Chicago

Mk1



Operating Manual

Thank you for choosing to back the Limited Edition Chicago Mk1 project.

Introduction:

The name ‘Chicago’ was chosen because it’s the birthplace of House music and the legendary analogue synthesizer bass lines.

The Chicago MK1 is a limited edition Riff and Bass synthesizer that has a restricted amount of functionality or sound variation, but this is compensated for by a sometimes ‘percussive’ or ‘snappy’ rich, deep sound (Phat) that can work well ‘in the mix’, and a sound that sits in between other classic synthesizers: It’s not quite a Moog, Roland or Korg sounding synthesizer, so there is room for the Chicago to compliment these legendary brands, or to find a sound that you can’t quite get with them.

The Chicago MK1 is not intended for those who really want to recreate a 1970’s Dr Who TV episode, or for those that want to use a pitch-bend wheel to try and impersonate Jimmy Hendrix – it’s intention is to sound a little more like an 80’s synthesizer playing bass lines (before the Yamaha DX7 took over that role) and operated by the basic 80’s Atari Midi Sequencers.

If you did want to compare this synthesizer with any other, it sort of follows the quirkiness of the Moog Prodigy, without the LFO modulation, but with MIDI and a very stable oscillator. At first, the Chicago can appear to have very little sound variations, but with a little effort, you can stumble across a good few settings that sound truly great with that specific line that’s being played – or even cheesy enough for a Pop track! If you have played with the well-known Moog Prodigy Free VST plugin, you can sort of understand the analogy.

Never the less, I really hope you enjoy what the Chicago has to offer, and it will be so nice to hear it being used on a Soundcloud/Youtube track, commercial track or even on TV!

Ren.

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1) Safety First!

The Chicago is designed to be a very safe and reliable product. However a few things need to be considered for the safe use of the product:

DO NOT power the Chicago with more than 15 VDC. Use 9 VDC (preferred) that has a current output of at least 250 mA. Over voltages will rupture the internal fuse.

DO NOT power the Chicago with un-isolated 9 VDC power supplies. Use approved isolated mains power supplies: Look for any of these types of recognisable safety symbols on the Power Supply:



DO NOT use 9 V**AC** power supplies – These are 'alternating current' and they could stress the internal capacitors or create hum.

DO NOT power the Chicago with 110 VAC or 230 VAC.

DO NOT connect power to the Audio output, or the MIDI connectors – as damage may occur.

1.1) Operating

DO NOT operate in the rain (IP50 when rack mounted). Keep the Chicago dry. (You won't get electrocuted, but galvanic corrosion may take place if powered and the PCB is wet). Operate at between -10 ^{o}C to +40 ^{o}C, <95% Relative humidity, Non-condensing (i.e. no dew or condensation).

Try not to expose to direct sunlight. Long term exposure to UV may degrade the paint surface or lead to 'chalking'.

