SQ-3P - Users Manual

!!! PRE RELEASE DRAFT !!!
Firmware Version 1.10
VMC-1 Hardware Version 1.5.4

"**SQ-3P**" is a programm for an Arduino Nano mounted on a "**fanwander VMC-1**". The SQ-3P is a MIDI step sequencer which can be triggered by external positive voltage trigger signals or by an internal clock. The basic idea comes from the sequencer, which was implement in the Roland® Synthesizer JX-3P.

Usually you will buy a fanwander VMC-1 with the software installed already. If your VMC-1 runs a different software at the moment, then please consult the manual of the VMC-1 on how to install software.

Quickstart...

...for those, who think they don't need manuals:

- The function of the five buttons

	PLAY	STOP	WRITE	F1	F2
Stop Mode	Play		Write	Enter Setup	
				MIDI-Reset	(Transpose)
Play Mode	Mute/ Continue on 1	Stop	Gate-Mode	Enter Setup	
				MIDI-Reset	Transpose
Write Mode	End & Play	End & Stop	Back	Tie	Rest
	Setup Mode				
Select Param	Exit Setup		Edit	< Parameter >	
Set Param			Set	-- Value ++	

- Good Luck :-)

Now more details for the patient ones...

Connect and Configure the Hardware

This is described also in the manual of the VMC-1, but we will repeat it here, so you don't have to switch between the two manuals.

MIDI connections

Basically you need a device which sends MIDI-notes (I will call this "the keyboard") and a device which can create sounds from MIDI-notes (I will call this "the synth"). I will not explain how to connect MIDI devices. So establish the following MIDI connections
`Keyboard-MIDI-Out <-> SQ-3P-MIDI-In`,
and
`SQ-3P MIDI-Out <-> Synth-MIDI-In.`

To test with the factory settings of the SQ-3P, set keyboard and synth to MIDI channel “1”.
For other settings please consult the description of the “setup menu”.

Press PLAY. The sequencer should play on the synth a C-major scale and you should be able to play the synth on the keyboard along with the sequence.

If the sequencer plays other notes than the major scale then please to a "Factory Reset" as described in the section "setup menu".
You may also check the instruction for "Adjust Poti-CVs" in the section "setup menu".

Write Mode

Writing a sequence in the SQ-3P - Basics

We assume you can play the default sequence successfully and your keyboard plays notes on the synth.

- If the sequencer is running hit the STOP button (you cannot change to WRITE from the PLAY mode).
- Hit the WRITE button.
  => the display says “WRITE” (who would guess...)
- Play a few single notes on your keyboard. Be sure not to overlap notes.
  => you should see on the display the counter in the upper line count up with each note. Also you should see a “+”-character for each step in the lower line.
- Hit STOP and then PLAY.
  => the SQ-3P will play the notes that you've entered before.

The WRITE-mode ends either if you hit STOP or PLAY or it ends automatically if you reach the limit of 64 notes.

The sequencer can store up to 64 steps and 6 notes per step. A step is finally written, when all keys of your keyboard are released (or more technically spoken: when noteOffs have been received for all noteOns of this step). This means, there are several methods to enter a chord.

- Play the chord on the keyboard as a piano player would do
- Press and hold(!) the key for one note of the chord with one finger; then press with another finger (of the other hand) the other notes of the chord one after the other. Then release the held note. The following example will enter a Cmaj7 chord:
  ```
  Right Hand: ....E...G..H.....
  Left Hand:  ..C----------....
  ```
- This way you may enter chords which spread over the full keyboard range, which a pianist never could play with two hands.
- Play the chord broken, but legato. Again a Cmaj7 as example:
  ```
  .........H----.
  .......G----...
  ....E----......
  ..C---.........
  ```

Writing will store a sequence only in the runtime memory. The sequence will be lost after a powering off or reset as it happens after uploading a new firmware.

