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Polytik 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.

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Notice

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

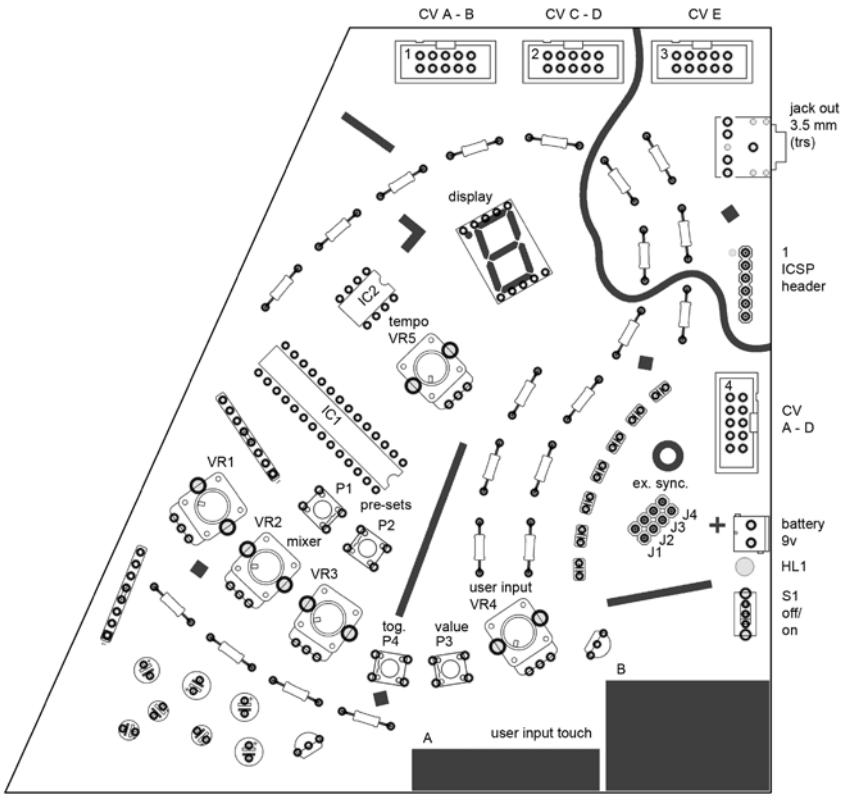
Take care with the battery connection particularly moving the Core module with the battery connected. The battery clip connecter can

be replaced by disconnecting it from the battery terminal with a screwdriver (Core top right). Thread battery connector wires through hole (Core HL1) before fixing to battery connector (to brace/take stain of connection).

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

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

POLYTIK – GETTING STARTED



THE MINIMUM REQUIREMENT FOR POLYTIK IS CORE +1 **(COMBI, VCO, NOISE, ETC.)**.

Requires 9 volt PP3 battery **(not provided)**

Connect ribbon cable **(provided)** - Core IDE Header 1 **(CV A - B) (Core top left)** to a sound module IDE Header

Connect battery - battery clip **(Core bottom right)**

Connect audio output/jack socket **(Core top right)** to amp/speakers or headphones - use a 3.5 mm **(TRS/stereo)** jack plug

On/off switch **(Core bottom right)** - when on **(down)** the red LED display should light

Adjust/mix the level of the sound module - Core VR1 pot **(IDE Header 1)**

Play with pots/knobs of the sound module **(see guide for separate modules)**

Change the tempo of the sequence - Core VR5 pot **(clockwise = faster; anti-clockwise = slower)**

Explore different patterns - Core P2 tactile switch **(up)**; P1 **(down)**

Try different patches using the pull-tab jumpers of the sound module

Lick your fingers and touch the silver graphics of the sound module **(see guide for separate modules)**

Detailed instructions can be downloaded from the Polytik website

POLYTIK – CORE & GUIDE

Dirty Electronics and Jack Featherstone come together through Artists & Engineers in the creation of a range of electronic sound modules. The work is a collection of printed circuit boards where the design is distributed across multiple boards. Polytik (a play on the word polyptych) explores electronic components, not only for functionality, but also their visual qualities, where components are laid out in abstract and graphical patterns. Circuit board production processes of coloured protective lacquers, copper traces, tin coatings and screen prints inform the design. Each circuit board is part of a customisable modular environment that combines noise generation and alternative electronic sound synthesis. The hybrid analogue/digital device investigates the intersection between generative system and gestural instrument, producing a palette of sounds from angular rhythmic sequences to abstract noise.

