Test Report

(IEC 60945 and IEC 62388)

For

Trade name: Furuno
Model: MARINE RADAR
Type: FAR-3330SW

Report No.: FLI 12-13-081

Date of Issue: 18 November 2013

Furuno Labotech International Co., Ltd.

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Report Summary

FLI project number:	FLI 04-13-0325		
Test report number of initial issue:	FLI 12-13-081	Date of initial issue	18 November 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, 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 60068-2-6: 2007, IEC 60068-2-30: 2005, IEC 60529: 2001, 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-3330SW		
Product function and intended use:	For marine safety navigation		
Number of test samples tested:	One		
Serial number:	R00007-000002 (RSB-131)/R00008-000002 (RTR-109)		
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:	20 August 2013		
Test period:	From 20 August 2013 to1 November 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, Tadayuki Ekawa, Yasuharu Nakamura, Osamu Araki, Katsumi Imamura, and Koji Kawai		
Written by:	Akiko Inoue		
Verified by:	Yoshihiro Ishii		
Approved by:	Date: 18 November 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:
  Elecrtrical 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 Resister (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)
- Recogintion 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, interfave 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	Test setup	Note
1	Antenna Unit			Exposed	Table-top	
	Gear Box (with built-in deicer)	RSB-131	R00007-000002			
	Performance Monitor	PM-52A	---			Contained in Gear Box.
	Antenna Radiator (*1)	SN36CF	---			
2	Transceiver Unit	RTR-109	R00008-000002	Protected		TX: 30 kW_{pp}, S-band, TX/RX freq.: 3050 MHz Magnetron used: MG5223F

(*): 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 (S-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	Antenna Unit	---	3810 × 769 × 640 (for Antenna Radiator SN36CF)	126	with Performance Monitor and Gear Box (with built-in deicer)
2	Transceiver unit	RTR-109	606×576×313	22	

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

No. (*)	Name	Type	Unit serial number	Manufacturer	Note
3	Power Supply Unit	PSU-015	000003	Furuno	
4	Processor Unit	EC-3000	4395-1207	Furuno	Used for Vibration and Antenna shock tests.
			4395-1704	Furuno	Used for the tests other than Vibration and Antenna shock.
5	Monitor Unit (23.1”)	MU-231	000026	Furuno	Used for Vibration and Antenna shock tests.
			000010	Furuno	Used for the tests other than Vibration and Antenna shock.
6	Control Unit	RCU-025	000168	Furuno	Used for Vibration and Antenna shock tests.
			000235	Furuno	Used for the tests other than Vibration and Antenna shock.
7	Processor Unit	RPU-013	4317-2240	Furuno	Used for Vibration and Antenna shock tests.
			4317-5131	Furuno	Used for the tests other than Vibration and Antenna shock.
8	Display Unit	U2412Mb	CN-007H8X-74221-31F-4L4S	DELL	Used for Vibration and Antenna shock tests.
		AL2017	ETL6909021705022F03720	acer	Used for the tests other than Vibration and Antenna shock.
9	Control Unit	RCU-014	5453	Furuno	Used for Vibration and Antenna shock tests.
			1-8067	Furuno	Used for the tests other than Vibration and Antenna shock.

(*): 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
10	Dummy Load (S-band)	TF300-A	85D11	SANKEN	Used for the tests other than Climatic.
		4D106	8R18084	SPC	Used for Climatic tests
11	USB Serial Adapter	COM-1PD (USB)H	8DRZD7600 2358	CONTEC	Used for Vibration and Antenna shock tests.
		ESU2-400 (RS-422)	0306410002 7	QUATECH	Used for the tests other than Vibration and Antenna shock.
12	Keyboard	SK-8175	CN-0W213F-7161612O-0 BCH-A00	DELL	Used for the tests other than Vibration and Antenna shock.
13	LCD Monitor	V193	ETLDQ0C03 5915015764 010	ACER	Used for the tests other than Vibration and Antenna shock.
14	PC	PB451ENB NR7A51	9C086208H	TOSHIBA	Used for Vibration and Antenna shock tests.
		DCCY1F	DTCNTBX	DELL	Used for the tests other than Vibration and Antenna shock.
15	Mouse	MOC5UO	H1702PFE	FUJITSU	Used for the tests other than Vibration and Antenna shock.

(*): 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
1	EUT	Antenna Unit	App(MTR-DRV)	0359293	01.04
			App(PM)	0359296	01.04
2	EUT	Transceiver unit	App(SPU MAG)	0359281	01.04
3	AU	Power Supply Unit PSU-015	App(PSU-Control)	0359299	01.04
4	AU	Processor Unit EC-3000	App	0359266	02.04
6	AU	Control Unit RCU-025	Key1	2450086	01.05
5	AU	Monitor Unit (23.1”)	Monitor2	2651020	01.03
7	AU	Processor Unit	RPU-013	0359204	03.50
9	AU	Control Unit	RCU-014	0359203	01.04
14	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-36240	Z1	
2	Supplier’s specifications for Magnetron type MG5223F	03S6963	---	

1.2 EUT Operation mode and Performance Check

1.2.1 EUT Operation mode

Operation state: TX-on

RANGE: 6NM
TUNE: AUTO
GAIN: Manual, 85
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: 97

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) 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-043 dated 11 November 2013.)

(3) "Emission from visual display unit (VDU)" test was not applicable, because the EUT had no display devices.

(4) "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: ±1.5°C
8.2.2	- Functional test:	Temperature: ±1.5°C
8.3	Damp heat	
8.3.1	- Functional test:	Temperature: ±1.5°C, Humidity: ±4%
8.4	Low temperature	----
8.4.1	- Storage test:	Temperature: ±1.5°C
8.4.2	- Functional tests:	Temperature: ±1.5°C
8.7	Vibration:	Acceleration: ±2.2 m/s^2
8.8	Rain and spray:	Delivery rate: ±3.1 l/min for 100 l/min.
8.12	Corrosion:	----
11	Special purpose tests	
11.1	Acoustic noise and signals:	±2.4 dB
11.2	Compass safe distance (CSD):	±7.4%
12	Safety precautions	
12.1	Protection against accidental access to dangerous voltages:	Not applicable.
12.2	Electromagnetic radiofrequency radiation:	±2.3 dB
12.4	X-radiation:	----

IEC 62388 Clause	Item	Measurement uncertainty (*)
17.3.2	Antenna shock test	Acceleration: ±2.2 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.	T. Ekawa, Y. Nakamura.
7.2	Excessive conditions:	Passed.	Y.Nakamura, O.Araki
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.	T. Ekawa.
8.3.1	Damp heat - Functional test:	Passed.	T. Ekawa.
8.4	Low temperature		
8.4.1	- Storage test:	Not applicable.	---
8.4.2	- Functional tests:	Passed.	T. Ekawa.
8.7	Vibration:	Passed.	A. Inoue, K. Imamura
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, T. Ekawa.
11.2	Compass safe distance (CSD):	Passed.	K. Imamura, Y. Nakamura T. Ekawa.
12	Safety precautions		
12.1	Protection against accidental access to dangerous voltages:	Passed.	Y. Nakamura, O.Araki
12.2	Electromagnetic radiofrequency radiation:	Passed.	Y. Nakamura, K. Imamura
12.3	Emission from visual display unit (VDU):	Not applicable.	----
12.4	X-radiation:	Not performed	----

IEC 62388 Clause	Test Item	Result	Test Engineer
17.3.2	Antenna shock test	Passed.	K. Imamura

3 Test Results

3.1 Power supply

3.1.1 Extreme power supply

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 (F2) and 3 A (F1) fuses for both AC lines were activated, and the EUT was protected from damage.
2	Against Excessive voltage:	Passed	Overvoltage protection circuits were provided in PSU-015. (activated at 290 VAC to 310 VAC)
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.

