

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 61672-1: 2002, IEC 60068-2-6: 2007, ISO 25862: 2009,		
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>).

TABLE OF CONTENTS

Report Summary.....	2
Testing Laboratory Status	3
1 Principal Information.....	5
1.1 Equipment under test (EUT).....	5
1.2 EUT Operation mode and Performance Check.....	6
1.3 Test Conditions.....	7
1.4 Observation and comments.....	7
1.5 Measurement uncertainties	8
2 Test Results Summary	8
3 Test Results.....	9
3.1 Power supply	9
3.1.1 Extreme power supply	9
3.1.2 Excessive conditions	9
3.2 Dry heat	9
3.2.1 Storage test	9
3.2.2 Functional test	9
3.3 Damp heat - Functional test	9
3.4 Low temperature	9
3.4.1 Storage test (Not applicable)	9
3.4.2 Functional test	9
3.5 Vibration.....	9
3.5.1 EUT attitude/mounting and Test fixture:	9
3.5.2 Resonance search and Endurance tests	10
3.6 Antenna shock.....	10
3.6.1 EUT attitude/mounting and Test fixture:	10
3.6.2 Results:.....	10
3.7 Rain and spray.....	10
3.8 Corrosion (salt mist) (Not performed)	10
3.9 Special purpose tests	10
3.9.1 Acoustic noise and signals	10
3.9.2 Compass safe distance (CSD)	11
3.10 Safety precautions	11
3.10.1 Protection against accidental access to dangerous voltages.....	11
3.10.2 Electromagnetic radiofrequency radiation	11
3.10.3 Emission from visual display unit (VDU) (Not applicable)	11
3.10.4 X-radiation (Not performed).....	11
3.11 Environmental conditions during Testing	12
4 List of Measuring/Test Instruments	14
5 EUT Setup/Test Arrangement	16
6 Photographs of Test Setup/Arrangement.....	17
7 Temperature/humidity records taken during Dry heat/Damp heat/Low temperature tests	23
8 Vibration response plots taken during tests	30
9 Test results data of the EUT obtained during the climatic tests.	35

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 (*1)

(*1): 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 2013	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

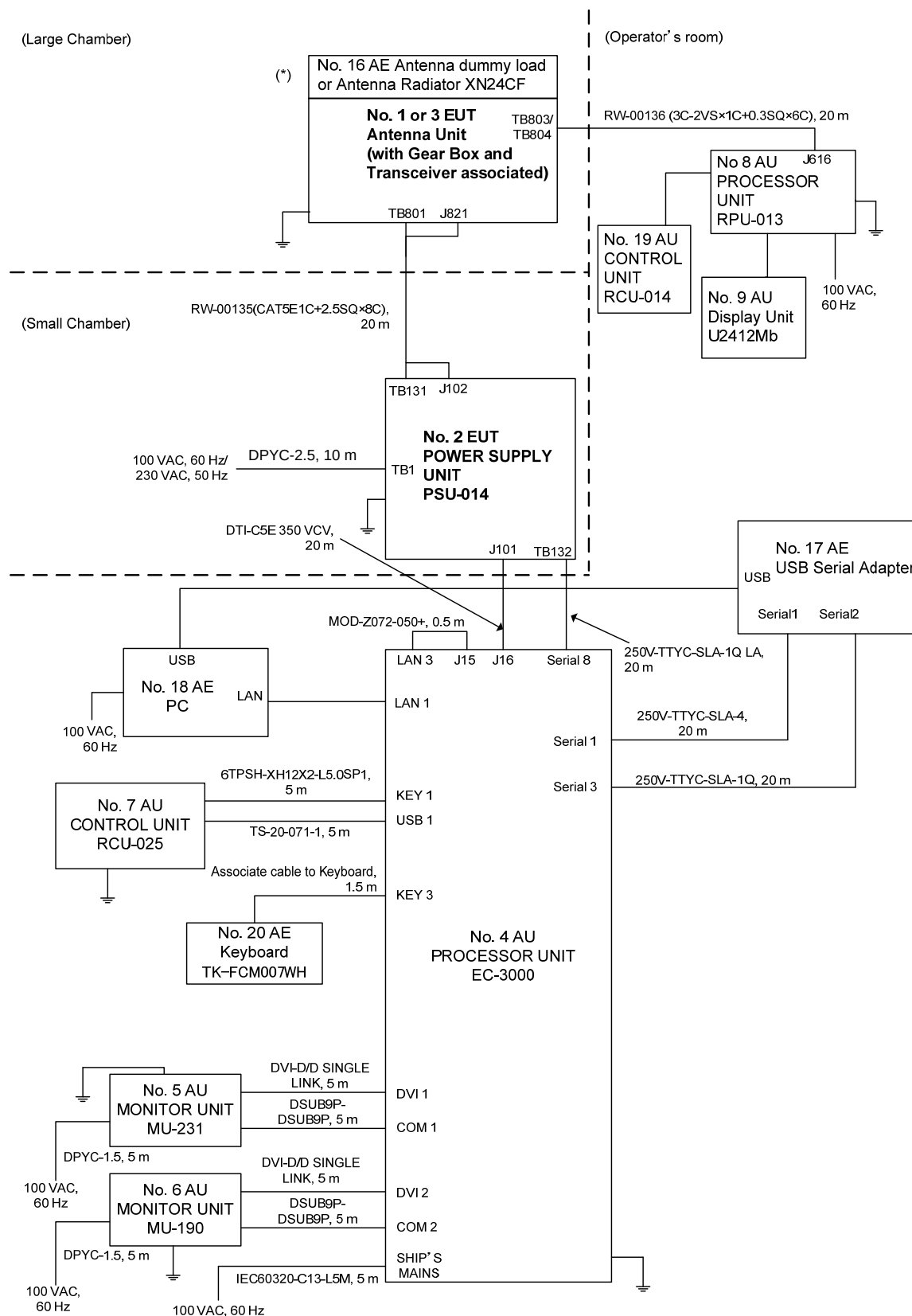
(*): X – indicates instruments used for the tests, -- – not used.

