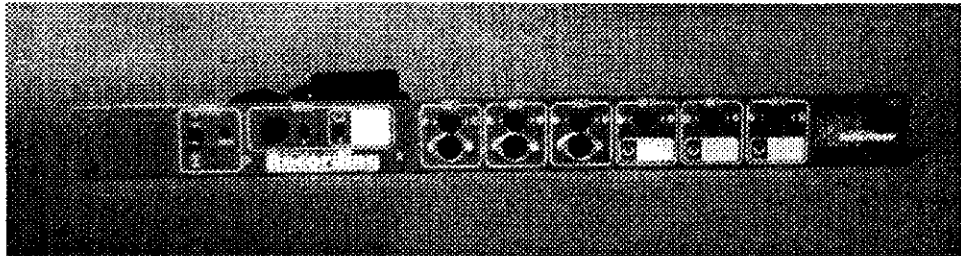


PAiA MIDI Studio Interface

Model 9211
Assembly and Using Manual



Do you have enough MIDI outs for all your gear?
Are things so chained together there's time for a
quick snack between hitting a key and hearing a
sound? Does a piece of "guest" equipment coming
into your studio mean a flurry of opening racks
and endless plugging and un-plugging?

The MIDI Studio Interface is a simple solution to
these and other problems. This utilitarian device acts
as a Distribution Amplifier with up to six MIDI Outputs
driven from a single MIDI Input. As a Router, each output
can be turned off or switched between either of two inputs.
Its front and rear facing switchable Inputs and Outputs
also allow external equipment to be easily patched
into a cabinet. LEDs provide a clear visual indication
that your MIDI data is really streaming.

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an article in the March 1993 issue of
Home & Studio Recording magazine, copyright 1993,
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ASSEMBLING THE MIDI Studio Interface / Distribution Amplifier

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 MSI/DA is built on a single-sided circuit board. Before beginning assembly, clean oxidation from the copper side of the circuit board using scouring cleanser and water. The copper should be bright and shiny before beginning assembly.

Once you begin putting parts on the circuit board, it's a good idea to continue until all the parts are mounted. Stopping overnight may allow the copper to oxidize and make soldering more difficult.

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.

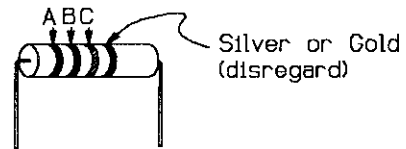
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This product originated as a Do-It-Yourself article by Jules Ryckebusch in the March 1993 issue of Home & Studio Recording magazine. There may be differences between what appeared in the article and what is supplied with the kit. These differences, 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.

-*-

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 lead in either of the holes in the circuit board.. Before mounting each resistor, bend its leads so that they are at a right angle to the body of the part. Put the leads through the holes and then push the resistor firmly into place. 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.



DESIGNATION	VALUE	COLOR CODE A-B-C	
listed below:	330 ohm	orange-orange-brown	
() R1	() R5	() R9	
listed below:	10k	brown-black-orange	
() R10	() R11	() R12	() R13
() R14	() R15		
() R2	1000 ohms	brown-black-red	
() R3	33 ohms	orange-orange-black	
() R4	220k	red-red-yellow	
() R6	1000 ohms	brown-black-red	
() R7	33 ohms	orange-orange-black	
() R8	220k	red-red-yellow	
listed below:	220 ohm	red-red-brown	
() R16	() R17	() R18	() R19
() R20	() R21	() R22	() R23
() R24	() R25	() R26	() R27

-*-
*In the Home & Studio
 Recording article R2 & R6
 were 10k and R4 & R8
 were 100k. These value
 changes were made to
 improve rise and fall times
 of the Opto-Isolators.*

-*-

CERAMIC DISK CAPACITORS

Some of the capacitors used in the MSI/DA are non-polarized ceramic disks, either lead can go in either of the holes on the circuit board. Leads are already parallel to one another but still may need to be bent slightly 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 rarely marked with something so simple as their values these days, instead component manufacturers prefer obscure codes. Since there are only two ceramic disk capacitors used in the MSI/DA and they are the same value, this should not be a problem.

