

## FCC PART 90 TEST REPORT

For

### Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications

20809 Kensington Blvd, Lakeville, Minnesota, 55044-8385, USA

**FCC ID: Q9SAWR4000**

|                                                        |                                                                                                                                                                                                                                                         |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Report Type:</b><br>Original Report                 | <b>Product Type:</b><br>Two-way radio                                                                                                                                                                                                                   |
| <b>Test Engineer:</b> <u>Dean Liu</u>                  | <i>Dean Liu</i>                                                                                                                                                                                                                                         |
| <b>Report Number:</b> <u>RDG150420002-00</u>           |                                                                                                                                                                                                                                                         |
| <b>Report Date:</b> <u>2015-05-25</u>                  |                                                                                                                                                                                                                                                         |
| <b>Reviewed By:</b> <u>Jerry Zhang<br/>EMC Manager</u> | <i>Jerry Zhang</i>                                                                                                                                                                                                                                      |
| <b>Test Laboratory:</b>                                | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industrial Zone,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br><a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a> |

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FINAL

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications*'s product, model: *AWR4000 (FCC ID: Q9SAWR4000)* (the "EUT") in this report is a *Two-way radio*, which was measured approximately: 14.7 cm (H) x 5.0 cm (W) x 2.6 cm (T), rated input voltage: DC3.7V rechargeable Li-ion battery.

*\* All measurement and test data in this report was gathered from production sample serial number: 150420002 (Assigned by applicant). The EUT was received on 2015-04-22.*

### Objective

This test report is prepared on behalf of *Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications* in accordance with Part 2 and Part 90 of the Federal Communications Commission rules.

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

No related submittal(s).

### 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 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D and ANSI 63.4-2003.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

### Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications Commission (FCC). 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 06, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

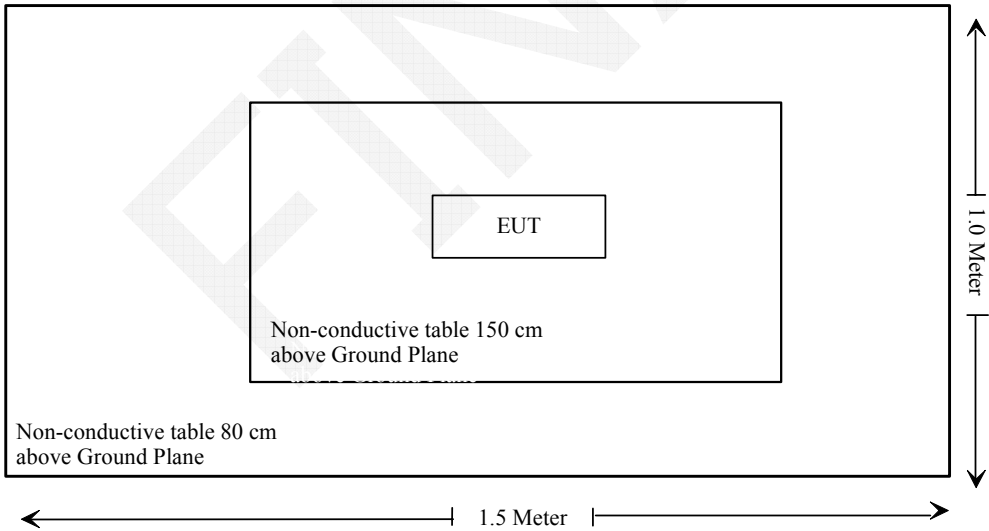
EUT Specification:

|                          |                                                   |
|--------------------------|---------------------------------------------------|
| Operating Frequency Band | 450-470 MHz                                       |
| Modulation Mode          | FM                                                |
| Channel Separation       | 6.25 kHz, 12.5 kHz                                |
| Rated Output Power       | High power level: 2.0 W<br>Low power level: 0.5 W |

Support Equipment List and Details

| Manufacturer   | Description     | Model   | Serial Number |
|----------------|-----------------|---------|---------------|
| Pro instrument | DC Power Supply | pps3300 | /             |

Block Diagram of Test Setup



**SUMMARY OF TEST RESULTS**

| FCC Rules                   | Description of Test                   | Results   |
|-----------------------------|---------------------------------------|-----------|
| §2.1093                     | RF Exposure                           | Compliant |
| §2.1046;§90.205             | RF Output Power                       | Compliant |
| §2.1047;§90.207             | Modulation Characteristic             | Compliant |
| §2.1049;§90.209;<br>§90.210 | Occupied Bandwidth & Emission Mask    | Compliant |
| §2.1051;§90.210             | Spurious Emission at Antenna Terminal | Compliant |
| §2.1053;§90.210             | Spurious Radiated Emissions           | Compliant |
| §2.1055;§90.213             | Frequency Stability                   | Compliant |
| §90.214                     | Transient Frequency Behavior          | Compliant |

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## **FCC §1.1310 & §2.1093 - RF EXPOSURE**

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### **Applicable Standard**

FCC§1.1310 and §2.1093.

### **Test Result**

Compliance, please refer to the SAR report: RDG150420002-20A

FINAL

**FCC §2.1046§90.205- RF OUTPUT POWER****Applicable Standard**

FCC §2.1046 and §90.205.

**Test Procedure**

Conducted RF Output Power:

TIA-603-D section 2.2.1

Radiated method:

ANSI/TIA 603-D section 2.2.17

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

Spectrum Analyzer setting:

| RBW     | VBW     |
|---------|---------|
| 100 kHz | 300 kHz |

**Test Equipment List and Details**

| Manufacturer   | Description               | Model | Serial Number | Calibration Date | Calibration Due Date |
|----------------|---------------------------|-------|---------------|------------------|----------------------|
| R&S            | EMI Test Receiver         | ESCI  | 100224        | 2014-05-09       | 2015-05-09           |
| Sunol Sciences | Antenna                   | JB3   | A060611-3     | 2014-11-06       | 2017-11-05           |
| Giga           | Signal Generator          | 1026  | 320408        | 2014-05-09       | 2015-05-09           |
| EMCO           | Adjustable Dipole Antenna | 3121C | 9109-753      | N/A              | N/A                  |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Data****Environmental Conditions**

|                    |           |
|--------------------|-----------|
| Temperature:       | 25.3°C    |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 100.5 kPa |

*The testing was performed by Dean Liu on 2015-05-07.*

Test Result: Compliant. Please refer to following tables.

Conducted Power:

| Modulation | Channel Separation | $f_c$    | Conducted Output Power |      |
|------------|--------------------|----------|------------------------|------|
|            |                    | MHz      | High                   | Low  |
|            |                    |          | W                      | W    |
| FM         | 12.5kHz            | 450.0125 | 1.95                   | 0.51 |
|            |                    | 460      | 1.91                   | 0.50 |
|            |                    | 469.9875 | 1.89                   | 0.50 |
|            | 6.25kHz            | 450.0125 | 1.94                   | 0.51 |
|            |                    | 460      | 1.92                   | 0.50 |
|            |                    | 469.9875 | 1.89                   | 0.50 |

Note: the rated output power is 2.0W (High); 0.5W (Low).

ERP:

| Frequency<br>(MHz)                   | Polar<br>(H/V) | Receiver<br>Reading<br>(dBμV) | Substituted Method     |                              |                    | Absolute<br>Level<br>(dBm) |
|--------------------------------------|----------------|-------------------------------|------------------------|------------------------------|--------------------|----------------------------|
|                                      |                |                               | S.G.<br>Level<br>(dBm) | Antenna<br>Gain<br>(dBd/dBi) | Cable Loss<br>(dB) |                            |
| Channel Spacing:12.5 kHz, High Power |                |                               |                        |                              |                    |                            |
| 450.0125                             | V              | 109.06                        | 30.3                   | 0.0                          | 0.7                | 29.6                       |
| 460                                  | V              | 110.69                        | 32.2                   | 0.0                          | 0.7                | 31.5                       |
| 469.9875                             | V              | 110.31                        | 32.2                   | 0.0                          | 0.7                | 31.5                       |
| Channel Spacing:6.25 kHz, High Power |                |                               |                        |                              |                    |                            |
| 450.0125                             | V              | 109.21                        | 30.4                   | 0.0                          | 0.7                | 29.7                       |
| 460                                  | V              | 110.38                        | 31.9                   | 0.0                          | 0.7                | 31.2                       |
| 469.9875                             | V              | 110.18                        | 32.0                   | 0.0                          | 0.7                | 31.3                       |

Note:

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = SG Level - Cable loss + Antenna Gain

**FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC****Applicable Standard**

FCC§2.1047 &amp; §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

**Test Procedure**

Test Method: TIA/EIA-603 2.2.3

**Test Equipment List and Details**

| Manufacturer | Description                | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|--------------|----------------------------|-----------|------------|------------------|----------------------|
| HP           | RF Communications Test Set | 8920A     | 00 235     | 2014-05-09       | 2015-05-09           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25.3°C    |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 100.5 kPa |