Features (full collection)

Multi-board/PCB artwork (polyptych)

Voltage controlled feedback

Voltage controlled oscillator

Voltage controlled filter

Noise generator

Waveshaping (triangle - square)

Mixer

Buffered output

Programmable sequencer

External clock/sync option

Touch and knob/pot controls

Curated artists' sequences/patterns

Expansion board/modules capability

Mini jack/headphone output

Battery powered

Core

As the name suggests, the Core is central to the design and functionality of Polytik. The Core can be used in combination with up to three sound modules (see Core Layout). Connections are made with 10-way IDE header connectors and ribbon cable (see Ribbon Cable). Analogue voltages are created by a microprocessor and technique known as pulse width modulation (PWM) and filtering. The voltages can be used to control a range of parameters of the sound modules. The analogy of the Core as brain and the modules (Combi, VCO, Noise, etc.) as body can be

used. Different combinations and duplications of sound modules can be used (for example, two VCOs, etc.) and connected in any order to the IDE headers (ribbon connections) 1 - 3. Each sound module is designed to receive two control voltages (CVs). There are a maximum of five independent control voltages. For a more detailed account of the control voltages and connections see Core Layout. The voltages are organised into 'pre-sets' that are given a unique glyphw. Note the pre-sets are simply voltages that can also be manipulated in real-time; so they are not exactly fixed in terms of a pre-set.

The minimum requirement for polytik is core +1 (COMBI, VCO, NOISE, Etc).

Glyphs

The pre-sets are not represented by decimal numbers. Glyphs are based on the different combinations of segments of a 7-segment display.

Glyphs 0 - 30 include standard pre-set patterns; glyph 31, dot, is programmable (see user-input/sequence programming below).

Sequence/pattern select (P1/P2)

P1 backwards through pre-sets

P2 forwards through pre-sets

Holding P1 or P2 button will auto-scroll and loop through the characters/pre-sets

Pre-set outputs 0 - 30 output all five CVs (CV A - E) to the designated IDE headers irrespective of sound modules being connected or not. Depending on the pre-set, this may result in five different patterns being sent to the headers. Although pre-sets and connection of sound modules to specific headers is recommended, the modules can be patched to any of the three IDE headers to use the associated CVs.

Tempo/Clock (VR5)

The internal tempo/clock requires J3 jumper inserted. Removal of this jumper will disable the internal clock and VR5.

Patchbay

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 the tempo CV output. Connect a jack socket/patchbay connector to J1 (top/+; bottom/-) (cable not provided).

External sync

An external control voltage 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/-) (cable not provided).

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/patterns to their first step/index. Connect a jack socket/patchbay connector to J2 (top/+; bottom/-) (cable not provided).

MIDI can be used for external tempo and sync control by using a MIDI to CV interface.

Mixer (VR1/VR2/VR3)

Three sound modules can be connected to the Core and mixed independently.

Mixer channels

VR1 = Ch. 1 (CV A - B)

VR2 = Ch. 2 (CV C - D)

VR3 = Ch. 3 (CV E)

Each channel corresponds to IDE Header (ribbon con.) 1, 2, and 3

(see below for IDE Header 4).

User-input/sequence programming (dot/pre-set 31) (VR4/P3/P4/Touch)

When the display shows the dot (pre-set 31), Polytik can be programmed using pot VR4 and/or the touch controls and user-input value select button P3. Two control voltages, CV A and CV B, can be programmed in this way with a maximum of 16 steps/CV values. Note: sound module connected to IDE Header (ribbon con.) 1.

P4 toggles between control voltages CV A and CV B (default power-on = CV A).

NOTE: 'DOT' SEQUENCES WILL BE LOST/RE-SET ON POWER-OFF/ON

Programming

1. Connect sound module to IDE Header (ribbon con.) 1.

2. Switch on power (S1)

3. Select dot display character pre-set 31 (P1/P2)

Example using Combi and CV A - set cross-fade to VCO (see Combi Layout)

4. Adjust VR4 to select pitch/CV A value (default on power-on). A continuous pitch should sound, one step looped.

5. Store CV value using button P3

6. Adjust VR4 to select pitch (step 2). A 2-step sequence will loop (the tempo of the

sequence can be adjusted with VR5).

7. Etc. Values can be added until 16-steps are completed. On writing the seventeenth step the values will be automatically cleared and the process will begin a new.

The same value can be selected to create different step length.

In this example re. pitch, pseudo silences can be generated by selecting values at the extremes of the range (above or below audible frequencies).

Holding P3 and simultaneously adjusting VR4 will produce a kind of continuous read/write, 'gestural' programming.

The same method can be applied to programming CV B. Use P4 to toggle to CV B (VR4 and P3 will now program CV B). When using the Combi, this will program the feedback - set cross-fade to feedback (see Combi Layout).

