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-114

Report no.: LIC 12-16-096

Date of issue: 31 August 2016

Labotech International Co., Ltd.

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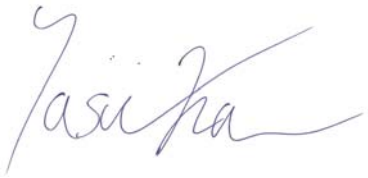
Report Summary

LIC project number:	LIC 04-16-0334		
Test report number of initial issue:	LIC 12-16-096	Date of initial issue	31 August 2016
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: 9 November 2015) 80.209 - Transmitter frequency tolerances 80.211 - Emission limitations. 80.213 - Modulation requirements. 80.215 - Transmitter power (Date of issue: 5 November 2015)		
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-114		
Product function and intended use:	For marine safety navigation		
Number of samples tested:	One		
Serial number:	1000-7000-0010		
Power rating:	24 VDC		
Product status:	Pre-production model		
Modifications made to samples during testing:	None.		
Date of receipt of samples:	24 June 2015		
Test period:	From 27 June 2016 to 28 July 2016		
Place of test:	Labotech International Co., Ltd. - 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:	Akira Inoue, Atsushi Takagi, Koji Kawai		
Written by:	Akiko Inoue		
Verified by:	Yasuharu Nakamura		

Approved by:	Date: 31 August 2016 Name: Yasuharu Nakamura Title: 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, Climatic, and Vibration 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 and IEC 62288

(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:
  - 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.

(4) 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

(5) 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

(6) 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.

(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

Note: (*) – The current certificates may be found in the LIC web site (http://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, 662-8580 Japan

(c) Model: Radar Sensor DRS25A X-Class

	Type	Serial Number	Note
Radar Sensor	DRS25A X-Class	1000-7000-0010	
Scanner module	RSB-134	---	Antenna rotation rate: 24/36/48 rpm
Transceiver module	RTR-114	---	Contained in the Antenna Unit
Antenna radiator	XN12A/XN13A	---	One (1) selectable.

(d) Certification number: FCC ID: ADB9ZWRTR114

(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	L
Occupied bandwidth (MHz)	61.4	50.4	34.8	22.0	12.8	8.3

Note: representative measured data.

(h) Size and mass: Antenna Unit: 1252 mm x 445 mm (H), 21 kg (*1)
Antenna Unit: 1791 mm x 445 mm (H), 23 kg (*2)
(*1): with Antenna XN12A installed.
(*2): with Antenna XN13A installed.

(i) Power Supply: 24 VDC, 135 W

1.1.2 Transceiver

Type: RTR-114 (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: MG5436
Peak Output Power: 25 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	L
Pulselength (μs)	0.08	0.15	0.3	0.5	0.8	1.2
PRR(Hz)	3000	3000	1500	1000	600	600

1.1.2.2 Modulator

(a) FET Type: FGN40N120WD

Trigger Voltage: Approx. +5 VDC positive

1.1.2.3 Receiver

(a) Passband

RF Stage: 60 MHz

IF Stage:

Pulse type	S1	S2	M1	M2	M3	L
Passband (MHz)	18	8	8	1.7	1.7	1.7

(b) Intermediate Frequency: 60 MHz

(c) Gain (overall): approximately 100 dB

(d) Overall Noise Figure: 4.5 dB (typical)

(e) Video Output Voltage: ±1 V differential

(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 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: Not Provided.

(b) Construction: Slotted array antenna

(c) Length:

Antenna type	XN12A	XN13A
Length (cm)	125.2	179.1

(d) Type of Beam: Vertical fan

(e) Beam Width (3 dB):

Antenna type	XN12A	XN13A
Horizontal (°)	1.9	1.4
Vertical (°)	22	22

(f) Polarization: Horizontal

(g) Antenna Gain:

Antenna type	XN12A	XN13A
Gain (dBi)	28.5	30.0

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

Antenna type	XN12A	XN13A
Within ±10° (dB)	27	29
Outside ±10° (dB)	34	37

(i) Scanning (rotating or oscillating): Rotating over 360° continuously clockwise

(j) Antenna Rotation Rate: 24/36/48 rpm

(k) Sector Scan: Not 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: 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

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.	A. Inoue and A. Takagi
3.2	2.1047	Modulation Characteristics	Passed.	A. Inoue and A. Takagi
3.3	2.1055 (a)(2),(d)(1),(d)(3) 80.209 (b)	Frequency Stability	Passed.	K. Kawai
3.4	2.1049 (c)(1), 80.209 (b), 80.211 (f)	Occupied Bandwidth	Passed.	A. Inoue and A. Takagi
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/L) 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	L
Magnetron Output, mean Pm (W)	4.2	7.4	7.5	8.8	8.8	15.5
Magnetron Output, peak Pp (kW) (*1)	16.1	15.4	16.2	17.7	18.4	20.7
Pulse length T (µs) (-3 dB points)	0.088	0.160	0.310	0.497	0.800	1.252
PRF (Hz)	3000	3000	1500	1000	600	600

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

Environmental conditions observed: On 27 June 2016, 25°C to 25°C, 68%RH to 68%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC.

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	L
Pulselength T (µs) (-3 dB points)	0.088	0.160	0.310	0.497	0.800	1.252
Rise time t_r (µs) (10 - 90 % amplitude)	0.011	0.013	0.013	0.015	0.017	0.018
Decay time t_f (µs) (90 - 10 % amplitude)	0.062	0.068	0.066	0.064	0.072	0.076
PRR (Hz)	3000	3000	1500	1000	600	600

Measured Plots: See Clause 7.

Environmental conditions observed: On 27 June 2016, 25°C to 25°C, 68% to 68%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC.

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/L) 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)

(2) Test setup:

See Clause 4.

