

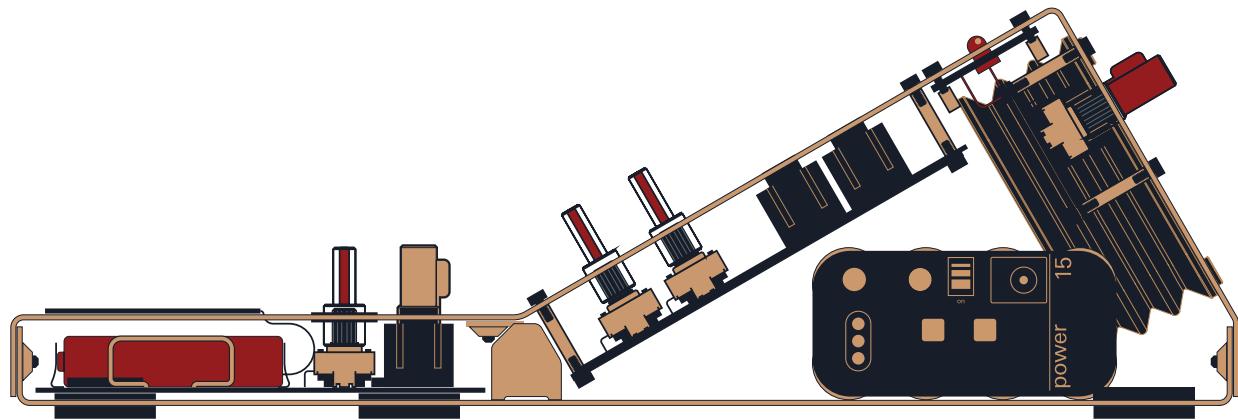
170

pocket  
operator  
modular

user guide

ガイド

v.2.0



## notice. read this first.

the product is esd sensitive and is sold without casing

battery information:

1. install only new batteries of the same type.
2. failure to insert batteries in the correct polarity, as indicated in the battery compartment, may shorten the life of the batteries or cause batteries to leak.
3. do not mix old and new batteries.
4. do not mix alkaline, standard (carbon-zinc) or rechargeable (nickel cadmium) or (nickel metal hydride) batteries.
5. do not dispose of batteries in fire.
6. batteries should be recycled or disposed of as per state and local guidelines.

fcc statement:

note: this equipment has been tested and found to comply with the limits for a class b digital device, pursuant to part 15 of the fcc rules. these limits are designed to provide reasonable protection against harmful interference in a residential installation. this equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. however, there is no guarantee that interference will not occur in a particular installation;

if this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures;

- orient or relocate the receiving antenna
- increase the separation between the equipment and receiver
- connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- consult the dealer or an experienced radio/tv technician for help.

this device complies with part 15 of the fcc rules. operation is subject to the following conditions;

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

caution: changes or modifications not expressly approved by the party responsible for compliance could void user's authority to operate the equipment.

teenage engineering warrants that this product will be free from defects in material or workmanship for a period of 12 months from the date of teenage engineering's shipment of the product to you, the customer; in the event of a defect covered by this limited warranty, teenage engineering will, at its option and free of charge to customer, repair, replace or refund the purchase price paid.

TEENAGE ENGINEERING MAKES NO OTHER EXPRESS WARRANTIES EXCEPT AS PROVIDED HEREIN, AND ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL ONLY BE IN EFFECT DURING THE 12 MONTH WARRANTY PERIOD PROVIDED HEREUNDER. TEENAGE ENGINEERING'S LIABILITY ON ANY WARRANTY CLAIM SHALL BE LIMITED TO THE ACTUAL PURCHASE PRICE PAID. TEENAGE ENGINEERING SHALL NOT BE RESPONSIBLE TO CUSTOMER OR ANY THIRD PARTY FOR ANY CONSEQUENTIAL, INCIDENTAL OR INDIRECT DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF DATA, REVENUES, SALES, BUSINESS, GOODWILL OR USE.

