

TEST REPORT

Report No.: Z01C-03105

Issue Date: May 16, 2003

The device, as described herewith, was tested pursuant to applicable test procedure indicated below and complies with the requirements of;

FCC Part15 Subpart C / IC RSS-210

The test results are traceable to the international or national standards.

Applicant	: Seiko Instruments Inc. Printsystem Division 8, Nakase 1-chome, Mihama-ku Chiba-shi, Chiba 261-8507, Japan Phone: +81-43-211-1877 Fax.: +81-43-211-8489
Equipment under test (EUT)	: Thermal Printer
FCC ID	: C4ZAB000001
Model Number	: MPU-L465
Serial Number	: N/A
EUT Condition	: Pre-production

Test procedure	: ANSI C63.4-1992
Date of test	: April 22-26, 2003
Test place	: Site 2 Shielded room
Test results	: Complied
Remarks	: The limits of FCC Part 15 section 15.207 that became effective on September 9, 2002, adopted under FCC 02-157 (ET Docket 98-80), were applied to conducted emission measurements. As for Industry Canada requirements, the limits of RSS-210 paragraph 6.6(a) were applied.

Zacta Technology Corporation certifies that no party to the application is subject to a denial of federal benefits that include FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

The results in this report are applicable only to the samples tested.

This report shall not be re-produced except in full without the written approval of ZACTA Technology Corporation.

Authorized by:


Katsumi Sumiyoshi / Assistant manager



NVLAP accreditation is valid for
FCC Part15(Digital Devices).
NVLAP accreditation does not cover RSS-210.

FCC ID: C4ZAB000001

Table of contents

	<i>Page</i>
1. Summary of Test Results	5
2. Equipment description	6
2.1 EUT information.....	6
2.2 Operating channels and frequencies.....	7
3. Configuration information.....	8
3.1 Peripheral(s) information [RF Radiated test].....	8
3.2 Cable(s) information [RF Radiated test].....	8
3.3 System configuration [RF Radiated test].....	9
3.4 Peripheral(s) information [RF conducted test].....	10
3.5 Cable(s) information [RF conducted test].....	10
3.6 System configuration [RF conducted test].....	11
3.7 Peripheral(s) information [Conducted emission test].....	12
3.8 Cable(s) information [Conducted emission test].....	12
3.9 System configuration [Conducted emission test].....	13
3.10 Operating flow	14
3.10.1 Operating condition	14
3.10.2 Test mode.....	14
4. Test Instruments.....	15
5. Test Type and Results	16
5.1. 20dB Bandwidth / Occupied Bandwidth.....	16
5.1.1 Test Procedure [FCC 15.247(a)(1), IC 5.9.1].....	16
5.1.2 Test Instruments and Measurement Setup.....	16
5.1.3 Limit of Bandwidth at 20 dB below.....	16
5.1.4 Measurement Result.....	16
5.1.5 Trace Data	16
5.2. Carrier Frequency Separation.....	17
5.2.1 Test Procedure [FCC 15.247(a)(1), IC 6.2.2(o)(a1)].....	17
5.2.2 Test Instruments and Measurement Setup.....	17
5.2.3 Limit of Carrier Frequency Separation.....	17
5.2.4 Measurement Result.....	17
5.2.5 Trace Data	17
5.3. Number of Hopping Frequencies.....	18
5.3.1 Test Procedure [FCC 15.247(a)(1)(iii), IC 6.2.2(o)(a3)].....	18
5.3.2 Test Instruments and Measurement Setup.....	18
5.3.3 Limit of Number of Hopping Frequencies.....	18

5.3.4 Measurement Result.....	18
5.3.5 Trace Data	18
5.4. Time of Occupancy (Dwell Time).....	19
5.4.1 Test Procedure [FCC 15.247(a)(1)(iii), IC 6.2.2(o)(a3)].....	19
5.4.2 Test Instruments and Measurement Setup.....	19
5.4.3 Limit of Time of Occupancy (Dwell Time)	19
5.4.4 Measurement Result.....	19
5.4.5 Trace Data	19
5.5. Maximum Peak Output Power - Conducted -.....	20
5.5.1 Test Procedure [FCC 15.247(b)(1), 15.31(e), IC 6.2.2(o)(a3)].....	20
5.5.2 Test Instruments and Measurement Setup.....	20
5.5.3 Limit of Maximum Peak Output Power.....	20
5.5.4 Measurement Result.....	20
5.5.5 Trace Data	21
5.6. Maximum Peak Output Power - Radiated -.....	22
5.6.1 Test Procedure [FCC 15.247(b)(1), 15.31(e), IC 6.2.2(o)(a3)].....	22
5.6.2 Test Instruments and Measurement Setup.....	22
5.6.3 Limit of Maximum Peak Output Power.....	22
5.6.4 Measurement Result.....	23
5.7. Band Edge Compliance of RF Conducted Emissions	24
5.7.1 Test Procedure [FCC 15.247 (c), IC6.2.2 (o)(e1)].....	24
5.7.2 Test Instruments and Measurement Setup.....	24
5.7.3 Limit of Band-edge Compliance of RF Conducted Emissions.....	24
5.7.4 Measurement Results of Band-edge	25
5.7.5 Trace Data	25
5.8. Spurious Emissions - Conducted -.....	26
5.8.1 Test Procedure [FCC 15.247(c), IC 6.2.2(o)(e1)].....	26
5.8.2 Test Instruments and Measurement Setup.....	26
5.8.3 Limit of Spurious Emissions - Conducted -.....	26
5.8.4 Measurement Results of Spurious Emissions - Conducted -.....	26
5.8.5 Trace Data	26
5.9. Spurious Emissions - Radiated- (9kHz – 25GHz).....	27
5.9.1 Test Procedure [FCC 15.205/209/247(c), IC 6.2.1/6.2.2(o)(e1)/6.3].....	27
5.9.2 Test Instruments and Measurement Setup.....	27
5.9.3 Limit of Radiated Emission Measurement.....	29
5.9.4 Sample of field strength calculation	30
5.9.5 Measurement Results	30
5.9.6 Data.....	30
5.10. Restricted Band of Operation	31
5.10.1 Test Procedure [FCC 15.205, 15.209, 15.247(c), IC 6.3].....	31
5.10.2 Test Instruments and Measurement Setup.....	31

5.10.3 Limit of Restricted Band of Operation.....	31
5.10.4 Measurement Result.....	32
5.10.5 Trace Data.....	32
5.11. Transmitter Power Spectral Density.....	33
5.11.1. Test Procedure [FCC 15.247(d)/247(f), IC 6.2.2(o)(b)].....	33
5.11.2 Test Instruments and Measurement Setup.....	33
5.11.3 Limit of Transmitter Power Spectral Density	33
5.11.4 Measurement Results.....	33
5.11.5 Trace Data.....	33
5.12. Conducted emission measurements	34
5.12.1 Test Procedure [FCC 15.207, IC 6.6].....	34
5.12.2 Test equipment for Conducted emission.....	34
5.12.3 Limit of Conducted Emission Measurement	35
5.12.4 Sample of field strength calculation.....	35
5.12.5 Measurement Results.....	35
5.12.6 Data	35
6. Laboratory Description	36
6.1 Description for Test Site.....	36
6.2 Uncertainty.....	37
Appendix A	38
Appendix B.....	41
Appendix C.....	43
Appendix D.....	45
Appendix E.....	49
Appendix F.....	56
Appendix G.....	59
Appendix H.....	72
Appendix I.....	74
Appendix J.....	77
Appendix K.....	79

1. Summary of Test Results

Table-A presents the list of the measurement items for Spread Spectrum, Frequency hopping devices under FCC Part 15 Subpart C and Industry Canada RSS-210.

The section numbers of upper portion are showing FCC number, and the other (lower) ones are for IC.

