TEST DATA

MARINE RADAR

RA775UA

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 Anritsu Marine Radar, Type **RA775UA**.

All testing was performed by the Anritsu Corporation
Atsugi Factory, 1800, Onna, Atsugi-shi, Kanagawa 243, Japan.

Serial Number Tested: R51000L

Reprt Prepared By:

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STANDARD TEST CONDITIONS

and

ENGINEERING PRACTICES

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

ROOM TEMPERATURE	=25±5℃
ROOM HUMIDITY	=20-50%

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.

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Data for the acceptance of the Anritsu Marine Rdar Type **RA775UA**

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Exhibit 1

RF POWER OUTPUT (2.985)

Type of Transmission:	PON
Type of Modulation:	Pulse
Frequency Band:	9445 MHz ± 30 MHz
Frequency Source:	Fixed Cavity Resonator
Pulse Rate:	580 Hz to 1800 Hz, Selectable as a function of Range
Pulse Width:	0.12 us to 0.8 us, Selectable as a function of Range

TEST EQUIPMENT

Equipment	Manufacturer	Model
1. X-Band Directional Coupler	Hewlett-Packard	X752D
2. Variable Attenuator	Hewlett-Packard	X382A
3. Power Meter	Hewlett-Packard	432A
4. Crystal Detector	Hewlett-Packard	423B
5. Oscilloscope	IWATSU ELECTRIC	SS-5121B
6. Frequency Counter	ANRITSU	MF63A
7. X-Band Dummy Load	NIHON KOSHUHA	WDL095

RF POWER OUTPUT(2.985) & MODULATION CHARACTERISTICS(2.987)

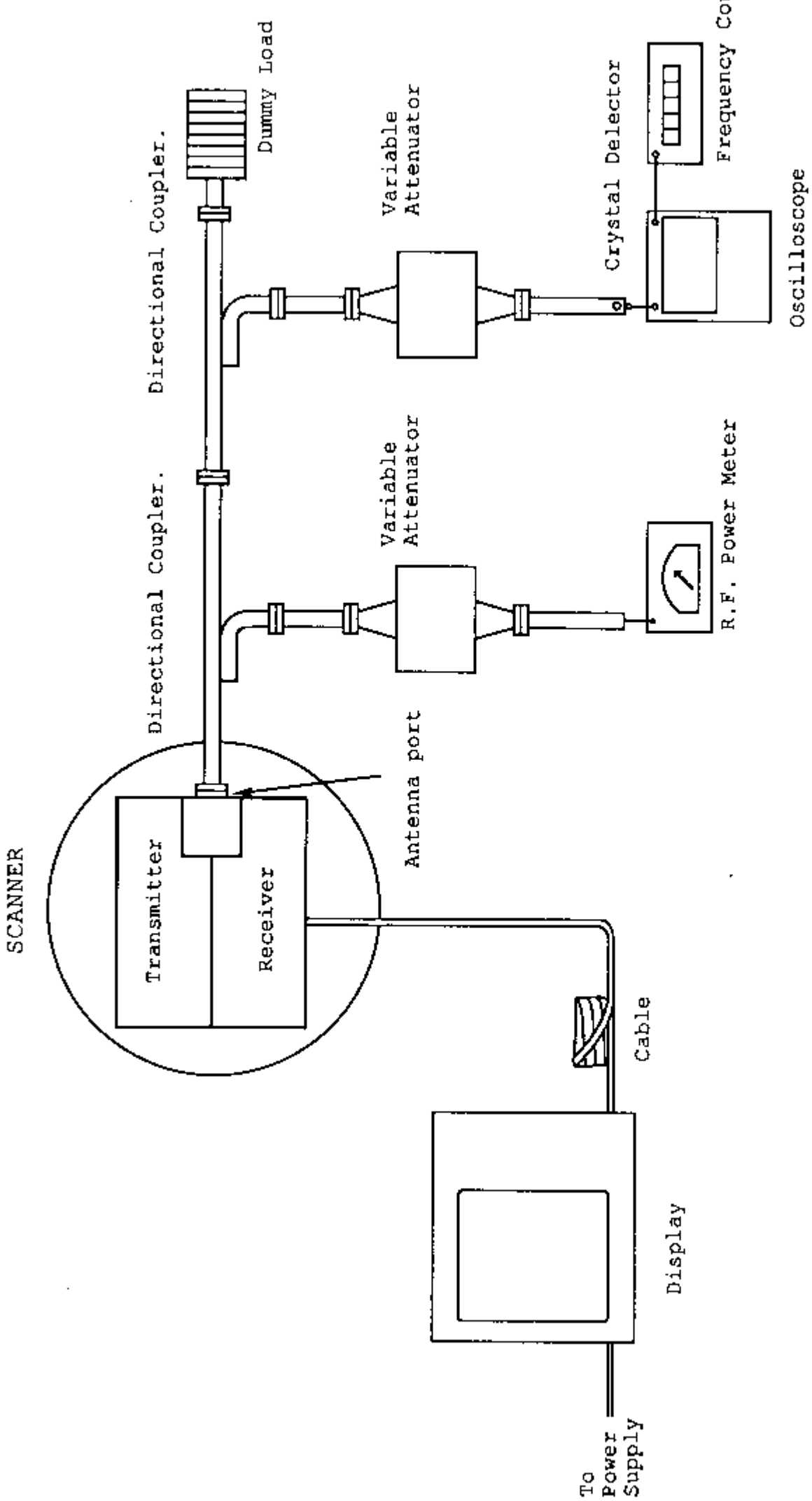


Figure 1

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:

120ns × 1800Hz, 300ns × 1200Hz, 0.8 × 580Hz

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 pulse width and P.R.F. by using oscilloscope and frequency counter.

(5) Caluculate peak power as follows:

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

P_0 : Peak Power, P_m : Mean Power, Fr : P.R.F.

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

Exhibit 1

TEST RESULT

Transmit Pulse Width and P.R.F	Measured Mean Power	Measured Pusle Width	Measured P.R.F	Caluculated Peak Power
0.12 us 1800 Hz	0.3 W	0.125 us	1808 Hz	1.33 KW
0.3 us 1200 Hz	0.6 W	0.31 us	1169 Hz	1.65 KW
0.8 us 580 Hz	0.9 W	0.8 us	580 Hz	1.93 KW

Exhibit 2

MODULATION CHARACTERISITICS (2.987)

Type of Transmission:	PON
Type of Modulation:	Pulse
Frequency Band:	9445 MHz ± 30MHz
Frequency Source:	Fixed Cavity Resonator
Pulse Rate:	580 to 1800 Hz, Selectable as a function of Range
Pulse Width:	0.12 us to 0.8 us, Selectable as a function of Range

TEST EQUIPMENT

	Equipment	Manufacturer	Model
1.	X-Band Directional Coupler	Hewlett-Packard	X752D
2.	Variable Attenuator	Hewlett-Packard	X382A
3.	Power Meter	Hewlett-Packard	432A
4.	Crystal Detector	Hewlett-Packard	423B
5.	Oscilloscope	IWATSU ELECTRIC	SS-5121B
6.	Frequency Counter	ANRITSU	MF63A
7.	X-Band Dummy Load	NIHON KOSHUHA	WDL095

Exhibit 2

TEST PROCEDURER

The Marine Radar is capable of generating the following pulses:
0.12 us x 1800 Hz, 0.3 us x 1200 Hz, 0.8 us x 580 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 Pusle)

(1) Short Pulse_____ photo-1

50 ns/div.

