

# Test Report

(FCC Rules 47 CFR,  
2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 80.217 and 90.213)

**For**

**Trade name: Furuno**

**Model: Transceiver for Marine Radar**

**Type: RTR-101**

**Report No. LIC 12-15-048, Rev.1**

**Date of revised issue: 9 September 2022**

**Labotech International Co., Ltd.**

1-16, Fukazu-cho, Nishinomiya-shi, Hyogo, 663-8203 Japan

Tel: +81-798-63-1094 Fax: +81-798-63-1098

## Report Summary

|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                                |                                                                                                                                                     |                                                     |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| LIC project number:                           | FLI 04-15-0069 (LIC 04-22-0461)                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                                |                                                                                                                                                     |                                                     |
| Test report number of initial issue:          | LIC 12-15-048                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             | Date of initial issue          |                                                                                                                                                     | 21 May 2015                                         |
| Test report number of revised/replaced issue: | LIC 12-15-048, Rev.1                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             | Date of revised/replaced issue |                                                                                                                                                     | 9 September 2022                                    |
| Test report revision/<br>replacement history: | Rev. No                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Date        | Page                           | Item                                                                                                                                                | Description of change/reason                        |
|                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 9 Sep. 2022 | 1, 2, 5, 9 and 12              | Cover page,<br>Report Summary<br>Test standard(s)/Test specifications,<br>TABLE OF CONTENTS,<br>2 Test Results Summary,<br>3.4 Frequency Stability, | Added FCC Part 90 (90.213)                          |
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | 3 and 14                       | Report Summary<br>Place of test,<br>3.5.2 (2) Test Site                                                                                             | Updated the registered laboratory information       |
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | 3                              | Report Summary<br>Written by                                                                                                                        | Changed the preparer to:<br>Written by: Arisa Ogino |
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | 3                              | Report Summary<br>Verified by<br>Approved by                                                                                                        | Changed the approver to:<br>Name: Tadayuki Ekawa    |
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | 3                              | Report Summary                                                                                                                                      | Added the disclaimer                                |
|                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | 4                              | Testing Laboratory Status                                                                                                                           | Updated the laboratory status                       |
| Test standard(s)/<br>Test specifications:     | FCC Rules 47 CFR, Sections:<br>2.1046 - RF Power Output,<br>2.1047 - Modulation Characteristics,<br>2.1049 - Occupied Bandwidth,<br>2.1051 - Spurious Emissions at Antenna Terminals,<br>2.1053 - Field Strength of Spurious Radiation,<br>2.1055 - Frequency Stability,<br>80.217 - Suppression of Interference Aboard Ships.<br>(Date of issue: 1 October 2014)<br><br>90.213 - Frequency stability<br>(the latest version on the day when the revised version was issued.) |             |                                |                                                                                                                                                     |                                                     |
| Customer:                                     | Furuno Electric Co., Ltd.<br>9-52 Ashihara-Cho, Nishinomiya-City, 662-8580 Japan                                                                                                                                                                                                                                                                                                                                                                                              |             |                                |                                                                                                                                                     |                                                     |
| Manufacturer:                                 | Furuno Electric Co., Ltd.<br>9-52 Ashihara-Cho, Nishinomiya-City, 662-8580 Japan                                                                                                                                                                                                                                                                                                                                                                                              |             |                                |                                                                                                                                                     |                                                     |
| Trade name:                                   | FURUNO                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                                |                                                                                                                                                     |                                                     |
| Model:                                        | Transceiver for Marine Radar                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                                |                                                                                                                                                     |                                                     |
| Type:                                         | RTR-101                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                                |                                                                                                                                                     |                                                     |
| Product function and intended use:            | For marine safety navigation                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                                |                                                                                                                                                     |                                                     |
| Number of samples tested:                     | One                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                                |                                                                                                                                                     |                                                     |
| Serial number:                                | R180-0769                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                                |                                                                                                                                                     |                                                     |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                                |                                                                                                                                                     |                                                     |
| Test period:                                  | From 6 April 2015 to 20 April 2015                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                |                                                                                                                                                     |                                                     |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Place of test:            | <p>Labotech International Co., Ltd.</p> <p>- Nishinomiya Lab.<br/>9-52, Ashihara-cho, Nishinomiya-shi, Hyogo, 662-8580 Japan<br/>Test firm designation number: JP2010<br/>Test firm registration number: 696248</p> <p>- Nishinomiya-Hama Lab.<br/>2-20, Nishinomiya-Hama, Nishinomiya-shi, Hyogo, 662-0934 Japan<br/>Test firm designation number: JP2011<br/>Test firm registration number: 738202</p> |
| Test results/ Compliance: | <p>Passed.</p> <p>The test results of this report relate only to the samples tested.</p>                                                                                                                                                                                                                                                                                                                 |
| Tested by:                | Koji Kawai                                                                                                                                                                                                                                                                                                                                                                                               |
| Written by:               | Arisa Ogino                                                                                                                                                                                                                                                                                                                                                                                              |
| Verified by:              | Tadayuki Ekawa                                                                                                                                                                                                                                                                                                                                                                                           |
| Approved by:              | <p>Date: 9 September 2022<br/>Name: Tadayuki Ekawa<br/>Title: Manager, Testing &amp; Facilities Control Section, Technical Department,<br/>Labotech International Co., Ltd.</p> <p>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 of this report and 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.  
Ashihara-cho 9-52, Nishinomiya-city, 662-8580 Japan
- (c) Model:

|              | Type             | Serial Number | Note                                         |
|--------------|------------------|---------------|----------------------------------------------|
| Antenna Unit | ---              | ---           | ---                                          |
| Transceiver  | RTR-101          | R180-0769     | Contained in the Scanner.                    |
| Scanner      | RSB-120          |               | Antenna rotation rate:<br>26 rpm             |
| Antenna      | XN20AF<br>XN24AF | ---           | One (1) selectable.<br>Installed on Scanner. |

- (d) Certification number: FCC ID: ADB9ZWRT101
- (e) Primary Function: Search, Navigation and Anti-collision
- (f) Frequency Range: Fixed frequency, X-band (9410 MHz)
- Type of Emission: P0N  
(Emission designator)
- (g) Size and mass: Antenna Unit: 2550 mm (dia) X 570 mm (H), 41 kg (\*)  
(\*): Scanner with Antenna XN24AF installed.
- (h) Power Supply: 24 VDC, 100-115/220-230 VAC (\*)  
(\*): fed through Processor unit, not directly from AC/DC mains.

### 1.1.2 Transceiver

**Type:** RTR-101 (Contained in the Radar Scanner)

#### 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:  $\pm 30$  MHz  
Pulling: 23 MHz  
Tolerance for 20°C temperature variation: -5 MHz

(d) Pulse Characteristics:

| Pulse type             | S1   | S2   | M1   | M2   | M3   | L1  | L2  |
|------------------------|------|------|------|------|------|-----|-----|
| Pulselength ( $\mu$ s) | 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: Approx. +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)

### 1.1.3 Antenna and Scanner

- (a) Antenna Rotation ON-OFF Switch: Provided.  
(b) Construction: Slotted array antenna  
(c) Length:

| Antenna type | XN20AF | XN24AF |
|--------------|--------|--------|
| Length (cm)  | 204    | 255    |

- (d) Type of Beam: Vertical fan  
(e) Beam Width (3 dB):

| Antenna type              | XN20AF | XN24AF |
|---------------------------|--------|--------|
| Horizontal ( $^{\circ}$ ) | 1.23   | 0.95   |
| Vertical ( $^{\circ}$ )   | 20     | 20     |

(f) Polarization: Horizontal

(g) Antenna Gain:

|              |        |        |
|--------------|--------|--------|
| Antenna type | XN20AF | XN24AF |
| Gain (dBi)   | 30.0   | 31.5   |

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

|                             |        |        |
|-----------------------------|--------|--------|
| Antenna type                | XN20AF | XN24AF |
| Within $\pm 10^\circ$ (dB)  | -28    | -28    |
| Outside $\pm 10^\circ$ (dB) | -32    | -32    |

(i) Scanning (rotating or oscillating): Rotating

(j) Antenna Rotation Rate: 26 rpm

(k) Sector Scan: Not provided.

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

Negligible. (Transmission path is only in the scanner 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: Scanner (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 scanner: Not applicable.

### 1.2 Observation and comments

None.

## 2 Test Results Summary

| Clause no.<br>of this<br>report | 47 CFR<br>Section | Item                                      | Result  | Test Engineer |
|---------------------------------|-------------------|-------------------------------------------|---------|---------------|
| 3.1                             | 2.1046            | RF Power Output                           | Passed. | K. Kawai      |
| 3.2                             | 2.1047            | Modulation Characteristics                | Passed. | K. Kawai      |
| 3.3                             | 2.1049            | Occupied Bandwidth                        | Passed. | K. Kawai      |
| 3.4                             | 2.1055<br>90.213  | Frequency Stability                       | Passed. | K. Kawai      |
| 3.5                             |                   | Spurious Emissions                        | ---     | ---           |
| 3.5.1                           | 2.1051            | - Spurious Emissions at Antenna Terminals | Passed. | K. Kawai      |
| 3.5.2                           | 2.1053            | - Field Strength of Spurious Radiation    | Passed. | K. Kawai      |
| 3.6                             | 80.217            | Suppression of Interference Aboard Ships  | Passed. | K. Kawai      |

### 3 Test Results

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

##### (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 $P_m$ (W)               | 5.6   | 6.8   | 7.4   | 8.3   | 16.5  | 17.7  | 14.7  |
| Magnetron Output, peak $P_p$ (kW) (*1)         | 20.4  | 20.0  | 22.3  | 22.2  | 24.3  | 25.2  | 25.1  |
| Pulselength $T$ ( $\mu$ s) (-3 dB points) (*2) | 0.091 | 0.123 | 0.220 | 0.372 | 0.680 | 1.168 | 1.168 |
| PRR (Hz)                                       | 2998  | 2758  | 1499  | 1000  | 1000  | 600   | 500   |

(\*1)  $P_p$  (kW) = ( $P_m$  (W) / ( $T$  ( $\mu$ s)  $\times$  PRR (Hz)))  $\times$  1000

(\*2): Measured at -3 dB points of the RF envelope of the magnetron output pulse instead of at 50% points of the current of the magnetron, which are equivalent.

Environmental conditions observed: On 6 April 2015, 22°C to 22°C, 66% to 66%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

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

#### 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) Limits (FCC Rule, 80.213 (g)/80.209(b)):

Upper limit frequency,  $f(U) = f_0 + f(AUBW)/2 - 1.5/T$

Lower limit frequency,  $f(L) = f_0 - f(AUBW)/2 + 1.5/T$

Note: Assigned frequency ( $f_0$ ): 9410 MHz (for X-band radars)

Authorized bandwidth ( $f(AUBW)$ ): 110 MHz (for X-band radars)

#### (4) Test Results:

Complied.

| Pulse type                                              | S1     | S2     | M1     | M2     | M3     | L1     | L2     | Result          |
|---------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|-----------------|
| Pulselength T (μs)<br>(-3 dB points) (*1)               | 0.091  | 0.123  | 0.220  | 0.372  | 0.680  | 1.168  | 1.168  | Not applicable. |
| Rise time t <sub>r</sub> (μs)<br>(10 - 90 % amplitude)  | 0.011  | 0.011  | 0.014  | 0.154  | 0.193  | 0.188  | 0.188  | Not applicable. |
| Decay time t <sub>d</sub> (μs)<br>(90 - 10 % amplitude) | 0.125  | 0.107  | 0.108  | 0.110  | 0.130  | 0.120  | 0.124  | Not applicable. |
| PRR (Hz)                                                | 2998   | 2758   | 1499   | 1000   | 1000   | 600    | 500    | Not applicable. |
| Guard Band f(1.5/T)<br>(MHz) (*2)                       | 16.4   | 12.2   | 6.8    | 4.0    | 2.2    | 1.3    | 1.3    | Not applicable. |
| f(U) (MHz)                                              | 9448.6 | 9452.8 | 9458.2 | 9461.0 | 9462.8 | 9463.7 | 9463.7 | Not applicable. |
| f(L) (MHz)                                              | 9371.4 | 9367.2 | 9361.8 | 9359.0 | 9357.2 | 9356.3 | 9356.3 | Not applicable. |
| Frequency at maximum<br>emission (MHz)                  | 9410.2 | 9410.5 | 9411.7 | 9412.1 | 9411.7 | 9411.7 | 9412.1 | Complied.       |

(\*1): Measured at -3 dB points of the RF envelope of the magnetron output pulse instead of at 50% points of the voltage/current of the magnetron, which are equivalent.

(\*2): 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))

Measured Plots: See Clause 7.

Environmental conditions observed: On 6 April 2015, 22°C to 22°C, 66% to 66%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

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

### 3.3 Occupied Bandwidth (FCC Rule 47 CFR, 2.1049)

#### (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) Test Results:

| Pulse type                  | S1   | S2   | M1   | M2   | M3   | L1  | L2   |
|-----------------------------|------|------|------|------|------|-----|------|
| Occupied<br>bandwidth (MHz) | 59.6 | 55.0 | 41.3 | 33.0 | 15.6 | 9.2 | 10.1 |

Spectrum plots: See Clause 8.

Environmental conditions observed: On 1 April 2015, 22°C to 22°C, 66% to 66%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

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

### 3.4 Frequency Stability (FCC Rule 47 CFR, 2.1055 and 90.213)

#### (1) Test Conditions:

- (1) Radar Transmitter settings: All TX (S1/S2/M1/M2/M3/L1/L2) Pulses
- (2) Ambient Temperature settings: - 30°C to + 50°C (10°C interval)
- (3) Power Supply Voltage settings: 85 /100/115 % of nominal voltage (20.4/24.0/27.6 VDC)

#### (2) Test setup:

See Clause 4.

#### (3) Frequency Tolerance Limits (FCC Rule 47 CFR, 80.209(b), 90.213(a)):

| Pulse type | S1     | S2     | M1     | M2     | M3     | L1     | L2     |
|------------|--------|--------|--------|--------|--------|--------|--------|
| f(U) (MHz) | 9448.6 | 9452.8 | 9458.2 | 9461.0 | 9462.8 | 9463.7 | 9463.7 |
| f(L) (MHz) | 9371.4 | 9367.2 | 9361.8 | 9359.0 | 9357.2 | 9356.3 | 9356.3 |

See Clause 3.2 for details.

#### (4) Test Results:

Complied.

