

Modular experiments

Friday, July 14, 2017

An Unofficial Build Guide for a MIDIBox Seq V4



Thanks and credit to the MIDIBox originator, Thorsten Klose, aka TK... and I applaud his continued support via the MIDIBox Forum! Additional thanks to forum members Mongrol, Hawkeye, Latigid On, Slo, Seppoman, and others for their inspirational build-guides, answered questions, and trouble-shooting help...and thanks to Sean Pendleton for laser-cut prototype and Andrew Scheidler for demo videos.

Disclaimer: I am in no way affiliated with MIDIBOX.ORG, and I do NOT profess to know all there is to know about the MIDIBox Hardware Platform. I do not profit from any information contained on this site, nor the purchase of PCBs, enclosures, parts kits, or anything else discussed on this post. To the best of my knowledge, all the information contained herein is accurate. My own SeqV4 is *almost* complete, and this page will be updated as I make progress. Email questions, comments, and corrections to nirokeforums@gmail.com



This is a DIY project. If DIY is not for you, join the MIDIBox Forum (find link below),

visit the Flea-Market, and find a pre-built unit for sale that will fit your needs.

- Updated 17 July 2017 - added female IDC connectors to relevant parts lists and added link to connections diagram in Line Driver section
- Updated 23 July 2017 - changed electrolytic capacitors in AOUT_NG kit to better fit layout and lead spacing
- Updated 08 August 2017 - MODULAR ADDICT NEW SOURCE FOR MIDIBOX PCBs INCLUDING CS BOARD PCBs!!! SEE BELOW.... plus a suggestion added to Core Board build if adding a Quad_IIC_MIDI board
- Updated 02 October 2017 - Modular Addict now also carries "Waldorf" knobs and data wheel (see below), and I've added notes to the CS Board section with regards to bottom-mounting the Data Encoder
- Updated 02 December 2017 - removed links to MIDIBox Shop boards and kits :(Added some thanks and credits at the top :) Other general edits, info about costs, etc
- Updated 10 December 2017 - kind of a lot. Formatting, images, updated some project files, progress updates and additional info

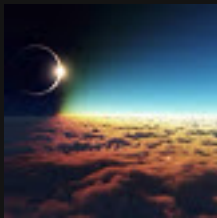
Let's begin !

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About Me



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What *IS* this thing ?

The MIDIbox SEQv4 is a *"16 Track Live/Step/Morph Sequencer and Advanced Arpeggiator"*, and frankly, the most powerful music sequencer I have ever owned or used. Its list of features is dizzying, and its results are immediate.

Each of the 16 tracks, and every *type* of track...

- NOTE (polyphonic)
- CHORD (plays one of 37 pre-defined chords)
- *MIDI CC* (like a note track, but *layers* are not pre-assigned to note on/off)
- DRUM (up to 16 drum voices per track)

... has its own settings (clock, length, direction, rotation, LFO, groove, scale, etc) ... has up to 16 parameter layers (note, velocity, bend, CC, probability, delay, aftertouch, etc) ... has up to 8 trigger layers (gate, accent, glide on/off, roll, random value, etc) ... and is fully editable while running.



Group, Track, and Layer Select buttons

While the tracks *are* grouped in fours (*track 5 is actually called G2T1, or Group 2/Track 1*) they remain independent, but they can also be made to interact with one another (one transposes another, one advances another, etc), or be fed by one of up to 4 MIDI inputs. Not only does the SEQv4 have the most flexible, powerful, and interactive step-sequencing I've used, it also has "live sequencing" (Jam Mode) where you can play in and overdub MIDI data which will begin to play back as soon as the tracks loop. Morphing allows you to smoothly change between two parts of the same track, adjusting the first and last steps of a looped section. The arpeggiator is programmable (settings per note) and can be further modified by all the same parameters that the Step and Live-recorded tracks get to play with, and it can be applied to an existing track or to any of the MIDI inputs in realtime. Sequence data can be output via MIDI ports, USB MIDI, OSC (ethernet), or CV/Gate. All that said, this summary still doesn't do it justice.

(for some example videos of what the SEQv4 can do, scroll to the bottom of the page)

Building my MIDIBox Seq v4 required a bit of research....

All the information you will need is available on the internet, but it can be confusing and overwhelming when you first approach the project, especially as there is no *ONE WAY* to build it. "**MIDIBox**" (or MBHP) is actually the name of the hardware platform developed by Thorsten Klose (*there are several MIDIbox-based synthesizers, controllers, and drum machines, etc in addition to this sequencer*), "**SeqV4**" is the name of the application that gets loaded on to your finished hardware *to make it* a sequencer, and there are many possible hardware configurations and parts selections available so every device can be uniquely customized. With that in mind, the goal of this guide is not to examine every possible option, but to simply help others get a head start if they are considering building a MIDIBox SeqV4, whether that be a minimal, midi step sequencer or one like mine which has a few more options. I do not intend to create guides for any peripherals which I have not built (and tested) myself. This document compiles relevant links and information from multiple sites in an effort to make it easier to understand and navigate the process of designing and building your own MIDIBox SeqV4.

The main page for everything MIDIBox related is <http://www.uCApps.de/>. Admittedly, this page can be an *information overload* if you are just starting your build, but almost everything you need to know (and a ton more) is on this site. Much of what I am doing in this write-up is taking links from the uCApps site (and a few others like <http://midiboxshop.bigcartel.com/info>) that are relevant to building *my* Seq V4 and introducing them in a way that might have made more immediate sense to me when I started my build. Also check out <http://wiki.midibox.org/>

User manual : http://www.uCApps.de/midibox_seq_manual.html

What Do I Need ?

To put it simply, you need a set of PCBs, a bunch of parts, something to put them in, and a way to teach it.

Anyone building a Seq V4 will need *at the least*:

- a "Core" module.... This is the center of the MBHP, or MIDIBox Hardware Platform, which hosts the CPU board (purchased separately) and links to all the optional peripherals.

- a CPU (referred to often as the “discovery board” or by the model number, like STM32f4)
- a MIDI IN and/or OUT interface (most likely, and often more than one)
- a control surface (Wilba’s CS, the future V4+, or DIY)
- displays
- a case or front panel and relevant hardware
- USB cables and SD Card (the SeqV4 can be powered via USB, but cables are also needed for programming and firmware)
- a computer running freeware to flash and update MIOS (MIDIBox operating system)
- ribbon cable, soldering equipment and various tools

You, like me, may opt to include other peripherals:

- an analog output board for CV outputs
- a “digital” output board for gates, clocks, triggers, etc.
- a set of boards to transmit and receive signals from the MIDIBox enclosure to a breakout box or panel
 - external power supply

And you may choose to add other options which I have not built:

- 4-16x16 X0X-style button array (Button/LED Matrix, or BLM)
- Tempo display and control knob
- Track position display (TPD)
- And more....see the left-hand column on <http://www.uCApps.de/> under “MB Hardware Platform”...but keep in mind that not all peripherals are necessary with every Core variant

My build includes the following:

- STM32F4 based Core with STM32F407G* Discovery Board CPU
 - * it is essential that your discovery board have the suffix 07G!
- ST-Link, MIOS32, and SEQ v4.094 software (or latest version)
 - Wilba CS Board
 - MIDI I/O module (x2)
- Quad IIC_MIDI module
- DOUT digital output module
- AOUT_NG analog output module
- Line Driver transmit and receive module
- LCDs
- Custom laser cut case (modified design based on the Mongbox)
- Breakout box with custom output PCBs
 - Internal 5V regulator, power receptacle, power switch



PCBs :

ModularAddict.com has started stocking a near full range of [MBHP pcbs](#)! All board prices mentioned below will be based on their prices. However, you may need to have some (like the Line Driver Tx and Rx boards used to boost signals sent to an optional breakout unit for CV/Gate, etc) fabricated at a PCB manufacturer like OSH Park (<https://oshpark.com/>), or you may be lucky enough to find someone on the MIDIBox Forum (<http://midibox.org/forums/>) who has a few extra to off-load. You could also make your own circuit boards if you are inclined and determined as schematics are available for each board! Some older boards are still available at Mike's Midishop (http://www.mikes-elektronikseite.de/mshop_englisch/index.htm), but I didn't have a use for these in my build.

