

MIDIplant
micro MIDI-2-CV device
version 3.8

USER MANUAL

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1. Overview

Thank you for choosing *MIDImplant* as your new MIDI2CV converter. This short manual will guide you through installation, and available settings.

The board can be mounted inside any electronic instrument thanks to its small size. No mounting holes are provided. The strength of connecting wires is enough to secure it in place, as it weighs barely 2 grams. If flexible wires were used, you may add a bit of 2-sided adhesive tape to make sure it does not get loose, or stick it on a drop of hot-melt glue.

MIDImplant has 2 groups of analog outputs, suitable to control analog synths with **V/oct or Hz/V** scaling. MIDImplant comes factory set to 1V/oct scale. CV1 responds to MIDI keyboard on channel 1 and "C" lowest key. CV2 is velocity output. Each CV can be reassigned to different type of MIDI event, not only keyboard notes - this is described in chapter 5.

The board requires only single power supply, and most important settings are done with use of one SPST button - it's not part of the delivery, any normally open momentary switch will work. More settings are accessible via MIDI System-Exclusive commands.

2. Layout

Picture below shows how to locate the soldering pads in MIDImplant, and depicts their role.

Counting from left to right they are:

- MIDI input (1-2)
- power supply 6-17V (3)
- power supply ground and reference point for CV outputs (4)
- CV outputs (5-6)
- MIDI repeater output (7)
- setup ("Learn") button input (8)
- Gate outputs (9-10)



The "Learn" button should be connected between the pad indicated in the picture, and ground. You don't need it if Sys-Ex will be used or if default setting is OK: channel 1, starting note C (MIDI #36), 1V/oct, velocity on CV2.

MIDI IN signal from DIN socket pins 4 and 5 should be connected to pads 1 and 2 of MIDImplant. DIN terminal 5 goes to leftmost pad of MIDImplant, DIN terminal 4 goes to 2nd pad, as indicated in the picture above. Middle contact of DIN socket, number "2", must not be connected anywhere, it must be left open to comply with MIDI specification. There is LED on board, that indicates presence of MIDI signal. It blinks whenever MIDI comes IN. If MIDI is decoded to be within selected range configured for CV1 or CV2, the blink is stronger.

3. Power supply

First connect the ground input, as shown in layout diagram. The ground pad should be connected with reasonably thick wire to the same reference ground that was used to measure all voltages during calibration of your synthesizer. The quality of ground connection directly affects the quality of generated Control Voltage. It's the reference point of CV outs and if there is any noise or voltage offset at your selected ground source, it will be directly transformed to errors in pitch. However, you may compensate small DC offsets via SysEx. See chapter 6.9. for details

MIDImplant is designed to work with typical supply voltages present in any electronic instrument. It requires only one positive supply line, and voltage range from +6V up to +17V, preferably +12V to +15V. Current drawn is about 2mA. It can be taken from any place inside the synth, as long as it does not exceed 17V. Power input must be DC. **Connecting AC power, or reversing the power leads will immediately damage the board.**

4. CV/gate outputs

MIDImplant has 2 sets of outputs. CV outputs have series resistance of 100 ohms and should be connected to resistance of 100k to achieve calibrated precision in 1V/oct setting. It is possible to use it with other loads, but no less than 10k, otherwise it may be difficult to reach full range (5V) and maintain precision. Usually CV inputs have 100k impedance, so it's perfectly OK. **If MIDImplant is destined for a box/module with CV jacks, you should consider adding voltage buffers.** Gate outputs use high-side transistor with 1k output resistor. Gate signal amplitude is equal to the voltage of power supply (6..17V).

4.1. CV outputs

Each CV output can be configured to respond to one MIDI event. Both outputs are independent to some extent. The only case when they work in conjunction is CV1 configured as MIDI notes. CV2 then becomes Velocity output for the notes played by CV1. It is possible then to change CV2 to something else, but CV2 always becomes velocity right after programming CV1 as MIDI notes.

All available MIDI events represented in Control Voltage are listed below:

- Note on/off (with PitchBend)
- Note velocity - possible only in CV2
- Pitch Bend
- Continuous Controller
- Program Change
- Channel After Touch
- Polyphonic After Touch

Control Voltage varies from 0V up to 5V. It makes 61-note range for 1V/oct scale. If CV is configured as MIDI event different than notes, 0V represents lowest MIDI value, and 5V is output when highest MIDI value is received.

