Through-hole Braids

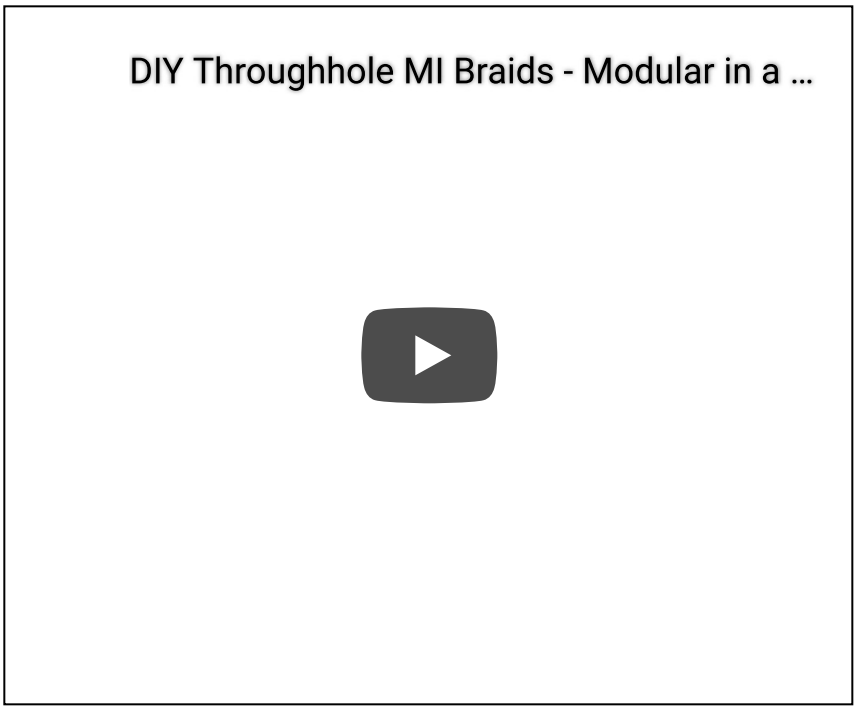
Contents

Features

- Through hole version of Mutable Instruments Braids (https://mutable-instruments.net/modules/braids/)
- Braids is a voltage-controlled monophonic digital sound source

Credits / Resources

- Ordered card set from Sourcery Studios on Tindie (https://www.tindie.com/products/Sourcery/braids-throughhole-pcb-and-panel-set/)
  - Sound-Force.nl (https://sound-force.nl/?page_id=3179)
  - Front Panel (https://github.com/MyModularJourney/Braids)
- Vagrant environment for Mutable Instruments modules hacking (https://github.com/pichenettes/mutable-dev-environment)
- Schematic (https://sound-force.nl/wp-content/uploads/2020/07/braids_through-hole_V1.2.pdf)
- BOM (https://docs.google.com/spreadsheets/d/1Df8stfFI7w85-BXjg3eo-WGQV3X9572D4Pd4wxk09Cs/edit?usp=sharing)



Original Braids

- Braids page (https://mutable-instruments.net/modules/braids/)
  - Braids Manual (https://mutable-instruments.net/modules/braids/manual/)

- 16 HP
- 25mm deep
- +12V@100mA, -12V@15mA
- Braids Through Hole version has differences
  - Output is PWM
  - A/D is 10-bits

Original Braids Features

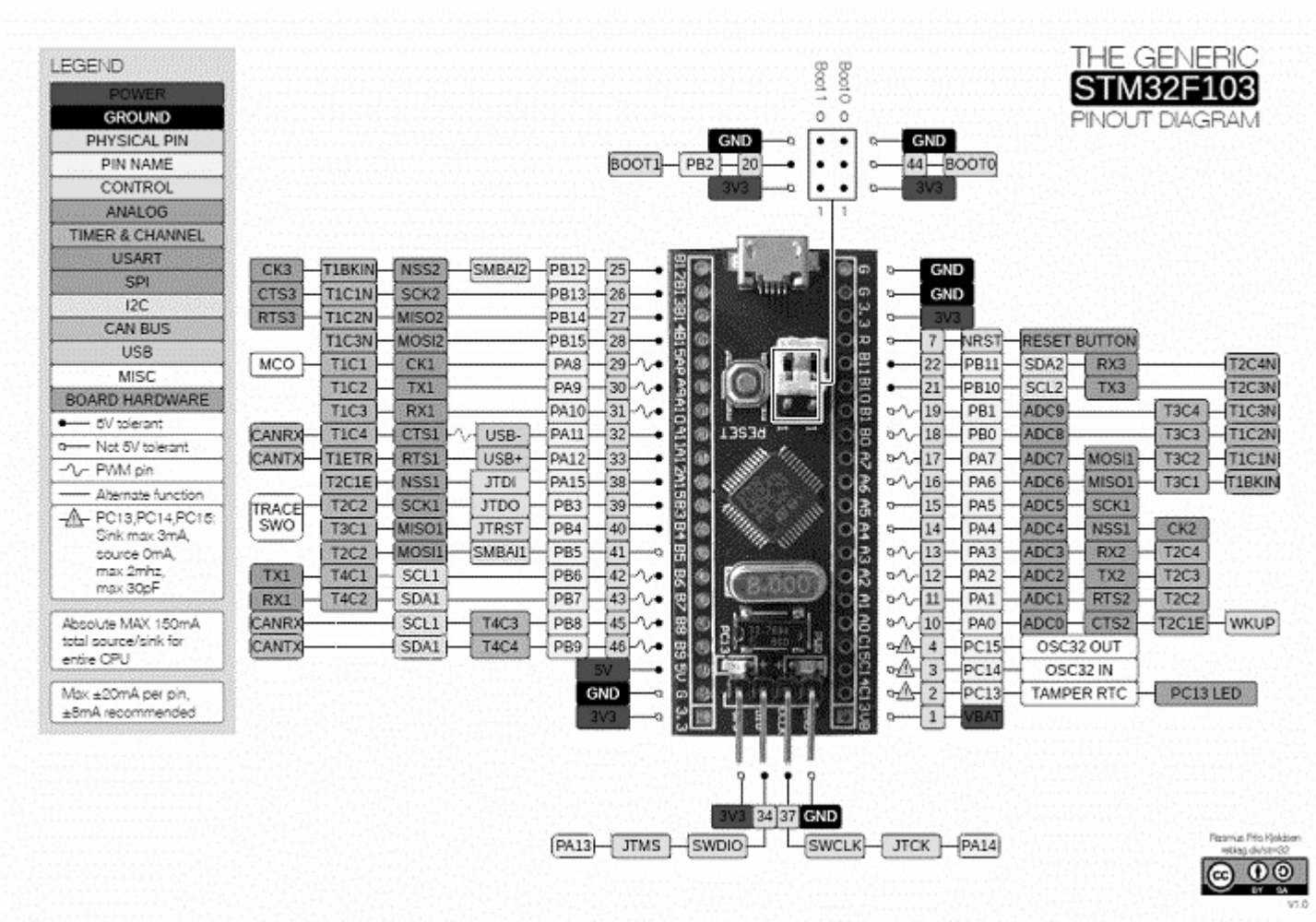
AN ATLAS OF WAVEFORM GENERATION TECHNIQUES