Disk Capacitors

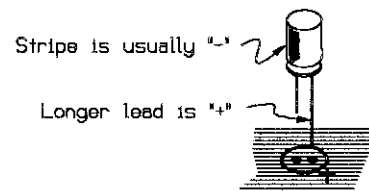


DESIGNATION	VALUE/TYPE	MARKING
() C1	.01 uF	103
() C2	.01 uF	103

ELECTROLYTIC CAPACITORS

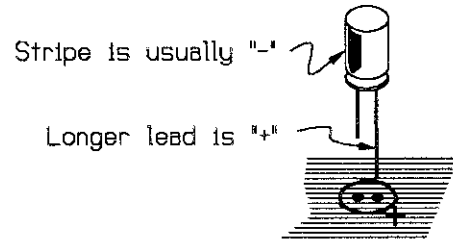
Two of the capacitors used in the MSI/DA are electrolytic types. Unlike the previous components, electrolytic capacitors are polarized and the leads are not interchangeable. Leads are marked "+" and/or "-" and the "+" lead must go through the "+" hole in the circuit board. Frequently the positive lead of the capacitor is significantly 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 the minimum specified below.

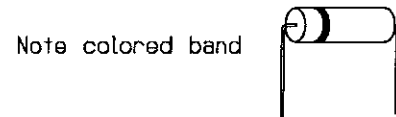
DESIGNATION	VALUE
() C3	100 uF / 15V
() C4	100 uF / 15V



DIODES

Diodes are polarized and must be installed 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 provided in the circuit board.

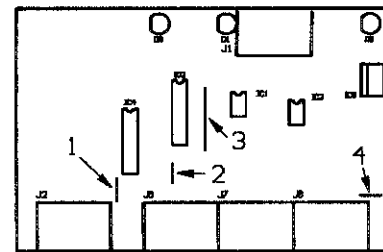
Diodes are also somewhat heat sensitive so the soldering operation should be done as quickly as possible.



DESIGNATION	TYPE
() D2	1N4148 or 1N914
() D4	1N4148 or 1N914

JUMPERS

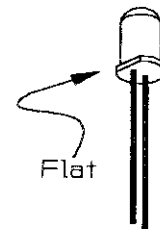
() Using the bare wire supplied, form and install the four circuit board jumpers which are designated on the circuit board by bold lines.



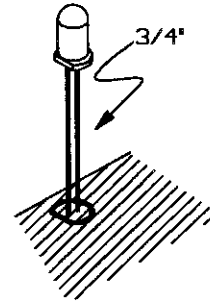
There are 4 Jumpers used on the board

LEDs

Note that the LEDs are polarized by the flat in the collar at the base of part. When properly installed, this flat will align with the corresponding flat in the LED symbol printed on the circuit board.



Push the two leads through the holes provided in the circuit board and space the LED above the board by about 3/4". Solder both leads and check the spacing from the board to the LED before trimming the leads off flush with the solder joint.



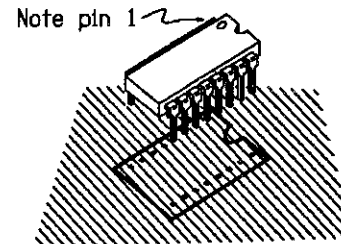
DESIGNATION TYPE

- () D1 red LED
- () D3 red LED
- () D5 red LED

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 destroyed 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 circuit board graphics.

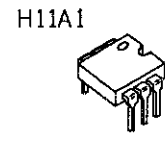
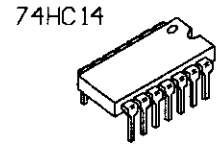


The pins of the ICs may be splayed somewhat and not match up exactly with the holes in the circuit board. Carefully re-form the leads if necessary so that they are at right angles to the part. Solder each IC in place as it is installed by initially soldering two pins in diagonal corners of the pattern. Make sure that the part is seated firmly

against the pc board by pressing it down while re-melting the solder joint at first one corner, then the other. Finally, solder the remaining connections.

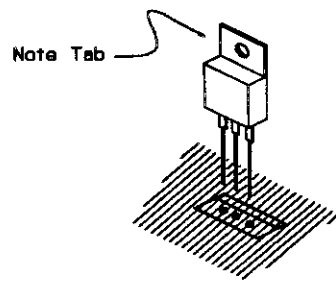
DESIGNATION TYPE

- () IC1 H11A1 Opto-Isolator
- () IC2 H11A1 Opto-Isolator
- () IC3 74HC14 Hex Schmitt Trigger
- () IC4 74HC14 Hex Schmitt Trigger



VOLTAGE REGULATOR

- () Install the 7805 type +5V Voltage Regulator on the circuit board at the location marked IC5. Notice that this part is polarized and must be mounted so that its tab corresponds to the tab marking on the circuit board graphics. Solder all three leads and clip any excess off flush with the solder joint.