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),

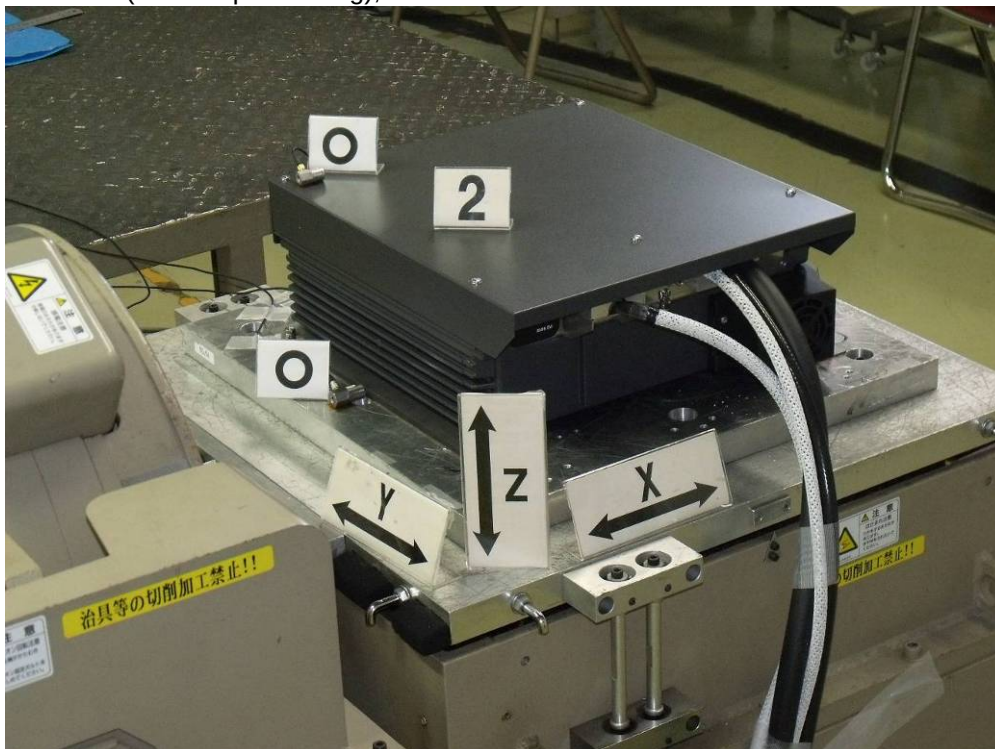


PSU-014,



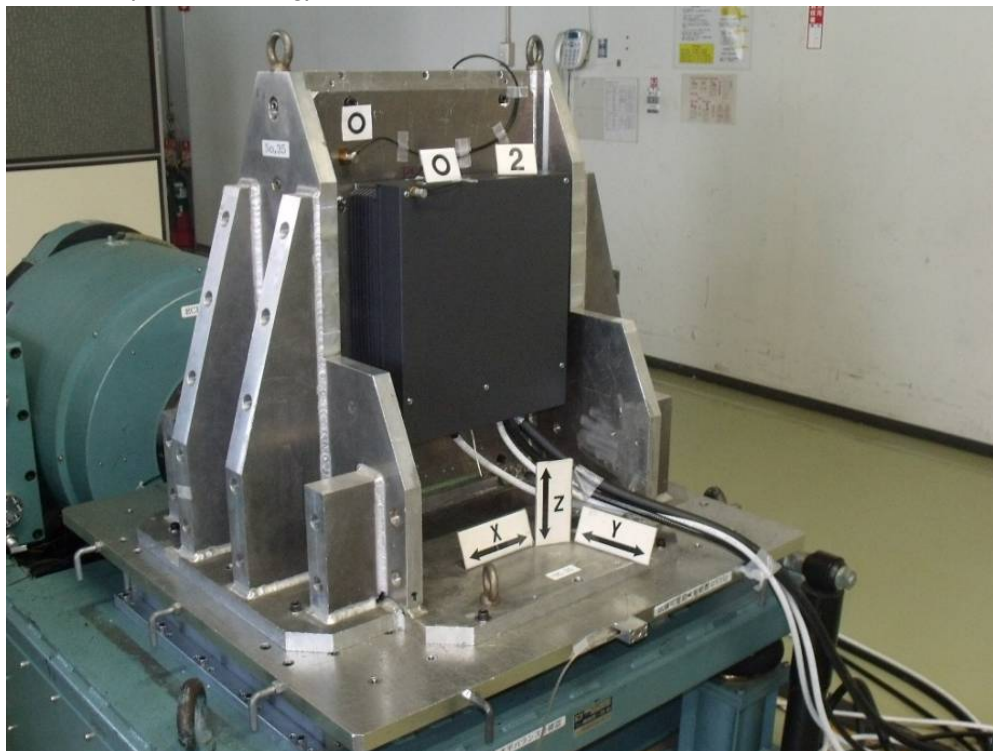
6.2 Vibration

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

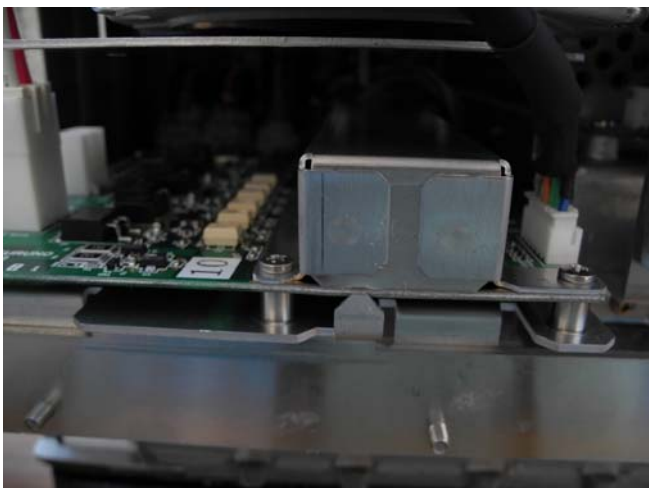
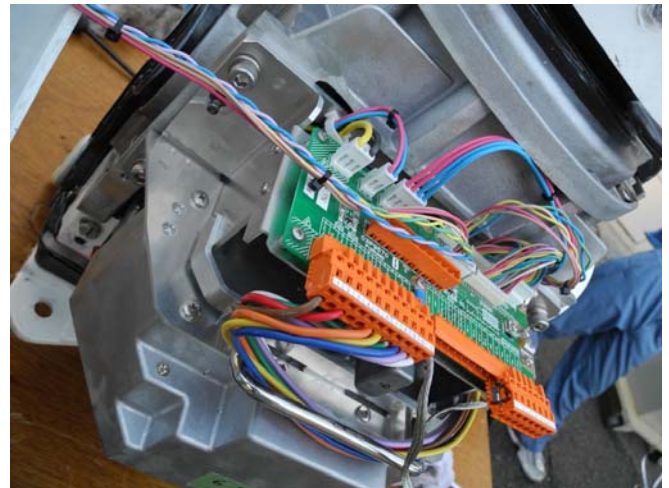
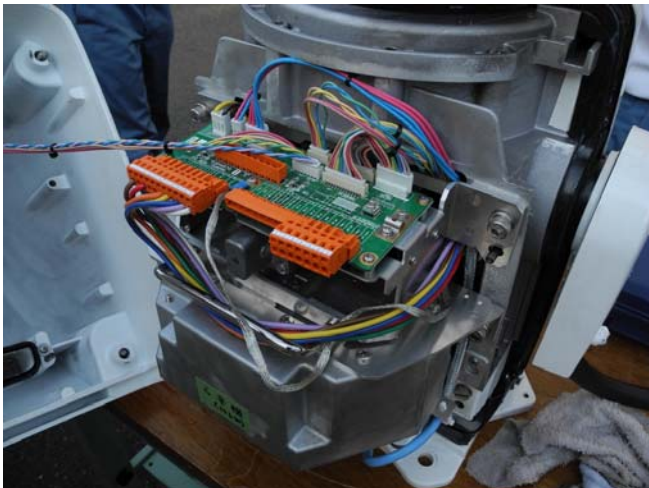
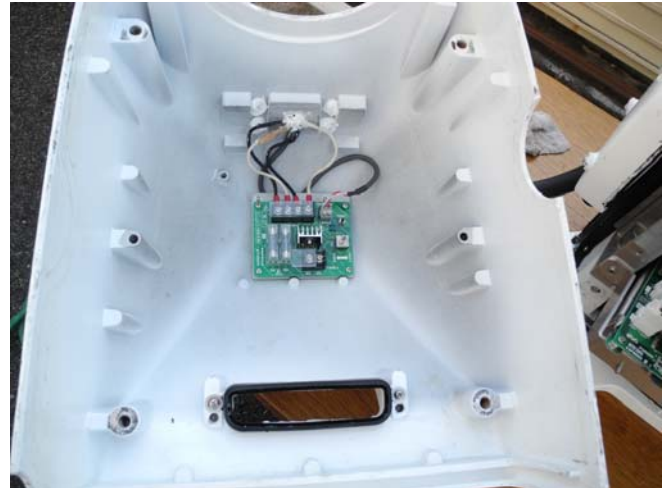
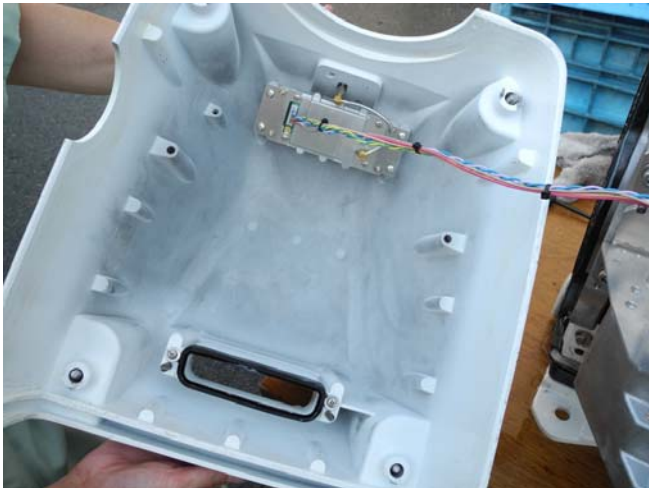
For Antenna Unit (RSB-128 + RTR-106 + XN24CF),
 Test Setup,

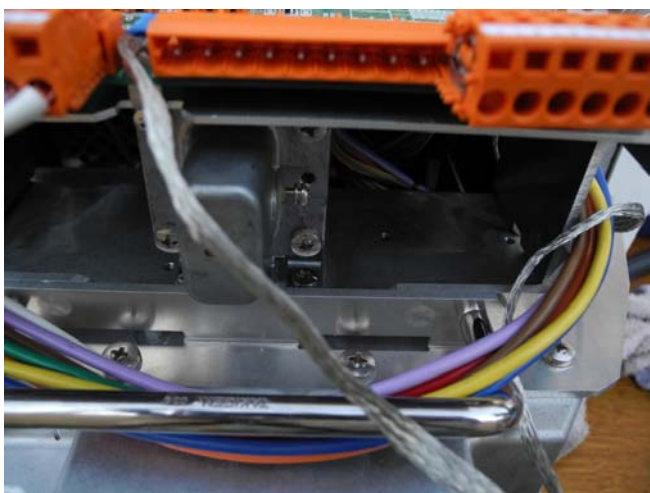
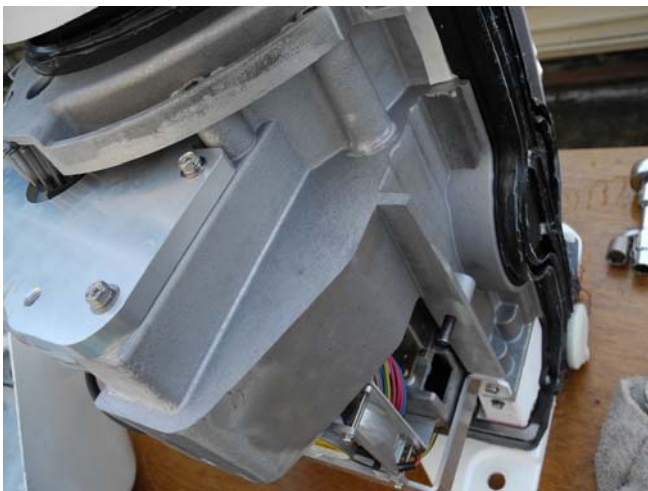
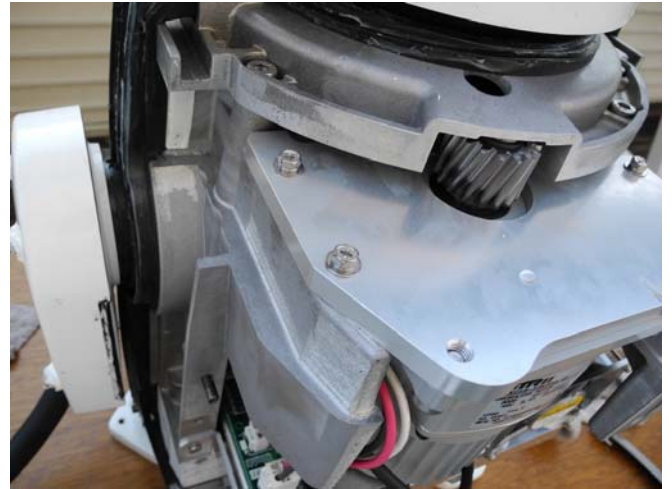


