

# **Service Manual**

## **INTRODUCTION**

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This Service Manual has been put together to enable you to give your customer fast and dependable service with a minimum of difficulties for yourself. The reason you will be able to service this machine so efficiently is because all really time consuming problems that can turn up will probably be located on one of the two digital boards (I/O or Prozboard). These boards are so incredibly complex that, apart from very few exceptions, they have to be swapped if something goes wrong with them.

The machine is a fully digital synthesizer with analog filters. All its functions (e.g. waveform processing and sound modification) are controlled and executed by a computer.

What makes the WAVE what it is are the four boards plugged into the motherboard.

The heart of the machine is the CPU 6809 which is located on the I/O BOARD. Its intelligence (the machine program) is stored in four 2764 E-PROMS. They are plugged into sockets on the I/O BOARD and labeled 8, A, C, E. These are the E-PROMS that are exchanged in the event of a SOFTWARE UPDATE. Next to them you find the 2 E-PROMS labeled 4 and 6 which contains the WAVEFORM DATA.

The following manual should be sufficient help for you to restore a PPG WAVE to its normal working condition.

## **PPG WAVE 2.3 ADJUSTING INTRODUCTIONS**

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**– You must generally do all adjusting in 2.2 Mode –**

The PPG WAVE 2.3 has fully digital tone-generators which need no tuning at all. Because of the pitch wheel which is an analog control there can be a total detuning of the instrument. Follow these instructions to get proper function.

Open the instrument as follows:

Remove the 2 screws on both sides of the WAVE 2.3's case.

Loosen the two screws at both posterior sides which work as hinges.

Lift the cover and remove the safety-plate of the printed circuit boards.

Now the instrument is ready for service.

### **1. Adjusting the A/D Converter of the analog controls**

Call up any program and have a look into the ANALOG DISPLAY. Move one control to the right end position (full clockwise) and check the corresponding analog value. A full clockwise turned control must show the value "63". If not, you have to adjust the A/D Converter. Adjust the A/D trim control to show "63" just before the end position of the analog control. Make this adjustment before adjusting the Pitch Wheel (Bender).

### **2. Adjusting the Pitch Wheel**

Call up any program that uses keyb. mode "0". Make sure that no detuning is set on the oscillators (DETU: 0). Choose Bender Intensity BI: "3". Whenever the Bender spreads from one limitation to the other, there are parts with no effect called "windows". One "window", for example, is at the center position. The center position of the wheel should be in the middle of this window. It can be adjusted by loosening the screw of the plastic wheel fixed on the potentiometer axis and adjusting the center position of the wheel exactly to the centre of the window.

### **3. Adjusting the filters**

#### **3.1. Adjusting the resonance intensity:**

The instrument is opened and power is on. Call up program 74 group A (original PPG program). Tune the instrument to 440 Hz (TTUNE: 440). Choose group A for adjusting the resonance. After power is switched ON the voices of the PPG WAVE 2.3 are in the normal order. Each time you press a key the next is played. (in the sequence 1,2,3,4,5,6,7,8) Now press the first key in the centre of the keyboard and adjust the trimpot so that the filter resonance is directly before self-oscillation. Press the same key again and trim the next voice. Go through all the eight voices this way. It is important that they are all trimmed to the same intensity.

#### **3.2. Adjusting the cut-off frequency of the filters:**

Switch to group B (program 74). Press a key in the higher range of the keyboard and adjust the cut-off frequency so that it becomes equal to the fundamental frequency of the tone generator. Repeat the same procedure for all 8 voices.

## **COMPATIBLE SYSTEMS SOFTWARE**

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	<b>WAVE 2.3</b>	<b>PRK</b>	<b>WAVETERM</b>	<b>EVU</b>
2' 84	V 4	V 0	V 2.2	V 0
5' 84	V 4.1	V 1	V 2.3	V 1
10' 84	V 4.2	V 1.1	V 2.3.3	V 1

### **SPECIAL SOFTWARE:**

- Waveterm: Names - Disc
- Wave 2.3: Second Wave 2.3 connected to Waveterm (only 1 E-Prom, labeled 2nd).
- EVU: Second EVU connected to Waveterm (only 1 E-Prom, labeled 2nd).
- Wave 2.2: For Midi-Update needs also the hardware update.

### **SOFTWAREBUGS WAVE 2.3**

- V 4:
- a). Sequencer: changes Soundbanks in Record and Playbackmode.
  - b). Pitch/ Mod Wheel: works only in Bank 0.
  - c). Natural Sounds: Loading problems by using the PRK – Natural Sounds and by using Waveterm Natural Sounds.
  - d). Midi: 2.3 freezes if it's controlled by another Midi – Keyboard.
  - e). Communication Problems with the EVU.
- V 4.1: Midiproblems still in the machine.  
Communication Problems with the EVU.
- V 4.2: Actual Software.

## **SOUND MISTAKES**

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In general there are two different kinds of sound mistakes that can arise in the PPG WAVE 2.3 .

- a) Mistakes that occur in the computer.
- b) Mistakes that occur because of a defect in one of the 8 digital dual oscillators.

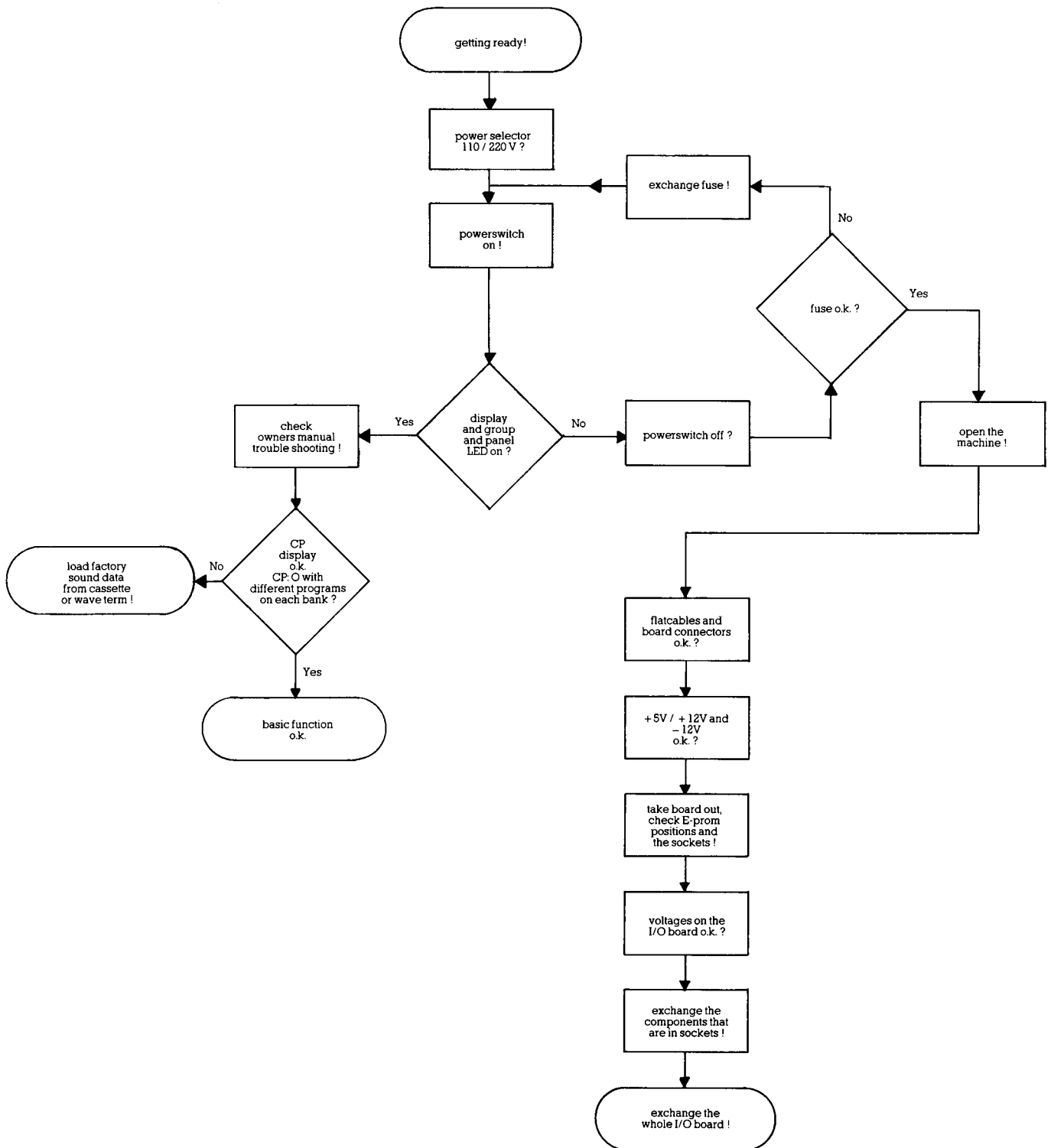
Here is a relatively easy test to determine which case is at hand:

- Turn on the machine and find a suitable sound in keyboard mode 0
- Press a key and hold it to determine if the sound is alright.
- After the keyboard has been turned on oscillator No. 1 is activated as soon as a key is pressed. Releasing the key and pressing it a second time activates oscillator No. 2. This makes it possible to step through the 8 oscillators one after the other.
- If the sound mistakes can be heard in regular intervals, (every eight time the key is pressed) the problem is probably a defect in one of the oscillators.
- If the mistake arises erratically it is usually a mistake in the computer.

A third problem can come from sounds that the customer has created himself. Certain natural electro acoustic effects (e.g. the modulation of certain parameter) can cause sound distortions that are than attributed to a defect in the synthesizer. There are two ways to determine whether this is the case:

- a) Load the factory sounds from tape into the WAVE.
- b) Load the customer's sounds into a different WAVE and compare them to each other.

# TROUBLE SHOOTING FLOW CHART



## **VARIOUS COMPONENTS OF THE WAVE 2.3 / 2.2**

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### 1) Power supply

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The power supply consists of a transformer with an input of 220 V or 110 V (depending on the switch on the back panel) and outputs of 2 x 15 V with a common ground lead and a 1 x 10 V secondary.

These a.c.'s are converted to the following d.c.'s:

+12 V, -12 V and +5 V.

The voltage controllers 7812 and 7912 are on the mother board, 78H05 is mounted on the back panel.

The 5 V are converted to a higher voltage for the LCD. This current is an alternating current.

### 2) Analog panel

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On the analog panel board are the corresponding pots and an mpx circuit.

Not on the board are the pots for "Master volume" and "Basis".

The adjustments for these pots cannot be stored in memory.

### 3) Digital Panel (TAS – board)

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a) On this board is a PIA-circuit for the LC-display. This PIA communicates also with the "Numerical" and the "Display Select" keypads.

b) The "Intensity"-Pot for the LCD.

#### 4) I/O Board

The following circuits and components are on this board:

- a) The A/D converter that changes the voltages from the analog panel board to digital values.
- b) Part of the Midi interface. The interface's buffer and optically coupled isolator are on a separate board mounted on the rear panel of the machine. Also mounted on this board is a resistor network and the jack sockets for the channel outputs.
- c) The multiplex keyboard interface.
- d) The connection to the digital panel.
- e) The RAM banks for the internal sound, the combi-program and the sequencer data. The power for these banks is supplied by a 4,8 V accumulator.
- f) The operating system E-proms (labeled: 8,A,C,E) and the wavetable E-proms (labeled: 4 and 6).
- g) A trimpot to adjust the range of all the pots on the analog panel board. The maximum value for these pots is "63" when turned to the extreme right. The adjusted value can be seen in the LCD.
- h) Three additional D/A converters that supply the power for the ADSR envelopes of the VCA, the VCF and the Resonance which are all on the voice cards. There are also various computer components on the board such as a CPU, a PTM, a VIA and a PIA.

#### 5) PROZ Board

On this board in a PIA circuit for the "PPG – Communication Bus", the sound bank RAMs and various TTL and PAL components for the "Sound computer".

#### 6 + 7) Voice Boards

On these 2 identical boards, that each hold 4 of the 8 voices, are the following circuits and components:

- 4 twelve bit D/A converters
- 4 VCF ICs, model: SSM 2044
- 2 Double VCAs, model: CEM 3360
- A row of operational amplifiers, model: TL 084
- Analog switches, model: CD 4066, for the processing of the envelopes.
- Trim pots to adjust filters, resonance, cut off and click.  
There are three pots for each voice.

#### 8) MB Mother Board

On this board are:

