MKS-80 (from p. 1 to p. 34)
MPG-80 (from p. 35 to p. 44)

SERVICE NOTES

Second Edition

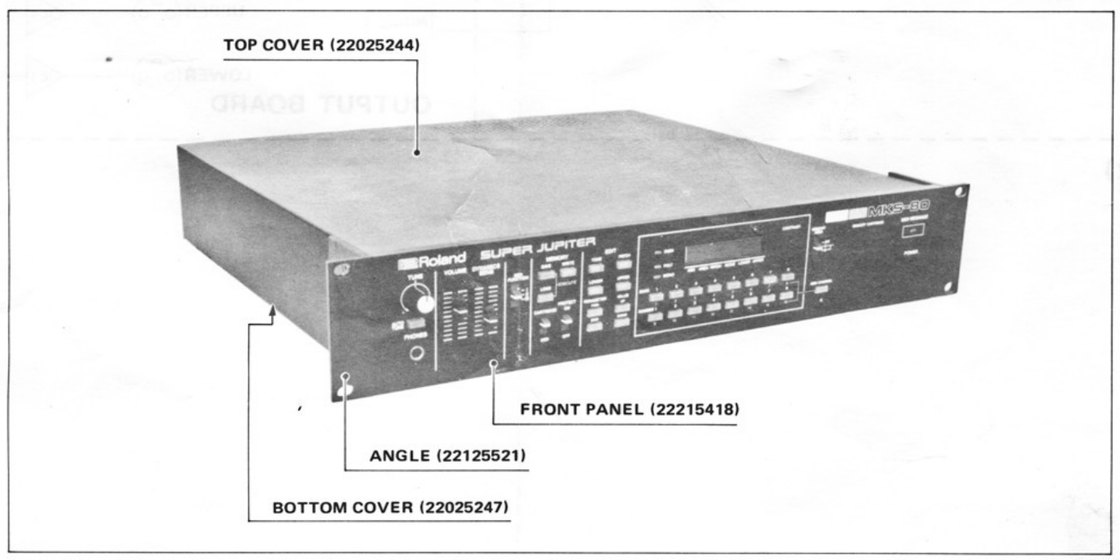
April. 1985

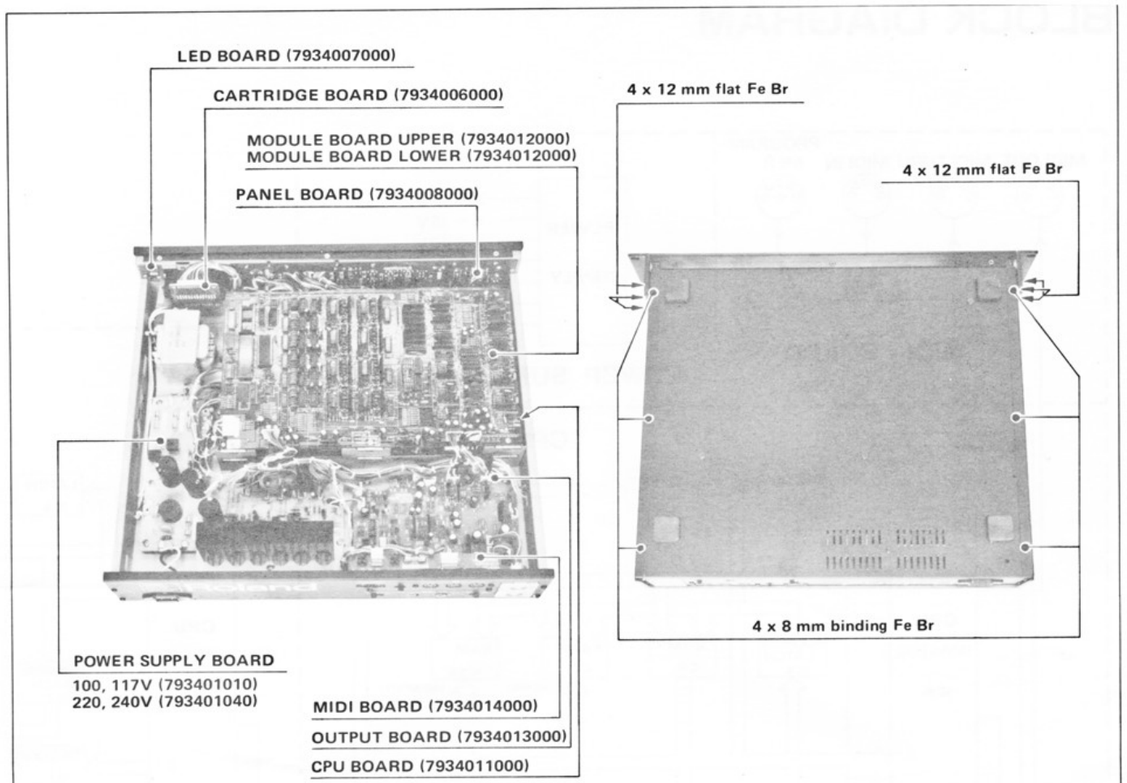
MKS-80 Part 1

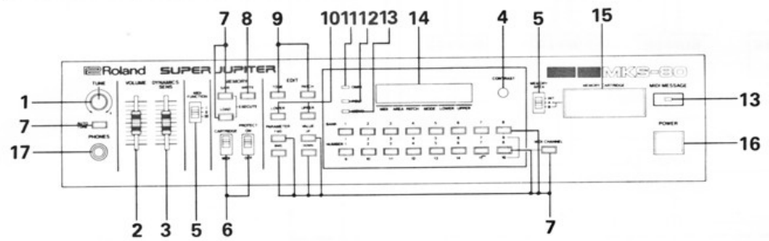
This Notes makes First Edition obsolete and consists of two parts:

SPECIFICATIONS

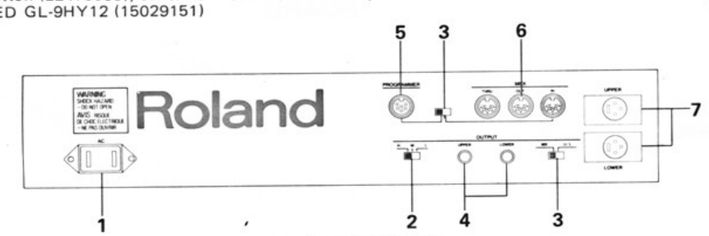
MASTER TUNE	±50 cents
VCO MOD	LFO 5 oct; ENV-1 4 oct (Dynamics-max)
PWM	50–0%
VCF (LPF)	24dB/oct Cutoff frequency 5Hz–30kHz ENV more than 10 octaves Key Follow 0–100%
(HPF)	6dB/oct
VCA	ENV–2 Level 60dB max. LFO Modulation ±30dB max.
ENV–1	Attack Time 32s max. Decay Time 32s max. Release Time 32s max. Key Follow 0–100%
ENV–2	Attack Time 32s max. Decay Time 32s max. Release Time 32s max. Key Follow 0–100%
LFO–1	Rate 0.02–64Hz Random 0.06–250Hz Delay Time 0–4s
AFTER TOUCH	LFO–2 Rate 0.016–16Hz. VCO sense more than ±100 cent. VCF sense more than 6 octs max.
GLIDE	Time 0–1.6s/oct
BENDER	Range more than 2 octs Up/Down (Wide). Range more than 1 oct Up/Down (Normal).
OUTPUT	1/4" phone jack 0/–15/–30dB XLR impedance 600 ohms Headphones 8 ohms, stereo
POWER CONSUMPTION	35 watts
DIMENSIONS	430(W) x 400 (D) x 88 (H) mm 16-7/8" x 15-3/4" x 3-1/2"
WEIGHT	8 kg/17 lb 10 oz





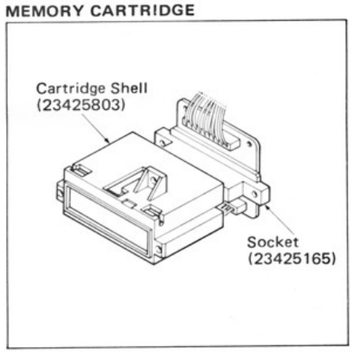


1. Pot K161M0Z1A 100KB (13219369), Knob (22470261)
2. Pot S3028P401M 10KW (13359351), Knob (22475329)
3. Pot S3018P405-B15 100KB (13339421), Knob (22475329)
4. Pot K121-2KB (13279758)
5. Switch SSY023-12PN (13159336), Knob (22475325)
6. Switch SSY022-12PN (13159149), Knob (22475325)
7. Button (22475598), Switch SPQ009G (13129351)
8. Button (22475598), Switch SPQ009G (13129351), LED GL-9HD12 (15029152)
9. Button (22475598), Switch SPQ009G (13129351), LED GL-9HY12 (15029151)
10. Button (22475598), Switch SPQ009G (13129351), LED GL-9PG12 (15029149)
11. LED GL-9HD12 (15029152)
12. LED GL-9HY12 (15029151)
13. LED GL-9PG12 (15029149)
14. LCD LCM-560-08HZ (15029417)
15. Cartridge Shell (23425803), Socket (23425165)
16. Button (2247024000), Switch SDGA-3P (13129124)
17. Jack HLJ-0520-01-010 (13449126)

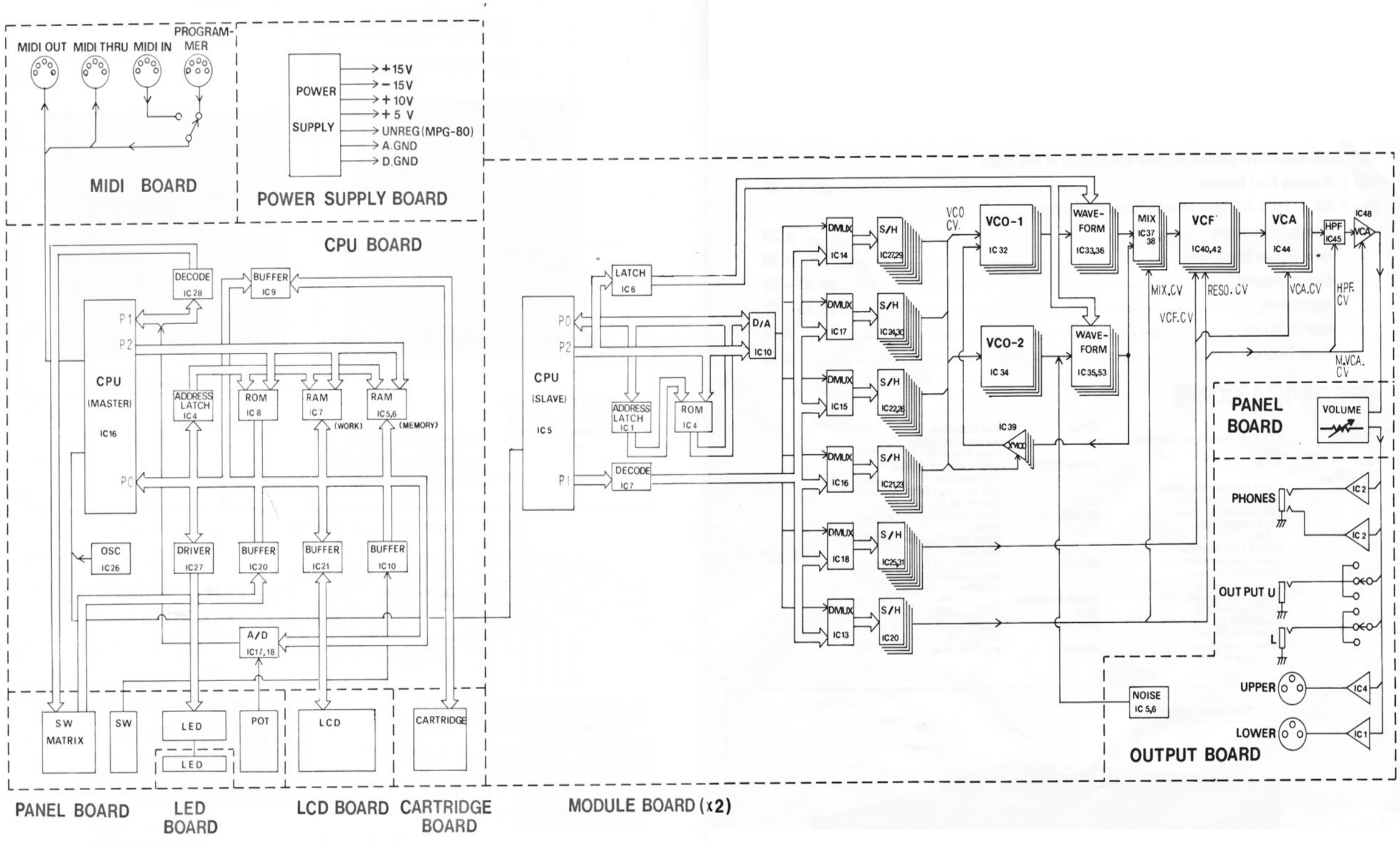


1. AC inlet	PA-126	(13429710)	100/117/220V
	PA-125	(13429709)	240V
2. Slide switch	SSP-323-9PS	(13159335)	
3. Slide switch	SSP-322-9PN	(13159111)	
4. Jack	HLJ0520-01-110	(13449125)	
5. DIN socket	TCS5360-01-1111	(13429621)	6P
6. DIN socket	MIDI3-NS	(13429168)	5P
7. XLR socket	HA16R-3P	(13439851)	

MEMORY CARTRIDGE

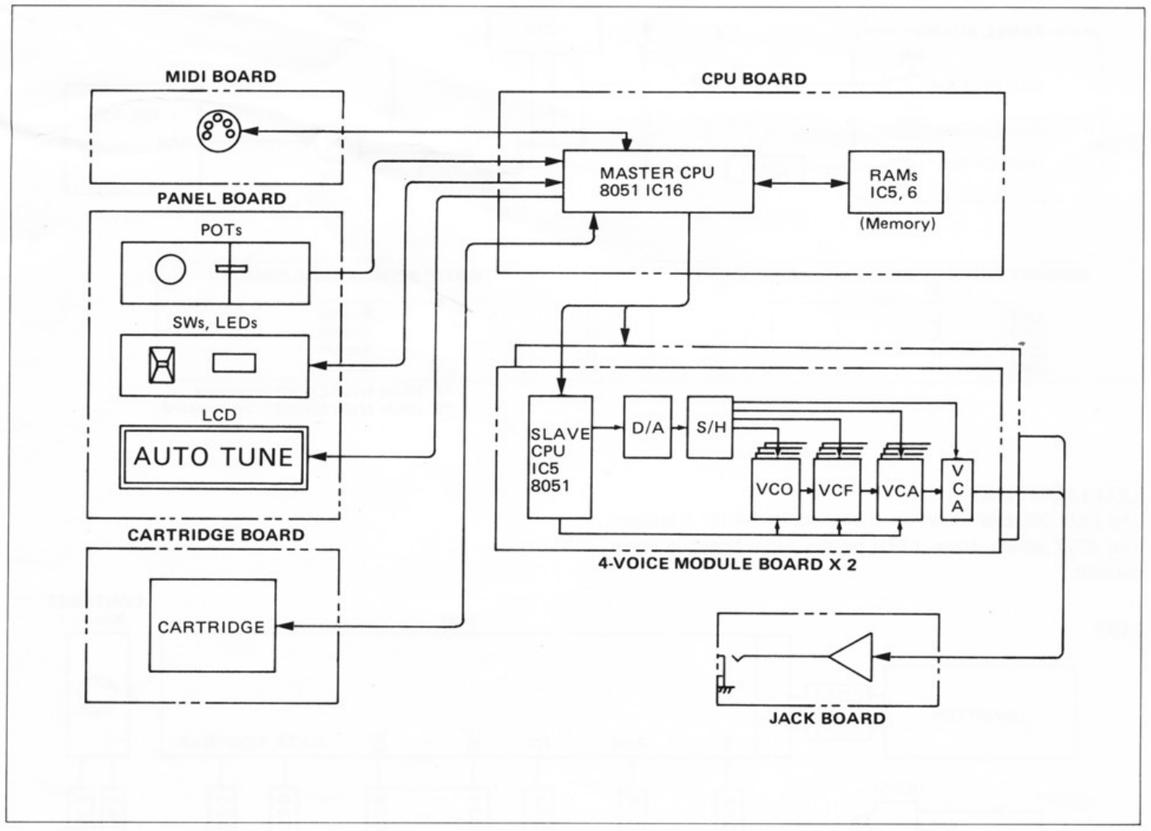


BLOCK DIAGRAM



CIRCUIT DESCRIPTION

GENERAL



MASTER CPU

1) Transferring of MIDI information
2) Reading of switches data from panel board
3) Reading of potentiometers from panel
4) Driving of LCD
5) Saving and loading of Tone and/or patch data into/from memory cartridge

SERIAL DATA

SLAVE CPU

1) Controls VCO, VCF and VCA according to data from master CPU:
   - Key ON
   - Key OFF
   - Tone and/or patch

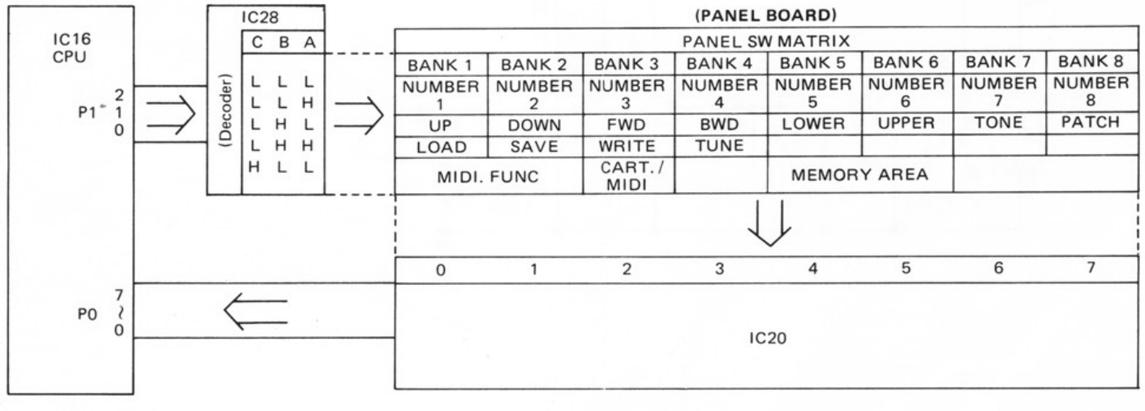
CPU BOARD

MASTER CPU 8051 OR 8031

CPU (IC16) terminal			Pin No.	Function							
Port 2.	7	Address	28	L	L	L	L	H	H	H	H
	6	bus	27	L	L	H	H	L	L	H	H
	5	Higher-	26	L	H	L	H	L	H	L	H
	4	order	25	Memory RAM	Memory cartridge	Working RAM	A/D Converter	LED/SW	IC10 $\overline{RD}$	LCD	
	3		24								
	2		23								
	1		22								
	0		21								
Port 0.	7	Address	32								
	6	bus	33								
	5	Lower-	34								
	4	order	35								
	3	and	36								
	2	data bus	37								
	1		38								
	0		39								
Port 1.	7		8	Data input for A/D conversion (Dynamics sens)							
	6		7	Data input for A/D conversion (Tune)							
	5		6	Memory cartridge area A/B & LCD control data							
	4		5	Controls DIR terminals of IC9 and IC21							
	3		4	$\overline{CE}$ for memory cartridge							
	2		3	] SW scan							
	1		2								
	0		1								
$\overline{ALE}$			30	Address latch enable							
$\overline{PSEN}$			29	Program store enable							
$\overline{RD}$			17	Read pulse							
$\overline{WR}$			16	Write pulse							
$\overline{INT1}$			13	Stereo/mono select							
RXD			10	MIDI IN							
TXD			11	MIDI/slave CPU serial output							
T0			14	] MIDI/slave select							
T1			15								
XTAL2			18	] Clock 12MHz							
XTAL1			19								
RST			9	Reset pulse input							

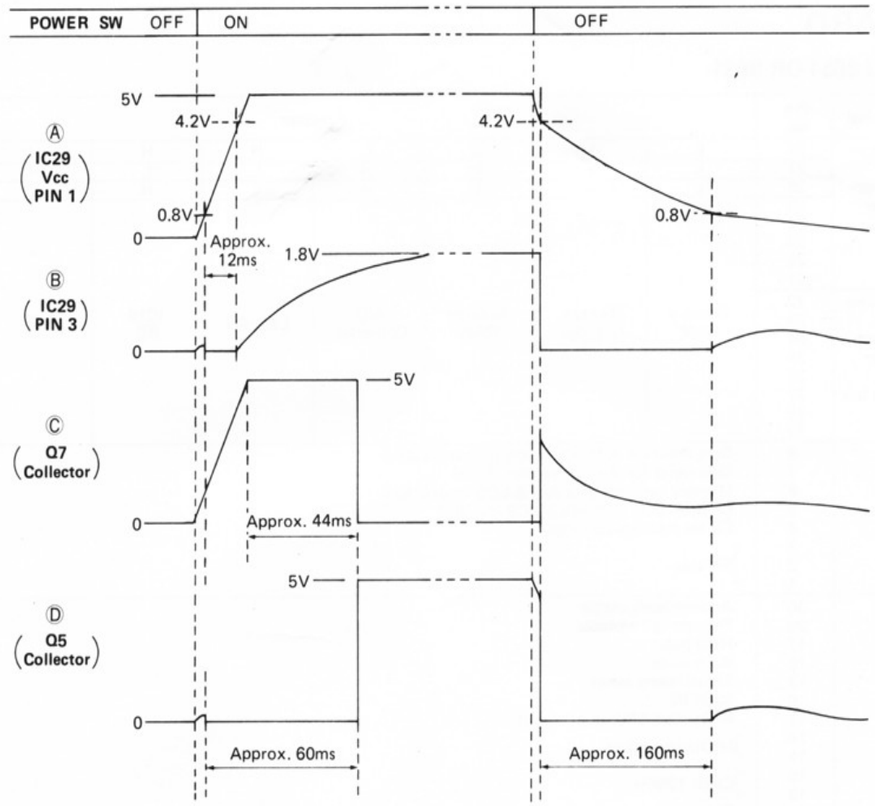
PANEL SWITCH READING

The CPU (IC16) scans the status (ON, OFF) of the 33 switches on the panel board through matrix.

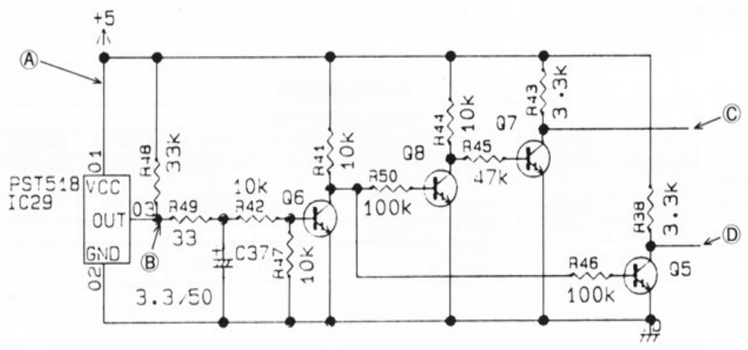


Scanning data from P1.0–P1.2 of the CPU IC16 is applied to IC28. IC28 decodes the data and pulls corresponding matrix bus low (e,g, BANKs). If BANK 1 is being pressed, pin 0 of IC20 becomes low. A combination of Port 1 and 2 shows a status of 8 BANKs. The CPU repeats the process for the remaining four switch groups.

RESET CIRCUIT

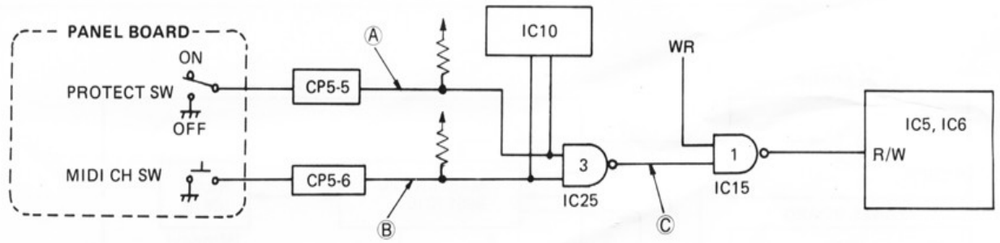


Reset circuit diagram



MEMORY PROTECT SWITCH

The function of MEMORY PROTECT switch is interrupted by MIDI CH switch: protect ON is disabled when MIDI CH is pressed.



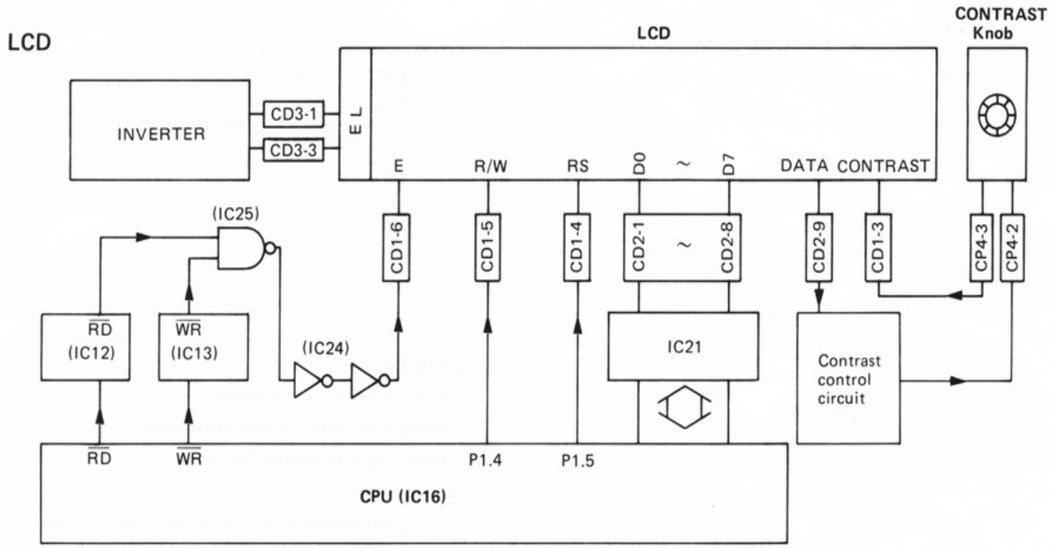
MEMORY PROTECT SW Ⓐ		MIDI CH SW Ⓑ		Ⓒ	WRITE TO INTERNAL MEMORY
(OFF)	L	(*1)	L	H	Enable
(OFF)	L	(*2)	H	H	Enable
(ON)	H	(*1)	L	H	Enable
(ON)	H	(*2)	H	L	Disable

**1: While MIDI CH SW is pressed*
**2: While MIDI CH SW is not pressed*

LED LIGHTING

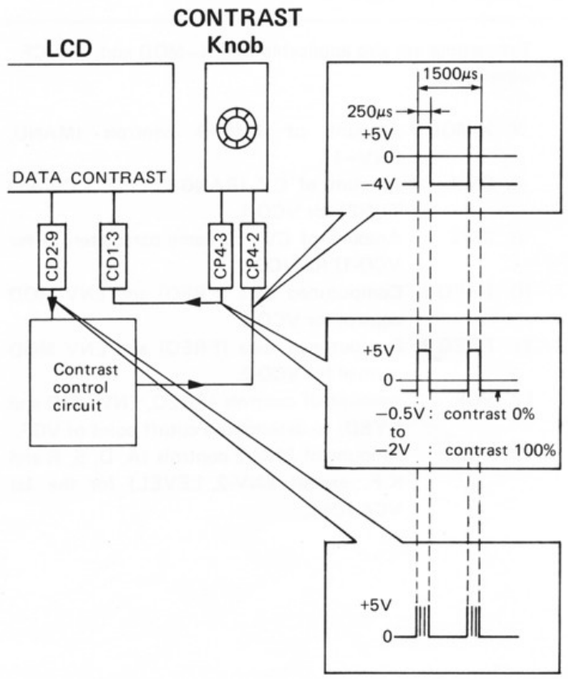
The LED ON data from Port 0 of the CPU (IC16) is latched into IC27 which drives LEDs on the panel board in static method.

LCD



The LCD consists of the data I/O section, control section, display section and contrast control section. A back-light illumination EL (electol-luminescence) behind the display makes the LCD visible in dim light. The EL operates on a sine wave signal of 73Vrms (100V peak), approximately 500Hz, from the inverter (composed of L1, Q3, C32, etc.) on the CPU board.

Contrast control circuit



LCD DATA

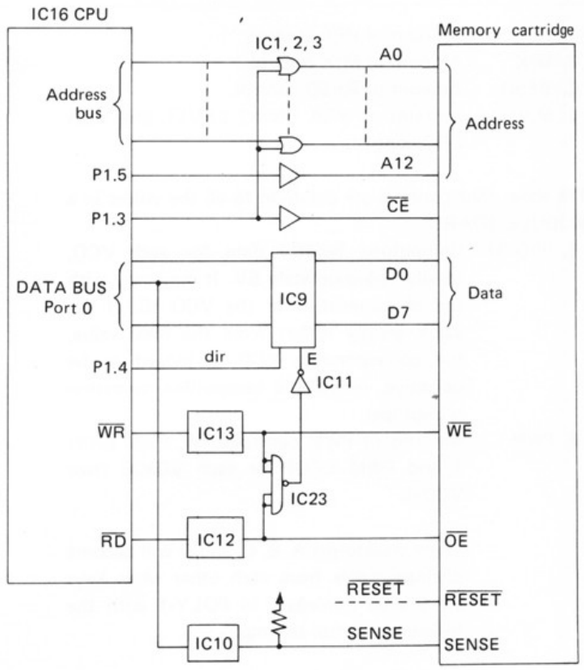
D0–D7: Data bus for transferring on 8-bit data to and from LCD.

RS: The CPU writes a display data into the LCD, or reads data from the LCD with a low RS.
When the CPU wants to change the LCD display mode it sends a HIGH to the RS terminal.
The signal level on the RS terminal will swing between HIGH and LOW for a short time when the power switch is turned on, then will stay steady at LOW.

R/W: This terminal goes LOW (WRITE) when the CPU is to send display data to the LCD, and goes HIGH (READ) when the CPU is to monitor the LCD status.

E (Enable): After the levels of RS and R/W have been established, an 8-bit data is actually written into or read from the LCD on a high E.

MEMORY CARTRIDGE AND ITS PERIPHERAL CIRCUITS



DATA FLOW DIRECTION

BUS BUFFER

IC9 on the data bus between the CPU and Memory cartridge is a bidirectional bus buffer. The direction of data flow is determined by DIR and ENABLE.

DIR	E(G)	DATA
H	L	Cartridge to CPU
L	L	CPU to Cartridge
X	H	High impedance

SENSE

This line becomes and stays at a ground level when the memory cartridge (8-Kbyte) is inserted. The status is detected by the CPU through IC10.

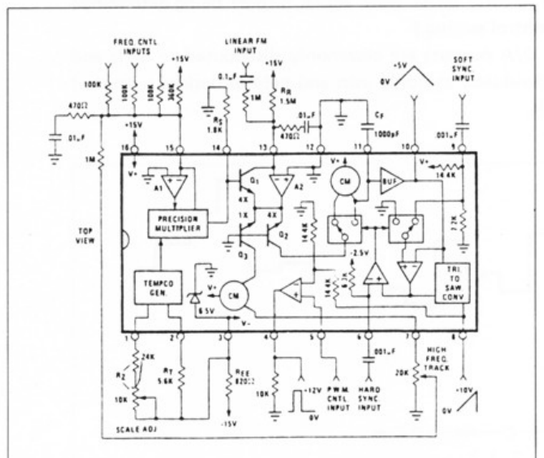
MODULE BOARD

SLAVE CPU 8051

CPU (IC5) terminal		Pin No.	Function
Port 2. 7	Address	28	Program area; D/A converter data; AUTO TUNE select ports; VCO WF select ports
6	bus	27	
5	Higher-	26	
4	order	25	
3		24	
2		23	
1		22	
0		21	
Port 0. 7	Address	32	
6	bus	33	
5	lower-	34	
4	order	35	
3	and	36	
2	data bus	37	
1		38	
0		39	
Port 1. 7		8	VCO-1 SYNC
6		7	
5		6	S/H Address
4		5	
3		4	
2		3	
1		2	
0		1	
INT1		13	VCO-2 SYNC
INT0		12	AUTO TUNE data input
T0		14	LFO synchronizing signal I/O terminal between upper/lower module boards.
T1		15	
TXD		11	For data communication with master CPU
RXD		10	
XTAL2		18	12MHz clock pulse from CPU board
RST		9	RESET signal from CPU board
WR		16	For D/A converter WR
RD		17	For (IC6) latch

VCO

Each VCO (IC32, IC34) is composed of a single chip IC, CEM3340. Three waveforms from the VCO are unequal in amplitude, which is compensated in the next stage (IC33 or IC35) for uniformed levels. Synchronization with the associated VCO is accomplished by external connections, leaving the internal SYNC disabled.



CEM 3340 Circuit Block and Connection Diagram

AUTO TUNE

When the TUNE button is pressed, the sawtooth wave selected among the outputs from the VCOs by IC19 passes through the comparator (IC3) then to CPU (IC5). The CPU measures the frequency of the wave and delivers a corrected CV data for that VCO through D/A converter IC10. The CPU repeats the cycle for the remainder of VCOs.

