

2.4 Test Data

ENGINEERING TEST REPORT ON RA55 KODEN MARINE RADAR

APPLICANT: KODEN ELECTRONICS CO., LTD
EQUIPMENT: MARINE RADAR
TEST SITE: UENOHARA-FACTORY OF KODEN ELECTRONICS CO., LTD
TEST DATE: July in 2002
To: Whom it concern

Good engineering practice were followed while performing test for FCC type acceptance application, and the result are accurate.

Respectfully,

Report Prepared by:

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Manager
Design Section

Table of contents

Data for the acceptance of the Kodan Marine Radar Type RA55

List of Exhibit

Exhibit Number

- 1 RF Power Output (2.985)
- 2 Modulation Characteristics (2.987)
- 3 Occupied Bandwidth (2.989)
- 4 Spurious Emissions at Antenna Terminal (2.991)
- 5 Spurious Emissions Field Strength (2.993)
- 6 Frequency Stability (2.995)

Foreword

The following information is being submitted in compliance with paragraphs 2.983, 2.985, 2.987, 2.989, 2.991, 2.993 and 2.995 as provided by part 83 of the FCC Rules and Regulations for Type Acceptance of the Kodan Marine Radar, Type RA55.

All testing was performed by the Kodan Electronics Co., Ltd.

Uenohara Factory, 5278, Uenohara, Uenohara-Machi, Kitatsuru-Gun, Yamanashi, 409-0112, Japan.

STANDARD TEST CONDITIONS and ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedure were observed during the testing:

ROOM TEMPERATURE	= 25 +/- 5 Degree-Centigrade
ROOM HUMIDITY	= 20 to 50%

Prior to testing, the E.U.T. was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

MEASUREMENT DATA, unless otherwise noted, are WORST CASE measurements.

Exhibit 1

RF POWER OUTPUT (2.985)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30 MHz
Frequency Source: Fixed Cavity Resonator
Pulse Rate: 500 Hz to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
1.	X-Band Directional Coupler	NIHON KOSHUHA	WDK-1018
2.	Attenuator	SHIMADA RIKA	4A390
3.	Variable Attenuator	Hewlett-Packard	8494B
4.	X-Band Dummy Load	SPC	R9678
5.	Crystal Detector	Hewlett-Packard	8474B
6.	Power Meter	Hewlett-Packard	437B
7.	Oscilloscope	TEKTRONIX	2465B
8.	Frequency Counter	ADVANTEST	TR5826

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The Power output for each of these combinations was measured by using the following procedure:

- (1) Set up the equipment as shown in Fig.1.
- (2) Record reading of Power Meter.
- (3) Calculate mean power according to attenuation.
- (4) Measure and record pulsewidth and P.R.F. by using oscilloscope and frequency counter.
- (5) Calculate peak power as follows:

$$P_0 = P_m / (F_r \times T)$$

P_0 : Peak Power, P_m : Mean Power, F_r : P.R.F.*

T : Pulse Width, * P.R.F. : Pulse Repetition Frequency

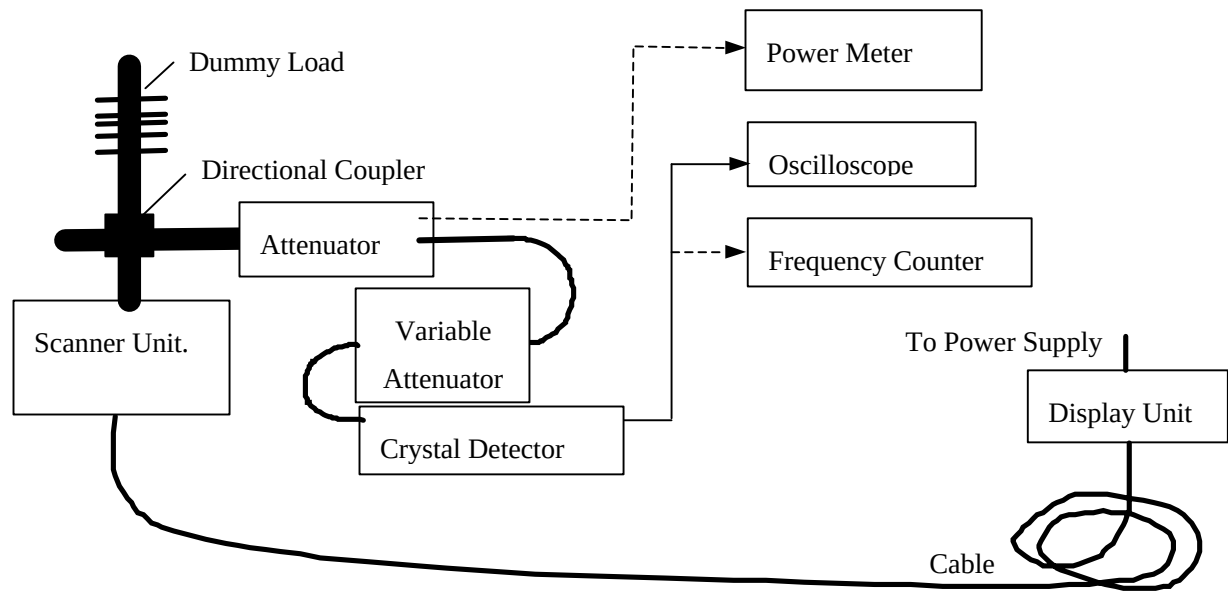


Figure.1 RF POWER OUTPUT & MODULATION CHARACTERISTICS (2.987)

Exhibit 1

TEST RESULT

<u>Transmit Pulse width and P.R.F.</u>	<u>Measured Mean Power</u>	<u>Measured Pulse width</u>	<u>Measured P.R.F.</u>	<u>Calculated Peak power Output</u>
80ns X 2000Hz	3.21W	85ns	1997Hz	18.9kW
300ns X 1500Hz	8.64W	306ns	1337Hz	21.1kW
600ns X 800Hz	11.38W	602ns	799Hz	23.7kW
1200ns X 500Hz	14.23w	1209ns	469Hz	25.1kW

Exhibit 2

MODULATION CHARACTERISTICS (2.987)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30MHz
Frequency Source: Fixed Cavity Resonator
Pulse Rate: 500 to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
1.	X-Band Directional Coupler	NIHON KOSHUHA	WDK-1018
2.	Attenuator	SHIMADA RIKA	4A390
3.	Variable Attenuator	Hewlett-Packard	8494B
4.	X-Band Dummy Load	SPC	R9678
5.	Crystal Detector	Hewlett-Packard	8474B
6.	Power Meter	Hewlett-Packard	437B
7.	Oscilloscope	TEKTRONIX	2465B
8.	Frequency Counter	ADVANTEST	TR5826

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The Modulation characteristics for each of these combinations was measured by using the following procedure:

- (1) Set up the equipment as shown in Fig.1.
- (2) Obtain a convenient display on the oscilloscope and adjust peak to the suitable cursor line.
- (3) Decrease variable attenuator 3 dB, and measure the pulse width at the cursor line.
- (4) Photograph the oscilloscope display.
- (5) Note and record the Frequency Readout of the counter as "Pulse Repetition Frequency".

