

Test Report

(IEC 60945 and IEC 62388)

For

Trade name: Furuno
Model: MARINE RADAR
Type: FAR-3210/-3310/-3220/-3320

Report No.: FLI 12-13-058

Date of Issue: 18 October 2013


Furuno Labotech International Co., Ltd.

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Report Summary

| | | | |
|---|--|--------------------------------|-----------------|
| FLI project number: | FLI 04-13-0177 | | |
| Test report number of initial issue: | FLI 12-13-058 | Date of initial issue | 18 October 2013 |
| Test report number of revised/replaced issue: | --- | Date of revised/replaced issue | --- |
| Test report revision/replacement history: | --- | | |
| Test standard(s)/ Test specifications: | IEC 60945: 2002 (ed. 4), Clause 7.1, 7.2, 8.2, 8.3, 8.4, 8.7, 8.8, 11, and 12.1, including IEC 60945 Corrigendum 1 (2008). IEC 62388: 2013 (ed.2.0), 17.3.2 Antenna shock test IEC 60068-2-1: 2007, IEC 60068-2-2: 2007, IEC 60068-2-30: 2005, IEC 60529: 2001, IEC 60068-2-6: 2007, ISO 25862: 2009, IEC 61672-1: 2002. | | |
| Customer: | Furuno Electric Co., Ltd. 9-52 Ashihara-Cho, Nishinomiya-City, 662-8580 Japan | | |
| Manufacturer: | Furuno Electric Co., Ltd. 9-52 Ashihara-Cho, Nishinomiya-City, 662-8580 Japan | | |
| Trade name: | FURUNO | | |
| Model: | MARINE RADAR | | |
| Type: | FAR-3210/-3310/-3220/-3320 | | |
| Product function and intended use: | For marine safety navigation | | |
| Number of test samples tested: | One | | |
| Serial number: | R000001-000001 (for RSB-128) 000002 (for PSU-014) | | |
| Power rating: | 100 - 230 VAC, 50-60 Hz, 8 A | | |
| Product status: | Pre-production model | | |
| Modifications made to samples during testing: | None. | | |
| Date of receipt of samples: | 18 July 2013 | | |
| Test period: | From 18 July 2013 to 29 August 2013 | | |
| Place of test: | Furuno Labotech International Co., Ltd. - LABOTECH EMC Center 1-16, Fukazu-cho, Nishinomiya-shi, Hyogo, 663-8203 Japan - Nishinomiya Lab. 9-52 Ashihara-cho, Nishinomiya-shi, Hyogo, 662-8580 Japan - Nishinomiya-Hama Lab. 2-20, Nishinomiya-Hama, Nishinomiya-shi, Hyogo, 662-0934 Japan | | |
| Test results/ Compliance: | Passed. The test results of this report relate only to the samples tested. | | |
| Tested by: | Akira Inoue, Fumiya Ueki, Ryoichi Ito, Tadayuki Ekawa, Osamu Araki, Yasuharu Nakamura, Katsumi Imamura, and Koji Kawai | | |
| Written by: | Akiko Inoue | | |
| Verified by: | Yoshihiro Ishii | | |
| Approved by: | Date: 18 October 2013 Name: Yoshihiro Ishii Title: Senior Manager, Technical Department, Furuno Labotech International Co., Ltd. Signature:  | | |

Testing Laboratory Status

Furuno Labotech International Co., Ltd. (hereafter called "FLI") has been holding the following status after having been assessed according to the provisions of ISO/IEC 17025 and/or the relevant rules:

(1) JAB Accredited Testing Laboratory:

- accredited by Japan Accreditation Board (JAB),
- Laboratory accreditation number: RTL03220
- Date of initial accreditation: 14 January 2011
- Scope of accreditation: Electrical testing - EMC testing (*)

(2) Telefication Listed Testing Laboratory:

- listed by Telefication B. V., (The Netherlands)
- Laboratory assignment number: L116
- Date of initial listing: 26 July 1999 (*)
- for testing the following product categories/ test standards: EN 60945, IEC 61162-1/-2, and IEC 62288

(3) BSH Recognized Testing Laboratory:

- recognized by Bundesamt für Seeschifffahrt und Hydrographie (BSH), (Germany)
- Recognition certificate number: BSH/4613/06202/1864/11
- Date of initial recognition: 4 April 2003 (*)
- for testing the following product categories/ test standards:
 - IEC/EN 60945, IEC 62388, IEC 61162-1/-2, and IEC 62288

(4) TÜV Appointed EMC Test Laboratory:

- appointed by TÜV Rheinland Japan Ltd.,
- Laboratory assignment number: UA 50046428
- Date of initial appointment: 21 December 1998 (*)
- for carrying out the tests of:
 - EN 55011, CISPR 11, EN 55022, CISPR 22, EN 55024, CISPR 24, EN 55025, CISPR 25, EN/IEC 61000-3-2/-3, EN/IEC 61000-4-2/-3/-4/-5/-6/-8/-11, EN/IEC 61000-6-1/-2/-3/-4, EN/IEC 60945, EN/IEC 61326-1, EN/IEC 61326-2-6, EN/IEC 60601-1-2, JIS T 0601-1-2, JIS C 1806-1, ISO 11452-1/-2/-4.

(5) RMRS Recognized Testing Laboratory:

- recognized by Russian Maritime Register of Shipping (RMRS), (Russia)
- Laboratory recognition number: 11.02594.011
- Date of initial recognition: 27 January 2009 (*)
- for carrying out testing in the field of:
 - Electrical measurements and tests, EMC tests, Mechanical measurements and tests, Equipment protection degree tests, and Climatic tests for Ship's radio and navigational equipment and IEC 60945: 2002

(6) RRR Recognized Test Laboratory:

- recognized by Russian River Register (RRR), (Russia)
- Recognition certificate number: 154262
- Date of initial recognition: 31 May 2013
- for carrying out of tests of ships radio and navigation equipment

(7) DNV Recognized Environmental Test Laboratory:

- recognized by Det Norske Veritas AS (DNV), (Norway)
- Recognition certificate number: 262.1-015854-J-12
- Date of initial recognition: 12 July 2013
- Scope of recognition: Testing according to the standards IEC 60945, IEC 61162-1/-2/-450, IEC 62288, IEC 62388 and IEC 62252 Annex E
- Application: Provisions of Environmental, interference and safety testing.

Note: (*) – The current certificates may be found in the FLI web site (<http://www.furuno-labotech.co.jp>).

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1 Principal Information

1.1 Equipment under test (EUT)

Configurations of the EUT units:

| No. (*) | Item | Type | Unit serial number | Equipment category | Note |
|---------|---------------------------------|---------|--------------------|--------------------|--|
| 1 | Antenna Unit | | | Exposed | TX: 25 kW _{pp} , TX/RX freq.: 9410 MHz Magnetron used: MG5436 |
| | Transceiver | RTR-106 | --- | | |
| | Gear Box (with built-in deicer) | RSB-128 | R00001-000001 | | |
| | Performance Monitor | PM-32A | --- | | |
| | Antenna Radiator (*1) | XN24CF | --- | | |
| 2 | Power Supply Unit | PSU-014 | 000002 | Protected | |
| 3 | Antenna Unit | | | Exposed | TX: 12 kW _{pp} , TX/RX freq.: 9410 MHz Magnetron used: FNE1201 |
| | Transceiver | RTR-105 | --- | | |
| | Gear Box (with built-in deicer) | RSB-128 | R00001-000001 | | |
| | Performance Monitor | PM-32A | --- | | |
| | Antenna Radiator (*1) | XN24CF | --- | | |

(*): Item number(s) is(are) corresponding to the unit(s) shown in Clause 5 “EUT Setup/Test Arrangement” and Clause 6 “Photographs of Test Setup/Arrangement” of this report.

Note (*1): Antenna Radiator was replaced with Auxiliary Equipment, “Antenna Dummy Load (X-band)” except for “Vibration”, “Antenna shock”, “Rain and Spray”, and “Electromagnetic radio frequency radiation” tests.

Size and Mass of the EUT unit(s):

| No. | Name | Type | Dimensions (W × H × D, or φ × H) (mm) | Mass (kg) | Note |
|--------|-------------------|---------|--|--------------|---|
| 1 or 3 | Antenna Unit | --- | 2595 × 572 × 511 | 55 | with Performance Monitor, Transceiver, and Gear Box (with built-in deicer), and XN24CF contained. |
| 2 | Power Supply Unit | PSU-014 | 392×147×405 | 8.5 | |

Configurations of the Associated unit(s) (AU) forming the system except EUT:

| No. (*) | Name | Type | Unit serial number | Manufacturer | Note |
|---------|--------------------------|---------|--------------------------|--------------|------|
| 4 | Processor Unit | EC-3000 | 4395-1207 | Furuno | |
| 5 | Monitor Unit (19.0-inch) | MU-190 | 000457 | Furuno | |
| 6 | Monitor Unit (23.1-inch) | MU-231 | 000026 | Furuno | |
| 7 | Control Unit | RCU-025 | 000168 | Furuno | |
| 8 | Processor Unit | RPU-013 | 4317-2240 | Furuno | |
| 9 | Display Unit | U2412Mb | CN-007H8X-74221-31F-4L4S | DELL | |
| 19 | CONTROL UNIT | RCU-014 | 5453 | Furuno | |

(*): Item number(s) is(are) corresponding to the unit(s) shown in Clause 5 “EUT Setup/Test Arrangement” of this report.

Auxiliary Equipment (AE) used for exercising and/or monitoring the operation and/or the performance of the EUT during testing:

| No. (*) | Name | Type | Unit serial number | Manufacturer | Note |
|---------|-----------------------------|----------------|--------------------|-----------------|------|
| 16 | Antenna Dummy Load (X-band) | 4D376 | 4535002 | SPC ELECTRONICS | |
| 17 | USB Serial Adapter (RS-422) | COM-1PD(USB)H | 8DRZD76002358 | CONTEC | |
| 18 | PC | PB451ENBNR7A51 | 9C086208H | TOSHIBA | |
| 20 | Keyboard | TK-FCM007WH | 28067474 | ELECOM | |

(*): Item number(s) is(are) corresponding to the unit(s) shown in Clause 5 “EUT Setup/Test Arrangement” of this report.

Software(s) contained in the EUT, AU:

| No. | Category | Item/Type | Program name | Program number | Rev. number | Note |
|-----|----------|--------------------------|------------------|---|-------------|---|
| 1 | EUT | Antenna Unit | App(SPU MAG) | 0359281 | 01.03 | used for Climatic and Rain and spray tests. |
| | | | | | 01.03 | used for other than the above tests. |
| | | | App(MTR-DRV) | 0359293 | 01.03 | |
| | | | App(PM) | 0359296 | 01.03 | |
| 2 | EUT | Power Supply Unit | App(PSU-Control) | 0359299 | 01.03 | |
| 3 | AU | Processor Unit EC-3000 | App | 0359266 | 02.03 | |
| 4 | AU | Control Unit RCU-025 | Key1 | 2450086 | 01.05 | |
| 5 | AU | Monitor Unit (19.0-inch) | Monitor1 | 2651020 | 01.03 | |
| 6 | AU | Monitor Unit (23.1-inch) | Monitor2 | 2651020 | 01.03 | |
| 7 | AU | Processor Unit RPU-013 | --- | 0359204 | 03.51 | |
| 8 | AU | CONTROL UNIT RCU-014 | --- | 0359203 | 01.04 | |
| 9 | AE | PC | Winiec | Winexe=14(Feb 27 2013) Winiec.mcr=02 | --- | |

EUT documentation used for the tests:

| No. | Item | Publication no. | Rev. number | Note |
|-----|--|-----------------|-------------|---------------------|
| 1 | Installation Manual | IME-36160 | Z2 | |
| 2 | Supplier's specifications for Magnetron type MG5436 | 03S9414 | --- | For RTR-106 (25 kW) |
| 3 | Supplier's specifications for Magnetron type FNE1201 | 03S001960 | --- | For RTR-105 (12 kW) |

1.2 EUT Operation mode and Performance Check

1.2.1 EUT Operation mode

Operation state: TX-on

RANGE: 6 NM
TUNE: AUTO
GAIN: Manual, 96
A/C SEA: Manual, 0 (Min.)
A/C RAIN: Manual, 0 (Min.)
Range rings: ON
VRM1, 2: ON
EBL1, 2: ON
Brilliance of all attributes: Max.

1.2.2 Performance Test (PT)

(1) Radar display on MU-190 and MU-231 (AUs):

- Noise echo level/area should not change. Radar display should be updated (scanning).

(2) Antenna rotation:

- Antenna should be rotated in a clockwise direction through 360° continuously and automatically with the rotation rate of 40 rpm or more for HSC Radar.

(3) Tuning indicator:

- Indicator bar of RX tuning indicator should be 50% or more.

- (4) Sub display:
 - Radar display on Display Unit (No. 9 AU) should be displayed and updated (scanning).
- (5) Own ship's information:
 - Own ship's information should be displayed on MU-190 and MU-231 (AUs).
- (6) Track ball control:
 - Cursor should be moved as intended.
- (7) TT-Test:
 - Target should be tracked and Echo trail functions should be activated as intended.
- (8) Startup:
 - Startup time from Power-ON to the ST-BY state should be 4 min. or less.
- (9) Magnetron:
 - Magnetron current indicated in System monitor should be more than 0 A.

1.2.3 Performance Check (PC)

Same as those for PT.

1.3 Test Conditions

1.3.1 Normal power supply conditions:

100 VAC, 60 Hz (for "Vibration", "Antenna shock" and "Rain and Spray" tests)
230 VAC, 50 Hz (for the tests other than the above)

1.3.2 Extreme power supply conditions:

Upper extreme conditions:

253 VAC, 52.5 Hz (230 VAC + 10 %, 50 Hz + 5 %).

Lower extreme conditions:

207 VAC, 47.5 Hz (230 VAC - 10 %, 50 Hz - 5 %). (*)

(*) specified by the customer.

1.4 Observation and comments

- (1) Test items to be performed were specified by the customer.
Test items under IEC 60945 Clause 6, 9, 10, 13, 14, and 15 are separately reported.
- (2) Unit combinations for Radar Systems of FAR-3210/-3310/-3220/-3320 are as follows, and tests were performed with the combinations of "EUT1 (25 kW antenna unit) and EUT2 (PSU-014)", and "EUT 3 (12 kW antenna unit) and EUT2 (PSU-014)".

| Model | Band | TX power | Scanner | Transceiver | Radiator | Display | Power Supply Unit |
|----------|--------|----------|---------|-------------|----------|---------|-------------------|
| FAR-3210 | X band | 12 kW | RSB-128 | RTR-105 | XN12CF | MU-190 | PSU-014 |
| FAR-3310 | | | | | XN20CF | MU-231 | |
| FAR-3220 | | 25 kW | | RTR-106 | XN24CF | MU-190 | |
| FAR-3320 | | | | | | MU-231 | |

- (3) Corrosion (salt mist) test was not performed, because the evidence that the components, materials and finishes employed in the EUT satisfy the test was submitted by the manufacturer.
(See Furuno Electric Statement CW-037 dated 30 September 2013.)
- (4) "Emission from visual display unit (VDU)" test was not applicable, because the EUT had no display devices.
- (5) "X-radiation" test was not performed, because the evidence that the Magnetrons employed in the EUT satisfy the test was submitted by the manufacturer.