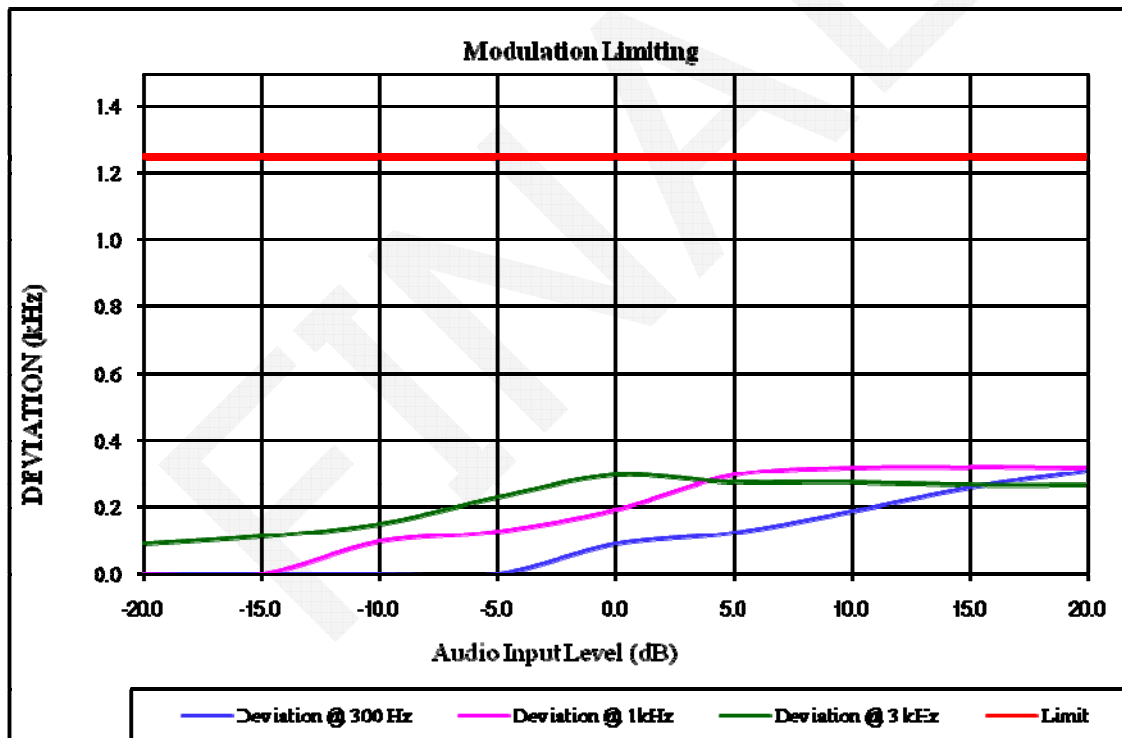
*The testing was performed by Dean Liu on 2015-05-07.*

*Test Result: Compliant. Please refer to following plots.*

**MODULATION LIMITING**

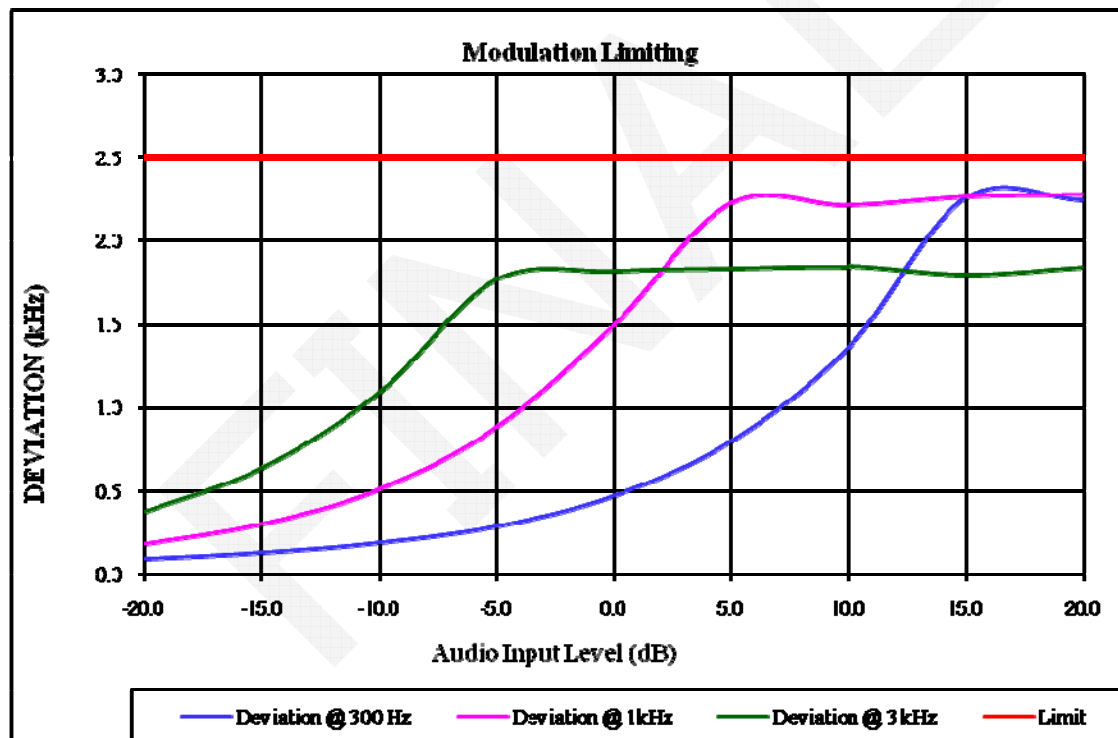
Carrier Frequency: 460 MHz, Channel Separation = 6.25 kHz, high power level

| AUDIO INPUT LEVEL | DEVIATION (@300Hz) | DEVIATION (@ 1kHz) | DEVIATION (@ 3kHz) | Result |
|-------------------|--------------------|--------------------|--------------------|--------|
| dB                | kHz                | kHz                | kHz                |        |
| 20.0              | 0.308              | 0.317              | 0.265              | Pass   |
| 15.0              | 0.260              | 0.321              | 0.265              | Pass   |
| 10.0              | 0.186              | 0.319              | 0.274              | Pass   |
| 5.0               | 0.122              | 0.296              | 0.274              | Pass   |
| 0.0               | 0.087              | 0.192              | 0.297              | Pass   |
| -5.0              | /                  | 0.127              | 0.227              | Pass   |
| -10.0             | /                  | 0.098              | 0.149              | Pass   |
| -15.0             | /                  | /                  | 0.112              | Pass   |
| -20.0             | /                  | /                  | 0.087              | Pass   |



Carrier Frequency: 460 MHz, Channel Separation = 12.5 kHz, high power level

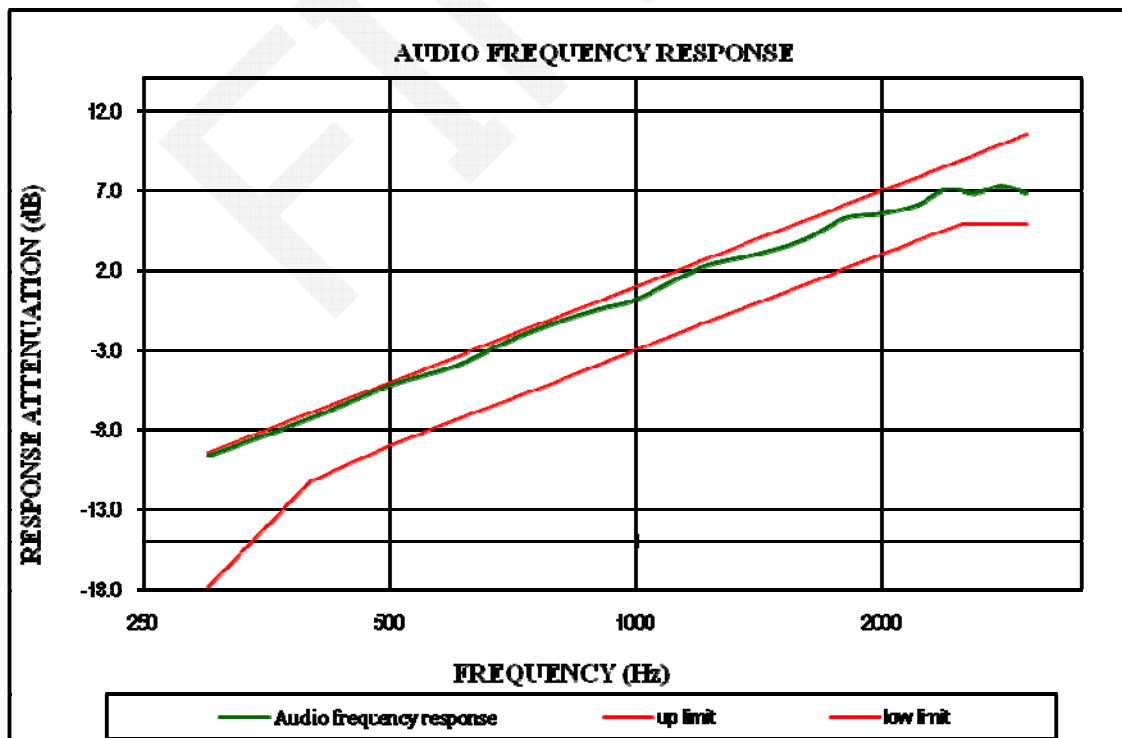
| AUDIO INPUT LEVEL | DEVIATION (@300Hz) | DEVIATION (@ 1kHz) | DEVIATION (@ 3kHz) | Limit |
|-------------------|--------------------|--------------------|--------------------|-------|
| dB                | kHz                | kHz                | kHz                | kHz   |
| 20.0              | 2.247              | 2.277              | 1.840              | 2.5   |
| 15.0              | 2.264              | 2.268              | 1.799              | 2.5   |
| 10.0              | 1.362              | 2.214              | 1.846              | 2.5   |
| 5.0               | 0.799              | 2.227              | 1.836              | 2.5   |
| 0.0               | 0.469              | 1.500              | 1.821              | 2.5   |
| -5.0              | 0.287              | 0.879              | 1.768              | 2.5   |
| -10.0             | 0.185              | 0.509              | 1.089              | 2.5   |
| -15.0             | 0.128              | 0.302              | 0.638              | 2.5   |
| -20.0             | 0.094              | 0.183              | 0.373              | 2.5   |