Exhibit 2

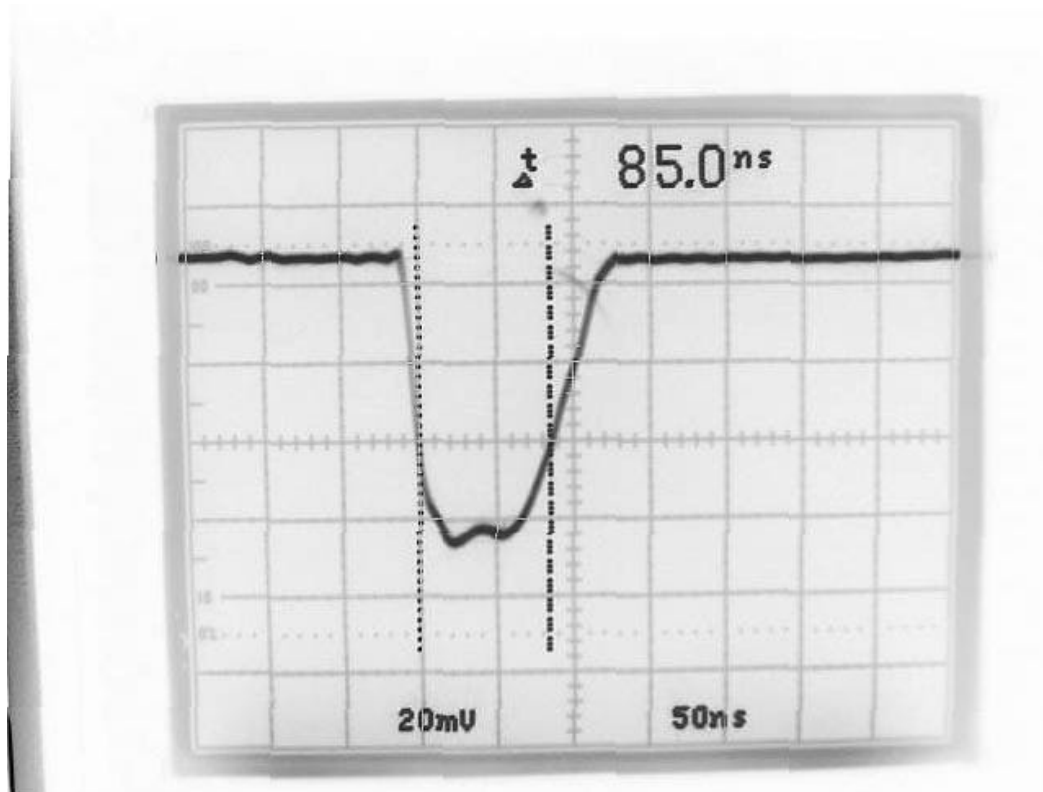
TEST RESULT

Modulation Characteristics (Detected Pulse)

(1) Short Pulse

Pulse width (-3 dB) = 0.085 μ s

Pulse repetition Frequency = 1997 Hz



50 ns/div.

Exhibit 2

TEST RESULT

Modulation Characteristics
(Detected Pulse)

(2) Middle Pulse-1

Pulse width (-3 dB) = 0.306 μ s

Pulse repetition Frequency = 1337 Hz



100 ns/div.

Exhibit 2

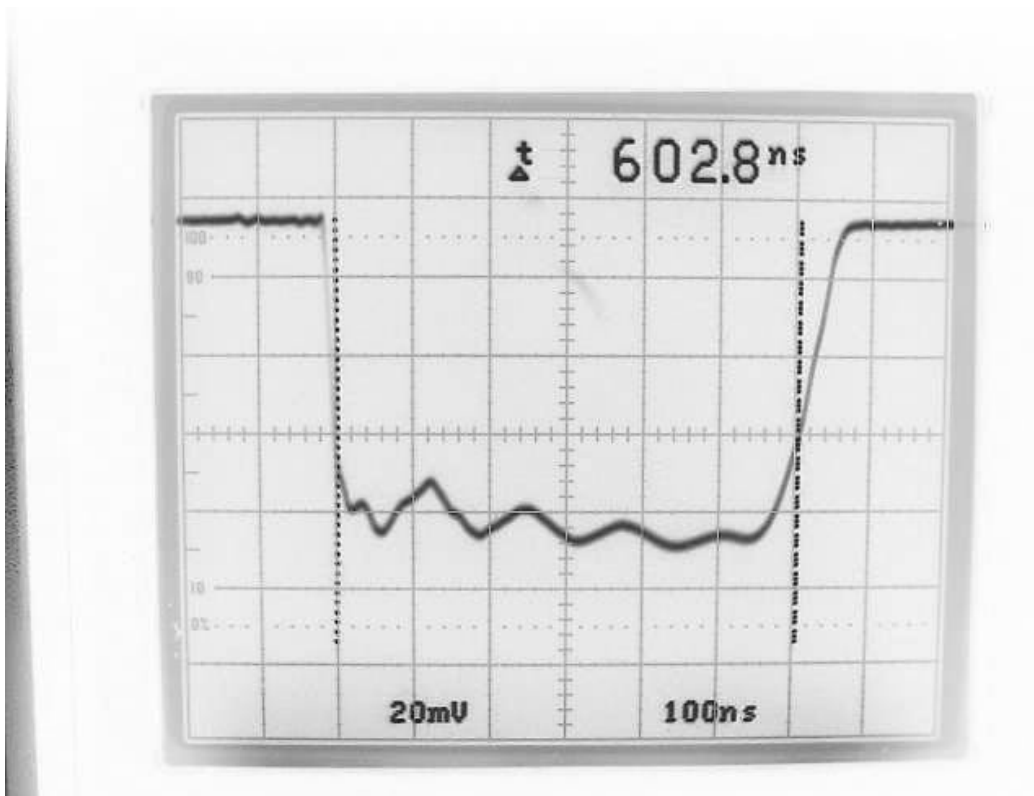
TEST RESULT

Modulation Characteristics
(Detected Pulse)

(3) Middle Pulse-2

Pulse width (-3 dB) = 0.602 μ s

Pulse repetition Frequency = 799 Hz



100 ns/div.