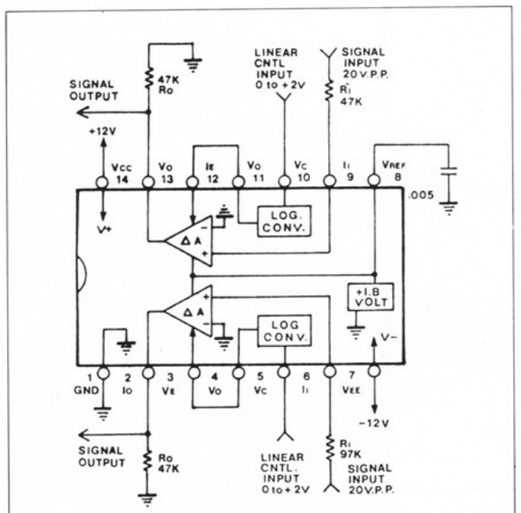
VCF

VCF is comprised of two seriese-connected filters of basically the same configuration. Slight difference between two stages in circuit diagram illustrates compensation means for level and prevention against peak clips.

VCA

1st VCA

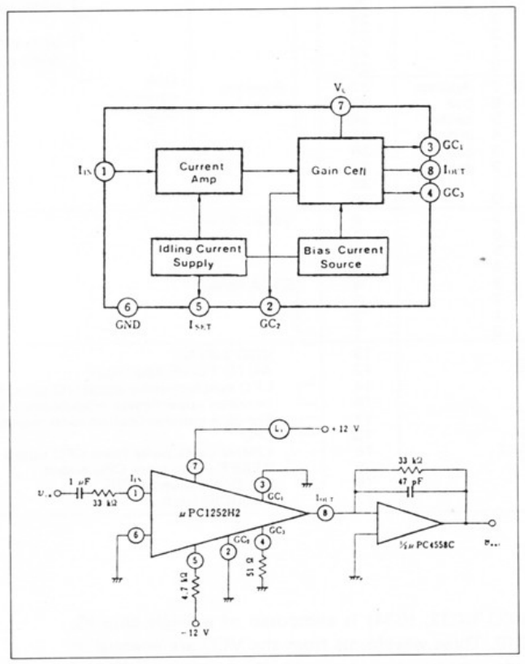
This device functions as a linear VCA accepting control signal through its linear control terminal.
The signal is called ENV–2, a combination of A, D, S, R and KF data.



CEM 3360 Block Diagram and Typical Connection

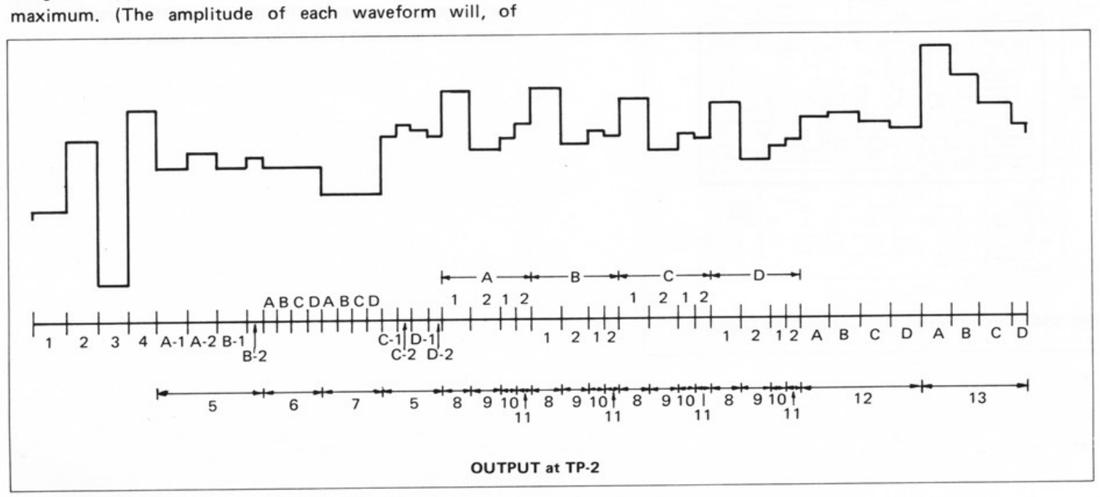
2nd VCA

This device is controlled by the control knobs, VCA ENV-2 LEVEL and VCA LFO, and determines the entire output level of the MODULE BOARD.



MODULE CONTROL VOLTAGE

The SLAVE CPU IC5 routes the data to IC10 and has the serial analog equivalents (CVs) at IC11 output, TP-2. Connect the scope to the TP-2 (TRIG on TP-1 signal). The figures exampled below will appear on the screen, taking altogether approx. 2.6ms with amplitudes about 10.7V maximum. (The amplitude of each waveform will, of course, greatly differ from actual display being determined by a control setting.)
These D/A outputs are commonly distributed to S/Hs and are individually sampled into and held at desired output of the S/H.



OUTPUT at TP-2

Each designation in the list below corresponds, respectively, to:
Number ..... the number in the chart above
Heading ..... the S/H output shown in the Module Board circuit diagram on P.15.

1. HPF — Amount of HPF control.
2. MIX — Amount of MIX control.
3. RESO — Amount of RESO control.
4. M.VCA — Amount of VCA ENV-2 LEVEL and VCA LFO controls.

The above four controls are common to all the voices in a MODULE BOARD.

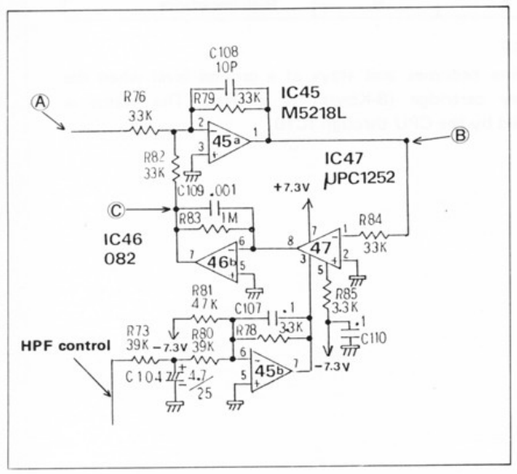
5. WIDTH — Computune (width) data for each VCO, ideally approximately 5V. It may vary with the characteristics of the VCO IC. If the value greatly differs from the ideal value, the corresponding VCO is judged to be defective, unless the computune operation is improper.
6. PWM — Amount of PWM controls (PW, PWM ENV-1 and PWM LFO) for each VOICE (two VCOs).

These waveforms A, B, C, and D will become distinguishable from each other when keys are played nonlegato in POLY-1 with the following control settings:

PWM = 10; ENV-1: S = 10, R = 0, A and D = as small amount.

The module board of MKS-80 features the following in addition to that of JP-6, its brother module.

1) HPF
2) Low boost circuit in the 2nd VCA.
3) DC supply current boost circuit (IC50).

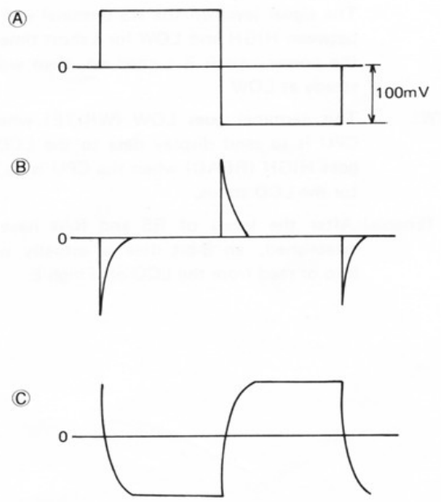


7. X-MOD — Amount of X-MOD controls (MANU, ENV–1).
8. CV 1 — Amount of CV (RANGE, LFO, KCV and TUNE) for VCO-1.
9. CV 2 — Amount of CV (the same parameters as for VCO-1) for VCO-2.
10. FREQ 1 — Computuned data (FREQ) and ENV MOD control for VCO-1.
11. FREQ 2 — Computuned data (FREQ) and ENV MOD control for VCO-2.
12. VCF — Amount of controls (FREQ, ENV, LFO and KYBD) to determine a cutoff point of VCF.
13. VCA — Amount of ENV-2 controls (A, D, S, R and K.F, except ENV-2 LEVEL) for the 1st VCA IC44.

The settings are also applicable to 7.X–MOD and 12. VCF waveforms

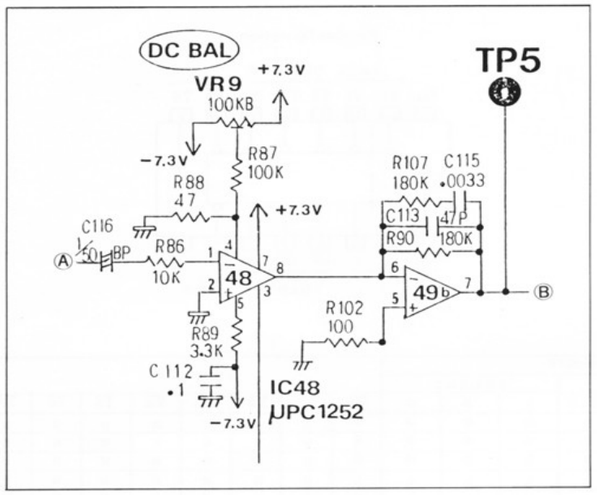
HPF has a configuration that an LPF (IC46b, IC47) is added to the negative feedback loop of the inverting amplifier (IC45a).

With HPF set at max. waveforms on B and C are as shown.



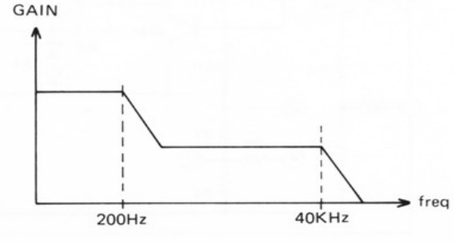
LOW BOOST CIRCUIT IN THE 2nd VCA

This circuit enhances the weight of low frequency range.



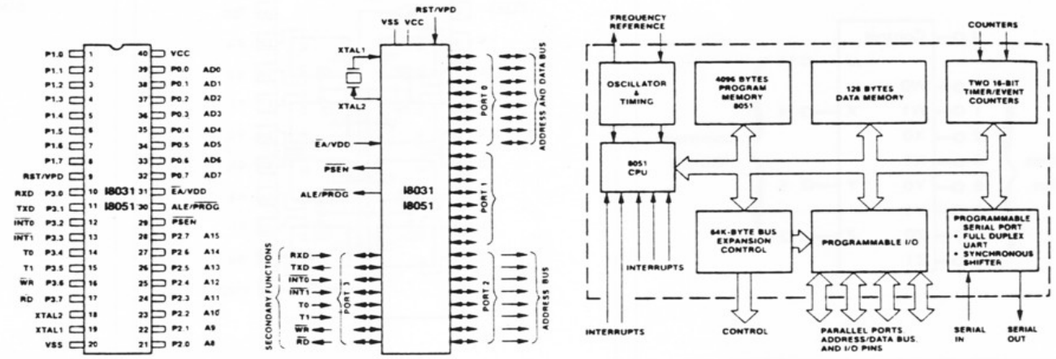
	Input waveform Ⓐ	Output waveform Ⓑ
200Hz	100mV / 0	500mV / 0
2KHz	100mV / 0	500mV / 0

The low boost circuit (IC49b) has a frequency response shown below.



IC DATA

P-8051-319-0 SINGLE-COMPONENT 8-BIT MICROCOMPUTER



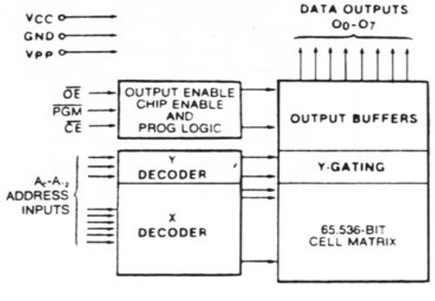
Pin Configuration　　Logic Symbol　　Block Diagram

TMM2764D (8K x 8) UV ERASABLE PROM

Pin Configuration

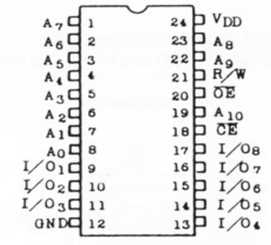
[1] For total compatibility and upgradability from the 2732A and ROMs provide a trace to pin 26.

Block Diagram

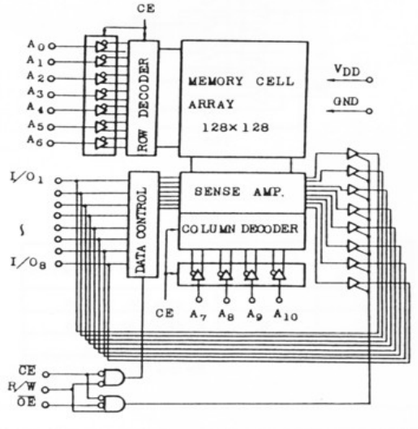


TC5517AP/APL 16K CMOS Static RAM (2,048 x 8)

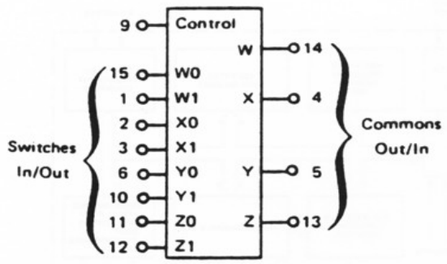
Pin Configuration



Block Diagram



MC14551B
QUAD 2-INPUT ANALOG MULTIPLEXER /DEMULTIPLEXER

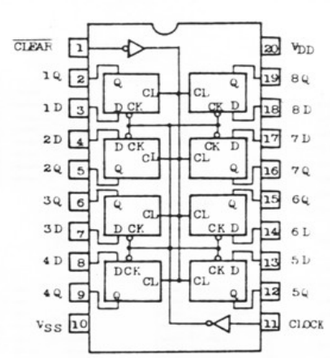


Control	ON
0	W0 X0 Y0 Z0
1	W1 X1 Y1 Z1

V_{DD} = Pin 16
V_{SS} = Pin 8
V_{EE} = Pin 7

TC40H273P
OCTAL D-TYPE FLIP-FLOP

Pin Configuration



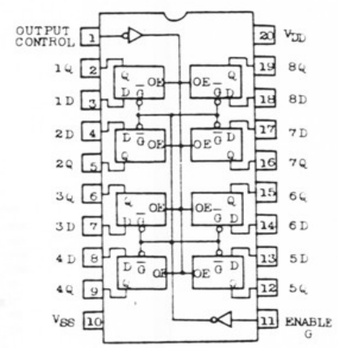
Truth Table

INPUTS			OUTPUT
$\overline{CLEAR}$	CLOCK	DATA	Q
L	※	※	L
H	↑	H	H
H	↑	L	L
H	L	※	Q_0

※ = Don't Care

TC40H373P
OCTAL D-TYPE LATCH (3-STATE OUTPUT)

Pin Configuration



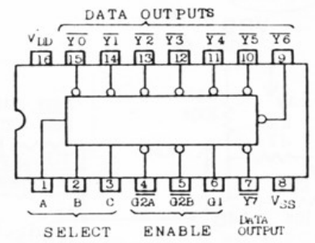
Truth Table

INPUTS			OUTPUT
OUTPUT CONTROL	ENABLE G	DATA	Q
L	H	H	H
L	H	L	L
L	L	※	Q_0
H	※	※	High Impedance

※ = Don't care

TC40H138P 3-TO-8-LINE DECODER/DEMULTIPLEXER

Pin Configuration



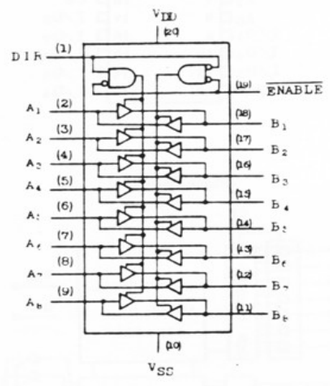
Truth Table

INPUTS						OUTPUTS							
ENABLE			SELECT										
G1	$\overline{G2A}$	$\overline{G2B}$	A	B	C	$\overline{Y0}$	$\overline{Y1}$	$\overline{Y2}$	$\overline{Y3}$	$\overline{Y4}$	$\overline{Y5}$	$\overline{Y6}$	$\overline{Y7}$
L	※	※	※	※	※	H	H	H	H	H	H	H	H
※	H	※	※	※	※	H	H	H	H	H	H	H	H
※	※	H	※	※	※	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	H	L	L	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	L	H	H	H	L	H	H	H	H
H	L	L	L	L	H	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

※ : Don't care

TC40H245P OCTAL BIDIRECTIONAL BUS BUFFER NONINVERTED 3-STATE OUTPUTS

Pin Configuration

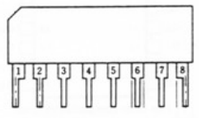


Truth Table

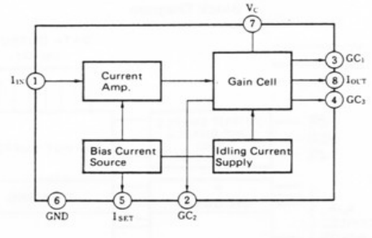
CONTROL INPUTS		DATA PORT STATUS
$\overline{ENABLE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	High impedance

X = Don't care

μPC1252H2 Bipolar Analog Integrated Circuit

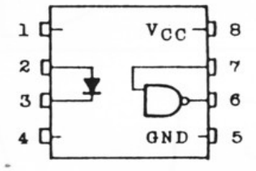


Block Diagram



TLP552 PHOTO COUPLER

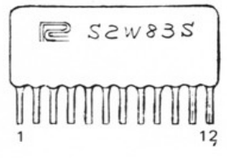
Pin Configuration

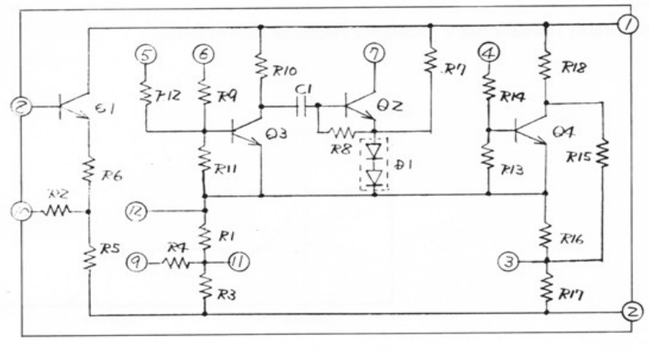


Truth Table

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

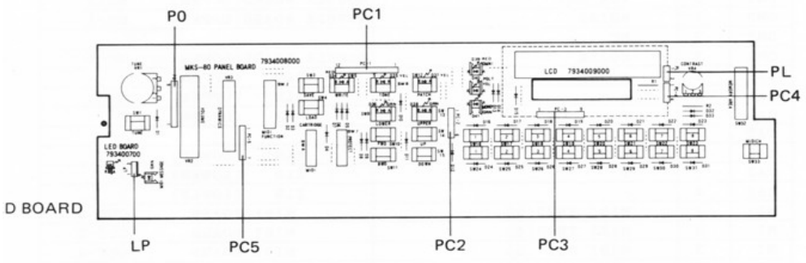
EHM-S226W83S Hybrid IC





WIRING DATA TABLE

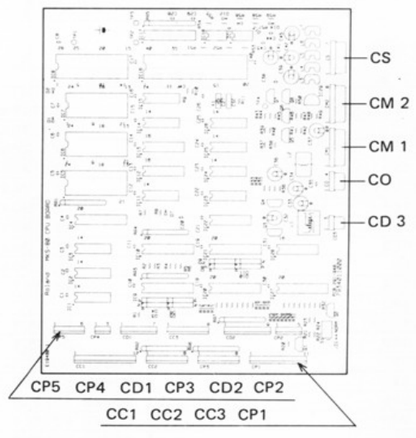
PANEL BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
PC1	1	PATCH	CPU BOARD	CP1-1
PC1	2	TONE	CPU BOARD	CP1-2
PC1	3	LOWER	CPU BOARD	CP1-3
PC1	4	UPPER	CPU BOARD	CP1-4
PC1	5	WRITE	CPU BOARD	CP1-5
PC1	6	OMNI	CPU BOARD	CP1-6
PC1	7	MONO	CPU BOARD	CP1-7
PC1	8	POLY	CPU BOARD	CP1-8
PC1	9	MIDI MESSAGE	CPU BOARD	CP1-9
PC1	10	+5V	CPU BOARD	CP1-10
PC1	11	NC		
PC1	12	D.GND	CPU BOARD	CP1-11
PC2	1	DIGIT 0	CPU BOARD	CP2-1
PC2	2	NC		
PC2	3	DIGIT 1	CPU BOARD	CP2-2
PC2	4	DIGIT 2	CPU BOARD	CP2-3
PC2	5	DIGIT 3	CPU BOARD	CP2-4
PC2	6	DIGIT 4	CPU BOARD	CP2-5
PC3	1	BIT 0	CPU BOARD	CP3-1
PC3	2	BIT 1	CPU BOARD	CP3-2
PC3	3	BIT 2	CPU BOARD	CP3-3
PC3	4	BIT 3	CPU BOARD	CP3-4
PC3	5	BIT 4	CPU BOARD	CP3-5
PC3	6	BIT 5	CPU BOARD	CP3-6
PC3	7	NC		
PC3	8	BIT 6	CPU BOARD	CP3-7
PC3	9	BIT 7	CPU BOARD	CP3-8
PC4	1	+5V	CPU BOARD	CP4-1
PC4	2	NC		
PC4	3	CONTRAST(3)	CPU BOARD	CP4-2
PC4	4	CONTRAST(2)	CPU BOARD	CP4-3
PO	1	A.GND	OUTPUT BOARD	OP8-1
PO	2	NC		
PO	3	VOLUME IN (LOWER)	OUTPUT BOARD	OP8-2
PO	4	A.GND	OUTPUT BOARD	OP8-3
PO	5	VOLUME IN (UPPER)	OUTPUT BOARD	OP8-4
PO	6	A.GND	OUTPUT BOARD	OP8-5
PO	7	VOLUME OUT(UPPER)	OUTPUT BOARD	OP8-6
PO	8	A.GND	OUTPUT BOARD	OP8-7
PO	9	VOLUME OUT(LOWER)	OUTPUT BOARD	OP8-8
PL	1	MIDI MESSAGE LED(A)	LED BOARD	LP-1
PL	2	MIDI MESSAGE LED(K)	LED BOARD	LP-2
PL	3	MIDI MESSAGE LED(A)	LED BOARD	LP-3



PANEL BOARD

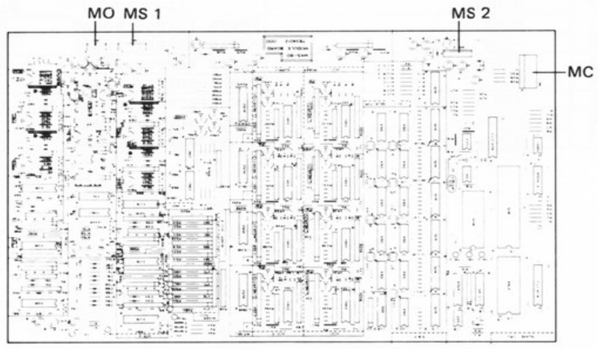
L E D BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
LP	1	MIDI MESSAGE LED(A)	PANEL BOARD	PL-1
LP	2	MIDI MESSAGE LED(K)	PANEL BOARD	PL-2
LP	3	MIDI MESSAGE LED(A)	PANEL BOARD	PL-3

'CPU BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
CC1	1	A0	CARTRIDGE BOARD	C1-1
CC1	2	A1	CARTRIDGE BOARD	C1-2
CC1	3	A2	CARTRIDGE BOARD	C1-3
CC1	4	A3	CARTRIDGE BOARD	C1-4
CC1	5	A4	CARTRIDGE BOARD	C1-5
CC1	6	A5	CARTRIDGE BOARD	C1-6
CC1	7	A6	CARTRIDGE BOARD	C1-7
CC1	8	A7	CARTRIDGE BOARD	C1-8
CC1	9	A8	CARTRIDGE BOARD	C1-9
CC1	10	A9	CARTRIDGE BOARD	C1-10
CC1	11	A10	CARTRIDGE BOARD	C1-11
CC1	12	A11	CARTRIDGE BOARD	C1-13
CC2	1	D0	CARTRIDGE BOARD	C2-9
CC2	2	D1	CARTRIDGE BOARD	C2-7
CC2	3	D2	CARTRIDGE BOARD	C2-6
CC2	4	D3	CARTRIDGE BOARD	C2-5
CC2	5	D4	CARTRIDGE BOARD	C2-4
CC2	6	D5	CARTRIDGE BOARD	C2-3
CC2	7	D6	CARTRIDGE BOARD	C2-2
CC2	8	D7	CARTRIDGE BOARD	C2-1
CC3	1	SENS	CARTRIDGE BOARD	C3-1
CC3	2	RESET	CARTRIDGE BOARD	C3-2
CC3	3	D.GND	CARTRIDGE BOARD	C3-3
CC3	4	CF	CARTRIDGE BOARD	C3-5
CC3	5	WE	CARTRIDGE BOARD	C3-6
CC3	6	OE	CARTRIDGE BOARD	C3-7
CC3	7	VDD	CARTRIDGE BOARD	C3-8
CC3	8	A12	CARTRIDGE BOARD	C3-9
CP1	1	PATCH	PANEL BOARD	PC1-1
CP1	2	TONE	PANEL BOARD	PC1-2
CP1	3	LOWER	PANEL BOARD	PC1-3
CP1	4	UPPER	PANEL BOARD	PC1-4
CP1	5	WRITE	PANEL BOARD	PC1-5
CP1	6	OMNI	PANEL BOARD	PC1-6
CP1	7	MONO	PANEL BOARD	PC1-7
CP1	8	POLY	PANEL BOARD	PC1-8
CP1	9	MIDI MESSAGE	PANEL BOARD	PC1-9
CP1	10	+5V	PANEL BOARD	PC1-10
CP1	11	D.GND	PANEL BOARD	PC1-12
CP2	1	DIGIT 0	PANEL BOARD	PC2-1
CP2	2	DIGIT 1	PANEL BOARD	PC2-3
CP2	3	DIGIT 2	PANEL BOARD	PC2-4
CP2	4	DIGIT 3	PANEL BOARD	PC2-5
CP2	5	DIGIT 4	PANEL BOARD	PC2-6
CP3	1	D0	PANEL BOARD	PC3-1
CP3	2	D1	PANEL BOARD	PC3-2
CP3	3	D2	PANEL BOARD	PC3-3
CP3	4	D3	PANEL BOARD	PC3-4
CP3	5	D4	PANEL BOARD	PC3-5
CP3	6	D5	PANEL BOARD	PC3-6
CP3	7	D6	PANEL BOARD	PC3-7
CP3	8	D7	PANEL BOARD	PC3-9
CP4	1	+5V	PANEL BOARD	PC4-1
CP4	2	CONTRAST VR(3)	PANEL BOARD	PC4-3
CP4	3	CONTRAST VR(2)	PANEL BOARD	PC4-4
CP5	1	TUNE,DYNAMIC VR(3)	PANEL BOARD	PC5-1
CP5	2	A.GND	PANEL BOARD	PC5-2
CP5	3	DYNAMIC VR(2)	PANEL BOARD	PC5-3
CP5	4	TUNE VR(2)	PANEL BOARD	PC5-4
CP5	5	PROTECT SW	PANEL BOARD	PC5-5
CP5	6	MIDI CH SW	PANEL BOARD	PC5-7
CO	1	STEREO/MONO	OUTPUT BOARD	OC-4
CO	2	MIDI IN	OUTPUT BOARD	OC-3
CO	3	RESET	OUTPUT BOARD	OC-2
CO	4	MIDI OUT	OUTPUT BOARD	OC-1
CM1	1	T0	MODULE BOARD(UPPER)	MC-8
CM1	2	T1	MODULE BOARD(UPPER)	MC-7
CM1	3	D.GND	MODULE BOARD(UPPER)	MC-6
CM1	4	RX DATA	MODULE BOARD(UPPER)	MC-5
CM1	5	RESET	MODULE BOARD(UPPER)	MC-4
CM1	6	TX DATA	MODULE BOARD(UPPER)	MC-3
CM1	7	D.GND	MODULE BOARD(UPPER)	MC-2
CM1	8	CLK	MODULE BOARD(UPPER)	MC-1
CM2	1	T0	MODULE BOARD(LOWER)	MC-1
CM2	2	T1	MODULE BOARD(LOWER)	MC-2
CM2	3	D.GND	MODULE BOARD(LOWER)	MC-3
CM2	4	RX DATA	MODULE BOARD(LOWER)	MC-4
CM2	5	RESET	MODULE BOARD(LOWER)	MC-5
CM2	6	TX DATA	MODULE BOARD(LOWER)	MC-6
CM2	7	D.GND	MODULE BOARD(LOWER)	MC-7
CM2	8	CLK	MODULE BOARD(LOWER)	MC-8
CD1	1	D.GND	LCD	LCD-1
CD1	2	+5V	LCD	LCD-2
CD1	3	CONTRAST VR(2)	LCD	LCD-3
CD1	4	RS	LCD	LCD-4
CD1	5	R/W	LCD	LCD-5
CD1	6	ENABLE	LCD	LCD-6
CD1	7	NC		
CD2	1	D0	LCD	LCD-7
CD2	2	D1	LCD	LCD-8
CD2	3	D2	LCD	LCD-9
CD2	4	D3	LCD	LCD-10
CD2	5	D4	LCD	LCD-11
CD2	6	D5	LCD	LCD-12
CD2	7	D6	LCD	LCD-13
CD2	8	D7	LCD	LCD-14
CD2	9	DATA	LCD	LCD-15
CD3	1	EL	EL	EL-17
CD3	2	NC		
CD3	3	D.GND	EL	EL-16
CS1	1	A.GND	POWER SUPPLY BOARD	P-2
CS1	2	-15V	POWER SUPPLY BOARD	P-3
CS1	3	+15V	POWER SUPPLY BOARD	P-1
CS1	4	+5V	POWER SUPPLY BOARD	P-5
CS1	5	+5V	POWER SUPPLY BOARD	P-5
CS1	6	D.GND	POWER SUPPLY BOARD	P-4
CS1	7	D.GND	POWER SUPPLY BOARD	P-4



CPU BOARD

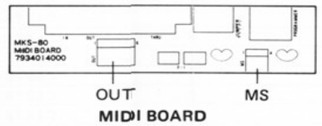
MODULE BOARD (LOWER)				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
MC	1	T0	CPU BOARD	CM2-1
MC	2	T1	CPU BOARD	CM2-2
MC	3	D.GND	CPU BOARD	CM2-3
MC	4	RX.DATA	CPU BOARD	CM2-4
MC	5	RESET	CPU BOARD	CM2-5
MC	6	TX.DATA	CPU BOARD	CM2-6
MC	7	D.GND	CPU BOARD	CM2-7
MC	8	CLK	CPU BOARD	CM2-8
MO	1	NOISE	OUTPUT BOARD	OM2-3
MO	2	A.GND		
MO	3	VCA OUT	OUTPUT BOARD	OM1-2
MO	4	A.GND	OUTPUT BOARD	OM1-1
MS1	1	-15V	POWER SUPPLY BOARD	P3
MS1	2	-15V	POWER SUPPLY BOARD	P3
MS1	3	A.GND	POWER SUPPLY BOARD	P2
MS1	4	A.GND	POWER SUPPLY BOARD	P2
MS1	5	+15V	POWER SUPPLY BOARD	P1
MS1	6	+15V	POWER SUPPLY BOARD	P1
MS2	1	+5V	POWER SUPPLY BOARD	P5
MS2	2	D.GND	POWER SUPPLY BOARD	P4
MS2	3	-15V	POWER SUPPLY BOARD	P3
MS2	4	A.GND	POWER SUPPLY BOARD	P2
MS2	5	+15V	POWER SUPPLY BOARD	P1
MS2	6	+10V	POWER SUPPLY BOARD	P6



MODULE BOARD

MODULE BOARD (UPPER)				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
MC	1	T0	CPU BOARD	CM1-1
MC	2	T1	CPU BOARD	CM1-2
MC	3	D.GND	CPU BOARD	CM1-3
MC	4	RX.DATA	CPU BOARD	CM1-4
MC	5	RESET	CPU BOARD	CM1-5
MC	6	TX.DATA	CPU BOARD	CM1-6
MC	7	D.GND	CPU BOARD	CM1-7
MC	8	CLK	CPU BOARD	CM1-8
MO	1	NOISE	OUTPUT BOARD	OM2-1
MO	2	A.GND		
MO	3	VCA OUT	OUTPUT BOARD	OM1-5
MO	4	A.GND	OUTPUT BOARD	OM1-3
MS1	1	-15V	POWER SUPPLY BOARD	P3
MS1	2	-15V	POWER SUPPLY BOARD	P3
MS1	3	A.GND	POWER SUPPLY BOARD	P2
MS1	4	A.GND	POWER SUPPLY BOARD	P2
MS1	5	+15V	POWER SUPPLY BOARD	P1
MS1	6	+15V	POWER SUPPLY BOARD	P1
MS2	1	+5V	POWER SUPPLY BOARD	P5
MS2	2	D.GND	POWER SUPPLY BOARD	P4
MS2	3	-15V	POWER SUPPLY BOARD	P3
MS2	4	A.GND	POWER SUPPLY BOARD	P2
MS2	5	+15V	POWER SUPPLY BOARD	P1
MS2	6	+10V	POWER SUPPLY BOARD	P6

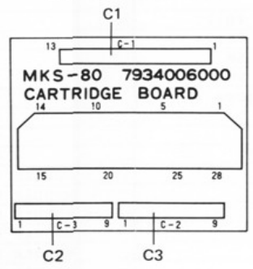
MIDI BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
OUT	1	PROGRAMER SW(COM)	OUTPUT BOARD	MI-7
OUT	2	PROGRAMER SW(COM)	OUTPUT BOARD	MI-5
OUT	3	MIDI OUT(4)	OUTPUT BOARD	MI-4
OUT	4	MIDI OUT(5)	OUTPUT BOARD	MI-3
OUT	5	MIDI THRU(4)	OUTPUT BOARD	MI-2
OUT	6	MIDI THRU(5)	OUTPUT BOARD	MI-1
MS	1	UNREG	POWER SUPPLY BOARD	P7-59
MS	2	UNREG	POWER SUPPLY BOARD	P7-57
MS	3	D.GND	POWER SUPPLY BOARD	P7-56
MS	4	D.GND	POWER SUPPLY BOARD	P7-55



