NTX-8CV

User manual

Version 1.0

Is your mind in computer mode?

- *Donna Summer, “All Systems Go”*

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Table of Contents

Introduction

Congratulations on your purchase of an Expert Sleepers NTX-8CV. Please read this user manual before operating your new module.

A note on navigating this manual

When one part of the manual refers to another, it may say something like “see Settings, below”. In such cases the word 'below' (or 'above') is a hyperlink, and can be clicked on. Try it.

Where to get help

Email, forum, and social media links can be found at the bottom of every page on our website[1]. We also have a Discord server[2].

We prefer support requests to be made through the forum or Discord server, if possible – failing that, by email.

If you’re lucky enough to have a local bricks and mortar modular store, please visit them, try things out, and get help there. And most of all, buy your modules from them too.

What is it?

The NTX-8CV has three roles:

- It’s a MIDI/CV converter – it will take MIDI from a USB host (e.g. computer) or USB device (e.g. keyboard) and output CVs.
- It’s an audio interface – it will connect to your computer (or phone etc.) and output audio, and/or software-generated CVs (from Silent Way, Ableton CV Tools, Bitwig Studio etc.).
- It’s an output expander for the disting NT[3].

When connected to a computer, the MIDI/CV and audio interface functions can be active simultaneously, with the outputs divided between them.

Getting started

First, carefully read the installation instructions below.

Then, download the configuration tool, which can be found on our website here[4]. Use the tool to check if you have the latest firmware (“Request NTX-8CV Info” at the top).

1 https://www.expert-sleepers.co.uk/

2 https://modwiggler.com/forum/viewtopic.php?t=287914

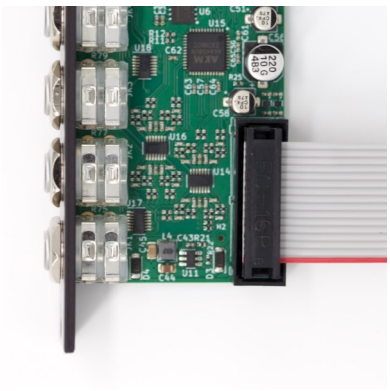
3 https://expert-sleepers.co.uk/distingNT.html

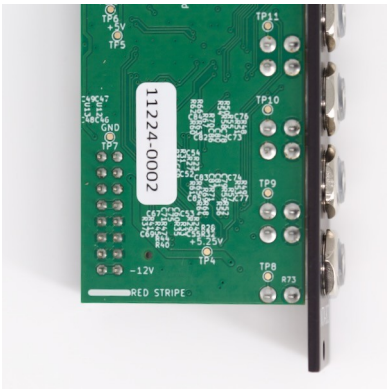
4 https://expert-sleepers.co.uk/ntx8cvfirmwareupdates.html

If necessary, update the firmware – instructions are below.

Installation

House the module in a Eurorack case of your choosing. The power connector is 16-pin Doepfer standard[5]. If using the power cable supplied with the module, the red edge of the cable is closest to the bottom edge of the PCB, and carries -12V. ("-12V" and “RED STRIPE” are marked on the rear of the PCB itself next to this end of the connector.) Be sure to connect the other end of the power cable correctly, again so -12V corresponds to the red stripe on the cable.





Please observe ESD (electro-static discharge) precautions when handling the module (and indeed, any module).

Please do not operate the module without it being securely fastened in a case.

Physical dimensions

The NTX-8CV is 4HP wide and 36mm deep.

Power requirements

The NTX-8CV draws 74mA on the +12V rail, and 17mA on the -12V rail, when idling. The actual power consumption is heavily dependent on how many output socket LEDs are lit. Each fully illuminated socket draws about 4mA (from the +12V rail or -12V rail depending on the polarity), so you could in theory pull another 32mA, but that is highly unlikely to occur in actual use. When budgeting for case power it’s probably safe to split that 32mA between the two rails and say it draws 90mA on the +12V rail and 33mA on the -12V rail. But really, if 32mA is enough to put your PSU over the edge, you need a bigger PSU anyway.

The NTX-8CV does not use the 5V rail.

5 http://www.doepfer.de/a100_man/a100t_e.htm

Powering USB devices

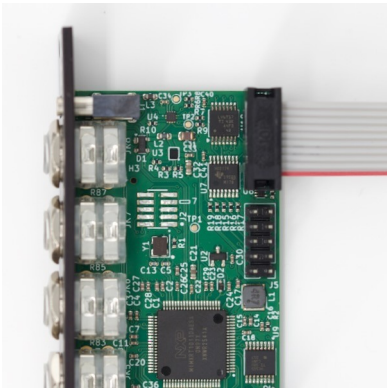
The NTX-8CV will provide power to USB devices connected to its USB socket. This is drawn from the +12V rail, in addition to the current drawn by the module itself.

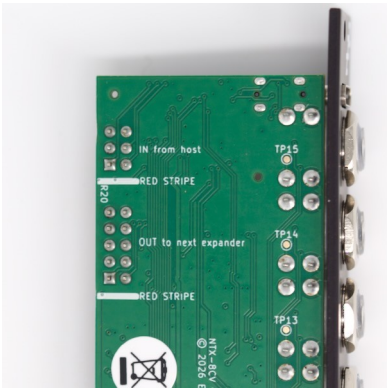
The module uses a DC/DC converter which is approximately 90% efficient. This means that a USB device consuming 2.5W (the maximum power allowed by USB 2.0) will draw about 2.8W from the case PSU, or about 230mA at 12V.

So, if you plan to use your NTX-8CV to power a USB device, allow another 230mA on the +12V rail in addition to the 74mA used by the module. Of course many USB devices will use a lot less than this.

Connection to a disting NT

When using the NTX-8CV as an expander for the disting NT, connect it via the header marked J4 “IN from host”, using the 10-way cable supplied with the NTX-8CV.

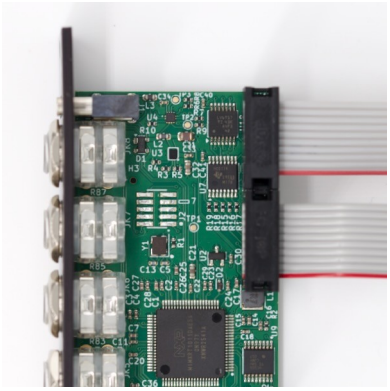




Align the red stripe on the cable downwards, as indicated by the “RED STRIPE” text on the back of the PCB. The 6 holes on the cable connector closest to the red stripe fit on the 6 pins of the header; the remaining 4 holes are not used.

Connect the other end of the cable either

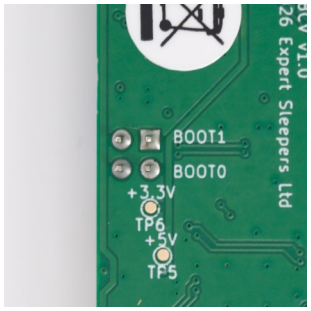
- to the disting NT, using its header marked J11 “ES-5”, or
- to an upstream NTX-8CV, using its header marked J5 “OUT to next expander”.



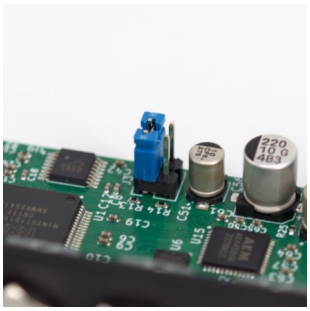
Again, orient the red stripe downwards. If you find yourself twisting the cable, you’ve done it wrong.

Jumpers

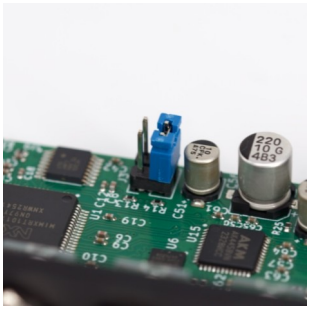
The jumper block labelled J3 can be used to force the module into serial bootloader mode, allowing firmware update over the USB port. There are two pairs of pins, labelled BOOT0 and BOOT1 on the back of the PCB.



In normal use, the jumper is across the BOOT1 pins. This is the position the jumper will be in when you receive the module.



Normally you would leave the jumper in the BOOT1 position and use the module's configuration tool to enter bootloader mode. If however this is not possible, move the jumper to the BOOT0 position to force it into bootloader mode. Note though that you will then have to return it to the BOOT1 position to boot normally after installing new firmware. See below for a description of the usual firmware update procedure.



Please observe ESD (electro-static discharge) precautions when handling the module to move the jumper.

USB

Understanding USB 'hosts' and 'devices'

In USB there is a clear distinction between 'hosts' and 'devices'. A 'device' has to connect to a 'host'. A 'host' can connect to one or more 'devices' (using a hub for multiple connections). A 'host' may power a 'device', or a 'device' may be self-powered.

In normal computing terms, the host is usually the PC, laptop, tablet etc. Devices are things like mice, keyboards, drives etc. and most USB MIDI hardware also falls into this category.

The NTX-8CV can operate as both.

USB on the NTX-8CV

The module has a type C USB socket at the top of the panel. It is what's known as a "Dual-Role Port (DRP)", operating as either a device or a host depending on what is connected.

The NTX-8CV is a uses High Speed USB 2.0.

