

E370 Quad Morphing VCO

www.synthtech.com/euro rack/e370



What is the E370?

The Synthesis Technology E370 contains 4 independent DSP-based wavetable VCOs.

Using a 'shallow' menu system (maximum of 2 pages 'deep'), each VCO can be set to 1 of 7 different operating modes. Although the default setting is 4 separate VCOs, the 16 CV inputs can be shared, as well as each output can be a mixture of all 4. There are 16 user presets that save the state of the entire module, without the need for an external uSD card.

The E370 ships with 3 banks of 64 each wavetables and allows users to import their own wavetables using our free, cross-platform tool WaveEdit. The E370 uses a mil-spec Grayhill optical encoder/switch, and like all SynthTech modules, comes with a lifetime warranty. Size is 54HP width, only 0.85in (21.6mm) deep.

Additional information

Go to the link at the top of this sheet for additional videos, demos, and other files. Content will be added more and more each month. The E352 Cloud Terrarium tutorial videos are a good place to start.

MAIN MENU



The Main Menu is like a table of contents. The encoder is used to highlight the function, and the encoder knob is 'clicked' (like a mouse) to go to that page. The current E370 firmware is available at the link above and is V1.4.

The color scheme is customizable.

The green dot in the lower right turns red (default) when the memory is being written. Do NOT power down the module during this time.

For a free, cross-platform wavetable editor, please visit www.synthtech.com/waveedit

Controls and Jacks

Each VCO has the following panel controls and CV inputs/audio output.

Pitch control: COARSE, FINE and 1V/OCT are internally summed together and presented to the VCO as a single CV source.

FM: this is a separate CV Frequency Modulation input to each VCO. The panel control is a 0-100% attenuator for the CV applied to the FM jack.

SYNC: this is used as a trigger function input. The action is based on the VCO mode.

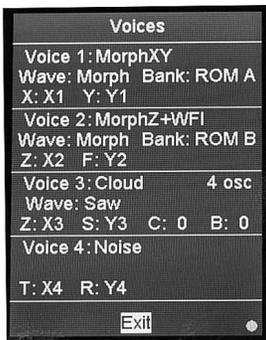
CV X/CV Y: each VCO has 2 CV inputs. In the menu system, these are called X1/Y1 for VCO1, X2/Y2 for VCO2, etc. The applied CV input at the jack is first attenuated by the associated MOD panel control, then summed with the PARAM panel control. The functions change based on VCO mode.

OUT: the audio out, which is a mixture of all 4 VCOs as set in the Mixer page.

QUICK GUIDE

Voice Settings Page

The top level page (shown) is a view of how each VCO is set up. The VCO operating mode is programmed by highlighting the desired VCO and clicking. This will take you to the settings page, where the algorithm and CV assignments are set.



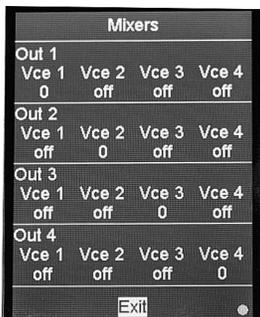
The screen shows the default setting when you received the E370.

It is important to note that all 16 CV inputs (1V/O, FM, PARM X and PARM Y for each VCO) and the 4 SYNC inputs are **fully assignable** and can be used multiple times. Of example, if you have only 1 pitch CV source available, you can assign it to all 4 VCOs, and it doesn't HAVE to be on VCO #1. Any of the CVs can be assigned to any of a VCO's variable parameters. In fact, you can for example assign all 4 VCOs to use PARAM X3 in different algorithms, so turning 1 panel knob affect all 4 VCOs in many different ways.

The default is "no sharing", meaning X1/Y1 are only assigned to VCO1 variables and so on.

Some VCO algorithms have more than 2 variable CV parameters. If you 'run out' of assignable CVs, you can select a fixed 0-99 value (like a static panel knob). For example, the Cloud Mode has 4 parameters, and default uses the 'static' parameters for Chaos (C) and Chaos Bandwidth (B). Of course, these can be over-written to be any CV source.

Mixer Page



Each VCO output is a mixture of all 4 VCOs. As seen here, the default setting is each VCO is 'full on' (a 0dB setting) while the other 3 are muted ('off').

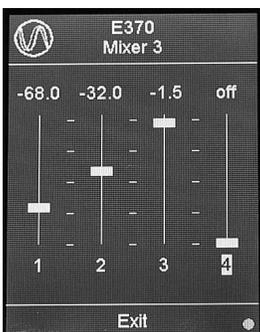
If you want a different setting, use the encoder to select a VCO and click. This will take you to the 'Mixer Sliders' page, where you can, in real-time, set the levels for each VCO to be summed into that output. Use the encoder to highlight a VCO, then click to adjust the level up/down.