MIDI BOARD

CARTRIDGE BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
C1	1	A0	CPU BOARD	CC1-1
C1	2	A1	CPU BOARD	CC1-2
C1	3	A2	CPU BOARD	CC1-3
C1	4	A3	CPU BOARD	CC1-4
C1	5	A4	CPU BOARD	CC1-5
C1	6	A5	CPU BOARD	CC1-6
C1	7	A6	CPU BOARD	CC1-7
C1	8	A7	CPU BOARD	CC1-8
C1	9	A8	CPU BOARD	CC1-9
C1	10	A9	CPU BOARD	CC1-10
C1	11	A10	CPU BOARD	CC1-11
C1	12	NC		
C1	13	A11	CPU BOARD	CC1-12
C2	1	D7	CPU BOARD	CC2-8
C2	2	D6	CPU BOARD	CC2-7
C2	3	D5	CPU BOARD	CC2-6
C2	4	D4	CPU BOARD	CC2-5
C2	5	D3	CPU BOARD	CC2-4
C2	6	D2	CPU BOARD	CC2-3
C2	7	D1	CPU BOARD	CC2-2
C2	8	NC		
C2	9	D0	CPU BOARD	CC2-1
C3	1	SENS	CPU BOARD	CC3-1
C3	2	RESET	CPU BOARD	CC3-2
C3	3	D.GND	CPU BOARD	CC3-3
C3	4	NC		
C3	5	CF	CPU BOARD	CC3-4
C3	6	WE	CPU BOARD	CC3-5
C3	7	OE	CPU BOARD	CC3-6
C3	8	VDD	CPU BOARD	CC3-7
C3	9	A12	CPU BOARD	CC3-8

CARTRIDGE BOARD

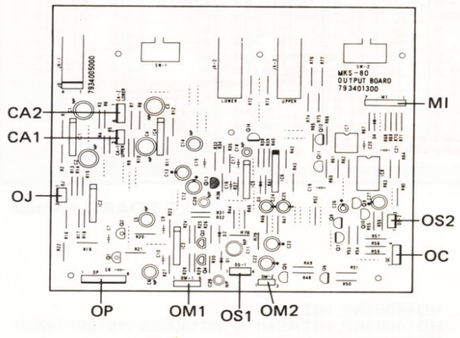


L C D				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
LCD	1	D.GND	CPU BOARD	CD1-1
LCD	2	+5V	CPU BOARD	CD1-2
LCD	3	CONTRAST VR(2)	CPU BOARD	CD1-3
LCD	4	RS	CPU BOARD	CD1-4
LCD	5	R/W	CPU BOARD	CD1-5
LCD	6	ENABLE	CPU BOARD	CD1-6
LCD	7	D0	CPU BOARD	CD2-1
LCD	8	D1	CPU BOARD	CD2-2
LCD	9	D2	CPU BOARD	CD2-3
LCD	10	D3	CPU BOARD	CD2-4
LCD	11	D4	CPU BOARD	CD2-5
LCD	12	D5	CPU BOARD	CD2-6
LCD	13	D6	CPU BOARD	CD2-7
LCD	14	D7	CPU BOARD	CD2-8
LCD	15	DATA	CPU BOARD	CD2-9
LCD	16	EL	CPU BOARD	CD3-3
LCD	17	EL	CPU BOARD	CD3-1

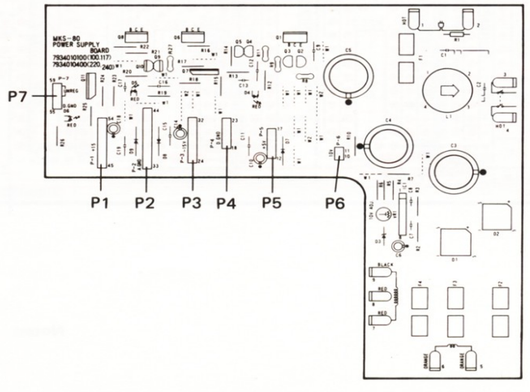
OUTPUT BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
OC	1	STEREO/MONO	CPU BOARD	CO-4
OC	2	RESET	CPU BOARD	CO-3
OC	3	MIDI IN	CPU BOARD	CO-2
OC	4	MIDI OUT	CPU BOARD	CO-1
OJ	1	A.GND	PHONES BOARD	JO-1
OJ	2	PHONES(LOWER)	PHONES BOARD	JO-3
OJ	3	PHONES(UPPER)	PHONES BOARD	JO-4
OP	1	VOLUME OUT(LOWER)	PANEL BOARD	PO-9
OP	2	A.GND	PANEL BOARD	PO-8
OP	3	VOLUME OUT(UPPER)	PANEL BOARD	PO-7
OP	4	A.GND	PANEL BOARD	PO-6
OP	5	VOLUME IN (UPPER)	PANEL BOARD	PO-5
OP	6	A.GND	PANEL BOARD	PO-4
OP	7	VOLUME IN (LOWER)	PANEL BOARD	PO-3
OP	8	A.GND	PANEL BOARD	PO-1
OM1	1	A.GND	MODULE BOARD(LOWER)	MO-4
OM1	2	VCA OUT	MODULE BOARD(LOWER)	MO-3
OM1	3	A.GND	MODULE BOARD(UPPER)	MO-4
OM1	4	NC		
OM1	5	VCA OUT	MODULE BOARD(UPPER)	MO-3
OM2	1	NOISE	MODULE BOARD(UPPER)	MO-1
OM2	2	NC		
OM2	3	NOISE	MODULE BOARD(LOWER)	MO-1
CA1	1	A.GND	XLR (UPPER)	1
CA1	2	+	XLR (UPPER)	3
CA1	3	-	XLR (UPPER)	2
CA2	1	NC		
CA2	2	A.GND	XLR (LOWER)	1
CA2	3	+	XLR (LOWER)	3
CA2	4	-	XLR (LOWER)	2
MI	1	MIDI THRU(5)	MIDI BOARD	OUT-6
MI	2	MIDI THRU(4)	MIDI BOARD	OUT-5
MI	3	MIDI OUT (5)	MIDI BOARD	OUT-4
MI	4	MIDI OUT (4)	MIDI BOARD	OUT-3
MI	5	PROGRAMER OUT SW(COM)	MIDI BOARD	OUT-2
MI	6	NC		
MI	7	PROGRAMER OUT SW(COM)	MIDI BOARD	OUT-1
OS1	1	-15V	POWER SUPPLY BOARD	P3-32
OS1	2	A.GND	POWER SUPPLY BOARD	P2-41
OS1	3	A.GND	POWER SUPPLY BOARD	P2-42
OS1	4	+15V	POWER SUPPLY BOARD	P1-53
OS2	1	+15V	POWER SUPPLY BOARD	P1-54
OS2	2	D.GND	POWER SUPPLY BOARD	P4-23
OS2	3	+5V	POWER SUPPLY BOARD	P5-17

POWER SUPPLY BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
P1	45	+15V	MODULE BOARD(LOWER)	MS1
P1	46	+15V	MODULE BOARD(LOWER)	MS1
P1	47	NC		
P1	48	+15V	MODULE BOARD(UPPER)	MS1
P1	49	+15V	MODULE BOARD(UPPER)	MS1
P1	50	+15V	MODULE BOARD(LOWER)	MS2
P1	51	+15V	MODULE BOARD(UPPER)	MS2
P1	52	NC		
P1	53	NC		
P1	54	NC		
P2	33	A.GND	MODULE BOARD(LOWER)	MS1
P2	34	NC		
P2	35	A.GND	MODULE BOARD(UPPER)	MS1
P2	36	A.GND	MODULE BOARD(UPPER)	MS1
P2	37	A.GND	MODULE BOARD(UPPER)	MS1
P2	38	A.GND	MODULE BOARD(LOWER)	MS2
P2	39	A.GND	MODULE BOARD(UPPER)	MS2
P2	40	A.GND	CPU BOARD	CS
P2	41	A.GND	OUTPUT BOARD	OS1
P2	42	A.GND	OUTPUT BOARD	OS1
P2	43	NC		
P2	44	NC		
P3	24	-15V	MODULE BOARD(LOWER)	MS1
P3	25	NC		
P3	26	-15V	MODULE BOARD(UPPER)	MS1
P3	27	-15V	MODULE BOARD(UPPER)	MS1
P3	28	-15V	MODULE BOARD(UPPER)	MS1
P3	29	-15V	MODULE BOARD(LOWER)	MS2
P3	30	-15V	MODULE BOARD(UPPER)	MS2
P3	31	-15V	CPU BOARD	CS
P3	32	-15V	OUTPUT BOARD	OS1
P4	18	D.GND	MODULE BOARD(LOWER)	MS2
P4	19	D.GND	MODULE BOARD(UPPER)	MS2
P4	20	NC		
P4	21	D.GND	CPU BOARD	CS
P4	22	D.GND	CPU BOARD	CS
P4	23	D.GND	OUTPUT BOARD	OS2
P5	12	+5V	MODULE BOARD(LOWER)	MS2
P5	13	NC		
P5	14	+5V	MODULE BOARD(UPPER)	MS2
P5	15	+5V	CPU BOARD	CS
P5	16	+5V	CPU BOARD	CS
P5	17	+5V	OUTPUT BOARD	OS2
P6	10	REF +10V	MODULE BOARD(LOWER)	MS2
P6	11	REF +10V	MODULE BOARD	MS2

OUTPUT BOARD



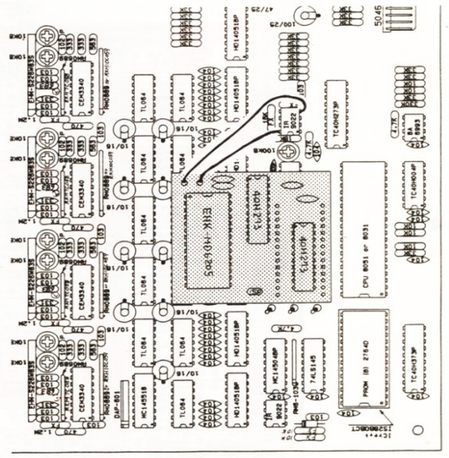
POWER SUPPLY BOARD

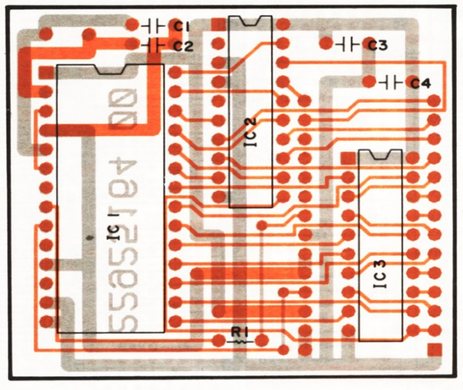


D/A BOARD(pcb 22925164)

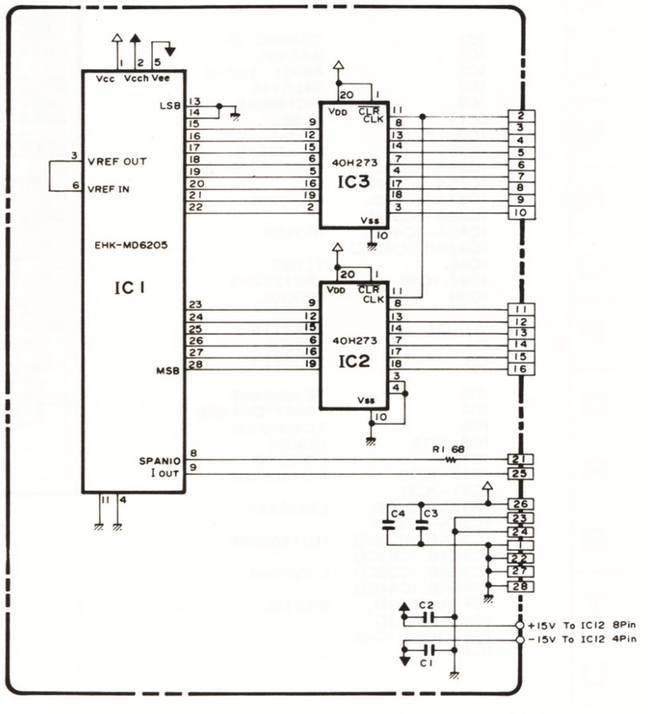
Substitutive for IC10 ITS80141 of Module Board

D/A Board is equivalent to ITS80141 in operation and is pin-for-pin compatible.
This board is installed on some Module Boards in place of the ITS80141.
The board can also be used as a direct replacement of the ITS80141 when additional ±15V are supplied.





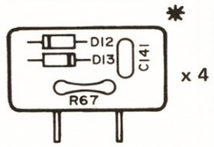
IC1 : EHK-MD6205
IC2, IC3 : 40H273
C1 – C4 : RPE132F104Z50 0.1μF

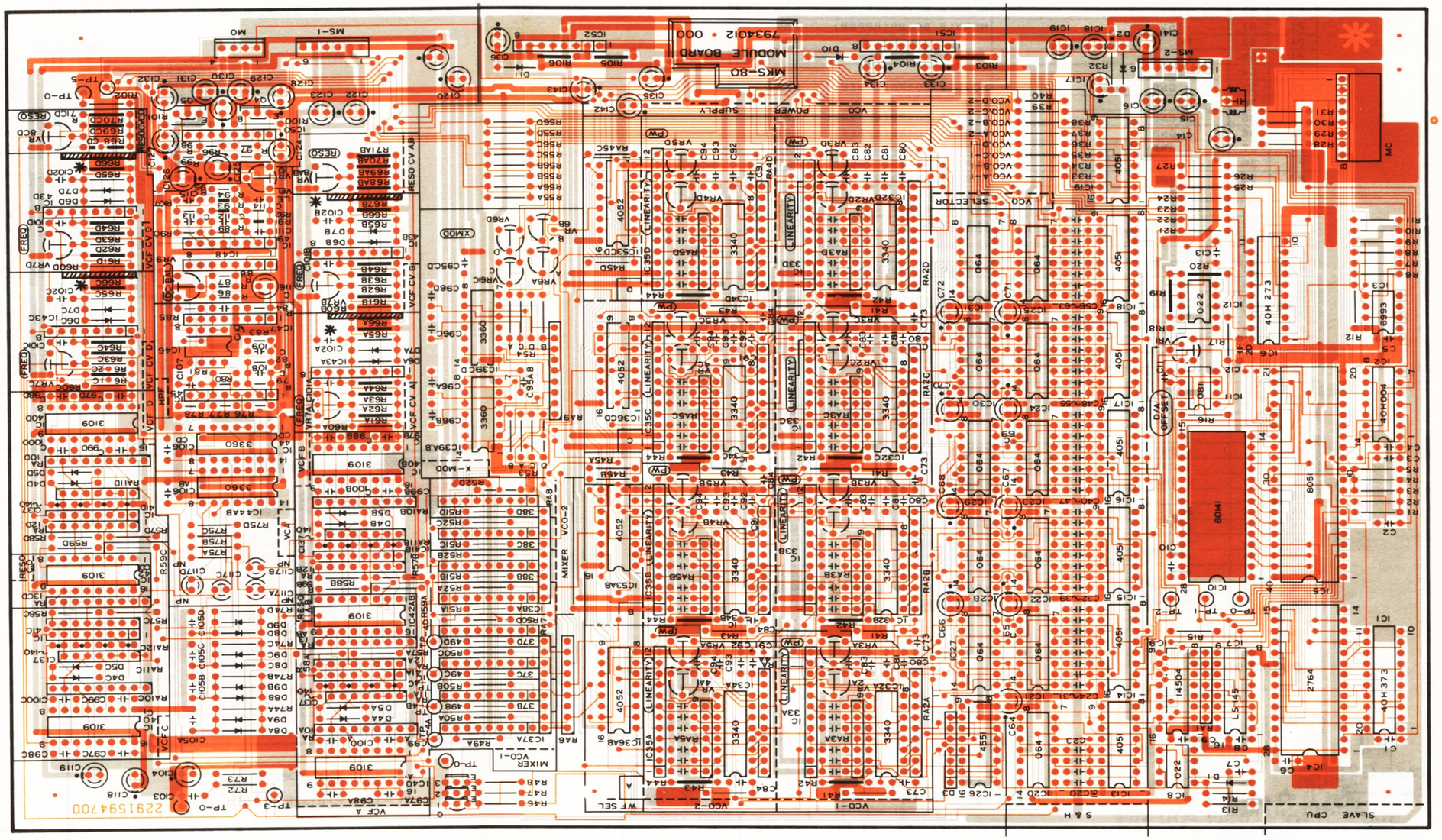


MODULE BOARD 7934012000 (pcb 22915947)

See P.15 for whole Circuit Diagram

ATTACK BOARD
PCB 22925119





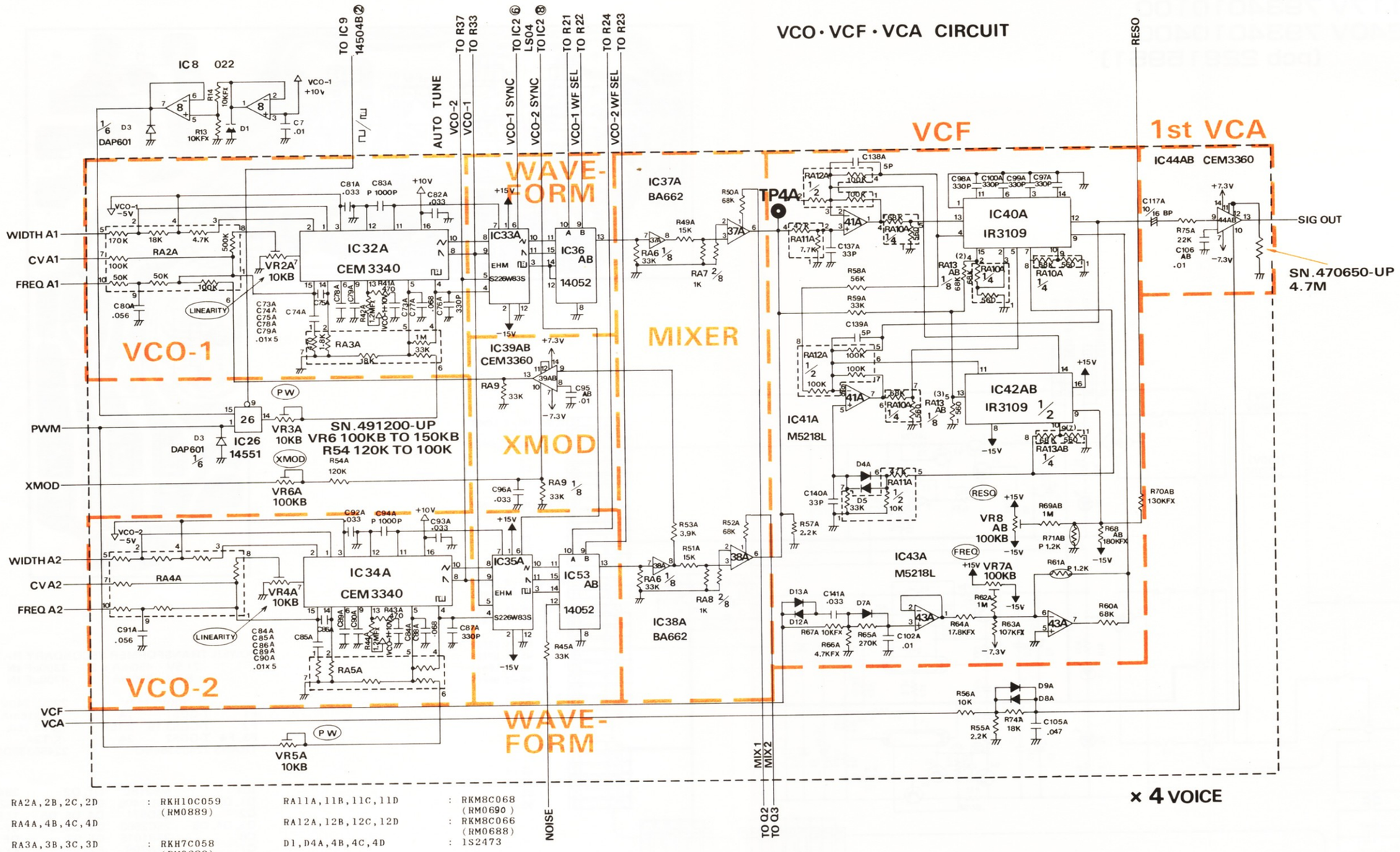
A, B, C, D; MODULE BOARD 4 Voice

IC1	TC40H373P
IC3	BA6993
IC5	P8051−319−0
IC7	74LS145
IC9	MC14504B
IC11	TL081
IC20−IC25, IC26	TL064
IC33A−IC33D, IC35A−IC35D	MC14551B
IC37A−IC37D, IC38A−IC38D	EHM−S226W83S
IC40A−IC40D, IC42AB, IC42CD	BA662 A
IC46	IR3109
IC47, IC48	TL082
IC50	µPC1252H2
	M5230L
Q1−Q3	2SA1115 E
Q4	2SB605 L
Q5	2SD571 L
IC2	TC40H004P
IC4	TMM27C64-680
IC6	TC40H273P
IC8, IC12	IR9022
IC10	ITS80141
IC13−IC19	HD14051BP
IC27−IC31	
IC32A−IC32D, IC34A−IC34D	CEM3340
IC36AB, IC36CD, IC53AB, IC53CD	HD14052BP
IC39AB, IC39CD, IC44AB, IC44CD	CEM3360
IC41A−IC41D, IC43A−IC43D, IC51, IC52, IC45, IC49	M5218L

Notes: IC13−19 ..... HD14051BP, HITACHI only
IC36, IC53 .. HD14052BP, HITACHI or MC14052B (15159114ZO) MOTOROLA only

VCO·VCF·VCA CIRCUIT DIAGRAM

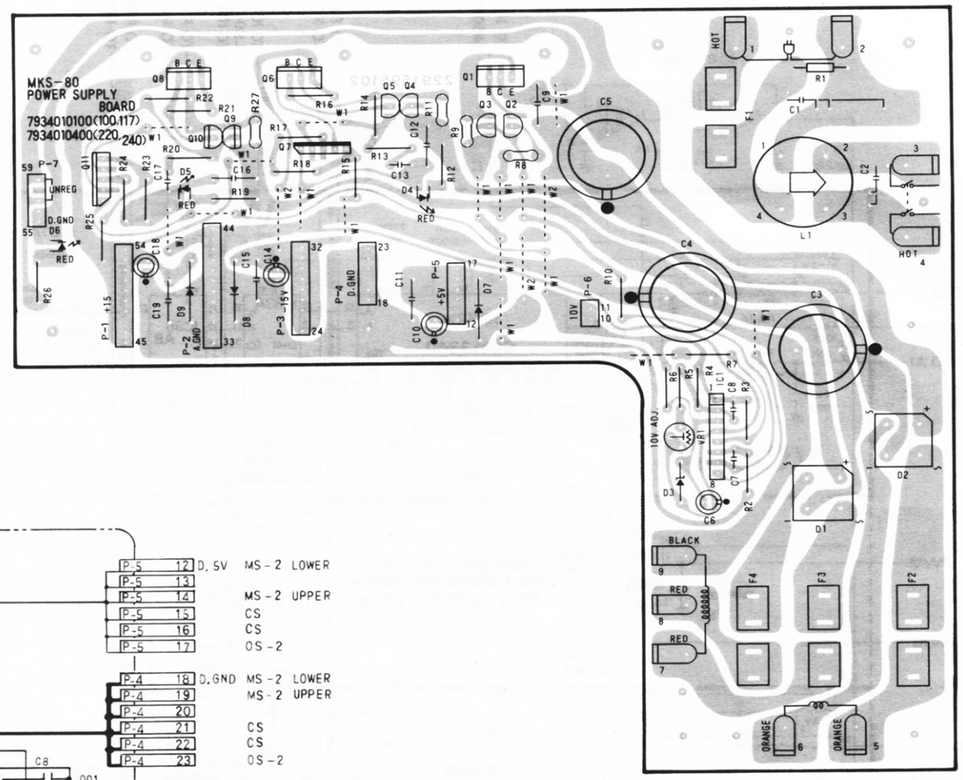
See P.15 for whole Module Circuit Diagram

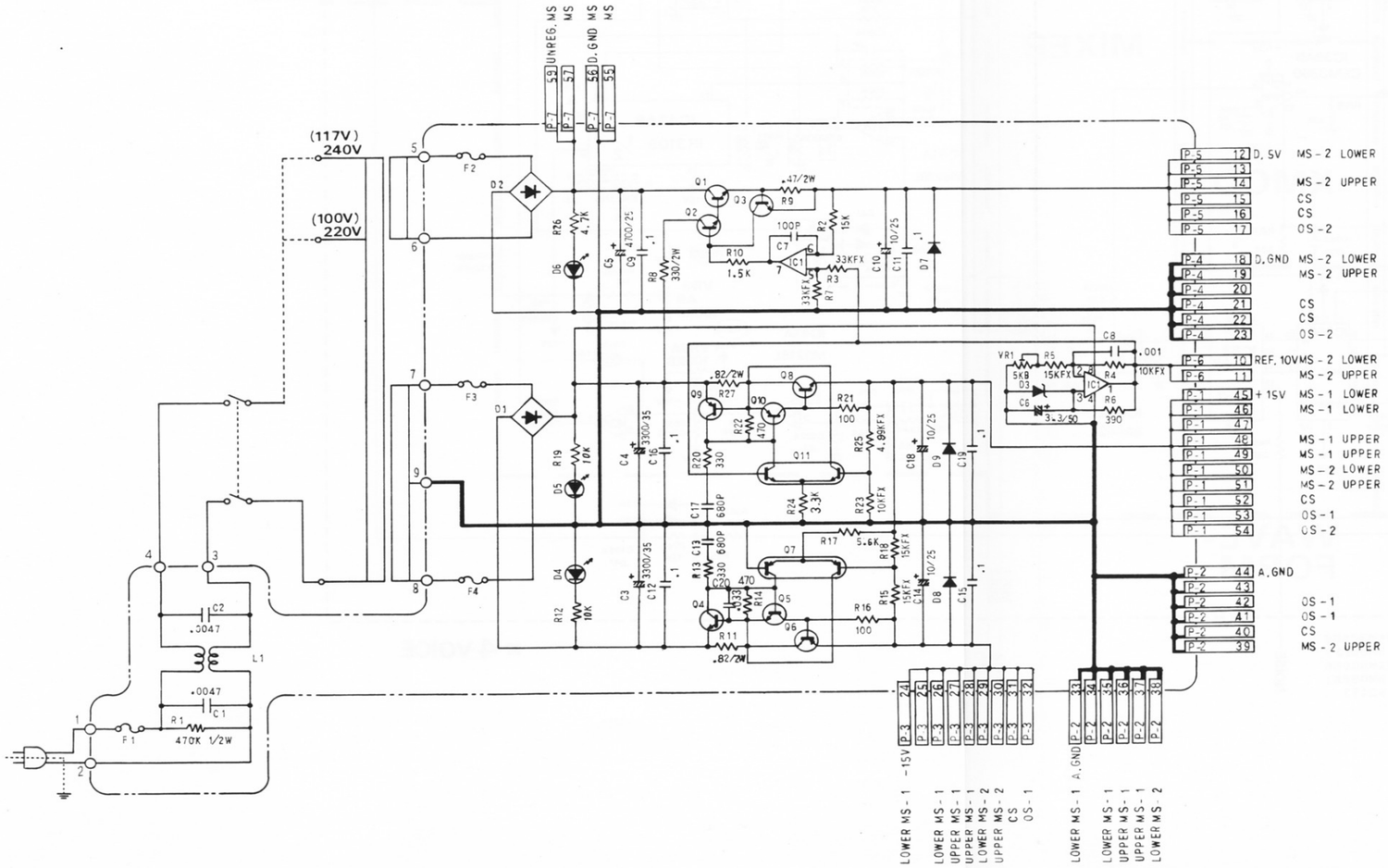


RA2A,2B,2C,2D	:	RKH10C059 (RM0889)	RA11A,11B,11C,11D	:	RKM8C068 (RM0690)
RA4A,4B,4C,4D			RA12A,12B,12C,12D	:	RKM8C066 (RM0688)
RA3A,3B,3C,3D	:	RKH7C058 (RM0689)	D1,D4A,4B,4C,4D	:	1S2473
RA5A,5B,5C,5D			D5A,5B,5C,5D		
RA6,RA9	:	RM8-333J	D6A,6B,6C,6D		
RA7,RA8	:	RM8-102J	D7A,7B,7C,7D		
RA10A,10B,10C,10D	:	RKM9F561/683GP (RM0891)	D8A,8B,8C,8D		
RA13AB,13CD			D9A,9B,9C,9D		
			D12A,12B,12C,12D		
			D13A,13B,13C,13D		

POWER SUPPLY BOARD

100V,117V 7934010100
220V,240V 7934010400
(pcb 229915951)





POWER TRANSFORMER SECONDARY RATINGS

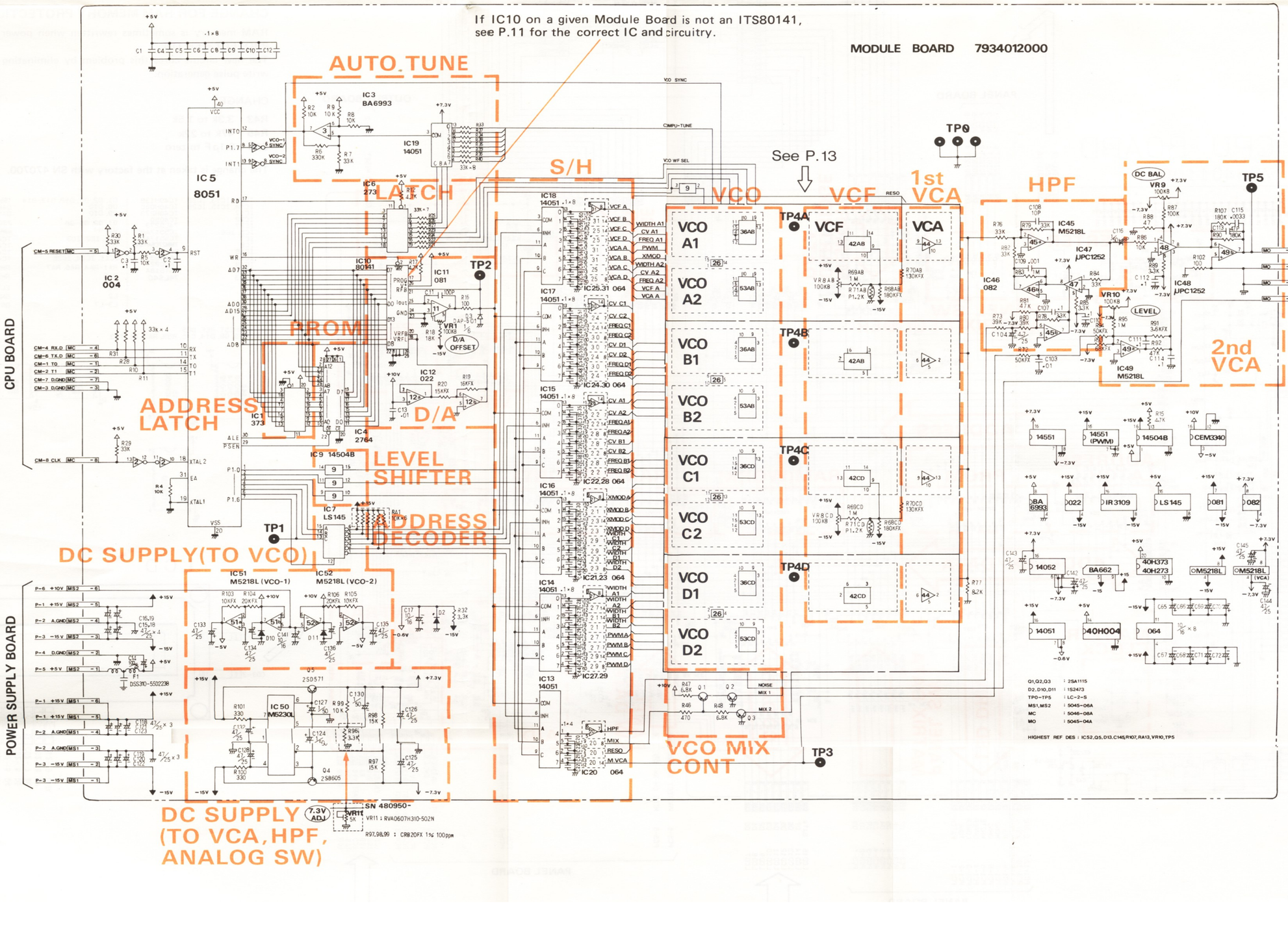
21.5V	450mA x 2	3300μF IN
8.5V	800mA	4700μF IN

	100V, 117V	220V, 240V
F1	T-GGS1 1A	Ⓢ T315mA
F2	T-GGS3.15 3.15A	Ⓢ T3.15A
F3, F4	T-GGS2 2A	Ⓢ T2A
TRANS	22455384NO	22455388DO

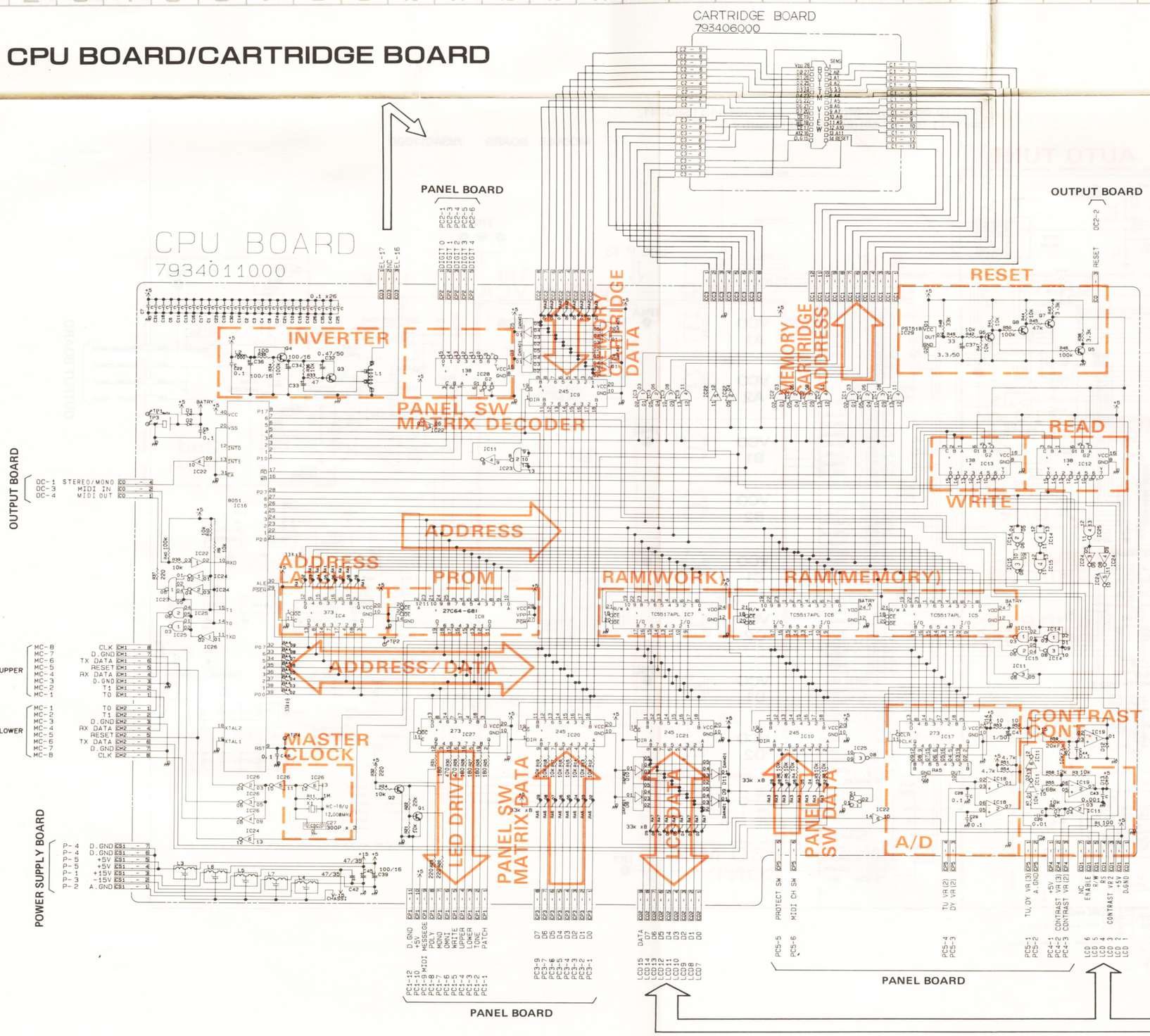
IC1	M5218L	D1, D2	2B4B41
Q1, Q8	2SD1406	D3	1SZ59
Q2	2SD571	D4, D5, D6	TLR124
Q3, Q4, Q5	2SC2603	D7, D8, D9	GP-30G
Q6	2SB1015	C1, C2	DE7150F472MVA1
Q7	2SA798	L1	FKOB-160MH15
Q9, Q10	2SA1115		
Q11	2SC1583		

HIGHEST REF DES IC1, Q11, D9, C19, R27
L1, F4

MODULE BOARD



CPU BOARD/CARTRIDGE BOARD



CHANGE FOR RAM MEMORY PROTECTION

RAM memory is sometimes rewritten when power is turned ON without PROTECT set at ON.
The new circuit cures this problem by eliminating the chance of a RAM write pulse generation.