The module does not draw power from the USB connection. When acting as a host, it will supply power to a connected device, as noted above.

The NTX-8CV is a MIDI Class and Audio 2.0 Class compliant device. As such it needs no drivers when used with macOS, iOS, and Linux. An audio driver for Windows is available via our website[6].

As a host, the NTX-8CV supports devices which are MIDI Class compliant.

Outputs

The NTX-8CV's output jack sockets are illuminated, lighting red for positive voltage and blue for negative voltage. (Audio-rate signals appear purple, since you see a rapid alternation of positive and negative.)

The sockets are 3.5mm TS jacks. Do not use TRS cables.

The outputs are all DC coupled, and have a maximum range of ±11V.

The outputs are calibrated at the factory. When used as an audio interface, the notional software signal range of ±1.0 is mapped to ±10V, which is the same convention as used by VCV Rack[7].

In other words, software-generated CVs will produce the correct voltages; and full-range audio in the DAW will produce full-range modular signal levels. (If you want to output line-level signals, just turn it down in the DAW.)

6 https://expert-sleepers.co.uk/downloads.html

7 https://vcvrack.com

The outputs as status indicators

Since there are no LEDs as such on the front panel, the LEDs in the sockets are used to display essential status information.

At startup (power on or reboot), all eight sockets flash blue in sequence. If the module doesn't do this, it doesn't have power, or is in bootloader mode (see above), or is just plain broken (in which case see "Where to get help", above).

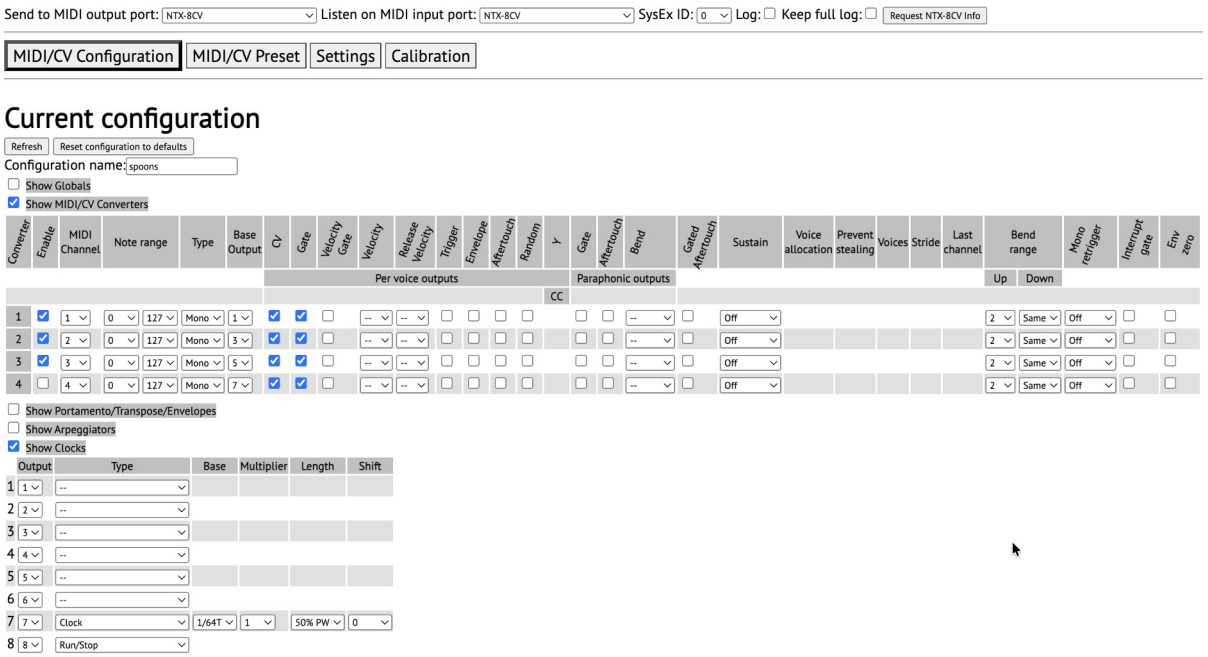
If the module connects to a host as a USB MIDI device, output 8 flashes blue. If the module disconnects from the host (e.g. if the cable is removed), output 8 flashes red.

If a host starts using the module as a USB audio device (e.g. when you select it in the DAW), output 7 flashes blue. If the host stops using the module for USB audio, output 7 flashes red.

If you connect a USB MIDI device, and the NTX-8CV enters host mode, all eight outputs flash blue. If you disconnect the device, all eight outputs flash red.

The Configuration Tool

The configuration of the NTX-8CV is done via a browser-based tool, which connects to the module over USB via MIDI SysEx.



The tool uses the Web MIDI API, which at the time of writing will work only in browsers based on Google's Chromium (which includes Chrome itself).

The tool can be downloaded from the NTX-8CV firmware download page here[8]. Download the tool version that corresponds to your firmware version.

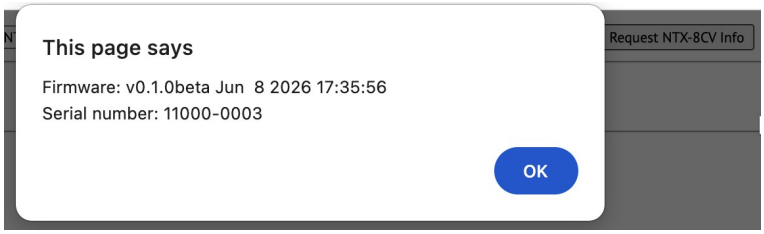
Connecting to the NTX-8CV

At the very top of the tool are two drop-down menus, “Send to MIDI output port” and “Listen on MIDI input port”. These need to be set to the MIDI ports that connect to the NTX-8CV. If the NTX-8CV is plugged directly into the computer (the normal and recommended way to do it), simply select the ports named “NTX-8CV”.

The “SysEx ID” drop-down allows you to set the ID of the module you want to communicate with, allowing you in theory to have multiple modules connected on the same MIDI port. In practice, you’ll probably have such multiple modules each directly connected to the computer, and so on different MIDI ports, in which case leave all the SysEx IDs at the default “0”. The special value “Any” will communicate with any connected NTX-8CV, which is useful if you’ve forgotten the SysEx ID of your module. The SysEx ID itself is a Global Setting (below).

8 https://expert-sleepers.co.uk/ntx8cvfirmwareupdates.html

The button “Request NTX-8CV Info” retrieves the module’s firmware version and serial number, which can be a useful way to validate the connection.



Organisation of the tool

The configuration tool has four pages, which are activated one at a time via the large buttons near the top.

“MIDI/CV Configuration” and “MIDI/CV Preset” relate to the module’s MIDI/CV conversion capabilities. These are explained in considerable depth below.

“Settings” allows you to view and edit various global module settings. More on this below.

The final page “Calibration” allows you to view the module’s calibration. See below.

MIDI/CV conversion

The MIDI/CV functionality of the NTX-8CV is based on our FH-2[9] module. Anyone familiar with that module will be right at home. Any videos, tutorials, etc. that you may find for the FH-2 are likely to apply equally well to the NTX-8CV.

The NTX-8CV configuration tool combines both the FH-2 configuration tool and the FH-2 preset tool. Largely the behaviour is the same – the main difference is that, whereas the FH-2 tools require you to send your changes manually by pressing the “Send to FH-2” button, the NTX-8CV tool sends an update automatically each time you make a change.

Key concepts

Signal flow

The basic signal flow in the NTX-8CV is

- CVs are generated
- LFOs and envelopes are added
- smoothing is applied.

Generators of CVs are: the MIDI/CV Converters, the Clocks, the Triggers, the Euclidean Patterns, the Shift Register Random generators, or the Direct control. All of these can generate CVs destined for one or more outputs.

The LFOs and envelopes, if active, are always added to the CVs generated by one of the above.

Finally smoothing, if active, is applied to the sum of the LFOs/envelopes and generated CVs.

In this document, the term 'CV' (Control Voltage) is used interchangeably to mean either an actual voltage on one of the module outputs, or a digital signal within the module's processing that will eventually emerge as a control signal.

Clocking

All clocking in the NTX-8CV is in terms of 24ppqn (pulse-per-quarter-note) pulses. This is the rate used by MIDI clock messages, and also by the analogue DINsync standard. Thus if for example an LFO rate is given as '24' it means it will cycle at the speed of quarter notes; '12' means an eighth note etc.

When using the NTX-8CV to bridge between analogue and MIDI devices, if possible choose 24ppqn clocks (i.e. a divider value of 1). Then the analogue and MIDI clocks are in one-to-one correspondence and there's no scope for error when generating the 'in between' pulses.

9 https://expert-sleepers.co.uk/fh2.html

Understanding 'configurations' and 'presets'

The NTX-8CV's state is divided into two separate concepts – 'configurations' and 'presets'.

The 'configuration' defines what the module's outputs do (e.g. are they clocks, are they MIDI/CV converters), and how they're mapped to MIDI messages (e.g. MIDI CC assignments for controlling the LFOs).

The 'preset' defines the module's state, in response to the incoming MIDI – for example, the directly-controlled outputs levels, the LFO rates etc.

To put it another way, the 'preset' is everything that is expected to change in real time – the 'configuration' defines how the preset will be controlled.