Exhibit 2

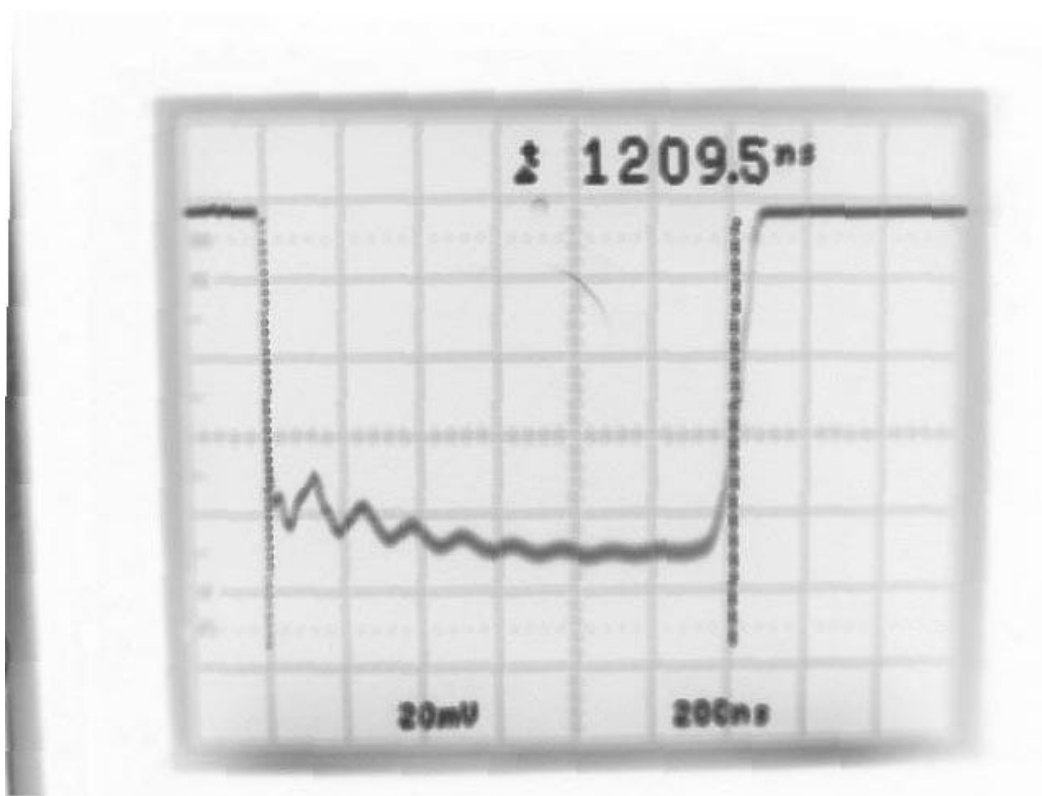
TEST RESULT

Modulation Characteristics
(Detected Pulse)

(4) Long Pulse

Pulse width (-3 dB) = 1.209 μ s

Pulse repetition Frequency = 496 Hz



200 ns/div.

Exhibit 3

OCCUPIED BANDWIDTH (2.989)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30 MHz
Frequency Source: Fixed Cavity Resonator
Pulse Rate: 500 Hz to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
1.	X-Band Directional Coupler	NIHON KOSHUHA	WDK-1018
2.	Attenuator	SHIMADA RIKA	4A390
3.	Variable Attenuator	Hewlett-Packard	8494B
4.	X-Band Dummy Load	SPC	R9678
5.	Spectrum Analyzer	Agilent	8566B

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The occupied bandwidth for each of these combinations was measured by using the following procedure:

- (1) Connect the equipment as shown in Fig.2.
- (2) Adjust center frequency, span reference level of spectrum analyzer and attenuator if necessary, such that the display nearly fills the screen.
- (3) Measure and record spectrum and bandwidth

The bandwidth is calculated so that the total powers lower than the lowest frequency in the bandwidth and higher than the highest frequency in the bandwidth occupy 0.5% of the transmitted total power respectively.

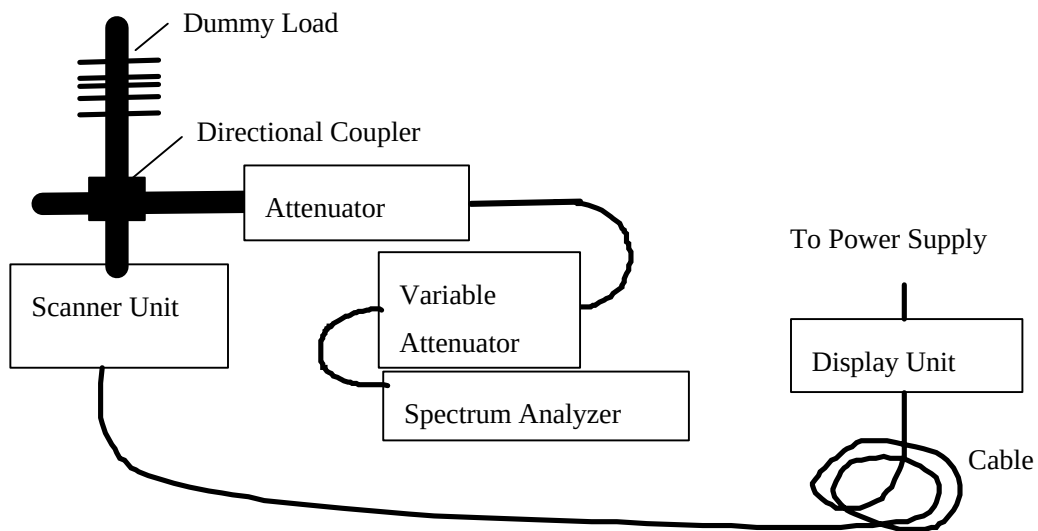


Figure.2 OCCUPIED BAND WIDTH (2.989)
& SPURIOUS EMISSION AT ANTENNA TERMINAL (2.991)

Exhibit 3

TEST RESULT

Pulse x rate	Bandwidth
0.08 us X 2000 Hz	54.5 MHz
0.3 us X 1500 Hz	19.7 MHz
0.6 us X 800 Hz	11.9 MHz
1.2 us X 500 Hz	5.8 MHz

Exhibit 4

SPURIOUS EMISSION AT ANTENNA TERMINAL (2.991)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30MHz
Frequency Source: Fixed cavity resonator
Pulse Rate: 500 Hz to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
1.	X-Band Directional Coupler	NIHON KOSHUHA	WDK-1018
2.	Attenuator	SHIMADA RIKA	4A390
3.	Variable Attenuator	Hewlett-Packard	8494B
4.	X-Band Dummy Load	SPC	R9678
5.	Crystal Detector	Hewlett-Packard	8474B
6.	Spectrum Analyzer	Agilent	8564EC

TEST PROCEDURE

The Marine Radar is capable of generating the following pulse:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The spurious emission at the antenna terminal for each of these combinations were measured by using the following procedure:

- (1) Set up the equipment as shown in Fig.2
- (2) At first, the 0 dB reference level for the main Pulse was established.
- (3) The spectrum was searched over the range 8 to 40 GHz using spectrum analyzer.

NOTE

The FCC limit is calculated as follows:

Spurious limit (L)=43 + 10 Log P, in dB below the transmitter output power, where P is the mean power output in watts (See Exhibit 1).

Exhibit 4

TEST RESULT

9410 MHz	0 dB
2nd	-65 dB

All other spurious and harmonics up to 40 GHz were found to be than -70dB below maximum mean power, and/or 10.5 dB below limit.

Limit: $-(43 + 10 \log 14.23) = -54.5 \text{ dB}$

mean power:14.23 watts at 1.2 us X 500 Hz.

