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FCC MEASUREMENT REPORT

Scope – Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

Applicant Name : RF TECH CO., LTD

Address : 3F DuckWoo B/D, 69-4 Munjeong-Dong, Songpa-Gu, Seoul, Korea
Attention : Jong – Bae, Kim / Production Manager

EUT Type	**: Numeric Radio Paging Receiver**
Model Name	**: RFTECH**
Model No.	**: RFN – 350**
FCC ID	**: QERRFN-350**
Trade Name	**: RF TECH CO., LTD**
Freq. Range	**: 929MHz – 931MHz**
Bit Rate	**: 1200/2400bps**
Channel Spacing	**: 25KHz**
FCC Rule Part(s)	**: FCC Part 15**
FCC Procedure	**: Certification**
Dates of Tests	**: July 18 ~ 20, 2000**
Place of Tests	**: E-Rae Testing Lab.**
Test Report No.	**: ETL.T15.200718022.RFT**

1. Introduction

The measurement test for radiated and conducted emission test were conducted at the open area Test site of E-RAE Testing Laboratiry Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyoungki-do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-1992 and CISPR Publication 22. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission(Registration Number : 95422).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-1992) was used in determining radiated and conducted emissions from the **RF TECH CO., LTD. Model : RFN-350 Numeric Paging Receiver.**

ETL Site Location

E-RAE Testing Laboratory Inc.
584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyoungki-do, 469-880. Korea
ETL has site descriptions on file with the FCC for 3 and 10 meter site configurations.

2. Product Information

2.1 Equipment Description

The Equipment Under Test(EUT) is the Numeric Paging Receiver Model : RFN-350 of the RF Tech Co., Ltd.

- **Freq. Range : 929 MHz ~ 931 MHz**
- **Channel Spacing : 25 kHz**
- **Crystal/ Oscillator(s) : Logic 76.8 kHz, RF 21.4 MHz**
- **Main Chipset : AR 5010-7502 / AR 5010-7503**
- **Bit Rate : 1200/ 2400 bps**
- **Antenna : Loop**
- **Power supply 1.5V AAA Size**
- **Dimension(HxWxT) : 60 X 40 X 15 mm**
- **Weight : 27g**

2.2 EMI Suppression Device(s)

EMI suppression device(s) installed in production :

EMI suppression device(s) added and/or modified during testing : None

3. Description of Radiated Emissions Test

Preliminary measurements were made at indoors 3 meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME.
Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 200MHz using biconical antenna and from 200 to 1000MHz using log-periodic antenna. Above 1GHz, linearly polarized double ridge horn antennas were used.

Final measurements were made outdoors at 3-meter test range using Schwarzbeck Precision Dipole antennas or horn antenna. The test equipment was placed on a wooden and plastic bench on a 1.5 X 2 meter area adjacent to the measurement area. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was reexamined and investigated using Rohde & Schwarz EMI field strength meter. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 100kHz or 1MHz depending on the frequency or type of signal.

The half-wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The EUT , support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1 X 1.5 meter table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.
Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment; powering the monitor from the floor mounted outlet box and the computer aux AC outlet if applicable, and changing the polarity of the antenna; whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Attachment H. Each EME reported was calibrated using the HP8640B signal generator.

4. Frequency Measurements

The following table shows the highest levels of Radiated Emissions on both polarization of horizontal and vertical.

Humidity & Temperature : 56 % , 26 •
Limit apply to : FCC CFR 47, Part 15, Subpart B
Date : July 13, 2000
EUT : Numeric Paging Receiver RFN-350
Operating Condition : Stand by
Result : Passed by –14.4 dB

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Radiated Emissions

Freq. (MHz)	Level (dBm)	AFCL (dB)	POL (H/V)	Height (m)	Azimuth (angle)	F/S (μV/m)	MARGIN (dB)
76.1	-101.4	10.81	H	2.0•	10•	16.41•	-15.7
151.7	-102.1	15.06	H	2.0	350	19.96	-17.5
227.7	-98.5	12.88•	H	2.3	350	21.38	-19.4
303.1	-97.6	16.15	H	1.7	270	25.55	-17.9
605.7	-99.0	24.16	H	1.5	180	32.16	-15.9
832.6	-98.5	27.60	H	1.2	10	36.10	-14.8
909.0	-97.5	28.71	H	1.2	10	38.21	-14.4