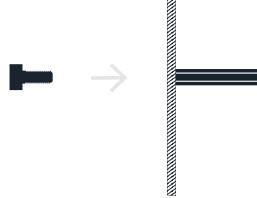
what does this limited warranty not cover?

teenage engineering has no obligation to repair, replace, or provide refunds in the following instances:

- if the alleged defect arises because customer has altered or repaired the product without the prior written consent or authorization of teenage engineering.
- if customer did not follow any applicable instructions for proper storage, usage, or maintenance of this product,
- if customer has failed to notify teenage engineering of any defect where the defect should have been reasonably apparent on inspection; or
- if customer fails to notify teenage engineering of the defect within 12 months of teenage engineering's shipment of this product to customer, this limited warranty does not cover the cost of shipping the defective product to teenage engineering for repair, or the cost of shipping the repaired or replacement product to you, how do customers receive warranty service? please call your teenage engineering customer service representative for details on how to raise an issue in relation to your product.

## 1. module assembly

### 1.1 installing the standoffs



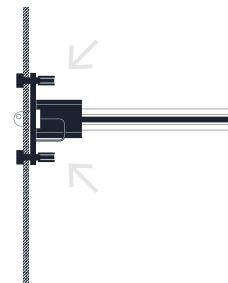
before connecting the modules first add the standoffs to the back of the faceplate to make installation easier. start from the bottom and continue up, leaving the keyboard until last.

to attach the standoffs, place the screws through the holes from the outside and using a pair of needle nose pliers, hold the standoffs firmly at the back while screwing.

now repeat this procedure for all module holes leaving only the power distro without standoffs.

note: be careful not to over tighten!

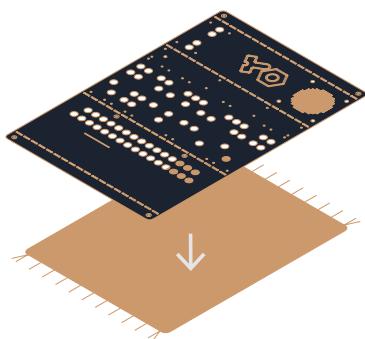
## 1.2 power distro



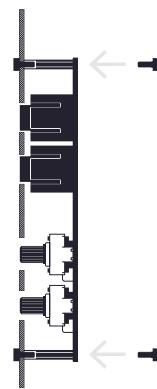
the power distro attaches to the frame differently than the other modules. first cut the standoffs from the psu in half using a pair of pliers or wire cutters. then place the screws through the holes and place the power distro on the back, on top of the pre-attached protective sticker cover.

finally attach the shorter standoffs to the top of the frame to fasten the power distro. make sure it is seated flush to the back of the faceplate.

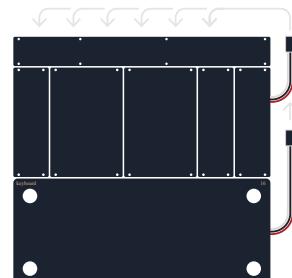
## 1.3 installing the modules and keyboard



place the front plate face down. tip: put a soft surface such as a towel beneath. it is easier to attach the modules before bending the chassis.

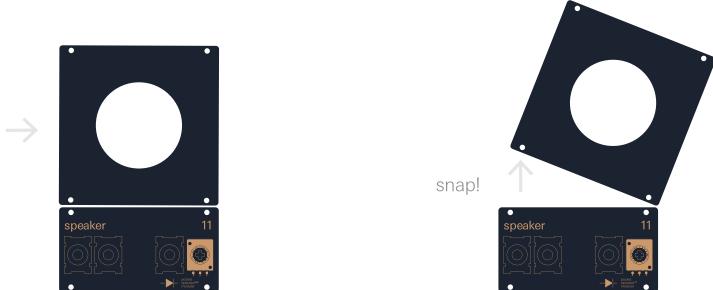


place the modules on top of the standoffs and ensure the jacks are correctly aligned with the holes. screw the modules to the standoffs.



ensure the screws on the faceplate are not rotating. be careful not to over tighten. once screwed in place, plug in the cables to the power sockets.