Pulse width (-3 dB) = 125 ns

Pulse repention Frequency - 1808 Hz

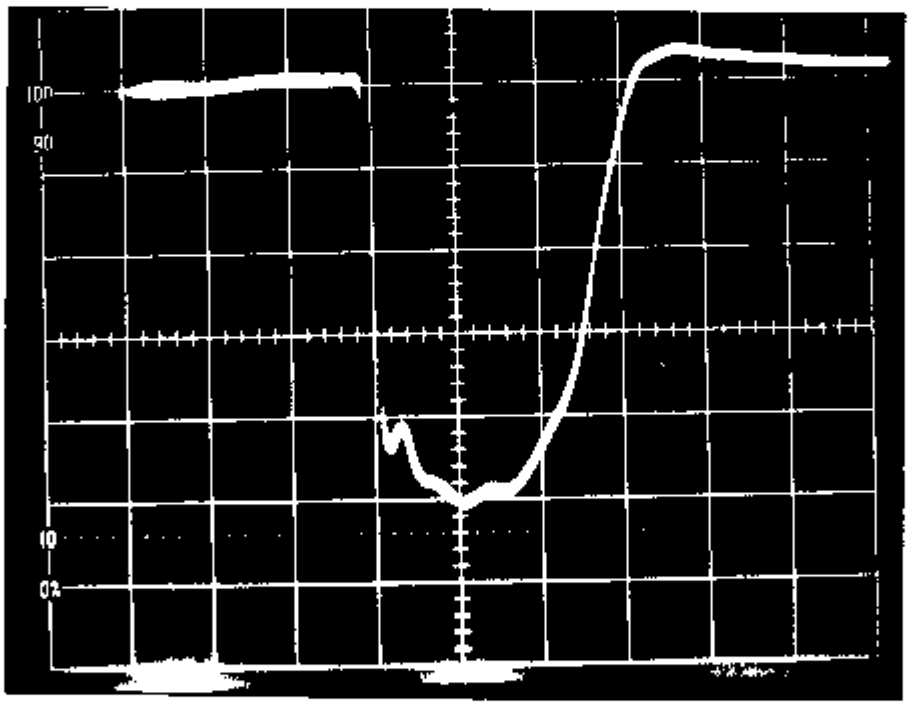


Exhibit 2

TEST RESULT

Modulation Characteristics
(Detected Pusle)

(1) Middle Pulse_____ photo-2
100 ns/div.

Pulse width (-3 dB) = 310 ns
Pulse repention Frequency = 1169 Hz

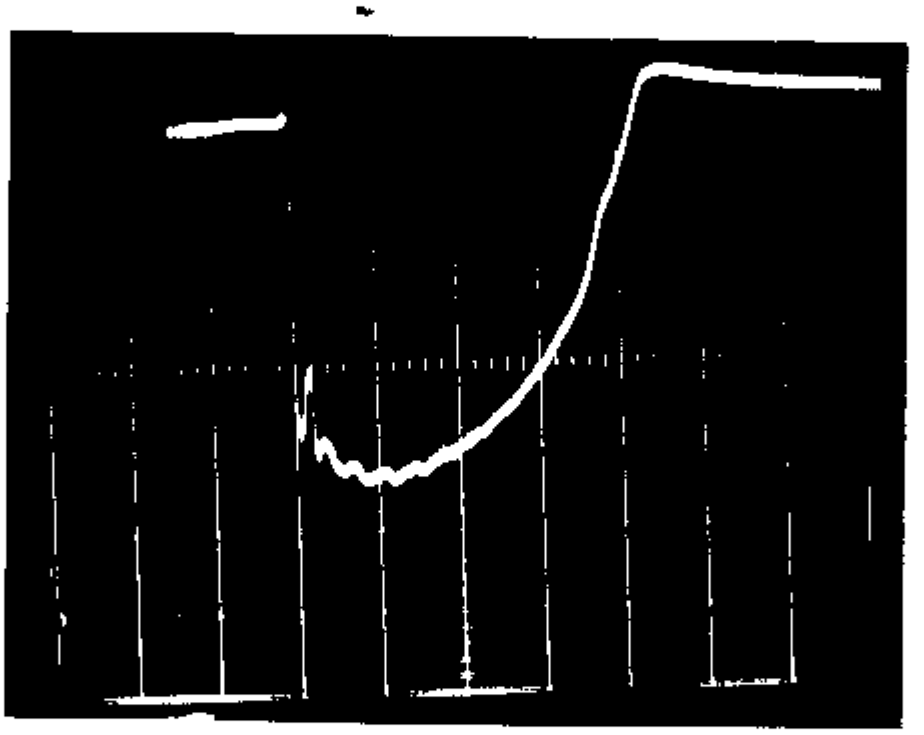


Exhibit 2

TEST RESULT

Modulation Characteristics
(Detected Pusle)

(1) Long Pulse_____ photo-3

200 ns/div.