1.5 Measurement uncertainties

| IEC 60945 Clause | Item | Measurement uncertainty (*) |
|------------------|---|--|
| 7 | Power supply | |
| 7.1 | Extreme power supply: | ---- |
| 7.2 | Excessive conditions: | ---- |
| 8 | Durability and resistance to environmental conditions | |
| 8.2 | Dry heat | ---- |
| 8.2.1 | - Storage test: | Temperature: $\pm 1.5^{\circ}\text{C}$ |
| 8.2.2 | - Functional test: | Temperature: $\pm 1.5^{\circ}\text{C}$ |
| 8.3 | Damp heat | |
| 8.3.1 | - Functional test: | Temperature: $\pm 1.5^{\circ}\text{C}$, Humidity: $\pm 4\%$ |
| 8.4 | Low temperature | ---- |
| 8.4.1 | - Storage test: | Temperature: $\pm 1.5^{\circ}\text{C}$ |
| 8.4.2 | - Functional tests: | Temperature: $\pm 1.5^{\circ}\text{C}$ |
| 8.7 | Vibration: | Acceleration: $\pm 2.2 \text{ m/s}^2$ |
| 8.8 | Rain and spray: | Delivery rate: $\pm 3.1 \text{ l/min}$ for 100 l/min. |
| 8.12 | Corrosion: | ---- |
| 11 | Special purpose tests | |
| 11.1 | Acoustic noise and signals: | $\pm 2.4 \text{ dB}$ |
| 11.2 | Compass safe distance (CSD): | $\pm 7.4\%$ |
| 12 | Safety precautions | |
| 12.1 | Protection against accidental access to dangerous voltages: | Not applicable. |
| 12.2 | Electromagnetic radiofrequency radiation: | $\pm 2.3 \text{ dB}$ |
| 12.4 | X-radiation: | ---- |

(*): confidence level = 95%, coverage factor $k = 2$

| IEC 62388 Clause | Item | Measurement uncertainty (*) |
|------------------|--------------------|---------------------------------------|
| 17.3.2 | Antenna shock test | Acceleration: $\pm 2.2 \text{ m/s}^2$ |

(*): confidence level = 95%, coverage factor $k = 2$

2 Test Results Summary

| IEC 60945 Clause | Test Item | Result | Test Engineer |
|------------------|---|-----------------|-------------------------------------|
| 7 | Power supply | | |
| 7.1 | Extreme power supply: | Passed. | Y. Nakamura |
| 7.2 | Excessive conditions: | Passed. | Y. Nakamura |
| 8 | Durability and resistance to environmental conditions | | |
| 8.2 | Dry heat | | |
| 8.2.1 | - Storage test: | Passed. | Y. Nakamura |
| 8.2.2 | - Functional test: | Passed. | Y. Nakamura |
| 8.3.1 | Damp heat - Functional test: | Passed. | Y. Nakamura |
| 8.4 | Low temperature | | |
| 8.4.1 | - Storage test: | Not applicable. | --- |
| 8.4.2 | - Functional tests: | Passed. | Y. Nakamura |
| 8.7 | Vibration: | Passed. | R. Ito and F. Ueki |
| 8.8 | Rain and spray: | Passed | Y. Nakamura, T. Ekawa, and F. Ueki |
| 8.12 | Corrosion: | Not performed. | ---- |
| 11 | Special purpose tests | | |
| 11.1 | Acoustic noise and signals: | Passed. | Y. Nakamura |
| 11.2 | Compass safe distance (CSD): | Passed. | Y. Nakamura, K. Kawai, and T. Ekawa |
| 12 | Safety precautions | | |
| 12.1 | Protection against accidental access to dangerous voltages: | Passed. | Y. Nakamura |
| 12.2 | Electromagnetic radiofrequency radiation: | Passed. | K. Imamura |
| 12.3 | Emission from visual display unit (VDU): | Not applicable. | ---- |
| 12.4 | X-radiation: | Not performed | Y. Nakamura |

| IEC 62388 Clause | Test Item | Result | Test Engineer |
|------------------|--------------------|---------|---------------|
| 17.3.2 | Antenna shock test | Passed. | R. Ito |

3 Test Results

3.1 Power supply

3.1.1 Extreme power supply

For FAR-3220/-3320 (RSB-128 + RTR-106 (25 kW) + PSU-014),

| Environment | Normal power supply | | Extreme power supply | |
|--------------------|------------------------|---------|------------------------|---------|
| Dry heat | Performance test (PT) | Passed. | Performance check (PC) | Passed. |
| Damp heat | Performance check (PC) | Passed. | --- | --- |
| Low temperature | Performance test (PT) | Passed. | Performance check (PC) | Passed. |
| Normal temperature | Performance test (PT) | Passed. | Performance test (PT) | Passed. |

For FAR-3210/-3310 (RSB-128 + RTR-105 (12 kW) + PSU-014),

| Environment | Normal power supply | | Extreme power supply | |
|--------------------|------------------------|---------|------------------------|---------|
| Dry heat | Performance test (PT) | Passed. | Performance check (PC) | Passed. |
| Damp heat | Performance check (PC) | Passed. | --- | --- |
| Low temperature | Performance test (PT) | Passed. | Performance check (PC) | Passed. |
| Normal temperature | Performance test (PT) | Passed. | Performance test (PT) | Passed. |

3.1.2 Excessive conditions

| | Item | Result | Description |
|---|---|---------|---|
| 1 | Against Excessive current: | Passed. | 7 A Fuse was activated, and the EUT was protected from damage. |
| 2 | Against Excessive voltage: | Passed. | Overvoltage protection circuits were provided in PSU-014, and activated at the voltages of 304.1 VAC (> 230 VAC+10%). |
| 3 | When subjected to the input of 300 VAC (> 230 VAC + 10%) of: - improper phase sequence (for AC), for 5 min. | Passed. | No abnormality or damage occurred. |

After the tests, PC was successfully performed without errors or abnormality.

3.2 Dry heat

3.2.1 Storage test

After the test, PT/PC were performed at the Normal temperature. See Clause 3.1 of this report.

3.2.2 Functional test

See Clause 3.1 of this report.

3.3 Damp heat - Functional test

See Clause 3.1 of this report.

3.4 Low temperature

3.4.1 Storage test (Not applicable)

See Clause 3.1 of this report.

Not applicable to "Exposed", "Protected" and "Submerged" equipment.

3.4.2 Functional test

See Clause 3.1 of this report.

3.5 Vibration

3.5.1 EUT attitude/mounting and Test fixture:

| Unit | Attitude/mounting | Test fixture |
|--|-------------------|------------------------|
| Power Supply Unit PSU-014 | Table-top | No.45 (*) |
| | Wall-mounting | No. 35 and No. 63 (*1) |
| Antenna Unit RSB-128+RTR-106+XN24CF | Table-top | No. 44 (*1) |

(*1): prepared by FLI.

3.5.2 Resonance search and Endurance tests

Position of Vibration Pick-up Sensors and Directions of Vibration: See Clause 6 of this report.

| Unit | Vibration Direction | Resonance detected | | | Endurance test performed at freq. (Hz) | Results | Note |
|--|---------------------|--------------------|----------------------------------|-------------------|--|---------|------|
| | | Freq. (Hz) | Acceleration (m/s ²) | Magnitude ratio Q | | | |
| PSU-014 Table-top | X (left/right) | 89.6 | 10.4 | 1.5 | 89.6 | Passed. | |
| | Y (back/forth) | 91.6 | 12.3 | 1.8 | 91.6 | Passed. | |
| | Z (up/down) | 91.8 | 15.7 | 2.2 | 91.8 | Passed. | |
| PSU-014 Wall-mounting | X (left/right) | 98.5 | 8.5 | 1.2 | 98.5 | Passed. | |
| | Y (back/forth) | 100.0 | 11.8 | 1.7 | 100.0 | Passed. | |
| | Z (up/down) | 96.2 | 19.7 | 2.8 | 96.2 | Passed. | |
| Antenna Unit RSB-128+RTR-106+ XN24CF | X (left/right) | 52.2 | 87.4 | 12.5 | 52.2 | Passed. | |
| | Y (back/forth) | 55.5 | 78.0 | 11.1 | 55.5 | Passed. | |
| | Z (up/down) | (*) | (*) | (*) | 30.0 | Passed. | |

There was no damage, or degradation of performance during and after the tests.

Note: The Antenna Unit was tested with the combinations of RSB128 + RTR-106 + XN24CF for representing all combinations (TX power: max., Antenna length: max.).

3.6 Antenna shock

3.6.1 EUT attitude/mounting and Test fixture:

| Unit | Attitude/mounting | Test fixture |
|--|-------------------|--------------|
| Antenna Unit RSB-128+RTR-106+XN24CF | Table-top | No. 44 (*) |

(*)): prepared by FLI.

3.6.2 Results:

| Unit | Test conditions | Results |
|--|--|---------|
| Antenna Unit RSB-128+RTR-106+XN24CF | Acceleration: 100 m/s ² Duration: 25 ms Number of shocks: Three Direction: Z -upward | Passed. |

There was no damage, or degradation of performance during and after the tests.

3.7 Rain and spray

| Unit | Results |
|--|---------|
| Antenna Unit RSB-128+RTR-106+XN24CF | Passed. |

There was no damage, or unwanted ingress water.

3.8 Corrosion (salt mist) (Not performed)

Not performed. See Clause 1.4 of this report.

3.9 Special purpose tests

3.9.1 Acoustic noise and signals

| Unit | Acoustic noise pressure (dB (A)) | | | Limits | |
|---------|------------------------------------|----------------|----------------|---------------------------------------|--------------------------------------|
| | EUT powered off (Background noise) | EUT powered on | Alarm: on (*) | Acoustic noise power (pressure) dB(A) | Audible alarm power (pressure) dB(A) |
| PSU-014 | < 30 | 49.8 | Not applicable | ≤ 60 | 75 to 85 |

Note: (*) The EUT had no audible alarm function or level control.

The tests to Antenna Units were not applicable, because those units were intended not to be installed in wheelhouses or bridge wings.

3.9.2 Compass safe distance (CSD)

Test Conditions:

- (1) with EUT powered-off in the received condition,
- (2) with EUT powered-off after normalization,
- (3) with EUT powered-on (100 VAC and 230 VAC).

Results:

| Unit | CSD for Standard compass (m) | CSD for Steering compass (m) | CSD Marking | Test conditions that the worst measured results were obtained |
|-------------------------|------------------------------|------------------------------|-------------------------|---|
| RSB-128+RTR-016 (25 kW) | 2.45 | 1.60 | Described in the manual | (2) |
| RSB-128+RTR-015 (12 kW) | 2.15 | 1.40 | Described in the manual | (1) |
| PSU-014 | 2.20 | 1.40 | Described in the manual | (2) |

Normalization was done at about 23 m apart from the CSD test site.

3.10 Safety precautions

3.10.1 Protection against accidental access to dangerous voltages

| IEC 60945 Clause | Requirement | Result | Note |
|------------------|--|---------|--|
| 4.6.1/12.1 | There shall be no openings of the enclosure of the EUT to allow access to hazardous parts with the access probe (test finger), or there shall be adequate clearance between the access probe and hazardous parts. | Passed. | Dangerous voltages were provided in the EUT, but there were no openings to allow with test finger. |
| | All parts and wiring in the EUT shall be isolated automatically from all sources of electrical energy when protective covers are removed. Alternatively any further access to the interior of the EUT shall be only possible by means of a spanner or screwdriver. | Passed. | Screw driver needed. |
| | Warning labels shall be prominently displayed both within the EUT and on protective covers. | Passed. | Warning label provided on the protective cover. |
| | Means shall be provided for earthing exposed metallic parts of the EUT, but this shall not cause any terminal of the source of electrical energy to be earthed. | Passed. | Earth terminal provided. |

3.10.2 Electromagnetic radiofrequency radiation

For FAR-3210/-3310 (12 kW),

| Antenna Unit | Distance to 100 W/m ² (m) | Distance to 50 W/m ² (m) | Distance to 10 W/m ² (m) |
|----------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| RSB-128 + RTR-105 + XN12CF | 0.6 | 1.4 | 4.4 |
| RSB-128 + RTR-105 + XN20CF | 0.4 | 0.9 | 3.0 |
| RSB-128 + RTR-105 + XN24CF | 0.3 | 0.6 | 2.5 |

For FAR-3220/-3320 (25 kW),

| Antenna Unit | Distance to 100 W/m ² (m) | Distance to 50 W/m ² (m) | Distance to 10 W/m ² (m) |
|----------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| RSB-128 + RTR-106 + XN12CF | 1.3 | 2.7 | 9.5 |
| RSB-128 + RTR-106 + XN20CF | 1.0 | 1.7 | 6.8 |
| RSB-128 + RTR-106 + XN24CF | 0.7 | 1.3 | 5.5 |

Note: According to the results of the pre-tests performed with the radar pulse types of Short 1, Short 2, Middle 1, Middle 2, Middle 3, and Long, final tests were performed with Long pulse type (longest distance).

3.10.3 Emission from visual display unit (VDU) (Not applicable)

Not applicable. The EUT had no display devices.

3.10.4 X-radiation (Not performed)

The test was waived according to the evidence submitted by the manufacture.

3.11 Environmental conditions during Testing

| IEC 60945 Clause | Item | Date of test | Temperature, humidity (Before-test to After-test) | Power supply voltage (Before-test to After-test) |
|------------------|---|-----------------|--|--|
| 7 | Power supply | | | |
| 7.1 | Extreme Power supply: | (25 kW) | | |
| | | 10 Aug 2013 | 26°C to 25°C, 62% to 61%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| | | 11 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| | | 13 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| | | (12 kW) | | |
| | | 15 Aug 2013 | 26°C to 26°C, 62% to 61%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| | | 16 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| | | 17 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 207.0 VAC, 50.0 Hz to 207.0 VAC, 50.0 Hz 253.0 VAC, 50.0 Hz to 253.0 VAC, 50.0 Hz |
| 7.2 | Excessive conditions tests | 29 August 2013 | 26°C to 25°C, 62% to 61%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 8 | Durability and resistance to environmental conditions | | | |
| 8.2 | Dry heat | ---- | ---- | ---- |
| 8.2.1 | - Storage test: | (25 kW) | | |
| | | 13 Aug 2013 | 26°C to 26°C, 62% to 61%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| | | (12 kW) | | |
| | | 16 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 8.2.2 | - Functional test: | (25 kW) | | |
| | | 11 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| | | (12 kW) | | |
| | | 15 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 8.3.1 | Damp heat-Functional test: | (25 kW) | | |
| | | 12 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| | | (12 kW) | | |
| | | 18 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 8.4 | Low temperature | | | |
| 8.4.1 | - Storage test: | Not applicable. | ---- | ---- |
| 8.4.2 | - Functional tests: | (25 kW) | | |
| | | 10 Aug 2013 | 26°C to 25°C, 62% to 61%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| | | (12 kW) | | |
| | | 17 Aug 2013 | 26°C to 26°C, 62% to 62%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 8.7 | Vibration: | 18 July 2009 | 24°C to 25°C, 60% to 65%RH | 101.0 VAC, 60.0 Hz to 101.1 VAC, 60.0 Hz |
| | | 19 July 2009 | 27°C to 27°C, 63% to 59%RH | 101.0 VAC, 60.0 Hz to 101.1 VAC, 60.0 Hz |
| | | 20 July 2009 | 26°C to 26°C, 62% to 62%RH | 101.0 VAC, 60.0 Hz to 101.1 VAC, 60.0 Hz |
| 8.8 | Rain and spray: | 26 August 2013 | 33°C to 30°C, 62% to 57%RH. Water temperature: 28°C to 28°C | 101.0 VAC, 60.0 Hz to 100.2 VAC, 60.0 Hz |
| 8.12 | Corrosion: | Not performed. | ---- | ---- |

| IEC 60945 Clause | Item | Date of test | Temperature, humidity (Before-test to After-test) | Power supply voltage (Before-test to After-test) |
|------------------------|---|-----------------|---|---|
| 11 | Special purpose tests | | | |
| 11.1 | Acoustic noise and signals: | 31 July 2013 | 24°C to 24°C, 54% to 54%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 11.2 | Compass safe distance (CSD): | 20 July 20013 | 25°C to 25°C, 61% to 61%RH. | 230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz |
| 12 | Safety precautions | | | |
| 12.1 | Protection against accidental access to dangerous voltages: | 29 August 2013 | 26°C to 25°C, 62% to 61%RH. | --- |
| 12.2 | Electromagnetic radiofrequency radiation: | 9 August 2013 | 23°C to 23°C, 59% to 59%RH. | 230.3 VAC, 50.0 Hz to 230.1 VAC, 50.0 Hz |
| 12.3 | Emission from visual display unit (VDU): | Not applicable. | ---- | ---- |
| 12.4 | X-radiation measurement: | Not performed. | --- | --- |

| IEC 62388 | Item | Date of test | Temperature, humidity (Before-test to After-test) | Power supply voltage (Before-test to After-test) |
|--------------|---------------|--------------|---|---|
| 17.3.2 | Antenna shock | 18 July 2013 | 24°C to 25°C, 60% to 65%RH | 101.0 VAC, 60.0 Hz to 101.1 VAC, 60.0 Hz |

4 List of Measuring/Test Instruments

Measuring/Test instruments have been appropriately calibrated/maintained according to the FLI programs/procedures and ISO/IEC 17025. Measuring/Test instruments used for the tests are listed below.

