

## FCC ID: H8GRW29

1/14

## CERTIFICATION

**We hereby certify that:**

The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (1992) and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15, Subpart C.

**Prepared by :** Sherry Kuo

Sherry Kuo

**Reviewed by :** Vincent Su

Vincent Su

**Approved by :** George Yao

George Yao

**Issued Date :** Sep. 05, 2000

**Report No. :** NEI-FCCB-00103

**Company Stamp :**

**NEUTRON ENGINEERING INC.**

No. 132-1, Lane 329, Sec. 2, Palain Rd.,  
Shijr Jen, Taipei, Taiwan  
TEL ; (02) 2646-5426 FAX ; (02) 2646-6815

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## 1. GENERAL INFORMATION

### 1-1. Product Description

The A-FOUR Tech Co., Ltd. Model: RFW-29 (referred to as the EUT in the report) is a RF mouse transmitter that use FSK radio frequency technology to operate a special designed receiver which associated with an IBM compatible PC. Center frequency designed for EUT operation is 27.045 or 27.145MHz (select by switch). It is considered as a low power Communication device transmitter.

### 1-2. Related Submittal(s) / Grant (s)

#### 1-2-1. Models Covered

This submittal(s) (test report) is intended for FCC ID: H8GRW29 filing to comply with Section 15.227 of the FCC Part 15, Subpart C Rules. The receiver in compliance with Subpart B is authorized under a Certification.

### 1-3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance 3 meters.

### 1-4. Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the address of No. 132-1, Lane 329, Sec. 2, Palain Road, Shijr Jen, Taipei, Taiwan, R.O.C. of NEUTRON ENGINEERING INC. This site has been fully described in report dated Jun. 4, 1999 Submitted to your office, and accepted in a letter dated Sep. 02, 1999 (Reg. No. 95335).

## 2. System Test Configuration

### 2-1. EUT Configuration

The EUT was placed on a turn table which is 0.8m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

### 2-2. EUT Exercise

The EUT (Transmitter) was operated continuously in its normal operating mode for the purpose of the measurements. and used the block new battery.

### 2-3. Test Procedure

#### 2-3-1. Connducted Emissions

(Not applicable in this report)

#### 2-3-2. Radiated Emissions

Radiated emissions from the EUT measured in the **frequency range between 25 MHz and 1000MHz** were made with a **Spectrum Analyzer, HP Model 8568B**, using **CISPR Quasi-Peak detector mode** and appropriate broadband linearly polarized antenna.

Radiated emissions measurement for **frequency above 1000MHz** were made with a **Test Receiver, R&S model ESMI**, plus a **Pre-amplifier R&S model ESMI-Z7**, and a **Horn Antenna, EMCO model 3115** to measure its **Peak Detector Mode** level and **Average Detector Mode** level.

**2-4. Limitation****(1) Conducted Emission (Not applicable in this report)****(2) Radiated Emission**

- a. The field strength of any emission within this band shall not exceed 10000 microvolts/meter at 3 meters. (80dBuV at 3m) The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in section 15.35 for limiting peak emissions apply.
- b. The field strength of any emissions which appear outside of this band shall not exceed the general radiated emission limits in section 15.209(Unintentional Radiators general limit).as below.

| <b>Frequency<br/>(MHz)</b> | <b>Field strength<br/>mV/m</b> | <b>Distance(m)</b> | <b>Field strength at 3m<br/>dBmV/m</b> |
|----------------------------|--------------------------------|--------------------|----------------------------------------|
| <b>1.705-30</b>            | <b>30</b>                      | <b>30</b>          | <b>69.54</b>                           |
| <b>30-88</b>               | <b>100</b>                     | <b>3</b>           | <b>40</b>                              |
| <b>88-216</b>              | <b>150</b>                     | <b>3</b>           | <b>43.5</b>                            |
| <b>216-960</b>             | <b>200</b>                     | <b>3</b>           | <b>46</b>                              |

- Remark:
1. Emission level in dBuV/m= $20 \log(uV/m)$
  2. Measurement was performed at an antenna to the coldest point of EUT distance of 3 meters.
  3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
  4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.109 apply.

