MonoWave(X) Manual

User Guide

October 11, 2020

Firmware V5.5

Please note that this manual is still undergoing development and that additions to this manual will be posted on my website.
(extensively borrowed from the manual by Till Kopper)

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Description

Imagine a monophonic, MIDI controllable, 19" rack mountable PPG blue wavetable synth minus the wavetable scanning, plus a user selectable De-Rez, with a classic Moog[a] filter ladder and real analogue knobs……

The MonoWave has balls and a special "umpfh" that give it, its unique sound.

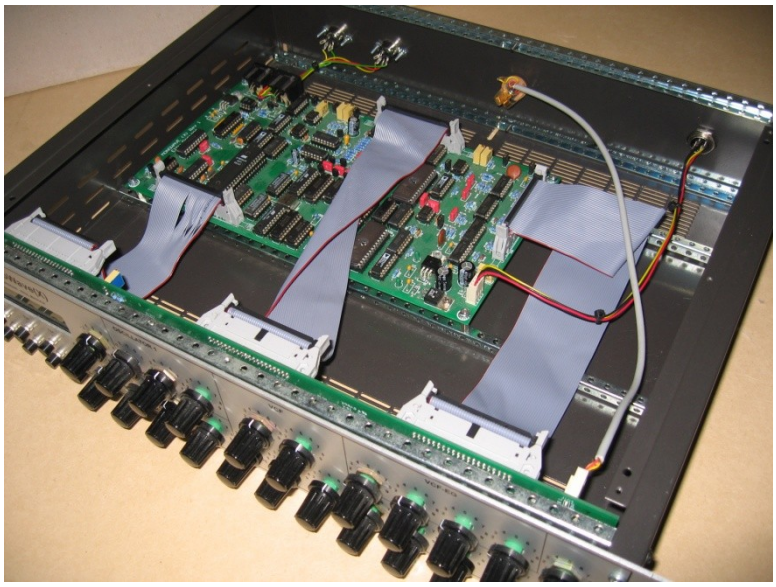
Features

The MonoWave(X) features two digital oscillators with 256 different waveshapes selectable individually. There is also a unique de-res function that lowers the digital waveshapes' sample resolution, to give a sound very much like the famous German PPG wave synthesizers from the eighties. The signal of these oscillators and their suboctave signals are mixed together and then fed in to the pure analog part of the synth: a 24db low-pass filter a la Moog synthesizer, and a VCA. Both of them controlled by their own ADSR envelopes.

The MonoWave(X) has no patch memory. It can be played by incoming MIDI signals from software, sequencers or MIDI keyboards.

The MonoWave(X) comprises 2 boards:-

1) Main Board. This provides all the functionality of the MonoWave(X). The board measures 269mm x 145mm and all connections to panel components are via 3 x 40-way IDC ribbon-cable connectors.
2) Panel Board. This houses all of the panel components for the MonoWave(X) and greatly simplifies construction of the unit with connection to the Main Board being via 3 x 40-way IDC ribbon-cable connectors. This board measures 392mm x 76mm and is intended to be mounted behind a 2U x 84HP front panel.



Enhancements in the MonoWave(X) over the original MonoWave include:-

1) Reduction of interconnecting cables to 3 x 40-way IDC ribbon cables
2) Upgrading of the AT90S8515 to an ATMEGA16
3) Upgrading of the AT90S1200 to ATtiny2313
4) Expansion of LCD from 1x16 to a 2x16 line display

Development of a front panel support PCB to substantially improve the construction process

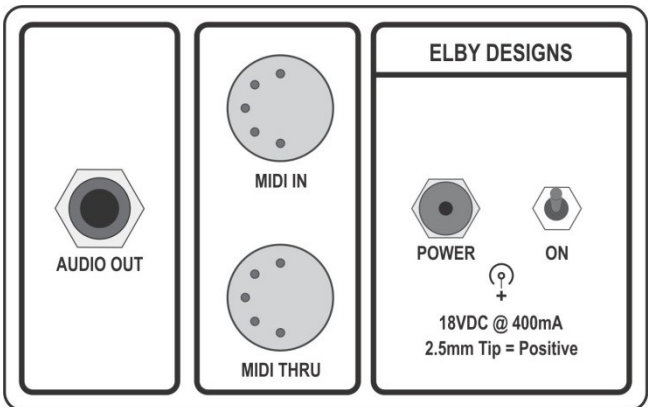
Specifications

Power	Input: 15VDC @ 400mA (NB: panel incorrectly marked as 18VDC)
Audio out	Headphone socket: best if used with 32 ohms impedance Monophonic 6.3 mm (1/4") socket
ROM waves	8-bit depth 256 samples per cycle DE-REZ reduces cycle to 64 samples
ADSR timing range	Attack: <8mS to >4 Seconds Decay: <8mS to >15 Seconds Release: <8mS to >15 Seconds
Dynamic range	About 90dB
MIDI Note Range	C#-2 to C6
MIDI Note Offs	Recognises real Note Offs as well as velocity Note Offs
Size	2U 19” rack unit
Display	2 x 16 backlit LCD

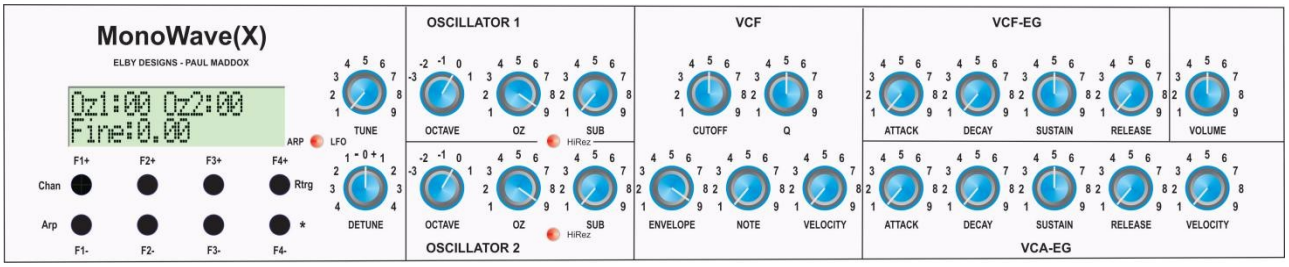
All specifications are subject to change without notice.

MonoWave(X) User Guide

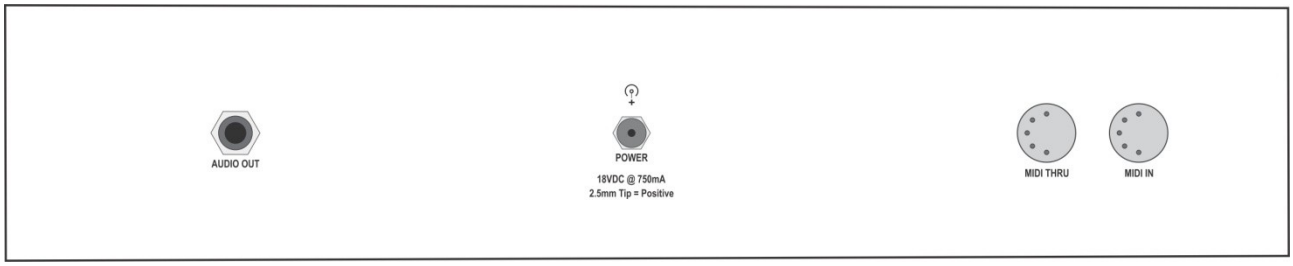
Setting up the instrument



- Connect the [**MIDI IN**] socket to the MIDI OUT of your MIDI controller such as a keyboard or computer
- Connect the [**AUDIO OUT**] socket to the line input of your mixer or amp. Make sure the gain/level/volume control is set low
- Connect the [**POWER**] socket to a suitable power source*
- Turn [ON] the MonoWave(X) which should now show an information screen indicating that the MonoWave(X) is powered on.
- Press the [**F1+**] and the [**F4-**] button together to select the MIDI channel display. Select the MIDI channel you wish the MonoWave(X) to receive on by pressing the [**F1+**] and [**F1-**] buttons
- Press [**F4-**] to exit back to the main system
- Now set up a patch like that shown below
- Press a key on your keyboard and hold it.
- Slowly increase the gain of your mixer or amp until the level is OK for your equipment.