4.1 Dry heat/Damp heat/Low temperature

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|--|--------------|----------------|--------------|
| X | HT370 | Climatic chamber (L) | TBE-3HW5GE2F | 3013000995 | Tabai Espec |
| X | HT723 | Paperless recorder/Dual communication logger DAQSTATION FX100 | FX106-4-1 | S5JA01445 | Yokogawa |
| X | HT415 | Climatic chamber (S) | PL-4KP | 14004204 | Tabai Espec |
| X | HT724 | Paperless recorder/Dual communication logger DAQSTATION FX100 | FX106-4-1 | S5JA01450 | Yokogawa |
| -- | HT510 | Climatic chamber (Hama-L) | TBE-3HW4PE2F | 3013002540 | Tabai Espec |
| -- | HT725 | Paperless recorder/Dual communication logger DAQSTATION FX100 | FX106-4-1 | S5JA01447 | Yokogawa |
| -- | HT364 | Climatic/Air pressure chamber (Hama-AL) | MZH-21HS | 581989 | Tabai Espec |
| -- | HT161 | Temperature recorder (Hama-AL) | μR180 | 4177WA303 | Yokogawa |
| -- | HT414 | Climatic chamber (Hama-S) | PL-4KP | 14004203 | Tabai Espec |
| -- | HT726 | Paperless recorder/Dual communication logger DAQSTATION FX100 | FX106-4-1 | S5JA01448 | Yokogawa |
| X | HT446 | Programmable AC power supply | 4420/4471 | 306043-4420024 | NF |
| -- | HT432 | DC power supply | PAN55-20 | AK003307 | Kikusui |
| X | HT461 | Digital Multimeter | 111 | 78410077 | Fluke |

(*): X – indicates instruments used for the tests, -- – not used.

4.2 Vibration

| (*) | C/N | Instrument | Type | S/N | Manufacturer | Note |
|-----|-------|--------------------------------------|------------|----------|--------------|--|
| X | HT562 | Vibration test system (3.5-ton type) | G-0235LS | SG-4420 | Shinken | Used for Antenna unit and PSU-014 wall-mounting. |
| -- | HT367 | Vibration test system (2.0-ton type) | VS-2000-20 | S-4798 | IMV | |
| -- | HT373 | Vibration test system (0.6-ton type) | VS-600-140 | 212540 | IMV | Used for PSU-014 table-top mounting |
| -- | HT439 | Pickup sensor | VP-15 | 2325T | IMV | |
| X | HT577 | Pickup sensor (Response) | V11-101S | 0522 | Shinken | Used for PSU-014 table-top mounting |
| -- | HT578 | Pickup sensor | V11-101S | 0521 | SHINKEN | |
| X | HT661 | Pickup sensor (Reference) | V11-101S | 1112 | Shinken | Used for Antenna unit and PSU-014 wall-mounting. |
| X | HT662 | Pickup sensor (Reference) | VP-15 | 0025U | IMV | Used for PSU-014 table-top mounting |
| X | HT663 | Pickup sensor (Response) | VP-15 | 0026U | IMV | Used for Antenna unit and PSU-014 wall-mounting. |
| -- | HT434 | AC/DC Power Supply | PCR2000L | BB002789 | Kikusui | |
| -- | HT431 | DC Power Supply | PAN55-20 | AK003303 | Kikusui | |
| X | HT462 | Digital Multimeter | 111 | 78120001 | Fluke | Used for Antenna unit and PSU-014 wall-mounting. |
| -- | HT430 | DC Power supply | PAD55-20L | 10091786 | Kikusui | |

(*): X – indicates instruments used for the tests, -- – not used.

4.3 Antenna shock

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|--------------------------------------|------------|---------|--------------|
| X | HT562 | Vibration test system (3.5-ton type) | G-0235LS | SG-4420 | Shinken |
| -- | HT367 | Vibration test system (2.0-ton type) | VS-2000-20 | S-4798 | IMV |
| -- | HT373 | Vibration test system (0.6-ton type) | VS-600-140 | 212540 | IMV |
| -- | HT439 | Pickup sensor | VP-15 | 2325T | IMV |
| -- | HT577 | Pickup sensor | V11-101S | 0522 | Shinken |

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|----------------------------------|-----------|----------|--------------|
| -- | HT578 | Pickup sensor | V11-101S | 0521 | SHINKEN |
| X | HT661 | Pickup sensor (Reference) | V11-101S | 1112 | Shinken |
| -- | HT662 | Pickup sensor | VP-15 | 0025U | IMV |
| X | HT663 | Pickup sensor (Response) | VP-15 | 0026U | IMV |
| -- | HT434 | AC/DC Power Supply | PCR2000L | BB002789 | Kikusui |
| -- | HT431 | DC Power Supply | PAN55-20 | AK003303 | Kikusui |
| X | HT462 | Digital Multimeter | 111 | 78120001 | Fluke |
| -- | HT430 | DC Power supply | PAD55-20L | 10091786 | Kikusui |

(*): X – indicates instruments used for the tests, -- – not used.

4.4 Rain and Spray

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|-------------------------------|-------|----------|--------------|
| X | HT587 | Liquid flow meter (Area type) | SPG-1 | 050278 | NFC |
| X | HT584 | Rain test set for IPX6 | IPX6 | 05-001 | FLI |
| X | HT689 | Digital Multimeter | 115 | 10821185 | Fluke |

(*): X – indicates instruments used for the tests, -- – not used.

4.5 Special purpose tests

4.5.1 Acoustic noise and signals

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|---------------------------------|-----------|-------------------------|--------------|
| -- | HT453 | Sound level meter | VS-3701A | 66645 | Panasonic |
| X | HT702 | Sound level meter | 556A | 935983 | Testo |
| -- | HT177 | Screened room | USC-26 | D-003 | USC |
| -- | HT164 | Digital multimeter | E2378A | 2943J06324 | HP |
| -- | HT173 | DC power supply | GP035-30R | 1014397082 | Takasago |
| X | HT779 | Semi-Anechoic chamber | 10mAC | 90984 | TOKIN |
| X | HT780 | Programmable AC/DC Power Supply | ES18000W | 9128767-1+ 9128767-2 | NF |
| X | HT687 | Digital multimeter | 115 | 10821183 | FLUKE |

(*): X – indicates instruments used for the tests, -- – not used.

4.5.2 Compass safe distance (CSD)

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|------------------------------|-----------|----------------|--------------|
| X | HT433 | 3-axis Magnetic field meter | HM-310NR | 003111 | MTI |
| X | HT189 | Helmholtz coil | 2X2M-10T | 0001 | TSJ |
| -- | HT157 | Programmable AC power supply | 8461 | 209648 | NF |
| -- | HT446 | Programmable AC power supply | 4420/4471 | 306043-4420024 | NF |
| -- | HT432 | DC power supply | PAN55-20 | AK003307 | Kikusui |
| X | HT571 | Programmable AC power supply | PCR6000W2 | DH001240 | Kikusui |
| X | HT430 | DC power supply | PAD55-20L | 10091786 | Kikusui |

(*): X – indicates instruments used for the tests, -- – not used.

4.6 Safety precautions

4.6.1 Protection against accidental access to dangerous voltages

| (*) | C/N | Instrument | Type | S/N | Manufacturer |
|-----|-------|---------------------|---------|-------|--------------|
| X | HT435 | Jointed test finger | P-10.09 | D-008 | EXCEL |

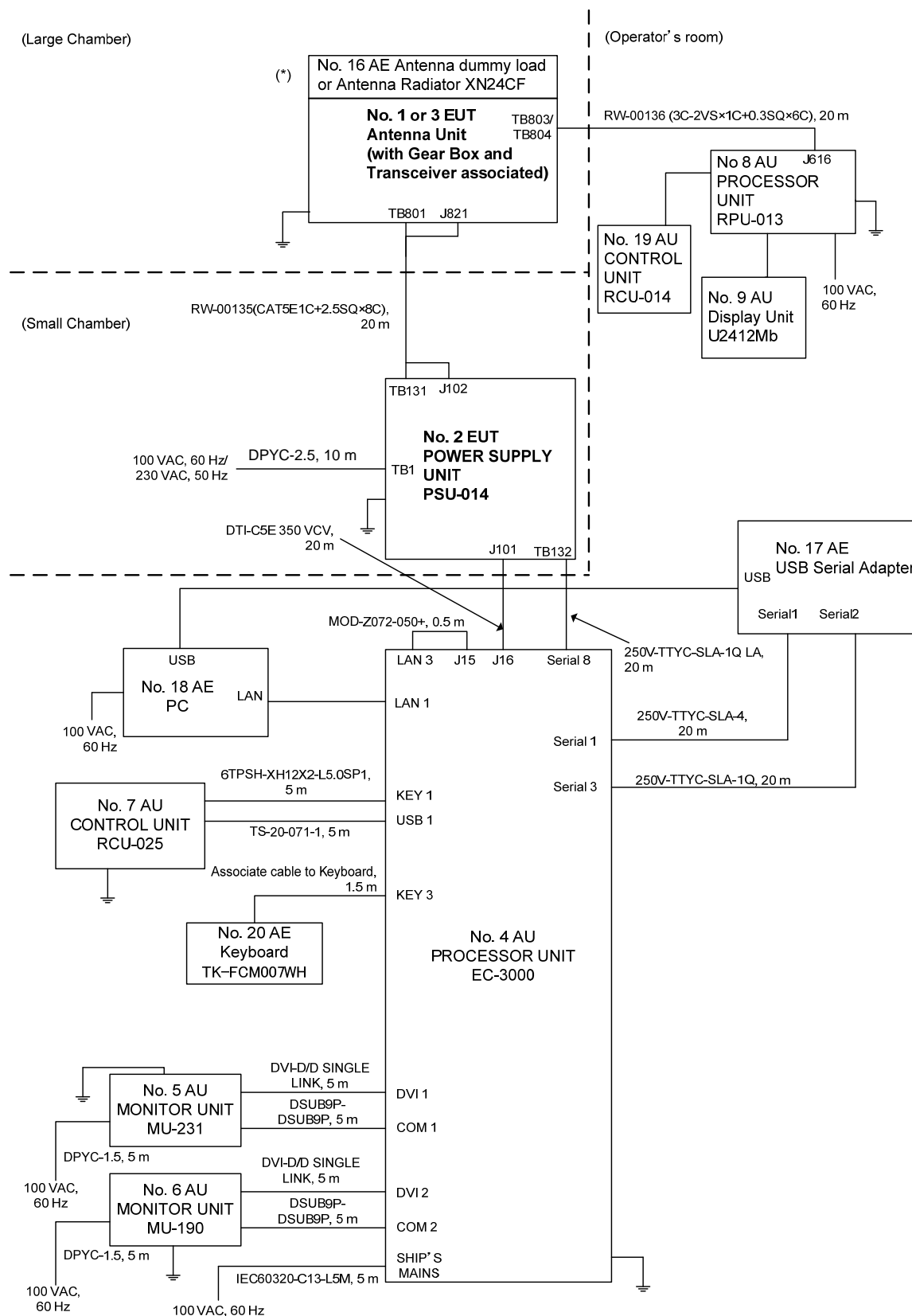
(*): X – indicates instruments used for the tests, -- – not used.

4.6.2 Electromagnetic radio frequency radiation

| | C/N | Instrument | Type | S/N | Manufacturer |
|---|-------|--------------------|-------------|----------------|--------------|
| X | HT590 | RF Radiation meter | EMR-300/33C | AY-0029/F-0021 | Narda |

(*): X – indicates instruments used for the tests, -- – not used.

5 EUT Setup/Test Arrangement



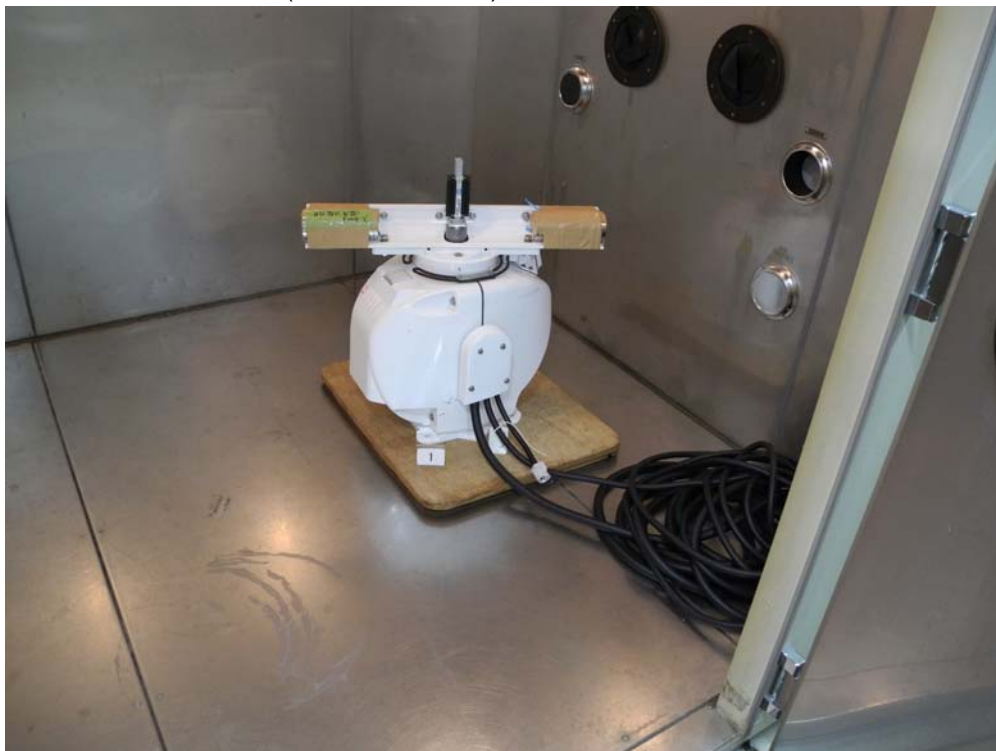
Note: AU - Auxiliary Unit, AE - Associated Equipment.

(*) - Antenna radiator was used for Vibration, Antenna shock, Rain and spray, and Electromagnetic RF radiation tests.