Table-A List of the measurements

Test Items Section	Test Items			Condition	Result	
	Transmit mode [Tx]:	Limit				
15.247(a)(1) 5.9.1	Occupied Bandwidth (20dB Bandwidth)	None			Conducted	Pass
15.247(a)(1) 6.2.2(o)(a1)	Carrier Frequency Separation	Systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.			Conducted	Pass
15.247(a)(1)(iii) 6.2.2(o)(a3)	Number of Hopping Frequencies	Shall have more than 15 channels.			Conducted	Pass
15.247(a)(1)(iii) 6.2.2(o)(a3)	Time of Occupancy (Dwell Time)	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed..			Conducted	Pass
15.247(b)(1) 15.31(e) 6.2.2(o)(a3)	Maximum Peak Output Power - Conducted -	Shall not exceed 1.0 W.			Conducted	Pass
15.247(b)(1) 15.31(e) 6.2.2(o)(a3)	Maximum Peak Output Power - Radiated -	Shall not exceed 1.0 W.			Radiated	Pass
15.247(c) 6.2.2(o)(e1)	Band Edge Compliance of RF Conducted Emissions	The emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.			Conducted	Pass
15.247(c) 6.2.2(o)(e1)	Spurious Emissions - Conducted -	The emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.			Conducted	Pass
15.247(c) 15.205 15.209 6.2.1 6.2.2(o)(e1) 6.3	Spurious Emissions - Radiated -	The emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.			Radiated (9kHz-25GHz)	Pass
15.247(c) 15.205 15.209 6.2.1 6.3	Restricted Bands of Operation	Emission at the boundary of the restricted band provided by 15.205 shall be lower than 15.209 limit.			Radiated	Pass
15.247(d) 15.247(f) 6.2.2(o)(b)	Transmitter power spectral Density	Shall not be greater than 8 dBm in any 3KHz band.			Conducted	Pass
15.207	AC Power Conducted Emissions 150kHz – 30MHz	MHz	QP[dBuV]	AV[dBuV]	Conducted	Pass
		0.15 - 0.50	66 - 56	56 - 46		
		0.50 - 5	56	46		
		5 - 30	60	50		
6.6	AC Power Conducted Emissions 450kHz – 30MHz	250uV			Conducted	Pass

2. Equipment description

2.1 EUT information

No.	EUT	Company	Model No.	Serial No.	FCC ID/DoC	Comment
1	Thermal Printer	Seiko Instruments Inc.	MPU-L465	N/A	C4ZAB000001	-

Oscillator(s)/Crystal(s) : Main PCBA
Operating frequency : CPU clock : 22.10MHz
USB controller clock : 6.00MHz
Print head clock : 5.50MHz
Bluetooth PCBA
CPU main clock : 12MHz
CPU sub clock :32kHz
Power ratings : Printer
DC 7.4V(Li-ion battery)
DC 9.4V(Switching power supply)
Switching power supply
Input AC100-240V 50/60Hz
Output DC 9.3V 4A
Port(s) : DC port
USB port
Serial port
Size : (W) 168.1 x (D) 155 x (H) 93.7 mm
Operating mode : Test mode
Inquiry mode
Variation of model(s) : Not applicable
RF Specification
Protocol : Bluetooth
Spread method : Frequency hopping spread spectrum (FHSS)
Communication method : TDD
Frequency Range : 2402MHz – 2480MHz
Number of FR Channels : 79 Channels
Modulation Method : Gauss Ian Frequency Shift Keying (GFSK)
Nominal Bit Rates : 1600hops/s
Symbol rate on channel : 1Mbps
Channel Separation : 1MHz
Output power : 0.457mW
Antenna (Rx and Tx) : Integral antenna
Antenna gain : -5.8dBi
RF type : Tranceiver
Intended use : Data transmission
RF emission type designator : M889FXD

2.2 Operating channels and frequencies.

Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
1	2402	28	2429	55	2456
2	2403	29	2430	56	2457
3	2404	30	2431	57	2458
4	2405	31	2432	58	2459
5	2406	32	2433	59	2460
6	2407	33	2434	60	2461
7	2408	34	2435	61	2462
8	2409	35	2436	62	2463
9	2410	36	2437	63	2464
10	2411	37	2438	64	2465
11	2412	38	2439	65	2466
12	2413	39	2440	66	2467
13	2414	40	2441	67	2468
14	2415	41	2442	68	2469
15	2416	42	2443	69	2470
16	2417	43	2444	70	2471
17	2418	44	2445	71	2472
18	2419	45	2446	72	2473
19	2420	46	2447	73	2474
20	2421	47	2448	74	2475
21	2422	48	2449	75	2476
22	2423	49	2450	76	2477
23	2424	50	2451	77	2478
24	2425	51	2452	78	2479
25	2426	52	2453	79	2480
26	2427	53	2454		
27	2428	54	2455		

3. Configuration information

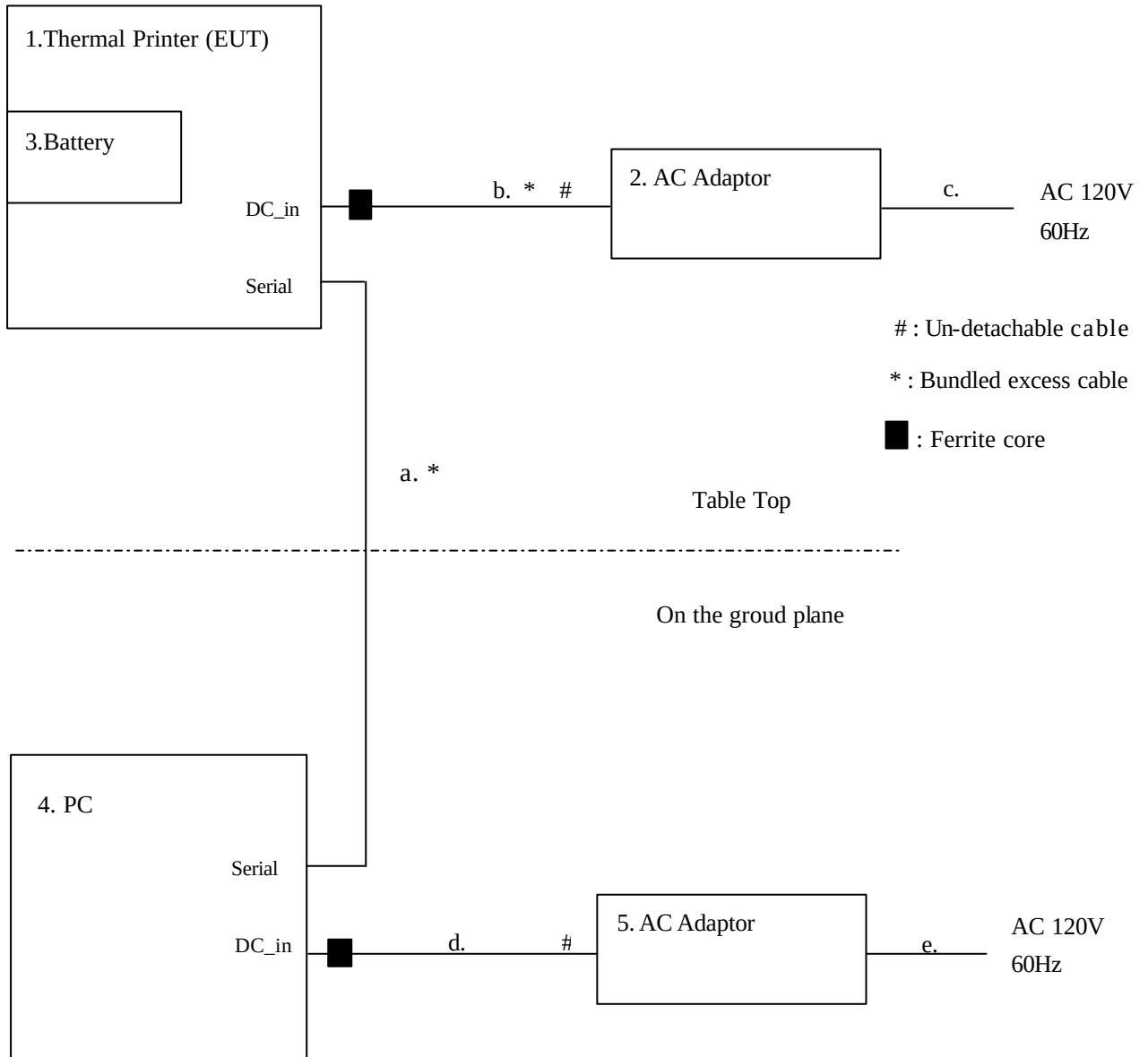
3.1 Peripheral(s) information [RF Radiated test]

No.	Equipment	Company	Model No.	Serial No.	DoC / FCC ID	Comment
2	AC adaptor for EUT	Seiko Instruments Inc.	NU50-2093400-I3	N/A	-	Option
3	Battery	MITSUBISHI CABLE INDUSTRIES, LTD.	RB-B2001	N/A	-	Option
4	PC	NEC	PC-LL7003D	2520158KA	-	-
5	AC adaptor for PC	NEC	PC-VP-BP21/OP-520-75301	2613355DA	-	-

3.2 Cable(s) information [RF Radiated test]

No.	Cable	Length [m]	Shield	Connector	From	To	Comment
a	Serial cable	1.8	Shielded	Metal	EUT	PC	-
b	DC cable for AC adaptor (EUT)	1.9	Unshielded	Metal	EUT	AC adaptor	-
c	AC power cord for AC adaptor (EUT)	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-
d	DC cable for AC adaptor (PC)	1.8	Unshielded	Metal	PC	AC adaptor	-
e	AC power cord for PC	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-

3.3 System configuration [RF Radiated test]



Note 1: Numbers assigned to equipment or cables on this diagram are corresponded to the list in “2.1 EUT information”, “3.1 Peripheral(s) information” and “3.2 Cable(s) information”.

