# RADIO TEST REPORT

## Test Report No. : 29CE0014-HO-01-A-R1

| | | |
|---|---|---|
| **Applicant** | : | **FURUNO SYSTEMS CO., LTD.** |
| **Type of Equipment** | : | **Handy Terminal** |
| **Model No.** | : | **PI-13700-W** |
| **FCC ID** | : | **T87SS25BGXXT** |
| **Test regulation** | : | **FCC Part 15 Subpart C 2008 Section 15.247** |
| **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 above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. Original test report number of this report is 29CE0014-HO-01-A.

**Date of test:** December 12, 2008 to January 9, 2009

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NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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http://uljapan.co.jp/emc/nvlap.html

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## SECTION 1: Customer information

| | | |
|---|---|---|
| Company Name | : | FURUNO SYSTEMS CO., LTD. |
| Address | : | Kobe Kimec Center Bldg., 1-5-2 Minamimachi, Minatojima Chuo-ku, Kobe, Hyogo, 650-0047 Japan |
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## SECTION 2: Equipment under test (E.U.T.)

### 2.1 Identification of E.U.T.

| | | |
|---|---|---|
| Type of Equipment | : | Handy Terminal |
| Model No. | : | PI-13700-W<br>PI-13703-W (Variant model) |
| Serial No. | : | 7059-1901 (PI-13700-W): Used for Radiated Spurious emission test<br>7059-1899 (PI-13700-W): Used for Antenna terminal conducted test<br>7060-0320 (PI-13703-W): Used for Radiated Spurious emission test |
| Receipt Date of Sample | : | December 12, 2008 |
| Rating | : | Li-ion Battery DC3.7V 1950mAh |
| Country of Mass-production | : | Japan |
| Condition of EUT | : | Production prototype<br>(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 No: PI-13700-W (referred to as the EUT in this report) is the Handy Terminal.

Feature of EUT: Barcode scanner built in the head of the body reads a wide variety of barcodes.
The compact body houses a TFT-LCD panel, laser scanner, Bluetooth and 802.11b/g transceiver.
The EUT contains IEEE802.11b/g and Bluetooth modules.
Those modules do not transmit simultaneously.

*The EUT (PI-13700-W) has a variant model (PI-13703-W). The differentia of them is shown in the following table.

| Model | Scanner part |
|---|---|
| PI-13700-W | Visible semiconductor laser |
| PI-13703-W | CMOS image sensor |

For confirming influence for radio part by their differentia, specific tests were performed and data were attached in this test report.

Clock frequencies in the system : 100MHz (Bus), 200MHz (CPU(INT)), 16MHz (BT), 40MHz (WLAN)

**Radio specification / Wireless LAN (IEEE802.11b/g)**

| | |
|---|---|
| Equipment Type | Transceiver |
| Frequency of Operation | 2412-2462MHz |
| Bandwidth & Channel spacing | 18MHz, 5MHz/CH |
| Type of Modulation | DSSS&OFDM |
| Antenna Type | Inverted F Antenna: EX02-0923-00 |
| Antenna Connector Type | Hirose U.FL-R-SMT(01) |
| Antenna Gain | 1.35dBi |
| Operating frequency | Crystal |
| Operating Voltage (Inner) | DC3.3V |

**Radio specification / Bluetooth (FCC ID: RYYEYXFDC)**

| | |
|---|---|
| Equipment Type | Transceiver |
| Frequency of Operation | 2402-2480MHz |
| Bandwidth & Channel spacing | 1MHz & 1MHz |
| Type of Modulation | FHSS |
| Antenna Type | PWB Pattern Antenna |
| Antenna Connector Type | N/A |
| Antenna Gain | 2dBi |
| Operating frequency | Crystal |
| Operating Voltage (Inner) | DC3.3V |

# SECTION 3: Test specification, procedures & 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<br>Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz |

**FCC 15.31 (e)**
This EUT provides stable voltage(DC3.3V) constantly to RF Part regardless of input voltage. Therefore, this EUT complies with the requirement.

