

佳和集團

怡安科技

CHIA HEIR GROUP

RF-LINK SYSTEMS INC.

FCC ID.: MIBRF60102

EXHIBIT 3

Test Report With Eut Photograph

FCC ID: MIBRF60102

RF-Link System Inc. / Wireless RS232, Model RF-60102-XX ,

QTK99-F002A: 2.4 GHz Spread Spectrum Transceiver

QTK99-F002B: Class B Computing Device Peripheral

**FCC Test Report
Application for Certification**

On Behalf Of

RF-Link Systems Inc.

Wireless RS232

Model # : RF 60102-xx

FCC ID : MIBRF60102

Prepared For:

RF-Link Systems Inc.

**1F, No.9, Chan Yeh Road 1, Science-Based
Industrial Park, HsinChu, Taiwan, R.O.C.**

**Report By : QuieTek Corporation
No.75-1, Wang-Yeh Valley, Yung-Hsing
Tsuen, Chiung-Lin, Hsin-Chu County,
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Tel : (03) 592-8858
Fax : (03) 592-8859**

The test results are traceable to the national or international standards
Test results given in this report only relate to the specimen(s) tested or measured.
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This report must not be used to claim product endorsement by NVLAP any agency of the U.S. Government

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1. Test Report Certification

QTK99-F002A/B

Applicant : RF-Link Systems Inc.

EUT Description *SPREAD SPECTRUM TRANSCEIVER & CLASS B COMPUTING DEVICE PERIPHERAL*

(1) Model Name : Wireless RS232

(2) Model No. : RF 60102-xx

(3) Serial Number : N/A

(4) FCC ID. : MIBRF60102

(5) Power Supply : 120V/60Hz AC

MEASUREMENT STANDARD USED :

CFR 47, Part 15 Radio Frequency Device Subpart C Paragraph 15.247

CFR 47, Part 15 Radio Frequency Device Subpart B Unintentional Radiators Class B :1996

MEASUREMENT PROCEDURE USED :

ANSI C63.4 Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9kHz to 40GHz. :1992

The device described above was tested by QuiTek Corporation to determine the maximum emission levels emanating from the device. The maximum emission levels were compared to the FCC Part 15 limits for various standard requirements.

The measurement results are contained in this test report and QuiTek Corporation is assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT to be technically compliant with the FCC Part 15 limits.

And there are no deviation from the above measurement process.

Sample Received Date : December 10, 1998

Test Date : December 29, 1998

Documented by : Kathy Lee

NVLAP[®]

Test Engineer:

Approve & Authorized Signer:

Neil Huang
Neil Huang

Gene Chang
Gene Chang

FCC ID: MIBRF60102
RF-Link System Inc. / Wireless RS232, Model RF-60102-XX
QTK99-F002A: 2.4 GHz Spread Spectrum Transceiver
QTK99-F002B: Class B Computing Device Peripheral

2. General Information

QTK99-F002

2.1 Production Description

Description : Wireless RS232
Model Number : RF 60102-xx
Serial Number : N/A
FCC ID. : MIBRF60102
Applicant : RF-Link Systems Inc.
Address : 1F, No.9, Chan Yeh Road 1, Science-Based
Industrial Park, HsinChu, Taiwan, R.O.C.
Manufacturer : RF-Link Systems Inc.
Address : 1F, No.9, Chan Yeh Road 1, Science-Based
Industrial Park, HsinChu, Taiwan, R.O.C.
Frequency Range : 2400 MHz to 2483.5 Mhz
Channel Number : 15
Tx Frequency of each Channel : 2406.40, 2411.52, 2416.64, 2421.76, 2426.88, 2432.00,
2437.12, 2442.24, 2447.36, 2452.48, 2457.60, 2462.72,
2467.84, 2472.96, 2478.08
Rx Frequency of each Channel : 2267.392, 2275.512, 2277.632, 2282.752, 2287.872,
2292.992, 2298.112, 2303.232, 2308.352, 2313.472,
2318.592, 2323.712, 2328.832, 2333.952, 2339.072
Type of Modulation : Direct Sequence Spread Spectrum
Operator Selection of : Configuration Channel from User's Application Software
Operating Frequency
Type of Antenna : Patch Antenna
Data Cable : Shielded, Detachable, 1.2m
Power Cord : Shielded, Detachable, 1.5m

Mode Difference :

- (1) Mode 1 : Channel 1 (Frequency : 2406.40 Mhz for Tx, 2267.392 Mhz for Rx)
- (2) Mode 2 : Channel 8 (Frequency : 2442.24 Mhz for Tx, 2303.232 Mhz for Rx)
- (3) Mode 3 : Channel 15 (Frequency : 2478.08 Mhz for Tx, 2339.072 Mhz for Rx)

Note: 1. The data show in this test report reflects the worst-case data for each operation mode.
2. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.247 for non-spread spectrum devices.

2.2 Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

☒ Host Personal Computer

Model Number : PIIL97
Manufacturer : ASUS
Serial Number : AS10228
FCC ID : DoC
Power Cord : Non-shielded, Detachable, 1.8m

☒ Keyboard

Model Number : 6311-TW2C
Serial Number : N/A
FCC ID : DoC
Manufacturer : ACER
Data Cable : Shielded, Non-detachable, 1.8m

☒ Monitor

Model Number : CM752ET-311
Serial Number : T8F006364
FCC ID : DoC
Manufacturer : HITACHI
Data Cable : Shielded, Non-Detachable 1.5m
Power Cord : Shielded, Detachable 1.8m

☒ Printer

Model Number : C2642A
Serial Number : MY75J1D1D0
FCC ID : B94C2642X
Manufacturer : HP
Data Cable : Shielded, Detachable, 1.2m
Power Adapter : NMB, M/N: C2175A
Cable for AC IN: Unshielded, Non-detachable, 0.7m
Cable for AC Out: Unshielded, Non-detachable, 1.5m

☒ Modem

Model Number : 1414
Serial Number : 980033038
FCC ID : IFAXDM1414
Manufacturer : ACEEX
Data Cable : Shielded, Detachable, 1.5m
Power Adapter : ACCEX, M/N: SCP41-91000A
Cable Output : Shielded, Non-detachable, 1.5m

☒ Mouse

Model Number : M-S34
Serial Number : LZB75078428
FCC ID : DZL211029
Manufacturer : HP
Data Cable : Shielded, Non-detachable, 1.8m

☒ Wireless RS232 (EUT)

Model Number : RF60102-xx
Serial Number : N/A
FCC ID : MIBRF60102
Manufacturer : RF-Link Systems Inc.
Data Cable : Shielded, Detachable, 1.2m *WITH ONE BONDED FERRITE CORE*
Power Cord : Shielded, Detachable, 1.5m

9V DC POWER ADAPTOR WITH DC CABLE WITH ONE BONDED FERRITE CORE.

2.3

Test Methodology

FCC part 15 Subpart C Paragraph 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5875 MHz

The fundamental, harmonics and general radiated emissions testing were performed according to the procedures in ANSI C63.4-1992.

Radiated testing was performed at an antenna to EUT distance of 3 meters.

2.4 Test Facility

Site Description : November 3, 1998 File on
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046
Reference 31040/SIT1300F2

NVLAP Lab Code: 200347-0
United States Department of commerce
National Institute of Standards and Technology
National Voluntary Laboratory Accreditation Program

Name of firm : QuieTek Corporation

Site location : No.75-1, Wang-Yeh Valley, Yung-Hsing Tsuen,
Chiung-Lin, Hsin-Chu County, Taiwan, R.O.C.