Presets and configurations can be separately saved to and recalled from flash memory. For example, you might have two configurations saved, one for when you want to use the NTX-8CV with a MIDI keyboard, which might define all 8 outputs as MIDI/CV converter outputs, and another for when you want to use the NTX-8CV with a MIDI controller, which might define all 8 outputs as being directly controlled from knobs. When switching between these two use cases, you would simply recall the appropriate configuration. Similarly, you might save two presets, one applying smoothing to some outputs (for example, the aftertouch output from the MIDI/CV converters), and one setting up default levels and speeds for some LFOs.

In the Settings (see below) you can choose to have a certain configuration and/or preset loaded automatically at startup.

Functionality first

You will find it easier to understand the FH-2 configuration if you follow the simple rule:

- Decide the functionality first, and then set the outputs that the functionality affects.

This is contrast to the opposite “for each output, decide what functionality it should have” which is how some other devices work.

For example, don’t go in thinking “I would like output 1 to be a pitch CV and output 2 to be a gate”. If instead you go to the tool with “I would like a MIDI/CV converter, and I would like it to use outputs 1 & 2” you are likely to have more success.

Configurations

A configuration consists of the following:

- the configuration name
- some global settings (trigger length, global transpose etc.)
- setup of the MIDI/CV converters
- setup of the MIDI CC assignments ('mappings')
- setup of the HID gamepad and keyboard assignments
- setup of the Clocks
- setup of the Triggers
- setup of the Euclidean Patterns and Shift Register Random generators
- for every output:
  - the voltage range setting
  - the output levels used if the output is a gate/trigger

The default configuration

The default configuration is what you get when the module starts up without loading a saved configuration, or when you do “Reset configuration to defaults”.

This configures the module as follows:

- Three MIDI/CV converters, each with pitch CV and gate outputs, on MIDI channels 1, 2, and 3, using outputs in pairs 1/2, 3/4, and 5/6.
- A 24ppqn clock on output 7.
- A run/stop signal on output 8.
- CC mappings for direct control of all 8 outputs from MIDI channel 1, CCs 0-7.

Out of the box you can therefore send MIDI notes on channels 1-3 and have them converted to CV/gate, and send MIDI clocks and have them emerge on outputs 7 & 8, and send CCs to directly control all 8 outputs.

Name

The configuration name is 16 characters long.

Globals

These are items that don't refer to a specific output or function.

Name	Value range	Description
Legato velocity	0-1	When enabled, playing legato in monophonic MIDI/CV modes will use the note velocity only from the first note in a phrase.
Global transpose	-48 - 48	Applies a transposition to all MIDI/CV converters.
Trigger length	1-100	Length of all triggers, in milliseconds.

Name	Value range	Description
Euclidean Accent	0-127	Sets the scaling of non-accented pulses when accents are enabled for Euclidean Patterns (see below).
Preset Program Change Ch	0-16	The MIDI channel on which to respond to Program Change messages by changing the current Preset, or '0' for Off.
Soft takeover	0-1	Enables the 'soft takeover' feature. When enabled, an incoming MIDI CC will not control its target parameter until the CC has passed through the value matching the last loaded preset.

Tap Tempo

Tap tempo can be controlled via an incoming MIDI note or CC. This is set up in the configuration as follows:

Name	Value range	Description
Type	0-2	Sets how tap tempo is controlled via MIDI.
Channel	1-16	Sets the MIDI channel for the tap tempo control.
Note or CC	0-127	Sets the note or CC number for the tap tempo control.

The options for Type are "None", "Note", or "CC".

If the Type is Note, tap tempo happens when a Note On message is received matching the specified note number. If the Type is CC, tap tempo happens when a CC message is received matching the specified CC number, with a value of 64 or more.

Start/Stop

The internal clock can be started or stopped via an incoming MIDI note or CC. This is set up in the configuration as follows:

Name	Value range	Description
Type	0-4	Sets how the clock is controlled via MIDI.
Channel	1-16	Sets the MIDI channel for the start/stop control.
Note or CC	0-127	Sets the note or CC number for the start/stop control.

The options for Type are "None", "Note Toggle", "CC Toggle", "Note Gate", "CC Gate".

'Note Toggle' starts or stops the clock when a Note On message is received. Similarly 'CC Toggle' starts or stops the clock when a CC with a value of 64 or more is received.

'Note Gate' causes the clock to start on a Note On and stop on a Note Off. Similarly 'CC Gate' starts the clock on a CC of 64 or more and stops it on a CC of less than 64.

Internal tempo CC

The tempo of the internal clock can be controlled via an incoming MIDI CC. The MDI channel and CC number can be freely chosen. You can also set the minimum and maximum tempos that will correspond to CC values 0-127.

Swing type/amount CCs

You can configure MIDI CCs to control the type and amount of swing applied to clocks etc.

Beat matching CCs

You can configure MIDI CCs to aid with matching the NTX-8CV's internal tempo to other music by ear.

The 'Nudge faster/slower' CCs temporarily increase/decrease the NTX-8CV's tempo while the CC is 64 or more. (Typically you would map this to a button which sends the value 127 when held and 0 when released.) The percentage change in tempo is set via the 'Nudge amount' global setting.

The 'Inc/Dec tempo' CCs simply increase or decrease the tempo by 0.1bpm when a CC value of 64 or more is received.

MIDI/CV converters

There are 4 MIDI/CV converters available, any number of which can be active in any given configuration. Each converter has the following properties:

Name	Value range	Description
Enable	0-1	Enable the converter.
MIDI Channel	1-16	The MIDI channel for the converter.
Min Note	0-127	Lowest MIDI note (inclusive) to respond to.
Max Note	0-127	Highest MIDI note (inclusive) to respond to.
Type	0-2	Converter type: Monophonic, Polyphonic, or MPE.
Base output	1-8	The base output of the converter.
CV	0-1	If enabled, the converter will have a (pitch) CV output.
Gate	0-1	If enabled, the converter will have a gate output.
Velocity Gate	0-1	If enabled, the converter will have a velocity gate output, that is, a gate output the level of which is scaled by the note on velocity.
Velocity	0-2	If enabled, the converter will have a velocity output. If set to 'Inv', the output will be inverted i.e. higher velocity means lower voltage.
Release Velocity	0-2	If enabled, the converter will have a release velocity output. If set to 'Inv', the output will be inverted i.e. higher velocity means lower voltage.
Trigger	0-1	If enabled, the converter will have a trigger output.
Envelope	0-1	If enabled, the converter will have an envelope output.

Name	Value range	Description
Aftertouch	0-1	If enabled, the converter will have a per-voice aftertouch output (using polyphonic aftertouch for Monophonic & Polyphonic converters, or per-voice channel pressure for MPE converters).
Random	0-1	If enabled, the converter will have an output for a random voltage, updated at the start of each note. Note that this voltage is controlled by the preset's “Random Depth”.
Y CC	0-127	The MIDI CC number for the MPE 'y control', or 0 for off. (MPE type only.)
(Paraphonic) Gate	0-1	If enabled, the converter will have a paraphonic gate output, that is, a gate output that is high when one or more notes are held down.
(Paraphonic) Aftertouch	0-1	If enabled, the converter will have an aftertouch (aka channel pressure) output.
(Paraphonic) Bend	0-2	If 'Single', the converter will have an output for pitch bend. If 'Double', the converter has two outputs for pitch bend – one for bend up, and a second for bend down. Set the 'Bend range' to zero if you don't wish to combine pitch bend into the pitch CV outputs as well.
Gated Aftertouch	0-1	If enabled, the aftertouch output is automatically set to zero when all keys are released.
Sustain	0-3	Controls whether MIDI CCs 64 & 66 are used in their normal role as sustain & sostenuto pedals. You can enable neither, either, or both.
Voice allocation	0-3	Voice allocation scheme: Round robin, Lowest voice, Unison, or Note range. See below. (Polyphonic or MPE types only.)
Prevent stealing	0-1	If enabled, prevent voice stealing – any keys pressed beyond the polyphony of the converter are ignored. Without this option, new notes replace any old ones being held. (Polyphonic or MPE types only.)
Voices	1-16	Number of voices. (Polyphonic or MPE types only.)
Stride	1-32	Sets the spacing between the per-voice sets of CVs. For example, if a polyphonic converter has just CV and gate per voice, and a base output of 1, then the voice outputs will be 1/2, 3/4, 5/6 etc. If however the stride is set to 3, then the outputs will be 1/2, 4/5, 7/8 etc. (Polyphonic or MPE types only.)
Last channel	2-16	The last MIDI channel to respond to, if the converter type is MPE.
Bend range - Up	0-64	Pitch bend depth, in semitones. See also 'Bend down' below.
Bend range - down	-1-64	If 'Same', the 'Bend range - Up' as above is used for pitch bend in both directions. Otherwise, 'Bend range - Up' is used for bending up, and 'Bend range - down' is used for bending down.

Name	Value range	Description
Mono retrigger	0-1	Controls when triggers and envelopes are fired for monophonic converters, specifically in the case when a note is triggered as the result of a key being released while another is held. When this option is on, such notes do not fire the trigger or envelope.
Interrupt gate	0-1	If enabled, the gate will briefly go low when playing a new note legato, so an external envelope can be retriggered. (Note – a better solution is to use a gate and trigger output, and an envelope generator with both gate and trigger inputs, if available.)
Env zero	0-1	(Envelope zero start) If enabled, envelopes start from zero at every note on. Otherwise, the attack portion ramps up from the current envelope value.