3.2 Dry heat

3.2.1 Storage test

For RSB-131 and RTR-109 (*),
after the duration period, PT/PC were performed at the Normal temperature. See Clause 3.1.1 of this report.

(*): Transceiver Unit RTR-109 was additionally tested under the temperature of +70°C specified to "Exposed equipment" at the same time at the customer's request.

3.2.2 Functional test

See Clause 3.1.1 of this report.

3.3 Damp heat - Functional test

For RSB-131 and RTR-109,
see Clause 3.1.1 of this report.

3.4 Low temperature

3.4.1 Storage test (Not applicable)

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

3.4.2 Functional test

For RSB-131 and RTR-109 (*),
see Clause 3.1.1 of this report.

(*): Transceiver Unit RTR-109 was additionally tested under the temperature of -25°C specified to "Exposed equipment" at the same time at the customer's request.

3.5 Vibration

3.5.1 EUT attitude/mounting and Test fixture:

Unit	Attitude/mounting	Test fixture
RSB-131+ SN36CF	Table-top	No. 9 (*1)
RTR-109	Wall-mounting	No. 80 and No. 83 (*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			
RSB-131+ SN36CF Table-top	X (left/right)	58.5	28.7	4.1	58.5	Passed.	
	Y (back/forth)	59.4	27.3	3.9	59.4	Passed.	
	Z (up/down)	(*)	(*)	(*)	30.0	Passed.	
RTR-109 Wall-mounting	X (left/right)	69.5	20.6	2.9	69.5	Passed.	
	Y (back/forth)	59.0	52.9	7.6	59.0	Passed.	
	Z (up/down)	90.0	18.1	2.6	90.0	Passed.	

(*): No resonance detected.

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

3.6 Antenna shock

3.6.1 EUT attitude/mounting and Test fixture:

Unit	Attitude/mounting	Test fixture
RSB-131+ SN36CF	Table-top	No. 9 (*1)

(*1): prepared by FLI.

3.6.2 Results:

Unit	Test conditions	Results
RSB-131+ SN36CF	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-131+SN36CF	Passed. (*)

There was no damage.

(*) Ingress of water was found. However, it was considered to have no effects for EUT operation. For water ingress areas/points, see Clause 6 for details.

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)
RTR-109	30.4	45	Not applicable	≤ 60

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

The test to RSB-131 was 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.

Results:

Unit	CSD for Standard compass (m)	CSD for Steering compass (m)	CSD Marking	Note
RSB-131	1.55	0.95	Described in the manual	(3) TX-on.
RTR-109	4.50	2.90	Described in the manual	(3) TX-on.

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

Unit	Distance to 100 W/m^2 (m)	Distance to 50 W/m^2 (m)	Distance to 10 W/m^2 (m)
RSB-131+SN36CF, and RTR-109	Not applicable.	0.26	2.3

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:	21 August 2013	27°C to 27°C, 63% to 63%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.
		22 August 2013	27°C to 26°C, 63% 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.
		24 August 2013	27°C to 26°C, 66% 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	22 October 2013	26°C to 26°C, 62% to 62%RH.	230.0 VAC, 50.0 Hz to 230.2 VAC, 50.0 Hz.
8	Durability and resistance to environmental conditions			
8.2	Dry heat	----	----	----
8.2.1	- Storage test:	24 August 2013	27°C to 26°C, 63% to 58%RH.	230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz.
8.2.2	- Functional test:	22 July 2013	27°C to 26°C, 70% to 65%RH.	230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz.
8.3.1	Damp heat- Functional test:	23 July 2013	27°C to 27°C, 63% to 63%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:	21 July 2013	26°C to 26°C, 62% to 65%RH.	230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz.
8.7	Vibration:	15 September 2013	25°C to 25°C, 57% to 61%RH.	99.8 VAC, 60.0 Hz to 99.7 VAC, 60.0 Hz.
		16 September 2013	24°C to 24°C, 56% to 60%RH.	100.2 VAC, 60.0 Hz to 99.9 VAC, 60.0 Hz.
8.8	Rain and spray:	1 November 2013	22°C to 20°C, 47% to 43%RH. Water temperature: 17°C to 17°C	100.8 VAC, 59.9 Hz to 100.8 VAC, 59.9 Hz.
8.12	Corrosion:	Not performed.	----	----
11	Special purpose tests			
11.1	Acoustic noise and signals:	22 October2013	26°C to 26°C, 58% to 58%RH.	230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz.
11.2	Compass safe distance (CSD):	6 October2013	25°C to 25°C, 65% to 65%RH.	230.0 VAC, 50.0 Hz to 230.0 VAC, 50.0 Hz. 100.0 VAC, 60.0 Hz to 100.0 VAC, 60.0 Hz.
12	Safety precautions			
12.1	Protection against accidental access to dangerous voltages:	22 October 2013	26°C to 26°C, 62% to 62%RH.	---
12.2	Electromagnetic radiofrequency radiation:	1 September 2013	24°C to 24°C, 58% to 58%RH.	230.0 VAC, 50.0 Hz to 230.0 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	16 September 2013	24°C to 24°C, 60% to 60%RH.	100.2 VAC, 60.0 Hz to 100.0 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
--	HT415	Climatic chamber (S)	PL-4KP	14004204	Tabai Espec
--	HT724	Paperless recorder/Dual communication logger DAQSTATIOM 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	
X	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	
X	HT577	Pickup sensor **(Reference)**	V11-101S	0522	Shinken	RTR-109
--	HT578	Pickup sensor	V11-101S	0521	SHINKEN	
X	HT661	Pickup sensor **(Reference)**	V11-101S	1112	Shinken	RSB-131
X	HT662	Pickup sensor **(Response)**	VP-15	0025U	IMV	RTR-109
X	HT663	Pickup sensor **(Response)**	VP-15	0026U	IMV	RSB-131
--	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.

