Pub. No. : TI-1698
Date : July, 1998

FURUNO®

TECHNICAL INFORMATION

TEST REPORT ON THE PERFORMANCE OF MARINE RADAR

MODEL 1761 MARK-3

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA CITY, JAPAN

Pub. No. : TI-1698
Date : July. 1998

July 24, 1998

All data herein contained is true and correct to my best knowledge.

T. Yoshihara

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Personal History

Born: January 29, 1944

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1 GENERAL INFORMATION

1.1 General

(a)	Manufacturer:	Furuno Electric Co., Ltd.
		Ashihara-cho 9-52, Nishinomiya-city, 662-8580 Japan
(b)	Model:	Model 1761 MARK-3
	Serial no.:	3378-0001
(c)	Primary Function:	Search, navigation and anticollision
(d)	Maximum Range Scale:	48 nm
(e)	Minimum Range:	37 meters on a range scale of 0.25 nm
(f)	Frequency Range:	Fixed frequency, X-band
	Type of Emission:	P0N
(g)	Power Supply:	12/24/32 VDC

1.2 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: MG5388 , E3571 or MG5248

Peak Output Power: 4 kW nominal

(c) Magnetron Ratings

Center frequency of Magnetron: 9410 MHz

Tolerances

	MG5388	E3571	MG5248
Manufacturing:	±30 MHz	±30 MHz	±30 MHz
Pulling:	23 MHz	18 MHz	23 MHz
Tolerance for 20° C temperature variation:	5 MHz	5 MHz	5 MHz

(d) Guard Band:

Guard Band is specified to be equal to 1.5/T MHz, where "T" is the pulselength in microseconds. See para (e). (FCC Rule § 80.209)

(e) Pulse Characteristics:

Pulse Type	Short	Middle	Long
Range Scale (nm)	0.25		
	0.5		
	0.75		
	1		
		1.5	
		2	
		3	
			4
			6
			8
			12
			16
			24
			48
Output pulselength (μs)	0.08	0.30	0.80
P.R.R. (Hz)	2100	1200	600
Duty cycle	1.68E-4	3.60E-4	4.80E-4
Guard Band (MHz)	18.75	5.00	1.88

Note: Tests were carried out for the underlined Range Scales.

1.3 Modulator

(a) FET Type: 2SK1450

Trigger Voltage: Approx. +10 VDC

1.4 Receiver

(a) Passband

IF Stage:

Pulse Type	Short	Middle	Long
(MHz)	7		

(b) Gain (overall) (dB): Sufficient to cause limiting, approximately 130

(c) Overall Noise Figure (dB): 6 (typical)

(d) Video Output Voltage (V): 3.8 V positive across 400 ohms

(e) Features Provided: Sensitivity Time Controls (Anti-clutter Sea), Fast Time Constant (Anti-clutter Rain)

(f) If receiver is tunable, describe method of adjusting frequency:
Adjustment of tuning voltage of receiver local oscillator (Automatic)

1.5 Display

(a) Type: 7 (in.) mono-color(green), PPI, raster scan.

(b) Size of Indicator Tube: 7 in. diagonal CRT effective dia., 100 mm

(c) Sweep Linearity: 2 % on all ranges

(d) Range Scales:

Range (nm)	Number of Range Rings	Range Ring Interval (nm)
0.25	2	0.125
0.5	5	0.1
0.75	3	0.25
1	5	0.2
1.5	3	0.5
2	4	0.5
3	3	1
4	4	1
6	3	2
8	4	2
12	4	3
16	4	4
24	4	6
48	4	12

(e) Range Ring Accuracy: Better than 0.9 % of maximum scale in use or 8 m, whichever is the greater

(f) Overall Bearing Accuracy from Scanner to Display:
Better than 1°

(g) Target Plot Facility: Simulated afterglow in low shade

(h) Heading Indicator: Provided, automatic alignment.

(i) True Bearing Indicator: Provided.

1.6 Antenna

(a) Antenna Rotation ON-OFF Switch:
Not provided.

(b) Reflector: Slotted waveguide array,

Radiator Type	XN8
Length (cm)	100
Length (ft)	3

(c) Type of Beam: Vertical fan

(d) Beam Width (between half-Radiator power points)

Radiator Type	XN8
Horizontal	2.4 °
Vertical	27 °

(e) Polarization: Horizontal

(f) Antenna Gain:

Radiator Type	XN8
(dB)	26

(g) Attenuation of Major Side Lobes with respect to main beam:
Within ±20° , 24 dB
Outside ±20° , 30 dB

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

(i) Antenna Rotation Rate: 24 rpm (for RSB-0082)

(j) Number of Degrees Scanned: 360°

(k) Sector Scan: Not provided. Sector blanking available.

(l) Type of Transmission System: Contained in scanner unit

(m) Rated Loss of Transmission System per hundred feet:
None. Transmission path is only in the antenna scanner unit.

1.7 Line Power Supply Requirements

(a) Input Voltage: 12/24/32 VDC

(b) Power Drain: 58 W

1.8 Functional Controls

*Range selector	*Range ring on/off	*Power Switch
*Economy mode	*FTC switch	*Panel dimmer
*A/C Sea control	*Gain control	*MENU
*Heading line off	*Echo stretch	*Trackball (VRM,EBL,GUARD)
*Guard zone set/Audio alarm off	*STBY/TX	*A/C Rain control
*Interference rejector	*Off-center (SHIFT)	*EBL on/off
*VRM on/off	*Zoom	*TRU/REL
*Range set	*Brilliance	
*Echo plot	*Plot brilliance	
*Navigation on/off	*Watch mode	

1.9 Construction Features

(a) Does equipment embody replacement units with chassis type assembly:

Yes

(b) Are fuse alarms provided: Fuses are provided.

(c) State units which are weatherproof: Scanner Unit (IEC 529/IPX6)

(d) If all units are not housed in a single container, indicate number and give description of individual units:

1 × Display Unit	Type:	RDP-099	
1 × Scanner Unit	Type:	RSB-0082	(24 V, 24 rpm)
(Transceiver	Type:	RTR-065	(contained in the Scanner unit))

(e) Approximate Weight of Complete Installation:

Display Unit:	8 kg	
Scanner Unit:	23 kg	(XN8-RSB-0082)

(f) Approximate space required for installation excluding scanner:

Display Unit: 276 mm (W) X 224 mm (H) X 323 mm (D)

1.10 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:

Magnetron/Xtal checker

(b) Is the equipment for continuous operation:

Yes

(c) Is provision made for operation with shore based radar beacons (RACONS):

Yes (RACONS and SART)

2 IDENTIFICATION OF EQUIPMENT (FCC Rule § 2.925)

The following nameplates are permanently fixed on the corresponding equipment units.

FCC ID: ADB9ZW1761M3

Material of nameplate: Polyester, 0.1 mm thick

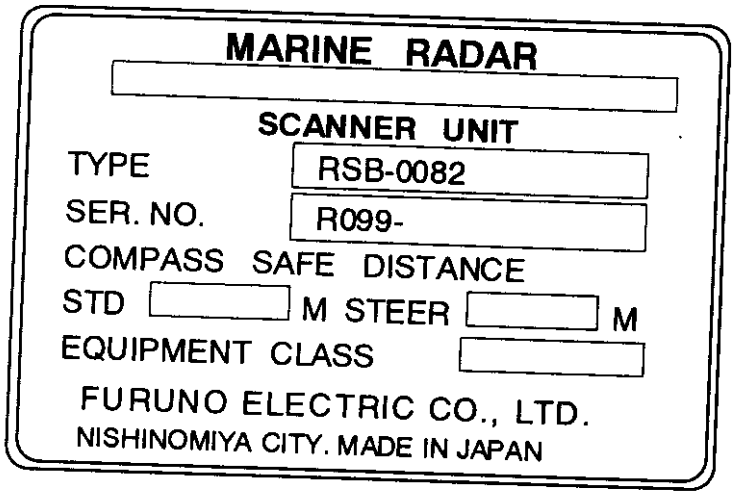

Fig. 2.1 Nameplate for Scanner unit at RSB-0082

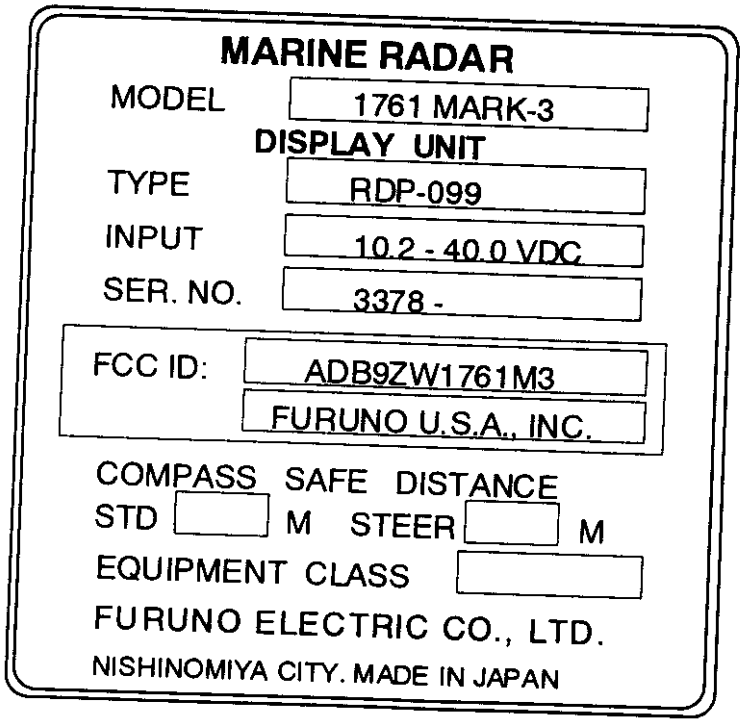

Fig. 2.2 Nameplate for Display unit

3 RF POWER OUTPUT (FCC Rule §2.985)

3.1 Microwave characteristics

The peak voltage was determined using the divider having a ratio of 1000 to 1 and the oscilloscope. Current pulse was viewed across the wideband current transformer with output voltage per ampere 1.00.

Nominal values

Pulse Type	Short	Middle	Long
Range scale (nm)	0.25	2	48
Pulselength (μs)	0.08	0.30	0.80
PRR (Hz)	2100	1200	600
Duty cycle	1.68E-4	3.60E-4	4.80E-4
Guard band (MHz)	18.75	5.00	1.88

Measured values

Magnetron input pulse voltage was measured at its cathode using the oscilloscope and divider with ratio 1000 to 1.

Pulse Type	Short	Middle	Long
Directional coupler attenuation (dB)	40.54	40.54	40.54
Magnetron input voltage (kV)	3.90	3.70	3.70
Pulselength (μs) (50 % amplitude)	0.290	0.510	0.970
Rise time (μs) (10-90 % amplitude)	0.060	0.060	0.060
Decay time (μs) (90-10 % amplitude)	0.760	0.640	0.270

Magnetron input pulse current

Magnetron input pulse current was observed across the wideband current transformer with output voltage per ampere 1.00.

Pulse Type	Short	Middle	Long
Magnetron input current (A)	3.3	3.3	3.3

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Pulse Type	Short	Middle	Long
Pulselength (μs) (50 % amplitude)	0.110	0.300	0.828
Rise time (μs) (10-90 % amplitude)	0.067	0.070	0.070
Decay time (μs) (90-10 % amplitude)	0.060	0.072	0.076

RF envelope of the magnetron output pulse

The RF envelope of the magnetron output pulse was measured using a diode and the oscilloscope with the following results:

Pulse Type	Short	Middle	Long
Pulselength (μs) (-3 dB points)	0.115	0.300	0.810
Rise time (μs) (10-90 % amplitude)	0.010	0.010	0.010
Decay time (μs) (90-10 % amplitude)	0.060	0.060	0.060

Estimated efficiency

The estimated efficiency of the RF generator (magnetron) was determined by the following measurements and calculation. Power output from magnetron was measured using the directional coupler, power meter and the oscilloscope.

Pulse Type	Short	Middle	Long
Range scale (nm)	0.25	2	48
PRR (Hz)	2028.9	1198.9	586.1
Duty cycle	2.33E-4	3.59E-4	4.74E-4
Magnetron input, av. (W)	3.00	4.39	5.80
Magnetron input, peak (kW)	12.87	12.21	12.21
Power meter reading (mW)	0.080	0.122	0.162
Magnetron output, av. (W)	0.910	1.382	1.834
Spurious response limits (dB)	42.59	44.40	45.64
Magnetron Output, peak (kW):	3.90	3.84	3.86
Magnetron efficiency (%):	30.3	31.5	31.6

Peak Power Input to RF Generator : 12.43 kW
Estimated Efficiency of RF Generator : 31.1 %

4 MODULATION CHARACTERISTICS (FCC Rule §2.987)

4.1 FET Trigger Pulse

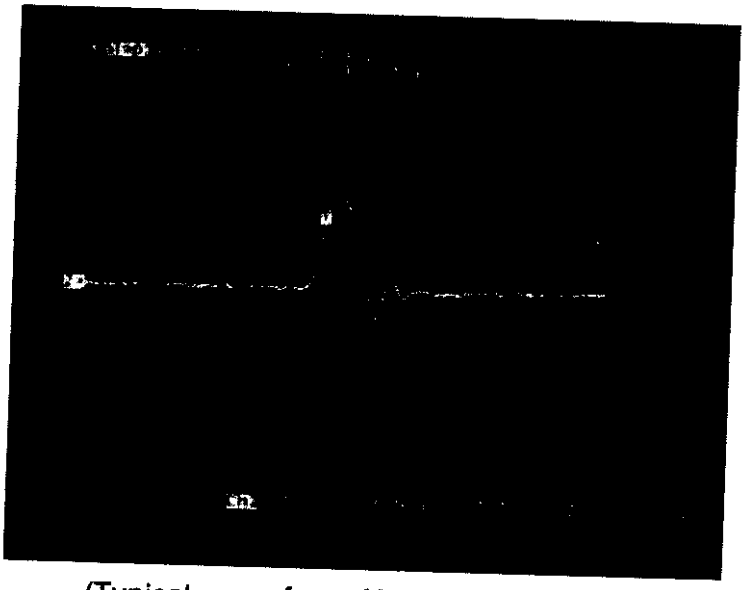

Fig. 4.1 (Typical wave form of Trigger Pulse) Scale: 10 V/div.
Short Pulse (0.25 nm Range) 200 ns/div.

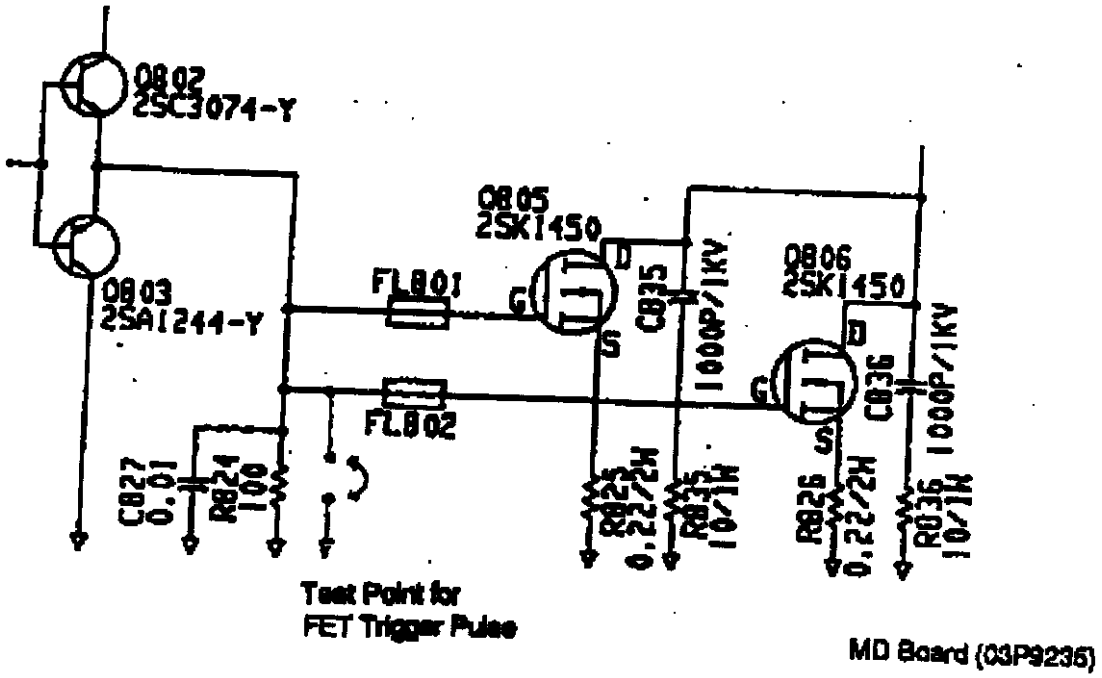

Fig. 4.1.2 Test Point for Trigger Pulse

4.2 Trigger Pulse at Magnetron Cathode

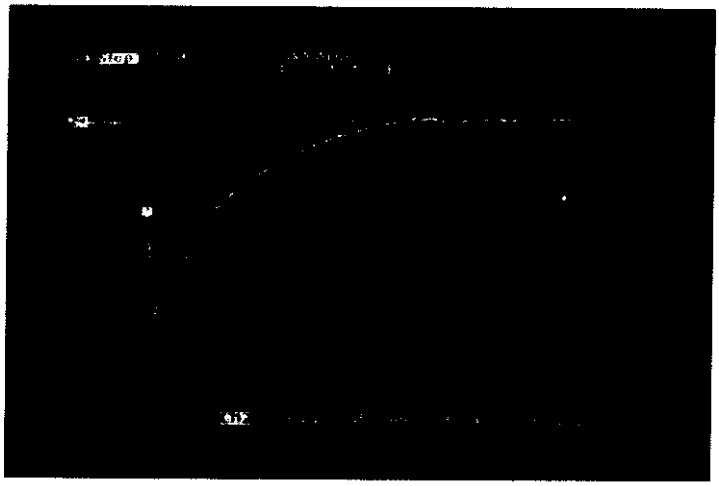

Fig. 4.2.1 Short Pulse (0.25 nm Range) Scale: 1 kV/div. 200 ns/div.

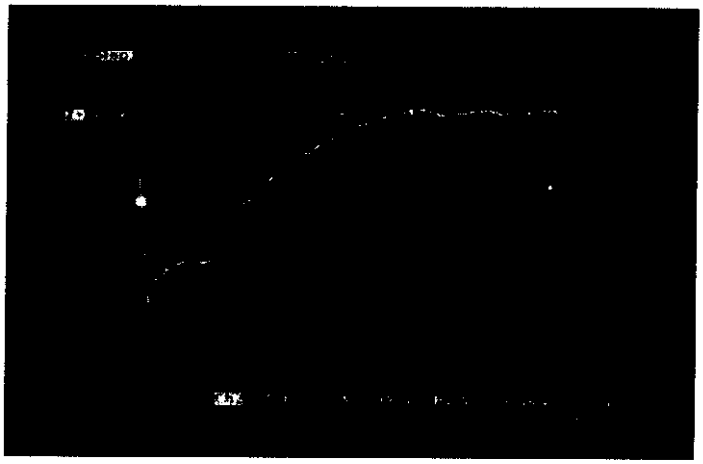

Fig. 4.2.2 Middle Pulse (2 nm Range) Scale: 1 kV/div. 200 ns/div.

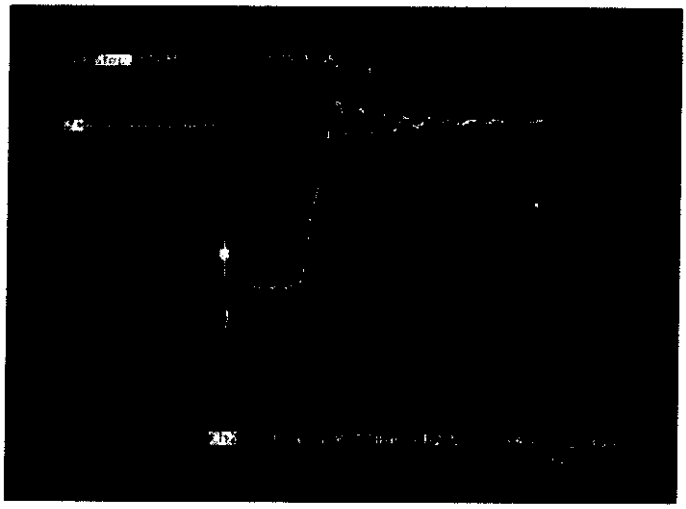

Fig. 4.2.3 Long Pulse (48 nm Range) Scale: 1 kV/div. 500 ns/div.

4.3 **Magnetron Output** (detected):

4.3.1 Setup for Measurement:

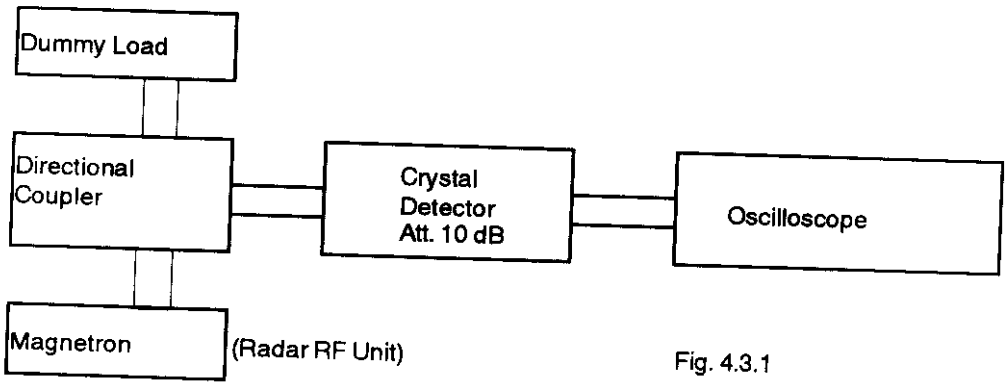

Fig. 4.3.1

4.3.2 Measuring Equipment List:

See ATTACHMENT 4 [LIST OF TEST/MEASURING EQUIPMENT].

4.3.3 Measured Data:

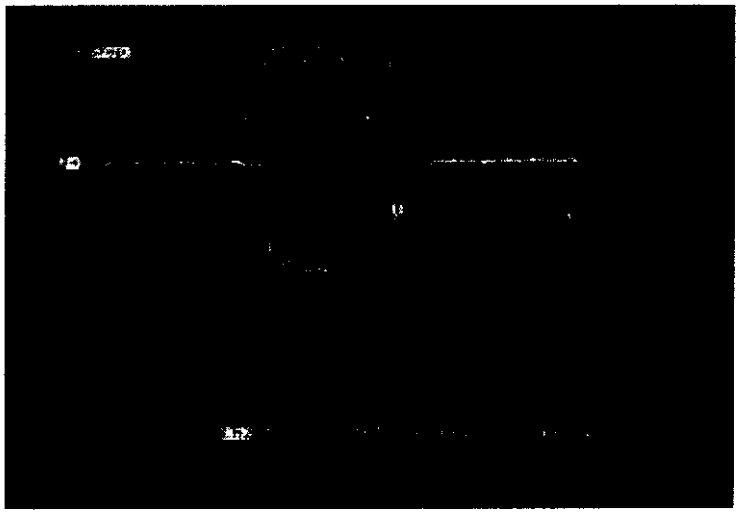

Fig. 4.3.2 Short Pulse (0.25 nm Range) Scale: 50 mV/div. 50 ns/div.

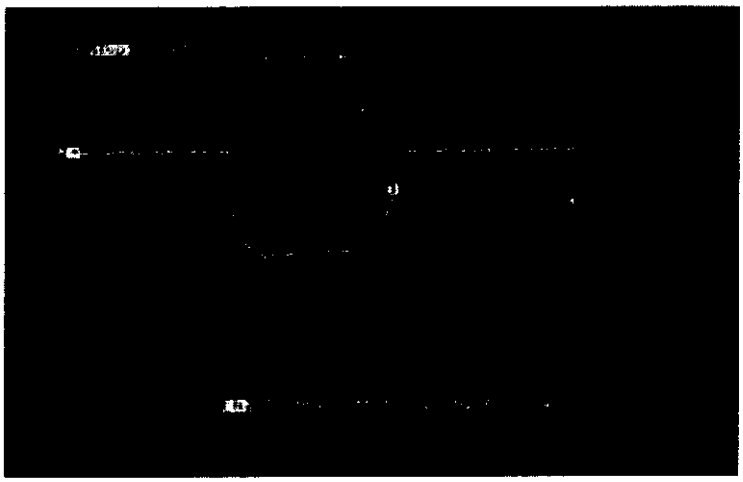

Fig. 4.3.3 Middle Pulse (2 nm Range) Scale: 50 mV/div. 100 ns/div.

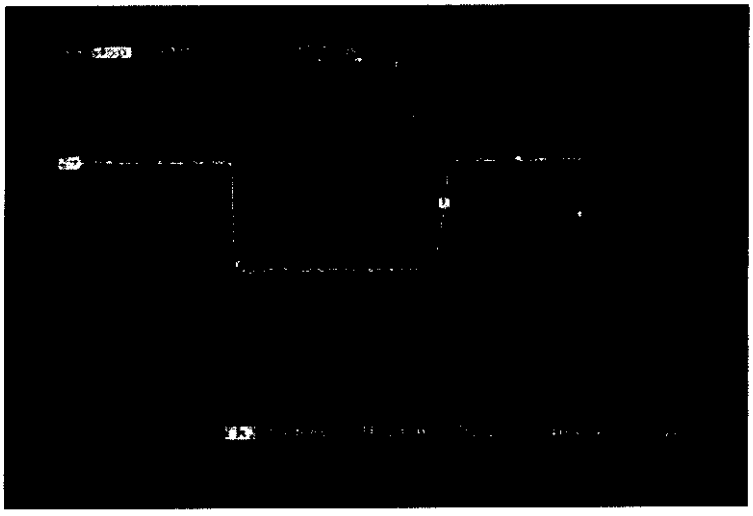

Fig. 4.3.4 Long Pulse (48 nm Range) Scale: 50 mV/div. 200 ns/div.

4.4 Radar Pulse Spectrum:

Measured by the spectrum analyzer.

(Test Equipment Setup and Measuring Equipment List are same as Clause 6.1 and 6.2.)

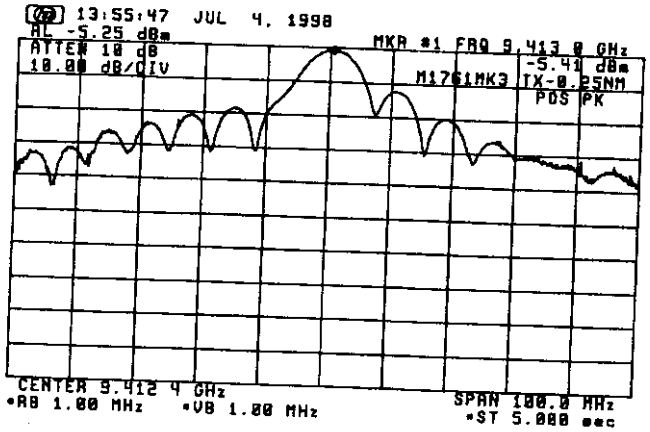

Fig. 4.4.1 Short Pulse (0.25 nm Range)

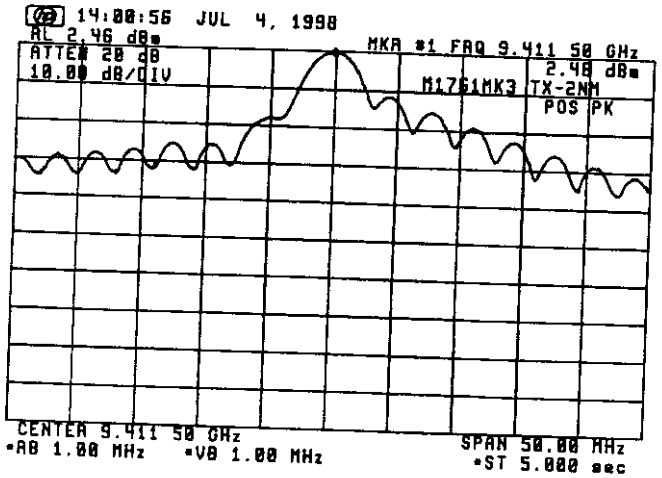

Fig. 4.4.2 Middle Pulse (2 nm Range)

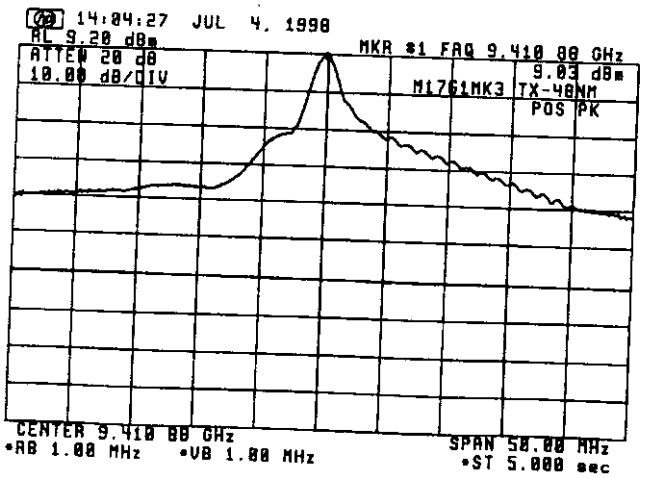

Fig. 4.4.3 Long Pulse (48 nm Range)

5 OCCUPIED BANDWIDTH (FCC Rule §2.989)

5.1 Measuring Method

FCC rule 47 CFR 2.989 requires measurements of the occupied bandwidth which is defined in the same section as "the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission."

To obtain the occupied bandwidth of the radar transmitter, a special program (program list shown below) was loaded to the Hewlett-Packard spectrum analyzer and run by entering the HP-provided POWER BANDWIDTH calculation command [PWRBW].

