
DIRTY ELECTRONICS
MUTE 2018
MUTE
4.0
SYNTH

DISCLAIMER & WARRANTY

Disclaimer

THE SELLER AND AUTHOR DISCLAIM ANY LIABILITY FOR DAMAGES AND INJURY THAT MAY RESULT FROM THE USE, PROPER OR IMPROPER, OF THE MUTE 4.0 SYNTH. THERE IS NO GUARANTEE THAT THE INFORMATION FOUND IN THE DOCUMENTATION IS COMPLETE, SAFE OR ACCURATE.

THE SELLER AND AUTHOR DISCLAIM ANY LIABILITY FOR DAMAGES AND INJURY THAT MAY RESULT FROM FAULTY EXTERNAL ELECTRONIC EQUIPMENT PLUGGED INTO OR CONNECTED TO THE MUTE 4.0 SYNTH.

Warranty and return policy

The Mute 4.0 Synth is assembled by hand in the UK and comes with a 12 month warranty. This does not include malfunction due to misuse of the device, such as being dropped, crushed or exposed to liquids. Any mods or hacks are at the risk of the owner. The warranty does not cover shipping charges.

Notice

Do not place the Synth on conductive surfaces, such as a metal table, and avoid loose objects touching the bottom-side of the circuit boards.

Take care with the battery connection particularly when moving the Synth with the battery connected. The battery clip connecter can be replaced by disconnecting it from the battery terminal with a screwdriver.

Make sure the connection to the battery terminal is correct (see guide).

Store small parts out of the reach of children and infants.

BATTERY OPERATION ONLY (9V, PP3)

MUTE 4.0 SYNTH - GETTING STARTED

[see fig. Mute 4.0 Synth]

Requires 9 volt PP3 battery (not provided)

Connect battery - battery clip (top left)

Connect audio output/jack socket (top right) to output, amp/speakers or headphones - use a 3.5 mm (TRS/stereo) with jumper J14 (red) inserted (default)

Set switches to default position - all down; horizontal switches (CV4/CV5) to the right; and fully turn down (anti-clockwise) sound sources 1 and 2 (mix1/mix2)

Power off/on switch (top left) - when on (down) the red LED display should light (CV no. 1/ see programming CVs)