4.3 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
--	HT578	Pickup sensor	V11-101S	0521	SHINKEN
X	HT661	Pickup sensor **(Reference)**	V11-101S	1112	Shinken
--	HT662	Pickup sensor	VP-15	0025U	IMV
--	HT663	Pickup sensor	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
X	HT177	Screened room	USC-26	D-003	USC
X	HT164	Digital multimeter	E2378A	2943J06324	HP
--	HT173	DC power supply	GP035-30R	1014397082	Takasago

(*): 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
--	HT435	Jointed test finger	P-10.09	D-008	EXCEL

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

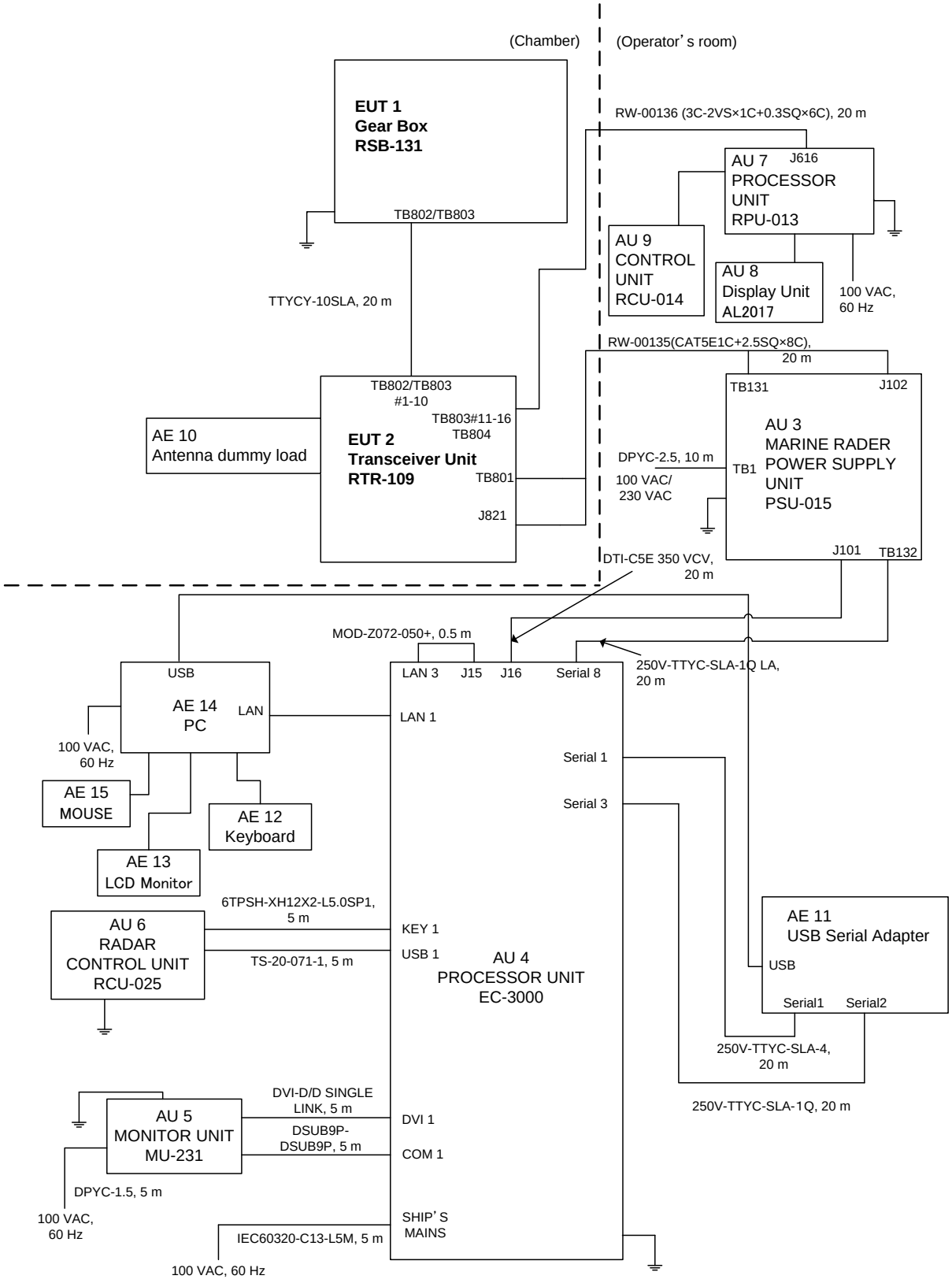
4.6.2 Electromagnetic radio frequency radiation

(*)	C/N	Instrument	Type	S/N	Manufacturer
X	HT590	RF Radiation meter	EMR-300/33C	211171	Narda

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

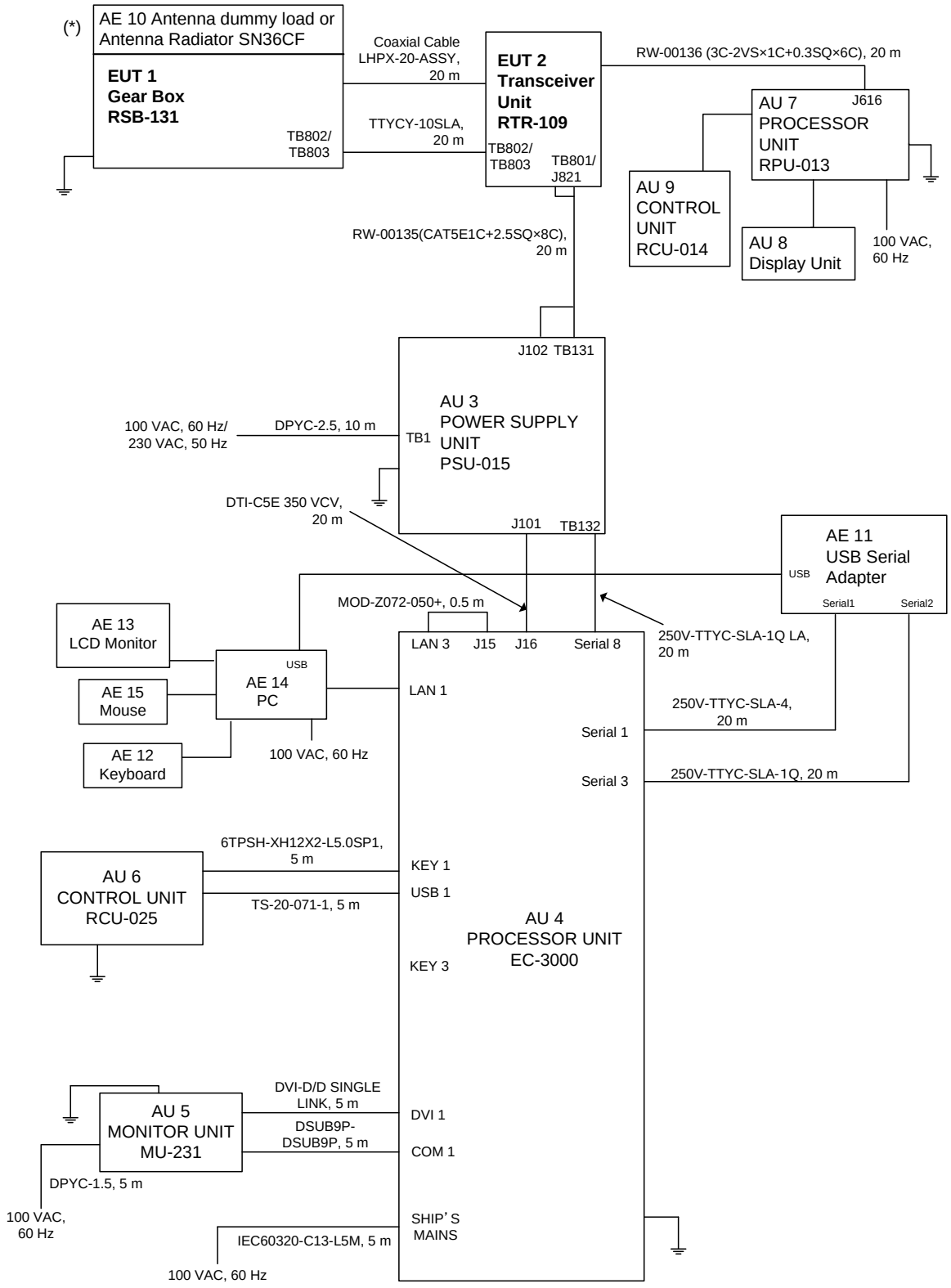
5 EUT Setup/Test Arrangement

5.1 For Climatic test,



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

5.2 For Vibration test,



Note: AU - Auxiliary Unit, AE - Associated Equipment.
(*) - Antenna radiator was used for Vibration, Antenna shock, Rain and spray, and Electromagnetic RF radiation tests.

