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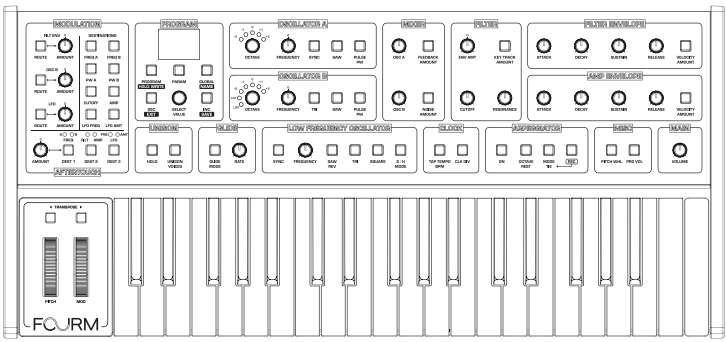

COMPACT 4-VOICE ANALOG SYNTH WITH POLY AFTERTOUCH KEYBED

SEQUENTIAL®

User Guide

Version 1

August, 2025

Sequential LLC
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USA

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Tested to Comply
With FCC Standards
CLASS B

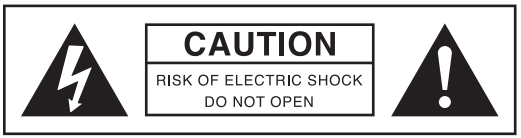
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la classe B respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

For pluggable equipment, the socket-outlet must be installed near the equipment and must be easily accessible.

For Technical Support, email: support@sequential.com



This device is to be serviced by a Sequential-qualified technician only. Service technician must exercise due caution when opening the device to avoid electric shock and the device being unsecured when open.

CALIFORNIA PROP 65 WARNING

This product may expose you to chemicals including BPA, which is known to the State of California to cause cancer and birth defects or other reproductive harm. Though independent laboratory testing has certified that our products are several orders of magnitude below safe limits, it is our responsibility to alert you to this fact and direct you to: https://www.p65warnings.ca.gov for more information.

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Special thanks to Ryan Gray and Adrien Fauconnet for help with Tactive™ keybed developmentt.

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A Few Words of Thanks

Thank you for choosing Fourm. We know that a synthesizer is a significant investment, and we're honored that you've put your trust in us to be a part of your musical life.

For decades, we've focused on crafting instruments that are as thoughtfully designed and well-built as they are inspiring. With Fourm, we've worked hard to bring Sequential's premium analog experience to a wider range of musicians.

The result is an instrument that embodies the very best of our synthesis design. From its solid steel chassis to the meticulously engineered keybed with its responsive polyphonic aftertouch, every element of Fourm was crafted to create a truly integrated and uncompromised playing experience.

We hope Fourm becomes a trusted part of your creative process — a synthesizer you reach for not just because it sounds great, but because it feels right. That's always been our goal, and it's what Dave Smith believed in: building instruments that help musicians make their best music.

> "Keep it approachable, fun to play, give it the personality that comes from the voice. That's, I think, where the magic is."
>
> - Dave Smith, March 2022

Now go make music!

— The Sequential Team

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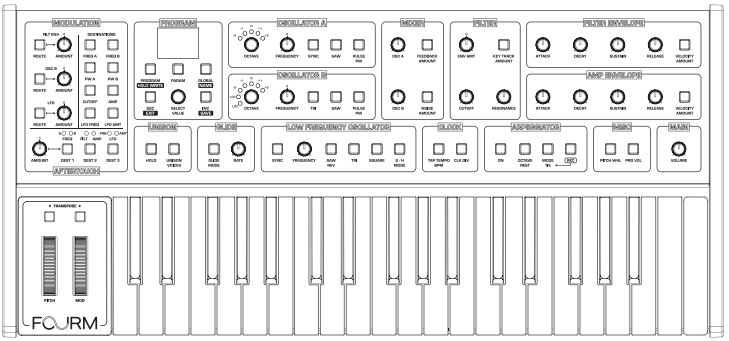
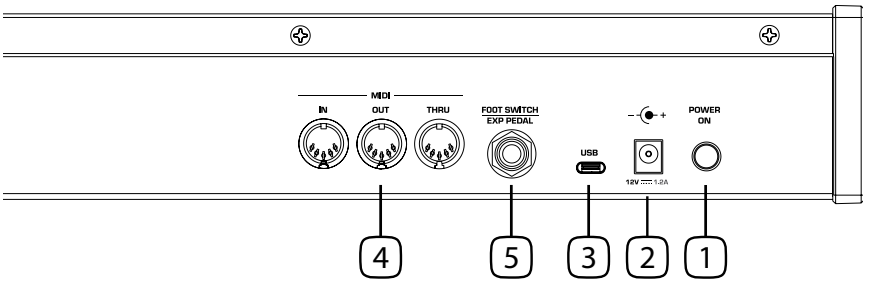
Chapter 1: Getting Started

Fourm is a compact and powerful 4-voice poly synth equipped with a Tactive™ polyphonic aftertouch keybed. It combines the warmth and punch of two analog, voltage-controlled oscillators and the recognizable character of vintage Sequential analog filters, drawing on design cues from the venerable Pro ~ One monosynth. The result is a classic, warm, organic-sounding subtractive synth with a hard-hitting modern voice.

This chapter of your user's guide provides an overview of essential tasks such as how to connect Fourm to your audio system and how to edit and save sounds. Later chapters explain each of Fourm's parameters, as well as how to program sounds using the panel parameters and how to use the GLOBAL menu to manage its overall behavior.

We've designed Fourm to be as easy to use as possible. Almost all of its essential controls are within easy reach on its front panel, so don't hesitate to dive in and start turning knobs and pressing buttons. Then, when you're ready, dig into this user's guide to explore the deeper parts of the synth.





Rear Panel Connections

The rear panel of the Fourm has connectors for power, USB, MIDI, audio, and pedals.

1. Power On/Off—This switch controls power on and off to the Fourm.

2. DC Power Connector—Accepts the included 12.0V 1.25A wall-wart PSU. The PSU operates over a range of 100 to 240 volts, 50 to 60 Hz, and 15W.

3. USB-C—For bidirectional MIDI communication with a computer. The Fourm is a Class Compliant USB device and does not require additional drivers when used with Mac OS or Windows.

4. MIDI In, Out, Thru—Standard 5-pin MIDI DIN connectors for communicating with MIDI-equipped devices.

5. Footswitch/Expression Pedal—Accepts a momentary, normally open or normally closed footswitch to control sustain or to latch the Arpeggiator on when keys are held, or accepts a standard expression pedal that has a variable resistor on a TRS (tip-ring-sleeve) ¼ inch phone plug. Once connected, you can use the Global menu to route the pedal to control a variety of things such as volume or filter cutoff frequency to add expressiveness to live performance.

6. Main Audio Output—Unbalanced, ¼ inch audio output.

7. Headphones — ¼ inch stereo headphone jack. Headphone volume is controlled by the MASTER VOLUME knob on the front panel.

8. Security Cable Lock Slot — You can secure your Fourm by connecting any standard computer-style security cable lock to this slot.

Setting Up Fourm

Here's how to get your Fourm up and running:

1. Attach the prong adaptor for your region to the included PSU, and plug it into the power connector on the back of Fourm.
2. If you have an expression pedal, connect it to the FOOTSWITCH|EXP PEDAL jack on the back of Fourm. You can use it to control volume, filter cutoff, or mod amounts. You can also connect a sustain switch here instead - the behavior of the jack is set in the Global menu.
3. Connect the MAIN AUDIO OUT connector on the back of the Fourm to a line input on your interface/amp/mixer/powered speakers using a ¼ inch/6.35mm unbalanced/TS audio cable.
4. Turn on the Fourm.
5. Turn up the volume on your interface/amp/mixer/powered speakers.
6. Turn up the MAIN VOLUME on the Fourm.

Tune the Oscillators and Filters

The first time you use Fourm, you may need to run its built-in oscillator and filter calibration procedure. Repeat the calibration procedure as needed over the next few days. The Fourm learns the range of operating temperatures and will keep itself in tune over this range.

To calibrate the oscillators and filters:

1. Press the GLOBAL settings button.
2. With the SELECT/VALUE knob, scroll to the TUNE VOICES command.
3. Press on the SELECT encoder to select the command line, then press INC/SAVE.
4. The Fourm performs its auto-calibration procedure. Note that calibration data won't be saved if Fourm is powered off during calibration.
5. When finished, the front panel controls return to normal and you can play the Fourm.

Listen to the Factory Sounds

The Fourm contains 512 program locations. These are divided into two sets of 256 programs — over-writable User Banks 1 and 2, and Factory Banks 1 and 2.

1. When Fourm is powered on, the PROGRAM button is lit and a Program is selected in the middle of the OLED display.
2. Select among the User Banks programs by scrolling with the SELECT encoder. User programs are copies of the permanent Factory Bank programs, but can be overwritten. User Bank 2 contains 128 Basic Programs for starting your own patch creations.
3. Access the Factory Banks by pressing down on the SELECT encoder and scroll to navigate to the Factory Banks. On the display, Program will change to Bank User. Scroll with the SELECT encoder to change to Bank Factory 1 or 2. The Factory Bank programs cannot be overwritten.
4. Press the SELECT encoder to return to Program selection.

Many factory programs have an arp, mod, or note sequence associated with them. A quick and easy way to audition programs is to press the Arpeggiator's ON button to hear its associated arepggiation, mod sequence, or note sequence.

To choose a program:

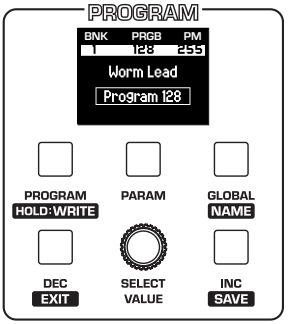
1. Press the PROGRAM button.
2. Use the SELECT encoder to scroll through Programs.
3. You can also use the DEC and INC buttons to move through the programs. Hold INC or DEC to quickly scroll up or down through programs within a bank.

Using the Program Display

The most frequently used controls on the Fourm are on its front panel. However, there are additional Global settings and Program-specific Param settings accessible in its main display.

For example, pressing the PARAM settings button gives you access to several program-related parameters such as pitch bend wheel range, unison detuning, noise type, filter keytracking, Vintage amount, and more. You can select and edit these additional parameters using the dual-function SELECT push encoder located below the display. Some of these parameters can also be accessed by holding panel buttons marked with secondary parameter text in blue. When a button with blue text below it is held, the SELECT|VALUE encoder can be used to immediately change the value.

The dual-function SELECT knob is used both for scrolling through the list of available parameters and commands and, when pressed, for changing selected values. The INC and DEC buttons can also be used for adjusting the selected value up and down, respectively.



The Program display

Editing Programs

The sound-shaping controls of Fourm appear on its front panel. To edit an existing program, just turn a knob and listen to its effect. Keep turning knobs and pressing buttons and if you like what you've created, save the program (see "Saving a Program" below).

Creating a Program from Scratch

Fourm makes it easy to create a new sound from scratch by providing a "basic program" that you can quickly recall at any time. This provides a simple starting point that you can quickly build on. It consists of a single oscillator (sawtooth), basic filter settings, basic envelope settings, and simple mod and pitch wheel setups.

To recall the Basic Program:

1. Press the GLOBAL button.
2. With the SELECT knob, choose 30:BASIC PROGRAM.
3. Press down on the SELECT encoder.
4. Press the INC button.
5. The Fourm resets its parameters to the Basic Program.

Alternatively, you can hold down the TRANSPOSE DOWN button then press the PROGRAM button to quickly recall the basic program.

Saving a Program

To save a program you've made or edited, it must be saved to the User bank. If you edit a Factory program, saving the sound will save it to the User bank.

To save a User program to the same preset location:

1. Press and hold the PROGRAM button until the LED begins blinking. Let go of the button.
2. The middle portion of the display changes to read "WRITE: Program X" (where X equals the current program location number).
3. Press the INC/SAVE button. The PROGRAM LED stops blinking and the program is saved to its current location.

To save a program to a different location:

1. Press and hold the PROGRAM button. Its LED begins blinking.
2. Turn the SELECT encoder to choose a program location, from 1-128.
3. To save your program to a different bank, press SELECT again to change the selection row to Bank User and scroll to select Bank User 1 or 2.
4. Press the INC/SAVE button. The PROGRAM LED stops blinking and the program is saved to its selected location.

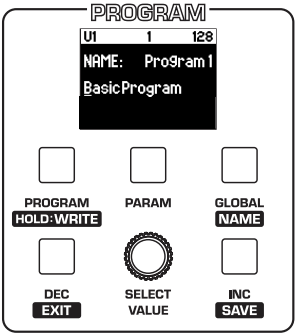
Canceling Save

To cancel the Save process:

- If the PROGRAM button LED is flashing, press the DEC/EXIT button. The LED stops flashing and saving is canceled. You can return to editing if you want.

Naming a Program

You can give a custom name to any program you've made or edited.



To name a User program while saving:

1. Press and hold the PROGRAM button until the LED begins blinking. Let go of the button.
2. Press GLOBAL/NAME.
3. The display changes to show a generic name for the program, or its current name is saving an existing program with a new name, on the

bottom row of the screen.

4. Turn the SELECT encoder to choose which of the characters you wish to edit.
5. Once you have selected a character to change, press down on the SELECT encoder to edit it. The cursor changes to indicate that it's selected.
6. Press SELECT again to return to the character position selection view.
7. When you've made your desired changes press INC/SAVE to save the program with its new name. The display will switch back to the Program screen.

Live Panel Mode

Fourm also features a "live panel" mode in which its sound output switches to the current settings of its knobs and buttons. In other words, the current preset is ignored and what you see on the front panel is what you hear. This is a great mode for learning, experimentation, and instant gratification.

To enter live panel mode:

- Press the GLOBAL button and use SELECT to scroll to 25:PRESET MODE.
- Press SELECT to change focus to the middle row.
- Turn SELECT to change the value from On to Off.
- Press PROGRAM to return to the program screen. The display will now read "Preset Off" to indicate the new panel mode.

To return to preset mode:

- Press GLOBAL button again and use SELECT to toggle Preset Mode back to On.

Exploring Fourm in More Depth

Before you explore the sound creation possibilities of Fourm, we'd like to point you toward a few things that will help you tailor it to your needs. The better you know it, the more you'll get out of it.

First, read "Global Settings" on page 10. There are many useful settings and functions found in the Global menu that will affect the overall behavior of your Fourm, including tuning, MIDI connections, calibration, and more. In particular, read about Pot Modes and determine which works best for you when you're editing sounds.

Also, in "Rear Panel Connections" on page 1 read about the various connectors on the back of your Fourm and how you can use its various pedal, audio, MIDI, and USB inputs and outputs.

Visit https://sequential.com/product/fourm to download the latest factory programs.

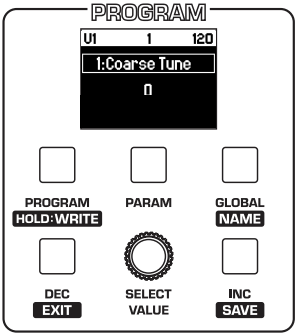
Finally, be on the lookout for tips and notes scattered throughout this manual to gain a better working knowledge of the Fourm. We wish you many hours of expressive musical exploration!

Chapter 2: Fourm Controls

This chapter explains all of the front-panel controls of Fourm, section by section, including the role each plays in synthesizing sounds. If you're just getting started with synthesis, take a look at *Chapter 4, Creating Sounds*, for step-by-step tutorials on how to program some classic sounds such as synth bass, brass, strings, and more.

Global Settings

Global settings are parameters that affect all programs. These include settings such as MIDI Channel, Velocity and Aftertouch curves, and more. Press the GLOBAL button to access them. Note that panel parameters except Main Volume are locked out when the Global menu is open.



Accessing Global settings

To set a Global parameter:

1. Press the GLOBAL button.
2. Use the SELECT knob to scroll through the list of parameters.
3. Press the SELECT knob to set a selected parameter value. The cursor will move to the bottom row and you can set your value with SELECT or INC/DEC.
4. After changing Global settings, press PROGRAM to exit Globals and return to the previously selected program.

You can set Fourm's default program (the one that loads when you turn Fourm on) by pressing GLOBAL, so be aware that any time you enter the Global menu you are setting a new default program.

Here are descriptions of all of the GLOBAL menu parameters:

1. Coarse Tune: -12…+12—Global Transpose control; a setting of 0 is the equivalent of concert pitch. This control steps in semitones one octave up (+12) or down (-12).

2. Fine Tune: -50…+50—Global Fine Tune control; 0 centered. Steps in cents as much as a quarter-tone up (+50) or down (-50).

3. Local Control: All Off, Key/Wheels Off, On—When on (the default), the keyboard and front panel controls directly affect Fourm. When off, the controls are transmitted via MIDI but do not directly affect the "local" synth (that is, the Fourm). This is primarily useful for avoiding MIDI data loops that can occur with some DAWs and external sequencers. When KEY/WHEELS OFF is selected, the front panel controls are enabled (so that you can edit them) but the keyboard and Pitch/Mod wheels are disconnected from the synth engine.

4. Pot Mode: Relative, Passthru, Jump—The rotary controls on Fourm's front panel are a mixture of "endless" rotary encoders and potentiometers or "pots." The pots are identifiable by their lined knobs and limited amount of travel. There are three pot modes to determine how the synth reacts when the programmable parameters are edited. (Main volume is not programmable, so these modes don't apply.)

When set to RELATIVE, changes are relative to the stored setting. In Relative mode, the full value range is not available until either the minimum or maximum value and the respective lower or upper limit of the pot's travel is reached.

For example, the Resonance parameter has a value range of 0 to 127. Let's say the physical position of the Resonance pot is at 12 o'clock. If you switch to a program that has a different Resonance setting and turn the pot all the way up, it may not go to its maximum value. To get to the maximum value, you first have to turn the pot down (counter clockwise) until the value is at the other extreme and the pot is at the limit of its travel (in this case, 0 and fully counter-clockwise, respectively).

In PASSTHRU mode, turning the pot has no effect until after the edited value equals the preset value (that is, until the edited value "passes through" the stored value).

JUMP mode uses an absolute value based upon the position of the pot when edited: turn a pot and the value jumps immediately from the stored value to the edited value.

5. Foot Control: Exp Pedal, Foot Switch—Sets the function for the Foot Switch/Exp Pedal input at the rear of the synthesizer. Selecting EXP PEDAL chooses normal expression pedal operation. Selecting FOOT SWITCH chooses sustain pedal operation. Only one type of pedal can be selected at a time.

6. Ft Switch Function: Sustain, Arp Hold, Arp Hold Mom,Seq Start/Stop, Trigger, Gate, T+G—When Foot Switch is selected for the Foot Control global, this parameter sets the operation of a foot switch or sustain pedal connected to the Foot Switch/Exp Pedal input.