MIDI/CV converter output assigment

The assignment of functions to outputs is as follows:

The first (lowest numbered) output used by the converter is specified by the 'Base output'.

Then outputs are assigned in sequence in the order above, that is

- CV
- Gate
- Velocity Gate
- Trigger
- Velocity
- Release Velocity
- Envelope
- Pressure
- Random
- MPE Y

for any outputs that are enabled.

For polyphonic converters, the outputs for each voice are assigned in this manner in turn.

Finally, if enabled, the Paraphonic Aftertouch, Gate, and Bend outputs are assigned.

Converter types: Monophonic, Polyphonic & MPE

The type of the converter is fundamental to how it generates output CVs from incoming MIDI notes.

- *Monophonic* converters generate a single voice's set of CVs – one pitch, gate etc. A monophonic converter receives on one MIDI channel only. Incoming MIDI notes replace the current note.
- *Polyphonic* converters generate CVs for a number of voices, controlled by the converter's polyphony setting. Each voice has the same set of CVs; there are also three CVs that apply globally (the paraphonic gate, aftertouch, and bend CVs). A polyphonic converter receives on one MIDI channel only. Incoming MIDI notes are assigned to the voices according to the

Voice Allocation and Prevent Stealing settings.

- *MPE* converters are much like polyphonic converters, but also make use of MIDI Polyphonic Expression or MPE[10]. An MPE converter receives on a number of MIDI channels. The Channel setting is taken as the MPE 'global' channel, so the voice channels will begin one channel up from that. The last channel to receive on is set by the Last Channel setting. So for example if Channel is 2 and Last Channel is 14, the converter will receive MIDI notes on channels 3 to 14.
  As a special case, if the Channel is set to 16, the voice channels will be from 15 down to the Last Channel. This is to support the ‘Upper Zone’ allowed for by the MPE specification.
  MPE converters may have per-channel aftertouch and 'Y dimension' CVs. The y dimension CV is enabled by choosing its CC number; 0 means off. Typically MPE controllers default to CC #74 for the y dimension.

Voice allocation schemes

Polyphonic and MPE converters use the Voice allocation setting to control how new MIDI notes are assigned to the available voices. The options are:

Round robin	Each voice is used in turn. For example, in a 4 voice polyphonic converter, pressing the same note repeatedly will use voice 1, then 2, then 3, then 4, then 1 etc.
Lowest voice	The lowest numbered available voice is used. For example, in a 4 voice polyphonic converter, pressing the same note repeatedly will always use voice 1. Only when a note is held on voice 1 and another note played will voice 2 be used. If the note on voice 1 is then released while voice 2 is held, the next note will use voice 1 again.
Unison	All voices are always used. For example, in a 4 voice polyphonic converter, playing one note will play that note on all 4 voices. Playing 2 notes will play those notes on 2 voices each.
Unison 2	As 'Unison', but with different behaviour when notes stop. In 'Unison' mode, if you hold one note, add another, and then release one, all voices will revert to the one remaining note. In 'Unison 2' mode, if you do the same, both notes will still sound until you hold a new note. 'Unison 2' mode is particularly useful when playing a polyphonic VCO which doesn't have separate per-voice outputs, when you want to play a sequence of chords.
Note range	The voice is allocated strictly by its note number. This is a somewhat experimental option that was added for a specific customer requirement. The complete MIDI note range (0-127) is divided equally amongst the voices. For example, a 4 voice polyphonic converter will assign 32 notes per voice. A note numbered 0-31 will always use voice 1; a note numbered 32-63 will always use voice 2, and so on.

10 https://www.midi.org/articles/midi-polyphonic-expression-mpe

Alternating	Each voice is used in turn, first in increasing order, then in decreasing order. For example, in a 4 voice polyphonic converter, the voices are used in the order 1-2-3-4-3-2-1-2 etc.
Random	The voice is chosen randomly from those available.

All Notes Off

Unless specifically mapped to control something else, MIDI CC numbers 120 and 123 are used by the MIDI/CV converters as All Notes Off messages.

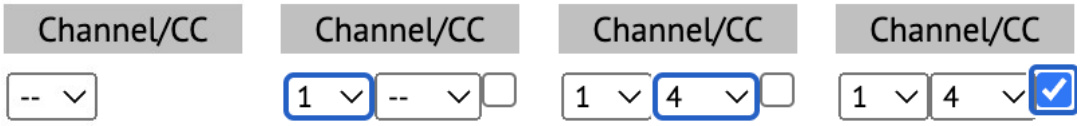
Mappings

Much of an NTX-8CV configuration is devoted to mappings, which defines how the module will respond to MIDI controllers, typically MIDI CCs (continuous controllers).

A configuration can have a maximum of 384 mappings.

Many items that can be controlled by mappings have a range of 0-127 anyway, so the MIDI CC value is simply used directly. In other cases the MIDI CC range of 0-127 is scaled to map onto the range of the controlled parameter.

Mappings are set by UI elements like so:



The left drop-down is the MIDI channel; the right drop-down is the CC number. If either is “--”, the mapping is not defined. The checkbox activates relative (up/down) mode – see below.

Relative (up/down) CCs

Some MIDI controllers support 'relative' mode, where rather than sending out an absolute CC value when you move a control, it will send out a message to increment or decrement the current value. This has the advantage that you never get any ugly jumps due to the controller and module being out of sync; the disadvantage is that the controller isn't aware of the actual current value, so cannot show it on any display it might have.

You can choose absolute or relative mode for each CC mapping.

The NTX-8CV recognises two different relative CC conventions – one uses value '1' for up and '127' for down; the other uses '65' for up and '63' for down. It does so automatically – there is nothing to configure.

14 bit MIDI CCs

Some of the NTX-8CV parameters use a 14 bit representation for higher accuracy: specifically, the Direct levels, the LFO Speed and the LFO Multiplier.

A convention exists for sending 14 bit values via MIDI CCs, using two CCs (of 7 bits each). The high

7 bits are sent on a CC in the range 0-31, and the low 7 bits are sent on the CC numbered 32 higher (which is therefore in the range 32-63). Which of these two CCs is sent first is a matter of some debate – both options are supported on the NTX-8CV, via a setting (see below).

The NTX-8CV configures 14 bit control automatically, if

- one of the three 14 bit quantities is mapped to a CC in the range 0-31, and
- the corresponding low bits CC is not mapped to anything else.

For example, say the direct level on output 5 is mapped to CC 4 on MIDI channel 1 (as it is in the default configuration). Then CC 36 (36 being 4 + 32) on MIDI channel 1 is automatically mapped as the low 7 bits, unless that CC has been explicitly mapped to control something else.

Note that this doesn't mean you have to control these quantities with 14 bit controllers. Sending a single CC to control the mapped value will control it perfectly well, just at a coarser resolution.

Arpeggiators

Most of the arpeggiator functionality is defined by the preset (see below). The configuration defines:

- The arpeggiator clock source when the rate is set to zero, which can be the external clock, or one of the Euclidean patterns.
- The MIDI channel and destination(s) to which to send the arpeggiator pattern.

Clocks

There are 8 clock generators available. These parameters define the clock:

Name	Value range	Description
Output	1-8	The clock output.
Type	0-8	The type of clock output: one of None, Clock, Run/Stop, Stop/Run, Start/Cont, Stop, All Trig, Start, or Start/Stop. See below.
Base	1-96	The rate of the clock, in terms of 24ppqn pulses. Some convenient values include: 24 quarter notes 12 eighth notes 8 eighth note triplets 6 sixteenth notes
Multiplier	1-127	Multiplies the 'clock base' to give the actual clock rate. So for example if 'clock base' is 12 (1/8th notes) and 'multiplier' is 3, the clock will run at a rate of 3/8th notes.
Length	0-127	The length of the clock pulse in milliseconds. The special value '0' means that the clock is not a pulse, but a 50% duty cycle square wave.
Shift	0-127	The amount by which to advance the clock, in terms of 24ppqn pulses. For example a half note clock advanced by a quarter note will fall on the off beats (2 & 4 of a 4/4 pattern).

The available Clock Types are as follows:

Value	Name	Description
0	None	No output.
1	Clock	A clock output, using the other parameters to determine its speed etc.
2	Run/Stop	Outputs a high gate level when the transport is running, low otherwise.
3	Stop/Run	Outputs a low gate level when the transport is running, high otherwise.
4	Start/Cont	Outputs a trigger pulse when the transport starts or continues[11].
5	Stop	Outputs a trigger pulse when the transport stops.
6	All Trig	Outputs a trigger pulse when the transport starts, continues, or stops.
7	Start	Outputs a trigger pulse when the transport starts, but not when it continues.
8	Start/Stop	Outputs a trigger pulse when the transport starts and stops but not when it continues.

Triggers/Gates

There are 8 trigger generators available, which take an incoming MIDI note and generate a trigger or gate signal in response. These parameters define the trigger generator:

Name	Value range	Description
Output	1-128	The trigger output.
Type	0-10	The type of trigger output: one of None, Trigger, Gate, Velocity Trig, Velocity Gate, Accent Trig, Accent Gate, Toggle, On/off Trig, Envelope, Velocity
Channel	1-16	The MIDI channel.
Note	0-127	The MIDI note number to respond to. The special value '--' means the trigger will respond to any note number.
Envelope Settings	1-4	Which MIDI/CV converter's envelope settings to use, if the type is 'Envelope'.