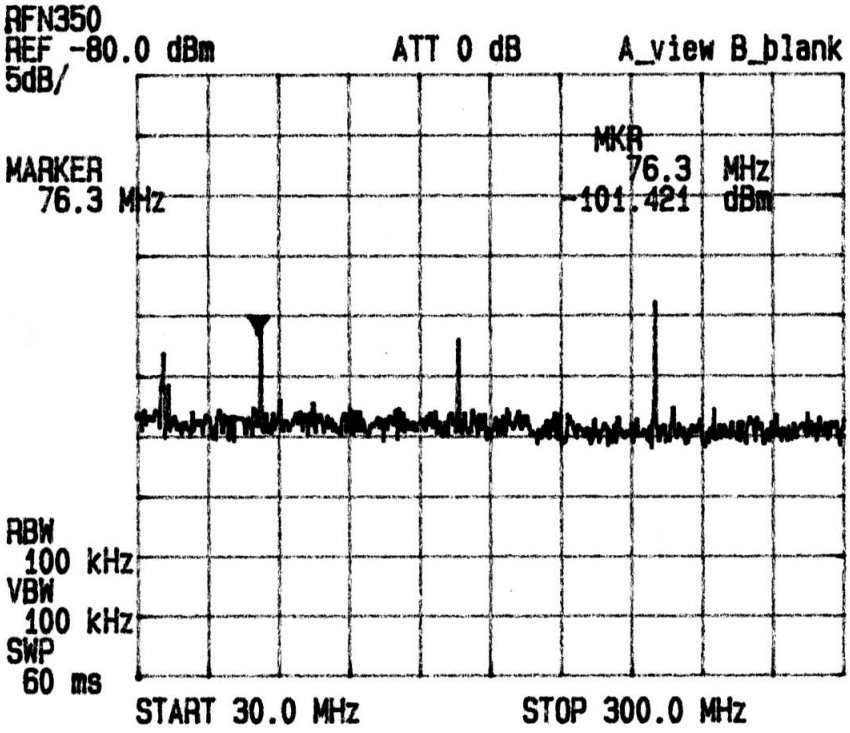
Table 1. Radiated Measurements at 3-meters

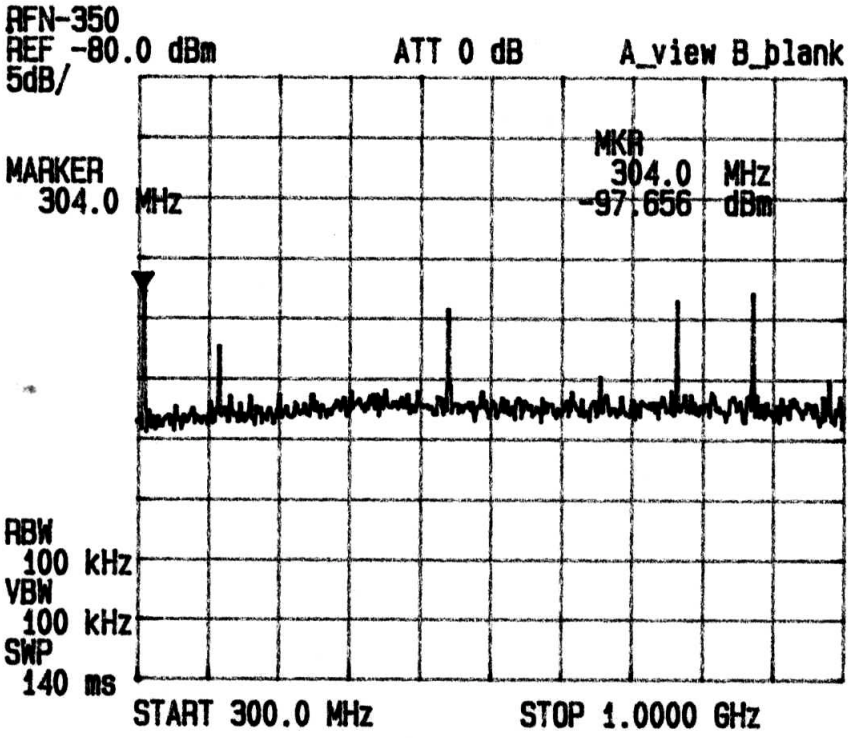
Notes :