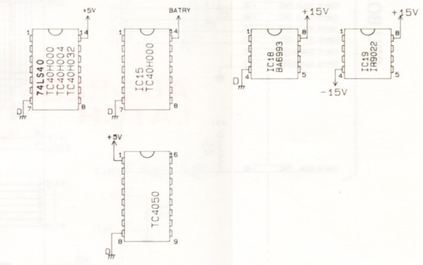
CHANGE

R43 3.3k to 1.5k
R45 47k to 22k
C38 0.1μF to zero

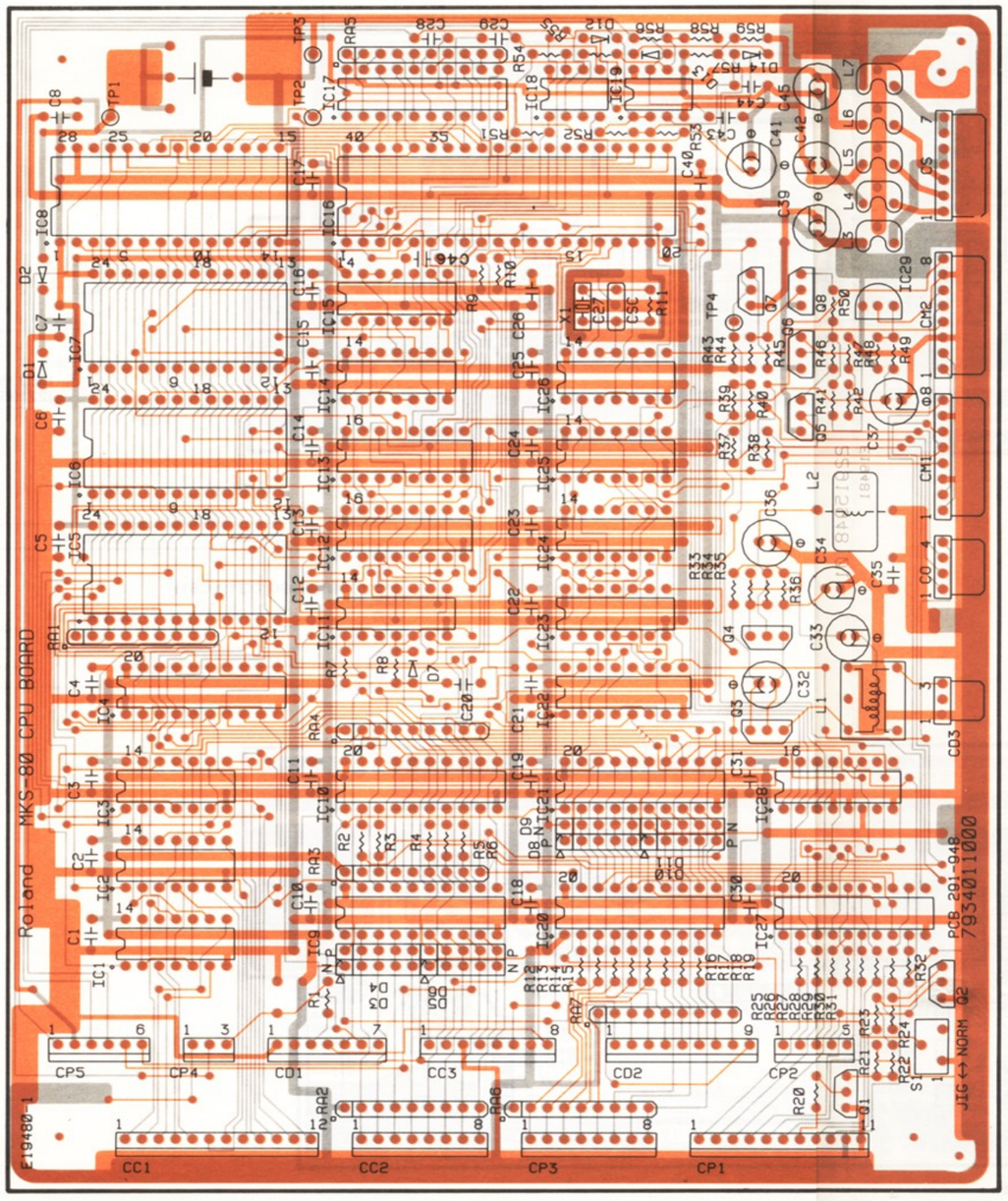
The change is taken at the factory with SN 470700.

IC12, IC13, IC28	TC40H138	D1, D2, D7, D12, D13, D14	1SS-133
IC14, IC15, IC25	TC40H000	D8, D10	DAP401
IC17	TC40H273	D9, D10	DAN401
IC22	TC4050	Q1, Q2, Q5-Q8	2SC2603E
IC27	74LS273	Q3, Q4	2SC1815GR
IC5, IC6	TC5517APL		
IC7	TC5517AP	IC1, IC2, IC3	TC40H032
IC8	TMM27C64-68I	IC4	TC40H373
IC16	8051	IC9, IC10, IC20, IC21	TC40H245
IC18	BA6993	IC11, IC24, IC26	TC40H004
IC19	IR9022	RA1-RA4, RA6, RA7	RMB-333J (33kJ x8)
IC29	PST518A	RA5	RKB00-R601611
IC23	74LS40	L1	ELT-07
		L2	SNBD-500
		L3-L7	DSS310-55D223S

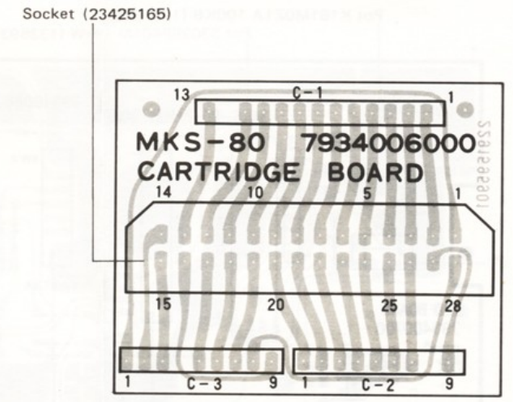
HIGHEST REF DES
IC29, Q8, D14, C45, R59, RA7, X1, TP3



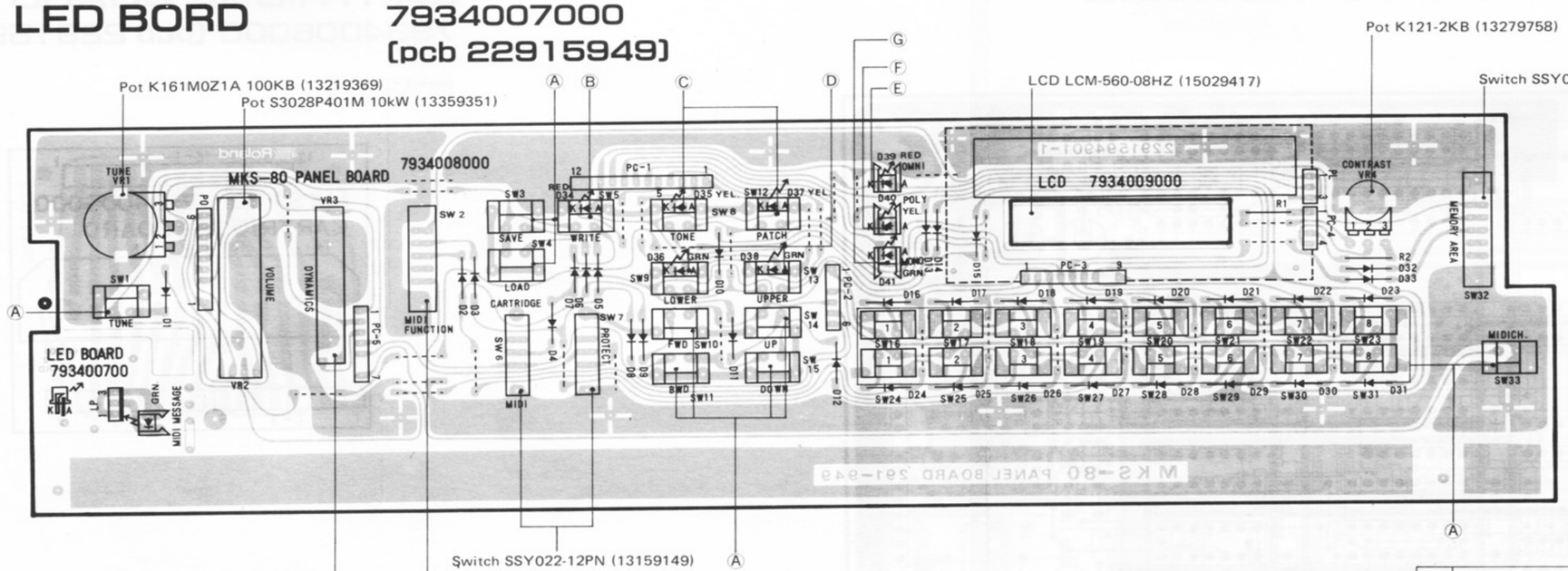
CPU BOARD 7934011000 (pcb 22915948)

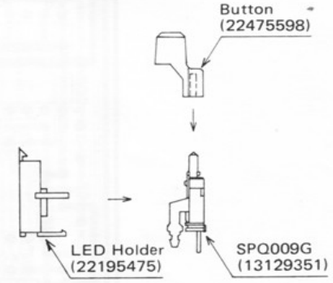


CARTRIDGE BOARD
7934006000 (pcb 22915959)

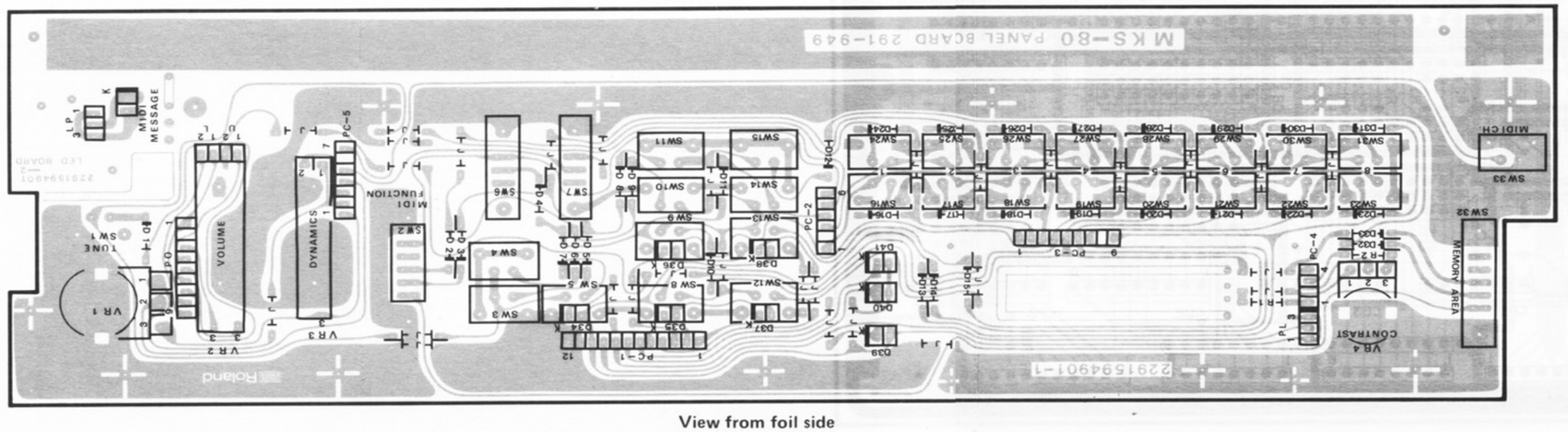


PANEL BOARD 7934008000
LED BORD 7934007000
(pcb 22915949)



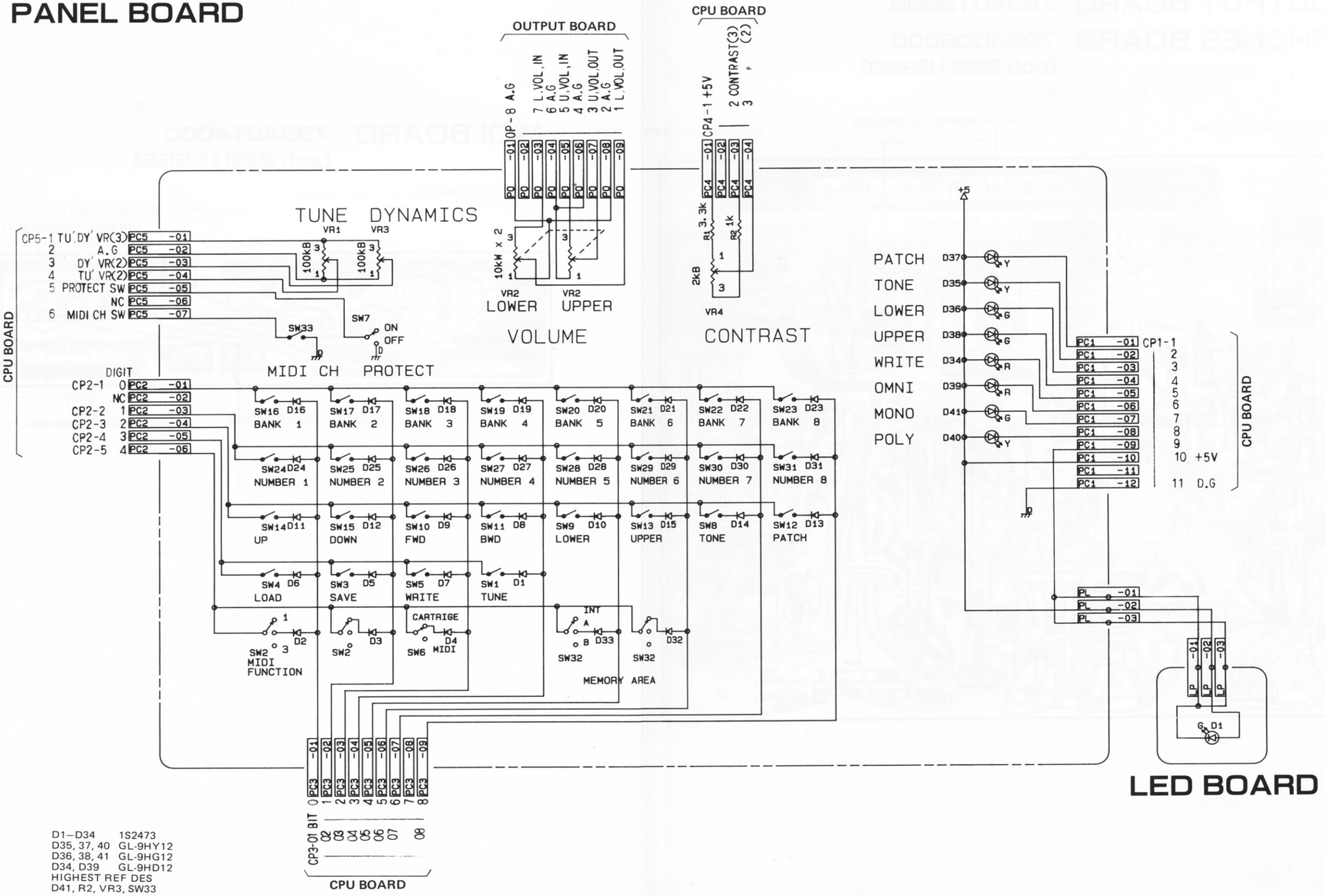


	Switch	LED holder	Button	LED
A	SPQ009G (13129351)	(22195475)	(22475598)	——
B				GL-9HD12 (15029152)
C				GL-9HY12 (15029151)
D				GL-9PG12 (15029149)
E	——		——	GL-9HD12 (15029152)
F	——		——	GL-9HY12 (15029151)
G	——		——	GL-9PG12 (15029149)



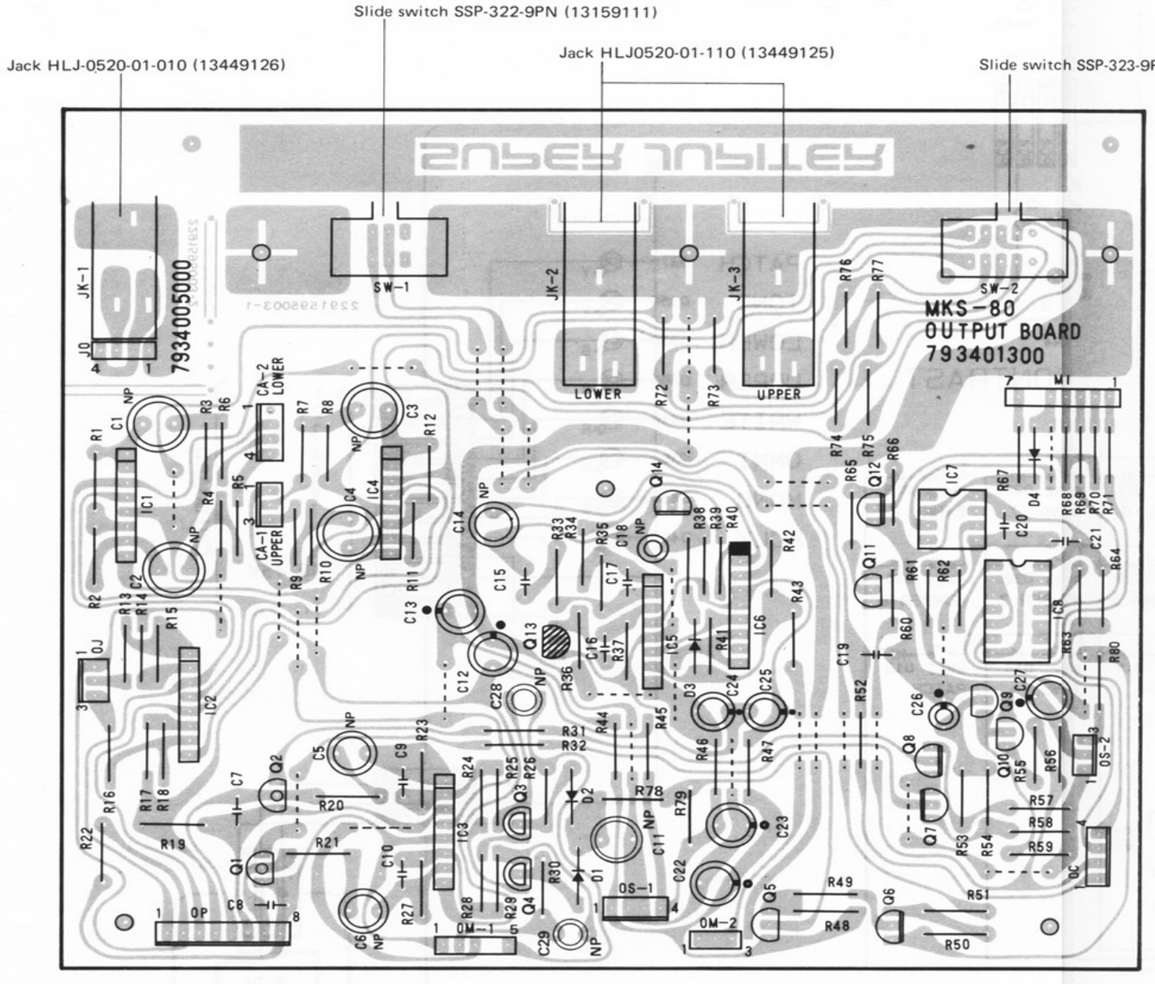
View from foil side

PANEL BOARD

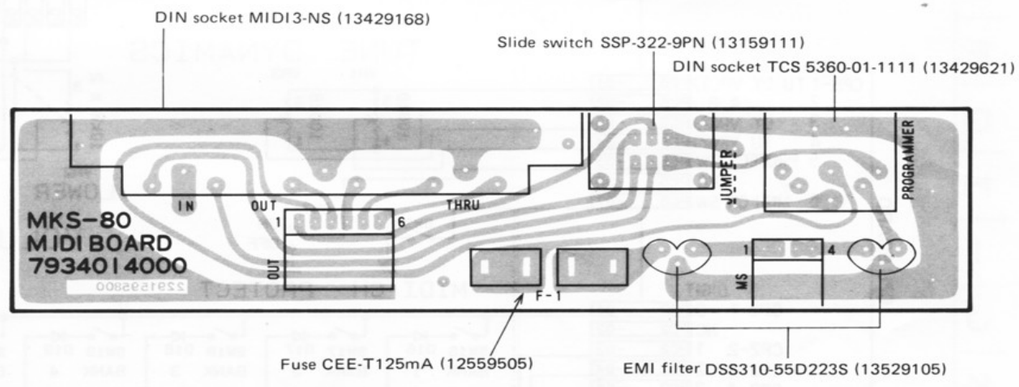


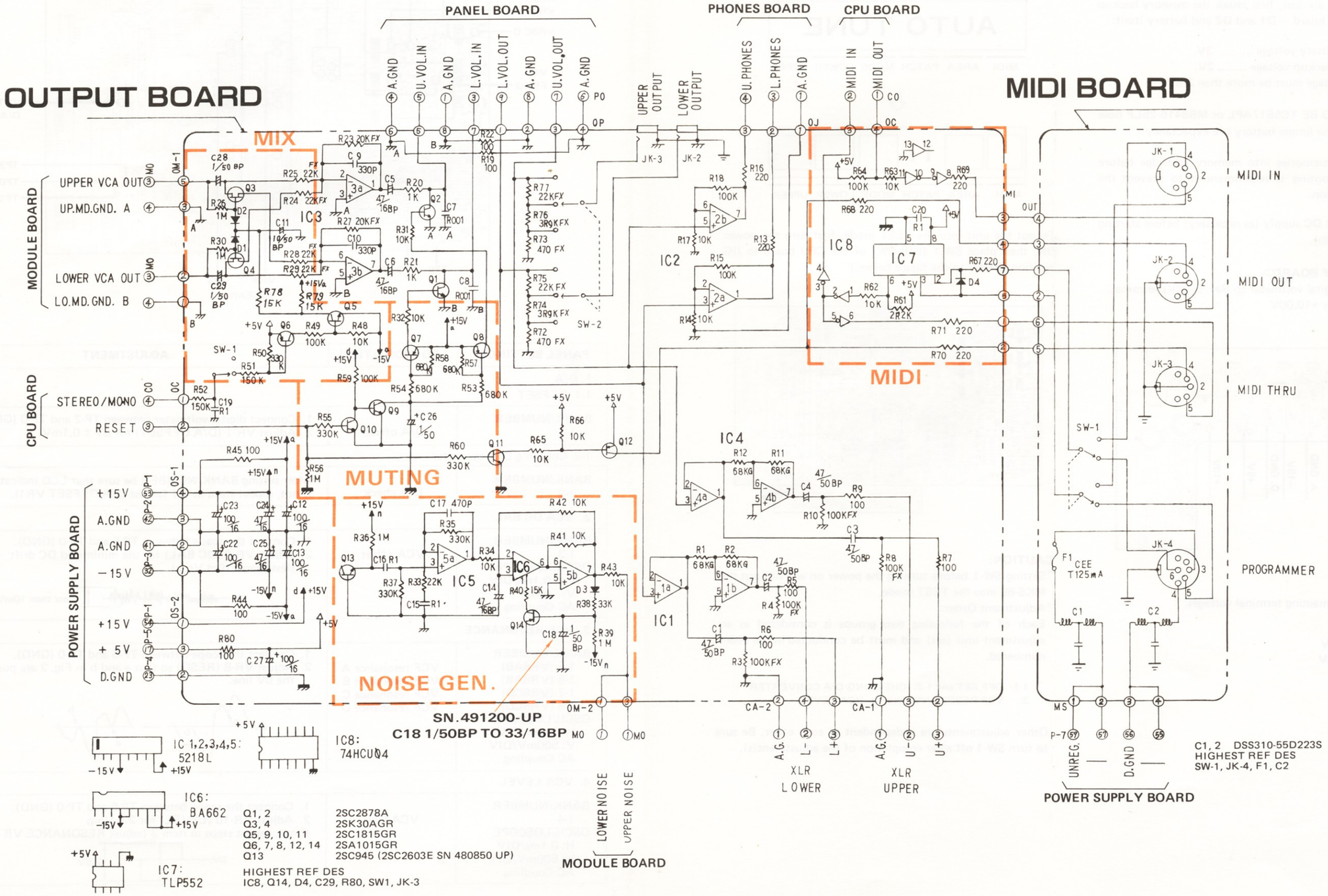
D1–D34 1S2473
D35, 37, 40 GL-9HY12
D36, 38, 41 GL-9HG12
D34, D39 GL-9HD12
HIGHEST REF DES
D41, R2, VR3, SW33

OUTPUT BOARD 7934013000
PHONES BOARD 7934005000
(pcb 22915950)



MIDI BOARD 7934014000
(pcb 22915958)




OUTPUT BOARD
PANEL BOARD
PHONES BOARD
CPU BOARD
MIDI BOARD
MIX
MUTING
NOISE GEN.
MIDI
MODULE BOARD
UPPER VCA OUT
UP.MD.GND. A
LOWER VCA OUT
LO.MD.GND. B
STEREO/MONO
RESET
+15V
A.GND
-15V
+5V
D.GND
A.GND
U.VOL.IN
L.VOL.IN
U.VOL.OUT
L.VOL.OUT
U.VOL.OUT
A.GND
UPPER OUTPUT
LOWER OUTPUT
U.PHONES
L.PHONES
A.GND
MIDI IN
MIDI OUT
MIDI IN
MIDI OUT
MIDI THRU
PROGRAMMER
SW-1
F1
CEE
T125mA
MS
UNREG.
D.GND
POWER SUPPLY BOARD
XLR LOWER
XLR UPPER
A.G.
L-
L+
U-
U+
LOWER NOISE
UPPER NOISE
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
SN.491200-UP
C18 1/50BP TO 33/16BP
IC 1,2,3,4,5: 5218L
IC8: 74HCU04
IC6: BA662
IC7: TLP552
Q1, 2 2SC2878A
Q3, 4 2SK30AGR
Q5, 9, 10, 11 2SC1815GR
Q6, 7, 8, 12, 14 2SA1015GR
Q13 2SC945 (2SC2603E SN 480850 UP)
HIGHEST REF DES
IC8, Q14, D4, C29, R80, SW1, JK-3
C1, 2 DSS310-55D223S
HIGHEST REF DES
SW-1, JK-4, F1, C2

ADJUSTMENT

CAUTIONS:
When the MKS-80 program cannot proceed orderly or overruns intermittently, first check the power line for excessive fluctuation, loose contact or external pulses.

If Patch Memories are lost, first check the memory backup circuit on the CPU board — D1 and D2 and battery itself:

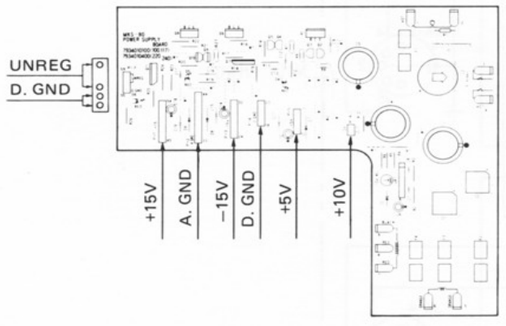
Nominal battery voltage ..... 3V.
Minimum backup voltage ..... 2V.
Battery voltage must be more than 2.6V.

IC6 RAM SHOULD BE TC5517APL or MB8416-25LP (low current type) for the longer battery life expectancy.

Saving the Patch memories into memory cartridge before starting troubleshooting is recommended to prevent the possible volatilization.

Check and readjust DC supply (as necessary) before starting particular adjustment.

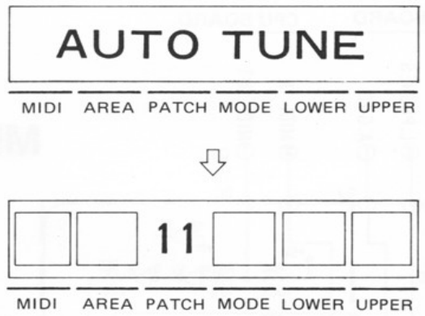
<POWER SUPPLY BOARD>
1. Connect the digital voltmeter to Ref. (+10V) terminal.
2. Adjust VR-1 for +10.00V



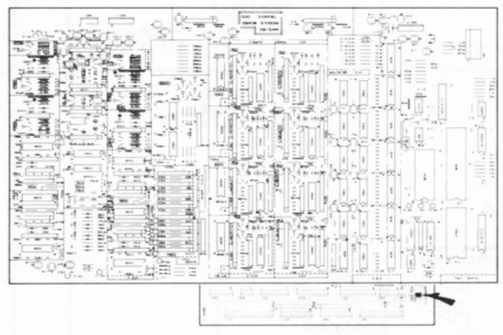
3. Confirm the remaining terminal voltages.

+5V ± 30mV
+15V ± 100mV
−15V ± 400mV

Turn the power ON, The display will read twice as shown below.
The numbers other then PATCH (11) are conditional.