3. Summarization of Test Results

The test results were performed according to the requirements of measurement standard and process. QuieTek Corporation is assumed full responsibility for the accuracy and completeness of these measurements. The summarization of the worst value is described as below:

Name of Test	Para. No.	Spec.	Meas.	Result
The Powerline Conducted Emission	15.207(a)	48dBuV	Test Data	Pass
The Occupied Bandwidth	15.247(a)(2)	$\geq 500\text{KHz}$	1.6MHz	Pass
Peak Power Output	15.247(b)	1 Watt	12.39dBm	Pass
Spurious Emissions (Band Edge Antenna Radiated)	15.247(c)	-20dBc	Chart	Pass
Spurious Emissions(radiated)	15.247(c)	Table 15.209(a)	Test Data	Pass
Transmitter Power Density	15.247(d)	$\leq +8\text{dBm}$	1.05dBm	Pass
Processing Gain	15.247(e)	$\geq 10\text{ dB}$	Cust. Data	Pass

4. Conducted Power Line Test

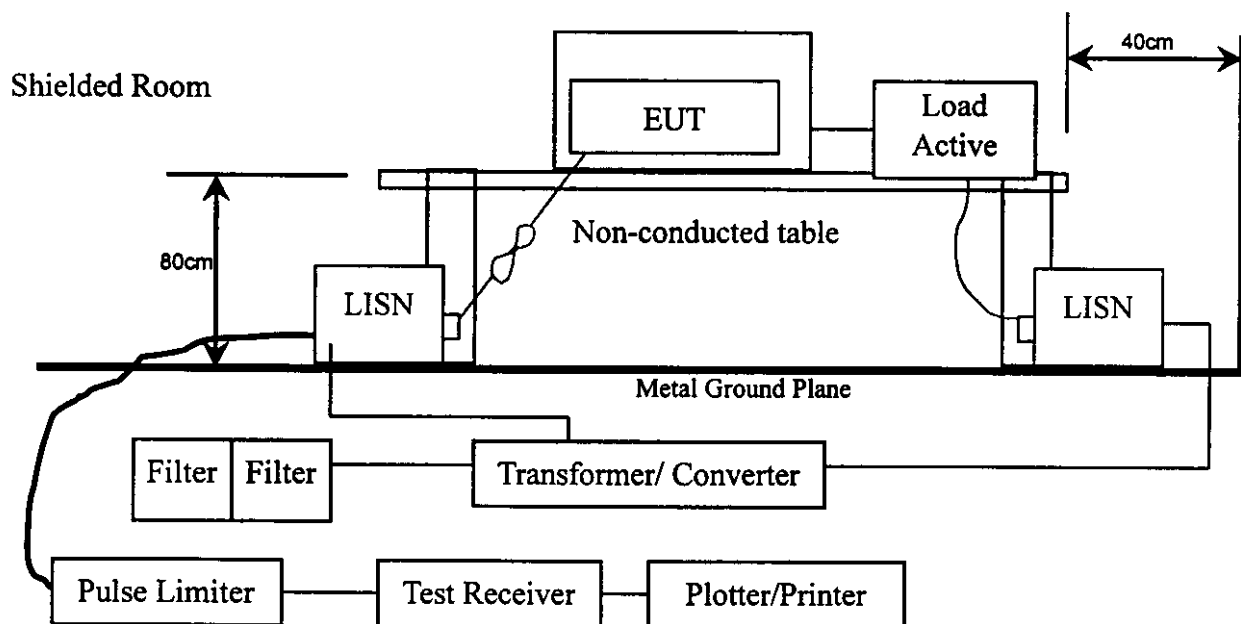
4.1 Test Equipments

The following test equipments are used during the conducted power line tests:

Item	Instrument	Manufacturer	Type No./Serial No	Last Cal..	Remark
1	Test Receiver	R & S	ESCS 30/825442/17	May, 1998	
2	L.I.S.N.	R & S	ESH3-Z5/825016/6	May, 1998	EUT
3	L.I.S.N.	Kyoritsu	KNW-407/8-1420-3	May, 1998	Peripherals
4	Pulse Limiter	R & S	ESH3-Z2	N/A	
5	N0.2 Shielded Room			N/A	

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

4.2 Block Diagram of Test Setup



4.3 Conducted Powerline Emission Limit

➤ 15.207(a) Limits

Frequency	Maximum RF Line Voltage	
	uV	dBuV
0.45 – 30	250	48.0

Remarks : In the Above Table, the tighter limit applies at the band edges.

4.4 EUT Configuration on Measurement

The equipments which is listed 3.2 are installed on Conducted Power Line Test to meet the Commission requirement and operating in a manner which tends to maximize its emission characteristics in a normal application.

4.5 EUT Exercise Software

The EUT exercise program used during conducted testing was designed to exercise the EUT in a manner similar to a typical use. The exercise sequence is listed as below:

- 3.5.1 Setup the EUT and simulators as shown on 3.2
- 3.5.2 Turn on the power of all equipment.
- 3.5.3 Personal Computer reads data from disk.
- 3.5.4 Personal computer sends "H" pattern to printer, the printer will print "H" pattern on paper.
- 3.5.5 Personal computer reads and writes data into and from modem.
- 3.5.6 Personal computer will read data from floppy disk and then writes the data into floppy disk , same operation for hard disk.
- 3.5.6 The EUT will stand by for waiting to receive or transmit the fundamental frequency with data signal.
- 3.5.7 Repeat the above procedure 3.5.4 to 3.5.6

4.6 Test Procedure

The EUT is connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipments and all of the interface cables must be changed according to ANSI C63.4-1992 on conducted measurement.

The bandwidth of the field strength meter (R & S Test Receiver ESCS 30) is set at 10Khz.

The frequency range from 0.45 MHz to 30 MHz is checked.

4.7 Conducted Emission Data

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range for all the test modes. Then the worst modes were reported the following data pages.

The uncertainty is calculated in accordance with NAMAS NIS 81. The total uncertainty for this test is as follows:

- Uncertainty in the field strength measured: $< \pm 2.0$ dB

CONDUCTED EMISSION DATA

Date of Test	: Dec. 29, 1998	Temperature	: 25 °C
EUT	: Wireless RS232	Humidity	: 61 %
Test Mode	: Mode 1	Display Pattern	: H Pattern
Detector Mode	: Quasi-Peak		

Frequency	Cable	LISN	Reading Level	Measurement Level	Limits
MHz	Loss	Factor	Line1	Line1	
	dB	dB	dBuV	dBuV	uV
0.516	0.07	0.10	31.60	31.77	38.7 250.0
0.579	0.07	0.10	30.50	30.67	34.2 250.0
0.622	0.07	0.10	29.80	29.97	31.5 250.0
0.668	0.08	0.10	29.00	29.18	28.8 250.0
0.731	0.08	0.10	28.10	28.28	26.0 250.0
0.776	0.09	0.10	28.02	28.21	25.7 250.0

Remarks : " * " means that this data is the worse emission level.

CONDUCTED EMISSION DATA

Date of Test	:	Dec. 29, 1998	Temperature	:	25 °C
EUT	:	Wireless RS232	Humidity	:	61 %
Test Mode	:	Mode 1	Display Pattern	:	H Pattern
Detector Mode	:	Quasi-Peak			

Frequency	Cable	LISN	Reading Level	Measurement Level	Limits	
	Loss	Factor	Line2	Line2		
MHz	dB	dB	dBuV	dBuV	uV	uV
0.505	0.06	0.10	31.91	32.07	40.2	250.0
0.524	0.07	0.10	31.33	31.50	37.6	250.0
0.559	0.07	0.10	30.63	30.80	34.7	250.0
0.630	0.08	0.10	29.59	29.77	30.8	250.0
0.680	0.08	0.10	28.89	29.07	28.4	250.0
0.751	0.08	0.10	27.86	28.04	25.2	250.0

Remarks : “ * ” means that this data is the worse emission level.

5. Occupied Bandwidth

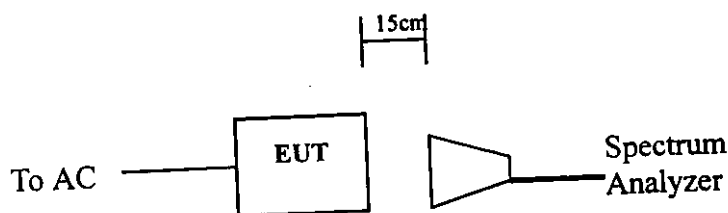
5.1 Test Equipment

The following test equipments are used during the radiated emission tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	Advantest	R3272 / 72421194	May, 1998
X	Horn Antenna	EM	EM6917 / 103325	May, 1998

Note: 1. All equipment upon which need to calibrated are with calibration period of 1 year.
2. Mark "X" test instruments are used to measure the final test results.

5.2 Test Setup



5.3 Test Condition

Standard Temperature and Humidity, Standard Test Voltage

5.4 Minimum Standard

The minimum bandwidth shall be at least 500Khz.

