Overview

Brain v2 consists of the main Brain circuit board used in Brain v1, and an accompanying Bus Board board. We've completely redesigned the Brain v2 to provide an Easy Method way to build your own controller with our Omni Board, and have provided a means for connectivity for totally customized setups using the Advanced Method.

The Brain v2 Bus Board is the main board for Builder v2. The Bus Board extends the Brain by making the Brain's capabilities of 128 buttons (or 63-encoders), 192 bright LEDs and 64* analog connections more accessible. In addition to easy ribbon cable connections, there are direct connections for LED outputs and button inputs. Populated with many of the necessary chips and components, the BusBoard greatly expands your DIY controller possibilities. When used in combination with the Omni Board, connections are made with 10 pin ribbon cables to carry Button, Analog, and LED control data.

The Bus Board easily connects to the Brain by "sandwiching" to the main Brain board with female socket connectors.

To see how many controls your Brain v2 can fit, check out our Brain v2 Hardware Calculator

- **63 Active Analog Inputs/ 1 Ground Reference*

Connecting the Brain

The Brain uses USB for both power and communication, and an optional 5v DC power supply for standalone MIDI operation when not connected to a computer.

USB Connectivity

1. Using a USB cable, connect the Brain board to your computer.
2. The device will show up as "Brainv2" in Mac OSX, and Windows 7, and as "USB Audio Device" in Windows XP. (There are no drivers needed)

5V DC Connectivity

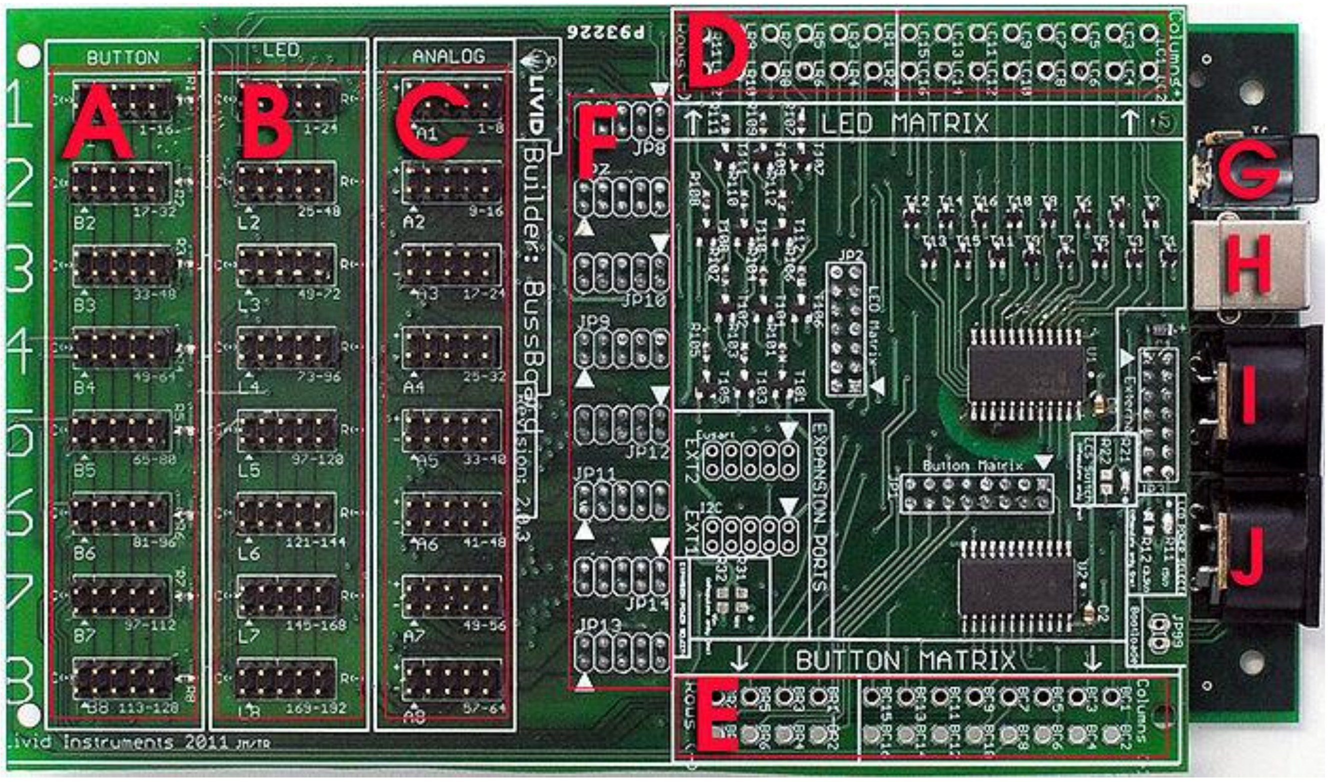
1. Using the power jack on the Brain plug in the 5v DC Brain power adapter
2. Connect a standard 5pin MIDI cable to the MIDI out and or in jacks to operate without using a computer

Configuring the Brain

Brain v2 does not require any configuration when using LEDs, switches, and analog controls. All unused analog connections do need to be grounded with the supplied analog ground headers or disabled in the Brain V2 Configureapplication.