Parts for the +12V / -12V power supply

The power-on-reset circuit

The sync. in/out circuit

The after touch sensor circuit

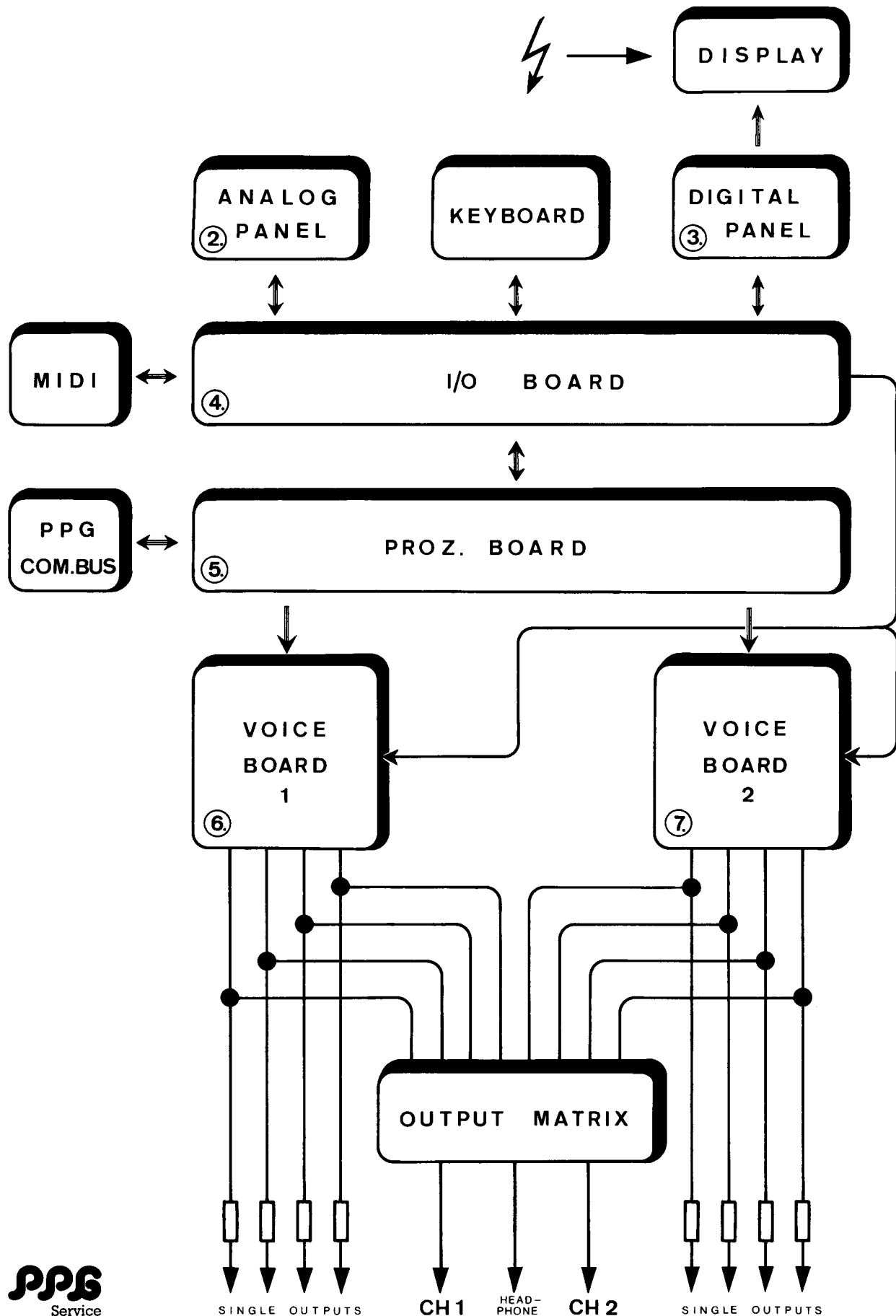
The Audio Output matrix

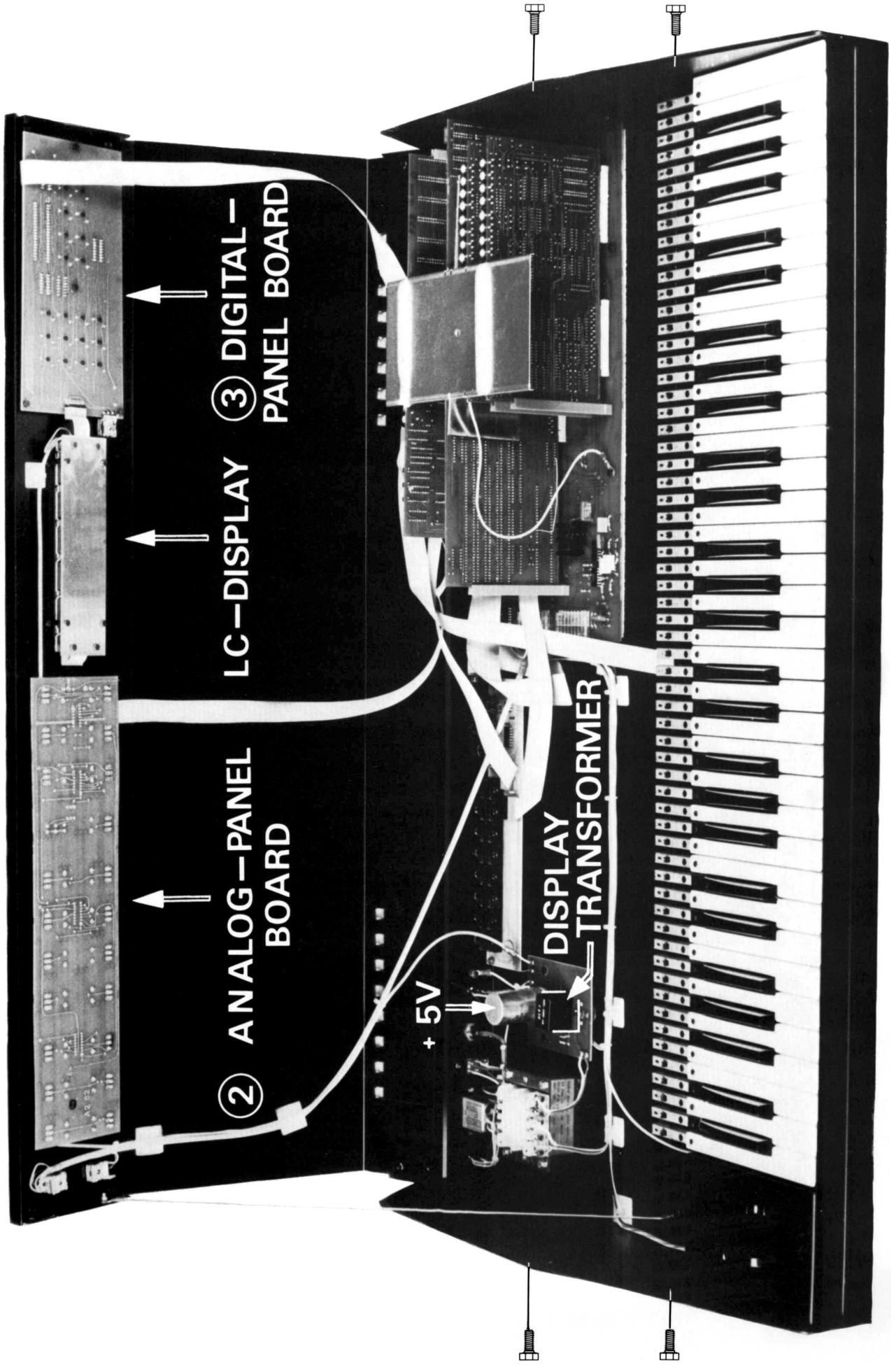
The cassette interface circuit

A select latch enable Circuit (IC 6) and a select D/A enable circuit (IC 7) which controls each voice on the Voiceboard.



# BLOCKDIAGRAM





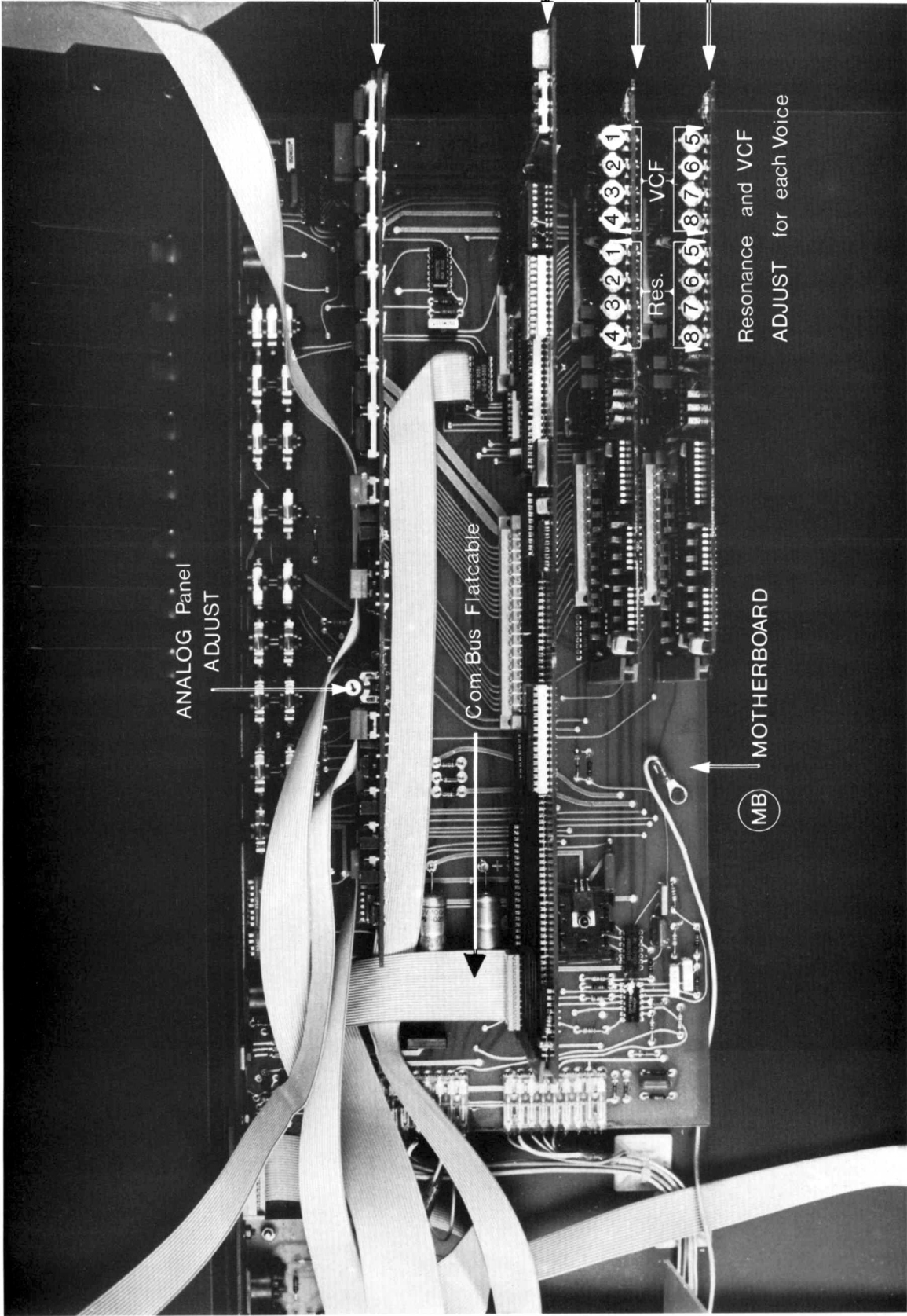
③ DIGITAL-PANEL BOARD

LC-DISPLAY

② ANALOG-PANEL BOARD

DISPLAY TRANSFORMER

+ 5V



ANALOG Panel  
ADJUST

④ I/O BOARD

⑤ PROZ. BOARD

⑥/⑦ VOICE  
BOARDS

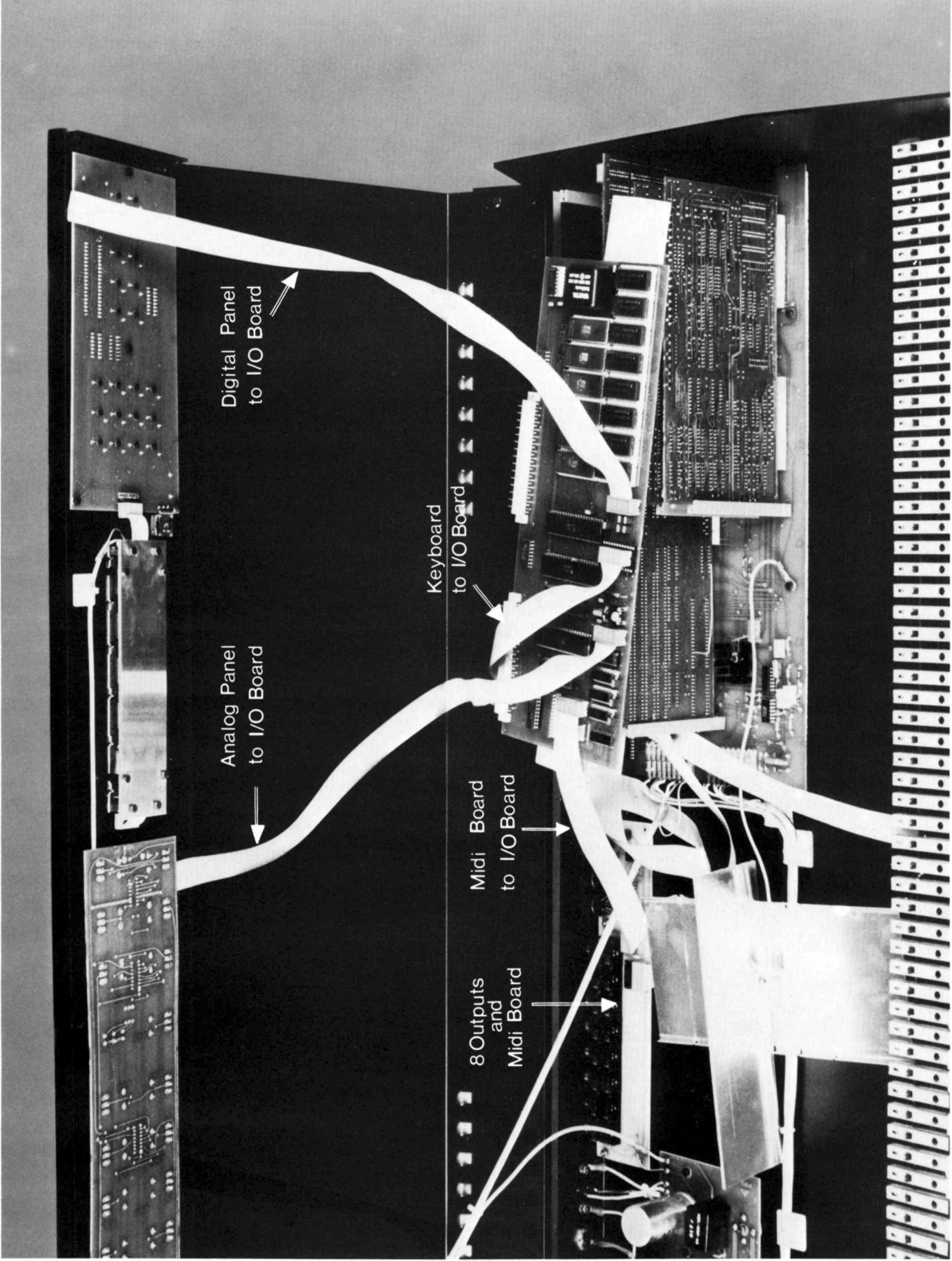
Resonance and VCF  
ADJUST for each Voice

