Troublemaker

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User Manual
version 1.2.1

Version history

Version history (this document's state reflects the latest available software version: 1.0

1.0	January 6, 2017	Initial publication
1.1.3	January 17, 2017	Updated with Mutation Engine feature
1.2.1	January 28, 2017	Updated MIDI implementation and sequencer description

Introduction and disclaimer

Welcome to a wonderful world of barking, chirping, quacking, wowing and growling silver boxes. Troublemaker is obviously heavily inspired by the legendary Roland TB-303 bassline synthesizer of the early 1980s and it can sound pretty close to one. However, Troublemaker does not claim to be a full emulation nor a clone of the legendary silver box.

Actually, trying to fully emulate "the TB-303" would be rather futile because there is no such thing as "the TB-303". The original instrument was only in production for 3 years and all remaining specimens are well over 30 years old. Each TB will sound different to the next, and very few TBs will sound exactly the same way they did the moment they left the factory. Such is the reality of fragile vintage analog electronics.

But we're lucky to live in a time where digital technology and computing power are so plentiful that we can now digitally generate the lively, soulful synth sounds that will have the same mesmerising hypnotic effect on the listener as the original TB-303 had when electronic music pioneers accidentally established acid house.

The sound of acid house, as originally generated by the TB-303, is above anything fun. Fun to make, addictive to listen to. And Troublemaker aims to recreate this aspect of fun.

1. The Synth

Troublemaker consists of two sections:
- The Synthesizer engine (the top part)
- The Sequencer section (the bottom part of the standalone app)

Let's start with the synthesizer engine. This part of Troublemaker is the MIDI module which generates the sound. It can be run stand-alone, but is also available in your iOS DAWs as an Audio Unit plugin (AU). The advantage of using it as a plugin, beside convenient integration in your favourite composing tools, is that you can run multiple instances simultaneously. Want to sound like Hardfloor with their typical 3 x 303 setup? You now can thanks to the AUv3 plugin format!

The controls of the synth are deceptively simple. There is only a handful of knobs available for sound tweaking and they comfortably fit on a single screen. However, there are some intricate interdependencies between these controls and I'll try to highlight the ones that are most important to the sound.

The two envelopes
But before we dive into the individual controls of Troublemaker there's one important synthesis aspect to note, which makes this synth very different from other 'conventional' analog monosynths: the envelopes.

Basically, there are two envelopes in Troublemaker (like in the original TB); the AMP envelope, and the filter envelope. Where most synths give the user control over the AMP envelope using ADSR EG controls, there is no control whatsoever over the AMP envelope in Troublemaker. The AMP EG is triggered when a note starts, and it has a long, fixed decay of a few seconds. It is, in summary, the most unexciting envelope in the world.

On the other hand, most of the magic of the acid sound comes from that other envelope: the filter envelope. Almost all of the main knobs on the synth interact with the filter envelope in one way or another.

Cutoff
The cutoff knob controls how many high frequencies are filtered out by the low pass filter. Turn the knob clockwise to 'open the filter' (let more high frequencies through), and anti-clockwise to 'close the filter' (cut away more higher frequencies, leaving only the lower part of the spectrum).

The exact range of the cutoff knob (from lowest point to highest point) depends on the position of the envmod knob ('Envelope Modulation'). If the envmod knob is in its lowest position, the cutoff range is fairly short. If the envmod knob is fully open, then the filter cutoff range is quite long.

Fun fact: contrary to what many people claim the filter in the TB is most certainly *not* an 18dB LPF. It is in fact a bog standard 24dB 4-pole diode LPF executed in a rather unusual way so that one of the poles doesn't contribute much to the filter's behavior.

Reso (Resonance)
In analog filters, resonance is an internal feedback loop which emphasises the frequency range around the cutoff point. It is responsible for the typical liquid squelchy overtones which change in character when the cutoff knob is tweaked (because this moves the cutoff point up or down). Without resonance, the filtered sound gets quite dry and dull.

As the resonance increases, the gain of the filtered signal may dip a little bit and loses some of its low end. So for actual bass sounds, limit the resonance to moderate levels. When fed through a distortion or overdrive effect, the resonance is what makes the sound scream (and the lack of low-end actually becomes an advantage, because bass sounds tend to muddy a distorted sound).

Envmod & Punch (Envelope Modulation)
In Troublemaker, the filter is never static. When a note is triggered the filter starts at the point specified by the cutoff knob. Then it closes over time (the actual duration is specified by the decay knob). Envelope modulation effect can be set from weak (short filter drop) to strong (long filter drop), but can not be disabled. This means that even when it's set to 0, there will be a filter drop of a few dozen to a couple hundred Hz.