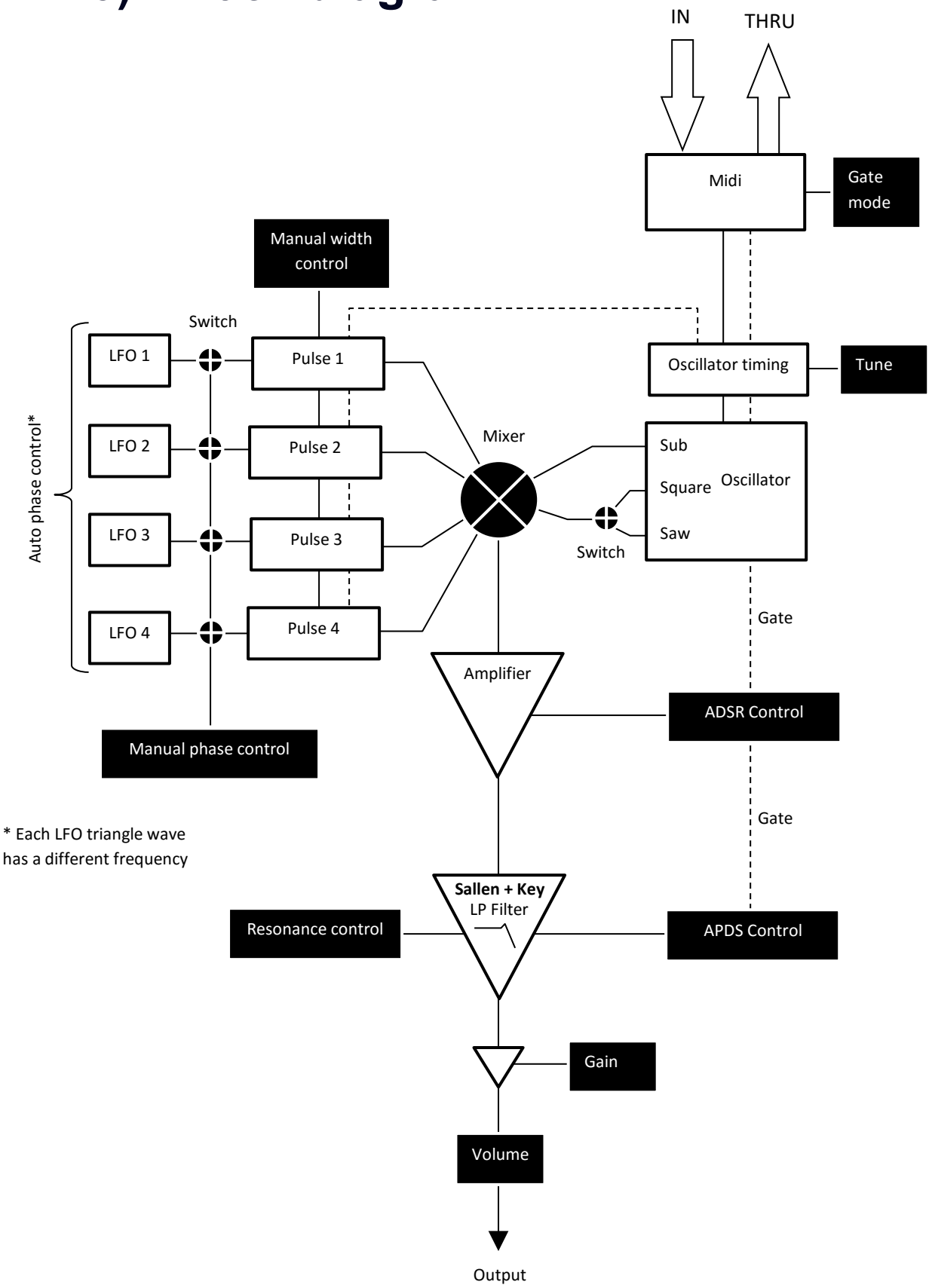
1.2) Maintenance

DO NOT clean with solvent based cleaners or abrasive cleaners. Use a lint free cloth or a damp cloth with mild detergent. Solvents may affect the paint surface or dissolve the silk screen paint.

2) Product features

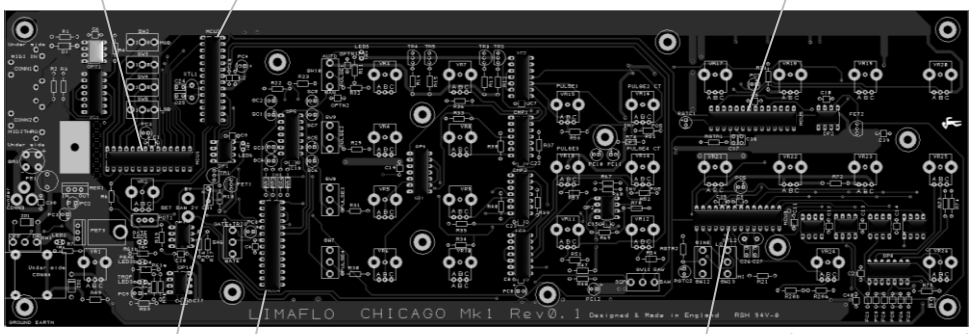
- Analogue signal path from the oscillator to the output.
- 1 x Saw or Square wave (selectable). The Saw is generated by a discrete transistor circuit.
- 1 x Synced Square Sub (-1 Octave) - it also divides the Saw frequency by 2.
- 4 x independent Pulse waves with automatic or manual adjustment of the phase, and manual adjustment of the pulse width. In automatic mode, the effect is similar to detuning the waveforms.
- Tune (0 to +60 cents), Major 3rd, Perfect 4th or Perfect 5th.
- MIDI In, MIDI Thru, channel selection 1 to 16.
- Classic Gate mode or Gate and 'Trigger on every note' mode.
- 6 channel mixer.
- Amplifier ADSR.
- Sallen & Key 24dB/Octave Low pass filter with Attack, Peak, Decay, Sustain and Resonance control.
- Set to sine (low frequency filter) switch.
- Filter decay mode switch.
- 482 mm (19") x 132 mm (3U) and ~40 mm from face to base.
- 1 Watt power dissipation.
- Approx. 2 kg.
- Potentiometer life expectancy 100,000 full revolutions (as per all 'audio' pot manufacturer's specifications).
- MTBF ~125 Years.

3) Block diagram



3.1) The micro’s & analogues

This is a section for the more technically inquisitive.



