

# CFR 47 FCC Part 15.231

## TEST REPORT

Product : Temp/Water sensor

Trade Name :



Model Number : VHS TWS-02

FCC ID : 2AD4D-TWS-02

Prepared for

**Vital Home Systems LLC**

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Prepared by

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### Remark:

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The test result in the report is only subjected to the test sample.

# Statement of Compliance

**Applicant:** Vital Home Systems LLC

**Manufacturer:** Nutek Corporation

**Product:** Temp/Water sensor

**Model No.:** VHS TWS-02

**Tested Power Supply:** DC 3V (For Battery)

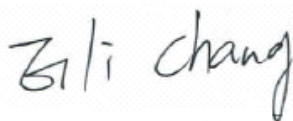
**Date of Final Test:** Apr. 28, 2016

**Configuration of Measurements and Standards Used :**

FCC Rules and Regulations Part 15 Subpart C

1. The result of the testing report relate only to the item tested.
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Report Issued: 2016/05/25

Project Engineer:   
Elli Chang

Approved:   
Jerry Liu

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## 1 Summary of Measurement

| Report Clause | Test Parameter     | Reference Document<br>CFR47 Part15 | Results |
|---------------|--------------------|------------------------------------|---------|
| 4             | Timing requirement | §15.231(a)                         | Pass    |
| 4             | Radiated Emission  | §15.231(b), 15.209                 | Pass    |
| 5             | Emission Bandwidth | §15.231(c)                         | Pass    |

## 2 General Information

### 2.1 Description of Equipment Under Test

|                               |                                                                                                                                                                                                   |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>                | : Temp/Water sensor                                                                                                                                                                               |
| <b>Model Number</b>           | : VHS TWS-02                                                                                                                                                                                      |
| <b>Applicant</b>              | : <b>Vital Home Systems LLC</b><br>2266 Tigereye Place Carlsbad, CA 92009 United States                                                                                                           |
| <b>Manufacturer</b>           | : <b>Nutek Corporation</b><br>No.167, Lane 235, Bauchiau Rd., Shindian City,<br>Taipei Country 23145, Taiwan                                                                                      |
| <b>Power Supply</b>           | : DC 3 V (For Battery)                                                                                                                                                                            |
| <b>Operating Frequency</b>    | : 433.92MHz                                                                                                                                                                                       |
| <b>Type of Modulation</b>     | : ASK                                                                                                                                                                                             |
| <b>Antenna Description</b>    | : This device uses Helix Antenna.<br><br>The antenna is integral to the device, thereby meeting the requirement of FCC 15.203.                                                                    |
| <b>Measurement Software</b>   | : e3; Ver: 8.120803a7-2                                                                                                                                                                           |
| <b>Date of Test</b>           | : Apr. 26 ~ 28, 2016                                                                                                                                                                              |
| <b>Product information</b>    | : Cable: Non-shielded, Detachable, 1.9m, w/o core                                                                                                                                                 |
| <b>Additional Description</b> | : 1) The Model Number " <b>VHS TWS-02</b> " is representative selected in the test and included in this report.<br>2) For more detail specification about EUT, please refer to the user's manual. |