The types of trigger available include 'Trigger', a pulse (set by the configuration's global trigger length), and 'Gate', which stays high as long as the MIDI note is held.

'Velocity Trig' and 'Velocity Gate' use the MIDI note's velocity to set the output trigger level.

'Accent Trig' and 'Accent Gate' generate both the base trigger/gate and an additional accent trigger/gate, on the next output up (e.g. if the trigger output is set to 7, the accent will be on 8). The accent fires when the MIDI note velocity is 96 or more.

A 'Toggle' trigger changes from low to high or high to low at each MIDI note on. (Note offs are ignored.)

An 'On/off Trig' trigger fires a trigger pulse both at note on and at note off.

An 'Envelope' trigger uses an envelope generator, exactly as used by the MIDI/CV converters. The

11 In the sense of a MIDI clock Start or Continue message. The internal and external clocks only start and stop.

envelope times are set via the preset items for one of the MIDI/CV converters; which converter's times are used is set via the Trigger's 'Envelope Settings' parameter. Note that envelopes also use the velocity of the triggering note – again, the velocity depth is set via the chosen MIDI/CV converter's preset.

A 'Velocity' trigger isn't really a trigger at all, but the velocity of the triggering note, which stays constant until the next time it's triggered.

Euclidean Patterns

Most of the Euclidean Pattern setup is in the preset – see below. The configuration only defines the outputs that each pattern generator uses. The 'Output' outputs a trigger whenever a 'pulse' occurs in the pattern; the 'Off Output' outputs a trigger on steps where a 'pulse' does not occur.

Shift Register Random generators

See below for the main documentation of this feature. The configuration sets, for each generator,

- which outputs it uses (if any).
- the MIDI channel on which it generates notes (if any).
- which destinations receive those notes (internal, USB C).
- the source of clocks when the generator rate is set to zero, which can be one of the Euclidean patterns.

Most of the Shift Register Random configuration is in the mapping of its various parameters to CCs.

Output Configurator

The Output Configurator section of the configuration tool contains various features that are set up per-output:

- The output voltage range.
- CC mappings for the Direct Levels (see below)
- CC mappings for the LFOs (see below)
- CC mappings for smoothing (see below)
- The gate levels.

The output voltage range is used by the direct levels, the envelopes, the velocity outputs, the LFOs, and the HID Gamepad. Note that the output voltage is not clamped to the range defined here – the range merely defines the scaling. (Outputs are clamped at ±10V.)

The gate levels are used by anything that outputs a gate-like signal – for example, the clocks, the gates of MIDI/CV converters, the Euclidean patterns etc.

HID Gamepad

This section of the configuration defines the NTX-8CV's response to a connected HID gamepad. Any class-compliant USB gamepad should work. The NTX-8CV's default configuration is set up to give a useful response from a Sony DualShock 4.

There are 32 mapping 'slots' available, each of which maps a 'usage' to an NTX-8CV output. A usage in USB HID terminology is a button press or joystick axis etc.

If a gamepad button is mapped, the button pressed/released status is simply mapped to the selected output, using the gate levels set in the configuration (see above).

If a continuous quantity from the gamepad is mapped (e.g. a joystick axis), you can set a scale and offset that translates the USB HID value to the output value. The values set in the configuration are multiplied by 4 to give a 14 bit value. The output voltage range for the output (see above) is then used to compute a final output voltage.

For example, in the default configuration, axis Y is mapped with scale -16 and offset 4096. The USB HID value is 8 bit i.e. has the range 0-255, so these values cover the full 14 bit range:

4*(4096-16*0)=16384 4*(4096-16*255)=64

HID Keyboard

This section of the configuration defines the NTX-8CV's response to a connected HID keyboard (i.e. a generic USB computer keyboard, not a musical keyboard). The NTX-8CV's default configuration maps the keyboard keys 1-8 to the NTX-8CV's eight outputs.

There are 32 mapping 'slots' available, each of which maps a key to an NTX-8CV output.

There are two types of mapping available: 'Press/Release' and 'Press only'. 'Press/Release' mappings change the output on key press and key release, and as such might be useful as triggers, gates etc. 'Press only' mappings only change the output on key press; this could be used to choose from a number of different CV values for an output, depending on which key was last pressed.

The output values for each key press and release can be set in the configuration. These are in millivolts (mV).

Presets

A preset consists of the following:

- the preset name
- the internal clock tempo
- swing type and amount
- for every output:
  - the direct output levels
  - the LFO state
  - the smoothing amount
- for every MIDI/CV converter:
  - the arpeggiator state
  - the portamento rate
  - the transpose setting
- the Euclidean pattern generator states
- the Shift Register Random generator states

In general most of these can be controlled via MIDI CCs, as defined in the mappings.

The default preset

The default preset is what you get when the module starts up without loading a saved preset, or when you do “Reset preset to defaults”.

Everything is essentially at zero. There are no output voltages, none of the LFOs or pattern generators is active, etc.

Name

The preset name is 16 characters long.

Internal clock tempo

This is the tempo of the internal clock, set directly or via tap-tempo.

Swing

The swing type can be 'Off', '16th note', '8th note', or one of a number of tuplet options. The swing amount goes from 0 (no swing) to 127 (maximum swing). The swing applies globally to anything driven from the NTX-8CV’s internal timebase – the clock outputs, the Euclidean patterns, the sequencers etc.

When set to one of the tuplet options, you can adjust the position of the four 16th notes within a quarter note.

Direct output levels

'Direct' outputs levels is our term for when a MIDI controller directly controls an output e.g. the

controller goes from 0-127 and the output goes from 0-10V.

The direct level is a 14 bit quantity – see above.

The voltage range used by the direct control CCs is set in the Output Configurator section – see above.

LFOs

Each output has an LFO, defined by the parameters below. The LFOs are added to any other CV being generated at a particular output. In the absence of a MIDI/CV converter, clock etc. this means the LFO waveforms are centred around the 'direct level' of the output.

The maximum amplitude of an LFO is set by the voltage range settings for the output – see above. The peak-to-peak LFO amplitude is set by the difference in the minimum and maximum output range values. So, an output range of -5V to 5V defines a maximum LFO swing of ±5V; similarly, an output range of 0V to 10V also defines a maximum LFO swing of ±5V. In the latter case, if you wanted an LFO that actually oscillated between 0V and 10V you would also need to set the direct level to 5V.

The speed of each LFO can be set to a value in Hz, or it can be locked to the current tempo. Which is used depends on the last setting made; setting the 'Speed' switches the LFO into its Hz-based mode, whereas setting the 'Base' or 'Multiplier' switches the LFO into its tempo-synced mode.

Name	Description
LFO Speed	Sets the LFO speed, from 0.1Hz to 10Hz. A logarithmic scaling of the value is used, to allow finer control over the slower end of the range. A 14 bit quantity.
Base	The rate of the LFO, in terms of 24ppqn pulses.
Multiplier	Multiplies the 'Tempo Base' to give the actual LFO rate. So for example if 'Tempo Base' is 12 (1/8th notes) and 'multiplier' is 3, the LFO will run at a rate of 3/8th notes.
LFO Level	This scales the overall waveform that is the result of combining the 6 basic shapes. It defaults to maximum, so to apply an LFO it is only necessary to set one of the basic shapes to a non-zero level. A 14 bit quantity.
Sine	The level of a sine wave's contribution to the LFO shape.
Square	The level of a square wave's contribution to the LFO shape.
PW	Pulse width control for the square waveform.
Triangle	The level of a triangle wave's contribution to the LFO shape.
Saw	The level of a saw wave's contribution to the LFO shape. The saw wave is set to zero at value 64. Values greater than 64 give a rising sawtooth shape; values less than 64 give a falling shape.
Random	The level of a random signal's contribution to the LFO shape.
Noise	The level of a noise signal's contribution to the LFO shape.
Phase	The phase of the LFO waveform.
Fade	The time over which the LFO will fade up from zero when retriggered.

Smoothing

Each output has a 'smoothing' amount. When enabled, a low pass filter is applied to the output to smooth sudden changes into an exponential response. Zero means off; other values apply progressively more smoothing, up to a time constant set by the ‘Max smoothing’ setting.

Smoothing applies to every function of the NTX-8CV: direct control, LFOs, sequencers, etc. You may find it particularly useful to smooth out e.g. aftertouch response in a MIDI/CV converter, but it can also be applied creatively, for example to make new LFO shapes, or to introduce glide on a pitch CV.

Arpeggiators

Each MIDI/CV converter of the NTX-8CV has its own arpeggiator.

The arpeggiator is controlled partly by items in the preset (which can be mapped to MIDI CCs as usual), and partly by CC 'commands', which have no corresponding item in the preset, but which should be considered live, performance controls, in much the same way that triggering MIDI notes drives the arpeggiator without changing the preset as such.

For Polyphonic and MPE converters, each new note in the arpeggio triggers a new voice, using a Round Robin allocation pattern.

