| | |
|---|---|
| Product Name: | Wireless Communication Product |
| Model No.: | NP-14 |
| Applicant: | 8th FL., No. 56, LE-QUN 3rd Road, Taipei 104, Taiwan |
| Date of Receipt: | Jun. 24, 2015 |
| Finished date of Test: | Jun. 29, 2015 |
| Applicable Standards: | 47 CFR Part 2<br>47 CFR Part 90<br>ANSI C 63.4:2003<br>TIA/EIA 603-D |

We, **Spectrum Research & Testing Laboratory Inc.**, hereby certify that one sample of the above was tested in our laboratory with positive results according to the above-mentioned standards. The records in the report are an accurate account of the results. Details of the results are given in the subsequent pages of this report.

Tested By : Lin, Shu-Hsuan, Date: 7/2/2015
(Boris Lin)

Approved By : , Date: 7/2/2015
( Johnson Ho, Director )

# Revisions History

| Report No. | Issue Date | Revisions |
|---|---|---|
| FCCA15062402 | Jul. 02, 2015 | Initial issue |
| | Jul. 13, 2015 | - Part 15 data and references removed<br>- Applicable Standards : TIA/EIA 603-D version indicated<br>- Emissions Designator revised<br>- Photos of Testing removed |
| | Jul. 16, 2015 | - External Photos removed on page 7<br>- Emissions Designator revised to correct format on page 9 |

# Table of Contents

# 1. DOCUMENT POLICY AND TEST STATEMENT

## 1.1 DOCUMENT POLICY

- The report shall not be reproduced except in full, without the written approval of SRT Lab, Inc.

## 1.2 TEST STATEMENT

- The test results in the report apply only to the unit tested by SRT Lab.
- There was no deviation from the requirements of test standards during the test.
- AC 120V/60Hz was supplied during the test.

## 1.3 EUT MODIFICATION

- No modification in SRT Lab.

## 2. DESCRIPTION OF EUT AND TEST MODE

### 2.1 GENERAL DESCRIPTION OF EUT

| | |
|---|---|
| **PRODUCT** | Wireless Communication Product |
| **MODEL NO.** | NP-14 |
| **POWER SUPPLY** | AC power source from AC adapter:<br>Brand: Dee Van Enterprise Co., Ltd.<br>Model: DSA-0421S-12 2<br>Input: 100 ~ 240 V, 50 ~60 Hz 1.2 A Max.<br>Output: +12 V, 2.0 A |
| **FREQUENCY BAND** | 450 ~ 470 MHz (§90.267) |
| **CARRIER FREQUENCY** | 457.575 |
| **NUMBER OF CHANNEL** | 1 |
| **FREQUENCY DEVIATION** | 2.5 kHz |
| **CHANNEL SPACING** | 12.5 kHz |
| **RATED RF OUTPUT POWER** | 34.14 dBm (2590 mW) |
| **MODULATION TYPE** | NFSK |
| **MODE of OPERATION** | Simplex |
| **ANTENNA TYPE** | External |
| **ANTENNA GAIN** | 2 dBi |
| **OPERATING TEMPERATURE RANGE** | -30 ~ 50°C |

**NOTE:** For more detailed information, please refer to the EUT's specification or user's manual provided by manufacturer.

### 2.2 DESCRIPTION OF EUT INTERNAL DEVICE

| DEVICE | BRAND / MAKER | MODEL # | FCC ID / DOC | REMARK |
|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A |

### 2.3 EUT OPERATING CONDITION

1. Setup the EUT and all peripheral devices .
2. Turn on the power of all equipment and EUT.
3. Set the EUT under continuous transmission condition, and standby mode.
4. The EUT was set to the highest available power level.

## 2.4 DESCRIPTION OF TEST MODE

There is only 1 channel for this device; therefore CH01 is chosen for the following test modes.

Test modes for each configuration are as shown below:

| Test Mode | | | Channel | Frequency(MHz) |
|---|---|---|---|---|
| 1 | Transmitter, Continuous Transmission Mode | Tx | 01 | 457.575 |
| 2 | Transmitter, Standby Mode | Standby | N/A | N/A |

**NOTE :**

1. Tests conducted for channel 1 below 1 GHz were pre-tested in chamber, and the worst test results were chosen for conducted and radiated emission tests
2. Tests for CH01 were conducted individually

X axis: Y axis: Z axis:

**NOTE:**

1. Axis X,Y and Z were evaluated in the chamber, and we determine that the X axis has the worst results.

## 2.5 DESCRIPTION OF SUPPORT UNIT

The EUT was configured by the requirement of ANSI C63.4:2003. All interface ports were connected to the appropriate support units via specific cables. The support units and cables are listed below.

| NO | DEVICE | BRAND | MODEL # | FCC ID/DoC | CABLE / DESCRIPTION |
|---|---|---|---|---|---|
| 1 | Dual Directional Coupler | A.R. | DC6080 | DoC | 40dB±0.5dB |
| 2 | Coaxial Termination | Weinschel Engineering | M 1418 | DoC | DC-18GHz<br>10W AVG / 1kW PK |
| 3 | Terminator | N/A | 11593A | DoC | 50Ω |

## 3. DESCRIPTION OF APPLIED STANDARDS

The EUT is a wireless product. According to the specifications provided by the applicant, it must comply with the requirements of the following standards:

47 CFR Part 2

47 CFR Part 90

All tests have been performed and recorded as the above standards.

### 3.1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications：

| STANDARD SECTION | TEST TYPE AND LIMIT RESULTS | RESULTS |
|---|---|---|
| PART 2.1047 | Modulation Characteristics | PASS |
| Part 2.1046,<br>Part 90.267 | RF Power Output | PASS |
| Part 2.1049<br>Part 90.210 | Occupied Bandwidth | PASS |
| Part 90.214 | Transient Frequency Behavior | PASS |
| Part 90.210 | Field Strength of Spurious Radiation | PASS |
| Part 2.1051<br>Part 90.210 | Spurious Emissions at Antenna Terminals | PASS |
| Part 2.1055<br>Part 90.213 | Frequency Stability | PASS |

**NOTE:** The radiated emission testing was performed according to the procedures of ANSI C 63.4:2003; TIA/EIA 603-D.

## 4. EMISSIONS DESIGNATOR

Referencing Part 2.201 and 2.202 of the FCC Rules and Regulation and using the following formula the Emissions Designator(s) and Necessary Bandwidths were calculated.