Note: to build my SEQv4 using Modular Addict boards would cost \$88 for the PCBs and would include the data wheel knob (plus shipping, would not include Line Driver boards or my custom boards). I probably paid another \$60+ for that set of PCBs when I built mine because I did not order them all at once and paid for shipping repeatedly, so it makes sense to plan ahead and order once. To build a bare-bones SEQv4 (2midiIN/2midiOut only), your PCBs would cost just \$56 plus shipping (includes CS board, STM32Core, MIDI I/O, and data wheel knob).

Parts Kits :

I have links to Project Files at Mouser for each module which will save you from finding all the parts you need yourself. Any price quoted on these pages are subject to change but accurate at time of writing.

(Mouser has several ways to save lists of parts for different projects: BOM, shared carts, project files, etc, but I will me using the Project File level. These allow

you to load a project, click "order project" to send those parts to a cart, then load another project to purchase more in the same order. Sharing BOM would still require you to select individual parts, and sharing carts makes it difficult to purchase more than one project in one order. So if I use the term Project File or Kit, I am referring to the Project File level of saved files in my Mouser account. I don't profit in any way by you using these kits.)

Of course, some parts may be unavailable or out of stock at Mouser, cheaper from other distributors, or not the highest quality available, so if you want to shop around, you will at least have the specs about each part in my project file. For example, the Switchcraft brand midi sockets in my Mouser carts are \$2.93 each, but you can get CUI,Inc. brand midi sockets from Digi-Key for \$1.02 each. As my build uses 12 sockets, that's a difference of \$22.91, but you'll want to compare the savings you will get to the cost of additional shipping fees. Obviously it made sense for me to place two orders from different distributors, but for the sake of simplicity, I have created carts that source all parts from a single distributor (per MBHP module). Honestly, Digi-Key has better prices on DIN (midi) connectors and IDC headers/connectors, so if you are on a tight budget, it may be worth the effort to make a list of these parts from each module of your planned build, remove them from the Mouser Project Files, and order them all at one time from Digi-Key. Reichelt in Germany has better prices than ANY of the US options, but I have not ordered anything from them (...yet...perhaps for my next build!) In some cases, it is cheaper to buy more of something than it is to buy just the required quantity, so you may end up with extra parts if you use my Mouser parts kits.

There are some parts that are customizable in the sense that you might want a specific knob style, LCD color combination (or even OLED or VFD), LED shape, etc., so keep this in mind when reviewing my BOMs or project files and when deciding on a front panel or enclosure design (**my build uses rectangular LEDs, but my kits contain the more common round LEDs instead**). Check the forum for a post about a new Seq V4+ control surface PCB, panel, and software before committing to a case, panel, or control surface (CS) board.

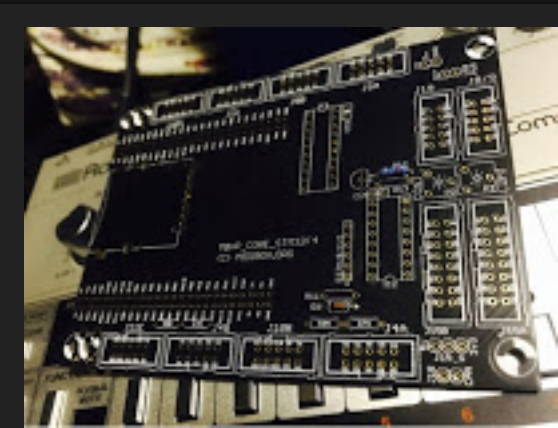
Programming :

Really most of the programming has been done for you already, you just have to transfer the data to the STM32F4 to set up the platform and the sequencer application, create a couple folders on the SD Card, and then if necessary, edit the hardware configuration file (MBSEQ_HW.V4) that is stored on the SD Card. I had to edit mine (Wilba version) to assign duties to the DOUT module's outputs, but that's all, if I remember correctly. See **"OS Links"** at the bottom of the **STM32F4 Core** section below.

The SEQv4 Modules I've Built

STM32F4 Core

I chose to use the STM32F4 Core mainly for its availability, although it seemed like the best choice at the time of writing. An STM32F407G Discovery Board (the CPU) mounts to the Core PCB and is programmed using freeware (this is much easier than it might sound). Be sure to purchase the 07G version of the STM32F4!



At time of writing, the Board alone is \$9.99. My MBHP_Core_STM32F4 project file at Mouser totals about \$52 plus shipping, includes all parts from the Shop's Kit plus the STM32F407G Discovery Board (\$19+) and 5' of 16-conductor ribbon cable, but some parts may not be ROHS compliant. Some parts in my kit are currently cheaper from other distributors: the IC sockets, shrouded IDE headers, and 2x25 female headers. However, these item can be added to a future order, you don't need them to build the Core.



Note: It is not necessary to purchase and install all the shrouded headers. For example, if you know that you only ever want to have a bare-bones SEQv4 (CS and MIDI I/O), then you only need to include 4 of the 12 shrouded headers

My Mouser cart doesn't contain the required SD card (2GB) or USB cables as they are far too expensive when sourced from distributors like Mouser. The cables can probably be purchased locally (if you don't already have some from a phone, camera, game device, etc), and the SD card from eBay or Amazon.

Diagrams of connections and assembly/programming instructions are available on the main page for the STM32f4 Core, scroll down to the relevant section:



http://www.ucapps.de/mbhp_core_stm32f4.html

Note the need to update firmware on discovery boards marked with MB997D.

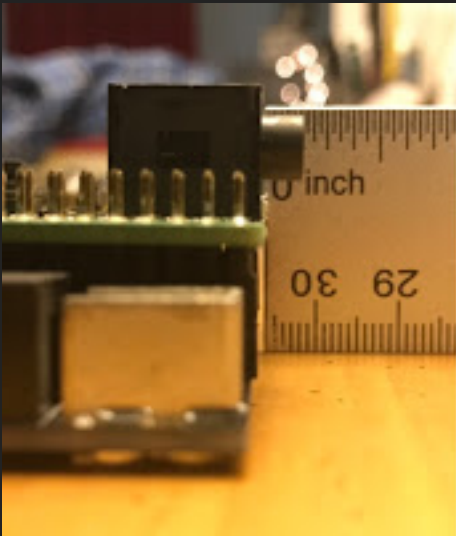
The discovery board can be programmed before the Core Module is built. The bootloader and application software current at time of writing is also linked below. Once your Core is built and the discovery board is coupled to it, you may want to connect your chosen display screens (see below) so you can verify that the software is correctly installed and that the SD Card is recognized.

Until you decide on how your boards will be mounted and the style of your enclosure, I suggest you leave the mounting lugs off the board. You may find later on that the legs are too long or that they obstruct the holes on the PCB should you choose to use stand-offs. Also, I don't know if the older STM32 boards had the same dimensions, but my STM32F407G hangs over the edge of the Core board, so the lugs would not fit flush against the inside of the case. You would need to include a washer/spacer between the case and the lug to prevent putting stress on the discovery board. I ended up cutting mine off as they interfered with the screw holes on the PCB.



NOTE: If you plan to use the Quad_Illc_MIDI module as your MIDI output, you may want to use a different connector on the Core at location J4A or J4B. The Quad_Illc only requires four pins to connect to the Core, and a 10-pin header does not fit well on the Quad_Illc board. Had I known I wanted to add a Quad_Illc to my project when I built my Core, I would have ordered something like this to connect the two boards: <http://www.allelectronics.com/item/con-244/4-pin-connector-w/header-0.10/1.html>

This part is not included in the parts kits!!