**FCC Part 15.203 Antenna requirement**
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 of Section 15.203.

## 3.2 Procedures and results

**[DSSS and other forms of modulation ]**

| No. | Item | Test Procedure | Specification | Remarks | Deviation | Worst margin | Results |
|---|---|---|---|---|---|---|---|
| 1 | Conducted emission | **FCC:** ANSI C63.4:2003 7. AC powerline conducted emission measurements | **FCC:** Section 15.207 | Conducted | N/A | N/A | N/A*1) |
| | | **IC:** RSS-Gen 7.2.2 | **IC:** RSS-Gen 7.2.2 | | | | |
| 2 | 6dB Bandwidth | **FCC:** "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" | **FCC:** Section 15.247(a)(2) | Conducted | N/A | See data. | Complied |
| | | **IC:** RSS-Gen 4.6.2 | **IC:** RSS-210 A8.2(a) | | | | |
| 3 | Maximum Peak Output Power | **FCC:** "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" | **FCC:** Section 15.247(b)(3) | Conducted | N/A | | Complied |
| | | **IC:** RSS-Gen 4.8 | **IC:** RSS-210 A8.4(4) | | | | |
| 4 | Restricted Band Edges | **FCC:** "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" | **FCC:** Section 15.247 (d) | Conducted/ Radiated | N/A | | Complied |
| | | **IC:** - | **IC:** RSS-210 A8.5 | | | | |
| 5 | Power Density | **FCC:** "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" | **FCC:** Section 15.247 (e) | Conducted | N/A | | Complied |
| | | **IC:** - | **IC:** RSS-210 A8.2(b) | | | | |
| 6 | Spurious Emission | **FCC:** "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" | **FCC:** Section15.247(d) | Conducted/ Radiated | N/A | 1.3dB<br>2483.50MHz (AV)<br>Horizontal<br>11g, 6Mbps, Tx, Ch: High | Complied |
| | | **IC:** RSS-Gen 4.9<br>RSS-Gen 4.10 | **IC:** RSS-210 A8.5<br>RSS-Gen 7.2.1 and 7.2.3 | | | | |
| Note: UL Japan, Inc.'s EMI Work Procedures No.QPM05 and QPM15.<br>*1) The test is not applicable since EUT does not work AC power supply. | | | | | | | |

*These tests were performed without any deviations from test procedure except for addition or exclusion.
* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

## 3.3 Addition to standards

| No. | Item | Test Procedure | Specification | Remarks | Deviation | Worst margin | Results |
|---|---|---|---|---|---|---|---|
| 1 | 99% Occupied Bandwidth | **IC:** RSS-Gen 4.6.1 | **IC:** RSS-Gen 4.6.1 | Conducted | N/A | N/A | N/A |

## 3.4 Uncertainty

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

| Test room | Conducted emission | Radiated emission (10m*) | | | Radiated emission (3m*) | | | Radiated emission (3m*) | |
|---|---|---|---|---|---|---|---|---|---|
| | 150kHz-30MHz | 9kHz-30MHz | 30MHz-300MHz | 300MHz-1GHz | 9kHz-30MHz | 30MHz-300MHz | 300MHz-1GHz | 1GHz-18GHz | 18GHz-40GHz |
| No.1 semi-anechoic chamber (±) | 3.7dB | 3.1dB | 4.4dB | 4.2dB | 3.2dB | 3.8dB | 3.9dB | 5.9dB | 6.1dB |
| No.2 semi-anechoic chamber (±) | 3.7dB | - | - | - | 3.2dB | 4.4dB | 4.0dB | 5.9dB | 6.1dB |
| No.3 semi-anechoic chamber (±) | 3.7dB | - | - | - | 3.2dB | 4.6dB | 4.0dB | 5.9dB | 6.1dB |
| No.4 semi-anechoic chamber (±) | 3.7dB | - | - | - | 3.2dB | 3.9dB | 3.9dB | 5.9dB | 6.1dB |

*10m/3m = Measurement distance

Radiated emission test(3m)
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

Other test except Conducted Emission and Spurious Emission (Radiated)
The measurement uncertainty for this test is 3.0dB.