Necessary Bandwidth:
B = 2M + 2DK
Frequency deviation (D) = 2.5 kHz
Baud rate = 12500 baud
M = Baud / 2 = 6250 / 2 = 3125
D = 2.5 kHz and using K = 1
For the 2.5 KHz deviation:
B = 2 (3125) + (2) (2500) (1) = 11250, so Emissions Designator = 11K3F1D

Referencing Part 90.209(b)5 Subnote [3]:

[3] Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of §90.203(j)(3).

Necessary Bandwidth for a 12.5 kHz channel bandwidth is 11.25 kHz

## 5. MODULATION CHARACTERISTICS (PART 2.1047)

The test procedure is in accordance of TIA/EIA 603-D §2.2.3

The device is set to 2.5KHz deviation as default value. It can be tuned up to a 4.5KHz deviation. This change can not be made by end user. Also, the modulation description as Section 2.1033(C)(13) requested was attached.

There is no specific requirement for digital modulation; therefore modulation characteristic is not presented.

## 6. RF POWER OUTPUT (PART 2.1046, 90.205)

### 6.1 LIMIT

§90.267 Assignment and use of frequencies in the 450-470 MHz band for low power use.

(b) Group A1 Frequencies. The Industrial/Business Pool frequencies in Group A1 are available on a coordinated basis, pursuant to §§90.35(b)(2) and 90.175(b), as follows:

(2) Within 80 kilometers (50 miles) of the specified coordinates of the top 100 urban areas listed in §90.741 of this chapter ("80 km circles") only low power operation will be authorized. The coordinates of an operational fixed or base station and the geographic center (latitude and longitude) of a mobile area of operation determine whether a station is within an "80 km circle."

(i) The maximum ERP for low power operation on Group A1 frequencies is as follows:

| Operation | Low side of frequency pair (watts) | High side of frequency pair (watts) |
|---|---|---|
| **Operational Fixed or Base** | 20 | 6 |
| **Mobile** | 6 | 6 |
| **Portable** | 2 | 2 |

(4) The Industrial/Business Pool Group A1 Low Power Frequencies are as follows:

| | | | |
|---|---|---|---|
| 451/456.18125 | 451/456.58125 | 452/457.10625 | 452/457.70625 |
| 451/456.1875 | 451/456.5875 | 452/457.1125 | 452/457.7125 |
| 451/456.19375 | 451/456.59375 | 452/457.11875 | 452/457.71875 |
| 451/456.28125 | 451/456.60625 | 452/457.13125 | 452/457.78125 |
| 451/456.2875 | 451/456.6125 | 452/457.1375 | 452/457.7875 |
| 451/456.29375 | 451/456.61875 | 452/457.14375 | 452/457.79375 |
| 451/456.30625 | 451/456.65625 | 452/457.15625 | 452/457.80625 |
| 451/456.3125 | 451/456.6625 | 452/457.1625 | 452/457.8125 |
| 451/456.31875 | 451/456.66875 | 452/457.16875 | 452/457.81875 |
| 451/456.35625 | 451/456.68125 | 452/457.18125 | 452/457.83125 |
| 451/456.3625 | 451/456.6875 | 452/457.1875 | 452/457.8375 |
| 451/456.36875 | 451/456.69375 | 452/457.19375 | 452/457.84375 |
| 451/456.38125 | 451/456.70625 | 452/457.28125 | 452/457.88125 |
| 451/456.3875 | 451/456.7125 | 452/457.2875 | 452/457.8875 |
| 451/456.39375 | 451/456.71875 | 452/457.29375 | 452/457.89375 |
| 451/456.40625 | 451/456.73125 | 452/457.48125 | 452/457.98125 |
| 451/456.4125 | 451/456.7375 | 452/457.4875 | 452/457.9875 |
| 451/456.41875 | 451/456.74375 | 452/457.49375 | 452/457.99375 |
| 451/456.45625 | 451/456.75625 | 452.53125 (unpaired) | 462/467.18125 |
| 451/456.4625 | 451/456.7625 | 452.5375 (unpaired) | 462/467.1875 |
| 451/456.46875 | 451/456.76875 | 452.54375 (unpaired) | 462/467.19375 |
| 451/456.48125 | 452/457.03125 | 452/457.63125 | 462/467.45625 |
| 451/456.4875 | 452/457.0375 | 452/457.6375 | 462/467.4625 |
| 451/456.49375 | 452/457.04375 | 452/457.64375 | 462/467.46875 |
| 451/456.50625 | 452/457.05625 | 452/457.65625 | 462/467.48125 |

| | | | |
|---|---|---|---|
| 451/456.5125 | 452/457.0625 | 452/457.6625 | 462/467.4875 |
| 451/456.51875 | 452/457.06875 | 452/457.66875 | 462/467.49375 |
| 451/456.55625 | 452/457.08125 | 452/457.68125 | 462/467.50625 |
| 451/456.5625 | 452/457.0875 | 452/457.6875 | 462/467.5125 |
| 451/456.56875 | 452/457.09375 | 452/457.69375 | 462/467.51875 |

| Carrier Frequency (MHz) | Side of Frequency Pair (Low / High) | Limit (watts) |
|---|---|---|
| 457.575 | High | 6 |