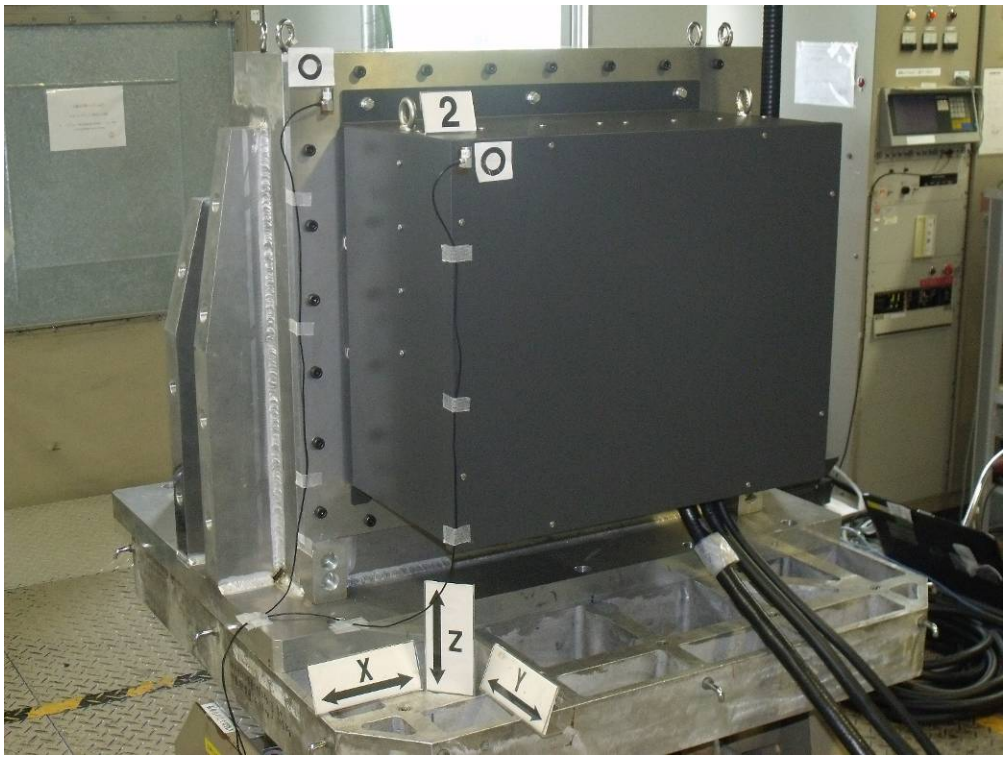
6 Photographs of Test Setup/Arrangement

6.1 Dry heat/Damp heat/Low temperature

6.2 Vibration

RSB-131+SN36CF,

RTR-109,



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

6.3 Antenna shock

RSB-131+SN36CF (Only for Z direction)