If you are using encoders, velocity sensitive pads (FSR), or LED groups you will need to configure them using the [Brain V2 Configure]() application. This application can also be used to edit the default MIDI mappings of the Brain.

Diagram



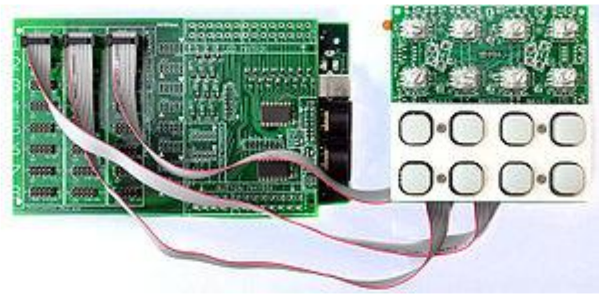
- **A. Button Headers** - For connecting 10 Pin connections from the Omni Board for ribbon cables for buttons or encoders
- **B. LED Headers** - For connecting 10 Pin connections from the Omni Board for ribbon cables for LEDs
- **C. Analog Header** - For connecting 10 Pin connections from the Omni Board for analog connection
- **D. LED Matrix Direct Connect** - Alternative wiring for for direct wiring LEDs
- **E Button Matrix Direct Connect** - Alternative wiring for direct wiring buttons or encoders
- **F. Brain Headers** - Connects the underside of the Bus Board to the Brain.
- **G. 5V DC Power Jack** - Used for standalone MIDI operation
- **H. USB Jack** - For USB Power and USB MIDI connectivity
- **I. MIDI Out Jack**
- **J. MIDI In Jack**

Ribbon Cable Connections (Easy Method)

The main connections on the Bus Board allow you to connect our Omni Board with simple ribbon cables. This provides a very easy and modular format for designing and building your own controllers. While it is possible to wire your own setup using the pin headers and ribbon cables, we've provided solder pin holes with the Advanced Method to streamline the process for custom configurations.

The Bus Board has three columns of pin headers to connect to. One column of eight pin headers is for designated for button connections, one column of eight pin headers is designated for LED connections, and one column of eight pin headers is designated for Analog connections. The Bus Board is labeled with rows 1 through 8. For naming purposes we refer to individual pin headers by their purpose followed by the row number. For example, the 3rd pin header down in the LED column is referred to as L3 pin header.

Example Setup with an 8K8B Omni Board



If you are only using our Omni Boards to build your device, you will only need to concern yourself with these pin header connections.

Button Headers

Button headers are used to connect buttons and encoders to the Bus Board. Connection to the Omni Board is made by 10 pin ribbon cables. Each pin header is responsible for up to

16 buttons. No additional circuitry is needed. The pins of the button headers are assigned default note numbers of 0 through 127 starting with note 0 on the B1 pin header and ending with note 127 on the B8 pin header. The default note numbers for each pin header are labeled under each header on the BusBoard. When plugging an Omni Board into any given pin header, the buttons on that Omni Board will be assigned with the note numbers that are designated to the Busboard header they are plugged into. All button note numbers are re-assignable using the Brain V2 Configure application.

LED Headers

Acceptable "Forward Voltage" for LEDs 1.8V - 3.6V, We use this whole range on our RGBs, and this covers most LEDs

LED headers are used to connect LEDs to the Bus Board. Connection to the Omni Board is made by 10 pin ribbon cables. Each pin header is responsible for up to 24 LEDs. No additional circuitry is needed. The pins of the LED headers are assigned default note numbers of 0 through 127 followed by CC 0 through 63 starting with note 0 on the L1 pin header through note 127 in the middle of L6 pin header. The default assignment then changes to CC 0 in the second half of L6 and to CC 63 of L8. The default note numbers for each pin header are labeled under each header on the BusBoard when plugging an Omni Board into any given pin header, the LED's on that Omni Board will be assigned with the note numbers that are designated to the Busboard header they are plugged into. All LED note numbers are re-assignable using the Brain V2 Configure application.