Spraying,



Photographs of the internal examinations done after the test,





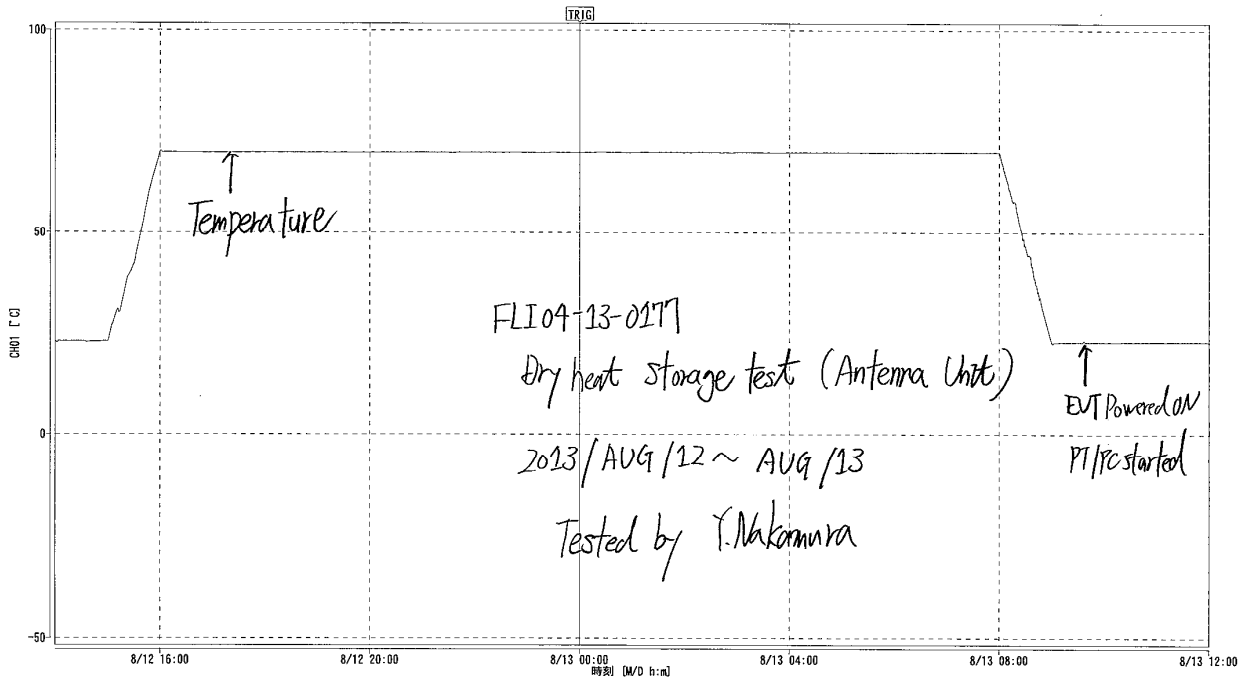
No ingress of water found.

