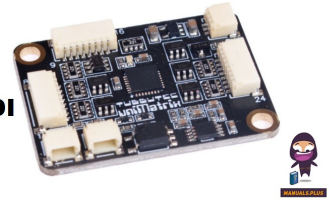
 **Unimatrix**
D879 Universal MIDI
Interface
Synthesizers



uniMatrix D879 Universal MIDI Interface Synthesizers Instruction Manual

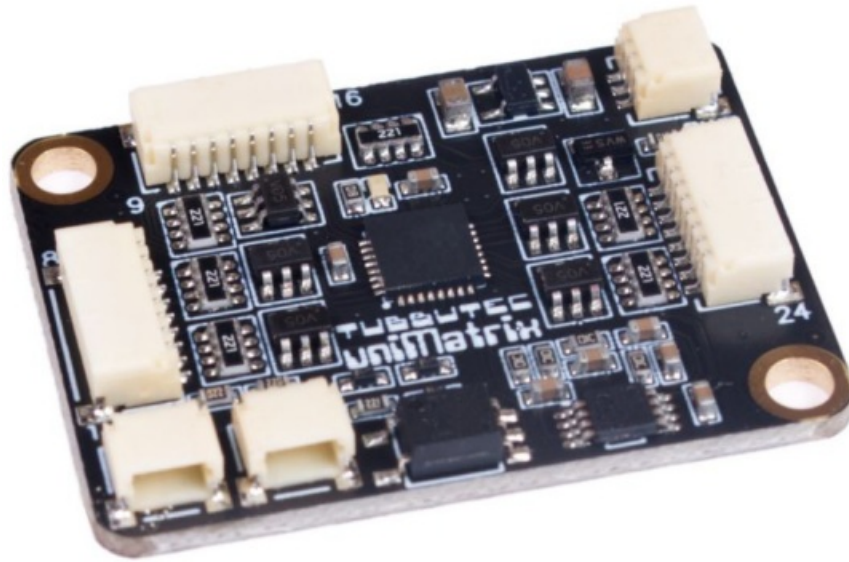
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uniMatrix D879 Universal MIDI Interface Synthesizers



Product Usage Instructions

- The uniMatrix is a versatile MIDI interface with various synthesizers, drum machines, and effects. It can interface with keyboard matrixes and provide MIDI input and output, as well as control analog and digital parameters.
- Before using the uniMatrix, ensure that it is properly installed in your gear according to the specific machine's user guide available on the manufacturer's website.
- Use the configurator tool provided to configure the uniMatrix to suit your specific requirements. This tool allows you to customize the MIDI settings and control parameters as needed.
- Connect the unit matrix to your synthesizer, drum machine, or other gear using the appropriate cables. Configure the input and output settings using the configurator tool to control various aspects of your equipment via MIDI.
- It may be unsuitable for string synthesizers or organs unless they use a diode matrix. For such devices, consider using the OrganDonor interface.

FAQ

- **Q: Can uniMatrix be used with all synthesizers?**
 - **A:** uniMatrix is designed to work with synthesizers that use keyboard matrixes. However, it may not be compatible with string synthesizers or organs unless they have a diode matrix.
- **Q: How many input and output signals does uniMatrix support?**
 - **A:** uniMatrix supports up to 9 input signals and 16 output signals, allowing for versatile control over various parameters.

Introduction

- uniMatrix is a universal MIDI interface suitable for many synthesizers, drum machines, and other gear. It can interface existing keyboard matrixes directly and provide MIDI input and output. Additionally, it offers multiple inputs and outputs to control or read additional parameters both analog and digital. These features allow it to control many aspects of a synthesizer, not just the keyboard. Often, sound or patch settings, filter cutoff, or similar can be controlled as well.

- uniMatrix is freely configurable by using our [configurator tool](#).
- This manual explains how uniMatrix works and how it can be utilized to add MIDI to various types of gear. This is not a user guide on how to install uniMatrix in a specific machine, or how to use a uniMatrix modified machine. For specific machines, we do have install and user guides on our website.
- If a manual exists for a specific machine, you probably do not need to read this document.

Features

- Midi input and (in some cases) output
- Freely configurable universal midi interface
- Can interface existing keyboard matrixes of any size up to 13×9, each contact freely configurable
- Supports Notes, CC, program change, and more
- Up to 22 I/O pins can be configured as digital inputs and outputs
- Outputs up to 22 MIDI clocks with adjustable divider and MIDI start/stop signals
- 2 additional CV-outputs to control filter or other parameters
- 6 pins configurable as CV inputs
- Short-push mode to simulate short button presses
- Optional learn button to change the MIDI channel quickly
- Small size fits into almost any gear
- 3-12V supply voltage, 3-5V signal voltage
- All I/Os with over-voltage protection
- DIN or TRS Midi sockets available

What is uniMatrix

- uniMatrix is retrofitted by Tubbutec and designed to provide a MIDI interface to various types of synthesizers, drum machines, or effects.
- Specifically, it can interface keyboard diode matrixes, but can also provide digital and analog outputs to interface other kinds of architectures. Furthermore, uniMatrix can be used to output MIDI from key presses, or analog voltages. The turn of a knob of a synthesizer could be sent out via MIDI CC for example.
- uniMatrix is not suited to interface string synthesizers or organs (unless they use a diode matrix). For this purpose, please have a look at our OrganDonor interface. For drum machines, please see uniPulse. Even though uniMatrix provides two CV outputs, these are not designed to output pitch CVs. An interface to control synthesizers via CV/Gate is in development.