Pulse width (-3 dB) = 800 ns

Pulse repention Frequency = 580 Hz

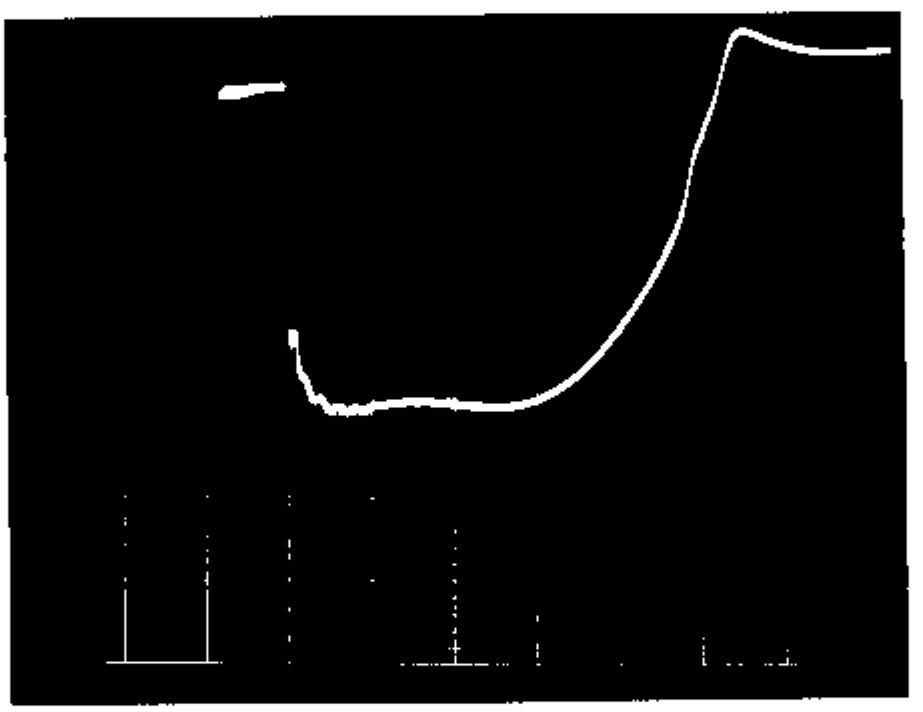


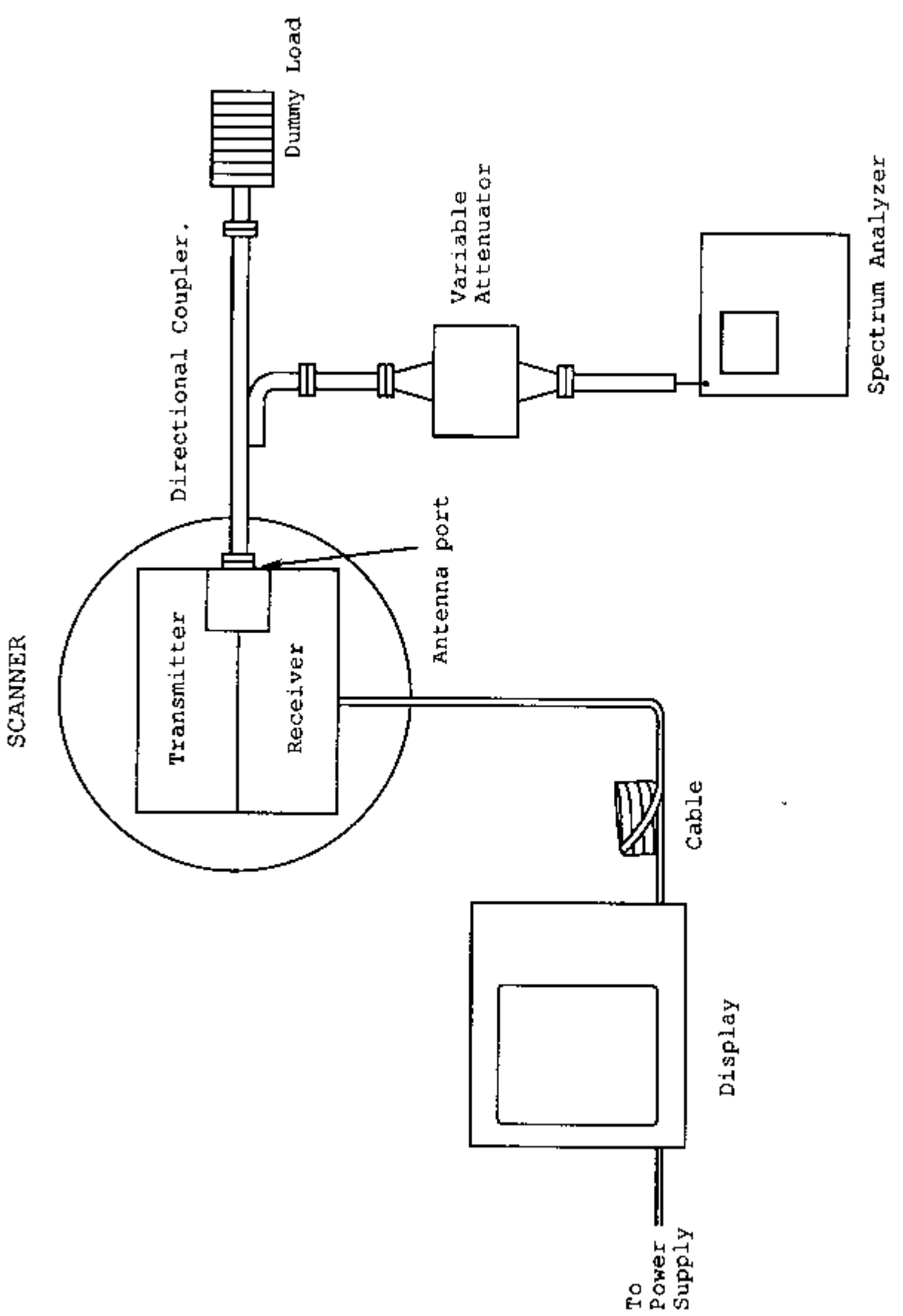
Exhibit 3

OCCUPIED BANDWIDTH (2.989)

Type of Transmission:	P0N
Type of Modulation:	Pulse
Frequency Band:	9445 MHz ± 30 MHz
Frequency Source:	Fixed Cavity Resonator
Pulse Rate:	580 to 1800 Hz, Selectable as a function of Range
Pulse Width:	0.12 us to 0.8 us, Selectable as a function of Range

TEST EQUIPMENT

	Equipment	Manufacturer	Model
1.	X-Band Directional Coupler	Hewlett-Packard	X752D
2.	Variable Attenuator	Hewlett-Packard	X382A
3.	X-Band Dummy Load	NIHON KOSHUHA	WDL095
4.	Spectrum Analyzer	Anritsu	MS710C



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

Figure 2

Exhibit 3

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:
120 ns × 1800 Hz, 300 ns × 1200 Hz, 800 ns × 580 Hz

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

(1) Connect the equipment as shown in Fig.3.

(2) Adjust center frequency, span reference level of spectrum analyzer and attenuator if necessary, such that the display nearly fills the screen.

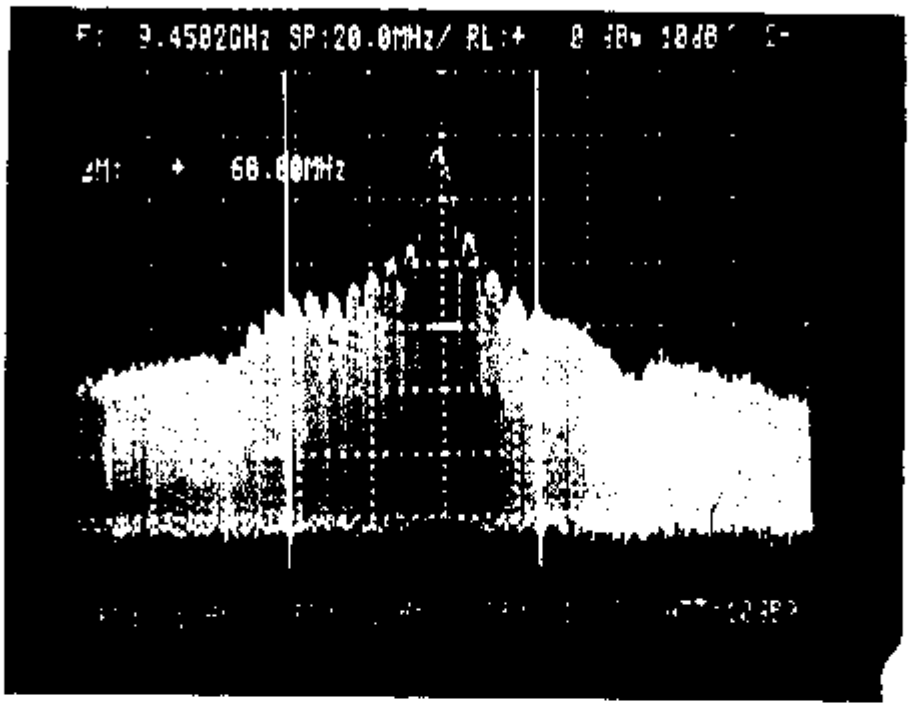
(3) Measure and record spectrum and bandwidth

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.

Exhibit 3

TEST RESULT

Transmission Spectrum of 120 ns × 1800 Hz



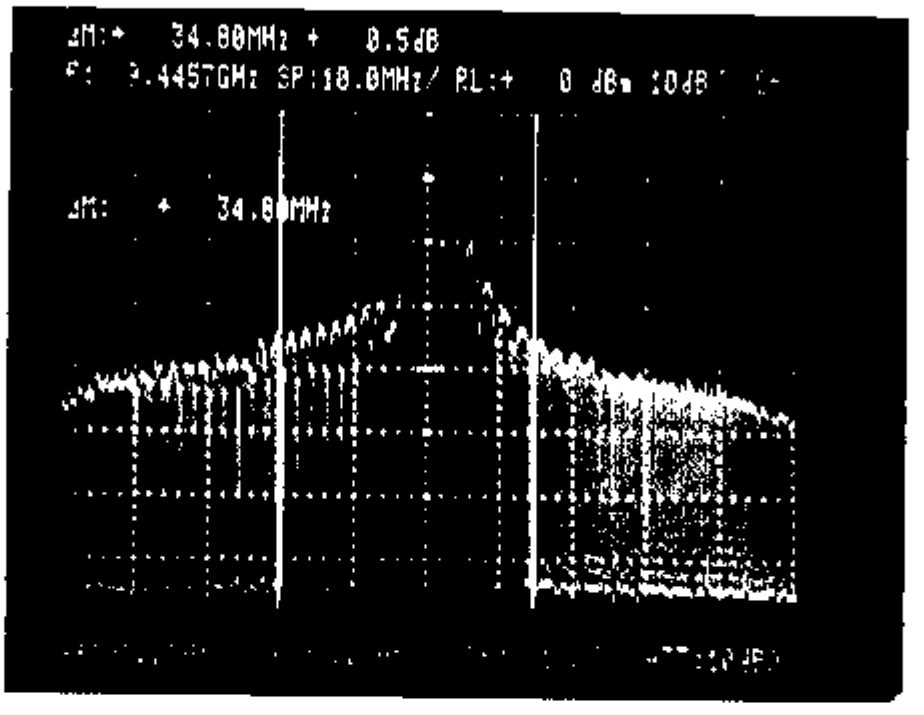
Center frequency	:	9.4502GHz
Frequency span	:	20.0 MHz/div.
Level	:	10 dB/div.
Resolution band width	:	1 MHz/div.
Video band width	:	1 MHz/div.
Sweep time	:	1 sec/div.

