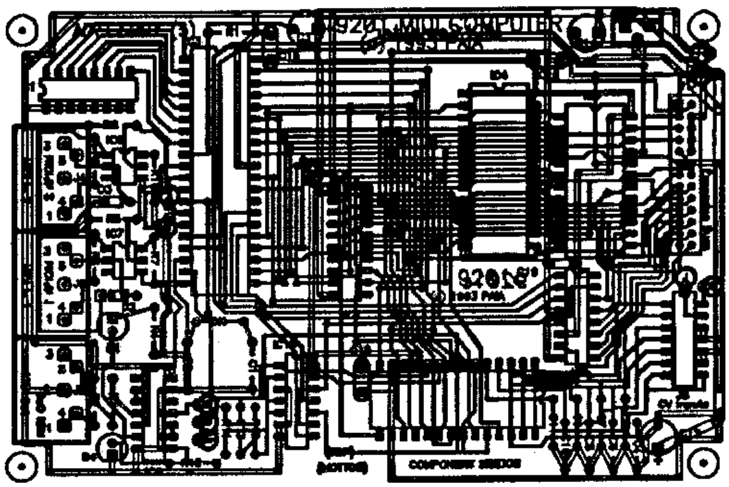
MIDI Drum Computer Board

Model 9201DK
Assembly, Testing and Application Manual



The MIDI Drum Computer Board converts variable amplitude voltage pulses from percussion sensors into MIDI Note On, Note Off and Velocity data that can be used to control sounds from any MIDI keyboard, Sound Module or Multimedia PC. When a voltage pulse appears on one of eight inputs the Computer Board sends a MIDI Note On message for the Note Number assigned to the input. The Velocity Data sent along with the note is proportional to the amplitude of the pulse, which is in turn proportional to how hard the sensor was struck.

The firmware includes maps for eight drum kits in PROM and provides remapping capabilities so that any MIDI Note Number can be triggered by any input. Either logarithmic or linear response curves can be selected for converting pulse amplitude to Velocity. MIDI Channel Number can be set from 1-16. A MIDI In jack and intelligent merging function allow you to easily daisy-chain the Computer Board into the typical MIDI environment.

ASSEMBLING THE MIDI Drum Brain

Before beginning assembly, go through the manual. Look at the drawings. Feel the parts. You're naturally eager to plunge right in, but take a few deep breaths first.

Notice that each step in the manual is marked with a checkoff box like this:

DESIGNATION	VALUE	COLOR CODE
( ) R27	100 ohm	brown-black-brown

Checking off each step as you do it may seem silly and ritualistic, but it greatly decreases the chance of omitting a step and also provides some gratification and reward as each step is completed.

Numbered figures are printed in the Illustrations Supplement in the center of this manual. These pages may be removed for easy reference during assembly.

THE CIRCUIT BOARD

The MIDI Drum Brain is built on a double sided, plated through-hole circuit board. The tin-lead plating on the circuit board conductors easily accepts solder with no further preparation or cleaning of the board.

Most parts will be mounted so that their leads enter the board from the "Component" side (the side with parts placement legending in colored ink). The other side of the board is the "Solder Side" and the leads of most components will be soldered on this side. The exception is the default program switch (DIP switch S1). This switch will be mounted on the "bottom" (SOLDER) side of the circuit board so that it can be accessed through a hole in the bottom of the case which houses the Drum Brain.

There will be some components marked on the board that will not be used in this device.

TOOLS

You'll need a minimum of tools to assemble the kit - a small pair of diagonal wire cutters and pliers, screwdriver, sharp knife, ruler, soldering iron and solder.

Modern electronic components are small (in case you hadn't noticed) and values marked on the part are often difficult to see. Another handy tool for your bench will be a good magnifying glass. Also use the magnifier to examine each solder joint as it is made to make sure that it doesn't have any of the problems described in the SOLDERING section which follows.

SOLDERING

Select a soldering iron with a small tip and a power rating not more than 35 watts. Soldering guns are completely unacceptable for assembling solid state equipment because the large magnetic field they generate can damage components.

Use only rosin core solder (acid core solder is for plumbing, not electronics work). A proper solder joint has just enough solder to cover the soldering pad and about 1/16-inch of lead passing through it. There are two improper connections to beware of: Using too little solder will sometimes result in a connection which appears to be soldered when actually there is a layer of flux insulating the component lead from the solder bead. This situation can be cured by reheating the joint and applying more solder. If too much solder is used on a joint there is the danger that a conducting bridge of excess solder will flow between adjacent circuit board conductors forming a short circuit. Accidental bridges can be cleaned off by holding the board upside down and flowing the excess solder off onto a clean, hot soldering iron.

Use care when mounting all components. Never force a component into place.

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This product originated as a Do-It-Yourself article by John Simonton & Kent Clark in the June & July 1993 issues of Electronics Now magazine. There may be differences between what appeared in thearticle and what is supplied with the kit. These differences, and any discussion of them, will be set aside with this italicized type. In some cases, notes packed with the parts will be used to call your attention to special situations.

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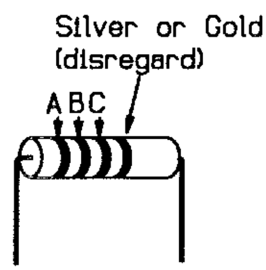
RESISTORS

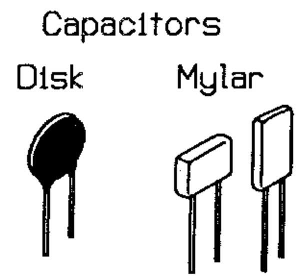
Solder each resistor in place following the parts placement designators printed on the circuit board and the assembly drawing Fig 1. Note that resistors are nonpolarized and may be mounted with either of their two leads in either of the holes provided. Before mounting each resistor, bend its leads so that they are at a right angle to the body of the part. Put the lead through the holes and then push the resistor firmly into place. Before soldering, cinch the resistor in place by bending the leads on the solder side of the board out to an angle of about 45 degrees. Solder both ends of each resistor in place as you install it. Clip each lead flush with the solder joint as the joint is made. Save a resistor clipping to use as a jumper in a later step.



DESIGNATION	VALUE	COLOR CODE A-B-C
( ) R1	4700 ohms	yellow-violet-red
( ) R2	220 ohms	red-red-brown
( ) R3	220 ohms	red-red-brown
( ) R4	680 ohms	blue-grey-brown
( ) R5	3300 ohms	orange-orange-red
( ) R6	10 ohms	brown-black-black
( ) R7	220k	red-red-yellow
( ) R11	100k	brown-black-yellow
( ) R12	3900 ohms	orange-white-red

CERAMIC DISK AND MYLAR CAPACITORS

Many capacitors used in the MIDI Drum Computer are Ceramic Disk and Mylar types. These parts are nonpolarized so the leads are interchangeable. The leads are already parallel to each other but still may need to be bent to match the spacing of the circuit board holes. Like the resistors, push the leads through the holes in the board and push the part against the circuit board as far as it wants to go. Don't force it, it's OK if it sits a little off the board.



