

Test Report

CFR Title 47 Sections:

Part 2 (2.201, 2.202, 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055)

Part 80 (80.209, 80.211, 80.213, 80.215, 80.273)

Part 90 (90.205, 90.207, 90.209, 90.210, 90.213, 90.215, 90.248)

for

**Trade name: FURUNO
Model: Transceiver
for MARINE RADAR
FAR-2028-MARK-2, FAR-3025
Type: RTR-132**

Report no.: LIC 12-22-130

Date of issue: 31 August 2022

Labotech International Co., Ltd.


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Report Summary

| | | | |
|---|---|--------------------------------|----------------|
| LIC project number: | LIC 04-22-0062 | | |
| Test report number of initial issue: | LIC 12-22-130 | Date of initial issue | 31 August 2022 |
| Test report number of revised/replaced issue: | -- | Date of revised/replaced issue | -- |
| Test report revision/replacement history: | -- | | |
| Test standard(s)/ Test specifications: | CFR Title 47 Sections: 2.201 - Emission, modulation, and transmission characteristics 2.202 - Bandwidths 2.1046 - RF Power Output 2.1047 - Measurements required: Modulation Characteristics 2.1049 - Occupied Bandwidth 2.1051 - Spurious Emissions at Antenna Terminals 2.1053 - Field Strength of Spurious Radiation 2.1055 - Measurements required: Frequency Stability 80.209 - Transmitter frequency tolerances 80.211 - Emission limitations 80.213 - Modulation requirements 80.215 - Transmitter power 80.273 - Radar standards 90.205 - Power and antenna height limits 90.207 - Types of emissions 90.209 - Bandwidth limitations 90.210 - Emission masks 90.213 - Frequency stability 90.215 - Transmitter measurement 90.248 - Wildlife and ocean buoy tracking (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 | | |
| Model: | Transceiver for MARINE RADAR FAR-2028-MARK-2, FAR-3025 | | |
| Type: | RTR-132 | | |
| Product function and intended use: | Marine radar: CAT 1C, 2C/ 1HC, 2HC | | |
| Serial number: | See Clause 1.1 of this report. | | |
| Power rating: | 100–115/220-230VAC, 50–60 Hz, 2.6/1.3 A (for DE-ICER) | | |
| Modifications made to samples during testing: | See Clause 1.3 of this report. | | |
| Date of receipt of samples: | 8 March 2022 | | |
| Test period: | 4 May 2022 and from 11 June 2022 to 21 June 2022 | | |

| | |
|--------------------------|---|
| Place of test: | <p>Labotech International Co., Ltd. - LABOTECH EMC Center FCC Test firm Designation Number: JP2007 FCC Test firm Registration Number: 838049 1-16, Fukazu-cho, Nishinomiya-shi, Hyogo, 663-8203 Japan - Nishinomiya Lab. FCC Test firm Designation Number: JP2010 FCC Test firm Registration Number: 696248 9-52 Ashihara-cho, Nishinomiya-shi, Hyogo, 662-8580 Japan</p> |
| Test results/Compliance: | <p>Passed. (*) The test results of this report relate only to the samples tested. (*) For the test result in Clause 3.5 of this report, the measurement results for the frequency below 6.54 GHz were not taken into account as the final result of this test with the consent of the customer.</p> |
| Approved by: | <p>Date: 31 August 2022 Name: Tadayuki Ekawa Title: Manager, Testing & Facilities Control Section, Technical Department, Labotech International Co., Ltd. Signature:</p>  |

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 MARINE RADAR FAR-2018-MARK-2, FAR-2028-MARK-2, FAR-3015, FAR-3025

| Name | Type | Serial number | Note |
|---------------------------|-------------|----------------|--|
| MARINE RADAR ANTENNA UNIT | RSB-146-132 | R000-3100-0004 | -- |
| Transceiver | RTR-132 | -- | -- |
| Scanner | RSB-146 | -- | Antenna rotation rate: 24/36/42 rpm |
| Performance monitor | PM-32A | -- | -- |
| DE-ICER | CP03-274 | R00001-00001 | -- |
| ANTENNA RADIATOR | XN12AF | A010-6102 | One (1) selectable. (*) |
| | XN20AF | A024-3942 | |
| | XN24AF | A031-2690 | |

(*) Test was performed with ANTENNA RADIATOR XN12AF.

Associated units (AU)

| Name | Type | Serial number | Note |
|-----------------------------|---------|----------------|------|
| MARINE RADAR PROCESSOR UNIT | RPU-025 | 1000-7910-0105 | -- |
| CONTROL UNIT | RCU-014 | 100068 | -- |
| MONITOR UNIT | MU-190 | 001436 | -- |

Auxiliary Equipment (AE)

| Name | Type | Serial number | Note |
|---------------------------|----------------|----------------|--|
| PC | PR6DNTC4447FD1 | XK194109H | -- |
| CONTROL UNIT | RCU-029 | 101216 | -- |
| MARINE RADAR DISPLAY UNIT | RDP-155 | 1000-5900-0004 | -- |
| AC/DC POWER SUPPLY UNIT | PR-241 | 999924 | -- |
| Dummy load 1 | 4D376 | R27200010 | Used for the test in Clause 3.6. |
| Dummy load 2 | 4D376 | R4535001 | Used for the test in Clause 3.1, 3.2, 3.3, 3.4, and 3.5. |

- (d) FCC ID: ADB9ZWRTR132
 (e) Primary function: Ship radar station operating in the band 9300–9500 MHz
 (f) Frequency range: Fixed frequency, X-band (9380–9440 MHz)
 (g) Type of emission: P0N

(h) Occupied bandwidth:

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L |
|--------------------------|-----------|-------|-------|-------|-------|-------|-------|
| Occupied bandwidth (MHz) | TT24NM | 65.56 | 52.81 | 39.69 | 22.15 | 16.22 | 11.52 |
| | TT32NM | 65.10 | 52.20 | 39.51 | 21.93 | 16.25 | 11.94 |
| | 2nd trace | 65.63 | 52.70 | 38.20 | 20.45 | 14.32 | 11.08 |

Note: measured data

(i) Size and mass:

MARINE RADAR ANTENNA UNIT:

1260 mm (W) × 570 mm (H) × 449 mm (D), 42 kg (*1)

2040 mm (W) × 570 mm (H) × 449 mm (D), 47 kg (*2)

2550 mm (W) × 570 mm (H) × 449 mm (D), 49 kg (*3)

(*1) with ANTENNA RADIATOR (Type: XN12AF) installed.

(*2) with ANTENNA RADIATOR (Type: XN20AF) installed.

(*3) with ANTENNA RADIATOR (Type: XN24AF) installed.

(j) Power supply:

100-230 VAC, 50-60 Hz (*)

(*) Powered from MARINE RADAR PROCESSOR UNIT(AU), not directly from AC mains.

1.1.2 Transceiver module

Type: RTR-132 (Contained in MARINE RADAR 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:

- Magnetron type: MG5436
- Peak output power: 25 kW nominal
- Fundamental frequency: 9410 MHz
- Manufacturing: ±30 MHz
- Pulling: 23 MHz
- Tolerance for 20°C temperature variation: -5 MHz

(c) Pulse characteristics:

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L |
|-------------------|-----------|------|------|------|------|------|-----|
| Pulse length (μs) | P0N | 0.07 | 0.15 | 0.30 | 0.50 | 0.70 | 1.2 |
| PRF(Hz) | TT24NM | 3000 | 3000 | 1500 | 1200 | 1000 | 600 |
| | TT32NM | 2200 | 2200 | 1200 | 1000 | 1000 | 600 |
| | 2nd trace | 3000 | 3000 | 500 | 500 | 500 | 500 |

1.1.2.2 Modulator

(a) FET Type: FGW40N120WD

Trigger Voltage: Approx. +16.8 VDC positive

1.1.2.3 Receiver

(a) Passband

RF Stage: 300 MHz

IF Stage:

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|-----------------|----|----|----|----|----|-----|
| Pass band (MHz) | 18 | 11 | 11 | 4 | 4 | 1.7 |

(b) Intermediate Frequency: 60 MHz

(c) Gain (overall): Approximately 25.5 dB

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

(e) Video Output Voltage: ± 1 V

(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)

1.1.3 Antenna and Scanner

(a) Antenna specifications

| Antenna model | XN12AF | XN20AF | XN24AF |
|-------------------------------|--------------------------|----------|----------|
| Length (mm) | 1260 | 2040 | 2550 |
| Rotation diameter (mm) | 1400 | 2200 | 2700 |
| Transmission frequency | 9410 \pm 30 MHz | | |
| Horizontal beam width (-3 dB) | 1.9° | 1.23° | 0.95° |
| Vertical beam width (-3 dB) | 20° | | |
| Side lobe (max.) | Less than $\pm 10^\circ$ | -24 dB | -28 dB |
| | Outside $\pm 10^\circ$ | -30 dB | -32 dB |
| Gain | 27.5 dBi | 30.0 dBi | 31.5 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: 24/36/42 rpm

(e) Sector Scan: Provided

(f) Rated Loss of Transmission Line per 100 Feet: Negligible (Transmission path is only in ANTENNA RADIATOR.)

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 (Hardware alarms)
- (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

For Spurious Emissions at Antenna Terminals in Clause 3.5 of this report, the measurement for the frequency below 6.54 GHz were unmeasurable due to the large path loss. The measurement results for the frequency below 6.54 GHz were not taken into account as the final result of this test with the consent of the customer.

1.3 Modification made to the EUT

Following modifications were made to the EUT during testing:

| State | Description | Made by | Date |
|-------|---|----------|---------------|
| 0 | As supplied by the customer. | -- | 8 March 2022 |
| 1 | Replaced the DE-ICER cover with a pre-production type (material: A5052) from a cut part used as a substitute for the cover (material: ADC12). | Customer | 30 March 2022 |

2 Test Results Summary

| Clause number of this report | CFR Title 47 Sections | Item | Result | Test engineer |
|------------------------------|--|--|----------------|---------------|
| 3.1 | 2.1046 (a) 80.215 90.205 (s) | RF Power Output | Passed. | Y. Hijiri |
| 3.2 | 2.201 2.1047 (d) 90.207 | Modulation Characteristics | Passed. | Y. Hijiri |
| 3.3 | 2.1055 (a)(2),(d)(1),(d)(3) 80.209 (b) 90.213 90.248 | Frequency Stability –temperature & voltage | Passed. | Y. Hijiri |
| 3.4 | 2.202 (a) 2.1049 (c)(1) 80.209 (b) 80.211 (f) 90.210 (b) | Occupied Bandwidth | Passed. | Y. Hijiri |
| 3.5 | 2.1051 80.211 (f) 80.273 90.210 90.215 | Spurious Emissions at Antenna Terminals | Passed. (*) | Y. Hijiri |
| 3.6 | 2.1053 80.211 (f) 90.210 90.215 | Field Strength of Spurious Radiation | Passed. | Y. Katoh |

(*) The measurement results for the frequency below 6.54 GHz were not taken into account as the final result of this test with the consent of the customer.

3 Test Results

3.1 RF Power Output

3.1.1 Test conditions:

For all TX (S1/S2/M1/M2/M3/L) pulses, the transmitter output power was measured at the antenna port with a non-reflective load as a substitute for ANTENNA RADIATOR.

3.1.2 Test setup:

See Clause 4.

3.1.3 Test Results:

Complied. (Modification status: 1)

TT24NM mode (Normal mode)

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|--------------------------------------|--------|--------|--------|--------|-------|-------|
| Transmission mean power Pm (W) | 4.9 | 9.0 | 7.8 | 10.9 | 13.1 | 14.3 |
| Pulse length T (μs) (50% points) | 0.076 | 0.155 | 0.296 | 0.498 | 0.700 | 1.204 |
| Pulse Repetition Frequency (Hz) | 3000.0 | 3000.0 | 1500.0 | 1200.0 | 999.8 | 600.0 |
| Transmission pulse power Pp (kW) (*) | 21.8 | 19.3 | 17.7 | 18.2 | 18.8 | 19.9 |

TT32NM mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|--------------------------------------|--------|--------|--------|--------|-------|-------|
| Transmission mean power Pm (W) | 3.7 | 6.6 | 7.9 | 10.9 | 13.1 | 14.3 |
| Pulse length T (μs) (50% points) | 0.076 | 0.153 | 0.295 | 0.497 | 0.700 | 1.204 |
| Pulse Repetition Frequency (Hz) | 2199.0 | 2199.0 | 1500.0 | 1200.0 | 999.8 | 600.0 |
| Transmission pulse power Pp (kW) (*) | 22.0 | 19.7 | 17.8 | 18.3 | 18.8 | 19.9 |

2nd trace mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|--------------------------------------|--------|--------|-------|-------|-------|-------|
| Transmission mean power Pm (W) | 5.0 | 9.0 | 2.6 | 4.6 | 6.7 | 12.1 |
| Pulse length T (μs) (50% points) | 0.076 | 0.155 | 0.295 | 0.501 | 0.700 | 1.204 |
| Pulse Repetition Frequency (Hz) | 3000.0 | 3000.0 | 500.0 | 500.0 | 500.0 | 500.0 |
| Transmission pulse power Pp (kW) (*) | 21.8 | 19.4 | 17.8 | 18.3 | 19.1 | 20.0 |

$$(*) P_p \text{ (kW)} = (P_m \text{ (W)} / (T \text{ (}\mu\text{s)} \times PRF \text{ (Hz)})) \times 1000$$

Environmental conditions observed: On 14 June 2022, 23°C to 23°C, 67%RH to 67%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

3.2 Modulation Characteristics

3.2.1 Test Conditions:

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

3.2.2 Test setup:

See Clause 4.

3.2.3 Test Results:

Complied. (Modification status: 1)

TT24NM mode (Normal mode)

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|---|-------|-------|-------|-------|-------|-------|
| Pulse length T (μ s) (50% points) | 0.076 | 0.155 | 0.296 | 0.498 | 0.700 | 1.204 |
| Rise time t_r (μ s) (10 to 90 % amplitude) | 0.014 | 0.011 | 0.012 | 0.011 | 0.013 | 0.014 |
| Fall time t_f (μ s) (90 to 10 % amplitude) | 0.098 | 0.096 | 0.087 | 0.082 | 0.094 | 0.096 |
| Pulse Repetition Frequency (Hz) | 3000 | 3000 | 1500 | 1200 | 1000 | 600 |

TT32NM mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|---|-------|-------|-------|-------|-------|-------|
| Pulse length T (μ s) (50% points) | 0.076 | 0.153 | 0.295 | 0.497 | 0.700 | 1.204 |
| Rise time t_r (μ s) (10 to 90 % amplitude) | 0.014 | 0.012 | 0.012 | 0.012 | 0.013 | 0.014 |
| Fall time t_f (μ s) (90 to 10 % amplitude) | 0.098 | 0.107 | 0.085 | 0.091 | 0.093 | 0.100 |
| Pulse Repetition Frequency (Hz) | 2199 | 2199 | 1500 | 1200 | 1000 | 600 |

2nd trace mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|---|-------|-------|-------|-------|-------|-------|
| Pulse length T (μ s) (50% points) | 0.076 | 0.155 | 0.295 | 0.501 | 0.700 | 1.204 |
| Rise time t_r (μ s) (10 to 90 % amplitude) | 0.013 | 0.011 | 0.013 | 0.013 | 0.015 | 0.014 |
| Fall time t_f (μ s) (90 to 10 % amplitude) | 0.096 | 0.096 | 0.091 | 0.084 | 0.093 | 0.096 |
| Pulse Repetition Frequency (Hz) | 3000 | 3000 | 500 | 500 | 500 | 500 |

Measured Plots: See Clause 6.

Environmental conditions observed: On 14 June 2022, 23°C to 23°C, 67%RH to 67%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

3.3 Frequency Stability –temperature & voltage

3.3.1 Test Conditions:

- (1) Radar transmitter settings: All TX (S1/S2/M1/M2/M3/L) pulses
- (2) Ambient temperature settings: -30°C to +50°C (10°C interval)
- (3) Power supply voltage settings: 85/100/115% of nominal voltage

MARINE RADAR PROCESSOR UNIT: 100 VAC – 230 VAC

V_L : 85 VAC / V_{nom} : 100 VAC / V_H : 264.5 VAC

3.3.2 Test setup:

See Clause 4.