- SUSTAIN: Chooses normal sustain pedal operation.
- ARP HOLD: Selecting ARP HOLD and pressing the sustain pedal causes the Arpeggiator to hold the current arpeggio as if you had pressed the HOLD button on the front panel.
- ARP HOLD MOM (Momentary): Causes the Arpeggiator to sustain (even when you release the notes on the keyboard) for as long as you hold down the pedal. Releasing the Sustain pedal stops the Arpeggiator.
- SEQ START/STOP: Allows any connected and compatible foot pedal to control Start and Stop functions on Fourm's Arpeggiator.
- TRIGGER: Allows a footswitch or audio signal connected to the Foot Switch input to step the Arpeggiator when the ON button is engaged.
- GATE: Allows a footswitch or audio signal connected to the Foot Switch input to gate the Filter and Amp envelopes when a note or chord is held. A foot switch connected here will perform the same function as an audio source.
- T+G: Allows a footswitch or audio signal to trigger and gate the envelopes as above. Additionally, this will trigger the Arpeggiator at the rate of the audio signal when ON is engaged.

7. Exp Pedal Function: Filter Full, Filter Half, Mod Filter Env, Mod Osc B, Mod LFO, Volume—When Exp Pedal is selected for the FOOT CONTROL global, this parameter allows you to set the function of the pedal.

- FILTER FULL: Allows a connected expression pedal to control the filter cutoff frequency within its full range (fully closed to fully open).
- FILTER HALF: Allows an expression pedal to control the filter over half of its range, with the heel-down setting of the pedal starting from the current filter CUTOFF knob position.

- MOD FILTER ENV: Allows a connected expression pedal to control Filt Env mod amount applied in the Modulation section.
- MOD OSC B: Allows a connected expression pedal to control the amount of Osc B modulation applied in the Modulation section.
- MOD LFO: Allows an expression pedal to control the amount of Mod LFO applied in the Modulation section.
- VOLUME: Allows a connected expression pedal to control Fourm's MAIN VOLUME parameter.

8. FtSw Polarity: Normal, Reverse—Selects polarity for Foot Switch input, accommodating various types of sustain and foot switches.

9. Aftertouch: Off, Mono, Poly—Enables standard monophonic aftertouch, Fourm's native polyphonic aftertouch, or turns it off entirely.

10. Atouch Curve: Medium, Hard 1, Hard 2, Soft 1, Soft 2, —Sets one of the four aftertouch curves for the keyboard to adjust the AT response to your playing style. MEDIUM is essentially a linear curve, and is a good starting point. The Hard and Soft curves require more and less force, respectively, to engage aftertouch. We recommend experimenting with the different curves to find the right feeling for your playing style.

11. Velocity Curve: Medium, Hard+, Hard, Soft+, Soft—Sets one of five curves to adjust the keyboard's velocity response to your playing style. The Hard+ and Soft+ settings start from respectively higher and lower fixed offsets at minimum velocity input. This means both settings start their velocity curves from non-zero values.

12. MIDI Channel: All, 1…16—Selects which MIDI channel to send and receive data, 1 to 16. Choosing ALL receives on all 16 channels.

13. Clock Mode: Sets the synthesizer's ability to send and receive MIDI clock messages:

- OFF: MIDI Clock is neither sent nor received
- OUT: MIDI Clock is sent, but not received.
- IN: MIDI Clock is received, but not sent.
- IN/THRU: MIDI Clock is received and passed to MIDI Out.

With IN and IN /THRU modes, if no MIDI clock is present at the selected input, the Arpeggiator will not function until clock is received.

14. Clock Input: MIDI, USB—Sets the port, MIDI or USB, by which MIDI clock is received.

15. Clock Output: None, MIDI, USB, ALL—Sets the port by which MIDI clock is sent, or disables clock output entirely when NONE is selected.

16. MIDI Param Out: Off, CC, NRPN—Changes to the values of front panel controls are transmitted via MIDI as Non-registered Parameter Number (NRPN) controllers or as Continuous Controllers (CC). Transmission of parameters can also be turned off.

NRPNs are the preferred method of parameter transmission, since they cover the complete range of all parameters, while CCs are limited to a range of 128.

17. MIDI Param In: Off, CC, NRPN—Sets the method by which parameter changes are received via MIDI. As with transmission, NRPNs are the preferred method.

18. MIDI Control: Off, On—When set to ON, the synth will respond to MIDI controllers, including Pitch Wheel, Mod Wheel, Pedal, Breath, Volume, and Expression.

19. MIDI SysX: On, Off—Sets whether MIDI System Exclusive data will be received or ignored.

20. MIDI SysX Port: MIDI, USB—Sets the port, MIDI or USB, by which System Exclusive data will be transmitted and received.

21. MIDI Out Port: Off, MIDI, USB, All—Sets the ports by which MIDI data will be transmitted.

22. MIDI Prog Send: Off, On—When On, the synth will transmit MIDI Program Change and other SysEx messages to the selected MIDI Out.

23. MIDI Prog Rcv: Off, On—When On, the synth will respond to received MIDI Program Change and related SysEx messages.

24. Arp Xmits MIDI: Off, On—When On, the synth's Arpeggiator outputs MIDI note numbers. You can use this feature to drive other MIDI-equipped devices such as synthesizers and drum machines.

25. Preset Mode: Off, On—Allows you to enter live panel mode, when OFF is selected. Setting this back to ON allows access to the preset banks.

26. Category: Off, On—When set to ON, preset selection changes from User and Factory banks to Categories. This allows you search for programs via saved Categories such as Favorites, Misc, Pad, Lead, Bass, Poly, Keys, String, Pluck, Bell, Arp, Brass, Voice, Organ, Percussion, Tuned Percussion, SFX.

With CATEGORY mode selected, the Program/Bank top line of the display changes to reflect Category type and currently-selected number of that particular Category bank, or Category type, respectively,

27. Seq Review: Off, On—When Seq Review is ON, you can use the SELECT encoder to audibly scroll through each Note, Rest, and Tie of a recorded Note Sequence. This is handy for editing sequences. When OFF, no sound will be heard when using select to step through the Notes, Rests, and Ties of a sequence. See the section on Fourm's Arpeggiator for more information on recording and playing back Note and Mod sequences.

28. Alt Scale: Equal Temperment, 1…65—Selects one of the Fourm's 65 built-in tunings. Set to 1. EQUAL TEMPERMENT, the tuning is standard, chromatic tuning. Choosing 2 through 65 selects an alternative, non-chromatic, scale that can be used to emulate non-Western instruments or in other creative ways. See "Appendix E: Alternative Tunings" for a description of each tuning. Additional tunings can be imported as SysEx files.

29. Screen Saver: Enables a screen saver to automatically turn off the OLED display when Fourm has been powered on and idle for several minutes.

30. Basic Program: Press down SELECT and then press INC to load an initiated program into the edit buffer. As a shortcut, hold TRANSPOSE DOWN and press PROGRAM to initiate the basic program.

31. Align Wheels: Calibrates the Pitch and Mod wheels. Follow the on-screen instructions to calibrate each wheel.

32. Tune Voices: Calibrates Fourm's VCOs, VCFs, and VCAs. After calibration, Fourm will automatically exit the Global menu.

33. Reset Globals: Resets all of Fourm's background Global parameters to the factory defaults. It's advisable to reset Globals after updating the OS.

34. Dump Preset: Transmits the currently selected Preset in SysEx format via the selected MIDI port. (See "MIDI SysEx Port: on page 14.) Dumped programs will load back into the same location in memory when imported back into the synth.

35. Dump Bank: Transmits the currently selected User Bank in SysEx format via the selected MIDI port. Dumped banks will load back into the same location in memory when imported back into the synth.

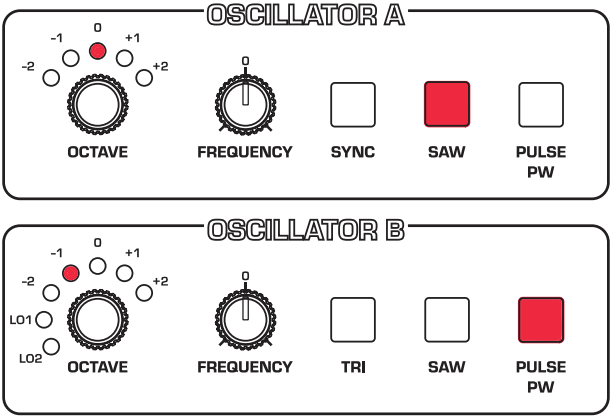
36. Dump All Banks: Transmits all User Banks in SysEx format via the selected MIDI port. As above, dumped banks will load back into the same location in memory when imported back into the synth via MIDI.

Oscillators

Oscillators generate the raw building blocks of Fourm's sound by generating *waveforms*, each of which has its own sound character based on its unfiltered harmonic content. Fourm features two analog, voltage-controlled oscillators.

Oscillators A and B generate sawtooth and pulse waves. Oscillator B also generates a triangle wave. You can activate any number of wave shapes simultaneously by pressing multiple wave shape buttons. This allows for a variety of different combined waveshapes and timbres. The pulse waves available in each oscillator feature adjustable pulse width.

Oscillator B also features two LO modes, which drop the oscillator into low, LFO-range frequency, to be used for polyphonic modulation purposes, as found on many past and present Sequential instruments, like the Prophet 6, Prophet 5, and others.



The Oscillator section, with Saw and Pulse wave shapes selected

To listen to the oscillators:

1. Hold the TRANSPOSE DOWN button and press the PROGRAM button to call up the basic program.
2. In the basic program, only Oscillator A SAW is enabled, and only Osc A is turned up in the Mixer. Play a key to hear Osc A's unfiltered saw wave.
3. Now press Oscillator B PULSE button to select that wave shape, and turn up OSC B in the mixer section. Play a key and you will hear both oscillators sound together.
4. Press and hold Oscillator B's PULSE button to engage PW, or pulse width. The display will change to show Osc B Pulse Width. This can be adjusted by holding the PULSE button and turning the SELECT encoder. Let go of the PULSE button and press down the SELECT encoder and then turn it to enable adjustment of Osc B pulse width while holding a key and listening to the effect this creates. Note that when adjusting PULSE WIDTH, it's possible to make the pulse width so narrow that the sound seems to disappear.
5. Experiment with selecting different wave shapes for each oscillator, and note how the various combinations influence their sound. Try selecting multiple shapes for each oscillator and notice what effect this has.

6. Try changing the OCTAVE settings for each oscillator and notice how setting each oscillator to a different octave influences their combined sound. The LO1 and LO2 OCTAVE settings on Osc B allow you to set it to very low frequency range. This allows Osc B to be used as an LFO when routed through the OSC B Modulation bus. LO1 maintains key tracking, forcing the oscillator to follow the keyboard. LO2 disconnects the oscillator from the keyboard, making it behave like a standard LFO. At these octave settings, Oscillator B's audio output is so low that it's perceived only as clicking, unless keyboard TRANSPOSE is set to maximum and the OCTAVE setting is at LO1.

7. Experiment with the FREQUENCY knob on the oscillators and notice how slightly detuning the oscillators in relation to each other creates chorus-like movement and thickness in their combined sound.

8. Rotate the filter's CUTOFF and RESONANCE knobs to see how this affects the sound of the oscillators.

9. With Oscillator A and B engaged (any wave shapes selected), press the SYNC button on Oscillator A and set it's OCTAVE to +2. Then rotate the FREQUENCY knob on Oscillator A while holding a note. This is the classic *hard sync* sound that you've probably heard before. Instead of rotating the FREQUENCY knob by hand, you can use the Modulation section to route FILT ENV (filter envelope) to FREQ A to sweep the oscillator's pitch and create the hard sync effect each time you play a note. You'll learn more about the Modulation section in "Modulation" on page 32.

Oscillator Parameters

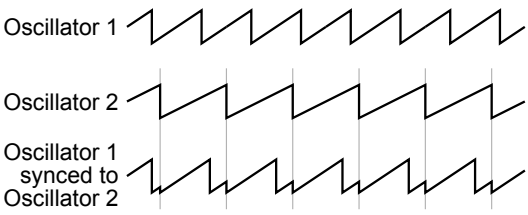
Octave: Sets the base frequency of an oscillator over a 5-octave range. The global COARSE TUNE and FINE TUNE settings affect the pitch of the oscillators. See "Global Settings" on page 11 for more information.

Frequency: Fine tune control with a range of 7 semitones (a major 5th) up or down. The 12 o'clock position is detented.

Shape: These buttons select the waveshapes generated by the oscillator. Oscillator A generates sawtooth, and pulse analog waveshapes. Oscillator B generates triangle, sawtooth, and pulse waveshapes. Pulse width is continuously variable for both oscillators.

In the Modulation section you can use a modulator such as Filter Envelope, Oscillator B, and LFO to modulate pulse width of Oscillator A, B, or both simultaneously. This modifies the harmonic content and timbre.

Sync: Off, On—Turns on oscillator hard sync. When an oscillator is hard synced, its wave cycle is forced to conform to another oscillator's wave cycle and is forced to reset each time the master oscillator's wave cycle restarts. This causes the synced oscillator to create harmonically complex waveforms — particularly when the synced oscillator's pitch is set higher than the master oscillator's pitch. See "Creating a Hard-Sync Lead" on page 65 to learn how to set up a classic oscillator hard sync sound.



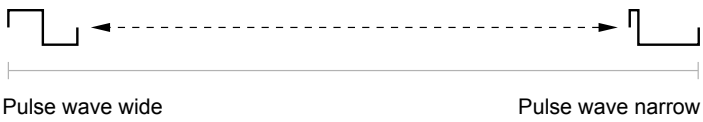
Oscillator hard sync

Additional Oscillator Parameters (Param Menu)

Additional oscillator parameters are accessible by pressing the front-panel PARAM button and scrolling through the list that appears.

Pulse Width A (PW): -63-64—In the Param menu, adjust Pulse Width A using the select encoder. Or hold PULSE and turn SELECT to set pulse width for Oscillator A. You can set Pulse Width from -100% to %100 duty cycle, with %50 (wide pulse) at 0. At -%100 and 100% the pulse width narrows to silence. Setting this parameter to negative amount, or fully counterclockwise (0 to -63, or 50% to -100%) reverses pulse phase. Oscillator phase can be a useful sound design feature when using oscillator sync, for example.

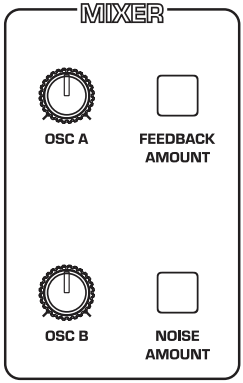
Pulse Width B (PW): -63-64—Allows adjustment of Oscillator B pulse width, to the same effect as Oscillator B.



Oscillator Pulse Width

Mixer

The Mixer section is where you set the levels of the various sound generators on the Fourm. These include oscillators A and B, feedback, and the noise generator. You must select and/or turn up at least one of these sources in order to make sound with the Fourm. Alternatively, you can make the filter generate its own sine wave by turning up RESONANCE all the way so that it self-oscillates.



The Mixer section

Mixer Parameters

Osc A: Sets the output level of Oscillator A.

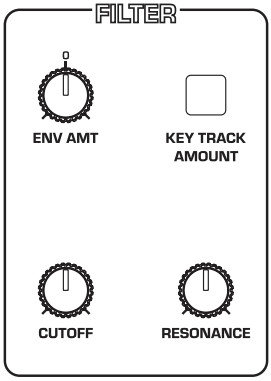
Osc B: Sets the output level of Oscillator B.

Feedback (Amount): When on, post-filter audio is routed back into the filter, in a feedback loop. This can be useful in sound design for thickening, or adding chaotic elements to a sound. When engaged, Feedback level defaults to 100, but this can be changed by holding the FEEDBACK button while using the SELECT encoder to alter the value. The Feedback mixer stage uses soft-clipping diodes in the circuit for extra saturation.

Noise (Amount): Engages the white/pink/violet noise generator. When selected in a basic program, Noise level will be preset to 127, or maximum volume. Change Noise level by holding NOISE and then using the SELECT encoder to change the level value. White noise is selected by default, but can be changed to pink or violet in the PARAM menu.

Filter

The function of the filter is to subtract frequencies from the sound produced by the oscillators and noise generator, thereby changing the overall harmonic content of the synth's sound. This change is varied over time using the Filter Envelope to produce more dynamic timbres.



The Filter section

To hear the effect of the filter:

1. Recall the Basic Program by holding the TRANSPOSE DOWN button and pressing the PROGRAM button.
2. Hold down a note and rotate the filter's CUTOFF knob. Notice how it cuts the high frequencies as you rotate counter-clockwise, making the sound of the oscillator less bright. If you turn the CUTOFF knob fully counter-clockwise you'll filter out all frequencies and hear nothing.
3. Return the CUTOFF knob to its halfway position, hold down a note again then turn the RESONANCE knob about halfway up.
4. Rotate the filter's CUTOFF knob again and listen to the sound change as a band of frequencies near the cutoff is amplified. This is how to create a classic resonant filter sweep.

In the previous example, you controlled the filter cutoff by hand. In most cases, you will use the Filter Envelope to do this. To learn more about the Filter Envelope, see "About the Filter Envelope" on page 24.

Filter Parameters

Cutoff: Sets the filter's cutoff frequency.

Resonance: Emphasizes a narrow band of frequencies around the cutoff frequency. High levels of resonance can cause the filter to self-oscillate and generate its own pitch.

Key Track (Amount): Quarter, Half, Full—Sets the amount of modulation from the keyboard to the filter's cutoff frequency. Any setting other than off means that the higher the note played on the keyboard, the more the filter opens. This is useful for adding brightness to a sound as higher notes are played, which is typically how acoustic instruments behave. When turned off (LED not lit), keyboard filter tracking is off, meaning that filter frequency is unaffected by playing higher or lower notes on the keyboard. When set to FULL, the filter will track in half-step increments, which can be useful if you are using the filter to generate a pitch through self-oscillation. QUARTER and HALF settings reduce the amount of keyboard tracking by their respective amounts.

You can set Key Track Amount by holding the KEY TRACK button while changing the value with the SELECT encoder, or you can enter the Param menu and scroll to 5. Filter Keytrack to change it there.

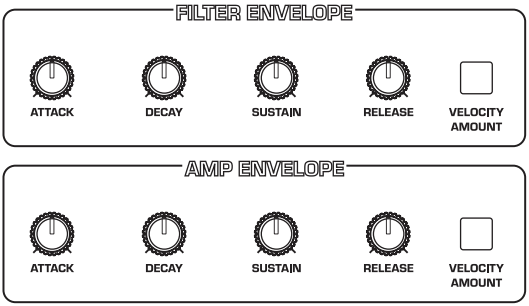
Envelopes

The Fourm has two 4-stage ADSR envelope generators (**a**ttack, **d**ecay, **s**ustain, **r**elease). They are useful for creating modulation that varies over time according to the shape of the envelope. The Filter Envelope, for example, is routed to Filter Frequency, and causes the filter to open or close according to the contour of the envelope. The Amp Envelope causes the volume to change over time according to the contour of the envelope.

