**Quilcom SIM-GUQIN**



**Design**

A Guqin (pronounced “Koo-shin”) is a long Chinese zither instrument with a 3000 year old history. Many variations have been found, but the modern version has stabilised at 7 strings with the open strings tuned to the “Zheng Diao” pentatonic scale. To get notes pitched above the open strings, they are pressed onto the fingerboard below them, to reduce their length and thus raise the pitch when plucked with the other hand. There are no frets and this allows for sliding single notes and adding vibrato.

Alongside the lowest string there are white markers provided called Hui (pronounced “whey”) and these mark the integer harmonic points for frequency ratios from x2 to x8, but excluding x7. For the player these Hui provide reference points for the regular notes and if they want to sound a harmonic they press lightly on a string, aligned with a Hui, and lift the finger as it’s plucked (like on a regular guitar). The Hui are numbered traditionally from 1 to 13 and 7 is the centre one for one octave up. The harmonics are mirrored left to right since the Hui mark the relevant string vibration node peaks.

If you want to find out more about the instrument, look in the *Background info* folder.

**Playing**

There are lots of great videos on YouTube featuring amazingly skilled players. As you will see there’s a huge range of expression potentially available which would not be suitable for a MIDI keyboard to input. As such, the SIM-GUQIN is capable of simulating a subset of what a skilled player could achieve on a real instrument.

I won’t pretend this synthesiser is easy to play immediately but, like any instrument, a bit of practice helps. Also of course, automation and editing is your friend ;)

In the following details middle C is called C4:

The strings are played using the white keys from C3 to B3 (7 strings) and the keys are velocity sensitive.

There are various methods of changing the pitch, but in all cases the string keys need to be *held down* for them to be affected. If you just stab and release a string key there is no way to change its pitch. This is because there’s a synthesiser for each string but only one (of several) control system available at any time. So a pitch bend is directed to the string whose key is held down and no others. I carefully watched many performances and this simulates what players actually do; they bend only one string pitch at a time. Having said that, on this synth you can play and hold *chords* and bend all the held notes (bonus?).

At the top of the GUI is a long slider which allows you to shift the pitch of *all* the notes.

On the right side is a panel which allows you to bend/tune individual stings, leaving the others untouched.

The Pitch bend wheel on your MIDI keyboard can bend any *held* notes.

Finally, there is a pitch envelope which can bend any *held* notes when the sustain pedal is pressed. For this you have to have the pedal pressed *before* you play the string. The sustain pedal doesn’t affect the actual sustain of the strings.

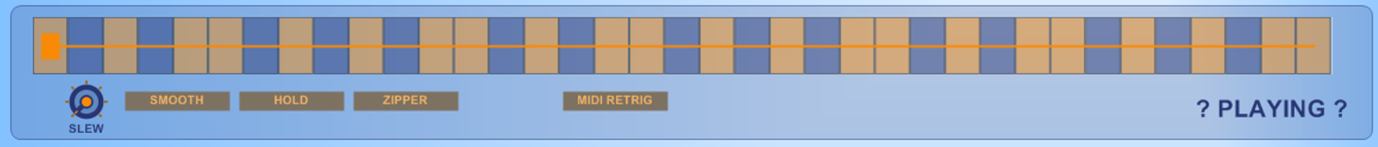
Vibrato can be applied to any held notes using the mouse or the automatic vibrato LFO which can be set to fade in after a note is held. When a string key is released the vibrato stops (like on a real one!).

The synth can play harmonics. For them to sound correctly ALL the sliders have to be fully down to the left, because the harmonics can only be played on *open* strings on a real Guqin.

To hear harmonics you use the white keys from C2 to B2. These keys correspond to *frequency* multiples from x2 for C2 up to x8 for B2. To get a harmonic for any string played you have to press the appropriate harmonic key *before* you strike the string key. This takes a bit of practice like it does on a real Guqin (but you can edit and automate it of course).

So now I’ll go into detail about the various panel controls and this will provide more guidance about playing etc.

**Big slider**



The big slider position offsets/bends the whole instrument so any string keys that are played will be tuned accordingly. If you want to change the pitch (bend) while a string is sounding you must *hold the string key down*. If you release the slider *while dragging*, the pitch will be frozen at that point.