### 3.5 Test Location

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| | FCC Registration Number | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms |
|---|---|---|---|---|---|
| No.1 semi-anechoic chamber | 313583 | 2973C-1 | 19.2 x 11.2 x 7.7m | 7.0 x 6.0m | No.1 Power source room |
| No.2 semi-anechoic chamber | 655103 | 2973C-2 | 7.5 x 5.8 x 5.2m | 4.0 x 4.0m | - |
| No.3 semi-anechoic chamber | 148738 | 2973C-3 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.3 Preparation room |
| No.3 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.4 semi-anechoic chamber | 134570 | 2973C-4 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.4 Preparation room |
| No.4 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.5 semi-anechoic chamber | - | - | 6.0 x 6.0 x 3.9m | 6.0 x 6.0m | - |
| No.6 shielded room | - | - | 4.0 x 4.5 x 2.7m | 4.75 x 5.4 m | - |
| No.6 measurement room | - | - | 4.75 x 5.4 x 3.0m | 4.75 x 4.15 m | - |
| No.7 shielded room | - | - | 4.7 x 7.5 x 2.7m | 4.7 x 7.5m | - |
| No.8 measurement room | - | - | 3.1 x 5.0 x 2.7m | N/A | - |
| No.9 measurement room | - | - | 8.0 x 4.5 x 2.8m | 2.0 x 2.0m | - |
| No.10 measurement room | - | - | 2.6 x 2.8 x 2.5m | 2.4 x 2.4m | - |
| No.11 measurement room | - | - | 3.1 x 3.4 x 3.0m | 2.4 x 3.4m | - |

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

### 3.6 Test set up, Data of EMI, and Test instruments

Refer to APPENDIX 1 to 3.

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

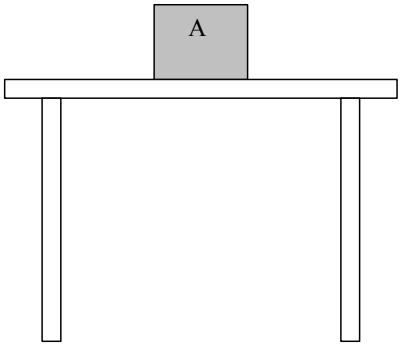
## 4.1 Operating Mode(s)

| Test Item | Operating Mode | Tested frequency |
|---|---|---|
| Spurious Emission*1)<br>6dB Bandwidth*2)<br>Maximum Peak Output Power*2)<br>Power Density*2)<br>99% Occupied Bandwidth*2) | IEEE802.11b Transmitting (Tx), 11Mbps, PN9<br>IEEE802.11g Transmitting (Tx), 6Mbps, PN9 | 2412MHz(L)<br>2437MHz(M)<br>2462MHz(H) |
| Restricted Band Edge | IEEE802.11b Transmitting (Tx), 11Mbps, PN9<br>IEEE802.11g Transmitting (Tx), 6Mbps, PN9 | 2412MHz(L)<br>2462MHz(H) |
| *Transmitting duty was 100% on all tests. | | |

*As a result of preliminary test, the formal test was performed with the above modes, which had the maximum rated power.

*1) For comparing to PI-13700-W, from 30MHz to 1GHz test of Spurious emission for PI-13703-W was only performed with the mode of IEEE802.11b Transmitting (Tx), 11Mbps, PN9, 2462MHz(H) which was the worst case of PI-13700-W, also, above 1GHz of this test for PI-13703-W was only performed from 1GHz to 10GHz since the radio part of PI-13700-W and PI-13703-W is identical.
*2) These tests were only performed on PI-13700-W as a representative since the radio part of PI-13700-W and PI-13703-W is identical.

## 4.2 Configuration and peripherals




*Setup was taken into consideration and test data was taken under worse case conditions.

