



## 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 :** Carol Chen

*Carol Chen*

**Reviewed by :** Andy Chiu

*Andy Chiu*

**Approved by :** George Yao

*George Yao*

**Issued Date :** Sep. 30, 2002

**Report No. :** NEI-FCCB-02192

**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: RFSW-15; RF-1515 (referred to as the EUT in the report) is a RF mouse transmitter that uses 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 (selected by switch). It is considered as a low power Communication device transmitter.

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

This submittal(s) (test report) is intended for FCC ID: H8GRSW15 filing to comply with Section 15.227 of the FCC Part 15, Subpart C Rules. The composite system(including receiver and transmitter) in compliance with Subpart B is authorized under a DoC procedure.

### 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).

### 3. System Test Configuration

#### 3-1. 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.

#### 3-2. 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.

#### 3-3. Test Procedure

##### 3-3-1. Conducted Emissions

Conducted emissions from the EUT measured in the **frequency range between 0.45 MHz and 30MHz** were made with a **Spectrum Analyzer, HP Model 8568B**, using **CISPR Quasi-Peak detector mode** and appropriate broadband linearly polarized antenna.

##### 3-3-2. 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.

**3-4. Limitation****(1) Conducted Emission (Not applicable in this report)**

| Frequency Range<br>(MHz) | Quasi-Peak |
|--------------------------|------------|
| 0.45 - 30                | 48         |

**(2) Radiated Emission**

- a. The field strength of any emission within this band (26.96-27.28MHz) shall not exceed 10000 micro volts/meter at 3 meters. (80dB $\mu$ V 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.

| Frequency<br>(MHz) | Field strength<br>$\mu$ V/m | Distance(m) | Field strength at 3m<br>dB $\mu$ V/m |
|--------------------|-----------------------------|-------------|--------------------------------------|
| 1.705-30           | 30                          | 30          | 69.54                                |
| 30-88              | 100                         | 3           | 40                                   |
| 88-216             | 150                         | 3           | 43.5                                 |
| 216-960            | 200                         | 3           | 46                                   |