Similarly, the Filter Envelope exists as one of the three modulation sources in the Modulation section, allowing you to apply modulation that changes according to the contour of the envelope.

Fourm's Modulation section allows many creative ways to use the Envelopes:

- Use the FILT ENV Modulation bus to route Filt Env one of the oscillators' FREQUENCY (pitch) parameter to create the classic "pitch blip" effect used in many synth lead sounds.
- Use the FILT ENV Modulation bus to route the filter envelope to one or both of the oscillators' PW parameter to make their pulse width evolve according to envelope's contour.
- Use the Filt Env Modulation bus to route the Filter Envelope with slow attack, decay, and release times to LFO FREQ to speed up or slow down the LFO frequency over time (setting a negative Filter Env modulation amount will gradually slow down the LFO; setting it to a positive amount will gradually speed it up, using the above envelope settings).



Fourm's Envelopes

Filter Envelope:

- FILTER ENVELOPE controls Filter Cutoff frequency
- A Modulation Source–The Filter Envelope also functions as an assignable modulation source that can be used to modulate any destination selected through the Modulation Bus. In the Modulation section, modulation from the Filter Envelope can be set to positive (clockwise) or negative amounts (counter clockwise). See page 32 to learn about the Modulation section.

Amp Envelope:

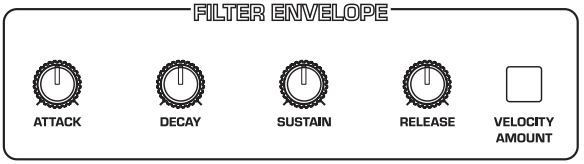
- AMP ENVELOPE controls the Amplifier (loudness).

About the Filter Envelope

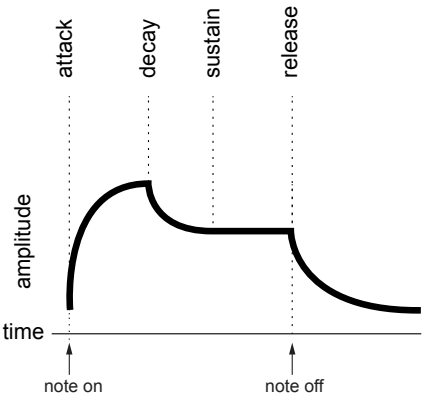
Routing Filter Envelope to filter Cutoff shapes the harmonic characteristics of a synthesized sound by giving you filtering control with each of the envelope stages (attack, decay, sustain, release).

A filter envelope is one of the most important aspects of a synthesized sound. Without an envelope, the filter would be static and unchanging. It would stay open or closed by a fixed amount that wouldn't change over the duration of a sound. That's not very expressive or interesting to listen to — and it's not how most real-world instruments behave.

In general, sounds produced by an acoustic instrument are brighter at their beginning (the attack stage) and grow mellower as they die out (the decay and release stages). In other words, their harmonic content changes over time. This is exactly what the filter envelope is designed to emulate.



Filter Envelope parameters



A typical 4-stage ADSR envelope

To hear the effect of the Filter Envelope:

1. Recall the Basic Program by holding the TRANSPOSE DOWN button and pressing the PROGRAM button.
2. Hold down a note and rotate the filter's CUTOFF knob to set it to the 9 o'clock position.
3. Play a note. At this point you may not hear anything because you've closed the filter significantly.
4. In the Filter section, set the ENV AMT knob to the 3 o'clock position.
5. Play a note. Notice how the sound has changed. The Filter Envelope is controlling filter cutoff to the degree you set with the AMOUNT knob.
6. Repeatedly strike notes on the keyboard as you turn the Filter Envelope's DECAY knob clockwise. Notice how it changes the sound as the note decays faster or slower after its initial attack stage.
7. Now experiment with the Filter Envelope's ATTACK knob. Notice how the onset of the filter cutoff increasing ("opening" the filter) becomes faster or slower.
8. Now hold down a note and experiment with the Filter Envelope's SUSTAIN knob. This controls how long the filter stays open while you hold down a key on the keyboard.
9. The Filter Envelope's RELEASE parameter acts in conjunction with the Amp Envelope, so to hear its effect, first set the Amp Envelope's RELEASE value to the 2 o'clock position.
10. Now repeatedly strike notes on the keyboard as you turn the Filter Envelope's RELEASE knob clockwise and counterclockwise. Notice how the note fades out faster or slower as you change the RELEASE value.
11. Continue experimenting with various Filter Envelope settings while you adjust the Filter Envelope AMOUNT knob, clockwise and counterclockwise. Notice how positive AMOUNT settings increase the effect of the envelope on the filter, and negative amount settings invert the envelope's time contour, with greater effect on cutoff as the pot is turned counter clockwise.

The Filter and Amp Envelopes often work in conjunction, with the Filter Envelope controlling how the filter opens and closes and the Amp Envelope controlling how the amplifier shapes the volume of sounds. To learn more about the Amplifier Envelope, see "About the Amp Envelope" on page 27.

Envelope Parameters

Attack: Sets the attack time of the envelope. The higher the setting, the slower the attack time and the longer it takes for the filter to open from the level set with the filter CUTOFF knob to the level set by the filter envelope amount. Percussive sounds typically have sharp (short) attacks.

Decay: Sets the decay time of the envelope. After a sound reaches the filter frequency set at its attack stage, DECAY controls how quickly the filter then transitions to the cutoff frequency set with the SUSTAIN knob. The higher the setting, the longer the decay. Percussive sounds, such as synth bass, typically have shorter decays (and a generous amount of low-pass filter resonance).

Sustain: Sets the filter cutoff frequency for the sustained portion of the sound. The sound will stay at this filter frequency for as long as a note is held on the keyboard.

Release: Sets the release time of the envelope. This controls how quickly the filter closes after a note is released.

Velocity (Amount): 0-127—Allows key velocity to influence filter cutoff frequency. When turned on, the harder/faster you play, the more the filter will open and the brighter the sound will be. If off, key velocity will not affect the filter. This control allows for more touch-sensitive sounds.

The default Velocity amount setting is 127. To set a precise amount, hold VELOCITY and turn SELECT to choose a value on the display. Or enter the Param menu and scroll to 7:FILT ENV VEL to set a value.

Additional Envelope Parameter (Param Menu)

Additional Envelope parameters are accessible by pressing the front-panel PROGRAM button and scrolling through the list that appears. The parameters below do not appear on the front panel.

Env Retrig: Off, On—When on, causes each key press to retrigger both envelopes at their Attack phases. This can help with creating sounds for articulate keyboard phrasing.

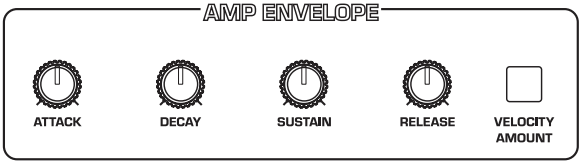
When off, each voice's envelope will progress through its entire contour when a key is pressed.

About the Amp Envelope

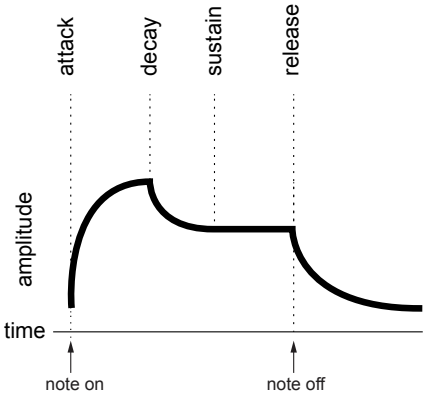
After passing through the filters, a synthesized sound goes into an amplifier, which controls its overall volume. The Amp envelope is used to shape the volume characteristics of a sound over time by giving you control over these stages. Along with the Filter envelope, this is one of the most important aspects of a synthesized sound.

Without a volume envelope, the volume of a sound wouldn't change over the duration of a note. It would begin immediately, remain at its full volume for its duration of the note, then end immediately when the note was released. Again, that's not very interesting sonically and it's not typically how instruments behave in the real world.

To give you a real-world example, the main difference between the sound of the wind and the sound of a snare drum is that they have very different volume envelopes. Otherwise, they are essentially both white noise. Wind has a relatively slow attack, a long sustain, and a long decay and release. A snare drum has a sharp attack, no sustain, and very little decay or release. But again, they are both fundamentally white noise.



Amp Envelope parameters



ADSR envelope

As noted above, the Amp Envelope works in conjunction with the Filter Envelope, with the Filter Envelope controlling how the filter opens and closes, and the Amp Envelope controlling how the amplifier stage contours the overall volume of the sound over time.

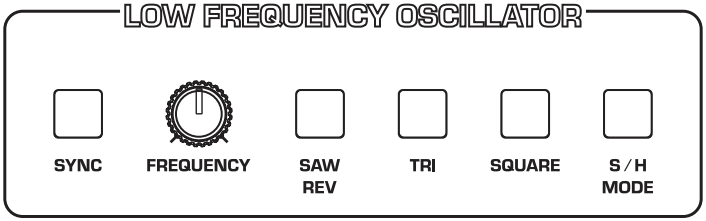
To hear the effect of the Amplifier Envelope:

1. Recall the Basic Program by holding TRANSPOSE DOWN and pressing PROGRAM to load the basic program.
2. Repeatedly strike a note on the keyboard as you turn the Amp Envelope's ATTACK knob clockwise. Notice how the onset of sound becomes slower and more gradual the further clockwise you turn the knob.
3. Reset the ATTACK parameter to zero (fully counter-clockwise).
4. Next, repeatedly strike a note on the keyboard as you turn the Amp Envelope's SUSTAIN to zero. Notice how the sound no longer sustains even if you hold down the key. The only sound you hear is from the DECAY portion of the envelope.
5. Now, with SUSTAIN still set to zero, repeatedly strike notes on the keyboard as you turn the Amp Envelope's DECAY knob clockwise and counterclockwise. Notice how it changes the sound as the note decays faster or slower after its initial ATTACK stage.
6. Set the DECAY parameter to 3 o'clock.
7. With DECAY set to 3 o'clock and SUSTAIN still set to zero, repeatedly strike notes on the keyboard as you turn the Amp Envelope's RELEASE knob clockwise. Notice how the sound takes longer to fade the further you turn the knob.
8. Continue experimenting with various Amp Envelope settings while you also adjust the Filter Envelope to hear how these two modulators interact.

Low Frequency Oscillator

An LFO is a special-purpose oscillator that produces a frequency typically below the range of human hearing (although some can actually extend into the audio range if set to their maximum frequency). The LFO is used for periodic modulation such as vibrato (periodic pitch modulation) and tremolo (periodic amplitude modulation). The LFO can also be used as a modulation source for any of the Modulation bus destinations in Fourm.

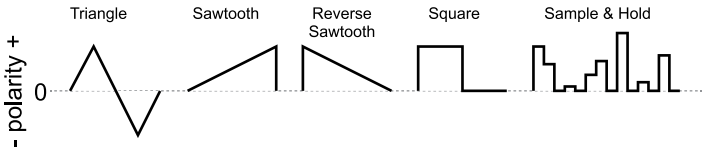
The LFO produces a variety of waveshapes, including triangle, sawtooth, reverse sawtooth, square, S&H (sample & hold & random), as well as three colors of noise and direct current. Though most often used for low-frequency modulation, the LFO can actually function at speeds that extend into the audible range for extreme effects. Fourm's LFO rates range from 0.021Hz to 556Hz.



Fourm's Low Frequency Oscillator

The triangle wave is bipolar. That is, its waveshape is positive for half of its cycle and negative for the other half. This makes it possible to generate a vibrato that goes alternately sharp and flat in equal amounts on either side of a center frequency.

The square, sawtooth, reverse sawtooth, and sample & hold, and random waves generate only positive values. In the case of the square wave, this makes it possible to generate trills.



LFO waveshapes

The LFO can be free-running or synced to the Arpeggiator or MIDI clock for tempo-sync effects such as filter sweeps, trance gates, and so on.

LFO Parameters

Sync: When on, the LFO synchronizes with Fourm's Clock, which controls the Arpeggiator. If Fourm is set to synchronize to an external clock source, the LFO will also follow external sync timing.

You can select the LFO clock division when synced using the LFO Sync Frequency parameter in the PARAM menu.

Frequency: Sets the frequency of the selected LFO from a slow .021Hz to a fast 556Hz. This is affected by the CLK SYNC (clock sync) parameter as explained below.

Shape: Saw, Reverse Sawtooth, Triangle, Square, S/H—Selected by pressing the shape buttons. Multiple shapes can be selected simultaneously, simply by toggling any of the shape buttons on.

A quick way to access the reverse saw LFO shape is to press and hold SAW. This opens the LFO Rev Saw option. Use SELECT to change the setting from Off to On. Note that only one direction for the sawtooth LFO wave shape can be selected at a time.

The S/H shape also has more than one wave shape hidden under the hood. Press and hold S/H /MODE to access the different S/H modes:

S/H Modes:

- S/H–Sample & Hold samples and holds a random value at the rate set by the LFO FREQUENCY control, and by the BPM and CLOCK DIVIDE parameters when LFO SYNC is engaged.
- RANDOM–Samples and holds a random value for as long as a key is pressed. In other words, it sets a new random value on each successive key press. As such, the LFO FREQUENCY control has no effect when Random is selected.
- PINK–Generates pink noise to use as a modulator. Pink noise is characterised by a reduced energy at higher frequencies, resulting in a grainier signal. FREQUENCY will have no effect when this mode is chosen.
- WHITE–Generates white noise. Unlike pink noise, white noise features

equal energy across all frequencies. LFO FREQUENCY control has no effect in this mode.

- VIOLET–Generates violet noise, a noise type with energy increasing at higher frequencies, and reducing at lower frequencies. Use this to generate 'dusty' modulations.
- DC–DC allows you to send Direct Current through the LFO modulation bus. This can be very handy for evolving a patch "by hand." For example, select DC as LFO Mode and assign the LFO to the ***blue*** Mod Wheel bus. Then assign the LFO bus destination to CUTOFF, WITH A POSITIVE AMOUNT. Now the filter's cutoff frequency will be increased when you raise the mod wheel. Set the LFO amount to a negative value to decrease filter cutoff when raising the wheel.

There are many ways to make creative use of the LFOs:

- Route the LFO to the FINE parameter of the oscillators to create vibrato (TRIANGLE wave) or random pitches (S&H/RANDOM wave).
- Route the LFO's triangle wave to the filter's CUTOFF parameter and use a medium FREQ and AMOUNT setting to create a wah-wah effect, or use a slow FREQ setting and low AMOUNT setting to create subtle harmonic movement.
- Route the LFO's square wave to the amplifier's AMOUNT parameter and use a medium FREQ and AMOUNT setting to create a tremolo effect.
- Route the LFO to an oscillator's SHAPE parameter to make its timbre evolve.
- Route the LFO's triangle wave to the TIME parameter of the stereo delay and use a slow FREQ and low AMOUNT setting to create a chorus effect.

Additional LFO Parameters (Param Menu)

Additional LFO parameters are accessible by pressing the PARAM button and scrolling through the menu.

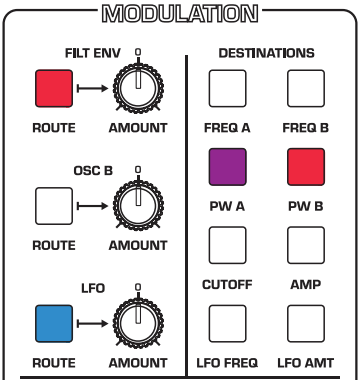
12: LFO Reverse Saw: Off, On—Allows reversal of the SAW LFO wave shape. When reversed, the SAW wave shape will start at the peak of the slope and descend from there. Useful for choppy-sounding modulations.

LFO S/H Type: S/H, Random, Pink, White, Violet, DC—Allows selection of random or unconventional modulation sources for the S/H wave form. Although only one mode of S/H wave can be selected, it can be freely combined with any of the other LFO wave shapes for more complex modulations.

LFO Sync Freq: 32 Steps, 16 Steps, 8 Steps, 6, Steps, 4 Steps, 3 Steps, 2 Steps, 1.5 Steps, 1 Step, 2/3 Step, 1/2 Step, 1/3 Step, 1/4 Step, 1/6 Step, 1/8 Step, 1/16 Step—When LFO Sync Freq is selected, the rate of the LFO is locked by clock division to either an external clock source or Fourm's internal clock.

Modulation

Although the overall sonic character of Fourm is determined by its oscillators and filters, much of its power to make unique sounds comes from creative use of modulation. Modulation is the process of routing one parameter (used as a control voltage) to another parameter in order to change the way the targeted parameter behaves. Fourm's modulation system is directly inspired by the legendary Pro ~ One monosynth.



This is the MODULATION section, with modulation from the Filter Envelope and LFO routed to Pulse Width of Oscillator A and B. PW A is receiving modulation from both the FILT ENV and LFO, while PW B is receiving modulation only from FILT ENV. Turning the associated AMOUNT knobs to left or right will set the degree of negative or positive modulation applied to each destination.

The idea is simple:

1. Press a ROUTE button on the left side to enable one or more of three modulation sources–FILTER ENV ROUTE, OSC B ROUTE, LFO ROUTE. Press once to route the chosen source through the direct modulation bus (LED lights **red**), press twice to route through the Mod Wheel bus (LED lights **blue**). You enable modulations routed through the Mod Wheel bus by raising the Mod Wheel.

2. Press a button on the right, or DESTINATION, side to select one or more of eight destinations. Press once to receive modulation from the **direct bus**, twice to receive modulation from the **Mod Wheel bus**, and press a third time to receive modulation simultaneously from both Modulation buses (LED lights **purple**).

3. Set an amount for each modulation source on the left side. The amount can be either positive or negative. Note that any modulation routed through the Mod Wheel bus will only be heard when the Mod Wheel is raised, and the maximum Modulation amount is set by the source's AMOUNT knob.

You already apply the concept of modulation whenever you use the filter envelope to control the filter's cutoff frequency. In that example, the modulation *source* is the filter envelope (or more precisely, any of its controls, such as attack, decay, sustain, or release). The modulation *destination* is the filter's CUTOFF frequency. The modulation *amount* is set with the Filter Envelope's AMOUNT knob.

There are 3 different modulation sources and 8 different destinations to choose from, with positive or negative amounts available. This gives you a large number of sound-shaping options.

Modulation Examples

Here are several modulation scenarios that illustrate how to use the modulation matrix. The examples provide step-by-step instructions for clarity. Some of these setups are built into the Basic Program, which you can recall from the GLOBAL menu.