MIDI processing MCU (ATTiny48 @ 8MHz)

Oscillator Tune and amplitude leveller MCU (ATMEGA328P @ 16 MHz)

ADSR generator and amplifier MCU (ATTiny48 @ 8MHz)

Analog mixer section

The ‘bare’ PCB

The constant current based Pulse generation section

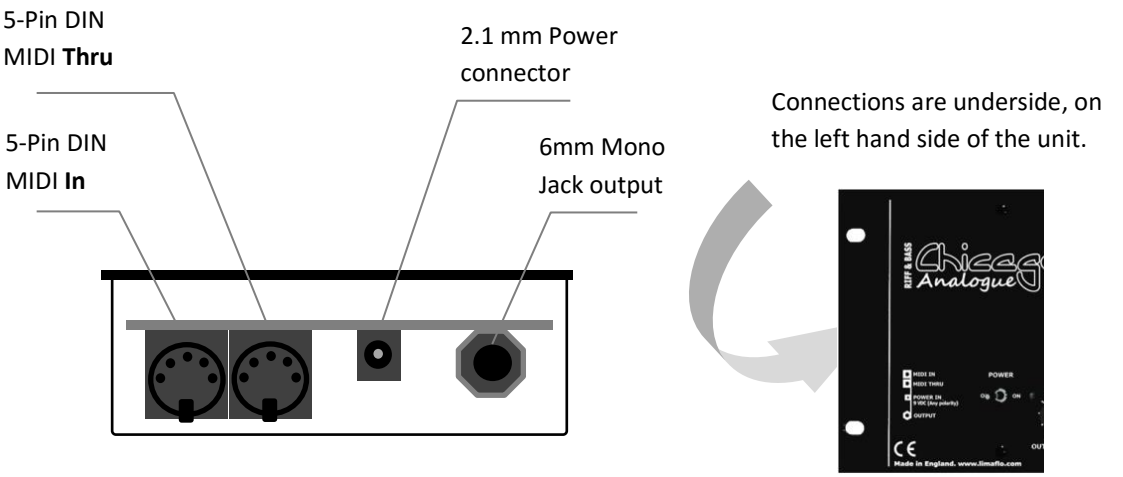
Analogue Sallen & Key 4-pole filter with feedback section

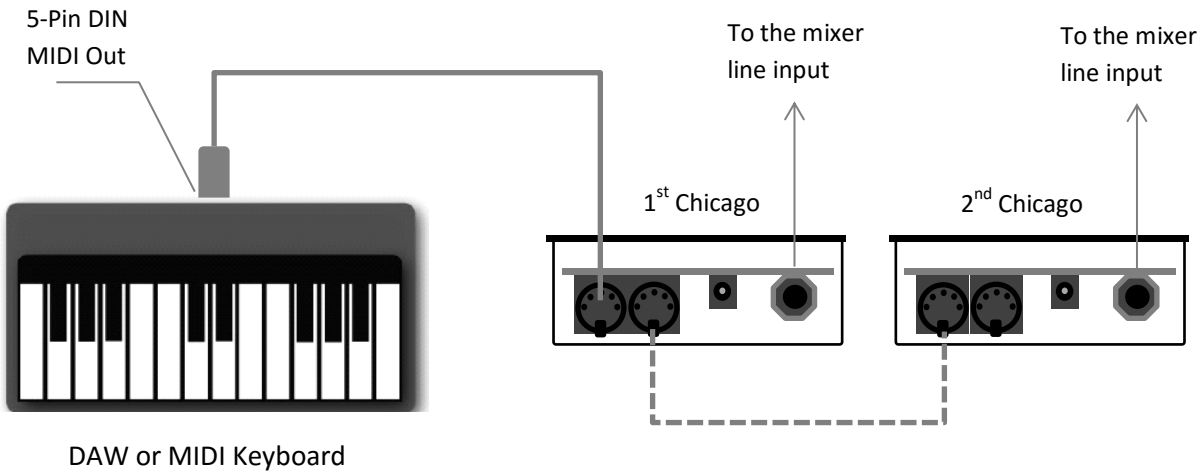
Discrete Transistor Saw-tooth oscillator

LFO and trigger/event timing manager MCU (ATTiny48 @ 8MHz)

APDS generator and filter MCU (ATMEGA328P @ 20MHz)

4) Connecting up





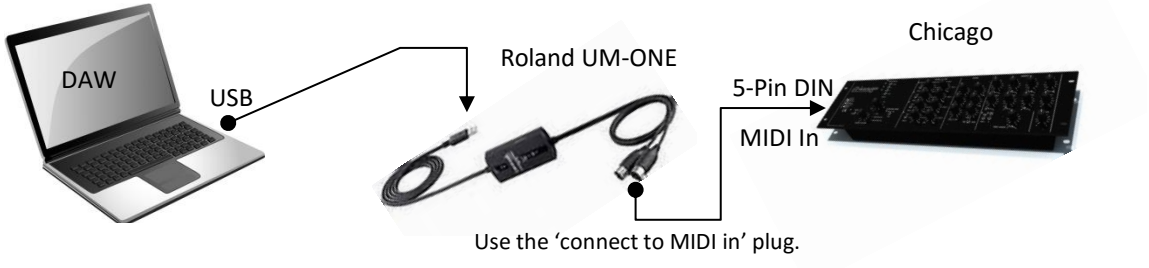
DAW or MIDI Keyboard

NOTE:
Sometimes Keyboards have a USB MIDI setting or a Classic 5-pin MIDI setting – so choose the classic 5-Pin DIN MIDI setting.