You should hear the first sounds from your MonoWave(X) now.



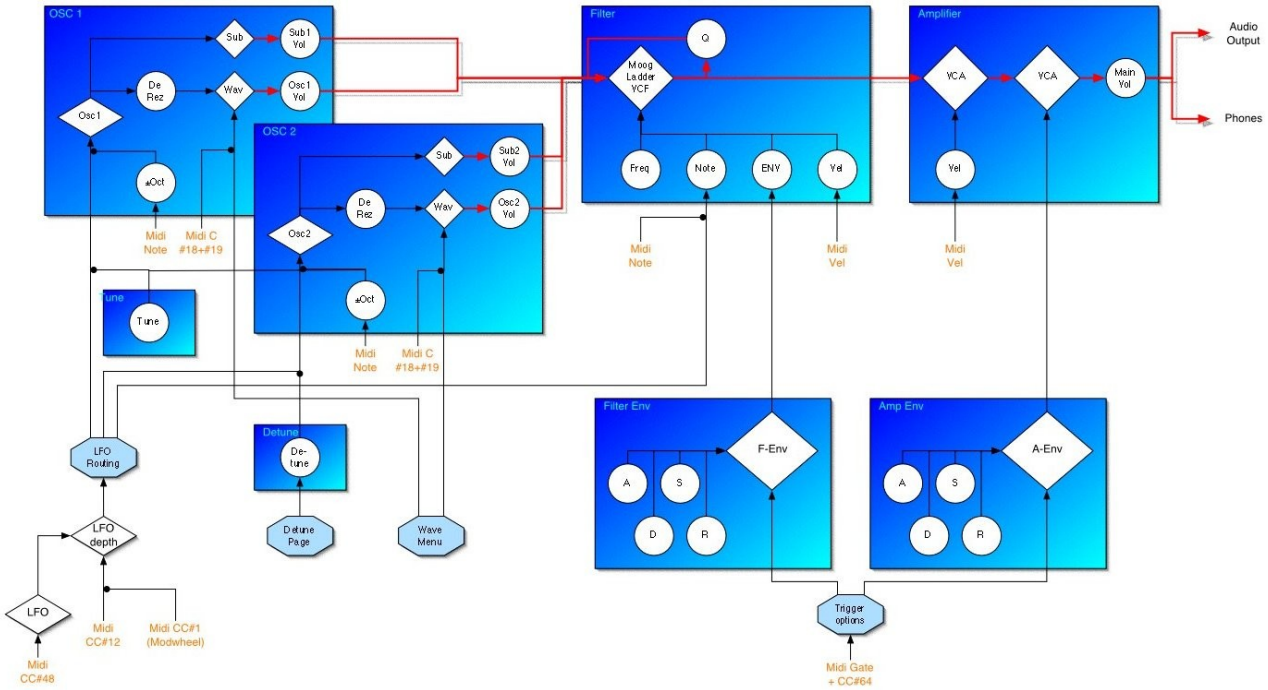
Alternate rear panel layout

- External power supply should be a well regulated 15VDC supply terminated with a 2.5mm DC plug (tip = positive).

The Analogue Section

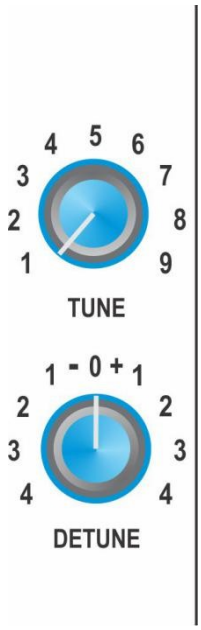
The MonoWave(X) has the following analogue sections:

- **Tune and Detune**
- **Oscillator #1**
- **Oscillator #2**
- **Analogue 24dB Moog Ladder Filter** with envelope, velocity and note tracking control
- **ADSR Filter Envelope**
- **ADSR Amplifier Envelope** with velocity on volume control
- **Main Volume**



MonoWave(X) Block Diagram

The TUNE and Detune Section



The **TUNE** knob tunes the MonoWave(X) to other instruments.

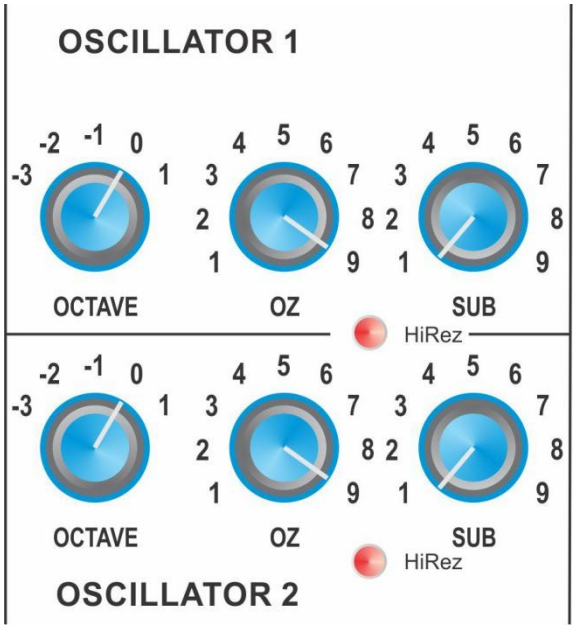
The MonoWave(X) has digital oscillators which will not drift out of tune.

The **DETUNE** knob detunes the second oscillator in relation to the first.

Centre is no Detune.
Clockwise will increase the pitch of the second oscillator.
Counter-clockwise will decrease its pitch.

The `amount' of Detune available is determined by the TUNE setting which can be either **FINE** (+/-99 cents) or **SEMI** (+/-8 semitone)

The Oscillator (OZ1 & OZ2) section



The 5-step octave switch selects octave transpose. This is handy if your keyboard does not have the full range or just for quick live changes. The 1 O'clock position is the normal 16' footage.

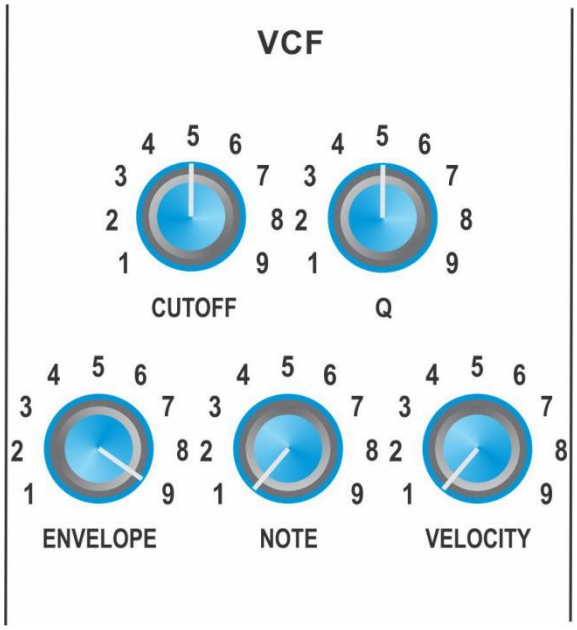
The **HI-REZ** button is integrated in to the **OZ** knob and, when OFF, will lower the sample frequency of the digital oscillator by a factor of 4 (256 samples per waveshape will drop to 64 samples) to get a more sexy low-fi sound. Many old digital synthesizers got their special harsh sound due to this. This is a part of the digital controller, but it's positioned near the analogue section of the oscillators for ease of use. An LED near the **OZ** knob will show you when the **HI-REZ** is active. You might have to raise the filter cut-off to hear the effect of **HI-REZ**.