To store the sequence permanently on the EEPROM you have to use the functions SAVE and LOAD in the setup menu. If you want to use this Arduino board for other applications please obey the remarks in the chapter about -> setup -> save/store.

Write Mode extended - tied notes and rests

Lets write now a four note phrase.
Select an organ like sound at your synth. Take care, that there is no long “Release” on the sound.

- Press WRITE
- Play Key C
- Press F2 (=REST)
- Play Key C
- Press F1 (=TIE)
- Press STOP

Already while writing the steps, on the lower line of the display appeared a “+” (plus) for each key, a “-” (dash) for each F1/TIE and a “.” (dot) for each F2/REST.

- Press PLAY

The sequence will play something like “Dap, Daaaah, Dap, Daaah,....”
Do the same with `A.A-C.C-A.A-E-G-` and sing “Fly, Robin, Fly”.

Write Mode extended - Correcting Steps

There is no real editing of a sequence for now (it may be possible in a later firmware version), but while writing you can step back by hitting the WRITE button for each step back. Example:
We want to enter a Cmaj scale, but hit G# instead of G:

- WRITE
- C
- D
- E
- F
- G#
- A ... Aaargh, Hold it! The G# was wrong...
- WRITE (will step back and clear the A)
- WRITE (will step back and clear the G#)
- G
- A
- B
- C
- STOP
- PLAY

Check the step counter and the “+++...”-step-display-line while stepping back.
I think you 've got it.

Write Mode extended - Cancel Write!

Sometimes it happens (at least to me), that you press WRITE, though you did not want to write a new sequence. In this moment you have the chance to cancel the write-mode (and keep the existing sequence), by pressing WRITE again. But it is important, that no MIDI-NoteOn came in meanwhile and that you did not hit TIE, REST, PLAY, or STOP. As soon as one event happens, that the write-mode would record, the former sequence is gone.
By the way: it is not possible to enter the write-mode while playing or while the setup. So the chance for this problem is quite low.

Play Mode

Playing a written sequence is simple: hit PLAY. The sequence will play in the tempo of the tempo potentiometer and with the blinking LED. (The LED blinks always - even when the sequence is stopped). Hit STOP to end the play mode.

Play Mode - set Tempo

The SQ-3P provides an internal clock generator. The tempo-knob controls the speed of the clock. This clock generator is software generated and may become slower if the processor has more tasks to handle. This is for sure while the setup mode and while the save action. For a stable tempo use an external trigger (see below).

Play Mode extended - Thru and Transpose

While the sequence is playing, MIDI information from the keyboard may be forwarded to the output (so called Soft-Thru); depending on the setup-settings the synth will play the notes from the keyboard. The SQ-3P provides various thru-settings. For details see the setup section.

The SQ-3P also provides the possibility to transpose the played sequence according to the incoming keyboard notes. There are three different types of TRANSPOSE. For details see the setup section.

Play Mode extended - external Trigger-In

This is the topic, where the SQ-3P is different to all other MIDI step sequencers, we know.
Please read now first at the chapter “Setup Mode” about the two different NoteOff modes

You may replace the internal tempo clock, by an external trigger signal fed to the CLOCK-IN socket. To speak more exact: this is handled as a GATE signal. The input expects a voltage of +5 Volt (=gate on) or 0 Volt (=gate off).
If the input rises from 0V to +5V the MIDI noteOn messages for the notes in the actual step are sent.
If the input falls down from +5V to 0V the MIDI noteOff messages for the notes in the actual step are sent.
This means the length of the incoming “trigger gate” determines the length of the played note.
(The gate signal may be higher than 5V, but gate off has to be 0 Volts)

What is that good for?

Example 1:
Have a drum machine like Roland TR-808 that sends continuous 5V-clocks.

- Connect the clock out of the drum machine with the CLOCK-IN of the SQ-3P.
- Press PLAY on the SQ-3P (the sequence will not play yet!)
- Start the drum machine

=> The SQ-3P will play in the tempo of the drum machine.