5.5 Occupied Bandwidth Data

Channel No.	Frequency(Mhz)	Measurement	Required Limit	Result
1	2406.4	1.60Mhz	$\geq 500\text{Khz}$	Pass
8	2442.24	1.68Mhz	$\geq 500\text{Khz}$	Pass
15	2478.08	2.32Mhz	$\geq 500\text{Khz}$	Pass

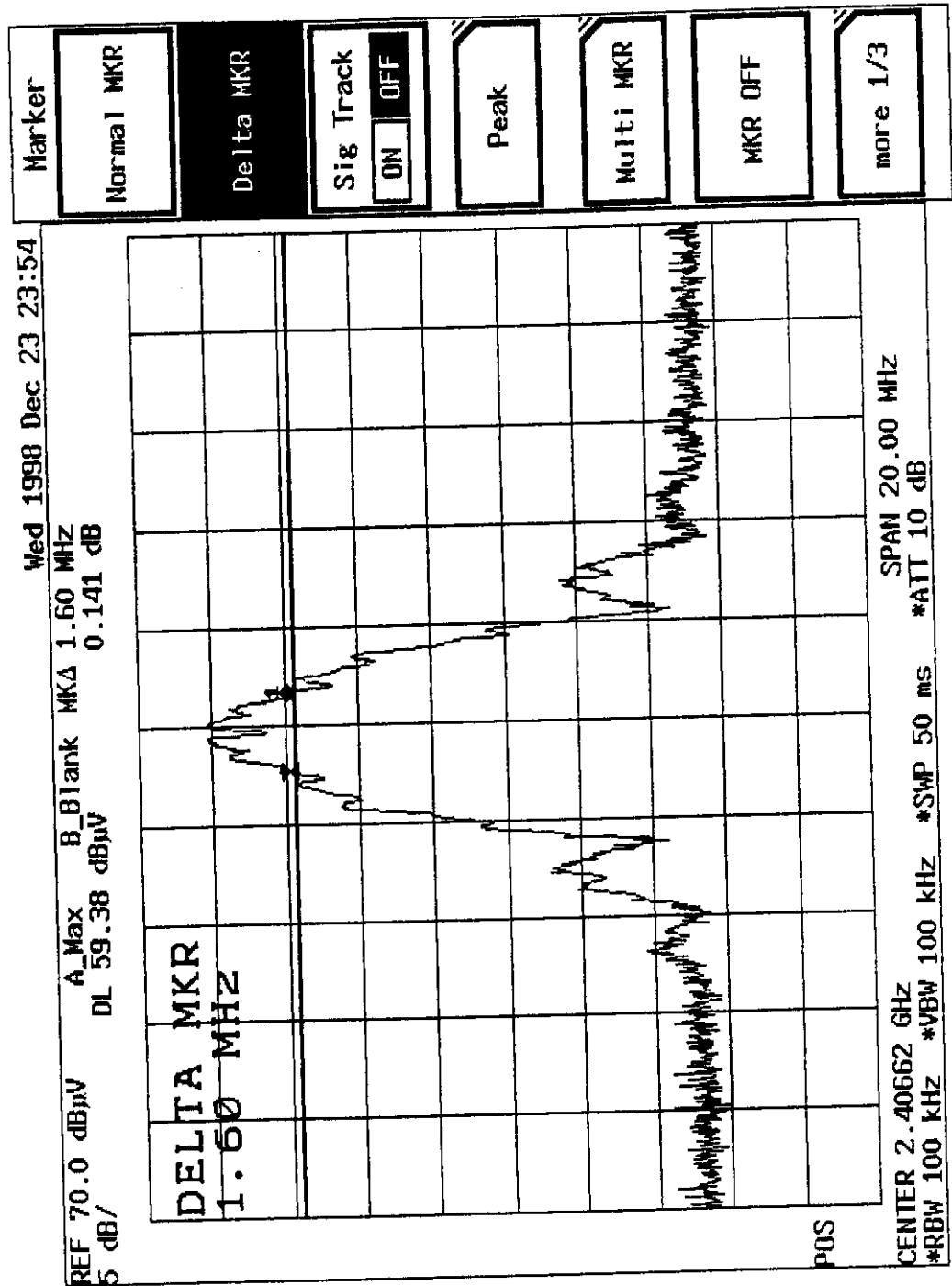
See attached graphs.

FCC ID: MIBRF60102

RF-Link System Inc. / Wireless RS232, Model RF-60102-XX

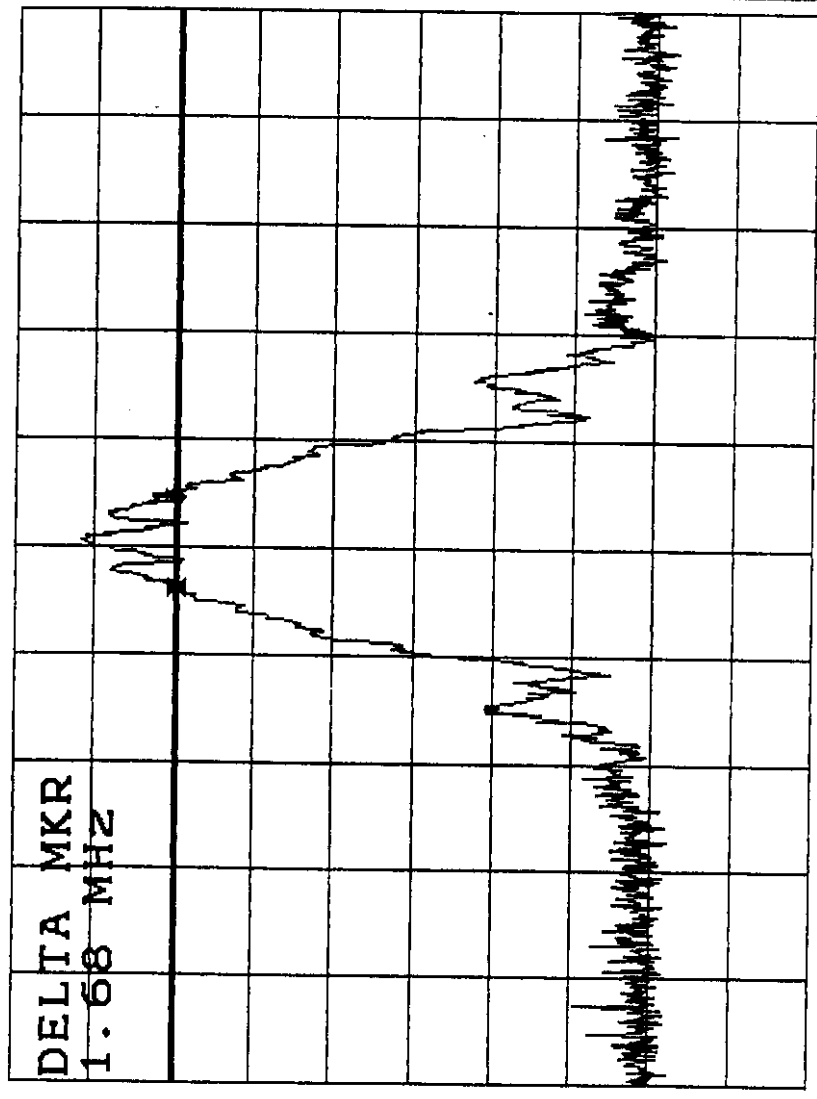
QTK99-F002A: 2.4 GHz Spread Spectrum Transceiver

QTK99-F002B: Class B Computing Device Peripheral



Wed 1998 Dec 23 22:20

REF 70.0 dBuV 5 dB/ A_View B_Blank MK4 1.68 MHz DL 59.88 dBuV 0.027 dB



POS

CENTER 2.44224 GHz *RBW 100 kHz *VBW 100 kHz *SMP 50 ms *ATT 10 dB SPAN 20.00 MHz