Touch controls A/B

Lick fingers for touch control. The touch controls pull the signal to ground, reducing the voltage. 'Tune' the range of the touch controls by adjusting VR4. The touch controls of the Core are for fine value adjustments only.

External programming

In addition to user-input/sequence programming, it is possible to erase and write data on to the PIC microprocessor (IC1) to create new data/sequences. A compatible programmer can be connected to the ICSP header (dot = pin 1). This should be considered a hack rather than a standard feature of Polytik. The Core was developed using PIC18F26K22, PICKIT3 and software MPLAB X IDE v2.26. Code for the default pre-sets can be downloaded from the Polytik website.

IDE Header (ribbon con.) 4.

This IDE header outputs four control voltages A - D. There is no audio output from IDE Header (ribbon con.) 4. Power is also supplied as standardised (see Ribbon Cable).

Other

A stereo (TRS) 3.5 mm jack plug must be used. The output is mono summed.

Headphones may be connected directly to the jack output.

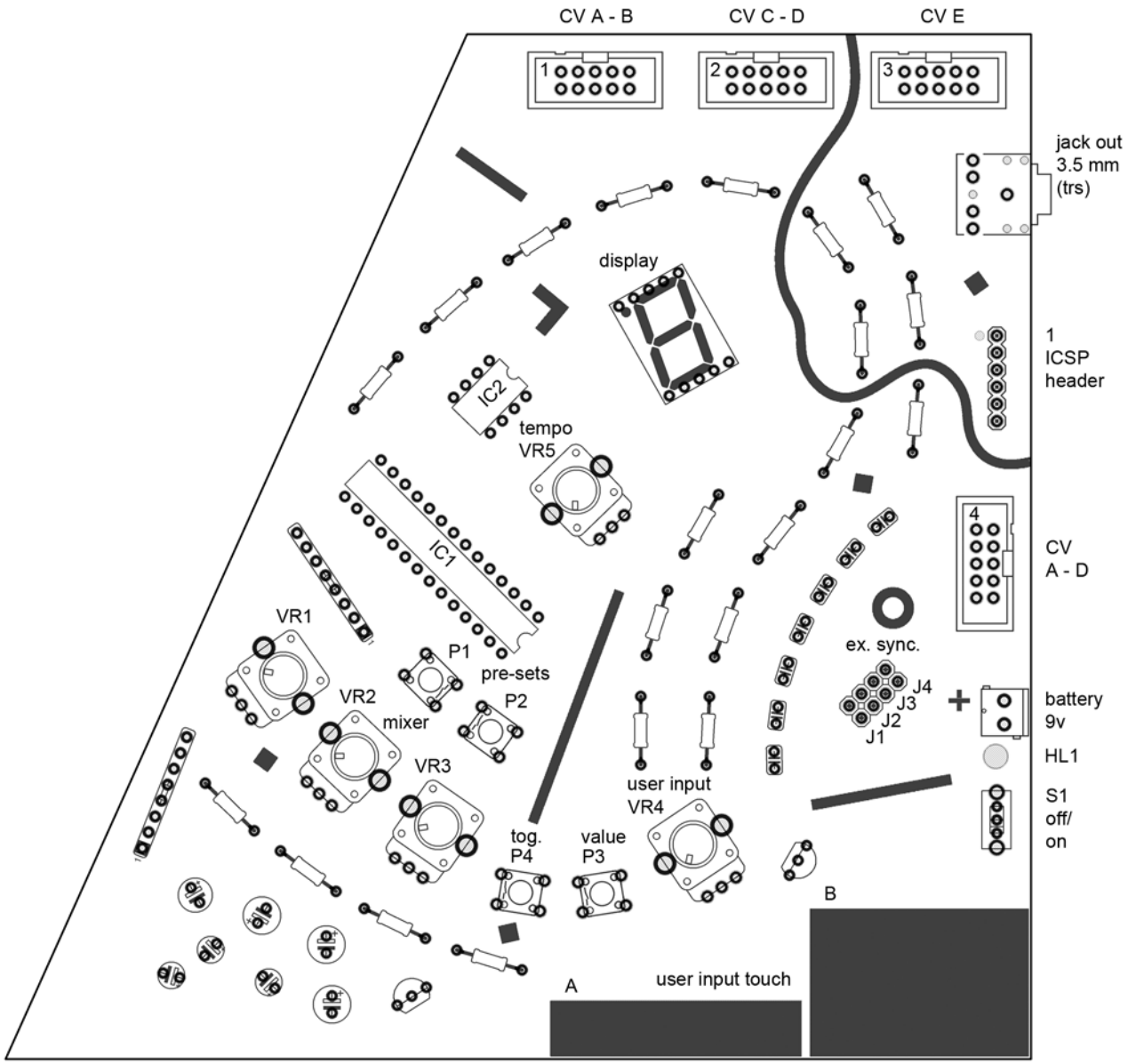
Thread battery connector wires through hole **HL1** before fixing to battery connector (to brace/take stain of connection).