Example 2:

- Have a drum machine with progammable trigger out, like the Roland TR-606 or Roland TR-08 or many others.
- In the Setup reassure, that the “Note Off Mode” is set to “Held Note” (this is the default value from the factory - if you didn't change it until now, then go on)
- Write a sequence of four chords (each column represents a chord):
  ```
  G  G  G  G
  E  F  E  F
  D  C  D  D
  C  A  C  G
  ```
- In the drum machine set a trigger at the first step of a bar, but none on the other steps in the bar
- Hit PLAY at the SQ-3P and start the drum machine

=> The SQ-3P will play a four bar sequence, with changing chords at every bar.
If you would try this with a regular internal 16th clock, you would need all 64 steps using the TIE function. Having the externally programmed trigger on step one, you have to enter only four steps.

Example 3:

- Have a drum machine with programmable trigger out, like the Roland TR-606 or Roland TR-08 or many others.
- Write a sequence of four single notes:
  `D E G A`
- In the drum machine set triggers at the following positions of a 4/4 pattern
  `x.x.xx.x.xx.x.x.` (**x** means a trigger, dot means no trigger)
- Hit PLAY at the SQ-3P and start the drum machine

=> The SQ-3P will play a sequence which will repeat not before 9 bars.
Now change the sequence to “D” “E” “REST” “G” “A” “REST” => I think you will get it.

Mute sequenced MIDI while playing

If the sequencer is playing and you press PLAY again, then the MIDI-Out will be muted. No NoteOn messages will be sent from the sequence. MIDI NoteThru will still work. The “PLAY” in the top line of the display will change to “play” but you will see in the second display line, that the sequence continues running.
As soon as you press PLAY again, the display will change to “plAY” and beginning with the next step 1 of the sequence the NoteOn messages will be sent again (and the display will change back to “PLAY”).
Keep in mind: if your sequencer/trigger-combination is like in the “example 3” described abovem then the next step 1 of the sequence may not be the start of the next bar!
If you press PLAY again while the display shows “plAY” then the sequence will be unmuted immediately.

The muting will not affect the MIDI events provided by the MIDI-Thru functions!

Velocity Control

The velocity of the notes sent by the sequencer is always fix, because the sequencer does not record the velocity value of the incoming notes. The velocity value of the outgoing note messages is set by the rotary potentiometer CV1. If you feed a voltage to the input CV1, then the velocity will depend on the voltage fed here. The potentiometer will set the amount of this voltage.

Note Length Control

The length of the played notes depends on the setting of the parameter NOTEOFF-MODE (please see section “Setup”). If the NoteOff-Mode is set to “Gated CV-ctrl”, you may control the length of a (not tied) note by the rotary potentiometer CV2. If you feed a voltage to the input CV2, then the note length will depend on the voltage fed here. The potentiometer will set its amount

Shut up mode :-)

Under certain cirumstances it may happen that the synth produces “hanging” notes - even if the sequencer is stopped. To cancel these notes in play mode or stop mode simply press F1/TIE. This will send NoteOff messages for all 128 Notes and the All Notes Off CC on the selected MIDI-out channel.
Pressing STOP usually sends also NoteOff messages for all 128 Notes.

Setup Mode

In the setup mode you configure the general behaviour of the SQ-3P. You can enter the setup mode in play mode or in stop mode. In write mode the setup is not available.

- To enter the setup menu press F1 and F2 together.
- The display will change and list the actual parameter in the upper line. The lower line will display the actual value of the parameter.
- To page through the parameters use F2 for “next” and F1 for “previous”. The setup starts always with “transpose mode”. For save or load sequence you may use “previous”-function; for the note modes and channel settings you may use the “next”-function. You may step through all parameters in a circle in the both directions.
- To change the value of a parameter press WRITE.
  => An exclamation mark (“!”) will appear at the start of the lower line.
- Change the value with F1 (=decrease) and F2 (=increase)
- Press WRITE again.
  => the value will be stored in the non volatile memory and the “!” disappears.
- To leave the setup menu press PLAY and STOP together.