**2-5. Special Accessories**

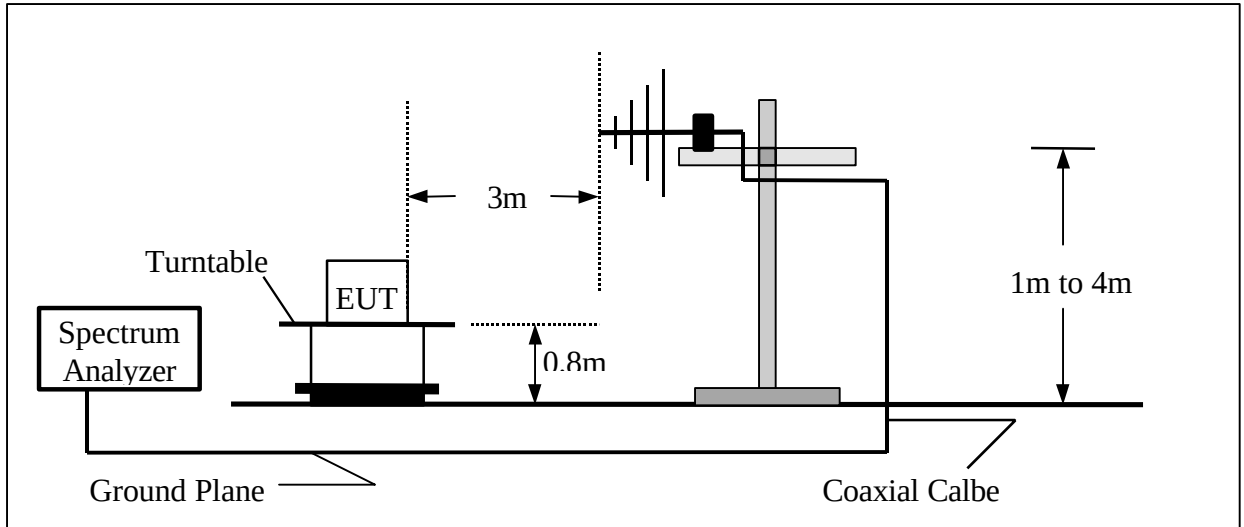
Not available for this EUT intended for grant.

**2-6. Equipment Modifications**

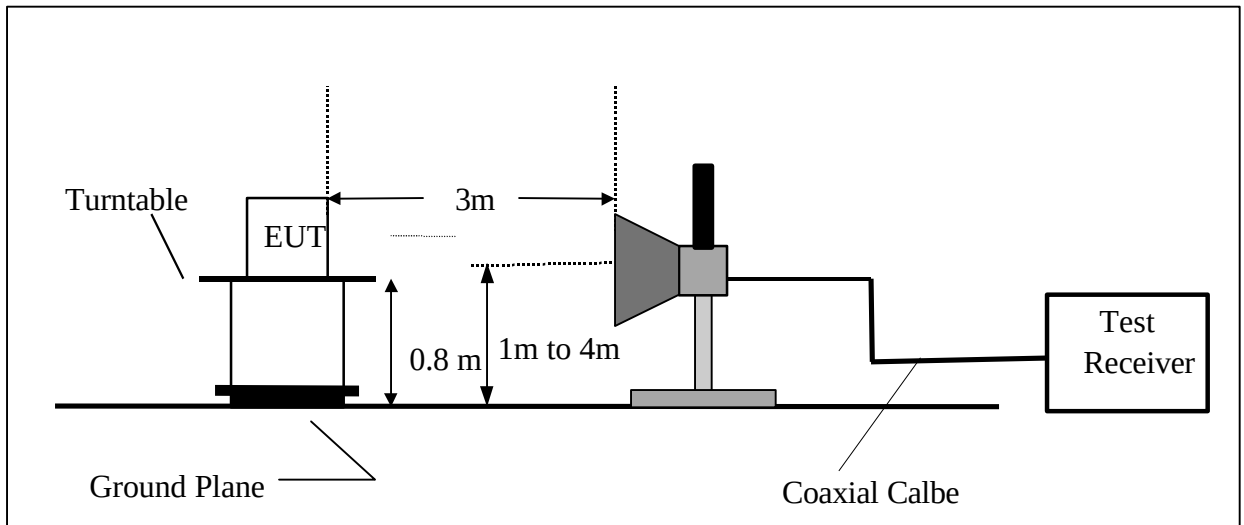
Not available for this EUT intended for grant.

