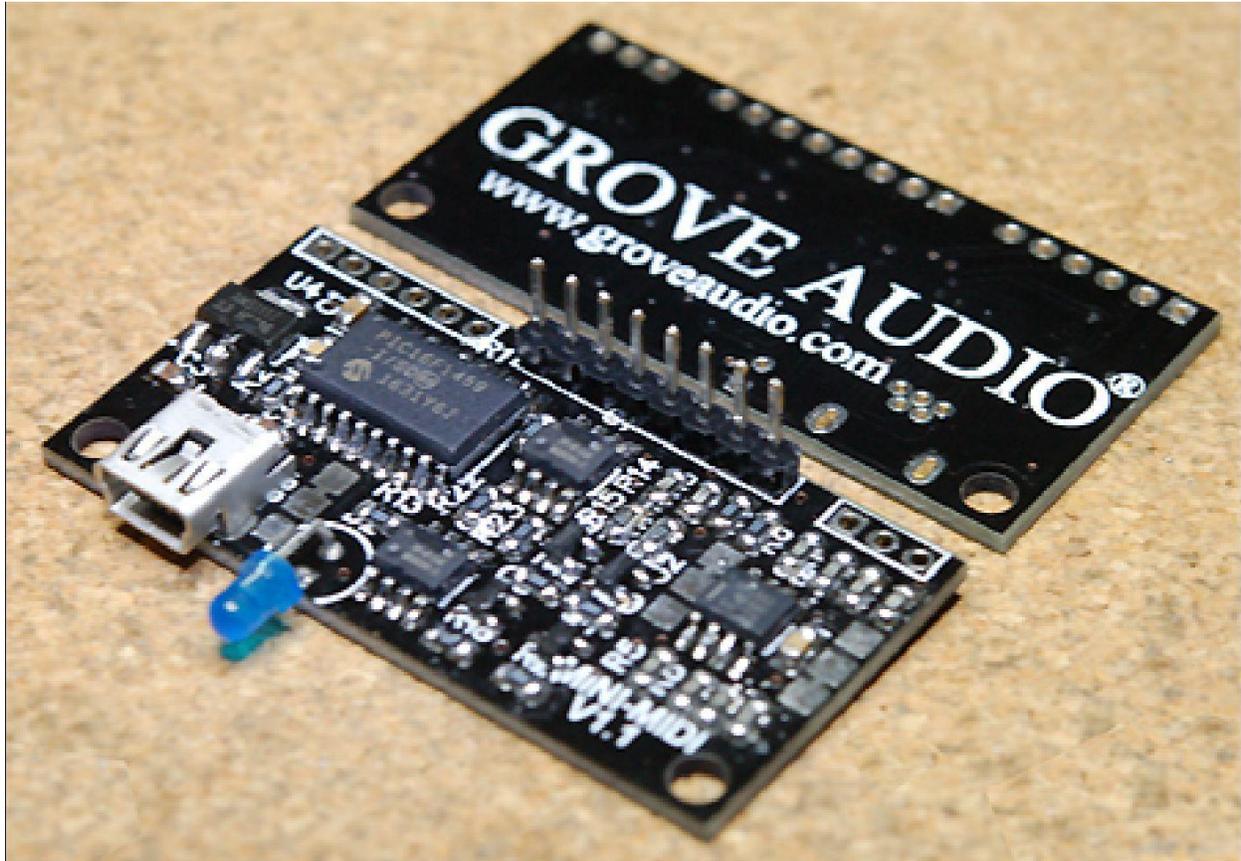# MINI-MIDI USBMIDI to CV CONVERTER

EMBEDDABLE CARD PRODUCES TWO CONTROL VOLTAGE AND TWO GATE SIGNAL OUTPUTS

The assembled Mini-MIDI USBMIDI to CV Converter.

The MINI-MIDI USBMIDI to CV converter will convert USBMIDI messages received via USB to two control voltage outputs and produce accompanying gate voltage pulses. When powered by the USB host, the control voltage range is 0 Volts to slightly less than 5 Volts and is scaled at 1V/Octave. If the output circuit is powered by an external power supply, the board can supply a voltage range of 0 Volts to 10 Volts with 1V/Octave scaling.

The board can be used as a first surface mount project, for surface mount soldering practice or as a key fob for that extra set of garage keys. The information below includes assembly instructions for the board and links to obtain programmed microprocessor chips or a complete parts kit.

USER MANUAL

The MINI-MIDI converter is a class-compliant USB Device. The device can be hosted by a computer, tablet, or phone with USB support and it does not require the installation of drivers on the host device. The unit is compatible with MAC, Linux and Windows operating systems. The converter USB port cannot be used to host another USB Device such as a USB keyboard controller.