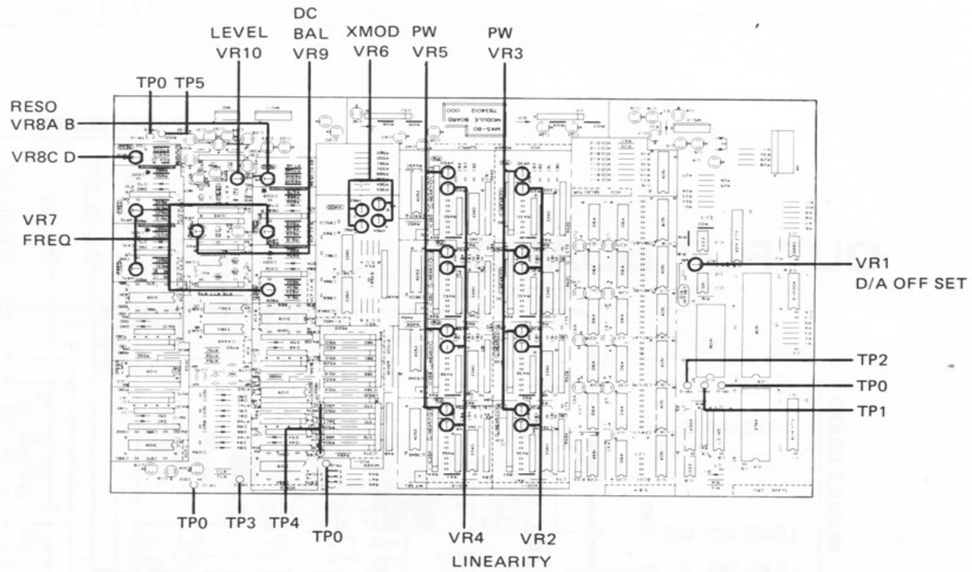
To put the unit into the TEST mode, first turn the power ON, then place SW-1 (DIP SW) of the CPU board to JIG position. (Refer to the figure below.)



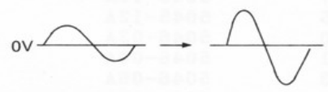
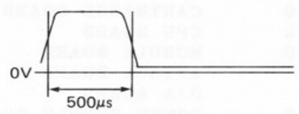
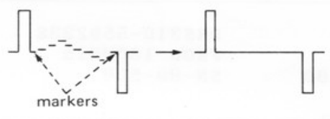
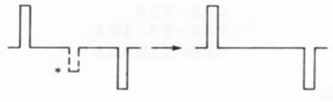
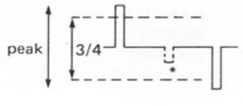
CAUTION:
*Setting SW-1 before turning the power on will not put the MKS-80 into the TEST mode.
*Adjustment Order:
Each of the following two groups is considered as an adjustment unit (set) and must be conducted in the order numbered.

1-1: OFF SET and 1-2: CHECKING D/A CONVERTER
3: VCF RESONANCE and 4: VCA LEVEL

Other adjustments are independent of each other. Be sure to turn SW-1 off after completion of the adjustment(s).



PANEL SETTINGS	LCD INDICATION	ADJUSTMENT
1. D/A 1-1 OFFSET		
BANK/NUMBER 1-1	D/A offset	1. Connect digital voltmeter between TP-2 and TP-0 (GND). 2. Adjust VR-1 (D/A OFFSET) for 0V ± 0.1mV.
1-2 Checking D/A converter		
BANK/NUMBER 1-2	D/A check	After setting BANK/NUMBER be sure that LCD indicates 'OK OK' If not, repeat steps in 1-1 (adjust D/A OFFSET VR1).
2. VCA DC BAL		
BANK/NUMBER 1-3 OSCILLOSCOPE H: 0.1ms/DIV V: MAX AC Coupling	VCA offset	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-9 (DC BAL) for the minimized DC drift (less than ±10m Vp-p). 0V — less than 10mV **Fig. 1**
3. VCF RESONANCE		
BANK/NUMBER 1-5 (VR8AB) 1-6 (VR8AB) 1-7 (VR8CD) 1-8 (VR8CD) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCF resonance A VCF resonance B VCF resonance C VCF resonance D	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-8 (RESO) so that a and b in Fig. 2 are positioned on the 0V line. 0V a b → b a **Fig. 2**
4. VCA LEVEL		
BANK/NUMBER 1-4 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCA level	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-10 (LEVEL) for 2.5 Vp-p If not, repeat steps in item 3 (adjust RESONANCE VR-8). 0V — 2.5V **Fig. 3**

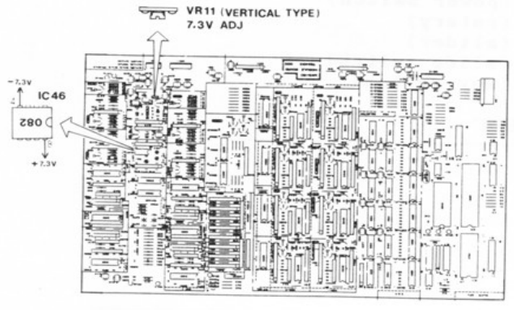
PANEL SETTINGS	LCD INDICATION	ADJUSTMENT
5. VCF FREQ		
BANK/NUMBER 2-1 (VR7A) 2-2 (VR7B) 2-3 (VR7C) 2-4 (VR7D) OSCILLOSCOPE H: 0.1ms/DIV V: 2V/DIV AC Coupling	VCF freq A VCF freq B VCF freq C VCF freq D	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-7 (FREQ) for the maximum amplitude.  Fig. 4
6. VCO PW		
BANK/NUMBER 3-1 (VR3A) 3-2 (VR5A) 3-3 (VR3B) 3-4 (VR5B) 3-5 (VR3C) 3-6 (VR5C) 3-7 (VR3D) 3-8 (VR5D) OSCILLOSCOPE H: 0.1ms/DIV V: 1V/DIV AC Coupling	VCO pw A1 VCO pw A2 VCO pw B1 VCO pw B2 VCO pw C1 VCO pw C2 VCO pw D1 VCO pw D2	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-3 (VR-5) (PW) for the 500μs pulse length.  Fig. 5
7. VCO LINEARITY		
BANK/NUMBER 4-1 (VR2A) 4-2 (VR4A) 4-3 (VR2B) 4-4 (VR4B) 4-5 (VR2C) 4-6 (VR4C) 4-7 (VR2D) 4-8 (VR4C) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO linearity A1 VCO linearity A2 VCO linearity B1 VCO linearity B2 VCO linearity C1 VCO linearity C2 VCO linearity D1 VCO linearity D2	1. Connect the scope between TP-3 and TP-0 (GND). 2. Adjust VR-2 (VR-4) (LINEARITY) for straightness by aligning signals to the markers. Increase V sensitivity for fine adjustment. Press the BANK/NUMBER button again when the detune is too great for adjustment.  Fig. 6
8. VCO CROSS MOD		
BANK/NUMBER 5-1 (VR6A) 5-2 (VR6B) 5-3 (VR6C) 5-4 (VR6D) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO cross mod A VCO cross mod B VCO cross mod C VCO cross mod D	1. Connect the scope between TP-3 and TP-0 (GND). 2. Adjust VR6 (XMOD) to flatten the part (*) as shown in Fig. 7.  Fig. 7
9. VCO FREQ CHECK		
BANK/NUMBER 6-1 6-2 6-3 6-4 6-5 6-6 6-7 6-8 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO check-f A1 VCO check-f A2 VCO check-f B1 VCO check-f B2 VCO check-f C1 VCO check-f C2 VCO check-f D1 VCO check-f D2	1. Connect the scope between TP-3 and TP-0 (GND). 2. Confirm that the '*' part of oscilloscope waveform is less than 3/4 of the peak level.  Fig. 8

PANEL SETTINGS	LCD INDICATION	ADJUSTMENT
10. VCO WIDTH CHECK		
BANK/NUMBER 7-1 7-2 7-3 7-4 7-5 7-6 7-7 7-8 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO check-w A1 VCO check-w A2 VCO check-w B1 VCO check-w B2 VCO check-w C1 VCO check-w C2 VCO check-w D1 VCO check-w D2	Same procedure as VCO FREQ CHECK.

SUPPLEMENTARY ADJUSTMENT (SN480950 to SN511799)

<MODULE BOARD>

1. Connect the digital voltmeter to pin 4 of IC46.
2. Adjust VR11 for −7.3V.



3. Connect the digital voltmeter to pin 8 of IC46.
   Confirm +7.3V ±200mV

PROM REVISIONS INFORMATION (SN470650-UP)

CHANGES:

CPU BOARD	(IC 8)	TMM2764D-681 Ver.3.0 to MBM27C64-25CZ-681 Ver.4.0
MODULE BOARD	(IC 4)	TMM2764D-680 Ver.1.0 to MBM27C64-25CZ-680 Ver.2.0

Module Board PROM Ver.2.0 has new AUTO TUNE routine which should solve the problem of unreliable auto tune during long-hour performance.

Upward compatibility
PROM Ver.2.0 for Module Board is a direct replacement of Ver.1.0.
It can work well in combination with CPU Board PROM of any revision.

There are no significant differences between software versions 3 and 4 of CPU Board PROM. Version 0, 1 or 2 is installed in a few MKS-80's and should be replaced by an updated one, i.e. Versions 3 and subsequent for more reliable operation.

VERSION DISCRIMINATION

To determine the software version number of a CPU Board PROM, switch the power ON while pressing AUTO TUNE and WRITE buttons. The display will show the version number of the currently installed PROM for a couple of seconds, and enter normal operation mode without having any effect on the other functions and the subsequent operation.

The version number of the PROM on a Module Board will not be indicated on the display. It is recognized only by the label.

The table below illustrates a typical PROM software combination for each display, provided that the PROMs in a given MKS-80 remains as-delivered.

PROM REVISIONS INFORMATION

SERIAL NUMBER	PROM A (CPU BOARD) VERSION	PROM B (MODULE BOARD) VERSION	LCD INDICATION
450100 to 460649	Ver 3.0 	Ver 1.0 	"MKS–80 Ver 3.0"
470650 to 511799	Ver 4.0 	Ver 2.0 	"MKS–80 Ver 4.0"
511800 UP	Ver 5.0 	Ver 3.0 	"MKS–80 Ver 5.0"

Note:
PROMs on the units with SN511799 and below should be updated, if not, PROM A to Ver. 4.0, PROM B to Ver. 2.0.

MKS-80 PARTS LIST

CHASSIS

22025247	Bottom cover	
22025244	Top cover	
22125139	Plate	(power transformer)
22125521	Angle	(handle)

PANEL

22215418	Front panel	

HOLDER

22195471	Front holder	
22195472	Side holder	
22195491	Holder	(for module)
22195493	Jack holder	
22195475	LED holder	
22195399	Holder	(for heat sink)

COVER

22025683	LCD cover	
22240402	Cover	(slide Pot mask)
22245131	Cover	(slide switch mask)
22265226	Cover	(dust cover)

KNOB,BUTTON

2247024000	Knob	(power switch)
22470261	Knob	(rotary)
22475329	Knob	(slider)
22475325	Knob	(slide switch)
22475598	Button	(key switch)

DETACHABLE AC CORD SET

13439825	DC-320-J01	100V
13439812F0	UC-704-J01	117V
13439813F0	EC-210-J06	220V
13439846	BH-301-J01	240V2P
13439814F0	SC-415-J06	240V3P

SWITCH

13129124	SDGA-3P	(power)
13159336	SSY023-12PN	(slide)
13159149	SSY022-12PN	(slide)
13129351	SPQ009G	(key)
13159111	SSP-322-9PN	(slide)
13159335	SSP-323-9PS	(slide)
13159137	SSS212A	(DIP)

JACK

13449125	HLJ0520-01-110	(mono)
13449126	HLJ0520-01-010	(stereo)

SOCKET

13429710	PA-126	(AC inlet 100/117/220V)
13429709	PA-125	(AC inlet 240V)
13429621	TCS5360-01-1111	(6P DIN)
13429168	MIDI3-NS	(5P DIN)
13439851	HA16R-3P	(XLR)
23425165	Socket	(memory cartridge)
23425803	Cartridge shell	(memory cartridge)
13429525	IS28B0BCT	(IC 28P)

CONNECTOR

13439119	5045-03A	
13439120	5045-04A	
13439121	5045-05A	
13439122	5045-06A	
13439123	5045-07A	
13439124	5045-08A	
13439125	5045-09A	
13439127	5045-11A	
13439155	5045-12A	
13439130	5046-03A	
13439131	5046-04A	
13439133	5046-06A	
13439134	5046-07A	
13439169	5046-08A	

PCB

7934013000	OUTPUT BOARD		(PCB 22915950)
7934005000	PHONES BOARD		(PCB 22915950)
7934008000	PANEL BOARD		(PCB 22915949)
7934007000	LED BOARD		(PCB 22915949)
7934014000	MIDI BOARD		(PCB 22915958)
7934006000	CARTRIDGE BOARD		(PCB 22915959)
7934011000	CPU BOARD		(PCB 22915948)
7934012000	MODULE BOARD		(PCB 22915947)
	ATTACK BOARD		(PCB 22925119)
	D/A BOARD		(PCB 22925164)
7934010100	POWER SUPPLY BOARD	100V,117V	(PCB 22915951)
7934010400	POWER SUPPLY BOARD	220V,240V	(PCB 22915951)

TRANSFORMER

22455384N0	100/117V	(power)
22455388D0	220/240V	(power)
12449537	ELT-07	(inverter)

FILTER

13529105	DSS310-55D223S	(bypass capacitor)
12449229	FKOB-160MH15	(coil)
2244021500	SN-8D-500	(SN coil)

FUSE

12559335	T-GGS1(CSA) 1A	prim.100V,117V
12559336	T-GGS2(CSA) 2A	sec. 100V,117V
12559338	T-GGS3.15(CSA) 3.15A	sec. 100V,117V
12559509	CEE-T315mA	prim.220V,240V
12559514	CEE-T2A	sec. 220V,240V
12559516	CEE-T3.15A	sec. 220V,240V
12559505	CEE-T125mA	(MIDI Board)

DIODE

15019639	1SZ59	(zener)
15019254	2B4B41	(bridge rectifier)
15019247	GP-30G(Hi-Fi SPECIAL)	
15029103	TLR124	(LED)
15029152	GL-9HD12	(LED,red,package white)
15029149	GL-9PG12	(LED,green,package white)
15029151	GL-9HY12	(LED,yellow,package white)
15019103	1S2473	
15019136	DAN401	(ARRAY)
15019137	DAP401	(ARRAY)
15019116	DAP601	(ARRAY)
15019125	1SS-133	
15019103	1S2473	

POTENTIOMETER

	SLIDER	
13359351	S3028P401M 10KW	
13339421	S3018P405-B15 100KB	
	ROTARY	
13219369	K161M0Z1A 100KB	
13279758	K121L-2KB	
	TRIMMER	
13299177	H0615C119-10KB	
13299178	H0615C119-100KB	
13299525	3321P-1-502-5KB	
13299801	RVA0607H310-502N-5KB (SN. 480950-UP)	

TRANSISTOR

15129156	2SC2603-TP-E	
15119129	2SA1115-E	
15119601	2SB605-L	
15129600	2SD571-L	
151291070G	2SC945	NZ selected
151291400G	2SC2603-E	NZ selected (SN. 480850-UP)
15139108	2SK30A-GR	
15119113	2SA1015-GR	
15129114	2SC1815-GR	
15129136	2SC2878-A	
15119108	2SA798-G	
151291300G	2SC1583-G	
15119814	2SB1015-O	
15129827	2SD1406-O	
15129140	2SC2603-E	
15129600	2SD571-L (or 15129830 2SD571-M)	

CAPACITOR

13589308	YM-92P 1000P 50VJ	(polypropylen)
13589314	ECQ-B1H102JZ 0.001uF	(polypropylen)
13529104	DE7150F472MVA1	(line bypass capacitor)
13639922M0	ECEA1CN100S 10/16 NP	(electro)
13639942M0	ECEA1HN010S 1/50 NP	(electro)
13639945M0	ECEA1HN470S 47/50 NP	(electro)
13639923M0	ECEA1CN470S 47/16 NP	(electro)
13639944M0	ECEA1HN100S 10/50 NP	(electro)
13529108	RPE132F104Z50 0.1u	(celamic)

IC

15179319	P-8051-319-0	CPU
15179317	TC5517APL	RAM
15179316	TC5517AP	RAM
1517968104	TMM27C64D-681	PROM(CPU BOARD)
1517968002	TMM27C64D-680	PROM(MODULE BOARD)
15159508	TC40H373P	Octal D-type latch
15159507	TC40H273P	Octal D-type flip-flop
15159524	TC40H245P	Octal bus transceiver
15159506	TC40H138P	3-to-8 line decoder/demultiplexer
15159514	TC40H032P	Quad 2-input OR gate
15159503	TC40H000P	Quad 2-input NAND gate
15159505	TC40H004P	HEX inverter
15159128T0	TC4050BP	HEX buffer/converter non-inverting type
15169352	74LS40	Dual 4-input positive NAND buffer
15219139	PST518A	Reset
15189146	IR9022	Low power dual OP AMP
15169325	74LS273	Octal positive edge triggered D-type flip-flop with reset
15219146	BA6993	Dual comparators
15159313	MC14551B	Quad 2-input analog multiplexer/demultiplexer
15159311	MC14504B	HEX level shifter
15219127	ITS80141	D/A converter
15219153	EHK-MD6205	D/A converter
15229810	CEM3340	VCO
15219129	CEM3360	VCA
15219124	uPC1252H2	VCA selected (white)
15159113H0	HD14051BP	8-channel analog multiplexer/demultiplexer
15159114H0	HD14052BP	Dual 4-channel analog multiplexer/demultiplexer
15189136	M5218L	Dual low noise OP AMP
15199117	M5230L	Variable output voltage regulator
15229801	IR3109	VCF
15169353	74LS145	BCD-to-decimal decoder/driver
15189154	TL064CP	Low power OP AMP
15189117	TL081CP	OP AMP
15229802	BA662-A	VCA
15189118	TL082CP	OP AMP
15229812	EHM-S226W83S	Hybrid AMP
15169512T0	TC74HCU04P	HEX inverter

PHOTO COUPLER

15229706	TLP552	

BATTERY

12569148	CR-1/3-P	

RESISTOR

13769263K0	SN14K2EF	4.99K	
13769173K0	SN14K2EF	10K	
13769177K0	SN14K2EF	15K	
13769180K0	SN14K2EF	20K	
13769185K0	SN14K2EF	33K	
13769235K0	SN14K2EF	50K	
13769249K0	SN14K2EF	1.2M	
13769141K0	SN14K2EF	470	
13769163K0	SN14K2EF	3.9K	
13769165K0	SN14K2EF	4.7K	
13769178K0	SN14K2EF	16K	
13769181K0	SN14K2EF	22K	
13769197K0	SN14K2EF	100K	
13769200K0	SN14K2EF	130K	
13769203K0	SN14K2EF	180K	
13769674D0	SN14K2EF T-26	17.8K	
13769675D0	SN14K2EF T-26	107K	
13799719D0	CRB20FX T-23E	3.6K (or 13769162K0 SN14K2EF 3.6K)	
13799710D0	CRB20FX T-23E	10K (or 13769173K0 SN14K2EF 10K)	
13799718D0	CRB20FX T-23E	20K (or 13769180K0 SN14K2EF 20K)	
13799721D0	CRB20FX T-23E	50K (or 13769235K0 SN14K2EF 50K)	
13799711D0	CRB20FX T-23E	68K	
13859106	KNY2W	0.47	
13859107	KNY2W	0.82	
13859110	KNY2W	330	
	POSISTOR		
15229910	ERS-B33G122	1.2K	
	ARRAY		
13919302	RM8-102J	1K	
13919303	RM8-333J	33K	
13919308	RM6-103J	10K	
13919128	RKM8C066	(RM0688)	
13919129	RKH7C058	(RM0689)	
13919130	RKM8C068	(RM0690)	
13919131	RKH10C059	(RM0889)	
13919132	RKM9F561/683GP	(RM0891)	
13919118R0	RKM10L104F	(RK600-R601611)	

OTHERS

12389719	KMFC 1007T31	(ceramic resonator)
15029417	LCM-560-08HZ	(LCD)
15029181	EL-001	(electro luminescence)
12199550	H-0446	(fuse clip)
22465706	Hheat sink	
22375603	M-64C	(Memory Cartridge MKS-80 Sample Patches)

8-Voice Sound module

MODEL MKS-80 MIDI Implementation Chart

Function.....		Transmitted I	Transmitted II	Transmitted III	Recognized I	Recognized II	Recognized III	Remarks
Basic Channel	Default	1 – 16			1 – 16			memorized
	Changed	1 – 16			1 – 16			
Mode	Default	Mode 3			Mode 3			
	Messages	×			MONO,POLY,OMNI ON/OFF			m ≠ 1 ignored
	Altered	**********			×			
Note Number		×	×	×	0 – 127			
	True voice	**********			21 – 108			
Velocity	Note ON	×	×	×	○	○	○	v = 1 – 127
	Note OFF	×	×	×	×	×	×	
After Touch	Key's	×	×	×	×	×	×	
	Ch's	×	×	×	×	○	○	
Pitch Bender		×	×	×	×	○	○	
Control Change	1	×	×	×	×	○	○	Modulation
	7	×	×	×	×	○	○	Volume
	31	×	×	×	×	○	○	Bender Sense
	64	×	×	×	*	*	*	Hold * ○ or × by Patch preset
Prog Change	True #	×	○(0–63)	×	×	○	○(0–127)	
		**********			0 – 127			
System Exclusive		×	×	○	×	×	○	
System Common	Song Pos	×	×	×	×	×	×	
	Song Sel	×	×	×	×	×	×	
	Tune	×	○	○	×	○	○	
System Real Time	Clock	×	×	×	×	×	×	
	Commands	×	×	×	×	×	×	
Aux Mes-sages	Local ON OFF	×	×	×	×	×	×	
	All Notes OFF	×	×	×	○	○	○	(123 – 127)
	Active Sense	×	×	×	○	○	○	
	Reset	×	×	×	×	×	×	
Notes		Received messages are usually transmitted. Program change: MIDI func Tx Rx II Tone # Tone # III Patch #						

Mode 1 : OMNI ON, POLY Mode 2 : OMNI ON, MONO ○ : Yes

Mode 3 : OMNI OFF, POLY Mode 4 : OMNI OFF, MONO × : No

8-Voice Sound module

MODEL MKS-80 MIDI Implementation

1. RECOGNIZED RECEIVE DATA

1.1 When the MIDI FUNCTION is at I
Note events, Hold ON/OFF, Mode Messages and Active Sensing are recognized.

Status	Second	Third	Description
1000 nnnn	0kkk kkkk	0vvv vvvv	Note OFF, velocity ignored
1001 nnnn	0kkk kkkk	0000 0000	Note OFF kkkkkkk = 0 - 127 (21 - 108) *1
1001 nnnn	0kkk kkkk	0vvv vvvv	Note ON kkkkkkk = 0 - 127 (21 - 108) *1 vvvvvvv = 1 - 127
1011 nnnn	0100 0000	01xx xxxx	Hold ON xxxxxx = 0 - 63
1011 nnnn	0100 0000	00xx xxxx	Hold OFF xxxxxx = 0 - 63
1011 nnnn	0111 1011	0000 0000	ALL NOTES OFF
1011 nnnn	0111 1100	0000 0000	OMNI OFF *2
1011 nnnn	0111 1101	0000 0000	OMNI ON *2
1011 nnnn	0111 1110	0000 mmmm	MONO ON *2 mmmm = 1
1011 nnnn	0111 1111	0000 0000	POLY ON *2
1111 1110			Active Sensing

Notes :
*1 Note numbers outside of the range 21 - 108 are transposed to the nearest octave inside this range.

*2 Mode Messages (123 - 127) are also recognized as ALL NOTES OFF. MONO ON messages in which mmmm = 0 or 2 - 15 are ignored.

Mode Messages are recognized as follows:

	: POLY ON (127) :	: MONO ON (126) : mmmm = 1 :	: MONO ON (126) : mmmm <> 1
OMNI OFF (124)	: OMNI = OFF : POLY	: OMNI = OFF : MONO	: ignored : (not changed)
OMNI ON (125)	: OMNI = ON : POLY	: OMNI = ON : MONO	: ignored : (not changed)

1.2 When the MIDI FUNCTION is at II
Modulation, Volume, Bender Sens, Program Change, Channel After Touch, Pitch Bender and Tune Request are recognized in addition to the messages described in 1.1.

Status	Second	Third	Description
1011 nnnn	0000 0001	0vvv vvvv	Modulation vvvvvvv = 0 - 127
1011 nnnn	0000 0111	0vvv vvvv	Volume vvvvvvv = 0 - 127
1011 nnnn	0001 1111	0vvv vvvv	Bender Sensitivity vvvvvvv = 0 - 127
1100 nnnn	0ppp pppp		Program Change ppppppp = 0 - 127 *
1101 nnnn	0vvv vvvv		Channel After Touch vvvvvvv = 0 - 127
1110 nnnn	0vvv vvvv	0vvv vvvv	Pitch Bender Change
1111 0110			Tune Request

Note :
The Program Change number in the basic channel is recognized as an Upper 'Tone Number' and that in the basic channel + 1 as a Lower one.

1.3 When the MIDI FUNCTION is at III
EXCLUSIVE messages and the messages described in 2.2 are recognized. The Program Change number only in the basic channel is recognized as a 'Patch Number'.

The Program Change assignments

Prog #	Number (see note)	MEMORY AREA switch INT	A	B
0 - 63	: 11 - 88	Internal	cart A	cart B
64 - 127	: 11 - 88	cart A	cart B	Internal

Note :

MIDI function	Number
II	'Tone Number'
III	'Patch Number'

2. TRANSMITTED DATA

2.1 When the MIDI FUNCTION is at I
Only messages received from MIDI IN are sent to MIDI OUT. No messages are internally originated.

2.2 When the MIDI FUNCTION is at II
Program Change and Tune Request will be sent in addition to the messages desdribed in 2.1.

Status	Second	Third	Description
1100 nnnn	0ppp pppp		Program Change ppppppp = 0 - 63
1111 0110			Tune Request

Notes :
nnnn : MIDI channel number (0000 - 1111), ch-1 = 0000

When the 'Patch Number' is changed, Program Change messages are transmitted in the basic channel for the Upper 'Tone Number' defined by the 'Patch Number', and in the basic channel + 1 for the Lower 'Tone Number'.

When the 'Tone Number' is changed, a Program Change message is transmitted in the basic channel for the Upper 'Tone Number', or in the basic channel + 1 for the Lower one, according to the panel setting.

2.3 When the MIDI FUNCTION is at III
Tune Requestand Exclusive Messages will be sent in addition to the messages described in 2.1. The Program Change is not internally originated.

3. TRANSMITTED EXCLUSIVE MESSAGES

3.1 When the Tone Parameters are changed while the MIDI FUNCTION is set at III, the following exclusive message (IPR) is sent.

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0110	Operation code = IPR (individual parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0010 0000	Level # = 1
g 0000 00gg	Group # gg = 01 : Upper Tone gg = 10 : Lower Tone
h 0ppp pppp	Parameter # (0 - 47)
i 0vvv vvvv :	Value (0 - 100) h and i (repetitively)
j 1111 0111	End of System Exclusive

Note :

Parameter #	Function	Value
0	LFO-1 RATE	0 - 100
1	LFO-1 DELAY TIME	0 - 100
2	LFO-1 WAVEFORM	0 = Random 1 = Square Wave 2 = Sawtooth Wave 3 = Triangle Wave
3	VCO MOD LFO-1 DEPTH	0 - 100
4	VCO MOD ENV-1 DEPTH	0 - 100
5	PW	0 - 100
6	PWM	0 - 100
7	PWM MODE SEL	0 = Keyboard 1 = LFO-1 2 = ENV-1
8	PWM POL	0 = Inverted 1 = Normal
9	VCO KEY FOLLOW	0 - 100
10	VCO SEL	0 = VCO-2 1 = OFF 2 = VCO-1
11	XMOD MANUAL DEPTH	0 - 100
12	XMOD ENV-1 DEPTH	0 - 100
13	XMOD POL	0 = Inverted 1 = Normal
14	VCO-1 MOD	0 = Inverted 1 = OFF 2 = Normal
15	VCO-1 RANGE	36 - 84 (60 = middle C of 8')
16	VCO-1 WAVEFORM	0 = Square Wave 1 = Pulse Wave 2 = Sawtooth Wave 3 = Triangle Wave
17	VCO SYNC	0 = VCO-1 <- VCO-2 1 = OFF 2 = VCO-1 -> VCO-2
18	VCO-2 MOD	0 = Inverted 1 = OFF 2 = Normal
19	VCO-2 RANGE	0 = Low Frequency 36 - 84 (60 = middle C of 8') 100 = High Frequency
20	VCO-2 FINE TUNE	0 - 100
21	VCO-2 WAVEFORM	0 = Noise 1 = Pulse Wave 2 = Sawtooth Wave 3 = Triangle Wave
22	MIXER	0 - 100
23	HPF CUTOFF FREQ	0 - 100
24	VCF CUTOFF FREQ	0 - 100
25	VCF RESONANCE	0 - 100
26	VCF ENV SEL	0 = ENV-2 1 = ENV-1
27	VCF ENV POL	0 = Inverted 1 = Normal
28	VCF MOD ENV DEPTH	0 - 100
29	VCF MOD LFO-1 DEPTH	0 - 100
30	VCF KEY FOLLOW	0 - 100
31	VCA ENV-2 LEVEL	0 - 100
32	VCA MOD LFO-1 DEPTH	0 - 100
33	DYNAMICS TIME	0 - 100
34	DYNAMICS LEVEL	0 - 100
35	ENV RESET	0 = OFF 1 = ON
36	ENV-1 DYNAMICS	0 = OFF 1 = ON
37	ENV-1 ATTACK TIME	0 - 100
38	ENV-1 DECAY TIME	0 - 100
39	ENV-1 SUSTAIN LEVEL	0 - 100
40	ENV-1 RELEASE TIME	0 - 100
41	ENV-1 KEY FOLLOW	0 - 100
42	ENV-2 DYNAMICS	0 = OFF 1 = ON
43	ENV-2 ATTACK TIME	0 - 100
44	ENV-2 DECAY TIME	0 - 100
45	ENV-2 SUSTAIN LEVEL	0 - 100
46	ENV-2 RELEASE TIME	0 - 100
47	ENV-2 KEY FOLLOW	0 - 100

3.2 When the Patch Parameters are changed while the MIDI FUNCTION is set at III, the following exclusive message (IPR) is sent.

byte	description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0110	Operation code = IPR (individual parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #

e	0010 0000	Format type
f	0011 0000	Level # = 2
g	0000 00gg	Group #
		gg = 01 : Upper Patch
		gg = 10 : Lower Patch
h	0ppp pppp	Parameter # (0 - 14)
i	0vvv vvvv	Value (0 - 108)
	:	h and i (repetitively)
j	1111 0111	End of System Exclusive

Note :

Parameter #	Function	Value
0	KEY MODE SELECT	0 = Dual 1 = Split-1 2 = Split-2 3 = Whole
1	SPLIT POINT	21 - 108 (Note number)
2	BALANCE	0 - 100
3	TONE NUMBER	0 - 63
4	OCT SHIFT	0 = 2 OCT Down 1 = 1 OCT Down 2 = Normal 3 = 1 OCT Up 4 = 2 OCT Up
5	ASSIGN MODE SELECT	0 = Solo 1 = Unison-1 2 = Unison-2 3 = Poly-1 4 = Poly-2
6	UNISON DETUNE	0 - 100
7	HOLD	0 = OFF 1 = ON (always) (MIDI Damper messages are ignored) 2 = MIDI Damper messages are recognized
8	GLIDE	0 - 100
9	BENDER SENS	0 - 100
10	VCO-1 BEND	0 = OFF 1 = Normal (Slightly more than 1 octave) 2 = Wide (2.5 octaves)
11	VCO-2 BEND	0 = OFF 1 = Normal (Slightly more than 1 octave) 2 = Wide (2.5 octaves)
12	AFTER TOUCH SENS	0 - 100
13	AFTER TOUCH MODE SELECT	0 = VCF Frequency 1 = VCO LFO-2 MOD (1 and 2)
14	LFO-2 RATE	0 - 100

3.3 When the 'Patch Number' is changed while the MIDI FUNCTION is set at III, the following exclusive messages (A through E) are sent in sequence.

A. PGR (Program number) which indicates the 'Patch Number'

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0100	Operation code = PGR (program number)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0011 0000	Level # = 2
g 0000 0000	Dummy
h 0000 0000	Next program number indicates the 'Patch Number'
i 0ppp pppp	Program # ('Patch Number')
j 0000 0000	NOP
k 1111 0111	End of System Exclusive

B. APR (All parameter) which indicates the Patch Parameters for Upper section

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0101	Operation code = APR (all parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0011 0000	Level # = 2
g 0000 0001	Group # = Upper
h 0vvv vvvv	
:	values (0 - 108) of parameter # 0 - 14
:	in sequence, (15 bytes total)
0vvv vvvv	
i 1111 0111	End of System Exclusive.

C. APR (All parameter) which indicates the Patch Parameters for Lower section

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0101	Operation code = APR (all parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0011 0000	Level # = 2
g 0000 0010	Group # = Lower
h 0vvv vvvv	
:	values (0 - 108) of parameter # 0 - 14
:	in sequence, (15 bytes total)
0vvv vvvv	
i 1111 0111	End of System Exclusive

D. APR (All parameter) which indicates the Tone Parameters for Upper section

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0101	Operation code = APR (all parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0010 0000	Level # = 1
g 0000 0000	Group # = Upper
h 0vvv vvvv	
:	values (0 - 100) of parameter # 0 - 47
:	in sequence, (48 bytes total)
0vvv vvvv	
i 1111 0111	End of System Exclusive

E. APR (All parameter) which indicates the Tone Parameters for Lower section

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0101	Operation code = APR (all parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0010 0000	Level # = 1
g 0000 0010	Group # = Lower
h 0vvv vvvv	
:	values (0 - 100) of parameter # 0 - 47
:	in sequence, (48 bytes total)
0vvv vvvv	
i 1111 0111	End of System Exclusive

3.4 When the 'Tone Number' is changed while the MIDI FUNCTION is set at III, the following exclusive messages (A and B) are sent.