Occupied band width : 68.8 MHz

Exhibit 3

TEST RESULT

Transmission Spectrum of 300 ns × 1200 Hz



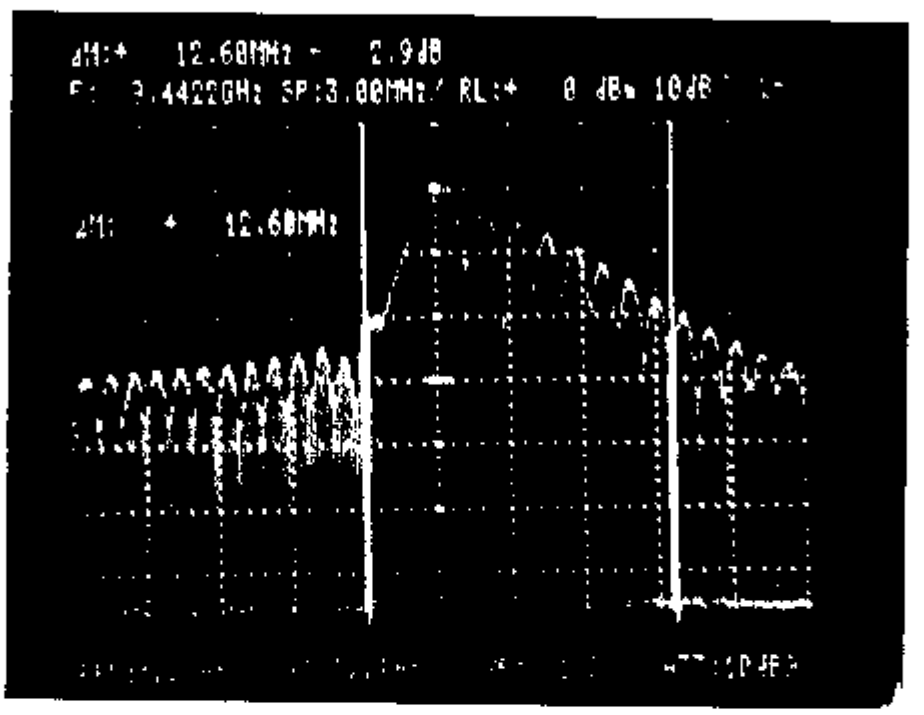
Center frequency	:	9.4457GHz
Frequency span	:	10.0 MHz/div.
Level	:	10 dB/div.
Resolution band width	:	300 kHz/div.
Video band width	:	300 kHz/div.
Sweep time	:	1 sec/div.

Occupied band width : 34.8 MHz

Exhibit 3

TEST RESULT

Transmission Spectrum of 800 ns × 580 Hz



Center frequency	:	9.4422GHz
Frequency span	:	3.0 MHz/div.
Level	:	10 dB/div.
Resolution band width	:	100 kHz/div.
Video band width	:	300 kHz/div.
Sweep time	:	1 sec/div.

Occupied band width : 12.6 MHz

Exhibit 3

TEST RESULT

Pulse	Bandwidth
120 ns × 1800 Hz	68.8 MHz
300 ns × 1200 Hz	34.8 MHz
800 ns × 580 Hz	12.6 MHz

Exhibit 4

SPURIOUS EMISSION AT ANTENNA TERMINAL (2.991)

Type of Transmission: PON

Type of Modulation: Pulse

Frequency Band: 9445 MHz ± 30MHz

Frequency Source: Fixed cavity resonator

Pulse Rate: 580 Hz to 1800 Hz, Selectable as a function of Range

TEST EQUIPMENT

	Equipment	Manufacture	Model
1.	Directional Coupler	Hewlett-Packard	X752D
2.	Variable Attenuator	Hewlrtt-Packard	X382A
3.	Spectrum Analyzer	Anritsu	MS710C

Exhibit 4

TEST PROCEDURE

The Marine Radar is capable if generating the following pule:
120 ns × 1800 Hz, 300 ns × 1200 Hz, 800 ns × 580 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 estabilished.
(3) The spectrum was seached over the range 0 to 23 GHz using spectrum analyzer.

NOTE

(2) 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).

TEST RESULT

9445 MHz	0 dB
2nd	-65 dB

All other spurious and harmonics up to 23 GHz were found to be than -70dB below maxmum mean power, and/or 20 dB below limit.

Lmit: -(43 + 10 log 0.9) = -42.5dB

mean power:0.9 watts at 0.8 us × 580 Hz.

Exhibit 5

SPRIOUS EMISSIONS FIELD STRENGTH (2.993)

Type of Transmission: P0N

Type of Modulation: Pulse

Frequency Band: 9445 MHz ± 30 MHz

Frequency Soerce: Fixed cavity resonator

Pulse Rate: 580 Hz to 1800 Hz, Selectable as a function of range

TEST EQUIPMENT

	Equipment	Manufacture	Model
1.	EMI Measuring system	Anritsu	ME2601A
2.	Antenna(10 kHz ~ 30 MHz)	AIL TECH	95010-1
3.	Antenna(30 MHz ~ 200 MHz)	EMCO	3104(Biconical)
4.	Antenna(200 MHz ~ 1 GHz)	EMCO	3164(Log-Periodic)
5.	Antenna(1 GHz ~ 23 GHz)	EMCO	3115(Duble Rdged Guide)
6.	Spectrum analyzer	Anritsu	MS710C
7.	Mains Network	Anritsu	MN424B

Exhibit 5

CARIBRATION

All test equipment is calibrated and maintained by Anritsu Test Equipment section.

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:
120 ns × 1800 Hz, 300 ns × 1200 Hz, 800 ns × 580 Hz
The spurious emissions field strength for each of these combination was measured using following procedure.

