Test Report

(FCC Rules 47 CFR,
2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, and 80.209, 80.211, 80.213, 80.215)

For

Trade name: Furuno
Model: Transceiver for Marine Radar
Type: RTR-100

Report no.: LIC 12-15-093

Date of issue: 14 September 2015

Labotech International Co., Ltd.

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Report Summary

FLI project number:	LIC 04-14-0701/15-0400		
Test report number of initial issue:	LIC 12-15-093	Date of initial issue	14 September 2015
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: 2.1046 - RF Power Output, 2.1047 - Modulation Characteristics, 2.1049 - Occupied Bandwidth, 2.1051 - Spurious Emissions at Antenna Terminals, 2.1053 - Field Strength of Spurious Radiation, 2.1055 - Frequency Stability. (Date of issue: 23 June 2015) 80.209 - Transmitter frequency tolerances, 80.211 - Emission limitations, 80.213 - Modulation requirements, 80.215 - Transmitter power.		
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:	Transceiver for Marine Radar		
Type:	RTR-100		
Product function and intended use:	For marine safety navigation		
Number of samples tested:	One		
Serial number:	R179-0298		
Power rating:	24 VDC, 100-115/220-230 VAC (for Processor unit)		
Product status:	Pre-production model		
Modifications made to samples during testing:	None.		
Date of receipt of samples:	1 April 2015 and 5 August 2015		
Test period:	From 1 April 2015 to 4 April 2015 From 17 August 2015 to 26 August 2015		
Place of test:	Labotech International Co., Ltd. - 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 Anechoic Chamber used for the test has been registered by FCC. (File number: 90607) Test firm Designation Number: JP2007, Test firm Registration #: 838049		
Test results/ Compliance:	Passed. The test results of this report relate only to the samples tested.		
Tested by:	Koji Kawai		
Written by:	Akiko Inoue		
Verified by:	Yoshihiro Ishii		
Approved by:	Date: 14 September 2015 Name: Yoshihiro Ishii Title: Senior Manager, Technical Department Labotech International Co., Ltd. Signature: 		

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 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, IEC/EN 61162-450 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, and 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, interface and safety testing.

(8) 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

Note: (*) – The current certificates may be found in the LIC web site (http://www.furuno-labotech.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.

Ashihara-cho 9-52, Nishinomiya-city, 662-8580 Japan

(c) Model:

	Type	Serial Number	Note
Transceiver module	RTR-100	R179-0298	Contained in the Antenna unit.
Scanner module	RSB-120/ RSB-121		Antenna rotation rate: 26 rpm/48 rpm
Antenna radiator	XN12AF XN20AF	---	One (1) selectable.

(d) Certification number: FCC ID: ADB9ZWRTR100

(e) Primary Function: Search, Navigation and Anti-collision

(f) Frequency Range: Fixed frequency, X-band (9410 MHz)

Type of Emission: P0N
(Emission designator)

(g) Occupied bandwidth:

Pulse type	S1	S2	M1	M2	M3	L1	L2
Occupied bandwidth (MHz)	44.0	43.1	31.2	20.2	5.5	6.4	6.4

Note: representative measured data.

(h) Size and mass: Antenna Unit: 1260 mm (dia) X 555 mm (H), 33 kg (*1)

Antenna Unit: 2040 mm (dia) X 570 mm (H), 39 kg (*2)

(*1): Antenna Unit with XN12AF.
(*2): Antenna Unit with XN20AF.

(i) Power Supply: 24 VDC (*) (for Processor unit)
or 100-115 / 220-230 VAC (*) (for Processor unit)
(*): fed through the specified external equipment, not directly from AC/DC mains.

1.1.2 Transceiver

Type: RTR-100 (Contained in the Antenna unit)

1.1.2.1 Transmitter

(a) Assignable Frequency for Shipborne Radar:

Between 9300 and 9500 MHz (FCC Rule, 80.375 (d)-(1))

(b) Type of RF Generator:

Magnetron Type: MAF1615B

Peak Output Power: 12 kW nominal

(c) Magnetron Ratings:

Center frequency of Magnetron: 9410 MHz nominal

Tolerances:

Manufacturing: ± 30 MHz

Pulling: 23 MHz

Tolerance for 20°C temperature variation: -5 MHz

(d) Pulse Characteristics:

Pulse type	S1	S2	M1	M2	M3	L1	L2
Pulse length (μs)	0.08	0.12	0.22	0.38	0.68	1.2	1.2
PRR(Hz)	3000	2760	1500	1000	1000	600	500

1.1.2.2 Modulator

(a) FET Type: 2SK1450

Trigger Voltage: Approximately +20 VDC positive

1.1.2.3 Receiver

(a) Passband

RF Stage: 100 MHz

IF Stage:

Pulse type	S1	S2	M1	M2	M3	L1	L2
Passband (MHz)	17.5	10	10	4	4	1.7	1.7

(b) Intermediate Frequency: 60 MHz

(c) Gain (overall): Approximately 100 dB

(d) Overall Noise Figure: 4 dB (typical)

(e) Video Output Voltage: 4 V Negative

(f) Features Provided: Main bang suppression

(g) If receiver is tunable, describe method for adjusting frequency:

By adjustment of tuning voltage of receiver local oscillator (automatic and manual)

(h) Frequency adjustable range: 9410 MHz (center) ± 30 MHz

1.1.3 Antenna and Scanner

(a) Antenna Rotation ON-OFF Switch: Provided.

(b) Construction: Slotted array antenna

(c) Length:

Antenna type	XN12AF	XN20AF
Length (mm)	1260	2040

0(d) Type of Beam: Vertical fan

(e) Beam Width (3 dB):

Antenna type	XN12AF	XN20AF
Horizontal (°)	1.9	1.23
Vertical (°)	20	20

(f) Polarization: Horizontal

(g) Antenna Gain:

Antenna type	XN12AF	XN20AF
Gain (dBi)	27.5	30.0

(h) Attenuation of Major Side and Back Lobes with respect to main beam:

Antenna type	XN12AF	XN20AF
Within ±10° (dB)	-24	-28
Outside ±10° (dB)	-30	-32

(i) Scanning (rotating or oscillating): Rotating

(j) Antenna Rotation Rate: 26 rpm or 48 rpm

(k) Sector Scan: Provided.

(l) Rated Loss of Transmission line per hundred feet:

Negligible. (Transmission path is only in the 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: Yes

(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

None.

2 Test Results Summary

Clause no. of this report	47 CFR Section	Item	Result	Test Engineer
3.1	2.1046 (a), 80.215	RF Power Output	Passed.	K. Kawai
3.2	2.1047	Modulation Characteristics	Passed.	K. Kawai
3.3	2.1055 (a)(2) 80.209 (b)	Frequency Stability	Passed.	K. Kawai
3.4	2.1049 (c)(1), 80.219 (b), 80.211 (f)	Occupied Bandwidth	Passed.	K. Kawai
3.5	2.1051, 80.211 (f)	- Spurious Emissions at Antenna Terminals	Passed.	K. Kawai
3.6	2.1053, 80.211 (f)	- Field Strength of Spurious Radiation	Passed.	K. Kawai

3 Test Results

3.1 RF Power Output (FCC Rule 47 CFR, 2.1046 (a), 80.215)

(1) Test conditions:

For all TX (S1/S2/M1/M2/M3/L1/L2) Pulses, the transmitter output power was measured at the antenna port with Antenna replaced with the non-reflective load.

(2) Test setup:

See Clause 4.

(3) Test Results:

Pulse type	S1	S2	M1	M2	M3	L1	L2
Magnetron Output, mean Pm (W)	3.7	4.9	4.2	5.0	9.1	9.3	7.7
Magnetron Output, peak Pp (kW) (*1)	14.3	14.5	13.2	13.3	13.2	13.2	13.2
Pulselength T (µs) (-3dB points)	0.085	0.122	0.210	0.373	0.687	1.173	1.175
PRF (Hz)	2998	2758	1499	1000	1000	600	500

(*1) P_p (kW) = (P_m (W) / (T (µs) × PRF (Hz))) × 1000

Environmental conditions observed: On 1 April 2015, 24°C to 24°C, 60%RH to 60%RH
On 17 August 2015, 24°C to 24°C, 56%RH to 56%RH
Power supply voltage measured (*2): 24.0 VDC to 24.0 VDC.

