

## MEASUREMENT/TECHNICAL REPORT

**APPLICANT:** FORWARD ELECTRONICS CO., LTD.

**MODEL NO.:** FDM-M31-H

FCC ID: F4Z4K3FDM-M31-H

This report concerns ( check one ) : **Original Grant** ✓  
**Class II Change**

**Equipment type:** RF Keyboard

Deferred grant requested per 47CFR 0.457(d)(1)(ii)?

Yes \_\_\_\_\_ No  If yes, defer until: \_\_\_\_\_ (date)

We, the undersigned, agree to notify the Commission by (date) \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ of the intended date of announcement of the product so that the grant can be issued on that date.

### Transition Rules Request per 15.37?

If no, assumed Part 15, Subpart B for unintentional radiator the new 47 CFR (10-1-90 Edition) provision.

## Report Prepared

by Testing House : Neutron Engineering Inc.

for Company :

Name FORWARD ELECTRONICS CO., LTD.

**Address** : 393 Chung Cheng Rd. Sec. 1 San-Hsia town, Taipei County Taiwan, 237, R.O.C.

**Applicant Signature :**

Jung - Chien Chang

(Jung-Chien Chang)/ R&D Manager

## 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 :** Yu Chien Lee**Reviewed by :** Vincent Su**Approved by :** George Yao**Issued Date :** Jan. 17, 2002**Report No. :** NEI-FCCB-01205**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 FORWARD ELECTRONICS CO., LTD. Model FDM-M31-H(referred to as the EUT in this report) The EUT is an short range, lower power, wireless mouse system designed as an "Input Device. It is designed by way of utilizing the FSK modulation achieves the system operating.

Details of technical specification for EUT, refer to the follows:

(1) Transmitter Frequency Designation

Operating Frequency Range : 27.045 MHz

Frequency Tolerance :  $\pm$  5 KHz @ center frequency.

(2) Power Rating

3V powered by either battery or Mouse Receiver.

(3) Operation Methodology

The mouse encoder generates a pulse code serially transmit (typical designation) into the modulator(or called as mixer) stage in circuit. This pulse signal mixed with the carrier at modulator(mixer) stage by way of FSK mode frequency modulation. The modulation depth is designed such as  $\pm$  5KHz in this application, that means the pulse(may be at high level state or low level state) will trigger the oscillator to generate a frequency at a specified fundamental frequency +5KHz or -5KHz, depended on the designation. For example, if the carrier frequency defined as fundamental frequency +5KHz at high level state, then the alternative carrier frequency will be fundamental frequency -5KHz at low level state.

Then the modulator(mixer) will output a modulated signal into RF amplifier stage and finally to the transmit antenna.

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

This submittal(s) (test report) is intended for FCC ID: F4Z4K3FDM-M31-H filing to comply with Section 15.227 of the FCC Part 15, Subpart C Rules. The composite system(receiver) 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.

The EUT was tested in 3 orthogonal planes and the “Laid on table” mode of the worst case was used for final testing and collecting test data included in this report.

#### 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 Limits**

Frequency Range (MHz)	Quasi-Peak
0.45 - 30	48

**(3) Radiated Emission Limits ( Field strength at 3m)**

- 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(Intentional Radiators general limit).as below.

Frequency (MHz)	Field strength mV/m	Distance(m)	Field strength at 3m dBmV/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  $\xi$  15.205
5. Emission spurious frequency which appearing within the Restricted Bands specified in provision of  $\xi$ 15.205, then the general radiated emission limits in  $\xi$  15.209 apply.