⑧ MB MOTHERBOARD

Com. Bus Flatcable

4 3 2 1 4 3 2 1  
Res. VCF

8 7 6 5 8 7 6 5



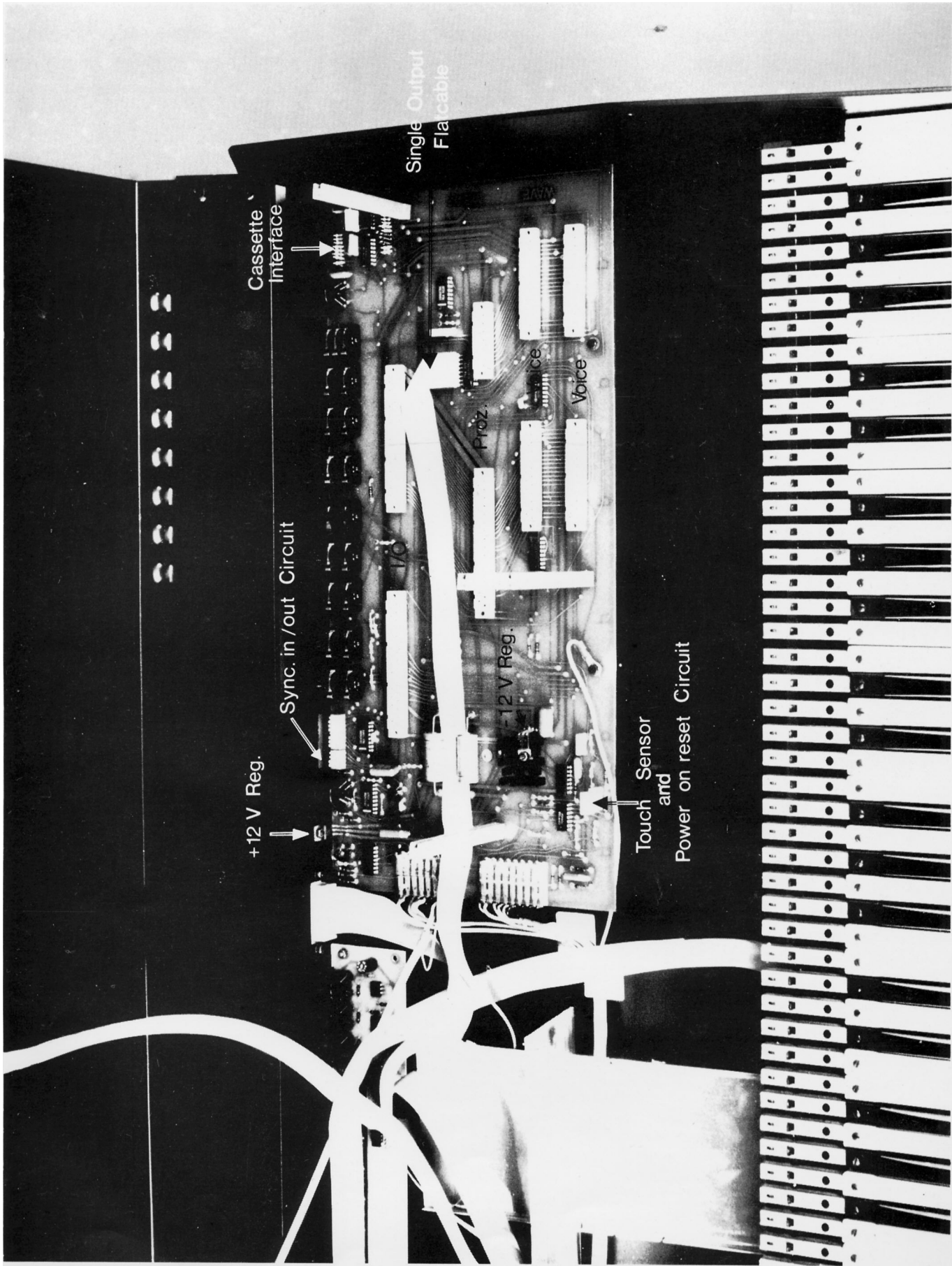
Digital Panel  
to I/O Board

Analog Panel  
to I/O Board

Keyboard  
to I/O Board

Midi Board  
to I/O Board

8 Outputs  
and  
Midi Board



Cassette Interface

Sync. in /out Circuit

+12 V Reg.

12 V Reg.

Proz.

Voice

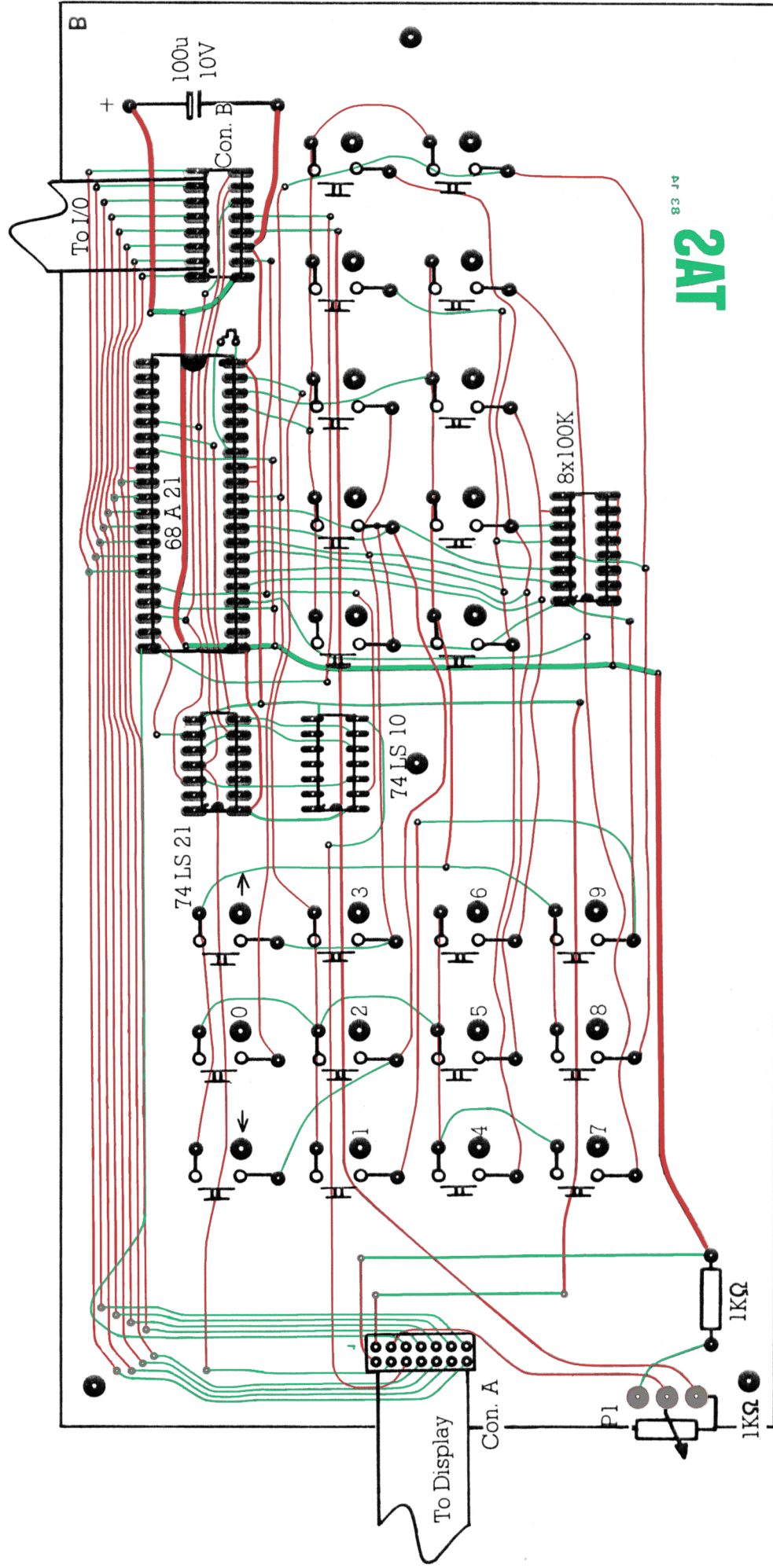
Touch Sensor and Power on reset Circuit

Single Output Flatcable

# PS6

## DIGITAL PANEL BOARD

( TAS - BOARD )