(*2): Power input voltages to the external equipment (Processor unit) measured.
Power supply to Magnetron was not directly from ship's mains but 12 VDC generated in control part was supplied. The test was performed with 24 VDC because there was no difference by ship's mains as long as power supply was within the rating.

3.2 Modulation Characteristics (FCC Rule 47 CFR, 2.1047)

(1) Test Conditions:

The RF envelope of the magnetron output pulse was measured using an envelope detector and an oscilloscope. Each pulse spectrum was measured using a spectrum analyzer.

(2) Test setup:

See Clause 4.

(3) Test Results:

Pulse type	S1	S2	M1	M2	M3	L1	L2
Pulselength T (µs) (-3dB points)	0.085	0.122	0.210	0.373	0.687	1.173	1.175
Rise time t_r (µs) (10 to 90 % amplitude)	0.020	0.026	0.029	0.052	0.056	0.056	0.056
Decay time t_f (µs) (90 to 10 % amplitude)	0.102	0.122	0.119	0.128	0.124	0.120	0.128
PRR (Hz)	2998	2758	1499	1000	1000	600	500

Measured Plots: See Clause 7.

Environmental conditions observed: On 17 August 2015, 24°C to 24°C, 56%RH to 56%RH
Power supply voltage measured (*1): 24.0 VDC to 24.0 VDC.

(*1): Power input voltages to the external equipment (Processor unit) measured.
Power supply to Magnetron was not directly from ship's mains but 12 VDC generated in control part was supplied. The test was performed with 24 VDC because there was no difference by ship's mains as long as power supply was within the rating.

3.3 Frequency Stability – temperature & voltage (FCC Rule 47 CFR, 2.1055(a)(2)/(d)(1)/(d)(3), 80.209(b))

(1) Test Conditions:

1) Radar Transmitter settings: All TX (S1/S2/M1/M2/M3/L1/L2) Pulses
2) Ambient Temperature settings: - 20°C to + 50°C (10°C interval)
3) Power Supply Voltage settings: 85 /100/115 % of nominal voltage
   DC Processor unit (24 VDC): 20.4/24.0/27.6 VDC
   AC Processor unit (100 to 115 VAC): 85/100/132.3 VAC
   AC Processor unit (220 to 230 VAC): 187/230/264.5 VAC

(2) Test setup:

See Clause 4.

(3) Frequency Tolerance Limits (FCC Rule 47 CFR, 80.209(b)):

Pulse type	S1	S2	M1	M2	M3	L1	L2
Guard Band f(1.5/T) (MHz) (*1)	17.6	12.3	7.1	4.0	2.2	1.3	1.3
f(U) (MHz) (*2)	9482.4	9487.7	9492.9	9496.0	9497.8	9498.7	9498.7
f(L) (MHz) (*2)	9317.6	9312.3	9307.1	9304.0	9302.2	9301.3	9301.3

(*1): Guard Band is specified to be equal to 1.5/T MHz, where "T" is the pulse length in microseconds. (FCC Rule 47 CFR, 80.209(b))

(*2): Upper limit frequency, f(U) = 9500 -1.5/T
Lower limit frequency, f(L) = 9300 +1.5/T

(4) Test Results:

Complied.

(4.1) At the rated supply voltage of 24.0 VDC:

Power Supply Voltage setting: DC Processor unit 24 VDC (*1)

Pulse type		S1	S2	M1	M2	M3	L1	L2	Result
Frequency at maximum emission (MHz)	-20°C	9421.5	9421.3	9421.8	9421.7	9420.5	9420.6	9420.8	Complied.
	-10°C	9419.5	9419.3	9420.3	9419.8	9419.3	9419.4	9419.1	Complied.
	0°C	9417.5	9417.7	9417.9	9417.9	9417.1	9417.1	9417.4	Complied.
	+10°C	9416.5	9416.4	9416.5	9416.5	9415.6	9415.9	9415.8	Complied.
	+20°C	9413.6	9413.7	9414.5	9414.3	9413.7	9413.7	9413.7	Complied.
	+30°C	9412.5	9412.2	9412.8	9412.6	9412.0	9412.2	9412.2	Complied.
	+40°C	9410.7	9410.2	9410.9	9410.1	9410.3	9410.2	9410.6	Complied.
	+50°C	9408.5	9409.0	9409.4	9409.6	9409.3	9409.1	9409.4	Complied.

(*1): Power supply to Magnetron was not directly from ship's mains and 12 VDC generated in control part was supplied. Therefore, the test was performed with 24 VDC because there was no difference by ship's mains when power supply was within the rating.

(4.2) At the temperature of +20°C:

DC Processor unit

Pulse type		S1	S2	M1	M2	M3	L1	L2	Result
24 VDC	20.4 VDC	9413.8	9414.1	9414.7	9414.8	9413.6	9413.6	9413.6	Complied.
	24.0 VDC	9413.6	9413.7	9414.5	9414.3	9413.7	9413.7	9413.7	Complied.
	27.6 VDC	9413.8	9414.1	9414.5	9414.7	9413.8	9413.7	9413.7	Complied.

AC Processor unit

Pulse type		S1	S2	M1	M2	M3	L1	L2	Result
100 to 115 VAC	85 VAC	9413.2	9412.9	9413.2	9412.7	9412.4	9412.1	9412.2	Complied.
	100 VAC	9413.2	9412.7	9412.8	9412.3	9411.9	9411.4	9412.2	Complied.
	132.3 VAC	9412.9	9412.4	9412.8	9412.2	9411.6	9411.2	9412.1	Complied.

AC Processor unit

Pulse type		S1	S2	M1	M2	M3	L1	L2	Result
220 to 230 VAC	187 VAC	9413.6	9413.0	9413.5	9412.8	9412.1	9411.7	9411.9	Complied.
	230 VAC	9413.2	9413.3	9413.8	9413.3	9413.0	9412.2	9412.4	Complied.
	264.5 VAC	9413.2	9413.0	9413.3	9412.5	9412.2	9411.6	9412.0	Complied.

Environmental conditions observed: On 2 April 2015, 22°C to 24°C, 58%RH to 56%RH
On 3 April 2015, 24°C to 23°C, 60%RH to 63%RH
On 4 April 2015, 22°C to 24°C, 62%RH to 64%RH
On 17 August 2015, 24°C to 24°C, 56%RH to 56%RH

Power supply voltage measured (*2): 24.0 VDC to 24.0 VDC.
100.0 VAC, 60 Hz to 100.0 VAC, 60 Hz
230.0 VAC, 50 Hz to 230.0 VAC, 50 Hz

(*2): Power input voltages to the external equipment (Processor unit) measured.

3.4 Occupied Bandwidth (FCC Rule 47 CFR, 2.1049(c)(1), 80.209(b), 80.211(f))

(1) Test conditions:

For all TX (S1/S2/M1/M2/M3/L1/L2) Pulses, the transmitter occupied bandwidth was measured at the antenna port with Antenna replaced with the non-reflective load.

(2) Test setup:

See Clause 4.

(3) Emission Limits (FCC Rule 47 CFR, 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
50 - 100 % (of the authorized bandwidth) (*2)	At least 25
100 - 250 % (of the authorized bandwidth) (*2)	At least 35
more than 250 % (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts)=-13 dBm

(*1): Assigned frequency (center frequency) = 9410 MHz (for X-band radars)
(*2): Authorized bandwidth = 110 MHz (for X-band radars)

(4) Test Results:

Spectrum plots: See Clause 8.

Environmental conditions observed: On 1 April 2015, 22°C to 22°C, 66%RH to 66%RH
Power supply voltage measured (*3): 24.0 VDC to 24.0 VDC.