6 Photographs of Test Setup/Arrangement

6.1 Dry heat/Damp heat/Low temperature

For RSB-128+RTR-106 (FAR-3220/-3320),



For RSB-128+RTR-105 (FAR-3210/-3310),

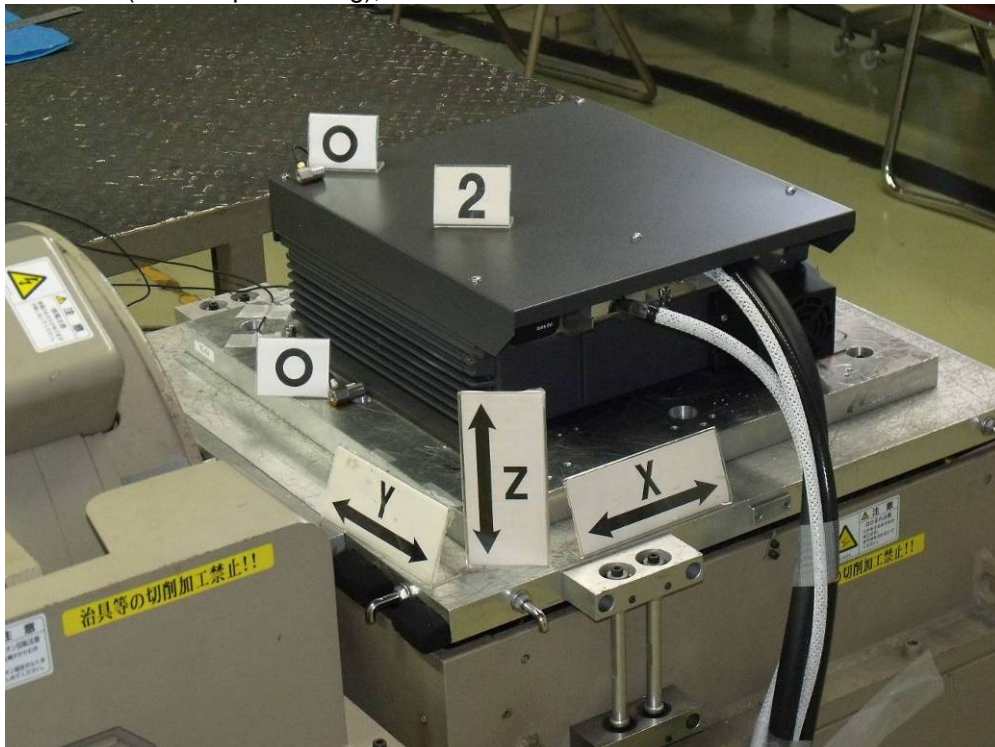


PSU-014,



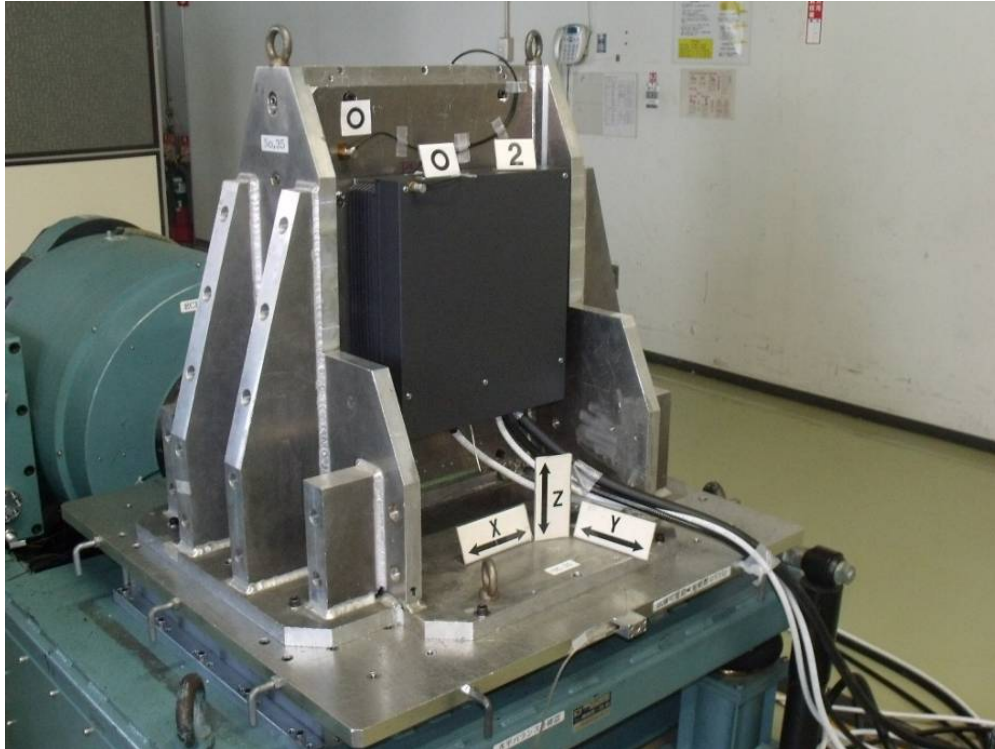
6.2 Vibration

PSU-014 (Table-top mounting),



Note: ○ - Pick-up sensor, ↔ - Vibration direction.

PSU-014 (Wall-mounting)



Note: ○ - Pick-up sensor, ↔ - Vibration direction.

Antenna Unit (RSB-128 + RTR-106 + XN24CF),



6.3 Rain and spray

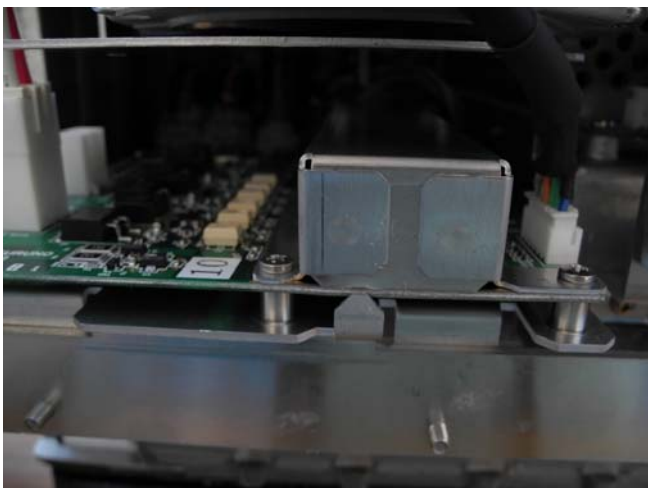
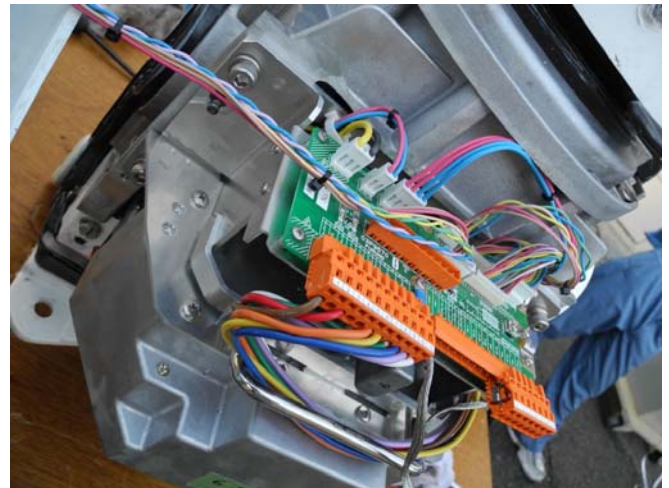
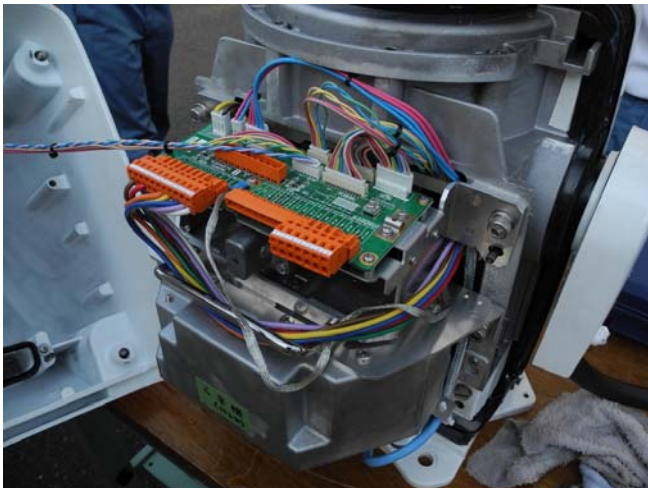
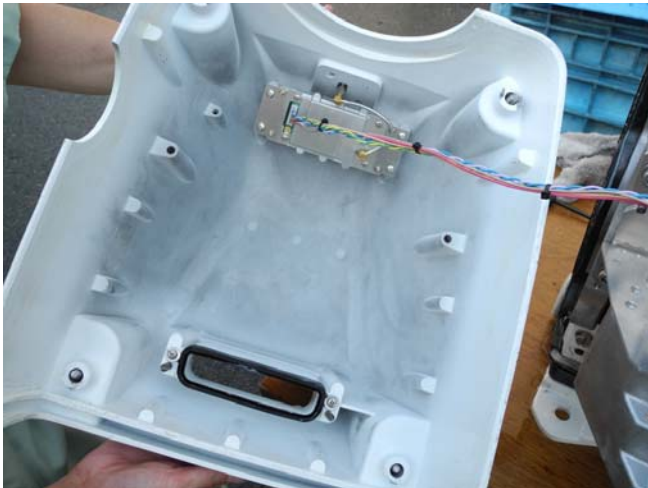
For Antenna Unit (RSB-128 + RTR-106 + XN24CF),
Test Setup,

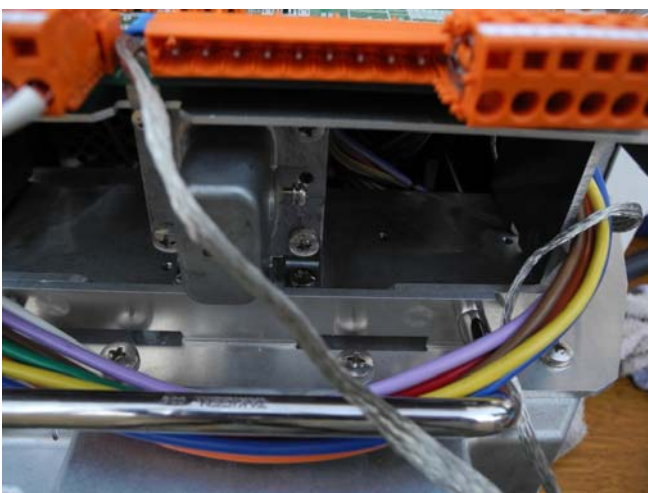
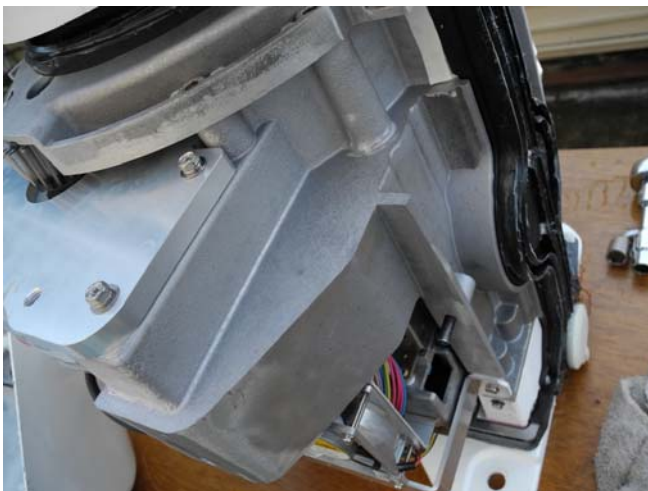
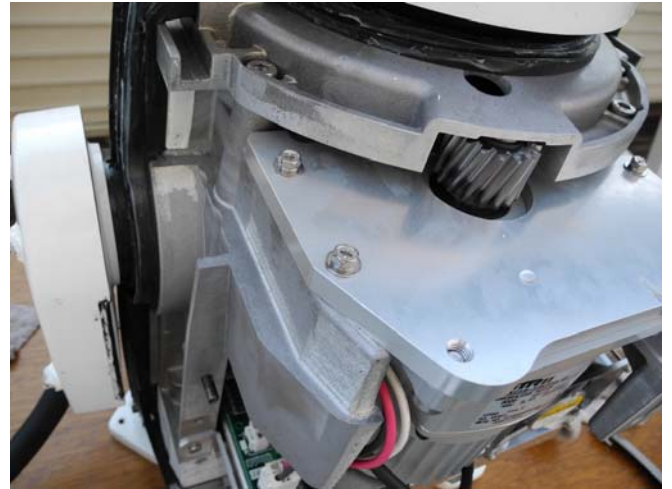


Spraying,



Photographs of the internal examinations done after the test,





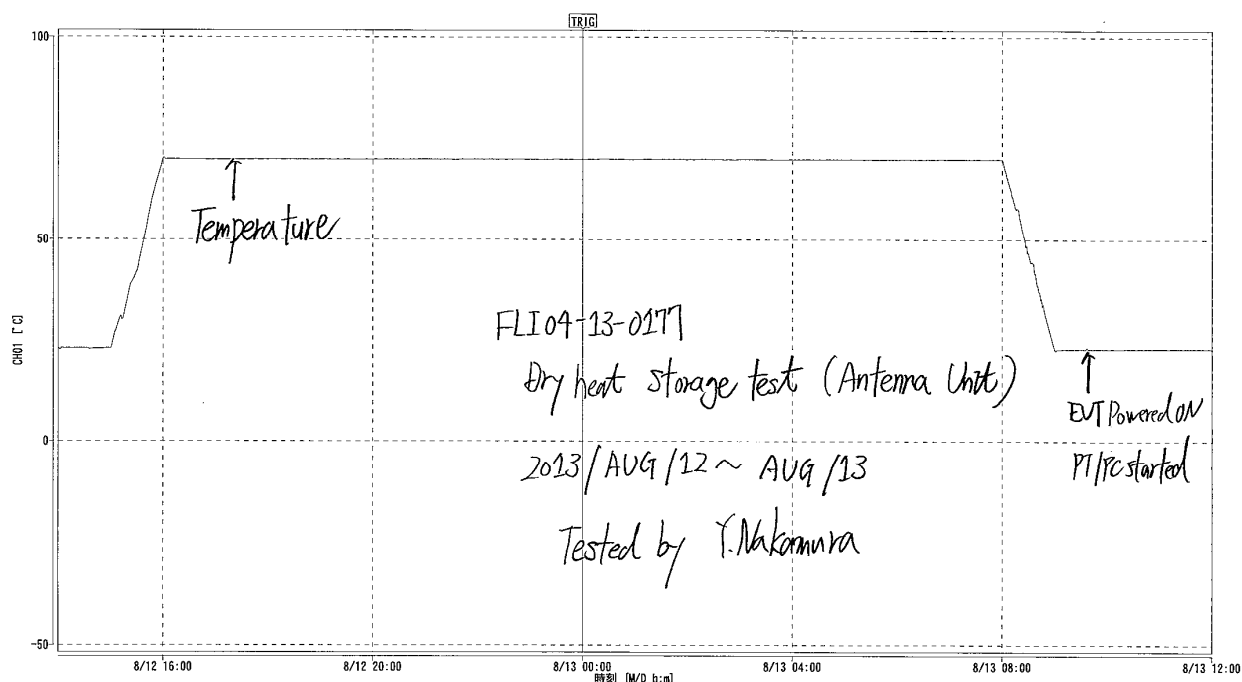
No ingress of water found.