Select ‘dot’ (P1/P2) - Dirty Electronics Voltage Collection

Adjust pots mix1 and mix2 to listen to the Collection

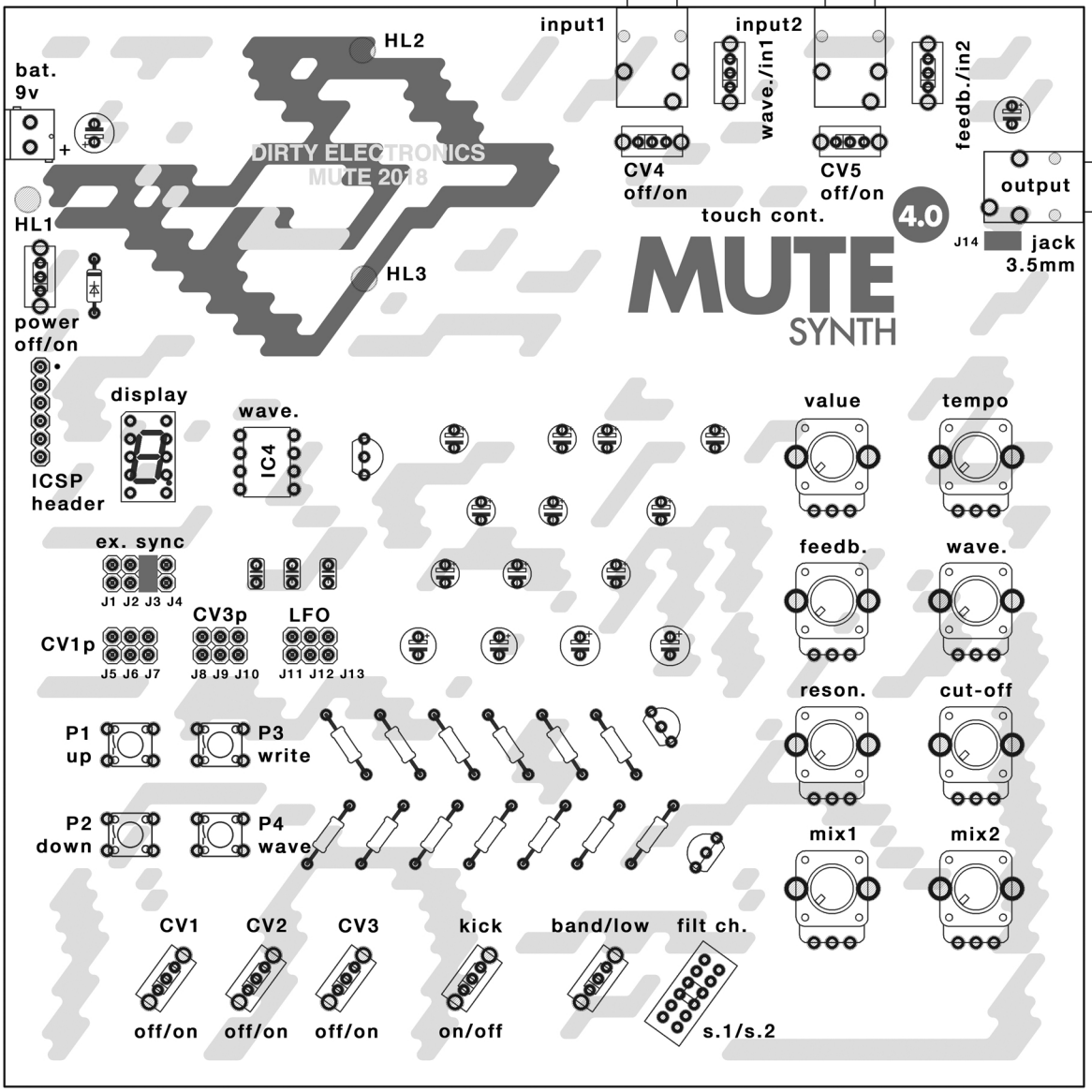
Play with pots/knobs and switches of the Synth (see guide for each feature)

Change the tempo of the sequence - tempo (clockwise = faster; anti-clockwise = slower)

Try different patches using the pull-tab jumpers

Lick your fingers and the touch silver graphics ‘MUTE 4.0’ (see touch control)

Detailed instructions can be found in this document for programming your own sequences and control voltages (CVs)


input1
input2
wave./in1
feedb./in2
bat.
9v
HL2
DIRTY ELECTRONICS
MUTE 2018
CV4
off/on
CV5
off/on
output
touch cont.
4.0
J14
jack
3.5mm
MUTE
SYNTH
HL1
HL3
power
off/on
display
wave.
IC4
ICSP
header
value
tempo
ex. sync
J1 J2 J3 J4
feedb.
wave.
CV1p
J5 J6 J7
CV3p
J8 J9 J10
LFO
J11 J12 J13
reson.
cut-off
P1
up
P3
write
P2
down
P4
wave
mix1
mix2
CV1
CV2
CV3
kick
band/low
filt ch.
off/on
off/on
off/on
on/off
s.1/s.2

MUTE 4.0 SYNTH - GUIDE ED. 1 (JR18)

The Dirty Electronics MUTE 4.0 SYNTH is a synth with inputs, a digital wavetable synthesiser, an analogue noise circuit, and programmable sequencer. These features can all be combined in an environment to experiment with sound. Being hand-held, battery-powered and with headphone and line out, the synth is ideal for music making on the move as well as in the studio. At a turn of a knob and press of a button, sequences, control voltages, and cut-up loops can be programmed; or listen to the Voltage Collection by Dirty Electronics.

The MUTE 4.0 SYNTH is on-going research by Dirty Electronics into making music with wires and code, objects and materials; and an artwork printed circuit board collaboration with Adrian Shaughnessy and Regular Practice. Printed circuit board meets album cover.