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

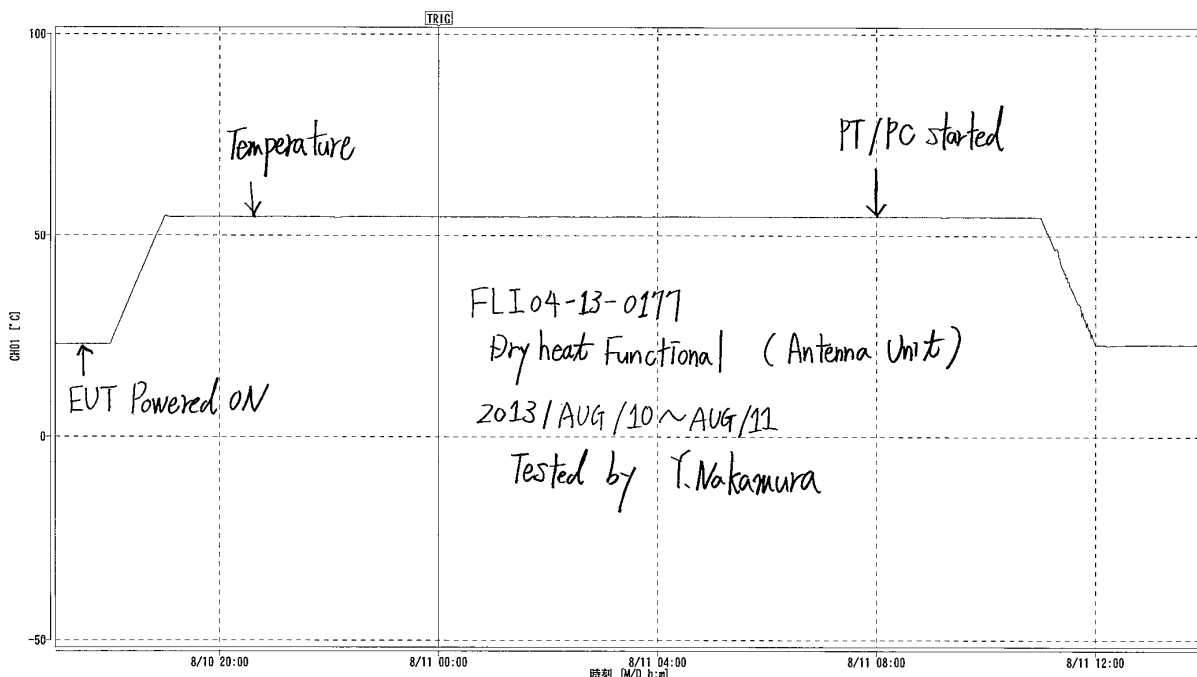
7.1 For FAR-3220/-3320,

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

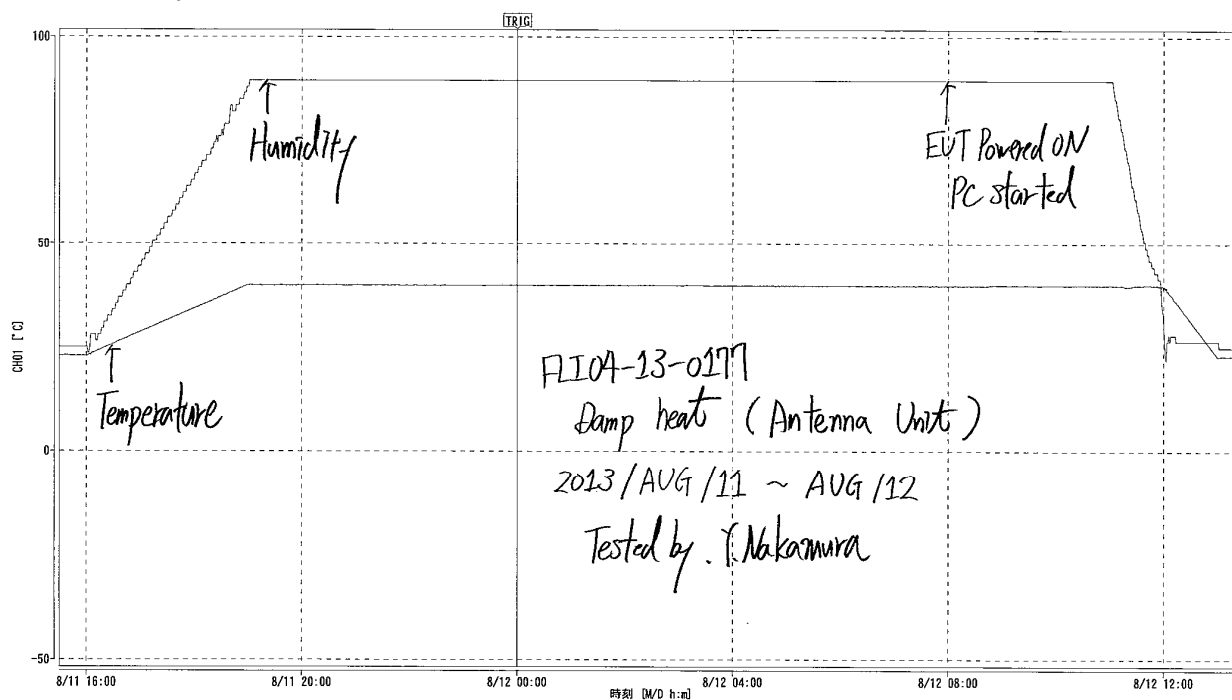
7.1.1.1 Dry heat - Storage,



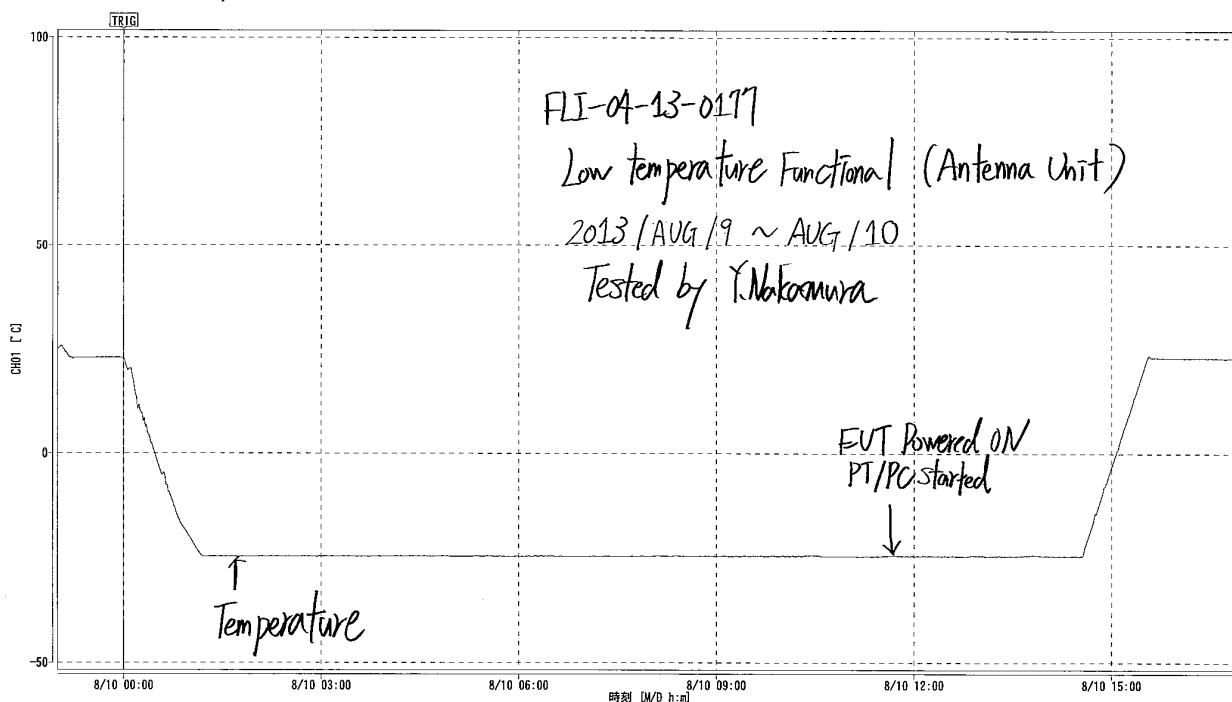
7.1.1.2 Dry heat - Functional,



7.1.1.3 Damp heat,

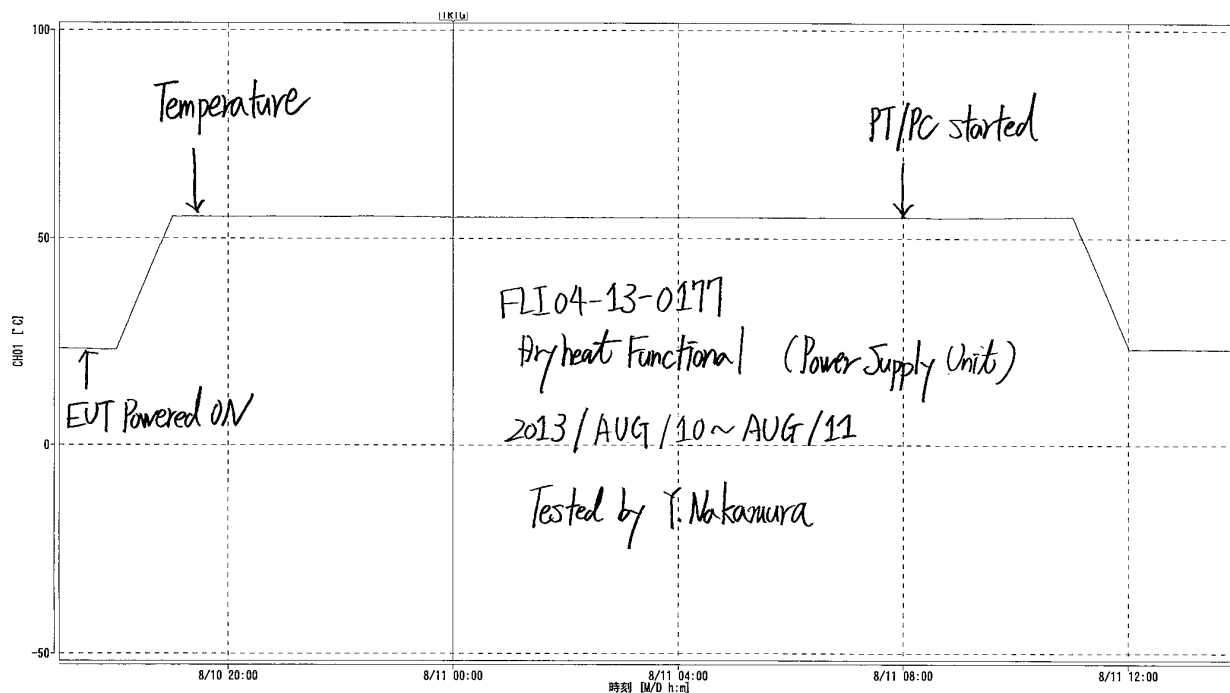


7.1.1.4 Low temperature - Functional,

