

Test Report

FCC Rules 47 CFR,
Part 90 (90.213)
Part 2 (2.1055)

for

**Trade name: FURUNO
System: Marine Radar
Model: Transceiver
for RADAR SENSOR
Type: RTR-122**

Report no.: LIC 12-22-149

Date of issue: 16 September 2022

Labotech International Co., Ltd.

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Report Summary

LIC project number:	LIC 04-22-0292		
Test report number of initial issue:	LIC 12-22-149	Date of initial issue	16 September 2022
Test report number of revised/replaced issue:	--	Date of revised/replaced issue	--
Test report revision/replacement history:	--		
Test standard(s)/ Test specifications:	FCC Rules 47 CFR, Sections: 2.1055 - Frequency stability 90.213 - Frequency stability (the latest version on the first day of the testing period)		
Customer:	FURUNO ELECTRIC CO., LTD. 9-52 Ashihara-cho, Nishinomiya City, Hyogo. 662-8580, Japan		
Manufacturer:	FURUNO ELECTRIC CO., LTD. 9-52 Ashihara-cho, Nishinomiya City, Hyogo. 662-8580, Japan		
Trade name:	FURUNO		
System:	Marine Radar		
Model:	Transceiver for RADAR SENSOR		
Type:	RTR-122		
Product function and intended use:	Marine Radar		
Number of samples tested:	One		
Serial number:	R000-2410-0020		
Power rating:	100-115 VAC/220-230 VAC, 50-60 Hz, 3.1/1.5 A (for Power Supply Unit) 100-230 VAC, 50/60 Hz, 2.4-1.2 A (for Processor Unit)		
Modifications made to samples during testing:	None		
Date of receipt of samples:	17 August 2022		
Test period:	From 17 August 2022 to 18 August 2022		
Place of test:	Labotech International Co., Ltd. - Nishinomiya Lab. FCC Test firm Designation Number: JP2010 FCC Test firm Registration Number: 696248 9-52, Ashihara-cho, Nishinomiya-shi, Hyogo, 662-8580 Japan		
Test results/Compliance:	Passed. The test results of this report relate only to the samples tested.		
Tested by:	Atsushi Takagi		
Written by:	Arisa Ogino		
Verified by:	Tadayuki Ekawa		
Approved by:	Date: 16 September 2022 Name: Tadayuki Ekawa Title: Manager, Testing & Facilities Control Section, Technical Department, Labotech International Co., Ltd. Signature: 		

Disclaimer:

The test results of this report relate only to the samples tested.

LIC has no responsibility for the followings except for the requirements of test standards.

- The thing(s) in association with the test and information pertaining to it/them, which are provided by the customer; information described in Clause 1 and the information of the cable(s) used.
- The matter(s) specified by the customer; Test standard(s) applied, test item(s), test conditions, criteria, object(s) to be tested or excluded, operation mode(s) and connection/configuration.

Testing Laboratory Status

Labotech International Co., Ltd. (hereafter called "LIC") 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, Climatic, Vibration and Radio tests

(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, IEC/EN 61162-450, IEC 62288, ETSI EN 301 843-1 / -2, ETSI EN 301 489-1 / -3 / -17

(3) 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 EMC emission and immunity

(4) RMRS Recognized Testing Laboratory:

- recognized by Russian Maritime Register of Shipping (Russia)
- Laboratory recognition number: 17.13259.170 (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

(5) RRR Recognized Test Laboratory:

- recognized by Russian River Register (Russia)
- Certificate number: 131927 (Date of initial recognition: 31 May 2013 (*))
- for carrying out of tests of ships radio and navigation equipment

(6) DNV Recognized Environmental Test Laboratory:

- recognized by Det Norske Veritas AS
- 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, interface and safety testing

(7) CCS Recognized Test Agency:

- recognized by China Classification Society
- Recognition certificate number : DB13A00001 (Date of initial recognition : 29 January 2014 (*))
- Scope of recognition : Performance/Environmental/EMC/Special purpose/Safety precautions tests for Electrical & Electronic Product including Maritime Navigation and Radio-communication Equipment & Systems