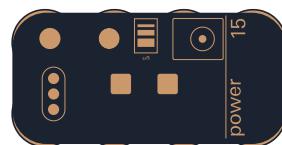
## 1.4 speaker assembly



the speaker module pcb comes with a part that is not needed.

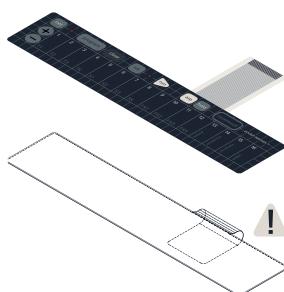
firmly and carefully break off the square part. take care when installing the speaker as the cable connecting the speaker unit to the pcb needs to fit nicely.

## 1.5 psu



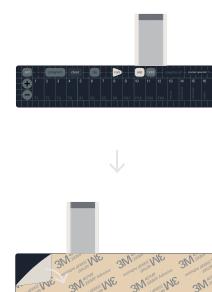
the psu holds 8 x AA batteries. with high quality rechargeable batteries you can expect up to about 5 hour battery life. it is recommended to use a power adapter whenever possible.

## 1.6 keyboard assembly

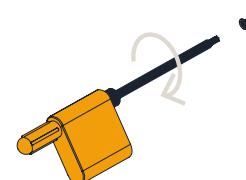
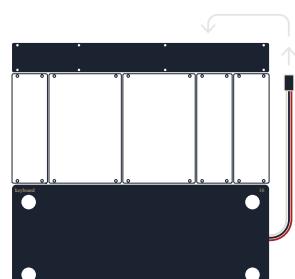
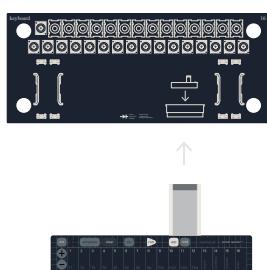


the keyboard attaches via a ribbon cable to the keyboard pcb. fold it firmly.

to attach the keyboard first feed the ribbon cable through the faceplate slot.



once the cable is fed through you can remove the sticky tape backing and carefully attach the keyboard to the top faceplate.



after assembling all modules and before attaching plate a to b, push the ribbon cable firmly into the ribbon cable slot on the keyboard pcb. take care to ensure proper alignment and orientation.

connect the power adapter cable to the power distro board using the supplied cable, to allow power from one source. this way there

once the ribbon cable is installed you screw the two sections together.

## 2. basics

### 2.1 types of signals

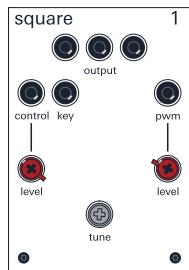
in modular synthesis there are two types of signals. audio signals and control voltages (cv). audio signals are for sounds and cv is for controlling things. these two different signals will be used to connect the different modules together.

this is how sounds and patterns are created in a modular system. the beauty of modular is that you can pretty much connect anything to anything, creating all kinds of relationships and interesting sounds, that all dynamically interact with each other.

that said you should generally avoid connecting outputs to outputs or inputs to inputs.

pro-tip: you can use audio signals as cv for some very interesting results and some cv modules such as the lfo can run at audio rates.

#### 2.1.1 audio signals

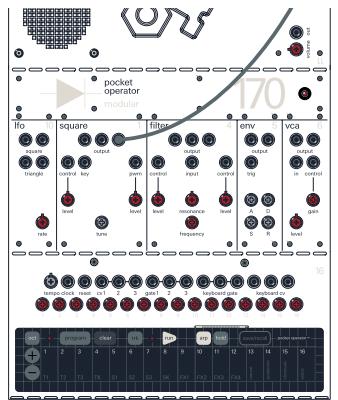


in a modular synthesizer it is usually the job of the oscillators to make the sounds that are processed by the rest of the system. the 170 includes one square wave oscillator.

lets hear the sound of this oscillator through the 170's built-in speaker. first let's make sure the volume of the speaker module is turned down. locate the volume knob on the speaker module and turn it to about mid way.

warning: never connect headphones directly to the outputs of the 170. you can damage your ears and your headphones if you do this, so be very careful.





to hear the sound of the oscillator we need to connect it to the speaker. to do this take a yellow cable and connect it to any of the three jacks labeled output on the top of the square oscillator. any of these jacks are fine as all three will output the same signal. take the other end of the cable and plug it into the jack on the speaker called right.