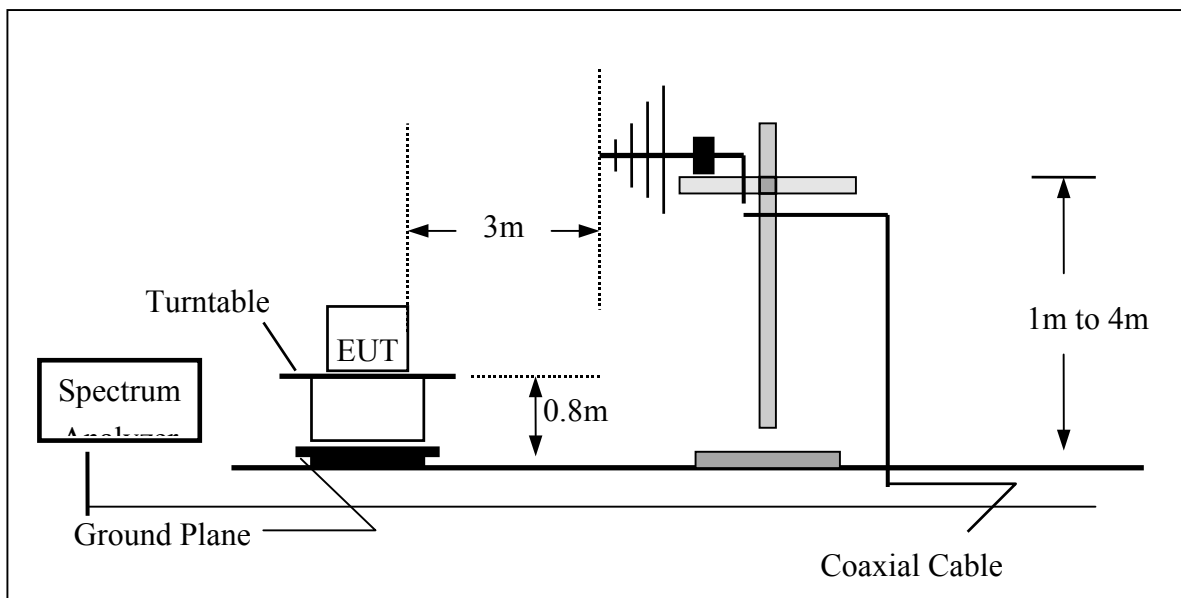
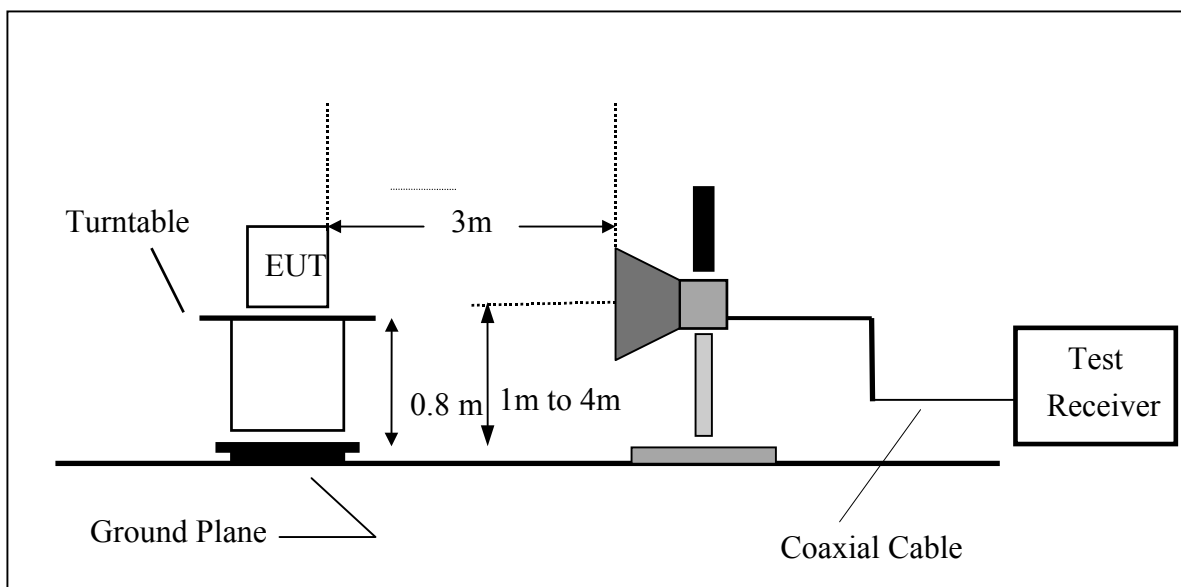
- Remark:
1. Emission level in dB $\mu$ V/m=20 log (uV/m)
  2. Measurement was performed at an antenna to the colsed point of EUT distance of 3. meters.
  4. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
  5. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.209 apply.

**3-5. Special Accessories**

Not available for this EUT intended for grant.

**3-6. Equipment Modifications**

Not available for this EUT intended for grant.