A. PGR (Program number) which indicates the 'Tone Number'

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0100	Operation code = PGR (program number)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0010 0000	Level # = 1
g 0000 00gg	Group #
	gg = 01 Upper Tone
	gg = 10 Lower Tone
h 0000 0000	Next program number indicates the 'Tone Number'
i 0ppp pppp	Program # ('Tone Number')
j 0000 0000	NOP
k 1111 0111	End of System Exclusive

B. APR (All parameter) which indicates the All parameters for the 'Tone Number'

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0011 0101	Operation code = APR (all parameter)
d 0000 nnnn	Unit # = MIDI basic channel, nnnn = 0 - 15 where nnnn + 1 = channel #
e 0010 0000	Format type
f 0010 0000	Level # = 1
g 0000 00gg	Group #
	gg = 01 Upper Tone
	gg = 10 Lower Tone
h 0vvv vvvv	
:	values (0 - 100) of parameter # 0 - 47
:	in sequence, (48 bytes total)
0vvv vvvv	
i 1111 0111	End of System Exclusive

4. RECOGNIZED EXCLUSIVE MESSAGES

All Exclusive messages described in section 3.

5. HANDSHAKING COMMUNICATION

5.1 Message type

5.1.1 Want to send a file (WSF)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 0000	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 0100 1101	M :
0100 1011	K :
0101 0011	S : - File name in ASCII
0010 1101	- :
0011 1000	8 :
0011 0000	0 :
g 0000 0000	Check sum
h 1111 0111	End of System Exclusive

5.1.2 Request a file (RQF)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 0001	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 0100 1101	M :
0100 1011	K :
0101 0011	S : - File name in ASCII
0010 1101	- :
0011 1000	8 :
0011 0000	0 :
g 0000 0000	Check sum
h 1111 0111	End of System Exclusive

5.1.3 Data (DAT)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 0010	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 0ddd dddd	
:	Data 248 bytes = 4 sets of data
0ddd dddd	
g 0sss ssss	Check sum
h 1111 0111	End of System Exclusive

Notes :

Summed value of the all bytes in data and the check sum must be 0 (7 bits).

Each DAT message consists of 4 sets of the Patch and Tone data. Each data set consists of 62 bytes total --- 39 bytes for Tone Parameters of a number and 23 bytes for Patch Parameters of the same number.

These parameters are sent in sequence of the 'Tone Number's and 'Patch Number's. 2 DATs are sent for each 'Bank'.

In normal operation, 16 DATs are totally sent for all 'bank's (1 - 8).

5.1.4 Acknowledge (ACK)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 0011	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 1111 0111	End of System Exclusive

5.1.5 End of file (EOF)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 0101	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 1111 0111	End of System Exclusive

5.1.6 Communication error (ERR)

Byte	Description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 1110	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 1111 0111	End of System Exclusive

5.1.7 Rejection (RJC)

byte	description
a 1111 0000	Exclusive status
b 0100 0001	Roland ID #
c 0100 1111	Operation code
d 0000 nnnn	Unit # MIDI basic chennel, nnnn = 0 - 15 where nnnn = 0 for channel 1
e 0010 0000	Format type
f 1111 0111	End of System Exclusive

5.2 Data format of DAT (62 bytes total)

5.2.1 Tone section (39 bytes)

a Continuous values (33 bytes, value = 0 - 100)

1	LFO-1 RATE	18	VCF MOD LFO-1 DEPTH
2	LFO-1 DELAY TIME	19	VCF KEY FOLLOW
3	VCO MOD LFO-1 DEPTH	20	VCA ENV-2 LEVEL
4	VCO MOD ENV-1 DEPTH	21	VCA MOD LFO-1 DEPTH
5	PW	22	DYNAMICS TIME
6	PWM	23	DYNAMICS LEVEL
7	VCO KEY FOLLOW	24	ENV-1 A
8	XMOD MANUAL DEPTH	25	ENV-1 D
9	XMOD ENV-1 DEPTH	26	ENV-1 S
*1 10	VCO-1 RANGE	27	ENV-1 R
*2 11	VCO-2 RANGE	28	ENV-1 KEY FOLLOW
12	VCO-2 FINE TUNE	29	ENV-2 A
13	MIXER	30	ENV-2 D
14	HPF CUTOFF FREQ	31	ENV-2 S
15	VCF CUTOFF FREQ	32	ENV-2 R
16	VCF RESONANCE	33	ENV-2 KEY FOLLOW
17	VCF MOD ENV DEPTH		

Note :

Parameter	Type of Exclusive message Value in DAT	Value in IPR
*1 10 VCO-1 RANGE	0 - 48	36 - 84
*2 11 VCO-2 RANGE	0	0
	1 - 49	36 - 84
	50	100

b Bit data (6 bytes) bits 4-7 are not used

34

bit 2,3 PWM MODE SEL	bit 0,1 LFO-1 WAVEFORM
00 = Keyboard	00 = Random
01 = LFO-1	01 = Square Wave
10 = ENV-1	10 = Sawtooth Wave
	11 = Triangle Wave

35

bit 2,3 VCO SEL	bit 1 XMOD POL	bit 0 PWM POL
00 = VCO-2	0 = Inverted	0 = Inverted
01 = OFF	1 = Normal	1 = Normal
10 = VCO-1		

36

bit 2,3 VCO-2 MOD	bit 0,1 VCO-1 MOD
00 = Inverted	00 = Inverted
01 = OFF	01 = OFF
10 = Normal	10 = Normal

37

bit 3 ENV-2 DYNAMICS	bit 2 ENV-1 DYNAMICS	bit 1 VCF ENV POL	bit 0 VCF ENV SEL
0 = OFF	0 = OFF	0 = Inverted	0 = ENV-2
1 = ON	1 = ON	1 = Normal	1 = ENV-1

38

bit 2,3 VCO-2 WAVEFORM	bit 0,1 VCO-1 WAVEFORM
00 = Noise	00 = Square Wave
01 = Pulse Wave	01 = Pulse Wave
10 = Sawtooth Wave	10 = Sawtooth Wave
11 = Triangle Wave	11 = Triangle Wave

39

bit 2 ENV RESET	bit 0,1 VCO SYNC
0 = OFF	00 = VCO-1 <- VCO-2
1 = ON	01 = OFF
	10 = VCO-1 -> VCO-2

5.2.2 Patch section (23 bytes)

a Common data (3 bytes)

40	KEY MODE	0 = DUAL 1 = SPLIT-1 2 = SPLIT-2 3 = WHOLE	
* 41	SPLIT POINT	0 - 87	
42	BALANCE	0 - 100	

Note :

Parameter	Type of Exclusive message Value in DAT	Value in IPR
* SPLIT POINT	0 - 87	21 - 108

b Upper Tone Number (1 byte)

43 0 - 63

c Upper bit data (4 bytes)

bits 4-7 are not used

44

bit 0-2 ASSIGN MODE SELECT
000 = Solo
001 = Unison-1
010 = Unison-2
011 = Poly-1
100 = Poly-2

45

bit 0,1 HOLD
00 = OFF
01 = ON (always)
10 = by damper messages

46

bit 2,3 VCO-2 BEND	bit 0,1 VCO-1 BEND
00 = OFF	00 = OFF
01 = Normal	01 = Normal
10 = Wide	10 = Wide

47

bit 1-3 OCT SHIFT	bit 0 AFTER TOUCH MODE SELECT
000 = 2 OCT Down	0 = VCF Frequency
001 = 1 OCT Down	1 = VCO LFO-2 MOD
010 = Normal	
011 = 1 OCT Up	
100 = 2 OCT Up	

d Upper continuous values (5 bytes, value = 0 - 100)

48 UNISON DETUNE 51 AFTER TOUCH SENS
49 GLIDE 52 LFO-2 RATE
50 BENDER SENS

e Lower Tone Number (1 byte)

53 0 - 63

f Lower bit data (4 bytes)

54 - 57 The same as Upper SW data.

g Lower continuous values (5 bytes, value = 0 - 100)

58 UNISON DETUNE 61 AFTER TOUCH SENS
59 GLIDE 62 LFO-2 RATE
60 BENDER SENS

5.3 Sequence of communication

5.3.1 In the Save mode.

a	WSF :	Want to send a file	(transmitted)
b	ACK :	Acknowledge	(received)
c	DAT :	Data	(transmitted)
	ACK :	Acknowledge	(received)
	DAT :	Data	(transmitted)
	:	:	
	:	:	
	DAT :	Data	(transmitted)
	ACK :	Acknowledge	(received)
d	EOF :	End of file	(transmitted)
e	ACK :	Acknowledge	(received)

5.3.2 In the Load mode.

a	RQF :	Request a file	(transmitted)
b	DAT :	Data	(received)
c	ACK :	Acknowledge	(transmitted)
	DAT :	Data	(receiver)
	ACK :	Acknowledge	(transmitted)
	:	:	
	:	:	
	DAT :	Data	(received)
	ACK :	Acknowledge	(transmitted)
d	EOF :	End of file	(received)
e	ACK :	Acknowledge	(transmitted)

5.3.3 When the WSF is recognized

a	WSF :	Want to send a file	(received)
b	ACK :	Acknowledge	(transmitted)
c	DAT :	Data	(received)
	ACK :	Acknowledge	(transmitted)
	DAT :	Data	(received)
	:	:	
	:	:	
	DAT :	Data	(received)
	ACK :	Acknowledge	(transmitted)
d	EOF :	End of file	(received)
e	ACK :	Acknowledge	(transmitted)

5.3.4 When the RQF is recognized

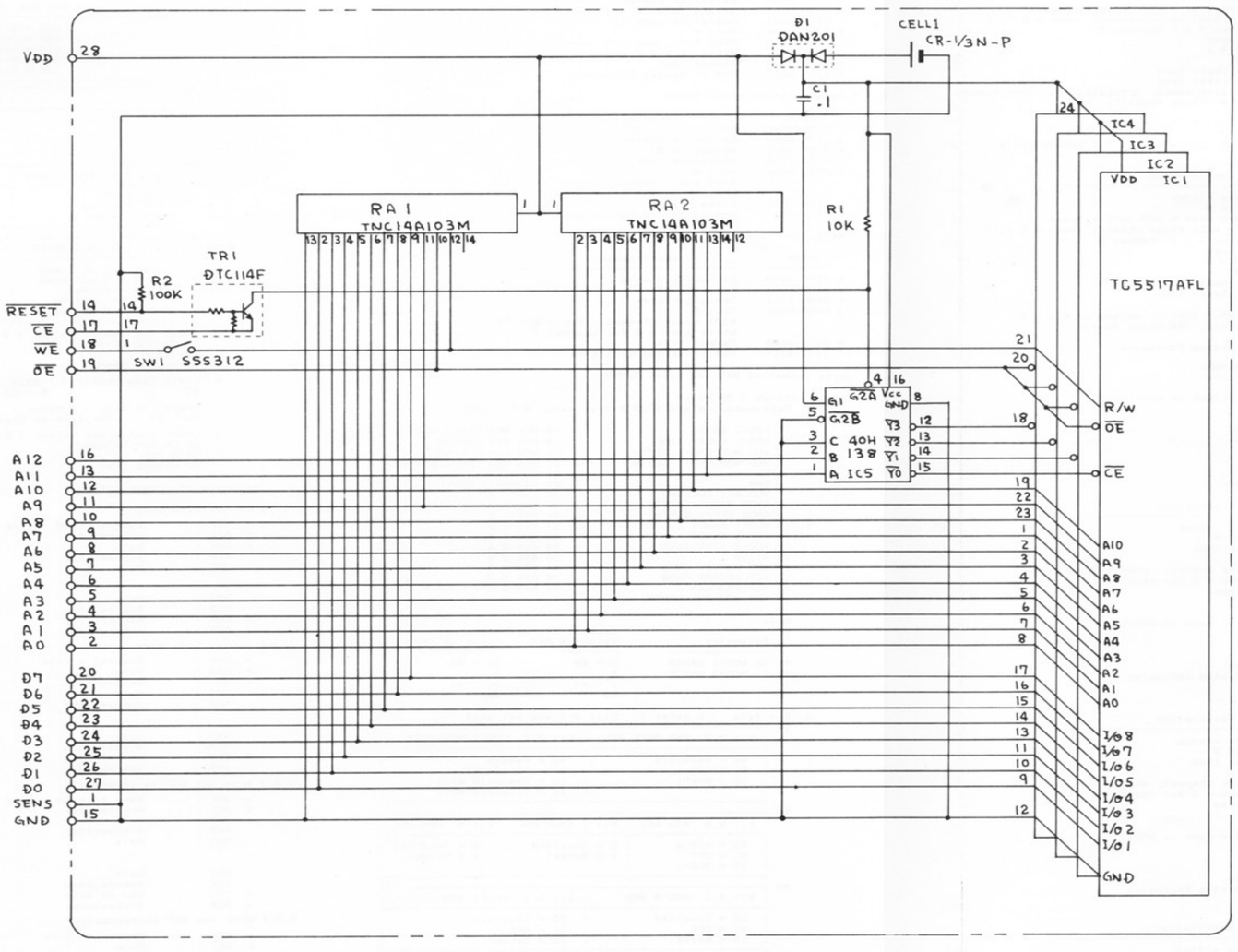
a	RQF :	Request a file	(received)
b	DAT :	Data	(transmitted)
c	ACK :	Acknowledge	(received)
	DAT :	Data	(transmitted)
	ACK :	Acknowledge	(received)
	:	:	
	:	:	
	DAT :	Data	(transmitted)
	ACK :	Acknowledge	(received)
d	EOF :	End of file	(transmitted)
e	ACK :	Acknowledge	(received)

5.3.5 When the ERR is recognized

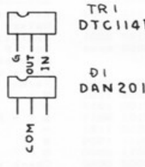
	:	:	
	:	:	
	DAT :	Data	(transmitted)
	ACK :	Acknowledge	(received)
	DAT :	Data	(transmitted)
a	ERR :	Communication error	(received)
b	RJC :	Rejection	(transmitted)

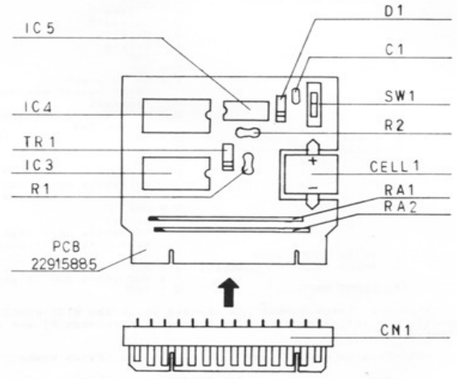
M-64C MEMORY CARTRIDGE

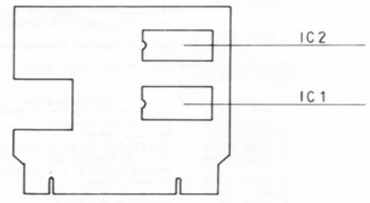
Electrostatic Discharge Protection:
CHANGE
R1 10k → R1 3.3k



IC1, IC2, IC3, IC4 TC5517AFL
IC5 40H138F
TR1 DTC114F
D1 DAN201
SW1 SSS312
C1 BLOCK-LAYER CERAMIC .1μF
RA1 RA2 TNC14A103M
R1 R2 R25NJ







MKS-80 Part 2

CHANGE INFORMATION EFFECTIVE SN511800-UP

MODULE BOARD, SOFTWARE

Affected components are as follows:

- Change VCO, VCF and VCA ICs on the Module Board to customized-ICs.
- Re-layout the Module Board to accommodate new ICs.
- Reprogram CROSS-MOD and RESONNANCE adjustments through the revisions of CPU Board PROM A and MODULE Board PROM B.

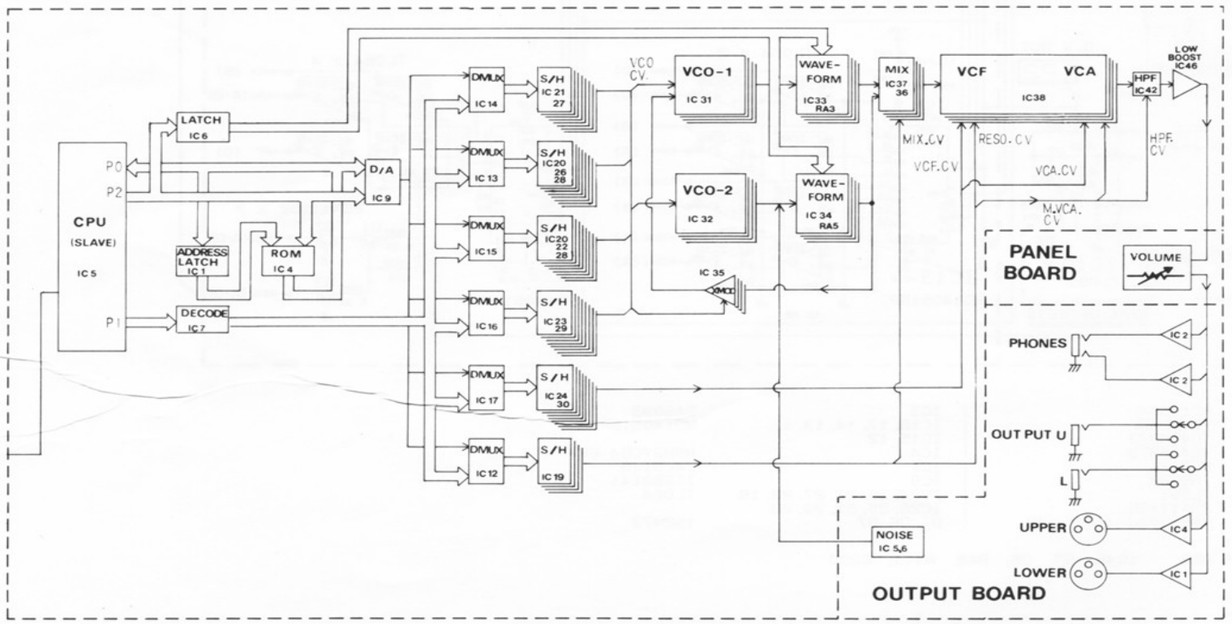
Note:

New module will produce slightly different timbre when compared with that from ealier modules. This is due to characteristic differences between these ICs. The difference will prove if data (memory cartridge) saved from products with SN511799 and below is loaded into the later units.

Reason for timbre difference

	SN450100-511799	SN511800-UP
Difference in RESONNANCE LEVEL	High RESONNANCE LEVEL Waveforms clipped when played in UNISON.	Low RESONNANCE LEVEL Waveforms kept below clipping levels.
Difference in GAIN characteristic of VCA IC	Fast Decay rate due to non-linear GAIN characteristic.	Linear GAIN characteristic makes Decay rate reasonably slow.
Difference in CROSS-MOD LEVEL	High CROSS-MOD output causes overmodulation with particular panel settings with CROSS-MOD Pot. in MAX.	CROSS-MOD output is kept below the level at which overmodulation does not occur.

BLOCK DIAGRAM



MODULE BOARD (x2)

Parts Changed

FROM (PART No.)	TO (PART No.)
MODULE BOARD ASSY (7934012000)	MODULE BOARD ASSY (7934012001)
PCB 291-947 (2291594700)	PWB 292-156 (2292515600)
VCO IC CEM3340 (1522981000)	VCO IC IR3R03 (1522982700)
VCF IC IR3109 (1522980100) VCA IC CEM336 (1521912900) μPC1252H124 (1521912400)	VCF, VCA IC IR3R05 (1522982600)
PROM A Ver. 4 (1517968104)	PROM A Ver. 5 (1517968105)
PROM B Ver. 2 (1517968002)	PROM B Ver. 3 (1517968400)
MEMORY CARTRIDGE (2237560300)	MEMORY CARTRIDGE (2237560301)

CAUTIONS in relation to Change.

- A new MODULE BOARD and a previous one are interchangeable, but there will be some difference in timber when interchanged.
  (The difference can be modified by editing timber DATA.)
- Do not mix-use two PCB versions on the same unit.
- Both module board versions require specific parameter setting for their patch program. Memory cartridge used on one version needs reediting when loaded into the other version, for correcting timber difference.
- ROM A Ver 4 and Ver 5 are not interchangeable.
- ROM B Ver 2 and Ver 3 are also not interchangeable.

VCF, VCA

Parts of VCF and VCA composed of IR3109, CEM3360 and associated circuits are superseded by IR3R05. VCF serves as a 24dB/oct (12dB/oct x 2) state variable filter, which is composed of BPF and LPF.

VCA section has both LINEAR control input and EXPONENTIAL control input. The control voltage of ENV-2 is applied to LINEAR input and the control voltages of VCA LEVEL and VCA LFO MOD are applied to EXPO input.

Each pin of IR3R05 has the function as shown below.
The bracketed figures indicate the pin number.

IN (1) Signal Input. The signal having 20mVp-p waveform will be applied.

FREQ (2), RESO (3), LINE (4), EXPO (5) } CV Input. These CVs determine timber and levels.

C1 (13) shows the waveform (Fig. A) of a signal which passed through BPF.
C2 (12) shows the waveform (Fig. B) of a signal which passed through LPF.
C3 (11) shows the waveform (Fig. C) of a signal which passed through LPF + BPF.
C4 (10) shows the waveform (Fig. D) of a signal which passed through LPF + LPF.
LOAD (6) shows the waveform of a signal which passed through from C4 to the buffer.

PIN CONFIGURATION

BLOCK DIAGRAM

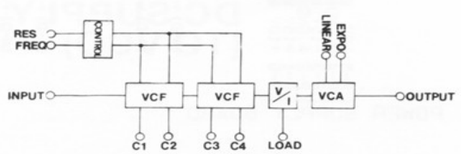


Fig. A

Fig. B

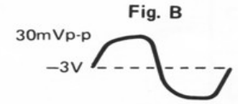
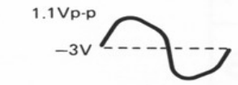


Fig. C

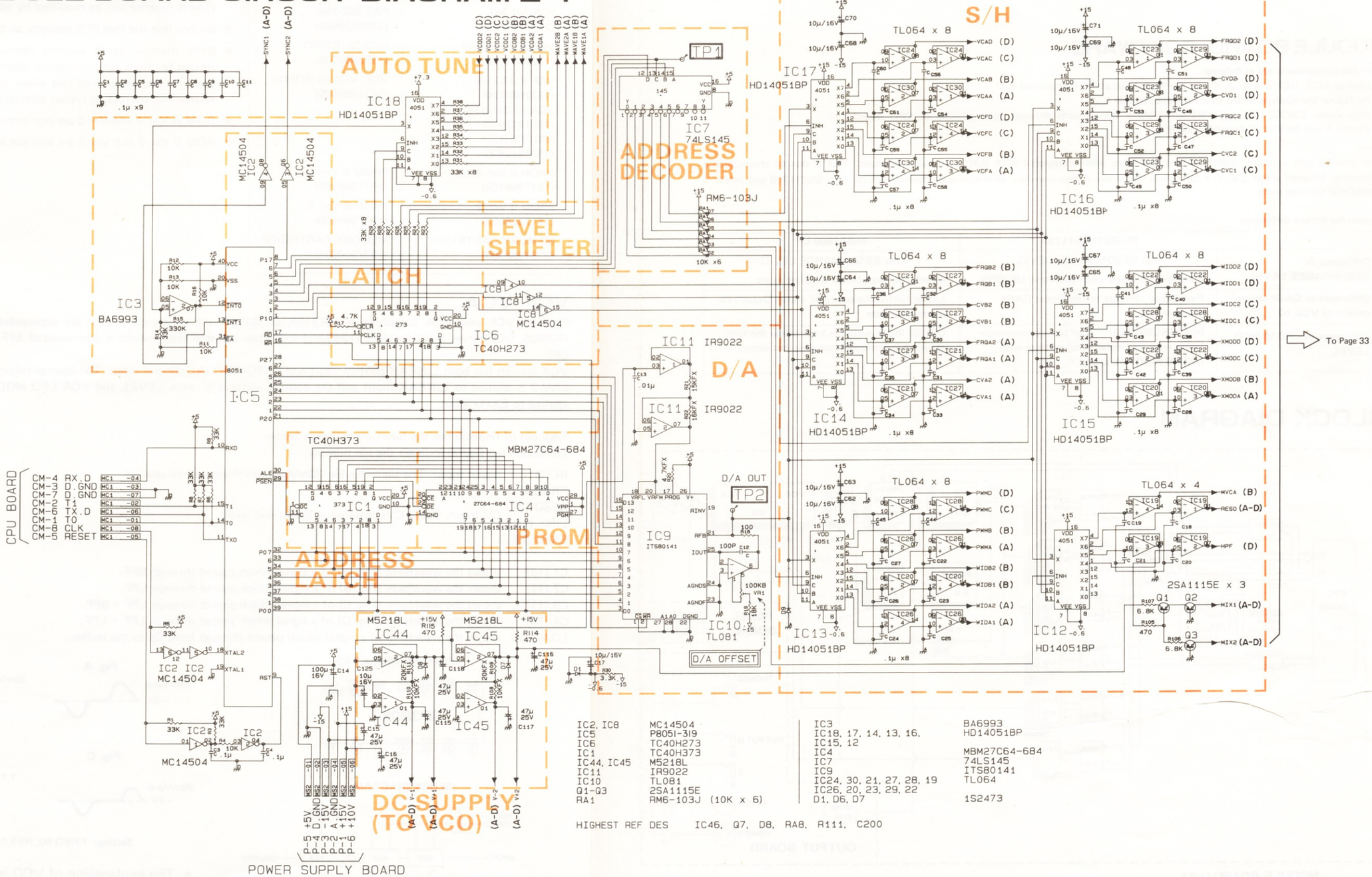
Fig. D



Setting: FREQ 50, RES 0, f = 200Hz

• The explanation of VCO is on page 34.

MODULE BOARD CIRCUIT DIAGRAM 2-1

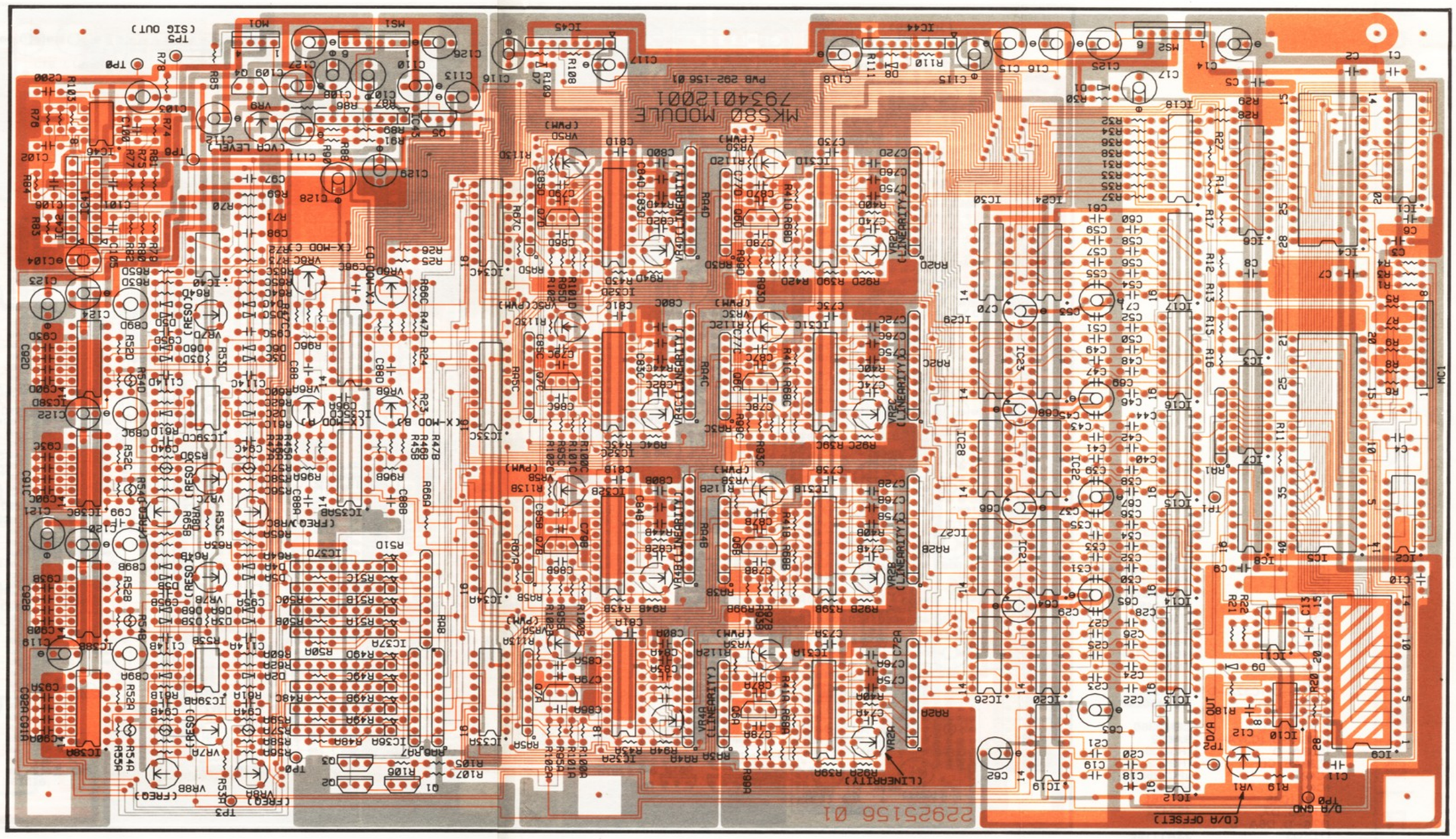


IC2, IC8	MC14504	IC3	BA6993
IC5	P8051-319	IC18, 17, 14, 13, 16, IC15, 12	HD14051BP
IC6	TC40H273	IC4	MBM27C64-684
IC1	TC40H373	IC7	74LS145
IC44, IC45	M5218L	IC9	ITS80141
IC11	IR9022	IC24, 30, 21, 27, 28, 19	TL064
IC10	TL081	IC26, 20, 23, 29, 22	
Q1-Q3	2SA1115E	D1, D6, D7	1S2473
RA1	RM6-103J (10K x 6)		

HIGHEST REF DES IC46, Q7, D8, RA8, R111, C200

MODULE BOARD 7934012001 (pwb 22925156)

This Module Board is the same one as on Page 32.