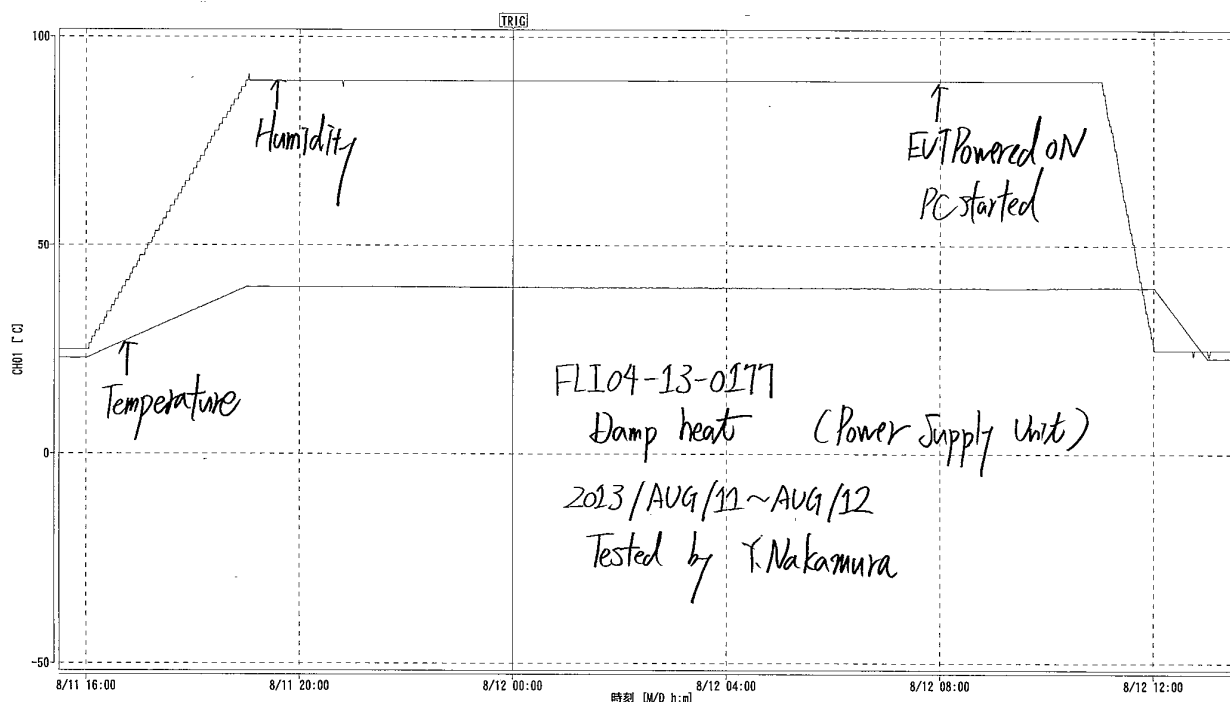


7.1.2 Power Supply Unit PSU-014

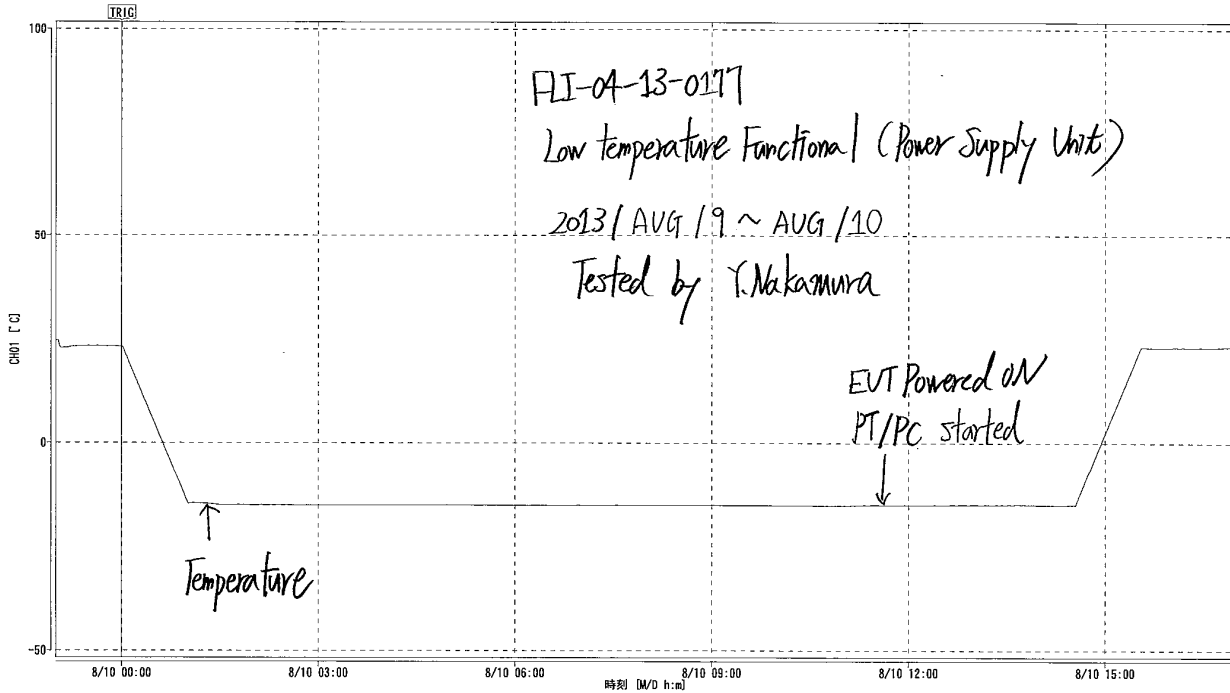
7.1.2.1 Dry heat - Functional,



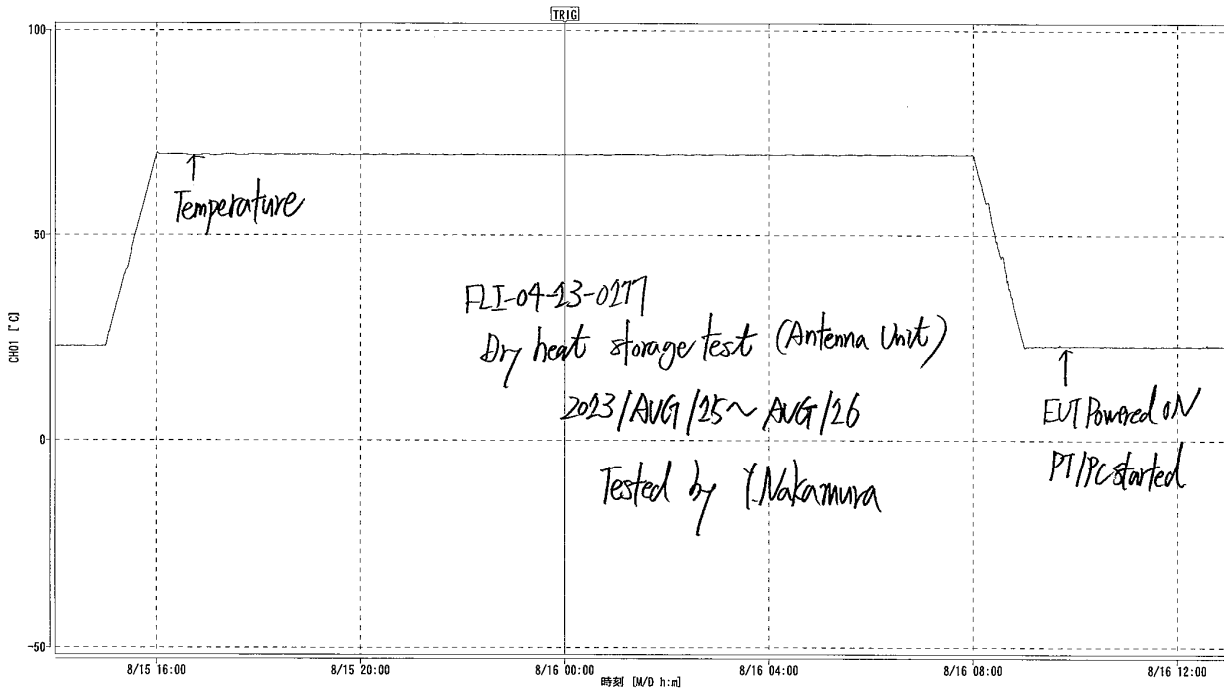
7.1.2.2 Damp heat,



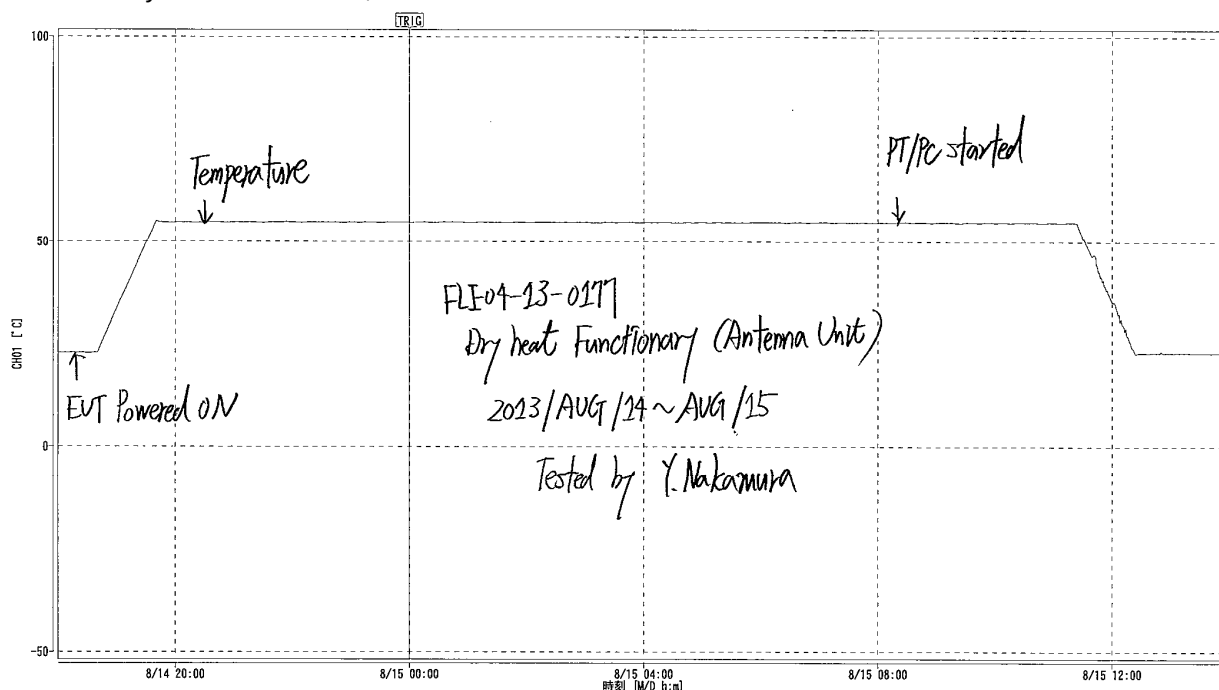
7.1.2.3 Low temperature - Functional,



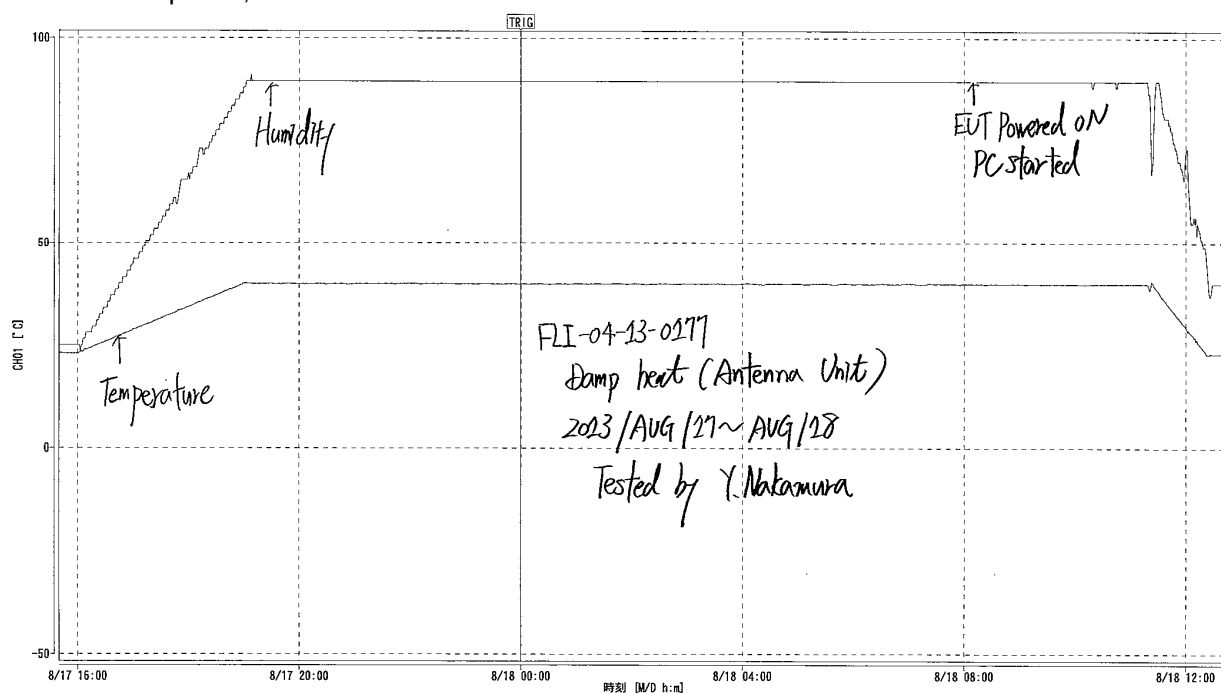
7.2 For FAR-3210/3310,
7.2.1 Antenna Unit (RSB-128-RTR-105) (12 kW)
7.2.1.1 Dry heat - Storage,