3.3.3 Frequency Tolerance Limits

TT24NM mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|----------------------------------|--------|--------|--------|--------|--------|--------|
| Guard Band $f(1.5/T)$ (MHz) (*1) | 19.8 | 9.7 | 5.1 | 3.0 | 2.1 | 1.2 |
| Upper limit (MHz) (*2) | 9480.2 | 9490.3 | 9494.9 | 9497.0 | 9497.9 | 9498.8 |
| Lower limit (MHz) (*2) | 9319.8 | 9309.7 | 9305.1 | 9303.0 | 9302.1 | 9301.2 |

TT32NM mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|----------------------------------|--------|--------|--------|--------|--------|--------|
| Guard Band $f(1.5/T)$ (MHz) (*1) | 19.8 | 9.8 | 5.1 | 3.0 | 2.1 | 1.2 |
| Upper limit (MHz) (*2) | 9480.2 | 9490.2 | 9494.9 | 9497.0 | 9497.9 | 9498.8 |
| Lower limit (MHz) (*2) | 9319.8 | 9309.8 | 9305.1 | 9303.0 | 9302.1 | 9301.2 |

2nd trace mode

| Pulse type | S1 | S2 | M1 | M2 | M3 | L |
|----------------------------------|--------|--------|--------|--------|--------|--------|
| Guard Band $f(1.5/T)$ (MHz) (*1) | 19.7 | 9.7 | 5.1 | 3.0 | 2.1 | 1.2 |
| Upper limit (MHz) (*2) | 9480.3 | 9490.3 | 9494.9 | 9497.0 | 9497.9 | 9498.8 |
| Lower limit (MHz) (*2) | 9319.7 | 9309.7 | 9305.1 | 9303.0 | 9302.1 | 9301.2 |

(*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, $f(L) = 9300 + 1.5/T$

3.3.4 Test Results:

Complied. (Modification status: 1)

(1) Temperature test at the rated supply voltage of 100 VAC, 60 Hz:

TT24NM mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9421.9 | 9421.6 | 9422.3 | 9421.0 | 9420.0 | 9419.4 | Complied. |
| | -20°C | 9420.9 | 9420.4 | 9421.6 | 9420.1 | 9419.2 | 9418.7 | Complied. |
| | -10°C | 9418.9 | 9418.6 | 9419.5 | 9418.2 | 9417.1 | 9416.3 | Complied. |
| | 0°C | 9416.7 | 9416.2 | 9417.2 | 9415.9 | 9414.9 | 9414.3 | Complied. |
| | +10°C | 9414.4 | 9414.3 | 9415.1 | 9413.8 | 9412.6 | 9411.9 | Complied. |
| | +20°C | 9412.5 | 9412.4 | 9412.8 | 9411.7 | 9410.7 | 9409.7 | Complied. |
| | +30°C | 9410.4 | 9410.2 | 9411.3 | 9409.9 | 9408.9 | 9408.1 | Complied. |
| | +40°C | 9408.2 | 9408.2 | 9409.2 | 9407.8 | 9406.7 | 9405.9 | Complied. |
| | +50°C | 9405.6 | 9405.6 | 9406.4 | 9405.4 | 9404.1 | 9403.3 | Complied. |

TT32NM mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9422.7 | 9422.5 | 9422.5 | 9420.8 | 9419.9 | 9419.3 | Complied. |
| | -20°C | 9421.9 | 9421.1 | 9421.1 | 9419.7 | 9418.6 | 9417.9 | Complied. |
| | -10°C | 9419.5 | 9419.1 | 9418.9 | 9417.6 | 9416.6 | 9415.9 | Complied. |
| | 0°C | 9417.1 | 9416.8 | 9417.1 | 9415.6 | 9414.5 | 9413.7 | Complied. |
| | +10°C | 9415.0 | 9415.2 | 9415.2 | 9414.0 | 9413.0 | 9412.3 | Complied. |
| | +20°C | 9412.7 | 9412.6 | 9412.8 | 9411.3 | 9410.2 | 9409.3 | Complied. |
| | +30°C | 9410.8 | 9410.7 | 9410.8 | 9409.4 | 9408.3 | 9407.5 | Complied. |
| | +40°C | 9408.4 | 9408.4 | 9408.6 | 9407.3 | 9406.3 | 9405.3 | Complied. |
| | +50°C | 9407.1 | 9406.8 | 9406.9 | 9405.6 | 9404.5 | 9403.7 | Complied. |

2nd trace mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9422.3 | 9422.2 | 9424.8 | 9423.7 | 9422.4 | 9419.8 | Complied. |
| | -20°C | 9421.3 | 9421.0 | 9424.0 | 9423.0 | 9421.6 | 9419.0 | Complied. |
| | -10°C | 9419.4 | 9419.5 | 9421.9 | 9421.1 | 9420.0 | 9417.1 | Complied. |
| | 0°C | 9417.3 | 9416.9 | 9419.9 | 9418.7 | 9417.5 | 9414.9 | Complied. |
| | +10°C | 9414.8 | 9414.8 | 9417.1 | 9416.3 | 9415.3 | 9412.8 | Complied. |
| | +20°C | 9412.4 | 9412.1 | 9415.7 | 9414.5 | 9413.3 | 9410.8 | Complied. |
| | +30°C | 9411.1 | 9410.9 | 9413.6 | 9412.5 | 9411.3 | 9408.8 | Complied. |
| | +40°C | 9408.8 | 9408.8 | 9411.6 | 9410.6 | 9409.6 | 9406.5 | Complied. |
| | +50°C | 9407.0 | 9407.1 | 9409.5 | 9408.5 | 9407.3 | 9404.6 | Complied. |

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

TT24NM mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|------------------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | V _L | 9412.9 | 9412.2 | 9413.3 | 9412.1 | 9410.7 | 9409.5 | Complied. |
| | V _{nom} | 9412.5 | 9412.4 | 9412.8 | 9411.7 | 9410.7 | 9409.7 | Complied. |
| | V _H | 9412.4 | 9412.1 | 9413.3 | 9411.9 | 9410.8 | 9409.3 | Complied. |

TT32NM mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|------------------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | V _L | 9412.6 | 9412.9 | 9412.7 | 9411.5 | 9410.2 | 9409.2 | Complied. |
| | V _{nom} | 9412.7 | 9412.6 | 9412.8 | 9411.3 | 9410.2 | 9409.3 | Complied. |
| | V _H | 9412.9 | 9412.8 | 9412.9 | 9411.3 | 9410.3 | 9409.3 | Complied. |

2nd trace mode

| Pulse type | | S1 | S2 | M1 | M2 | M3 | L | Result |
|-------------------------------------|------------------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | V _L | 9412.5 | 9412.0 | 9415.6 | 9414.7 | 9413.3 | 9410.6 | Complied. |
| | V _{nom} | 9412.4 | 9412.1 | 9415.7 | 9414.5 | 9413.3 | 9410.8 | Complied. |
| | V _H | 9412.5 | 9412.1 | 9415.7 | 9414.6 | 9413.3 | 9410.7 | Complied. |

Environmental conditions observed: On 11 June 2022, 24°C to 24°C, 53%RH to 53%RH
 On 12 June 2022, 23°C to 24°C, 67%RH to 60%RH
 On 13 June 2022, 23°C to 23°C, 67%RH to 67%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

3.4 Occupied Bandwidth

3.4.1 Test conditions:

For all TX (S1/S2/M1/M2/M3/L) pulses, the transmitter output power was measured at the antenna port with a non-reflective load as a substitute for ANTENNA RADIATOR.

3.4.2 Test setup:

See Clause 4.

3.4.3 Emission Limits (CFR Title 47 Sections: 80.211 (f)):

| Frequency removed from the assigned frequency (*1) (of the authorized bandwidth) (*2) | Emission attenuation (mean power, dB) |
|--|---|
| 50 to 100 % (of the authorized bandwidth) (*2) | At least 25 |
| 100 to 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 band width = 200 MHz (for X-band radars)

3.4.4 Test Results:

Complied. (Modification status: 1)

Spectrum plots: See Clause 7.1.

Environmental conditions observed: On 16 June 2022, 24°C to 24°C, 75%RH to 75%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

3.5 Spurious Emissions at Antenna Terminals

3.5.1 Test Conditions:

(a) For S1 pulse, the transmitter output power was measured at the antenna port with a non-reflective load converter as a substitute for ANTENNA RADIATOR. (*1)

(*1) 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)

(b) Spurious measurement range for X-band radar: 4.59 GHz to 40 GHz

| Lower measurement band | Upper measurement band |
|--|---------------------------------------|
| From 4.59 GHz (*1) to the lower OoB boundary | From the upper OoB boundary to 40 GHz |

(*1) 0.7 times of the waveguide cut-off frequency for WRJ-10 (ITU-R SM.329-12, Section 2.5)

3.5.2 Test setup:

See Clause 4.

3.5.3 Emission Limits (CFR Title 47 Sections: 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 = 200 MHz (for X-band radars)

(*3) Spurious measurement range for X-band radar (WRJ-10): 4.59 GHz to 40 GHz

3.5.4 Harmonics Frequencies:

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

3.5.5 Test Results:

Complied. (Modification status: 1) (*)

(*) The measurement results for the frequency below 6.54 GHz were not taken into account as the final result of this test with the consent of the customer.

| Frequency (GHz) | Level (dBm) | Limit (dBm) | Margin (dB) |
|-----------------|-------------|-------------|-------------|
| 18.826 | -38.68 | -13 | 25.68 |

Environmental conditions observed: On 20 June 2022, 23°C to 23°C, 75%RH to 75%RH
On 21 June 2022, 24°C to 24°C, 56%RH to 56%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

3.6 Field Strength of Spurious Radiation

3.6.1 Test Conditions:

(a) For S1 pulse, the transmitter output power was measured at the antenna port with a non-reflective load as a substitute for ANTENNA RADIATOR. (*1)

(*1) 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)

(b) Spurious measurement range for X-Band RADAR: 4.59 GHz to 40 GHz

| Lower measurement band | Upper measurement band |
|--|---------------------------------------|
| From 4.59 GHz (*1) to the lower OoB boundary | From the upper OoB boundary to 40 GHz |

(*1) 0.7 times of the waveguide cut-off frequency for WRJ-10 (ITU-R SM.329-12, Section 2.5)

(c) Antenna port was terminated with dummy load.

3.6.2 Test Site: LIC EMC Center, Semi-anechoic chamber

3.6.3 Distance between the Radar and Measuring Antenna: 3 m

3.6.4 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 (3.0 m × 2.4 m × 0.3 m) to reduce the influences of the reflections of the RF waves from the floor.

Measuring (receiving) the antenna height and polarization:

- (a) Antenna height: EUT center (2.01 m)
- (b) Antenna polarization: vertical and horizontal.

EUT height: 1.5 m

3.6.5 Field Strength Limits (CFR Title 47 Sections: 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 = 200 MHz (for X-band radars)

(*3) Spurious measurement range for X-band radar: 4.59 GHz to 40 GHz

3.6.6 Harmonics Frequencies:

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

3.6.7 Test Results:

Complied. (Modification status: 1)

Measured maximum emission value

| Frequency (GHz) | Level (dB μ V/m) | Limit (dB μ V/m) (*1) | Margin (dB) |
|-----------------|----------------------|---------------------------|-------------|
| 17.663 | 55.65 | 82.2 | 26.5 |

(*1) -13 dBm = 82.2 dB μ V/m (3 m) (Refer to ITU-R SM.329-12/ Annex 1, Section 3.)

Spectrum plots: See Clause 8.

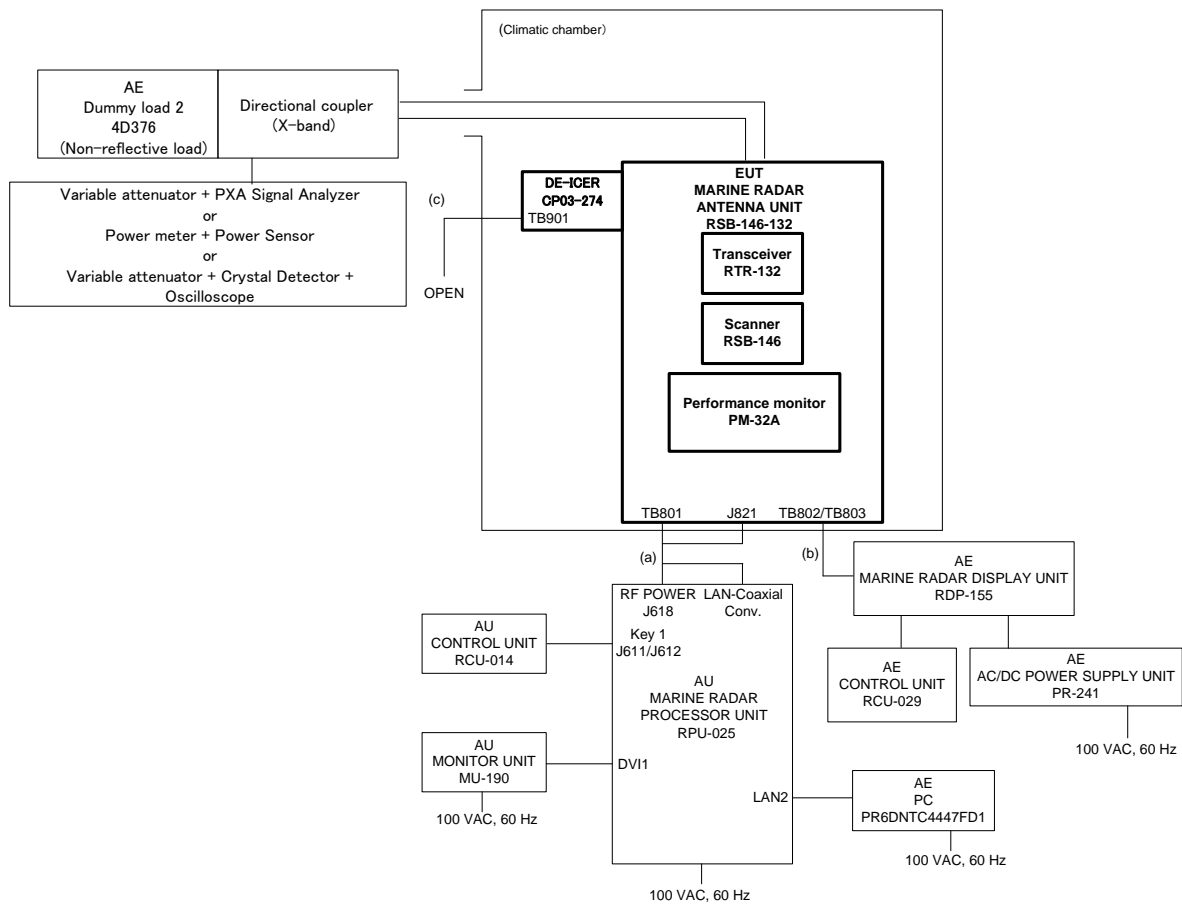
Environmental conditions observed: On 4 May 2022, 20°C to 20°C, 56%RH to 56%RH

Power supply voltage measured: 100 VAC, 60 Hz to 100 VAC, 60 Hz (*)

(*) The power supplied to MARINE RADAR PROCESSOR UNIT (AU).

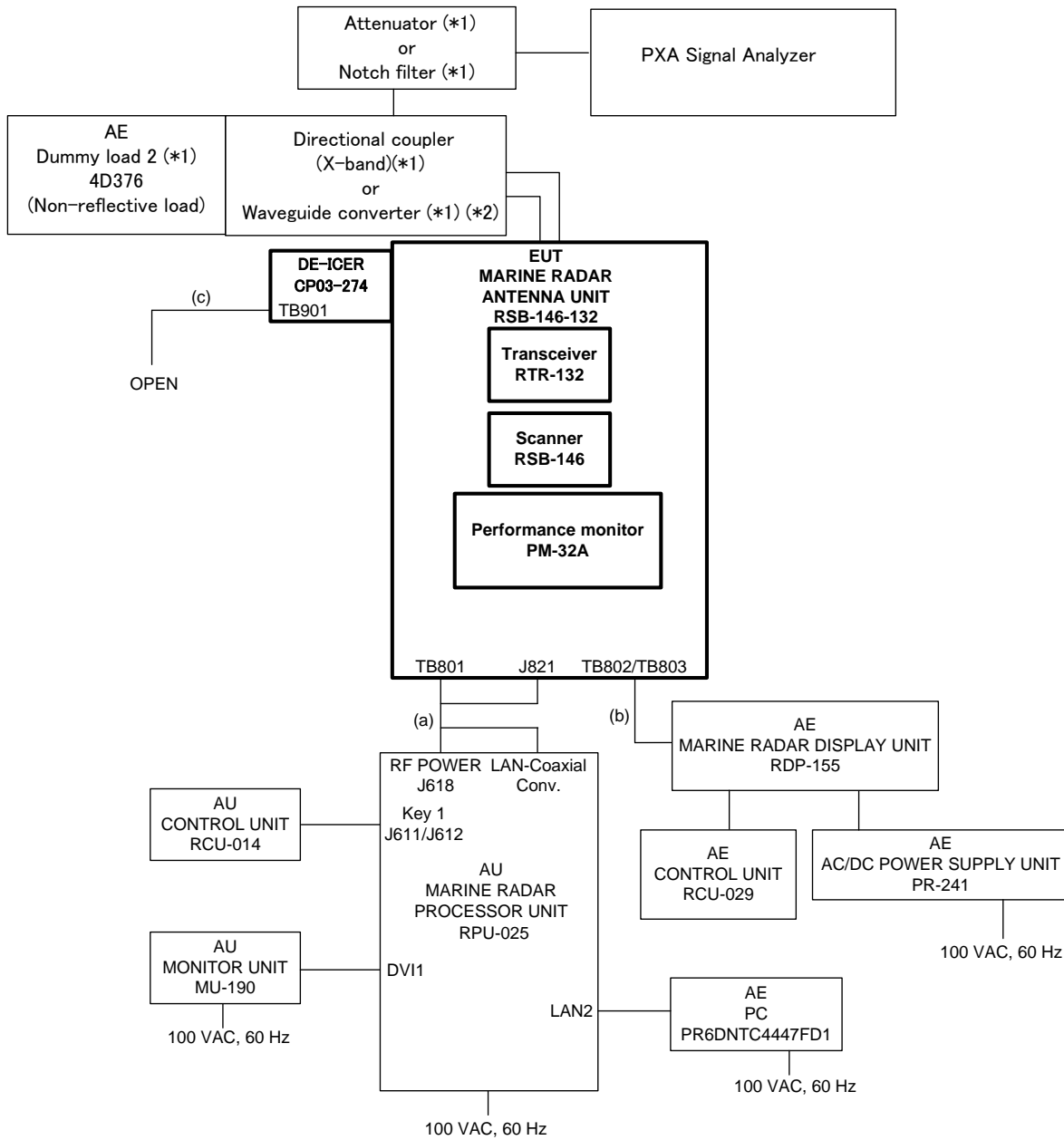
4 Test Setup for Measurements

4.1 Test Setup for Clause 3.1, 3.2, 3.3 and 3.4



Note: For the test of “Spurious Emissions at Antenna Port”, the test was conducted with the EUT outside the climatic chamber.