Purchase:

Board only - <https://modularaddict.com/manufacture/midibox/midibox-core-stm32-pcb>

My FULL Mouser Kit (includes STM32F4, ribbons, and connectors) - - <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=e9426707a4>

Adafruit Power and USB parts :

- USB cables : <https://www.adafruit.com/category/801>
- 5V DC/DC convertor : <https://www.adafruit.com/product/1385>
- DC Power Connector : <https://www.adafruit.com/product/610>
- DC Power Extension : <https://www.adafruit.com/product/327>

Schematic/Dimensions/Image/Software/Parts List

Schematic - http://www.ucapps.de/mbhp/mbhp_core_stm32f4.pdf

Board dimensions - https://images.bigcartel.com/product_images/150336994/STM32F4D_CORE_X9_7_dim.png?auto=format&fit=max&h=1000&w=1000

Quick view, component side - http://www.ucapps.de/mbhp/mbhp_core_stm32f4_0.jpg

uCApps Parts List : http://www.ucapps.de/mbhp/mbhp_core_stm32f4_orderlist.txt

OS links:

http://www.ucapps.de/mios32_download.html

- scroll down to "STM32F4 Applications" to find latest SEQv4 software, as of 09 Nov 2017 http://ucapps.de/mios32/midibox_seq_v4_094.zip
The file "MBSEQ_HW.V4" is contained in this package.

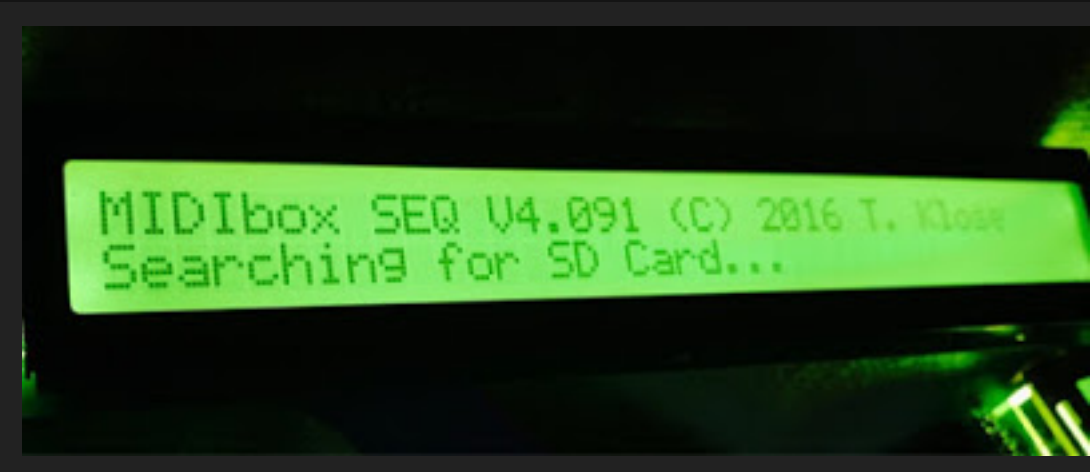
http://www.ucapps.de/mios32/mios32_bootloader_v1_018.zip

<http://www.st.com/en/development-tools/st-link-v2.html>

http://www.ucapps.de/mios_studio.html

Display Screens (LCD)

At this point, you may want to connect some displays so you can verify that things are working properly. As this is my first SEQv4 build, I'm choosing to keep things simple with regards to the display screens to start with, so I am just using backlit LCDs. As I'm using the Wilba CS board and a Wilba-based panel design, I'm also using the standard 40x2 character displays. The 40x2 LCDs must be Hitachi HD44780 compatible as MIOS supports this format internally. When searching for LCDs, its easiest if HD44780 and 4002 is mentioned in the specs (but there is a list of possible compatible drivers on the wiki page, <http://www.midibox.org/dokuwiki/doku.php?id=lcd>). I ordered mine from a Chinese source on eBay, and while they were quite cheap, they took about 6 weeks to arrive! As of writing this, Mouser, Jameco, and Digi-Key do not have an affordable screen on the compatibility list. You might try BuyDisplay.com or Crystalfontz.com, but I cannot personally vouch for these sources.



In addition to the screens themselves, you will need two 2x8 male IDE headers which you will solder to the PCBs that the LCDs come mounted on, and four 16-pin female IDC connectors to connect the LCDs to the Core Board. You should have all these if you ordered my FULL cart for the Core or the Discovery and Ribbon cart above, but if not, add those to your next Mouser order.





For a guide on how to connect the LCDs to the STM32F4 Core, see the uCApps Core page [HERE](#) (scroll down to the bottom)





NOTE: If you are making a custom enclosure (or building a Mongbox or my variation of the Mongbox), you may find it necessary to use "right angle" headers on the LCD units to reduce the depth from the front panel, or perhaps even to solderi the ribbon cable directly to the LCD PCBs. Using straight headers and connectors in a shallow enclosure will likely interfere with your "rear panel" modules like MIDI connectors, serial connectors, etc. Of course, if you only plan to have one MIDI_IO module and a Line Driver, you can probably place those modules under the LCDs in such a way that they have plenty of clearance.

Some people have chosen to use OLED or VFD displays which may take a bit more work to get going, so search the MIDIBox Forum for posts about these options if you are leaning that way. I will say, they look fantastic! You can always change the type or color of display anytime.

More info on MBHP LCDs here, but only read this if you are really interested in using something other than a 40x2 screen: <http://www.midibox.org/dokuwiki/doku.php?id=lcd>

[eBay search result for HD44780 40x2 LCD](#)

	W/Tutorial/HD44780/Bezel,Backlit	\$13.49 Free shipping
	5V Blue 40x2 4002 LCM Character LCD Display Module w/Tutorial/HD44780,Bezel	\$12.04 Free shipping
	3.3V 40x2 Character Monochrome LCD Display Module	\$12.67 Free shipping
	5V 40x2 Character Monochrome LCD Display Module,LCM w/Tutorial/HD44780,Arduino	\$12.04 Free shipping

	Display w/Tutorial	\$13.00 Free shipping
	5V Wide Angle Black White 40x2 Character LCD Module Display w/Tutorial HD44780	\$13.00 Free shipping
	3.3V Wide Angle Black White 40x2 Character LCD Module Display w/Tutorial HD44780	\$13.62 Free shipping
	3.3V Blue 40x2 4002 LCM Character LCD Display Module w/Tutorial/HD44780,Bezel	\$12.67 Free shipping

MIDI_I/O (2In/2Out)

The MIDI I/O module is a 2In/2Out midi interface that can be chained to include 2 modules giving you 4 MIDI In ports and 4 MIDI Out ports! There are some other MIDI I/O options, like the Ilc (1 in, 1 out) and the Quad Ilc_MIDI (4 outs). *My build includes two MIDI I/O modules and one Quad Ilc_MIDI for a total of 4 Ins, 8 Outs.*

The PCB is \$7, and my Mouser cart is \$22.47 today. Again, my mouser cart includes the mounting lugs, but I suggest you leave these off the PCB until you have decided on a case design.

http://www.ucapps.de/mbhp_midi_io.html

Purchase

Board - <https://modularaddict.com/manufacture/midibox/midibox-midiio-pcb>

My Mouser Kit - <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=37d69f5473>

Schematic/Dimensions/Image/Parts List

schematic - http://www.ucapps.de/mbhp/mbhp_midi_io.pdf

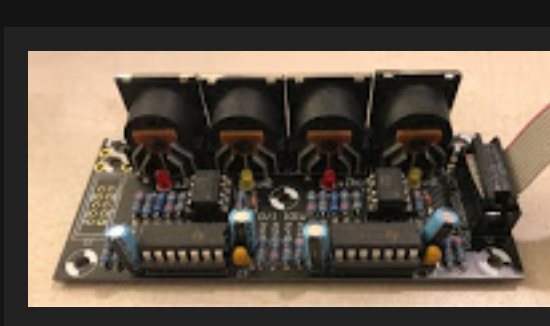
quick view - http://www.ucapps.de/mbhp/mbhp_midi_io_0.jpg