**Audio Frequency Response**

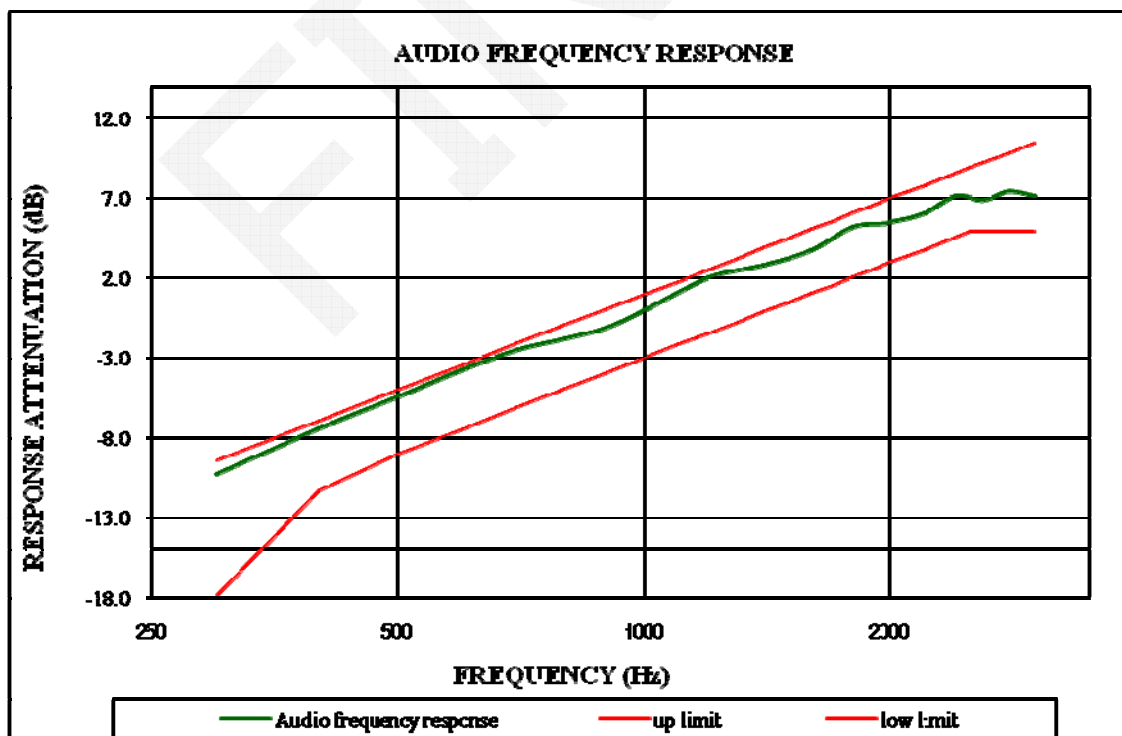
Carrier Frequency: 460 MHz, Channel Separation = 6.25 kHz, high power level

| Audio Frequency | Response Attenuation |
|-----------------|----------------------|
| Hz              | dB                   |
| 300             | -9.62                |
| 400             | -7.31                |
| 500             | -5.22                |
| 600             | -4.04                |
| 700             | -2.43                |
| 800             | -1.28                |
| 900             | -0.44                |
| 1000            | 0.17                 |
| 1200            | 2.15                 |
| 1400            | 2.96                 |
| 1600            | 3.85                 |
| 1800            | 5.24                 |
| 2000            | 5.52                 |
| 2200            | 6.08                 |
| 2400            | 7.10                 |
| 2600            | 6.83                 |
| 2800            | 7.29                 |
| 3000            | 6.85                 |



Carrier Frequency: 460 MHz, Channel Separation = 12.5 kHz, high power level

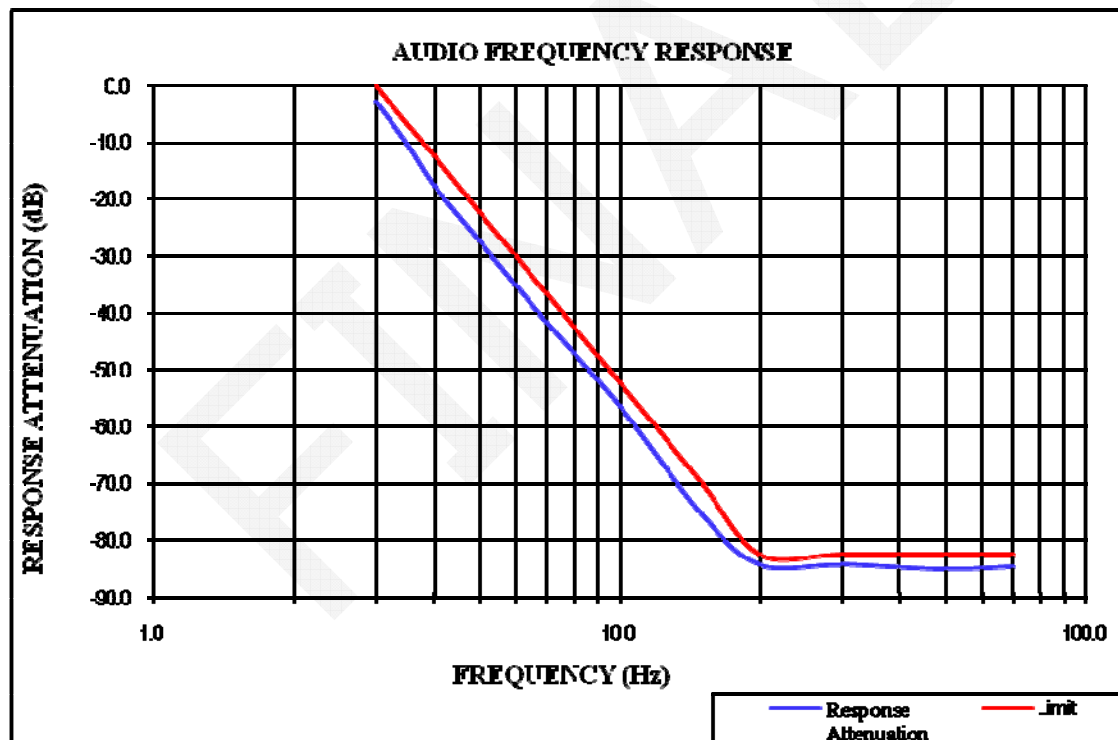
| Audio Frequency | Response Attenuation |
|-----------------|----------------------|
| Hz              | dB                   |
| 300             | -10.25               |
| 400             | -7.39                |
| 500             | -5.39                |
| 600             | -3.74                |
| 700             | -2.48                |
| 800             | -1.77                |
| 900             | -1.08                |
| 1000            | 0.00                 |
| 1200            | 2.04                 |
| 1400            | 2.82                 |
| 1600            | 3.73                 |
| 1800            | 5.25                 |
| 2000            | 5.49                 |
| 2200            | 6.08                 |
| 2400            | 7.16                 |
| 2600            | 6.92                 |
| 2800            | 7.45                 |
| 3000            | 7.12                 |



**Audio Frequency Low Pass Filter Response**

Carrier Frequency: 460 MHz, Channel Separation = 12.5 kHz, high power level

| Audio Frequency | Response Attenuation | Limit |
|-----------------|----------------------|-------|
| kHz             | dB                   | dB    |
| 3.0             | -2.7                 | 0.0   |
| 3.5             | -10.2                | -6.7  |
| 4.0             | -17.8                | -12.5 |
| 5.0             | -27.3                | -22.2 |
| 7.0             | -41.8                | -36.8 |
| 10.0            | -56.5                | -52.3 |
| 15.0            | -75.5                | -69.9 |
| 20.0            | -84.3                | -82.5 |
| 30.0            | -84.3                | -82.5 |
| 50.0            | -85.0                | -82.5 |
| 70.0            | -84.6                | -82.5 |



## FCC §2.1049 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

### Applicable Standard

FCC §2.1049, §90.209 and §90.210

Applicable Emission Masks

| Frequency band (MHz) | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|----------------------|-----------------------------------------------|--------------------------------------------------|
| Below 25             | A or B                                        | A or C                                           |
| 25-50                | B                                             | C                                                |
| 72-76                | B                                             | C                                                |
| 150-174              | B, D, or E                                    | C, D or E                                        |
| 150 paging only      | B                                             | C                                                |
| 220-222              | F                                             | F                                                |
| 421-512              | B, D, or E                                    | C, D, or E                                       |
| 450 paging only      | B                                             | G                                                |
| 806-809/851-854      | B                                             | H                                                |
| 809-824/854-869      | B                                             | G                                                |
| 896-901/935-940      | I                                             | J                                                |
| 902-928              | K                                             | K                                                |
| 929-930              | B                                             | G                                                |
| 4940-4990 MHz        | L or M                                        | L or M                                           |
| 5850-5925            |                                               |                                                  |
| All other bands      | B                                             | C                                                |

**Emission Mask D**—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least  $7.27(f_d - 2.88 \text{ kHz})$  dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: At least  $50 + 10 \log(P)$  dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

**Emission Mask E**—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 3.0 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

### Test Equipment List and Details

| Manufacturer | Description                | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|--------------|----------------------------|-----------|------------|------------------|----------------------|
| R&S          | Spectrum Analyzer          | FSEM      | DE31388    | 2014-05-09       | 2015-05-09           |
| HP           | RF Communications Test Set | 8920A     | 00 235     | 2014-05-09       | 2015-05-09           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