The gain structure is designed so that if all 4 VCOs are set to -12dB (second tick mark), that output is at maximum non-clipping level (~11V pk-pk).

Here is an example for VCO3 having a mixture of several outputs. The numbers at the top of each slider is that VCO's mixed level in relative dB (0dB = full level).

Note the sliders have a finer resolution in the 0dB to -12dB range.

Having the slider all the way down mutes that VCO's mixing. It does NOT mute that VCO's output overall: only for this particular mixed output.





Freq & Chords Page

The top-level page is a status screen which shows all 4 VCOs and their settings as they relate to 'traditional' VCOs.

The displayed parameters are individually set by highlighting the VCO you want to edit, clicking, and going to the second page (middle photo). The following is a list of the parameters you can select for each VCO. Note that some of these parameters have "no meaning" if that VCO is a noise generator (such as FM TYPE).

Rng/Frequency Range: High (10Hz – 10Khz), Med (0.15Hz to 160Hz) and Low (1 cycle in 14min to 1Hz)

Qnt/Quantize: whole tone equal temperament quantizer on/off

Quantize offset: can offset the overall scale, in increments of +/- 3 cents. (roughly -100 to +100 cents)

FMQ/FM Quantize: the FM input does not have to be quantized (for pitch bending, etc), but it can be.

FMT/FM Type: sets Exponential or linear TZFM (Thru-Zero FM). In Linear, there are 3 ranges for the sensitivity of the FM CV applied (L/M/H for low range, medium range and high range). Please note that there will always be a small frequency 'jump'/offset when switching from Expo to a Linear mode, and the 'wider' the FM depth, the larger the offset. Such is the nature of things.

1VO/1V/Oct Source: you can assign any of the 4 1V/Oct summers (COARSE+FINE+the CV on the 1V/OCT jack) or 1 of the 4 Chord tables. If you want to use the Chord Mode (below), you select it here.

FM/FM Source: selects what drives this VCO's FM response (FM1 – FM4 CV input jack) and can be a fixed amount (useful to 'detune' the VCOs in fixed ratios).

SYN/Sync Source: selects what drives the SYNC for the VCO (not for the Sample Player or Chord), jacks SYNC1-4

Calibration: if you need to over-ride the factory 1V/Oct tracking for the 4 VCOs, this takes you to a page to reprogram. Each VCO is calibrated individually. The calibration does not use traditional 'trim pots', rather a software routine reads and stores the calibration into the internal EEPROM memory. Be SURE the VCO to be calibrated is in EXPO mode (you cannot calibrate in a Linear mode) with Phase Interpolation set to ON. Follow the screen prompts: you send a 1V change and the E370 calculates a proper octave and saves the data. Playing 3 octaves apart via a MIDI-CV converter and keyboard is the easiest method. The calibration range is ~0.5V to 1.5V/Oct. Calibration data is saved in on-board memory. Note V1.4 has greatly improved tuning algorithms and if upgrading from an older version, please recalibrate all 4 VCOs. The procedure is different than prior versions, where the calibration interval was 1 octave: it is now 3 octaves. The E370 can easily calibrate to non-standard intervals, like 1.2V/Oct.

Chord Mode

Chord Mode uses a table of pre-programmed *frequency offsets* to control the E370 globally (Chord mode over-rides all other modes). There are 4 pre-programmed factory chord tables (ROM1-4), or you can load your own tables (USR1-4) with the uSD card and a plain text file.

Each Chord table can be up to 64 entries in length. Each entry (line of text) contains 4 numbers separated by a space. The numbers are the frequency offset, in semitones, from what we call the 'root frequency'. The root is set in the menu as the 'master' 1V/Oct source. In the example shown (ROM1), this is set to IN1. What is meant by IN1? This is the summation of VCO1's COARSE, FINE and 1V/OCT input CV jack.

Chord Select is the method used to select which Chord in the table is being played.

To 'play' in Chord mode:

- a) Go to the Frequency page
- b) For each voice you want to play, select Chordn as a 1V/O source, where n is which of the 4 'columns' of the chord table to use (1-4). Usually, VCO1 is Chord1, etc.
- c) Not all VCOs have to respond to data in the chord table. Only VCOs assigned to a Chord1-4 will be used. In this manner, you can play both chords and independent VCOs simultaneously.

Here are the 'rules' for creating your own Chord tables.