USB to 5-PIN DIN
To get from USB to 5-PIN MIDI, a converter like the **Roland™ UM-ONE** works well.

TIP!

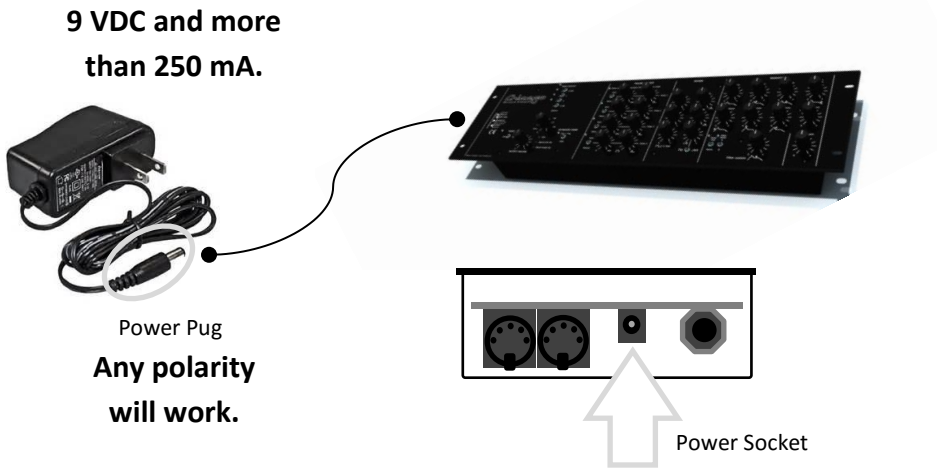
The first Chicago, if only using one Chicago, will be panned centrally on the mixer channel (or panned however you need). When using two Chicago's in unison, then panning one left or half way left, and panning the other right or half way right, and detuning one slightly, the true stereo effect is quite impressive.



Use the 'connect to MIDI in' plug.

The 'connect to MIDI out' plug will connect to your keyboard.

5) Power supply



Power supply specification

Any power supply that has a **9 VDC** Output, and is capable of delivering at least **250 mA** can be used. The power plug must be a **2.1 mm** type, with an outer barrel diameter of **5.5 mm**. You don't have to worry about whether the Pole is Positive or Negative, because the Chicago Power input can work with any polarity.

A 12 VDC power supply may be used if you can't get a 9 Volt version. The Chicago just runs a bit warmer and loses a little more energy.

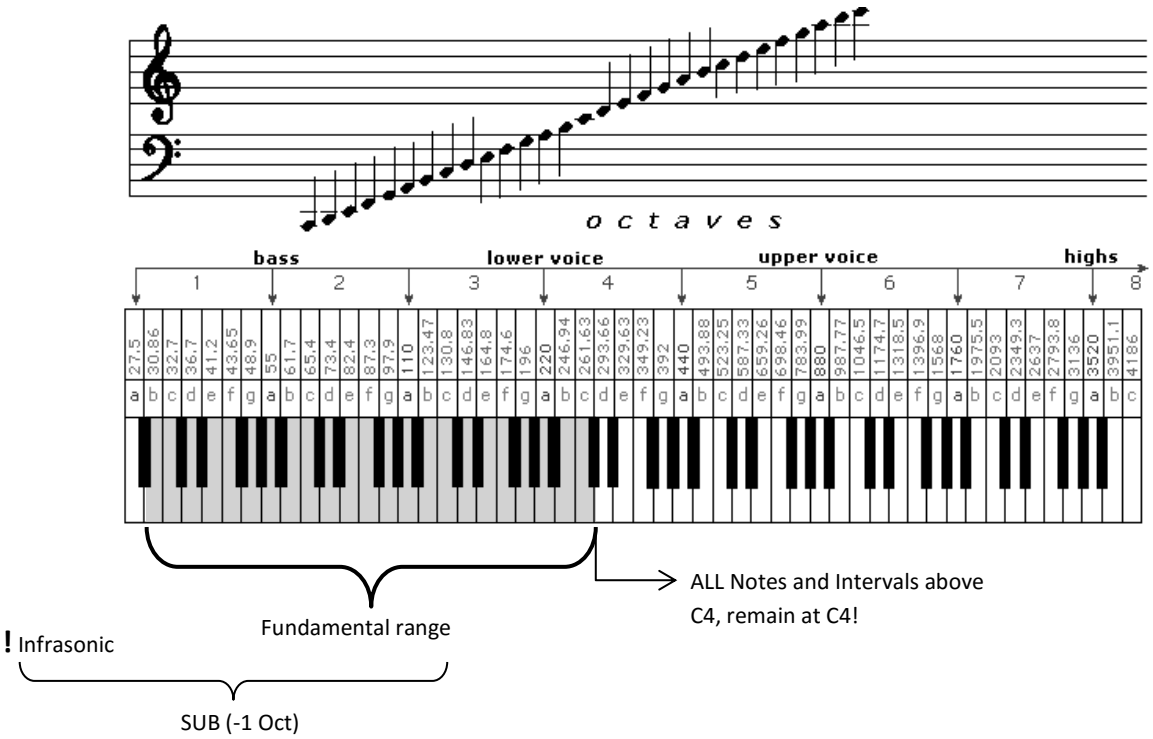
Here is an example of a power supply for reference, which you can get from Farnell or Digikey:

- Manufacturer: XP POWER
- Manufacturer Part No VER05US090-JA

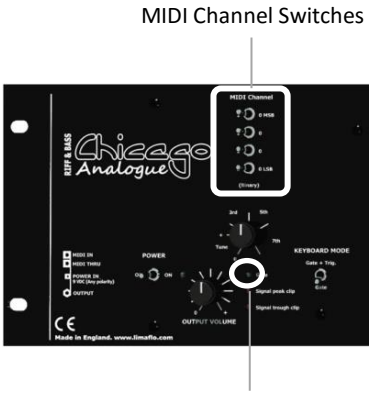
NOTE:

The power supply has not been included, because you may already have one, or you may prefer desk-top types rather than 'wall-warts', and you may need a specific cable length. Also, you may not like the idea of universal plug connectors or you may prefer a certain safety approval. However, these are inexpensive items that are really easy to get hold of. Any music shop will also stock them (for guitar pedals mainly).

6) Keyboard range:



7) Setting the MIDI Channel Number



Selecting the MIDI channel number uses a classic method, similar to the DIP switches used on the Boutique Synthesizers of the 80's. It's in Binary. If you can count in binary, then it is straight forwards, but here is some help if you need:

Channel	1	2	3	4	5	6	7	8
MSB								
LSB								

Channel	9	10	11	12	13	14	15	16
MSB								
LSB								

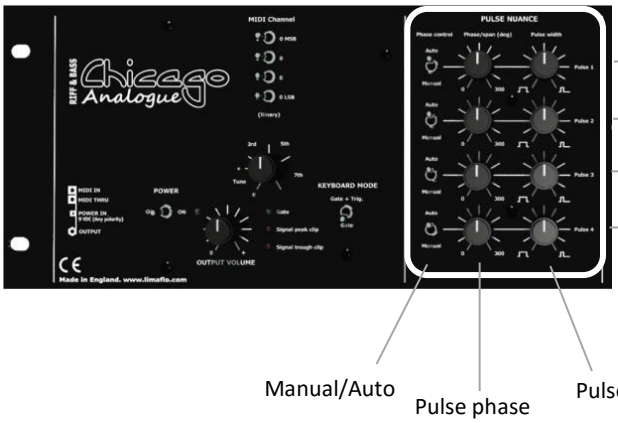
NOTE:

When the matching MIDI channel is set on the DAW or on the MIDI keyboard, any note press or sequencer note will activate the **Gate LED**, so you know it is working.

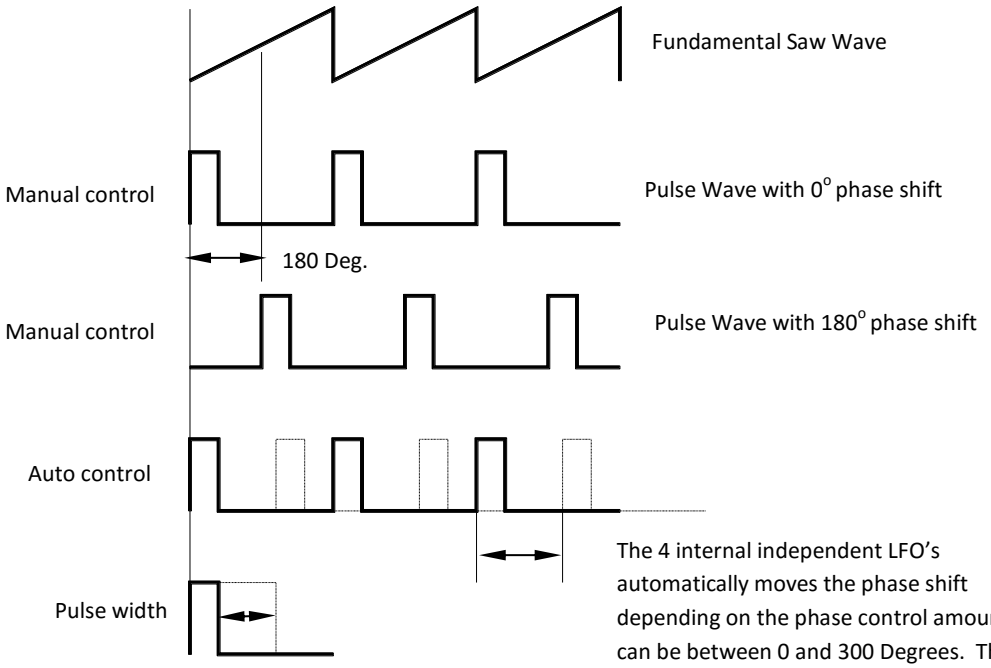
Illegal MIDI commands (history behind the dreaded dropped and stuck notes).