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

### Test Data

#### Environmental Conditions

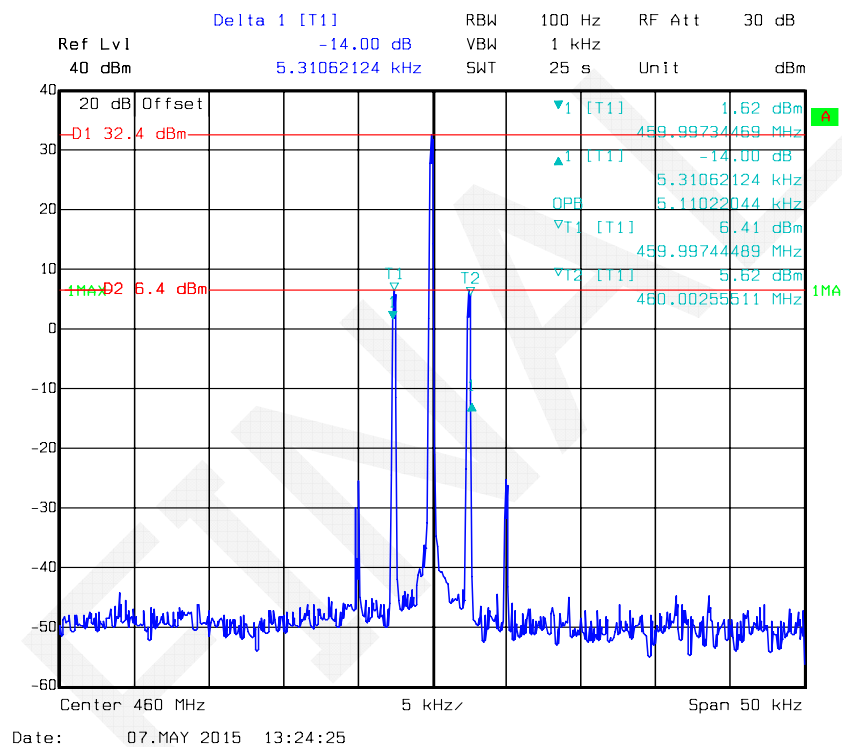
|                    |           |
|--------------------|-----------|
| Temperature:       | 25.3°C    |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 100.5 kPa |

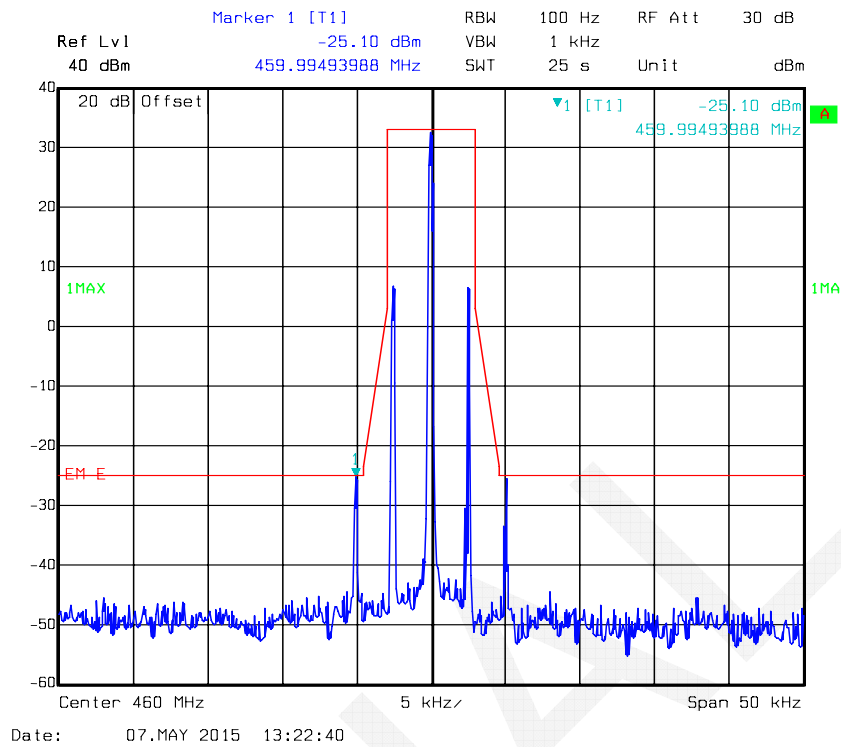
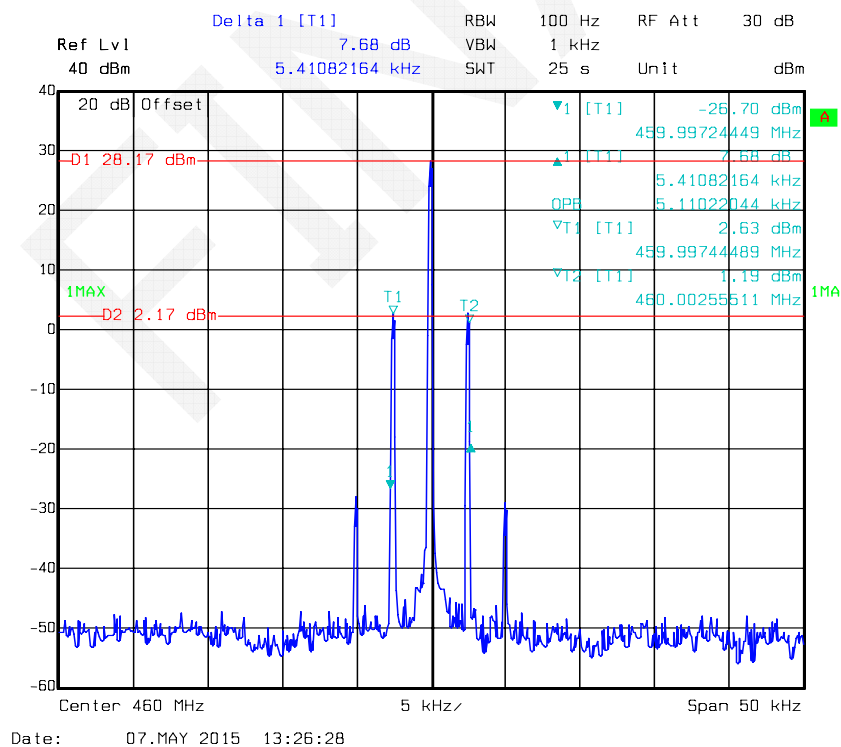
*The testing was performed by Dean Liu on 2015-05-07.*

Test Result: Compliant. Please refer to the following tables and plots.

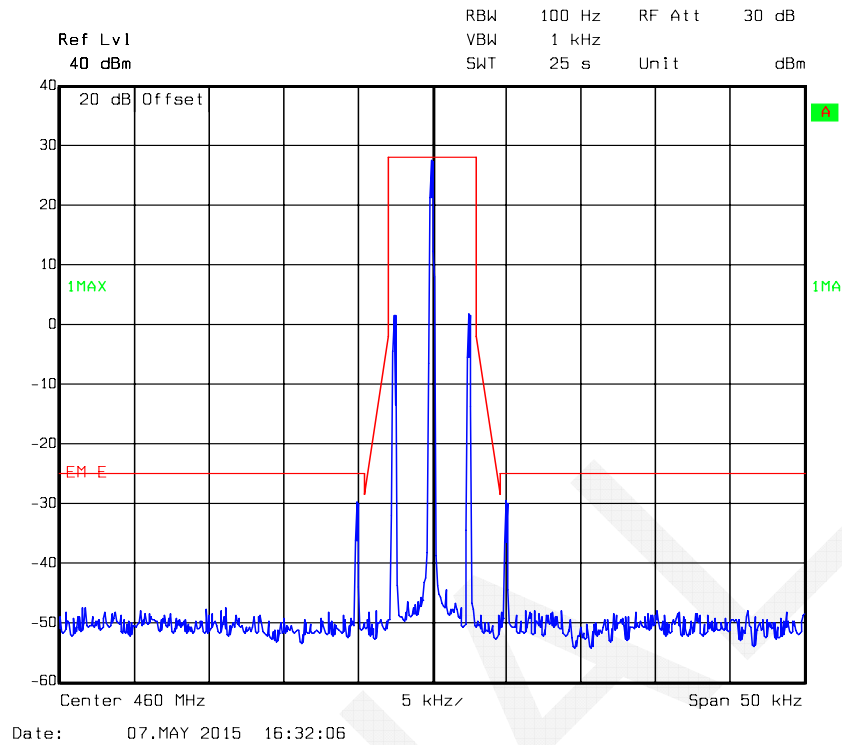
| Modulation | Channel Separation | $f_c$ | 26 dB Bandwidth | Power Level |
|------------|--------------------|-------|-----------------|-------------|
|            | kHz                |       | kHz             |             |
| FM         | 6.25               | 460   | 5.31            | High        |
|            | 12.5               |       | 10.32           |             |
|            | 6.25               | 460   | 5.41            | Low         |
|            | 12.5               |       | 10.31           |             |