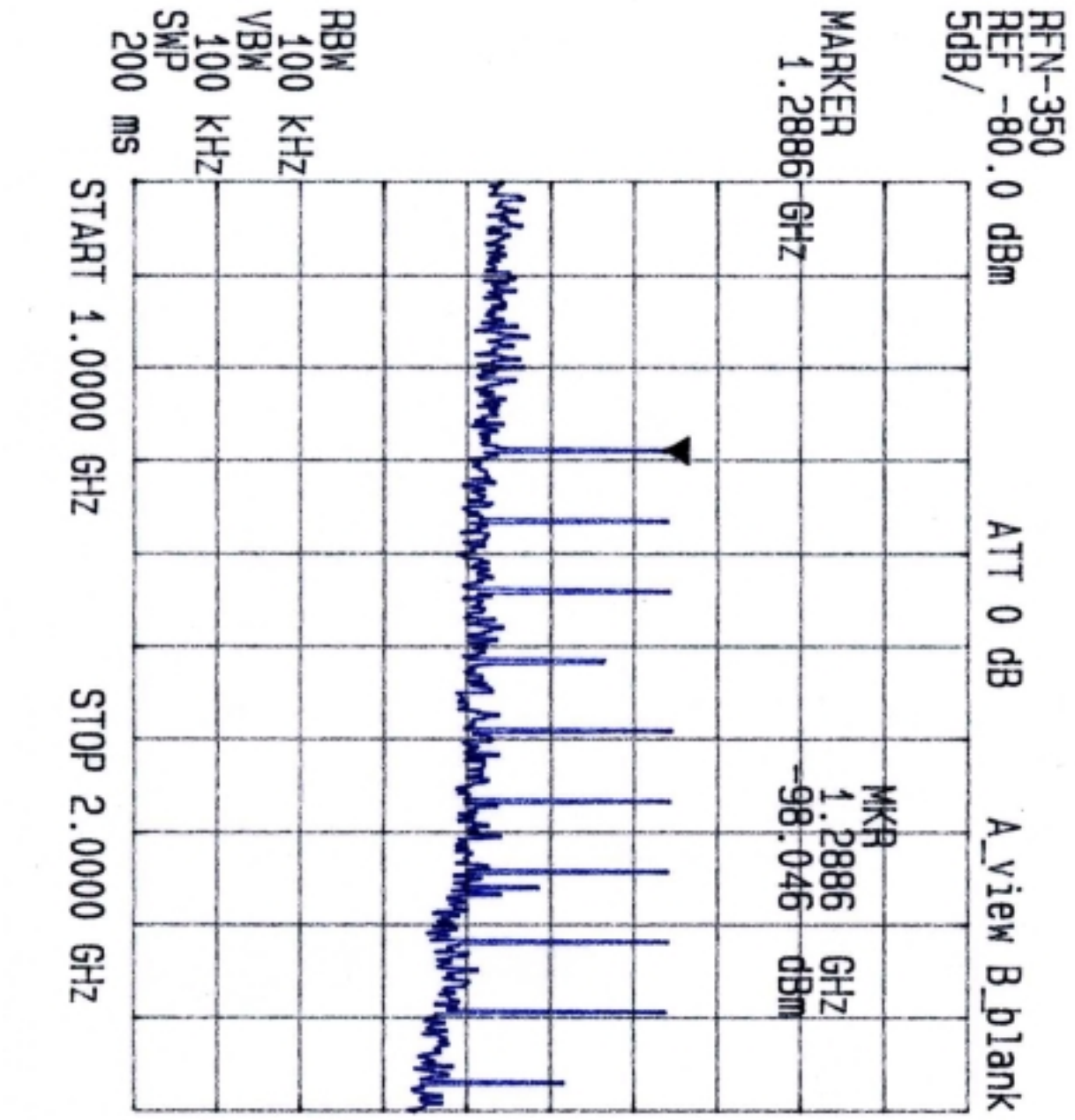
1. The antenna is manipulated through typical positions and/or three orthogonal position during the tests.
2. The emissions are maximixed by changing polarity of the antenna.
3. The EUT is supplied with a new/fully changed battery.
4. AFCL : Antenna Factor (Pipole) + Cable loss
5. HA : Horn Antenna, used above 1GHz
   Limit 54.0dBuV above 1GHz

5. Plot(s) of Emissions

Note : Radiated Emission (Antenna Conducted)
There are no significant emissions found in antenna power conducted measurements. All emissions were below 2n W (see plot). The EUT was tested up to 2GHz.


RFN350
REF -80.0 dBm
ATT 0 dB
A_view B_blank
5dB/
MKR
76.3 MHz
-101.421 dBm
MARKER
76.3 MHz
RBW
100 kHz
VBW
100 kHz
SWP
60 ms
START 30.0 MHz
STOP 300.0 MHz


RFN-350
REF -80.0 dBm
ATT 0 dB
A_view B_blank
5dB/
MKR
304.0 MHz
-97.656 dBm
MARKER
304.0 MHz
RBW
100 kHz
VBW
100 kHz
SWP
140 ms
START 300.0 MHz
STOP 1.0000 GHz



6. Conducted Emission Test Data

Not applicable , The EUT is a battery operated device.