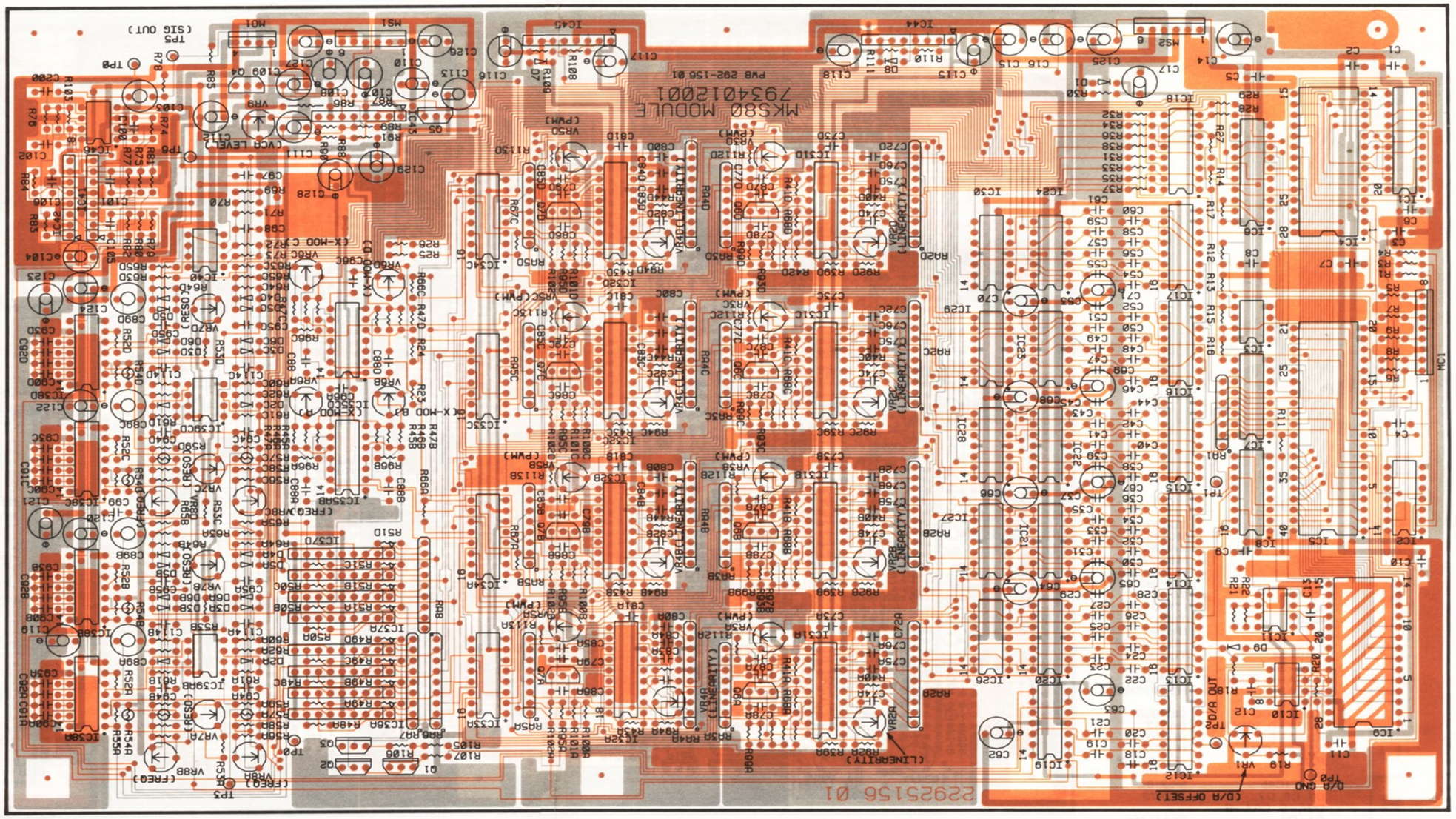


IC1	TC40H373
IC2, IC8	MC14504
IC3	BA6993
IC4	MBM27C64–684
IC5	P8051–319
IC6	TC40H273
IC7	74LS145
IC9	ITS80141
IC10	TL081
IC11	IR9022
IC12–IC18	HD14501BP
IC19–24, IC26–30	TL064
IC31A–D, IC32A–D	IR3R03
IC33AB, CD, IC34AB, CD	HD14502BP
IC35AB, CD	CEM3360
IC36A–D, IC37A–D	BA662
IC38A–D	IR3R05
IC39AB, CD	IR9022
IC42	μPC1252H2
IC43	M5230L
IC44, IC45	M5218L
D1, D6, D7, D2A–D, D6A–D	1S2473
Q1–Q3	2SA1115E
Q4	2SD571
Q5	2SB605
Q6A–D, Q7A–D	2SC2603E
RA1	RM6–103J (10K x 6)
RA2A–D, RA4A–D	RKH10C59
RA3A–D, RA5A–D	RKH8C069
RA6	RM8–333J (33K x 8)
RA7, RA8	RM8–102J (1K x 8)

Note: IC12–18 ..... HD14501BP, HITACHI only
IC33, 34 ..... HD14502BP, HITACHI or MC14502B (15159114ZO) MOTOROLA only

MODULE BOARD 7934012001 (pwb 22925156)

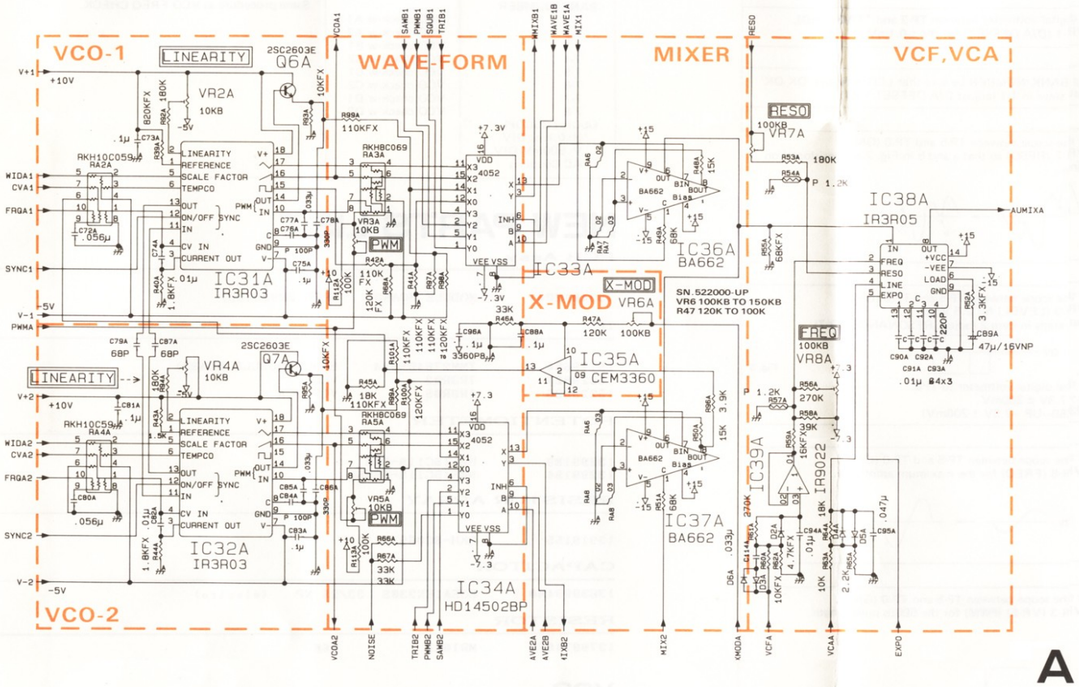
This Module Board is the same one as on Page 31.

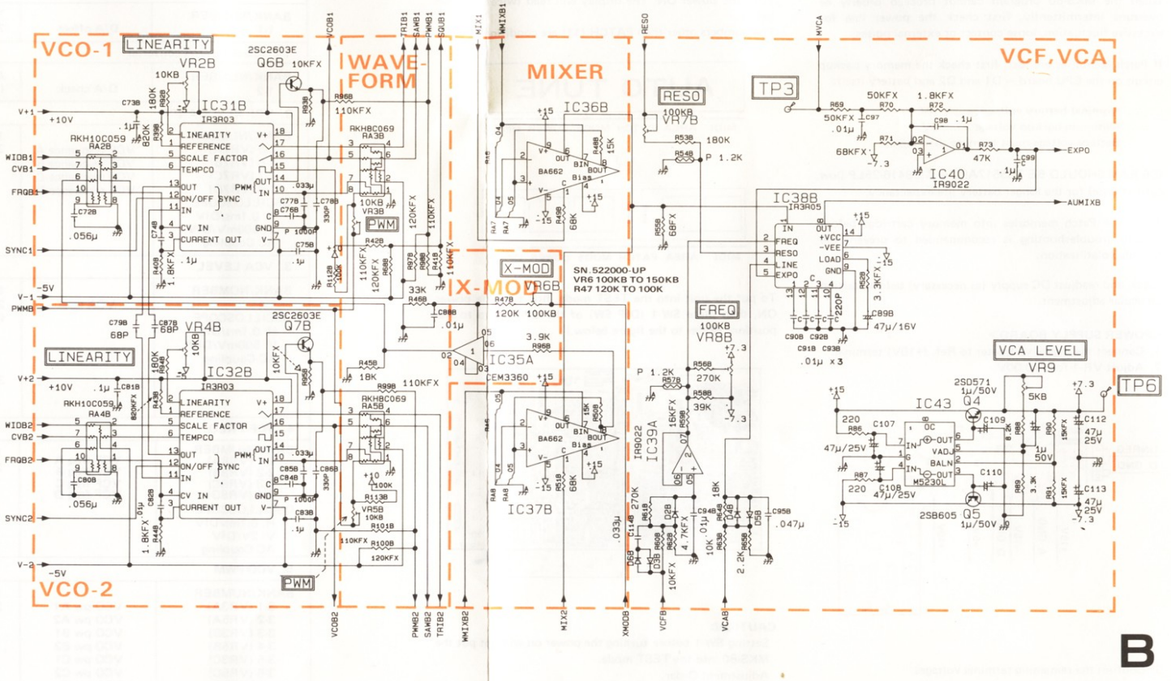


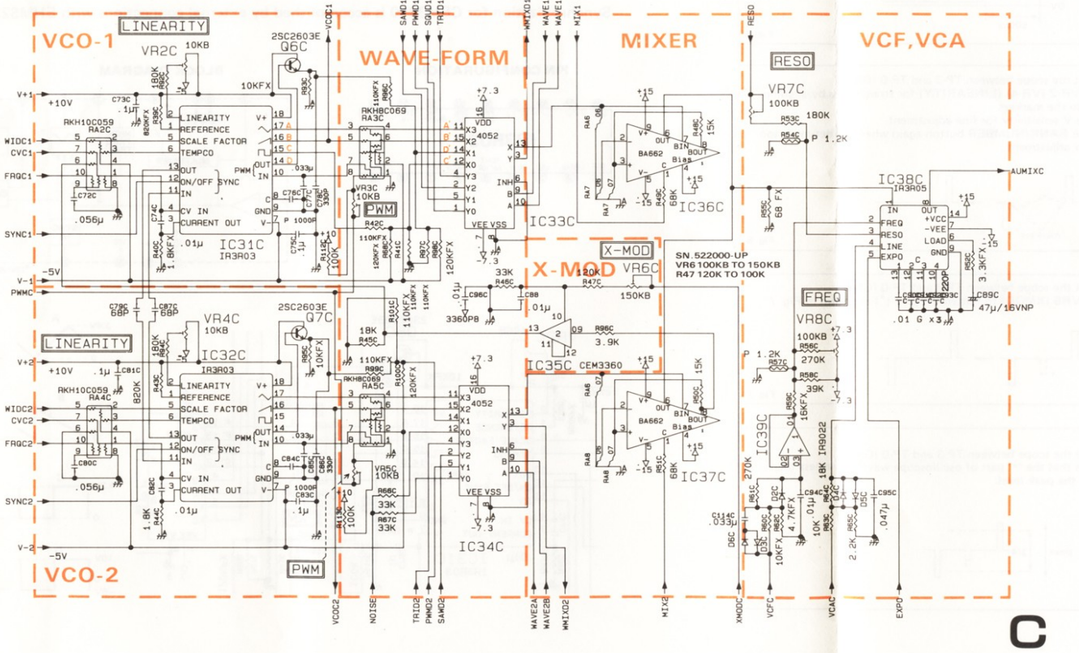
IC1	TC40H373
IC2, IC8	MC14504
IC3	BA6993
IC4	MBM27C64–684
IC5	P8051–319
IC6	TC40H273
IC7	74LS145
IC9	ITS80141
IC10	TL081
IC11	IR9022
IC12–IC18	HD14501BP
IC19–24, IC26–30	TL064
IC31A–D, IC32A–D	IR3R03
IC33AB, CD, IC34AB, CD	HD14502BP
IC35AB, CD	CEM3360
IC36A–D, IC37A–D	BA662
IC38A–D	IR3R05
IC39AB, CD	IR9022
IC42	μPC1252H2
IC43	M5230L
IC44, IC45	M5218L
D1, D6, D7, D2A–D, D6A–D	1S2473
Q1–Q3	2SA1115E
Q4	2SD571
Q5	2SB605
Q6A–D, Q7A–D	2SC2603E
RA1	RM6–103J (10K x 6)
RA2A–D, RA4A–D	RKH10C59
RA3A–D, RA5A–D	RKH8C069
RA6	RM8–333J (33K x 8)
RA7, RA8	RM8–102J (1K x 8)

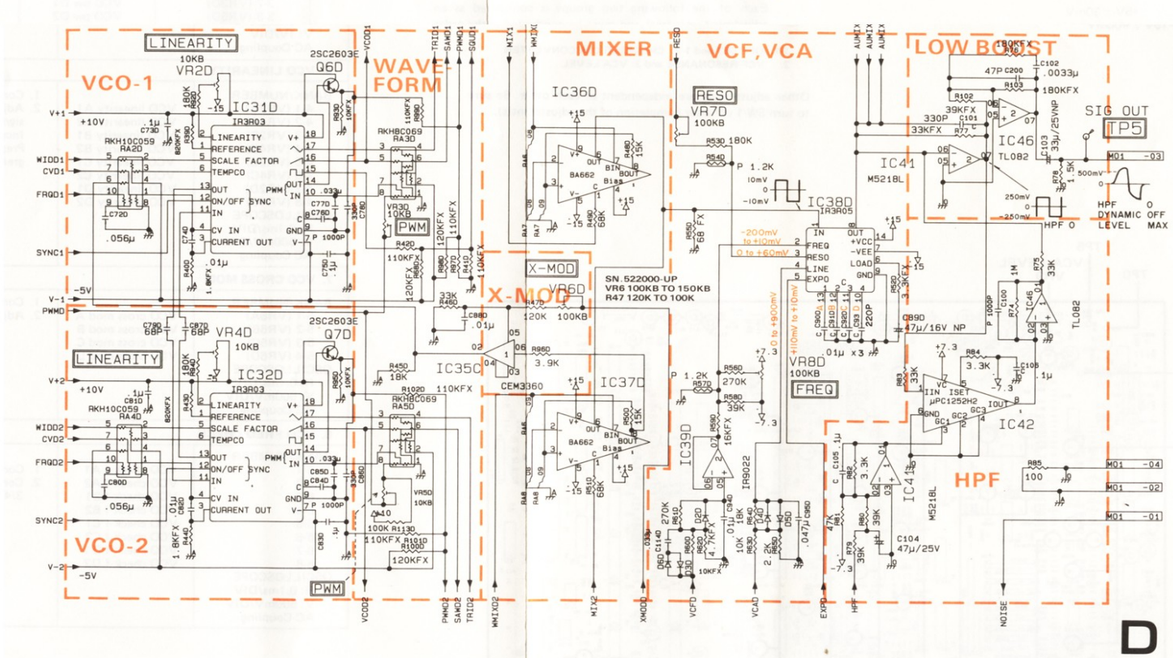
Note: IC12–18 ..... HD14501BP, HITACHI only
IC33, 34 ..... HD14502BP, HITACHI or MC14502B (15159114ZO) MOTOROLA only

MODULE BOARD CIRCUIT DIAGRAM 2-2 (VCO,VCF,VCA)









IC31, 32	IR3R03	IC39, 40	IR9022	Q4	2SD571	RA2, 4	RKH10C059
IC33, 34	HD14502BP	IC41	M5218L	Q5	2SB605	RA3, 5	RKH8C069
IC35	CEM3360	IC42	μPC1252H2	Q6, 7	2SC2603E	RA6	RM8-333J (33k J x 8)
IC36, 37	BA662	IC43	M5230L	D2 – D6	1S2473	RA7, 8	RM8-102J (1k J x 8)
IC38	IR3R05	IC46	TL082				

ADJUSTMENT (SN. 511800-UP)

CAUTIONS:
When the MKS-80 program cannot proceed orderly or overruns intermittently, first check the power line for excessive fluctuation, loose contact or external pulses.

If Patch Memories are lost, first check the memory backup circuit on the CPU board – D1 and D2 and battery itself:

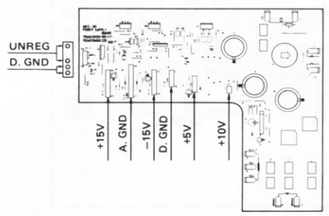
Nominal battery voltage ..... 3V.
Minimum backup voltage ..... 2V.
Battery voltage must be more than 2.6V.

IC6 RAM SHOULD BE TC5517APL or MB8416-25LP (low current type) for the longer battery life expectancy.

Saving the Patch memories into memory cartridge before starting troubleshooting is recommended to prevent the possible volatilization.

Check and readjust DC supply (as necessary) before starting particular adjustment.

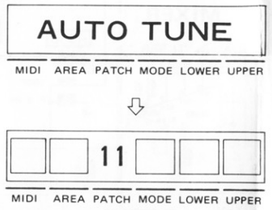
<POWER SUPPLY BOARD>
1. Connect the digital voltmeter to Ref. (+10V) terminal.
2. Adjust VR-1 for +10.00V



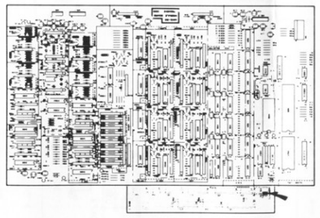
3. Confirm the remaining terminal voltages.

+5V ± 30mV
+15V ± 100mV
–15V ± 400mV

Turn the power ON, The display will read twice as shown below.
The numbers other then PATCH (11) are conditional.



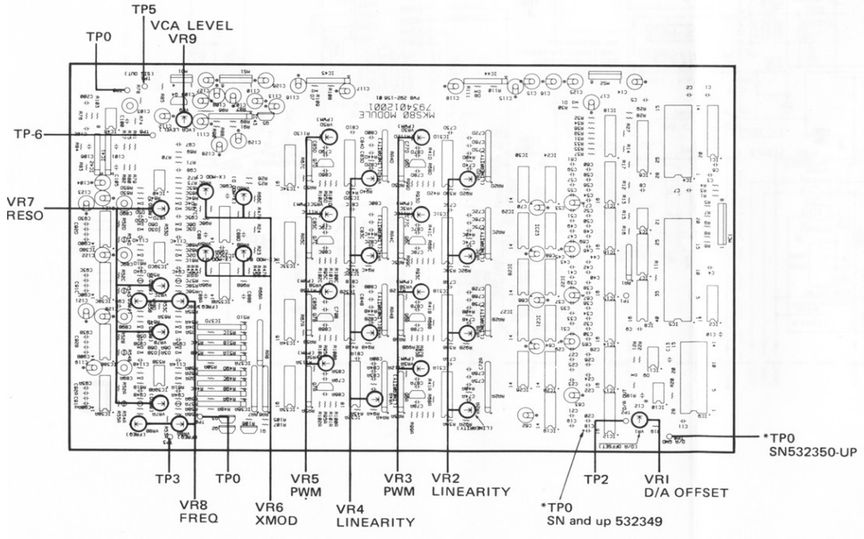
To put the unit into the TEST mode, first turn the power ON, then place SW-1 (DIP SW) of the CPU board to JIG position. (Refer to the figure below.)

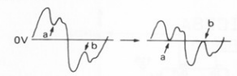
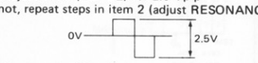
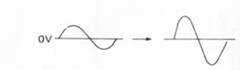
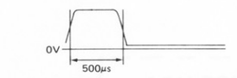
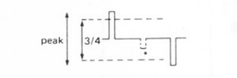


CAUTION:
Setting SW-1 before turning the power on will not put the MKS-80 into the TEST mode.
Adjustment Order:
Each of the following two groups is considered as an adjustment unit (set) and must be conducted in the order numbered.

1-1: OFF SET and 1-2: CHECKING D/A CONVERTER
2: VCF RESONANCE and 3: VCA LEVEL

Other adjustments are independent of each other. Be sure to turn SW-1 off after completion of the adjustment(s).



PANEL SETTINGS	LCD INDICATION	ADJUSTMENT
1. D/A		
1-1 OFFSET		
BANK/NUMBER 1-1	D/A offset	1. Connect digital voltmeter between TP-2 and *TP-0 (GND). 2. Adjust VR-1 (D/A OFFSET) for 0V ± 0.1mV.
1-2 Checking D/A converter		
BANK/NUMBER 1-2	D/A check	After setting BANK/NUMBER be sure that LCD indicates 'OK OK' If not, repeat steps in 1-1 (adjust D/A OFFSET VR1).
2. VCF RESONANCE		
BANK/NUMBER 1-5 (VR7A) 1-6 (VR7B) 1-7 (VR7C) 1-8 (VR7D) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCF resonance A VCF resonance B VCF resonance C VCF resonance D	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-7 (RESO) so that a and b in Fig. 2 are positioned on the 0V line.  Fig. 2
3. VCA LEVEL		
BANK/NUMBER 1-4 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCA level	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-9 (LEVEL) for 2.5 Vp-p If not, repeat steps in item 2 (adjust RESONANCE VR-7).  Fig. 3 3. Connect the digital voltmeter to TP6. Confirm +7.3V ± 200mV (SN. 532350–UP –7.3V ± 200mV)
4. VCF FREQ		
BANK/NUMBER 2-1 (VR8A) 2-2 (VR8B) 2-3 (VR8C) 2-4 (VR8D) OSCILLOSCOPE H: 0.1ms/DIV V: 2V/DIV AC Coupling	VCF freq A VCF freq B VCF freq C VCF freq D	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-8 (FREQ) for the maximum amplitude.  Fig. 4
5. VCO PWM		
BANK/NUMBER 3-1 (VR3A) 3-2 (VR5A) 3-3 (VR3B) 3-4 (VR5B) 3-5 (VR3C) 3-6 (VR5C) 3-7 (VR3D) 3-8 (VR5D) OSCILLOSCOPE H: 0.1ms/DIV V: 1V/DIV AC Coupling	VCO pw A1 VCO pw A2 VCO pw B1 VCO pw B2 VCO pw C1 VCO pw C2 VCO pw D1 VCO pw D2	1. Connect the scope between TP-5 and TP-0 (GND). 2. Adjust VR-3 (VR-5) (PWM) for the 500μs pulse length.  Fig. 5
6. VCO LINEARITY		
BANK/NUMBER 4-1 (VR2A) 4-2 (VR4A) 4-3 (VR2B) 4-4 (VR4B) 4-5 (VR2C) 4-6 (VR4C) 4-7 (VR2D) 4-8 (VR4C) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO linearity A1 VCO linearity A2 VCO linearity B1 VCO linearity B2 VCO linearity C1 VCO linearity C2 VCO linearity D1 VCO linearity D2	1. Connect the scope between TP-3 and TP-0 (GND). 2. Adjust VR-2 (VR-4) (LINEARITY) for straightness by aligning signals to the markers. Increase V sensitivity for fine adjustment. Press the BANK/NUMBER button again when the detune is too great for adjustment.  Fig. 6
7. VCO CROSS MOD		
BANK/NUMBER 5-1 (VR6A) 5-2 (VR6B) 5-3 (VR6C) 5-4 (VR6D) OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO cross mod A VCO cross mod B VCO cross mod C VCO cross mod D	1. Connect the scope between TP-3 and TP-0 (GND). 2. Adjust VR6 (XMOD) to flatten the part (*) as shown in Fig. 7.  Fig. 7
8. VCO FREQ CHECK		
BANK/NUMBER 6-1 6-2 6-3 6-4 6-5 6-6 6-7 6-8 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO check-f A1 VCO check-f A2 VCO check-f B1 VCO check-f B2 VCO check-f C1 VCO check-f C2 VCO check-f D1 VCO check-f D2	1. Connect the scope between TP-3 and TP-0 (GND). 2. Confirm that the '*' part of oscilloscope waveform is less than 3/4 of the peak level.  Fig. 8

PANEL SETTINGS	LCD INDICATION	ADJUSTMENT
9. VCO WIDTH CHECK		
BANK/NUMBER 7-1 7-2 7-3 7-4 7-5 7-6 7-7 7-8 OSCILLOSCOPE H: 0.1ms/DIV V: 500mV/DIV AC Coupling	VCO check-w A1 VCO check-w A2 VCO check-w B1 VCO check-w B2 VCO check-w C1 VCO check-w C2 VCO check-w D1 VCO check-w D2	Same procedure as VCO FREQ CHECK.

NEW PARTS LIST

PCB Assy

7934012001	MODULE BOARD	(PWB 22925156)

IC

15179684	TMM2764D-684	EPROM (MODULE BOARD)
15229827	IR3R03	VCO
15229826	IR3R05	VCF, VCA

POTENTIOMETER

13299189	H0615C119-5KB	
13299194	H0615C119-150KB	

RESISTOR ARRAY

13919155	RKH-8C069	

CAPACITOR

13639934M0	ECEA1EN330S	33/25 NP	(electro)

RESISTOR

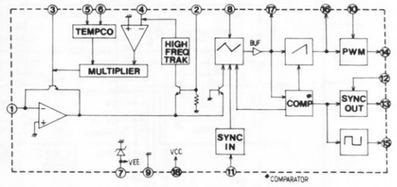
13799748T0	MR16KF	16K

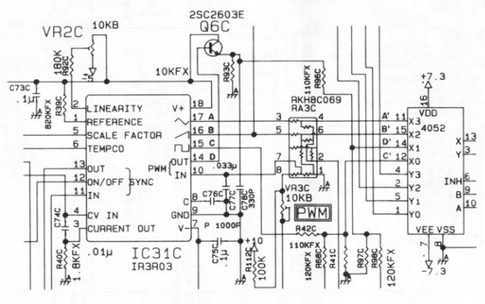
VCO

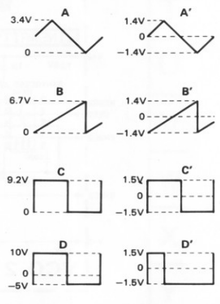
Synchronization for CEM3340 is accomplished by external connections with EHMS226W83S.

PIN CONFIGURATION

BLOCK DIAGRAM







Note:
The amplitude of a waveform (A', B', C' and D') is approx. one half when being selected and connected to the next stage by IC33 4052.

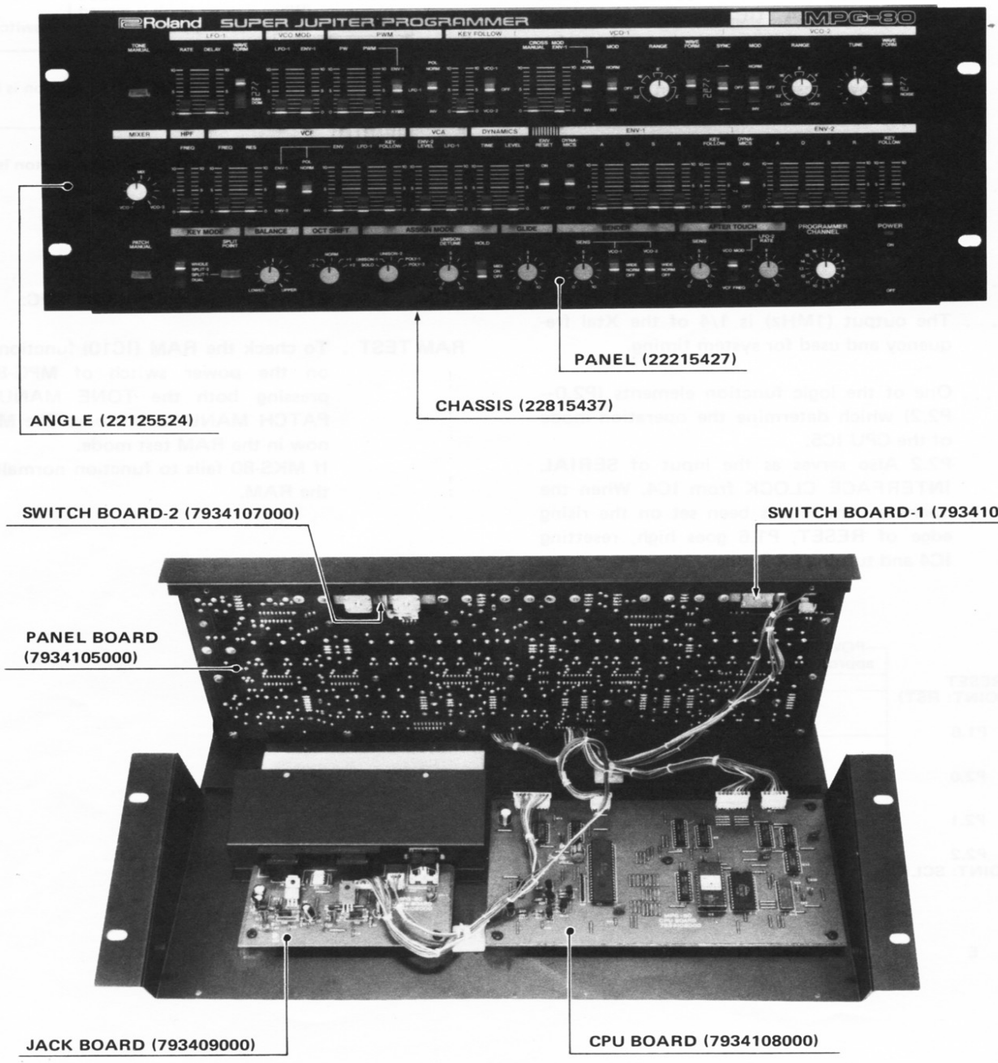
MPG-80

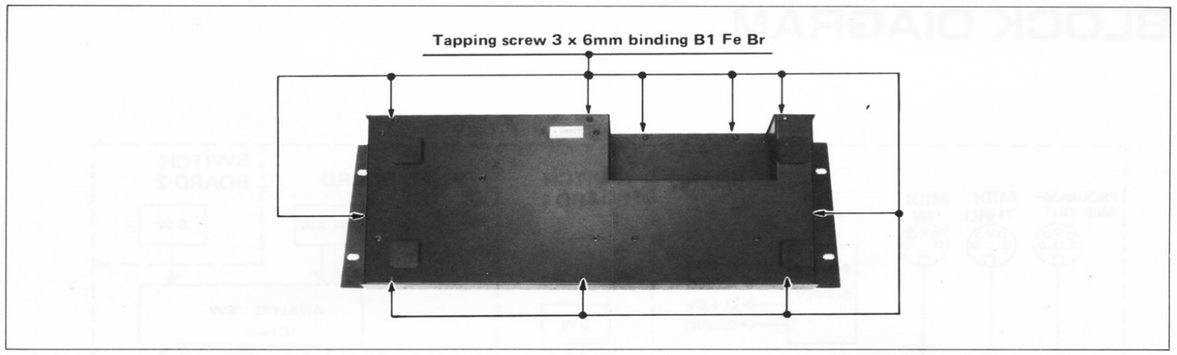
SPECIFICATIONS

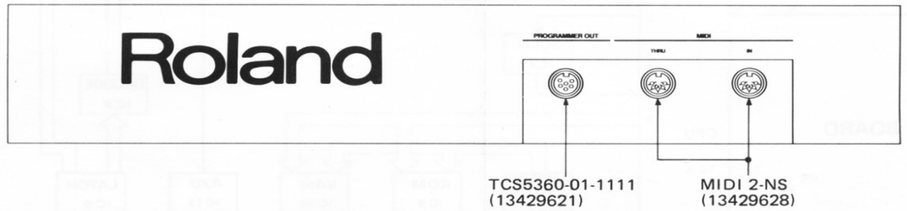
Power Consumption 0.9W

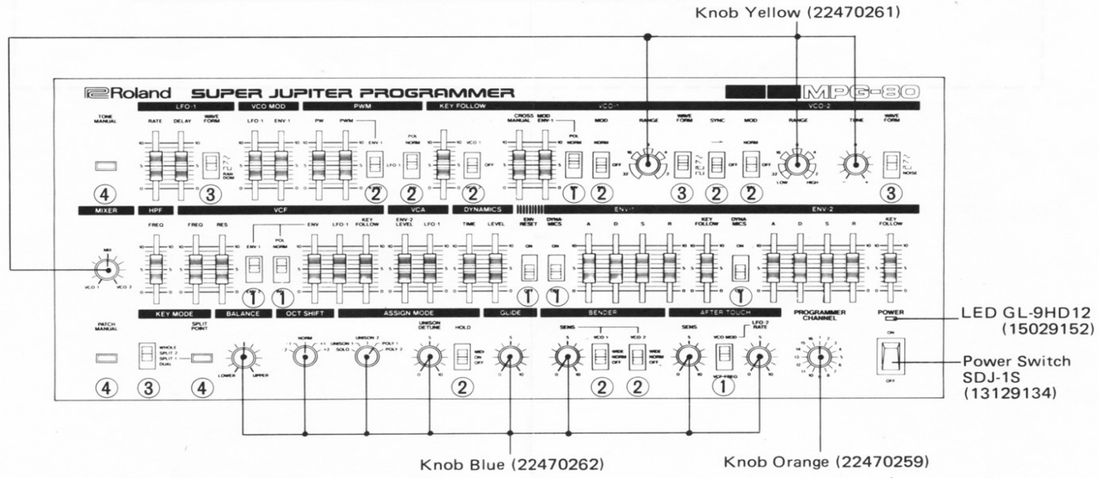
Dimensions 480(W) x 78(D) x 177(H) mm
19''(W) x 3-1/8''(D) x 7-1/16''(H)

Weight 3 kg/6 lb 10 oz







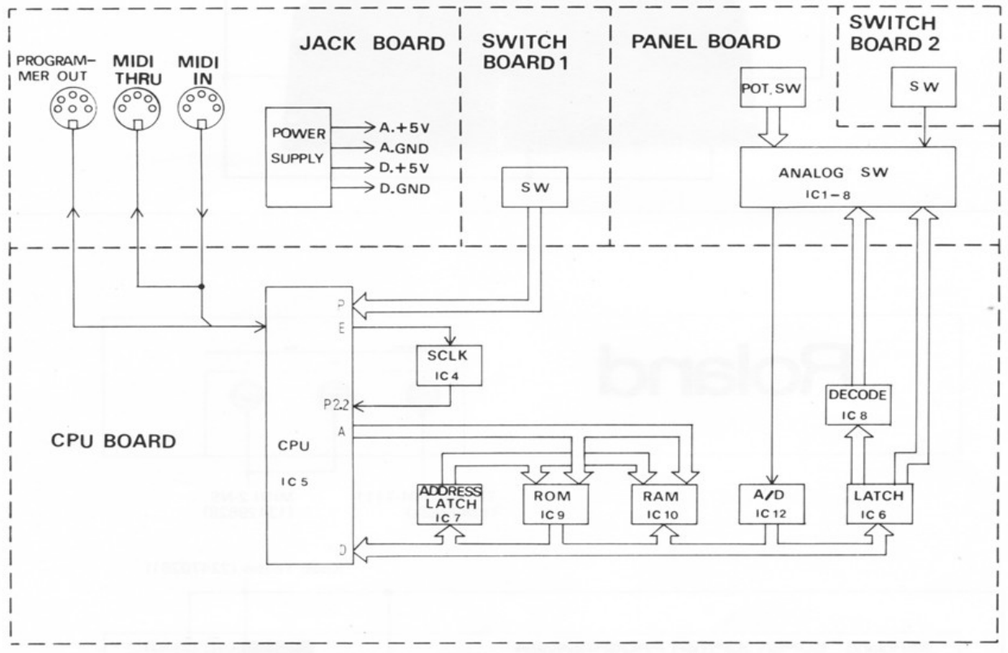


① 2-contact slide switches SSY022-12PN	(13159149)
② 3-contact slide switches SSY023-12PN	(13159336)
③ 4-contact slide switches SSY024-12PN	(13159508)
④ Button (22475598), Switch SPQ009G	(13129351)

UNLESS OTHERWISE SPECIFIED

Knob (Slider)	(22475329)
Knob (Slide switch)	(22475372)
All rotary Potentiometers K161MOZ1A–50KB.	(13219371)
All sliders are S2518G401–50KB.	(13339957)

BLOCK DIAGRAM



CIRCUIT DESCRIPTION

GENERAL

Signals from the potentiometers and switches on the panel board are converted to digital equivalent at the A/D converter (IC12) output and passed on to the CPU (IC5) for further processes.