Marker

Normal MKR

Delta MKR

Sig Track
ON OFF

Peak

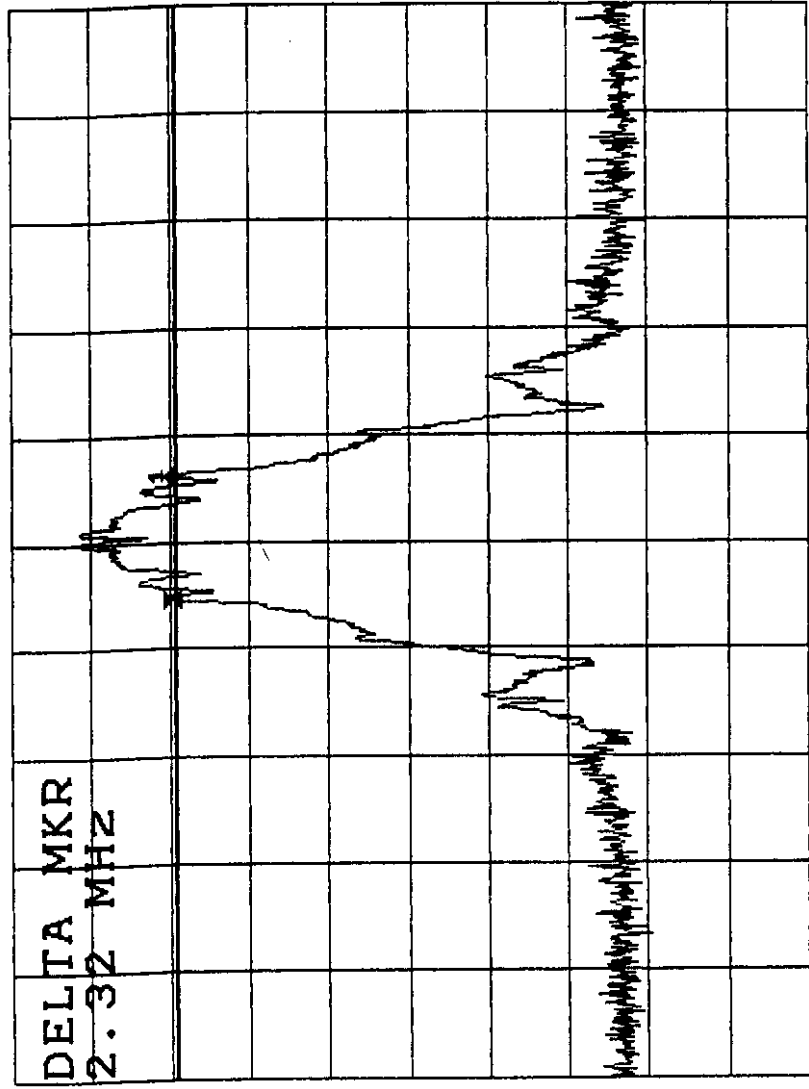
Multi MKR

MKR OFF

more 1/3

Med 1998 Dec 23 23:04

REF 70.0 dBμV 5 dB/ A_Max B_Blank MKΔ 2.32 MHz DL 59.75 dBμV 0.008 dB



POS

CENTER 2.47814 GHz *RBW 100 kHz *VBW 100 kHz *SMP 50 ms *ATT 10 dB SPAN 20.00 MHz

Marker
Normal MKR
Delta MKR
Sig Track ON OFF
Peak
Multi MKR
MKR OFF
more 1/3

6. Peak Power Output

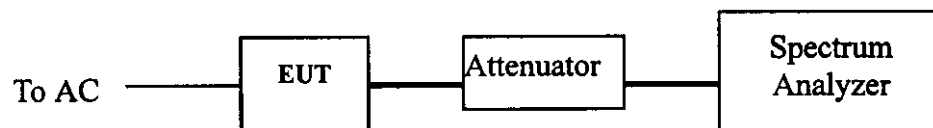
6.1 Test Equipment

The following test equipments are used during the radiated emission tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	Advantest	R3272 / 72421194	May, 1998
X	Attenuator	HP		May, 1998
X	Horn Antenna	EM	EM6917 / 103325	May, 1998

Note: 1. All equipment upon which need to calibrated are with calibration period of 1 year.
2. Mark "X" test instruments are used to measure the final test results.

6.2 Test Setup



6.3 Test Condition

Standard Temperature and Humidity, Standard Test Voltage

6.4 Minimum Standard

The maximum peak power shall be less 1 Watt.

6.5 Peak Power Output Data

Channel No.	Frequency(Mhz)	Measurement	Required Limit	Result
1	2406.4	15.28dBm	1 Watt	Pass
8	2442.24	13.39dBm	1 Watt	Pass
15	2478.08	13.98dBm	1 Watt	Pass

7. Radiation Emission Test

FCC ID: MIBRF60102
RF-Link System Inc. / Wireless RS232, Model RF-60102-XX
QTK99-F002A: 2.4 GHz Spread Spectrum Transceiver
QTK99-F002B: Class B Computing Device Peripheral

2

7.1 Test Equipment

The following test equipments are used during the radiated emission tests:

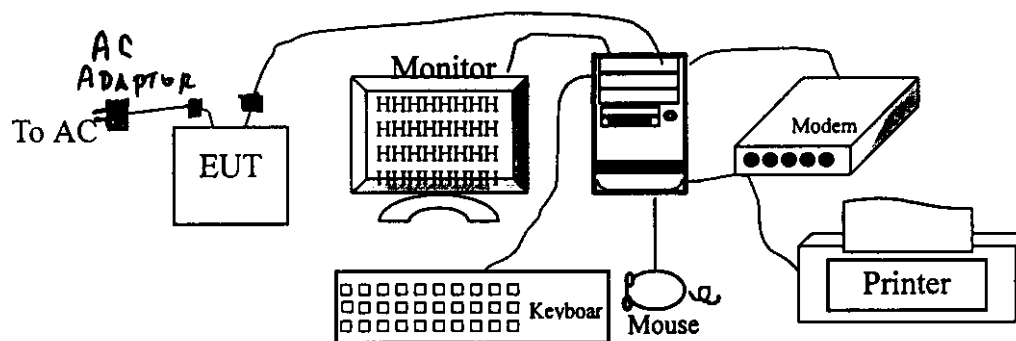
Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
SITE # 1	X	Test Receiver	R & S	ESCS 30 / 825442/14	May, 1998
	X	Spectrum Analyzer	Advantest	R3272 / 72421194	May, 1998
	X	Pre-Amplifier	HP	8447D/3307A01812	May, 1998
	X	Pre-Amplifier	HP	8449B / 3008A01123	May, 1998
	X	Bilog Antenna	Chase	CBL6112B / 12452	Sep., 1998
	X	Horn Antenna	EM	EM6917 / 103325	May, 1998

Note: 1. All equipment upon which need to calibrated are with calibration period of 1 year.

2. Mark "X" test instruments are used to measure the final test results.

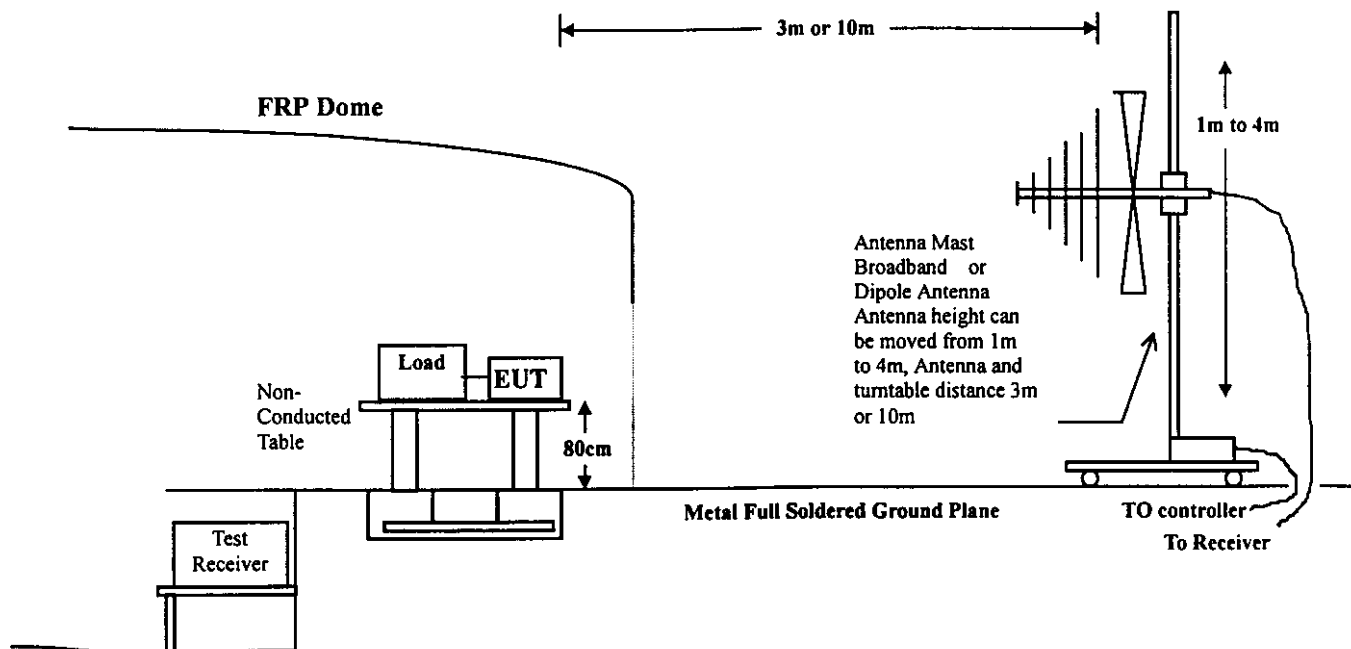
7.2 Test Setup

7.2.1 Block Diagram of Connections between EUT and simulators



*EUT PROVIDED WITH 9V ADAPTER WITH DC CABLE WITH FERRITE CORE
AND SERIAL INTERFACE WITH FERRITE CORE*

7.2.2 Open Test Site Setup Diagram



Spurious Emissions
(Band Edge Antenna Radiated)

7.3 Test Condition

Standard Temperature and Humidity, Standard Test Voltage

7.4 Minimum Standard

In any 100Khz bandwidth outside the 2400 – 483.5Mhz bands emission shall be at least 20dB below the fundamental emission or shall not exceed the following field strength limits.