Capacitors are often marked with obscure codes that indicate their values. The 2 or 3 digit number that specifies value may be preceded or followed by letters indicating such things as tolerance. If you get confused about which capacitors are which, it may help to group then by same type and check them against quantities on the packing list at the end of this manual.

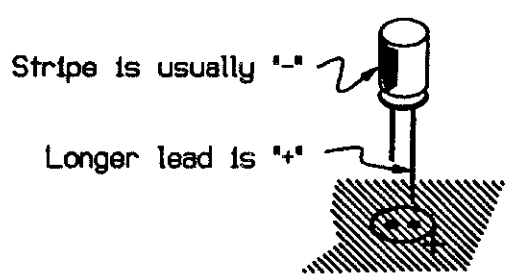
DESIGNATION	VALUE/TYPE	MARKING
( ) C1	33pF Disk	33
( ) C2	33pF Disk	33
( ) C13	100pF Disk	101
listed below:	.01uF Disk	103

( ) C15	( ) C16	( ) C17	( ) C18
( ) C19			

listed below:	.1uF Mylar	104

( ) C4	( ) C5	( ) C6	( ) C7
( ) C8	( ) C9	( ) C10	( ) C11

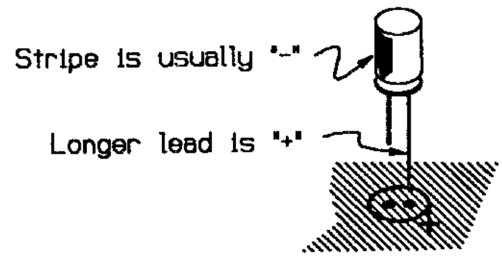
ELECTROLYTIC CAPACITORS



The remaining capacitors are electrolytic types. Unlike the previous components, electrolytic capacitors are polarized and the leads are not interchangeable. Leads are marked "+" and/or "-" and the "+" lead must go through the "+" hole in the circuit board. Frequently the positive lead of the capacitor is longer than the negative lead.

Usually the Negative lead of the capacitor is marked rather than the positive. It naturally goes through the hole not marked "+".

Capacitors supplied with specific kits may have a higher Voltage (V) rating than that specified below.

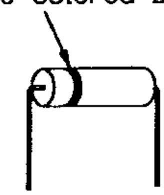


DESIGNATION VALUE

( ) C3 33uF / 10V
( ) C12 1 uF / 10V

DIODE - D2

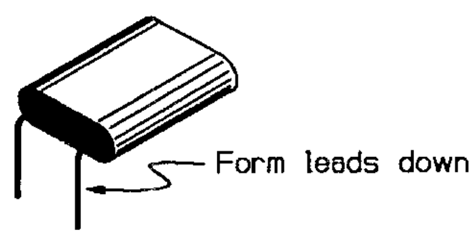
( ) Locate the glass-cased 1N914 (or equiv.) Silicon Signal Diode. Install this diode in the location labeled D2. Note that the diode is polarized and must be oriented so that the lead on the banded end of the part corresponds to the banded end of the designator on the circuit board. Bend the leads so they are at right angles to the body of the part and insert them through the holes in the circuit board from the component side. Diodes are slightly heat sensitive so the soldering operation should be done as quickly as possible.



Signal Diodes are usually in clear or colored glass cases.

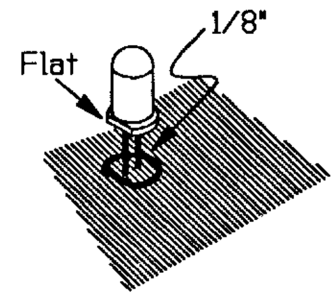
CRYSTAL - X1

( ) Locate the 12 mHz. crystal. This part is nonpolarized and is installed at the location marked X1 on the circuit board. Prepare the leads by bending them at right angles to the body of the part as shown. Insert the leads through the holes in the circuit board from the Component Side so that the body of the crystal is laying on the board between ceramic disk capacitors C1 and C2. Make sure the metal body of the part doesn't touch the leads or circuit board traces. Solder on the Solder Side and clip the excess lead off flush with the solder joint.



LED - D1

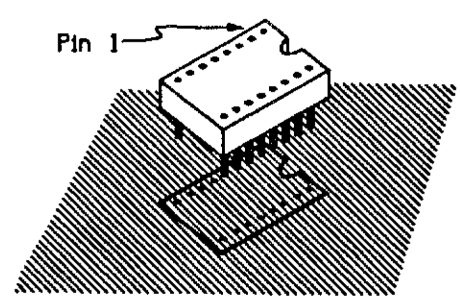
( ) Install the Light Emitting Diode from the Component Side of the circuit board at the location shown as D1 by the parts placement graphics. Notice that the LED is polarized and the lead marked by the flat on the collar of the case must go in the similarly marked hole in the board (closest to the diode D2). Push the LED's leads through the holes from the Component Side and push the part down until it stands off from the board about 1/8". Solder both leads on the Solder Side and clip them off flush with the solder joints.



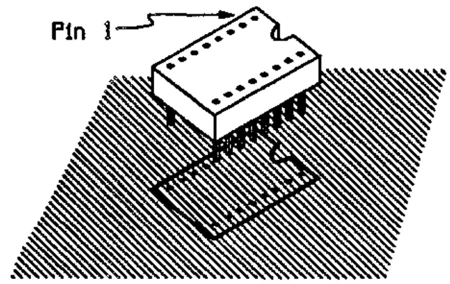
IC SOCKETS

Sockets are notorious for being the weak links in the chain of connections between electronic components. We use them only in places where their advantages outweigh their lack of reliability. The PROM is socketed so that it can be easily changed for upgrades. The 8031 uC and ADC0809 are socketed for peace of mind - so that if trouble shooting is needed these parts can be easily removed and/or replaced. A 14 pin socket at J5 will serve as connector for sensor inputs and power. Less expensive "glue" logic will be soldered directly to the board.

Sockets are polarized with a rectangular or semicircular notch at one end of the part which corresponds to a similar indicator on the circuit board graphics. The socket would work just as well if it were inserted backward to the marked polarity, but this would surely generate confusion when the time came to install or replace the ICs.