Interfacing keyboard matrixes

Many electronic devices utilize a circuit called keyboard matrix, sometimes also referred to as diode matrix to read buttons and switches. Here, buttons are arranged in a grid defined by several output pins and input pins. Typically, each button has a diode in series to prevent cross-talk. Each output is turned on one by one and the inputs are read. This allows it to read many buttons with a relatively small amount of pins.

uniMatrix can interface this type of configuration by 'listening' to the outputs and injecting the correct stimulus signal into the device inputs at the right time. uniMatrix supports both kinds of polarities. Up to 9 input (N) and 16 output (M) signals are supported, where $N+M \leq 22$. uniMatrix can also generate MIDI output by reading the buttons or keys connected to the keyboard matrix, debouncing and sending out corresponding midi messages. In some cases, MIDI input and output can even work simultaneously, but this depends on various timing factors and can not be guaranteed to work.

Each button in a matrix can be freely configured to react to MIDI notes, CC, or program change messages.

Furthermore, uniMatix can simulate short button presses automatically.

Types of matrixes

A keyboard matrix has some outputs N and many inputs M forming an $N \times M$ grid. There are two types of matrix polarity: Active high and active low.

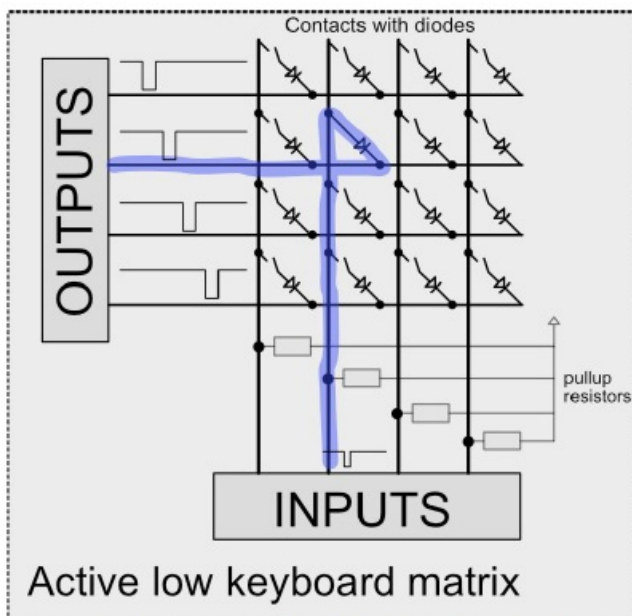
In active high matrixes, the signals at the outputs are normally low and turn high sequentially to read one row of the matrix. At the input side, pulldown resistors are used to prevent the inputs from floating. If a button is pressed, the signal at the corresponding input becomes high via the path through the switch and diode.

In active low matrixes, the signals at the outputs are normally high and turn low sequentially to read one row of the matrix. At the input side, pullup resistors are used to prevent the inputs from floating. If a button is pressed, the signal at the corresponding input gets pulled low via the path through the switch and diode.

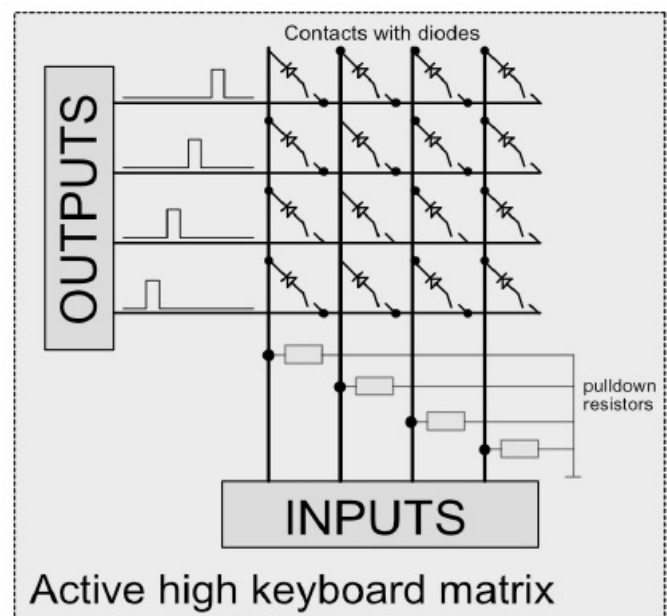
Identifying the matrix type

The simplest way to identify the matrix type is to check if the circuit uses pulldown or pullup resistors. This directly identifies the location and number of inputs and outputs and the matrix polarity.