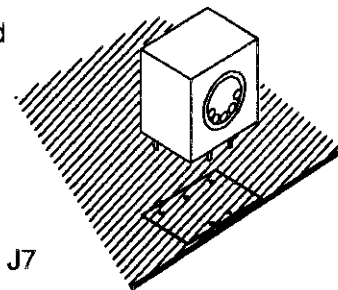
DIN (MIDI) Connectors

Five of the MIDI connectors mount directly on the circuit board. Push the 7 pins of each connector through the holes provided in the circuit board and make sure it is pushed down fully against the board before soldering in place.

DESIGNATION TYPE

listed below: pc mount 5 pin DIN connector

- () J1 () J2 () J6 () J7
- () J8

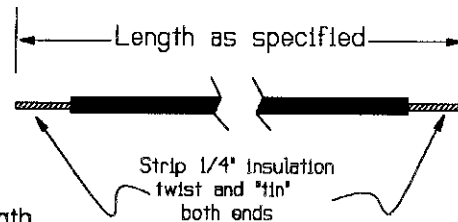


“FLYING” WIRES

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

In the following steps, wires will be soldered to the MSI/DA circuit board which in later steps will be connected to the front panel switches and DIN connectors. At each step, cut a piece of wire to the specified length and strip 1/4" of the insulation from each end. Twist the exposed wire strands together and “tin” them by melting a small amount of solder into the strands. This will make soldering easier when the wires are installed and prevents fraying of the wire strands when they are pushed through the holes. Solder each connection as it is made and clip any excess wire from the solder side of the board.

Notice that there will be some circuit board points that will not have wires connected to them until later.



PC POINT/Length

() "A"	2"
() "B"	3-1/2"
() "C"	4"
() "D"	2-1/2"
() "E"	4-1/4"
() "F"	5-1/2"
() "H"	7"
() "I"	8-3/4"
() "J"	11"

PC POINT/Length

() "K"	2"
() "L"	2"
() "M"	3-1/2"
() "N"	3-1/2"
() "O"	5"
() "P"	5"
() "G2"	3"

We will now put the circuit board aside and begin putting parts on the front panel. This is a good time to kick back and admire your work to this point. Be critical - are the solder joints nice and shiny? Are there any blobs of solder on the board that could use cleaning up (see **SOLDERING** on page 3). Are the polarized components mounted properly?

PANEL CONTROLS

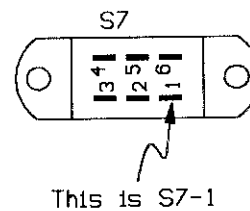
If you have the optional panel available from PAiA, you will be installing these parts as shown in Fig 2. Note that this figure shows the panel from the rear.

- () Using two 4-40 X 1/4" machine screws and two #4 nuts, mount the power switch S1. Note that this is the only two-position switch; i.e. when you slide the switch bat back and forth there will be no detent at the center position.
- () Using twelve 4-40 X 1/4" machine screws and twelve #4 nuts, mount the remaining slide switches S2-S7. Note that all of these are three-position switches; the switch bat slides to either side and there is also a center detent position.
- () Using six 4-40 X 1/4" machine screws and six #4 nuts mount the three 5 pin DIN Connectors J3, J4 and J5. These connectors are shown sliding into the panel from the front in the illustrations (the "recommended" way to install them) but they may also mount from the rear if you prefer not seeing the bezel.

PANEL PRE-WIRING

Now we'll do some preliminary wiring on the front panel jacks and controls as shown in Fig 3. At each step prepare a wire of the length specified by stripping 1/4" of insulation from the end and twisting and tinning the exposed strands.

Individual solder lugs are identified by part number and lug number. For example, S7-1 means lug #1 of switch S7 as identified in the illustrations.