## 6.2 TEST EQUIPMENT

The following test equipment was used during the test：

| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE OF CAL. & CAL. CENTER |
|---|---|---|---|---|
| EMITEST RECEIVER (INCLUDE SPECTRUM ANALYZER) | 9 KHz ~ 6 GHz | ROHDE & SCHWARZ | ESL /100176 | MAR. 28, 2016 ETC |
| POWER METER | N/A | BOONTON | 4232A / 105302 | OCT. 25, 2015 ETC |
| POWER SENSOR | N/A | BOONTON | 51011-EMC / 31181 | OCT. 25, 2015 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

## 6.3 TEST SETUP

As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

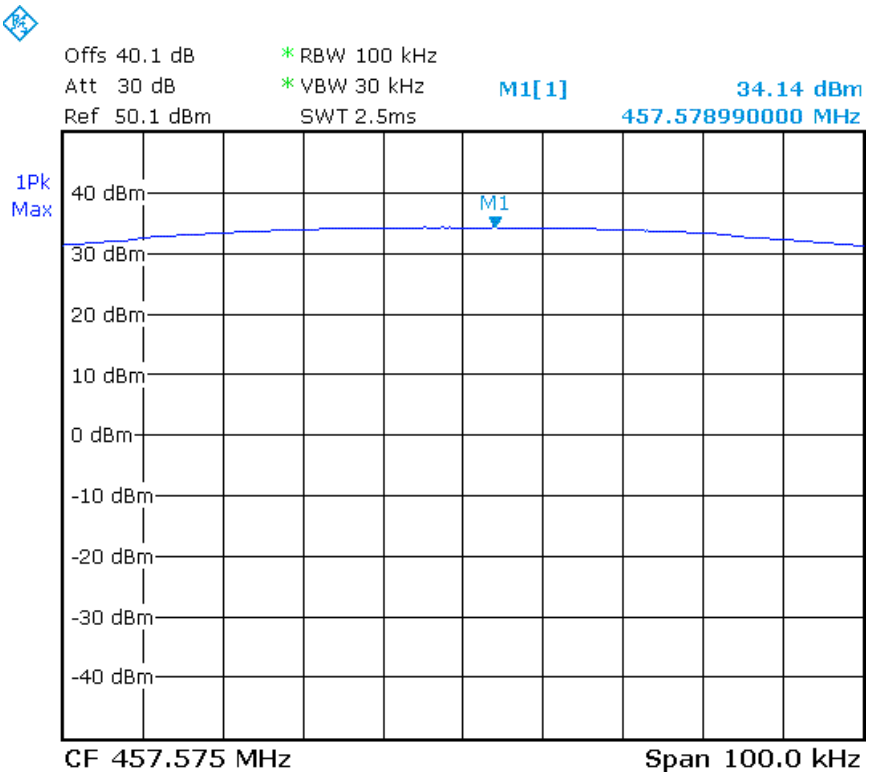
## 6.4 TEST PROCEDURE

- Antenna was replaced with a short connector which was connected with a directional coupler as an attenuator.
- The spectrum offset was adjusted to compensate the attenuator and losses caused by the connection.

## 6.5 TEST RESULT

| Carrier Frequency (MHz) | RF Output Power (dBm) | RF Output Power (mW) | Frequency Deviation (kHz) | Limit (watts) | Test Resut |
|---|---|---|---|---|---|
| 457.575 | 34.14 | 2590 | 2.5 | 6 | Pass |

2.5 kHz



## 7. OCCUPIED BANDWIDTH (PART 2.1049)

### 7.1 LIMIT

**Applicable Emission Masks**

| Frequency band (MHz) | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|---|---|---|
| **Below 251** | A or B | A or C |
| **25-50** | B | C |
| **72-76** | B | C |
| **150-1742** | B, D, or E | C, D or E |
| **150 paging only** | B | C |
| **220-222** | F | F |
| **421-5122 5** | B, D, or E | C, D, or E |
| **450 paging only** | B | G |
| **806-809/851-854** | B | H |
| **809-824/854-8693 5** | 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 |
| **5850-59254** | | |
| **All other bands** | B | C |

1. Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
2. Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

Emissions shall be attenuated below the mean output power of the transmitter as follows:

| Carrier Frequency (MHz) | Channel Spacing (kHz) | Maximum Authorized BW (kHz) | Recommended Frequency Deviation (kHz) | FCC Applicable Mask |
|---|---|---|---|---|
| 457.575 | 12.5 | 11.25 | 2.5 | Mask D – Data |

## 7.2 TEST EQUIPMENT

The following test equipment was used during the test：

| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE oF CAL. & CAL. CENTER |
|---|---|---|---|---|
| EMITEST RECEIVER (INCLUDE SPECTRUM ANALYZER) | 9 KHz ~ 6 GHz | ROHDE & SCHWARZ | ESL /100176 | MAR. 28, 2016 ETC |
| POWER METER | N/A | BOONTON | 4232A / 105302 | OCT. 25, 2015 ETC |
| POWER SENSOR | N/A | BOONTON | 51011-EMC / 31181 | OCT. 25, 2015 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

## 7.3 TEST SETUP

As required by 47 CFR 2.1046, *Occupied Bandwidth measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