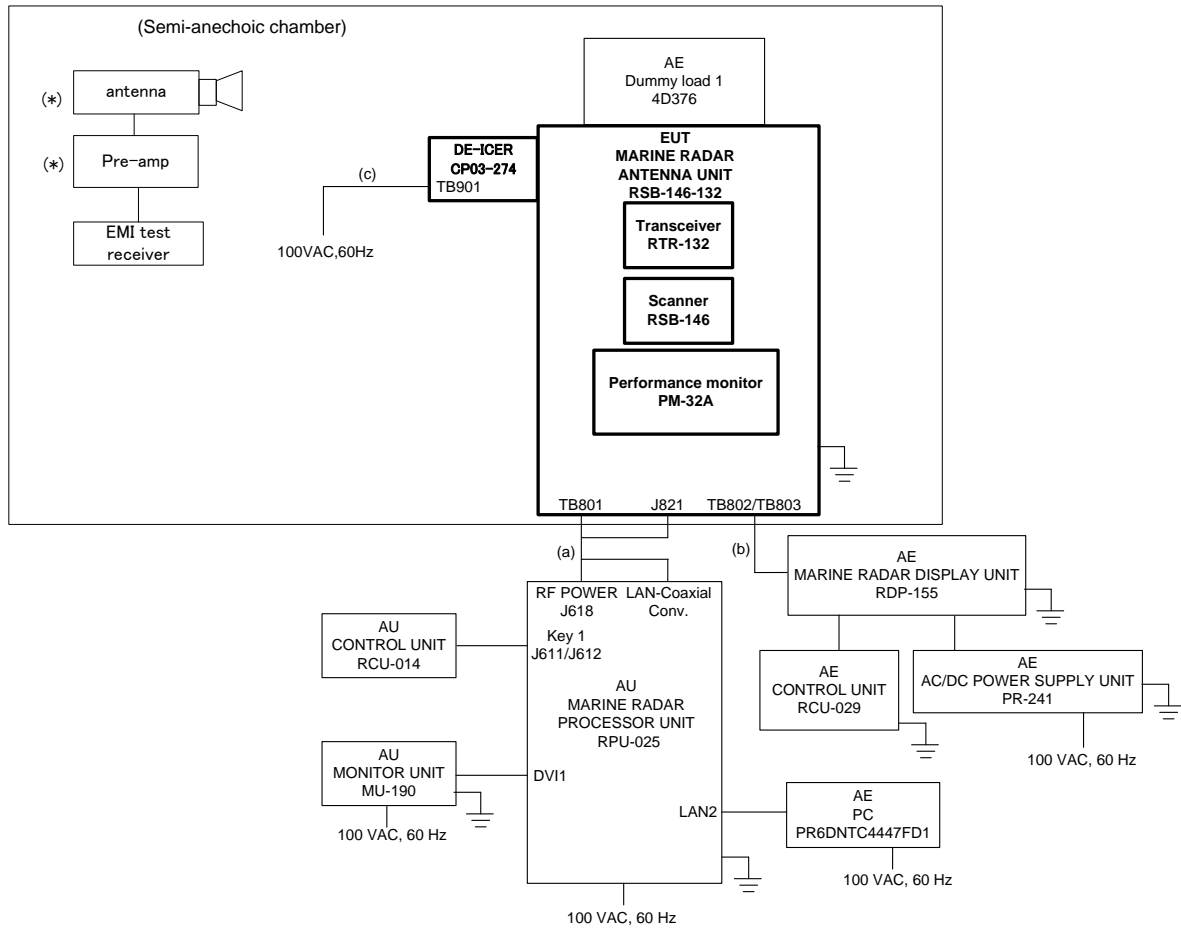
4.2 Test Setup for Clause 3.5



(*1) Used depending on measurement frequency bandwidth.

(*2) Submitted by the customer.

4.3 Test Setup for Clause 3.6



(*) Used depending on measurement frequency bandwidth.

Cable designations

| No. | Category | Name | Type | Length (m) | Number of cables used | Cable shielded |
|-----|----------------|-----------------|-----------|------------|-----------------------|----------------|
| a | Signal/control | Multicore cable | RW-9600 | 20 | 1 | Yes |
| b | Signal/control | Multicore cable | RW-00136 | 20 | 1 | Yes |
| c | Power | JIS cable | DPYCY-1.5 | 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.

(1) For Clause 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 | 8 April 2022 | 1 year |
| RT200 | Power meter | E4419B | MY45101375 | ANRITSU | 3 March 2022 | 1 year |
| RT201 | Power sensor | 8481A | 2349A39603 | Agilent | 7 March 2022 | 1 year |
| RT213 | Waveguide | WRJ-10 | -- | Furuno | 13 July 2021 | 1 year |
| HT654 | Attenuator | 8494B | MY42148134 | Agilent | 7 March 2022 | 1 year |
| HT1223 | Attenuator | 8495B | MY42148137 | Agilent | 7 March 2022 | 1 year |
| HT972 | Oscilloscope | MSO4054B | C030483 | TEKTRONIX | 11 March 2022 | 1 year |
| HT415 | Climatic chamber (Small) | PL-4KP | 14004204 | Espec | 21 July 2021 | 1 year |
| HT724 | Paperless recorder/ Dual communication logger | FX106-4-1 | S5JA01450 | Yokogawa | Not applicable. | -- |
| HT461 | Digital multi-meter | 111 | 78410077 | Fluke | 6 January 2022 | 1 year |

(2) For Clause 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 | 8 April 2022 | 1 year |
| RT213 | Waveguide | WRJ-10 | -- | Furuno | 13 July 2021 | 1 year |
| HT654 | Attenuator | 8494B | MY42148134 | Agilent | 7 March 2022 | 1 year |
| HT1223 | Attenuator | 8495B | MY42148137 | Agilent | 7 March 2022 | 1 year |
| HT1317 | PXA Signal Analyzer | N9030B | SG57142024 | KEYSIGHT | 9 March 2022 | 1 year |
| HT415 | Climatic chamber (Small) | PL-4KP | 14004204 | Espec | 21 July 2021 | 1 year |
| HT724 | Paperless recorder/ Dual communication logger | FX106-4-1 | S5JA01450 | Yokogawa | Not applicable. | -- |
| HT1204 | Programmable AC power source | DP045M | 9158465 | NF | Not applicable. | -- |
| HT461 | Digital multi-meter | 111 | 78410077 | Fluke | 6 January 2022 | 1 year |
| HT1221 | Crystal detector | 423B | MY51342422 | Agilent | 5 March 2022 | 1 year |
| HT972 | Oscilloscope | MSO4054B | C030483 | TEKTRONIX | 11 March 2022 | 1 year |

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

| C/N | Instrument | Type | S/N | Manufacturer | Date of last calibration | Calibration interval |
|--------|--|-----------|------------|--------------|--------------------------|----------------------|
| RT198 | Directional coupler (X-band) | 5D364S | R05762 | Shimada | 8 April 2022 | 1 year |
| RT213 | Waveguide | WRJ-10 | -- | Furuno | 13 July 2021 | 1 year |
| HT654 | Attenuator | 8494B | MY42148134 | Agilent | 7 March 2022 | 1 year |
| HT1223 | Attenuator | 8495B | MY42148137 | Agilent | 7 March 2022 | 1 year |
| HT1317 | PXA Signal Analyzer | N9030B | SG57142024 | KEYSIGHT | 9 March 2022 | 1 year |
| HT415 | Climatic chamber (Small) | PL-4KP | 14004204 | Espec | 21 July 2021 | 1 year |
| HT724 | Paperless recorder/ Dual communication logger | FX106-4-1 | S5JA01450 | Yokogawa | Not applicable. | -- |
| HT1204 | Programmable AC power source | DP045M | 9158465 | NF | Not applicable. | -- |
| HT461 | Digital multi-meter | 111 | 78410077 | Fluke | 6 January 2022 | 1 year |

(4) For Clause 3.4 Occupied Bandwidth

| C/N | Instrument | Type | S/N | Manufacturer | Date of last calibration | Calibration interval |
|--------|------------------------------|--------|------------|-----------------|--------------------------|----------------------|
| RT198 | Directional coupler (X-band) | 5D364S | R05762 | SPC Electronics | 8 April 2022 | 1 year |
| HT654 | Attenuator | 8494B | MY42148134 | Agilent | 7 March 2022 | 1 year |
| HT1223 | Attenuator | 8495B | MY42148137 | Agilent | 7 March 2022 | 1 year |
| HT1317 | PXA Signal Analyzer | N9030B | SG57142024 | KEYSIGHT | 9 March 2022 | 1 year |
| HT1204 | Programmable AC power source | DP045M | 9158465 | NF | Not applicable. | -- |
| HT461 | Digital multi-meter | 111 | 78410077 | Fluke | 6 January 2022 | 1 year |

(5) For Clause 3.5 Spurious Emissions at Antenna Terminals

| C/N | Instrument | Type | S/N | Manufacturer | Date of last calibration | Calibration interval |
|--------|------------------------------|---------------------------------|------------|------------------------|--------------------------|----------------------|
| RT198 | Directional coupler (X-band) | 5D364S | R05762 | Aeroflex/ Weinschel | 8 April 2022 | 1 year |
| -- | Adapter | X281A | -- | HEWLETT PACKARD | Not applicable. | -- |
| -- | Adapter | K281C | -- | Agilent | Not applicable. | -- |
| -- | Adapter | R281B | 00472 | HEWLETT PACKARD | Not applicable. | -- |
| -- | Isolator | OMC FX0157 | -- | -- | Not applicable. | -- |
| HT1328 | Notch filter | BRC20663 | 001 | MICRO- TRONICS | 18.August 2021 | 1 year |
| HT1317 | PXA Signal Analyzer | N9030B | SG57142024 | KEYSIGHT | 9 March 2022 | 1 year |
| HT1204 | Programmable AC power source | DP045M | 9158465 | NF | Not applicable. | -- |
| HT461 | Digital multi-meter | 111 | 78410077 | Fluke | 6 January 2022 | 1 year |
| KB289 | Coaxial cable | SF104A/11PC35/11 PC35/5500MM | 800048/4A | HUBER+ SUHNER | 7 August 2021 | 1 year |
| KB181 | Coaxial cable | SUCOFLEX 102A | 1261/2A | HUBER+ SUHNER | 7 August 2021 | 1 year |
| HT654 | Attenuator | 8494B | MY42148134 | Agilent | 7 March 2022 | 1 year |
| HT1223 | Attenuator | 8495B | MY42148137 | Agilent | 7 March 2022 | 1 year |

(6) For Clause 3.6 Field Strength of Spurious Radiation

| C/N | Instrument | Type | S/N | Manufacturer | Date of last calibration | Calibration interval |
|--------|---|-----------|-------------------------|--------------------|---------------------------|----------------------|
| HT779 | Semi-anechoic chamber | 10mSAC | 90984 | Tokin | SVSWR: 9 December 2019 | 3 years |
| HT1277 | Test software | EP5/RE | Ver.6.0.112 | Toyo | Not applicable. | -- |
| HT1270 | EMI test receiver (2 Hz to 44 GHz) | ESW44 | 101841 | Rohde & Schwarz | 7 August 2021 | 1 year |
| NK004 | Double rigged horn antenna (1 GHz to 18 GHz) | TR17206 | 93370015 | Advantest | 7 August 2021 | 1 year |
| HT761 | Double rigged horn antenna & amp. (18 GHz to 26 GHz) | HAP18-26N | 00000017 | Toyo | 11 August 2021 | 1 year |
| HT762 | Double rigged horn antenna & amp. (26 GHz to 40 GHz) | HAP26-40N | 00000010 | Toyo | 1 December 2021 | 1 year |
| HT866 | Digital multimeter | 115 | 19170029 | Fluke | 1 February 2022 | 1 year |
| HT780 | Programmable AC/DC power supply | ES18000W | 9128767-1 +9128767-2 | NF | Not applicable. | -- |