**3-7. 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**

**3-8 Tested Equipments**

| Item | Instruments        | Mfr/Brand       | Model/Type No. | Serial No.  | Calibrated Date | Next Cali. Date | Note |
|------|--------------------|-----------------|----------------|-------------|-----------------|-----------------|------|
| 1    | LISN               | EMCO            | 3825/2         | 9605-2539   | 2002-05-20      | 2003-05-48      | ✓    |
| 2    | LISN               | Rolf Heine      | NNB-2/16Z      | 98083       | 2001-10-20      | 2002-10-48      | ✓    |
| 3    | LISN               | Rolf Heine      | NNB-2/16Z      | 98053       | 2001-11-22      | 2002-11-21      |      |
| 4    | Pulse Limiter      | Electro-Metrics | EM-7600        | 112644      | 2001-12-10      | 2002-12-48      | ✓    |
| 5    | 50Ω Terminator     | N/A             | N/A            | N/A         | 2002-05-10      | 2003-05-09      | ✓    |
| 6    | Test Cable         | N/A             | C01            | N/A         | 2001-12-08      | 2002-12-07      | ✓    |
| 7    | Log-Bicon Antenna  | MESS-ELEKTRONIK | VULB 9160      | 3058        | 2001-10-27      | 2002-10-26      |      |
| 8    | Log-Bicon Antenna  | MESS-ELEKTRONIK | VULB 9160      | 3060        | 2001-10-20      | 2002-10-48      | ✓    |
| 9    | Log-Bicon Antenna  | MESS-ELEKTRONIK | VULB 9161      | 4022        | 2001-07-04      | 2002-07-03      |      |
| 10   | Test Cable         | N/A             | 10M_OS01       | N/A         | 2001-12-08      | 2002-12-07      | ✓    |
| 11   | Test Cable         | N/A             | OS01-1/-2      | N/A         | 2001-12-08      | 2002-12-07      | ✓    |
| 12   | Test Cable         | N/A             | 10M_OS02       | N/A         | 2001-12-08      | 2002-12-07      |      |
| 13   | Test Cable         | N/A             | OS02-1/-2/-3   | N/A         | 2001-12-08      | 2002-12-07      |      |
| 14   | RF Switch          | Anritsu         | MP59B          | M65982      | 2001-12-10      | 2002-12-09      | ✓    |
| 15   | Quasi-Peak Adapter | HP              | 85650A         | 2521A00844  | 2002-04-08      | 2002-10-07      | ✓    |
| 16   | RF Pre-Selector    | HP              | 85685A         | 2648A00417  | 2002-04-08      | 2002-10-07      | ✓    |
| 17   | Spectrum Analyzer  | HP              | 85680B         | 2634A03025  | 2002-04-08      | 2002-10-07      | ✓    |
| 18   | Spectrum Monitor   | HP              | 85662B         | 2648A13616  | 2002-04-08      | 2002-10-07      | ✓    |
| 19   | Pre-Amplifier      | Anritsu         | MH648A         | M09961      | 2001-12-10      | 2002-12-09      | ✓    |
| 20   | Spectrum Analyzer  | ADVAN TEST      | R3261C         | 81720298    | 2002-08-17      | 2003-08-16      |      |
| 21   | Test Receiver      | R&S             | ESH3           | 860156/018  | 2001-10-23      | 2002-10-22      |      |
| 22   | Test Receiver      | R&S             | ESVP           | 860687/009  | 2001-10-23      | 2002-10-22      |      |
| 23   | Test Receiver      | MEB             | SMV41          | 130         | 2001-12-05      | 2002-12-04      | ✓    |
| 24   | Test Receiver      | PMM             | PMM 9000       | 4310J01002  | 2001-12-31      | 2002-12-30      |      |
| 25   | Horn Antenna       | EMCO            | 3115           | 9605-4803   | 2001-05-09      | 2002-05-08      |      |
| 26   | Test Receiver      | R&S             | ESMI           | 843977/005  | 2001-11-14      | 2002-11-05      |      |
| 27   | Pre-Amplifier      | R&S             | ESMI-Z7        | 1045.5020   | 2001-05-21      | 2002-05-20      |      |
| 28   | Absorbing Clamp    | R&S             | MDS-21         | 841077/011  | 2001-08-18      | 2002-08-17      |      |
| 29   | Voltage Probe      | R&S             | ESH2-Z3        | 841.800/023 | 2001-08-20      | 2002-08-48      |      |
| 30   | Signal Generator   | HP              | 8648A          | 3426A01034  | 2000-02-10      | 2003-09-23      |      |
| 31   | Antenna Mast       | Chance Most     | CMTB-1.5       | N/A         | N/A             | N/A             | ✓    |
| 32   | Turn Table         | Chance Most     | CMTB-1.5       | N/A         | N/A             | N/A             | ✓    |

Remark :

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

#### **4. Block Diagram(s)**

Figure 4.1 Block diagram of system, Page 10.A

**6. Radiated Emission Data**

**6.1.** 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 -7.96 dB at 54.090 MHz Ant.Pol.: Ver.  
 Operation frequency 27.045MHz Mode: CH1