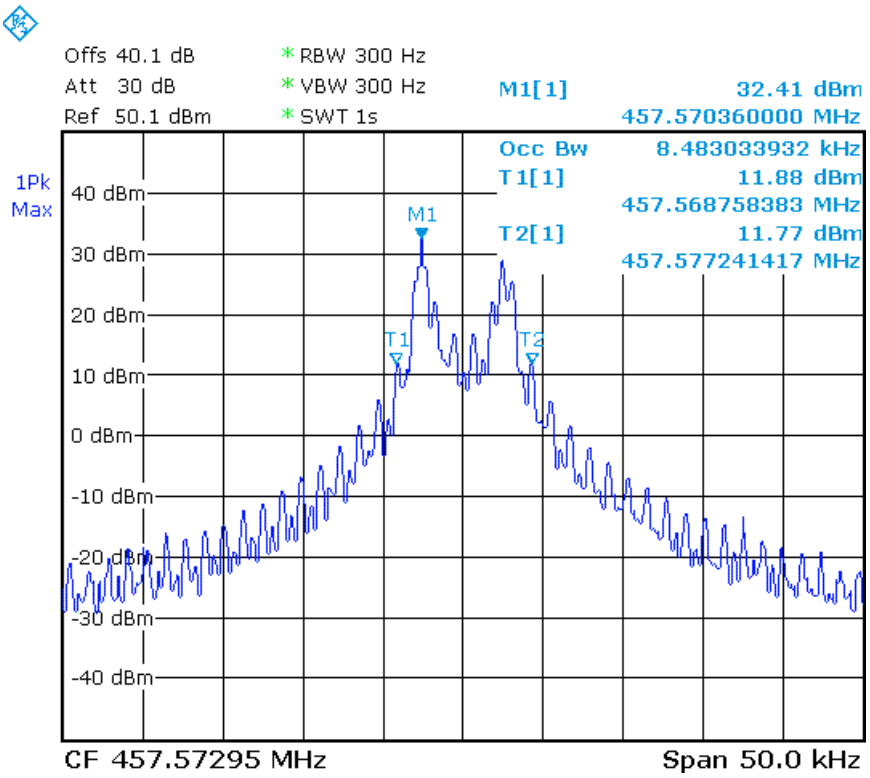
## 7.4 TEST PROCEDURE

- Antenna was replaced with a short connector which was connected with a directional coupler as an attenuator.
- The spectrum offset was adjusted to compensate the attenuator and losses caused by the connection.

## 7.5 TEST RESULT

| Carrier Frequency (MHz) | Occupied Bandwidth (kHz) | Frequency Deviation (kHz) | Channel Spacing (kHz) | Limit (kHz) | Test Result |
|---|---|---|---|---|---|
| 457.575 | 8.4830 | 2.5 | 12.5 | 11.25 | Pass |

2.5KHz



## 8. TRANSIENT FREQUENCY BEHAVIOR (PART 90.214)

### 8.1 LIMIT

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

| Time intervals 1. 2. | Maximum Frequency difference 3. | **All equipment** | |
|---|---|---|---|
| | | **150 to 174 MHz** | **421 to 512 MHz** |
| Transient Frequency Behavior for Equipment Designed to Operate on **25 kHz** Channels | | | |
| **t1** 4. | ±25.0 kHz | 5.0 ms | 10.0 ms |
| **t2** | ±12.5 kHz | 20.0 ms | 25.0 ms |
| **t3** 4. | ±25.0 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on **12.5 kHz** Channels | | | |
| **t1** 4. | ±12.5 kHz | 5.0 ms | 10.0 ms |
| **t2** | ±6.25 kHz | 20.0 ms | 25.0 ms |
| **t3** 4. | ±12.5 kHz | 5.0 ms | 10.0 ms |
| Transient Frequency Behavior for Equipment Designed to Operate on **6.25 kHz** Channels | | | |
| **t1** 4. | ±6.25 kHz | 5.0 ms | 10.0 ms |
| **t2** | ±3.125 kHz | 20.0 ms | 25.0 ms |
| **t3** 4. | ±6.25 kHz | 5.0ms | 10.0ms |

1. on is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until toff.
toff is the instant when the 1 kHz test signal starts to rise.

2. During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in §90.213.

3. Difference between the actual transmitter frequency and the assigned transmitter frequency.

4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

## 8.2 TEST EQUIPMENT

The following test equipment was used during the test：

| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE oF CAL. & CAL. CENTER |
|---|---|---|---|---|
| Signal Generator | 100 KHz ~ 1 GHz | HP | 3636A02776 | SEP. 18, 2015 ETC |
| EMITEST RECEIVER (INCLUDE SPECTRUM ANALYZER) | 9 KHz ~ 6 GHz | ROHDE & SCHWARZ | ESL /100176 | MAR. 28, 2016 ETC |
| Oscilloscope | 500Mhz | HP | US39150351 | NOV. 16, 2015 ETC |
| POWER METER | N/A | BOONTON | 4232A / 105302 | OCT. 25, 2015 ETC |
| POWER SENSOR | N/A | BOONTON | 51011-EMC / 31181 | OCT. 25, 2015 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

## 8.3 TEST SETUP

As required by 47 CFR 2.1046, *Transient Behavior measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter. Setup meets the requirements of TIA/EIA 603-D §2.2.19

