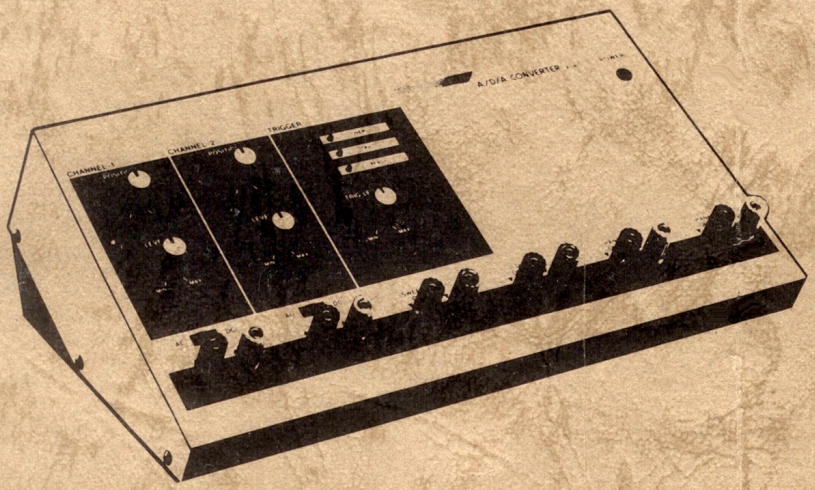
ADA-200R

Roland

Operation Manual



A/D/A CONVERTER

ADA-200R

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I .Introduction

1. General Description

The ADA-200 consists of an A/D, D/A converter with the OP-1, 2 channel card installed. The ADA-200 is designed for use with almost any personal computer, allowing conversion of analog signals to digital data for processing by the computer, and conversion back to analog signals.

Features

1. Hardware and Software interfacing to most of the popular personal computers, including the APPLE II , etc.
2. Includes built-in input/output filters, sample and hold, A/D converter, D/A converter, Address Decoder and Power Supply.
3. Allows 2 Channel Input and Output by software selection. Up to 8 channels are available as an option.
4. Schematics and data supplied to allow User modification of input/output filter cut-off frequencies.
   Note: User modification may void the Guarantee.
5. Fully self contained in an attractive, rugged cabinet. All Analog signal I/O and control is on the Front panel for easy access.

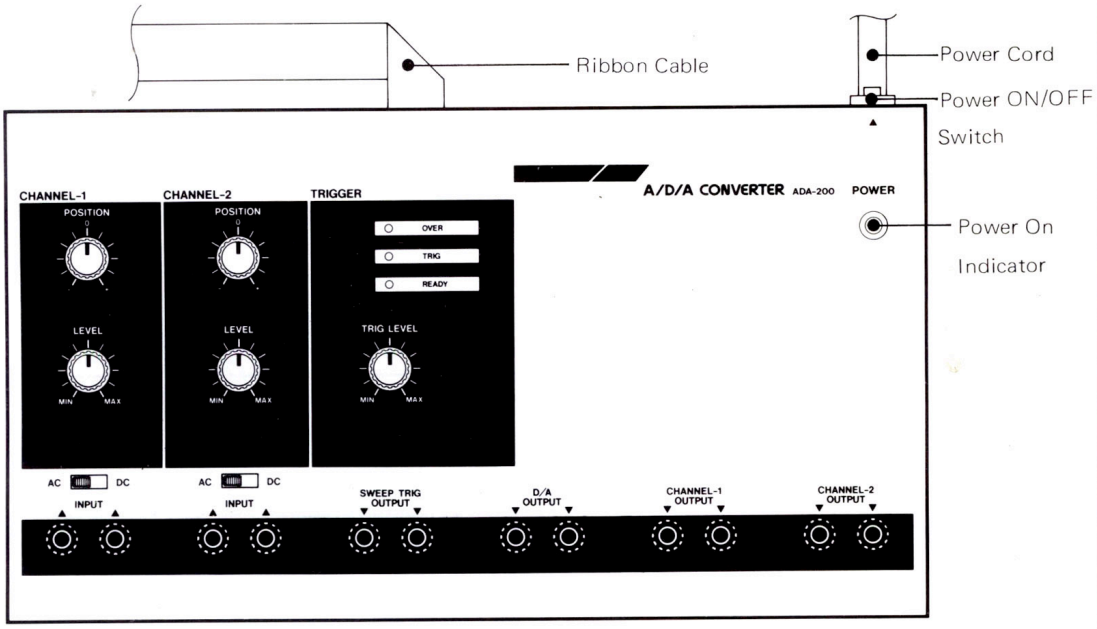
2. Typical Applications

1. Waveform analysis, such as Voice, Music, etc.
2. Controlling Music Synthesizers.
3. Joystick and Paddle interfacing.
4. Arbitrary Waveform generation.
5. Digital Oscilloscope Display.
6. Data Logging for Scientific applications.

II . Hardware Section

1. Panel Description

Figure 1.



Ribbon Cable: connection to computer.

Position Control: DC bias control for shifting input signals to the 0-5 volt range of the A/D converter.

Level Control: to adjust amplification/attenuation of input signals.

Trigger Control: to set the threshold voltage of the input trigger circuit.

Over-Range LED: to indicate an over-range input signal.

Trigger LED: indicates that the internal Trigger Flip/Flop has been set.

Ready LED: is turned off when an input signal exceeding the trigger threshold voltage is received.

Power Cord.

Power ON/OFF Switch.

Power On Indicator.

AC/DC Switch: selects Direct or Capacitive coupling to the input of the A/D.

***Sweep Trigger output is detailed later on.**

The following are included in the ADA-200:

1. Input Pre-Amp
2. Input Filter
3. Sample & Hold
4. Output Filter
5. Over-Level Detecter circuit
6. Trigger Signal Detecter circuit
7. I/O Address Decoder
8. Power Connection
9. A/D & D/A circuitry
10. 2 on-board Connectors for 2 Channel I/O & Expansion

Figure 2.

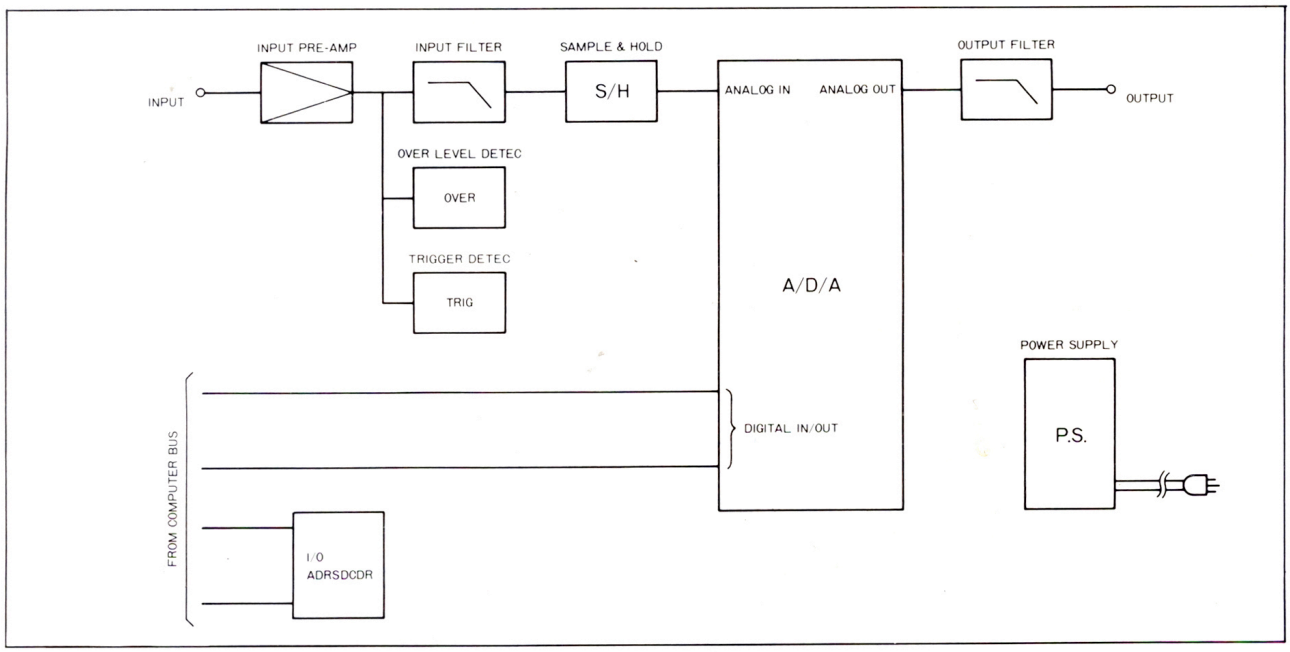


Figure 3.