In some cases, however, the pull resistors are internal to an IC. Here, it is not directly possible to identify inputs and outputs. A multimeter, or even better an oscilloscope can be used to find outputs (they carry a signal), and inputs (they only carry a signal when a key is pressed). If an input measures high without pressing a key, the matrix is active low. If it measures low without pressing a key, it is active high. The polarity of the diodes can also give some clues.



Active low keyboard matrix with pullup resistors. One switch is closed allowing output signal to drive an input high

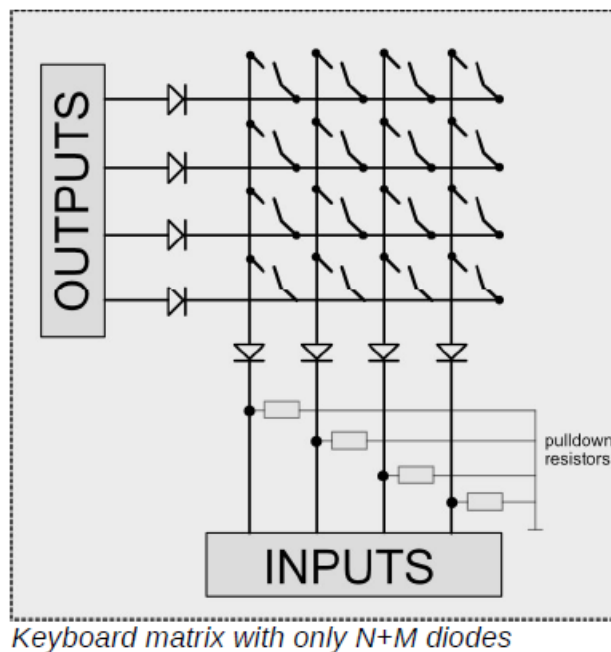


Active high keyboard matrix with pulldown resistors.

Fewer diodes

Some keyboard matrixes save on diodes and only use them at the outputs and inputs ($N+M$), instead of for every key ($N \times M$). This diode saving has some drawbacks:

- $N \times M$ diodes: All keys can be detected simultaneously without interference
- $N+M$ diodes: Can detect up to 2 keys pressed correctly, but will create an additional 'ghost' key pressed if more are pressed.

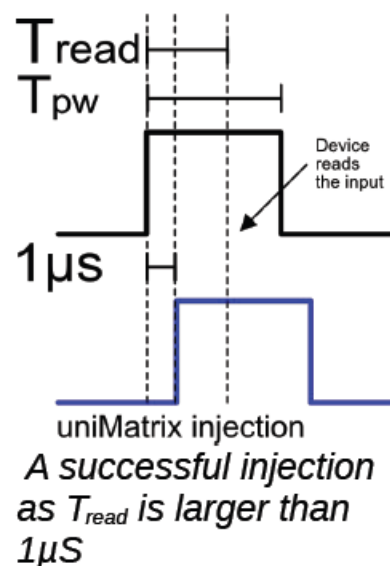


Timing

MIDI input timing

The sequential output signals of a host device have a certain width of time T_{pw} . At some point, while the signal is active, the device reads the state of its inputs. At this moment, the injection signal from uniMatrix needs to be present. Otherwise, the key press will not be detected. The typical delay between an output signal change and the injection signal generated by uniMatrix is about $1\mu S$.

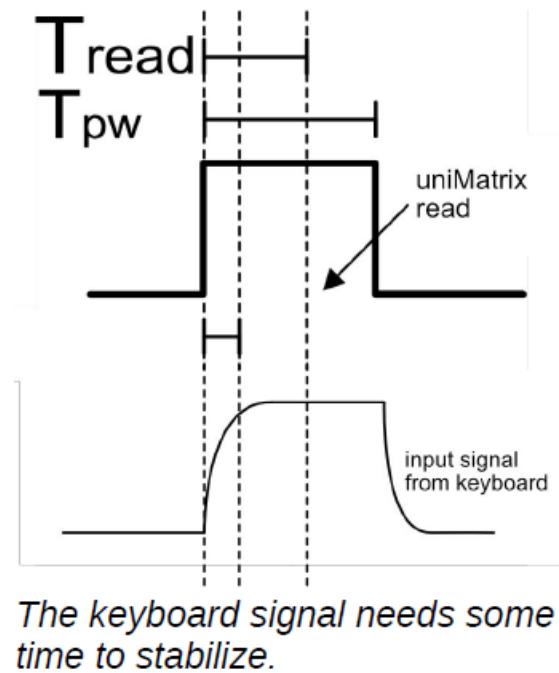
The time T_{read} is usually not known, so it is hard to predict if uniMatrix will work in advance. However, by looking at the pulse width T_{pw} , one can at least get an idea. If T_{pw} is much larger than $1\mu S$, you can be pretty certain, that it will work. In many devices, T_{read} is typically in the order of $10\mu S - 1ms$, to allow correct keyboard reading and circumvent issues with keyboard capacitance. However, we have also found an instance of a synthesizer with $T_{read} < 1\mu S$ (a Kawai SX210). In such a case uniMatrix will not work and we recommend using our OrganDonor interface instead.