7. Sample Calculations

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.

The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor

$dB(\mu V/m) = 20 \log_{10} (\mu V/m)$: Equation 1
$dB\mu V$ = dBm + 107 : Equation 2

Level $\mu V/m \cong$ 3meters = Log 10^{-1}(dBm + 107 + AFCL) / 20
If signal generator level is –14 dBm, then the field strength is calculated as follows,
Log 10^{-1}(-14 + 107 + 31.7) / 20 = 1717908.4 $\mu V/m \cong$ 3meters

For margin calculation, use the Equation 2
$dB(\mu V/m) = 20 \log_{10} (\mu V/m)$

8. List of Test Equipment

Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
Spectrum Analyzer	R3261A	Advantest	21720033	99-10-08
Receiver	ESVS 10	R & S	835165/001	00-04-06
Spectrum Analyzer		H.P	US37360920	99-10-20
LISN	3825/2	EMCO	9208-1995	00-07-12
LISN	3825/2	EMCO	9006-1669	
TriLog Antenna	VULB9160	Schwarz Beck	3082	00-05-08
LogBicon	VULB9165	Schwarz Beck	2023	00-05-08
Dipole Antenna	VHAP	Schwarz Beck	964	00-05-03
Dipole Antenna	VHAP	Schwarz Beck	965	00-05-03
Dipole Antenna	UHAP	Schwarz Beck	949	00-05-03
Dipole Antenna	UHAP	Schwarz Beck	950	00-05-03
Diploe Antenna	CC2762	Schaffner Chase	1277	00-04-11
Dipole Antenna	UHA9105	Schwarz Beck	9105 2168	00-04-11
Double Ridged Horn	3115	EMCO	9809-2334	00-09-20
Turn-Table	DETT-03	Daeil EMC	-	N/A
Antenna Master	DEAM-03	Daeil EMC	-	N/A
Plotter	7440A	H.P	2725A 75722	N/A
Chamber	DTEC01	•••••	-	N/A
Thermo Hygrograph	3-3122	ISUZU	3312201	99-12-20
BaroMeter	-	Regulus		
ESD,Surge,Burst Generator	Best Plus 1/5.5	Schaffner	SC3697-012	00-05-02
Filcker Meter	CCN1000-1	Schaffner	X71804	00-05-02
AC Power Source	NSG 10078-3-240	Schaffner	HK53644	00-05-02
Signal Generator	2025	IFR	202301/933	99-11-01
Function Generator	33120A	Agilent	US36042014	00-01-07

Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
Amplifier	AR75A250	Amplifier research	27568	00-02-03
Amplifier	AR75A250	Amplifier research	27568	00-02-03
Amplifier	GRF5066	Ophir	1011	00-01-25
Field Monitoring Controller	SI-300	EMC Automation	20700	N/A
Field Probe	HI-6005	Holaday	102119	00-03-16
Switch Module	RSM-02	EMC Automation	20002	00-03-16
Power Meter	4232A	Boonton	4001	00-04-11
Power Sensor	51011	Boonton	31619	00-04-11
Power Sensor	51011	Boonton	31620	00-04-11
Dual Directional Coupler	C5571		7860	00-01-26
Dual Directional Coupler	C3653		7825	00-01-26
CDN	FCC-801-M1-25A	FCC	2005	00-02-11
CDN	FCC-801-M2-25A	FCC	2011	00-02-11
CDN	FCC-801-M3-25A	FCC	2018	00-02-11
EM Inection Clamp	FCC-2031-32mm	FCC	410	00-02-11
Decoupling Clamp	FCC-2031-32mm-DCN	FCC	248	00-02-11
EM Clamp Cal. Fixture	FCC-2031-32mm-CF	FCC	287	00-02-15
Attenuator (6dB, 25W)	33-6-34	Weinschel	BH4542	99-09-15
Attenuator (6dB, 25W)	33-6-34	Weinschel	BH4546	99-09-15
Attenuator (20dB, 25W)	33-20-34	Weinschel	BH3583	99-08-06
Attenuator (20dB, 25W)	33-20-34	Weinschel	BH5997	99-08-06
Attenuator (30dB, 25W)	33-30-34	Weinschel	BG9477	
Attenuator (30B, 25W)	33-30-34	Weinschel	BG9487	

9. Conclusion

The data collected shows that the RF Tech Co., Ltd. Numeric Paging Receiver Model : RFN-350 complies with the FCC Rule Section 15.