RE-303 CPU

SONIC-POTIONS

!!! PRELIMINARY DRAFT !!!

v 0.911

WORK IN PROGRESS

Intro

The RE-303 CPU was developed for the DinSync.info RE-303 replica.

The basic sequencer concept is the same as on the original 303. Pitch and Time information is stored independently. There are time steps that only hold **step**(note on) **tie** (note length) and **rest** (no note) information. The pitch steps store the note value, accent, slide and transpose information.

Quickstart

The random way

The fastest way to get some sounds out of your new CPU is to use the random pattern generator.

- Make sure you are in Pattern Write mode (rotary mode switch)

- Press `FUNCTION` to make sure you are in normal mode.

- Hold `CLEAR` and press the `ACCENT` button. A random pattern is generated.

- Press `RUN` and enjoy!

The manual way

- Make sure you are in Pattern Write mode (rotary mode switch)

- Hold `FUNCTION` and press `C2` to set the pattern length to 8 steps

- Press `PITCH` to enter pitch mode

- Use the `note buttons` to enter a few notes

- Press `TIME` to enter time mode

- Use the `DOWN`, `UP` and `ACCENT` buttons to set steps, ties and rests

- Hit `RUN` and enjoy!

Control scheme

The 303 has four modes:

- **Write Track** – edit and arrange tracks by chaining up to 64 patterns

- **Play Track** – play previously created tracks

- **Write Pattern** - create and edit patterns

- **Play Pattern** – play previously created patterns and modify them live

Each mode has multiple control layers that give the buttons and LEDs other functions. These are

- **Normal mode**

- **Pitch mode**

- **Time mode**

- **Clear mode**

- **Config mode**

These modes are accessed by pressing or holding the corresponding button. An in depth description of these control layers is given in the next chapters where we take a closer look at the four modes.

Pattern Write Mode

In this mode you create and edit patterns.

Auto Exit

In pitch and time mode the machine will automatically return to normal mode when the end of the pattern is reached.

Normal Mode

Normal mode is indicated by a lit normal mode LED. You can select the active pattern to edit using the 8 **PATTERN BUTTONS** and the A/B pattern section using the **ACCENT** and **SLIDE** buttons. This gives access to 16 patterns per pattern group.

When the sequencer is running a chaselight is shown on the pattern button LEDs.

Switching Patterns

The active pattern is indicated by a flashing LED. While the sequencer is stopped, pattern changes are instantaneous. If the sequencer is running, pattern changes are queued until the end of the bar. Queued Patterns are indicated by a constantly lit LED.

Pattern length

There are various ways to set the pattern length (1 to 16 Steps). Length is edited in **function mode**. This mode is active while the **FUNCTION** button is held down.

Here are the track length key combos:

Hold **FUNCTION** = show pattern length

FUNCTION + tap **DOWN** = tap pattern length (8xDOWN => pattern length 8) like on the original 303

FUNCTION + **note buttons** = set pattern length directly. white = 1-8/8-16 depending on C# or D#

FUNCTION + **BACK**/**NEXT** = decrease/increase pattern length one step at a time

FUNCTION + **ACCENT** = half pattern length

FUNCTION + **SLIDE** = double pattern length

Triplets

Triplet mode is used to create patterns in a 3/4 measure. In the normal 4/4 measure a complete bar has 16 steps with 6 clock pulses used for each step. The gate is on for 3 clocks and off for the other 3 clocks.

In triplet mode a bar has a **maximum of 12 steps** and uses 8 clock pulses for a step. The gate is on for the first 5 and off for the last 3 clock pulses of the step, so you get a different gate length and tempo compared to the 4/4 mode.

To turn triplet mode on or off press FUNCTION + UP

While the FUNCTION key is held, the UP LED will indicate if the triplet mode is active or not.

Pattern Chain

It is possible to chain up to 8 patterns from the same pattern group and section.
To create a chain:

- hold down the first pattern select button to select chain start

- Press the second pattern button to set the chain end.

All patterns in between will be played one after another. Chained pattern LEDs will light up, playing pattern LED will flash.

This also works for live recording mode! That is, you can chain up to 8 patterns to record a 8 bar pattern in one go.

Pattern Direction

The pattern playback direction can be changed and is saved with the pattern.

Use the UP and DOWN buttons In normal mode to set the playback direction:

- DOWN = backward, down LED lit

- UP = forward, up LED lit

- $\boxed{\text{UP}}$ + $\boxed{\text{DOWN}}$ = pingpong, up and down LED lit

- $\boxed{\text{DOWN}}$ + $\boxed{\text{UP}}$ = random, up and down LED blinking

Time Mode

Time mode is indicated by a lit time mode LED. Here you can edit the timing information of the pattern. The note LEDs will show the active step number and you can step forward an backward through the sequence with the $\boxed{\text{NEXT}}$ and $\boxed{\text{BACK}}$ buttons.