The **OZ** knob allows you to adjust the oscillator's volume. It also incorporates the **HI-REZ** switch as discussed above.

The **SUB** knob allows you to fade in the sub oscillator - a square wave one octave below the main pitch of the oscillator. By using this wave shape together with the oscillator's normal wave shape, you get a very fat sound.

The Oscillators may be modulated by the LFO (refer to "LFO" in the "**The Digital Section**")

The FILTER Section



CUT-OFF = Lowpass filter cut off point.

Q = Emphasis = Resonance

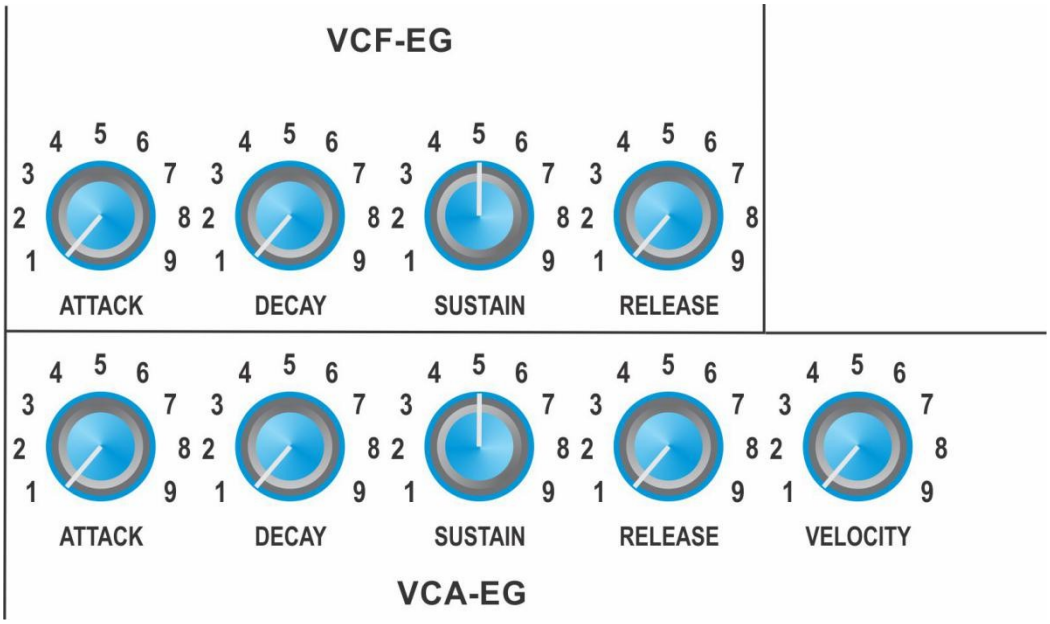
ENVELOPE adds the envelope modulation amount to the cut off frequency.

NOTE adds a voltage according to the note number send to the MIDI input. The full counter clockwise position means no key tracking; Fully clockwise gives 200 % tracking. That is, playing an octave above the previous note will raise the cut-off frequency by 2 octaves.

VELOCITY opens the filter according the velocity of played notes. The more you turn this knob clockwise, the greater effect velocity has on the cut-off (until the filter is fully open anyway). Thus, playing with full force will raise the cut-off and make the sound brighter. Playing softly will only alter the sound by a small amount (almost in-audible). This can be very expressive.

The Filter may be modulated by the LFO (refer to “LFO” in "**The Digital Section**")

The Filter and Amplifier Envelope Sections



The MonoWave(X) has two analogue ADSR-style envelope generators. They are optimised for short but very precisely controlled timescales.

- **ATTACK** time,
- **DECAY** time,
- **RELEASE** time.

Note: There is a special hold mode

- Let the **ATTACK** phase finish
- Set **DECAY** below **2**.
- Turn **SUSTAIN** above **9**
- And **RELEASE** above **2**.

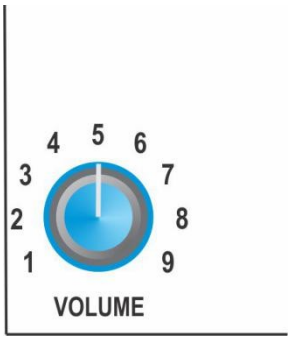
All these conditions must be met at the same time.

The last note played will ring endlessly. If you experience a hanging note, check if you have set the ADSR to `hold mode' by accident.

The **Amplifier Envelope** has an additional **VELOCITY** control that allows you to change the level of velocity modulation - useful for dynamic control.

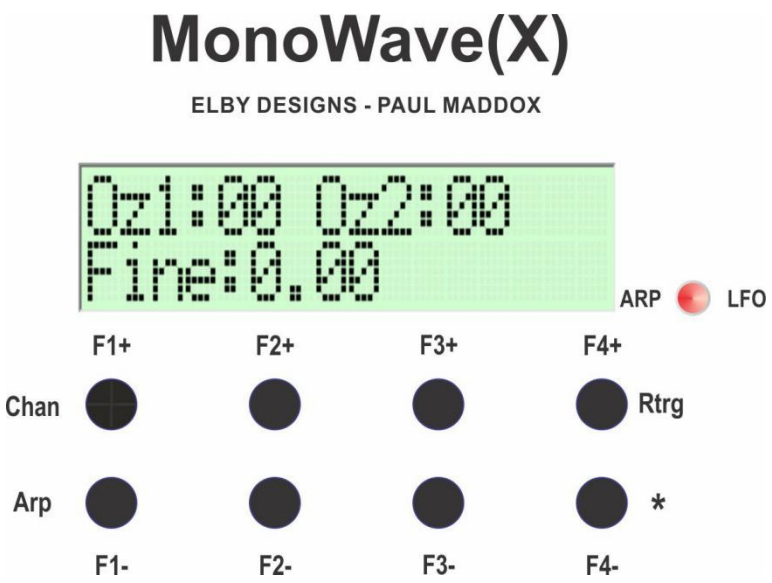
If set to zero (full counter clockwise), velocity will have no effect on loudness. At maximum (fully clockwise) the velocity value will have maximum velocity effect. That is, near to no volume at all if played very softly and maximum volume if played real hard. The maximum volume you may gain will always be the same. This way you don't overdrive or destroy your audio equipment.

The Main Volume Knob



Use this knob to adjust the volume of the MonoWave(X) to match the mixer or amp to your needs.

The Digital Section



The **MonoWave(X)** has the following digital parameter pages:

- The **Information** page (only at power on)
- the **Wave Form** page (this is the default)
- the **LFO** page
- the **MIDI Channel** selection page
- the **Tune/Detune** page
- the **Retrigger Options** page
- the **Arpeggiator Speed and Mode** selection page
- the **Velocity** page
- the **Test Mode** page

The various pages are selected by pressing [**F4-**] in combination with one of the other [F..] keys as listed below:-

[**F1+**] and [**F4-**] = MIDI Channel page
[**F2+**] and [**F4-**] = Tune and Detune page
[**F3+**] and [**F4-**] = Velocity page
[**F4+**] and [**F4-**] = Re-Trigger page
[**F1-**] and [**F4-**] = ARP page
[**F2-**] and [**F4-**] = LFO page
[**F3-**] and [**F4-**] = Test Mode page

In most cases, pressing [F4-] will exit the selected page and return you to the main display page. In some cases, pressing [F4-] will take you to a further 'option' within the menu. In all cases, not pressing any key for a few seconds will allow the system to automatically exit the selected page and return to the main display page.