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | DetectorMode<br>(PK/AV) | Reading<br>(dBUV) | Ant./CL/<br>Amp. CF(dB) | Actual FS<br>(dBUV/m) | Limit3m<br>(dBUV/m) | Safe Margin<br>(dB) | Note |
|----------------|-----------------|-------------------------|-------------------|-------------------------|-----------------------|---------------------|---------------------|------|
| 27.065         | V               | Peak                    | 51.80             | 19.31                   | 71.11                 | 80.00               | -8.89               | F    |
| 26.961         | V               | Peak                    | 47.84             | 18.89                   | 66.73                 | 80.00               | -13.27              | E    |
| 27.279         | V               | Peak                    | 46.20             | 18.49                   | 64.69                 | 80.00               | -15.31              | E    |
| 54.090         | V               | Peak                    | 47.80             | -12.26                  | 35.54                 | 43.50               | -7.96               | H    |
| 81.135         | V               | Peak                    | 38.40             | -15.85                  | 22.55                 | 46.00               | -23.45              | H    |
| 108.176        | V               | Peak                    | 38.10             | -13.09                  | 25.01                 | 46.00               | -20.99              | H    |
| 135.219        | V               | Peak                    | 34.70             | -10.90                  | 23.80                 | 46.00               | -22.20              | H    |
| 180.800        | V               | Peak                    | 33.80             | -12.13                  | 21.67                 | 46.00               | -24.33              | H    |
|                |                 |                         |                   |                         |                       |                     |                     |      |
| 27.040         | H               | Peak                    | 49.40             | 16.19                   | 65.59                 | 80.00               | -14.41              | F    |
| 26.961         | H               | Peak                    | 44.19             | 16.30                   | 60.49                 | 80.00               | -19.51              | E    |
| 27.279         | H               | Peak                    | 42.00             | 15.70                   | 57.70                 | 80.00               | -22.30              | E    |
| 54.090         | H               | Peak                    | 46.00             | -12.26                  | 33.74                 | 46.00               | -12.26              | H    |
| 74.050         | H               | Peak                    | 36.50             | -15.22                  | 21.28                 | 46.00               | -24.72              | H    |
| 150.800        | H               | Peak                    | 37.00             | -10.20                  | 26.80                 | 80.00               | -53.20              | F    |
| 158.750        | H               | Peak                    | 38.80             | -10.12                  | 28.68                 | 40.00               | -11.32              | H    |
| 189.450        | H               | Peak                    | 35.00             | -12.86                  | 22.14                 | 43.50               | -21.36              | H    |

**Remark :**

- (1) Measuring frequencies from 25 MHz to the 1GHz.
- (2) Radiated emissions measured in frequency range from 25MHz to 1000MHz were made with an instrument using Peak detector mode.
- (3) 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.
- (4) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (5) \* 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.
- (6) 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.
- (7) The IF bandwidth of SPA between 25MHz to 30MHz was 10KHz; 30MHz to 1GHz was 100KHz.

Review: Andy Chiu Test Engr.: James Test Date : Sep. 16, 2002

## 6. Radiated Emission Data

6.1 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 -8.77 dB at 54.290 MHz Ant. Pol.: Ver.  
 Operation frequency 27.145 MHz Mode: CH2