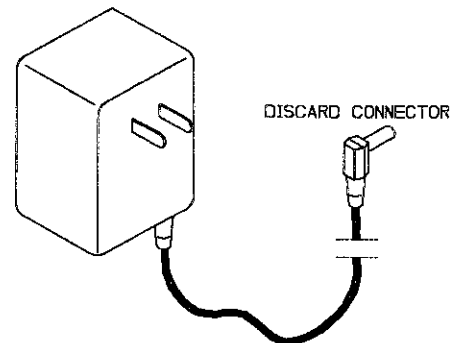
This convention will be followed in these steps: Do not solder a connection to a lug until told to do so with an instruction such as (S2), which means that at that point there will be two wires on the lug in question. If there are not the number of wires specified at the lug when you get ready to solder, recheck to see what has gone wrong. Connections which should not be soldered yet will be marked (NS) for No Solder. On these unsoldered connections simply push the end of the wire through the lug and crimp it back to mechanically secure it.

LENGTH	FROM	TO
() 2-1/2"	S7-1 (S1)	S6-1 (NS)
() 2-1/2"	S6-1 (S2)	S5-1 (NS)
() 2-1/2"	S5-1 (S2)	S4-1 (NS)
() 2-1/2"	S4-1 (S2)	S3-1 (NS)
() 2-1/2"	S3-1 (S2)	S2-1 (NS)
() 2-1/2"	S7-3 (S1)	S6-3 (NS)
() 2-1/2"	S6-3 (S2)	S5-3 (NS)
() 2-1/2"	S5-3 (S2)	S4-3 (NS)
() 2-1/2"	S4-3 (S2)	S3-3 (NS)
() 2-1/2"	S3-3 (S2)	S2-3 (NS)
() 2-1/2"	J3-2 (S1)	J4-2 (NS)
() 2-1/2"	J5-2 (S1)	J4-2 (NS)

We're just about ready to mount the circuit board and the cable-supporting tray to the front panel. One final connection needs to be made to the circuit board first.

POWER TRANSFORMER

Locate the Wall-Mount Power Supply PWR1. If this part has a connector on the end of its cable, remove and discard it as shown. Notice that one of the two wires coming from PWR1 is polarized with a contrasting stripe. A note packed with the Power Supply will identify the striped lead as being (+) or (-). Power Supplies provided with individual kits may

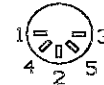
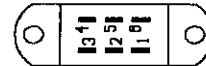
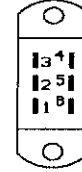


have a current rating greater than the 100mA minimum.

- () Locate the circuit board tray and install the 1/4" grommet in the hole in the rear of this sheet metal as shown in fig 4. Pass the cord of the Power Supply through the grommet and knot the cord 5-1/2" from the end.
- () Separate the Power Supply's cord into two wires back a distance of 2" from the end. Cut 1" from the Power Supply's (-) lead and prepare both wires by stripping 1/4" of insulation from their ends before twisting and tinning the exposed wire strands.
- () Solder the (-) wire from the Power Supply to circuit board point "G".
- () Attach the "L" brackets to the circuit board using two 1/4" machine screws and #4 nuts. As shown in Fig 4, the screws pass down through the circuit board and unthreaded holes in the "L" brackets before being secured by the nuts. Since some movement of the "L" brackets will be needed to get them to align with the holes in the front panel, do not fully tighten this hardware yet.
- () Attach the circuit board to the tray using two 3/4" machine screws, two 1/2" spacers and two #4 nuts. As above, do not fully tighten this hardware yet.
- () Finally, mount the circuit board/tray assembly to the front panel using two 1/4" machine screws. Pass the screws through the front panel and front lip of the tray so that they engage the threaded holes in the "L" brackets. Bend the three LEDs so they face forward and project through the holes in the front panel. Fully tighten all the hardware from the previous steps.

We finish assembly by connecting the wires from the circuit board to the front panel switches and jacks. See fig 5.

ORIGIN	TO	ORIGIN	TO
() "A"	S1-5 (S1)	() "P"	J5-4 (S1)
() "B"	S2-1 (S2)	() "D"	S2-2 (S1)
() "C"	S2-3 (S2)	() "E"	S3-2 (S1)
() "G2"	J4-2 (S3)	() "F"	S4-2 (S1)
() "K"	J3-5 (S1)	() "H"	S5-2 (S1)
() "L"	J3-4 (S1)	() "I"	S6-2 (S1)
() "M"	J4-5 (S1)	() "J"	S7-2 (S1)
() "N"	J4-4 (S1)	() PWR1(+)	S1-4 (S1)
() "O"	J5-5 (S1)		



Note non-sequential pin numbers

THIS COMPLETES THE ELECTRONIC ASSEMBLY OF THE MSI/DA. Before plugging the unit in and testing it, take a well earned break then come back and check your work completely.