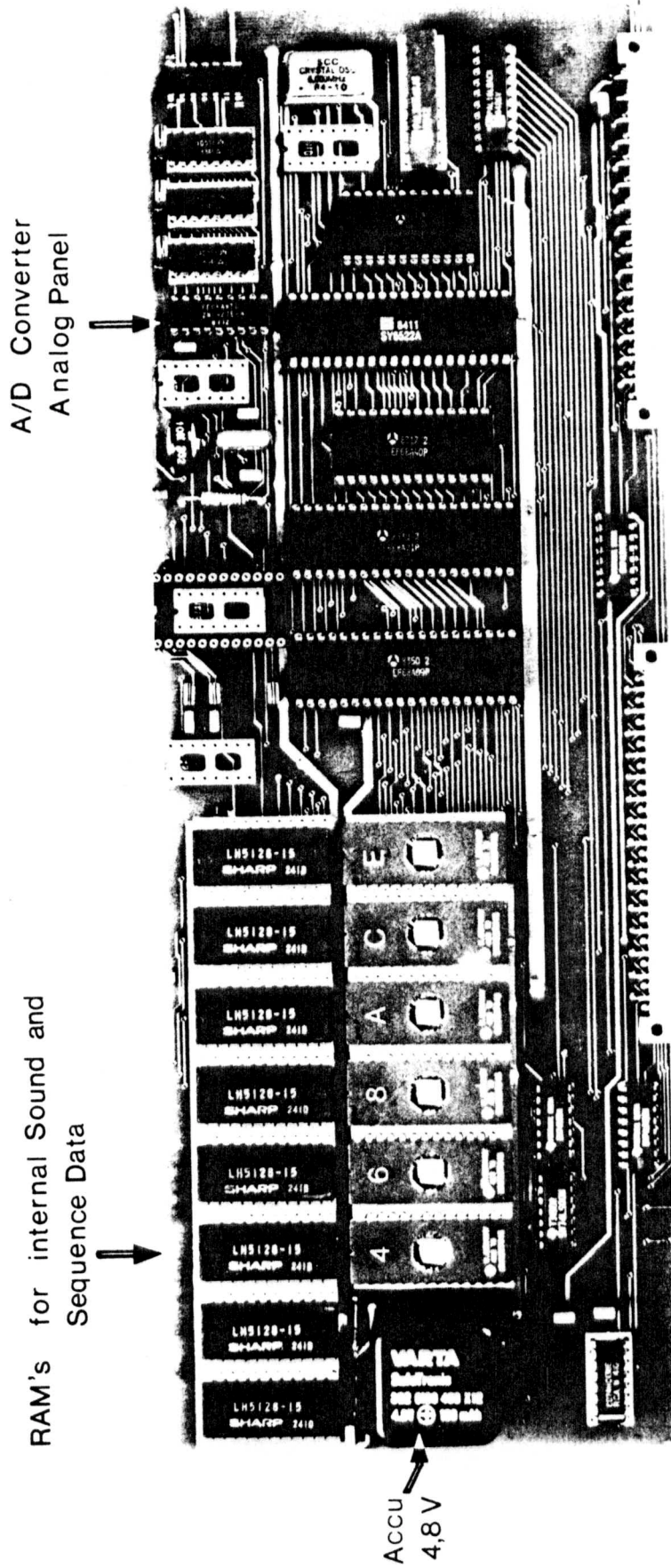
83 149  
**2AT**

red circuit lines - solder side

**PPS**

**THE I/O BOARD 2.3**

# I/O Board 2.3

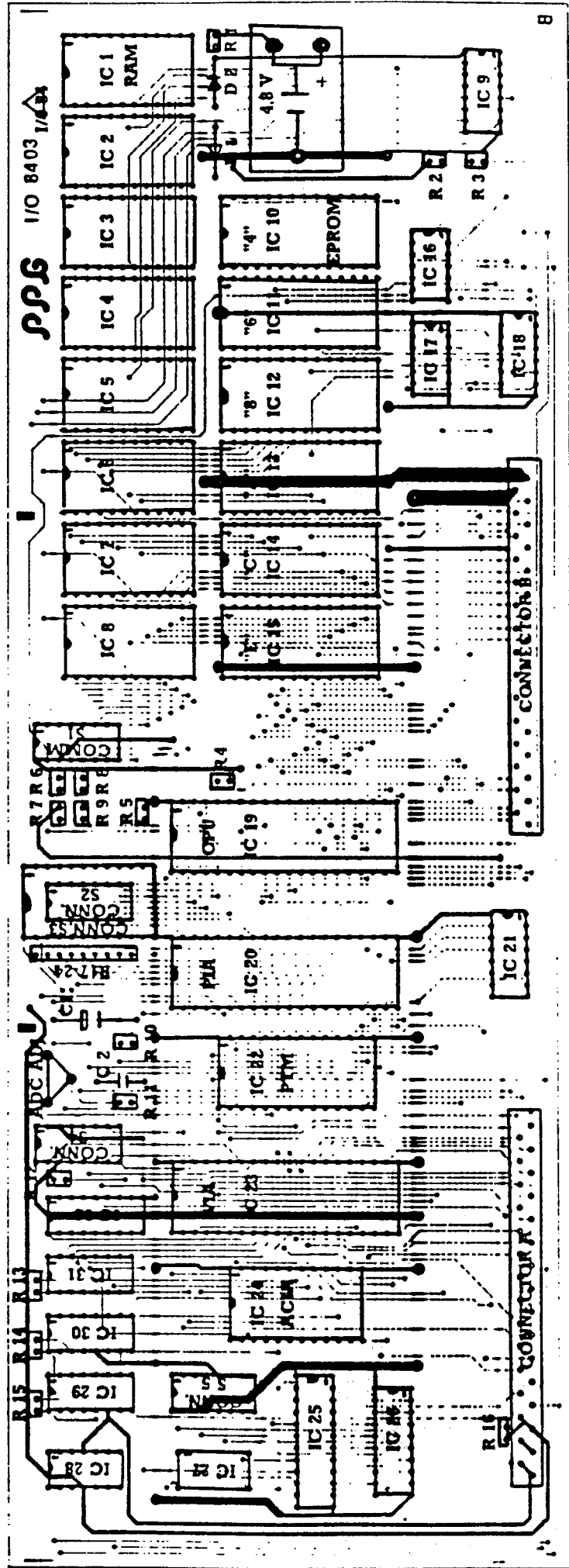


- E - Proms 4 and 6 = Wave tables
- E - Proms 8,A,C,E = Operating Instructions



# PPG

## THE I/O BOARD 2.3



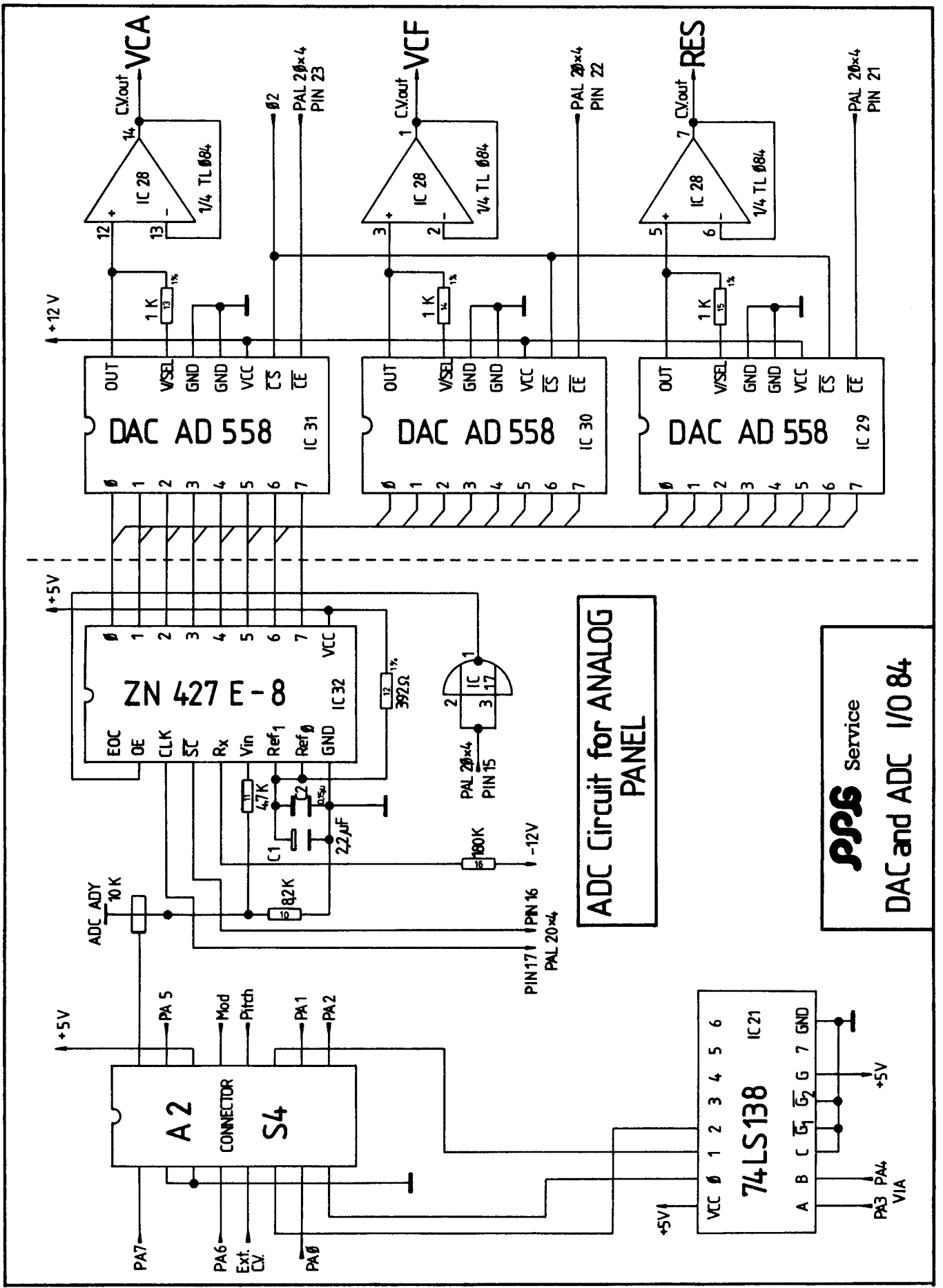
red circuit lines — solder side

31

1

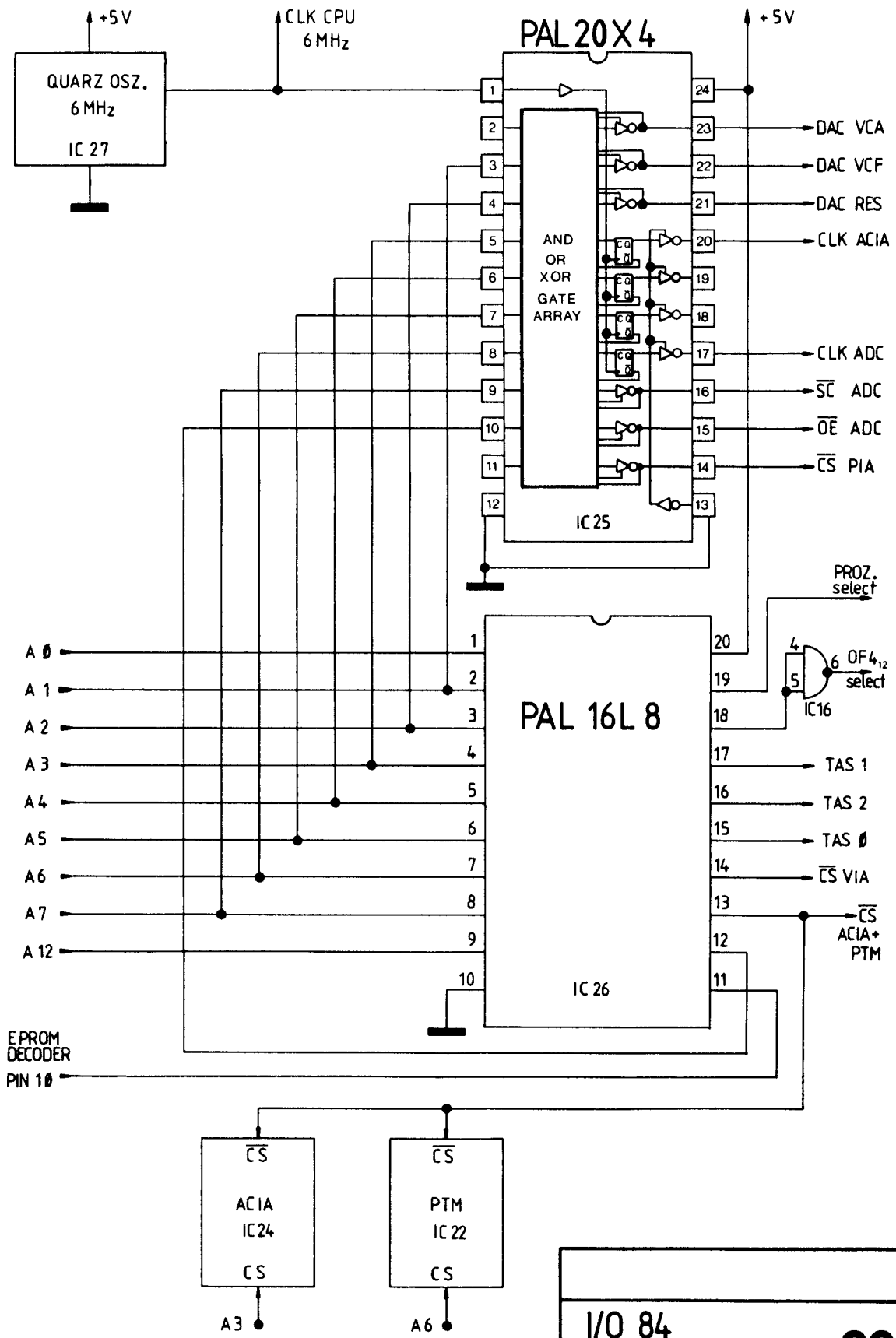
31

1



**ADC Circuit for ANALOG PANEL**

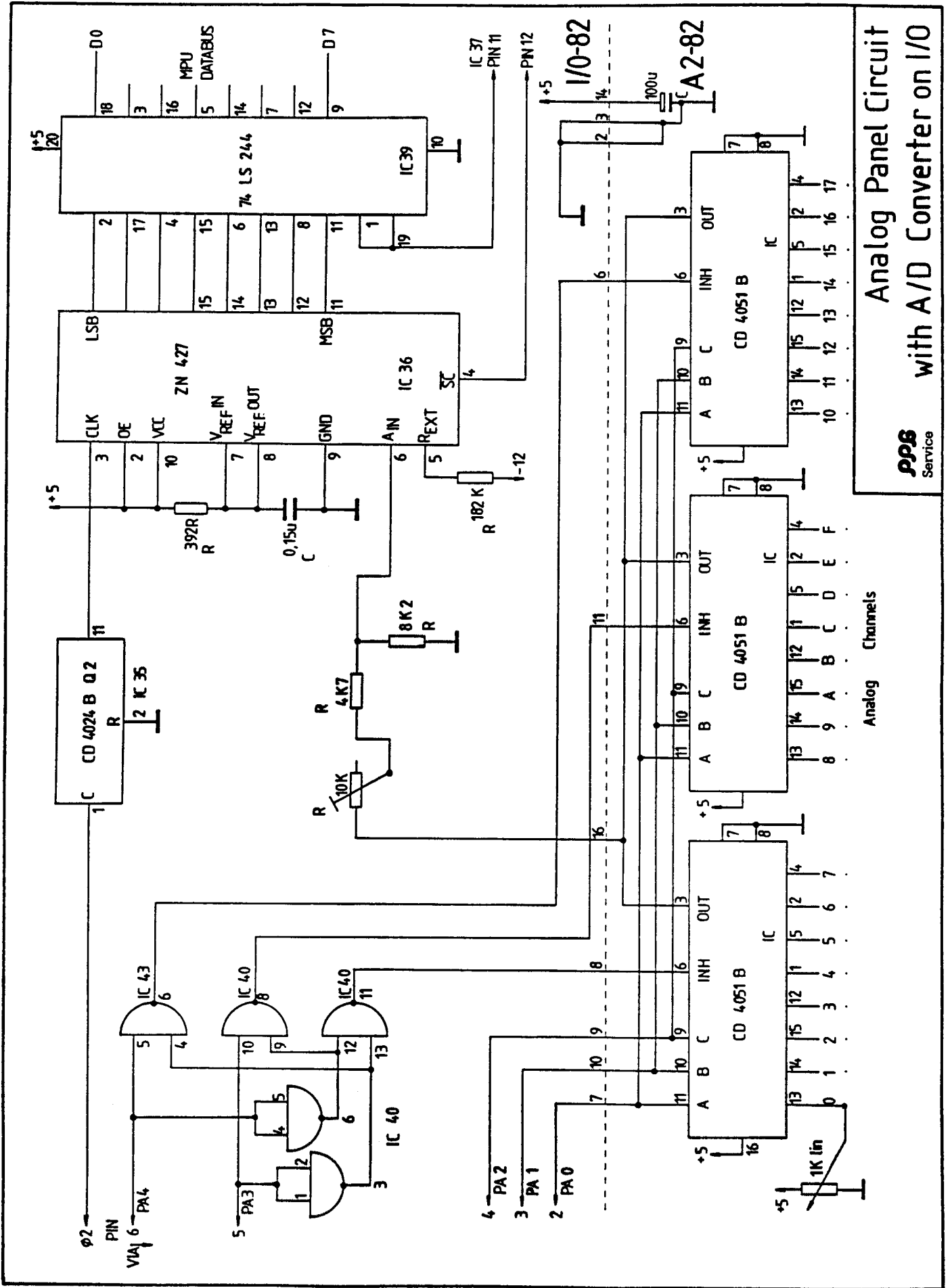
**Service**  
**PPS**  
 DAC and ADC I/O 84