## 2-7. Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



## 2-8 Tested Equipments

| Item | Instruments          | Mfr/Brand       | Model/Type No. | Serial No.     | Calibrated Date | Next Cali. Date | Note |
|------|----------------------|-----------------|----------------|----------------|-----------------|-----------------|------|
| 1    | Log-Bicon Antenna    | MESS-ELEKTRONIK | VULB 9160      | 3058           | 1999-10-29      | 2000-10-28      |      |
| 2    | Log-Bicon Antenna    | MESS-ELEKTRONIK | VULB 9160      | 3060           | 1999-10-22      | 2000-10-21      | ✓    |
| 3    | Log-Bicon Antenna    | MESS-ELEKTRONIK | VULB 9161      | 4022           | 2000-07-05      | 2001-07-04      |      |
| 4    | LISN                 | EMCO            | 3825/2         | 9605-2539      | 2000-06-23      | 2001-06-22      |      |
| 5    | LISN                 | Rolf Heine      | NNB-2/16Z      | 98083          | 1999-10-22      | 2000-10-21      | ✓    |
| 6    | LISN                 | Rolf Heine      | NNB-2/16Z      | 98053          | 1999-11-29      | 2000-11-28      | ✓    |
| 7    | Horn Antenna         | EMCO            | 3115           | 9605-4803      | 2000-05-10      | 2001-05-09      |      |
| 8    | Quasi-eakAdapter     | HP              | 85650A         | 2521A00844     | 2000-03-28      | 2000-09-27      | ✓    |
| 9    | RF Pre-Selector      | HP              | 85685A         | 2648A00417     | 2000-03-28      | 2000-09-27      | ✓    |
| 10   | Spectrum Analyzer    | HP              | 85680B         | 2634A03025     | 2000-03-28      | 2000-09-27      | ✓    |
| 11   | Spectrum Monitor     | HP              | 85662B         | 2648A13616     | 2000-03-28      | 2000-09-27      | ✓    |
| 12   | Pre-Amplifier        | Anritsu         | MH648A         | M09961         | 1999-12-05      | 2000-12-04      | ✓    |
| 13   | Test Receiver        | R&S             | ESMI           | 843977/005     | 1999-11-02      | 2000-11-01      |      |
| 14   | Pre-Amplifier        | R&S             | ESMI-Z7        | 1045.5020      | 2000-05-22      | 2001-05-21      |      |
| 15   | Test Receiver        | R&S             | ESH3           | 860156/018     | 1999-10-25      | 2000-10-24      |      |
| 16   | Test Receiver        | R&S             | ESVP           | 860687/009     | 1999-10-25      | 2000-10-24      |      |
| 17   | Test Receiver        | MEB             | SMV41          | 130            | 1999-12-21      | 2000-12-20      | ✓    |
| 18   | Absorbing Clamp      | R&S             | MDS-21         | 841077/011     | 1999-08-04      | 2000-08-03      |      |
| 19   | Voltage Probe        | R&S             | ESH2-Z3        | 841.800/023    | 1999-08-03      | 2000-08-02      |      |
| 20   | Pulse Limiter        | Electro-Metrics | EM-7600        | 112644         | 2000-02-08      | 2001-02-09      | ✓    |
| 21   | Spectrum Analyzer    | ADVAN TEST      | R3261C         | 81720298       | 1999-08-19      | 2000-08-18      |      |
| 22   | TV Pattern Generator | FLUKE           | PM5415TX       | 9452 054 15103 | 2000-03-16      | 2001-03-15      |      |
| 23   | Oscilloscope         | Tektronix       | 2465B          | J305135        | 1999-11-03      | 2000-11-02      |      |
| 24   | Antenna Mast         | Chance Most     | CMTB-1.5       | N/A            |                 |                 | ✓    |
| 25   | Turn Table           | Chance Most     | CMTB-1.5       | N/A            |                 |                 | ✓    |

Remark; G

- (1) ✓ indicates the instrument used in Test Report.
- (2) N/A denotes No Model No. / Serial No. and No Calibration specified.