The steepness and falloff characteristics of the filter envelope decay have a huge impact on the sound of the TB. Even when all other filter parameters are set correctly, using the wrong decay curve will make the synth sound like something completely different. It also seems that there is a bit of a bandwidth between different TBs in the steepness of the curve, although they all share similar falloff characteristics. To account for this variability, the envmod decay curve can be fine-tuned using the **Punch** knob.

Negative punch values make the curve slightly more mellow and gentle. Positive punch values make the curve slightly more aggressive and steep. Note that changing the punch changes the simulated discharge characteristic of a capacitor, which will affect a number of other variables, such as the accent strength.

Decay
This sets the decay time of the filter envelope. The minimum decay time is ~200ms., (although there is still a bit of a falloff tail going on for another 100ms. which can be measured, but barely heard). The maximum decay time is a few seconds. You will rarely hear the full filter decay when it's set to a higher value because most notes are not long enough even when chaining slides and ties.

Note that the filter does not have an attack (other than the very short <1ms inertia of the analog components), so the decay and envmod knobs are the only controls available for tweaking the filter envelope.

Also, keep in mind that accented notes have their decay fixed to the minimum decay duration, so they will not be affected by changes to the decay knob.

Accent
The accent is the star of the TB show. It is what makes all the difference between any other analog monosynth and the TB. Accented notes behave completely different from normal notes.

Not only do they sound louder than normal notes, they also go through an extra piece of analog circuitry which Roland (in their maintenance documents) refer to as “the gimmick circuit”.

The gimmick circuit receives a voltage burst whenever an accented note is triggered. The strength of the jolt depends on the position of the accent knob combined with the position of the resonance knob. When both are in maximum position the burst boosts the filter, effectively opening the filter a bit further than the cutoff knob indicates. Hence accented notes typically sound a bit brighter than unaccented notes.

Additionally, the position of the envmod knob routes this voltage jolt either directly to the filter (maximum envmod) or via a slow capacitor (minimum envmod). The effect of this is the very characteristic “wowwww” sound produced by the TB when accents are strong and envmod is low.

For the most spectacular “wow sound”, use multiple successive accented notes with minimal cutoff, minimal envmod, maximum resonance and maximum accent strength. When you do this, another (unintended?) side-effect kicks in: the accent circuitry doesn’t get enough time to fully discharge at higher tempos, which results in the next accented note starting its charge where the last note left off. The effect (although subtle) is that each successive accent gets a slightly more dramatic filter response.

Note that accented notes have a fixed filter decay time, which is identical to the minimal decay time of regular notes. I.e. changes to the decay knob setting have no effect on accented notes.

LFO & LFO Rate
This is a feature not present on the original TB. It is a tempo-synced low frequency oscillator modulating the filter cutoff properties. It changes the starting cutoff frequency for the filter envelope, based on the current settings of the filter. So the actual LFO range depends on the current settings of the cutoff knob and the envmod knob. Hence the LFO effect is an extra filter effect which can not be achieved by simply opening and closing the cutoff knob.

Just like the oscillators on the TB, the LFO is free running, ensuring a more organic behaviour of the sound as the patterns repeat.

The LFO effect will be more pronounced if EnvMod and Cutoff are set to higher values. For lower values, the effect may be quite subtle.

Wave
This lets you choose the oscillator type. There are 2 classic TB oscillators and 8 ‘special’ waves for letting you apply the TB’s architecture to waves with a very different frequency spectrum - even allowing you to make Troublemaker sound like a bass guitar of sorts.

The two classic waves are generated in such a way as to mimic the original TB oscillators as closely as possible in terms of frequency build up. They are quite special (some would call them strange) and very different from typical oscillators found on other analog synths from the same era. Especially the square wave has some bizarre properties (it seems to go through some high-pass circuitry somewhere in the signal path, which may also account for its bizarre pulse width changes depending on the pitch of the tone).

In short, special care has been put into making the sawtooth appropriately raspy and nasal, and giving the square wave its rubbery weightlessness.

Fold & Fuzz
These are two different distortion effects which can be used together or separately. Fuzz is a classic overdrive effect reminiscent of a guitar distortion.

Fold is a variant of a digital fold-back distortion based on phase modulation. The input signal is used to modulate a sine wave generator. The higher the amplitude of the input, the stronger the output gets excited. The result is something which sounds like a distorted FM synth with a very distinctive ‘liquid’ touch around the edges.