## 2.2 Test Facility

- Site Description** : ☒ Chamber 3
- Name of Firm** : Interocean EMC Technology Corp.
- Company web** : <http://www.ietc.com.tw>
- Location** : No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City, Taiwan 244, R.O.C.
- Site Filing** :
- Federal Communication Commissions – USA  
Registration No.: 651092 (OATS 1, 2, 3 & Chamber 3)  
Designation No.: TW1020
  - Industry Canada (IC)  
OUR FILE: 46405-4437  
Registration No. (OATS 1): Site# 4437A-1  
Registration No. (OATS 3): Site# 4437A-3  
Registration No. (Chamber 3): Site# 4437A-5  
Registration No. (OATS 5): Site# 4437A-6
  - Voluntary Control Council for Interference by Information Technology Equipment (VCCI) – Japan  
Member No.: 1349  
Registration No. (Conducted Room): C-1094  
Registration No. (Conducted Room): T-1562  
Registration No. (OATS 1): R-1040; G-274
- Site Accreditation** :
- Bureau of Standards and Metrology and Inspection (BSMI) – Taiwan, R.O.C.  
Accreditation No.:  
SL2-IN-E-0026 for CNS 13438 / CISPR 22  
SL2-IN-E-0026 for CNS 14757-2 / IEC 62040-2  
SL2-R1-E-0026 for CNS 13439 / CISPR 13  
SL2-R2-E-0026 for CNS 13439 / CISPR 13  
SL2-L1-E-0026 for CNS 14115 / CISPR 15
  - Taiwan Accreditation Foundation (TAF)  
Accreditation No.: 1113
  - Vehicle Safety Certification Center (VSCC)  
Approval No.: TW16-11-0
  - TÜV NORD  
Certificate No: TNTW0801R-04

### **3 Test Specifications**

#### **3.1 Test Standard**

The EUT was performed according to FCC Part 15 Subpart C Section 15.231 procedure and setup followed by ANSI C63.10, 2013 requirements.

#### **3.2 Test Step of EUT**

- 3.2.1 Setup the fixture to EUT for power supplying.
- 3.2.2 Turn on the power of all equipment.
- 3.2.3 Let the EUT continuous transmission. Executed the test.

### 3.3 Test Equipment

| Instrument                            | Manufacturer    | Model       | Serial No. | Next Cal. Date |
|---------------------------------------|-----------------|-------------|------------|----------------|
| Spectrum Analyzer                     | R&S             | FSP40       | 100478     | 2016/06/03     |
| EMI Test Spectrum Analyzer & Receiver | Rohde & Schwarz | ESI7        | 830154/002 | 2016/09/24     |
| Preamplifier                          | Burgeon         | BPA-530     | 100216     | 2016/06/30     |
| Preamplifier                          | Schaffner       | CAP9231A    | 3351       | 2016/08/25     |
| Preamplifier                          | Mini-Circuits   | ZVA-213-S+  | 491801136  | 2016/08/25     |
| Preamplifier                          | EMCI            | EMC 051845  | 980110     | 2016/10/20     |
| Preamplifier                          | Agilent         | 83050A      | 3950M00225 | 2016/09/21     |
| Bilog Antenna                         | Schwarzbeck     | VULB 9163   | 113        | 2016/07/26     |
| Horn Antenna                          | Schwarzbeck     | BBHA 9120   | 9120D-583  | 2016/09/29     |
| Horn Antenna                          | Schwarzbeck     | BBHA 9170   | 213        | 2016/07/19     |
| RF Cable                              | HARBOUR         | 27478LL142  | CBL22      | 2017/03/22     |
| RF Cable                              | Jye Bao         | A30N30-5005 | CBL51      | 2017/03/22     |
| RF Cable                              | Jye Bao         | N30N30-5006 | CBL53      | 2017/03/29     |
| RF Cable                              | HARBOUR         | 27478LL142  | CBL65      | 2017/03/22     |
| Measurement Software                  | AUDIX-e3        |             |            |                |

Note: The above equipments are within the valid calibration period.

## 4 Radiated Emission Test

### 4.1 Limits

According to FCC 15.231(b) requirement:

In addition to the provisions of §15.205, the field strength of emissions from intentional radiator operated under this section shall not exceed the following:

#### Fundamental and Harmonics Emission Limits

| Frequency<br>(MHz) | Field Strength of Fundamental |                   | Field Strength of Harmonics |                   |
|--------------------|-------------------------------|-------------------|-----------------------------|-------------------|
|                    | ( $\mu$ V/m@3m)               | (dB $\mu$ V/m@3m) | ( $\mu$ V/m@3m)             | (dB $\mu$ V/m@3m) |
| 433.92             | 10996                         | 80.8              | 1099.6                      | 60.8              |