- Braids is a voltage-controlled monophonic digital sound source.
- Sound source… like an oscillator? Not really.
  - Most of the timbres it generates are so complex that approaching them with a classic analog modular setup would require a full case of oscillators, filters, VCAs, waveshapers and ring-modulators – that's why we call it a macro-oscillator – intricate digital synthesis algorithms wrapped in oscillator's clothes.
- 2 KNOBS TO RULE THEM ALL
  - Each algorithm is controlled by two continuously variable parameters, TIMBRE and COLOR, both of them voltage controllable.
  - Instead of being directly assigned to the intricate details of the synthesis algorithm, they work as meta-parameters going through all the sweet spots.
  - Very often, these parameters simultaneously affect several dimensions of timbre, creating very complex movements which would be hard to generate with a traditional setup.
- Synthesis models
- The classics
  - CS-80 style sawtooth with a notch.
  - Continuously variable morphing between triangle, sawtooth, square and pulse, with character control.
  - Square/sawtooth with pulse width control.
  - Triangle to sine morphing, with wavefolder.
- Direct digital synthesis
  - Band-limited dual pulse train, with detuning.
  - Dual square or sawtooth oscillator with hard sync.
  - Triple saw, square, triangle or sine.
  - Stack of three ring-modulated sine waves.
  - Swarm of seven sawtooth waves.
  - Comb-filtered sawtooth wave
  - Circuit-bent sawtooth generator with sample rate reduction and bit toggling.
  - Direct synthesis of filtered waveforms, casio CZ style.
  - Low-fi or hi-fi vowel/formant synthesis.
  - Harmonic oscillator.
  - FM with various feedback paths.
- Physical and percussive models
  - Plucked string (Karplus Strong).
  - Bowed string.
  - Reed and flute.
  - Bell and metallic drum.
  - 808 bass drum, cymbal noise and snare drum.
- Wavetables
  - 256 waveforms, organized as 21 wavetables or as a 16x16 XY map.
  - 4-note chord synthesis.
- Noise sources
  - Noise processed by a tuned multimode filter.
  - Noise processed by a dual BP filter.
  - Clocked digital noise.
  - Cloud of sinusoidal grains.
  - Particle synthesis.

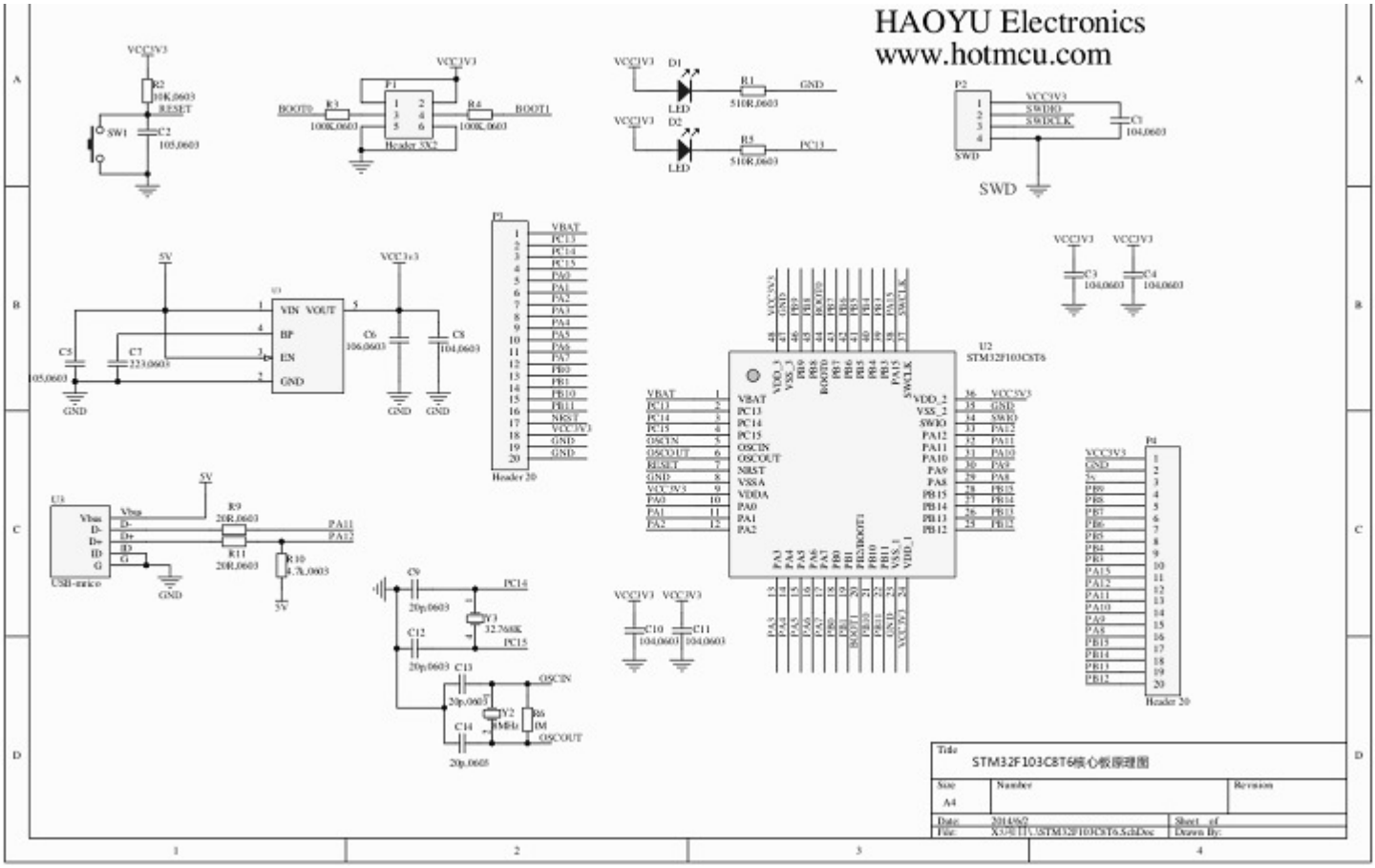
- Additional settings
  - These settings are accessible through a menu, and are not CV controllable.
  - Bit-depth (from 4 to 16 bits) and sample rate (from 4kHz to 96kHz).
  - Quantizer on the CV-input with a large selection of scales.
  - Analog VCO-style linear detuning of higher frequencies.
  - Analog VCO-style pitch drifting.
  - Waveform quirks, unique to each module built.
  - Built-in AD envelope, assignable to the oscillator frequency, the COLOR and TIMBRE parameters, and to the amplitude.
  - META mode enabling CV-controlled model selection with the FM input.
- Specifications
  - All inputs: 100k impedance, DC to 4kHz.
  - 12-bit CV capture.
  - 96kHz, 16-bit audio processing (some algorithms are 2x or 4x oversampled).