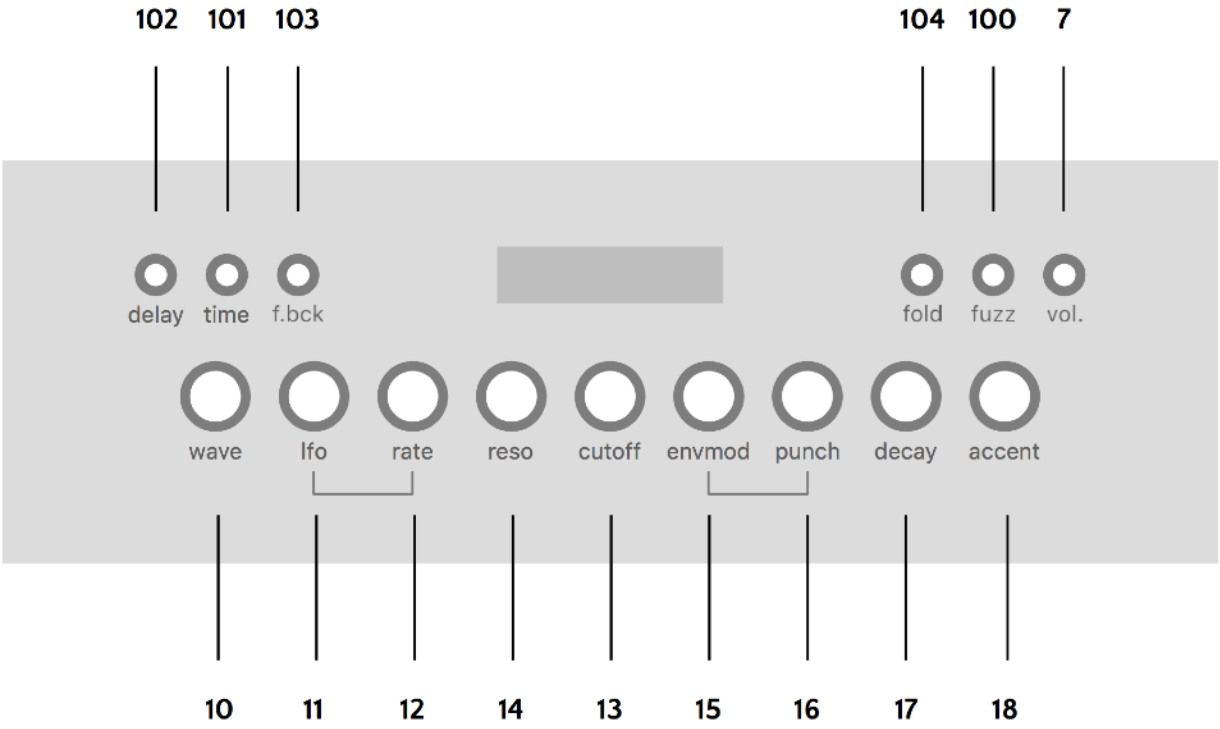
Delay, delay time & delay feedback
This is a classic tempo-synced delay effect. Time values > 64 increase in 16th note steps. Time values < 64 are measured in fractions of a 16th note step and can be used for metallic pseudo reverb effects etc.

Volume
Output signal gain of the AMP. Uses a logarithmic scale.

2. AU Parameters & MIDI CC Controllers

Every aspect of the Troublemaker plugin that can be accessed via the on-screen user interface can also be controlled and automated using AU parameters and MIDI CC codes. The following controller numbers are for MIDI CC. The respective Audio Unit parameters use their corresponding names.

Example: to change the cutoff to maximum, send a MIDI CC command 13 with a value of 127