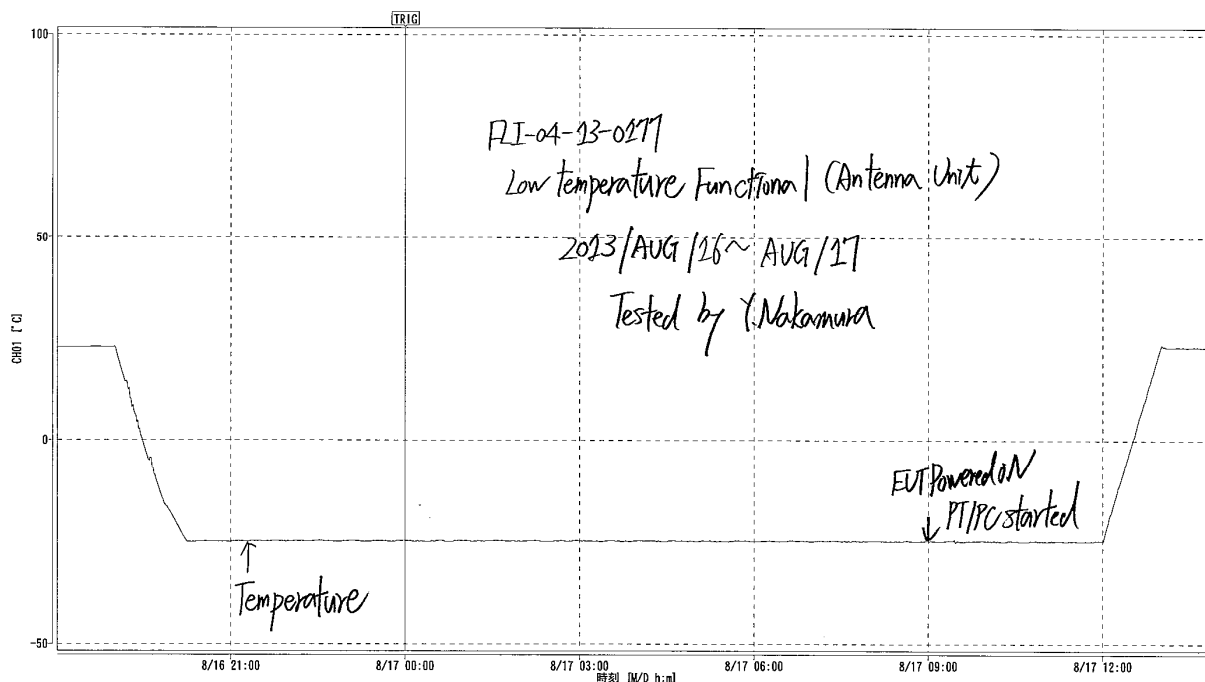
7.2.1.2 Dry heat - Functional,



7.2.1.3 Damp heat,

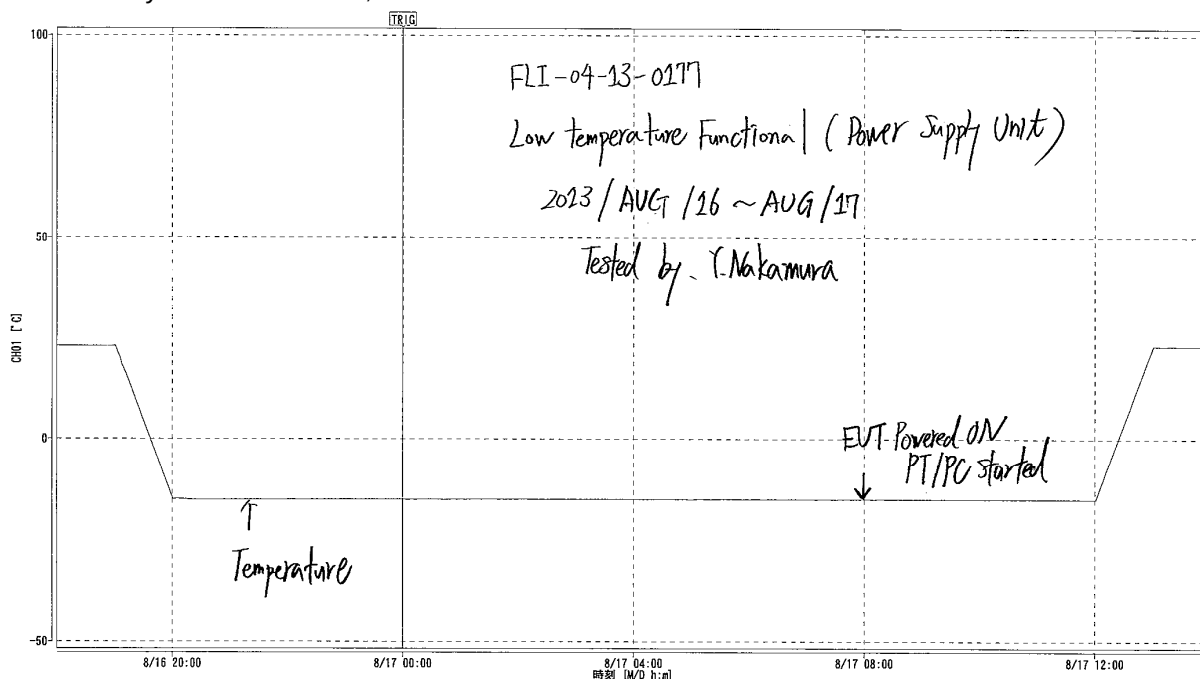


7.2.1.4 Low temperature - Functional,

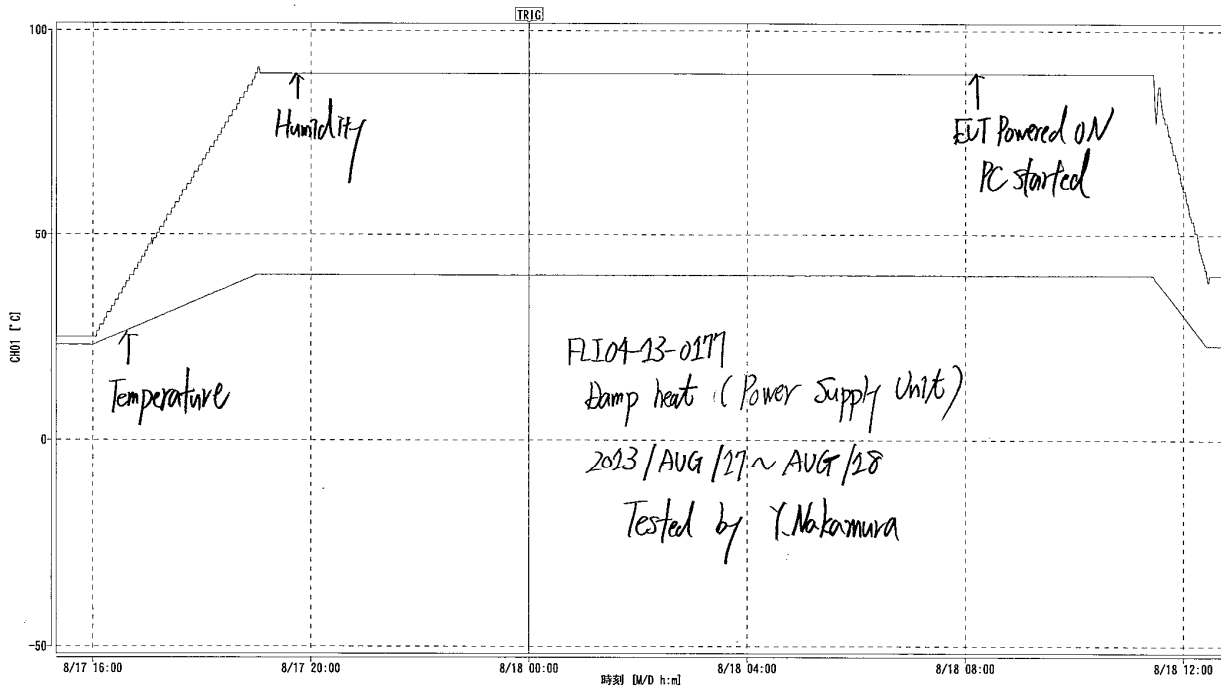


7.2.2 Power Supply Unit PSU-014

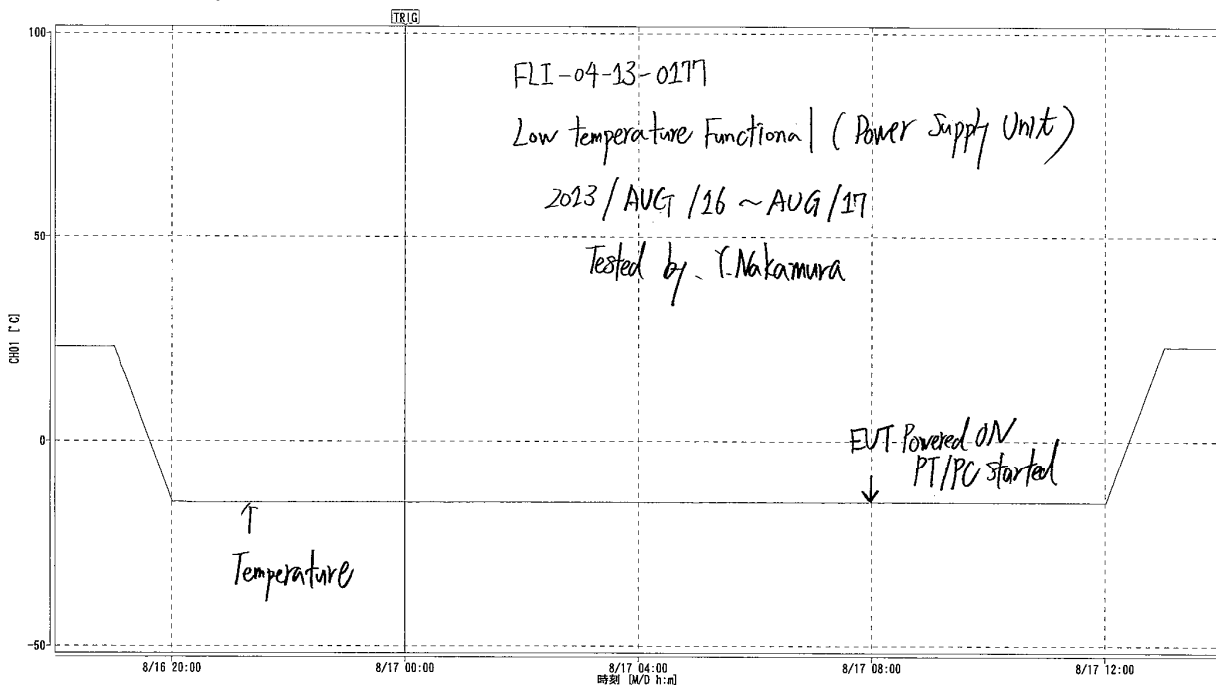
7.2.2.1 Dry heat - Functional,



7.2.2.2 Damp heat,

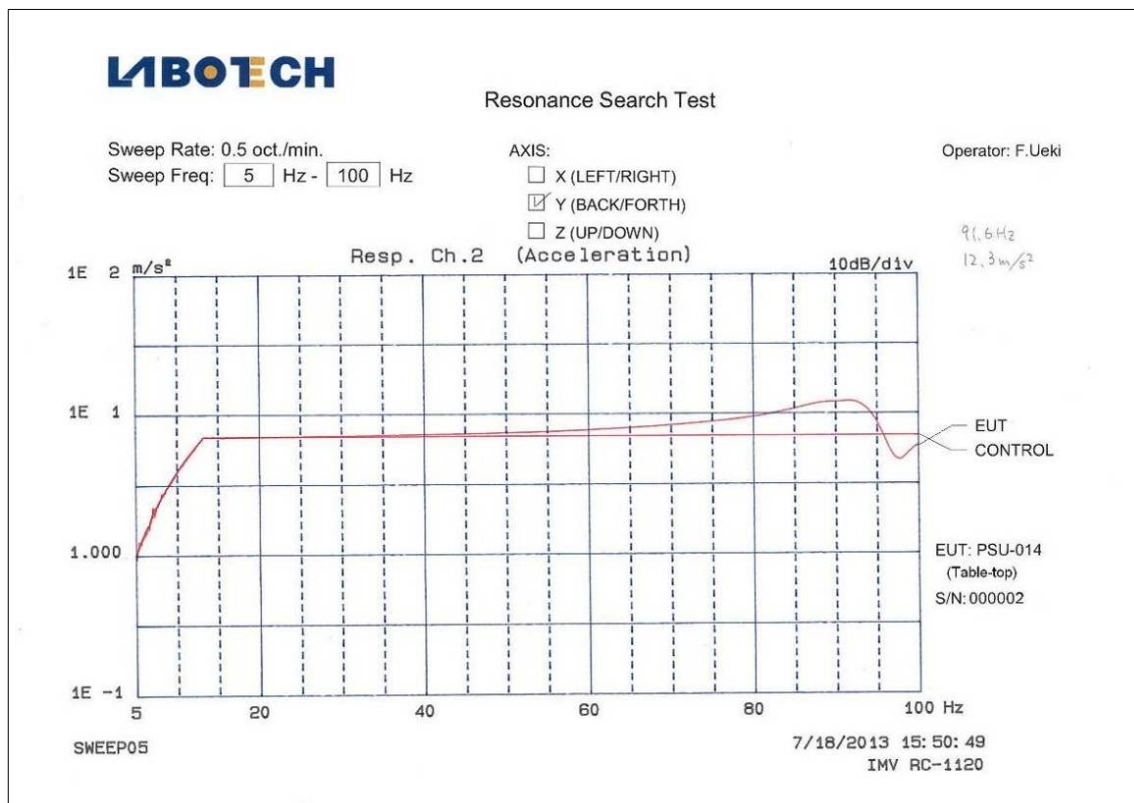
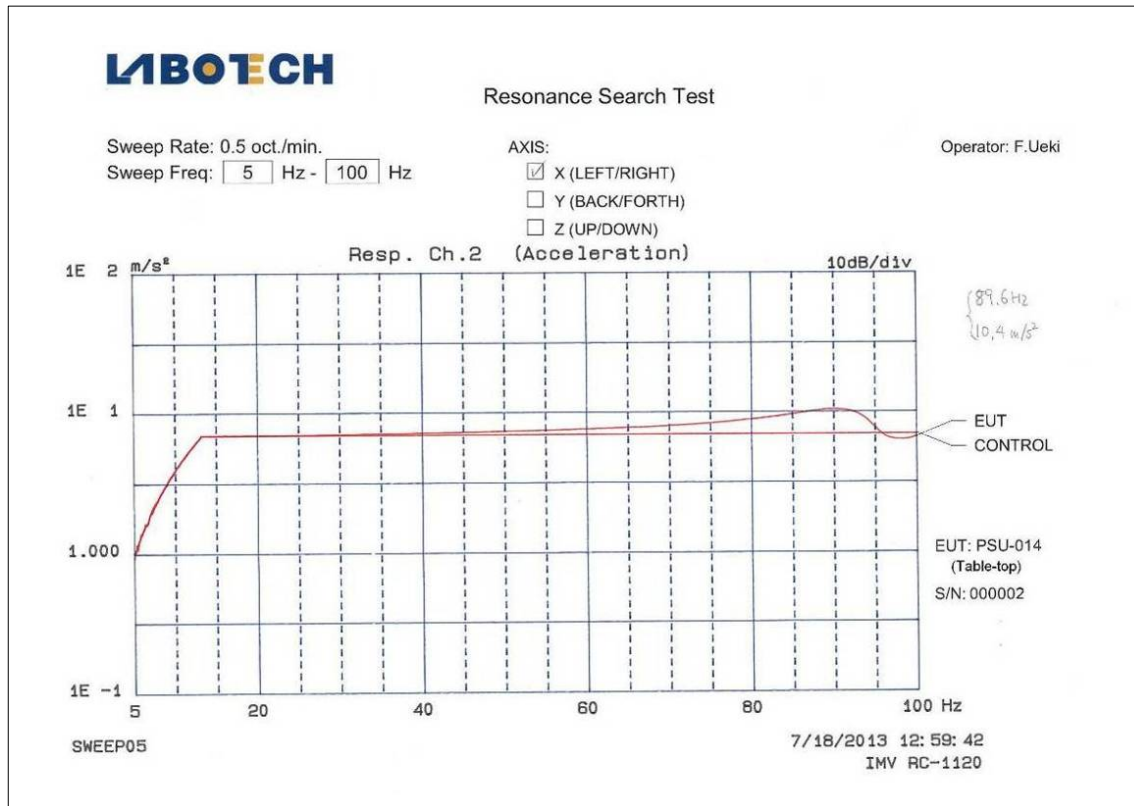