I/O 84  
DECODIERUNG

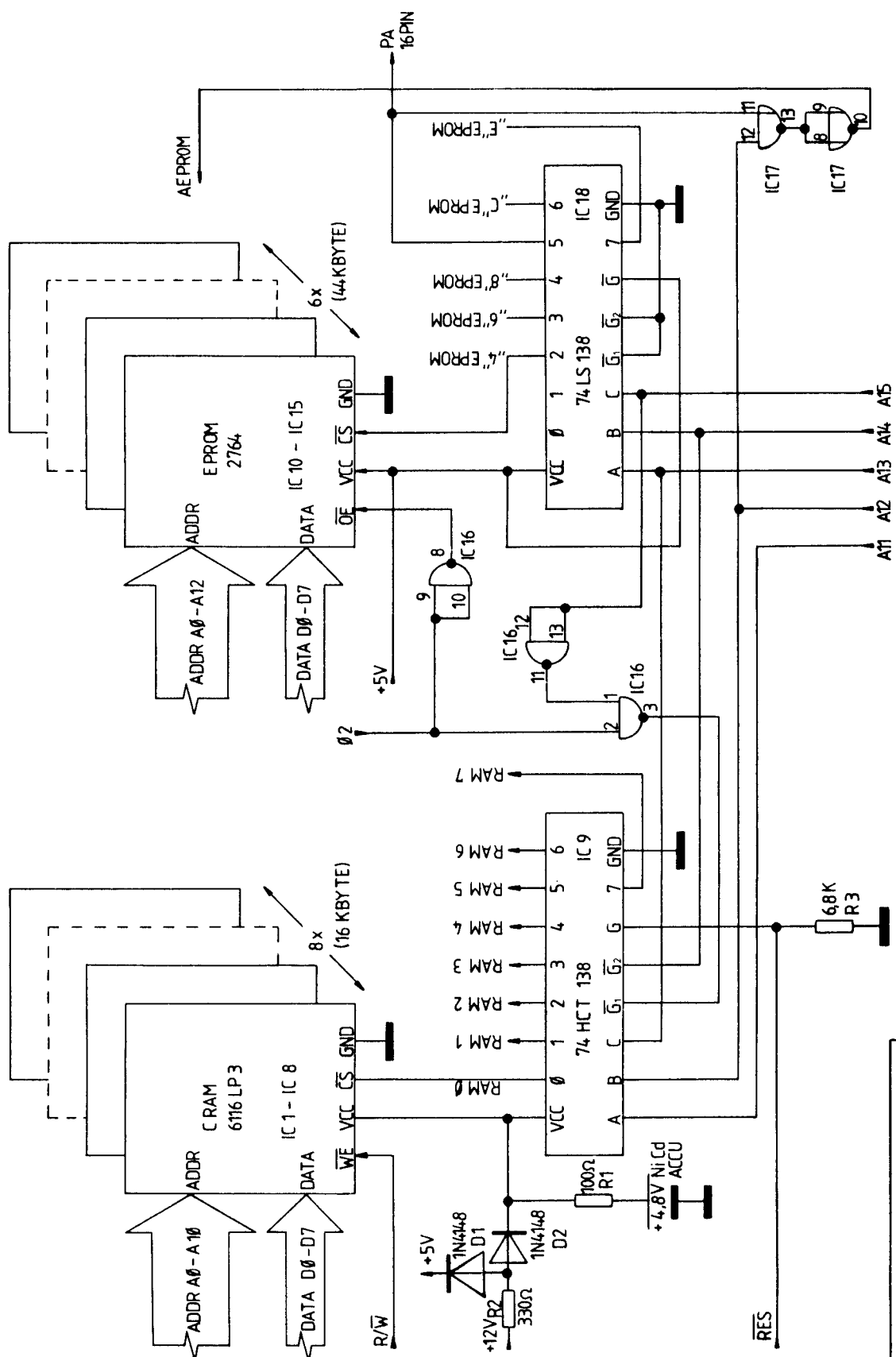






**PPS**  
Service

**Analog Panel Circuit  
with A/D Converter on I/O**

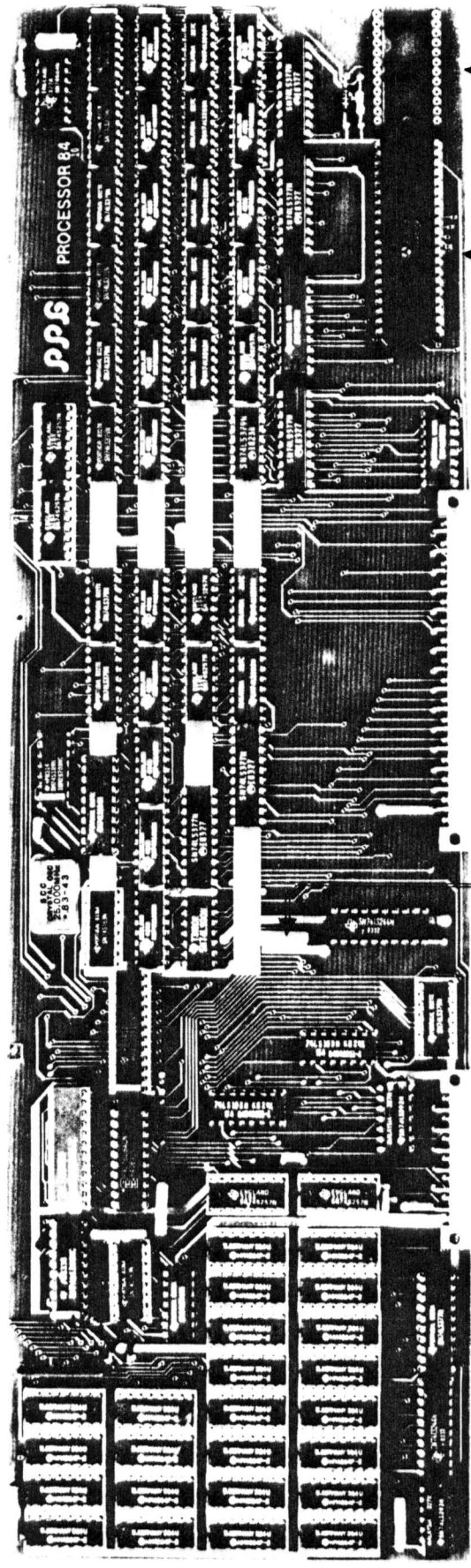


I/O 84 MEMORY

**PPS**  
Service

# Proz. Board 2.3

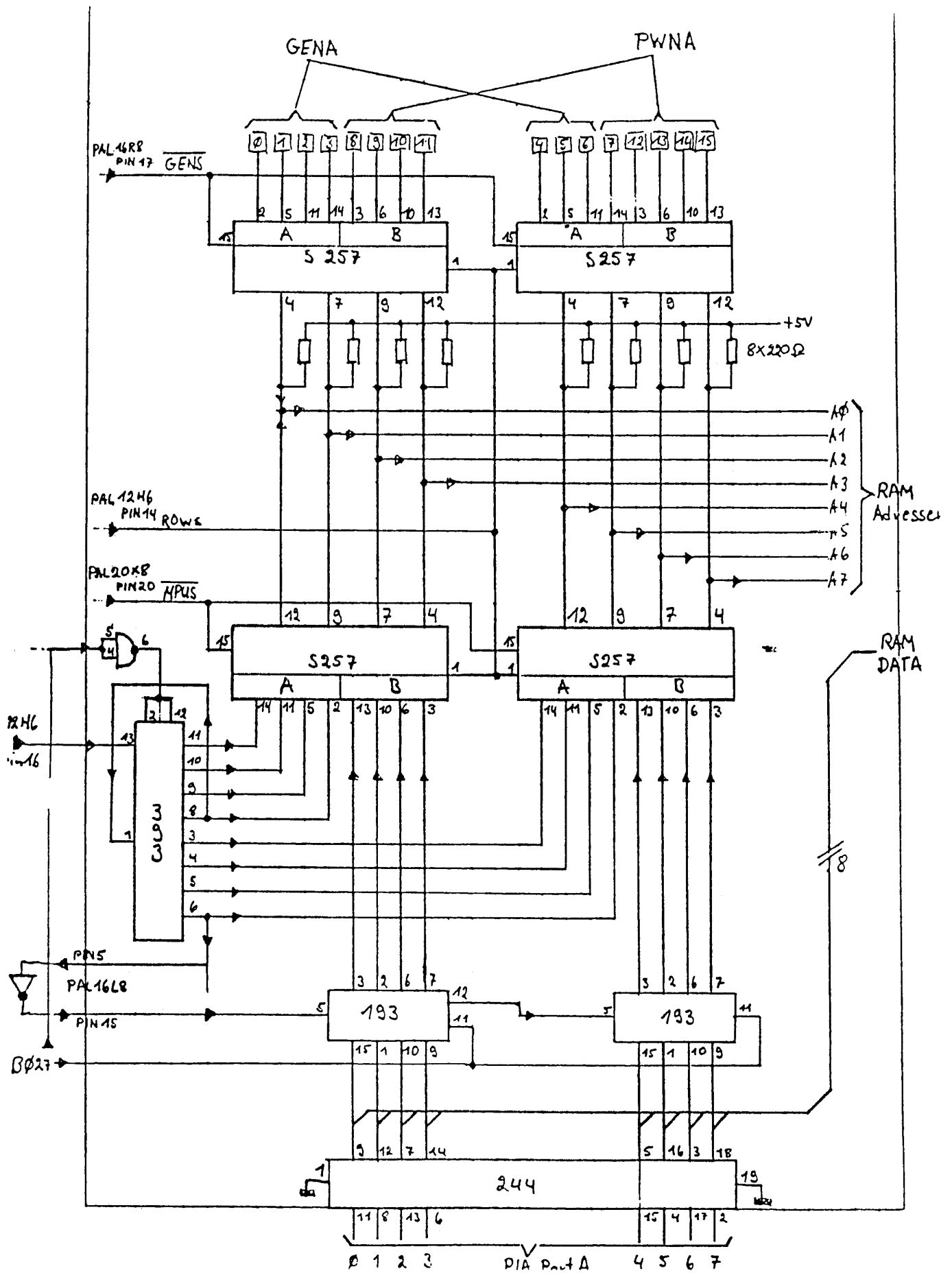
SOUND - RAM BANKS



! Irregular Sound - Dropouts  
or Distortions:  
If this Capacitor is 330 pF  
exchange it to 680 pF !

Com. bus PIA

Com. bus Connector

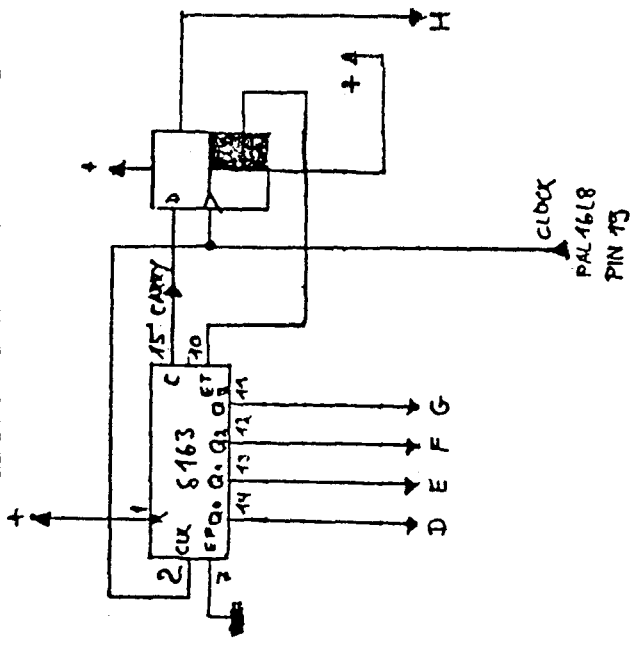




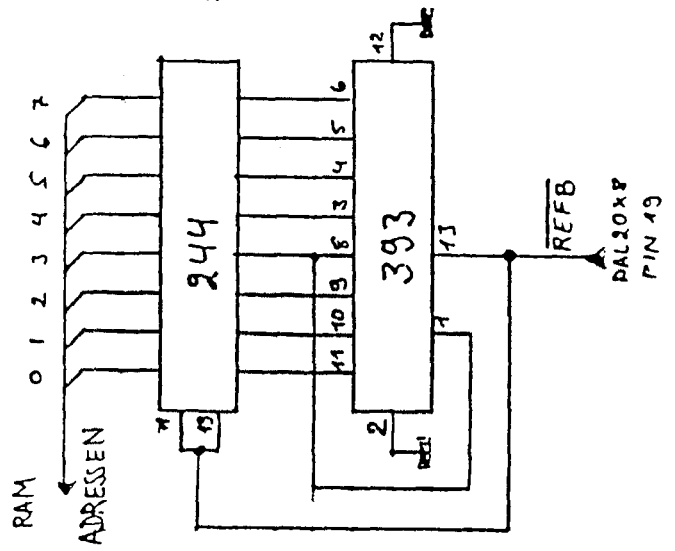
PROZ 83

27.01.84

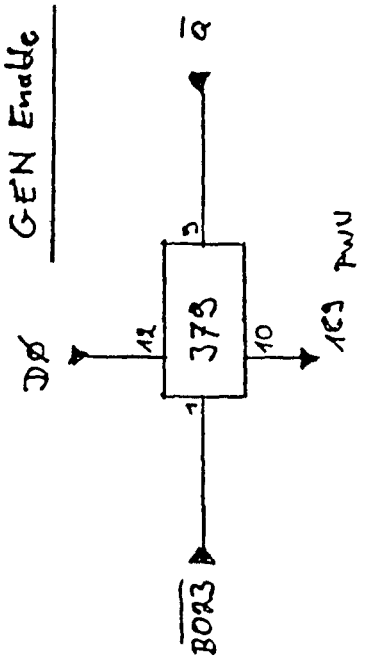
PHASENERZEUGUNG



D-RAM REFRESH



GEN Enable

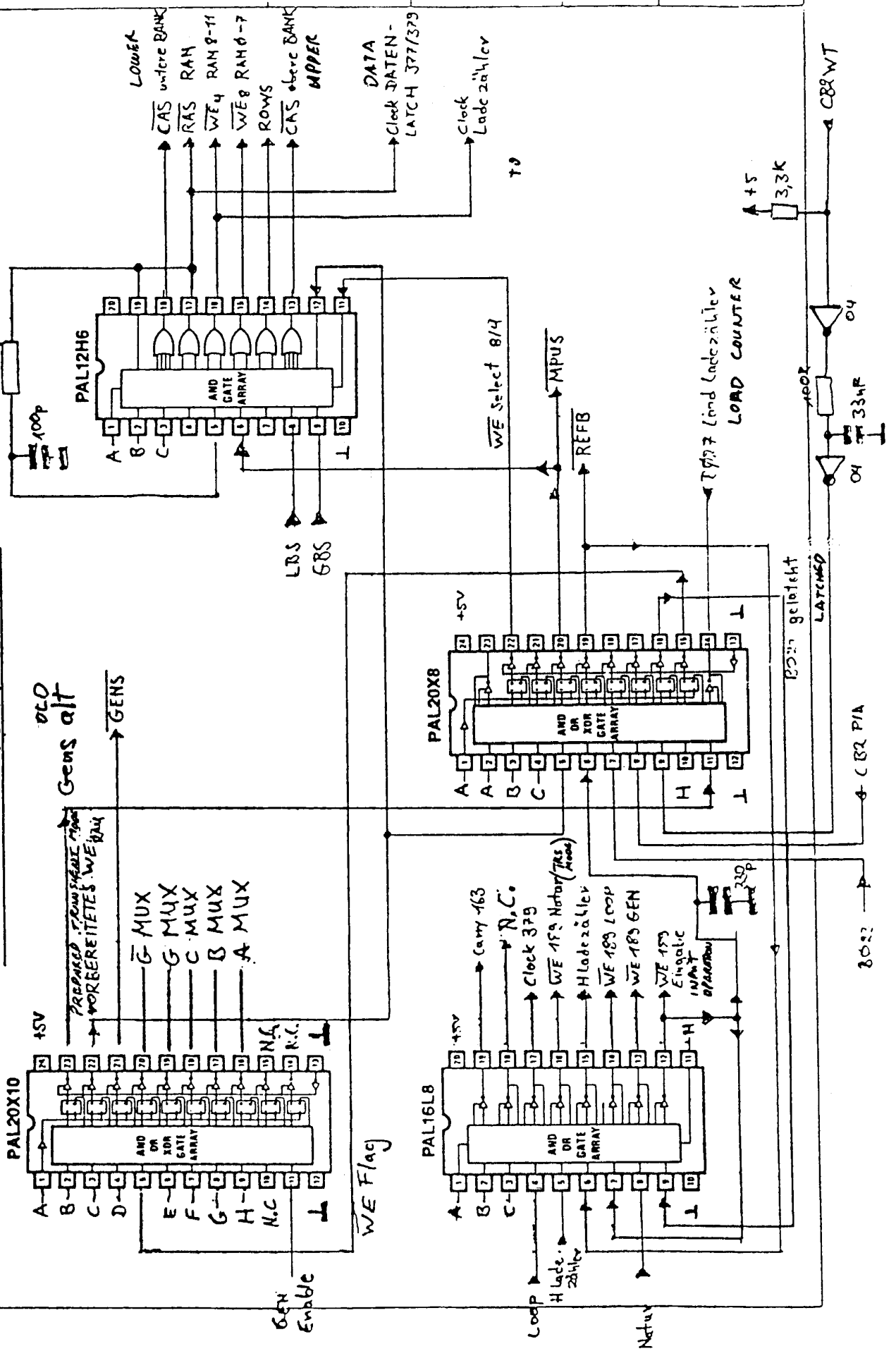




# PROZ - STEUERUNG

Control

27.01.84





27.01.84

FAIRCHILD GENERATION

Frequenzerzeugung

PROZ. 83

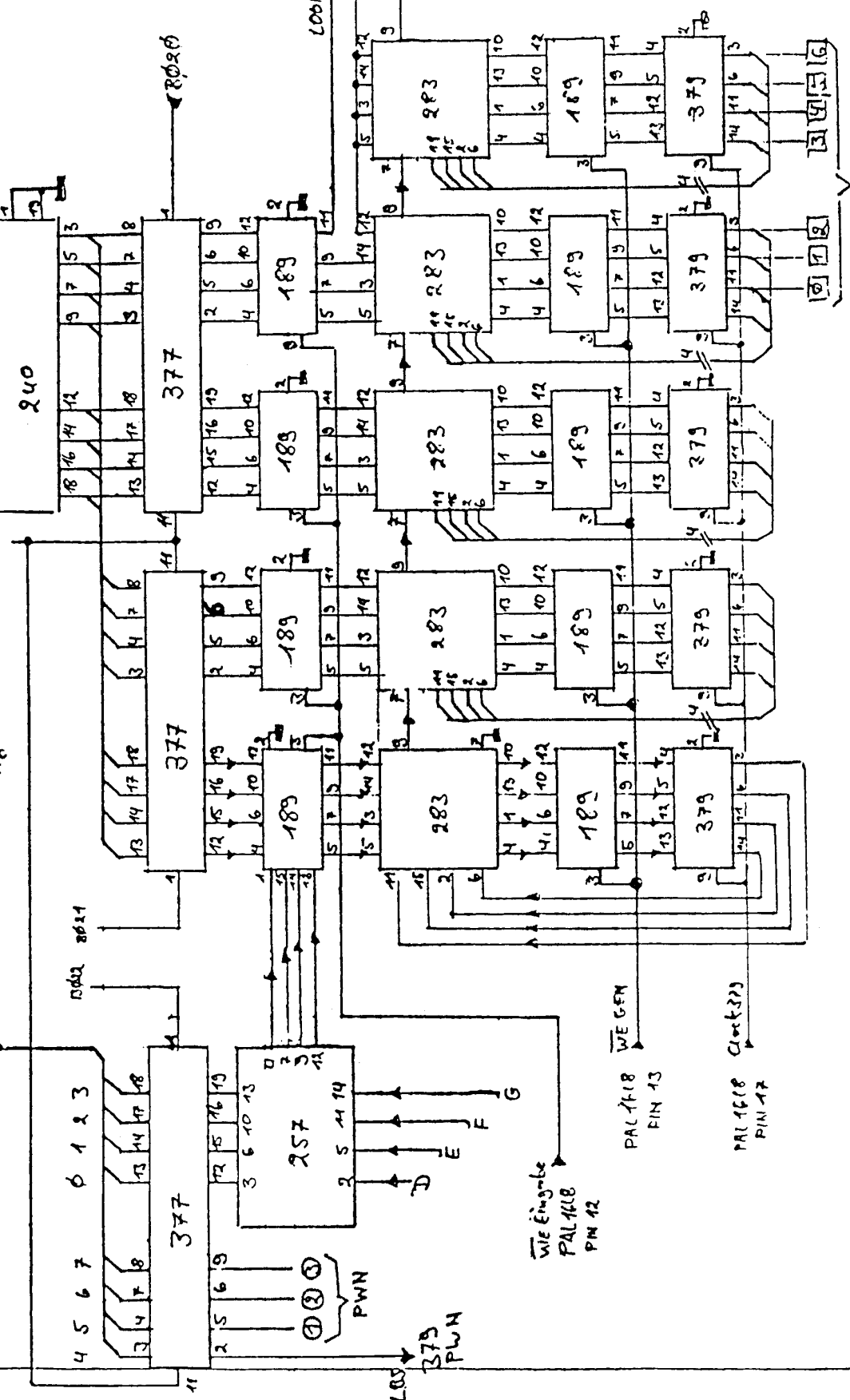
MPU DATA  
D0-D7

Q  
0 1 2 3 4 5 6 7  
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Q  
0 1 2 3 4 5 6 7  
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Q  
0 1 2 3 4 5 6 7  
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