To use the Mod wheel to add modulation to Filter Cutoff:

1. In the LFO section, select TRI and set FREQUENCY to a medium value.
2. In the MODULATION section, press the LFO ROUTE button twice, so the LED lights blue.
3. On the DESTINATION side, press CUTOFF twice to set it to receive modulation from the Mod Wheel bus.
4. Turn the LFO AMOUNT knob all the way clockwise.
5. Hold down some notes while raising the Mod Wheel. You'll hear the filter cutoff frequency modulating at the rate set in the LFO section.

To use the Filter Envelope to control Oscillator Pulse Width:

1. Select a pulse wave in the OSCILLATOR A section by pressing its PULSE button. You can disable the SAW wave shape if it's currently selected by pressing it once.
2. In the MODULATION section press FILT ENV once. It lights red. Turn its amount knob all the way clockwise.
3. On the DESTINATION side press PW A once, so it lights red.
4. Set the Filter Envelope ATTACK knob to three o'clock.
5. Now hold a key and listen as Oscillator A's pulse width slowly narrows at the rate of Filter Envelope Attack.

Other modulation ideas:

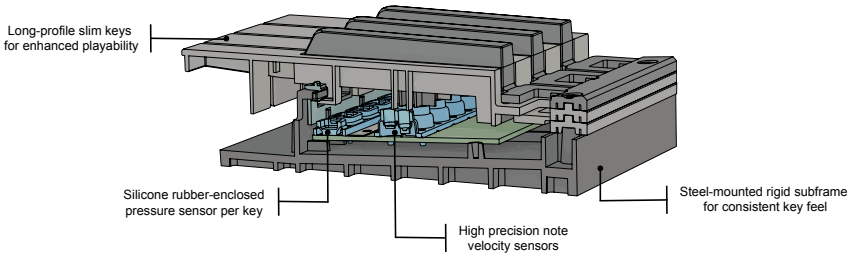
- To create the classic "attack pitch blip" effect in many synth brass sounds, choose a good two-oscillator saw wave brass sound. Send FILT ENV via the direct bus with the amount knob at about 2 o'clock to FREQ A. Set the Filter Envelope to Attack: 0, Decay: 10 o'clock, Sustain: 0, and Release: 0.
- Set OSC B OCTAVE encoder to its LO1 setting and route it via the Mod Wheel bus to CUTOFF to create a polyphonic LFO effect. Make sure you have Filter CUTOFF set fairly low, and add some RESONANCE to taste. Set OSC B ROUTE AMOUNT fully clockwise and raise the Mod Wheel - you'll

get a unique cascading poly LFO effect, with each of Fourm's four voices contributing a different modulation rate depending on the notes you play. Set Filter and Amp Envelope release times to 2 or 3 o'clock to hear the cascading modulations trail off into the distance. You can also play around with the various wave shapes (or combine them!) of Oscillator B for different effects.

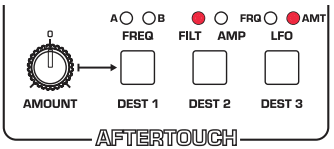
(Polyphonic) Aftertouch

Aftertouch is a performance feature that allows you to add modulation to a sound by applying additional pressure to a key after the key is already down. The greater the pressure applied, the more modulation is applied.

Fourm features a Tactive™ *polyphonic* aftertouch-capable keybed. This means that each of the four voices can be independently modulated in differing amounts by pressure applied to individual keys. Although many Sequential synths have been reactive to poly aftertouch, Fourm is our first modern instrument to feature it natively, provided by its own specially-designed keybed.



Cutaway view of the Tactive™ keybed



The Aftertouch Section, with Filter Cutoff and LFO Amount destinations selected

The Aftertouch section lets you choose the amount of modulation applied via aftertouch and also which of six possible parameters are modulated (oscillator frequency, filter frequency, amp envelope amount, LFO frequency and amount). You can set either a positive or negative overall amount.

For example, if you select the filter cutoff as modulation destination (FILT), set a *positive* amount of pressure by turning the AMOUNT knob clockwise, then press a key harder, the filter cutoff frequency will increase, making the filter open wider and the sound become brighter.

Conversely, if you select FILT as destination, set a *negative* amount of pressure by turning AMOUNT counterclockwise, then press a key harder, the filter cutoff frequency will be lowered, making the filter close, with the resulting sound becoming more muted.

Fourm provides five different aftertouch/pressure response settings. The default setting (Medium) provides a linear response. To choose a different response curve, use the ATOUCH CURVE parameter in the Global menu to select from Hard 2, Hard 1, Medium, Soft 1, or Soft 2. MEDIUM is essentially a linear curve, and is a good starting point. The Hard and Soft curves require more and less force, respectively, to engage aftertouch. We recommend experimenting with the different curves to find the one that provides the right feeling for your playing style.

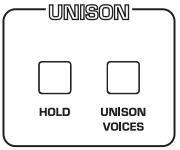
To assign Aftertouch:

1. Choose one or more of six destinations - FREQ A, FREQ B, FILT, AMP, LFO FREQ, LFO AMT - by pressing the DEST buttons.
2. Press one of the three DEST buttons. Pressing DEST repeatedly will toggle selection between the first destination, the second destination, both destinations, and off.
3. Set the overall amount of poly aftertouch key pressure modulation with the AMOUNT knob. This can be positive or negative.

Note that although there are three Destination busses with two possible simultaneous destinations for each, there is only a single amount knob, which affects all destinations equally. Also note that the LFO destination is monophonic; therefore, the key with the greatest amount of aftertouch pressure applied will set the amount of LFO modulation.

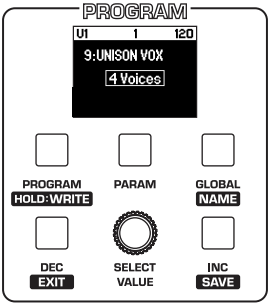
Unison

When UNISON is on, Fourm acts like a monophonic synthesizer in that only one note can be played at a time. However, that one note can be powered by as many as four voices, depending on how many you choose to use.



To use Unison:

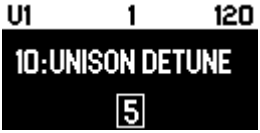
1. Press and hold the UNISON button.
2. With UNISON held down, use the SELECT knob to choose the number of voices to stack, from one to four, then release the Unison switch.



Setting the number of Unison voices

To detune the oscillators in Unison mode:

1. Press the PARAM settings button.
2. With the SELECT knob, choose the 10: UNISON DETUNE parameter.
3. Press the SELECT knob to select the value entry row, then turn it to set the amount of detuning. A setting of 0 is no detuning. A setting of 127 is maximum detuning.
4. Press PROGRAM to exit the PARAM screen.



Detuning Unison voices

Using Chord Memory

Unison has a useful feature called chord memory. Instead of assigning voices to a single note, hold down a chord on the keyboard and press the UNISON switch. The Fourm memorizes the notes of the chord. Single notes played on the keyboard then trigger all notes of the stored chord, transposing them as you play up or down the keyboard. Try using this feature to create powerful chord stabs.

To use Chord Mode:

1. Press the UNISON button.
2. Push the SELECT encoder to change focus to the middle row of the display, and scroll right to Chord.
3. Press UNISON to change focus to the top row of the Unison menu.
4. Play and hold a chord with any number of voices from two to four.
5. Press UNISON again to turn Chord Mode on. Now you can play or arpeggiate your selected chord across the keyboard.
6. A chord selected in Chord Mode is saved with your program.

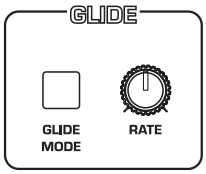
To clear chord memory:

1. Hold UNISON and use select to change the Unison Vox setting to any setting from 1 Voice to 4 Voice.
2. Press UNISON again to turn it off.
3. Save the program again.

Hold: HOLD sustains any currently-held notes, up to four. When HOLD is engaged, the Amp Envelope SUSTAIN stage controls the overall level of held notes, from no volume at minimum SUSTAIN setting, up to the current Program Volume setting at maximum SUSTAIN.

Glide

Glide causes the pitch of a note to glide up or down from the pitch of the previously played note. Glide is turned on and off using the GLIDE switch, but the RATE must also be set. If the GLIDE button is on, but RATE is set to 0, Glide has no effect.



To use Glide:

1. Press the GLIDE button to turn Glide on.
2. Play some notes up and down the keyboard while you turn the GLIDE RATE knob to adjust the amount of glide.

Glide Modes

There are four modes that determine how Glide behaves. You can quickly set your preferred glide style by holding the GLIDE/MODE button while using SELECT to choose a mode on the display.

Fixed Rate: The time to transition between notes varies with the interval between the notes; the greater the interval, the longer the transition time. The glide rate is fixed. This is the default glide mode.

Fixed Rate A: The same as Fixed Rate, but glide is only applied when playing legato. That is, glide only occurs when a note is held until the next note is played. This mode is only available when Unison is on.

Fixed Time: Glide is set to a fixed time, regardless of the interval between notes. This mode is only available when Unison is on.

Fixed Time A: The same as Fixed Time, but glide only occurs when playing legato.

To select a Glide Mode:

1. Press the PARAM button.
2. Use the SELECT knob to scroll to 17: GLIDE MODE.
3. Use the SELECT knob to choose a glide mode.
4. Play a series of notes up and down the keyboard to hear the effect.
5. Once you've chosen a mode, press PROGRAM to exit the PARAM menu.

Arpeggiator

The Arpeggiator allows the synthesizer to play a pattern based on the individual notes of a chord you hold. You can adjust the note playback mode (Up, Down, Up+Down 1, Up+Down 2, Random, Assign), the octave range (1, 2, or 3), the number of repeats per note, and the tempo.

While you hold down a chord, pressing any additional notes will add those notes to the arpeggio. You can change chords and notes and the arpeggio will continue to play as long as at least one note is always held.

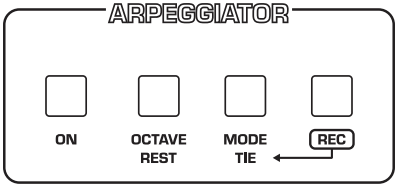
You can also use the HOLD feature with the Arpeggiator. When you enable HOLD, you can release the notes on the keyboard and the arpeggio will continue to play — with any additional notes that you play added to the arpeggio.

To prevent the Arpeggiator from adding new notes to an arpeggio when keys are continuously held (and instead start a new arpeggio each time you change notes), turn ARP RELATCH mode on in the Arpeggiator Mode settings. To do this, press the PARAM button and use the SELECT knob to scroll to the ARP RELATCH parameter. Press the SELECT encoder and turn the knob to turn Relatch on.

Set the tempo of the Arpeggiator with the TAP TEMPO|BPM and CLK DIV controls. To use TAP TEMPO, tap this button 4 times to set the tempo. To select a specific tempo, hold TAP TEMPO|BPM and turn SELECT to set the BPM.

You can also sync the Arpeggiator to external MIDI clock by selecting In or In/Thru in the Clock Mode global setting.

Fourm's Arpeggiator also has modes that allow it to function as a simple 64-step note or modulation sequencer, with the sequence triggered from the keyboard, rather than free-running like most standard sequencers. By turning the Sequencer Review global parameter on, you can also step through and edit each step in a sequence.



The Arpeggiator

To use the Arpeggiator:

1. Press the Arpeggiator ON button to turn it on.
2. Hold down one or more notes on the keyboard. The Arpeggiator plays them according to the default settings (Mode: Up+Down 1; Arp Relatch: On; Arp Repeat: 0; Octave: 1 Octave).
3. To latch the arpeggiator on (so that you don't have to continuously hold down notes) press the HOLD button.
4. To change the Arp Mode, hold the MODE button while using SELECT to change the value.
5. To change the Octave setting, hold OCTAVE and use SELECT to change values.
6. To change the Arp Relatch and/or Arp Repeat settings, press MODE and use SELECT to scroll up through the Param menu, then press and turn SELECT to change the values.
7. To synchronize Fourm's LFO to the Arpeggiator, press SYNC in the LFO section. This will synchronize the LFO to the BPM setting of Fourm's CLOCK parameter. See "**LFO Sync Freq**" on page 32 to learn about LFO clock divisions available when the LFO is synced to clock.

To record a Note Sequence:

1. Press PARAM to enter the Param menu, and scroll to ARP MODE. Press the select encoder and turn it to select SEQ NOTE.
2. Press the REC button to arm the sequencer for recording. The display changes to show SEQ STEP 1, with NOTE selected.
3. Hold down one or more notes on the keyboard. The note or chord will be written and the sequence will advance to SEQ STEP 2 with RESET selected. If you stop recording here, you'll get a one-note sequence resetting at step 2. You can record up to 64 steps.
4. To continue adding notes, press a key or play a chord. The display will advance to SEQ STEP 3.
5. You can add a Rest or Tie to the sequence at any time by pressing the OCTAVE|REST or MODE|TIE buttons. Pressing REST will add a space between notes of the sequence; stack as many Rests as you desire. Pressing TIE will extend the length of a note or chord for as many steps as you wish.
6. You can input a glide from one note to the next by holding a key then holding MODE|TIE. The display changes to show Note Glide until the MODE|TIE button is released. The notes will glide at the rate set by the GLIDE RATE control (and note that GLIDE does not need to be enabled for Note Glide to be heard in a sequence).
7. When you're done entering notes, press REC. The Arpeggiator will be automatically enabled and you can play and transpose your sequence by playing any key. You can also press ON, which will automatically end recording. Note that Note Sequencer playback will be monophonic, though you can get around this by entering a chord of up to four notes on any step.
8. A sequence is saved with a program, so save the program now if you want to keep the sequence.

To record a Mod Sequence:

1. Press PARAM to enter the Param menu, and scroll to ARP MODE. Press the select encoder and turn it to select SEQ MOD.
2. Press the REC button to arm the sequencer for recording. The display changes to show SEQ STEP 1, with MOD AMT selected.

3. Hold down a note on the keyboard. The note will be written and the sequence will advance to SEQ STEP 2 with RESET selected.
4. The note number of each step entered in a Mod Sequence determines the mod amount for each step. You can use the octave up and down buttons to record a wide range of mod notes.
5. You can add Rest, Tie, and Note Glide steps, just as in a Note Sequence.
6. When you're done recording the Mod Sequence, press REC or ON to stop recording and enable the Arpeggiator. Hold note or chord to hear the Mod Sequence in action.
7. The Mod Sequence destination defaults to Osc Freq A. You can change this to any other destination by entering the Param menu and scrolling to SEQ MOD DEST. Press SELECT and scroll to choose a destination: Osc Freq A, Osc Freq B, Filter Cutoff, MOD 1 Amt, MOD 2 Amt, MOD 3 Amt, LFO Freq, Pulse Width A, Pulse Width B, Pulse Width All, or Feedback.

To edit a Sequence:

1. Press PARAM to enter the Param menu, and scroll to SEQ REVIEW. Press the select encoder and turn it to select ON.
2. Press the REC button and record a sequence.
3. When you're finished recording press REC or ON to enable the Arpeggiator sequence.
4. Press REC again and the display will change to show SEQ STEP 1 and indicates whether a Note, Rest, or Tie was originally entered on that step.
5. Turn SELECT to scroll through each recorded step. Fourm will play each note or chord as you do so you can hear what was entered on each step.
6. To change a Note, Tie, or Rest on any of the steps simply press a key, the OCTAVE|REST button, or the MODE|TIE button when the step you want to change is selected in the display.
7. To exit Sequence Review press REC or ON.

Arpeggiator Momentary Sustain Mode

Fourm allows you to use a sustain pedal connected to the Footswitch|Exp Pedal jack to turn the Arpeggiator's Hold function on and off and perform other Arpeggiator-related functions.

There are four modes to choose from:

- Sustain– With the Arpeggiator running in this mode, pressing and holding the sustain pedal sustains the notes, as a sustain pedal normally would.
- Arp Hold– With the Arpeggiator running in this mode, pressing the Sustain pedal once causes the Arpeggiator to hold the sequence (even when you release the notes on the keyboard). Pressing it again stops the Arpeggiator.
- Arp Hold Mom– With the Arpeggiator running in this mode, pressing and holding the sustain pedal causes the Arpeggiator to sustain (even when you release the notes on the keyboard) for as long as you hold down the pedal. Releasing the Sustain pedal stops the Arpeggiator.
- Seq Start/Stop–In this mode, pressing the sustain once starts a Note or Mod Sequence. Pressing it a second time stops the Sequence.

To select the Arpeggiator's sustain pedal mode:

1. Press the global button and use the select knob to scroll to Foot Control. Press and turn select to change this to Foot Switch.
2. Press select and turn it to scroll to Ft. Switch Function.
3. Press select and turn it to select one of four modes listed above.
4. Press program or dec|exit to exit the Global menu.

MIDI Note Output from the Arpeggiator

The Arpeggiator is able to output MIDI note messages. Any notes that you hold on the keyboard can be arpeggiated according to the current settings of the Arpeggiator and output over MIDI as MIDI notes. You can use this feature to drive other MIDI-equipped devices such as synthesizers and drum machines. To access this feature, use the midi arp notes setting in the global menu.

To enable MIDI Note output from the Arpeggiator:

1. Press the global button, then use the select knob to locate the arp xmits midi parameter.
2. Press the select encoder, then turn select to choose On.

To control an external MIDI device:

1. Connect the MIDI or USB output of Fourm to the MIDI or USB input

of the external device, depending on which type of connection the external device requires.

2. On Fourm, press the GLOBAL button, then use the SELECT knob to locate the MIDI OUT PORT parameter.
3. Press the SELECT encoder, then turn it to select MIDI, USB, or ALL, depending on how your Fourm and external device are connected.
4. Press the PROGRAM button to exit the Global menu.
5. On the external device, set the MIDI Channel and MIDI Receive port to match Fourm's output.
6. Press ON in Fourm's Arpeggiator section, then hold a chord. The external device will be triggered by the arpeggiated or sequenced notes.

Arpeggiator Parameters

Arpeggiator On/Off: This button turns the Arpeggiator on and off.

Octave: 1, 2, 3—Set to 1, only the held notes are arpeggiated. Set to 2, the held notes and the notes one octave above them will arpeggiate. Set to 3, the held notes and the notes one and two octaves above them arpeggiate.

Mode: Sets the order in which notes play when the Arpeggiator is on. The setting appears in the lower left of the display. See the table below.

Arp Mode	Behavior
Up	Plays from lowest to highest note
Down	Plays from highest to lowest note
Up + Down 1	Plays from lowest to highest and back to lowest
Up + Down 2	Plays the lowest and highest note twice in succession before the direction flips
Random	Plays notes in random order
Assign	Plays notes in the order the keys were pressed

Arp Relatch (Param Menu): Off, On—Works in conjunction with HOLD. When HOLD and the Arpeggiator are on, and ARP RELATCH is off, played notes are held on and arpeggiated, with additional played notes added to the held notes and the arpeggio. When ARP RELATCH is on, played notes are held on and arpeggiated, but additional played notes will restart the arpeggio with the new notes. If you release all keys and play new notes, the arpeggio restarts using the new notes.