There are some DAWs that send out successive Same-Note, MIDI Note On commands as a priority, so that timing can be tighter. This is actually 'illegal' in terms of the MIDI specification and true Piano characteristics. You may have encountered stuck notes and notes dropping out of sequences, wherever the same-notes are butted against each other, and this is often the cause. The Chicago can deal with this, but if it does occur, then a solution is to apply a little gap between the end of one note and the beginning of the next. Overlaps are fine when they are different notes.

8) The Pulse Waves and Nuance control



The pulse waves are adjustable manually or automatically for the phase position, from 0 to ~300 Degrees, to the fundamental saw or square wave (or sub wave). The pulse width is adjustable from approx. 5% to 55%. The pulse width is maintained for any phase potion, unless the phase exceeds the width:



The 4 internal independent LFO's automatically moves the phase shift depending on the phase control amount. This can be between 0 and 300 Degrees. The effect is similar to detuning the oscillators. Each LFO has a different frequency, which is fixed.

The pulse width can be adjusted between about 5% (narrow) to about 55% (wide) duty cycle. The wider the pulse, the 'phatter' the sound.

NOTES ON NUANCE CONTROL:

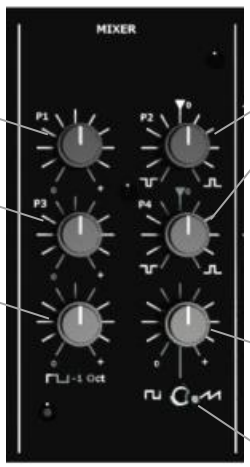
When in Automatic mode, and sometimes in Manual mode, and the low pass filter decay is short, changes to the pulse controls have little noticeable effect, particularly the phase control. Increasing the width does add a thicker sound, but the difference between pulses is not highly discernible.

With shorter pulses widths in manual mode, and the filter sustain set high, subtle nuances can be obtain with the sound, which changes the character of the sound, further enhanced by the pulse 2 and pulse 4 mixer controls. This is quite good for 'Clav' type sounds.

It takes a bit of adjustment, but occasionally, you can achieve very nice subtle harmonics.

It's often best to start with a basic saw wave, by turning the Pulses low (or off) on the Mixer, then gradually add each pulse in turn. The tendency is to set everything on full, to instantly achieve that 'Phat' sound, and if truth be known, this is often what you do with the top end synthesizers anyway when playing bass lines.

9) The Mixer



Pulse 1 volume (0 to +)

Pulse 3 volume (0 to +)

Sub volume (0 to +)

This is -1 Octave to the fundamental saw. Adding this to the saw, and at 100% volume, makes the saw decrease by one octave.

Pulse 2 and Pulse 4 volume controls are a little different. The top centre is '0' volume. As you pan left, the volume increases, and the wave is inverted. As you pan right, the volume increases and the wave is not inverted. Inverted waves can give a different sound, or balance the wave a little to reduce signal clipping.

Saw/Square volume (0 to +)

Saw/Square selector switch.

10) The Modifiers

The modifiers are tailored more for bass and riff characteristics, without over complicating the sound or modifying the sound too much (to sound 'silly'). It must be remembered that the envelope controls are interactive, and slightly different to capacitor based envelope generators. The **Filter sustain** is semi-linear, so it quickly gets up to the highs, at the later part of the Pot turn. This is sort of useful in that the lower end is more subtle, and gives a better, less rapid, 'wow' effect when used on a sustained note or a sequence. There is a little interaction between the automatic filter control and the manual set point of the filter sustain. Sometimes it can jump to the automatic filter control if the change between the two is rapid enough (but it doesn't always happen) – this can be avoided by making slower manual changes or using longer notes. Over time, you will get used to the characteristics of the filter controls and their quirkiness (either limitation or advantages).