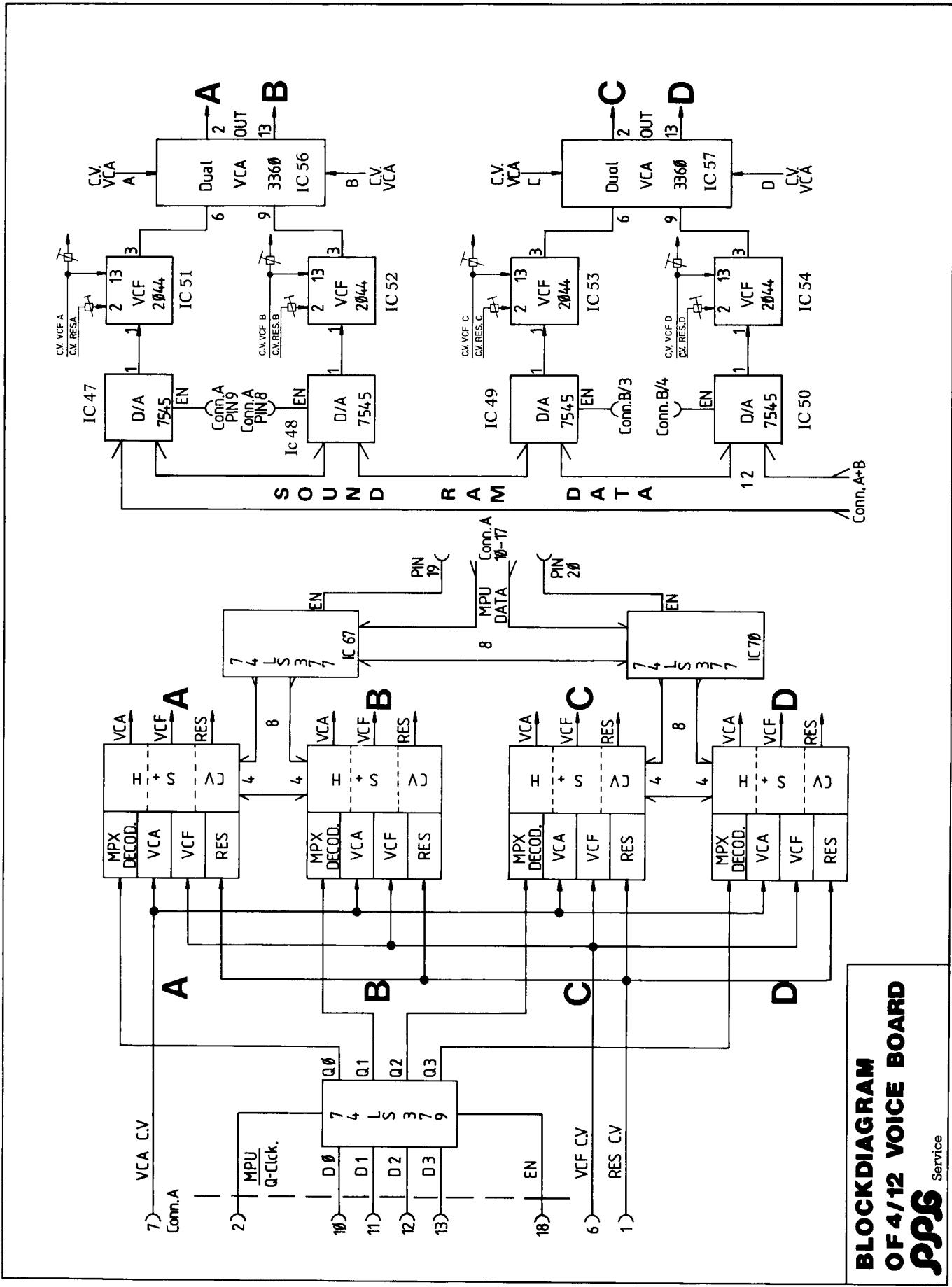
Q  
0 1 2 3 4 5 6 7  
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31