Emission falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency MHz	Field Strength (uV/m @3m)	Field Strength (uV/m @3m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

7.5 Operating Condition of EUT

Each mode of operation was exercised to produce worst emission. The worst case emissions were with the EUT powered up in the transmit mode.

7.6 Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Broadband antenna (calibrated bi-log and horn antenna) are used as a receiving antenna. Both horizontal and vertical polarization of the antenna are set on measurement. And a high frequency preamplifier were used increase the sensitivity of the measuring. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4-1992 on radiated measurement.

The additional latch filter below 1Ghz was used to measure the level of harmonics radiated emission during field dtrength of harmonics measurement.

The bandwidth below 1Ghz setting on the field strength meter (R&S Test Receiver ESCS 30) is 120 KHz, above 1Ghz are 1 MHz.

The frequency range from 30MHz to 10th harminics is checked.

7.7 Radiated Emission Data

The initial step in collecting radiated data is a spectrum analyzer peak scan of the measurement range for all the test modes. Then the worst modes were reported the following data pages.

Spurious Emission (Band Edge)

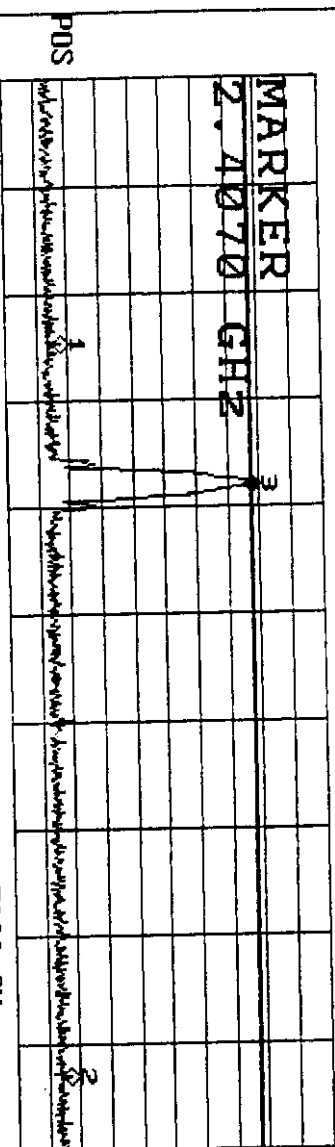
Date of Test : Dec. 15, 1998 Temperature : 24.3 °C
EUT : Wireless RS232 Humidity : 61 %
Test Mode : Mode 1, 2 & 3 Display Pattern :
Detector Mode : Peak

Channel	Fundamental Level	Upper Band Level	Lower Band Level	Upper Margin Level(dBc)	Lower Margin Level(dBc)	Limit
1	63.75	33.38	34.00	-30.37	-29.75	20 dBc
8	64.50	32.89	34.08	-31.61	-30.42	20 dBc
15	60.50	34.20	33.81	-26.83	-26.69	20 dBc

See Attached Chart

Med 1999 Jan 27 11:33

REF 75.0 dBuV A_View B_Blank MKR 2.4070 GHz
5 dB/ DL 63.75 dBuV 0.047 dB



START 2.3500 GHz STOP 2.5000 GHz
*RBW 100 kHz *VBW 1 MHz *SMP 500 ms ATT 10 dB

Multi Marker List

	Frequency (GHz)	Amplitude (dB)
1:	2.3869	-29.754
2:	2.4895	-30.371
3:	2.4070	0.047
4:		
5:		
6:		
7:		
8:		
9:		
10:		
4:		

Multi MKR

MKR NO

3

MKR ON

MKR OFF

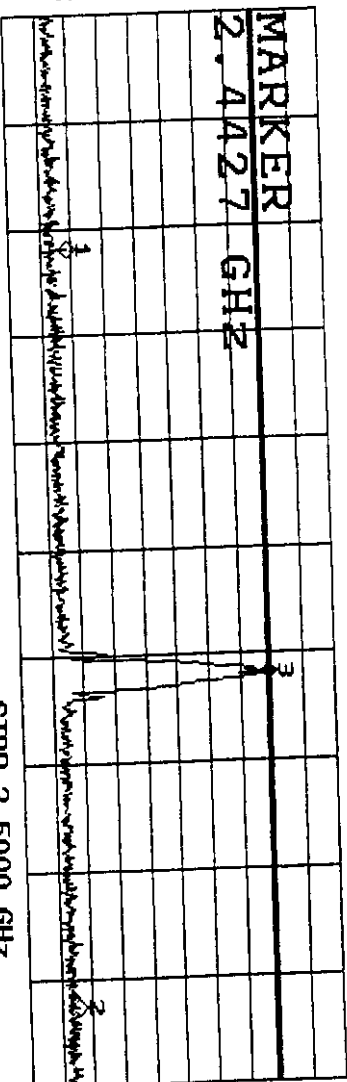
Active MKR

Reset MKR

return

Wed 1999 Jan 27 11:42

REF 75.0 dBmV A_View B_Blank MKR 2.4427 GHz
5 dB/ DL 64.50 dBmV 0.039 dB



START 2.3500 GHz STOP 2.5000 GHz
*RBW 100 kHz *VBW 1 MHz *SMP 500 ms ATT 10 dB

Multi Marker List

1:	2.3827 GHz	-30.426 dB
2:	2.4888 GHz	-31.609 dB
3:	2.4427 GHz	0.039 dB
4:		
5:		
6:		
7:		
8:		

10:
A:

Multi MKR

MKR NO

3

MKR ON

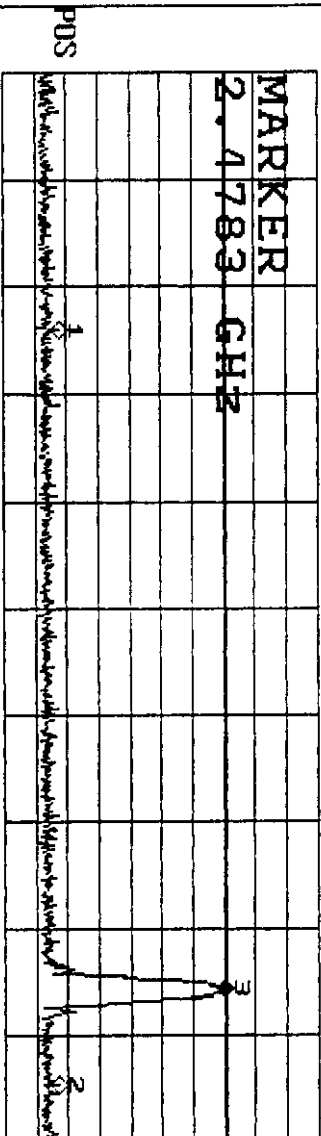
MKR OFF

Active MKR

Reset MKR

return

REF 75.0 dBmV A_View B_Blank MKR 2.4783 GHz Wed 1999 Jan 27 11:49
 5 dB/ DL 60.50 dBmV -0.516 dB



START 2.3500 GHz STOP 2.5000 GHz
 *RBW 100 kHz *VBW 1 MHz *SWP 500 ms ATT 10 dB

Multi Marker List

1:	2.3859 GHz	-26.688 dB
2:	2.4918 GHz	-26.828 dB
3:	2.4783 GHz	-0.516 dB
4:		
5:		
6:		
7:		
8:		
9:		
10:		
4:		

Multi MKR

MKR NO

3

MKR ON

MKR OFF

Active MKR

Reset MKR

return

Radiated Emission Data

Date of Test	:	Dec. 15, 1998	Temperature	:	24.3 °C
EUT	:	Wireless RS232	Humidity	:	61 %
Test Mode	:	Mode 1	Display Pattern	:	H Pattern
Detector Mode	:	Quasi-Peak			

Frequency	Cable	Ant	Reading Level	Emission Level	Limits	Ant	Table
	Loss	Factor	Horizontal	Horizontal		Pos	Pos
MHz	dB	dB/m	dBuV/m	dBuV/m	uV/m	uV/m	cm deg
167.423	2.48	11.10	11.00	24.58	16.94	150 400	79
246.100	3.23	12.44	5.04	20.71	10.86	200 100	95
282.626	3.58	13.26	16.48	33.32	46.36	200 100	124
552.963	5.07	18.92	7.22	31.21	36.37	200 132	201
624.123	5.44	19.29	4.24	28.97	28.08	200 212	34
958.469	7.18	21.34	5.23	33.75	48.71	200 154	4