Amplifier ADSR

Amplifier **Attack**

Amplifier **Decay**

Amplifier **Sustain**

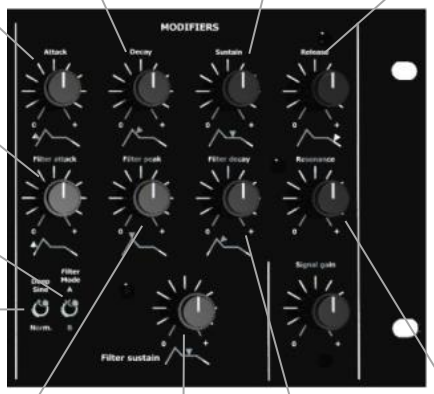
Amplifier **Release**

The Amplifier controls are subtle, but the one that would be used the most is the Amplifier decay, to adjust from a very tight cut-off on note release, to a reasonably long decay. It can sometimes add a little 'click' with a very tight decay (set to 0), because it can actually 'chop' the wave. This is solved by adding just a tiny bit of decay if you do come across a 'click' on deeper bass sounds.

Filter **Attack**

This switch changes the **Decay** characteristic of the filter.

With no notes pressed, this switch sets the filter to a low sine type wave, and disables any filter peak for deep 'lounge' type basses.



Filter **Peak**

This limits the attack to a given filter peak value, reducing or increasing the 'brightness' of the note at the attack phase.

Filter **Sustain**

Filter **Decay**

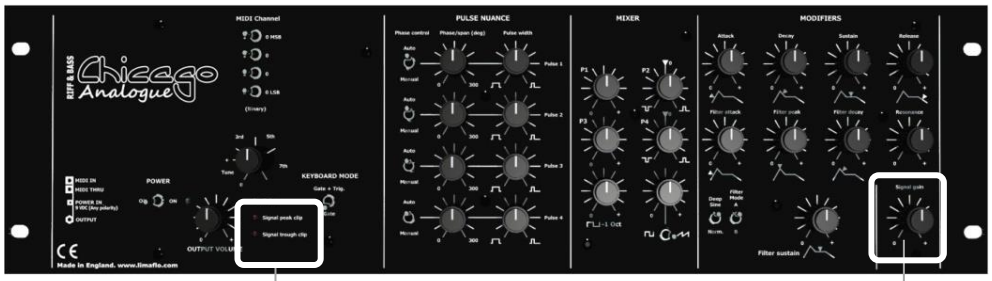
Filter **Resonance**

Filter APDS

11) Signal gain

If either, or both, of the Red clipping LED's are illuminating or glowing, then turn down the gain control and/ or you can reduce the volume controls on the mixer. The Resonance control also boosts the lower end, and this can lead to clipping too.

HOWEVER – clipping is distortion, and in certain settings or sounds, with everything turned up, it can be quite nice sounding. In essence, the gain control is an effect – but use it carefully (it can sound bad in some cases).

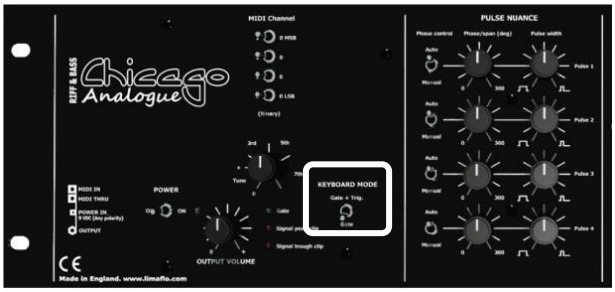


12) Keyboard Mode

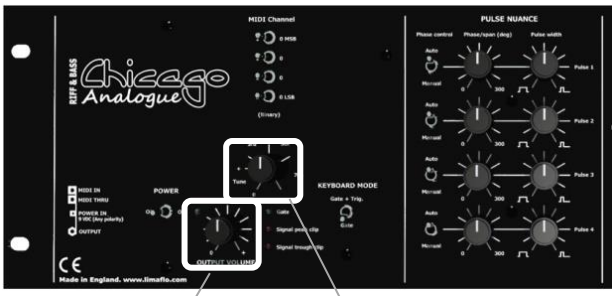
The Keyboard (or sequencer) can be played in two modes:

The first is **Gate Mode**. In gate mode, overlapped notes do not trigger the filter envelope.

The second mode is **Gate + Trigger Mode**. In Gate + trig. Mode, every note press, even with overlapped notes, will trigger the filter envelope.



13) Volume and tune



Master Volume control

Tune.

This can be used to detune the oscillator from 0 to + 60 Cents, which is useful when double tracking or if using two Chicago's' together. It is also possible to tune to a **Major 3rd** interval, **Perfect 4th** interval or **Perfect 5th** interval when using two Chicago's.

NOTE: The tune cannot be applied to a held or sustained note, the note has to be pressed first to activate any new tuning.