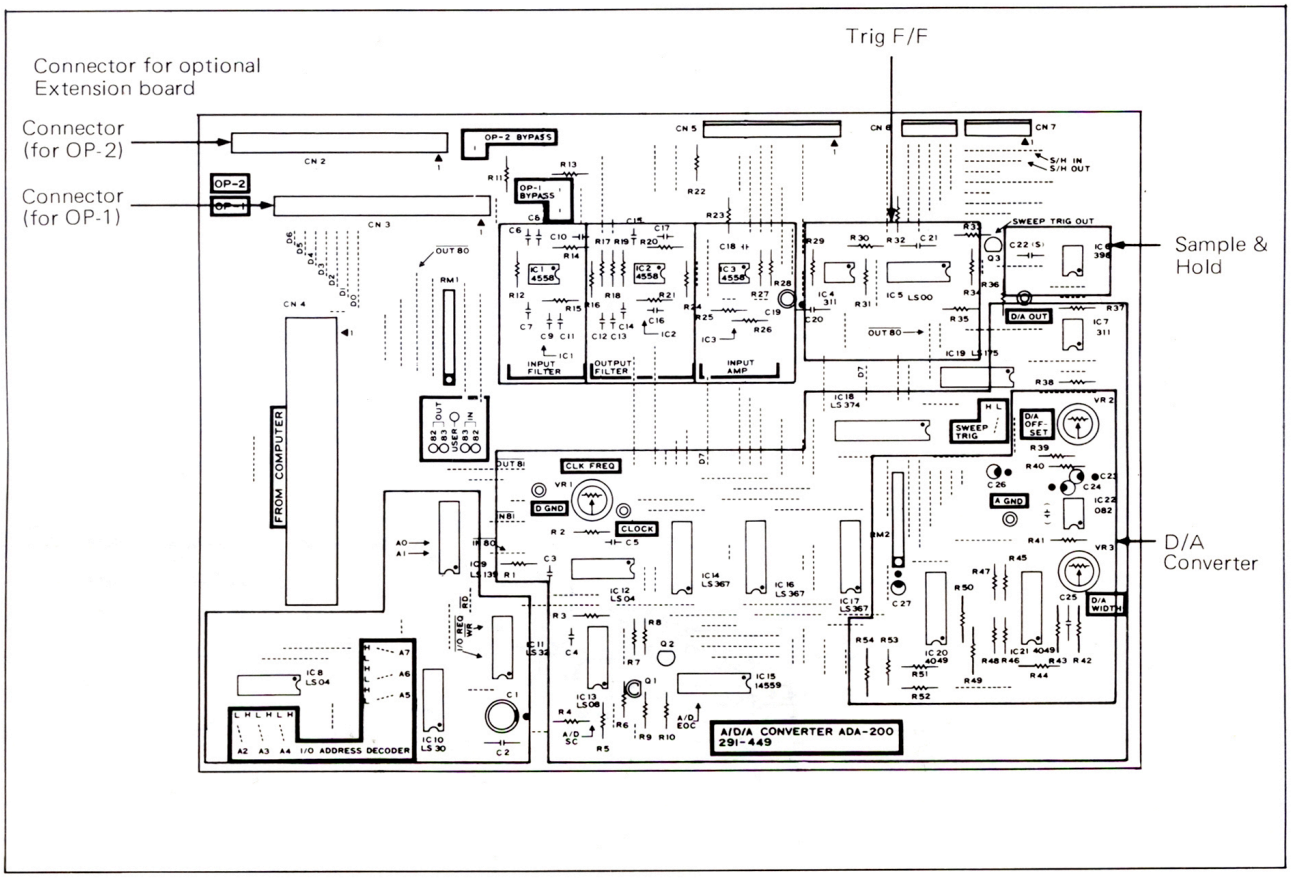
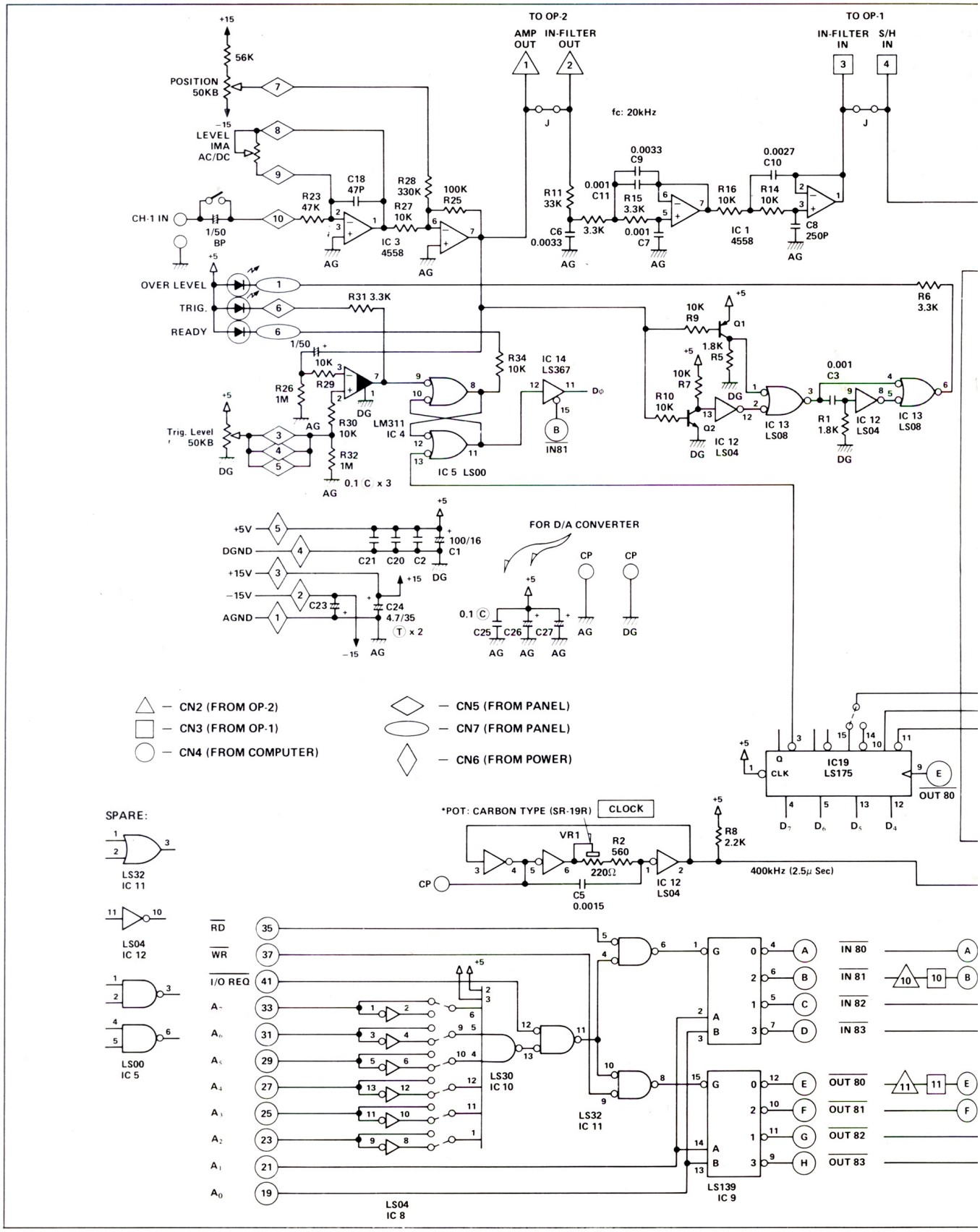
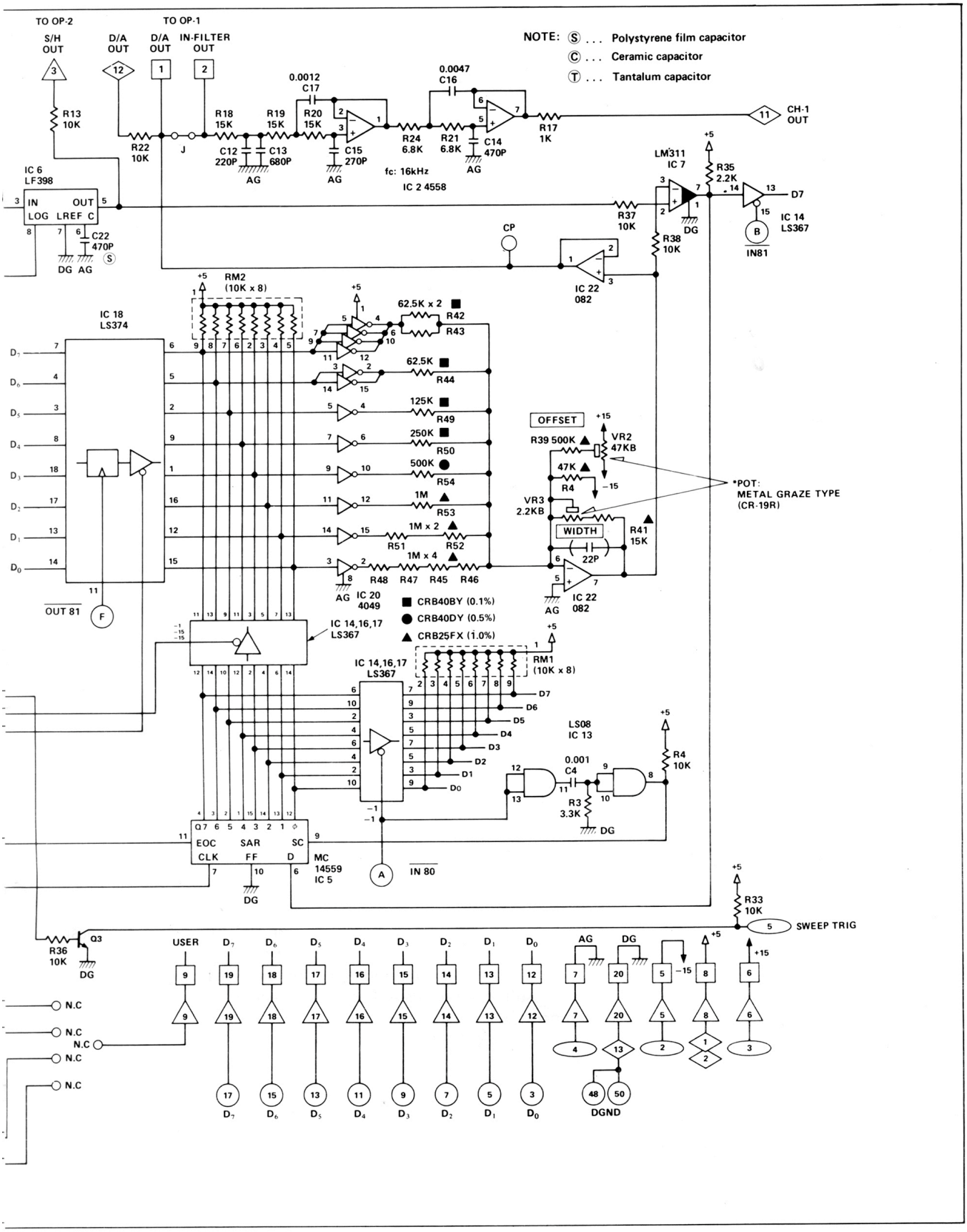


