



KODEN

KODEN
SERVICE MANUAL

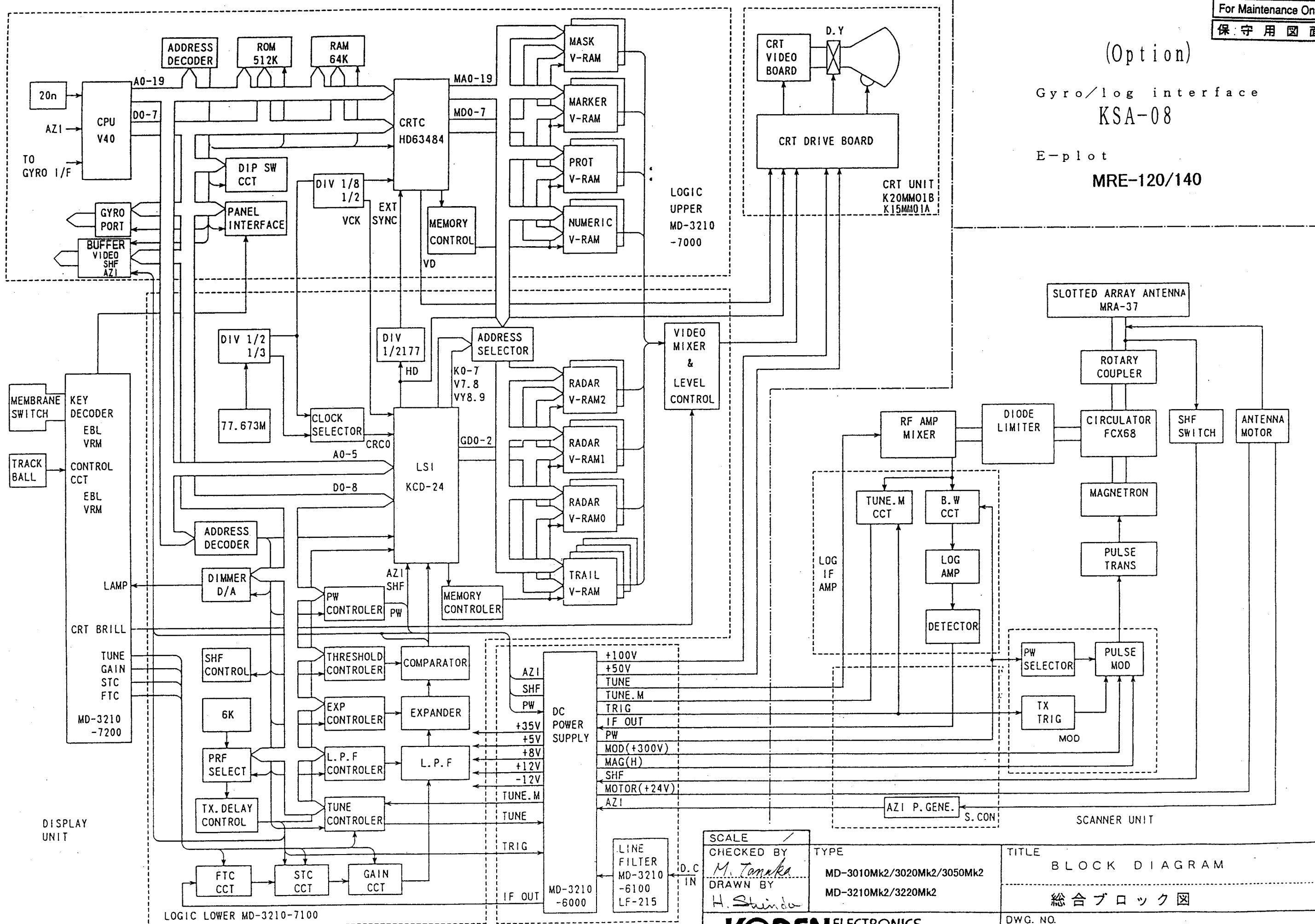
KODEN ELECTRONICS CO.,LTD.
13-24, TAMAGAWA 2-CHOME, OTA-KU
TOKYO 146-0095 JAPAN
TEL: +81 3 3756 6918
FAX: +81 3 3756 6831

<http://www.koden-electronics.co.jp/>

MARINE RADAR

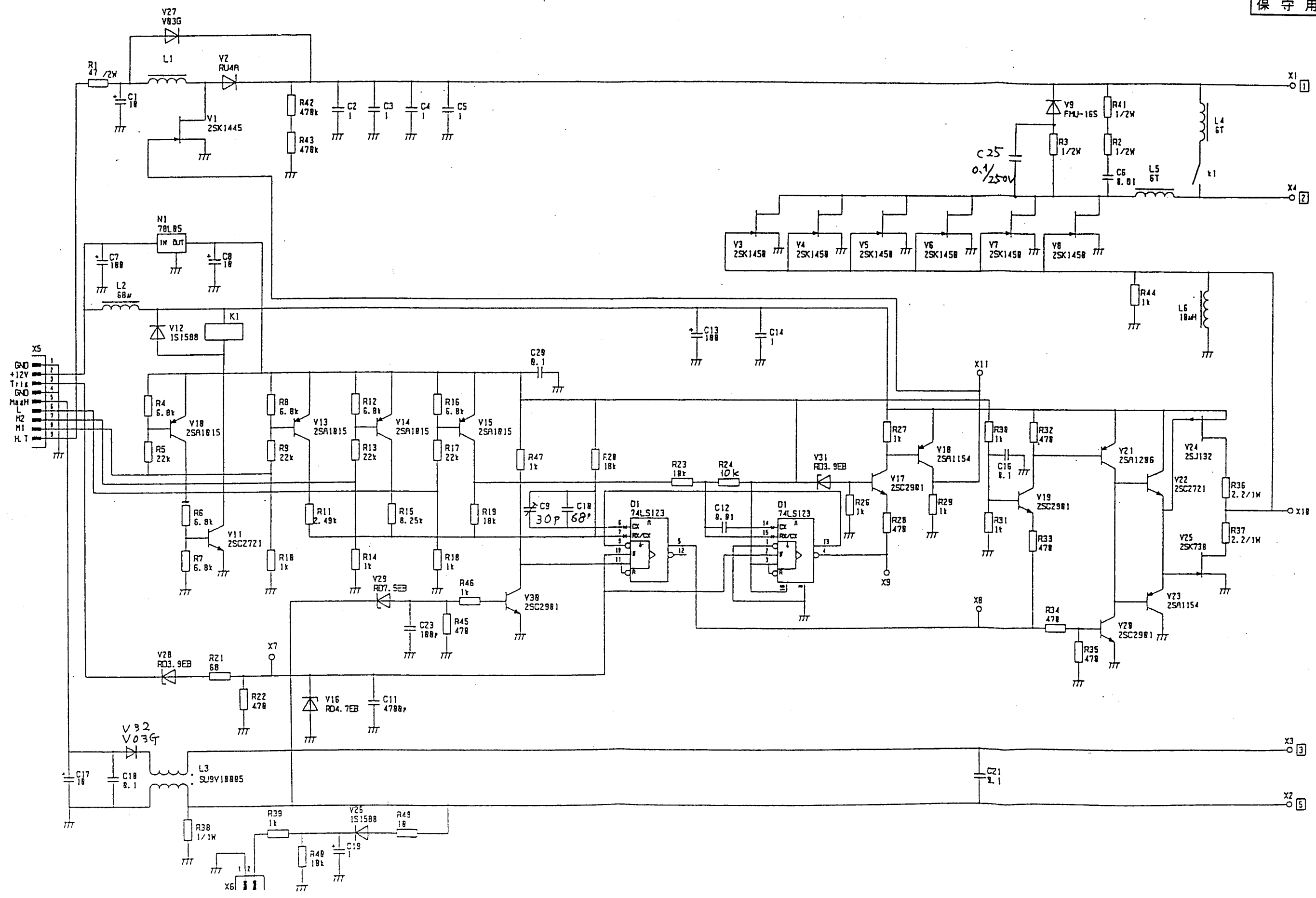
MD-3210/3220
MD-3210Mk2/3220Mk2

(Option)
Gyro/log interface
KSA-08
E-plot
MRE-120/140



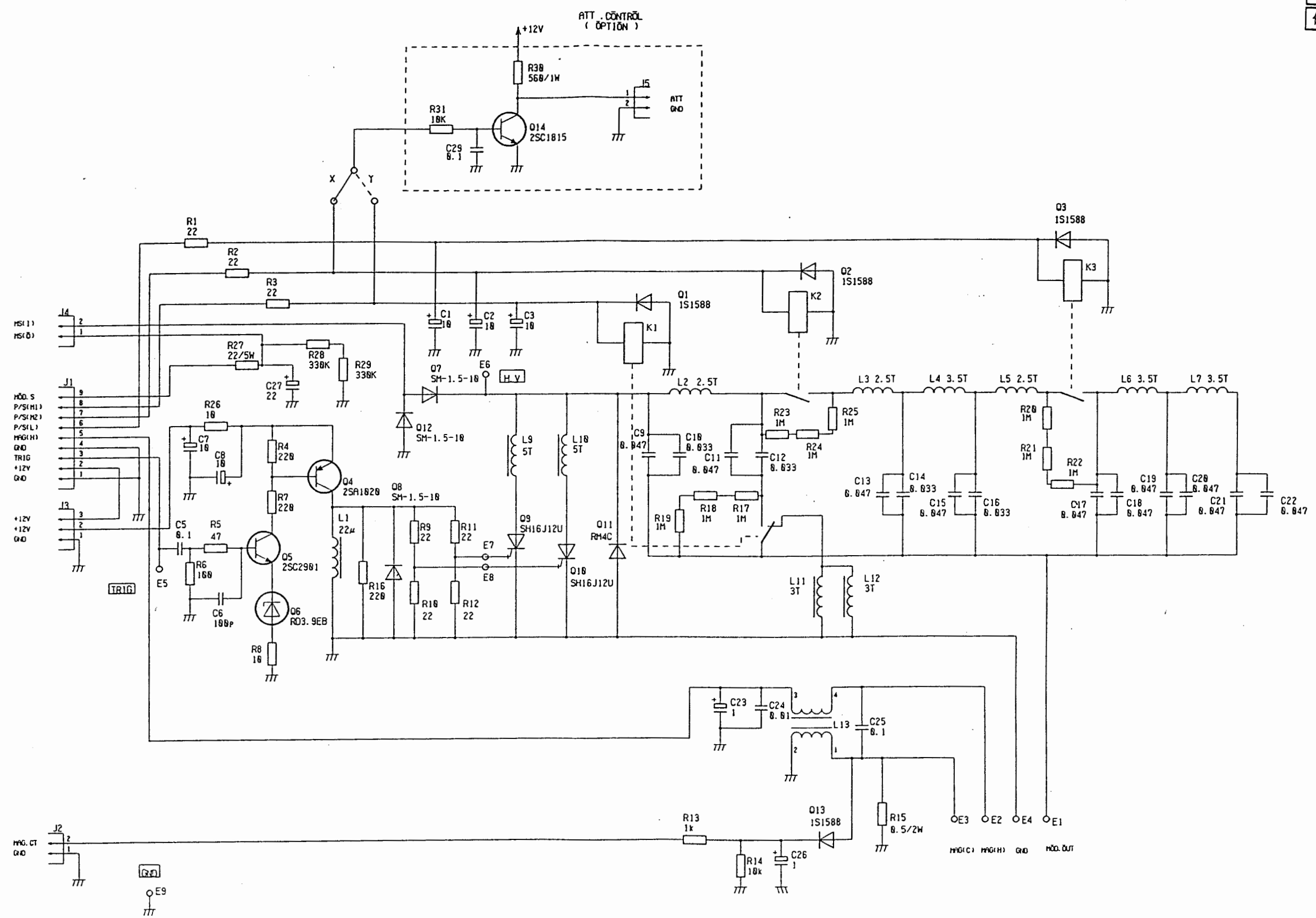
SCALE	CHECKED BY	TYPE	TITLE
	<i>M. Tanaka</i>	MD-3010mk2/3020mk2/3050mk2	BLOCK DIAGRAM
	DRAWN BY	MD-3210mk2/3220mk2	総合ブロック図
	<i>H. Shinoda</i>		DWG. NO. 556-0010M1*
KODEN ELECTRONICS CO., LTD.			

For Maintenance Only
保守用図面



APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE		
<i>M. Tanaka</i>	<i>Y. Umemiya</i>	<i>H. Saino</i>	<i>H. Shiro</i>	MRT-133	10KW MOD		
DATE	REVISD	CHECKED	APPROVED	KODEN KODEN ELECTRONICS CO., LTD.		DWG. NO.	PAGE
'97.2.24	'97.2.24	'77.2.24	'77.2.24			E05CGB1110*	

For Maintenance Only
保守用図面



APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
M. Tanaka	Y. Uemura	H. Sudo	H. Sudo	MRT-134	25 KW MOD
DATE	REVISD	CHECKED	APPROVED	DWG. NO.	PAGE
'97.2.24		'97.2.24	'97.2.24	E05CGB2100*	

S-ARPA CONT. E05-7300

1	A0	2	A1
3	A2	4	A3
5	A4	6	A5
7	A6	8	A7
9	A8	10	A9
11	A10	12	A11
13	N.C.	14	POC
15	R/W	16	CSA
17	D0	18	D1
19	D2	20	D3
21	D4	22	D5
23	D6	24	D7
25	N.C.	26	GND
27	SHFA	28	GND
29	AZIPA	30	GND
31	TRIGA	32	GND
33	VIDEOA	34	GND
35	LOGPULSE	36	GND
37	+5V	38	GND
39	+5V	40	GND

1	N.C.
2	RXD
3	TXD
4	N.C.
5	GND
6	N.C.
7	RTS
8	CTS
9	F.G.

E-SELECT 00500

E-PLOT MRE-140 (Option)

1	A0	2	A1
3	A2	4	A3
5	A4	6	A5
7	A6	8	A7
9	A8	10	A9
11	A10	12	A11
13	N.C.	14	POC
15	R/W	16	CSA
17	D0	18	D1
19	D2	20	D3
21	D4	22	D5
23	D6	24	D7
25	N.C.	26	GND
27	SHFA	28	GND
29	AZIPA	30	GND
31	TRIGA	32	GND
33	VIDEOA	34	GND
35	LOGPULSE	36	GND
37	+5V	38	GND
39	+5V	40	GND

1	AV0	2	AV1
3	AV2	4	AV3
5	AV4	6	AV5
7	AV6	8	AV7
9	AV8	10	AV9
11	A0	12	A1
13	A2	14	A3
15	A4	16	A5
17	A6	18	A7
19	LD0	20	LD1
21	LD2	22	LD3
23	LD4	24	LD5
25	LD6	26	LD7
27	DISP	28	EXSYNC
29	C0	30	SHFA
31	C1	32	TRIGA
33	C2	34	VIDEOA
35	C3	36	LOGPULSE
37	GND	38	VCK
39	GND	40	DCK
41	GND	42	RCK
43	PCK	44	PDT
45	POC	46	H1
47	LCLR	48	LOWER
49	RD	50	WR
51	INT3	52	AZP
53	SIN	54	VSYNC
55	+5V	56	GND
57	+5V	58	GND
59	+5V	60	GND

1	GND
2	+5V
3	INT6
4	D0
5	D1
6	D2
7	D3
8	D4
9	D5
10	D6
11	D7
12	G1
13	G2
14	RD
15	WR

555-3613

1	+5V	2	+5V
3	LOG.P	4	GND
5	S1[0]	6	S2[0]
7	S3[0]	8	REF[0]
9	OFF	10	ON
11	Vx[0]	12	COM
13	Vy[0]	14	Vy[0]
15	G/C	16	GND
17	GND	18	GND
19	+12V	20	+12V

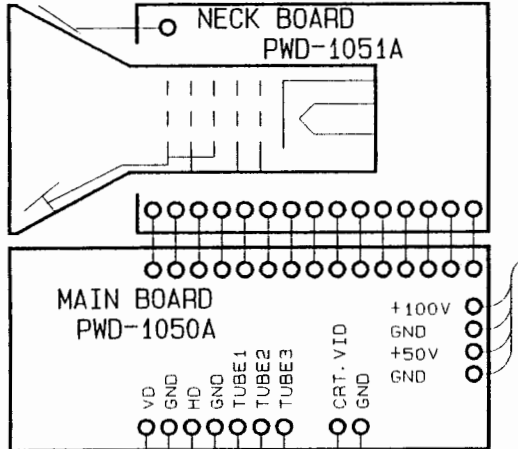
555-3614-1

1	R2[I]	2	R1[I]
3	COM[I]	4	GND
5	S3[I]	6	S2[I]
7	S1[I]	8	S1

1	LOG1	2	LOG2
3	LOG3	4	LOG4
5	VREF[I]	6	VX[I]
7	VY[I]		

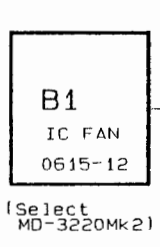
1	S1	2	S2
3	S3	4	R1
5	R2	6	COM
7	GND	8	LOG1
9	LOG2	10	LOG3
11	LOG4		

1	R2[I]	2	R1[I]
3	COM	4	GND
5	S3	6	S2
7	S1		



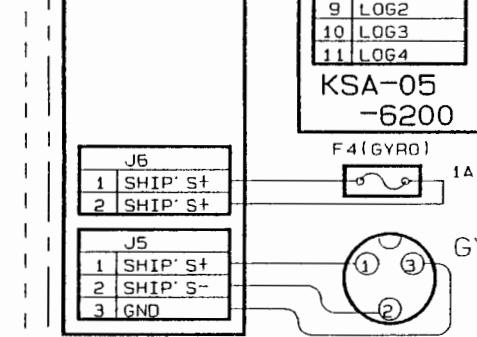
LOGIC UPPER MD-3210-7000

(Option CABLE)



POWER SUPPLY MD-3210/3220-6000

1	AZIP.O	1	VIDEO.G
2	SHF.O	2	VIDEO
3	EXT.TRIG	3	PS(M1)
4	TRIG.O	4	PS(L)
5	VIDEO.O	5	TRIG.G
6	BUOY	6	TRIG
7	GND	7	PS(M2)
		8	
		9	AZIP
		10	MOD.S



MEMBRANE SHEET 0019-1243 (D)

(Select MD-2000A)

1	SYM/TGT
2	SYM/TGT
3	SYM/TGT
4	SYM/TGT
5	OFFCTR
6	FLTEBL
7	VECTER
8	ENT/ACQ
9	SYM/TGT
10	ALLCLR
11	DELETE
12	SYM/TGT
13	EBL
14	VRM

MEMBRANE SHEET 0019-1241 (E)

0019-1245 (J)

(Select MD-3210mk2 MD-3220mk2)

1	SYM/TGT
2	SYM/TGT
3	SYM/TGT
4	SYM/TGT
5	OFFCTR
6	FLTEBL
7	VECTER
8	ENT/ACQ
9	SYM/TGT
10	ALLCLR
11	DELETE
12	SYM/TGT
13	EBL
14	VRM

CONTROL PANEL MD-3210-7200

1	SYM/TGT	2	SYM/TGT
3	SYM/TGT	4	SYM/TGT
5	OFFCTR	6	FLTEBL
7	VECTER	8	ENT/ACQ
9	SYM/TGT	10	ALLCLR
11	DELETE	12	SYM/TGT
13	EBL	14	VRM

J7203

1	SYM/TGT	2	SYM/TGT
3	SYM/TGT	4	SYM/TGT
5	OFFCTR	6	FLTEBL
7	VECTER	8	ENT/ACQ
9	SYM/TGT	10	ALLCLR
11	DELETE	12	SYM/TGT
13	EBL	14	VRM

LOWER LOGIC MD-3210-7100

1	POWER2	2	POWER1
3	GAIN	4	STC
5	FTC	6	TUNE
7	BR NUM	8	BR PLT
9	BR MRK	10	BR VID
11	P DATA	12	STB
13	PCLK	14	DIMMER
15	GND	16	GND
17	+5V	18	+5V
19	+8V	20	+8V

J7101

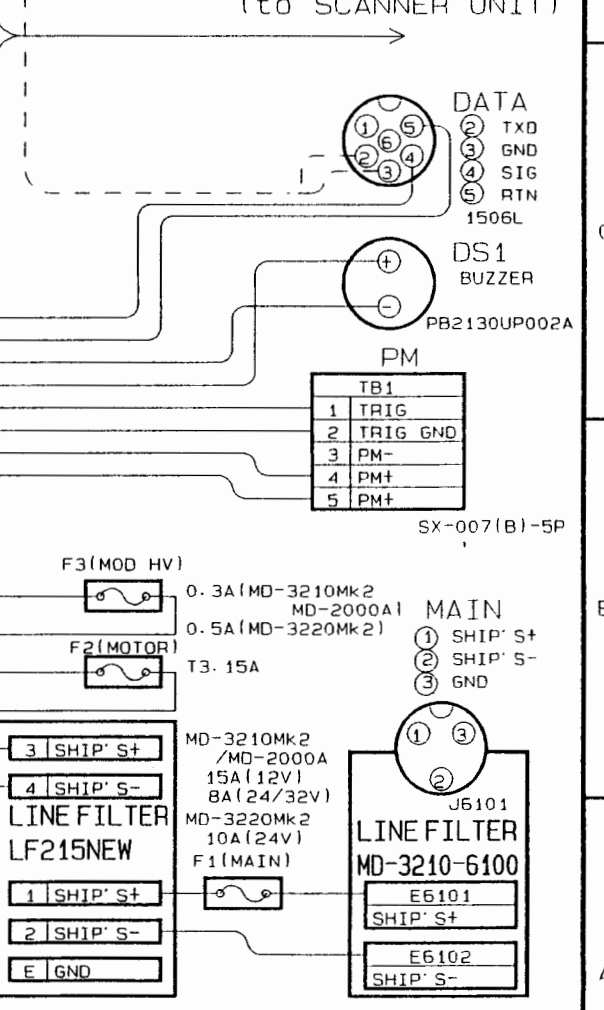
1	A0	2	A1
3	A2	4	A3
5	A4	6	A5
7	A6	8	A7
9	A8	10	A9
11	A10	12	A11
13	N.C.	14	POC
15	R/W	16	CSA
17	D0	18	D1
19	D2	20	D3
21	D4	22	D5
23	D6	24	D7
25	N.C.	26	GND
27	SHFA	28	GND
29	AZIPA	30	GND
31	TRIGA	32	GND
33	VIDEOA	34	GND
35	LOGPULSE	36	GND
37	+5V	38	GND
39	+5V	40	GND

J6002

1	GND
2	VIDEO
3	GND
4	TRIG

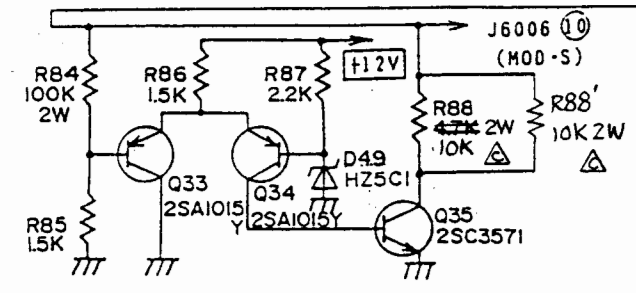
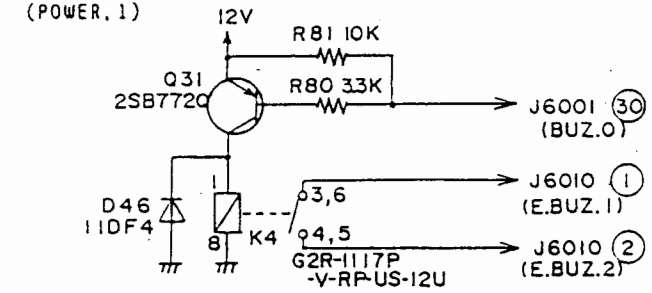
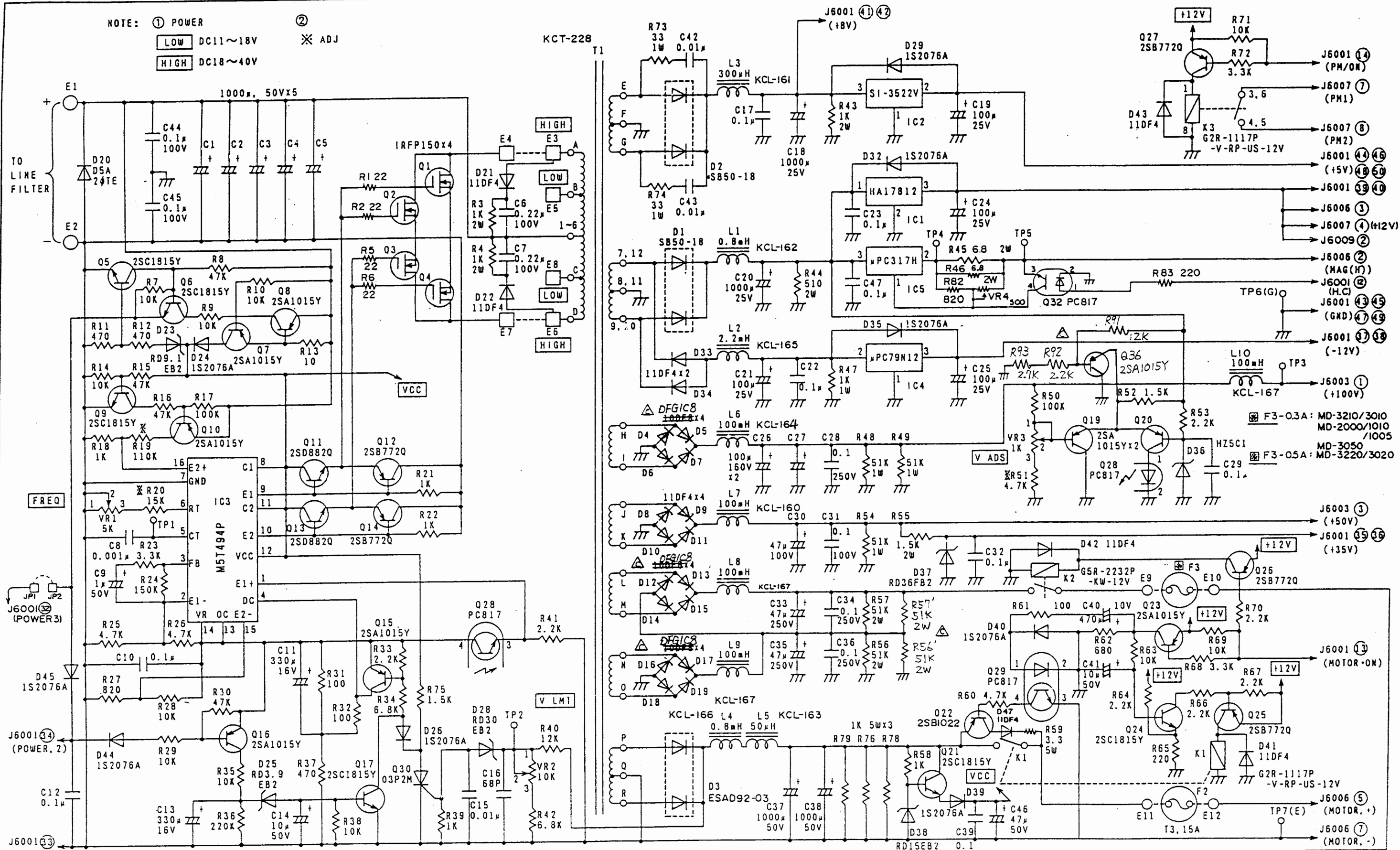
J6001

1	P/S M1	2	P/S L
3	P/S M2	4	GND
5	AZIP	6	GND
7	SHF	8	GND
9	TUNE.O	10	TUNE.M
11	TUNE.R	12	H.C.
13	MOTOR ON	14	PM/ON
15	AZIP.O	16	GND
17	SHF.O	18	GND
19	EX.TRIG	20	GND
21	TRIG.O	22	GND
23	VIDEO.O	24	GND
25	BUOY	26	GND
27	SD	28	SG
29	BUZ	30	BUZ.O
31	PM.TRIG	32	POWER3
33	POWER1	34	POWER2
35	+35V	36	+35V
37	-12V	38	-12V
39	+12V	40	+12V
41	+8V	42	+8V
43	GND	44	+5V
45	GND	46	+5V
47	GND	48	+5V
49	GND	50	+5V



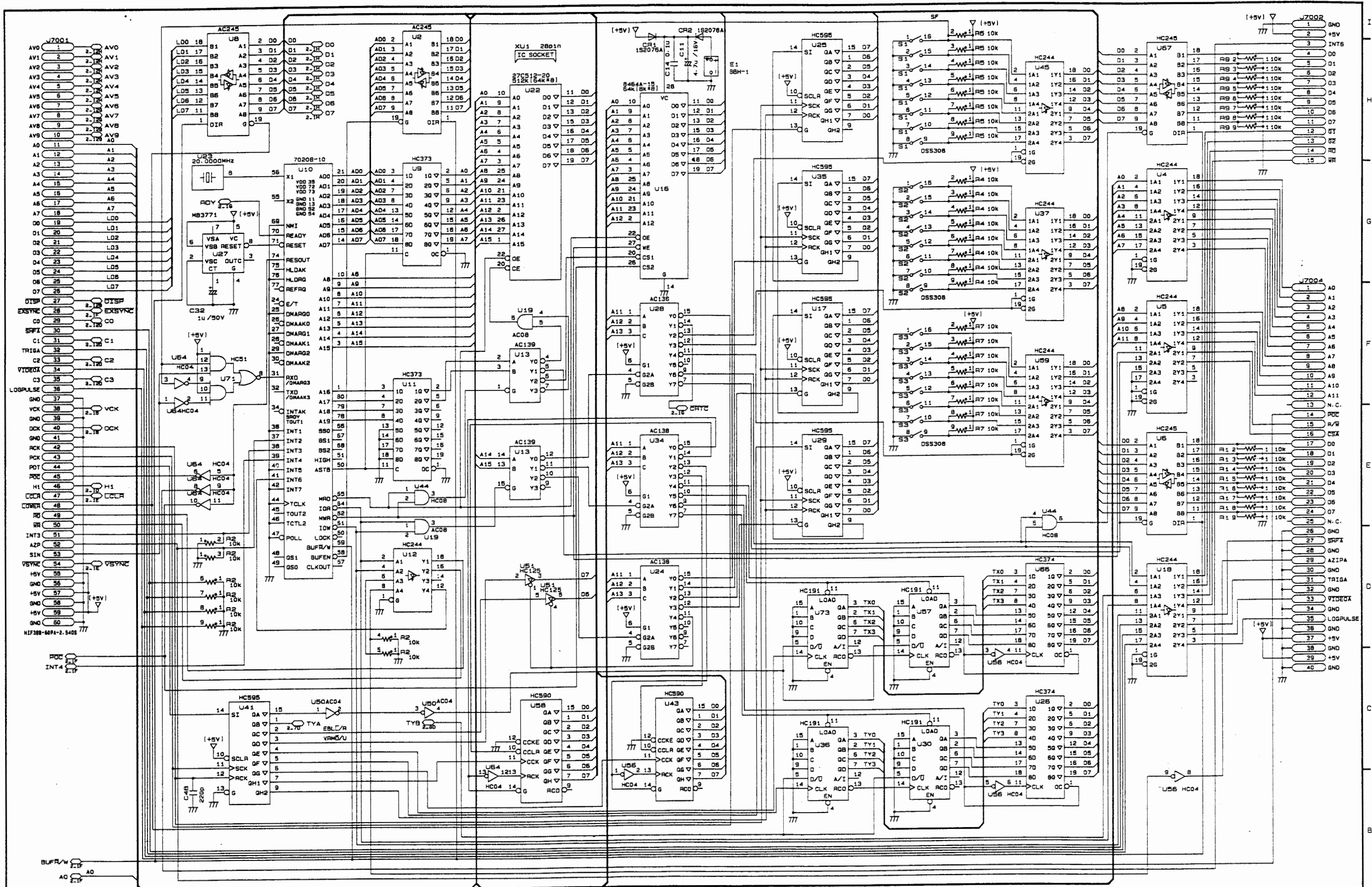
APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
M. TANAKA	H. KUSHIMA	T. HARA	T. HARA	MD-3210MK2/3220MK2 MD-2000A	INTERCONNECTION DIAGRAM DISPLAY (1/1)
92.11.17	92.11.17	92.11.17	92.11.17	KODEN KODEN ELECTRONICS CO., LTD.	DWG. NO. 555-0019*
DATE	REVISED	APPROVED			PAGE

NOTE: ① POWER
 LOW DC11~18V ✖ ADJ
 HIGH DC18~40V



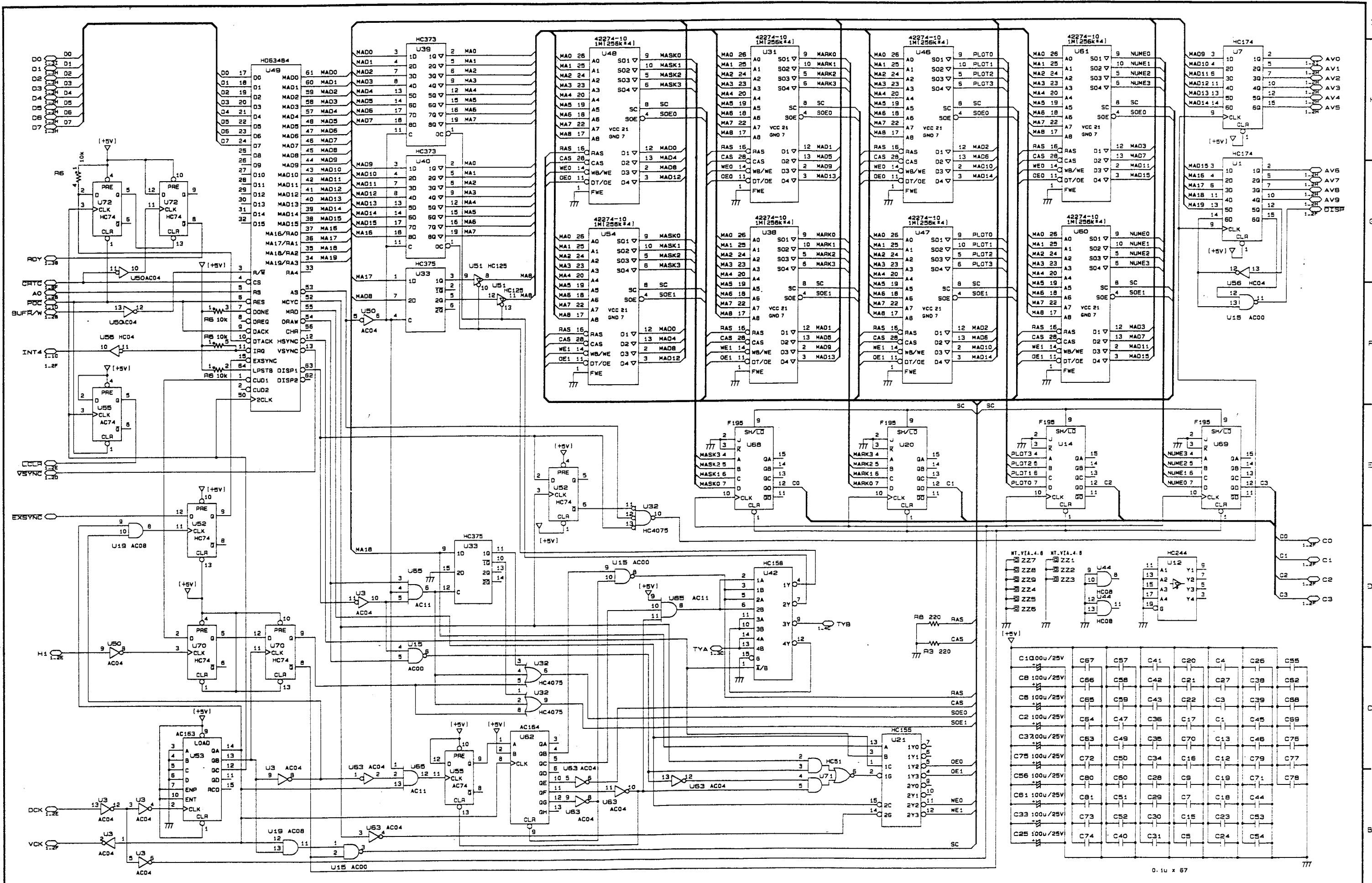
SCALE	TYPE	TITLE
CHECKED BY <i>M. Tanaka</i>	MD-3010mk2/3020mk2 MD-3050mk2 MD-3210mk2/3220mk2	POWER SUPPLY
DRAWN BY <i>H. Stinde</i>		MD-3210/3220-6000M3·1/2
DWG. NO.		555-0012M1*

KODEN ELECTRONICS CO., LTD.



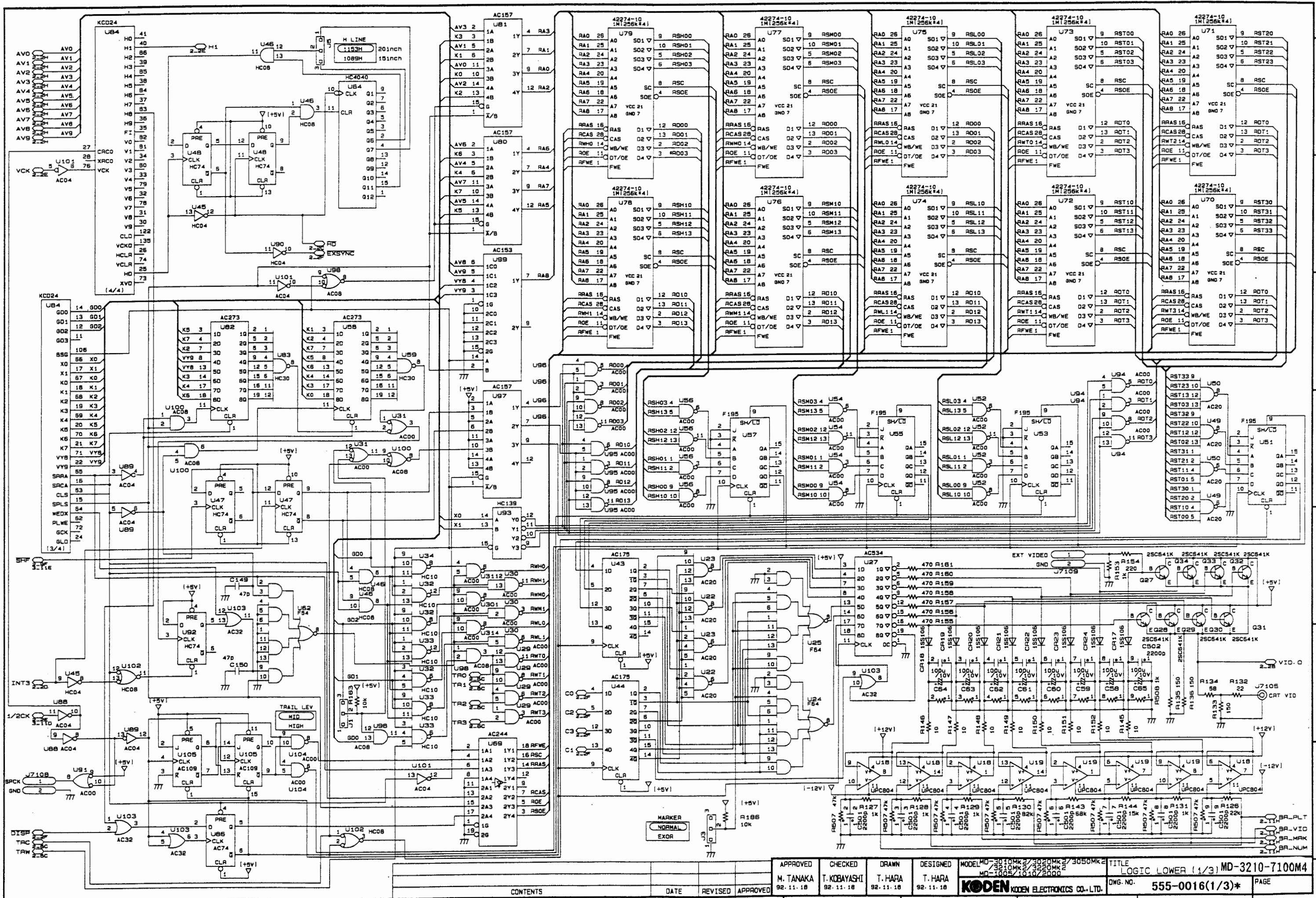
APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
M. TANAKA	T. KOBAYASHI	T. HARA	T. HARA	MD-3210MK2/3020MK2/3050MK2 73210MK2/3220MK2 MD-1005/10/6/2000	LOGIC UPPER (1/2) MD-3210-7000M4
DATE	REVISED	APPROVED			DWG. NO. 555-0015(1/2)*
					PAGE

CONTENTS DATE REVISED APPROVED

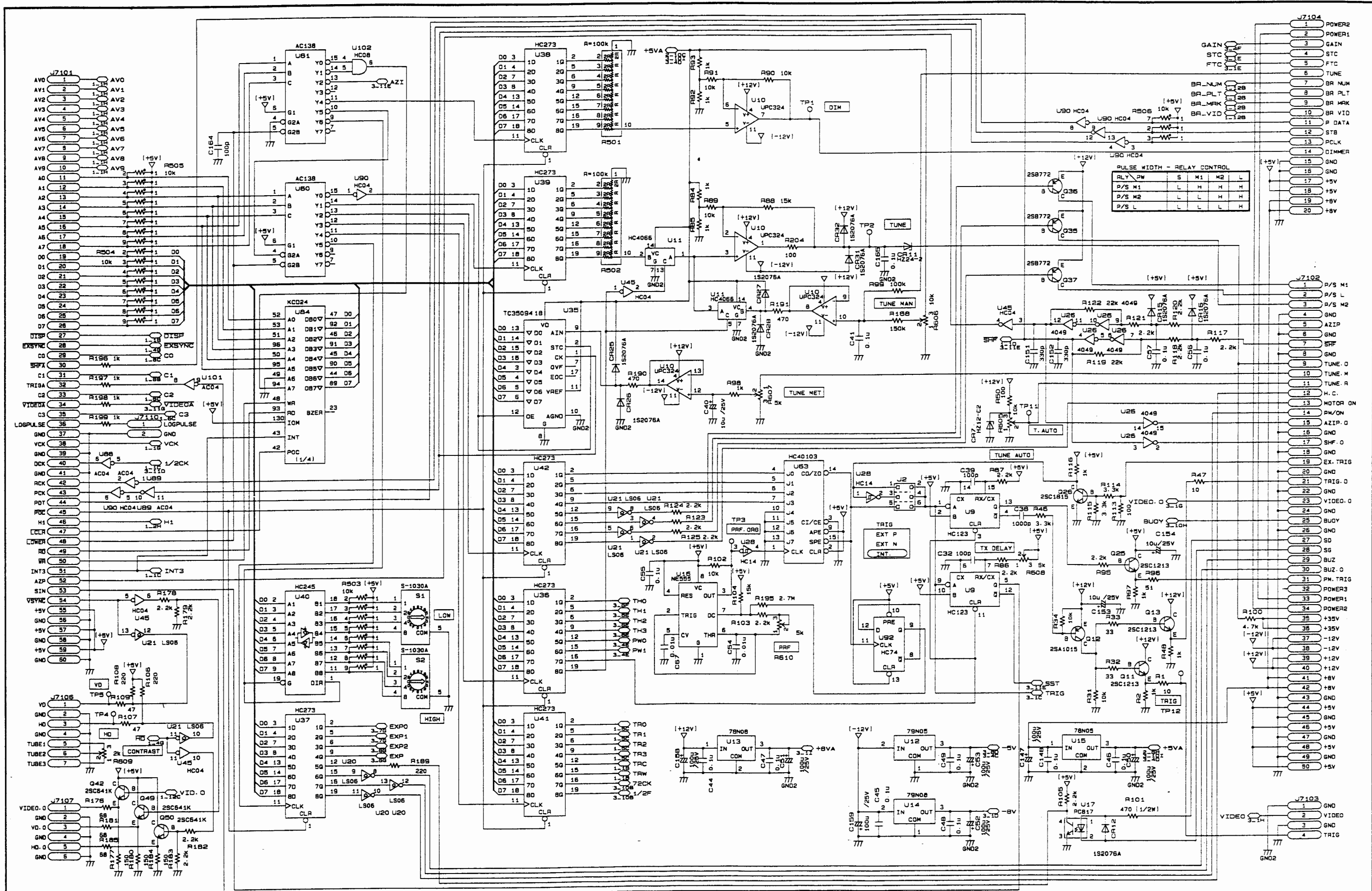


0.1u x 57

APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
M. TANAKA	T. KOBAYASHI	T. HARA	T. HARA	MD-3210MK2/3050MK2 MD-1005/2.610/2000	LOGIC UPPER (2/2) MD-3210-7000M4
DATE	REVISED	APPROVED		KODEN	DWG. NO.
				KODEN ELECTRONICS CO., LTD.	555-0015(2/2)*
CONTENTS					PAGE



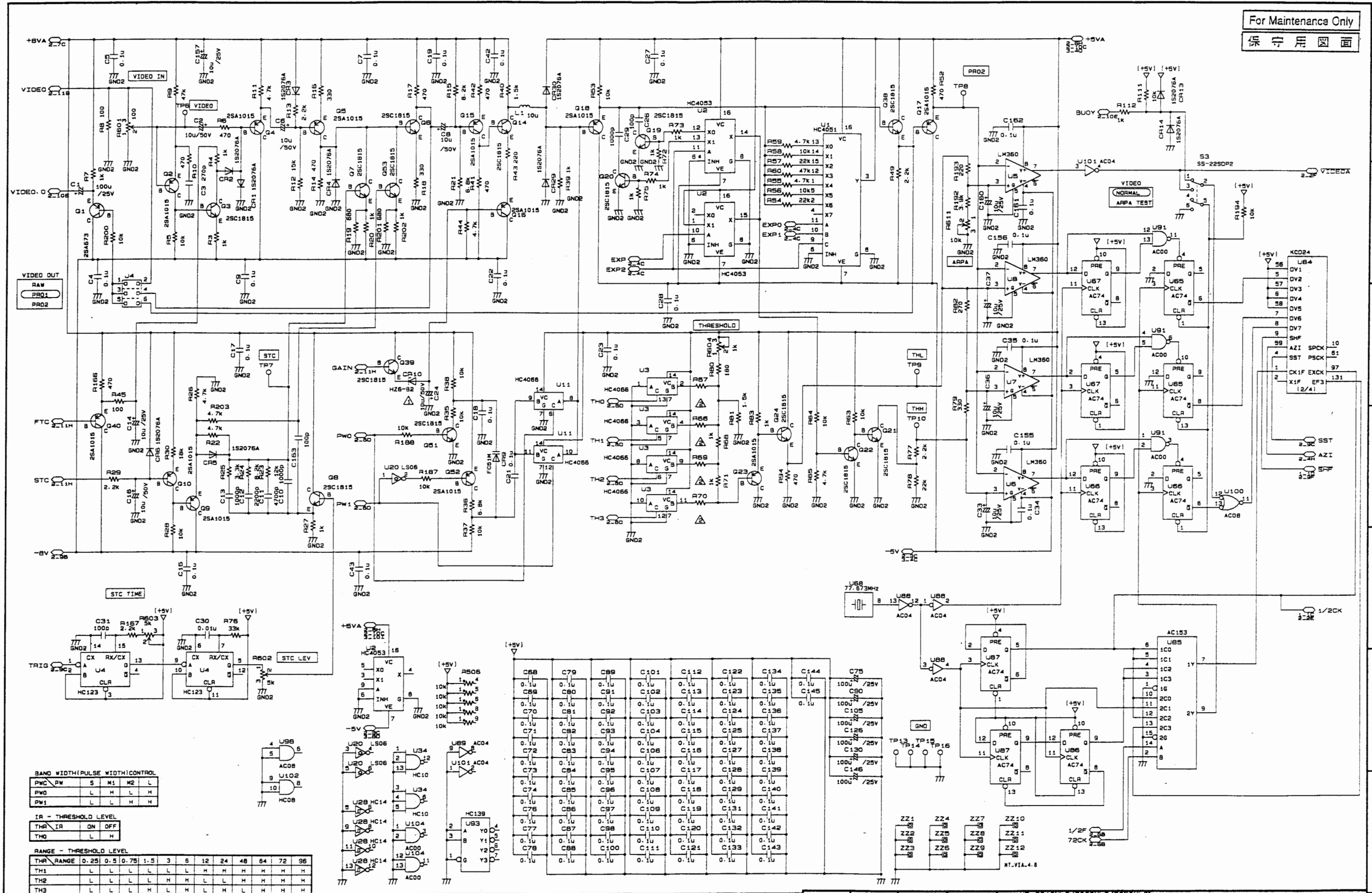
APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
M. TANAKA	T. KOBAYASHI	T. HARA	T. HARA	MD-3010MK2/3020MK2/3050MK2 MD-1002/1010/2000	LOGIC LOWER (1/3) MD-3210-7100M4
DATE	REVISED	APPROVED			DWG. NO. 555-0016(1/3)*
92.11.18	92.11.18	92.11.18	92.11.18		PAGE



PULSE WIDTH - RELAY CONTROL

RLY	PW	S	M1	M2	L
P/S M1	L	H	H	H	H
P/S M2	L	L	L	H	H
P/S L	L	L	L	L	H

APPROVED	CHECKED	DRAWN	DESIGNED	MODEL NO.	TITLE
M. TANAKA	T. KOBAYASHI	T. HARA	T. HARA	MD-3010K2/3020K2/3050K2 MD-1005/1016/2006	LOGIC LOWER (2/3) MD-3210-7100M4
DATE	REVISED	APPROVED			DWG. NO.
					555-0016(2/3)*
KODEN KODEN ELECTRONICS CO., LTD.					PAGE
					1



BAND WIDTH (PULSE WIDTH) CONTROL

PWC PW	S	M1	M2	L
PW0	L	H	L	H
PW1	L	L	H	H

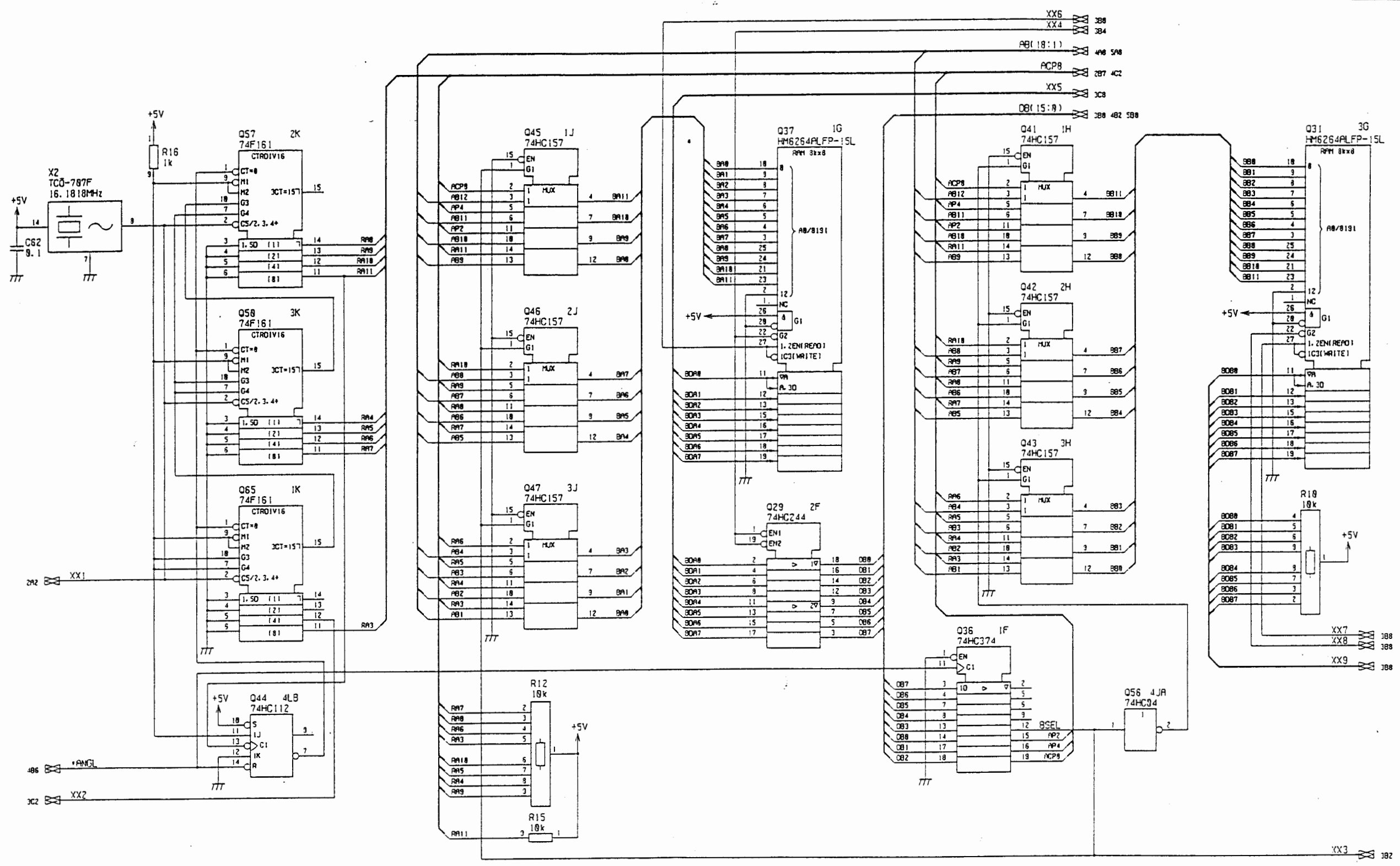
IR - THRESHOLD LEVEL

THR IR	ON	OFF
TH0	L	H

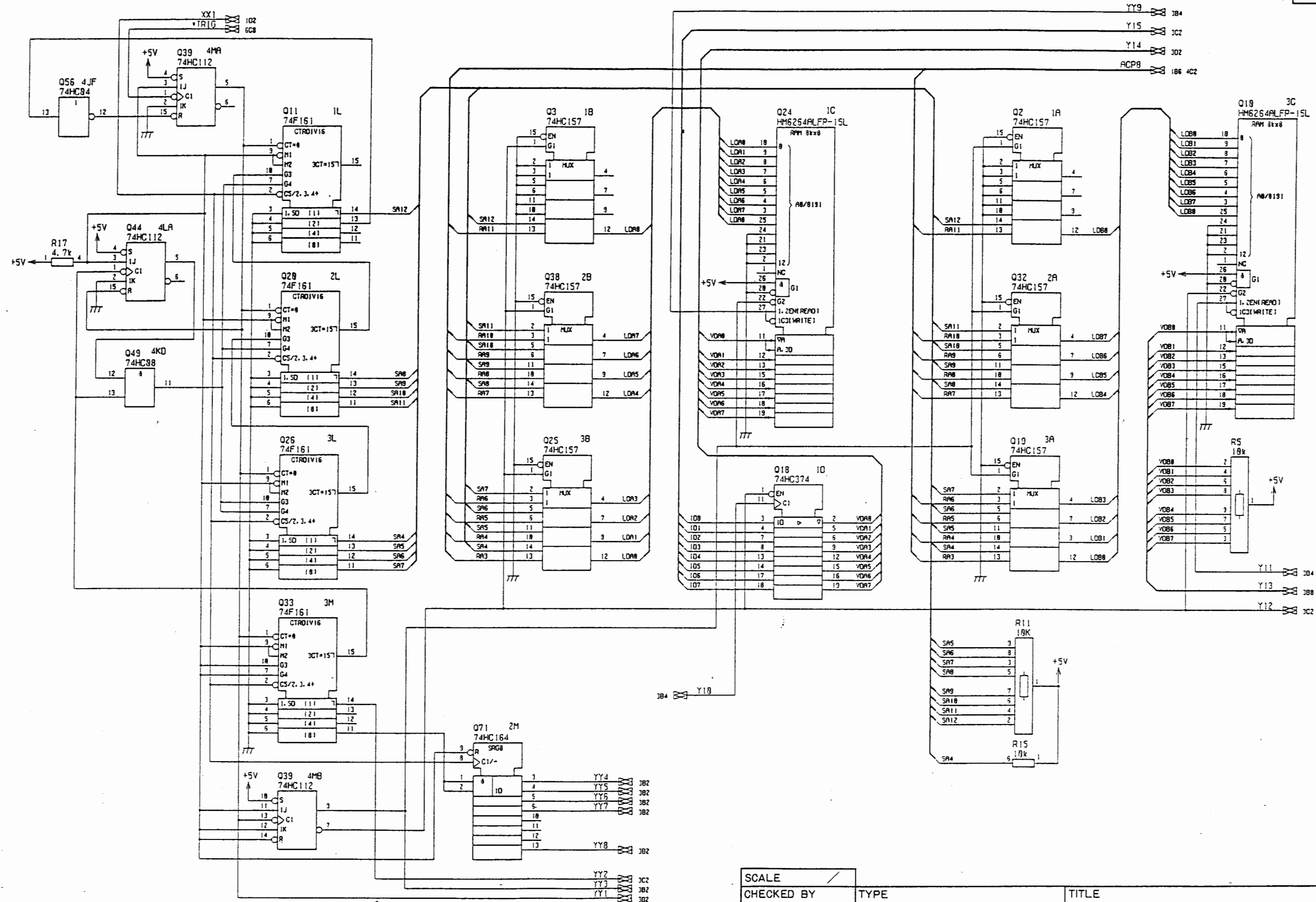
RANGE - THRESHOLD LEVEL

THR RANGE	0.25	0.5	0.75	1.5	3	5	12	24	48	84	72	96
TH1	L	L	L	L	L	L	H	H	H	H	H	H
TH2	L	L	L	L	H	H	L	L	H	H	H	H
TH3	L	L	L	H	L	L	L	L	H	H	H	H

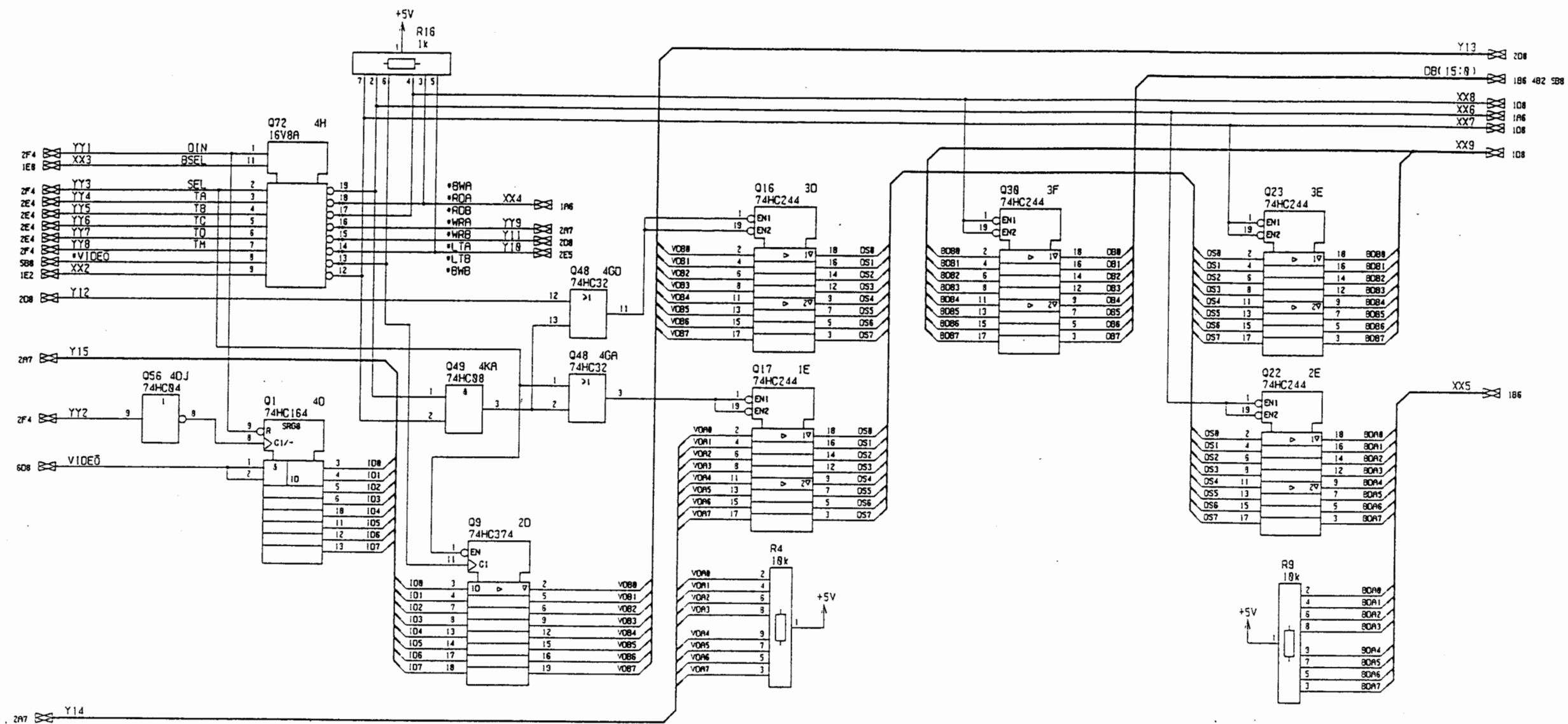
C24 connection. R66, 67, 69, 70 open		APPROVED	CHECKED	DRAWN	DESIGNED	MODEL MD-3010MK2/3020MK2/3050MK2/3210MK2/3220MK2 MD-1005/1010/2000	TITLE LOGIC LOWER (3/3) MD-3210-7100M4
DATE	REVISED	APPROVED					DWG. NO. 555-0016(3/3)*
92.11.18	T. HARA	M. TANAKA	M. TANAKA	T. KOBAYASHI	T. HARA	T. HARA	PAGE
CONTENTS		92.11.18	92.11.18	92.11.18	92.11.18	KODEN KODEN ELECTRONICS CO., LTD.	



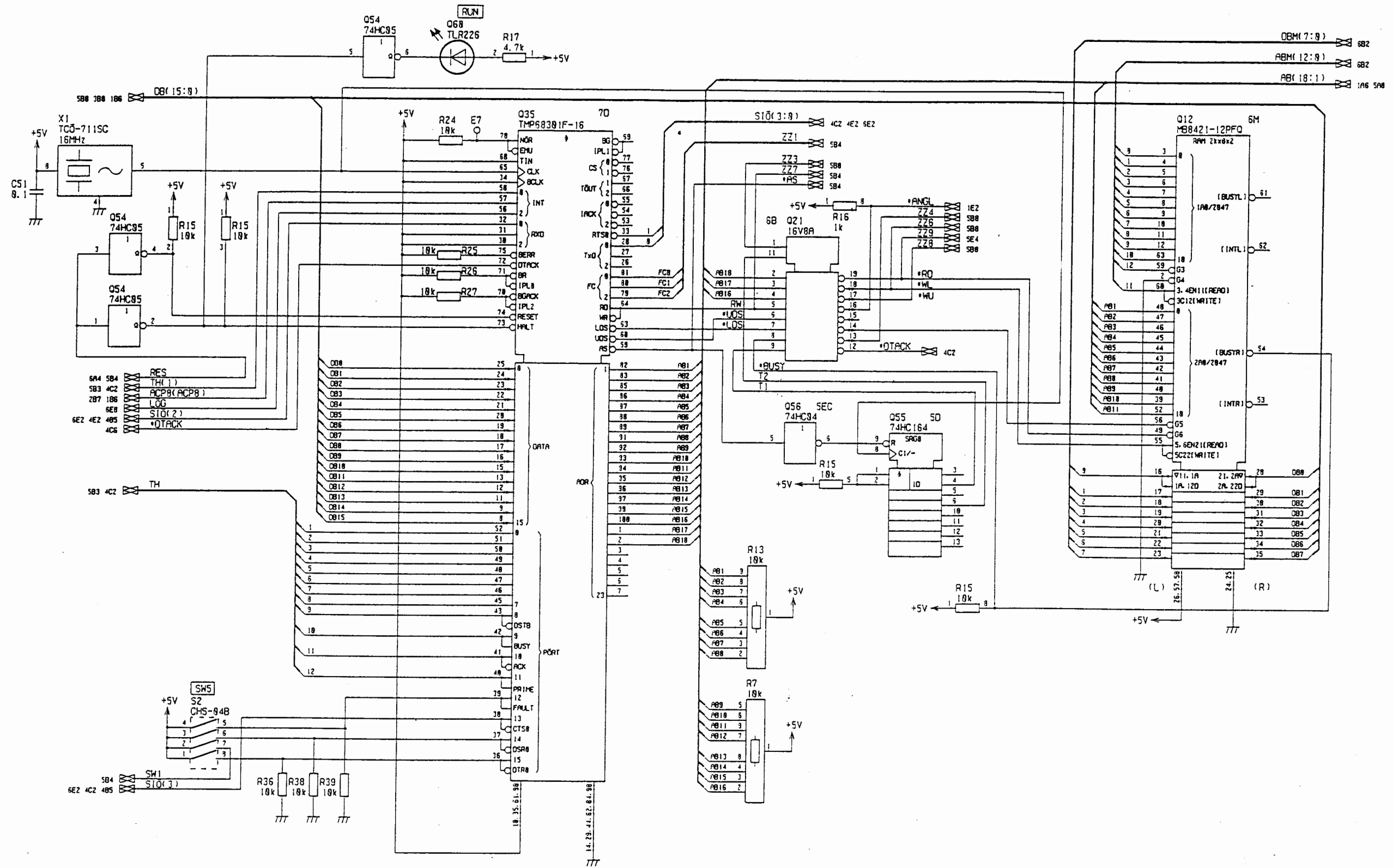
SCALE	TYPE	TITLE
CHECKED BY <i>M. Tanaka</i>	S-ARPA (MRE-120/140)	S-ARPA CONT CONT プリント板回路図
DRAWN BY <i>H. Suido</i>		DRW. NO 555-0018M1(1/7)*
KODEN ELECTRONICS CO., LTD.		