All controllers are converted to voltage as one of 128 levels, except Pitch Bend, working with full MIDI resolution (16384 steps). Neutral position of Pitch Bender gives 2.5V at the output. Note on/off can output 61 levels of voltage at most. By default **MIDI Pitch Bend affects note CV**, with full range of +/-2 semitones at 1V/oct scale. This can be turned off if you want to have full range Pitch Bend voltage at the other CV. Bent notes cannot go below 0V, or above 5V, so 2 lowest and 2 highest notes from 5-octave keyboard will obviously have limited bend range.

For note on/off, CV scale can be adjusted in a wide range, **from 0.47V/oct to over 2V/oct** if using settings button, and from 0 to 1.9V/oct via Sys-Ex. If the scale is higher than 1V/oct, there is no room for 61 keys in 5V range. Every note higher than that gives 5V at CV output. It is possible (by Sys-Ex only) to **reverse voltage response**, so lowest note gives 5V output, and top note gives 0V. This may be helpful in synth circuits, where reversed response control input can be added easier than the straight one.

When configured in Hz/V scale, the voltage always reaches 4V at the top note, which is often treated by Hz/V synths as standard voltage required to reach top "C" note on the keyboard. The lowest note may start at 5 different levels (from 0.125 to 2V), depending on number of octaves chosen. This is described in chapter about tuning (5.3-5.4).

4.2. Gate outputs

Each Gate output associated with CV output generates voltage indicating the duration of MIDI note. When MIDImplant is configured to respond to MIDI notes, gate output remains at 0V when no notes are playing. It then goes up to the supply voltage level, and stays there until all notes are released, as in typical V-trigger mode. It is possible to reverse the Gate signal individually for each output, so note on is then at 0V, and note off is at power supply level. By default Gate output **re-triggers** on next note if previous one is still on (i.e. when playing legato). Gate is turned off for very short time (0.5ms) which is usually enough to re-trigger envelopes etc. It's also possible to re-trigger on note off, so when you release any key, gate will re-trigger if there was any held note still.

Re-trigger can be turned off completely if you want to have flat gate signal as long as any note is playing.

All those settings are done by SysEx only.

If CV is configured to anything else than notes, associated Gate stays off at all times.

4.3. MIDI repeater output

This output can be used to add MIDI THRU to your MIDI2CV device. The signal available here is regenerated and MIDIimplants can be chained using this option without limits. This is not actual MIDI THRU, because it introduces slight delay, and chaining dozens of MIDIimplants may cause noticeable delays. To comply with MIDI standard, MIDI repeater output must be connected to lead number 5 of THRU DIN socket, while contact "4" of the socket must be connected via 220 ohms resistor to +5V source. MIDIimplant cannot provide +5V for that purpose, so the voltage must be taken from elsewhere, for example 78L05 regulator supplied from the same power supply as MIDIimplant. Connector "2" of THRU DIN socket should be connected to ground.

5. User settings with "Learn" button

After successful installation, you can set up the MIDI events associated with each CV output. To do so, your synth must be powered on, and "Learn" button connected (see the layout). There are only 4 parameters to set this way:

1. channel and MIDI event for CV1/gate1
2. channel and MIDI event for CV2/gate2
3. Keyboard scale select (common for both CVs)
4. V/oct fine tuning (common for both CVs)

To select which parameter you want to edit, press the setup button appropriate number of times. Press once for setting CV1, twice for CV2, 3 times for scale select or 4 times to fine tune the scale. There's no time limit for pressing the "Learn" button several times. But don't push it too fast, because it may be treated as contact bounce, and ignored.

All user settings are memorized in nonvolatile memory, taking power off does not reset anything to defaults, the settings are kept as they were last entered.

5.1. Channel and event of CV1 and Gate1

1. press "Learn" button **once**
2. generate MIDI event from your device connected to MIDIplant

If it's going to be Pitch Bend, CV1 will be set as such with first movement of your Pitch Bend wheel. It will then follow your Pitch Bend movement by outputting voltage proportional to what is happening with the Pitch Bender. Same applies to all other controls except notes.

If it's going to be note on/off, you must play **the lowest note** of your keyboard to be associated with

CV1. With next note played, CV1 will output voltage determined by MIDI note combined with PitchBender position (range +/-2 semitones at 1V/oct), and Gate1 will go high whenever there's any key pressed. At the same time CV2 will represent the value of note Velocity

5.2. Channel and event of CV2 and Gate 2

1. press "Learn" button **twice**
2. generate MIDI event from your device connected to MIDIImplant

If it's going to be Modulation, CV2 will be set as such with first movement of your Modulation wheel. It will then follow your Modulation movement by outputting voltage proportional to what is happening with the wheel. Same applies to all other controls except notes.

