	PK
48.22	12.74	0	100	V	34.5	0	0	47.24	63.54	-16.3	AV
60.65	26.76	0	100	V	45.6	0	0	72.36	83.54	-11.18	PK
60.65	13.16	0	100	V	45.6	0	0	58.76	63.54	-4.78	AV
95.58	25.06	0	100	V	50.1	0	0	75.16	83.54	-8.38	PK
95.58	13.29	0	100	V	50.1	0	0	63.39	63.54	-0.15	AV

MW-100AL

Frequency (GHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Fundamental Signal 24.123 GHz											
48.24	25.15	0	100	V	34.5	0	0	59.65	83.54	-23.89	PK
48.24	12.53	0	100	V	34.5	0	0	47.03	63.54	-16.51	AV
61.35	24.7	0	100	V	45.6	0	0	70.3	83.54	-13.24	PK
61.35	12.39	0	100	V	45.6	0	0	57.99	63.54	-5.55	AV
90	26.51	0	100	V	50.1	0	0	76.61	83.54	-6.93	PK
90	13.13	0	100	V	50.1	0	0	63.23	63.54	-0.31	AV

**Note: Because the test is done in 1 meter and the limit is for 3 meter, the distance correction factor 9.54 dB has been added into the Limit.*

9 ANNEX A (NORMATIVE) – ISO/IEC 17025 CERTIFICATE AND SCOPE OF ACCREDITATION

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 30th day of August 2016.

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.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf