



**Underwriters
Laboratories UL Japan, Inc.**

FCC ID : MMFRWMTM2
Test report No. : 28JE0227-YK-B
Page : 1 of 74
Issued date : August 4, 2008

RADIO TEST REPORT

Test Report No.: 28JE0227-YK-B

Applicant : SATO CORPORATION

Type of Equipment : RFID Reader Module

Model No. : M5e

FCC ID : MMFRWMTM2

Test regulation : FCC Part15 Subpart C: 2008

Test result : Complied

1. This test report shall not be reproduced except in full or partial, without the written approval of UL Japan, Inc.
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.

Date of test: June 24, 26, 27 and 30, 2008

Tested by:

M. Hosaka

Makoto Hosaka

&

T. Suzuki

Takahiro Suzuki

T. Imamura

Toyokazu Imamura

Approved by:

O. Watatani

Osamu Watatani
Manager of Yamakita EMC Lab.

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

Table of Contents	Page
1 Applicant information	3
2 Equipment under test (E.U.T.)	3
3 Test specification, procedures and results	4
4 System test configuration	6
5 Conducted emission	8
6 Carrier frequency separation	9
7 20dB bandwidth & Occupied bandwidth (99%)	9
8 Number of hopping frequency	9
9 Dwell time	8
10 Maximum peak output power	8
11 Out of band emissions (Antenna Port Conducted)	9
12 Out of band emissions (Radiated)	10
<u>Contents of Appendixes</u>	11
APPENDIX 1: Photographs of test setup	12
APPENDIX 2: Test data	19
APPENDIX 3: Test instruments	74

1 Applicant information

Company Name : SATO CORPORATION
Address : 1-207 Onari-cho, Omiya-ku, Saitama-shi, Saitama-ken, 330-0852 JAPAN
Telephone Number : +81 48 663 8112
Facsimile Number : +81 48 651 6662
Contact Person : Yoshimitsu Maeda

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

2.1 Identification of E.U.T.

Type of Equipment : RFID Reader Module
Model No. : M5e
Serial No. : 110801101018
Rating : DC5.0V
Country of Mass-production : USA
Receipt Date of Sample : June 23, 2008
Condition of EUT : Production model
Modification of EUT : No modification by the test lab.

2.2 Product description

Model: M5e (referred to as the EUT in this report) is a RFID Reader Module.

The RFID Reader/Writer and the antenna for performing communication with a RFID tag are built in Sato's RFID printer. The inlet (the RFID tag) which an IC chip was incorporated into is pasted on the label to use and in addition to the reading and writing of RFID; it can do a printout to the surface. In the surface, the text, the image, the bar code and so on can be printed out. The printout data which was entered from the host interface is analyzed inside the printer and is changed and is sent to RFID Reader/Writer module. A RFID Reader/Writer module communicates with the inlet (the RFID tag) which was converted to the label through the antenna. Reading of data, writing, etc. are performed between IC chips. When the writing in to the IC chip ends, a label is conveyed and a printout is done in the surface by the thermal head. The label that RFID data was written will be used for physical distribution, product management and so on.

Equipment type : Transceiver
Frequency of operation : 902.75 - 927.25MHz
Clock frequency : 18.43MHz
Type of modulation : FHSS (ASK)
Antenna type : Dipole, Miniature
Antenna connector type : MMCX
Antenna gain : Dipole: -7.5dBi, Miniature: -3.72dBi
ITU code : G1D
Operation temperature range : -20 to +60 deg.C.

FCC Part15.31 (e)

Host device provides the module with stable power supply (DC 5.0 V), therefore the equipment complies power supply regulation.

FCC Part15.203 Antenna requirement

The equipment and its antenna comply with this requirement since this antenna is connected with unique connector and installed in the end product (Printer), it cannot be replaced by end users.

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

3 Test specification, procedures and results

3.1 Test specification

Test specification : FCC Part15 Subpart C: 2008, final revised on May 19, 2008
 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 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

3.2 Procedures & results

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.4:2003 7. AC powerline conducted emission measurements	FCC Section 15.207	-	N/A	27.0dB (0.2000MHz, L1 Tx 902.75MHz, QP, Dipole antenna)	Complied
Carrier frequency separation	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (a)(1)	Conducted	N/A		Complied
20dB bandwidth	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (a)(1)	Conducted	N/A		Complied
Number of hopping frequency	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (a)(1)(iii)	Conducted	N/A		Complied
Dwell time	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (a)(1)(iii)	Conducted	N/A		Complied
Maximum peak output power	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (b)(1)	Conducted	N/A		Complied
Spurious emission	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.247 (d)	Conducted	N/A		Complied
Spurious emission & Band edge compliance	FCC Public Notice DA 00-705 & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC Section15.209 & Section15.247 (d)	Radiated	N/A	0.6dB (138.15MHz, Vertical, Tx 915.25MHz, QP, Dipole antenna)	Complied

Note: UL Japan's EMI Work Procedures No.QPM05 and QPM15.

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.4:2003 13. Measurement of intentional radiators RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	Complied

* 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.

	No.1 open site (±)	No.2 open site (±)	No.1 anechoic chamber (±)
Conducted emission			
150kHz-30MHz	2.8 dB	2.8 dB	2.8 dB
Radiated emission (3m)			
30-300MHz	4.5 dB	4.4 dB	4.5 dB
300-1000MHz	4.3 dB	4.3 dB	4.3 dB
1GHz<	5.7 dB	5.7 dB	5.7 dB

Conducted Emission Test

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

Radiated Emission Test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test location

UL Japan, Inc. Yamakita EMC Lab.

907, Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken 258-0124 JAPAN

Telephone number : +81 465 77 1011

Faxsimile number : +81 465 77 2112

NVLAP Lab. code : 200441-0

No. 1 test site has been fully described in a report submitted to FCC office, and accepted on July 23, 2008 (Registration No.: 95486).

IC Registration No. : 2973B-1

No. 2 test site has been fully described in a report submitted to FCC office, and accepted on February 27, 2008 (Registration No.: 466226).

IC Registration No. : 2973B-3

No. 1 anechoic chamber has been fully described in a report submitted to FCC office, and accepted on November 2, 2005 (Registration No.: 95967).

IC Registration No. : 2973B-2

Test room	Width x Depth x Height (m)	Test room	Width x Depth x Height (m)
No.1 shielded room	8.0 x 5.0 x 2.5	No.1	10.0 x 7.5 x 5.7
No.2 shielded room	5.0 x 4.0 x 2.5	Semi-anechoic chamber	
No.3 shielded room	4.0 x 5.0 x 2.7		

Open test site	Maximum measurement distance
No.1 open test site	30m
No.2 open test site	10m

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

4 System test configuration

4.1 Operation mode

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

Test item	Operating mode	Tested frequency
Conducted emission	Transmitting	902.75MHz, 915.25MHz, 927.25MHz
Carrier frequency separation	Transmitting Hopping ON	-
20dB bandwidth	Transmitting Hopping OFF	902.75MHz, 915.25MHz, 927.25MHz
Number of hopping frequency	Transmitting Hopping ON	-
Dwell time	Transmitting (Hopping ON)	-
Maximum peak output power	Transmitting -Hopping ON -Hopping OFF	902.750MHz, 915.25MHz, 927.25MHz
Spurious emission & Band edge compliance (Conducted) (Radiated)	Transmitting -Hopping ON -Hopping OFF Transmitting	Spurious emission: 902.75MHz, 915.25MHz, 927.25MHz Band edge compliance: 902.75MHz, 927.25MHz
99% occupied bandwidth	Transmitting -Hopping ON -Hopping OFF	902.75MHz, 915.25MHz, 927.25MHz

*Transmitting data

02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 00 01 02 03 04 05 06 07 08 09 0A 0B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 10 11 12 13 14 15 16 17 18 19 1A 1B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 20 21 22 23 24 25 26 27 28 29 2A 2B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 30 31 32 33 34 35 36 37 38 39 3A 3B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 40 41 42 43 44 45 46 47 48 49 4A 4B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 50 51 52 53 54 55 56 57 58 59 5A 5B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 60 61 62 63 64 65 66 67 68 69 6A 6B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 70 71 72 73 74 75 76 77 78 79 7A 7B
 02 21 03 E8
 14 24 03 E8 00 00 00 00 02 01 80 81 82 83 84 85 86 87 88 89 9A 9B

** Output power: +20dBm

The power is controlled to +20dBm by the firmware when installed in printer.

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

UL Japan, Inc.

YAMAKITA EMC LAB.

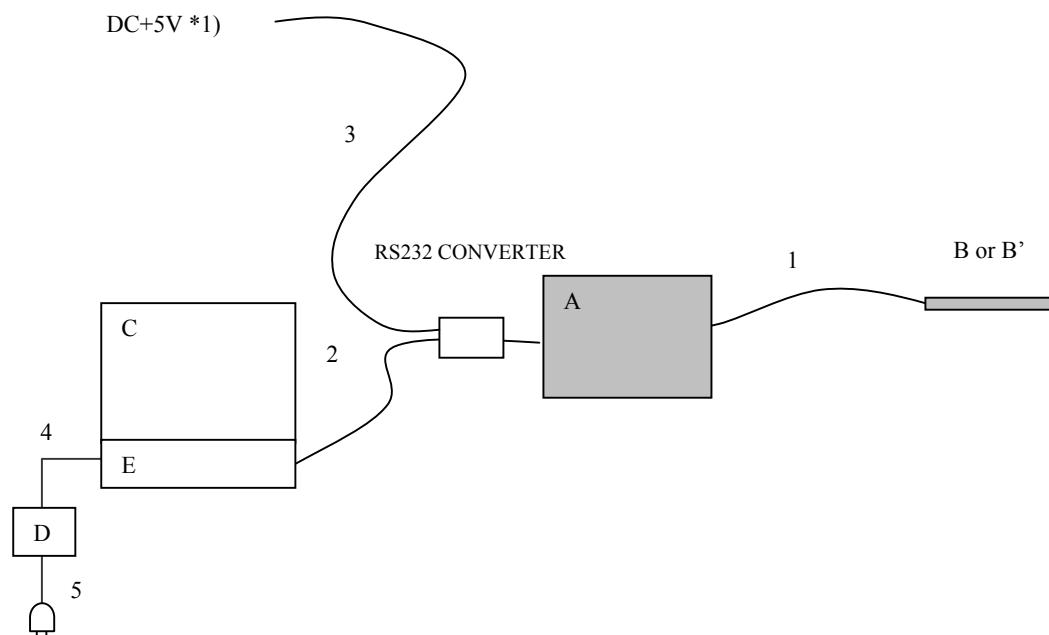
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011

Facsimile: +81 465 77 2112

MF060b (09.01.08)

4.2 Configuration of tested system



* Test data was taken under worse case conditions.

Description of EUT and support equipments

No.	Item	Model number	Serial number	Manufacturer	Remark
A	RFID Reader Module	M5e	110801101018	ThingMagic	EUT *1)
B	Antenna	Dipole	-	SATO	EUT
B'	Antenna	Miniature	-	SATO	EUT
C	Note PC	PA1252JA	X7040930	TOSHIBA	-
D	AC adapter	PA2440U	9804 C 0220382	TOSHIBA	-
E	Port replicater	PA2720UJ	08728022	TOSHIBA	-

*1) DC power supply (Model No.: PAN35-10A) was used for DC input.

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Antenna cable	0.5	Shielded	Shielded	-
2	RS232C cable	1.8	Shielded	Shielded	-
3	DC power cable	1.0	Unshielded	Unshielded	-
4	DC cable	1.6	Unshielded	Unshielded	-
5	AC power cable	1.8	Unshielded	Unshielded	-

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011

Facsimile: +81 465 77 2112

MF060b (09.01.08)

5 Conducted emissions

5.1 Operating environment

The test was carried out in No.1 anechoic chamber.

5.2 Test configuration

EUT was placed on a wooden platform of nominal size, 1m by 1.8m, raised 80cm above the conducting ground plane. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from a Line Impedance Stabilization Network (LISN) and excess AC cable was bundled in center. I/O cable were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. Photographs of the setup are shown in Appendix 1.

5.3 Test conditions

Frequency range : 0.15 - 30MHz

5.4 Test procedure

The EUT was connected to a LISN (AMN). An overview sweep with peak detection has been performed. The Conducted emission measurements were made with the following detector function of the test receiver.

Detector: QP/AV

IF Bandwidth: 9kHz

5.5 Results

Summary of the test results : Pass

Date : June 27, 2008 Test engineer : Takahiro Suzuki

UL Japan, Inc.
YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

6 Carrier frequency separation

Test procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

7 20dB bandwidth & Occupied bandwidth (99%)

Test procedure

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

The channel separation in Hopping mode and Inquiry mode was separated by 25kHz and 2/3 of the 20dB bandwidth.

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

8 Number of hopping frequency

Test procedure

The Number of Hopping Frequency was measured with a spectrum analyzer connected to the antenna port.

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

9 Dwell time

Test procedure

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

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

10 Maximum peak output power

Test procedure

The Maximum Peak Output Power was measured with a power meter connected to the antenna port.

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

11 Out of band emissions (Antenna port conducted)

Test procedure

The Out of Band Emissions was measured with a spectrum analyzer connected to the antenna port.

In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a conducted measurement.

Summary of the test results: Pass

Date : June 30, 2008 Test engineer : Makoto Hosaka

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011

Facsimile: +81 465 77 2112

MF060b (09.01.08)

12 Out of band emissions (Radiated)

12.1 Operating environment

The test was carried out in No.1 anechoic chamber.

12.2 Test configuration

EUT was placed on a platform of nominal size, 0.5m by 0.5m, raised 80cm above the conducting ground plane. The setup was not the one for a system which is specified in ANSI C63.4: 2003. The cables did not have much effect on spurious emission. Photographs of the setup are shown in Appendix 1.

12.3 Test conditions

Frequency range : 30MHz - 10GHz
Test distance : 3m

12.4 Test procedure

The Radiated Electric Field Strength intensity has been measured with a ground plane and at a distance of 3m or 1m. 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. Measurements were performed with QP, PK, and AV detector.

The radiated emission measurements were made with the following detector function of the test receiver.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Frequency	Below 1GHz	Above 1GHz
Instrument used	Test Receiver	Spectrum Analyzer
Detector IF Bandwidth	QP: BW 120kHz	PK: RBW: 1MHz/VBW: 1MHz AV RBW: 1MHz/VBW: See data and duty cycle
Measuring antenna	Biconical (30-299.99MHz) Logperiodic (300MHz-1GHz)	Horn

The equipment and its antenna were previously checked at each position of three axes X, Y and Z. The position in which the maximum noise occurred was chosen to put into measurement. See the table below and photographs in page 16 to 18. With the position, the noise levels of all the frequencies were measured.

Model	Below 1GHz	Above 1GHz
Module	Horizontal: X, Vertical: Z	Horizontal: Y, Vertical: Y
Antenna (Dipole)	Horizontal: Y, Vertical: Z	Horizontal: X, Vertical: Y
Antenna (Miniature)	Horizontal: Y, Vertical: Z	Horizontal: X, Vertical: Z

It was confirmed that spurious emission frequencies are 20dB or more lower than fundamental waves. These spurious emission frequencies are not the restricted band regulated in FCC 15.205 (a). Refer to the data.

12.5 Band edge

Band edge level at 902.75MHz and 927.25MHz is below the limits of FCC 15.209. Refer to the data.

12.6 Results

Summary of the test results : Pass
No noise was detected above the 7th order harmonics.

Date : June 24 and 26, 2008 Test engineer : Toyokazu Imamura and Takahiro Suzuki

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)

APPENDIX 1: Photographs of test setup

Page 12 - 13 : Conducted emission
Page 14 - 15 : Radiated emission
Page 16 - 18 : Pre-check of the worst position

APPENDIX 2: Test Data

Page 19 - 28 : Conducted emission
Page 29 : Carrier frequency separation
Page 30 : 20dB bandwidth
Page 31 : Number of hopping frequency
Page 32 - 37 : Dwell time
Page 38 : Maximum peak output power
Page 39 - 46 : Out of band emissions (Antenna port conducted)
Page 47 - 64 : Out of band emissions (Radiated)
47-52 30-1000MHz
53-64 1-10GHz
65-70 2nd harmonics
Page 71 : Duty cycle
Page 72 - 73 : Occupied bandwidth

APPENDIX 3: Test instruments

Page 74 : Test instruments

UL Japan, Inc.

YAMAKITA EMC LAB.

907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN

Telephone: +81 465 77 1011 Facsimile: +81 465 77 2112

MF060b (09.01.08)