(8) SABS EMC A-Lab program Laboratory:

- recognized by South African Bureau of Standards
- Assigned Lab number : SABS/A-LAB/0042/2018 (Date of initial recognition : 5 July 2018 (*))
- Approved List of EMC Standards : SANS 211 / 214-1 / 214-2 / 222 / 2332 / 2335, CISPR 11 / 14-1 / 14-2 / 22 / 32 / 35, SANS/IEC 60601-1-2, SANS/IEC 61326-1, IEC 61326-2-6, SANS/IEC 61000-3-2 / -3-3 / -4-2 / -4-3 / -4-4 / -4-5 / -4-6 / -4-8 / -4-11 / -6-1 / -6-2 / -6-3 / -6-4

(9) A2LA accredited Testing Laboratory:

- accredited by American Association of Laboratory Accreditation (A2LA)
- Certificate number: 5241.01 (Date of initial accreditation: 17 Jul 2019 (*))
- Scope of accreditation: Electrical testing - Emissions - Radiated and Conducted, Radio - Maritime Radio Systems, Stations in the maritime services, Private land mobile radio service, Radio / Intentional radiators, RF Exposure and EMC - Automotive Electronic Devices (AED), Machine and Vehicle

(*) The latest certification status may be found on the LIC website (<https://www.labotech-intl.co.jp/>).

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1 Principal Information

1.1 Equipment under test (EUT)

1.1.1 General

- (a) Trade name: FURUNO
- (b) Manufacturer: FURUNO ELECTRIC CO., LTD.
9-52 Ashihara-cho, Nishinomiya City, Hyogo. 662-8580, Japan
- (c) Model: Transceiver for RADAR SENSOR

Name	Type	Serial number	Note
Antenna Unit	RSB-139-122	R000-2410-0020	--
Transceiver module	RTR-122	--	--
Scanner module	RSB-139	--	Antenna rotation rate: 24 rpm
Antenna radiator	XN24AF	--	One (1) selectable.
	XN30AF	--	

Associated units (AU)

Name	Type	Serial number	Manufacturer
Power Supply Unit	PSU-019	100104	FURUNO
Monitor Unit	RDTI96LM(BK)	12224880KJ	MITSUBISHI
Processor Unit	PRU-025	1000-7910-0061	FURUNO
Control Unit	RCU-031	--	FURUNO

- (d) FCC ID: ADB9ZWRTR122
- (e) Primary function: Ship radar station operating in the band 9300–9500 MHz
- (f) Frequency range: Fixed frequency, 9410 MHz±30 MHz
- (g) Type of emission: P0N
(Emission designator)

(h) Occupied bandwidth:

Pulse type		S	M1	M2	L
Occupied bandwidth (MHz)	Normal mode	57.7	34.7	18.1	12.6
	TT 48NM	59.4	35.2	18.0	12.6
	2nd trace	59.1	38.2	18.5	13.3

- (i) Size and mass: Antenna Unit: $\phi 2550$ mm $\times$ 635 mm (H), 74.0 kg (*1)
Antenna Unit: $\phi 3171$ mm $\times$ 635 mm (H), 79.0 kg (*2)
(*1) with Antenna radiator XN24AF installed.
(*2) with Antenna radiator XN30AF installed.
- (j) Power supply: 100-115 / 220-230 VAC (*)
(*) Powered from Power Supply Unit (AU), not directly from AC mains.