#### General Radiated Emission Limit

Spurious Emission tested through until 10<sup>th</sup> harmonic. Radiated emissions, which fall in the restricted bands, as defined in §15.205 (a), comply with the radiated emission limits specified in §15.209 (a).

| Frequency<br>(MHz) | 15.209 Limits   |                   |
|--------------------|-----------------|-------------------|
|                    | ( $\mu$ V/m@3m) | (dB $\mu$ V/m@3m) |
| 30-88              | 100             | 40                |
| 88-216             | 150             | 43.5              |
| 216-960            | 200             | 46                |
| Above 960          | 500             | 54                |

Remark :

1. The table above tighter limit applies at the band edges.
2. The measurement distance in meters, which that between form closest point of EUT to instrument antenna.

## 4.2 Calculation of Average Factor

The output field strengths of specification in accordance with the FCC rules specify measurements with an average detector. During the test, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The duty cycle is measured in 100 ms or the repetition cycle period, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer to set zero span at 100kHz resolution bandwidth.

Averaging factor in dB =  $20 \log (\text{duty cycle})$

The duration of one cycle = 112.03ms

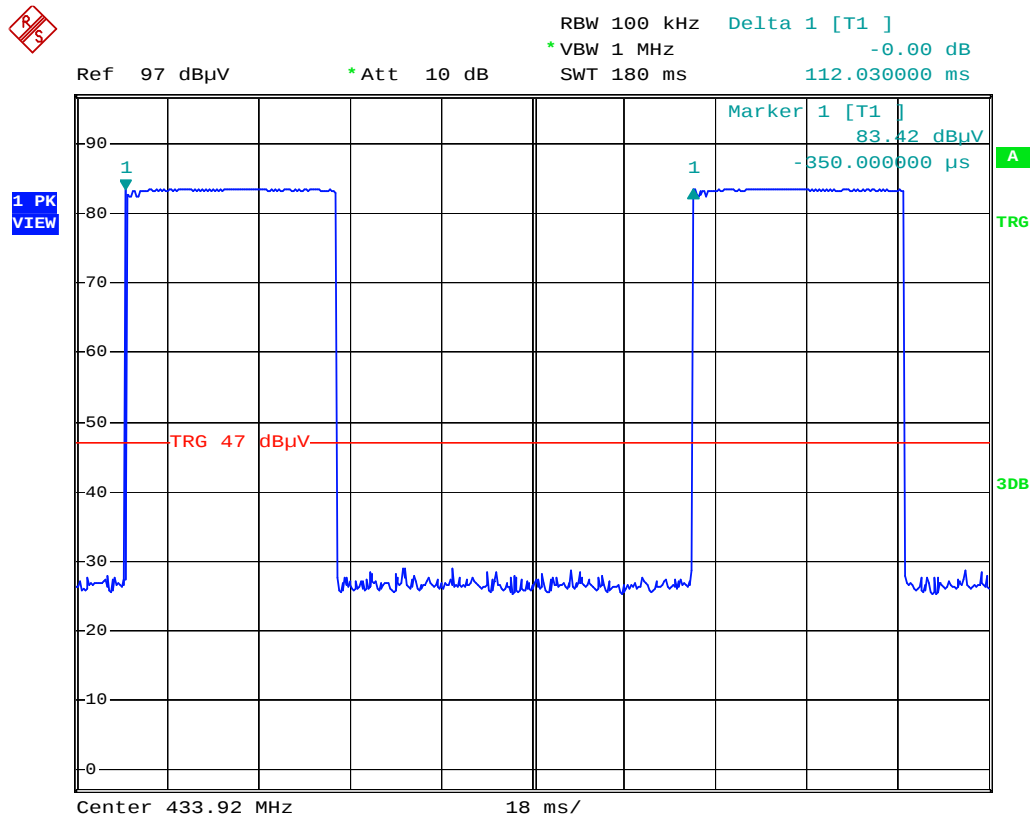
The duty cycle is simply the on-time divided by 100ms

Duty Cycle =  $(1.06\text{ms} \times 2 + 0.22\text{ms} \times 58) / 100\text{ms} = 14.88 \text{ ms} / 100\text{ms}$

