



FCC PART 95J



TEST AND MEASUREMENT REPORT

For

South Pacific Electronics Ltd.

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Nadi Airport, Nadi, Fiji

FCC ID: OHKFMT154
Model: FMT15408E

Report Type: Original Report	Product Type: 154.6 MHz Transmitter
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Report Number: <u>R1212124-95</u>	
Report Date: <u>2013-03-11</u>	
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" ...

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1212124-95	Original Report	2013-03-11

1. General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *South Pacific Electronics Ltd.* and their product, FCC ID: OHKFMT154, model: FMT15408E, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a base station part 95J MURS transmitter to turn on/off lights or water pumps.

The EUT operates under FCC Part 95J

Specifications	
Fixed Frequency	154.6 MHz
Modulation Type	FM
Emission Designator	F1D
RF Output Power	1 Watt
Power Supply	12 VDC

1.2 Mechanical Description

The EUT measures approximately 14cm (L) x 6 cm (W) x 3.4 cm (H) and weighs approximately 250g.

The test data gathered are from production sample provided by the manufacturer. Serial number: R1212124, assigned by BACL Sunnyvale.

1.3 Objective

This type approval report is prepared on behalf of *South Pacific Electronics Ltd.* in accordance with Part 95 of the Federal Communication Commissions rules.

The objective was to determine the RF output power, Occupied Bandwidth and Spurious Emissions are in compliance with the FCC rules.

1.4 Related Submittal(s)/Grant(s)

None.

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 individual parts:

Part 95J – Personal Radio Services

Applicable Standards: TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All emissions measurement was performed by Bay Area Compliance Laboratories 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 CISPR16-4-2:2003, 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

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 C63.4-2003, ANSI C63.4-2009, TIA/EIA-603-C & 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

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

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

2.2 Equipment Modifications

No modifications were made to the EUT.

2.3 Local Support Equipment

N/A

2.4 Local Support Equipment Details

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

2.5 EUT Internal Configuration Details

Manufacturers	Descriptions	Model	Serial Numbers
South Pacific Electronics Ltd.	PCB	FMT 154 ver.2	-

2.6 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
RF cable	<1.0	EUT	PSA
Power supply cable	1.0	Power Supply	EUT

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§95.631(j)	Emission Types	Compliant
§2.1091(a)	RF Exposure	Compliant
§95.647	Antenna Requirement	N/A ¹
§95.639(h)	RF Output Power	Compliant
§95.637	Modulation Standards	N/A ¹
§95.632(b), §95.633f(2)	Emission Bandwidth	Compliant
§95.635(e)	Unwanted Emissions and Emission Mask	Compliant
§95.635(e)	Radiated Emissions	Compliant
§95.632(c), §2.1055(c)	Frequency Stability	Compliant

Note 1: No requirement for base station transmitter

4 FCC §95.631 (j) – Emission types

4.1 Applicable Standards

FCC §95.631(j), A MURS transmitter must transmit only emission types A1D, A2B, A2D, A3E, F2B, F1D, F2D, F3E, G3E. Emission types A3E, F3E and G3E include selective calling or tone-operated squelch tones to establish or continue voice communications. MURS transmitters are prohibited from transmitting in the continuous carrier mode.

4.2 Result

The transmitter is using emission type of Frequency Modulation; one channel contains digital data that is data transmission for remote control (F1D.)

Part Number	Type of Emission
PMT15408E	Frequency Modulation, 1 Channel data, F1D

5 FCC §2.1091 - RF Exposure Information

5.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	842/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	30

f = frequency in MHz

* = Plane-wave equivalent power density

5.2 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

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>29.85</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>966.05</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>154.595</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1</u>
<u>Power density of prediction frequency at 20 cm (mW/cm²):</u>	<u>0.19</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>0.2</u>

5.3 Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 20 cm between the antenna with maximum 0 dBi gain, including any radiating structure, and any persons when normally operated.

6 FCC §95.639 (h) – RF Output Power

6.1 Applicable Standard

According to FCC §95.639 (h), No MURS unit, under any condition of modulation, shall exceed 2 Watts transmitter power output.

6.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year

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 °C
Relative Humidity:	41 %
ATM Pressure:	101.7 kPa

The testing was performed by Ning Ma on 2012-12-21 in the RF Site.