The down, up and accent LEDs will show the value of the active step and the respective buttons are used to change the value of a step.

Some notes on editing time sequences

The time sequence is composed of 3 basic values:

- **Step** ($\boxed{\text{DOWN}}$) – A note is played

- **Tie** ($\boxed{\text{UP}}$) – the previous note is sustained

- **Rest** ($\boxed{\text{ACCENT}}$) – silence/pause

It is important to remember the 303 sequencer concept of slit time and note information. You can think of it as 2 separate sequencers. One holding only the time information about active steps and note durations, the other holding only the note/pitch information.

Only when a **Step** value is set in the time sequencer, the pitch sequencer is advanced. Here is an example:

Time sequence	STEP	REST	REST	STEP	TIE
Pitch sequence	C	D	E	F	G

There are only two **STEP** events in the time sequence. On a classic step sequencer with combined pitch and time information you would expect that the two notes C and F would

play. But since the pitch sequencer on the 303 is only advanced on **STEP** events in the time sequencer, only the two notes C and D will play.

Active steps, ties and rests are placed like in a 'normal' 16 step sequencer grid.

Pitch mode

Pitch mode is indicated by a lit pitch mode LED. Here the pitch information of the pattern can be edited and note attributes (accent, slide and transpose) can be set.

The note buttons show the active step/position in the pattern.

> /* - Pitch mode LED lit
>
> * - steps indicate selected pitch of active steps
>
> * - accent, slide, up/down show active attributes
>
> */

Pitch, accent, slide and transpose are set in the pitch sequencer.

When the seq is stopped, entered notes are played.

Note entry

- Step buttons enter notes

- auto advance

- hold acc,slide,up/down while pressing note to add attributes

Note attributes

- hold next or back to show step information and step through the sequence

- pitch is shown on step buttons

- attributes are shown

- attributes can be toggled with their buttons

Live Recording Mode

- no mode led lit

- chaselight

Allows to record notes into the running sequencer either by playing the 303s note buttons or a MIDI controller.

To enter live recording mode press the **BACK** button while the sequencer is running in normal mode. To return to normal mode pres **BACK** or the **FUNCTION** button.

Recording with internal buttons

- record notes using note buttons

- add accented or transposed notes by holding acc/up/down before pressing note button

- slides are recorded by playing legato

Recording MIDI

MIDI can be used to input notes. A note on velocity above 65 plays an accented note. To add slides play 2 notes legato.

Classic 303 Tap Time Mode

The **TAP** button can be used to tap in time information (step and tie events)

live pitch mode

- Pitch led lit

- chaselight

- accent slide up down

-

- hold pitch -> live pitch mode

- acc/slide/up/down can be toggled and viewed via the buttons

Chain Recording

If a pattern chain is activated before entering live recording mode, sequences up to 8 patterns (128 Steps) can be recorded in realtime.

Clear Mode

Clear mode is active while the **CLEAR** button is held.

Pattern Randomizer

A random pattern can be generated in the current active slot.

CLEAR + ACCENT   = randomize all

CLEAR + TIME + ACCENT   = randomize time

CLEAR + PITCH + ACCENT   = randomize pitch

Forcing random patterns to a scale

The random patterns generated can be forced to major and minor scales. To select the scale, enter the randomizer config page by holding the FUNCTION key and then pressing the PITCH key. The function and pitch LED will light up while the config page is active.

You can now select if you want a major or minor scale with the UP and DOWN buttons.

UP = Major

DOWN = Minor

The corresponding LED on the buttons will show which mode is currently active.

The 12 NOTE BUTTONS select the base note. The note LEDs will show the currently selected base note.

The SLIDE button is used to turn the force to scale function on and off. If the slide LED is lit, the scale function is active.

Here is an example how to limit the pattern randomizer to F-Minor scales

- Hold down **FUNCTION** and press **PITCH** to enter config page

- check if force to scale is active (slide LED lit)

- if not press **SLIDE** to activate it

- select MINOR by pressing the **DOWN** button.

- Down LED lights up to indicate the selected minor mode

- press the **F** button on the internal keyboard to select the base note F.

- All generated patterns are now forced to F-Minor

To turn the foce to scale function off again, enter the config pasge and press the **SLIDE** button, so the LED is off again. Patterns will now be generated completely random again.