6 RF Envelope and Spectrum of the Output Pulse

TT24NM mode

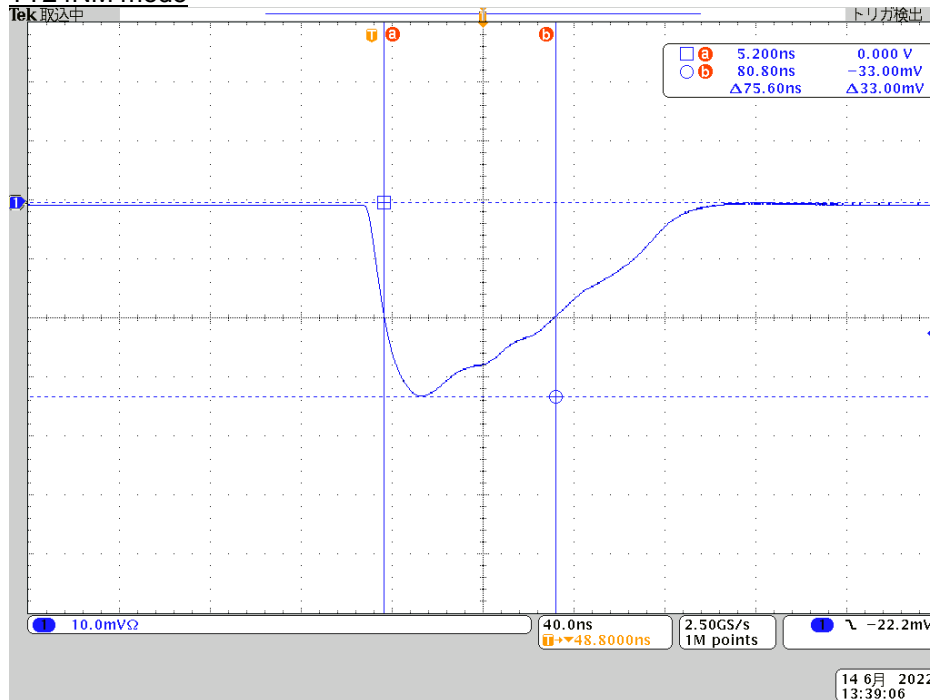


Fig. 6.1 S1 pulse envelope

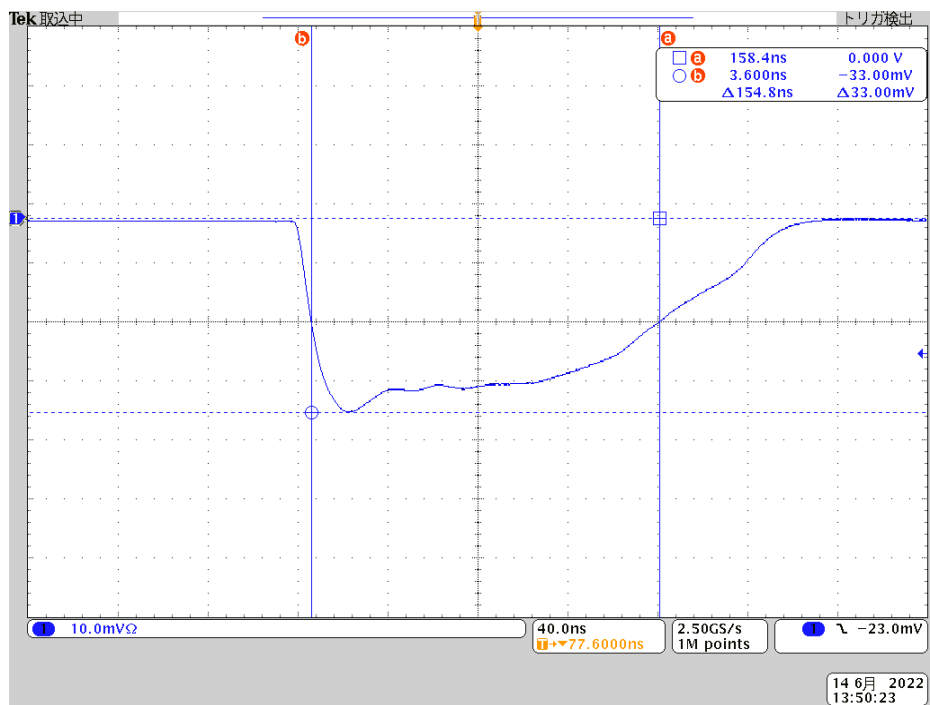


Fig. 6.2 S2 pulse envelope

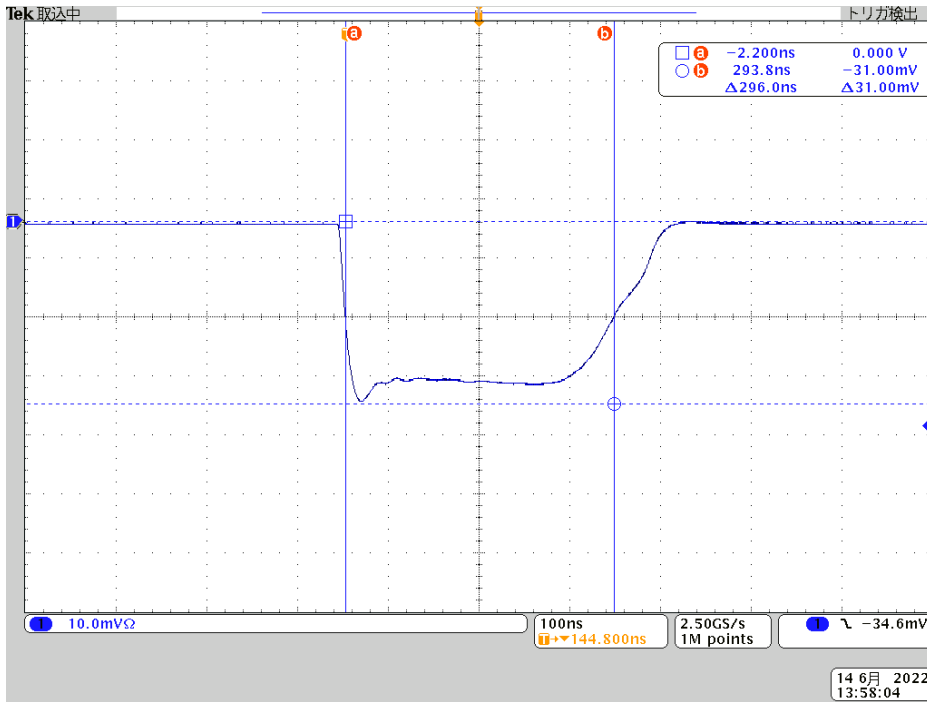


Fig. 6.3 M1 pulse envelope

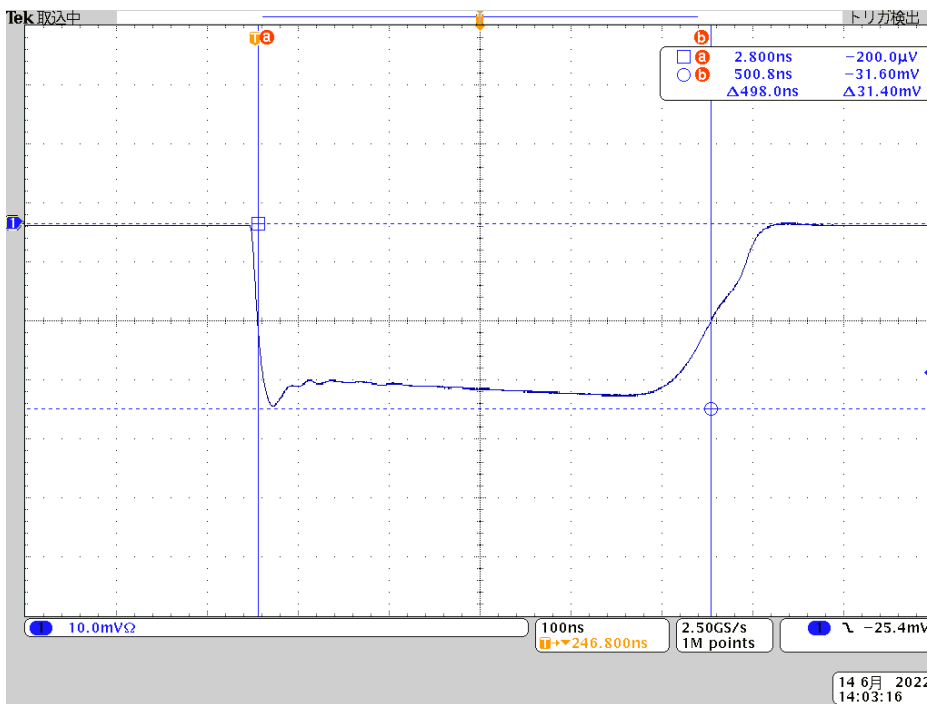


Fig. 6.4 M2 pulse envelope

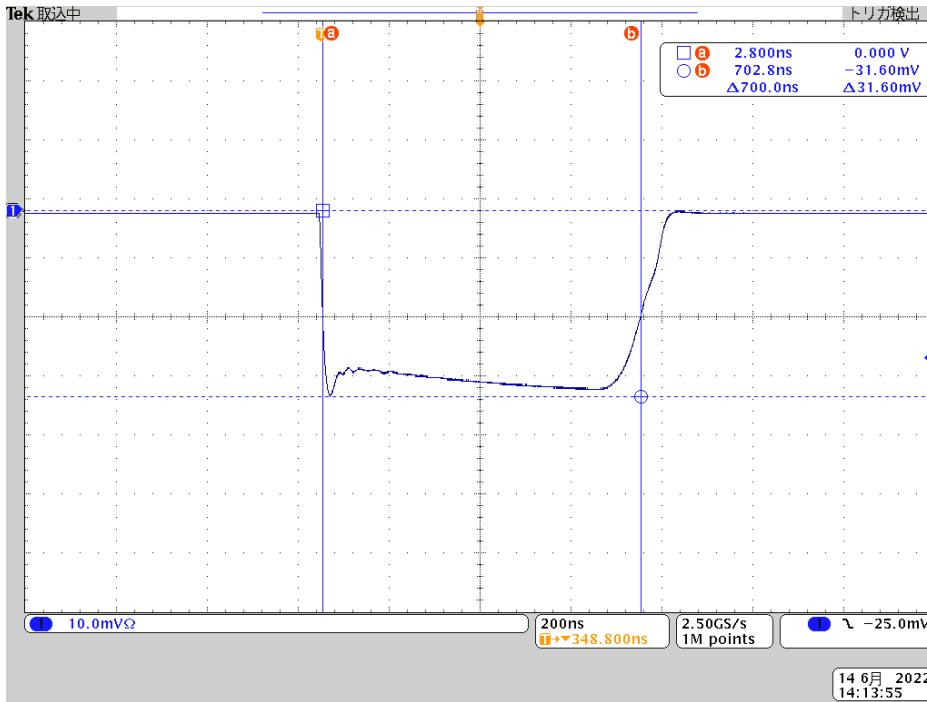


Fig. 6.5 M3 pulse envelope

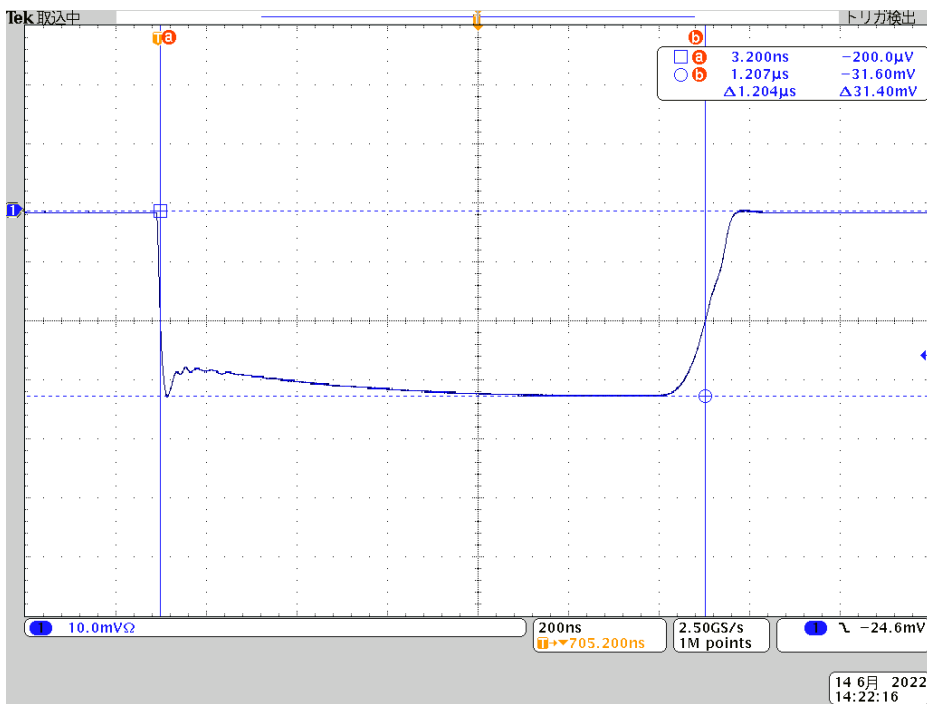


Fig. 6.6 L pulse envelope

TT32NM mode

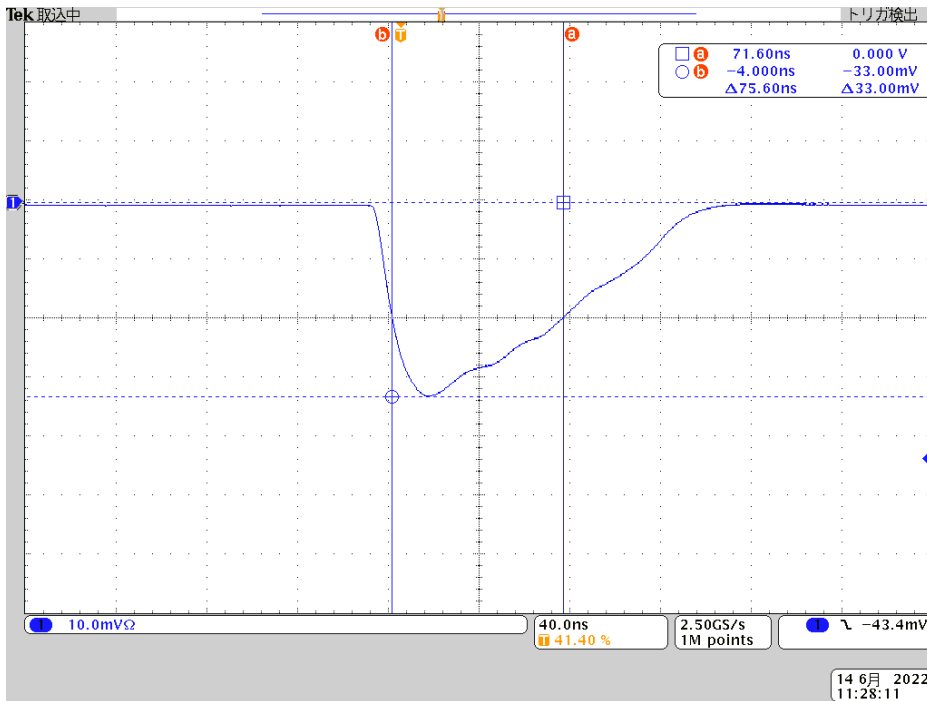


Fig. 6.7 S1 pulse envelope

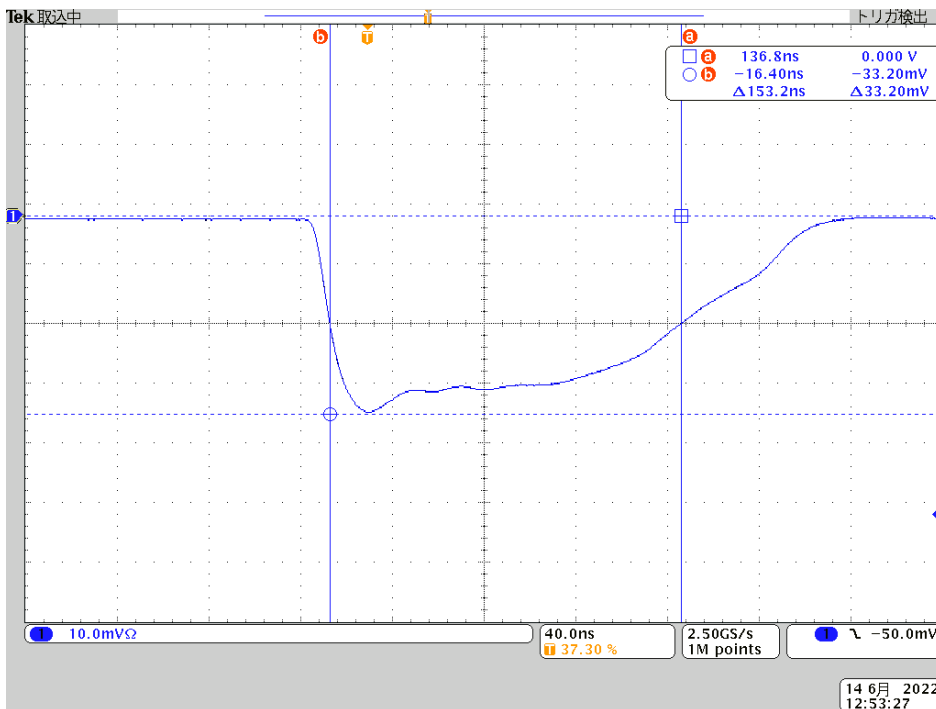


Fig. 6.8 S2 pulse envelope

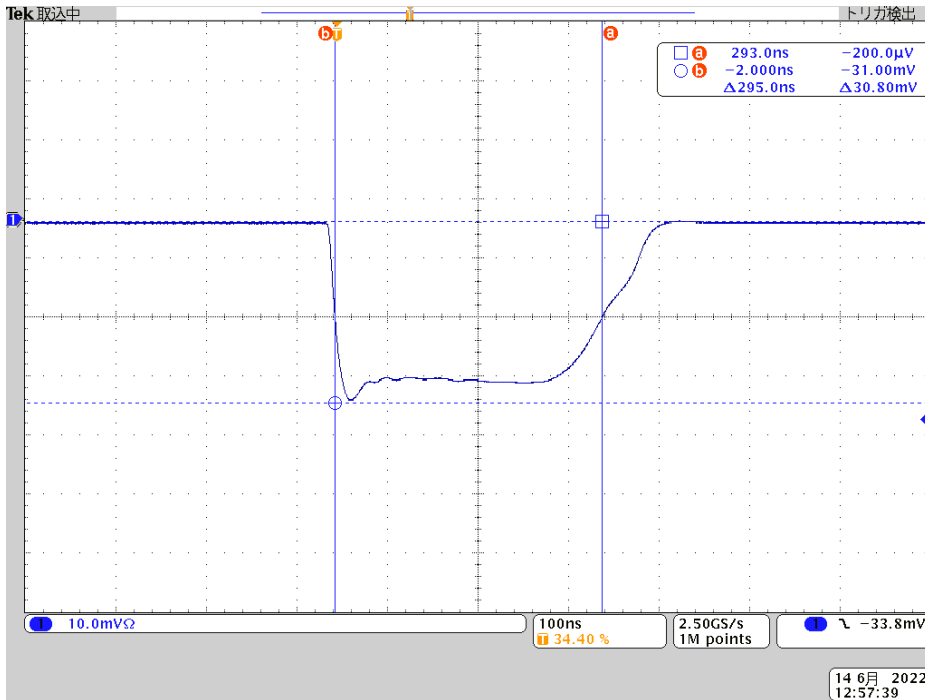


Fig. 6.9 M1 pulse envelope

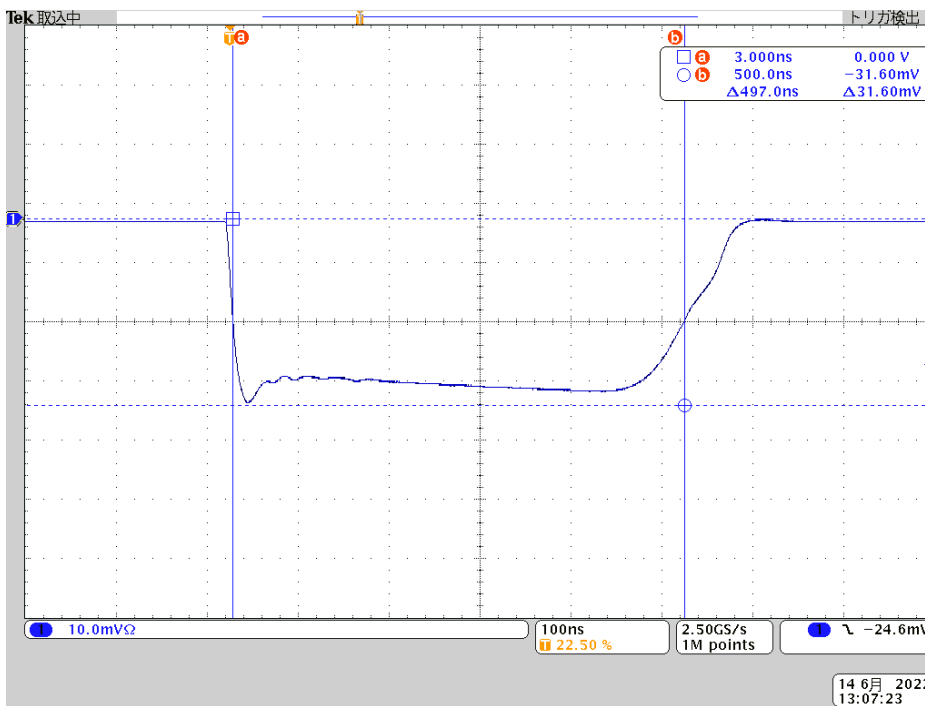


Fig. 6.10 M2 pulse envelope

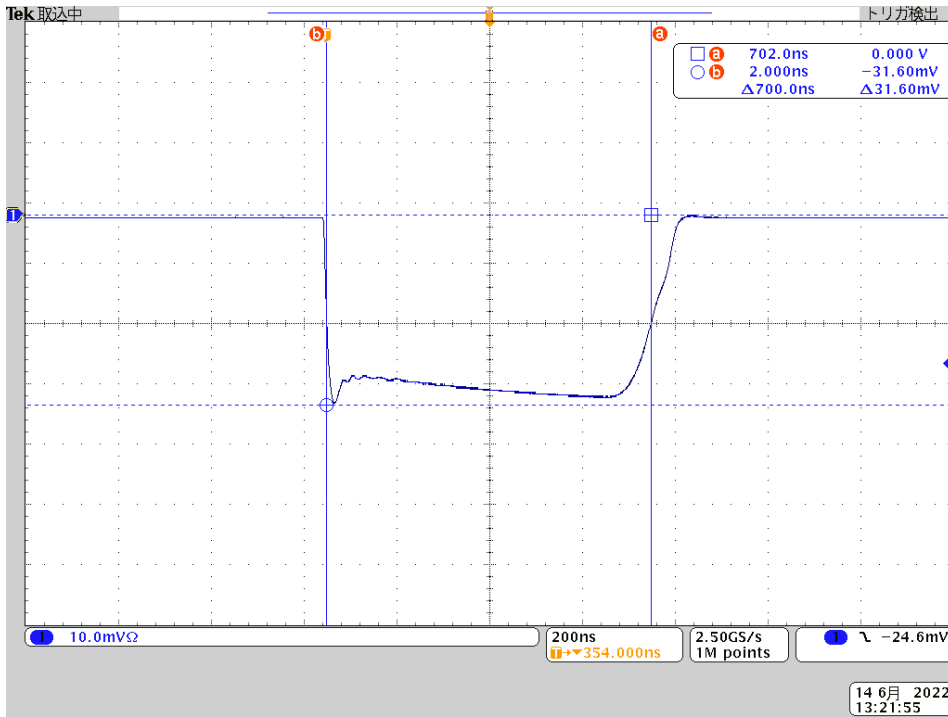


Fig. 6.11 M3 pulse envelope