Figure 4.


TO OP-2
AMP OUT
IN-FILTER OUT
TO OP-1
IN-FILTER IN
S/H IN
fc: 20kHz
POSITION 50KB
LEVEL IMA AC/DC
CH-1 IN
1/50 BP
OVER LEVEL
TRIG.
READY
Trig. Level 50KB
IC 3 4558
IC 1 4558
LM311 IC 4
IC 5 LS00
IC 14 LS367
IC 13 LS08
IC 12 LS04
IN81
FOR D/A CONVERTER
+5V
DGND
+15V
−15V
AGND
CN2 (FROM OP-2)
CN3 (FROM OP-1)
CN4 (FROM COMPUTER)
CN5 (FROM PANEL)
CN7 (FROM PANEL)
CN6 (FROM POWER)
IC19 LS175
OUT 80
SPARE:
LS32 IC 11
LS04 IC 12
LS00 IC 5
*POT: CARBON TYPE (SR-19R)
CLOCK
400kHz (2.5μ Sec)
RD
WR
I/O REQ
LS30 IC 10
LS32 IC 11
LS04 IC 8
LS139 IC 9
IN 80
IN 81
IN 82
IN 83
OUT 80
OUT 81
OUT 82
OUT 83


TO OP-2
S/H OUT
D/A OUT
TO OP-1
D/A OUT
IN-FILTER OUT
NOTE: (S) ... Polystyrene film capacitor
(C) ... Ceramic capacitor
(T) ... Tantalum capacitor
R13 10K
R22 10K
R18 15K
R19 15K
0.0012 C17
R20 15K
C12 220P
C13 680P
C15 270P
AG
fc: 16kHz
IC 2 4558
0.0047 C16
R24 6.8K
R21 6.8K
C14 470P
R17 1K
CH-1 OUT
IC 6 LF398
IN
OUT
LOG
LREF
C22 470P
DG
LM311 IC 7
R35 2.2K
D7
IC 14 LS367
R37 10K
R38 10K
CP
IC 22 082
IN81
RM2 (10K x 8)
IC 18 LS374
62.5K x 2
R42
R43
62.5K
R44
125K
R49
250K
R50
500K
R54
1M
R53
1M x 2
R51
R52
1M x 4
R48
R47
R45
R46
IC 20 4049
OUT 81
OFFSET
R39 500K
VR2 47KB
47K
R4
VR3 2.2KB
WIDTH
R41 15K
22P
*POT: METAL GRAZE TYPE (CR-19R)
CRB40BY (0.1%)
CRB40DY (0.5%)
CRB25FX (1.0%)
IC 14,16,17 LS367
RM1 (10K x 8)
LS08 IC 13
0.001 C4
R3 3.3K
R4 10K
EOC
SAR
SC
CLK
FF
D
MC 14559 IC 5
IN 80
R33 10K
SWEEP TRIG
R36 10K
Q3
USER
N.C
DGND

2. Circuit Description

1. Input Pre-Amp
The input Pre-Amp provides continuously variable amplification of 0 to 200 times. The input may be AC or DC coupled, depending on the DC bias of the signal.

2. Over-Level Detection circuit
Input signals are fed through the input Pre-Amp, Input Filter, Sample & Hold, and to the A/D converter. The operational range of the A/D is 0 to 5 volts, so as a warning, the Over-Level detecter will turn on the Over-Level Indicator when the input signal is greater than 4.4 or less than 0.6 volts.

3. Trigger Deterctor circuit
This circuit is made up of a Comparator, which senses when the input level exceeds the voltage setting on the Trigger Level control. When triggered, a Flip/Flop is set which may be read by the computer through a 3-state output gate. This Flip/Flop should be RESET by the computer before attempting to read its status.

4. Input Filter Circuit
This circuit is a 'Butterworth Filter' which has a cut-off slope of 30 db/octave. It is used to prevent 'ALIASING' caused by the input frequency being more than 1/2 of the Sampling frequency. (see Note #1.) This filter is set at the factory to 20 kHz.

5. Sample & Hold
If the input signal changes its level during the conversion process, the accuracy of the conversion will suffer. (see Note #2.) The role of the Sample & Hold is to very quickly 'SAMPLE' the input level, then 'HOLD' it at a steady voltage level for the A/D converter.

6. The A/D & D/A
The A/D/A converter is composed of a precision 8-bit D/A converter, an SAR (Successive Approximation Register), and a Comparator, along with related logic circuits.
The resistor ladder in the D/A circuit is made up of precision metal-oxide film resistors. The error tolerance and temperature co-efficients are:

1. ±0.1% and ±50ppm/deg. C. for the resistors on the most significant 4 bits.
2. ±0.5% and ±50ppm/deg. C. for the 4th bit of the least significant 4 bits.
3. ±1.0% and 100ppm/deg. C. for the 3 least significant bits.

As a result, the converter has good linearity and excellent noise/temperature co-efficients etc.
Employment of the SAR I.C. has made it possible to use the same D/A converter for both A/D & D/A modes. This in turn results in the least deviation possible of data obtained from the A/D converter and re-output to the D/A converter.

7. Output Filter

Since the D/A output is a STAIR-CASE waveform, it has high harmonic content. The purpose of the output filter is to 'roll-off" the excess harmonics and smooth the output signal. This filter is factory set for a cut-off frequency of 16 kHz with a roll-off of 30 db/octave.

8. I/O decoder

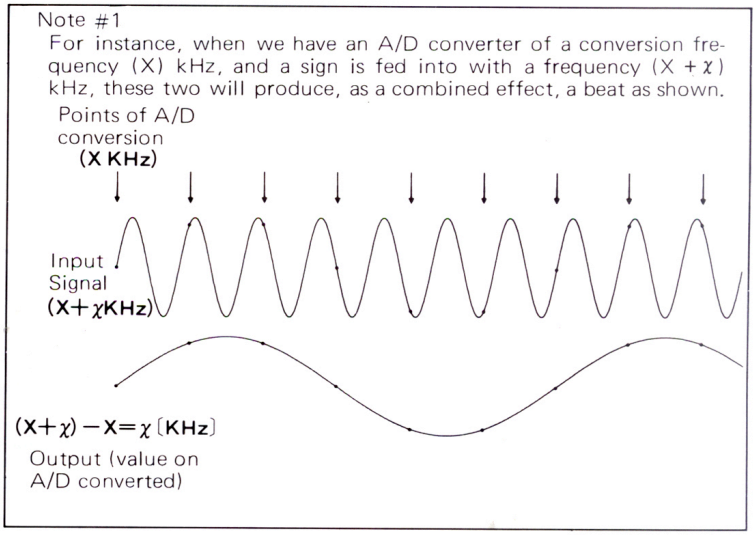
The I/O decoder decodes the address data sent by the computer and enables the selected port address on the ADA-200. The 6 most significant bits determine the address of the 4 ports on the ADA-200, and the user may alter these to suit the particular computer I/O addresses.