Ucapps Parts List : http://www.ucapps.de/mbhp/mbhp_midi_io_orderlist.txt

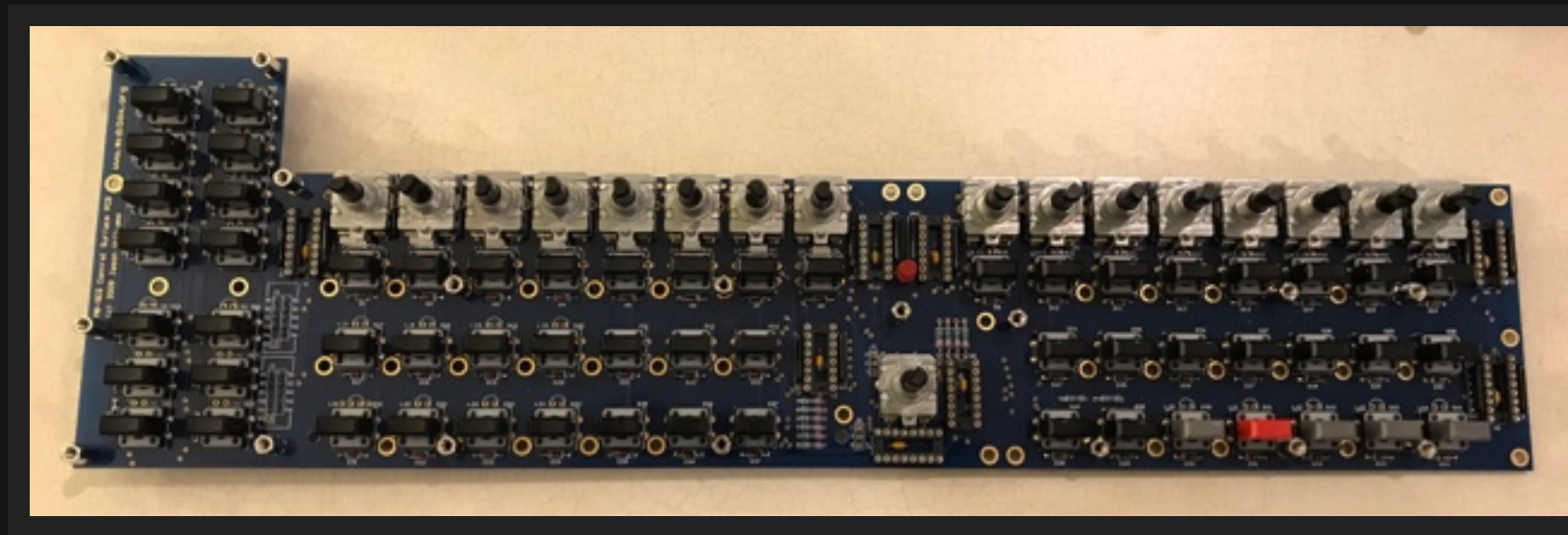
Dimensions: 102.8mm x 43.9mm



Red stripe on ribbon shown incorrect



SEQ CS (control surface)



Note: shown with data encoder top-mounted! This is incorrect! See below.

The Seq CS Board is the user interface for the SeqV4 application. There is some talk of the development of a V4+ on the MIDIBox Forum, so you may want to follow the discussion there for progress and availablitiy. You could create your own control surface on perf-board or by designing your own PCB for fabrication, but unless you also plan to design your own panel, using the "Wilba" CS board is your best option.

Building the CS Board requires a handful of ICs, dozens of push-button switches, diodes, and LEDs, 17 rotary encoders, knobs, and a few other parts. The CS Board PCB costs about \$35 and a parts kit will cost about \$102 (without knobs, data wheel, or shipping, and with 3mm round LEDs instead of 2x5mm rect LEDs).

Note: at the time of writing this, Mouser does not stock a suitable knob or data wheel, so you will need to choose your preferred style and order from elsewhere. Some options are described below.

For my own build, I chose to use 2mm x 5mm rectangular **LEDs** rather than the more common 3mm round LEDs, which required a modification to Wilba's front panel design. However, my cart for this module will contain 3mm round, so keep that in mind when looking at photos of my finished build (whenever that happens) or if you should decide to use my case redesign (a variation of the Mongbox design by forum user Mongrol). You will either have to modify my case for 3mm round

(I will add a version of my case with 3mm holes at some point), or order rectangular LEDs instead.

Even with 3mm round LEDs, there is some room for customization. I imagine most people use the typical, dome-topped LEDs which is what I have included in the kit, but I would prefer to have flat-topped LEDs mounted flush with the faceplate (like the "Beat" LED on my SEQv4 and the LEDs on my Breakout Box). You can also change the color selection, but you need to be aware of any change to resistor values this would require.

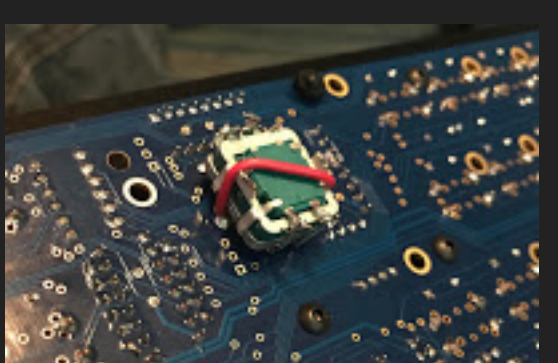
The Wilba panel is designed for a certain type of **button cap**, the type included in this cart (some others might fit the same panel cut-out), but if you plan to design a custom front panel, you can use whatever type of button or cap that you like. I have seen round, square, and even illuminated while checking out other people's builds on the forum. The current CS board has multiple hole patterns for each button/tact switch so a variety of models can be used. The **tact switches** I used were relatively affordable, but you can probably get some fancier and more rugged switches if you want to search for advice on the forum. As this is my first build and I am on somewhat of a strict budget, I decided to use a cheaper alternative. I can always upgrade at a later date. While the switches I used were inexpensive, they are the same make and model suggested in TK's parts list.

The **encoders** are another part that is not limited to only one model. There are a few brands to choose from, some with push-button function and some without. Some users have commented about more reliability with certain models, so check the forum for the latest reports. The encoders should have 24 detents, but the push-button feature is optional. You can adjust settings later somewhat to accommodate the encoders you choose and how they perform, but the encoders I installed seem to work properly so I have not modified the standard configuration.

Keep in mind that the descriptions for different encoders (and brands of encoder... and distributors of encoders?) don't always match. When I talk here about a "15mm or 20mm encoder", I'm referring to the part description on the Mouser website and therefore in my parts kits, which says for example, "PEC16-4220F-S0024 - Bourns - **Encoders 20MM SHAFT w/switch**". Here the 20mm describes the **shaft length**. Both of these Bourns encoders are 16mm wide, a perfect fit for the CS Board.

However, the Alphas mentioned in [Hawkeye's photo guide](#) as being "12mm or 16mm encoders" refers to how they are described on the same Mouser site, "**Encoders 16MM ROTARY ENCODER**". In this case, the values 12 and 16 indicate the width of the encoder body, and the shaft length is not clear. Perhaps the "20A" in the part number means 20mm shaft, but the datasheet I found did not explain the nomenclature.