**3-5. Special Accessories**

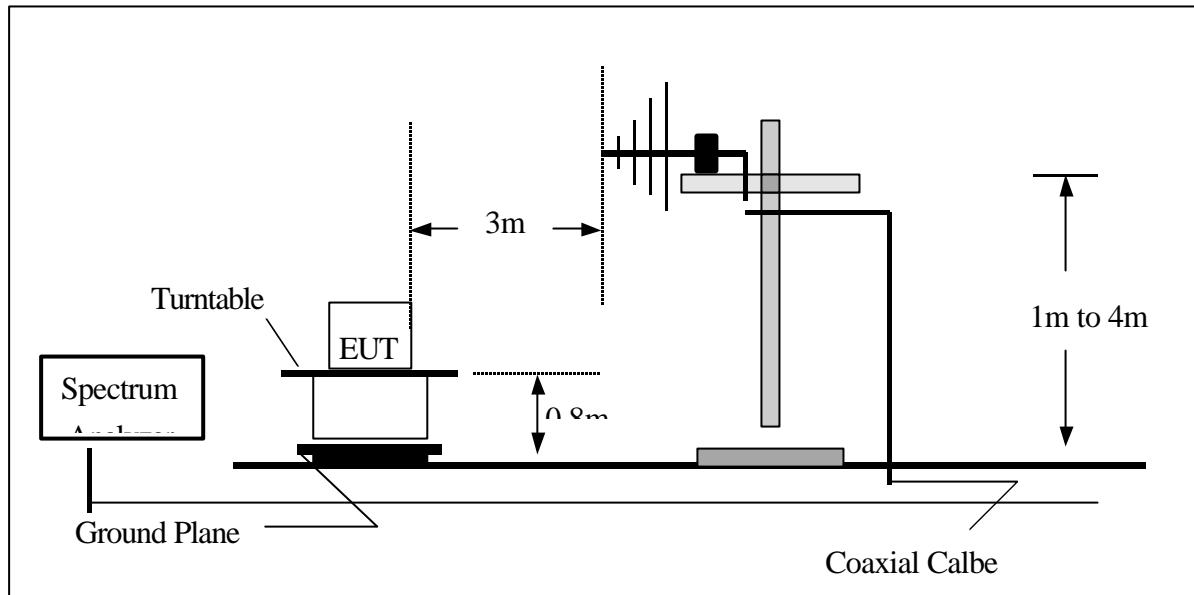
Not available for this EUT intended for grant.

**3-6. Equipment Modifications**

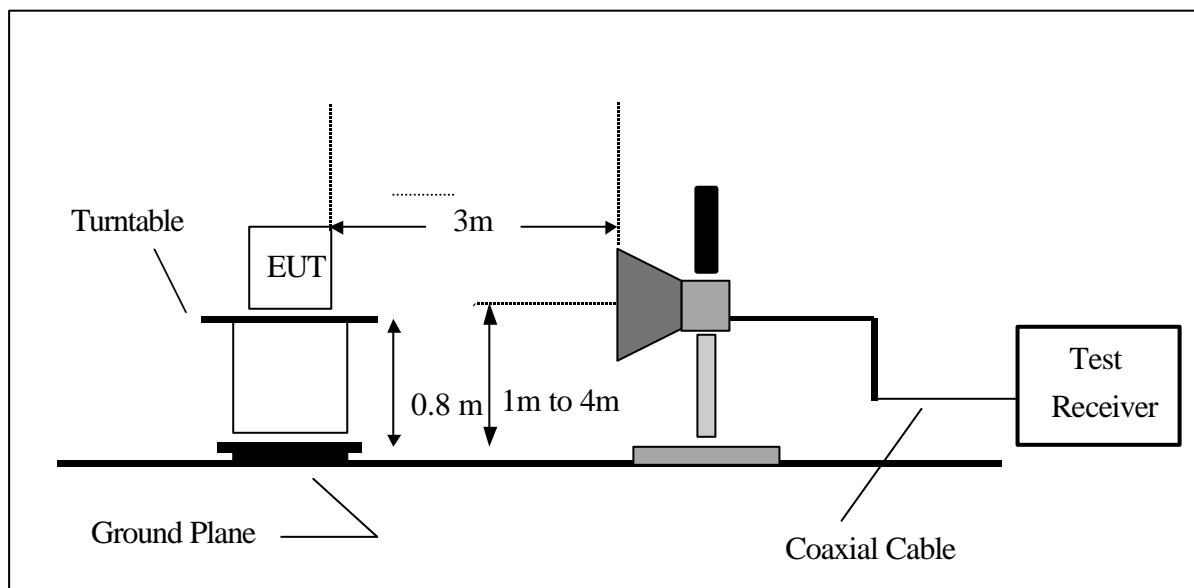
Not available for this EUT intended for grant.

**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 Configuration of Tested System

The configuration of tested system is described as the block diagram shown in next page Figure 3.1 and details information of I/O cable and power cord connection are tabulated as Table A and B. The monitor is powered from a floor mounted receptacle (referred to as the wall outlet in the previous described) was tested.