9. Sweep Trigger Output

Sweep Trigger Output is a 1-bit output controlled by a program. Its output will be "L" when the bit 5 of the OUT•80 (STA$C380) data is set to "H". In the Wave Memory Program, it will be used as the trigger output to synchronize the Oscilloscope, the start signal or the signal that selects the mode (Pen Up/Down) to the XY Plotter. You can invert its polarity (H, L) by changing the appropriate jumper wire on the board.

10. Power source

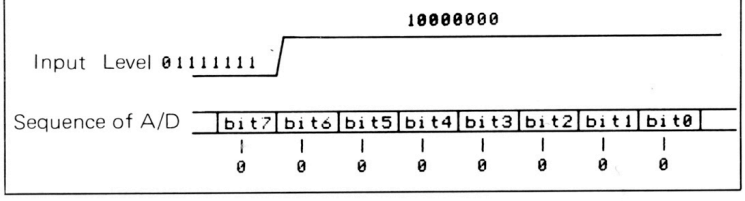
The voltage regulators employed in the ADA-200 provide a stable, ripple-free source of power for the ±15 volt and +5 volt supplies.



If, for instance, we have an A/D sampling frequency of 30 kHz, and an input frequency of 25 kHz, the 'difference' frequency will be 5 kHz. This will be audible as a 'beat frequency' or 'ALIAS'. A good rule fo thumb is to never let the input frequency exceed 1/2 the sampling frequency.

Note #2

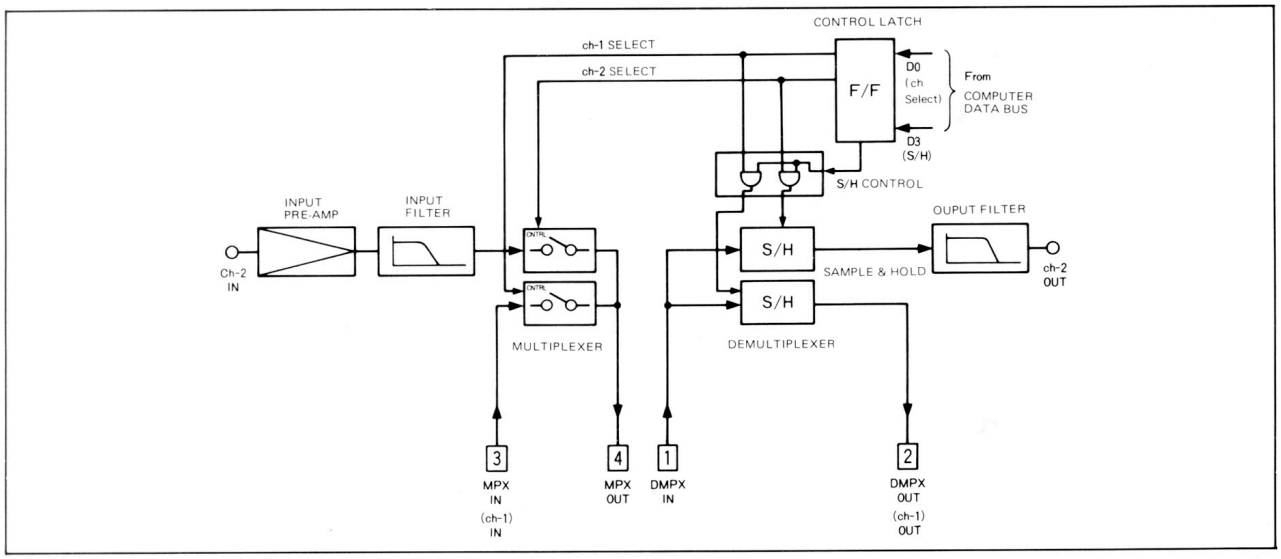
The A/D converter takes a finite time to digitize the input signal because it converts, bit by bit, from the most significant bit (MSB) to the least significant bit (LSB). If during this time the real value is 0111,1111 (7FH) and during conversion, the input value changes to 1000,0000 (80H), the final output will be 0000,0000 (OH) because the MSB will have been detected as a '0'. This will produce a rather gross error! .
The role of the Sample & Hold is to 'FREEZE' the input signal during the conversion process.



3. 2 Channel Unit

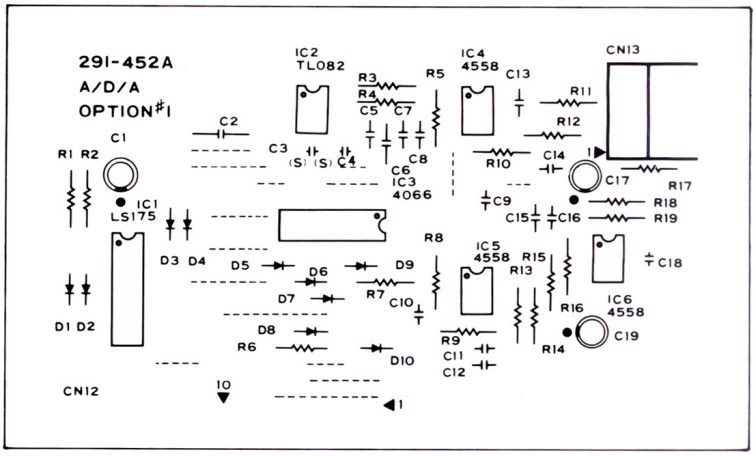
The 2 Channel unit allows input and output of 2 separate analog signals. This is standard on the ADA-200, but the ADA-200 may be expanded to 8 Channels by inserting the optional 8 channel board on the spare board connector. (See Figure 5.)

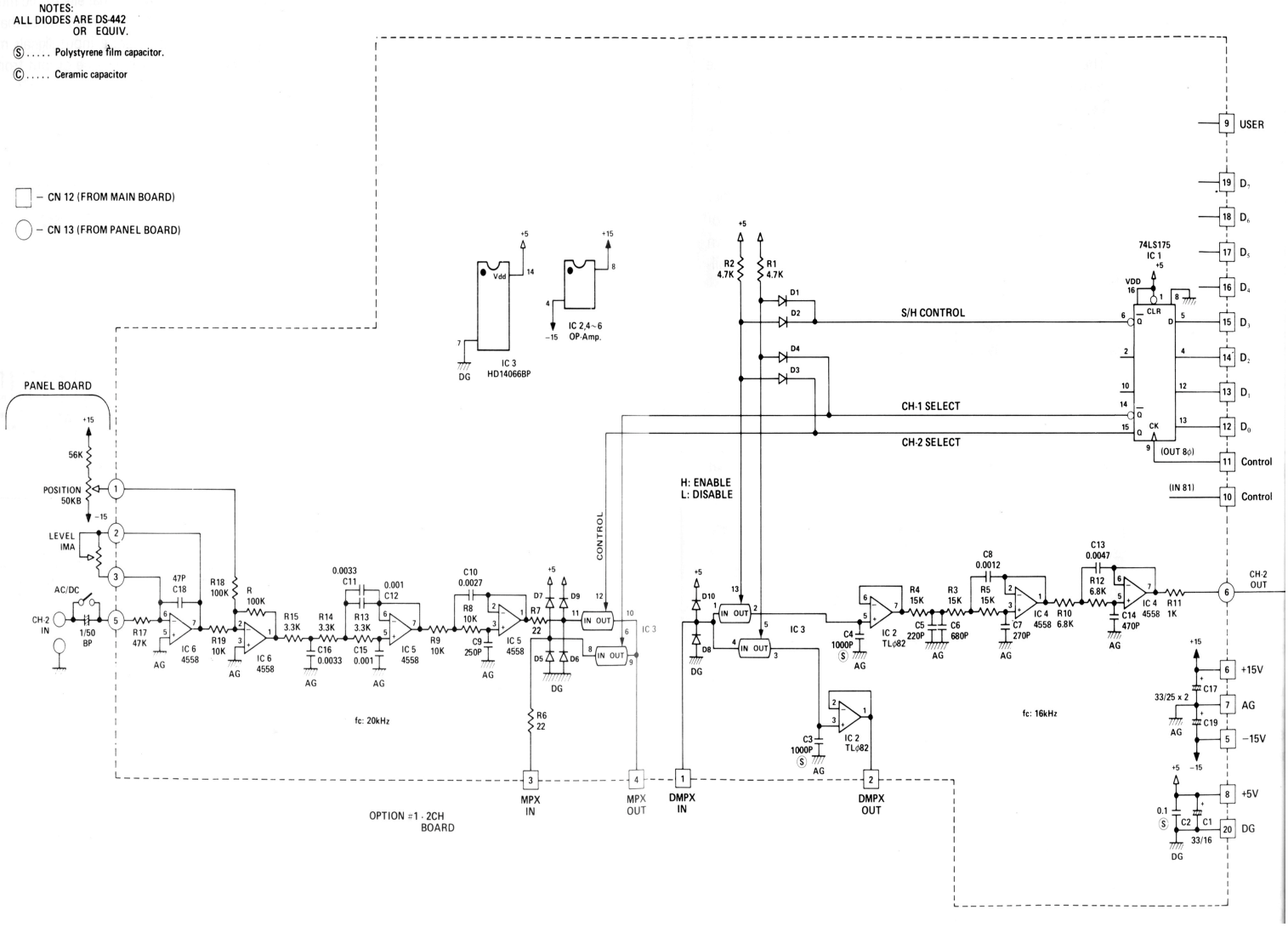
Figure 5.