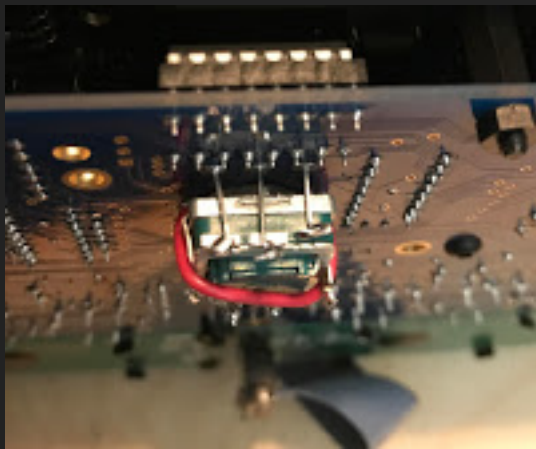
Note: MISTAKE #1 - It is important to match the shaft of the encoder to the knob dimensions! The 20mm encoders I installed seemed perfect when tested with the knobs from my Waldorf MWxt, but the Cliff knobs I ordered for my SEQv4 were NOT AS DEEP. When pushed on to the shafts, there was about 6mm of space between the bottom of the knob and the face plate. Unacceptable! Rather than remove and replace the encoders or search for knobs that fit properly (spending more time and money on the build), I used some tools at my disposal (1/2" square stock and a 4-1/2" angle grinder with a sanding disk 🥹) and shortened the shafts down to a suitable height. I highly recommend you compare datasheets and do the math so that the encoders and knobs you choose mate well! I have changed the Parts Kit to contain ONE 20mm encoder for the bottom-mounted Data encoder and SIXTEEN 15mm encoders for the step encoders (aka GPK 1-16) which should better fit the Cliff K88 knobs I used. Of course, had I realized the issue before installing the LEDs, I could have changed the height of the stand-offs between the CS board and the front panel if my case design would have allowed it.



NOTE: MISTAKE #2 - I realized once I received my prototype case and data wheel that I should have mounted the encoder **UNDERNEATH** the PCB instead of soldering to the top-side like the other encoders! If you want to use a regular knob for your data encoder, then this isn't a problem. But I wanted to use the "jog/alpha/scrub wheel"-style knob like on my Waldorf MWxt! As I'm always in a rush to do things and couldn't settle for ordering a replacement encoder, I disassembled the installed encoder and desoldered it from the PCB. After reassembling, I found two nuts on some other pots I had laying around and mounted the encoder to the board using one nut as a spacer and one to secure the encoder in place. I added a short piece of insulated wire to help hold the encoder in place and together and added some clipped LED legs (removed from the bicolor LEDs which didn't need them) to connect the terminals back to the solder pads. Now the data wheel sits at a perfect height and still allows room for the push-button function.



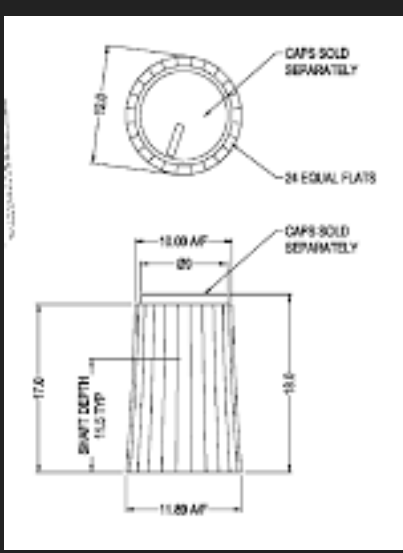
Finally, the **knobs and data wheel** that you choose are a matter of taste. Of course, they need to match the shaft style of the encoders you choose, knurled encoders won't accept a D-Shaft knob. For the 16 "general purpose" encoders, I used Cliff K88 Black D-shaft knobs with K85 black caps, but also got some grey caps for the quarter note steps if needed...all from TME in Poland, which had a great price and super fast shipping. I had them in Florida in 4 days with their standard



shipping! A few other places in Europe carry them, but they either didn't ship to the US, charged too much for shipping, or didn't carry the right color or shaft type.



ALBS DK38 data wheel



Cliff K88/85 detail

Cliff in the US does not import this model, so no US distributors carry them. I also considered the "Small Soft (10mm)" Sifam knobs at Thonk.co.uk, and the ALPS knobs at Reichelt.de (*who has MUCH better prices than US distributors, especially for IDC connectors and shrouded headers, for example...any European builder should consider ordering all their parts from them*). **Modular Addict now offers** some knobs that might suit some builders (but I do not care for those). They also offer a **data wheel (ALBS DK38)** which I have chosen to use for my sequencer. It is taller than some others I've seen (like the one from Adafruit which is VERY short). You can find the Modular Addict option here. *If you choose to order the DK38, I recommend the Bourns 20mm encoder with switch from my parts kit and that it be mounted as shown above, from the underside.*

My Mouser kit for this module includes the rotary encoders (I used modified Bourns 20mm w/ switch for all encoders, but the kit *now* contains one 20mm w/s and sixteen 15mm w/s), the tact switches (E-Switch brand), switch caps (see additional part numbers below for some optional gray and red caps for the transport controls), a flat-top 5mm "Beat" LED, all caps, resistors and arrays, 3mm LEDs (single and bi-color), diodes, sockets, chips, and headers.....but again, no knobs or wheel. I figured that the selection of knob style should up to the individual builder. You'll need to select a 6mm D-shaft knob (preferably with no indicator mark), but the color, material, and shape is up to you. Likewise, the data wheel you choose should be for 6mm D-shaft, but the color and diameter is a matter of taste. Note that some data wheels will sit high on the shaft of these encoders, so some modification may be required or an encoder with a shaft of different length.

As suggested in Hawkeye's build guide, all the LEDs I used are bi-color, so I needed to remove one leg and bend the remaining two slightly to align with the panel. You can choose to do this too, but it is probably easier to order single color for those locations that don't require bi-color. Follow this datasheet for the bi-color LED for proper installation: http://www.mouser.com/ds/2/239/S_110_LTL1BEKVJNN-369643.pdf

I made my 2x5mm LED cutouts very tight, only about 0.1-0.2mm clearance, so I beveled the underside of the top panel around each LED hole using a Dremel-type rotary tool to help the LEDs realign properly when I have to remove and replace the panel. I would probably do this with a panel made for 3mm round LEDs as well using a drill press and an appropriate countersink for acrylic.



More Info : http://www.midibox.org/dokuwiki/doku.php?id=wilba_mb_seq

Purchase

Board - <https://modularaddict.com/manufacturer/midibox/midibox-seq-pcb>

My Mouser Kit - <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=d6c1fe6040>

Mouser part numbers :

Gray Cap - **611-PEGY**

Red Cap - 611-PERD

2x5mm Rectangular Bicolor LED - **604-WP119EGWT**

Schematics/Images

PCB Image - http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=wilba_mb_seq:wilba_mbseq_pcb.pdf

PCB Image with Dimensions - http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=wilba_mb_seq:wilba_mbseq_pcb_dimensioned.pdf

Panel / Enclosure

Forum member Mongrol designed an acrylic case called **MONGBOX** for the STM32F4-based SeqV4 and made the files available for others to use to make their own if they or someone they know have access to a laser cutter or if they want to order from a company like Ponoko. This is the design that I adapted to build my case, but there was an issue with the scale. See the "scale fixed" version of the file if you are using Inkscape. I advise that you have whoever will cut your case verify that the measurements are correct when they load the file on their machines! Neither Mongrol nor I assume responsibility for any mistakes!



Mongbox

Mongbox enclosure thread : <http://midibox.org/forums/topic/20221-mongbox-enclosure/>

Mongbox build thread : <http://midibox.org/forums/topic/19900-mongrols-midiboxseqv4-build/>

Mongbox files : https://github.com/mongrol/mongbox_enclosure

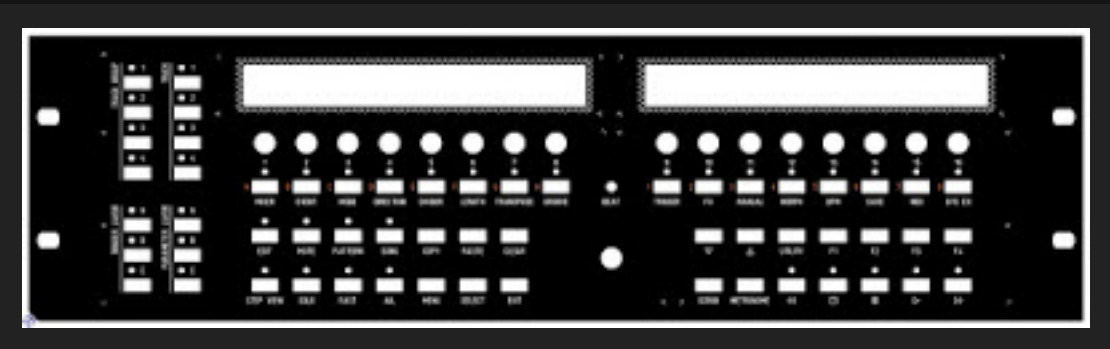


Original panel style

The original MIDIBox SeqV4 used an older Core which did not have built-in USB, SD reader, etc, so this design does not work properly with an STM32F4-based V4, so you will need to modify the rear panel. Here's a link to a set of panels for that case style:

<http://thebeast.co.uk/?product=midibox-mbseq-v4-desktop-enclosure-panel-set>

There are DXF and FPD files available on the Wiki page if you'd like to have aluminum panels made, either the 17" panels like used in "the beast" case above, or a 19" panel for use with a 3U rack case. Double check that the design has all the mounting holes you need for fastening to your case of choice.