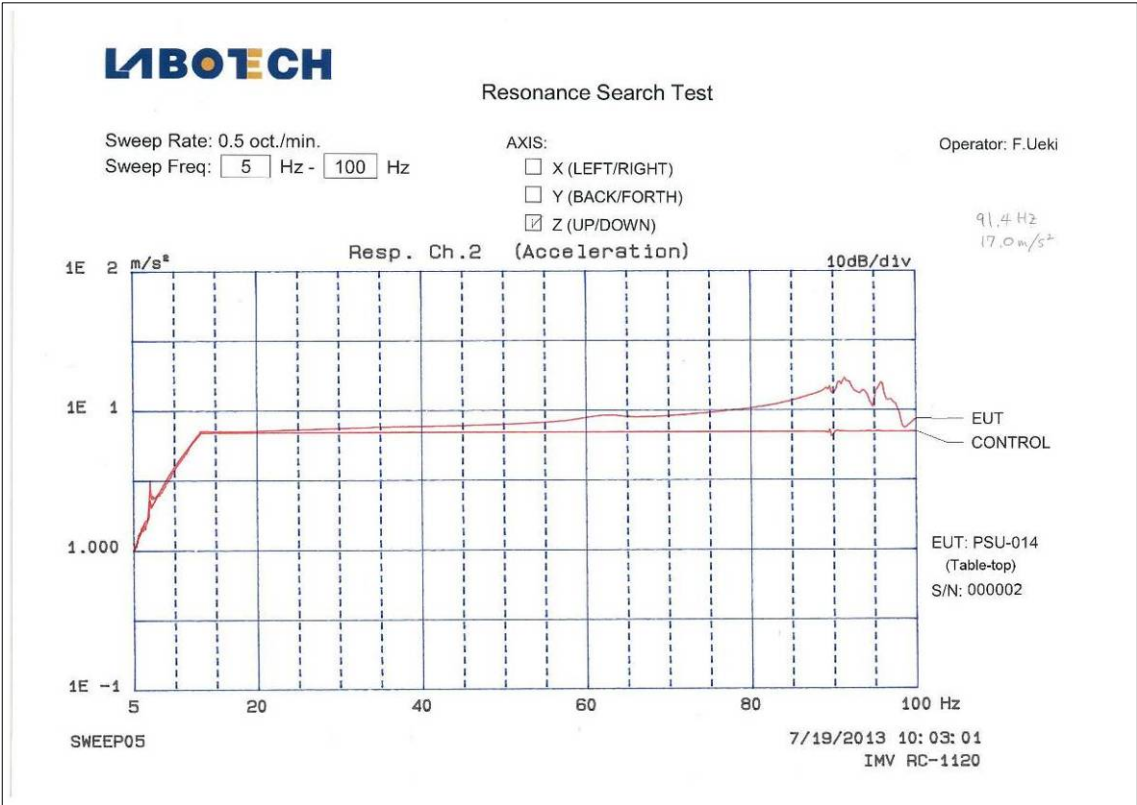
7.2.2.3 Low temperature - Functional,



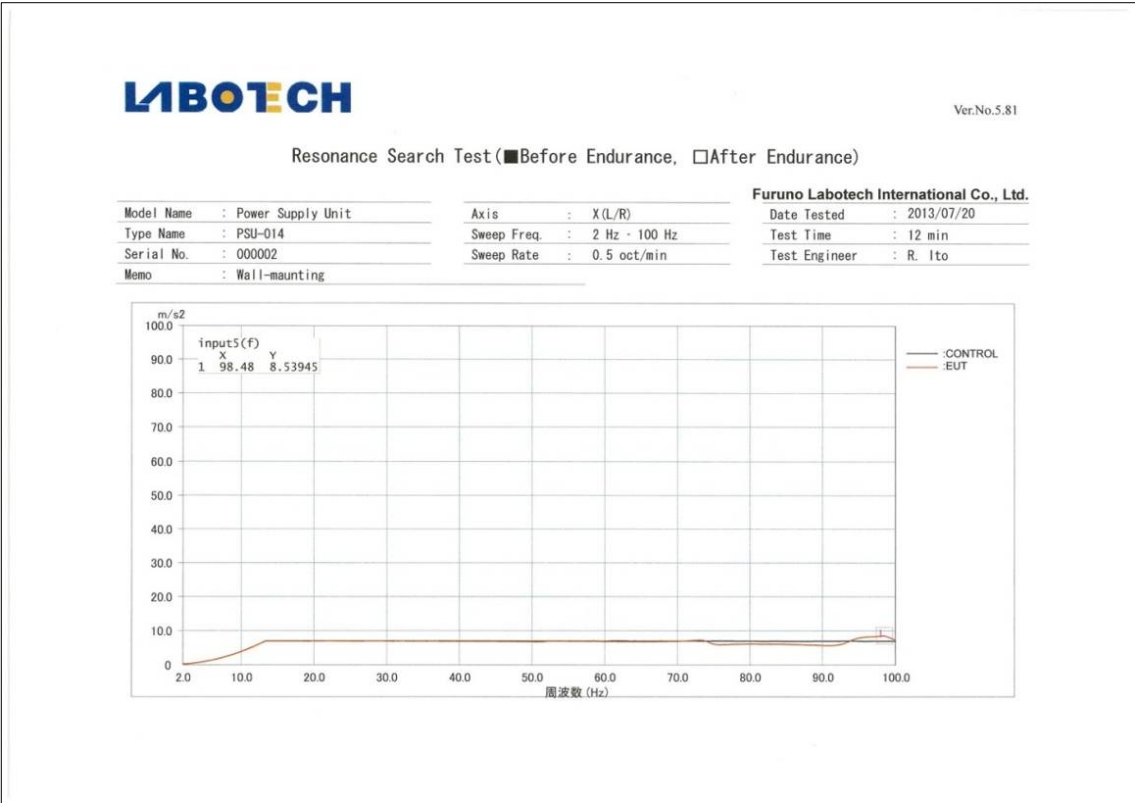
8 Vibration response plots taken during tests