The circuitry for the OP-1 is the same as the main input circuitry, with the exception of an additional electronic multiplexed switch for channel selection. This switch has 2 states that are selected by the computer so that 2 separate input signals may be digitized, and 2 separate analog signals may be output from the ADA-200.

Figure 6.




NOTES:
ALL DIODES ARE DS-442
OR EQUIV.
Ⓢ ..... Polystyrene film capacitor.
Ⓒ ..... Ceramic capacitor
– CN 12 (FROM MAIN BOARD)
– CN 13 (FROM PANEL BOARD)
PANEL BOARD
OPTION #1 · 2CH BOARD
IC 3 HD14066BP
IC 2,4~6 OP-Amp.
74LS175 IC 1
S/H CONTROL
CH-1 SELECT
CH-2 SELECT
H: ENABLE
L: DISABLE
CONTROL
USER
Control
(IN 81)
(OUT 8φ)
CH-2 IN
CH-2 OUT
MPX IN
MPX OUT
DMPX IN
DMPX OUT
fc: 20kHz
fc: 16kHz
+15V
–15V
+5V
AG
DG

1. Preliminary Remarks

1. The user may modify Hardware or Software as is necessary to suit the individual needs. However, the Guarantee may be voided by modifying the hardware.

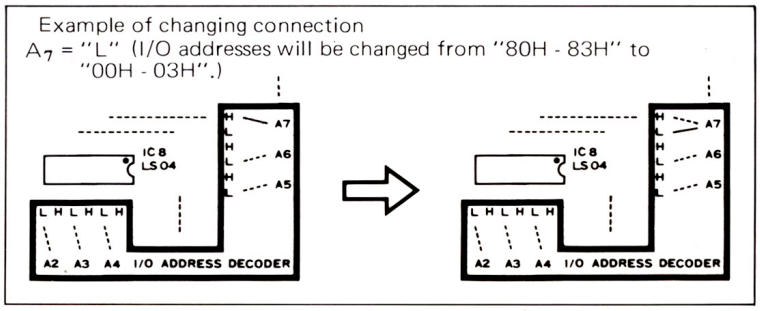
2. The I/O Addresses will have to be selected according to the type of computer used to control the ADA-200. For the 68xx or 65xx CPU families, the I/O is memory mapped, meaning that the input/output ports occupy memory locations. In the case of the 8080/Z-80 CPU family, the I/O will be through I/O addressed ports, which do not occupy memory space.
Be sure that you have the proper interface connector for your particular type of computer. We supplies interfaces to most of the popular brands of computers. If you wish to make your own interface, all of the circuit and basic software details are available in the appendices of this manual.

3. Programs listed here are for the APPLE II and for MicroSoft Basic, which is easily translated into other dialects of basic, or into Pascal etc.

2. I/O Addressing

The I/O addresses on the ADA-200 are set at the factory so that the most significant 6 bits determine the address, with the MSB being set to a '1', and the remainder set to 0's
In the case of the APPLE II, this will correspond to SLOT #3, using memory-mapped address $C380 to $C383. We supplies an adapter board so that the 50 conductor cable from the ADA-200 will plug into Slot #3.
In the case of an S-100 computer, or similar 8080/Z-80 device, the port addresses are 80H to 83H. We supplies some interface cards, depending on the type of computer.
To change the I/O addresses in the ADA-200, refer to Figure 8, and change the appropriate jumper wires.

Figure 8.



3. A/D, D/A Mode Selection

In order that the data acquisition and voltage output correspond precisely to each other, a single D/A converter is used for both functions. This prevents simultaneous use of the D/A for input and output, so it is necessary to change the operational mode between A/D and D/A as needed.

Refering to Figure 9, note that bit 4 of port 0, (referenced to $C380 or 80H), selects the A/D-D/A mode. When this bit is LOW, the ADA-200 is in the A/D mode, while if HIGH, it is in the D/A mode.

Figure 9.

Effective on Main body	bit 7	to re-set trig F/F	"reset" when turned to "H". (Be sure to output "L" after "reset")
	bit 6	N.C.	
	bit 5	to output sweep trig	When "H", TRIG is ON. (Logic can be changed by changing jumper wire connections.)
	bit 4	A/D, D/A mode select	When "H", to D/A mode.
Effective on OP - 1	bit 3	Mode select between sample/hold	When "L", to "sample".
	bit 2	N.C.	
	bit 1	N.C.	
	bit 0	Channel select	When "L", to ch-1.

Figure 10.

ASSEMBLER

80 family	68 family
LD A,10H	LDA #$10
OUT 80H,A	STA $C380

BASIC

PC-8001, MZ-80K/C	APPLE II
OUT 128,16	POKE -15488,16

Figure 11.

ASSEMBLER

80 family	68 family
LD A,(8000H)	LDA $8000
OUT 81H,A	STA $C381

BASIC

PC-8001, MZ-80K/C	APPLE II
A=PEEK(-32768)	A=PEEK(-32768)
OUT 129,A	POKE -15487,A

Figure 12.

ASSEMBLER

80 family	68 family
LD A,00H	LDA #$00H
OUT 80H,A	STA $C380

BASIC

PC-8001, MZ-80K/C	APPLE II
OUT 128,0	POKE -15488,0

1. D/A Converter Mode

To select the D/A converter mode, output the HEX byte 10, (0001,0000) to port 0, ($C380 or 80H). This will select the D/A output on Channel 1. To select Channel 2, output a 11 hex, (0001,00001) to port 0.

To send data to the D/A port, send it out of port 1, ($C381 or 81H). The analog data will appear at the selected channel output, and also at the output of the D/A converter.

Try running the example programs in Figure 12.

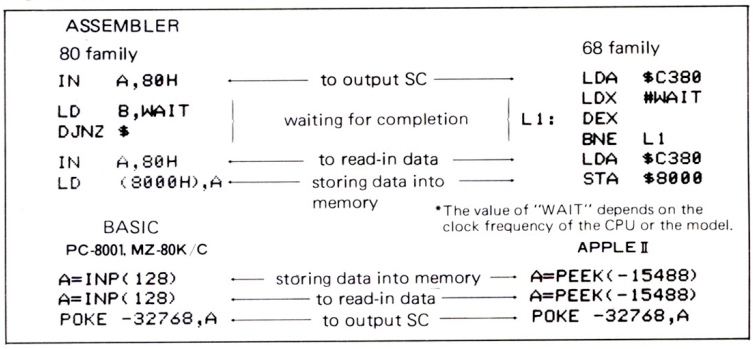
2. A/D Converter Mode

To select the A/D converter mode, set bit 4 to a '0', and choose the input channel by setting bit 0 to a '0' for channel 1, or to a '1' to select channel 2. Send this command (00H), (0000,0000) or (01H), (0000,00001) to port 0, ($C380 or 80H).

To send a START CONVERSION command to the ADA-200, simply read port 0 ($C380 or 80H). This will start the conversion so that successive conversions may be made by simply re-reading this port.

The maximum sampling rate is 44 kHz, so a software timing loop will be necessary if using machine language, but is not necessary if using an interpreted language, like BASIC, as it is slow enough to allow a complete conversion between reads. See Figure 15.

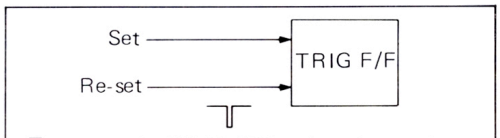
Figure 13.



3. Reading the Trigger Flip/Flop

The ADA-200 is equipped with an Input Voltage Comparator, and a Trigger Level Flip/Flop. When the incoming voltage exceeds the level as set by the Trigger Level Control, a Flip/Flop is set. This F/F may be read by the computer so that a conversion cycle may be initiated.
First of all, it is necessary to reset or clear the F/F, so that it may be set by the incoming voltage exceeding the trigger threshold. To reset the F/F, set bit 7 'HIGH', output it to port 0, ($C380 or 80H), then set bit 7 'LOW' and output it again. This bit (7) may be 'OR' ed with the A/D mode select bit, and the Channel select bit (See Figure 14.).

Figure 14.