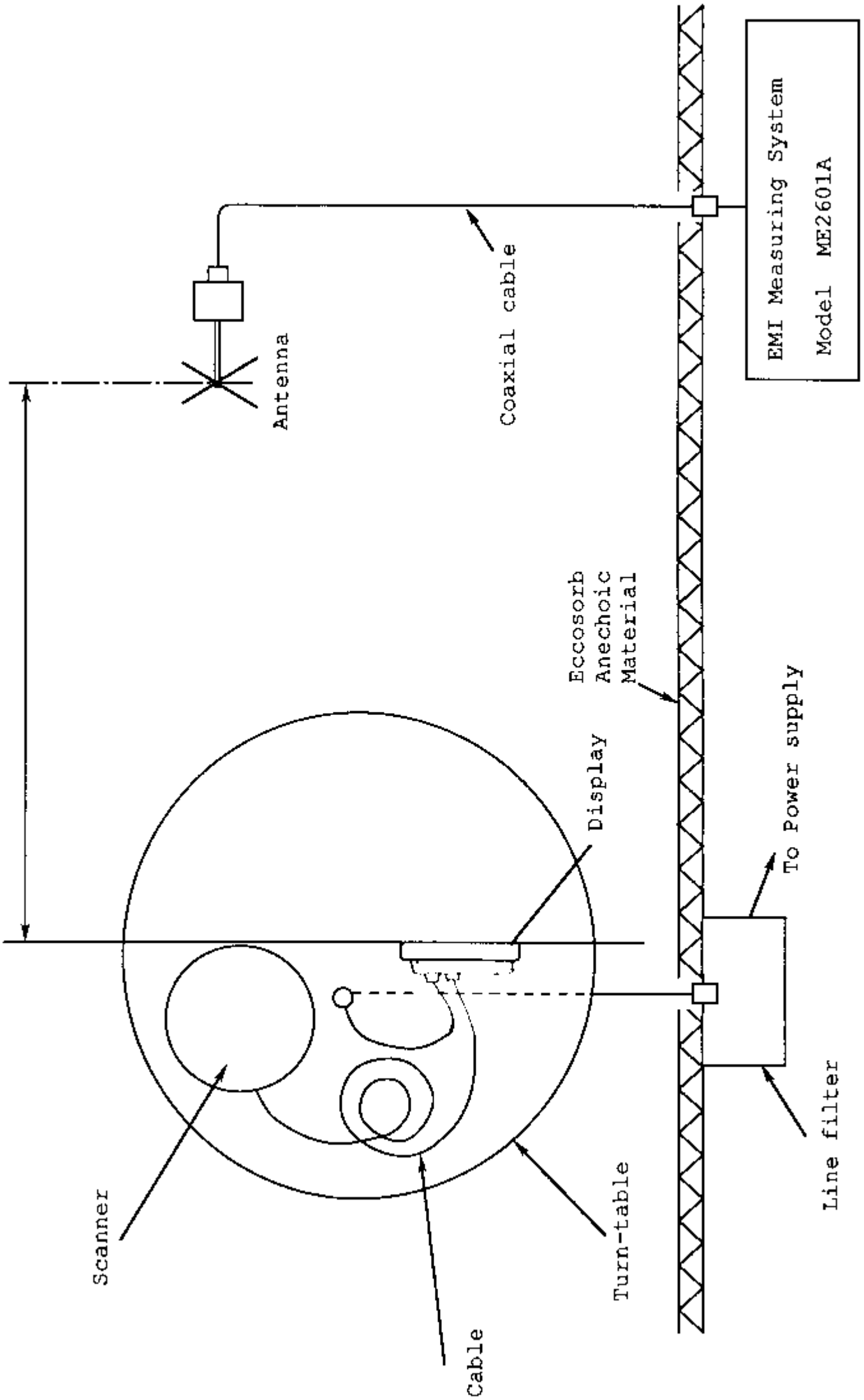
(1) Set up the equipment as shown in Fig.3.
(2) Using the automatic EMI Measuring System, measure and record the spurious radiated emissions from 10 kHz to 1 GHz. The computer in the Measuring system program automatically adds antenna factors and cable losses to the raw voltage measurements to obtain 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 to23 GHz.
(5) Calculate the field strength of sprious emissions from 1 GHz to 18 GHz by add in antenna factor (including cable loss) to the observed reading.
(6) Set up the equipment as shown in Fig.5.
(7) Using the automatic EMI Measuring system, measure and record terminal interference voltage from 10 kHz to 30 MHz.

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 0.9) = -42.5dB
mean power:0.9 watts at 0.8 us × 580 Hz

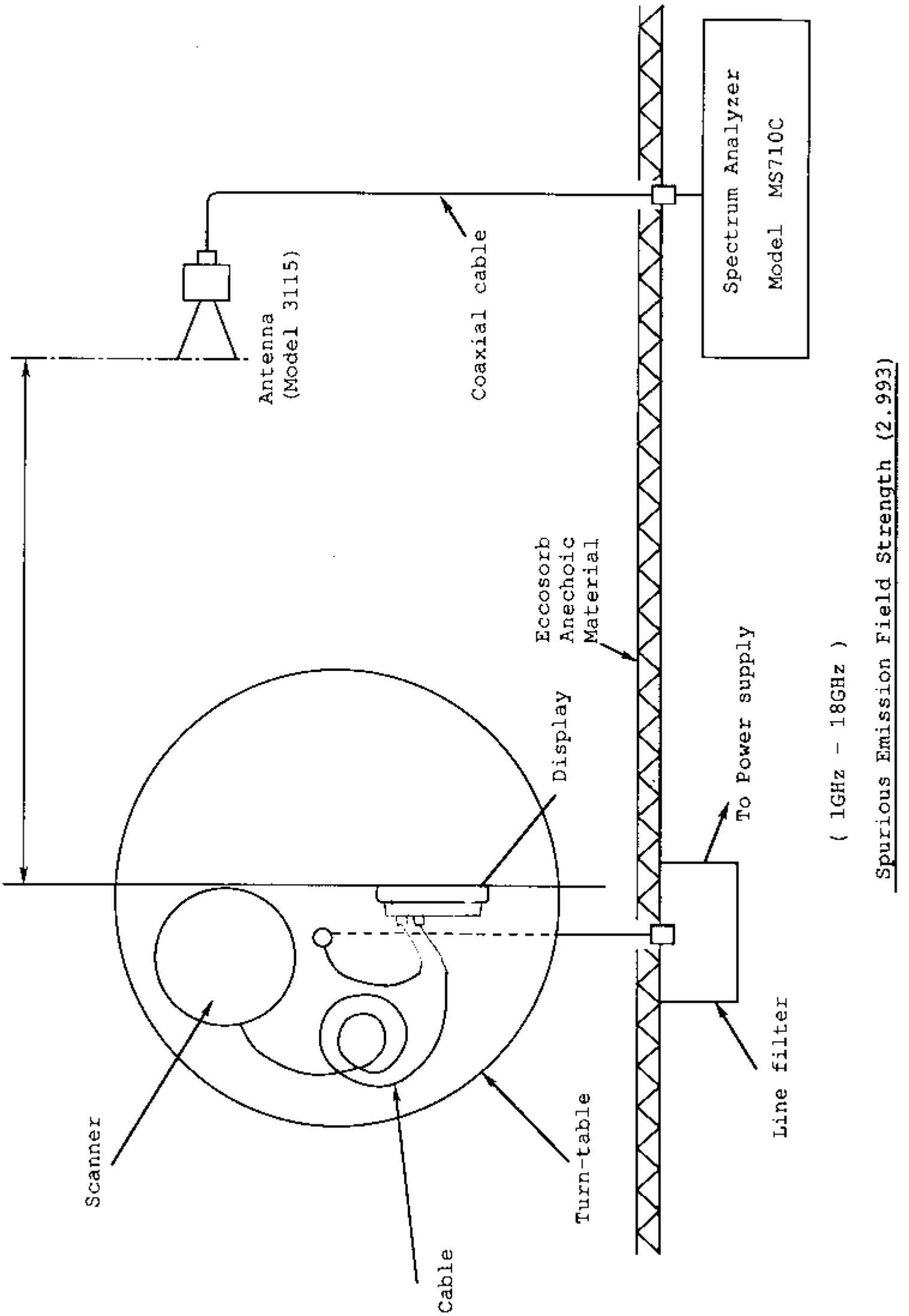
Exhibit 5



Spurious Emission Field Strength (2.993)
(10kHz - 1GHz)