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | DetectorMode<br>(PK/AV) | Reading<br>(dBuV) | Ant./CL/<br>Amp. CF(dB) | Actual FS<br>(dBuV/m) | Limit3m<br>(dBuV/m) | Safe Margin<br>(dB) | Note |
|----------------|-----------------|-------------------------|-------------------|-------------------------|-----------------------|---------------------|---------------------|------|
| 27.155         | V               | Peak                    | 52.20             | 19.18                   | 71.38                 | 80.00               | -8.62               | F    |
| 26.961         | V               | Peak                    | 47.04             | 18.89                   | 65.93                 | 80.00               | -14.07              | E    |
| 27.279         | V               | Peak                    | 46.60             | 18.49                   | 65.09                 | 80.00               | -14.91              | E    |
| 54.290         | V               | Peak                    | 47.00             | -12.27                  | 34.73                 | 43.50               | -8.77               | H    |
| 81.435         | V               | Peak                    | 39.00             | -15.81                  | 23.19                 | 46.00               | -22.81              | H    |
| 108.580        | V               | Peak                    | 37.50             | -13.05                  | 24.45                 | 46.00               | -21.55              | H    |
| 135.717        | V               | Peak                    | 33.60             | -10.87                  | 22.73                 | 46.00               | -23.27              | H    |
| 188.520        | V               | Peak                    | 38.40             | -12.82                  | 25.58                 | 46.00               | -20.42              | H    |
| 27.155         | H               | Peak                    | 49.80             | 16.20                   | 66.00                 | 80.00               | -14.00              | F    |
| 26.961         | H               | Peak                    | 41.79             | 16.30                   | 58.09                 | 80.00               | -21.91              | E    |
| 27.279         | H               | Peak                    | 43.20             | 15.70                   | 58.90                 | 80.00               | -21.10              | E    |
| 54.290         | H               | Peak                    | 44.40             | -12.27                  | 32.13                 | 46.00               | -13.87              | H    |
| 81.435         | H               | Peak                    | 34.30             | -15.81                  | 18.49                 | 46.00               | -27.51              | H    |
| 108.580        | H               | Peak                    | 36.20             | -13.04                  | 23.16                 | 80.00               | -56.84              | F    |
| 150.800        | H               | Peak                    | 36.20             | -10.20                  | 26.00                 | 40.00               | -14.00              | H    |
| 160.850        | H               | Peak                    | 36.50             | -10.29                  | 26.21                 | 43.50               | -17.29              | H    |

### Remark :

- (1) Measuring frequencies from 25 MHz to the 1GHz.
- (2) Radiated emissions measured in frequency range from 25MHz to 1000MHz were made with an instrument using Peak detector mode.
- (3) 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.
- (4) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (5) \* 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.
- (6) 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.
- (7) The IF bandwidth of SPA between 25MHz to 30MHz was 10KHz; 30MHz to 1GHz was 100KHz.

Review: Andy Chiu Test Engr.: James Test Date : Sep. 16, 2002

## 6-2. 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:

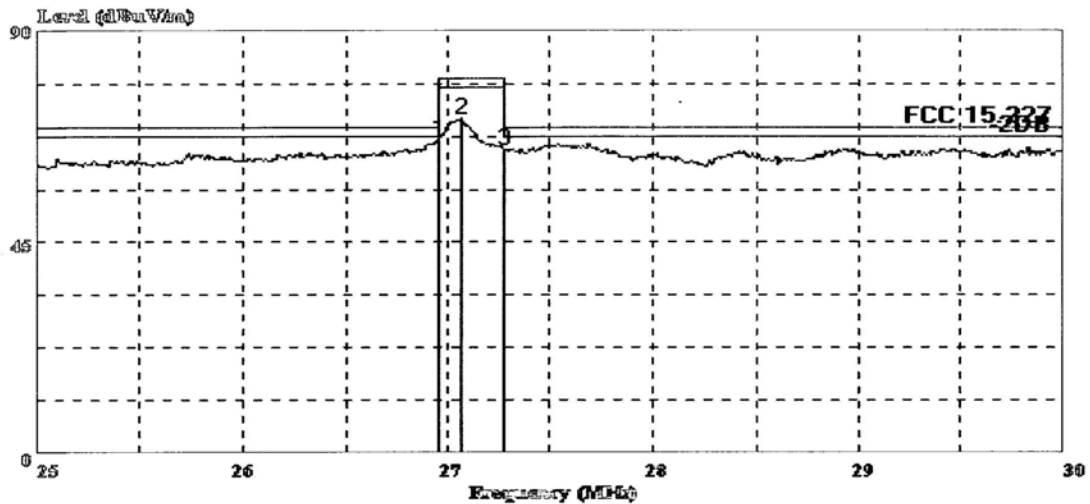
$$\text{Log}^{-1}\{(32.0\text{dBuV/m})/20\} = 39.8 \text{ (uV/m)}$$

## 6.3 Bandwidth requirement Mode : Operation frequency: 27.045 MHz, CH1



Neutron Engineering Inc.  
132-1, Lane 329, Sec. 2, Palian Rd.,  
Sjijr 221, Taipei, Taiwan, R.O.C.  
Tel: 02-26465426  
Fax: 02-26466815