To re-set the TRIG F/F, when the mode is A/D and input is through ch-1, have the bit7 firstly turned to "H", bit4 to "L" and bit0 to "L", to get the data turned to 10000000 = 80H.
Then, turn again the bit7 to "L", bit 4 and bit0 to "L", to turn to 00000000 again, or to output 00H.

ASSEMBLER

80 family	68 family
LD A,80H	LDA #$80
OUT 80H,A	STA $C380
LD A,00H	LDA #$00
OUT 80H,A	STA $C380

BASIC

PC-8001, MZ-80K/C	APPLE II
10 OUT 128,128	10 POKE -15488,128
20 OUT 128,0	20 POKE -15488,0
	70 END

Second, to read the status of the F/F, read port 1, ($C381 or 81H), and mask bit 0 by using an 'AND' $01, (0000,0001), and test if it is still set to a '1'. If it is, then 'LOOP' back and keep testing till bit 0 of port 1 is LOW, (0) (See Figure 15.).

Figure 15.

ASSEMBLER

80 family

```
LOOP:IN     A,81H
     RRCA
     JP     NC,BASIC
     JP     LOOP
```

68 family

```
LOOP:LDA $C381
     LSR  A
     BCS  LOOP
     JMP  BASIC
```

BASIC

PC-8001. MZ-80K/C

```
30 A=INP(129)
40 B=INT(A/2)*2
50 IF A<>B THEN GOTO 30
60 PRINT"TRIG ON"
```

APPLE II 6K BASIC

```
30 A=PEEK(-15487)
40 B=A/2*2
50 IF A<>B THEN GOTO 30
60 PRINT"TRIG ON"
70 END
```

4. Input and Output Filters

The cut-off frequency of the input filter is determined by the sampling rate of the A/D converter. This cut-off frequency is set at the factory to 20 kHz, but may be adjusted by the user. Generally, the cut-off frequency, (fc)/sampling rate ratio is 1/2.5. This also applies to the output filter which is factory set to 16 kHz.

To adjust the fc, determine the fc for the purpose. Then select a suitable value for 'R', (eg. R=10Kohms). Using the circuit in Figure 16, and the table of Capacitor values in Figure 17, select the proper capacitor values for the values of fc and R.

Warning.

This should only be attempted if the user is completely familiar with the circuitry. The Guarantee may be voided if improper modifications result in damaging the ADA-200.

Figure 16.

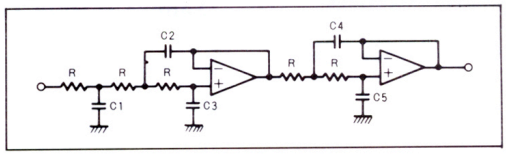


Figure 17.

C1=1.3541/2πRf
C2=1.7529/2πRf
C3=0.4213/2πRf
C4=3.2361/2πRf
C5=0.3090/2πRf

e.g. fc=10KHz、 R=10KΩ

C1=1.3541/2π×10⁴×10⁴=0.00216〔μF〕
C2=1.7529/2π×10⁴×10⁴=0.00279〔μF〕
C3=0.4213/2π×10⁴×10⁴=670.5〔PF〕
C4=3.2361/2π×10⁴×10⁴=0.00515〔μF〕
C5=0.3090/2π×10⁴×10⁴=491.8〔PF〕

5. Reading the Comparator Data

The output of the D/A converter and the input signal are both connected to the input terminals of the Comparator, (I.C.7-LM311). The Comparator's output is connected to bit 7 of input port 1, ($C381 or 81H). The comparator outputs a 'HIGH' when the input voltage is HIGHER than the D/A voltage, and outputs a 'LOW' when LOWER. This allows use of the 'DELTA MODULATION' method of converting incoming voltages, and may be used in Voice Synthesis.

4. 2 Channel Unit

The 2 Channel unit is standard equipment with the ADA-200, and its Input Pre-Amp, Input Filter, and Output Filter are the same as the main input channel.
As mentioned earlier, Channel 1 or 2 may be selected by software, by setting bit 0 of port 0, ($C380 or 80H), to a '0' or channel 1, or to a '1' for channel 2.

[Sample & Hold Control Functions vs Output Leakage]

The D/A converter's output is connected to the output filter. It is possible, when doing an A/D conversion, to have the D/A converter's output appear at the Channel 1 or 2 output terminals. To avoid this problem, the output may be suspended during the A/D conversion process. To 'FREEZE' the output signal, set bit 3 of port 0, (C$380 or 80H), to a '1', which will 'HOLD' the output. This would normally happen during the A/D conversion period, and bit 3 would be set to '0' while outputting D/A data.

[Sample & Hold Timing while Changing Channels]

In order to avoid leakage from one channel to other during output channel switching, the bit 3, (S & H, Hold), should be set to a '1' and output to port 0, ($C380 or 80H). See Figure 18. for Flowchart details regarding channel changing.

[A/D of 2 channels]

When a high speed A/D conversion is desired, using both channels, the channel change must be made immediately after reading in the A/D data, because of the 'EOC', (End of Conversion) signal which is sent from I.C.15, (MC14559), to the Sample & Hold circuit.
The channel change must proceed the output of EOC, and never after the EOC has gone LOW (active LOW).
Figure 19 gives an example of 2 channel A/D conversion.

Figure 18.

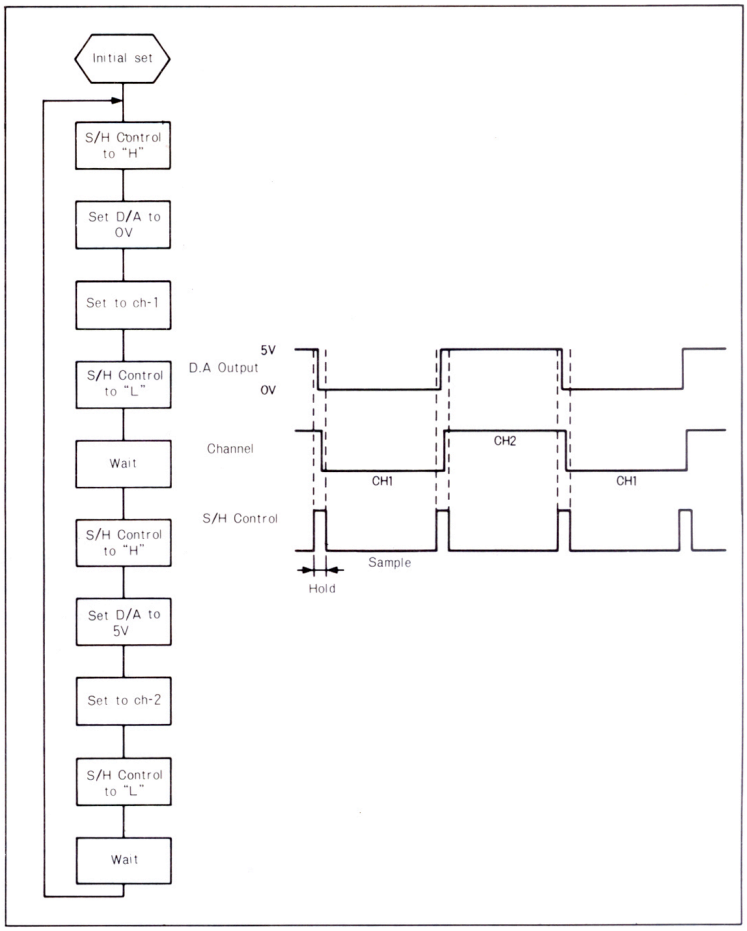
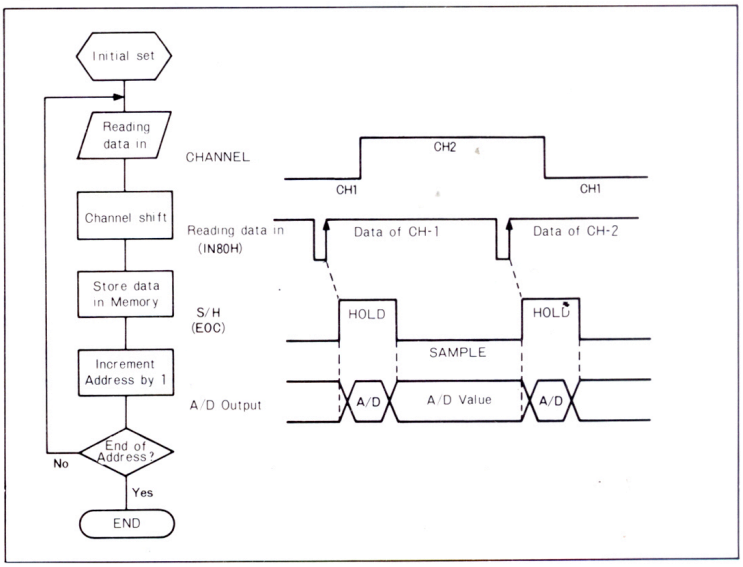


Figure 19.