MIDI output timing

- The same reason the host device needs to wait a little bit after sending the output signals is also true for uniMatrix in MIDI output mode.
- Due to keyboard capacitance, it takes a while for the keyboard signal to be valid.

- The waiting delay of uniMatrix is adjustable in 50ns steps



Simultaneous input and output

- uniMatrix supports simultaneous MIDI input and output. However, this feature is not guaranteed to work as its success greatly on the signals generated by the host device.
- Essentially, uniMatrix will first read the state of the host device's input signals to generate MIDI output and then inject its signals into the inputs. The read must happen at a time when the keyboard signals are already stable, but still, the injection must happen before the host device reads the state.
- This can sometimes be tricky, especially when the host happens to read different keys at different times.

The problem with simultaneous MIDI input and output

When trying to use MIDI input and output simultaneously, depending on the way the host device scans the matrix problems can arise. We can not guarantee MIDI input and output to work on all devices simultaneously.

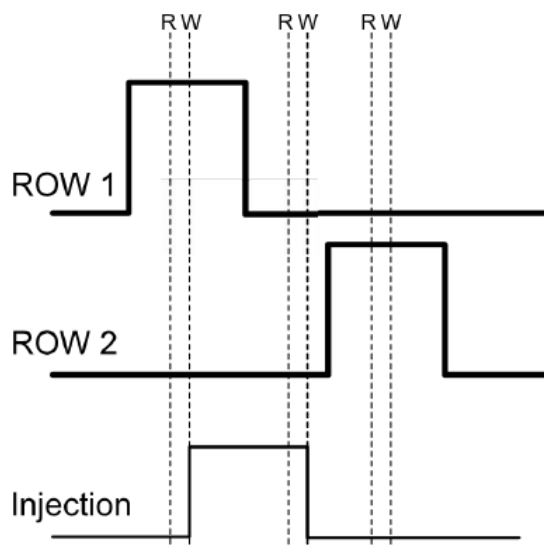


Figure 2: the injection signal turns off before the next row read

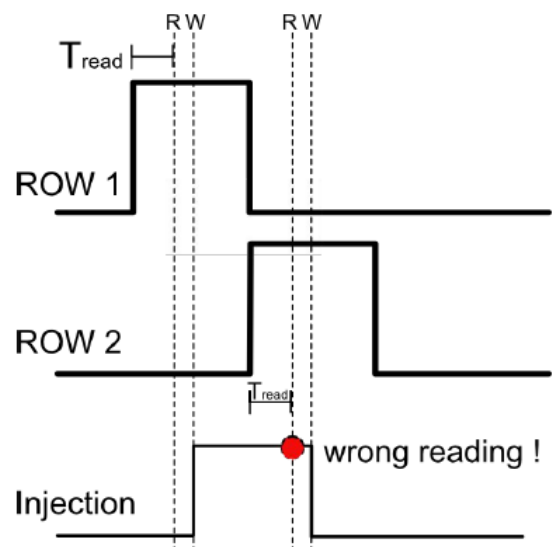


Figure 1: The read occurs before the injection signal turns off, resulting in an incorrect reading

- Figure 1 shows a situation, where the host device outputs a selection signal on row 1, then turns it off, and after a break turns on the activation signal for row 2. You can see, that the uniMatrix injection signal is delayed by the configured Tread time and not active when row 2 is read. In this case, there is a well-defined separation between read and write events and MIDI input and output possible simultaneously.
- In figure 2 however, the host devices turn off row 1 and simultaneously turn on row 2. When uniMatrix reads the signals for ROW2, its injection signal has not turned off yet. The result is an incorrect reading. In such a case, sending a note to uniMatrix will result in a different note being returned from uniMatrix via MIDI.
- One way to fix this behavior is shown in Figure 3: Every time the row signals change, uniMatrix first turns off all injection signals and only turns them back on after reading. In theory, this solves the above issue, but can cause other problems, mostly due to keyboard capacitance. It can be very difficult to find the right value for Tread. In one synthesizer we tested, incorrect output notes were eliminated for some keys, but not for others.
- This mode is available as “midi input and output v2” in the configurator.