Write RAM Address  
GENA  
LOCAL







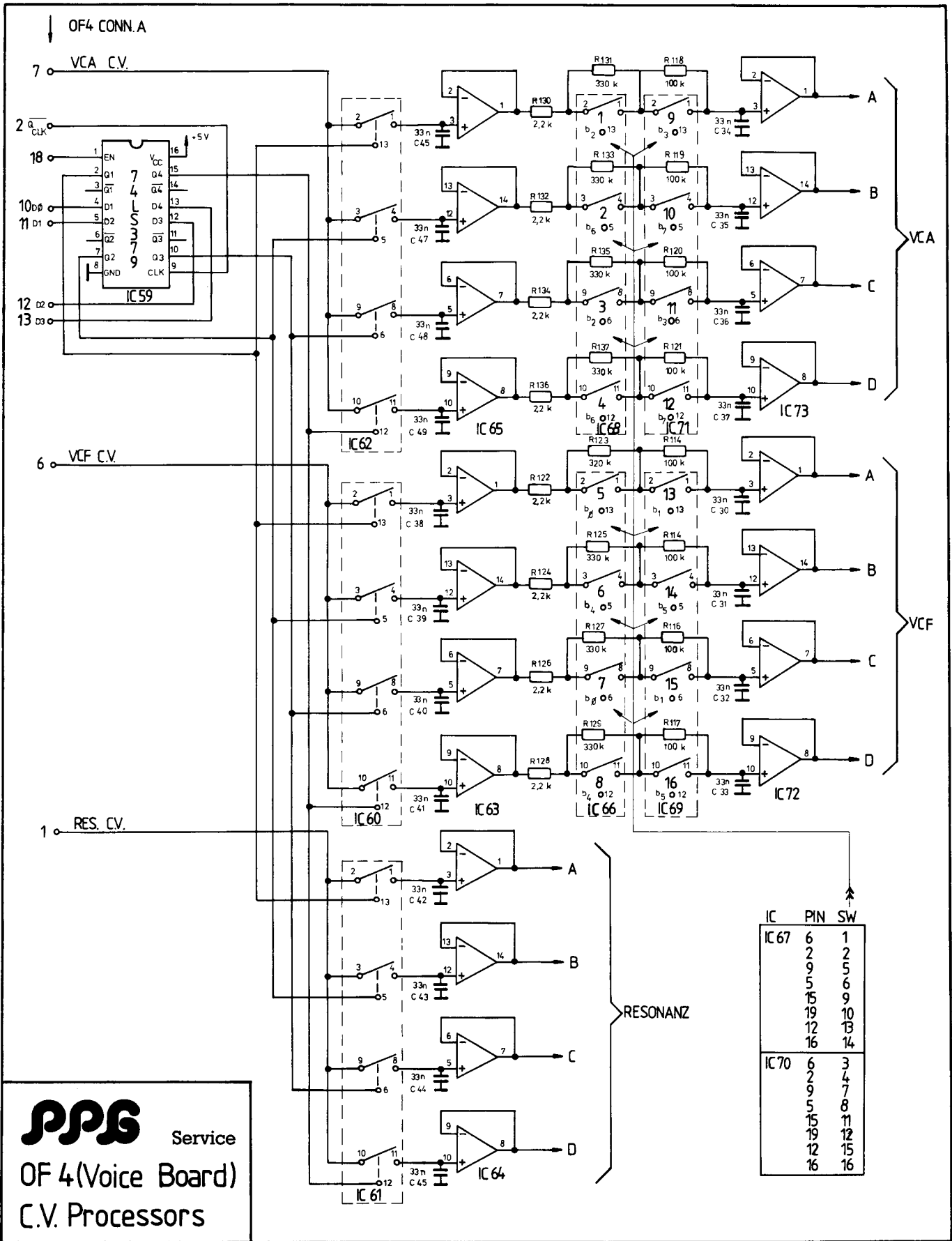
**BLOCKDIAGRAM  
OF 4/12 VOICE BOARD**



Service





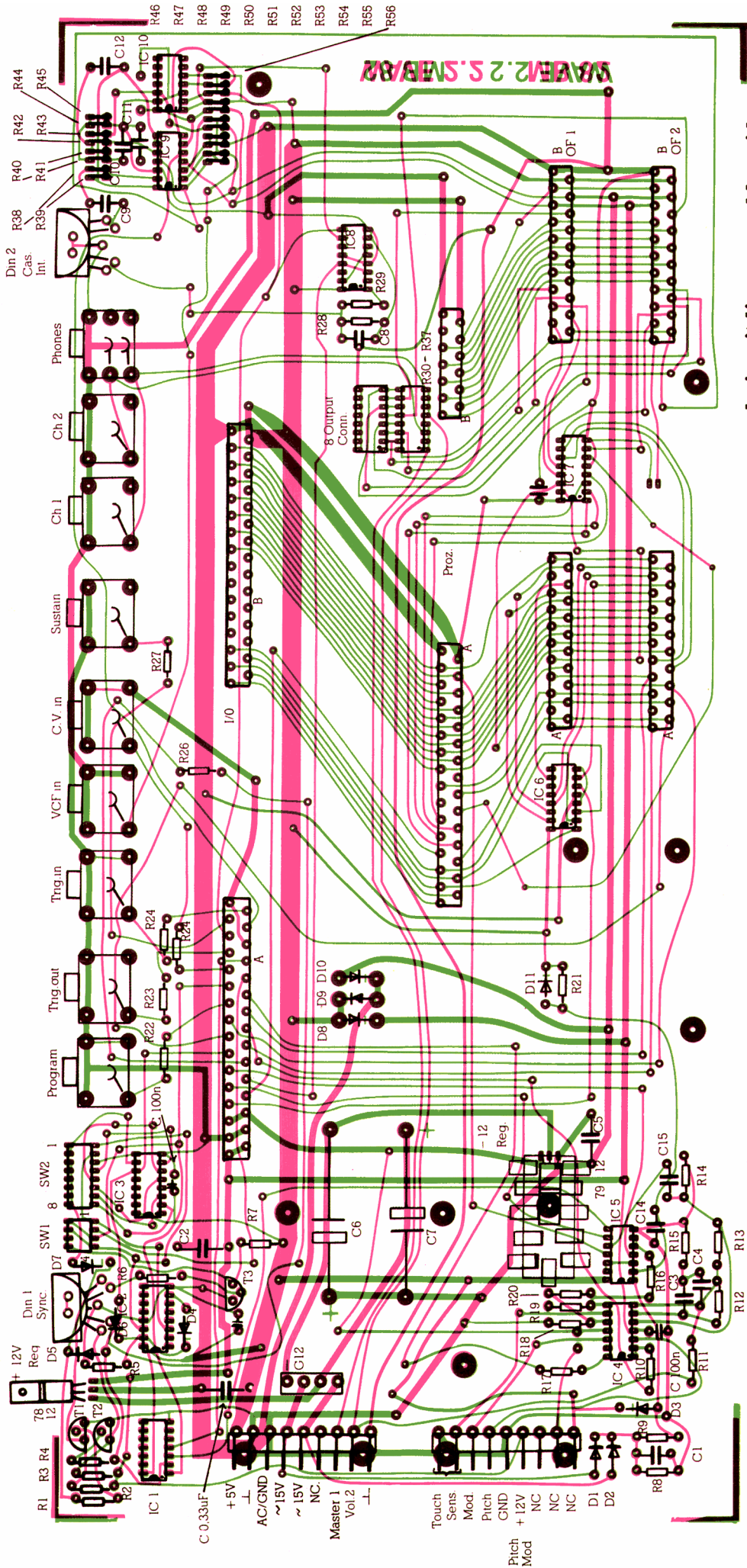


IC	PIN	SW
IC 67	6	1
	2	2
	9	5
	5	6
	15	9
	19	10
	12	13
	16	14
IC 70	6	3
	2	4
	9	7
	5	8
	15	11
	19	12
	12	15
	16	16

**PPG** Service  
**OF 4 (Voice Board)**  
**C.V. Processors**

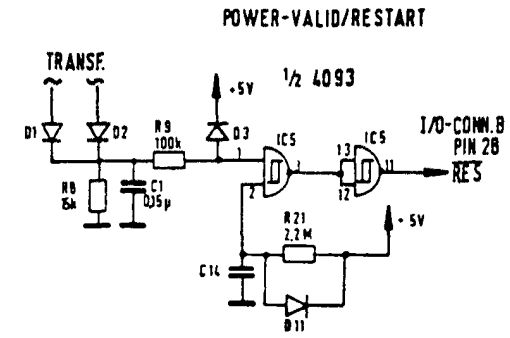
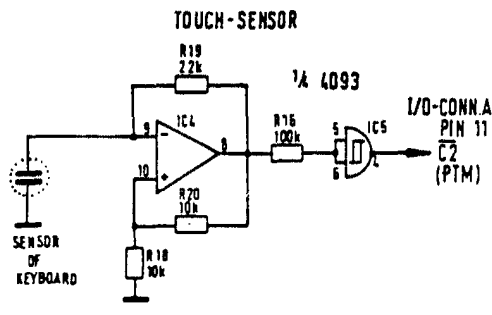
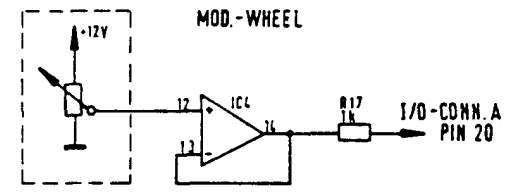
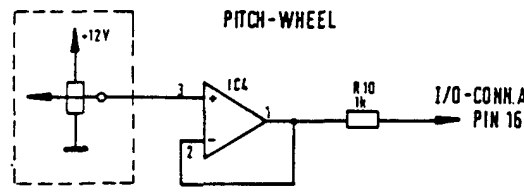
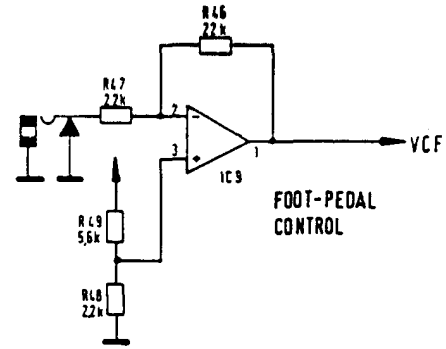
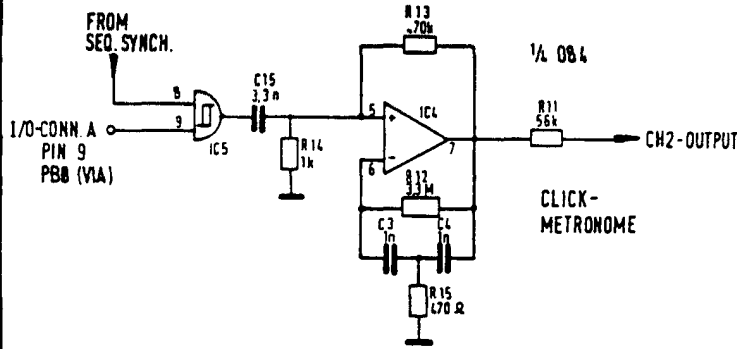
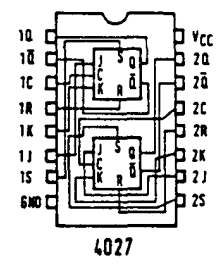
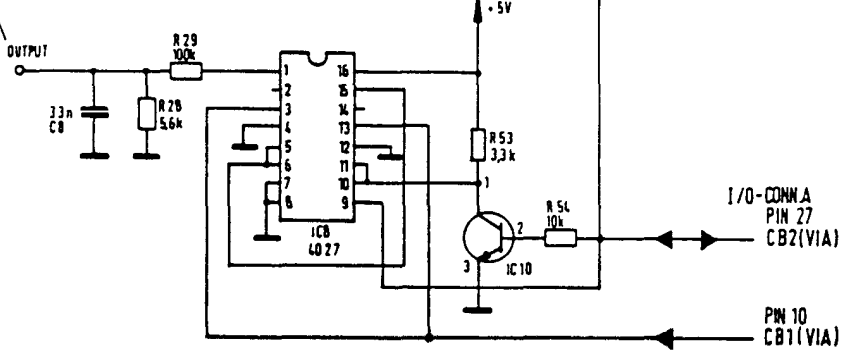
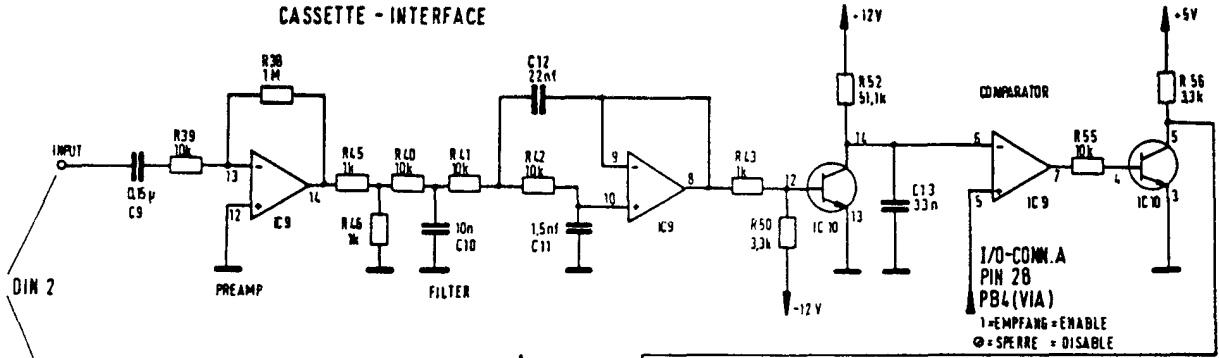


# WAVE 2.3 MOTHER BOARD WAVE 2.2 MOTHER BOARD 82

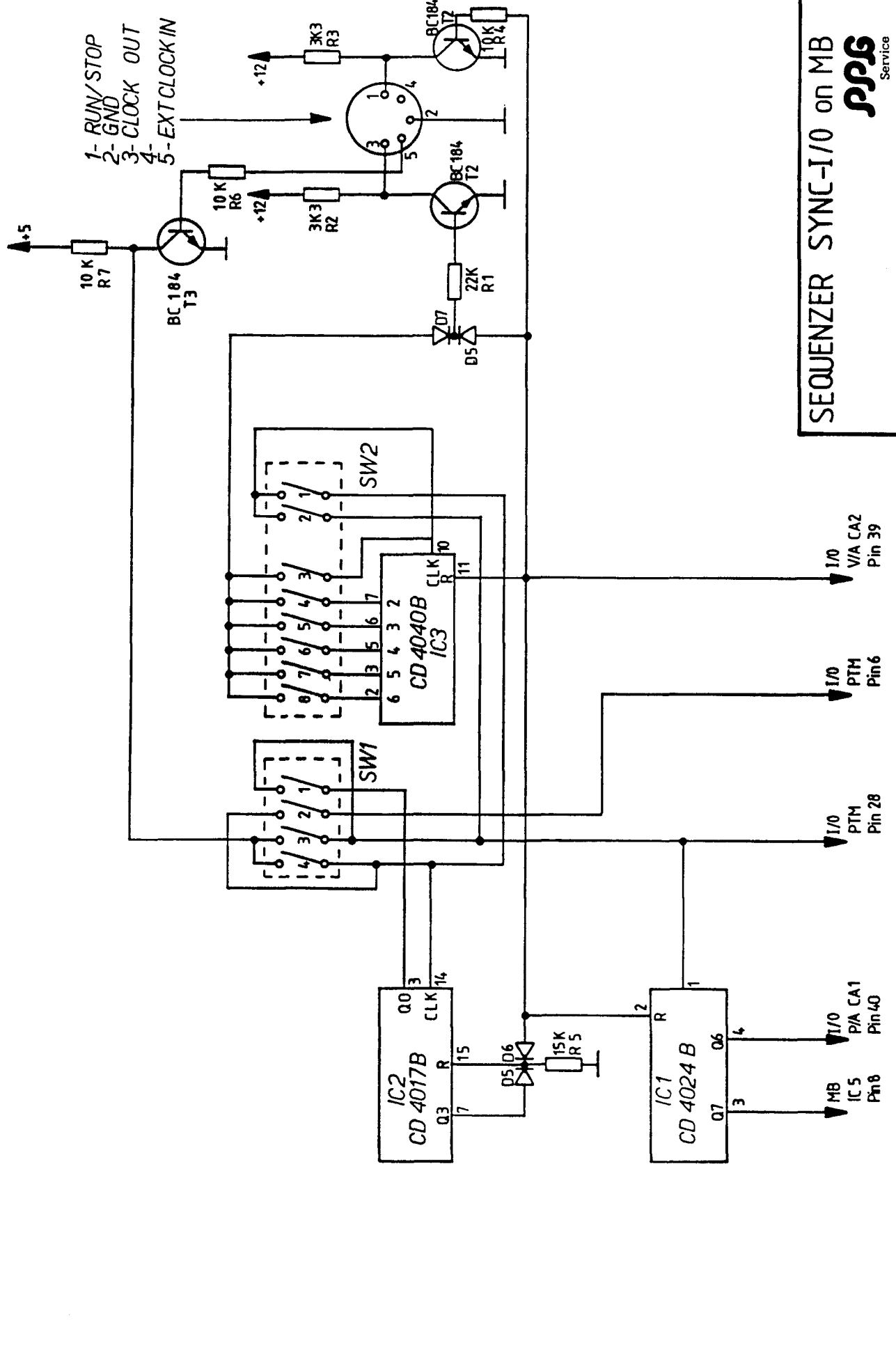


red circuit lines — solder side

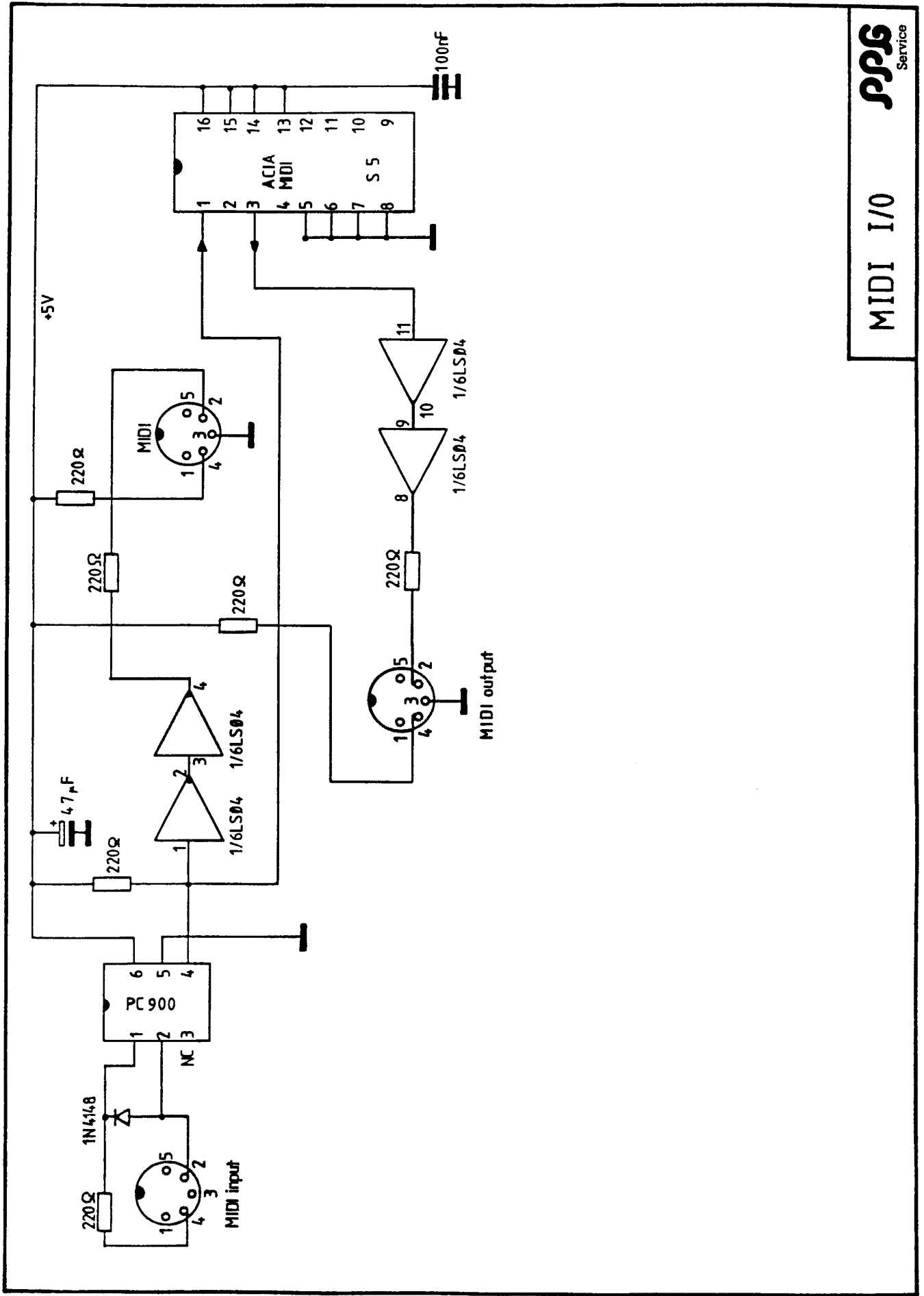
### CASSETTE - INTERFACE



**PPS**  
Services  
CIRCUITS ON MB

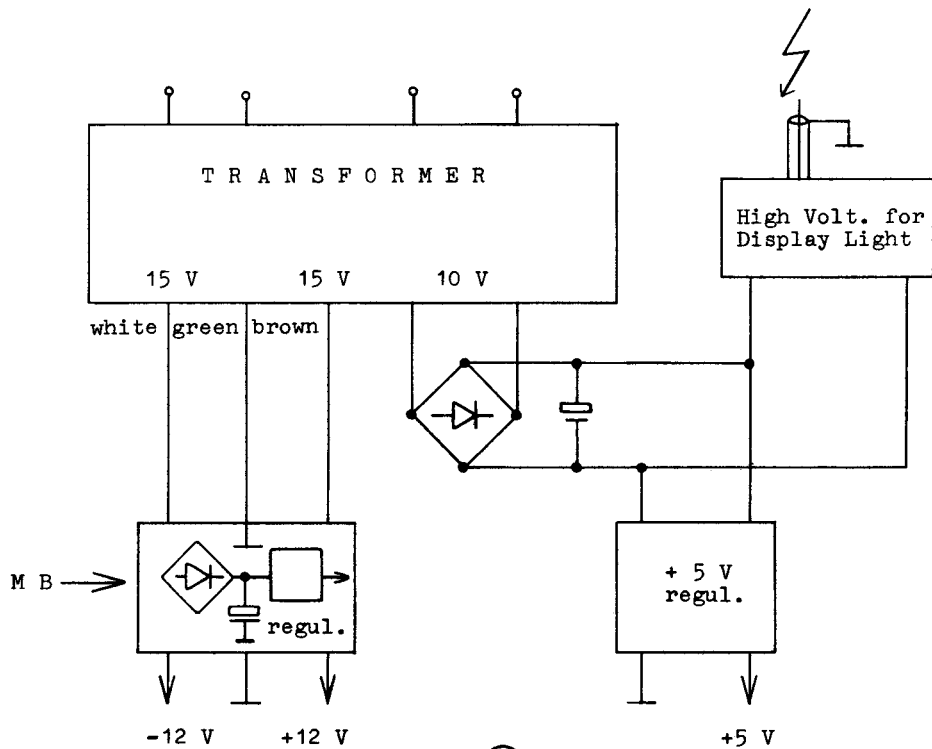
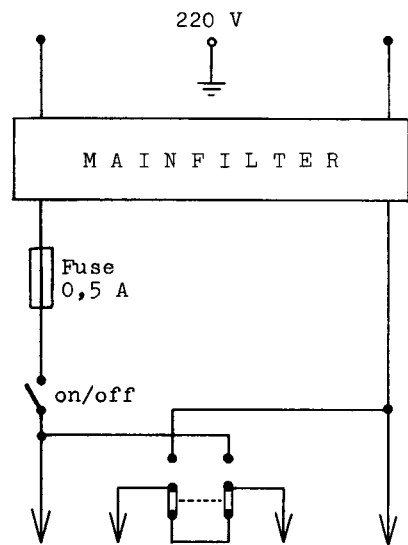
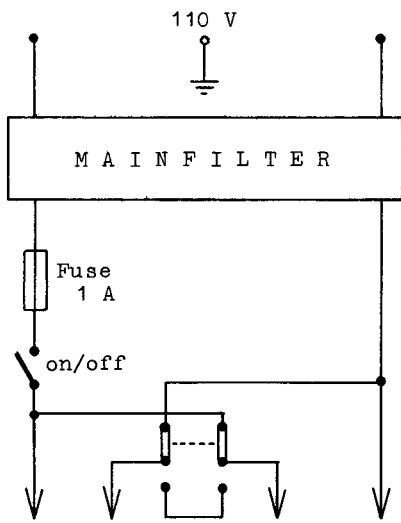