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.

Plug the wall-mount power supply into a 120-VAC outlet and slide the MSI/DA power switch to "ON." The LED to the right of the switch should light and if it doesn't, you should immediately unplug the unit from the wall and find out why. The problem could be nothing more than a dead wall outlet. Reversed power connections or solder bridges on the circuit board may be the cause. Check the orientation of the Integrated Circuits.

When the POWER LED lights. Let the unit idle for a few minutes while you check for parts that may be getting hot (ICs in particular) or any unusual smell, smoke, etc.

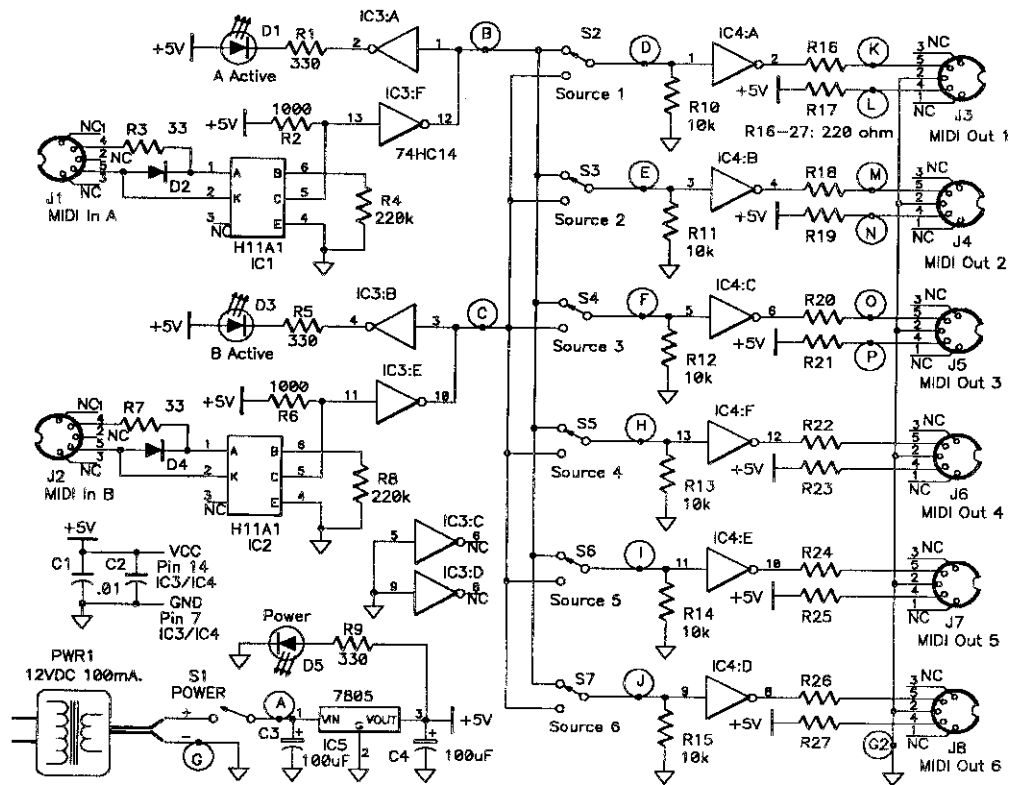
If nothing seems out of place after a few minutes, hook up a MIDI source to one of the inputs. A sequencer or drum machine which continuously sends MIDI data is a good choice. You should see the associated LED flashing as data is received. If not, check over your wiring, especially the MIDI In jacks. If the input protection diode is reversed, the optocoupler won't work. If the LED is flashing, indicating that MIDI data is present, unplug the MIDI source and plug it into the other input. Verify that the second LED flashes. Now connect a MIDI tone source to one of the output jacks and verify proper data transfer. If you don't get an output, try selecting the other input with the switch - you may have your wires crossed. If the first output works, check the other five outputs.

USING THE MIDI STUDIO INTERFACE

The MSI/DA has two main benefits in your studio. First, it lets you set up a neat system without the need for constant re-patching. Secondly, by simultaneously feeding up to six MIDI-receiving devices, it does away with the problems that can arise from daisy chaining too many instruments via MIDI Out or Thru ports.