(*3): Power input voltages to the external equipment (Processor unit) measured.
Power supply to Magnetron was not directly from ship's mains but 12 VDC generated in control part was supplied. The test was performed with 24 VDC because there was no difference by ship's mains as long as power supply was within the rating.

3.5 Spurious Emissions at Antenna Port (FCC Rule 47 CFR, 2.1051, 80.211(f))

(1) Test Conditions:

For S1 Pulses, the transmitter output power was measured at the antenna port with Antenna replaced with the non-reflective load. (*1)

(*1): Tested only with S1 pulse that is the widest in B-40 calculation. The requirement is as follows.
Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B–40 bandwidth. (IEC 62388 Ed.2/ Annex B.4.2 part)

(2) Test setup:

See Clause 4.

(3) Emission Limits (FCC Rule 47 CFR, 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
more than 250 % (*3) (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts)=-13 dBm

(*1): Assigned frequency (center frequency) = 9410 MHz (for X-band radars)
(*2): Authorized bandwidth = 110 MHz (for X-band radars)
(*3): The measurement range for X-Band RADAR: from 4.59 GHz to 40 GHz

(4) Spurious Frequencies:

f_0 (GHz)	$1/2f_0$	$2f_0$	$3f_0$	$4f_0$
9.410	4.705	18.822	28.23	37.64

(5) Test Results:

Complied.

Spurious emission levels measured were found to be attenuated more than 20 dB below the limits.

Environmental conditions observed: On 26 August 2015, 25°C to 25°C, 68%RH to 68%RH
Power supply voltage measured (*4): 24.0 VDC to 24.0 VDC.

(*4): Power input voltages to the external equipment (Processor unit) measured.
Power supply to Magnetron was not directly from ship's mains but 12 VDC generated in control part was supplied. The test was performed with 24 VDC because there was no difference by ship's mains as long as power supply was within the rating.

3.6 Field Strength of Spurious Radiation (FCC Rule 47 CFR, 2.1053, 80.211(f))

(1) Test Conditions:

For S1 Pulses, the transmitter output power was measured at the antenna port with Antenna replaced with the Non-reflective load. (*1)

(*1): Tested only with S1 pulse that is the widest in B-40 calculation. The requirement is as follows:
Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B–40 bandwidth. (IEC 62388 Ed.2/ Annex B.4.2 part)

(a): The measurement range for X-Band RADAR: from 4.59 GHz to 40 GHz
(b): The antenna port was terminated with dummy load.

(2) Test Site: LIC Nishinomiya-Hama Laboratory, Semi-Anechoic Chamber
(FCC file number: 90607)

(3) Distance between the radar set and measuring antenna: 3 m

(4) Test setup:

The GRP (Ground Reference Plane, metal floor) between the EUT and the measuring (receiving) antenna was lined with the Radio Absorbers (2.4 m × 3.6 m × 0.3 m) to reduce the influences of the reflections of the RF waves from the floor.

Measuring (Receiving) Antenna height and polarization:
(a) Antenna height: EUT center (1.75 m)
(b) Antenna polarization: vertical and horizontal.

EUT height: 1.5 m

(5) Field Strength Limits (FCC Rule 47 CFR, 80.211 (f)):

Frequency removed from the assigned frequency (*1)	Emission attenuation (mean power, dB)
more than 250 % (of the authorized bandwidth) (*2)	At least 43 + 10 $\log_{10}$ (mean power in watts) =-13 dBm

(*1): Assigned frequency (center frequency) = 9410 MHz (for X-band radars)
(*2): Authorized bandwidth = 110 MHz (for X-band radars)

(6) Spurious Frequencies:

f_0 (GHz)	$1/2f_0$	$2f_0$	$3f_0$	$4f_0$
9.410	4.705	18.822	28.23	37.64

(7) Test Results:

Complied.

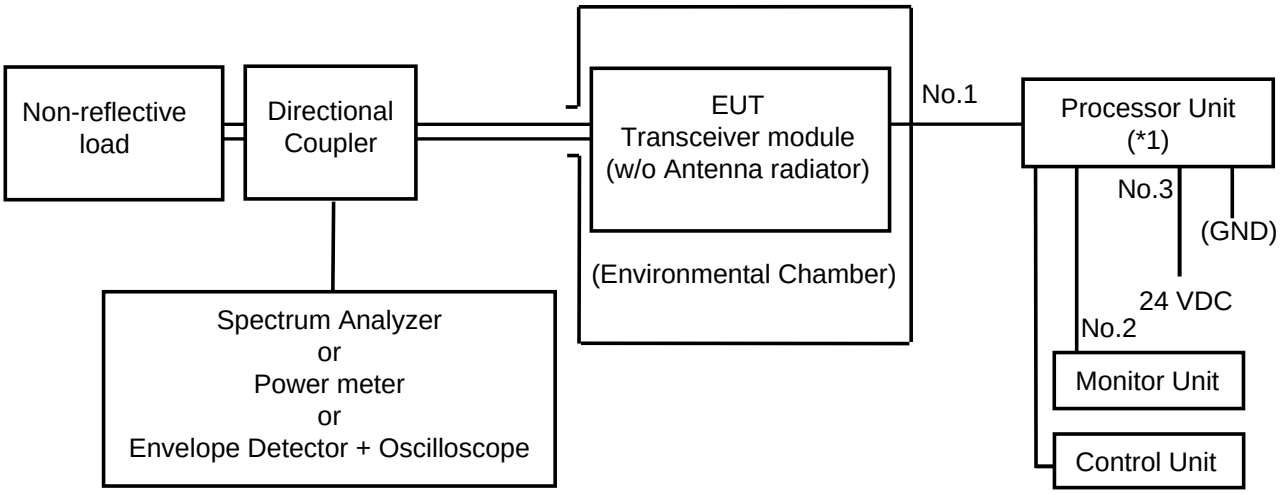
Spurious emission levels measured were found to be attenuated more than 20 dB below the limits.

Environmental conditions observed: On 19 August 2015, 25°C to 25°C, 56%RH to 56%RH
Power supply voltage measured (*3):24.0 VDC to 24.0 VAC.

(*3): Power input voltages to the external equipment (Processor unit) measured.
Power supply to Magnetron was not directly from ship's mains but 12 VDC generated in control part was supplied. The test was performed with 24 VDC because there was no difference by ship's mains as long as power supply was within the rating.

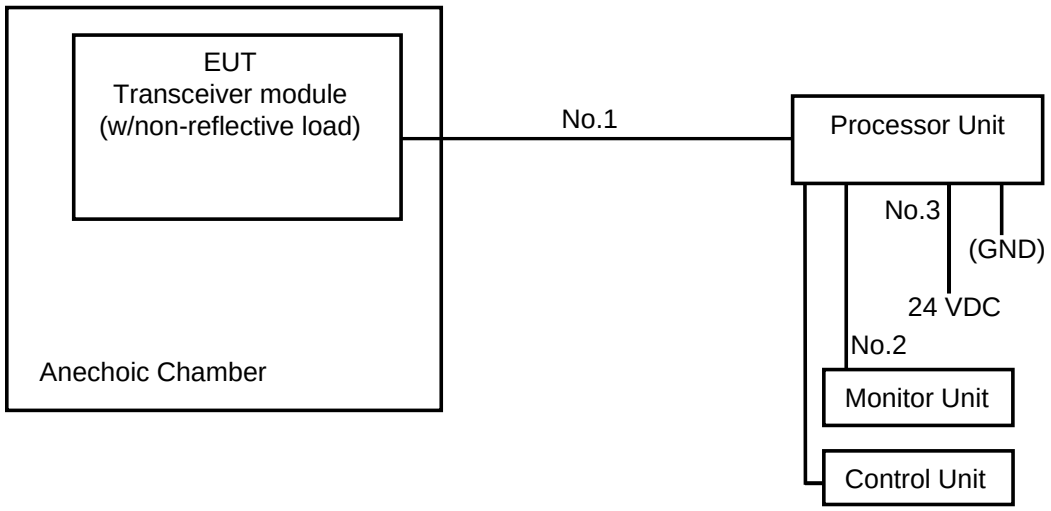
4 Test Setup for Measurements

(1) Test Setup for Clauses 3.1, 3.2, 3.3, 3.4, and 3.5.