6.4 Rain and spray

For Antenna Unit (RSB-131+SN36CF),
Test Setup,

Spraying,

Photographs of the internal examinations done after the test,

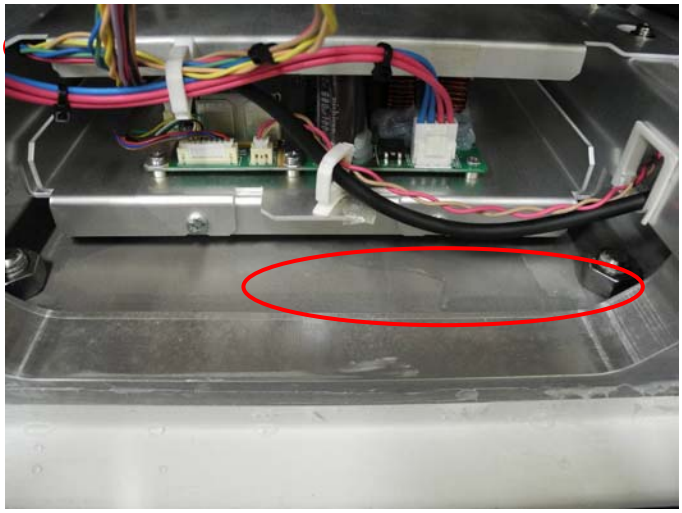
Top side,

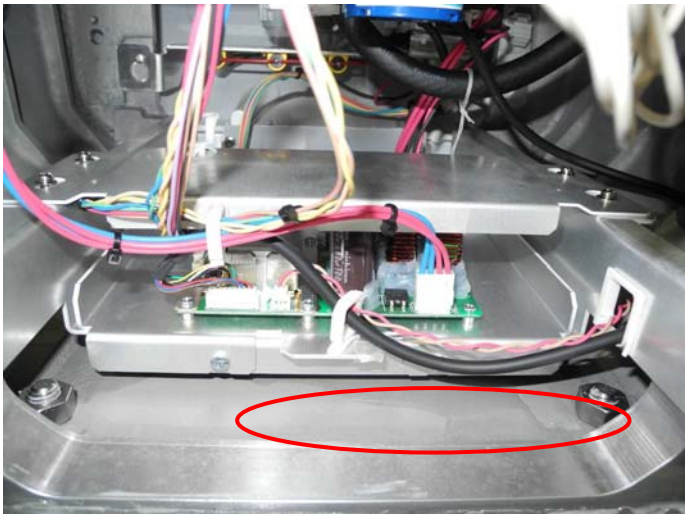
Side cover (No ingress of water),

Internal

Internal,

Internal-bottom

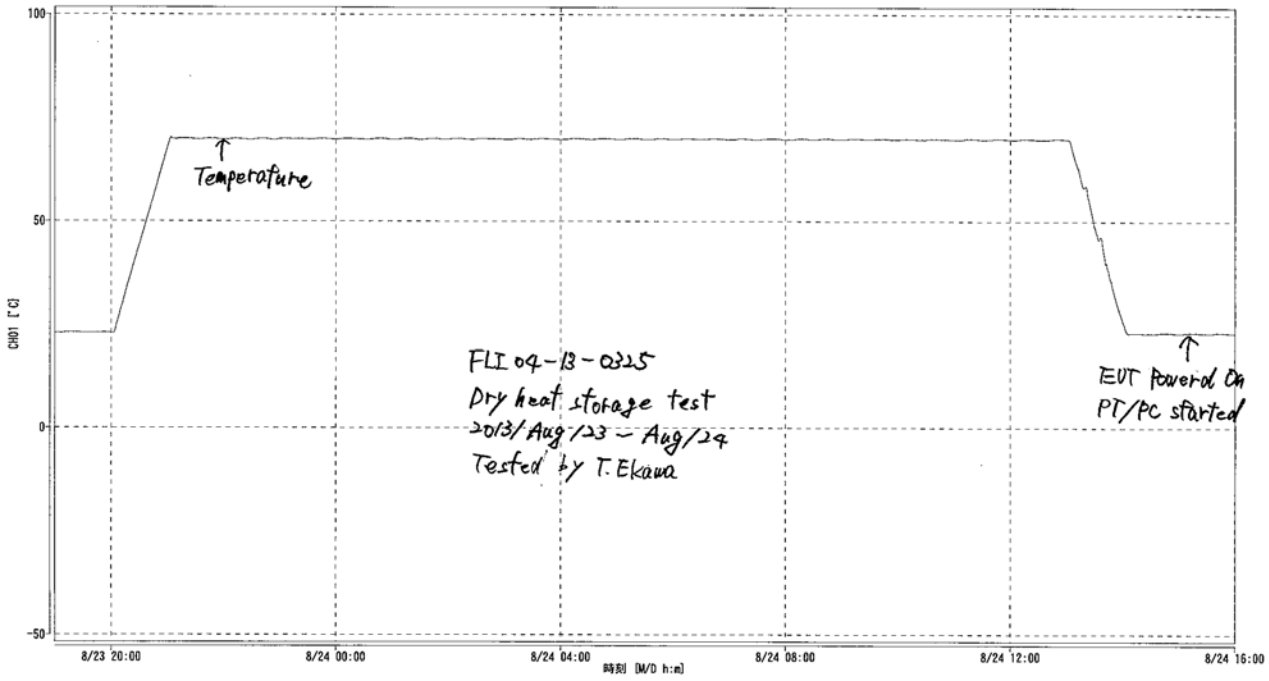




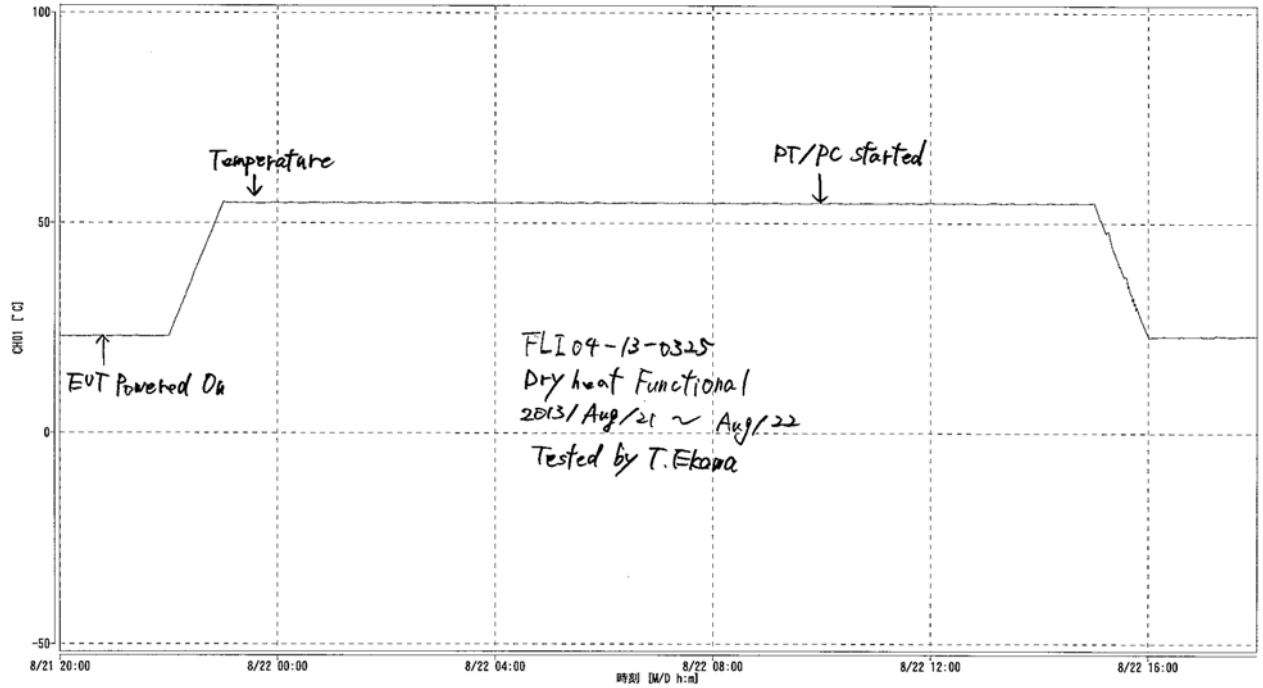
: Ingress of water found.