Arp Repeat (Param Menu): 1, 2, 3—Set to off, each note in the arpeggio plays once. Set to 1, each note in the arpeggio plays twice. Set to 2, each note in the arpeggio plays three times. Set to 3, each note in the arpeggio plays four times.

Arp Beat Sync (Param Menu): Off, On—When set to On, Arpeggiator note playback occurs only on the beat (relative to the current clock divide setting) regardless of when you press a key on the keyboard.

Seq Play Mode (Param Menu): Retrig, Continue, One Shot, Step—Determines how a Note or Mod Sequence plays back when a key is pressed.

- RETRIG–When Retrig is selected each new key press starts the sequence over from the beginning. Holding a key allows it to loop.
- CONTINUE–Continue will play for as long as a key is held. However, each new key press will pick up at the next note in the sequence.
- ONE SHOT–One Shot will play through the entire sequence each time a key is pressed, much like a standard synth envelope.
- STEP–Step causes the sequence to advance one step with each key press.

Seq Mod Dest (Param Menu): Osc Freq A, Osc Freq B, Filter Cutoff, MOD 1 Amt, MOD 2 Amt, MOD 3 Amt, LFO Freq, Pulse Width A, Pulse Width B, Pulse Width All, Feedback—When Seq Mod is the selected Arpeggiator mode, the sequence can control any one of these selected destinations.

The MOD 1-3 Amt destinations will increase the selected Modulation Route Amount parameter by an amount dreived from each step's note number.

Selecting Feedback as the Seq Mod destination will increase the feedback by the amount equivalent to note number. FEEDBACK must be enabled for this to be heard.

Clock

Fourm's Clock provides timing in BPM (or, Beats Per Minute) for the Arpeggiator, and if Sync is enabled, the LFO. The BPM can be set by dialing in a specific value using the SELECT encoder, or by physically tapping the TAP TEMPO button, to synchronize Fourm to non-MIDI sources.

Clock Parameters

Tap Tempo|BPM: 30…250—Sets the tempo for the Arpeggiator in BPM (beats per minute). The TAP TEMPO LED flashes at the BPM rate. Pressing the TAP TEMPO button 4 times sets the tempo.

When SYNC is enabled on the low-frequency oscillator, the BPM rate controls the LFO frequency, divided by the LFO's Sync Frequency setting. When syncing to an external MIDI clock source, the BPM will adjust LFO Sync Frequency.

Clock Div—Selects a basic note value relative to the BPM. See the table below:

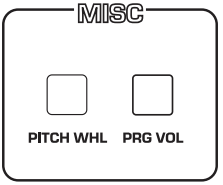
Name	Tempo	Timing Division
1/2	BPM/2	Half note
1/4	BPM	Quarter note
1/8	BPM x 2	Eighth note
1/8D	BPM x 2	Eighth note dotted
1/8S	BPM x 2	Eighth note swung
1/8 T	BPM x 3	Eighth note triplet
1/16	BPM x 4	Sixteenth note
1/16S	BPM x 4	Sixteenth note swung
1/16 T	BPM x 6	Sixteenth note triplet
1/32	BPM x 8	Thirty-second note
1/64	BPM x 16	Sixty-fourth note

Misc

Pitch Wheel: 0-12—Allows you to set the range of Fourm's Pitch Bend Wheel, from zero steps to one full octave up and down. To quickly set Pitch Bend range, hold PITCH WHEEL and use SELECT to set a pitch bend value on the display.

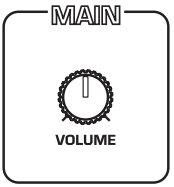
Prog Vol: 0-127—Program Volume sets an overall volume level for the current program. This is useful for ensuring that your sounds have roughly the same volume from program to program.

Separate from Fourm's Main Volume, Program Volume is saved with each program. To quickly change Program Volume, hold PROG VOL and use SELECT to set a value on the display.



Main Volume

The master output level of the Fourm is controlled by the front-panel VOLUME knob. In addition, the volume of an individual program can be set with the PROGRAM VOL parameter in the PARAM menu.



To set the volume of an individual program:

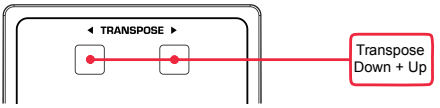
1. Choose a program.
2. Press and hold the PROG VOL.
3. Use the SELECT knob to set an appropriate volume value. 100 is the default
4. Release the PROG VOL button, then press and hold PROGRAM until its LED blinks. Press INC|SAVE to save the program with the new Program Volume setting.

MIDI volume can also influence the overall volume of the Fourm if you are controlling it from an external MIDI source, usually via CC#7 or CC#4.

Transpose

The UP and DOWN buttons in the TRANSPOSE section transpose the keyboard of the Fourm Keyboard (not available on the Module) up or down in octaves. The LED indicates the current keyboard transposition state. Transposing the keyboard also changes the MIDI note numbers of the keys so that MIDI notes sent are also transposed.

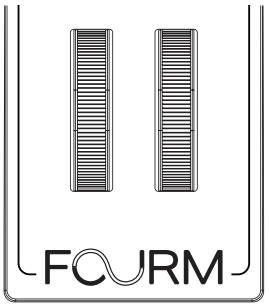
Transpose settings are Param-level and are saved with individual programs. Note that pressing one of the TRANSPOSE buttons won't affect any keys currently held down. It only affects keys/notes played after you have transposed the keyboard.



The Keyboard Transpose controls

Pitch and Mod Wheels

The Fourm has a spring-loaded Pitch wheel and a Mod wheel. You can use these controls to enhance live performance by bending notes and adding modulation in real time as you play.



The Pitch and Modulation wheels

Pitch Wheel

You can set a range in semitones for the Pitch wheel, depending on your playing preference. The upward range is 12 semitones (1 octave). The downward range is also 12 semitones (1 octaves). Many musicians use a range of 2 semitones (a whole step) since this is the bend range of many acoustic instruments. For guitar whammy bar-type effects, you many wish to set a wider range.

To set the pitch bend range:

1. Press the PITCH WHEEL button.
2. Press the SELECT knob to select the value entry row in the display.
3. Use the SELECT knob to choose a bend interval.
4. Hold a note and move the Pitch wheel to hear the effect.
5. Once you've set the bend up interval as desired, press the PROGRAM button to exit the Param menu.

Modulation Wheel

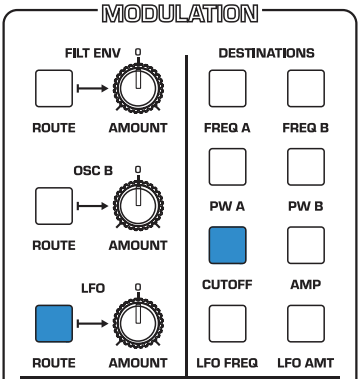
The Mod wheel controls the amount of modulation for any program that uses it as a modulation source. This allows you to "perform" modulation in real time by moving the wheel. This is a great way to add expressiveness to a sound or performance by using it to control vibrato, filter effects, and potentially a lot more.

The Mod Wheel has its own routing bus in the Modulation section signified by the blue LEDs.

To choose a modulation destination for the Mod wheel:

1. In the MODULATION section, press the LFO ROUTE button twice. Its LED will turn blue. Turn the AMOUNT knob all the way clockwise, or to any point between 0/center and fully clockwise. This will set the maximum amount of LFO modulation activated by the Mod Wheel.
2. Press the CUTOFF button twice, until its LED lights blue.
3. Now hold a note or chord while you raise the Mod Wheel. You will hear the filter cutoff being modulated at the rate currently set in the LFO section. Reduce Filter Cutoff to hear a more obvious cutoff modulation.

Any of the three Modulation sources can be assigned to the Mod Wheel - simply press its corresponding route button and any Destination buttons twice to light them blue. Pressing a Destination button three times will light it purple, signifying that it will receive modulation from the Mod Wheel bus and the direct modulation bus.



Mod Wheel assignment for LFO to modulate Filter Cutoff

Param Menu

1. Pulse Width A: -63-64—set pulse width for Oscillator A. You can set Pulse Width from -100% to %100 duty cycle, with %50 (wide pulse) at 0.

2. Pulse Width B: -63-64—set pulse width for Oscillator A. You can set Pulse Width from -100% to %100 duty cycle, with %50 (wide pulse) at 0.

3. Noise Level: 0-127—Sets level of the Noise source in the Mixer.

4. Noise Type: White, Pink, Violet—Sets the color of the Noise source. Pink noise is characterised by a reduced energy at higher frequencies, white noise features equal energy across all frequencies, and violet noise features energy increasing at higher frequencies, and reducing at lower frequencies.

5. Filt Keytrack: Quarter, Half, Full—Sets the amount of modulation from the keyboard to the filter's cutoff frequency.

6. Feedback: 0-127—Sets level of the Feedback routed from the Filter output back into the Mixer.

7. Filter Env Vel: 0-127—Allows keyboard velocity to modulate filter cutoff frequency.

8. Amp Env Vel: 0-127—Allows keyboard velocity to modulate Amp Envelope amount.

9. Unison Vox: 1-4—Sets the number of Unison voices, from a single voice to all four voices stacked.

10. Unison Detune: 0-127—Sets the amount of oscillator detune between Unison voices, for a fatter, chorused sound.

11. Vintage: 0-127—Sets the amount of the Vintage parameter. Vintage simulates the effect of aging electronic circuits and the associated variations among the oscillators, filters, and envelopes of the synthesizer. You can use this to dial in effects ranging from slight oscillator and filter variations among voices, to better-get-this-synth-to-a-repair-tech kinds of sounds.

12. LFO Rev Saw: Off, On—Allows you to reverse the polarity of the Sawtooth LFO wave shape.

13. LFO S/H Type: S/H, Random, Pink, White, Violet, DC—Allows selection of random or unconventional modulation sources for the S/H wave form.

14. LFO Sync Freq: 32 Steps, 16 Steps, 8 Steps, 6, Steps, 4 Steps, 3 Steps, 2 Steps, 1.5 Steps, 1 Step, 2/3 Step, 1/2 Step, 1/3 Step, 1/4 Step, 1/6 Step, 1/8 Step, 1/16 Step—When LFO Sync Freq is selected, the rate of the LFO is locked by clock division to either an external clock source or Fourm's internal clock.

15. Env Retrig: Off, On—When on, causes each key press to retrigger both envelopes at their Attack phases.

16. Key Priority: Low, High, Last—Determines which note has priority when more than one note is played simultaneously in Unison mode. Low selects lowest-played-note priority. High selects highest-note priority. Last selects last-note priority.

17. Glide Mode: Fixed Rate, Fixed Rate A, Fixed Time, Fixed Time A—Sets the mode that determine how Glide behaves. See page 39 for complete descriptions of the available modes.

18. BPM: 30-250–Sets the rate of Fourm's internal clock by BPM.

19. Clock Div: 1/2, 1/4, 1/8, 1/8D, 1/8S, 1/8S, 1/16, 1/16S, 1/16T, 1/32, 1/64–Selects a basic note/clock division value relative to the BPM.

20. Arp Octave: 30-250–1, 2, 3 Octaves. Sets the range of octaves the Arpeggiator will play over.

21. Arp Mode: Up, Down, Up+Down1, Up+Down2, Random, Assign, Seq Note, Seq Mod–Sets the order in which notes play when the Arpeggiator is on. The setting appears in the lower left of the display. See the table on page 46 for descriptions of the Arp Modes.

22. Arp Relatch: Off, On—Sets Arpeggiator behavior. When ARP RELATCH is on, played notes are held on and arpeggiated, but additional played notes will restart the arpeggio with the new notes.

23. Arp Repeat: Off, 1, 2, 3—Sets the number of times each note in an arpeggio repeats before going to the next note.

24. Arp Beat Sync: Off, On—When set to On, Arpeggiator note playback occurs only on the beat (relative to the current clock divide setting) regardless of when you press a key on the keyboard.

25. Seq Play Mode: Retrig, Continue, One Shot, Step—Determines how a Note or Mod Sequence plays back when a key is pressed. See page 46 for more details.

26. Seq Mod Dest: Osc Freq A, Osc Freq B, Filter Cutoff, MOD 1 Amt, MOD 2 Amt, MOD 3 Amt, LFO Freq, Pulse Width A, Pulse Width B, Pulse Width All, Feedback—When Seq Mod is the selected Arpeggiator mode, the sequence can control any one of these destinations.

27. Wheel Range: 0-12—Sets the range of the pitch wheel in semitones, up to one octave up and down.

28. Program Vol: 0-127—Program Volume sets an overall volume level for the current program.

29. Category: Misc, Pad, Lead, Bass, Poly, Keys. String, Pluck, Bell, Arp, Brass, Voice, Organ, Percussion, Tuned Percussion, SFX—When the Global Category feature is turned on, preset selection changes from User and Factory banks to Categories. This allows you search for programs via Category.

To save a program with a particular Category, enter the Param menu and scroll to CATEGORY. Press the SELECT encoder, then use it to scroll to select one of the Categories - whichever best fits the sound you created. Press SELECT again to exit the value row, then save the program as usual. Your patch will now show up in the Category bank.

30. Alt Tune: Use Global**,** Equal Temperment, 1…65—Allows you to set and save an alternative tuning per program. If this is set to Use Global, the current program will default its tuning to whatever has been set globally. Otherwise, any of the 65 available tunings can be selected for a program.

Chapter 3: Creating Sounds

Fourm can produce a huge variety of sounds. While the factory programs give you some idea of its scope, if you only make use of its presets, you're not really using the Fourm to its full potential. The real excitement is in creating sounds that are uniquely your own.

This chapter provides some brief tutorials. While there isn't enough space here to cover how to use every Fourm function or feature, these examples will help you get familiar with some basic concepts.

Synthesis 101: Synth Bass

Many great synth bass sounds consist of a single oscillator, a bit of filter resonance, the right envelope, and not much else. So start with the Basic Program and go from there.

Short Version

To create a classic synth bass:

1. Hold the TRANSPOSE DOWN button and press the PROGRAM button to bring up the basic program.
2. In the basic program, only Oscillator A is selected. Press SAW to deselect this wave shape, and press PULSE to select it instead.
3. Repeatedly strike notes on the keyboard as you do the following and listen to how the sound evolves:
4. Set Oscillator A's OCTAVE knob to -2.
5. Set Filter CUTOFF to near zero.
6. In the Filter section, set env AMT to about 4 o'clock
7. Press the KEY TRACK button to turn Key Tracking on.
8. Set filter RESONANCE to a 9 o'clock position.
9. Play a low note on the keyboard. Instant synth bass!
10. Experiment with the Filter ENV AMT and Filter Envelope DECAY and SUSTAIN settings to fine tune your synth bass sound. You can also try a saw wave, rather that square, to hear what that sounds like.

Long Version with Explanations

Here's a more detailed version that provides insight into the process. You'll start with the Basic Program, then learn how to choose an appropriate oscillator waveshape, how to use the filter, how to use the envelopes, and how to use Unison to fatten things up.

In the Basic Program, only Oscillator 1 is audible. Its waveshape is set to sawtooth and its level is 127 in the MIXER.

To start with the Basic Program:

1. Hold the TRANSPOSE DOWN button and press the PROGRAM button to bring up the basic program.

Each of the oscillator's waveforms have their own unique sound:

- The sawtooth waveform is a good starting point for sounds because it has plenty of harmonics. This gives you a lot to work with in terms of a raw sound that you can filter and modulate.
- The pulse wave is a good starting point, too, but sounds different than the sawtooth, because of its different harmonic content. The sawtooth has even and odd-numbered harmonics and the square wave has odd-numbered harmonics.
- The triangle (TRI) wave has few harmonics. It's useful alone for its pure tone, or in combination with another oscillator to reinforce the fundamental pitch of a sound and add weight.

To listen to the various oscillator waveshapes:

1. In the OSCILLATOR A section, the Sawtooth waveform is selected by default in the basic program. Play and hold a note, listening to characteristic harmonic buzz of the sawtooth shape
2. Press the SAW button to disable the saw waveform and press PULSE to enable the pulse waveform. Play and hold a note to listen to the reedy harmonic of the pulse shape.
3. Now press saw again to combine the two wave shapes. Notice how the harmonic content of the sound instantly brightens.
4. Hold PULSE|PW and use SELECT to change the pulse width of the wave. Notice how the overall harmonic texture of the combined waveforms changes as pulse width is adjusted.

5. In the Oscillator B section, turn on the triangle wave by pressing TRI. Set its OCTAVE knob to -1.

6. Turn up Oscillator B in the Mixer section to hear how the added triangle oscillator thickens up the sound without changing the overall harmonic tone much.

7. Now try adding different combinations of Oscillator A and B wave shapes at different octaves to hear what Fourm's oscillators can do.

Next, you'll use the filter to shape the raw sound of the sawtooth wave.

To adjust the filter:

1. Call up the basic program again by holding TRANSPOSE DOWN and pressing PROGRAM.

1. Press and hold down a key and turn the filter's CUTOFF knob. Notice how it cuts the high frequencies as you rotate counter-clockwise, making the sound of the oscillators less bright. If you turn the CUTOFF knob fully counterclockwise you'll filter out all frequencies and hear nothing.

2. Return the CUTOFF knob to its 12 o'clock position.

3. Repeatedly strike a note and turn the RESONANCE knob about halfway up. Notice how the sound changes as a band of frequencies near the cutoff is amplified.

4. Rotate the filter's CUTOFF knob again and you'll hear a classic resonant filter sweep. You're going to use this to create your synth bass.

5. Set the filter CUTOFF to zero.

6. In the Filter section, set ENV AMT close to fully clockwise. This will cause the Filter Envelope to open the filter frequency according to the shape of the envelope (its attack, decay, sustain, and release settings). Note that increasing the SUSTAIN stage of the Filter Envelope will open the filter even more when a key is held.

7. Set filter RESONANCE to a 10 o'clock position. This gives the synth bass its funky "zap."

8. Play some low notes and listen to the sound. Classic synth bass.

To tweak the sound:

1. Experiment with the Filter Envelope's ENV AMT knob in conjunction with the KEY TRACK button. Notice how greater ENV AMT settings amplify the effect of the envelope on the filter. Also notice how engaging KEY TRACK will close the filter on lower notes, and open the filter on higher notes.

2. Repeatedly strike a note on the keyboard as you turn the Filter Envelope's DECAY knob clockwise and counterclockwise. Notice how it changes the sound as the note decays faster or slower.

3. The Filter Envelope's RELEASE parameter acts in conjunction with the Amplifier Envelope. In other words, you can't hear a long release on the filter envelope if the amplifier envelope is short! So to hear the filter envelope's RELEASE parameter in action, set the both the Filter Envelope and Amp Envelope's RELEASE values to the 3 o'clock position.

4. Now repeatedly strike a note on the keyboard as you turn the Filter Envelope's RELEASE knob clockwise and counterclockwise. Notice how the note fades out faster or slower as you change the RELEASE value.