(*1): For the test of 3.3 Frequency Stability, the test was performed with AC and DC control parts.

(2) Test Setup for Clause 3.6.



Cable designations;

No.	Type	Length (m)
1	RW-0030	20
2	DVI-D/D S-LINK	10
3	DPYC-6	5

5 Measuring Equipment List

(1) For 3.1 RF Power Output:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
120121202	Directional Coupler (X-band)	5D364S	R05762	Shimada	1 July 2015	1 year
120121202	Dummy Load (X-band)	4D376	R4535004	Shimada	1 July 2015	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
HT552	Power meter	E4418B	GB43315050	Agilent	1 June 2015	1 year
HT653	Attenuator	8491B(10dB)	MY39264135	Agilent	6 March 2015	1 year
HT655	Step Attenuator	8495B	MY42144403	Agilent	6 March 2015	1 year
HT926	Power Sensor	E9304A-H18	MY53100039	Agilent	28 July 2015	1 year
HT432	DC Power Supply	PAN55-20	AK003307	KIKUSUI	----	----

(2) For 3.2 Modulation Characteristics:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
120121202	Directional Coupler (X-band)	5D364S	R05762	Shimada	1 July 2015	1 year
120121202	Dummy Load (X-band)	4D376	R4535004	Shimada	1 July 2015	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
HT654	Step Attenuator	8494B	MY42148134	Agilent	6 March 2015	1 year
HT655	Step Attenuator	8495B	MY42144403	Agilent	6 March 2015	1 year
HT913	Crystal Detector	423B	MY51340543	Agilent	10 February 2015	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	11 March 2015	1 year
HT553	Frequency Counter	53150A	US40501919	Agilent	17 October 2014	1 year
HT972	Oscilloscope	MSO4054B	C030483	Tektronix	23 March 2015	1 year
HT432	DC Power Supply	PAN55-20	AK003307	KIKUSUI	----	----

(3) For 3.3 Frequency Stability –temperature & voltage:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT370	Climatic Chamber (Large)	TBE-3HW5GE2F	3013000995	Espec	18 August 2014	1 year
HT723	Paperless recorder/Dual communication logger DAQSTATIOM FX100	FX106-4-1	S5JA01445	Yokogawa	18 August 2014	1 year
120121202	Directional Coupler (X-band)	5D364S	R05762	Shimada	1 July 2015	1 year
120121202	Dummy Load (X-band)	4D376	R4535004	Shimada	1 July 2015	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
HT654	Step Attenuator	8494B	MY42148134	Agilent	6 March 2015	1 year
HT655	Step Attenuator	8495B	MY42144403	Agilent	6 March 2015	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	11 March 2015	1 year
HT432	DC Power Supply	PAN55-20	AK003307	KIKUSUI	----	----
HT434	AC/DC power supply	PCR2000L	BB002789	KIKUSUI	----	----

(4) For 3.4 Occupied Bandwidth and for 3.5 Spurious Emissions at Antenna Port:

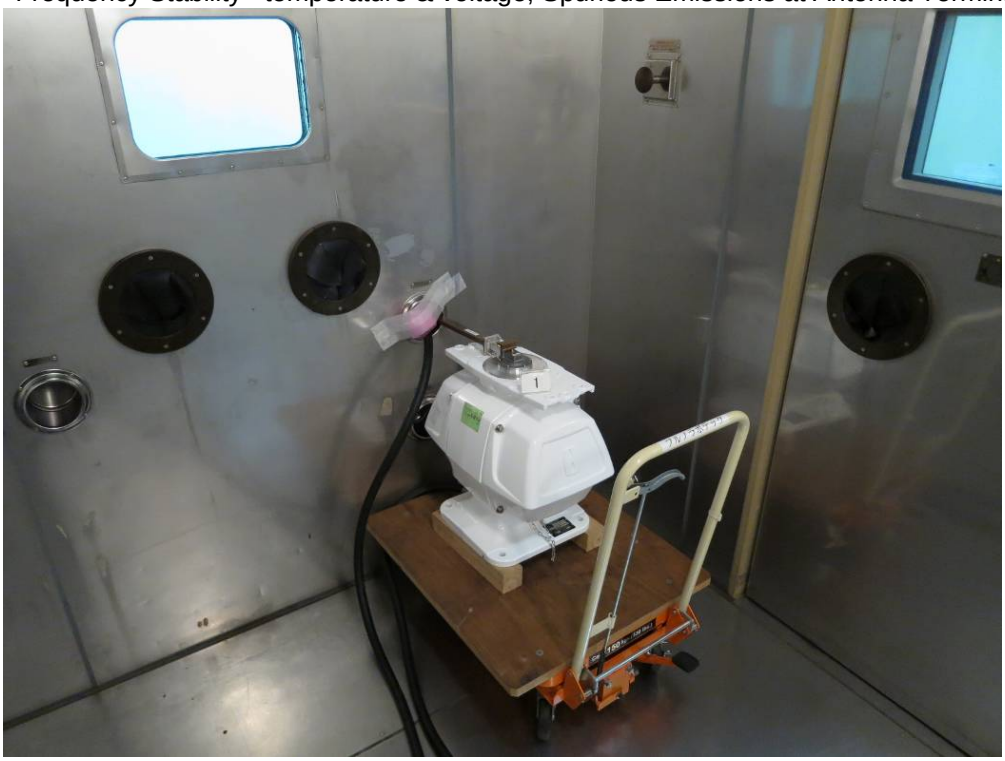
C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
120121202	Directional Coupler (X-band)	5D364S	R05762	Shimada	1 July 2015	1 year
120121202	Dummy Load (X-band)	4D376	R4535004	Shimada	1 July 2015	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
HT654	Step Attenuator	8494B	MY42148134	Agilent	6 March 2015	1 year
HT655	Step Attenuator	8495B	MY42144403	Agilent	6 March 2015	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	11 March 2015	1 year
HT432	DC Power Supply	PAN55-20	AK003307	KIKUSUI	----	----
KB179	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48932/4A	HUBER+ SUHNER	1 July 2015	1 year
KB180	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48933/4A	HUBER+ SUHNER	8 August 2015	1 year
KB181	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 102A	1261/2A	HUBER+ SUHNER	8 August 2015	1 year

(5) For 3.6 Field Strength of Spurious Radiation:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	11 March 2015	1 year
HT467	Double-ridged waveguide horn antenna (1 GHz to 18 GHz)	3115	6520	EMCO	13 August 2015	1 year
HT759	Double rigged horn antenna & amp.	HAP06-18W	00000065	TOYO	29 December 2014	1 year
HT761	Double rigged horn antenna & amp.	HAP18-26N	00000017	TOYO	29 December 2014	1 year
HT762	Double rigged horn antenna & amp.	HAP26-40N	00000010	TOYO	29 December 2014	1 year
HT755	Pre-amp. (1 GHz - 8 GHz, Gain 40 dB)	TAP0108-40	1017	Toyo Corp.	7 July 2015	1 year
HT365	Semi-anechoic Chamber	3mSAC	D-002	Riken	----	----
HT156	DC power supply	GP035-30	1014396080	Takasago	----	----
---	Dummy Load (X-band)	4D376	R25510001	Shimada		
KB179	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48932/4A	HUBER+ SUHNER	1 July 2015	1 year
KB180	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48933/4A	HUBER+ SUHNER	8 August 2015	1 year
KB181	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 102A	1261/2A	HUBER+ SUHNER	8 August 2015	1 year

6 Photograph of Test Setup/Arrangement

(1) For RF Power Output, Modulation Characteristics, Occupied Bandwidth,
Frequency Stability –temperature & voltage, Spurious Emissions at Antenna Terminal.