Cont.…

14) MIDI control from a DAW

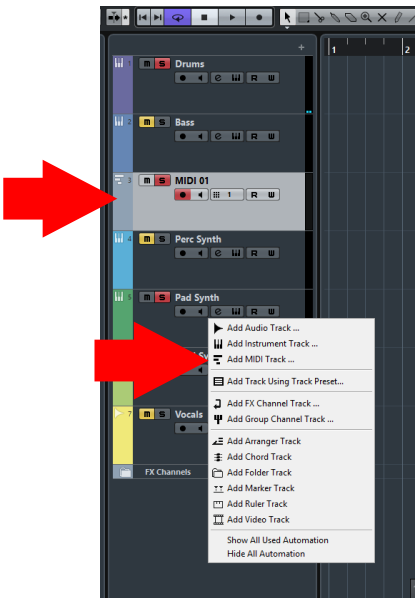
(Digital Audio Workstation)

For those who are thinking about using a MIDI sequencer, my preference would be Cubase, but other DAWs like Logic, Pro Tools, Cakewalk, Ableton, Reaper etc. are equally capable. I prefer Cubase because it's quite easy to set up and navigate around, and the Piano-Roll editor/composer and quantising is quite intuitive, giving the hardware sequencer users an alternative (but similar) way of composing. The Mix between Audio and MIDI is also great in Cubase, where they are treated the same right down to the Mixer and the Effects.

When using a DAW, the Chicago can be played using the integrated MIDI sequencer, or from your keyboard if you have one connected.

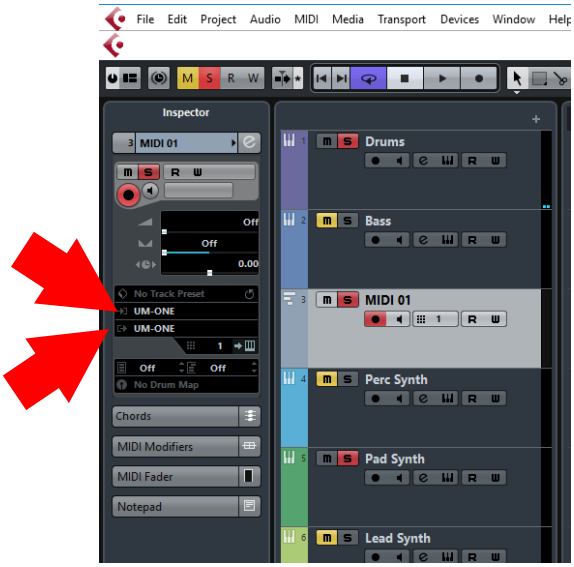
In this example, Cubase 8™ is used, and the Midi Interface is the Roland UM-ONE (this can be any Midi interface device you choose). Make sure it's plugged in before launching Cubase (or other DAWs).

To set up the UM-ONE and a Cubase Midi channel, first add a Midi Instrument Track:



Cont.…

Select Midi IN and OUT, in the Inspector column, using the UM-ONE: Midi IN is from the Keyboard, Midi OUT goes to the Chicago.



Select the Midi Chanel to correspond to the one set on the Chicago (this is exampled as Chanel 1) – see section 7. Make sure your Keyboard is also outputting Midi Chanel 1 and it is using the Classic Midi output (if also USB selectable).

To play the Chicago, you must select the Instrument Track (in this case it's titled MIDI 01).



NOTE: The Chicago has been tested with: Roland UM-ONE, SEQ24, Cubase 5 and 8. Yamaha Workstation (5-Pin Midi), ESI Keycontrol 25XT (5-Pin Midi), and Moog Sub 37 (5-Pin Midi). DAW Platform PC i7 64 bit with USB Midi.

EU regulation conformance

Health and the Environment

All component and metal casings are Lead-Free and Cadmium-Free.

The Low Voltage Directive

The device is operated under the Extra-Low-Voltage limits, so the Low-Voltage Directive will not apply. The Power supply will come under the Low Voltage Directive, but this item will not be supplied with this product. However, advice on selecting a suitable and conformant power supply is given.

EMC

There are no switching components or switch-mode circuits used, and the Microcontrollers are each decoupled with a 10uF electrolytic capacitor and a 100nF ceramic capacitor, where this is further blocked by the incoming Linear Regulator, which is Tantalum-capacitor decoupled. All trace designs and decoupling for each component is followed in accordance with the manufacturer's recommendations. The PCB comprises a digital and analogue ground-plain connected in a 'star' topology. Therefore radiated and conducted EMC is eliminated.

The Chicago Synths is not affected by an iPhone4 'updating' at a distance of 100 mm, whereas all other associated branded audio equipment, with CE marking, is affected at a distance of 300 mm. All other Radio signals will not affect the Chicago because the impedance path is very low and kept very short, assisted by PCB ground-planes.

Power Factor

The Chicago operates from a DC source, so there is no power phase shift. The PF is effectively 1. *Where the total power dissipated is 1W.*

Purpose

The Chicago is classified as a **'Musical Instrument'**, and normally sub-grouped with **'Synthesizers'**. It is intended to be used for recreation and entertainment, where its functionality is demonstrated through the various examples on the web site.

It is designed to be a high quality and reliable product when used in accordance to this instruction/operating manual.

END