7 Temperature/humidity records taken during Dry heat/Damp heat/Low temperature tests

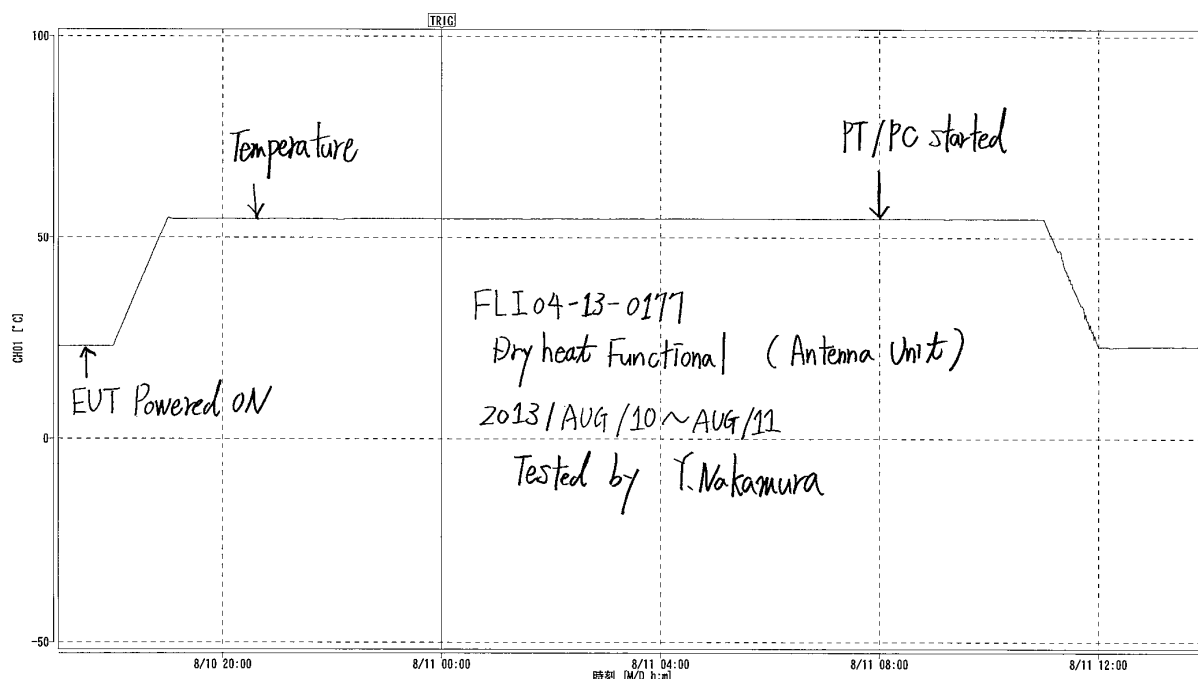
7.1 For FAR-3220/-3320,

7.1.1 Antenna Unit (RSB-128+RTR-106) (25 kW),

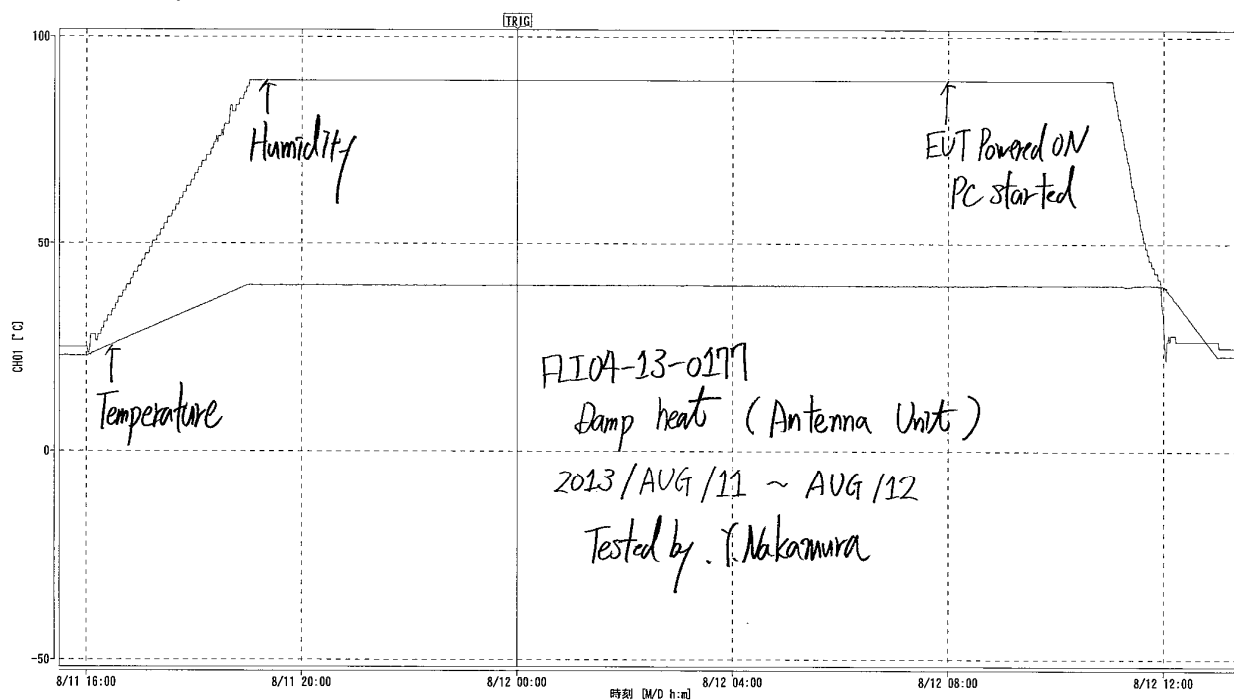
7.1.1.1 Dry heat - Storage,



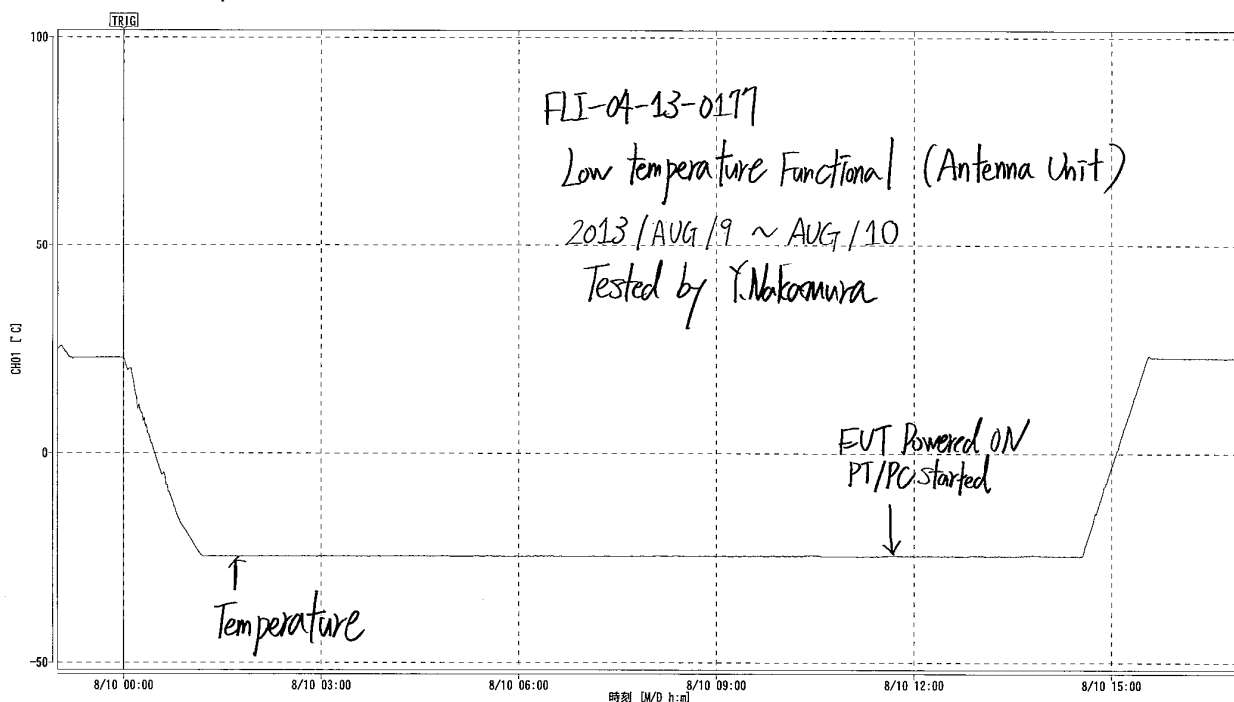
7.1.1.2 Dry heat - Functional,



7.1.1.3 Damp heat,

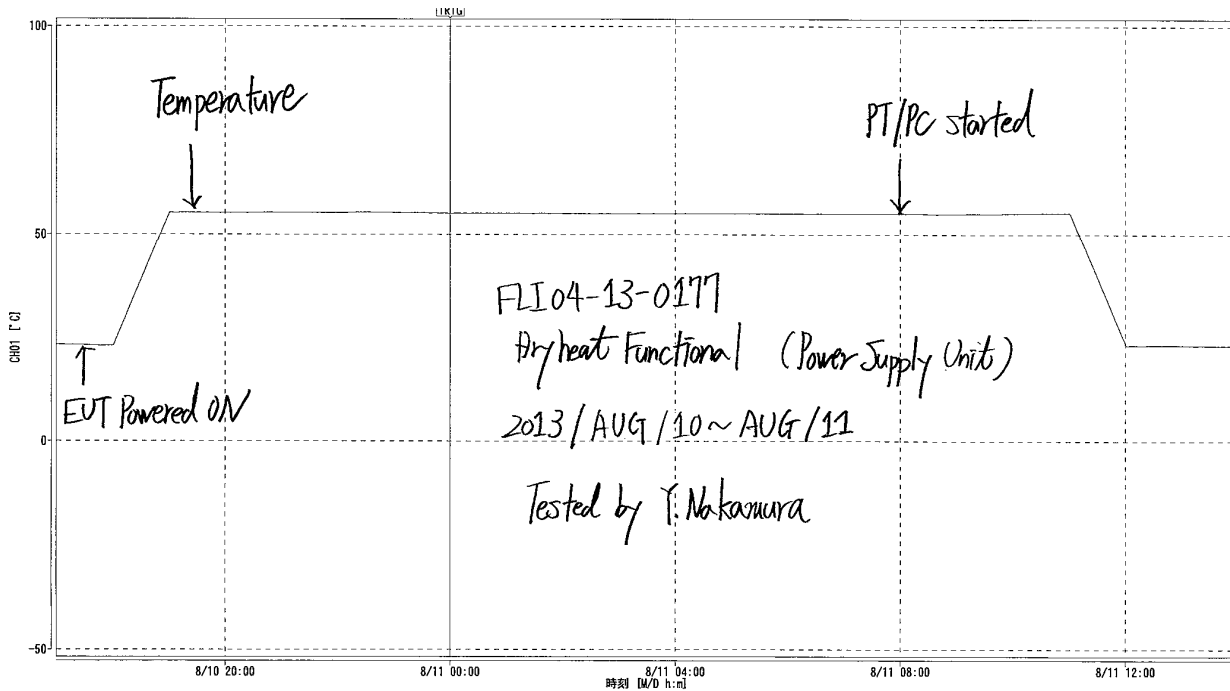


7.1.1.4 Low temperature - Functional,

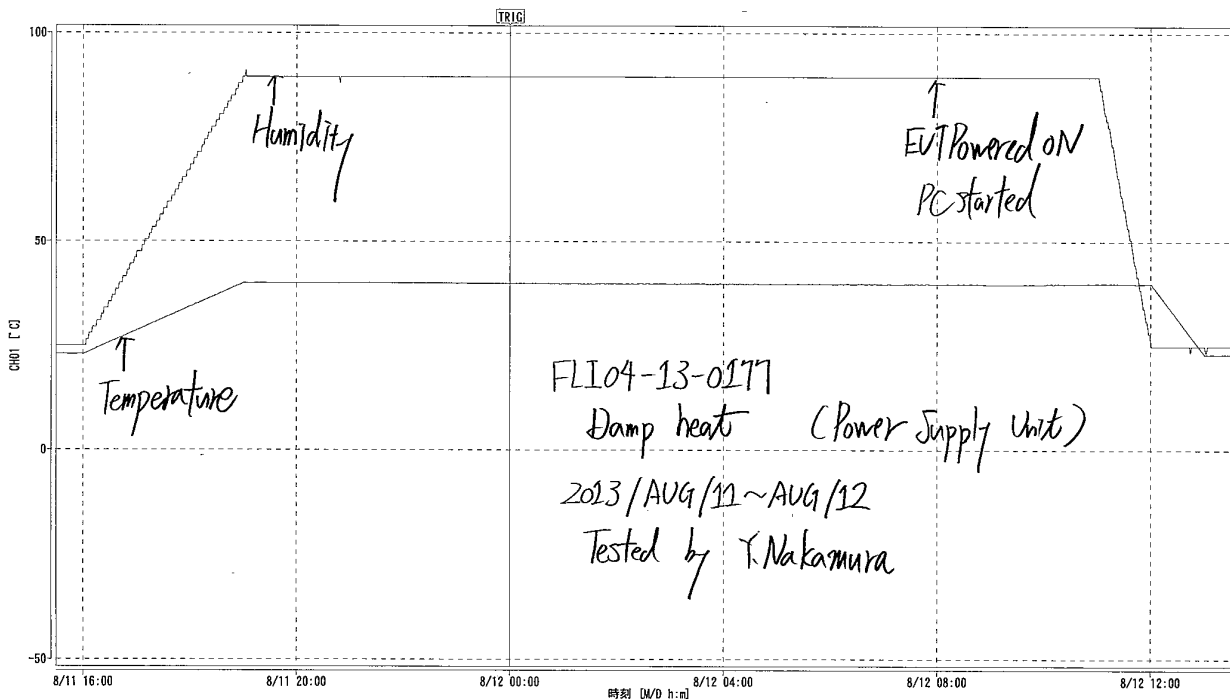


7.1.2 Power Supply Unit PSU-014

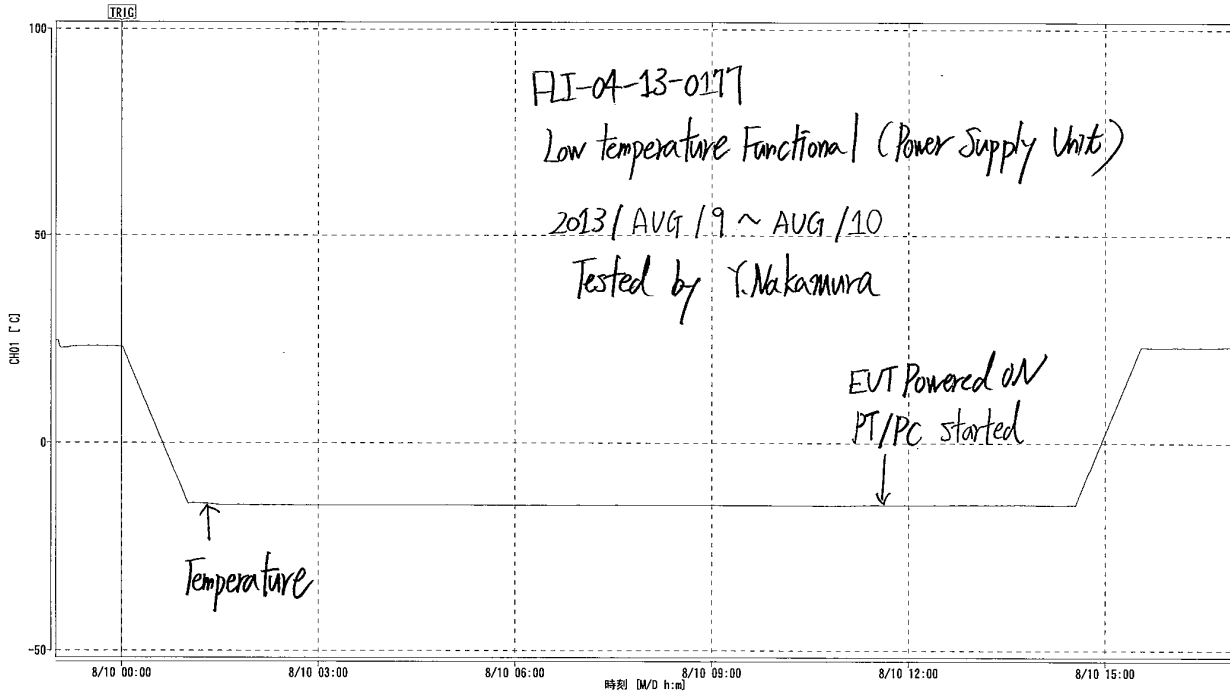
7.1.2.1 Dry heat - Functional,



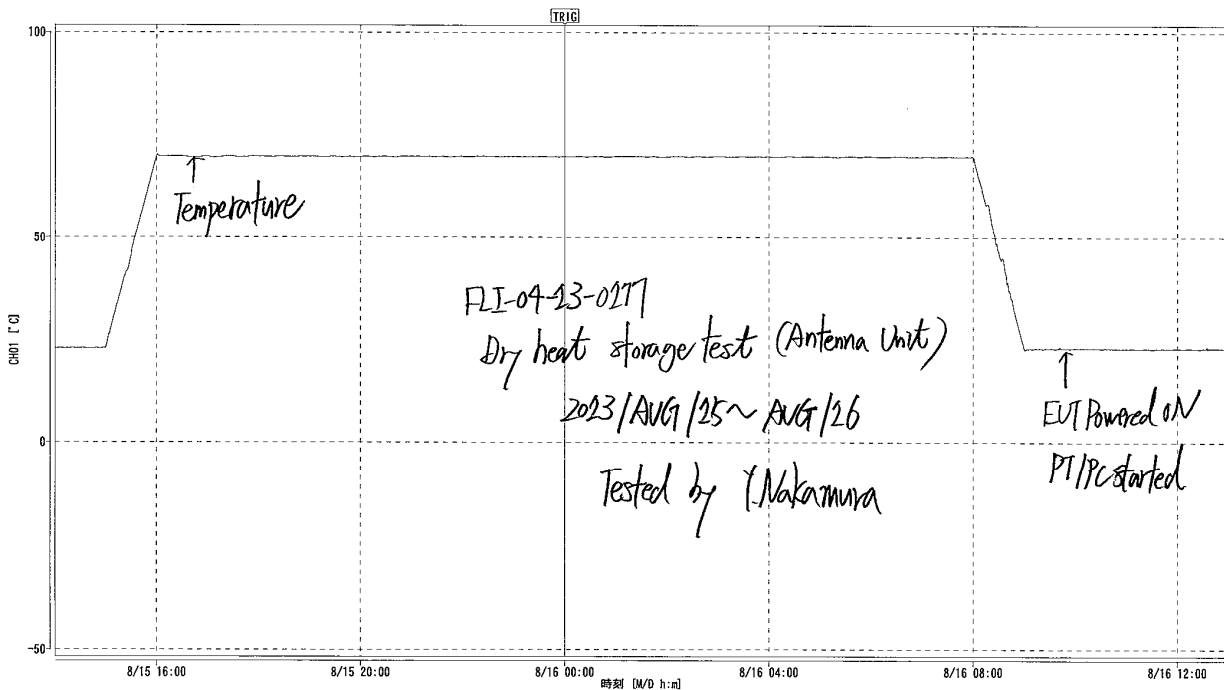
7.1.2.2 Damp heat,



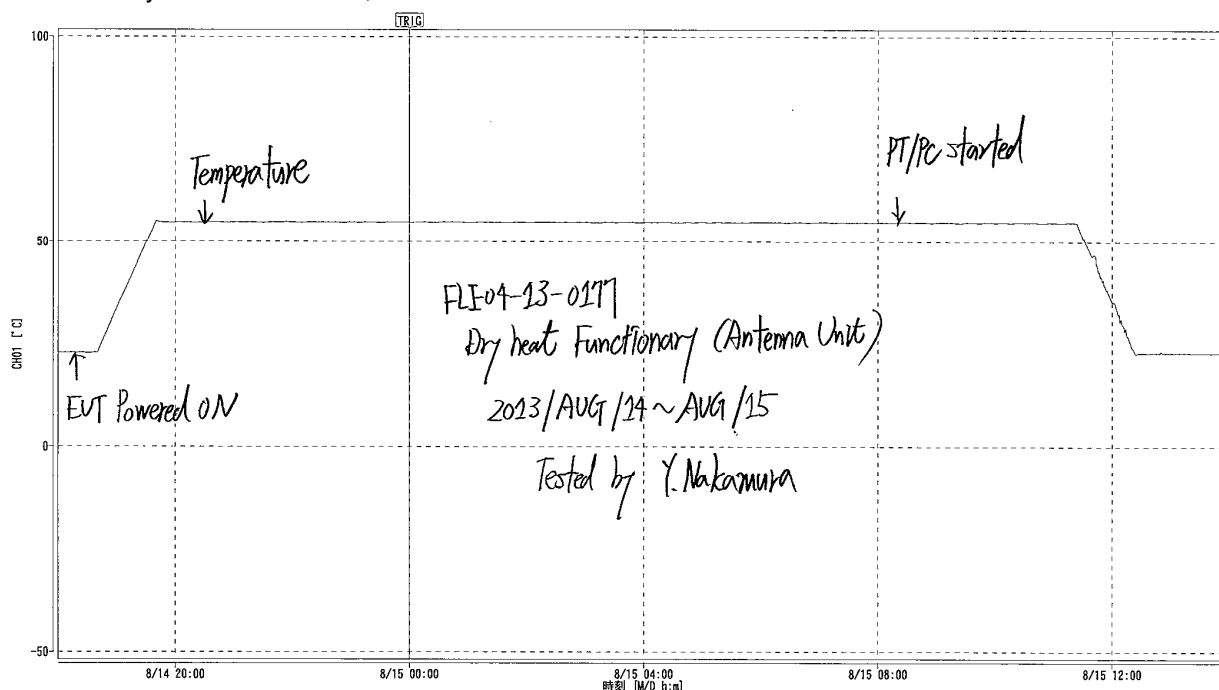
7.1.2.3 Low temperature - Functional,



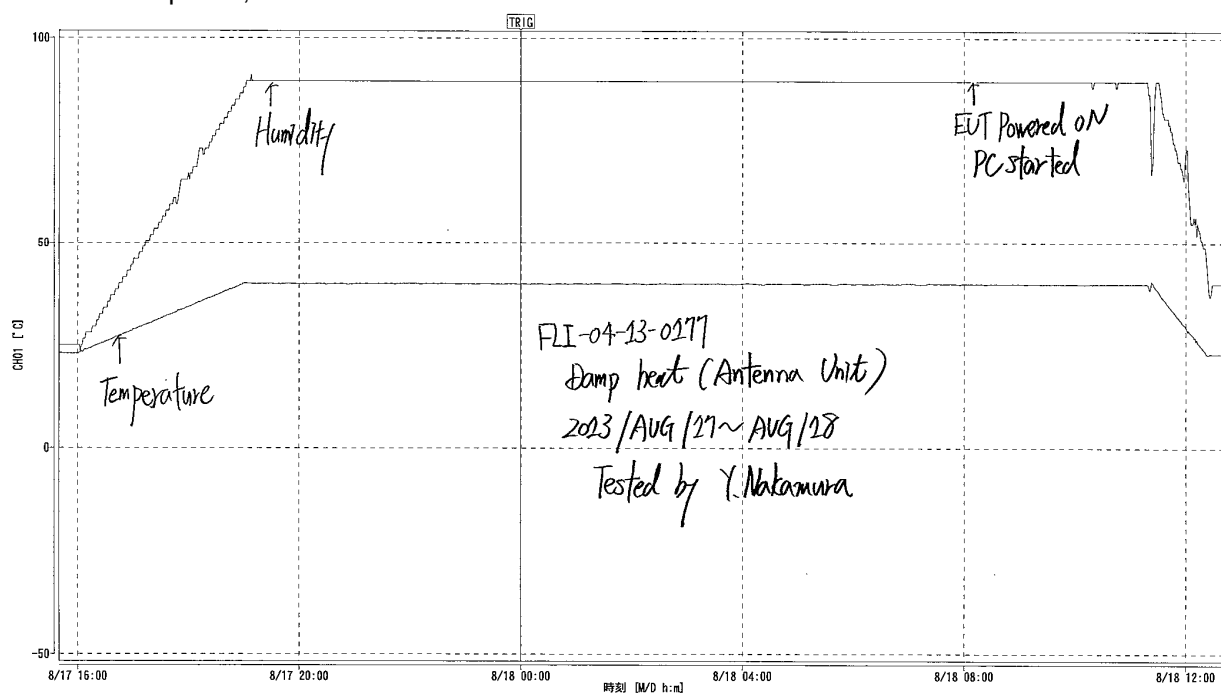
7.2 For FAR-3210/3310,
7.2.1 Antenna Unit (RSB-128-RTR-105) (12 kW)
7.2.1.1 Dry heat - Storage,