### Occupied Bandwidth – FM, 6.25 kHz, High Power Level

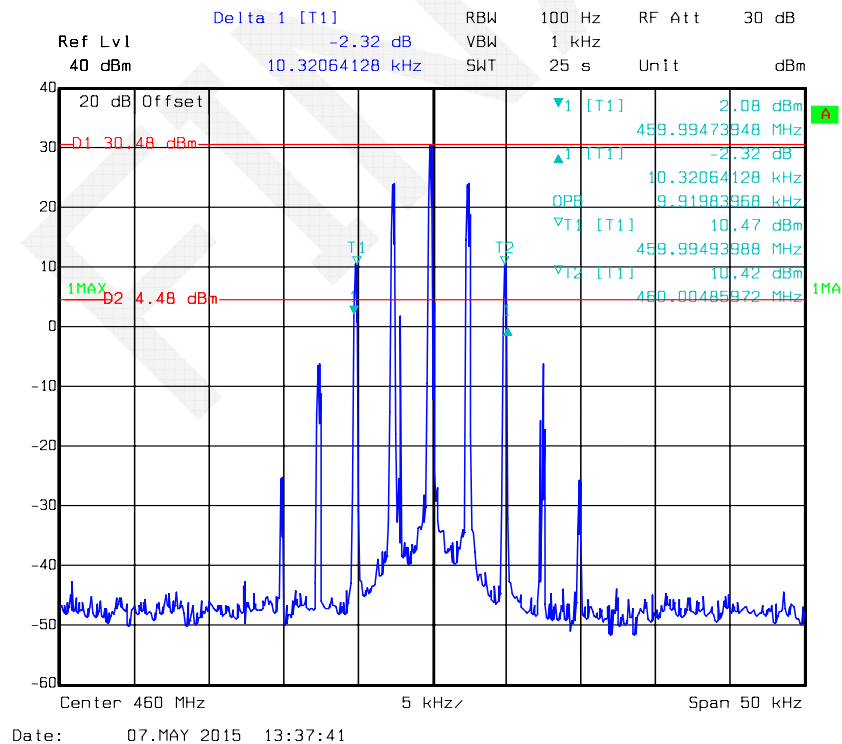


**Emission Mask - Type E****Occupied Bandwidth – FM, 6.25 kHz, Low Power Level**

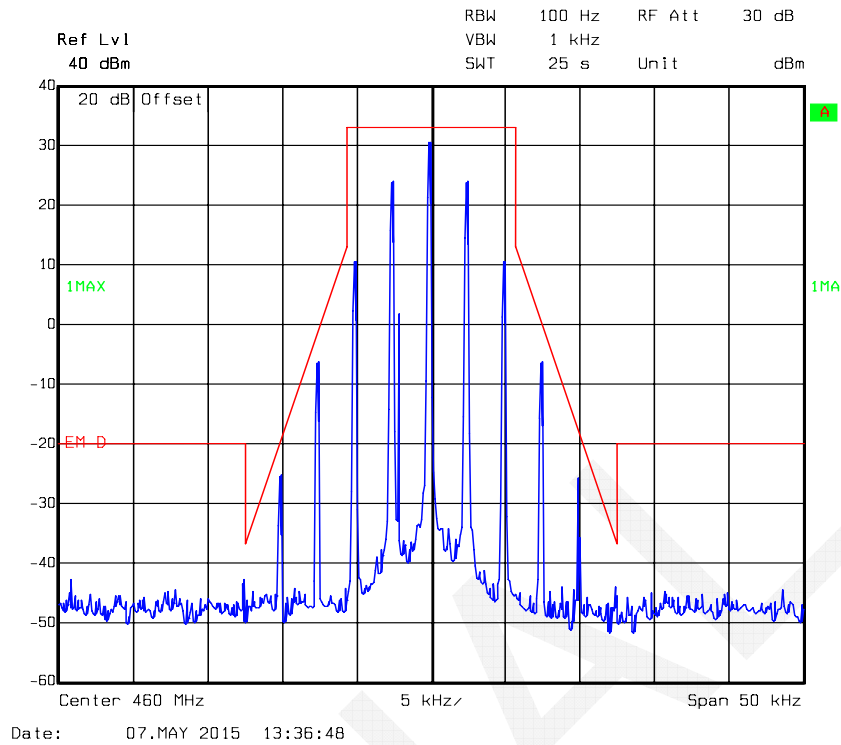
### Emission Mask - Type E



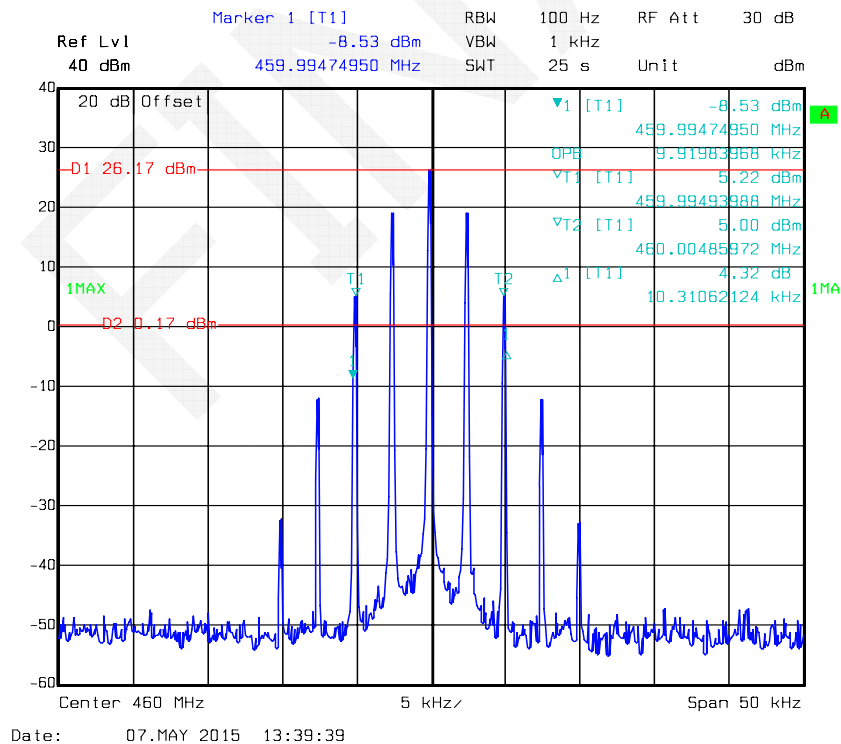
### Occupied Bandwidth -FM, 12.5 kHz, High Power Level



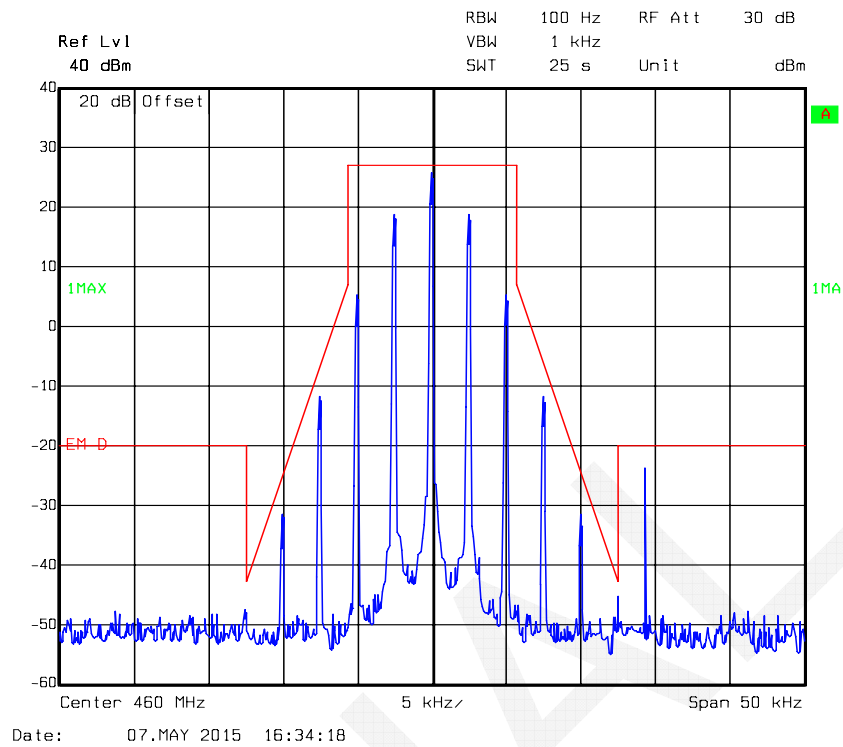
### Emission Mask - Type D



### Occupied Bandwidth – FM, 12.5 kHz, Low Power Level



### Emission Mask - Type D



## FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### Applicable Standard

**Emission Mask D**—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least  $7.27(f_d - 2.88 \text{ kHz})$  dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: At least  $50 + 10 \log(P)$  dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

**Emission Mask E**—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 3.0 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

**Test Equipment List and Details**

| Manufacturer | Description                | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|--------------|----------------------------|-----------|------------|------------------|----------------------|
| R&S          | Spectrum Analyzer          | FSEM      | DE31388    | 2014-05-09       | 2015-05-09           |
| HP           | RF Communications Test Set | 8920A     | 00 235     | 2014-05-09       | 2015-05-09           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Procedure**

Adjust the spectrum analyzer for the following settings:

- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth  $\geq 3$  times the resolution bandwidth.
- 3) Sweep Speed  $\leq 2000$  Hz per second.
- 4) Detector Mode = RMS or average power.