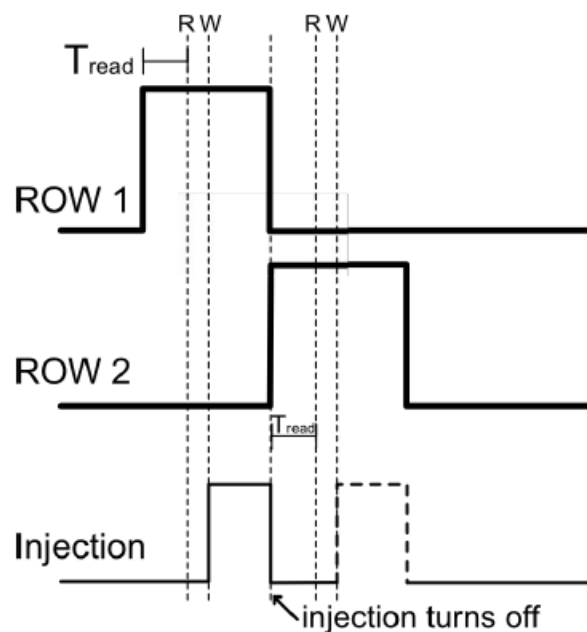


Figure 3: I/O mode v2

Switching between MIDI input and output

- As an alternative to simultaneous MIDI input and output, the user can select between input and output mode using a switch.
- If “Midi input and output switch” is selected as matrix mode, IO22 is configured as an input to switch between input and output. In this mode, IO22 has an internal pullup. Pulling IO22 to GND will result in MIDI output mode. Not pulling it to GND, will result in MIDI input.



Switch open: MIDI input, switch closed: MIDI output

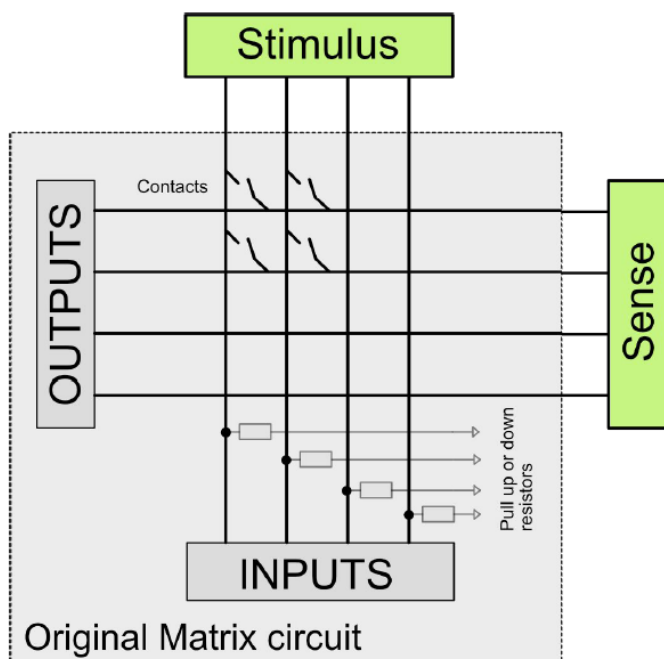
Interfacing the matrix

- After the matrix type and dimensions have been identified, uniMatrix can be connected to its input and output signals. In the configurator, select the correct number of inputs and outputs. The configurator will then tell you which signal to connect. Starting from uniMatrix pin 1, first connect to the output signals, then the input signals.
- uniMatrix will 'listen' to the host device's output signals via the sense lines and inject matching signals into the host device's input lines.

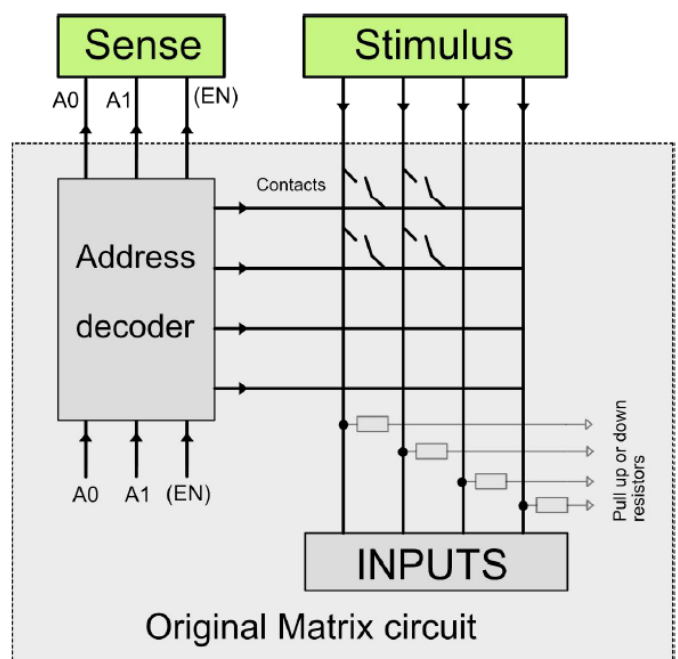
Output address mode

In some cases, the output signals are created using a multi-bit address signal decoded by an IC. For example, a circuit may use a 74xx137 to create keyboard matrix pulses using 3 addresses and one select signal. In this case, uniMatrix can directly read the address and select signals instead of having to read the output signals themselves. This saves pins, and may also be a bit faster.