Expand the Synth with a limited edition chip by Dirty Electronics and Max Wainwright with mangled waveforms and accompanying fold-out booklet on microcomputer music.

Features
Two inputs/sound sources - mixer
Sequencer (programmable)
Programmable control voltages (x5) +5v
Cut-up - brassage (programmable)
On-board wavetable synth (select sounds and algorithms)
Feedback/noise circuit
Filter (VCF) - bandpass/lowpass + resonance
Portamento
LFO
Touch and knob/pot controls
External sync
Battery powered (9v)
Headphone/line out
Hackable
Expandable - chip releases
Artwork PCB

mute.com
dirtyelectronics.org

Two inputs/sound sources - mixer
The Mute 4.0 Synth is a synth with inputs. Two sounds can be played and mixed independently (mix1 and mix2). Sounds can be from an external sound source (input1 and input2) or from the on-board wavetable synth (wave.) and feedback/noise circuit (feedb.). Use a 3.5mm jack socket to connect an external sound source to an input jack: for example, phone, cassette player, other synth.

External sound sources can be fed through the filter and gated; and controlled by CV3, CV4, CV5, and the LFO.

Sequencer and programmable CVs
Analogue voltages are created by a microprocessor and technique known as pulse width modulation (PWM) and filtering.

Control voltage range is from 0 to +5v.

There are five independent control voltages (CVs) (numbered on the LED display 1 - 5) that can be programmed:

1 = CV1 wavetable synth
2 = CV2 feedback/noise circuit
3 = CV3 voltage controlled filter/cut-off (VCF)
4 = CV4 gate (source 1)
5 = CV5 gate (source 2)

CV select (P1/P2) (LED display 1 - 5)
P1 count up through CVs
P2 count down through CVs

CV1 is dependent on the selected wavetable synth sound and may control pitch, filtering, etc.

CV2 controls the amplifier gain of the feedback/noise circuit resulting in a range sounds

CV3 voltage controlled filter (VCF) (see filter for details)

Cut-up - brassage (programmable)
Two sound sources can be cut-up/gated independently (wave./in1 and feedb./in2). This technique is akin to ‘brassage’ (French - a mash/brew) found in musique concrète where tape with recorded sound is cut into small segments and re-ordered and stuck back together. Although the Synth does not re-order segments - a gate is opened or closed on a ‘live’ sound - combining/gating two sound sources and looping the on-board wavetable synth or feedback/noise circuit, creates rhythmic, brassage-like sound effects.

CV4 and CV5 off (min value/anti-clockwise); on (max value/clockwise)

The gates for CV4 and CV5 are built around a MOSFET transistor. Although designed as an on/off function, slight distortion occurs at the threshold/knee of the gate, which can be used creatively.

CV1, CV2, CV3 can be switched on (down) or off (up); and CV4 and CV5 switched on (right) or off (left) with corresponding switches.

NOTE the Dirty Electronics Voltage Collection (dot display) can be manipulated in real-time, blurring the boundary between written piece of music, pre-set, and demo. The Collection is made from extended step sequences.

Example using CV1 and the wavetable synth
1. Switch on power (power off/on)
2. All switches down position (mixer1 = wave.) and the two horizontal switches (CV4 and CV5 to the right)
3. Select CV1 (LED display no. 1) (P1 up/P2 down)
4. Adjust pot value to select pitch/CV1 value. A continuous pitch should sound, one step looped. The range of value can be scaled/off-set using pot wave.
5. Write value using button P3 write
6. Adjust value to select another pitch (step 2). A 2-step sequence will loop (the speed of the sequence can be adjusted with tempo).
7. Etc. Values can be written/added until 16-steps are completed. On writing the seventeenth step, the values for the selected CV will be automatically cleared and the process will begin a new.
8. Other CV values remain and can be selected and added to until the maximum number of steps are reached. NOTE sequences have a maximum of 16-steps.

The same value can be written consecutively in the sequence to create different step (note) length, rhythms. In this example re. pitch, pseudo silences can also be generated by selecting values at the extremes of the range (above or below audible frequencies). Complex poly-rhythms can be created by combining different length CV sequences: for example, a three-step sequence (CV1) against a two-step sequence (CV2) etc. The overall length of the loop is subdivided proportionally for each CV.