Power Supply Voltage setting (\*): 20.4 VDC

| Pulse type                          |       | S1     | S2     | M1     | M2     | M3     | L1     | L2     | Result    |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9419.6 | 9420.3 | 9421.3 | 9421.5 | 9421.1 | 9421.3 | 9421.4 | Complied. |
|                                     | -20°C | 9417.4 | 9417.8 | 9419.6 | 9419.5 | 9419.9 | 9420.3 | 9420.1 | Complied. |
|                                     | -10°C | 9415.0 | 9415.7 | 9417.2 | 9417.3 | 9417.2 | 9417.2 | 9417.9 | Complied. |
|                                     | 0°C   | 9413.6 | 9414.0 | 9415.6 | 9415.9 | 9415.8 | 9415.8 | 9415.7 | Complied. |
|                                     | +10°C | 9411.3 | 9411.9 | 9413.5 | 9413.2 | 9413.1 | 9413.3 | 9413.8 | Complied. |
|                                     | +20°C | 9410.2 | 9410.5 | 9411.7 | 9412.1 | 9411.7 | 9411.7 | 9412.1 | Complied. |
|                                     | +30°C | 9408.3 | 9408.4 | 9410.0 | 9410.2 | 9410.2 | 9410.6 | 9410.5 | Complied. |
|                                     | +40°C | 9405.9 | 9406.9 | 9408.3 | 9408.3 | 9407.9 | 9408.0 | 9408.2 | Complied. |
|                                     | +50°C | 9404.5 | 9404.9 | 9406.1 | 9406.2 | 9406.3 | 9406.6 | 9406.7 | Complied. |

Power Supply Voltage setting (\*): 24.0 VDC

| Pulse type                          |       | S1     | S2     | M1     | M2     | M3     | L1     | L2     | Result    |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9419.9 | 9419.9 | 9421.8 | 9421.3 | 9421.4 | 9421.3 | 9421.4 | Complied. |
|                                     | -20°C | 9417.2 | 9417.2 | 9419.3 | 9419.3 | 9419.2 | 9419.4 | 9419.9 | Complied. |
|                                     | -10°C | 9415.5 | 9415.4 | 9417.0 | 9417.0 | 9416.9 | 9417.2 | 9417.6 | Complied. |
|                                     | 0°C   | 9414.5 | 9414.6 | 9416.3 | 9416.0 | 9415.9 | 9415.7 | 9416.0 | Complied. |
|                                     | +10°C | 9411.4 | 9412.1 | 9413.5 | 9413.4 | 9413.2 | 9413.6 | 9414.0 | Complied. |
|                                     | +20°C | 9409.9 | 9410.0 | 9411.7 | 9412.0 | 9411.4 | 9411.7 | 9412.0 | Complied. |
|                                     | +30°C | 9408.0 | 9408.5 | 9410.1 | 9410.3 | 9410.0 | 9410.6 | 9410.5 | Complied. |
|                                     | +40°C | 9406.8 | 9406.6 | 9408.8 | 9408.7 | 9408.3 | 9408.1 | 9408.1 | Complied. |
|                                     | +50°C | 9404.9 | 9405.6 | 9406.7 | 9406.9 | 9406.8 | 9406.4 | 9406.6 | Complied. |

Power Supply Voltage setting (\*): 27.6 VDC

| Pulse type                          |       | S1     | S2     | M1     | M2     | M3     | L1     | L2     | Result    |
|-------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|-----------|
| Frequency at maximum emission (MHz) | -30°C | 9419.9 | 9419.9 | 9421.3 | 9421.7 | 9421.5 | 9421.3 | 9422.1 | Complied. |
|                                     | -20°C | 9417.8 | 9417.6 | 9419.7 | 9419.4 | 9419.4 | 9419.4 | 9419.3 | Complied. |
|                                     | -10°C | 9415.5 | 9415.6 | 9417.2 | 9417.6 | 9417.3 | 9417.3 | 9417.8 | Complied. |
|                                     | 0°C   | 9414.1 | 9413.7 | 9415.7 | 9415.8 | 9415.8 | 9416.0 | 9416.4 | Complied. |
|                                     | +10°C | 9412.0 | 9412.3 | 9413.7 | 9413.8 | 9413.4 | 9413.2 | 9413.9 | Complied. |
|                                     | +20°C | 9409.6 | 9409.8 | 9411.5 | 9411.5 | 9411.7 | 9412.2 | 9412.4 | Complied. |
|                                     | +30°C | 9408.3 | 9408.9 | 9410.5 | 9410.6 | 9410.1 | 9410.0 | 9410.2 | Complied. |
|                                     | +40°C | 9405.9 | 9406.6 | 9407.9 | 9408.3 | 9408.1 | 9408.6 | 9408.6 | Complied. |
|                                     | +50°C | 9404.4 | 9405.0 | 9406.5 | 9406.6 | 9406.3 | 9406.3 | 9406.3 | Complied. |

Environmental conditions observed: On 7 April 2015, 20°C to 21°C, 64% to 65%RH

On 8 April 2015, 20°C to 23°C, 64% to 52%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

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

### 3.5 Spurious Emissions

#### 3.5.1 Spurious Emissions at Antenna Terminal (FCC Rule 47 CFR, 2.1051)

##### (1) Test Conditions:

For all TX (S1/S2/M1/M2/M3/L1/L2) Pulses, the transmitter output power will be 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        | Emission attenuation (mean power, dB)                    |
|------------------------------------------------------|----------------------------------------------------------|
| 50 - 100 %<br>(of the authorized bandwidth)          | At least 25                                              |
| 100 - 250 %<br>(of the authorized bandwidth)         | At least 35                                              |
| more than 250 % (*)<br>(of the authorized bandwidth) | At least 43 + 10 log <sub>10</sub> (mean power in watts) |

Note: (1) Authorized bandwidth = 110 MHz (for X-band radars)

(\*) for the relevant frequency bands, tests were performed according to FCC Rule, 2.1053. See Clause 3.5.2.

##### (4) Test Results:

Complied.

Spectrum Plots: See Clause 8.

Environmental conditions observed: On 1 April 2015, 22°C to 22°C, 66% to 66%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

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

### 3.5.2 Field Strength of Spurious Radiation (FCC Rule 47 CFR, 2.1053)

#### (1) Test Conditions:

For all TX (S1/S2/M1/M2/M3/L1/L2) Pulses, the Radiated Emission test was performed.

(a) For the test frequency range of 9 kHz to 2000 MHz, the Antenna for Transceiver was replaced with the rotating non-reflective load. Spurious emissions for 9 kHz to 2000 MHz are not found at the antenna terminal due to its structure (Waveguide tube). The EUT cabinet radiation was measured with the EUT rotated 360°.

(b) For 2 GHz to 40 GHz, the Antenna was set to the Transceiver with the rotating mode.

**(2) Test Site:** LIC Nishinomiya-Hama Laboratory, Semi-Anechoic Chamber

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

#### (4) Test setup:

For the test frequency range of 2 GHz to 40 GHz, 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:

(a1) 1.5 m for the test frequency range of 9 kHz to 30 MHz,

(a2) 1 m to 4 m for the test frequency range of 30 MHz to 2000 MHz,

(b) 2.0 m that was same as those for the EUT for the test frequency range of 2 GHz to 40 GHz.

(c) Antenna polarization: vertical and horizontal.

#### EUT height:

(a) 0.8 m for the test frequency range of 9 kHz to 2000 MHz,

(b) 2.0 m for the test frequency range of 2 GHz to 40 GHz.

See Clauses 4 and 6.

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

| Frequency removed from the assigned frequency    | Emission attenuation<br>(mean power, dB)                 |
|--------------------------------------------------|----------------------------------------------------------|
| 50 - 100 % (*)<br>(of the authorized bandwidth)  | At least 25                                              |
| 100 - 250 % (*)<br>(of the authorized bandwidth) | At least 35                                              |
| more than 250 %<br>(of the authorized bandwidth) | At least 43 + 10 log <sub>10</sub> (mean power in watts) |

Note: (1) Assigned frequency (center frequency) = 9410 MHz (for X-band radars)

(2) Authorized bandwidth = 110 MHz (for X-band radars)

(\*) for the relevant frequency bands, tests were performed according to FCC Rule 47 CFR, 2.1051. See Clause 3.5.1.

#### (6) Test Results:

Complied.

From the results of the pre-tests, the spurious emission level was found to be the maximum with S1 pulse. Consequently, the test was performed only with S1 pulse.

$$\begin{aligned} [\text{Limit}] &= 43 + 10 \log_{10} (\text{mean power in watts}) \\ &= 43 + 10 \log_{10} (5.6) \\ &= 50.5 \text{ dB} \end{aligned}$$

where, [ mean power in watts ] = 5.6 W for S1 pulse. See 3.1.

For this time, Limit of 60 dB was applied for the test.

From the results of the pre-tests, the spurious emission level was found to be the maximum with S1 pulse and XN20AF. Consequently, the final test was performed only with S1 pulse and XN20AF.

The electric field strength of the maximum power radiation was 167.6 dB $\mu$ V/m with S1 pulse. Consequently, the allowable emission limit was set to 107.6 dB $\mu$ V/m (= 167.6 dB $\mu$ V/m - 60 dB).

Spectrum plots: See Clause 9.

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

Environmental conditions observed: On 11 April 2015, 19°C to 20°C, 54% to 60%RH

On 20 April 2015, 21°C to 21°C, 65% to 65%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VAC.

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

### 3.6 Suppression of Interference Aboard Ships (FCC Rule 47 CFR, 80.217)

#### (1) Test Conditions/Test Setup:

The test was performed at the antenna port with the Standby (Receive) mode.

#### (2) Test frequency range: 9 kHz to 40 GHz

#### (3) Spurious Emission Limits for Receivers:

For delivered power to artificial antenna,

| Frequency          | Power to artificial antenna | Resolution bandwidth of<br>Spectrum analyzer |
|--------------------|-----------------------------|----------------------------------------------|
|                    | ( $\mu$ W)                  |                                              |
| 9 kHz - 150 kHz    | 400                         | 1 kHz                                        |
| 150 kHz - 30 MHz   |                             | 10 kHz                                       |
| 30 MHz - 100 MHz   | 4,000                       | 100 kHz                                      |
| 100 MHz to 300 MHz | 40,000                      |                                              |
| 300 MHz - 1 GHz    | 400,000                     |                                              |
| 1 GHz - 40 GHz     |                             | 1 MHz                                        |

#### (4) Test Results:

Complied.

Tests were performed with the EUT Standby mode (= receive only mode).

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

Spectrum plots: See Clause 10.

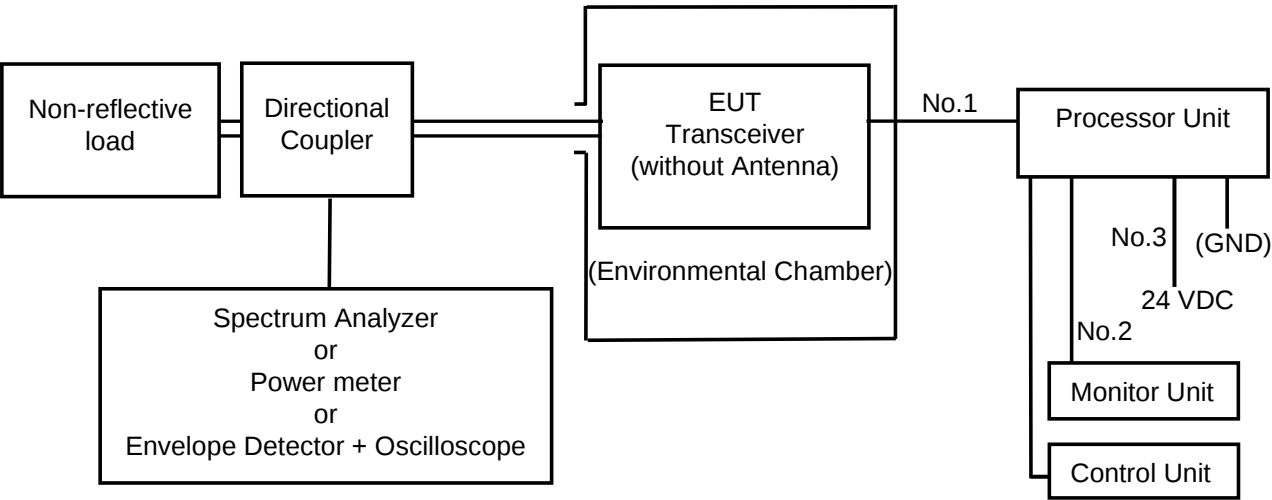
Environmental conditions observed: On 1 April 2015, 22°C to 22°C, 66% to 66%RH

Power supply voltage measured (\*): 24.0 VDC to 24.0 VDC.

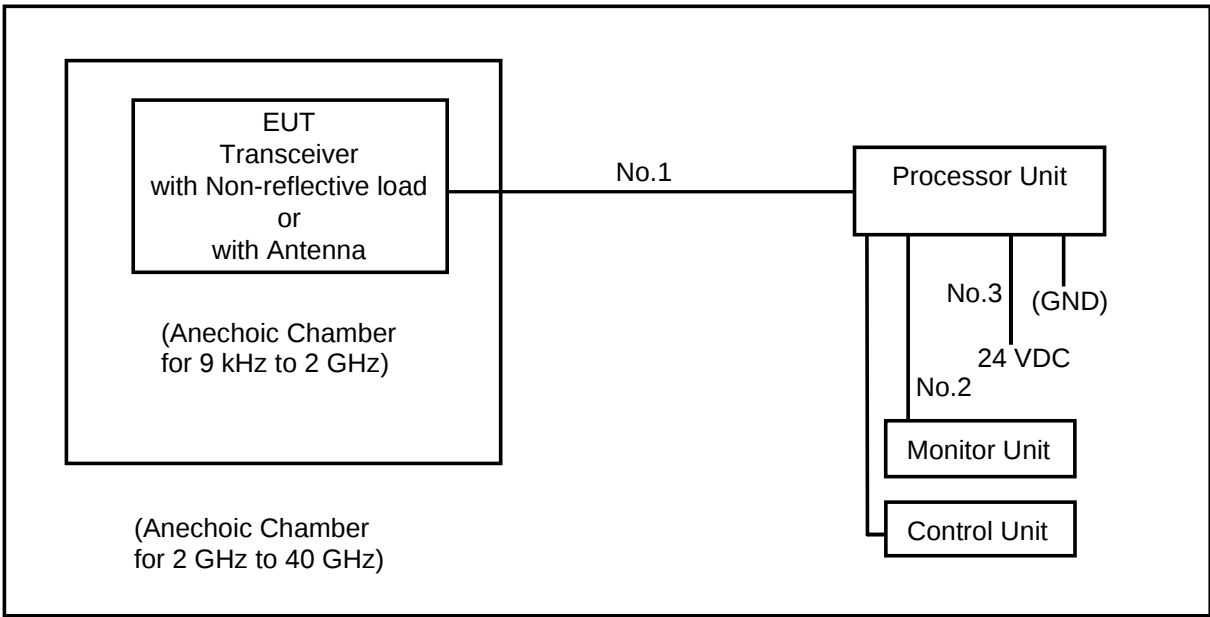
(\*): Power input voltages to the external equipment (Processor unit) measured.

**4 Test Setup for Measurements**

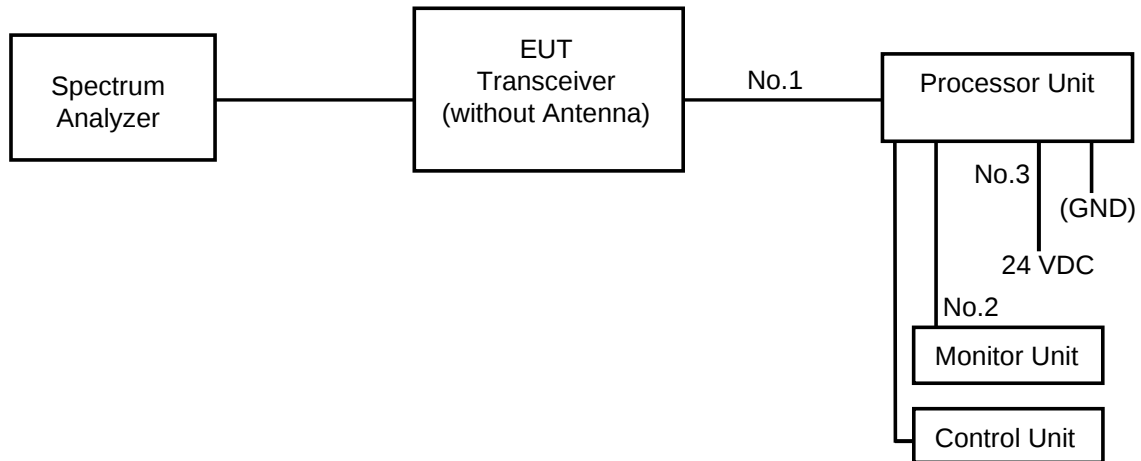
(1) Test Setup for Clauses 3.1, 3.2, 3.3, 3.4, and 3.5.1.



(2) Test Setup for Clause 3.5.2.