STM32 "Blue Pill"

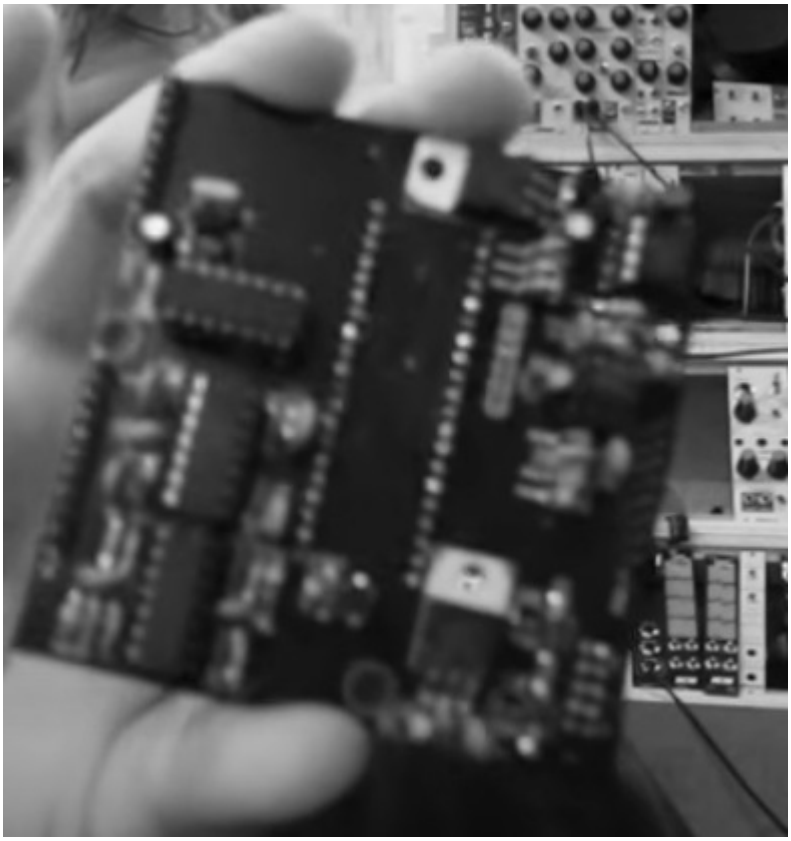
- "Blue Pill" Pins



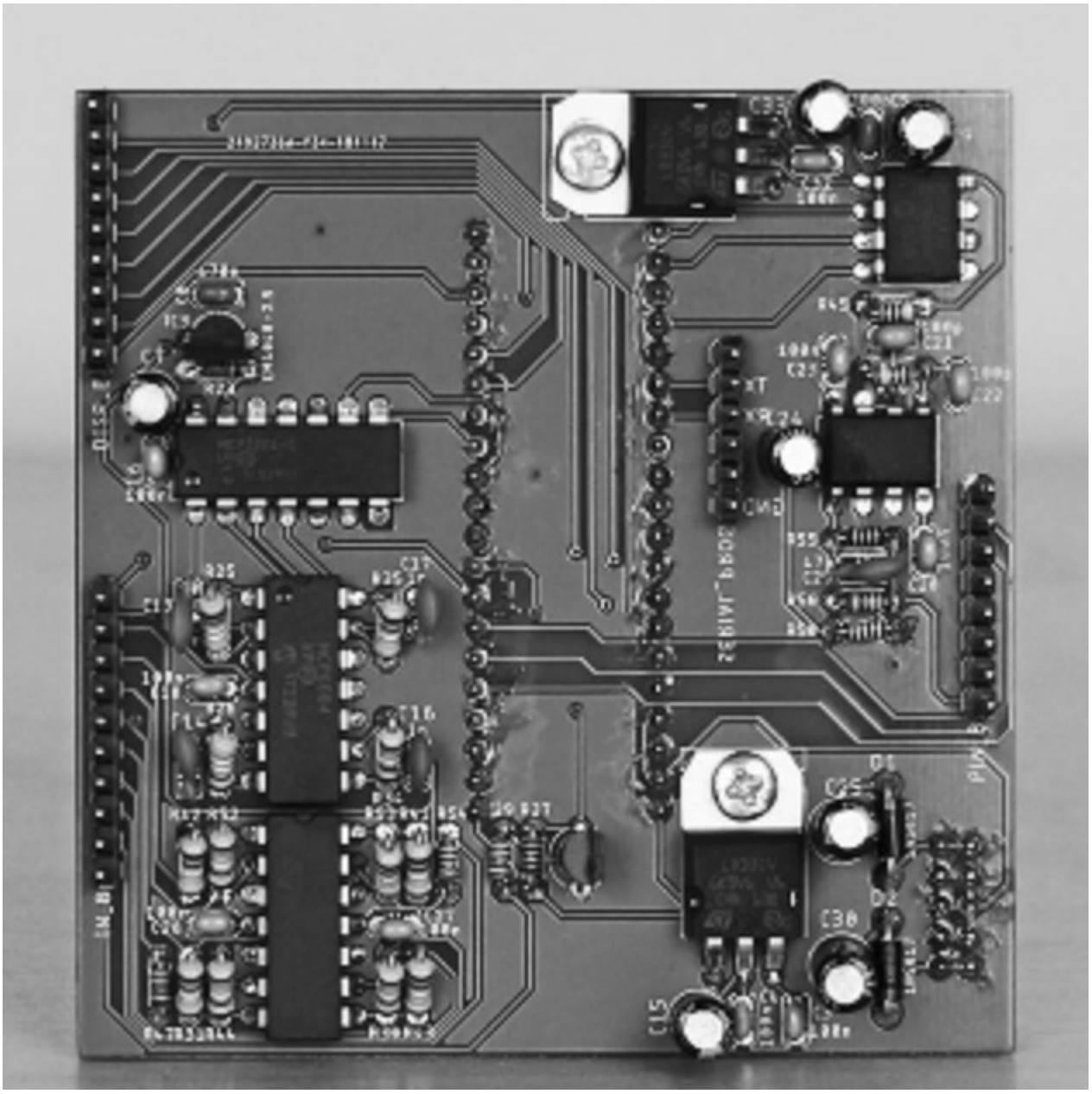
- "Blue Pill" Schematic

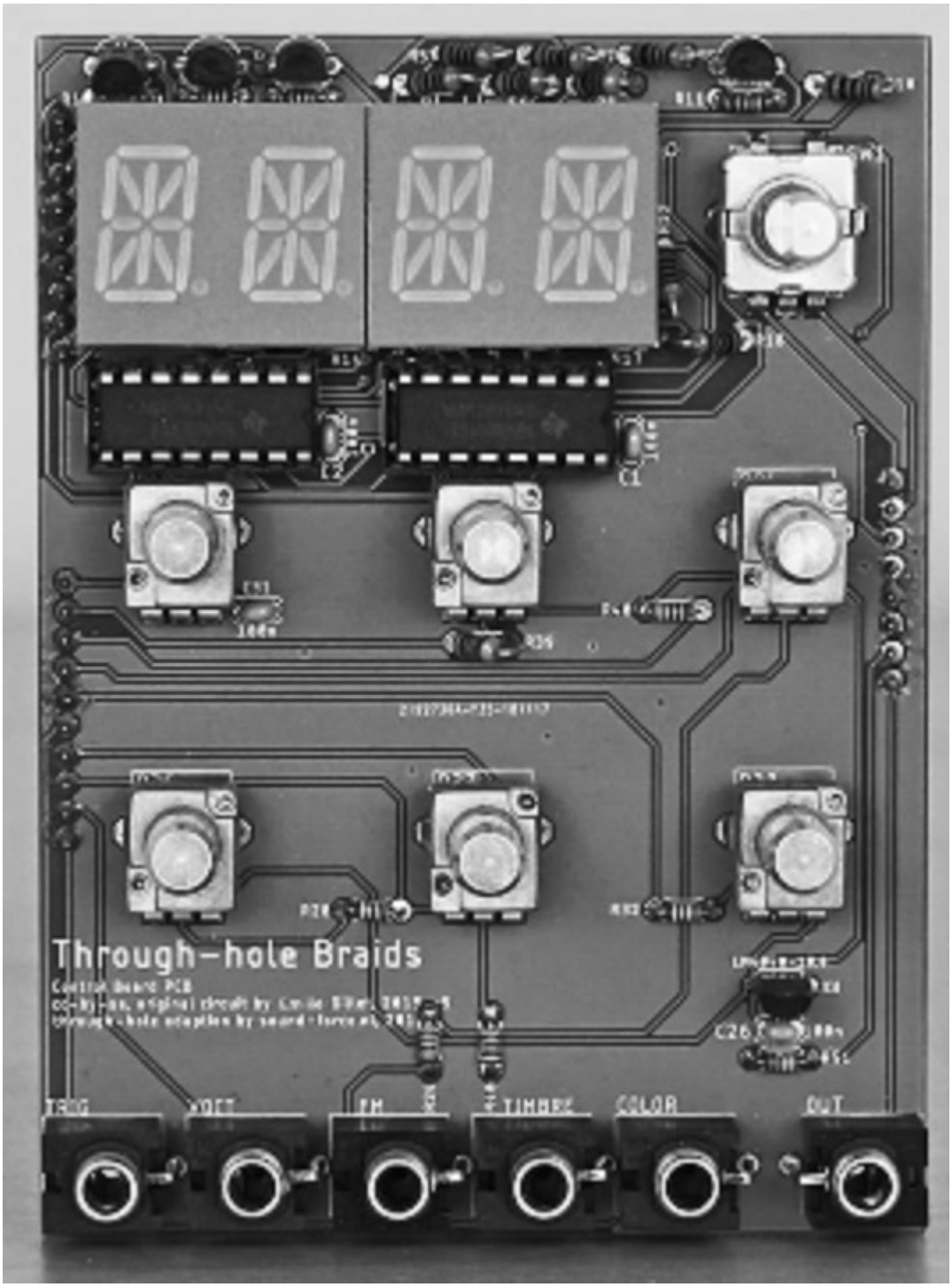


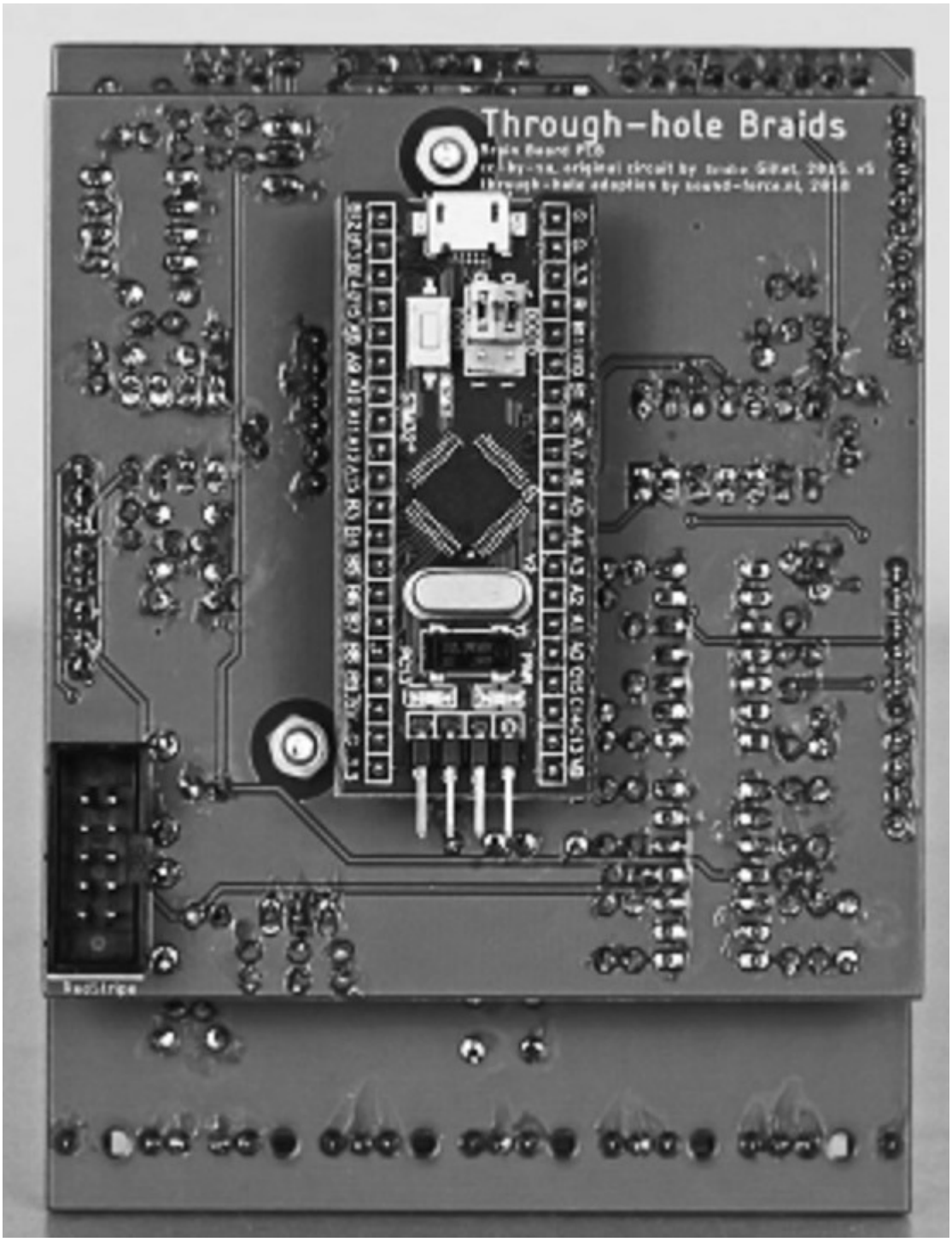
Show Screen Caps



- From sound-force (https://sound-force.nl/?page_id=3179)




Through-hole Braids
TRIG
XOFF
FM
TIMBRE
COLOR
OUT



Braids Show Notes

- Get the PCB set with panel and both PCBs for 9$ at Kristian's Tindie store (https://www.tindie.com/products/27457/)
  - Tindie store (https://www.tindie.com/stores/Sourcery/)
  - (Or) Download the Gerber files (https://sound-force.nl/?page_id=3179)