All parameters are stored in EEPROM and are automatically retrieved each time the MonoWave(X) is powered on. On exiting from any of these menu pages the system will display a message indicating that the data has been saved.

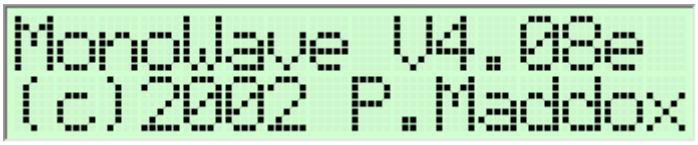
Where a number is to be displayed on the screen it may be in either hexadecimal or decimal depending upon the screen being displayed. In the following documentation any number that is displayed on the screen in hexadecimal format will be represented in the text with a preceding 0x. So, for example, when discussing the Wave Banks and Wave Forms for the two oscillators we use the form 0x12 (decimal 18) whereas in the Test Mode screen the MIDI Note number is displayed in decimal format such as 12 (0xC).

The Information Page

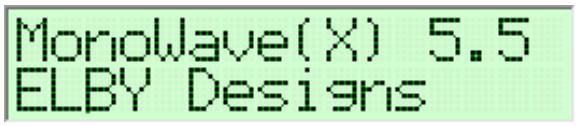
This page, which is only shown when the MonoWave(X) is powered on, provides information on the program version.

It consists of 2 screens:-

1. The first screen provides information on the original author of the program and the last revision upon which the current MonoWave(X) was based.
2. The second screen shows the current software revision for the MonoWave(X).



Information screen #1



Information screen #2

The Wave Shapes Menu (main display)

The Wave Shapes display is the main page. It is always shown when the MonoWave(X) is in normal play mode.

The MonoWave(X) features 256 different waveshapes which are divided in to 16 Wave Banks each of which contains 16 variants or Wave Shapes – see appendix.

These Wave Shapes can be selected independently for **OZ1** and **OZ2** as described below:-

[**F1+**] - increment the OZ1 Wave Bank
[**F2+**] - increment the OZ1 Wave Shape
[**F3+**] - increment the OZ2 Wave Bank
[**F4+**] - increment the OZ2 Wave Shape

The first 6 Wave Shapes (0x00 to 0x05) provide the basic waveshapes found in many oscillators:-

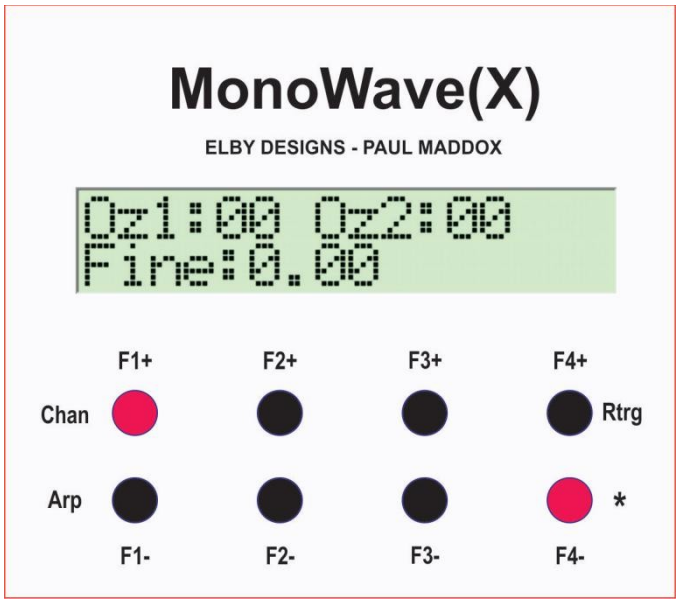
- **0x00** = sawtooth (ramp)
- **0x01** = reversed sawtooth (slope)
- **0x02** = sine
- **0x03** = square
- **0x04** = triangle
- **0x05** = pulse, 25%

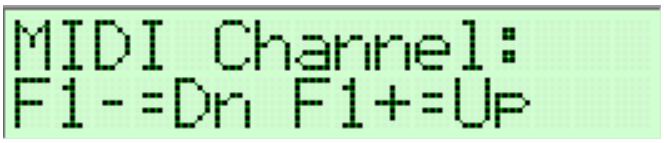
Wave Shapes **0x00** to **0x0F** (Wave Bank 0x0) were designed by Paul Maddox
Wave Shapes **0x10** to **0x7F** (Wave Bank 0x1 to 0x7) are from the PPG wave synths (!)
Wave Shapes **0x80** to **0xEF** (Wave Bank 0x8 to 0xE) are classic digital waveforms.
Wave Shapes **0xF0** to **0xFF** (Wave Bank 0xF) are from the PPG wave synths (!)

The display shows the active Wave Shape for both oscillators and the Detune setting for oscillator #2 and whether it is set for **FINE** or **SEMI**-tone tuning.

(!) PPG wave forms are used with the permission of Waldorf Music

The MIDI Channel Menu (F1+ & F4-)



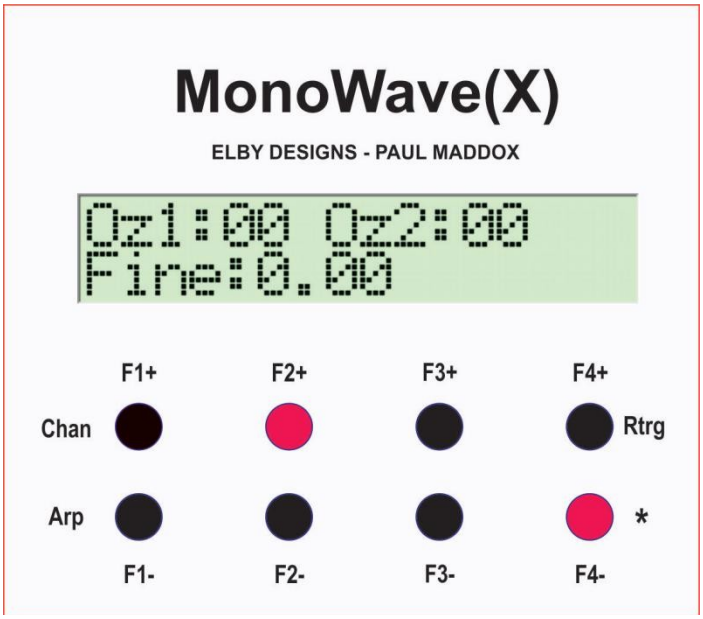


This page lets the user select which MIDI Channel the MonoWave(X) will respond to. The factory default is MIDI Channel 1 (i.e MIDI Address = 0x0).

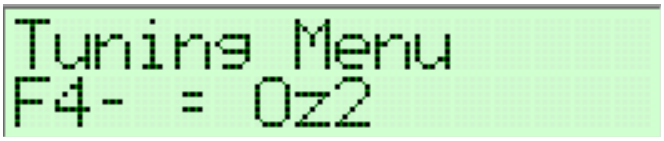
The [**F1+**] button will raise the channel number while the [**F1-**] button will lower it.

Pressing [**F4-**] will exit this page and take you back to the main display page.

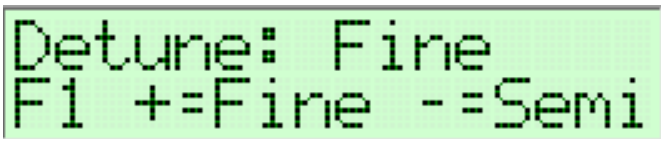
The Tune and Detune Menu (F2+ & F4-)



This page lets you store a tuning offset which will be recalled the next time you power up.