1.1.2 Transceiver module

Type: RTR-122 (Contained in Antenna Unit)

1.1.2.1 Transmitter

- (a) Assignable frequency band: Between 9300 and 9500 MHz (CFR Title 47 Sections: 80.375 (d)-(1))
- (b) Type of RF generator:
- Type: 9M31
 - Peak output power: 50 kW nominal
 - Fundamental frequency: 9410 MHz nominal
 - Tolerances:
 - Manufacturing: ± 30 MHz
 - Pulling: 15 MHz
 - Tolerance for 20°C temperature variation: -5 MHz

- (c) Pulse characteristics:

Pulse type		S	M1	M2	L
Pulse length (μ s)		0.08	0.20	0.60	1.2
PRF(Hz)	Normal mode	1900	1100	600	600
	TT 48NM	1100	1100	600	600
	2nd trace	1500	500	500	500

1.1.2.2 Modulator

SCR Type: TFC563D

Trigger Voltage: Approx. +12 VDC positive

1.1.2.3 Receiver

- (a) Passband

RF Stage: 60 MHz

IF Stage:

Pulse type	S	M1	M2	L
Passband (MHz)	18	11	4	1.7

- (b) Intermediate Frequency: 60 MHz
- (c) Gain (overall): Approximately 26.5 dB
- (d) Overall Noise figure: 3.4 dB (typical)
- (e) Video Output voltage: 2 V Negative
- (f) Features provided: Sensitivity Time Controls (Anti-clutter Sea), Fast Time Constant (Anti-clutter Rain)
- (g) If receiver is tunable, describe method for adjusting frequency:
By adjusting tuning voltage of receiver local oscillator (automatically and manually)
- (h) Frequency adjustable range: 9410 MHz (center) ± 30 MHz

1.1.3 Antenna and Scanner

(a) Antenna specifications

Antenna model	XN24AF	XN30AF
Length (mm)	2548	3172
Rotation diameter (mm)	2700	3340
Transmission frequency	9410±30 MHz	
Horizontal beam width (-3 dB)	0.95°	0.75°
Horizontal beam width (-20 dB)	2.4°	1.8°
Vertical beam width	20°	20°
Side lobe (max.)	Less than ±10°	-28 dB
	Outside ±10°	-32 dB
Gain	31.5 dBi	32.5 dBi
Radiator	Slot array	
Polarization	Horizontal	
Type of beam	Vertical fan	

- (b) Antenna Rotation ON-OFF Switch: Provided
- (c) Scanning (rotating or oscillating): Rotating over 360° continuously clockwise
- (d) Antenna Rotation Rate: 24 rpm
- (e) Sector Scan: Not provided
- (f) Rated Loss of Transmission Line per 100 Feet: Negligible (Transmission path is only in Antenna Unit.)

1.1.4 Operational Features

- (a) Is positive means provided to indicate whether or not the overall operation of the equipment is such that it may be relied upon to provide effective operation in accordance with its primary function:
Yes (Receiver tuning indicator)
- (b) Is the equipment for continuous operation: Yes
- (c) Is provision made for operation with shore based radar beacons (RACONS): Yes (RACONS)

1.1.5 Construction Features

- (a) Does equipment embody replacement units with chassis type assembly: Yes
- (b) Are fuse alarms provided: No
- (c) State units that are weatherproof: Antenna Unit (IEC 60529 – IP56)
- (d) If all units are not housed in a single container, indicate number and give description of individual units:
See Clause 1.1.1 (c) of this report.
- (e) Approximate space required for installation excluding Antenna Unit: Not applicable.

1.2 Observation and comments

As per the customer's instructions, the frequency stability was measured only at -30°C and +20°C.

2 Test Results Summary

Clause No. of this report	47 CFR Section	Item	Result	Test engineer
3.1	2.1055 (a)(1),(d)(1),(d)(3) 90.213	Frequency stability	Passed.	A. Takagi

3 Test Results

3.1 Frequency stability – temperature & voltage

(FCC Rule 47 CFR, 2.1055(a)(1)/(d)(1)/(d)(3) and 90.213)

3.1.1 Test conditions:

- (1) Radar transmitter: All TX (S/M1/M2/L) pulses
- (2) Ambient temperature: -30°C and +20°C
- (3) Power supply voltage: 85/100/115% of nominal voltage
 - Power supply unit: 220 – 230 VAC V_L : 187 VAC/ V_{nom} : 230 VAC/ V_H : 265 VAC
 - Processor unit: 100 – 230 VAC V_L : 85 VAC/ V_{nom} : 230 VAC/ V_H : 265 VAC

3.1.2 Test setup:

See Clause 4.