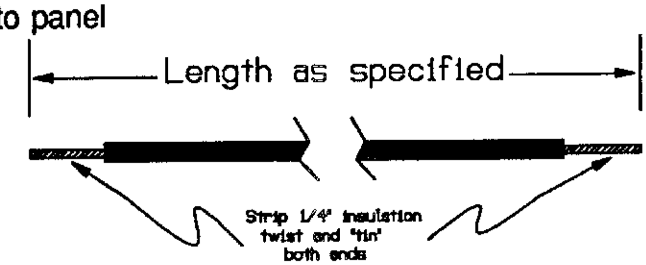


Insert the socket pins through the circuit board holes from the Component Side and initially solder two pins in diagonal corners of the pattern. Make sure that the socket is seated firmly against the pc board by pressing it down while remelting the solder joint at first one corner, then the other. Finally, solder the remaining connections.



DESIGNATOR	SOCKET TYPE
( ) IC3	40 pin
( ) IC4	28 pin
( ) IC11	28 pin
( ) J5	14 pin

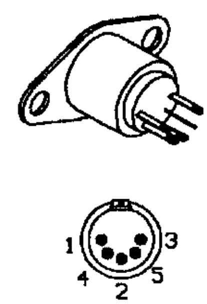
"FLYING" WIRES
(i.e. those which go from circuit board to panel mounted parts.)



The #22 stranded wire provided with the kit is used to connect the Computer Board to the MIDI Jacks and Remap Button.
At each step, cut a piece of wire to the specified length and strip 1/4" of insulation from each end. To make soldering easier, "tin" the ends by twisting the exposed wire strands together and melting a small amount of solder into them.

On the Computer Board, push the tinned wires through the designated pad from the Component Side and solder on the Solder Side. Solder each connection as it is made and trim any excess wire off flush with the solder joint.

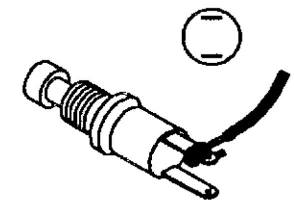
5 Pin DIN
(MIDI)
Jacks



Individual solder lugs on the panel mounted parts are identified by part number and lug number. For example, J2-3 means lug #3 of Jack J2 as identified in the illustrations. With one exception (Lug #2 of J2, which will have two wires connected to it) the connections to the Jacks and Push-button should be soldered as they are made.

LENGTH	FROM PC Point	TO
( ) 18"	"B"	either lug of S2
( ) 8-1/2"	J2-"2"	J2-2 (No Solder)
( ) 8-1/2"	J2-"4"	J2-4
( ) 8-1/2"	J2-"5"	J2-5
( ) 8-1/2"	J3-"4"	J3-4
( ) 8-1/2"	J3-"5"	J3-5

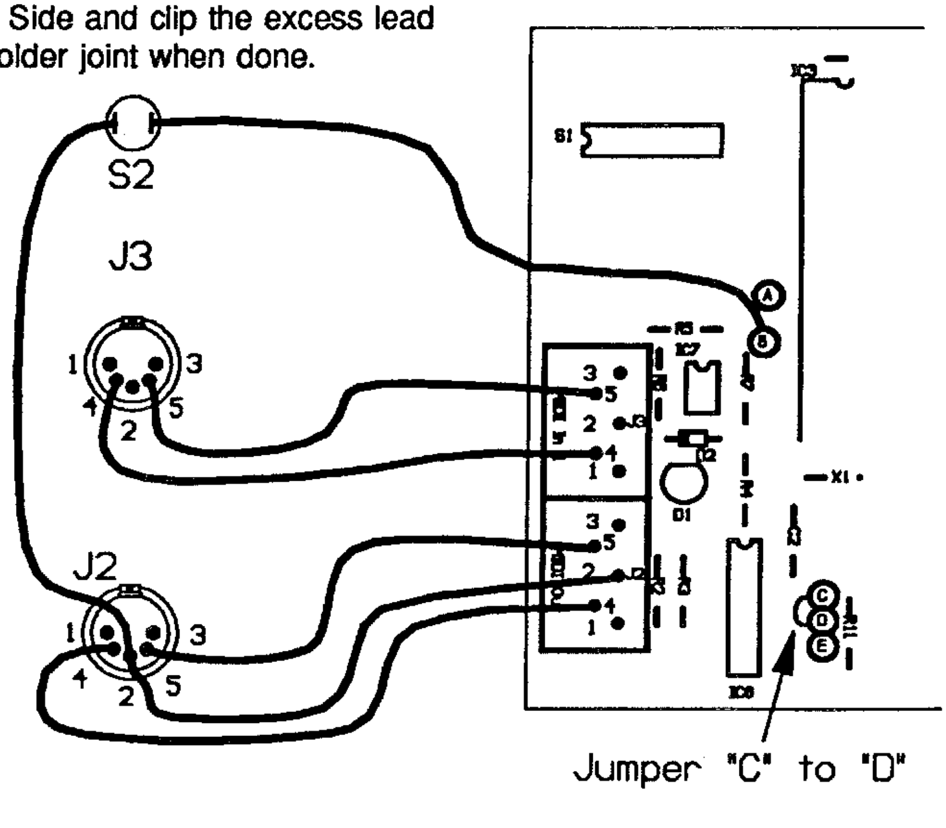
( ) Use a 14" length of stranded wire to connect the free lug of push-button S2 (solder) to lug #2 of MIDI Connector J2 (solder 2 wires at this connection). If you have trouble getting both wires through the hole, wrap the second wire around the lug.



The solder lugs on the push-botton can be used interchangeably. Wires wrap around the lugs and are soldered.

JUMPER

( ) Using a length of excess component lead, form and install a jumper between circuit board points "C" and "D". Insert the jumper from the Component Side and clip the excess lead flush with the solder joint when done.



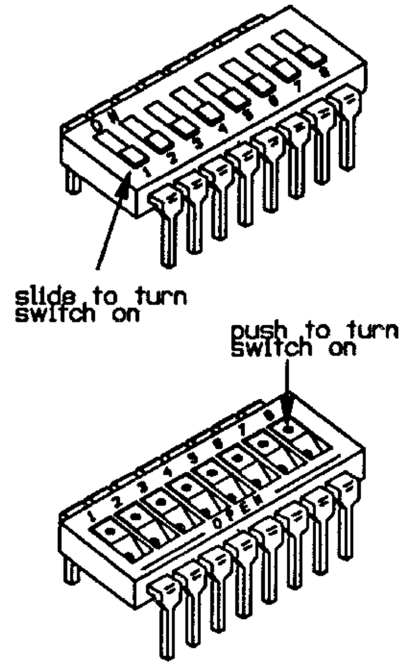
DEFAULT DIP SWITCH - S1

Locate the 8 position DIP Switch. While all of the other parts have mounted on the "Component Side" of the circuit board, this switch will mount on the Solder Side so it will be accessible through a hole in the bottom of the case. Notice that the switch is "polarized" by the numbering of the individual switches (1-8) which will be printed on the package. Make sure that the DIP package is mounted so that the switch actuator labeled as "1" is on the end of the package closest to the edge of the circuit board.