- Get a STM32 Programmer here (https://www.aliexpress.us/item/3256801435312142.html?aff_fcid=19e3c157d442455d96274e2a86d0207e-1668328775090-01714-_Ddyuri3&tt=CPS_NORMAL&aff_fsk=_Ddyuri3&aff_platform=shareComponent-detail&sk=_Ddyuri3&aff_trace_key=19e3c157d442455d96274e2a86d0207e-1668328775090-01714-_Ddyuri3&terminal_id=27d42930204b4f3ca90005888e7c8cd4&afSmartRedirect=y&gatewayAdapt=glo2usa4itemAdapt&_randl_shipto=US)
- STM32F013CBT8 (128kb version) on ebay... not that many to choose from :/
  - The STM32F103C8T6 is the 64kb version and thus too small but SOMETIMES they are 128kb

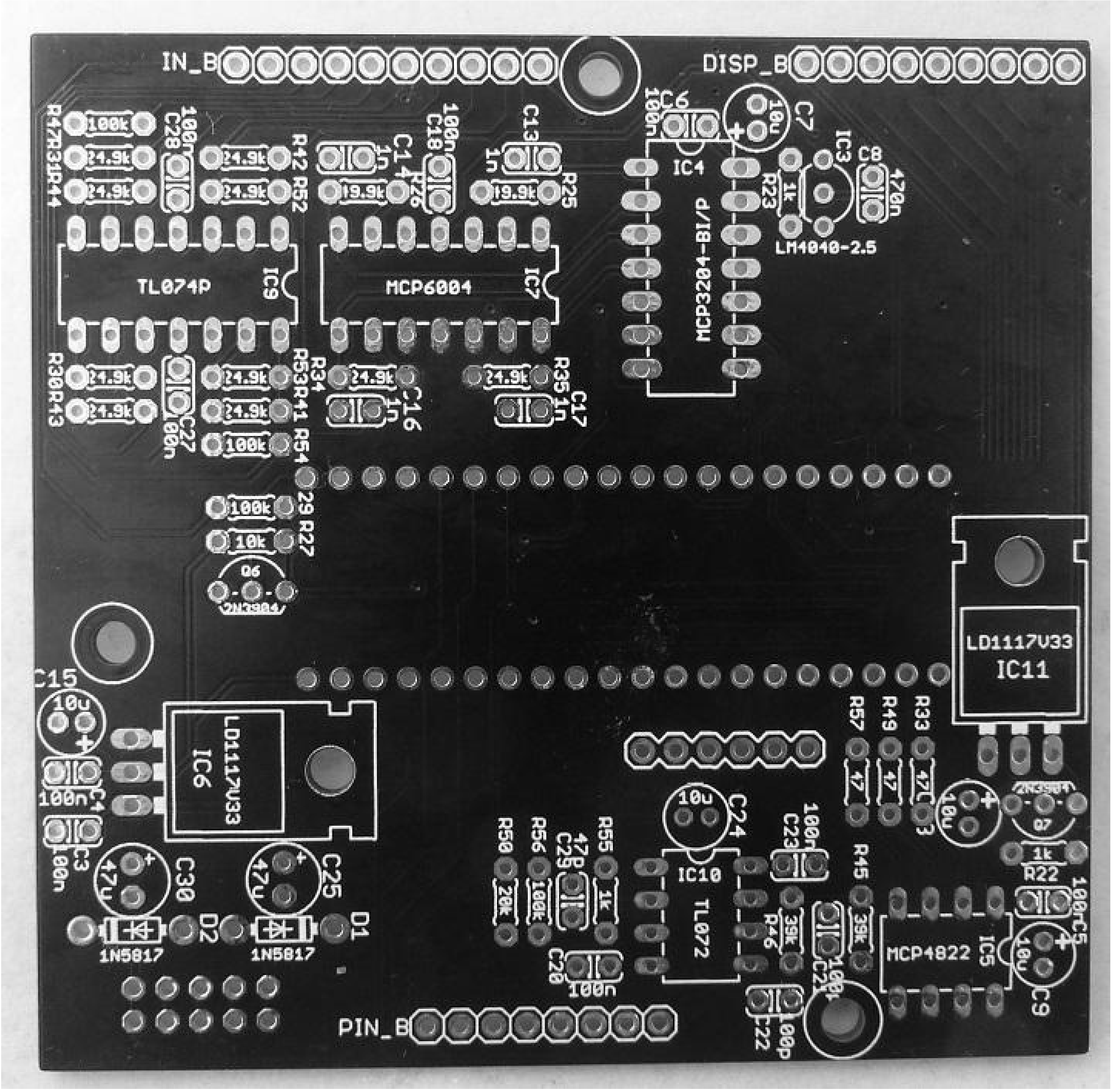
- Front panel gerber by MyModularJourney (https://github.com/MyModularJourney/Braids)
- Braids illustrated. all the waveforms explained (http://www.vo1t.com/Euro//BraidsIllustrated1.8.pdf)
- Emilie Gilet / Mutable Instruments modules Github (https://github.com/pichenettes/eurorack)
  - Braids specific files (https://github.com/pichenettes/eurorack/tree/master/braids)
- Modular in a Week playlist (https://www.youtube.com/playlist?list=PLyE56WXw0_5Q5QGMEXWmskuhojKyRdA3T)
- Support Kristian's work on Patreon (https://www.patreon.com/SourceryOne)
- Kristian's Discord server (https://discord.gg/pZtVheVCTW) - where you find the mi-th-braids channel and much more]
  - See mi-th-braids channel
  - See pinned messages
- Braids Manual (https://mutable-instruments.net/modules/braids/manual/)