- * Use plain, ASCII text
- * The file name is in 8.3 format, and has the extension TAB. The filename is used on the screen as the table name.
- * Comment lines start with a 'hash' symbol #
- * Data lines have four numeric values, of the frequency offset from the root, in semitones. A +12.00 is an octave up, etc. They can be with or without decimal points and values to the right, so either "1" or "1.00" or even "1.0000" are all fine. Values can range from -50.00 to +50.00. In this manner, microtuned chords/sequences are supported.
- * Each line must contain 4 entries (1 per VCO). There is no way to 'mute' a VCO. The entries can be separated by white space or a Tab. The end-of-line can be CR/LF (Windows) or Return (Mac).
- * You don't need to define all 64 slots in the table. If you provide more than 64 the extras are ignored.
- * By default, stepping will loop from the last slot to the first. If you prefer that it stops and holds on the last slot then terminate the file with a slash / character. If no / is present, the UI will show 'Loop'.

User Chord Tables are loaded into the non-volatile memory from uSD card on the File page. Once loaded, the uSD card can be removed and the Chord Table(s) are stored in the E370 memory.

A simple Chord Table file example:

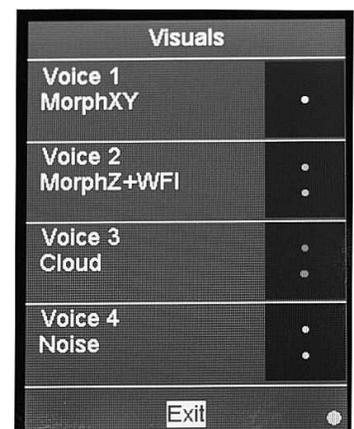
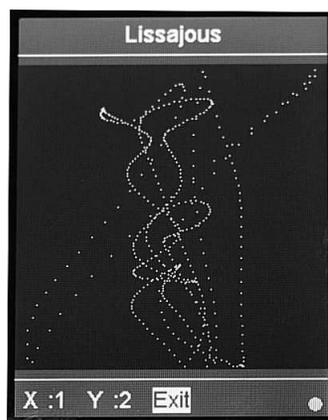
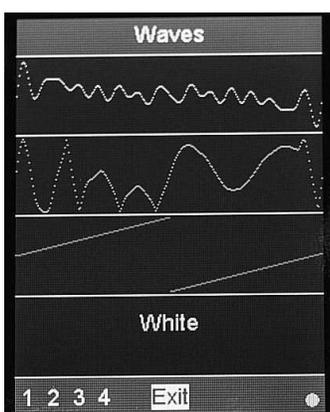
```
#EXAMPLE TABLE
0.0 3.0 5.0 -12.0
6.0 -1.25 -4.06 -6.0
/
```

Selecting Which Chord is Being Played

There are 2 methods to select which chord in the table is being 'played':

- 1) Using a control voltage which is divided into 64 steps (1 step per possible table entry)
- 2) Selecting "Step" mode. This uses SYNC1-3 as trigger inputs as follows:
 - SYNC1 steps forward 1 table entry per rising edge.
 - SYNC2 steps backward 1 table entry per rising edge
 - SYNC3 resets to the first entry per rising edge

This SYNC mapping will appear on the Chord page. The mapping is 'hard coded' and cannot be reassigned. Stepping at audio rates is allowed. If Loop is active, you can step backwards from Entry 1 to the last table entry, or loop forwards from the last entry to Entry 1. This implements a quad, 64-step sequencer.



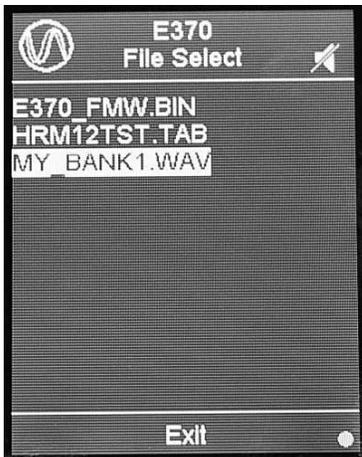
Presentation Pages

These 3 pages are different visual representations of the state of the 4 VCO outputs.

- Waves – displays the wavetable used or a data screen for Noise
- Lissajous – X/Y plots of the VCO wavetables. The X and Y axis can be selected as VCO1-4
- Visuals – little 'graphical helpers' that show simple plots of the CV (Morph and Cloud modes), a spectra map (FM mode) or payback (Sample Player).

In Waves and Visual screens, you can use the encoder to highlight a particular VCO. Clicking will then 'expand' the display and offers additional information or a larger, more detailed representation.

File Page



The OS in the E370 supports FAT32 formatted uSD cards 32GB or less in size and 'understands' the old MS-DOS 8.3 file naming format (all text will be converted to upper case). The speed rating of the uSD card is not important. The current OS only can READ from uSD card. The uSD card is NOT required to boot or use the E370.

Up to 26 USR wavetable banks (in V1.4) can be stored in the E370 internal memory. This is a total of $64 \times 26 = 1,664$ individual wavetables.