## 8.4 TEST PROCEDURE

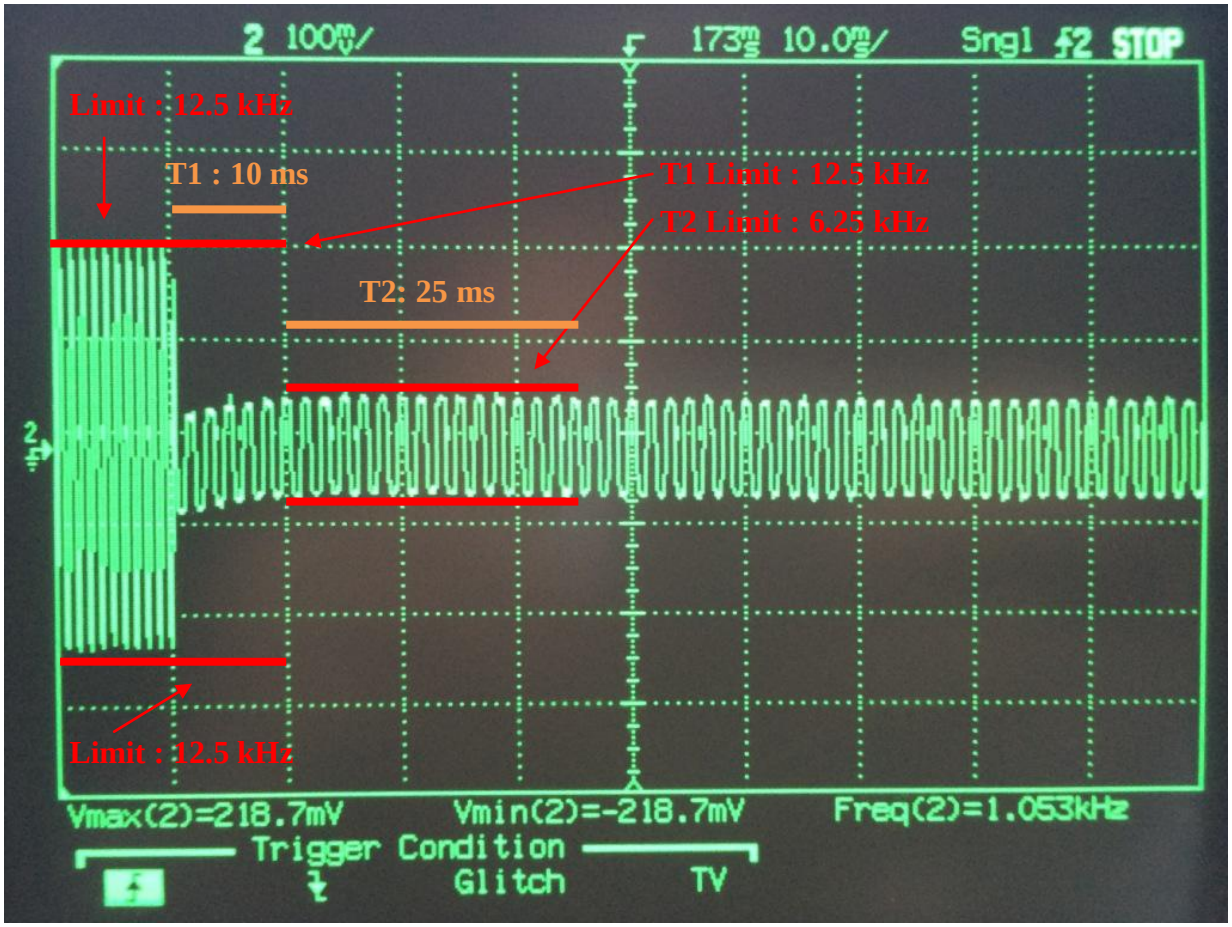
- EUT antenna was replaced with a short connector which was connected with a directional coupler as an attenuator.
- Connect the Signal Generator output and the EUT output VIA a combiner to the EMITEST Receiver input.
- Connect the audio output of the EMITEST Receiver to the Oscilloscope input.
- Set Signal Generator to match the EUT's carrier wave frequency, and then set the Signal Generator to output a 12.5 kHz signal with a 1 kHz standard FM modulated signal continuously as the test limit.
- Set the Oscilloscope trigger accordingly to capture the proper switch on and switch off test signals
- Capture and record the graphical test data

## 8.5 TEST RESULT

| Deviation / Time Intervals | | Frequency Band : 421 ~ 512 MHz @ 2.5 kHz | |
|---|---|---|---|
| | | Max Frequency Difference | Test Result |
| t1 | 10ms | ±12.5 kHz | Pass |
| t2 | 25ms | ±6.25 kHz | Pass |
| t3 | 10ms | ±12.5 kHz | Pass |

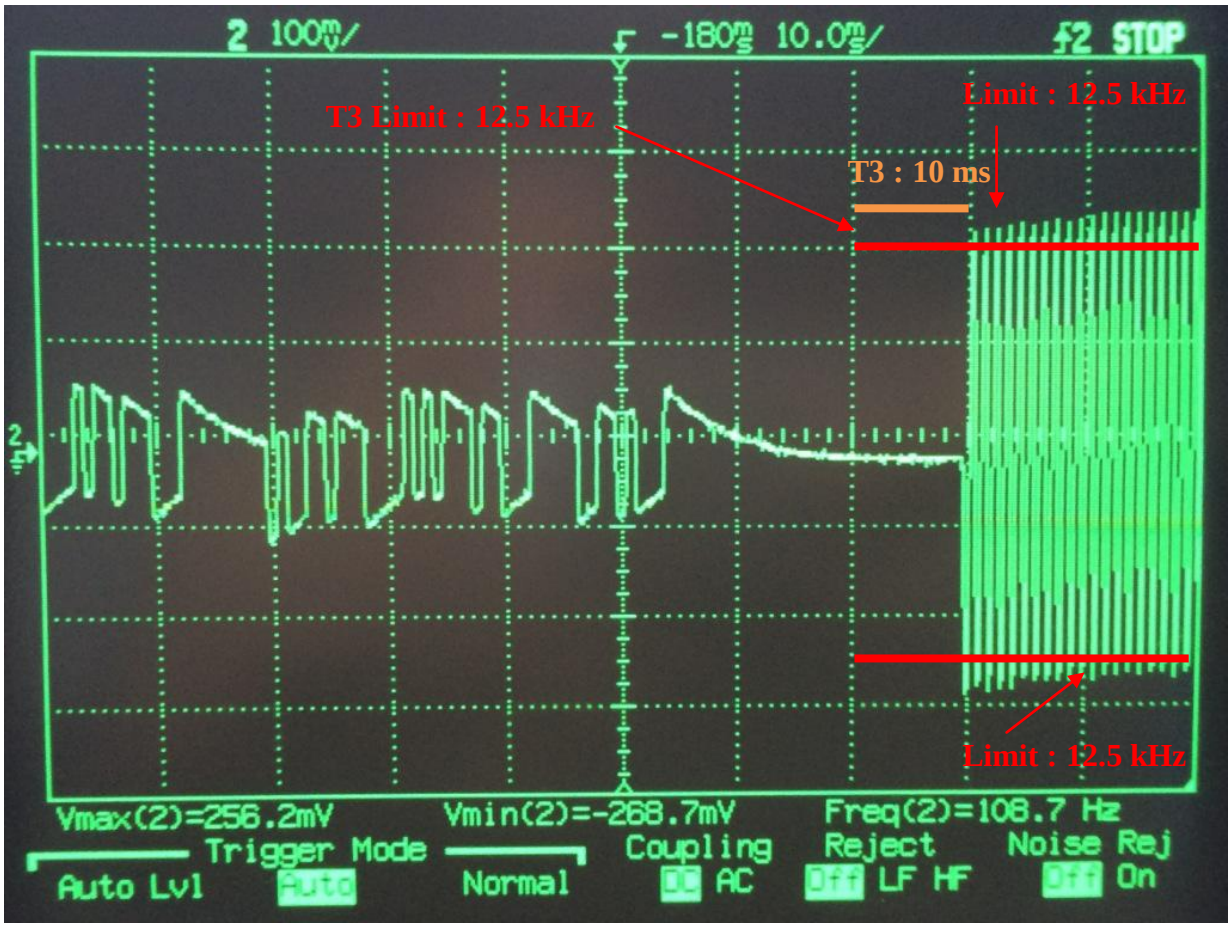
### 8.5.1 WHEN TEH TRANSMITTER OUTPUT POWER IS SWITCHED ON