1. Adjustment Procedures

The converter has been thoroughly checked before shipment from the factory, however, periodic calibration is recommended every year or so. Since precision parts are used in the ADA-200, care should be taken during calibration.

The ADA-200 has 3 major calibration points. These are:

(1) On A/D converter . . . . . Clock Frequency Adjustment.
(2) On D/A converter . . . . . Offset Adjustment.
(3) On D/A converter . . . . . Width (Modulation Width) Adjustment.

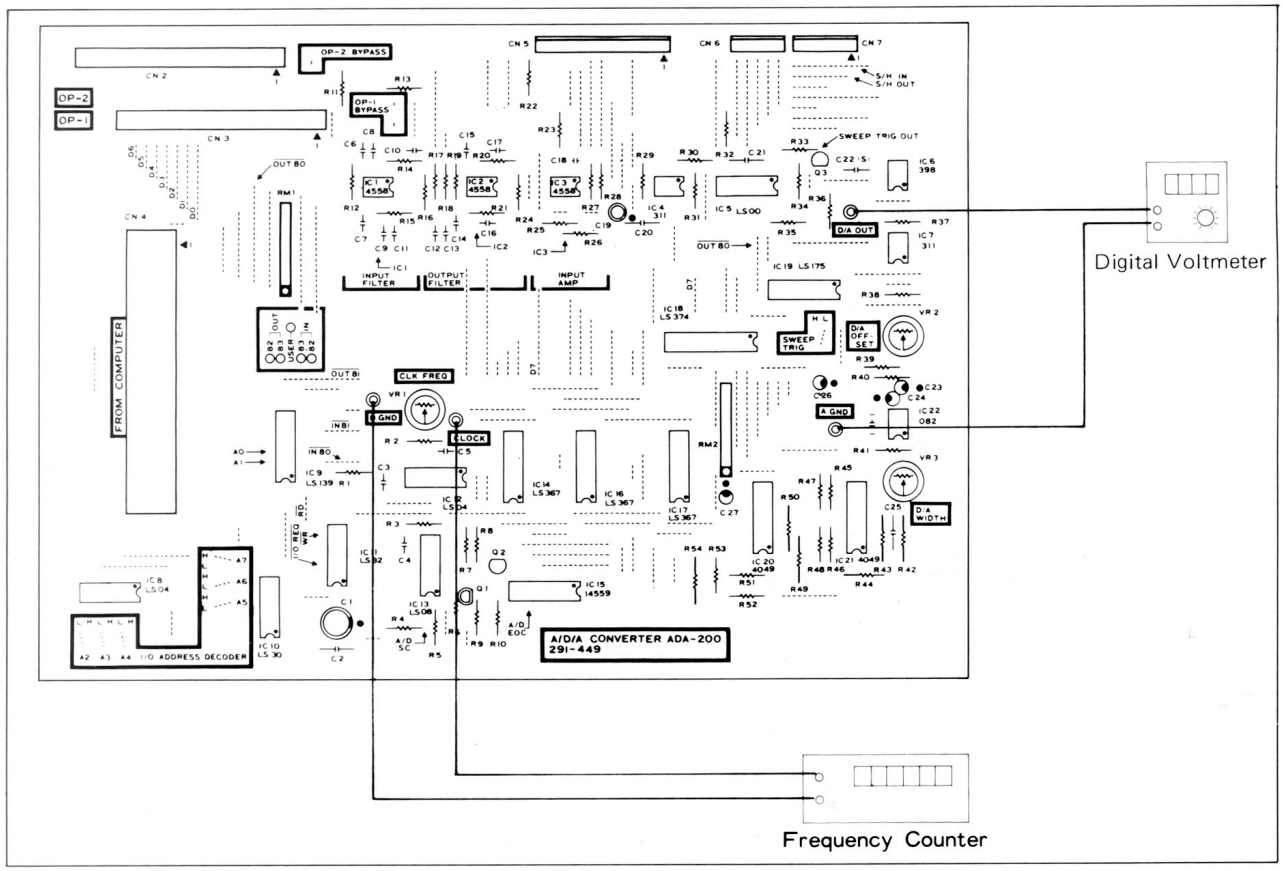
Besides the computer, to which the ADA-200 must be connected, the following test equipment is required;

(1) Frequency Counter.
(2) Oscilloscope.
(3) Digital Volt Meter.

To begin calibration, turn off the power to the ADA-200 and the computer, and disconnect the power cord on the ADA-200. Then lift the chassis cover on the ADA-200 by removing the screws from the sides of the case. Lastly, reconnect the computer to the ADA-200 and plug in the power cord and turn the power on.

You are now ready to proceed with the adjustments.

Figure 20.



(1) Adjustment of the A/D clock frequency (see Figure 20.)

a) Connect the Frequency Counter to the check points *Clock* and *Dgnd* (ground) on the board.
b) Adjust VR1 so the counter reads 400 kHz (±5%).

(2) Adjustment of the D/A Converter

a) Enter the program for your computer as shown in Figure 21.
b) Connect the DVM to the check points *D/A Out* and *Agnd*, (analog ground), on the board.
c) Run the test program from Figure 21.
d) Press the Return key and adjust VR2 to set the offset to 0.00 volts.
e) Press the Return key again and adjust VR3 to set the D/A Width to 5.0 volts.
f) Press the Return key one more time.
g) Repeat steps c) to f) several times until the readings on the DVM are set precisely to 0.0 and 5.0 volts respectively.

Figure 21.

PC-8001, MZ-80K/C

```
10 OUT 128,16
20 INPUT A$
30 OUT 129,0
40 PRINT "ADJUST OFFSET TO 0.00V"
50 INPUT A$
60 OUT 129,255
70 PRINT "ADJUST  WIDTH TO 5.00V"
80 GOTO 20
```

APPLE II

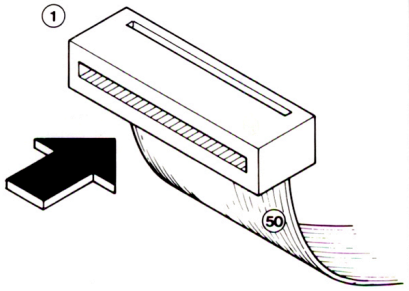
```
10 POKE -15488,16
20 INPUT A$
30 POKE -15487,0
40 PRINT "ADJUST OFFSET TO 0.00V"
50 INPUT A$
60 POKE -15487,255
70 PRINT "ADJUST  WIDTH TO 5.00V"
80 GOTO 20
```

2. Connection to Various Computers

The ADA-200 ribbon cable connector requires an 8 bit bidirectional data bus, (D0 to D7), 8 address lines, a RD* line, a WR* line, a Device or Chip select* line, and a ground connection in order to interface to a computer. The ADA-200 connector has 50 pins which are configured as in Figure 22.

Figure 22.

Signal	Pin No.		Signal
N.C	2	1	N.C
N.C	4	3	DB0
N.C	6	5	DB1
N.C	8	7	DB2
N.C	10	9	DB3
N.C	12	11	DB4
N.C	14	13	DB5
N.C	16	15	DB6
N.C	18	17	DB7
N.C	20	19	AB0
N.C	22	21	AB1
N.C	24	23	AB2
N.C	26	25	AB3
N.C	28	27	AB4
N.C	30	29	AB5
N.C	32	31	AB6
N.C	34	33	AB7
N.C	36	35	$\overline{RD}$
N.C	38	37	$\overline{WR}$
N.C	40	39	N.C
N.C	42	41	$\overline{I/O\ REQ}$
N.C	44	43	N.C
N.C	46	45	N.C
GND	48	47	N.C
GND	50	49	N.C

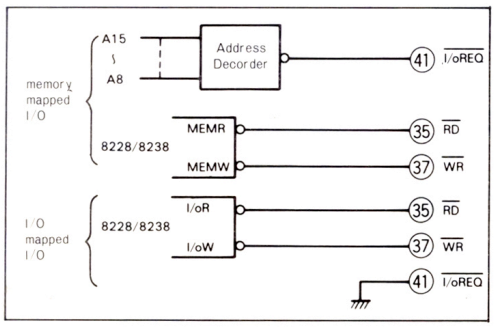


We will now discuss specific details of hookup to various processor types.

(1) 8080 type CPUs

8080 systems generally use a system controller such as the 8228 or 8238. On this type of system, use the Memory Read, (MEMR*), and the Memory Write, (MEMW*) of the 8228/38 when used as a memory mapped system. To use the 8080 in the I/O mapped mode, use the I/O Read, (I/OR*), and I/O Write, (I/OW*).
Figure 23 shows a typical hookup for the 8080. The Address decoder will be dependant on your particular system.