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

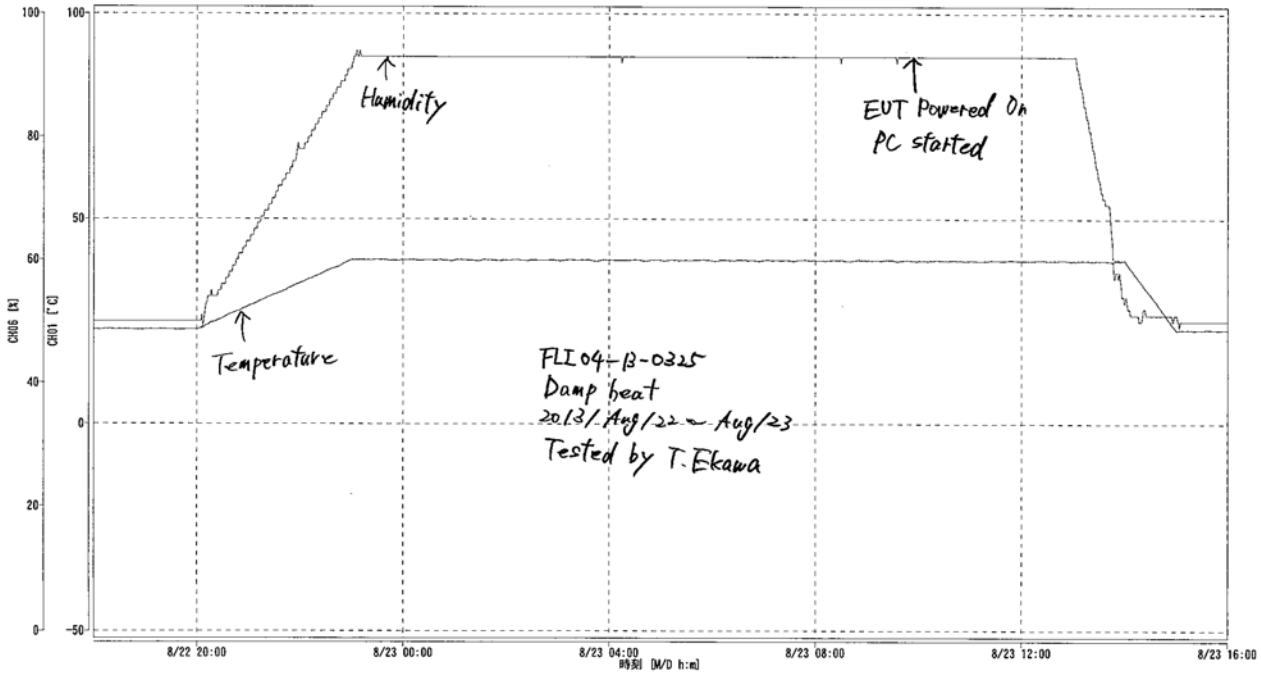
7.1 Dry heat - Storage,



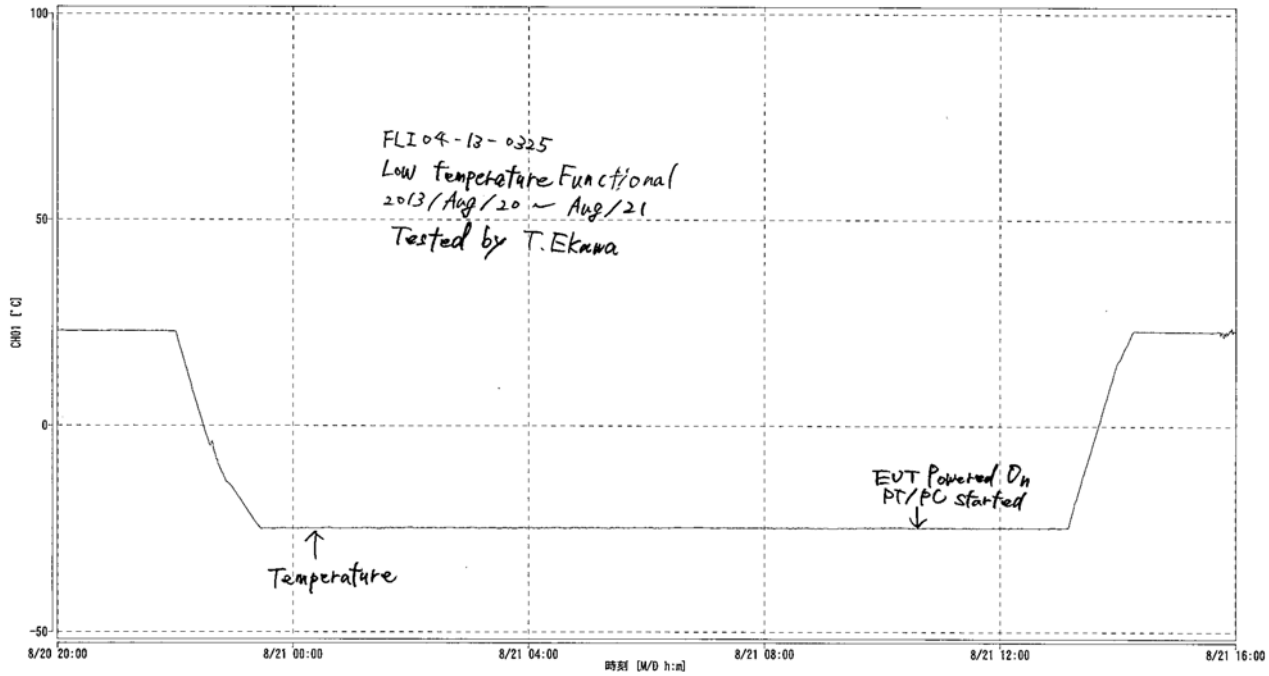
7.2 Dry heat - Functional,



7.3 Damp heat,

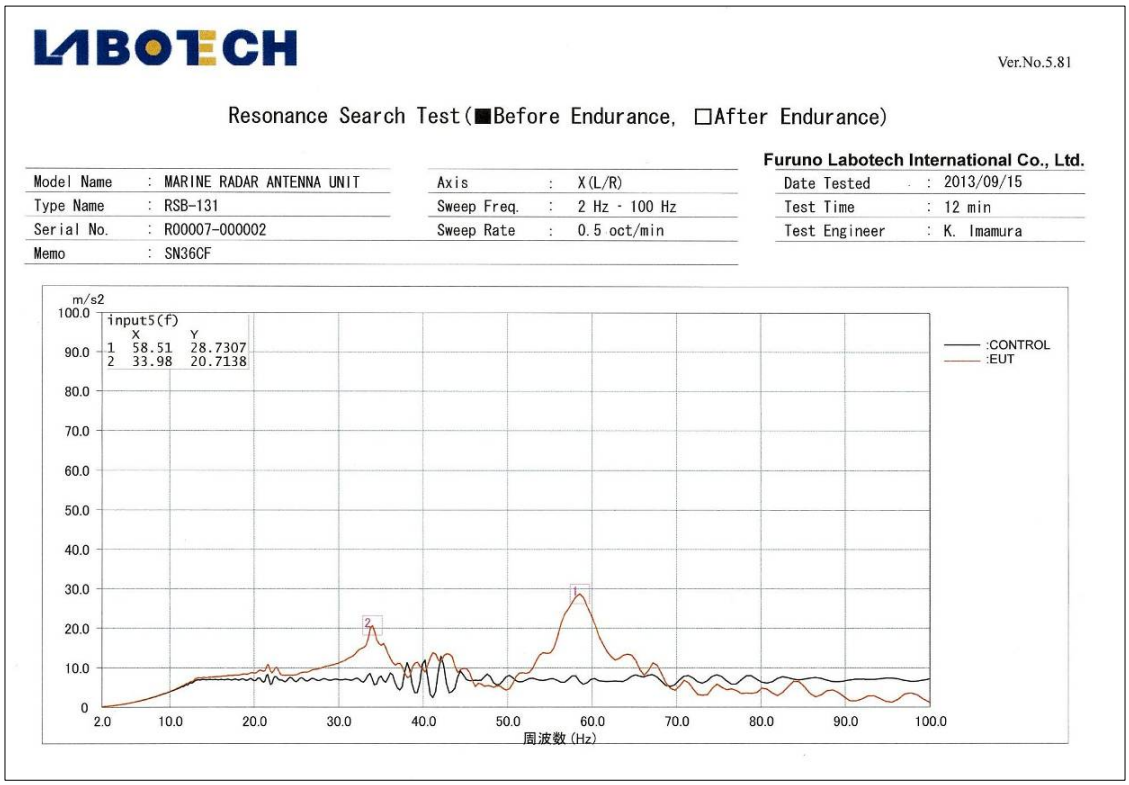


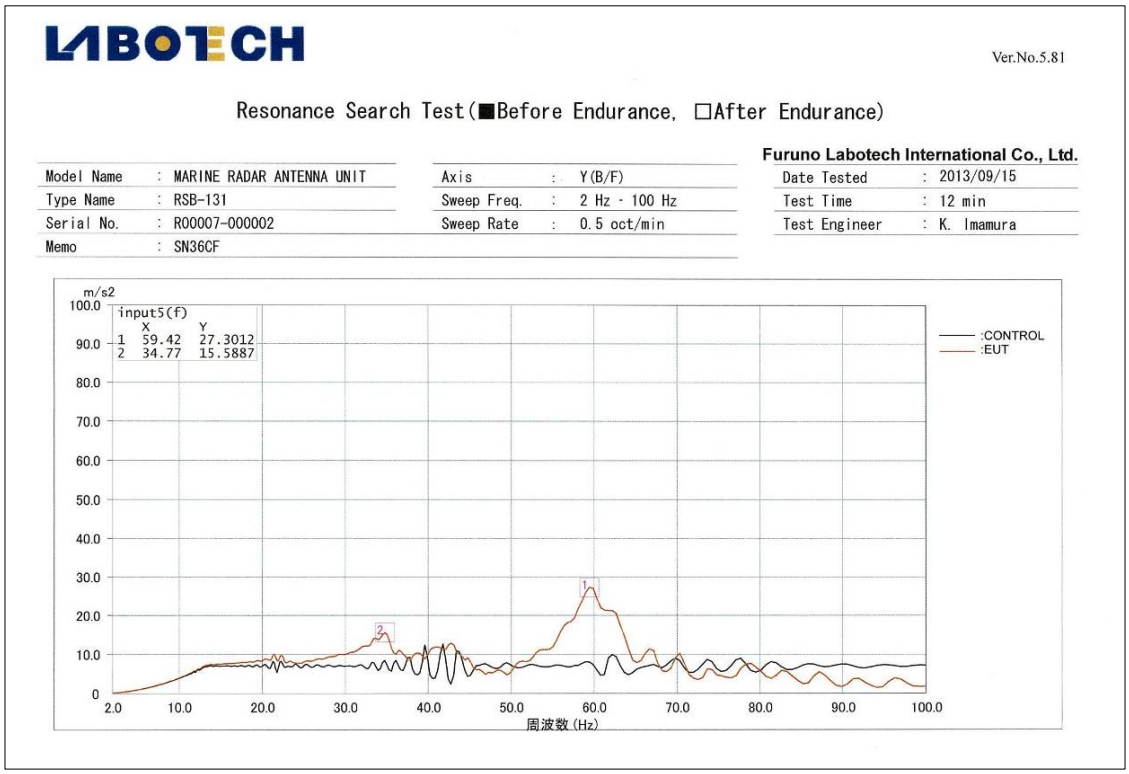
7.4 Low temperature - Functional,

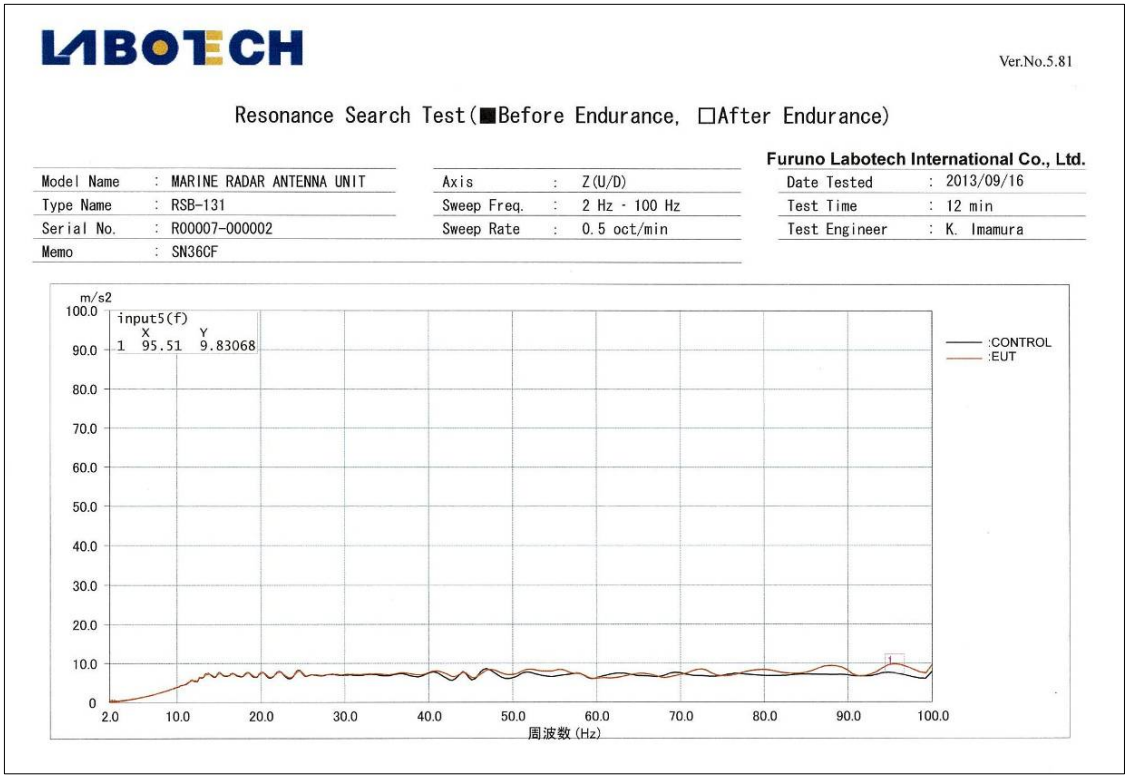