Technical Specifications

Each Channel	USB Bus Power	External Power
Voltage Scale	1 Volt/Octave - .0833 Volts/Semitone	1 Volt/Octave - .0833 Volts/Semitone
MIDI Note Range	Note number 24 - 84 produces 0.0 V to ~5.0 V 0 V = MIDI Note #24 = C1	Note number 0 - 127 produces 0.0 V to +10.0 V 0 V = MIDI Note #0 = C-1
D/A Converter Output	12 Bits; full-scale range 0V - ~5V	12 Bits; full-scale range 0V - 10V
Gate/Trigger Output	0 - +5 V	0 - +5 V
Module Power	+5 Volts 150 mA	+12V - +15V 25 mA., -12V - -15 Volts 25 mA., +5 Volts 150 mA
Module Size	0.5 inches (12.6 mm) includes headers; Width - 2.0 inches (52 mm); Depth (behind panel) 1.00 inches (25 mm)	0.5 inches (12.6 mm) includes headers; Width - 2.0 inches (52 mm); Depth (behind panel) 1.00 inches (25 mm)

MIDI CHANNEL FUNCTIONS

The type of conversion that is performed depends on which MIDI channel the data is sent on. For example, if MIDI data is sent to channel one, the converter will output a single channel monophonic pitch control voltage, velocity control voltage, a gate signal, and a 25 msec. wide trigger pulse. The list below shows the outputs and control functions for each supported MIDI channel.

Channel 1 - Single channel monophonic

This mode works as a single channel monophonic converter outputting pitch, velocity, gate and trigger signals.

OUTPUT SIGNALS

· CV1 - Pitch 1V/Octave

· CV2 - Velocity

· Gate1 - 5V Gate while note held

· Gate2 - 5V Trigger 25 msec. duration

Channel 2

TBD

Channel 3/Channel 4 - Dual Monophonic

Channel 3 and channel 4 provide two independent CV/gate output channels.

OUTPUT SIGNALS

· CV1 - Channel 3 Pitch 1V/Octave

· CV2 - Channel 4 Pitch 1V/Octave

· Gate1 - Channel 3 5V Gate

· Gate2 - Channel 4 5V Gate

Channel 5 - 2 Ch. Polyphonic

The channel 5 mode will accept two independent keypresses and output the pitches on the two CV outputs and associated gate signals on the two gate outputs. If one of the two held notes is releases and a new note is depressed, the output associated with the released note will transition to the new note and the gate output will be asserted for the new note.

OUTPUT SIGNALS

· CV1 - Note 1 Pitch 1V/Octave

· CV2 - Note 2 Pitch 1V/Octave

- Gate1 - Note 1 5V Gate

- Gate2 - Note 2 5V Gate

Channel 6

TBD

Channel 7

Channel 7 will provide a monophonic pitch conversion, an analog output of the Pitchbend wheel position, a gate, and a trigger signal. The pitchbend position is not added to the pitch output signal.

OUTPUT SIGNALS

- CV1 - Pitch 1V/Octave

- CV2 - Pitchbend wheel position

- Gate1 - Gate

- Gate2 - Trigger pulse 25 msec.

Channel 8

Channel 8 will provide a monophonic pitch conversion, an analog output of the Mod wheel position, a gate, and a trigger signal. The pitchbend position is added to the pitch output signal.

OUTPUT SIGNALS

- CV1 - Pitch 1V/Octave

- CV2 - Mod wheel position

- Gate1 - Gate

- Gate2 - Trigger pulse 25 msec.

Channel 9

TBD

Channel 10

This channel produces 4 trigger outputs assigned to specific MIDI notes. The notes correspond to drum triggers from the General MIDI drum map. Both the analog and gate outputs of the converter are used to produce 25 millisecond wide 0-5 Volt trigger signals. The MIDI notes and their associated drum map names are note 36 - kick drum, note 38 - snare drum, note 40 - snare drum 2, and note 46 - closed high hat.

The use of these trigger signals is not limited to generating percussion. They can be used to activate any event that will accept a trigger pulse signal.

OUTPUT SIGNALS

· CV1 - Note 36 BD trigger

· CV2 - Note 38 SD trigger

· Gate1 - Note 40 SD2 trigger

· Gate2 - Note 46 CHH trigger

Channel 11

This channel produces 4 gate outputs assigned to specific MIDI notes. The notes correspond to drum triggers from the General MIDI drum map. Both the analog and gate outputs of the converter are used to produce 0-5 Volt gate signals that are high for the duration of the time the note is held. The MIDI notes and their associated drum map names are note 36 - kick drum, note 38 - snare drum, note 40 - snare drum 2, and note 46 - closed high hat.