Note 2: One ferrite core for DC cable (No.b) is not added during testing.

Note 3: One ferrite core for DC cable (No.d) is not added during testing.

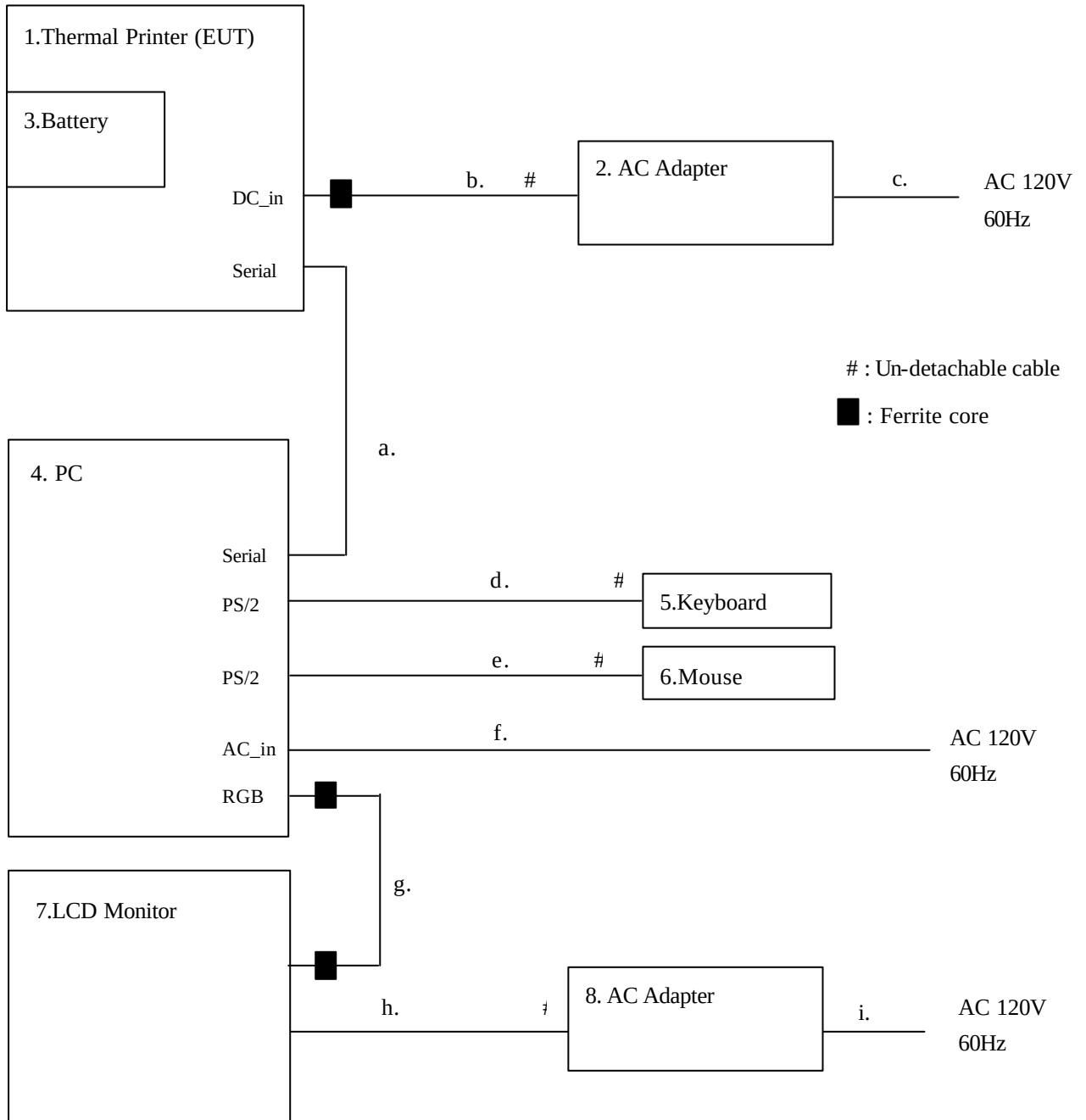
3.4 Peripheral(s) information [RF conducted test]

No.	Equipment	Company	Model No.	Serial No.	DoC / FCC ID	Comment
2	AC adaptor for EUT	Seiko Instruments Inc.	NU50-2093400-I3	N/A	-	Option
3	Battery	MITSUBISHI CABLE INDUSTRIES, LTD.	RB-B2001	N/A	-	Option
4	PC	DELL	MCM	FLXB41S	DoC	-
5	Keyboard	DELL	SK-8000	N/A	DoC	-
6	Mouse	Logitech	M-S34	LNA11312323	DoC	-
7	LCD Monitor	ViewSonic	VLCD521553-1	GU12303861	DoC	-
8	AC adaptor for LCD Monitor	ViewSonic	LSE9901B1250	C0122506259	DoC	-

3.5 Cable(s) information [RF conducted test]

No.	Cable	Length [m]	Shield	Connector	From	To	Comment
a	Serial cable	1.8	Shielded	Metal	EUT	PC	-
b	DC cable for AC adaptor (EUT)	1.9	Unshielded	Metal	EUT	AC adaptor	-
c	AC power cord for AC adaptor (EUT)	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-
d	Keyboard cable	1.9	Shielded	Metal	PC	Keyboard	-
e	Mouse cable	1.9	Shielded	Metal	PC	Mouse	-
f	AC power cord for PC	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-
g	RGB cable	1.8	Shielded	Metal	PC	LCD Monitor	-
h	DC cable for AC adaptor (PC)	1.8	Unshielded	Metal	PC	AC adaptor	-
i	AC power cord for AC adaptor (LCD Monitor)	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-

3.6 System configuration [RF conducted test]



Note 1: Numbers assigned to equipment or cables on this diagram are corresponded to the list in “2.1 EUT information”, “3.4 Peripheral(s) information” and “3.5 Cable(s) information”.

Note 2: One ferrite core for DC cable (No.b) is not added during testing.

Note 3: Two ferrite cores for RGB cable (No.g) is not added during testing.

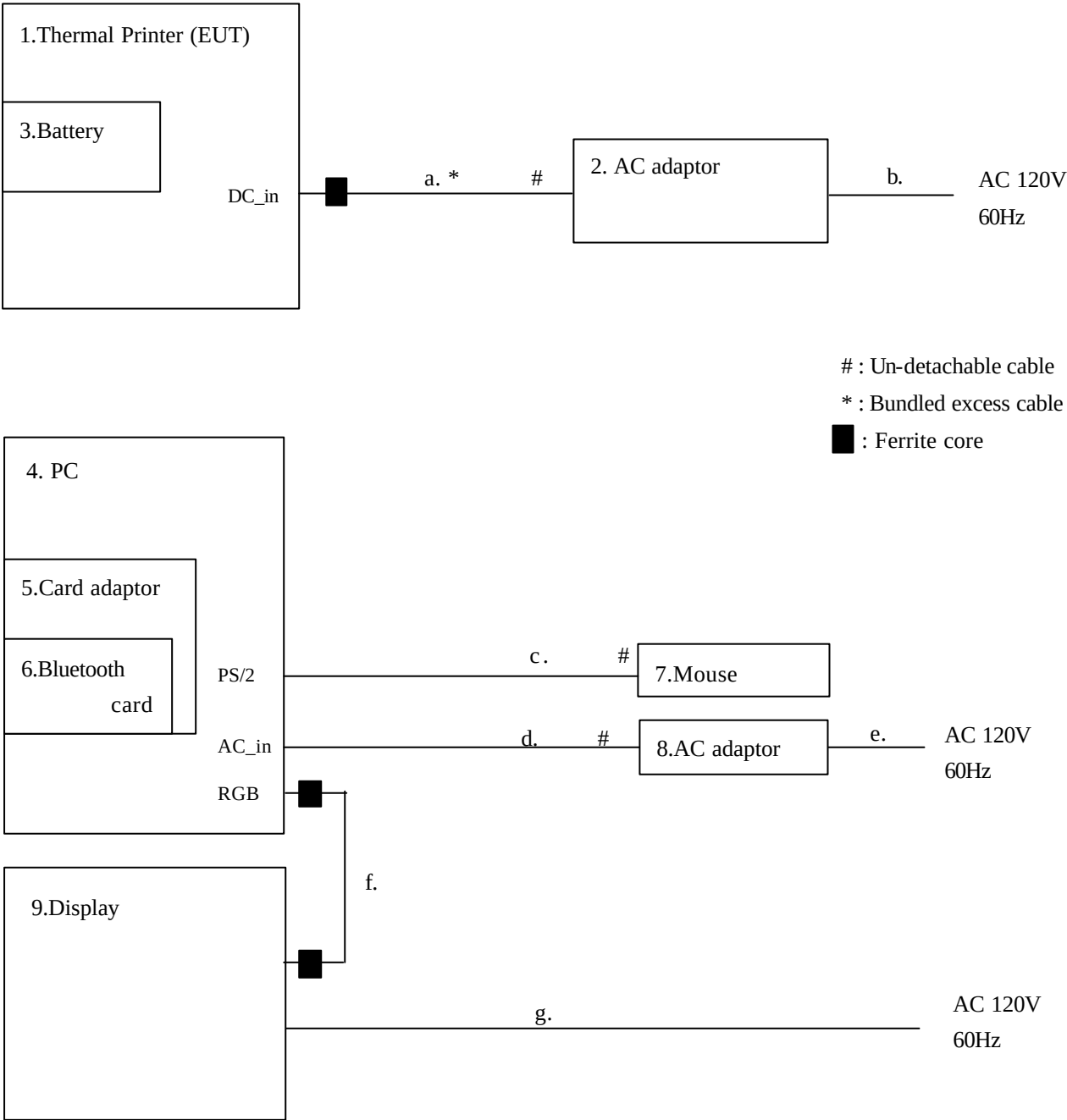
3.7 Peripheral(s) information [Conducted emission test]