The same method can be applied to programming all CVs.

When returning to a CV number, the last step in the sequence will re-read the current value from the pot value.

NOTE all programmed CV values will be lost on power-off

On-board wavetable synth
The Mute 4.0 Synth has an on-board digital wavetable synth (IC4). Select the wavetable synth wave./in1 switch (wave./down) (top).

There are five different sounds (pre-sets) that can be selected with button P4 wave. The bracket indicates the control parameter of knob/pot wave. and CV1:

1 = sine (pitch)
2 = sawtooth (pitch)
3 = FM bell (pitch)
4 = white/coloured noise (filter/low-pass)
5 = LFO (low-frequency oscillator) (pitch) (see LFO)

Button P4 wave incrementally cycles through the pre-sets. NOTE there is no LED display, indicator for the wavetable synth pre-sets: power-on = 1 (default).

NOTE pre-set 5 (LFO) is a sine tone with a frequency range below 20 Hz and does not 'sound'.

Pot wave. and CV1 (value) work together. The pitch range of CV1 can be scaled/off-set using pot wave. (as stated in example above), which pitch shifts, transposes the sequence.

CV1 can be switched off (bypassed) with CV1 switch (up/off; down/on).

mix1 is the volume control for the wavetable synth.

The digital wavetable synth (IC4) is designed to be removed and swapped with future chip releases containing new sets of sounds and algorithms (see chip releases for instructions).

Feedback/noise circuit
Analogue amplifier feedback using op-amps is a feature of many Dirty Electronics sound devices and covers a range of sounds including oscillation, noise, clicks and pulses. Select the feedback/noise circuit feedb./in2 switch (feedb./down) (top). The gain of the amplifier/amount of feedback, and resulting sounds, can be controlled by pot feedb. and CV2, which also work in tandem as CV1. NOTE the feedback is non-linear - sudden changes of sound may occur as the pot feedb. is turned. The battery charge will affect the quality of the feedback/noise circuit sound.

CV2 can be switched off (bypassed) with CV2 switch (up/off; down/on).

mix2 is the volume control for the feedback/noise circuit.

Filter (VCF) - bandpass/lowpass + resonance
The voltage controlled filter (VCF) circuit uses an operational transconductance amplifier (OTA) to produce a low-pass or band-pass filter (switch band/low) with resonance control (pot reson.).

The Mute 4.0 Synth has one filter only. This filter can be swapped between source 1 (s.1) and source 2 (s.2) with switch filt. ch. NOTE the switch may get stuck between the two settings due to its mechanism. Swapping the filter may also produce an audible pop or click.
The filter cut-off can be sequenced using CV3. This is linked to the overall tempo setting of the Synth. CV3 can be switched off (bypassed) with CV3 switch (up/off; down/on) allowing for manual control. Pot cut-off and CV3 (value) work together as CV1 and CV2.

Portamento
Two portamento (slide) pre-sets can be set for CV1 (wavetable synth) and CV3 (filter) using the pull-tab jumpers (CV1p/CV3p):

CV1p
J5 portamento fast
J6 portamento slow
J7 not connected/jumper holder

CV3p
J8 portamento fast
J9 portamento slow
J10 not connected/jumper holder

The kick switch puts a large capacitor in series with CV1. As the capacitor charges and discharges and with the wavetable synth set to a low frequency, a kind of electronic kick drum sound is produced. Other percussive sounds can be created with different wavetable synth pre-sets. NOTE with kick selected (on), the CV1 sequence becomes ‘abstracted’ (steps seem held or blurred).

Low-frequency oscillator (LFO)
The LFO is an added bonus of the Mute 4.0 Synth. The wavetable synth can be used to modulate other sound sources using the pull-tab jumpers (LFO), for example input1, input2 and the feedback/noise circuit. A range of modulated effects can be achieved using different wavetable pre-sets. Set the wavetable synth to pre-set 5 (LFO) for typical LFO-type results (vibrato and wobble etc.). The speed of the LFO is controlled by pot wave.