If it's going to be note on/off, you must play **the lowest note** of your keyboard to be associated with CV2. With next note played, CV2 will output voltage according to MIDI note, and Gate2 will go high whenever there's any note pressed.

You should never assign the same keyboard to both CVs. Only CV1 will work then. You can have two independent note CV outputs only if each of them is played in different MIDI channel.

The only way to have 2 note CV outputs is to setup CV1 first, and then CV2. Setting CV1 as note on/off will always change CV2 to velocity output, regardless of how it was programmed before.

5.3. Keyboard scale select

MIDIImplant comes factory calibrated to 1V/oct scale, but you can change it anytime to another V/oct ratio, or Hz/Volt response. If selected by "Learn" button, the scale is the same for both channels - CV1, and CV2, so if you change it for the keyboard associated with CV1, remember that CV2 will also

work in altered scale. To have V/oct in one CV and Hz/V in the other one, or different V/oct ratios in 2 channels, the only way to do it is via Sys-Ex configuration (see chapter 6).

The scale setup applies only to MIDI note on/off events. All other controls always use full 0-5V range for MIDI parameter value. No scaling is available for those.

To change the scale of your note CV, you must have the keyboard already associated to CV1. If it's already done, do the following:

1. press the "Learn" button **three times**
2. press a key on your MIDI keyboard to select the scale. 5 lowest notes are reserved for fixed scales like **Hz/V**, while notes above set **V/oct** scale in the following way, assuming 5 octave keyboard with lowest note "C":
 - "C" sets the scale to Hz/V and 1 octave span (CV range 2 - 4V)
 - "C#" sets the scale to Hz/V and 2 octaves span (CV range 1 - 4V)
 - "D" sets the scale to Hz/V and 3 octaves span (CV range 0.5V - 4V)
 - "D#" sets the scale to Hz/V and 4 octaves span (CV range 0.25V - 4V)
 - "E" sets the scale to Hz/V and 5 octaves span (CV range 0.125 - 4V)
 - "F" sets the scale to factory **calibrated 1V/oct**, with lowest pitch errors
 - "F#" is the low end of variable scale and sets it to about 0.47V/oct
 - top "C" sets 2.05V/oct. Any key in between lowest "F#" and top "C" may be selected for different scales. Middle "C" (25th key) sets nearly 1V/oct
3. if V/oct was selected, CV output will show the scale and it can be measured with voltmeter. If, for example you've selected 1V/oct by pressing 25th key, it will read 1V. For Hz/V scale, CV is set according to played note.

Every note played after this procedure will be converted according to newly selected scale. This procedure can be repeated many times, until you find proper scale. You can fine tune V/oct scale later, but coarse setting done here should rather be slightly lower than needed, because fine tuning can only increase the scale a bit as that's not "+/-" fine tuning.

5.4. V/oct fine tune

After you've selected the scale as described before, you may want to fine adjust it to match your expectations within single mV per octave. Fine tuning is only available for V/oct scales. Hz/V scales are factory calibrated to maximum 1 cent of tuning error over entire keyboard range and cannot be adjusted by the user.

To enter fine tuning mode, do the following:

1. press the "Learn" button **four times**
2. select fine adjustments with MIDI keyboard. Lowest note means no adjustment - the scale remains as set in V/oct scale select procedure. 61th key means increasing the scale of about 2 semitones per whole 5 octaves assuming you're working on 1V/oct scale. Every key in between sets the fine adjustment proportional to played key position.
3. at this time CV will output new scale value to be measured with voltmeter. This is the value for only 1 octave, and to achieve full accuracy, you may then want to measure the voltage after playing a key that is 3 or 4 octaves higher than the lowest one.

More precise tuning is possible via Sys-Ex.

6. User settings via System-Exclusive

All settings described in chapter 5 are also accessible via MIDI System-Exclusive messages. But Sys-Ex is the only way to set them separately for each CV output. The command's structure is as follows:

- **F0** - Sys-Ex header
- **00 20 7A** - manufacturer ID for "MIDI-hardware"
- **01** - device ID for MIDIImplant
- **01-02** - CV output ID
- **01-08** – command
- associated parameters (length varies for different command)
- **F7** - Sys-Ex footer.