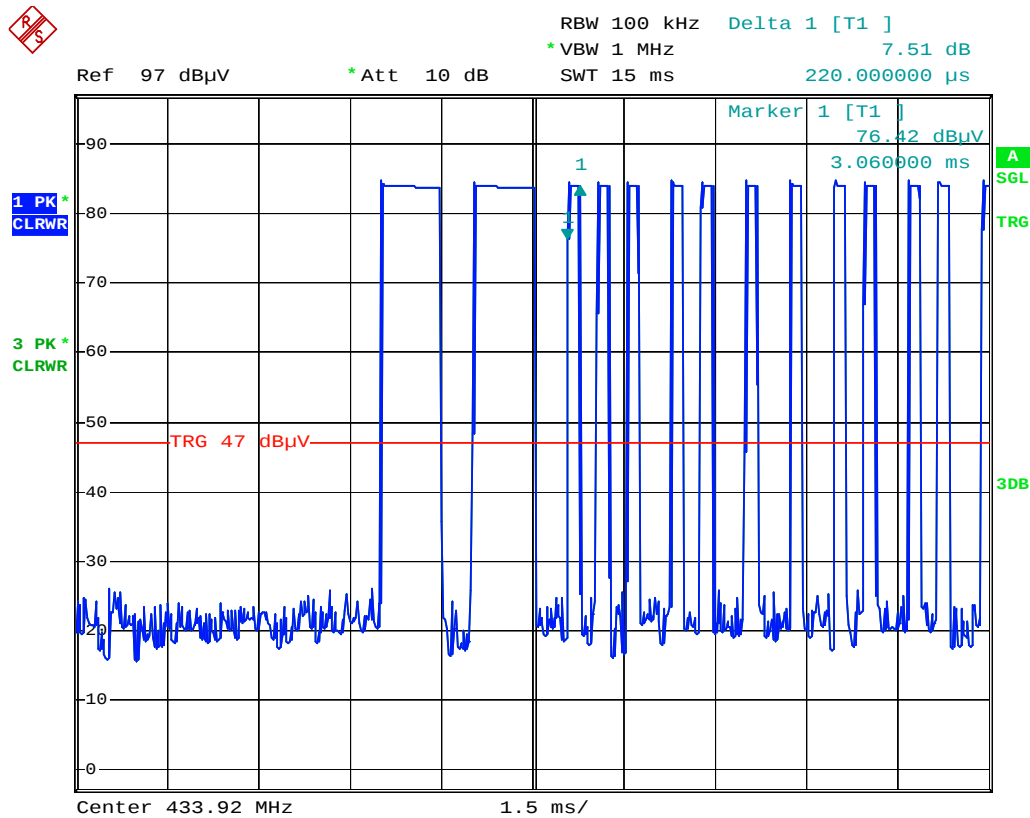
Therefore, the averaging factor is found by  $20 \log 0.1488 = -16.55 \text{ dB}$

Please see the diagrams below.