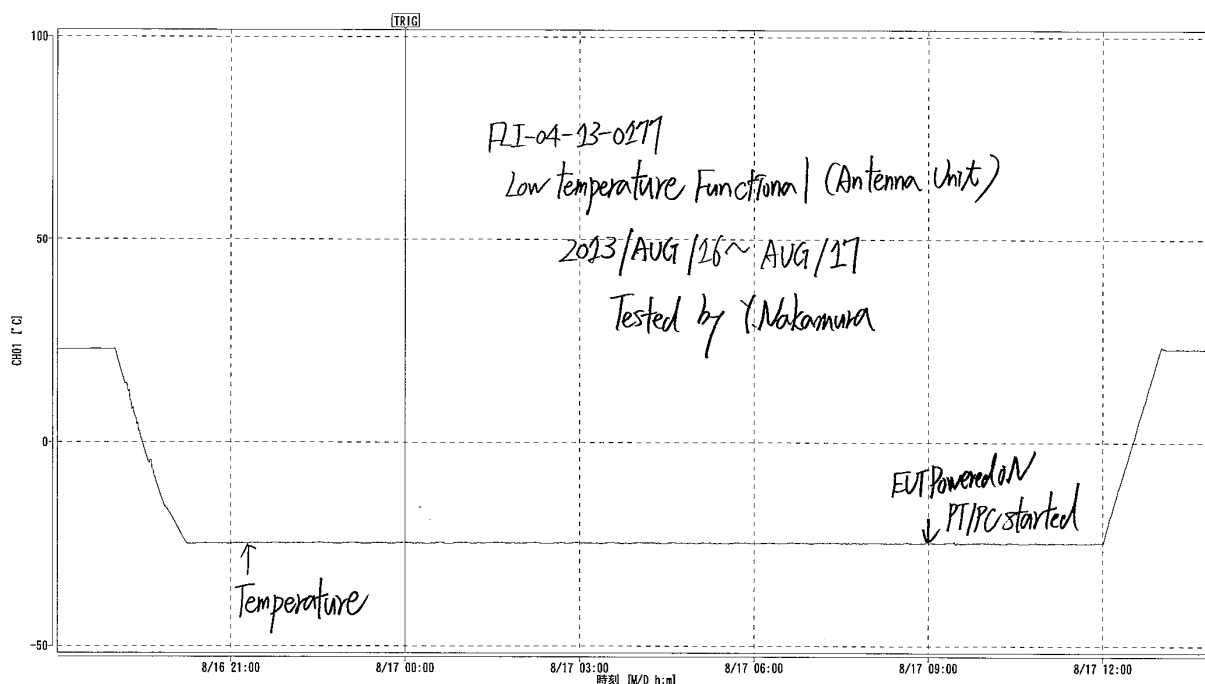
7.2.1.2 Dry heat - Functional,



7.2.1.3 Damp heat,

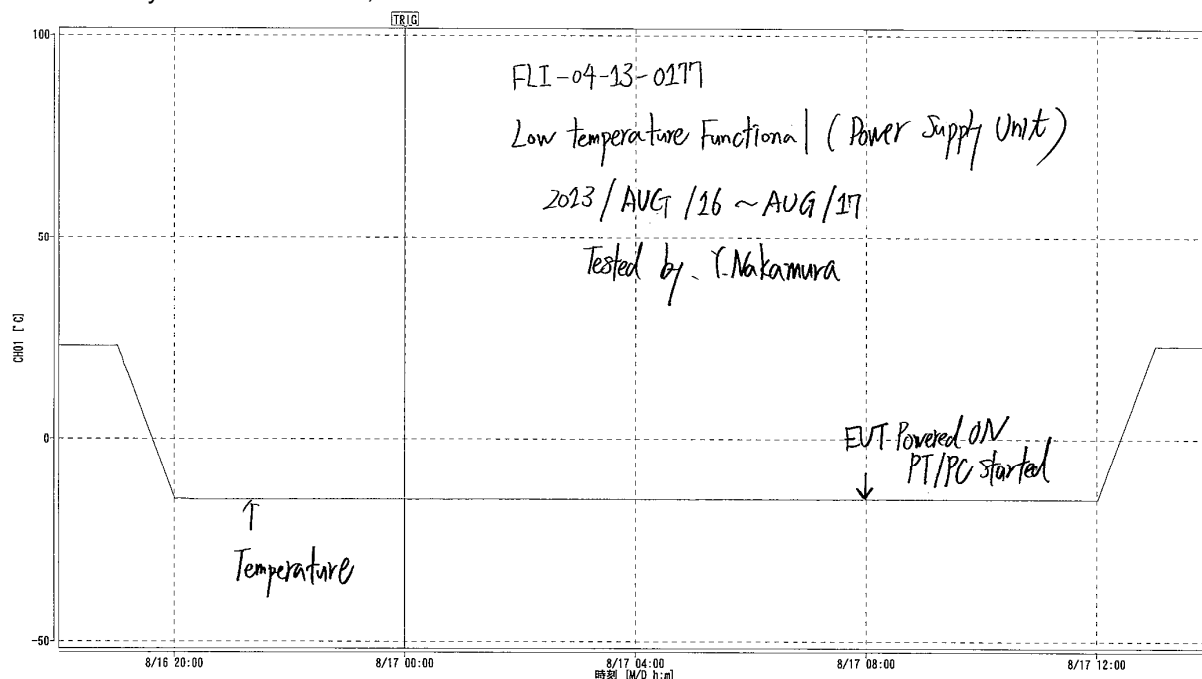


7.2.1.4 Low temperature - Functional,

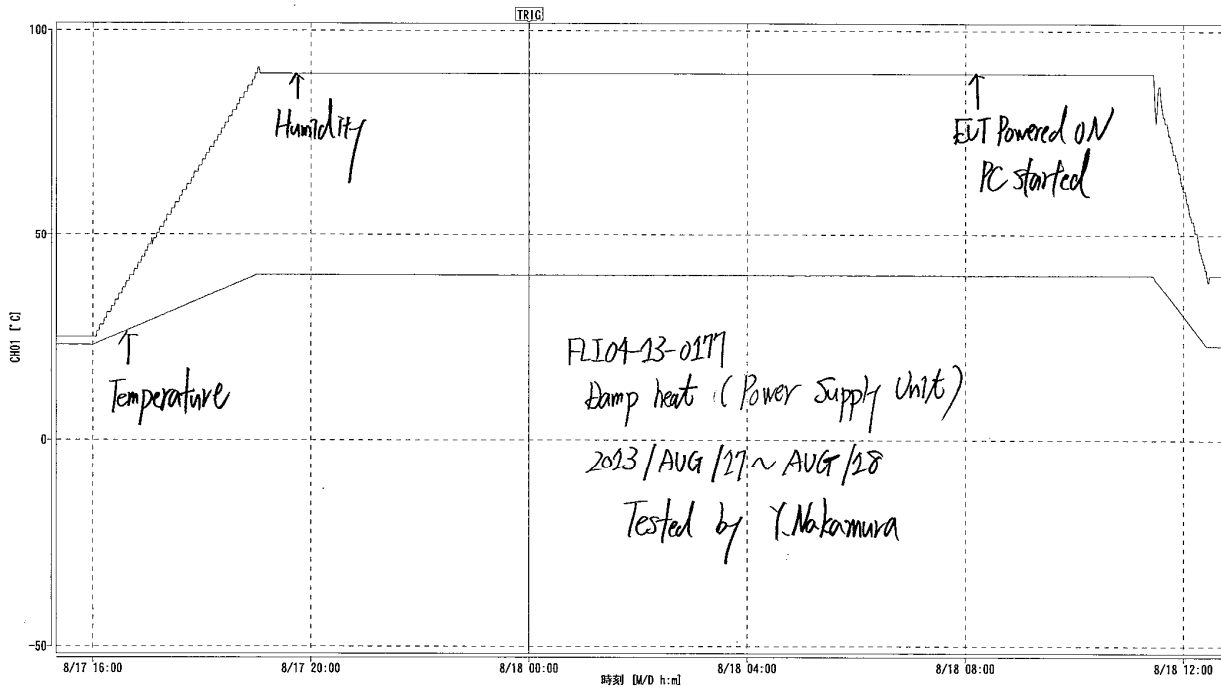


7.2.2 Power Supply Unit PSU-014

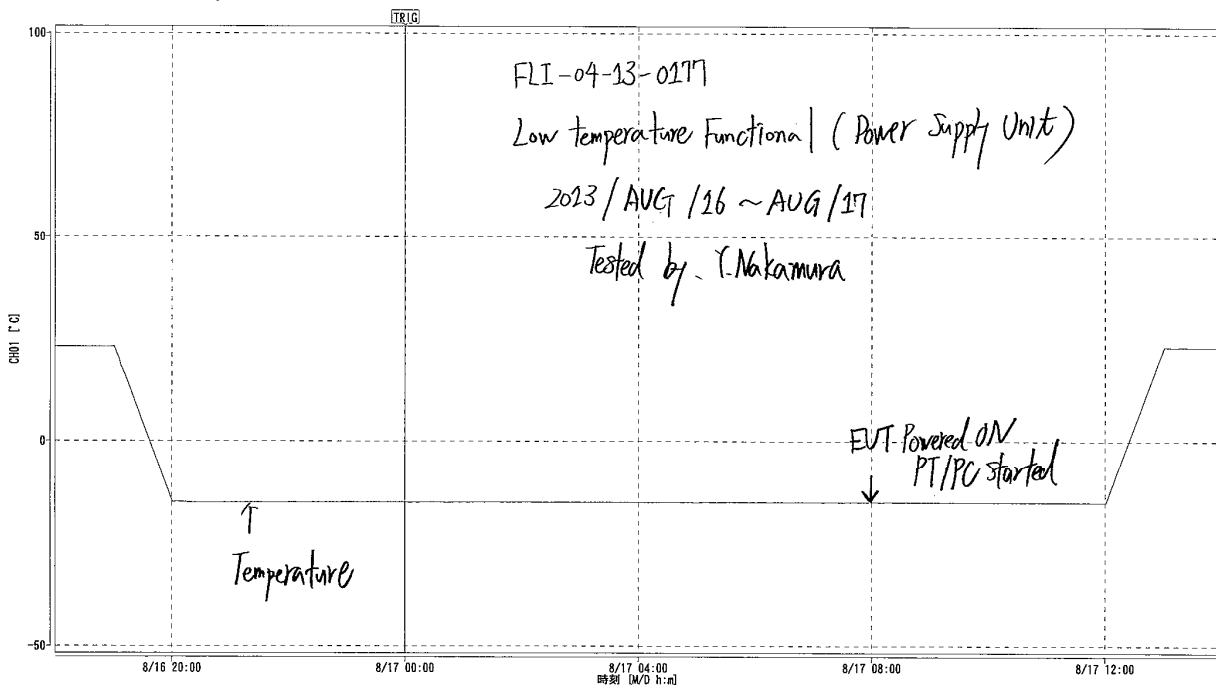
7.2.2.1 Dry heat - Functional,



7.2.2.2 Damp heat,

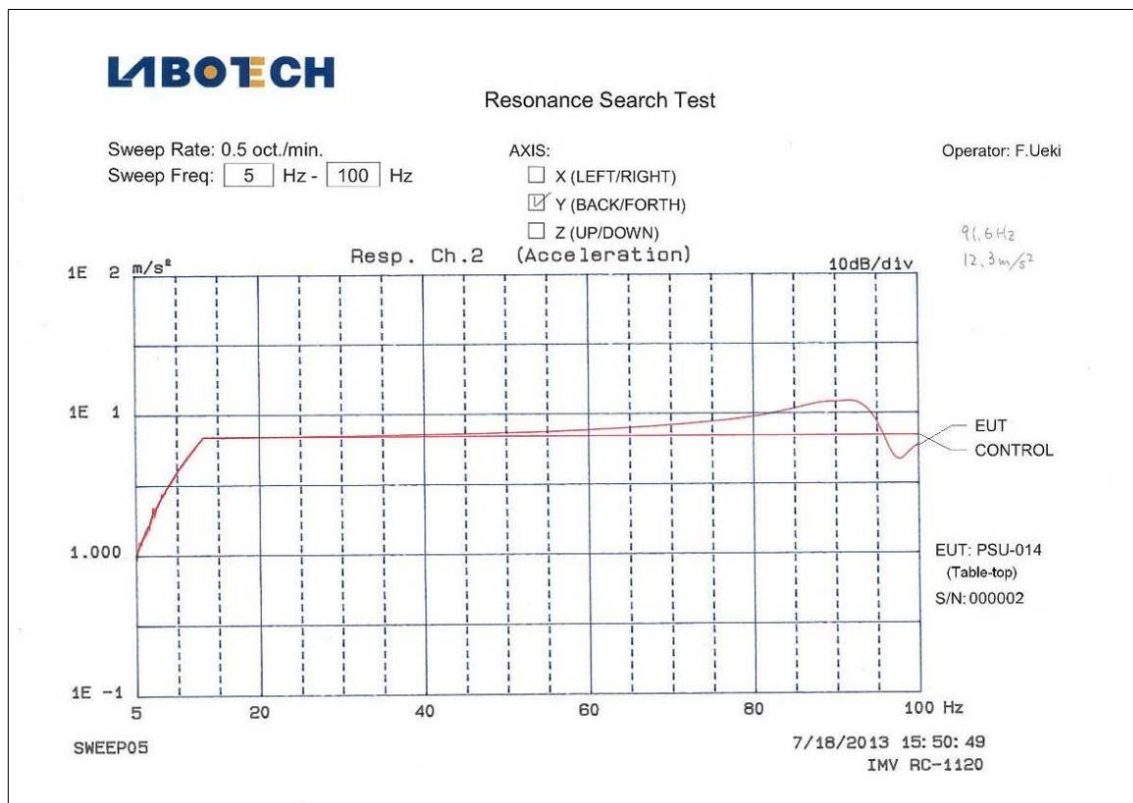
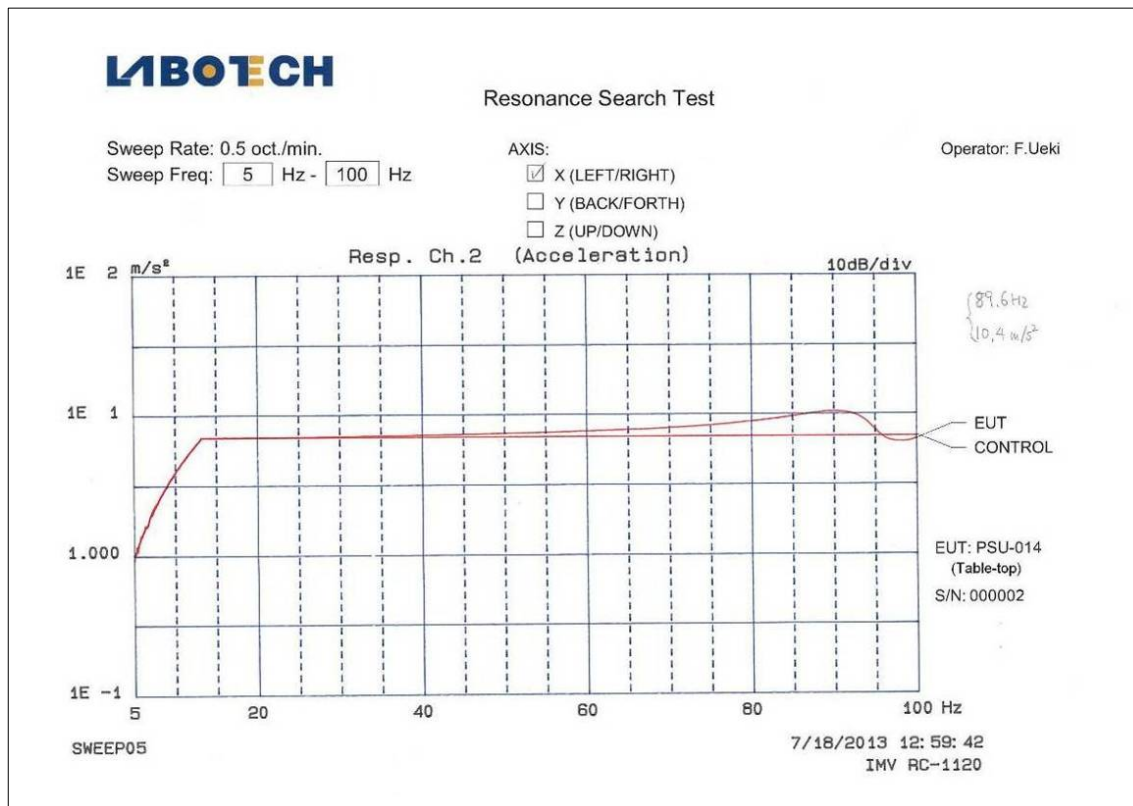


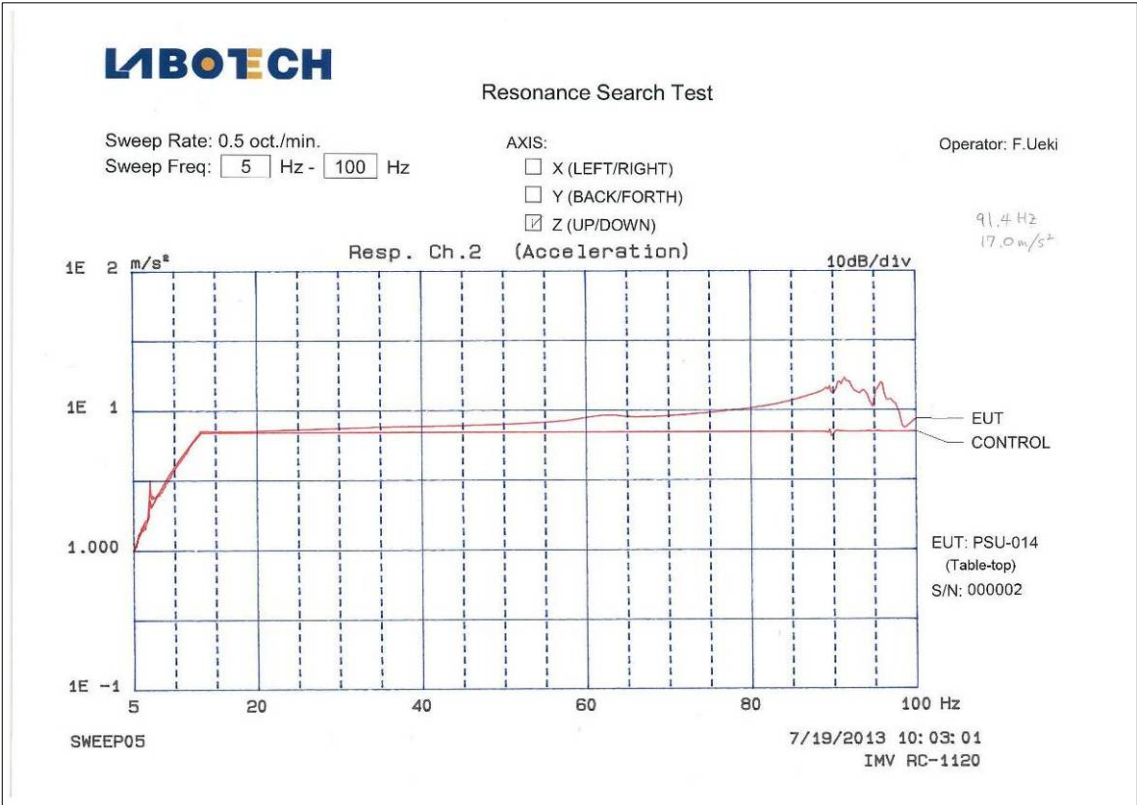
7.2.2.3 Low temperature - Functional,



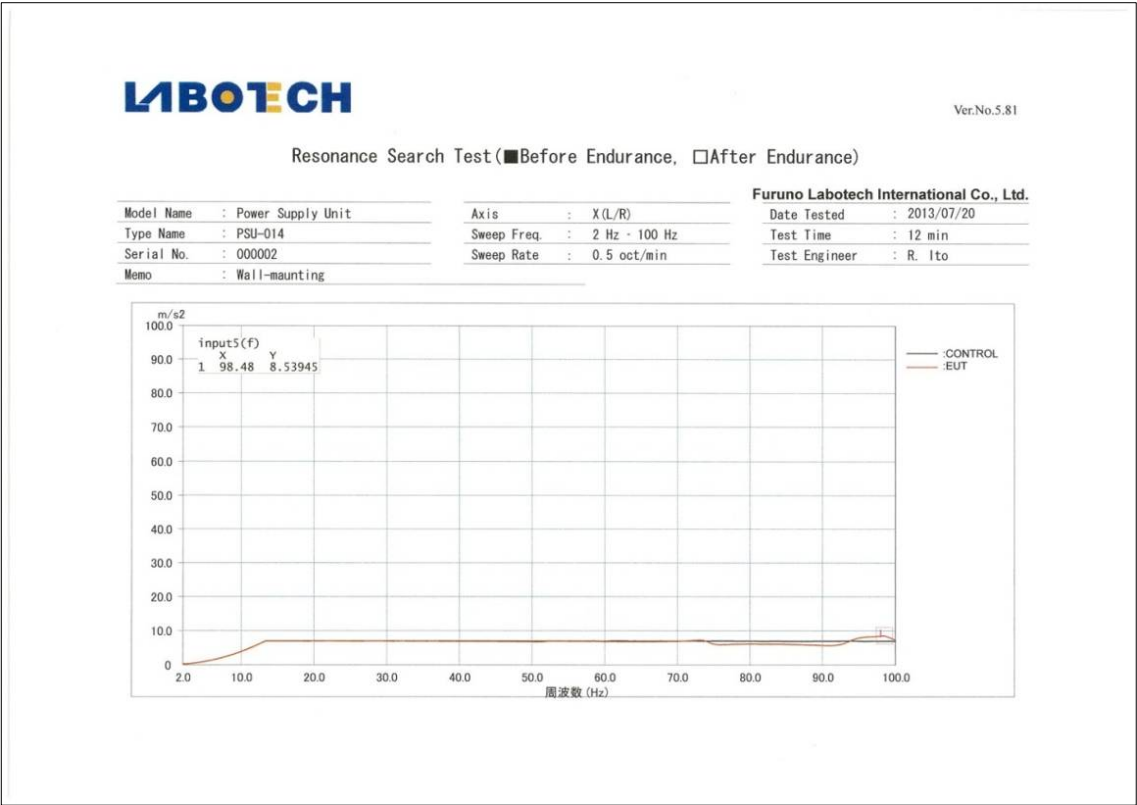
8 Vibration response plots taken during tests