3.1.3 Frequency tolerance limits (FCC Rule 47 CFR 2.1055 (a) (1), 90.213(a)):

Normal mode

Pulse type	S	M1	M2	L
Pulse length T (μ s)	0.0890	0.1990	0.4774	1.0670
Guard Band $f(1.5/T)$ (MHz) (*1)	16.9	7.5	3.1	1.4
Upper limit (MHz) (*2)	9483.1	9492.5	9496.9	9498.6
Lower limit (MHz) (*2)	9316.9	9307.5	9303.1	9301.4

TT48NM mode

Pulse type	S	M1	M2	L
Pulse length T (μ s)	0.0906	0.1906	0.4806	1.0686
Guard Band $f(1.5/T)$ (MHz) (*1)	16.6	7.9	3.1	1.4
Upper limit (MHz) (*2)	9483.4	9492.1	9496.9	9498.6
Lower limit (MHz) (*2)	9316.6	9307.9	9303.1	9301.4

2nd trace mode

Pulse type	S	M1	M2	L
Pulse length T (μ s)	0.0886	0.1826	0.4746	1.0646
Guard Band $f(1.5/T)$ (MHz) (*1)	16.9	8.2	3.2	1.4
Upper limit (MHz) (*2)	9483.1	9491.8	9496.8	9498.6
Lower limit (MHz) (*2)	9316.9	9308.2	9303.2	9301.4

(*1) Guard Band is specified to be equal to $1.5/T$ MHz, where "T" is the pulse length in microseconds.

(CFR Title 47 Sections: 80.209 (b))

(*2) Upper limit frequency, $f(U) = 9500 - 1.5/T$

Lower limit frequency, $f(L) = 9300 + 1.5/T$

3.1.4 Test Results:

Complied.

(1) Temperature test at the rated supply voltage of 230 VAC, 50 Hz:

Normal mode

Pulse type		S	M1	M2	L	Result
Frequency at maximum emission (MHz)	-30°C	9433.9	9431.4	9430.9	9426.2	Complied.
	+20°C	9424.9	9423.7	9422.5	9418.5	Complied.