**SEQUENZER SYNC-I/O ON MB**  
**pps** Service



MIDI I/O

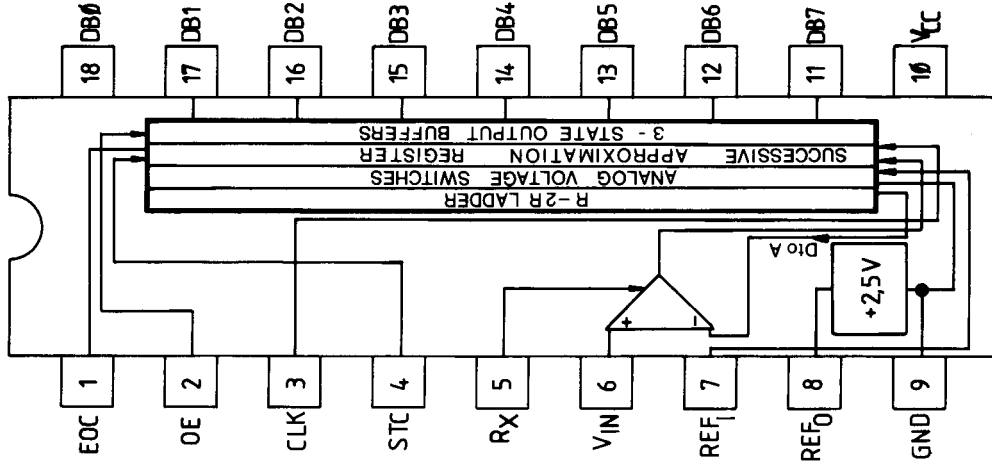




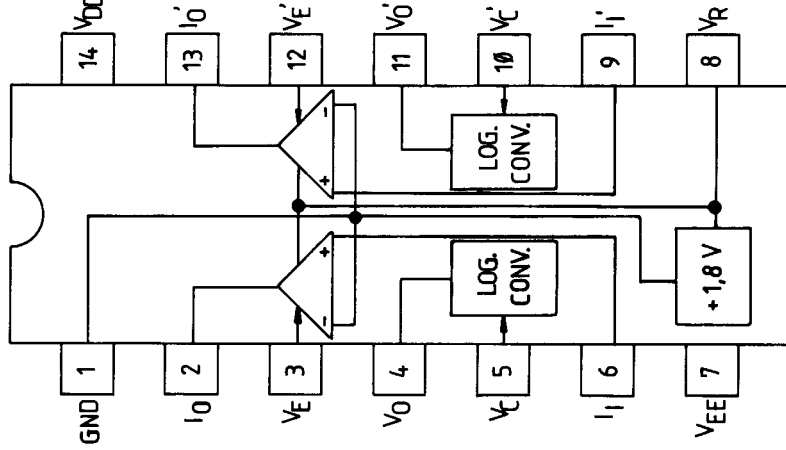
①

POWER SUPPLY

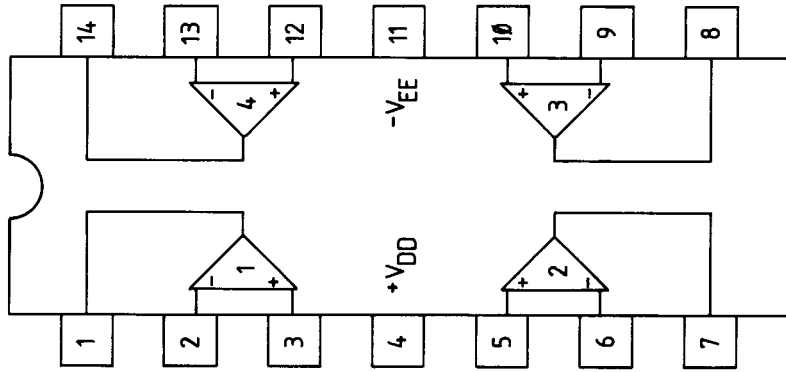
### ZN 427



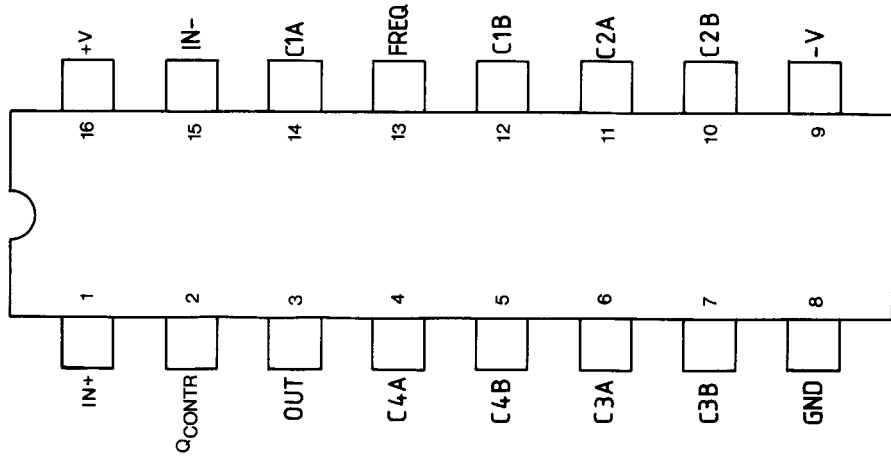
### CEM 3360



### TL 084



### SSM 2044



**ANALOG PARTS**







#### **"I/O" CONNECTOR S 4**

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1	LED Second Panel
2	GND
3	GND
4	LED "B"
5	Ext CV In
6	IC 76 Enable
7	IC 74/75/76 – A Bit
8	IC 74 Enable
9	IC 74/75/76 – C Bit
10	IC 74/75/76 – B Bit
11	IC 75 Enable
12	Pitch Wheel CV In
13	Mod Wheel CV In
14	+5 V
15	LED "A"
16	Multiplex CV OUT

## PCB: "MB" to "I/O" CONNECTOR A

---

1	+ 12 V
2	+ 12 V
3	GND
4	GND
5	- 12 V
6	- 12 V
7	B03X · B04X
8	B02X
9	PB0 via Metronom push under
10	CB1 via Cassette Interface Clock
11	C2 Timer Dyn Sensor in
12	Ext start Sequencer
13	CA2 via Reset Sequencer
14	CV OUT - VCF
18	CV OUT - VCA
19	PB7 VIA Footswitch - Program
20	Mod Wheel CV In
21	C1 Timer Clock divider (1/3) In
22	O3 Timer Sequence Clock
23	Ext CV In
24	CA1 PIA Sequencer Sync
25	PB5 VIA Trigger Out
26	GND CV In
27	CB2 VIA Cassette-Interface seriell DATA I/O
28	PB4 VIA Cassette-Interface enable
29	PB3 VIA Sustain
30	PB2 VIA Trigger In
31	GND CV In

## PCB "MB" to "I/O" CONNECTOR B

---

1	A 0	MPU-Adress Bus
2	A 1	"
3	A 2	"
4	A 3	"
5	A 4	"
6	A 5	"
7	A 6	"
8	A 7	"
9	A 8	"
10	A 9	"
11	A 10	"
12	A 11	"
13	A 12	"
14	A 13	"
15	A 14	"
16	A 15	"
17	D 0	Data Bus
18	D 1	"
19	D 2	"
20	D 3	"
21	D 4	"
22	D 5	"
23	D 6	"
24	D 7	"
25	FIRQ	
26	IRQ	
27	E (02)	
28	RES	
29	R/W	
30	+5 V	
31	GND	

## **POWER SUPPLY PART LIST**

---

	Order No.
Mainfilter	PS - 301
Fuse 1 A	PS - 302
Fuse 0,5 A	PS - 303
On - Off Switch	PS - 304
220 V/110 V Switch	PS - 305
Transformer	PS - 306
Rectifier +/- 12 V	PS - 307
Capacitor 1000 uF/40 V	PS - 308
Voltage Regulator 7812	PS - 309
Voltage Regulator 7912	PS - 310
Rectifier +5V	PS - 311
Capacitor 1000 uF 16 V	PS - 312
Voltage Regulator 7805	PS - 313
Display Transformer	PS - 314
Complete +5V/Display	PS - 333
Transformer Board (including 7805)	

## **PARTS LIST for I/O BOARD without ANALOG and ENVELOPE PARTS**

---

Pos.	Typ	Order No.
IC 1 – IC 8	LH 5128 – 15	I/O – 8408
IC 9	CD74 HC138	I/O – 8409
IC 10 – IC 11	Wavetable E-Proms	I/O – 8411
IC 12 – IC 15	Operating-Sys E-Proms (last version)	I/O – 8415
IC 16	SN74 LS00N	I/O – 8416
IC 17	SN74 S02N	I/O – 8417
IC 18	SN74 LS138N	I/O – 8418
IC 19	EF68 A09P	I/O – 8419
IC 20	EF68 A21P	I/O – 8420
IC 22	EF68 A40	I/O – 8422
IC 23	SY 6522 A	I/O – 8423
IC 24	EF68 A50P	I/O – 8424
IC 25	PAL 20x4	I/O – 8425
IC 26	PAL 16L8	I/O – 8426
IC 27	Quarz Osz. 6MHz.	I/O – 8427
ACCU	4,8 V	I/O – 8428
R 17 – R24	Resistorpack 8x33K	I/O – 8429
Connect. A/B	31 pol.	I/O – 8430
Complete I/O BOARD		I/O – 84100

**PARTS LIST for ANALOG PANEL CIRCUIT ON IO BOARD 82**

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Trimpot	10 Kohm	ORDER No.
Trimpot	392 ohm 1%	A-10-8201
IC 4024 B		A-10-8202
IC 74 LS 00		A-10-8203
IC 74 LS 244		A-10-8204
ADC ZN 427 E-8		A-10-8205
		A-10-8206

### **PARTS LIST for ANALOG PANEL CIRCUIT**

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Analog Panel Poti	1 Kohm	ORDER No. AP-001
IC 4051 B		AP-002
Flatcable AP to IO		AP-003
Complete Analog Panel Board		AP-100

### **PARTS LIST for ANALOG PANEL CIRCUIT ON I/O BOARD**

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Trimpot	10 Kohm	ORDER No. A-IO-8401
R 12	392 ohm 1%	A-IO-8401
IC 74 LS 138		A-IO-8403
ADC ZN 427 E-8		A-IO-8404

### **PARTS LIST for ENVELOPE CONTROL ON I/O 84**

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R 13, 14, 15	1 Kohm 1%	ORDER No. E-IO-8401
DAC AD 558		E-IO-8402
OP TL 084		E-I/O-8403



## **PARTS LIST for "OF 4 12 bit"**

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### VOICEBOARD

#### A.) CV — Processors

ORDER No.

Resistorpacks	(Dil-Pack):	
TRW 8305/222G	8x2.2 Kohm	OF 12—CV—001
TRW 8228/334G	8x330 Kohm	OF 12—CV—002
TRW 8345/104G	8x100 Kohm	OF 12—CV—003
IC 74 LS 379		OF 12—CV—004
IC 74 LS 377		OF 12—CV—005
IC CD 4066 B		OF 12—CV—006
IC TL 084		OF 12—CV—007

#### B.) DAC, VCA and VCF

Resistorpacks	8x680 ohm	OF 12—010
Resistorpacks	4x82 Kohm	OF 12—011
Resistorpacks	8x220 ohm	OF 12—012
Resistorpacks	4x2,2Kohm	OF 12—013
Resistorpacks	4x22 Kohm	OF 12—014
Resistorpacks	4x12 Kohm	OF 12—015
Resistorpacks	4x39 Kohm	OF 12—016
Resistorpacks	4x470Kohm	OF 12—017
Resistorpack	(Dil Pack)	
TRW 8345/1046	8x100Kohm	OF 12—018
Resistor	866 ohm	OF 12—019
Trimpot	10 Kohm	OF 12—020
DAC AD 7545		OF 12—021
OP TL 084		OF 12—022
VCF SSM 2044		OF 12—023
Dual VCA CEM 3360		OF 12—024
Complete OF 4/12 bit Board		OF 12—100

**SERVICESET A**  
**(single components)**

**ORDER No. SC 100**

**Pots**

<b>Localisation / Function</b>		<b>Pcs.</b>	<b>Order No.</b>
Analog Panel board	1 k Ohm	3	AP - 001
Master Vol.	2x10 k Ohm	1	MV - 001
Basis	100 k Ohm	1	B - 001
Pitch Wheel		1	PW - 001
Mod. Wheel		1	MW - 001
Display Intens.	1 k Ohm	1	D - 001
Trimpot on I/O	10 k Ohm	1	A - IO - 8401
Trimpots OF board	10 k Ohm	4	OF 12 - 020
Display		1	DS - 100
Voltage Regulator for + 5 V 78H05		1	PS - 100
Capacitor for + 5 V 10000 uF/16 V		1	PS - 312

**Switches**

<b>Localisation/Funktion</b>		<b>Pcs.</b>	<b>Order No.</b>
Power On / Off		1	PS - 304
220 / 110 V		1	PS - 305
8 - block MB		1	MB - 010
4 - block MB		1	MB - 011
Digital Panel		1	DP - 010

**Connectors and Sockets**

<b>Localisation/Function</b>		<b>Pcs.</b>	<b>Order No.</b>
Din Spin Cass / Sync.		1	MB - 001
Klinke Mono		2	MB - 002
Klinke Stereo		1	MB - 003
Siemens sockets / plugs		Sets	
31 pol.		2	MB - 004
21 pol.		1	MB - 005
13 pol.		1	MB - 006
Accu on I/O		1	I/O - 8428

## Flatcables

<b>Localisation/Function</b>	<b>Pcs.</b>	<b>Order No.</b>
AP - IO	1	AP - 003
DP - IO	1	DP - 001
Keyboard - I/O	1	KB - 010
Midi - I/O	1	M - 010
8 outputs - MB	1	MB - 007

## Integrated Circuits

<b>Localisation/Function</b>	<b>Pcs.</b>	<b>Order No.</b>
PIA 68A21	2	10 - 8420
VIA 6522	1	10 - 8423
RAM 5128-15	2	10 - 8408
ACIA 68A50	1	10 - 4824
AD Conv. AD 558	2	E - 10 - 8402
D/A Con. ZN427 E-8	1	A - 10 - 8404
PAL 20x4 (I/O board)	1	10 - 8425
PAL 16L8 (I/O board)	1	10 - 8426
DA Conv. 7545	2	OF 12 - 021
VCF SSM 2044	2	OF 12 - 023
Dual VCA CEM 3360	2	OF 12 - 024
Screwset	1	SRC - 100
Knopset	1	KS - 100
Internal Com. - Flatcable	1	ICF - 100

## SERVICASET B (3 boards)

<b>Localisation/Function</b>	<b>Pcs.</b>	<b>Order No.</b>
I/O board	1	I/O 84 - 100
Proz. board	1	Proz. 84 - 100
OF 4 / 12 bit	1	OF 21 - 100

## Complete boards (not included in the serviceset)

Motherboard MB 82	MB 82 - 100
Analog Panel board	AP - 100
Midi / 8 output board	MO - 100
Digital Panel board	DP - 100
Display Transformer board	PS - 333