6.5 Test Results

Model Name	Frequency (MHz)	Output Power (dBm)	Output Power (Watt)
FMT15408E	154.595	29.85	0.966

7 FCC §95.632 (b) & §95.633 (f)(2) – Emission Bandwidth

7.1 Applicable Standard

According to FCC §95.632 (b) and §95.633 (f)(2): the authorized bandwidth is 20.0 kHz on frequencies 154.570 and 154.60 MHz

7.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 1% of the OBW and the spectrum was recorded.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	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

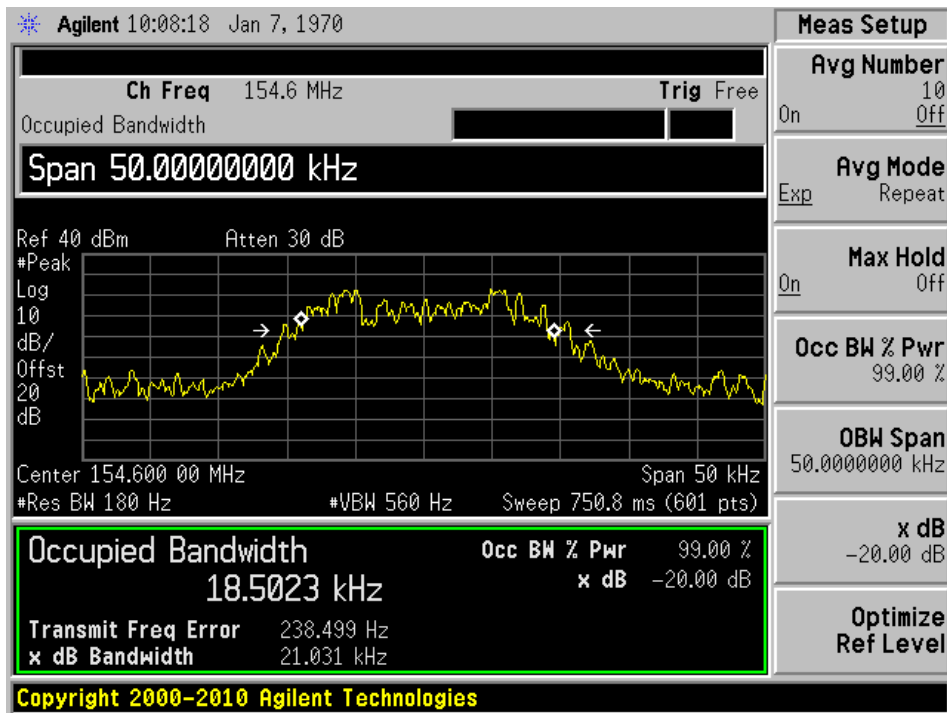
Temperature:	21 °C
Relative Humidity:	41 %
ATM Pressure:	101.7 kPa

The testing was performed by Ning Ma on 2012-12-21 in the RF Site.

7.5 Test Results

Please refer to the following plots.

Emission Bandwidth



8 FCC §95.635 (e) – Unwanted Emissions and Emission Mask

8.1 Applicable Standard

According to FCC §95.635(e): The power of each unwanted emission shall be less than TP as specified in the applicable paragraphs listed in the following table:

Frequency	Mask with Audio Low pass filter	Mask without audio low pass filter
151.820 MHz, 151.880 MHz and 151.940 MHz	(1)	(1)
154.570 MHz and 154.600 MHz	(2)	(3)

(2) *Emission Mask 2* —For transmitters designed to operate with a 25 kHz channel bandwidth that are equipped with an audio low-pass filter, the power of any emission must be below the unmodulated carrier power (P) as follows:

(i) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: at least 25 dB.

(ii) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: at least 35 dB.

(iii) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: at least $43 + 10 \log (P)$ dB.

(3) *Emission Mask 3* —For transmitters designed to operate with a 25 kHz channel bandwidth that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: at least $83 \log (f_d / 5)$ dB.

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: at least $29 \log (f_d^2 / 11)$ dB or 50 dB, whichever is the lesser attenuation.

(iii) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: at least $43 + 10 \log (P)$ dB.