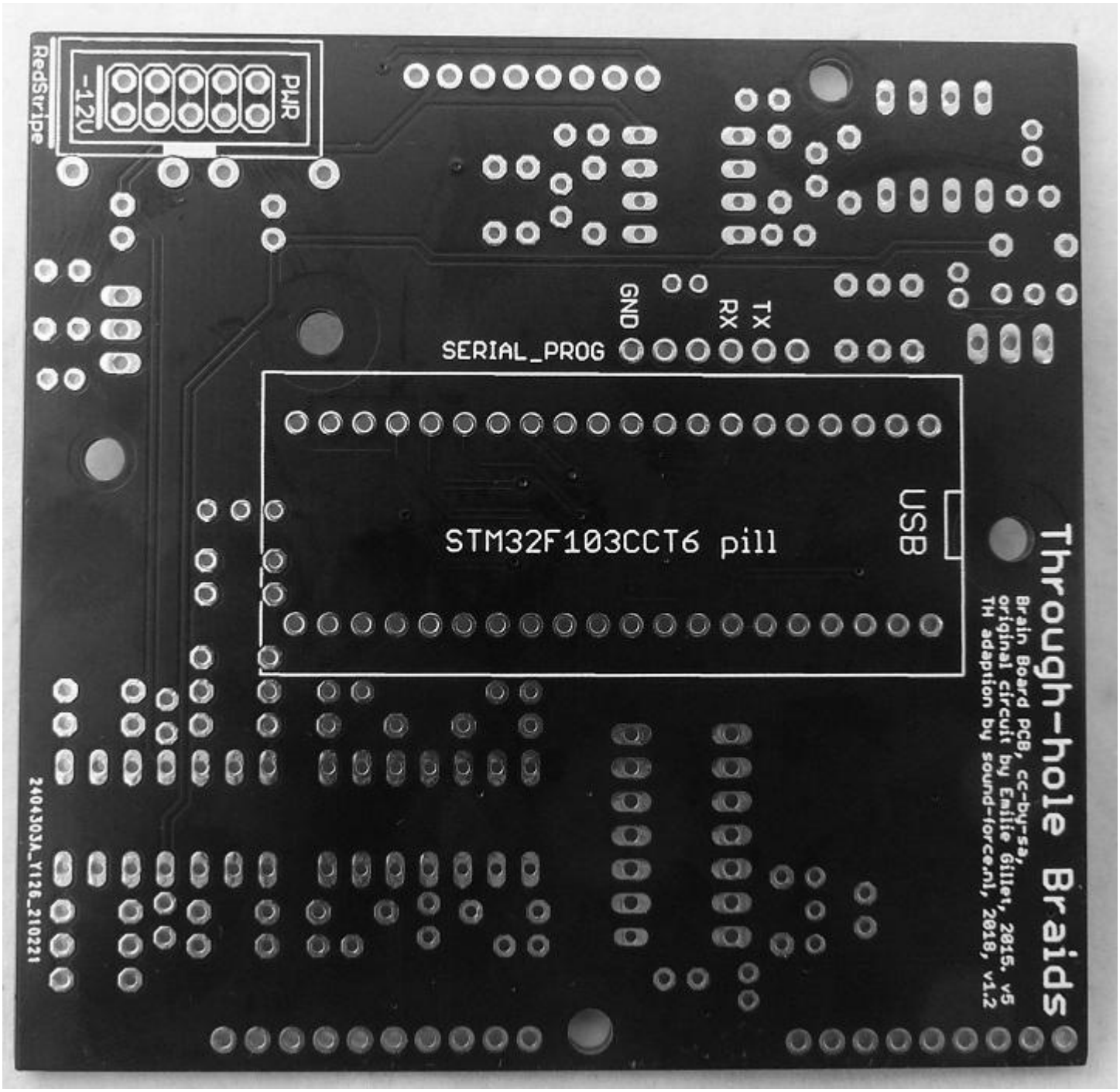
Build

- Assembly Notes (https://docs.google.com/document/d/1Abn1zaVfb9EWQT7AOmkBqb_WW_tSImPcawUhbSnykno/edit?usp=sharing)