Turn down the Oz2 output level and then adjust TUNE until the MonoWave(X) is in tune with your external equipment. Press [**F4-**] to save this `tune offset' and to proceed to the OZ2 TUNE settings.

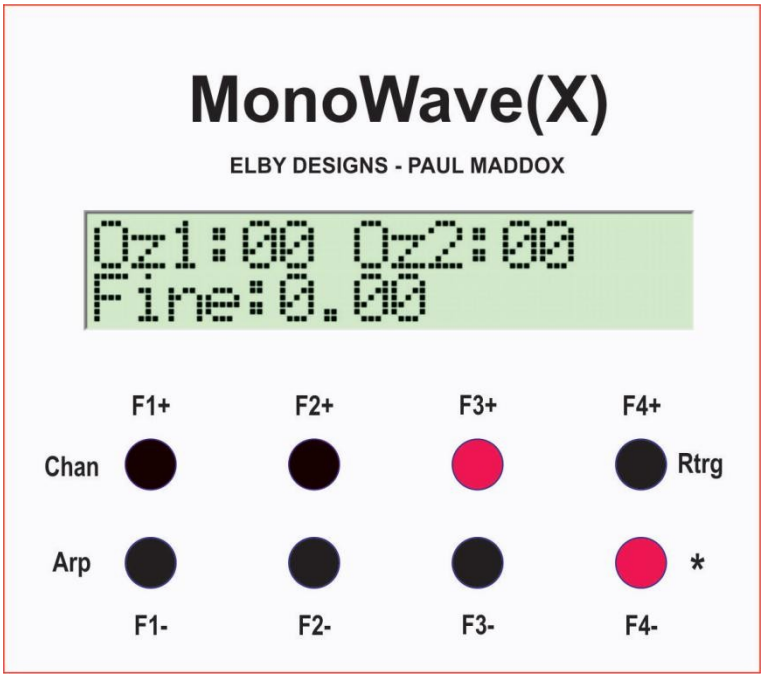


Turn down the Oz1 output level and turn up the Oz2 output level. Adjust the TUNE control until the MonoWave(X) is in tune with your external equipment. Press [**F4-**] to save this `tune offset' and to proceed to the DETUNE settings.

You can also determine the resolution of the DETUNE control:-
When you select **FINE**, the Detune control will have a narrow range of approximately+/-99 cents. This is ideal for slow beating detuned effects. When you select **SEMI,** the Detune control will allow you to transpose the second oscillator by +/-8 semitones.

Press [**F4-**] to exit and return to the main display page.

The Velocity Menu (F3+ & F4-)



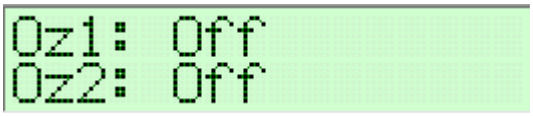
This page lets the user select if the Velocity value will be used to adjust the wave shape of the oscillators. The Velocity Wave Mode setting can be set individually for each oscillator to:-

- **Off** – The Velocity Wave is disabled
- **Wave** – The Velocity Wave value will be used to adjust the selected Wave Shapes
- **Bank** – The Velocity Wave value will be used to adjust the selected Wave Bank
- **All** - The Velocity Wave value will be used to adjust the selected Wave Bank and Wave Form

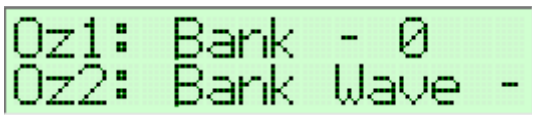
The settings can be made as follows:-

- [**F1+**] will step through the Velocity Wave Mode options for oscillator #1
- [**F1-**] will step through the Velocity Wave Mode options for oscillator #2
- [**F2+/-**] will increment/decrement the Velocity Wave Depth for oscillator #1
- [**F3+/-**] will increment/decrement the Velocity Wave Depth for oscillator #2
- **[F4-]** will exit the Velocity Menu

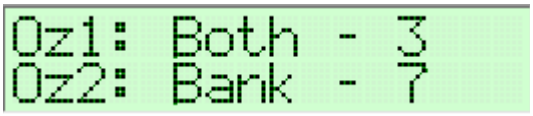
After a few seconds of inactivity the program will automatically exit back to the main display page.



Velocity Wave Mode for both oscillators disabled

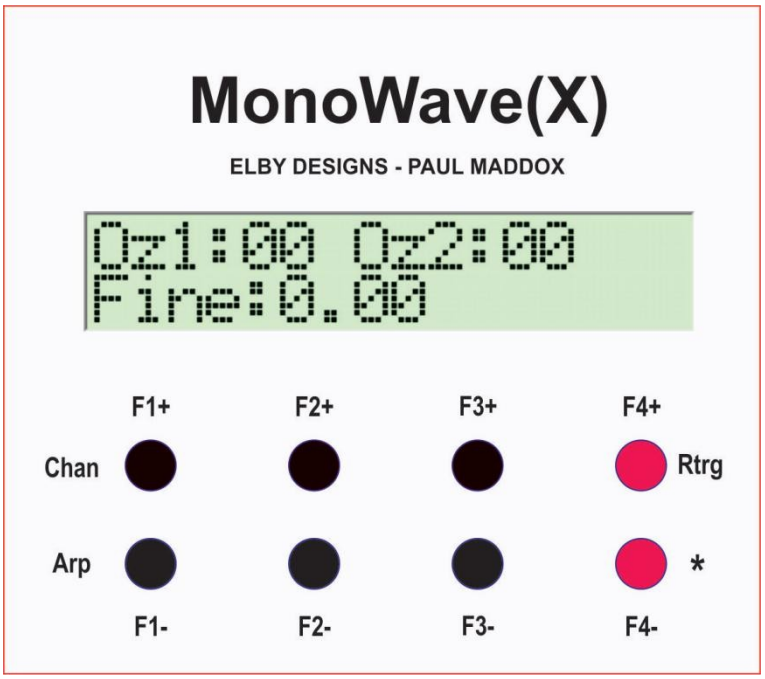


Bank mode selected for OZ1
Wave mode selected for OZ2



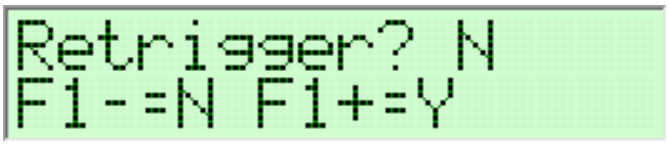
Both modes selected for OZ1
Bank mode selected for OZ2

The Re-Trigger Menu (F4+ & F4-)



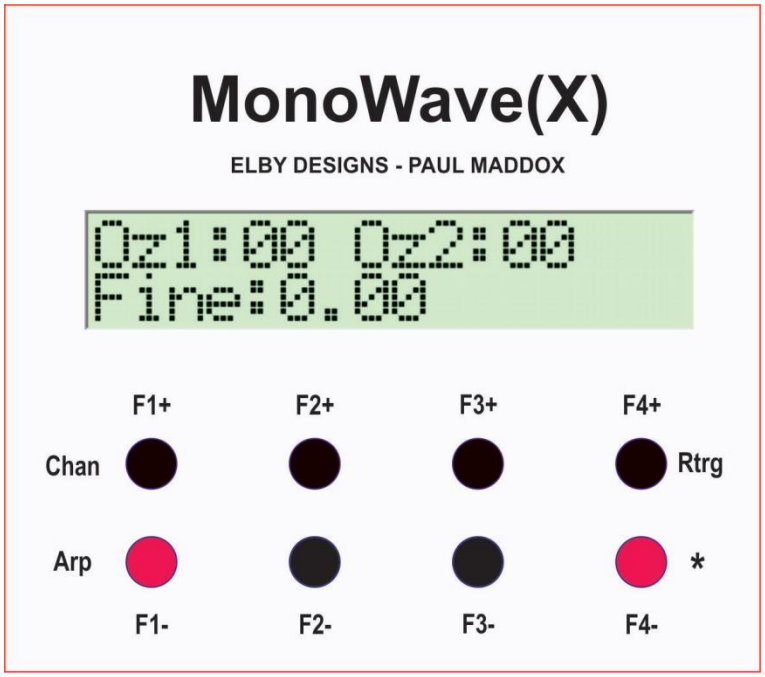
You can change the way the MonoWave(X) triggers.