The result was automatically displayed on the screen on the spectrum analyzer as:

POWER_BW=----- MHz

```
10    ! HP_71000 DOWNLOAD PROGRAM
20    ASSIGN @Sa TO 718
30    CLEAR @Sa
40    CALL M_ain(@Sa)
50    LOCAL @Sa
60    END
70    !
80     SUB M_ain(@Sa)
90 M_ain:      !
100   CALL Pwr_bw(@Sa)
110   CALL Limit_line(@Sa)
120   !
130   OUTPUT @Sa;"VARDEF K_ey,0;";
140   !
150   OUTPUT @Sa;"FUNCDEF D_LP,^";
160   OUTPUT @Sa;"MOV K_ey,0;";
170   !
180 Main_menu:   !
190   OUTPUT @Sa;"REPEAT;";
200   OUTPUT @Sa;"READMENU K_ey,";
210   !  location: %Top----Bottom-%
220   OUTPUT @Sa;" l,%Limit  line   %,";
230   OUTPUT @Sa;" 2,%Power  bw     %,";
240   OUTPUT @Sa;"14,%    Exit%;";
250   !
260   OUTPUT @Sa;"IF K_ey,EQ,1;THEN;LIMIT_LINE;";
270   OUTPUT @Sa;"ELSIF K_ey,EQ,2;THEN;PWR_BW;";
280   OUTPUT @Sa;"ELSIF K_ey,EQ,l4;THEN;ABORT;";
290   OUTPUT @Sa;"ENDIF;";
300   OUTPUT @Sa;"UNTIL K_ey,EQ,14;";
310   OUTPUT @Sa;"IP;TS;";
320   OUTPUT @Sa;"ADORT;";
330   OUTPUT @Sa;"^"
340   !
350 Define_keydef:   !
360   OUTPUT @Sa;"KEYDEF 7,D_LP, %DLP      TEST%;";
370   !
380   OUTPUT   @Sa;"FUNCDEF D,^";
390   OUTPUT   @Sa;"KEYPST;";
400   OUTPUT   @Sa;"^"
410   !
420   SUBEND
430   !
440   SUB Limit_line(@Sa)
450 Limit_line:    !
460   OUTPUT @Sa;"CLRDSP;";
470   OUTPUT@Sa;"FUNCDEF LIMIT_LINE,^";
480   OUTPUT   @Sa;"PU;PA   0,654;";
490   OUTPUT   @Sa;"LINET 1;";
500   OUTPUT   @Sa;"PD;PA 100,654;";
510   OUTPUT   @Sa;"PU;PA 201,654;";
520   OUTPUT   @Sa;"PD;PA 300,654;";
530   OUTPUT   @Sa;"PU;PA 105,630;";
540   OUTPUT   @Sa;"TEXT @-35dB@;";
550   OUTPUT   @Sa;"PU;PA 205,720;";
560   OUTPUT   @Sa;"TEXT @-25dB@;";
570   OUTPUT   @Sa;"PU;PA 301,743;";
580   OUTPUT   @Sa;"LINET 1;";
590   OUTPUT   @Sa;"PD;PA 400,743;";
600   OUTPUT   @Sa;"PU;PA 601,743;";
610   OUTPUT   @Sa;"LINET l;";
620   OUTPUT   @Sa;"PD;PA 700,743;";
630   OUTPUT   @Sa;"PU;PA 701,654;";
640   OUTPUT   @Sa;"LINET l;";
650   OUTPUT@Sa;"PD;PA 1000,654;HD;";
660   OUTPUT   @Sa;"^"
670   SUBEND
680   SUB Pwr_bw(@Sa)
690 Pwr_bw:      !
700   !     Calculating Power band width
710   OUTPUT @Sa;   "VARDEF P_bw,0;";
720   OUTPUT @Sa;"FUNCDEF PWR_BW,^";
730   OUTPUT @Sa;"CLRW TRA;";
740   OUTPUT @Sa;"CLRDSP;";
750   OUTPUT @Sa;"SNGLS;";
760   OUTPUT @Sa;"MXMH   TRA;TS;TS;TS;";
770   OUTPUT @Sa;"MOV   P_bw,PWRBW   TRA,99.0;";
780   OUTPUT@Sa;"DIV P__bw,P_bw,1000000;";
790   OUTPUT @Sa;"PU;PA 10,800;HD;";
800   OUTPUT @Sa;"TEXT @POWER_BW = @;";
810   OUTPUT @Sa;"DSPLY P_bw,8,3;";
820   OUTPUT @Sa;"TEXT @ MHz @;";
830   OUTPUT @Sa;"^"
840   SUBEND
```

Fig. 5.1 Program for Calculation of Occupied Bandwidth

5.2 Test Equipment Setup:

Same as Clause 6.1.

5.3 Measuring Equipment List:

Same as Clause 6.2.

5.4 Test Result:

The test result is shown below.

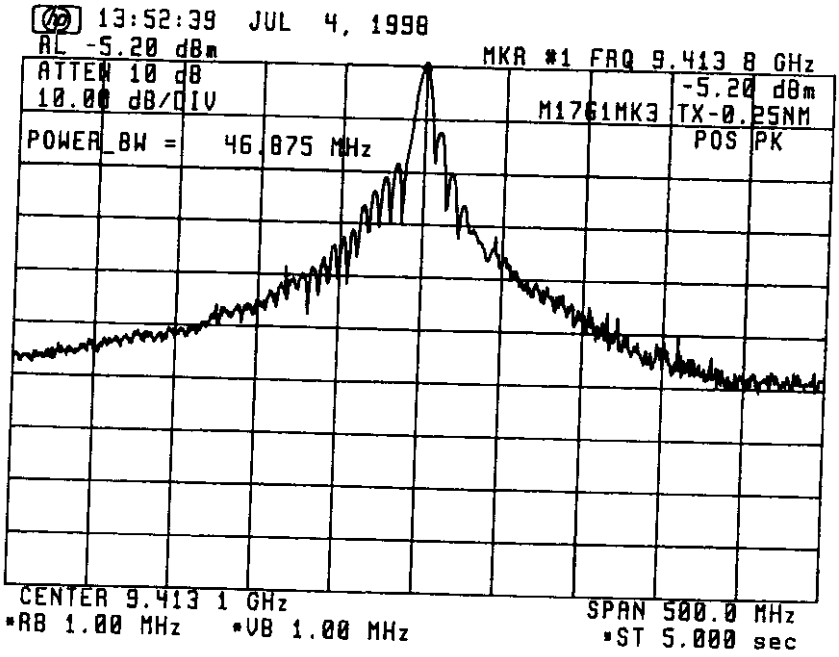

Fig. 5.2 Measurement of Occupied Bandwidth

Occupied bandwidth = 46.875 MHz

6 SPURIOUS EMISSIONS AT ANTENNA TERMINAL (FCC Rule § 2.991)

6.1 Test Equipment Setup:

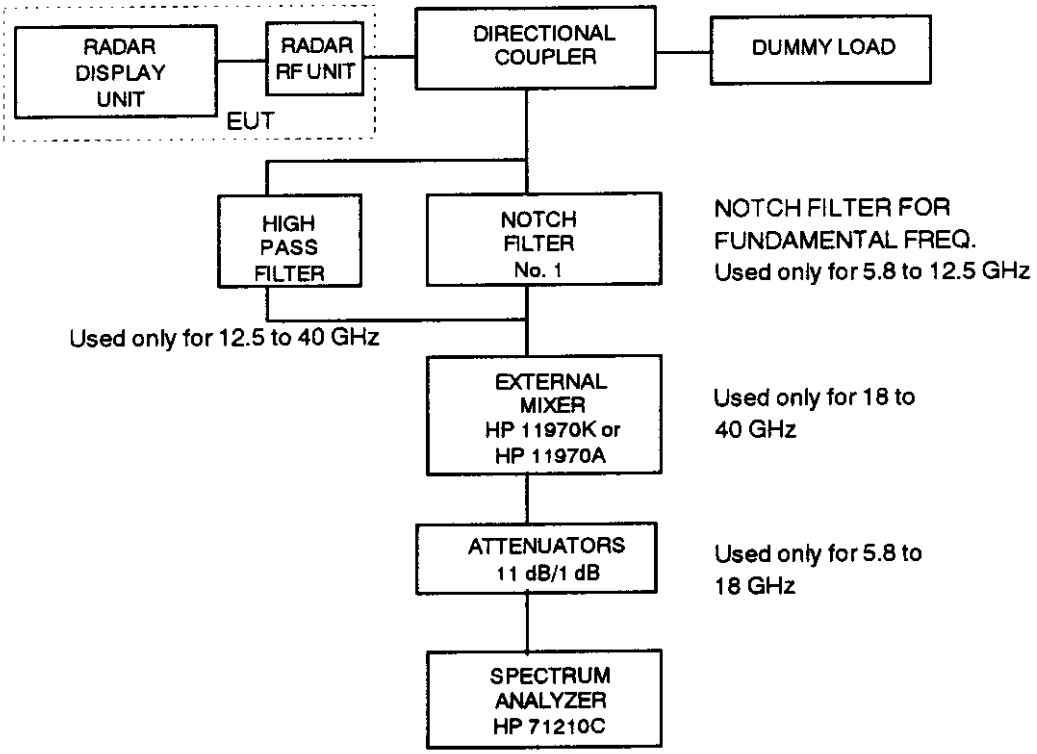

Fig. 6.1

6.2 Measuring Equipment List:

See ATTACHMENT 4 [LIST OF TEST/MEASURING EQUIPMENT].

Note : (1) The characteristics of Notch Filter (No. 1) are described in Fig. 6.2 to Fig. 6.5.
(2) The characteristic of High Pass Filter (No. 2) is described in Fig. 6.6.

6.3 Test Conditions:

Radar Range Settings: 0.25 nm (Short)/2 nm (Middle)/48 nm (Long)

6.4 Emission Limits:

(a) Frequency Range (FCC Rule §2.997) : 10 kHz - 40 GHz

(b) Emission Limits (FCC Rule §80.211) :

Frequency removed from the assigned frequency	Frequency (Hz)	Emission attenuation (mean power ,dB)
50 - 100 % (of the authorized bandwidth)	9310 - 9360 M 9460 - 9510 M	At least 25
100 - 250 %	9160 - 9310 M 9510 - 9660 M	At least 35
more than 250 %	10 k - 9160 M 9660 - 40,000 M	At least 43 + 10 log 10 (mean power in watts)

Note : (1) Assigned frequency (center frequency) = 9410 MHz

(2) Authorized bandwidth = 100 MHz

6.5 Test Results:

As shown in ATTACHMENT 1 , the spurious emissions at antenna terminal of EUT are found lower than the specified limits.

(Note: Spurious emissions for 10 kHz to 5 GHz are not found due to the antenna terminal structure. (wave guide tube)).

Characteristic of Filter No. 1 (for X-band)

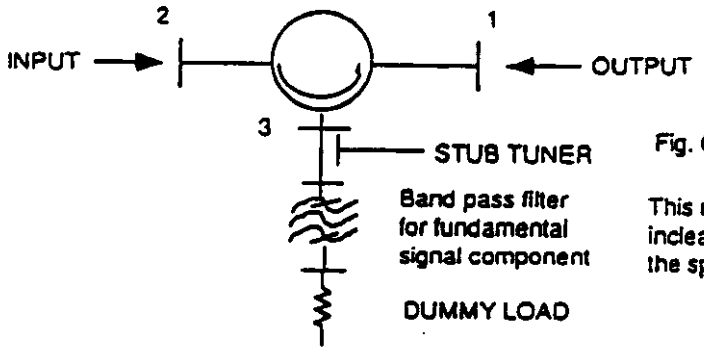

Fig. 6.2 Setup of Notch Filter No.1

This notch filter is used to inclease the dynamic range of the spectrum analyzer

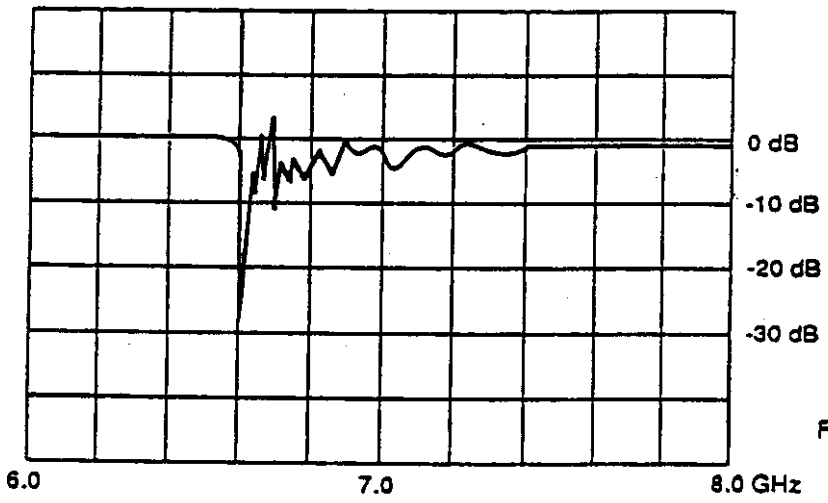

Fig. 6.3

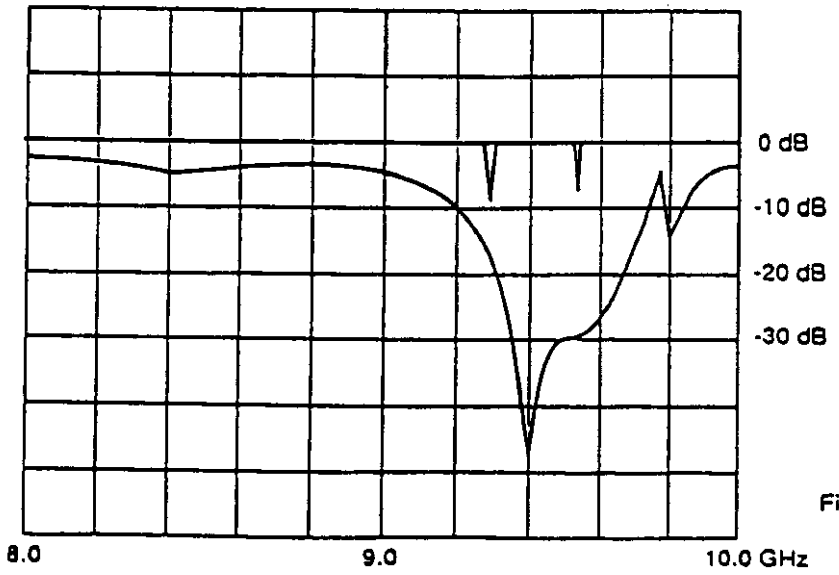

Fig. 6.4

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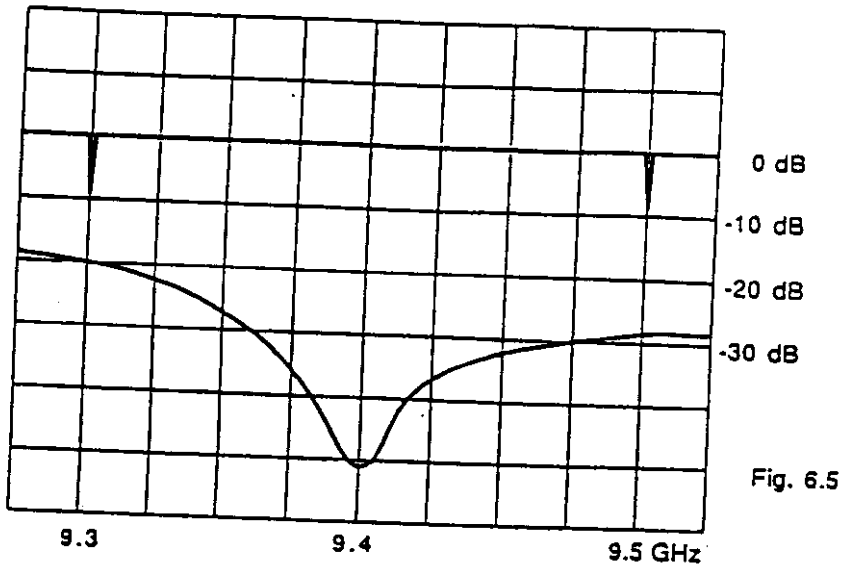
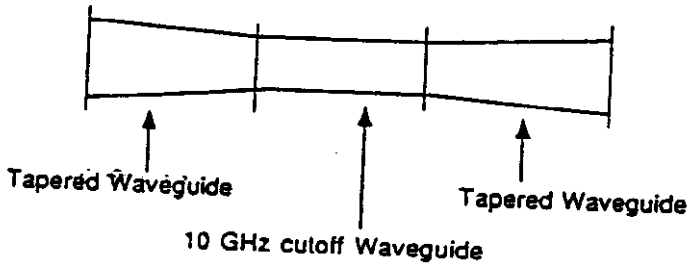


Fig. 6.5

Characteristic of Filter No. 2 (for X-band)



This filter is used to filter out the high level fundamental signal to avoid damage to the analyzer.

High Pass Filter Construction

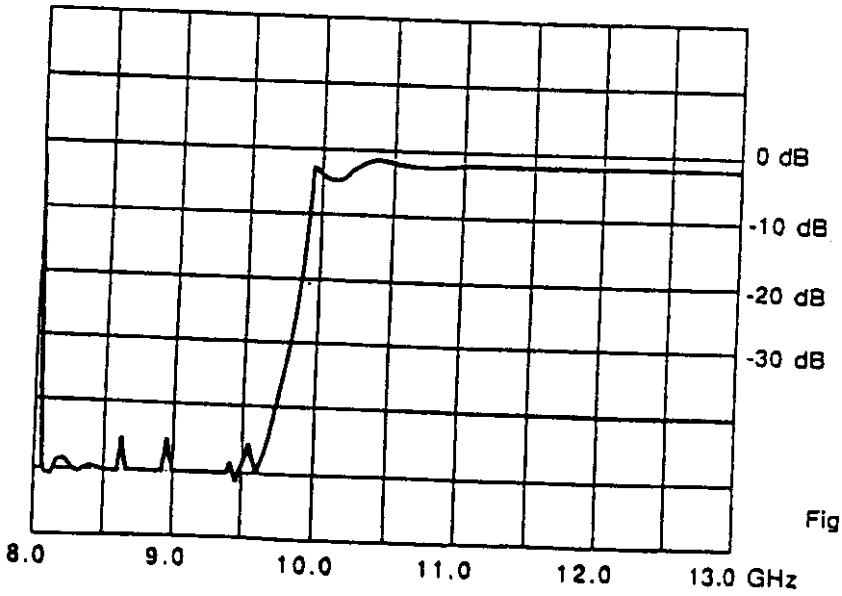


Fig.6.6

7 FIELD STRENGTH OF SPURIOUS RADIATION (FCC Rule §2.993)

7.1 Test Site: Rooftop of 6-story building,
FURUNO ELECTRIC CO., LTD.
Ashihara- cho 9-52, Nishinomiya-city, 662-8580 Japan

7.2 Date: July, 1998

7.3 Distance between the radar set and measuring antenna: 10 m

7.4 Radar Range settings: 0.25 nm (Short)/2 nm (Middle)/48 nm (Long)

7.5 Measuring Equipment List:
See ATTACHMENT 4 [LIST OF TEST/MEASURING EQUIPMENT].

7.6 Test settings:
See Fig. 7.1 - Fig. 7.5.

7.7 Field Strength Limits:
(a) Frequency Range (FCC Rule §2.997) : 10 kHz - 40 GHz
(b) Emission Limits (FCC Rule §80.211) :

Frequency removed from the assigned frequency	Frequency (Hz)	Emission attenuation (mean power ,dB)
50 - 100 % (of the authorized bandwidth)	9310 - 9360 M 9460 - 9510 M	At least 25
100 - 250 %	9160 - 9310 M 9510 - 9660 M	At least 35
more than 250 %	10 k - 9160 M 9660 - 40,000 M	At least 43 + 10 log 10 (mean power in watts)

Note : (1) Assigned frequency (center frequency) = 9410 MHz
(2) Authorized bandwidth = 100 MHz

7.8 Test Results:
As shown in ATTACHMENT 2 , the field strengths of spurious radiation generated by EUT are found lower than the specified limits.

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FREQUENCY STABILITY WITH VARIATION OF PRIMARY SUPPLY VOLTAGE:

The built-in voltage regulator allows no frequency variation against variations of ±15 % of nominal power supply voltage (20.4 to 27.6 VDC for nominal 24 VDC).

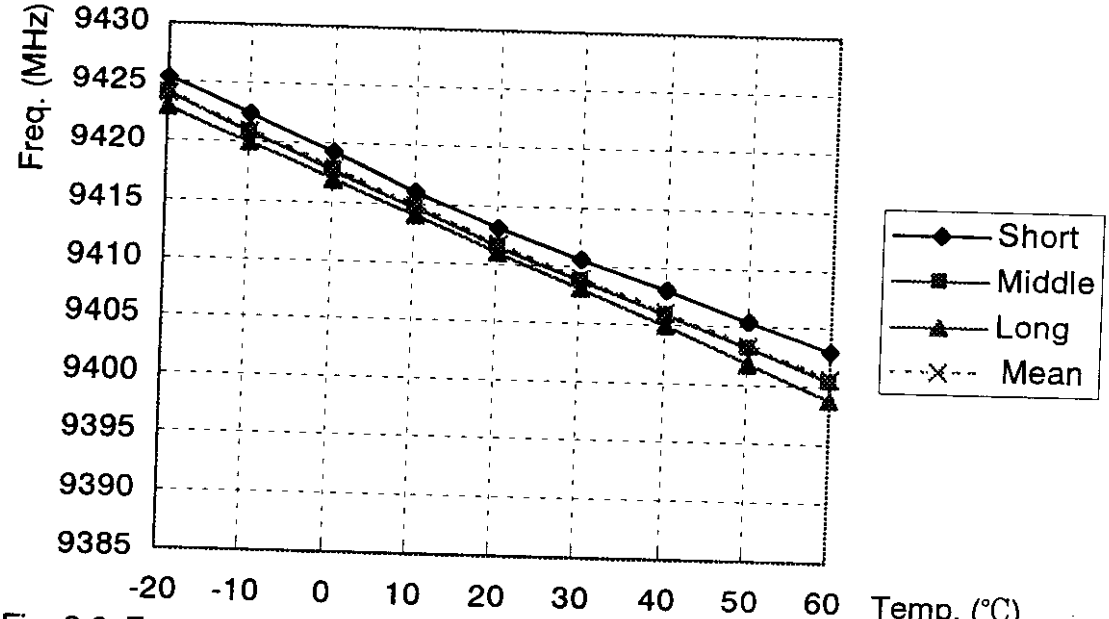

Fig. 8.2 Frequency Stability with Variation of Ambient Temperature

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9 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

(FCC Rule § 80.217)

9.1 Measuring Antenna Characteristics at Representative Frequencies:

Whip antennas are used to determine the level of interference caused by the radar to shipboard receivers. These antennas have the following characteristics (refer to impedance charts attached):

Length	Test Frequency (Hz)	Impedance (Ω)	θ	R (Ω)	C or L
6 m	500.5 k	1 k	-90°	0	80 pF
6 m	1.992 M	1.25 k	-86°	87.2	64 pF
6 m	10.00204 M	158		109	140 pF
4 m	27.5 M	95		83.5	128 pF
5/8 λ	150 M	116.5		105.5	52.5 nH
1/4 λ	450 M	70.5		34.5	5.68 pF

9.2 Test Site:

Rooftop of 6-story building,
Furuno Electric Company, Ltd.
Ashihara-cho 9-52, Nishinomiya-city, 662-8580 JAPAN

9.3 Measuring Instruments:

(1) RF Vector Impedance Meter, HP 4815A
(2) Spectrum Analyzer, ADVANTEST TR4172
(3) Spectrum Analyzer, HP 8566B
(4) Antennas,
for 14 k - 10 MHz, 6 m whip
for 10 - 30 MHz, 4 m whip
for 30 - 300 MHz, VHF whip
for 300 - 1000 MHz, UHF whip

9.4 Test Results:

Interference levels to the respective antenna were measured at 2 m from the radar which was put in OFF, STANDBY, TRANSMIT conditions., and found within the specified limits.

9.4.1 **Harmful Interference to Receiver** (FCC Rule § 80.217 (a))

Limits: for 14 - 490 kHz, 5 μV/m
for 490 kHz - 1 GHz, 1 μV/m

Results: There is no spurious component which is deemed harmful interference. (Test data are shown in ATTACHMENT 3)

9.4.2 **Electromagnetic Field** (FCC Rule § 80.217 (b) - 1)

Limits: for below 30 MHz, 0.1 μV/m at 1 nm (-20 dBμV/m)
for 30 to 100 MHz, 0.3 μV/m at 1 nm (-10.5 dBμV/m)
for 100 to 300 MHz, 1.0 μV/m at 1 nm (0 dBμV/m)
for over 300 MHz, 3.0 μV/m at 1 nm (9.5 dBμV/m)

Results: Interference was measured with the antenna located 2 m from the radar and converted to levels at 1 nm. There is no spurious component exceeding the limits.
(Test data are shown in ATTACHMENT 3)

9.4.3 **Power Input to an Artificial Antenna** (FCC Rule § 80.217 (b) - 2)

Limits: for below 30 MHz, 400 μW
for 30 to 100 MHz, 4,000 μW
for 100 to 300 MHz, 40,000 μW
for over 300 MHz, 400,000 μW

Results: There is no spurious component exceeding the limits.
(Test data are shown in ATTACHMENT 3)

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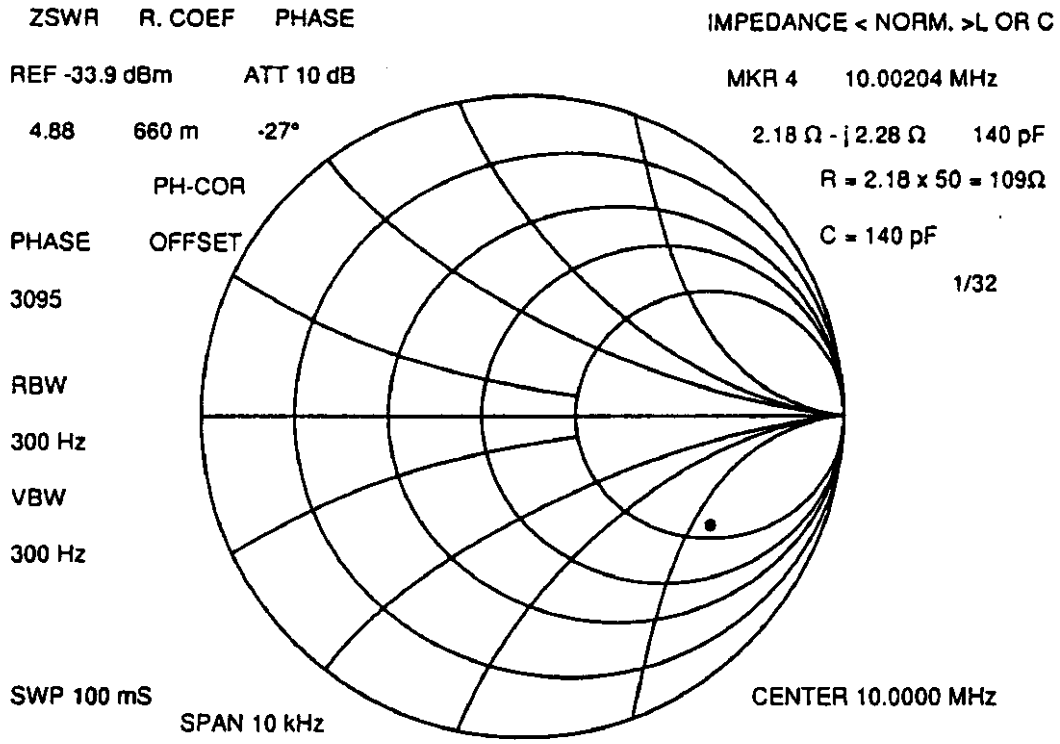
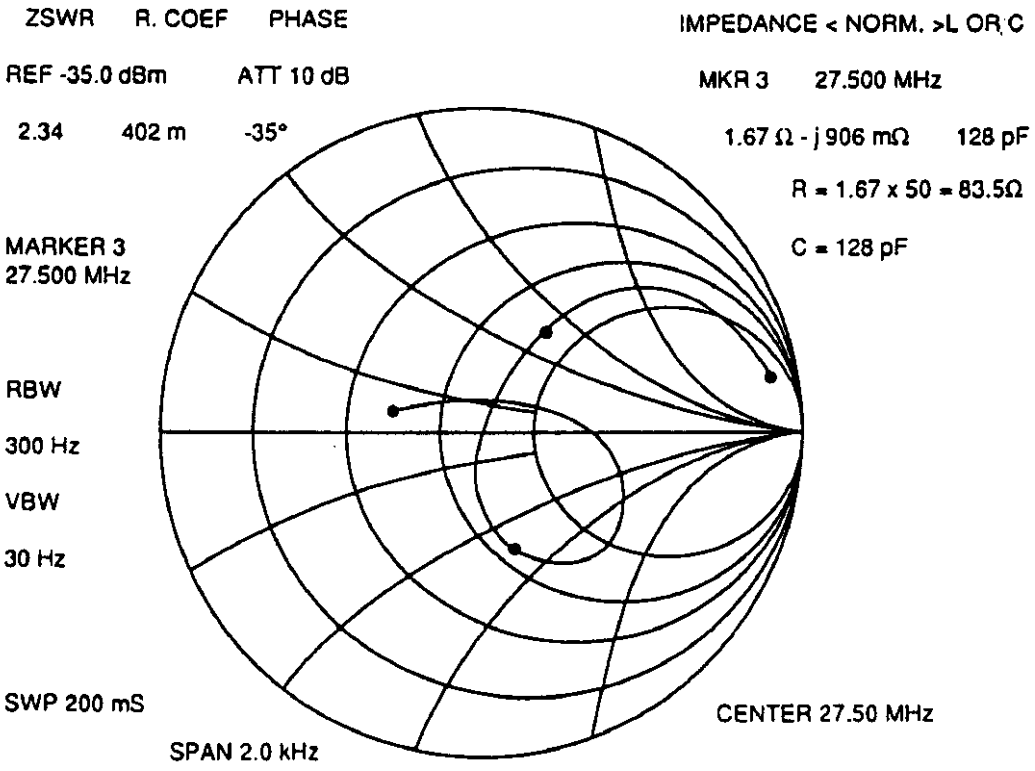
Measurement of Impedance of Test Antennas