Data#: 2 File#: 02E2585.EMI Date: 2002-09-16 Time: 09:35:28



(SR02)

Trace: 1

Ref Trace:

Condition: FCC 15.227 3m SR02 3M-LV VERTICAL

Operator : James Chiu

Project code: 02E2585

E.U.T. : RF Mouse

Model No. : RFMSW-15

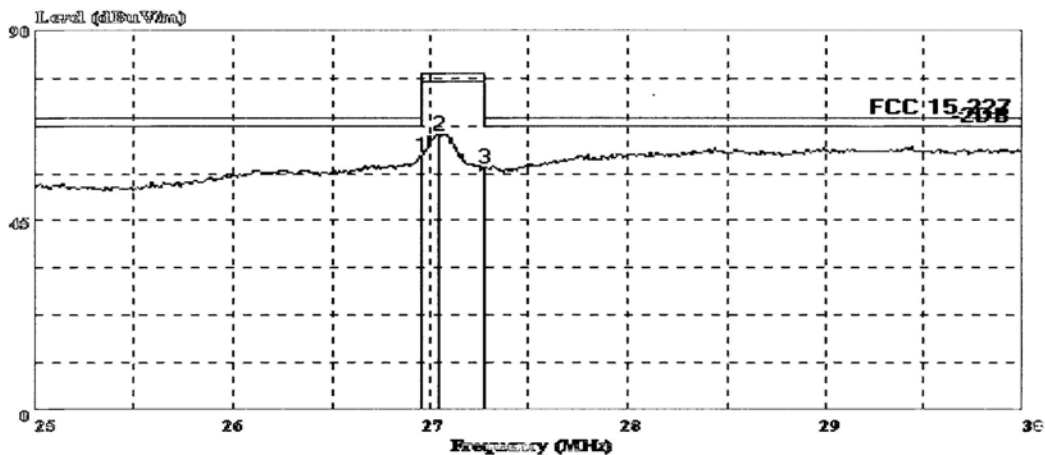
Test mode : CH1 , RBW = 100KHz, VBW = 100KHz, Sweep=200ms

Temp/ RH : 23/50



Neutron Engineering Inc.  
132-1, Lane 329, Sec. 2, Palian Rd.,  
Sjijr 221, Taipei, Taiwan, R.O.C.  
Tel: 02-26465426  
Fax: 02-26466815

Data#: 4 File#: 02E2585.EMI Date: 2002-09-16 Time: 09:37:38



(SR02)

Trace: 3

Ref Trace:

Condition: FCC 15.227 3m SR02 3M-LH HORIZONTAL

Operator : James Chiu

Project code: 02E2585

E.U.T. : RF Mouse

Model No. : RFMSW-15

Test mode : CH1 , RBW = 100KHz, VBW = 100KHz, Sweep=200ms

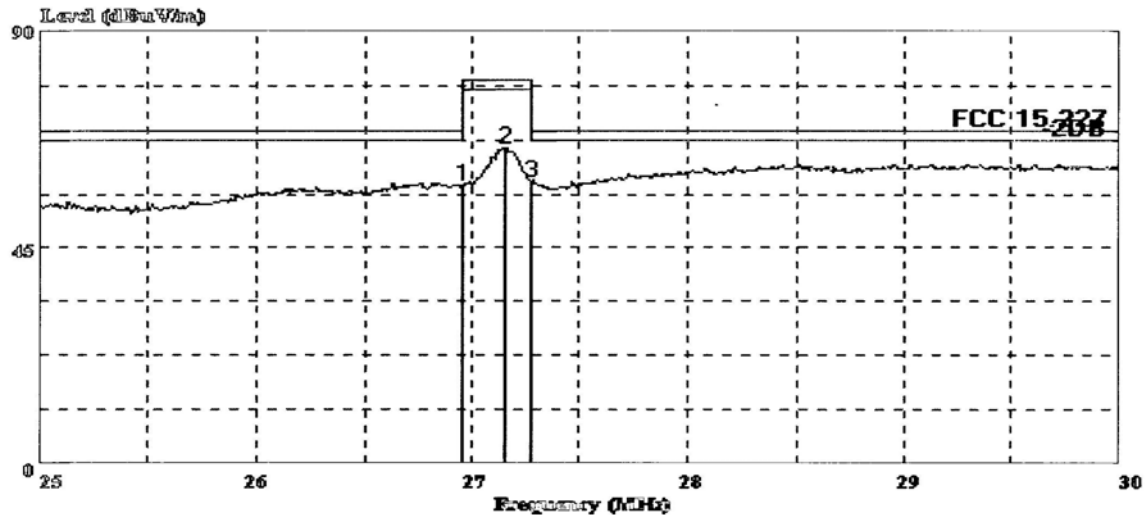
Temp/ RH : 23/50

## 6.3 Bandwidth requirement Mode : Operation frequency: 27.145 MHz, CH2



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Tel: 02-26465426  
Fax: 02-26466815

Data#: 6 File#: 02E2585.EMI Date: 2002-09-16 Time: 09:39:30



(SR02)

Trace: 5

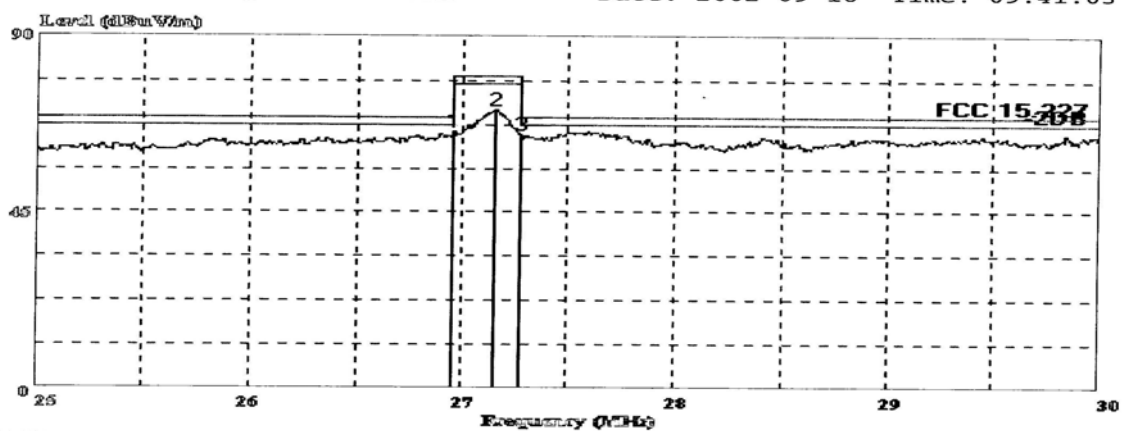
Ref Trace:

Condition: FCC 15.227 3m SR02 3M-LH HORIZONTAL  
Operator : James Chiu  
Project code: 02E2585  
E.U.T. : RF Mouse  
Model No. : RFMSW-15  
Test mode : CH2, RBW = 100KHz, VBW = 100KHz, Sweep=200ms  
Temp/ RH : 23/50



Neutron Engineering Inc.  
132-1, Lane 329, Sec. 2, Palian Rd.,  
Sjijr 221, Taipei, Taiwan, R.O.C.  
Tel: 02-26465426  
Fax: 02-26466815

Data#: 8 File#: 02E2585.EMI Date: 2002-09-16 Time: 09:41:03



(SR02)

Trace: 7

Ref Trace:

Condition: FCC 15.227 3m SR02 3M-LV VERTICAL  
Operator : James Chiu  
Project code: 02E2585  
E.U.T. : RF Mouse  
Model No. : RFMSW-15  
Test mode : CH2, RBW = 100KHz, VBW = 100KHz, Sweep=200ms  
Temp/ RH : 23/50

## **Attachment**

### **Photos of Tested EUT**

- |                      |                                    |
|----------------------|------------------------------------|
| <b>1. Photo # 1.</b> | <b>Front View Rear View</b>        |
| <b>2. Photo # 2.</b> | <b>Unit partially Disassembled</b> |
| <b>3. Photo # 3</b>  | <b>Unit partially Disassembled</b> |
| <b>4. Photo # 4</b>  | <b>Unit partially Disassembled</b> |

## **Attachment**

### **User's Manual**