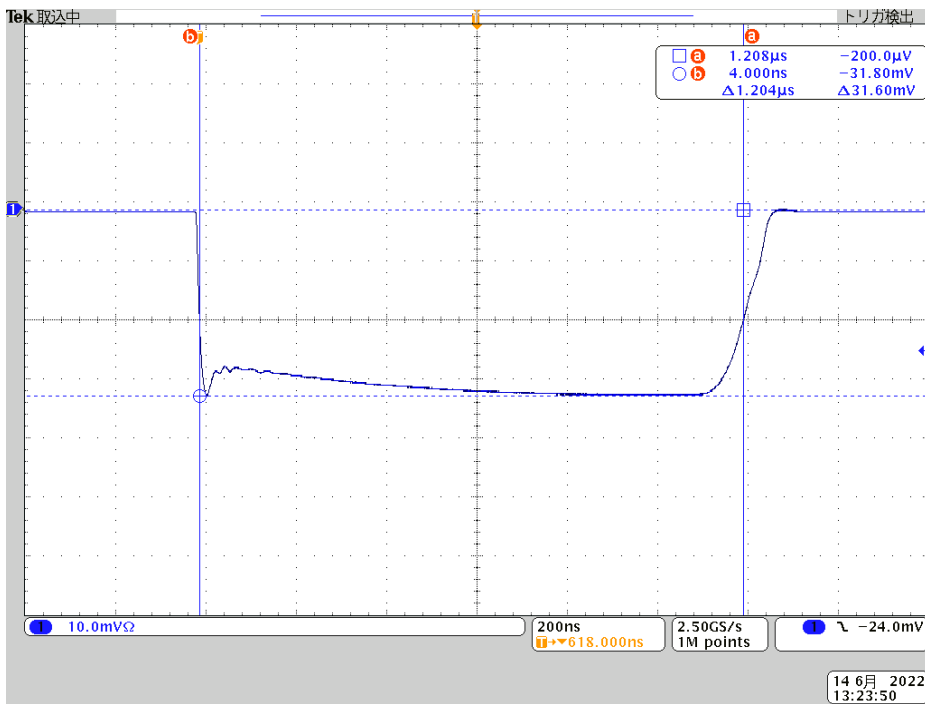


Fig. 6.12 L pulse envelope

2nd trace mode

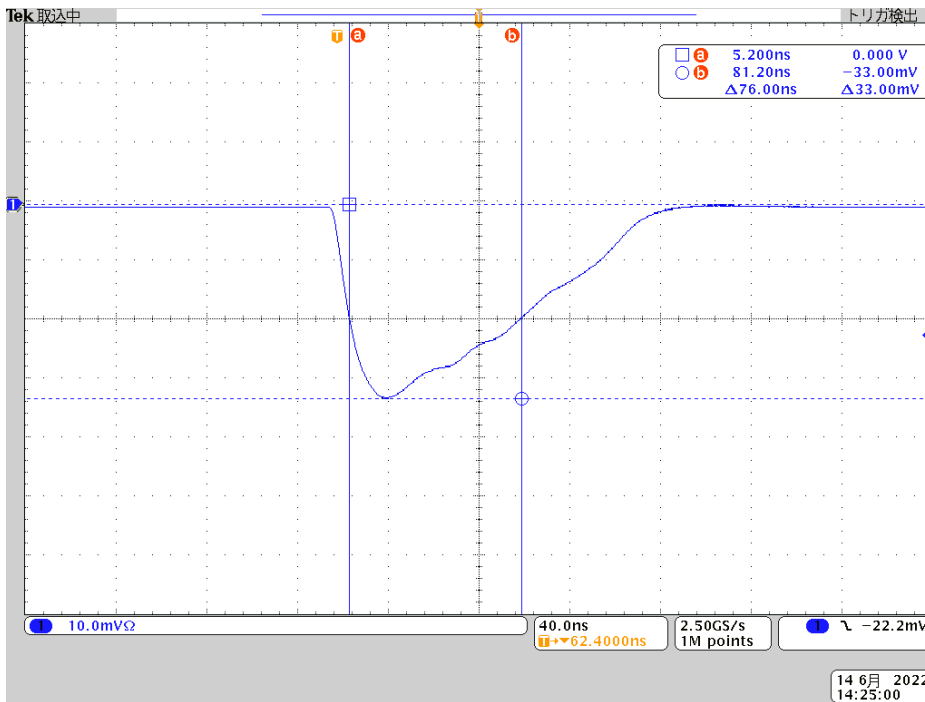


Fig. 6.13 S1 pulse envelope

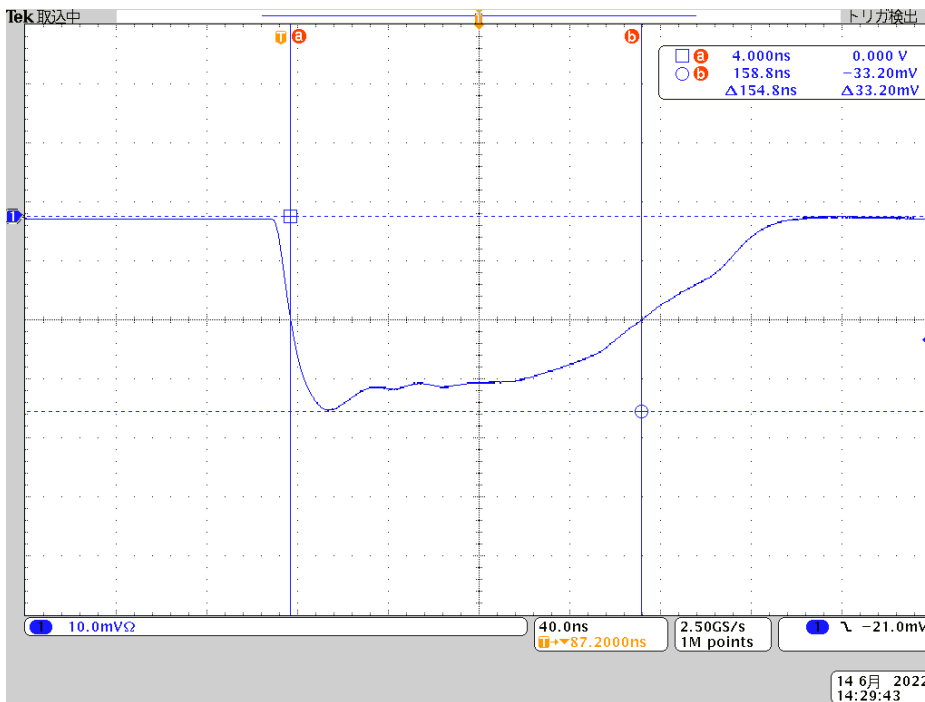


Fig. 6.14 S2 pulse envelope

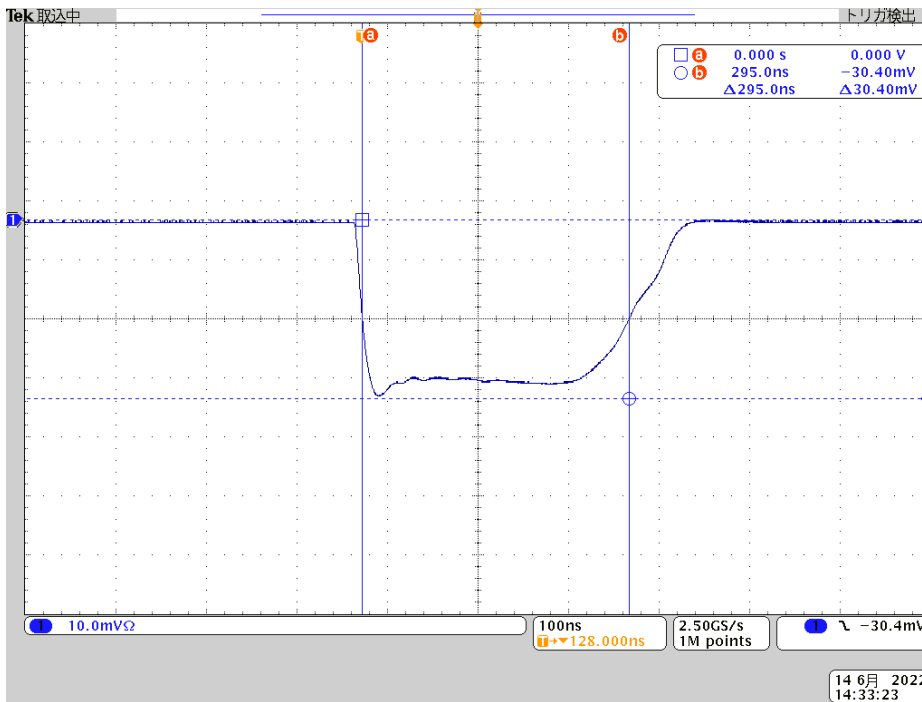


Fig. 6.15 M1 pulse envelope

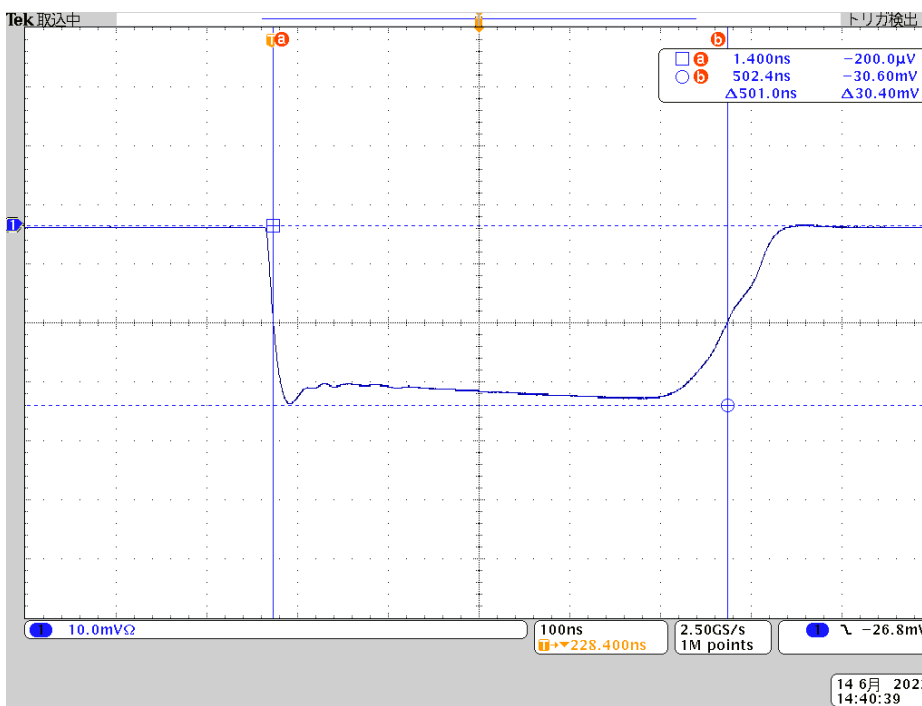


Fig. 6.16 M2 pulse envelope

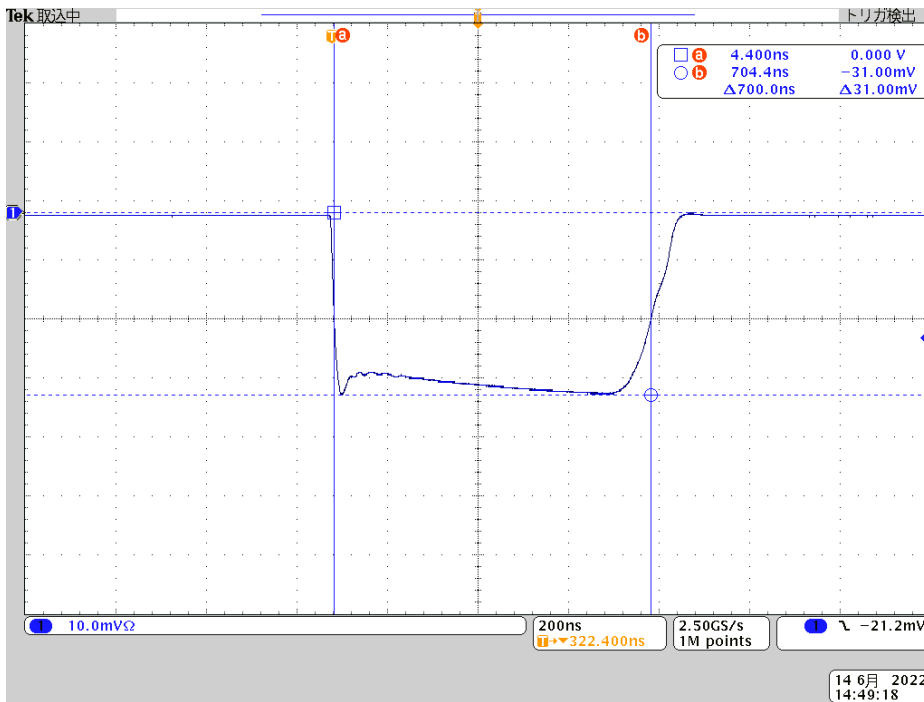


Fig. 6.17 M3 pulse envelope

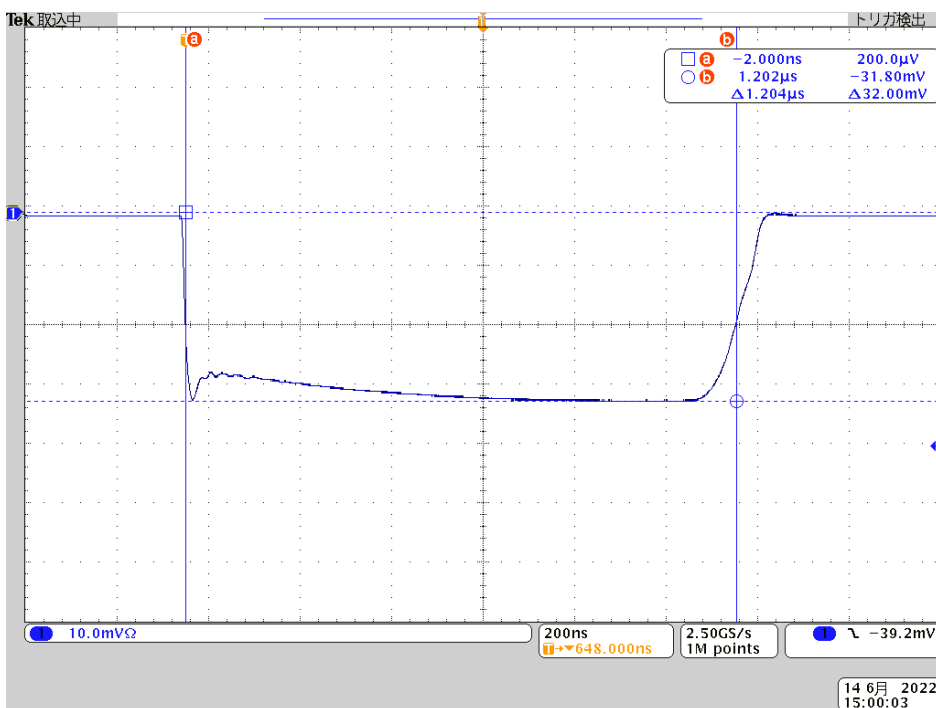


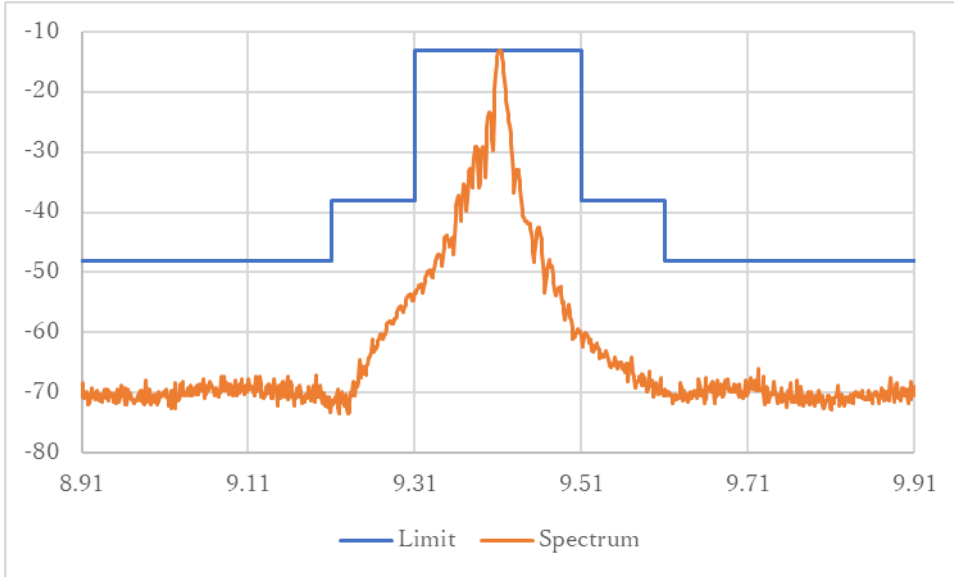
Fig. 6.18 L pulse envelope

7 Spurious Emission Plots measured at Antenna Terminal

7.1 Occupied Bandwidth

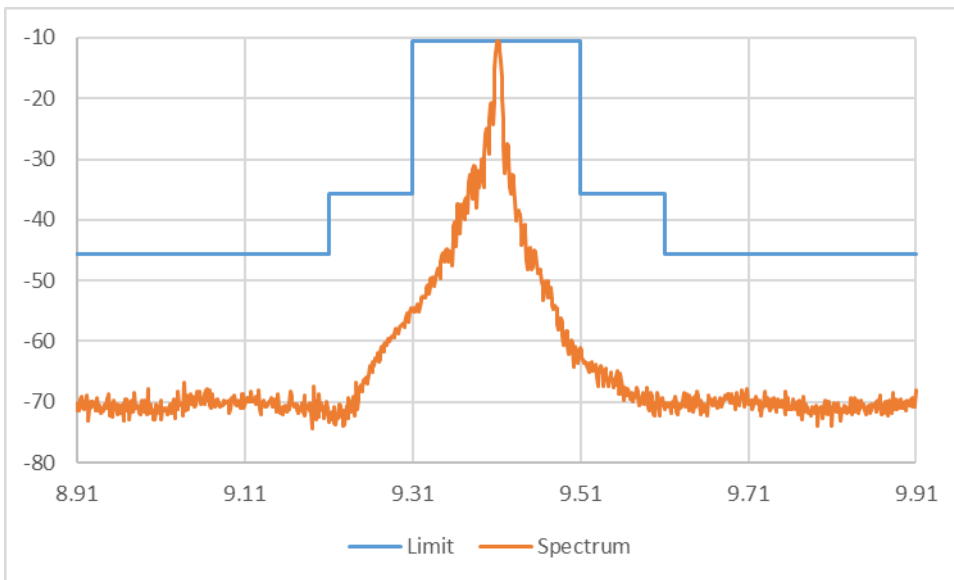
TT24NM mode

ch1, P0N



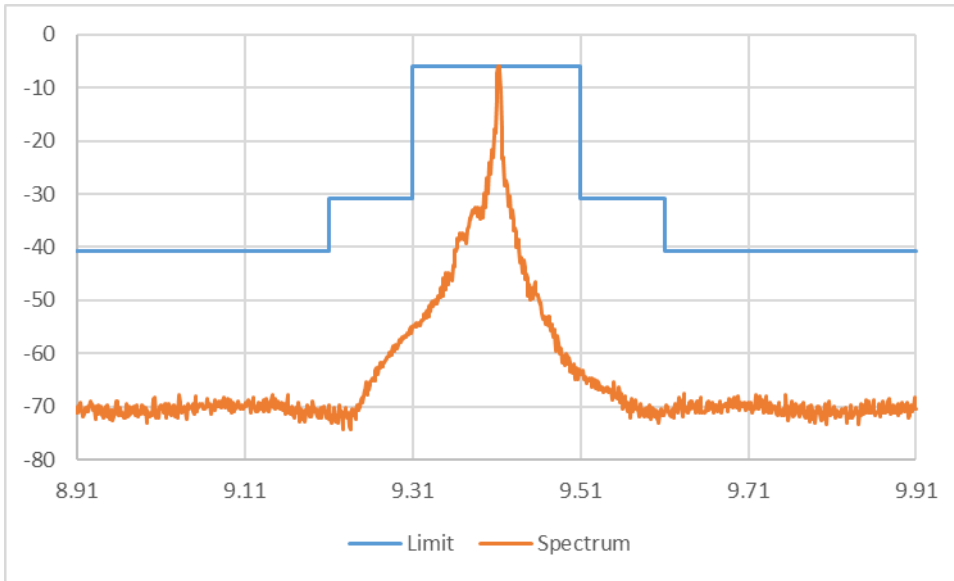
Occupied bandwidth: 65.561 MHz

Fig. 7.1 S1 pulse



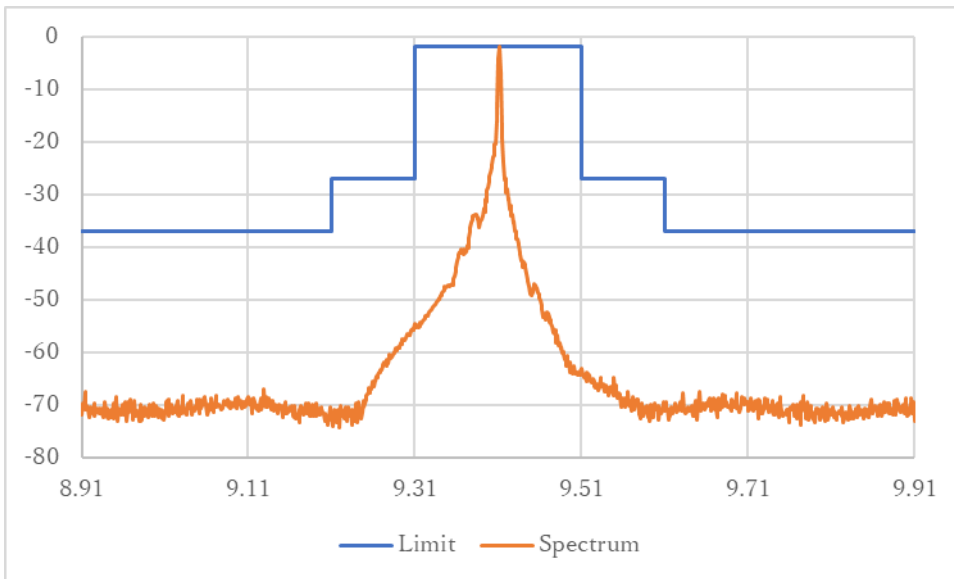
Occupied bandwidth: 52.812 MHz