The use of these gate signals is not limited to generating percussion. They can be used to activate any event that will accept a gate signal such as signal routing using external analog switches.

OUTPUT SIGNALS

· CV1 - Note 36 BD gate

· CV2 - Note 38 SD gate

· Gate1 - Note 40 SD2 gate

· Gate2 - Note 46 CHH gate

Channel 12

Using this channel will produce a note pitch conversion and gate output on the two analog output channels and will send MIDI clock and MIDI reset to the two gate outputs. Depending on the clock divisor that is set (see Channel 14 below), the clock signal will range from 24 PPQN to 1/4 PPQN. By using an adapter that combines both signals into one DIN24 cable connector (wiring in Appendix A) and a DIN24 cable, external DIN24 devices can be synchronized to DAW or sequencer software running on the host computer.

OUTPUT SIGNALS

· CV1 - Pitch 1V/Octave

· CV2 - Gate 0-5V

· Gate1 - MIDI clock

· Gate2 - MIDI run

Channel 13

TBD

Channel 14

By sending MIDI notes to this channel, the MIDI clock divisor can be set. The table below shows the MIDI notes to use and the corresponding division ratio. The default output is 1 pulse per quarter note (1PPQN).

Channel 15

Calibration channel for CV1 output. See the CALIBRATION section below.

Channel 16

Calibration channel for CV2 output. See the CALIBRATION section below.

CALIBRATION

In order to assure that the analog outputs accurately produce a 1V/Octave output, a calibration procedure is provided for each output channel. This procedure uses channel 15 for CV1 and channel 16 for CV2. Midi note commands are sent from a keyboard controller routed through the host computer or from a program such as MIDI-OX that uses the computer keyboard to

produce MIDI note commands. The calibration procedure is somewhat different depending on whether the converter is being powered from the USB bus or from an external power source. This is due to the differences in the output voltage range for the two powering methods. Calibration requires the use of a 3 1/2 digit or better digital multimeter or an accurately calibrated VCO with 1V/Octave input and either a tuner or an in-tune synthesizer keyboard or piano as a pitch reference.

To use the multimeter method, connect the negative lead of the meter to the CV1 ground terminal and the positive lead to the CV1 output terminal. In order to assure the most accurate calibration, connect a 100K Ohm 1% resistor across the output terminals, too. This will compensate for the internal resistance of the control voltage output caused by the short circuit protection components. Without the resistor, the calibration may be as much as 10 cents off over the range of the output.

To use the VCO and tuner method, connect the CV1 output to the 1V/Octave input of the VCO. Connect the VCO triangle wave output to the input of the tuner. Now, if the VCO has a fine frequency control, adjust this to the center of its range. No adjustment of this setting should be made during the procedure.

Using USB bus power

Start by calibrating CV1. To do this, be sure that the MIDI note commands are being sent on MIDI channel 15. When using the USB powered calibration method, the two MIDI notes that will be used are C3 (note #48) and C5 (note #72). The object of the procedure is to get the voltage corresponding to C3 to be as close to 1.000 Volts as possible and the voltage corresponding to C5 as close to 3.000 Volts as possible. Adjust the voltage for C3 first. To do this, hold the C3 key down. Then, by pressing the two white keys on either side of the held key, you can change the voltage. Pressing the key to the left will lower the voltage and to the right will raise the voltage. Do this until the voltage output is as close to 1.000 Volts as possible.

Now calibrate the C5 value. Again, press and hold the C5 key while pressing either of the two white keys to the left or right of it to adjust the output to as close to 3.000 Volts as possible. Once the value is set, it may be necessary to go back to the C3 and adjust the value again. Switch between the two keys and try to refine the adjustments. It may take several attempts as the two adjustments interact with each other.

Now, perform the calibration using the same procedure for CV2. Change the MIDI channel output of the keyboard controller so that MIDI note commands are sent on channel 16. Follow the same steps as for the CV1 calibration. The calibration information will automatically be saved to the internal EEPROM for use during the next power up so that the calibration will be restored.

Using external power

Start by calibrating CV1. To do this, be sure that the MIDI note commands are being sent on MIDI channel 15. When using the externally powered calibration method, the two MIDI notes that will be used are C0 (note #12) and C8 (note #108). The object of the procedure is to get the voltage corresponding to C0 to be as close to 1.000 Volts as possible and the voltage corresponding to C8 as close to 9.000 Volts as possible. Adjust the voltage for C0 first. To do this, hold the C0 key down. Then, by pressing the two white keys on either side of the held key, you can change the voltage. Pressing the key to the left will lower the voltage and to the right will raise the voltage. Do this until the voltage output is as close to 1.000 Volts as possible.