Radiated Emission Data

Date of Test	:	Dec. 15, 1998	Temperature	:	24.3 °C
EUT	:	Wireless RS232	Humidity	:	61 %
Test Mode	:	Mode 1	Display Pattern	:	H Pattern
Detector Mode	:	Quasi-Peak			

Frequency	Cable	Ant	Reading Level	Emission Level	Limits	Ant	Table	
	Loss	Factor	Vertical	Vertical		Pos	Pos	
MHz	dB	dB/m	dBuV/m	dBuV/m	uV/m	uV/m	cm	deg
167.045	2.47	9.63	14.38	26.48	21.08	150	400	135
245.758	3.22	12.86	8.54	24.62	17.03	200	100	36
282.626	3.58	13.38	12.62	29.58	30.14	200	100	28
552.963	5.07	18.65	8.78	32.50	42.17	200	132	36
624.120	5.44	19.28	5.39	30.11	32.02	200	212	35
958.469	7.18	21.94	7.14	36.26	65.03	200	154	114

Radiated Emission Data

Date of Test	:	Dec. 15, 1998	Temperature	:	24.3 °C
EUT	:	Wireless RS232	Humidity	:	61 %
Test Mode	:	Mode 1, 2 & 3	Display Pattern	:	Data Transfer
Detector Mode	:	Peak			

POLARIZATION: HORIZONTAL

CHAN		FREQUE	DETECT	Correction	READING	FIELD	LIMITS	MARGIN
NEL	NCY		OR	Factor	LEVEL	STRENGTH	dBuV/m	dB
		MHz			DBUV/M	DBUV/M		
*	1	4812.4	Peak	2.1	62.6	64.7	74.0	9.3
		7219.5	Peak	7.0	42.7	49.7	74.0	24.3
		9625.3	Peak	10.2	46.3	56.5	74.0	17.6
		1203.9	Peak	13.5	45.7	59.2	74.0	14.8
		14438.8	Peak	16.9	[44.2	61.2	74.0	12.9
		16844.5	Peak	19.6	[44.3	63.9	74.0	10.1
		8	4885.1	Peak	2.1	57.7	59.8	74.0
	7326.8		Peak	7.0	42.5	49.5	74.0	24.5
	9769.3		Peak	10.2	45.6	55.8	74.0	18.2
	12211.3		Peak	13.5	45.8	59.2	74.0	14.8
	14653.5		Peak	16.9	[44.4	61.3	74.0	12.7
	17095.8		Peak	19.6	[44.3	63.9	74.0	10.1
	15		4956.3	Peak	2.1	58.8	60.9	74.0
		7434.4	Peak	7.0	40.1	47.1	74.0	26.9
		9912.5	Peak	10.2	46.2	56.4	74.0	17.6
		12390.5	Peak	13.5	46.6	60.1	74.0	14.0
		14868.7	Peak	16.9	[44.3	61.2	74.0	12.8
		17346.9	Peak	19.6	[44.3	63.9	74.0	10.1

Radiated Emission Data

Date of Test	: Dec. 15, 1998	Temperature	: 24.3 °C
EUT	: Wireless RS232	Humidity	: 61 %
Test Mode	: Mode 1, 2 & 3	Display Pattern	: Data Transfer
Detector Mode	: Peak		

POLARIZATION: VERTICAL

CHAN	FREQUEN	DETECTO	Correction	READING	FIELD	LIMITS	MARGIN
NEL	CY	R	Factor	LEVEL	STRENGTH	dBuV/m	DB
	MHz			DBUV/M	DBUV/M		
* 1	4816	Peak	2.1	55.2	57.3	74.0	16.7
	7223	Peak	7.0	40.3	47.2	74.0	26.8
	9630	Peak	10.2	45.3	55.5	74.0	18.5
	12041	Peak	13.5	46.0	59.5	74.0	14.5
	14449	Peak	16.9	[44.1	61.0	74.0	13.0
	16858	Peak	19.6	[44.2	63.8	74.0	10.2
8	4885.1	Peak	2.1	57.7	59.8	74.0	14.2
	7326.8	Peak	7.0	40.7	47.6	74.0	26.4
	9769.3	Peak	10.2	45.9	56.1	74.0	17.9
	12211.3	Peak	13.5	44.2	57.7	74.0	16.3
	14653.5	Peak	16.9	[44.3	61.2	74.0	12.8
	17095.8	Peak	19.6	[44.2	63.8	74.0	10.2
15	4956.3	Peak	2.1	59.4	61.5	74.0	12.6
	7434.4	Peak	7.0	39.6	46.6	74.0	27.4
	9912.5	Peak	10.2	46.0	56.1	74.0	17.9
	12390.5	Peak	13.5	46.3	59.8	74.0	14.2
	14868.7	Peak	16.9	[44.3	61.2	74.0	8.7
	17346.9	Peak	19.6	[44.2	63.8	74.0	5.2

Remarks:

1. " * ", means this data is the worse emission level.
2. Field Strength = Reading Level + Correction Factor.
3. Correction Factor = Cable Loss + Antenna Factor- PreAmplifier.

8. Transmitter Power Density

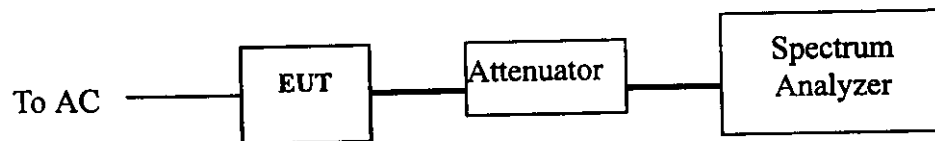
8.1 Test Equipment

The following test equipments are used during the radiated emission tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Spectrum Analyzer	Advantest	R3272 / 72421194	May, 1998
X	Attenuator	HP		May, 1998
X	Horn Antenna	EM	EM6917 / 103325	May, 1998

Note: 1. All equipment upon which need to calibrated are with calibration period of 1 year.
2. Mark "X" test instruments are used to measure the final test results.

8.2 Test Setup



8.3 Test Condition

Standard Temperature and Humidity, Standard Test Voltage

8.4 Minimum Standard

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3KHz bandwidth.

8.5 Transmitter Power Density Data

Channel No.	Frequency(Mhz)	Measurement	Required Limit	Result
1	2406.4	1.05dBm	$\leq 8\text{dBm}$	Pass
8	2442.24	-0.79dBm	$\leq 8\text{dBm}$	Pass
15	2478.08	-2.11dBm	$\leq 8\text{dBm}$	Pass

9. Processing Gain

9.1 Test Setup

See Figure 1 Processing Gain Measurement Test Setup.

9.2 Test Condition

Standard Temperature and Humidity, Standard Test Voltage

9.3 Minimum Standard

The processing gain shall be at least 10 dB.

9.4 Method of Measurement

The processing gain of this spread spectrum was measured the CW jamming method . The Section 9.1 illustrates the measurement setup. The output power of the spread spectrum transmitter is fixed and the output power of jammer is adjustable. The frequency of jammer was stopped through the pass band of nominal channel in 50KHz steps. In each frequency step of the jammer, the output power of jammer is adjusted to cause the Bit Error Rate (BER) to be 1.0×10^{-6} . The power levels are recorded to calculate the J/S as shown in Table 1.

9.5 Calculation of Processing Gain:

The processing gain was determined by measuring the jamming margin of the EUT and using the following formula:

$$G_p = (S/N)_o + M_j + L_{sys}$$

Where $(S/N)_o$ is the required signal to noise ratio at the receiver output

M_j is the jammer to signal ratio (J/S)

L_{sys} is the system loss

The $(S/N)_o$ is calculated from:

$$P_e = 1/2 \exp(-1/2(S/N)_o) \quad ; P_e = \text{probability of error (BER)}$$

For the $P_e(\text{BER}) = 1.0 \times 10^{-6}$, the required $(S/N)_o$ is 14.2dB

From Measurement, the minimum J/S(M_j) is -3.4dB

We assume the system loss is 1dB.

Therefore the processing gain is calculated below:

$$G_p = (S/N)_o + M_j + L_{sys} = 14.2 + (-3.4) + 1 = 11.8 \text{ (dB)}$$



佳和集團
怡安科技
CHIA HEIR GROUP
RF-LINK SYSTEMS INC.

WL-RS232 Processing Gain Measurement and Calculation

The processing gain of this spread spectrum was measured using the CW jamming method. Figure 1 illustrates the measurement setup. The out power of the spread spectrum transmitter is fixed and the output power of jammer is adjustable. The frequency of jammer was stopped through the pass band of nominal channel in 50KHz steps. In each frequency step of the jammer, the output power of jammer is adjusted to cause the Bit Error Rate (BER) to be 1.0×10^{-6} . The power levels are recorded to calculate the J/S as shown in Table 1.