457.575 MHz @ 12.5K



### 8.5.2 WHEN TEH TRANSMITTER OUTPUT POWER IS SWITCHED OFF

457.575 MHz @ 12.5K



## 9. FIELD STRENGTH OF SPURIOUS RADIATION (Part 90.210)

### 9.1 LIMIT

(1) 25kHz Channel Spacing: At least 43 + 10 log (P) dB

12.5kHz Channel Spacing: At least 50 + 10 log (P) dB

Where P = 2.59 W

| Carrier Frequency (MHz) | Channel Spacing (kHz) | Limit (Minimum dBc) |
|---|---|---|
| 457.575 | 12.5 | 54.13 |

**NOTE：** The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned per 30MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA / EIA STANDARD 603-D using the substitution method.

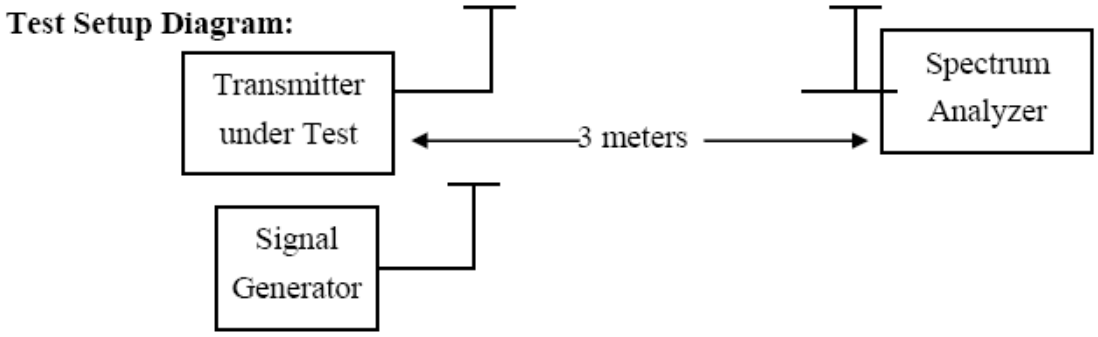
### 9.2 TEST EQUIPMENT

The following test equipment was used during the radiated emission test：

| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE OF CAL. & CAL. CENTER |
|---|---|---|---|---|
| SPECTRUM ANALYZER | 9 kHz ~ 7GHz | ROHDE & SCHWARZ | FSP7 / 100289 | APR. 12, 2016 ETC |
| Signal Generator | 100 KHz ~ 1 GHz | HP | 3636A02776 | SEP. 18, 2015 ETC |
| BI-LOG ANTENNA | 30 MHz ~ 2 GHz | SCHAFFNER | CBL6141A / 4181 | JUN. 25, 2016 ETC |
| HORN ANTENNA | 1 GHz ~ 18 GHz | EMCO | 3115/ 9602-4681 | DEC. 21, 2015 ETC |
| HORN ANTENNA | 18 ~ 40 GHZ | ETS-LINDGREN | 3116 /00032255 | JAN. 07, 2016 ETC |
| ANECHOIC CHAMBER | 3 M MEASUREMENT | SRT | A01 / SRT001 | MAY. 13, 2016 SRT |
| COAXIAL CABLE | 30 M | TIMES | LMR-400 / #30M | MAY. 21, 2016 ETC |
| FILTER | 2 LINE, 30 A | FIL.COIL | FC-943 / 869 | NCR |
| K-TYPE CABLE | UP TO 40 GHz, 3 m | HUBER+SUHNER | SF102-46/2*11S K252 /MY2611/2 | MAR. 07, 2016 ETC |
| K-TYPE CABLE | UP TO 40 GHz, 1 m | HUBER+SUHNER | SF 102-40/2*11 /23934/2 | MAY. 24, 2016 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

## 9.3 TEST SETUP




## 9.4 TEST PROCEDURE

Test method and setup followed by TIA/EIA 603-D 2.2.12 (Substitution Method)

## 9.5 TEST RESULT

Antenna Polarization: Horizontal Channel Spacing : 12.5K

| | Frequency (MHz) | Frequency Power (dBμV/m) | Db Below Carrier Frequency (dBc) | Limit Minimum (dBc) | Test Result |
|---|---|---|---|---|---|
| Foundation | 457.58 | 129.77 | 0 | N/A | N/A |
| 1st Harmonics | 915.16 | 38.96 | 90.81 | 54.13 | Pass |
| 2nd Harmonics | 1372.74 | 53.42 | 76.35 | | Pass |
| 3rd Harmonics | 1830.32 | 50.88 | 78.89 | | Pass |
| 4th Harmonics | 2287.90 | 53.24 | 76.53 | | Pass |
| 5th Harmonics | 2745.48 | 48.00 | 81.77 | | Pass |
| 6th Harmonics | 3203.06 | 53.01 | 76.76 | | Pass |
| 7th Harmonics | 3660.64 | 51.17 | 78.60 | | Pass |
| 8th Harmonics | 4118.22 | 45.50 | 84.27 | | Pass |
| 9th Harmonics | 4575.80 | 45.85 | 83.92 | | Pass |