( ) Install the 8-positon DIP switch from the Solder Side of the board. Solder pins in diagonal corners of the pattern. Check to make sure that switch section #1 is closest to the edge of the circuit board and the package is firmly seated against the board before soldering the remaining pins.

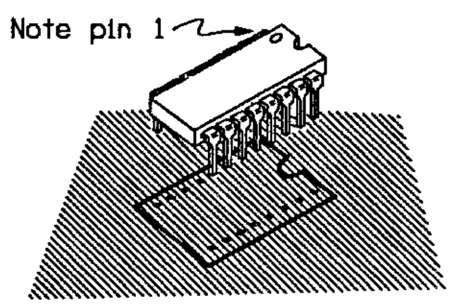
DIP Switch

In both of these examples all switches are off.



INTEGRATED CIRCUITS

Of all the parts, the ICs are the most easily damaged and should be treated with some respect. In particular, they may be damaged by discharges of static electricity. Modern ICs are not nearly as sensitive to this kind of damage as were earlier versions, but it is still good practice to handle these parts as little as possible. Also good practice: don't wear nylon during assembly. Don't shuffle around on the carpet immediately before assembly (or if you do, touch a lamp or something to make sure you're discharged). Don't be intimidated. It's rare for parts to be damaged this way.



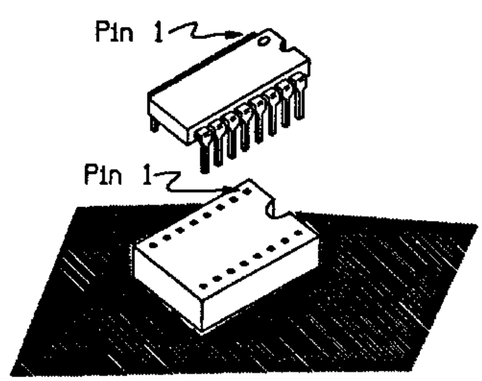
ICs are polarized in one or both of two ways; a dot formed into the case of the IC corresponding to pin 1 or a semicircular notch that indicates the end of the package with pin 1. Take care that this polarizing indicator corresponds to the similar indicator on the socket and/or circuit board.

The pins of the ICs may be splayed somewhat and not match up exactly with the holes they're to go through. Carefully re-form the leads if necessary so that they are at right angles to the part. Solder each IC in place as it is installed by initially soldering two pins in diagonal corners of the pattern. Make sure that the part is seated firmly against the pc board by pressing it down while remelting the solder joint at first one corner, then the other. Finally, solder the remaining connections.

DESIGNATOR	DESCRIPTION	
( ) IC2	74HC373	Octal Latch
( ) IC6	74HC04	Hex Inverter
( ) IC7	H11A1	OptoIsolator
( ) IC8	74HC138	1 of 8 Decoder
( ) IC10	74HC02	Quad NAND Gate

Socketed ICs

The final assembly step is to push the remaining ICs into their sockets. Make sure polarizing marks on the IC and the socket correspond. If the IC pins do not align closely enough to the holes in the socket, reform them as above. Be very careful that pins go into the socket holes and don't bend underneath the part. IC4, the 2764 EPROM will be identified by the copyright notice label on the part.



DESIGNATOR DESCRIPTION

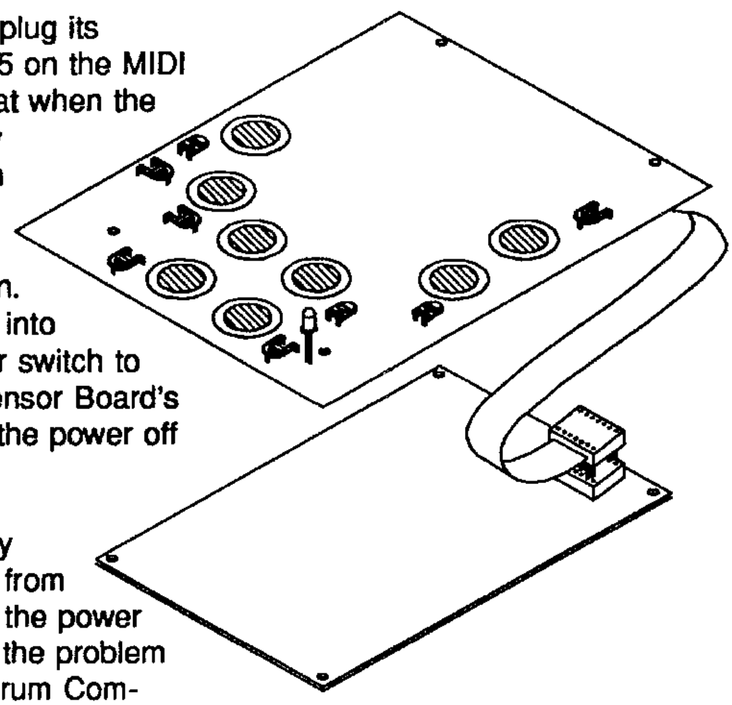
( ) IC3 8031 MicroController
( ) IC4 2764 EPROM (w/PAIADRUM firmware)
( ) IC11ADC0809 8 input 8 bit ADC

THIS COMPLETES THE ELECTRONIC ASSEMBLY of the MIDI Drum Computer Board. Before plugging the unit in and testing it, take a well earned break then come back and check your work completely. In particular, check your soldering. Make sure you have soldered all connections with bright, shiny joints. Remelt any connections that seem questionable. Watch for solder bridges and if you find any review the SOLDERING section on pg 3. Check polarity of the ICs, Diodes, and Electrolytic Capacitors.

POWER UP & TESTING

After rechecking your work, it's time for the all important smoke test. If anything unfortunate is going to happen, this is the most likely time.