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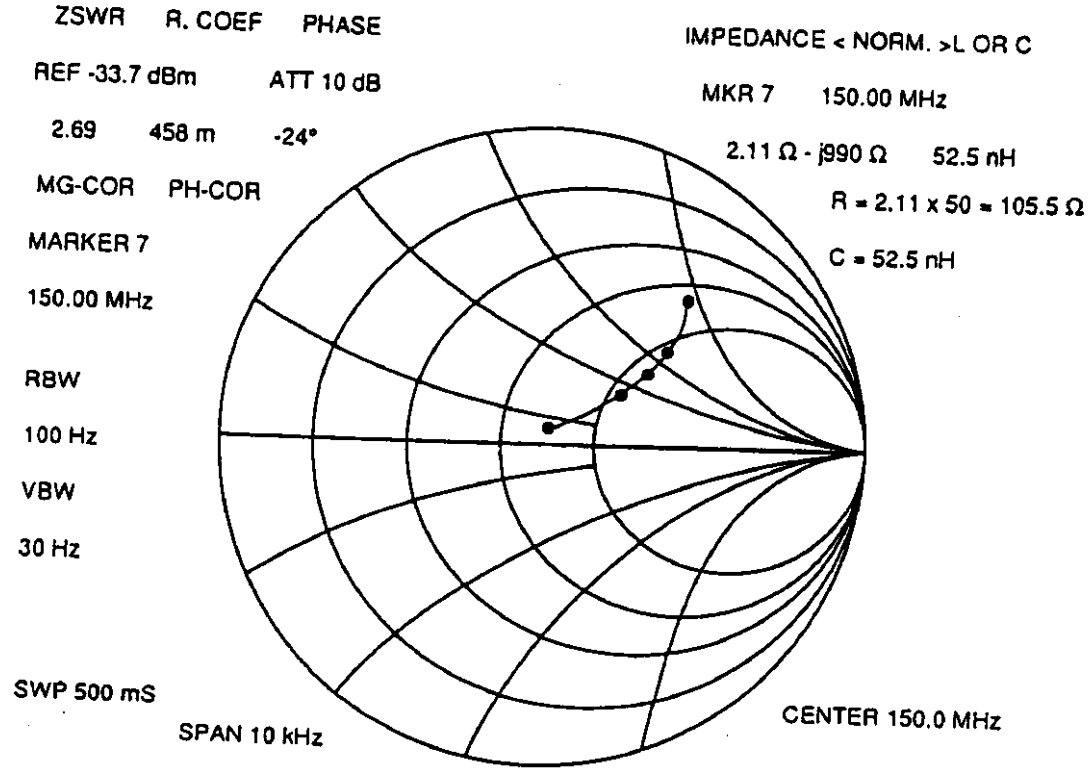
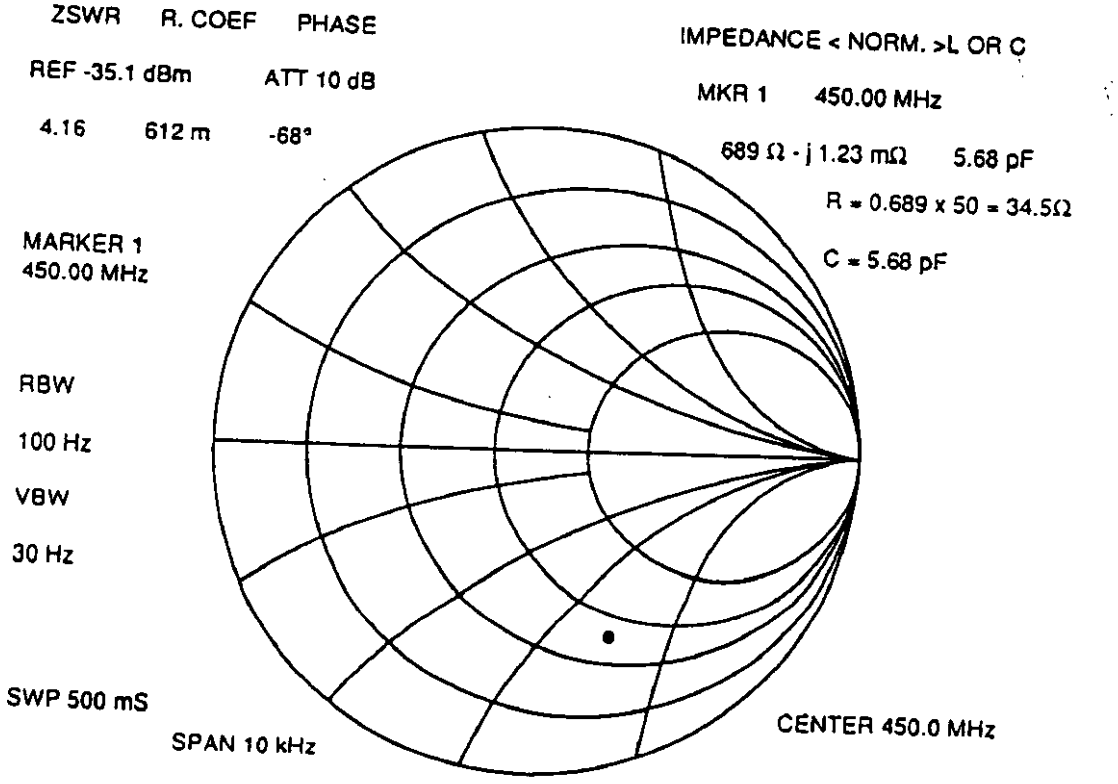
Measurement of Impedance of Test Antennas





11 TECHNICAL DESCRIPTION OF EQUIPMENT (FCC Rules § 2.983)

11.1 Function of Each Semiconductor or Active Device (FCC Rule § 2.983 (d)(6))

ANTENNA UNIT
TRANSCEIVER MODULE (RTR-065)

Modulator PCB 03P9235

CR801:	Rectifier
CR802:	Rectifier
CR803:	Rectifier
CR804:	Transient Suppression
CR805:	Rectifier
CR806:	Detector (Magnetron Current)
CR807:	Pulse width Select
CR809:	Reverse Voltage Protection
L801:	Noise Reject
L802:	Noise Reject
L804:	Noise Reject
Q801:	45 kHz PWM Output MOS FET
Q802:	Pulse Amplifier
Q803:	Pulse Amplifier
Q804:	Pulse width Select
Q805:	Pulse Amplifier
Q806:	Pulse Amplifier
Q807:	IF Bandwidth Select
Q808:	Pulse Amplifier
Q809:	Pulse Amplifier
Q810:	Protective Circuit Monitor
Q811:	Switching
Q812:	Switching
T801:	Transformer
T802:	Pulse Transformer
U802:	Voltage Detector
U803:	Voltage Detector
U804:	Voltage Detector

U805:	Pulse Forming Network
U806:	45 kHz PWM Inverter

Chassis Mounted Parts

HY801:	3 Ports Circulator
U801:	MIC Frequency Converter with Limiter
V801:	Magnetron

IF Amplifire PCB IF-9215

CR1 to CR5:	Band Width Switching
CR6:	Voltage Slicer (Overvoltage Protector)
CR7:	Voltage Slicer
CR11:	DC Restoring
CR12:	Voltage Slicer (Overvoltage Protector)
CR13:	DC Restoring
CR18:	DC Restoring (A/C SEA)
CR19:	DC Restoring (GAIN)
CR20:	Thermal Compensator
CR21:	DC Restoring (A/C RAIN)
CR22:	Voltage Slicer (Overvoltage Protector)
Q1 to Q3:	Video Amplifier
Q5:	I.F. Amplifier
Q6:	DC Bias
Q7 to Q8:	Video Amplifier
Q10 to Q12:	Voltage Buffer
Q14:	Transistor Switch (Tuning Amplifier Gate)
U1:	I. F. Amplifier
U2:	I. F. Amplifier/Video Amplifier
U3:	OP Amplifier (Band Width Switching)
U4:	Inverter
U5 to U7:	Voltage Regulator

Motor Soft Starter PCB 03P9249

CR1:	Reverse Voltage Protection
CR2:	C703 discharger
CR3:	Level Shifter
CR4:	Soft starter switch
CR5:	Reverse Voltage Protection
Q1:	Buffer for bearing pulse
Q2:	Buffer for bearing pulse
Q3:	Trigger switch for CR4

11.2 Description of the circuits employed for suppression of spurious radiation, for limiting or shaping the control pulse, and for limiting or controlling power

(FCC Rule §2.983 (d) (11))

ANTENNA UNIT
TRANSCEIVER MODULE (RTR-065)

Modulator PCB 03P9235

The primary function of the modulator is to produce narrow high tension pulses to drive the magnetron. To produce such pulses, the modulator board incorporates a modulator trigger circuit, a modulating pulse generator and a booster pulse transformer.

The modulator trigger circuit is composed of U805 and associated components. It generates pulses that fire modulator FET Q805, Q806. Normally, the circuit is stable with U805 off. The pulse to fire the modulator FET is produced when U805 turns on upon receiving the TX trigger pulse from the display unit. When U805 turns on at the positive-going edge of the TX trigger pulse, it produces a narrow pulse. This narrow pulse is boosted by pulse transformer T802 by the ratio 1:21. The resultant pulse, its level being 4.5 kV, is provided to limit the magnetron current.

C820 decouples the pulse energy that is liable to occur across the magnetron heater when T802's secondary windings are unbalanced or the load is asymmetric.

Also incorporated in the modulator board are the TX HV circuit and magnetron heater power supply circuit. The TX HV circuit provides a high tension of about 330 V to the pulse forming network through CR802,CR805. A DC voltage of 7.6 V is supplied to the magnetron heater through CR801.

Duplexer and Frequency Converter

The microwave energy produced by the magnetron enters the circulator from port 2. It is fed to port 3 with a negligible loss of energy; port 1 at this time is isolated. In the same manner, the received signal entering into port 3 is transferred to port 1, isolating port 2. This operation of the circulator protects the receiver during transmission and minimizes the loss of the received signal. Thus, the circulator allows a single antenna radiator to be

used for transmission and reception of radar signals.

A diode limiter, made up of a pair of PIN diodes, is incorporated in the first stage of the MIC (microwave IC, U801). It is a passive switching device which allows the low-level RF signal to pass through and prohibits relatively strong microwave energy, such as the leak from the magnetron. It also protects the sensitive amplifier from pulses received direct from other radars operating in the proximity.

When a low-level signal is received, the PIN diodes remain in the cutoff state, and the limiter's input impedance matches the characteristic impedance of the receiver allowing the signal to be delivered to the frequency converter of U801. When strong microwave energy is received, the PIN diodes are put in the conductive state (or short-circuited) causing the input energy to be attenuated. The strong input is further reduced to about 150 mW by the varacter diode.

The MIC converts 9 GHz RF signal into an intermediate frequency of 60 MHz. It is achieved by mixing the received signal with the local oscillator signal in the frequency converter of the MIC. The built-in local oscillator oscillates at a frequency 60 MHz higher than the magnetron frequency of 9410 MHz.

IF Amplifier IF9215

The received 60 MHz IF signal is amplified by the IF amplifier, the output of which is delivered to the Digital Signal Processor of the Display Unit. The 60 MHz IF signal from the MIC is fed to the IF amplifier U1.

The output of U1 is conductively coupled to the second-stage IF amplifier U2.

GAIN/STC signals are applied respectively to U1's pin 5 and U2's pin 14 via the STC circuit. The output of U2 is then coupled to video amplifier Q1. The video signal is taken from the emitter of Q2/Q3 through C25, and sent to the display via the video cable.

The IF amplifier PCB also incorporates an STC circuit. The STC circuit made up of Q10, Q11 changes the gain of the IF amplifier in the function of time so that the gain is minimum at the time of transmission and increases gradually to maximum gain with time (range).

The amount of current flowing into Q11 is determined by the time constant of the parallel-series capacitor/resistor network consisting of C50 to C52, R67 to R69. It gradually decreases as the capacitors are discharged. The rate of discharge is inversely proportional to "t", the elapsed time after transmission. The current flowing into Q11 is also controlled by the base potential in addition to the time constant of the capacitor/resistor network.

The time-varying waveform produced at capacitor/resistor network is restored via CR18 by the STC control potentiometer (located in the display) and applied to U1's pin 5 and U2's pin14.

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12 OPERATOR'S MANUAL INCL. CIRCUIT DIAGRAMS (FCC Rule § 2.983)

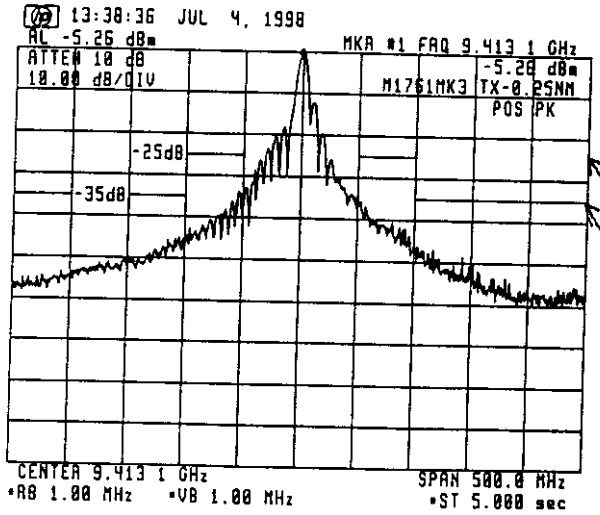
(See separate covers)

ATTACHMENT 1

[TEST DATA FOR 6. SPURIOUS EMISSIONS AT ANTENNA TERMINALS]

1. Spurious emissions for 0.25 nm Range:

Ref. level: -5.26 dBm

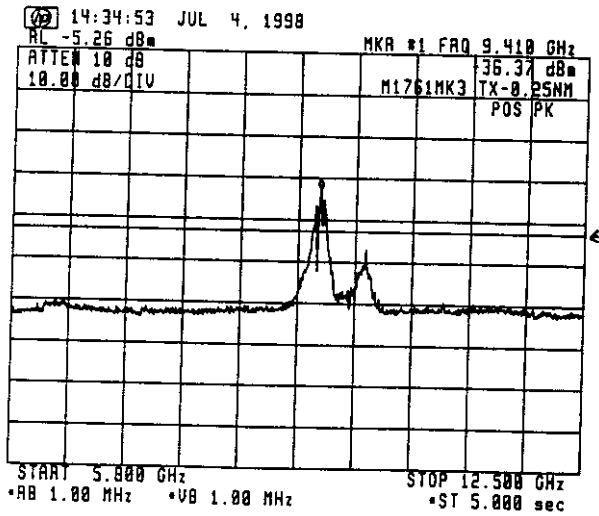


Emission limitations:

(a) 25 dB for 50 to 100 % of the authorized BW (100 MHz)

(b) 35 dB for 100 to 250 % of the authorized BW (100 MHz)

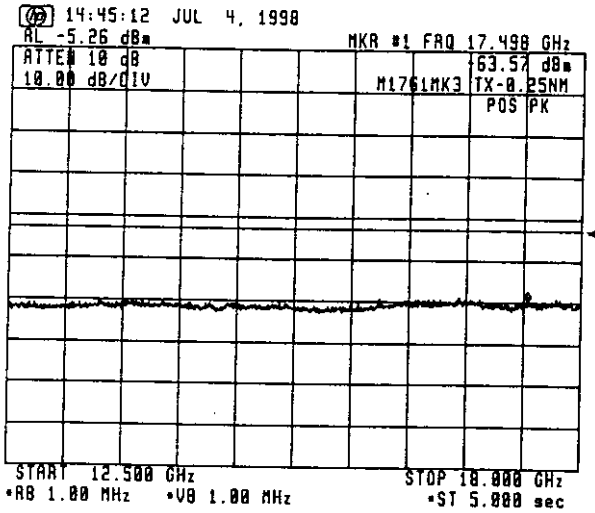
Fig. 1.1 Without Filter



Emission limitations:

(c) 43 + 10 log Pm = 42.59 dB for more than 250 % of the authorized BW (100 MHz)

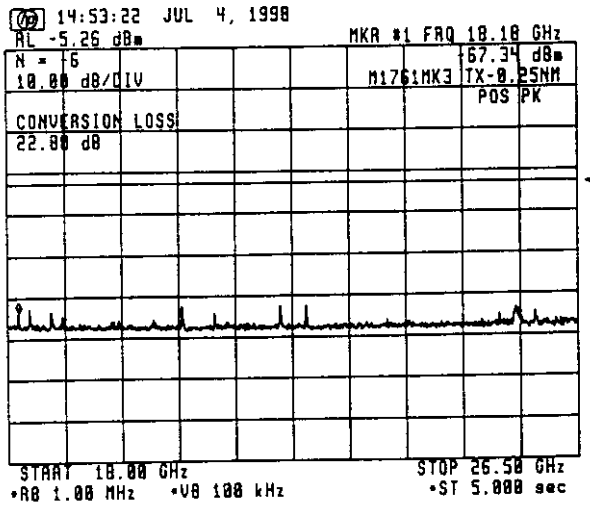
Fig. 1.2 With Filter No.1



Emission limitations:

(c) 43 + 10 log Pm = 42.59 dB for more than 250 % of the authorized BW (100 MHz)

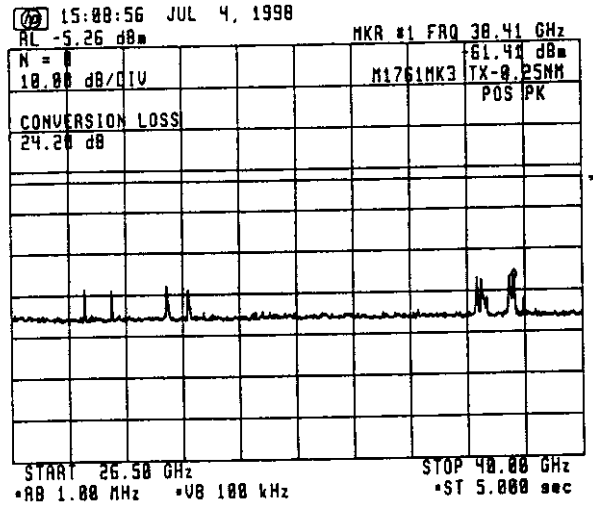
Fig. 1.3 With Filter No. 2



Emission limitations:

(c) 43 + 10 log Pm = 42.59 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 1.4 With Filter No. 2



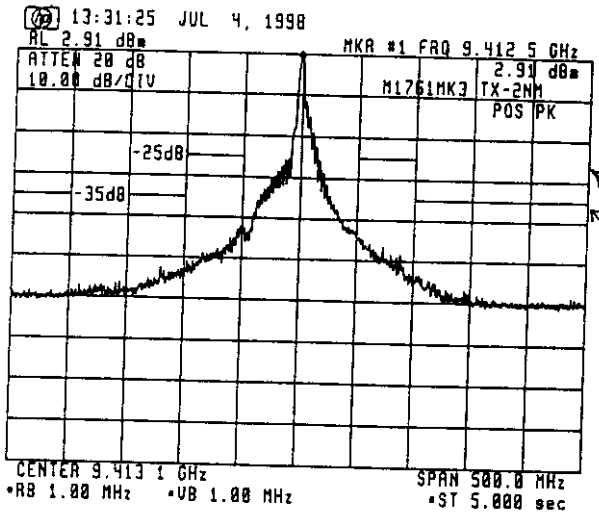
Emission limitations:

(c) 43 + 10 log Pm = 42.59 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 1.5 With Filter No. 2

2. Spurious emissions for 2 nm Range:

Ref. level: 2.91 dBm

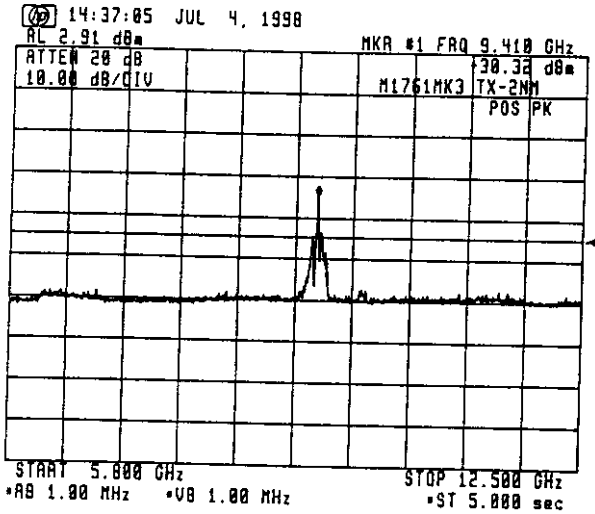


Emission limitations:

(a) 25 dB for 50 to 100 % of the authorized BW (100 MHz)

(b) 35 dB for 100 to 250 % of the authorized BW (100 MHz)

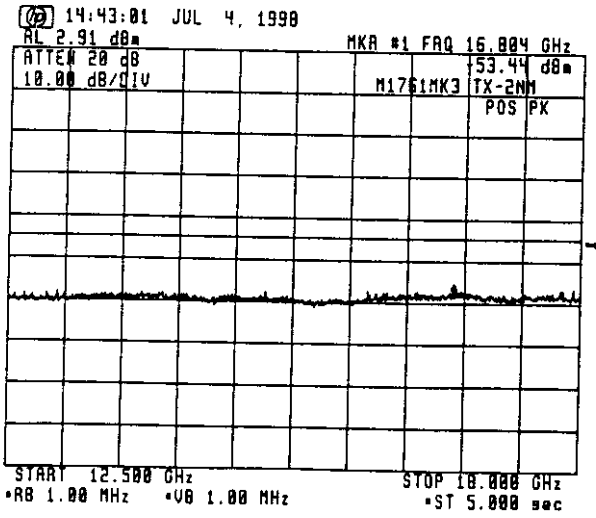
Fig. 2.1 Without Filter



Emission limitations:

(c) 43 + 10 log Pm = 44.4 dB for more than 250 % of the authorized BW (100 MHz)

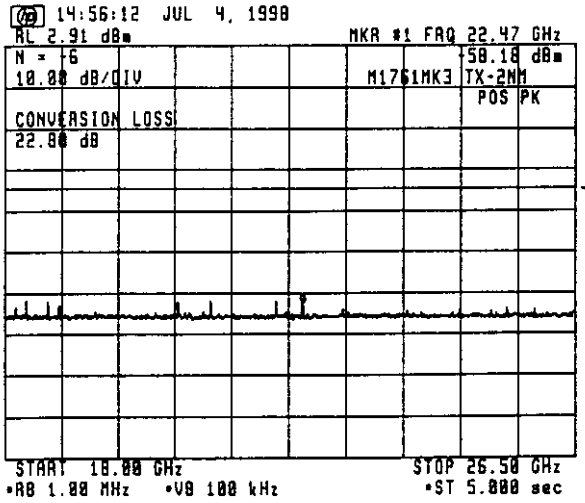
Fig. 2.2 With Filter No.1



Emission limitations:

(c) 43 + 10 log Pm = 44.4 dB for more than 250 % of the authorized BW (100 MHz)

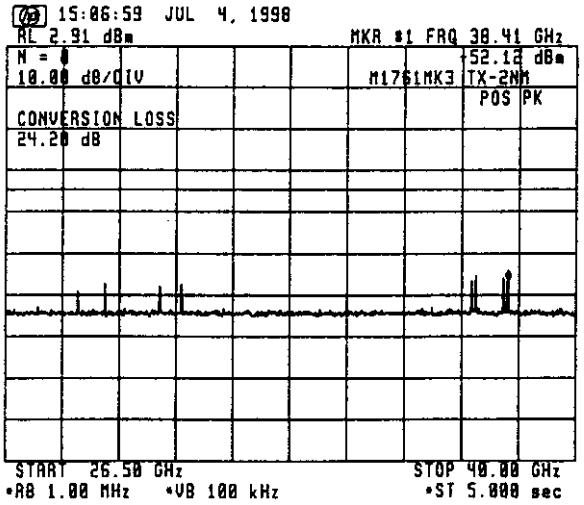
Fig. 2.3 With Filter No. 2



Emission limitations:

(c) 43 + 10 log Pm = 44.4 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 2.4 With Filter No. 2



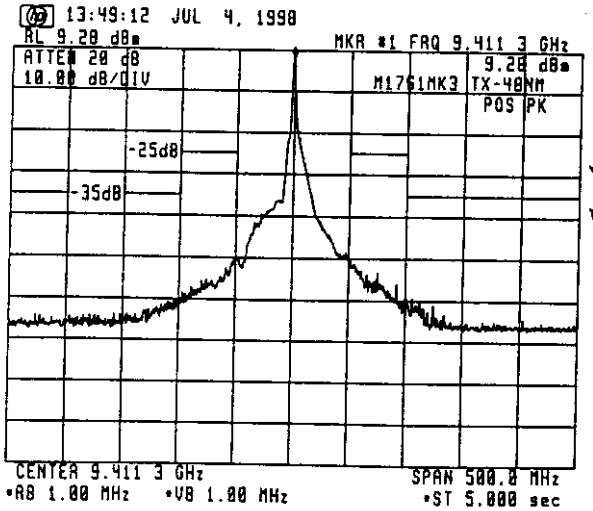
Emission limitations:

(c) 43 + 10 log Pm = 44.4 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 2.5 With Filter No. 2

3. Spurious emissions for 48 nm Range:

Ref. level: 9.28 dBm

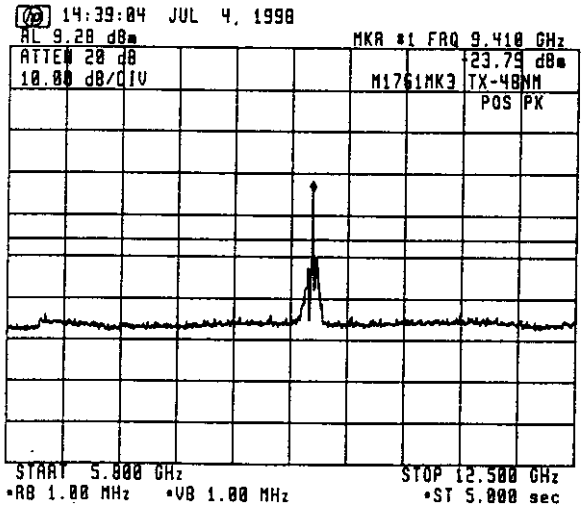


Emission limitations:

(a) 25 dB for 50 to 100 % of the authorized BW (100 MHz)

(b) 35 dB for 100 to 250 % of the authorized BW (100 MHz)

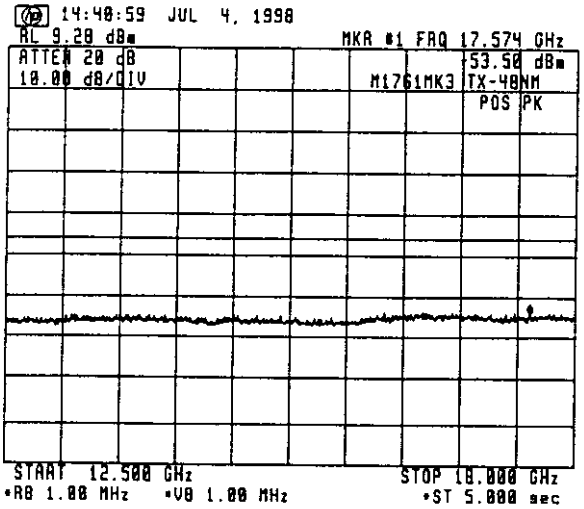
Fig. 3.1 Without Filter



Emission limitations:

(c) 43 + 10 log Pm = 45.64 dB for more than 250 % of the authorized BW (100 MHz)

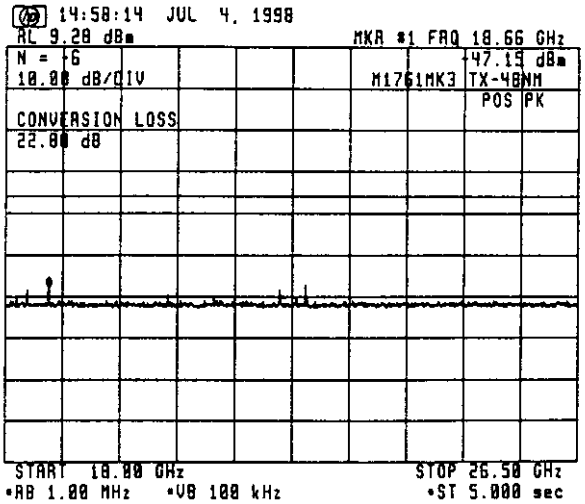
Fig. 3.2 With Filter No.1



Emission limitations:

(c) 43 + 10 log Pm = 45.64 dB for more than 250 % of the authorized BW (100 MHz)

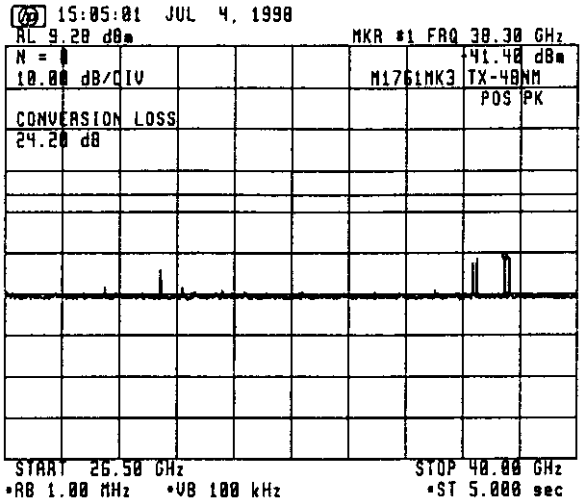
Fig. 3.3 With Filter No. 2



Emission limitations:

(c) 43 + 10 log Pm = 45.64 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 3.4 With Filter No. 2



Emission limitations:

(c) 43 + 10 log Pm = 45.64 dB
for more than 250 % of
the authorized BW (100 MHz)

Fig. 3.5 With Filter No. 2

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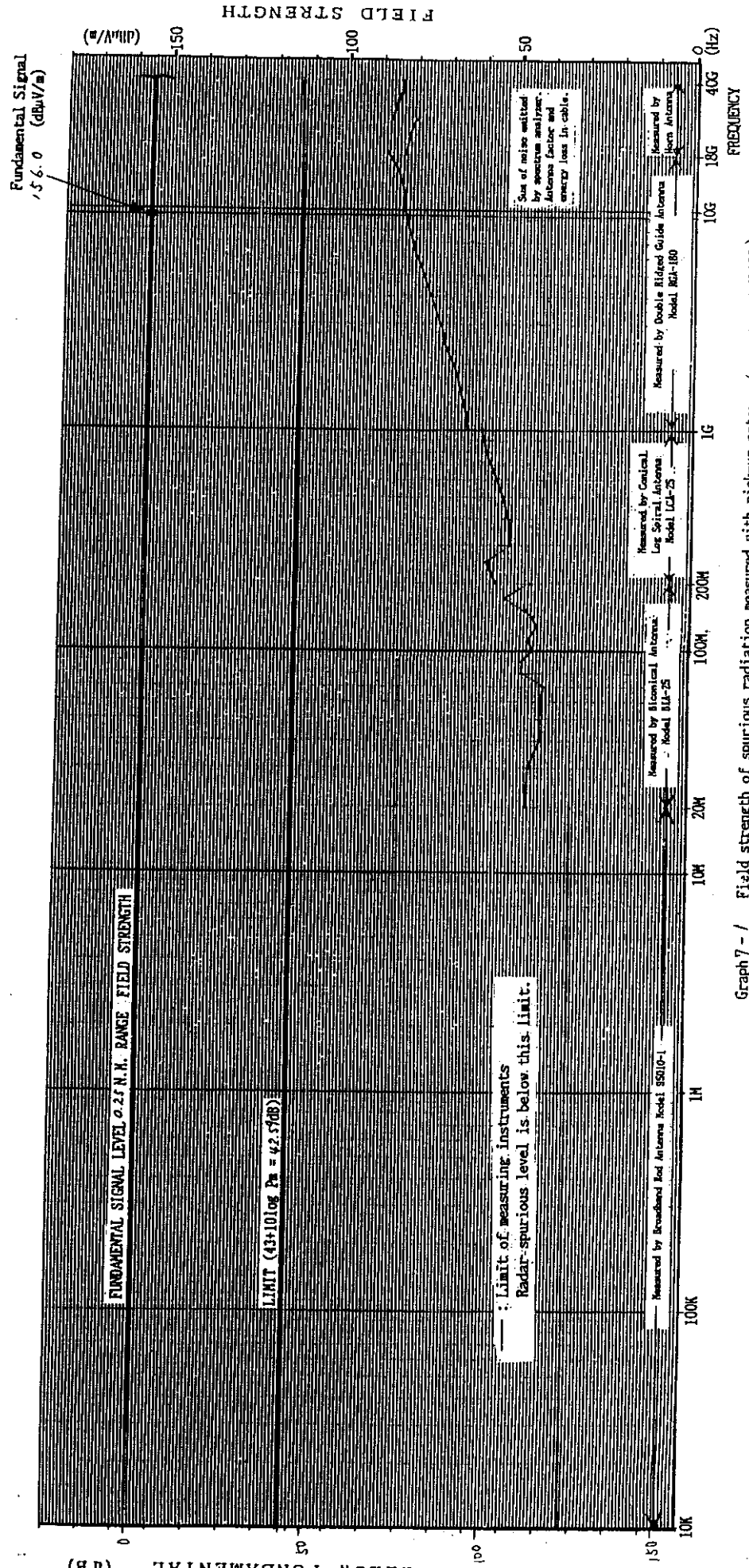
ATTACHMENT 2

[TEST DATA FOR 7. FIELD STRENGTH OF SPURIOUS RADIATION]



Graph 7 - 1 Field strength of spurious radiation measured with pick-up antenna (0.25 nm range)
(short Pulse)

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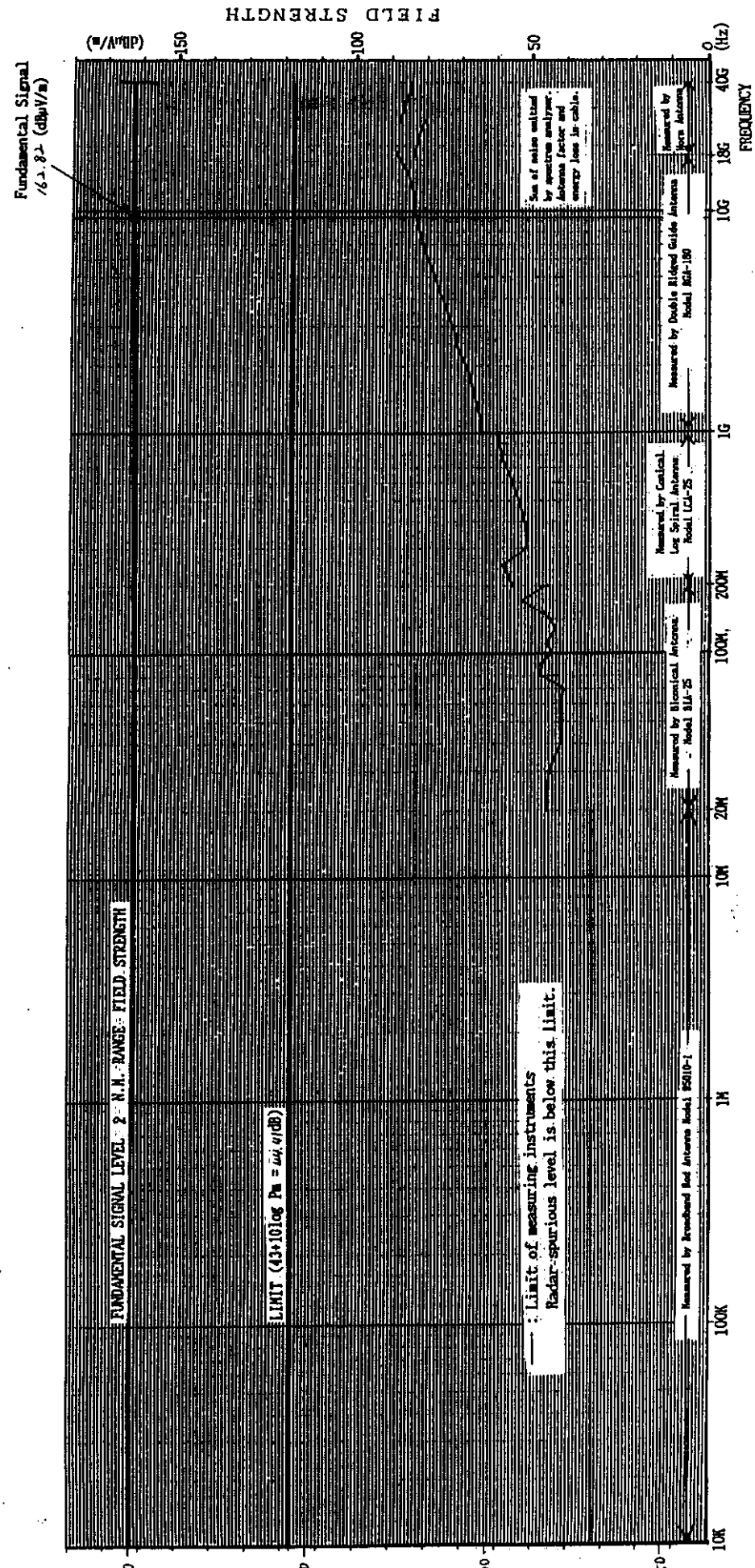
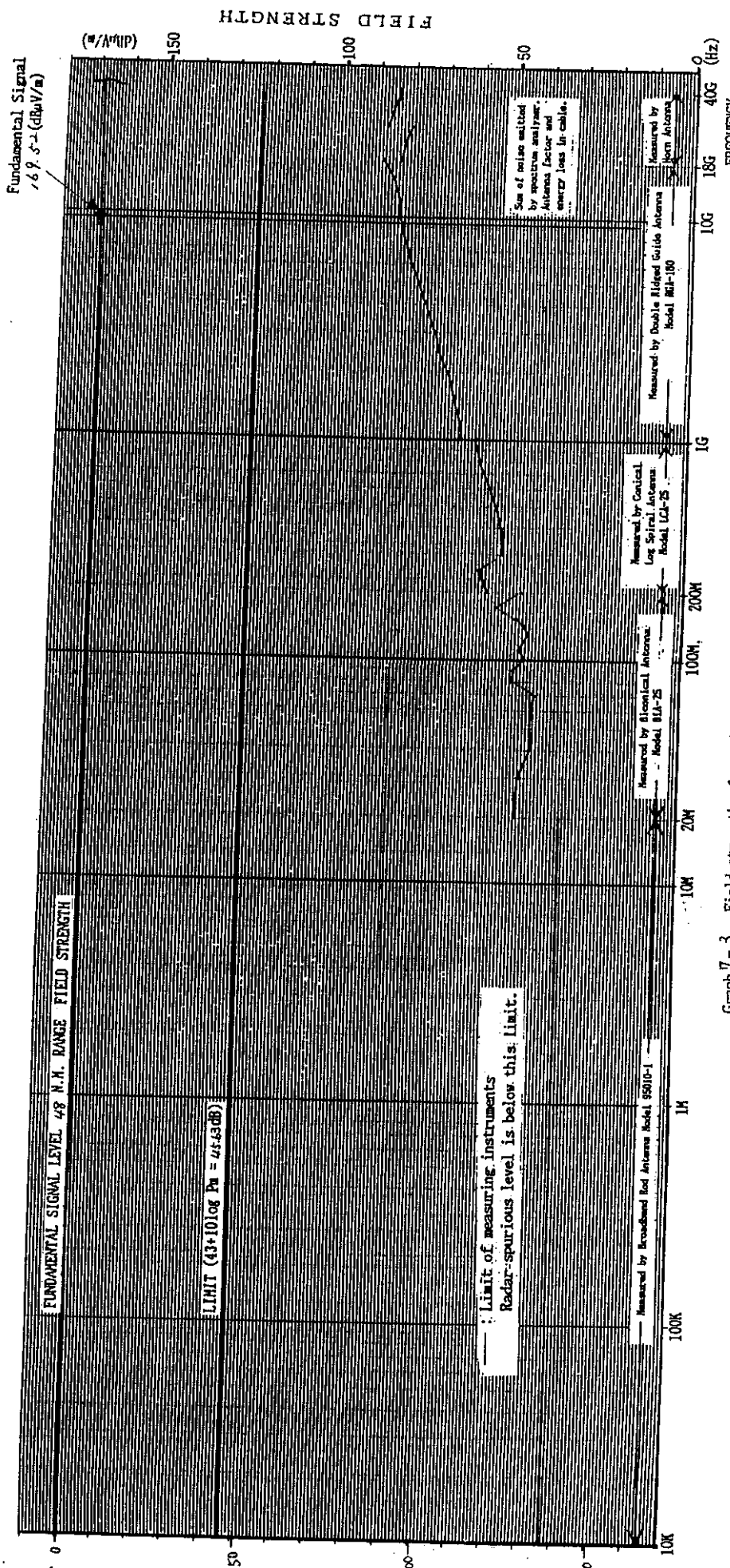


Graph 7 - 2 Field strength of spurious radiation measured with pick-up antenna (2 nm range)
(Middle Pulse)



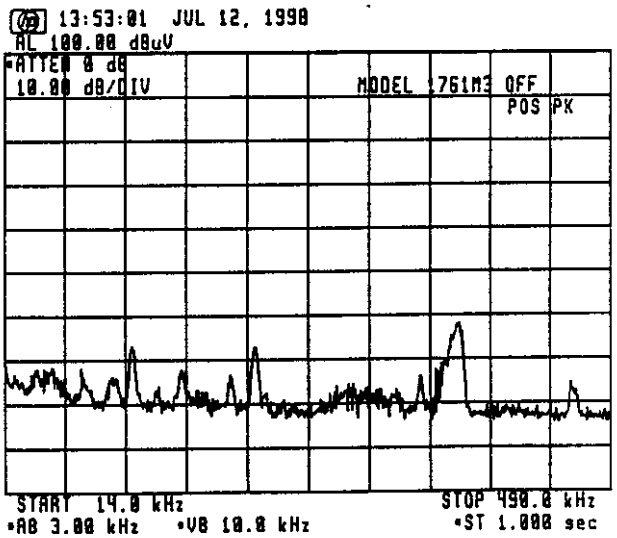
Graph 7-3 Field strength of spurious radiation measured with pick-up antenna (48 nm range)
(Long Pulse)

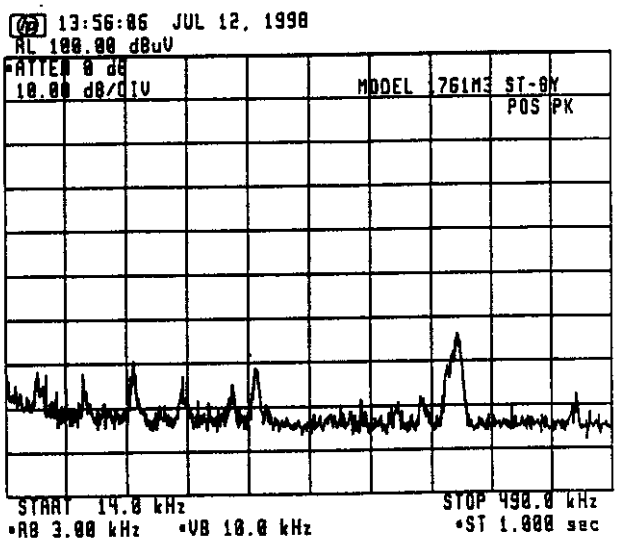
ATTACHMENT 3

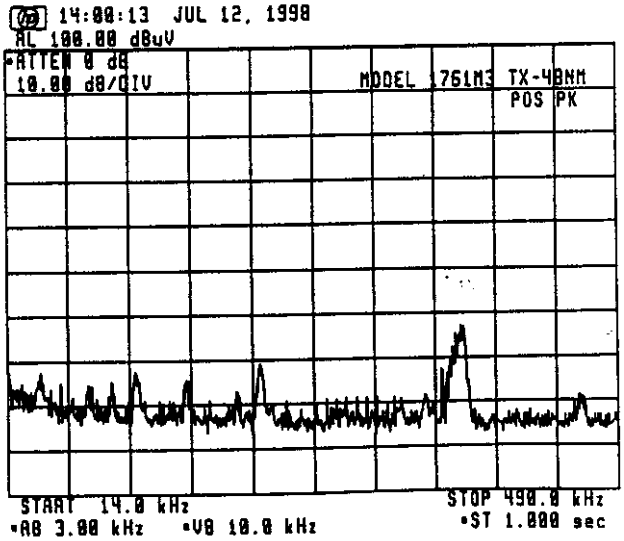
[TEST DATA FOR 9. SUPPRESSION OF INTERFERENCE ABOARD SHIPS]

1. Harmful Interference to Receiver

Band : 14kHz ~ 490kHz







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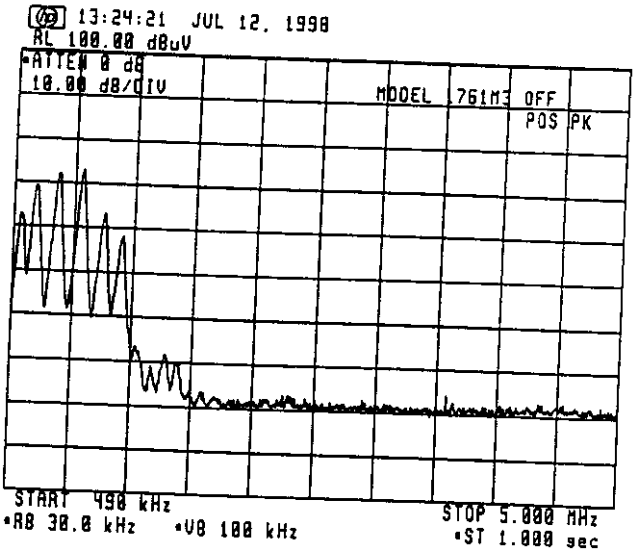
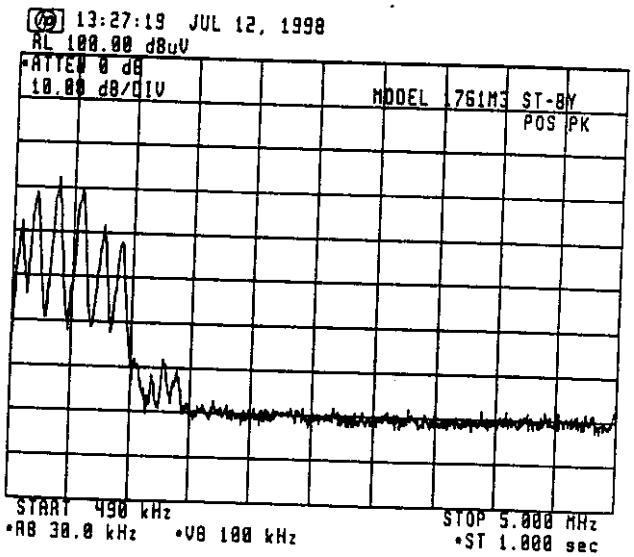
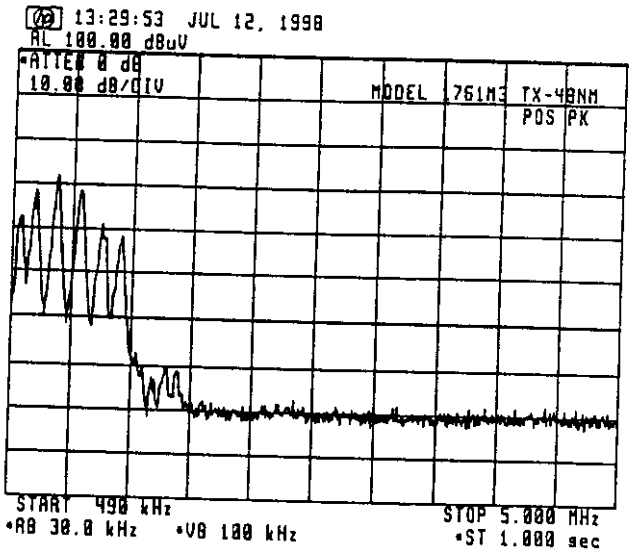
Band : 490kHz ~ 5MHz

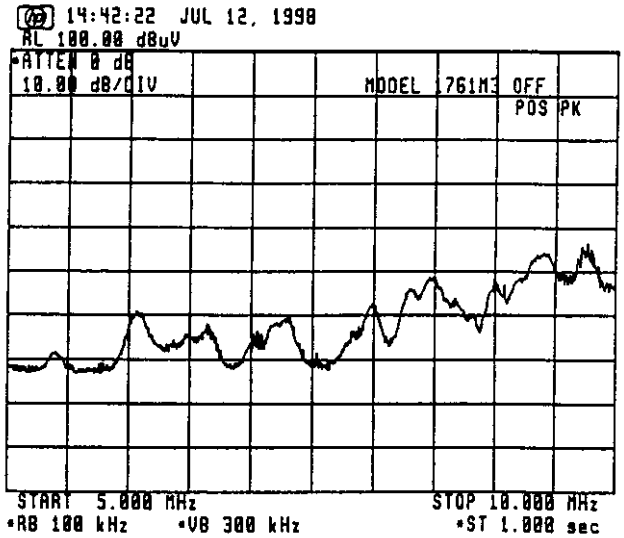


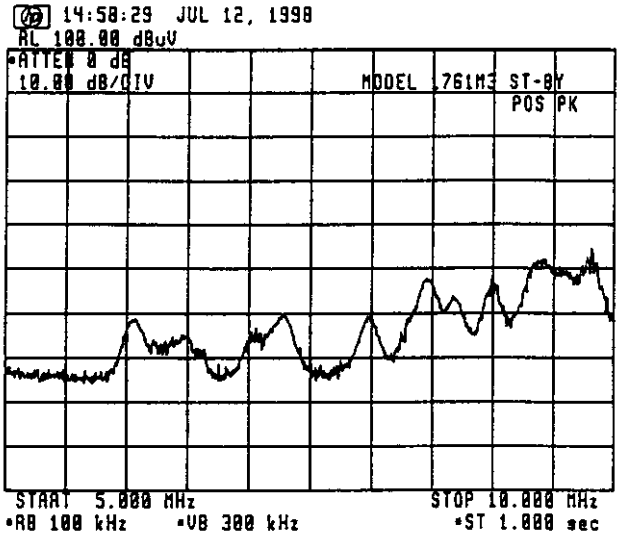


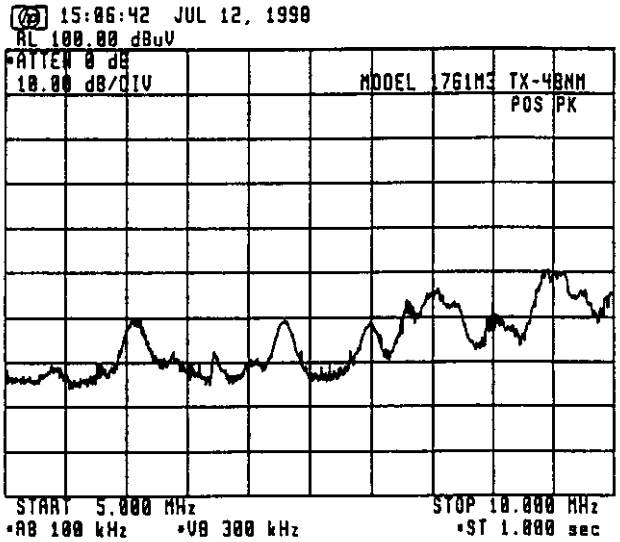


Pub. No. : TI-1698
Date : July. 1998

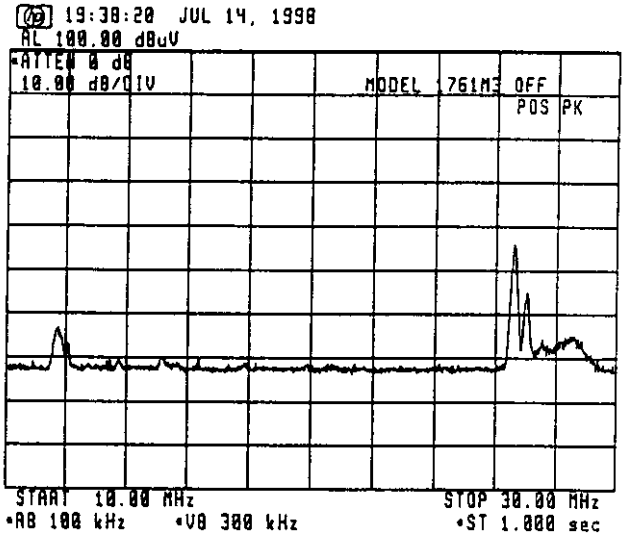
Band : 5MHz ~ 10MHz

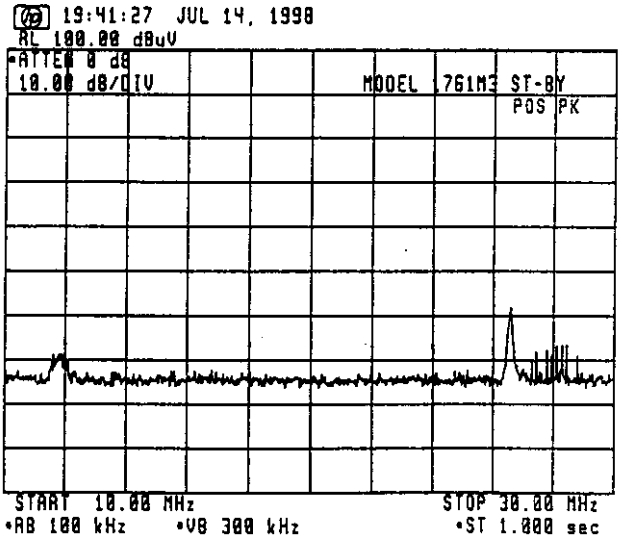


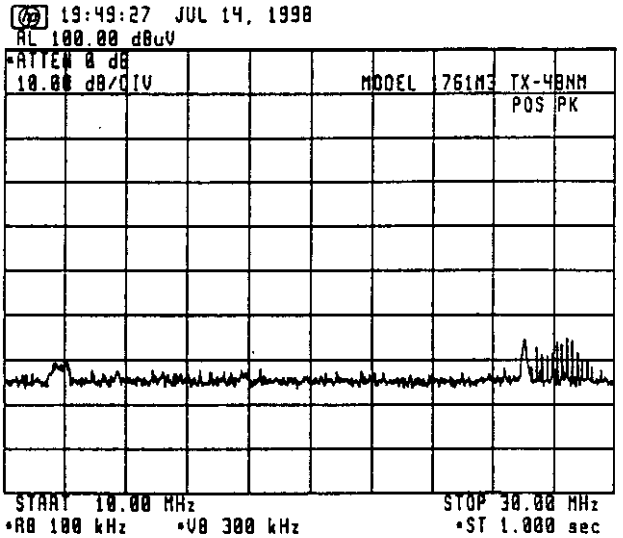




Band: 10MHz ~ 30MHz







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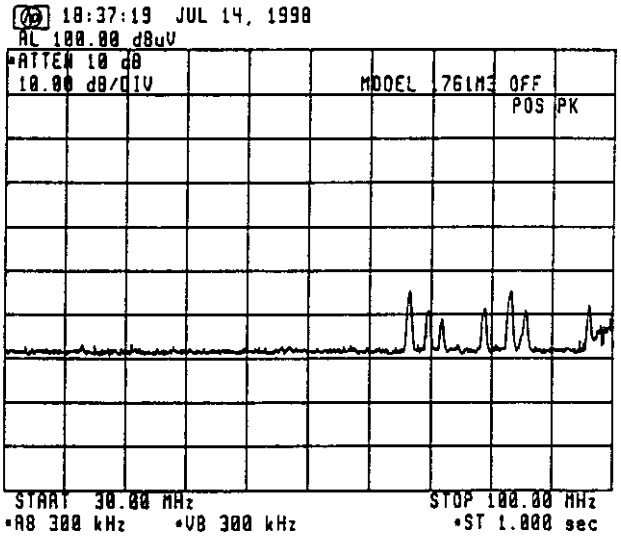
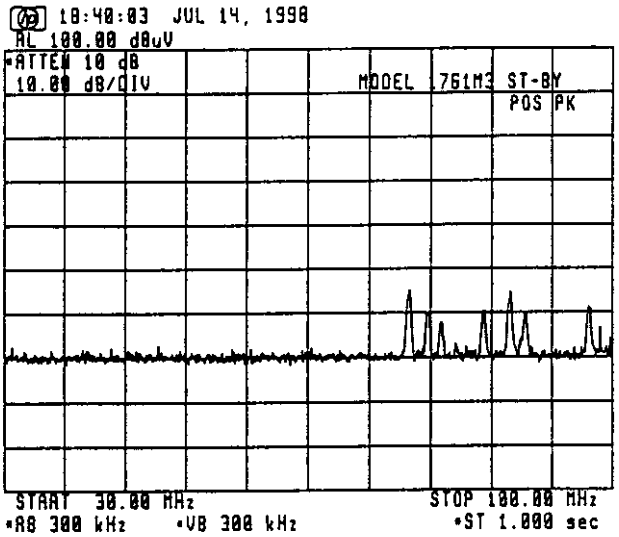
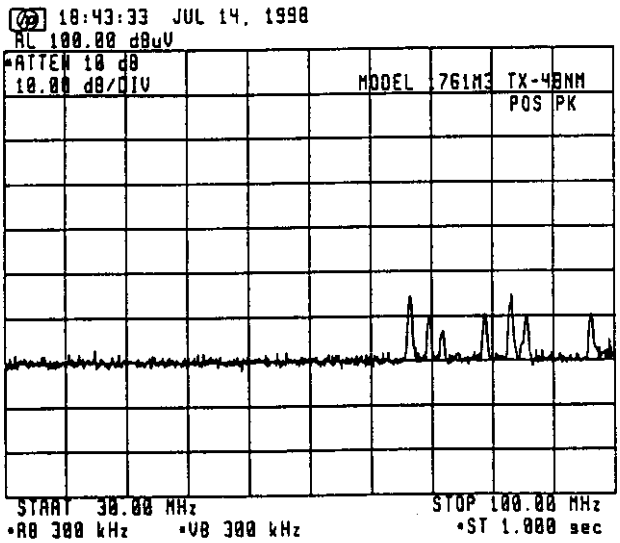
Date : July. 1998