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

Pulse type	S1	S2	M1	M2	M3	L
Guard Band f(1.5/T) (MHz) (*1)	17.0	9.4	4.8	3.0	1.9	1.2
f(U) (MHz) (*2)	9483.0	9490.6	9495.2	9497.0	9498.1	9498.8
f(L) (MHz) (*2)	9317.0	9309.4	9304.8	9303.0	9301.9	9301.2

(*1): Guard Band is specified to be equal to 1.5/T MHz, where "T" is the pulselength 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:

Pulse type		S1	S2	M1	M2	M3	L	Result
Frequency at maximum emission (MHz)	-20°C	9418.3	9416.7	9418.3	9416.7	9416.7	9416.0	Complied
	-10°C	9416.3	9416.3	9416.0	9416.0	9416.0	9415.0	Complied
	0°C	9414.0	9415.0	9415.0	9414.7	9414.3	9413.0	Complied
	+10°C	9412.3	9413.0	9413.0	9412.7	9412.0	9411.0	Complied
	+20°C	9411.3	9411.3	9411.3	9411.3	9410.7	9409.3	Complied
	+30°C	9409.0	9408.3	9408.7	9408.3	9407.7	9406.7	Complied
	+40°C	9406.0	9406.7	9407.3	9406.7	9406.7	9405.3	Complied
	+50°C	9403.3	9404.0	9404.0	9404.0	9404.0	9402.7	Complied

(4.2) At the temperature of +20°C:

Pulse type		S1	S2	M1	M2	M3	L	Result
24 VDC	20.4 VDC	9410.0	9410.0	9410.0	9410.7	9410.0	9409.3	Complied
	24.0 VDC	9411.3	9411.3	9411.3	9411.3	9410.7	9409.3	Complied
	27.6 VDC	9410.7	9410.0	9410.7	9410.0	9410.0	9409.3	Complied

Environmental conditions observed: On 14 July 2016, 23°C to 23°C, 67%RH to 67%RH.
On 15 July 2016, 24°C to 23°C, 68%RH to 67%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC.

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/L) 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:

Complied.

Spectrum plots: See Clause 8.

Environmental conditions observed: On 27 June 2016, 25°C to 25°C, 68%RH to 68%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC.

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	18.820	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 25 July 2016, 23°C to 23°C, 57%RH to 59%RH.
On 26 July 2016, 23°C to 23°C, 67%RH to 63%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC.

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:

See Clause 4.
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 (1.85 m)
(b) Antenna polarization: vertical and horizontal.

EUT height: 1.5 m

(6) 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)

(5) Spurious Frequencies:

f_0 (GHz)	$1/2f_0$	$2f_0$	$3f_0$	$4f_0$
9.410	4.705	18.820	28.23	37.64

(6) Test Results:

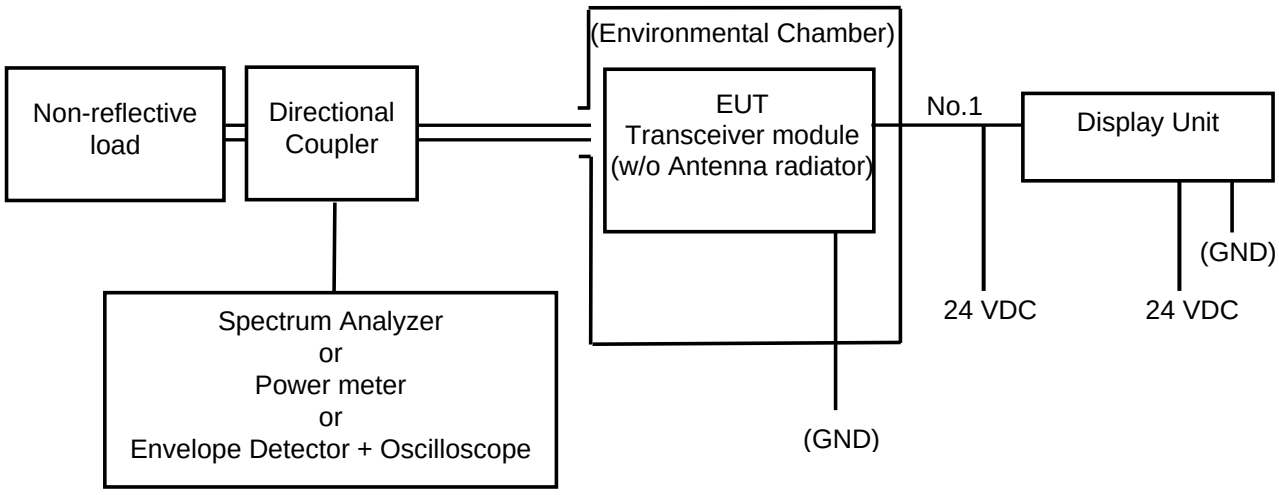
Complied.

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

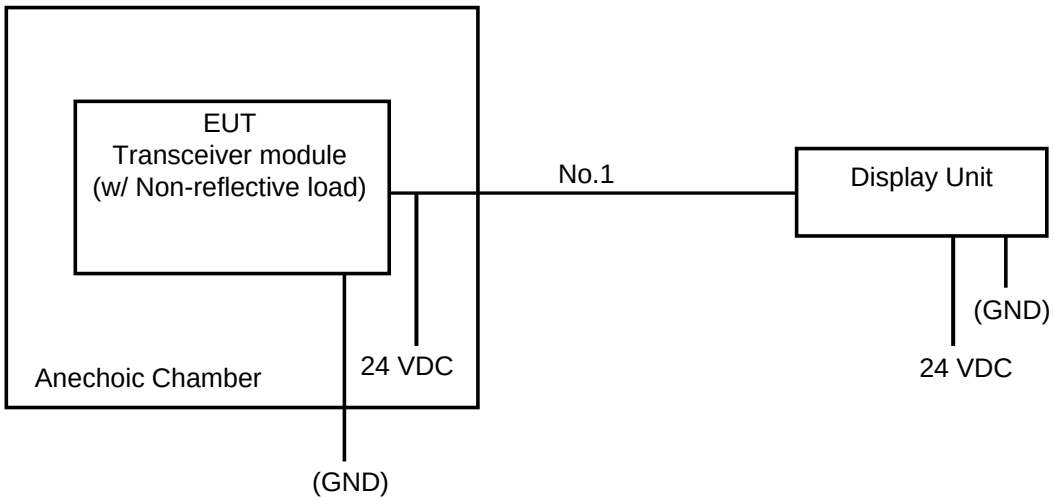
Environmental conditions observed: On 27 July 2016, 22°C to 22°C, 66%RH to 66%RH.
On 28 July 2016, 21°C to 23°C, 69%RH to 63%RH.
Power supply voltage measured: 24.0 VDC to 24.0 VDC