Battery terminal connector top/positive (red/+); bottom/negative (black/-)

Acknowledgements

Thanks to Jim Frize for help with programming.

Core Layout Fig. 1



POLYTIK – COMBI

The Combi sound module (with Core) was designed to give some of the functionality of the multi-board/modular environment in a single cost-effective PCB. The Core and Combi sound module were also designed as a starter package for Polytik.

The Combi, although containing the same VCO synthesis as the VCO sound module, has an exclusive voltage controlled feedback circuit (note: there are additional features included with the VCO sound module (see VCO)). Unique sounds are also generated through cross-modulation between the Combi's VCO and feedback circuit. This is dependent on the cross-fade mix.

Features

PCB artwork

Voltage controlled oscillator

Voltage controlled feedback

Pitch scale/off-set

Feedback scale/off-set

Feedback manual control (CV on/off)

Filter for VCO (manual)

Pre-set portamenti options

Active crossfade/mixer

CV1 pitch control

CV2 feedback control

Touch controls – pitch and feedback

The minimum requirement for Polytik is core +1 (COMBI, VCO, NOISE, ETC.).

Each sound module is designed to receive two control voltages (CVs).
For the Combi they are:

CV1 = VCO pitch

CV2 = voltage controlled feedback

VCO voltage controlled oscillator - pitch (VR1) (see Combi Layout)

Control voltages are used to change the pitch of the VCO. The VCO's pitch can be scaled and off-set using VR1. Patterns/sequences can be transposed to different pitch registers. Using extremes of the pitch range (low/high) (VR4) can lead to further abstraction of the patterns/sequences by placing some of the sequenced steps outside of the audible range.

Filter for VCO (manual) (VR2)

A filter can be applied manually to the VCO using VR2 (waveshaping triangle - square).

Clockwise = filter open (square - hard/bright)

Anti-clockwise = filter closed (triangle - soft/dull)

Voltage controlled feedback (VR3)

The Combi's voltage controlled feedback circuit is designed around a standard dual operational amplifier. The two amplifier signals are cascaded and looped. The overall gain of the feedback loop is set by VR3 and CV2 that in turn produces noise, feedback and oscillation. The voltage controlled feedback (gain) can be scaled and off-set using VR3. Switch **S1** allows for CV2 to be enabled/disabled. When disabled, the feedback will produce a steady state (subject to cross-modulation from the VCO) and can be adjusted using VR3. Behavior/scaling of feedback VR3:

Clockwise = high frequency and noise

Anti-clockwise = low frequency oscillation

The power of the voltage controlled feedback circuit is unregulated and battery strength will influence the circuit's behavior.

Cross-fader (VR4)

Clockwise = VCO

Anti-clockwise = VC feedback

Portamento

Two portamento (slide) pre-sets can be set for the VCO using the pull-tab jumper:

J1 portamento fast

J2 portamento slow

J3 not connected/jumper holder

Touch controls (lick fingers)