(2) For Field Strength of Spurious Radiation

7 RF Envelope and Spectrum of the output pulse

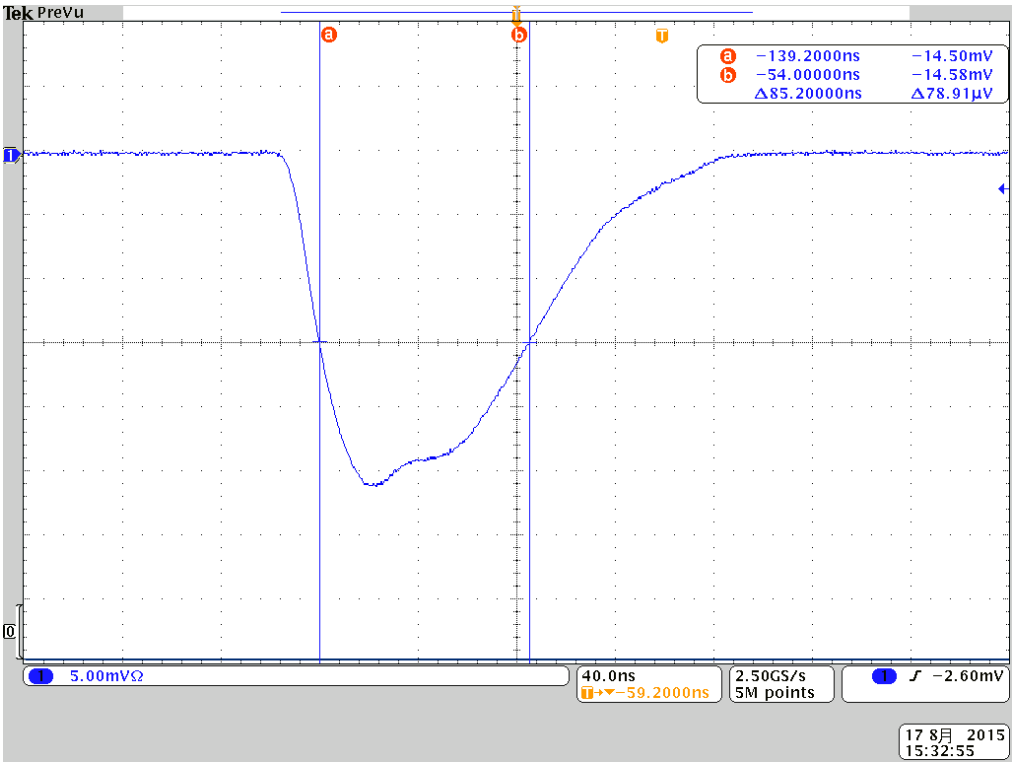


Fig. 7.1 S1 Pulse Envelope

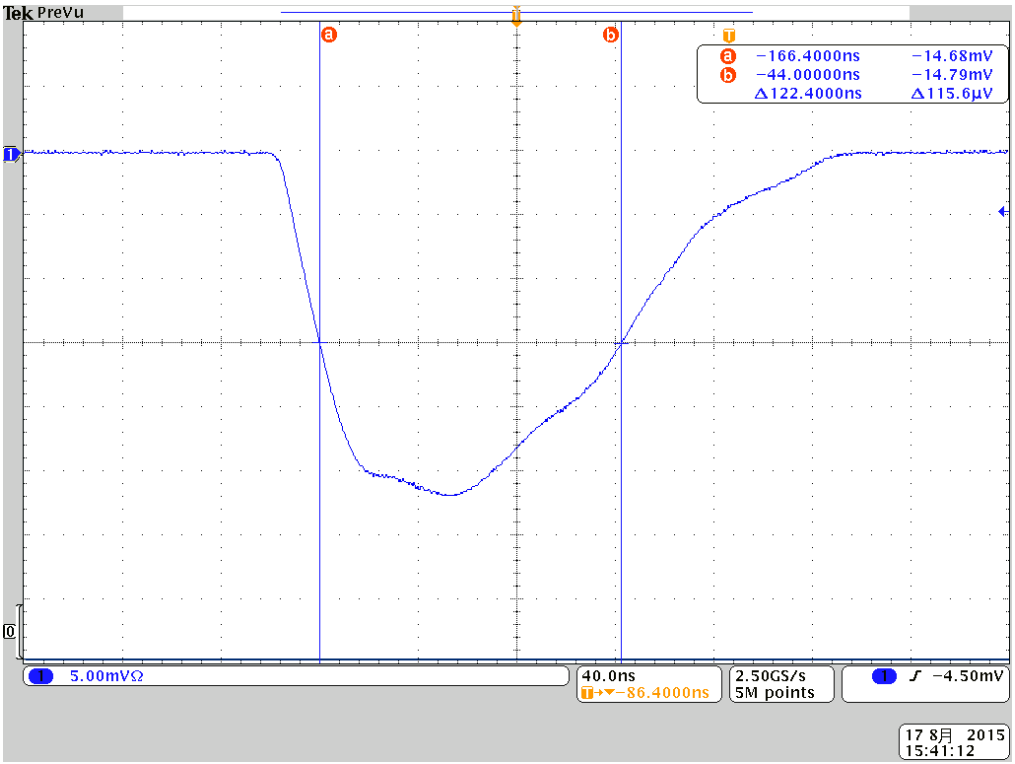


Fig. 7.2 S2 Pulse Envelope

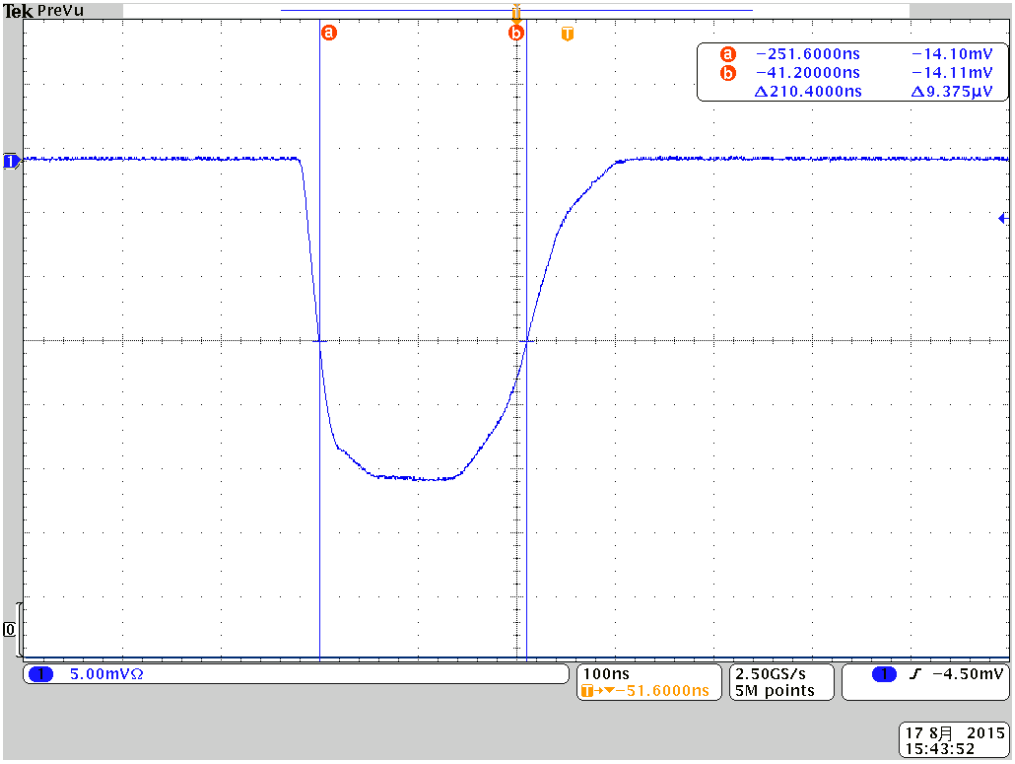