**3. Radiated Measurement Photos**



#### 4. Radiated Emission Data

**4.1** The following data lists the significant emission frequencies, measured emission levels, correction factor (including cable loss antenna factor, and if any needed, the duty cycle correction factor), the corrected field strength, as well as the limitation.

Judgement; Passed by -19.53 dB at 81.081 MHz Ant.Pol.: Vertical  
 Operation frequency 27.05 MHz

| Freq.<br>(MHz) | Ant.<br>Pol.<br>H/V | Detector<br>Mode<br>(PK/AV) | Reading<br>(dBuV) | Ant/CL/Amp.CF<br>(dB) | Actual FS<br>(dBuV/m) | Limit<br>3m<br>(dBuV/m) | Safe Margin<br>(dB) | Note |
|----------------|---------------------|-----------------------------|-------------------|-----------------------|-----------------------|-------------------------|---------------------|------|
| 26.962         | V                   | Peak                        | 62.62             | -28.22                | 34.40                 | 69.54                   | -35.14              | E    |
| 27.050         | V                   | Peak                        | 82.58             | -28.22                | 54.36                 | 80.00                   | -25.64              | F    |
| 27.274         | V                   | Peak                        | 64.58             | -28.22                | 36.36                 | 69.54                   | -33.18              | E    |
| 54.094         | V                   | Peak                        | 22.87             | -12.89                | 9.98                  | 40.00                   | -30.02              | H    |
| 81.081         | V                   | Peak                        | 37.00             | -16.53                | 20.47                 | 40.00                   | -19.53              | H    |
| 162.38         | V                   | Peak                        | 32.40             | -9.26                 | 23.14                 | 43.50                   | -20.36              | H    |
| 270.38         | V                   | Peak                        | 31.50             | -10.41                | 21.09                 | 46.00                   | -24.91              | H    |
| 405.72         | V                   | Peak                        | 31.04             | -5.93                 | 25.11                 | 46.00                   | -20.89              | H    |

Remark:

- (1) Measuring frequencies from 25 MHz to the 10th harmonic of fundamental frequency of 27.045 MHz.
- (2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency range from 25 MHz to 1000MHz were made with an instrument using Peak detector mode.
- (4) Emission frequencies above 1000MHz were measured with an instrument using both Average detector mode and peak detector mode.
- (5) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (6) "F" denotes fundamental frequency; "H" denotes Harmonics frequency. "E" denotes band edge frequency.
- (7) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.109 apply.
- (8) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (9) The IF bandwidth between 25 to 30MHz was 9KHz.

Review:

*Timothy Su*

Test Engr. :

*Nelson*

Test Date:

Sep. 01, 2000

#### 4. Radiated Emission Data

4.1 The following data lists the significant emission frequencies, measured emission levels, correction factor (including cable loss antenna factor, and if any needed, the duty cycle correction factor), the corrected field strength, as well as the limitation.

Judgement; Passed by -16.73 dB at 81.106 MHz Ant.Pol.: Horizontal  
 Operation frequency 27.05 MHz