It is also possible to output the arpeggiators’ patterns as MIDI. This is set up in the Arpeggiators section of the configuration.

The preset item controls are as follows:

Name	Description
Arp Mode	Mode - see below
Arp Range	Range - the number of octaves to repeat the arpeggiation pattern over. When mapped, CC values 0-127 map to 1-3 octaves.
Arp Gate Len	Gate length - the gate on time as a fraction of the clock rate. 64 is a 50% gate length. 0 is a special value and means a fixed length trigger pulse, unrelated to the clock rate.
Arp Latch	Latch on/off - see below
Arp Rate	The rate of the arpeggiator, in terms of 24ppqn clocks. The special value '0' means that the arpeggiator advances every time the NTX-8CV receives an external clock pulse *or* that the arpeggiator is clocked by one of the Euclidean patterns. (This is useful in order to create irregular arpeggiation rhythms.) See the relevant section of the configuration.
Arp Reset	Sets a number of quarter notes after which the arpeggiator will automatically reset to step 1. This function is disabled if the reset value is set to zero.

The available modes are:

CC value	Mode	Description
0 - 10	Off	The arpeggiator is disabled.
11 - 21	Up	Notes are used in order from lowest to highest.

CC value	Mode	Description
22 - 31	Down	Notes are used in order from highest to lowest.
32 - 42	Alt	Alternately up & down (e.g. 4 notes held gives you a 6 note pattern).
43 - 53	Alt2	Alternately up & down, repeating the highest and lowest notes (e.g. 4 notes held gives you an 8 note pattern).
54 - 63	Step Up	The lowest note alternates with the other notes in the chord, in rising order.
64 - 74	Step Down	The highest note alternates with the other notes in the chord, in descending order.
75 - 85	Step Play	The first note played alternates with the other notes in the chord, in the order played.
86 - 95	Random	The notes held play in a random order.
96 - 106	Random2	Notes are played in a random order, except that the same note cannot be played twice in a row.
107 - 117	Random3	The notes in the chord are played in a random permutation, then another random permutation, and so on.
118 - 127	As Played	The notes are repeated in the order in which they were played.

If 'latch' is enabled, notes are held until all keys are released and a new note played. This makes it particularly easy to play a chord, have it repeat and arpeggiate, play another chord, and so on.

The 'command' controls are as follows:

Name	Description
Add	While the CC is 64 or more, incoming MIDI notes will be added to the arpeggiation pattern. This is most useful when the Mode is 'As Played' and Latch is on. It allows you to have repeated notes in the pattern.
Remove	While the CC is 64 or more, incoming MIDI notes will be removed from the pattern (if the note in question is actually in the pattern already). If the same note appears multiple times, the last occurrence will be removed.
Rest	When the CC transitions from below 64 to 64 or more, a rest is added to or removed from the arpeggiation pattern, according to whether Add or Remove is currently active.
Truncate	Scales the total length of the arpeggiation pattern according to the CC value, from 1 step at CC value 0, to the full length at CC value 127.
Transpose	While the CC is 64 or more, incoming MIDI notes will transpose the current pattern, by the amount of the difference between the incoming note and the root note of the pattern. The root note is by default the lowest note of the pattern, but see 'Set root' below.
Transpose in key	Like Transpose, but rather than a straight chromatic transposition, the pattern is transposed within the key defined by the root note. For example, if the pattern is C-E-G (root note C) and D is played, 'Transpose' will produce D-F♯-A, whereas 'Transpose in key' will produce D-F-A.

Name	Description
Set root	While the CC is 64 or more, an incoming MIDI note overrides the root note, so that subsequent transposition is based on the overridden note. For example, if the pattern is E-G-C, the default root note will be E, but you could use the 'Set root' command to let the arpeggiator know the key is C.

For the commands such as 'Add' which take effect while the CC is 64 or more, it is up to you and how you program your MIDI controller whether you want the control to be momentary (i.e. taking effect only while you're holding down a button, like a shift key) or latching (i.e. taking effect until you turn it off, like a caps lock key).

Portamento

Monophonic and Unison MIDI/CV converters use the portamento setting. This sets a glide time between notes played legato ("fingered portamento").

Transpose

Each MIDI/CV converter has a transpose setting, which transposes its notes up or down in semitones.

Euclidean Patterns

These generate rhythmic patterns of output pulses known as Euclidean patterns. For a detailed description of these patterns and how they are commonly found in music around the world see e.g. here[12] or here[13].

A pattern is described by the total number of steps and the number of pulses (i.e. the number steps on which a pulse is output). There is also the 'rotation' of the pattern. At zero rotation, the first step in the pattern will always be a pulse, and the remaining pulses distributed according to the algorithm. The rotation setting moves the first pulse by a number of steps i.e. moves the down beat.

Each Euclidean generator also has an Accent Rate. If enabled, this superimposes a regular accent on the pattern (so for example you could have a pattern in 16th notes with an accent on every quarter note). In terms of the output, the unaccented pulses are scaled down by a percentage set in the configuration globals (see above).

12 https://en.wikipedia.org/wiki/Euclidean_rhythm

13 http://www.hisschemoller.com/blog/2011/euclidean-rhythms/

The controls are as follows:

Name	Description
Pulses	See above. A value of '0' effectively turns the generator off.
Steps	See above. The maximum number of steps is 32.
Rotation	See above.
Rate	The rate of the pattern, in terms of 24ppqn clocks. The special value '0' means that the pattern advances every time the NTX-8CV receives an external clock pulse. (This is useful in order to create irregular rhythms.)
Gate Length	Gate length – the gate on time as a fraction of the clock rate. 64 is a 50% gate length. 0 is a special value and means a fixed length trigger pulse, unrelated to the clock rate.
Accent Rate	The accent rate, in terms of 24ppqn clocks, or zero for off (no accents).
Reset	Sets a number of quarter notes after which the pattern will automatically reset to step 1. This function is disabled if the reset value is set to zero.

Envelopes

Each MIDI/CV converter of the NTX-8CV has a per-voice envelope generator, of the traditional ADSR variety.

The controls are as follows:

Name	Description
Attack	The envelope's attack time.
Decay	The envelope's decay time.
Sustain	The envelope's sustain level.
Release	The envelope's release time.
Range	Defines the time range for the Attack, Decay, and Release controls. The options are 200ms, 500ms, 1s, 2s, 5s, 10s, 20s, and 50s.
Depth	The envelope's depth i.e. amplitude. A value of 64 means zero depth; values greater than 64 mean a positive depth; values below 64 mean a negative depth.
Velocity Depth	The amount by which the note on velocity affects the envelope's depth. At 64, the velocity has no effect on the envelope. For values above 64, the envelope's depth is increasingly affected by velocity. For values below 64, the envelope's depth is inversely related to the velocity i.e. higher velocity gives a smaller envelope.
Attack Shape	The envelope's attack shape.
Decay Shape	The envelope's decay shape.
Release Shape	The envelope's release shape.

The maximum amplitude of an envelope is set by the voltage range settings for the output – see above.

Note that the envelope's depth setting is bipolar (centred around 64). For negative-going envelopes, you may want to set the direct output level to give the envelope a non-zero starting point.

Random Depth

(Note that this is located under the “Envelopes” section of the configuration tool.)

Sets the scaling of the random voltage produced if a MIDI/CV converter has a “Random” output, from 0 (no output) to 127 (maximum output). The actual voltage range depends on the output's Range setting. If the Range is bipolar (e.g. ±5V), then the random voltage will also be centred around 0V.

Shift Register Random generators

These generate random CVs via the popular rotating shift register method. The joy of this method is that it generates a loop of CVs, with a controllable likelihood of change, including the possibility to lock the loop so it does not change.

They can be used to control the module's CV outputs directly, or to generate MIDI notes, which can then be used to control external hardware, or to drive the NTX-8CV's own MIDI/CV converters.

The CVs can be unquantized, or quantized to semitones or to a musical scale, or to a selection of notes provided via MIDI.

There are 8 independent Shift Register Random generators available.

Configuration

Most of the setup in order to use the Shift Register Random generators is in setting up CC mappings to the various preset items which define their operation. There are however some aspects of the generators which are part of the Configuration.

Outputs

Each generator can use up to three outputs. It may use none at all, if it is purely generating MIDI. The three outputs available are:

- CV – this is the random control voltage, potentially quantized if a quantization is selected.
- Change – this is a gate output, which fires when the CV output changes.
- Trigger – this is a gate output, which fires when the leftmost bit in the shift register is high.

Typically you would use the CV & Change outputs as a CV/gate pair to generate melodies, while the Trigger output is a useful source of random rhythms, but you can of course mix and match to your liking.

Notes input

You can configure a MIDI channel on which the generator will receive MIDI notes, and use these for the two 'MIDI' quantization modes.

MIDI output

Each generator will optionally generate MIDI notes, which are derived from the random CV. Since MIDI notes are intrinsically quantized, these notes will be quantized even if the CV itself is not.

The MIDI notes can be sent out via USB or used internally (for example, by the MIDI/CV converters).

Clock source

Normally, the generators are synced to the NTX-8CV's global clock. If the generator's Rate is set to zero, it will be clocked by whatever is set for its 'Clock source' in the Configuration. This can be one

of the Euclidean pattern generators.