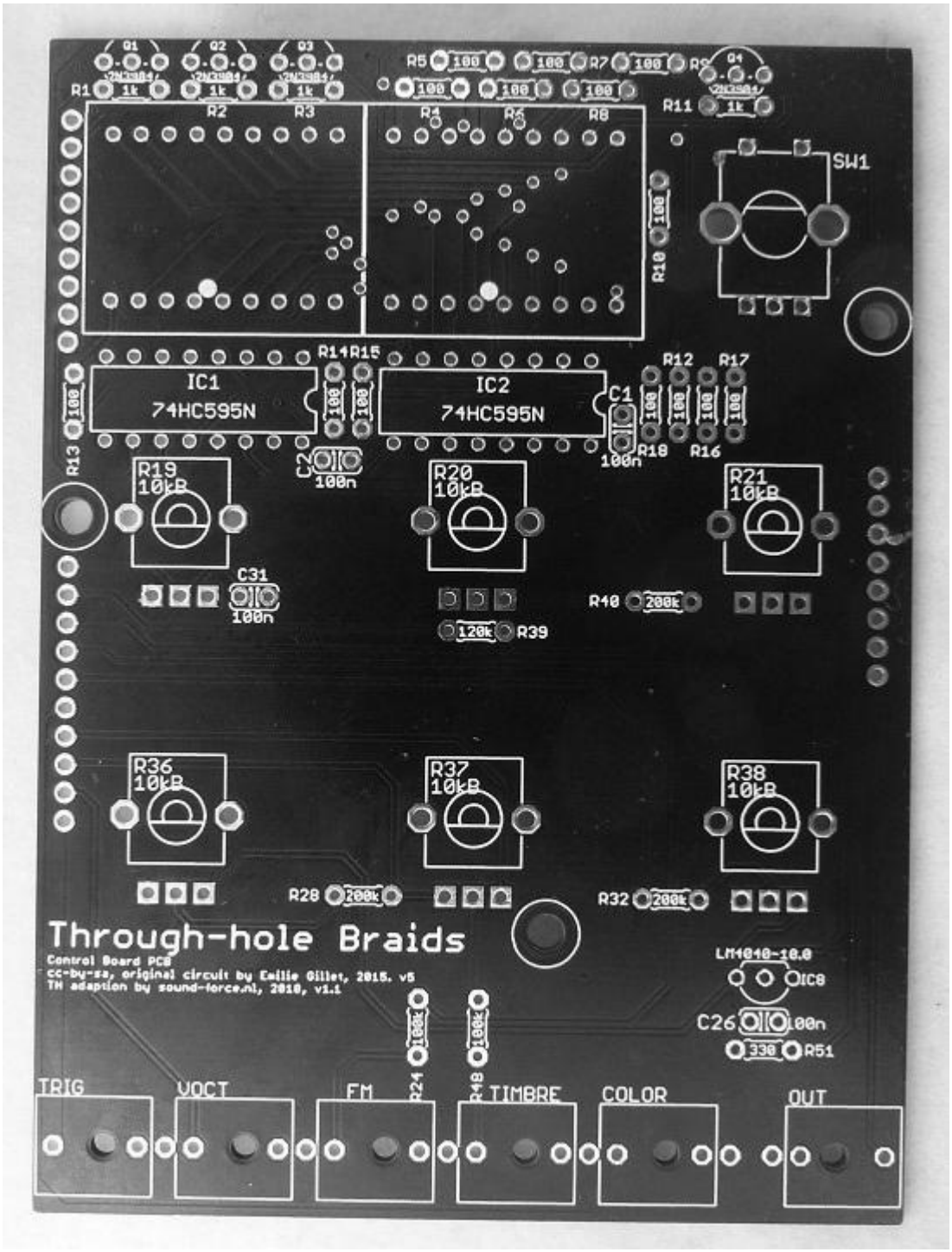
```
The PCBs were drawn with both parts numbers and part values on, so you can work faster without checking the BOM every
5 seconds. I also added PDFs of the PCB silkscreens on the project page, as the printed silkscreens can be sometimes
low resolution and difficult to read.

Recommendations:

- Always start with the lowest profile part (resistors) and then move on to next “in height”
- Check twice, solder once!!
- It’s better to solder all the resistors located around the display at the BACK of the PCB, as they are quite close
to the edge of the display.
- It’s better to solder the display when the front panel has been mounted so you can make it as flush as possible with
the back of the from panel.
- The STM32F103/blue pill needs to be soldered at the back!!
- Use female headers for the STM32F103!
- You can use sockets for all the ICs, especially if you are starting with Synth DIY
- You can screw the voltage regulators to the PCB for better heat sinking using M3 screw and nut
- The voltage reference have different grades (A, B, C, D), A means the best. MI uses C grade for all CV inputs (VOCT
as well). But you can use B or A, use D will probably not ruin your module.
- The voltage regulators could be either LM or LD1117
- If you got a V1.0 PCB, you won’t need R22 and Q7 around the analog 3.3V voltage regulator
```