This is described in details here. All numbers are represented in **hexadecimal** format. You may use any kind of Sys-Ex editor to send those commands to MIDIImplant. MIDI-OX (midiox.com) or SendSX (bome.com) are good examples.

At www.midimplant.com/config3.html you can find easy to use tool for selecting every parameter of MIDIImplant. It creates standard MIDI file, that can be played towards MIDIImplant and set all desired parameters without need for any knowledge of System Exclusive, or special editor. The file can be transferred to MIDIImplant from any sequencer as long as it has Sys-Ex transmission enabled.

6.1. Channel and event

F0 00 20 7A 01 <CV> 01 <channel> <event> <param> F7

where:

<CV> is CV output selector: 01 or 02

<channel> is MIDI channel in range 1-16 (01-10 in hex)

<event> with related *<param>* is MIDI event from the list below. Only 2 kinds of event require additional parameter: notes, and Continuous Controller. For others this byte may be omitted.

<i>event</i>	MIDI event type	meaning of <i>param</i>
01	Note on/off	starting note
02	Polyphonic Aftertouch	-
03	Continuous Controller	CC number (00-7F)
04	Program Change	-
05	Channel Aftertouch	-
06	Pitch Bend	-

If CV1 is assigned as note on/off, CV2 will be automatically set to note velocity. To change this, follow any procedure for CV2 assignment after CV1 is done.

By default, the Pitch Bend wheel position is modulating CV output. Maximum deviation is +/-2 semitones. You may want to turn it off using Sys-Ex command (see chapter 6.6) for example if PitchBend is used to control other parameter, or it is associated with CV2.

6.2. V/oct scale tune

F0 00 20 7A 01 <CV> 02 <MSB> <LSB> F7

where:

<CV> is CV output selector: 01 or 02

<MSB> is most significant byte of tuning scale. Possible values 00-7F

<LSB> is least significant byte of tuning scale. Possible values 00-7F

Both parameters combine to 14-bit value of tuning ratio. Tuning is adjusted in steps of about 0.12mV per octave in range from 0 to 1.9 V/oct. The MSB/LSB parameters are calculated according to the formula:

$$\text{TUNE} = 8710 * [\text{V/oct}]$$

$$\text{MSB} = \text{integer of } (\text{TUNE} / 128)$$

$$\text{LSB} = \text{TUNE} - \text{MSB} * 128$$

for example 1.2V/oct needs (in decimals) MSB=81, LSB=84, 1V/oct MSB=68, LSB=6 while 0.32V/oct needs MSB=21, LSB=99, so converted to hexadecimal values it would look like this for CV1:

1.2V/oct - F0 00 20 7A 01 01 02 51 54 F7

1V/oct - F0 00 20 7A 01 01 02 44 06 F7

0.32V/oct - F0 00 20 7A 01 01 02 15 63 F7

For each MIDImplant, and each installation, actual numbers needed to achieve given scale may differ slightly, this is only a guideline and starting point for final tuning. You should always check entire keyboard range with a tuner or frequency meter if tuning needs finer adjustments, and not rely solely on this equations. There's also offset trim possible for each CV individually – see chapter 6.9. Scale and offset settings work in conjunction the same way as relevant trimmers in any VCO circuit. Sometimes the scale is called "width", while offset can be called "tune".

6.3. *V/oct and Hz/V scale select*

F0 00 20 7A 01 <CV> 03 <select> F7

where:

<CV> is CV output selector: 01 or 02

<select> takes one of 7 possible values:

00: set CV output to variable **V/oct** scale tuned by parameter described in 6.2.

01 - 05: set CV output to **Hz/V** scale and define how many octaves are accessible.

06: set CV output to fixed, calibrated 1V/oct scale

In Hz/V mode <select>=01 sets only one octave range and lowest voltage is 2V. <select> = 05 means 5 octave range with starting note at 0.125V. Although MIDImplant is factory calibrated to match Hz/V response within +/-1 cent over full 5-octave range, it may be sometimes desirable to limit the number of octaves and start with higher voltage to achieve best accuracy at lowest notes.

When <select> = 6, the CV turns to factory calibrated 1V/oct scale (at 100k load) with lowest possible tuning errors. Variable V/oct scale tuned as described in chapters 5.3, 5.4 and 6.3 exhibit slightly bigger errors, within +/-2 cents over 5-octaves span.

6.4. *Gate polarity*

F0 00 20 7A 01 <CV> 04 <polarity> F7

where:

<CV> is CV output selector: 01 or 02

<polarity> takes one of 2 possible values:

00: Gate during note-on is at power supply voltage, when all notes are off - at 0V

01: Gate during note on is at 0V, when all notes are off - at power supply voltage.

