TABLE OF CONTENTS

INTRODUCTION

If you choose not to solder, a power drill will be the most complicated tool you need for this project.

The parts and tools here are a combination of items bought specifically for this build, and of items lying around the workshop.

In other words, what you see below is a reflection of what *actually* went into this build. It doesn't represent the absolute cheapest possible implementation of this project.

Basic Steps for any Build:

1. Start buying and collecting parts. Some items listed below may be cheaper at local Brick & Mortar stores. (Ever wondered what B&M meant?)
2. Begin to lay out your design on the plywood, or on paper.
3. Drill your plywood. Mount a few parts to ensure things fit properly. (Don't forget the aluminum enclosure has an inner "lip" where you cannot mount parts.)
4. Dismount all your parts.
5. (Optional) Apply sandpaper and wood finish to the plywood.

- **Sometime before step 6, test MIDI operation of at least one of each component with the UMC.**

6. Wire up the switches and knobs.
7. Begin final assembly. Mount everything to the plywood then connect components.
8. Configure the UMC to accept all your knobs and switches.

TOOLS YOU'LL NEED FOR THIS BUILD

Tape Measure or Ruler	
Wrench	
Cable Snips/Box Cutter	
Various Screwdrivers	
Electrical Tape	Required if you choose not to solder.
Power Drill	
1/2" Drill Bit	For Knob Part.
11/16" Drill Bit	For Switch Part.
15/16" Drill Bit	For USB Header Part.
Various Smaller Drill Bits	For screw hardware.

OPTIONAL TOOLS

Calipers	Useful all around. I use mine almost daily.
Wire Insulation Remover	
Needle Nose Pliers	

PARTS YOU'LL NEED FOR THIS BUILD

USB A-B Cable	Any will do, even your printer cable.	Link
USB Plug Header	This may arrive "backwards." Use a screwdriver to remove, then reverse the adapter for use as a header.	Link
Internal USB Cable	This specially angled cable is needed to fit inside the case with the USB header.	Link
Hale Micro UMC32+M	The MIDI Brain.	Link
(4) Hale Micro EXP-8SC	Screw-down breakout board.	Link
(6) Hale Micro PKNB1-4PK	Knob Caps.	Link
Enclosure	Bud Industries AC-415.	Link
Panel	1/8" thick plywood cut to 10" X 17" • Your local lumber store can cut this to size for a fee, though you may end up with more than you need. (But extra panels are good to have in case of mistakes.) • You can substitute Acrylic Glass (Plexiglass) but Google "How to Drill Plexiglass" first.	
(24) Knobs	BI Technologies P231-FC20BR10K. • You should just buy 25. • Feel free to cut off the metal nub that sticks out the top of the housing. There's enough torque with the included nut/washer to keep it snug. (Snip the nubs inside a plastic bag, or you could shoot your eye out!)	Link
(8) Switches	RadioShack 275-0602. • This is a popular switch style; there are many alternatives out there. • You want a Single Pole, Single Throw (SPST) Toggle Switch.	Link
Hook-up Wire	RadioShack 278-858 • As with the switch, there are numerous alternatives. • For our purposes, almost any wire will work.	Link
Assorted Screws & Nuts	(Apologies for the lack of exact listings here.) These, along with the "various smaller drill bits," are used to… • …mount the UMC and the EXP to the plywood. • …fasten the plywood to the holes in the aluminum. • …fasten the USB header.	

OPTIONAL PARTS

Alternative USB Header	This eliminates the need for an internal USB Cable, reducing some costs. • Keep in mind you'll need to cut/drill a hole to match.	Link
External USB Cable	This is specially angled to stay out of the way on a top-panel-mounted connector.	Link
Feet for Enclosure	Adhesive-backed black tapered bumpers.	Link
Miniature Solderless Breadboard	Helps temporarily bridge connections for testing.	Link
Jumper Wires, Male-Male	Helps temporarily bridge connections for testing.	Link
Jumper Wires, Female-Female	Helps temporarily bridge connections for testing.	Link
3/64" Wide Trim Tape	The indicators on the aluminum knobs were difficult to see, so I added black indicators with trim tape. • This was a tedious process involving a scalpel, tweezers and a Sharpie permanent marker (the tape was white and I wanted black indicators). • Trim tape can be found in hobby stores.	

PARTS FOR SOLDERED ELECTRICAL CONNECTIONS

Soldering Iron	You **don't** need this expensive one to do the work.	Link
Solder	This kind is nice for multiple reasons: • It's narrower than the kind you typically find at hardware/electronics stores. • It's not so thin that it's impossible to use. • It's lead-free.	Link
Solder Tip Tinner	Helps get connections going, and to extend the life of your tips.	Link
Helping Hands	These are those cute little things with alligator clips and pose-able arms. They're indispensible to solder wires together.	Link
Heat Gun	Yes, you can just use a hair dryer.	Link
Heat-Shrink Tubing	This diameter is effective for wire-to-wire connections.	Link
Heat-Shrink Tubing	This diameter (or something slightly narrower) effectively insulates wires to the knob/switch solder lugs (connectors).	Link

PARTS FOR A HIGHLY FINISHED WOOD SURFACE

Foam Brushes	If you have the proper chemicals, you could use a traditional brush. If you don't, 2-3 disposable foam brushes are perfect.	
Wood Finish	I used three coats of a combination finish. In hindsight, two coats would've looked better.	Link
Fine Grit Sandpaper	320-grit sandpaper is used between coats to help create that shiny look. You may need coarser paper based on the original condition of your plywood.	Link
Sanding Block	Obvious, but worth noting.	