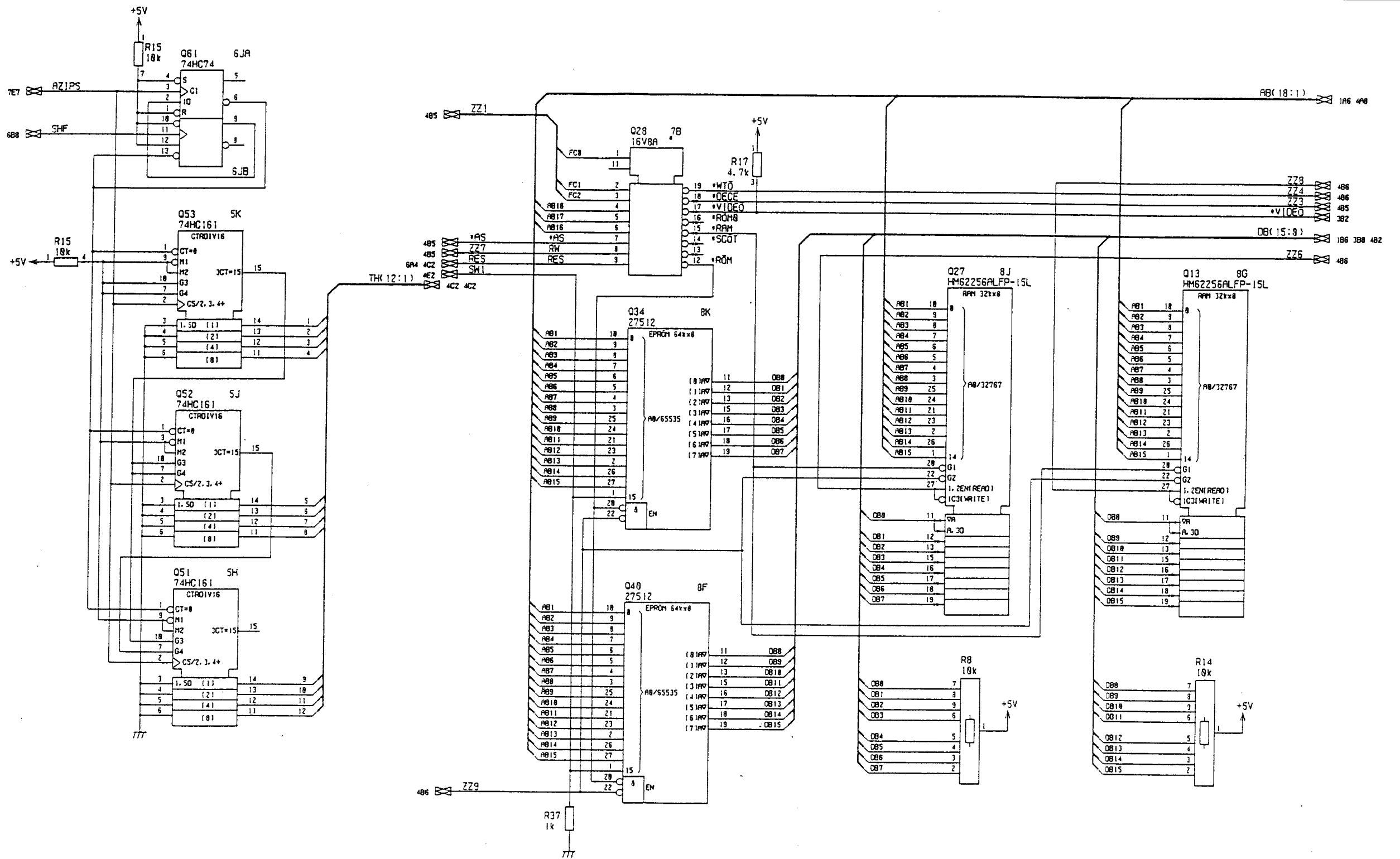
SCALE		TITLE
CHECKED BY	TYPE	S-ARPA CONT
<i>M. Tanaka</i>		CONT プリント板回路図
DRAWN BY		
<i>H. Skinder</i>		
KODEN ELECTRONICS CO., LTD.		DRW. NO
		555-0018M1(2/7)*



SCALE /		TITLE
CHECKED BY <i>M. Tanaka</i>	TYPE S-ARPA	S-ARPA CONT
DRAWN BY <i>H. Shindo</i>	(MRE-120/140)	CONT プリント板回路図
KODEN ELECTRONICS CO., LTD.		DRW. NO 555-0018M1(3/7)*

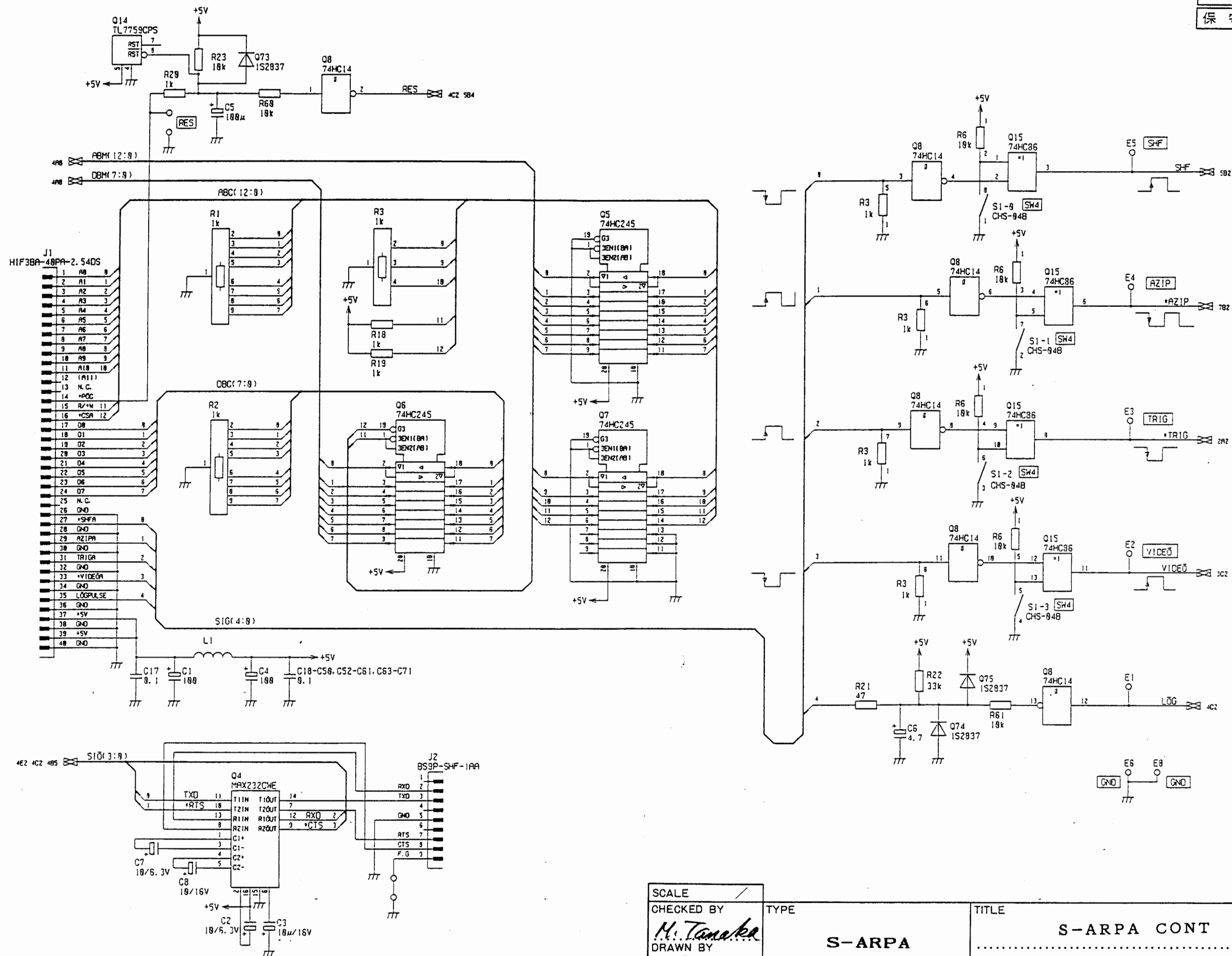


SCALE		TITLE
CHECKED BY	TYPE	S-ARPA CONT
<i>M. Tanaka</i>	S-ARPA	CONT プリント板回路図
DRAWN BY	(MRE-120/140)	
<i>H. Sando</i>		
KODEN ELECTRONICS CO., LTD.		DRW. NO
		555-0018M1(4/7)*

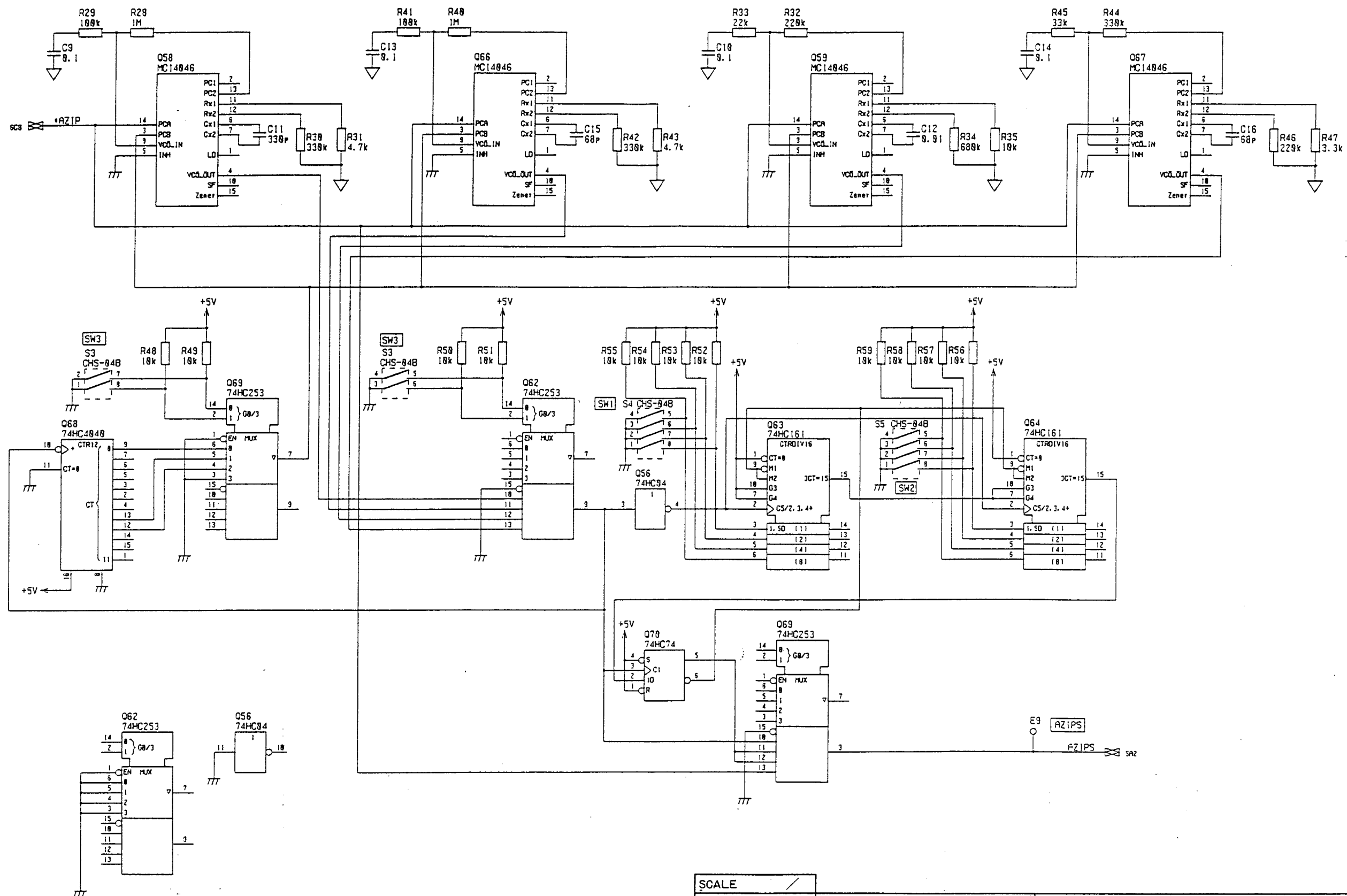


SCALE		TITLE	S-ARPA CONT
CHECKED BY	M. Tanaka	TYPE	S-ARPA
DRAWN BY	H. Saito		(MRE-120/140)
			CONT プリント板回路図
		DRW. NO	555-0018M1(5/7)*

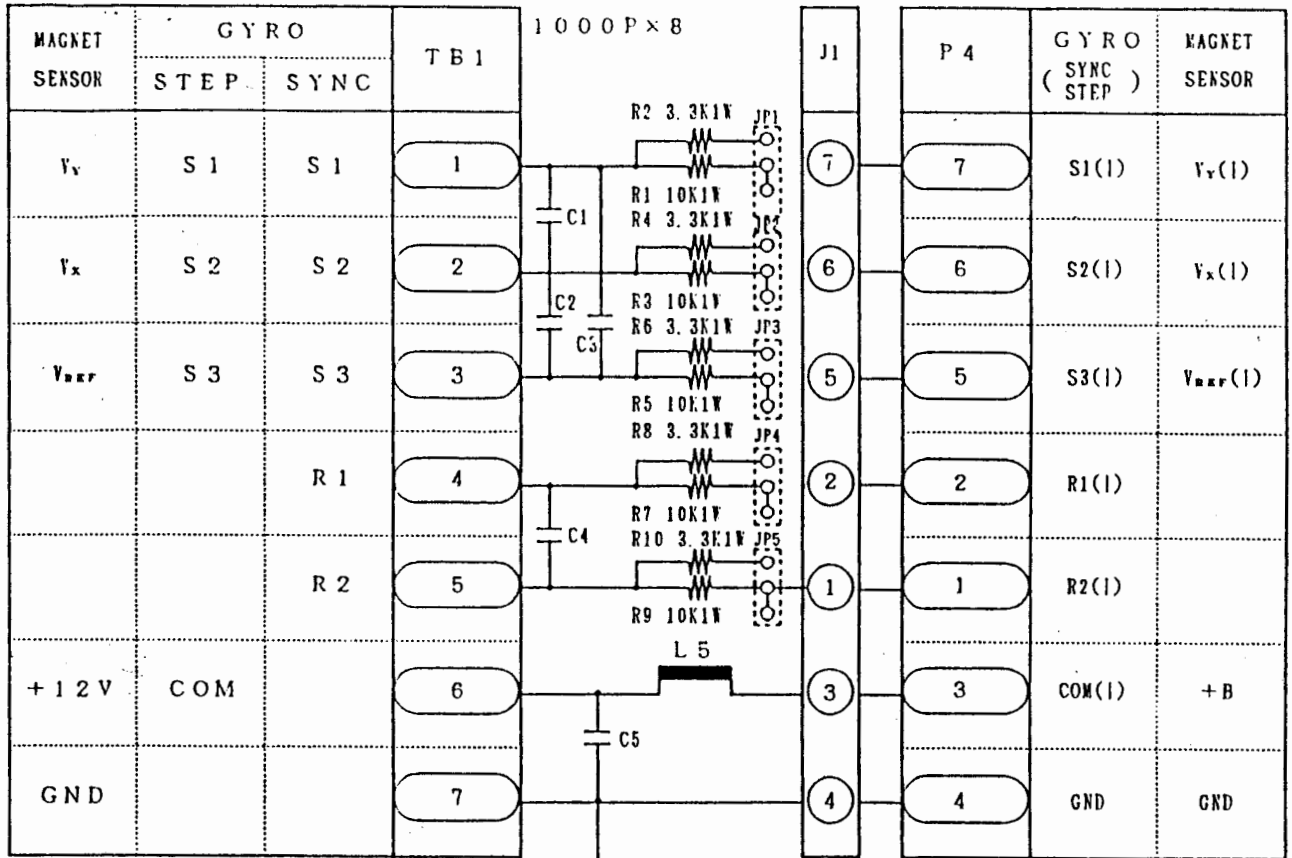
KODEN ELECTRONICS CO., LTD.



SCALE		TITLE
CHECKED BY	TYPE	S-ARPA CONT
<i>H. Tanaka</i>	S-ARPA	CONT プリント板回路図
DRAWN BY	(MRE-120/140)	
<i>H. Stainde</i>		
KODEN ELECTRONICS CO., LTD.		DRW. NO
		555-0018M1(6/7)*



SCALE		TITLE
CHECKED BY	TYPE	S-ARPA CONT
<i>M. Tanaka</i>	S-ARPA	CONT プリント板回路図
DRAWN BY	(MRE-120/140)	
<i>H. Shimbo</i>		
		DRW. NO
		555-0018M1(7/7)*

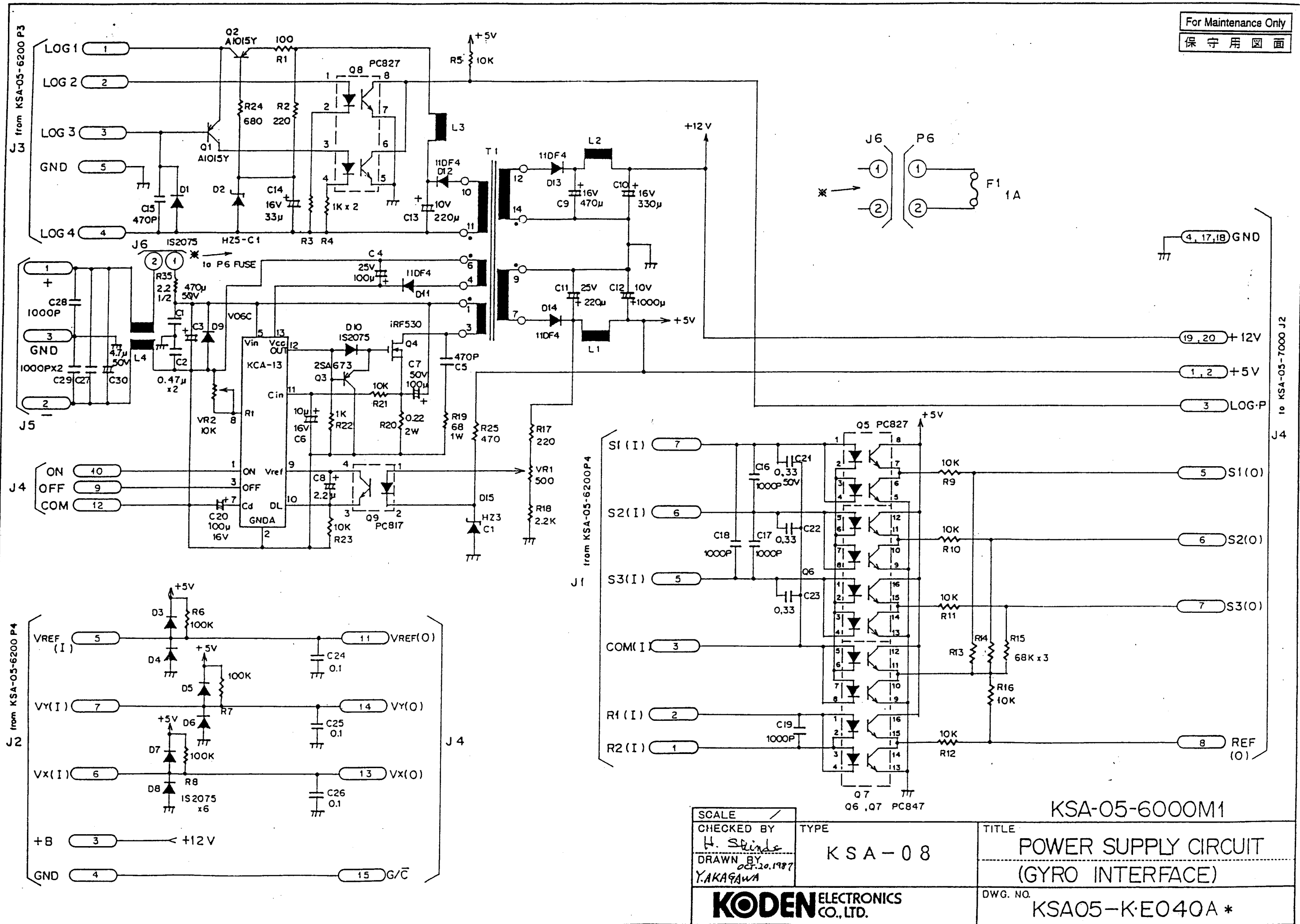


CONTACT SWITCH
SEMICONDUCTOR SWITCH

KSA-05-6200

SCALE /	CHECKED BY <i>M. Tanaka</i>	TYPE KSA-08	TITLE FILTER CIRCUIT (GYRO INTERFACE) ジャイロインターフェイス
	DRAWN BY <i>C. Sato</i>		DWG. NO. KSA-05-K·E043*

For Maintenance Only
保守用図面



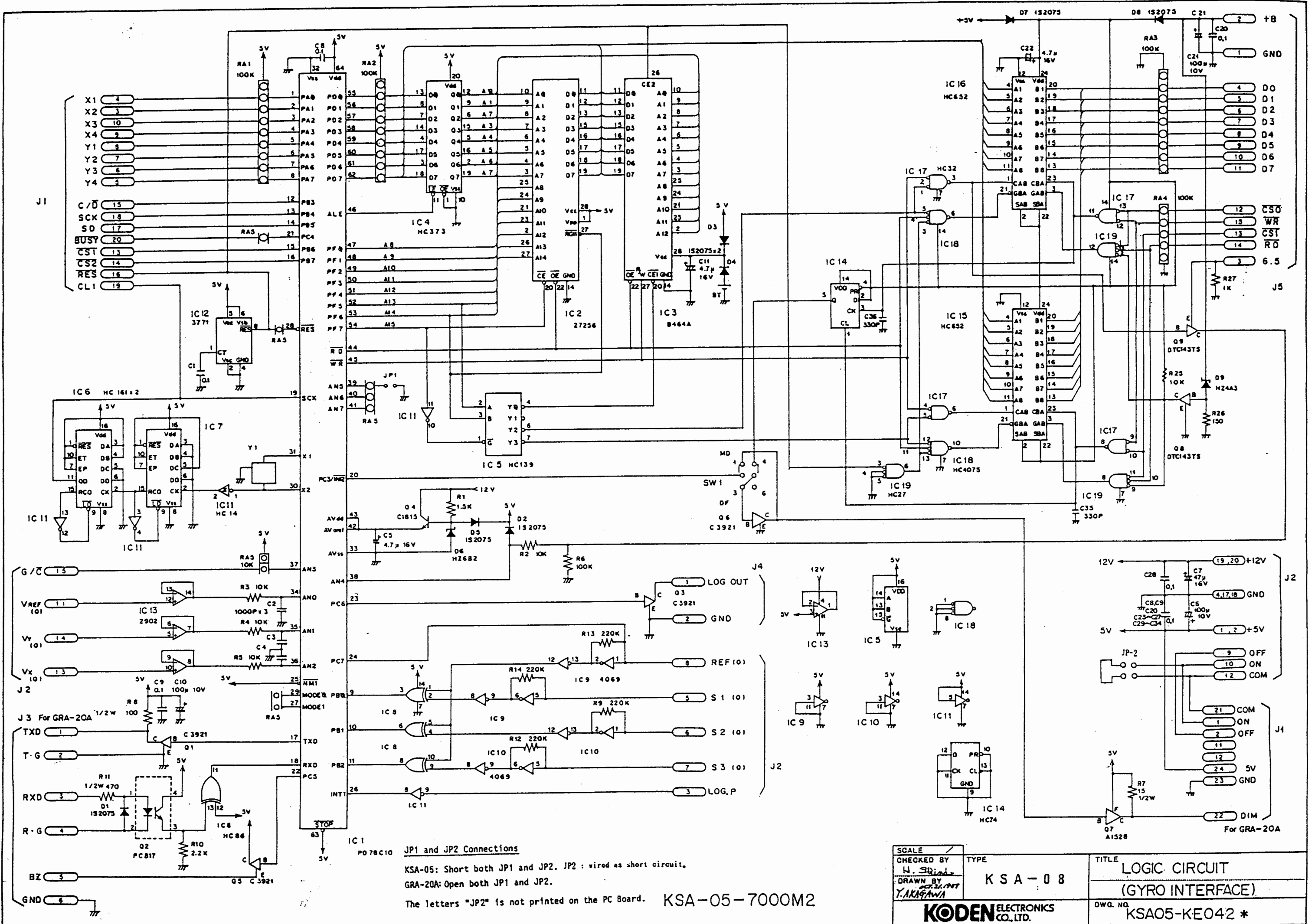
SCALE /
CHECKED BY H. Spinde
DRAWN BY YAKAGAWA
OCT. 20, 1987

TYPE
KSA-08

TITLE
POWER SUPPLY CIRCUIT
(GYRO INTERFACE)

KODEN ELECTRONICS CO., LTD.

DWG. NO.
KSA05-K-E040A *



JP1 and JP2 Connections
 KSA-05: Short both JP1 and JP2. JP2: wired as short circuit.
 GRA-20A: Open both JP1 and JP2.

The letters "JP2" is not printed on the PC Board. KSA-05-7000M2

SCALE	CHECKED BY	TYPE	TITLE
	N. S. I.	KSA-08	LOGIC CIRCUIT
	DRAWN BY		(GYRO INTERFACE)
	Y. KAWA		DWG. NO. KSA05-KE042 *

KODEN ELECTRONICS CO., LTD.

NOTE

The service manual is for MD-3210/3220 essentially.

For MD-3210Mk2/3220Mk2, a supplement is provided.

The supplement includes drawings amended or added for MD-3210Mk2/3220Mk2 only.

Also the supplement includes drawings of a GYRO repeater because the service manual had no drawings for it..

Drawings in the service manual are listed below.

Drawings in the supplement are indicated in italic below.

PCB NAME	MD-3210/3220	MD-3210Mk2/3220Mk2
<ANTENNA UNIT>		
1.INTERCONNECTION DIAGRAM	MD-3210-E·H001	<i>555-0019*</i>
2.GENERAL BLOCK DIAGRAM	MD-3210 MD-3220	<i>556-0010M1*</i> Same to the above
3.ANTENNA UNIT	10KW 25KW	Same to the left Same to the left
4.MODULATOR	10KW 25KW	<i>E05CGB1110*</i> <i>E05CGB2100*</i>
5.LOG IF AMP	MRT133-K·H003	Same to the left
6.S CON	MRT133-K·H004	Same to the left
<DISPLAY UNIT>		
1.INTERCONNECTION DIAGRAM	MD3210-J·E001	Same to the left
2 LINE FILTER	MRD62-K·H002	Same to the left
3 POWER SUPPLY	M2 Version M2 Version M3 Version M3 Version	————— ————— <i>555-0012M1*</i> Same to the left
4 LOGIC UPPER	MRD62-K·H003·A MRD62-K·H003·B —————	————— <i>555-0015(1/2)*</i> <i>555-0015(2/2)*</i>

5.LOGIC LOWER	MRD62-K·H004A(1/3)	<i>555-0016(1/3)*</i>
	MRD62-K·H004A(2/3)	_____
	MRD62-K·H004B(2/3)	<i>555-0016(2/3)*</i>
	MRD62-K·H004A(3/3)	<i>555-0016(3/3)*</i>
6.CONTROL PANEL	MRD62-K·H005	Same to the left
7.CRT UNIT	MRD-K·H006	Same to the left
8.S-ARPA CONTROLLER (MRE-120/140)	_____	<i>555-0018M1(1/7)*</i>
	_____	<i>555-0018M1(2/7)*</i>
	_____	<i>555-0018M1(3/7)*</i>
	_____	<i>555-0018M1(4/7)*</i>
	_____	<i>555-0018M1(5/7)*</i>
	_____	<i>555-0018M1(6/7)*</i>
	_____	<i>555-0018M1(7/7)*</i>
9.GYRO INTERFACE		
FILTER CIRCUIT	Same to the right	<i>KSA-05-K·E043*</i>
POWER SUPPLY CIRCUIT	Same to the right	<i>KSA05-K·E040A*</i>
LOGIC CIRCUIT	Same to the right	<i>KSA05-K·E042*</i>

Marine Radar MD-3210/3220

INDEX

	Page
PRECAUTIONS	
1. GENERAL	1-1
1.1 Major Performances	
1.1.1 Antenna unit	1-2
1.1.2 Display unit	1-2
1.1.3 Power supply	1-3
1.2 Composition	
1.2.1 MD-3210/3220	1-4
1.2.2 Optional equipment	1-5
1.3 System Configuration of MD-3210/3220	1-6
1.4 Interconnection of MD-3210/3220	1-7
1.5 Modification of Specifications	
1.5.1 Jumper pin setting	1-8
1.5.2 DIP switch setting	1-8
2. FUNCTION OF EACH UNIT	
2.1 Antenna Unit	2-1
2.1.1 Aerial	2-1
2.1.2 Antenna motor.....	2-2
2.1.3 SHF and AZI generators	2-2
2.1.4 Transmitting section	2-3
2.1.5 Duplexing assembly	2-5
2.1.6 Receiving section	2-5
2.2 Display Unit	2-7
2.2.1 Power supply (MD-3210/3220-6000)	2-7
2.2.2 Logic section	2-9
(1) Logic upper (MD-3210-7000)	2-9
(2) Logic lower (MD-3210-7100)	2-13
2.2.3 Control panel (MD-3210-7200)	2-18
3. ADJUSTMENT	
3.1 Location of Controls	3-1
3.2 Adjustment After Installation	3-1
3.2.1 Tuning	3-1
3.2.2 Preset gain (noise level)	3-2
3.2.3 STC	3-2
3.2.4 Trigger delay	3-2
3.2.5 SHF and bearing	3-3
3.3 Adjustment of Antenna Unit	3-3
3.4 Adjustment of Display	
3.4.1 Power supply (MD-3210/3220-6000)	3-3
3.4.2 Logic upper (MD-3210-7000)	3-5
3.4.3 logic lower (MD-3210-7100)	3-5
3.4.4 CRT unit (PWD-1050A/PWD-1051A)	3-6

4. WAVEFORMS	
4.1 Antenna Unit	
4.1.1 MRT-133 (MD-3210)	4-1
4.1.2 MRT-134 (MD-3220)	4-3
4.2 Display unit	
4.2.1 Power supply	4-4
4.2.2 Logic upper	4-5
4.2.3 Logic lower	4-5
5. REPLACEMENT OF MAJOR COMPONENTS	
5.1 Antenna unit.....	5-1
5.1.1 Dismounting transmitter/receiver (TR) unit	5-1
5.1.2 Replacement of TR unit components	5-1
5.1.3 Replacement of S CON	5-4
5.1.4 Replacement of motor brush	5-4
5.1.5 Replacement of motor	5-4
5.2 Display unit	
5.2.1 Control panel (MD-3210-7200)	5-5
5.2.2 Logic upper (MD-3210-7000) and	5-6
logic lower (MD-3210-7100)	
5.2.3 Power supply (MD-3210/3220-6000)	5-7
5.2.4 CRT unit	5-8
6. TROUBLESHOOTING	6-1
6.1 Troubleshooting by Observing Display	6-1
6.2 Operation Control Troubleshooting	6-4
6.3 Antenna Troubleshooting	6-7
7. DIAGRAMS	
7.1 Circuit Diagram	7-1
7.2 Drawings for parts location	7-24
8. PARTS LIST	
8.1 Electrical Parts	
8.1.1 Antenna unit MRT-133 (10 kW)	8-1
8.1.2 Antenna unit MRT-134 (25 kW)	8-8
8.1.3 Display unit MRD-62/MRD-68	8-18
8.2 Mechanical Parts	
8.2.1 Antenna unit MRT-133 (10 kW)	8-28
8.2.2 Antenna unit MRT-134 (25 kW)	8-31
8.2.3 Display unit MRD-62/MRD-68	8-32
8.3 Exploded View	
8.3.1 Antenna unit	8-35
8.3.2 Display unit	8-42

APPENDIX

RADAR LSI KCD-24	A-1
------------------------	-----

SUPPLEMENT(MD-3210Mk2/3220Mk2)

SUPPLEMENT FOR DRAWINGS AMENDED.....	B-1
--------------------------------------	-----

* * * * *

SERVICE MANUAL
for
MARINE RADAR MD-3210/3220

1. GENERAL

Koden MD-3210/3220 series is a highly efficient marine radar which conform the IMO standards to be used for a primary radar of fishing boat, workboat, and other vessel less than 10,000 gross weight tons. The system consists of only two units, i.e. the antenna and display. Except for magnetron and CRT, all the active components are solid state which maintain high reliability and maintainability.

The radar display uses a 20-inch diagonal high resolution green monochrome CRT. It employs X-Y coordinates to digitally process the radar information and display the image with a built-in microprocessor. The radar screen is divided into number of picture elements, so called pixels. Each pixel is assigned with X-Y coordinates which corresponds to the memory address. The radar return echoes in polar coordinates for every pulse transmission are converted into X-Y coordinates in accordance with the distance and azimuth. The distance is obtained from the time duration between transmission and reception of pulse, while the azimuth is given from the antenna unit. The coordinates converted data is stored into memory and then read out to display the image in a raster scan method allowing the picture to be monitored by plural persons under daylight condition without viewing hood. According to the transmitting power, system is classified into two models as below.

MD-3210	10 kW
MD-3220	25 kW

Antenna unit

Antenna unit consists of a 6-foot slotted array aerial, antenna drive unit, and transceiver unit. The slotted array aerial is contained in a reinforced plastic cylindrical case, providing smooth antenna rotation in a wind load of 100 knots. The antenna unit has been designed as water-tight, vibration-proof, and weather-resistant construction. The drive unit and transceiver unit are mounted in a rigid aluminum cast antenna base. The transceiver unit is a module type which enables speedy and easy maintenance.

Display unit

The radar picture is displayed on a 20-inch diagonal high resolution CRT with an effective diameter of 12 inches (270 mm). The green mono-color raster scan picture presents crisp and clear image under bright daylight condition. The display unit mainly consists of CRT mount, logic circuit, control, and power supply sections, all assembled together in a drip-proof aluminum case. Each section is of a module type providing easy maintenance capability. In addition to the radar presentation, the positioning data from an onboard navigational equipment such as GPS, and Locan C can be digitally displayed on the screen.

1.1 Major Performances

1.1.1 Antenna unit

(1) Antenna system	
Aerial	MRA-37
Transceiver	MRT-133 (MD-3210) MRT-134 (MD-3220)
(2) Aerial	6-foot slotted array
(3) Antenna rotation	24 rpm
(4) Main beam width	Horizontal: 1.2°, Vertical: 22°
(5) Sidelobe level	Less than -23 dB from the main beam
(6) Transmitting frequency	9,410 ±30 MHz
(7) Peak power output	10 kW (MRT-133) 25 kW (MRT-134)
(8) Type of emission	PON
(9) Spurious emission	Less than -40 dB from the main beam of the fundamental frequency output
(10) Occupied bandwidth	Within 110 MHz
(11) Pulse width/repetition rate	
S	0.08 μsec, 2,000 pps
M1	0.3 μsec, 1,500 pps
M2	0.6 μsec, 1,000 pps
L	1.2 μsec, 500 pps (MRT-133/134) 430 pps (MRT-134 at 96 nm range)
(12) IF center frequency	60 MHz
(13) IF bandwidth	15 MHz (S, M1) 3 MHz (M2, L)
(14) Receiver front-end module	MIC (Microwave Integrated Circuit)
(15) Modulator	Solid-state line type pulser
(16) Environmental conditions	
Ambient temperature	-25°C to 70°C
Relative humidity	95% at 35°C
Wind velocity	100 knots (51.5 m/sec), relative

1.1.2 Display unit

(1) Display system	20-inch diagonal green monochrome CRT
	MRD-62 (MD-3210) MRD-68 (MD-3220)
(2) Effective diameter	270 mm (12-inch)
(3) Range scale	
MRD-62 (MD-3210)	1/4, 1/2, 3/4, 1.5, 3, 6, 12, 24, 48, 72 nm
MRD-68 (MD-3220)	1/4, 1/2, 3/4, 1.5, 3, 6, 12, 24, 48, 96 nm

- (4) Range ring interval
- | | |
|------------------|---|
| MRD-62 (MD-3210) | 1/16, 1/8, 1/8, 1/4, 1/2, 1, 2, 4, 8, 12 nm |
| MRD-68 (MD-3220) | 1/16, 1/8, 1/8, 1/4, 1/2, 1, 2, 4, 8, 16 nm |
- (5) Min. detection range Better than 23 m on 1/4 nm range
- (6) Range resolution Better than 20 m
- (7) VRM accuracy 50 m or 1% of the selected range, whichever is the greater
- (8) EBL Accuracy 1°, in 0.2° steps rotation
- (9) Bearing resolution 1.8°
- (10) Bearing scal
- | | |
|----------|--------------------------------|
| Marking | 1°, 5°, 10° steps (0° to 359°) |
| Read-out | 10° steps |
- (11) Environmental conditions
- | | |
|-------------------|---------------|
| Temperature | -15°C to 55°C |
| Relative humidity | 95% at 35°C |
- (12) Rotary switch FUNCTION (S'BY, SP, LP, PM)
- (13) Rotary encoder VRM, EBL
- (14) Operatioal controls TUNE, GAIN, STC, FTC, VIDEO BRILL, MARKER BRILL, PLOT BRILL, NUMERIC BRILL, and track ball
- (15) Membrane switch EBL, POWER, RANGE, DIM, HM, RINGS, MODE (HU, CU, NU, TM), GYRO, SPD, IR, EXP, BEARING, TRAIL (OFF, 15, 30 sec, 1, 3, 6, 12 min), ALARM (OFF, 90°, 180°, 360°), SET (GYRO, ALARM), OFF CTR, FLT EBL, VECTOR, TRU/REL, DELETE, ALL CLR, ENTER, SYMBOL (○, □, △, ▽, ◇, ☆)
- (16) Presentation mode
- | |
|----------------------------------|
| Head-up |
| North-up (option, see Note 1) |
| Course-up (option, see Note 1) |
| True motion (option, see Note 1) |

Note 1: North-up, course-up, and true motion modes require built-in type optional gyro/log interface KSA-08.

1.1.3 Power supply

(1) Power requirements

- | | |
|---------|---|
| MD-3210 | 11 to 18 VDC or 21 to 36 VDC (See Note 2) |
| | Note 2: MD-3210 operates on 24/32 VDC mains as the standard. For operation on 12 VDC, change taps of the power transformer in the power supply MD-3210/3220-6000. |
| MD-3220 | 24 VDC |

(2) Power consumption

- | | |
|---------|-----------------|
| MD-3210 | 140 W at 24 VDC |
| MD-3220 | 160 W |

1.2 Composition

1.2.1 MD-3210/3220

(1) Standard equipment list

No.	Description	Rating	Remarks	Weight/Length	Q'ty
1	Aerial	MRA-37	6-foot span	8 kg (17.6 lb)	1
2	Transceiver unit	MRT-133	For MD-3210	17 kg (37.5 lb)	1
		MRT-134	For MD-3220	20 kg (44.0 lb)	1
3	Display unit	MRD-62	For MD-3210	37 kg (81.4 lb)	1
		MRD-68	For MD-3220	37 kg (81.4 lb)	1
4	Vinyl cover		For display unit		1
5	Connecting cable	9CD-3292C		15 m (49.5 ft)	1
6	Power cable	CW-89	250V-DPY2.0 8.5 mm Ø, with one end connector	5 m (16.5 ft)	1
7	Spare parts		See spare parts list		1 set
8	Installation materials		See installation material list		1 set
9	Operation manual				1

(2) Spare parts list

No.	Description	Rating	Use		Q'ty
			MD-3210	MD-3220	
1	Fuse, main	15 A (F-7165)	For 12 VDC	Not applicable	2
2	Fuse, main	8 A (F-7165)	For 24 VDC	Not applicable	2
		10 A (F-7165)	Not applicable	For 24 VDC	2
3	Fuse, MOD HV	0.3 A (F-7165)	For 10 kW TX	Not applicable	2
		0.5 A (F-7165)	Not applicable	For 25 kW TX	2
4	Fuse, CRT HV	1 A (F-7142)	For MD-3210/3220, see Note		2
5	Fuse, motor	3.15 A (TLC3.15A)	For antenna, MD-3210/3220		2
6	Lamp	KCDS-05	For control panel, MD-3210/3220		2
7	Motor brush	24Z125209	For antenna motor, MD-3210/3220		1 set

Note CRT HV fuse is not applied for the serial numbers shown below, equipped with power supply MD-3210/3220-6000M3.

MD-3210: No. 2100659 and thereafter
MD-3220: No. 3220336 and thereafter

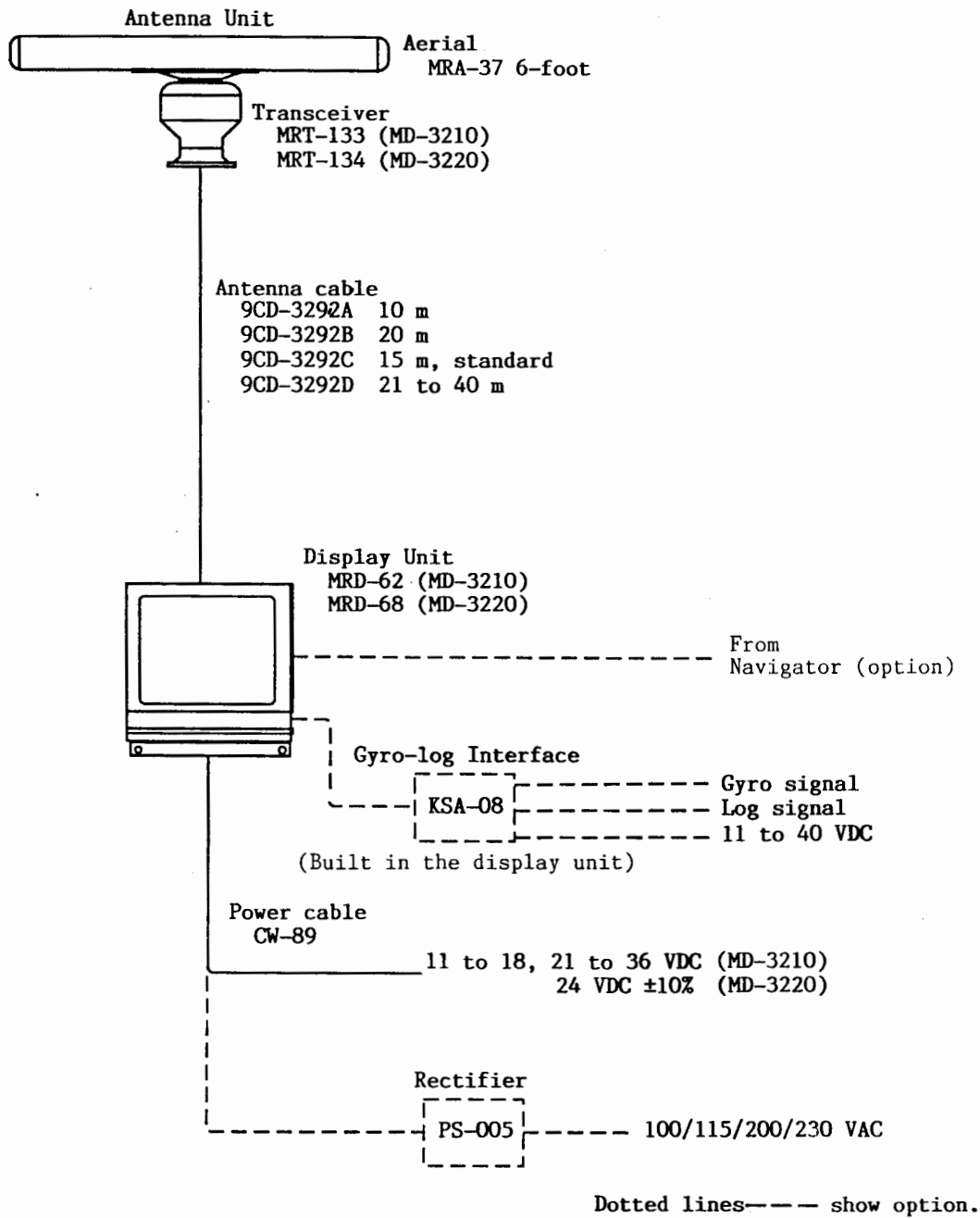
(3) Installation material list

No.	Description	Rating	Use	Q'ty
1	Coach screw	CW9 x 50S	For display unit	6
	Plain washer	W10S		6
	Spring washer	SW10S		6
2	Hexagonal bolt	B12 x 55U	For antenna unit	4
	Plain washer	2W12U		8
	Spring washer	SW12U		4
	Nut	N12U		8
3	Anti-corrosion washer	30 Ø	For antenna unit	4
4	Anti-corrosion washer	50 Ø	For antenna unit	4

1.2.2 Optional equipment

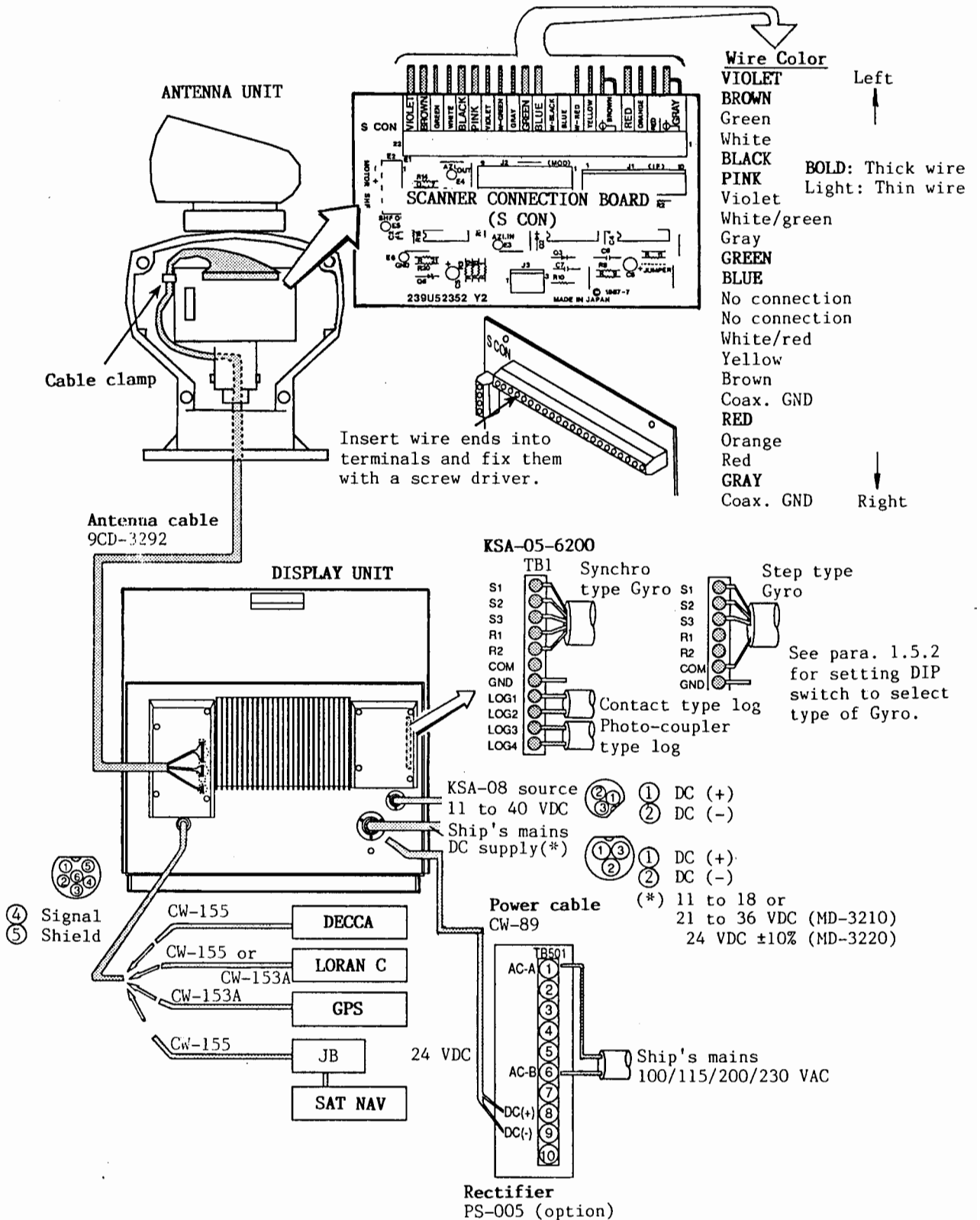
No.	Description	Rating	Remarks	Weight/Length
1	Gyro/Log interface	KSA-08	Built-in type	1 kg (2.2 lb)
2	Hood	HD-1100		
3	Base	0019-1219	Bulkhead mounting	
4	Rectifier	PS-005		8 kg (17.6 lb)
5	Navigator connecting cable	CW-94	With BNC/6-pin plugs	5 m (16.5 ft)
		CW-153A	With 6-pin plugs	5 m
		CW-155	With BNC/6-pin plugs	5 m

1.3 System Configuration of MD-3210/3220



Model	Antenna Unit		Display Unit
	Aerial	Transceiver	
MD-3210	MRA-37	MRT-133	MRD-62
MD-3220	MRA-37	MRT-134	MRD-68

1.4 Interconnection of MD-3210/3220



1.5 Modification of Specifications

1.5.1 Jumper pin setting

In order to set operational conditions of the unit, five jumper pins are provided on the logic lower board (MD-3210-7100). Functions and initial setting status of those pins are listed as follows:

Jumper Pin No.	Function	Initial setting	Modification
JP1	Level of plotting image	M: 3rd and 4th level of quantized 4-level video signal are plotted.	H: Only the highest (4th) level video signal is plotted.
JP2	Selection of trigger	OFF: Internal	ON: External
JP3	Composition of video signal and marker lines (EBL, VRM, SHF, and fixed range marker rings)	EXOR: Video signal level becomes [low] where marker lines ride on.	NORM: Video signal and marker lines are superimposed.
JP4	Status of output video	RAW: Raw video	PRO: Video signal processed on STC, FTC, and gain
JP5	Number of horizontal scanning lines	1,153: For 20-in CRT	1,089: For 15-in CRT

1.5.2 DIP switch setting

Three DIP switches, from SW1 to SW3 are mounted on the logic upper board (MD-3210-7000) in order to preset the operation of equipment. Functions set by those switches and their standard settings are listed below.

SW1 Element No.	Function				
1 2	Input data format	ON <input type="checkbox"/> NMEA-0183	OFF <input type="checkbox"/> KODEN-717	ON <input type="checkbox"/> NMEA-0182	OFF <input type="checkbox"/> No input
3 4	Speed log pulse ratio	ON <input type="checkbox"/> 100	OFF <input type="checkbox"/> 200	ON <input type="checkbox"/> 400	OFF <input type="checkbox"/> 500
5	Bearing data	ON: Serial (Loran, GPS)		OFF: Parallel (KSA-08)	
6	Gyro data	ON: Connected for NU, CU, or TM			OFF: Not connected
7 8	Gyro gear ratio	ON <input type="checkbox"/> 36:1	OFF <input type="checkbox"/> 90:1	ON <input type="checkbox"/> 180:1	OFF <input type="checkbox"/> 360:1

NU: North-up CU: Course-up TM: True motion, also need speed data
 Items marked with shadow are standard setting.

DIP switch setting, continue

SW2 Element No.	Function		
1	Range setting	ON: 2, 4, 8 nm series	OFF: 3, 6, 12 nm series
2 3	Maximum range	ON <input type="checkbox"/> 64 nm OFF <input type="checkbox"/>	OFF <input type="checkbox"/> Not used
			ON <input type="checkbox"/> 72 nm ON <input type="checkbox"/> MD-3210
			OFF <input type="checkbox"/> 96 nm ON <input type="checkbox"/> MD-3220
4	EXP effect range	ON: Above 3 or 4 nm range	OFF: All ranges
5	Trail mode	ON: Latest four tracks	OFF: Continue all tracks
6	Trail sampling	ON: Every antenna rotation	OFF: Intervals set by key
7	VRM unit	ON: km/hour	OFF: Nautical mile
8	Performance monitor	ON: Connected	OFF: Not connected

SW3 Element No.	Function		
1	Not used.		
2	Not used.		
3	Speed data	ON: Serial (Loran, GPS)	OFF: Parallel (KSA-08)
4	Off-centering mode	ON: Move 2/3 radius to stern OFF: Move to any point within 2/3 radius with cursor	
5	Parallel cursor	ON: Parallel cursor and EBL are selectively displayed. OFF: Only EBL is displayed.	
6	Waypoint	ON: Display WP (waypoint)	OFF: Does not display WP
7	CRT size	ON: 15" Note) MD-3210-7100 jumper pin JP5 must be set to 1,089 for 15" or 1,153 for 20" CRT. OFF: 20"	
8	Resetting true motion display center	ON: Sweep origin returns scope center when travelled up to 2/3 radius ahead. OFF: Sweep origin is set 2/3 radius off from scope center to stern when travelled 2/3 radius ahead.	

2. FUNCTION OF EACH UNIT

2.1 Antenna Unit

The antenna unit consists of the slotted array aerial, antenna drive mechanism, transmitter, receiver, and T/R switching assembly. The transmitter consists of the magnetron and modulator circuit with HT supply and trigger amplifier. Fig. 2.1 illustrates the block diagram of the antenna unit, and Table 2.1 lists the composition of antenna unit.

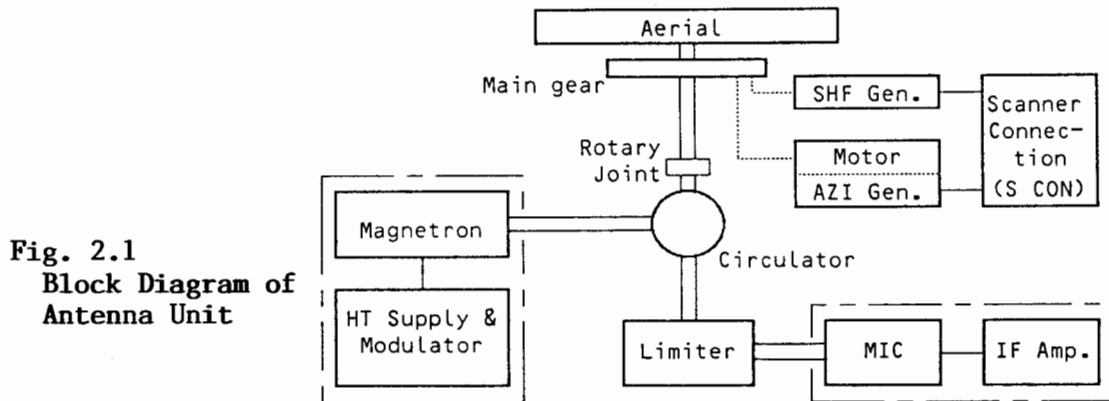


Fig. 2.1
Block Diagram of
Antenna Unit

Table 2.1 Composition of Antenna Unit

No.	Description	Function	Part No.	
			MRT-133	MRT-134
1	Aerial	RF emission and reception	MRA-37 (6-ft)	MRA-37 (6-ft)
2	SHF generator	Ship's heading flash generation	FRS-901-3	FRS-901-3
3	Motor with pinion	Aerial rotation and AZI pulse generation	23G53203	23G53203
4	Modulator	HT supply and pulse modulation	239U52236B (10 kW)	229U25361 (25 kW)
5	Magnetron	X-band RF oscillation	MSF1425B	E3564A
6	Circulator	RF signal duplexing	FCX68	FCX68
7	Limiter	Protection of receiver	NJS6930	S-LX17
8	MIC	RF amplification and frequency conversion	NJT1946	S-RX34
9	Log IF amp	Logarithmic IF amplification and detection	239U52512	239U52512

2.1.1 Aerial

The antenna units of MD-3210 and MD-3220 are respectively provided with a 6-foot aerial for transmitting and receiving radiowave. The aerial is a non resonant type slotted array waveguide which radiates and receives an X-band horizontal polarization microwave. One end of the aerial is connected to the magnetron via rotary joint and circulator, while the other end is ter-

minated with a matching load. The vertical beam width 22° is wide enough to avoid losing target echoes when the ship is rolling. The horizontal beam width 1.2° of 6-foot aerial gives good bearing resolution. Fig. 2.1.1 illustrates an example of slotted array waveguide aerial.

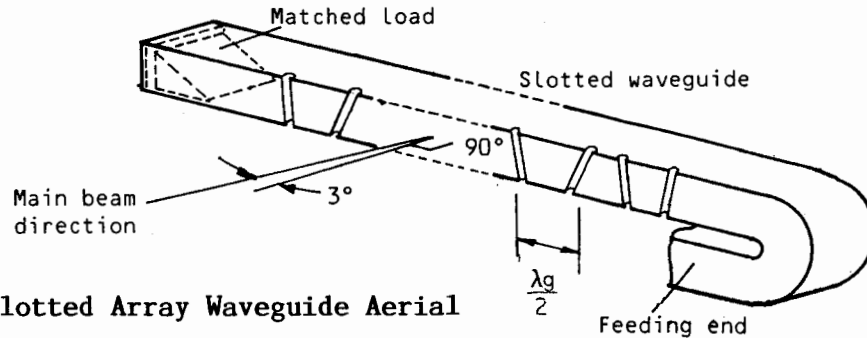


Fig. 2.1.1 Slotted Array Waveguide Aerial

2.1.2 Antenna motor

The antenna motor rotates at a speed of 2,160 rpm. It has built-in 15:1 reduction gears, and the pinion shaft is coupled to the main gear with reduction rate of 6:1 to rotate the aerial at 24 rpm. The motor is powered from 24 V DC with power consumption of 15-watt. A photo-interrupter is mounted on the motor to generate azimuth (AZI) pulses. Fig. 2.1.2 shows a simplified schematic of the antenna motor assembly.

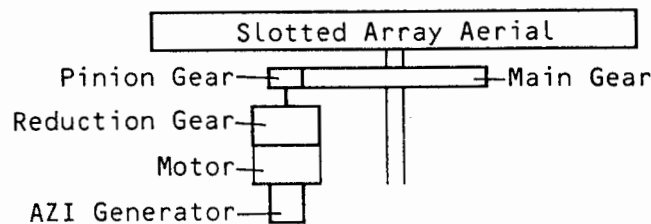


Fig. 2.1.2 Antenna Motor Assembly

2.1.3 SHF and AZI generators

(1) SHF

A lead switch associated with a magnet is provided for generating the ship's heading flash (SHF) signal. At the moment when the magnet mounted on the main gear passes by the lead switch, the contact closes and generates negative phase SHF pulse signal. The signal is fed to the buffer amplifier Q1-d of the scanner connection board (S CON), and then delivered to the display unit via pin #18 of E1.

(2) AZI

On the end of the motor shaft opposit to the pinion gear, a hole is made along the diameter. As shown in Fig. 2.1.3.1, the holed end of the shaft is inserted into the photo interrupter Q3 which produces two pulse signals at every rotation of the shaft. As the motor normally rotates at a speed of 36 revolutions per second, the repetition rate of signal is 72 pps. The aerial is rotated at one 90th of the motor revolution with the built-in reduction gears and pinion/main gears, 180 pulse signals are produced per one revolution of the aerial. The signal is fed to the buffer amplifier Q1-b, and then to Q4 of the PLL frequency multiplier in

the scanner connection (S CON) board. The multiplier Q4 consists of a phase comparator and voltage controlled oscillator (VCO). When the AZI pulse train from the motor is fed to Q4 pin #14 via AZI IN terminal E3, the circuit made of C7, C8, Q2, Q3, and R8 through R10 lowers the level of Q4 pin #5 which makes Q4 to start operation. The Q4 output frequency is ordinarily divided into 1/5 by dividers Q5 and Q1-a. The phase difference between output signals of the divider and buffer Q1-b is detected by the phase comparator. The error voltage is fed to the VCO so that the output frequency of Q4 is held at five times of the input. The output of Q4 is delivered as 360 Hz azimuth pulse signal (AZIP) to the display via buffer Q1-c.

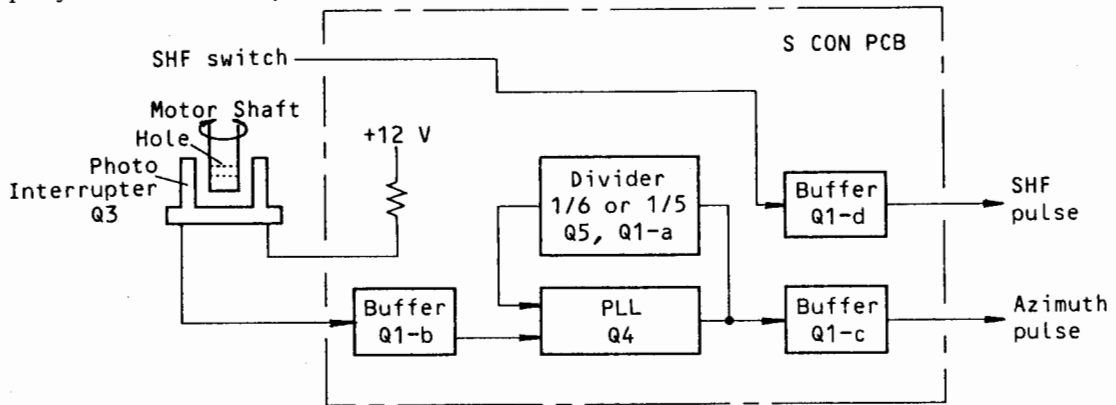


Fig. 2.1.3.1 Block Diagram of SHF/AZI Circuit (S CON)

Fig. 2.1.3.2 shows the waveforms of the AZI circuit.

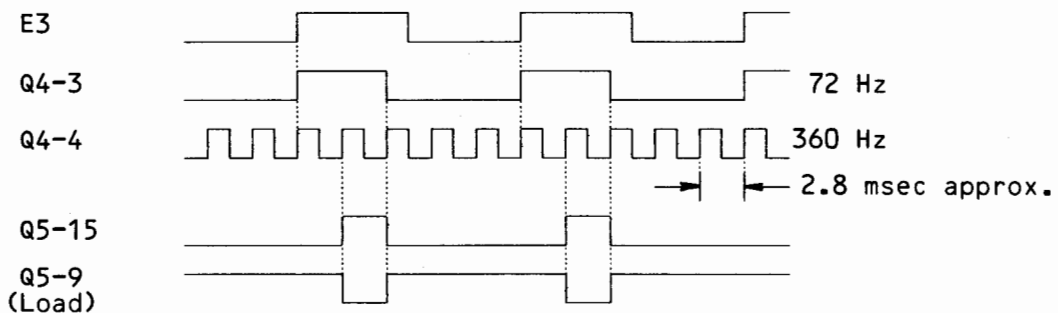


Fig. 2.1.3.2 Waveforms of AZI Circuit

2.1.4 Transmitting section

The transmitting section mainly consists of the modulator, pulse transformer, and magnetron. MRT-133 for MD-3210 is built with a 10 kW modulator, and MRT-134 for MD-3220 with 25 kW modulator. The operational theory of modulator is similar to both models; however, number and ratings of some components are different. In the following description, the ratings and components with brackets [] apply to 25 kW modulator. Fig. 2.1.4 shows a simplified block diagram of 10 kW modulator together with pulse transformer, magnetron, and protection diodes. Refer to respective circuit diagrams for detailed numbers of the circuit components.

(1) Modulator

A [two] thyristor is used for producing high voltage negative pulses to actuate the magnetron. Capacitors C9 to C16 [C9 to C22] of the pulse forming network (PFN) are charged up by the +300 V (MOD S) sent from the

display power supply, via charging choke T1 [L1] and series diode Q7. The charging operation utilizes the resonant frequency determined by inductance of the charging choke and capacitance of PFN. The charging current flows only in the positive half-cycle of the resonant sinusoidal wave and the voltage reaches twice as much of the source voltage. The series diode Q7 blocks reverse current flow in the falling period so that the line is held in high voltage.

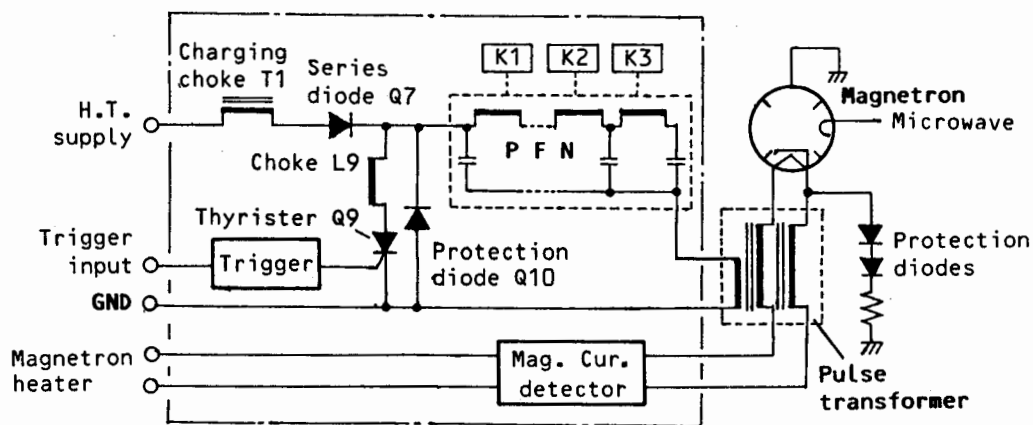


Fig. 2.1.4 Simplified Block Diagram of 10 kW Modulator

Shortly after the charging voltage became maximum, a trigger pulse is given to the gate of thyristor Q9 [Q9, Q10] and then thyristor conducts discharging the PFN. The L and C of PFN are switched by relays K1 to K3 as shown in the list below to determine the pulse length.

Table 2.1.4 Pulse Length Switching

Pulse length (μ sec)	Relay		
	K1	K2	K3
0.08	OFF	OFF	OFF
0.3	ON	OFF	OFF
0.6	ON	ON	OFF
1.2	ON	ON	ON

The protection diode Q10 [Q11] avoids damage of thyristor caused by a reverse voltage. Choke L9 [L9, L10] protects the thyristor from a rush current at the moment when it is turned on.

The circuit around T2 [L13] and Q11 [Q13] is provided to detect the magnetron current for monitoring the performance of the transmitter.

(2) Pulse transformer and magnetron

When the thyristor conducts, a discharging current flows from PFN capacitors through the primary winding of pulse transformer (PT), producing high voltage negative pulse. The output voltage of PT is then stepped up to 5.8 kV [7.8 kV] to energize the magnetron V1. As the PFN impedance is designed as matching to the magnetron impedance via pulse transformer, the energy from PFN is efficiently transferred to the load. Unavoidable slight mismatching between them may cause to induce a reverse voltage at the magnetron cathode. Protection diodes Q1 and Q2 with R1 are provided to shunt the reverse voltage to protect the magnetron.

2.1.5 Duplexing assembly

The duplexing assembly consists of circulator V4 and limiter V5. Circulator FCX68 for both type scanners functions to switch the microwave signal among the rotary joint, transmitter, and receiver. During the transmitting period, the circulator feeds the high power magnetron output to the slotted array aerial without leakage to the receiving section. In the receiving period, the circulator transfers the receiving microwave signal to the front end module via limiter with very low loss of the power.

The limiter diode NJS6930 [S-LX17] protects the front end module MIC from a high power microwave invasion, internally from the magnetron or externally from other radars.

2.1.6 Receiving section

The receiving section consists of the front end module (FEM) and IF unit with a logarithmic amplifier.

(1) Front end module (FEM)

A microwave integrated circuit so called MIC is used for the front end module (FEM) of the receiving section. The 10 kW output scanner MRT-133 uses the MIC type NJT1946, while 25 kW scanner MRT-134 uses type S-RX34. Both types require separate limiter, i.e. NJS6930 for MRT-133 and S-LX17 for MRT-134. The MIC mainly consists of a waveguide-to-coaxial converter, low noise front end GaAs FET amplifier, FET local oscillator, balanced mixer, monitor circuit, and power supply. All elements are mounted in a single module, making the FEM so compact. The GaAs FET amplifier directly amplifies the X-band microwave of the returned echo signal. The FET local oscillator frequency in 9,470 MHz is simply controlled by varying the tuning voltage. The balanced mixer converts the receiving signal frequency to 60 MHz intermediate frequency (IF). Fig. 2.1.6 illustrates the block diagram of MIC front end module.

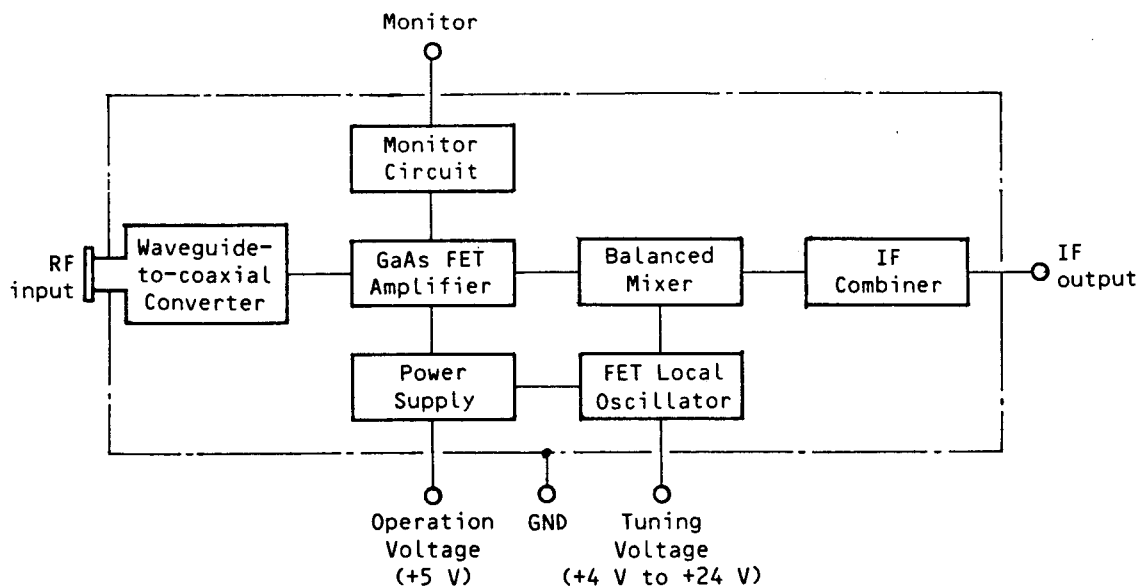


Fig. 2.1.6 Block diagram of MIC Front End Module

(2) IF unit

The IF unit mainly consists of the low-noise linear preamplifier, band-pass filter, logarithmic amplifier, and tuning indication circuit.

Transistor Q6 makes low-noise preamplifier with approx. 20dB gain. The receiving bandwidth of the amplifier is determined by "Q" of the band-pass filter (BPF) made of L1 and C54. The "Q" is controlled by BW signal sent from the display, according to transmitting pulse width as shown in Table 2.1.6. In long ranges, BW signal becomes 12 V and diode Q5 is cut off increasing "Q" of the circuit. High "Q" brings sharp resonance and high gain to the amplifier. In short ranges, BW signal becomes 0 V turning Q5 to conduct, lowering "Q" of the circuit. Low "Q" brings broad resonance with high fidelity for clearly presenting short range images.

Table 2.1.6 Tx Pulse Width vs IF Bandwidth

Tx Pulse Width (μ sec)	IF Bandwidth (MHz)	BW Signal
0.08 & 0.3	15	0 V
0.6 & 1.2	5	+12 V

The logarithmic IF amplifier circuit is made of cascade connected seven dual-gain log-amplifiers having high fidelity of pulse signal amplification. The IF signal is amplified by Q6 through Q35, and then detected by Q37. The detected signal is then amplified by the video amplifiers Q39, Q40, and Q41.

Amplifiers Q43 through Q51 receive partial output of Q6. The transmitting pulse leaked from circulator and converted to 60 MHz IF by FEM is detected by this circuit and transformed into DC voltage for tuning indication in the display. The bandwidth 5 MHz of the circuit is given by C74 and T2. In order to avoid interferences of other radars for stable tuning indication, Q43 is enabled only for the transmitting period when TRIG signal is applied.

The front end module MIC tuning voltage $+25 \pm 5$ V is supplied from the display. The semifixed resistor R1 is adjusted so that the receiver is tuned to the best point on the long range when the voltage is +25 V.

2.2 Display unit

The display unit consists of the following printed circuit boards and assemblies.

- | | |
|--|-------------------------|
| (1) Power supply | MD-3210/3220-6000 |
| (2) Line filters | MD-3210-6100 & LF215NEW |
| (3) Logic upper | MD-3210-7000 |
| (4) Logic lower | MD-3210-7100 |
| (5) Control panel with
membrane sheet | MD-3210-7200 |
| (6) CRT unit | K20MM-01B |

The block diagram of the display unit is illustrated in Fig. 2.2.

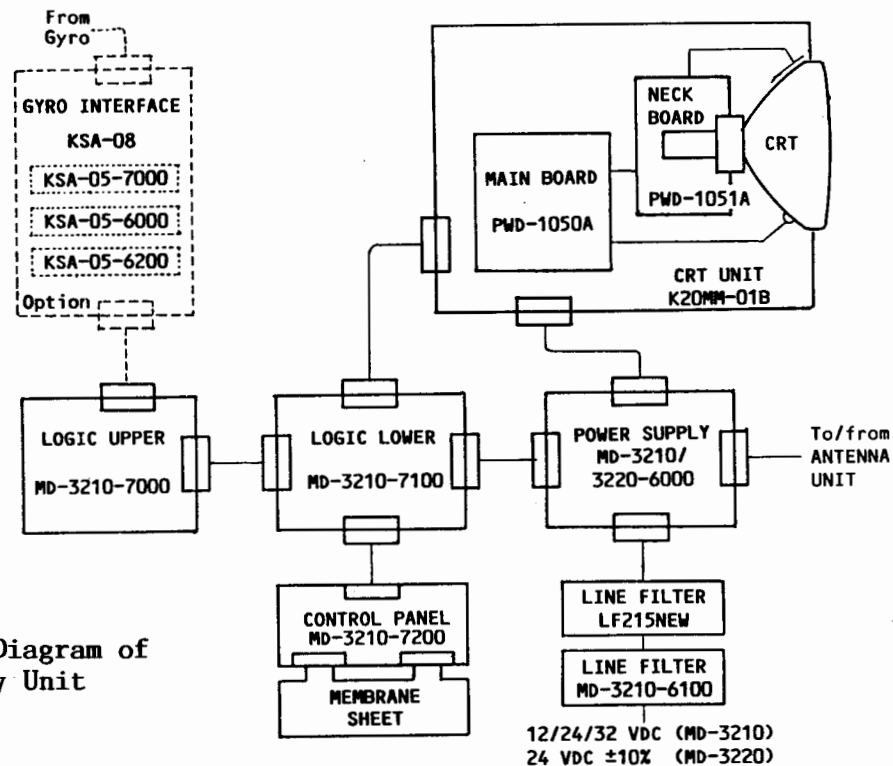


Fig. 2.2
Block Diagram of
Display Unit

2.2.1 Power supply (MD-3210/3220-6000)

MD-3210 is operated by the ship's mains of 11 to 18, or 21 to 36 VDC, while MD-3220 by 24 VDC $\pm 10\%$. The ship's main is fed via line filters (MD-3210-6100 and LF-215). The power supply MD-3210/3220-6000 is used for both type radars. The power supply converts the ship's mains to several kinds of supply voltages by means of a pulse controlled switching regulator. Fig. 2.2.1 (a) shows the block diagram of the power supply and line filters.

(1) Control circuit

The control circuit (IC3) functions to oscillates the switching square wave signal and controls the duty of that signal in order to regulate the output voltage level. When the power is turned ON by pressing the POWER switch, approx. 10 V starting voltage is given to the control circuit. According to the CR constant (C8, R20, and VR1) connected to the

IC, the circuit oscillates a switching signal in a frequency of $70 \pm 1 \text{ kHz}$. Half-cycles of the signal are alternately applied to push-pull switching circuit 1 and 2 respectively. The width of applied square wave is controlled so that the output voltage of the circuit is stabilized.

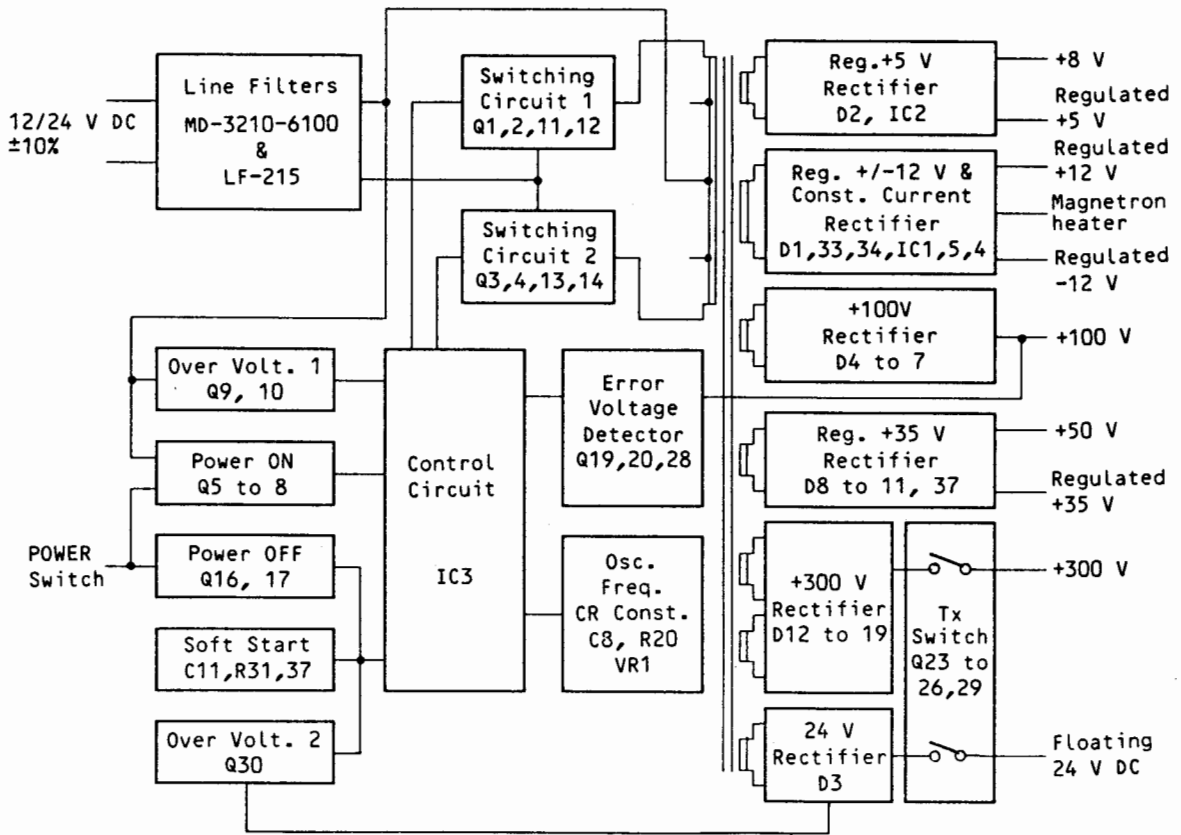


Fig. 2.2.1 (a) Block Diagram of Power Supply and Line Filters

Just after the power is turned ON, the soft-start circuit gradually activates IC3 preventing rush current and ringing of the switching circuit to protect the switching FETs, and rectifier diodes. Typical waveforms are shown in Fig. 2.2.1 (b).

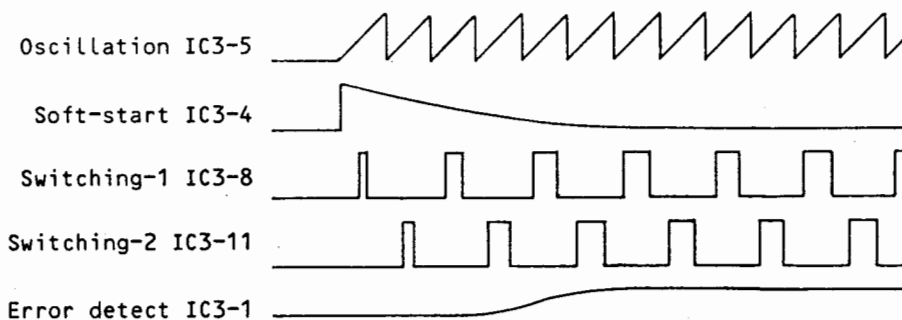


Fig. 2.2.1 (b) Waveforms of Control Circuit

When the soft-start period completes and the DC voltages become stable, a part of the +100 V output is fed to the error voltage detector (Q19, 20, D36). VR3 [V ADJ] sets the reference point of the voltage regulator circuit. The error voltage is fed back by photo-coupler Q28 to the con-

trol circuit IC3 to automatically adjust the duty of switching waveform so that the error voltage is minimized.