**Test Data****Environmental Conditions**

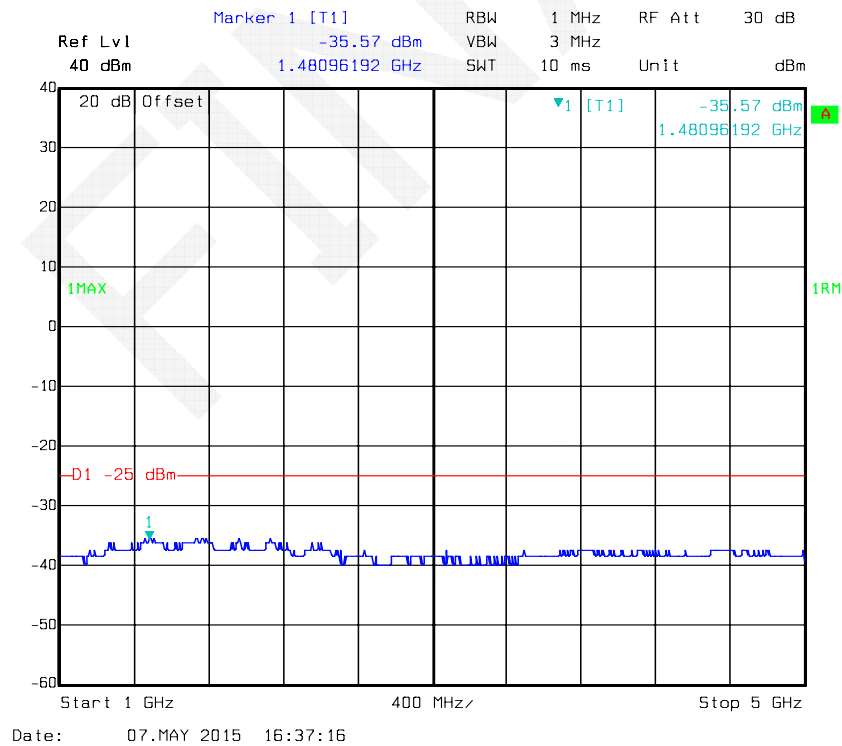
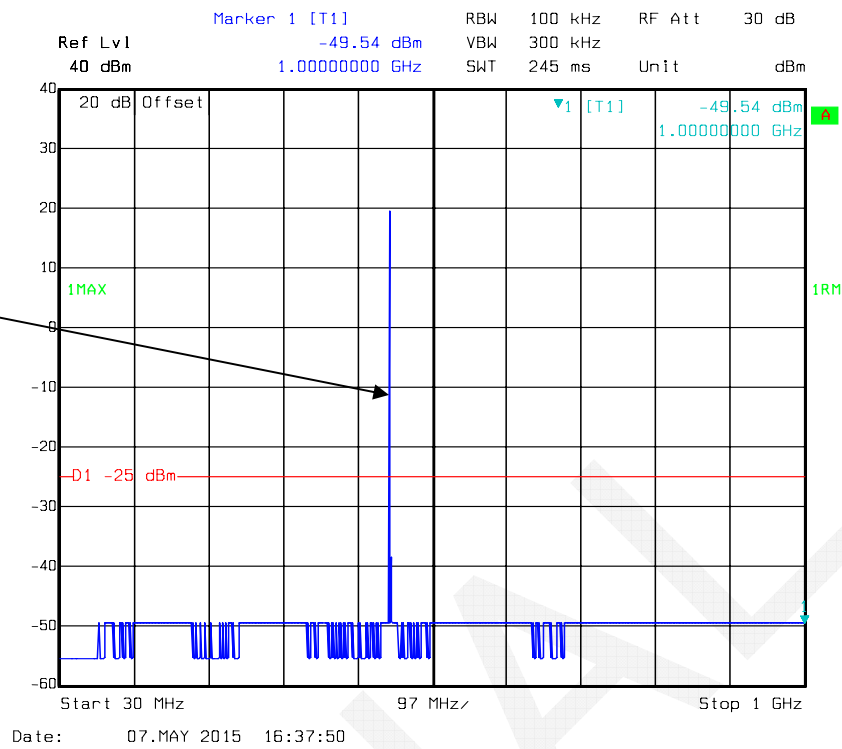
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25.3°C    |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 100.5 kPa |

*The testing was performed by Dean Liu on 2015-05-07.*

Note: for conducted spurious emissions were tested at high rated power, which was the worst case. And there was a band reject filter between the EUT and test equipment when testing.

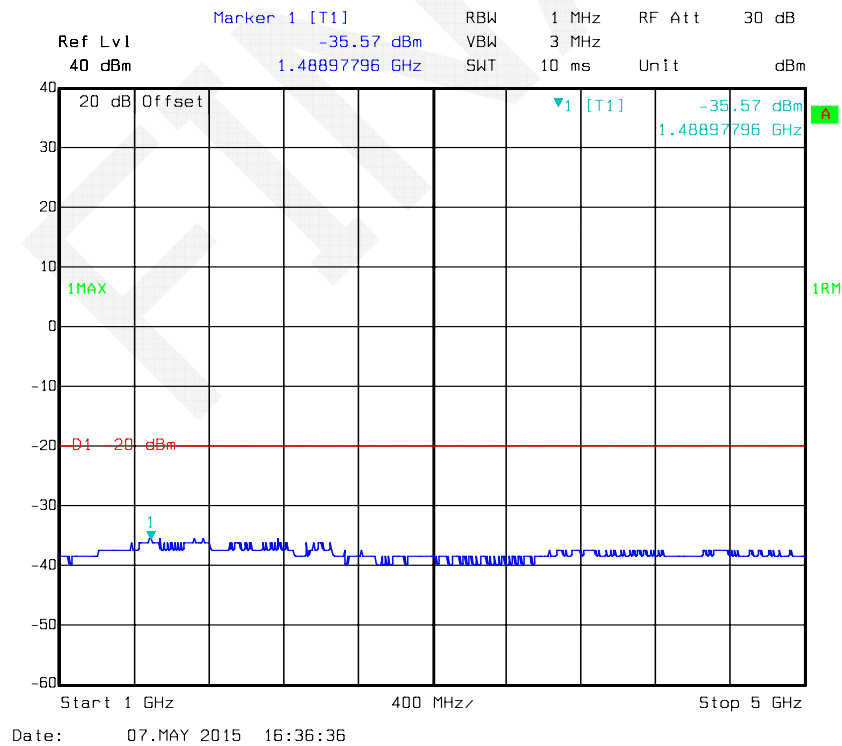
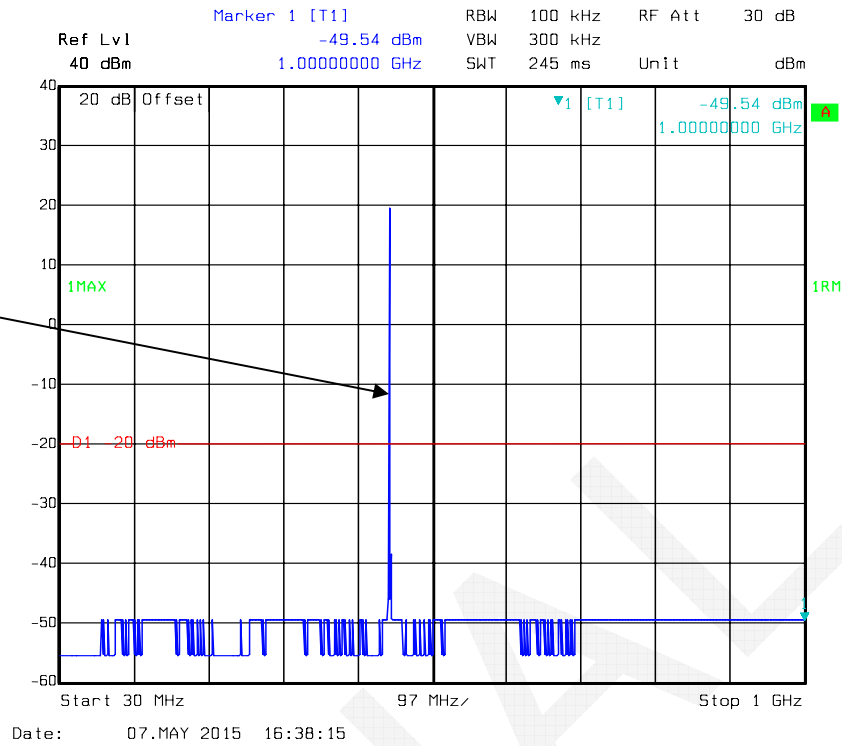
### 6.25 kHz –FM Mode,High Power

Fundamental test  
with Band Reject  
Filter



### 12.5 kHz –FM Mode,High Power

Fundamental test  
with Band Reject  
Filter



## FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

### Applicable Standard

FCC §2.1053 and §90.210

### Test Equipment List and Details

| Manufacturer   | Description               | Model No.  | Serial No. | Calibration Date | Calibration Due Date |
|----------------|---------------------------|------------|------------|------------------|----------------------|
| HP             | Signal Generator          | 8648A      | 3426A00831 | 2014-11-06       | 2015-11-06           |
| Sunol Sciences | Antenna                   | JB3        | A060611-3  | 2014-07-28       | 2017-07-27           |
| EMCO           | Adjustable Dipole Antenna | 3121C      | 9109-753   | N/A              | N/A                  |
| HP             | Amplifier                 | 8447E      | 2434A02181 | 2014-09-01       | 2015-09-01           |
| R&S            | EMI Test Receiver         | ESCI       | 100224     | 2014-05-09       | 2015-05-09           |
| Agilent        | Signal Generator          | E8247C     | MY43321350 | 2014-10-16       | 2015-10-16           |
| Mini-Circuit   | Amplifier                 | ZVA-213-S+ | 054201245  | 2015-02-19       | 2016-02-19           |
| TDK RF         | Horn Antenna              | HRN-0118   | 130 084    | 2012-09-06       | 2015-09-06           |
| ETS LINDGREN   | Horn Antenna              | 3115       | 000 527 35 | 2012-09-06       | 2015-09-06           |
| Agilent        | Spectrum Analyzer         | E4440A     | SG43360054 | 2014-12-04       | 2015-12-04           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

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

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

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

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

For part 90:

Spurious emissions in dB =  $10 \log_{10}$  (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =  $50 + 10 \log_{10}$  (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

Spurious attenuation limit in dB =  $55 + 10 \log_{10}$  (power out in Watts) for EUT with a 6.25 kHz channel bandwidth.