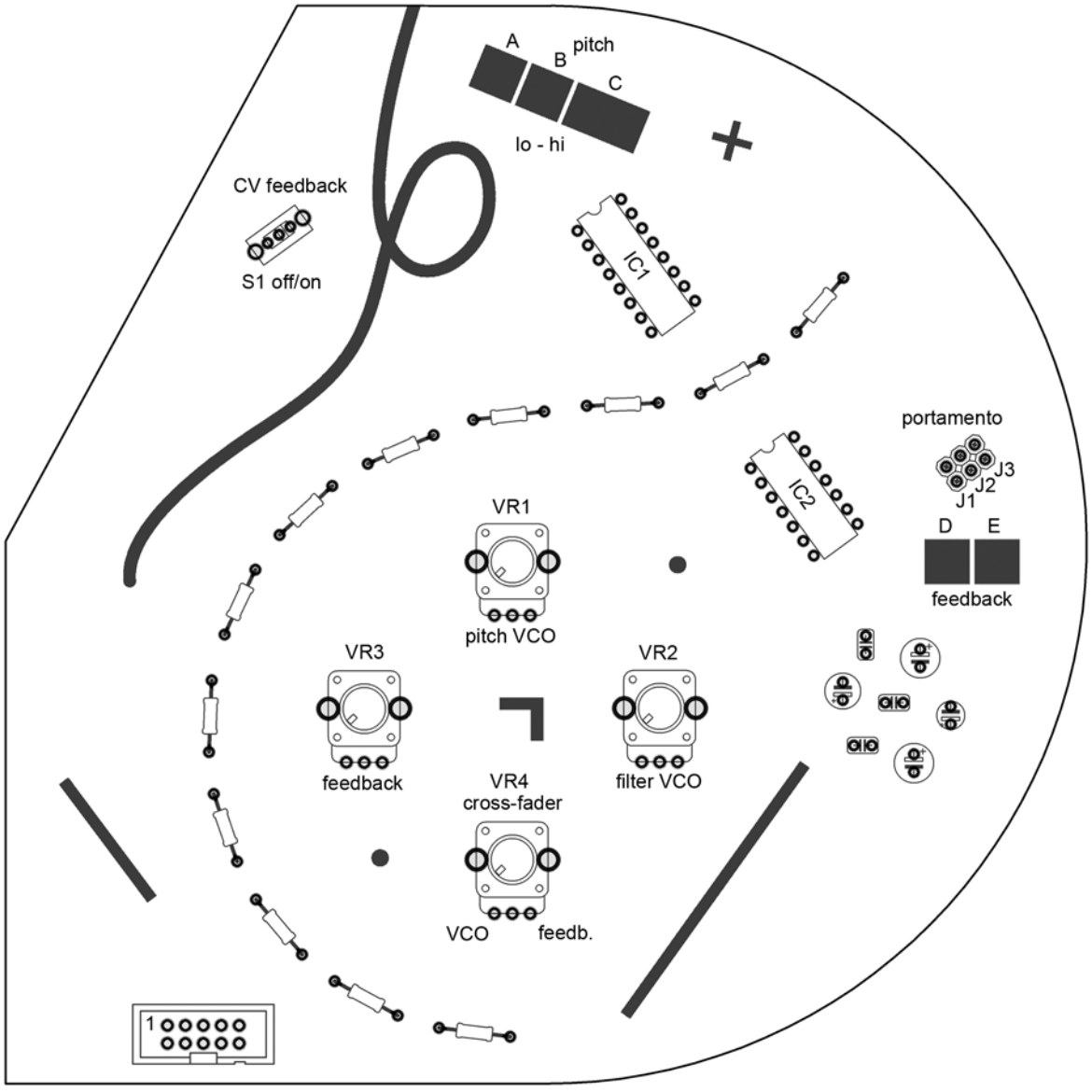
VCO pitch

A B lower pitch

B C raise pitch

Feedback (gain)
D E

Combi Layout Fig. 2



POLYTIK – VCO

The voltage controlled oscillator (VCO) epitomises the overall aesthetic of Polytik that is to have very clearly defined, distinctive functions and unique visual characteristics for each sound module. The idea was to design just a single VCO with a voltage controlled filter (VCF) to enable some degree of waveshaping.

Features

PCB artwork

Voltage controlled oscillator

Voltage controlled filter

Pitch scale/off-set

Voltage controlled filter scale/off-set

Filter manual control (CV on/off)

Pre-set portamenti options

CV1 pitch control

CV2 filter control

Touch controls - pitch and filter

The minimum requirement for Polytik is core +1 (Combi, VCO, Noise, Etc.).

Each sound module is designed to receive two control voltages (CVs).
For the VCO they are:

CV1 = VCO pitch

CV2 = voltage controlled filter

VCO voltage controlled oscillator - pitch (VR1) (see VCO Layout)

The VCO pitch control is also documented in the Combi guide.

Control voltages are used to change the pitch of the VCO. The VCO's pitch can be scaled and off-set using VR1. Patterns/sequences can be transposed to different pitch registers. Using extremes of the pitch range (low/high) (VR4) can lead to further abstraction of the patterns/sequences by placing some of the sequenced steps outside of the audible range.

Voltage controlled filter (VR2)

The voltage controlled filter circuit uses an operational transconductanceamplifier (OTA) to produce a low-pass filter. The opening and closing of the filter can be sequenced using CV2. This is linked to the overall tempo setting of the Core.

Switch **S1** allows for CV2 to be enabled/disabled and the filter to be controlled manually with VR2 (see VCO Layout). When CV2 is enabled, VR2 can be also used to scale the range of the filter.