A visual indication of MIDI data is really helpful in troubleshooting; knowing whether MIDI data is present or not is a big step toward diagnosing problems.

It's also nice to be able to turn off an instrument without squinting into a tiny LCD menu selection. But a few words of caution: Do not change the switch positions while data is being transferred - Note Off commands might go astray, resulting in stuck notes. Also, MIDI Running Status can make an instrument which taps into the Data stream after the Status Byte was sent seem non-responsive, despite visual indications that it is receiving. Sending a preset change (even to the current preset) should change Running Status and cure the problem.



MIDI Studio Interface Schematic

HOW IT WORKS

The MIDI Studio Interface is remarkably uncomplicated. The input sections consist of Opto-Isolators IC1 and IC2. Opto-Isolators are important in MIDI because they eliminate the need for a common digital ground between separate pieces of equipment - common grounds which if not handled exactly right can lead to ground loops and hum or lost data.

Internally, Opto-Isolators consist of a Light Emitting Diode and a photo-sensitive transistor. Current flowing through the LED causes it to light which then turns on the transistor. R2 and R5 are the load resistors for the

Opto's transistors. IC3:E and IC3:F, two of six identical Schmitt Trigger circuits in IC3, buffer and invert the outputs of the Opto's. IC3:A and :B drive the front panel LEDs that indicate MIDI activity on an input.

The inverted outputs of IC3:E and :F also go to the Source Select switches S2-S7 which select either the A or B inputs or can be set to their center-off position to disable an output. The six buffers in IC4 re-invert the source selected by the switch so that the outputs are back to the original sense of the inputs. Resistors R10-R15 hold the inputs to the buffers low when their associated switch is in the "off" position so that the buffers won't randomly change state in response to noise.

**MIDI Studio Interface
9211
Parts List**

2	.01 uF Ceramic Disk Capacitor
2	100 uF / 15V Electrolytic Capacitors
3	330 ohm 1/4w 5% Resistors
2	1000 ohm
6	10k ohm
2	33 ohm
2	220k ohm
12	220 ohm
3	Red LEDs
2	1N914 or 1N4148 Diodes
2	H11A1 Opto-isolator
2	74HC14 Hex Schmitt Trigger
1	7805 +5V Voltage Regulator
5	PC Mount 5 Pin DIN Connectors
3	Panel Mount 5 Pin DIN Connectors
1	12VDC 100mA Wall Mount Power Supply
1	DPDT Slide Switch
6	DPDT Center Off Slide Switch
2	#4 "L" Brackets
24	4-40 X 1/4" Machine Screws
2	4-40 X 3/4" Machine Screws
2	#4 X 1/2" Spacers
24	#4 Nuts
10 ft.	#22 Stranded Wire
6 in.	Small Bare Wire
1	1/4" Rubber Grommet
1	9211 Printed Circuit Board

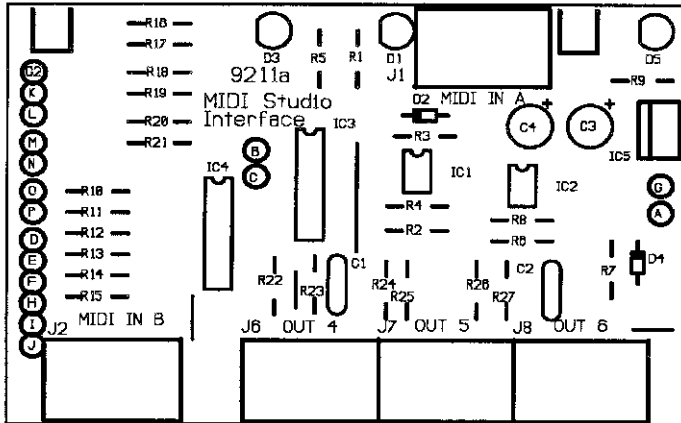


Fig 1a. Components are mounted on the circuit board in the locations shown by this parts placement drawing.

Fig 1b. This parts placement diagram with phantom traces will be useful if you have to trace out the circuitry.