Wiki page : http://www.midibox.org/dokuwiki/doku.php?id=wilba_mb_seq

DXF Files : http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=wilba_mb_seq:wilba_mbseq_dxf.zip

FPD Files : http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=wilba_mb_seq:wilba_mbseq_fpd.zip

My Mongbox "Remix"

I made my own case based on the Mongbox design above, but I had to modify it quite a bit to accommodate all the modules I wanted to squeeze in. I had several prototypes cut from wood and acrylic. I made my "remix" of the Mongbox a bit bigger in two dimensions to fit my additional modules, moved things on the rear panel to accommodate those modules, and changed the front and rear panels so that the split panel moves to the front. This was necessary to mount all the modules side by side. I will make my fabrication files available when they are edited in case anyone else would like to copy my build or use it as a template.



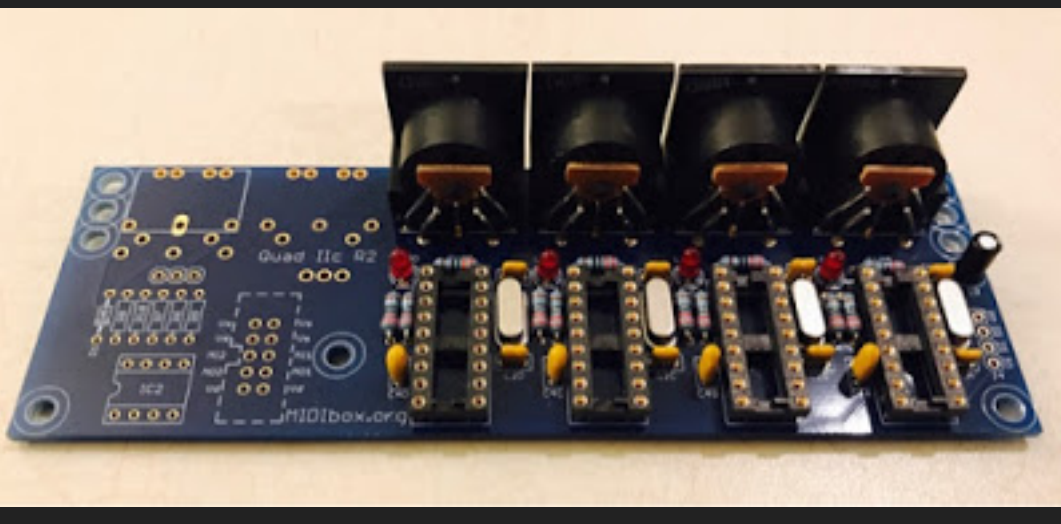
Finally, search the forum for the latest posts about cases, enclosures, and panels if none of these suggestions fit your needs

The above sections cover the bare-bones SEQv4 build as described in the beginning of this post. The following sections cover the additional features/modules I included in my own SEQv4 build....

Quad_IIC_MIDI (4 Outs)

As mentioned above, the Quad_IIC_MIDI board adds four more MIDI outputs as well as the BLM port and a place to mount another 5-pin DIN connector for DIN Sync (I've seen this described as an Input, but I'm not sure, need to find more info. Possibly not relevant with STM32F4 core).

I have put together a Mouser cart which you can order or just use as a reference. You may decide to search for a different DIN socket (the MIDI outs and DIN Sync socket are all the same part), but keep in mind that not all sockets are built the same. The all-black sockets I used (from DIGI-Key, as opposed to the silver-faced sockets in the Mouser cart) had a different measurement from face to front



Shown without BLM and Aux DIN options installed

leg. This slight difference affects the spacing between the rear panel of the enclosure and the connector, but more importantly may interfere with the mounting hole locations on the bottom panel. If you plan to use my enclosure design, double check the hole pattern and make sure it matches for your selected socket, and also that the Quad_MIDI_IIC board will not interfere with the STM32F4 core location.

The 5-pin DIN socket is one of the parts that I found to have a wide range of costs depending on the distributor, from \$1/each to \$4/each! The BLM/Sync section of the PCB could actually be cut off and separated from the MIDI port section as the circuits are fully independent, but the mounting holes on the PCB aren't designed for this, you may need to modify. In my case design, the power switch and DC input are inline with where the BLM and Sync sockets would be making those features unusable, but do not require the PCB to be modified.

*Note***: My Mouser cart contains the four 16F88 chips needed to build this module however they are NOT PREPROGRAMMED! You will need to program them yourself, OR omit them from the order and buy them preprogrammed from a member of the forum (that's what I did).*

I have included both a SIL 4-pin male header as well as a 5-pin male header and two 10-pin female IDC connectors for connecting the Quad_IIC to the core, but you can omit these if you prefer a SIL connector like shown in the top sections of this page. There are only four holes on the PCB for this header, so to assist in proper connection, I used a 5-pin header and cut off one leg on the bottom of the header and offset the dummy pin so that the female connector aligns correctly. (next time I disassemble my SEQv4, I will add a photo here)

The Quad IIC_MIDI PCB is \$9, and my full Mouser cart is \$40.50. *Actually, the kit is not quite full: it does not include a 5-Pin DIN socket or SIL 3-Pin male for the Aux DIN Sync because I cannot explain how this is implemented. If this is something you want from the Quad_IIC, you should research this feature on the forum before ordering a kit so you can add these parts.* If you don't plan to populate and use the BLM expansion part of the board, you can order the parts kit with the suffix "-no BLM" (\$36.50)
(see parts list below):

<http://www.midibox-shop.com/quadIICMIDI2.html>

Purchase

Board - <https://modularaddict.com/manufacture/midibox/midibox-quadIIC-pcb>

My FULL Mouser Kit - <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=a9ef9df865>

My Mouser Kit - no BLM - <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=447ac199b6>

Schematic/Dimensions/Image/Parts List

Quick View - http://www.midibox-shop.com/images/quad_IICMIDI_QV.gif

Schematic - http://www.midibox-shop.com/images/quad_IICMIDI_schem.pdf

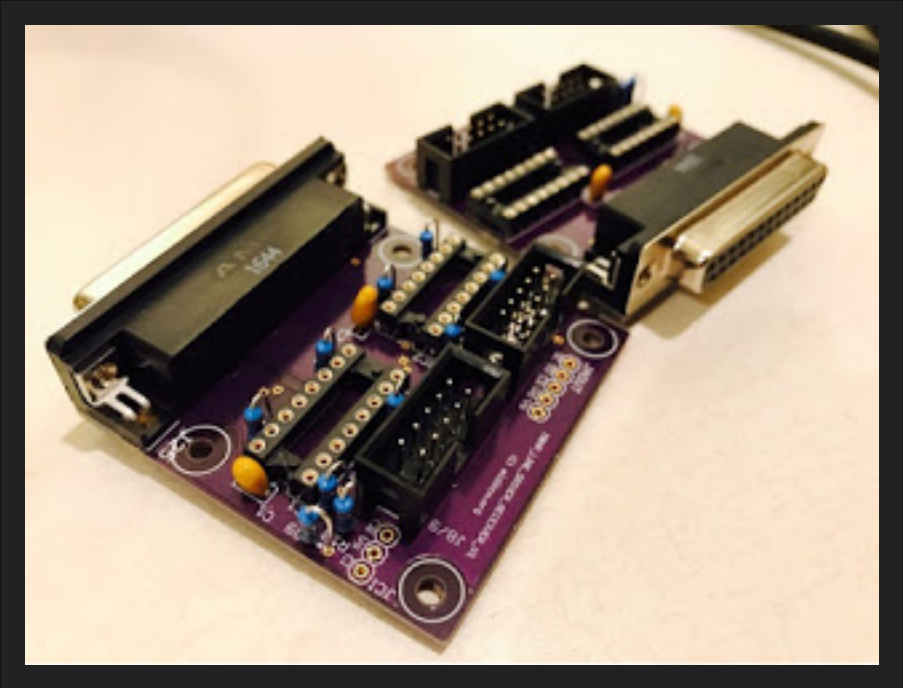
Parts List from MIDIBOX Shop:

IC1x	IC-Socket for 16F88	4	
LEDx	3mm LED red	4	
Q1x	20mhz crystal	4	
C3	10µF Electrolytic capacitor	1	
C1x,C2x	15pF Ceramic capacitor "33"	8	
C4x	100nF=.1µF Ceramic capacitor "104"	4	
R2x	220Ω resistor	4	
R9x	220Ω resistor	4	
R10x	220Ω resistor	4	
--	5 pin DIN connector	4	
J4	1x4 pinheader	1	
-----	---optional BLM connection parts----	-----	
IC2	6N138 optocoupler	1	
IC2	IC-Socket for 6N138	1	
R6	1KΩ resistor	1	
R7	4.7KΩ resistor	1	
R8-R10	220Ω resistor	3	
D1	1N4148 diode	1	
--	8 pin DIN connector	1	
--	Box Header 2x5	1	

Line Driver (transmit/receive)

The Line Driver is the module used to buffer signals sent from the MIDIBox Seq enclosure to a breakout box or auxiliary panel which typically contains the analog outputs for CVs, gates, triggers, and clocks. If your build does not require an external CV/Gate Interface, then you probably won't need the Line Driver. It may have some uses in other custom applications, but if you are just making a sequencer with MIDI in/out, you can probably do without it.

This module actually consists of two parts: a *transmitter* PCB and a *receiver* PCB, or Tx and Rx. Unfortunately, neither is available to order from the Modular Addict (at time of writing, doesn't hurt to check back there) nor Mike's, so you'll either have to get them fabricated or find some for sale on the Forum's Flea-market. The Tx board mounts inside the Seq enclosure and the Rx board mounts in your breakout box or aux panel. The Line Driver allows the two to be connected using a 25-pin serial cable with length up to "5M at 1Mbit/s", maybe even longer, according to uCapps site. Perhaps if you build the CV/Gate expansions into the same enclosure as your SeqV4, you may not need the Line Driver as the connections would be comparatively short. Search the Forum for answers to this if you prefer to build an all-inclusive device.



I had my Tx and Rx boards made at OSH Park as recommended on the uCapps page. The awkward part is that OSH Park requires you to accept and pay for three copies of any board you order. If you have them fabricated there, you end up paying almost \$50US and receive 6 PCBs. So check the Flea-market first to see if anyone already ordered and have extras to sell, and if you end up having to order from OSH, you can offer your extras for sale there (or give/sell them to your friends when they start their OWN SeqV4 build), or you could organize a group buy on the forum.

Images that depict different hardware configurations and how to connect them are shown on the uCapps site, but if you are building the SeqV4 and using the Line Driver Boards to add an analog expansion, you'll probably just need to see this one :

http://www.ucapps.de/mbhp/mbhp_line_driver_usecase_mbseq.png

Full page : http://www.ucapps.de/mbhp_line_driver.html

The files you need for fabrication are available on the uCapps page (also linked below), but I've also uploaded the .BRD files and shared the project at OSH Park to save you the trouble, and those are linked below under "Purchase"

Purchase

My Mouser Kit : <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=e7d04d9577>

OSH Park: <https://oshpark.com/>

 Order from
OSH Park

Transmitter PCB

 Order from
OSH Park

Receiver PCB

Schematics/Images/Files/Parts List

Tx Image : http://www.ucapps.de/mbhp/mbhp_line_driver_transmitter_v1.png

Rx Image : http://www.ucapps.de/mbhp/mbhp_line_driver_receiver_v1.png

Tx Schematic : http://www.ucapps.de/mbhp/mbhp_line_driver_transmitter.pdf

Rx Schematic : http://www.ucapps.de/mbhp/mbhp_line_driver_receiver.pdf

Tx .BRD File : http://www.ucapps.de/mbhp/mbhp_line_driver_transmitter_v1.brd

Rx .BRD File : http://www.ucapps.de/mbhp/mbhp_line_driver_receiver_v1.brd

Ucapps Parts List : http://www.ucapps.de/mbhp/mbhp_line_driver_orderlist.txt

AOUT_NG (CV Outputs)

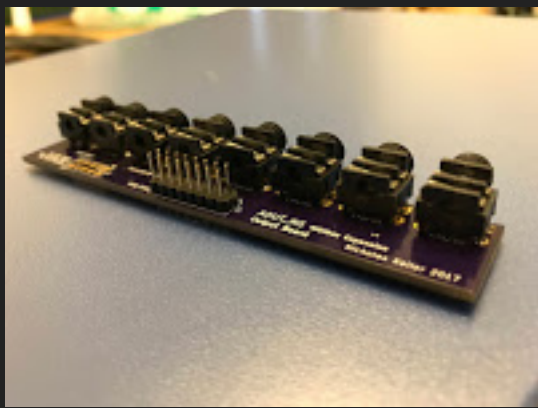
In order to add control voltage (or CV) outputs to the MIDIBox SeqV4, you will need to add one of the three AOUT modules (analog out). These are the AOUT, the AOUT_NG (no gates?), and the AOUT_LC (low cost?).

- AOUT provides eight 12-bit CV outputs and two gate outputs
- AOUT_NG provides eight 12-bit CV outputs with bi-polar option
- AOUT_LC provides two CV outputs at either 12/4-bit or both at 8-bit

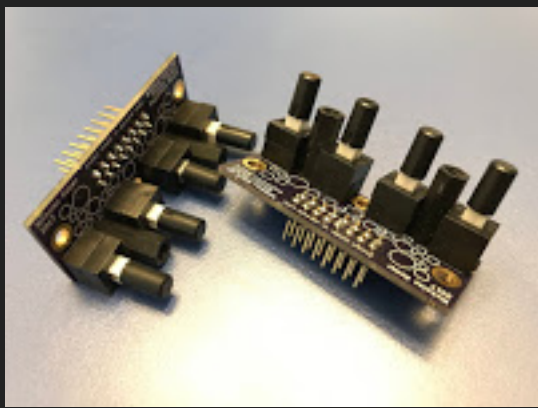
For a well worded comparison and more information, see the AOUT_NG wiki page here :
http://www.midibox.org/dokuwiki/aout_ng

I opted to build the AOUT_NG to start with, but if I find that the precision is not accurate enough for my taste, I will switch to the AOUT module instead.