Clockwise = filter open (square - hard/bright)

Anti-clockwise = filter closed (triangle - soft/dull)

Portamento

Two portamento (slide) pre-sets can be set for the VCO using the pull-tab jumper:

J1 portamento fast

J2 portamento slow

J3 not connected/jumper holder

Touch controls (lick fingers)

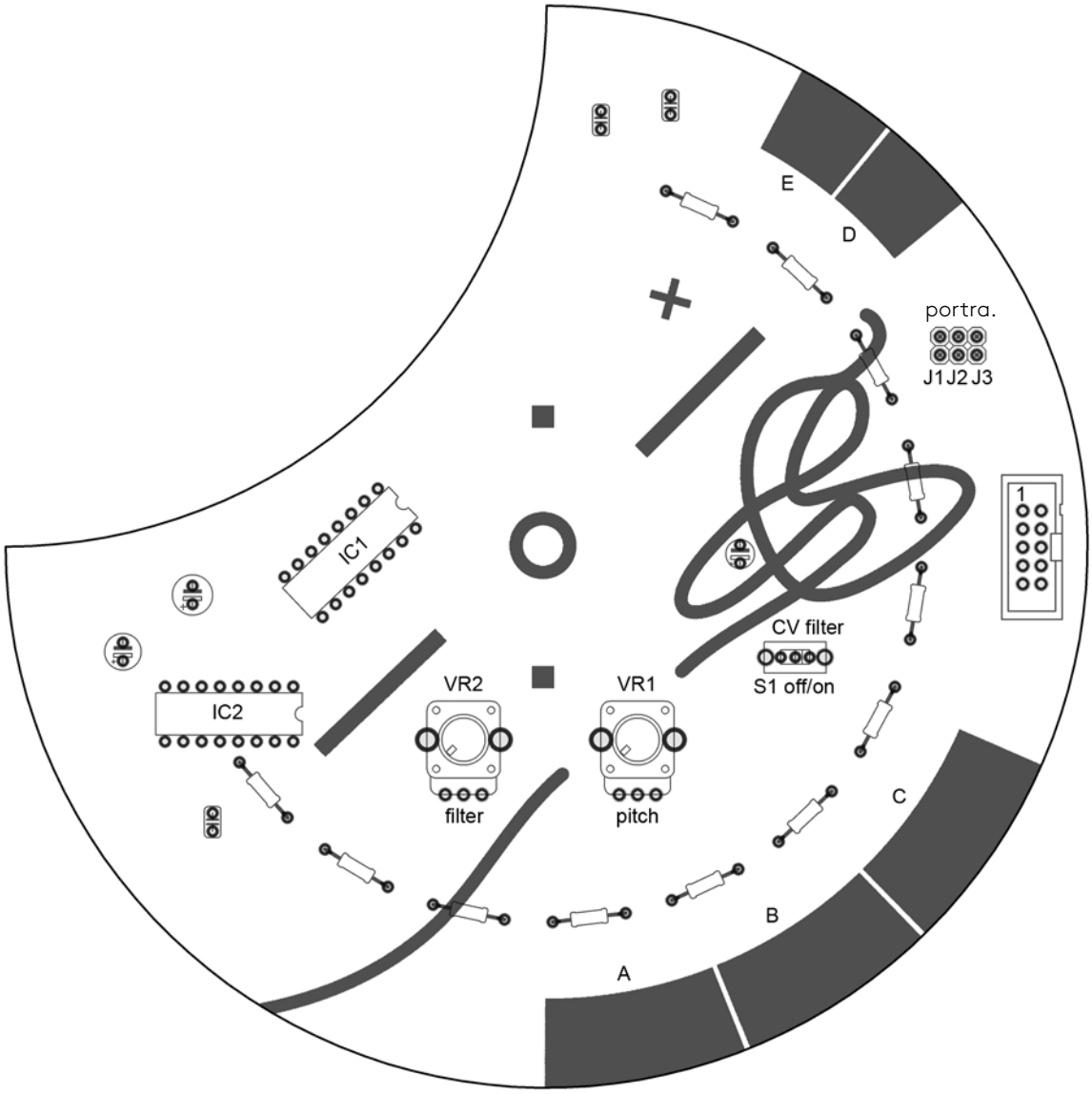
VCO pitch

A B lower pitch

B C raise pitch

Filter (pulls to ground)
D E

VCO Layout Fig. 3



POLYTIK – NOISE

The Noise sound module is based on a circuit that generates coloured noise through the amplification of latent noise found in a low value resistor. High gain amplification is achieved by cascading two stages of a dual operational amplifier. The noise circuit can also be looped/patched to create feedback sounds. The circuit's power is unregulated, and a drained battery will influence the sound quality of the noise.

A voltage controlled filter is also included with the noise circuit. The filter uses the same design and operation as found in the VCO (see VCO guide).

Like the VCO, the Noise sound module was initially designed to have only one specific function. However, with a few patches it can produce a wide variety of sounds. It is the 'chameleon' of Polytik and, out of all the modules, is arguably the most playful with the greatest number of patch options. The different combinations of patches and control voltages can produce complex and often unpredictable results.