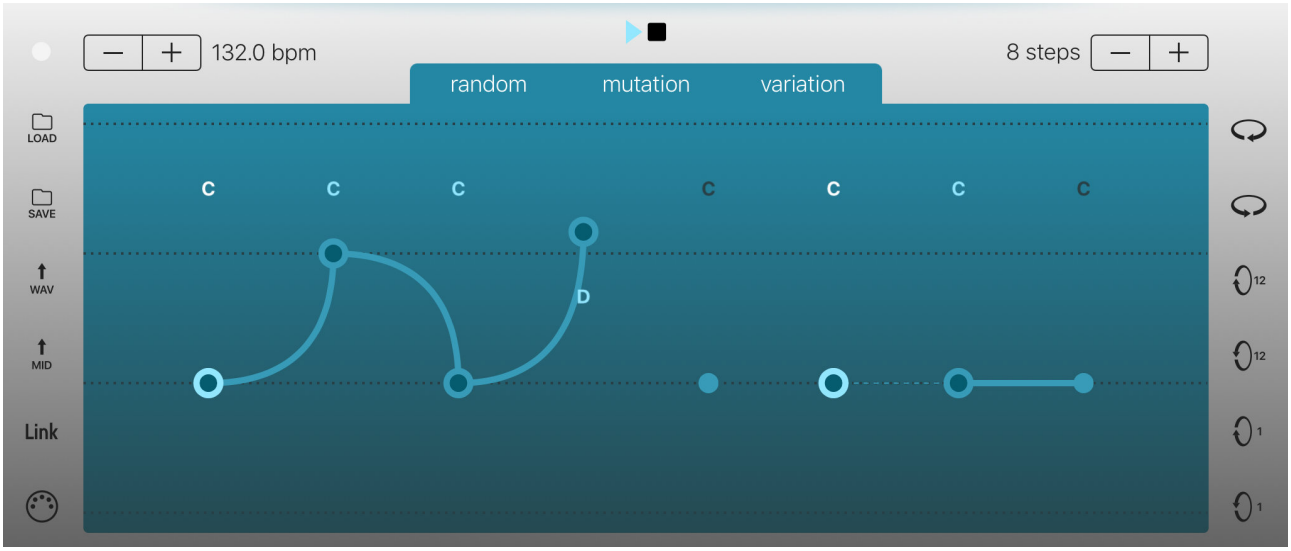


3. The sequencer section

When using Troublemaker as a standalone app, it lets you program synth patterns using its own special 16 step sequencer.

The sequencer is designed to display the pattern in a way that's most meaningful for the typical TB style acid patterns. Under the surface it is actually a MIDI sequencer sending regular midi commands to the synth module, but in its UI you can very easily identify which notes trigger slide and ties (and their destinations) and which notes are accented.

Once you have designed (or randomly generated) a nice pattern, you can export your pattern as a standard MID file and send it directly into your DAW of choice to build a full track out of it (taking advantage of the Audio Unit Plugin format of Troublemaker). The exported MIDI file should sound identical to the pattern played back in Troublemaker's own sequencer.



The piano roll
Well, it's not exactly a piano roll. But it was inspired by piano rolls. It covers the typical TB-303 range of C-2 to C-5. The dotted lines indicate where the C notes in their respective octaves are.

Fat blue circles are notes (the light variety are accented notes), dots are rests. Lines between notes are slides and ties. Tap on notes and slides to enable/disable them. Tap a dotted line to turn it into a slide and vice versa.

Drag a note to change its pitch. While you're dragging a note, a subtle piano roll appears in the background showing the exact positions of each note.

Steps
Using the 'steps' control you can set the length of your pattern. The steps value is in 16th notes. You can set values of 1-16, 24, 32, 48 and 64 steps. When using values > 16 Troublemaker assumes you're using more than one bar and additional vertical lines in the sequencer will be shown to indicate bar separators. Slide the screen horizontally to pan the sequencer view if needed.

Random
This button randomly generates a pattern for you. Most patterns will be 8 or 16 steps, but sometimes you'll get a more unusual number of steps.

Mutation
This is the realtime mutation engine. While you're playing patterns, these settings determine the probability that the sequencer will actually do something else. These mutations are a realtime playback feature. They are not permanent and will not be saved with the pattern. When exporting MID or WAV files, the current mutation settings will be used for the exported output though.

Variation
Takes the current pattern and makes a variation out of it. It will keep the existing notes and rests and the current pattern length, but will randomize the octaves, accents and slides.

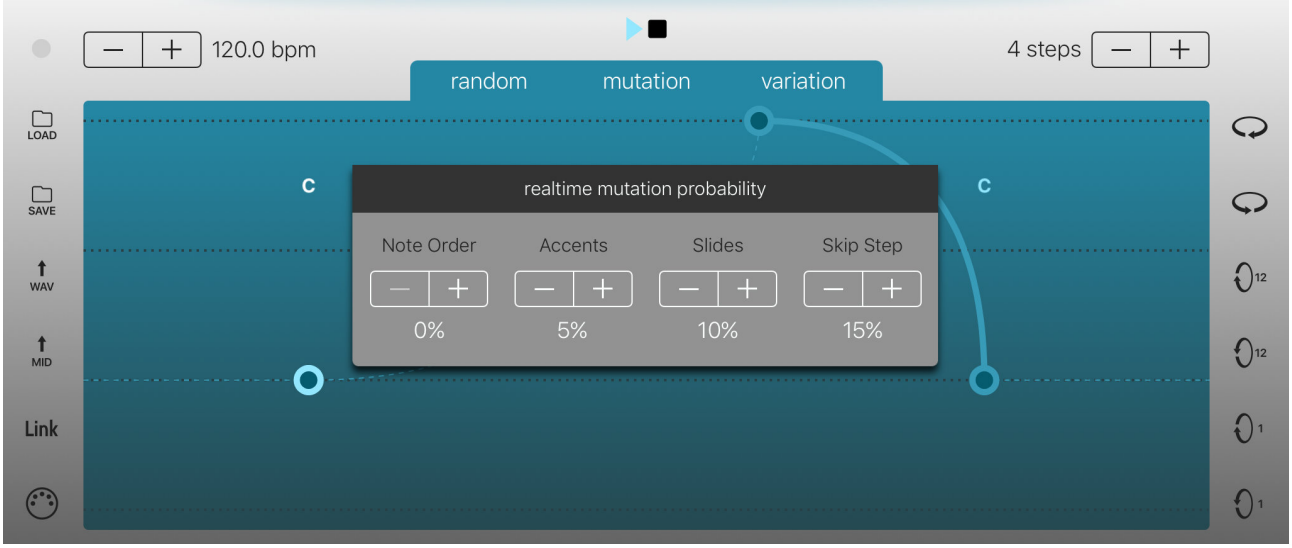
Play/Stop
This button starts and stops the playback of the pattern. If Ableton Link is enabled there may be a brief count-in before the pattern starts playing to ensure your pattern will be in sync with the other Ableton Link enabled apps on the network.