8.1 for PSU-014,
(1) Table-top mounting,





(2) Wall-mounting,





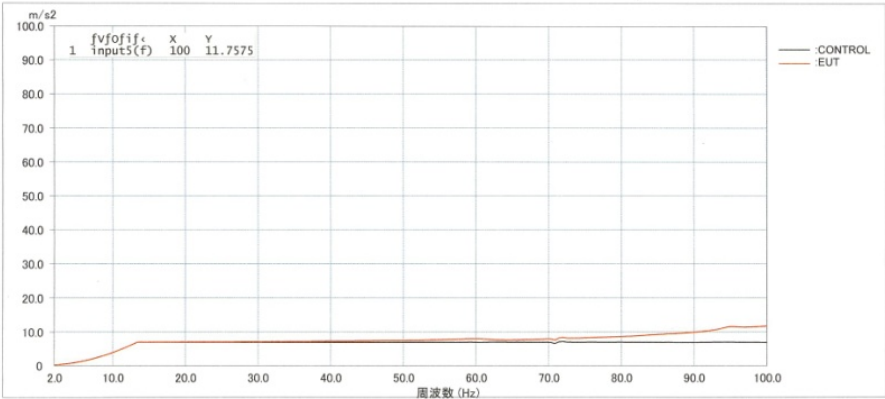
Ver.No.5.81

Resonance Search Test(■Before Endurance, □After Endurance)

Model Name : Power Supply Unit
Type Name : PSU-014
Serial No. : 000002
Memo : Wall-mounting

Axis : Y(B/F)
Sweep Freq. : 2 Hz - 100 Hz
Sweep Rate : 0.5 oct/min

Furuno Labotech International Co., Ltd.
Date Tested : 2013/07/20
Test Time : 12 min
Test Engineer : R. Ito



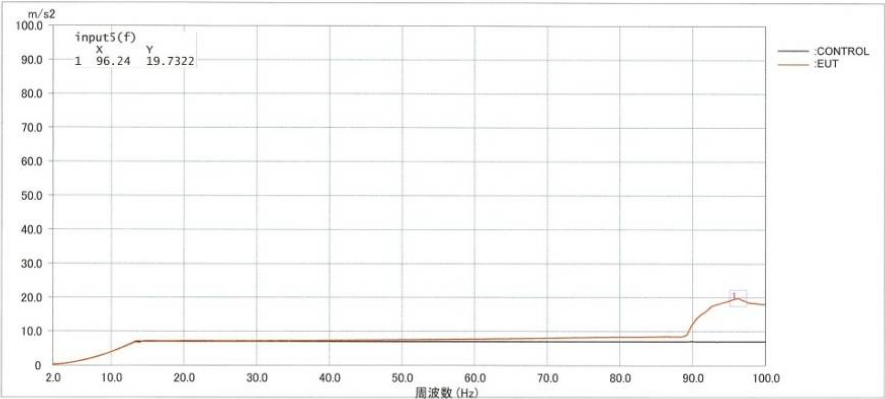
Ver.No.5.81

Resonance Search Test(■Before Endurance, □After Endurance)