## (3) 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      | 10 April 2014            | 1 year               |
| 120121202 | Dummy Load (X-band)          | 4D376                 | R4535004   | Shimada      | 10 April 2014            | 1 year               |
| ----      | Waveguide (for X-band)       | WRJ-10<br>(l = 60 cm) | ----       | Furuno       | ----                     | ----                 |
| HT552     | Power meter                  | E4418B                | GB43315050 | Agilent      | 17 October 2014          | 1 year               |
| HT653     | Attenuator                   | 8491B(10dB)           | MY39264135 | Agilent      | 6 March 2015             | 1 year               |
| HT926     | Power Sensor                 | E9304A-H18            | MY53100039 | Agilent      | 22 July 2014             | 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      | 10 April 2014            | 1 year               |
| 120121202 | Dummy Load (X-band)          | 4D376                 | R4535004   | Shimada      | 10 April 2014            | 1 year               |
| ----      | Waveguide (for X-band)       | WRJ-10<br>(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 Occupied Bandwidth and for 3.5.1 Spurious Emissions at Antenna Terminal:

| C/N       | Instrument                   | Type                  | S/N        | Manufacturer | Date of last calibration | Calibration interval |
|-----------|------------------------------|-----------------------|------------|--------------|--------------------------|----------------------|
| 120121202 | Directional Coupler (X-band) | 5D364S                | R05762     | Shimada      | 10 April 2014            | 1 year               |
| 120121202 | Dummy Load (X-band)          | 4D376                 | R4535004   | Shimada      | 10 April 2014            | 1 year               |
| ----      | Waveguide (for X-band)       | WRJ-10<br>(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      | ----                     | ----                 |

(4) For 3.4 Frequency Stability:

| 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 DAQSTATION FX100 | FX106-4-1             | S5JA01445  | Yokogawa     | 18 August 2014           | 1 year               |
| 120121202 | Directional Coupler (X-band)                                  | 5D364S                | R05762     | Shimada      | 10 April 2014            | 1 year               |
| 120121202 | Dummy Load (X-band)                                           | 4D376                 | R4535004   | Shimada      | 10 April 2014            | 1 year               |
| ----      | Waveguide (for X-band)                                        | WRJ-10<br>(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      | ----                     | ----                 |

## (5) For 3.5.2 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               |
| HT463   | Spectrum Analyzer                                      | R3132         | 110401654  | ADVANTEST         | 1 August 2014            | 1 year               |
| HT565   | Loop Antenna                                           | HFH2-Z2       | 100093     | ROHDE & SCHWARTZ  | 12 August 2014           | 1 year               |
| HT459   | Biconical antenna (30 MHz to 300 MHz)                  | VBA6106A      | 1296       | Schaffner         | 13 August 2014           | 1 year               |
| HT331   | Log periodic antenna (300 MHz to 1000 MHz)             | UHALP9107     | 91071214   | Schwarzbeck       | 13 August 2014           | 1 year               |
| HT467   | Double-ridged waveguide horn antenna (1 GHz to 18 GHz) | 3115          | 6520       | EMCO              | 12 August 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               |
| HT518   | Pre-amplifier (30 MHz to 2 GHz)                        | 87405A        | 3207A01643 | Agilent           | 23 June 2014             | 1 year               |
| HT568   | Amplifier (for Loop antenna)                           | 310N          | 250607     | Sonoma Instrument | 23 June 2014             | 1 year               |
| HT365   | Semi-anechoic Chamber                                  | 3mSAC         | D-002      | Riken             | ----                     | ----                 |
| HT156   | DC power supply                                        | GP035-30      | 1014396080 | Takasago          | ----                     | ----                 |
| 30-0021 | Notch Filter (X-band)                                  | CBR-X7-3A     | R986500    | Shimada           | 17 September 2014        | 1 year               |
| ---     | Dummy Load (X-band)                                    | 4D376         | R25510001  | Shimada           | ----                     | ----                 |
| KB137   | Coaxial cable                                          | MWX221-2m     | 0804S167   | JUNKOSHA          | 19 September 2014        | 1 year               |
| KB138   | Coaxial cable                                          | MWX221-5m     | 0804S166   | JUNKOSHA          | 19 September 2014        | 1 year               |
| KB179   | Coaxial Cable for Radiated Emission Measurement        | SUCOFLEX 104A | 48932/4A   | HUBER+SUHNER      | 9 August 2014            | 1 year               |
| KB180   | Coaxial Cable for Radiated Emission Measurement        | SUCOFLEX 104A | 48933/4A   | HUBER+SUHNER      | 9 August 2014            | 1 year               |
| KB181   | Coaxial Cable for Radiated Emission Measurement        | SUCOFLEX 102A | 1261/2A    | HUBER+SUHNER      | 9 August 2014            | 1 year               |

## (6) For 3.6 Suppression of Interference Aboard Ships:

| C/N   | Instrument        | Type     | S/N        | Manufacturer | Date of last calibration | Calibration interval |
|-------|-------------------|----------|------------|--------------|--------------------------|----------------------|
| HT676 | Spectrum Analyzer | 8564EC   | 4103A00440 | Agilent      | 11 March 2015            | 1 year               |
| HT432 | DC Power Supply   | PAN55-20 | AK003307   | KIKUSUI      | ----                     | ----                 |

## 6 Photograph of Test Setup/Arrangement

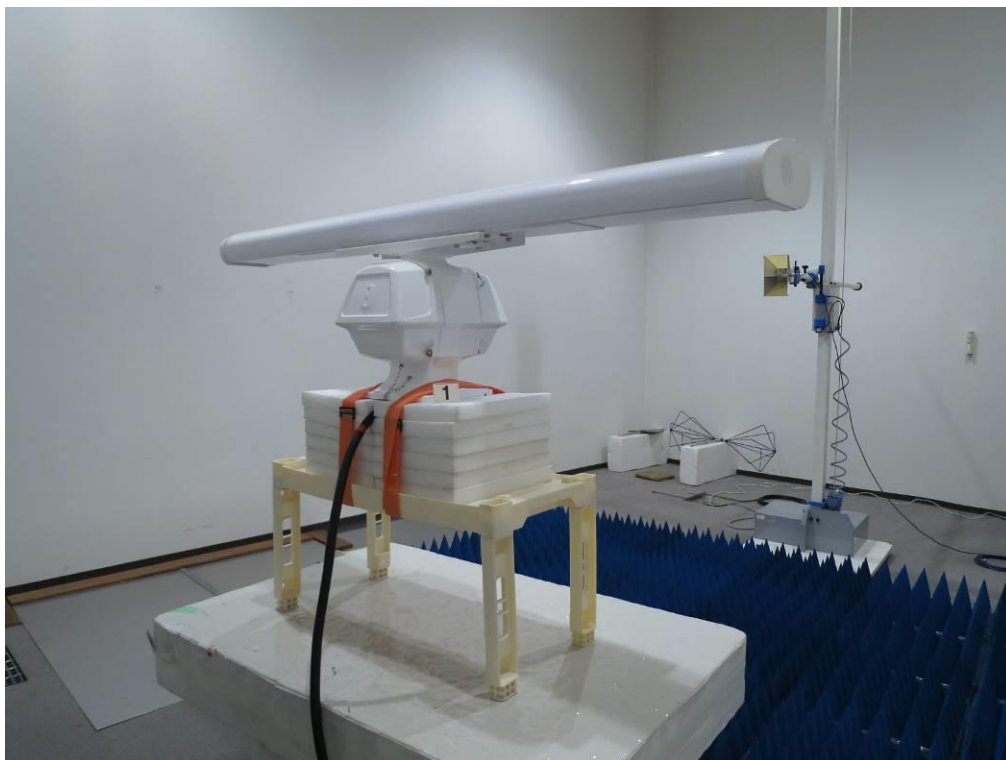
(1) For Temperature (TX frequency stability) tests,



(2) For Transmitter Unwanted Emissions measurements,



for 9 kHz to 2000 MHz



for 2 GHz to 40 GHz

## 7 RF Envelope and Spectrum of the output pulse

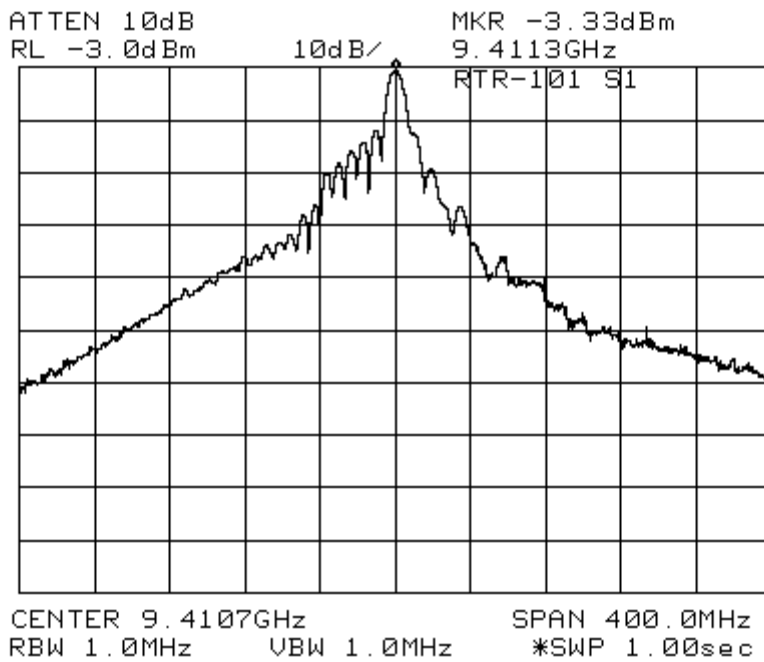
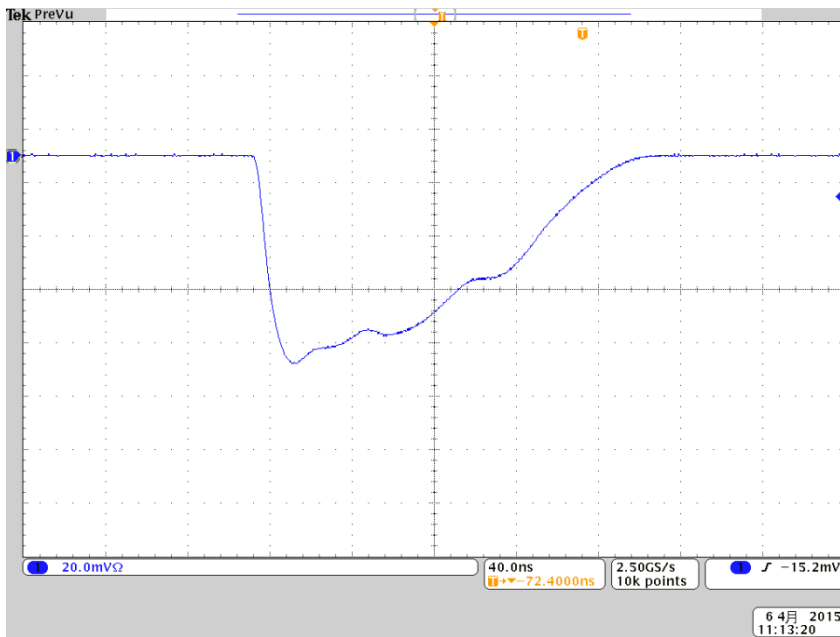


Fig. 7.1 S1 Pulse Envelope and Spectrum

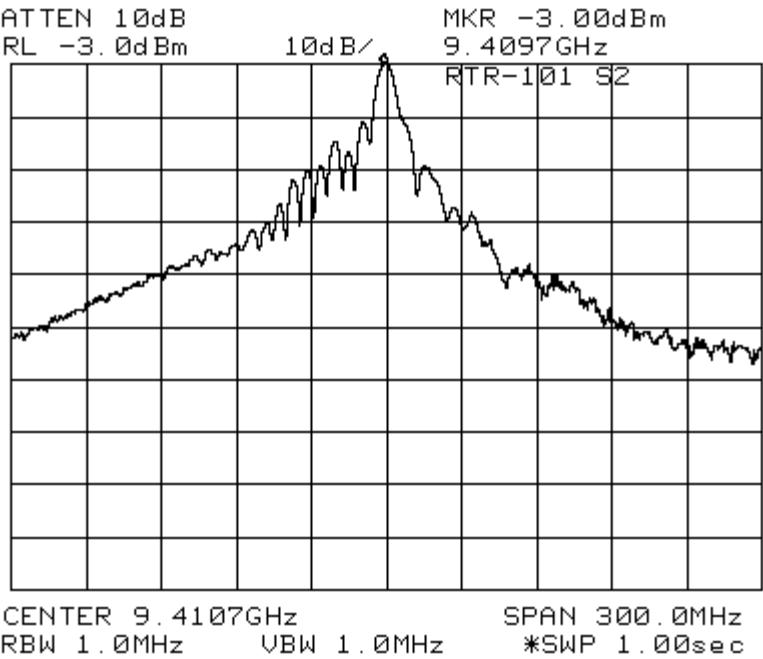
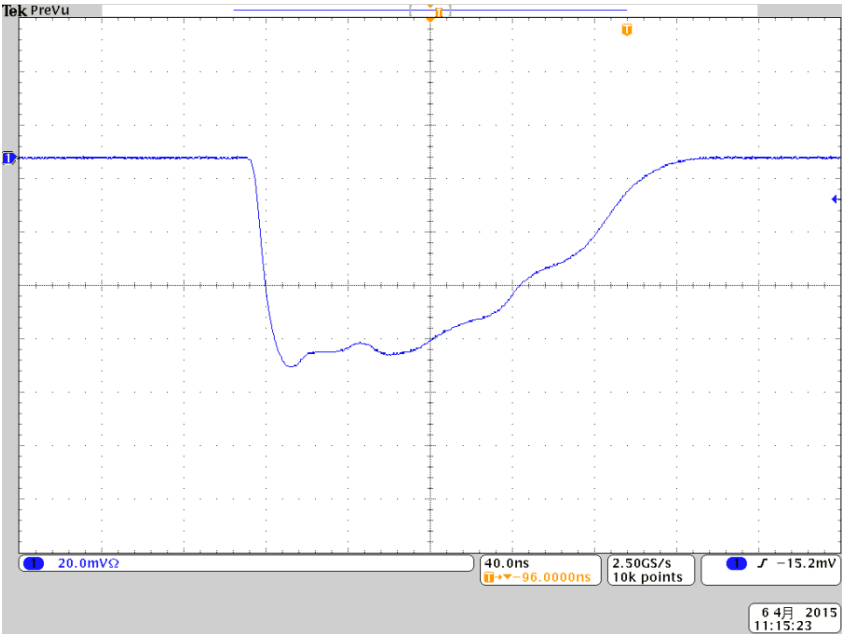


Fig. 7.2            S2 Pulse Envelope and Spectrum

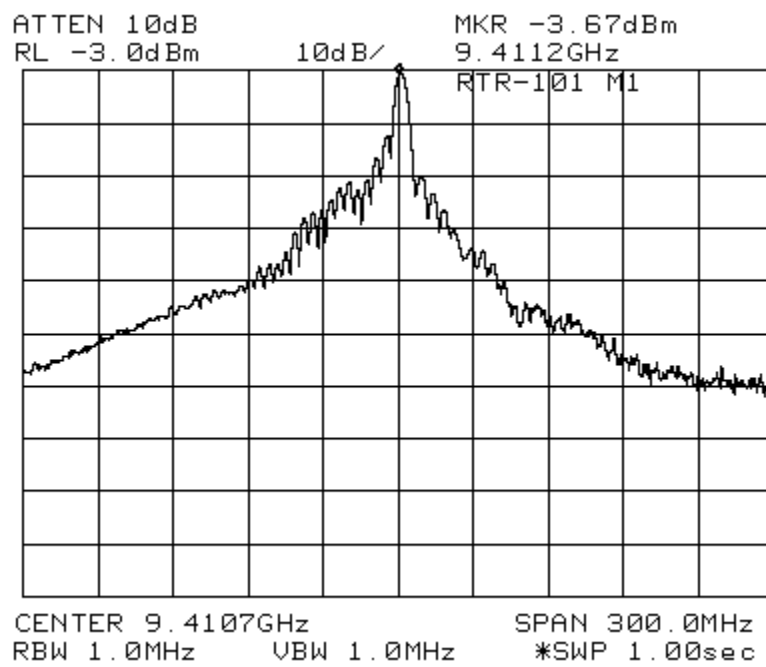
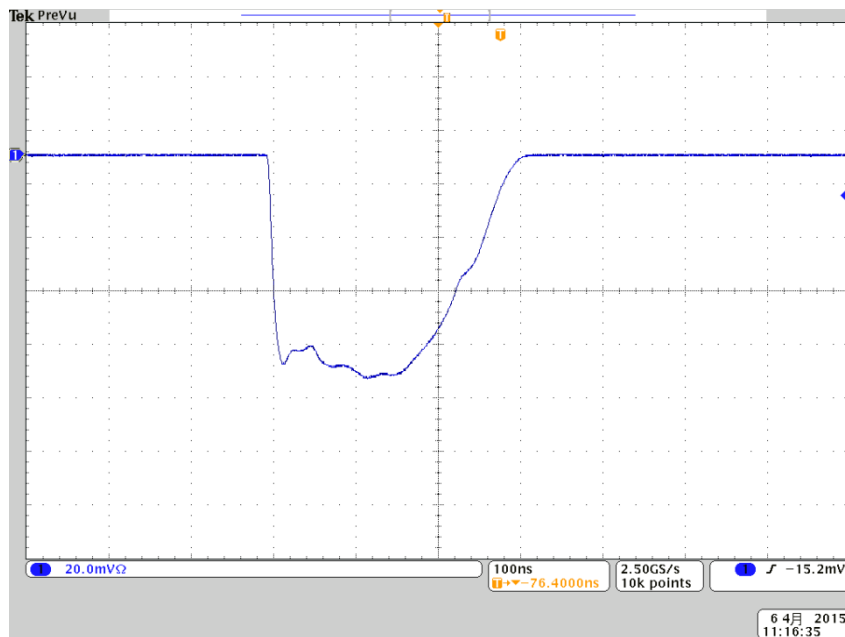