**Description of EUT**

| No. | Item | Model number | Serial number | Manufacturer | Remark |
|---|---|---|---|---|---|
| A | Handy Terminal | PI-13700-W | 7059-1901*1)<br>7059-1899*2) | FURUNO SYSTEMS CO., LTD. | - |
| | | PI-13703-W*3) | 7060-0320 | | |

*1) Used for Radiated Spurious Emission test.
*2) Used for Antenna terminal conducted test only.
*3) Used for Radiated Spurious Emission test (below 1GHz 11b, 11Mbps, Tx, Ch: High and above 1GHz tests).

## SECTION 5: Spurious Emission

**[Conducted]**
**Test Procedure**
The Out of Band Emission was measured with a spectrum analyzer connected to the antenna port.
It was measured based on "1. RF antenna conducted test" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".
The following spectrum analyzer setting was used:

- RBW: 100kHz
- VBW: 300kHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

**Test data : APPENDIX 2**
**Test result : Pass**

**[Radiated]**
**Test Procedure**
It was measured based on "2. Radiated emission test" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".
EUT was placed on a urethane platform of nominal size, 1.0m by 0.5m, raised 0.8m above the conducting ground plane.
The Radiated Electric Field Strength intensity has been measured in a Semi Anechoic Chamber with a ground plane and at a distance of 3m(Below 10GHz) and 1m(Upper 10GHz).
The height of the measuring 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 with the Test Receiver, or the Spectrum Analyzer.
The radiated emission measurements were made with the following detector function of the Test Receiver and the Spectrum analyzer.
In any 100kHz bandwidth outside the restricted 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 radiated measurement.

**20dBc was applied to the frequency over the limit of FCC 15.209 / Table 2 of RSS-210 2.7 (IC) and outside the restricted band of FCC15.205 / Table 1 of RSS-210 2.7 (IC).**

| Frequency | Below 1GHz | Above 1GHz |
|---|---|---|
| Instrument used | Test Receiver | Spectrum Analyzer |
| Detector<br>IF Bandwidth | QP: BW 120kHz(T/R) | PK: RBW: 1MHz/VBW: 1MHz<br>AV *1): RBW: 1MHz/VBW: 10Hz<br>20dBc: RBW: 100kHz/VBW: 300kHz |

*1) The test was made with adjusting span to zero by using peak hold.

- 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.

**Test data : APPENDIX 2**
**Test result : Pass**

# SECTION 6: Bandwidth

## 6dB Bandwidth

**Test Procedure**

The bandwidth was measured with a spectrum analyzer connected to the antenna port.
It was measured based on "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".
The following spectrum analyzer setting was used:

- Span: 50MHz
- RBW: 100kHz
- VBW: 300kHz
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

**Test data : APPENDIX 2**
**Test result : Pass**

## 99% Occupied Bandwidth

**Test Procedure**

The bandwidth was measured with a spectrum analyzer connected to the antenna port.
The following spectrum analyzer setting was used:

- Span: Enough width to display 20dB Bandwidth
- RBW: as close to 1% of the Span as is possible without being below 1%
- VBW: Three times of RBW
- Sweep: Auto
- Detector: Peak
- Trace: Max Hold

**Test data : APPENDIX 2**
**Test result : Pass**

## SECTION 7: Maximum Peak Output Power

**Test Procedure**

The Maximum Peak Output Power was measured with a power meter (tested bandwidth: 50MHz) connected to the antenna port.
It was measured based on "Power Output Option 1" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".

**Test data : APPENDIX 2**
**Test result : Pass**

## SECTION 8: Peak Power Density

**Test Procedure**
The Peak Power Density was measured with a spectrum analyzer connected to the antenna port.
It was measured based on "PSD Option 1" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".

- Span: 18MHz
- RBW: 30kHz*)
- VBW: 100kHz
- Sweep: 600sec
- Detector: Peak
- Trace: Max Hold

*) The test was not performed at RBW: 3kHz since the test data met the limit with RBW: 30kHz.

**Test data : APPENDIX 2**
**Test result : Pass**