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





(2) Wall-mounting,





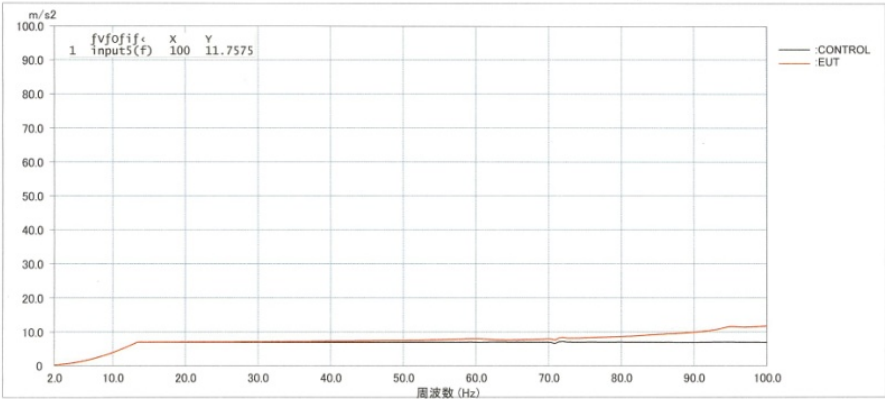
Ver.No.5.81

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



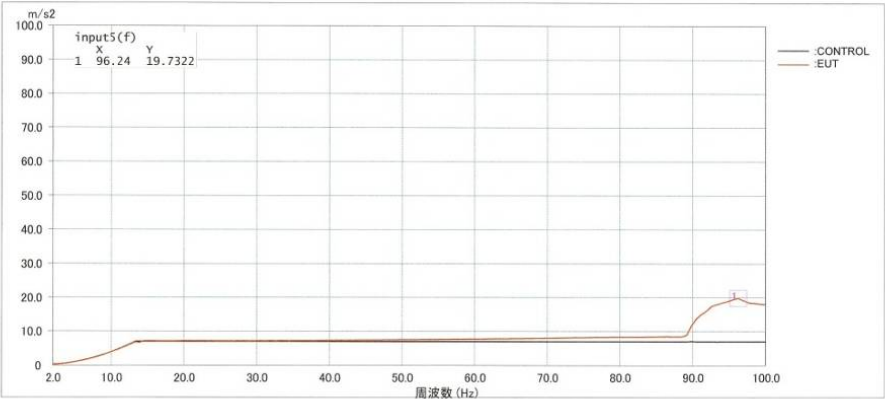
Ver.No.5.81

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

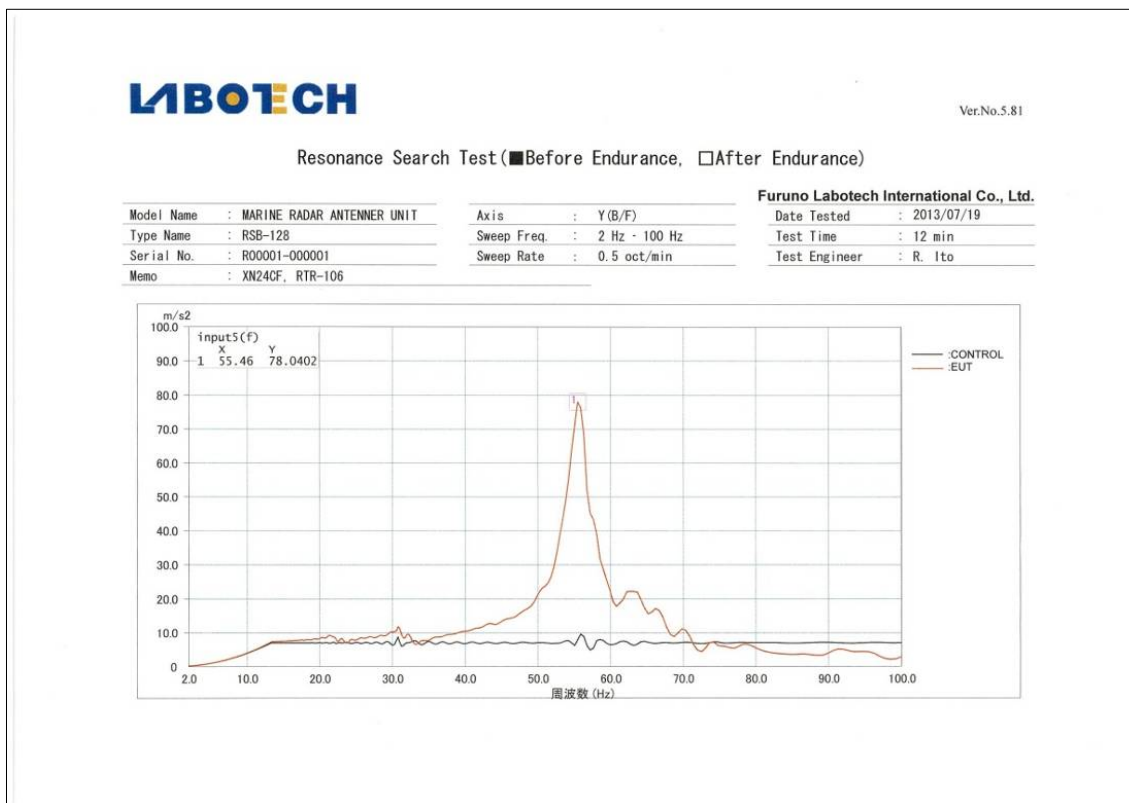
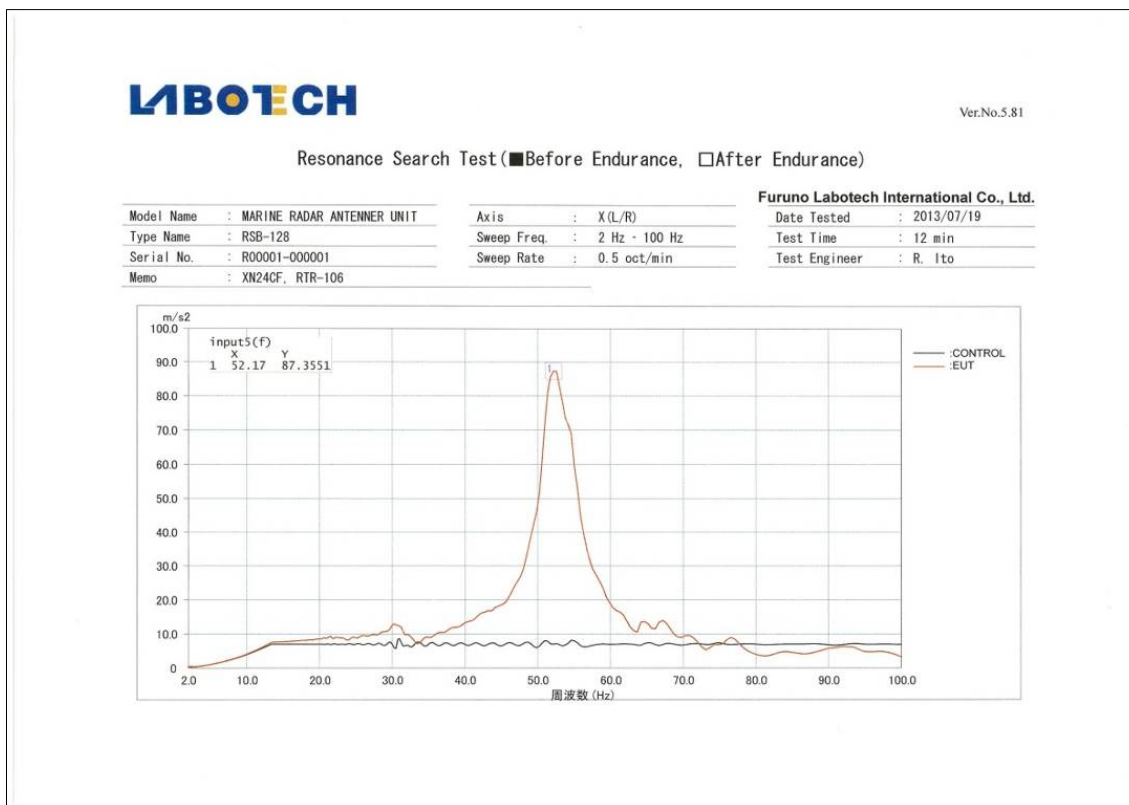
Model Name	: Power Supply Unit
Type Name	: PSU-014
Serial No.	: 000002
Memo	: Wall-mounting

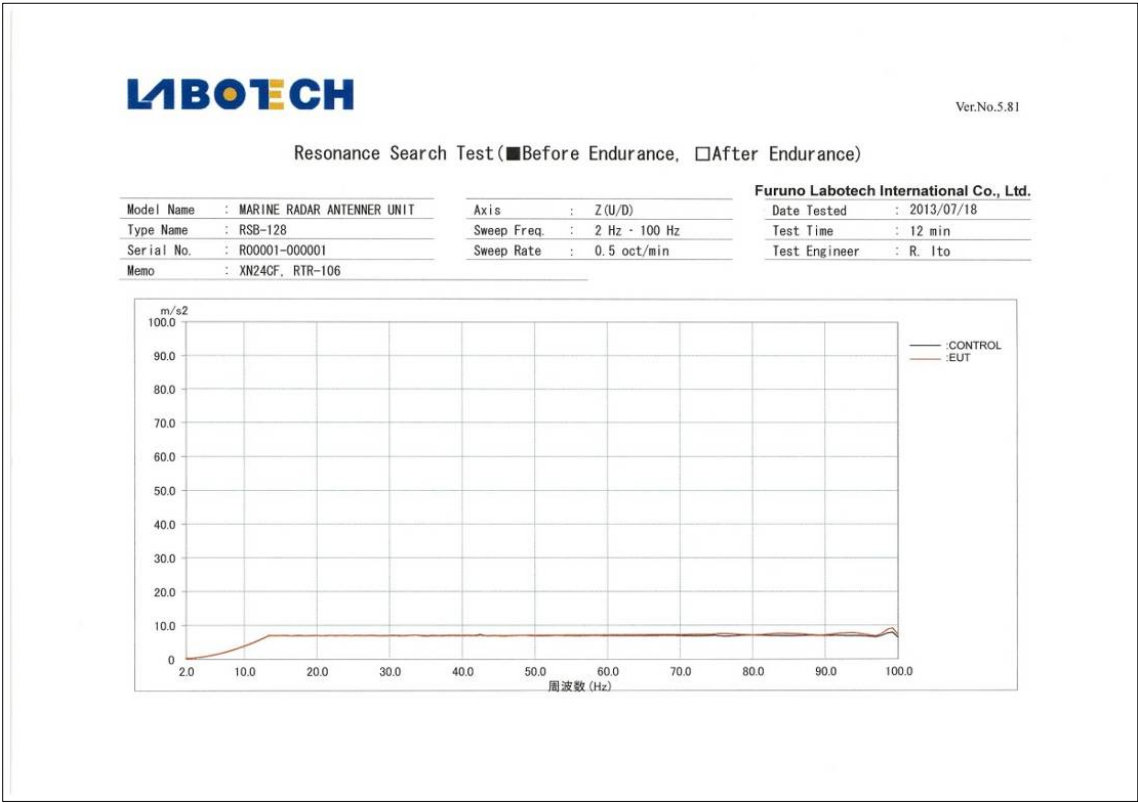
Axis	: Z (U/D)
Sweep Freq.	: 2 Hz - 100 Hz
Sweep Rate	: 0.5 oct/min

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	≤ 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	$\leq 4:00$
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)

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)

GRTAR 5210/ 5310 (RSD 120 : RTR 105 : 1 SS 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	< 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	---