When using address mode, an optional enable signal is provided. The signal will only be injected if enable is active and the enable polarity can be selected.



uniMatrix sense and stimulus signals connected to a keyboard matrix



A matrix with address decoder. uniMatrix can interface the address signals directly saving pins

Short push

- Some devices can only handle short presses of certain buttons. Longer presses would block other functionality. An example is the instrument select buttons of many Casio keyboards.
- uniMatrix can automatically simulate short presses, even if the midi signal would normally generate a long press or just an 'on' signal.
- The 'short press time' can be adjusted globally and the short press function activated for each key independently.

Midi output and debouncing

uniMatrix also supports MIDI output, turning a keyboard into a MIDI controller.

Here, an additional debouncing time can be selected. When a button is pressed, its signal typically changes polarity a few times before settling into its new state (bouncing). Debouncing filters this by only detecting a new state if two consecutive readings are identical. The debouncing time is the reading interval – the time between two readings.

Matrix key configuration

After setting up the matrix parameters in the configurator, the individual keys or buttons of the matrix (now called matrix contact) can be freely configured.

Each matrix contact can react to

- MIDI Note
- MIDI CC
- MIDI Program change

A global midi channel can be used for all contacts, or individual channels configured for each contact.

The note number, CC number, or program change number can be defined as well.

A velocity/ CC value can be defined:

- Midi note input: The note must have at least this velocity value to turn on the note.
- Midi note output: Sends this velocity. If 0: sends 127
- CC input: received CC must have at least this value to turn on contact.
- CC output: Outputs this CC value when pressed, 0 when released. If 0: outputs 127

Additionally, you can select if the contact should be on/off or of short push type (see above).

Additional inputs and outputs

- Pins not used by the keyboard matrix can serve a variety of different functions.

The learn pin

One pin can be configured as a 'learn' input. If a button is connected between this pin and GND it can be used to learn a new midi channel for uniPulse.Press and hold the button for 2 seconds, then send a midi note to uniMatrix. The note's midi channel will be used as uniMatrix's global MIDI input channel.

Note output

- Configuring a pin as a Note-out will output a logic high signal if a MIDI on message is received and a low signal

if a note-off message is received.

- It is possible to invert this behavior and to active short push mode.

CC output

- Configuring a pin as Note-out will output a logic low signal if a MIDI CC value is below 64 and a high signal if above or equal 64.
- It is possible to invert this behavior and to active short push mode.

Clock output

- Configuring a pin as a clock will output a clock derived from an incoming MIDI clock. 16 different clock dividers are available.
- Using this feature, uniMatrix can output up to 22 different clocks simultaneously.
- The clock can be inverted. Activating the short-push feature will result in a clock pulse instead of a square wave clock signal.

Start/stop

- Configuring a pin as Start / Stop will output a start-stop signal derived from an incoming MIDI clock.
- The signal can be inverted.

Note input

When a high signal is detected at this pin, a 'note on' MIDI message is sent. When a low signal is detected, uniMatrix sends a 'note off' message. This behavior can be inverted . Optionally, a pull up resistor can be activated, so a button can be directly connected between the pin and GND

CC input

When a high signal is detected at this pin, a CC message with value 127 is sent. When a low signal is detected, uniMatrix sends a CC message with the value 0. This behavior can be inverted . Optionally, a pull up resistor can be activated, so a button can be directly connected between the pin and GND

CV input

- Pins 17-22 can be configured as analog inputs. The voltages at these inputs are translated to MIDI CC messages.
- This can be used to send a knob's position back via MIDI or to build a midi controller.

PLL output

- IO21 can be configured to output a multiplied MIDI clock.
- The multiplier factor can be adjusted.
- See Clock multiplier PLL output.

CV outputs

Two additional CV outputs are available that can be used to control filters or similar parameters. These are not suitable for pitch control.

The outputs can be mapped to

- MIDI controller / CC
- MIDI velocity (of the last received note)
- MIDI Aftertouch (of the last received note)
- MIDI Channel Pressure

The CV outputs can also be inverted

Clock multiplier PLL output

Some synthesizers need a clock that is faster than the MIDI clock to be synced properly. IO21 can be configured to output a clock with a frequency that is a multiple of the MIDI clock. This is achieved using a PLL.

The MIDI clock runs at 24 PPQN or 3 clocks for each 32nd note. Using the multiplier, this frequency can further be multiplied by an adjustable factor between 2 and 24.

Please note: Due to an unfortunate hardware limitation, using the clock multiplier will result in a ripple on the CV outputs with a frequency of 612 Hz. The CV outputs can still be used, but need additional filtering to function properly.