Clear Pattern

To clear pitch and time information on the selected pattern, press **CLEAR** + **PATTERN**

Press **CLEAR** + **TIME** + **PATTERN** to only delete the time information.

Press **CLEAR** + **PITCH** + **PATTERN** to only delete the time information.

Pattern Copy/Paste

A Pattern can be copied to another slot.

CLEAR + **C#** + **PATTERN** copies the pattern data from the selected pattern slot.

CLEAR + **D#** + **PATTERN** pastes the previously copied data to the selected pattern slot.

CLEAR + **D#** + **Pitch** + **PATTERN** = paste pitch info

CLEAR + **D#** + **Time** + **PATTERN** = paste time info

Rotate Pattern Steps

`CLEAR` + `UP` = rotate all right

`CLEAR` + `DOWN` = rotate all left

`CLEAR` + `PITCH` + `UP` = rotate pitch right

`CLEAR` + `PITCH` + `DOWN` = rotate pitch left

`CLEAR` + `TIME` + `UP` = rotate time right

`CLEAR` + `TIME` + `DOWN` = rotate time left

Pattern Play Mode

Normal Mode

/* - Normal Mode LED lit

* - white notes show playing pattern (blinking)

* - light next pattern/chain

- pattern section

*/

Pitch Mode

- led pitch

- steps = transpose

- acc, slide up down

AllAccent + AllSlide

Pitch + **acc** = allAccent

Pitch + **Slide** = All Slide

Transpose pattern up/down

Pitch + **up** = transpose octave down

Pitch + **down** = transpose oct up

Pitch + **Note buttons** = transpose semitones

Pattern Chain

hold down first white note/pattern button to select chain start

then press 2nd white note/pattern button to select chain end.

All patterns in between will be played after one another

Chained pattern LEDs will light up, playing pattern will blink

Track Write Mode

Normal Mode

- next/back select track step to edit

- note buttons select assigned pattern

- acc/slide select pattern section A/B

- pattern chains can be assigned by holding 1st pattern button and pressing a 2nd one

Pitch Mode

Hold pitch -> pitch mode

- note buttons = semitone transpose (track step transpose, independent of pattern transpose value)

- up/down => octave transpose

Time Mode

Hold Time => time mode

- leds show track step repeats (1-16)

- last step indicator => ACC,SLIDE;UP,DOWN lit

- next/back inc/dec repeats

- down = 1 repeat, up=2, acc=4, slide=8

- time + clear = set current step as last step

- note buttons select repeats (white notes 1-8, black notes = range 1-8 or 9-16)

Clear Mode

Clear Track

- clear + next, then back = clear track

Copying tracks

- C# -> track copy

- D# -> track paste

Track Play Mode

############## Track Play ##################

- leds show playing/active pattern

- hold tap/next => show playing track step (realtime update)

- tap+back -> restart track

hold pitch -> pitch mode

- all accent, all slide

- LEDs show current transpose value (realtime update)

hold time -> time mode

- leds show repeats (realtime update)

- leds show playing/active pattern

- hold tap/next => show playing track step (realtime update)

- tap+back -> restart track

Pitch Mode

Pitch mode is active while the **PITCH** button is held down.

- all accent, all slide

- LEDs show current transpose value (realtime update)

Time Mode

hold time -> time mode

- leds show repeats (realtime update)

MIDI control

While the sequencer is stopped the 303 can be played via MIDI note messages.

Accent

If the MIDI note on velocity >= 65 the note is played accented.

Slide

Legato play of 2 notes causes a slide

SysEx

Pattern SysEx dump

A pattern can be send and received via SysEx to make backups on a computer or sequencer. If a SysEx dump is **received while in pattern write mode**, the data will be written to the currently active pattern. A pattern SysEx dump always sends the currently active pattern.

To send out a pattern SysEx dump goto **Pattern write mode**, hold down the CLEAR button and press F# . The pattern data will be send out via the out jack.

`CLEAR` + `F#` while in Pattern Write Mode = send pattern SysEx dump

Track SysEx dump

Single tracks can be saved and restored via SysEx, too. Similar to the pattern dump above, goto **Track Write Mode**, hold down `CLEAR` and push `G#` to send out the active track. If a SysEx track dump is received **while in Track Write Mode**, it will be written to the currently active track.

`CLEAR` + `G#` while in Track Write Mode = send Track SysEx dump

Bulk SysEx dump

To backup the complete memory of the machine, you can send and receive SysEx Bulk Dumps. Go either to **Track or Pattern Write Mode and press** `CLEAR` + `A#` to send out a bulk dump.

A bulk dump received while in either Pattern or Track write mode will overwrite the complete memory of the machine (track and pattern data in all banks).