Exhibit 5

SPURIOUS EMISSIONS FIELD STRENGTH (2.993)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30 MHz
Frequency Source: Fixed cavity resonator
Pulse Rate: 500 Hz to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>
1.	EMI Test system	ADVANTEST	R2541
2.	Active Loop Antenna	Electro-Mechanics	6502
3.	Bi-Conical Antenna	Raven	11966P
4.	Double Ridged Guide Antenna	EMCO	3115
5.	Pre Amplifier	Hewlett-Packard	8447D-OPT011
6.	Spectrum analyzer	Agilent	8564EC

CALIBRATION

All test equipment is calibrated and maintained by Koden Quality Assurance Dept.

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The spurious emissions field strength for each of these combination was measured using following procedure.

- (1) Set up the equipment as shown in Fig.3.
- (2) Using the automatic EMI Test System, measure and record the spurious radiated emissions from 150 kHz to 1 GHz. The computer in the Test system program automatically adds antenna factors and cable losses to the raw voltage measurements to obtain field strength units.
- (3) Set up the equipment as shown in Fig.4.
- (4) Measure and record spurious radiated emissions from 1 GHz to 18GHz (antenna limit). Observe and note any emissions from 1GHz to 18 GHz.

- (5) Calculate the field strength of spurious emissions from 1 GHz to 18 GHz by add in antenna factor (including cable loss) to the observed reading. The 3115(Double Ridged Guide) antenna gain and cable loss is calculated by the Table-5.1 below.
- (6) Set up the equipment as shown in Fig.5.
- (7) Using the spectrum analyzer, measure and record terminal interference voltage from 10 kHz to 30 MHz.

Table-5.1 3115(Double Ridged Guide) Antenna Gain and Cable Loss

Frequency (GHz)	3115 Antenna Gain (dBi)	Cable Loss (dB/m)	Wave Length (m)
1 - 2	8.2	0.4	0.20
2 - 3	8.9	0.5	0.12
3 - 4	9.0	0.7	0.09
4 - 5	10.2	0.8	0.07
5 - 6	8.8	0.9	0.05
6 - 7	10.9	1.0	0.04
7 - 8	10.1	1.1	0.04
8 - 9	10.7	1.2	0.03
9 - 10	11.3	1.2	0.03
10 - 11	11.1	1.3	0.03
11 - 12	11.9	1.4	0.02
12 - 13	13.5	1.5	0.02
13 - 14	12.0	1.6	0.02
14 - 15	12.6	1.6	0.02
15 - 16	15.8	1.7	0.02
16 - 17	15.8	1.8	0.02
17 - 18	11.0	1.8	0.02

Note

Spurious emission limit is calculated as follows:

Limit (L) = $43 + 10 \log P$, in dB below the fundamental field strength,
where P is the mean power output in watts (See Exhibit 1).

Limit: $-(43 + 10 \log 3.21) = -48.0 \text{ dB}$

mean power: 3.21 watts at 0.08 us X 2000 Hz

Limit: $-(43 + 10 \log 14.23) = -54.5 \text{ dB}$

mean power: 14.23 watts at 1.2 us X 500 Hz

Test result (All data)

	Frequency	Ratio to Main Transmission	Limit	Refer to
Spurious Emission Field Strength	9.410GHz	0dB		Figure 4
	150kHz to 30MHz	-66.7dB (LP)	-54.5 dB	Figure 3
	30MHz to 1GHz	-79.3dB (SP)	-48.0 dB	Figure 3
	1GHz to 18GHz	-60dB (LP)	-54.5 dB	Figure 4
Terminal Interference Voltage	10kHz to 30MHz	(-68.2dB) (LP)	-54.5 dB	Figure 5

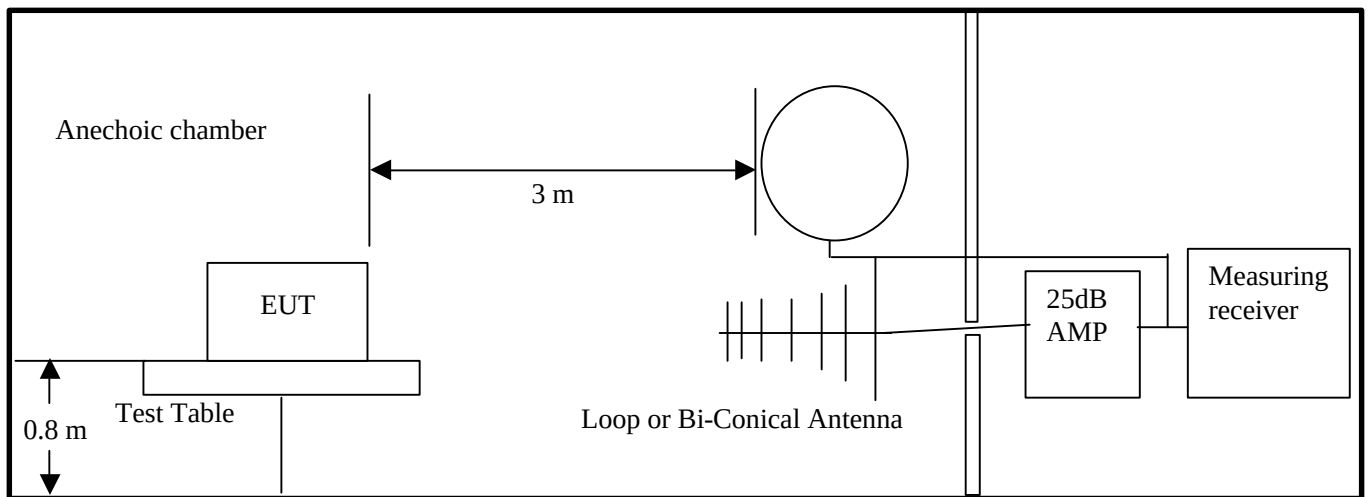


Figure 3 Spurious Emissions Field Strength (150kHz - 1GHz)