Files supported are in 3 categories:

- .WAV – for loading in single wavetables or an entire bank of 64 wavetables
- .TAB – Chord Table
- .BIN – E370 firmware update file (supported by the Bootloader function)

Highlighting a TAB or WAV file and clicking will parse the file for 'correctness' and open up the load screen. The file size of the .WAV file is used to load an individual wavetable into a specific bank, or load in an entire bank of 64 wavetables into a selected USR slot.

Selecting a BIN file or other files not supported by the File page will result in an error screen. The E370 restricts the number of files in the root directory to be 255 or less.

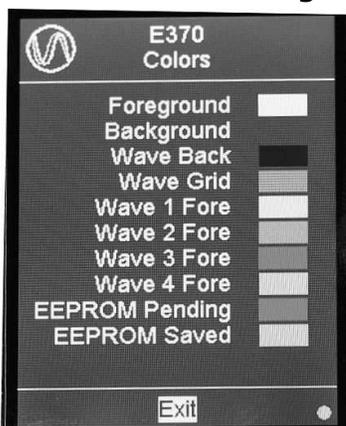
The 'No Audio' icon will appear in the upper right corner to indicate the 4 VCO outputs are muted during file operations.

LOADING NEW FIRMWARE

- The firmware will be called E370_FM.WBIN and will be on the website as required.
- Put the .BIN file in the root directory, and place in the uSD slot
- Turn power off to the module.
- Press and hold the encoder, and turn power back on. Release the encoder knob.
- The boot screen as shown should appear. Select YES and click, the E370 will upload the new OS.
- Turn power off and remove the uSD card when loading is completed (about 20 seconds). Turn power back on and the new OS will execute.



Color Selection Page



The E370's LCD supports 64 colors and this page allows you to set foreground/background/text and other colors.

The intensity/contrast is fixed and cannot be adjusted.

Loading and Saving Patches

There are 16 user patches that are stored in the E370's internal memory (no uSD required).

Each patch saves the complete, entire state of the E370: all the pages, referenced Wavetable banks (but not the Banks themselves) and all the settings. The panel pot positions are not saved.

Patches must be saved/recalled via the encoder system. Patches cannot be 'backed up', but they can be over-written.

About Page/Credits

The top portion will show the OS build date/version, then after a short delay will continuously scroll the E370 credits.

The lower half is a simple diagnostic screen. It shows on a scale of -99 to +99 the 16 CV values and a 1/0 indication if the 4 SYNC lines (1 is no SYNC, 0 is SYNC active).

Specifications

Input voltage range (all inputs): -5V to +5V, 12KHz max frequency

Audio output voltage: 11V pk-pk nominal before clipping

SYNC input voltage threshold: +0.6V nominal, positive-edge slope generated internal SYNC

Number of wavetables: 1,664 in 26 shared banks: a Bank is an array of 8x8 wavetables

Wavetable Size: 256 samples, 16bit unsigned integer (7FFFh is mid-scale)

Power Requirement

+12V @ 105ma, -12V @32ma. If the DIY power connector is installed, the power can be +-9V to +-15V.

VCO MODES

MorphXY: the 2 parameters are used to create an output from the 8x8 wavetable array. X will scan back & forth across a row and Y scans up & down a column. Think of each wavetable is a square on a chess board. To turn off the 'smooth morphing', turn Phase Interpolation to OFF. You can then select 3 levels of 'Glitching' if desired. In this manner, you can 'dial in' a specific wavetable in a bank without any influence from adjacent wavetables. Will see this on the Wave display, as the waves will 'jump and lock' as you scan through them. The generated 'glitch' when crossing to another wavetable is not displayed.

MorphZ + Phase: scans all 64 waves 'end-to-end' in the selected bank, and has phase shift and amplitude controls (the amplitude is a reversing attenuator, ranging from -1 to 0 to +1 gain).

MorphZ + Wavefolder: scans all 64 waves 'end-to-end' and has a Chebyshev polynomial wavefolder

Cloud: creates 2, 4 or 8 copies of the wave, and then detunes them (Spread) and adds filtered noise FM. You can select 'standard' VCO waves (Sine, Saw, etc) or 'Morph', which allows the "Morphing Clouds" mode of the E352. This can be a very dramatic effect!

2-OP FM: 2-operator FM. You can select standard Sines or other waves/wavetables. The 3 parameters are mapped as follows:

- FM Index ('depth') 0 – 314%
- quantized frequency Ratio of Modulator to Carrier (1/8 to 8)

Noise: 4 types of noise plus optional 4-pole, resonant lowpass ladder filter applied.

Sample Player: this treats the selected bank as 1 giant wavetable/sample. There are Start and Stop points applied, so all or a tiny portion of the wavetable is played back. You can use a SYNC input to play the sample back in "1-shot" mode, like a drum machine.

Please note that no anti-aliasing filtering is applied during playback. Very short sample lengths will increase aliasing/noise.

Tech support/primary contact information is via our Facebook page: SynthTech Modular

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