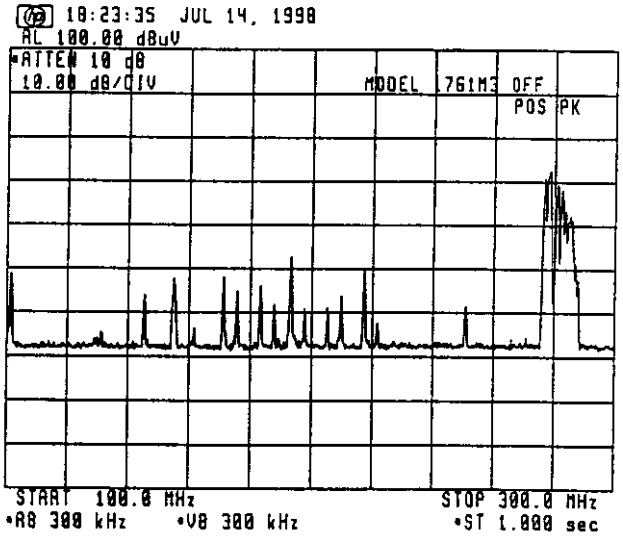
Band: 30MHz ~ 100MHz

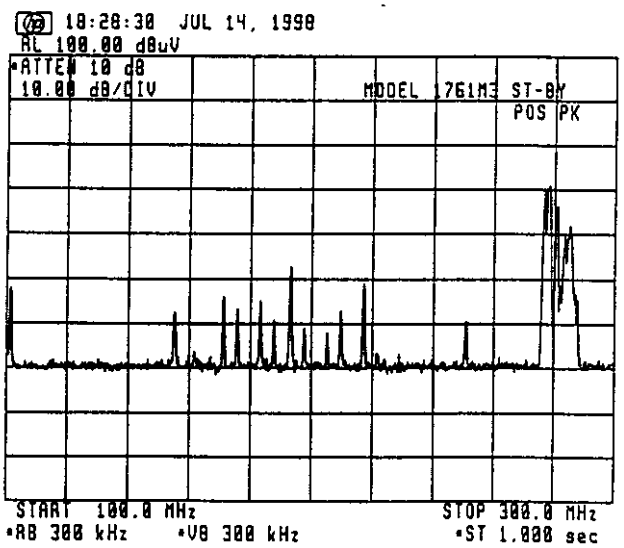


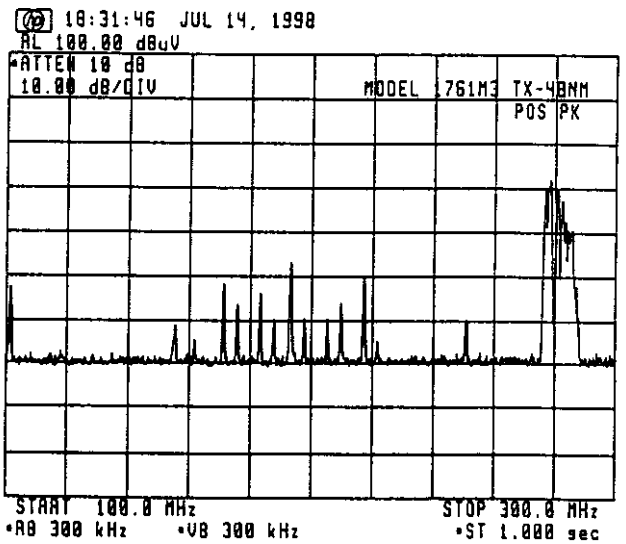




Band : 100MHz ~ 300MHz

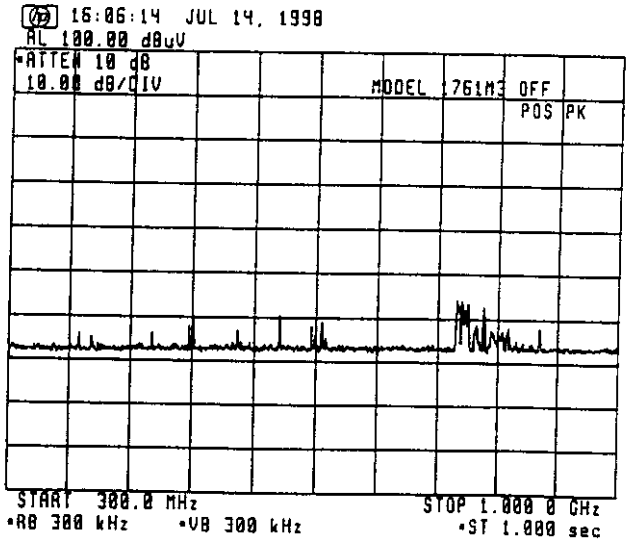


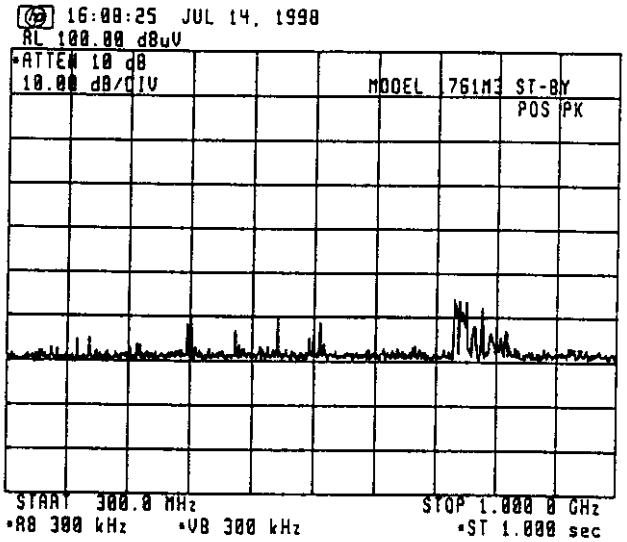


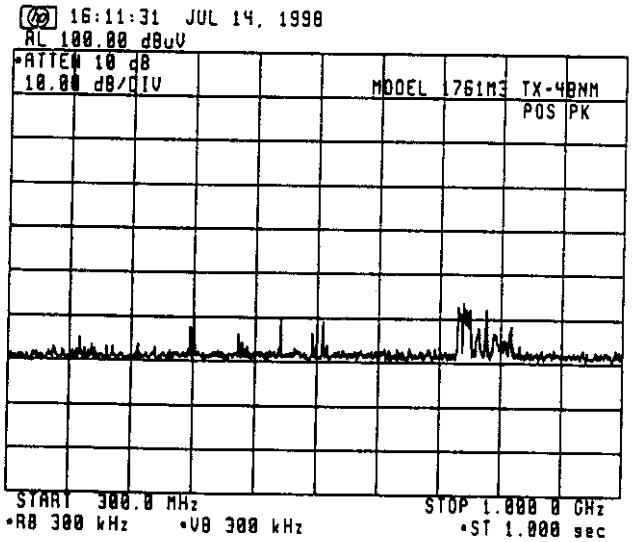


Pub. No. : TI-1698
Date : July, 1998

Band: 300MHz ~ 1GHz

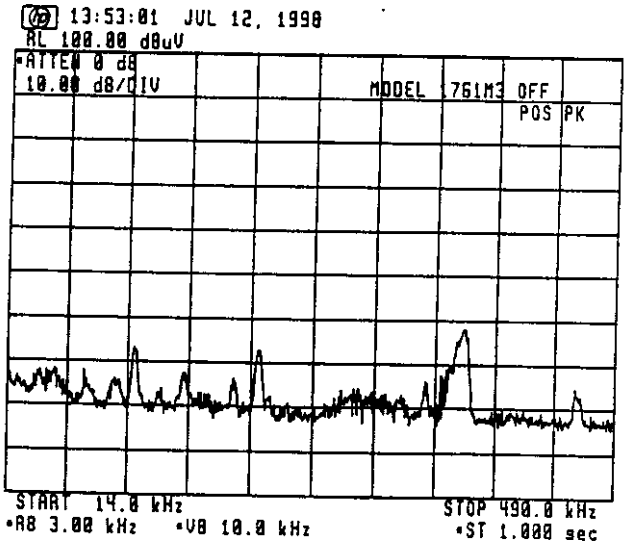


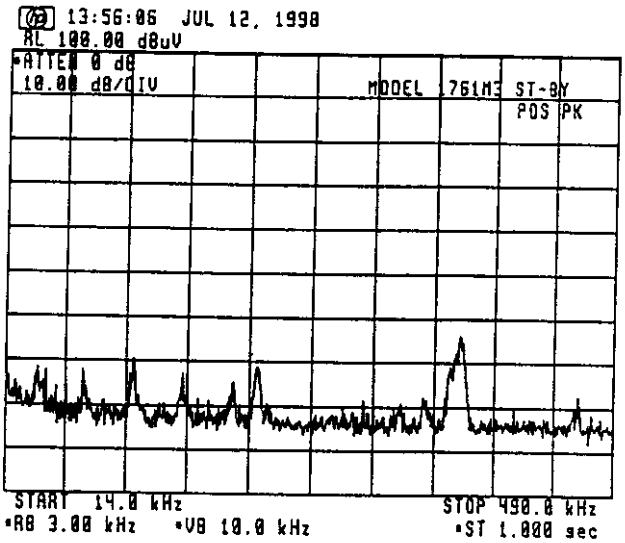




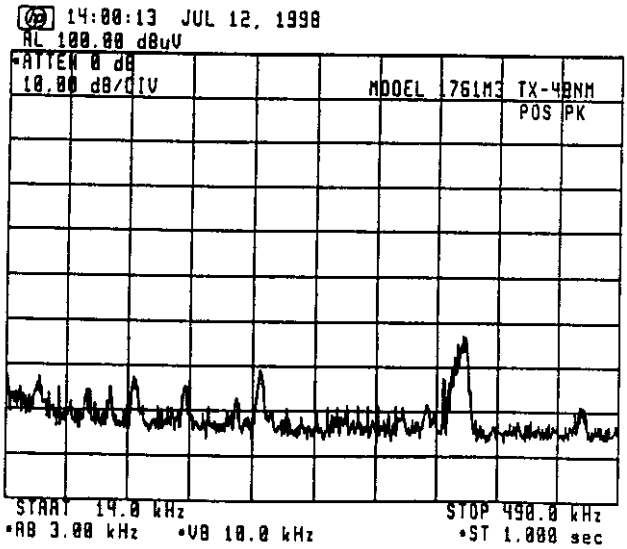
2. Electromagnetic Field

Band: 14kHz ~ 490kHz (Limit at 1N.M. = 0.1μV/m = -20 dBμV/m)



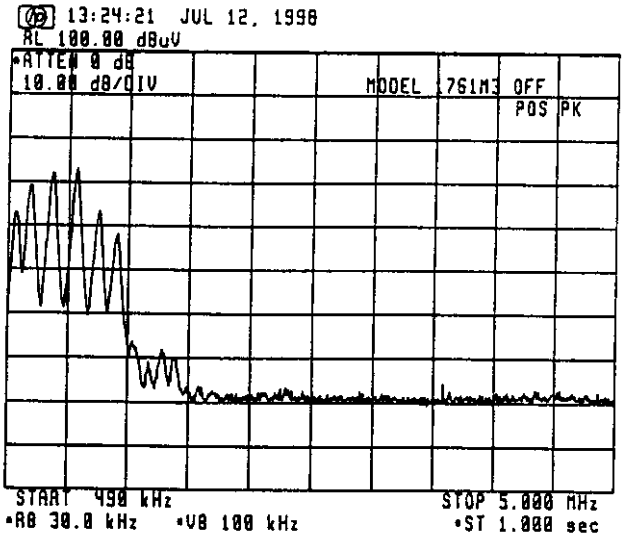


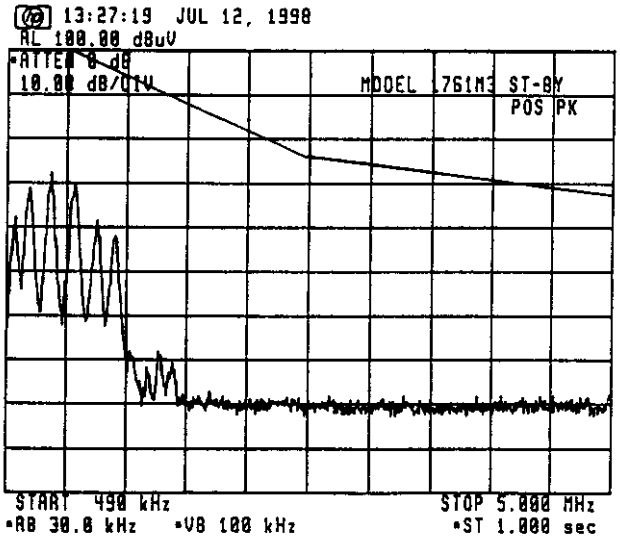
REF.
-26 dBμV/m



REF.
-26 dBμV/m

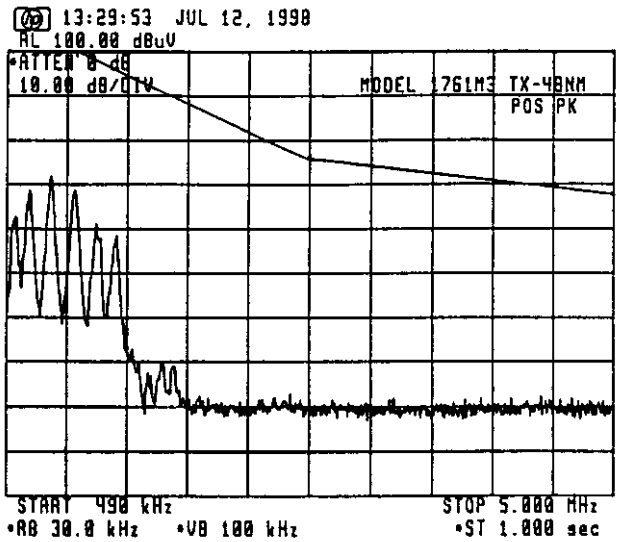
Band = 490kHz ~ 5MHz (Limit at 1N.M. = 0.1μV/m = -20dBμV/m)





REF. (dBμV/m)
100 - 126 = -26 (0.5MHz)
100 - 96 = 4 (3MHz)
100 - 88 = 12 (5MHz)

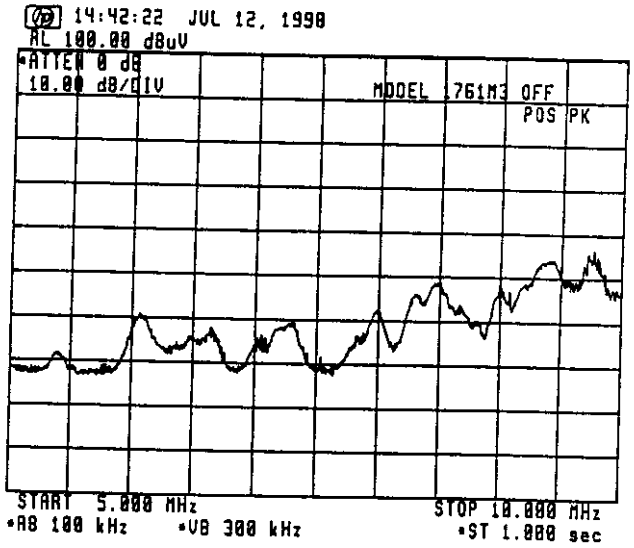
-20dBμV/m

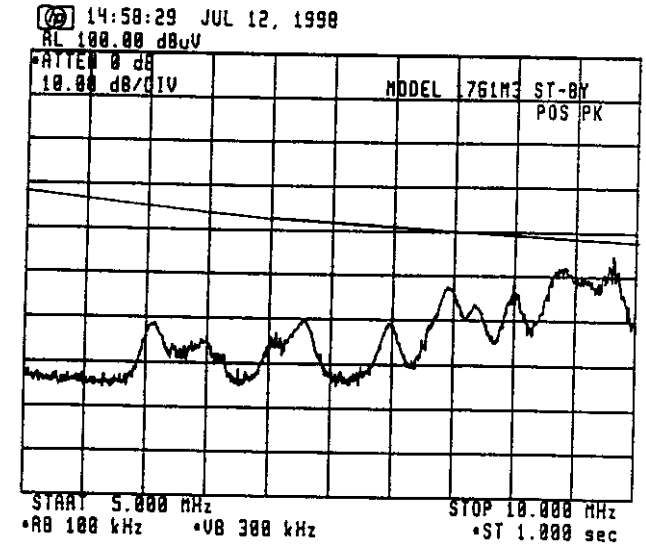


REF. (dBμV/m)
100 - 126 = -26 (0.5MHz)
100 - 96 = 4 (3MHz)
100 - 88 = 12 (5MHz)

-20dBμV/m

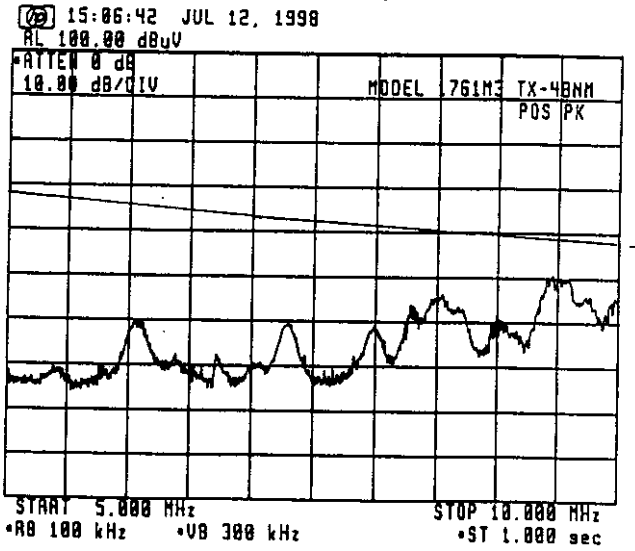
Band : 5MHz ~ 10MHz (Limit at 1N.M. = 0.1μV/m = -20dBμV/m)





REF. (dBμV/m)
100 - 88 = 12 (5MHz)
100 - 83 = 17 (7MHz)
100 - 78 = 22 (10MHz)

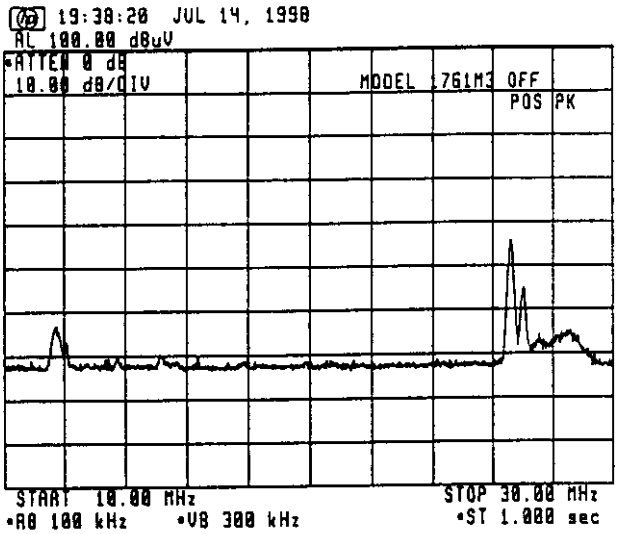
-20dBμV/m

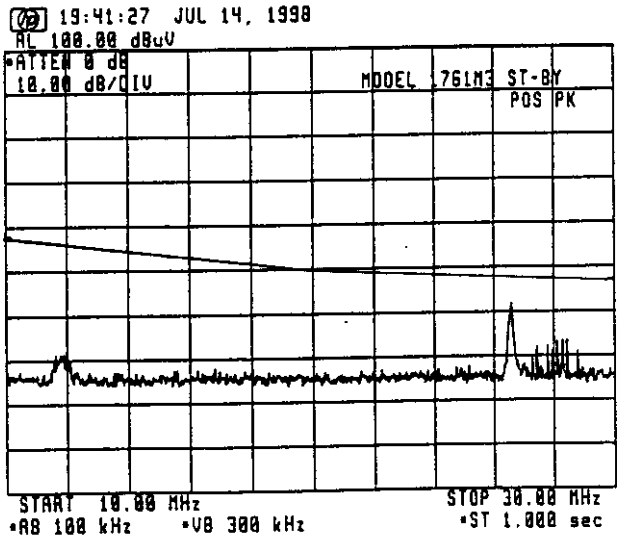


REF. (dBμV/m)
100 - 88 = 12 (5MHz)
100 - 83 = 17 (7MHz)
100 - 78 = 22 (10MHz)

-20dBμV/m

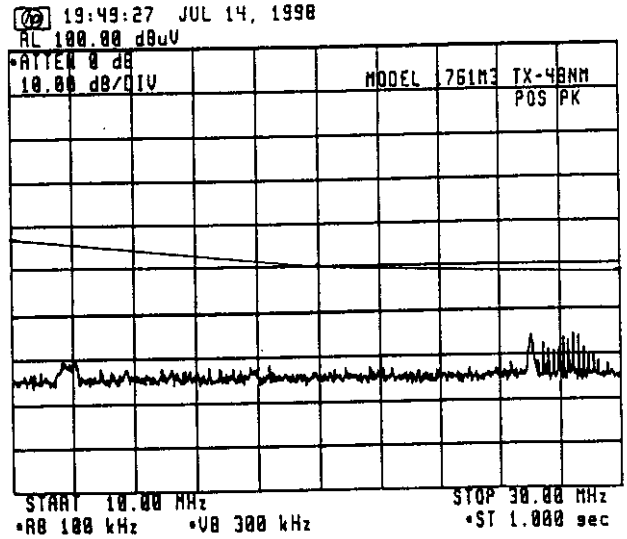
Band = 10MHz ~ 30MHz (Limit at 1 N.M. = 0.1μV/m = -20dBμV/m)





REF. (dBμV/m)
100 - 78 = 22 (10MHz)
100 - 70 = 30 (20MHz)
100 - 67 = 33 (30MHz)

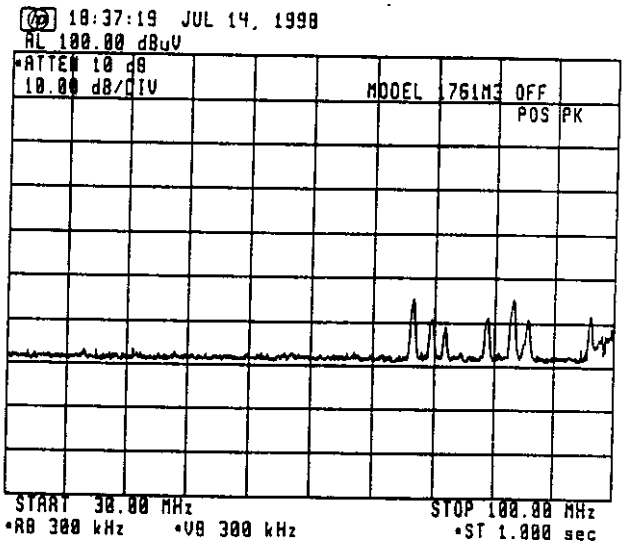
-20dBμV/m

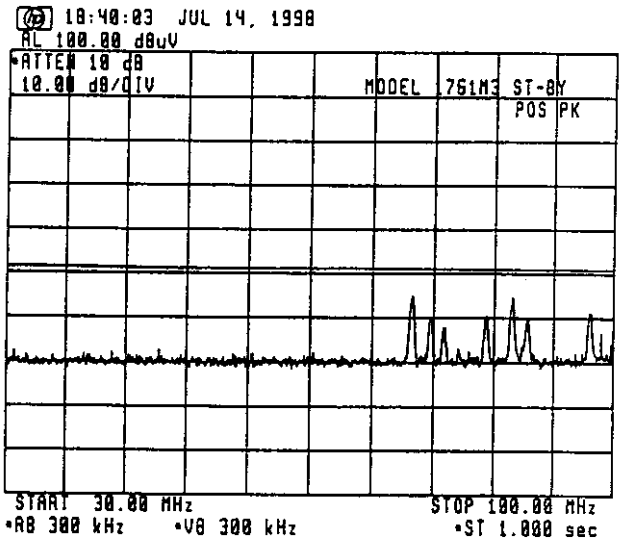


REF. (dBμV/m)
100 - 78 = 22 (10MHz)
100 - 70 = 30 (20MHz)
100 - 67 = 33 (30MHz)

-20dBμV/m

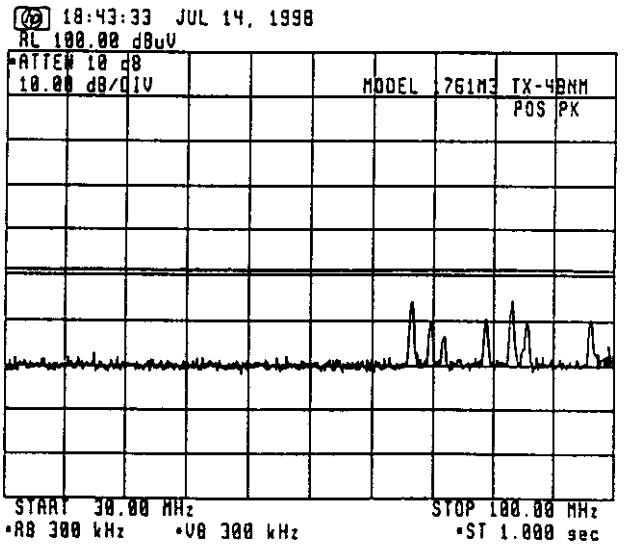
Band: 30MHz ~ 100MHz (Limit at 1N.M. = 0.1μV/m = -10.5dBμV/m)





REF. (dBμV/m)
100 - 61 = 39

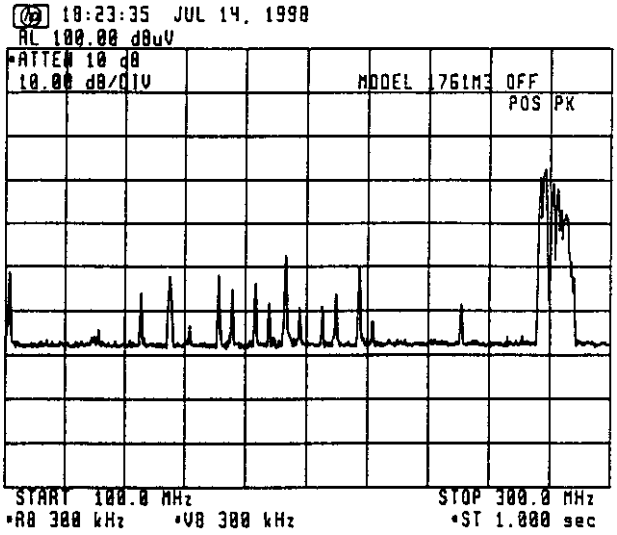
- 10.5dBμV/m

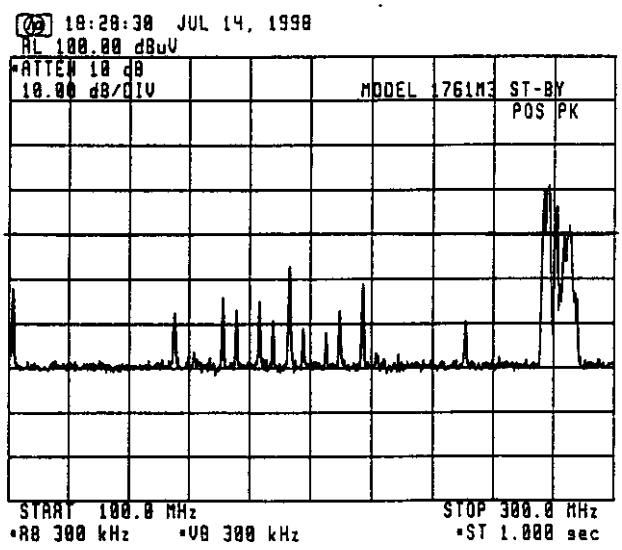


REF. (dBμV/m)
100 - 61 = 39

- 10.5dBμV/m

Band: 100MHz ~ 300MHz (Limit at 1N.M. = 0.1μV/m = 0dBμV/m)

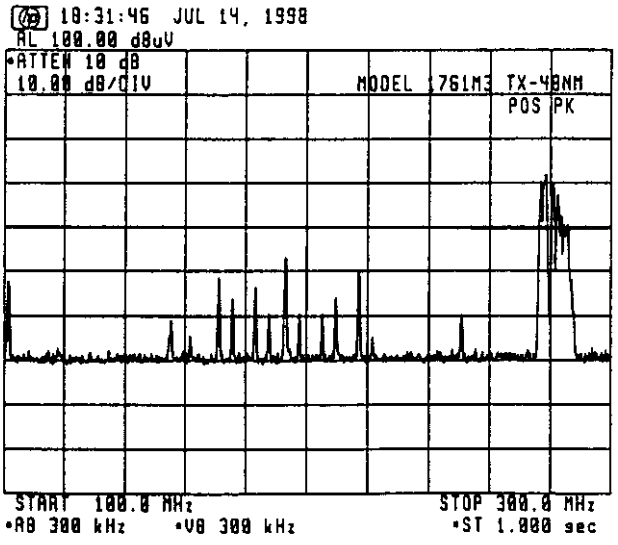




REF. (dBμV/m)
100 - 60 = 40

0dBμV/m

ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.