Fig. 7.3 M1 Pulse Envelope and Spectrum

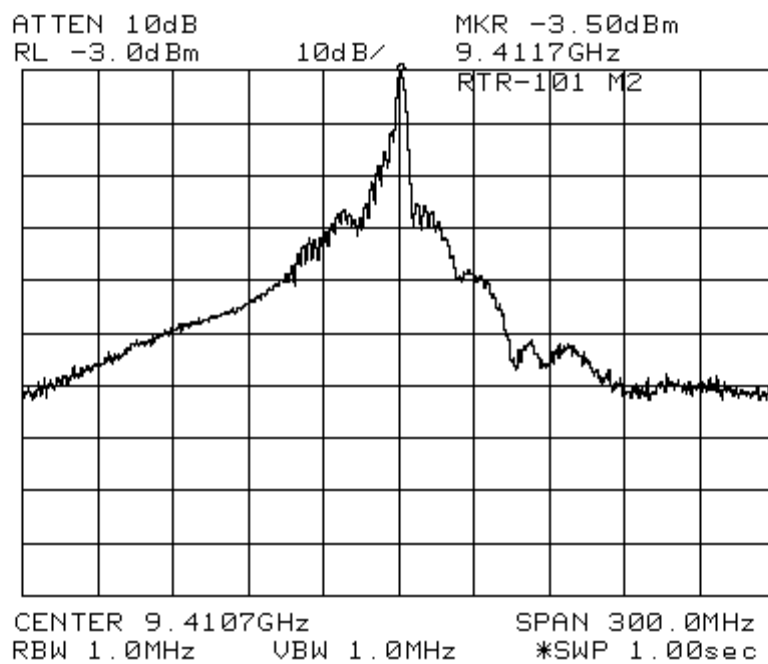
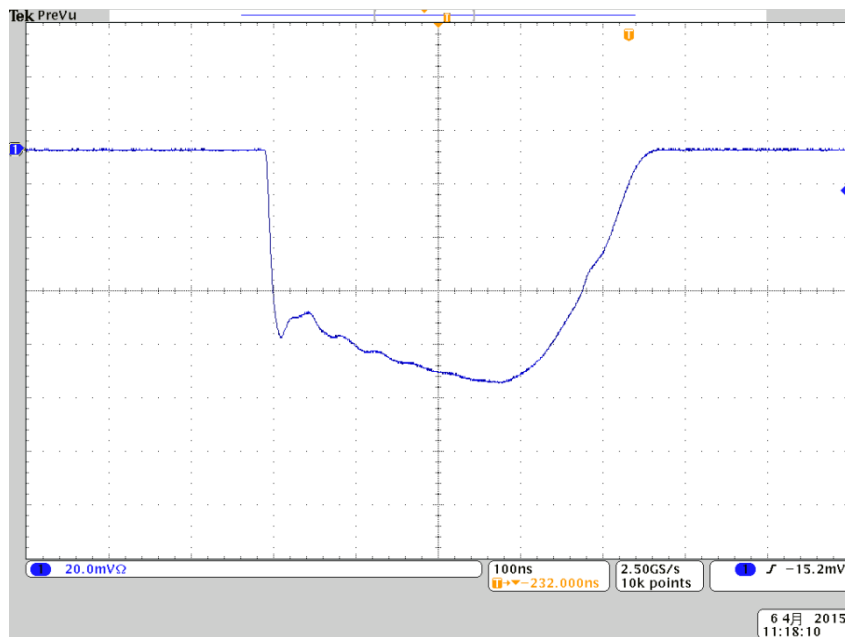


Fig. 7.4 M2 Pulse Envelope and Spectrum

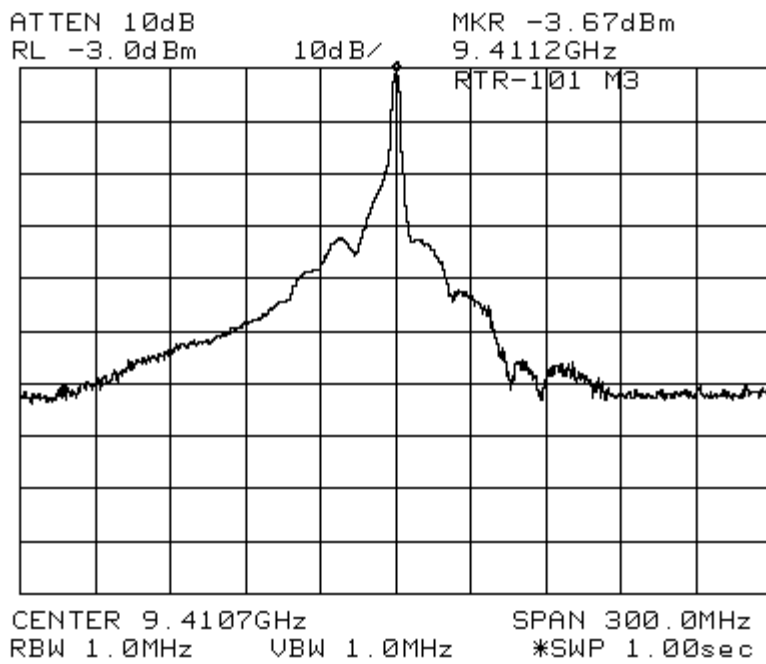
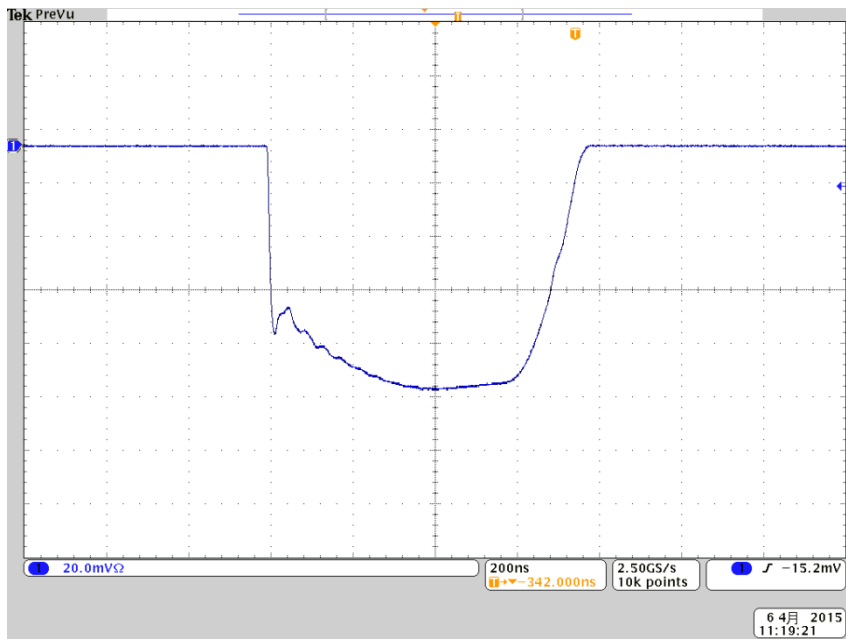


Fig. 7.5 M3 Pulse Envelope and Spectrum

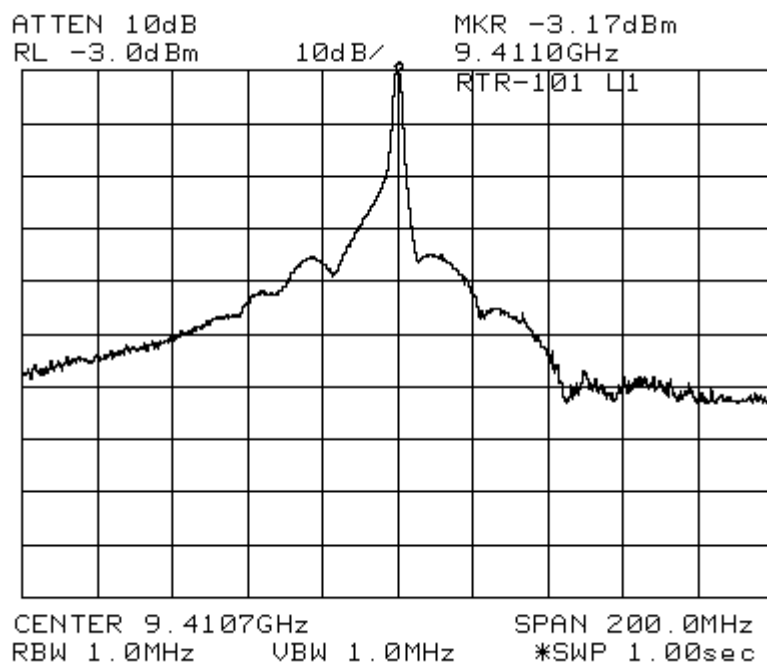
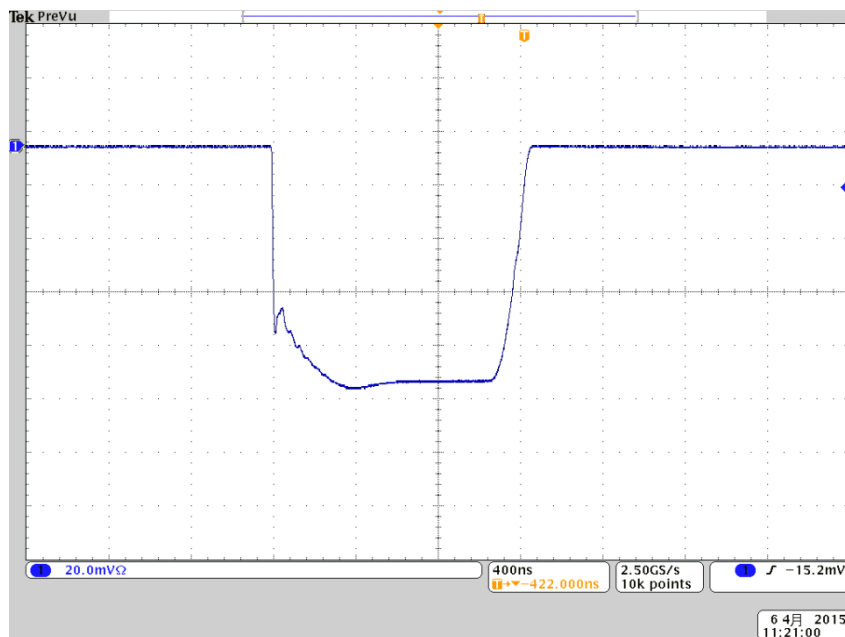


Fig. 7.6 L1 Pulse Envelope and Spectrum

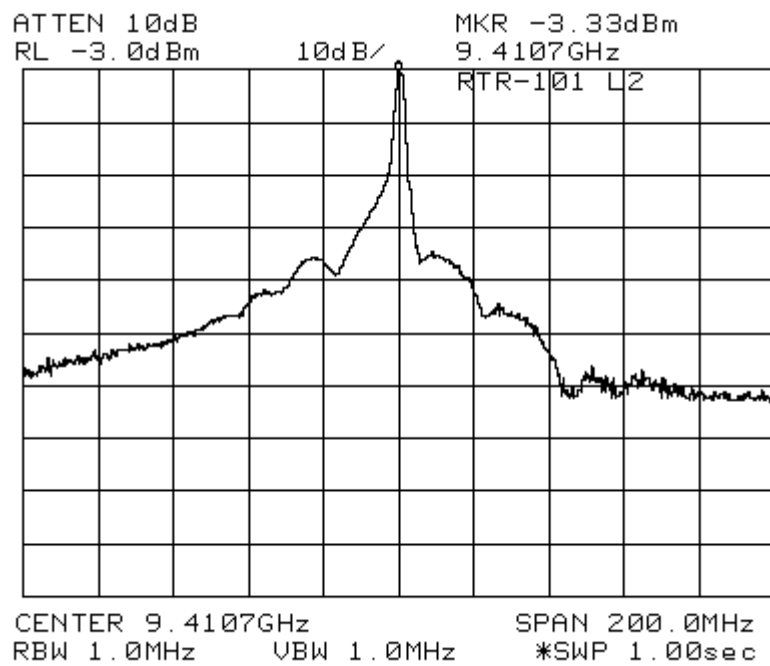
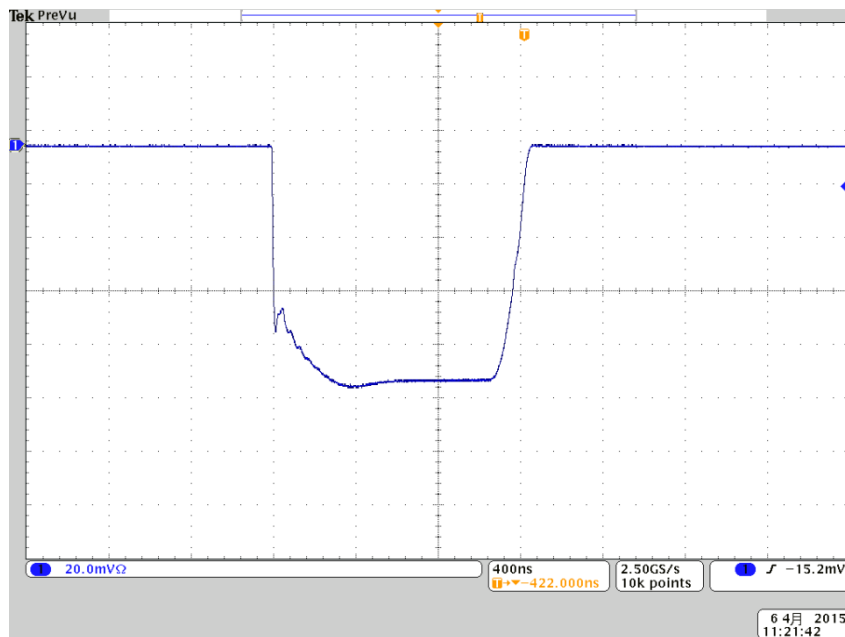