**TABLE A - Test Equipment**

Item	Equipment	Mfr/Brand	Model/Type No.	Port Connected	FCC ID	Series No.	Note
E-1	RF Mouse	Forward	FDM-M31-H			N/A	EUT
E-2	Monitor	Hitachi	CM753ET	VGA Port	DOC	T8L000003	
E-3	PC	IBM	444		DOC	AAD13M3	
E-4	Printer	SII	DPU-414	Com Port	DOC	1045105A	
E-5	Modem	ACEEX	DM-1414V	Com Port	DOC	8041708	
E-6	Keyboard	Forward	FDA-104GA	PS/2 Port	F42FDA-104G	FDKB8110136	
E-7	Mouse	HP	M-S34	PS/2 Port	DZL211029	C3751-60201	
E-8	Receiver	Forward	FDM-M31-R	USB Port	DOC	N/A	EUT

**Remark:**

- (1) Unless otherwise denoted as EUT in "Remark" column, device(s) used in tested system is a support equipment.
- (2) Unless otherwise marked as in "Remark" column, Neutron consigns the supporting equipment(s) to the tested system.
- (3) The support equipment was authorized by Declaration of Conformity.

**Table B. - Informations Cable Information**

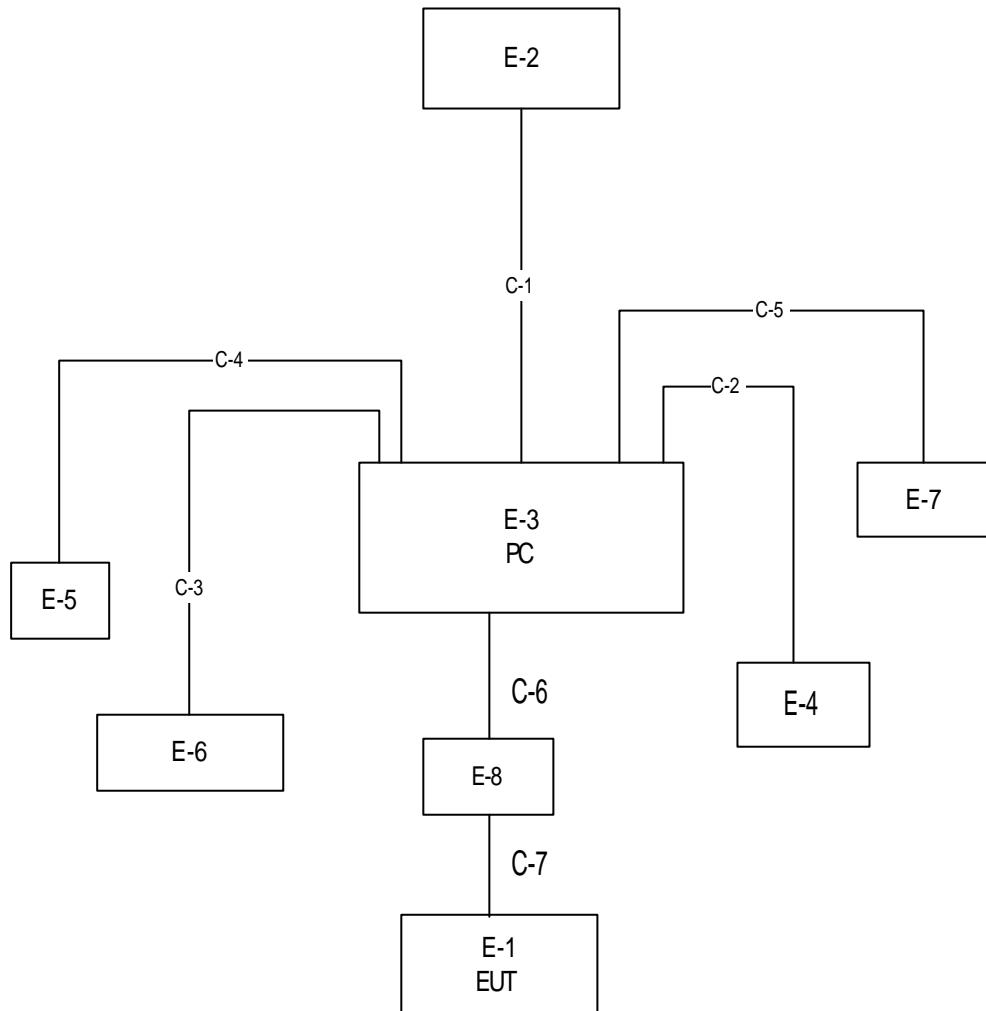
Item	I/O Cable	Device Connected	Shielded Type	Ferrite Core	Detachable/ Permanently	Length	Note
C-1	Video Cable	EUT-Monitor	Yes	No	Permanently attached on Monitor	150 cm	
C-2	Centronics Cable	PC-Printer	Yes	No	Part of Printer, Detachable	200 cm	
C-3	Keyboard Cable	PC-Keyboard	Yes	No	Permanently attached on KB	200 cm	
C-4	RS-232 Cable	PC-Modem	Yes	No	Part of Modem, Detachable	175 cm	
C-5	Mouse Cable	PC-Mouse	Yes	No	Permanently attached on Mouse	280cm	
C-6	USB Cable	PC-Receiver	Yes	No	Permanently attached on Receiver	200 cm	
C-7	DC Power Cable	Receiver-EUT	No	No	Detachable Part of Receiver	100cm	