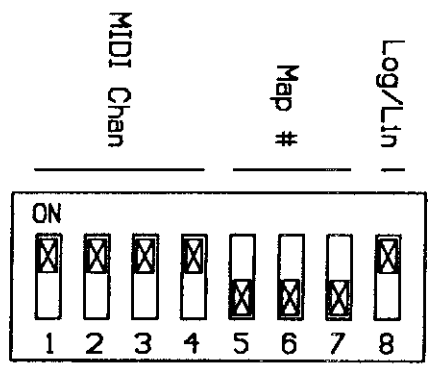
Bring out the Sensor Board and plug its ribbon Cable into the socket at J5 on the MIDI Drum Computer Board. Note that when the Ribbon Cable Header is properly mated with the socket the ribbon will exit the header toward the center of the MIDI Computer Board as shown in the illustration. Plug the wall-mount transformer into a 120VAC outlet, slide the power switch to "ON" and make sure that the Sensor Board's POWER LED lights. If not, turn the power off immediately and find out why.



If there is a problem, localize it by disconnecting the Sensor Board from the Computer Board and turning the power on again. If the LED now lights, the problem is almost certainly on the MIDI Drum Computer Board and is very likely a short circuit of some kind. Look carefully for solder bridges or reversed components on this board.

Once the LED lights, let the units idle for a few minutes while you check for any parts that might be getting overly warm. Anything too hot to hold your finger on is too hot. Find out why.

Set the MIDI Drum Computer's DIP switch S1 as shown in the illustration. This sets MIDI to send on Channel 1, selects Map 8 and linear touch response. Turn the Sensitivity trimmers on the Sensor Board fully clockwise (maximum sensitivity). At shis point, tapping the Piezo Disks on the Sensor Board should cause the "Send Active" LED on the MIDI Computer Board to blink on briefly with each strike. When this happens you're probably home free -the uC is almost certainly sending MIDI.



If the LED doesn't wink at you, check again for solder bridges and wrong parts/wrong place/ wrong way. Check the voltage at the supply pins of the ICs (not at the socket), all these should be 5V. Also check for IC pins that may have rolled under the chip rather than going into the socket.

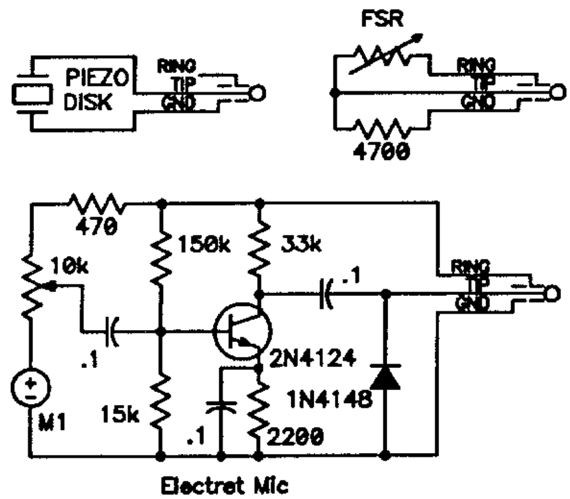
For the final acid test, connect a MIDI cable from the Computer Board's J2 (MIDI Out) to the MIDI input of your favorite keyboard, sound module or MPC and set this receiving device for MIDI Channel 1. As you strike percussion pads, you should hear sounds from the audio output of the receiving device. If you run into problems here, check to make sure that the receiving device is set to receive MIDI and that it is set to receive on Channel 1. Check the Default switch settings on the MIDI Drum Computer Board to make sure you have not confused "ON" (closed) and "OFF" (open) settings of the switches.

Tips on using the MIDI Drum Computer:

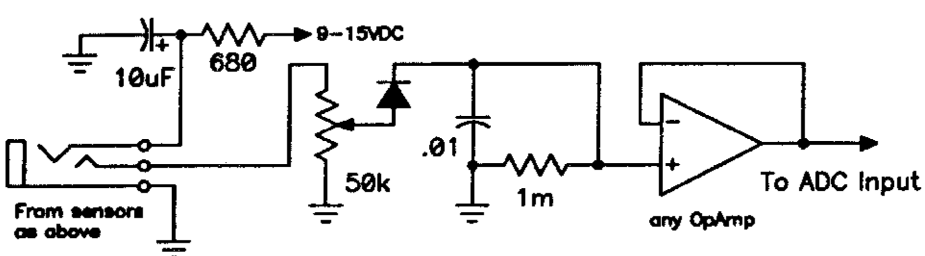
Full details of using the MIDI Drum Computer in a specific application (such as the MIDI ThumbDrum) are given in the Final Assembly and Using manual for that kit. The following material is intended for those who are designing a custom system.

In many cases it is convenient to provide the regulated +5V power required by the MIDI Drum Computer from an "applications" board that also provides analog processing and conditioning for the outputs of the sensors used. But there are provisions on the board for a voltage regulator (IC1) and input filter capacitor (C14). If this onboard regulation approach is used, power (9-15VDC @ 100mA) can be brought onto the board a circuit board points "+" and "G", adjacent to expansion connector J1.

The peak level of the voltages applied to the input of the Analog to Digital Converter is very important. Trigger pulses greater than 5V produce unpredictable results that will most likely sound like all the drums going at once. The output of most drum sensors will need to be processed by active circuitry like that shown in the illustrations.



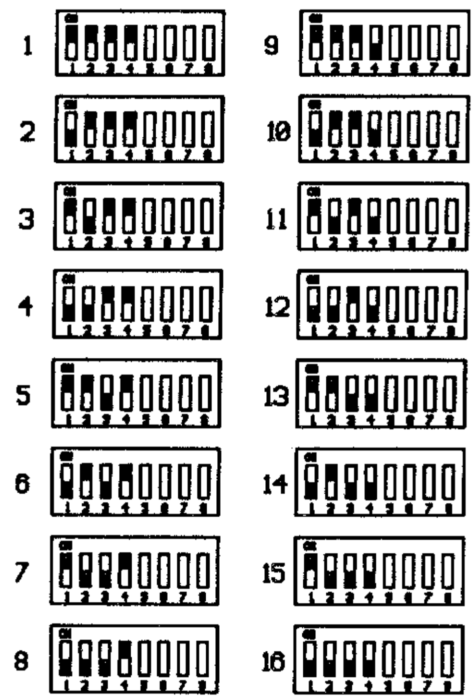
Any of these sensors will plug directly into the peak detector buffer shown below



The output of most sensor types will need to be peak-detected and buffered by circuitry like this. The wiring of the jack allows the use of a variety of sensors.

Sections s1-s4 of the DEFAULT Switch S1 select the MIDI channel on which the Drum Computer will transmit. The illustration to the right show switch settings and corresponding Channel Number.

MIDI Channel Number is set by s1 - s4



Sections s5-s7 of the DEFAULT Switch select one of 8 "maps" assigning different drum sounds (MIDI Notes Numbers) to different ADC Inputs. There are a few instrument-specific maps and General MIDI maps of different drum "kits"; A "Latin Kit" with claves and maracas and a "Rock Kit" with cymbals and snares. These maps and the corresponding DEFAULT Switch settings are shown on pg. 17.