8.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	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

Temperature:	21 °C
Relative Humidity:	41 %
ATM Pressure:	101.7 kPa

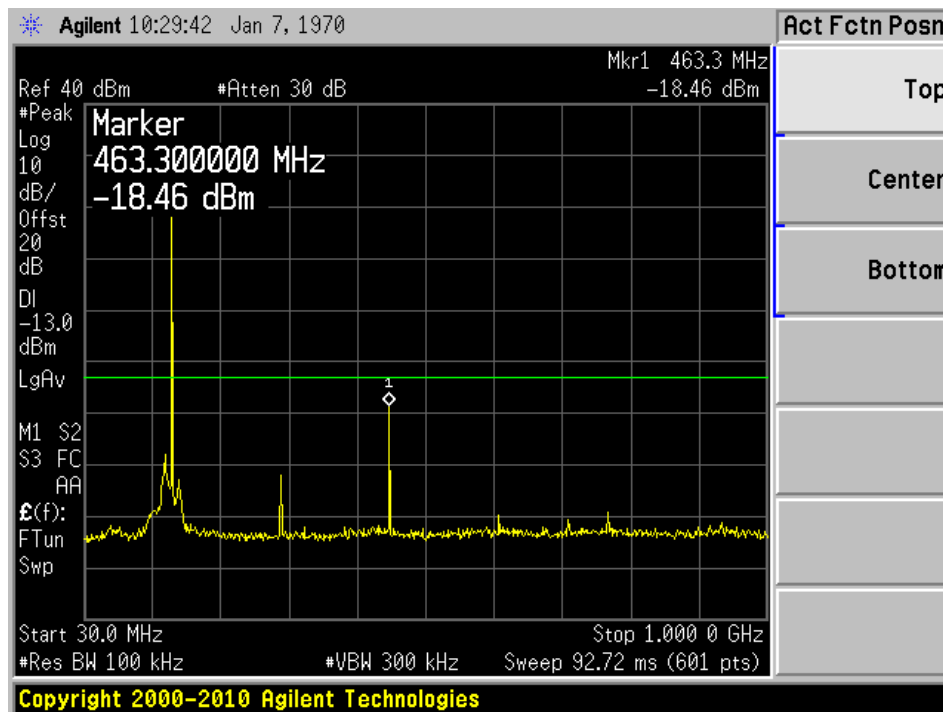
The testing was performed by Ning Ma on 2012-12-21 in the RF Site.

8.5 Test Results

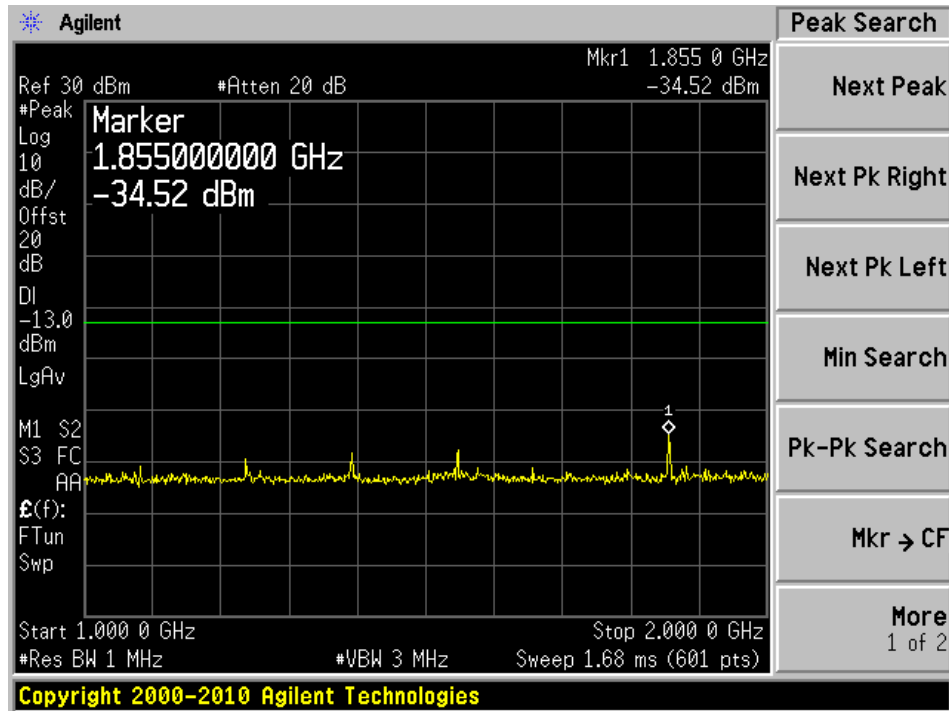
Please refer to the following plots.