**Note:**

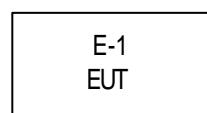
(1) Unless otherwise marked as in (Remark) column, Neutron consigns the supporting equipment(s) to the tested system.

**Figure 3.1 Configuration of Tested System**

Test mode : EUT powered by mouse receiver



Test mode : EUT powered by battery



## 3-9 Tested Equipments

Item	Instruments	Mfr/Brand	Model/Type No.	Serial No.	Calibrated Date	Next Cali. Date	Note
1	LISN	EMCO	3825/2	9605-2539	2001-06-22	2002-06-21	
2	LISN	Rolf Heine	NNB-2/16Z	98083	2001-10-20	2002-10-19	✓
3	LISN	Rolf Heine	NNB-2/16Z	98053	2001-11-22	2002-11-21	✓
4	Pulse Limiter	Electro-Metrics	EM-7600	112644	2001-02-09	2002-02-08	✓
5	50 Terminator	N/A	N/A	N/A	2001-05-21	2002-05-20	✓
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	2002-10-19	✓
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/-3	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	2001-09-24	2002-03-23	✓
16	RF Pre-Selector	HP	85685A	2648A00417	2001-09-24	2002-03-23	✓
17	Spectrum Analyzer	HP	85680B	2634A03025	2001-09-24	2002-03-23	✓
18	Spectrum Monitor	HP	85662B	2648A13616	2001-09-24	2002-03-23	✓
19	Pre-Amplifier	Anritsu	MH648A	M09961	2001-12-10	2002-12-09	✓
20	Spectrum Analyzer	ADVAN TEST	R3261C	81720298	2001-08-17	2002-08-16	
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	2002-08-19	
30	Signal Generator	HP	8648A	3426A01034	2000-02-10	2002-02-09	
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 this test report.  
 (2) N/A denotes No Brand measurement facility.