You're not stuck with just these eight drum maps. The MIDI Drum Computer firmware allows for remapping; It requires that a keyboard or some other source of MIDI note data be plugged into the MIDI In jack. To change the Note Number assigned to an input line, push and hold the REMAP button while playing a note on the keyboard. Release the button, and within five seconds hit the pad that you want to assign the note to. If you decide you don't want to make a change after pushing the REMAP button, just release it and wait five seconds.

In the basic configuration, only Map 8 can be changed. Installing RAM for IC5 extends remapping capabilities. If you populate IC5 with a 6116, you can change all maps but the changes are volatile and will go away when power is turned off. If you install a RAM with internal backup power (such as an MK48Z02) all maps can be altered and changes will be preserved when power is turned off.

While remapping, make sure only Note Data is sent to the Thumdrum. The firmware can be confused by System Common, System Exclusive and System Real Time messages. Particularly , any controller supplying Note Data for remapping purposes must have Active Sensing disabled.

Section s8 of the DEFAULT switch selects linear or logarithmic conversion of pulse amplitude to MIDI velocity. If there seems to be a lack of dynamic range, (the sounds don't want to play softly) try turning this switch off to select a logarithmic response.

The MIDI In jack also provides a "merging" function that allows data appearing there to be combined with Note and Velocity Data generated internally in response to changing voltage inputs. This function "knows about" MIDI and will not insert drum messages into the middle of multibyte message from the MIDI In.

Merging allows keyboards and other controllers (which, like the Drum Computer, may have no sound producing capabilities) to be daisy-chained into sound modules as shown in the illustration. If, for example, eight percussion inputs don't seem like enough, the "other controller" can be another MIDI Drum Computer for another eight inputs. By assigning each controller to its own Channel Number, different controllers can produce different sounds from a single Sound Module.

DRUM MAPS

MAP 1:
BASIC KIT "A" (GENERAL MIDI)

Input#	Note	Drum Name
1	C1	KICK
2	D1	SNARE
3	C2	HIGH-MID TOM
4	A1	MID TOM
5	F1	LOW TOM
6	C#2	CRASH CYMBAL
7	F#1	CLOSED HI-HAT
8	A#1	OPEN HI-HAT

MAP 2:
BASIC KIT "B" (ROLAND STANDARD)

1	C1	KICK DRUM
2	D1	SNARE
3	B1	TOM 1
4	F1	TOM 2
5	E3	RAP TOM
6	C#2	CYMBAL
7	F#1	CLOSED HI-HAT
8	G#1	HI-HAT

MAP 3:
BASIC KIT "C" (E-MU DRUMS)

1	C1	BASS DRUM
2	D1	SNARE
3	C2	TOM 1
4	A1	TOM 2
5	D#2	TAMBOURINE
6	A2	CHOKE CYMBAL
7	F#1	RAP HI-HAT
8	C3	TABLA

MAP 4:
BALLAD KIT (GENERAL MIDI)

1	C1	BASS DRUM
2	C#1	RIMSHOT
3	D1	SNARE
4	A1	HI TOM
5	F1	LO TOM
6	D#2	RIDE CYMBAL
7	F#1	CLOSED HI-HAT
8	C#2	CRASH CYMBAL

MAP 5:
LATIN KIT "A" (GENERAL MIDI)

Input#	Note	Drum Name
1	E3	LO CONGA
2	D#3	OPEN HI CONGA
3	D3	MUTED HI CONGA
4	F3	HI TIMBALE
5	C#3	LOW BONGO
6	C3	HI BONGO
7	A#3	MARACAS
8	A3	CABASA (SHAKER)

MAP 6:
LATIN KIT "B" (GENERAL MIDI)

1	C1	KICK DRUM
2	D1	SNARE
3	G3	AGOGO 1
4	G#3	AGOGO 2
5	F3	HI TIMBALE
6	C3	LO WOODBLOCK
7	D3	HI WOODBLOCK
8	A3	CABASA (SHAKER)

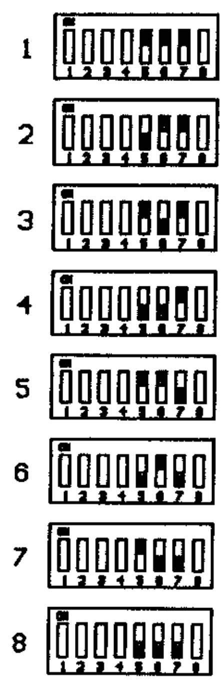
MAP 7:
(PENTATONIC SCALE)

1	C1
2	D1
3	D#1
4	F1
5	G1
6	A#1
7	C2
8	D#2

MAP 8:
(C MAJOR SCALE)

1	C3
2	D3
3	E3
4	F3
5	G3
6	A3
7	B3
8	C4

s5-s7 select the drum map



Special thanks to Charles R. Fischer for putting together these maps

Hardware Design Analysis

A schematic for the computer board is shown in Fig 2. In terms of hardware, the design is much like those that you'll see in any application note or textbook dealing with 8031 MicroControllers. The 12 mHz crystal X1 serves as the timing source for the 8031's clock. R1 and C3 provide power-on reset.

IC2, a 74HC373 Octal Latch, under control of the Address Latch Enable output of the 8031, demultiplexes the Address and Data lines and provides the lower 8 bits of address to the PROM and optional RAM. IC8, a 74HC138 1/8 decoder is used as an address decoder to change the states of the address lines A12-A14 into one of eight Enable lines.

Two of the NAND gates in IC10 are used to combine one of these Enable lines with the processor's (not)RD and (not)WR to select and control IC11, an ADC0809 type eight input Analog to Digital Converter. Address lines A0-A2 select which one of the ADC's eight analog inputs is to be converted. The remaining two gates in IC10 along with R11, R12 and C13 form a 500kHz clock required by the ADC.

The serial MIDI data streams are handled by the UART that is part of the 8031. MIDI data coming from the processor's TxD output is buffered by IC6:A and :B, two of the six inverters in the 74HC04 package. A third inverter (IC6:C) drives the "send active" LED D1 as MIDI Data is output.

On the MIDI input the ground isolation required by the MIDI spec is provided by the OptoIsolator IC7, an H11A1. The output of IC7 is routed to the 8031's UART input, RxD. There are provisions on the circuit board for a second MIDI input (J4, IC9, etc.) but these are not used in this application and are shown in the schematic to be consistent with the circuit board artwork. Similarly, the general purpose LED indicator D4 is not used.