8 Vibration response plots taken during tests

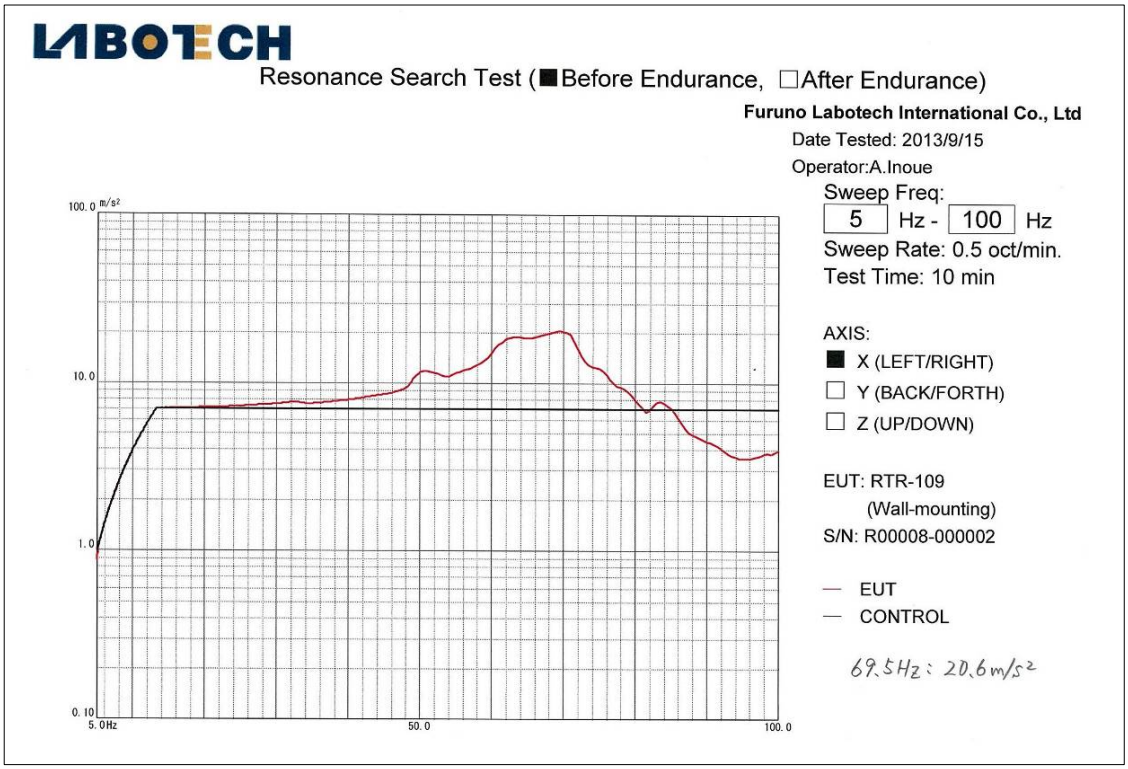
8.1 for RSB-131+SN36CF,







8.2 for RTR-109,



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

Furuno Labotech International Co., Ltd

Date Tested: 2013/9/15

Operator:A.Inoue

Sweep Freq:

5 Hz - 100 Hz

Sweep Rate: 0.5 oct/min.