Fig. 7.2 S2 pulse



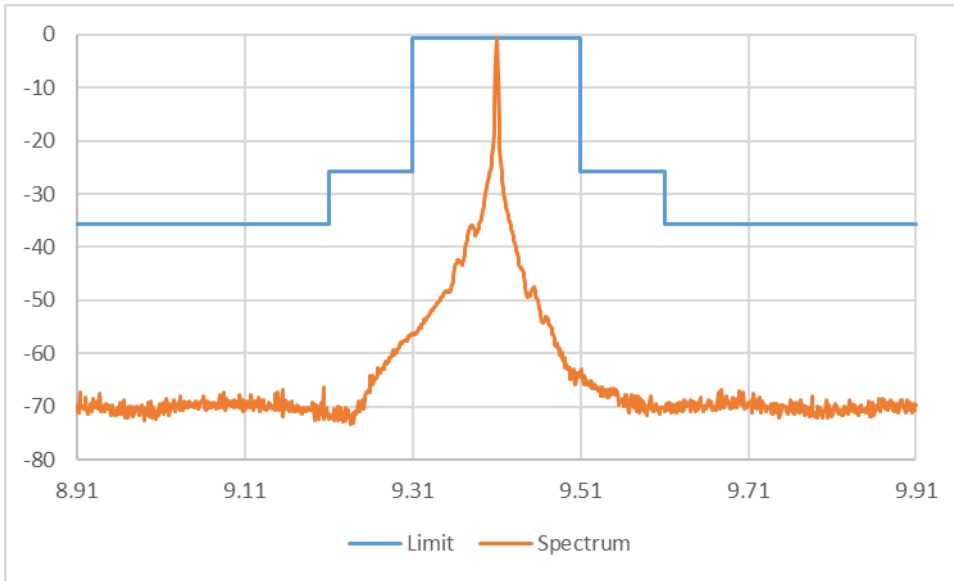
Occupied bandwidth: 39.690 MHz

Fig. 7.3 M1 pulse



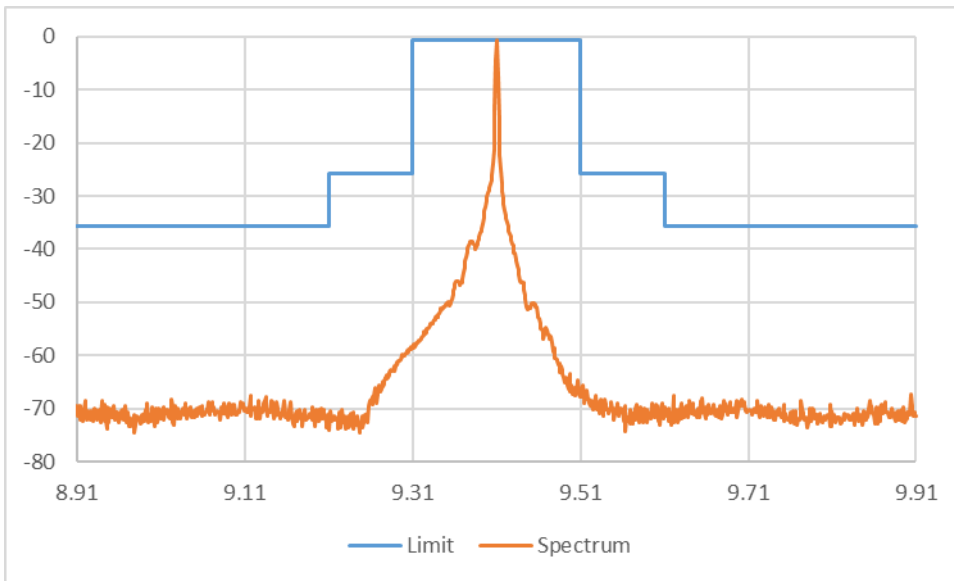
Occupied bandwidth: 22.145 MHz

Fig. 7.4 M2 pulse



Occupied bandwidth: 16.222 MHz

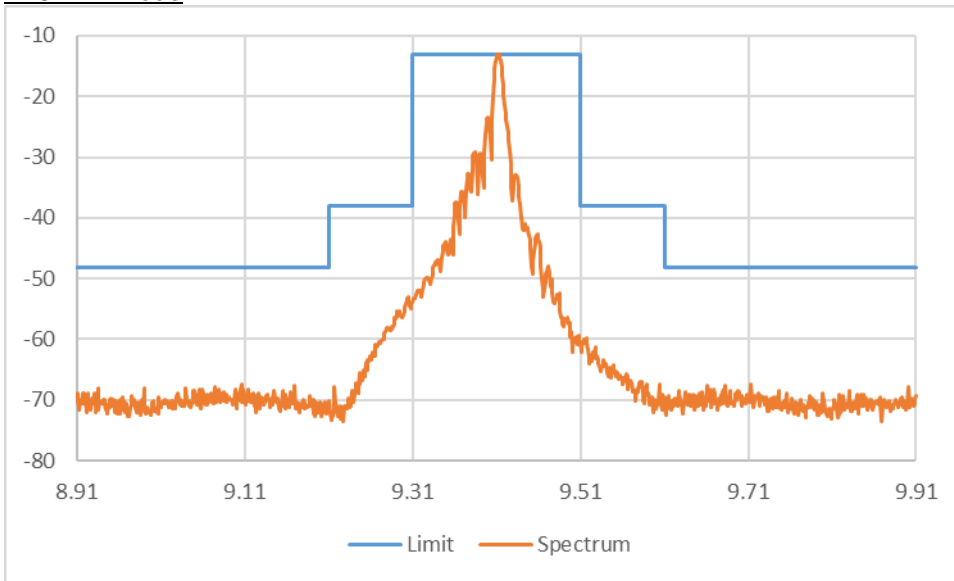
Fig. 7.5 M3 pulse



Occupied bandwidth: 11.517 MHz

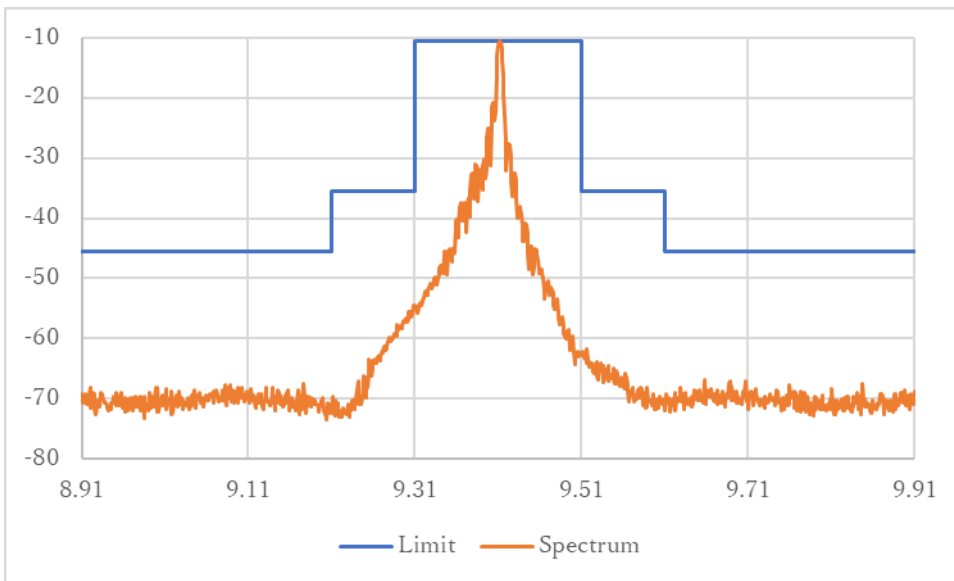
Fig. 7.6 L pulse

TT32NM mode



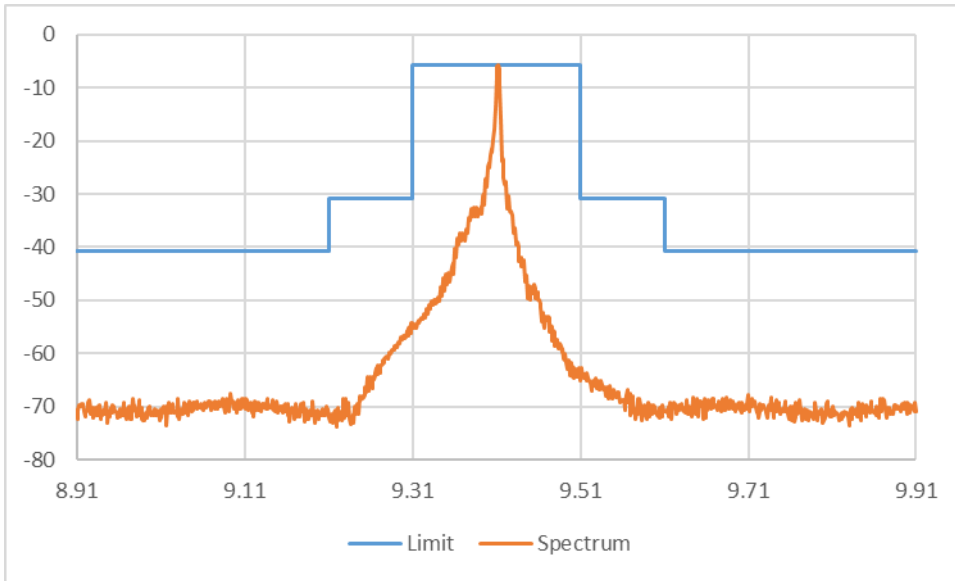
Occupied bandwidth: 65.095 MHz

Fig. 7.7 S1 pulse



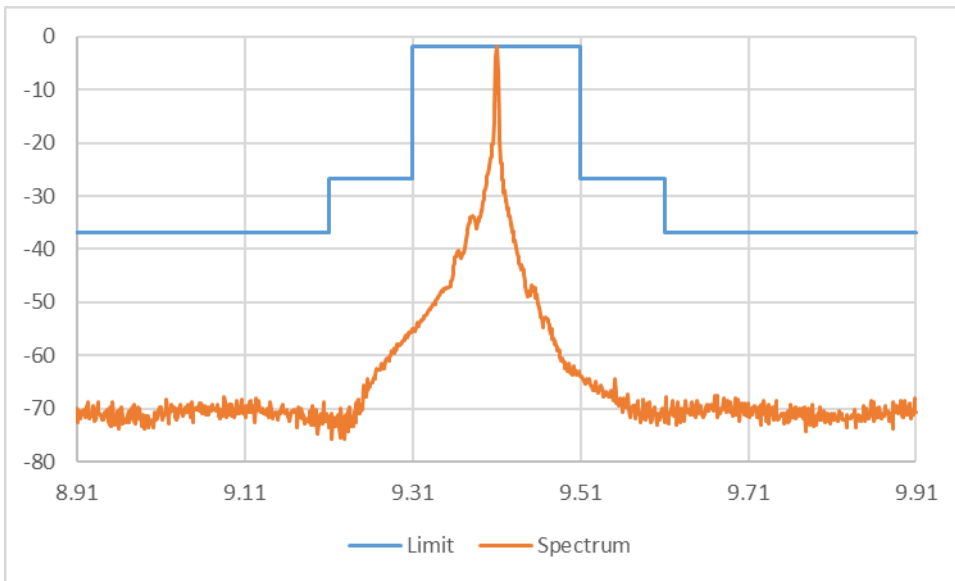
Occupied bandwidth: 52.201 MHz

Fig. 7.8 S2 pulse



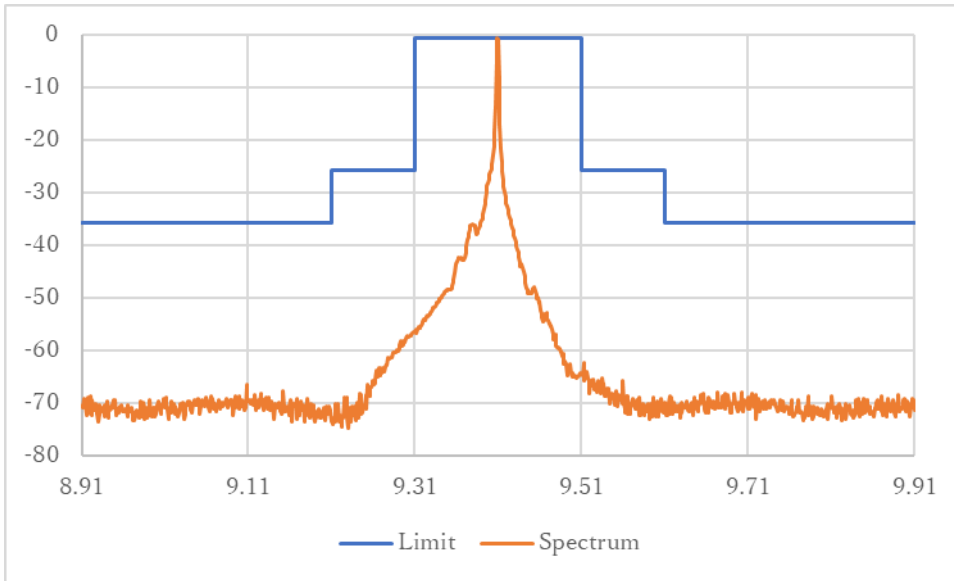
Occupied bandwidth: 39.505 MHz

Fig. 7.9 M1 pulse



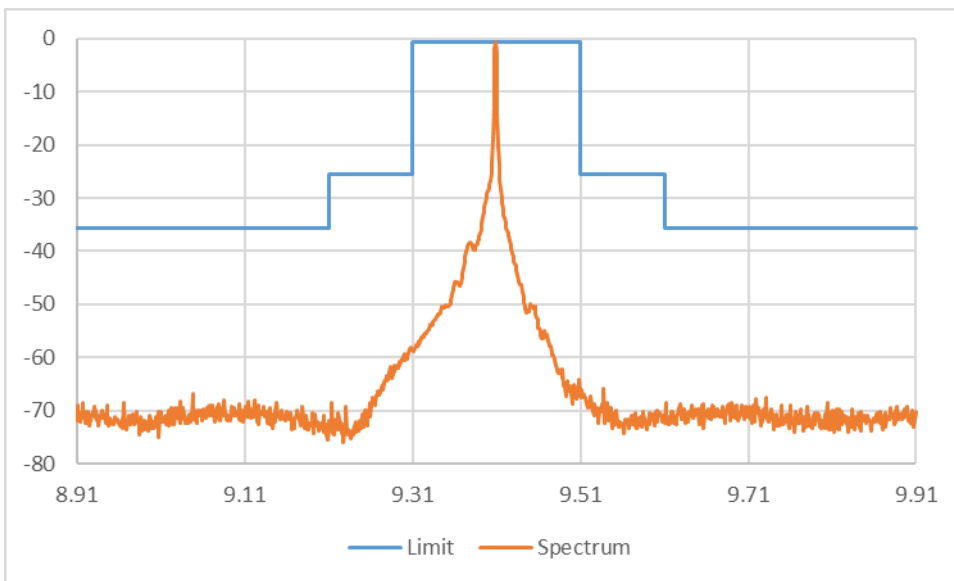
Occupied bandwidth: 21.931 MHz

Fig. 7.10 M2 pulse



Occupied bandwidth: 16.251 MHz

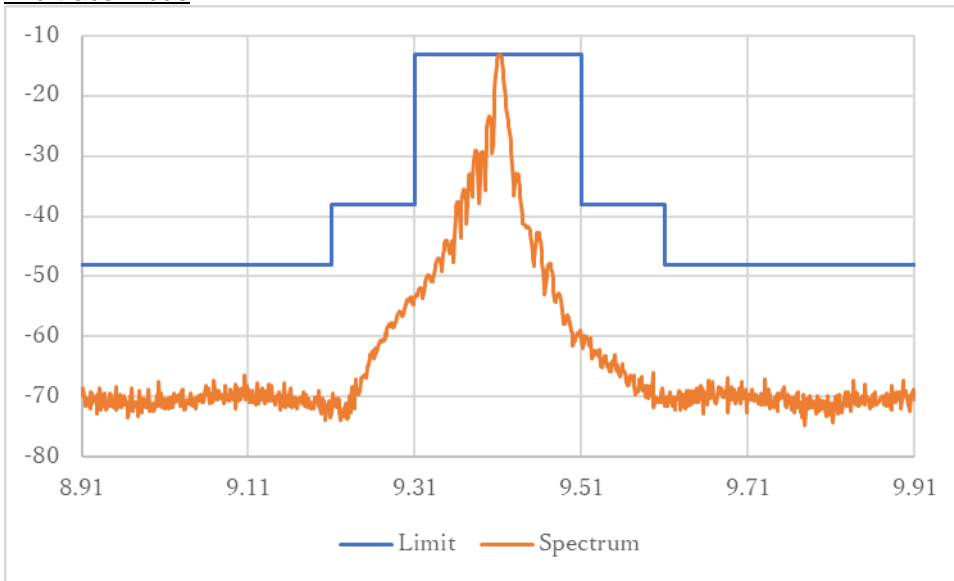