4 Test Setup for Measurements

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



(2) Test Setup for Clause 3.6.



Cable designations:

No.	Type	Length (m)
1	FRU-2P5S-FF-15M	15

5 Measuring Equipment List:

(1) For 3.1 RF Power Output:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
RT198	Directional Coupler (X-band)	5D364S	R05762	Shimada	25 February 2016	1 year
----	Dummy Load (X-band)	4D376	R4535004	Shimada	25 February 2016	1 year
0505026	Power meter	E4418B	GB43317662	Agilent	13 June 2016	1 year
120110402	Power Sensor	N8481A	MY48100658	Agilent	13 June 2016	1 year
HT156	DC Power Supply	GP035-30	1014396080	Takasago	----	----

(2) For 3.2 Modulation Characteristics:

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
RT198	Directional Coupler (X-band)	5D364S	R05762	Shimada	25 February 2016	1 year
----	Dummy Load (X-band)	4D376	R4535004	Shimada	25 February 2016	1 year
8305070	Step Attenuator	8494B	US00430229	Agilent	13 June 2016	1 year
8305070	Step Attenuator	8495B	3308A22026	Agilent	13 June 2016	1 year
740040701	Crystal Detector	423B	MY42241658	Agilent	8 October 2015	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	4 April 2016	1 year
8408087	Frequency Counter	TR5824A	41940036	ADVANTEST	23 May 2016	1 year
HT594	Oscilloscope	DSO6102A	MY44001501	Agilent	23 October 2015	1 year
HT156	DC Power Supply	GP035-30	1014396080	Takasago	----	----

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

C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT510	Climatic chamber (Hama-L)	TBE-3HW4PE2F	3013002540	Tabai Espec	1 September 2015	1 year
HT725	Paperless recorder/Dual communication logger DAQSTATION FX100	FX106-4-1	S5JA01447	Yokogawa	1 September 2015	1 year
RT198	Directional Coupler (X-band)	5D364S	R05762	Shimada	25 February 2016	1 year
----	Dummy Load (X-band)	4D376	R4535004	Shimada	25 February 2016	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
HT654	Step Attenuator	8494B	MY42148134	Agilent	19 February 2016	1 year
HT655	Step Attenuator	8495B	MY42144403	Agilent	22 February 2016	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	4 April 2016	1 year
HT430	DC Power Supply	PAD55-20L	10091786	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
RT198	Directional Coupler (X-band)	5D364S	R05762	Shimada	25 February 2016	1 year
----	Dummy Load (X-band)	4D376	R4535004	Shimada	25 February 2016	1 year
----	Waveguide (for X-band)	WRJ-10 (l = 60 cm)	----	Furuno	----	----
8305070	Step Attenuator	8494B	US00430229	Agilent	13 June 2016	1 year
8305070	Step Attenuator	8495B	3308A22026	Agilent	13 June 2016	1 year
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	4 April 2016	1 year
HT430	DC Power Supply	PAD55-20L	10091786	KIKUSUI	----	----
KB179	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48932/4A	HUBER+ SUHNER	8 August 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
KB192	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	500066/4A	HUBER+ SUHNER	1 June 2016	1 year

(5) For 3.6 Field Strength of Spurious Radiation:

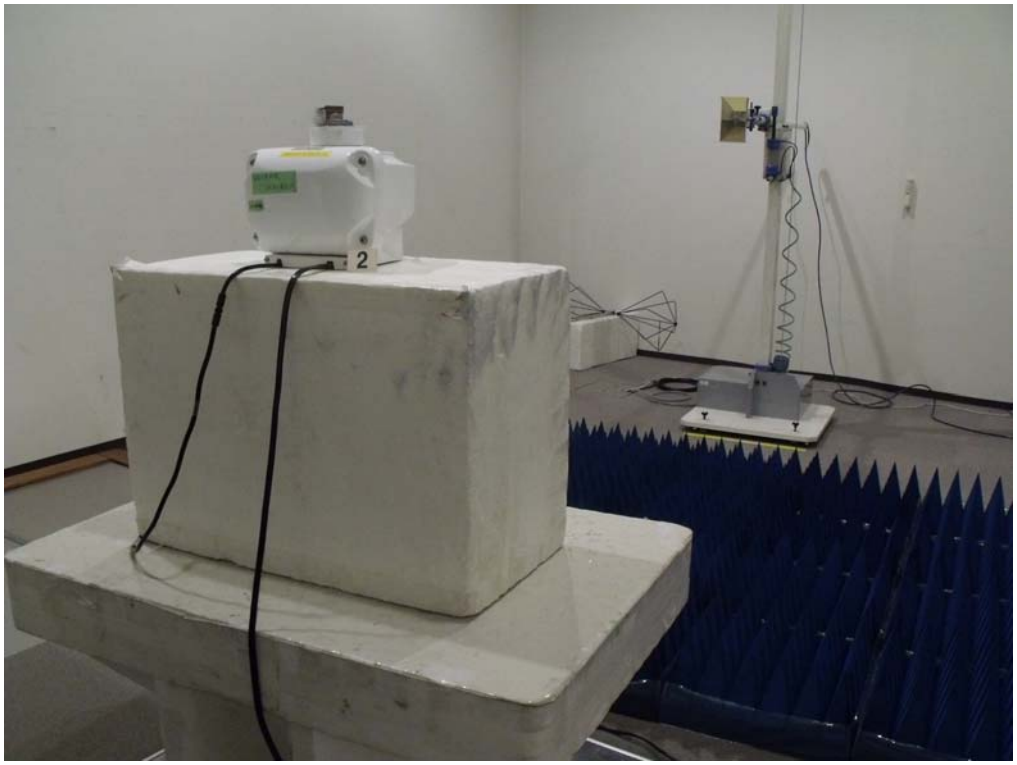
C/N	Instrument	Type	S/N	Manufacturer	Date of last calibration	Calibration interval
HT676	Spectrum Analyzer	8564EC	4103A00440	Agilent	4 April 2016	1 year
HT467	Double-ridged waveguide horn antenna (1 GHz to 18 GHz)	3115	6520	EMCO	13 August 2015	1 year
HT759	Double rigged horn antenna & amp.	HAP06-18W	00000065	TOYO	30 April 2016	1 year
HT761	Double rigged horn antenna & amp.	HAP18-26N	00000017	TOYO	30 December 2015	1 year
HT762	Double rigged horn antenna & amp.	HAP26-40N	00000010	TOYO	30 December 2015	1 year
NK012	Pre-amplifier	8449B	3008A01286	Agilent	18 February 2016	1 year
HT365	Semi-anechoic Chamber	3mSAC	D-002	Riken	----	----
HT156	DC power supply	GP035-30	1014396080	Takasago	----	----
---	Dummy Load (X-band)	4D376	----	SPC ELECTRONICS	----	----
KB179	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	48932/4A	HUBER+ SUHNER	8 August 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
KB192	Coaxial Cable for Radiated Emission Measurement	SUCOFLEX 104A	500066/4A	HUBER+ SUHNER	1 June 2016	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

Note: Test was performed with DRS12A X-Class (No.1) at the customer's request.