| Freq.<br>(MHz) | Ant.<br>Pol.<br>H/V | Detector<br>Mode<br>(PK/AV) | Reading<br>(dBuV) | Ant/CL/Amp.CF<br>(dB) | Actual FS<br>(dBuV/m) | Limit<br>3m<br>(dBuV/m) | Safe Margin<br>(dB) | Note |
|----------------|---------------------|-----------------------------|-------------------|-----------------------|-----------------------|-------------------------|---------------------|------|
| 26.964         | H                   | Peak                        | 62.80             | -28.22                | 34.58                 | 69.50                   | -34.92              | E    |
| 27.047         | H                   | Peak                        | 84.78             | -28.22                | 56.56                 | 80.00                   | -23.44              | F    |
| 27.282         | H                   | Peak                        | 63.77             | -28.22                | 35.55                 | 69.50                   | -33.95              | E    |
| 54.094         | H                   | Peak                        | 27.67             | -12.89                | 14.78                 | 40.00                   | -25.22              | H    |
| 81.106         | H                   | Peak                        | 39.74             | -16.48                | 23.27                 | 40.00                   | -16.73              | H    |
| 108.20         | H                   | Peak                        | 35.80             | -13.18                | 22.62                 | 43.50                   | -20.88              | H    |
| 162.29         | H                   | Peak                        | 31.60             | -9.26                 | 22.34                 | 43.50                   | -21.16              | H    |
| 216.26         | H                   | Peak                        | 30.67             | -12.56                | 18.11                 | 46.00                   | -27.89              | H    |

#### Remark:

- (1) Measuring frequencies from 25 MHz to the 10th harmonic of fundamental frequency of 27.045 MHz.
- (2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency range from 25 MHz to 1000MHz were made with an instrument using Peak detector mode.
- (4) Emission frequencies above 1000MHz were measured with an instrument using both Average detector mode and peak detector mode.
- (5) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (6) "F" denotes fundamental frequency; "H" denotes Harmonics frequency. "E" denotes band edge frequency.
- (7) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.109 apply.
- (8) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (9) The IF bandwidth between 25 to 30MHz was 9KHz.

Review:



Test Engr. :



Test Date:

Sep. 01, 2000

#### 4. Radiated Emission Data

4.1 The following data lists the significant emission frequencies, measured emission levels, correction factor (including cable loss antenna factor, and if any needed, the duty cycle correction factor), the corrected field strength, as well as the limitation.

Judgement; Passed by -19.72 dB at 54.197 MHz Ant.Pol.: Vertical  
 Operation frequency 27.14 MHz

| Freq.<br>(MHz) | Ant.<br>Pol.<br>H/V | Detector<br>Mode<br>(PK/AV) | Reading<br>(dBuV) | Ant/CL/Amp.CF<br>(dB) | Actual FS<br>(dBuV/m) | Limit<br>3m<br>(dBuV/m) | Safe Margin<br>(dB) | Note |
|----------------|---------------------|-----------------------------|-------------------|-----------------------|-----------------------|-------------------------|---------------------|------|
| 26.962         | V                   | Peak                        | 68.04             | -28.22                | 39.82                 | 69.50                   | -29.68              | E    |
| 27.140         | V                   | Peak                        | 83.22             | -28.22                | 55.00                 | 80.00                   | -25.00              | F    |
| 27.282         | V                   | Peak                        | 65.13             | -28.22                | 36.91                 | 69.50                   | -32.59              | E    |
| 54.197         | V                   | Peak                        | 33.17             | -12.89                | 20.28                 | 40.00                   | -19.72              | H    |
| 81.437         | V                   | Peak                        | 35.45             | -16.28                | 19.17                 | 40.00                   | -20.83              | H    |
| 108.56         | V                   | Peak                        | 37.56             | -13.15                | 24.42                 | 43.50                   | -19.08              | H    |
| 189.98         | V                   | Peak                        | 33.20             | -12.42                | 20.78                 | 43.50                   | -22.72              | H    |

Remark; G

- (1) Measuring frequencies from 25 MHz to the 10th harmonic of fundamental frequency of 27.045 MHz.
- (2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency range from 25 MHz to 1000MHz were made with an instrument using Peak detector mode.
- (4) Emission frequencies above 1000MHz were measured with an instrument using both Average detector mode and peak detector mode.
- (5) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (6) "F" denotes fundamental frequency; "H" denotes Harmonics frequency. "E" denotes band edge frequency.
- (7) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.109 apply.
- (8) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (9) The IF bandwidth between 25 to 30MHz was 9KHz.