If you have entered the setup mode while the sequence was playing, the sequence will continue playing, but you cannot stop it in setup mode. You have to leave the setup mode to stop a playing sequence.
Since the internal clock is software created and the setup mode eats up a lot of processing, the internal clock will assumingly become a little slower.

List of the available Parameters:

- "Transpose": switches between various transpose modes and off.
- "Noteoff Mode": switches between a gated note length and notelength until the next step.
- "Note Length": sets a minimum note length for the gated NoteOff mode.
- "Out-Channel": sets the MIDI channel on which the SQ-3P sends its sequence.
- "In-Channel": sets the MIDI channel on which the SQ-3P expects incoming note data.
- "Note-Thru": determines under which conditions incoming notes from the keyboard are forwarded to the synth.
- "Control-Thru": sets whether incoming MIDI-ControlChange data are forwarded to the synth.
- "Program-Thru": sets whether incoming MIDI-ProgramChange data are forwarded to the synth.
- "Bend-Thru": sets whether incoming MIDI-Pitchbend data are forwarded to the synth.
- "OtherCh-Thru": sets whether MIDI-data on other channels than the out channel are forwarded to the MIDI out.
- "Adjust Poti-CVs": adopts the software for the real potentiometer values
- "Factory Reset": restores to the default parameter values and loads the test sequence
- "SaveSequence": saves the actual sequence in the EEPROM
- "LoadSequence": loads the sequence from the EEPROM

Now the detailled desciption of the parameters

Transpose Mode

Transpose shifts the played sequence. Incoming noteOns on the selected MIDI-channel will shift the played sequence corresponding.
C5 (MIDI NoteNumber 60) corresponds to no transpose. MIDI NoteNumber 62 = D5 will shift the sequence a full note up, MIDI NoteNumber 53 = F4 will shift a quint down.
If a transpose shift is effective its amount will be displayed in play mode and stop mode.

Transpose does NOT affect the notes played manually via MIDI thru, and never affects the notes written in the memory - it is only a playback function. Transpose is not active for the Thru-Notes in write mode.

Value	Comment
`off`	No transpose.
`Continous`	All incoming MIDI NoteOn events are used for the transposition. MIDI Thru is deactivated in this transpose mode.
`Momentary`	The sequence is transposed only as long as the transposing key on the keyboard is pressed. MIDI Thru is deactivated in this transpose mode.
`ButtonEnabled` (Factory Default)	While play mode press the REST button and play a key on your keyboard to set the transposition. As soon as you release the REST button this transpose value is kept and incoming MIDI Note events are used for MIDI Thru. Only the sequence will be transposed. The MIDI Thru events will not be changed. This mode corresponds to the transpose mode of the Roland JX-3P or Juno-Series.

Noteoff Mode

The noteOff mode selects, what determines the outgoing noteOff.

Value	Comment
`Held Note` (Factory Default)	The noteOff is sent immediately before the next step. This mode is the same as in the Roland JX-3P or SH-101. This mode is required for the chord progression trick described in “Example 2” in the section “What is it good for". Please keep in mind that stopping an external clock source in this mode without stopping the SQ-3P sequence will cause the last note to “hang”. Press STOP on the SQ-3P then.
`Gated fix`	The noteOff is sent when the incoming clock signal goes from +5V to 0V. With the internal clock this is at 50% off the step time. The noteOff can be delayed by a fix number of milliseconds (See also parameter “Note length”)
`Gated CV-ctrl`	The time until the noteOff is sent is determined by the value provided by CV2 If a voltage is provided to input CV2, this voltage will control the notelength. In this case the potentiometer CV2 controls the amount of this voltage. While play-mode this setup page can be reached directly by pressing the WRITE button.