Fig. 7.3 M1 Pulse Envelope

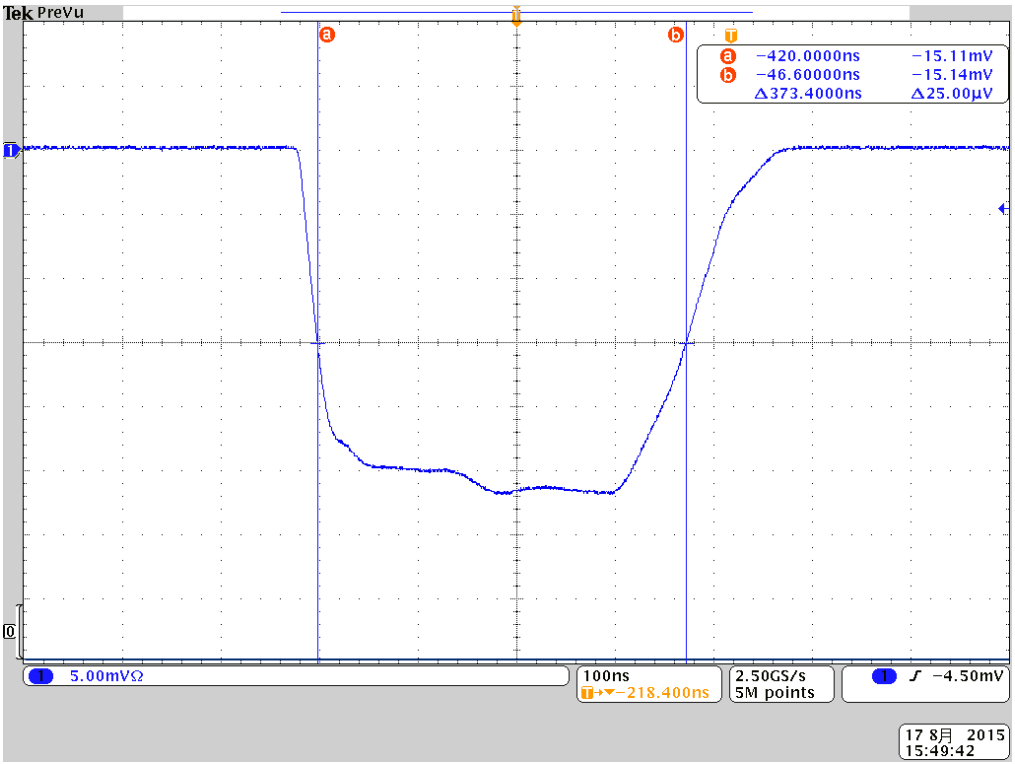


Fig. 7.4 M2 Pulse Envelope

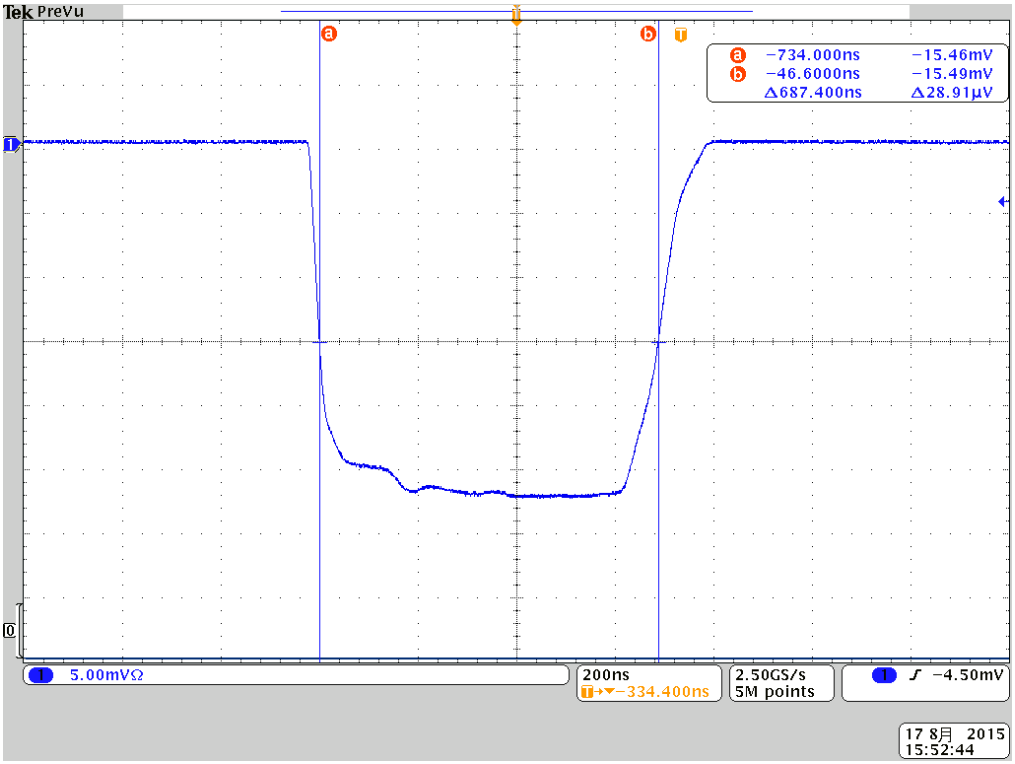


Fig. 7.5 M3 Pulse Envelope

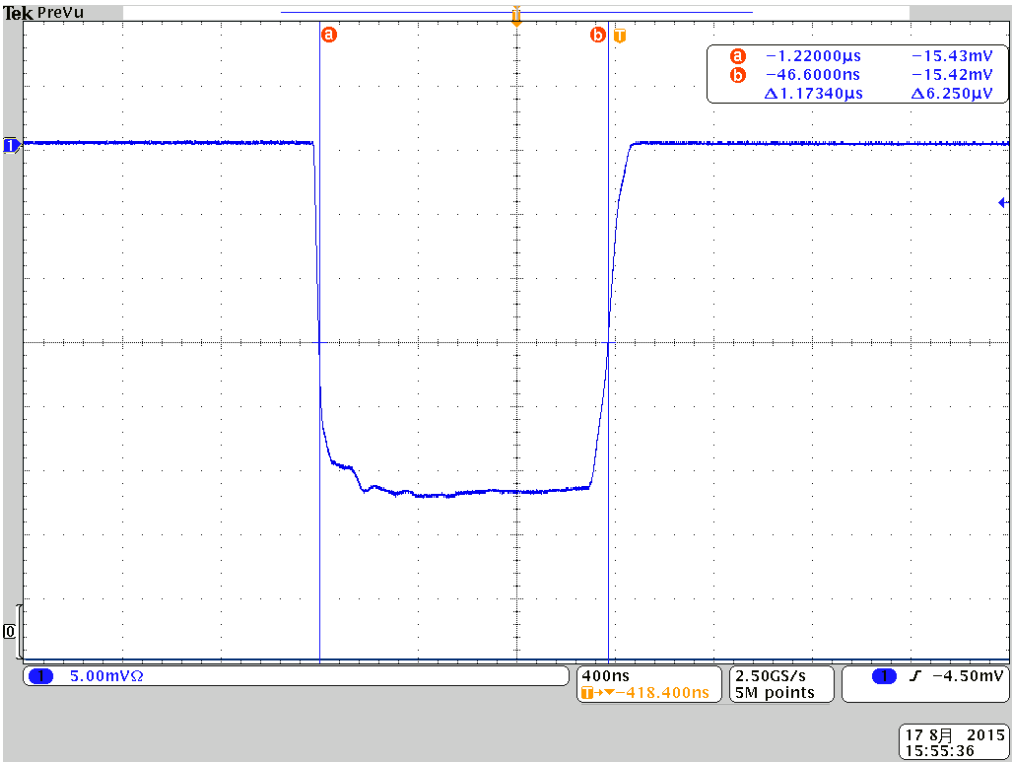


Fig. 7.6 L1 Pulse Envelope

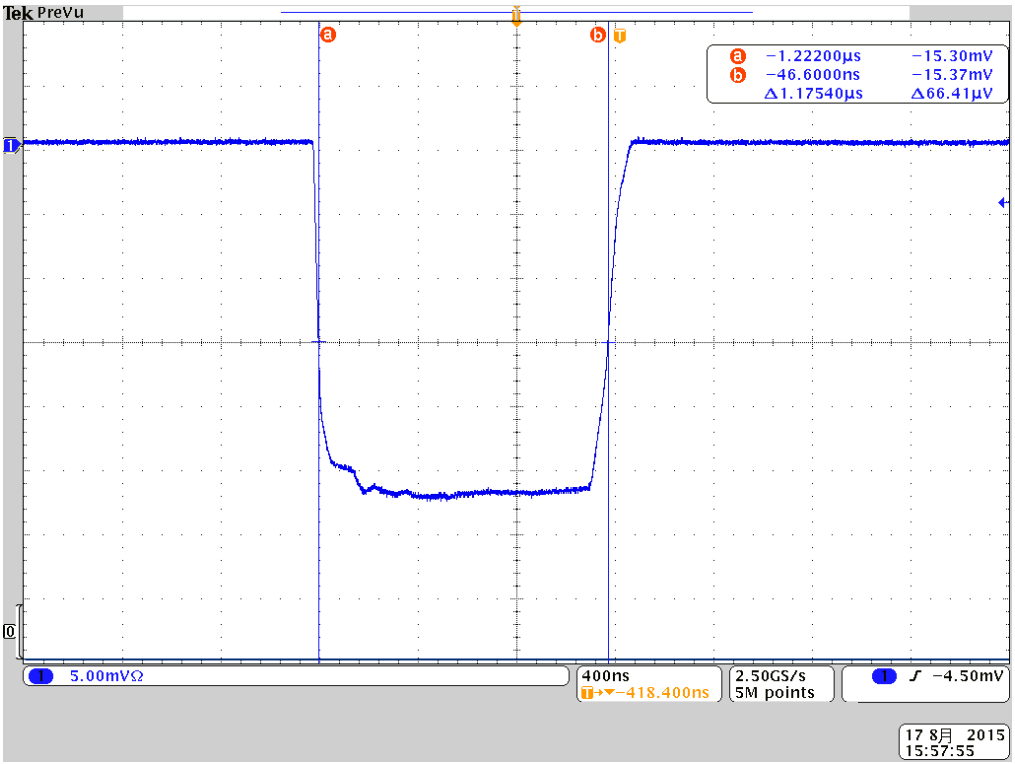