Now you know how to create a simple synth bass patch using the most essential synthesizer components of Fourm: the oscillators, the filters, and the envelopes. Using just these three things you can create an enormous variety of sounds. Keep experimenting with them and if you like what you've created, save the programs in one of the user banks. (See "Saving a Program" on page 10.)

Creating Synth Brass

Here's another easy-to-construct sound: synth brass, with a classic "pitch blip" effect on the attack. In this example you'll learn how to use the Filter Envelope routed via the Modulation Bus to modulate the pitch of oscillator 2 to simulate an aggressively blown horn-type sound.

To create synth brass:

1. Hold TRANSPOSE DOWN and press PROGRAM to recall the basic program.

2. In the mixer, turn OSC B fully clockwise to maximize its volume. (OSC A is already at full volume.) Leave the SAW wave shape selected.

3. In the OSCILLATOR section, adjust the FREQUENCY knob on Oscillator B a small amount left or right to slightly detune it and thicken the sound.

4. In the FILTER section, set CUTOFF to the 10 o'clock position.
5. Set RESONANCE to 9 o'clock.
6. Set the Filter's ENV AMT to 4 o'clock.
7. Set the Filter Envelope's ATTACK to 10 o'clock, DECAY to 10 o'clock, SUSTAIN to 11 o'clock, and RELEASE to 10 o'clock.
8. Enable touch sensitivity by pressing and enabling the VELOCITY button.
9. Play some chords and listen to the sound: Passable synth brass!
10. Use the VINTAGE parameter in the Param menu to make the brass sound even more organic by adding parameter variations from voice to voice.

To add a "pitch blip" to the brass sound:

1. In the MODULATION section, press the FILT ENV ROUTE button once so it lights red.
2. On the destination side, press the FREQ B button to turn it red (if you're using the basic program, you'll need to press this three times).
3. Set the Filter Envelope's ATTACK knob to 8 o'clock, DECAY to 10 o'clock, SUSTAIN to 9 o'clock, and RELEASE to 12 o'clock.
4. Turn the FILT ENV AMT knob IN THE MODULATION section to 1 o'clock.
5. Play some notes in the upper range of the keyboard. Classic synth brass!
6. Experiment with different Filter Envelope AMOUNT and DECAY settings, along with increasing the amount of the FILT ENV Modulation AMOUNT.

Turning Synth Brass into a String Pad

It's a simple matter to turn the previous synth brass sound into a string pad by simply adjusting its envelope and filter settings.

To turn the synth brass into a string pad:

1. Remove the pitch blip effect by setting the FILT ENV AMOUNT in the Modulation section to the center (value to 0).
2. In the FILTER section, set CUTOFF to 11 o'clock, and RESONANCE to 10 o'clock.
3. In the FILTER section, set ENV AMT to 2 o'clock.

4. Set Filter Envelope ATTACK to 2 o'clock, DECAY to 2 o'clock, SUSTAIN to 3 o'clock, and RELEASE to 2 o'clock.
5. Press KEY TRACK to turn it on.
6. Set Amp Envelope ATTACK to 2 o'clock, DECAY to 2 o'clock, SUSTAIN to 3 o'clock, and RELEASE to 2 o'clock.
7. Play some chords. You've now got a good basic string pad.

Making the String Pad More Lush

Now lets make the string pad more lush by using the LFOs to modulate the oscillator waveshapes and recreate the classic "pulse-width mod" strings found on many vintage synths.

To use waveshape mod to make the string pad more lush:

1. On Oscillator A, press SAW once to turn it off and press PULSE to turn it on.
2. On Oscillator B, press SAW once to turn it off and press PULSE to turn it on.
3. On Oscillator A, hold PULSE|PW and turn SELECT counter clockwise to a value of about -25.
4. On Oscillator B, hold PULSE|PW and turn SELECT clockwise to a value of about 24.
5. In the Modulation section, press LFO ROUTE so that it turns blue.
6. In the Destination section press both PW A and PW B twice to turn the LEDs blue, to select the Mod Wheel modulation bus.
7. Turn the LFO AMOUNT knob fully clockwise.
8. In the LOW FREQUENCY OSCILLATOR section set FREQUENCY to 11 o'clock.
9. Now play and hold a chord as you raise the Mod Wheel.
10. Play some chords and listen to the sound.

You are now modulating the waveshape of each oscillator slightly differently - just enough to give the sound more complex animation. Try experimenting with different LFO FREQUENCY and AMOUNT settings.

Creating a Hard-Sync Lead

Here's another classic sound: a hard-sync lead. A famous example of this is "Let's Go" by the Cars (originally performed on a Prophet-5). In this example you'll learn how to hard-sync the oscillators and pitch-modulate one of them using the Filter Envelope.

To create a hard-sync lead:

1. Hold TRANSPOSE DOWN and press PROGRAM to recall the basic program.
1. On Oscillator A, press SAW once to turn the saw wave shape off and press PULSE to turn the pulse wave shape on.
2. In the mixer, turn up Oscillator B to 127.
3. Press the Oscillator A SYNC button to turn it on.
4. Set Oscillator A's OCTAVE to +1. This will allow for a wide range of pitch modulation.
5. Set Oscillator B's OCTAVE to -1. This will help create a more aggressive hard-sync effect.
6. In the Filter Envelope section, set ATTACK to 1 o'clock and DECAY to 1 o'clock.
7. In the Modulation section, press the FILT ENV ROUTE button once to turn it red, then set the FILT ENV ROUTE AMOUNT knob all the way clockwise.
8. On the DESTINATION side, press the FREQ A button three times to turn it red (this will allow it to receive modulation over the Direct bus).
9. This routes the Filter Envelope to modulate Oscillator A pitch according to its ADSR (attack, decay, sustain, release) settings.
10. Play some notes. Classic hard-sync lead!
11. Experiment with the Filter Envelope's Attack, Decay, Sustain, and Release settings to better understand how these affect the shape of pitch modulation routed to Oscillator A.
12. Press freq a in the modulation section twice more to turn it purple - with the preset LFO modulation in the basic program, this will allow you to apply pitch vibrato via the LFO to both oscillators when you raise the Mod Wheel.

A Final Word

The examples given here are fairly basic, but they give you some idea of the power of subtractive synthesis. Imagine what you can create by using these as starting points, then modulating the filter, oscillators, LFO frequency and amount, and amp with the LFO, Filter Envelope, and Oscillator B.

It's often useful to start with a simple sound and make it progressively more complex, while saving edited versions as you go so that you can retrace your steps and branch off at different points in the sound design process.

Appendix A: Modulation Sources

Filter Envelope
Osc B
LFO
Mod Sequence

Modulation Destinations

Frequency A
Frequency B
Pulse Width A
Pulse Width B
Cutoff
Amp
LFO Frequency
LFO Amount
Mod 1 Amt (via Seq Mod)
Mod 2 Amt (via Seq Mod)
Mod 3 Amt (via Seq Mod)
Pulse Width All (via Seq Mod)
Feedback (via Seq Mod)

Appendix B: Troubleshooting and Support

Troubleshooting

If you're experiencing problems or unexpected behavior from your Fourm, here are a few typical scenarios and their solutions:

If the Fourm isn't producing sound:.

1. Recall the Basic Program. (Global>BasicProgram>Press SELECT>Press INC)
2. If the problem is still there, check the following:

- Volume - make sure it's set to an appropriate value
- Rear-panel output jack - make your audio cable is connected to MAIN OUTPUT.
- In the GLOBAL menu, make sure that LOCAL CONTROL is set to ON.

If the Arpeggiator has stopped running:

- Check the CLOCK MODE setting in GLOBAL to ensure Fourm is set to OUT or OFF. Or if set to IN or IN THRU, make sure the Fourm is receiving MIDI clock or set it to OFF or OUT.

If some of the programs sound different than usual:

- In the Global menu, check ALT SCALE and make sure it's set to EQUAL TEMPERAMENT. Also, check the Mod wheel position. The Mod wheel can do more than just add vibrato. Also, check the CLOCK MODE setting in the GLOBAL menu to ensure the Fourm is set to OUT or OFF. Or if set to IN or IN THRU, make sure the Fourm is receiving MIDI clock.

If Aftertouch isn't responding polyphonically, if aftertouch response is too sensitive or not sensitive enough, or if some keys fail to trigger sound:

- In the Global menu, check the Aftertouch parameter to ensure it's set to Poly, rather than Mono.
- If aftertouch response is too sensitive or not sensitive enough, check the Aftertouch Curve global and try some different settings.
- If changing these globals does not resolve the issue, please reach out to support@sequential.com and we will have some easy solutions for you.

If there is a ground hum in the audio output:

- USB can cause ground loops, so try to resolve any grounding issues between the computer (if connected) and the Fourm. Or use MIDI, which is opto-isolated.

If the Fourm is behaving erratically:

- This is almost always caused by a MIDI feedback loop. Make sure that any MIDI Thru functionality is turned off on the MIDI interface/hardware or in the MIDI software application. Disconnect all Fourm MIDI connections (MIDI and USB cables) and see if the problem persists. You can also monitor the MIDI traffic with *MIDI Monitor* (Mac OS) or *MIDI-OX* (Windows) to see if the Fourm is being overrun with duplicate messages.

If the Fourm doesn't seem to respond to its controls:

- Make sure LOCAL CONTROL is ON in the GLOBAL menu.

If MIDI System Exclusive data is not transmitted/received:

- Make sure that the MIDI SYSX PORT setting in the GLOBAL menu is set to USB or MIDI depending on which you are using to transmit or receive MIDI messages.

If the Fourm plays out of tune:

- Check the COARSE TUNE and FINE TUNE parameters in the GLOBAL menu to make sure they are both set to 0.
- You may need to recalibrate the oscillators. See "Calibrating the VCOs and Filters" on page 69.

If the pitch or Mod wheel doesn't go to full range:

- Recalibrate the Pitch and Mod wheels. See "Calibrating the Pitch and Mod Wheels" on page 69.

If the filter sounds strange or out of tune:

- You may need to recalibrate the filters. See "Calibrating the VCOs and Filters" on page 69.

Resetting the Global Parameters

If you're trying to track down a problem, it's sometimes a good idea to reset the Global parameters to their defaults. This is a quick way to make sure that the Fourm returns to its factory settings.

To reset all Global parameters to their default settings:

1. Press the GLOBAL button.
2. Use the SELECT knob to select RESET GLOBALS, then press SELECT followed by INC. Globals will now be reset to factory defaults. You can play the Fourm again.

Contacting Technical Support

If you are still having a problem with the Fourm, contact Technical Support at *support@sequential.com*. Please include the purchase date of your Fourm, its serial number, and the operating system version. Press the GLOBAL button to see this at the bottom of the main display.

If you haven't already reset the Global parameters and run the calibration routines (see Troubleshooting), you should do it before contacting Technical Support. This is probably the first thing you will be asked to do.

Warranty Repair

Sequential warrants* that the Fourm will be free from defects in materials and/or workmanship for 1 year from the date of purchase. Please register your product online at www.sequential.com to establish the date of purchase. (This is not a requirement for warranty service, but it will help expedite the process.)

Please contact *support@sequential.com* to determine the best course of action for getting your Fourm repaired. For your own protection, as well as ours, please do not return any product to Sequential without a return authorization (RA) number. To issue an RA number, Technical Support needs:

- Your name
- Your return address
- Your email address
- A phone number where you can be reached
- Your Fourm's serial number
- The date of purchase and where purchased

If you need to return your instrument for repair, you are responsible for getting it to Sequential. We highly recommend insuring it and packing in the original packaging. Damage resulting from shipping a product with insufficient packaging is not covered by warranty.

** – This warranty gives you specific legal rights that vary from country to country. Other than as permitted by law, Sequential does not exclude, limit or suspend other rights you may have, including any rights under consumer protection laws that cannot be lawfully changed or excluded. For a full understanding of your rights, you should consult the laws of your country, province or state.*

Appendix C: Calibrating Your Fourm

Because the Fourm is calibrated at the factory, controls such as the Pitch and Mod wheels, oscillators and analog filters won't usually require re-calibration. But if you experience unexpected behavior with these functions, you can use the calibration procedure to tune them.

Calibrating the VCOs and Filters

To calibrate the VCOs and filters:

1. Press the GLOBAL button.
2. Use the SELECT knob to scroll to TUNE VOICES, then press SELECT followed by INC.
3. The synthesizer performs its auto-calibration procedure. Don't turn off the power while it's doing this.
4. When finished, the front panel controls will return to normal and you can play the Fourm again.

Calibrating the Pitch and Mod Wheels

To calibrate the Pitch and Mod wheels:

1. Press the GLOBAL button.
2. Use the SELECT knob to scroll to ALIGN WHEELS, then press SELECT followed by INC.
3. Follow the instructions in the display.
4. When finished, press the PROGRAM button to exit the GLOBAL menu.

Appendix D: Exporting and Importing Programs and Banks

You can use the DUMP PRESET, DUMP BANK, and DUMP ALL BANKS commands in the GLOBAL menu to transmit the current program, bank, or all banks in SysEx format via the selected MIDI port. This allows you to save your programs so that you can share or archive them. You will need a computer and software application such as SysEx Librarian for Macintosh, or MIDIOX for Windows.

To export a program or bank as a SysEx file over USB:

1. Connect your synthesizer to a computer using a USB cable.
2. Open your MIDI librarian software (SysEx Librarian, etc.) and configure it to receive SysEx messages.
3. Press the GLOBAL button on the Fourm.
4. Use the SELECT knob to scroll to MIDI SYSX PORT, then press and turn SELECT to choose USB.
5. Press the SELECT knob again and use it to scroll to DUMP PRESET, DUMP BANK, or DUMP ALL BANKS, depending on which of these you would like to do.
6. Press SELECT and then INC. The program or bank is exported.


Dumped programs will load back into the same bank and program location in memory when received by the Fourm via MIDI.

Programs can also be dumped directly from one Fourm to another using the MIDI DIN jack, if the MIDI SYSX PORT parameter is set to MIDI in the GLOBAL menu.

To send a program or bank to another Fourm as a SysEx file over MIDI:

1. Connect two Fourm synthesizers together using MIDI cables and the MIDI IN AND MIDI OUT jacks on their rear panels.
2. On both synthesizers, Press the GLOBAL button and use the SELECT knob to select MIDI SYSX PORT, then press and turn the SELECT knob to choose MIDI.
3. On the Fourm that you want to send the programs **to**, press the PROGRAM button again to exit the GLOBAL menu.

4. On the Fourm that you want to send the programs **from**, in the GLOBAL menu select DUMP PRESET, DUMP BANK, or DUMP ALL BANKS, depending on which of these you would like to do.

5. Press WRITE. The program or bank is exported to the other Fourm.

 Dumped programs will load back into the same bank and program location in memory when received by the Fourm via MIDI.

Importing Programs and Banks

You can use a MIDI librarian application such as such as SysEx Librarian for Macintosh, or MIDI-OX for Windows to transmit exported program or banks back into your Fourm. You will need a computer and an appropriate software application.

To import a program or bank as a SysEx file over MIDI:

1. Connect your synthesizer to a computer using a USB cable (or MIDI cable, if you are using a dedicated MIDI interface).

2. Press the GLOBAL button on the Fourm.

3. Use the SELECT knob to scroll to MIDI SYSX PORT, then use the press and turn SELECT to choose USB or MIDI, depending on which port you are using to connect to your computer.

4. Open your MIDI librarian software and configure it to send SysEx messages to your Fourm.

5. In the MIDI librarian, open the programs and/or banks you want to send.

6. Transmit the programs. The Fourm should load them. **They will replace any existing programs in those same memory locations on the synth**.

Programs will load back into the same bank and program locations from which they were originally exported.

Appendix E: Alternative Tunings

By default, the Fourm is set to standard, chromatic western tuning. Additionally, it supports up to 64 additional alternative tunings, which you can access using the ALT TUNINGS parameter in the GLOBAL menu.

These 64 alternative tunings range from Equal temperament to Indonesian Gamelan tunings. If you want, you can replace these with other tunings that you can find on the Internet. These must be in SysEx format. You can download them into the Fourm using SysEx Librarian for Mac or MIDI-OX for Windows.

Here are descriptions of the default Fourm alternative tunings:

1. 12-Tone Equal Temperament (non-erasable)

The default Western tuning, based on the twelfth root of two.

2. Harmonic Series

MIDI notes 36-95 reflect harmonics 2 through 60 based on the fundamental of A = 27.5 Hz. The low C on a standard 5 octave keyboard acts as the root note (55Hz), and the harmonics play upwards from there. The remaining keys above and below the 5 octave range are filled with the same intervals as Carlos' Harmonic 12 Tone that follows.

3. Carlos Harmonic Twelve Tone

Wendy Carlos' twelve note scale based on octave-repeating harmonics. A = 1/1 (440 Hz). 1/1 17/16 9/8 19/16 5/4 21/16 11/8 3/2 13/8 27/16 7/4 15/8

4. Meantone Temperament

An early tempered tuning, with better thirds than 12ET. Sounds best in the key of C. Use this to add an authentic touch to performances of early Baroque music. C=1/1 (260 Hz)

5. 1/4 Tone Equal Temperament

24 notes per octave, equally spaced 24root2 intervals. Mexican composer Julian Carillo used this for custom-built pianos in the early 20th century.

6. 19 Tone Equal Temperament

19 notes per octave (19root2) offering better thirds than 12 ET, a better overall compromise if you can figure out the keyboard patterns.

7. 31 Tone Equal Temperament

Many people consider 31root2 to offer the best compromise towards just intonation in an equal temperament, but it can get very tricky to keep track of the intervals.