Antenna Polarization: Vertical Channel Spacing : 12.5K

| | Frequency (MHz) | Frequency Power (dBμV/m) | Db Below Carrier Frequency (dBc) | Limit Minimum (dBc) | Test Result |
|---|---|---|---|---|---|
| Foundation | 457.58 | 125.92 | 0 | N/A | N/A |
| 1st Harmonics | 915.16 | 38.28 | 87.64 | 54.13 | Pass |
| 2nd Harmonics | 1372.74 | 53.45 | 72.47 | | Pass |
| 3rd Harmonics | 1830.32 | 51.10 | 74.82 | | Pass |
| 4th Harmonics | 2287.90 | 51.85 | 74.07 | | Pass |
| 5th Harmonics | 2745.48 | 46.84 | 79.08 | | Pass |
| 6th Harmonics | 3203.06 | 53.19 | 72.73 | | Pass |
| 7th Harmonics | 3660.64 | 50.67 | 75.25 | | Pass |
| 8th Harmonics | 4118.22 | 47.42 | 78.50 | | Pass |
| 9th Harmonics | 4575.80 | 45.43 | 80.49 | | Pass |

## 10. SPURIOUS EMISSIONS AT ANTENNA TERMINALS (Part 2.1051, 90.210)

### 10.1 LIMIT

(1) 25kHz Channel Spacing: At least 43 + 10 log (P) dB

12.5kHz Channel Spacing: At least 50 + 10 log (P) dB

Where P = 2.59 W

| Carrier Frequency (MHz) | Channel Spacing (kHz) | Limit (Minimum dBc) |
|---|---|---|
| 457.575 | 12.5 | 54.13 |

**NOTE：** The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned per 30MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA / EIA STANDARD 603-D using the substitution method.

### 10.2 TEST EQUIPMENT

The following test equipment was used during the radiated emission test：

| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE OF CAL. & CAL. CENTER |
|---|---|---|---|---|
| SPECTRUM ANALYZER | 9 kHz ~ 7GHz | ROHDE & SCHWARZ | FSP7 / 100289 | APR. 12, 2016 ETC |
| POWER METER | N/A | BOONTON | 4232A / 105302 | OCT. 25, 2015 ETC |
| POWER SENSOR | N/A | BOONTON | 51011-EMC / 31181 | OCT. 25, 2015 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

### 10.3 TEST SETUP

As required by 47 CFR 2.1046, *Spurious Emissions at Antenna Terminals measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

### 10.4 TEST PROCEDURE

- Antenna was replaced with a short connector which was connected with a directional coupler as an attenuator.
- The spectrum offset was adjusted to compensate the attenuator and losses caused by the connection.

## 10.5 TEST RESULT

| | Frequency (MHz) | Frequency Power (dBm) | Db Below Carrier Frequency (dBc) | Limit Minimum (dBc) | Test Result |
|---|---|---|---|---|---|
| Foundation | 457.58 | 33.84 | 0 | N/A | N/A |
| 1st Harmonics | 915.16 | -24.24 | 58.08 | 54.13 | Pass |
| 2nd Harmonics | 1372.74 | -23.58 | 57.42 | | Pass |
| 3rd Harmonics | 1830.32 | -22.18 | 56.02 | | Pass |
| 4th Harmonics | 2287.90 | -22.03 | 55.87 | | Pass |
| 5th Harmonics | 2745.48 | -22.96 | 56.80 | | Pass |
| 6th Harmonics | 3203.06 | -22.90 | 56.74 | | Pass |
| 7th Harmonics | 3660.64 | -21.51 | 55.35 | | Pass |
| 8th Harmonics | 4118.22 | -22.63 | 56.47 | | Pass |
| 9th Harmonics | 4575.80 | -22.45 | 56.29 | | Pass |

**NOTE：** The spectrum was scanned per 30MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA / EIA STANDARD 603-D using the substitution method.

## 11. FREQUENCY STABILITY (Part 2.1055, 90.213)

### 11.1 LIMIT

a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

**Minimum Frequency Stability**

[Parts per million (ppm)]

| Frequency range (MHz) | Fixed and base stations | Mobile stations | |
|---|---|---|---|
| | | Over 2 watts output power | 2 watts or less output power |
| Below 25 | [1 2 3] 100 | 100 | 200 |
| 25-50 | 20 | 20 | 50 |
| 72-76 | 5 | | 50 |
| 150-174 | [5 11] 5 | 65 | [4] 650 |
| 216-220 | 1.0 | | 1.0 |
| 220-22212 | 0.1 | 1.5 | 1.5 |
| 421-512 | [7 11 14] 2.5 | 85 | 85 |
| 806-809 | [14] 1.0 | 1.5 | 1.5 |
| 809-824 | [14] 1.5 | 2.5 | 2.5 |
| 851-854 | 1.0 | 1.5 | 1.5 |
| 854-869 | 1.5 | 2.5 | 2.5 |
| 896-901 | [14] 0.1 | 1.5 | 1.5 |
| 902-928 | 2.5 | 2.5 | 2.5 |
| 902-92813 | 2.5 | 2.5 | 2.5 |
| 929-930 | 1.5 | | |
| 935-940 | 0.1 | 1.5 | 1.5 |
| 1427-1435 | 9300 | 300 | 300 |
| Above 245010 | | | |

[1] Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.

[2] For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.

[3] Travelers information station transmitters operating from 530-1700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to §§90.242 and 90.264 must maintain the carrier frequency to within 20 Hz of the authorized frequency.

[4] Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.

[5] In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

[6] In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

[7] In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

[8] In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

[9] Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.