Fig. 7.7 L2 Pulse Envelope

8 Spurious Emission Plots measured at Antenna Terminal

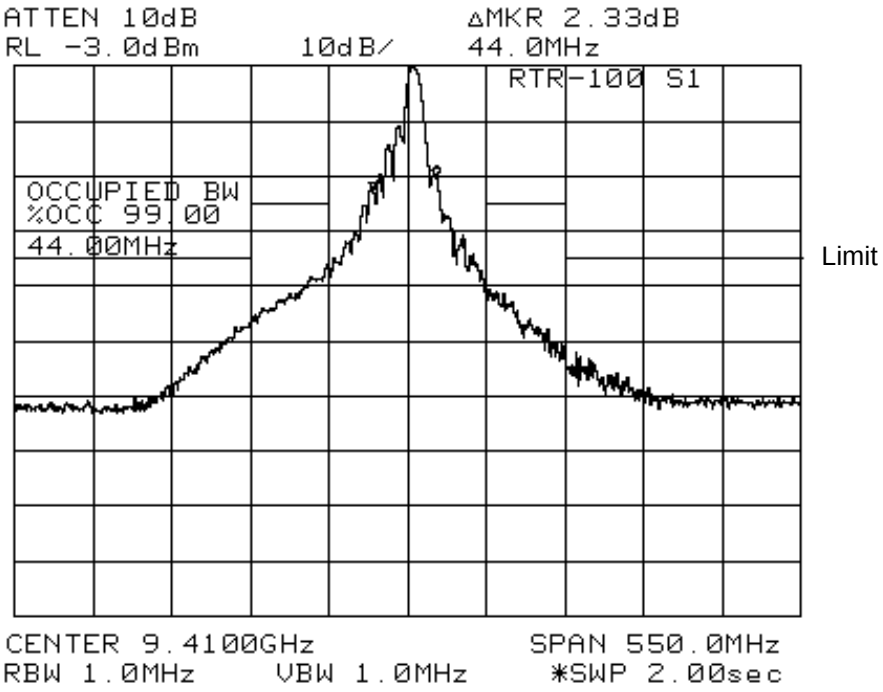


Fig. 8.1 for S1 Pulse

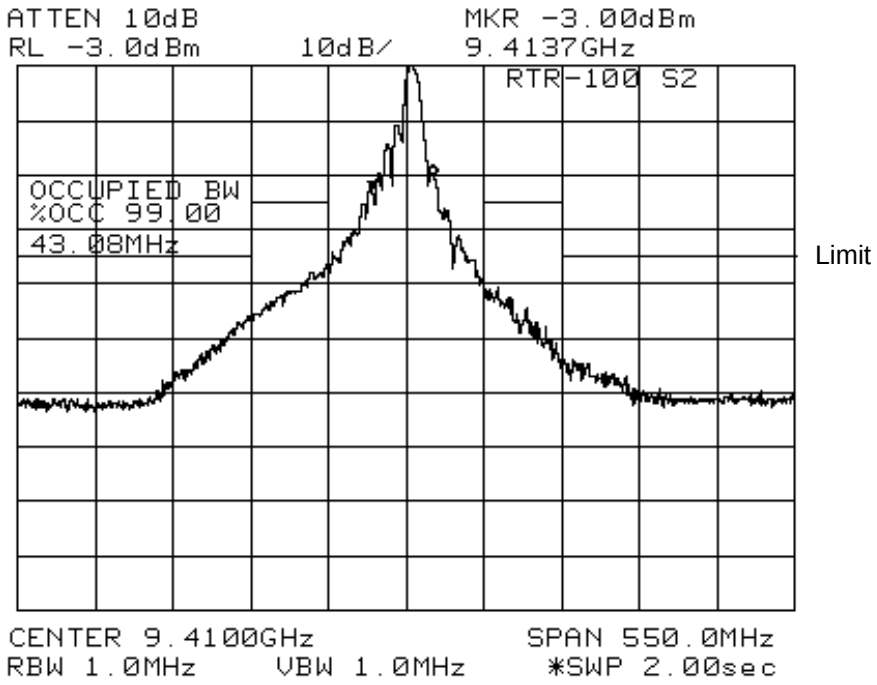


Fig. 8.2 for S2 Pulse

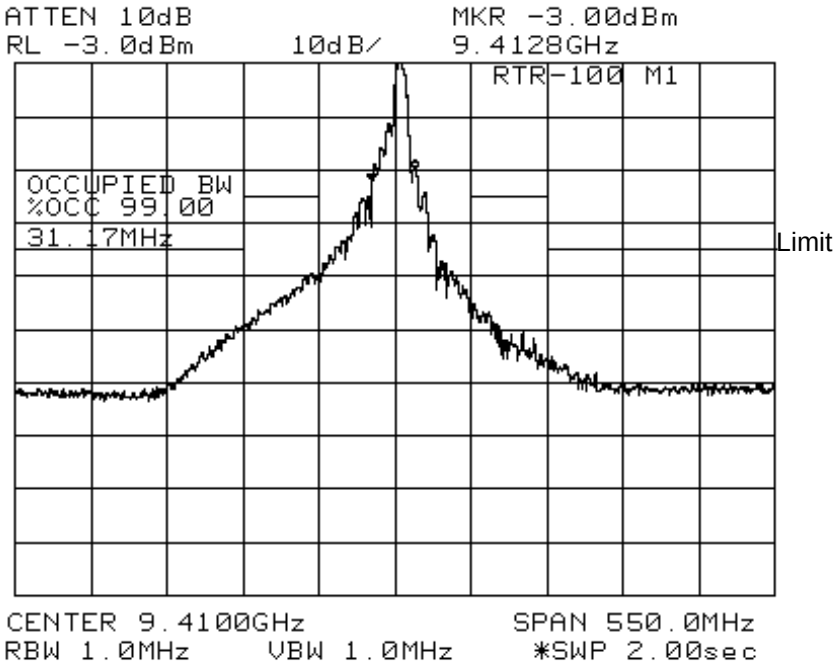