- If you set Re-Trigger to "**Y**es" [**F1+**] then the MonoWave(X) will retrigger on all incoming new notes - whether the last note is still pressed or not.
- If you set Re-Trigger to "**N**o" [**F1-**] then the MonoWave(X) will not retrigger on an incoming new note if the last note is still pressed. This allows legato playing.

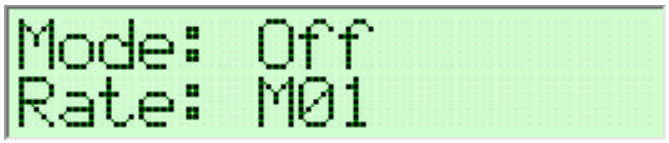


Press [**F4-**], or wait a few seconds, to exit this page and return to the main display page.

The ARP Menu (F1- & F4-)



The display will show something like:



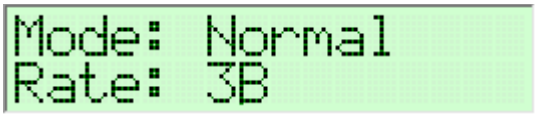
Rate:
The rate may be controlled by sending modwheel data to the MonoWave(X) while its running. When the MonoWave(X) is set to be synced to MIDI clock, the modwheel can't control the rate anymore. You may enter and memorise the tempo setting by setting the tempo by values, not by using the modwheel.

The unsynced tempo ranges from **0x10** to **0xFF**. You can select the tempo by using the 4 left most buttons. The left button changes the first digit, the right one the last digit.

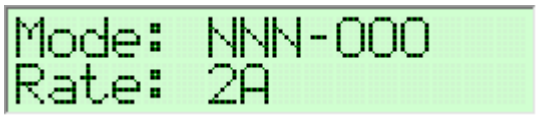
The tempo ranges from 0x00 to 0x0F are 'synced to MIDI' values :-
M01, **M02**, **M03**, **M04**, **M06**, **M08**, **M12**, **M16**, **M24**, **M36**, **M48**, **M96**
(*"**M**" stands for synced to **M**IDI*)

The number is the fraction of a whole note each note of the ARP is playing. **M04** means a quarter note per whole note, ie 4 notes to the bar (4/4 time).

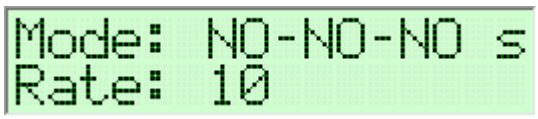
There are 6 different **ARP** modes to choose from:-



Normal: The notes are played in the order you pressed them, Legato playing style.
Normal s: Same as above, but in a more staccato playing style.



NNN-OOO: The notes are played in the order you pressed them. And the whole sequence is then repeated after being transposed up an octave, Legato playing style.
NNN-OOO s: Same as above, but in a more staccato playing style.

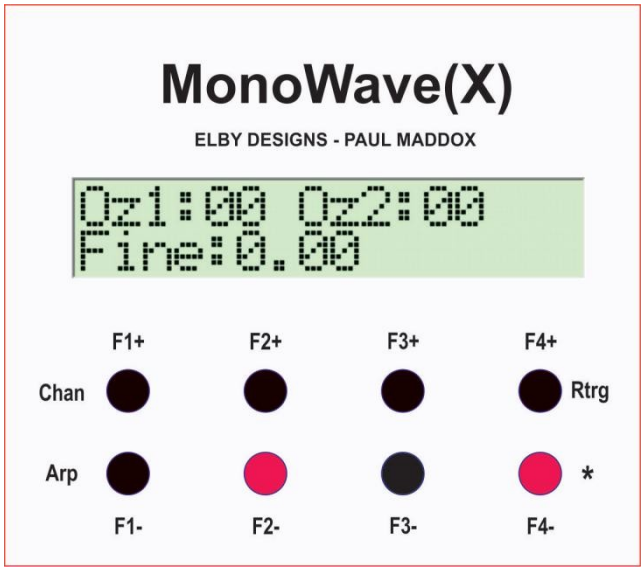


NO-NO-NO: The notes are played in the order you pressed them with each note being repeated after being transposed up an octave, Legato playing style.
NO-NO-NO s: Same as above, but in a more staccato playing style.

The **ARP** starts playing when you press a key (in non-MIDI sync mode).
The ARP LED lights with the beat of the ARP notes to help you. This feature isn't available, if the MonoWave(X) is set to sync to MIDI clock. In the case of MIDI sync (speed settings "Mxx") it will start playing if you're upto 1/16th after the beat, otherwise it will wait until the next beat is due before starting. This ensures your sequence is always in time with MIDI clock.

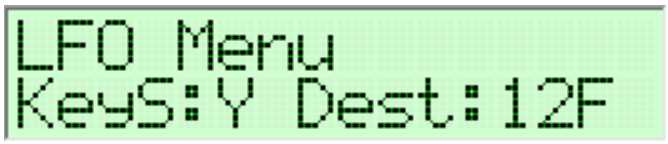
Sending the sustain pedal MIDI CC will cause the MonoWave(X) to hold the played ARP notes even after releasing all keys. Without this controller being sent, the ARP will be silent after you release the last pressed key. That is, if you press a few notes and press and hold the sustain pedal before lifting all fingers, you can enter more notes into the 64 notes long **ARP** memory of the MonoWave(X).

The LFO Menu (F2- & F4-)



This page lets you assign a triangle wave LFO output as a modulation source. The routing destinations can be any combination of these 3 paths:-

1. **Oscillator #1**
2. **Oscillator #2**
3. **Filter Cut-off**



[**F1+**] and [**F1-**] set the "LFO Sync on Key Trigger" option. When set to "**Y**es" ([**F1+**]) the LFO will start a new wave cycle when ever a key is depressed. When set to "**N**o" ([**F1-**]) the LFO will generate a free running LFO waveform.

The LFO may be routed to oscillator #1 and/or #2 and/or the filter as described below:-

- [**F2+**] and [**F2-**] will enable [**1**] or disable [.] routing to oscillator #1
- [**F3+**] and [**F3-**] will enable [**2**] or disable [.] routing to oscillator #2
- [**F4+**] and [**F4-**] will enable [**F**] or disable [.] routing to the filter

A ModWheel (the one on your chosen keyboard controller) can be used to adjust the modulation depth to the oscillators.

The maximum modulation depth of the filter can be set by the Key-Tracking knob **[Note]**. This way you are able to have heavy filter modulation and tiny oscillator modulation combined and controlled by the same ModWheel.

The setting will be automatically saved after a few seconds of not pressing any buttons.