No.	Equipment	Company	Model No.	Serial No.	DoC / FCC ID	Comment
2	AC adaptor for EUT	Seiko Instruments Inc.	NU50-2093400-I3	N/A	-	Option
3	Battery	MITSUBISHI CABLE INDUSTRIES, LTD.	RB-B2001	N/A	-	Option
4	PC	NEC	PC-LT5003D	2500644GA	DoC	-
5	Card adaptor	socket	8520-00031	N/A	-	-
6	Bluetooth card	socket	Socket Bluetooth Card	0206004352	LUB BTC-1	-
7	Mouse	Logitech	M-S34	LNA11312323	DoC	-
8	AC adaptor for PC	NEC	SQS60W15P-01	N/A	-	-
9	Display	SAMSUNG	700IFT	PG17H2GN40 3266N	N/A	-

3.8 Cable(s) information [Conducted emission test]

No.	Cable	Length [m]	Shield	Connector	From	To	Comment
a	DC cable for AC adaptor (EUT)	1.9	Unshielded	Metal	EUT	AC adaptor	-
b	AC power cord for AC adaptor (EUT)	1.8	Unshielded	Plastic	AC adaptor	AC outlet	-
c	Mouse cable	1.9	Unshielded	Metal	PC	Mouse	-
d	DC cable for AC adaptor (PC)	1.8	Unshielded	Metal	PC	AC adaptor (PC)	-
e	AC power cord for PC	1.8	Unshielded	Plastic	AC adaptor (PC)	AC outlet	-
f	RGB cable	1.8	Shielded	Metal	PC	Display	-
g	AC power cord for Display	1.8	Unshielded	Plastic	Display	AC outlet	-

3.9 System configuration [Conducted emission test]



Note 1: Numbers assigned to equipment or cables on this diagram are corresponded to the list in “2.1 EUT information”, “3.7 Peripheral(s) information” and “3.8 Cable(s) information”.
Note 2: One ferrite core for DC cable (No.a) is not added during testing.
Note 3: Two ferrite cores for RGB cable (No.f) is not added during testing.

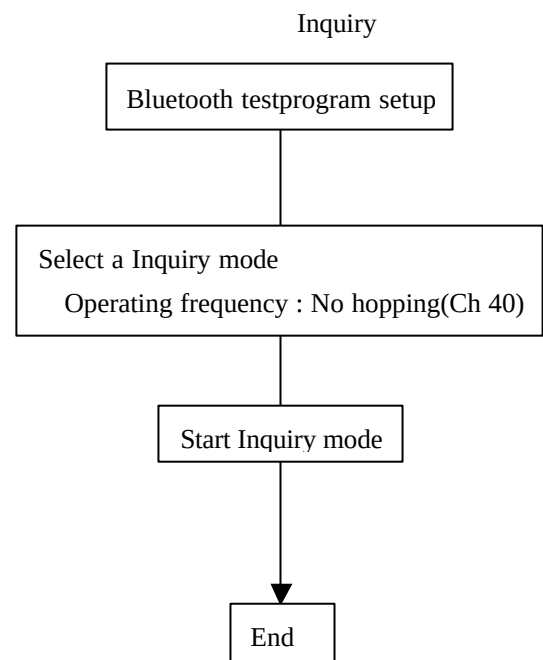
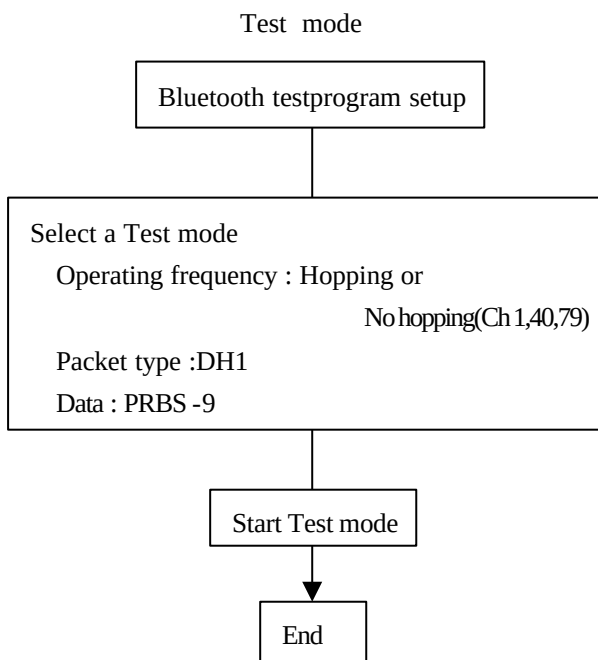
3.10 Operating flow

3.10.1 Operating condition

The test was carried out under the following conditions during the test.

3.10.2 Test mode

Following programs were performed continuously.



4. Test Instruments

List of Measuring Instruments

Equipment	Company	Model No.	Serial No.	Cal. due
Spectrum Analyzer (100Hz-1.5GHz)	Agilent Technologies	8568B	2732A03847	Feb. 2004
Spectrum Analyzer (100kHz-26GHz)	ADVANTEST	R3271A	65050042	May. 2004
Preamplifier (100kHz-1.2GHz)	Anritsu	MH648A	M96157	Aug. 2003
Preamplifier (1GHz-26.5GHz)	Agilent Technologies	HP8449B	3008A01008	Nov. 2003
Test Receiver (9kHz-30MHz)	ROHDE&SCHWARZ	ESHS10	842884/009	Jan. 2004
Test Receiver (25MHz-1.5GHz)	ROHDE&SCHWARZ	ESVP	891807/010	Mar. 2004
Loop Antenna	ROHDE&SCHWARZ	HFH2-Z2	892246/010	Nov. 2003
Biconical Antenna	Schwarzbeck	VHA9103/BBA9106	1563	Apr. 2004
Log Periodic Antenna	Schwarzbeck	UHALP9108A	0438	Apr. 2004
Double Ridged Guide Antenna	EMCO	3115	4327	Sep. 2003
HORN Antenna	Schwarzbeck	BBHA9170	BBHA9170189	Oct. 2004
50 Ω terminator	Agilent Technologies	11593A	N/A	Sep. 2003
Artificial mains network	Kyoritsu Electrical Works, Ltd.	KNW-407	8-693-20	Mar. 2004
Artificial mains network	Kyoritsu Electrical Works, Ltd.	KNW-242C	8-1096-37	Mar. 2004
Microwave cable	Suhner	SUCOFLEX 104/15m SUCOFLEX 104/1m	108014/4 108015/4	Sep. 2003
Coaxial cable	Fujikura	8D-2W/8m 10D-SFA/29m 5D-2W/1m	YTCRFC#2R	Jun. 2003
Coaxial cable	Fujikura	8D-2W/15m 5D-2W/1m	YTCRFC#2C	May. 2003
Coax cable	N/A	N/A	N/A	Apr. 2004
Coaxial Switch	Anritsu	MP59B	6100097264	May. 2003
Site attenuation	ZACTA Technology Corp.	Site 2	N/A	Nov. 2003

*The calibrations of the above equipment are traceable to NIST or equivalent standards of the reference organizations.

5. Test Type and Results

5.1. 20dB Bandwidth / Occupied Bandwidth

5.1.1 Test Procedure [FCC 15.247(a)(1), IC 5.9.1]

The bandwidth at 20 dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=30kHz, VBW=100kHz, Span=2MHz, Sweep=auto

The EUT was set to operate with following conditions.