Analog Headers

Analog headers are used to connect analog sensors (slide potentiometers, rotary potentiometers, accelerometer, photoresistors, etc) to the BusBoard. Connection to the Omni Board is made by 10 pin ribbon cables. Each pin header is responsible for up to 8 analog connections. No additional circuitry is needed. The pins of the Analog headers are assigned default CC numbers of 0 through 63 starting with note 0 on A1 pin header and ending with CC63 of A8 pin header. The default CC numbers for each pin header are labeled under each header on the BusBoard. When plugging an Omni Board into any given pin header, the Analogs on that Omni Board will be assigned with the CC numbers that are designated to the Busboard header they are plugged into. All Analog CC numbers are re-assignable using the Brain V2 Configure application.

Unused analog pin headers need to be physically grounded using our header ground boards supplied with each Bus Board. If unused analog connections are left open you will have a noisy stream of MIDI data from the open pins! Grounding unused headers are easy by just plugging in the female socket of the ground board making sure to line up the arrow designating pin 1 marked on the BusBoard header to the white square marked on pin 1 of the grounding board.

- As of December 2013, Brain v2 is shipping without the grounding headers. The new firmware v189 (and above) disables all analogs by default. You will need to manually enable each active analog using the Brain v2 configure software.

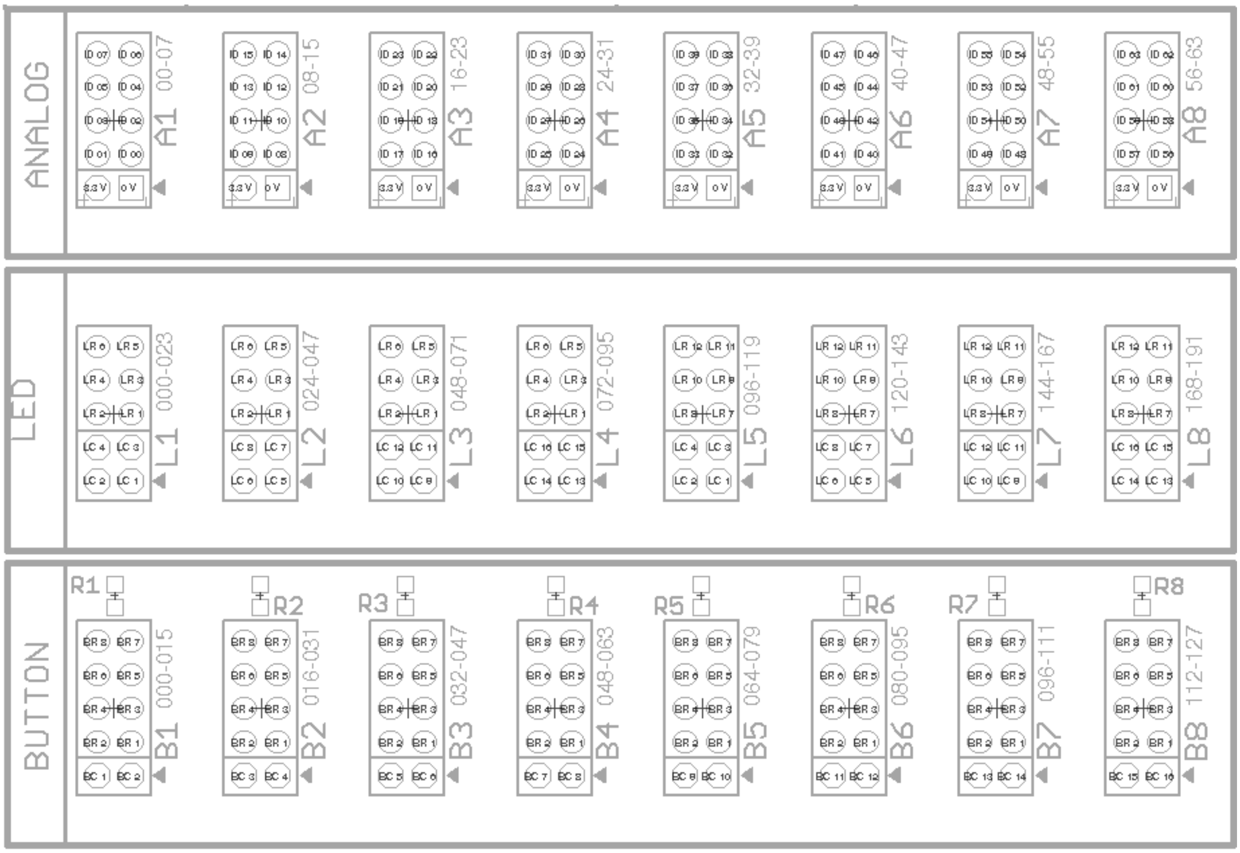
Ground Reference

Currently, Analog ID 63 (Pin Header: A8, Pin: 10) is used by the firmware as a reference ground.
For optimal operation of the A/D Converter, this Analog Signal must currently be connected to ground (and not an analog device).