(2) For Field Strength of Spurious Radiation



7 RF Envelope and Spectrum of the output pulse

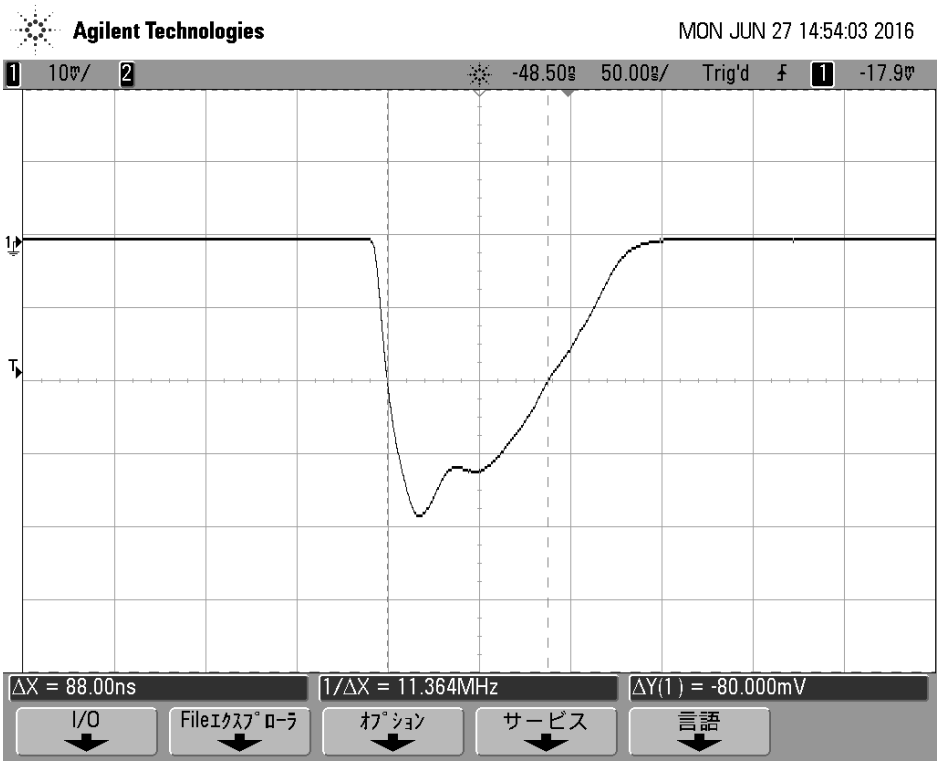


Fig. 7.1 S1 Pulse Envelope

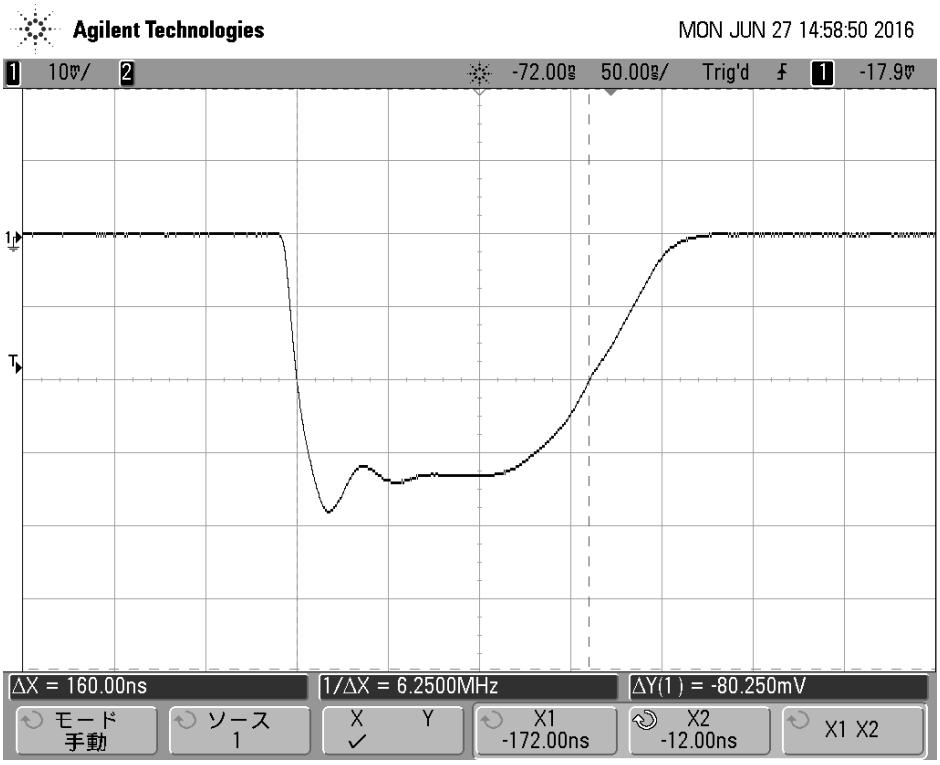


Fig. 7.2 S2 Pulse Envelope