- No hopping [ch 1 (low), ch 40 (mid) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode

5.1.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.1.3 Limit of Bandwidth at 20 dB below

None

5.1.4 Measurement Result

[Test mode]

Channel	Center Frequency [MHz]	Lower Frequency [MHz]	Upper Frequency [MHz]	20dB Bandwidth [MHz]
1	2402.0	2401.605	2402.494	0.889
40	2441.0	2440.611	2441.471	0.860
79	2480.0	2479.609	2480.489	0.880

5.1.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix A**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 22, 2003
Temperature : 19.1 [°C]
Humidity : 37.3 [%]
Test place : Shielded room

5.2. Carrier Frequency Separation

5.2.1 Test Procedure [FCC 15.247(a)(1), IC 6.2.2(o)(a1)]

The adjacent channel interval is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=100KHz, VBW=100KHz, Span=5MHz, Sweep=auto

The EUT was set to operate with following conditions.

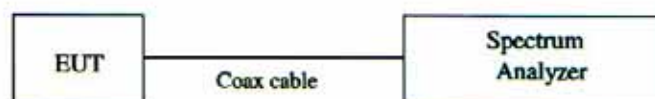
- Hopping

The test mode of EUT is as follows.

- Test mode

5.2.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm	Loss: 0.1dB
			N/A



5.2.3 Limit of Carrier Frequency Separation

Systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

5.2.4 Measurement Result

[Test mode]

Measurement Frequency 1 [MHz]	Measurement Frequency 2 [MHz]	Channel Separation [MHz]	Limit [MHz]	PASS / FAIL
2440.007	2441.029	1.022	>20dB Bandwidth	PASS

5.2.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix B**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 22, 2003
Temperature : 19.1 [°C]
Humidity : 37.3 [%]
Test place : Shielded room

5.3. Number of Hopping Frequencies

5.3.1 Test Procedure [FCC 15.247(a)(1)(iii), IC 6.2.2(o)(a3)]

The number of hopping channels is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=100kHz, VBW=100kHz, Span=Arbitrary setting, Sweep=auto

The EUT was set to operate with following conditions.

- Hopping

The test mode of EUT is as follows.

- Test mode

5.3.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer $\leftrightarrow$ EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.3.3 Limit of Number of Hopping Frequencies

Shall have more than 15 channels.

5.3.4 Measurement Result

[Test mode]		
Number of channels	Limit	PASS / FAIL
79	≥ 15 channel	PASS

5.3.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix C**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 22, 2003
Temperature : 19.1 [°C]
Humidity : 37.3 [%]
Test place : Shielded room

5.4. Time of Occupancy (Dwell Time)

5.4.1 Test Procedure [FCC 15.247(a)(1)(iii), IC 6.2.2(o)(a3)]

The time occupancy of hopping channel is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

Step A: RBW=1MHz, VBW=1MHz, Span=0MHz, Sweep=5ms

Step B: RBW=1MHz, VBW=1MHz, Span=0MHz, Sweep=500ms

The EUT was set to operate with following conditions.

- Hopping [ch 1 (low), ch 40 (mid) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode

5.4.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.4.3 Limit of Time of Occupancy (Dwell Time)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed..

5.4.4 Measurement Result

[Test mode]

Channel	Frequency [MHz]	Step A [ms]	Step B [times]	Occupancy time of 31.6 seconds [s]	Limit	PASS / FAIL
1	2402.0	0.400	10	0.253	< 0.4 s	PASS
40	2441.0	0.407	13	0.334	< 0.4 s	PASS
79	2480.0	0.400	10	0.253	< 0.4 s	PASS

Calculation :

Occupancy time of 31.6 seconds * = One channel stay time (ms) x Frequency of hopping for 500ms period (times) x 63.2

*: 31.6 seconds = 0.4 s x 79 channel

5.4.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix D**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 24, 2003
Temperature : 18.3 [°C]
Humidity : 33.1 [%]
Test place : Shielded room

5.5. Maximum Peak Output Power - Conducted -

5.5.1 Test Procedure [FCC 15.247(b)(1), 15.31(e), IC 6.2.2(o)(a3)]

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=3MHz, VBW=3MHz, Span=10MHz, Sweep=auto

The EUT was set to operate with following conditions.

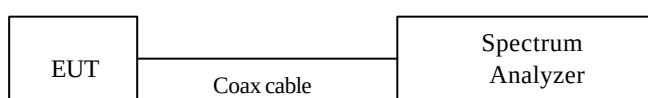
- No hopping [ch 1 (low), ch 40 (mid) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode in AC120V operation.
- Test mode in AC102V operation.(85%)
- Test mode in AC138V operation.(115%)
- Test mode in Battery operation. (Full charge)

5.5.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.5.3 Limit of Maximum Peak Output Power

1 watt or less.

5.5.4 Measurement Result

[Test mode in AC120V operation.]

channel	Center Frequency [MHz]	Factor [dB]	Reading [dBm]	Antenna Gain of EUT [dBi]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	0.1	2.3	-5.8	-3.4	0.457	≤1000	PASS
40	2441.0	0.1	0.0	-5.8	-5.7	0.269	≤1000	PASS
79	2480.0	0.1	-1.9	-5.8	-7.6	0.174	≤1000	PASS

[Test mode in AC102V operation. (85%)]

channel	Center Frequency [MHz]	Factor [dB]	Reading [dBm]	Antenna Gain of EUT [dBi]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	0.1	2.1	-5.8	-3.6	0.437	≤1000	PASS
40	2441.0	0.1	-0.1	-5.8	-5.8	0.263	≤1000	PASS
79	2480.0	0.1	-2.0	-5.8	-7.7	0.170	≤1000	PASS

[Test mode in AC138V operation. (115%)]

channel	Center Frequency [MHz]	Factor [dB]	Reading [dBm]	Antenna Gain of EUT [dBi]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS/FAIL
1	2402.0	0.1	2.0	-5.8	-3.7	0.427	≤1000	PASS
40	2441.0	0.1	0.1	-5.8	-5.6	0.275	≤1000	PASS
79	2480.0	0.1	-1.9	-5.8	-7.6	0.174	≤1000	PASS

[Test mode in Battery operation. (Full charge)]

channel	Center Frequency [MHz]	Factor [dB]	Reading [dBm]	Antenna Gain of EUT [dBi]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS/FAIL
1	2402.0	0.1	2.1	-5.8	-3.6	0.437	≤1000	PASS
40	2441.0	0.1	-0.1	-5.8	-5.8	0.263	≤1000	PASS
79	2480.0	0.1	-1.9	-5.8	-7.6	0.174	≤1000	PASS

Calculation :

Reading (dBm) + Factor (dB) + Antenna Gain of EUT (dBi) = Level (dBm)

$10\log P = \text{Level (dBm)}$

$P = 10^{(\text{Maximum Peak Output Power (dBm)} / 10)} \text{ (mW)}$

5.5.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix E**.

Test Personnel:

Tester Signature:

Tester Name:


Jun Shimanuki

Date : Apr. 23, 2003
Temperature : 21.3 [°C]
Humidity : 38.5 [%]
Test place : Shielded room

5.6. Maximum Peak Output Power - Radiated -

5.6.1 Test Procedure [FCC 15.247(b)(1), 15.31(e), IC 6.2.2(o)(a3)]

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=3MHz, VBW=3MHz, Span=10MHz, Sweep=auto

The EUT was set to operate with following conditions.

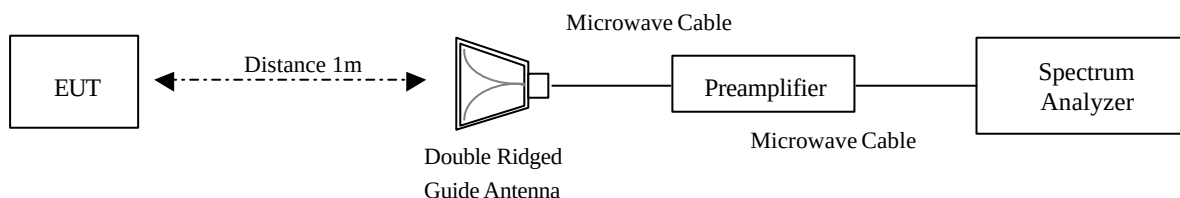
- No hopping [ch 1 (low), ch 40 (mid) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode in AC120V operation.
- Test mode in AC102V operation.(85%)
- Test mode in AC138V operation.(115%)
- Test mode in Battery operation. (Full charge)

5.6.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Preamplifier	Agilent Technologies	HP8449B	3008A01008
Double Ridged Guide Antenna	EMCO	3115	4327
Microwave cable	Suhner	SUCOFLEX 104/15m SUCOFLEX 104/1m	108014/4 108015/4



5.6.3 Limit of Maximum Peak Output Power

1 watt or less.

5.6.4 Measurement Result

[Test mode in AC120V operation.]