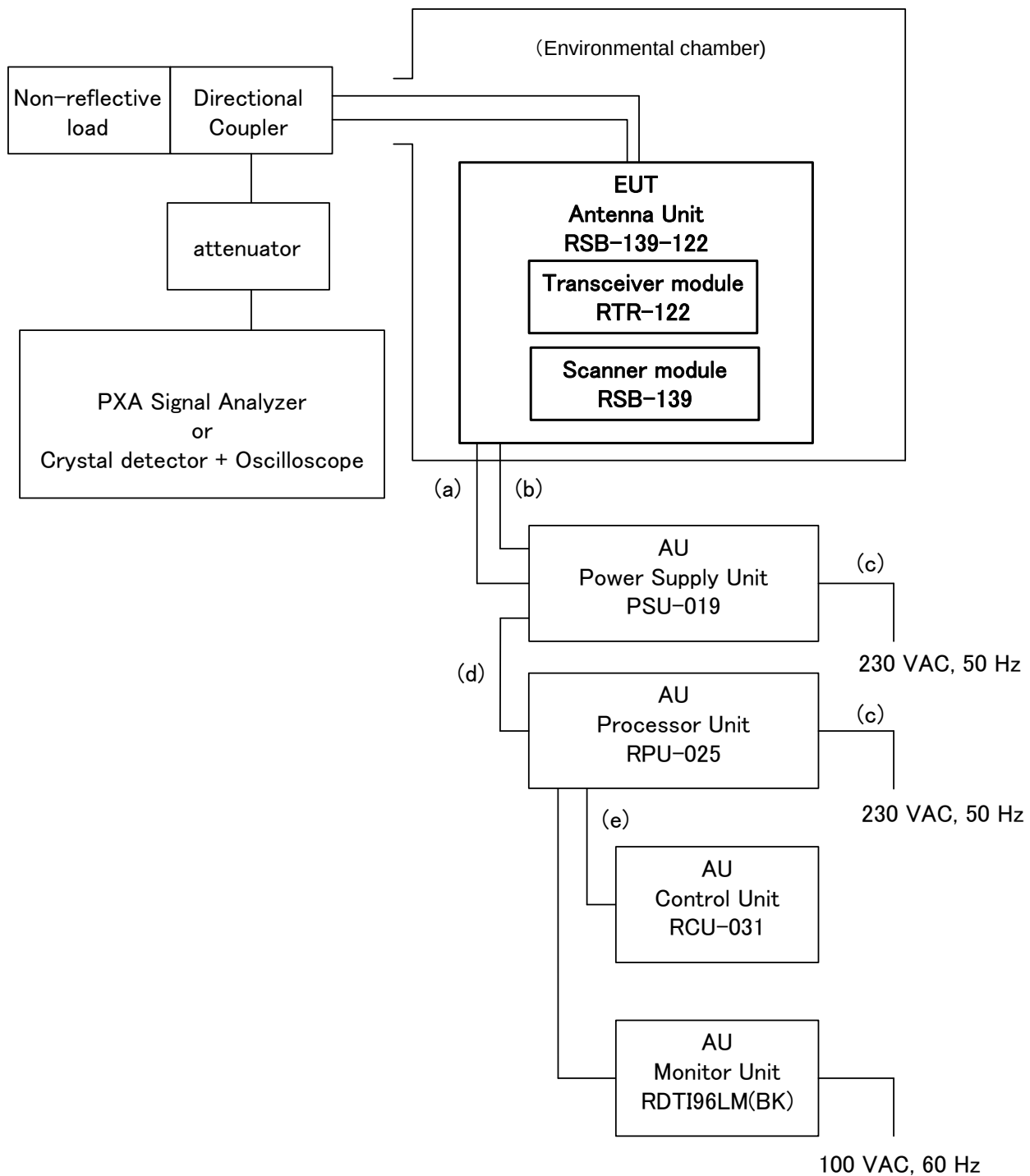
(2) Voltage variation test at the temperature of +20°C:

Normal mode

Pulse type		S	M1	M2	L	Result
Frequency at maximum emission (MHz)	V _L	9425.2	9423.4	9422.6	9418.0	Complied.
	V _{nom}	9424.9	9423.7	9422.5	9418.5	Complied.
	V _H	9425.2	9423.7	9422.7	9418.0	Complied.

Environmental conditions observed: On 17 August 2022, 23°C to 23°C, 67%RH to 66%RH
On 18 August 2022, 22°C to 22°C, 66%RH to 66%RH

4 Test Setup for Measurements



Cable designations

No.	Category	Name	Type	Length (m)	Number of cables used	Cable shielded
a	Power	Power Signal cable	RW-0013	20	1	Yes
b	Power	Power Cable	TPYCY-2.5	20	1	Yes
c	Power	Power Cable	DPYC-2.5	20	2	No
d	Power	Power Signal cable	RW-00339	20	1	Yes
e	Signal	Controller Cable	XH10P-W-6P	20	1	Yes

5 Measuring Equipment List

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

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT1325	Climatic chamber (Large)	TBE-3EW0P2T	3015007516	Espec	2 June 2022	1 year
HT1223	Attenuator	8495B	MY42148137	Keysight	7 March 2022	1 year
HT654	Attenuator	8494B	MY42148134	Agilent	7 March 2022	1 year
HT1317	PXA Signal Analyzer	N9030B	SG57142024	KEYSIGHT	9 March 2022	1 year
HT972	Oscilloscope	MSO4054B	C030483	TEKTRONIX	11 March 2022	1 year
HT1221	Crystal detector	423B	MY51342422	Agilent	5 March 2022	1 year
HT688	Digital multi-meter	115	10821184	Fluke	9 November 2021	1 year
--	Directional Coupler	5D0364S	R0170002	SPC ELECTRONICS	--	--
--	Dummy Load	90-745-6	U250605-02	SPC ELECTRONICS	--	--

End of text