REF. (dBμV/m)
100 - 60 = 40

0dBμV/m

ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

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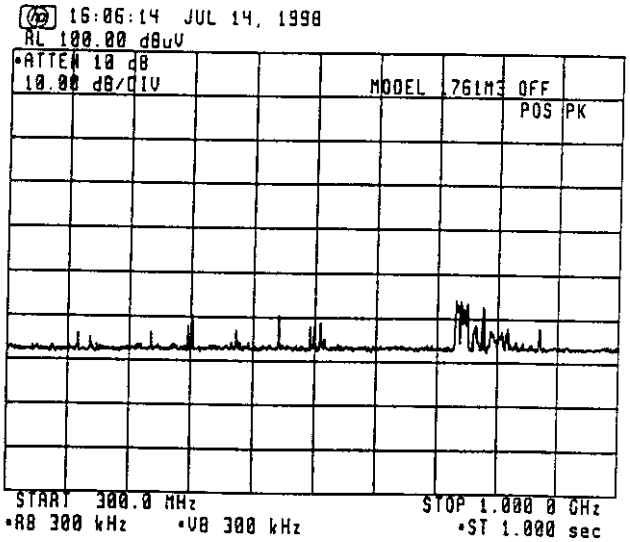
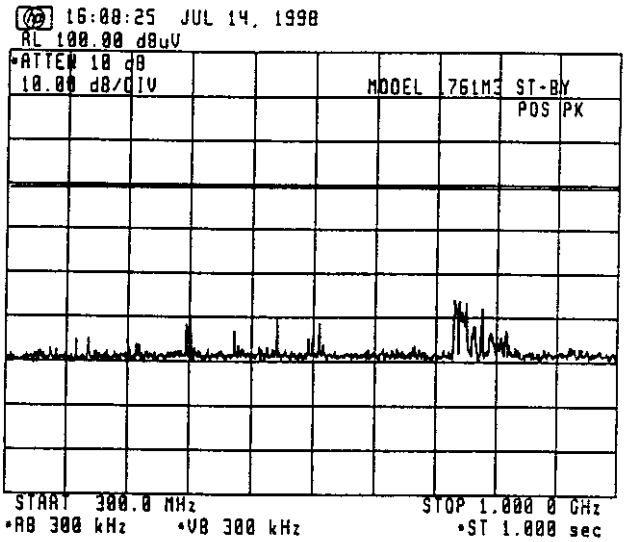
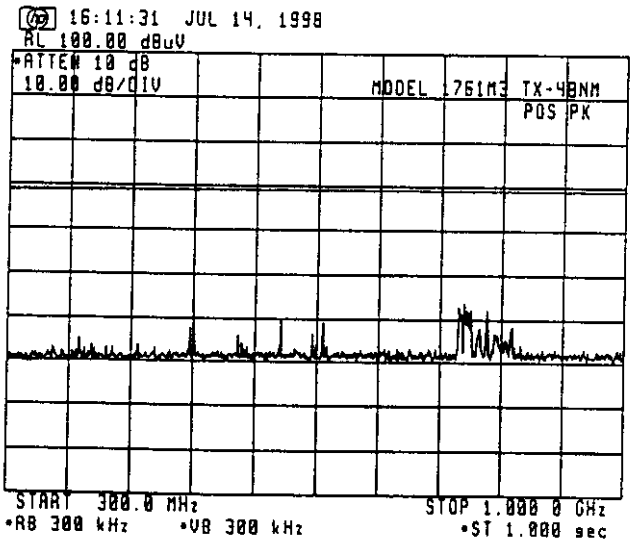
Band = 300MHz ~ 1GHz (Limit at 1N.M. = 3μV/m = 9.5dBμV/m)





REF. (dBμV/m)
100 - 59.5 = 40.5

9.5dBμV/m

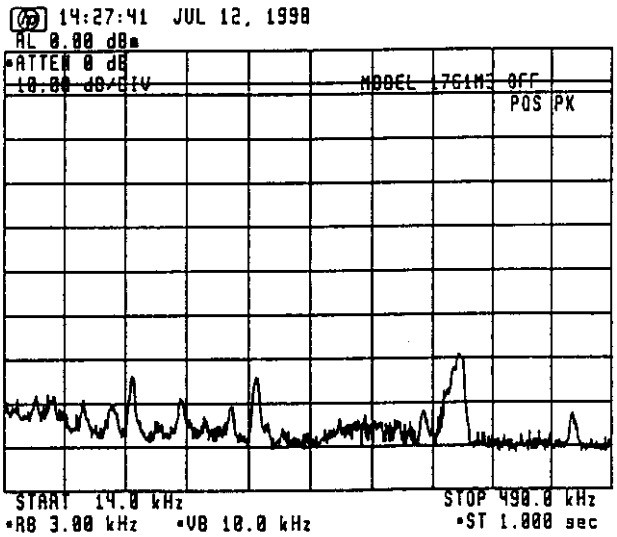


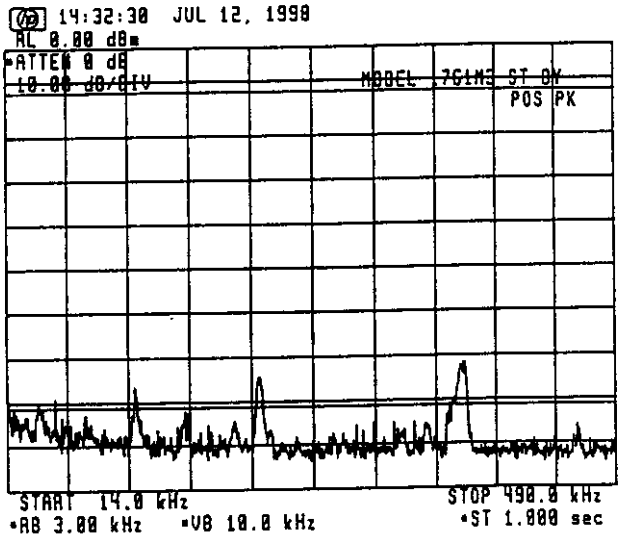
REF. (dBμV/m)
100 - 59.5 = 40.5

9.5 dBμV/m

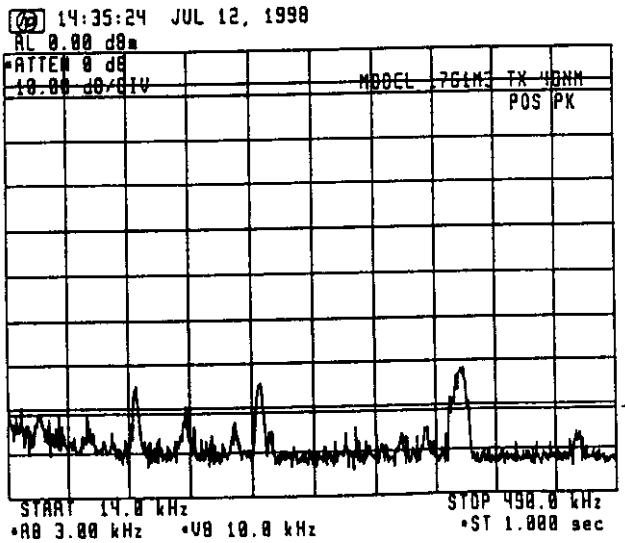
3. Power Input to an Artificial Antenna

Band: 14kHz ~ 490kHz (Limit at 3meter = -81dBm)



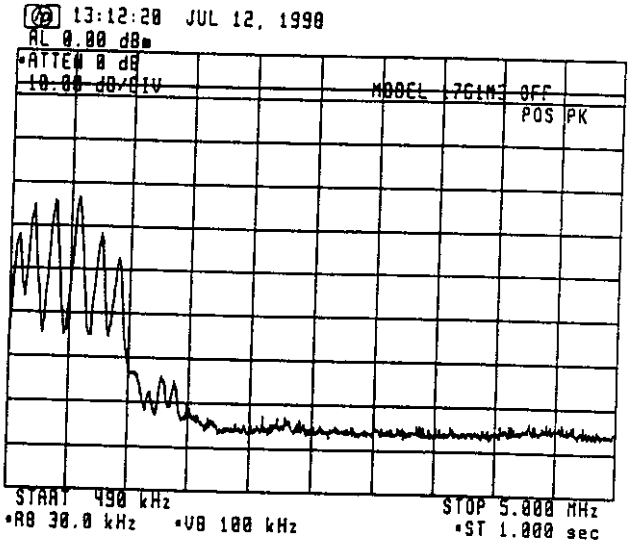


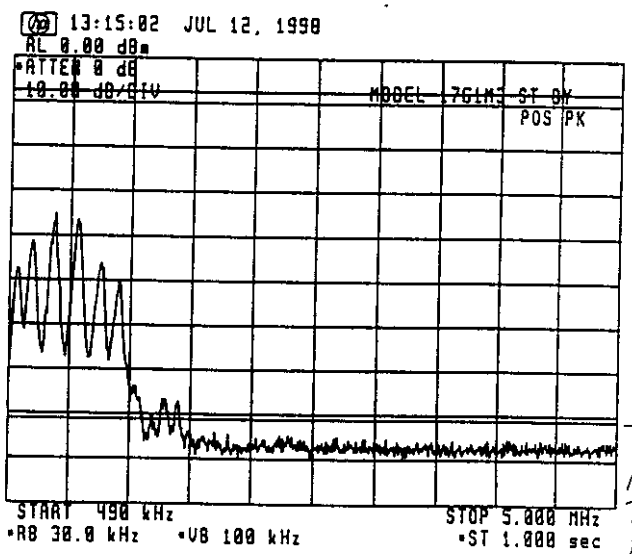
-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.



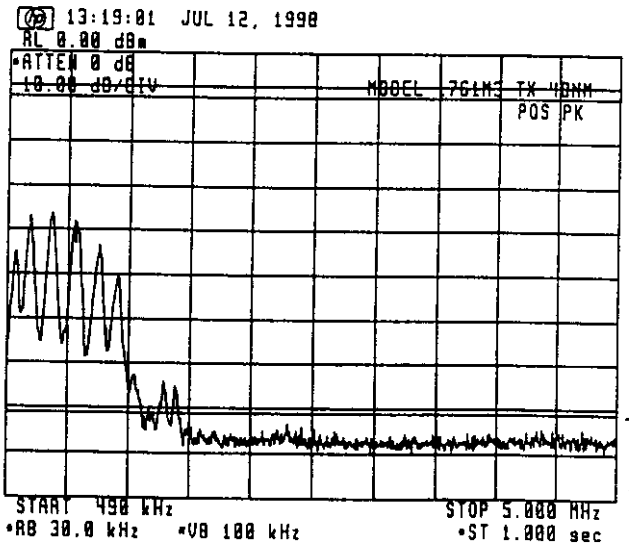
-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNALS NOISE OR SIGNALS, NOT FROM RADAR.

Band: 490kHz ~ 5MHz (Limit at 3meter = -81dBm)



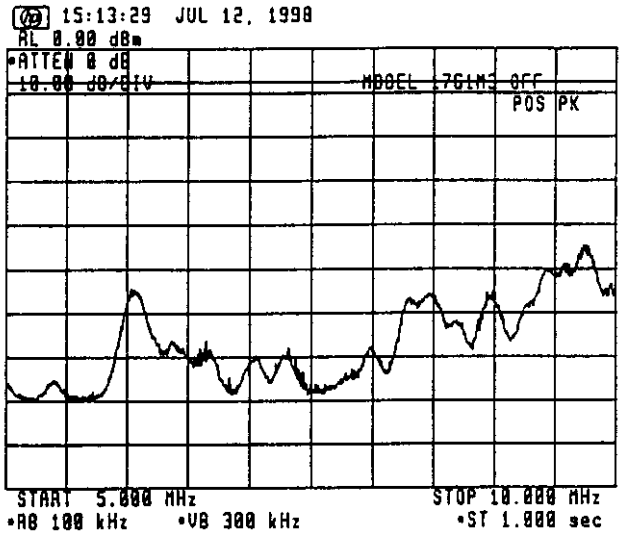


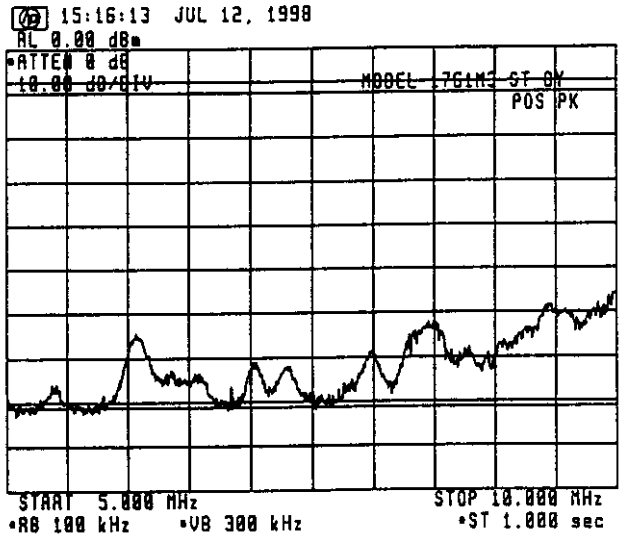
-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.



-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

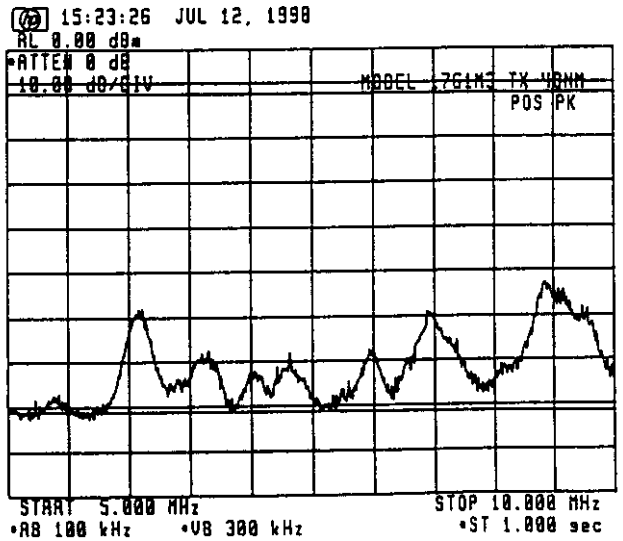
Band = 5MHz ~ 10MHz (Limit at 2meter = -81dBm)





-81dBm

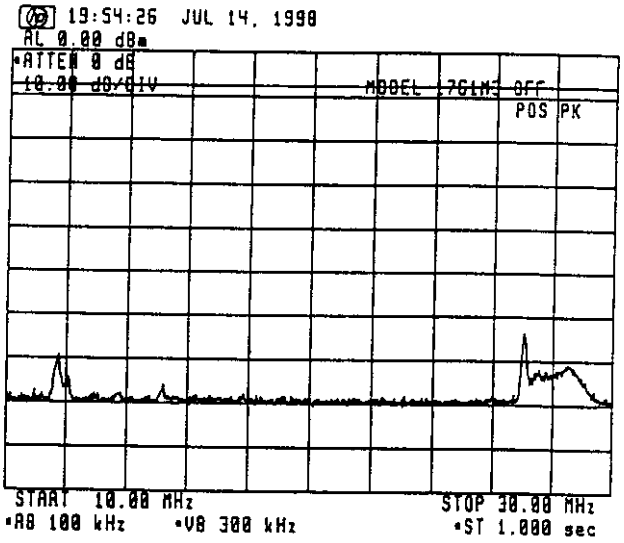
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

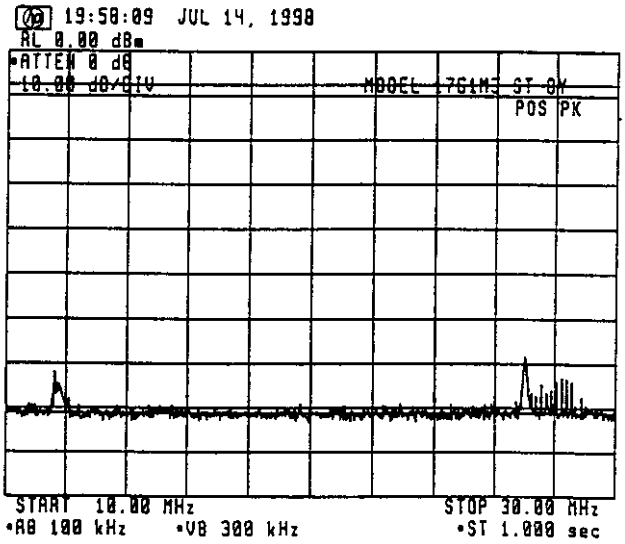


-81dBm

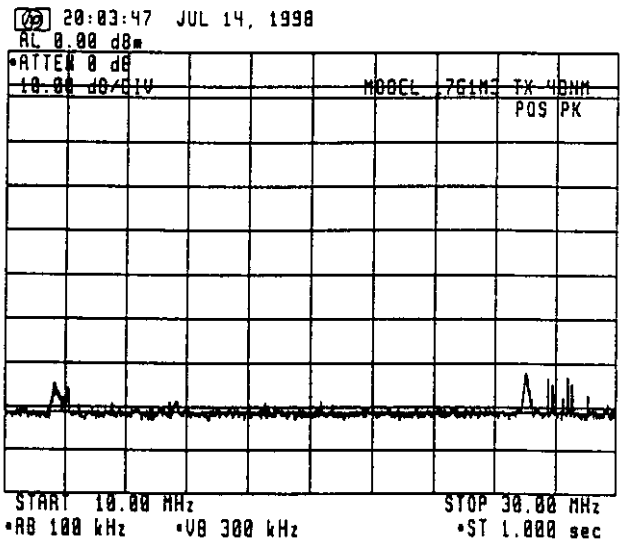
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

Band: 10MHz ~ 30MHz (Limit at 3meter = -81dBm)





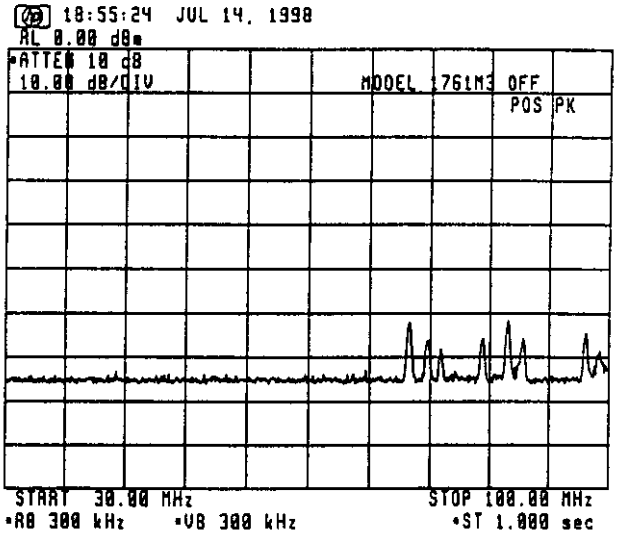
-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

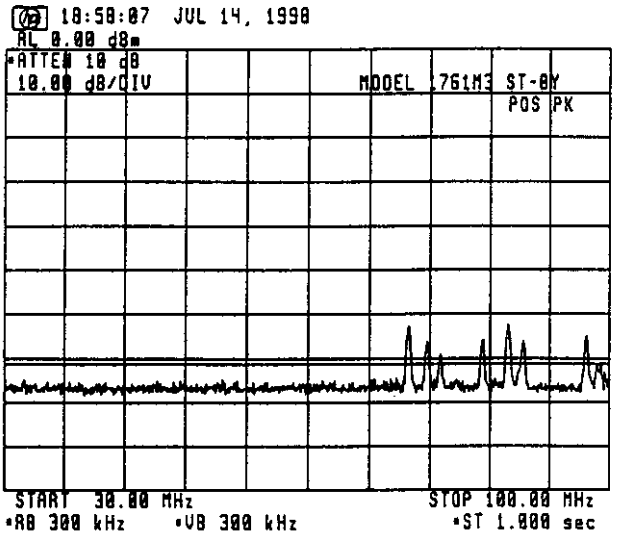


-81dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

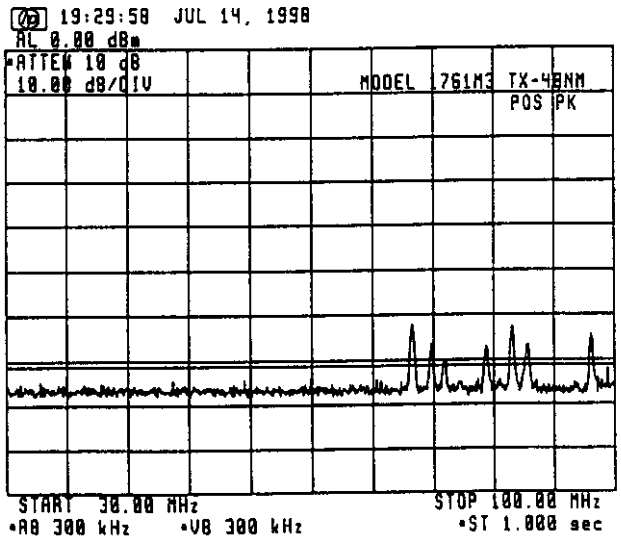
Pub. No. : TI-1698
Date : July. 1998

Band: 30MHz ~ 100MHz (Limit at 2meter --71dBm)



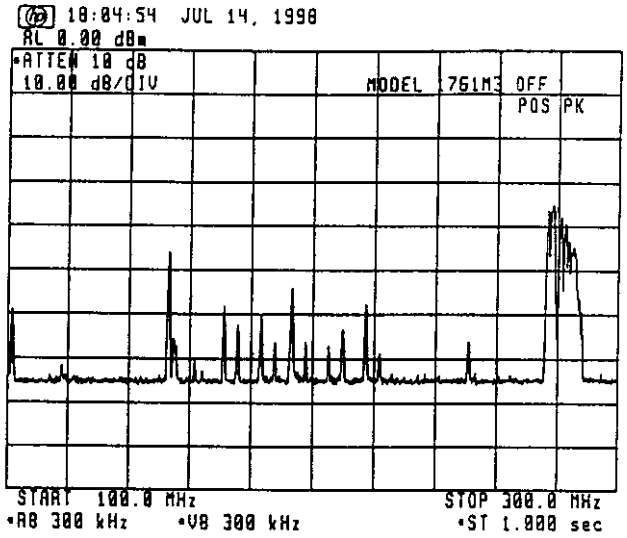


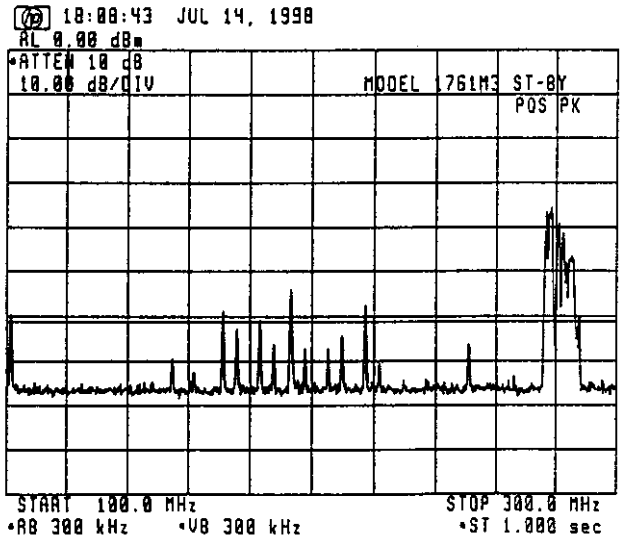
-71dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.



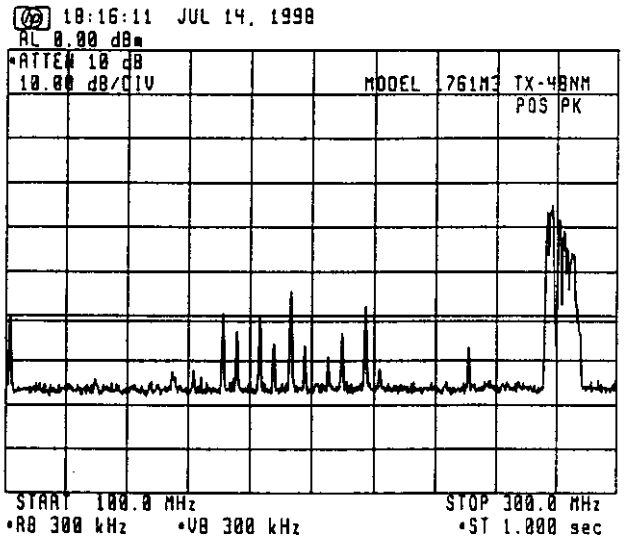
-71dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

Band: 100MHz ~ 300MHz (Limit at 2meter = -61dBm)



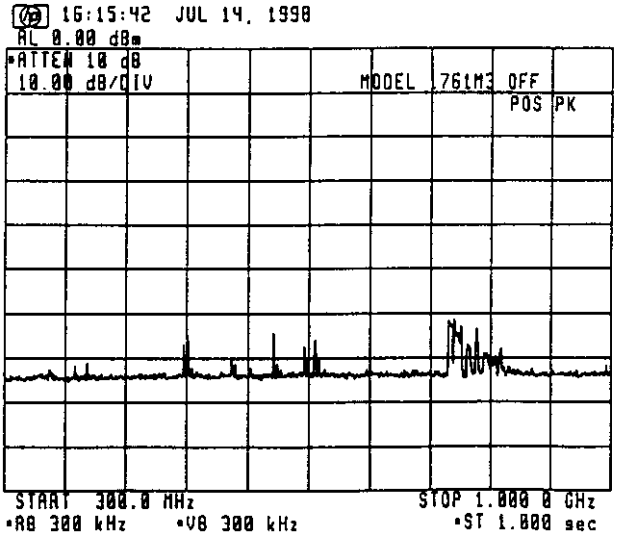


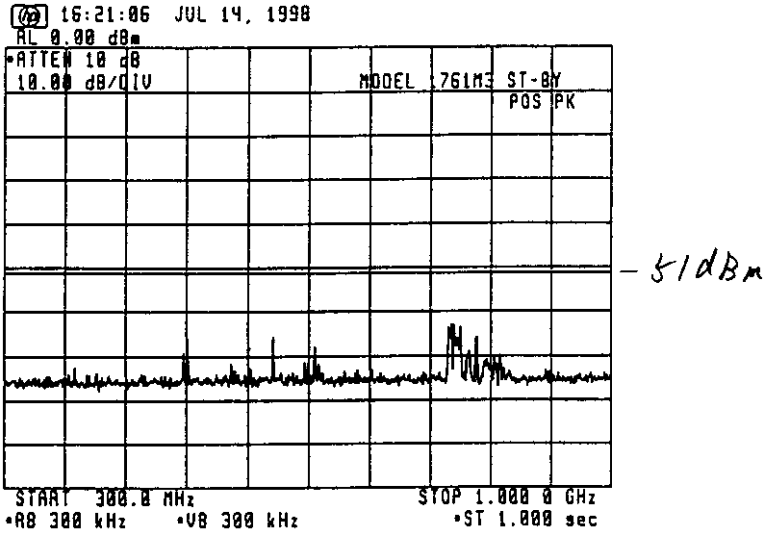
-61dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

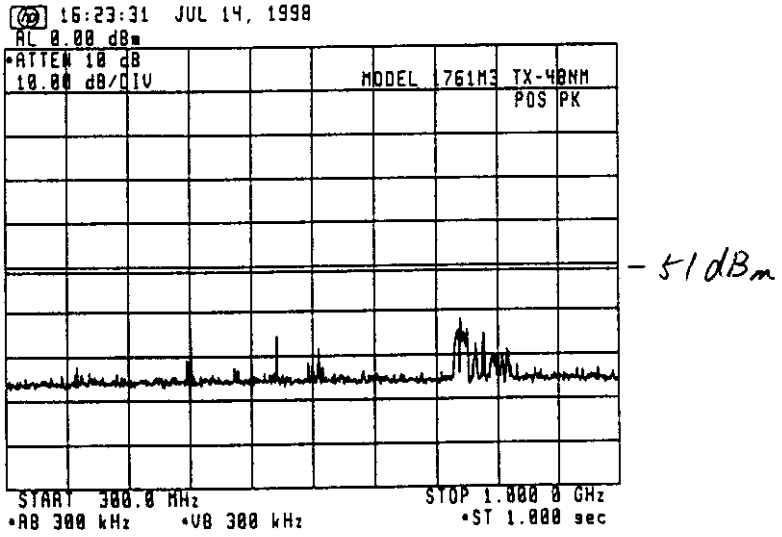


-61dBm
ALL COMPONENTS ABOVE THE LIMIT ARE FROM EXTERNAL NOISE OR SIGNALS, NOT FROM RADAR.