Channel	Center Frequency [MHz]	Pol. [H/V]	Reading [dBm]	Factor [dB]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	H	-7.4	-0.7	-8.1	0.259	≤1000	PASS
40	2441.0	H	-10.0	-0.7	-10.7	0.142	≤1000	PASS
79	2480.0	H	-11.7	-0.7	-12.4	0.096	≤1000	PASS

[Test mode in AC102V operation. (85%)]

Channel	Center Frequency [MHz]	Pol. [H/V]	Reading [dBm]	Factor [dB]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	H	-7.8	-0.7	-8.5	0.236	≤1000	PASS
40	2441.0	H	-10.5	-0.7	-11.2	0.127	≤1000	PASS
79	2480.0	H	-11.9	-0.7	-12.6	0.092	≤1000	PASS

[Test mode in AC138V operation. (115%)]

Channel	Center Frequency [MHz]	Pol. [H/V]	Reading [dBm]	Factor [dB]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	H	-7.9	-0.7	-8.6	0.231	≤1000	PASS
40	2441.0	H	-9.7	-0.7	-10.4	0.152	≤1000	PASS
79	2480.0	H	-11.7	-0.7	-12.4	0.096	≤1000	PASS

[Test mode in Battery operation. (Full charge)]

Channel	Center Frequency [MHz]	Pol. [H/V]	Reading [dBm]	Factor [dB]	Level [dBm]	Peak Output Power [mW]	Limit [mW]	PASS /FAIL
1	2402.0	H	-6.4	-0.7	-7.1	0.326	≤1000	PASS
40	2441.0	H	-9.2	-0.7	-9.9	0.171	≤1000	PASS
79	2480.0	H	-12.1	-0.7	-12.9	0.086	≤1000	PASS

Calculation :

$$\text{Peak output power : } P = (E \times d)^2 / 30G$$

P : The power, in Watts

E : The measured peak field strength, in Volts/meter

D : The distance at which the measurement was made, in meters

G : The numeric gain of the radiating element

Test Personnel:

Tester Signature:

Tester Name:


Jun Shimanuki

Date : Apr. 24, 2003

Temperature : 19.1 [°C]

Humidity : 56.4 [%]

Test place : Site 2

5.7. Band Edge Compliance of RF Conducted Emissions

5.7.1 Test Procedure [FCC 15.247 (c), IC6.2.2 (o)(e1)]

The Band Edge is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to :

- RBW=100KHz, VBW=100KHz, Span=Arbitrary setting, Sweep=Auto

The EUT was set to operate with following conditions.

- Hopping [ch 1 (low) and ch 79 (high)]
- No hopping [ch 1 (low) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode

5.7.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm	Loss: 0.1dB
			N/A



5.7.3 Limit of Band-edge Compliance of RF Conducted Emissions

The emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.

5.7.4 Measurement Results of Band-edge

[Hopping]

Channel	Frequency [MHz]	The highest inband spectral density of 100kHz bandwidth. [dBm]	Band-edge Frequency [MHz]	Band-edge Level [dBm]	Difference Level [dBm]	Limit [dBm]	PASS/FAIL
1	2402.0	1.67	2401.31	-28.55	30.22	At least 20dB below from peak of RF.	PASS
79	2480.0	-1.47	2481.11	-32.62	31.15	At least 20dB below from peak of RF.	PASS

[No hopping]

Channel	Frequency [MHz]	The highest inband spectral density of 100kHz bandwidth. [dBm]	Band-edge Frequency [MHz]	Band-edge Level [dBm]	Difference Level [dBm]	Limit [dBm]	PASS/FAIL
1	2402.0	2.25	2401.14	-32.57	34.82	At least 20dB below from peak of RF.	PASS
79	2480.0	-1.67	2481.06	-32.45	30.78	At least 20dB below from peak of RF.	PASS

5.7.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix F**.

Test Personnel:

Tester Signature:

Tester Name:


Jun Shimanuki

Date : Apr . 24, 2003
Temperature : 20.1 [°C]
Humidity : 53.6 [%]
Test place : Shielded room

5.8. Spurious Emissions - Conducted -

5.8.1 Test Procedure [FCC 15.247(c), IC 6.2.2(o)(e1)]

The spurious emissions (Conducted) is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=100kHz, VBW=100kHz, Span=Arbitrary setting, Sweep=300ms

The EUT was set to operate with following conditions.

- Hopping
- No hopping [ch 1 (low), ch 40 (mid) and ch 79 (high)]

The test mode of EUT is as follows.

- Test mode

5.8.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.8.3 Limit of Spurious Emissions - Conducted -

The emission in any 100KHz of outband shall be at least 20dB below the highest inband spectral density.

5.8.4 Measurement Results of Spurious Emissions - Conducted -

[Hopping]

Channel	Frequency [MHz]	Limit [dBm]	Results Chart	PASS / FAIL
1	2402.0 – 2480.0	At least 20dB below from peak of RF.	Appendix H	PASS

[No hopping]

Channel	Frequency [MHz]	Limit [dBm]	Results Chart	PASS / FAIL
1	2402.0	At least 20dB below from peak of RF.	Appendix H	PASS
40	2441.0	At least 20dB below from peak of RF.	Appendix H	PASS
79	2480.0	At least 20dB below from peak of RF.	Appendix H	PASS

5.8.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix G**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 24, 2003

Temperature : 17.3 [°C]

Humidity : 39.2 [%]

Test place : Shielded room

5.9. Spurious Emissions - Radiated - (9kHz – 25GHz)

5.9.1 Test Procedure [FCC 15.205/209/247(c), IC 6.2.1/6.2.2(o)(e1)/6.3]

Radiated emission measurements are performed at 3m distance with the broadband antenna (Loop antenna, Biconical antenna, log-periodic antenna and double-ridged guide antenna). The antenna is positioned both the horizontal and vertical planes of polarization and height is varied 1 to 4 meters and stopped at height producing the maximum emission. As for the Loop antenna, it is positioned with its plane vertical, and the center of the Loop is 1.0meter above the ground plane. Frequency Range: 9kHz –1GHz is scanned and investigated with the test receiver, and above 1GHz, with the spectrum analyzer. The detector function of the test receiver is set to CISPR Quasi-peak mode and the bandwidth is set to 120kHz. Peak and average detectors are used for measurements above 1GHz. The bandwidth of the spectrum analyzer is set to 1MHz.

The EUT and support equipment are placed on a 1 meter x 2.3meter surface, 0.8meter height wooden table. The turntable is rotated by 360 degrees and stopped at azimuth of producing the maximum emission.

Interconnecting cables, which hanging closer than 40cm to the horizontal metal ground plane are bundled its excess in center. The highest fundamental frequency generated in the EUT is 2402-2480MHz, therefore the frequency was investigated up to 25GHz, as specified in CFR section 15.33, and at least six highest emissions are reported. The test results represent the worst-case emission for each emission with manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation.

Sufficient time for the EUT, support equipment, and test equipment are allowed in order for them to warm up to their normal operating condition.

5.9.2 Test Instruments and Measurement Setup

Spurious Emission Test Instrumentation

[Testing below 30MHz]

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer (100Hz-1.5GHz)	Agilent Technologies	8568B	2732A03847
Test Receiver (9kHz-30MHz)	ROHDE&SCHWARZ	ESHS10	842884/009
Loop Antenna	ROHDE&SCHWARZ	HFH2-Z2	892246/010
Coaxial cable	Fujikura	8D-2W/15m 5D-2W/1m	YTCRFC#2C
Coaxial Switch	Anritsu	MP59B	6100097264