8. Pythagorean C

One of the earliest tuning systems known from history, the Pythagorean scale is constructed from an upward series of pure fifths (3/2) transposed down into a single octave. The tuning works well for monophonic melodies against fifth drones, but has a very narrow palate of good chords to choose from. C=1/1 (261.625 Hz) 1/1 256/243 9/8 32/27 81/64 4/3 729/512 3/2 128/81 27/16 16/9 243/128

9. Just Intonation in A with 7-Limit Tritone at D#

A rather vanilla 5-limit small interval JI, except for a single 7/5 tritone at D#, which offers some nice possibilities for rotating around bluesy sevenths. A=1/1 (440 Hz) 1/1 16/15 9/8 6/5 5/4 7/5 3/2 8/5 5/3 9/5 15/8

10. 3-5 Lattice in A

A pure 3 and 5-limit tuning which resolves to very symmetrical derived relationships between notes. A=1/1 (440 Hz) 1/1 16/15 10/9 6/5 5/4 4/3 64/45 3/2 8/5 5/3 16/9 15/8

11. 3-7 Lattice in A

A pure 3 and 7-limit tuning which resolves to very symmetrical derived relationships between notes. Some of the intervals are very close together, offering several choices for the same nominal chords. A=1/1 (440 Hz) 1/1 9/8 8/7 7/6 9/7 21/16 4/3 3/2 32/21 12/7 7/4 63/32

12. Other Music 7-Limit Black Keys in C

Created by the group Other Music for their homemade gamelan, this offers a wide range of interesting chords and modes. C=1/1 (261.625 Hz) 1/1 15/14 9/8 7/6 5/4 4/3 7/5 3/2 14/9 5/3 7/4 15/8

13. Dan Schmidt Pelog/Slendro

Created for the Berkeley Gamelan group, this tuning fits an Indonesian-style heptatonic Pelog on the white keys and pentatonic Slendro on the black keys, with B and Bb acting as 1/1 for their respective modes. Note that some of the notes will have the same frequency. By tuning the 1/1 to 60 Hz, Dan found a creative way to incorporate the inevitable line hum into his scale. Bb, B = 1/1 (60 Hz) 1/1 1/1 9/8 7/6 5/4 4/3 11/8 3/2 3/2 7/4 7/4 15/8

14. Yamaha Just Major C

When Yamaha decided to put preset microtunings into their FM synth product line, they selected this and the following tuning as representative just intonations. As such, they became the de-facto introduction to JI for many people. Just Major gives preferential treatment to major thirds on the sharps, and a good fourth relative to the second. C= 1/1 (261.625) 1/1 16/15 9/8 6/5 5/4 4/3 45/32 3/2 8/5 5/3 16/9 15/8

15. Yamaha Just Minor C

Similar to Yamaha's preset Just Major, the Just Minor gives preferential treatment to minor thirds on the sharps, and has a good fifth relative to the second. C= 1/1 (261.625) 1/1 25/24 10/9 6/5 5/4 4/3 45/32 3/2 8/5 5/3 16/9 15/8

16. Harry Partch 11-Limit 43 Note Just Intonation

One of the pioneers of modern microtonal composition, Partch built a unique orchestra with this tuning during the first half of the 20th century, to perform his own compositions. The large number of intervals in this very dense scale offers a full vocabulary of expressive chords and complex key changes. The narrow spacing also allows fixed-pitched instruments like marimbas and organs to perform glissando-like passages. G = 1/1 (392 Hz, MIDI note 67)

1/1 81/80 33/32 21/20 16/15 12/11 11/10 10/9 9/8 8/7 7/6 32/27 6/5 11/9 5/4 14/11 9/7 21/16 4/3 27/20 11/8 7/5 10/7 16/11 40/27 3/2 32/21 14/9 11/7 8/5 18/11 5/3 27/16 12/7 7/4 16/9 9/5 20/11 11/6 15/8 40/21 64/33 160/81

17. Arabic 12-Tone

A 12-tone approximation of an Arabic scale, which appears in some electronic keyboards designed for use with Arabic music. Not a JI scale, nor equal tempered. These are the intervals in Cents relative to C:

60 = Cents 0

61 = Cents +151

62 = Cents +204

63 = Cents +294

64 = Cents +355

65 = Cents +498

66 = Cents +649

67 = Cents +702

68 = Cents +853

69 = Cents +906

70 = Cents +996

71 = Cents +1057

72 = Cents +1200

18. 12 Out of 19-tET Scale from Mandelbaum's Dissertation

An interesting non-just 12 tone scale that has some unusual relationships.

note 0=0

note 1=63

note 2=189

note 3=253

note 4=379

note 5=505

note 6=568

note 7=695

note 8=758

note 9=884

note 10=947

note 11=1074

note 12=1200

19. 12 Out of 31-tET, Meantone Eb-G#

note 0=0

note 1=77

note 2=194

note 3=310

note 4=387

note 5=503

note 6=581

note 7=697

note 8=774

note 9=890

note 10=1006

note 11=1084

note 12=1200

20. Terry Riley's Harp of New Albion scale, Inverse Malcolm's Monochord

Original 1/1 on C#, here it is set to C.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +609.776284	Ratio: 64/45 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

21. Lute tuning of Giovanni Maria Artusi (1603). 1/4-comma w. Acc. 1/2-way Naturals

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +96.578	Ratio: 8607/8140
62 = Cents +193.157	Ratio: 2889/2584
63 = Cents +289.735	Ratio: 11687/9886
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +503.422	Ratio: 5267/3938
66 = Cents +600.	Ratio: 11482/8119
67 = Cents +696.578	Ratio: 7876/5267
68 = Cents +793.157	Ratio: 14771/9342
69 = Cents +889.735	Ratio: 11718/7009
70 = Cents +986.314	Ratio: 17561/9934
71 = Cents +1082.892	Ratio: 18204/9739
72 = Cents +1200.	Ratio: 2/1 (JUST)

22. J.S. Bach "well temperament", Acc. to Jacob Breetvelt's Tuner

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +92.18	Ratio: 10472/9929
62 = Cents +200.	Ratio: 5252/4679
63 = Cents +296.09	Ratio: 11781/9929
64 = Cents +390.225	Ratio: 9638/7693
65 = Cents +500.	Ratio: 6793/5089
66 = Cents +590.225	Ratio: 45/32 (just)
67 = Cents +700.	Ratio: 10178/6793
68 = Cents +794.135	Ratio: 15708/9929
69 = Cents +895.1125	Ratio: 14857/8859
70 = Cents +998.045	Ratio: 12503/7025
71 = Cents +1090.225	Ratio: 18484/9847
72 = Cents +1200.	Ratio: 2/1 (JUST)

23. Bulgarian Bagpipe tuning, Empirically Measured.

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +66.	Ratio: 5427/5224
2 = Cents +202.	Ratio: 1925/1713
3 = Cents +316.	Ratio: 11586/9653
4 = Cents +399.	Ratio: 4965/3943
5 = Cents +509.	Ratio: 7451/5553
6 = Cents +640.	Ratio: 13435/9283
7 = Cents +706.	Ratio: 857/570
8 = Cents +803.	Ratio: 2681/1686
9 = Cents +910.	Ratio: 12130/7171
10 = Cents +1011.	Ratio: 1205/672
11 = Cents +1092.	Ratio: 12599/6705
12 = Cents +1200.	Ratio: 2/1 (JUST)

24. Wendy Carlos' Alpha Scale with Perfect Fifth Divided in Nine. 19 Tone cycle

Octaves are stretched, and the tuning is quite microtonal.

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +78.	Ratio: 7241/6922
2 = Cents +156.	Ratio: 8994/8219
3 = Cents +234.	Ratio: 10686/9335
4 = Cents +312.	Ratio: 11873/9915
5 = Cents +390.	Ratio: 11636/9289
6 = Cents +468.	Ratio: 13024/9939
7 = Cents +546.	Ratio: 12433/9070
8 = Cents +624.	Ratio: 11605/8093
9 = Cents +702.	Ratio: 14999/9999
10 = Cents +780.	Ratio: 3471/2212
11 = Cents +858.	Ratio: 15361/9358
12 = Cents +936.	Ratio: 11467/6678
13 = Cents +1014.	Ratio: 17889/9959
14 = Cents +1092.	Ratio: 12599/6705
15 = Cents +1170.	Ratio: 18593/9459
16 = Cents +1248.	Ratio: 14957/7274
17 = Cents +1326.	Ratio: 8049/3742
18 = Cents +1404.	Ratio: 9617/4274
19 = Cents +1482.	Ratio: 1111/472

25. Wendy Carlos' Beta Scale with Perfect Fifth Divided by Eleven. 23-Tone Cycle

Octaves are stretched, and the tuning is quite microtonal (First repeat shown.)

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +63.8	Ratio: 6191/5967
2 = Cents +127.6	Ratio: 9725/9034
3 = Cents +191.4	Ratio: 7739/6929
4 = Cents +255.2	Ratio: 8821/7612
5 = Cents +319.	Ratio: 7636/6351
6 = Cents +382.8	Ratio: 11690/9371
7 = Cents +446.6	Ratio: 9007/6959
8 = Cents +510.4	Ratio: 1500/1117
9 = Cents +574.2	Ratio: 13547/9723
10 = Cents +638.	Ratio: 12529/8667
11 = Cents +701.8	Ratio: 5584/3723
12 = Cents +765.6	Ratio: 9281/5964
13 = Cents +829.4	Ratio: 15760/9761
14 = Cents +893.2	Ratio: 1047/625
15 = Cents +957.	Ratio: 9629/5540
16 = Cents +1020.8	Ratio: 16551/9178
17 = Cents +1084.6	Ratio: 16263/8692
18 = Cents +1148.4	Ratio: 13585/6998
19 = Cents +1212.2	Ratio: 17231/8555
20 = Cents +1276.	Ratio: 12503/5983
21 = Cents +1339.8	Ratio: 10583/4881
22 = Cents +1403.6	Ratio: 12564/5585
23 = Cents +1467.4	Ratio: 8727/3739

26. Wendy Carlos' Gamma Scale with Third Divided by Eleven or Fifth by Twenty. 36 Tone

Octaves are stretched, and the tuning is quite microtonal.

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +35.099	Ratio: 1146/1123
2 = Cents +70.198	Ratio: 7449/7153
3 = Cents +105.297	Ratio: 4118/3875
4 = Cents +140.396	Ratio: 475/438
5 = Cents +175.495	Ratio: 5363/4846
6 = Cents +210.594	Ratio: 3990/3533
7 = Cents +245.693	Ratio: 11307/9811
8 = Cents +280.792	Ratio: 4495/3822
9 = Cents +315.891	Ratio: 9707/8088
10 = Cents +350.99	Ratio: 1989/1624
11 = Cents +386.089	Ratio: 1926/1541
12 = Cents +421.188	Ratio: 7321/5740
13 = Cents +456.287	Ratio: 2089/1605
14 = Cents +491.386	Ratio: 8563/6447
15 = Cents +526.485	Ratio: 6117/4513
16 = Cents +561.584	Ratio: 148/107
17 = Cents +596.683	Ratio: 2895/2051
18 = Cents +631.782	Ratio: 7627/5295
19 = Cents +666.881	Ratio: 13901/9457
20 = Cents +701.98	Ratio: 3/2 (just)
21 = Cents +737.079	Ratio: 5477/3578
22 = Cents +772.178	Ratio: 6981/4469
23 = Cents +807.277	Ratio: 14613/9167
24 = Cents +842.376	Ratio: 10660/6553
25 = Cents +877.475	Ratio: 1255/756
26 = Cents +912.574	Ratio: 3959/2337
27 = Cents +947.673	Ratio: 16513/9552
28 = Cents +982.772	Ratio: 15424/8743
29 = Cents +1017.871	Ratio: 7563/4201
30 = Cents +1052.97	Ratio: 7367/4010
31 = Cents +1088.069	Ratio: 11918/6357
32 = Cents +1123.168	Ratio: 13310/6957
33 = Cents +1158.267	Ratio: 17050/8733
34 = Cents +1193.366	Ratio: 14586/7321
35 = Cents +1228.465	Ratio: 13368/6575
36 = Cents +1263.564	Ratio: 1276/615

27. Carlos Super Just

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +104.95541	Ratio: 17/16 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +551.317942	Ratio: 11/8 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +840.527662	Ratio: 13/8 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

28. Jon Catler 24-tone JI from "Over and Under the 13 Limit"

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +53.272943	Ratio: 33/32 (JUST)
62 = Cents +111.731285	Ratio: 16/15 (JUST)
63 = Cents +203.910002	Ratio: 9/8 (JUST)
64 = Cents +231.174094	Ratio: 8/7 (JUST)
65 = Cents +266.870906	Ratio: 7/6 (JUST)
66 = Cents +315.641287	Ratio: 6/5 (JUST)
67 = Cents +342.905379	Ratio: 128/105
68 = Cents +359.472338	Ratio: 16/13 (JUST)
69 = Cents +386.313714	Ratio: 5/4 (JUST)
70 = Cents +470.780907	Ratio: 21/16 (JUST)
71 = Cents +498.044999	Ratio: 4/3 (JUST)
72 = Cents +551.317942	Ratio: 11/8 (JUST)
73 = Cents +590.223716	Ratio: 45/32 (JUST)
74 = Cents +648.682058	Ratio: 16/11 (JUST)
75 = Cents +701.955001	Ratio: 3/2 (JUST)
76 = Cents +813.686286	Ratio: 8/5 (JUST)
77 = Cents +840.527662	Ratio: 13/8 (JUST)
78 = Cents +884.358713	Ratio: 5/3 (JUST)
79 = Cents +905.865003	Ratio: 27/16 (JUST)
80 = Cents +968.825906	Ratio: 7/4 (JUST)
81 = Cents +996.089998	Ratio: 16/9 (JUST)
82 = Cents +1061.427339	Ratio: 24/13 (JUST)
83 = Cents +1088.268715	Ratio: 15/8 (JUST)
84 = Cents +1200.	Ratio: 2/1 (JUST)

29. John Chalmers JI-1, Based loosely on Wronski's and similar JI scales, May 2, 1997.

(Chalmer's book "Divisions of the Tetrachord" is a late 20th century masterwork, exploring the mathematical underpinnings of just tunings.)

6 0 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +104.95541	Ratio: 17/16 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +297.513016	Ratio: 19/16 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +603.000409	Ratio: 17/12 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +795.558015	Ratio: 19/12 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +999.468017	Ratio: 57/32 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

30. John Chalmers JI-3, 15 16 17 18 19 20 21 on 1/1, 15-20 on 3/2, May 2, 1997.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +216.686695	Ratio: 17/15 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +409.244301	Ratio: 19/15 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +582.512193	Ratio: 7/5 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +918.641696	Ratio: 17/10 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1111.199302	Ratio: 19/10 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

31. John Chalmers JI-4, 15 16 17 18 19 20 on 1/1, same on 4/3, + 16/15 on 16/9

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +216.686695	Ratio: 17/15 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +409.244301	Ratio: 19/15 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +609.776284	Ratio: 64/45 (JUST)
67 = Cents +714.731694	Ratio: 68/45 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +907.289301	Ratio: 76/45 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1107.821284	Ratio: 256/135
72 = Cents +1200.	Ratio: 2/1 (JUST)

32. Chinese scale, 4th century

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +99.2	Ratio: 3735/3527
2 = Cents +199.5	Ratio: 11126/9915
3 = Cents +296.7	Ratio: 9181/7735
4 = Cents +398.	Ratio: 10405/8268
5 = Cents +492.9	Ratio: 448/337
6 = Cents +595.2	Ratio: 11312/8021
7 = Cents +699.	Ratio: 6439/4300
8 = Cents +790.9	Ratio: 7578/4799
9 = Cents +896.1	Ratio: 15436/9199
10 = Cents +984.9	Ratio: 6357/3599
11 = Cents +1091.4	Ratio: 1591/847
12 = Cents +1200.	Ratio: 2/1 (JUST)

33. Chinese Lu scale by Huai Nan Zi, Han era. (P. Amiot 1780, Kurt Reinhard)

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +98.954592 Ratio: 18/17 (JUST)
62 = Cents +203.910002 Ratio: 9/8 (JUST)
63 = Cents +315.641287 Ratio: 6/5 (JUST)
64 = Cents +394.347297 Ratio: 54/43 (JUST)
65 = Cents +498.044999 Ratio: 4/3 (JUST)
66 = Cents +608.351986 Ratio: 27/19 (JUST)
67 = Cents +701.955001 Ratio: 3/2 (JUST)
68 = Cents +800.909593 Ratio: 27/17 (JUST)
69 = Cents +905.865003 Ratio: 27/16 (JUST)
70 = Cents +1017.596288 Ratio: 9/5 (JUST)
71 = Cents +1106.396986 Ratio: 36/19 (JUST)
72 = Cents +1200. Ratio: 2/1 (JUST)

34. Colonna 1

Fabio Colonna lived in Naples, and published a treatise in 1618 called "La Sambuca Lincea", which included a description of the instrument by that name which he built on commission from Scipione Stella, who had had the opportunity in 1594 to examine Vincentino's "Archicembalo" — a 31-tone-per-octave (not equal-tempered) keyboard instrument.

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +70.672427 Ratio: 25/24 (JUST)
62 = Cents +182.403712 Ratio: 10/9 (JUST)
63 = Cents +287.359122 Ratio: 85/72 (JUST)
64 = Cents +386.313714 Ratio: 5/4 (JUST)
65 = Cents +498.044999 Ratio: 4/3 (JUST)
66 = Cents +568.717426 Ratio: 25/18 (JUST)
67 = Cents +701.955001 Ratio: 3/2 (JUST)
68 = Cents +733.721654 Ratio: 55/36 (JUST)
69 = Cents +884.358713 Ratio: 5/3 (JUST)
70 = Cents +989.314122 Ratio: 85/48 (JUST)
71 = Cents +1088.268715 Ratio: 15/8 (JUST)
72 = Cents +1200. Ratio: 2/1 (JUST)

35. Colonna 2 - Second 12 Note Subset of the Colonna Scale

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +70.672427 Ratio: 25/24 (JUST)
62 = Cents +203.910002 Ratio: 9/8 (JUST)
63 = Cents +315.641287 Ratio: 6/5 (JUST)
64 = Cents +386.313714 Ratio: 5/4 (JUST)
65 = Cents +498.044999 Ratio: 4/3 (JUST)
66 = Cents +582.512193 Ratio: 7/5 (JUST)
67 = Cents +701.955001 Ratio: 3/2 (JUST)
68 = Cents +813.686286 Ratio: 8/5 (JUST)
69 = Cents +884.358713 Ratio: 5/3 (JUST)
70 = Cents +1017.596288 Ratio: 9/5 (JUST)
71 = Cents +1049.362941 Ratio: 11/6 (JUST)
72 = Cents +1200. Ratio: 2/1 (JUST)

36. Ivor Darreg's 19 ratios in 5-limit JI for his Megalyra Family

Darreg was one of the great modern theorists of just intonation.

