RADIO TEST REPORT

Test Report No. : 32IE0296-SH-01-A

Applicant	:	**Seiko Epson Corporation**
Type of Equipment	:	**Runner's tool with GPS function**
Model No.	:	**SS-500**
FCC ID	:	**BKMAP001**
Test regulation	:	**FCC Part15 Subpart C: 2012**
Test result	:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test: June 14 to 18, 2012

Representative test engineer:

Akio Hayashi
Engineer of WiSE Japan,
UL Verification Service

Approved by :

Toyokazu Imamura
Leader of WiSE Japan,
UL Verification Service

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

JAB Testing RTL02610

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Shonan EMC Lab.
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REVISION HISTORY

Original Test Report No.: 32IE0296-SH-01-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	32IE0296-SH-01-A	June 29, 2012	-	-
1	32IE0296-SH-01-A	July 20, 2012	1-2 4-5 6, 9, 11 13-15	P1-2: Update P4-5: Deletion of photo P6, 9, 11: Modification caused by data correction P13-15: Correction of data
2	32IE0296-SH-01-A	July 24, 2012	1-2 6, 9, 11 14-15	P1-2: Update P6, 9, 11: Modification caused by data correction P14-15: Correction of data

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Contents

SECTION 1: Customer information

Company Name	:	Seiko Epson Corporation
Address	:	6925 Toyoshina-tazawa, Azumino-shi, Nagano-ken 399-8285 Japan
Telephone Number	:	+81-263-73-5795
Facsimile Number	:	+81-263-73-5795
Contact Person	:	Manabu Komiyama

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Runner's tool with GPS function
Model No.	:	SS-500
Serial No.	:	Refer to 4.2 of this report.
Rating	:	DC3.7V
Receipt Date of Sample	:	June 8, 2012
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No modification by the test lab.

2.2 Product description

Model: SS-500 (referred to as the EUT in this report) is a Runner's tool with GPS function.

Clock frequency(ies) in the system : 16MHz

Radio specification

Equipment type	:	Transceiver
Frequency of operation	:	2457MHz
Type of modulation	:	GFSK
Antenna type	:	Chip
Antenna connector type	:	None
Operation temperature range	:	-5 to +50 deg.C.
ITU code	:	F1D

FCC 15.31 (e)
This EUT provides stable voltage (DC3.0V and DC1.8V) constantly to RF transmitter regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC 15.203
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement.

Derived models of the EUT: SS-700
- Modules are common. Form and the colors of the case are different. (SS-500: Square type, SS-700: Round type)
- The difference of appearance does not affect to the radio function.

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2012,
final revised on May 17, 2012 and effective June 18, 2012

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits, general requirements
Section 15.249 Operation within the bands 902-928MHz, 2400-2483.5MHz, 5725-5875MHz, and 24.0-24.25GHz

*The revision on May 17, 2012 does not affect the test specification applied to the EUT.

The EUT complies with FCC Part 15 Subpart B. Refer to the test report: 32IE0296-SH-01-B.

3.2 Procedures & Results

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.4:2009 7. AC powerline conducted emission measurements	FCC 15.207	-	N/A *1)	N/A	N/A
20dB bandwidth	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.215	Conducted	N/A	-	-
Electric field strength of fundamental emission	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.249 (a)(e), 15.209	Radiated	N/A	11.0dB (for Average Limit) *3) Detector: Peak Polarization: Vertical	Complied
Electric field strength of spurious emission	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.205 (a)(b), 15.209, 15.249 (a)(d)(e)	Radiated	N/A	0.3dB (for Average Limit) *3) Freq.: 4914.000 MHz Detector: Peak Polarization: Vertical	Complied
Frequency tolerance	ANSI C63.4:2009 13. Measurement of intentional radiators	FCC 15.249 (b)	-	N/A *2)	N/A	N/A

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422
*1) The test is not applicable since the EUT has no AC mains. (The EUT does not perform the radio function during recharging.)
*2) The test is not required since this EUT does not operate in the restricted bands and the prohibited TV bands.
*3) The limit for Average detector is applied to the measurement value with Peak detector.

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied bandwidth (99%)	ANSI C63.4:2009 13. Measurement of intentional radiators, RSS-Gen 4.6.1	-	Conducted	-	-

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422

* Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Item	Frequency range	No.1 SAC*1/SR*2 (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.7 dB	3.7 dB	3.6 dB
	30MHz-300MHz	4.9 dB	5.1 dB	5.0 dB
	300MHz-1GHz	5.0 dB	5.2 dB	5.0 dB
	1GHz-18GHz	4.8 dB	4.8 dB	4.9 dB
	18GHz-26.5GHz	5.0 dB	4.5 dB	4.5 dB

*1: SAC=Semi-Anechoic Chamber
*2: SR= Shielded Room is applied besides radiated emission

The data listed in this test report has enough margin, more than site margin.

Antenna port conducted test
Bandwidth measurement uncertainty for this test was: (±) 5.4%

3.5 Test location

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Telephone number : +81 463 50 6400
Facsimile number : +81 463 50 6401
JAB Accreditation No. : RTL02610

	FCC Registration No.	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
☐ No.1 Semi-anechoic chamber	697847	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☒ No.2 Semi-anechoic chamber	697847	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☐ No.3 Semi-anechoic chamber	697847	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
☐ No.4 Full-anechoic chamber	-	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
☐ No.1 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
☐ No.2 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
☐ No.3 shielded room	-	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
☐ No.4 shielded room	-	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
☒ No.5 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
☐ No.6 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-

3.6 Test setup, Data of test & Test instruments

Refer to APPENDIX 1 to 3.

SECTION 4: Operation of E.U.T. during testing

4.1 Operating mode

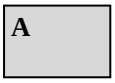
The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

Test item	Operating mode	Tested frequency
All items	Transmitting	2457MHz

Firmware: TEST ver. 07132 (manufactured by Seiko Epson)

Justification: The system was configured in typical fashion (as customer would normally use it) for testing.

4.2 Configuration and peripherals



* Test data was taken under worse case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Runner's tool with GPS function	SS-500	*1)	Seiko Epson	EUT

*1) Antenna terminal conducted test: 83, Other tests:ES016

SECTION 5: Radiated emission

5.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

5.2 Test configuration

EUT was placed on a urethane platform of nominal size, 0.5m by 0.5m, raised 0.8m above the conducting ground plane. Photographs of the set up are shown in APPENDIX 3.

5.3 Test conditions

Frequency range : 9kHz to 26GHz
EUT position : Table top

5.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 3m

<9kHz to 30MHz>
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0deg.to 360deg.) and horizontal polarization.

* FCC 15.31 (f)(2) (9kHz-30MHz)
9kHz – 490kHz [Limit at 3m]= [Limit at 300m]-40log (3[m]/300[m])
490kHz – 30MHz [Limit at 3m]= [Limit at 30m]-40log (3[m]/30[m])

<30MHz to 26GHz>
The measuring antenna height was varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity. The measurements were performed for both vertical and horizontal antenna polarization.

The radiated emission measurements were made with the following detection of the test receiver and spectrum analyzer.

	9kHz to 90kHz & 110kHz to 150kHz	90kHz to 110kHz	150kHz to 490kHz	490kHz to 30MHz	30MHz to 1GHz	1GHz to 26GHz	
Detector type	PK/AV	QP	PK/AV	QP	QP	PK	AV *1)
IF Bandwidth	200Hz	200Hz	10kHz	9kHz	120kHz	RBW: 1MHz /VBW: 3MHz	-

*1) Measurement with Average detector was not performed. The limit for Average detector is applied to the measurement value with Peak detector.

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Worst position:

Frequency / Antenna polarization	Carrier	Spurious		
		9kHz-30MHz	30-1000MHz	1-26GHz
Horizontal	Z	X	X	Y
Vertical	Y	X	X	X

Figure 1. Direction of the Loop Antenna

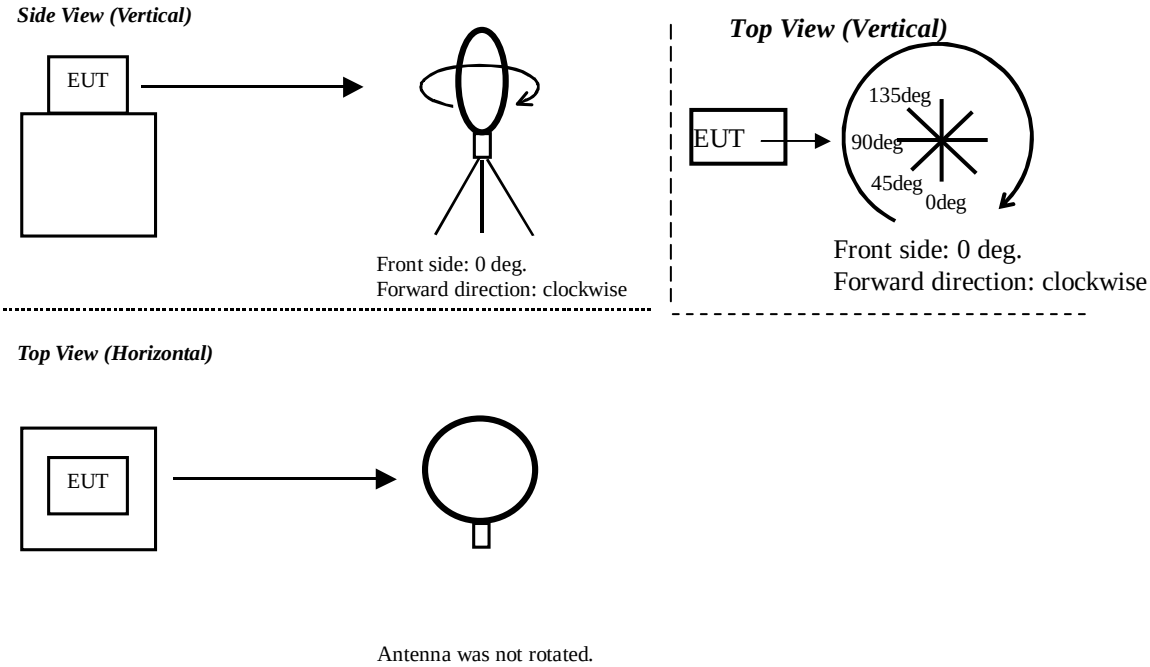
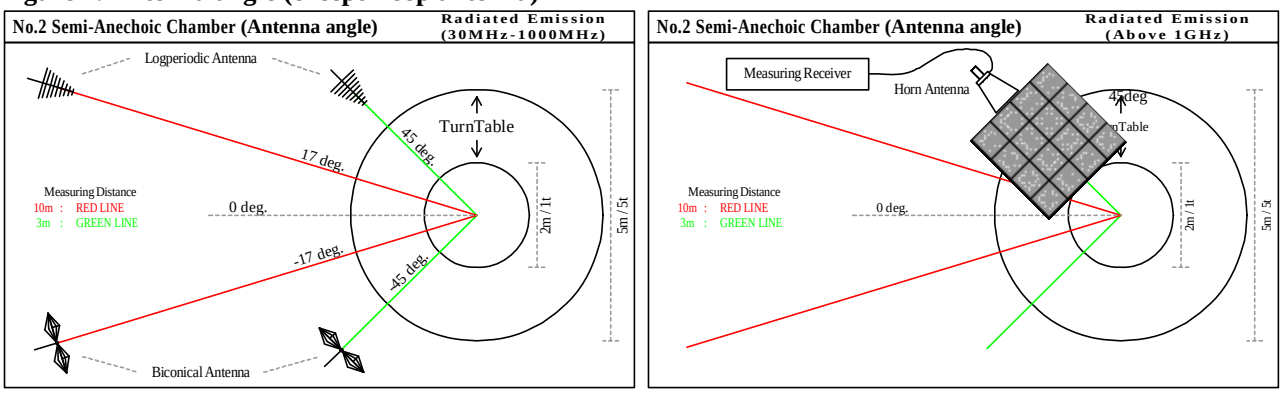


Figure 2. Antenna angle (except Loop antenna)



5.5 Results

Summary of the test results : Pass
* No noise was detected in the 6th to 10th harmonics and below 30MHz.

Refer to APPENDIX 1

SECTION 6: 20dB bandwidth & Occupied bandwidth (99%)

6.1 Test procedure

The bandwidth was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass

Refer to APPENDIX 1

Contents of APPENDIXES

APPENDIX 1: Test data

20dB bandwidth
Radiated emission
Duty cycle chart (For Reference)
99% Occupied bandwidth

APPENDIX 2: Test instruments

Test instruments

APPENDIX 3: Photographs of test setup

Radiated emission
Pre-check of the worst position

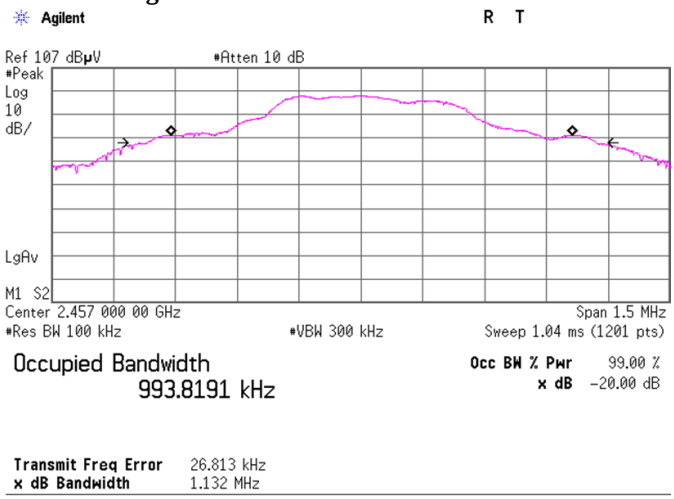
APPENDIX 1: Test data

20dB Bandwidth

		UL Japan, Inc.	
		Shonan EMC Lab.	No.5 Shielded Room
Company	: Seiko Epson Corporation	Regulation	: FCC Part15C Section 15.215
Equipment	: Runner's tool with GPS function	Test Distance	: 3m
Model	: SS-500	Date	: June 14, 2012
Sample No.	: 83	Temperature	: 23deg.C
Power	: DC3.7V	Humidity	: 52%RH
Mode	: Transmitting	Engineer	: Akio Hayashi

	20dB Bandwidth [MHz]
2457MHz	1.132

Transmitting 2457MHz



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Radiated Emission (Below 1GHz)

Test place UL Japan, Inc. Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date 2012/6/18
Temperature / Humidity 24 deg.C , 50%RH
Engineer Akio Hayashi
Mode Transmitting

(* QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	30.097	QP	24.5	18.5	6.9	31.9	18	40	22	202	287	
Hori.	188.703	QP	23.2	16.2	9.2	31.8	16.8	43.5	26.7	198	167	
Hori.	857.985	QP	22.9	21.5	9.8	31.1	23.1	46	22.9	150	242	
Vert.	31.923	QP	24.6	17.7	7	31.9	17.4	40	22.6	100	1	
Vert.	212.003	QP	24.2	16.6	9.6	31.8	18.6	43.5	24.9	100	172	
Vert.	700.489	QP	23.7	20.2	9.1	31.6	21.4	46	24.6	100	352	
Vert.	929.3	QP	23.1	22.4	10.1	30.7	24.9	46	21.1	100	116	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).
*The 10th harmonic was not seen so the result was its base noise level.
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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Radiated Emission (Above 1GHz)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.2 Semi Anechoic Chamber
Date	2012/6/17	
Temperature / Humidity	23 deg.C , 49%RH	
Engineer	Akio Hayashi	
Mode	Transmitting	