- As of December 2013, the Brain v2 firmware no longer uses a ground reference. You are now free to connect analog controls to ID 63.

Ribbon Cable to Pin Headers (Hacker Method)

We designed the ribbon cable (or easy) method to allow you to easily connect our Omni boards to the Brain, eliminating a lot of soldering and cable management. You however may find that you still want to use the pin headers to wire your controller. This can be useful for easy plugging and unplugging of your device, or to have multiple setups so you can use the Brain for multiple controllers. It is important to never solder directly to the pin header! If you are using this method it is important to use ribbon cable connectors. The best thing to do is to get some 10 pin ribbon cables and splice into the ends.

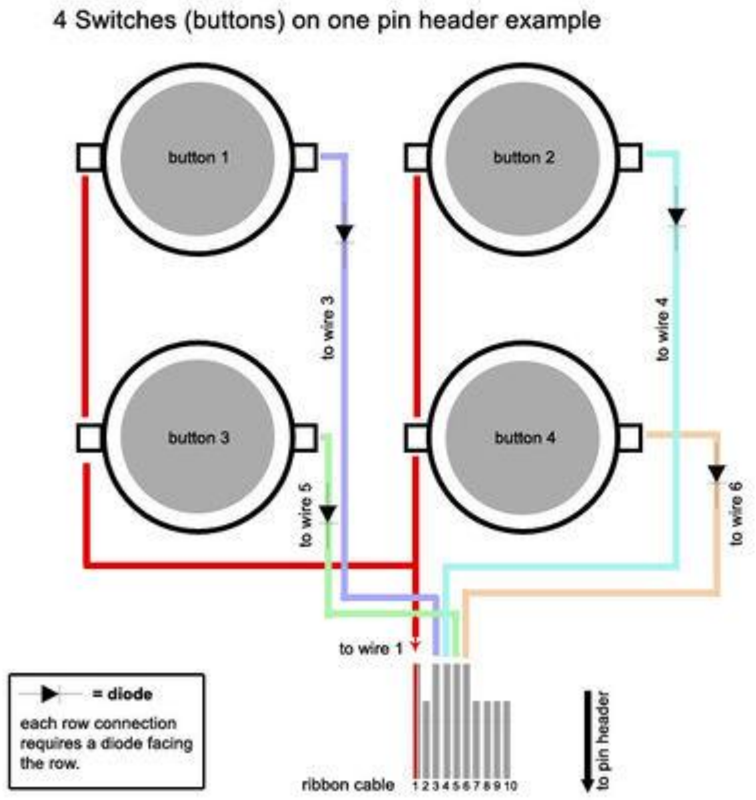


Wiring

It's a good idea to read the Simple Method above to understand how the headers work. In short each type of connection (buttons, or switches, LED's, and analog control) has it's own pin header.