The processing gain G_p was calculated using the formula:

$$G_p = (S/N)_o + M_j + L_{sys}$$

Where $(S/N)_o$ is the required signal to noise ratio at the receiver output
 M_j is the jammer to signal ratio (J/S)
 L_{sys} is the system loss

The $(S/N)_o$ is calculated from:

$$P_e = 1/2 \exp(-1/2(S/N)_o) \quad ; P_e = \text{probability of error (BER)}$$

For the $P_e(\text{BER}) = 1.0 \times 10^{-6}$, the required $(S/N)_o$ is 14.2db

From Table 1, the minimum J/S(M_j) is -3.4db.

We assume the system loss is 1db.

Therefore the processing gain is calculated below:

$$G_p = (S/N)_o + M_j + L_{sys} = 14.2 + (-3.4) + 1 = 11.8(\text{db})$$

Figure 1. Processing Gain Measurement Test Setup

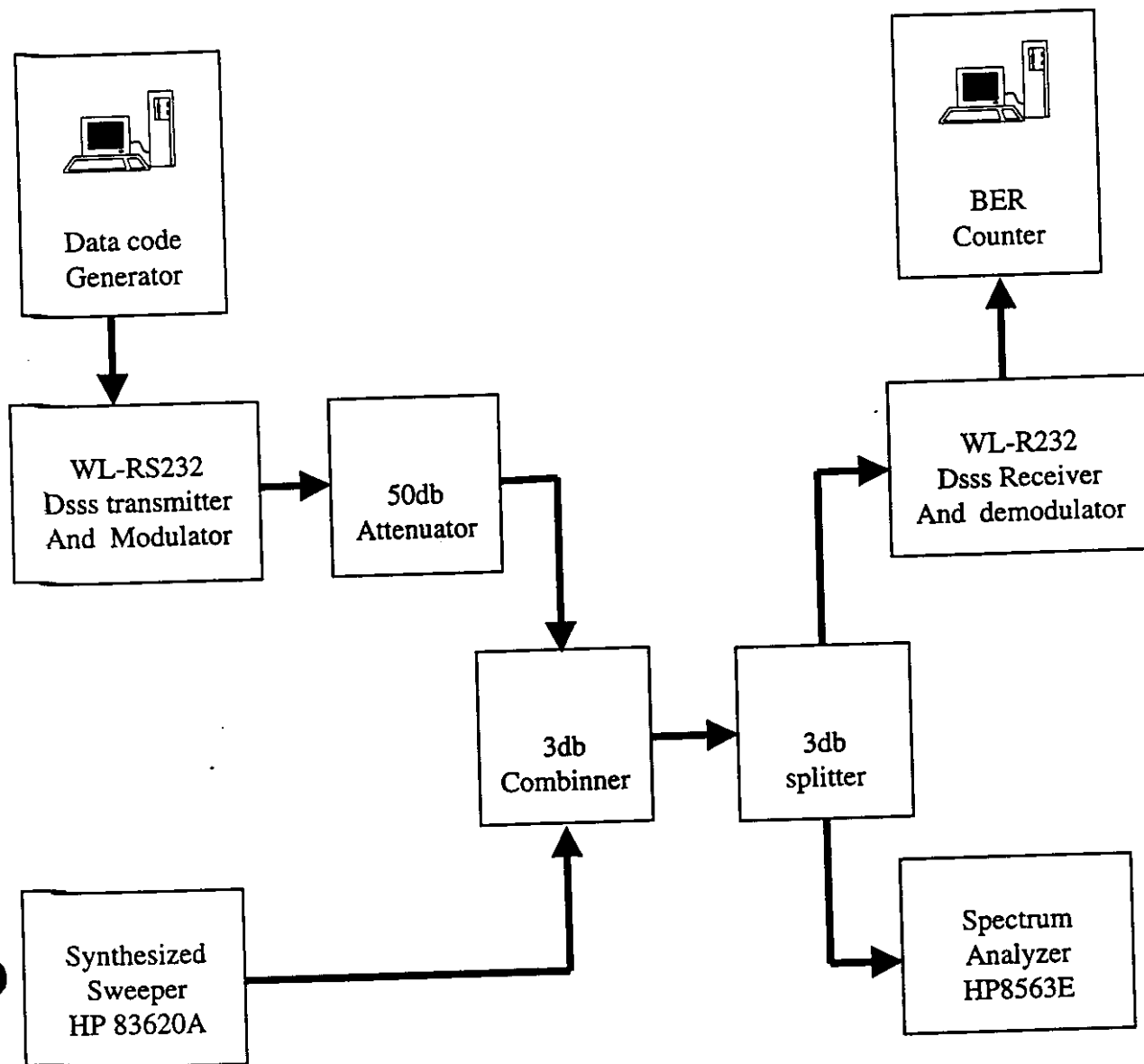


Figure 1

Frequency(MHz)	J/S(db)	Signal(dBm)	J(dBm)
2435.84	4.7	-43.5	-38.8
2435.89	4.6	-43.5	-38.9
2435.94	4.4	-43.5	-39.1
2435.99	4.2	-43.5	-39.3
2436.04	4.2	-43.5	-39.3
2436.09	4.2	-43.5	-39.3
2436.14	4.1	-43.5	-39.4
2436.19	4	-43.5	-39.5
2436.24	3.8	-43.5	-39.7
2436.29	3.8	-43.5	-39.7
2436.34	3.7	-43.5	-39.8
2436.39	3.6	-43.5	-39.9
2436.44	3.4	-43.5	-40.1
2436.49	3.4	-43.5	-40.1
2436.54	3.3	-43.5	-40.2
2436.59	3.1	-43.5	-40.4
2436.64	3.1	-43.5	-40.4
2436.69	3	-43.5	-40.5
2436.74	2.8	-43.5	-40.7
2436.79	2.7	-43.5	-40.8
2436.84	2.5	-43.5	-41
2436.89	2.2	-43.5	-41.3
2436.94	2	-43.5	-41.5
2436.99	1.9	-43.5	-41.6
2437.04	1.8	-43.5	-41.7
2437.09	1.7	-43.5	-41.8
2437.14	1.7	-43.5	-41.8
2437.19	1.7	-43.5	-41.8
2437.24	1.6	-43.5	-41.9
2437.29	1.5	-43.5	-42
2437.34	1.6	-43.5	-41.9
2437.39	1.4	-43.5	-42.1
2437.44	1.5	-43.5	-42
2437.49	1.4	-43.5	-42.1
2437.54	1.5	-43.5	-42
2437.59	1.5	-43.5	-42
2437.64	1.3	-43.5	-42.2
2437.69	1.3	-43.5	-42.2
2437.74	1.3	-43.5	-42.2
2437.79	1.2	-43.5	-42.3
2437.84	1.1	-43.5	-42.4
2437.89	1	-43.5	-42.5
2437.94	0.9	-43.5	-42.6
2437.99	0.9	-43.5	-42.6
2438.04	0.7	-43.5	-42.8
2438.09	0.6	-43.5	-42.9
2438.14	0.6	-43.5	-42.9
2438.19	0.5	-43.5	-43
2438.24	0.4	-43.5	-43.1
2438.29	0.3	-43.5	-43.2
2438.34	0.1	-43.5	-43.4
2438.39	0.1	-43.5	-43.4
2438.44	-0.1	-43.5	-43.6
2438.49	-0.2	-43.5	-43.7
2438.54	-0.3	-43.5	-43.8