Preset

The guts of the Shift Register Random generators lie in the CC-mapped items which are part of the Preset. These are:

Name	Description
Direction	Controls in which direction the shift register rotates – forwards, backwards, or stop. The two directions have a different sound to the patterns they tend to generate. Note that this defaults to ‘stop’. This is the one parameter that you absolutely must change (either manually or via CC mapping) for the generator to function.
Length	Sets the number of bits in the shift register, and so the length of the repeating CV pattern in terms of clocks.
Randomness	On each clock the shift register rotates and a new CV is output. On each rotation, there is the possibility that one bit of the shift register will be flipped, changing the pattern. The likelihood of a flip is set by this parameter, Randomness. When set to 64 (mid-range) there is a 50% chance that the bit will flip, which is the most random setting. As the parameter rises, the chance of a flip reduces, until at 127 the chance of a flip hits zero and the pattern is effectively locked. Conversely, as the parameter goes below 64, the chance of a flip goes up, reaching 100% at 0. This also effectively locks the pattern, but at twice the length (since it is alternating between the locked pattern and its inverse).
Rate	Sets the clock speed, in terms of 24ppqn clocks.
Attenuator	Sets the maximum amplitude of the random CV. At 127, the CV uses the full range of the output (according to the output’s voltage range setting). At lower values, the amplitude of the CV is reduced, towards zero. Note that this implies a slightly different behaviour depending on whether the output’s voltage range is bipolar (e.g. ±5V) or unipolar (e.g. 0-10V).
Scale	Chooses whether the CV is quantized, and if so, to what scale. See below for more detail.
Key	If the CV is quantized, this sets the key of the scale.
Gate Length	Sets the length of the gates on the Change or Trigger outputs, as a fraction of the clock rate. If set to zero, the global trigger length as set in the Configuration is used.

Quantization

The ‘Scale’ parameter chooses how to quantize the CV. The first option is ‘Unquantized’, which applies no quantization at all. The other options are:

Display name	Description
Chromatic	Chromatic scale.
Major	Major scale.

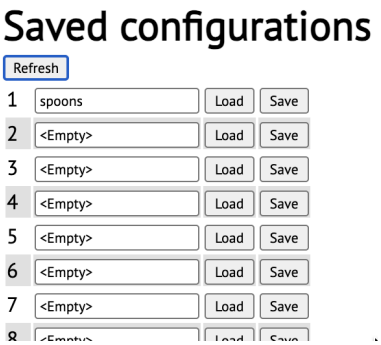
Display name	Description
Minor	Melodic minor (ascending) scale.
Triad	Major triad.
3b+5	Minor triad.
Fifth	Root and fifth.
Triad+6	Major triad plus sixth.
3b+5+6	Minor triad plus sixth.
Triad+7	Major triad plus seventh.
3b+5+7	Minor triad plus seventh.
5+6	Root, fifth, and sixth.
5+7	Root, fifth, and seventh.
Pent	Pentatonic scale.
Minor Pent	Minor pentatonic scale.
Nat Minor	Natural minor scale.
Harm Minor	Harmonic minor scale.
MIDI-octve	Uses MIDI notes played on the ‘Notes input’ MIDI channel. Allows the quantizer to choose notes as held, but in any octave. For example, if you hold any C and any G on your keyboard, the quantizer is free to choose any C or G.
MIDI-exact	Uses MIDI notes played on the ‘Notes input’ MIDI channel. Allows the quantizer to choose only the actual notes played. For example, if you hold C4 and G5, the quantizer may only choose C4 or G5, not any other C or G.

The ‘Key’ parameter chooses the key of the scale, except for the two ‘MIDI’ options, in which case it applies a transposition of the notes played.

Saving and loading configurations and presets

Configurations and presets can be saved in the module's flash memory. There are 30 slots for each.

The "MIDI/CV Configuration" and "MIDI/CV Preset" pages of the configuration tool present identical interfaces for viewing, loading, and saving configurations and presets respectively.



Every configuration/preset is shown in a list. Each row shows the number, the name, and buttons for 'Load' and 'Save'. The name field shows "<Empty>" if nothing is saved in that slot.

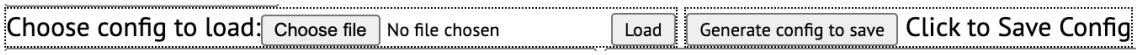
Note that saving is fully manual. If you make changes, they are lost when the module is powered off unless you save them.

There are settings for which configuration and preset are loaded at power on – see below.

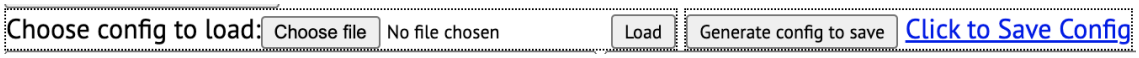
Loading an empty slot will reset the current configuration/preset to defaults.

Saving and loading to your computer

You can also save configurations as SysEx files, which are compatible with standard SysEx librarian software, for example, SysEx Librarian by Snoize[14]. This is done via this section of the UI:



To save the configuration to your computer, first click "Generate config to save". The text "Click to Save Config" will then become a link:



Click or right-click the link to download and save the file (remember you're working in a browser, so the paradigm is the same as when downloading items from the web).

To load a saved configuration, click the "Choose file" button and choose the file, and then press "Load".

14 https://www.snoize.com/SysExLibrarian/

Settings

The “Settings” page of the configuration tool is split into several sections, as follows.

All settings are persistent and are stored in the module as soon as they are changed.

Resetting the settings

The button at the top of the page “Reset settings to defaults” resets all settings to default values.

MIDI/CV settings

These settings relate to MIDI/CV conversion.

Setting	Value range	Function
Startup configuration	None, Last used, 1-30	The configuration number to load at startup. ‘None’ will start up the module with a default configuration (as if you’d done “Reset configuration to defaults”). ‘Last used’ will start up the module with the last configuration that was loaded or saved.
Startup preset	None, Last used, 1-30	The preset number to load at startup. ‘None’ will start up the module with a default preset (as if you’d done “Reset preset to defaults”). ‘Last used’ will start up the module with the last preset that was loaded or saved.
Stop LFOs when no clock	On/off	When set, causes tempo-synced LFOs to stop when all internal and external clocks are stopped.
Constrain rates	Off, 32nd note, 16th note, 8th note	Constrains tempo-based rates (e.g. the arpeggiator rate) set from MIDI to multiples of the given division.
MIDI channel for configuration Program Change	Off, 1-16	Sets a MIDI channel on which Program Change messages will change the current configuration, or 'Off' to disable this feature.
Ignore MIDI clock	On/off	If set, ignore incoming MIDI clock messages.
Enable MMC (MIDI Machine Control)	On/off	If set, the NTX-8CV responds to MIDI Machine Control messages (by starting or stopping its internal clock).

Setting	Value range	Function
Enable MIDI clock out	Off, On, Clocks only	Enable output of MIDI clock. The options are "Off", "On" (start and stop messages are sent) and "Clocks only" (no start and stop messages are sent).
14 bit CC byte order	LSB first, MSB first	Sets whether 14 bit CCs are received as LSB-first (the default, and most common) or MSB-first.
Nudge amount	1-100	The percentage change in tempo applied by the ‘Nudge faster/slower’ function.
Send all CCs on preset load	On/off	If set, loading (or resetting) a preset will send out MIDI CCs for all mapped controllers.
Always load direct levels	On/off	If set, the Direct Levels from a preset are always applied to the outputs. If not set, Direct Levels are only applied to outputs not controlled by other functions, for example, MIDI/CV converters.
Max smoothing	1-100	Sets the maximum amount of smoothing, in seconds (approximately).

USB settings

These settings relate to the USB port and to USB audio functionality.

Setting	Value range	Function
Enable NTX-8CV to be USB host	On/off	This setting defaults to ‘On’. If ‘Off’, the NTX-8CV will not function as a USB host, only as a device. This can be helpful if you only plan to use it as a device – it avoids the situation where you connect the NTX-8CV to your laptop and the laptop decides to be a device and to start charging from the NTX-8CV port.
Allow USB audio host to change sample rate	On/off	If ‘On’, the USB host can change the NTX-8CV’s sample rate from the available options. If ‘Off’, the NTX-8CV’s sample rate is fixed (to that set in Global Settings, below) and any DAW connected to it will have to run at that rate.
Enable audio channel 1-8	On/off	Enables each NTX-8CV output for use by USB audio. If a channel is unchecked here, it can be used for MIDI/CV conversion when the module is selected as a USB audio device on your computer.

disting NT expander settings

These settings relate to using the NTX-8CV as an expander for a disting NT.

Setting	Value range	Function
Channel Group	1-8 thru 57-64	Sets the channel group for this module. NTX-8CV channels are enabled in groups of 8, and correspond to 8 consecutive busses. “Channels 1-8” correspond to Aux busses 1-8, “Channels 9-16” to Aux busses 9-16, and so on. Note that the corresponding channel group needs to be enabled in the disting NT settings.
Also use ES-5	On/off	Allows the NTX-8CVs to share the connection with an ES-5 module and up to two connected ESX expanders (using slots GT1/2/3 on the ES-5). Note that the corresponding setting also needs to be enabled on the disting NT.

Global settings

These settings are basic settings affecting the whole module.