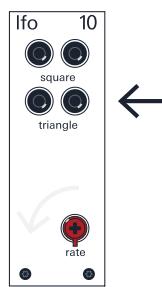
now we can slowly increase the volume of the speaker by turning the volume knob.

if you do not hear a sound it may be that your oscillator tuning is too high or too low. turn the tune knob to alter the pitch of the oscillator so that it is in the audible range. also turn the pwm level all the way to the left.

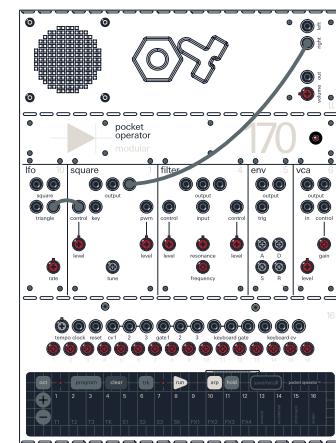
## 2.1.2 control voltages

control voltages are used to control different parts of the modular system. for example in the last example we manually altered the pitch of the oscillator but in this example we will use a control voltage to alter the pitch for us.

continuing from the last patch: set up a control voltage to control the pitch of our oscillator.



use the triangle wave from the Ifo. locate the Ifo module and plug a cable into either of the triangle outputs. tip: set the rate to its slowest setting by turning the rate knob all the way to the left.



plug the other end of the cable into the input labeled control on the square oscillator.



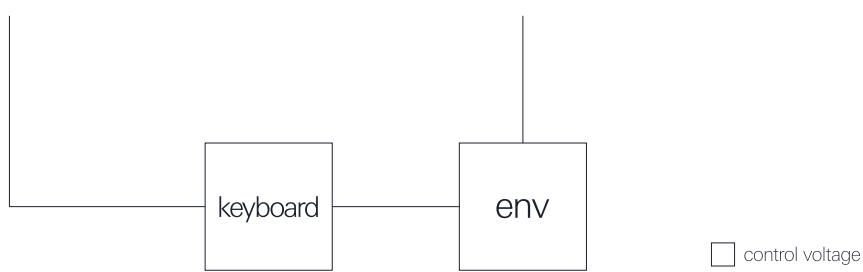
turn the knob underneath that is labeled level all the way to the right. you should hear the pitch slowly rising and falling.

now lets change the 'rate' (speed of the control voltage). very slowly turn the knob labeled rate on the Ifo to the right. the change in pitch should become faster until eventually we reach what is called audio rate modulation.

**pro-tip:** audio rate is a term used to describe cycling control signals that move so fast they actually become audible and enter the audible frequency range.

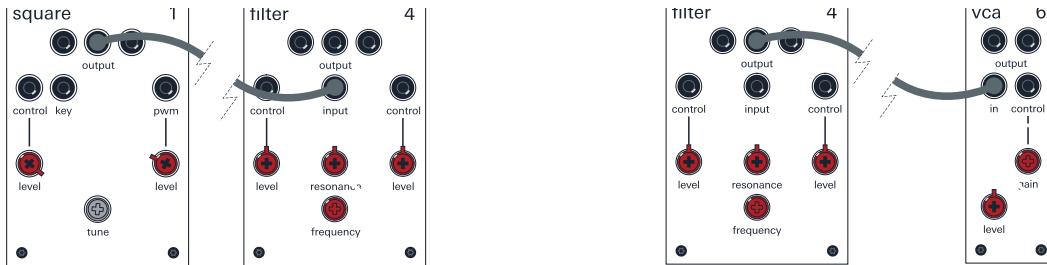
the Ifo is actually just an oscillator that can reach very slow speeds. by modulating parameters at audio rates we can get all kinds of interesting effects.