If the ship's main supply is higher than 42 V, over-voltage detector-1 (Q9, 10) doesn't allow IC3 to start switching oscillation. Over-voltage detector-2 (Q30) monitors the output voltage of the motor power 24 V rectifier diode D3. The voltage is adjusted by VR2 [V LMT] and fed to Q30 via zener diode D28. If the ship's main supply or oscillating output level become excessively high, Q30 conducts to stop operation of IC3. Fully clockwise position of VR2 corresponds the ship's main of 41 V.

When POWER switch is pressed for more than 3 seconds, C13 is charged up first, and then C14 is charged up through Q16 and D25. Q17 and Q15 then conduct consequently to stop IC3 switching operation.

(2) Rectifier circuits

Stepped up/down switching wave voltages derived from secondary windings of transformer T1 are rectified and smoothed by full-wave or bridge-type rectifiers into various DC supply voltages. +12 V, -12 V, and +5 V are further regulated by respective three terminal voltage regulators.

The magnetron heater voltage is supplied from IC5 through R45, 46, 82, and VR4. The circuit delivers 0.55 A constant current in short range and 0.44 A in long range operation to the magnetron heater. The output voltage at TP5 is approx. 7 V for obtaining 6.3 V at magnetron heater. VR4 adjusts the current to 0.55 A constant in short range operation. In long range, the logic board CPU delivers 'high' [H.C.: heater control] signal, which actuates photo-coupler Q32 to shunt VR4. As a result, the circuit becomes to deliver 0.44 A constant current to the magnetron.

2.2.2 Logic section

The logic section is composed of the logic upper and logic lower boards. The logic upper board basically functions with a CPU to digitally control the system. The logic lower board mainly functions to process the radar video signal, as well as to produce trigger pulse.

(1) Logic upper (MD-3210-7000)

The logic upper board consists of the following circuits:

- CPU and peripheral circuit
- Advanced CRT controller (ACRTC)
- ACRTC control circuit
- Character video memory
- Character output circuit
- DIP switch reading circuit
- Others

(a) CPU and peripheral circuit

A 16-bit microprocessor UPD70208 (V40) is used as CPU with 64-k ROM and 8-k RAM. The CPU transfers 8-bit data through the data bus. Address bus contains A0 through A19. A0 to A7 are latched at IC2C (HC373), A16 to A19 at IC2H (HC373), while A8 to A15 are directly transferred from CPU.

CPU operates with 10 MHz clock made from the 20 MHz oscillator output.

When the power is turned on, the power-on-clear (POC) IC4K holds RESET terminal (pin #71) of CPU in "low" for several milliseconds after the logic voltage has been stabilized. CPU is reset (cleared) in this period until the level becomes "high". At the same time, POC signal delivered from POC terminal resets other digital circuits such as RAM and ACRTC.

CPU is provided with built-in serial data control unit (SCU) to accept a series input data directly from navigators via RXD terminal.

The block diagram of CPU is shown in Fig. 2.2.2.1.

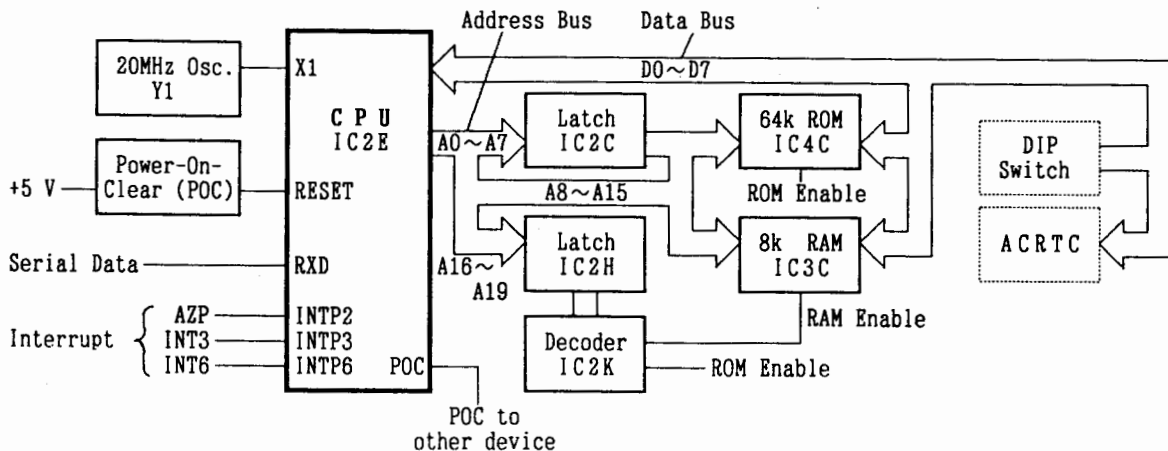


Fig. 2.2.2.1 Block Diagram of CPU

The CPU accepts following interrupt signals.

- INTP2 AZP sent from logic lower board (Reformed AZIP)
- INTP3 Transfer end signal from KCD-24
- INTP6 Request from gyro interface unit

AZP and transfer end signal control the timing of data transfer from LSI to radar memory. The azimuth pulses are generated in the antenna drive motor. The signal is applied to the PLL 6-time frequency multiplier in the S CON board as mentioned in para. 2.1.3 (2), and 1,080 AZIP pulses are sent to the display per one antenna revolution. AZIP is reformed in the logic lower board into AZP and sent to CPU. Between AZP pulses, CPU generates final timing pulse AZI to transfer 6-sweep data from LSI to the video memory. A total of 6,480 sweep data transfer completes one antenna revolution, i.e. 360° rotation. Fig. 2.2.2.2 shows the data transferring timing chart.

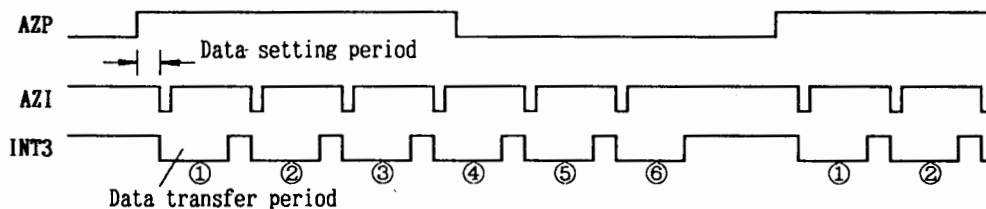


Fig. 2.2.2.2 Data Transferring Timing Chart

(b) Advanced CRT controller (ACRTC) and character video memory

Under CPU control, ACRTC IC9C (HC63484) generates all images other than radar images. Those images include lines, rings, symbols, marks, as well as alpha-numerical characters such as range scales, VRM/EBL values, and other data. The produced image data are written into the character video memories from IC5A to IC12A. The operating clock is 2CLK which is made by dividing the reading clock DCK of video RAM into 1/8. Fig. 2.2.2.3 illustrates the block diagram of ACRTC, video RAM (VRAM) and their peripheral devices.

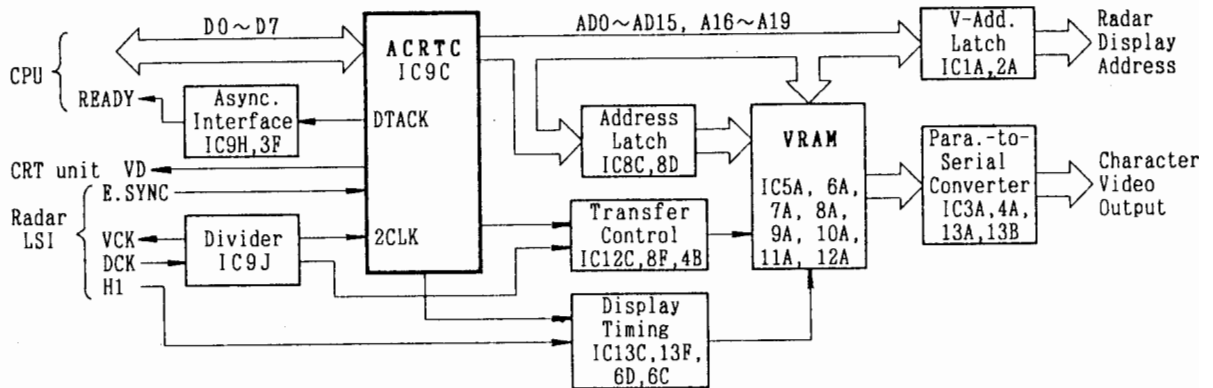


Fig. 2.2.2.3 Block Diagram of ACRTC and Peripheral Devices

E.SYNC synchronizes the presentation of radar echo image and character video. It handles the radar LSI as master device and ACRTC slave; however, as the horizontal scanning line number 1,153 for 20-inch CRT exceeds the radar LSI maximum scanning line number 1,024, the vertical sync and vertical address of ACRTC are used for radar picture display, instead of such signals of radar LSI. Fig. 2.2.2.4 illustrates the timing chart of ACRTC operation, where A designates 'address' and D 'data'.

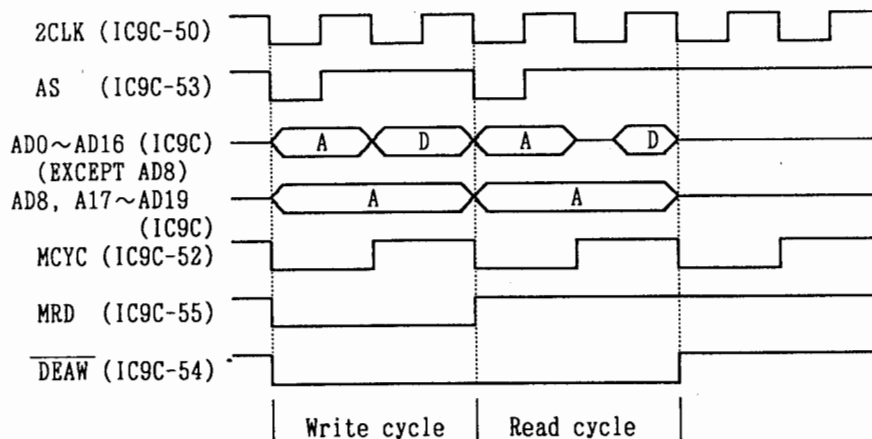


Fig. 2.2.2.4 ACRTC Timing Chart

As shown in Fig. 2.2.2.5, the character video memory consists of four memory groups. Those groups include the memories for markers, plotting images, and alpha-numerical letters, plus one group named 'mask' which determines the presentation area of the radar image picture. Contents of the video RAM is administrated by ACRTC which writes and reads the data in accordance with the command or data sent from CPU.

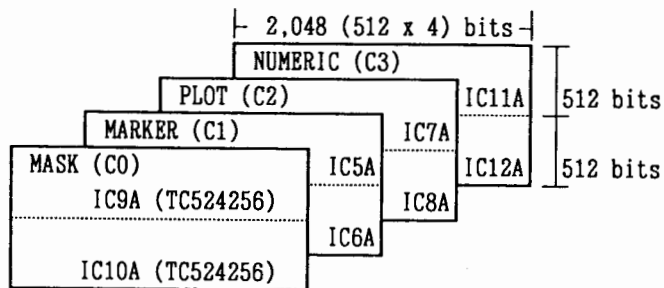


Fig. 2.2.2.5 Composition of Character Video Memory

One chip of the video RAM (TC524256Z) is a device called 'dual port RAM' commonly used for memory of images. In addition to ordinary I/O port, it has series data output port to deliver the data in series. The memory consists of RAM and SAM (series access memory) portions, each of them is further divided into four blocks. One block comprises 512 x 512 bits RAM and 512 bits SAM. When reading the contents of RAM, 2,048 bits memories for one CRT sweep line (512 in four blocks) are transferred to respective SAM in parallel as shown in Fig. 2.2.2.6. The data in SAM can be read out in series, like a shift register, by the series clock SC. Four bits parallel output of SAM is then fed to a parallel/series converter (F915) to finally deliver the data in series. Once the data is transferred from RAM to SAM, both memory portions become independent. That means, during relatively long period when the data is being read from SAM, RAM can be freely read or written by CPU control.

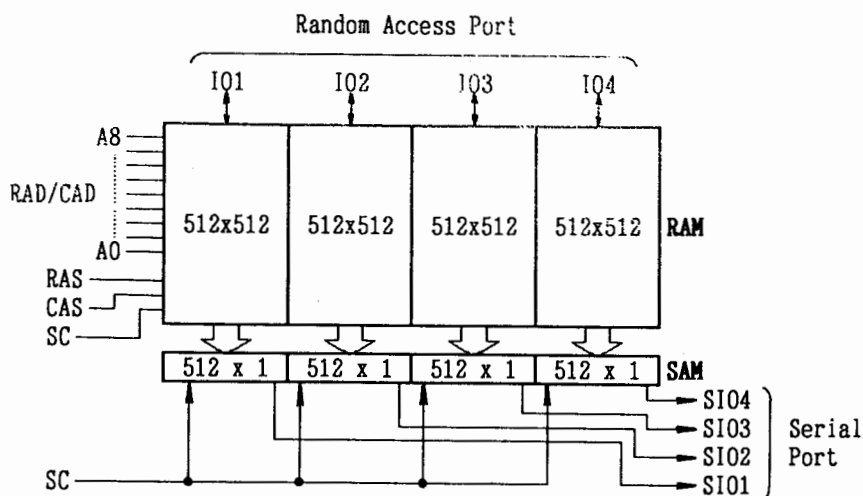


Fig. 2.2.2.6 Block Diagram of Dual Port RAM

(c) DIP switches

Three DIP switches, SW1, SW2, and SW3 are provided on the logic upper board in order to preset the function of the equipment. Refer to para. 1.5.2 for details of the functions set by these switches. The status of three switches is read by the CPU via data bus, D0 through D7.

(d) Panel interface circuit

The panel data signal (PDT) delivered in series from the control panel is converted into 8-bit parallel data in the panel interface circuit.

The panel clock (PCK) and panel strobe signal (RCK) are used for timing. The output pulse of VRM, EBL and track-ball encoders are respectively counted and read by CPU through the data bus. Fig. 2.2.2.7 shows the timing chart of the panel interface circuit.

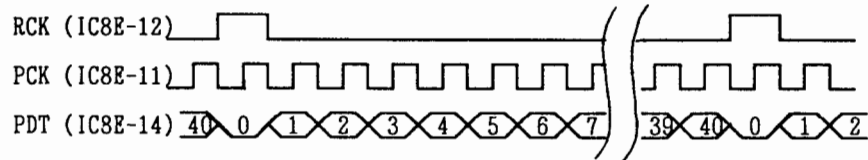


Fig. 2.2.2.7 Timing Chart of Panel Interface Circuit

Five pieces 8-bit shift registers with latch HC595 (IC8E, 5H, 3H, 6H, and 4H) are provided for panel interface circuit to receive the signals from control panel. The PDT signal train is shifted into the registers connected in series. Every time when the 41st data (always 'low' named dammy data 0) is entered, all the data bits are latched by the strobe pulse PCK.

(2) Logic lower (MD-3210-7100)

The logic lower board MD-3210-7100 contains analog circuits to produce the antenna control signals such as trigger, tune signal, pulse width relay control, and others. It also has analog circuits to process radar return echo video signal entered from the antenna. Application specified IC (ASIC) LSI KD-24 is mounted in the circuit to digitally process the echo signals for sampling, scan conversion, interference rejection, expansion, and to write the radar video data into the video memory under the control of CPU in the logic upper board. The radar video data in the video memory is then composed with the character video produced in the logic upper, and sent to the CRT unit to display.

For understanding the ASIC LSI for radar Type KCD-24, refer to Appendix.

(a) Analog signal processing circuit (Circuit diagram 3/3)

Fig. 2.2.2.8 illustrates the block diagram of analog signal processing circuit. The front end of the circuit is designed to accept video signals of 2 Vp-p maximum level. As the raw video signal sent from the antenna unit is about 3.5 Vp-p, the level is appropriately adjusted to 2 Vp-p by the potentiometer VR1 [VIDEO IN].

The FTC circuit suppresses the rain or snow echo images by attenuating the low frequency component of the signal. Transistor Q2 detects rapidly falling edge of the incoming video signal. The FTC control voltage sent from the display is given to Q40 and varies the current flowing through diodes D2 and D1. In other words, the operating voltage level at Q4 base is determined by diodes according to the FTC control, and front edges of echo signals are selectively amplified by the following circuit. Transistor Q3 stops the current of echo front to flow through D2 and D1.

The STC waveform is made from the trigger pulse fed to IC1L. The maximum amplitude of STC waveform is adjusted by VR2 [STCLEV], while the starting time by VR3 [STC TIME]. The discharging curve of STC waveform is determined by the CR time constant given by C10 to C13, and R22 to R25. When the STC voltage is applied to Q7, the load resistance of Q5 is low-

ered and the video gain is decreased. According to the recovering voltage, the gain of distant echoes is recovered. STC knob of the control panel varies the level of STC curve to adjust the effective area of STC.

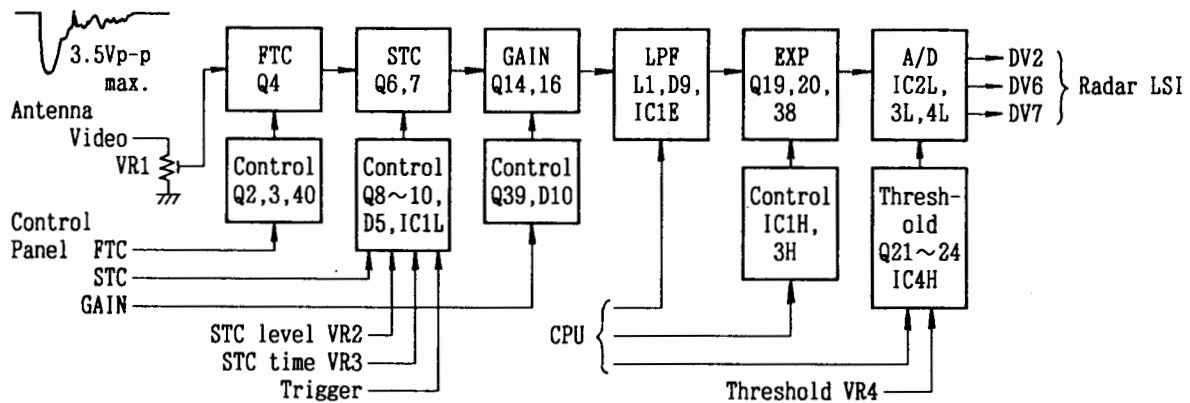


Fig. 2.2.2.8 Block Diagram of Analog Signal Processing Circuit

The voltage given from GAIN control varies the operational resistance of Q16 to adjust the amplitude gain. The bandwidth of low-pass filter is varied by L1 and varicap diode D9 with the control signals PWO and PW1 delivered from CPU according to RANGE.

The EXP circuit enhances the size of target images by holding the peak value to the length determined by the CR constant of C26, C29 and R54 to R60. The CR constant is switched over so that image enhancement stays unchanged on the screen even RANGE is varied. Control signals EXP, EXPO, EXP1, and EXP2 are delivered from CPU.

The amplified analog signal is finally converted into 3-digit digital signals by high speed comparators IC2L, 3L, and 4L. The reference level of comparator is given from the threshold circuit. The threshold is deep in short range while shallow in long range, so that the noise density on the screen becomes uniform. The threshold level is adjusted by VR4 [THRESHOLD], as well as controlled by signals TH0, TH1, TH2, and TH3 sent from CPU. The digitalized video signals, DV2, DV6, and DV7 are sampled by 77.673 MHz high frequency sampling circuit composed of IC6X, 6Y, and 6Z. The output of these circuits is sent to the sampling circuit of the radar LSI KCD-24.

(b) Radar LSI (KCD-24, IC7T)

The application specified IC (ASIC) radar LSI KCD-24 (IC7V) is controlled by the CPU through data bus. The radar LSI contains major radar signal processing circuits as listed below.

- Sampling circuit and sampling clock divider
- High speed buffer memories
- Interference rejection circuit
- Polar to X-Y coordinates converter
- CRT drive control
- Others

Fig. 2.2.2.9 illustrates the block diagram of radar LSI KCD-24.

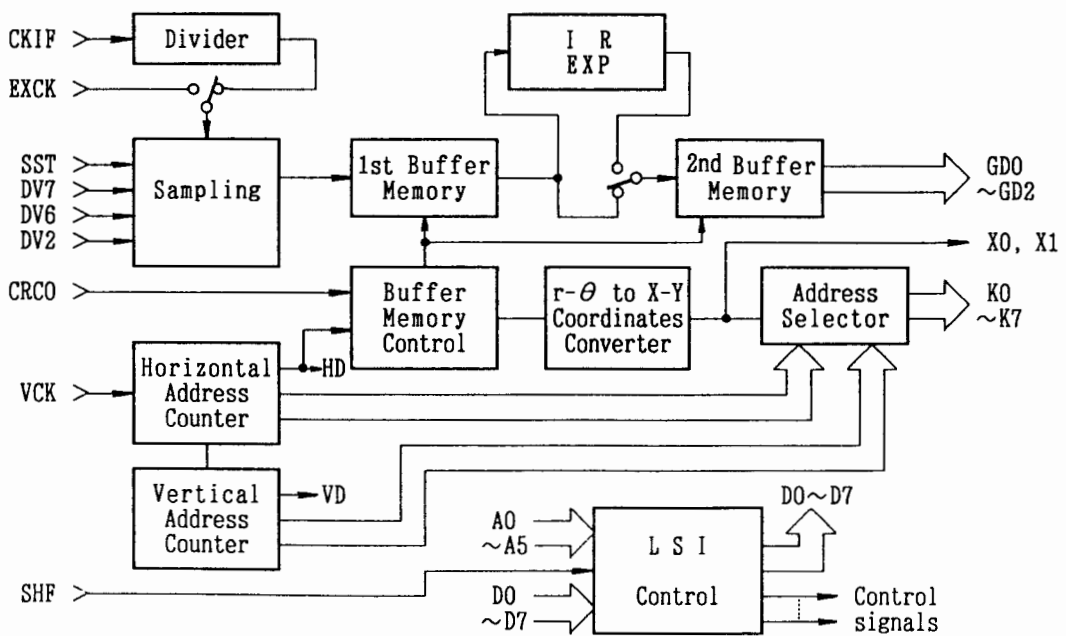


Fig. 2.2.2.9 Block Diagram of Radar LSI KCD-24

Flow of signals in radar processing operation is explained as follows.

i) Sampling

The digital radar video signals DV2, DV6, and DV7 sampled in the high frequency sampling ICs IC6X, 6Y, and 6Z are further sampled in the LSI, starting at the leading edge of SST timing pulse. Number of the samples per one radar sweep is set to 800 constant by CPU. Because the radar sweep period differs according to range scale, the sampling frequency is determined by the selected range. The reference signal for sampling clock pulse is generated by the 77.673 MHz oscillator (Y1), divided by IC7Z, 7Y, and 7X, then fed to LSI as CKIF at IC7T-1. CKIF is divided within the LSI to make correct sampling intervals in accordance with the selected radar range.

ii) High speed buffer memories

The sampled radar video signal is converted to 8-bit parallel data and written into the 1st buffer memory. The memory has a capacity for holding two sweeps video data. The memory area is altered at the timing of transmitting trigger (SST). When one cycle of 800 bits sampling is completed, the data is immediately transferred to the 2nd buffer memory. When the interference rejection (IR) is turned on, two sweep data memories are simultaneously read, correlated, and then written into the 2nd buffer. The radar video is delivered from the 2nd buffer memory as digital signals, GDO to GD2. Fig. 2.2.2.10 shows the timing chart of data transfer in LSI.

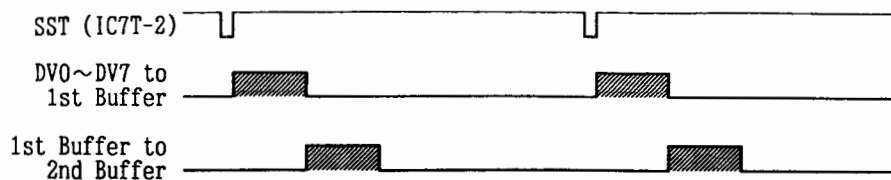


Fig. 2.2.2.10 Data Transfer Timing in LSI

iii) Coordinates conversion

Memory transfer from the 2nd buffer to the radar video RAM is started by the control pulse AZI made of AZP, the reformed pulse of AZIP sent from the antenna unit. (Refer to Fig. 2.2.2.2 Data Transferring Timing Chart.) When the data is transferred, address of the radar video RAM is produced by the coordinates converter. That is, the polar coordinates of each bit radar video is converted into X-Y address referring the sine/cosine data set by CPU at every AZI timing. The X-Y address codes X0, X1, and K0 through K7 are delivered from LSI. The data is transferred bit by bit in 206 ns intervals, 8 times longer period of CRCO clock intervals. Fig. 2.2.2.11 shows the timing chart of data transfer from LSI to radar video RAM.

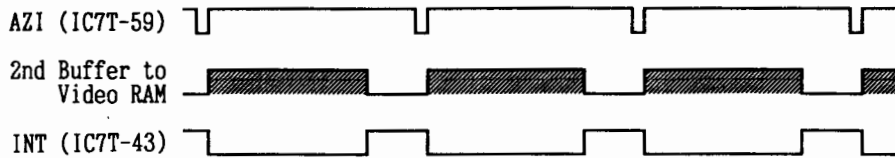


Fig. 2.2.2.11 Data Transfer Timing from LSI to VRAM

iv) Radar video RAM and peripheral circuits

Six chips of 1 M-bit dual port RAM (μ PD42274V, IC7F to 7H, 7J to 7L) are provided for radar image, while four chips of the same RAM (IC7B to 7E) for trail image video. A total of 1,024 x 1,024-bit memories are allocated to whole CRT screen. Among them, a circle with 980 bits horizontal or vertical diameter is assigned to the radar image area. In a conventional method, one radar video memory area was directly up-dated regarding the existence or not of the echo signals on the latest pulse transmission. This method has a disadvantage that the radar information in the pixels near the sweep center may be reduced. The reason is that such a pixel participates in many sweeps and if the latest sweep does not contain echo, previous return signal in the same pixel is lost. In order to improve such disadvantage, the memory for radar image is divided into two groups, and used simultaneously as shown in Fig. 2.2.2.12. One group consists of IC7F, 7H and 7K, while the other group IC7G, 7J and 7L. When one is writing radar echo images, the other is erasing previous image data. The status is altered by SHF pulse.

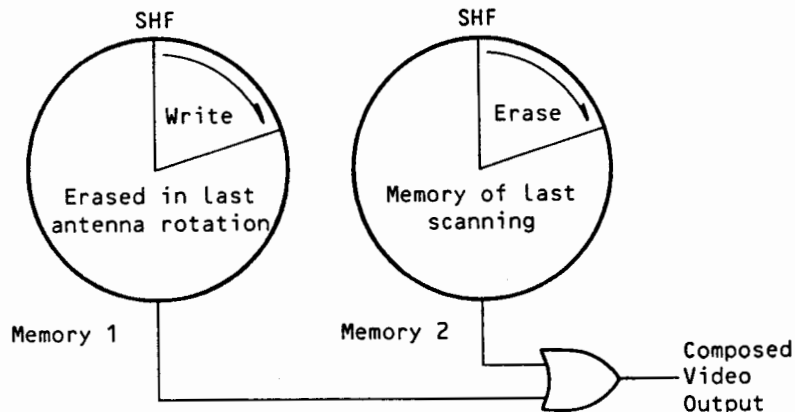


Fig. 2.2.2.12 Read/Write Method of Radar Video Memory

Two radar memories are read simultaneously and composed as shown in the drawing. In this method, writing any pixel does not affect previous stored memory and losing target near scope center is avoided. When the radar sweep origin does not coincide with the display center, for example when off-centering is turned on, CPU generally calculates appropriate transferring amount of video images from 2nd buffer to video RAM. This method, however, gives heavy duty to CPU especially in 'true motion' mode, as it should continuously carry out such calculations. In this radar, 800-bit memories per one sweep are transferred every time to the video RAM, covering full extent of off-centering image. When reading out the data from RAM on the other hand, the portion of memories outside the radar scope area is masked by the CRT video composer. Furthermore, if LSI delivered any wrong address exceeding the video RAM area, IC8N, 8P, 6N, and 6P functions to cancel the write enable pulse (WEDK) derived from LSI IC7T-64.

v) CRT video composer

Fig. 2.2.2.13 shows the block diagram of CRT video composer. The circuit mixes the radar video and character video by synchronizing them with the dot clock occurring in the same timing of CRCO. The radar video images outside the effective radar scope of 960-dot dia. circle are rejected by MASK data fed from ACRTC of the logic upper board, MD-3210-7000.

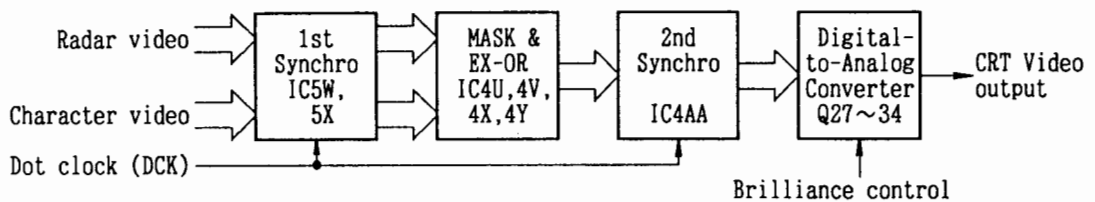


Fig. 2.2.2.13 CRT Video Composer

When jumper JP3 [MARKER] is set to [EXOR], part of images superimposed with markers such as rings, EBL, and VRM becomes dark. When JP3 is set to [NORM], such part becomes more bright. IC4AA also actuated by the dot clock synchronizes all the gate output. Brilliance of radar video images, markers, trail images, and alpha-numeral letters are independently adjusted by respective controls on the control panel. Signals are combined with respective data at the digital-to-analog converter. The analog voltage output of the converter is amplified in the current amplifiers Q27 through Q34. Collectors of these transistors are connected in parallel composing a wired OR circuit, thus the highest level signal is sent to CRT for image presentation.

iv) TUNE circuit

Under CPU control, the logic lower board provides automatic tuning function to supply the optimum MIC tuning voltage to the antenna. In manual tuning mode, a tuning voltage is manually delivered from VR4 [TUNE] of the control panel. When [TUNE] knob is turned to AUTO, CPU automatically adjusts the tuning voltage to the point where the tuning meter shows maximum. In order to make coincidence of the receiver optimum tuning point and tuning meter maximum point, VR5 [TUNE AUTO] is carefully adjusted. If the tuning meter reaches full scale or exceeds the scale, AUTO TUNE does not function properly. In such a case, adjust VR7 [TUNE MET] so that the tuning meter maximum point

becomes from 70 to 80% of the full scale.

2.2.3 Control panel (MD-3210-7200)

Control panel MD-3210-7200 is built in a tilting type case unit. The unit is connected to the display with a 75 cm long standard cable. The unit can be dismantled from the display unit enabling remote control. The cable can be extended up to five meters on optional order. The circuit is divided into parallel/series converter, EBL VRM encoder/track-ball controller, and controls.

(1) Parallel/series converter

IC3, R3 and C3 compose an oscillator for serial shift clock. IC4 is a programmable counter with full count set to 40. IC1, IC5, IC7, IC9, and IC11 are 8-bit shift registers to hold 40 bits of panel switch status. When a strobe pulse is delivered from IC4 #15, all the registers latch the panel switch status in parallel. The held data are then shifted via IC1 #13 (QH) bit by bit with the clock pulse from IC3 #2. When the final 40th bit is delivered, the counter resets and produces next strobe. The serial data signal is sent to the logic upper via logic lower for CPU process. Refer to para. 2.2.2 (1) (d).

(2) EBL VRM encoder/track-ball controller

The phase of output signal from EBL/VRM encoder differs 90° between rotations in CW (clockwise) and CCW (counter-clockwise). CR circuits made of R5/7 and C4/5, as well as R9/11 and C6/7 eliminate chattering of the encoder signal. The track-ball is provided with a built-in chattering eliminator. The signals reformed in IC8 are fed to CW/CCW detector IC10. CW or CCW of track-ball is detected by IC6. CW/CCW signal and encoder pulse output are sent to parallel/serial converter IC11. Waveforms of those signals are shown in Fig. 2.2.3.

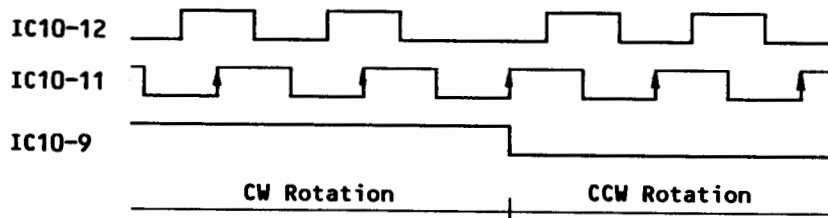


Fig. 2.2.3 EBL/VRM Encoder Waveforms

(3) Controls

VR1 (GAIN), VR2 (STC), and VR3 (FTC) are provided to control the amplification of the analog signal circuit of logic lower board. VR3 is provided with FTC ON/OFF switch. The voltage from VR4 (TUNE) is sent to the MIC of antenna unit for varying the local oscillation frequency to obtain fine tuning point. When the control is turned fully CCW to A.TUNE (automatic tuning) position, the status is fed to IC7 #14 to be sent to the CPU of logic upper. VR5 (NUMERIC), VR6 (PLOT), VR7 (MARKER), and VR8 (VIDEO) control the brilliance of respective video signals. The marker is not turned to complete dark as the minimum level is limited by R12.

(4) Lamp control

Q1 controls the brilliance of lamps from DS1 through DS6 with the signal sent from CPU via J7201 #14 (DIMMER).

3. ADJUSTMENT

CAUTIONS

- (1) High voltages are applied to the antenna and display units.
- (2) Ship's mains supply is applied to a certain internal unit even when the power is turned off.
- (3) Confirm that the rated fuses are used according to the ship's mains.
- (4) Preheat magnetron in STANDBY more than 30 minutes, for the first time turning the power on after installation, or magnetron is replaced.
- (5) Before adjustment, allow the equipment about 30 minutes in the transmitting condition.

3.1 Location of Controls

Adjusting controls and switches are located on logic upper (MD-3210-7000) and logic lower (MD-3210-7100) boards mounted right hand inside the display unit as shown in Fig. 3.1. By removing fourteen (14) fixing screws, the display cover can be removed to access these controls and switches.

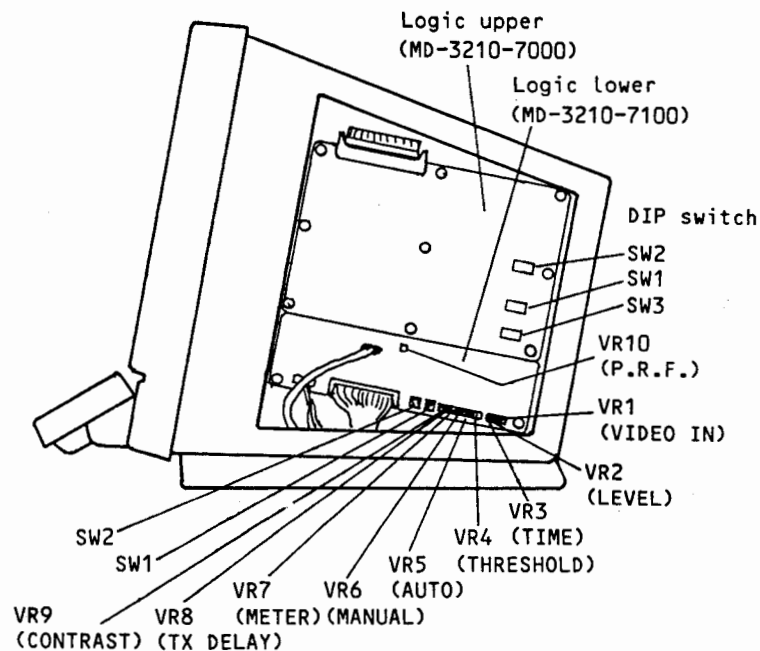


Fig. 3.1 Location of Controls and Switches

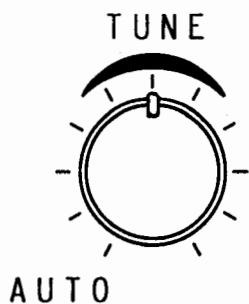
3.2 Adjustment After Installation

IMPORTANT

After installation, do not fail to make initial adjustment of controls as mentioned below.

3.2.1 Tuning

MD-3210/3220 is provided with automatic tuning facility. When TUNE control is turned fully counter-clockwise to AUTO position, the image gain should be maximum as presented in manual tuning mode set at the maximum point by TUNE control. If AUTO tuning optimum point is abnormal, carry out following adjustment in order.



- (1) With **RANGE** key, select 24 nm (long pulse) range.
- (2) Set the pointer of **TUNE** control on the control panel at the center position as shown left.
- (3) Slowly turn **VR6 (MANUAL)** of MD-3210-7100 to the point where targets are most strongly visible on the screen. (+25 ±1V at pin #3 of the rear panel connector J6005)
- (4) Adjust **VR5 (AUTO)** so that the tuning meter shows maximum indication. (+5 ±0.5V at pin #9 of the rear panel connector J6006)
- (5) If the tuning meter lights up all the way and the maximum point cannot be discriminated, adjust **VR7 (METER)** so that the maximum indication becomes about 80% of full scale, then repeat step (4).

3.2.2 Preset gain (noise level)

This adjustment is required to clearly display relatively small targets.

- (1) Rotate **GAIN** control of the control panel fully clockwise.
- (2) Rotate **STC**, **FTC** and **TUNE** controls fully counter-clockwise.
- (3) With **RANGE** key, select the maximum range.
- (4) Turn **IR.EXP** and **PLOT** off with respective control keys.
- (5) Adjust **VR4 (THRESHOLD)** of MD-3210-7100 so that noise speckle becomes just visible.

3.2.3 STC

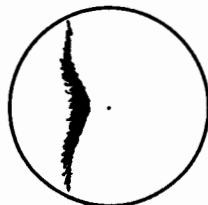
- (1) Rotate **FTC** and **TUNE** controls fully counter-clockwise.
- (2) Turn **IR.EXP** and **PLOT** off with respective control keys.
- (3) With **RANGE** key, select 12 nm range.
- (4) Rotate **GAIN** control of the control panel fully clockwise.
- (5) Rotate **STC** control so that noise speckles are suppressed up to 6 nm, and a few strong echoes remain near center of the screen.

If adjustment (5) above is difficult caused by excessive images, take following steps:

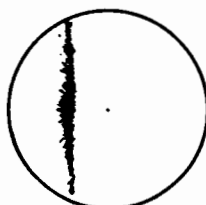
- (5) Rotate **STC** control fully clockwise.
- (6) Adjust **VR3 (TIME)** and **VR2 (LEVEL)** of logic lower MD-3210-7100 as below.
 - (a) Set **RANGE** to 0.25 nm and adjust **VR3** from clockwise to counter-clockwise, so that the starting point of **STC** becomes the center of screen.
 - (b) Set **RANGE** to 12 nm and adjust **VR2** so that noise is suppressed up to 6 nm on the screen.

3.2.4 Trigger delay

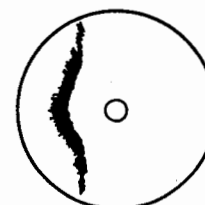
If the image of a straight target, such as breakwater is deformed as shown below, it may be caused by improper trigger delay, according to the length of antenna cable.



Short delay



Normal



Excessive delay

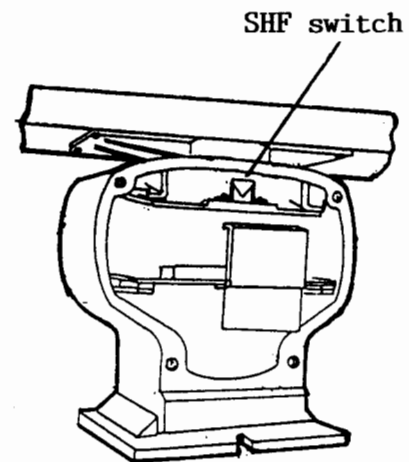
In such a case, adjustment is made as follows:

- (1) With **RANGE** key, select 0.25 nm.
- (2) Adjust **VR6 (TX DELAY)** of MD-3210-7100 so that the image on the screen becomes normal as follows.
 - (a) The straight targets are correctly presented.
 - (b) A target with known distance is presented at correct position. Use VRM for range measurement.

3.2.5 SHF and bearing

After installation adjustments mentioned above are completed, confirm SHF and adjust bearing, if necessary, as follows.

- (1) When the ship is mooring or calmly anchoring, find some stationary visible targets in a distance of 4 to 8 nm.
- (2) Measure the bearing of targets on the compass as well as on the radar screen. If the radar bearing deviates more than $\pm 1^\circ$ from the compass bearing, correction can be made as below.
- (3) Bearing error within $\pm 11^\circ$ can be corrected to $\pm 1^\circ$ by rotary switches **SW2** (coarse) and **SW1** (fine) of MD-3210-7100. If error is more than $\pm 11^\circ$, further $\pm 5^\circ$ adjustable range is provided in the antenna unit.
- (4) Bearing adjustment in antenna unit is made as follows:
 - i) First of all, note that images are to be rotated clockwise (CW) or counter-clockwise (CCW) for correcting error.
 - ii) Turn off the power.
 - iii) Open the antenna rear cover.
 - iv) Find the SHF lead switch as shown in the right. Loosen fixing screws and move the board fully leftwards for CW image rotation, or rightwards for CCW rotation.
 - v) Fix the board with fixing screws and restore the rear cover. Turn on the power and transmit.
 - vi) Readjust SW2 and SW1 of MD-3210-7100 so that the bearing error becomes less than $\pm 1^\circ$ on the scope.



Note: If bearing error exceeds $\pm 16^\circ$, check the direction of antenna unit is aligned with the bow line or not.

3.3 Adjustment of Antenna Unit

No adjusting point exists in the antenna for ordinary maintenance, except for initial bearing adjustment by SHF switch mentioned in para. 3.2.5.

3.4 Adjustment of Display

3.4.1 Power supply (MD-3210/3220-6000)

The power supply board is adjusted for the switching regulator oscillating frequency, +100 V output level, and magnetron heater voltage. Adjustment

is made as following procedure. Access to the board can be made by disassembling the rear panel of the display. Fig. 3.4.1 illustrates the location of measuring/adjusting points of power supply board.

(1) Oscillating frequency

- (a) With **RANGE** key, select 24 nm range.
- (b) Connect a frequency counter between IC3 pin #9 [E1] and #7 [DC(-) of input line].
- (c) Adjust **VR1** so that the frequency becomes **35 ±0.5 kHz**.

(2) 100 V output voltage

- (a) Connect a DC voltmeter or circuit tester measurable 150 V DC, between TP3 and TP6 (GND).
- (b) Adjust **VR3** so that the voltage becomes **+100 ±0.1 V**.

(3) Magnetron heater current

- (a) Connect a DC voltmeter or circuit tester measurable 3 V DC, between TP4 and TP5 [(-) side].
- (b) Adjust **VR4** so that the voltage becomes as follows:
 MD-3210: +1.87 ±0.19 V
 MD-3220: +1.77 ±0.18 V

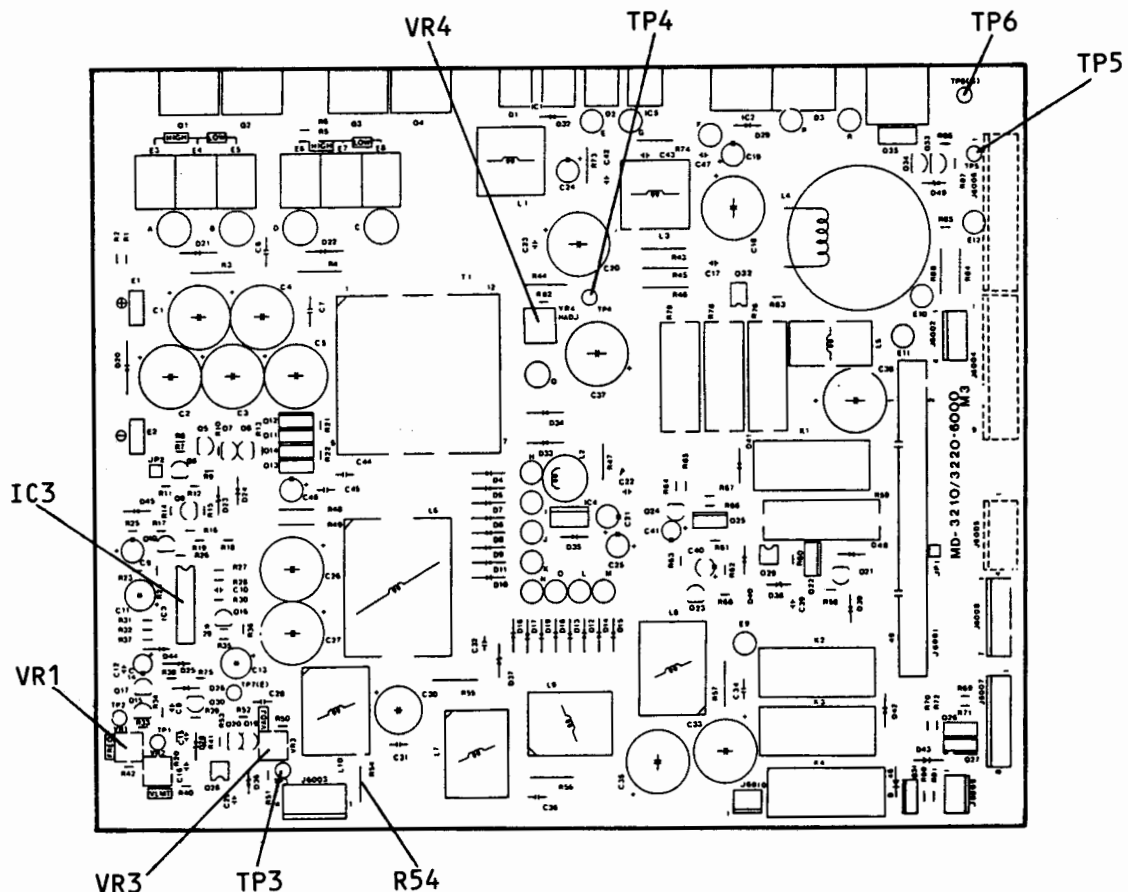


Fig. 3.4.1 Measuring/Adjusting Points of Power Supply

3.4.2 Logic upper (MD-3210-7000)

As shown in Fig. 3.1, three DIP switches, SW1 through SW3 are mounted on the logic upper board (MD-3210-7000) in order to preset the operation of equipment. Functions set by those switches and their standard settings are listed in para. 1.5.2.

3.4.3 Logic lower (MD-3210-7100)

Adjusting controls and switches of logic lower board (MD-3210-7100) are illustrated in Fig. 3.1. Most of the adjustments should be carried out just after installation, which are explained in para. 3.2.

(1) Pulse repetition frequency (PRF)

The pulse repetition frequency (PRF) adjustment is made as follows.

- (a) With the function switch set at **STANDBY**, connect a frequency counter to TP3.
- (b) Adjust **VR10 (PRF)** so that the frequency becomes **6,000 \pm 50 Hz**.

(2) Tuning

Refer to para. 3.2.1.

(3) Video input level

In order to optimize the effect of STC, FTC and gain control, the input level of video signal from the IF unit is adjusted as follows:

- (a) Connect an oscilloscope to TP6 (base of Q2).
- (b) Synchronize the oscilloscope to the positive phase radar trigger.
- (c) Turn the radar to transmission and observe the video input signal. Adjust **VRI** so that the input signal level becomes **2 Vp-p**.

(4) Preset gain (noise level)

Refer to para. 3.2.2.

(5) STC

Refer to para. 3.2.3.

(6) Trigger delay

Refer to para. 3.2.4.

(7) SHF and bearing

Refer to para. 3.2.5.

(8) Jumper pin setting

In order to set operational conditions of the unit, five jumper pins are provided on the logic lower board (MD-3210-7100). Functions and initial setting status of those pins are explained in para. 1.5.1.

3.4.4 CRT unit (PWD-1050A/PWD-1051A)

The CRT unit adjustment is roughly divided into four categories, i.e. synchronization, picture size, brilliance, and focus. As the CRT unit applies extra high tension, extreme care should be taken when adjusting controls.

(1) Access to controls

- (a) Remove all the fixing screws of the display cover and open it.
- (b) At the bottom of display, the main board PWD-1050A can be seen.
- (c) Find various controls as shown in Fig. 3.4.4.1. Also find coil **L402** [H.WIDTH]. PWD-1051A is mounted on the CRT socket.

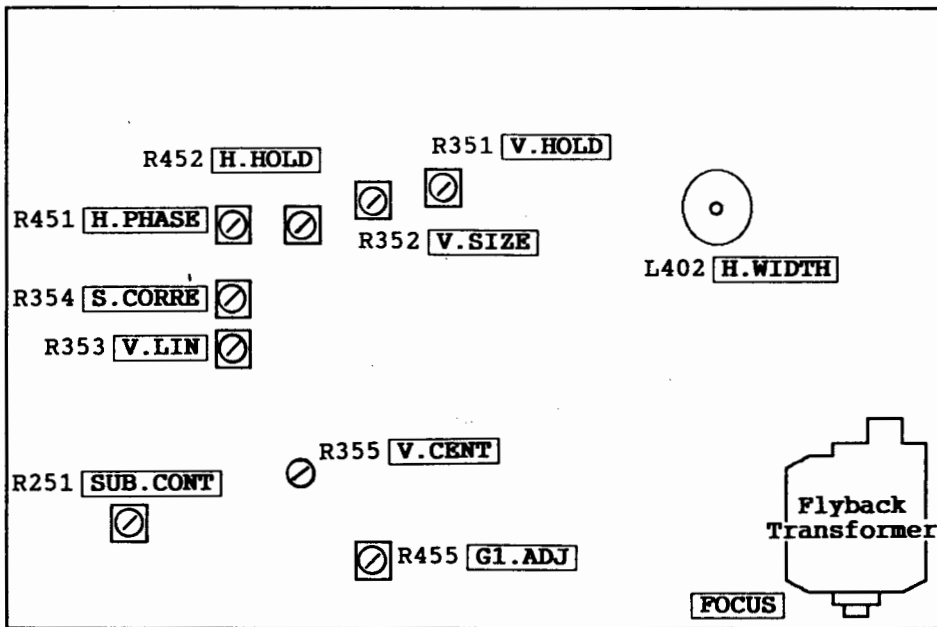


Fig. 3.4.4.1 Location of Controls on CRT Main Board

(2) Adjustment

- (a) Turn ON the radar transmitter, after 3 minutes STANDBY.
- (b) Display some letters or symbols at four corners of the CRT, with EBL, VRM, (or any other symbol), and ENTER keys.
- (c) Slowly rotate **R455** [G1.ADJ] to show back raster on the CRT.
- (d) By adjusting **R451** [H.PHASE], make the spaces at left and right edges of back raster equal to each other as shown in Fig. 3.4.4.2.
- (e) By **L402** [H.WIDTH], adjust the width of back raster to almost full of the CRT scope.

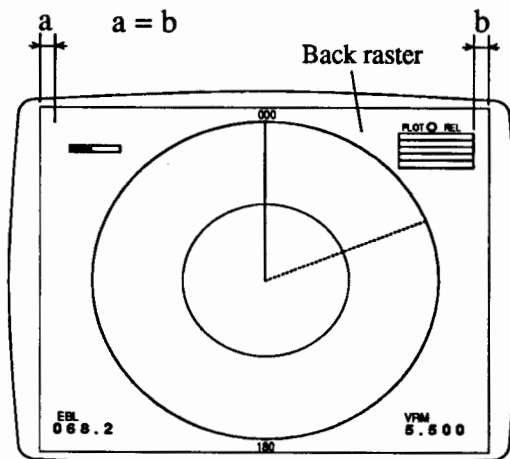


Fig. 3.4.4.2 Back Raster

- (f) By adjusting **R353 [V.LIN]**, make the size of top letters **000** and bottom letters **180** of the bearing scale equal to each other.
- (g) Align two magnet rings around the CRT neck on a line along which the center of back raster is wanted to move, as shown in Fig. 3.4.4.3. By manipulating two magnets carefully, shift the back raster to the center of CRT, so that top/bottom and left/right gaps between CRT and raster are balanced. Also adjust **R355 [V.CENT]**, if necessary. After adjustment, fix the magnets with silicon rubber or the like.

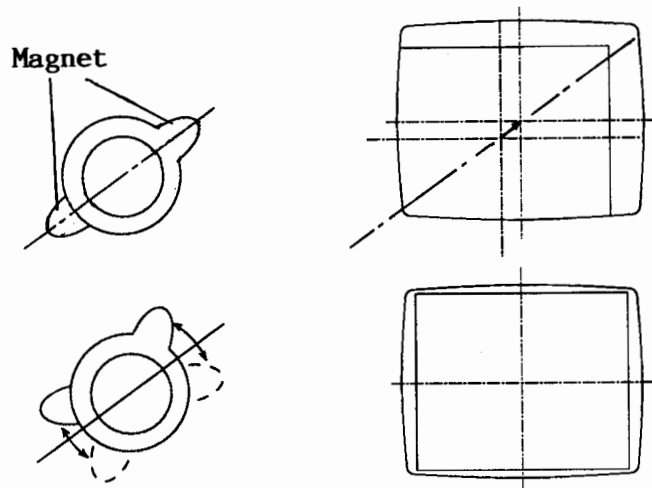


Fig. 3.4.4.3 Back Raster Centering

- (h) With **R352 [V.SIZE]** control, adjust the vertical diameter of the radar scope circle to 274 ± 2 mm (20 inches). If upper and lower radii are unbalanced as shown in Fig. 3.4.4.4 (a), adjust **R353 [V.LIN]** to make correct marker rings in real circles.
- (i) If the linearity on radius is abnormal as shown in Fig. 3.4.4.4 (b), correct it by **R354 [S.CORRE]**.

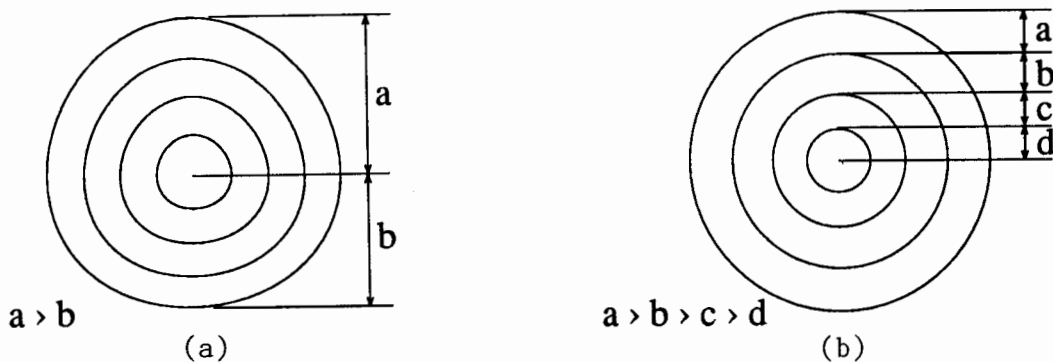
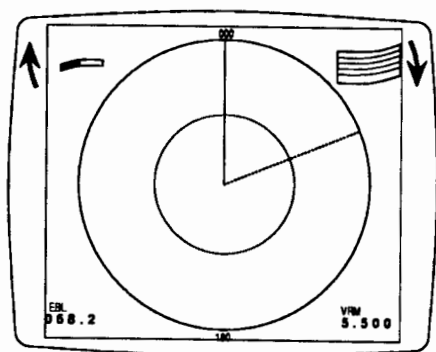
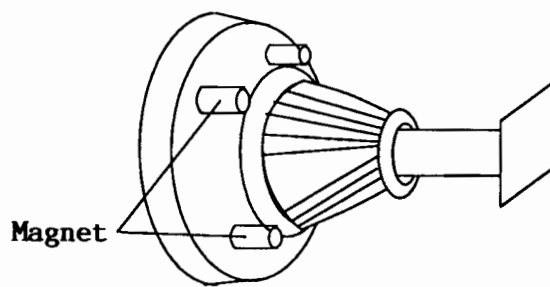


Fig. 3.4.4.4 Abnormal Linearity

- (j) If the display at corner of the raster is deformed as shown in Fig. 3.4.4.5 (a), correct it by rotating magnets mounted at four corners of the deflection yoke as shown in Fig. 3.4.4.5 (b).
- (k) Rotate **R251 [SUB.CONT]** fully counter-clockwise to obtain the maximum contrast, and then slowly lower the brightness of back raster with **R455 [G1.ADJ]** so that the back raster has just become invisible.



(a)



(b)

Fig. 3.4.4.5 Corner Display Alignment

- (1) Adjust [**FOCUS**] control (some unit may be marked [**SCREEN**]) on the fly-back transformer to obtain fine focus of the picture on the CRT.

4. WAVEFORMS

4.1 Antenna Unit

4.1.1 MRT-133 (MD-3210)

(1) HV short pulse (SP)

(a) Modulator 239U52236

E5: TX trigger

X scale: 500 nsec/div

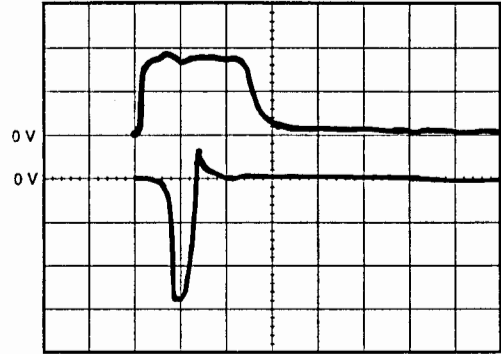
Y scale: 5 V/div

(b) Pulse transformer T1

Pin #6 (YEL): SP to magnetron

X scale: 500 nsec/div

Y scale: 2,000 V/div



(2) HV long pulse (LP)

(a) Modulator 239U52236

E5: TX trigger

X scale: 500 nsec/div

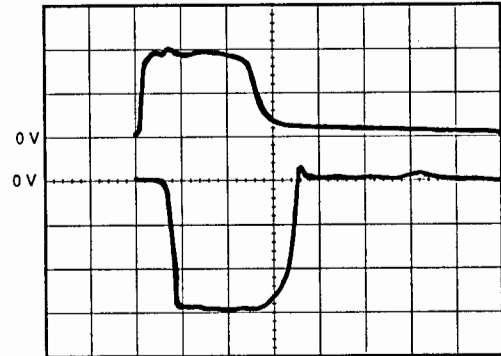
Y scale: 5 V/div

(b) Pulse transformer T1

Pin #6 (YEL): LP to magnetron

X scale: 500 nsec/div

Y scale: 2,000 V/div



(3) HV charging waveform

(a) Modulator 239U52236

E5: TX trigger

X scale: 100 usec/div

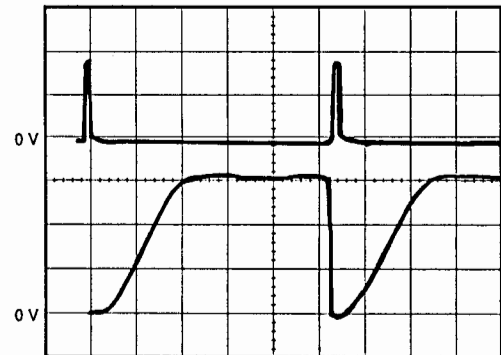
Y scale: 5 V/div

(c) Modulator 239U52236

E6: H.V. charging

X scale: 100 usec/div

Y scale: 200 V/div



(4) AZI pulse

(d) Scanner connection (S CON)

E3: AZI input

X scale: 2 msec/div

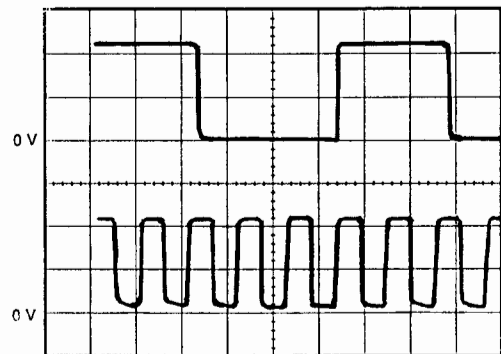
Y scale: 5 V/div

(e) Scanner connection (S CON)

E4: AZI output

X scale: 2 msec/div

Y scale: 5 V/div



Checking points

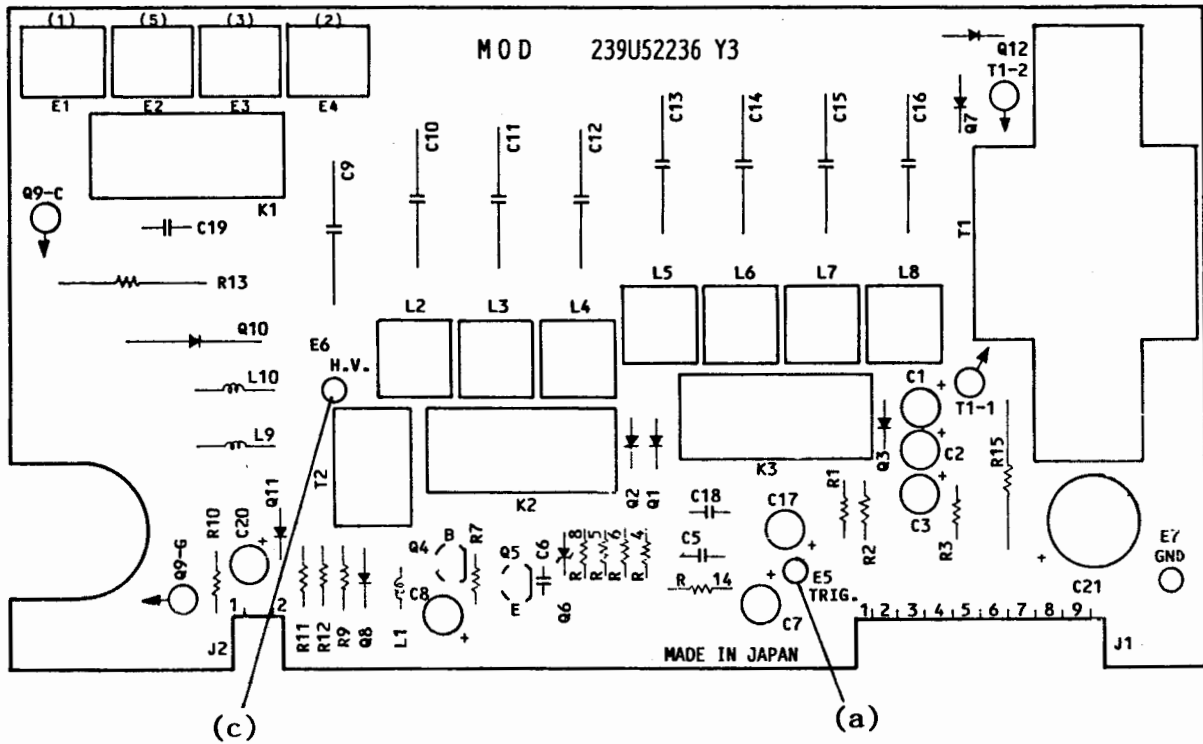


Fig. 4.1.1.1 10 kW Type Modulator

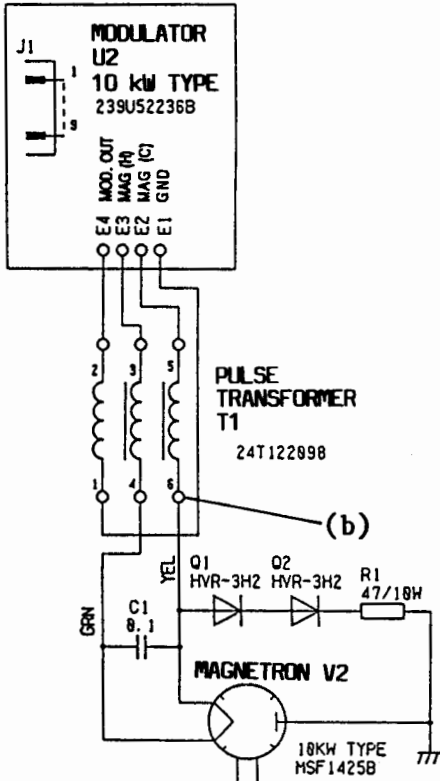


Fig. 4.1.1.2 Pulse Transformer of 10 kW TR Unit

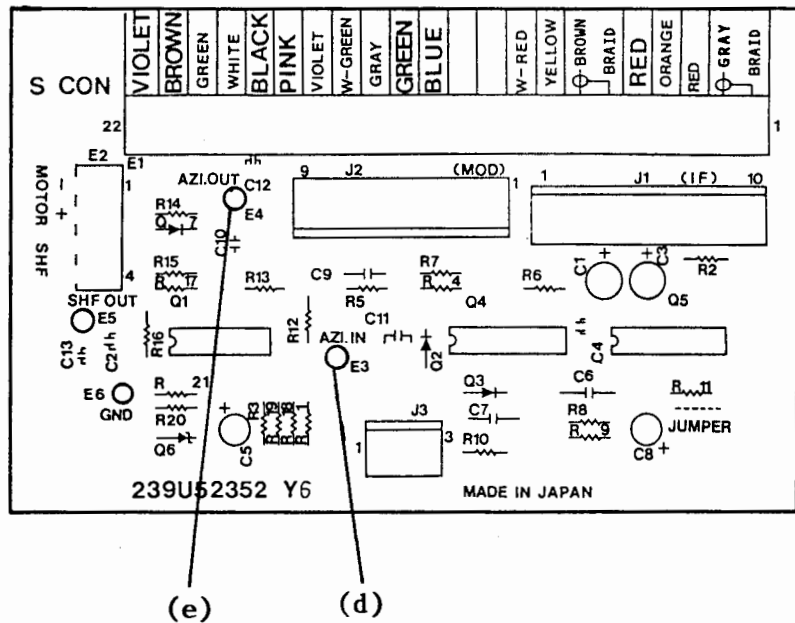


Fig. 4.1.1.3 Scanner Connection Board (S CON)

4.1.2 MRT-134 (MD-3220)

(1) HV short pulse (SP)

(a) Modulator 229U25361

Waveform is same as MRT-133.

E5: TX trigger

(b) Pulse transformer T1

Waveform is similar to MRT-133, but the peak voltage is about 7.8 kV.

Pin #6 (YEL): SP to magnetron

(2) HV long pulse (LP)

(a) Modulator 229U25361

Waveform is same as MRT-133.

E5: TX trigger

(b) Pulse transformer T1

Waveform is similar to MRT-133, but the peak voltage is about 7.8 kV

Pin #6 (YEL): LP to magnetron

(3) HV charging waveform

(c) Modulator 229U25361

Waveform is same as MRT-133.

E6: H.V. charging

See para. 4.1.1 (3).

(4) AZI pulse

Scanner connection (S CON)

Waveform is same as MRT-133.

E3: AZI input & E4: AZI output

See para. 4.1.1 (4).