Figure 3

Exhibit 5

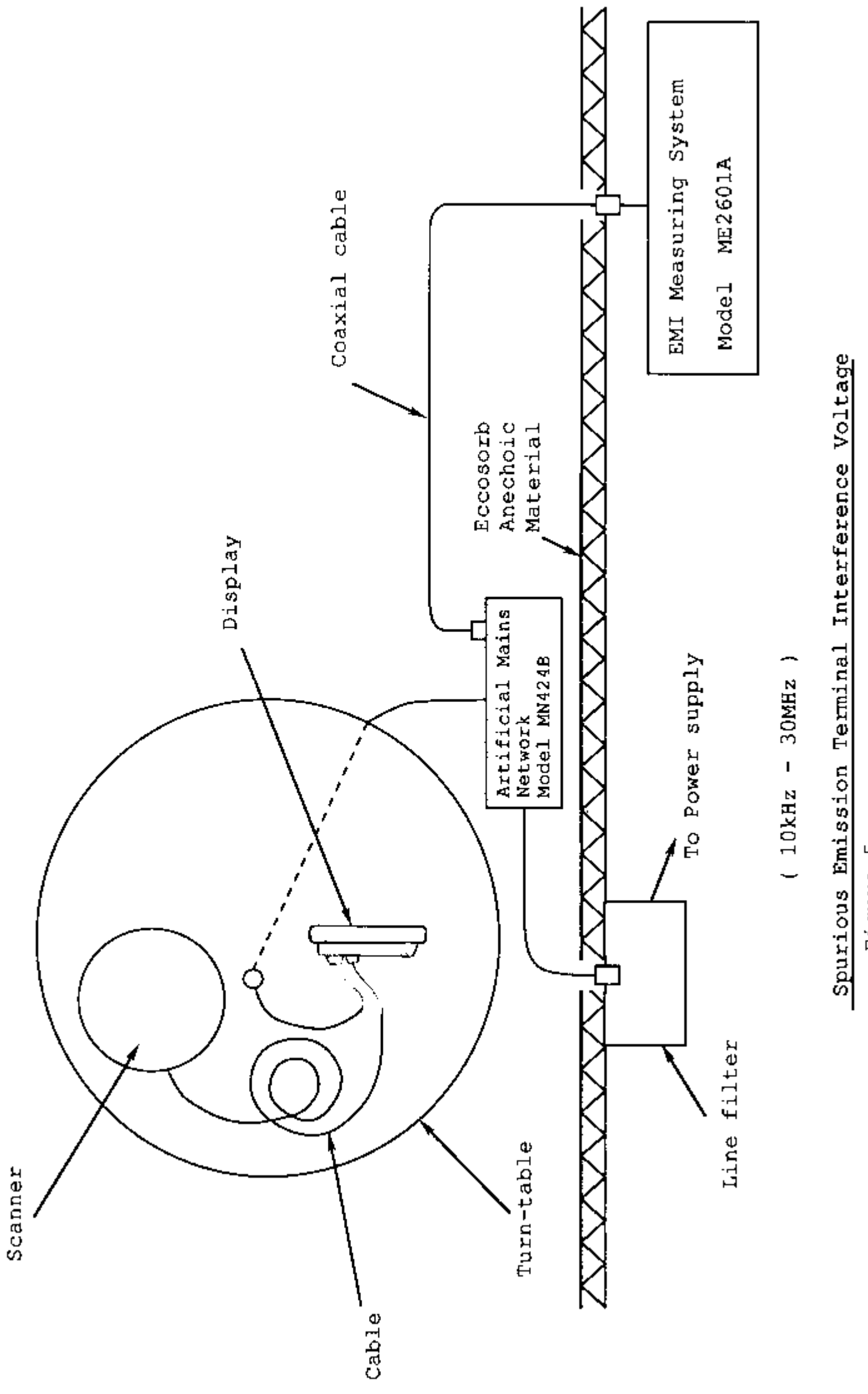


Spurious Emission Field Strength (2.993)

(1GHz - 18GHz)