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +70.672427 Ratio: 25/24 (JUST)
62 = Cents +111.731285 Ratio: 16/15 (JUST)
63 = Cents +182.403712 Ratio: 10/9 (JUST)
64 = Cents +203.910002 Ratio: 9/8 (JUST)
65 = Cents +274.582429 Ratio: 75/64 (JUST)
66 = Cents +315.641287 Ratio: 6/5 (JUST)
67 = Cents +386.313714 Ratio: 5/4 (JUST)
68 = Cents +498.044999 Ratio: 4/3 (JUST)
69 = Cents +590.223716 Ratio: 45/32 (JUST)
70 = Cents +609.776284 Ratio: 64/45 (JUST)
71 = Cents +701.955001 Ratio: 3/2 (JUST)
72 = Cents +772.627428 Ratio: 25/16 (JUST)
73 = Cents +813.686286 Ratio: 8/5 (JUST)
74 = Cents +884.358713 Ratio: 5/3 (JUST)
75 = Cents +905.865003 Ratio: 27/16 (JUST)
76 = Cents +976.537429 Ratio: 225/128
77 = Cents +1017.596288 Ratio: 9/5 (JUST)
78 = Cents +1088.268715 Ratio: 15/8 (JUST)
79 = Cents +1200. Ratio: 2/1 (JUST)

37. Dorian Diatonic Tonos

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +231.174094	Ratio: 8/7 (JUST)
63 = Cents +359.472338	Ratio: 16/13 (JUST)
64 = Cents +427.372572	Ratio: 32/25 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +571.725653	Ratio: 32/23 (JUST)
67 = Cents +648.682058	Ratio: 16/11 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +902.486984	Ratio: 32/19 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1095.04459	Ratio: 32/17 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

38. Almost Equal 12-tone Subset of Duodenarium

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +92.178716	Ratio: 135/128
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +296.088718	Ratio: 1215/1024
64 = Cents +405.866283	Ratio: 512/405
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +609.776284	Ratio: 64/45 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +794.133717	Ratio: 405/256
69 = Cents +903.911282	Ratio: 2048/1215
70 = Cents +998.043719	Ratio: 3645/2048
71 = Cents +1107.821284	Ratio: 256/135
72 = Cents +1200.	Ratio: 2/1 (JUST)

39. Ellis's Just Harmonium

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +519.551289	Ratio: 27/20 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

40. Bali/Java Slendro, Siam 7, empirical

0 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +519.551289	Ratio: 27/20 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

41. Tibetian Ceremonial, empirical

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +58.	Ratio: 2762/2671
2 = Cents +232.	Ratio: 6889/6025
3 = Cents +310.	Ratio: 10601/8863
4 = Cents +378.	Ratio: 11945/9602
5 = Cents +522.	Ratio: 849/628
6 = Cents +618.	Ratio: 483/338
7 = Cents +725.	Ratio: 605/398
8 = Cents +773.	Ratio: 13070/8363
9 = Cents +896.	Ratio: 14076/8389
10 = Cents +1019.	Ratio: 12585/6986
11 = Cents +1086.	Ratio: 16205/8654

42. Erlangen, revised

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +92.178716	Ratio: 135/128
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +294.134997	Ratio: 32/27 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +590.223716	Ratio: 45/32 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +794.133717	Ratio: 405/256
69 = Cents +905.865003	Ratio: 27/16 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

43. Euler - Monochord (1739)

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +70.672427 Ratio: 25/24 (JUST)
62 = Cents +203.910002 Ratio: 9/8 (JUST)
63 = Cents +274.582429 Ratio: 75/64 (JUST)
64 = Cents +386.313714 Ratio: 5/4 (JUST)
65 = Cents +498.044999 Ratio: 4/3 (JUST)
66 = Cents +590.223716 Ratio: 45/32 (JUST)
67 = Cents +701.955001 Ratio: 3/2 (JUST)
68 = Cents +772.627428 Ratio: 25/16 (JUST)
69 = Cents +884.358713 Ratio: 5/3 (JUST)
70 = Cents +976.537429 Ratio: 225/128
71 = Cents +1088.268715 Ratio: 15/8 (JUST)
72 = Cents +1200. Ratio: 2/1 (JUST)

44. Fokker's 7-limit 12-tone Just Scale

60 = Cents 0. Ratio: 1/1 (JUST)
61 = Cents +119.442808 Ratio: 15/14 (JUST)
62 = Cents +203.910002 Ratio: 9/8 (JUST)
63 = Cents +266.870906 Ratio: 7/6 (JUST)
64 = Cents +386.313714 Ratio: 5/4 (JUST)
65 = Cents +498.044999 Ratio: 4/3 (JUST)
66 = Cents +590.223716 Ratio: 45/32 (JUST)
67 = Cents +701.955001 Ratio: 3/2 (JUST)
68 = Cents +821.397809 Ratio: 45/28 (JUST)
69 = Cents +884.358713 Ratio: 5/3 (JUST)
70 = Cents +968.825906 Ratio: 7/4 (JUST)
71 = Cents +1088.268715 Ratio: 15/8 (JUST)
72 = Cents +1200. Ratio: 2/1 (JUST)

45. Bagpipe tuning from Fortuna ("Try Key of G with F Natural")

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +29.849602	Ratio: 117/115
62 = Cents +187.681869	Ratio: 146/131
63 = Cents +256.596489	Ratio: 196/169
64 = Cents +343.090647	Ratio: 89/73 (JUST)
65 = Cents +493.957077	Ratio: 141/106
66 = Cents +548.648344	Ratio: 81/59 (JUST)
67 = Cents +684.728649	Ratio: 150/101
68 = Cents +729.878736	Ratio: 125/82 (JUST)
69 = Cents +871.94838	Ratio: 139/84 (JUST)
70 = Cents +985.798925	Ratio: 205/116
71 = Cents +1049.362941	Ratio: 11/6 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

46. Gamelan Udan Mas (approx) s6,p6,p7,s1,p1,s2,p2,p3,s3,p 4,s5,p5

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents 0.	Ratio: 1/1 (JUST)
62 = Cents +182.403712	Ratio: 10/9 (JUST)
63 = Cents +266.870906	Ratio: 7/6 (JUST)
64 = Cents +427.372572	Ratio: 32/25 (JUST)
65 = Cents +510.367002	Ratio: 47/35 (JUST)
66 = Cents +571.725653	Ratio: 32/23 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +745.786052	Ratio: 20/13 (JUST)
69 = Cents +996.089998	Ratio: 16/9 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1126.319346	Ratio: 23/12 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)
73 = Cents +1200.	Ratio: 2/1 (JUST)

47. Kraig Grady's 7-limit "Centaur" Scale, 1987.

See Xenharmonikon 16.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +84.467193	Ratio: 21/20 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +266.870906	Ratio: 7/6 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +582.512193	Ratio: 7/5 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +764.915905	Ratio: 14/9 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

48. Harmonics 1 to 12 and Subharmonics Mixed

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +203.910002	Ratio: 9/8 (JUST)
62 = Cents +231.174094	Ratio: 8/7 (JUST)
63 = Cents +386.313714	Ratio: 5/4 (JUST)
64 = Cents +498.044999	Ratio: 4/3 (JUST)
65 = Cents +551.317942	Ratio: 11/8 (JUST)
66 = Cents +648.682058	Ratio: 16/11 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +968.825906	Ratio: 7/4 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1200.	Ratio: 2/1 (JUST)

49. Michael Harrison, Ppiano Tuning for "Revelation" (2001)

Original 1/1=F, here it is set to C.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents -27.264092	Ratio: 63/64 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +176.64591	Ratio: 567/512
64 = Cents +407.820003	Ratio: 81/64 (JUST)
65 = Cents +470.780907	Ratio: 21/16 (JUST)
66 = Cents +611.730005	Ratio: 729/512
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +674.690909	Ratio: 189/128
69 = Cents +905.865003	Ratio: 27/16 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1109.775004	Ratio: 243/128
72 = Cents +1200.	Ratio: 2/1 (JUST)

50. Helmholtz's two-keyboard Harmonium Tuning Untempered, 24 notes per octave

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +92.178716	Ratio: 135/128
62 = Cents +111.731285	Ratio: 16/15 (JUST)
63 = Cents +182.403712	Ratio: 10/9 (JUST)
64 = Cents +203.910002	Ratio: 9/8 (JUST)
65 = Cents +274.582429	Ratio: 75/64 (JUST)
66 = Cents +294.134997	Ratio: 32/27 (JUST)
67 = Cents +386.313714	Ratio: 5/4 (JUST)
68 = Cents +405.866283	Ratio: 512/405
69 = Cents +478.49243	Ratio: 675/512
70 = Cents +498.044999	Ratio: 4/3 (JUST)
71 = Cents +590.223716	Ratio: 45/32 (JUST)
72 = Cents +609.776284	Ratio: 64/45 (JUST)
73 = Cents +680.448711	Ratio: 40/27 (JUST)
74 = Cents +701.955001	Ratio: 3/2 (JUST)
75 = Cents +772.627428	Ratio: 25/16 (JUST)
76 = Cents +792.179997	Ratio: 128/81 (JUST)
77 = Cents +884.358713	Ratio: 5/3 (JUST)
78 = Cents +905.865003	Ratio: 27/16 (JUST)
79 = Cents +976.537429	Ratio: 225/128
80 = Cents +996.089998	Ratio: 16/9 (JUST)
81 = Cents +1088.268715	Ratio: 15/8 (JUST)
82 = Cents +1107.821284	Ratio: 256/135
83 = Cents +1178.49371	Ratio: 160/81 (JUST)
84 = Cents +1200.	Ratio: 2/1 (JUST)

51. North Indian Gamut, Modern Hindustani 12 Selected from 22 or More Shrutis

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +590.223716	Ratio: 45/32 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +905.865003	Ratio: 27/16 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

52. Carnatic Gamut. Kuppuswami: Carnatic Music and the Tamils, p. v

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +98.954592	Ratio: 18/17 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +394.347297	Ratio: 54/43 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +596.999591	Ratio: 24/17 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +800.909593	Ratio: 27/17 (JUST)
69 = Cents +905.865003	Ratio: 27/16 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1096.302298	Ratio: 81/43 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

53. Observed South Indian Tuning of a vina, Ellis

Octaves are stretched.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +97.	Ratio: 8644/8173
62 = Cents +195.	Ratio: 10974/9805
63 = Cents +312.	Ratio: 11873/9915
64 = Cents +397.	Ratio: 3372/2681
65 = Cents +515.	Ratio: 9782/7265
66 = Cents +596.	Ratio: 12731/9023
67 = Cents +692.	Ratio: 13439/9011
68 = Cents +782.	Ratio: 6031/3839
69 = Cents +883.	Ratio: 6793/4079
70 = Cents +997.	Ratio: 4863/2734
71 = Cents +1092.	Ratio: 12599/6705
72 = Cents +1207.	Ratio: 15117/7528

54. 7-limit 12-tone Scale

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +266.870906	Ratio: 7/6 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +582.512193	Ratio: 7/5 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +933.129094	Ratio: 12/7 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

55. Alternate 7-limit 12-tone Scale

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +70.672427	Ratio: 25/24 (JUST)
62 = Cents +182.403712	Ratio: 10/9 (JUST)
63 = Cents +266.870906	Ratio: 7/6 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +470.780907	Ratio: 21/16 (JUST)
66 = Cents +582.512193	Ratio: 7/5 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +933.129094	Ratio: 12/7 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

56. Kurzweil "Just with Natural b7th", is Sauveur Just with 7/4

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +70.672427	Ratio: 25/24 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +590.223716	Ratio: 45/32 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +968.825906	Ratio: 7/4 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

57. 3 and 7 prime rational interpretation of 17-tET

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +62.960904	Ratio: 28/27 (JUST)
62 = Cents +140.949098	Ratio: 243/224
63 = Cents +203.910002	Ratio: 9/8 (JUST)
64 = Cents +294.134997	Ratio: 32/27 (JUST)
65 = Cents +357.095901	Ratio: 896/729
66 = Cents +435.084095	Ratio: 9/7 (JUST)
67 = Cents +498.044999	Ratio: 4/3 (JUST)
68 = Cents +561.005903	Ratio: 112/81 (JUST)
69 = Cents +638.994097	Ratio: 81/56 (JUST)
70 = Cents +701.955001	Ratio: 3/2 (JUST)
71 = Cents +764.915905	Ratio: 14/9 (JUST)
72 = Cents +842.904099	Ratio: 729/448
73 = Cents +905.865003	Ratio: 27/16 (JUST)
74 = Cents +996.089998	Ratio: 16/9 (JUST)
75 = Cents +1059.050902	Ratio: 448/243
76 = Cents +1137.039096	Ratio: 27/14 (JUST)
77 = Cents +1200.	Ratio: 2/1 (JUST)

58. 11-limit 'prime row' from Ben Johnston's "6th Quartet".

Not octave repeating, with some very narrow intervals. These are the first 30 pitches:

0 = Cents 0.	Ratio: 1/1 (JUST)
1 = Cents +70.672427	Ratio: 25/24 (JUST)
2 = Cents +182.403712	Ratio: 10/9 (JUST)
3 = Cents +274.582429	Ratio: 75/64 (JUST)
4 = Cents +386.313714	Ratio: 5/4 (JUST)
5 = Cents +505.756522	Ratio: 75/56 (JUST)
6 = Cents +568.717426	Ratio: 25/18 (JUST)
7 = Cents +733.721654	Ratio: 55/36 (JUST)
8 = Cents +772.627428	Ratio: 25/16 (JUST)
9 = Cents +884.358713	Ratio: 5/3 (JUST)
10 = Cents +923.264486	Ratio: 75/44 (JUST)
11 = Cents +1088.268715	Ratio: 15/8 (JUST)
12 = Cents +1151.229619	Ratio: 35/18 (JUST)
13 = Cents +1221.902045	Ratio: 875/432
14 = Cents +1333.633331	Ratio: 175/81 (JUST)
15 = Cents +1425.812047	Ratio: 875/384
16 = Cents +1537.543332	Ratio: 175/72 (JUST)
17 = Cents +1656.986141	Ratio: 125/48 (JUST)
18 = Cents +1719.947045	Ratio: 875/324
19 = Cents +1884.951273	Ratio: 1925/648
20 = Cents +1923.857046	Ratio: 875/288
21 = Cents +2035.588332	Ratio: 175/54 (JUST)
22 = Cents +2074.494105	Ratio: 875/264
23 = Cents +2239.498333	Ratio: 175/48 (JUST)
24 = Cents +2302.459237	Ratio: 1225/324
25 = Cents +2373.131664	Ratio: 30625/7776
26 = Cents +2484.862949	Ratio: 6125/1458
27 = Cents +2577.041666	Ratio: 30625/6912
28 = Cents +2688.772951	Ratio: 6125/1296
29 = Cents +2808.215759	Ratio: 4375/864
30 = Cents +2871.176663	Ratio: 30625/5832

59. 1/9-Harrison's comma mean-tone scale

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +74.23293	Ratio: 8315/7966
62 = Cents +192.63798	Ratio: 6334/5667
63 = Cents +266.870906	Ratio: 7/6 (JUST)
64 = Cents +385.27596	Ratio: 6671/5340
65 = Cents +503.68101	Ratio: 13025/9737
66 = Cents +577.91394	Ratio: 2632/1885
67 = Cents +696.31899	Ratio: 14567/9743
68 = Cents +770.55192	Ratio: 9743/6243
69 = Cents +888.95697	Ratio: 1885/1128
70 = Cents +963.1899	Ratio: 13187/7560
71 = Cents +1081.59495	Ratio: 1780/953
72 = Cents +1200.	Ratio: 2/1 (JUST)

60. Rousseau's Monochord, Dictionnaire de musique (1768)

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +70.672427	Ratio: 25/24 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +568.717426	Ratio: 25/18 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

61. Persian santur tuning. 1/1=E in Original

Here it is set to C. Note that scale is 8 notes per octave, so it will not map normally to a 12 note keyboard.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +129.99971	Ratio: 10727/9951
62 = Cents +345.	Ratio: 4710/3859
63 = Cents +490.00034	Ratio: 5797/4368
64 = Cents +630.00051	Ratio: 8153/5666
65 = Cents +849.99952	Ratio: 13952/8539
66 = Cents +1034.99975	Ratio: 20/11 (just)
67 = Cents +1137.00011	Ratio: 15866/8227
68 = Cents +1200.	Ratio: 2/1 (JUST)
69 = Cents +1329.99971	Ratio: 21454/9951
70 = Cents +1545.	Ratio: 18281/7489
71 = Cents +1690.00034	Ratio: 5797/2184
72 = Cents +1830.00051	Ratio: 28347/9850
73 = Cents +2049.99952	Ratio: 32211/9857
74 = Cents +2234.99975	Ratio: 36331/9991
75 = Cents +2337.00011	Ratio: 38073/9871
76 = Cents +2400.	Ratio: 4/1 (JUST)

62. Vallotti & Young (Vallotti Version)

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +94.135	Ratio: 10487/9932
62 = Cents +196.09	Ratio: 10851/9689
63 = Cents +298.045	Ratio: 4679/3939
64 = Cents +392.18	Ratio: 3843/3064
65 = Cents +501.955	Ratio: 5467/4091
66 = Cents +592.18	Ratio: 13863/9847
67 = Cents +698.045	Ratio: 8182/5467
68 = Cents +796.09	Ratio: 13019/8220
69 = Cents +894.135	Ratio: 2427/1448
70 = Cents +1000.	Ratio: 17189/9647
71 = Cents +1090.225	Ratio: 18484/9847
72 = Cents +1200.	Ratio: 2/1 (JUST)

63. LaMonte Young, Tuning of For Guitar '58. 1/1 March '92, inv.of Mersenne lute 1

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +182.403712	Ratio: 10/9 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +590.223716	Ratio: 45/32 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +1017.596288	Ratio: 9/5 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

64. LaMonte Young's Well-Tuned Piano

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +176.64591	Ratio: 567/512
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +239.606814	Ratio: 147/128
64 = Cents +470.780907	Ratio: 21/16 (JUST)
65 = Cents +443.516816	Ratio: 1323/1024
66 = Cents +674.690909	Ratio: 189/128
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +737.651813	Ratio: 49/32 (JUST)
69 = Cents +968.825906	Ratio: 7/4 (JUST)
70 = Cents +941.561815	Ratio: 441/256
71 = Cents +1172.735908	Ratio: 63/32 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

65. Thomas Young - well temperament (1807). Also Luigi Malerbi nr.2 (1794)

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +90.224996	Ratio: 256/243
62 = Cents +196.09	Ratio: 10851/9689
63 = Cents +294.134997	Ratio: 32/27 (JUST)
64 = Cents +392.18	Ratio: 3843/3064
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +588.269995	Ratio: 1024/729
67 = Cents +698.045	Ratio: 8182/5467
68 = Cents +792.179997	Ratio: 128/81 (JUST)
69 = Cents +894.135	Ratio: 2427/1448
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1090.225	Ratio: 18484/9847
72 = Cents +1200.	Ratio: 2/1 (JUST)

Original 1/1 on C#, here it is set to C.

60 = Cents 0.	Ratio: 1/1 (JUST)
61 = Cents +111.731285	Ratio: 16/15 (JUST)
62 = Cents +203.910002	Ratio: 9/8 (JUST)
63 = Cents +315.641287	Ratio: 6/5 (JUST)
64 = Cents +386.313714	Ratio: 5/4 (JUST)
65 = Cents +498.044999	Ratio: 4/3 (JUST)
66 = Cents +609.776284	Ratio: 64/45 (JUST)
67 = Cents +701.955001	Ratio: 3/2 (JUST)
68 = Cents +813.686286	Ratio: 8/5 (JUST)
69 = Cents +884.358713	Ratio: 5/3 (JUST)
70 = Cents +996.089998	Ratio: 16/9 (JUST)
71 = Cents +1088.268715	Ratio: 15/8 (JUST)
72 = Cents +1200.	Ratio: 2/1 (JUST)

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