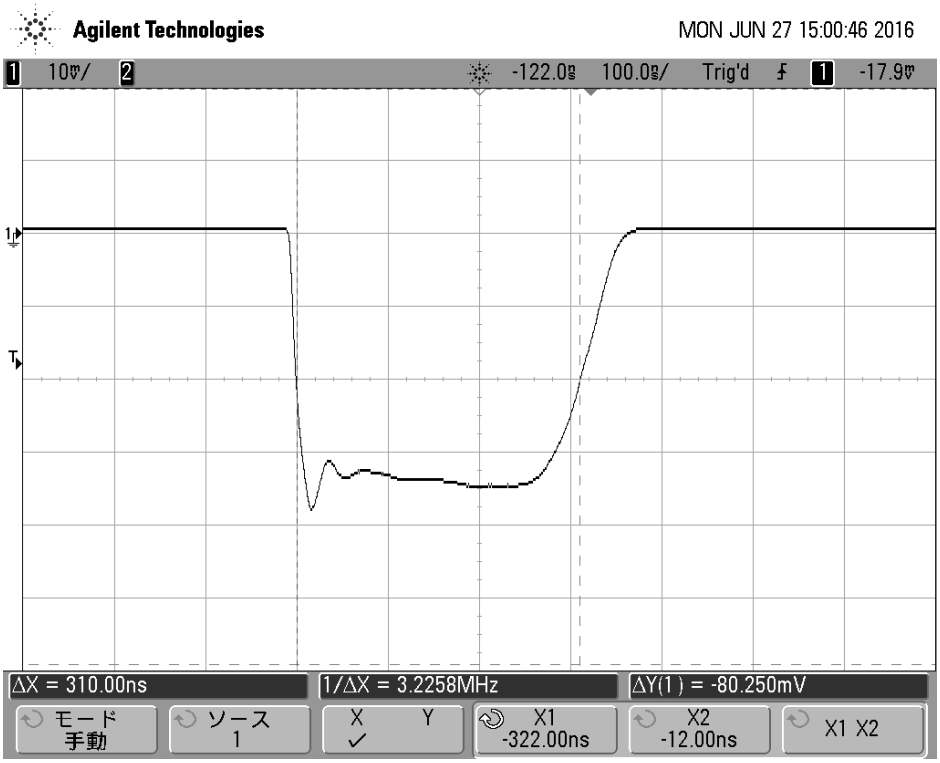


Fig. 7.3 M1 Pulse Envelope

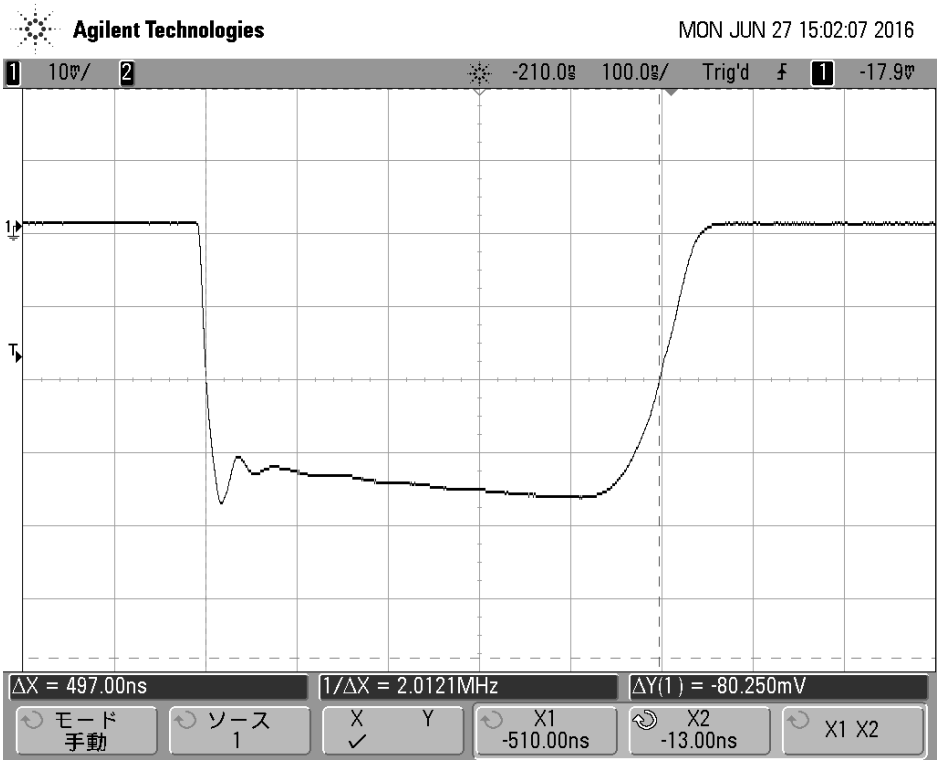


Fig. 7.4 M2 Pulse Envelope

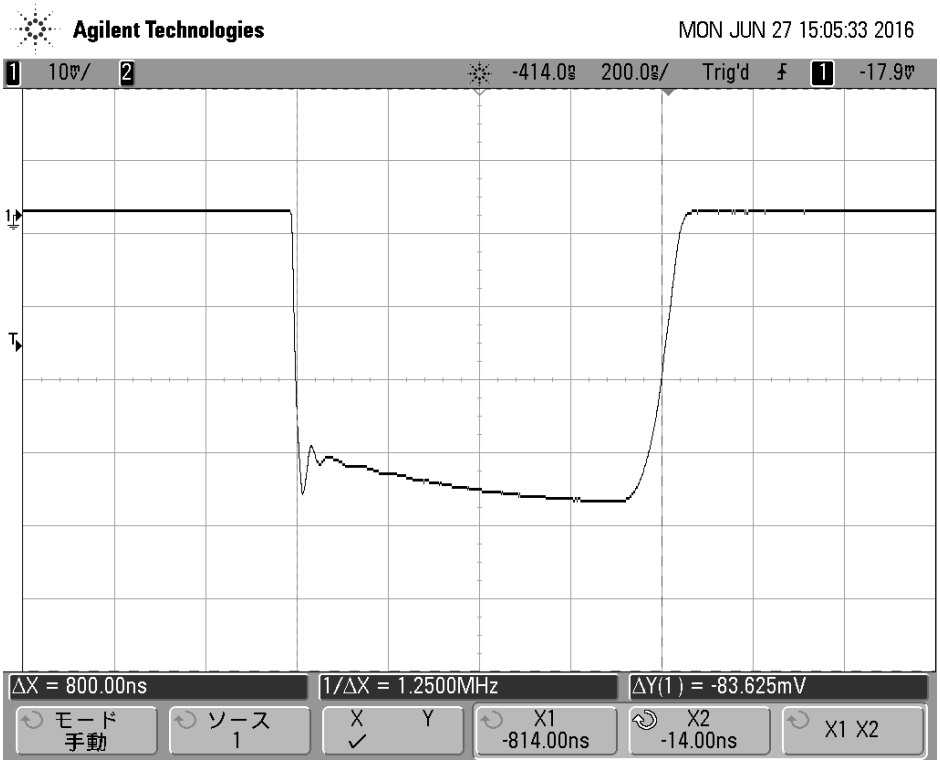


Fig. 7.5 M3 Pulse Envelope

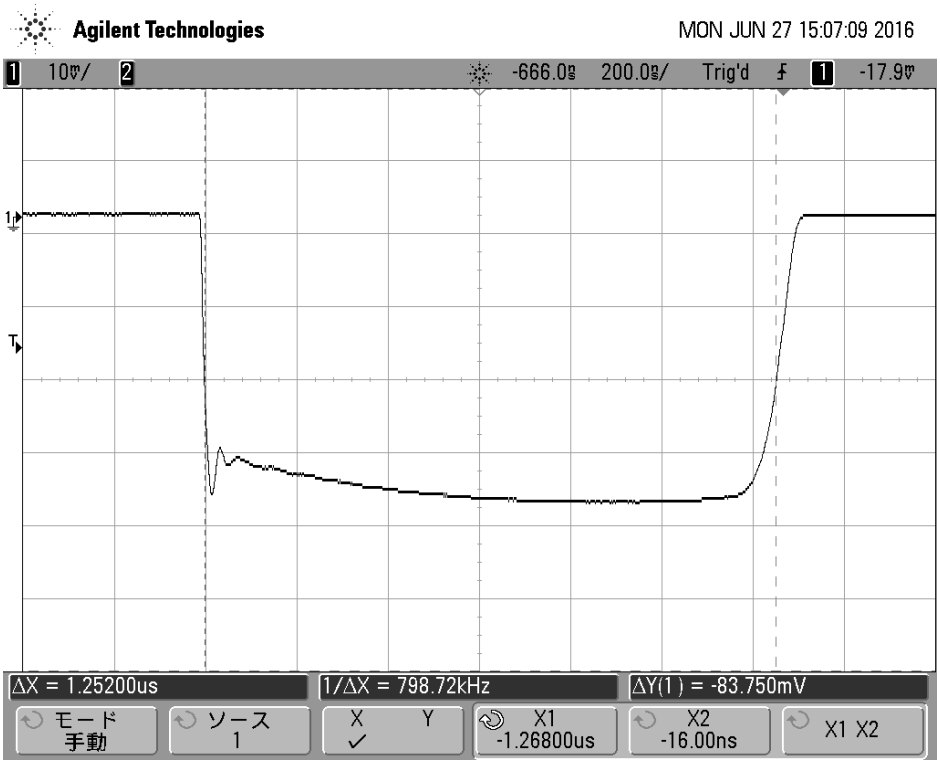