Fig. 7.7 L2 Pulse Envelope and Spectrum

## 8 Spurious Emission Plots measured at Antenna Terminal

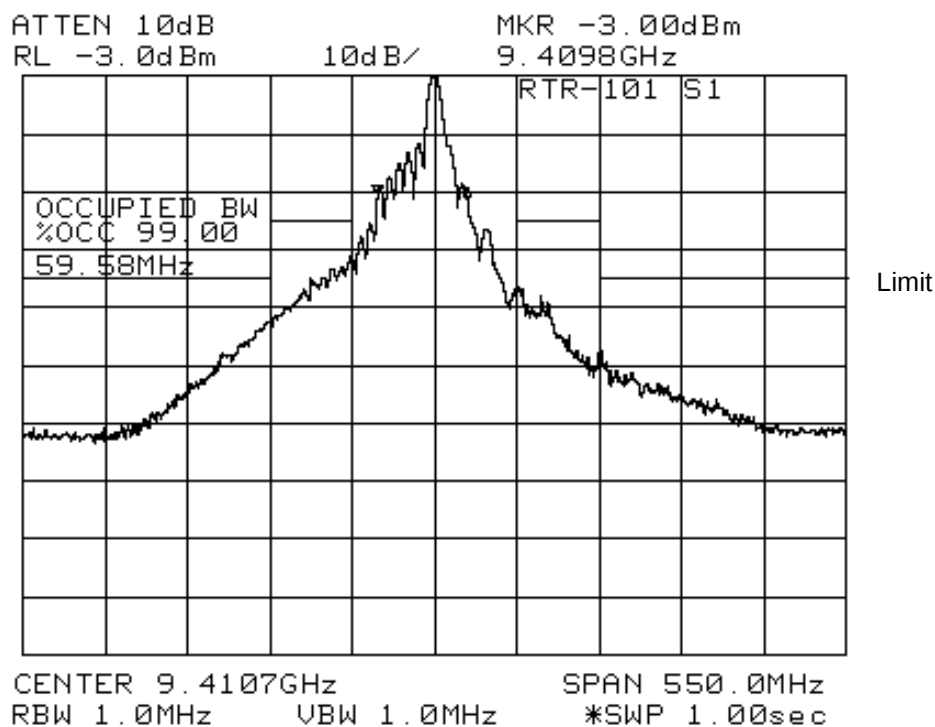


Fig. 8.1 for S1 Pulse

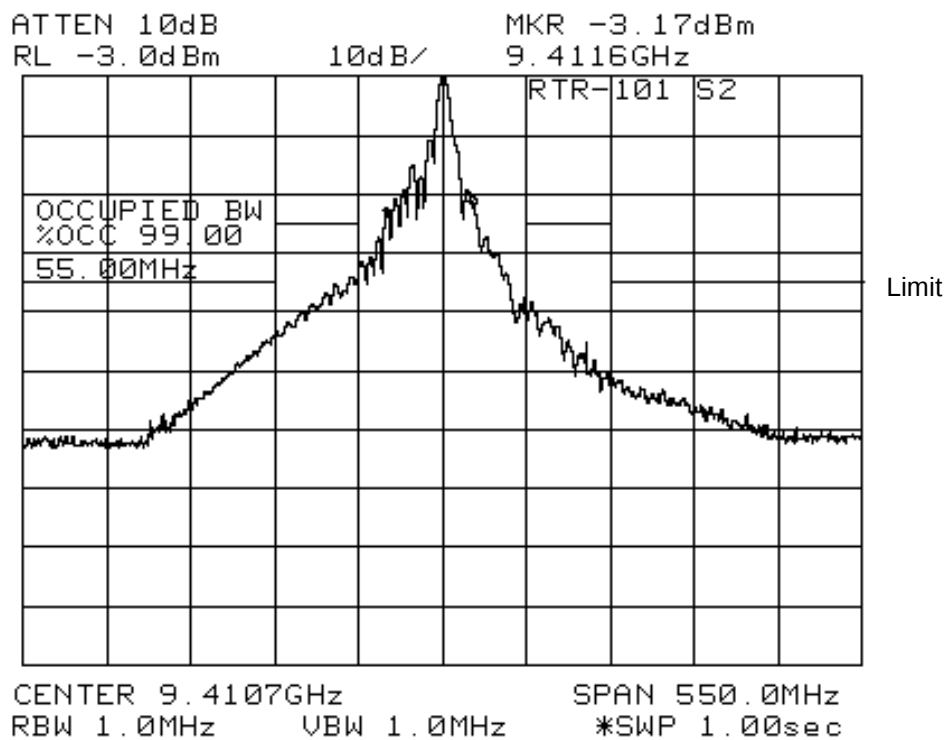


Fig. 8.2 for S2 Pulse

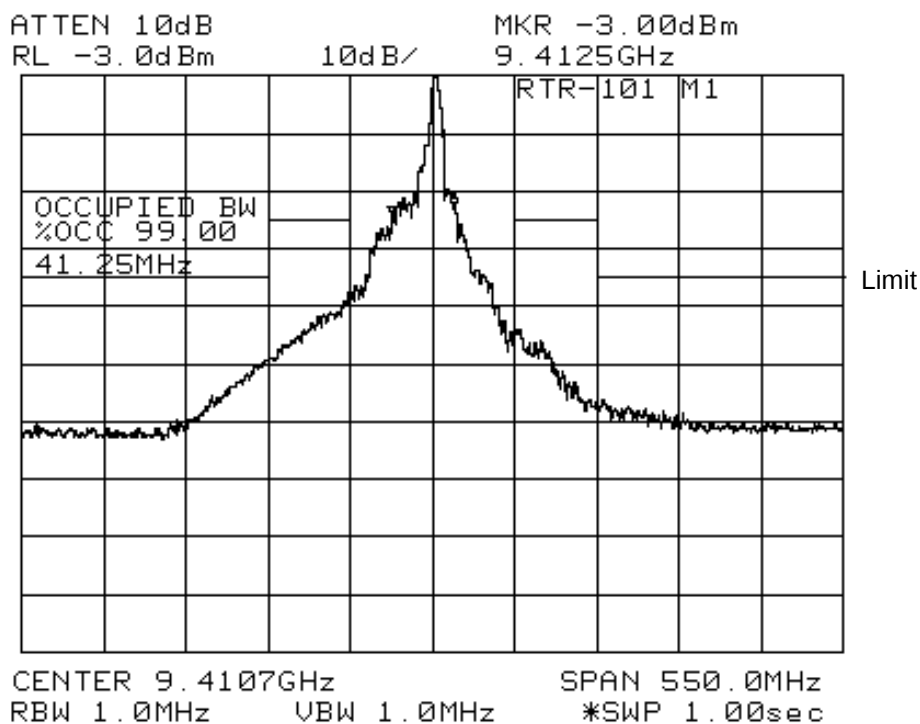


Fig. 8.3 for M1 Pulse

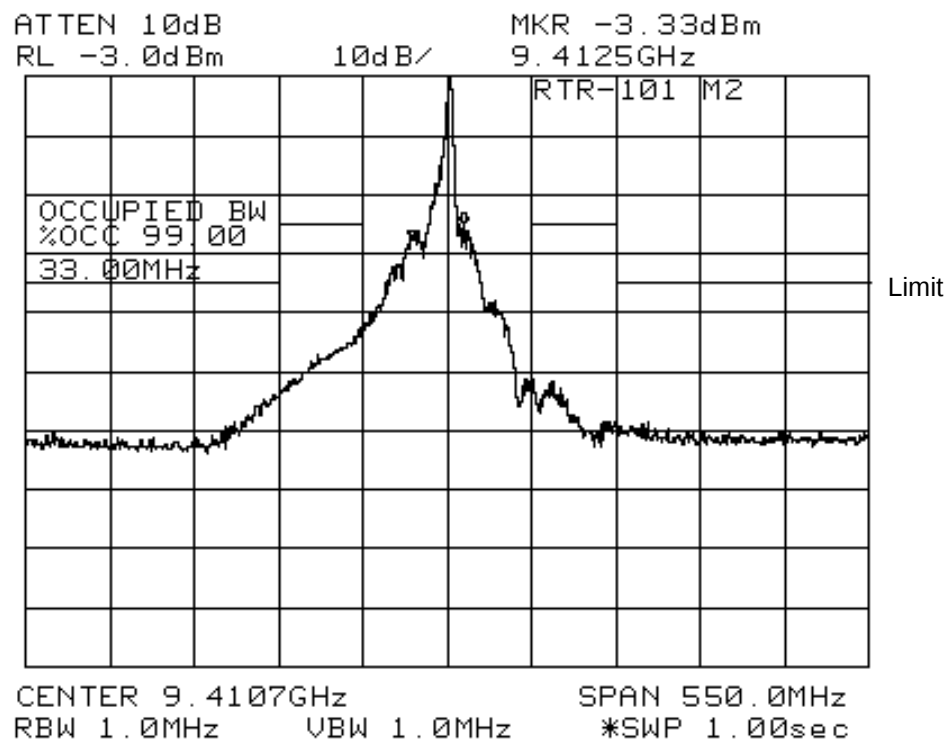


Fig. 8.4 for M2 Pulse

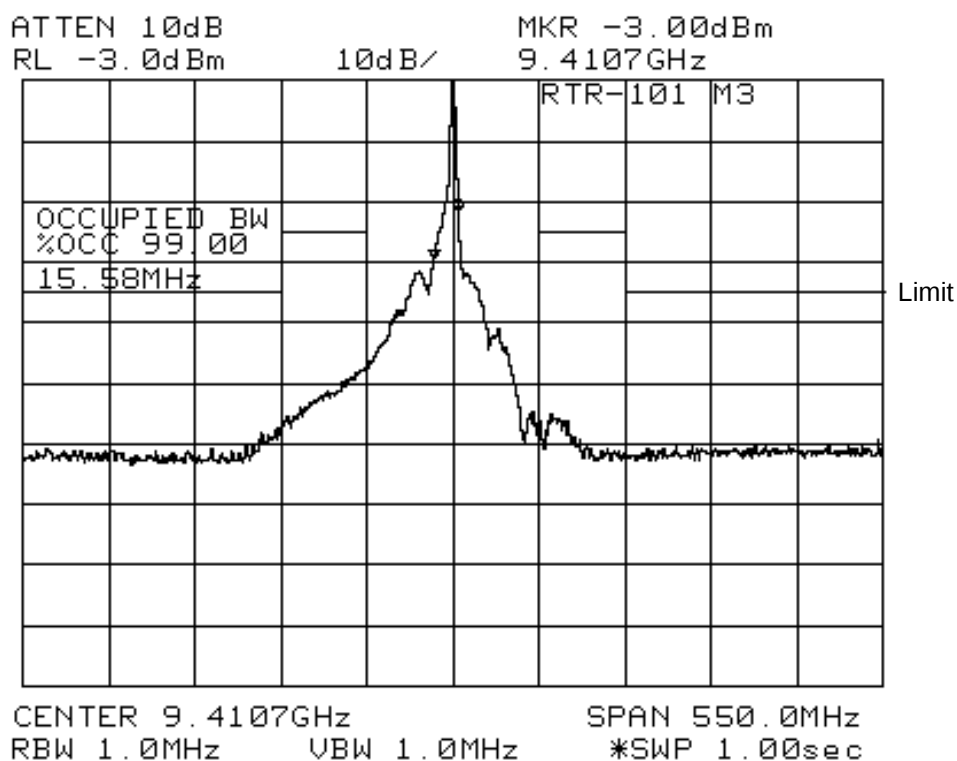


Fig. 8.5 for M3 Pulse

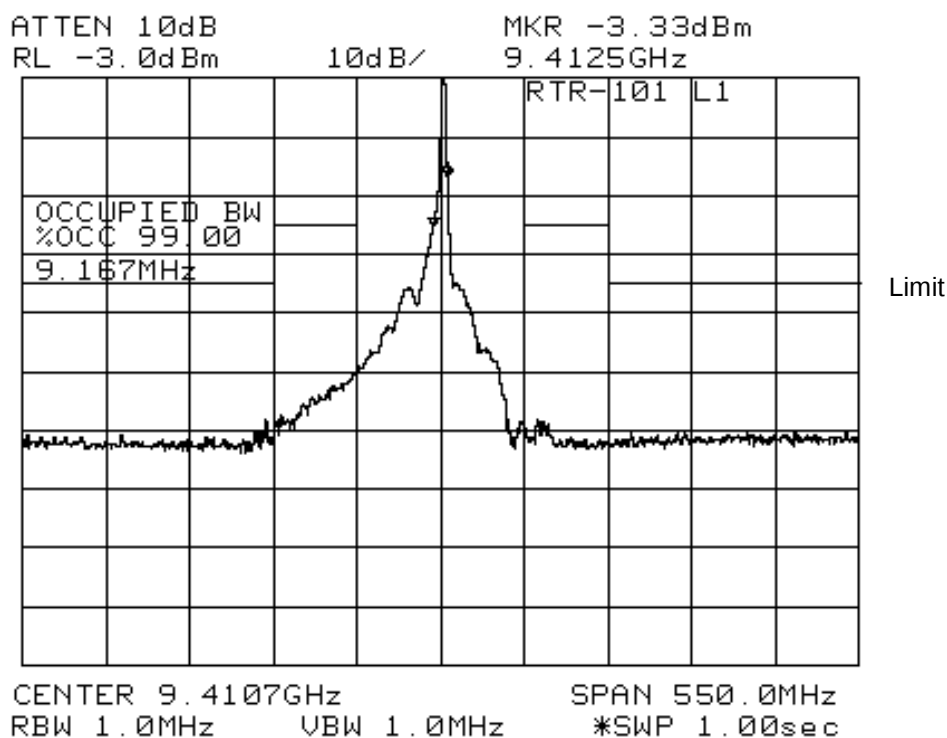


Fig. 8.6 for L1 Pulse

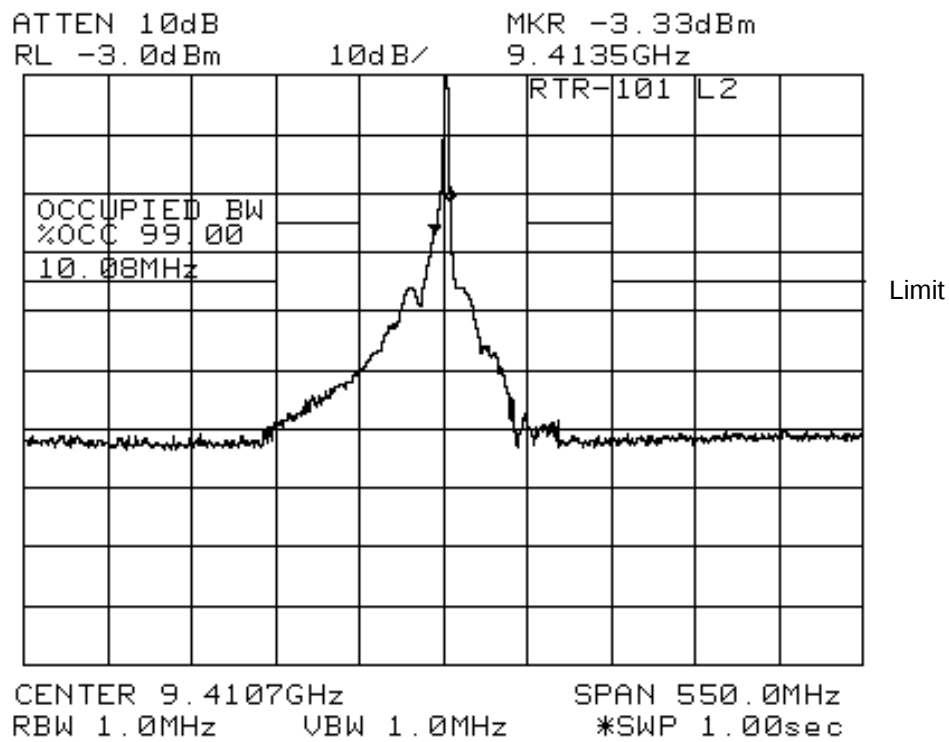


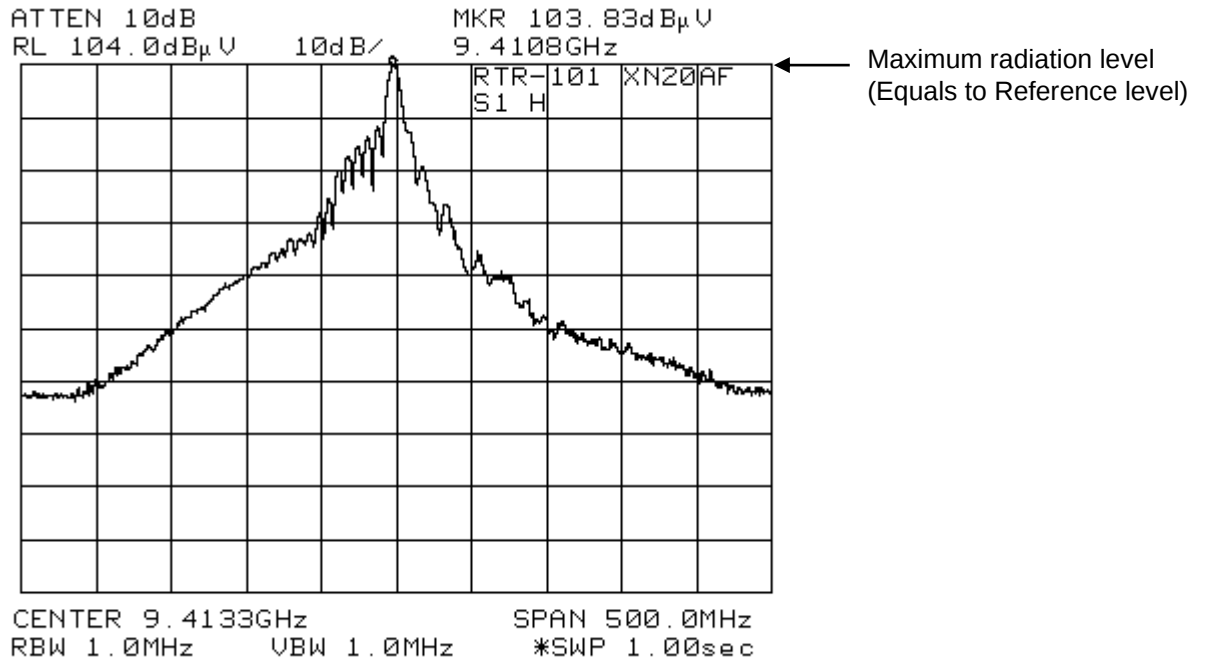
Fig. 8.7      for L2 Pulse

## 9 Field Strength Plots of Spurious Radiation

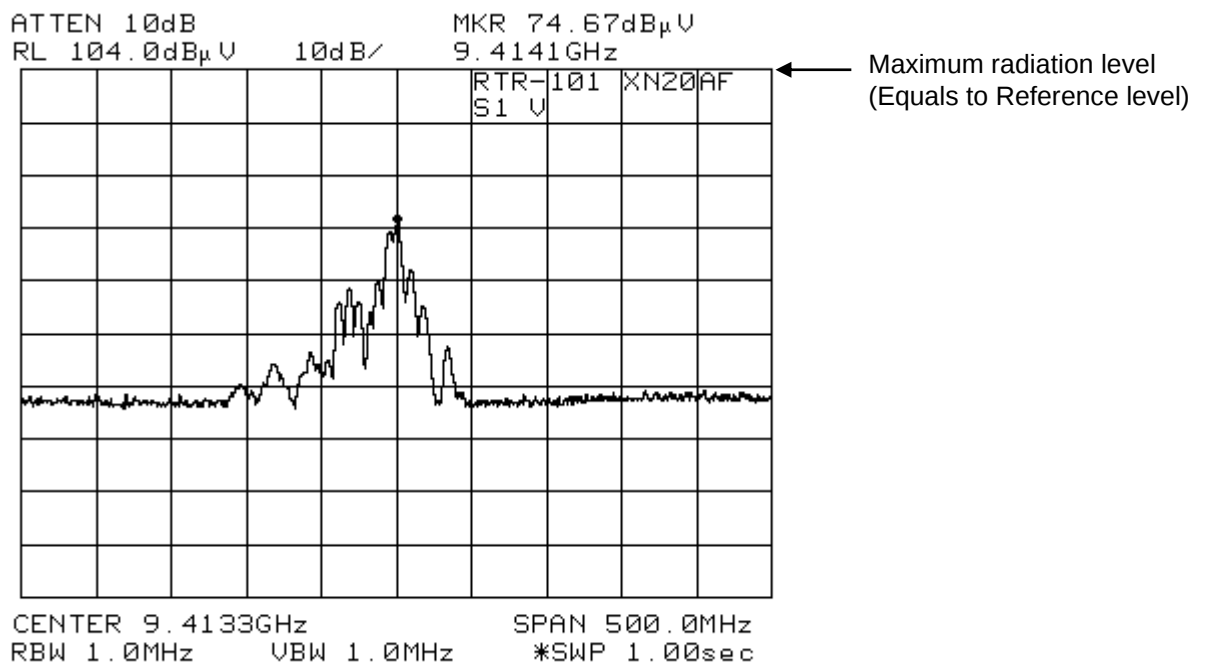
### 9.1 Maximum power radiation level

#### 9.1.1 for S1 Pulse and XN20AF

(1) for Horizontal



(2) for Vertical



For the maximum power radiation level, the voltage value measured by the spectrum analyzer was converted into the electric field strength with the measuring antenna factor, Cable loss and Amp. gain.