Fig. 7.11 M3 pulse



Occupied bandwidth: 11.940 MHz

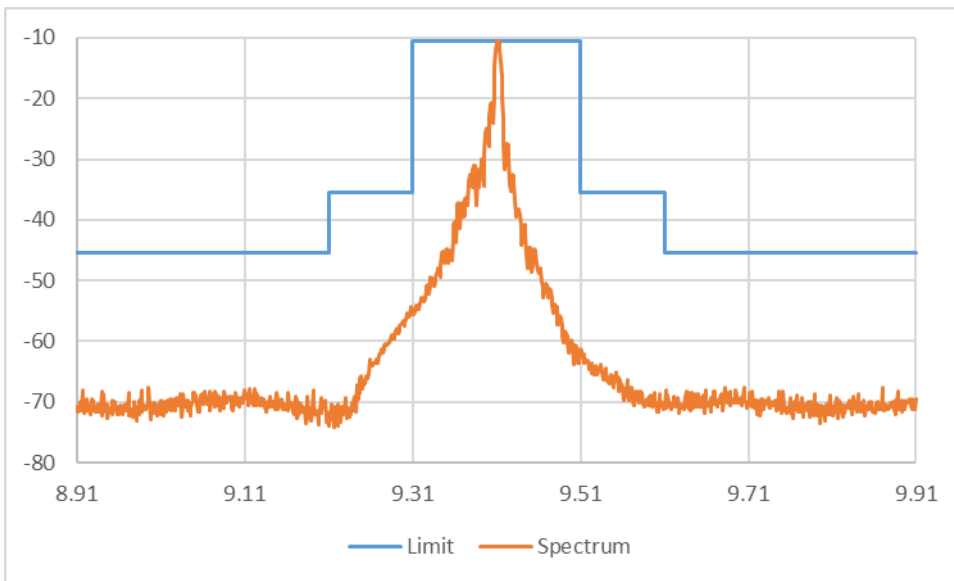
Fig. 7.12 L pulse

2nd trace mode



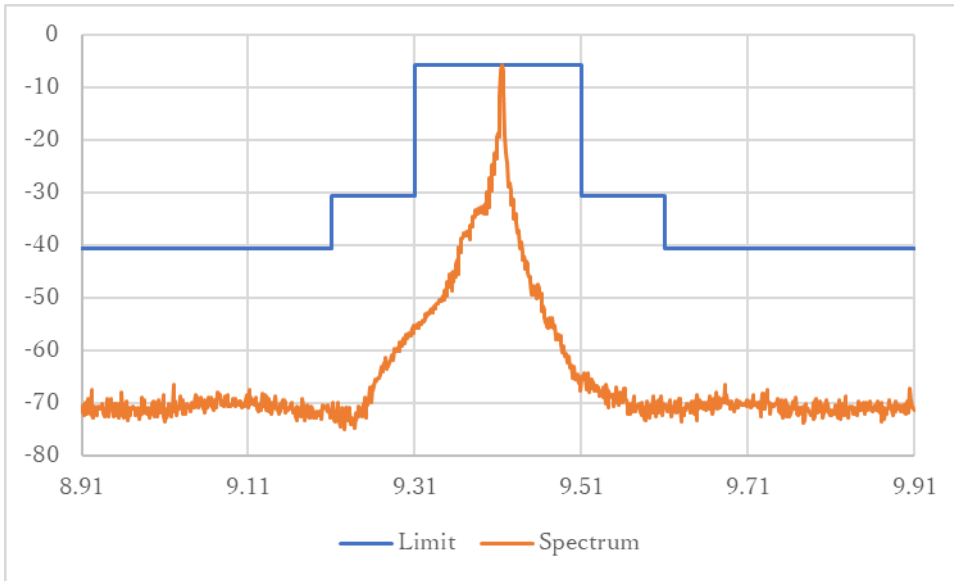
Occupied bandwidth: 65.630 MHz

Fig. 7.13 S1 pulse



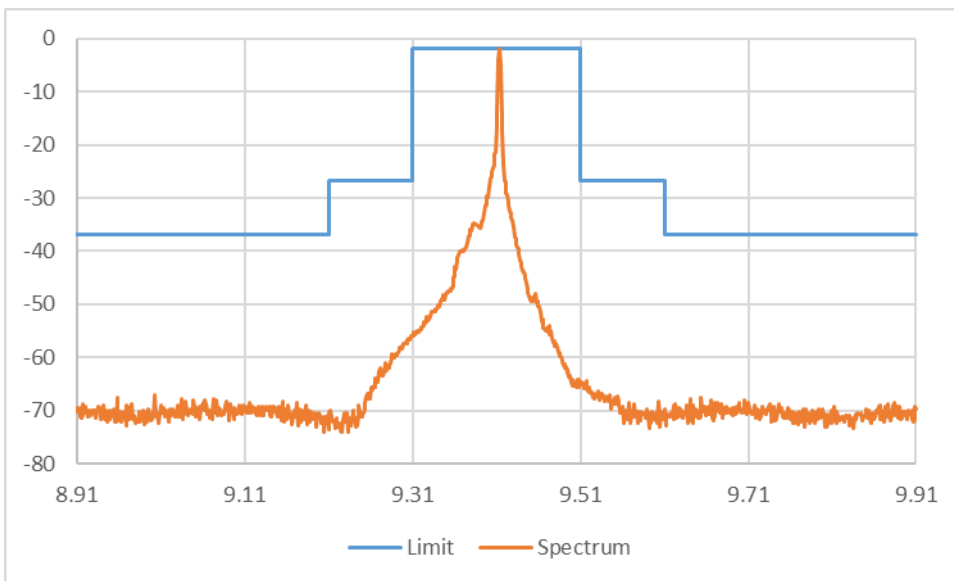
Occupied bandwidth: 52.719 MHz

Fig. 7.14 S2 pulse



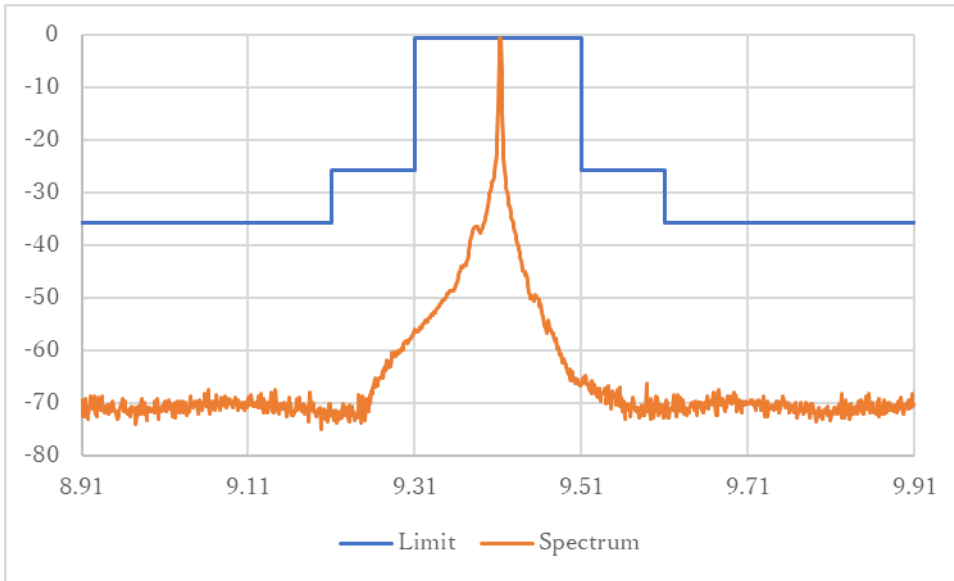
Occupied bandwidth: 38.202 MHz

Fig. 7.15 M1 pulse



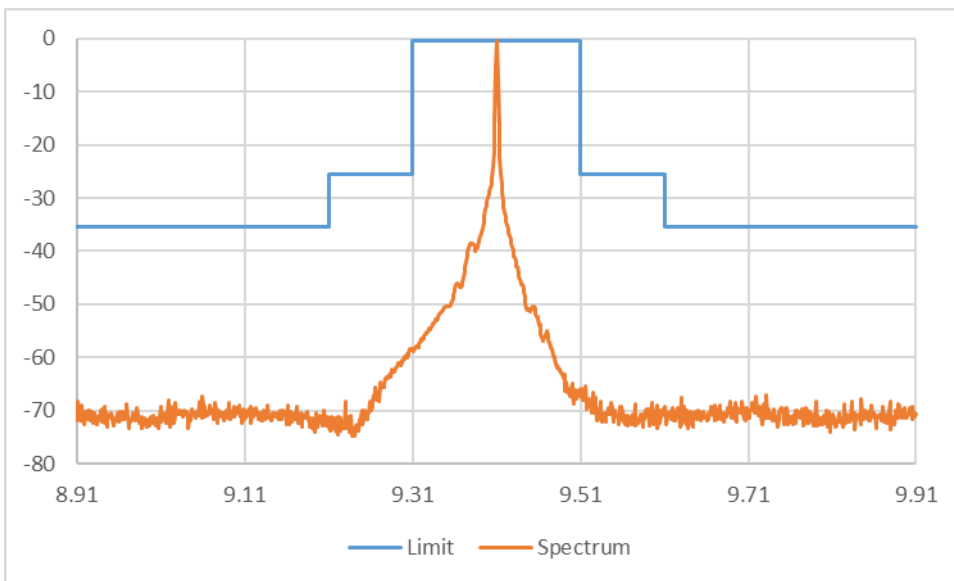
Occupied bandwidth: 20.451 MHz

Fig. 7.16 M2 pulse



Occupied bandwidth: 14.322 MHz

Fig. 7.17 M3 pulse



Occupied bandwidth: 11.077 MHz

Fig. 7.18 L pulse

7.2 Spurious Emissions

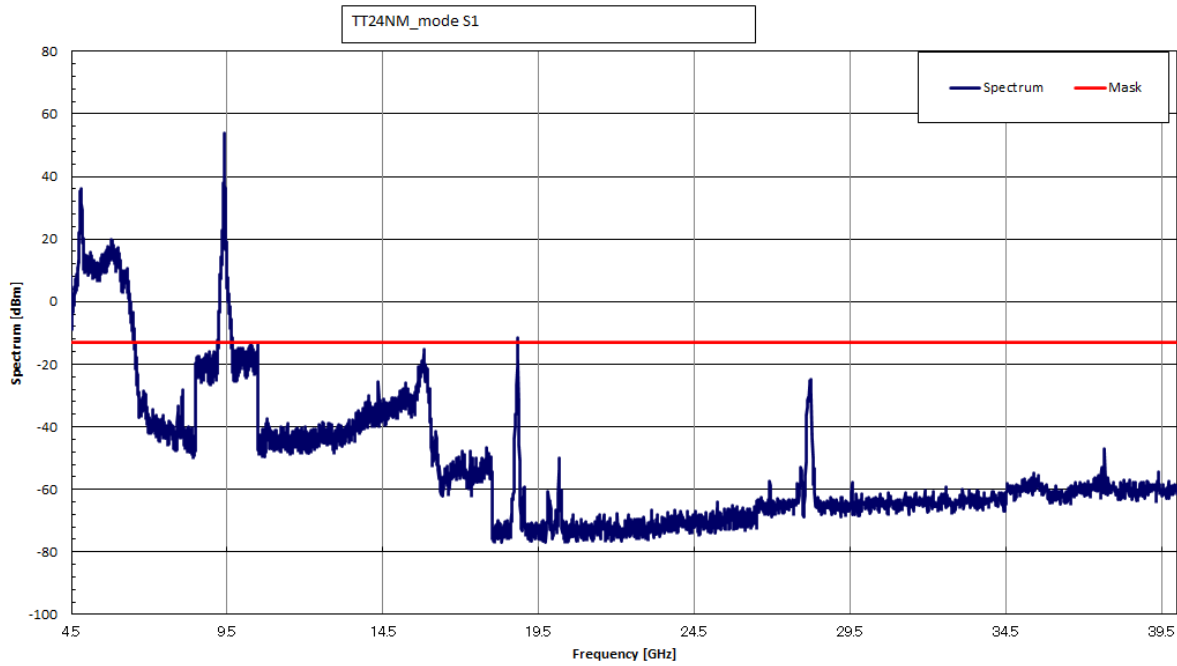


Fig 7.19 Peak, 4.5 GHz to 40 GHz

Note: The measurement for the frequency below 6.54 GHz were unmeasurable due to the large path loss even though the EUT operation was OFF.