PARTS FOR AN LED INDICATOR

Panel-mount LED Housing	Again, I don't have an exact part number here. The link to the right offers a good start. • This will mount to the "Ext LED" header on the UMC. You'll need to create a simple wiring connection from the LED to the board. • Keep in mind you'll need to cut/drill a hole to match.	Link
Resistor	The wiring connection requires a resistor to operate properly. I used a random 80 Ohm one and it's working well.	
Pin Headers	These cute little things help a bare wire attach to pins on a printed circuit board.	Link

PARAMETRIC EQ KIT: SPECIFICATIONS

Layout

Using a pencil and ruler, mark the following points on the plywood.

Lay the ruler parallel to the short edge of the plywood.

- 1 and 4/16”
- 3 and 2/16”
- 5 and 14/16”
- 8 and 10/16”

Lay the ruler parallel to the long edge of the plywood.

- 1”
- 2 and 14/16”
- 4 and 12/16”
- 6 and 10”16”

Flip the plywood 180 degrees. Repeat along the other long side.

What’s going on here? You’re creating reference points. The intersections of these marks represent the center of a drill hole for a knob or switch. Using a straightedge, create horizontal and vertical lines until you see 32 little crosses, with an empty chunk in the middle.

At the crosses, you’ll be drilling 24 holes with the 1/2” bit, and 8 holes with the 11/16” bit.

The UMC and the EXP-8SC are pretty easy to drill for. Carefully lay them on the plywood and stick a pencil through their mounting holes. Those marks will be drilled with a smaller bit. Small bolts and washers will keep them in place.

- The UMC can mount in the center section.
- The EXPs can mount between the rows of components. It’s a close fit.

In the center, I simply eyeballed the USB header drill holes, as well as the (optional) LED indicator hole.

Finally, drill four holes to match the holes on the aluminum box. This is the trickest part – the measurements on the box’s data sheet are not exact, so you have to be extra careful.

Wiring the Knobs

The knob has three connectors. You want to ensure the MIDDLE one touches the “IO #” connector on the EXP-8SC. The left and right pins connect to the +5V and GND connectors.

- It doesn’t matter which one is connected to which (+5V & GND), just be sure to do it the same on every knob.

Wiring the Switches

The Switch has two connectors, labeled ‘1’ and ‘4.’ Connect ‘1’ to “GND” on the EXP-8SC and ‘4’ to “IO #.” We don’t need “+5V” for this one.

Programming the UMC: Identifying Pins
The UMC Config software displays 32 sets of drop-down menus to represent the 32 connectors. How do we know what's hooked up to each pin?

The pin headers on the UMC32 are labeled in bunches of eight ("01-08", "09-16","17-24", "25-32"). The EXP-8SC is labeled to reflect "IO 1" through "IO 8."

It's just a bit of simple math. If the EXP is connected to pin header "01-08," the pins are correctly reflected. If the EXP is connected to pin header "17-24," IO 1 becomes pin 17, IO 8 is pin 24 and IO 5 is pin 21. You get the picture.

Programming the UMC: Using the Config Software
It's not too hard, you just need know a few tricks. The manual does a good job of laying this out. A few common pitfalls:

- Before you do anything, select the appropriate UMC "IN" and "OUT" ports and click "Open."
- UNPLUG AND RE-PLUG THE BOARD AFTER YOU PROGRAM IT. The UMC won't send MIDI until you do this. You'll think you broke the board, and will email Hale Micro, in tears.

Programming the UMC: Knobs
Hardware I/O Type: IN Analog Average
Message Type: Controller
MIDI CH: Up to you (leave alone if you don't care)
Msg Num: Up to you (leave alone if you don't care)

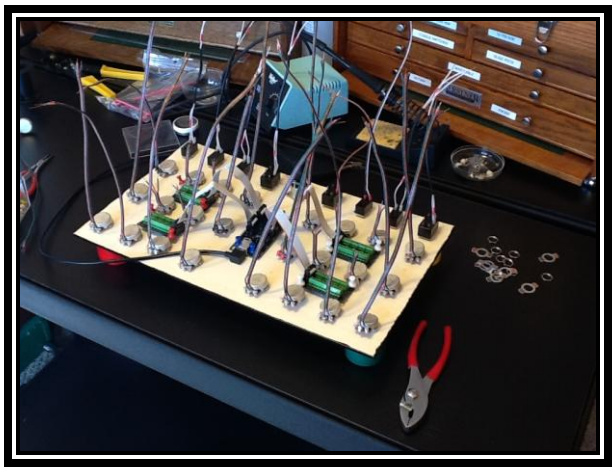
Are your knobs acting funny? Like they're reversed? Then select "IN Analog Average (inverted)" for the Hardware I/O Type. (This explains why we were so cavalier about the +5V and GND connections on the knobs. There's no "wrong" way to do it, because the UMC lets you reverse them right here.)