## 2.2 a simple mono synth



let's patch a simple mono synth including the following modules: [square], [filter], [vca], [env], [speaker], [keyboard].

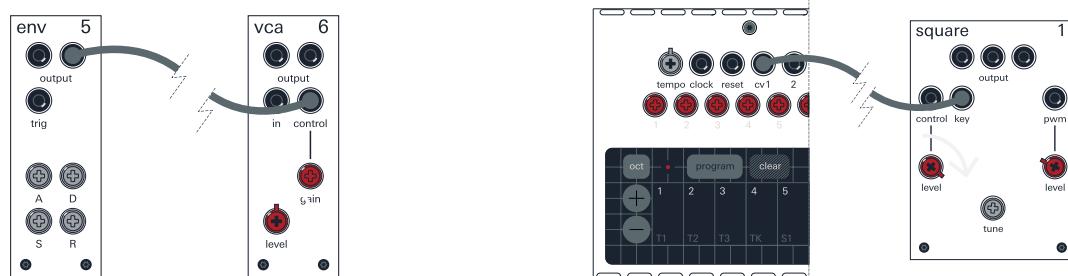
the diagram shows the flow of audio signals and control voltages when patching this mono synth.



first step is to connect the sound source [square] to the filter. connect a patch cable to any of the [square] outputs. connect the other end to the jack labeled input on the [filter]. this will pass the audio generated from the oscillator to the filter. now open the filter all the way by turning the frequency knob all the way to the right.

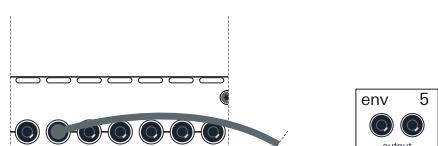
next: take the filter output and connect to the input on the vca. then connect the output of the vca to the left speaker input. turn up both the level and the gain on the vca. you should hear a constant note. if you don't, adjust the tuning of the saw oscillator or check that you opened the filter by moving frequency all the way to the right.

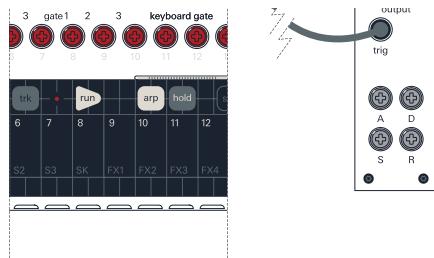
**note:** the vca or voltage controlled amplifier will control the volume of the signal. it is possible to do that manually using the level and gain knobs. this patch uses the envelope for this.



now connect the envelope output to the control input on the vca. this will let the envelope signal control the volume of the sound. the envelope has to be triggered to know when a note is sounded. we can do this from the keyboard which we will also use to set the note.

next connect the cv1 out to the key input of the square oscillator. this will let the keyboard control the pitch of our oscillator.