The background keyboard guide covers 3 octaves and allows you to aim for the desired pitch offset. I based the keyboard guide on C, even though the actual notes could be anything. I figured this made it easier to aim for a fifth offset, for example, by going to the “G” on the guide. Irrespective of the string’s actual open tuning, it would go up by a fifth.

The most obvious way to use the big slider is with your mouse to drag it to the note you want. Wherever you click, the slider handle will jump to that point.

The **SLEW** knob adjusts the rate of change as you go from one position to another. It’s only useful while a string key is held down. At minimum the slew is fastest.

The **SMOOTH** switch can be switched to **CHROMATIC**.

**SMOOTH** means the transitions across the slider are continuous so could be used for mouse vibrato or micro-tuning.

**CHROMATIC** means the pitch offset will jump to the nearest semitone and this will guarantee accurate equal temperament intervals. Of course, if you use this with a longer slew rate, the slew will be smooth but always end up on the right note.

The **HOLD** switch can be switched to **SNAP BACK**.

**HOLD** means the slider will stay where you left it after releasing the mouse. This means it could transpose the seven strings to any key interval.

**SNAP BACK** will make the slider snap back fully left, so there’s no offset with the mouse off.

When **ZIPPER** is lit the movement of the big slider will allow a zipper sound to be heard, provided the Zipper level on the synthesiser panel is not set to zero (see later).

The big slider position can also be controlled by the MIDI keyboard. Keys from C4 up to C7 can chromatically shift the slider. This is probably easier than using the mouse, but obviously only exact semitone shifts will be possible.

If you turn the **MIDI RETRIG** switch ON, when you *hold down* a key string and play from C4 to C7 each press of a new (different) note will retrigger the string currently held down. If **MIDI RETRIG** is OFF you can change the pitch without re-triggering a note (to slide *after* plucking).

If you click on **? PLAYING ?** you’ll get a text reminder of the basics of playing the synth.

**7 sliders panel**



There are 2 functions on this panel: Open string tuning and individual string pitch offset (bend).

**Tuning:**

The 7 knobs down the left side set the open note for each string, and have a wide range to more-than accommodate many tuning schemes.

The iso standard is for Middle C to be labelled C4 but you can change the octave numbering with the **C [60] = C4** selector.

Any changes you make to the open tuning knobs will be stored in the song and/or preset if you save it. However, the **SCALE…** selector allows you to pre-load the range of scales as per the info available online. The selected scale is stored from the knobs and not this selector, so you could make a scale selection and change it afterwards. Because of this there is no readout of the chosen scale, since you may change it.

The **DEFAULT** button resets the scale to the standard Zheng Diao pentatonic.

**7 Sliders**

The 7 sliders represent the 7 strings. Number 1 refers to the lowest pitch which is furthest away from the player on a real Guqin. These sliders can only be operated by the mouse (no MIDI) but, of course, can be automated in the DAW.

The **1 OCT** selector allows you to change the range that the sliders will cover, and the keyboard guide will change to match your chosen range. You can choose from **FIFTH**, **1 OCT**, **2 OCT** and **3 OCT**.

The sliders operate in the same way as the big slider, but for each individual string. That means you can set up any tuning for the 7 strings individually.

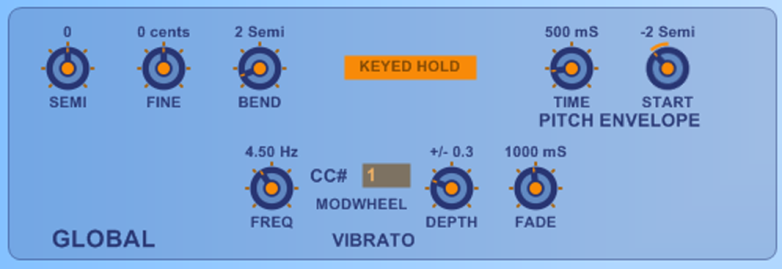
**CHROMATIC** steps in exact semitones but it can be switched to **SMOOTH** for continuous control.

**SLEW** sets the rate of change of pitch as you move the sliders.

**HOLD** keeps the current position when you release the mouse. It can be switched to **SNAP BACK** so it will return fully left when the mouse is released.

When a string key is pressed, the corresponding knob turns red and its slider briefly goes red. While a note is sounding the slider will be orange (even when the key is released). These two indications are to help you to adjust the correct slider or knob without checking the MIDI keyboard all the time.