Review:

*Timothy Liu*

Test Engr. :

*Nelson*

Test Date:

Sep. 01, 2000

#### 4. Radiated Emission Data

4.1 The following data lists the significant emission frequencies, measured emission levels, correction factor (including cable loss antenna factor, and if any needed, the duty cycle correction factor), the corrected field strength, as well as the limitation.

Judgement; Passed by -9.71 dB at 27.152 MHz Ant.Pol.: Horizontal  
 Operation frequency 27.14 MHz

| Freq.<br>(MHz) | Ant.<br>Pol.<br>H/V | Detector<br>Mode<br>(PK/AV) | Reading<br>(dBuV) | Ant/CL/Amp.CF<br>(dB) | Actual FS<br>(dBuV/m) | Limit<br>3m<br>(dBuV/m) | Safe Margin<br>(dB) | Note |
|----------------|---------------------|-----------------------------|-------------------|-----------------------|-----------------------|-------------------------|---------------------|------|
| 26.967         | H                   | Peak                        | 62.97             | -28.22                | 34.75                 | 69.50                   | -34.75              | E    |
| 27.152         | H                   | Peak                        | 88.01             | -28.22                | 59.79                 | 69.50                   | -9.71               | E    |
| 27.287         | H                   | Peak                        | 65.00             | -28.22                | 36.78                 | 69.50                   | -32.72              | E    |
| 27.142         | H                   | Peak                        | 75.10             | -15.21                | 59.89                 | 80.00                   | -20.11              | F    |
| 54.28          | H                   | Peak                        | 38.50             | -12.89                | 25.61                 | 40.00                   | -14.39              | H    |
| 81.42          | H                   | Peak                        | 43.05             | -16.28                | 26.77                 | 40.00                   | -13.23              | H    |
| 108.56         | H                   | Peak                        | 33.06             | -13.15                | 19.92                 | 43.50                   | -23.58              | H    |
| 162.86         | H                   | Peak                        | 29.80             | -9.41                 | 20.39                 | 43.50                   | -23.11              | H    |
| 189.99         | H                   | Peak                        | 31.40             | -12.42                | 18.98                 | 43.50                   | -24.52              | H    |

Remark:

- (1) Measuring frequencies from 25 MHz to the 10th harmonic of fundamental frequency of 27.045 MHz.
- (2) Datas of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (3) Radiated emissions measured in frequency range from 25 MHz to 1000MHz were made with an instrument using Peak detector mode.
- (4) Emission frequencies above 1000MHz were measured with an instrument using both Average detector mode and peak detector mode.
- (5) Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB
- (6) "F" denotes fundamental frequency; "H" denotes Harmonics frequency. "E" denotes band edge frequency.
- (7) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.109 apply.
- (8) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (9) The IF bandwidth between 25 to 30MHz was 9KHz.

Review:

*Tinnet Su*

Test Engr. :

*Nelson*

Test Date:

Sep. 01, 2000

#### 4-2. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

**Where**      **FS = Field Strength**

**RA = Receiver Amplitude**

**AF = Antenna Factor (1)**

**CL = Cable Attenuation Factor (1)**

**AG = Amplifier Gain (1) (2)**

**Remark :**

(1) The Correction Factor = AF + CF - AG, as shown in the data tables' Correction Factor column.

(2) AG is not available for Neutron's Open Site Facility

**Example of Calculation:**

Assume a Receiver Reading of 23.7 dBuV is obtained with an Antenna Factor of 7.2 dB and a Cable Factor of 1.1 dBuV. Then:

1. The Correction Factor will be calculated by

$$\text{Correction Factor} = AF + CF - AG = 7.2 + 1.1 - 0 = 8.3 \text{ (dB)}$$

as shown in the data tables' Correction Factor column.

2. The Field Strength will be calculated by

$$FS = RA + \text{Correction Factor} = 23.7 + 8.3 = 32 \text{ (dBuV/m)}.$$

FS is the value shown in the data tables' Corrected Reading column and RA is the value shown in the data tables' Receiver Reading column. The 32 dBuV/m value was mathematically converted to its corresponding level in uV/m as:

$$\text{Log}^{-1} [(32.0 \text{ dBuV/m})/20] \times 39.8 \text{ (uV/m)}$$