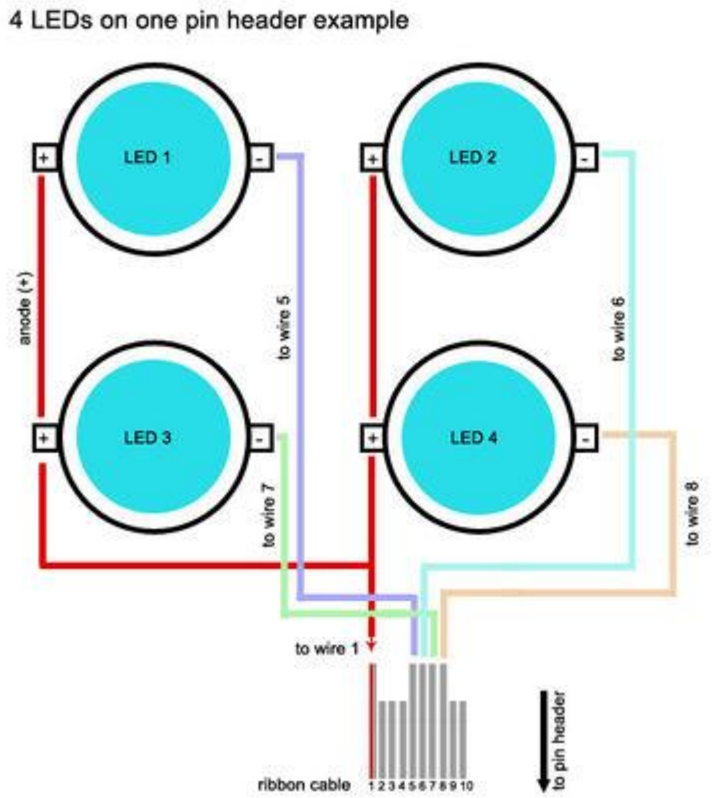
Button Header

There are eight button headers used to connect buttons (switches) to the Brain Bus. Each button header can accommodate 16 switches. Everything will need to be wired as a matrix. The first two pins on each header are columns, and the remaining eight are rows. As an example lets say you wanted to connect four arcade buttons to the first button pin header. You would need to create a matrix that uses 1 column and 4 rows. You would start by "daisy chaining" one side of each of the arcade buttons together. You will then need to connect them to the first wire in the ribbon cable. In general you will want to use the red wire in the ribbon cable to indicate pin 1, which will line up with the arrow on the bus board for each header. Once you have the column connected you'll need to connect the rows. To do this use wire 3,4,5, and 6 and connect them individually to the other side of the switch. Each row connection needs to have a diode inline, pointing towards the row, in order for the matrix to properly work. You should now have a working button matrix.



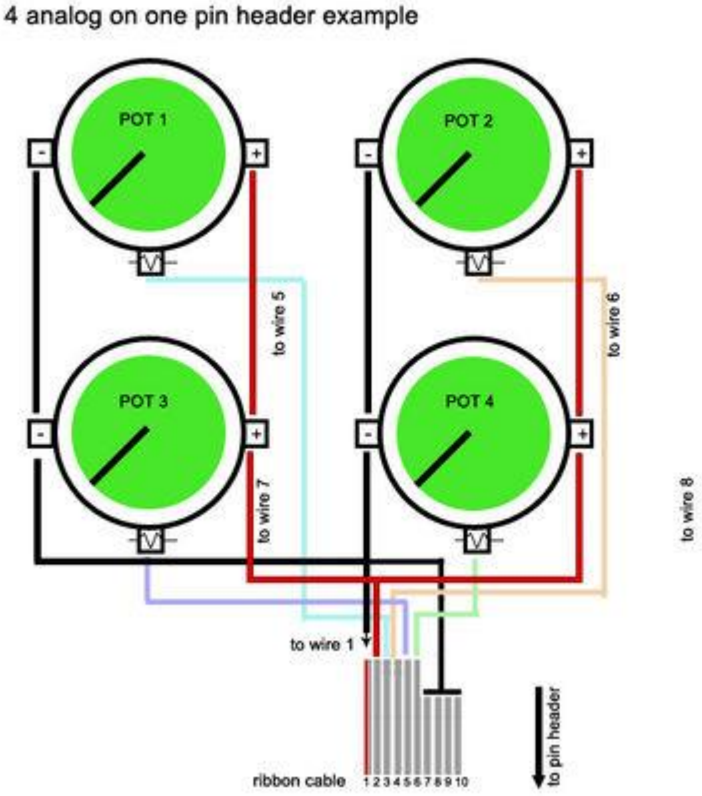
LED Header

There are eight LED headers used to connect LEDs to the Brain Bus. Each header can accommodate 24 LED's (4x6 matrix, 4 columns 6 rows). Everything needs to be wired in a matrix for use with the Brain V2. The first four pins on each header are columns, and the remaining six are rows. As an example lets say you want to connect four LED's to the first LED pin header. You would need to first daisy chain all of the anodes (+) together and connect them to column one, which is also pin 1 on the header. You should use a ribbon cable and splice the first wire, the one with the red line, to the connected anode chain. Next you'll connect wires 5,6,7, and 8, which are rows, to the cathode (-) of each LED. You should now have a working LED matrix.