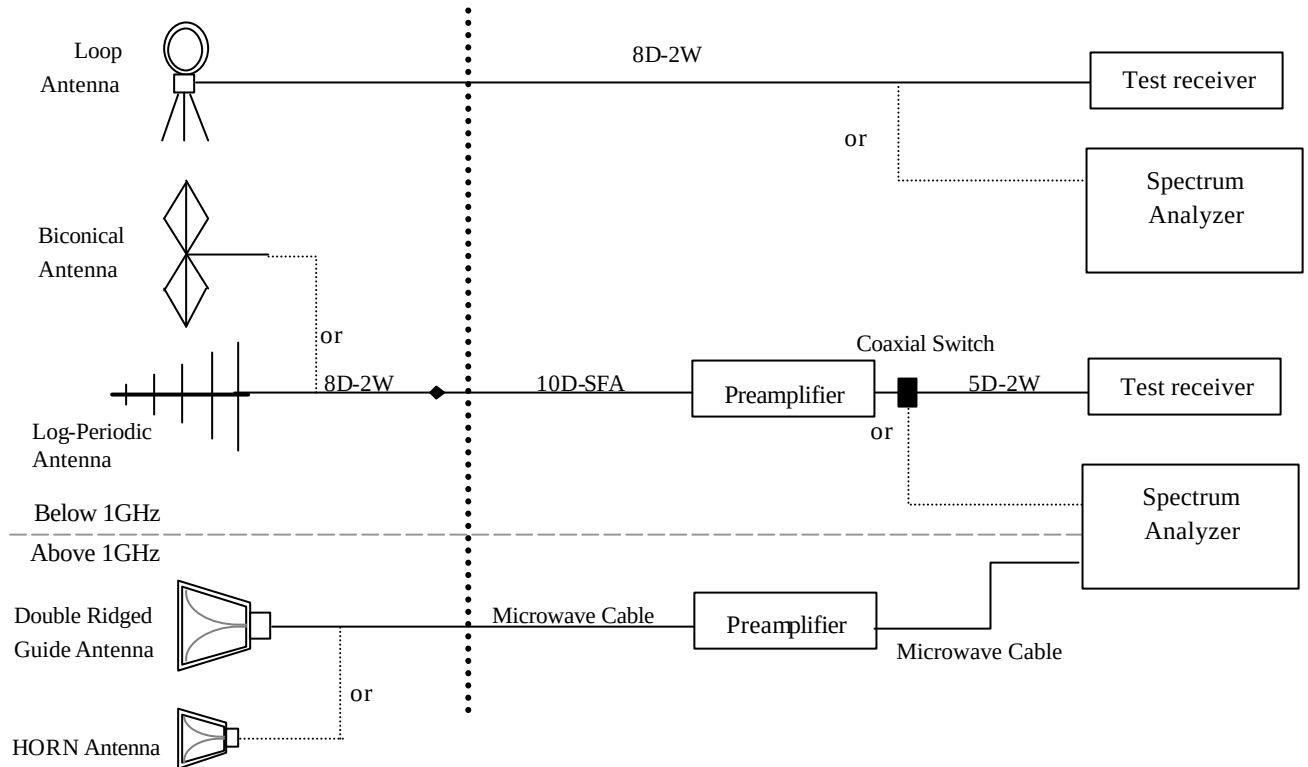
[Testing 30MHz-1GHz]

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer (100Hz-1.5GHz)	Agilent Technologies	8568B	2732A03847
Preamplifier (100kHz-1.2GHz)	Anritsu	MH648A	M96157
Test Receiver (20MHz-1.3GHz)	ROHDE&SCHWARZ	ESVP	891807/010
Biconical Antenna	Schwarzbeck	VHA9103/BBA9106	1563
Log Periodic Antenna	Schwarzbeck	UHALP9108A	0438
Coaxial cable	Fujikura	8D-2W/8m 10D-SFA/29m 5D-2W/1m	YTCRFC#2R
Coaxial Switch	Anritsu	MP59B	6100097273

[Testing above 1GHz]

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Preamplifier	Agilent Technologies	HP8449B	3008A01008
Double Ridged Guide Antenna	EMCO	3115	4327
HORN Antenna	Schwarzbeck	BBHA9170	BBHA9170189
Microwave cable	Suhner	SUCOFLEX 104/15m SUCOFLEX 104/1m	108014/4 108015/4

Test configuration for Conducted emission



5.9.3 Limit of Radiated Emission Measurement

Frequency [MHz]	Field Strength	
	[uV/m]	[dBuV/m]
0.009 – 0.490	$2400 / F$ [kHz]	$20\log E$ [uV/m]
0.490 – 1.705	$24000 / F$ [kHz]	$20\log E$ [uV/m]
1.705-30	30	29.5
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level [dBuV/m] = $20 \log$ Emission [uV/m]
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

5.9.4 Sample of field strength calculation

Radiated Emission	$\text{dB } \mu\text{V/m} = 20\log_{10} (\mu\text{V/m})$
Limit @147.6MHz = 150 $\mu\text{V/m}$ = 43.5dB $\mu\text{V/m}$	
Reading = 42.8dB μV	
Ant. Factor + Cable Loss - Amp. Gain = 14.2 + 3.0 - 30.0 = -12.8dB	
Total = 42.8 - 12.8 = 30.0dB $\mu\text{V/m}$	
Margin = 43.5 - 30.0 = <u>13.5dB</u>	

5.9.5 Measurement Results

The minimum margins to the limits are as follows:

Channel	Frequency [MHz]	Pol. [H/V]	Antenna Height [m]	Table Degree [deg.]	Margin [dB]	Detector
1	7206.70	H	1.4	250	14.8	Average
40	7323.70	H	1.5	305	14.8	Average
79	7440.70	H	1.5	310	15.5	Average

Note:

- 1.Emission Level (Margin) = Limit – [Reading + Factor (Antenna + Cable - Amp)]
- 2.The 6 highest emissions relative to the limits are reported.
- 3.The EUT was found to comply to the limits of FCC Part15 Subpart C and RSS-210 with a margin of 14.8dB.
4. No emissions were detected in frequency range 9KHz to 30MHz at the 3 meters distance.

5.9.6 Data

As for the chart of the observed RF profiles, refer to **Appendix H**.

5.10. Restricted Band of Operation

5.10.1 Test Procedure [FCC 15.205, 15.209, 15.247(c), IC 6.2.1/6.3]

The peak power is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

- RBW=1MHz, VBW=1MHz, Span=Arbitrary setting, Sweep=auto

The EUT was set to operate with following conditions.

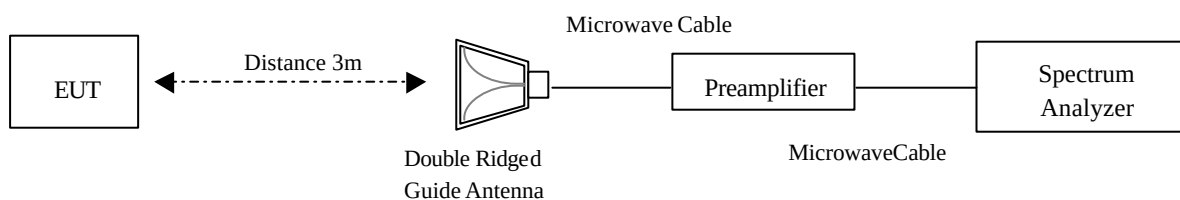
- Hopping

The test mode of EUT is as follows.

- Test mode

5.10.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Preamplifier	Agilent Technologies	HP8449B	3008A01008
Double Ridged Guide Antenna	EMCO	3115	4327
Microwave cable	Suhner	SUCOFLEX 104/15m SUCOFLEX 104/1m	108014/4 108015/4



5.10.3 Limit of Restricted Band of Operation

Emission at the boundary of the restricted band provided by 15.205 shall be lower than 15.209 limit.

5.10.4 Measurement Result

Frequency [MHz]	Pol. [H/V]	Reading [dBuV/m]		Factor [dB]	Emission Level [dBuV/m]		Limit [dBuV/m]		Margin [dB]		PASS /FAIL
		Peak	Ave.		Peak	Ave.	Peak	Ave.	Peak	Ave.	
2390.0	H	49.0	24.3	-1.0	48.0	23.3	74.0	54.0	26.0	30.7	PASS
2390.0	V	52.2	24.6	-1.0	51.2	23.6	74.0	54.0	22.8	30.4	PASS
2483.5	H	58.9	23.1	-0.7	58.2	22.4	74.0	54.0	15.8	31.6	PASS
2483.5	V	55.0	23.9	-0.7	54.3	23.2	74.0	54.0	19.7	30.8	PASS

5.10.5 Trace Data

As for the chart of the observed RF profiles, refer to Appendix I.

Test Personnel:

Tester Signature:

Tester Name:


Hiroaki Suzuki

Date : Apr. 24, 2003
Temperature : 20.1 [°C]
Humidity : 53.6 [%]
Test place : Site 2

5.11. Transmitter Power Spectral Density

5.11.1. Test Procedure [FCC 15.247(d)/247(f), IC 6.2.2(o)(b)]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

The spectrum analyzer is set to:

RBW= 3KHz, VBW=10KHz, Span=300kHz, Sweep = 100 sec.

5.11.2 Test Instruments and Measurement Setup

Equipment	Company	Model Number	Serial Number
Spectrum Analyzer	ADVANTEST	R3271A	65050042
Coax cable: - Spectrum Analyzer <=> EUT	N/A	Length: 5cm Loss: 0.1dB	N/A



5.11.3 Limit of Transmitter Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band.

5.11.4 Measurement Results

Test Mode	Ch No.	Frequency [MHz]	Reading [dBm]	Factor (Cable loss) [dB]	Level [dBm]	Limit [dBm]	Margin [dB]
Inquiry	40	2441.0	-13.0	0.1	-12.9	8.0	20.9

Note:

1. Transmitter Power Spectral Density Level (Margin) = Limit – [Reading + Factor (Cable)]

5.11.5 Trace Data

As for the chart of the observed RF profiles, refer to **Appendix J**.