**GLOBAL**



The **SEMI** and **FINE** knobs tune the whole instrument.

The **BEND** range relates to the pitch bend wheel. The pitch bend wheel will only affect a string key which is *held down*. This means you could have strings sounding, push the bend wheel up and then hold a new note and slide the pitch wheel back down to add very controllable expression to the bend. No other notes will be affected, only any held ones.

**KEYED HOLD** is an ON/OFF switch. I found it much more useful to be ON. In this mode the note is only bent when a key is held down, which is what I’ve described in all the text above. However, you can turn this OFF and then you can bend notes which are not held down but still sounding. So you have a choice at least!

Top right is the **PITCH ENVELOPE**. To create a pitch bend envelope you have to press the sustain pedal (or automate CC#64 in the DAW) *before* playing a string.

The **START** knob sets the initial pitch offset. So if it’s set to -2 Semi the bend will start 2 semitones down and bend *up* to the note.

The **TIME** knob sets the duration of the pitch bend. The bend **TIME** is independent of the bend range and is linear with respect to pitch (not frequency).

The lower central area is for the **VIBRATO** LFO. Of course vibrato can be made manually with the mouse or automation, but the LFO is more convenient.

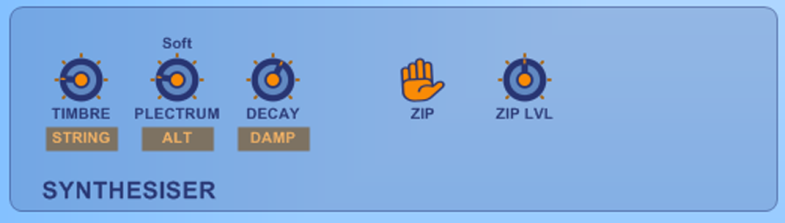
Vibrato can only happen to string when the string key is *held down*. When it’s released the vibrato stops.

The **FREQ** knob sets the speed of the LFO.

The **DEPTH** knob sets the maximum excursion of the vibrato range in semitones. You can enter a CC number if you wish to use any CC generator to control the depth in real time (or automated). Just type the number into the edit box and, if it’s a common one, the label will change to show it. Note that it’s possible to set CC64 which is normally for sustain. This means that if you trigger a pitch envelope with the sustain pedal you’ll also get vibrato (preset at half way). Vibrato **DEPTH** is determined by the last-touched control, so if you have CC#1 set and adjust the **DEPTH** knob, the knob will jump if you move the modwheel and the modwheel will then be in control.

It’s good if the vibrato doesn’t start the instant a note is held down. Normally a player will start vibrato after a short time. The **FADE** knob sets the fade-in rate for the vibrato when it’s started. It always stops very quickly when the note is released and waits for the next start-up.

**SYNTHESISER**



This panel adjusts the sound of the strings. It makes use of my zither engine, modified to suit the somewhat softer sound of a Guqin. The heart of the engine uses Karplus-Strong resonators made by Martin Vicanek which are significantly improved over more simple designs.

**TIMBRE** is a macro which adjusts several parameters to give a wide range of tone quality. Normally the **STRING** switch would be used for a Guqin, but it can be switched to **SYNTH** to give a much more synthetic sound for experimentation.

The **PLECTRUM** knob is a macro to simulate different plectrum hardness. In reality the Guqin is expected to be a soft-sounding solo instrument and is usually played with the fingers and nails rather than an actual plectrum. When playing rapidly on one note (“tremolo”) a player may flick the fingertip back and forth. This means that the hardness of the “plectrum” will alternate as the pluck changes between finger and nail. If you turn **ALT** ON, the hardness is subtly alternated for every pluck, back and forth between 2 values based on the knob’s setting.

The duration of the note is controlled by the **DECAY** knob and there is some interaction between the **DECAY** and **TIMBRE** settings. Also, higher pitched notes will decay more rapidly than lower pitched ones.

The **DAMP** switch damps all notes currently sounding by reducing the **DECAY** time significantly.

The sound I’ve called “zipper” or “zip” refers to the sound of wound strings when the finger slides over them. You hear this on regular guitars on the lower pitched wound strings. This sound can be generated by the sliders moving or by moving the **ZIP** “hand” knob back and forth. The speed of movement determines the pitch and volume of the sound. The **ZIP LVL** knob sets the maximum volume for the zip sound.