(* PK: Peak, AV: Average)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit *1) [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	1227	PK	46.9	24.2	12.9	38.7	45.3	53.9	8.6	100	223	
Hori.	2390	PK	45.3	27.2	14.1	38.2	48.4	53.9	5.5	100	231	
Hori.	2399.99	PK	45	27.3	14.1	38.2	48.2	53.9	5.7	100	231	
Hori.	2457	PK	78.2	27.4	14.1	38.1	81.6	93.9	12.3	100	231	
Hori.	2483.5	PK	44.2	27.5	14.1	38.1	47.7	53.9	6.2	100	231	
Hori.	2810.282	PK	45.6	28.2	6.2	38	42	53.9	11.9	100	24	
Hori.	2853.249	PK	44.9	28.3	6	38	41.2	53.9	12.7	100	331	
Hori.	2920.57	PK	46.4	28.4	5.8	38	42.6	53.9	11.3	100	46	
Hori.	4406.972	PK	43.8	30.3	6.3	37.3	43.1	53.9	10.8	100	165	
Hori.	4913	PK	50.9	31.4	6.6	36.9	52	53.9	1.9	100	356	
Hori.	7371	PK	46.7	36.8	8.3	39	52.8	53.9	1.1	100	187	
Vert.	1227	PK	46.2	24.2	12.9	38.7	44.6	53.9	9.3	100	187	
Vert.	2390	PK	44.2	27.2	14.1	38.2	47.3	53.9	6.6	100	188	
Vert.	2399.99	PK	44.5	27.3	14.1	38.2	47.7	53.9	6.2	100	188	
Vert.	2457	PK	79.5	27.4	14.1	38.1	82.9	93.9	11.0	100	188	
Vert.	2483.5	PK	44.3	27.5	14.1	38.1	47.8	53.9	6.1	100	188	
Vert.	2810	PK	47.3	28.2	6.2	38	43.7	53.9	10.2	100	35	
Vert.	2853.344	PK	47.3	28.3	6	38	43.6	53.9	10.3	100	256	
Vert.	2919.847	PK	45.9	28.4	5.8	38	42.1	53.9	11.8	100	154	
Vert.	4407.095	PK	46.1	30.3	6.3	37.3	45.4	53.9	8.5	100	44	
Vert.	4914	PK	52.5	31.4	6.6	36.9	53.6	53.9	0.3	100	302	
Vert.	7371	PK	47.4	36.8	8.3	39	53.5	53.9	0.4	100	196	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)

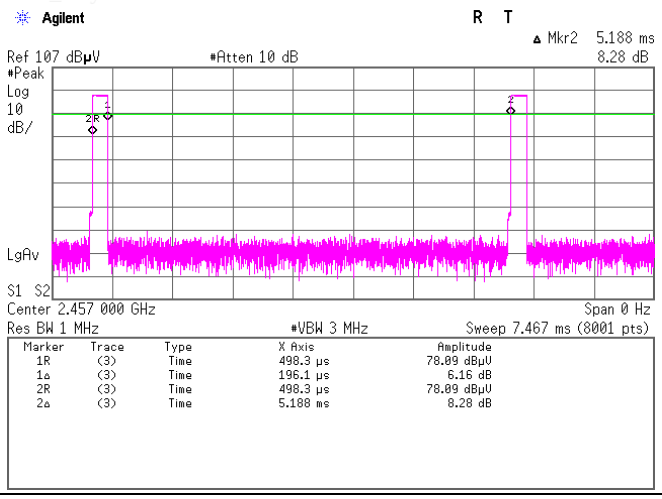
*1) The limit for Average detector is applied.