A note on saving received SysEx dumps

A received dump will first be written to the temporary memory of the machine and will not be written to the internal RAM until the sequencer is stopped. So if you receive a dump, you have to start and stop the sequencer to write it to non volatile memory.

If you've overwritten some data by accident, you can turn off the machine without stopping the sequencer to restore the previous memory content.

Config Mode

`FUNCTION` + `CLEAR` => config mode

The config is saved when leaving config page (press function button again to leave)

MIDI Channel

`DOWN` = MIDI Rx channel can be selected with next/back keys. channel displayed on LEDs

`UP` = MIDI TX channel can be selected with next/back keys. channel displayed on LEDs

MIDI Rx

`C` = MIDI RX on/off

MIDI Sync Rx

`D` = MIDI sync rx on/off

MIDI Tx

`E` = MIDI Tx On/off

Timing

`F` = Internal timing

on = Original Mode

delayed gate offs

off = tight mode

Gate on/off completely same length (3 clocks on, 3 off)

Saving data

Pattern and track data is auto saved whenever the sequencer is stopped and automatically loaded on power on.

Firmware Update

The firmware can be updated via MIDI SysEx. To update the firmware:

- hold **CLEAR** while powering up

- the first 4 step LEDs will light up

- The unit is now ready to receive firmware via sysex

- While the data is transmitted the progress is shown on the step LEDs.

- Once the update is done the machine will reboot and the new firmware is ready to use

MIDI implementation chart

Manufacturer: Sonic Potions	Model: Re-303 CPU	Version: 1.0	Date: 01.16.2017	
		Transmit/Export	Recognize/Import	Remarks
1. Basic information				
MIDI channels		1-16	1-16	
Note numbers			0-63	Tx range?
Program change		N	N	
Bank select response? (Yes/No) If yes, list banks utilized in remarks column		N	N	
Modes supported:	Mode 1: Omni-On, Poly (Yes/No)			
	Mode 2: Omni-On, Mono (Yes/No)			
	Mode 3: Omni-Off, Poly (Yes/No)			
	Mode 4: Omni-Off, Mono (Yes/No)			

	Multi Mode (Yes/No)			
Note-On Velocity (Yes/No)		Y	Y	Only used for accent.
Note-Off Velocity (Yes/No)				
Channel Aftertouch (Yes/No)				
Poly (Key) Aftertouch (Yes/No)				
Pitch Bend (Yes/No)				
Active Sensing (Yes/No)				
System Reset (Yes/No)				
Tune Request (Yes/No)				
Universal System Exclusive:	Sample Dump Standard (Yes/No)			
	Device Inquiry (Yes/No)			
	File Dump (Yes/No)	Y	Y	
	MIDI Tuning (Yes/No)			
	Master Volume (Yes/No)			
	Master Balance (Yes/No)			
	Notation Information (Yes/No)			
	Turn GM1 System On (Yes/No)			
	Turn GM2 System On (Yes/No)			
	Turn GM System Off (Yes/No)			
	DLS-1 (Yes/No)			
	File Reference (Yes/No)			
	Controller			

Destination (Yes/No)		
Key-based Instrument Ctrl (Yes/No)		
Master Fine/Coarse Tune (Yes/No)		
Other Universal System Exclusive		
Manufacturer or Non-Commercial System Exclusive	Y	Y
NRPNs (Yes/No)	N	N
RPN 00 (Pitch Bend Sensitivity) (Yes/No)		
RPN 01 (Channel Fine Tune) (Yes/No)		
RPN 02 (Channel Coarse Tune) (Yes/No)		
RPN 03 (Tuning Program Select) (Yes/No)		
RPN 04 (Tuning Bank Select) (Yes/No)		
RPN 05 (Modulation Depth Range) (Yes/No)		
2. MIDI Timing and Synchronization		
MIDI Clock (Yes/No)	Y	Y
Song Position Pointer (Yes/No)	Y	Y
Song Select (Yes/No)		
Start (Yes/No)	Y	Y
Continue (Yes/No)	Y	Y
Stop (Yes/No)	Y	Y
MIDI Time Code (Yes/No)		
MIDI Machine Control (Yes/No)		
MIDI Show Control (Yes/No) If yes, MSC Level supporte		
3. Extensions Compatibility		

| General MIDI compatible? (Level(s)/No) |
| Is GM default power-up mode? (Level/No) |
| DLS compatible? (Levels(s)/No) |
| (DLS File Type(s)/No) |
| Standard MIDI Files (Type(s)/No) |
| XMF Files (Type(s)/No) |
| SP-MIDI compatible? (Yes/No) |