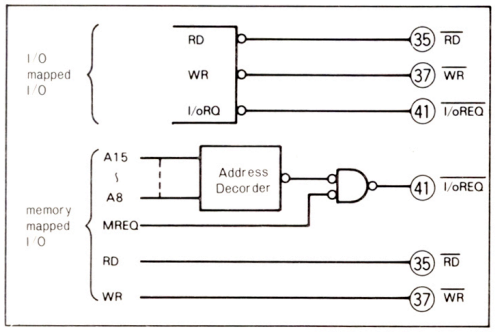
Figure 23.



(2) Z-80 type CPUs

With the Z-80 type CPUs, these lines are already available and are named Read, (RD*), Write, (WR*), I/O Request, (I/OREQ*), and Memory Request (MREQ*).
With the Z-80, connection may be made to directly to the CPU for an I/O mapped system, or alternately, using a simple address decoder, connection may be made using the High Order address lines, (A8 to A15), on the CPU. (See Figure 24.)

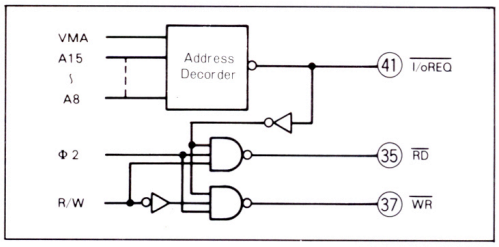
Figure 24.



(3) The 6800 CPU

The 6800 uses the VMA. (Valid Memory Address), 2 Clock, and the R/W* lines. (See Figure 25.)

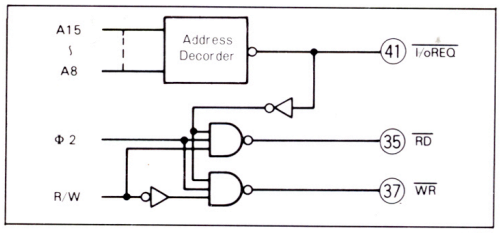
Figure 25.



(4) The 6502 CPU

The 6502 uses the 2 Clock and the R/W lines. (See Figure 26).

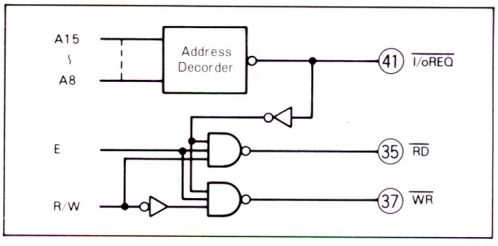
Figure 26.



(5) The 6809 CPU

The 6809 R/W* is controlled by the 'E' Clock signal.
(See Figure 27.)

Figure 27.

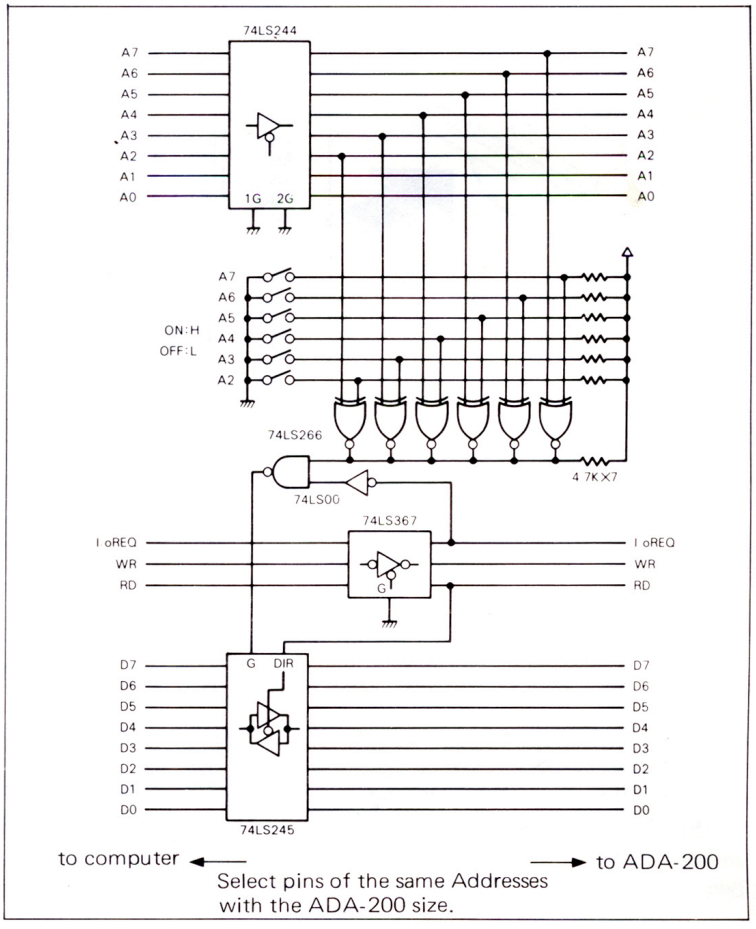


Note: The examples shown here relate to the CPU only and not to the particular system. Please bear this in mind when connecting the ADA-200 to your computer.

3. Ribbon Cable Extension

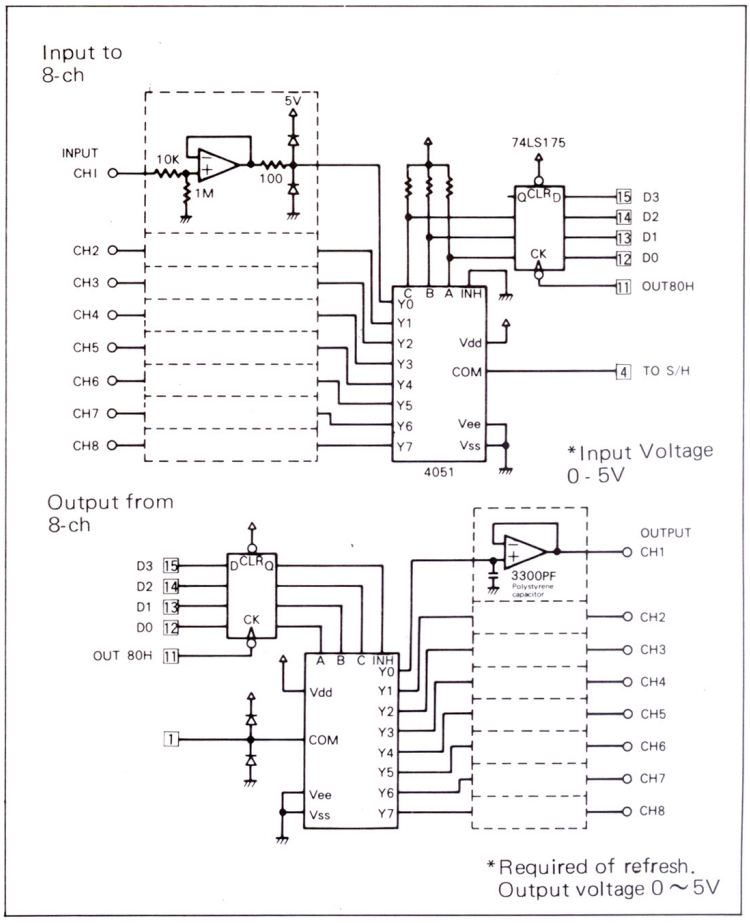
If the ADA-200 is to be used some distance away from the computer, an extended ribbon cable may be used. However, in order to prevent capacitive and inductive loading of the CPU address lines, and to minimize the noise, an active buffer circuit, as in Figure 28, should be used.

Figure 28.



4. 8 Channel Optional Extension Unit

Figure 29.



Note: To use the Extension Unit, it is required to cut the appropriate jumper wires on the main board.

See Figure 29 regarding the circuit diagram of the 8 Channel Extension Unit.

5. Specifications

●Input:	2 ch (Lowest input sensitivity = 25mVp-p) (Maximum input voltage = 50Vp-p)
●Output:	2 ch (Maximum output level = 5Vp-p
●Quantization bits:	8 bits
●Highest sampling frequency:	44 kHz
●Input gain control:	0 - 200 times
●Input filter:	AC/DC, fo = 20 kHz, 30 dB/oct
●Output filter:	fo = 16 kHz, 30 dB/oct
●Output load impedance:	1 kΩ or more
●Functions:	INPUT - ch-1, ch-2 OUTPUT - ch-1, ch-2 SWEEP TRIG OUTPUT D/A OUTPUT
●Switches:	POWER, INPUT, AC/DC Changeover (ch-1, ch-2)
●Controls:	LEVEL (ch-1, ch-2) POSITION (ch-1, ch-2) TRIG LEVEL
●Indicators:	POWER, INPUT OVERSHOOT, TRIG, READY
●Expansion unit connectors:	2
●Expansion unit:	2-ch expansion unit is installed
●Dimensions:	333(W) x 108(H) x 193(D) mm 13(W) x 4-1/4(H) x 7-5/8(D) in.
●Weight:	2.7 kg 5 lb. 15 oz.
●Power source:	AC 117/220/240V 10W

* Specifications are subject to change without notice.