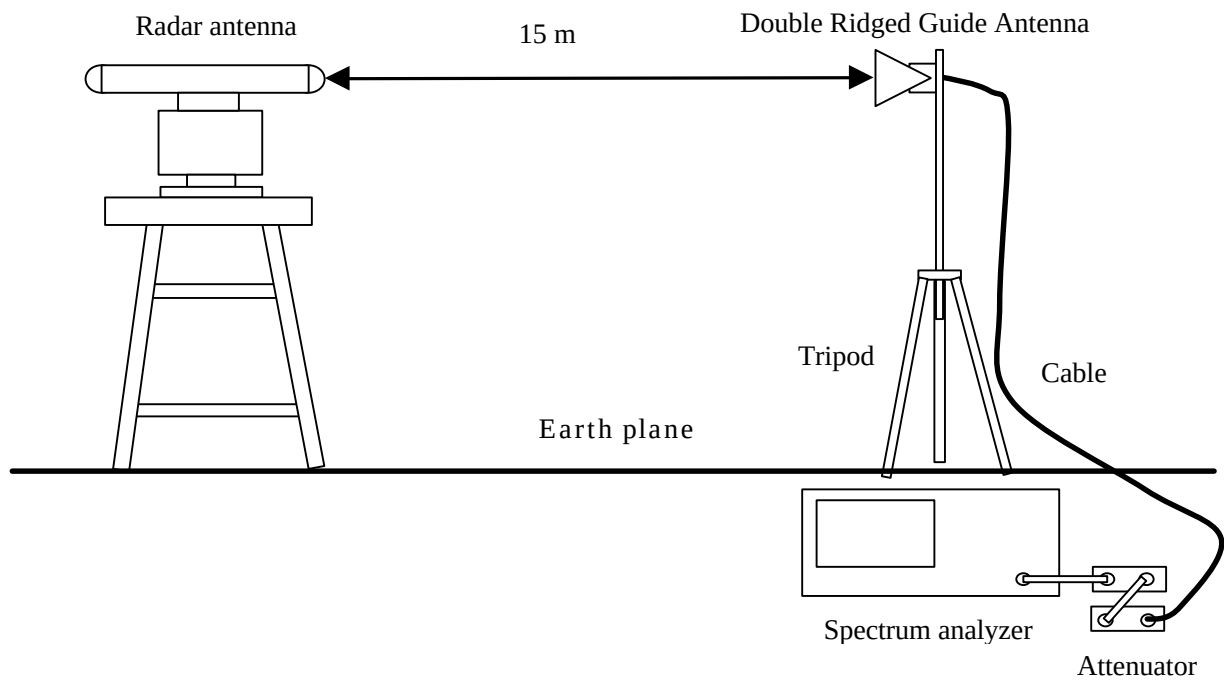


Figure 4 Spurious Emissions Field Strength (1GHz - 18GHz)

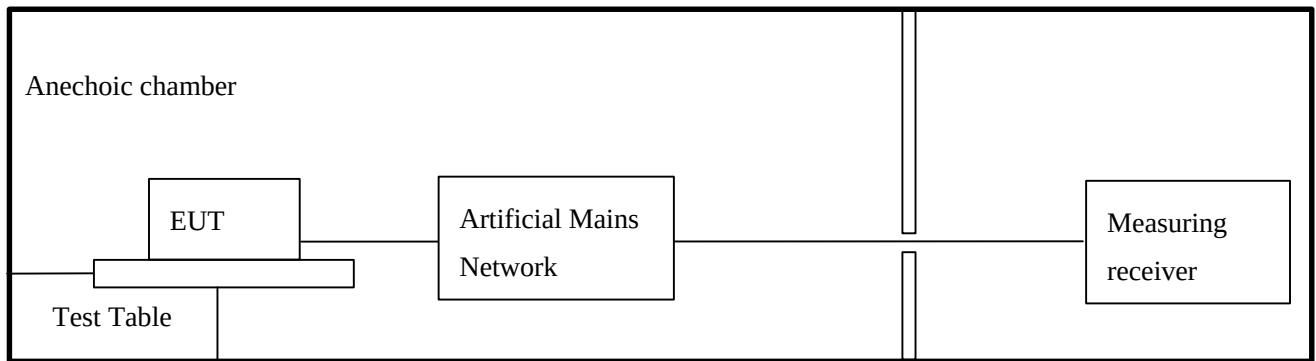


Figure 5 TERMINAL INTERFERENCE VOLTAGE (10kHz - 30MHz)

TEST RESULTS OF MAGNETIC FIELD STRENGTH (150kHz – 30MHz)

Product : Marine Radar

Model : RA55

Serial No. : E4360003

Rating : 24v dc

Mode : **STBY**

Date : 24 July.2002

Condition : 23°C 28%

QUASI-PEAK LEVEL

FREQ	FSM	CL	AF	EFS	MRGN	Limit	Note
MHz	dBuV	dB	dB	dBuV/m	dB	dBuV/m	
0.1500	43.0	0.0	10.0	53.1	26.9	80.0	Q,
0.2000	42.9	0.0	10.0	53.0	15.4	68.4	Q,
0.2500	39.4	0.0	10.0	49.4	9.9	59.4	Q,
0.3000	37.7	0.0	10.0	47.7	4.3	52.0	Q,
0.4000	34.9	0.0	10.0	45.0	5.9	50.9	Q,
0.5000	33.0	0.0	10.0	43.1	6.9	50.0	Q,
0.7500	28.3	0.0	10.0	38.3	10.1	48.4	Q,
1.0000	26.8	0.0	10.0	36.9	10.4	47.3	Q,
2.0000	19.5	0.1	10.0	29.7	14.9	44.6	Q,
3.0000	17.1	0.1	10.0	27.2	15.8	43.0	Q,
4.0000	15.9	0.1	10.0	26.1	15.8	41.9	Q,
5.0000	15.1	0.1	10.0	25.3	15.7	41.0	Q,
7.5000	14.3	0.1	10.0	24.5	15.0	39.4	Q,
10.0000	14.1	0.1	10.0	24.2	14.1	38.3	Q,
15.0000	14.1	0.1	9.5	23.7	13.0	36.7	Q,
18.0000	13.6	0.1	9.2	23.0	13.0	36.0	Q,
20.0000	16.6	0.1	9.0	25.8	9.8	35.6	Q,
25.0000	13.7	0.1	7.9	21.8	13.0	34.7	Q,
30.0000	14.7	0.1	6.8	21.6	12.4	34.0	Q,

FSM : Field Strength Meter Reading

CL : Cable Loss

AF : Antenna Factor

EFS : Electric Field Strength (EFS=FSM+CL+AF)

MRGN : Margin (MRGN=Limit-EFS)

Q : CISPR Quasi-Peak

L : Loop Antenna

Ratio to Main Transmission : -66.9 = 53.1 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (150kHz – 30MHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, S-Pulse**
 Date : 24 July.2002
 Condition : 23°C 28%

QUASI-PEAK LEVEL

FREQ	FSM	CL	AF	EFS	MRGN	Limit	Note
MHz	dBuV	dB	dB	dBuV/m	dB	dBuV/m	
0.1500	43.3	0.0	10.0	53.3	26.7	80.0	Q,
0.2000	41.1	0.0	10.0	51.1	17.3	68.4	Q,
0.2500	39.7	0.0	10.0	49.8	9.6	59.4	Q,
0.3000	37.8	0.0	10.0	47.8	4.2	52.0	Q,
0.4000	35.1	0.0	10.0	45.1	5.7	50.9	Q,
0.5000	33.0	0.0	10.0	43.1	6.9	50.0	Q,
0.7500	28.4	0.0	10.0	38.4	10.0	48.4	Q,
1.0000	29.0	0.0	10.0	39.1	8.2	47.3	Q,
2.0000	19.6	0.1	10.0	29.7	14.8	44.6	Q,
3.0000	17.1	0.1	10.0	27.3	15.7	43.0	Q,
4.0000	15.9	0.1	10.0	26.1	15.8	41.9	Q,
5.0000	15.1	0.1	10.0	25.3	15.7	41.0	Q,
7.5000	14.3	0.1	10.0	24.4	15.0	39.4	Q,
10.0000	14.0	0.1	10.0	24.1	14.2	38.3	Q,
15.0000	14.0	0.1	9.5	23.7	13.0	36.7	Q,
18.0000	13.9	0.1	9.2	23.3	12.7	36.0	Q,
20.0000	16.7	0.1	9.0	25.9	9.7	35.6	Q,
25.0000	13.7	0.1	7.9	21.7	13.0	34.7	Q,
30.0000	14.8	0.1	6.8	21.8	12.2	34.0	Q,