program

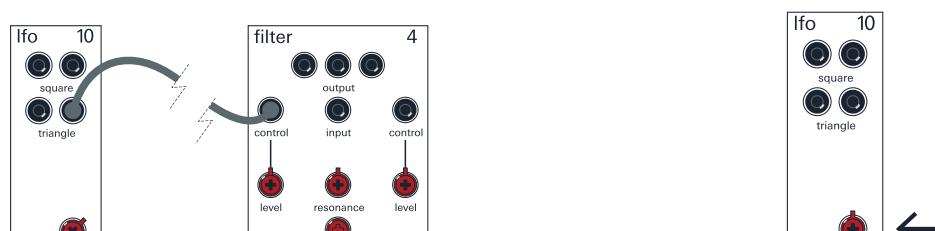
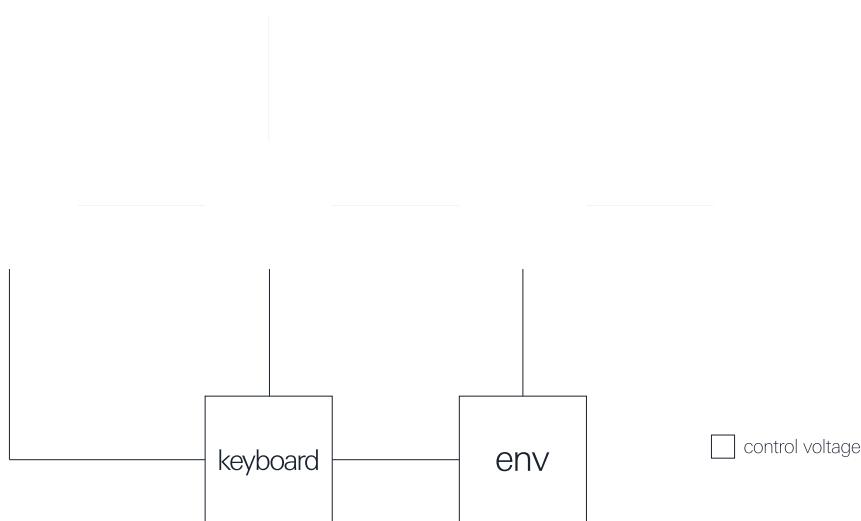


clear

then connect the gate1 out of the keyboard to the trigger input of the envelope. the keyboard gates will trigger the envelope when played or when the sequencer is running. adjust the adsr (attack, decay, sustain and release) on the envelope to get different changes in the volume. try setting attack all the way to the left.

rather than just playing the notes on the keyboard we can also record a sequence to be played back. to do this first press program to enter program mode. the program led should flash red. then press program and clear to clear the current pattern on the active track. you can now play a melody of your choice. each note you press will be recorded as a step in the sequence. when finished press run and your sequence should begin playing.

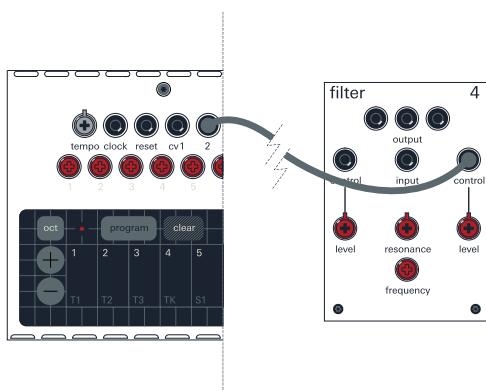
## 2.3 fm filter patch





we can expand upon the patch in the previous example using both the keyboard and the lfo. first connect the lfo triangle output into the left control input on the filter.

set the rate of the lfo to around 12 o'clock for audio rate modulation.



trk + T2

next take the T2 cv 2 out of the keyboard and connect it to the control input on the right hand side of the filter module.

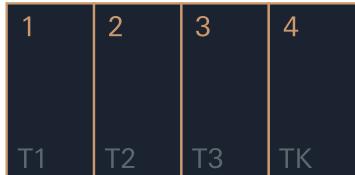
select track two on the on the keyboard by holding track and pressing T2.



# program

adjust the first four knobs (1-4) to four random values.

now ensure the keyboard sequencer is not running and press program. notice the left led light up.



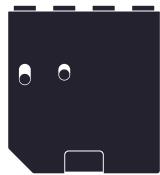
run

press key 1, 2, 3 and then 4. press program again to confirm your sequence. notice the left led turn off.

now press run and adjust the control levels on both filter control inputs. the lfo will produce filter fm while the T2 cv 2 output will provide four steps of filter adjust for a rhythmic filter pattern.