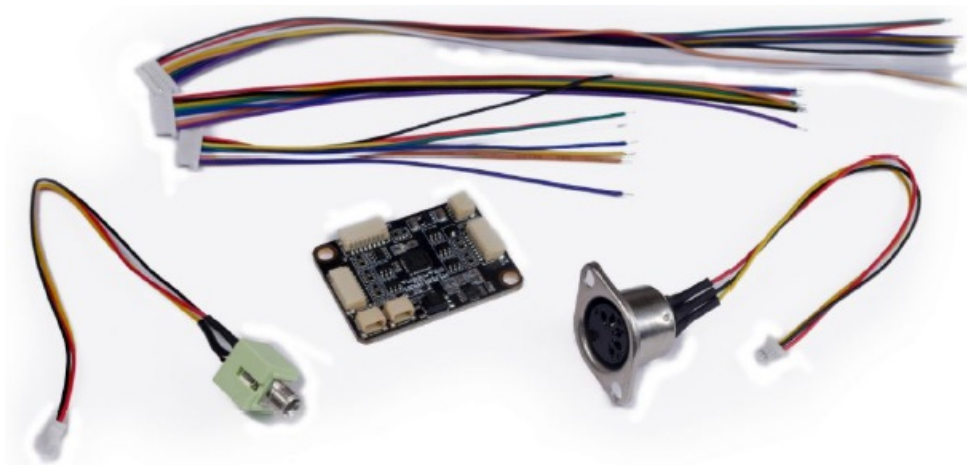
Powering uniMatrix

- uniMatrix needs a single supply voltage between 3V and 12V. The current draw is about 18mA.
- uniMatrix has a built-in voltage regulator. If powered at 5V or higher, it will run at 5V. Signal outputs are 0-5V. When the host devices' signals are greater than 5V, uniMatrix may need additional circuitry.
- While inputs and outputs are protected against overvoltage, the protection diodes will clamp higher voltages to 5V. So it is not possible to directly connect a uniMatrix input to a 12V signal. Additional series resistors will be needed.
- When powered from a supply between 3V – 5V, signal inputs and outputs are restricted to that supply voltage.

Electrical connections



- There are multiple ways to connect uniMatrix to a host device. Depending on the device, one of these might be the most preferred way.
- UniMatrix features JST SH (1mm pitch) connectors on the top. We can supply pre-fabricated wires with various lengths. These can then be soldered to the necessary points in the host device to get power and connect signals. MIDI sockets can also be connected this way.
- Alternatively, one can use the solder pads on the back. These can be used to solder wires directly or to install pin headers and use Dupont or jumper wires.



Mechanical

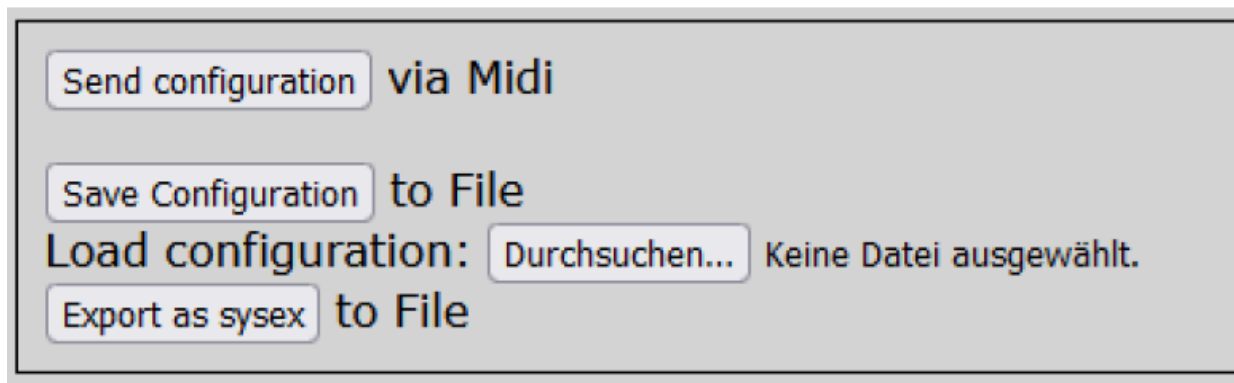
- The board's dimensions are 37x28mm (1.5x1.1 in) with a height 5mm (0.2in). Two mounting holes are provided to fix the board inside a device. Alternatively, double-sided tape can be used easily, as there are no components on the underside.

The configurator

The uniMatrix configurator comes in the form of a web-based application running in your browser. To work directly, your browser needs to support web-MIDI, which most do. Alternatively, a sysex file can be generated and sent to uniMatrix with 3rd party tools.

The configurator can be found at <https://tubbutec.de/files/uniMatrix/uniMatrix-configurator.html>. It is possible to download this file and use it without an internet connection.