Unwanted Emissions

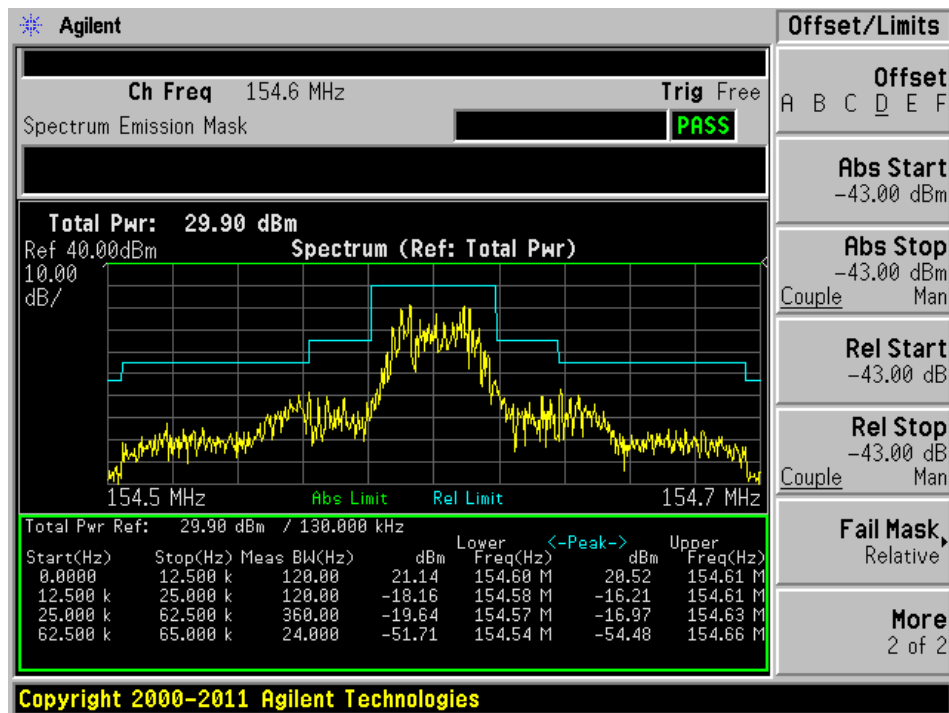
30 MHz to 1 GHz



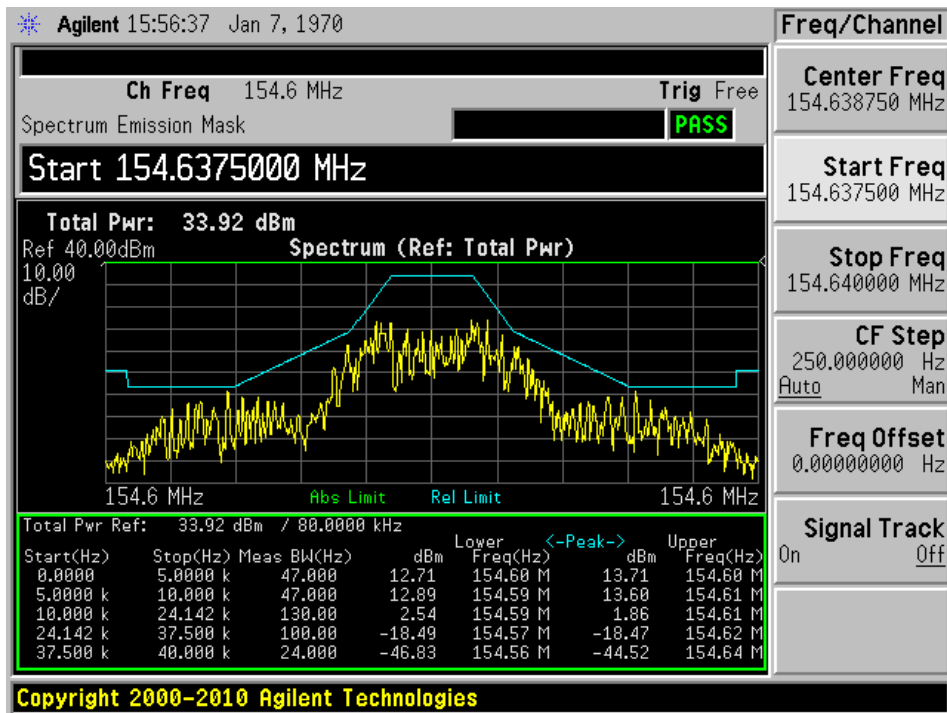
1 GHz to 2 GHz



§95.635(e)(2)Emission Mask with audio low pass filter



95.635(e)(3)Emission Mask without audio low pass filter



9 FCC §95.635(e)(2)(iii) & §95.635(e)(3)(iii) – Unwanted Emissions

9.1 Applicable Standard

According to FCC §95.635(e)(2)(iii) and §95.635(e)(3)(iii) and : On any frequency removed from the center of the authorized bandwidth by more than 250%: At least $43 + 10 \log_{10}(T)$ dB.

9.2 Test Procedure

The transmitter was placed on Styrofoam on the turntable, and it was normal transmitting with 50ohm termination 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 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 = $10 \lg(\text{TXpwr in Watts}/0.001)$ – the absolute level

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-06-18	1 Year
Rohde & Schwarz	Signal Generator	SMIQ03	849192/0085/DE23746	2012-04-23 ^{Note 1}	2 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09	1 Year
Antenna Horn	Eaton	96001	Mar-07	2012-10-17	1 Year
Antenna Horn	A.R.A	DRG-118/A	1132	2012-01-18	1 year

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

9.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	45 %
ATM Pressure:	101.9 kPa

The testing was performed by Ning Ma on 2012-12-22 in 5 meter chamber 3.

9.5 Test Results

Worst Margin: **-17.81 dB** at **773 MHz** in the **Horizontal** polarization.

Please see following table for detailed results.

Indicated		Turntable Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
310	30	281	160	H	310	-34.7	0	0.09	-34.79	-13	-21.79
310	27	48	134	V	310	-37.7	0	0.09	-37.79	-13	-24.79
773	33.52	333	100	H	773	-30.61	0	0.2	-30.81	-13	-17.81
773	29.35	160	160	V	773	-34.78	0	0.2	-34.98	-13	-21.98
1082	67.44	137	195	V	1082	-45.07	6.203	0.3	-39.167	-13	-26.167