The noise setting will be referred to as the default: CV1 enabled; all patches and CV2 disabled (see below). As a noise generator, this makes the module ideal to connect to the one CV output IDE Header 3 (CV E). This Noise documentation refers to the default setting unless otherwise stated.

Features

PCB artwork

Voltage controlled oscillator

Voltage controlled filter

Pitch scale/off-set

Voltage controlled filter scale/off-set

Filter manual control (CV on/off)

Pre-set portamenti options

CV1 filter control

CV2 noise/feedback control

Touch controls - pitch and filter

The minimum requirement for Polytik is core +1 (COMBI, VCO, NOISE, ETC.).

Each sound module is designed to receive two control voltages (CVs).
For the Noise they are:

CV1 = voltage controlled filter

CV2 = voltage controlled noise/feedback

Voltage controlled filter (VR1)

The voltage controlled filter circuit uses an operational transconductance amplifier (OTA) to produce a low-pass filter. The filter design is the same as the Polytik VCO. The opening and closing of the filter can be sequenced using CV1 with the Noise sound module. This is linked to the overall tempo setting of the Core.

Switch **S1** allows for CV1 to be enabled/disabled and the filter to be controlled manually with VR1 (see Noise Layout):

Clockwise = filter open (square - hard/bright)

Anti-clockwise = filter closed (triangle - soft/dull)

Patchbays
Portamento

Two portamento (slide) pre-sets can be set for the Noise using the pull-tab jumper:

J1 portamento fast

J2 portamento slow

J3 not connected/jumper holder

In the default setting, the Noise's portamento will create sweeps with the filter to produce swishing sounds.

Feedback

J4 feedback 1

J5 feedback 2 (full oscillation)

J6 not connected/jumper holder

Note: if feedback 1 and 2 are both patched/enabled, there will be no sound from the Noise sound module (it is one or the other).

The feedback patches (J1 or J2) cause the Noise circuit to oscillate, radically transforming the behavior of both the noise generation and filter. With the feedback patches enabled, VR1 will affect the pitch of the oscillation.

CV levels low/high

The CV levels can be set with a patch jumper either low (disabled) or high (enabled) and mixed with the voltages of VR1. The balance/mix of these voltages has a significant impact on the behavior of the sound module. This applies to both CVs.

J7 CV1 low (disabled) high (enabled)

J8 CV2 low (disabled) high (enabled)