Programming the UMC: Switches
Hardware I/O Type: IN Digital w/pullup (5 mS) (any one of the mS settings is probably fine)
Message Type: Controller (this is important: use Controller, not "Note On/Off")
MIDI CH: Up to you (leave alone if you don't care)
Msg Num: Up to you (leave alone if you don't care)

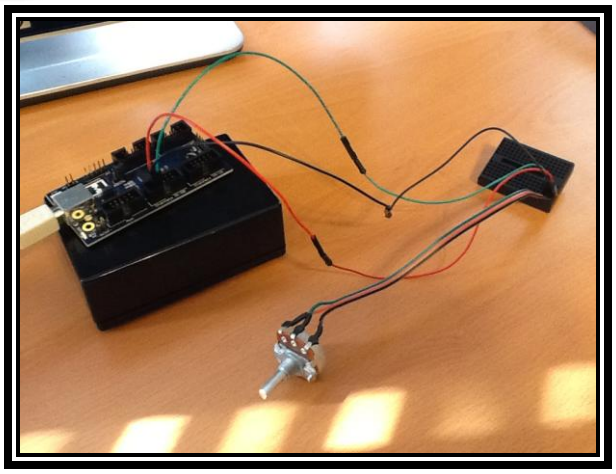
This gives us a switch that behaves properly for a majority of MIDI applications. It has a distinct On and Off position. There are ways to program the switch so that every flick sends a message, but that's not the intended behavior for an On/Off toggle like we have here.

PICTURES

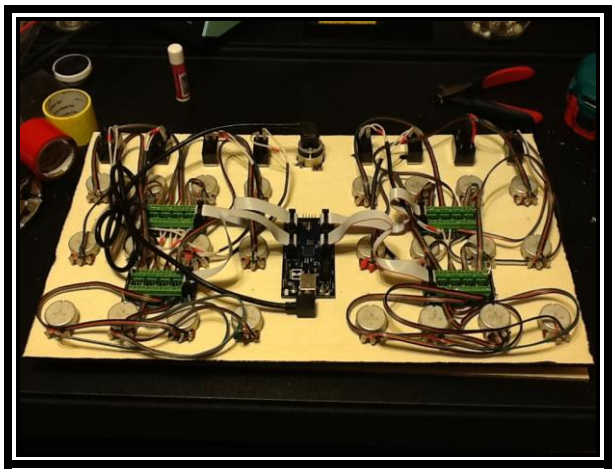
Laying out parts to ensure a fit (Step 2).



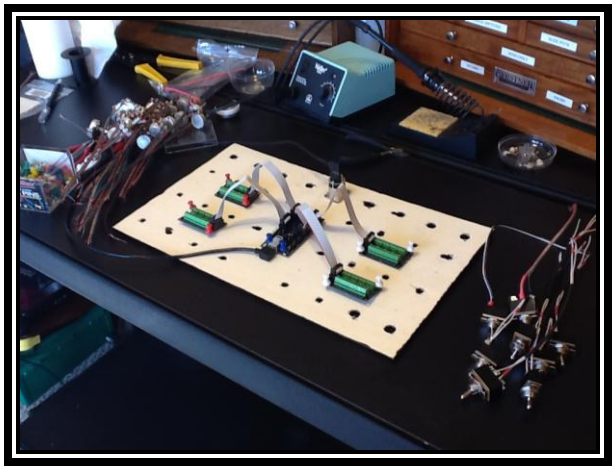
Components mounted (Step 7).



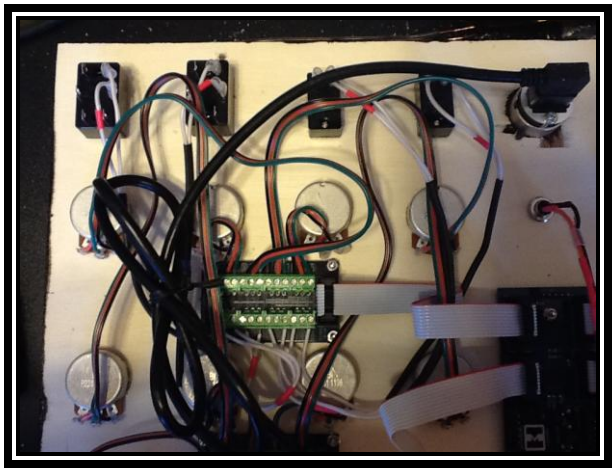
Testing MIDI operation of the Knob.



Mounted & connected.



Components ready to mount (End Step 6).



Mounted & connected (close-up).