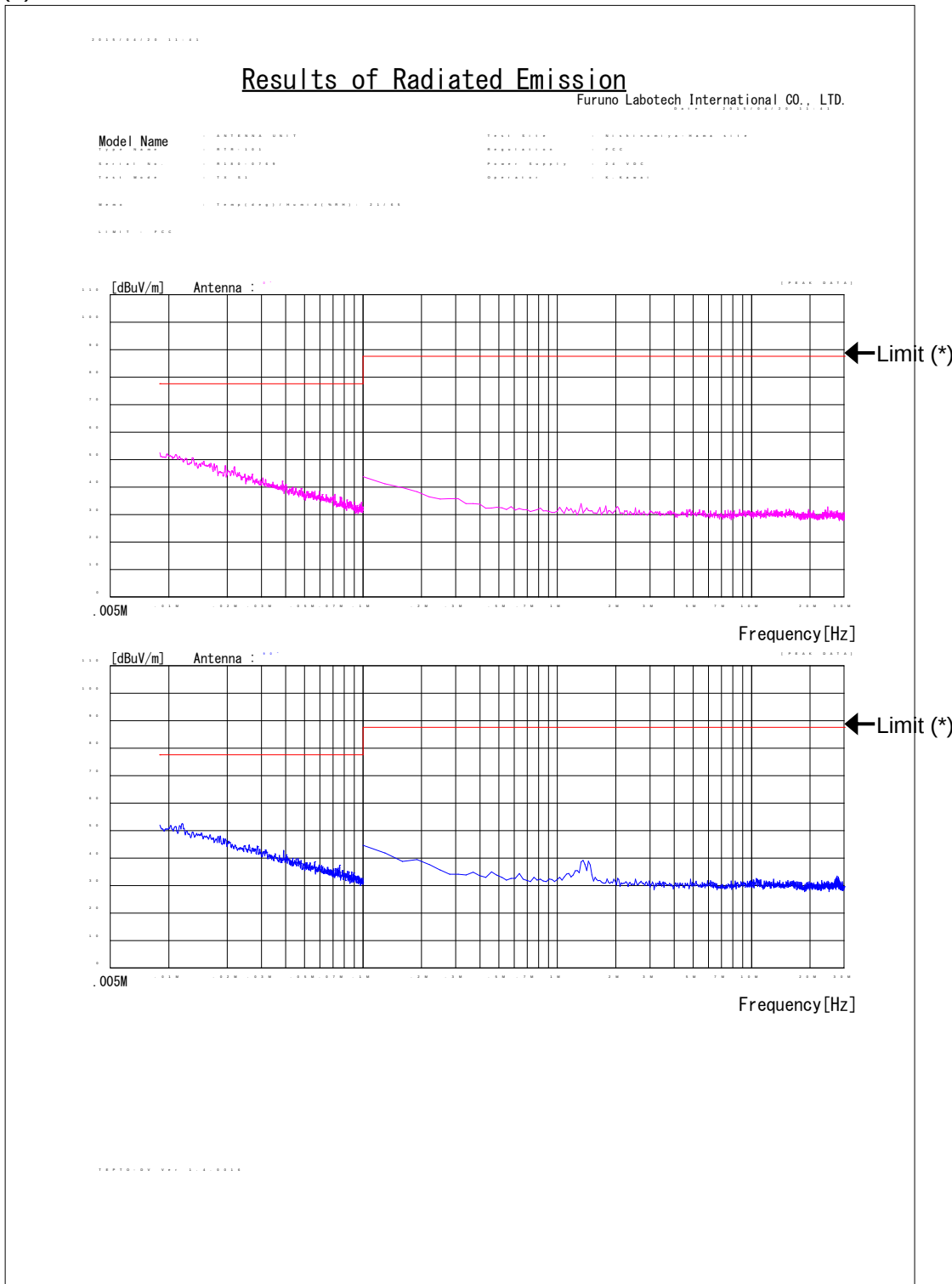
Maximum power radiation level = 167.6 dBμV/m

Therefore, Emission Limit = 167.6 dBμV/m - 60 dB = 107.6 dBμV/m

## 9.2 Spurious emissions

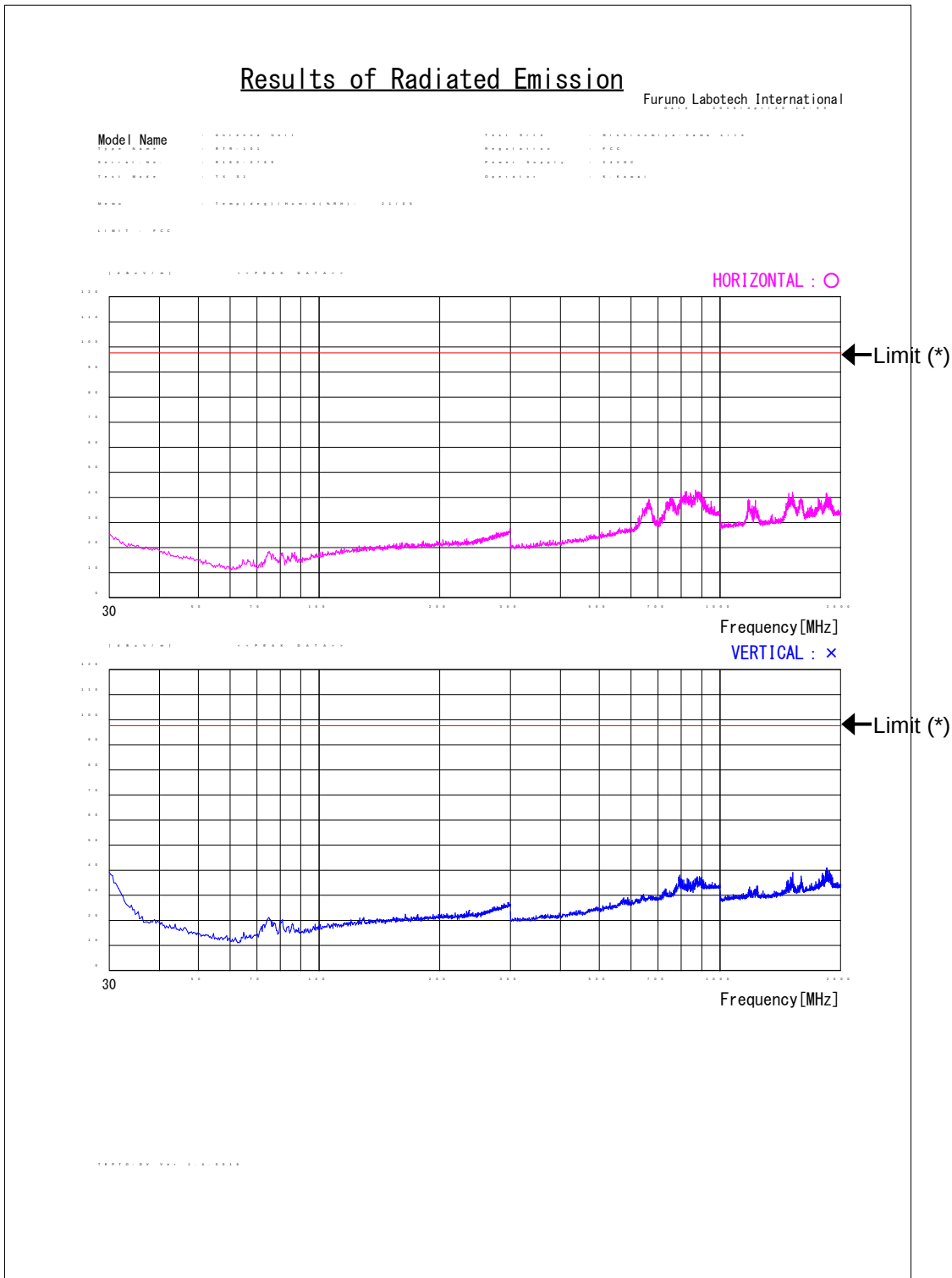
### 9.2.1 for S1 pulse,

(1) for 9 kHz to 30 MHz



(\*) The resolution bandwidth of the spectrum analyzer for the frequency range of 9 kHz to 100 kHz was set to 1 kHz, and to 10 kHz for 100 kHz to 30 MHz, instead of 1 MHz for the frequency range of 2 GHz to 40 GHz. The applicable limit was set at 30 dB lower than that computed in Clause 9.1 for the former frequency range, and 20 dB lower for the latter frequency range.

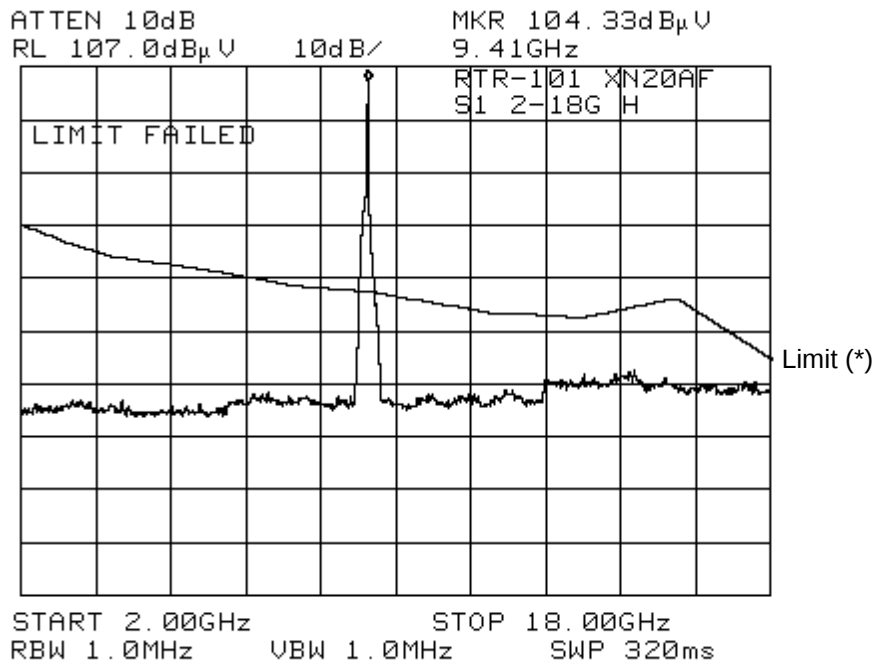
(2) for 30 MHz to 2000 MHz



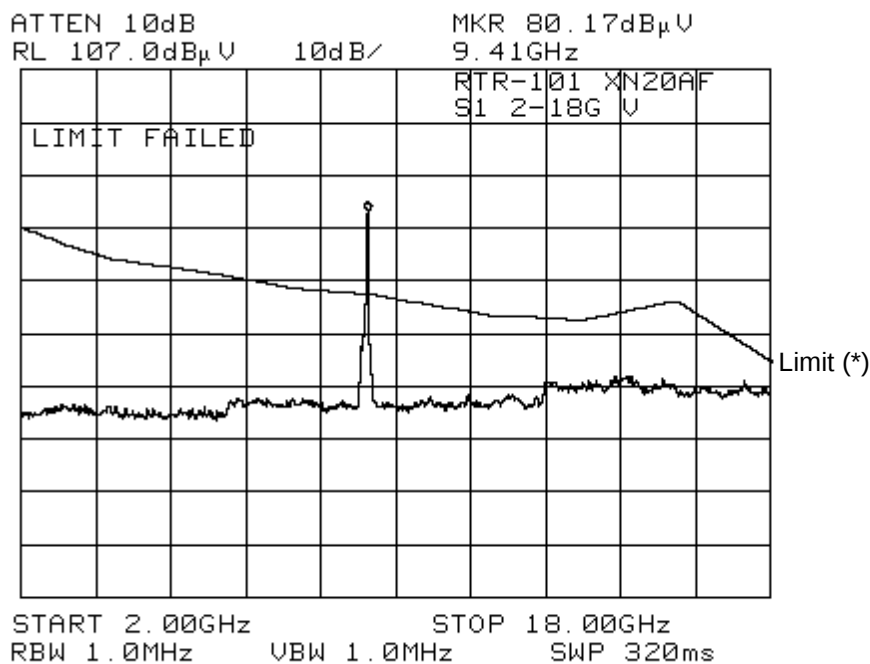
(\*) The resolution bandwidth of the spectrum analyzer for the frequency range of 30 MHz to 2000 MHz was set to 100 kHz instead of 1 MHz for the frequency range of 2 GHz to 40 GHz. The applicable limit was set at 10 dB lower than that computed in Clause 9.1.