Band: 300MHz ~ 1GHz (Limit at 3 meter = -51dBm)







Pub. No. : TI-1698
Date : July, 1998

ATTACHMENT 4 [List of Test/Measuring Equipment]

3. RF Power Output

Model	Type	Serial no.	Mfr.
Spectrum Analyzer	71210C	2927A02847	HP
Oscilloscope	TDS680B	B030202	Tektronix
Directional Coupler	----	R94471	Shimada
Directional Coupler	5D364S	R05762	Shimada
Voltage Divider	P6015	----	Tektronix
Current Transformer	2100	----	Pearson Electronics
Power Meter	436A	2410A19137	HP
Power Sensor	9481A	2349A39603	HP
Frequency Counter	TR5824A	41940036	Advantest
Frequency Meter	X532B	1441A00523	HP
Crystal Detector	423B	03696	HP
Step Attenuator	8494B	1510A07310	HP
Step Attenuator	8495B	1350A04754	HP
Dummy Load	----	8411057	Shimada

4. Modulation Characteristics

Model	Type	Serial no.	Mfr.
Oscilloscope	TDS680B	B030202	Tektronix
Step Attenuator	8494B	1510A07310	HP
Step Attenuator	8495B	1350A04754	HP
Crystal Detector	423B	1822A24214	HP
Directional Coupler	5D364S	R9425	Shimada
Dummy Load	-----	8411057	Shimada
Voltage Divider	P6015	----	Tektronix
Spectrum Analyzer	71210C	2927A02847	HP
External Mixer:	11970K	----	HP
External Mixer:	11970A	----	HP
Directional Coupler	5D364S	R9425	Shimada

6. Spurious Emissions at Antenna Terminal

Model	Type	Serial no.	Mfr.
Spectrum Analyzer	71210C	2927A0847	HP
Attenuator (11dB/1dB)	8494B	1510A07310	HP
External Mixer:	11970K	----	HP
External Mixer:	11970A	----	HP
Directional Coupler	5D364S	R0576	Shimada
Dummy Load	-----	8411057	Shimada
Notch Filter	MA8L32#8	----	Microwave
High Pass Filter	MAS15905004	R9904	Shimada

7. Field Strength of Spurious Radiation

Model	Type	Serial no.	Mfr.
Broadband Rod Antenna	M 95010-1	0496	Advanced Electronics
Biconical Antenna	BIA-25	2650	Electro Metrics
Conical Log-Spiral Antenna	LCA-25	2886	Electro Metrics
Double Ridged Guide Horn Antenna:	RGA-180	----	EMD
Horn Antenna:	----	----	Toshiba
Spectrum Analyzer:	71210C	2927A0287	HP
External Mixer:	11970K	----	HP
External Mixer:	11970A	----	HP

8. Frequency Stability

Model	Type	Serial no.	Mfr.
Power Meter:	436A	2410A19137	HP
Power Sensor:	8481A	2349A39603	HP
Frequency Meter:	X532B	1441A00523	HP
Directional Coupler:	5D364S	R9425	Shimada
Dummy Load:	----	8411057	Shimada
Environmental Chamber:	PL-4E	1632712	Tabai Espec

9. Suppression of Interference Aboard Ships

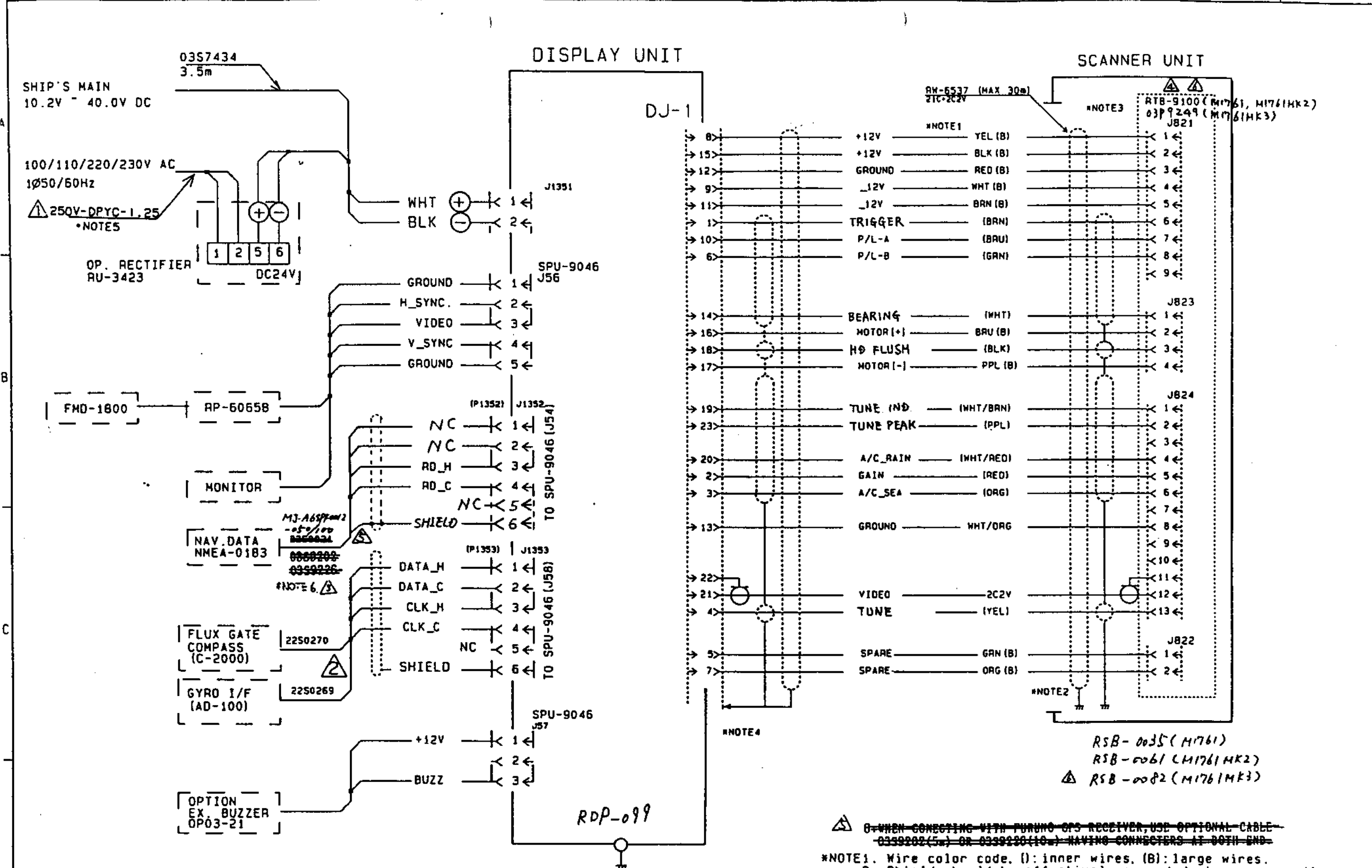
Model	Type	Serial no.	Mfr.
Spectrum Analyzer:	71210C	2927A02847	HP
6 m Whip Antenna	14 k - 10 MHz	----	Furuno
4 m Whip Antenna	10 - 30 MHz	----	Furuno
VHF Whip Antenna	30 - 300 MHz	150M-W2UM	Anten
UHF Whip Antenna	300 - 1000 MHz	----	Anten
RF Vector Impedance Meter:	4815A	2048A03354	HP
Spectrum Analyzer	TR4172	30690116	Advantest
Spectrum Analyzer	8566B	2637A03642	HP

Pub. No. : TI-1698

Date : July, 1998

CIRCUIT DIAGRAMS

	Name	Title	Drawing No.	Total pages
1.	Interconnection Diagram	---	03-112-6004	1
2.	Display Unit Block Diagram (RDP-099)	---	03-112-6007	1
2.1	SPU Board	SPU-9046	03-112-6014	3
2.2	PANEL/VOL/TB Board	PNL-9043 VOL-9044 TB-9045	03-112-6010	1
2.3	PTU/FIL Board	PTU-9048 FIL-9049	03-112-6012	1
2.5	CRT Display Monitor	A1QA9DSP45	----	1
3.	Scanner Unit Block Diagram	---	03-142-6009	1
3.1	MD Board	03P9235	03-142-6012	1
3.2	IF Board	IF-9215	03-136-6013	1
3.3	TB & Motor Soft Starter Board	03P9249	03-142-6013	1



~~6. WHEN CONECTING WITH FURUNO GPS RECEIVER, USE OPTIONAL CABLE 0359202(5m) OR 0359220(10m) HAVING CONNECTERS AT BOTH END.~~

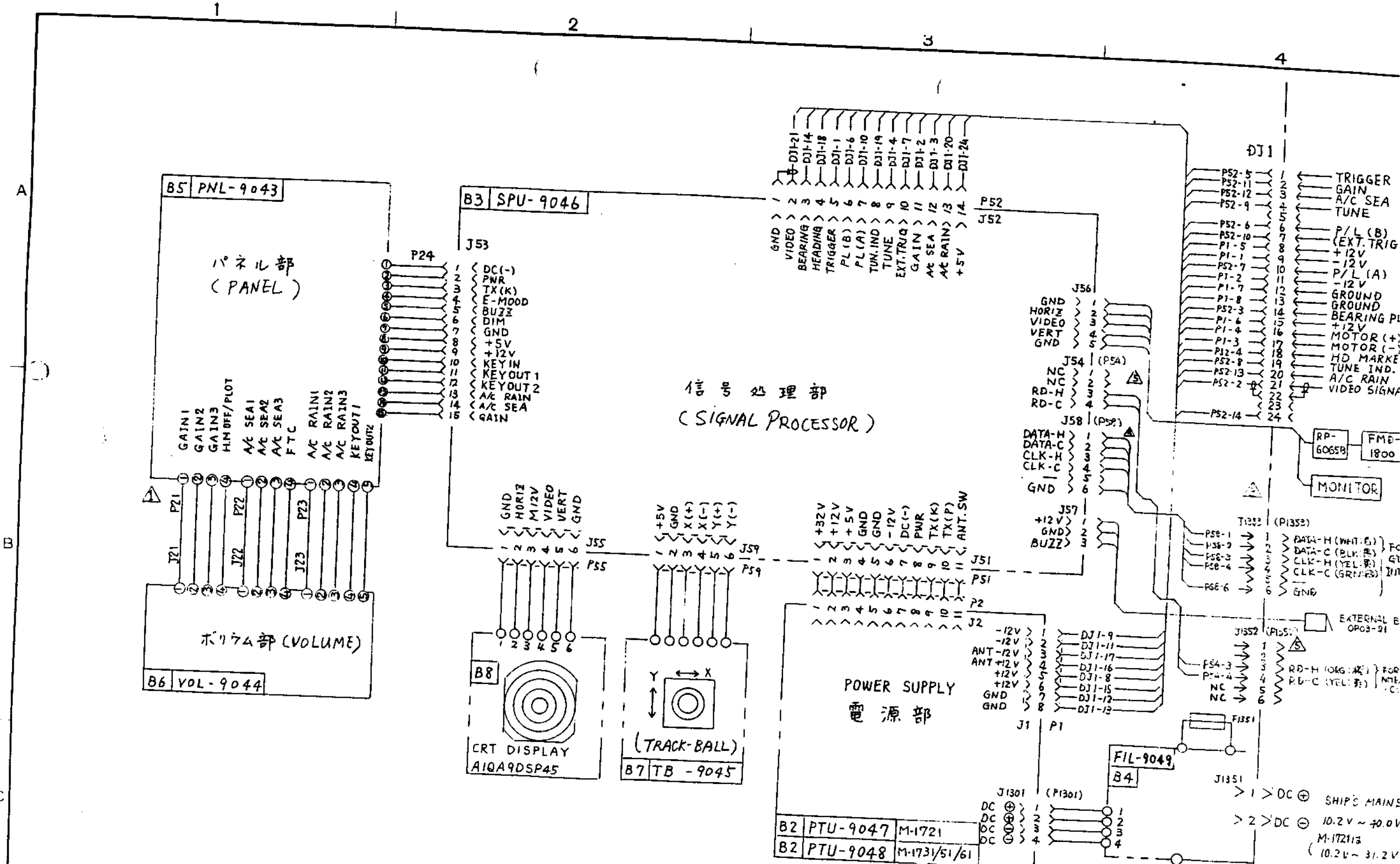
*NOTE1. Wire color code. (): inner wires. (B): large wires.
2. Shield should be effectively grounded at scanner unit.
3. Connector plug factory-wired.
4. Shield grounded thru connector case.
5. Shipsyard supply

MODEL 1761 MARK-3
MODEL 1761 MARK-2

REV No.	MARK	DATE	REMARKS	RV-BY
03E2-4507	5	'95.11.17	艤装コネクタ4pin→6pin	有留
03E2-4257	4	'94 5.12	RTB製品追加 部品削除	田中
03E2-9129	3	'93 7.5	オプションケーブル追加	北野
03E2-3930	2	'92.6.24	オプションケーブル変更	有留
	1	'91.11.11	ケーブル 変更	有留
	6	98.2.18	MARK-3追加	70申

M-1761	CODE No. / ITEM No.		SHEET No.	1/1
APPRV	CHCKD	DSGND	DRAWN '91.11.11 有留	TITLE: INTERCONNECTION DIAGRAM
			DWG. No.	03-112-6004-6

FURUNO ELECTRIC CO., LTD.

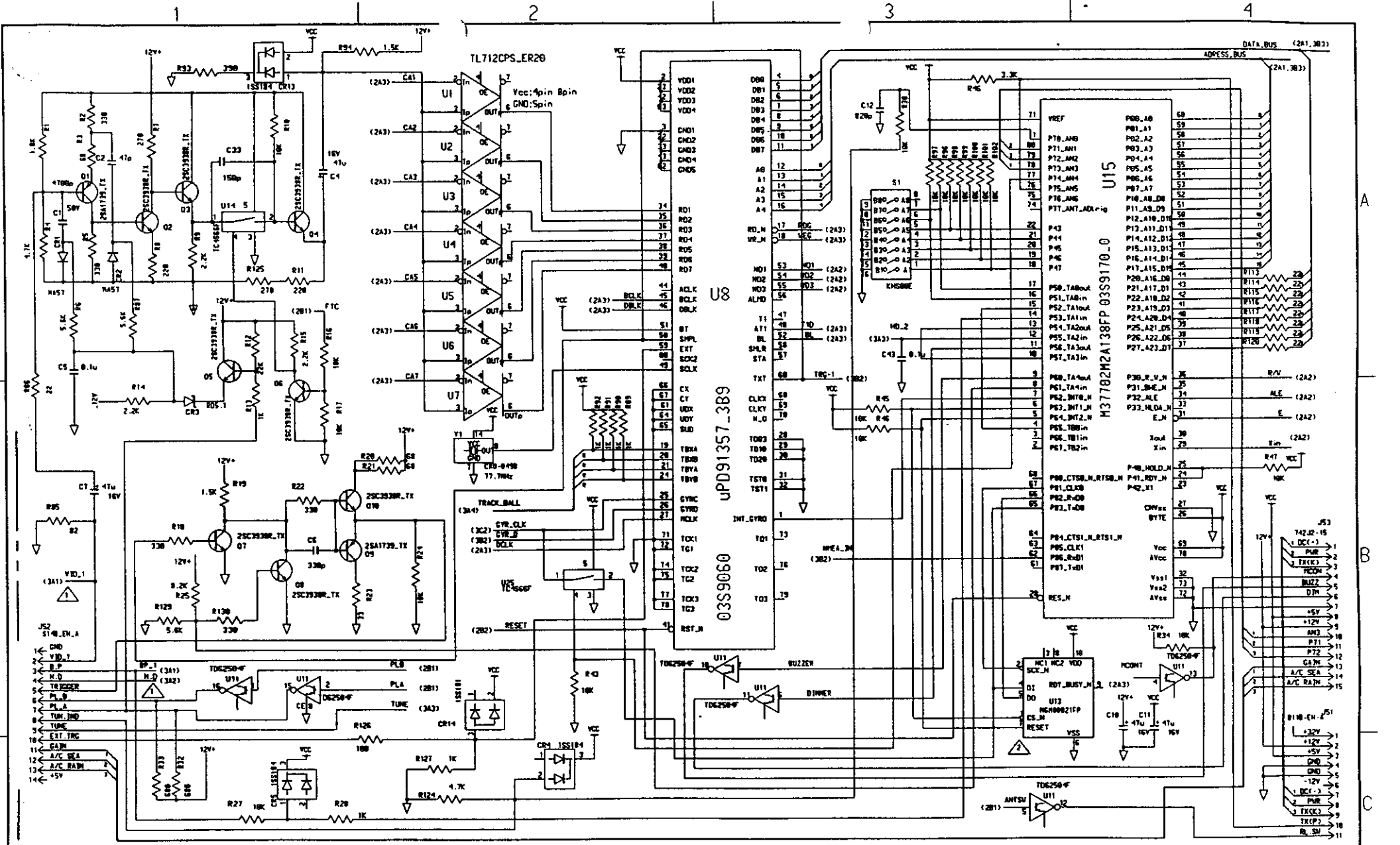


変更通知書番号	符号	訂正年月日	訂正記事	担当
03E2-4507	5	'95. 11. 17	航法指標コネクタ 4→6pin	有留
03E2-4145	4	'93. 8. 5	M-1831シリーズと兼線共通の為	有留
03E2-2982	3	92. 6. 19		片山
03E2-3890	2	'92. 3. 11	PNL-9043 ソケット削除, ドーターケーブル直付けに変更	
03E2-3819	1	'91. 11. 27	PNL-9043 P21, P22, P23 ソケット削除	鶴本

フューズ F1351は 入力 12v の時 10A を使用) M-1731/1751/1761
〃 24/32 v 〃 5A) ただしM-1721は5Aのみ

M-1731HK3
M-1761HK3
M-1731 / 1751 / 1761, M-1721MK2/1731MK2/1751MK2/1761M

主機種	MODEL	コード		SHEET NO.	1
	1721/1731/1751/1761	型名			
課長	検図	設計	製図	分類	名称
'91. 8. 1		91.7.31	91.7.31		DISPLAY UNIT BLOCK DIAGRAM 指示器ブロック図

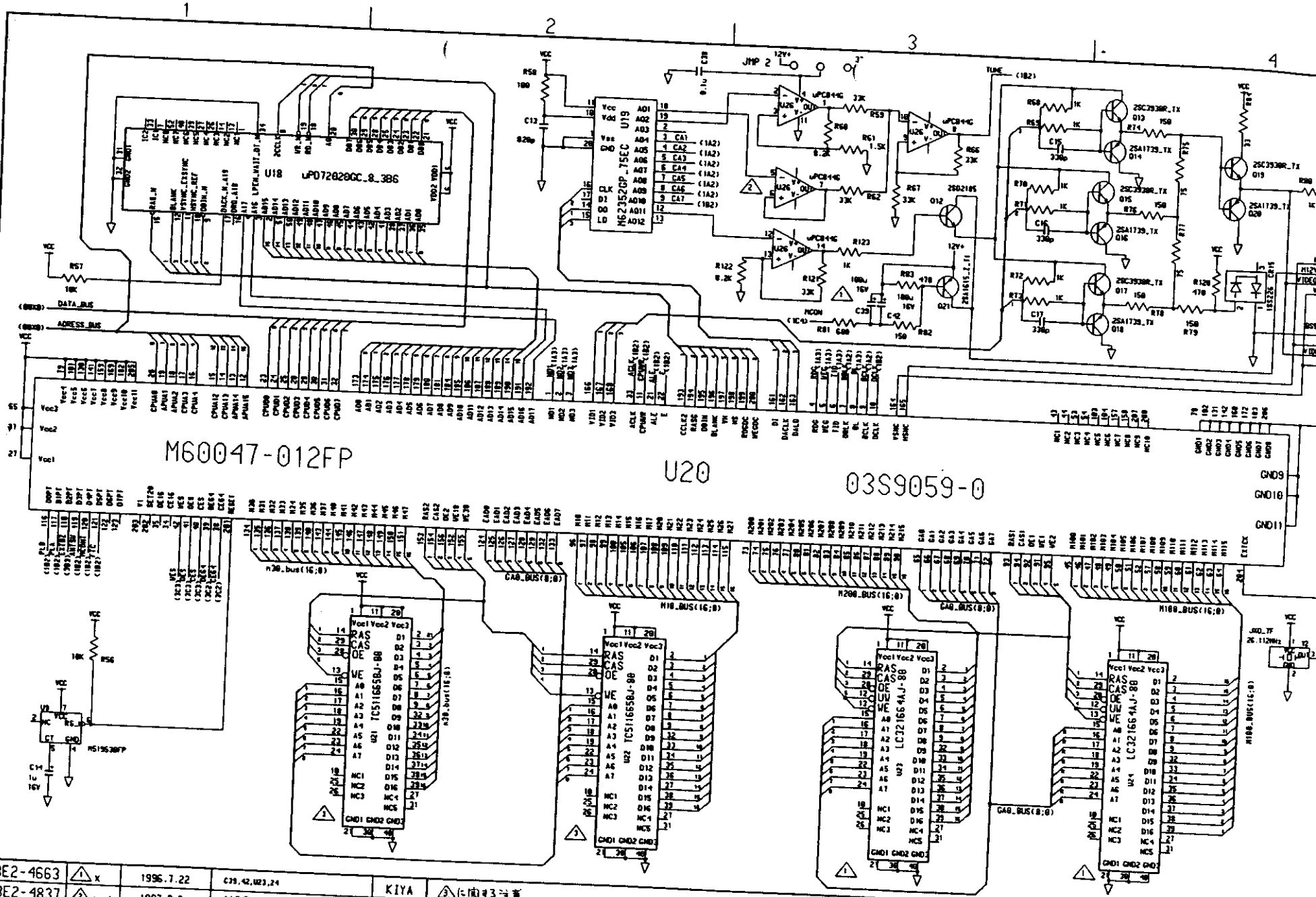


REV No.	MARK	DATE	REMARKS	REV-BY
03E2-4663	1 x	1996.7.22	vid_1,H.D.	KIYA
03E2-4684	2 x 1	1996.9.12	U13 M6M80021	KIYA
	x			
	x			
	x			

MDL	M-1721/M2 / 1761M3	CODE No.		SHEET No.	1/3
		ITEM No.			

APPRV	CHCKD	DSIGND	DRAWN	TIT-LE	SPU-9046 (SPU BOARD)
		96.7.22 KIYA	96.7.22 KIYA	DWG No.	03-112-6014-3

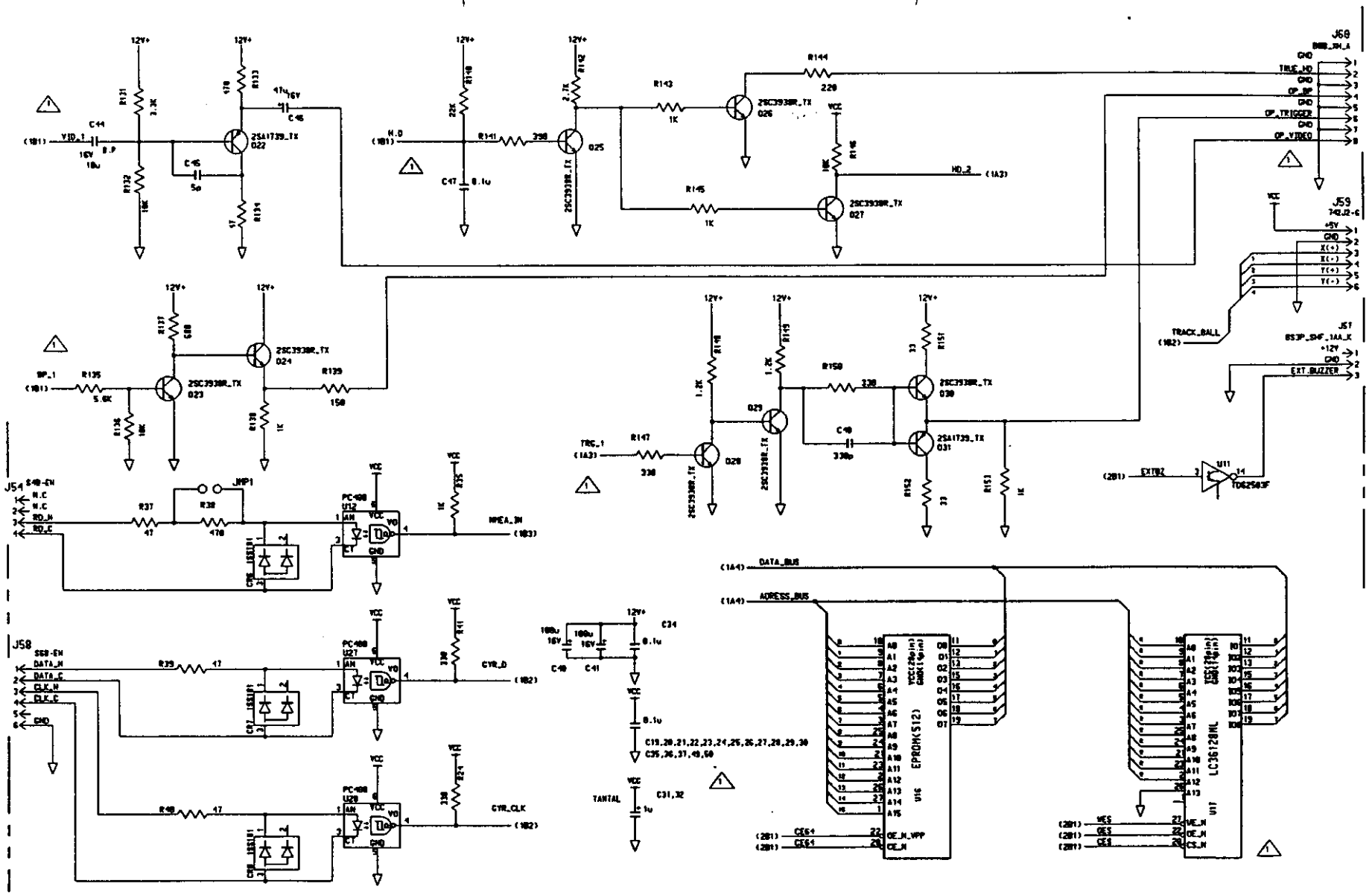
FURUNO ELECTRIC CO.,LTD.



REV No.	MARK	DATE	REMARKS	REV-BY
03E2-4663	1 x	1996.7.22	C39,42,U23,24	KIYA
03E2-4837	2 x 1	1997.9.3	U26	ARIDOME
03E2-4864	3 x 2	1998.1.20	U21, U22	KIYA
	x			
	x			

③に関する注意.
※1 OKI製 MSM51V1665A-70JSに変更し、部品消化後、上記部品に変更します。

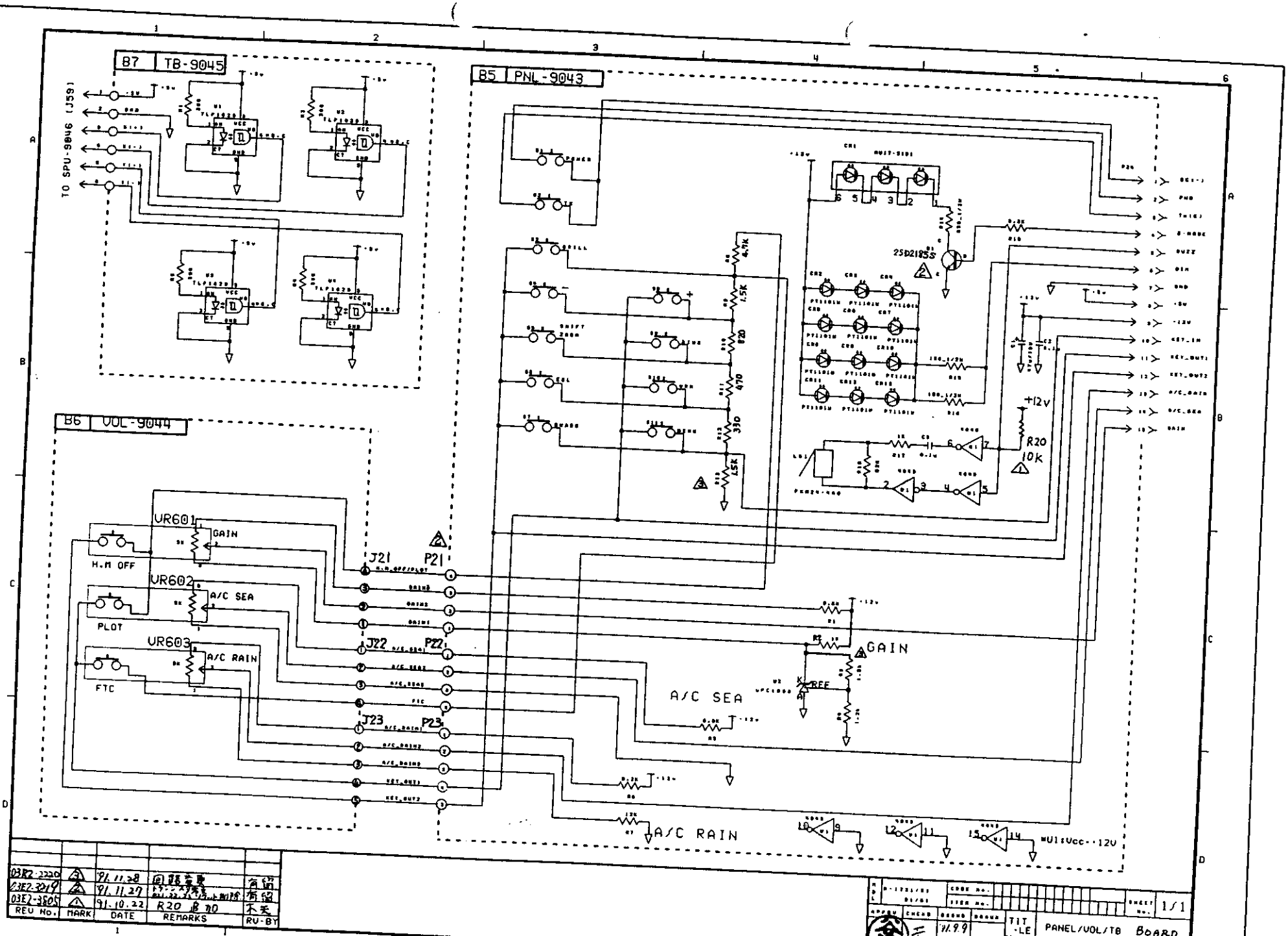
MDL	M-1721/M2 1761 M3	CODE No.			SHEET No. 2
		ITEM No.			
APPRV	CHCKD	DSIGND	DRAWN	TIT-LE	SPU-9046
		96.7.22	96.7.22		
		KIYA	KIYA	DWG	