Fig. 7.6 L Pulse Envelope

8 Spurious Emission Plots measured at Antenna Terminal

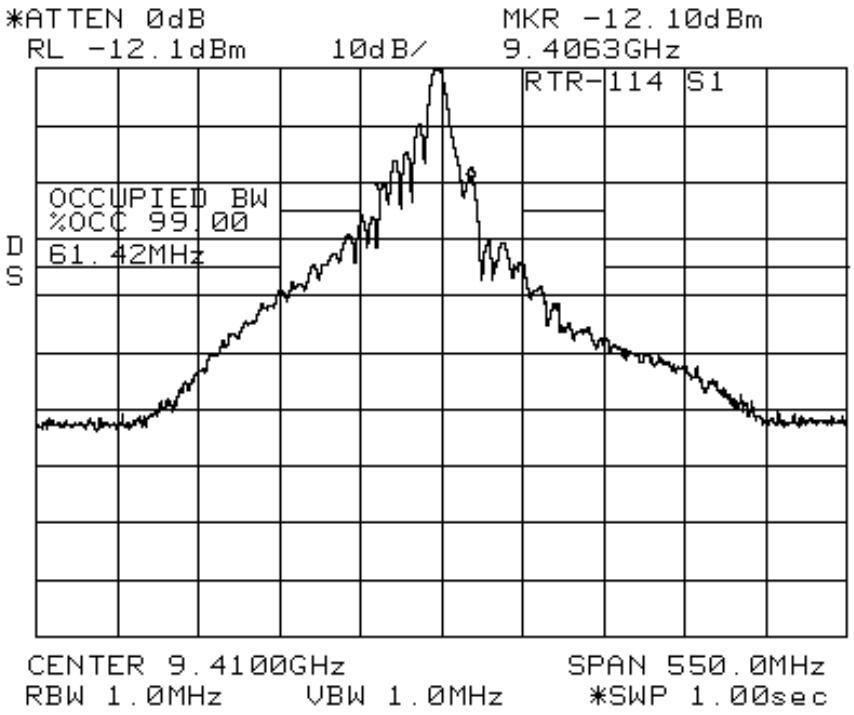


Fig. 8.1 for S1 Pulse

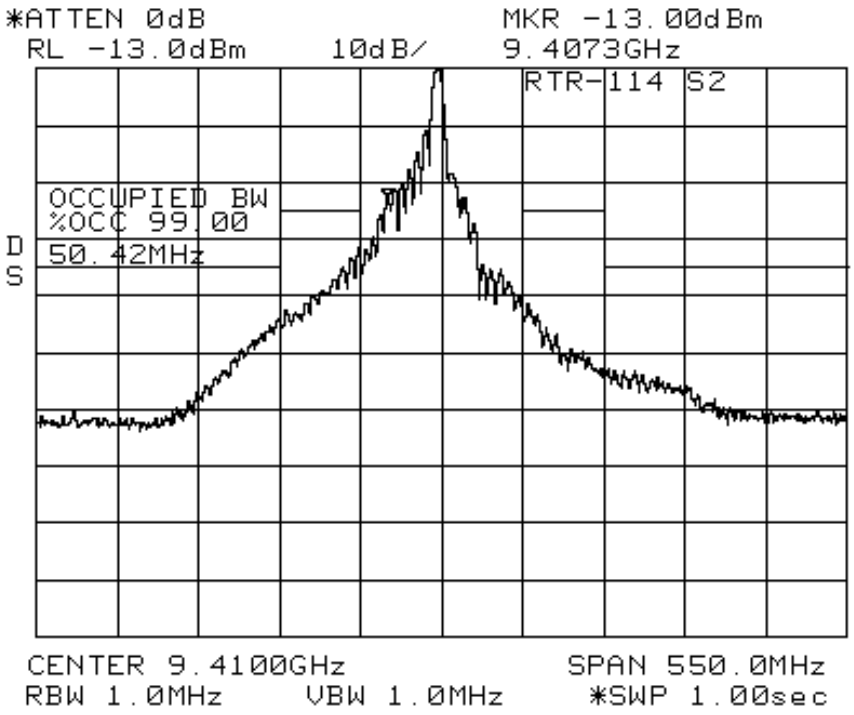


Fig. 8.2 for S2 Pulse