(3) for 2 GHz to 18 GHz

- for Horizontal



- for Vertical

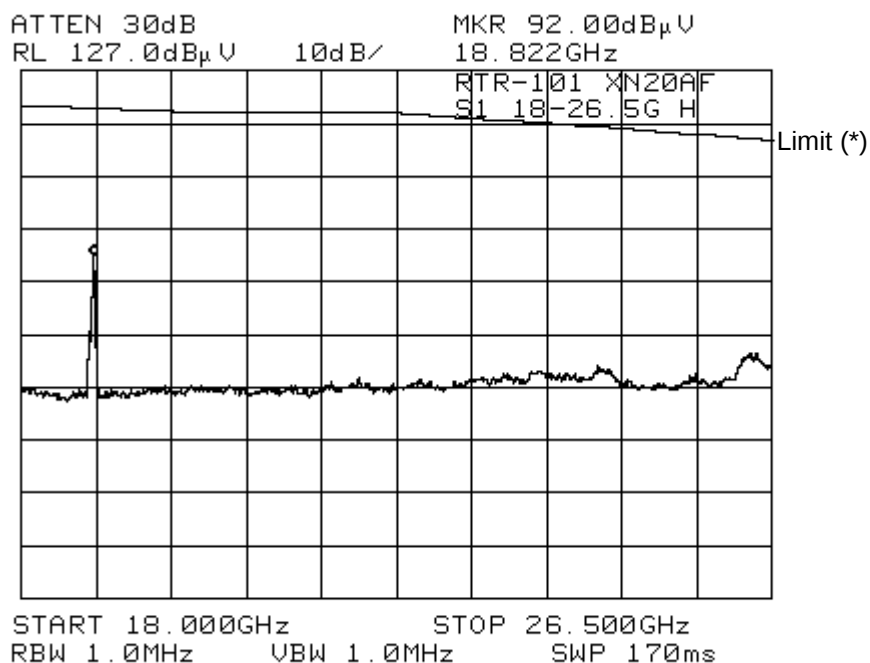


The notch filter ( Pass band:  $9410 \pm 150$  MHz) was inserted between the measuring antenna and Spectrum Analyzer to prevent the excessive input to Spectrum Analyzer only for the test frequency range of 2 GHz to 18 GHz.

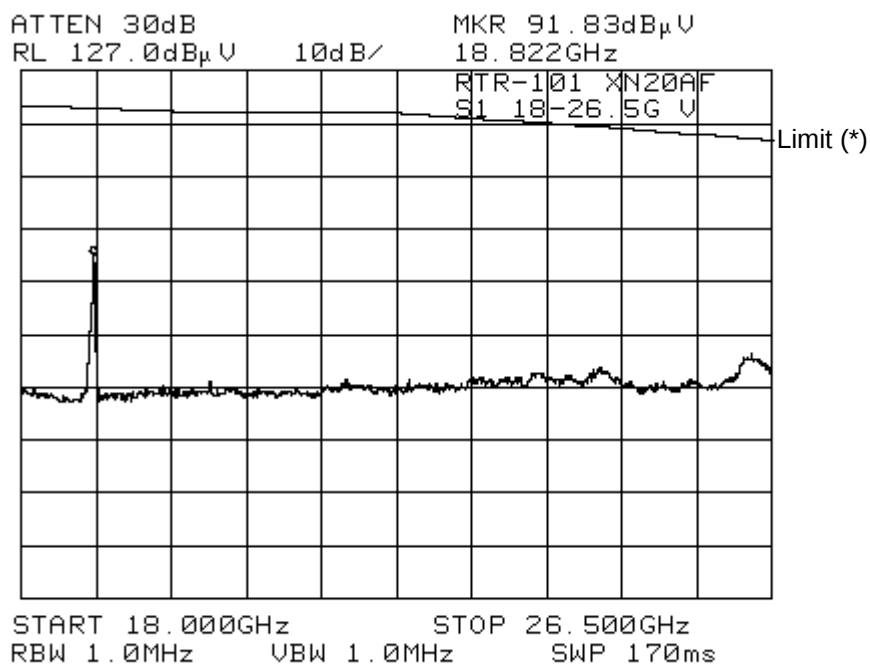
(\*) The Limit is represented by the voltage value, which was derived from the electric field strength value with Antenna factor, Cable loss and Amp. gain included.

(4) for 18 GHz to 26.5 GHz

- for Horizontal



- for Vertical

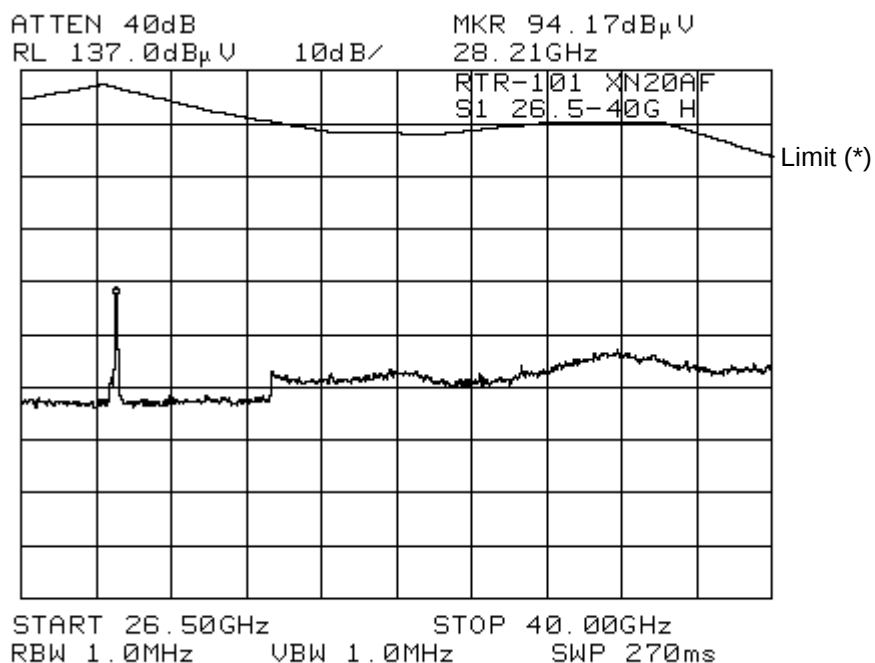


(\*) The Limit is represented by the voltage value, which was derived from the electric field strength value with Antenna factor, Cable loss and Amp. gain.

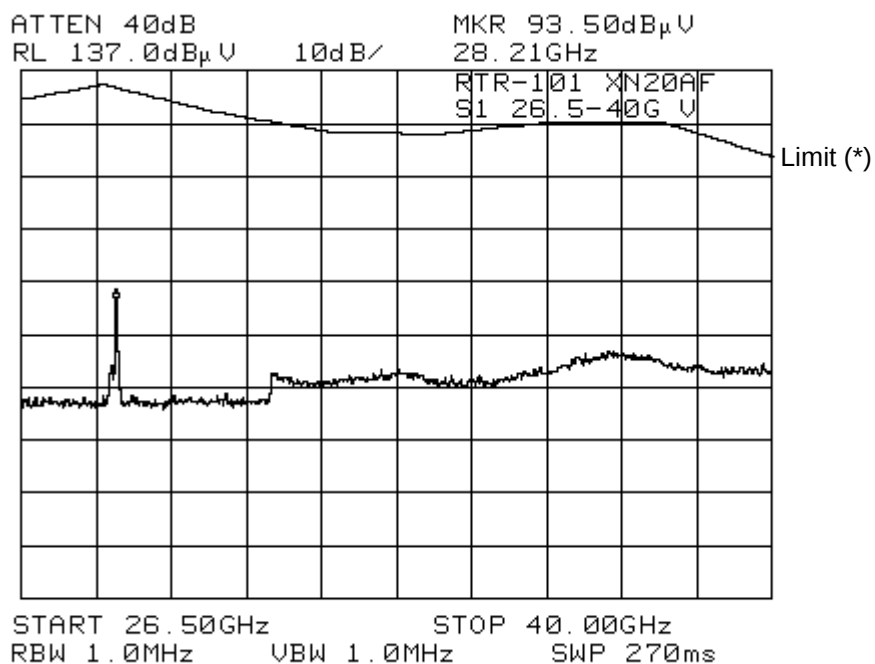
Minimum limit line for the frequency range of 18 GHz to 26.5 GHz is indicated in the above plots.

(5) for 26.5 GHz to 40 GHz

- for Horizontal



- for Vertical

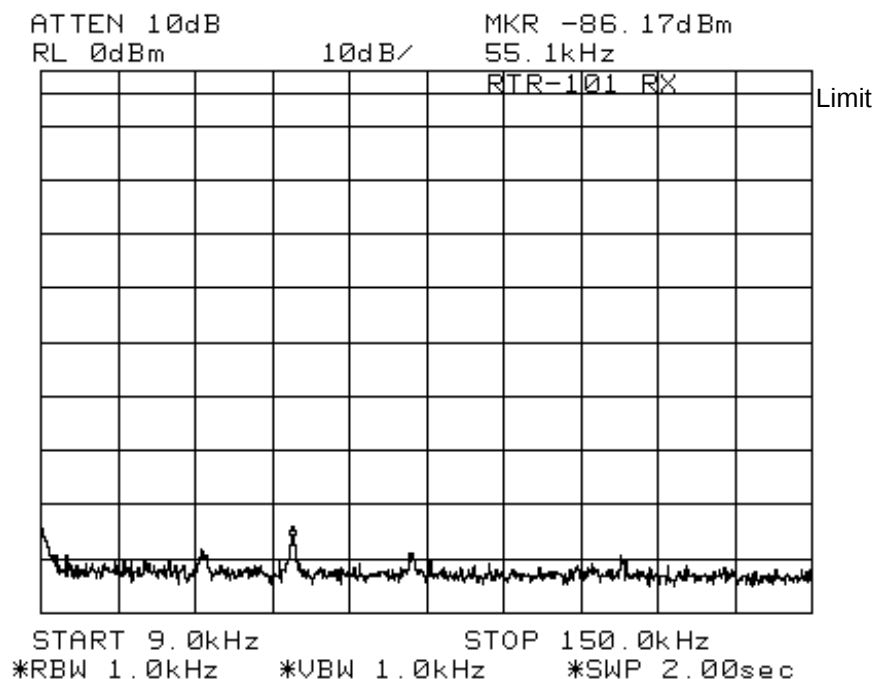


(\*) Emission limit was converted from the electric field strength into the voltage values with Antenna factor, Cable loss and Amp. gain added to the calculation.

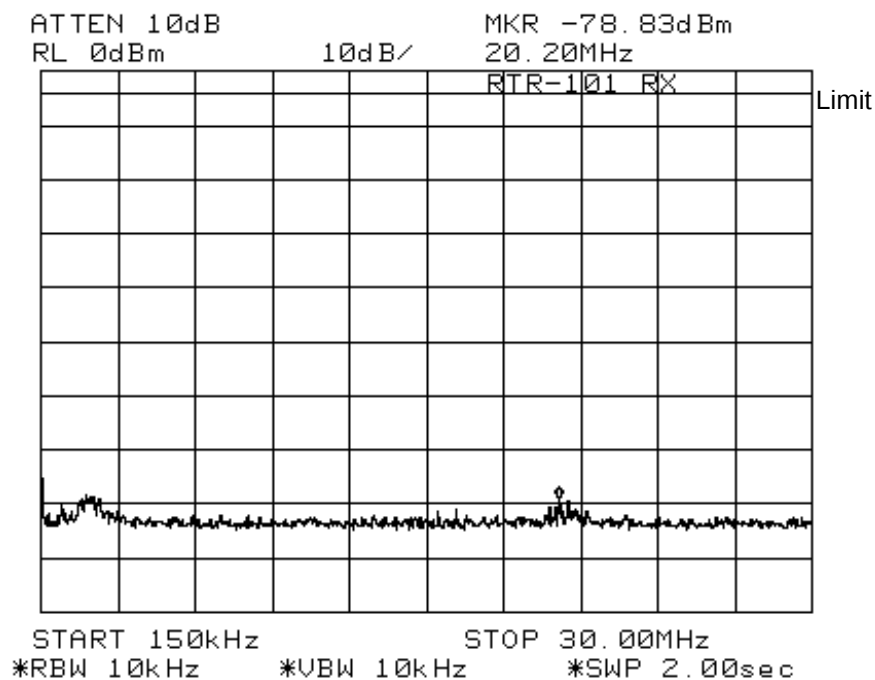
Minimum limit line for the frequency range of 26.5 GHz to 40 GHz is indicated in the above plots.

## 10 Field Strength Plots for Suppression of Interference Aboard Ships

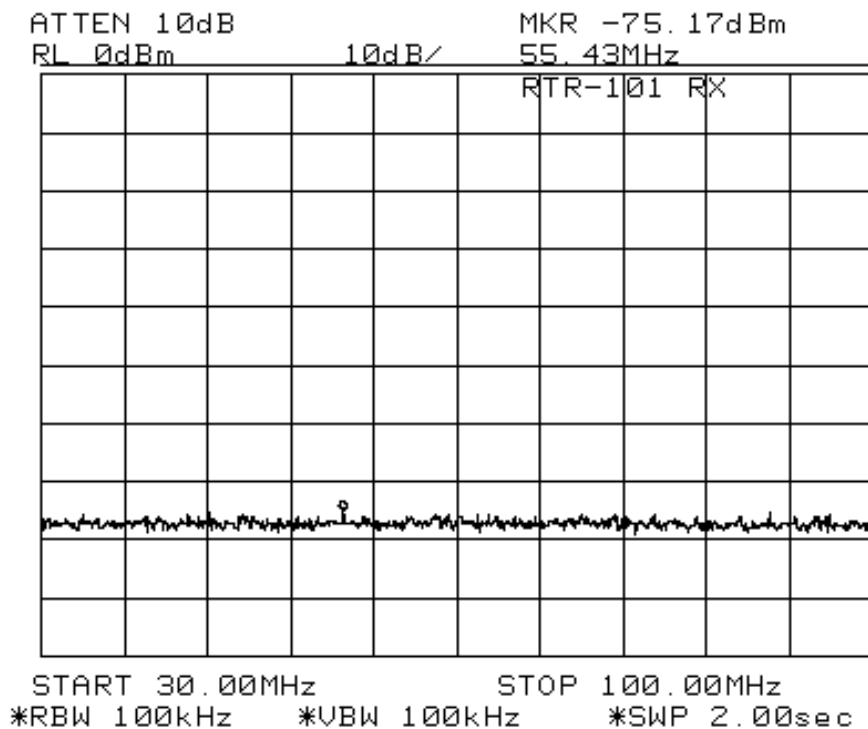
(1) 9 kHz – 150 kHz: Limit = 400  $\mu$ W (-4 dBm)