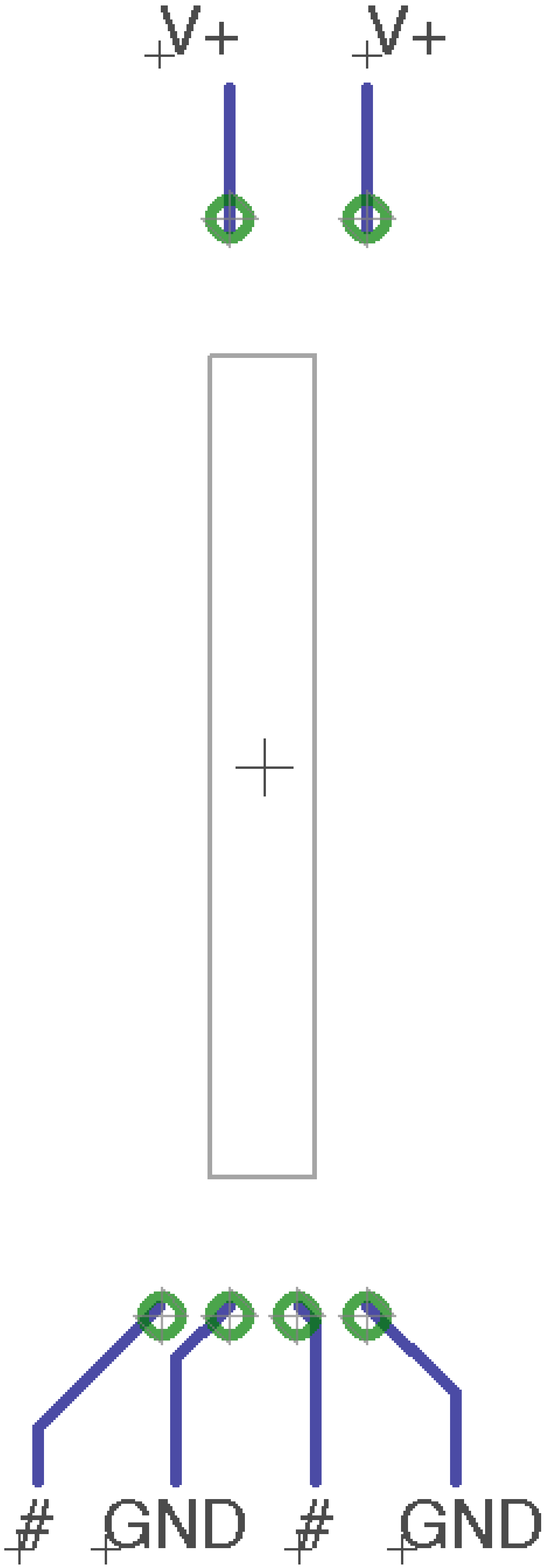
Analog Header

Analog headers are used to connect analog sensors (slide potentiometers, rotary potentiometers, accelerometer, photoresistors, etc) to the BusBoard. Connection to the Omni Board is made by 10 pin ribbon cables. Each pin header is responsible for up to 8 analog connections. The first pin is ground (red wire on pin header), the second pin is voltage, and the remaining pins are wipers. Lets say you want to have four rotary pots connected to the first analog pin header. You would connect all of the ground connections to pin one, the positive (or voltage +) connections to pin two, and the wiper signal to each analog connections to pin 3, 4, 5, and 6. The remaining four unused connections MUST be grounded by connecting them to pin 1 (ground) or you will have a noisy stream of analog data coming off of those pins.

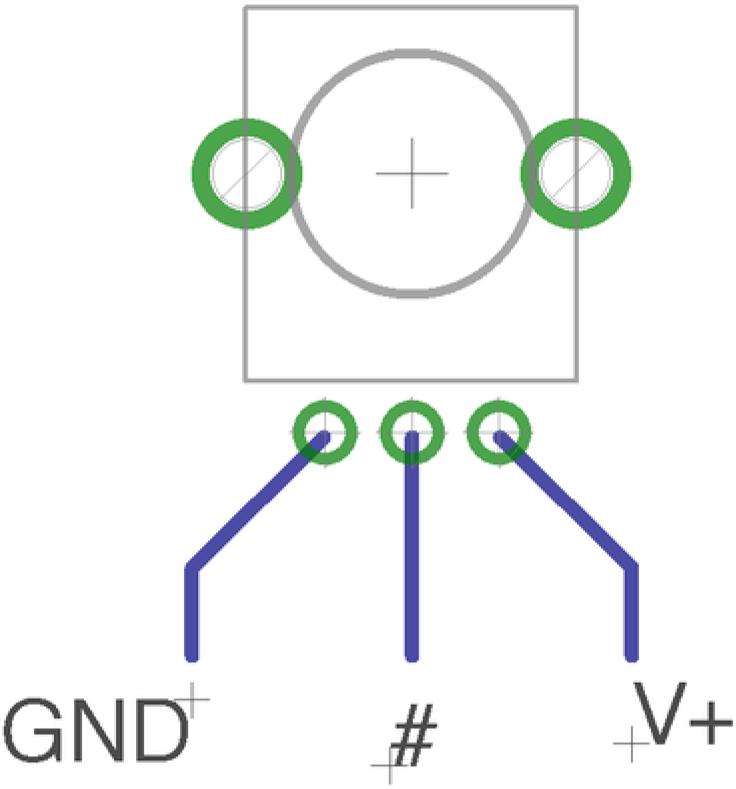


Each analog control needs a .01uF capacitor between the Ground and Signal to stabilize the signal.