Duty Cycle

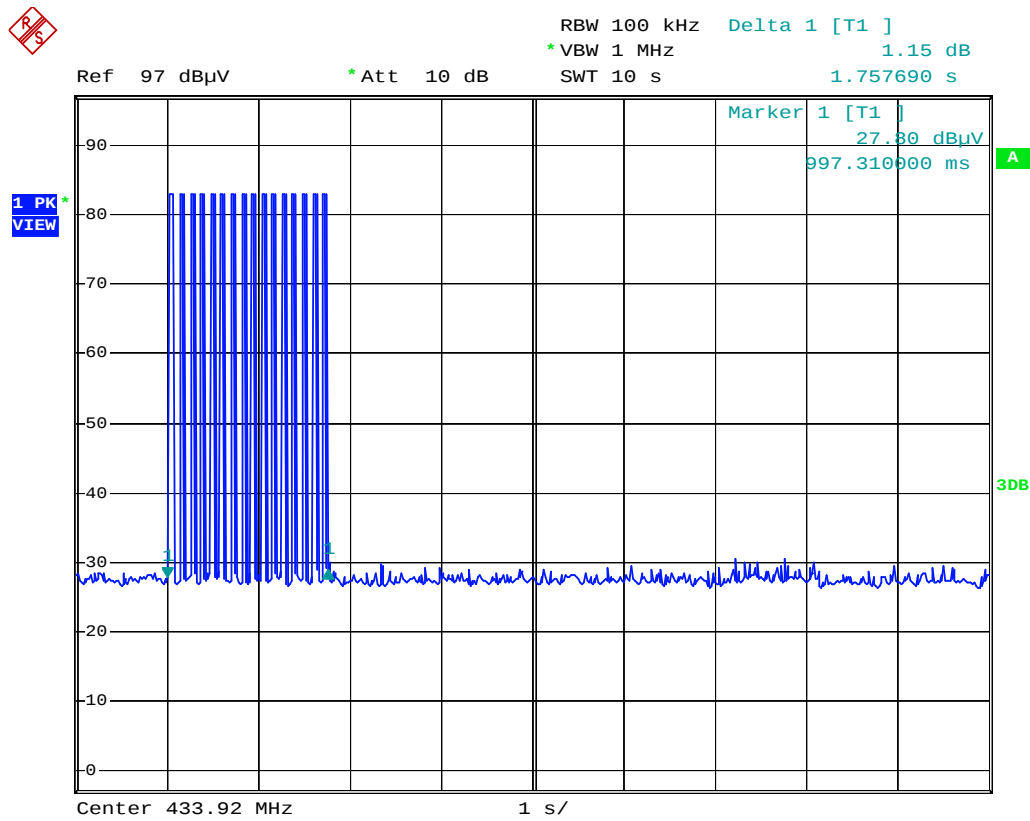






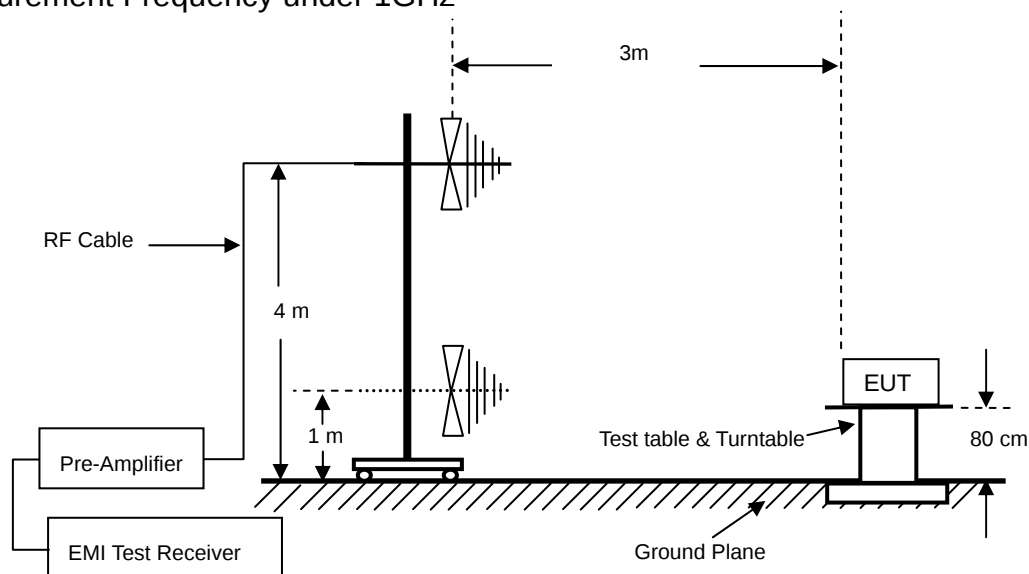
Time Slot 2

The EUT complies with FCC 15.231 (a)(2) requirement :  
A transmitter activated automatically shall cease transmission within 5 seconds after activation.