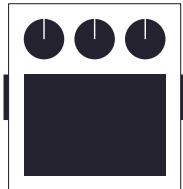
### 3. connections

#### 3.1 oplab module

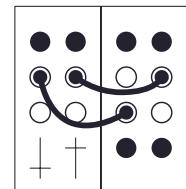


using the oplab module it is possible to control the 170 from the OP-Z. to fully use the oplab module, you will need two splitters cables (y cables). the stereo cables provided with the 170 also work but will only give access to the basic features of the ZM-1 module.

#### 3.2 effect pedals



when connecting to effects pedals it is very important to be careful with signal levels. it is possible to damage your pedal by running the audio through at full volume. always start with the volume at minimum and slowly raise it to the correct level.



#### 3.3 modular

it is possible to integrate 170 with other modular systems and semi modular synths.

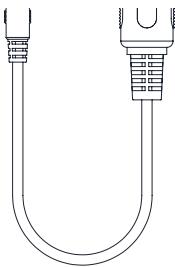
why not try connecting in some extra envelopes from your external system?

#### 3.4 midi devices



#### 3.5 pocket operators



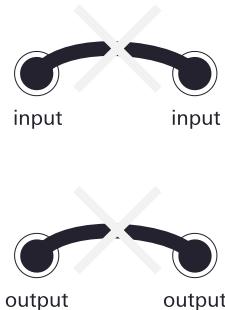


the 170 can control midi compliant devices via the trs midi jack located on the right hand side of the module. to connect to a midi device, a midi adapter cable is required and can be purchased here. for further details on midi connectivity please see [this page](#)

the 170 has a pocket operator sync out jack located on the right side of the keyboard module. this can be used to sync pocket operators to the 170.

## 4. notes of caution

unlike most other audio equipment, modular synthesizers output audio and control voltage at much higher level (voltage) than other studio equipment. for this reason we recommend the following precautions and practices.



do not connect headphones directly to the 170. you can damage your headphones or much worse, your ears. always protect your hearing.

do not plug outputs of the 170 directly into equipment that is not designed to handle the larger voltage. for example, pocket operators, effects pedals etc. please consult the manufacturer of the product in question if you are not sure.

it is generally advised that you avoid connecting inputs to inputs or outputs to outputs. doing so can put unnecessary strain on the system and over time may eventually lead to damage.

## 5. module specs

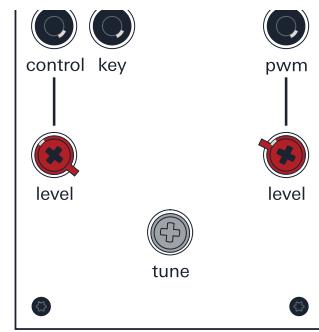
### 5.1 square

square is a square wave oscillator that can be used both as an audio signal and as an lfo, to control, trigger and modulate other sources.

pro-tip: with pwm set to above 50% no sound is heard. this can be great when modulated to create interesting rhythmic effects.



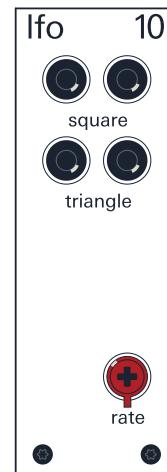
note: if you do not hear a sound it may be that your oscillator tuning is too high or too low. turn the tune knob to alter the pitch of the oscillator so that it is in the audible range. also turn the pwm level all the way to the left.



|               |   |
|---------------|---|
| output        | these three identical outputs can be used simultaneously.   |
| control + key | these are inputs for controlling the pitch of the square waveform. key is set to 1v/oct, and control can be scaled by level.  |
| level (left)  | turn level to adjust how much any incoming control signal should modulate the waveform.   |
| pwm           | pulse width modulation or pwm input can be used to shape the waveform by offsetting the ratio between maximum and minimum voltage. try patching any signal through the pwm input to hear what this sounds like. |
| level (right) | adjust the pwm level with this knob. if nothing is connected to the input this knob acts as manual pwm control. if you can't hear anything make sure to turn this all the way down.                             |
| tune          | tune sets the main frequency of the waveform. if you can't hear anything try setting this to somewhere in the middle.   |