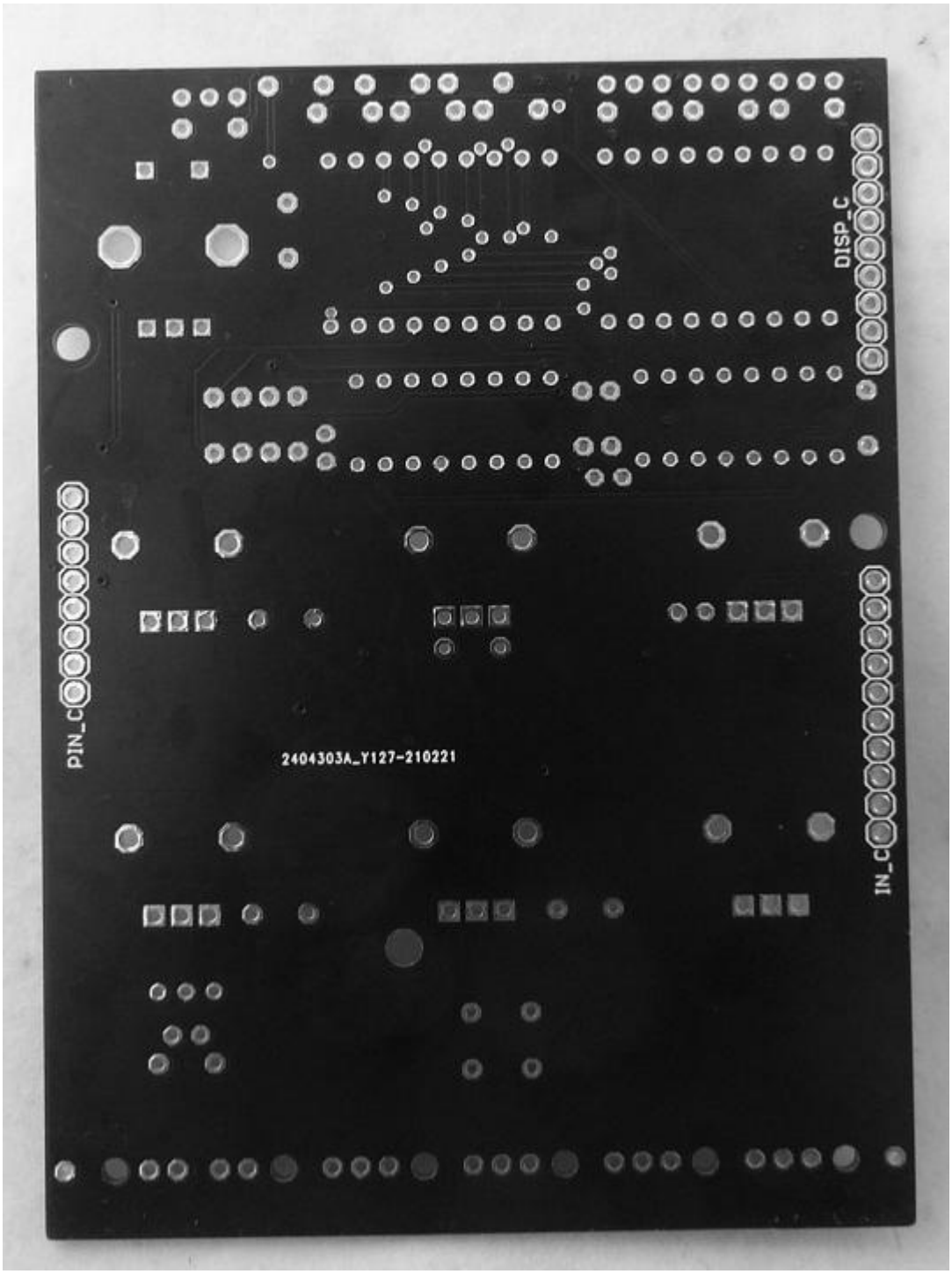
Processing Card


IN_B
DISP_B
TL074P
IC9
MCP6004
IC7
IC4
MCP3204-BI/P
IC3
LM4040-2.5
LD1117V33
IC11
IC6
IC10
TL072
MCP4822
IC5
1N5817
D1
D2
PIN_B
2N3904
Q6
C15
C25
C30
C24
R22
C5
C9



Controls Card


Q1
Q2
Q3
Q4
2N3904
R1
1k
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
100
SW1
IC1
74HC595N
IC2
74HC595N
R12
R13
R14
R15
R16
R17
R18
C1
100n
C2
R19
10kB
R20
10kB
R21
10kB
C31
R39
120k
R40
200k
R36
10kB
R37
10kB
R38
10kB
R28
R32
Through-hole Braids
Control Board PCB
cc-by-sa, original circuit by Emilie Gillet, 2015. v5
TH adaption by sound-force.nl, 2018, v1.1
LM4040-10.0
IC8
C26
100n
330
R51
R24
R48
TRIG
VOCT
FM
TIMBRE
COLOR
OUT



Parts List

Controls Card Parts List

Qty	Index	Desc
14	R4-R10, R12-R18 (R4-R9 on rear)	100 Resistor, 1%
1	R51	330 Resistor, 1%
7	R1-R3, R11, R22, R23, R55 (R1-R3 on rear)	1k Resistor, 1%
1	R27	10k Resistor, 1%
1	R50	20k Resistor, 1%
10	R30, R31, R34, R35, R41-R44, R52, R53	24.9k Resistor, 1%
2	R45, R46	39k Resistor, 1%
2	R25, R26	49.9k Resistor, 1%
6	R24, R29, R47, R48, R54, R56	100k Resistor, 1%
1	R39	120k Resistor, 1%
3	R28, R32, R40	200k Resistor, 1%
3	R33, R49, R57 (Optional see note, only on Brain 1.2)	47 Resistor, 1%
1	C29	47p Capacitor, ceramic
2	C21, C22	100p Capacitor, ceramic
4	C13, C14, C16, C17	1n Capacitor, ceramic
13	C1-C6, C18, C20, C23, C26, C27, C28, C31	100n Capacitor, ceramic
1	C8	470n Capacitor, ceramic
1	C24	10u Capacitor, electrolytic NP
4	C7, C9, C15, C33	10u Capacitor, electrolytic
2	C25, C30	47u Capacitor, electrolytic
2	D1, D2	1N5817
2	IC1, IC2	SN74HC595
1	IC3	2.5V LM4040 Shunt Vref
1	IC4	MCP3204 quad 12-bit ADC
1	IC5	MCP4822 dual 12-bit DAC
2	IC6, IC11	3.3V LD1117V33
1	IC7	MCP6004 dual op-amp R2R IO
1	IC8	10V LM4040 Shunt Vref
1	IC9	TL074 quad op-amp
1	IC10	TL072 dual op-amp
6	Q1-Q4, Q6, Q7	NPN transistor 2N3904
1	UC1	STM32F103C8T6 NEEDS TO BE 124kb

Display Card Parts List

- 5pcs Red Common Cathode 14 segment display (https://www.aliexpress.us/item/2251801139870562.html?aff_fcid=3b9fa86eb0554ff29ba0a6b77c812cbd-1668328660760-01745-_DFPvQEB&tt=CPS_NORMAL&aff_fsk=_DFPvQEB&aff_platform=shareComponent-detail&sk=_DFPvQEB&aff_trace_key=3b9fa86eb0554ff29ba0a6b77c812cbd-16683286

60760-01745-_DFPvQEB&terminal_id=27d42930204b4f3ca90005888e7c8cd4&afSmartRedirect=y&gatewayAdapt=glo2usa4itemAdapt&_randl_shipto=US) - **MAKE SURE TO CHOOSE COMMON CATHODE**

Qty	Index	Desc
2	DISP1, DISP2	Red Common Cathode 14 segment display (https://www.aliexpress.us/item/2251801139870562.html?aff_fcid=3b9fa86eb0554ff29ba0a6b77c812cbd-1668328660760-01745-_DFPvQEB&tt=CPS_NORMAL&aff_fsk=_DFPvQEB&aff_platform=shareComponent-detail&sk=_DFPvQEB&aff_trace_key=3b9fa86eb0554ff29ba0a6b77c812cbd-1668328660760-01745-_DFPvQEB&terminal_id=27d42930204b4f3ca90005888e7c8cd4&afSmartRedirect=y&gatewayAdapt=glo2usa4itemAdapt&_randl_shipto=US)
6	COLOR, FM, OUT, TIMBRE, TRIG, VOCT	Vertical jack connector
6	R19-R21, R36-R38	10k linear pot, 15mm shaft
1	SW1	Encoder, 24 steps w/ clicks, w/ switch
	Headers	
	Single row male	1X06, 1X10, 1X8, 1X09
	Single row female	1X10, 1X8, 1X09,
2	Female header for the blue pill (optional)	1x20
	Euro power	2x05 (Preferably shrouded)
	Programmer	
	Programmer to program the STM32 board	
	Alternative Serial "programmer"	or FTDI's or CH430

Software

- ST-Link V2 pinout (https://dh1tw.de/2020/01/st-link-blue-pill-development-board/) - corrections to pinout

Videos

Modular Monthly: A guide to Mutable Instr…

Going Modular: Mutable Instruments Brai…

Braids through-hole super rough demo