Note Length

Some clock sources e.g. drum machines send extremely short trigger pulses. This may cause trouble with some sounds. To avoid this a minimum note length can be defined

Value	Comment
`1 - 240 milliseconds` (Factory Default 30ms)	Between 1ms and 20ms changed in 1ms steps. Between 20ms and 240ms changed in 10ms steps. Attention: large values at fast clock speeds will make the sequence stumble, because the noteOff is delayed after the next incoming clock pulse.

Out Channel

The MIDI-channel on which the sequence and thru'ed Program/Control/Bend-data are sent out.

Value	Comment
`1 - 16` (Factory Default = 1)	Pay attention if you are in playmode: Changing the Channel while the sequence is playing or thru'ed notes are active will cause note hangs. In some special cases this may be wanted behaviour, so we did not prevent this. To end these hangs while play mode switch back to the former channel, leave the setup mode and press TIE (the sequence will play on) or STOP (the sequence will stop).

In Channel

The MIDI-channel on which the SQ-3P expects the data, that shall be written into the sequence.

Value	Comment
`0 = Out-Channel` (Factory Default)	Incoming MIDI data on the in-channel will be sent out on the out-channel. This is valid also for control, programchange, and pitchbend data! It is recommended to deactivate OtherChannelThru if in-channel and out-channel are different.
or `1 - 16`	The main intention for this feature is that you may have a single keyboard, but several SQ-3Ps (or similar devices) in the thru chain. In that case you don't have to change the send channel on your keyboard, but simply use the out-channel on the SQ-3P. Otherwise we recommend to set the In-Channel the same as the Out-Channel.

Note Thru

This parameter determines under which condition note messages from the keyboard (= on the in-channel) are forwarded to the synth (= on the out-channel).

Value	Comment
`Off`	Incoming note data are not forwarded.
`Rec`	Incoming data will be forwarded while writing the sequence, but not while play or stop.
`Play`	Incoming data will be forwarded while playing the sequence or stop, but not while writing the sequence. This mode may be useful for using the SQ-3P live on stage. You may enter the sequence unheard, without the need to mute the synth.
`Rec+Play` (Factory Default)	Incoming data will be forwarded all the time.
`Play-Triggered`	This is an experimental mode, coming with version 1.1x: Incoming notes will be forwarded normally while recording and while stop-mode. In play-mode the incoming notes will be played in the same rhythm as the sequence. In detail the play-mode works like this: The original NoteOn is forwarded. If a NoteOff is sent for the sequence, also a NoteOff is sent for the incoming held notes. If the incoming note is still active (no NoteOff has been received) then a NoteOn for the sequence will redo a NoteOn for the incoming note. If a NoteOff is coming in, it will not(!) be sent to the output immediately. It will be sent with the next NoteOff from the sequence.

Control-Thru

Determines whether MIDI controlchange data from the keyboard (= in-channel) are forwarded to the synth (=out-channel)

Value	Comment
`On` (Factory Default)	see general comment regarding the thru modes below
`Off`	

Program-Thru

Determines whether MIDI Programchange data from the keyboard (= in-channel) are forwarded to the synth (=out-channel)

Value	Comment
`On`	see general comment regarding the thru modes below
`Off` (Factory Default)	

Bend-Thru

Determines whether MIDI controlchange data from the keyboard (= in-channel) are forwarded to the synth (=out-channel)

Value	Comment
`On` (Factory Default)	see general comment regarding the thru modes below
`Off`	

!!! Important Remark on Thru-Modes !!!