LFO
J11 wave./input1
J12 feedb./input2
J13 not connected/jumper holder

NOTE it is possible to modulate the wavetable synth with itself: (wave.) selected and J11 enabled. This results in phase-cancellation of the wavetable synth sound (weak sound). Modulation is created by opening and closing the gate of the MOSFET transistors with an audio signal (wavetable synth). As a result, CV4 and CV5 will also interact with, over-ride the LFO.

Touch controls
As well as knobs/pots, parameters of the Mute 4.0 Synth can be controlled by touching the 'MUTE 4.0' silver graphic (lick fingers).

Wavetable synth touch controls M U T
The common touch control is U. Different parameters, dependent on the wavetable synth pre-set, can be controlled by touching M U or U T. These touch controls are also dependent on pot wave. and CV1.

Feedback/noise circuit touch control
E 4.0 (feedback control) - dependent on pot feedb. and CV2

External sync
The internal tempo/clock requires J3 jumper (red) inserted. NOTE removal of this jumper will disable the internal clock and tempo.

ex. sync
J1 external CV tempo/internal CV out
J2 external CV trigger
J3 internal tempo/clock enable/disable
J4 not connected/jumper holder

With J3 inserted, J1 can be used as a tempo internal CV out to sync other external devices. Connect a jack socket/patchbay connector to J1 (top/+; bottom/-).

An external control voltage (0 to 5v) can be used to control the tempo/clock of the sequence. In this mode of operation, remove the internal clock jumper J3 and connect a jack socket/patchbay connector to J1 (top/+; bottom/-).

J4 of the external sync patchbay is not connected and intended as a holder for the jumper.

An external CV trigger can be used to reset/set sequences/CVs to their first step/index. Connect a jack socket/patchbay connector to J2 (top/+; bottom/-).

MIDI can be used for external tempo and trigger (sync) control by using a MIDI to CV interface; and an audio pulse or click (high gain) can also be used as a trigger.

Jack socket/patchbay connectors are not provided (see Dirty Electronics website for info).

Headphone/line out
Jumper J14 allows for two types of 3.5 mm jack plugs/connectors to be used for the output.

Mono summed - jumper J14 (red) inserted; a stereo (TRS) 3.5 mm jack plug (headphone listening)

Mono - no jumper J14; a mono 3.5 mm jack plug

Battery (info also in Disclaimer & Warranty)
Take care with the battery connection particularly when moving the Synth with the battery connected. The battery clip connecter can be replaced by disconnecting it from the battery terminal with a screwdriver (top left). Thread battery connector wires through hole (HL1) before fixing to battery connector to brace/take strain of connection.

A rubber band may be knotted and threaded through the battery holder holes (HL2/3) and used to secure the battery (not supplied).

Make sure the connection to the battery terminal is correct: top/negative (black/-); bottom/positive (red/+).

BATTERY OPERATION ONLY (9V, PP3)

Hackable and Expandable
It is possible to erase and write data on to the PIC microprocessor (IC1)(sequencer/Voltage Collection). IC1 is not read or write protected and is soldered to the bottom of the circuit board (surface mount). A compatible programmer can be connected to the ICSP header (dot = pin 1).

The wavetable synth (wave./IC4)(PIC12F1822) can be removed from the Synth (DIL socket), and replaced, swapped, or reprogrammed off-board. See also the limited edition chip by Dirty Electronics and Max Wainwright.

The Mute 4.0 Synth was developed using the PIC18F26K22, PIC12F1822, PICKIT3 and software MPLAB X IDE v4.15 with compiler xc8-v1.41.

NOTE any hacks or modification to the code or hardware are at the owners' risk.

Acknowledgements
Thanks to Paul A. Taylor, Daniel Miller, Adrian Shaughnessy, Regular Practice, Stu Smith, Jim Frize and Max Wainwright

DOCUMENT

Early design ideas
Design of the Mute 4.0 Synth started in early 2017. I got an email from Paul A. Taylor at Mute:

> subject: mute synth 3
> waddya think?
> how are you anyway?