FSM : Field Strength Meter Reading

CL : Cable Loss

AF : Antenna Factor

EFS : Electric Field Strength (EFS=FSM+CL+AF)

MRGN : Margin (MRGN=Limit-EFS)

Q : CISPR Quasi-Peak

L : Loop Antenna

Ratio to Main Transmission : $-66.7 = 53.3 - 120$

TEST RESULTS OF MAGNETIC FIELD STRENGTH (150kHz – 30MHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, L-Pulse**
 Date : 24 July.2002
 Condition : 23°C 28%

QUASI-PEAK LEVEL

FREQ	FSM	CL	AF	EFS	MRGN	Limit	Note
MHz	dBuV	dB	dB	dBuV/m	dB	dBuV/m	
0.1500	43.2	0.0	10.0	53.2	26.7	80.0	Q,
0.2000	41.0	0.0	10.0	51.0	17.4	68.4	Q,
0.2500	39.5	0.0	10.0	49.5	9.8	59.4	Q,
0.3000	37.9	0.0	10.0	47.9	4.1	52.0	Q,
0.4000	35.2	0.0	10.0	45.3	5.6	50.9	Q,
0.5000	33.0	0.0	10.0	43.0	7.0	50.0	Q,
0.7500	28.2	0.0	10.0	38.3	10.1	48.4	Q,
1.0000	29.4	0.0	10.0	39.5	7.8	47.3	Q,
2.0000	19.6	0.1	10.0	29.7	14.8	44.6	Q,
3.0000	17.2	0.1	10.0	27.4	15.6	43.0	Q,
4.0000	16.0	0.1	10.0	26.2	15.7	41.9	Q,
5.0000	15.2	0.1	10.0	25.4	15.7	41.0	Q,
7.5000	14.6	0.1	10.0	24.8	14.7	39.4	Q,
10.0000	14.3	0.1	10.0	24.4	13.9	38.3	Q,
15.0000	14.2	0.1	9.5	23.9	12.8	36.7	Q,
18.0000	13.7	0.1	9.2	23.1	12.9	36.0	Q,
20.0000	16.9	0.1	9.0	26.0	9.6	35.6	Q,
25.0000	14.0	0.1	7.9	22.0	12.7	34.7	Q,
30.0000	14.9	0.1	6.8	21.9	12.2	34.0	Q,

FSM : Field Strength Meter Reading
 CL : Cable Loss
 AF : Antenna Factor
 EFS : Electric Field Strength (EFS=FSM+CL+AF)
 MRGN : Margin (MRGN=Limit-EFS)
 Q : CISPR Quasi-Peak
 L : Loop Antenna

Ratio to Main Transmission : -66.8 = 53.2 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (156MHz – 165MHz)

Product : Marine Radar

Model : RA55

Serial No. : E4360003

Rating : 24v dc

Mode : **STBY**

Date : 22 July.2002

Condition : 24°C 35%

(VERTICAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
158.77	13.6	25.0	2.7	0.8	10.5	2.7	20.8	23.5	265	1.1	Q,
157.80	14.0	25.0	2.8	0.8	10.6	3.2	20.3	23.5	265	1.1	Q,
156.57	13.9	25.0	3.0	0.8	10.6	3.4	20.1	23.5	265	1.1	Q,
157.61	14.0	25.0	2.8	0.8	10.6	3.2	20.3	23.5	265	1.1	Q,
164.80	13.8	25.0	2.1	0.8	10.0	1.8	21.7	23.5	265	1.1	Q,

(HORIZONTAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
157.64	14.3	25.0	1.8	0.8	10.6	2.5	21.0	23.5	265	1.1	Q,
159.70	14.4	25.0	2.0	0.8	10.4	2.7	20.8	23.5	265	1.1	Q,
160.76	14.9	25.0	2.0	0.8	10.3	3.0	20.5	23.5	265	1.1	Q,
163.19	15.1	25.0	2.0	0.8	10.1	3.1	20.4	23.5	265	1.1	Q,
163.90	16.6	25.0	2.0	0.8	10.1	4.5	19.0	23.5	265	1.1	Q,

MFSM : Maximum Field Strength Meter Reading

PAG : Pre-Amplifier Gain

SAL : Site Attenuation Loss

CL : Cable Loss

AF : Antenna Factor

MEFS : Maximum Electric Field Strength (MEFS=MFSM-PAG+SAL+CL+AF)

MRGN : Margin (MRGN=Limit-MEFS)

DIR : Direction of Turn Table

ANT.H : Antenna Hight

Q : CISPR Quasi-Peak

B : Broad Band Dipole Antenna

D : Dipole Antenna

M6 : Maximum Six Data

Ratio to Main Transmission : -98.3 = 21.7 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (156MHz – 165MHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, S-Pulse**
 Date : 22 July.2002
 Condition : 24°C 35%

(VERTICAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
158.77	14.0	25.0	2.7	0.8	10.5	3.1	20.4	23.5	265	1.1	Q,
157.80	14.1	25.0	2.8	0.8	10.6	3.3	20.2	23.5	265	1.1	Q,
156.57	14.1	25.0	3.0	0.8	10.6	3.6	19.9	23.5	265	1.1	Q,
157.61	14.1	25.0	2.8	0.8	10.6	3.3	20.2	23.5	265	1.1	Q,
164.80	14.1	25.0	2.1	0.8	10.0	2.0	21.5	23.5	265	1.1	Q,

(HORIZONTAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
157.47	19.2	25.0	1.8	0.8	10.6	7.4	16.1	23.5	265	1.1	Q,
159.70	14.8	25.0	2.0	0.8	10.4	3.0	20.5	23.5	265	1.1	Q,
160.76	22.4	25.0	2.0	0.8	10.3	10.6	12.9	23.5	265	1.1	Q,
163.19	19.7	25.0	2.0	0.8	10.1	7.6	15.9	23.5	265	1.1	Q,
163.80	25.6	25.0	2.0	0.8	10.1	13.5	10.0	23.5	265	1.1	Q,

MFSM : Maximum Field Strength Meter Reading

PAG : Pre-Amplifier Gain

SAL : Site Attenuation Loss

CL : Cable Loss

AF : Antenna Factor

MEFS : Maximum Electric Field Strength (MEFS=MFSM-PAG+SAL+CL+AF)

MRGN : Margin (MRGN=Limit-MEFS)

DIR : Direction of Turn Table

ANT.H : Antenna Hight

Q : CISPR Quasi-Peak

B : Broad Band Dipole Antenna

D : Dipole Antenna

M6 : Maximum Six Data

Ratio to Main Transmission : -98.5 = 21.5 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (156MHz – 165MHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, L-Pulse**
 Date : 22 July.2002
 Condition : 24°C 35%

(VERTICAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
156.74	14.1	25.0	2.6	0.8	10.4	2.9	20.6	23.5	265	1.1	Q,
157.09	20.5	25.0	2.6	0.8	10.4	9.4	14.1	23.5	265	1.1	Q,
158.00	18.8	25.0	2.8	0.8	10.5	8.0	15.5	23.5	265	1.1	Q,
158.97	19.2	25.0	2.7	0.8	10.5	8.2	15.3	23.5	265	1.1	Q,
163.60	17.4	25.0	2.6	0.8	10.4	6.2	17.3	23.5	265	1.1	Q,
164.69	18.9	25.0	2.1	0.8	10.0	6.8	16.7	23.5	265	1.1	Q,

(HORIZONTAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
156.69	14.8	25.0	2.0	0.8	10.4	3.0	20.5	23.5	265	1.1	Q,
159.03	14.7	25.0	2.0	0.8	10.4	3.0	20.5	23.5	265	1.1	Q,
159.89	15.3	25.0	2.0	0.8	10.4	3.5	20.0	23.5	265	1.1	Q,
160.60	21.8	25.0	2.0	0.8	10.4	10.0	13.5	23.5	265	1.1	Q,
163.80	22.2	25.0	2.0	0.8	10.1	10.1	13.4	23.5	265	1.1	Q,

MFSM : Maximum Field Strength Meter Reading

PAG : Pre-Amplifier Gain

SAL : Site Attenuation Loss

CL : Cable Loss

AF : Antenna Factor

MEFS : Maximum Electric Field Strength (MEFS=MFSM-PAG+SAL+CL+AF)

MRGN : Margin (MRGN=Limit-MEFS)

DIR : Direction of Turn Table

ANT.H : Antenna Height

Q : CISPR Quasi-Peak

B : Broad Band Dipole Antenna

D : Dipole Antenna

M6 : Maximum Six Data

Ratio to Main Transmission : -109.9 = 10.1 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (30MHz – 1GHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, S-Pulse**
 Date : 23 July.2002
 Condition : 24°C 35%

(VERTICAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
138.2	28.1	25	2.9	0.7	11.7	18.5	35.4	54.0	59	1.0	Q,
271.8	47.1	25	0.1	1.1	13.0	36.4	17.5	54.0	164	1.7	Q,
382.1	40.1	25	-0.4	1.5	15.7	31.9	22.0	54.0	201	1.0	Q,
747.7	33.8	25	-0.9	2.0	22.0	32.0	21.9	54.0	182	1.6	Q,
812.6	42.4	25	-0.9	2.1	22.0	40.6	13.3	54.0	194	1.9	Q,
920.1	29.1	25	0.2	2.3	23.5	30.2	23.7	54.0	11	1.9	Q,

(HORIZONTAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
171.6	31.8	25	1.9	0.8	9.6	19.3	34.6	54.0	35	1.8	Q,
242.9	44.7	25	0.9	1.0	11.9	33.5	20.4	54.0	355	1.1	Q,
271.8	50.6	25	-0.4	1.1	13	39.2	14.7	54.0	2	1.0	Q,
383.1	47.2	25	-0.2	1.5	15.7	39.2	14.7	54.0	19	1.0	Q
814.4	37.8	25	0.0	2.1	22	37.0	16.9	54.0	173	1.0	Q,
922.2	26.9	25	-0.2	2.3	23.5	27.5	26.4	54.0	184	1.0	Q,

MFSM : Maximum Field Strength Meter Reading

PAG : Pre-Amplifier Gain

SAL : Site Attenuation Loss

CL : Cable Loss

AF : Antenna Factor

MEFS : Maximum Electric Field Strength (MEFS=MFSM-PAG+SAL+CL+AF)

MRGN : Margin (MRGN=Limit-MEFS)

DIR : Direction of Turn Table

ANT.H : Antenna Hight

Q : CISPR Quasi-Peak

B : Broad Band Dipole Antenna

D : Dipole Antenna

M6 : Maximum Six Data

Ratio to Main Transmission : -79.4 = 40.6 - 120

TEST RESULTS OF MAGNETIC FIELD STRENGTH (30MHz – 1GHz)

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, L-Pulse**
 Date : 23 July.2002
 Condition : 24°C 35%

(VERTICAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
143	25.8	25	3.1	0.7	11.5	16.3	37.6	54.0	52	1.0	Q,
277.2	41.2	25	-0.1	1.1	13.1	30.3	23.6	54.0	167	1.3	Q,
383.1	39.0	25	-0.4	1.5	15.7	30.8	23.1	54.0	117	1.1	Q,
815.7	35.8	25	-0.9	2.1	22.1	34.1	19.8	54.0	148	1.0	Q,
896.5	28.6	25	-0.2	2.2	22.9	28.5	25.4	54.0	359	1.0	Q,

(HORIZONTAL POLARIZATION)

FREQ	MFSM	PAG	SAL	CL	AF	MEFS	MRGN	Limit	DIR	ANT.H	Note
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dB	dBuV/m	deg	m	
112.4	25.9	25	2.5	0.6	11.2	15.3	38.6	54.0	265	1.0	Q,
126	29.2	25	3.2	0.7	11.8	20.0	33.9	54.0	265	1.0	Q,
135.4	25.3	25	2.9	0.7	11.7	15.8	38.1	54.0	265	1.0	Q,
170.4	27.6	25	1.4	0.8	9.5	14.4	39.5	54.0	265	1.0	Q,
186.1	27.5	25	-0.4	0.8	8.9	11.9	42.0	54.0	265	1.0	Q,
189.3	27.4	25	-0.7	0.8	8.9	11.6	42.3	54.0	265	1.0	Q,
239.6	40.5	25	0.9	1.0	11.8	29.4	24.5	54.0	1	1.0	Q,
242.3	41.9	25	0.8	1.0	12.0	30.8	23.1	54.0	350	1.0	Q,
268.4	51.2	25	-0.3	1.1	12.9	39.9	14.0	54.0	95	1.0	Q,
381.8	44.3	25	-0.3	1.5	15.7	29.4	24.5	54.0	40	0.9	Q,
695.7	39.6	25	-0.1	2.0	20.5	30.8	23.1	54.0	18	0.9	Q,
802.9	35.1	25	0.0	2.1	21.8	39.9	14.0	54.0	157	0.9	Q,

MFSM : Maximum Field Strength Meter Reading

PAG : Pre-Amplifier Gain

SAL : Site Attenuation Loss

CL : Cable Loss

AF : Antenna Factor

MEFS : Maximum Electric Field Strength (MEFS=MFSM-PAG+SAL+CL+AF)

MRGN : Margin (MRGN=Limit-MEFS)

DIR : Direction of Turn Table

ANT.H : Antenna Height

Q : CISPR Quasi-Peak

B : Broad Band Dipole Antenna

D : Dipole Antenna

M6 : Maximum Six Data

Ratio to Main Transmission : -80.1 = 39.9 - 120

TEST RESULTS OF CONDUCTED POWER-LINE STRENGTH

Product : Marine Radar
 Model : RA55
 Serial No. : E4360003
 Rating : 24v dc
 Mode : **TX ON, L-Pulse**
 Date : 18 July.2002
 Condition : 24°C 35%

QUASI-PEAK LEVEL (ONE)