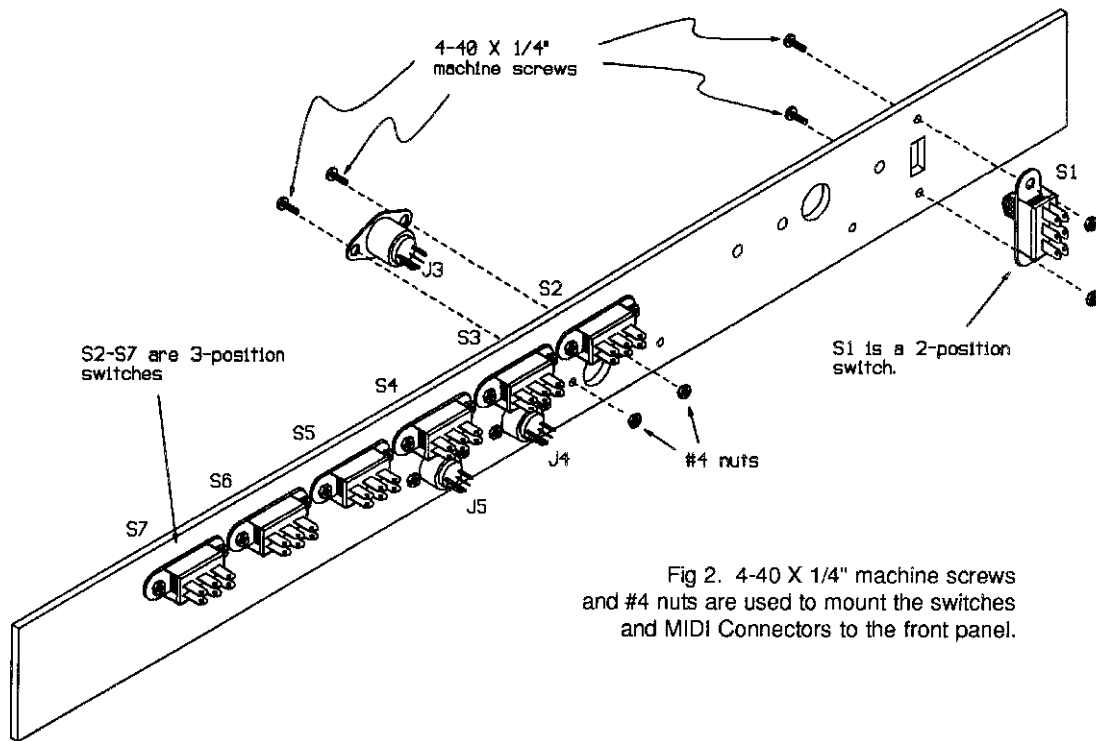
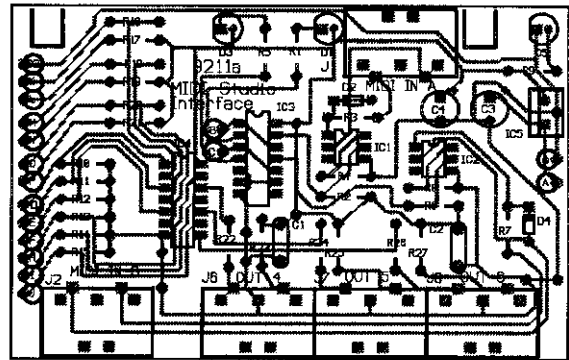


Fig 2. 4-40 X 1/4" machine screws and #4 nuts are used to mount the switches and MIDI Connectors to the front panel.

**MIDI Studio Interface
Assembly Drawings**

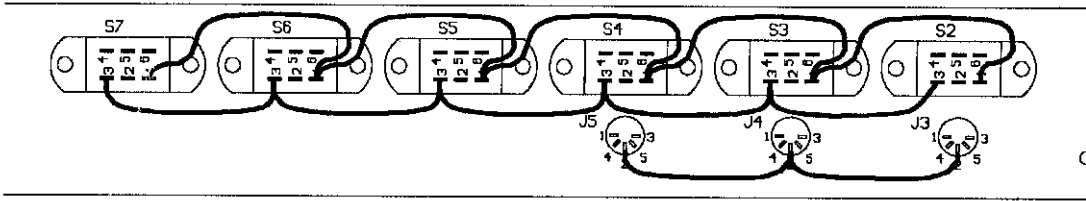


Fig 3. Some preliminary wiring is done on the front panel jacks and switches before the circuit board is installed.