Test Time: 10 min

AXIS:

□ X (LEFT/RIGHT)

■ Y (BACK/FORTH)

□ Z (UP/DOWN)

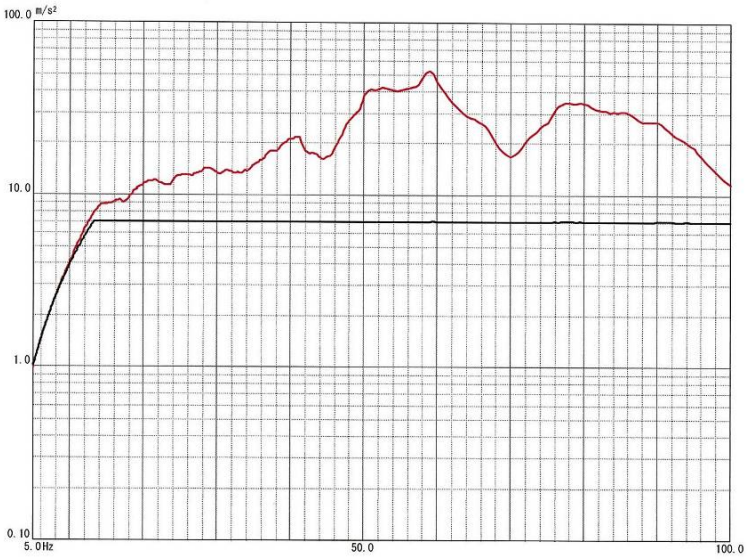
EUT: RTR-109

(Wall-mounting)

S/N: R00008-000002

— EUT

— CONTROL



59.0Hz : 52.9 m/s²

79.5Hz : 34.4 m/s²

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

Furuno Labotech International Co., Ltd

Date Tested: 2013/9/16

Operator:A.Inoue

Sweep Freq:

5 Hz - 100 Hz

Sweep Rate: 0.5 oct/min.

Test Time: 10 min

AXIS:

□ X (LEFT/RIGHT)

□ Y (BACK/FORTH)

■ Z (UP/DOWN)

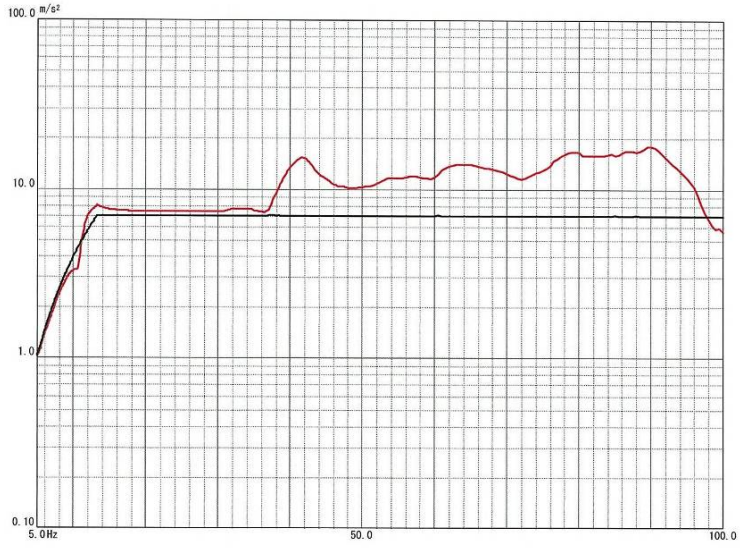
EUT: RTR-109

(Wall-mounting)

S/N: R00008-000002

— EUT

— CONTROL



90.0Hz : 18.1 m/s²

8.3 Antenn shock test (RSB-131+SN36CF)

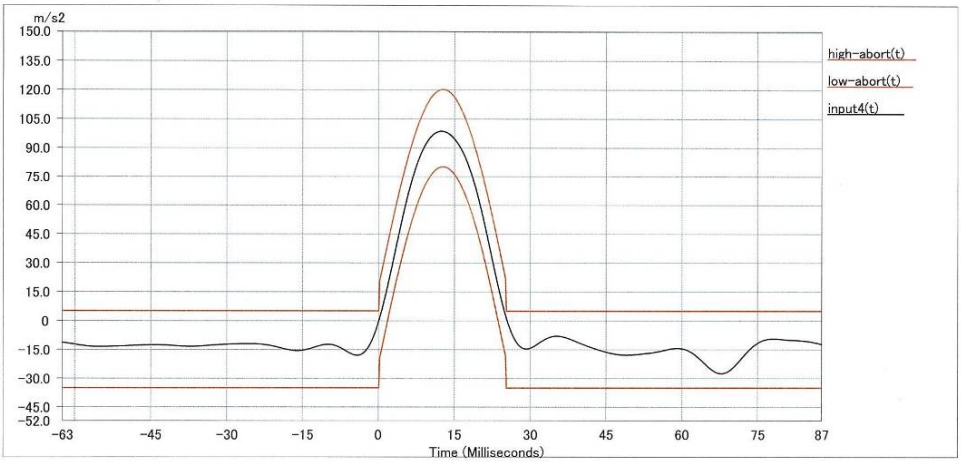
LABOTECH

Shock/Bump Test

Ver. No.: 5.81

Furuno Labotech International Co., Ltd

Model Name	:	MARINE RADAR ANTENNA UNIT	Axis	:	Z(U/D)	Wave Type	: Half sine At the end
Type Name	:	RSB-131	Acceleration	:	100 m/s^2		
Serial No.	:	R00007-000002	Bump Times	:	3 shock plotted.	Date Tested	: 2013/09/16
Memo	:	SN36CF	Interval	:	3 s		
			Duration	:	25 ms	Test Engineer	: K. Imamura



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

9.1 Dry heat - Storage test

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)	3:32	3:32	3:32	≤ 4:00
9 (A)	9.81	9.86	9.85	---

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

9.2 Dry heat – Functional test

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	42.0	≥ 40
3	Passed.	Passed.	Passed.	--
4	Passed.	Passed.	Passed.	---
5	Passed.	Passed.	Passed.	---
6	Passed.	Passed.	Passed.	---
7	Passed.	Passed.	Passed.	---
8 (m:s)	3:31	3:31	3:31	≤ 4:00
9 (A)	8.25	8.36	8.44	---

9.3 Damp heat – Functional test

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)	3:32			≤ 4:00
9 (A)	8.72			---

Note: NA - Not applicable.

9.4 Low temperature – Functional test

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)	3:32	3:32	3:32	≤ 4:00
9 (A)	9.81	9.86	9.85	---

9.5 Vibration

Item no.	Results	Limit
	Power supply voltage and frequency	
	230 VAC / 50 Hz	
1	Passed.	---
2 (rpm)	42.1	≥ 40
3	Passed.	--
4	Passed.	---
5	Passed.	---
6	Passed.	---
7	Passed.	---
8 (m:s)	3:32	≤ 4:00
9 (A)	9.81	---