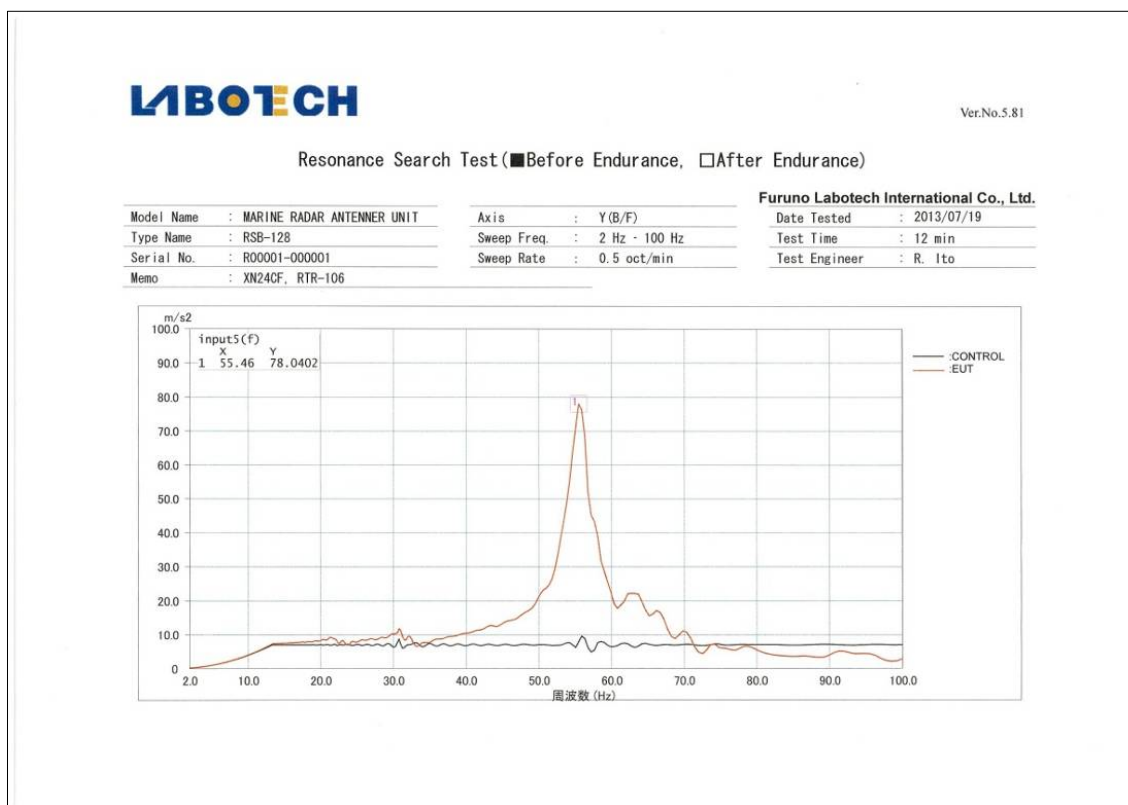
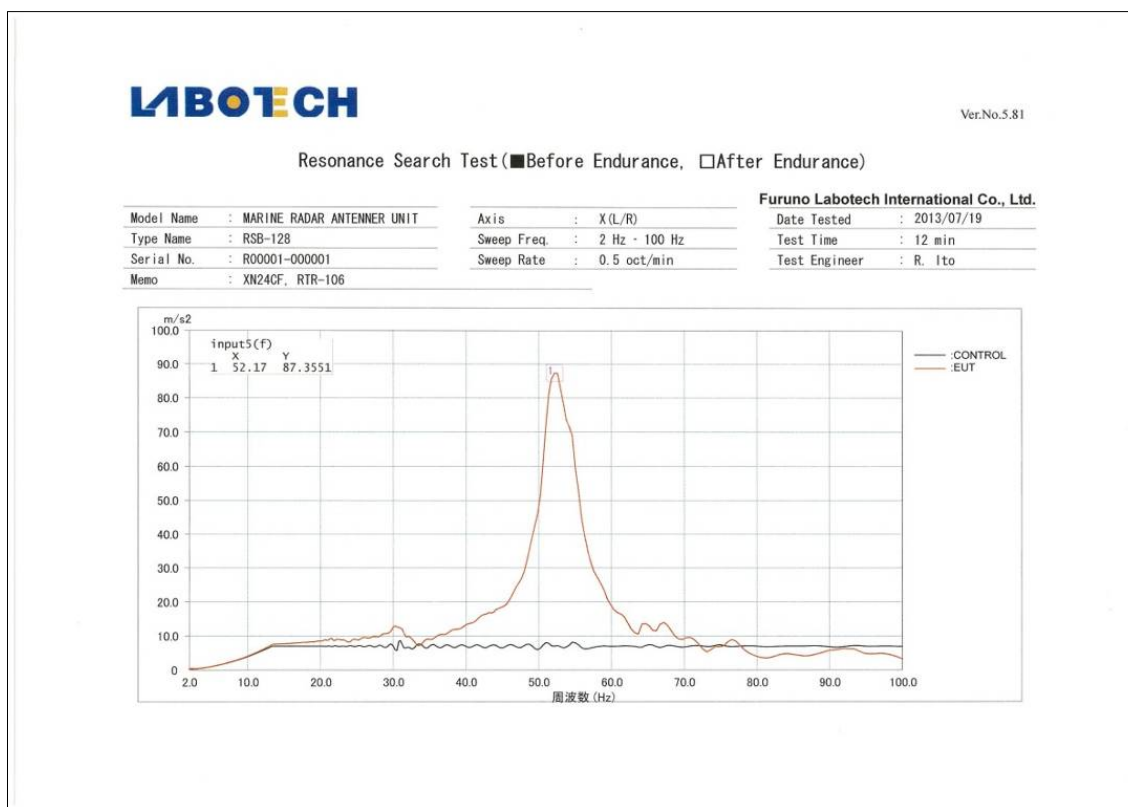
Model Name : Power Supply Unit
Type Name : PSU-014
Serial No. : 000002
Memo : Wall-mounting

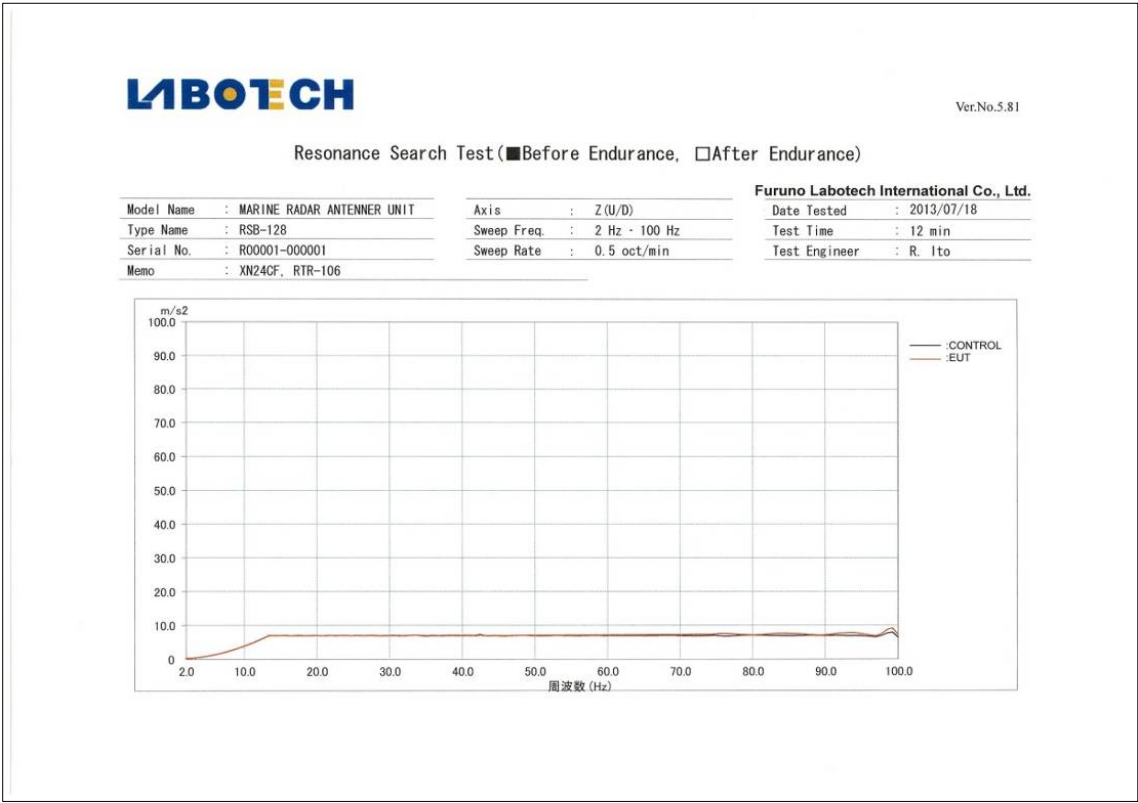
Axis : Z(U/D)
Sweep Freq. : 2 Hz - 100 Hz
Sweep Rate : 0.5 oct/min

Furuno Labotech International Co., Ltd.
Date Tested : 2013/07/19
Test Time : 12 min
Test Engineer : R. Ito

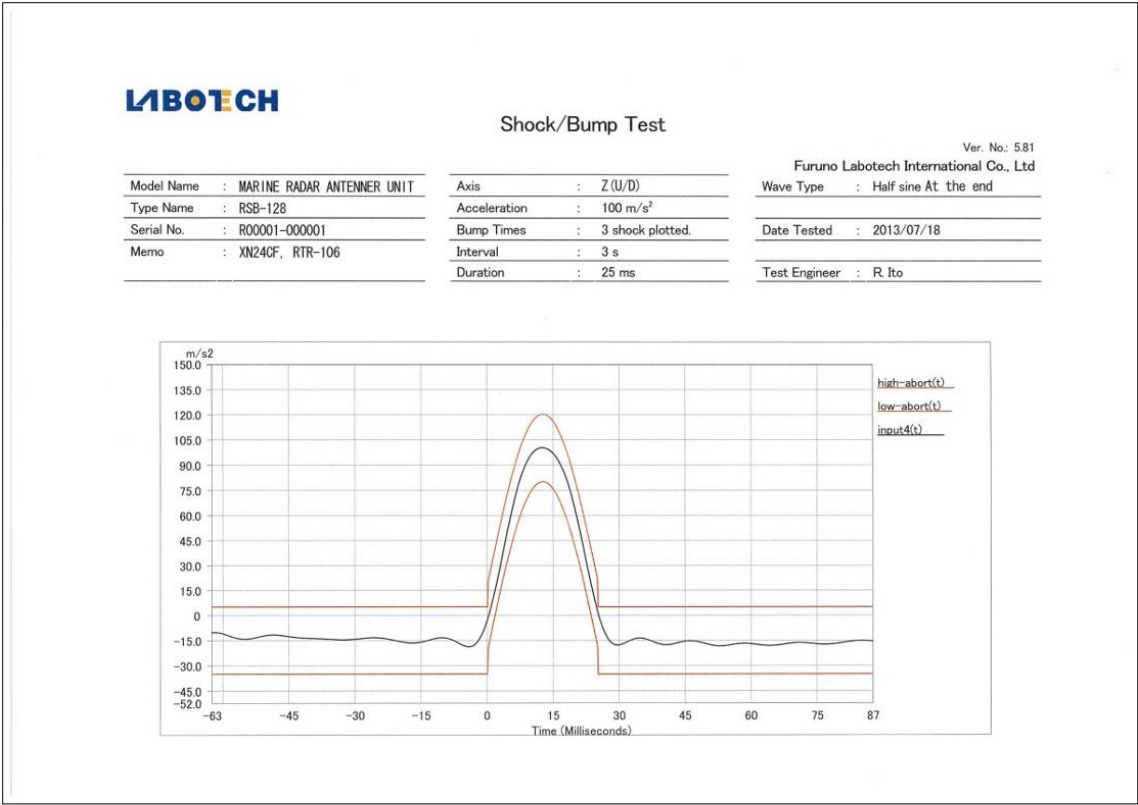


8.2 Antenna Unit (RSB-128 + RTR-106 + XN24CF)





8.3 IE 62388 Shock test to Antenna Unit (RSB-128 + RTR-106 + XN24CF)



9 Test results data of the EUT obtained during the climatic tests.

9.1 Dry heat - Storage test

For FAR-3220/-3320 (RSB-128 + RTR-106 + PSU-014, 25 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|-------------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | --- |
| 2 (rpm) | 42.1 | 42.2 | 42.1 | ≥ 40 |
| 3 | Passed. | Passed. | Passed. | -- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | --- |
| 8 (m:s) | 2:02 | 2:03 | 2:01 | $\leq 4:00$ |
| 9 (A) | 8.41 | 8.31 | 8.31 | --- |

Note: Item numbers are corresponding to those in Clause 1.2.2 Performance Test (PT).

For FAR-3210/-3310 (RSB-128 + RTR-105 + PSU-014, 12 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|--------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | --- |
| 2 (rpm) | 42.1 | 42.1 | 42.1 | ≥ 40 |
| 3 | Passed. | Passed. | Passed. | -- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | --- |
| 8 (m:s) | 1:59 | 2:01 | 2:01 | ≤ 4:00 |
| 9 (A) | 5.20 | 5.20 | 5.20 | --- |

9.2 Dry heat – Functional test

For FAR-3220/-3320 (RSB-128 + RTR-106 + PSU-014, 25 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|--------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | --- |
| 2 (rpm) | 42.2 | 42.2 | 42.2 | ≥ 40 |
| 3 | Passed. | Passed. | Passed. | -- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | --- |
| 8 (m:s) | 2:11 | 2:11 | 2:12 | ≤ 4:00 |
| 9 (A) | 8.38 | 8.44 | 8.38 | --- |

For FAR-3210/-3310 (RSB-128 + RTR-105 + PSU-014, 12 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|-------------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | --- |
| 2 (rpm) | 42.2 | 42.2 | 42.2 | ≥ 40 |
| 3 | Passed. | Passed. | Passed. | -- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | --- |
| 8 (m:s) | 2:01 | 2:01 | 2:01 | $\leq 4:00$ |
| 9 (A) | 5.22 | 5.22 | 5.20 | --- |

9.3 Damp heat – Functional test

For FAR-3220/-3320 (RSB-128 + RTR-106 + PSU-014, 25 kW)

| OP-PAK 5020/ 5025 (RSD 120 + RTR 100 + 100 W, 20 kW) | | | | |
|--|------------------------------------|-------------------|-------------------|-------------|
| Item no. | Results | | | Limit |
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | NA | NA | --- |
| 2 (rpm) | 42.1 | | | ≥ 40 |
| 3 | Passed. | | | -- |
| 4 | Passed. | | | --- |
| 5 | Passed. | | | --- |
| 6 | Passed. | | | --- |
| 7 | Passed. | | | --- |
| 8 (m:s) | 2:01 | | | $\leq 4:00$ |
| 9 (A) | 8.43 | | | --- |

Note: NA - Not applicable.

For FAR-3210/-3310 (RSB-128 + RTR-105 + PSU-014, 12 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|-------------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | NA | NA | --- |
| 2 (rpm) | 42.1 | | | ≥ 40 |
| 3 | Passed. | | | -- |
| 4 | Passed. | | | --- |
| 5 | Passed. | | | --- |
| 6 | Passed. | | | --- |
| 7 | Passed. | | | --- |
| 8 (m:s) | 2:01 | | | $\leq 4:00$ |
| 9 (A) | 5.20 | | | --- |

Note: NA - Not applicable.

9.4 Low temperature – Functional test

For FAR-3220/-3320 (RSB-128 + RTR-106 + PSU-014, 25 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|-------------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | --- |
| 2 (rpm) | 41.9 | 41.9 | 41.9 | ≥ 40 |
| 3 | Passed. | Passed. | Passed. | -- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | --- |
| 8 (m:s) | 2:03 | 2:03 | 2:03 | $\leq 4:00$ |
| 9 (A) | 8.17 | 8.23 | 8.20 | --- |

For FAR-3210/-3310 (RSB-128 + RTR-105 + PSU-014, 12 kW)

| Item no. | Results | | | Limit |
|----------|------------------------------------|-------------------|-------------------|--------|
| | Power supply voltage and frequency | | | |
| | 230 VAC / 50 Hz | 207 VAC / 47.5 Hz | 253 VAC / 52.5 Hz | |
| 1 | Passed. | Passed. | Passed. | ≥ 40 |
| 2 (rpm) | 41.9 | 41.9 | 41.9 | -- |
| 3 | Passed. | Passed. | Passed. | --- |
| 4 | Passed. | Passed. | Passed. | --- |
| 5 | Passed. | Passed. | Passed. | --- |
| 6 | Passed. | Passed. | Passed. | --- |
| 7 | Passed. | Passed. | Passed. | ≤ 4:00 |
| 8 (m:s) | 2:01 | 2:01 | 2:01 | --- |
| 9 (A) | 5.00 | 5.00 | 5.01 | --- |