Loading, Saving, Sending



- Send configuration via MIDI: Send the current configuration to uniMatrix via MIDI sysex
- Save configuration to a file: Save the configuration to a file to load it later. The file name is based on the synthesizer name (see below).
- Load configuration: Load a previously saved configuration
- Export as sysex: Export configuration to a sysex file for sending via a 3rd party tool

Name and description

Synthesizer name:	<input type="text" value="Casio SK-1"/>
Description:	<input type="text" value="an additional description"/>

- Synthesizer name and an additional description

MIDI config

Midi config		
Global midi input channel	Global midi out channel:	Midi base note:
1: <input type="text" value="1"/>	1: <input type="text" value="1"/>	1: <input type="text" value="0"/> C0

- Global MIDI input channel: MIDI channel to receive data unless specified otherwise at an individual contact level.
- Global MIDI output channel: MIDI channel to send data unless specified otherwise at an individual contact level.
- Midi base note: This base note gets added to the notes configured in the matrix key configuration. It is the lowest note sent.

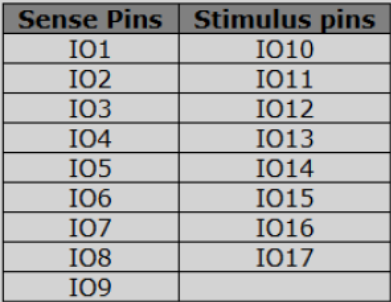
Matrix config

Here, the matrix can be configured. Select the type of matrix, input and output count, polarity and additional parameters. All parameters are explained in chapter Interfacing keyboard matrixes and a tooltip appears when hovering over the parameter names.

The configurator provides a list of pins and how to connect them based on the matrix dimensions.

- If you do not want to interface a matrix, select matrix mode 'OFF'.

Matrix mode	Midi Input
Use Address mode	<input type="checkbox"/>
Sense / Output count:	9
Stimulus / Input Count:	8
Short-push time:	5 ms
Polarity:	Active low



- Each matrix contact can be configured individually. The parameters are explained in the chapter Matrix Key Configuration.

Matrix settings
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
OUT8
OUT9

IN N°	SW N°	Kind	Note/CC	Note	Velocity / CC	use Chan	Midi Chan	Short- push	Memo
1	1	Note ▾	0	C2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
2	2	Note ▾	1	C#2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
3	3	Note ▾	2	D2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
4	4	Note ▾	3	D#2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
5	5	Note ▾	4	E2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
6	6	Note ▾	5	F2	0	<input type="checkbox"/>	0	<input type="checkbox"/>	
7	7	ProgCh ▾	0	F#2	0	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Piano
8	8	CC ▾	7	CC#7	0	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Rock

Switch table editor
 Number of notes to populate:

 Populate:
FWD
BACKW
Rotated
Rotated reversed

 Modifiers
-->
<--
+1
-1

Switch table editor
 Number of notes to populate:

 Populate:
FWD
BACKW
Rotated
Rotated reversed

 Modifiers
-->
<--
+1
-1

Switch table editor

- Some tools are provided to quickly populate the switch table with MIDI notes.
- Type in the number of notes and press one of the 4 populate options.
- The modifiers can be used to shift, increment, or decrement existing entries.

I/O and config

I/O config
 Activate Learn ☐ Learn pin number

IONum	Kind	Note / CC / ClkDiv	pullUp?	Invert?	Short-Push
17	CC-out ▾	16 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18	CC-out ▾	17 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19	CC-out ▾	18 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20	CC-out ▾	19 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21	CC-out ▾	20 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22	CC-out ▾	21 1 / 16 ▾	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Can be used to configure all pins not used by the matrix. Options are explained in the chapter Additional Inputs

CV-out config

CV-out config

CV-out	Mapping	Note/CC	Invert
1	None	0	<input type="checkbox"/>
2	None	1	<input type="checkbox"/>

- Here, you can configure the two CV outputs provided by uniMatrix. Options are explained in chapter CV outputs.

Documents / Resources

uniMatrix technical manual

Introduction

uniMatrix is a universal MIDI interface synthesizer for analog synthesizers. It is designed to be a bridge between the digital world of computers and the analog world of synthesizers. It can be used to control any analog synthesizer that has a MIDI input. It can also be used to control any digital synthesizer that has a MIDI input. It is a very flexible and powerful tool for anyone who wants to control their synthesizer from a computer.


Features

- 16 MIDI channels
- 16 MIDI notes
- 16 MIDI controllers
- 16 MIDI programs
- 16 MIDI banks
- 16 MIDI groups
- 16 MIDI filters
- 16 MIDI effects
- 16 MIDI arpeggiators
- 16 MIDI sequencers
- 16 MIDI triggers
- 16 MIDI latches
- 16 MIDI gates
- 16 MIDI velocities
- 16 MIDI pitches
- 16 MIDI timbres
- 16 MIDI dynamics
- 16 MIDI articulations
- 16 MIDI ornaments
- 16 MIDI decorations
- 16 MIDI ornaments
- 16 MIDI decorations

[uniMatrix D879 Universal MIDI Interface Synthesizers](#) [pdf] Instruction Manual

D879 Universal MIDI Interface Synthesizers, D879, Universal MIDI Interface Synthesizers, MIDI Interface Synthesizers, Interface Synthesizers, Synthesizers

References

-  [Tubbutec uniMatrix configurator](#)
- [User Manual](#)