Pattern rotation features
The buttons on the righthand side of the sequencer let you rotate the current pattern to the left, to the right, up and down (either one note or per octave). Notes that 'fall off the grid' will appear back on the other side.

Link
This lets you control the Ableton Link feature. You can use this to sync the app with other Ableton Link compatible apps and devices which are on the same device or on the same network as Troublemaker. Changing the tempo will then change the tempo in all linked apps and conversely Troublemaker will also respond to tempo changes initiated by other apps.

MIDI settings
This lets you change basic settings for midi input (channel) and select Bluetooth MIDI devices. Troublemaker is fully compatible with CoreMIDI, Virtual MIDI and BTLE MIDI on iOS and will respond to midi input while running in background mode.

4. Using realtime mutations



The realtime mutation engine takes your pattern and introduces semi-predictable variations during playback. Four different parameters can be individually processed using the engine.

For each parameter, the selected percentage represents the probability that a variation will happen. So in the example shown above, for each note in the pattern (rests are ignored) there is:

Note Order:	0% chance that the note will be replaced by a random other note from the same pattern
Accents:	5% chance that a regular note will be played back as an accented note (and vice versa
Slides:	10% chance that a regular note will have a slide (and vice versa)
Skip Step:	15% chance that a step in the pattern will be skipped, letting the pattern go “out of sync”

The higher the probability percentage, the higher the chance that the variation will happen. To disable a variation, set it to 0%

Probabilities can be changed (or disabled) in real-time using the following MIDI CC commands; the values from 0% to 100% are then mapped to the MIDI value range 0-127:

Setting	**CC code**	**Example**
Note Order	CC#40	CC#40 Value 0 disables the probability that a different note will trigger
Accents	CC#41	CC#41 Value 64 will set the probability of an accent variation to 50%
Slides	CC#42	CC#42 Value 127 will set the probability of a slide to 100%
Skip Step	CC#43	CC#43 Value 32 will set the chance of skipping a step to 25%

Mutation settings are a realtime playback feature only and are not saved, nor are they part of the pattern itself.

Transpose
Use MIDI CC#44 for realtime transposition of the current pattern. The range is -12 to +12 semitones.

- There is no visual feedback on the screen of the current transposition. Use with care!
- Set MIDI CC#44 to value 64 (centre value) to reset the transpose value to 0
- Incoming MIDI notes are not transposed, only pattern notes
- Transpose is not applied to exported MIDI files, but will be applied to exported WAVs

5. Using Troublemaker in plugin mode

When using Troublemaker as plugin inside third party hosts and DAWs it will behave as any regular MIDI instrument. You can run as many simultaneous instances as your device can handle.

Here are some tips and tricks:

- Use velocity to distinguish between normal and accented notes. Velocity values < 100 will result in normal notes. Anything >= 100 will result in an accented note
- Use overlapping notes to create slides and ties. Overlapping notes on the same note number result in ties, any other note number will trigger a slide.
- You are obviously free to choose your own note lengths, but if you want to sound like a 303, it's best to stick to note lengths of a 32nd step. It is convenient that in the original 303 sequencer the gate durations were also depending on the tempo. That makes it very easy to simulate the same behaviour in any sequencer.
- The delay and LFO are synced to the tempo of the host, so if you change the tempo you don't have to worry about changing the timing of these parameters. They will automatically adjust to the new tempo even in plugin mode.