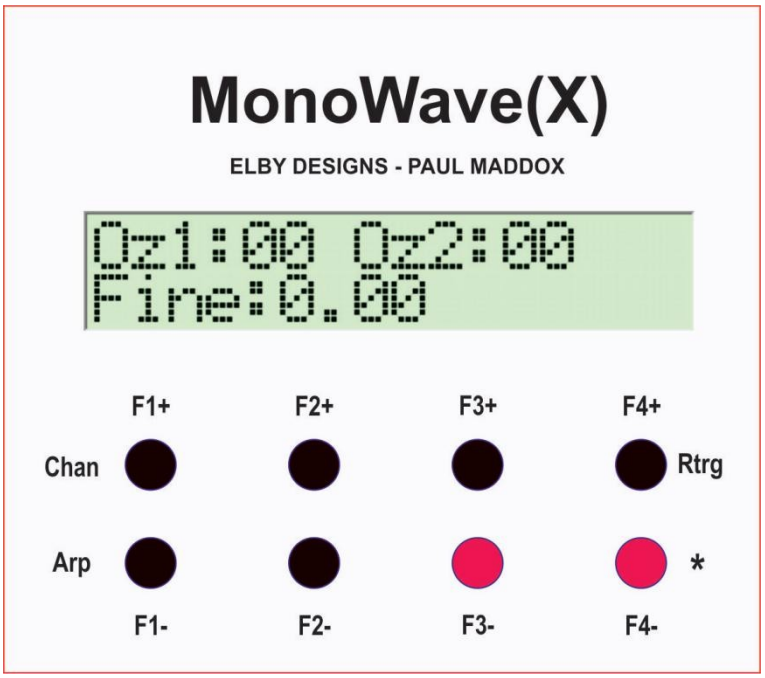
The maximum LFO depth can be controlled via Midi Controller #12. 8 settings are available. If no Midi Controller #12 event is ever send then it will stay on the default value of "1" (maximum pitch modulation ± 100 cent).

The LFO Speed is set up in the ARP menu while the ARP is switched off (refer to the **ARP** paragraph below). Midi Controller #48 can also be used to change the LFO speed however this setting will not be stored in the MonoWave(X).

The LED marked **ARP/LFO** will flash according to the speed of the **ARP/LFO**. It will glow when the LFO wave cycle is in the positive phase of its cycle.

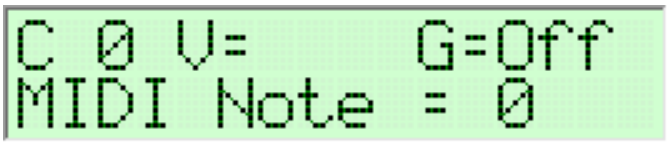
The ARP and the LFO modes may not be used at the same time.

The Test Mode Menu (F3- & F4-)



This page is useful to checking and testing both the MonoWave(X) and the audio output equipment connected to it by allowing the MonoWave(X) to play a sustained note without having a MIDI signal.

The display will show something similar to the following:-



The currently selected note in the form C#5 where:

- C# = the name of the note
- 5 = the current MIDI octave of the note
- Gate ON or OFF, and

The display also shows the MIDI Note number and MIDI Velocity value in the lower right of the screen.

[**F1+**] to increment the selected note. The note name, octave and MIDI Note value will change accordingly. If the NOTE values exceeds 96 the program will wrap this around to a minimum NOTE value of 24.

[**F1-**] to decrement the selected note. The note name, octave and MIDI Note value will change accordingly. If the NOTE values drops below 24 the program will wrap this around to a maximum NOTE value of 96

[**F2+**] to increment the velocity value for the current note. If the VELOCITY values exceeds 127 the program will wrap this around to a minimum VELOCITY value of 64.

[**F2-**] to decrement the velocity value for the current note. If the VELOCITY values drops below 64 the program will wrap this around to the maximum VELOCITY value of 127.

[**F3+**] to turn the Gate ON and to `play' the note.

[**F3-**] to turn the Gate OFF.

[**F4-**] to exit the **Test Mode** and return to the main display.

Factory Reset (*Firmware V5.4 onwards*)

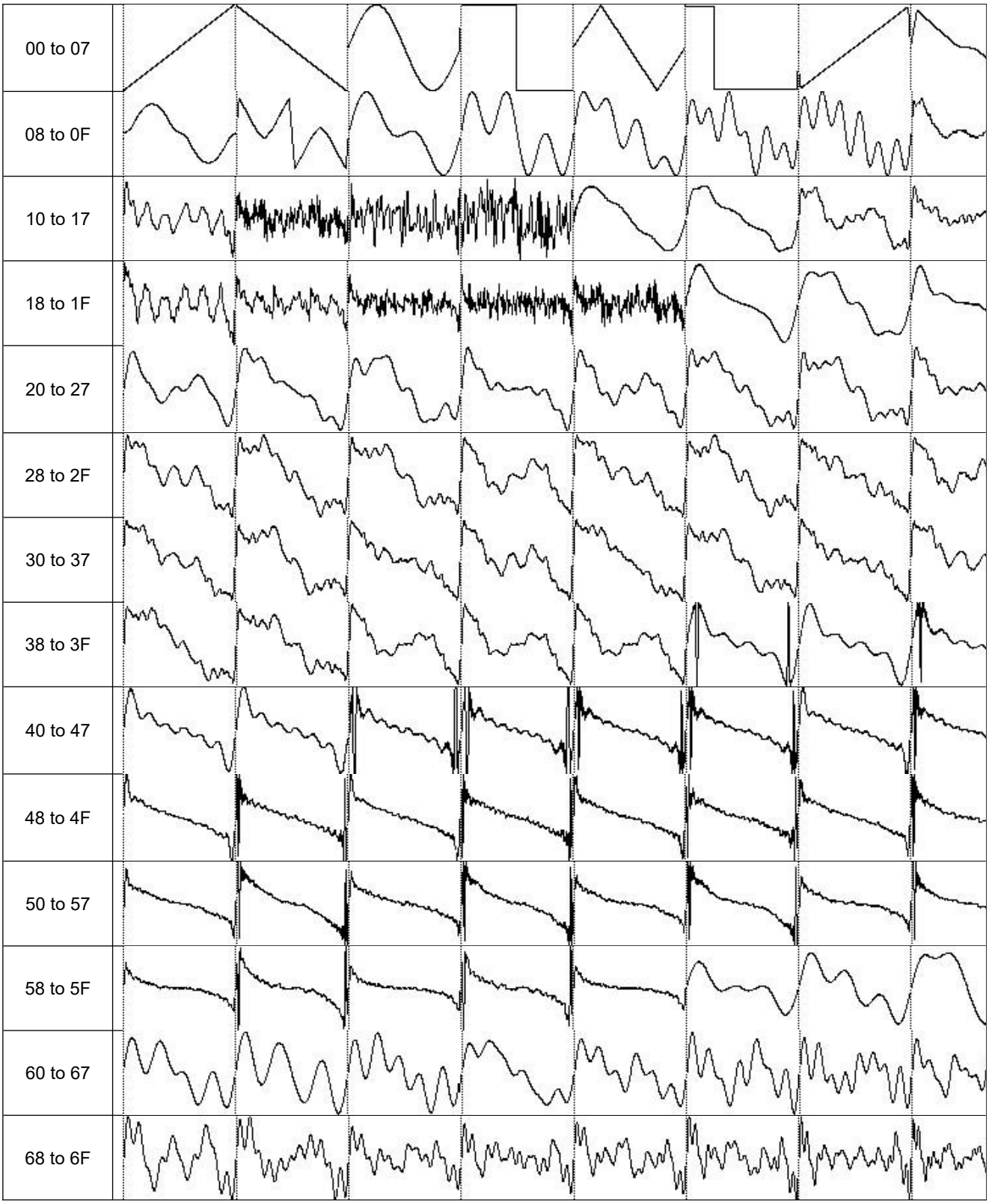
Pressing and holding [F3-] and [F4-] at power on will reset all storable parameters to a default value as listed below:-