## 5.6 Ifo

Ifo is short for low frequency oscillator. this one has four outputs, two square and two triangle waveforms. it can be used to modulate any control input.



|          |   |
|----------|---|
| square   | these square wave outputs can for example be used as gates to trigger the sequencer clock, or the env and rand modules.   |
| triangle | try patching these triangle wave outputs to any control input, for example to modulate the filter cutoff frequency, the pitch of the oscillators or the amplitude of the vca's. |
| rate     | use this knob to control the rate of the Ifo. at high rates the frequency goes into audio range.  |

## 5.7 env

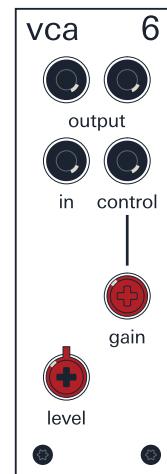
env is short for envelope. adsr stands for attack, decay, sustain and release, and when triggered it is a control source for shaping a sound over time.



|        |  |
|--------|--|
| output | this outputs the control signal used to shape the sound. try patching this to any control input. these two identical outputs can be used simultaneously. |
| trig   | patch a control signal into this input to trigger the envelope. you can for instance use one of the sequencer outputs or any clock or gate signal.       |
| A      | attack time.   |
| D      | decay time.  |
| S      | sustain level. this is the level at which sustained notes will be held.  |
| R      | release time.  |

## 5.8 vca

vca is short for voltage-controlled amplifier. patch any signal through this module to modulate its amplitude, such as changing the volume of a sound.



|         |  |
|---------|--|
| output  | whatever is patched into in gets modulated by control, and then back out through here. these two identical outputs can be used simultaneously. |
| in      | this is the main input for the vca. patch whatever audio signal you want to modulate into here.  |
| control | this is the input for the modulating control signal. try patching the output of an env into here.  |

gain

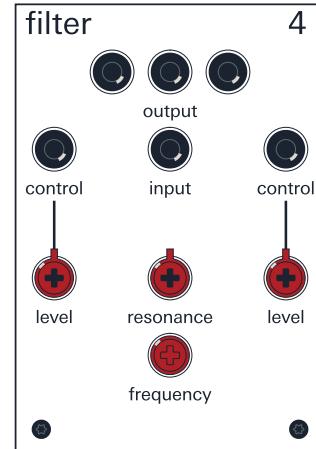
this knob adjusts depth of the control signal.

level

this knob adjusts level of the input signal.

## 5.10 filter

filter is a resonant low pass filter that allows you to shape a signal by filtering out high frequencies.



output

these three identical outputs can be used simultaneously.

control  
(left + right)

these are inputs for controlling the cutoff frequency of the filter.

input

this is the input for the filter. patch whatever audio signal you want to filter into here.

level  
(left + right)

turn level to adjust how much the incoming control signal should modulate the cutoff frequency.

resonance

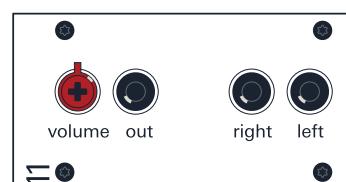
this controls the resonance of the filter. turn this up to emphasize the frequencies around the cut off point to get a sharper thinner sound. keep turning it up and the filter will start to self-oscillate.

frequency

this controls the main cutoff frequency of the filter. turn it down to only let low frequencies pass through. if you don't hear anything try turning this all the way up.

## 5.12 speaker

speaker is a dual input speaker module allowing you to hear what your patch sounds like.



|        |   |
|--------|---|
| left   | left input.   |
| right  | right input.  |
| out    | stereo output.  |
| volume | this is the volume control for the speaker module and for the output. turn it clockwise to turn the volume up and counterclockwise to turn it down. the control is reversed on the first production units. in that case treat it the opposite way. note: when using the speaker or the output always be careful with your ears and equipment. |

## 5.13 keyboard

the keyboard is a versatile 4 track polyrhythmic sequencer with midi out and pocket operator sync out. for details on the keyboard module please take a look at this guide