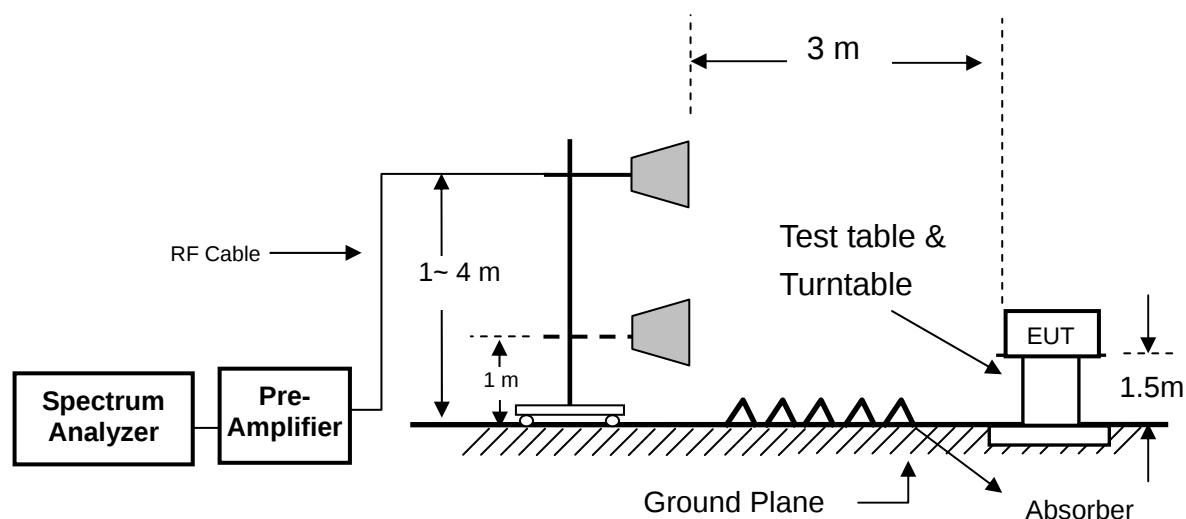


### 4.3 Configuration of Measurement

#### Measurement Frequency under 1GHz



#### Measurement Frequency above 1GHz



### 4.4 Test Procedure

Radiated emission measurements frequency range were performed from 30MHz to 5GHz. Spectrum Analyzer Resolution Bandwidth set to 100kHz or greater for frequencies from 30MHz to 1GHz, and set 1MHz Resolution Bandwidth for frequencies above 1GHz.

The EUT is place on non-conductive turntable for the test. If peripheral devices apply to the EUT, the peripheral devices will be connected to EUT and whole system. During the emission test, the signal is maximized through rotation and all cables were present worst-case emissions. The height of antenna and polarization is constantly changed for exploring maximum signal reading. The height of antenna can be up form reference ground to 4 meter and down to 1 meter.

### 4.5 Test Result

**PASS.**

The final test emission data is shown as following tables.

## Radiated Emission Below 1GHz

| Frequency | Antenna      | Reading | Preamp | Correction Factor | Corrected Level | Limits   | Margin | Det  |
|-----------|--------------|---------|--------|-------------------|-----------------|----------|--------|------|
| (MHz)     | Polarization | (dBuV)  | (dB)   | (dB/m)            | (dBuV/m)        | (dBuV/m) | (dB)   | Mode |
| 109.78    | H            | 39.72   | 31.47  | 13.18             | 21.43           | 43.50    | -22.07 | PK   |
| 203.70    | H            | 38.60   | 31.23  | 12.76             | 20.13           | 43.50    | -23.37 | PK   |
| 297.38    | H            | 38.63   | 31.22  | 15.88             | 23.29           | 46.00    | -22.71 | PK   |
| 360.20    | H            | 37.89   | 31.29  | 18.09             | 24.69           | 46.00    | -21.31 | PK   |
| 432.30    | H            | 37.14   | 31.32  | 19.42             | 25.24           | 46.00    | -20.76 | PK   |
| 558.60    | H            | 35.90   | 31.33  | 21.57             | 26.14           | 46.00    | -19.86 | PK   |
| 86.91     | V            | 39.05   | 31.54  | 11.05             | 18.56           | 40.00    | -21.44 | PK   |
| 197.48    | V            | 37.78   | 31.24  | 12.97             | 19.51           | 43.50    | -23.99 | PK   |
| 260.10    | V            | 40.19   | 31.22  | 14.63             | 23.60           | 46.00    | -22.40 | PK   |
| 348.69    | V            | 37.79   | 31.28  | 17.86             | 24.37           | 46.00    | -21.63 | PK   |
| 468.90    | V            | 38.05   | 31.31  | 20.23             | 26.97           | 46.00    | -19.03 | PK   |
| 561.47    | V            | 37.29   | 31.33  | 21.64             | 27.60           | 46.00    | -18.40 | PK   |