Fader pin-out:


V+
V+
#
GND
#
GND

Pot pin-out:



Direct Connect Wiring (Advanced Method)

The advanced method of wiring in Brain v2 allows you easy access to directly solder to pins for those who are not using the omni board and have their own button and LED connections. While it is still totally possible to wire to the pin headers, we've added these open pin holes to make the process a little more streamlined and customizable.

The Bus Board has two banks of open pin hole connections for direct soldering of custom buttons and LEDs. These banks are set up into two parts to support a matrix of buttons and LEDs. A matrix is composed of columns and rows. The Bus Board has individual connections for LED and Button columns and rows. We've made the process of creating your own LED matrix much easier in Brain v2. There is no need for you to add your own transistors or resistors as these are included on the Bus Board.

Acceptable "Forward Voltage" for LEDs 1.8V - 3.6V, We use this whole range on our RGBs, and this covers most LEDs

Direct Connect LED Matrix

The LED Matrix area has a section designated for 12 Rows and a section of 16 Columns.

The LED Matrix direct connections allow you to create your own LED matrices using LED columns LC1 - LC16 and rows LR1 - LR12. Up to 192 LEDs can be directly connected using this method.

For an example of an LED matrix we can look at 4 LED’s. They can be physically mounted in any order but for wiring purposes they can be arranged into the following possibilities.

As the number of LED’s increase, the possible number of wirings greatly increase. The important thing to consider is that an 2 LED’s cannot share the same row and the same column and that each LED must have a discrete combination of row and column.

LED Matrix Example

This is an example of a full 48 LED matrix arranged in 8 Rows and 6 Columns.

You do not need full rows and columns to use LEDs (you can or not use any LEDs that you want),

All of the LEDs in a column should have the anode '+ side' connected to an LED Column connections (LED Matrix direct connections LC1-LC6).

The cathodes (- side) of each LED should be connected to the cathodes of all of the other LEDs in the same LED Row (LR)

The other end each should connect to one of the LED Matrix row connections (LED Matrix direct connections LR1-LR8).

Direct Connect Button Matrix

These Button Matrix direct connections allow you to create your own button matrices using button columns and rows. Up to 128 Buttons can be directly connected using this method.

The Button Matrix area has a section designated for 8 Rows and a section of 16 Columns.

The Button Matrix direct connections allow you to create your own button matrices using button columns BC1 - BC16 and rows BR1 - BR8. Up to 128 buttons can be directly connected using this method.

In a Button Matrix it is necessary to connect a diode between one contact of the button and the row connection.

Button Wiring Example

'Required Components'

- 1 Diode Per Button

This is an example of a 29 button matrix, arranged in a 4 column, 8 row format. We have intentionally left column 4 with only 5 buttons to show that an even number of buttons is not necessary. For speed and efficiency, this matrix uses all 8 rows.

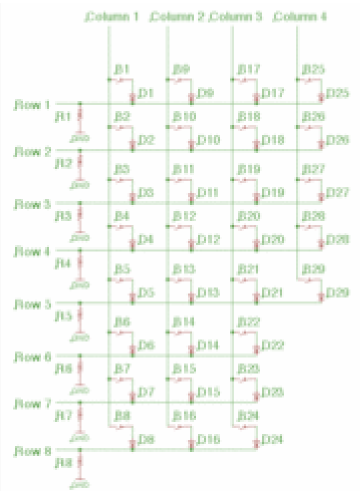
All rows are connected to pins BR1-BR8 of the Brain Button Matrix direct connections.

All columns are connected to pins BC1-BC4 of the Brain Button Matrix direct connections. Column pins BC5-BC16 of the Brain Button Matrix direct connection are not used for this matrix but could be used for more columns of a larger matrix.

One side of all the buttons in a column needs to be continuously connected to that column's connection.

The other side of each button connects to a diode. The opposite end of each diode connects to a continuous row connection.

All diodes should face towards the row connection.



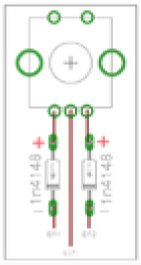
Encoder Wiring Example

'Required Components'

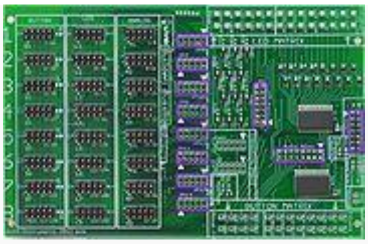
- 2 Diodes Per Encoder

The Brain v2 supports a 2-bit Quadrature Encoders.
This is the most common and generally the least expensive type of Encoder.
A Rotary Encoder is basically, just a set of 2 switches that are
set up in such a such a way that they output a code (called Gray Code) when they turn.
As such, a rotary Encoder is wired as two buttons.
Encoders much be placed in specific places in the Brain v2 Button Matrix in order to function properly.