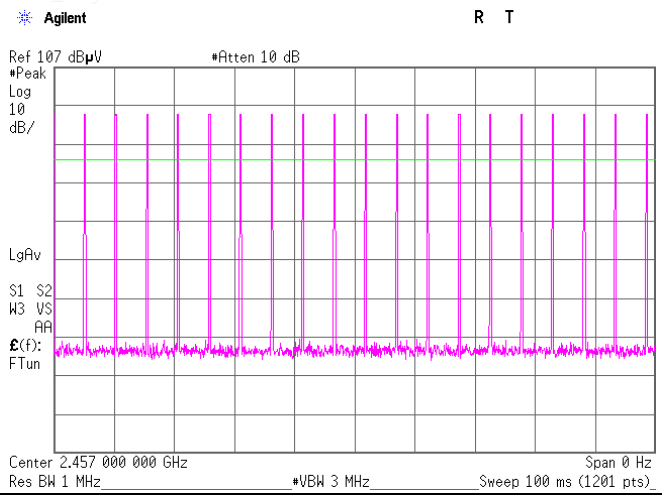
*2) Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

Distance factor 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

Duty Cycle Chart (For Reference)

1x2_duty1	1x2_duty2





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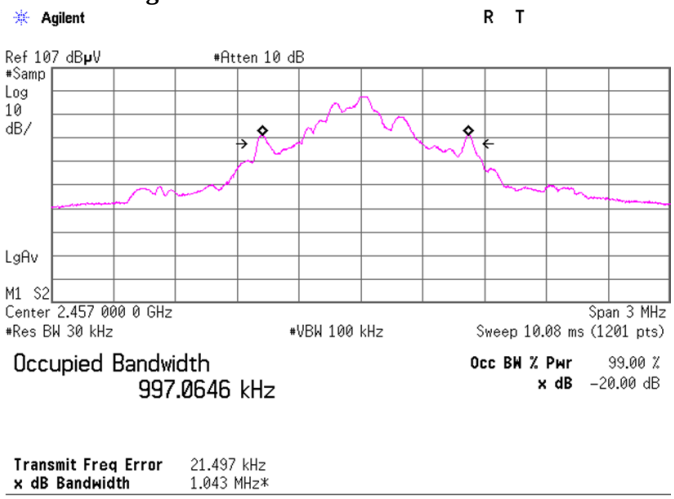
99% Occuiped Bandwidth

UL Japan, Inc.
Shonan EMC Lab. No.5 Shielded Room

Company	: Seiko Epson Corporation	Regulation	: RSS-Gen
Equipment	: Runner's tool with GPS function	Test Distance	: 3m
Model	: SS-500	Date	: June 14, 2012
Sample No.	: 83	Temperature	: 23deg.C
Power	: DC3.7V	Humidity	: 52%RH
Mode	: Transmitting	Engineer	: Akio Hayashi

	99% Occupied Bandwidth [kHz]
2457MHz	997.065

Transmitting 2457MHz



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APPENDIX 2
Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2012/03/26 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	AT	2012/03/16 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2012/03/12 * 12
SAT10-11	Attenuator	Weinschel Corp.	54A-10	37588	AT	2012/04/06 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2012/02/10 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2012/02/10 * 12
SAT3-02	Attenuator	JFW	50HF-003N	-	RE	2012/02/10 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2011/11/16 * 12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2012/04/10 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE, ME	2012/04/10 * 12
SLA-02	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0893	RE	2011/11/16 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2012/02/06 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	RE, ME	2011/08/04 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2011/09/25 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	RE	-
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2012/03/12 * 12
SCC-G02	Coaxial Cable	Suhner	SUCOFLEX 104A	46498/4A	RE	2012/04/10 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2012/05/22 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2011/08/28 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2012/02/16 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2011/12/27 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2011/12/27 * 12
SCC-G17	Coaxial Cable	Suhner	SUCOFLEX 104A	46291/4A	RE	2012/03/12 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2012/03/30 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2012/03/12 * 12
SLP-02	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100218	ME	2011/10/19 * 12
SAT6-07	Attenuator	JFW	50HF-006N	-	ME	2012/02/17 * 12

The expiration date of the calibration is the end of the expired month .
As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations .

All equipment is calibrated with valid calibrations . Each measurement data is traceable to the national or international standards .
Test Item :
ME: Magnetic emission ,
RE: Radiated emission ,
AT: Antenna terminal disturbance voltage