If you use the same device as keyboard and as synth then all those Thru-settings depend on your instrument.
If the instrument has a local-off mode, then you should activate this local-off mode and you should set all Thru-settings to “On” and the NoteThru not to “On”. For example my Rhodes Chroma Polaris in local off mode needs ControlThru and BendThru set to “On”. Otherwise the Chroma Polaris could not be edited. But ProgramThru has to be set to “Off”. Otherwise a MIDI-Loop on program change commands would happen and bring the whole MIDI-system to hang.
If the instrument has not(!) a local-off mode then you MUST set all Thru-settings to “Off”. Otherwise you would create an endless MIDI-loop which typically makes all processors overload and leave the system in unusable state, which typically can be solved only by switch off both the synth and the SQ-3P. The same is valid if you use the SQ-3P at the input and output of a MIDI-Sequencer like Logic, Cubase, Ableton, Reaper, what ever…

OtherCh-Thru

Determines whether incoming MIDI data (no matter which type) in channels other than the out-channel are forwarded to the output.

Value	Comment
`On`	A high MIDI traffic on other channels will affect the performance of the SQ-3P since every data byte has to be handle by the processor. It even may cause the sequence to stutter or to stop. (Imagine an orchestras conductor who also has to hand out dishes from the kitchen while the concert all the time...)
`Off` (Factory Default)	

Adjust Poti-CVs

Potentiometers are produced with a tolerance of 10% or even 20%. This function adopts the software to the individual potentiometers in this circuitry

Value	Comment
no value - display reads: `Press Write`	See process description below

After pressing WRITE a screen will be displayed like
```
Tempo: 513
!1023=513 0
```
The number in the first line is the value read directly from the potentiometer. Since the (ideal) maximum is 1023, this tempo-potentiometer is appearently somewhere in the center position.
Turn the tempo potentiometer fully clockwise. Now the first line will show a value like (for example) 1017.
```
Tempo: 1017
!1023=1017 0
```
The second line shows on the left the ideal "1023", and most to the right the offset value, which we are entering now (in this case it is "0"). After the 'equal'-sign we see the sum from the direct potentiometer value and the offset value. Now you should press F2 to increase the offset, the summed value will increase too, and as soon as the sum of original value and offset equals 1023, the display will read "`Tempo is good!`" and switch on to the next knob. The display will read now something like:
```
CV1raw: 843
!1023=843 0
```
Again turn the CV-1 potentiometer fully clockwise and adjust the offset until resulting value is 1023 and the display reads "`CV-1 is good!`".
The display will switch to "`CV2raw`"; turn the CV-2 potentiometer fully clockwise and adjust the offset until you get "`CV2 is good!`".
Under some circumstances the resulting value might be too high; then you can decrease the offset by pressing F1.

The offset-values will be stored in non-volatile EEPROM. So usually this procedure has to be called only once.

Factory Reset

Writes the factory default settings in the non-volatile EEPROM and loads them then into the runtime memory.

Value	Comment
no value - display reads: `Press Write twice`	Press the WRITE button twice. The display will change to "Reset EEProm", and then you will see the "Load Sequence" display (see below). After the first WRITE you can cancel the Reset by pressing STOP. This should not be done in PLAY mode. Hanging notes and other unwanted issues might occur.

Load Sequence

Loads the sequence stored in the non-volatile EEPROM into the runtime memory.

Value	Comment
no value - display reads: `Press Write twice`	Press the WRITE button twice. You will see a short flicker, when the function counts the notes and steps. Then the lower line reads “Load Done”. After the first press on WRITE you can cancel the Load-action by pressing STOP. Load should not be done in PLAY mode. Hanging notes and other unwanted issues might occur.

Save Sequence

Saves the sequence from the runtime memory in non-volatile EEPROM.

Value	Comment
no value - display reads: `Press Write twice`	Press the WRITE button twice. You will see a short flicker, when the function counts the notes and steps. Then the lower line reads “Save Done”. After the first press on WRITE you can cancel the Save-action by pressing STOP. Save may be done in PLAY mode, but the sequence may stumble if the save action takes longer than one step of the sequencer

This is a preliminary manual. It is based on prototypes only. Requirements of the final hardware may cause changes in the described feature.