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

Figure 4.1 Block diagram of system, Page 10.A

**5. Conducted and Radiated Measurement Photos**

**5-1. Conducted Measurement Photos**



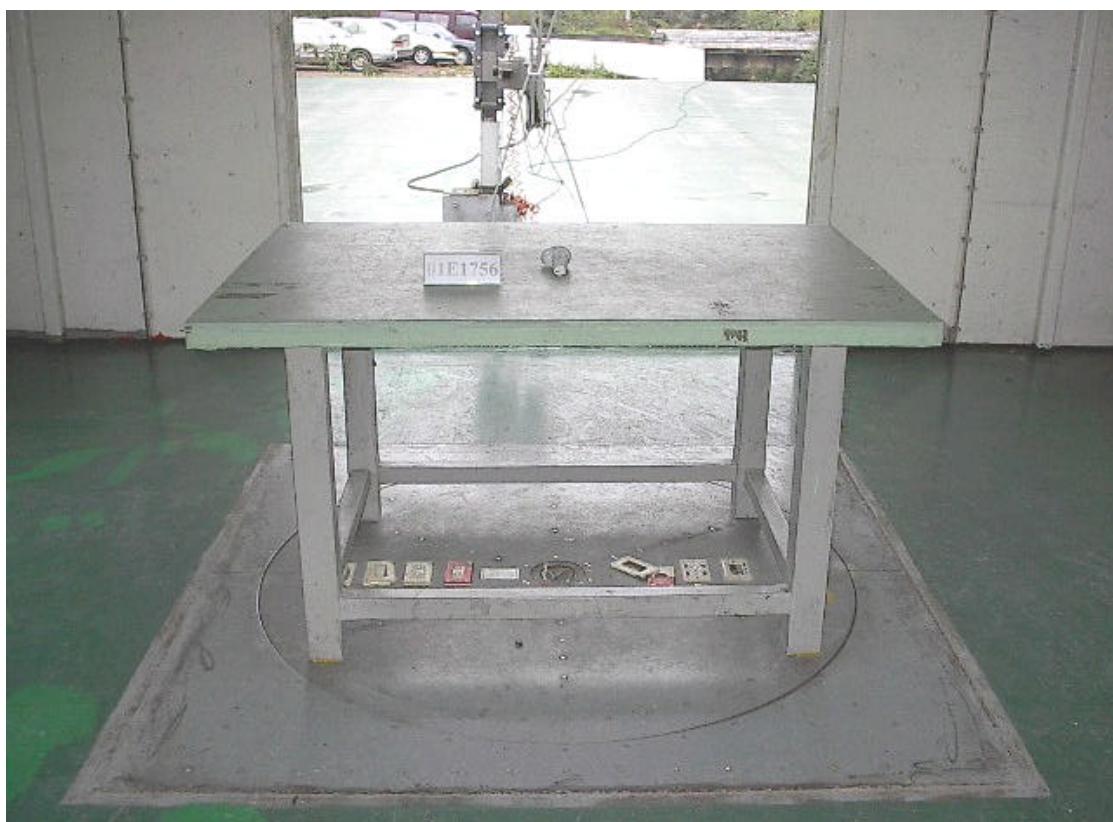
**5. Conducted and Radiated Measurement Photos**

**5-2. Radiated Measurement Photos**



## 5. Conducted and Radiated Measurement Photos

### 5-2. Radiated Measurement Photos



## 6. Conducted Emission Datas

**6.1** The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Judgement: Passed by **-1.80 dB** in mode of **Line** terminal **0.64 MHz**

Test Mode : Power by mouse receiver. (charge mode)

Freq. (MHz)	Terminal	Measured(dBuV)		Limits(dBuV)		Safe Margins (dBuV)	Note
		L/N	QP-Mode	QP-Mode	(dBuV)		
0.64	Line		46.20		48.00	-1.80	(QP)
0.91	Line		45.30		48.00	-2.70	(QP)
1.52	Line		37.43		48.00	-10.57	(QP)
12.58	Line		34.87		48.00	-13.13	(QP)
17.57	Line		35.64		48.00	-12.36	(QP)
0.64	Neutral		43.91		48.00	-4.09	(QP)
0.91	Neutral		45.20		48.00	-2.80	(QP)
1.12	Neutral		40.89		48.00	-7.11	(QP)
2.12	Neutral		38.23		48.00	-9.77	(QP)
7.06	Neutral		35.48		48.00	-12.52	(QP)

Remark :

- (1) Reading in which marked as QP means measurements by using are Quasi-Peak Mode with Detector BW=9KHz ; SPA setting in RBW=10KHz, VBW =10KHz, Swp. Time = 0.3 sec./MHz. Reading in which marked as AV means measurements by using are Average Mode detector.
- (2) All readings are QP Mode value unless otherwise stated AVG in column of Note. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits, a “ \* ” marked in AVG Mode column of Interference Voltage Measured.
- (3) Measuring frequency range from 150KHz to 30MHz.

Review: Vincent Liu Test Engr.: Eric Test Date : Dec. 17,2001

## 7. Radiated Emission Data

**7-1.** 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.

Test Mode : Power by mouse receiver.(charge mode)

Judgement : Passed by -16.63 DB at 81.023 MHz Ant.Pol.: Vertical  
Operation frequency 27.045MHz