FREQ	FSM	CL	LISN	CPLS	MRGN	Limit	Note
MHz	dBuV	dB	dB	dBuV	dB	dBuV/m	
0.0439	48.5	0.0	0.5	49.0	23.7	72.7	
0.1289	42.1	0.0	0.1	42.2	10.6	52.8	
0.2140	37.5	0.0	0.1	37.6	18.2	55.8	
0.3843	28.2	0.0	0.0	28.3	21.7	50.0	
25.2010	33.6	0.0	0.7	34.3	15.7	50.0	

QUASI-PEAK LEVEL (OTHER ONE)

FREQ	FSM	CL	LISN	CPLS	MRGN	Limit	Note
MHz	dBuV	Db	dB	dBuV	dB	dBuV/m	
0.0439	51.3	0.0	0.5	51.8	10.5	72.7	
0.1289	41.8	0.0	0.1	41.9	10.6	52.8	
0.2140	37.2	0.0	0.1	37.3	10.6	55.8	
0.3843	27.6	0.0	0.0	27.6	10.6	50.0	
25.2010	33.2	0.1	0.7	34.0	10.0	50.0	

FSM : Field Strength Meter Reading

CL : Cable Loss

LISN : LISN Factor

CPLS : Conducted Power-Line Strength (CPLS=FSM+CL+LISN)

MRGN : Margin (MRGN=Limit-CPLS)

Q : CISPR Quasi-Peak

Ratio to Main Transmission : -68.2 = 51.8 - 120

Exhibit 6

FREQUENCY STABILITY (2.995)

Type of Transmission: P0N
Type of Modulation: Pulse
Frequency Band: 9410 MHz +/- 30 MHz
Pulse Rate: 500 Hz to 2000 Hz, Selectable as a function of Range
Pulse Width: 0.08 us to 1.2 us, Selectable as a function of Range

TEST EQUIPMENT

	Equipment	Manufacturer	Model
1.	X-Band Directional Coupler	NIHON KOSHUHA	WDK-1018
2.	Attenuator	SHIMADA RIKI	4A390
3.	Variable Attenuator	Hewlett-Packard	8494B
4.	X-Band Dummy Load	SPC	R9678
5.	Power Meter	Hewlett-Packard	437B
6.	Spectrum Analyzer	Agilent	8564EC
7.	Temperature Chamber	ITABASHI KAGAKU	LTM

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

0.08 us x 2000 Hz, 0.3 us x 1500 Hz, 0.6 us x 800 Hz, 1.2 us x 500 Hz

The circuitry of the Radar contains a key-inhibit timer that prevents transmission until the magnetron has warmed-up for 2 minutes. Consequently, all data are taken after the 2 minutes warmed-up.

- (1) Set up the equipment in the temperature chamber as shown in Fig.6. Set the chamber to 25 Degree Centigrade and allow the equipment to stabilize.
- (2) Turn the equipment on and measure the transmitted frequency using the Spectrum Analyzer. Measure each the pulse types at one minute intervals until unit stability is achieved or 10 minutes have elapsed, whichever is longer.
- (3) Set the chamber temperature to -25 Degree Centigrade and repeat steps 1 and 2.
Set the chamber temperature to 55 Degree Centigrade and repeat steps 1 and 2.
- (4) Measure the output frequency at room ambient temperature following voltages applied to the power input.

24V input: Apply 20.4V and 27.6V

32V input: Apply 27.2V and 36.8V

(5) Calculate test frequency limits from the followings;

The frequency of the principal emission must not be nearer to the edge of the authorized band than $1.5/t$ in MHz, (where t is the shortest pulse used, in micro second).

$t = 80\text{ns}(\text{nominal})$

$1.5/t = 18.8 \text{ MHz}$

Band Limit = 9.300000 to 9.500000 GHz

Emission Limit = 9.3188 to 9.4812 GHz

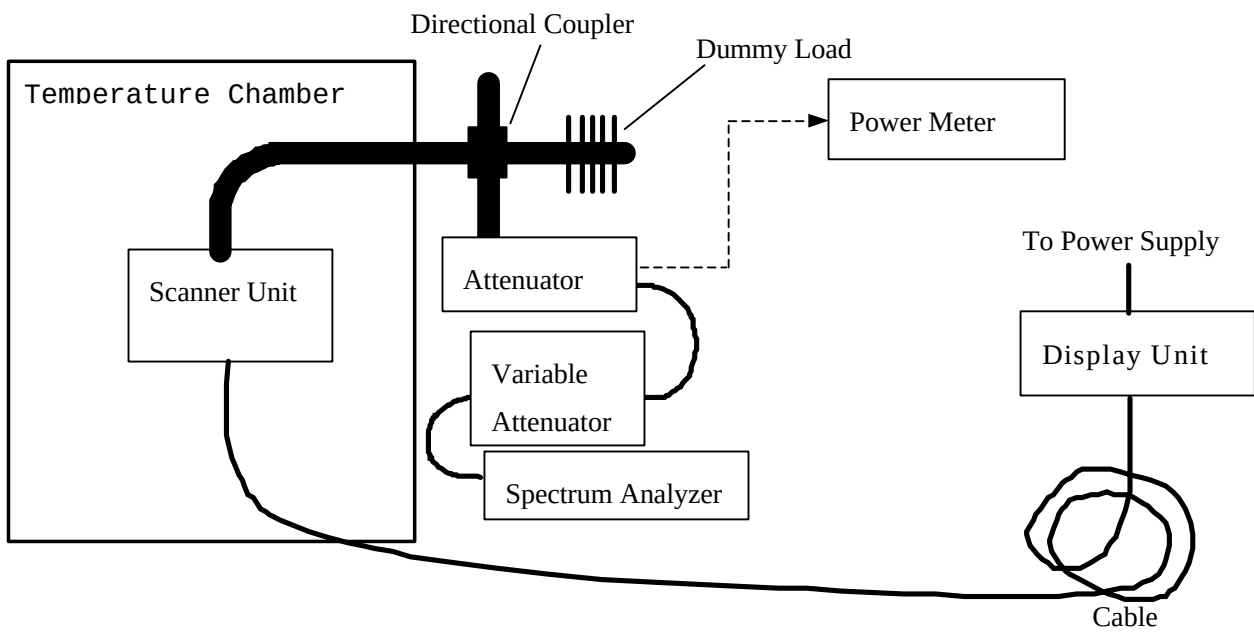


Figure.6 FREQUENCY STABILLITY (2.995)

Exhibit 6

TEST DATA

Temperature Stability

Pulse Type	80ns X 2000Hz	300ns X 1500Hz	600ns X 800Hz	1200ns X 500Hz
Temperature (Deg.)				
-25	9.414	9.413	9.411	9.410
+25	9.421	9.420	9.419	9.418
+55	9.410	9.408	9.407	9.406

Voltage Stability

Applied Voltage (Vdc)	Initial Frequency (GHz)	Final Frequency (GHz)
20.4	9.411	9.408
24.0	9.411	9.408
27.2	9.411	9.408
27.6	9.411	9.408
32.0	9.411	9.408
36.8	9.411	9.408

Note: All data taken in the 80 ns X 2000Hz mode.

*** Final reading taken 5 minutes following initial reading.