6.5. Off Velocity ignore

F0 00 20 7A 01 02 05 <off-velocity> F7

where:

<off-velocity> takes one of 2 possible values:

00: velocity is updated on both, note-on, and note-off events

01: velocity is updated only at note-on, and ignored at note-off (remains unchanged)

If your keyboard detects key release velocity, CV2 by default will set the voltage according to what it gets either at at note-on or note-off. To keep it at note's attack level, use this setting.

6.6. PitchBender combined with Notes

F0 00 20 7A 01 <CV> 06 <pbend> F7

where:

<CV> is CV output selector: 01 or 02

<pbend> takes one of 2 possible values:

00: Pitch Bend is affecting pitch voltage (default)

01: pitch voltage is determined only by notes

If CV is assigned to notes, its voltage also varies depending on Pitch Bend of the same channel. Full Bend range is 2 semitones up and down from the note's voltage. If you want to use Pitch Bend for other controls, or want to have full resolution Bend on 2nd CV, then you should turn this feature off, so the voltage stays unchanged regardless of Bender's movement.

6.7. Reversed pitch voltage

F0 00 20 7A 01 <CV> 07 <polarity> F7

where:

<CV> is CV output selector: 01 or 02

<polarity> takes one of 2 possible values:

00: standard operation, lowest note at 0V, 61th key at 5V or less, depending on scale ratio.

01: reversed voltage, **top note at 0V**, lowest note at 5V or less, depending on scale ratio.

Reversed pitch voltage can only be set for V/oct scales.

6.8. Gate re-trigger

F0 00 20 7A 01 <CV> 08 <re-trigger> F7

where:

<CV> is CV output selector: 01 or 02

<re-trigger> takes one of 3 possible values:

00: Gate output is on as long as any note is playing

01: Gate output goes off for 0.5ms at **each note on or off** in legato group

02: Gate output goes off for 0.5ms in legato **only when new note** starts (default)

6.9. CV offset

F0 00 20 7A 01 <CV> 09 <offset> F7

where:

<CV> is CV output selector: 01 or 02

<offset> determines little voltage offset applied to CV output, takes any value between 00 and 7F

00: most possible negative offset of about -9mV

40: no offset, default state

7F: most possible positive offset of about +9mV

Offset is adjusted in steps of about 0.15mV and can be very usable especially in Hz/V tuning, where lowest notes differ only by a few mV. If you use voltage buffers at CV, this allows for compensation of the offsets caused by the buffers, so you may use cheaper components.

6.10. Reset to factory defaults

Send the following System-Exclusive sequences, with short delays or separately, to go back to default settings:

F0 00 20 7A 01 01 01 01 01 24 F7 – notes in CV1, velocity in CV2

F0 00 20 7A 01 01 03 06 F7 – 1V/oct calibrated scale for CV1

F0 00 20 7A 01 02 03 06 F7 – 1V/oct calibrated scale for CV2

F0 00 20 7A 01 01 04 00 F7 – normal Gate1 polarity

F0 00 20 7A 01 02 04 00 F7 – normal Gate2 polarity

F0 00 20 7A 01 02 05 00 F7 – velocity CV changes at note on and off

F0 00 20 7A 01 01 06 00 F7 – Pitch Bender affects notes at CV1

F0 00 20 7A 01 02 06 00 F7 – Pitch Bender affects notes at CV2

F0 00 20 7A 01 01 07 00 F7 – normal dependency of voltage against note at CV1

F0 00 20 7A 01 02 07 00 F7 – normal dependency of voltage against note at CV2

F0 00 20 7A 01 01 08 02 F7 – Gate1 re-triggers in legato

F0 00 20 7A 01 02 08 02 F7 – Gate2 re-triggers in legato

F0 00 20 7A 01 01 09 40 F7 – CV1 offset 0mV

F0 00 20 7A 01 02 09 40 F7 – CV2 offset 0mV

You should **never, in any case, send all Sys-Ex sequences immediately in one go**. It needs at least 10ms delay between the commands, so if your Sys-Ex editor does not allow for introduction of short delays, send each of the sequences separately.

The best way to do it is via on-line configurator at www.midimplant.com/config3.html. When you go to that page, select needed parameters from drop down lists, and click "create MIDI file". Then play that file to MIDIImplant and all the configuration is done and saved. Default selection of parameters in that page will turn the MIDIImplant to its factory settings.