The MKS-80 feeds the MPG-80 with an unregulated 8.5V through the programmer cable (6P DIN). The voltage is split and converted to two regulated +5V for analog and digital circuits. These voltages are current–limited to 90mA.

CPU BOARD

PIN DESCRIPTION

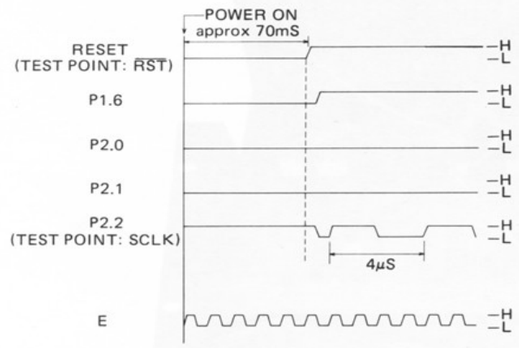
$\overline{RES}$ . . . . . When the power is first applied, the reset circuit PST518A (IC15) and associated circuits force this terminal to low for approx. 70ms. The same will take place as a power down resetting function if either of +5V supplies drops to the predetermined voltage.

D0–D7 . . . These buses are timeshared by data and addresses (A0 – A7). Addresses are latched into IC7 on a fall edge of address strobe (AS).

A8–A15 . . . Address buss

E . . . . . The output (1MHz) is 1/4 of the Xtal frequency and used for system timing.

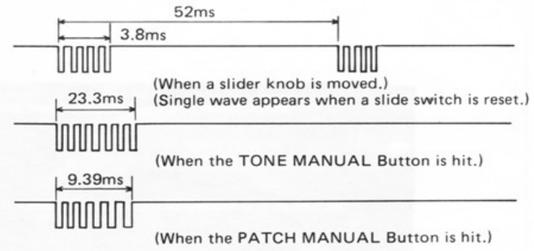
P2.0, P2.1, P2.2 . . . . . One of the logic function elements (P2.0–P2.2) which determine the operation mode of the CPU IC5.
P2.2 Also serves as the input of SERIAL INTERFACE CLOCK from IC4. When the operation mode has been set on the rising edge of RESET, P1.6 goes high, resetting IC4 and turning P2.2 low.



P1 . . . . . P1.0, P1.1, P1.2 and P1.3 read signals from the programmer channel switch (switch board –1).

P2, 3 . . . . . Data receive port of the serial communication interface.

P2, 4 . . . . . Data transmit port of the serial communication interface.



Test point: TX

ROM . . . . . 27C64, a lower current CMOS IC.

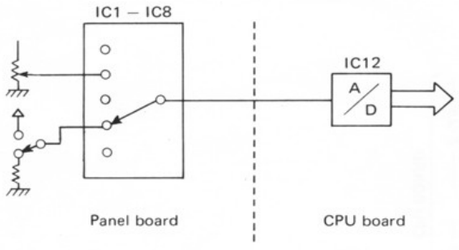
RAM TEST . To check the RAM (IC10) functioning, turn on the power switch of MPG-80 while pressing both the TONE MANUAL and PATCH MANUAL buttons. The MPG-80 is now in the RAM test mode.
If MKS-80 fails to function normally, check the RAM.

READING POTENTIOMETERS AND SWITCHES

Data from 39 potentiometers and 25 switches connected to analog switches (IC1—IC8) on the panel board are selected one by one by IC6 and IC8 on the CPU board. (The position of a switch is also represented in analog value by the voltage divider—resistors). Exceptions are PROGRAMMER CHANNEL and POWER switches.

Signals from the programmer channel switch (16 positions) are directly input in 4-bit binary code to the CPU port 1.

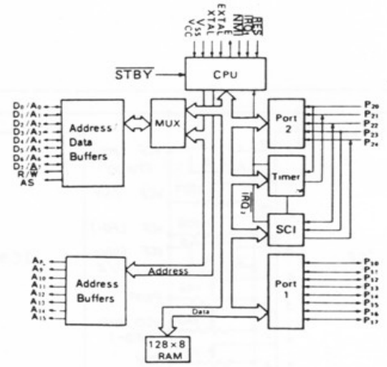
Selected analog data is converted into 8-bit code at the output of IC12 on the CPU board and routed to the CPU IC5.



IC DATA

HD6303RP
CMOS Micro Processing Unit

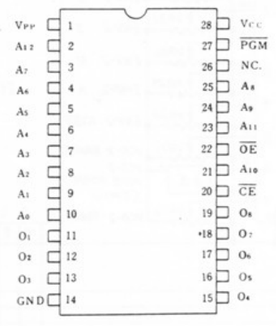
Block Diagram



Pin Configuration

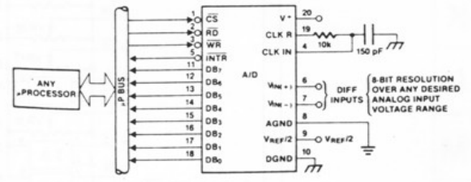
MBM27C-64-671
CMOS 65536-BIT UV ERASABLE AND ELECTRICALLY PROGRAMMABLE READ ONLY MEMORY

Pin Configuration

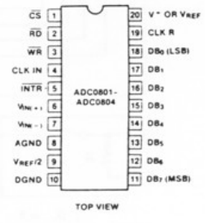


ADC0803LCN
8-Bit Microprocessor Compatible A/D Converters

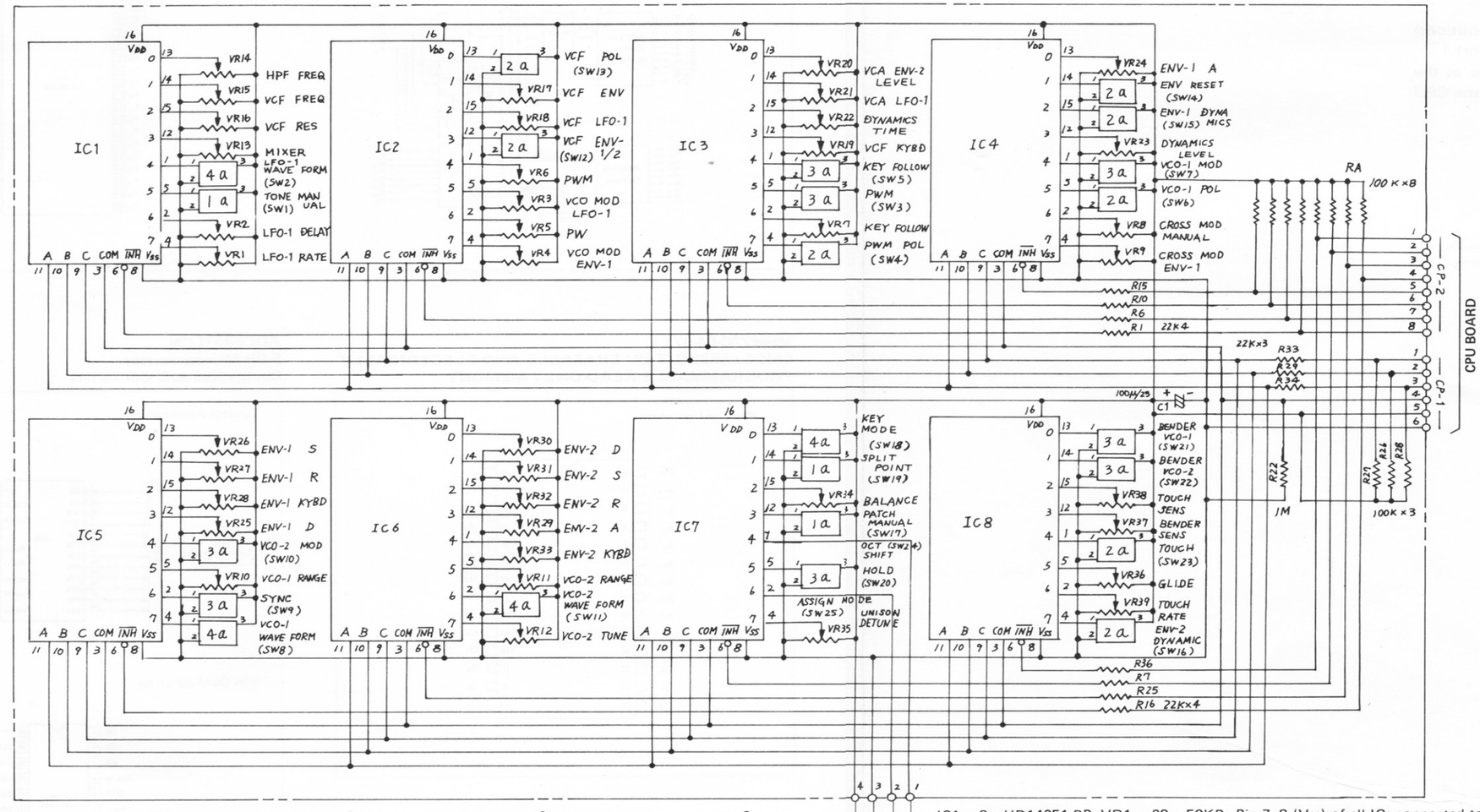
Typical Application



Pin Configuration



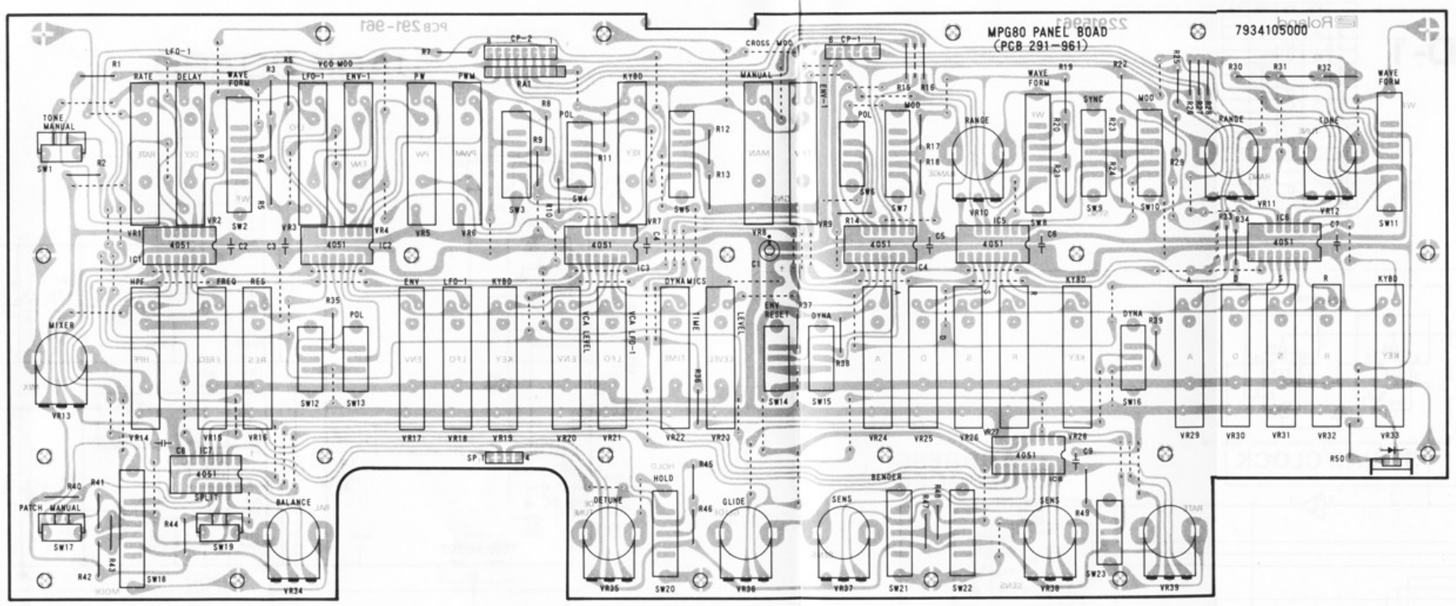
PANEL BOARD

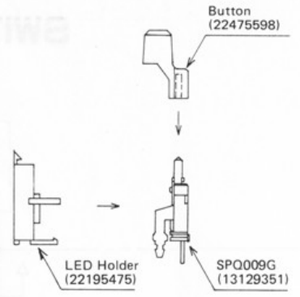


IC1 – 8: HD14051 BP, VR1 – 39: 50KB Pin 7, 8 (Vss) of all ICs connected to analog ground
Pin 16 (V_{DD}) of all ICs connected to +5V

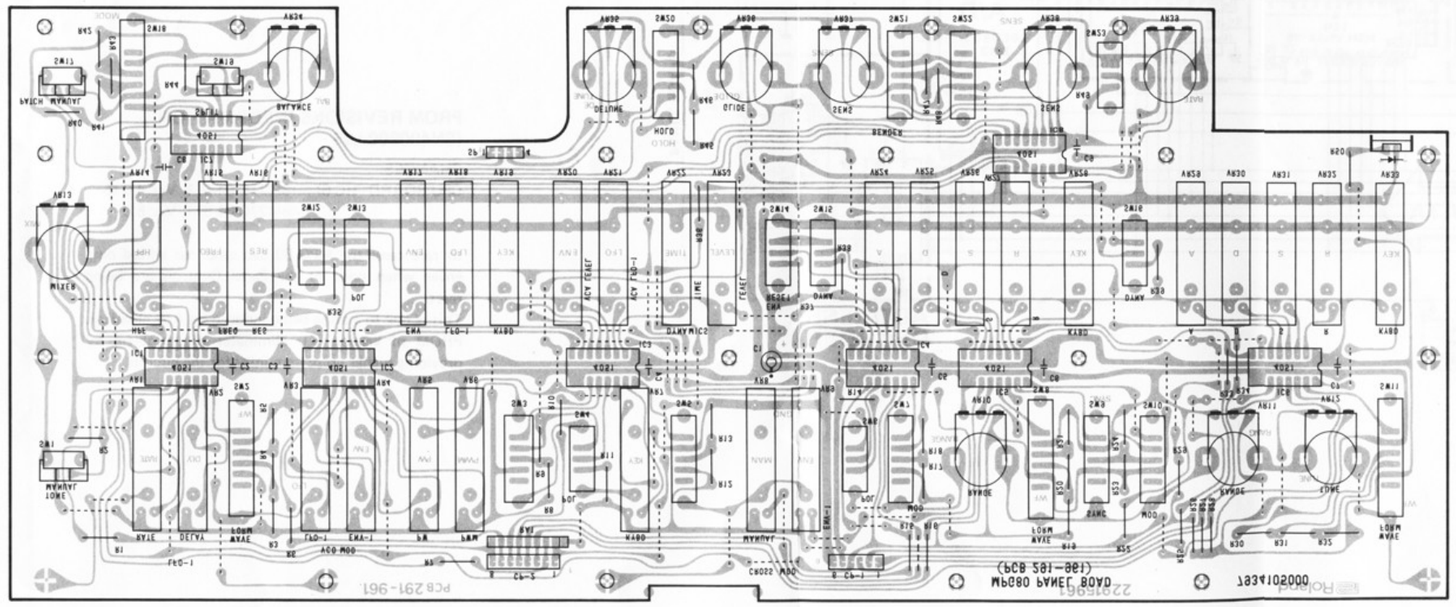
SWITCH BOARD-2

PANEL BOARD 7934105000 (pcb 22915961)

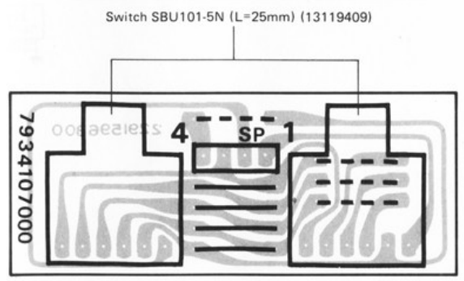




VR1 – 9, 14 – 33	S2518G401-50KB (L=20mm)	13339957
VR10 – 13, 34 – 39	K161M0Z1A-50KB (L=22.5mm)	13219371
SW1, 17, 19	SPQ009G	13129351
SW4, 6, 12 – 16, 23	SSY022-12PN	13159149
SW3, 5, 7, 9, 10, 20 – 22	SSY023-12PN	13159336
SW2, 8, 11, 18	SSY024-12PN	13159508



SWITCH BOARD-2
7934107000 (pcb 22915963)

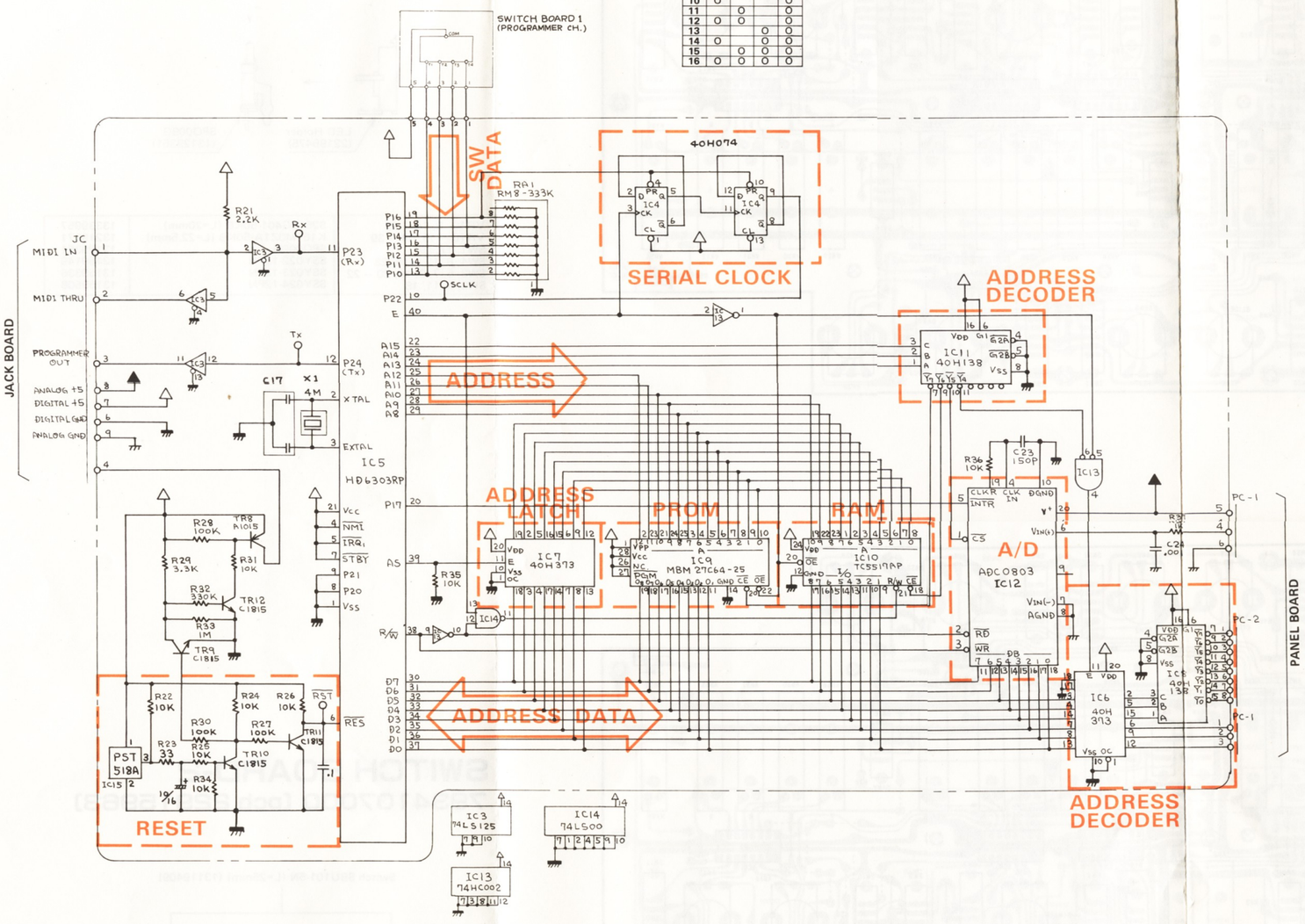


CPU BOARD

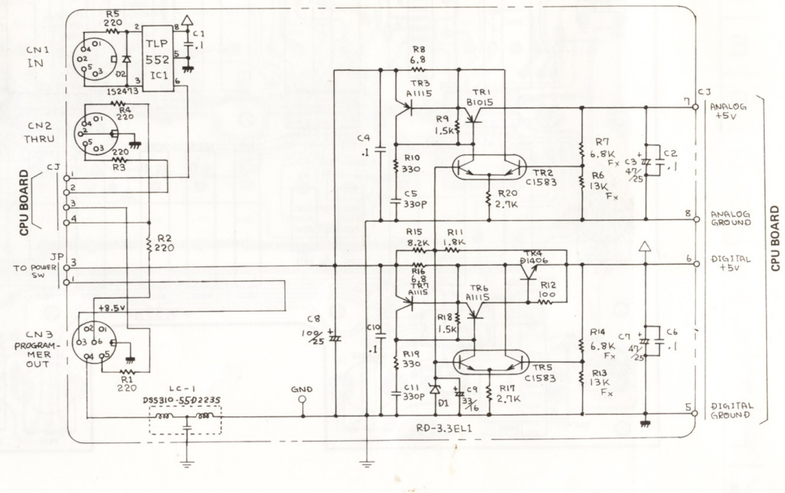
SWITCH BOARD-1

(O = ON)

	T1	T2	T3	T4
1				
2	O			
3		O		
4	O	O		
5			O	
6	O		O	
7		O	O	
8	O	O	O	
9				O
10	O			O
11		O		O
12	O	O		O
13			O	O
14	O		O	O
15		O	O	O
16	O	O	O	O



JACK BOARD



PROM REVISIONS INFORMATION (SN490900-UP)

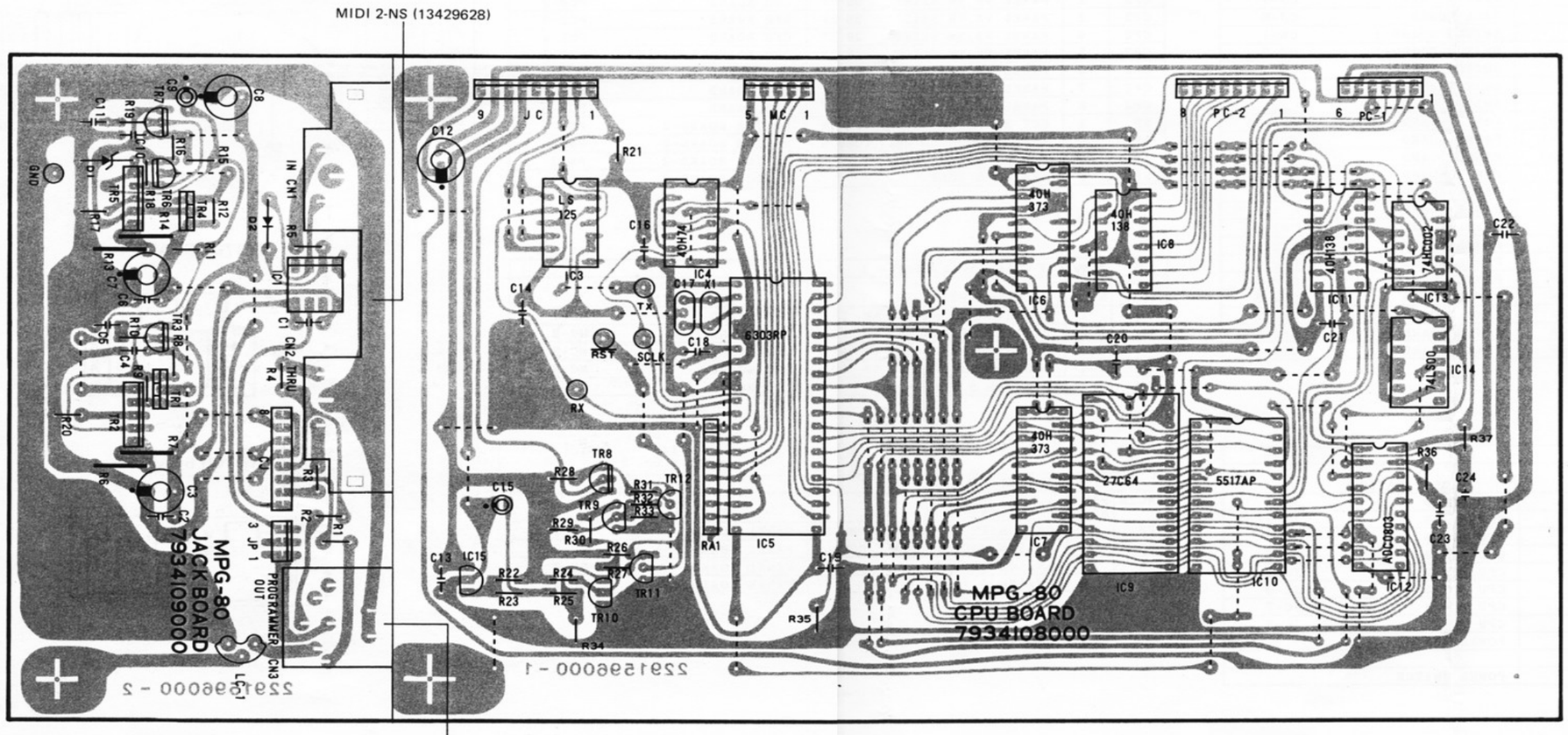
CHANGES:

CPU BOARD (IC 9) MBM27C-64-671 Ver.4.0 to MBM27C-64-671 Ver.5.0

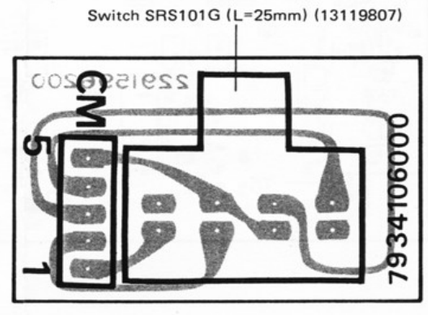
In rare cases the MPG-80 can send out edited data enven when none of the Panel Controls are being reset.

This is due to a noise being induced on A/D circuitry. PROM of version 5.0 eliminates this problem by providing higher noise immunity for the circuits.

CPU BOARD 7934108000
JACK BOARD 7934109000
(pcb 22915960)



SWITCH BOARD-1
7934106000 (pcb 22915962)

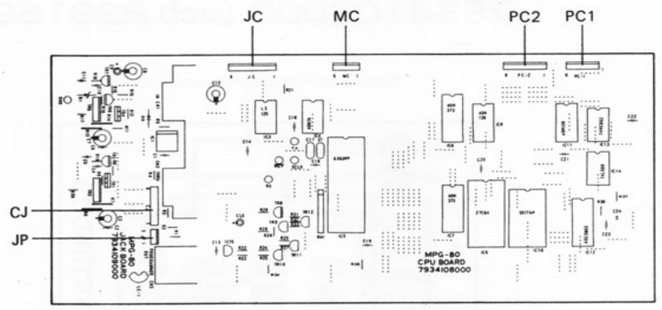


WIRING DATA TABLE

CPU BOARD				
CNCTR	PIN No.	DESCRIPTION		
JC	1	MIDI IN	JACK BOARD	CJ-1
JC	2	MIDI THRU	JACK BOARD	CJ-2
JC	3	PROGRAMMER OUT	JACK BOARD	CJ-3
JC	4	MIDI 5 VOLT WITH RESET	JACK BOARD	CJ-4
JC	5	NON CONNECTION		
JC	6	DIGITAL GROUND	JACK BOARD	CJ-5
JC	7	DIGITAL 5 VOLT	JACK BOARD	CJ-6
JC	8	ANALOG 5 VOLT	JACK BOARD	CJ-7
JC	9	ANALOG GROUND	JACK BOARD	CJ-8
MC	1	MIDI CHANNEL SW D3	SWITCH BOARD-1	CM-1
MC	2	MIDI CHANNEL SW D2	SWITCH BOARD-1	CM-2
MC	3	MIDI CHANNEL SW D1	SWITCH BOARD-1	CM-3
MC	4	MIDI CHANNEL SW D0	SWITCH BOARD-1	CM-4
MC	5	DIGITAL 5 VOLT	SWITCH BOARD-1	CM-5
PC1	1	PANEL VR,SW SELECT BUS D2	PANEL BOARD	CP1-1
PC1	2	PANEL VR,SW SELECT BUS D1	PANEL BOARD	CP1-2
PC1	3	PANEL VR,SW SELECT BUS D0	PANEL BOARD	CP1-3
PC1	4	PANEL VR,SW ANALOG DATA	PANEL BOARD	CP1-4
PC1	5	ANALOG 5 VOLT	PANEL BOARD	CP1-5
PC1	6	ANALOG GROUND	PANEL BOARD	CP1-6
PC2	1	PANEL VR,SW SELECT 38-3F	PANEL BOARD	CP2-1
PC2	2	PANEL VR,SW SELECT 30-37	PANEL BOARD	CP2-2
PC2	3	PANEL VR,SW SELECT 28-2F	PANEL BOARD	CP2-3
PC2	4	PANEL VR,SW SELECT 20-27	PANEL BOARD	CP2-4
PC2	5	PANEL VR,SW SELECT 18-1F	PANEL BOARD	CP2-5
PC2	6	PANEL VR,SW SELECT 10-17	PANEL BOARD	CP2-6
PC2	7	PANEL VR,SW SELECT 08-0F	PANEL BOARD	CP2-7
PC2	8	PANEL VR,SW SELECT 00-07	PANEL BOARD	CP2-8

JACK BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
CJ	1	MIDI IN	CPU BOARD	JC-1
CJ	2	MIDI THRU	CPU BOARD	JC-2
CJ	3	PROGRAMMER OUT	CPU BOARD	JC-3
CJ	4	MIDI 5 VOLT WITH RESET	CPU BOARD	JC-4
CJ	5	DIGITAL GROUND	CPU BOARD	JC-5
CJ	6	DIGITAL 5 VOLT	CPU BOARD	JC-6
CJ	7	ANALOG 5 VOLT	CPU BOARD	JC-7
CJ	8	ANALOG GROUND	CPU BOARD	JC-8
JP	1	POWER SWITCH	POWER SWITCH	
JP	2	NON CONNECTION		
JP	3	POWER SWITCH	POWER SWITCH	

CPU/JACK BOARD

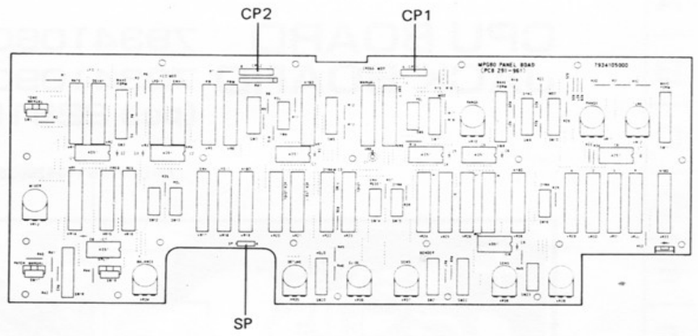


PANEL BOARD				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
CP1	1	PANEL VR,SW SELECT BUS D2	CPU BOARD	PC1-1
CP1	2	PANEL VR,SW SELECT BUS D1	CPU BOARD	PC1-2
CP1	3	PANEL VR,SW SELECT BUS D0	CPU BOARD	PC1-3
CP1	4	PANEL VR,SW ANALOG DATA	CPU BOARD	PC1-4
CP1	5	ANALOG 5 VOLT	CPU BOARD	PC1-5
CP1	6	ANALOG GROUND	CPU BOARD	PC1-6
CP2	1	PANEL VR,SW SELECT 38-3F	CPU BOARD	PC2-1
CP2	2	PANEL VR,SW SELECT 30-37	CPU BOARD	PC2-2
CP2	3	PANEL VR,SW SELECT 28-2F	CPU BOARD	PC2-3
CP2	4	PANEL VR,SW SELECT 20-27	CPU BOARD	PC2-4
CP2	5	PANEL VR,SW SELECT 18-1F	CPU BOARD	PC2-5
CP2	6	PANEL VR,SW SELECT 10-17	CPU BOARD	PC2-6
CP2	7	PANEL VR,SW SELECT 08-0F	CPU BOARD	PC2-7
CP2	8	PANEL VR,SW SELECT 00-07	CPU BOARD	PC2-8
SP	1	OCT SHIFT SW (SW24) COMMON	SWITCH BOARD-2	PS-1
SP	2	ASSIGN MODE SW(SW25)COMMON	SWITCH BOARD-2	PS-2
SP	3	ANALOG GROUND	SWITCH BOARD-2	PS-3
SP	4	ANALOG 5 VOLT	SWITCH BOARD-2	PS-4

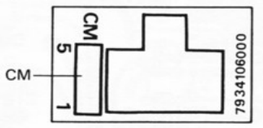
SWITCH BOARD-1				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
CM	1	PROGRAMMER CHENNEL SW D3	CPU BOARD	MC-1
CM	2	PROGRAMMER CHANNEL SW D2	CPU BOARD	MC-2
CM	3	PROGRAMMER CHANNEL SW D1	CPU BOARD	MC-3
CM	4	PROGRAMMER CHANNEL SW D0	CPU BOARD	MC-4
CM	5	DIGITAL 5 VOLT	CPU BOARD	MC-5

SWITCH BOARD-2				
CNCTR	PIN No.	DESCRIPTION	DESTINATION	
PS	1	OCT SHIFT SW (SW24) COMMON	PANEL BOARD	SP-1
PS	2	ASSIGN MODE SW (SW25)COMMON	PANEL BOARD	SP-2
PS	3	ANALOG GROUND	PANEL BOARD	SP-3
PS	4	ANALOG 5 VOLT	PANEL BOARD	SP-4

PANEL BOARD



SWITCH BOARD-1



SWITCH BOARD-2