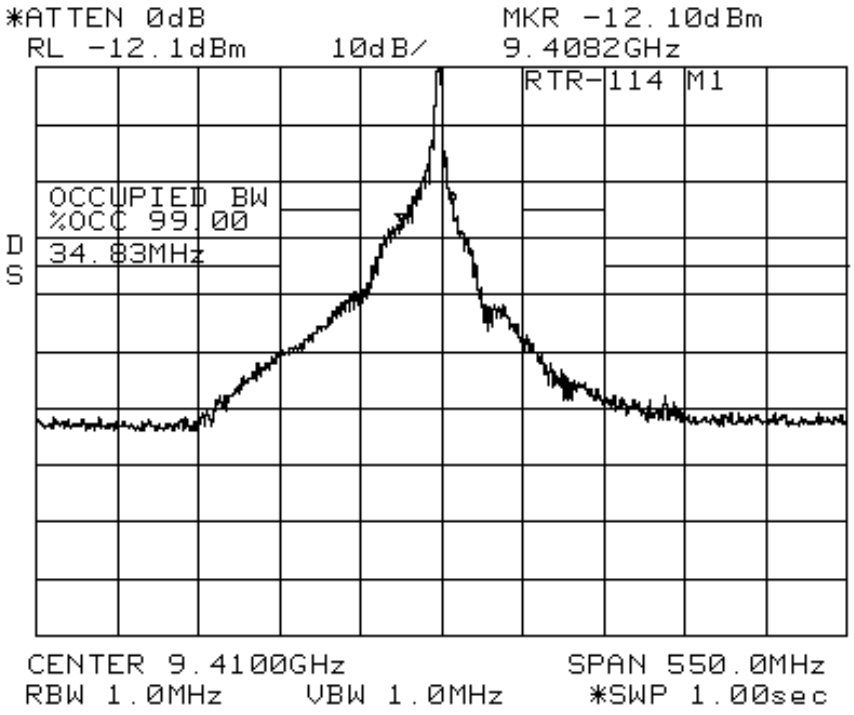


Fig. 8.3 for M1 Pulse

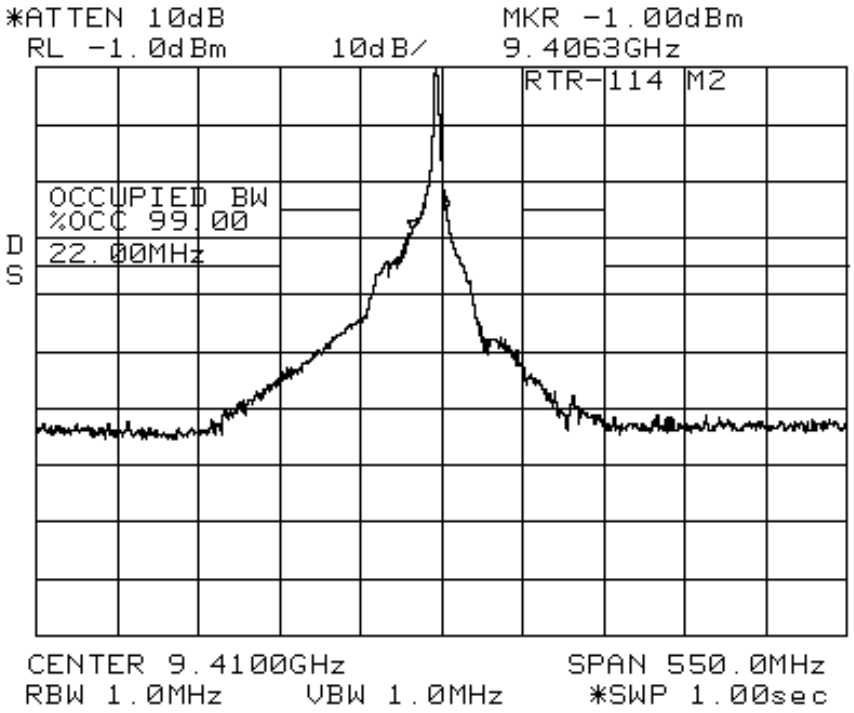


Fig. 8.4 for M2 Pulse

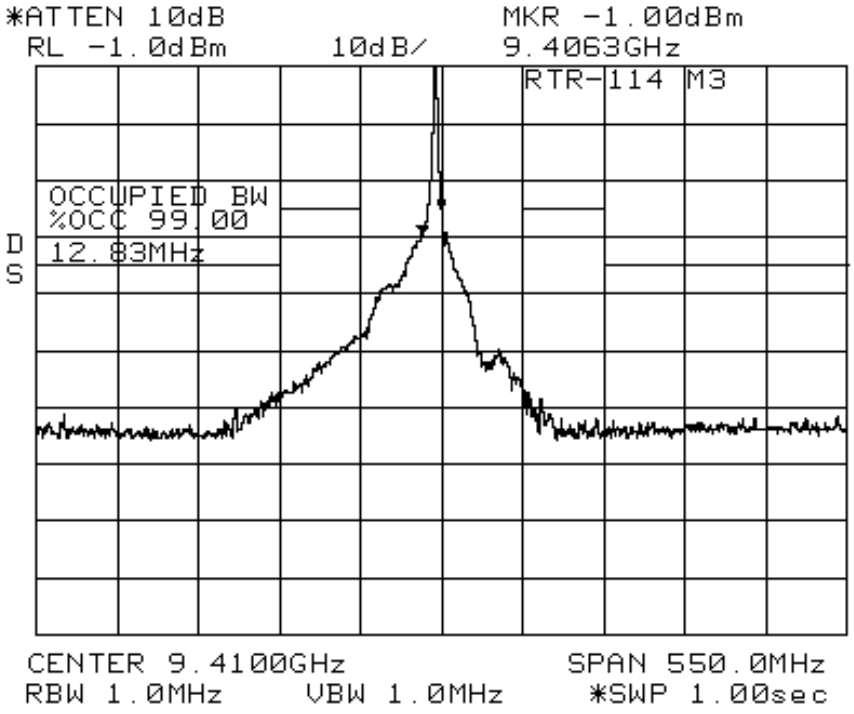


Fig. 8.5 for M3 Pulse

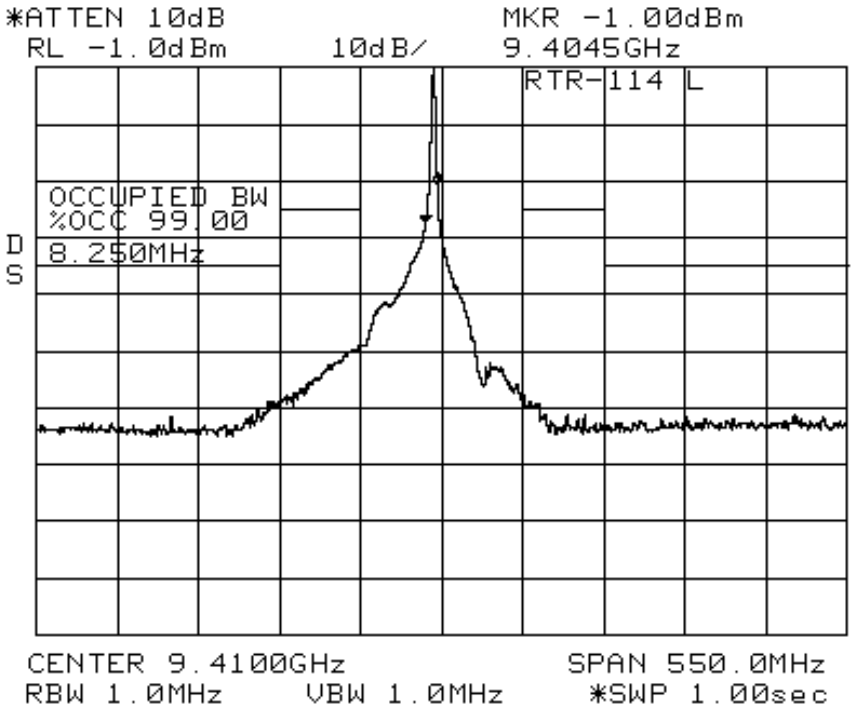


Fig. 8.6 for L Pulse