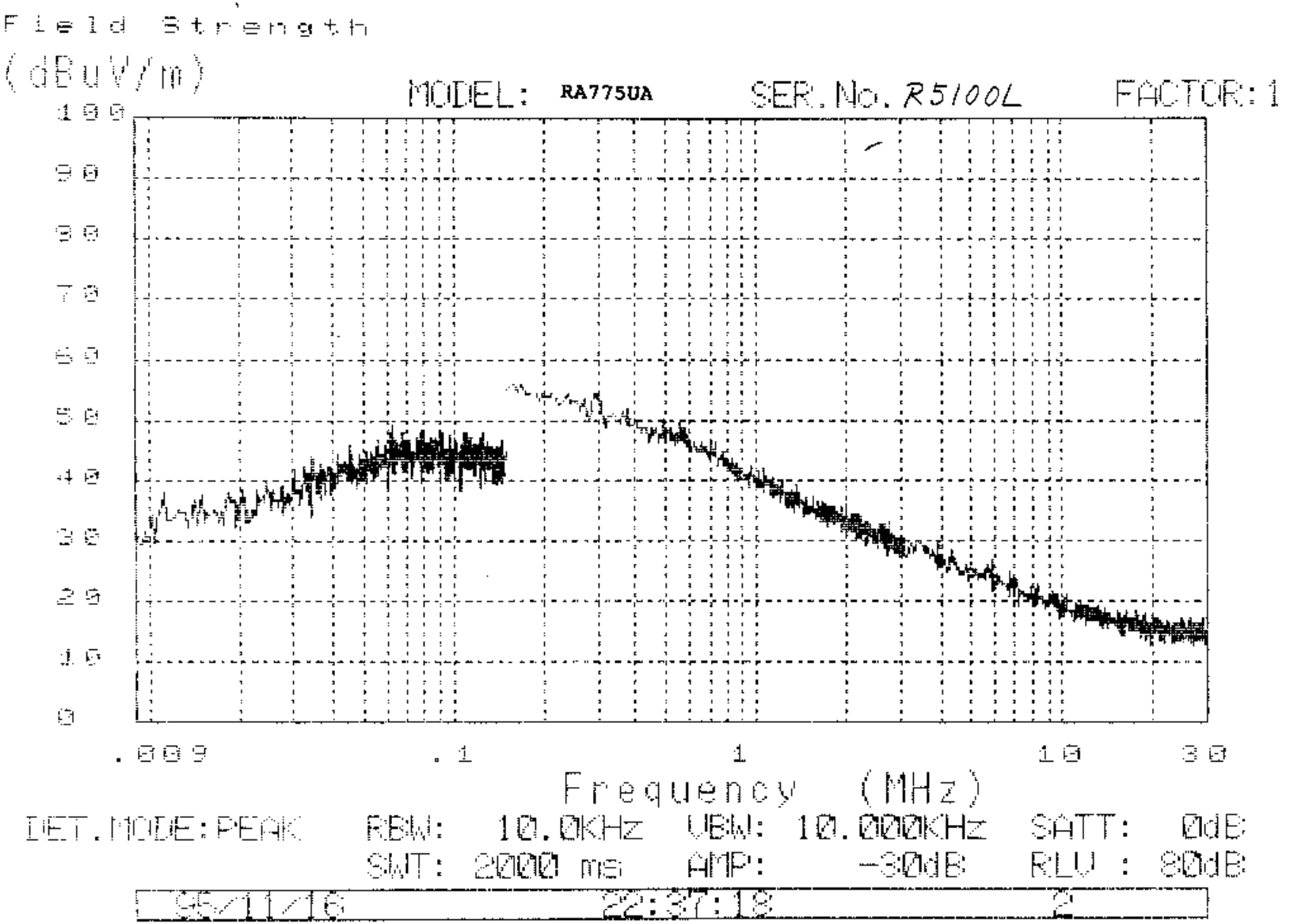
Figure 4

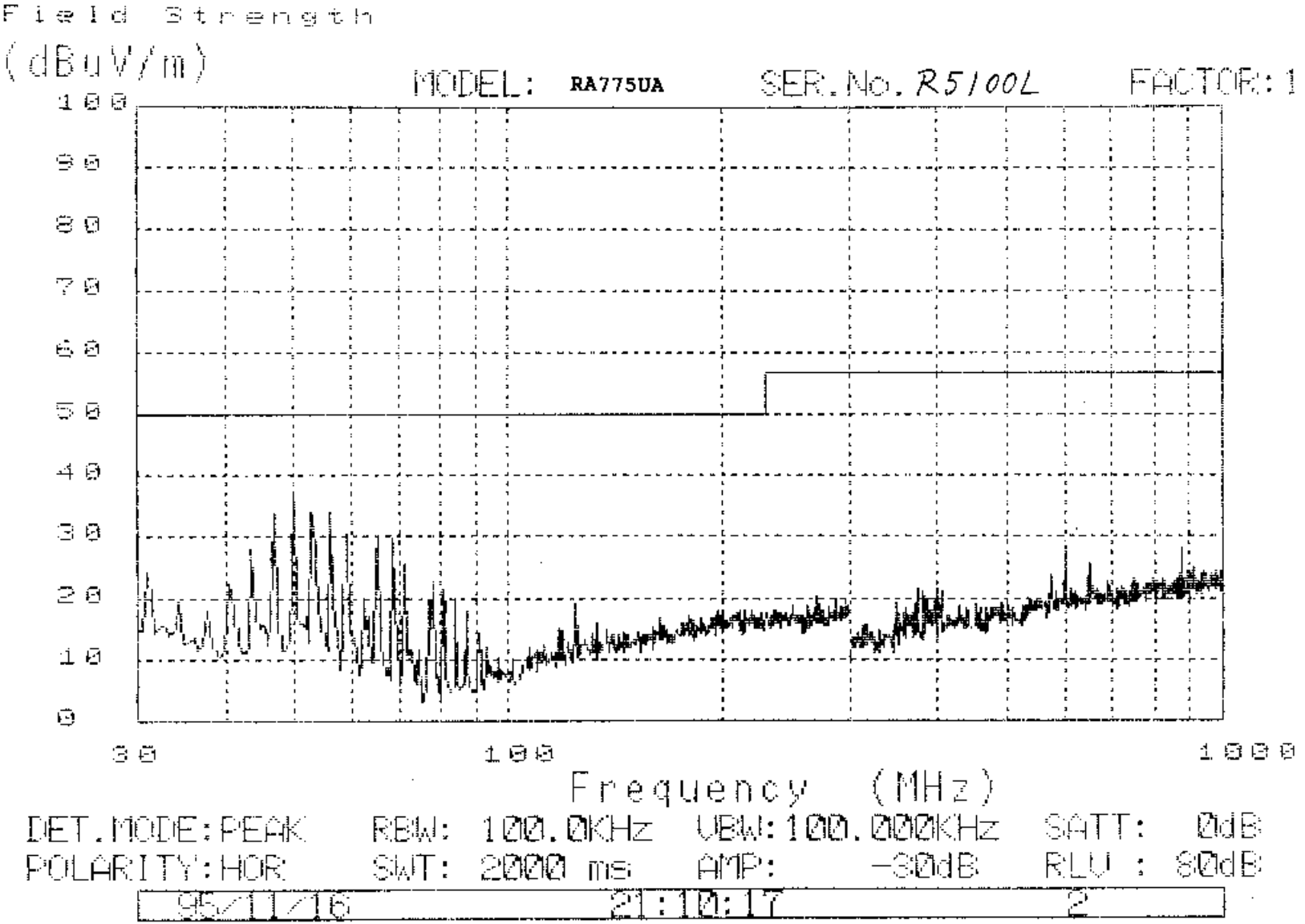
Exhibit 5



Spurious Emission Terminal Interference Voltage
(10kHz - 30MHz)

Figure 5


Field Strength
(dBuV/m)
MODEL: RA775UA
SER.No. R5100L
FACTOR: 1
100
90
80
70
60
50
40
30
20
10
0
.009
.1
1
10
30
Frequency (MHz)
DET.MODE: PEAK
RBW: 10.0KHz
VBW: 10.000KHz
SATT: 0dB
SWT: 2000 ms
AMP: -30dB
RLV : 80dB
95/11/16
22:37:18
2


Field Strength
(dBuV/m)
MODEL: RA775UA
SER.No. R5100L
FACTOR: 1
100
90
80
70
60
50
40
30
20
10
0
30
100
1000
Frequency (MHz)
DET.MODE: PEAK
RBW: 100.0KHz
VBW: 100.000KHz
SATT: 0dB
POLARITY: HOR
SWT: 2000 ms
AMP: -30dB
RLV : 80dB
95/11/16
21:10:17
2

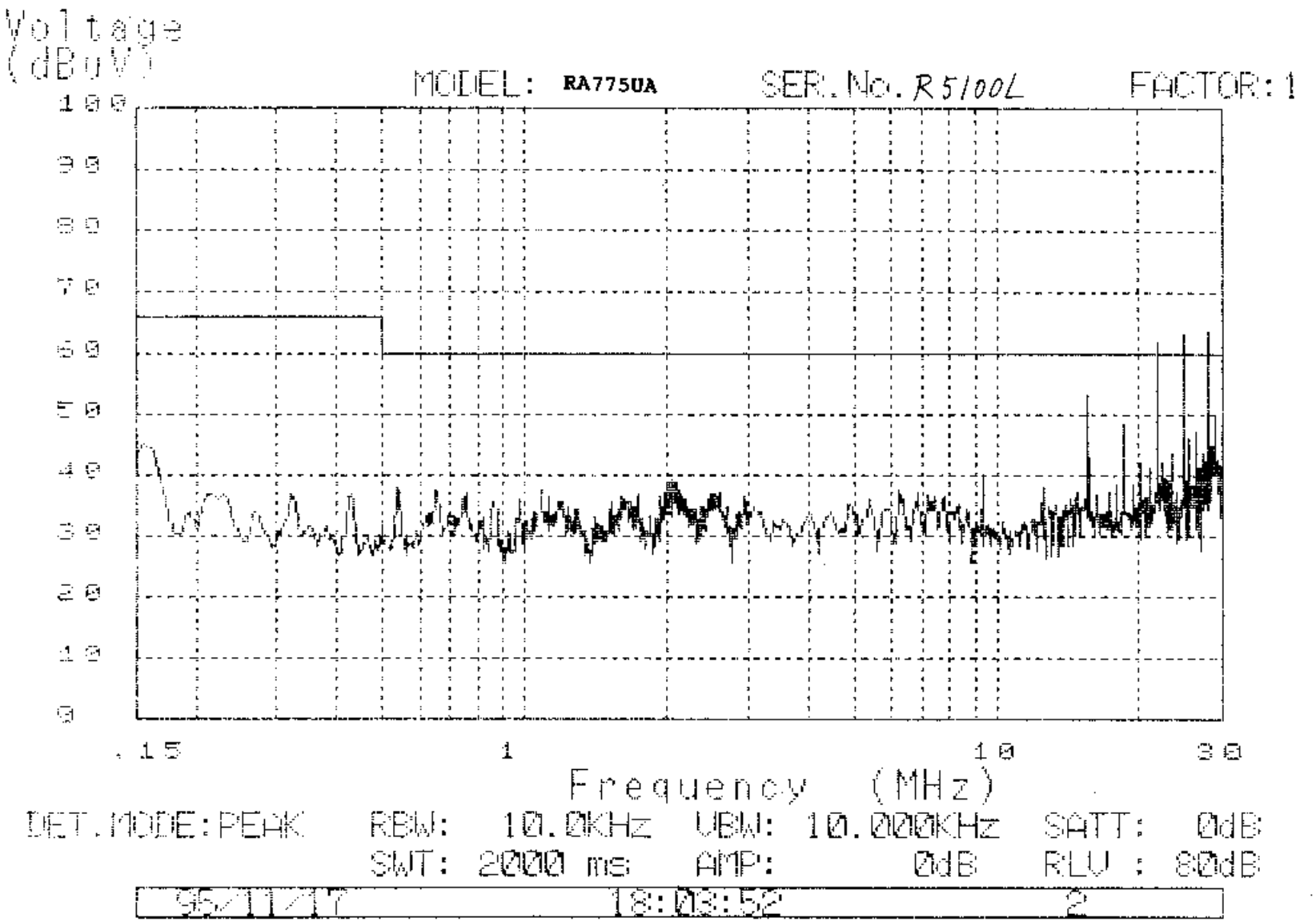

Voltage
(dBuV)
MODEL: RA775UA
SER.No. R5100L
FACTOR: 1
100
90
80
70
60
50
40
30
20
10
0
.15
1
10
30
Frequency (MHz)
DET.MODE: PEAK
RBW: 10.0KHz
VBW: 10.000KHz
SATT: 0dB
SWT: 2000 ms
AMP: 0dB
RLV: 80dB
96/11/17
18:03:52
2

Exhibit 5

TEST RESULT (All data)

	Frequency		Measurement Level	Radio to Main Transmission	Refer to
	9.445MHz		139dBu/m	0dB	Fig.4
Spurious	10kHz to 30MHz	Max.	56dBu/m	-83dB	Fig.3
Emission	30MHz to 1GHz	Max.	37dBu/m	-102dB	Fig.3
Field	1GHz to 18GHz	Max.	60dBu/m	-79dB	Fig.4
Strength	18GHz to 23GHz	(Max.	70dBu/m)	(-69dB)	Fig.4
Terminal Interference Voltage	10kHz to 30MHz	Max.	63dBu	-76dB	Fig.5

Note:All spurious ratio were smaller than -60dB.