J9 not connected/jumper holder

CV1 enabled (J7) brighter noise

CV1 disabled (J7) VR1 greater filter attenuation

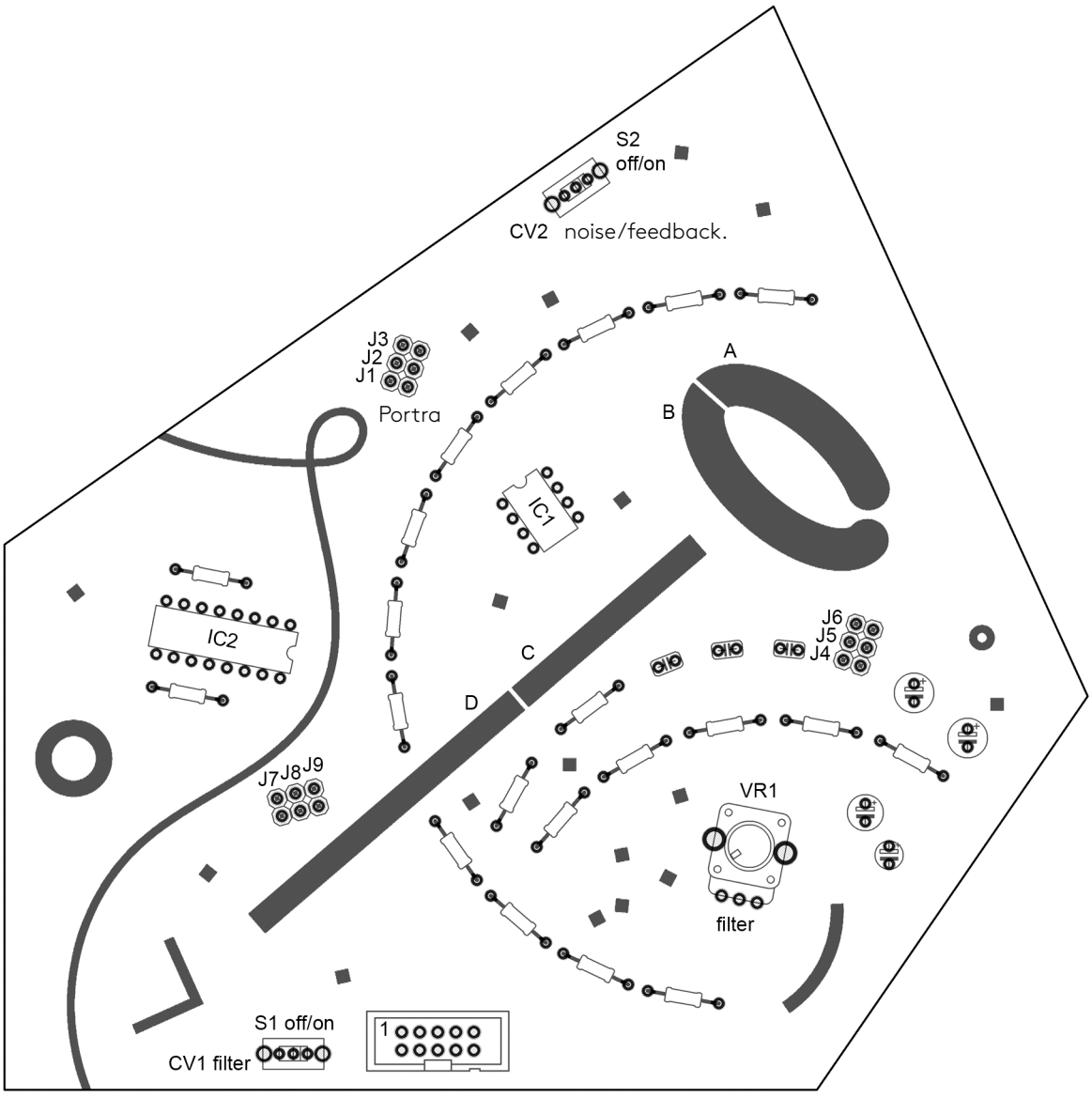
Switch **S2** allows for CV2 to be enabled/disabled. The level of CV2 can be set with J8. CV2 is used to change the gain of the noise circuit that in turn affects the quality of the noise and/or produces oscillation in the circuit. A gating-like effect of the noise is also produced. In this setting, the circuit's behavior is similar to the voltage controlled feedback of the Combi. However, the circuit is primarily designed to generate coloured noise, and the use of CV2 in this manner should be viewed as a bonus/hack.

Touch controls (lick fingers)

Feedback
A B

Filter (noise default/low-pass)
C D

Noise Layout Fig. 4



IDE Headers 1 - 3
(Core/top & sound modules)

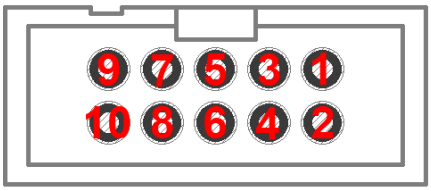


fig. 5

1. + (power 9v)
2. GRD
3. CV1
4. GRD
5. CV2
6. GRD
7. OUTA
8. GRD
9. OUTB (tied to OUTA)
10. GRD

IDE Header 4
(Core/right side)

1. + (power 9v)
2. GRD
3. CV_A
4. GRD
5. CV_B
6. GRD
7. CV_C
8. GRD
9. CV_D
10. GRD

CV range 0 to 5 volts

10-way ribbon cable and IDE headers/connectors are used for the interconnectivity of Polytik. Ribbon cable is notoriously noisy/prone to interference. To reduce the risk of unwanted noise and interference, multiple strands of the ribbon cable are grounded and alternated with signals.

RIBBON CABLE/IDE HEADERS

The audio output signal also uses two strands of ribbon cable (7 and 9 tied).

Note. IDE Header 3 (Core) outputs only one CV (CV_E).

IDE Header 4 (Core/right side) does not output an audio signal (see above). See Mods & Sods for additional info on connectivity.

This document only provides a starting point for mods and hacks.

CORE

With J3 inserted, J1 patchbay can be used as a CV output for the internal clock/tempo. This can be used to sync two Cores. J1 (top/+; bottom/-).

RIBBON CABLE

Hack the ribbon cable to produce separate, direct audio outputs for each module. This will influence the mixed audio signal from the jack output.

Use a 10-way IDE transition connector to duplicate the voltages from a CV/IDE Header.

JUMPERS

Add variable resistors (pots), capacitors and switches to the jumper terminals. Use a 2-way 2.54 mm PCB Header Socket (female).

CODE

Hack the code (the programming language is C). Store your own patterns. Comments are provided in the code. The Core was developed using PIC18F26K22, PICKIT3 and software MPLAB X IDE v2.26. Code for the default pre-sets can be downloaded from the Polytik website.