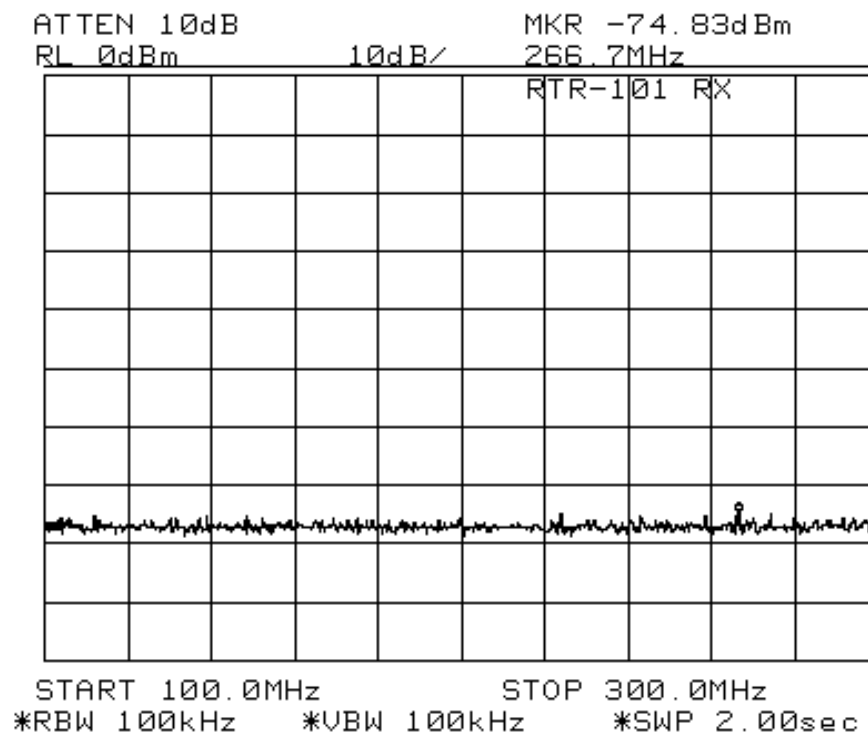
(2) 150 kHz – 30 MHz: Limit = 400  $\mu$ W (-4 dBm)



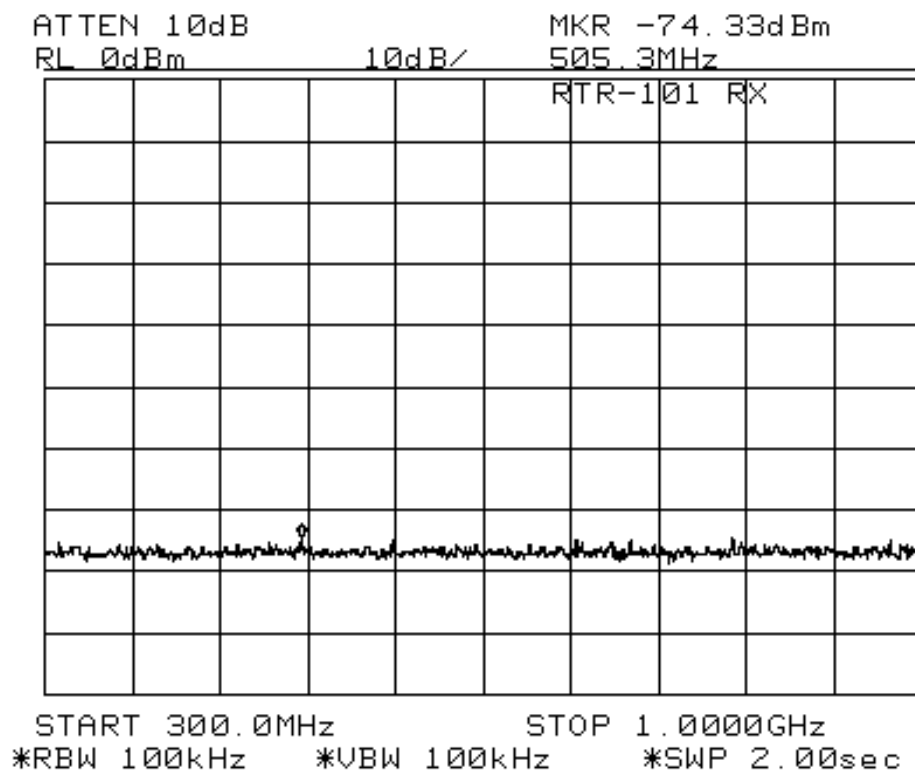
(3) 30 MHz – 100 MHz: Limit = 4000  $\mu$ W (+6 dBm)



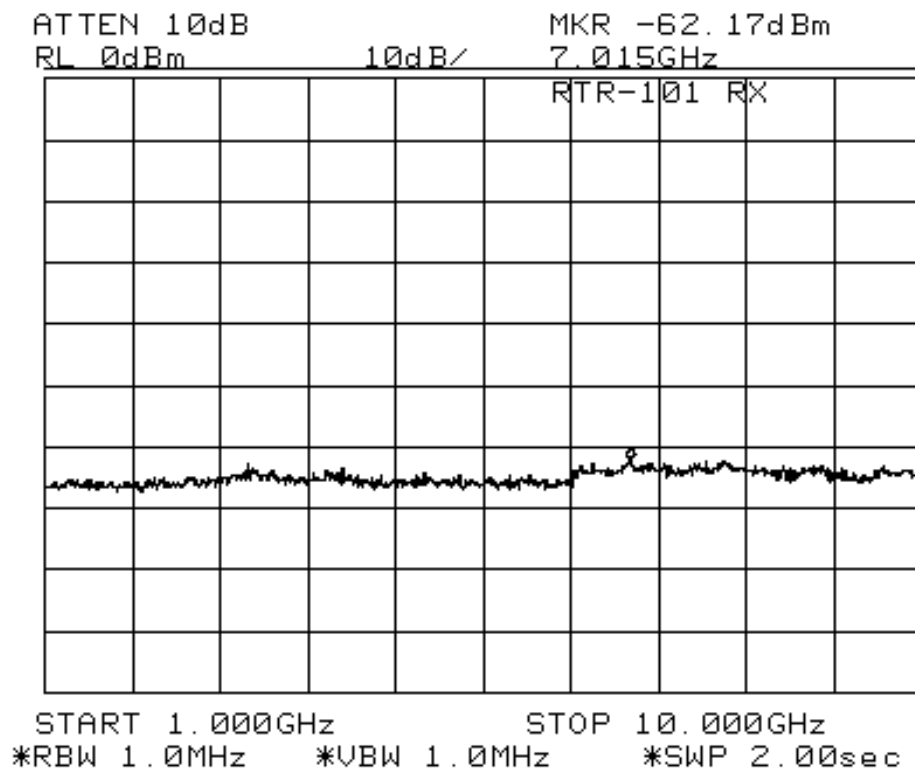
(4) 100 MHz – 300 MHz: Limit = 40000  $\mu$ W (+16 dBm)



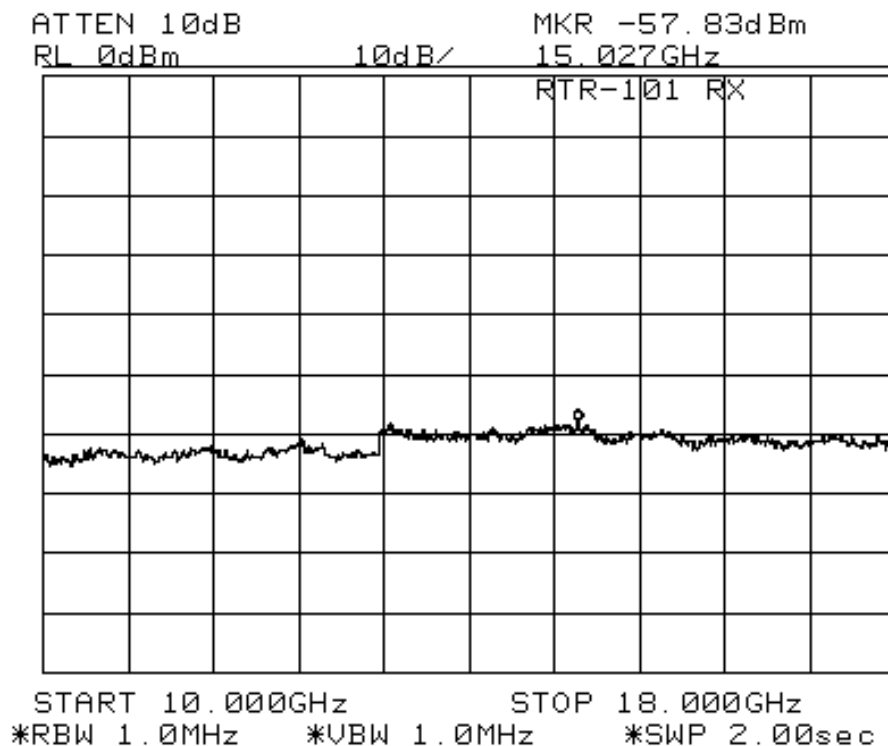
(5) 300 MHz – 1 GHz: Limit = 400000  $\mu$ W (+26 dBm)



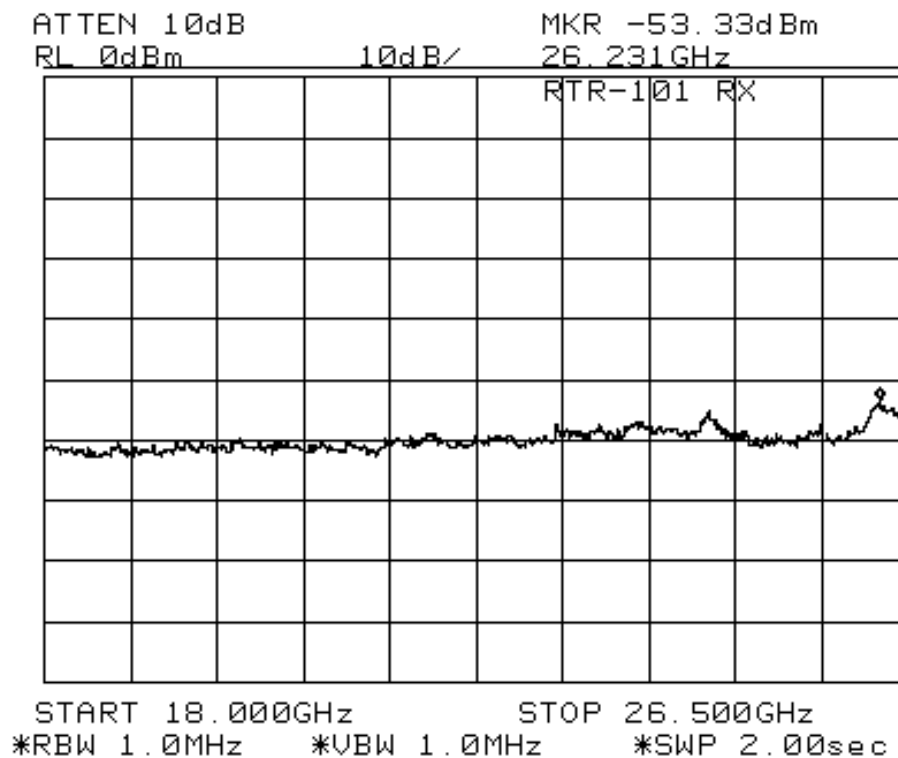
(6) 1 GHz – 10 GHz: Limit = 400000  $\mu$ W (+26 dBm)



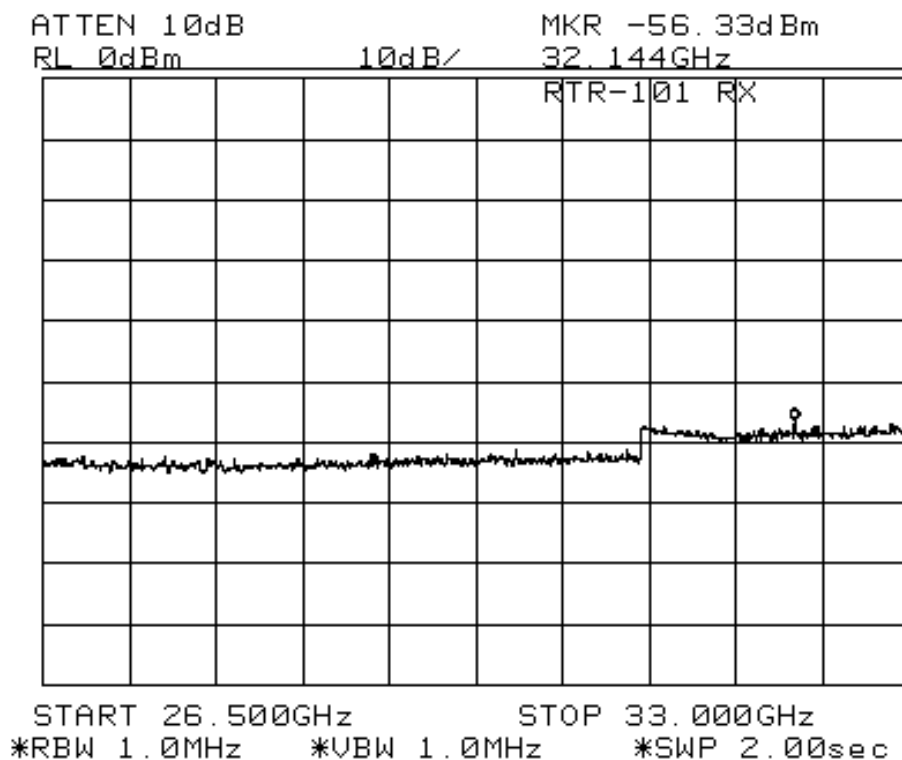
(7) 10 GHz – 18 GHz: Limit = 400000  $\mu$ W (+26 dBm)



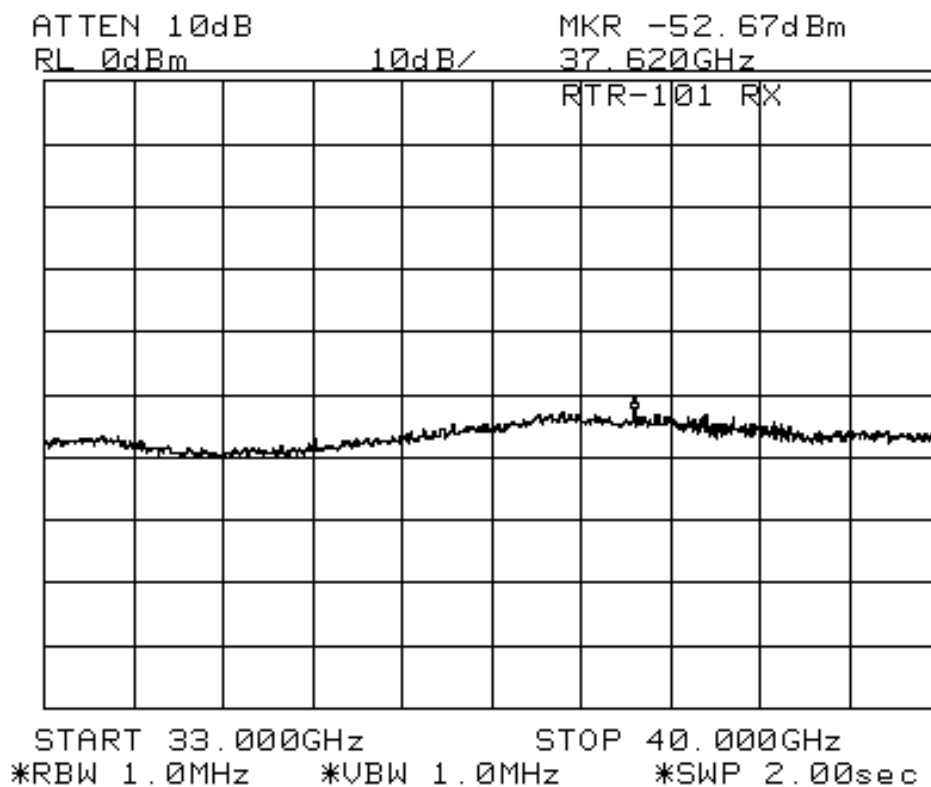
(8) 18 GHz – 26.5 GHz: Limit = 400000  $\mu$ W (+26 dBm)



(9) 26.5 GHz – 33 GHz: Limit = 400000  $\mu$ W (+26 dBm)



(10) 33 GHz – 40 GHz: Limit = 400000  $\mu$ W (+26 dBm)



End of text