The eight inputs to the ADC and the +5V needed to power the Drum Computer come into the Computer Board on the 14 pin DIP connector J5. This DIP pattern matches the corresponding connector on the Sensor Board. The expansion connector J1, which accesses important control, address and data lines from the uC, is not used in the MIDI Drum Computer configuration.

Software, briefly

Like any Single Board Computer, the personality of the MIDI Drum Computer is determined by the firmware in the EPROM, in this case a 2764 (IC4). The computer's biggest job is monitoring the eight Analog to Digital Converter inputs looking for rising and falling voltages that indicate a sensor has been hit. Each input gets checked about every 2ms.

The peak voltages reached by the outputs of the sensors represent the force of the strikes. To find the maximum value of an input, the firmware compares the latest two readings of that input from the ADC. If a reading is larger than the previous one, the old value is thrown away and the new one is saved.

When the firmware sees two consecutive readings that are smaller than the largest reading, the pulse is assumed to have passed the peak and the largest ADC value is saved.

Since the ADC is an eight bit device and the MIDI data word for velocity is only seven bits, the least significant bit (LSB) of the maximum output is thrown away. And to get well above the noise floor of the sensors, the next bit is thrown away also. This massaged data is saved as Velocity Data.

When the firmware determines that a peak has been captured, MIDI activity starts with a Note-On message with channel number as set on the lower four positions (s1-s4) of the controller's DEFAULT DIP switch S1. The firmware next fetches the MIDI note number assigned to the sensor in the map selected by s5-s7 of the DIP switch and sends it. Finally, the Velocity Data is fetched and either sent directly or used as a pointer to a logarithmic value in a look-up table depending on the lin/log option selected by the last switch (s8) in S1. After about 1/3 second, the firmware sends a running status Note-Off (the same Note On is sent with a Velocity of 0.)

The firmware does other task as well. It checks for the presence of additional RAM and sets remapping capabilities accordingly. It also merges MIDI data appearing on the MIDI Input Port #1 with the Note On/Off messages generated in response to sensor activity.

A source listing for the PAIADRUM firmware can be downloaded from the Electronics Now Bulletin Board: (516) 293-2203. The name of the file on this BBS is ENDRUM.

MIDI Drum Computer

Packing List

2	33 pF	Ceramic Disk Capacitors
8	0.1 uF	Mylar
1	100 pF	Ceramic Disk
5	.01 uF	Ceramic disk
1	33 uF / 10V	Electrolytic Capacitor
1	1 uF / 10V	Electrolytic Capacitor
1	1N914 or 1N4148 Silicon Diodes	
1	Red LED	
1	74HC373	Octal Latch
1	8031	8 bit MicroController
1	74HC04	Hex Inverter
1	H11A1	OptoIsolator
1	74HC138	1/8 Decoder
1	74HC02	Quad NAND Gate
1	ADC0809	8 input ADC

1	100k	all resistors
1	220k	1/4W 5%
2	220 ohms	
1	10 ohms	
1	3300 ohms	
1	3900 ohms	
1	4700 ohms	
1	680 ohms	
3	30" lengths #22 stranded wire	
1	8 Position DIP Switch	
1	N.O. Push Button Switch	
2	5 pin DIN Sockets (panel mount)	
1	40 pin IC Socket	
2	28 pin IC Socket	
1	14 pin IC Socket	
4	4-40 X 1/4" Machine Screws	
4	#4 Machine nuts	
1	12 mHz Crystal	
1	9201 Circuit Board	
1	2764 EPROM w/PAIADRUM firmware	

PAiA Electronics, Inc
(405) 340-6300

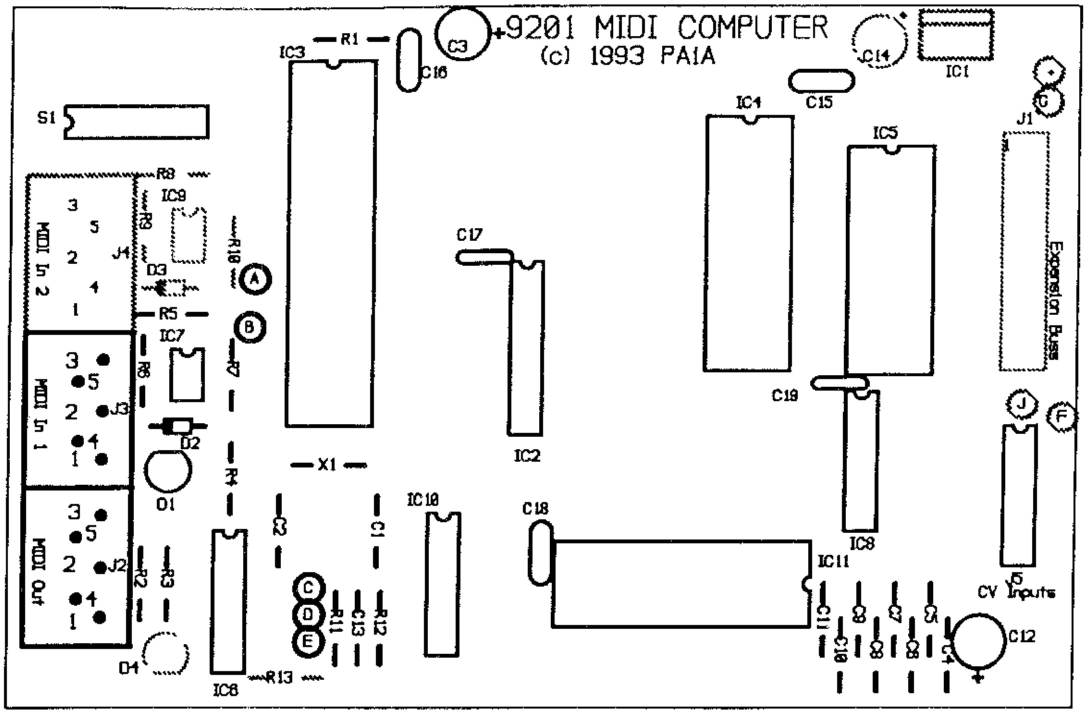


Fig 1a. In this parts placement diagram unused components are shown in phantom view