Checking points

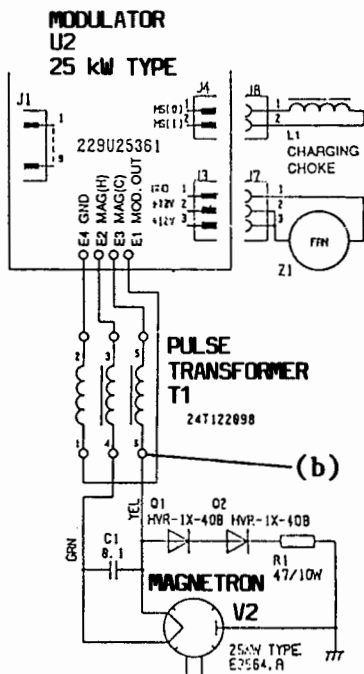


Fig. 4.1.2.1 Pulse Transformer of 25 kW TR Unit

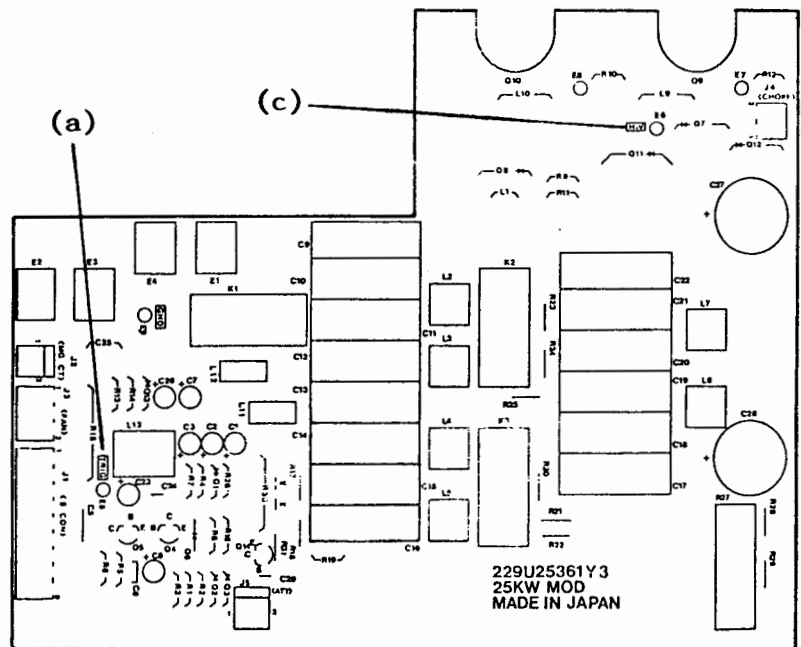


Fig. 4.1.2.1 25 kW Type Modulator

4.2 Display Unit

4.2.1 Power supply (MD-3210/3220-6000)

(1) Switching waveform

(a) Switching transistor Q1

Gate: Input

X scale: 5 μ sec/div

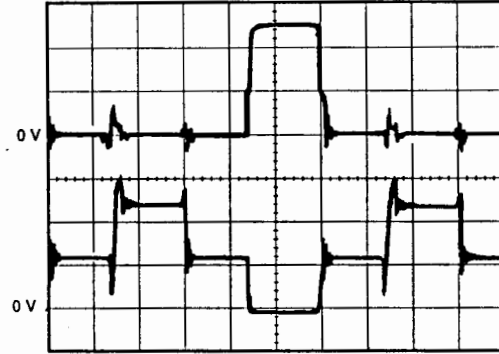
Y scale: 5 V/div

(b) Switching transistor Q1

Drain: Output

X scale: 5 μ sec/div

Y scale: 5 V/div



(2) T1 secondary square wave

(c) +50 V fullwave rectifier

D9 anode: Input

X scale: 5 μ sec/div

Y scale: 50 V/div

(d) Switching transistor Q1

D11 anode: Input

X scale: 5 μ sec/div

Y scale: 50 V/div

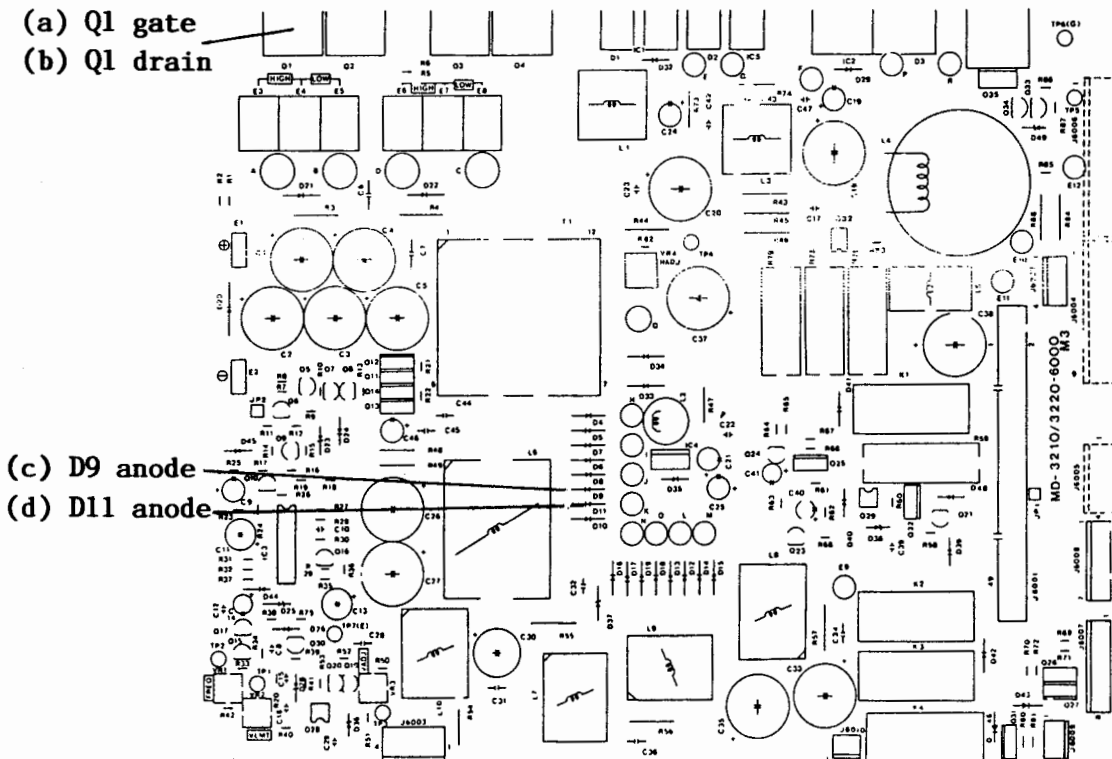
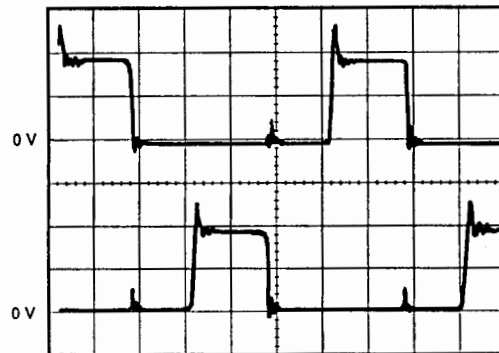


Fig. 4.2.1 Power Supply

4.2.2 Logic upper (MD-3210-7000)

Signal from control panel

(a) Data transfer clock

IC8E #12: RCK

X scale: 50 μ sec/div

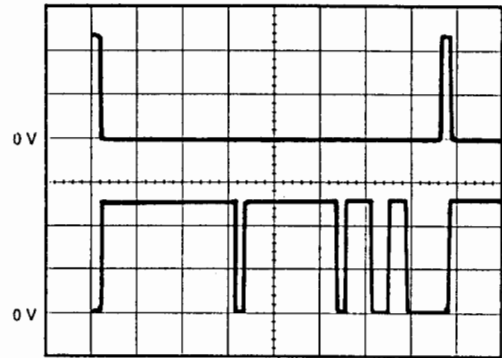
Y scale: 2 V/div

(b) Data signal

IC8E #14: PDT

X scale: 50 μ sec/div

Y scale: 2 V/div



Checking points

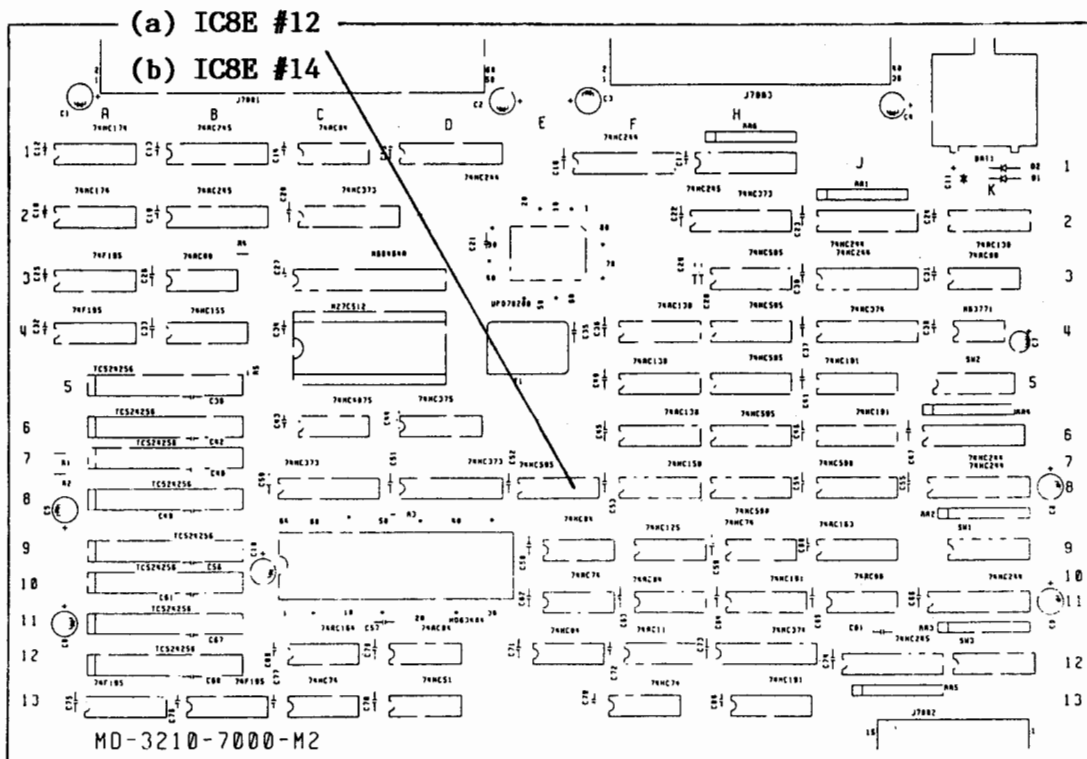


Fig. 4.2.2 Logic Upper

4.2.3 Logic lower (MD-3210-7100)

(1) Synchro signals

(a) Vertical synch

TP5: VD

X scale: 50 μ sec/div

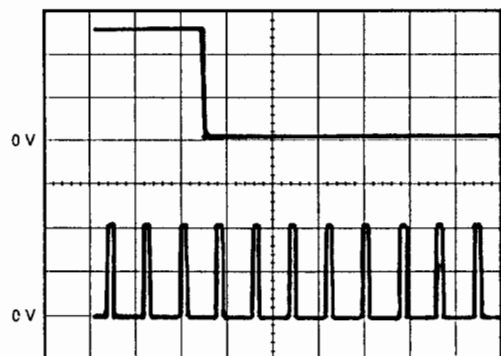
Y scale: 2 V/div

(b) Horizontal synch

TP4: HD

X scale: 50 μ sec/div

Y scale: 2 V/div



(2) Video signal to CRT unit

(b) Horizontal synch

TP4: HD

X scale: 5 μ sec/div

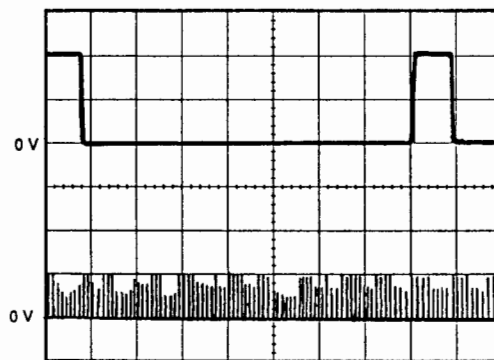
Y scale: 2 V/div

(c) CRT video

R132 (J7105)

X scale: 5 μ sec/div

Y scale: 0.5 V/div



(3) Video input from antenna

(d) Trigger pulse

R1: TRIG

X scale: 0.5 μ sec/div

Y scale: 5 V/div

(e) Video input

Q2 base: VIDEO IN

X scale: 0.5 μ sec/div

Y scale: 1 V/div



(4) STC

(d) Trigger pulse

R1: TRIG

X scale: 0.1 msec/div

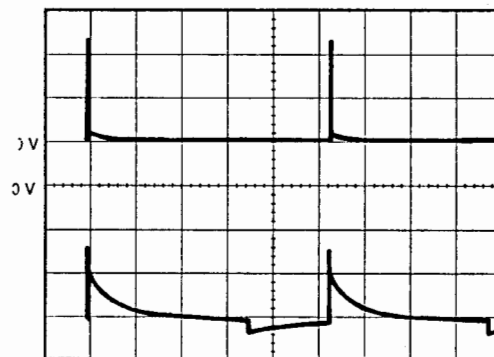
Y scale: 5 V/div

(f) STC

D5 cathode: STC

X scale: 0.1 msec/div

Y scale: 5 V/div



(5) Digital video

(d) Trigger pulse

R1: TRIG

X scale: 0.5 μ sec/div

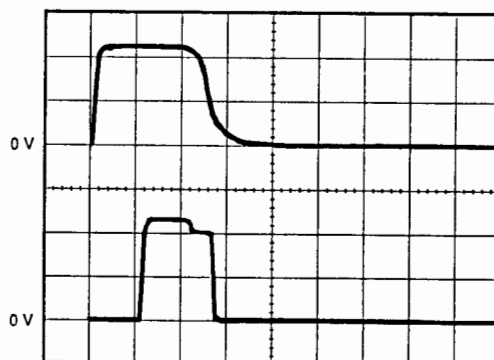
Y scale: 5 V/div

(g) Digital video

IC2L #7: DV7

X scale: 0.5 μ sec/div

Y scale: 2 V/div



(6) AZI pulse

(h) Azimuth input pulse

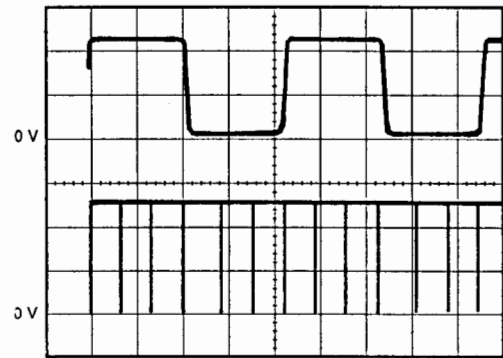
R120: AZIP

X scale: 0.5 msec/div
Y scale: 5 V/div

(i) Multiplied AZI pulse

IC6T #13: AZI

X scale: 0.5 msec/div
Y scale: 2 V/div



(7) Transfer signal from LSI to RAM

(b) Horizontal synch

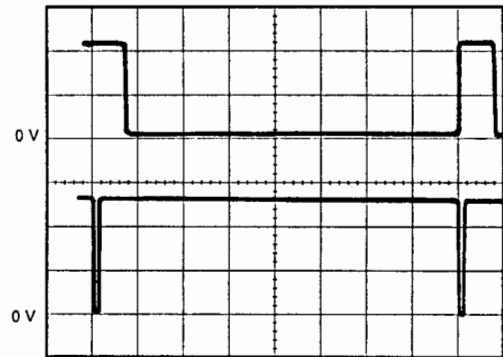
TP4: HD

X scale: 5 μ sec/div
Y scale: 2 V/div

(j) Video transfer signal

IC8A #15: SPLS

X scale: 5 μ sec/div
Y scale: 2 V/div



(8) Row address selection

(j) Video transfer signal

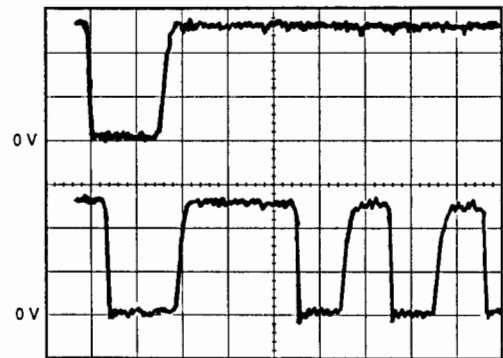
IC8A #15: SPLS

X scale: 100 nsec/div
Y scale: 2 V/div

(k) Row address selection

IC8A #14: RAS

X scale: 100 nsec/div
Y scale: 2 V/div



(9) Video RAM write enable

(j) Video transfer signal

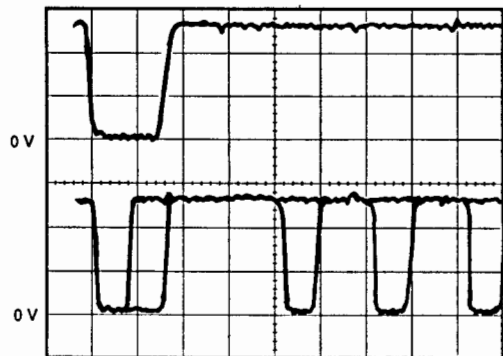
IC8A #15: SPLS

X scale: 100 nsec/div
Y scale: 2 V/div

(m) Write enable signal

IC7B to 7L #14: WE

X scale: 100 nsec/div
Y scale: 2 V/div



Checking points

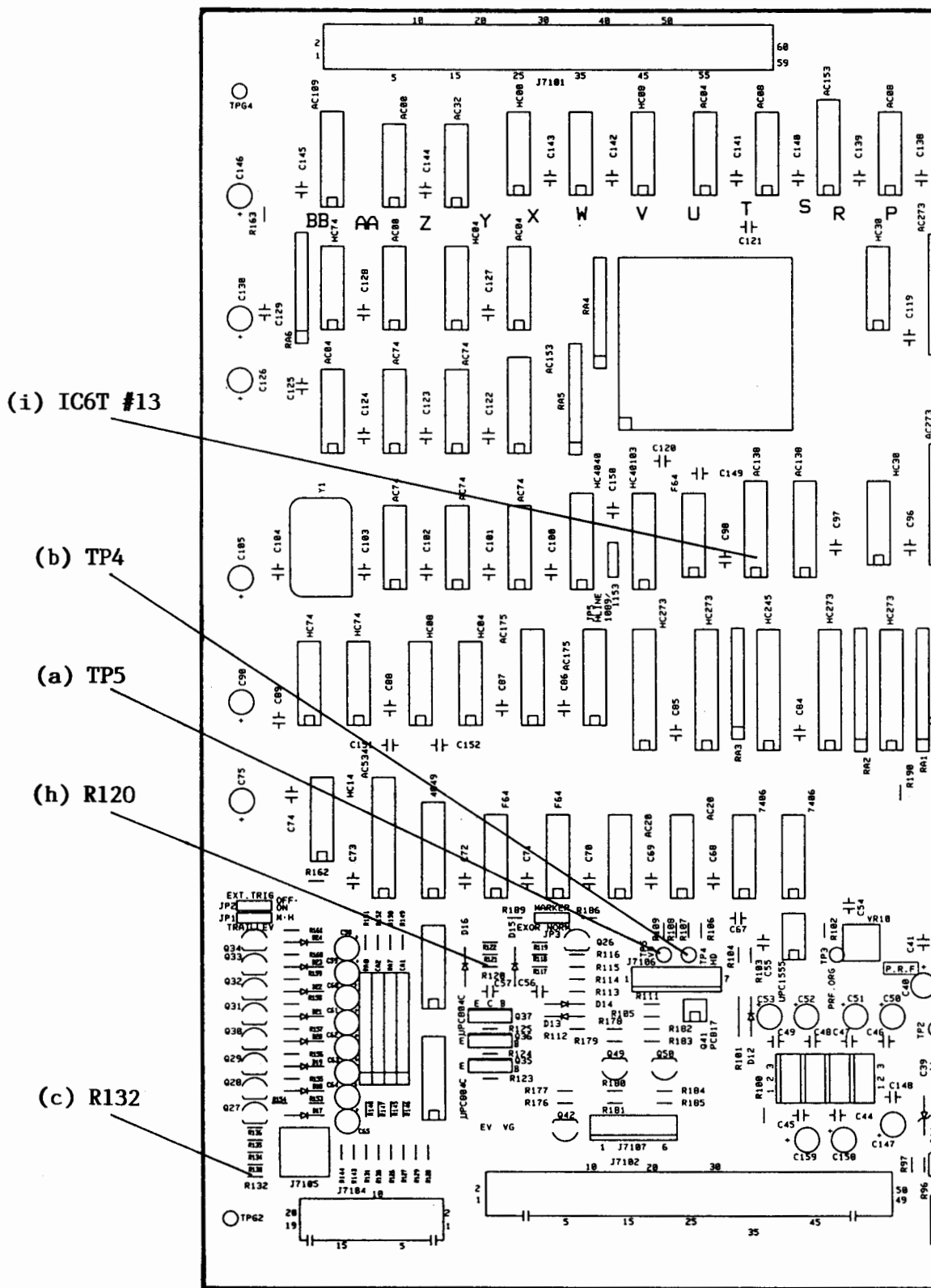


Fig. 4.2.3.1 Logic Lower (1/2)

Checking point, continued

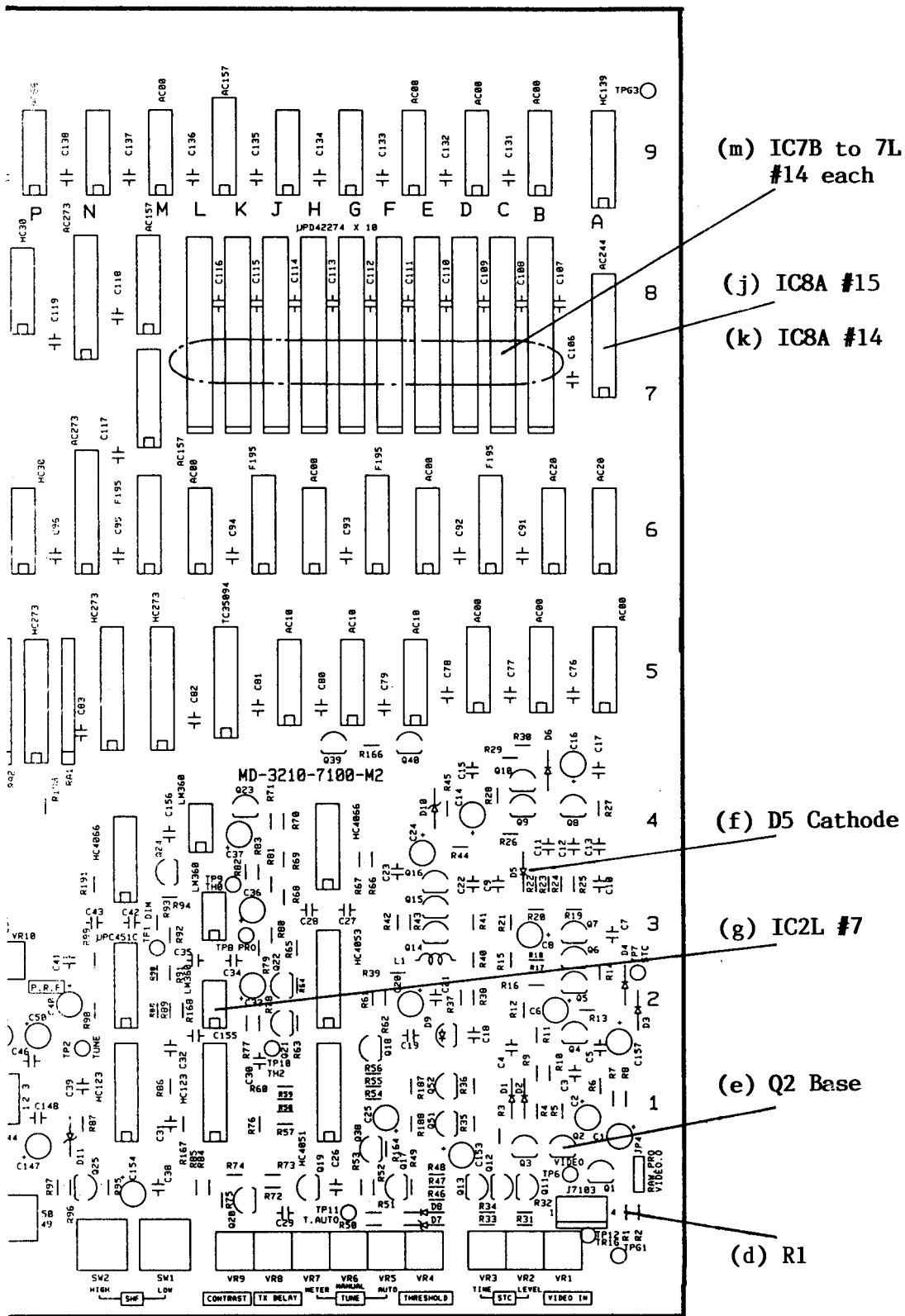


Fig. 4.2.3.2 Logic Lower (2/2)

5. REPLACEMENT OF MAJOR COMPONENTS

5.1 Antenna unit

When replacing any component of the antenna unit, be sure to turn off the power completely, and take out the antenna drive motor fuse. Place a notice like **"Antenna is Under Inspection"** near the power switch of the display, so that nobody turns the power on carelessly.

Referring to Fig. 5.1, loosen each four (total eight) fixing screws of the front and rear antenna covers, and remove covers.

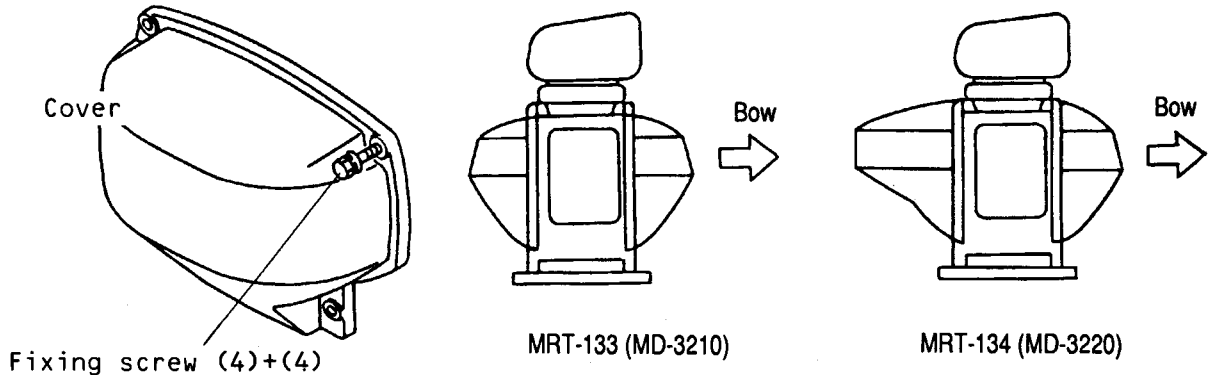


Fig. 5.1 MRT-133 and MRT-134

5.1.1 Dismounting transmitter/receiver (TR) unit

- The TR unit is mounted rear inside the antenna unit. At first disconnect connectors J1 of cable W1, and J4 of W2 shown in Fig. 5.1.1 (a).
- Remove two fixing screws of the TR unit.
- Take out the unit as shown in Fig. 5.1.1 (b).

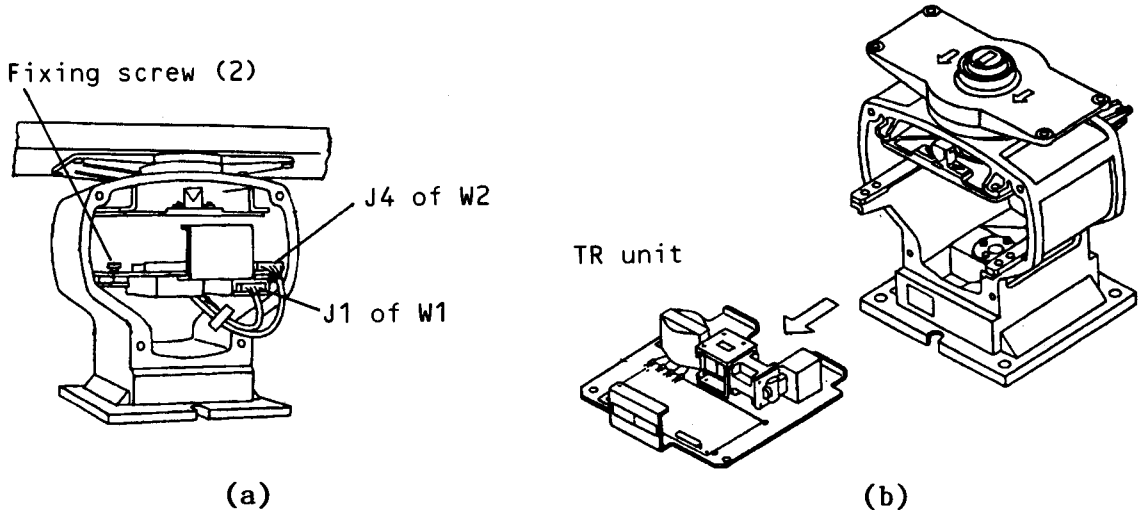


Fig. 5.1.1 Dismounting Transmitter/Receiver (TR) Unit

5.1.2 Replacement of TR unit components

Fig. 5.1.2.1 illustrates the 10 kW TR unit for MRT-133 (MD-3210), and Fig. 5.1.2.2 the 25 kW TR unit for MRT-134 (MD-3220).

(1) Magnetron [MSF1425B (10 kW) or E3564A (25 kW)]

CAUTION

- (a) Keep steel or iron tools such as wrench and screw drivers more than 2.5 cm apart from the magnetron. Use non-magnetizing screw driver for replacement of magnetron.
- (b) Although the magnetron looks solid, it has delicate internal structure. Handle with care and do not apply heavy shock.
- (c) After the magnetron is replaced, be sure to preheat the heater of new magnetron at least 20 minutes on STANDBY condition.

- (a) Place the TR unit with the magnetron side up.
- (b) Cut off the tie-lap fixing the magnetron leads.
- (c) Desolder two magnetron lead wires (green and yellow) from the pulse transformer.
- (d) By removing four fixing screws, dismount and take out the magnetron.
- (e) Fix a new magnetron to the chassis, and solder the yellow lead to pin #4, and green lead to #6 of the pulse transformer. In order to avoid corona discharging, the magnetron leads should be cut to possible minimum length and the wire ends must be correctly soldered to terminals.
- (f) Referring to para. 3.2.1, carry out the tuning adjustment.

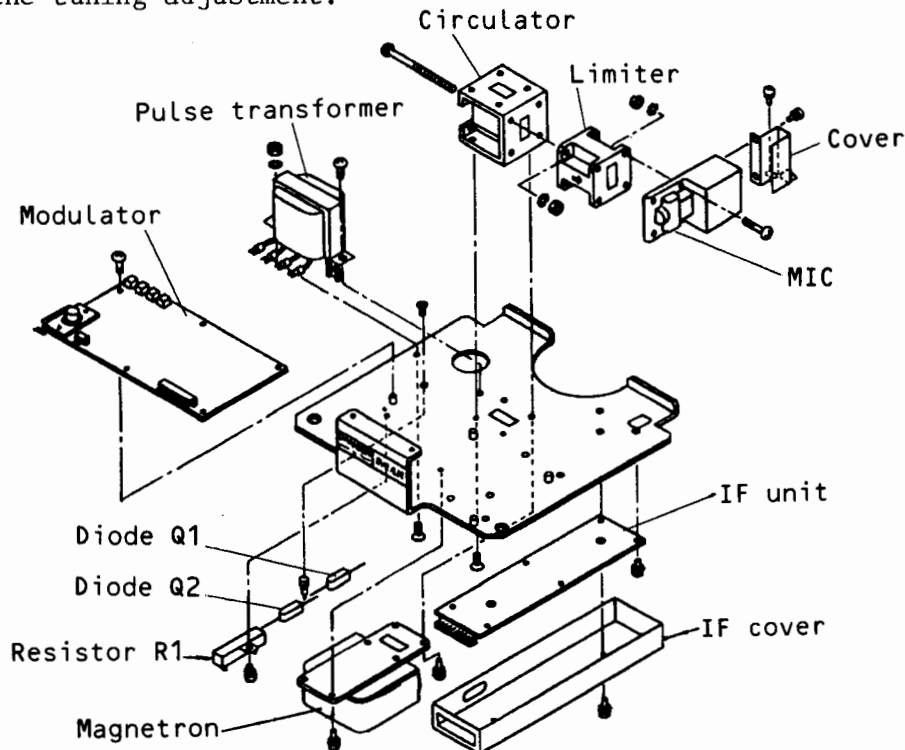
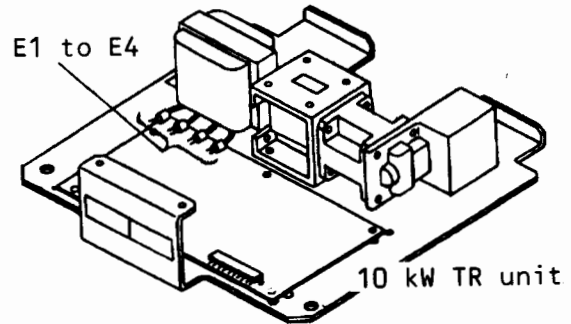


Fig. 5.1.2.1 Components of 10 kW TR Unit

(2) Modulator [239U52236B (10 kW) or 229U25361 (25 kW)]

- (a) Referring to Fig. 5.1.2.1 and Fig. 5.1.2.2, disconnect E1 to E4. In case of 25 kW modulator, also disconnect J3 and J4.
- (b) Remove seven fixing screws of the 10 kW modulator or nine screws of 25 kW modulator, then take out the board.

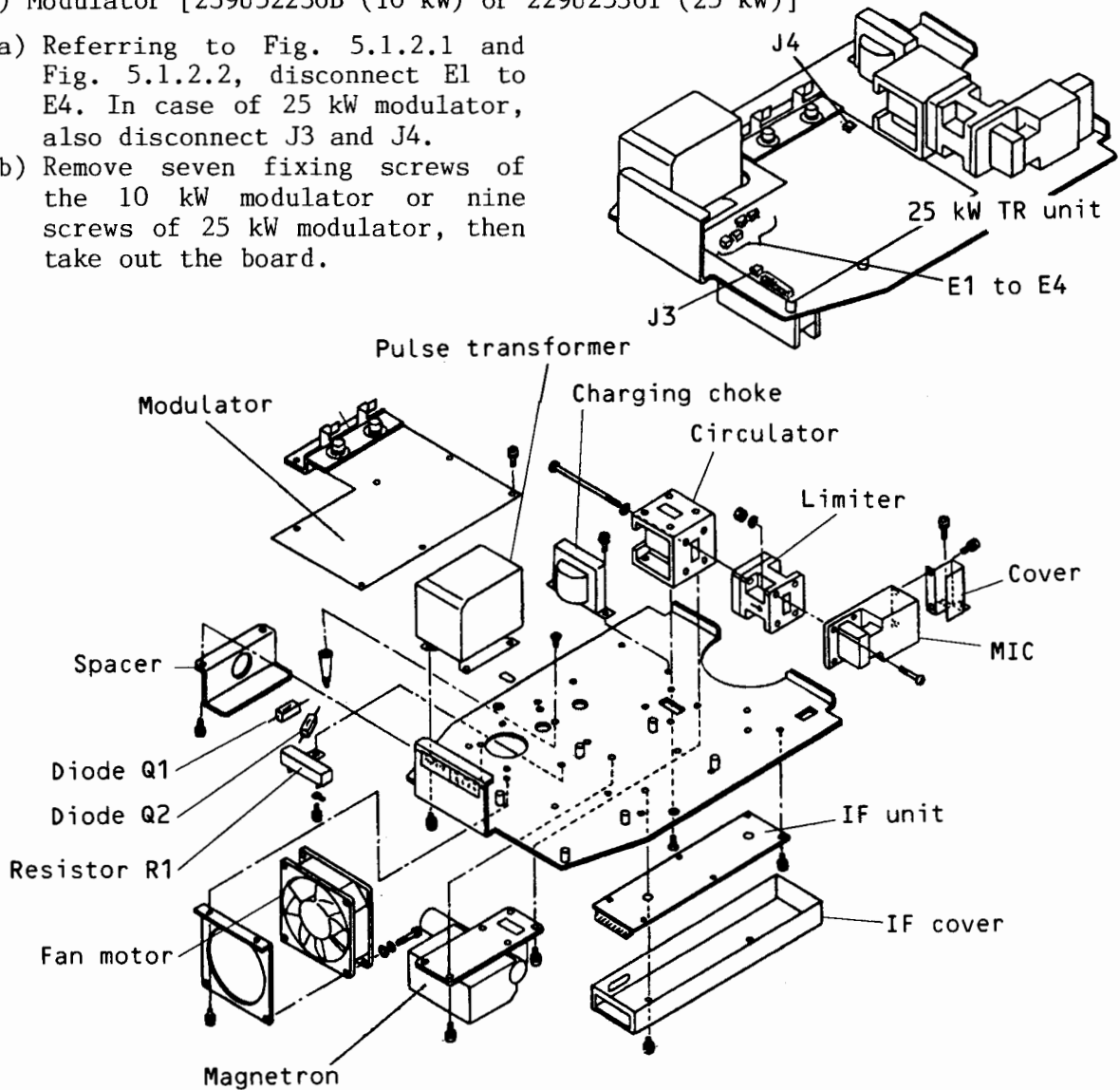


Fig. 5.1.2.2 Components of 25 kW TR Unit

(3) IF unit (239U52512)

- (a) Remove two IF cover fixing screws and remove the cover.
- (b) Disconnect J2, remove six fixing screws of the IF unit, and then take out the board. Mount new unit in reverse steps.
- (c) When new IF unit is mounted, carry out the tuning adjustment referring to para. 3.2.1.

(4) MIC (NJT1946 or S-RX34)

- (a) Remove three fixing screws (NJT1946) or four (S-RX34) of the MIC cover, and dismount the cover.
- (b) Remove four fixing screws and nuts of the MIC, then take out the MIC. Mount new MIC in reverse steps.
- (c) When new MIC is mounted, carry out the tuning adjustment referring to para. 3.2.1.

5.1.3 Replacement of S CON (scanner connection) board

The S CON (scanner connection) board interfaces the antenna and display, as well as other boards in the antenna unit. It also contains the SHF and AZI reforming circuits. As shown in Fig. 5.1.3, following connectors are mounted on the board for transferring various signals.

- E1: Interconnection of antenna and display with antenna cable.
- E2: Sends out drive motor power and receives SHF input signal.
- J1: Interface with IF unit
- J2: Interface with modulator board
- J3: Interface with AZI pulse generator at the bottom of drive motor

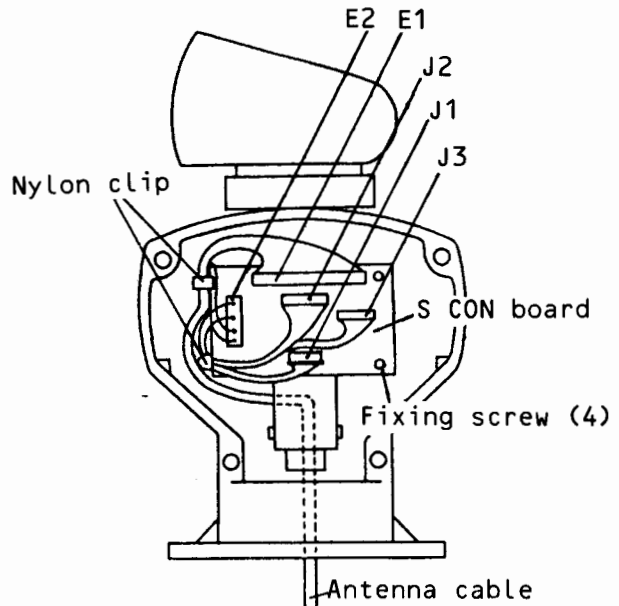


Fig. 5.1.3 Replacement of S CON Board

Replacement is done as follows:

- (1) Referring to Fig. 5.1, open the bow side antenna cover.
- (2) Remove all wires of E1 and E2. Disconnect connectors J1, J2, and J3, as well.
- (3) Remove four fixing screws and take out the board.
- (4) When new board is mounted, confirm that JUMPER wire is set to the same status of old board.

5.1.4 Replacement of motor brush

When the motor brush is worn, pair of them should be renewed.

- (1) Referring to Fig. 5.1, open the bow side antenna cover.
- (2) Referring to Fig. 5.1.4, unscrew both sides motor brushes and replace with new ones.

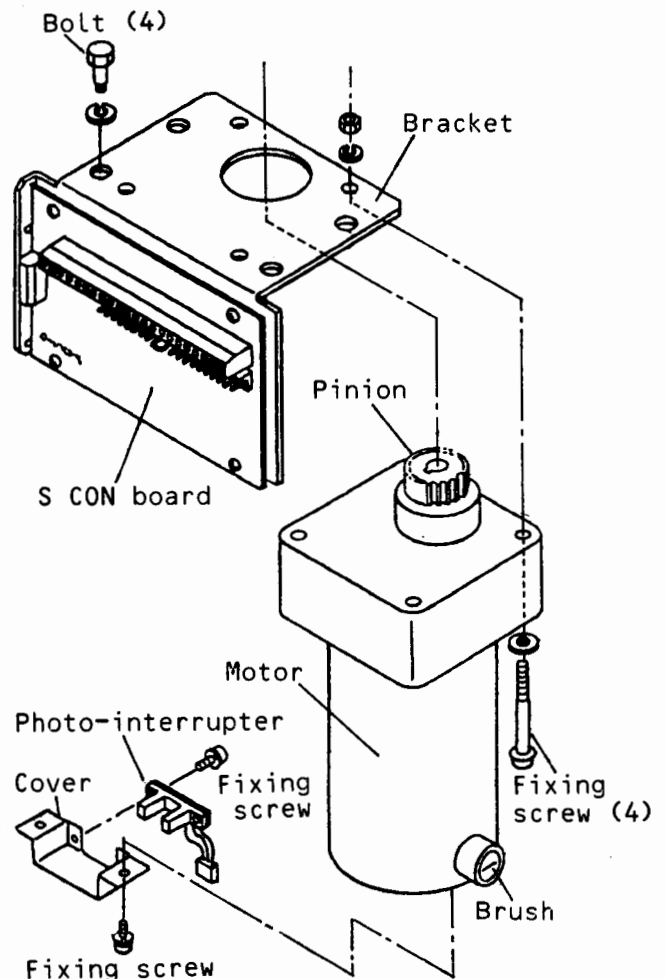


Fig. 5.1.4 Replacement of Motor

5.1.5 Replacement of motor

- (1) Referring to Fig. 5.1, open the bow side antenna cover.
- (2) Referring to Fig. 5.1.3, remove all wires of E1 and E2. Disconnect connectors J1, J2, and J3, as well.
- (3) Remove all nylon clips for cable and binds of motor wires.
- (4) Remove four fixing bolts for the bracket and take out the bracket

- together with the drive motor.
- (5) Detach the motor from the bracket by removing four fixing screws.
 - (6) When replacing the motor, detach the photo-coupler of AZI pulse generator by removing two fixing screws of the cover, and then mount the generator to the new motor.
 - (7) Take reverse steps of the above procedure for assembling new motor. In order to fix the motor at correct position, insert a sheet of paper between the main gear and pinion before tightening the fixing bolts of the bracket. Carefully adjust the gearing so that the paper is taken out by rotating the aerial by hand, and then securely fix the bolts.

5.2 Display Unit

5.2.1 Control panel (MD-3210-7200)

The control panel MD-3210-7200 is built in a tilting type case unit. The unit is connected to the display with a 75 cm long standard cable. The unit can be dismantled from the display unit enabling up to 75 cm long remote control. The cable can be extended up to five meters on optional order for long distance remote control.

Referring to Fig. 5.2.1.1, the control panel unit is dismantled as follows:

- (1) Disconnect the display side connector of the control unit cable.
- (2) Remove two side fixing screws and take out the unit.

The front frame and rear cover encapsulate the circuit components. As shown in Fig. 5.2.1.3, the membrane sheet with track ball, chassis, board of control panel with 3 switches and 8 controls are assembled inside the case. For disassembling those components, follow the following procedure:

- (3) Remove eleven knobs of the controls and switches as follows.
 - (a) Carefully remove the cap of each knob with a cutter blade or like. See Fig. 5.2.1.2.
 - (b) Loosen the center hexagonal head screw by rotating counter-clockwise with a box spanner or screw driver and remove the knob.
 - (c) Take out the packing.

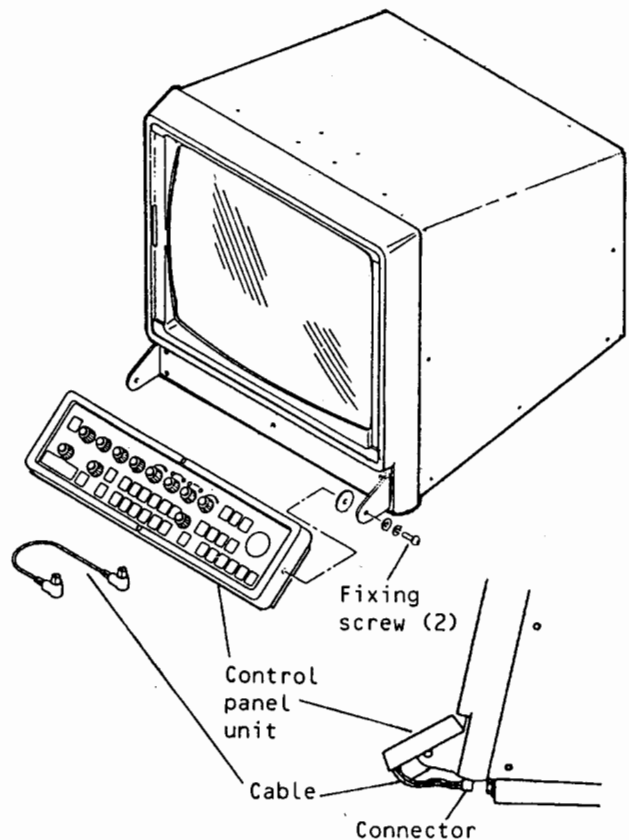


Fig. 5.2.1.1 Detaching Control Unit

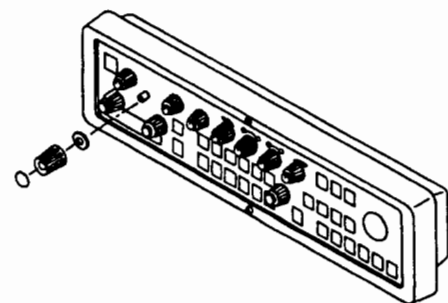


Fig. 5.2.1.2 Removing Knobs

- (4) Remove eight fixing screws of the rear cover and open the unit.
- (5) Disconnect connectors J7201, J7202, J7203, and J7204 on the control panel board.
- (6) Remove ten screws fixing the control panel board to the chassis, and take out the board. The track ball is disassembled by removing four screws fixing the component to the membrane sheet frame.

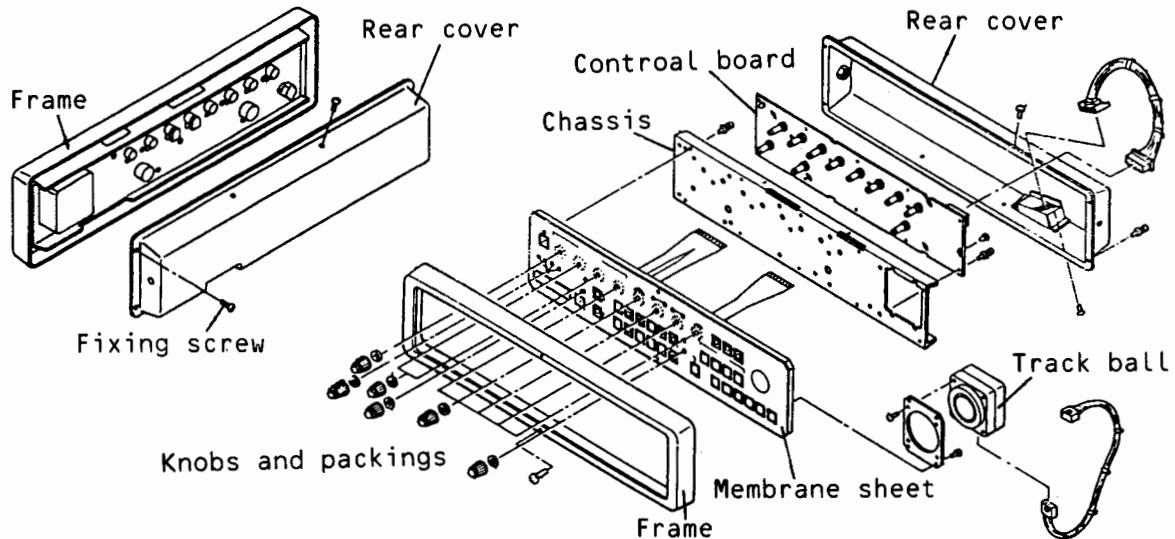


Fig. 5.2.1.3 Disassembling Control Panel Unit

5.2.2 Logic upper (MD-3210-7000) and logic lower (MD-3210-7100)

The logic boards are mounted on the right side of display. Dismounting the boards are carried out as follows:

- (1) Referring to Fig. 5.2.2 (a), remove 14 fixing screws, and open the display cover.
- (2) Referring to Fig. 5.2.2 (b), disconnect J7001 of the logic upper. When optional gyro/log interface is used, also disconnect J7002.
- (3) Remove nine fixing screws of the logic upper and take out the board.

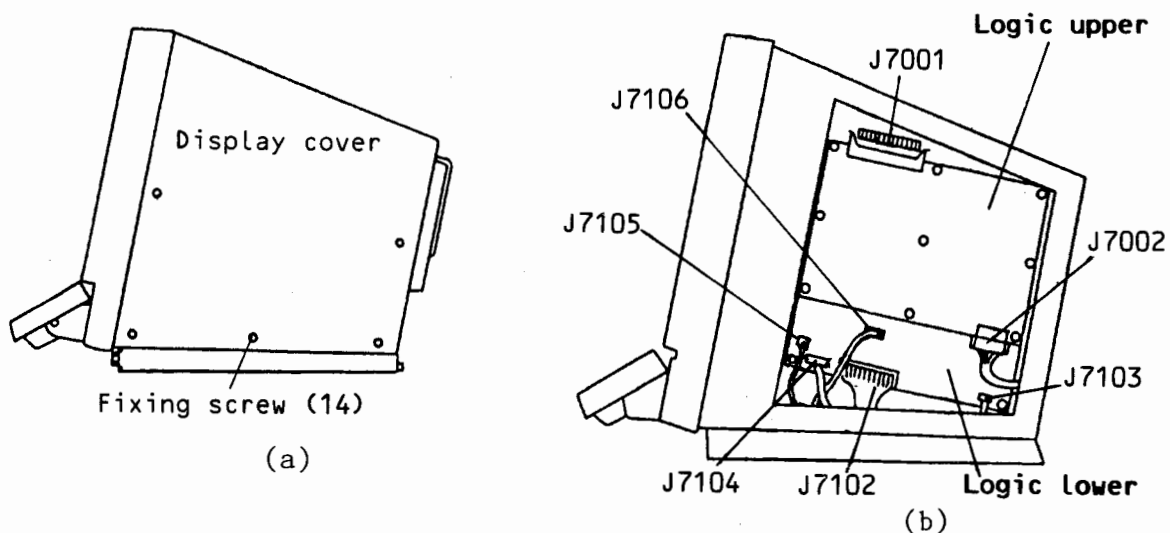


Fig. 5.2.2 Dismounting Logic Upper/Lower

CAUTION

The logic upper is assembled with a back-up battery. Do not place the board on conductive materials such as metallic plate or foil.

- (4) Disconnect J7102, J7103, J7104, J7105, and J7106 of the logic lower board.
- (5) Remove nine spacers and three fixing screws of the logic lower and take out the board.

When the logic upper (MD-3210-7000) is replaced with new board, setting of three DIP switches SW1, SW2, and SW3 should be checked. If the setting differs from previous board, restore the setting, if necessary. Functions set by DIP switches and their standard settings are listed in para. 1.5.2.

When the logic lower (MD-3210-7100) is replaced with new board, settings of five jumper pins should be checked, and corrected if necessary. Functions and initial setting status of those pins are explained in para. 1.5.1. Furthermore, ten controls and two switches are assembled on logic lower board as shown in Fig. 3.1.1. Adjustment of those controls as well as setting of switches should be made when the board is renewed. The adjustment includes:

- | | |
|--------------------------------------|---------------------|
| (a) Pulse repetition frequency (PRF) | See para. 3.3.3 (1) |
| (b) Tuning | See para. 3.1.2 |
| (c) Video input level | See para. 3.3.3 (3) |
| (d) Preset gain | See para. 3.1.3 |
| (e) STC | See para. 3.1.4 |
| (f) Trigger delay | See para. 3.1.5 |
| (g) SHF and bearing | See para. 3.1.6 |

5.2.3 Power supply (MD-3210/3220-6000)

The power supply board is mounded inside the rear panel. Dismounting the board is carried out as follows:

Refer to Fig. 5.2.3.1

- (1) Remove four fixing screws of the cover for terminals of the optional gyro/log interface board on the rear panel, and open the cover.

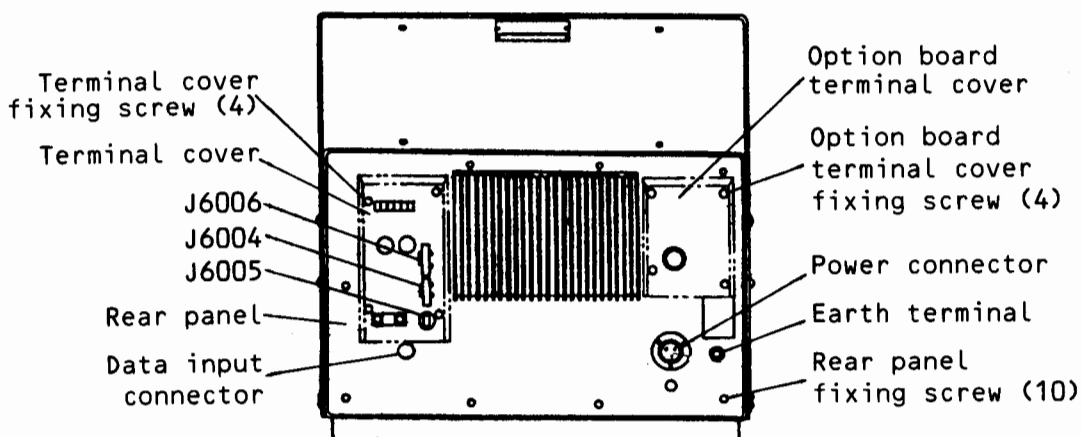


Fig. 5.2.3.1 Disassembling Display Rear Panel

- (2) Remove four fixing screws of the terminal cover on the rear panel, and open the cover. Disconnect the antenna cable connectors J6004, J6005, and J6006.
- (3) Disconnect the power cable connector and earth terminal.
- (4) Disconnect the data input connector from optional navigator, if used.
- (5) Remove ten fixing screws of the rear panel, and slowly open the panel.

Refer to Fig. 5.2.3.2.

- (6) Disconnect connectors J6001, J6002, and J6003. In case of MD-3220, also disconnect J6009.
- (7) Detach the rear panel from the display unit.
- (8) Find the power supply board mounted on the rear panel. Disconnect terminals E1, E2, E9, E10, E11, and E12, as well as connector J6007.
- (9) Remove fifteen (15) fixing screws of the power supply board, and take out the board from the chassis.

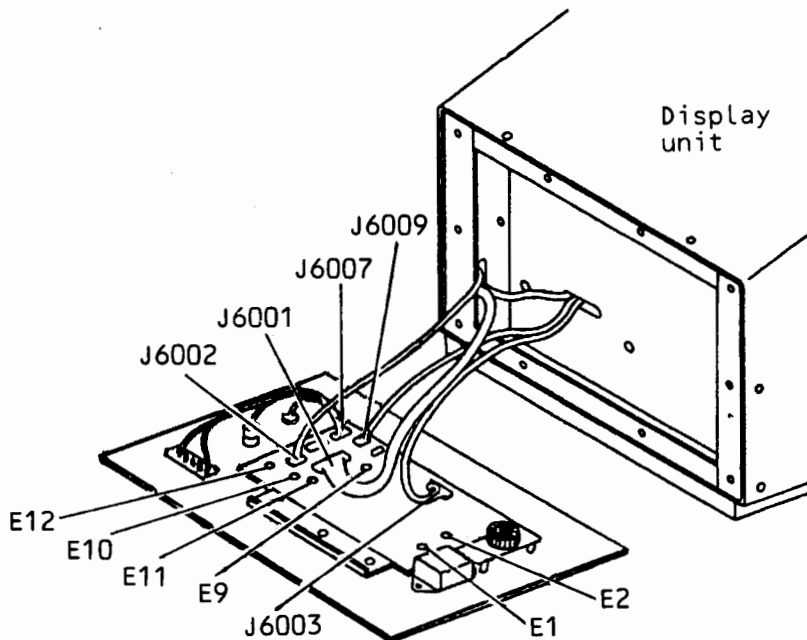


Fig. 5.2.3.2 Dismounting Power Supply Board

When the power supply (MD-3210-3220-6000) is replaced with new board, the switching regulator oscillating frequency, +100 V output level, and magnetron heater current should be adjusted. Refer to para. 3.3.1.

5.2.4 CRT unit

CAUTION

EHT (extra high tension) charge may be remained on the CRT anode cap. Prior to dismount the CRT unit, discharge the anode voltage with a clip cord or like.

- (1) Remove the display cover by removing 14 fixing screws.
- (2) Open the rear panel with power supply. [Refer to para. 5.2.3.] Disconnect J6001, J6002 and J6003 of the power supply and detach the rear panel from the display unit.

- (3) Find two circuit boards, the CRT main board PWD1050A (bottom), and CRT neck board PWD1051A (CRT socket) inside the display unit. Fig. 5.2.4.1 shows layout of the CRT circuit boards.
- (4) Disconnect connectors J7105 and 7106 on the logic lower MD-3210-7100. Pull the cables onto the CRT main board inside the unit.
- (5) Disconnect pin #16 of the CRT neck board and carefully remove the CRT socket from the CRT neck.
- (6) Disconnect connector P461 of the cable to CRT deflection yoke.
- (7) Disconnect the CRT anode cap.

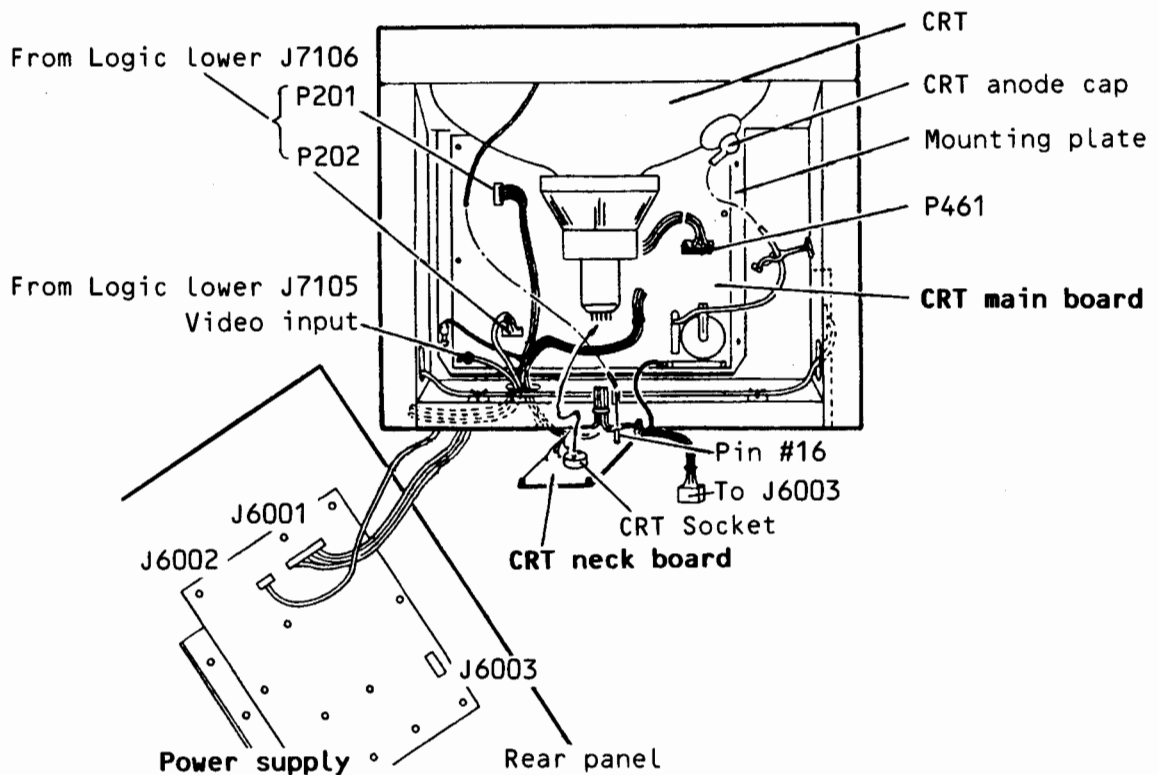


Fig. 5.2.4.1 Layout of CRT Unit Boards

- (8) When optional gyro/log interface board is mounted on the left hand side of the display unit, detach the board. Remove four (4) fixing screws of the mounting plate, referring to Fig. 5.2.4.1. Carefully take out the mounting plate with CRT main board and neck board through the left hand side opening of the display chassis as shown in Fig. 5.2.4.2.
- (9) Remove twelve (12) fixing screws of the CRT main board and detach the board from the mounting plate.
- (10) Referring to para. 5.2.1, dismount the control panel unit. Dismount the bracket by removing five (5) fixing screws.
- (11) Remove ten (10) screws fixing the front frame to the display chassis.

Securely hold the front frame and carefully draw it out with CRT. Be sure that the CRT is so heavy.

Place the CRT with the front face of the frame bottom.

- (12) Remove four (4) fixing nuts of the CRT at its corners, and take out associated washers.
- (13) Slowly lift up the CRT and detach from the front frame.
- (14) Follow the reverse procedure for mounting new CRT and CRT boards.

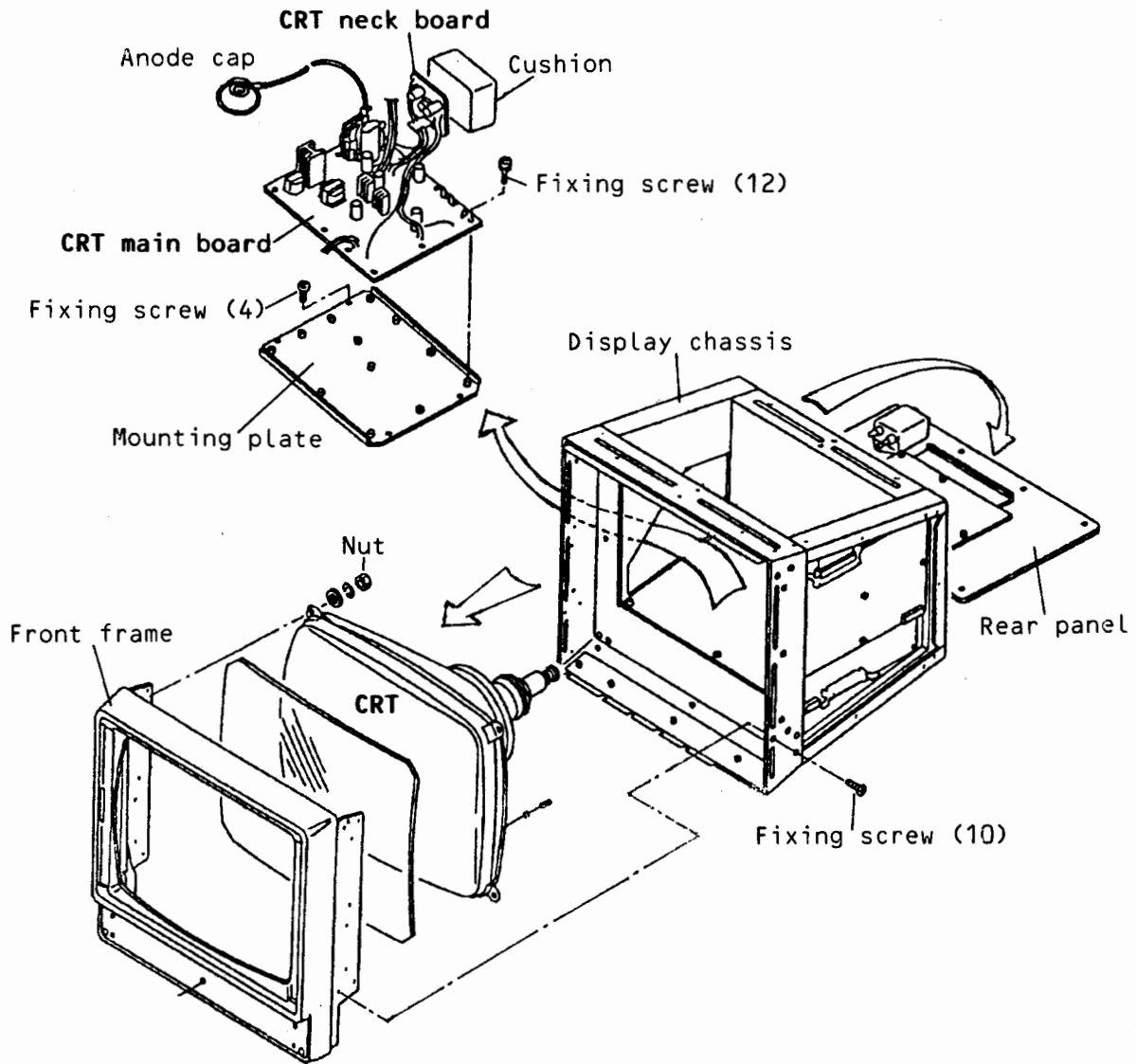


Fig. 5.2.4.2 Dismounting CRT and CRT Boards

6. TROUBLESHOOTING

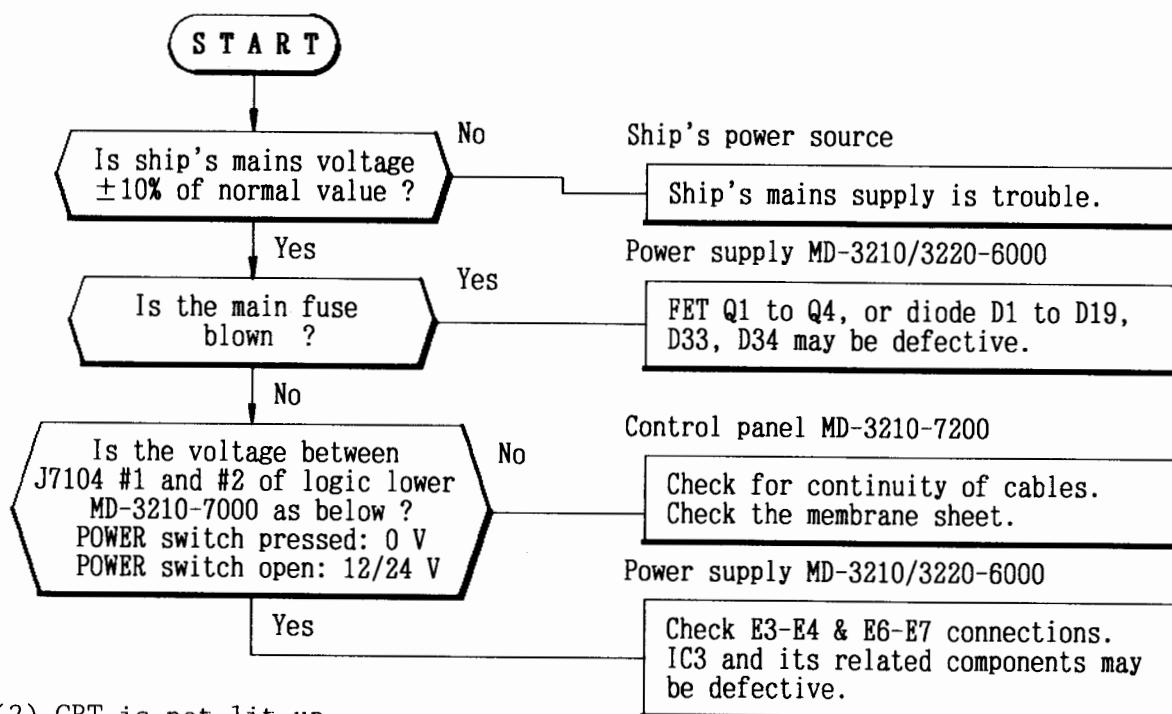
As most circuits of this radar are composed of integrated circuits (IC), it is rather difficult to locate defective components with usual instruments such as an oscilloscope or multi-meter. In order to restore the system in trouble to normal operation as quickly as possible, this section explains flowcharts and tables for troubleshooting based on replacement of printed circuit boards.

For troubleshooting measurement, prepare an oscilloscope, frequency counter, and/or a multi-meter with internal resistance of 20 k Ω /V DC, according to respective descriptions.

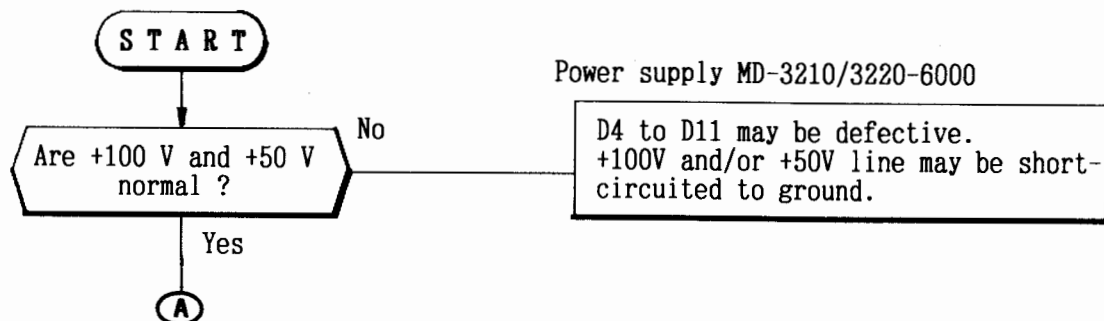
6.1 Troubleshooting by Observing Display

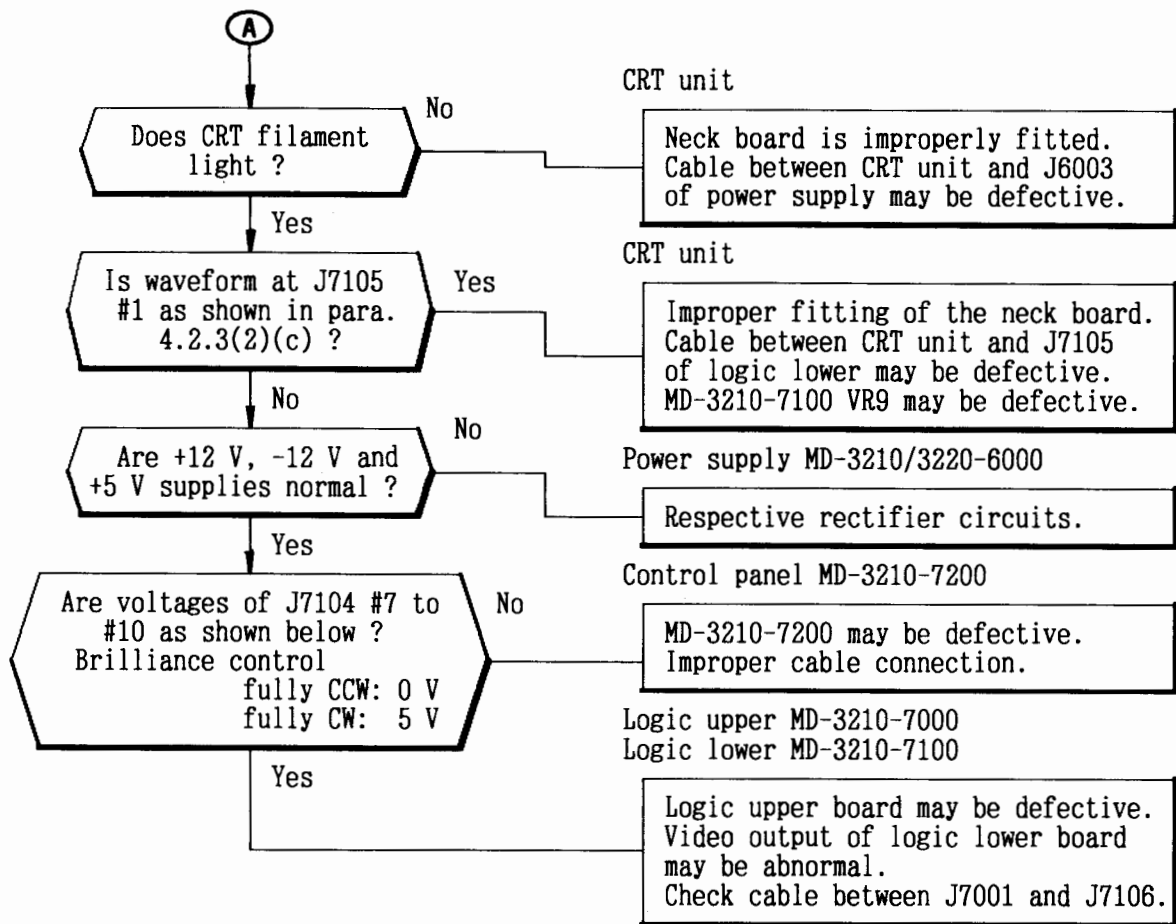
If the radar shows abnormal operation, sometimes the cause of malfunction can be found by carefully observing images shown on the CRT of the display unit. Refer to flowcharts and tables in this paragraph for analysing the faults.

- (1) Radar does not come on, although POWER switch is pressed.



- (2) CRT is not lit up.

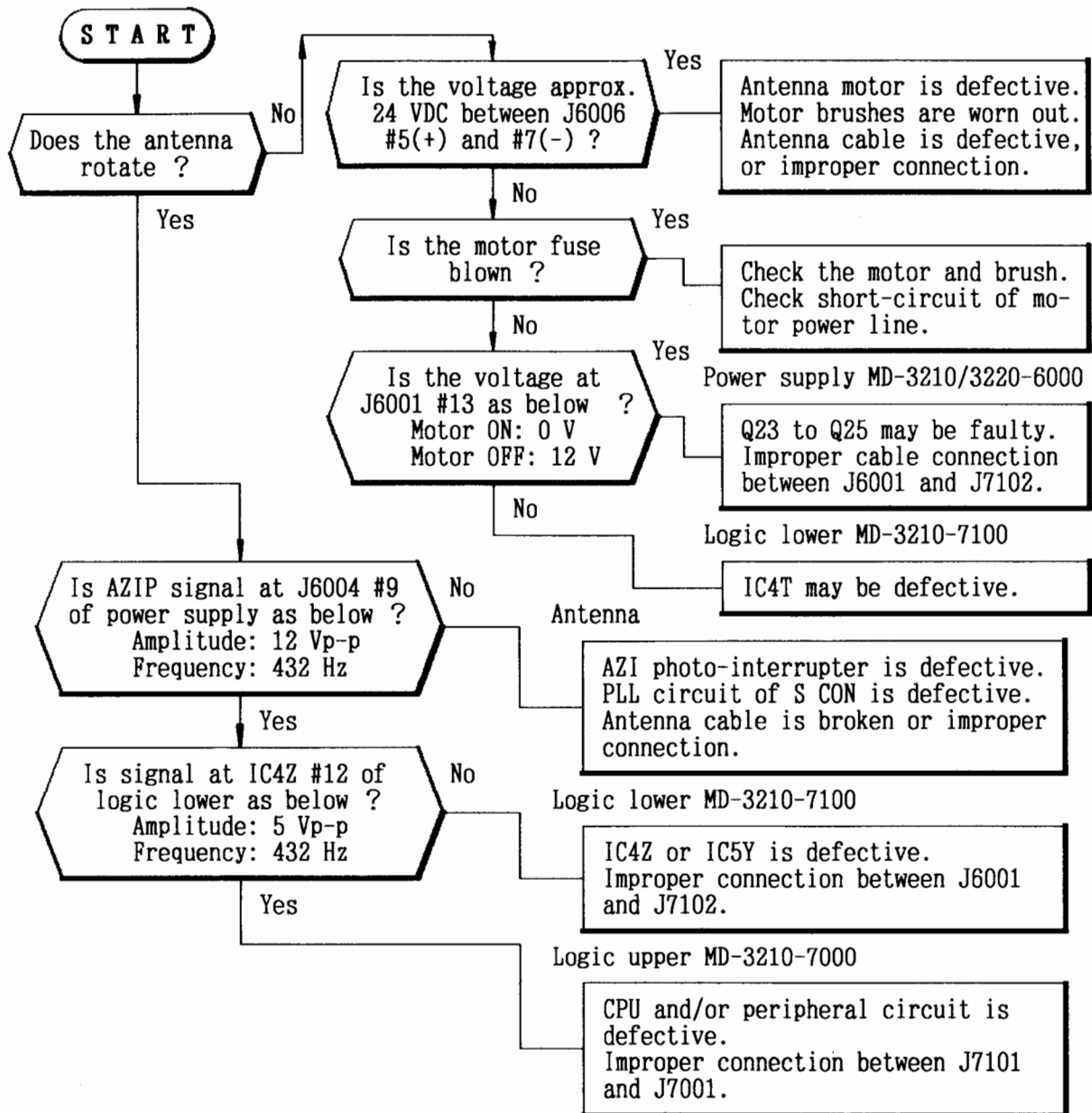




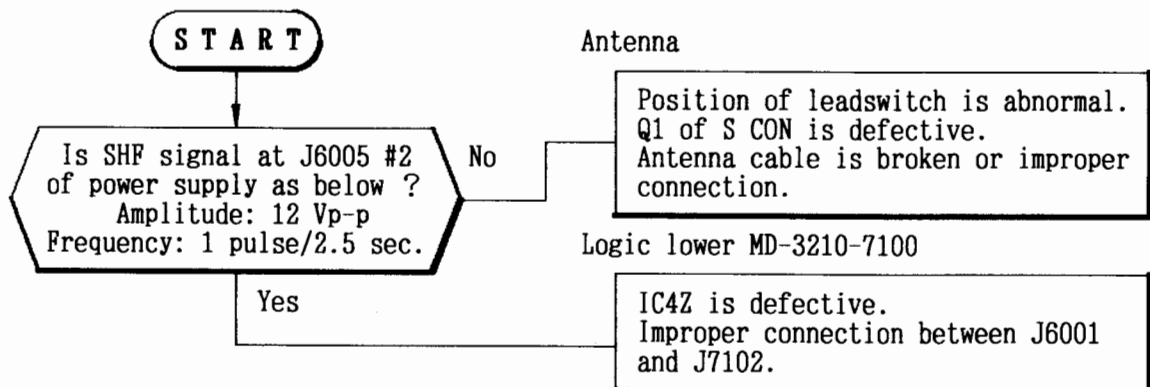
(3) Abnormal display on CRT

No.	Trouble	Cause	Action
1	Picture on CRT is not stabilized and moves up/down or left/right continuously.	(a) Improper setting of CRT size (b) Improper setting of horizontal scanning (c) Loose connection of cable between J7106 and CRT unit. (d) Improper adjustment of V.HOLD and H.HOLD of CRT main board. (e) Fault of logic lower	Turn OFF SW3 #7 of logic upper. Set Jumper JP5 of logic lower to 1,153. Securely connect the cable plugs. Adjust correctly. Replace the board.
2	Marker rings in the picture are distorted.	(a) Improper adjustment of V.SIZE, V.LINE, S.CORRE, and H.WIDTH. (b) Improper adjustment of CRT neck cores.	Adjust correctly. Adjust correctly.