Remark : Corrected Level = Reading + Correction Factor – Preamp  
Correction Factor = Antenna Factor + Cable Loss

## Fundamental and Harmonics Emissions

| Freq.   | Antenna      | Reading | Preamp | Correction Factor | Average Factor | Corrected Level | Limits   | Margin | Det  |
|---------|--------------|---------|--------|-------------------|----------------|-----------------|----------|--------|------|
| (MHz)   | Polarization | (dBUV)  | (dB)   | (dB/m)            | (dB)           | (dBUV/m)        | (dBUV/m) | (dB)   | Mode |
| 433.92  | H            | 72.54   | 0.00   | 19.44             | --             | 91.98           | 100.8    | -8.82  | PK   |
| 433.92  | H            | 72.54   | 0.00   | 19.44             | -16.55         | 75.43           | 80.8     | -5.37  | AV   |
| 867.84  | H            | 45.31   | 31.27  | 26.26             | --             | 40.30           | 80.8     | -40.50 | PK   |
| 867.84  | H            | 45.31   | 31.27  | 26.26             | -16.55         | 23.75           | 60.8     | -37.05 | AV   |
| 1301.76 | H            | 63.91   | 50.92  | 30.59             | --             | 43.58           | 74.0     | -30.42 | PK   |
| 1301.76 | H            | 63.91   | 50.92  | 30.59             | -16.55         | 27.03           | 54.0     | -26.97 | AV   |
| 1735.68 | H            | 73.68   | 50.95  | 32.16             | --             | 54.89           | 80.8     | -25.91 | PK   |
| 1735.68 | H            | 73.68   | 50.95  | 32.16             | -16.55         | 38.34           | 60.8     | -22.46 | AV   |
| 2169.60 | H            | 72.68   | 50.93  | 33.46             | --             | 55.21           | 80.8     | -25.59 | PK   |
| 2169.60 | H            | 72.68   | 50.93  | 33.46             | -16.55         | 38.66           | 60.8     | -22.14 | AV   |
| 2603.52 | H            | 78.03   | 51.02  | 34.76             | --             | 61.77           | 80.8     | -19.03 | PK   |
| 2603.52 | H            | 78.03   | 51.02  | 34.76             | -16.55         | 45.22           | 60.8     | -15.58 | AV   |
| 3037.44 | H            | 75.49   | 51.11  | 36.12             | --             | 60.50           | 80.8     | -20.30 | PK   |
| 3037.44 | H            | 75.49   | 51.11  | 36.12             | -16.55         | 43.95           | 60.8     | -16.85 | AV   |
| 3471.36 | H            | 83.69   | 51.29  | 36.68             | --             | 69.08           | 80.8     | -11.72 | PK   |
| 3471.36 | H            | 83.69   | 51.29  | 36.68             | -16.55         | 52.53           | 60.8     | -8.27  | AV   |
| 3905.28 | H            | 78.38   | 51.38  | 38.00             | --             | 65.00           | 74.0     | -9.00  | PK   |
| 3905.28 | H            | 78.38   | 51.38  | 38.00             | -16.55         | 48.45           | 54.0     | -5.55  | AV   |
| 4339.20 | H            | 65.52   | 51.54  | 39.45             | --             | 53.43           | 74.0     | -20.57 | PK   |
| 4339.20 | H            | 65.52   | 51.54  | 39.45             | -16.55         | 36.88           | 54.0     | -17.12 | AV   |
| 433.92  | V            | 61.45   | 0.00   | 19.44             | --             | 80.89           | 100.8    | -19.91 | PK   |