Test Personnel:

Tester Signature:

Tester Name:

Jun Shimanuki
Jun Shimanuki

Date : Apr. 26, 2002
Temperature : 17.3 [°C]
Humidity : 40.3 [%]
Test place : Shielded room

5.12. Conducted emission measurements

5.12.1 Test Procedure [FCC 15.207, IC 6.6]

FCC

The conducted emission measurements are performed with the test receiver. The detector function of the test receiver is set to CISPR quasi-peak mode and average mode with 9 kHz of bandwidth. The frequency range from 150kHz to 30 MHz is scanned, and at least six highest emissions are reported. The test results represent the worst-case emission for each emission with manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation.

EUT and support equipment are on a 1 meter x 2.3 meter surface, 0.8 meter height wooden table. EUT is placed 40 cm away from the vertical metal ground plane of 2.4 meter x 2.7 meter in size.

50 Ω /50 μ H Line Impedance Stabilization Network (LISN) are 80cm away from the EUT and placed on the conducting ground plane. LISN for peripheral is terminated in 50 Ω .

Sufficient time for the EUT, support equipment and test equipment are allowed in order for them to warm up to their normal operating condition.

IC

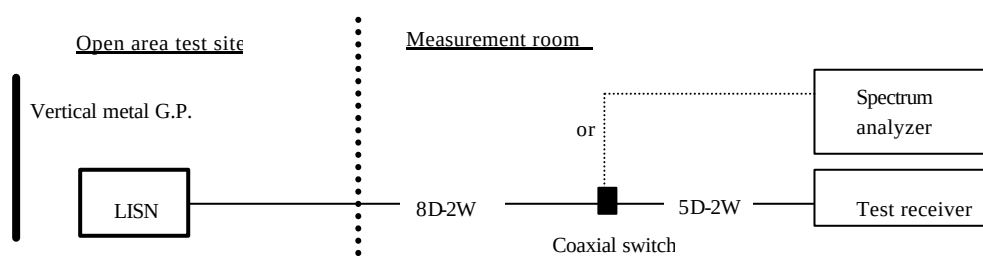
The conducted emission measurements are performed with the test receiver. The detector function of the test receiver is set to CISPR quasi-peak mode and the bandwidth is set to 9kHz. The frequency range from 450kHz to 30 MHz is scanned, and at least six highest emissions are reported. The test results represent the worst-case emission for each emission with manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation.

EUT and support equipment are on a 1 meter x 2.3 meter surface, 0.8 meter height wooden table. EUT is placed 40 cm away from the vertical metal ground plane of 2.4 meter x 2.7 meter in size.

50 Ω /50 μ H Line Impedance Stabilization Network (LISN) are 80cm away from the EUT and placed on the conducting ground plane. LISN for peripheral is terminated in 50 Ω .

Sufficient time for the EUT, support equipment and test equipment are allowed in order for them to warm up to their normal operating condition.

Test configuration for Conducted emission



5.12.2 Test equipment for Conducted emission

Equipment	Company	Model Number	Serial Number
Spectrum analyzer	Agilent Technologies	8568B	2732A03847
Test receiver	ROHDE&SCHWARZ	ESHS10	842884/009
Line impedance stabilization network for peripheral	Kyoritsu Electrical Works, Ltd.	KNW-242C	8-1096-3
Line impedance stabilization network for EUT	Kyoritsu Electrical Works, Ltd.	KNW-407	8-693-20
50 Ω terminator	Agilent Technologies	11593A	N/A
Coaxial cable	FUJIKURA	8D-2W/15m 5D-2W/1m	YTCRFC#2C
Coaxial switch	ANRITSU	MP59B	6100097264

5.12.3 Limit of Conducted Emission Measurement

FCC

Frequency [MHz]	Limit [dBuV]	
	Quasi-peak	Average
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5	56	46
5 - 30	60	50

IC

Frequency [MHz]	Limit [uV]
	Quasi-peak
0.450 - 30	250

NOTE:

The limits of FCC Part 15 section 15.207 that became effective on September 9, 2002, adopted under FCC 02-157 (ET Docket 98-80), were applied to conducted emission measurements.

As for Industry Canada requirements, the limits of RSS-210 paragraph 6.6(a) were applied.

5.12.4 Sample of field strength calculation

Conducted emission [Sample calculation] $\text{dB}\mu\text{V} = 20\log_{10} (\mu\text{V})$

FCC	
Limit @ 6.770MHz : 60.0dB μV (Quasi peak)	
50.0dB μV (Average)	
(Quasi peak) Reading = 51.2dB μV	
Cable loss + AMN factor = 0.3dB	
Total = 51.2 + 0.3 = 51.5dB μV	
Margin = 60.0 – 51.5 = <u>8.5dB</u>	
(Average) Reading = 45.0dB μV	
Cable loss + AMN factor = 0.3dB	
Total = 45.0 + 0.3 = 45.3dB μV	
Margin = 50.0 – 45.3 = <u>4.7dB</u>	

IC	
Limit @3.332MHz: = 250 μV = 48.0dB μV	
Reading = 41.6dB μV	
Cable loss + LISN factor = 0.2 + 0.5 = 0.7dB	
Total = 41.6 + 0.7 = 42.3dB μV	
Margin = 48.0 - 42.3 = <u>5.7dB</u>	

5.12.5 Measurement Results

The minimum margins to the limits are as follows:

FCC/IC	Frequency [MHz]	Phase	Margin [dB]	Detector
FCC	0.184	L1	9.5	Average
IC	19.287	L1	3.3	Quasi-peak

Note:

- 1.Emission Level (Margin) = Limit – [Reading + Factor]
- 2.The 6 highest emissions relative to the limits are reported.
- 3.The EUT was found to comply to the limit of FCC Part15 Subpart C with a margin of 9.5dB.
- 4.The EUT was found to comply to the limit of RSS-210 with a margin of 3.3dB.

5.12.6 Data

As for the chart of the observed RF profiles, refer to **Appendix K**.

6. Laboratory Description

6.1 Description for Test Site

1. Location: ZACTA Technology Corporation Yonezawa Testing Center

4149-7 Hachimanpara 5-chome Yonezawa-shi Yamagata 992-1128 Japan

Phone: +81-238-28-2880 Fax: +81-238-28-2888

2. The number and type of Site:

Site name: Site 1, Site 2 and Site 3 - Total 3 sites.

Site type : Whether protected site

*3m/10m Radiated emission & Conducted emission testing can be performed on each site

3. Facility filing information:

1) FCC site filing: Pursuant to CFR47 § 2.948

Site name	Filing date (Terms of validity: 3 years)
Site 1, Site 2 and Site 3	December 17, 2002

2) Industry Canada Oats site filing: Pursuant to RSS 212, Issue 1(Provisional)

Site name	Sites on file: Oats 3m/10m	Filing date (Terms of validity: 3 years)
Site 1	4224-1	January 31, 2002
Site 2	4224-2	January 31, 2002
Site 3	4224-3	January 31, 2002

3) VCCI site filing: Pursuant to V-5/99.05 VCCI regulations for registration of measurement facilities

Site name	Radiated emission registration No.	Conducted emission registration No.	Duration of registration
Site 1	R-136	C-132	September 30, 2003
Site 2	R-137	C-133	September 30, 2003
Site 3	R-138	C-134	September 30, 2003

4) NVLAP accreditation:

NVLAP Lab. code: 200306-0

This test report must not be used by client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Scope of accreditation

Emission test methods: CISPR 22, FCC Part 15-Digital devices (Conducted / Radiated emission), AS/NZS 3548.

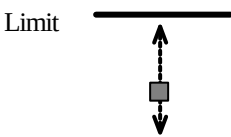
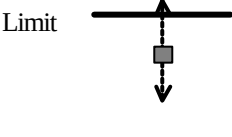
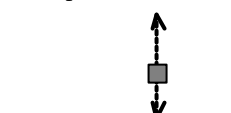
Immunity test methods: IEC 61000-4-2, 4-3, 4-4, 4-5, 4-6, 4-8, 4-11

6.2 Uncertainty

Expanded uncertainties stated were calculated with a coverage Factor **k=2**.

$\pm 2.97\text{dB}$	• • • For Conducted emission
$\pm 5.23\text{dB}$	• • • For 3m Radiated emission
$\pm 4.26\text{dB}$	• • • For 10m Radiated emission

Judgment of uncertainty under the measurement data and the scope of permission

Example A	Example B	Example C	Example D
			
Judgment: Complied	Judgment: Complied	Judgment: Not complied	Judgment: Not complied
The result of measurement is compliance with the limit in 95% or more confidence probability.	The result of measurement is compliance with the limit with less extent of uncertainty of the measurement. It is impossible to consider it complies with the limit in 95% confidence probability, but the result satisfies the limit in high probability.	The result of measurement is not compliance with the limit with less extent of uncertainty of the measurement. It is impossible to consider it complies with the limit in 95% confidence probability, but the result does not satisfy the limit in high probability.	The result of measurement is not compliance with the limit.

———— : Limit ■ : Result of the measurements ———— : Uncertainty