1082	67.32	283	147	H	1082	-45.19	6.234	0.3	-39.256	-13	-26.256
1391	64.99	154	159	V	1391	-47.05	7.623	0.41	-39.837	-13	-26.837
1391	66.81	170	150	H	1391	-45.23	7.685	0.41	-37.955	-13	-24.955
1546	63.04	124	128	V	1546	-48.33	8.412	0.5	-40.418	-13	-27.418
1546	64.92	348	168	H	1546	-46.45	8.397	0.5	-38.553	-13	-25.553
1700	64.77	233	156	V	1700	-45.23	8.919	0.6	-36.911	-13	-23.911
1700	64.59	346	148	H	1700	-45.41	8.889	0.6	-37.121	-13	-24.121

10 FCC §2.1055 & §95.632 (c) – Frequency Stability

10.1 Applicable Standard

According to §95.632 (c) MURS transmitters must maintain a frequency stability of 5.0 ppm, or 2.0 ppm if designed to operate with a 6.25 kHz bandwidth.

10.2 Test Procedure

The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from battery end point to 115 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification — the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within $\pm 0.0005\%$ (± 5 ppm) of the center frequency.

CW was tested as worst case.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 years
	Signal Generator	E4438C	MY45091309	2012-05-03	1 year
Espec	Temp/Humidity Chamber	ESL-4CA	18010	2012-02-10	1 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

Temperature:	21 °C
Relative Humidity:	41 %
ATM Pressure:	101.7 kPa

The testing was performed by Ning Ma on 2012-12-21 in the RF Site.

10.5 Test Results

Test Condition		Measured Frequency (MHz)	Reference Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vac)	Temperature (°C)				
Frequency vs. Temperature					
12	50	154.599981	154.6	-0.1229	± 5
12	45	154.599893	154.6	-0.6921	± 5
12	35	154.599912	154.6	-0.5692	± 5
12	25	154.599962	154.6	-0.2458	± 5
12	15	154.600028	154.6	0.1811	± 5
12	5	154.599959	154.6	-0.265	± 5
12	-5	154.600088	154.6	0.5692	± 5
Frequency vs. Voltage					
11	25	154.5999637	154.6	-0.2348	± 5
13.6	25	154.5999367	154.6	-0.4094	± 5