Some meetings with Daniel Miller and Paul A. Taylor followed. We discussed not just a synth, but also a system. A system that could cope with the proliferation of evermore available sound-making devices and synths, and a way of combining different sound sources. I've been working with cassette tapes recently, and I liked the prospect of playing these, processing them through the synth. I also wanted to continue developing musical ideas using code, wire, and electronics, and working with raw materials, as well as building on past work and stuff I'd explored in limited edition runs and commissions for various festivals and events. There were the analogue circuits of course, but this also involved using microprocessors and simple filtering to create control voltages; and then, more recently, direct digital synthesis (DDS). I'd also explored the microprocessor as a way of storing data, such as text stored on chips. This started to pose a series of questions: 'What can be stored?' 'Is it a synth or is it a book?' 'What ideas, musical or otherwise, could be disseminated in this way?' I was also toying with the idea of putting together a voltage collection, a form of microcomputer music that could be stored on the synth's chip.

A feature of my work has been creating artwork printed circuit boards. I like to think that this is a more direct way of engaging with artwork, where the artwork is not packaging or cosmetic but actually functional. The use of layers, etching, lacquers and silkscreen prints present many artistic possibilities as well as providing a vehicle for collaboration with visual artists. Consequently, there has always been an emphasis on the visual appearance of the synths and creating a design that lets the artwork breath. For the Mute 4.0 Synth, this meant mounting some components on the back as well as the front of the printed circuit board. Artwork ideas, sketches and CAD drawings were sent back and forth between myself, Adrian Shaughnessy and Regular Practice. Yet I had still not finalised the design.

There were so many choices, possibilities, feature creep! I had to go back to the drawing board and make some hard decisions about what was essential. It became about minimising choices, and a process of subtraction. Distilling ideas: noisy, cheap, coffee table, hand-held, visual ... I started erasing features. The decision to use miniature patch cables also became an issue. Correspondence with Daniel led us to the decision of avoiding such fragile and fiddly wires in favour of a switch-based system for routing signals. This, despite not being as flexible and versatile as patch cables, gave a more immediate 'state of readiness' for play, and for play to occur without having to consult a manual.

Months flew by and I became stuck again programing a microprocessor to produce sound. It always felt like I was earning the right to be let into some inner circle of magicians and enacting a rite to get these small chips to make sound. What started out as an idea to make a simple digital white noise generator ended up being a long journey down a path of digital wavetable synthesis. I began making bass sounds like those of the Yamaha TX81Z. Then there was some kind of poor man's/woman's FM synthesis, mucking about with different waveforms and even Fourier transform. Coding wasn't the only concern. There were the idiosyncrasies of the microprocessors too, their configuration, how a line of code would result in sound artefacts or change the feel of pushing a button. It was like learning to play an instrument. The result is, without doubt, the dirtiest and cleanest synth I have designed to date.

Dirty Electronics Voltage Collection (dot display)
The Voltage Collection could be thought of as composition, group of sequences, set of data, range of patterns, or fancy pre-set written for the Mute 4.0 Synth. The extended sequences, the longest being 1440 steps, automate the synth making what could be considered a generative artwork. The sequences are built around a three-part form and themes of movement, stasis and repetition; and each of the five sequences present the themes in different orders often working against each other. There is no end as such to the Collection. Each of the five sequences is different in length resulting in shifting relationships between them as they loop. However, the Collection is open to interpretation. It is intended, not only to be listened to, but also interacted with. This interaction may take the form of bypassing individual sequences, simply mixing the two sound sources or changing the overall tempo.

There is a nod to the composer Iannis Xenakis and creating sequences using the technique of setting random variables with other functions, as well as a celebration of creating music with code and standalone microprocessors. The microprocessors of the Mute 4.0 Synth are used to generate wavetable digital synthesis and sequences. But they also offer a basis to store data and musical ideas that can be disseminated. Hence this also being a 'release', a physical edition: the Dirty Electronics Voltage Collection.

ARTWORK: ADRIAN SHAUGHNESSY & REGULAR PRACTICE