2438.59	-0.3	-43.5	-43.8
2438.64	-0.4	-43.5	-43.9
2438.69	-0.4	-43.5	-43.9
2438.74	-0.5	-43.5	-44
2438.79	-0.6	-43.5	-44.1
2438.84	-0.7	-43.5	-44.2
2438.89	-0.8	-43.5	-44.3
2438.94	-0.9	-43.5	-44.4
2438.99	-1	-43.5	-44.5
2439.04	-1.2	-43.5	-44.7
2439.09	-1.3	-43.5	-44.8
2439.14	-1.3	-43.5	-44.8
2439.19	-1.2	-43.5	-44.7
2439.24	-1.3	-43.5	-44.8
2439.29	-1.3	-43.5	-44.8
2439.34	-1.2	-43.5	-44.7
2439.39	-1.3	-43.5	-44.8
2439.44	-1.4	-43.5	-44.9
2439.49	-1.3	-43.5	-44.8
2439.54	-1.5	-43.5	-45
2439.59	-1.5	-43.5	-45
2439.64	-1.5	-43.5	-45
2439.69	-1.3	-43.5	-44.8
2439.74	-1.1	-43.5	-44.6
2439.79	-1.2	-43.5	-44.7
2439.84	-1.1	-43.5	-44.6
2439.89	-1.1	-43.5	-44.6
2439.94	-1.2	-43.5	-44.7
2439.99	-1.2	-43.5	-44.7
2440.04	-1.3	-43.5	-44.8
2440.09	-1.2	-43.5	-44.7
2440.14	-1.3	-43.5	-44.8
2440.19	-1.3	-43.5	-44.8
2440.24	-1.3	-43.5	-44.8
2440.29	-1.2	-43.5	-44.7
2440.34	-1.3	-43.5	-44.8
2440.39	-1.4	-43.5	-44.9
2440.44	-1.5	-43.5	-45
2440.49	-1.6	-43.5	-45.1
2440.54	-1.8	-43.5	-45.3
2440.59	-1.8	-43.5	-45.3
2440.64	-1.7	-43.5	-45.2
2440.69	-1.8	-43.5	-45.3
2440.74	-1.8	-43.5	-45.3
2440.79	-1.9	-43.5	-45.4
2440.84	-1.9	-43.5	-45.4
2440.89	-1.9	-43.5	-45.4
2440.94	-1.8	-43.5	-45.3
2440.99	-2	-43.5	-45.5
2441.04	-2.1	-43.5	-45.6
2441.09	-2.2	-43.5	-45.7
2441.14	-2.2	-43.5	-45.7
2441.19	-2.3	-43.5	-45.8
2441.24	-2.4	-43.5	-45.9
2441.29	-2.4	-43.5	-45.9
2441.34	-2.5	-43.5	-46

Table 1. J/S Ratio Test Result

2441.39	-2.5	-43.5	-46
2441.44	-2.5	-43.5	-46
2441.49	-2.3	-43.5	-45.8
2441.54	-2.4	-43.5	-45.9
2441.59	-2.5	-43.5	-46
2441.64	-2.5	-43.5	-46
2441.69	-2.4	-43.5	-45.9
2441.74	-2.3	-43.5	-45.8
2441.79	-2.3	-43.5	-45.8
2441.84	-2.3	-43.5	-45.8
2441.89	-2.4	-43.5	-45.9
2441.94	-2.5	-43.5	-46
2441.99	-2.7	-43.5	-46.2
2442.04	-2.7	-43.5	-46.2
2442.09	-2.8	-43.5	-46.3
2442.14	-2.8	-43.5	-46.3
2442.19	-3.2	-43.5	-46.7
2442.24			
2442.29	-3.3	-43.5	-46.8
2442.34	-2.3	-43.5	-45.8
2442.39	-2.1	-43.5	-45.6
2442.44	-1.9	-43.5	-45.4
2442.49	-1.7	-43.5	-45.2
2442.54	-1.5	-43.5	-45
2442.59	-1.2	-43.5	-44.7
2442.64	-1	-43.5	-44.5
2442.69	-0.8	-43.5	-44.3
2442.74	-0.6	-43.5	-44.1
2442.79	-0.4	-43.5	-43.9
2442.84	-0.3	-43.5	-43.8
2442.89	0.1	-43.5	-43.4
2442.94	0.5	-43.5	-43
2442.99	1	-43.5	-42.5
2443.04	1.5	-43.5	-42
2443.09	1.9	-43.5	-41.6
2443.14	2.4	-43.5	-41.1
2443.19	3.1	-43.5	-40.4
2443.24	3.8	-43.5	-39.7
2443.29	4.3	-43.5	-39.2
2443.34	5.3	-43.5	-38.2
2443.39	5.9	-43.5	-37.6
2443.44	6.5	-43.5	-37
2443.49	7.8	-43.5	-35.7
2443.54	8.9	-43.5	-34.6
2443.59	9.7	-43.5	-33.8
2443.64	10.7	-43.5	-32.8
2443.69	11.8	-43.5	-31.7
2443.74	12	-43.5	-31.5
2443.79	12.2	-43.5	-31.3
2443.84	12.6	-43.5	-30.9
2443.89	12.8	-43.5	-30.7
2443.94	12.5	-43.5	-31
2443.99	12.4	-43.5	-31.1
2444.04	12.3	-43.5	-31.2
2444.09	9.8	-43.5	-33.7
2444.14	8.2	-43.5	-35.3

2444.19	6.5	-43.5	-37
2444.24	5.6	-43.5	-37.9
2444.29	4.9	-43.5	-38.6
2444.34	4	-43.5	-39.5
2444.39	4.3	-43.5	-39.2
2444.44	3.2	-43.5	-40.3
2444.49	3.3	-43.5	-40.2
2444.54	2.7	-43.5	-40.8
2444.59	2.7	-43.5	-40.8
2444.64	2.5	-43.5	-41
2444.69	2.7	-43.5	-40.8
2444.74	2.9	-43.5	-40.6
2444.79	2.5	-43.5	-41
2444.84	2.3	-43.5	-41.2
2444.89	1.4	-43.5	-42.1
2444.94	0.8	-43.5	-42.7
2444.99	-0.3	-43.5	-43.8
2445.04	-0.3	-43.5	-43.8
2445.09	-0.3	-43.5	-43.8
2445.14	-0.3	-43.5	-43.8
2445.19	-0.2	-43.5	-43.7
2445.24	-0.3	-43.5	-43.8
2445.29	-0.3	-43.5	-43.8
2445.34	-0.4	-43.5	-43.9
2445.39	-0.3	-43.5	-43.8
2445.44	-0.2	-43.5	-43.7
2445.49	0	-43.5	-43.5
2445.54	-0.1	-43.5	-43.6
2445.59	0	-43.5	-43.5
2445.64	0	-43.5	-43.5
2445.69	-0.1	-43.5	-43.6
2445.74	0	-43.5	-43.5
2445.79	0.2	-43.5	-43.3
2445.84	0.3	-43.5	-43.2
2445.89	0.5	-43.5	-43
2445.94	0.5	-43.5	-43
2445.99	0.6	-43.5	-42.9
2446.04	0.6	-43.5	-42.9
2446.09	0.5	-43.5	-43
2446.14	0.5	-43.5	-43
2446.19	0.5	-43.5	-43
2446.24	0.5	-43.5	-43
2446.29	0.6	-43.5	-42.9
2446.34	0.6	-43.5	-42.9
2446.39	0.7	-43.5	-42.8
2446.44	0.7	-43.5	-42.8
2446.49	0.7	-43.5	-42.8
2446.54	0.8	-43.5	-42.7
2446.59	0.9	-43.5	-42.6
2446.64	1	-43.5	-42.5
2446.69	1	-43.5	-42.5
2446.74	1.1	-43.5	-42.4
2446.79	1.1	-43.5	-42.4
2446.84	1.2	-43.5	-42.3
2446.89	1.2	-43.5	-42.3
2446.94	1.2	-43.5	-42.3

Table 1. J/S Ratio Test Result

2446.99		1.2	-43.5	-42.3
2447.04		1.3	-43.5	-42.2
2447.09		1.3	-43.5	-42.2
2447.14		1.4	-43.5	-42.1
2447.19		1.5	-43.5	-42
2447.24		1.6	-43.5	-41.9
2447.29		1.7	-43.5	-41.8
2447.34		1.7	-43.5	-41.8
2447.39		1.8	-43.5	-41.7
2447.44		1.8	-43.5	-41.7
2447.49		1.9	-43.5	-41.6
2447.54		1.9	-43.5	-41.6
2447.59		1.9	-43.5	-41.6
2447.64		1.9	-43.5	-41.6
2447.69		2	-43.5	-41.5
2447.74		2	-43.5	-41.5
2447.79		2	-43.5	-41.5
2447.84		2.1	-43.5	-41.4
2447.89		2.2	-43.5	-41.3
2447.94		2.3	-43.5	-41.2
2447.99		2.4	-43.5	-41.1
2448.04		2.4	-43.5	-41.1
2448.09		2.4	-43.5	-41.1
2448.14		2.5	-43.5	-41
2448.19		2.5	-43.5	-41
2448.24		2.5	-43.5	-41
2448.29		2.6	-43.5	-40.9
2448.34		2.7	-43.5	-40.8
2448.39		2.8	-43.5	-40.7

BER = 1.0×10^{-6}

Mj (db)

-3.4

Data Rate (Kbps)

192

Code Rate (Mbps)

3.072

Band Width (Mhz)

12.288

Non-coherent (S/N)_o(db)

14.2

Ls(db)

1

Pg=(S/N)_o+Mj+Ls (db)

11.8

Table 1. J/S Ratio Test Result

10. EMI Reduction Method During Compliance Testing

1. Added a ferrite core on the interface cable.
2. Added a ferrite core on the cable of power adapter.