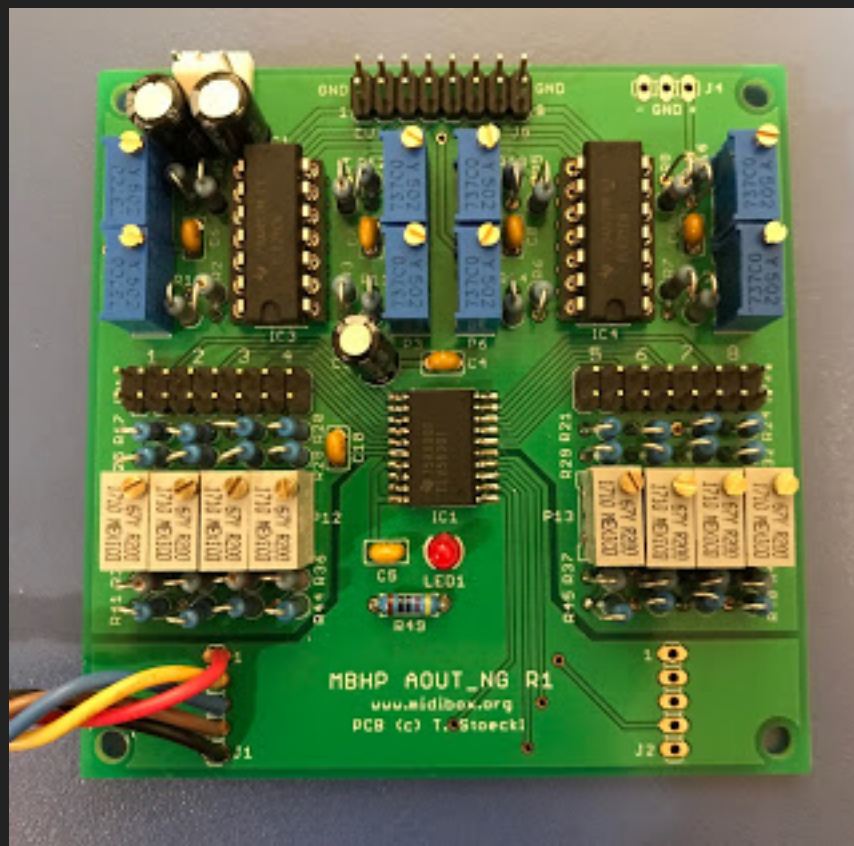
The AOUT_NG requires a bipolar power supply to provide +/-12VDC, and since the Line Driver Rx only provides +5VDC, I needed to include an additional power source in my build. *If you build your expansion as a Euro-rack module, you can use your rack for power if you have spare amperage.* I build a MFOS Wall Wart Supply, but I'll discuss that more when I post about the Breakout Box.



Note : You may want to leave the SIL 5-pin and SIL 3-pin male headers unpopulated until you decide what connectors to use. I ended up using a flying Male/Female connector for J1 and a pre-assembled locking connector for J3 which I ordered from allelectronics.com. I left off J2 and J4 completely as J2 was in the way of my power switch and AC inlet and J4 has no current application (see image above).



I've also designed and had fabricated some additional PCBs: some for mounting the output sockets and IDC headers for connecting to the AOUT_NG boards and some to connect the Bipolar Option switches to the option headers (so there will be no hand-wiring).



The AOUT_NG PCB costs \$9, and there are two parts kits I have assembled at Mouser. One kit includes all the necessary parts including those for the bipolar option (\$66, includes two 16pin female IDC connectors which you may not need), and one kit includes everything except the bipolar option parts. If you don't require the bi-polar option and/or want to source the parts yourself, see the wiki page below for what parts can be removed from the order. Also, you may choose to add a set of switches instead of the shunts/jumpers if you do install the bi-polar option so you can toggle between both modes for each output. I did not include these switches in either kit, but the part number for the switches and caps I used in my Breakout Box are linked below. If you are *REALLY* sure that you will *ALWAYS* or *NEVER* want the bipolar option for each output and want to save about \$4, you can omit two 16 pin male headers and the shunts from the kits and just bridge across the relevant solder pads with spare wire or a cut-off resistor leg. See wiki page below for correct jumper/bridge orientation.

http://www.midibox.org/dokuwiki/aout_ng

Purchase

Board only : <https://modularaddict.com/manufacture/midibox/midibox-aout-ng-pcb>

My Mouser Kit *with Bipolar option*: <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=284b61f2ef>
My Mouser Kit *WITHOUT Bipolar option*: <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=c4f557cb8b>

Schematics/Images/Files/Parts List

Quick View Image : http://www.midibox.org/dokuwiki/lib/exe/fetch.php?w=100&tok=cec3ae&media=seppoman:aout_ng.gif

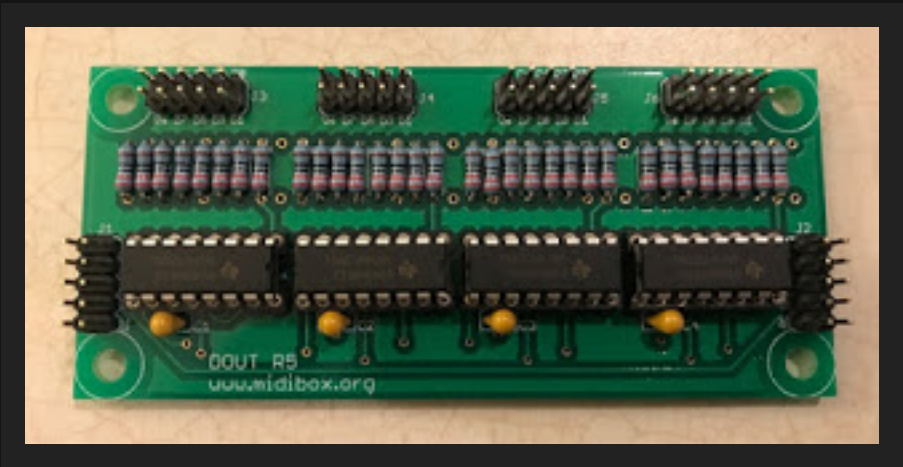
Schematic : http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=seppoman:mbhp_aout_ng_r1_schematic.pdf

Eagle Layout and Schematic : http://www.midibox.org/dokuwiki/lib/exe/fetch.php?media=mbhp_aout_ng_r1.zip

Parts List : http://www.midibox.org/dokuwiki/aout_ng#parts_list

DOUT (Gate/Trig/Clock)

The DOUT module (also referred to as DOUTX4 and DOUT_R5) is the digital output expansion for MBHP, and can be used for a variety of applications. With a MIDIBox SeqV4, it is typically used to send gate, trigger, and clock signals to analog equipment like synthesizers and drum machines. "Digital" in this instance means that there are two states to the signal: high and low, on and off, 5V and 0V, as examples. The suffix "X4" indicates that there are 4 separate shift registers, each providing 8 outputs, so a single DOUT board can deliver 32 outputs. Modules may be daisy-chained to add more outputs, or you can choose not to populate the entire board if you only require 8/16/24 outputs. Shift registers are assigned in the



I used individual resistors rather than the resistor array ICs. As with the AOUT_NG, I fabricated output PCBs for my breakout box/panel so I don't have to do any point-to-point wiring. These include LEDs and LED driver circuits for each output.

http://www.ucapps.de/mbhp_dout.html

Purchase

Board only : <https://modularaddict.com/manufacture/midibox/midibox-dout-pcb>

My Mouser Kit : <https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=deb19a45b2>

Schematics/Images/Files/Parts List

Parts List : http://www.ucapps.de/mbhp/mbhp_doutx4_r5_orderlist.txt

Schematic : http://www.ucapps.de/mbhp/mbhp_doutx4_r5.pdf

Dual-Layer Image : http://www.midibox-shop.com/images/dout/DOUT_R5qv.gif

PCB Image : http://www.ucapps.de/mbhp/mbhp_dout_r5_detail.jpg

Video Examples/Demos:

The following videos are posted with permission from Andrew Scheidler and cover some of the basics of what the SEQv4 can do:

MIDIBox Sequencer V4 - Part 1 - Note Track Basics

MIDIBox Sequencer V4 - Part 2 - Note Track Basics

MIDIBox Sequencer V4 - Part 3 - Note Tracks & Transpose

MIDIBox Sequencer V4 - Part 4 - Note Track Parameters & Triggers

MIDIBox Sequencer V4 - Part 5 - Arpeggiator Intro

MIDIBox Sequencer V4 - Part 6 - Delay layer

MIDIBox Sequencer V4 - Part 7 - Glide & Slide 303 Style

MIDIBox Sequencer V4 - Part 8 - CV/Gate/Triggers!

MIDIBox Sequencer V4 - Part 9 - Jam mode

MIDIBox Sequencer V4 - Part 10 - Step Triggering

Posted by Nicholas Keller at 6:09 PM

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