| 433.92  | V            | 61.45   | 0.00   | 19.44             | -16.55         | 64.34           | 80.8     | -16.46 | AV   |
| 867.84  | V            | 41.31   | 31.27  | 26.26             | --             | 36.30           | 80.8     | -44.50 | PK   |
| 867.84  | V            | 41.31   | 31.27  | 26.26             | -16.55         | 19.75           | 60.8     | -41.05 | AV   |
| 1301.76 | V            | 70.38   | 50.92  | 30.59             | --             | 50.05           | 74.0     | -23.95 | PK   |
| 1301.76 | V            | 70.38   | 50.92  | 30.59             | -16.55         | 33.50           | 54.0     | -20.50 | AV   |
| 1735.68 | V            | 67.77   | 50.95  | 32.16             | --             | 48.98           | 80.8     | -31.82 | PK   |
| 1735.68 | V            | 67.77   | 50.95  | 32.16             | -16.55         | 32.43           | 60.8     | -28.37 | AV   |
| 2169.60 | V            | 64.80   | 50.93  | 33.46             | --             | 47.33           | 80.8     | -33.47 | PK   |
| 2169.60 | V            | 64.80   | 50.93  | 33.46             | -16.55         | 30.78           | 60.8     | -30.02 | AV   |
| 2603.52 | V            | 73.17   | 51.02  | 34.76             | --             | 56.91           | 80.8     | -23.89 | PK   |
| 2603.52 | V            | 73.17   | 51.02  | 34.76             | -16.55         | 40.36           | 60.8     | -20.44 | AV   |
| 3037.44 | V            | 75.40   | 51.11  | 36.12             | --             | 60.41           | 80.8     | -20.39 | PK   |
| 3037.44 | V            | 75.40   | 51.11  | 36.12             | -16.55         | 43.86           | 60.8     | -16.94 | AV   |
| 3471.36 | V            | 81.50   | 51.29  | 36.68             | --             | 66.89           | 80.8     | -13.91 | PK   |
| 3471.36 | V            | 81.50   | 51.29  | 36.68             | -16.55         | 50.34           | 60.8     | -10.46 | AV   |
| 3905.28 | V            | 73.78   | 51.38  | 38.00             | --             | 60.40           | 74.0     | -13.60 | PK   |
| 3905.28 | V            | 73.78   | 51.38  | 38.00             | -16.55         | 43.85           | 54.0     | -10.15 | AV   |
| 4339.20 | V            | 63.86   | 51.54  | 39.45             | --             | 51.77           | 74.0     | -22.23 | PK   |
| 4339.20 | V            | 63.86   | 51.54  | 39.45             | -16.55         | 35.22           | 54.0     | -18.78 | AV   |

Remark : Corrected Level = Reading + Correction Factor – Preamp

Correction Factor = Antenna Factor + Cable Loss

“ \* ” Mark indicated Background Noise Level

## 5 Emission Bandwidth

### 5.1 Limits

According to FCC 15.231(c) requirement:

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz to 900 MHz. Those devices operating above 900 MHz, the emission spurious shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

B.W (20dBc) Limit =  $0.25\% * f(\text{MHz}) = 0.25\% * 433.92\text{MHz} = 1084.8\text{kHz}$

### 5.2 Test Result

**PASS.**

The final test data is shown as following.

| Channel Frequency<br>(MHz) | Measured<br>20dB Bandwidth<br>(kHz) | Limit<br>(kHz) | Result |
|----------------------------|-------------------------------------|----------------|--------|
| 433.92                     | 59.4                                | 1084.8         | PASS   |