I’m a bit puzzled by comments saying that this zip sound is part of the musical performance and “traditionally” it’s often used in pieces. My puzzlement about this is that wound strings are a modern thing so can’t be “traditional” since, originally, silk was used to make the strings which surely wouldn’t have made the zipper sound. Go figure! So if you want the silk string sound, just turn the **ZIP LVL** to minimum.

**SOUNDBOX**



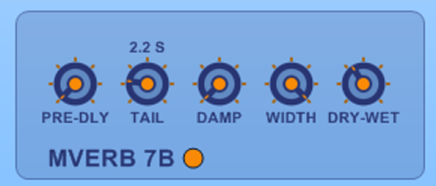
Like any acoustic string instrument, the vibration of the strings needs to be amplified and projected to be heard. The sound box also adds its own colour to the sound due to resonances that add to or subtract from elements of the spectrum produced by the strings. The **SOUNDBOX** effect DSP approximates this and has a wide adjustment range. You can turn it off and on with the Orange LED-switch so you can compare with and without the resonances.

The **SIZE** knob is an approximate simulation of the size of the instrument’s box, so a higher setting (bigger box) will give lower resonance frequencies.

The **RES** knob adjusts the height of peaks and troughs in the spectrum.

The **LEVEL** knob adjusts the amount of this resonance added to the dry signal. It’s *not* a wet-dry adjustment because in reality you would always hear the “dry” sound.

**Reverb**



The reverb uses the lovely **MVERB 7B** engine created by Martin Vicanek.

**PRE-DLY** sets a pre-delay time to simulate closeness in a reverberant space.

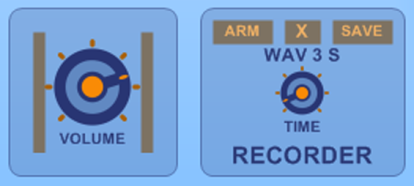
**TAIL** is the length of the decaying reverb tail and the time is T60 (the time taken to drop to -60dB).

**DAMP** simulates the damping of the higher frequencies to simulate a large but more absorbent space. When fully down there is no damping.

**WIDTH** sets the width of the stereo field created by the reverb.

**DRY-WET** sets the balance between the incoming (dry) sound and the reverb effect (wet).

**Volume and Recorder**



The master output **VOLUME** knob has 2 vertical bar graphs which indicate the average peak level left and right. If the signal goes even briefly above 0dBFS the inner ring turns red for 1 second to indicate clipping.

The **RECORDER** enables you to record and save wav files from what you play on the synth. The **TIME** can be set from 1 to 20 seconds. Click on **ARM** and the recording will start when you play your first note. The progress is indicated on a horizontal bar. Click on **SAVE** to store the wav file (stereo 44100 Hz 16 bit).

If you wish to cancel the recording click on the **X** button and the recording will be reset and cleared.

After saving a wav file please wait for several seconds before opening it because the creation and writing of the file isn’t instant.

**Preset manager**



I’ve provided a few presets to demo some sound variations and scales. They can be used as starting points to be tweaked as you wish. I don’t believe in making loads of presets which all sound pretty similar!

On the left side of the preset manager is the section where you select the preset by clicking on the preset name or paging though them using the arrow buttons. The synth is silenced when changing a preset to avoid unpleasant surprises!

The **MENU** selector is where you operate on presets and banks. You can save, load, copy or paste presets, or save and load a bank from this menu.

All changes made to any settings will be stored with the DAW song file unless the switch **UNLOCKED** is changed to **LOCKED**. This locking feature is to avoid losing settings if you just want to mess with editing but want to keep the original default parameters.

The **RENAME** button allows you to name or rename a preset providing the preset manager is **UNLOCKED**. Otherwise the **RENAME** button is dimmed.

On the right side is a free text area for adding comments to the preset. These comments are saved with the song, and the preset, if saved, providing the preset manager is **UNLOCKED**. Please be aware that you shouldn’t use a carriage return (Enter) in this text because the system won’t store any text after that. Also please be aware that when you **RENAME** a preset this text will clear, so if you want to keep it and just rename the preset, highlight the text, copy it then paste back in after you’ve renamed.