[10] Except for DSRCS equipment in the 5850-5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850-5925 MHz band is specified in subpart M of this part.

[11] Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

[12] Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.

[13] Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

[14] Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

| Type | Carrier Frequency (MHz) | Limit (PPM) |
|---|---|---|
| Fixed and base Stations | 457.575 | 2.5 |

## 11.2 TEST EQUIPMENT

The following test equipment was used during the test：

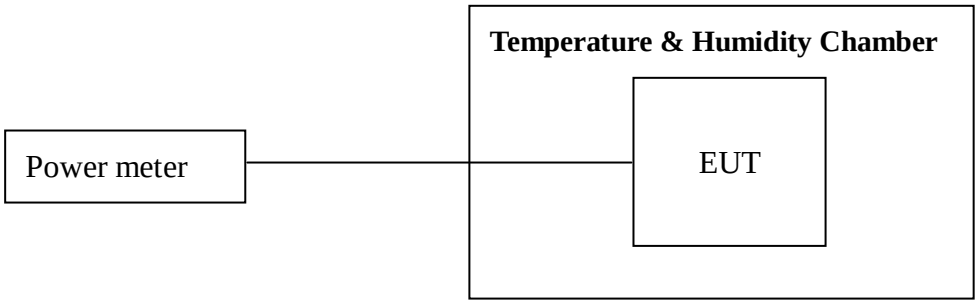
| EQUIPMENT/ FACILITIES | SPECIFICATIONS | MANUFACTURER | MODEL#/ SERIAL# | DUE DATE oF CAL. & CAL. CENTER |
|---|---|---|---|---|
| EMITEST RECEIVER (INCLUDE SPECTRUM ANALYZER) | 9 KHz ~ 6 GHz | ROHDE & SCHWARZ | ESL /100176 | MAR. 28, 2016 ETC |
| TEMPERATURE & HUMIDITY CHAMBER | -40 to 150°C 20 to 95% | KSON | THS-D4C-180-LN2 / 3324 | OCT. 24, 2015 ETC |
| Oscilloscope | 500MHz | HP | US39150351 | NOV. 16, 2015 ETC |
| POWER METER | N/A | BOONTON | 4232A / 105302 | OCT. 25, 2015 ETC |
| POWER SENSOR | N/A | BOONTON | 51011-EMC / 31181 | OCT. 25, 2015 ETC |

**NOTE：** The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

## 11.3 TEST SETUP

As required by 47 CFR 2.1046, *Frequency Stability measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

The tested unit was stayed in a Temperature & Humidity chamber and supplied with a power source for extreme condition (see configure below). It was adjusted to the maximum output power during the test.



## 11.4 TEST PROCEDURE

- Antenna was replaced with a short connector which was connected with a directional coupler as an attenuator.
- The spectrum offset was adjusted to compensate the attenuator and losses caused by the connection.
- Conducted measurement method was performed.
- A wide band power meter with a matched thermocouple detector was used to directly measure the output power from the RF output port of the EUT.
- The EIRP = A+G+10*log (1/x), where A is the average power measured in (1), G is the gain of the antenna of the EUT in dBi and x is the duty cycle of the EUT.

***Frequency Stability VS Temperature***

| Reference Frequency (MHz) | Ambient Temperature (℃) | Temperature Range (℃) |
|---|---|---|
| 457.575 | 25 | -30 ~ 50 |

***Frequency Stability VS Voltage***

| Reference Frequency (MHz) | Nominal Power (V AC) | Voltage Variation of Nominal Power Range (%) |
|---|---|---|
| 457.575 | 110 / 60 Hz | 85% ~ 115% |

## 11.5 TEST RESULT

***Frequency Stability VS Temperature***

| Reference Frequency (MHz) | Chamber Temperature (℃) | Measured Frequency (MHz) | Frequency Stability (PPM) | LIMIT (1.14 kHz or 2.5 PPM) |
|---|---|---|---|---|
| 457.575 | 50 | 457.575013 | 0.0284 | 2.5 |
| | 45 | 457.575028 | 0.0612 | |
| | 40 | 457.575008 | 0.0175 | |
| | 35 | 457.575082 | 0.1792 | |
| | 30 | 457.575031 | 0.0677 | |
| | 25 | 457.574909 | -0.1989 | |
| | 20 | 457.574911 | -0.1945 | |
| | 15 | 457.574965 | -0.0765 | |
| | 10 | 457.574978 | -0.0481 | |
| | 5 | 457.574986 | -0.0306 | |
| | 0 | 457.575007 | 0.0153 | |
| | -5 | 457.574998 | -0.0044 | |
| | -10 | 457.575018 | 0.0393 | |
| | -15 | 457.575290 | 0.6338 | |
| | -20 | 457.574962 | -0.0830 | |
| | -25 | 457.574938 | -0.1355 | |
| | -30 | 457.574910 | -0.1967 | |

***Frequency Stability VS Voltage***

| Reference Frequency (MHz) | Chamber Temperature (℃) | Supplied Voltage (V AC / 60 Hz) | Voltage Variation (%) | Measured Frequency (MHz) | Frequency Stability (PPM) |
|---|---|---|---|---|---|
| 457.575 | 25 | 102.00 | 85 | 457.574891 | -0.2382 |
| | | 120.00 | 100 | 457.575093 | 0.2032 |
| | | 138.00 | 115 | 457.575204 | 0.4458 |

## 12. TERMS OF ABBREVIATION

| | |
|---|---|
| AV. | Average detection |
| AZ(°) | Turn table azimuth |
| Correct. | Correction |
| EL(m) | Antenna height (meter) |
| EUT | Equipment Under Test |
| Horiz. | Horizontal direction |
| LISN | Line Impedance Stabilization Network |
| NSA | Normalized Site Attenuation |
| Q.P. | Quasi-peak detection |
| SRT Lab | Spectrum Research & Testing Laboratory, Inc. |
| Vert. | Vertical direction |