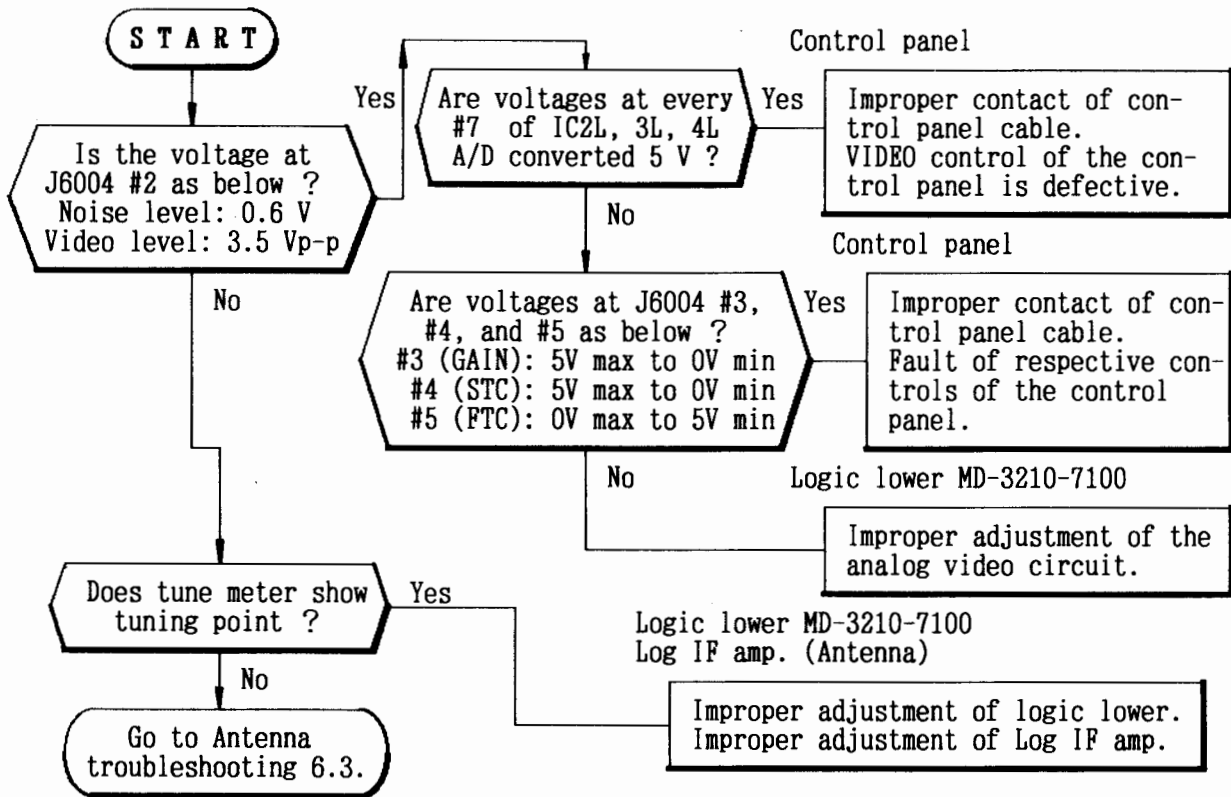
(4) [AZI FAIL] is displayed.



(5) [SHF FAIL] is displayed.



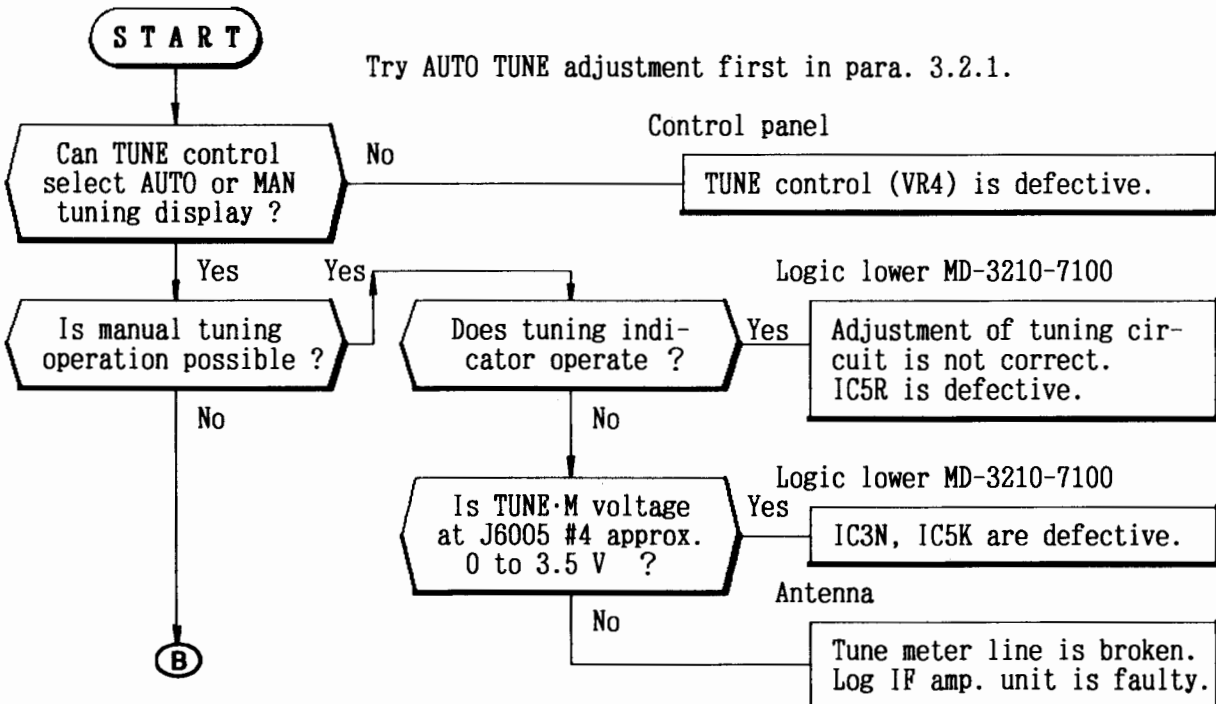
(6) Poor sensitivity, even gain and video controls are set to maximum, while STC and FTC suppression to minimum.

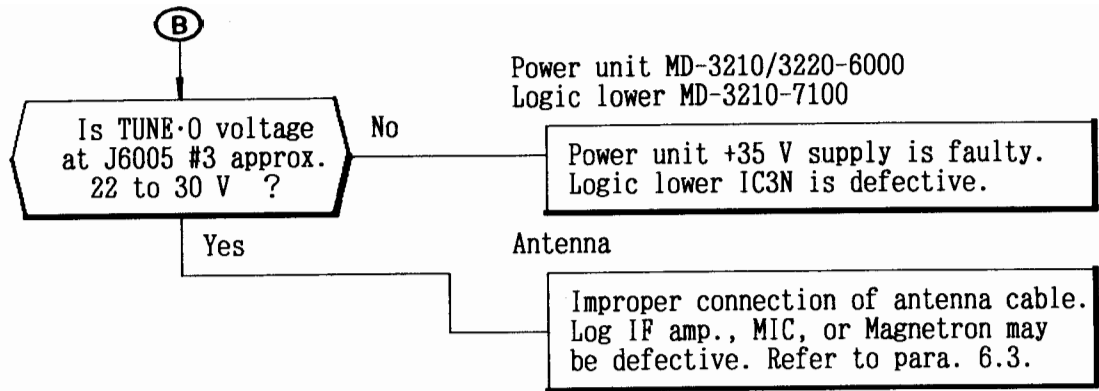


6.2 Operation Control Troubleshooting

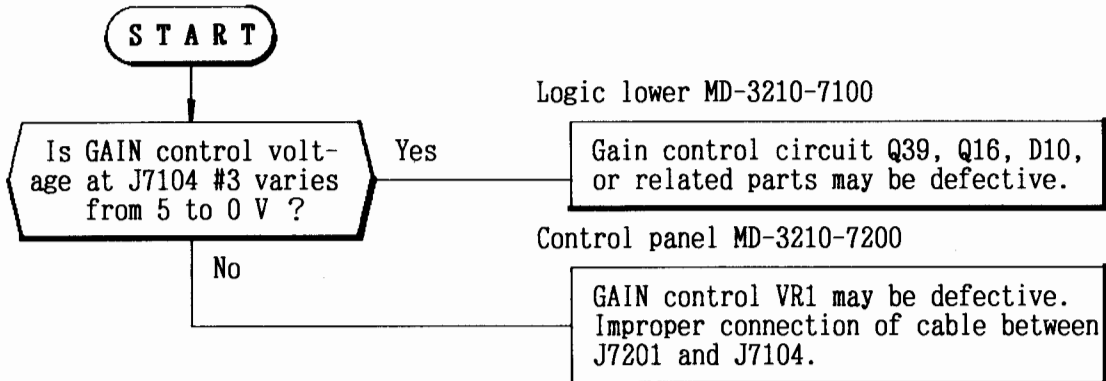
If operational control of the radar shows malfunction, troubleshooting is carried out as follows.

(1) AUTO TUNE does not operate.

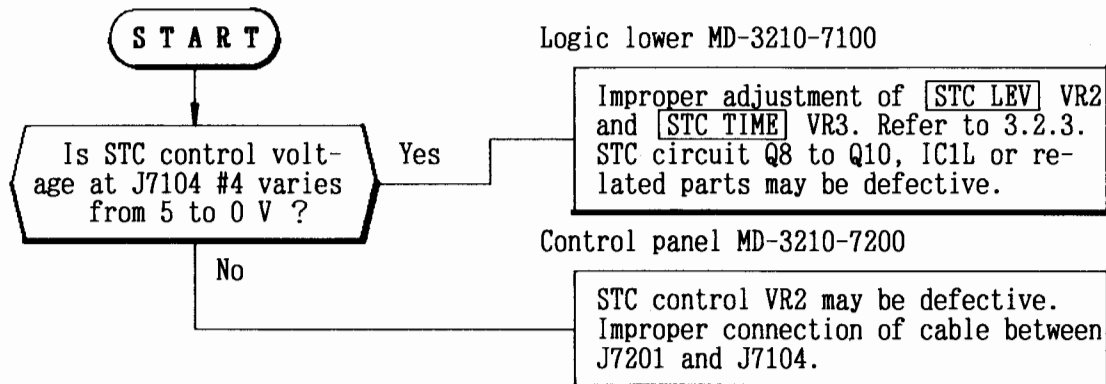




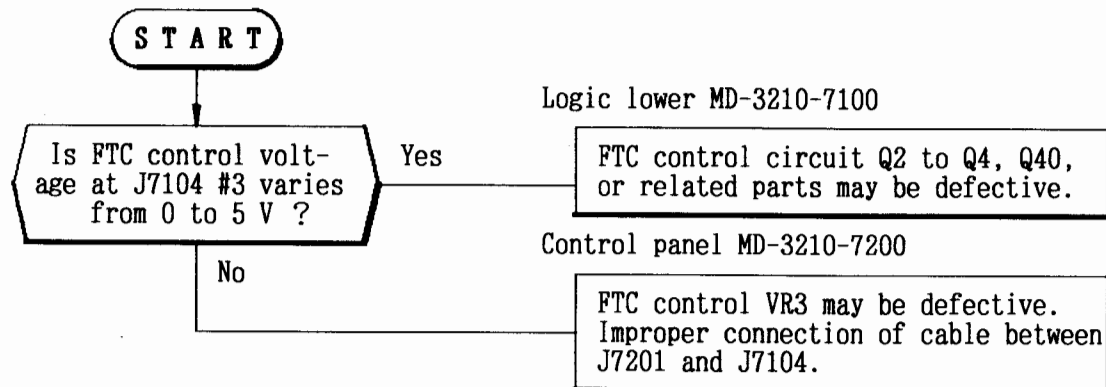
(2) GAIN control does not operate.



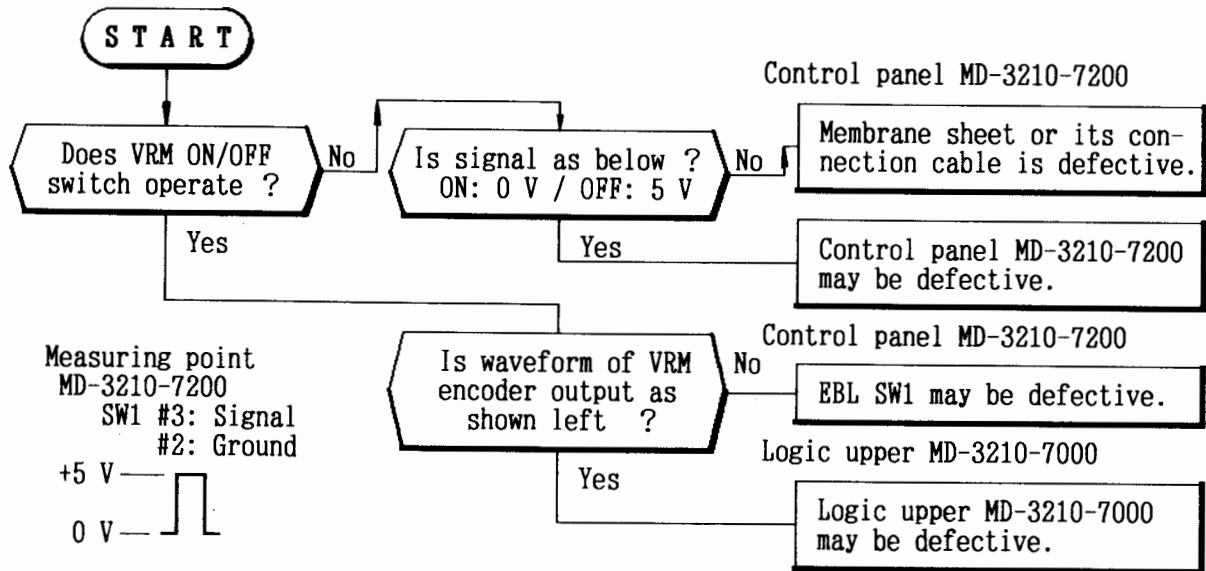
(3) STC control does not operate.



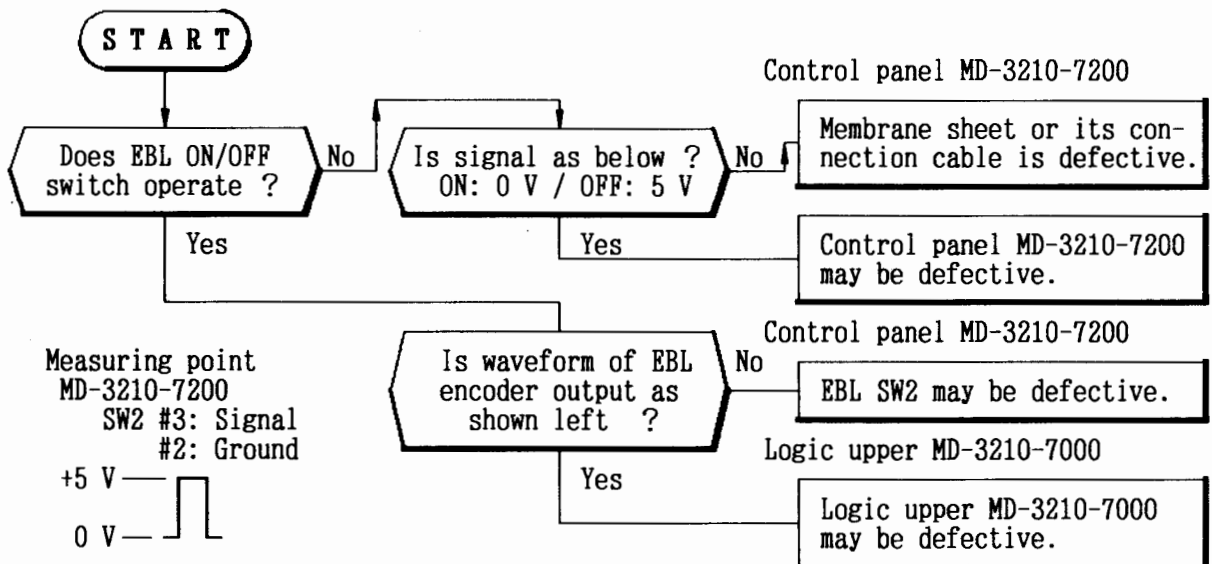
(4) FTC control does not operate.



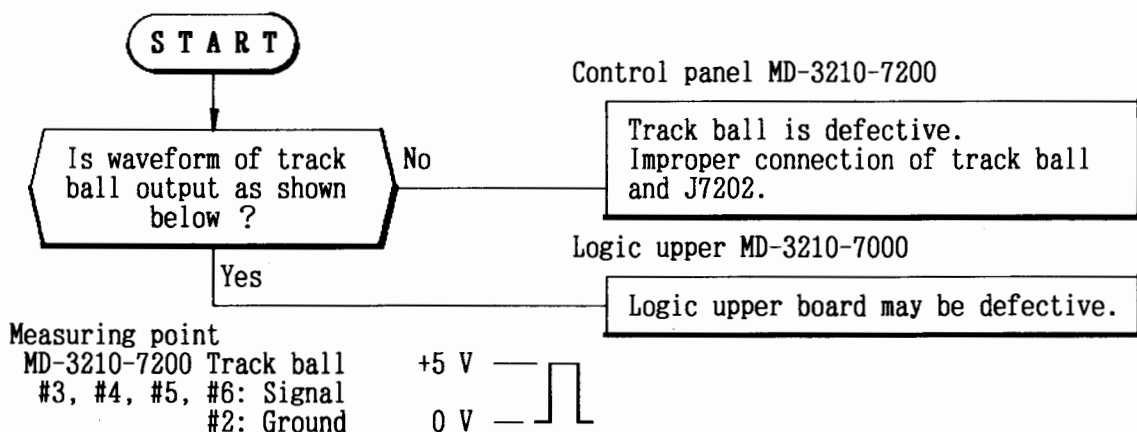
(5) VRM does not operate.



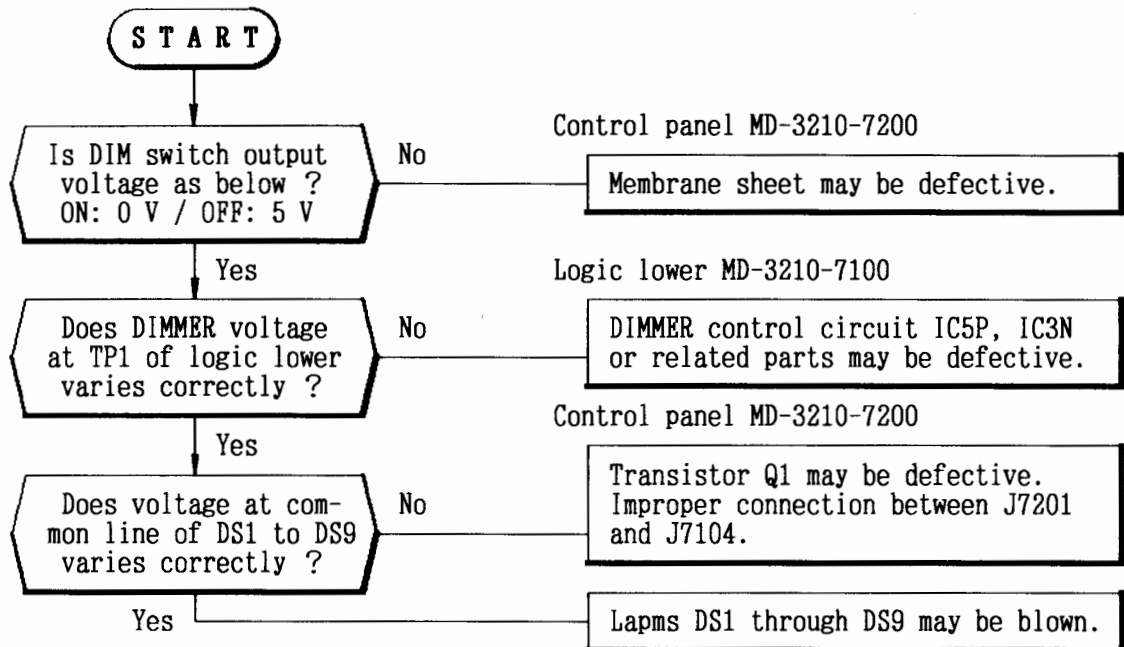
(6) EBL does not operate.



(7) Track ball does not operate.



(8) Dimmer lamps cannot be turned ON.



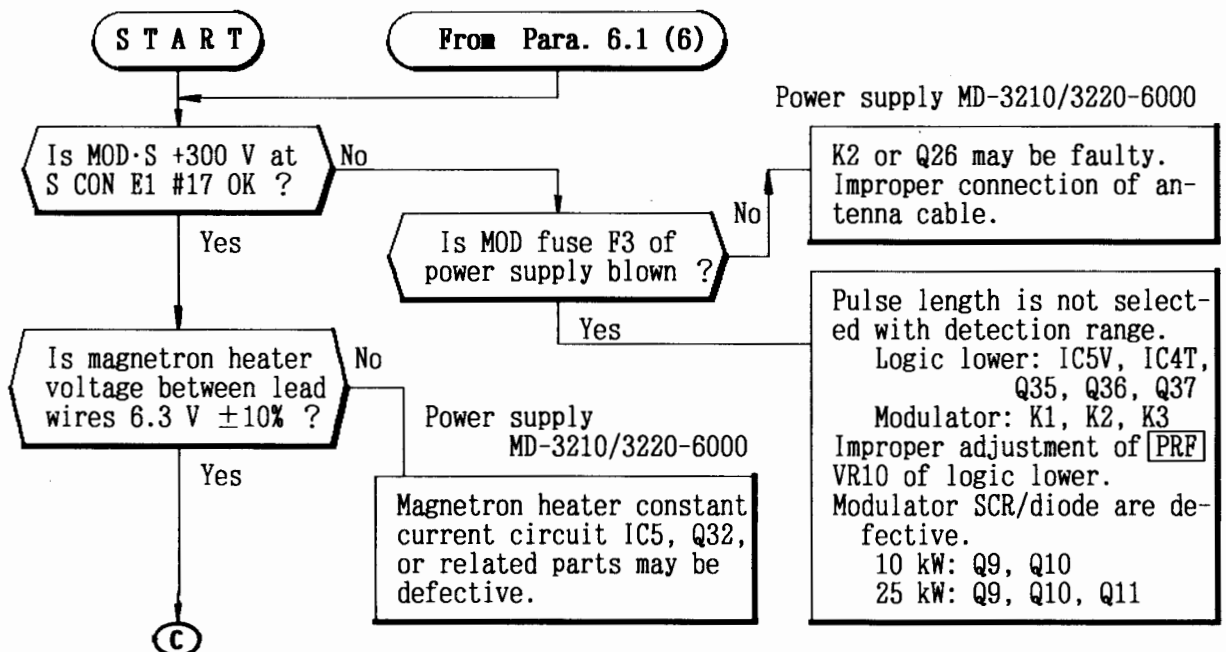
6.3 Antenna Troubleshooting

When it is estimated that malfunction of radar is due to trouble of antenna unit, troubleshooting is performed as follows:

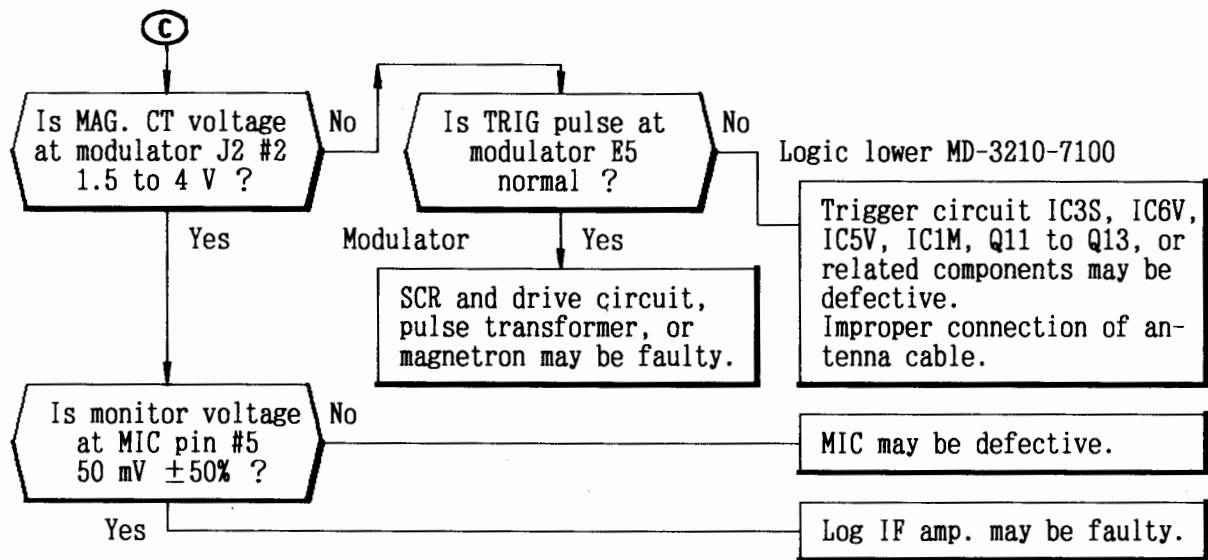
(1) Antenna does not rotate.

Follow the flowchart in para. 6.1 (4) AZI FAIL troubleshooting.

(2) Poor sensitivity caused by transmitter/receiver trouble is anticipated.

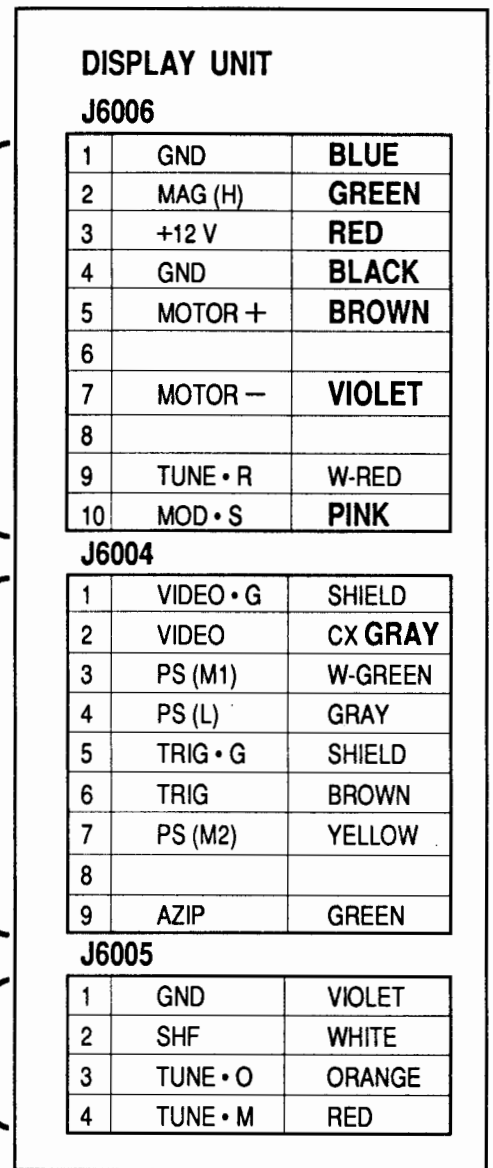
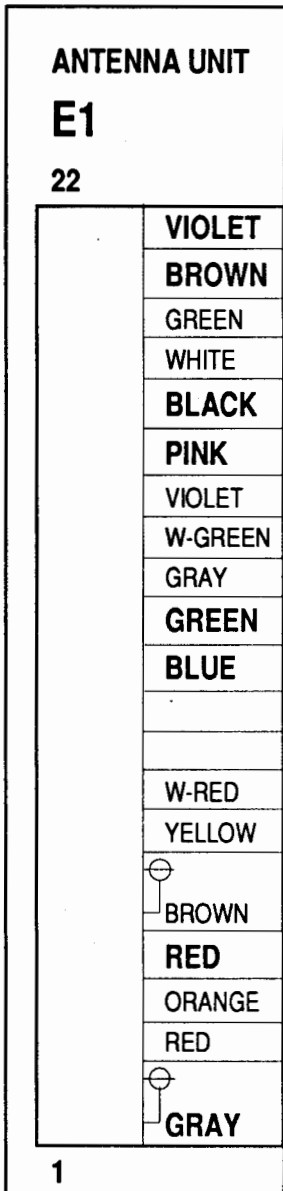


Antenna troubleshooting, continued



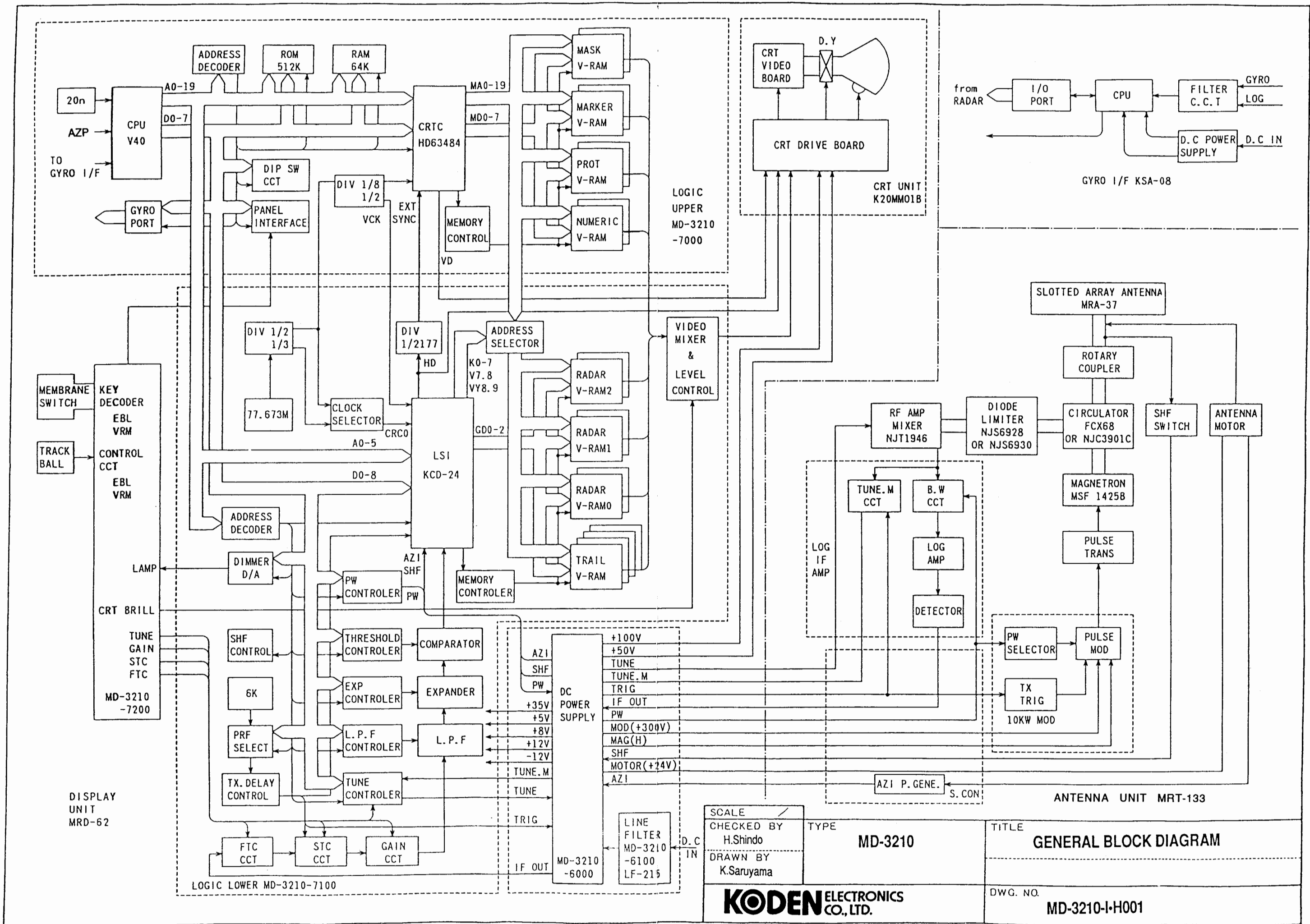
7. DIAGRAMS

7.1 Circuit Diagram

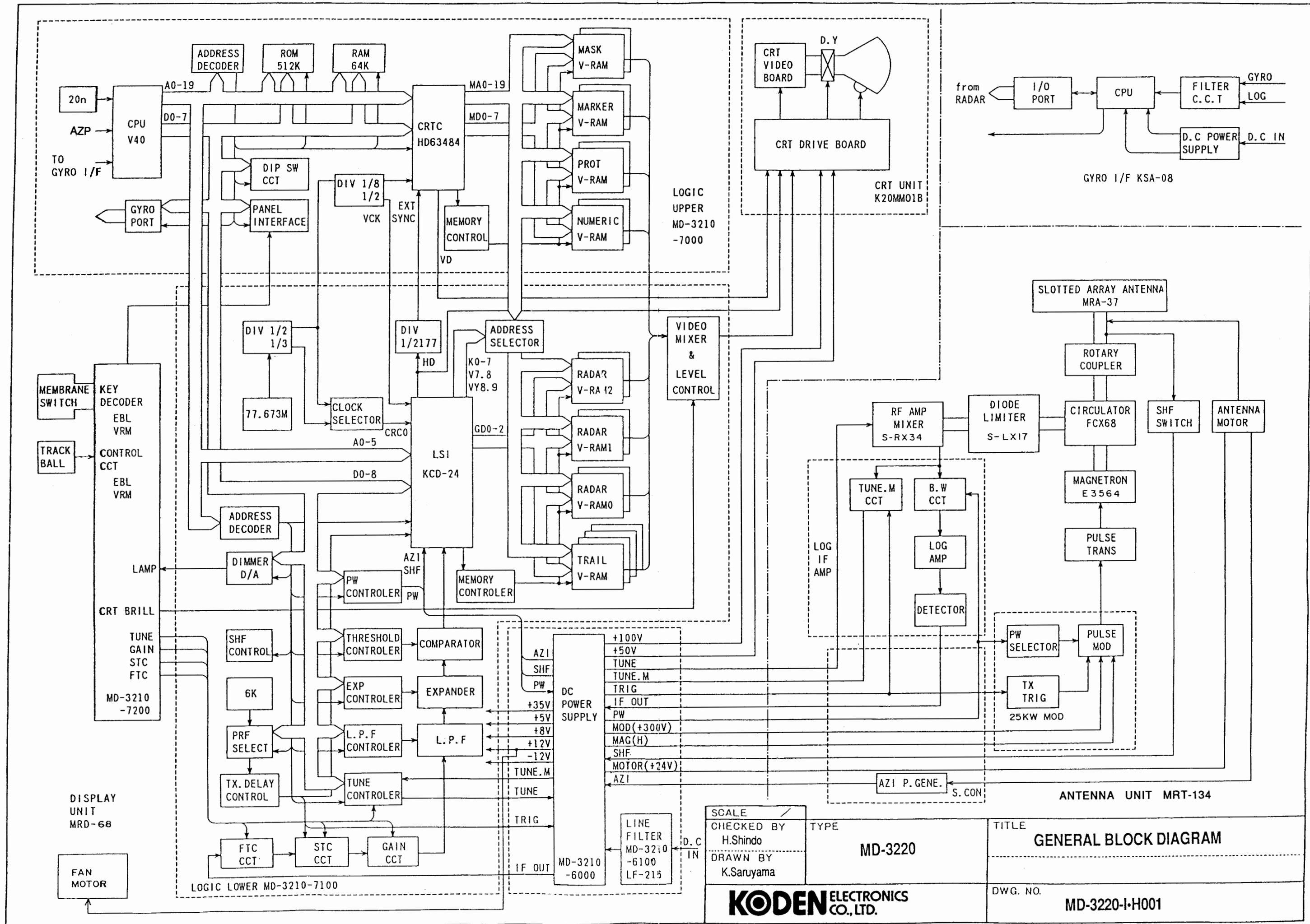


Bold letters (for example **VIOLET**) : The thicker wire
 Plain letters (for example VIOLET) : The thinner wire

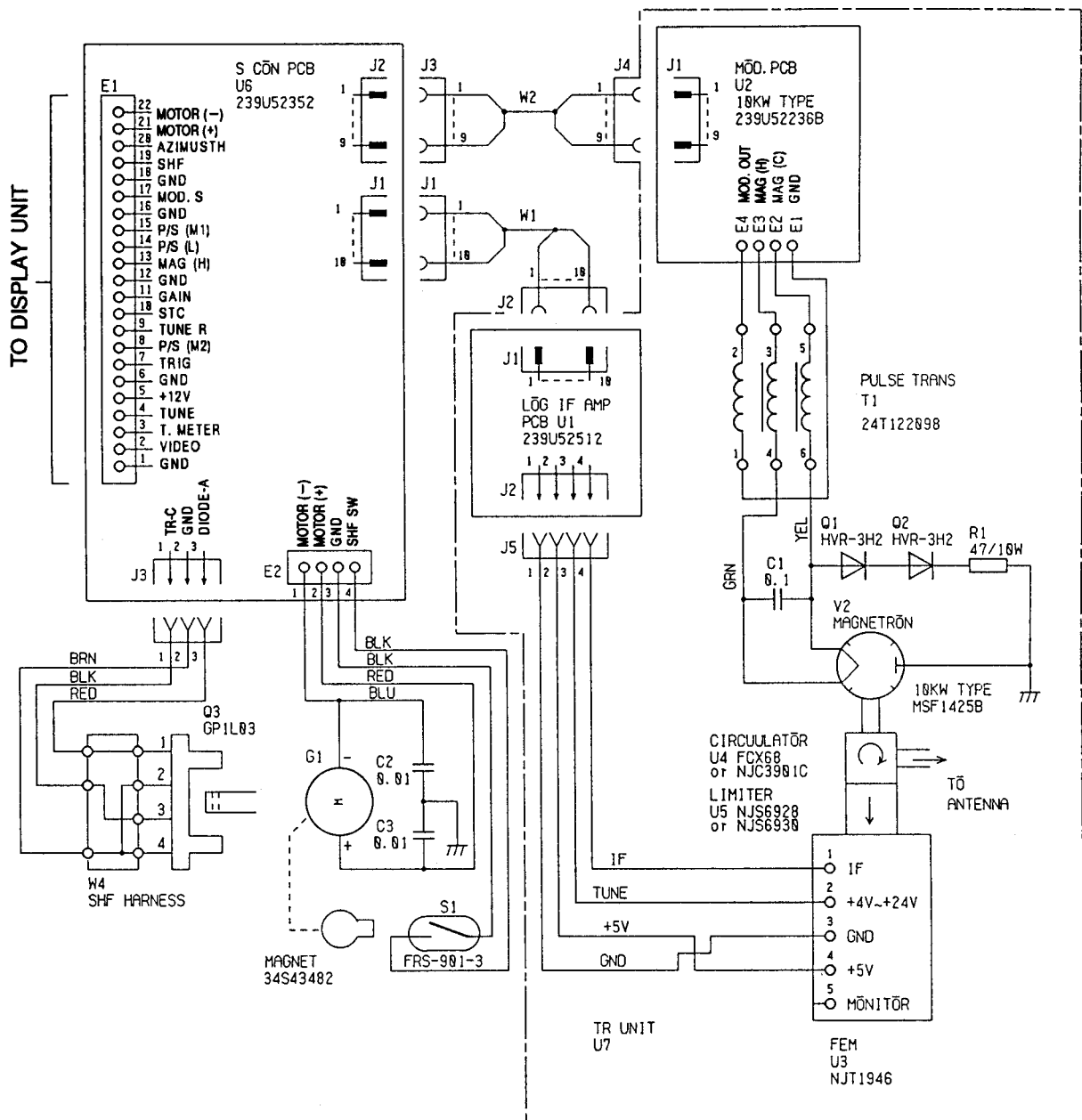
SCALE /	TYPE		TITLE
CHECKED BY H. Shindo	MD-3210/MD-3220		INTERCONNECTION DIAGRAM (ANTENNA-DISPLAY)
DRAWN BY K. Saruyama			
KODEN ELECTRONICS CO., LTD.			DWG. NO. MD-3210-E•H001



SCALE	CHECKED BY	TYPE	TITLE
	H.Shindo	MD-3210	GENERAL BLOCK DIAGRAM
	DRAWN BY		DWG. NO.
	K.Saruyama		MD-3210-I-H001



SCALE	CHECKED BY	TYPE	TITLE
	H.Shindo	MD-3220	GENERAL BLOCK DIAGRAM
	DRAWN BY		DWG. NO.
	K.Saruyama		MD-3220-I-H001



SCALE /
 CHECKED BY
H. SHindo
 DRAWN BY
K. Saruyama

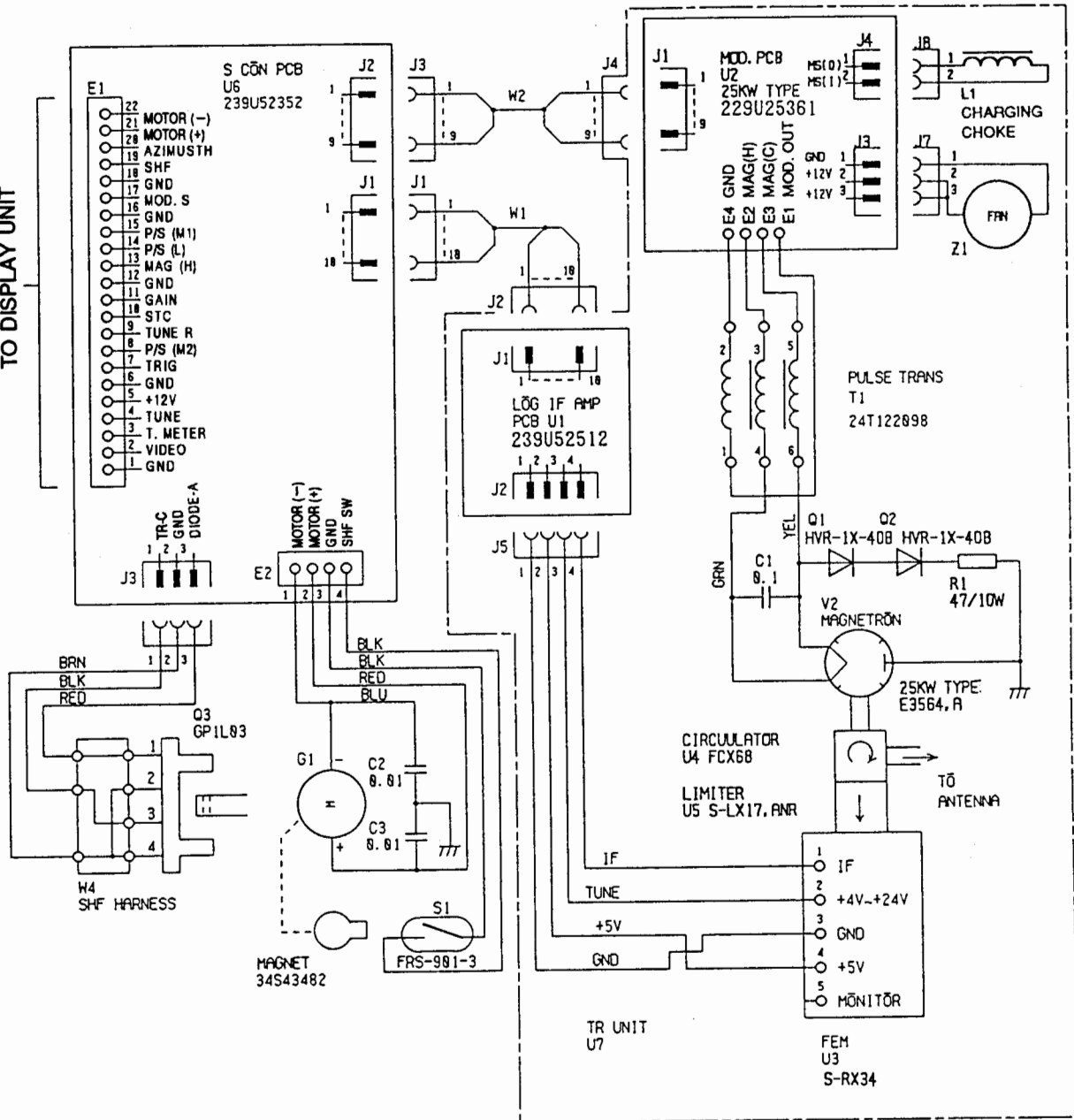
TYPE
MRT-133

TITLE
ANTENNA UNIT

KODEN ELECTRONICS
 CO., LTD.

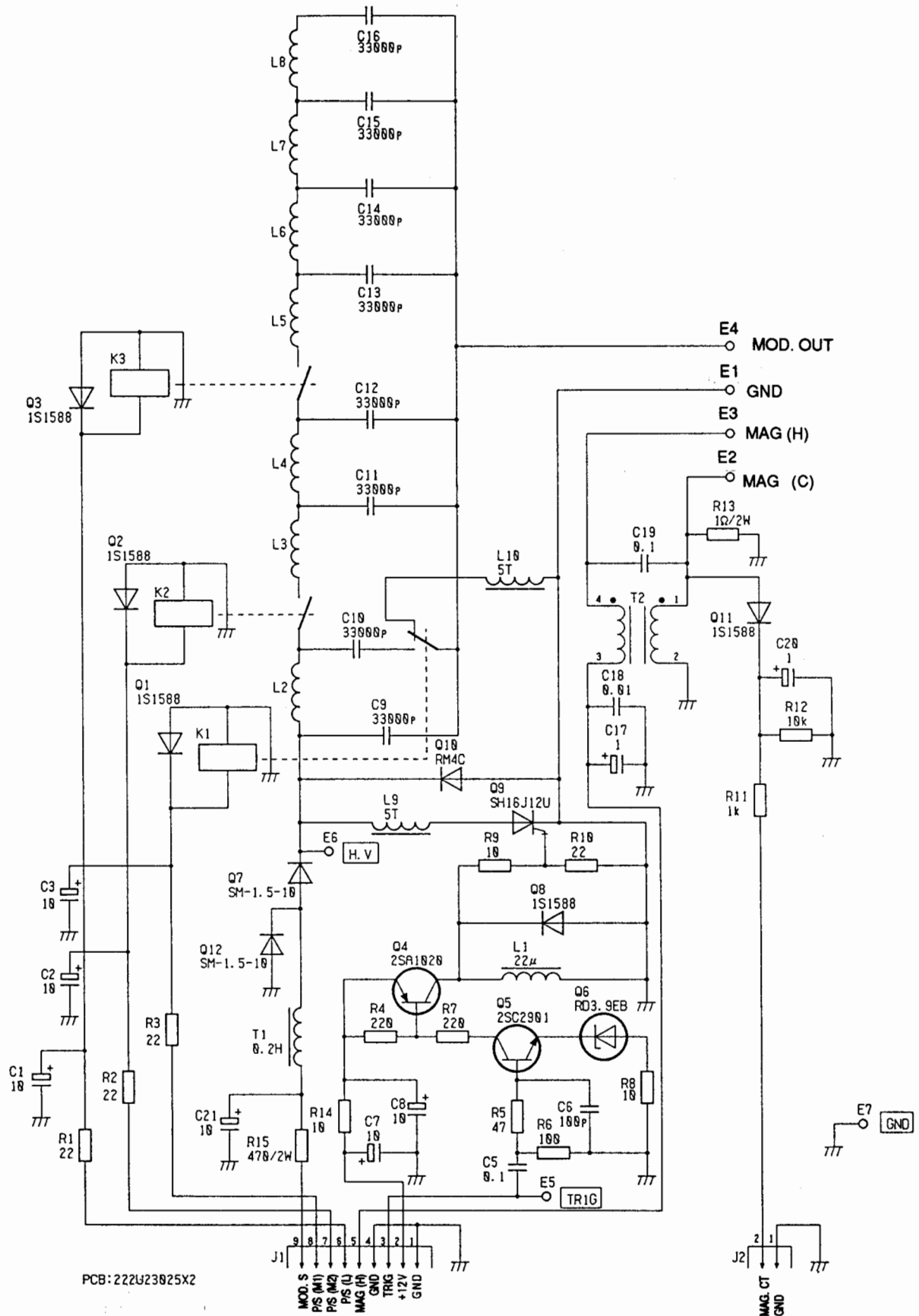
DWG. NO.
MRT133-K-H001

TO DISPLAY UNIT

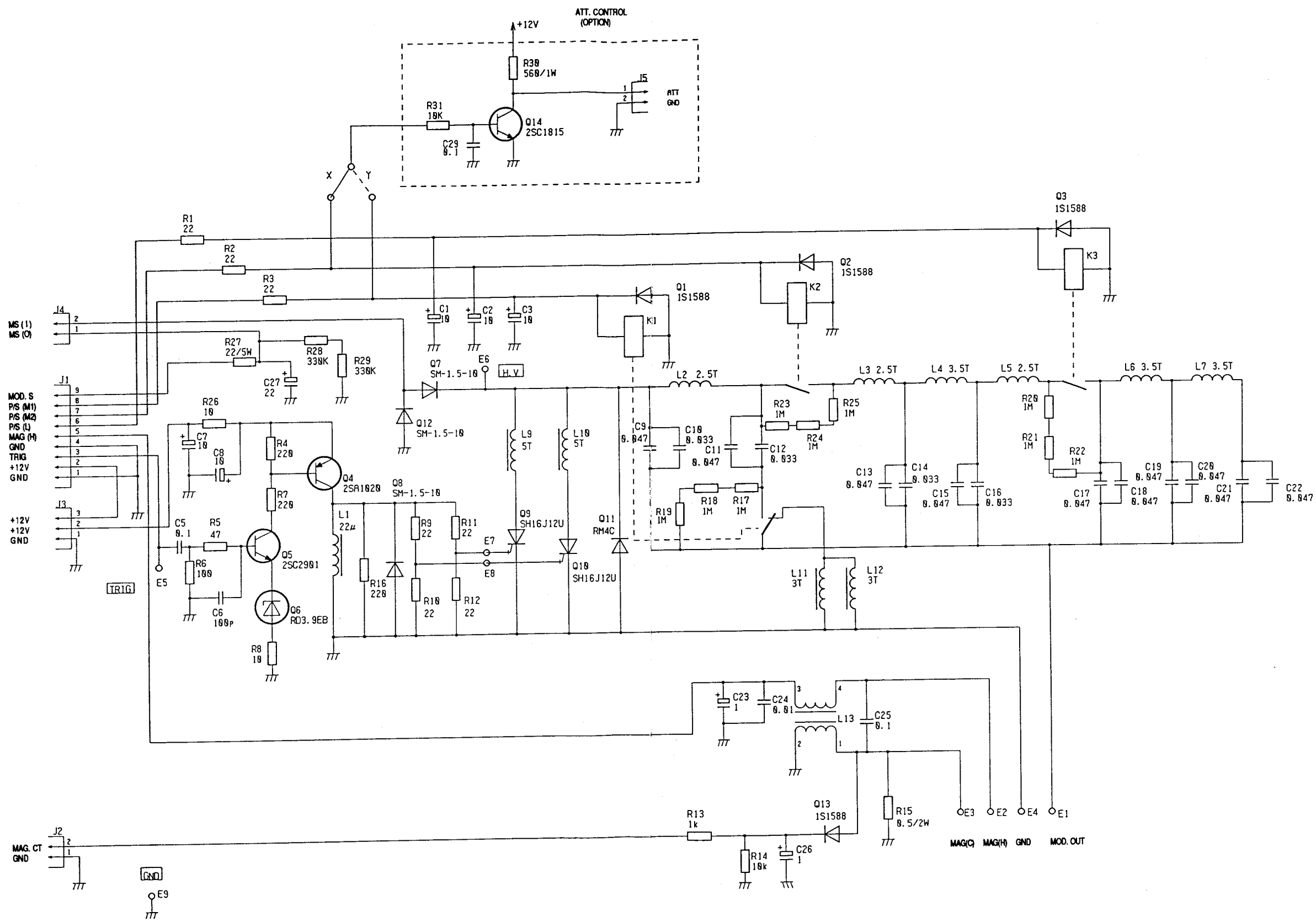


SCALE		TITLE	
CHECKED BY	TYPE	ANTENNA UNIT	
H. Shindo	MRT-134		
DRAWN BY		DWG. NO.	
K. Saruyama		MRT134-K-H001	

KODEN ELECTRONICS
CO., LTD.

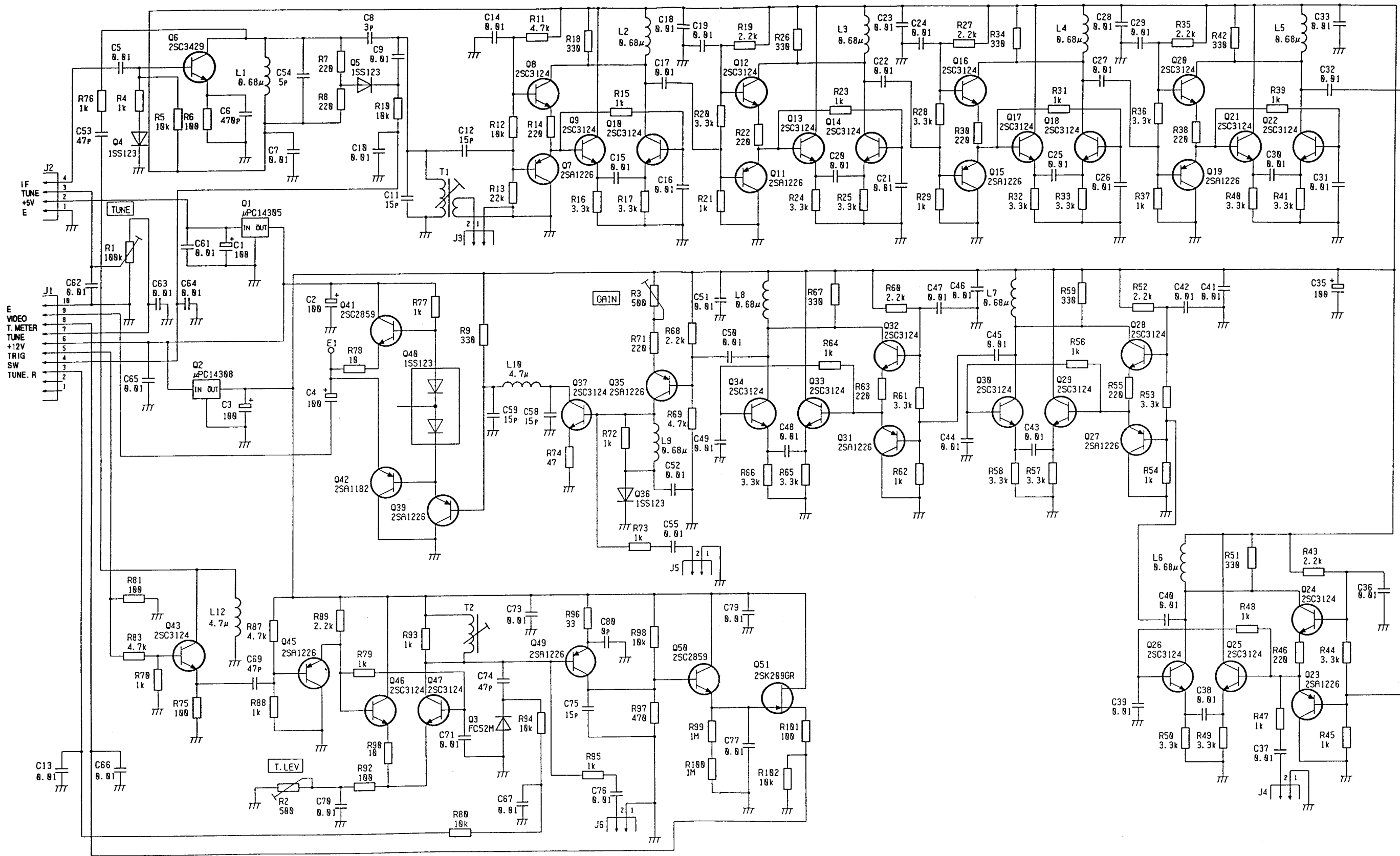


SCALE		TITLE	MOD (10kW)
CHECKED BY	H. Shindo	TYPE	MRT-133
DRAWN BY	K. Saruyama		
KODEN ELECTRONICS CO., LTD.		DWG. NO.	MRT133-K-H002



APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
H.Shindo	H.Shindo	K.Saruyama	K.Saruyama	MRT-134	MOD (25kW)
DATE	REVISED	APPROVED		KODEN KODEN ELECTRONICS CO., LTD.	DWG. NO. MRT134-K-H002
					PAGE 7-7

CONTENTS



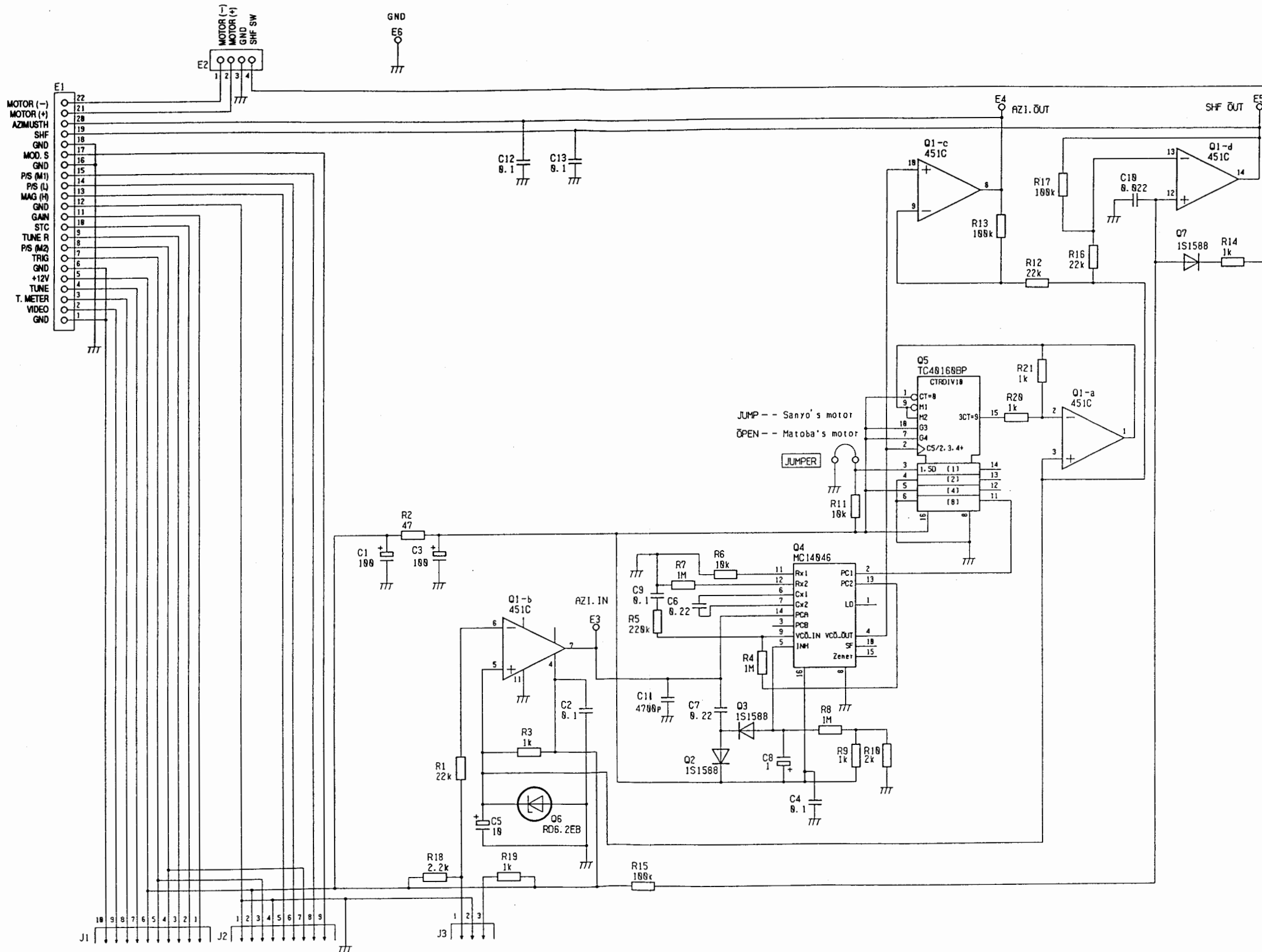
PCB: 232U52513X4

APPROVED				CHECKED		DRAWN		DESIGNED		MODEL	TITLE	
H.Shindo				H.Shindo		K.Saruyama		K.Saruyama		MRT-133 / MRT-134	LOG IF AMP	
DATE				REVISED		APPROVED				DWG. NO.		PAGE
										MRT133-K-H003		

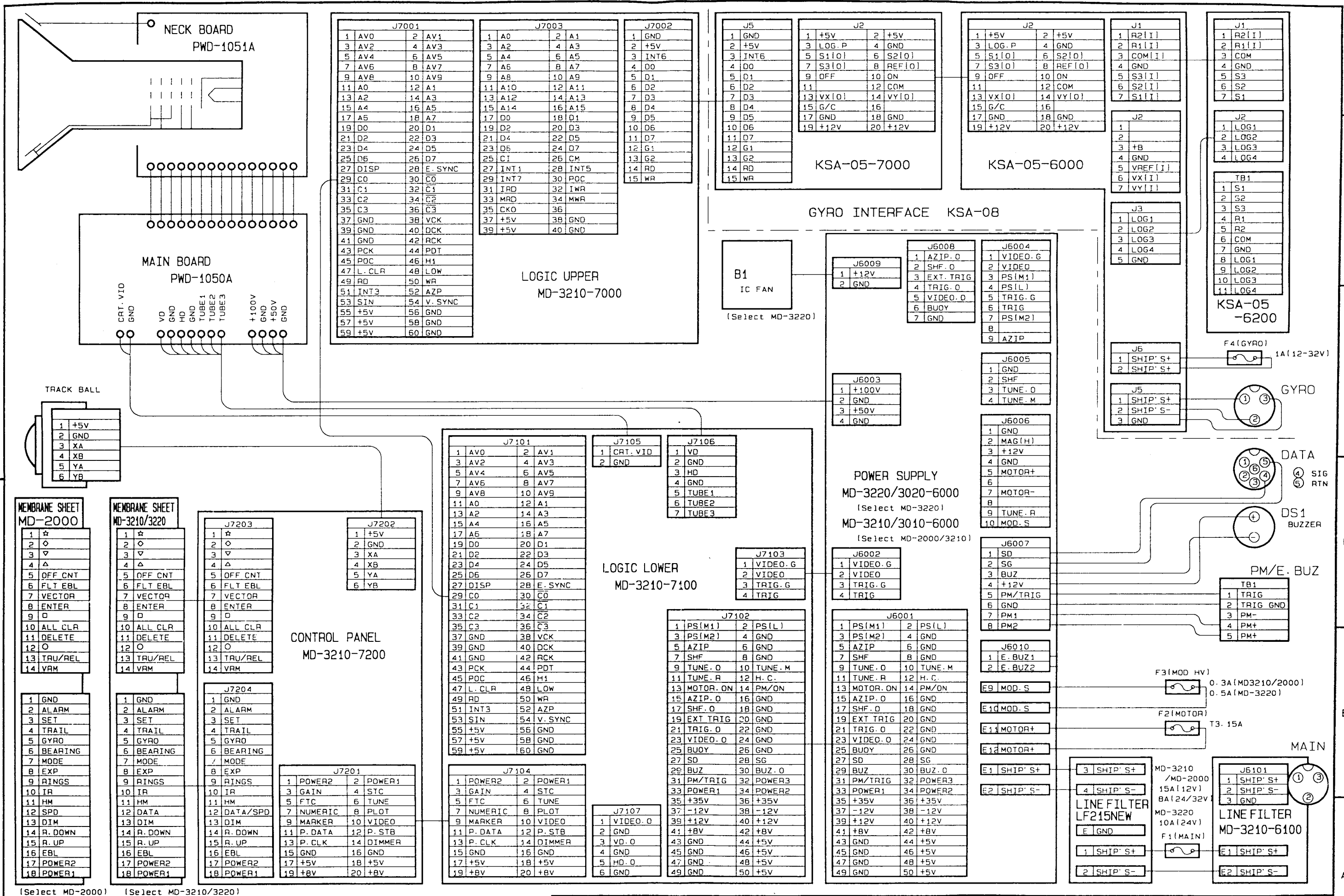
CONTENTS

DATE REVISED APPROVED

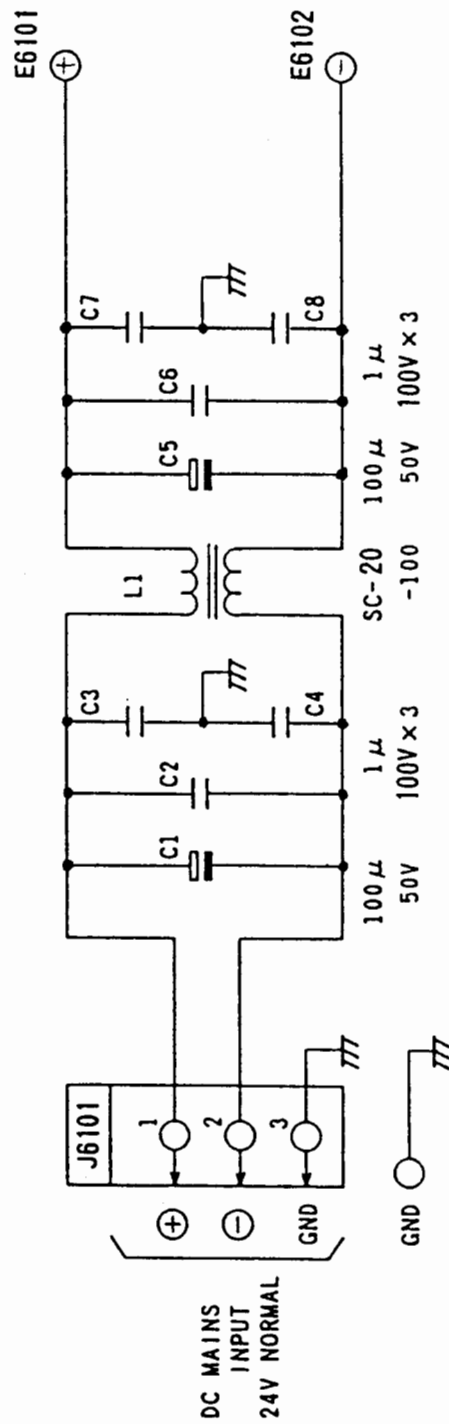
KODEN KODEN ELECTRONICS CO., LTD.



APPROVED				CHECKED		DRAWN		DESIGNED		MODEL MRT-133 / MRT-134		TITLE S CON	
H.Shindo				H.Shindo		K.Saruyama		K.Saruyama		KODEN KODEN ELECTRONICS CO., LTD.		DWG. NO. MRT133-K-H004	
DATE				REVISED		APPROVED						PAGE	

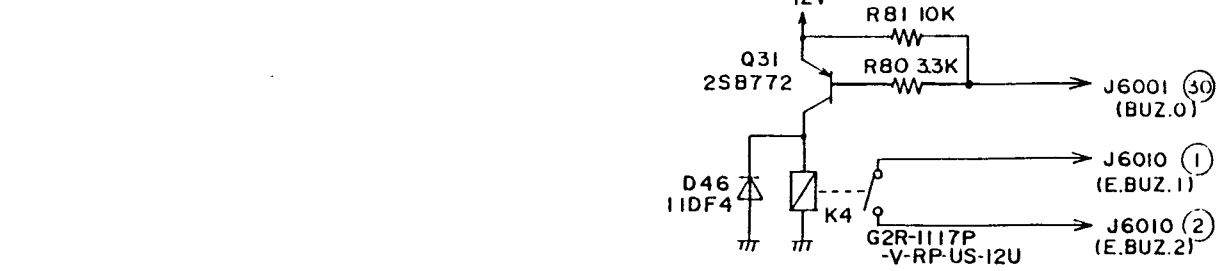
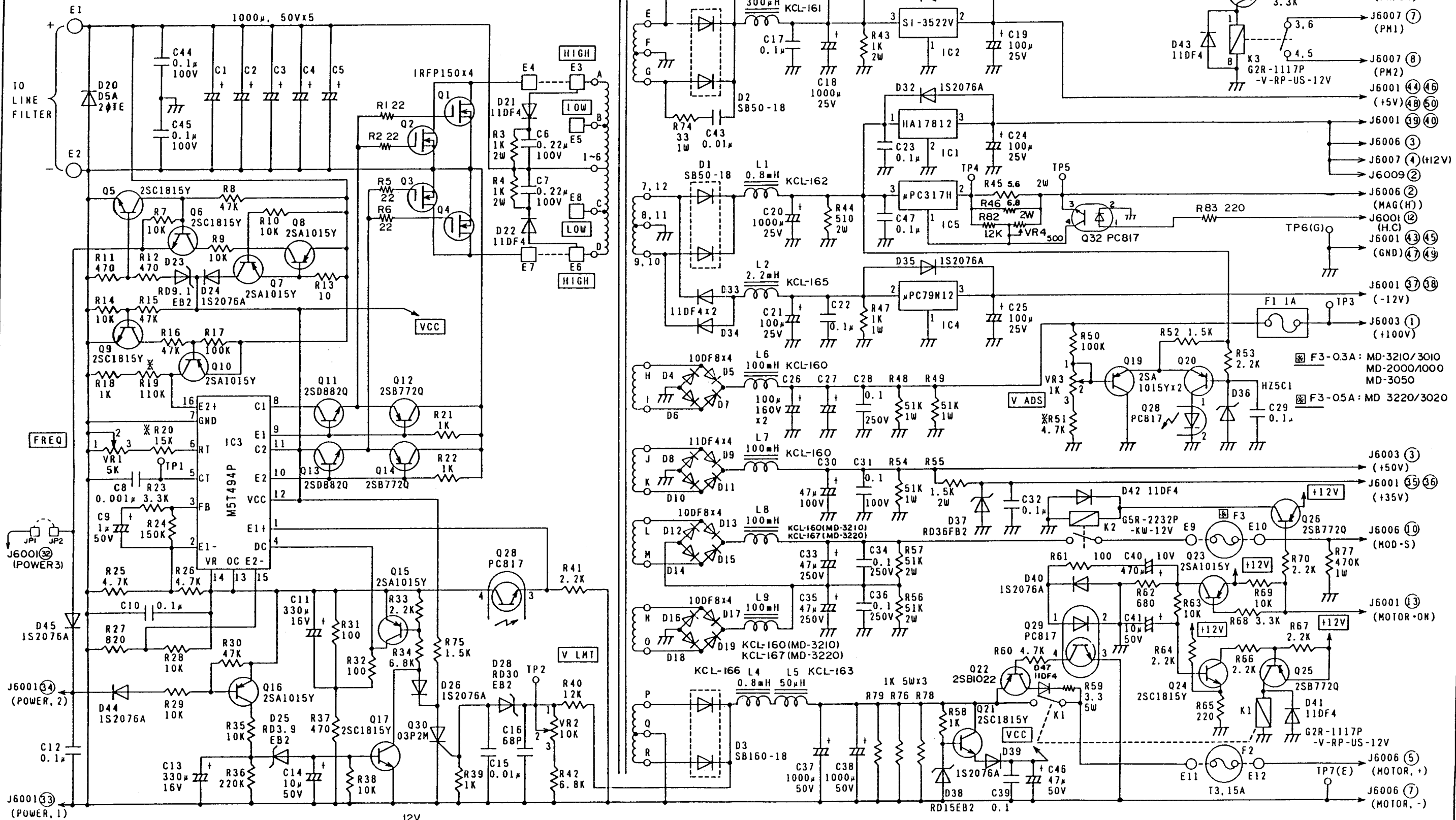


APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE
H.Shindo	H.Shindo	K.Saruyama	K.Saruyama	MRD-62 / MRD-68	DISPLAY UNIT INTERCONNECTION DIAGRAM
KODEN				KODEN ELECTRONICS CO., LTD.	DWG. NO. MD3210-J-E001
CONTENTS				DATE	REVIS
1	2	3	4	5	PAGE



SCALE		TITLE	LINE FILTER MD-3210-6100M1
CHECKED BY	H.Shindo	TYPE	MRD-62 / MRD-68
DRAWN BY	K.Saruyama		
KODEN ELECTRONICS CO., LTD.		DWG. NO.	MRD62-K-H002

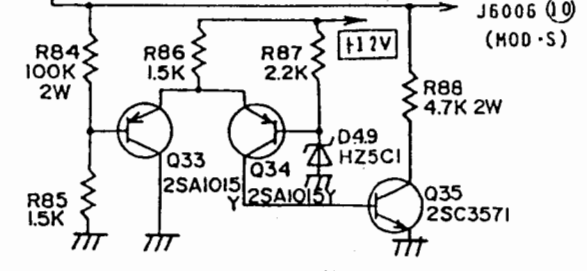
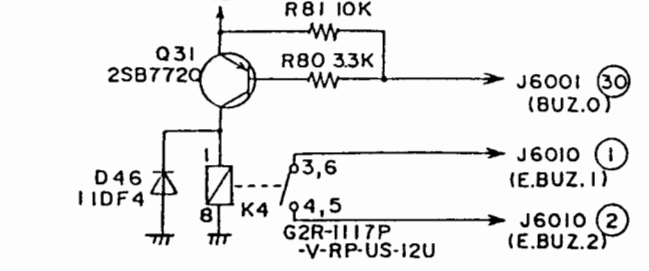
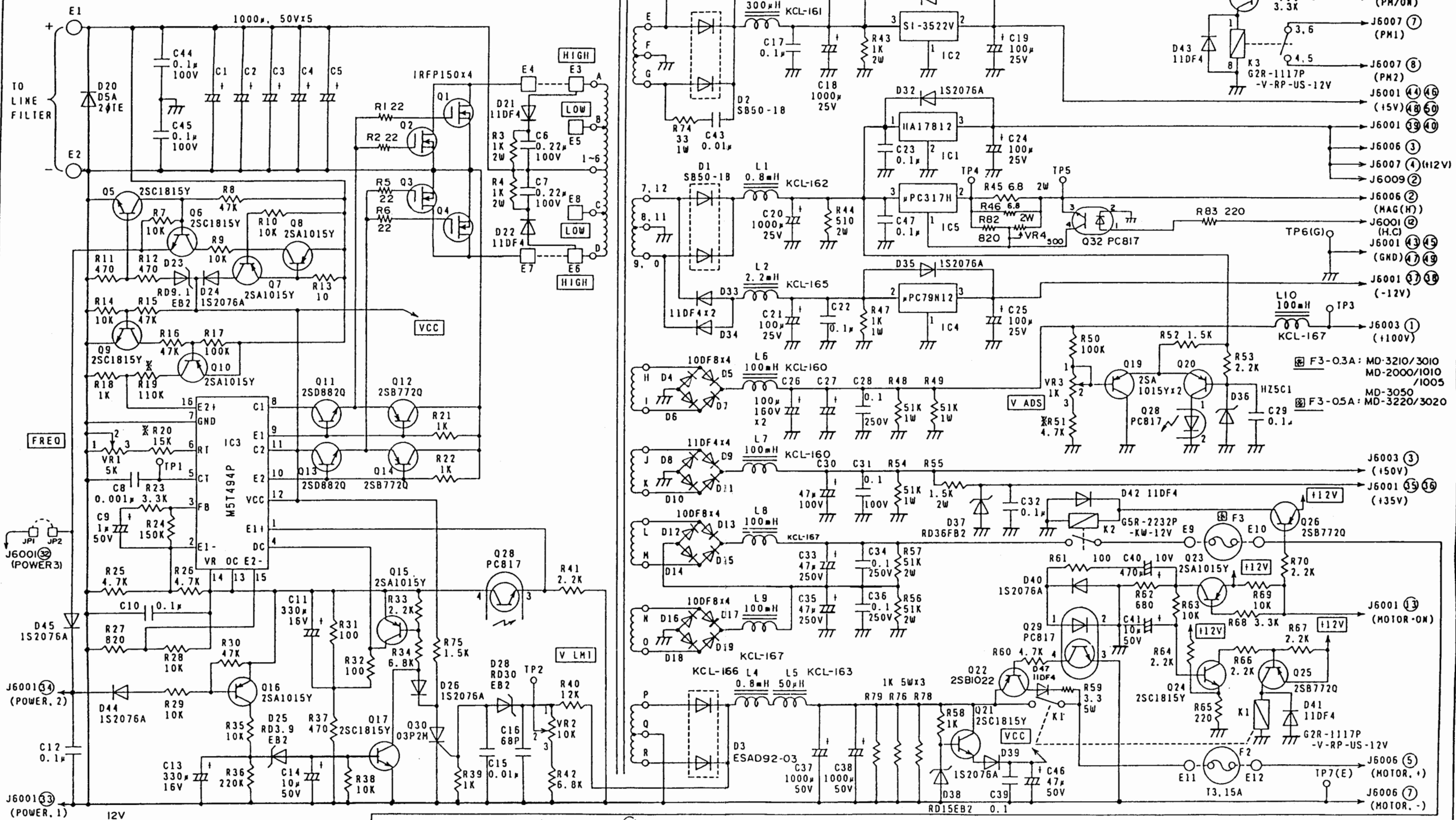
NOTE: ① POWER
 LOW DC11~18V ✕ ADJ
 HIGH DC18~40V



SCALE	TYPE	TITLE
CHECKED BY H.Shindo	MRD-63 / MRD-70 MRD-62 / MRD-68	POWER SUPPLY MD-3210/3220-6000M2-1/2
DRAWN BY K.Saruyama		DWG. NO. MRD62-K-H001-A1/2

NOTE: ① POWER
 LOW DC11~18V
 HIGH DC18~40V

② * ADJ



SCALE		
CHECKED BY	H.Shindo	TYPE
DRAWN BY	K.Saruyama	MRD-63 / MRD-70 MRD-62 / MRD-68
TITLE		POWER SUPPLY MD-3210/3220-6000M3-1/2
DWG. NO.		MRD62-K-H001-B1/2

J6001 (LOGIC)

NO	NAME	NO	NAME
1	PS(M1)	2	PS(L)
3	PS(M2)	4	GND
5	AZIP	6	GND
7	SHF	8	GND
9	TUNE.D	10	TUNE.M
11	TUNE.R	12	H.C
13	MOTOR ON	14	PM/ON
15	AZIP.0	16	GND
17	SHF.0	18	GND
19	EXT TRIG	20	GND
21	TRIG.0	22	GND
23	VIDEO.0	24	GND
25	BUO Y	26	GND
27	SD	28	S.G
29	BUZ	30	BUZ.0
31	PM/TRIG	32	POWER 3
33	POWER 1	34	POWER 2
35	+30V	36	+30V
37	-12V	38	-12V
39	+12V	40	+12V
41	+8V	42	+8V
43	GND	44	+5V
45	GND	46	+5V
47	GND	48	+5V
49	GND	50	+5V

J6004 (ANT)

NO	NAME
1	VIDEO GND
2	VIDEO
3	PS(M1)
4	PS(L)
5	TRIG GND
6	TRIG
7	PS(M2)
8	
9	AZIP

J6006 (ANT)

NO	NAME
1	GND
2	MAG(H)
3	+12V
4	GND
5	MOTOR +
6	
7	MOTOR -
8	
9	TUNE R
10	MOD S

J6007 (EXT OUTPUT)

NO	NAME
1	SD
2	SG
3	BUZ
4	+12V
5	PM/TRIG
6	GND
7	PM 1
8	PM 2

J6002 (LOGIC)

NO	NAME
1	VIDEO.G
2	VIDEO
3	TRIG.G
4	TRIG

J6005 (ANT)

NO	NAME
1	GND
2	SHF
3	TUNE.0
4	TINE.M

J6008 (OPTION)

NO	NAME
1	AZIP.0
2	SHF.0
3	EXT TRIG
4	TRIG.0
5	VIDEO.0
6	BUO Y
7	GND

J6003 (CRT)

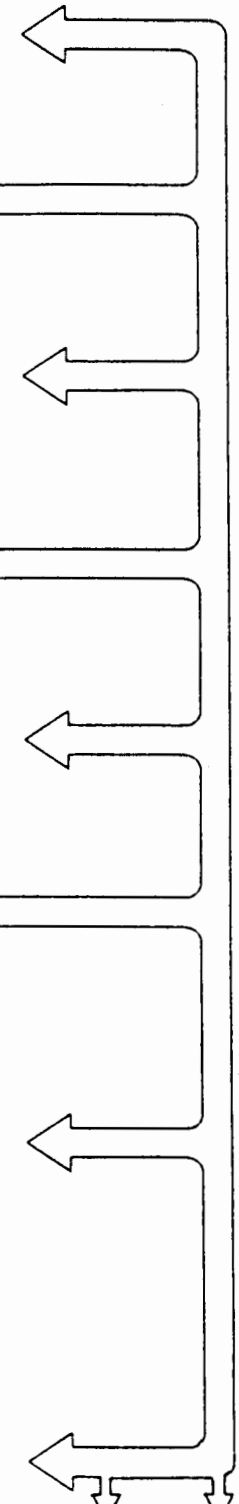
NO	NAME
1	+100V
2	GND
3	+50V
4	GND

J6009 (FAN)

NO	NAME
1	GND
2	12V

J6010 (BUZ)

NO	NAME
1	E.BUZ.1
2	E.BUZ.2



SCALE	/
CHECKED BY	H.Shindo
DRAWN BY	K.Saruyama

TYPE	MRD-62 / MRD-68
------	-----------------

TITLE	POWER SUPPLY MD-3210-6000M2-2/2
-------	---------------------------------

KODEN ELECTRONICS CO., LTD.

DWG. NO.	MRD62-K·H001·A2/2
----------	-------------------

J6001 (LOGIC)

NO	NAME	NO	NAME
1	PS(M1)	2	PS(L)
3	PS(M2)	4	GND
5	AZIP	6	GND
7	SHF	8	GND
9	TUNE.D	10	TUNE.M
11	TUNE.R	12	H.C
13	MOTOR ON	14	PM/ON
15	AZIP.0	16	GND
17	SHF.0	18	GND
19	EXT TRIG	20	GND
21	TRIG.0	22	GND
23	VIDEO.0	24	GND
25	BUO Y	26	GND
27	SD	28	S.G
29	BUZ	30	BUZ.0
31	PM/TRIG	32	POWER 3
33	POWER 1	34	POWER 2
35	+30V	36	+30V
37	-12V	38	-12V
39	+12V	40	+12V
41	+8V	42	+8V
43	GND	44	+5V
45	GND	46	+5V
47	GND	48	+5V
49	GND	50	+5V

J6004 (ANT)

NO	NAME
1	VIDEO GND
2	VIDEO
3	PS(M1)
4	PS(L)
5	TRIG GND
6	TRIG
7	PS(M2)
8	
9	AZIP

J6006 (ANT)

NO	NAME
1	GND
2	MAG(H)
3	+12V
4	GND
5	MOTOR +
6	
7	MOTOR -
8	
9	TUNE R
10	MOD S

J6007 (EXT OUTPUT)

NO	NAME
1	SD
2	SG
3	BUZ
4	+12V
5	PM/TRIG
6	GND
7	PM 1
8	PM 2

J6002 (LOGIC)

NO	NAME
1	VIDEO.G
2	VIDEO
3	TRIG.G
4	TRIG

J6005 (ANT)

NO	NAME
1	GND
2	SHF
3	TUNE.0
4	TUNE.M

J6008 (OPTION)

NO	NAME
1	AZIP.0
2	SHF.0
3	EXT TRIG
4	TRIG.0
5	VIDEO.0
6	BUO Y
7	GND

J6003 (CRT)

NO	NAME
1	+100V
2	GND
3	+50V
4	GND

J6009 (FAN)

NO	NAME
1	GND
2	12V

J6010 (BUZ)

NO	NAME
1	E.BUZ.1
2	E.BUZ.2

SCALE /

CHECKED BY
H.Shindo

DRAWN BY
K.Saruyama

TYPE

MRD-62 / MRD-68

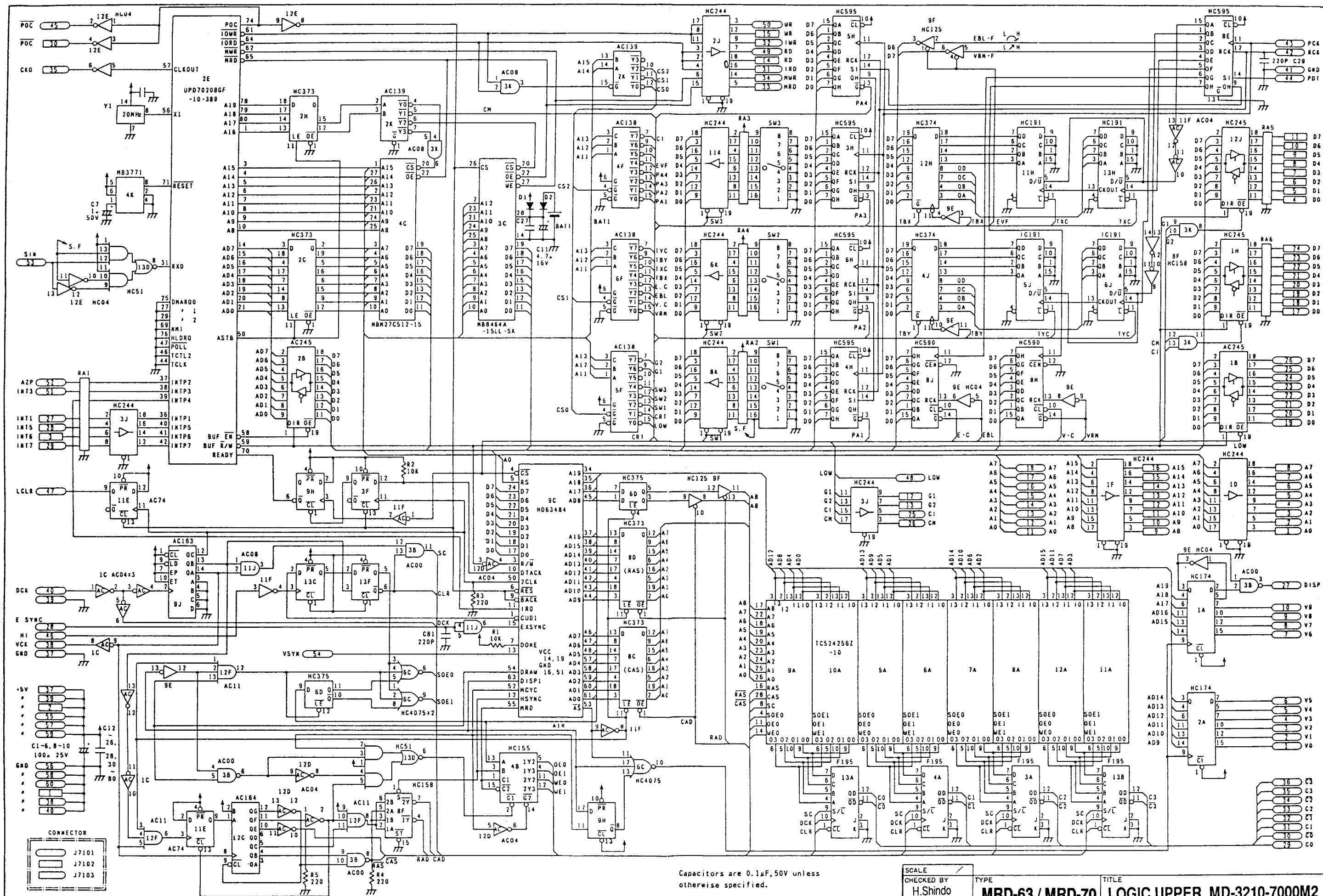
TITLE

POWER SUPPLY MD-3210-6000M3-2/2

KODEN ELECTRONICS
CO., LTD.

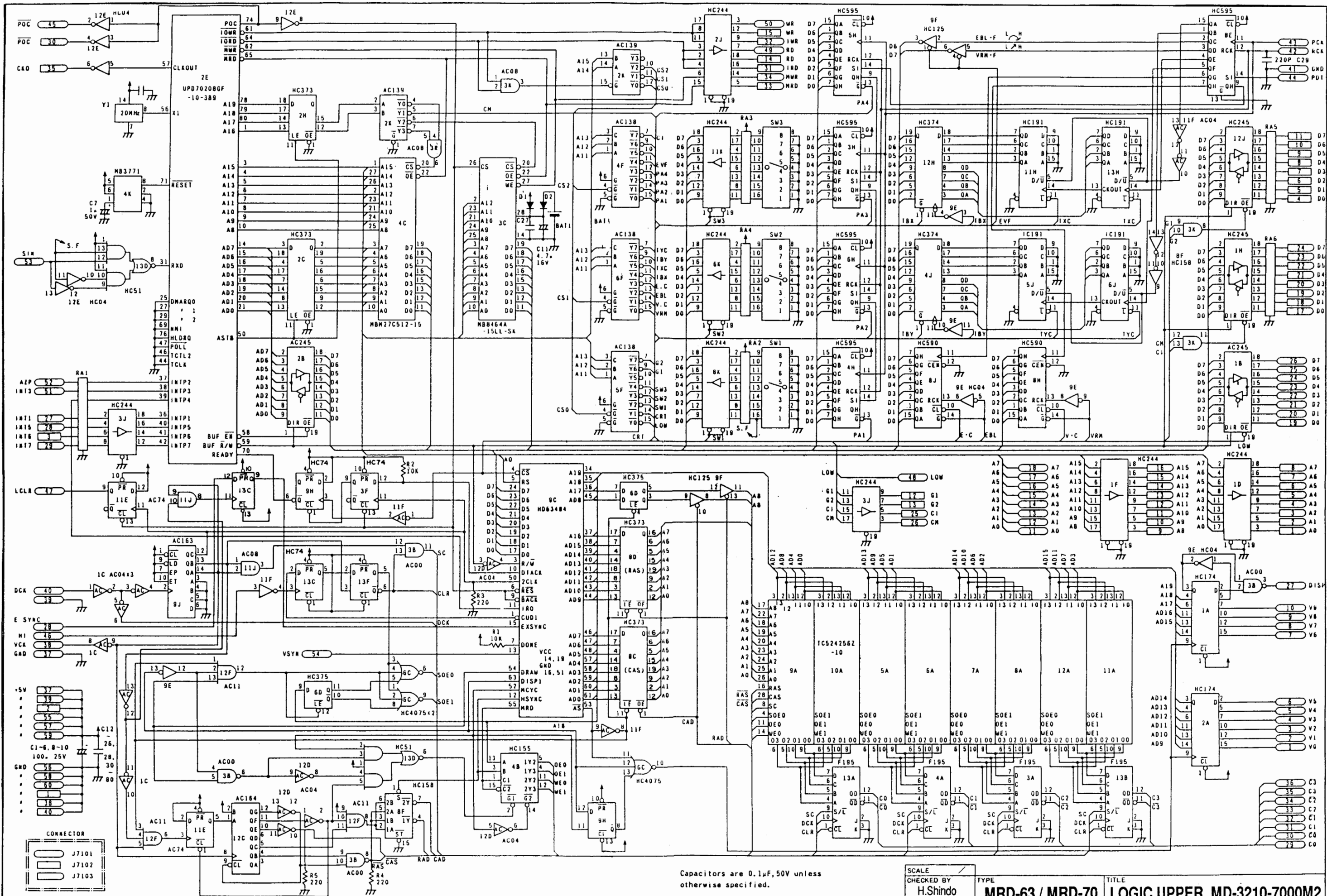
DWG. NO.

MRD62-K-H001-B2/2



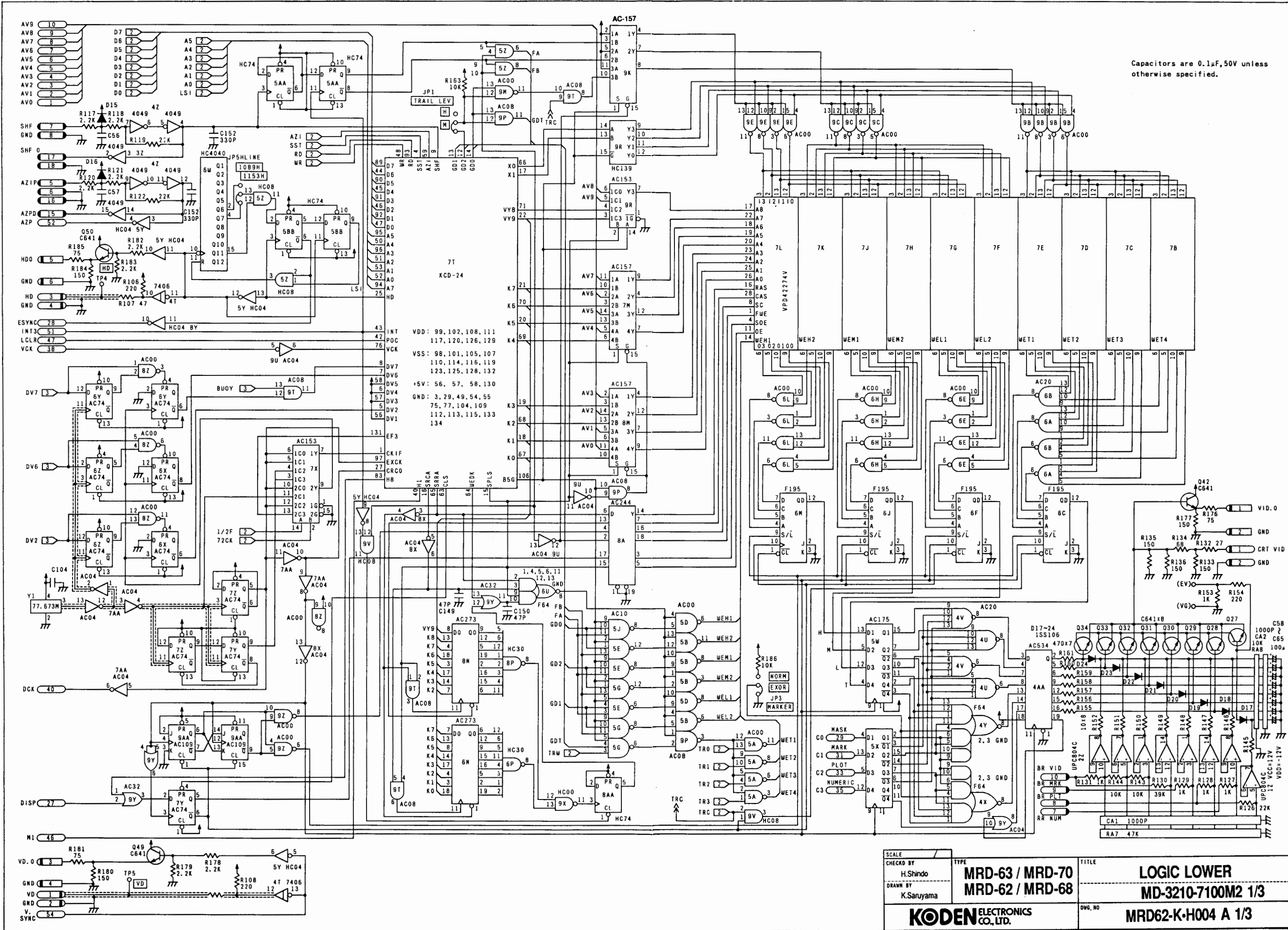
Capacitors are 0.1µF, 50V unless otherwise specified.

SCALE	CHECKED BY	TYPE	TITLE
	H.Shindo	MRD-63 / MRD-70	LOGIC UPPER MD-3210-7000M2
	K.Saruyama	MRD-62 / MRD-68	
DRAWN BY			DRW. NO
KODEN ELECTRONICS CO., LTD.			MRD62-K-H003-A



Capacitors are 0.1µF, 50V unless otherwise specified.

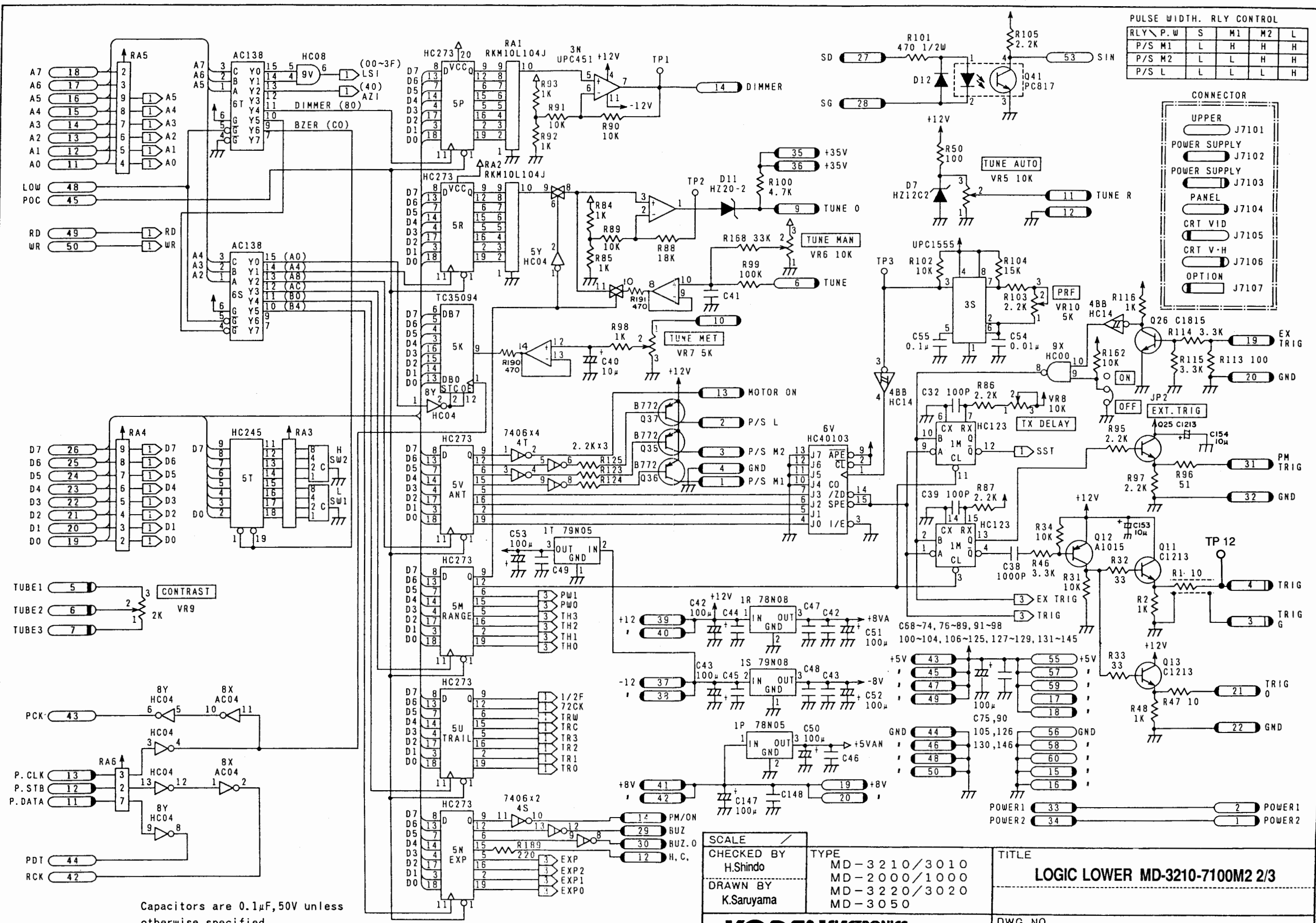
SCALE	CHECKED BY	TITLE
	H.Shindo	MRD-63 / MRD-70 MRD-62 / MRD-68
	DRAWN BY	LOGIC UPPER MD-3210-7000M2
	K.Saruyama	
		DRW. NO
		MRD62-K-H003-B



Capacitors are 0.1μF, 50V unless otherwise specified.

VDD: 99, 102, 108, 111
117, 120, 126, 129
VSS: 98, 101, 105, 107
110, 114, 116, 119
123, 125, 128, 132
+5V: 56, 57, 58, 130
GND: 3, 29, 49, 54, 55
75, 77, 104, 109
112, 113, 115, 133
134

SCALE	CHECKED BY	TYPE	TITLE
	H.Shindo	MRD-63 / MRD-70	LOGIC LOWER
	K.Saruyama	MRD-62 / MRD-68	MD-3210-7100M2 1/3
			MRD62-K-H004 A 1/3



PULSE WIDTH. RLY CONTROL

RLY \ P.W	S	M1	M2	L
P/S M1	L	H	H	H
P/S M2	L	L	H	H
P/S L	L	L	L	H

CONNECTOR

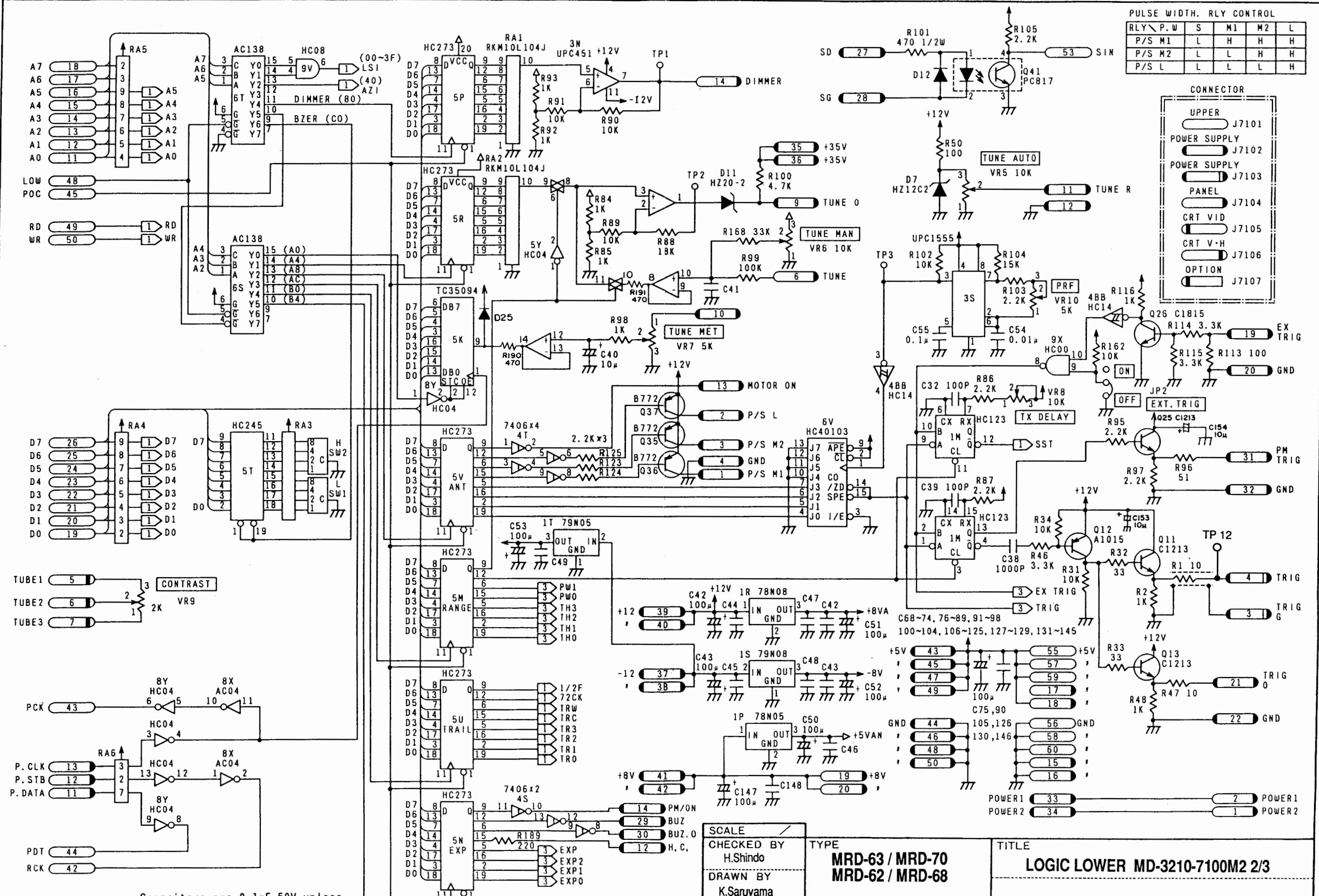
UPPER	POWER SUPPLY	POWER SUPPLY	PANEL	CRT VID	CRT V-H	OPTION
J7101	J7102	J7103	J7104	J7105	J7106	J7107

Capacitors are 0.1μF, 50V unless otherwise specified.

SCALE	
CHECKED BY	H.Shindo
DRAWN BY	K.Saruyama
TYPE	MD-3210/3010 MD-2000/1000 MD-3220/3020 MD-3050

TITLE
LOGIC LOWER MD-3210-7100M2 2/3

DWG. NO
MRD62-K-H004 A 2/3



PULSE WIDTH. RLY CONTROL

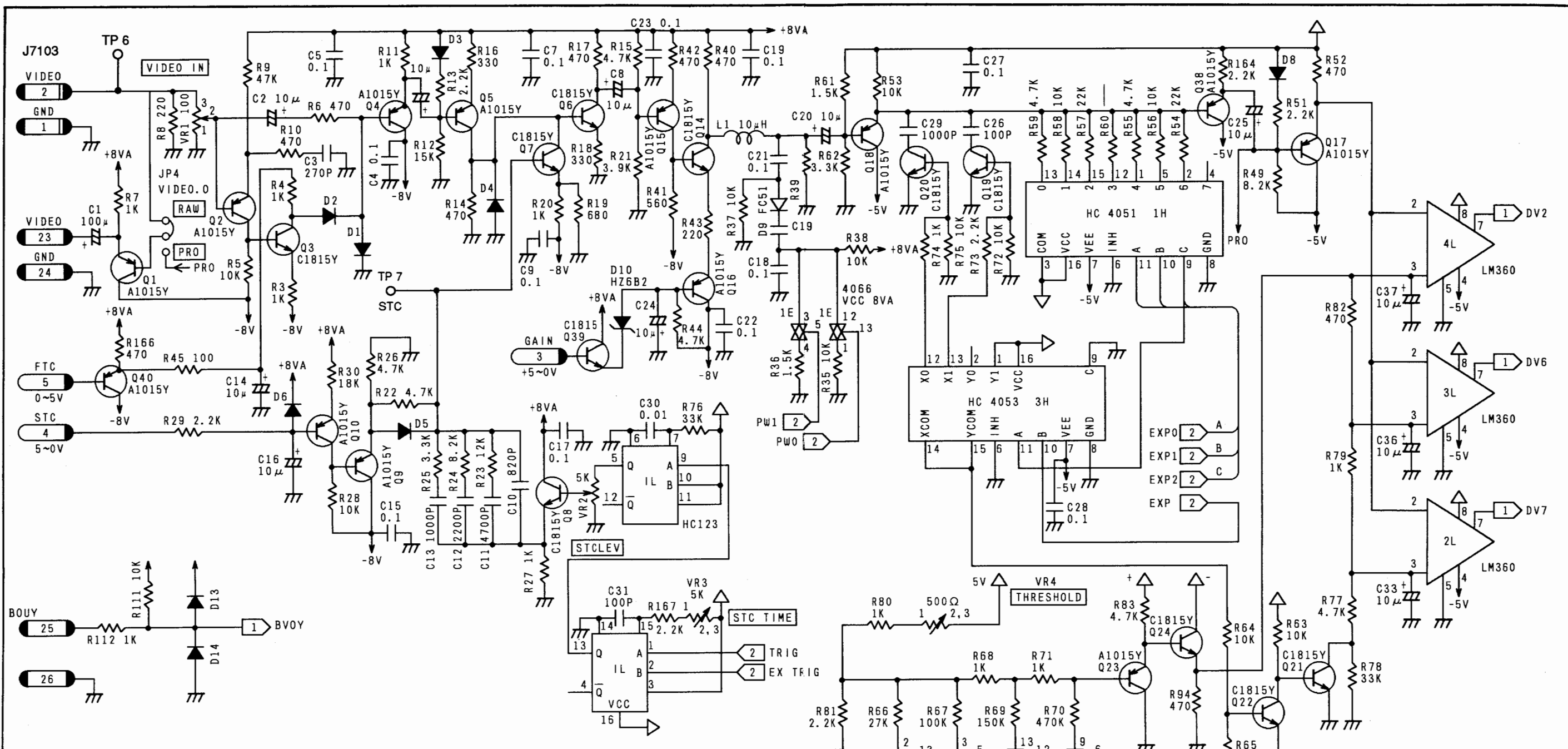
RLY \ P.W	S	M1	M2	L
P/S M1	L	H	H	H
P/S M2	L	L	H	H
P/S L	L	L	L	H

CONNECTOR

UPPER	LOWER
J7101	
J7102	
J7103	
J7104	
J7105	
J7106	
J7107	

Capacitors are 0.1μF, 50V unless otherwise specified.

SCALE		TITLE
CHECKED BY H.Shindo	TYPE MRD-63 / MRD-70 MRD-62 / MRD-68	LOGIC LOWER MD-3210-7100M2 2/3
DRAWN BY K.Saruyama		DWG. NO. MRD62-K-H004 B 2/3



BAND WIDTH(PULSE WIDTH)CONTROL

PWC	PW	S	M1	M2	L
PW0	L	H	L	H	
PW1	L	L	H	H	

RANGE. THRESHOLD LEVEL

TH. L	RANGE	0.25	0.5	0.75	1.5	3	6	12	24	48	72
TH1		L	L	L	L	L	L	H	H	H	H
TH2		L	L	L	L	H	H	L	L	H	H
TH3		L	L	L	H	L	H	L	H	L	H

IR. THRESHOLD LEVEL

TH. L	IR	OFF	ON
TH0		H	L

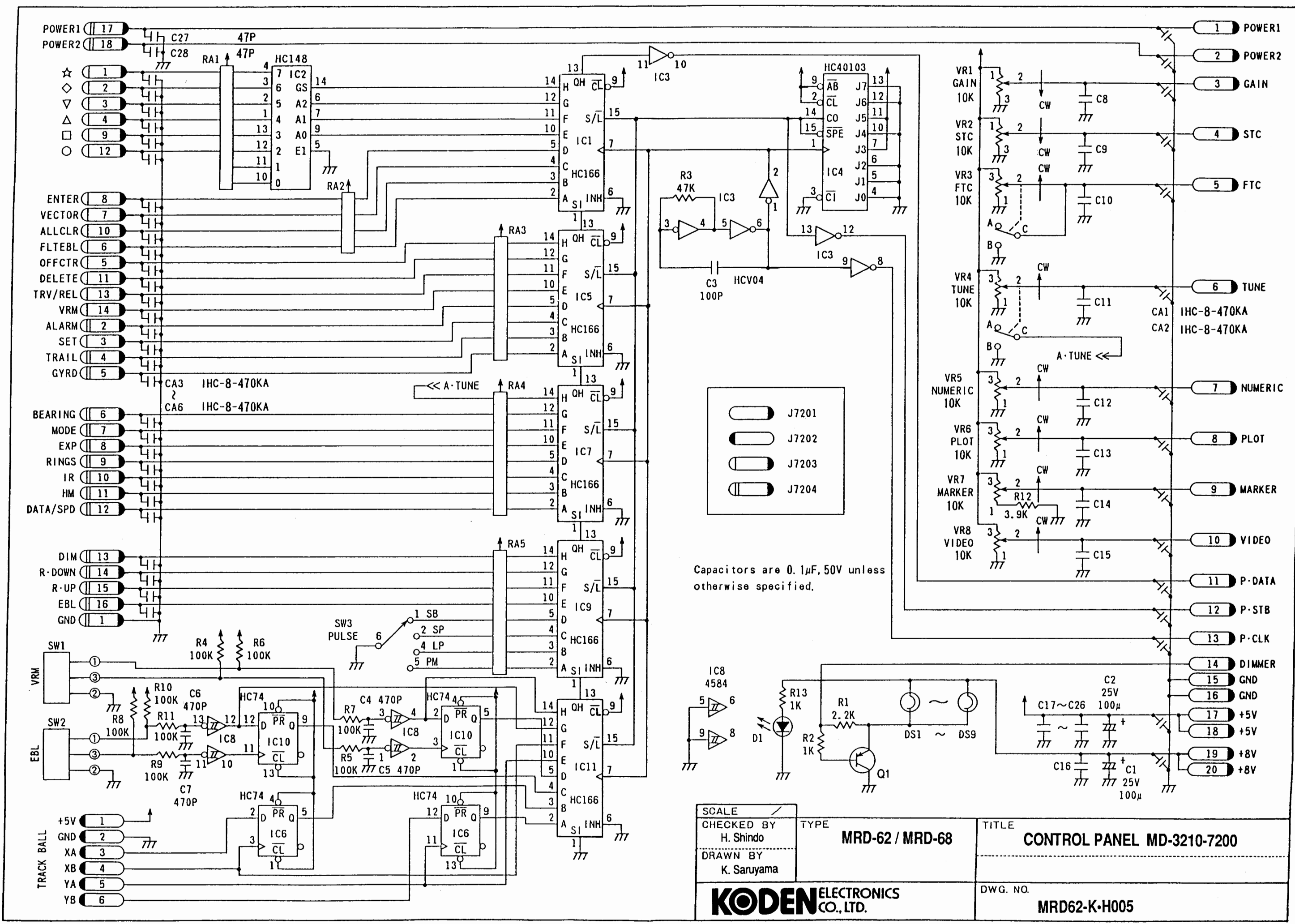
SCALE	
CHECKED BY	H.Shindo
DRAWN BY	K.Saruyama

TYPE	MRD-63 / MRD-70 MRD-62 / MRD-68
------	------------------------------------

TITLE	LOGIC LOWER MD-3210-7100M2 3/3
-------	--------------------------------

KODEN ELECTRONICS CO., LTD.

DWG. NO.	MRD62-K-H004 A 3/3
----------	--------------------



SCALE		
CHECKED BY	H. Shindo	TITLE CONTROL PANEL MD-3210-7200
TYPE	MRD-62 / MRD-68	
DRAWN BY	K. Saruyama	
KODEN ELECTRONICS CO., LTD.		DWG. NO. MRD62-K-H005

7. 2 Drawings for Parts Location

P.C. Board and corresponding serial number

Antenna unit

MOD (10kW)

Model	239U52236B
--------------	-------------------

MD-3210 2100251 and after

MOD (25kW)

Model	229U25361
--------------	------------------

MD-3220 3220251 and after

LOG IF AMP

Model	239U52512
--------------	------------------

MD-3210 2100251 and after

MD-3220 3220251 and after

S CON

Model	239U52352
--------------	------------------

MD-3210 2100251 and after

MD-3220 3220251 and after

Display unit

LINE FILTER

Model	MD-3210-6100M0	MD-3210-6100M1
--------------	-----------------------	-----------------------

MD-3210 2100251 to 2100420 2100421 and after

MD-3220 3220251 to 3220265 3220266 and after

POWER SUPPLY

Model	MD-3210-6000M1	MD-3210-6000M2	MD-3210-6000M3
--------------	-----------------------	-----------------------	-----------------------

MD-3210 2100251 to 2100618 - 2100619 and after

MD-3220 - 3220251 to 3220325 3220326 and after

LOGIC UPPER

Model	MD-3210-7000M1	MD-3210-7000M2
--------------	-----------------------	-----------------------

MD-3210 2100251 to 2100450 2100451 and after

MD-3220 3220251 to 3220265 3220266 and after

LOGIC LOWER

Model	MD-3210-7100M1	MD-3210-7100M2
--------------	-----------------------	-----------------------

MD-3210 2100251 to 2100450 2100451 and after

MD-3220 3220251 to 3220265 3220266 and after

CONTROL PANEL

Model	MD-3210-7200M1	MD-3210-7200M2
--------------	-----------------------	-----------------------

MD-3210 2100251 to 2100420 2100421 and after

MD-3220 3220251 to 3220265 3220266 and after

CRT MAIN BOARD

Model	PWD1050A
--------------	-----------------

MD-3210 2100251 and after

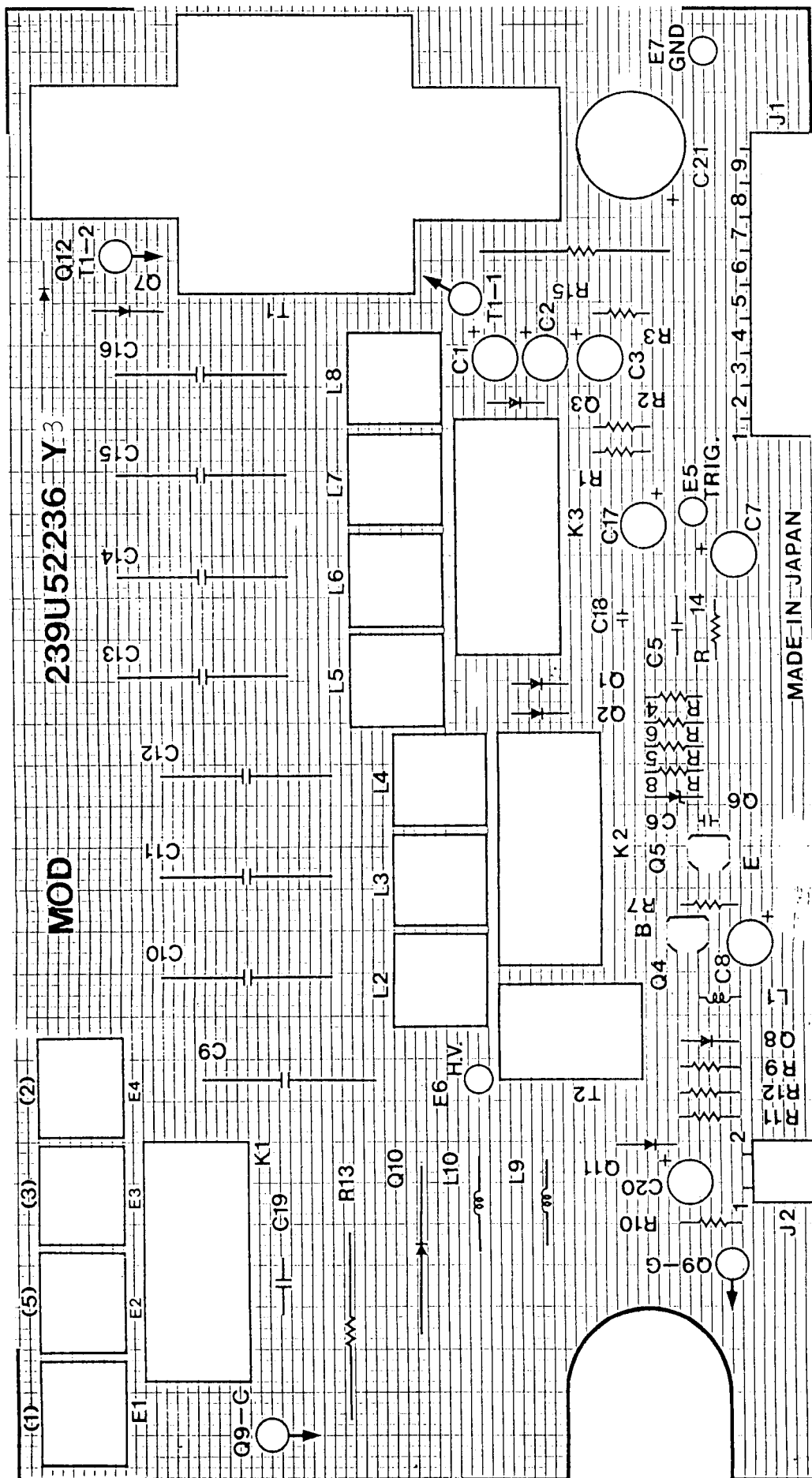
MD-3220 3220251 and after

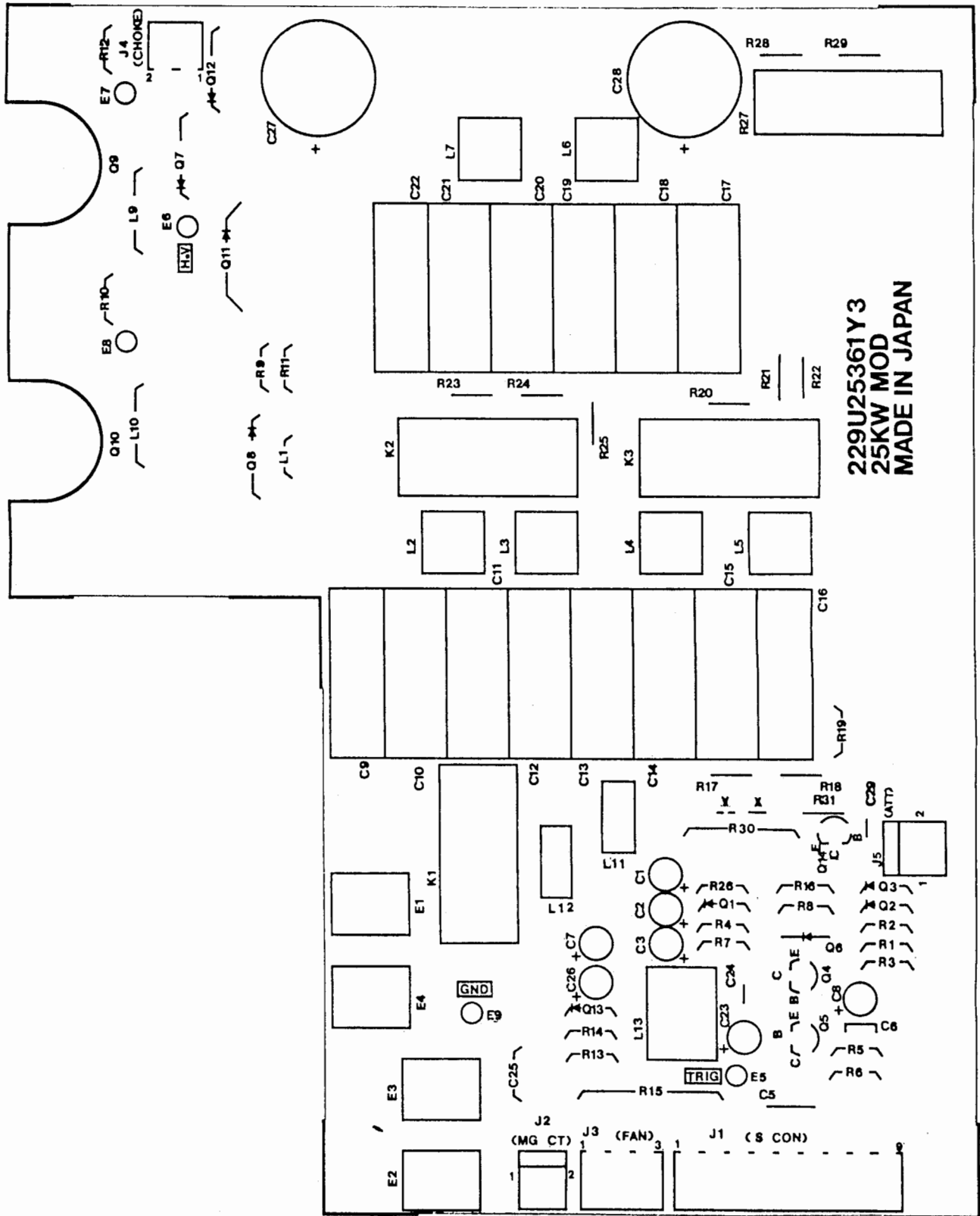
CRT NECK BOARD

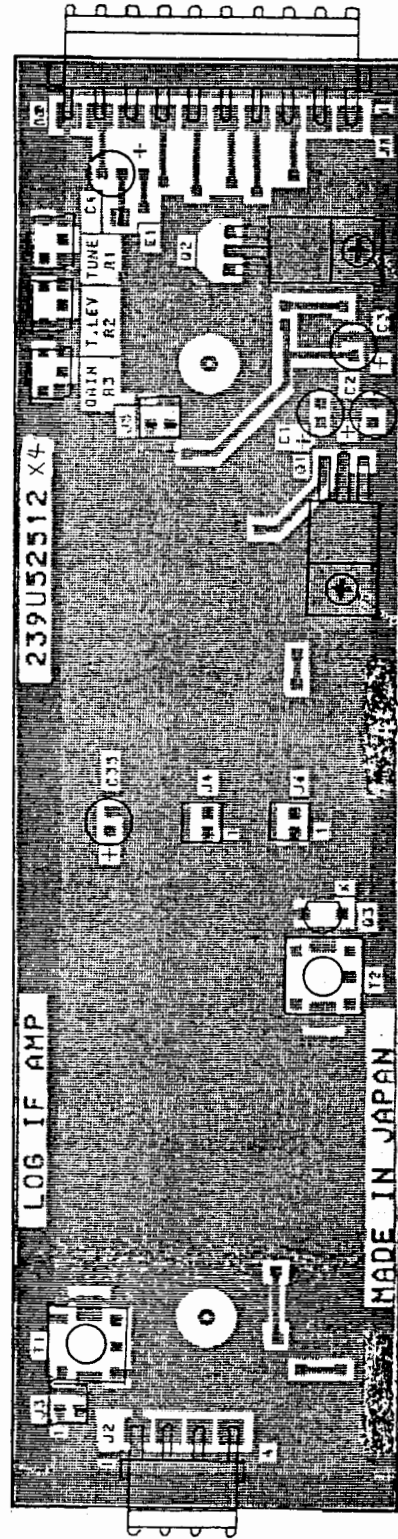
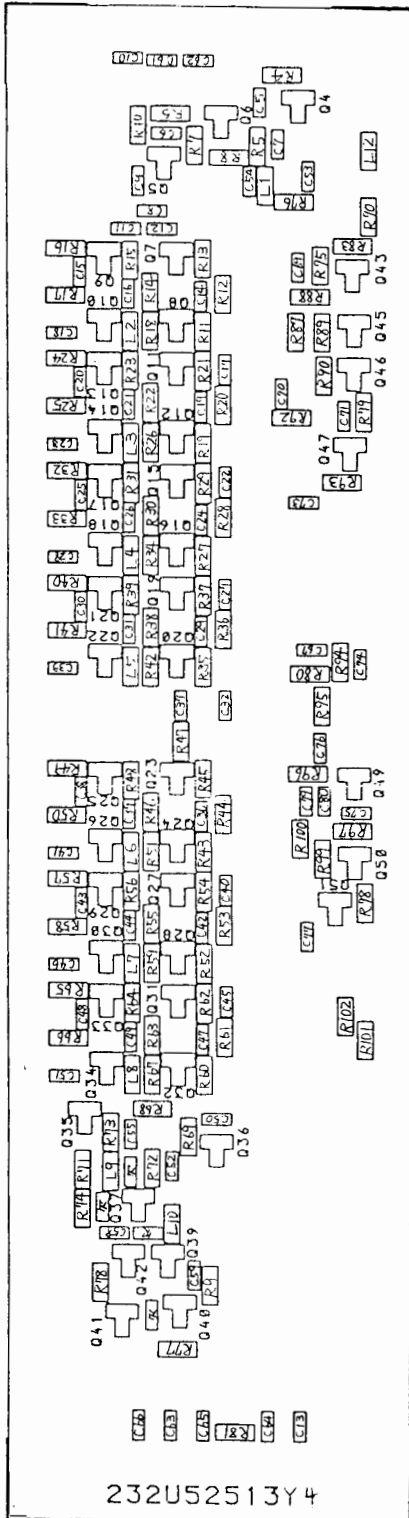
Model	PWD1051A
--------------	-----------------

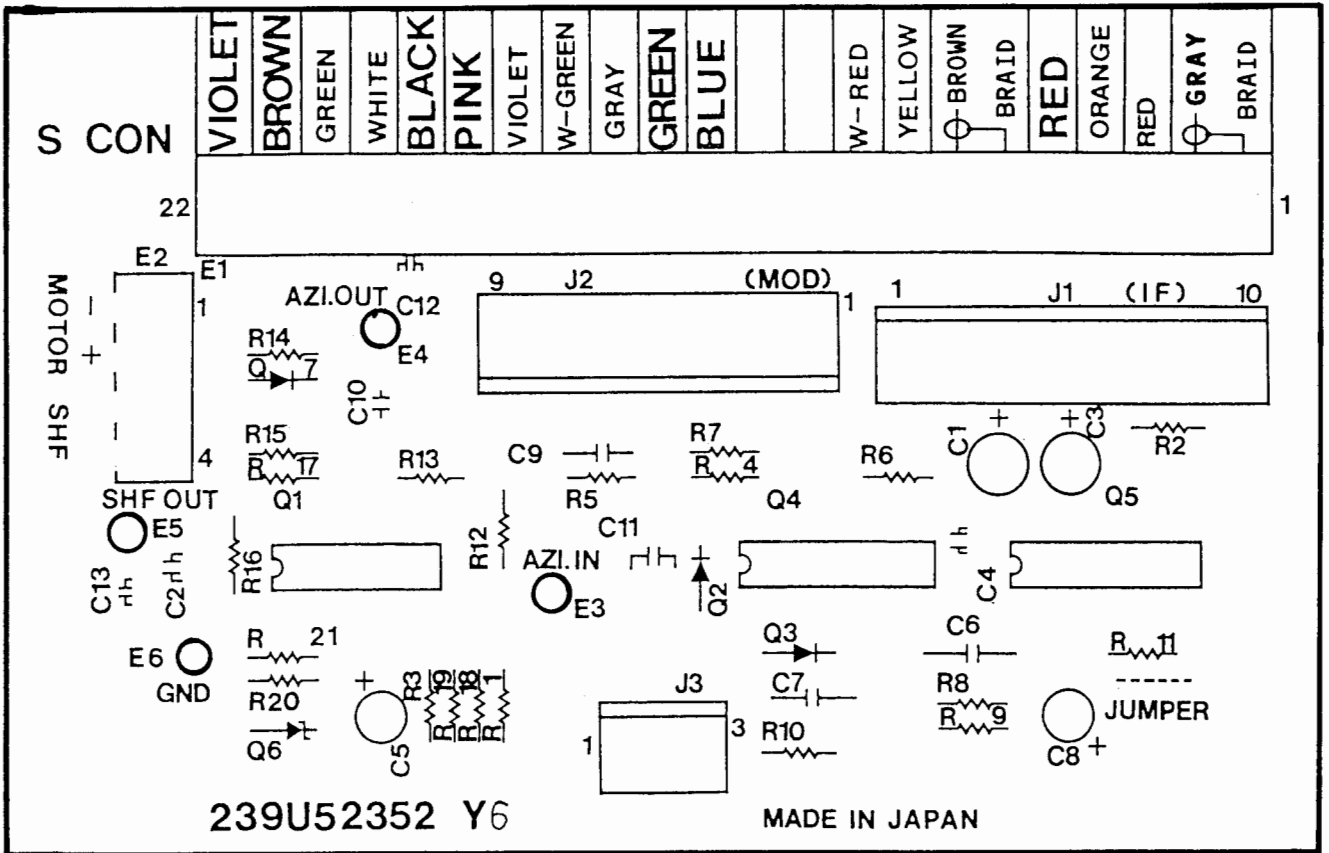
MD-3210 2100251 and after

MD-3220 3220251 and after

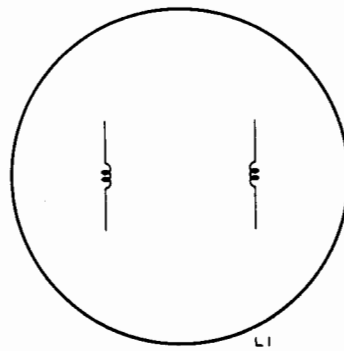
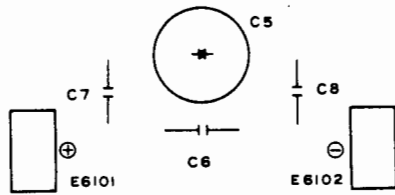




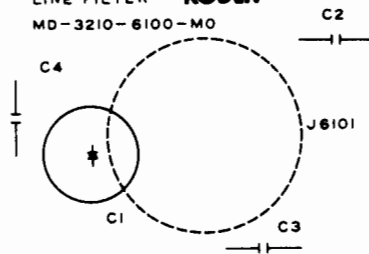




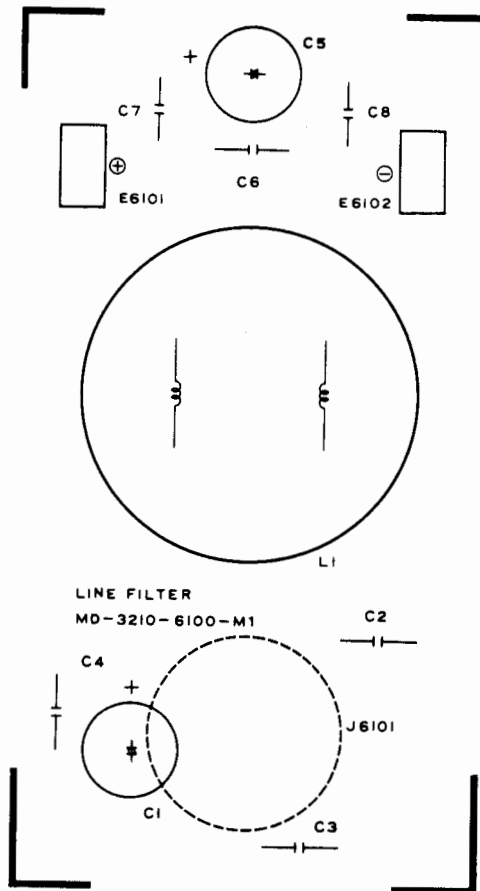
LINE FILTER MD-3210-6100M0



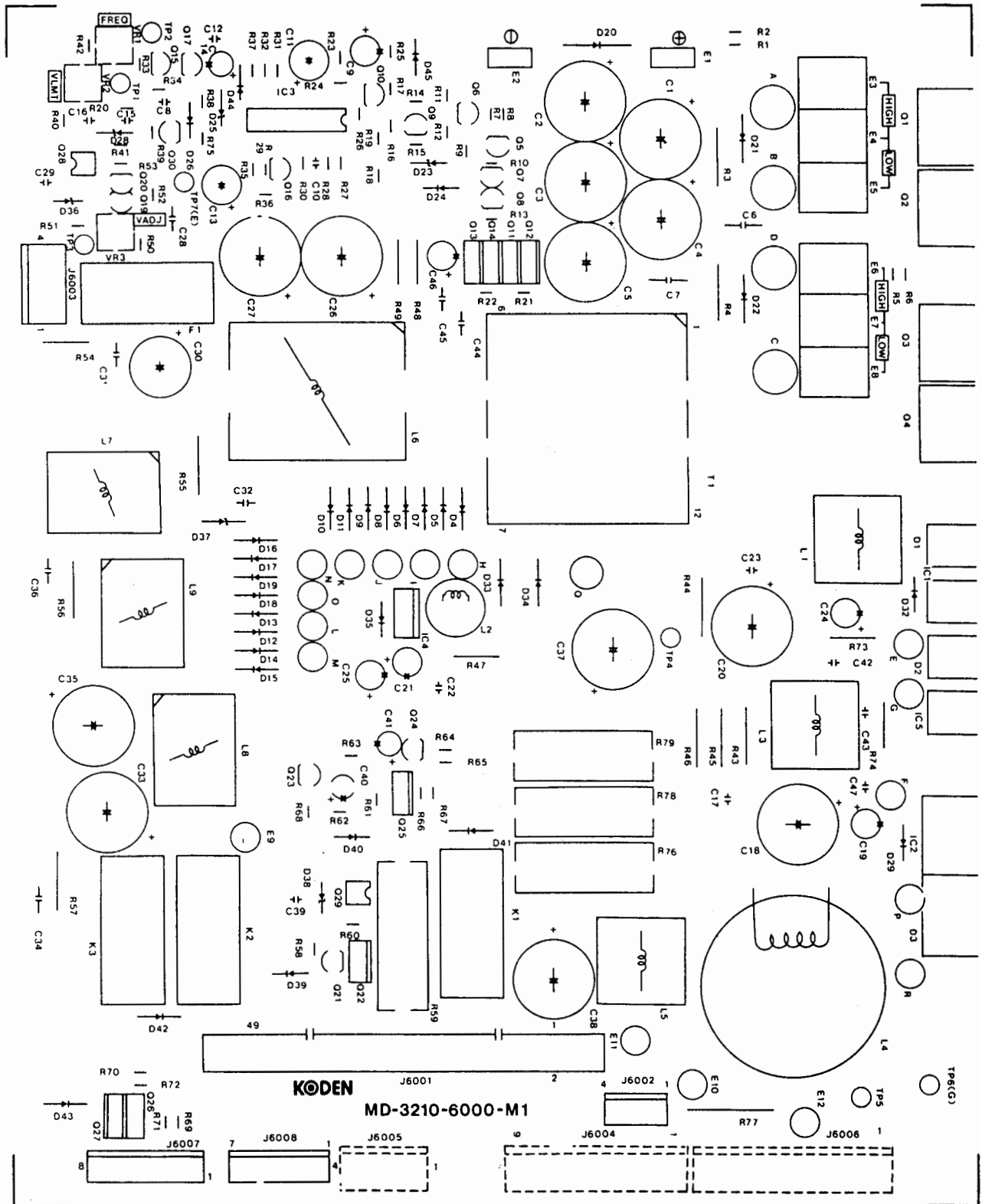
LINE FILTER **KODEN**
MD-3210-6100-M0



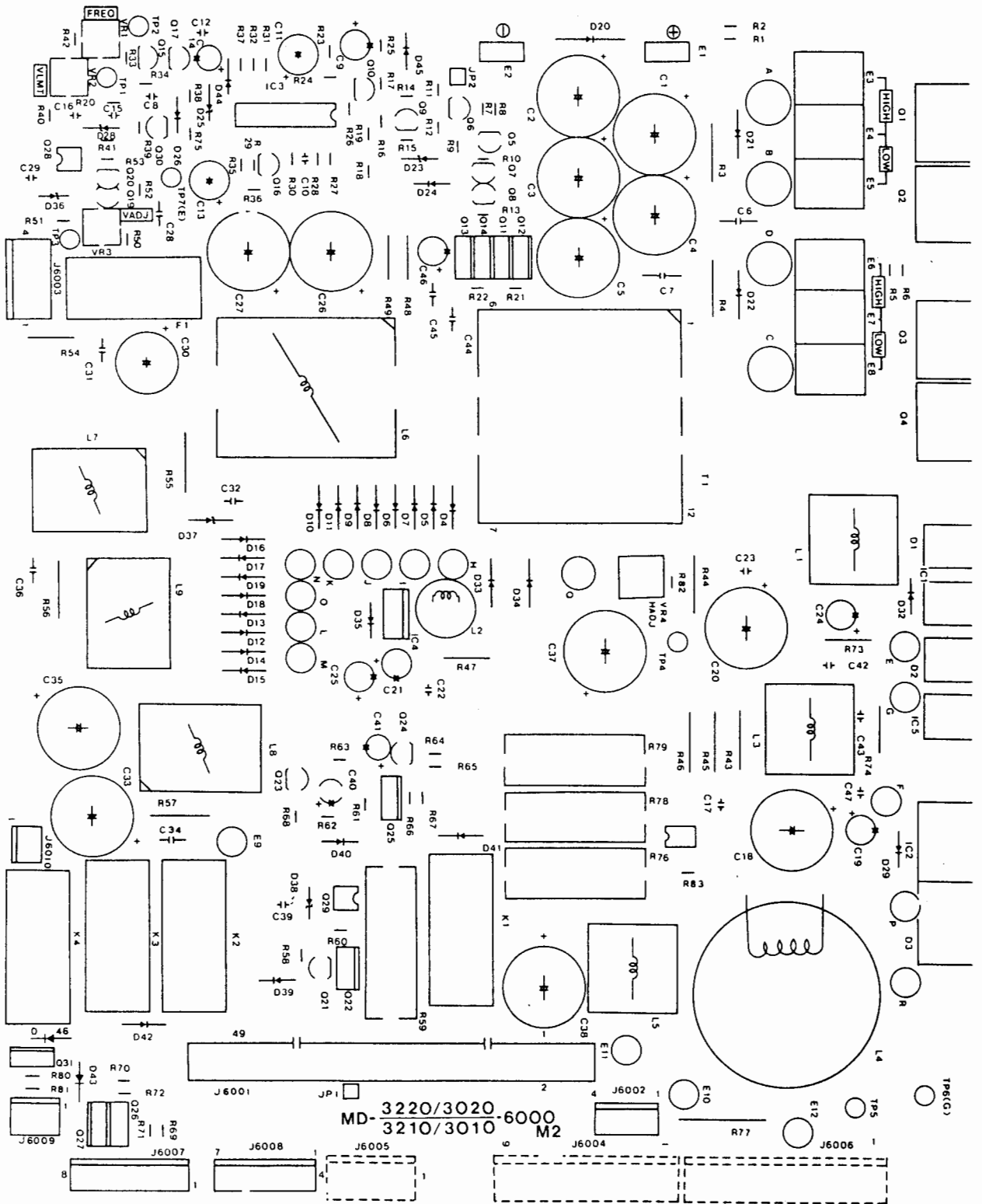
LINE FILTER MD-3210-6100M1



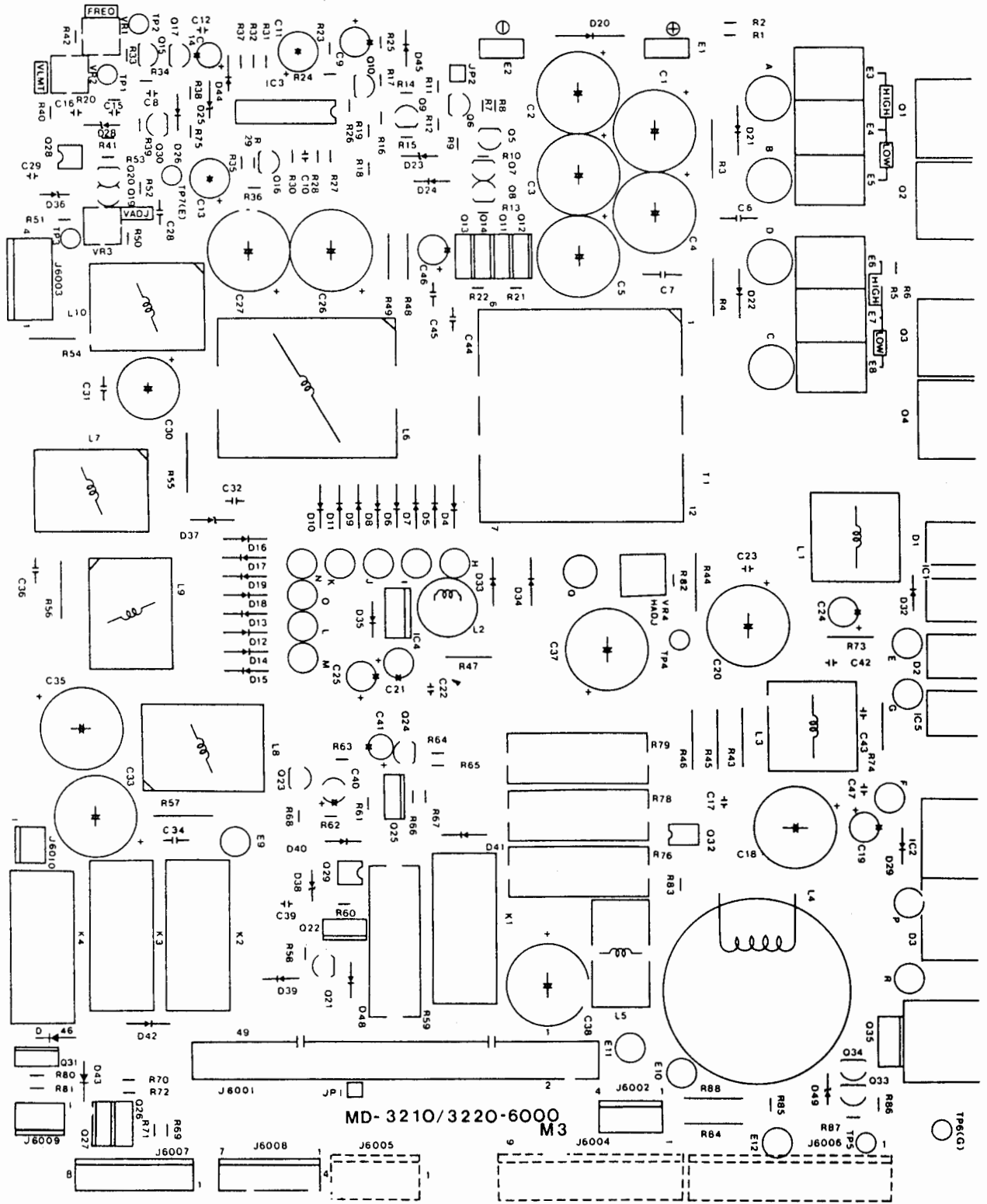
POWER SUPPLY MD-3210-6000M1



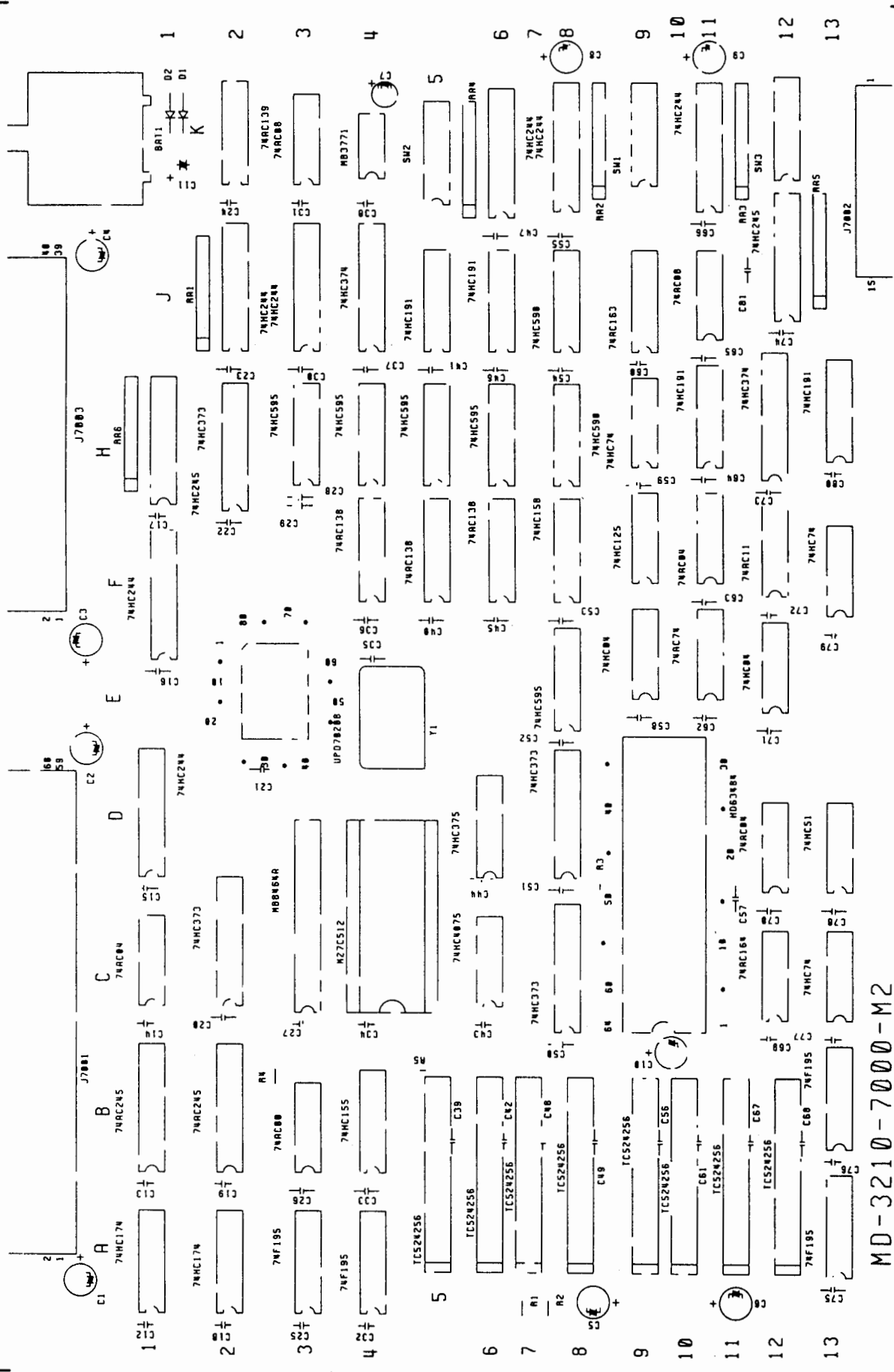
POWER SUPPLY MD-3210-6000M2



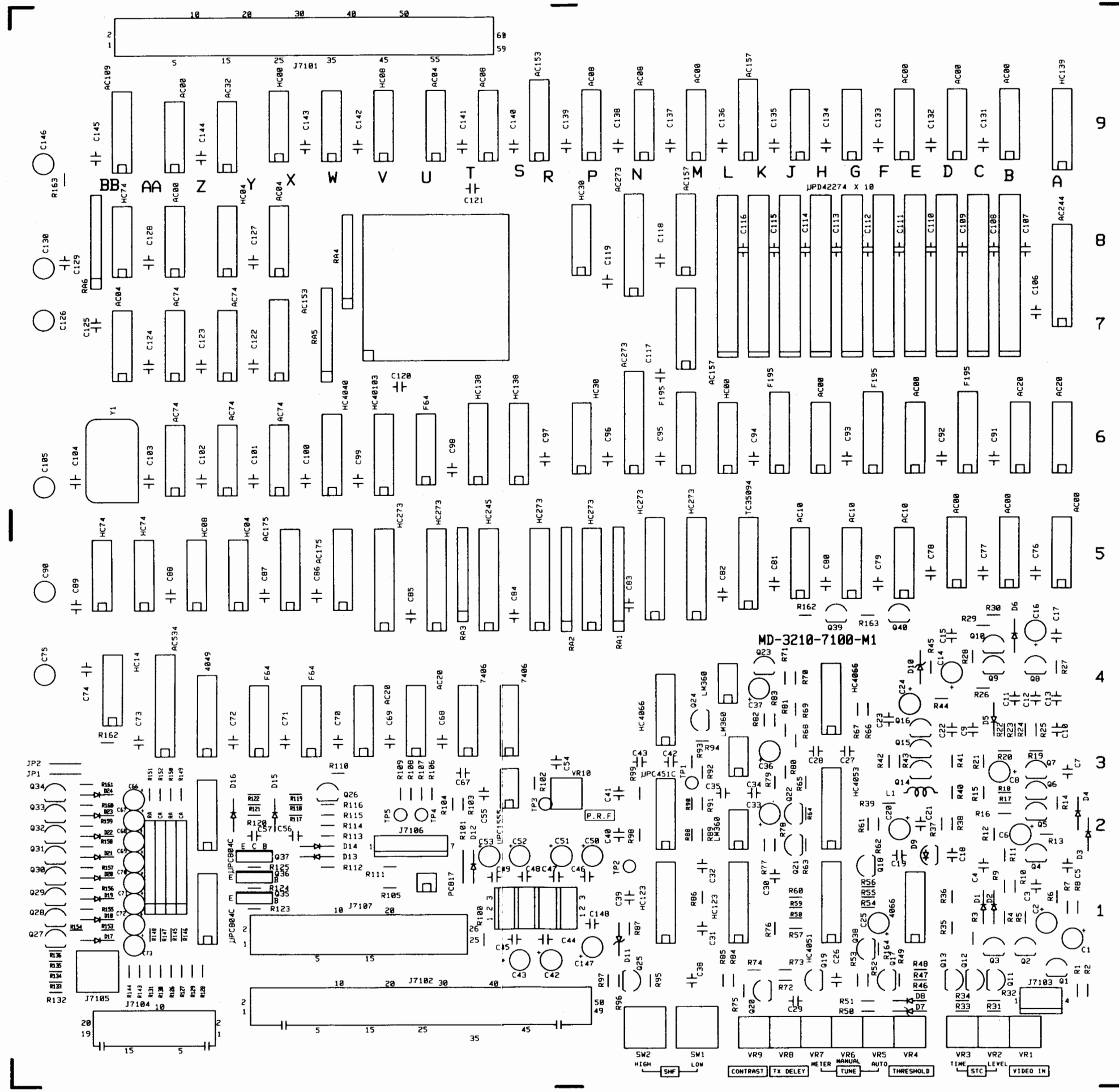
POWER SUPPLY MD-3210-6000M3



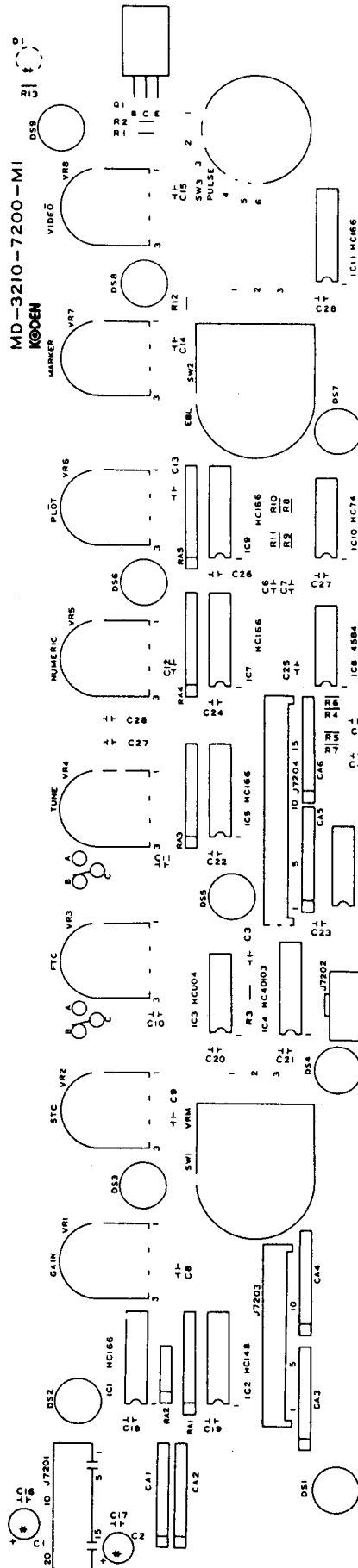
LOGIC UPPER MD-3210-7000M2



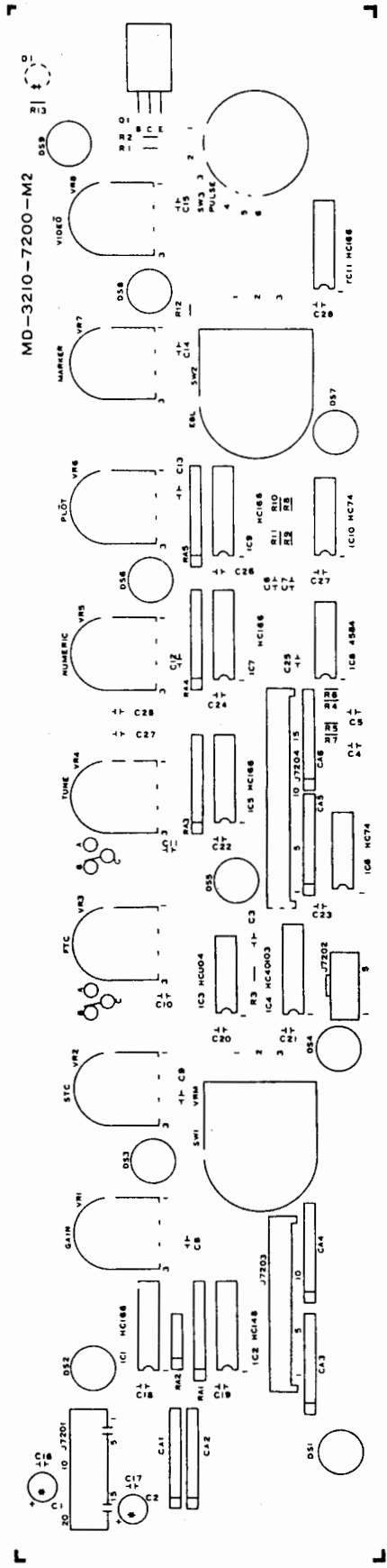
MD-3210-7000-M2



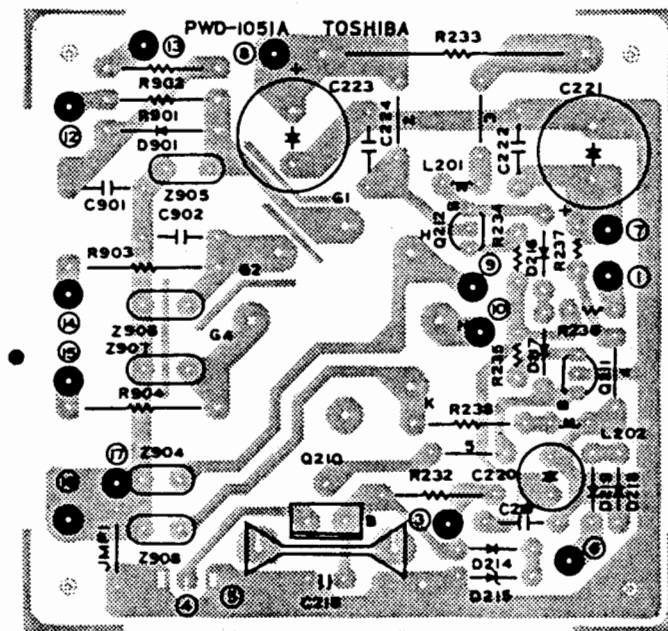
CONTROL PANEL MD-3210-7200M1



CONTROL PANEL MD-3210-7200M2



CRT Neck board PWD1051A



8. PARTS LIST

8.1 Electrical parts

8.1.1 Antenna unit MRT-133 (10kW)

(1) Antenna housing

Symbol	Code	Name	Specifications	Description
C2		Capacitor oil paper	OP40T-01	0.01 μ F 400 V
C3		Capacitor oil paper	OP40T-01	0.01 μ F 400 V
G1		Motor with pinion	23G53203	24 V 15 W
J1		Connector	VHR-10N (included in W1)	
J2		Connector	VHR-10N (included in W1)	
J3		Connector	VHR-9N (included in W2)	
J4		Connector	VHR-9N (included in W2)	
J5		Connector	VHR-4N (included in W3)	
J6		Connector	VHR-3N (included in W4)	
Q3		Photo interrupter	GP1L03	
S1		Switch lead	24J123749	FRS-901-3
U6		S. CON	239U52352	[See 8. 1. 1 item (2)]
U7		TR unit (10 kW)	229U23296D	[See 8. 1. 1 item (3)]
W1		Harness IF	24J124056 (with J1 and J 2)	
W2		Harness MOD	24J124056 (with J3 and J 4)	
W4		Harness	SHF	

(2) S. CON (239U52352)

Symbol	Code	Name	Specifications	Description
C1		Capacitor elctrolytic	CE04C1E101A	100 μ F 25V
C2		Capacitor ceramic	CK924C1H104Z	0.1 μ F 50V
C3		Capacitor electroytic	CE04C1E101A	100 μ F 25V
C4		Capacitor ceramic	CK924C1H104Z	0.1 μ F 50V
C5		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C6		Capacitor polyester film	ECQM1H224kZ	0.22 μ F 50V
C7		Capacitor polyester film	ECQM1H224kZ	0.22 μ F 50V
C8		Capacitor electrolytic	CE04C1H010A	1 μ F 50V
C9		Capacitor polyester film	ECQM1H104kZ	0.1 μ F 50V
C10		Capacitor polyester film	ECQM1H223kZ	0.022 μ F 50V
C11		Not used		
C12		Capacitor ceramic	CK924C1H104Z	0.1 μ F 50V
C13		Capacitor ceramic	CK924C1H104Z	0.1 μ F 50V
E1		Board terminal	24E123879 (22 pins)	2200.0301
E2		Board terminal	24E124005 (4 pins)	AK500/4DS
E3		Terminal	24E120361 (2 pins)	
E4		Terminal	24E120361	
E5		Terminal	24E120361	
E6		Terminal	24E120361	
J1		Connector	B10P-VH	
J2		Connector	B9P-VH	
J3		Connector	B3P-VH	
Q1		IC	μ PC451C	
Q2		Diode	1S1588	
Q3		Diode	1S1588	
Q4		IC	MC14046BCP	
Q5		IC	TC40160BP	
Q6		Diode	RD6.2EB	
Q7		Diode	1S1588	
Q8		Not used		

S. CON (cont'd)

Symbol	Code	Name	Specifications	Description
R1		Resistor fixed	NAM1/4 223JTP	22k Ω 1/4W
R2		Resistor fixed	NAM1/4 470JTP	47 Ω 1/4W
R3		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W
R4		Resistor fixed	NAM1/4 105JTP	1M Ω 1/4W
R5		Resistor fixed	NAM1/4 224JTP	220k Ω 1/4W
R6		Resistor fixed	NAM1/4 103JTP	10k Ω 1/4W
R7		Resistor fixed	NAM1/4 105JTP	1M Ω 1/4W
R8		Resistor fixed	NAM1/4 105JTP	1M Ω 1/4W
R9		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W
R10		Resistor fixed	NAM1/4 202JTP	2k Ω 1/4W
R11		Resistor fixed	NAM1/4 103JTP	10k Ω 1/4W
R12		Resistor fixed	NAM1/4 223JTP	22k Ω 1/4W
R13		Resistor fixed	NAM1/4 104JTP	100k Ω 1/4W
R14		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W
R15		Resistor fixed	NAM1/4 104JTP	100k Ω 1/4W
R16		Resistor fixed	NAM1/4 223JTP	22k Ω 1/4W
R17		Resistor fixed	NAM1/4 104JTP	100k Ω 1/4W
R18		Resistor fixed	NAM1/4 222JTP	2.2k Ω 1/4W
R19		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W
R20		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W
R21		Resistor fixed	NAM1/4 102JTP	1k Ω 1/4W

(3) TR unit (10kW) (229U23296D)

Symbol	Code	Name	Specifications	Description
C1		Capacitor polyester	ECQM1H104KZ	0.1 μ F 24 V
Q1		Diode	HVR-3H2	
Q2		Diode	HVR-3H2	
R1		Resistor	ERF-10HMJ470	47 Ω 10 w
T1		Transformer pulse	24T122098	
U1		LOG IF AMP	239U52512	[See 8. 1. 1 item (4)]
U2		MOD (10 kW)	239U52236B	[See 8. 1. 1 item (5)]
U3		MIC	NJT1946	
U4		Circulator	FCX68	
U5		Limiter	NJS6930	
V2		Magnetron 10 kW	MSF1425B	
W3		Harness FEM	24J123878	

(4) LOG IF AMP (239U52512)

Symbol	Code	Name	Specifications	Description
C1		Capacitor electrolytic	CE04C1E101A	100 μ F 25V
C2		Capacitor electrolytic	CE04C1E101A	100 μ F 25V
C3		Capacitor electrolytic	CE04C1E101A	100 μ F 25V
C4		Capacitor electrolytic	CE04C1E101A	100 μ F 25V
C5		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C6		Capacitor	GR40CH471J50V	470pF 50V
C7		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C8		Capacitor	GR40CJ030C50V	3pF 50V
C9		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C10		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C11		Capacitor	GR40CH150J50V	15pF 50V
C12		Capacitor	GR40CH150J50V	15pF 50V
C13 to C33		Capacitor	GR40W5R103K50V	0.01 μ F 50V

LOG IF AMP (cont'd)

Symbol	Code	Name	Specifications	Description
C34		Not used		
C35		Capacitor electrolytic	CE04C1E101A	100 μ F 25V
C36 to C52		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C53		Capacitor	GR40CH470J50V	47pF 50V
C54		Capacitor	GR40CJ030C50V	3pF 50V
C55		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C56		Capacitor	GR40CJ030C50V	3pF 50V
C57		Not used		
C58		Capacitor	GR40CH150J50V	15pF 50V
C59		Capacitor	GR40CH150J50V	15pF 50V
C60		Not used		
C61 to C67		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C68		Not used		
C69		Capacitor	GR40CH470J50V	47pF 50V
C70		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C71		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C72		Not used		
C73		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C74		Capacitor	GR40CH470J50V	47pF 50V
C75		Capacitor	GR40CH150J50V	15pF 50V
C76		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C77		Capacitor	GR40W5R103K50V	0.01 μ F 50V
C78		Not used		
C79		Capacitor	GR40W5R103K50V	0.01 μ F 50V
E1		Board terminal	24E120361	
J1		Connector	B10PS-VH	
J2		Connector	B4PS-VH	
J3 to J6		Connector	B2P-SHF-1AA	
L1 to L9		Inductor coil	MLF3216DR68K	0.68 μ H
L10		Inductor coil	MLF3216A4R7K	4.7 μ H
L11		Not used		
L12		Inductor coil	MLF3216A4R7K	4.7 μ H
L13		Not used		
Q1		IC regulator	μ PC14305H	5V
Q2		IC regulator	μ PC14308H	8V
Q4		Diode	1SS123	
Q5		Diode	1SS123	
Q6		Transistor	2SC3429	
Q7		Transistor	2SA1226	
Q8		Transistor	2SC3124	
Q9		Transistor	2SC3124	
Q10		Transistor	2SC3124	
Q11		Transistor	2SA1226	
Q12		Transistor	2SC3124	
Q13		Transistor	2SC3124	
Q14		Transistor	2SC3124	
Q15		Transistor	2SA1226	
Q16		Transistor	2SC3124	
Q17		Transistor	2SC3124	
Q18		Transistor	2SC3124	
Q19		Transistor	2SA1226	
Q20		Transistor	2SC3124	
Q21		Transistor	2SC3124	
Q22		Transistor	2SC3124	
Q23		Transistor	2SA1226	
Q24		Transistor	2SC3124	
Q25		Transistor	2SC3124	
Q26		Transistor	2SC3124	

LOG IF AMP (cont'd)

Symbol	Code	Name	Specifications	Description
Q27		Transistor	2SA1226	
Q28		Transistor	2SC3124	
Q29		Transistor	2SC3124	
Q30		Transistor	2SC3124	
Q31		Transistor	2SA1226	
Q32		Transistor	2SC3124	
Q33		Transistor	2SC3124	
Q34		Transistor	2SC3124	
Q35		Transistor	2SA1226	
Q36		Diode	1SS123	
Q37		Transistor	2SC3124	
Q38		Not used		
Q39		Transistor	2SA1226	
Q40		Diode	1SS123	
Q41		Transistor	2SC2859	
Q42		Transistor	2SA1182	
Q43		Transistor	2SC3124	
Q44		Not used		
Q45		Transistor	2SA1226	
Q46		Transistor	2SC3124	
Q47		Transistor	2SC3124	
Q48		Not used		
Q49		Transistor	2SA1226	
Q50		Transistor	2SC2859	
Q51		FET	2SK209GR	
R1		Resistor variable	RJ6S 100k Ω	100k Ω
R2		Resistor variable	RJ6S 500k Ω	500k Ω
R3		Resistor variable	RJ6S 500k Ω	500k Ω
R4		Resistor	RM73B2B 102JDTP	1k Ω
R5		Resistor	RM73B2B 103JDTP	10k Ω
R6		Resistor	RM73B2B 101JDTP	100 Ω
R7		Resistor	RM73B2B 221JDTP	220 Ω
R8		Resistor	RM73B2B 221JDTP	220 Ω
R9		Resistor	RM73B2B 331JDTP	330 Ω
R10		Resistor	RM73B2B 103JDTP	10k Ω
R11		Resistor	RM73B2B 472JDTP	4.7k Ω
R12		Resistor	RM73B2B 103JDTP	10k Ω
R13		Resistor	RM73B2B 222JDTP	2.2k Ω
R14		Resistor	RM73B2B 221JDTP	220 Ω
R15		Resistor	RM73B2B 102JDTP	1k Ω
R16		Resistor	RM73B2B 332JDTP	3.3k Ω
R17		Resistor	RM73B2B 332JDTP	3.3k Ω
R18		Resistor	RM73B2B 331JDTP	330 Ω
R19		Resistor	RM73B2B 222JDTP	2.2k Ω
R20		Resistor	RM73B2B 332JDTP	3.3k Ω
R21		Resistor	RM73B2B 102JDTP	1k Ω
R22		Resistor	RM73B2B 221JDTP	220 Ω
R23		Resistor	RM73B2B 102JDTP	1k Ω
R24		Resistor	RM73B2B 332JDTP	3.3k Ω
R25		Resistor	RM73B2B 332JDTP	3.3k Ω
R26		Resistor	RM73B2B 331JDTP	330 Ω
R27		Resistor	RM73B2B 222JDTP	2.2k Ω
R28		Resistor	RM73B2B 332JDTP	3.3k Ω
R29		Resistor	RM73B2B 102JDTP	1k Ω
R30		Resistor	RM73B2B 221JDTP	220 Ω
R31		Resistor	RM73B2B 102JDTP	1k Ω
R32		Resistor	RM73B2B 332JDTP	3.3k Ω
R33		Resistor	RM73B2B 332JDTP	3.3k Ω
R34		Resistor	RM73B2B 331JDTP	330 Ω

LOG IF AMP (cont'd)

Symbol	Code	Name	Specifications	Description
R35		Resistor	RM73B2B 222JDTP	2.2k Ω
R36		Resistor	RM73B2B 332JDTP	3.3k Ω
R37		Resistor	RM73B2B 102JDTP	1k Ω
R38		Resistor	RM73B2B 221JDTP	220 Ω
R39		Resistor	RM73B2B 102JDTP	1k Ω
R40		Resistor	RM73B2B 332JDTP	3.3k Ω
R41		Resistor	RM73B2B 332JDTP	3.3k Ω
R42		Resistor	RM73B2B 331JDTP	330 Ω
R43		Resistor	RM73B2B 222JDTP	2.2k Ω
R44		Resistor	RM73B2B 332JDTP	3.3k Ω
R45		Resistor	RM73B2B 102JDTP	1k Ω
R46		Resistor	RM73B2B 221JDTP	220 Ω
R47		Resistor	RM73B2B 102JDTP	1k Ω
R48		Resistor	RM73B2B 102JDTP	1k Ω
R49		Resistor	RM73B2B 332JDTP	3.3k Ω
R50		Resistor	RM73B2B 332JDTP	3.3k Ω
R51		Resistor	RM73B2B 331JDTP	330 Ω
R52		Resistor	RM73B2B 222JDTP	2.2k Ω
R53		Resistor	RM73B2B 332JDTP	3.3k Ω
R54		Resistor	RM73B2B 102JDTP	1k Ω
R55		Resistor	RM73B2B 221JDTP	220 Ω
R56		Resistor	RM73B2B 102JDTP	1k Ω
R57		Resistor	RM73B2B 332JDTP	3.3k Ω
R58		Resistor	RM73B2B 332JDTP	3.3k Ω
R59		Resistor	RM73B2B 331JDTP	330 Ω
R60		Resistor	RM73B2B 222JDTP	2.2k Ω
R61		Resistor	RM73B2B 332JDTP	3.3k Ω
R62		Resistor	RM73B2B 102JDTP	1k Ω
R63		Resistor	RM73B2B 221JDTP	220 Ω
R64		Resistor	RM73B2B 102JDTP	1k Ω
R65		Resistor	RM73B2B 332JDTP	3.3k Ω
R66		Resistor	RM73B2B 332JDTP	3.3k Ω
R67		Resistor	RM73B2B 331JDTP	330 Ω
R68		Resistor	RM73B2B 222JDTP	2.2k Ω
R69		Resistor	RM73B2B 472JDTP	4.7k Ω
R70		Resistor	RM73B2B 102JDTP	1k Ω
R71		Resistor	RM73B2B 221JDTP	220 Ω
R72		Resistor	RM73B2B 102JDTP	1k Ω
R73		Resistor	RM73B2B 102JDTP	1k Ω
R74		Resistor	RM73B2B 470JDTP	47 Ω
R75		Resistor	RM73B2B 101JDTP	100 Ω
R76		Resistor	RM73B2B 102JDTP	1k Ω
R77		Resistor	RM73B2B 102JDTP	1k Ω
R78		Resistor	RM73B2B 100JDTP	10 Ω
R79		Resistor	RM73B2B 102JDTP	1k Ω
R80		Resistor	RM73B2B 103JDTP	10k Ω
R81		Resistor	RM73B2B 101JDTP	100 Ω
R82		Not used		
R83		Resistor	RM73B2B 472JDTP	4.7k Ω
R84		Not used		
R85		Not used		
R86		Not used		
R87		Resistor	RM73B2B 472JDTP	4.7k Ω
R88		Resistor	RM73B2B 102JDTP	1k Ω
R89		Resistor	RM73B2B 222JDTP	2.2k Ω
R90		Resistor	RM73B2B 100JDTP	10 Ω
R91		Not used		
R92		Resistor	RM73B2B 101JDTP	100 Ω

LOG IF AMP (cont'd)

Symbol	Code	Name	Specifications	Description
R93		Resistor	RM73B2B 222JDTP	2.2k Ω
R94		Resistor	RM73B2B 100JDTP	10 Ω
R95		Resistor	RM73B2B 102JDTP	1k Ω
R96		Resistor	RM73B2B 470JDTP	47 Ω
R97		Resistor	RM73B2B 102JDTP	1k Ω
R98		Resistor	RM73B2B 103JDTP	10k Ω
R99		Resistor	RM73B2B 105JDTP	1M Ω
R100		Resistor	RM73B2B 105JDTP	1M Ω
R101		Resistor	RM73B2B 102JDTP	1k Ω
R102		Resistor	RM73B2B 332JDTP	3.3k Ω
T1		Transformer	10K-E0602	
T2		Transformer	10K-E0602	

(5) MOD (10kW) (239U52236)

Symbol	Code	Name	Specifications	Description
C1		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C2		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C3		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C4		Cap. metalized film	MD22G104K	0.1 μ F 400V
C5		Capacitor mylar	ECQM1H104KZ	0.1 μ F 50V
C6		Capacitor ceramic	CC45CH1H101JY	100pF 50V
C7		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C8		Capacitor electrolytic	CE04C1H100A	10 μ F 50V
C9		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C10		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C11		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C12		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C13		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C14		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C15		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C16		Cap. metalized film	PHMs3D333JD	33000pF 1.2kV
C17		Capacitor electrolytic	CE04C1H010A	1 μ F 50V
C18		Capacitor mylar	ECQM1H103KZ	0.01 μ F 50V
C19		Capacitor mylar	ECQM1H104KZ	0.1 μ F 50V
C20		Capacitor electrolytic	CE04C1H010A	1 μ F 50V
E1		Terminal	24E121330	
E2		Terminal	24E121330	
E3		Terminal	24E121330	
E4		Terminal	24E121330	
E5		Terminal	24E120361	
E6		Terminal	24E120361	
E7		Terminal	24E120361	
K1		Relay	MR-71C-12	
K2		Relay	MR-71A-12	
K3		Relay	MR-71A-12	
L1		Inductor	LF8-220K	22mH
L2		Coil PFN	AMC117-5	
L3		Coil PFN	AMC117-5	
L4		Coil PFN	AMC117-5	
L5		Coil PFN	AMC117-5	
L6		Coil PFN	AMC117-5	
L7		Coil PFN	AMC117-5	
L8		Coil PFN	AMC117-5	
L9		Coil choke	242L115498	
L10		Coil choke	242L115498	

MOD (10kW) (cont'd)

Symbol	Code	Name	Specifications	Description
J1		Connector	B9PS-VH	
J2		Connector	B2PS-VH	
Q1		Diode	1S1588	
Q2		Diode	1S1588	
Q3		Diode	1S1588	
Q4		Transistor	2SA1020	
Q5		Transistor	2SC2901	
Q6		Diode	RD3.9EB	
Q7		Diode	SM-1.5-10	
Q8		Diode	1S1588	
Q9		SCR	SH16J12U	
Q10		Diode	RM4C	
Q11		Diode	1S1588	
Q12		Diode	SM-1.5-10	
R1		Resistor fixed	NAM1/4 680JTP	68Ω 1/4W
R2		Resistor fixed	NAM1/4 680JTP	68Ω 1/4W
R3		Resistor fixed	NAM1/4 680JTP	68Ω 1/4W
R4		Resistor fixed	NAM1/4 221JTP	220Ω 1/4W
R5		Resistor fixed	NAM1/4 470JTP	47Ω 1/4W
R6		Resistor fixed	NAM1/4 101JTP	100Ω 1/4W
R7		Resistor fixed	NAM1/4 221JTP	220Ω 1/4W
R8		Resistor fixed	NAM1/4 100JTP	10Ω 1/4W
R9		Resistor fixed	NAM1/4 100JTP	10Ω 1/4W
R10		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R11		Resistor fixed	NAM1/4 102JTP	1kΩ 1/4W
R12		Resistor fixed	NAM1/4 103JTP	10kΩ 1/4W
R13		Resistor fixed	ERF-2SK1R0	1Ω 2W
R14		Resistor fixed	NAM1/4 100JTP	10Ω 1/4W
T1		Coil charging choke	24L122100	0.2H
T2		Coil choke	SU9V-10005	0.5mH

8.1.2 Antenna unit MRT-134 (25kW)

(1) Antenna housing

Symbol	Code	Name	Specifications	Description
C1		Capacitor polyester	ECQM1H104KZ	0.1μF 50V
G1		Motor with pinion	23G53203	24V 15W
J1		Connector	VHR-10N (included in W1)	
J2		Connector	VHR-10N (included in W1)	
J3		Connector	VHR-9N (included in W2)	
J4		Connector	VHR-9N (included in W2)	
J5		Not used		
J6		Connector	VHR-3N (included in W4)	
Q3		Photo-interrupter	GP1L03	
S1		Switch lead	24J123749	FRS-901-3
U6		S. CON	239U52352	[See 8. 1. 1 item (2)]
U7		TR unit (25kW)	229U26008B	[See 8. 1. 2 item (3)]
W1		Harness IF	24J124056(with J1 and J 2)	
W2		Harness MOD	24J124058(with J3 and J 4)	
W4		Harness	SHF	

(2) S. CON (239U52352) [See 8. 1. 1 item (4)]

(3) TR unit (25kW) (229U25361)

Symbol	Code	Name	Specifications	Description
C1		Capacitor polyester	ECQM1H104KZ	0.1μF 24 V
J5		Connector	VHR-4N	
J6		Not used		
J7		Connector	VHR-3N	
J8		Connector	VHR-2N	
L1		Coil charging choke	24T127876	
Q1		Diode	HVR-1X-40B	
Q2		Diode	HVR-1X-40B	
R1		Resistor	ERF-10HMJ470	47 Ω 10 w
T1		Transformer pulse	24T127875	
U1		LOG IF AMP	239U52512	[See 8. 1. 1 item (4)]
U2		MOD (25kW)	229U25361	[See 8. 1. 2 item (5)]
U3		MIC	S-RX34	
U4		Circulator	FCX68	
U5		Limiter	S-LX17	
V1		Magnetron (25kW)	E-3564,A	
W3		Harness	FEM	
Z1		Fan	FBK-08A12H	

(4) LOG IF AMP (239U52512) [See 8. 1. 1 item (4)]

(5) MOD (25kW) (229U26008B)

Symbol	Code	Name	Specifications	Description
C1		Capacitor electrolytic	CE04C1H100A	10μF 50V
C2		Capacitor electrolytic	CE04C1H100A	10μF 50V
C3		Capacitor electrolytic	CE04C1H100A	10μF 50V
C4		Not used		
C5		Capacitor mylar	ECQM1H104KZ	0.1μF 50V

MOD (25kW) (cont'd)

Symbol	Code	Name	Specifications	Description
C6		Capacitor ceramic	CC45CH1H101JY	100pF 50V
C7		Capacitor electrolytic	CE04C1H100A	10μF 50V
C8		Capacitor electrolytic	CE04C1H100A	10μF 50V
C9		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C10		Capacitor metalized film	PHM3A333J	0.033μF 1.0kV
C11		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C12		Capacitor metalized film	PHM3A333J	0.033μF 1.0kV
C13		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C14		Capacitor metalized film	PHM3A333J	0.033μF 1.0kV
C15		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C16		Capacitor metalized film	PHM3A333J	0.033μF 1.0kV
C17		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C18		Capacitor metalized film	PHM3A333J	0.033μF 1.0kV
C19		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C20		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C21		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C22		Capacitor metalized film	PHM3A473J	0.047μF 1.0kV
C23		Capacitor electrolytic	CE04C1E101A	100μF 25V
C24		Capacitor mylar	ECQM1H103KZ	0.01μF 50V
C25		Capacitor mylar	ECQM1H104KZ	0.1μF 50V
C26		Capacitor electrolytic	CE04C1H010A	1μF 50V
C27		Capacitor electrolytic	KME400VB22	22μF 400V
C28		Capacitor electrolytic	KME400VB22	22μF 400V
C29		Capacitor ceramic	CK924C1H104Z	0.1μF 50V
E1		Terminal	24E121330	
E2		Terminal	24E121330	
E3		Terminal	24E121330	
E4		Terminal	24E121330	
E5		Terminal	24E120361	
E6		Terminal	24E120361	
E7		Terminal	24E120361	
E8		Terminal	24E120361	
E9		Terminal	24E120361	
K1		Relay	MR-71C-12	
K2		Relay	MR-71A-12	
K3		Relay	MR-71A-12	
L1		Coil choke	LF8-220K	22mH
L2		Inductor	AMC117-2 (24L130252)	
L3		Inductor	AMC117-2 (24L130252)	
L4		Inductor	AMC117-3 (24L131245)	
L6		Inductor	AMC117-2 (24L130252)	
L7		Inductor	AMC117-2 (24L130252)	
L8		Not used		
L9		Coil choke	H5B2T7-14-3.5E (242L115498)	
L10		Coil choke	H5B2T7-14-3.5E (242L115498)	
L11		Coil choke	MB12X8X4.5-3T (24L132453)	
L12		Coil choke	MB12X8X4.5-3T (24L132453)	
L13		Coil choke	SU9V-10005	
J1		Connector	B9PS-VH	
J2		Connector	B2P-VH	
J3		Connector	B3PS-VH	
J4		Connector	B2PS-VH	
J5		Connector	B2P-VH	
Q1		Diode	1S1588	
Q2		Diode	1S1588	
Q3		Diode	1S1588	
Q4		Transistor	2SA1020	

MOD (25kW) (cont'd)

Symbol	Code	Name	Specifications	Description
Q5		Transistor	2SC2901	
Q6		Diode	RD3.9EB	
Q7		Diode	SM-1.5-10	
Q8		Diode	SM-1.5-10	
Q9		SCR	SH16J12U	
Q10		SCR	SH16J12U	
Q11		Diode	RM4C	
Q12		Diode	SM-1.5-10	
Q13		Diode	1S1588	
Q14		Diode	2SC1815	
R1		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R2		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R3		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R4		Resistor fixed	NAM1/4 221JTP	220Ω 1/4W
R5		Resistor fixed	NAM1/4 470JTP	47Ω 1/4W
R6		Resistor fixed	NAM1/4 101JTP	100Ω 1/4W
R7		Resistor fixed	NAM1/4 221JTP	220Ω 1/4W
R8		Resistor fixed	NAM1/4 100JTP	10Ω 1/4W
R9		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R10		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R11		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R12		Resistor fixed	NAM1/4 220JTP	22Ω 1/4W
R13		Resistor fixed	NAM1/4 102JTP	1kΩ 1/4W
R14		Resistor fixed	NAM1/4 103JTP	10kΩ 1/4W
R15		Resistor fixed	ERF-2SK0R5	0.5Ω 2W
R16		Resistor fixed	NAM1/4 221JTP	220Ω 1/4W
R17		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R18		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R19		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R20		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R21		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R22		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R23		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R24		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R25		Resistor fixed	NAM1/4 105JTP	1MΩ 1/4W
R26		Resistor fixed	NAM1/4 100JTP	10Ω 1/4W
R27		Resistor fixed	ERF-5ZXK220	22Ω 5W
R28		Resistor fixed	NAM1/4 334JTP	330kΩ 1/4W
R29		Resistor fixed	NAM1/4 334JTP	330kΩ 1/4W
R30		Resistor metal film	RS1FB560Ω	560Ω 1/4W
R31		Resistor nfixed	NAM1/4 103JTP	10kΩ 1/4W

8.1.3 Display unit MRD-62/MRD-68

(1) LINE FILTER (MD-3210-6100M1)

Symbol	Code	Name	Specifications	Description
C1	51416710	Capacitor electrolytic	ECEA1HN101S	100 μ F 50V
C2	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
C3	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
C4	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
C5	51416710	Capacitor electrolytic	ECEA1HN101S	100 μ F 50V
C6	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
C7	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
C8	52629511	Capacitor polyester	ECQE1105JN	1 μ F 100V
E6101	57272503	Tab faston	170267-1	
E6102	57272503	Tab faston	170267-1	
L1	56322181	Coil choke	SC-20-100	
J6101		Connector	HS21R-3	

(2) POWER SUPPLY (MD-3210-6000M2/M3)

Symbol	Code	Name	Specifications	Description
C1	51286810	Capacitor electrolytic	ECEA1HFS102	1000 μ F 50V
C2	51286810	Capacitor electrolytic	ECEA1HFS102	1000 μ F 50V
C3	51286810	Capacitor electrolytic	ECEA1HFS102	1000 μ F 50V
C4	51286810	Capacitor electrolytic	ECEA1HFS102	1000 μ F 50V
C5	51286810	Capacitor electrolytic	ECEA1HFS102	1000 μ F 50V
C6	52628422	Capacitor polyester	ECQE1224JN	0.22 μ F 100V
C7	52628422	Capacitor polyester	ECQE1224JN	0.22 μ F 100V
C8	52580210	Capacitor mylar	ECQB1H102JZ	1000pF 50V
C9	51440510	Capacitor electrolytic	ECEA1HGE010	1 μ F 50V
C10	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C11	51438733	Capacitor electrolytic	ECEA1CGE331	330 μ F 16V
C12	52259410	Capacitor ceramic	D55Y5V1H104Z51	0.1 μ F 50V
C13	51438733	Capacitor electrolytic	ECEA1CGE331	330 μ F 16V
C14	51440610	Capacitor electrolytic	ECEA1HGE100	10 μ F 50V
C15	52580310	Capacitor mylar	ECQB1H103JZ	0.01 μ F 50V
C16	52266068	Capacitor ceramic	ECCF1H680JC5	68pF 50V
C17	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C18	51418810	Capacitor electrolytic	ECEA1EFS102	1000 μ F 25V
C19	51418710	Capacitor electrolytic	ECEA1EFS101	100 μ F 25V
C20	51418810	Capacitor electrolytic	ECEA1EFS102	1000 μ F 25V
C21	51418710	Capacitor electrolytic	ECEA1EFS101	100 μ F 25V
C22	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C23	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C24	51418710	Capacitor electrolytic	ECEA1EFS101	100 μ F 25V
C25	51418710	Capacitor electrolytic	ECEA1EFS101	100 μ F 25V
C26	51471710	Capacitor electrolytic	ECEA2CG101S	100 μ F 160V
C27	51471710	Capacitor electrolytic	ECEA2CG101S	100 μ F 160V
C28	52662410	Capacitor polyester	ECQE2104JF	0.1 μ F 250V
C29	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C30	51470647	Capacitor electrolytic	ECEA2AGE470	47 μ F 100V
C31	52628410	Capacitor polyester	ECQE1104JN	0.1 μ F 100V
C32	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C33	51473647	Capacitor electrolytic	ECEA2EG470S	47 μ F 250V
C34	52662410	Capacitor polyester	ECQE2104JF	0.1 μ F 250V
C35	51473647	Capacitor electrolytic	ECEA2EG470S	47 μ F 250V
C36	52662410	Capacitor polyester	ECQE2104JF	0.1 μ F 250V
C37	51286810	Capacitor electrolytic	ECEA1HFS102	100 μ F 50V
C38	51286810	Capacitor electrolytic	ECEA1HFS102	100 μ F 50V
C39	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C40	51437747	Capacitor electrolytic	ECEA1AGE471	470 μ F 10V

POWER SUPPLY (cont'd)

Symbol	Code	Name	Specifications	Description
C41	51440610	Capacitor electrolytic	ECEA1HGE100	10 μ F 50V
C42	52580310	Capacitor mylar	ECQB1H103JZ	0.01 μ F 50V
C43	52580310	Capacitor mylar	ECQB1H103JZ	0.01 μ F 50V
C44	52628410	Capacitor polyester	ECQE1104JN	0.1 μ F 100V
C45	52628410	Capacitor polyester	ECQE1104JN	0.1 μ F 100V
C46	51440647	Capacitor electrolytic	ECEA1HGE470	47 μ F 50V
C47	52259410	Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
D1	50311510	Diode	SB50-18 with B-17 bush	
D2	50311510	Diode	SB50-18 with B-17 bush	
D3	50311092	Diode	ESAD92-03	
D4	50312103	Diode	10DF8	
D5	50312103	Diode	10DF8	
D6	50312103	Diode	10DF8	
D7	50312103	Diode	10DF8	
D8	50312102	Diode	11DF4	
D9	50312102	Diode	11DF4	
D10	50312102	Diode	11DF4	
D11	50312102	Diode	11DF4	
D12	50312103	Diode	10DF8	
D13	50312103	Diode	10DF8	
D14	50312103	Diode	10DF8	
D15	50312103	Diode	10DF8	
D16	50312103	Diode	10DF8	
D17	50312103	Diode	10DF8	
D18	50312103	Diode	10DF8	
D19	50312103	Diode	10DF8	
D20	50311184	Diode	DSA20TE	
D21	50312102	Diode	11DF4	
D22	50312102	Diode	11DF4	
D23	50325142	Diode	RD9.1EB2	
D24	50310762	Diode	1S2076A	
D25	50325037	Diode	RD3.9EB2	
D26	50310762	Diode	1S2076A	
D28	50325262	Diode	RD30EB2	
D29	50310762	Diode	1S2076A	
D32	50310762	Diode	1S2076A	
D33	50312102	Diode	11DF4	
D34	50312102	Diode	11DF4	
D35	50310762	Diode	1S2076A	
D36	50324045	Diode	HZ5C1	
D37	50325293	Diode	RD36FB2	
D38	50325214	Diode	RD15EB2	
D39	50310762	Diode	1S2076A	
D40	50310762	Diode	1S2076A	
D41	50312102	Diode	11DF4	
D42	50312102	Diode	11DF4	
D43	50312102	Diode	11DF4	
D44	50310762	Diode	1S2076A	
D45	50310762	Diode	1S2076A	
D46	50312102	Diode	11DF4	
D47	50312102	Diode	11DF4	
D49	50324045	Diode	HZ5C1	
E1	57272503	Tab faston	170267-1	
E2	57272503	Tab faston	170267-1	
E3	57021108	Terminal	P-436	
E4	57021108	Terminal	P-436	
E5	57021108	Terminal	P-436	
E6	57021108	Terminal	P-436	
E7	57021108	Terminal	P-436	
E8	57021108	Terminal	P-436	

POWER SUPPLY (cont'd)

Symbol	Code	Name	Specifications	Description
E9	57272732	Tab faston	61907-1	
E10	57272732	Tab faston	61907-1	
E11	57272732	Tab faston	61907-1	
E12	57272732	Tab faston	61907-1	
FH1		Fuse holder	F6 MD-3210-6000M2
F1		Fuse	F7142, 1A MD-3210-6000M2
IC1	50961519	IC regulator	HA17812P	
IC2	50989910	IC regulator	SI-3522V	
IC3	50903001	IC	M5T494P	
IC4	50974512	IC regulator	μPC79N12H	
IC5	50914013	IC regulator	μPC317H	
J6001	57221850	Connector	HIF3BA-50PA-2.54DSA	
J6002	57267004	Connector	5045-04A	
J6003	57231304	Connector	B4P-VH	
J6004	57231309	Connector	B9P-VH	
J6005	57231304	Connector	B4P-VH	
J6006	57231310	Connector	B10P-VH	
J6007	57231208	Connector	B8P-SHF-1AA	
J6008	57231207	Connector	B7P-SHF-1AA	
J6009	57231302	Connector	B2P-VH	
J6010	57231202	Connector	B2P-SHF-1AA	
K1	57988005	Relay	G2R-1117P-V-RP-US-12V	
K2	57988030	Relay	G5R-2234P-KW-12V	
K3	57988005	Relay	G2R-1117P-V-RP-US-12V	
K4	57988005	Relay	G2R-1117P-V-RP-US-12V	
L1	56317162	Coil choke	KCL-162	1.5A 800μH
L2	56317165	Coil choke	KCL-165	0.3A 2.2mH
L3	56317161	Coil choke	KCL-161	3A 300μH
L4	56317166	Coil choke	KCL-166	4A 800μH
L5	56317163	Coil choke	KCL-163	4A 50μH
L6	56317164	Coil choke	KCL-164	0.33A 100mH
L7	56317160	Coil choke	KCL-160	0.16A 100mH
L8	56317160	Coil choke	KCL-160.... MD-3210-6000M2	0.16A 100mH
L9	56317160	Coil choke	KCL-160.... MD-3210-6000M2	0.16A 100mH
L8		Coil choke	KCL-167	0.167A 100mH
L9		Coil choke	KCL-167	0.167A 100mH
L10		Coil choke	KCL-167	0.167A 100mH
Q1	50105909	FET	IRFP150	
Q2	50105909	FET	IRFP150	
Q3	50105909	FET	IRFP150	
Q4	50105909	FET	IRFP150	
Q5	50103362	Transistor	2SC1815Y	
Q6	50103362	Transistor	2SC1815Y	
Q7	50101220	Transistor	2SA1015Y	
Q8	50105909	Transistor	2SA1015Y	
Q9	50103362	Transistor	2SC1815Y	
Q10	50101220	Transistor	2SA1015Y	
Q11	50104130	Transistor	2SD882Q	
Q12	50102067	Transistor	2SB772Q	
Q13	50104130	Transistor	2SD882Q	
Q14	50102067	Transistor	2SB772Q	
Q15	50101220	Transistor	2SA1015Y	
Q16	50101220	Transistor	2SA1015Y	
Q17	50103362	Transistor	2SC1815Y	
Q19	50101220	Transistor	2SA1015Y	
Q20	50101220	Transistor	2SA1015Y	
Q21	50103362	Transistor	2SC1815Y	
Q22	50102122	Transistor	2SB1022	

P. C. Board assembly MD-3210-6000M2/M3 POWER SUPPLY (cont'd)

Symbol	Code	Name	Specifications	Description
Q23	50101220	Transistor	2SA1015Y	
Q24	50103362	Transistor	2SC1815Y	
Q25	50102067	Transistor	2SB772Q	
Q26	50102067	Transistor	2SB772Q	
Q27	50102067	Transistor	2SB772Q	
Q28	50253122	Photo-coupler	PC817	
Q29	50253122	Photo-coupler	PC817	
Q30	50331203	SCR	03P2M	
Q31	50102067	Transistor	2SB772Q	
Q32	50253122	Photo-coupler	PC817	
Q33	50101220	Transistor	2SA1015Y	
Q34	50101220	Transistor	2SA1015Y	
Q35	50103508	Transistor	2SC3571K	
R1	54032222	Resistor fixed	R20FC02J220	22Ω 1/5W
R2	54032222	Resistor fixed	R20FC02J220	22Ω 1/5W
R3	54445410	Resistor fixed	ERG2SJ102	1kΩ 2W
R4	54445410	Resistor fixed	ERG2SJ102	1kΩ 2W
R5	54032222	Resistor fixed	R20FC02J220	22Ω 1/5W
R6	54032222	Resistor fixed	R20FC02J220	22Ω 1/5W
R7	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R8	54032547	Resistor fixed	R20FC02J473	47kΩ 1/5W
R9	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R10	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R11	54032347	Resistor fixed	R20FC02J471	470Ω 1/5W
R12	54032347	Resistor fixed	R20FC02J471	470Ω 1/5W
R13	54032210	Resistor fixed	R20FC02J100	10Ω 1/5W
R14	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R15	54032547	Resistor fixed	R20FC02J473	47kΩ 1/5W
R16	54032547	Resistor fixed	R20FC02J473	47kΩ 1/5W
R17	54032610	Resistor fixed	R20FC02J104	100kΩ 1/5W
R18	54032410	Resistor fixed	R20FC02J102	1kΩ 1/5W
R19	54032611	Resistor fixed	R20FC02J114	110kΩ 1/5W
R20	54032512	Resistor fixed	R20FC02J153	15kΩ 1/5W
R21	54032410	Resistor fixed	R20FC02J102	1kΩ 1/5W
R22	54032410	Resistor fixed	R20FC02J102	1kΩ 1/5W
R23	54032433	Resistor fixed	R20FC02J332	3.3kΩ 1/5W
R24	54032615	Resistor fixed	R20FC02J154	150kΩ 1/5W
R25	54032447	Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R26	54032447	Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R27	54032382	Resistor fixed	R20FC02J821	820Ω 1/5W
R28	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R29	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R30	54032547	Resistor fixed	R20FC02J473	47kΩ 1/5W
R31	54032527	Resistor fixed	R20FC02J273	27kΩ 1/5W
R32	54032310	Resistor fixed	R20FC02J101	100Ω 1/5W
R33	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R34	54032468	Resistor fixed	R20FC02J682	6.8kΩ 1/5W
R35	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R36	54032622	Resistor fixed	R20FC02J224	220kΩ 1/5W
R37	54032512	Resistor fixed	R20FC02J471	470Ω 1/5W
R38	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R39	54032410	Resistor fixed	R20FC02J102	1kΩ 1/5W
R40	54032512	Resistor fixed	R20FC02J123	12kΩ 1/5W
R41	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R42	54032468	Resistor fixed	R20FC02J682	6.8kΩ 1/5W
R43	54445410	Resistor fixed	ERG2SJ102	1kΩ 2W
R44	54445351	Resistor fixed	ERG2SJ511	510Ω 2W
R45	54435168	Resistor fixed	ERX2SG6R8	6.8Ω 2W
R46	54435168	Resistor fixed	ERX2SG6R8	6.8Ω 2W

POWER SUPPLY (cont'd)

Symbol	Code	Name	Specifications	Description
R47	54444410	Resistor fixed	ERG1SJ102	1kΩ 1W
R48	54444551	Resistor fixed	ERG1SJ513	51kΩ 1W
R49	54444551	Resistor fixed	ERG1SJ513	51kΩ 1W
R50	54032610	Resistor fixed	R20FC02J104	100kΩ 1/5W
R51	54032447	Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R52	54032415	Resistor fixed	R20FC02J152	1.5kΩ 1/5W
R53	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R54	54444551	Resistor fixed	ERG1SJ513	51kΩ 1W
R55	54445415	Resistor fixed	ERG2SJ152	1.5kΩ 2W
R56	54445551	Resistor fixed	ERG2SJ513	51kΩ 2W
R57	54445551	Resistor fixed	ERG2SJ513	51kΩ 2W
R58	54032410	Resistor fixed	R20FC02J102	1kΩ 1/5W
R59	54857133	Resistor fixed	ERF5AK3R3	3.3Ω 5W
R60	54032447	Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R61	54032310	Resistor fixed	R20FC02J101	100Ω 1/5W
R62	54032368	Resistor fixed	R20FC02J681	680Ω 1/5W
R63	54032510	Resistor fixed	R20FC02J103	10kΩ 1/5W
R64	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R65	54032322	Resistor fixed	R20FC02J221	220Ω 1/5W
R66	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R67	54032422	Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R68	54032433	Resistor fixed	R20FC02J	3.3kΩ 1/5W
R69	54032510	Resistor fixed	R20FC02J	10kΩ 1/5W
R70	54032422	Resistor fixed	R20FC02J	2.2kΩ 1/5W
R71	54032510	Resistor fixed	R20FC02J	10kΩ 1/5W
R72	54032433	Resistor fixed	R20FC02J	3.3kΩ 1/5W
R73	54444233	Resistor fixed	ERG1SJ330	33Ω 1W
R74	54444233	Resistor fixed	ERG1SJ330	33Ω 1W
R75	54032415	Resistor fixed	R20FC02J	1.5kΩ 1/5W
R76	54822410	Resistor fixed	ERG5ZXJ102	1kΩ 5W
R77		Not used		
R78	54822410	Resistor fixed	ERG5ZXJ102	1kΩ 5W
R79	54822410	Resistor fixed	ERG5ZXJ102	1kΩ 5W
R80	54032433	Resistor fixed	R20FC02J332	3.3kΩ 1/5W
R81	54032433	Resistor fixed	R20FC02J332	3.3kΩ 1/5W
R82	54032382	Resistor fixed	R20FC02J821	820Ω 1/5W
R83	54032322	Resistor fixed	R20FC02J221	220Ω 1/5W
R84	54445610	Resistor fixed	ERG2SJ104	100kΩ 2W
R85	54032415	Resistor fixed	R20FC02J332	1.5kΩ 1/5W
R86	54032415	Resistor fixed	R20FC02J332	1.5kΩ 1/5W
R87	54032422	Resistor fixed	R20FC02J332	2.2kΩ 1/5W
R88	54445447	Resistor fixed	ERG2SJ472	4.7kΩ 2W
VR1	55411173	Resistor variable	CT-6P502	5kΩ
VR2	55411114	Resistor variable	CT-6P103	10kΩ
VR3	55411113	Resistor variable	CT-6P102	1kΩ
VR4	55411172	Resistor variable	CT-6P501	500Ω
T1		Transformer	KCT-211*** MD-3210-6000M2	
T1		Transformer	KCT-228	
TP1	57011111	Test pin	LC-1-S	
TP2	57011111	Test pin	LC-1-S	
TP3	57011111	Test pin	LC-1-S	
TP4	57011111	Test pin	LC-1-S	
TP5	57011111	Test pin	LC-1-S	
TP6	57011111	Test pin	LC-1-S	
TP7	57011111	Test pin	LC-1-S	
	71901014	Heat-sink	OSH-1625-SPL	

(3) LOGIC UPPER (MD-3210-7000M2)

Symbol	Code	Name	Specifications	Description
1A		IC	HD74HC174P	
1B		IC	HD74HC245P	
1C		IC	HD74AC04P	
1D		IC	HD74HC244P	
1F		IC	HD74HC244P	
1H		IC	HD74HC245P	
2A		IC	HD74HC174P	
2B		IC	HD74HC245P	
2C		IC	HD74HC373P	
2E		IC	μPD70208GF-10-3B9	
2H		IC	HD74HC373P	
2J		IC	HD74HC244P	
2K		IC	HD74AC139P	
3A		IC	F74F195PC	
3B		IC	HD74AC00P	
3C		IC RAM	MB8464A-15LL-SK	
3H		IC	HD74HC595P	
3J		IC	HD74HC244P	
3K		IC	HD74AC08P	
4A		IC	F74F195PC	
4B		IC	HD74HC155P	
4C		Socket IC	IC30-2806-G4	
4C		IC ROM	KM-736	
4F		IC	HD74AC138P	
4H		IC	HD74HC595P	
4J		IC	HD74HC374P	
4K		IC regulator	MB3771P	
5A		IC RAM	TC524256Z-10	
5F		IC	HD74AC138P	
5H		IC	HD74HC595P	
5J		IC	HD74HC191P	
6A		IC RAM	TC524256Z-10	
6C		IC	TC74HC4075AP	
6D		IC	HD74HC375P	
6F		IC	HD74AC138P	
6H		IC	HD74HC595P	
6J		IC	HD74HC191P	
7A		IC RAM	TC524256Z-10	
8A		IC RAM	TC524256Z-10	
8C		IC	HD74HC373P	
8D		IC	HD74HC373P	
8E		IC	HD74HC595P	
8F		IC	HD74HC158P	
8H		IC	HD74HC590P	
8J		IC	HD74HC590P	
9A		IC RAM	TC524256Z-10	
9C		IC	HD63484UPS8	
9E		IC	HD74HC04P	
9F		IC	HD74HC125P	
9H		IC	HD74HC74P	
9J		IC	HD74AC163P	
10A		IC RAM	TC524256Z-10	
11A		IC RAM	TC524256Z-10	
11E		IC	HD74AC74P	
11F		IC	HD74AC04P	
11H		IC	HD74HC191P	
11J		IC	HD74AC08P	
12A		IC RAM	TC524256Z-10	
12C		IC	HD74AC164P	
12D		IC	HD74AC04P	
12E		IC	HD74HC04P	

LOGIC UPPER (MD-3210-7000M2) (cont'd)

Symbol	Code	Name	Specifications	Description
12F		IC	HD74AC11P	
12H		IC	HD74HC374P	
12J		IC	HD74HC245P	
13A		IC	F74F195PC	
13B		IC	F74F195PC	
13C		IC	HD74HC74P	
13D		IC	HD74HC51P	
13F		IC	HD74HC74P	
13H		IC	HD74HC191P	
BAT1		Battery	CR2032	
BAT1		Case battery	BBH-1	
C1		Capacitor electrolytic	ECEA1EU101	
C2		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C3		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C4		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C5		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C6		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C7		Capacitor electrolytic	ECEA1HU010	1 μ F 50V
C8		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C9		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C10		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C11		Capacitor tantalum	CS92N1C4R7M	4.7 μ F 16V
C12		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C13		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C14		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C15		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C16		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C17		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C18		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C19		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C20		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C21		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C22		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C23		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C24		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C25		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C26		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C27		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C28		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C29		Capacitor mylar	ECQP1H221JZ	220pF 50V
C30 to C80		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
D1		Diode	1S2076A	
D2		Diode	1S2076A	
J7001		Connector	HIF3BA-60PA-2.54DS	
J7002		Connector	BS15P-SHF-1AA	
R1		Resistor fixed	R20FC02J103	10k Ω 1/5W
R2		Resistor fixed	R20FC02J103	10k Ω 1/5W
R3		Resistor fixed	R20FC02J221	220 Ω 1/5W
R4		Resistor fixed	R20FC02J221	220 Ω 1/5W
R5		Resistor fixed	R20FC02J221	220 Ω 1/5W
RA1		Resistor array	IHR-8-103JA	10k Ω
RA2		Resistor array	IHR-8-103JA	10k Ω
RA3		Resistor array	IHR-8-103JA	10k Ω
RA4		Resistor array	IHR-8-103JA	10k Ω
RA5		Resistor array	IHR-8-103JA	10k Ω
RA6		Resistor array	IHR-8-103JA	10k Ω
SW1		Switch dip	DSS708	
SW2		Switch dip	DSS708	
SW3		Switch dip	DSS708	
Y1		Oscillator crystal	TCO-707F-20MHz	

(4) LOGIC LOWER (MD-3210-7100M2)

Symbol	Code	Name	Specifications	Description
1H		IC	HD74HC4051P	
1L		IC	TC74HC123AP	
1M		IC	TC74HC123AP	
1P		IC	μPC78N05	
1R		IC	μPC78N08	
1S		IC	μPC79N08	
1T		IC	μPC79N05	
1Z		IC	μPC804C	
2L		IC	LM360N	
2Z		IC	μPC804C	
3H		IC	HD74HC4053P	
3L		IC	LM360N	
3N		IC	μPC451C	OPAMP
3S		IC	μPC1555C	TIMER
4AA		IC	F74AC534PC	
4BB		IC	HD74HC14P	
4H		IC	HD74HC4066P	
4L		IC	LM360N	
4N		IC	HD74HC4066P	
4S		IC	SN7406N	
4T		IC	SN7406N	
4U		IC	HD74AC20P	
4V		IC	HD74AC20P	
4X		IC	F74F64PC	
4Y		IC	F74F64PC	
4Z		IC	TC4049BP	
5AA		IC	HD74HC74P	
5BB		IC	HD74HC74P	
5A		IC	HD74AC00P	
5B		IC	HD74AC00P	
5D		IC	HD74AC00P	
5E		IC	HD74AC10P	
5G		IC	HD74AC10P	
5J		IC	HD74AC10P	
5K		IC	TC35094P	
5M		IC	HD74HC273P	
5N		IC	HD74HC273P	
5P		IC	HD74HC273P	
5R		IC	HD74HC273P	
5T		IC	HD74HC245P	
5U		IC	HD74HC273P	
5V		IC	HD74HC273P	
5W		IC	HD74AC175P	
5X		IC	HD74AC175P	
5Y		IC	HD74HC04P	
5Z		IC	HD74HC08P	
6A		IC	HD74AC20P	
6B		IC	HD74AC20P	
6C		IC	F74F195PC	
6E		IC	HD74AC00P	
6F		IC	F74F195PC	
6H		IC	HD74AC00P	
6J		IC	F74F195PC	
6L		IC	HD74AC00P	
6M		IC	F74F195PC	
6N		IC	HD74AC273P	
6P		IC	HD74HC30P	
6S		IC	HD74AC138P	
6T		IC	HD74AC138P	

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
6U		IC	F74F64PC	
6V		IC	TC74HC40103AP	
6W		IC	HD74HC4040P	
6X		IC	HD74AC74P	
6Y		IC	HD74AC74P	
6Z		IC	HD74AC74P	
7AA		IC	HD74AC04P	
7B		IC RAM	μPD42274V-10	
7C		IC RAM	μPD42274V-10	
7D		IC RAM	μPD42274V-10	
7E		IC RAM	μPD42274V-10	
7F		IC RAM	μPD42274V-10	
7G		IC RAM	μPD42274V-10	
7H		IC RAM	μPD42274V-10	
7J		IC RAM	μPD42274V-10	
7K		IC RAM	μPD42274V-10	
7L		IC RAM	μPD42274V-10	
7M		IC	HD74AC157P	
7T		IC	KCD-24	
7X		IC	HD74AC153P	
7Y		IC	HD74AC74P	
7Z		IC	HD74AC74P	
8AA		IC	HD74HC74P	
8A		IC	HD74AC244P	
8M		IC	HD74AC157P	
8N		IC	HD74AC273P	
8P		IC	HD74HC30P	
8X		IC	HD74AC04P	
8Y		IC	HD74HC04P	
8Z		IC	HD74AC00P	
9AA		IC	HD74AC109P	
9A		IC	HD74HC139P	
9B		IC	HD74AC00P	
9C		IC	HD74AC00P	
9E		IC	HD74AC00P	
9K		IC	HD74AC157P	
9M		IC	HD74AC00P	
9P		IC	HD74AC08P	
9R		IC	HD74AC153P	
9T		IC	HD74AC08P	
9U		IC	HD74AC04P	
9V		IC	HD74HC08P	
9X		IC	HD74HC00P	
9Y		IC	HD74AC32P	
9Z		IC	HD74AC00P	
C1		Capacitor electrolytic	ECEA1EU101	100μF 25V
C2		Capacitor electrolytic	ECEA1HU100	10μF 50V
C3		Capacitor mylar	ECQP1H271JZ	270pF 50V
C4		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C5		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C6		Capacitor electrolytic	ECEA1HU100	10μF 50V
C7		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C8		Capacitor electrolytic	ECEA1HU100	10μF 50V
C9		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C10		Capacitor mylar	ECQP1H821JZ	820pF 50V
C11		Capacitor mylar	ECQB1H472JZ	4700pF 50V
C12		Capacitor mylar	ECQB1H222JZ	2200pF 50V
C13		Capacitor mylar	ECQB1H102JZ	1000pF 50V
C14		Capacitor electrolytic	ECEA1HU100	10μF 50V

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
C15		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C16		Capacitor electrolytic	ECEA1HU100	10μF 50V
C17		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C18		Capacitor mylar	ECQV1H104JZ	0.1μF 50V
C19		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C20		Capacitor electrolytic	ECEA1HU100	10μF 50V
C21		Capacitor mylar	ECQV1H104JZ	0.1μF 50V
C22		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C23		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C24		Capacitor electrolytic	ECEA1HU100	10μF 50V
C25		Capacitor electrolytic	ECEA1HU100	10μF 50V
C26		Capacitor mylar	ECQP1H101JZ	100pF 50V
C27		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C28		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C29		Capacitor mylar	ECQB1H102JZ	1000pF 50V
C30		Capacitor mylar	ECQB1H103JZ	0.01μF 50V
C31		Capacitor mylar	ECQP1H101JZ	100pF 50V
C32		Capacitor mylar	ECQP1H101JZ	100pF 50V
C33		Capacitor electrolytic	ECEA1HU100	10μF 50V
C34		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C35		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C36		Capacitor electrolytic	ECEA1HU100	10μF 50V
C37		Capacitor electrolytic	ECEA1HU100	10μF 50V
C38		Capacitor mylar	ECQB1H102JZ	1000pF 50V
C39		Capacitor mylar	ECQP1H101JZ	100pF 50V
C40		Capacitor electrolytic	ECEA1HU100	10μF 50V
C41		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C42		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C43		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C44		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C45		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C46		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C47		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C48		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C49		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C50		Capacitor electrolytic	ECEA1EU101	100μF 25V
C51		Capacitor electrolytic	ECEA1EU101	100μF 25V
C52		Capacitor electrolytic	ECEA1EU101	100μF 25V
C53		Capacitor electrolytic	ECEA1EU101	100μF 25V
C54		Capacitor mylar	ECQB1H103JZ	0.01μF 50V
C55		Capacitor mylar	ECQV1H104JZ	0.1μF 50V
C56		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C57		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C58		Capacitor electrolytic	ECEA1AU101	100μF 10V
C59		Capacitor electrolytic	ECEA1AU101	100μF 10V
C60		Capacitor electrolytic	ECEA1AU101	100μF 10V
C61		Capacitor electrolytic	ECEA1AU101	100μF 10V
C62		Capacitor electrolytic	ECEA1AU101	100μF 10V
C63		Capacitor electrolytic	ECEA1AU101	100μF 10V
C64		Capacitor electrolytic	ECEA1AU101	100μF 10V
C65		Capacitor electrolytic	ECEA1AU101	100μF 10V
C67		Capacitor mylar	ECQB1H103JZ	0.01μF 50V
C68		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C69		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C70		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C71		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C72		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C73		Capacitor ceramic	RPE132F104Z50	0.1μF 50V

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
C74		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C75		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C76		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C77		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C78		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C79		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C80		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C81		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C82		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C83		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C84		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C85		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C86		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C87		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C88		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C89		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C90		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C91		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C92		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C93		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C94		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C95		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C96		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C97		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C98		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C100		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C101		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C102		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C103		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C104		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C105		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C106		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C107		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C108		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C109		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C110		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C111		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C112		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C113		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C114		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C115		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C116		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C117		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C118		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C119		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C120		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C121		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C122		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C123		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C124		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C125		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C126		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C127		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C128		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C129		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C130		Capacitor electrolytic	ECEA1EU101	100 μ F 25V
C131		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C132		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C133		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V
C134		Capacitor ceramic	RPE132F104Z50	0.1 μ F 50V

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
C135		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C136		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C137		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C138		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C139		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C140		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C141		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C142		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C143		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C144		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C145		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C146		Capacitor electrolytic	ECEA1EU101	100μF 25V
C147		Capacitor electrolytic	ECEA1EU101	100μF 25V
C148		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C149		Capacitor ceramic	ECCF1H470JC4	47pF 50V
C150		Capacitor ceramic	ECCF1H470JC4	47pF 50V
C151		Capacitor mylar	ECQP1H331JZ	330pF 50V
C152		Capacitor mylar	ECQP1H331JZ	330pF 50V
C153		Capacitor electrolytic	ECEA1HU100	10μF 50V
C154		Capacitor electrolytic	ECEA1HU100	10μF 50V
C155		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C156		Capacitor ceramic	RPE132F104Z50	0.1μF 50V
C157		Capacitor electrolytic	ECEA1HU100	10μF 50V
C158		Capacitor electrolytic	ECEA1EU101	100μF 25V
C159		Capacitor electrolytic	ECEA1EU101	100μF 25V
CA1		Capacitor array	EXFP8102ZW	
CA2		Capacitor array	EXFP8102ZW	
D1		Diode	1S2076A	
D2		Diode	1S2076A	
D3		Diode	1S2076A	
D4		Diode	1S2076A	
D5		Diode	1S2076A	
D6		Diode	1S2076A	
D7		Diode	HZ12-C2	
D8		Diode	1S2076A	
D9		Diode	FC51M	
D10		Diode	HZ6-B2	
D11		Diode	HZ24H-2	
D12		Diode	1S2076A	
D13		Diode	1S2076A	
D14		Diode	1S2076A	
D15		Diode	1S2076A	
D16		Diode	1S2076A	
D17		Diode	1SS106	
D18		Diode	1SS106	
D19		Diode	1SS106	
D20		Diode	1SS106	
D21		Diode	1SS106	
D22		Diode	1SS106	
D23		Diode	1SS106	
D24		Diode	1SS106	
D25		Diode	1S2076A	
J7101		Cable assembly	555-3601	
J7102		Connector		HIF3BA-50PA-2.54DSA
J7103		Connector		5045-04A
J7104		Connector		DF1B-20DP-2.5DSA
J7105		Connector		MSS-R-PC-3
J7106		Connector		5045-07A
J7107		Connector		B6P-SHF-1AA

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
L1		Inductor	LAL03NA100K	10 μ H
Q1		Transistor	2SA1015-Y	
Q2		Transistor	2SA1015-Y	
Q3		Transistor	2SC1815-Y	
Q4		Transistor	2SA1015-Y	
Q5		Transistor	2SA1015-Y	
Q6		Transistor	2SC1815-Y	
Q7		Transistor	2SC1815-Y	
Q8		Transistor	2SC1815-Y	
Q9		Transistor	2SA1015-Y	
C10		Transistor	2SA1015-Y	
Q11		Transistor	2SC1213-C	
Q12		Transistor	2SA1015-Y	
Q13		Transistor	2SC1213-C	
Q14		Transistor	2SC1815-Y	
Q15		Transistor	2SA1015-Y	
C16		Transistor	2SA1015-Y	
C17		Transistor	2SA1015-Y	
C18		Transistor	2SA1015-Y	
Q19		Transistor	2SC1815-Y	
Q20		Transistor	2SC1815-Y	
Q21		Transistor	2SC1815-Y	
Q22		Transistor	2SC1815-Y	
Q23		Transistor	2SA1015-Y	
Q24		Transistor	2SC1815-Y	
Q25		Transistor	2SC1213-C	
Q26		Transistor	2SC1815-Y	
Q27		Transistor	2SC641K-C	
Q28		Transistor	2SC641K-C	
Q29		Transistor	2SC641K-C	
Q30		Transistor	2SC641K-C	
Q31		Transistor	2SC641K-C	
Q32		Transistor	2SC641K-C	
Q33		Transistor	2SC641K-C	
Q34		Transistor	2SC641K-C	
Q35		Transistor	2SB772-Q	
Q36		Transistor	2SB772-Q	
Q37		Transistor	2SB772-Q	
Q38		Transistor	2SA1015-Y	
Q39		Transistor	2SC1815-Y	
Q40		Transistor	2SA1015-Y	
Q41		Photo coupler	PC817	
Q42		Transistor	2SC641K-C	
C49		Transistor	2SC1815-Y	
C50		Transistor	2SC1815-Y	
Q51		Transistor	2SC641K-C	
C52		Transistor	2SC641K-C	
R1		Resistor fixed	R20FC02J100	10 Ω 1/5W
R2		Resistor fixed	R20FC02J102	1k Ω 1/5W
R3		Resistor fixed	R20FC02J102	1k Ω 1/5W
R4		Resistor fixed	R20FC02J102	1k Ω 1/5W
R5		Resistor fixed	R20FC02J103	10k Ω 1/5W
R6		Resistor fixed	R20FC02J471	470 Ω 1/5W
R7		Resistor fixed	R20FC02J102	1k Ω 1/5W
R8		Resistor fixed	R20FC02J221	220 Ω 1/5W
R9		Resistor fixed	R20FC02J473	47k Ω 1/5W
R10		Resistor fixed	R20FC02J471	470 Ω 1/5W
R11		Resistor fixed	R20FC02J102	1k Ω 1/5W
R12		Resistor fixed	R20FC02J153	15k Ω 1/5W

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
R13		Resistor fixed	R20FC02J222	2.2k Ω 1/5W
R14		Resistor fixed	R20FC02J471	470 Ω 1/5W
R15		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R16		Resistor fixed	R20FC02J331	330 Ω 1/5W
R17		Resistor fixed	R20FC02J471	470 Ω 1/5W
R18		Resistor fixed	R20FC02J331	330 Ω 1/5W
R19		Resistor fixed	R20FC02J681	680 Ω 1/5W
R20		Resistor fixed	R20FC02J102	1k Ω 1/5W
R21		Resistor fixed	R20FC02J392	3.9k Ω 1/5W
R22		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R23		Resistor fixed	R20FC02J123	12k Ω 1/5W
R24		Resistor fixed	R20FC02J822	8.2k Ω 1/5W
R25		Resistor fixed	R20FC02J332	3.3k Ω 1/5W
R26		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R27		Resistor fixed	R20FC02J102	1k Ω 1/5W
R28		Resistor fixed	R20FC02J103	10k Ω 1/5W
R29		Resistor fixed	R20FC02J222	2.2k Ω 1/5W
R30		Resistor fixed	R20FC02J183	18k Ω 1/5W
R31		Resistor fixed	R20FC02J103	10k Ω 1/5W
R32		Resistor fixed	R20FC02J330	33 Ω 1/5W
R33		Resistor fixed	R20FC02J330	33 Ω 1/5W
R34		Resistor fixed	R20FC02J103	10k Ω 1/5W
R35		Resistor fixed	R20FC02J103	10k Ω 1/5W
R36		Resistor fixed	R20FC02J152	1.5k Ω 1/5W
R37		Resistor fixed	R20FC02J103	10k Ω 1/5W
R38		Resistor fixed	R20FC02J103	10k Ω 1/5W
R40		Resistor fixed	R20FC02J471	470 Ω 1/5W
R41		Resistor fixed	R20FC02J561	560 Ω 1/5W
R42		Resistor fixed	R20FC02J471	470 Ω 1/5W
R43		Resistor fixed	R20FC02J221	220 Ω 1/5W
R44		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R45		Resistor fixed	R20FC02J101	100 Ω 1/5W
R46		Resistor fixed	R20FC02J332	3.3k Ω 1/5W
R47		Resistor fixed	R20FC02J100	10 Ω 1/5W
R48		Resistor fixed	R20FC02J102	1k Ω 1/5W
R49		Resistor fixed	R20FC02J822	8.2k Ω 1/5W
R50		Resistor fixed	R20FC02J101	100 Ω 1/5W
R51		Resistor fixed	R20FC02J222	2.2k Ω 1/5W
R52		Resistor fixed	R20FC02J471	470 Ω 1/5W
R53		Resistor fixed	R20FC02J103	10k Ω 1/5W
R54		Resistor fixed	R20FC02J223	22k Ω 1/5W
R55		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R56		Resistor fixed	R20FC02J103	10k Ω 1/5W
R57		Resistor fixed	R20FC02J223	22k Ω 1/5W
R58		Resistor fixed	R20FC02J103	10k Ω 1/5W
R59		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R61		Resistor fixed	R20FC02J152	1.5k Ω 1/5W
R62		Resistor fixed	R20FC02J332	3.3k Ω 1/5W
R63		Resistor fixed	R20FC02J103	10k Ω 1/5W
R64		Resistor fixed	R20FC02J103	10k Ω 1/5W
R65		Resistor fixed	R20FC02J472	4.7k Ω 1/5W
R66		Resistor fixed	R20FC02J273	27k Ω 1/5W
R67		Resistor fixed	R20FC02J104	100k Ω 1/5W
R68		Resistor fixed	R20FC02J102	1k Ω 1/5W
R69		Resistor fixed	R20FC02J154	150k Ω 1/5W
R70		Resistor fixed	R20FC02J474	470k Ω 1/5W
R71		Resistor fixed	R20FC02J102	1k Ω 1/5W
R72		Resistor fixed	R20FC02J103	10k Ω 1/5W
R73		Resistor fixed	R20FC02J222	2.2k Ω 1/5W

LOGIC LOWER (MD-3210-7100M2) (cont'd)

Symbol	Code	Name	Specifications	Description
R74		Resistor fixed	R20FC02J102	1kΩ 1/5W
R75		Resistor fixed	R20FC02J103	10kΩ 1/5W
R76		Resistor fixed	R20FC02J333	33kΩ 1/5W
R77		Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R78		Resistor fixed	R20FC02J333	33kΩ 1/5W
R79		Resistor fixed	R20FC02J102	1kΩ 1/5W
R80		Resistor fixed	R20FC02J102	1kΩ 1/5W
R81		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R82		Resistor fixed	R20FC02J471	470Ω 1/5W
R83		Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R84		Resistor fixed	R20FC02J102	1kΩ 1/5W
R85		Resistor fixed	R20FC02J102	1kΩ 1/5W
R86		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R87		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R88		Resistor fixed	R20FC02J183	18kΩ 1/5W
R89		Resistor fixed	R20FC02J103	10kΩ 1/5W
R90		Resistor fixed	R20FC02J103	10kΩ 1/5W
R91		Resistor fixed	R20FC02J103	10kΩ 1/5W
R92		Resistor fixed	R20FC02J102	1kΩ 1/5W
R93		Resistor fixed	R20FC02J102	1kΩ 1/5W
R94		Resistor fixed	R20FC02J471	470Ω 1/5W
R95		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R96		Resistor fixed	R20FC02J510	51Ω 1/5W
R97		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R98		Resistor fixed	R20FC02J102	1kΩ 1/5W
R99		Resistor fixed	R20FC02J104	100kΩ 1/5W
R100		Resistor fixed	R20FC02J472	4.7kΩ 1/5W
R101		Resistor fixed	ERD-S1TJ471	470Ω 1W
R102		Resistor fixed	R20FC02J103	10kΩ 1/5W
R103		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R104		Resistor fixed	R20FC02J153	15kΩ 1/5W
R105		Resistor fixed	R20FC02J222	2.2kΩ 1/5W
R106		Resistor fixed	R20FC02J221	220Ω 1/5W
R107		Resistor fixed	R20FC02J470	47Ω 1/5W
R108		Resistor fixed	R20FC02J221	220Ω 1/5W
R109		Resistor fixed	R20FC02J470	47Ω 1/5W
R111		Resistor fixed	R20FC02J103	10kΩ 1/5W
R112		Resistor fixed	R20FC02J102	1kΩ 1/5W

(5) CONTROL PANEL (MD-3210-7200M2)

Symbol	Code	Name	Specifications	Description
C1		Capacitor electrolytic	ECEA1EU101	100µF 16V
C2		Capacitor electrolytic	ECEA1EU101	100µF 16V
C3		Capacitor ceramic	ECKF1H101KB	100pF 50V
C4		Capacitor polyester	ECQB1H471JZ	470pF 50V
C5		Capacitor polyester	ECQB1H471JZ	470pF 50V
C6		Capacitor polyester	ECQB1H471JZ	470pF 50V
C7		Capacitor polyester	ECQB1H471JZ	470pF 50V
C8		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C9		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C10		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C11		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C12		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C13		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C14		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C15		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C16		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C17		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C18		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C19		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C20		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C21		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C22		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C23		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C24		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C25		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C26		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C27		Capacitor ceramic	ECCF1H470JC	470pF 50V
C28		Capacitor ceramic	ECCF1H470JC	470pF 50V
C29		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
C30		Capacitor ceramic	D55Y5V1H104Z51	0.1µF 50V
CA1		Capacitor array	IHC-8-470KA	
CA2		Capacitor array	IHC-8-470KA	
CA3		Capacitor array	IHC-8-470KA	
CA4		Capacitor array	IHC-8-470KA	
CA5		Capacitor array	IHC-8-470KA	
CA6		Capacitor array	IHC-8-470KA	
DS1		Lamp	KCDS-05	T4.2 8V
DS2		Lamp	KCDS-05	T4.2 8V
DS3		Lamp	KCDS-05	T4.2 8V
DS4		Lamp	KCDS-05	T4.2 8V
DS5		Lamp	KCDS-05	T4.2 8V
DS6		Lamp	KCDS-05	T4.2 8V
DS7		Lamp	KCDS-05	T4.2 8V
DS8		Lamp	KCDS-05	T4.2 8V
DS9		Lamp	KCDS-05	T4.2 8V
D1		LED	TLG113A	
IC1		IC	HD74HC166AP	
IC2		IC	TC74HC148AP	
IC3		IC	TC74HCU04AP	
IC4		IC	TC74HC40103AP	
IC5		IC	HD74HC166AP	
IC6		IC	HD74HC74AP	
IC7		IC	HD74HC166AP	
IC8		IC	TC4584BP	
IC9		IC	HD74HC166AP	
IC10		IC	HD74HC74AP	
IC11		IC	HD74HC166AP	
J7201		Connector	DF1B-20DP-2.5DSA	
J7202		Connector	IL-6P-S3EN2-1	

CONTROL PANEL (MD-3210-7200M2) (cont'd)

Symbol	Code	Name	Specifications	Description
J7203		Connector	5229-14CPB	
J7204		Connector	5229-18CPB	
Q1		Transistor	2SA1010-L	
R1		Resistor fixed	R20FC02J	2.2k Ω 1/5W
R2		Resistor fixed	R20FC02J	1k Ω 1/5W
R3		Resistor fixed	R20FC02J	47k Ω 1/5W
R4		Resistor fixed	R20FC02J	100k Ω 1/5W
R5		Resistor fixed	R20FC02J	100k Ω 1/5W
R6		Resistor fixed	R20FC02J	100k Ω 1/5W
R7		Resistor fixed	R20FC02J	100k Ω 1/5W
R8		Resistor fixed	R20FC02J	100k Ω 1/5W
R9		Resistor fixed	R20FC02J	100k Ω 1/5W
R10		Resistor fixed	R20FC02J	100k Ω 1/5W
R11		Resistor fixed	R20FC02J	100k Ω 1/5W
R12		Resistor fixed	R20FC02J	3.9k Ω 1/5W
R13		Resistor fixed	R20FC02J	1k Ω 1/5W
RA1		Resistor array	IHR-8-103JA	
RA2		Resistor array	IHR-4-103JA	
RA3		Resistor array	IHR-8-103JA	
RA4		Resistor array	IHR-8-103JA	
RA5		Resistor array	IHR-8-103JA	
VR1		Resistor variable	KCVR-58	10k Ω
VR2		Resistor variable	KCVR-58	10k Ω
VR3		Resistor variable	KCVR-59	10k Ω
VR4		Resistor variable	KCVR-59	10k Ω
VR5		Resistor variable	KCVR-58	10k Ω
VR6		Resistor variable	KCVR-58	10k Ω
VR7		Resistor variable	KCVR-58	10k Ω
VR8		Resistor variable	KCVR-58	10k Ω
SW1		Encoder rotary	KCSW-60	
SW2		Encoder rotary	KCSW-60	
SW3		Switch rotary	KCSW-61	

Other

Symbol	Code	Name	Specifications	Description
		Fuse	F-7165-8A	
		Fuse	F-7165-15A	
		Fuse	TLC3.15A	
		Fuse	F-1065-0.3A	
		Lamp	KCDS-05	
		Fuse	F-7142-1A	
		15M antenna cable assembly	9CD-3292C	
		5M power cable assembly	CW-89	
		CRT unit	K20MM-01B	
		Filter	LF215NEW	

8.2 Mechanical parts

8.2.1 Antenna unit MRT-133 (10kW)

(1) Antenna Unit (23W53388)

Symbol	Code	Name	Specifications	Description
B0001		Not used		
B0002		Not used		
B0003		6 ft slotted antenna	229Z23210C	
B0004		Scanner box	229U23295	
B0005		TR unit	229U23296B	10kW LOG.IF
B0006		Drive unit	239U52270	
B0007		Cover	232H53657	
B0008		O ring	23E52136	
B0009		Bolt	24H123533	
B3001		Bolt	8HS16-S7	
B3002		Bolt	8HS20-S7	
B3003		Bolt	8HS25-SU	
B3004		Spring washer	8SW-S7	
B3005		Spring washer	8SW-SU	
B3006		Plain washer	8WB-S7	
B3007		Plain washer	8WB-SU	

(2) Scanner box (23W53389)

Symbol	Code	Name	Specifications	Description
B0001		Box	232Z52263	
B0002		Gland ring	24B123755	
B0003		Gasket	24E123756	
B0004		Gland plate	24B123754	
B0005		Tube	24E124591	
B0006		Base plate	242H123758	
B0007		Pedestal	23Z52132	
B0008		O ring	24E123751	
B0009		Ring	24B124493	
B0010		Key	242H801182	
B0011		Gear	24H123532	
B0012		Angle	23B123680	
B0013		Bearing plate	24B123541	
B0014		Bearing case	232H52589	
B0015		Bracket	23B52326	
B0016		Guide	24H123266	
B0017		Earth plate	24B123772	
B0018		Rail	24B123536	
B0019		Spacer	24B123537	
B0020		Plate	24B123539	
B1001		V packing	24E112007	
B1002		Bearing	#6013ZZ No. 1009	
B1003		Bearing	#6912ZZ No. 1009	
B2001		Magnet	34S43482	
B3001		Pan head screw	2NPS6-B3	
B3002		Hexagon head bolt	4HS12-S7	
B3003		Pan head screw	3NPS10-B3	
B3004		Flat head screw	3FPS8-B3	
B3005		Hexagon head bolt	4HS10-S7	
B3006		Pan head screw	5NPS16-S7	
B3007		Pan head screw	5NPS20-S7	
B3008		Flat head screw	5FPS14-S7	
B3009		Bolt	6HS12-S7	
B3010		Bolt	8HS20-S7	

Scanner box (cont'd)

Symbol	Code	Name	Specifications	Description
B3011		Spring washer	2SW-PB3	
B3012		Spring washer	3SW-PB3	
B3013		Spring washer	4SW-S7	
B3014		Spring washer	5SW-S7	
B3015		Spring washer	6SW-S7	
B3016		Spring washer	8SW-S7	
B3017		Plain washer	2WB-B3	
B3018		Plain washer	3WB-B3	

(3) Drive unit (23W53390)

Symbol	Code	Name	Specifications	Description
B0001		Geared motor	232H53658	with a pinion
B0002		Bracket	23B52241	
B0003		Cover	24B124995	
B0004		Not used		
B0005		Spacer	24H123559	
B0006		Reduction gear	24G125660	
B1001		Motor	24G125660	
B1002		Brush	24Z125209	
B3001		Not used		
B3002		Pan head screw	3NPS6-B3+SW	
B3003		Pan head screw	3NPS8-B3+SW+WB	
B3004		Pan head screw	5NPS50-S7	
B3005		Spring washer	4SW-PB3	
B3006		Spring washer	5SW-S7	
B3007		Plain washer	5WB-S7	
B3008		Nut	5PN-S7	

(4) TR unit (10kW) (23W53391)

Symbol	Code	Name	Specifications	Description
B0001		Chassis	222B23212	
B0002		IF cover	23B52240	
B0003		Shield cover	24B123769	
B0004		Shield cover	24B123770	
B2001		Terminal	STK-A2	
B3001		Pan head screw	3NPS6-B3+SW	
B3002		Pan head screw	3NPS6-B3+SW+WB	
B3003		Pan head screw	3NPS8-B3+SW	
B3004		Pan head screw	3NPS8-B3+SW+WB	
B3005		Flat head screw	3FPS6-B3	
B3006		Pan head screw	4NPS6-B3+SW	
B3007		Pan head screw	4NPS8-B3+SW	
B3008		Pan head screw	4NPS8-B3+SW+WB	
B3009		Pan head screw	4NPS10-B3+SW	
B3010		Pan head screw	4NPS14-B3+SW	
B3011		Pan head screw	4NPS20-B3	
B3012		Pan head screw	4NPS65-B3	
B3013		Flat head screw	4FPS8-B3	
B3014		Flat head screw	4FPS10-B3	
B3015		Spring washer	4SW-PB3	
B3016		Nut	4PN-B3	

8.2.2 Antenna unit MRT-134 (25kW)

(1) Antenna Unit (23W58237)

Symbol	Code	Name	Specifications	Description
B0001		Not used		
B0002		Not used		
B0003		6 ft slotted antenna	229Z23210C	
B0004		Scanner box	229U23295C	
B0005		TR unit	229U26008B	
B0006		Drive unit	239U52270	
B0007		Cover	232Z52204	
B0008		O ring	23E52136	
B0009		Bolt	24H123533	
B0010		Cover	232Z57795	
B3001		Bolt	8HS16-S7	
B3002		Bolt	8HS20-S7	
B3003		Bolt	8HS25-SU	
B3004		Spring washer	8SW-S7	
B3005		Spring washer	8SW-SU	
B3006		Plain washer	8WB-S7	
B3007		Plain washer	8WB-SU	

(2) Scanner box (23W58243)

Symbol	Code	Name	Specifications	Description
B0001		Box	232Z52263	
B0002		Gland ring	24B123755	
B0003		Gasket	24E123756	
B0004		Gland plate	24B123754	
B0005		Tube	24E124591	
B0006		Base plate	242H123758	
B0007		Pedestal	23Z52132	
B0008		O ring	24E123751	
B0009		Ring	24B124493	
B0010		Key	242H801182	
B0011		Gear	24H123532	
B0012		Angle	23B123680	
B0013		Bearing plate	24B123541	
B0014		Bearing case	232H52589	
B0015		Bracket	23B52326	
B0016		Guide	24H123266	
B0017		Earth plate	24B123772	
B0018		Rail	23B57838	
B0019		Spring	24B132078	
B1001		V packing	24E112007	
B1002		Bearing	#6013ZZ No. 1009	
B1003		Bearing	#6912ZZ No. 1009	
B2001		Magnet	34S43482	
B3001		Pan head screw	2NPS6-B3	
B3002		Hexagon head bolt	4HS12-S7	
B3003		Pan head screw	3NPS10-B3	
B3004		Flat head screw	3FPS8-B3	
B3005		Hexagon head bolt	4HS10-S7	
B3006		Pan head screw	5NPS16-S7	
B3007		Pan head screw	5NPS14-S7	
B3008		Flat head screw	5FPS14-S7	
B3009		Bolt	6HS12-S7	

Scanner box (cont'd)

Symbol	Code	Name	Specifications	Description
B3010		Bolt	8HS20-S7	
B3011		Spring washer	2SW-PB3	
B3012		Spring washer	3SW-PB3	
B3013		Spring washer	4SW-S7	
B3014		Spring washer	5SW-S7	
B3015		Spring washer	6SW-S7	
B3016		Spring washer	8SW-S7	
B3017		Plain washer	2WB-B3	
B3018		Plain washer	3WB-B3	

(3) Drive unit (23W53390) [See 8. 2. 1 item (3)]

(4) TR unit (25kW) (23W58238)

Symbol	Code	Name	Specifications	Description
B0001		Chassis	222B26010	
B0002		IF cover	23B56702	
B0003		Shield cover	24B132375	
B0004		Fan bracket	23B56703	
B0005		Terminal cover	23E57839	
B2001		Terminal	STK-A8	
B3001		Pan head screw	3NPS6-B3+SW+WB	
B3002		Pan head screw	3NPS6-B3+SW	
B3003		Pan head screw	4NPS8-B3+SW	
B3004		Pan head screw	4NPS6-B3+SW	
B3005		Pan head screw	4NPS12-B3+SW	
B3006		Pan head screw	4NPS16-B3	
B3007		Pan head screw	4NPS30-B3	
B3008		Pan head screw	4NPS70-B3	
B3009		Flat head screw	3FPS10-B3	
B3010		Flat head screw	4FPS8-B3	
B3011		Spring washer	4SW-PB3	
B3012		Plain washer	4WB-B3	
B3013		Nut	4PN-B3	
B3014		Plain washer	3WH	

8.2.3 Display unit MRD-62 / MRD-68

Refer to respective drawings of exploded view(MRD62-N•E001/MRD68-N•E001) for Symbols.

Symbol	Code	Name	Specifications	Description
1		Front frame	0019-2101P	
2		Frame (front)	0019-1220	
3		Frame (rear)	3220-1223	
4		Cover	0019-1204	
5		Frame of remote assembly	0019-1211	
6		Membrane sheet assembly	0019-1210	
7		Fixing plate	0019-2212	
8		Cable assembly	555-3606	
9		Base	0019-2211P	
10		Hood	253-1210(HD1100) .. option	
11		Base	0019-2214P	
12		Frame (right)	0019-1222	
13		Frame (left)	0019-1221	
14		Frame (base)	253-1302	
15		Angle (left)	253-1304-1	
16		Angle (right)	253-1304-2	
17		Plate	0019-1310	
18		Base plate	253-1313	
19		Cover	0019-1303	
20		Plate	3220-1301P	
21		Bolt	253-1404	
22		Cover	0019-1309	
23		Packing	253-1417	
24		Connector	1506	
25		CRT filter	0019-1320	
26		Heat sink	0019-1302	
27		Cool sheet	0019-1410	
28		Main name plate on display unit	R4702-11	
29		Flat head screw	F2 x 4B	
30		Knob	020-3425	
31		Knob	023-3425	
32		Knob	021-3425	
33		Plate	0016-8023	
34		Track ball	TRA-101B	
35		Cover	0019-2213	
36		Pan head screw	P2 x 10B (black)	
37		Sheet	0019-1416	
38		Sheet	0019-1417	
39		Screw and washer assembly	P2WSM3 x 10B	
40		P.C.Board assembly	MD3210-7200M2	
41		Screw and washer assembly	PWSM3 x 8B	
42		Oval head screw	OC3 x 10B	
43, 44 & 81		CRT assembly	K20MM-01B	
45		Screw and washer assembly	PWSM4 x 8B	
46		Screw and washer assembly	PSM4 x 8B .. Option	
47		P.C.Board assembly	MD-3210-6000M3	
48		P.C.Board assembly	MD-3210-6100M1	
49		Connector	HS21R-3	
50		Oval head screw	OC3 x 6B	
51		Holder, fuse	FH002	
52		Holder, fuse	F-7159	
53		Pan head screw	P2 x 4B	
54		Spring washer	SW4B	
55		Cable gland	886-2026	
56		Screw and washer assembly	PSM4 x 20B	
57		Band plate	COM-601	
58		Fuse	F-7165-8A	

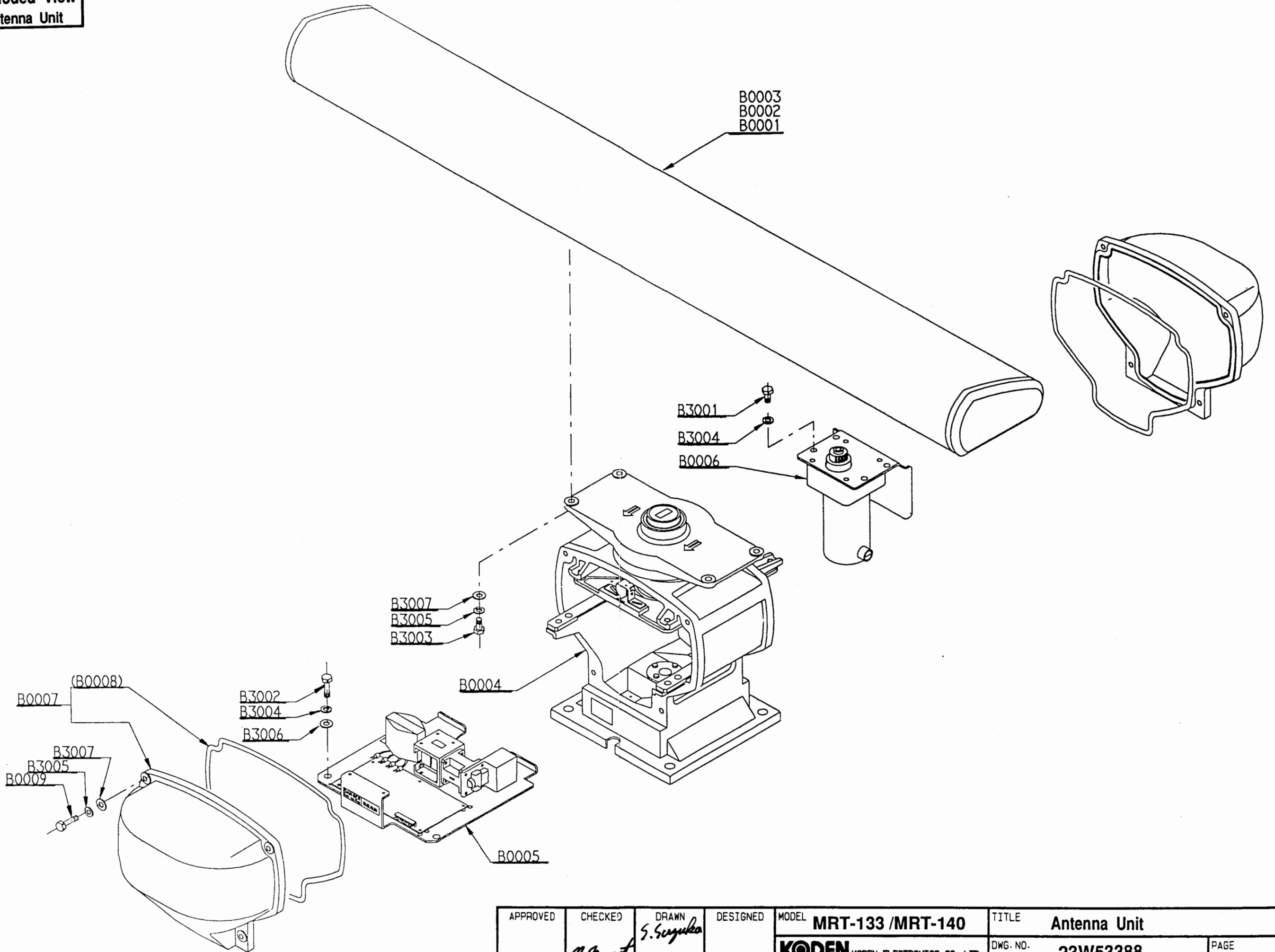
Display unit (cont'd)

Symbol	Code	Name	Specifications	Description
59		Fuse	TLC 3.15A	
60		Fuse	F-1065-0.3A	
61		Terminal	SX-007B5P	
62		Screw and washer assembly	PWSM3 x 15B	
63		Screw and washer assembly	PSM3 x 6B	
64		Screw and washer assembly	PSM3 x 8B	
65		Screw and washer assembly	PSM4 x 10B	
66		P.C.Board assembly	MD-3210-7100M2	
67		P.C.Board assembly	MD-3210-7000M2	
68		Stand	0019-1424	
69		Washer	W4B	
70		Bracket	0019-1426	
71		Bolt (-)	(-)B8 x 20U	
72		Spring washer	SW8U	
73		Washer	W8U	
74		Buzzer	PB2130UL100A	
75		Cable assembly	555-3604M1	
76		Plate	0019-1409	
77		Washer	2W6U	
78		Spring washer	SW6U	
79		Nut	N6U	
80		Spring washer	SW8S	
82		Flat head screw	F4 x 10B	
83		Bolt	B5 x 12U	
84		Spring washer	SW5U	
85		Washer	W5U	
86		Truss screw	TP4 x 10U	
87		Stand	0019-1411	
88		Screw and washer assembly	PSM4 x 6B	
89		Screw and washer assembly	P2WSM4 x 10B	
90		Spring washer	SW6B	
91		Nut	N6B	
92		Cushion	253-1425	
93		Pan head screw	P6 x 25B	
94		Washer	W6B	
95		Band plate	COM-606	
96		Angle	0019-1427	
97		Sub name plate	R-4902-1	
98		Bolt	253-1403	
99		Shield packing	253-1465	
100		Shield packing	253-1466	
101		Shield packing	253-1464	
102		Shield packing	253-1461	
103		Shield packing	253-1462	
104		Shield packing	253-1463	
105		Washer	TM-147-2	
106		Cable	555-3605	
107		Cover	0019-1304	
108		Pan head screw	P2 x 8B	
109		Spring washer	SW2B	
110		Washer	W2B	
111		Flat head screw	F3 x 5B	
112		Biding screw	BD3 x 6B	
113		Base	0019-1219	
114		Spacer	0019-1402	
115		Oval head screw	OC4 x 12B (black)	
116		Pan head screw	P6 x 12U	
117		Base	0019-1214P	
118		Plate	0019-1215P	
119		Lamp	KCDS-05	

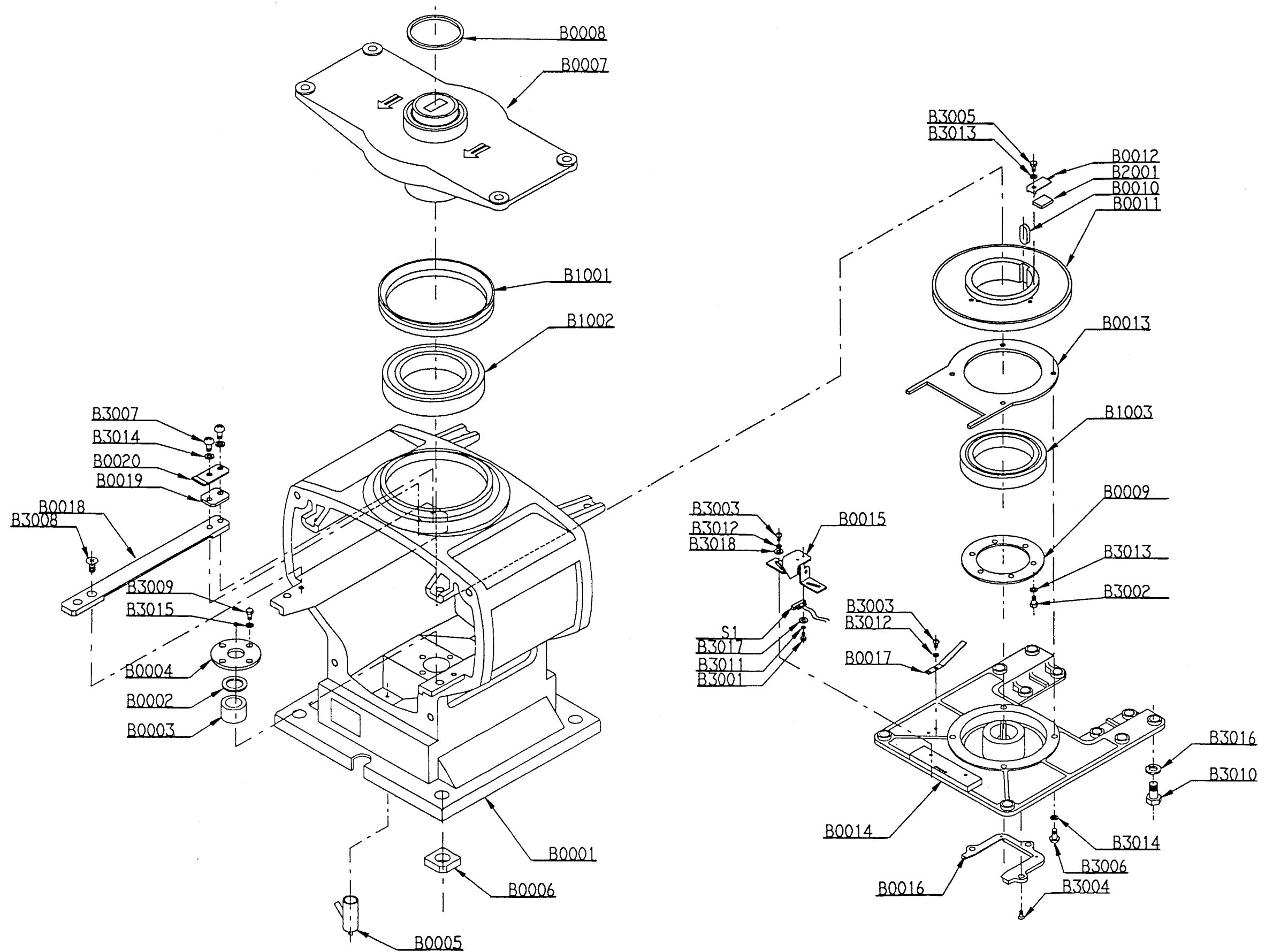
Display unit (cont'd)

Symbol	Code	Name	Specifications	Description
120		Washer	W6U	
121		Binding screw	BD5 x 10B	
122		Truss screw	TPT5 x 25U	
123		Cable clip	TM-191-1	
124		Flat head screw	F5 x 10B	
125		Cable assembly	555-3602	
126		Cable assembly	555-3603	
127		Cable assembly	555-3607M1	
128		Rectifier	KSA-08 .. Option	
129		Filter	LF215NEW	
130		Nut	N4B	For MRD-68(MD-3220)
131		Pan head screw	PSM4x8B	For MRD-68(MD-3220)
132		Fan motor	0615-12	For MRD-68(MD-3220)
133		Screw and washer assembly	PWSM4x20B	For MRD-68(MD-3220)

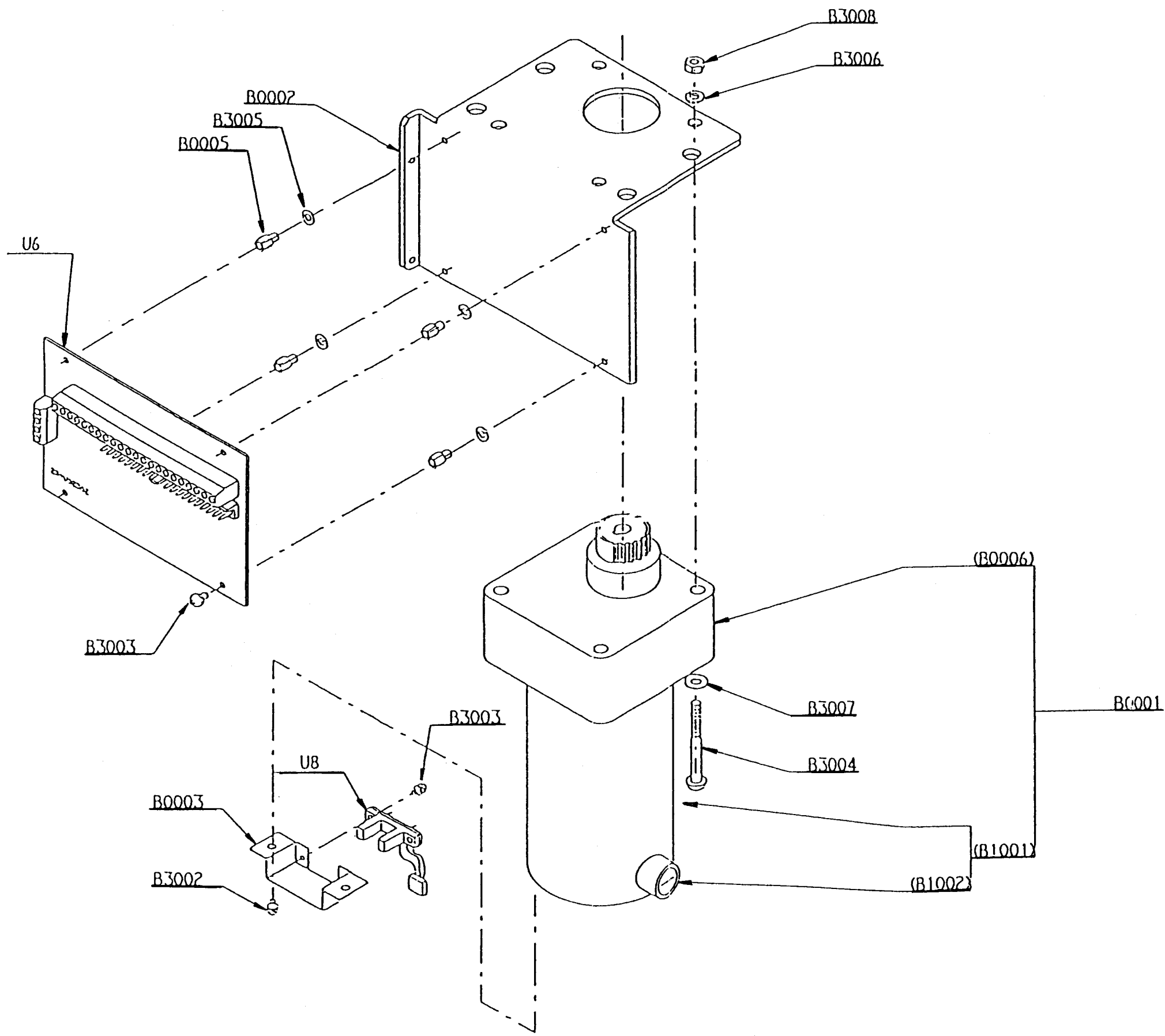
8. 3 Exploded View
8. 3. 1 Antenna Unit



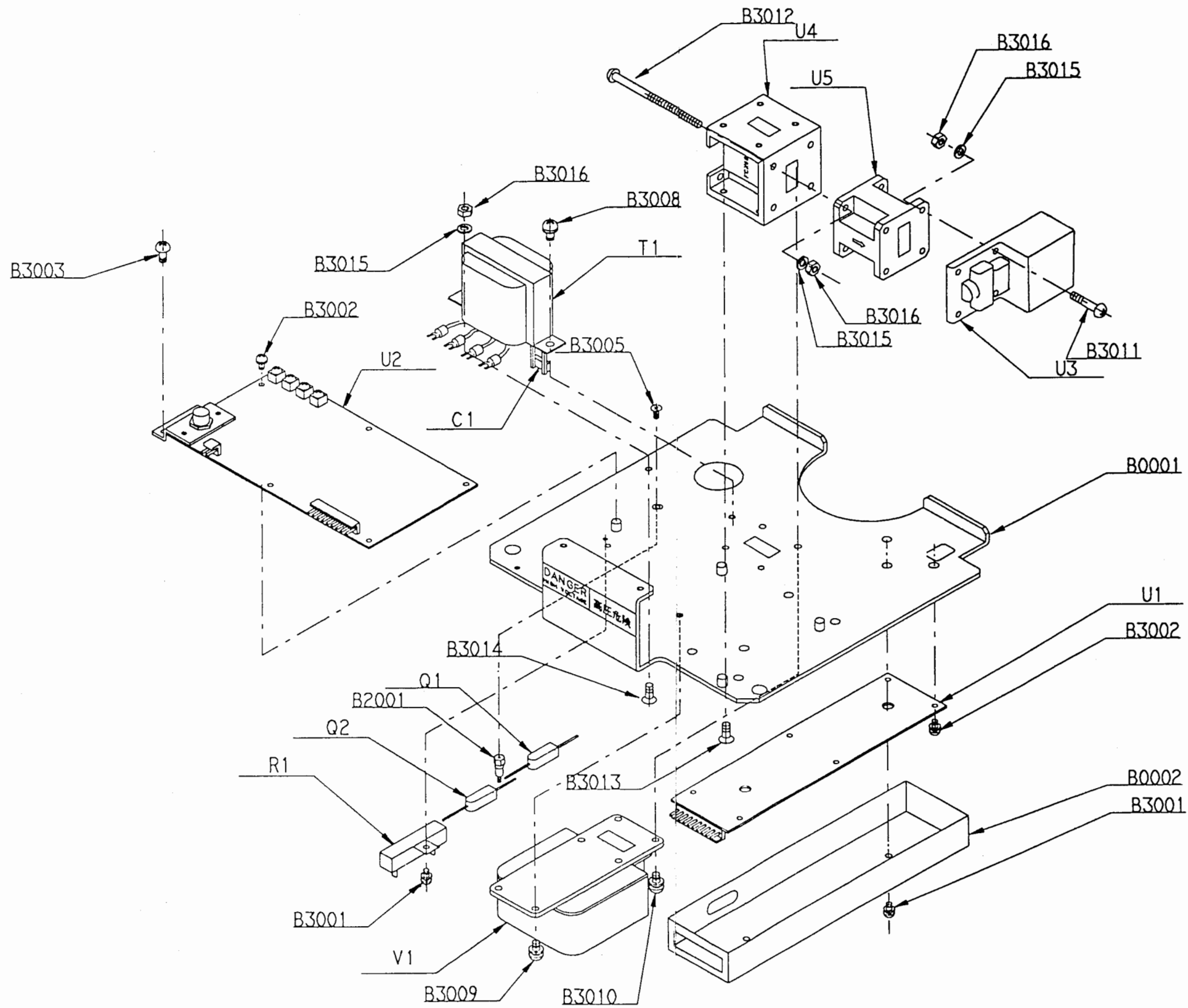
APPROVED	CHECKED	DRAWN <i>S. Suzuki</i>	DESIGNED	MODEL MRT-133 /MRT-140	TITLE Antenna Unit
	<i>N. Nomoto</i>			KODEN KODEN ELECTRONICS CO., LTD.	DWG. NO. 23W53388
					PAGE



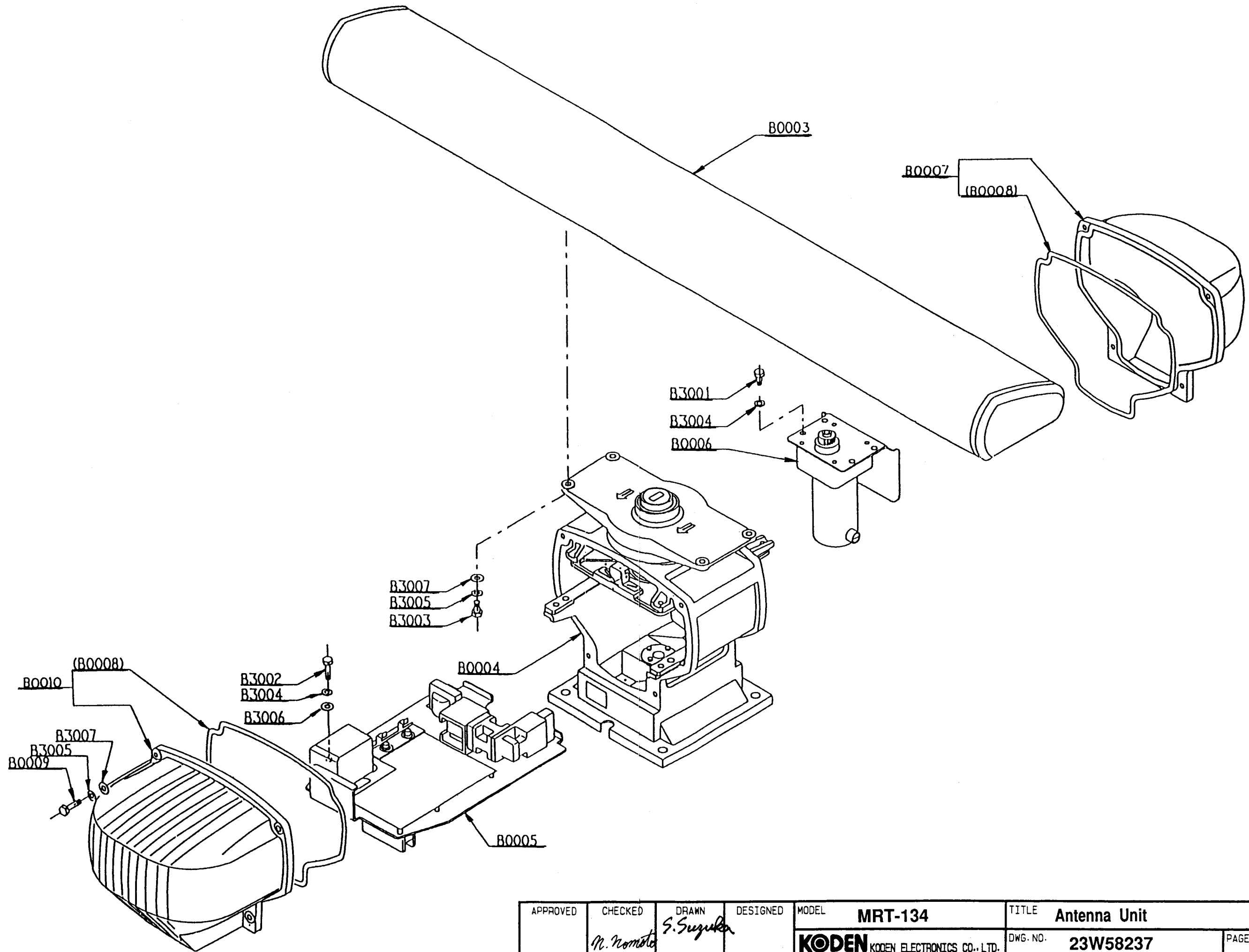
				APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	MRT-134 / MRT-140		TITLE	Scanner Box	
					<i>M. Nomoto</i>	<i>S. Sugaku</i>		KODEN KODEN ELECTRONICS CO., LTD.		DWG. NO.	23W53389		PAGE
1	CONTENTS	2	DATE	3	REVISED	4	APPROVED						



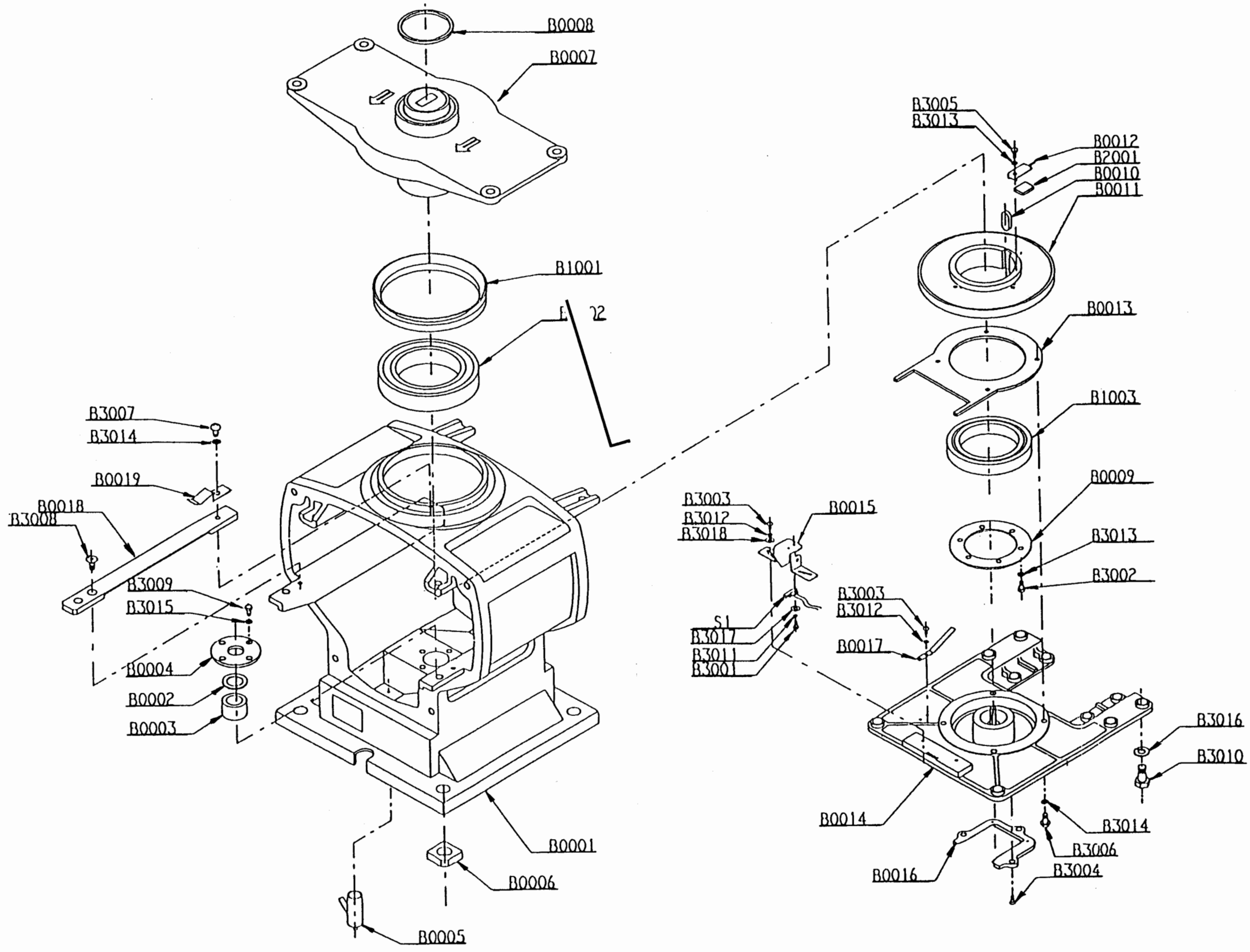
				APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	MRT-133 / MRT-134 / MRT-140	TITLE	Drive Unit
					<i>N. Nomoto</i>	<i>S. Suzuki</i>		KODEN	KODEN ELECTRONICS CO., LTD.	DWG. NO.	23W53390
CONTENTS				DATE	REVISED	APPROVED				PAGE	



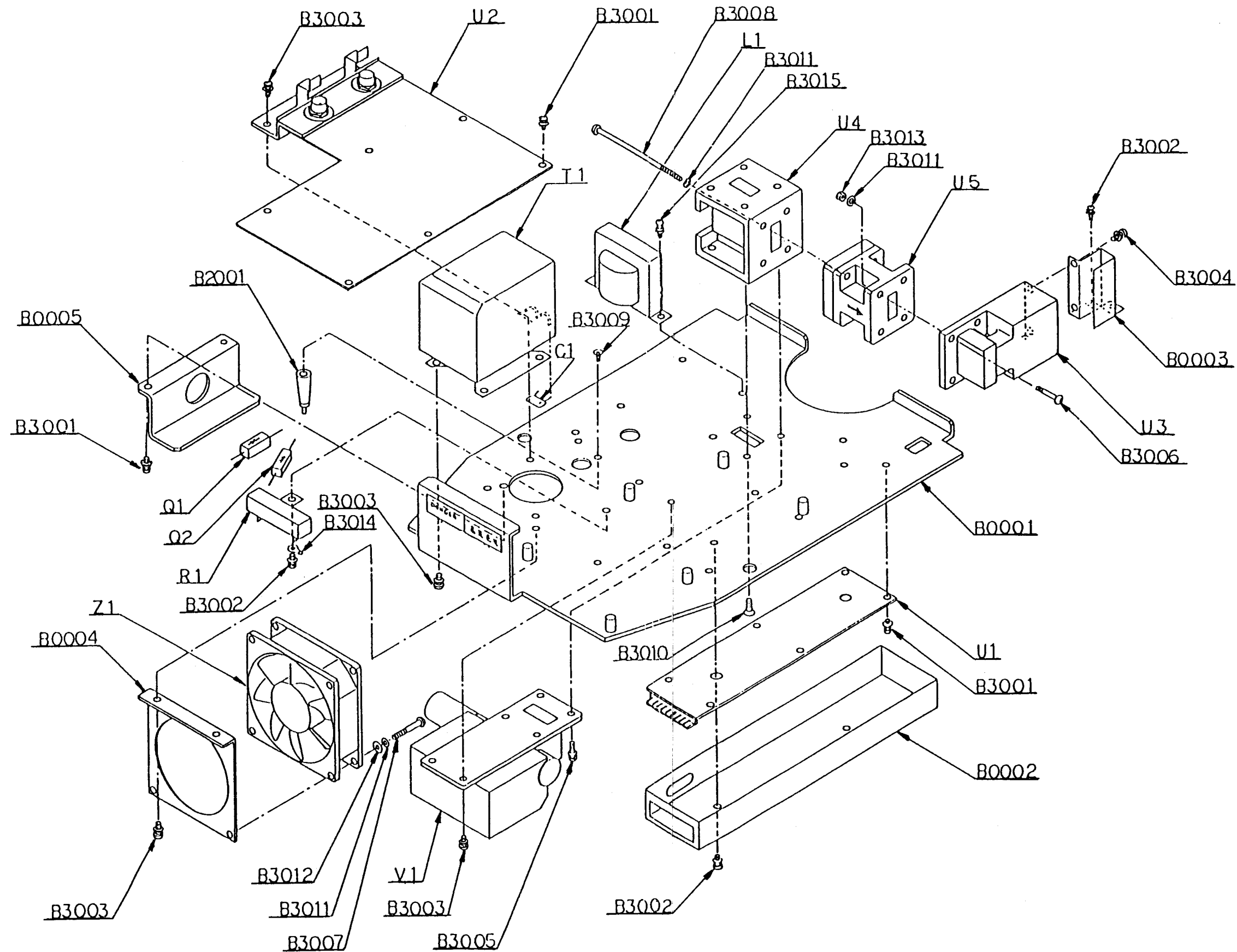
				APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	MRT-133	TITLE	T. R Unit (10kW)
					<i>N. Nomoto</i>	<i>S. Suzuki</i>				DWG. NO.	23W53391
CONTENTS				DATE	REVISED	APPROVED					PAGE



APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE	
	<i>M. Nomoto</i>	<i>S. Suzuki</i>		MRT-134	Antenna Unit	
KODEN KODEN ELECTRONICS CO., LTD.					DWG. NO.	PAGE
					23W58237	

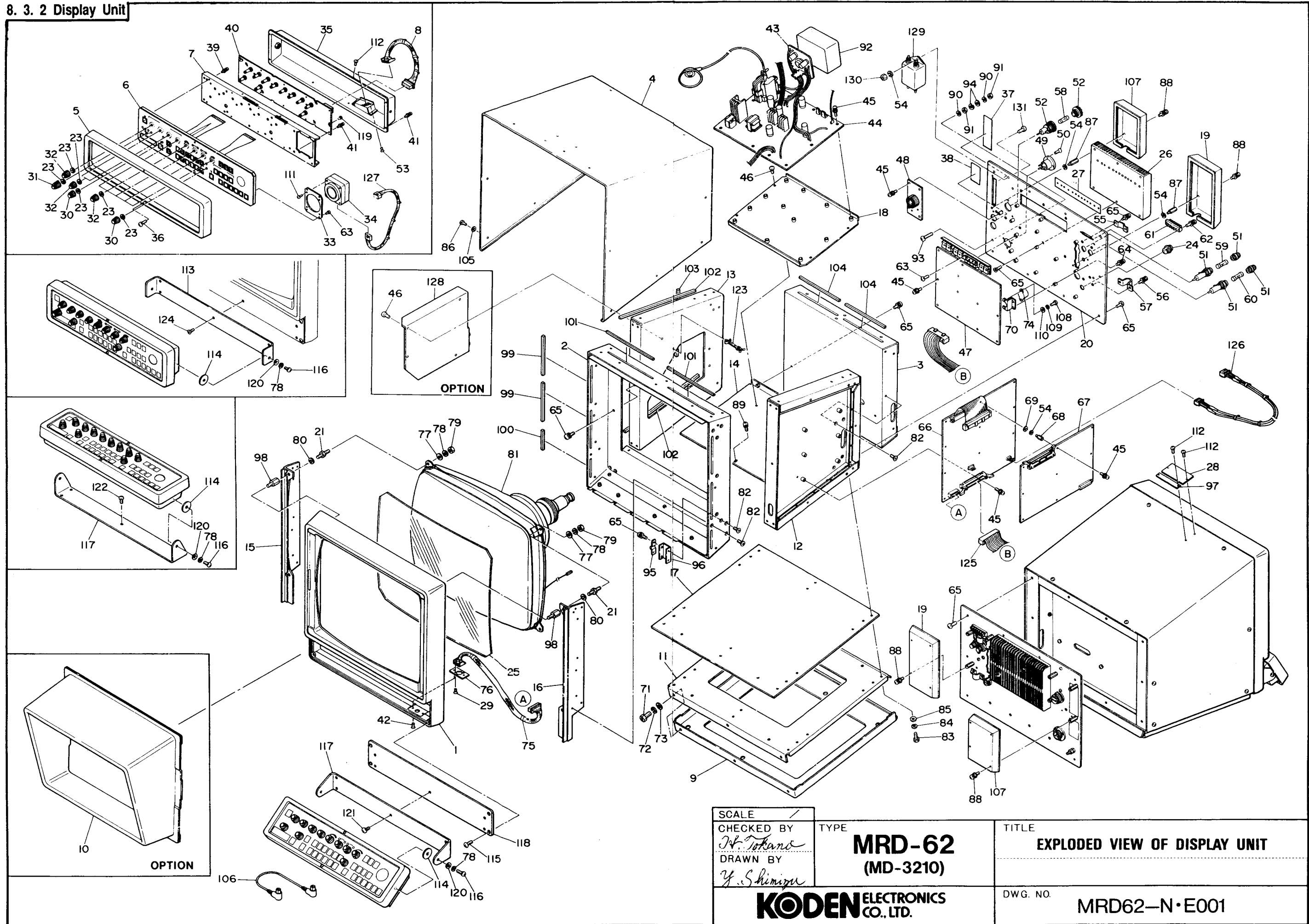


				APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	TITLE	
						<i>N. Nomoto</i>	<i>S. Suzuki</i>	MRT-134	Scanner Box	
								KODEN	DWG. NO.	PAGE
CONTENTS								KODEN ELECTRONICS CO., LTD.		23W58243
1	2	3	4	5	6	7	8	MD-3210/3220 Service Manual-02		8-40

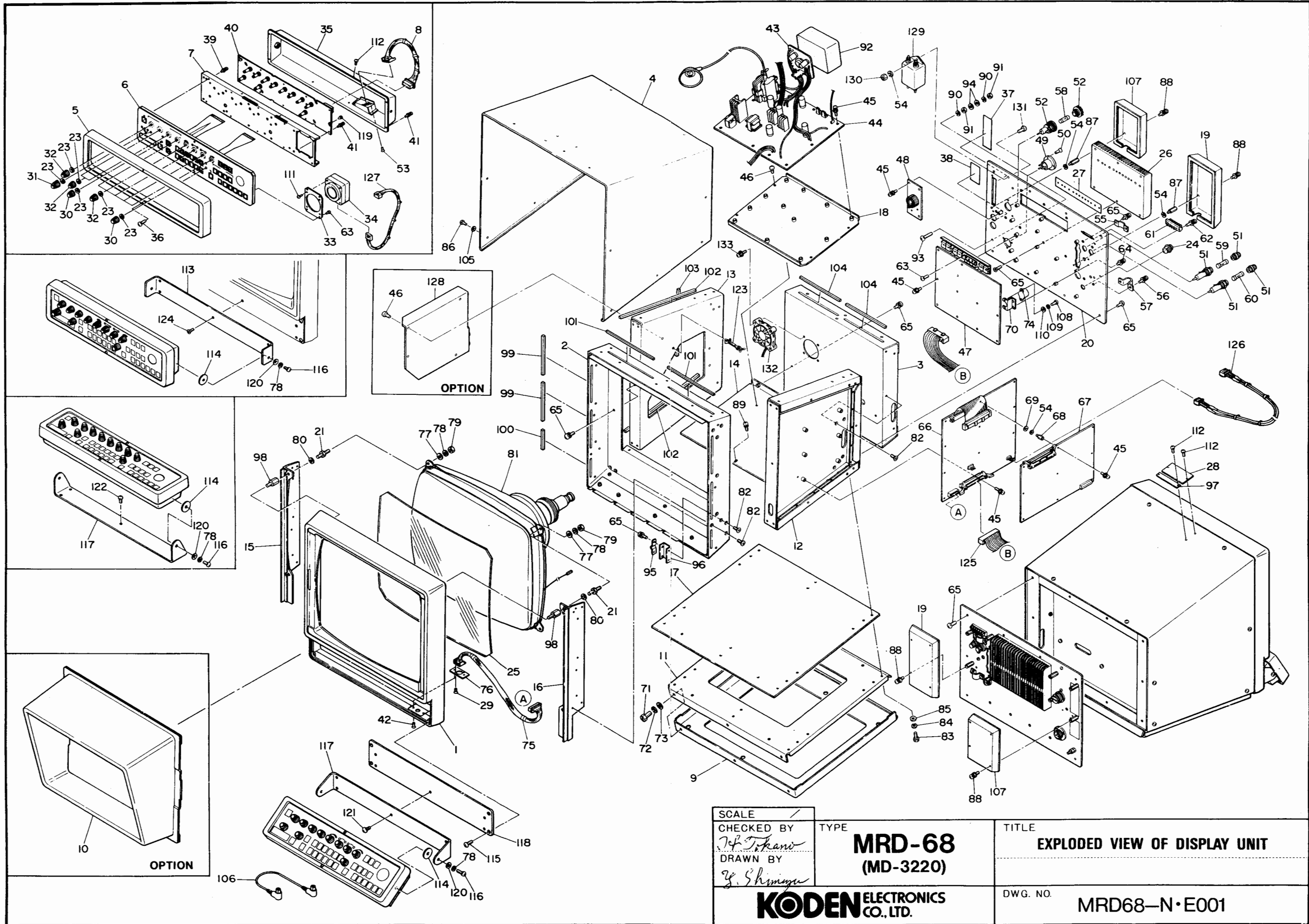


				APPROVED	CHECKED	DRAWN	DESIGNED	MODEL	MRT-134	TITLE	T. R Unit (25kW)
					<i>M. Nomoto</i>	<i>S. Suzuki</i>				DWG. NO.	23W58238
CONTENTS				DATE	REVISED	APPROVED		KODEN KODEN ELECTRONICS CO., LTD.		PAGE	

8. 3. 2 Display Unit



SCALE	TYPE	TITLE
CHECKED BY <i>N. Tokano</i>	MRD-62	EXPLODED VIEW OF DISPLAY UNIT
DRAWN BY <i>Y. Shimizu</i>	(MD-3210)	
KODEN ELECTRONICS CO., LTD.		DWG. NO. MRD62-N-E001



SCALE
 CHECKED BY
T. Tokano
 DRAWN BY
Y. Shimizu

TYPE
MRD-68
 (MD-3220)

TITLE
EXPLODED VIEW OF DISPLAY UNIT

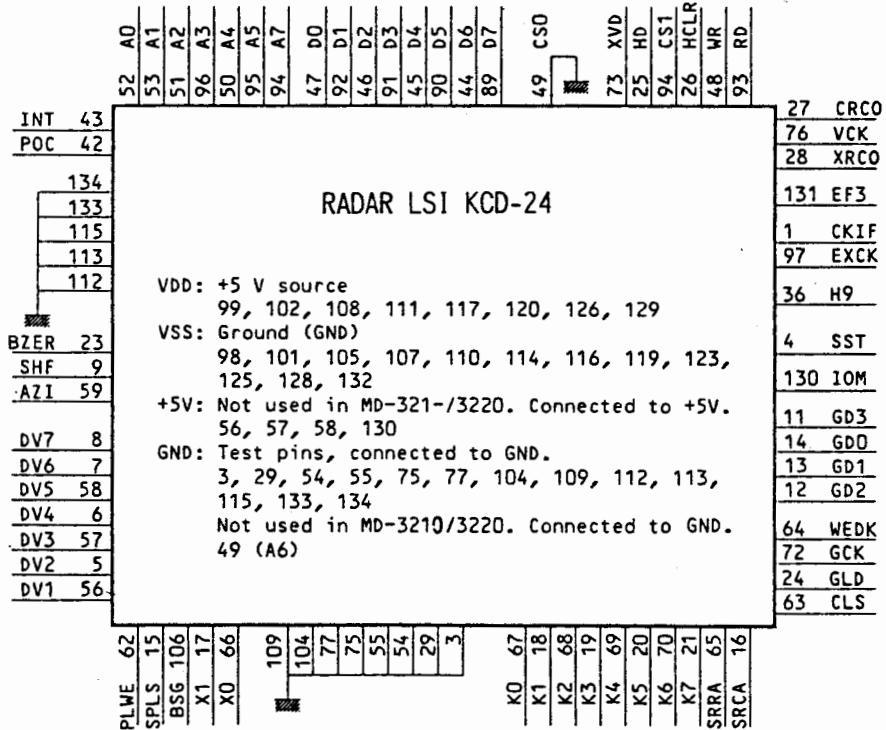
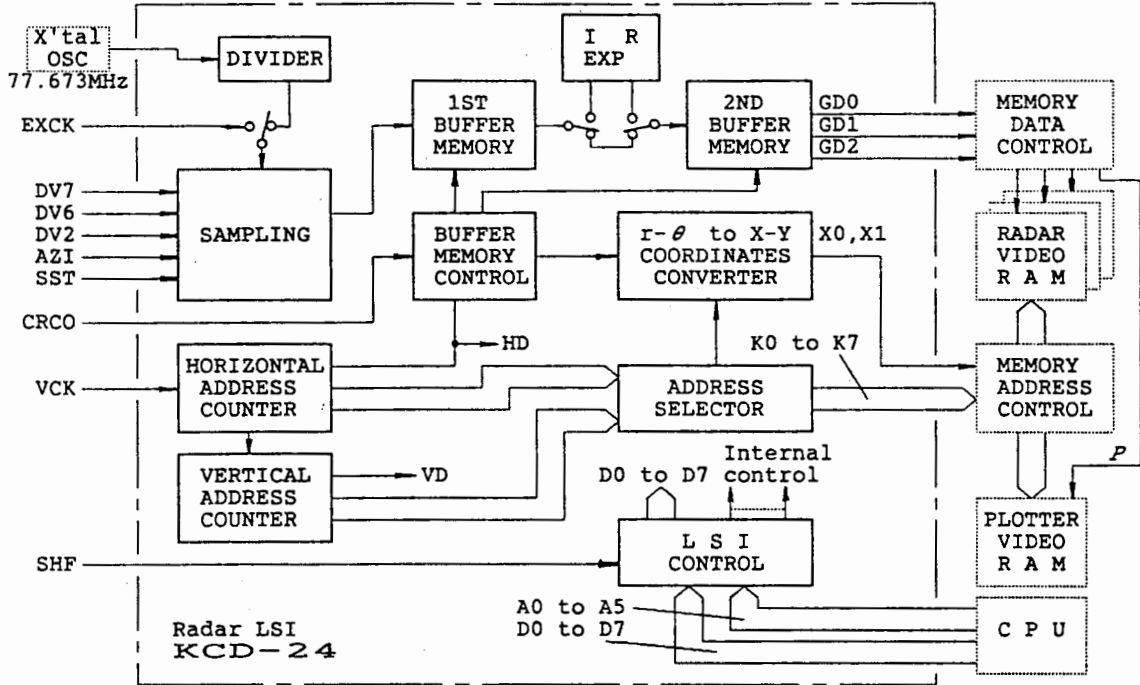
KODEN ELECTRONICS
 CO., LTD.

DWG. NO.
MRD68-N-E001

APPENDIX

RADAR LSI KCD-24

1. BLOCK DIAGRAM



2. DESCRIPTION OF SIGNAL

Pin No.	Abbreviation of Signal	Input/Output	Function of Signal
1	CKIF	Input	Fundamental frequency of sampling clock. XIF is the inverted output of CKIF. X'tal controlled oscillator can be formed at CKIF and XIF terminals.
2	XIF	Output	
3	TSTS	GND	Test pin, connected to ground
4	SST	Input	Sampling start signal. Sampling starts at the rising edge of this signal.
5 to 8 and 56 to 58	DV1 to DV7	Input	Sampling data input 7 level signal: DV1 to DV7 3 level signal: DV2, DV6, and DV7 where DV7 > DV6 > --- > DV2 > DV1
9	SHF	Input	Ship's heading signal. This signal is converted to AZI signal for one antenna rotation. Low level: active
10	SPCK	NC	Sample clock monitoring pin, no connection
11 to 14	GDO to GD3	Output	Video output GD3: Plotting video output 7 level signal: GD2, GD1, GDO 3 level signal: GD2, GD1 where GD2 > GD1 > GDO
15	SPLS	Output	Transfer signal to SAM of D-RAM
16	SRCA	Output	CAS signal of Video RAM
17 66	X1 X0	Output	Bit No. of Video RAM Selective signal for writing video data bit by bit into 64k-bit x 4 video D-RAM
18 to 21 and 67 to 70	K0 to K7	Output	Address of Video RAM
22 71	VY9 VY8	Output	Video RAM selection signal for 1024 x 1024-bit picture size [(64k-bit x 4) x 4]
23	BZER	Output	Alarm detection output signal Becomes "H" when echo is detected within the alarm zone for a period longer than 3 aerial rotations (3 SHF signals).
24	GLD	Output	Serial load clock of Video RAM

Pin No.	Abbreviation of Signal	Input/Output	Function of Signal
25	HD	Output	Horizontal synchro signal for CRT
26	HCLR	Output	Start signal for display gate
27	CRCO	Input	Fundamental frequency of the clock for Video RAM control. XRCO is the reversed output of CRCO. X'tal controlled oscillator can be formed at CRCO and XRCO.
28	XRCO	Output	
29 75 77 109 112 113 115 134	BI0 to BI7	GND	Test pins, connected to ground
30 to 34 and 78 to 82	V9 to V0	Output	Vertical address of character display
35	FI	Output	Field index
36 to 41 and 83 to 86	H9 to H0	Output	Horizontal address of character display
42	POC	Input	Power-on-clear, Low level: active
43	INT	Output	End of transfer to Video RAM. Becomes high when transfer finished.
44 to 47 and 89 to 92	D7 to D0	3-state Input/ Output	8-bit data bus Output: alarm detection data Input: all control data
48	WR	Input	Write control, Low level: active
93	RD	Input	Read control, Low level: active
49 to 53 and 94 to 96	A7 to A0	Input	Control port address
54 55	SEL1 SEL2	GND	Test pins, connected to ground
59	AZI	Input	Azimuth signal

Pin No.	Abbreviation of Signal	Input/Output	Function of Signal
60 87 88 100 103 118 121 124	B00 to B07	NC	Test pins, no connection
61	PSCK	NC	Test pin for monitoring the clock to determine continuous bits.
62	PLWE	Output	Plotter memory write enable Low level: active
63	CLS	Output	Memory clear Image memory is cleared when low.
64	WEDX	Output	Video RAM write enable
65	SRRA	Output	RAS signal of Video RAM
72	GCK	Output	Serial shift clock of Video RAM
73	XVD	Output	Vertical synchro signal for CRT
74	VCLR	Output	Vertical clear signal
76	VCK	Input	Fundamental frequency of V/H address control
97	EXCK	Input	External clock for sampling
104	EWE	GND	Test pin, connected to ground
106	BSG	Output	Write-per-bit signal
122	CLD	Output	Serial load signal for character display
127	-	NC	No connection
130	IOM	Input	Read/write control, High level: active
131	EF3	Output	1/3 division output of sampling clock at 50% duty.
133	ECK	Input	Test pin, connected to ground
135	VCKO	Output	Serial clock for character display

Pin No.	Abbreviation of Signal	Input/Output	Function of Signal
99 102 108 111 117 120 126 129	VDD		+5 V power supply
98 101 105 107 110 114 116 119 123 125 128 132	VSS		Ground (GND)

SUPPLEMENT FOR DRAWING AMENDED

PCB NAME	DRAWING NO.	PAGE
<ANTENNA UNIT>		
1.BLOCK DIAGRAM	556-0010M1*	B-1
2.MODULATOR 10KW MRT-133	E05CGB1110*	B-2
4.MODULATOR 25KW MRT-134	E05CGB2100*	B-3
<DISPLAY UNIT>		
1.INTERCONNECTION DIAGRAM DISPLAY	555-0019*	B-4
2.POWER SUPPLY	555-0012M1*	B-5
3.LOGIC UPPER(1/2)	555-0015(1/2)*	B-6
4.LOGIC UPPER(2/2)	555-0015(2/2)*	B-7
5.LOGIC LOWER(1/3)	555-0016(1/3)*	B-8
6.LOGIC LOWER(2/3)	555-0016(2/3)*	B-9
7.LOGIC LOWER(3/3)	555-0016(3/3)*	B-10
8.S-ARPA CONTROLLER	555-0018M1(1/7)*	B-11
9.S-ARPA CONTROLLER	555-0018M1(2/7)*	B-12
10.S-ARPA CONTROLLER	555-0018M1(3/7)*	B-13
11.S-ARPA CONTROLLER	555-0018M1(4/7)*	B-14
12.S-ARPA CONTROLLER	555-0018M1(5/7)*	B-15
13.S-ARPA CONTROLLER	555-0018M1(6/7)*	B-16
14.S-ARPA CONTROLLER	555-0018M1(7/7)*	B-17
15.FILTER CIRCUIT (GYRO INTERFACE)	KSA-05-K·E043*	B-18
16.POWER SUPPLY CIRCUIT (GYRO INTERFACE)	KSA05-K·E040A*	B-19
17.LOGIC CIRCUIT (GYRO INTERFACE)	KSA05-K·E042*	B-20