Setting	Value range	Function
SysEx Device ID	0-126	Sets the ID of the module, allowing for multiple modules to share a MIDI port. See “Connecting to the NTX-8CV”, above.
Sample rate	32kHz, 44.1kHz, 48kHz, 88.2kHz, 96kHz	Sets the module’s sample rate. Note that a USB audio host may change the sample rate (if allowed by the setting, above), but this is temporary and doesn’t change this setting – rebooting the module will return it to the sample rate set here.

Firmware update

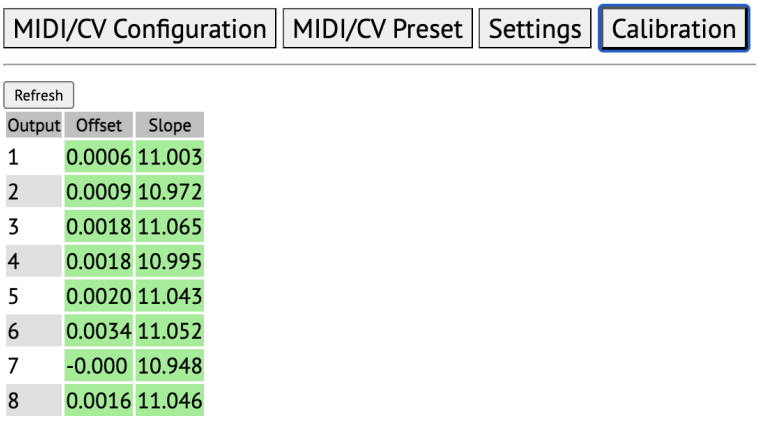
This section contains just two buttons.

“Reboot” reboots the module, just as if it had been powered off and on again.

“Reboot in bootloader mode” boots the module into a state in which it can receive a firmware update. See below for more information on updating the firmware. Note that in this state, the module no longer communicates with the configuration tool. Simply power cycle it to return to normal operation without updating the firmware.

Calibration

The “Calibration” page of the configuration tool allows you to view the module’s calibration. At some point in the future it may also allow you to adjust the calibration, but this is not currently possible.



Output	Offset	Slope
1	0.0006	11.003
2	0.0009	10.972
3	0.0018	11.065
4	0.0018	10.995
5	0.0020	11.043
6	0.0034	11.052
7	-0.000	10.948
8	0.0016	11.046

MIDI Machine Control (MMC)

The NTX-8CV responds to a small subset of the MMC protocol.

MMC commands 2 (play) & 3 (deferred play) cause the NTX-8CV to start its internal clock.

MMC commands 1 (stop) & 9 (pause) cause the NTX-8CV to stop its internal clock.

The NTX-8CV will respond to MMC commands that use SysEx device ID 0x7f (broadcast), or the ID defined in the settings (see above).

MIDI SysEx reference

The NTX-8CV supports a variety of functions via MIDI System Exclusive (SysEx) messages.

The browser-based tools here[15] can be considered as informal documentation of these messages, as in most cases the messages only exist to support these tools.

SysEx Header

All SysEx messages are prefixed with a manufacturer's ID, which is a unique series of hex bytes assigned by the MIDI Manufacturers Association. The Expert Sleepers ID is 00H 21H 27H, so all SysEx messages relating to Expert Sleepers hardware will begin

F0 00 21 27

Messages for the NTX-8CV follow this with 6AH:

F0 00 21 27 6A

followed by the module's SysEx ID (see the Settings, above)

F0 00 21 27 6A <SysEx ID>

and then with a byte to identify the specific type of message e.g.

F0 00 21 27 6A <SysEx ID> 01

Received SysEx messages

10H – Upload configuration

F0 00 21 27 6A <SysEx ID> 10 <configuration data> F7

Uses the enclosed data as the NTX-8CV's currently active configuration.

15 https://github.com/expertsleepersltd/distingNT/tree/main/tools

13H – Upload preset

F0 00 21 27 2F 6A <SysEx ID> <preset data> F7

Uses the enclosed data as the NTX-8CV's currently active preset.

18H – Save configuration to flash

F0 00 21 27 6A <SysEx ID> 18 <configuration index> F7

This causes the NTX-8CV to save its current configuration to flash. If ‘configuration index’ is zero, the most recently loaded or saved configuration slot is saved over. Otherwise, the indexed slot is used.

19H – Save preset to flash

F0 00 21 27 6A <SysEx ID> 19 <preset index> F7

This causes the NTX-8CV to save its current preset to flash. If ‘preset index’ is zero, the most recently loaded or saved preset slot is saved over. Otherwise, the indexed slot is used.

21H – Request configuration dump

F0 00 21 27 6A <SysEx ID> 21 F7

This causes the NTX-8CV to respond with a SysEx message containing the currently active configuration. The response message is in exactly the format of the '10H - Upload configuration' message above, so that it can be recorded into and played back from a SysEx librarian tool (for example, this1).

22H – Request version string

F0 00 21 27 6A <SysEx ID> 22 F7

This causes the NTX-8CV to respond with a SysEx message containing the module's version string as text, using the '32H – Message' format, below.

23H – Request preset dump

F0 00 21 27 6A <SysEx ID> 23 F7

This causes the NTX-8CV to respond with a SysEx message containing the currently active preset. The response message is in exactly the format of the '13H - Upload preset' message above, so that it can be recorded into and played back from a SysEx librarian tool.

49H – Request configuration name

F0 00 21 27 6A <SysEx ID> 49 F7

This causes the NTX-8CV to respond with a SysEx message containing the name of the current configuration, using the '49H – Configuration name' format, below.

4AH – Request preset name

F0 00 21 27 6A <SysEx ID> 4A F7

This causes the NTX-8CV to respond with a SysEx message containing the name of the current preset, using the '4AH – Preset name' format, below.

4BH – Request clock info

F0 00 21 27 6A <SysEx ID> 4B F7

This causes the NTX-8CV to respond with a SysEx message containing information about the current clock source and tempo, using the '4BH – Clock info' format, below.

7FH – Reboot

F0 00 21 27 6A <SysEx ID> 7F F7

F0 00 21 27 6A <SysEx ID> 7F 7F F7

There are two forms of this message. The first simply reboots the module. The second (with the double 7FH) reboots the module into bootloader mode.

Sent SysEx messages

10H – Upload configuration

See above. This message is transmitted in response to a '21H - Request configuration dump' message.

13H – Upload preset

See above. This message is transmitted in response to a '23H - Request preset dump' message.

32H – Message

F0 00 21 27 6A <SysEx ID> 32 <NULL terminated ASCII string> F7

This message is transmitted in response to a '22H - Request version string' message.

49H – Configuration name

F0 00 21 27 6A <SysEx ID> 49 <ASCII string> F7

This message is transmitted in response to a '49H – Request configuration name' message.

4AH – Preset name

F0 00 21 27 6A <SysEx ID> 4A <ASCII string> F7

This message is transmitted in response to a '4AH – Request preset name' message.

4BH – Clock info

F0 00 21 27 6A <SysEx ID> 4B <tempo as float packed into 5 bytes> <current clock source> <bitmask of which USB sources are sending clocks> F7

This message is transmitted in response to a '4BH – Request clock info' message.

Updating the firmware

The NTX-8CV's firmware is updated over its USB connection. You will need a computer and the appropriate USB cable to connect the module to it.

You can jump directly to any firmware version – you don't need to apply them incrementally. You can upgrade or downgrade at will, but note that older firmware versions may not be able to read configurations or presets saved with newer versions; similarly, if you downgrade you may find that your settings reset to defaults.

There are a number of ways of updating the firmware. In all cases, you first need to:

- Download the firmware from our website here[16].

  When downloading the firmware, do not let the browser automatically unzip the file (in Safari the option is "Open safe files after downloading" - that needs to be off). The tools require that you give them the original zip file.

- Put the NTX-8CV into bootloader mode, which you do either via the configuration tool (see above) or via the jumper (see above).

Method 1: ntx-flash

We provide a command line tool for updating the firmware, which builds for macOS, Linux, and Windows. You will find it in our GitHub here[17].

You can build the tool from source yourself, or you can download a pre-built release from the releases page here[18].

Instructions for building and running the tool are on the GitHub page.

Method 2: NXP GUI tool

If you wish, you can use the tool provided by the chip vendor NXP.

Download and install the correct version of the "MCUXpresso Secure Provisioning Tool". It is available for macOS, Linux, and Windows. Note that various versions of the tool may be available. You need to use the correct version that matches the NTX-8CV firmware package that you want to install. The tool version for each firmware version is noted on the firmware download page.

Download the tool for your platform of choice from this page[19]. The NXP website requires you to sign up for an account to do so and asks for a surprising amount of information. You can of course just

16 https://expert-sleepers.co.uk/ntx8cvfirmwareupdates.html

17 https://github.com/expertsleepersltd/ntx-flash

18 https://github.com/expertsleepersltd/ntx-flash/releases

19 https://www.nxp.com/design/design-center/software/development-software/mcuxpresso-software-and-tools-/mcuxpresso-secure-provisioning-tool:MCUXPRESSO-SECURE-PROVISIONING

make this up if you prefer to remain anonymous.

Follow the documentation provided by NXP to import the zip and flash the firmware.

Acknowledgments

Thanks to Neal Sanche (aka thorinside[20]) for the firmware update tool.

20 https://github.com/thorinside