**Test Data****Environmental Conditions**

|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25.5 °C   |
| <b>Relative Humidity:</b> | 57 %      |
| <b>ATM Pressure:</b>      | 100.5 kPa |

The testing was performed by Dean Liu on 2015-05-07.

Test Mode: Transmitting (FM mode, high power level)

| Frequency                                     | Receiver       | TurnTable    | Rx Antenna |               | Substituted    |                |                  | Absolute Level | PART90      |             |
|-----------------------------------------------|----------------|--------------|------------|---------------|----------------|----------------|------------------|----------------|-------------|-------------|
| (MHz)                                         | Reading (dBμV) | Angle Degree | Height (m) | Polar (H / V) | SG Level (dBm) | Cable loss(dB) | Antenna Gain(dB) | (dBm)          | Limit (dBm) | Margin (dB) |
| Frequency: 460 MHz; Channel Spacing: 12.5 kHz |                |              |            |               |                |                |                  |                |             |             |
| 920                                           | 49.80          | 187          | 1.9        | H             | -24.1          | 1              | 0                | -25.1          | -20         | 5.1*        |
| 920                                           | 44.18          | 192          | 1.8        | V             | -26.4          | 1              | 0                | -27.4          | -20         | 7.4         |
| 1380.00                                       | 50.76          | 245          | 1.6        | H             | -48.7          | 1.20           | 6.40             | -43.50         | -20         | 23.50       |
| 1380.00                                       | 65.54          | 69           | 1.5        | V             | -34.8          | 1.20           | 6.40             | -29.60         | -20         | 9.60        |
| 1840.00                                       | 54.46          | 231          | 2.3        | H             | -42.4          | 1.40           | 7.10             | -36.70         | -20         | 16.70       |
| 1840.00                                       | 54.86          | 292          | 2.4        | V             | -42.2          | 1.40           | 7.10             | -36.50         | -20         | 16.50       |
| 2300.00                                       | 48.29          | 145          | 1.8        | H             | -49.5          | 1.30           | 8.30             | -42.50         | -20         | 22.50       |
| 2300.00                                       | 56.56          | 290          | 2.2        | V             | -40.1          | 1.30           | 8.30             | -33.10         | -20         | 13.10       |
| Frequency: 460 MHz; Channel Spacing: 6.25 kHz |                |              |            |               |                |                |                  |                |             |             |
| 920                                           | 49.80          | 325          | 1.9        | H             | -25.4          | 1              | 0                | -26.4          | -25         | 1.4*        |
| 920                                           | 44.18          | 625          | 1.8        | V             | -25.2          | 1              | 0                | -26.2          | -25         | 1.2*        |
| 1380.00                                       | 52.17          | 63           | 1.1        | H             | -47.3          | 1.20           | 6.40             | -42.10         | -25         | 17.10       |
| 1380.00                                       | 68.65          | 312          | 2.4        | V             | -31.7          | 1.20           | 6.40             | -26.50         | -25         | 1.50        |
| 1840.00                                       | 48.89          | 154          | 1.9        | H             | -48.0          | 1.40           | 7.10             | -42.30         | -25         | 17.30       |
| 1840.00                                       | 54.09          | 330          | 2.2        | V             | -43.0          | 1.40           | 7.10             | -37.30         | -25         | 12.30       |
| 2300.00                                       | 48.25          | 76           | 1.7        | H             | -49.6          | 1.30           | 8.30             | -42.60         | -25         | 17.60       |
| 2300.00                                       | 57.01          | 286          | 1.5        | V             | -39.6          | 1.30           | 8.30             | -32.60         | -25         | 7.60        |

\*Within measurement uncertainty!

Note1: For radiated spurious emissions were tested at high rated power, which was the worst case.

Note2: The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.

Note3: Absolute Level = SG Level - Cable loss + Antenna Gain  
Margin = Limit-Absolute Level

## FCC §2.1055 & §90.213- FREQUENCY STABILITY

### Applicable Standard

FCC §2.1055, §90.213

### Test Equipment List and Details

| Manufacturer | Description                   | Model No. | Serial No.  | Calibration Date | Calibration Due Date |
|--------------|-------------------------------|-----------|-------------|------------------|----------------------|
| R&S          | Spectrum Analyzer             | FSP 38    | 100478      | 2014-05-09       | 2015-05-09           |
| Dongzhixu    | High Temperature Test Chamber | DP1000    | 201105083-3 | 2014-08-11       | 2015-08-11           |
| UNI-T        | Multimeter                    | UT39A     | M130199938  | 2015-04-10       | 2016-04-10           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

### Test Data

#### Environmental Conditions

|                    |           |
|--------------------|-----------|
| Temperature:       | 25.3°C    |
| Relative Humidity: | 56 %      |
| ATM Pressure:      | 100.5 kPa |

*The testing was performed by Dean Liu on 2015-05-07.*

Test Mode: Transmitting

| Frequency: 460 MHz, Channel Spacing: 12.5 kHz, Limit: 2.5 ppm |                 |            |                 |
|---------------------------------------------------------------|-----------------|------------|-----------------|
| Temperature                                                   | Voltage         | Reading    | Frequency Error |
| °C                                                            | V <sub>DC</sub> | MHz        | ppm             |
| -30                                                           | 3.7             | 459.999905 | -0.21           |
| -20                                                           | 3.7             | 459.999916 | -0.18           |
| -10                                                           | 3.7             | 459.999931 | -0.15           |
| 0                                                             | 3.7             | 459.999954 | -0.10           |
| 10                                                            | 3.7             | 459.999933 | -0.15           |
| 20                                                            | 3.7             | 459.999967 | -0.07           |
| 30                                                            | 3.7             | 459.999968 | -0.07           |
| 40                                                            | 3.7             | 459.999962 | -0.08           |
| 50                                                            | 3.7             | 459.999950 | -0.11           |
| 20                                                            | 3.5             | 459.999923 | -0.17           |

| Frequency: 460 MHz, Channel Spacing: 6.25 kHz, Limit: 1.0 ppm |                 |            |                 |
|---------------------------------------------------------------|-----------------|------------|-----------------|
| Temperature                                                   | Voltage         | Reading    | Frequency Error |
| °C                                                            | V <sub>DC</sub> | MHz        | ppm             |
| -30                                                           | 3.7             | 459.999932 | -0.15           |
| -20                                                           | 3.7             | 459.999941 | -0.13           |
| -10                                                           | 3.7             | 459.999953 | -0.10           |
| 0                                                             | 3.7             | 459.999909 | -0.20           |
| 10                                                            | 3.7             | 459.999964 | -0.08           |
| 20                                                            | 3.7             | 459.999973 | -0.06           |
| 30                                                            | 3.7             | 459.999971 | -0.06           |
| 40                                                            | 3.7             | 459.999965 | -0.08           |
| 50                                                            | 3.7             | 459.999926 | -0.16           |
| 20                                                            | 3.5             | 459.999955 | -0.10           |

Note: The battery operating end point is 3.5V which specified by the manufacturer.

## FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

### Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

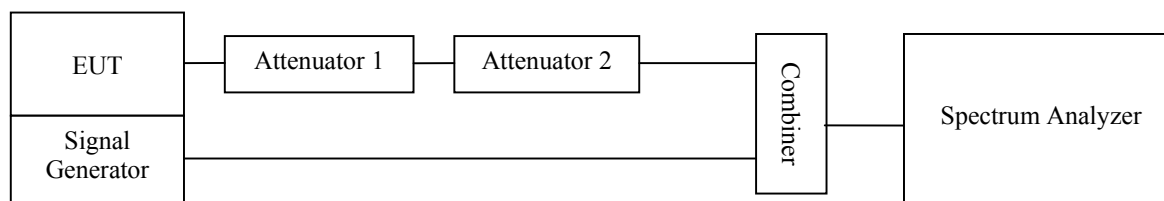
### Test Equipment List and Details

| Manufacturer | Description       | Model No. | Serial No. | Calibration Date | Calibration Due Date |
|--------------|-------------------|-----------|------------|------------------|----------------------|
| R&S          | Spectrum Analyzer | FSEM      | DE31388    | 2014-05-09       | 2015-05-09           |
| HP           | Signal Generator  | 8648A     | 3426A00831 | 2014-11-06       | 2015-11-06           |

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

### Test Procedure

- Connect the EUT and test equipment as shown on the following block diagram.
- Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at  $\pm 12.5$  kHz deviation and set its output level to -100dBm.
- Turn on the transmitter.
- Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as  $P_0$ .
- Turn off the transmitter.
- Adjust the RF level of the signal generator to provide RF power equal to  $P_0$ . This signal generator RF level shall be maintained throughout the rest of the measurement.
- Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at  $\pm 4$  divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
- Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be  $t_{on}$ . The trace should be maintained within the allowed divisions during the period  $t_1$  and  $t_2$ .
- Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period  $t_3$ .