Freq. (MHz)	Ant. Pol.	Detector Mode	Reading (dBuV)	Ant/CL/Amp.CF (dB)	Actual FS (dBuV/m)	Limit 3m (dBuV/m)	Safe Margin (dB)	Note
27.040	V	Peak	61.42	-15.46	45.96	80.00	-34.04	F
26.965	V	Peak	56.09	-15.53	40.56	69.50	-28.94	E
27.280	V	Peak	31.83	-15.46	16.37	69.50	-53.13	E
54.200	V	Peak	36.42	-15.40	21.02	40.00	-18.98	H
81.023	V	Peak	38.20	-14.83	23.37	40.00	-16.63	H
135.10	V	Peak	34.85	-9.90	24.95	43.50	-18.55	H
162.32	V	Peak	34.52	-9.78	24.74	43.50	-18.76	H
190.00	V	Peak	35.57	-12.65	22.92	46.00	-23.08	H
27.040	H	Peak	59.73	-15.46	44.27	80.00	-35.73	F
26.965	H	Peak	57.64	-15.53	42.11	69.50	-27.39	E
27.280	H	Peak	29.12	-15.46	13.66	69.50	-55.48	E
54.091	H	Peak	37.47	-15.40	22.07	40.00	-17.93	H
81.322	H	Peak	38.15	-14.86	23.29	40.00	-16.71	H
135.32	H	Peak	35.07	-11.66	23.41	43.50	-20.09	H
162.43	H	Peak	33.87	-9.78	24.09	43.50	-19.41	H
189.45	H	Peak	36.87	-12.69	24.18	46.00	-21.82	H

Remark :

- (1) Measuring frequencies from 25 MHz to 1GHz.
- (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) "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 15.209 apply.
- (6) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (7) The SPA setting of IF bandwidth between 25MHz to 30MHz was 10KHz, 30MHz to 1GHz was 100KHz.

Review: Vincent Liu Test Engr.: Eric Test Date : Jan. 24 2002

## 7. Radiated Emission Data

**7-1.** 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.

Test Mode : Power by battery.

Judgement : Passed by -20.27 DB at 81.883 MHz Ant.Pol.: Vertical  
Operation frequency 27.045MHz

Freq. (MHz)	Ant. Pol.	Detector Mode	Reading (dBuV)	Ant/CL/Amp.CF (dB)	Actual FS (dBuV/m)	Limit 3m (dBuV/m)	Safe Margin (dB)	Note
27.040	V	Peak	59.81	-15.46	44.35	80.00	-35.65	F
26.965	V	Peak	54.14	-15.53	38.61	69.50	-30.89	E
27.280	V	Peak	29.30	-15.46	13.84	69.50	-55.66	E
81.883	V	Peak	34.65	-14.92	19.73	40.00	-20.27	H
135.25	V	Peak	31.20	-9.93	21.27	43.50	-22.23	H
189.28	V	Peak	30.87	-12.69	18.18	43.50	-25.32	H
216.20	V	Peak	30.12	-12.13	17.99	46.00	-26.01	H
270.30	V	Peak	33.35	-9.97	23.38	46.00	-22.62	H
27.040	H	Peak	57.98	-15.46	42.52	80.00	-37.48	F
26.965	H	Peak	52.57	-15.53	37.04	69.50	-32.46	E
27.280	H	Peak	27.67	-15.46	11.21	69.50	-58.29	E
54.800	H	Peak	31.80	-13.09	18.71	40.00	-21.29	H
81.700	H	Peak	34.47	-14.87	19.60	40.00	-20.40	H
135.70	H	Peak	30.12	-11.66	18.46	43.50	-25.04	H
162.40	H	Peak	26.85	-9.78	17.07	43.50	-26.43	H
216.60	H	Peak	27.32	-12.26	15.06	46.00	-30.94	H

Remark :

- (1) Measuring frequencies from 25 MHz to 1GHz.
- (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) "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 15.209 apply.
- (6) Data of spurious emissions frequency weren't attached that were less than 20dB from the limit.
- (7) The SPA setting of IF bandwidth between 25MHz to 30MHz was 10KHz, 30MHz to 1GHz was 100KHz.

## 7-2. 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:

$$\mathbf{FS = RA + AF + CL - AG}$$

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

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

as shown in the data tables' Correction Factor column.

2. The Field Strength will be calculated by

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

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:

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

## Attachment

### Photos of Tested EUT

1. Photo # 1.      Front View / Rear View
2. Photo # 2.      Unit partially Disassembled
3. Photo # 3      Unit partially Disassembled
4. Photo # 4      Unit partially Disassembled
5. Photo # 5      Unit partially Disassembled

# **Attachment**

## **User's Manual**