Exhibit 6

FREQUENCY STABILITY (2.995)

Type of Transmission:	PON
Type of Modulation:	Pulse
Frequency Band:	9445 MHz ± 30 MHz
Pulse Rate:	580 Hz to 1800 Hz, Selectable as a function of range
Pulse Width:	0.12 us to 0.8 us, Selectable as a function if Range

TEST EQUIPMENT

Equipment	Manufacturer	Model
1. Temperature Chamber	Besthel	CLH-P
2. Directional Coupler	Hewlett-Packard	X752D
3. Resonate Cavity (frequency meter)	Hewlett-Packard	X552B
4. X-Band Dummy Load	NIHON KOSHUHA	WDL095
5. Variable Attenuator	Hewlett-Packard	X382A
6. R.F. Power meter	Hewlett-Packard	432A

Exhibit 6

TEST PROCEDURE

The Marine Radar is capable of generating the following pulses:
0.12 us x 1800 Hz, 0.3 us x 1200 Hz, 0.8 us x 580 Hz
The circuitry of the Radar contains a key-inhibit timer that prevents transmission unit 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 -20℃ and allow the equipment to stabulize.

(2) Turn the equipment on and measure the transmitted frequency using the resonate cavity frequency meter. Measure each the pulse types at one minute intervals until unit stability is acheved or 10 minutes have elapsed, whichever is longer.

(3) Increase the chamber temperature by 10℃ and repeat step 1 and 2.
Continue in 10℃ increments until 50℃ has been achieved.

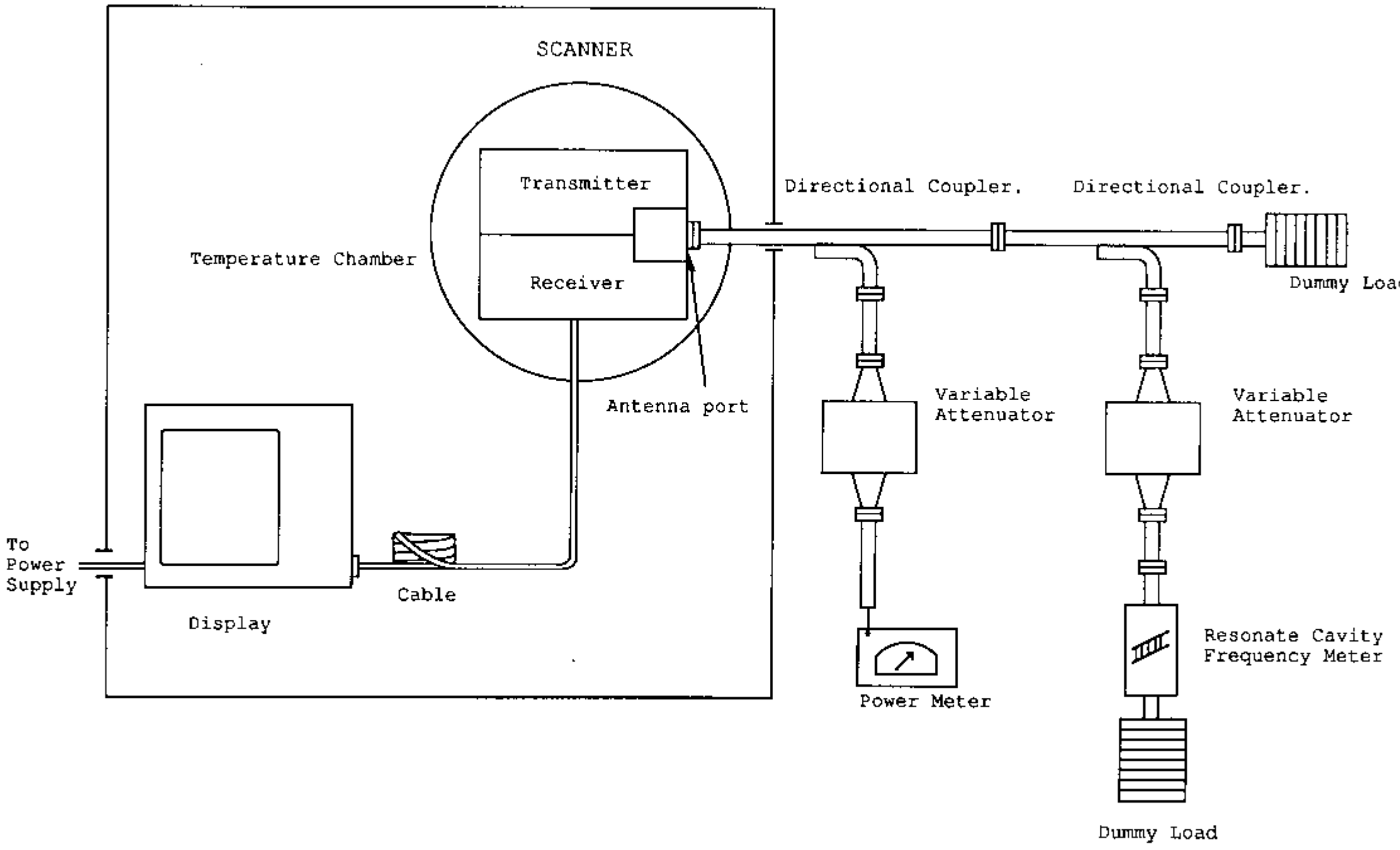
(4) Measure the output frequency at room ambient temperature following voltages applied to the power input.

12V input: Apply 10.2V and 13.8V

24V input: Apply 20.4V and 27.6V

(5) Calculate test frequency limits from the followings;
The frequency of the principal emission must not bu nearer to the edge of the autohorized band than 1.5/t in MHz, (where t is the shortest pulse used, in micre second).

t - 0.12us(nominal)
1.5/t = 12.75 MHz
Band Limit = 9.300000 to 9.500000 GHz
Emission Limit =9.312500 to 9.487500 GHz



FREQUENCY STABILITY (2.995)

Figure 6

Exhibit 6

TEST DATA

Temperature Stability

Pulse Type Frequrncy(GHz)	120 ns × 1800 Hz Initial/Final	300 ns × 1200 Hz Initial/Final	800 ns × 580 Hz Initial/Final
Temperature ℃			
-20	9.455/9.461	9.455/9.453	9.452/9.450
-10	9.453/9.459	9.452/9.450	9.449/9.447
0	9.451/9.457	9.450/9.448	9.447/9.445
+10	9.449/9.445	9.446/9.446	9.444/9.443
+20	9.447/9.443	9.445/9.443	9.442/9.440
+30	9.445/9.441	9.443/9.441	9.440/9.438
+40	9.443/9.439	9.441/9.438	9.438/9.435
+50	9.441/9.437	9.439/9.437	9.435/9.432

Exhibit 6

TEST DATA-Continued

Voltage Stability

Applied Voltage(Vdc)	Initial Frequency(GHz)	Final Frequency(GHz)
10.2	9.447	9.443
12.0	9.447	9.443
13.8	9.447	9.443
24.0	See note below	
27.2	9.447	9.443

Note: All data taken in the 120 ns × 1.8kHz mode.

Note: Qualification at both 12Vdc qualifies the 24Vdc input by similarity.

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