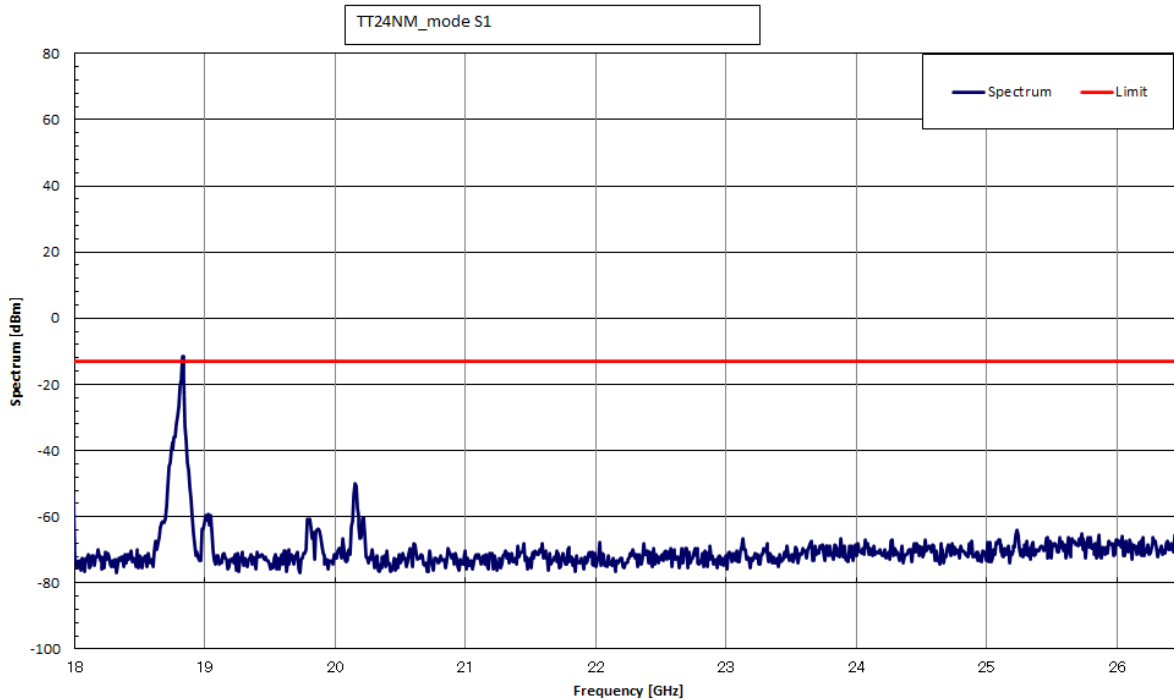


Fig 7.20 Peak, 18 GHz to 26.5 GHz (maximum peak value)

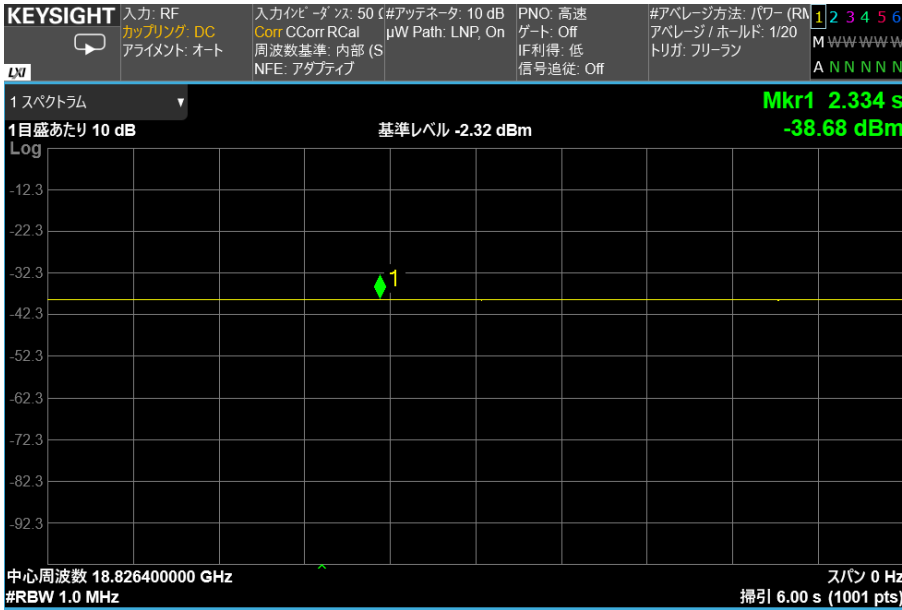
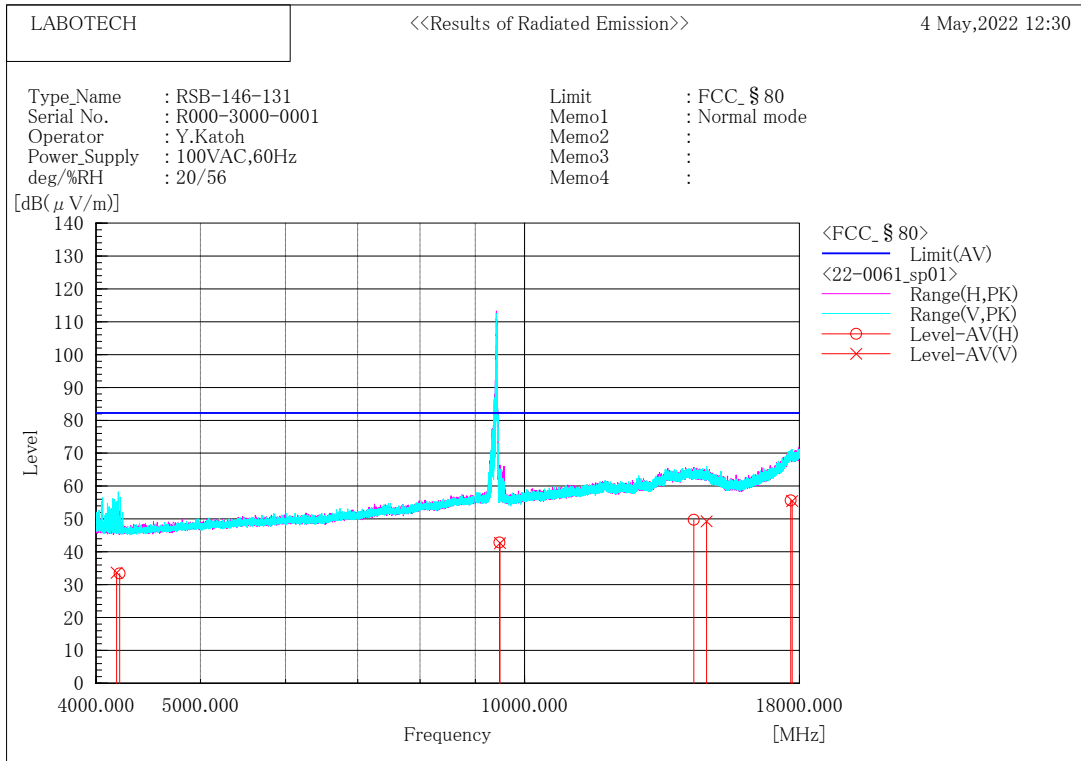


Fig 7.21 Average of the maximum peak value

8 Field Strength of Spurious Radiation Plots measured in the Spurious domain

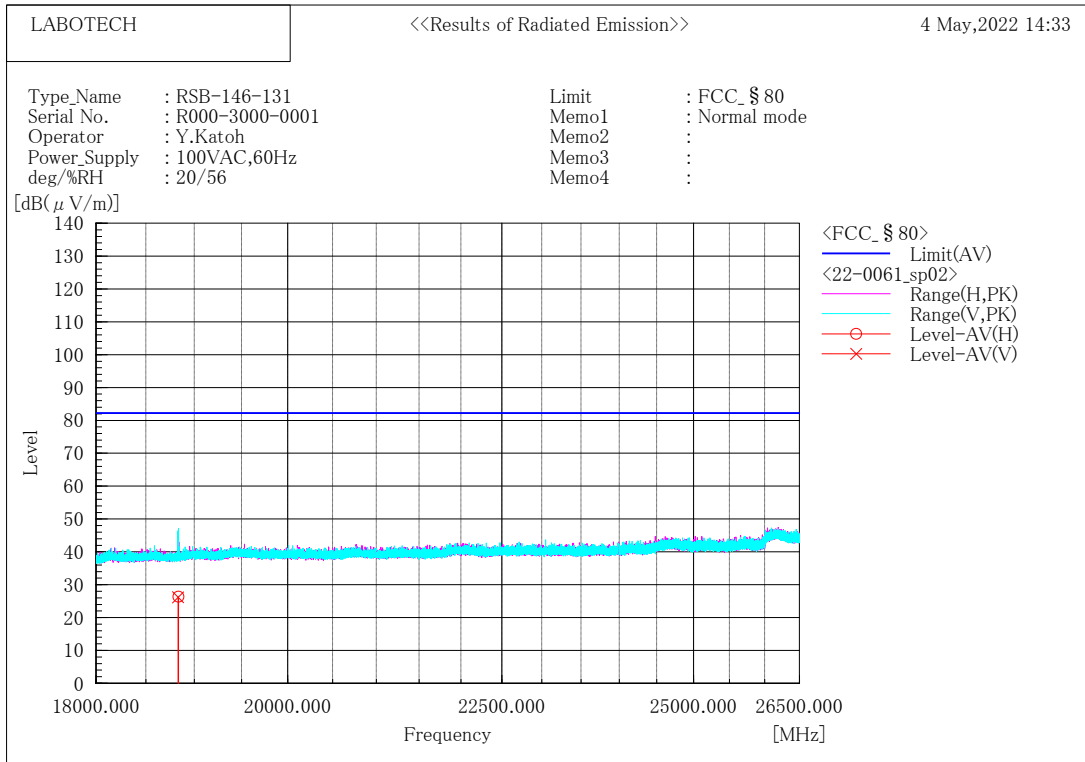
8.1 Measured maximum emission value



Final Result

| No. | Frequency [MHz] | (P) | Reading AV [dB(μV)] | c. f [dB(1/m)] | Result AV [dB(μV/m)] | Limit AV [dB(μV/m)] | Margin AV [dB] | Height [cm] | Angle [°] |
|-----|-----------------|-----|---------------------|----------------|----------------------|---------------------|----------------|-------------|-----------|
| 1 | 4179.111 | V | 32.22 | 1.48 | 33.70 | 82.2 | 48.5 | 257.0 | 224.0 |
| 2 | 4206.419 | H | 31.93 | 1.46 | 33.39 | 82.2 | 48.8 | 258.0 | 40.0 |
| 3 | 9480.148 | H | 33.28 | 9.53 | 42.81 | 82.2 | 39.4 | 225.0 | 165.0 |
| 4 | 9486.380 | V | 33.19 | 9.52 | 42.71 | 82.2 | 39.5 | 260.0 | 342.0 |
| 5 | 14360.050 | H | 32.01 | 17.76 | 49.77 | 82.2 | 32.4 | 150.0 | 75.0 |
| 6 | 14757.400 | V | 32.45 | 16.87 | 49.32 | 82.2 | 32.9 | 150.0 | 106.0 |
| 7 | 17663.090 | H | 33.24 | 22.41 | 55.65 | 82.2 | 26.5 | 150.0 | 84.0 |
| 8 | 17717.100 | V | 32.82 | 22.66 | 55.48 | 82.2 | 26.7 | 150.0 | 74.0 |

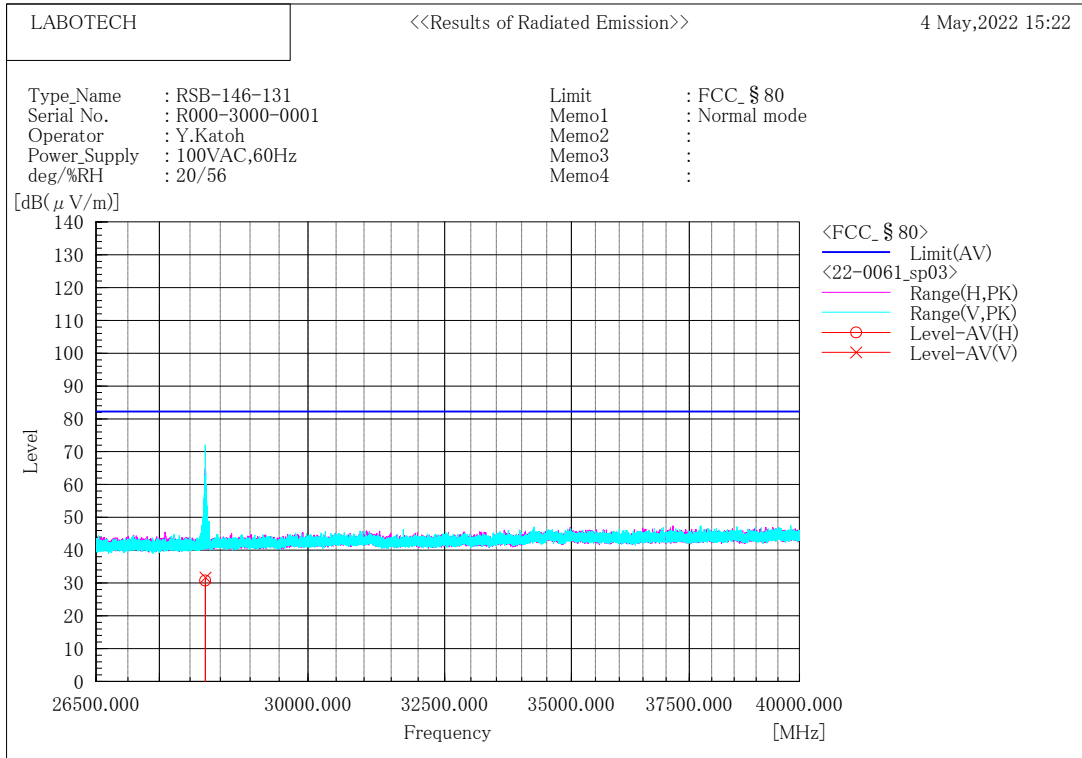
Note: Result AV (dBμV/m) = Reading (dBμV) + Antenna Factor (dB(1/m)) + Path Loss (dB).



Final Result

| No. | Frequency [MHz] | (P) | Reading AV [dB(μV)] | c. f [dB(1/m)] | Result AV [dB(μV/m)] | Limit AV [dB(μV/m)] | Margin AV [dB] | Height [cm] | Angle [°] |
|-----|-----------------|-----|---------------------|----------------|----------------------|---------------------|----------------|-------------|-----------|
| 1 | 18834.120 | H | 34.18 | -7.84 | 26.34 | 82.2 | 55.9 | 154.0 | 128.0 |
| 2 | 18830.960 | V | 34.06 | -7.84 | 26.22 | 82.2 | 56.0 | 146.0 | 171.0 |

Note: Result AV (dBμV/m) = Reading (dBμV) + Antenna Factor (dB(1/m)) + Path Loss (dB).



Final Result

| No. | Frequency [MHz] | (P) | Reading AV [dB(μV)] | c. f [dB(1/m)] | Result AV [dB(μV/m)] | Limit AV [dB(μV/m)] | Margin AV [dB] | Height [cm] | Angle [°] |
|-----|-----------------|-----|---------------------|----------------|----------------------|---------------------|----------------|-------------|-----------|
| 1 | 28250.510 | H | 45.89 | -15.13 | 30.76 | 82.2 | 51.4 | 153.0 | 66.0 |
| 2 | 28251.190 | V | 46.81 | -15.13 | 31.68 | 82.2 | 50.5 | 196.0 | 150.0 |

Note: Result AV (dBμV/m) = Reading (dBμV) + Antenna Factor (dB(1/m)) + Path Loss (dB).

End of text