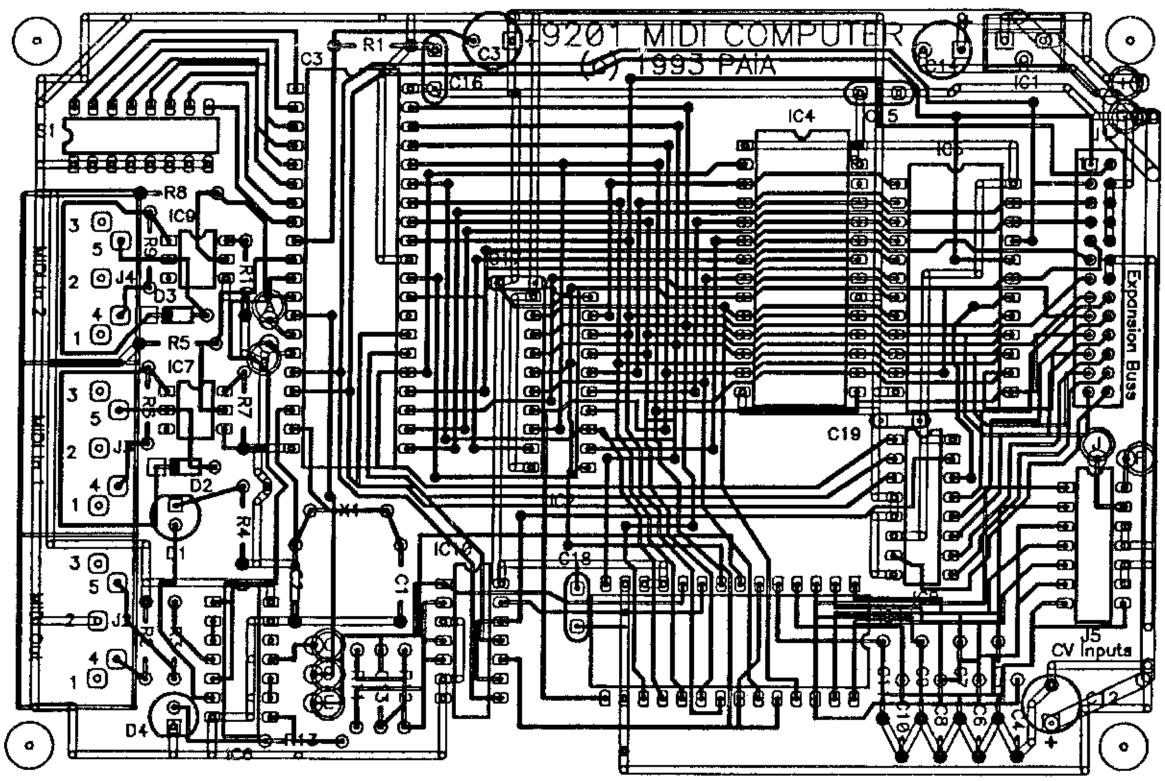


Fig 1b. This view of the circuit board with phantom traces will be useful if you need to trace out the circuit

PAiA MIDI Drum Computer

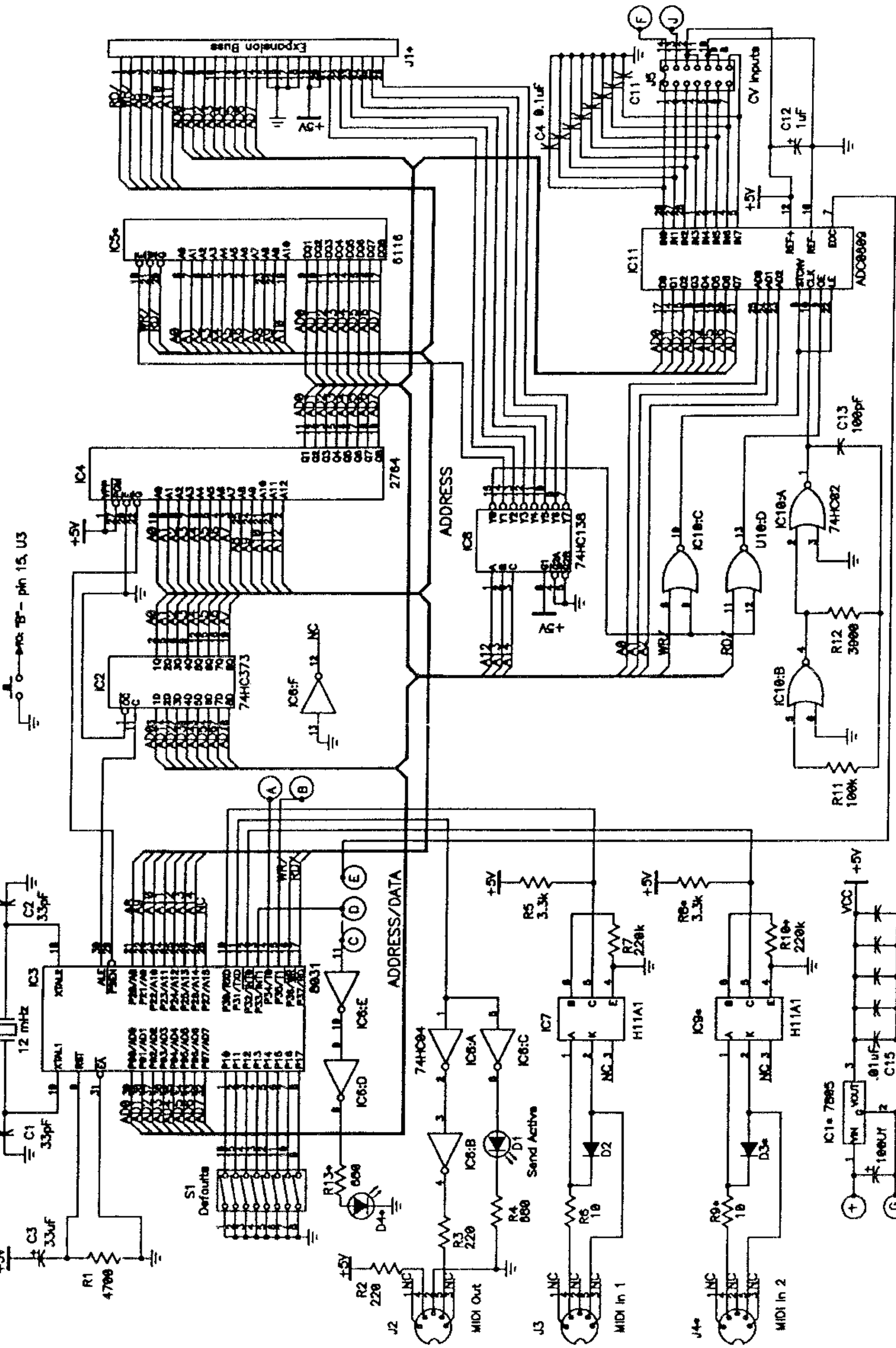


*Fig 2. In this schematic of the MIDI Computer optional components and parts not used in the Drum configuration are marked *.*