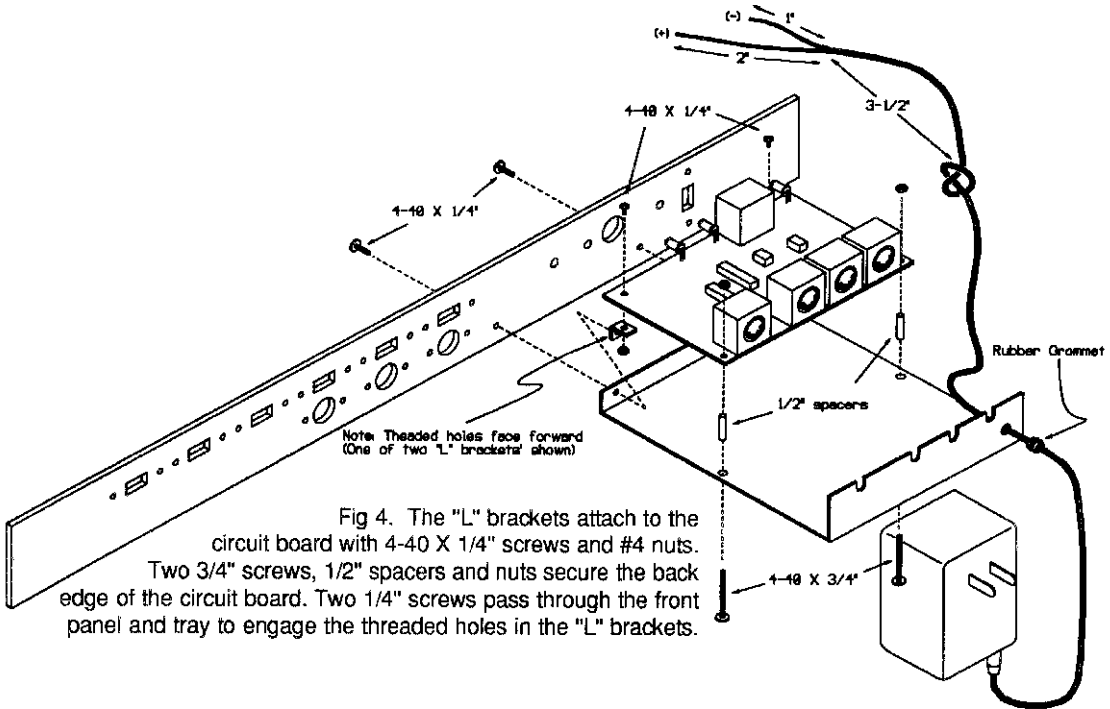


Fig 4. The "L" brackets attach to the circuit board with 4-40 X 1/4" screws and #4 nuts. Two 3/4" screws, 1/2" spacers and nuts secure the back edge of the circuit board. Two 1/4" screws pass through the front panel and tray to engage the threaded holes in the "L" brackets.

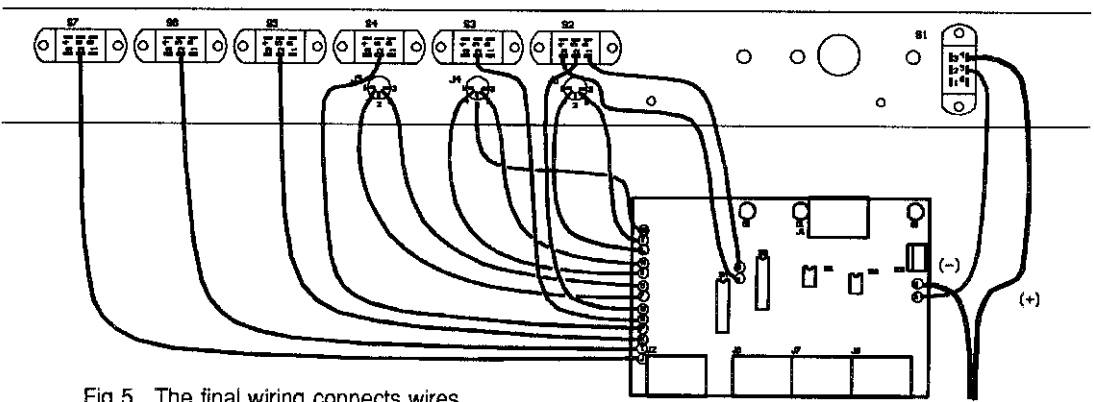


Fig 5. The final wiring connects wires previously soldered to the circuit board to the front panel components. Previous wiring has been eliminated for clarity.

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Assembly Drawings**