Check our the Code's Easy Wiring Reference for help.
Encoder 0's wiring is detailed in the following picture.



Brain Headers



The Brain headers are how the Bus Board connects to the Brain. The female pin header sockets on the back of the Bus Board line up with the male sockets on the Brain, allowing these two boards to be "sandwiched" together, essentially creating one board.

All pin headers on the Brain v2 have a pitch of 2.54mm.

Analog Modes

The Brain V2 supports many ways to interpret Analog Signals. This is useful for integrating FSRs, Potentiometers, Accelerometers, and other controls into your setup. The Brain V2 also allows Analog Controls to send individually mappable Note On and Note Off messages, when they leave and return to '0' state.

Potentiometer

- *0: POT* (CC/Pitchbend Output Only)

Potentiometer mode provides an even sweep from 0-127 for general Potentiometers and Sliders.

FSR 1-3

- *1: FSR1 (Note and CC/Pitchbend Output)*
- *2: FSR2 (Note Output Only)'*
- *3: FSR3 (CC Output Only)*

FSRs in general have a slightly limited output range when compared to Potentiometers because

it requires more than the average musician's strength to reach the maximum MIDI value of 127.
Also, Rubbery Drum pads have weight that must be ignored
Brainv2's FSR Mode takes these things into consideration portions out the useable area across the full range of MIDI Values (0-127).

FSR 4-6

- *4: FSR4 (Note and CC/Pitchbend output)*
- *5: FSR5 (Note Output Only)*
- *6: FSR6 (CC/Pitchbend Output Only)*

FSR Modes 4-6 are similar to Modes 1-3, but FSR Modes 4-6 also have a large Center area,
so that you can easily achieve and hold a value of '64'.
Recommended for use with those effects that just need to be centered.

Accelerometer

- *7: Accelerometer (Note and CC/Pitchbend output)*
- *8: Accelerometer (Note Output Only)*
- *9: Accelerometer (CC/Pitchbend Output Only)*

Accelerometers in general have a very limited output range when compared to Potentiometers.
Brainv2's Accelerometer Mode takes this limited range and evenly distributes it across the full range of MIDI Values (0-127).

Button (Note Output Only)

- *10: Button* (Note Output Only)

Button Mode Allows you to connect a button as an Analog Control. To connect a button as an analog:
1. Connect a 10K resistor between 1 side of the button and Analog Power (pin 2 of any Analog pin header)
2. Connect other side of the button to Analog Signal (pins 3-10 of any Analog pin header).
3. Connect a 10k resistor between the Analog Signal and Analog Ground (pin 1 of any Analog pin header).

LED Grouping

The Brain V2 supports LED grouping. This is useful for things like making LED rings for encoders like the ones on our Code controller. It can also be used with rotary and slide pots to show the current values, or with FSR/s to represent velocity.

Local and External LED Feedback

- *Supported Groups*: 3 , 6, 12, and 24 LEDs
- *Supported Hardware*: LED Strips, LED Rings, RGB LEDs (common-anode / 3-cathode style only)
- *LED Display Modes*: Walk/ Fill
- *Local Feedback*: Pots, Sliders, Encoders, and FSRs

Default Mapping and Wiring: http://lividinstruments.com/dl/technical/brainv2_defaults_leds_and_ledgroups.pdf
For information on configuring LED Groups check here: http://wiki.lividinstruments.com/wiki/Brain_V2_Configure#group_size_2
For information on configuring Encoder Local Control check here: http://wiki.lividinstruments.com/wiki/Brain_V2_Configure#LED_group_.23 *For information on configuring Analog Device Local Control check here:*http://wiki.lividinstruments.com/wiki/Brain_V2_Configure#LED_group_.23_2

LED Rings and LED Strips:
With Brain v2, you can control groups of LEDs with a Single MIDI Message.
This feature allows for simple wiring and easy configuration of LED Strips, LED Rings, and RGB LEDs.
Now, your Brain-Powered MIDI Controller is able to display output Track Volumes and Loop positions
(and any other MIDI Note Velocity or CC Value) in 3, 6, 12, and 24 LED Resolution.

Locally Controlled Feedback System:
You can also use your LED Rings and LED Strips to display the current value of your Encoders and Potentiometers.
Any Encoder, Potentiometer, FSR, or other Analog Control can be mapped to any LED Group Position.
Multiple encoders and potentiometers can be mapped to the same LED Group Position, allowing you to use a single LED strip to display the values of many controls.

Sysex Messages

The sysex messages used to configure the Brain are detailed on a separate page: Brain V2 Sysex.