**Test Data****Environmental Conditions**

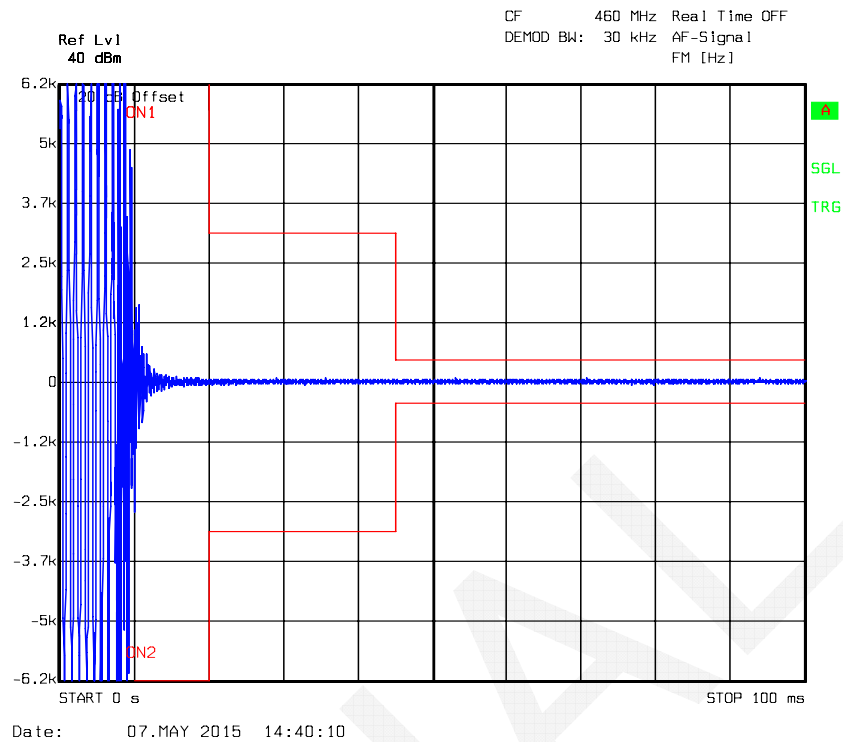
|                           |           |
|---------------------------|-----------|
| <b>Temperature:</b>       | 25.3°C    |
| <b>Relative Humidity:</b> | 56 %      |
| <b>ATM Pressure:</b>      | 100.5 kPa |

The testing was performed by Dean Liu on 2015-05-07.

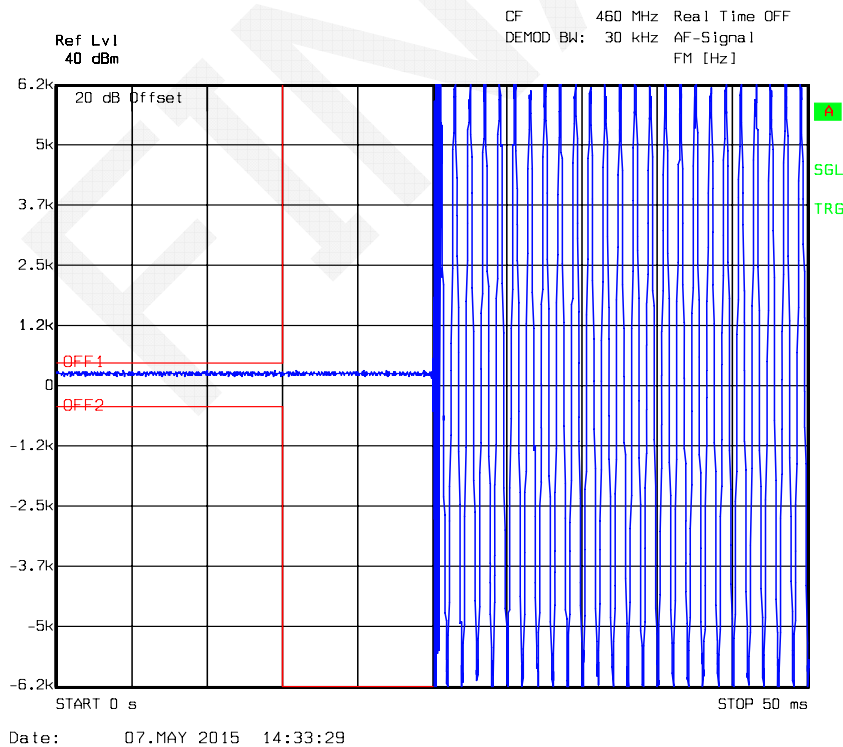
| Channel Separation<br>(kHz) | Transient Period<br>(ms) | Maximum frequency<br>difference | Result |
|-----------------------------|--------------------------|---------------------------------|--------|
| 6.25                        | $<10(t_1)$               | $\pm 6.25$ kHz                  | Pass   |
|                             | $<25(t_2)$               | $\pm 3.125$ kHz                 |        |
|                             | $<10(t_3)$               | $\pm 6.25$ kHz                  |        |
| 12.5                        | $<10(t_1)$               | $\pm 12.5$ kHz                  | Pass   |
|                             | $<25(t_2)$               | $\pm 6.25$ kHz                  |        |
|                             | $<10(t_3)$               | $\pm 12.5$ kHz                  |        |

Please refer to the following plots.

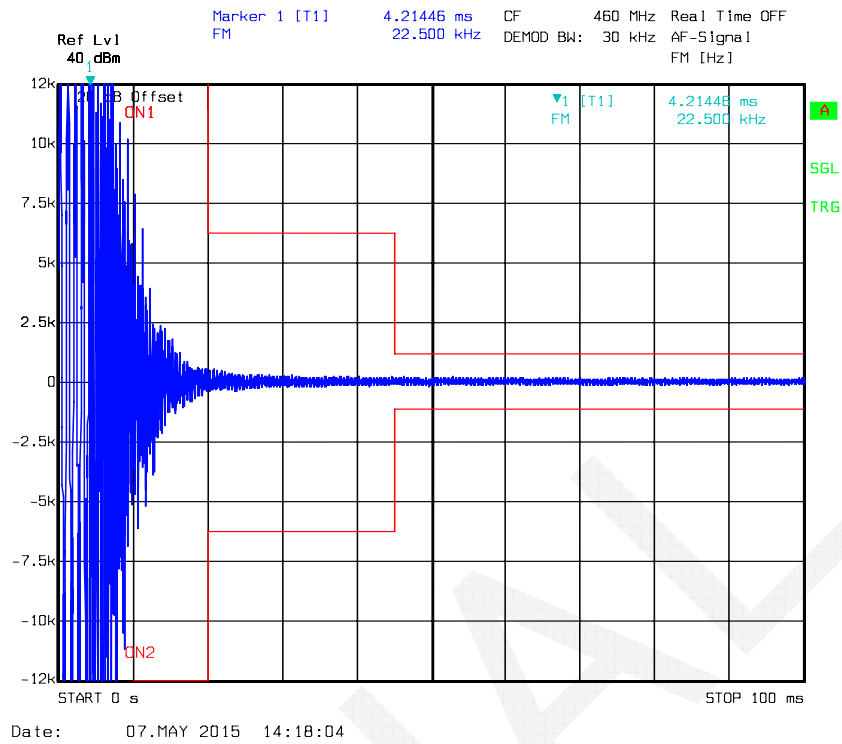
### Turn on – 6.25 kHz, High power level



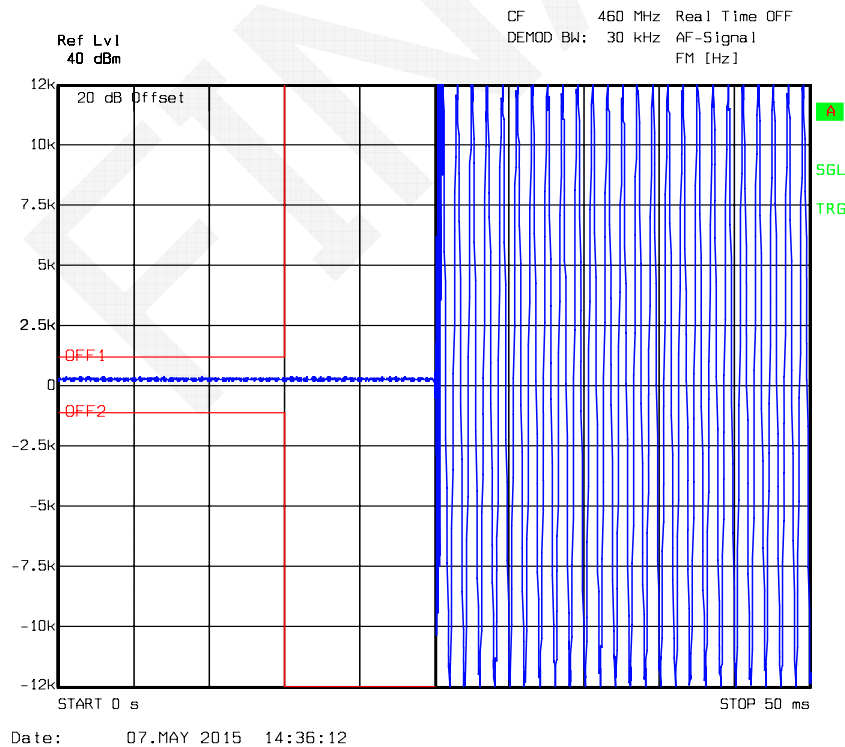
### Turn off – 6.25 kHz, High power level



### Turn on – 12.5 kHz, High power level



### Turn off – 12.5 kHz, High power level



\*\*\*\*\* END OF REPORT \*\*\*\*\*