Now calibrate the C8 value. Again, press and hold the C8 key while pressing either of the two white keys to the left or right of it to adjust the output to as close to 9.000 Volts as possible. Once the value is set, it may be necessary to go back to the C0 and adjust the value again. Switch between the two keys and try to refine the adjustments. It may take several attempts as the two adjustments interact with each other.

Now, perform the calibration using the same procedure for CV2. Change the MIDI channel output of the keyboard controller so that MIDI note commands are sent on channel 16. Follow the same steps as for the CV1 calibration. The calibration information will automatically be saved to the internal EEPROM for use during the next power up so that the calibration will be restored.

In order to be able to perform this procedure using a keyboard controller with less than 10 Octaves of range, it may be necessary to use the keyboard's octave transpose controls. A program like MIDI-OX is also valuable in monitoring the information being sent to the converter to be sure that the correct note is being sent for the held key value. If when pressing the keys to adjust the voltage value, it is noted that the voltage doesn't change, the wrong held key value was probably sent. Also note that the displayed key values in MIDI-OX are in hexadecimal, not

decimal. For this calibration, the C0 value is 12 (decimal) and 0C (hexadecimal). The C8 value is 108 (decimal) and 6C (hexadecimal).

APPENDIX A - External Connections

This diagram shows the external connections to the converter, their functions, and the locations of the jumpers used to select USB power or external power. The jumpers are already connected by a short board trace for USB power. In order to change to external power, the short trace should be cut with a sharp blade and a solder jumper should connect the alternate pad to the center pad.
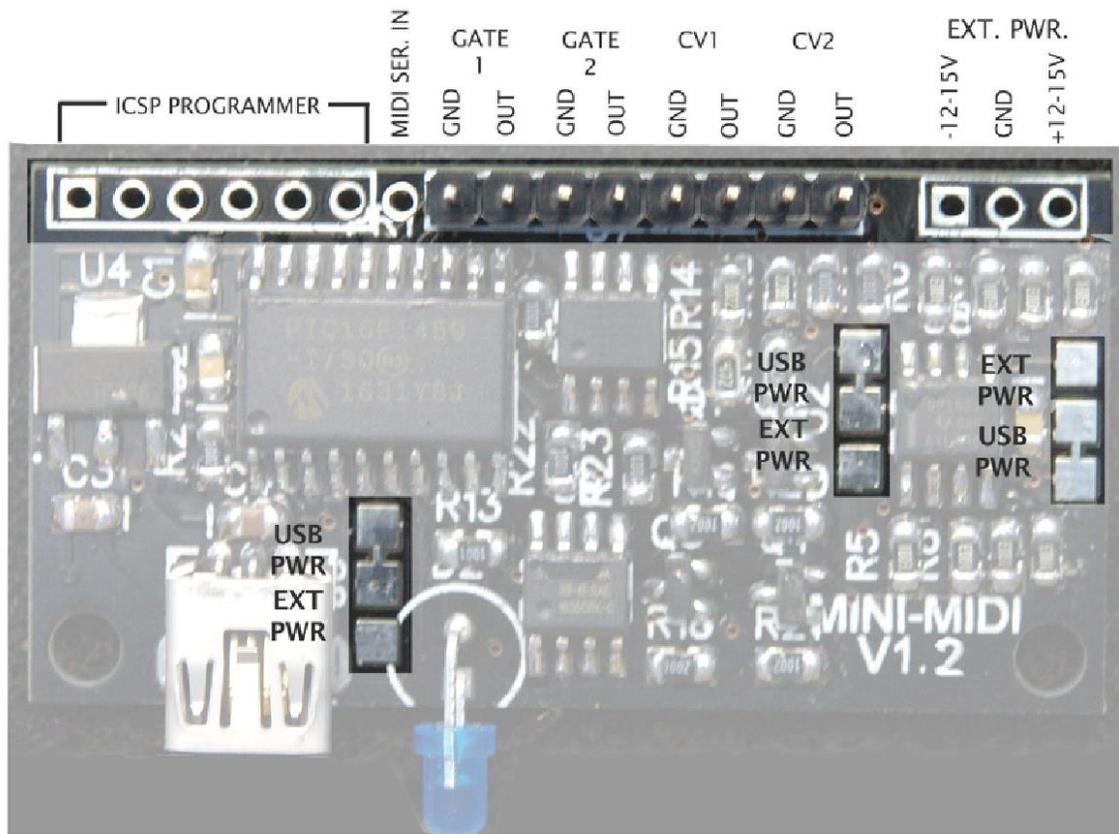
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