Fig. 8.3 for M1 Pulse

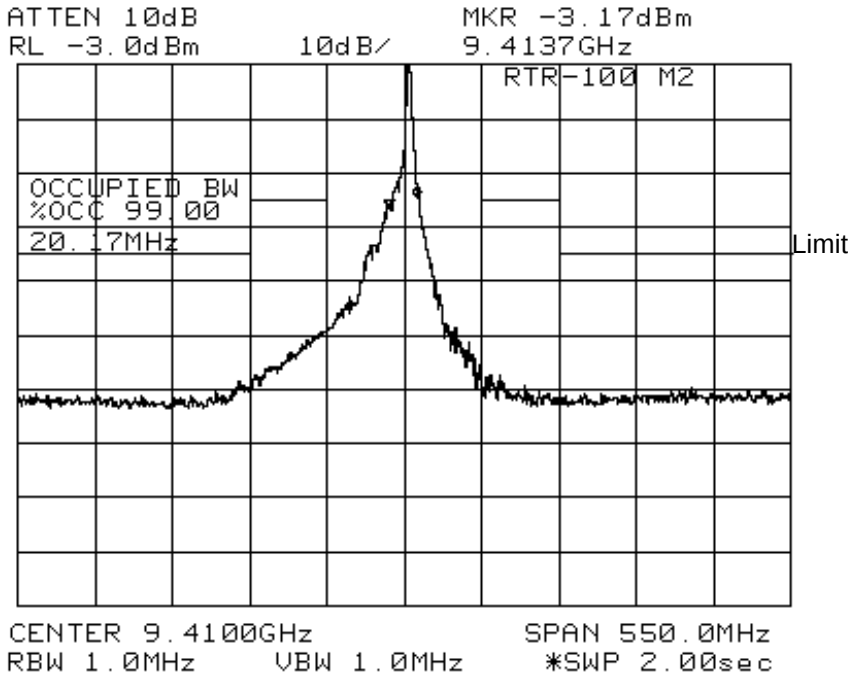


Fig. 8.4 for M2 Pulse

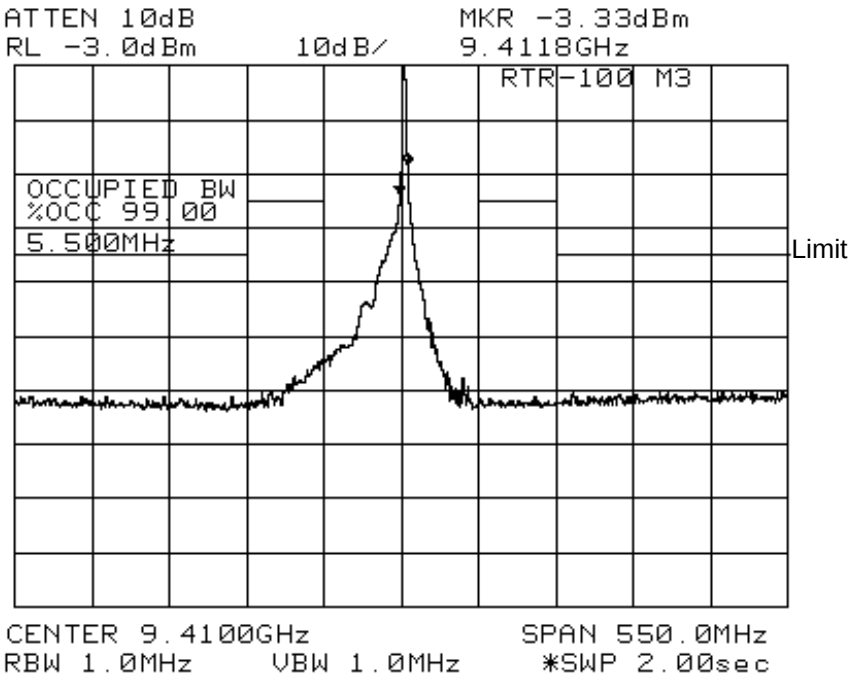


Fig. 8.5 for M3 Pulse

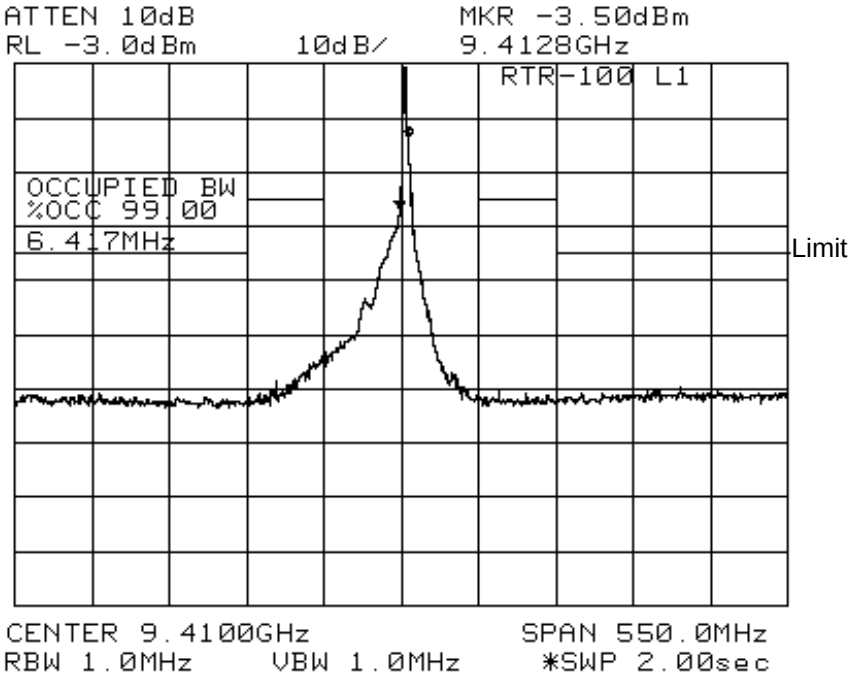


Fig. 8.6 for L1 Pulse

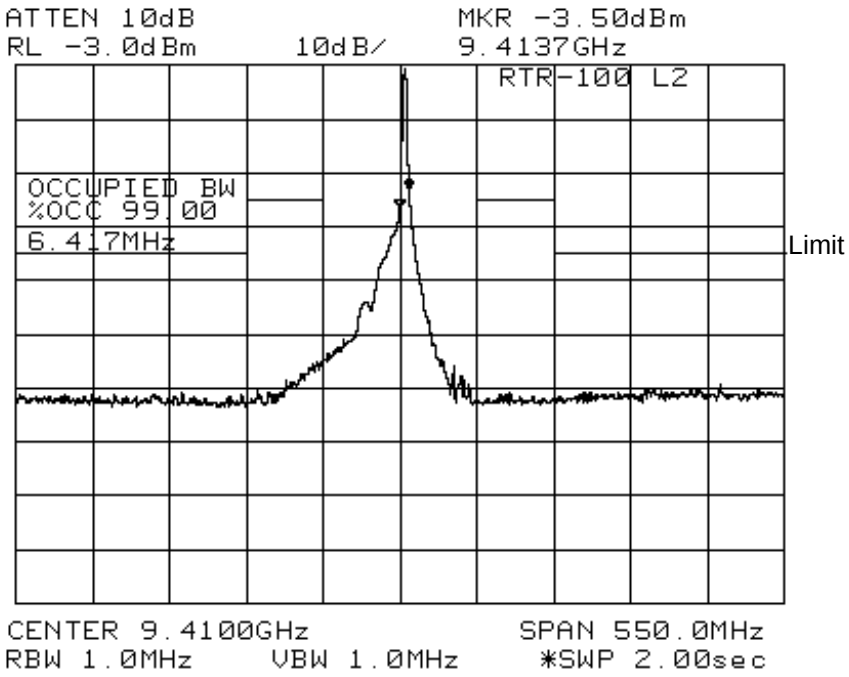


Fig. 8.7 for L2 Pulse