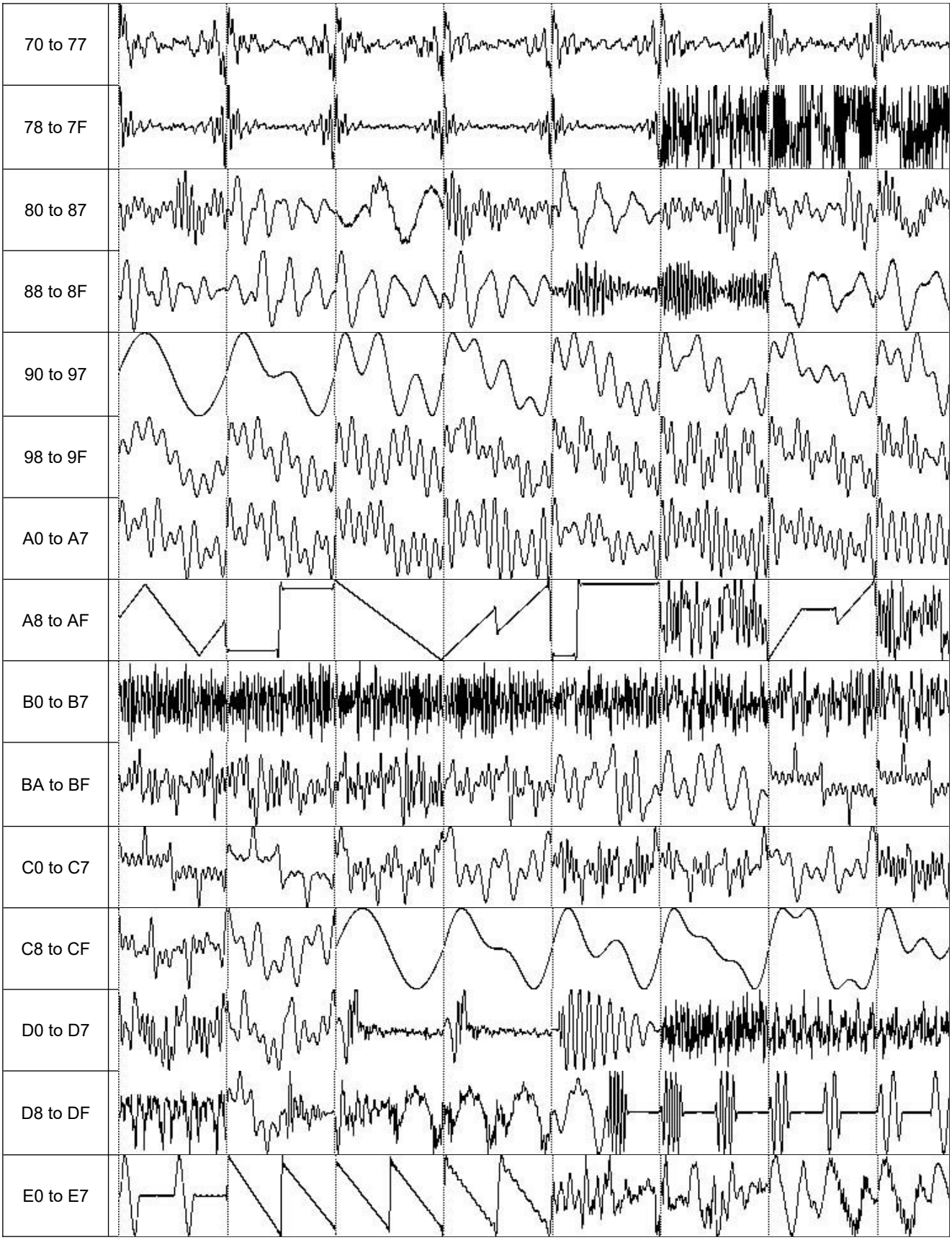
- ARP Rate = Maximum
- ARP Mode = 0
- Detune = 0
- Detune Resolution = FINE
- LFO Sync on Key Trigger = Off
- Maximum LFO Depth = 1
- LFO Modulation - OZ1 = Off
- LFO Modulation – OZ2 = Off
- LFO Modulation - VCF = Off
- MIDI Channel = 0
- OZ1 Wave Shape = 0 = Sawtooth
- OZ2 Wave Shape = 0 = Sawtooth
- Re-trigger Mode = 'No' (legato mode)
- Velocity Wave Depth – OZ1 = 0
- Velocity Wave Depth – OZ2 = 0
- Velocity Wave Mode – OZ1 = OFF
- Velocity Wave Mode – OZ2 = OFF

- **MIDI Implementation Chart**

Function	Function	Transmitted	Recognized	Remarks
Basic Channel	Default Changed	X X	1 1-16	Memorized
Mode	Default Messages Altered	X X X	X X X	No Modes supported
Note Number	 True Voice	X X	1-96 0-108	 *1
Velocity	Note ON Note OFF	X X	O X	
After Touch	Key's Ch's	X X	X X	
Pitch Bend		X	O	
Control Change	1 12 16 17 18 19 48 64	X X X X X X X X	O O O O O O O O	Modulation depth / ARP speed *2 LFO max depth Osc 1 Waveshape Bank (0-F) Osc 1 Waveshape Number (0-F) Osc 2 Waveshape Bank (0-F) Osc 2 Waveshape Number (0-F) LFO Speed Sustain Pedal
Program Change	 True #	X X	X X	No Programms available
System Exclusive		X	X	No MIDI Out provided
System Common	Song Pos Song Sel Tune	X X X	X X X	
System Real Time	Clock Commands	X X	O O	MIDI Clock Start, Stop, Continue
Aux Messages	Local ON/OFF All Notes OFF Active Sense Reset All Sound OFF	X X X X X	X O X O O	
Notes:	*1: Osc 1 & 2 octave switches serve as transpose.The 1 O'clock position is non transposing. *2: Modwheel controlls ARP speed only when ARP mode is on (if ARP not set to MIDI clock sync), otherwise it controls LFO modulation depth			

WAVESHAPES


00 to 07
08 to 0F
10 to 17
18 to 1F
20 to 27
28 to 2F
30 to 37
38 to 3F
40 to 47
48 to 4F
50 to 57
58 to 5F
60 to 67
68 to 6F



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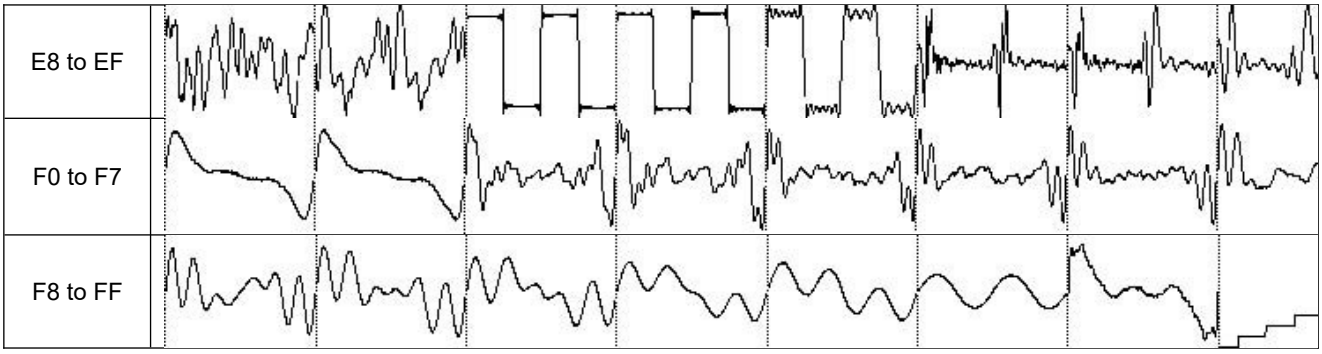

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