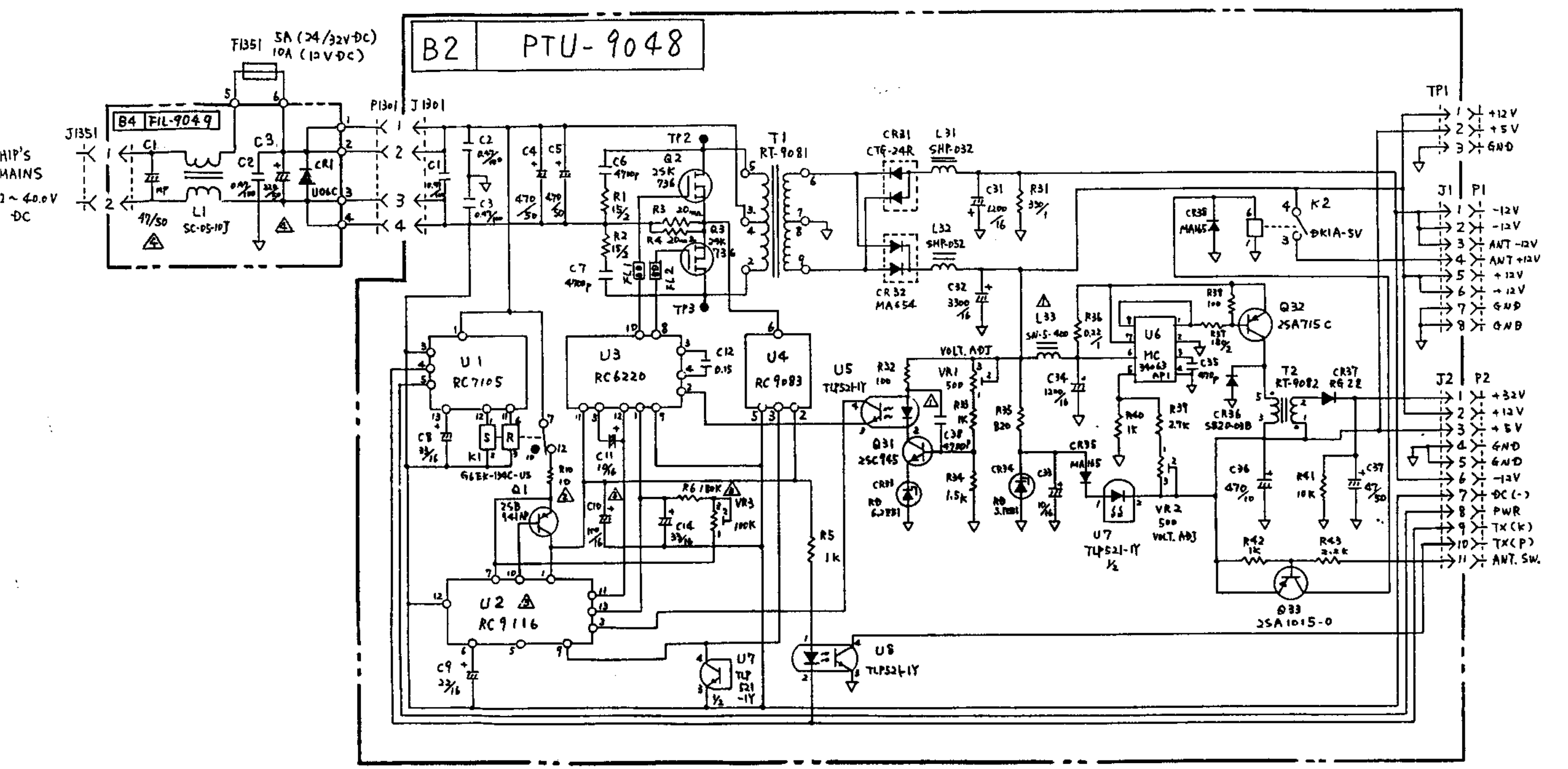


03E2-4663	1 x	1996.7.22	R131-153,C44-48,U17 C35,49,50,J58	KIYA
	2 x			
	3 x			
	4 x			
	5 x			
REV No.	MARK	DATE	REMARKS	REV-BY

MDL	M-1721/M2 1761M3	CODE No.			SHEET No.	3/3
		ITEM No.				
APPRV	CHCKD	DSIGND	DRAWN	TIT-LE	SPU-9046	
		96.5.10 鶴本	96.7.22 KIYA	DWG No.	03-112-6014-3	

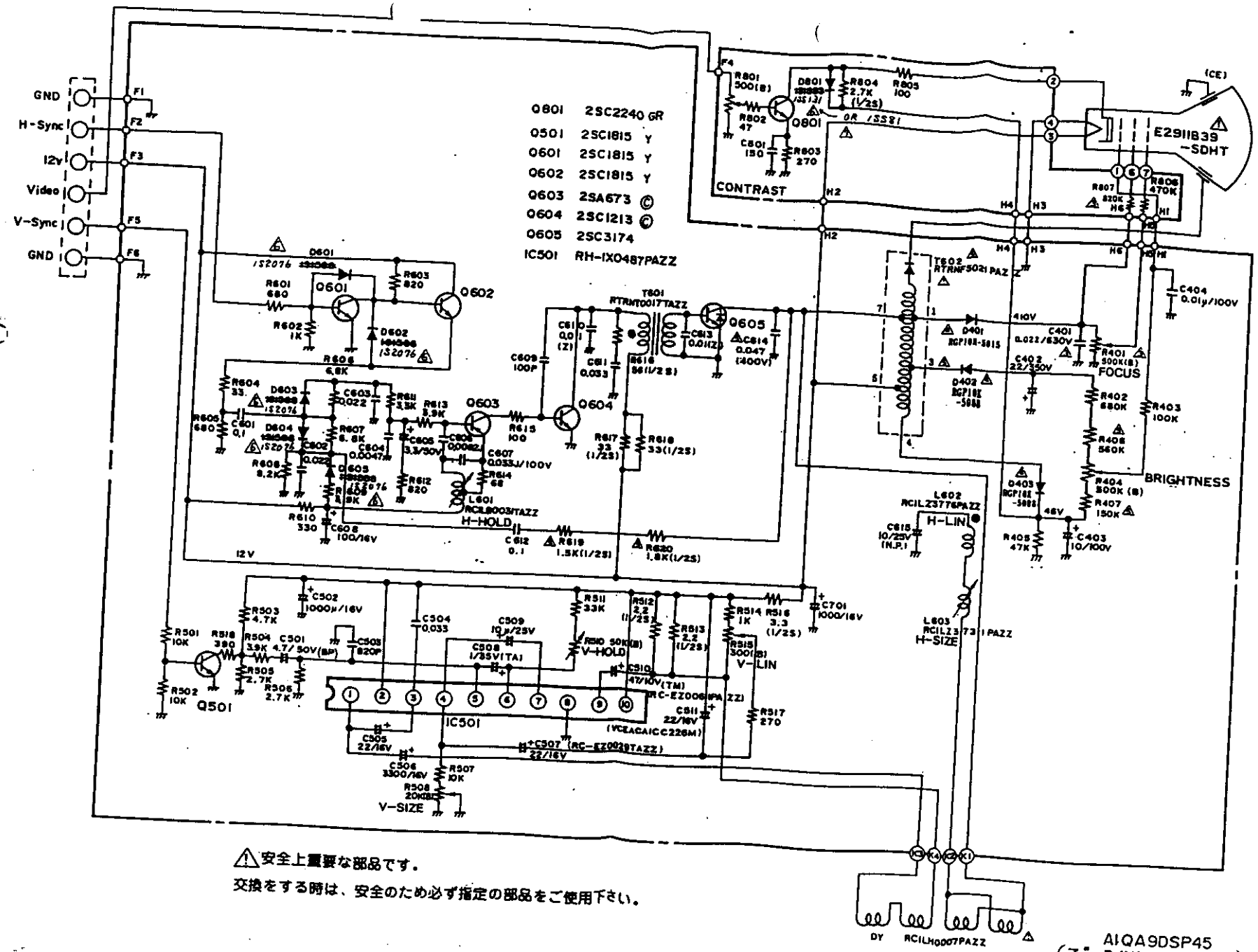
FURUNO ELECTRIC CO.,LTD.


B7 TB-9045
B5 PNL-9043
B6 VOL-9044
TO SPU-9846 (J59)
UR601
GAIN
H.M OFF
UR602
A/C SEA
PLOT
UR603
A/C RAIN
FTC
J21
P21
J22
P22
J23
P23
R20
10k
+12v
A/C SEA
A/C RAIN
GAIN
REF
03R2-2220
03E2-3019
03E2-3505
91.11.28
91.11.29
91.10.22
R20 JB 10
REMARKS
MARK
DATE
REV No.
RV-BY
PANEL/VOL/TB BOARD
1/1



	△	. .		
2-3928	4	H4. 6. 15	FILプリント C1変更 C4削除	山田
E2-3960	3	H4. 9. 29	C10, C14, R6, VR3, U2 変更 Q4, R7, R8, R9, CR1 削除	田中
E2-3820	2	H3. 11. 25	R10 追加 R6 変更	田中
E2-3797	1	H3. 10. 9	C10, C14, L33 変更 C13 削除 C38, Q4, R7, R8, R9, CR1 追加	田中
通知書番号	符号	訂正年月日	訂正記事	担当

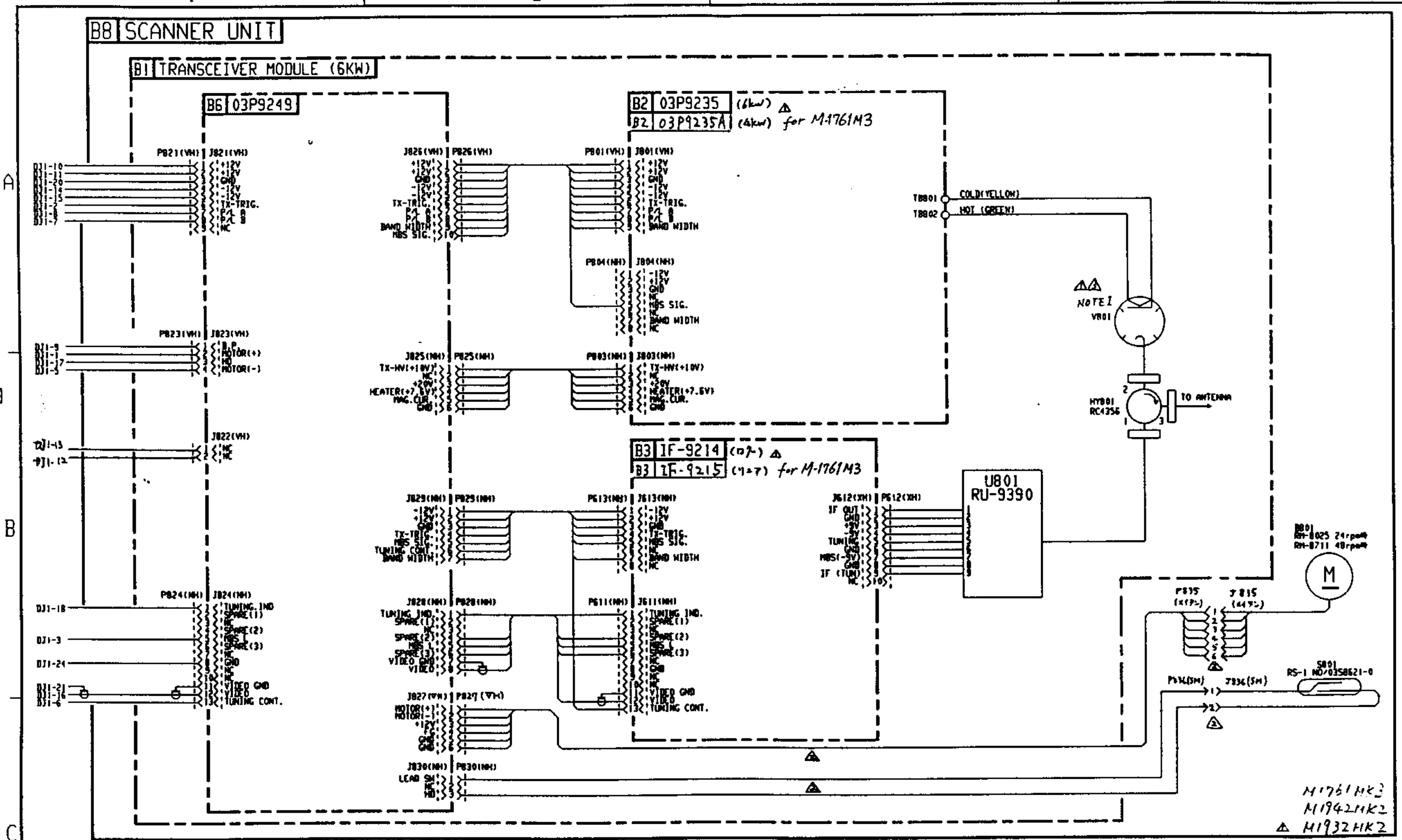
主機種	M1731 M1751 M1761		コード		SHEET NO.	1/1
			型名			
課長	検図	設計	製図	分類	名称	電源部 回路図 PTU/FIL BOARD
3.9.2	3.9.2	3.7.2	3.7.2			
谷垣	三沐	田中	田中		図番	03-112-6012-1



⚠安全上重要な部品です。

交換をする時は、安全のため必ず指定の部品をご使用下さい。

AIQA9DSP45
(7" B/W DISPLAY)

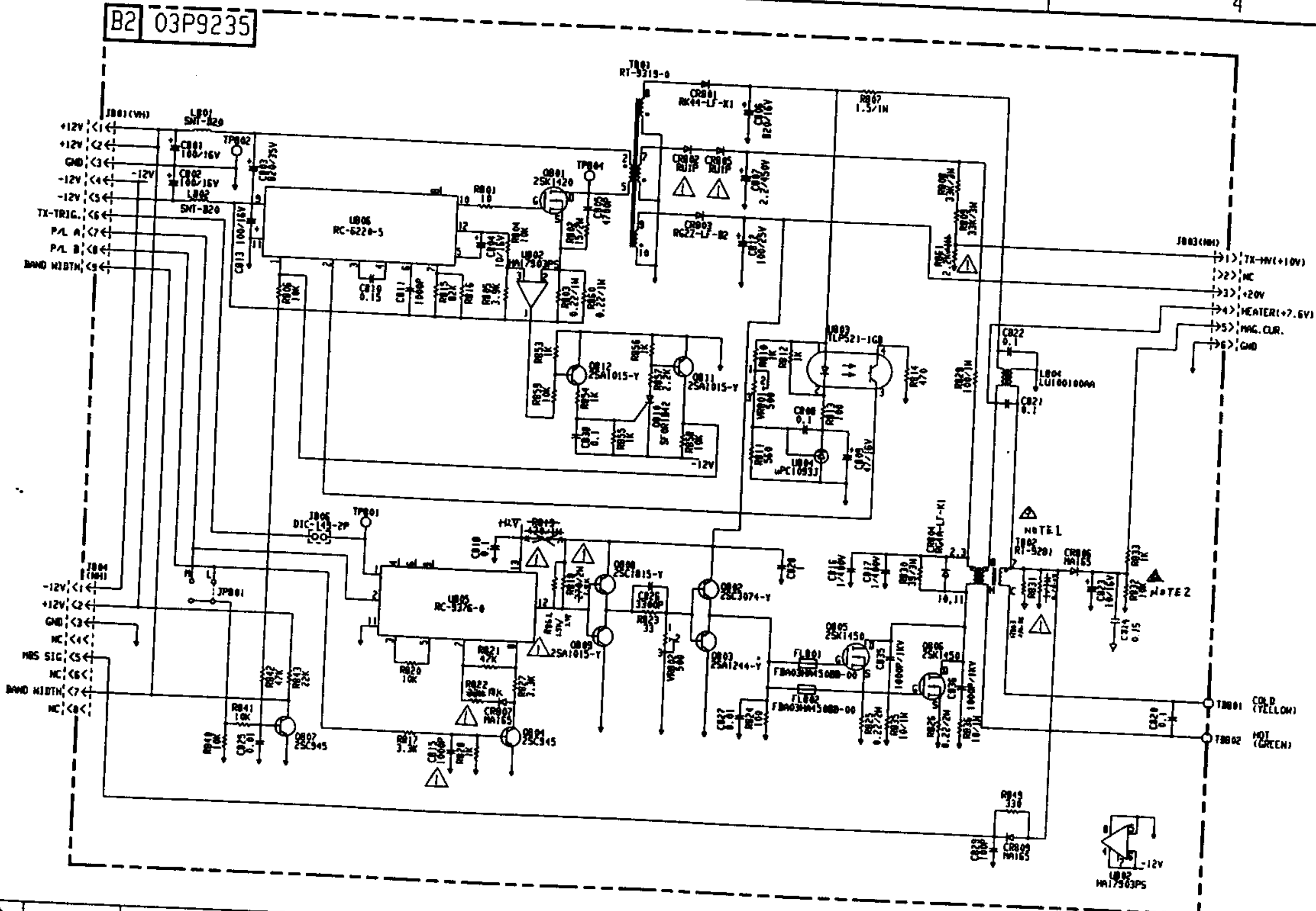


NOTE 1. HG5389 for RTR-059 (FR7062, M1942M2)
E3571 for RTR-064 (M1932M2)
HG5248 for RTR-065 (M1761M3)

変更通知書番号	符号	訂正年月日	訂正記事	担当
		. .		
		. .		
03E2-4925	3	98. 5. 12	RTR-065 ち HG5248	
03ES-0343	2	1998. 2. 25	製造設計課の依頼	井上
	1	98. 2. 19		

主機種	FR-7062 / M-1932/1942/1761
コード	
型名	
課長 / 検図 / 設計 / 製図	1997.10.17 井上 / 1997.10.17 井上
名称	SCANNER UNIT BLOCK DIAGRAM
図番	03-142-6009-3
SHEET NO.	1/1

古野電気株式会社



03E2-4925	4	98. 5. 12	NOTE2追加	
	3	98. 2. 19	NOTE1追加	
03E2-4872	2	1998. 2. 16	ｱｸﾃｨﾌﾞ電流検出回路の改善	井上
03E2-4856	1	1997. 12. 15	ｵﾌ管ｸﾞｩｯﾄｽﾞの性能向上	井上
変更通知書番号	符号	訂正年月日	訂正記事	担当

NOTE1: T802 RT-9281 for 03P9235 (6kW)
T802 RT-9926-0 for 03P9235A (4kW) (M-1761M3)

NOTE2: R832 10kΩ for 03P9235 (6kW)
R832 15kΩ for 03P9235A (4kW) (M-1761M3)

主機種: FR-7062 / M-1761M3

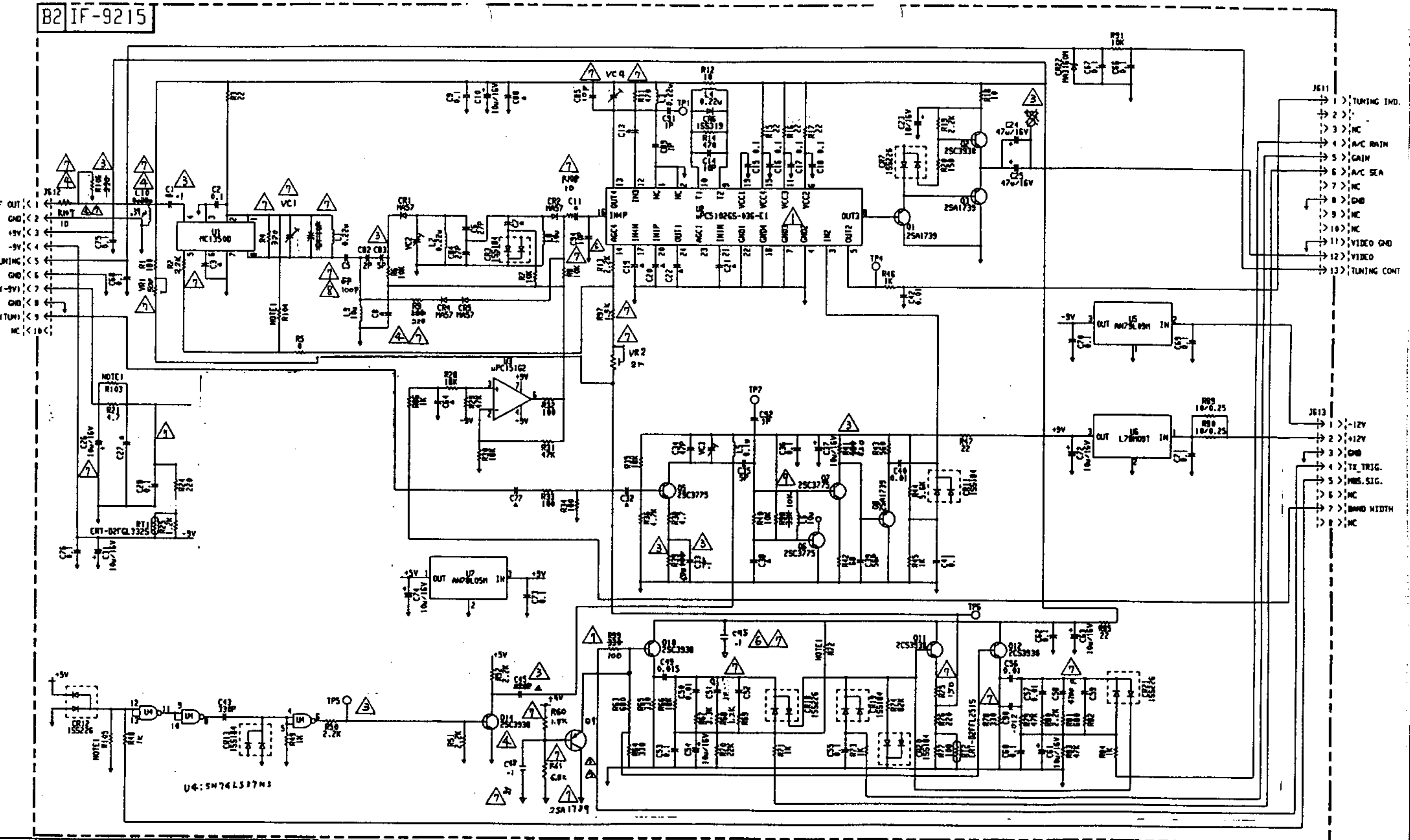
コード / 型名

課長 | 検図 | 設計 1997.10.17 井上 | 製図 1997.10.17 井上

名称: MD BOARD 03P9235

SHEET NO. 1/1

図番: 03-142-6012-4



-4794	7	1997. 4. 16	P板 バージョンアップ (9版)	小林
-4775	6	1997. 2. 26	STC 調整 対策 (1)	小林
2-4762	5	1997. 2. 10	中心部のエコー 取り (エクサー 調整) (2)	小林
2-4754	4	1997. 1. 28	メインバンク直後のエコー漏れ改善 (2)	小林
2-4746	3	1997. 1. 16	チューニングレベル・メインバンク直後のエコー	小林
2-4741	2	1997. 1. 7	性能を出す、変更部数 (41)	小林
2-4730	1	1996. 12. 12	未登録部品の追加	井上
通知書番号	符号	訂正年月日	訂正記事	担当

△:1800p
NOTE 1. 部品未登載

1997. 1. 9 回路図書き換え

03E2-4936	9	1998. 6. 2	チューニングレベル不足.	小林
03E2-4807	8	1997. 5. 19	ゲインアップ	小林

1 2 3

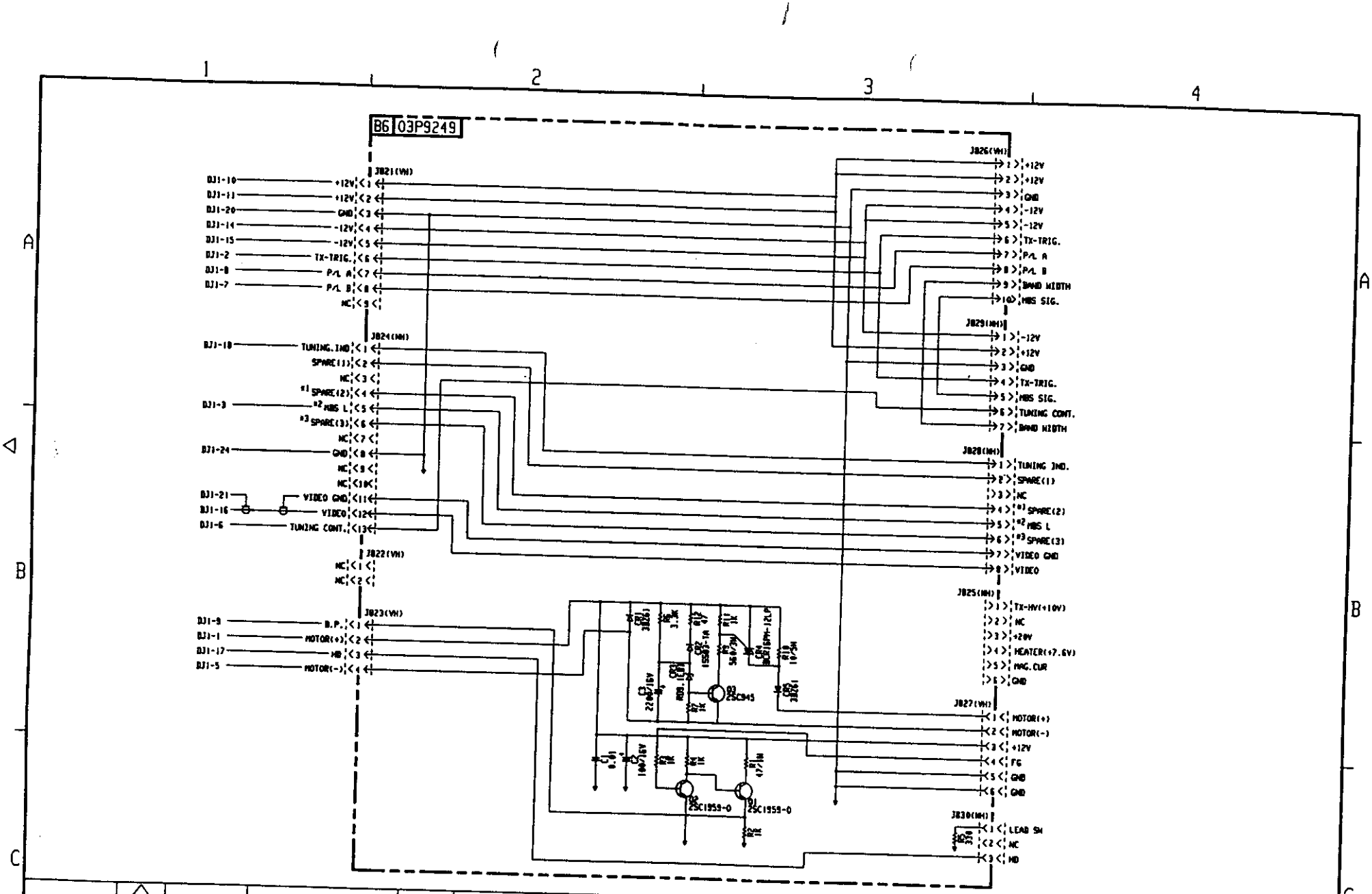
主機種	MODEL 1731/1761 MARK-3; MODEL 841 MARK-2	コード	
		型名	
課長	検図	設計	製図
			1997.1.K 井上

SHEET NO. 1/1

分類 名称: 03P9215 IF BOARD

図番: 03-136-6013-9

吉野電気株式会社



*1: サブアンプ用AA/C MAIN
*2: サブアンプ用AGAIN
*3: サブアンプ用AA/C SEA

変更通知書番号	符号	訂正年月日	訂正記事	担当
	△	. .		
	△	. .		
	△	. .		
	△	. .		
	△	. .		

主機種	FR-7062 M-1761 M3	コード	図名	SHEET NO. 1/1
課長	検図	設計	製図	分類 / 名称: TB and MOTOR SOFT STARTER BOARD
		1997.10.17 井上	1997.10.17 井上	図番: 03P9249 / 03142-6013-0

8.4 Frequency Tolerance Limits:

"The frequency at which maximum emission occurs must be within the authorized bandwidth and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized band width, where "T" is the pulse duration in microseconds. " (FCC Rule § 80.209)

1) Center frequency (f_0): 9410 MHz
2) Authorized bandwidth (f(AUBW)): 100 MHz

"Upper limit frequency of the authorized band", f(UAUBW) = f_0 + f(AUBW)/2 = 9460 Mhz
"Lower limit frequency of the authorized band", f(LAUBW) = f_0 - f(AUBW)/2 = 9360 Mhz

3) Assignanble frequency bandwidth : 200 MHz (between 9300 MHz and 9500 MHz)
(FCC Rule § 80.375 (d)-(1))

"Upper limit frequency of the assignable band", f(UASB) = 9500 MHz
"Lower limit frequency of the assignable band", f(LASB) = 9300 MHz

4) Guard Band (f(1.5/T)) :

Pulse Type	Short	Middle	Long
Range Scale (nm)	0.25	2	48
Pulselength (μ sec)	0.08	0.30	0.80
Guard Band f(1.5/T) (MHz)	18.75	5.00	1.88

8.5 Test Results:

Shown on Fig. 8.2.

(1) "Upper Tolerance Frequency measured (at - 20 ℃)", f(U) = 9425.5 MHz

(2) "Lower Tolerance Frequency measured (at + 50 ℃)", f(L) = 9402.0 MHz

(3)-(a)

f(U) + max. f(1.5/T) = 9444.25 MHz < f(UAUBW) = 9460 MHz < f(UASB) = 9500 MHz

(b)

f(L) - max. f(1.5/T) = 9383.25 MHz > f(LAUBW) = 9360 MHz > f(LASB) = 9300 MHz

So, both are found within the specified limits.

8 FREQUENCY STABILITY (FCC Rule § 2.995)

8.1 Setup for Measurement

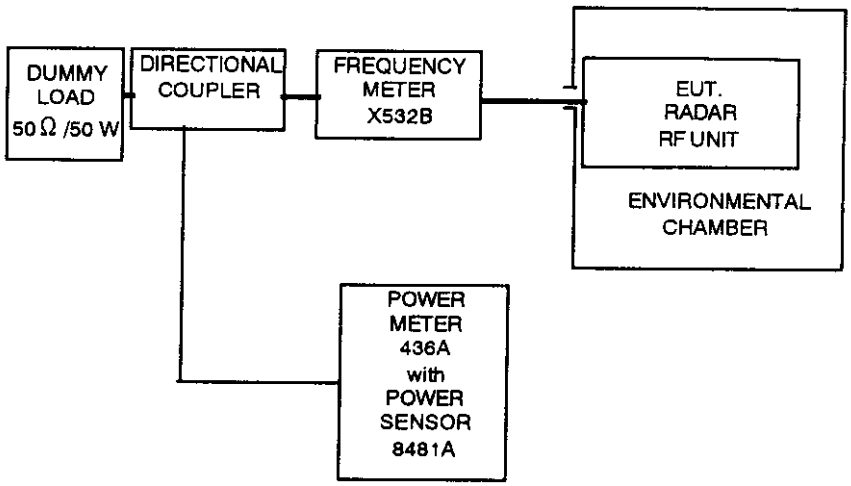


Fig. 8.1

8.2 Test Conditions:

1) Radar Range settings : 0.25 nm (Short)/2 nm (Middle)/48 nm (Long)
2) Ambient Temperature settings: - 20 to + 50 ℃ (10 ℃ step)
3) Power Supply Voltage settings: 85 /115 % of nominal voltage (20.4 to 27.5 VDC)

8.3 Measuring Equipment List:

See ATTACHMENT 4 [LIST OF TEST/MEASURING EQUIPMENT].