GMS-742a MIDI to CV CONVERTER

PRELIMINARY OPERATION MANUAL

APRIL 17, 2022

Grove Audio LLC

Copyright 2022 – All Rights Reserved

INTRODUCTION

The MIDI to CV Converter module is designed to convert MIDI note commands into corresponding analog voltage level outputs to be used by devices such as voltage controlled oscillators in analog synthesizers. In addition to a changing analog voltage on one channel, the module can also supply a second analog voltage corresponding to the MIDI velocity information. This analog voltage can be used to vary the response of an envelope generator to allow the channels dynamics to be controlled by keyboard velocity information.

BASIC FUNCTIONS

The GMS-742 MIDI to CV converter contains two complete converter channels, each channel capable of producing two analog outputs and two gate outputs. When a two channel mode is selected, one analog channel will produce the voltage equivalant of the input MIDI note value, one analog channel will produce the voltage equivalant of the MIDI velocity value, one gate channel will produce a gate signal for the duration of the MIDI note on to note off time, and one gate channel will produce a 25 millisecond trigger pulse.

MULTIVOICE OPERATING MODES

- Two channel with gate and trigger
- Three or four channels with gate
- Two channels with seperate sequential MIDI channel numbers
- Four channels with seperate sequential MIDI channel numbers
- Split keyboard with C0-B1 on ch. 1 and C2-C5 on ch. 2

ADDITIONAL FEATURES

A front panel selector allows setting the base MIDI channel on which the module listens. If the setting is not modified by system commands received on the port, the channel also serves as the default analog output channel. Depending on the selected operating mode, additional channels are assigned following the channel selected on the front panel switch.

The MIDI clock on the input channel is divided internally and output on the MIDI CLOCK output jack. Divisor ratio set by turning mode switch to the desired ratio and pressing the front panel set divisor pushbutton.

OPERATING MODE TABLE

Operating mode is selected by a front panel 16 position rotary switch.

MODE	FUNCTION
1	2 Ch. Independent Note CV, Velocity CV, Gate, Trigger Successive MIDI Channels
2	2 Ch. Polyphonic Note CV, Velocity CV, Gate, Trigger Common MIDI Channel
3	4 Ch. Polyphonic Note CV, Gate Common MIDI Channel
4	4 Ch. Polyphonic Note CV, Common Gate Common MIDI Channel
5	4 Ch. Independent Note CV, Gate Succesive MIDI Channels
6	2 Ch. Independent - Legato On Note CV, Velocity CV, Gate, Trigger Successive MIDI Channels
7	1 Ch. with Pitchbend, Mod Wheel Note CV, Velocity CV, Pitchbend CV, Mod Wheel CV, Gate, Trigger
8	1 Ch., Legato On with Pitchbend, Mod Wheel Note CV, Velocity CV, Pitchbend CV, Mod Wheel CV, Gate, Trigger
9	2 Ch. Independent - Split Keyboard Ch. 1 (C0-B1) Note CV, Gate; Ch. 2 (C2-C5) Note CV, Gate Common MIDI Channel
10	2 Ch. Independent, Legato On - Split Keyboard Ch. 1 (C0-B1) Note CV, Gate; Ch. 2 (C2-C5) Note CV, Gate Common MIDI Channel
15	Channel Calibration Mode
16	Test/Tuning Common Note CV and common Gate on all outputs Current MIDI Channel

MIDI CLOCK OUTPUT

If the input MIDI stream contains the MIDI clock (24ppqn clock), the module can be used to output the clock to external devices, divided by a preset factor. The clock is output through the front panel MIDI CLK jack. This is a stereo jack with the clock appearing as a 0-5V square wave on the tip connection. On the ring of the jack is a run/stop signal which can be configured to use the MIDI run/stop/reset realtime commands or a note message controlled run/stop command.

The division factor is controlled by the module programming grid Group 1. There is also a toggle bit to enable the MIDI clock note control. The factory default is a division ratio of 12 (1:8) which will give one clock per eighth note.

TECHNICAL SPECIFICATIONS GMS-742

Each Channel

Voltage Scale	1 Volt/Octave - .0833 Volts/Semitone Note number 0 - 127 produces -4.0 V to +6.0 V
MIDI Note Range	0 V = MIDI Note #48 = C4 (starting note for zero volts is presettable)
D/A Converter Output	16 Bits; full-scale range +-10 V
Gate/Trigger Output	0 - +5 V Gate width: duration of note Trigger width: 25 msec.
Module Power	+15 Volts 25 mA., -15 Volts 25 mA., +5 Volts 100 mA
Module Size	Panel height - 8.75 inches (222 mm); Panel width - 2.125 inches (54 mm); Depth (behind panel) 3.75 inches (96 mm)

MODULE PROGRAMMING OPTIONS

Certain module functions can be programmed by using the mode selector switch and a front panel toggle switch. To enter the programming mode, press and hold the toggle switch to the right (PGM) position for approximately two seconds until the Gate 1 LED starts to flash. This indicates that the module is in the programming mode. By briefly pressing the toggle switch to the right and releasing it, the program group can be selected. The Gate 2, Trig 1, and Trig 2 LEDs will successively flash, indicating that the corresponding program group is selected. There are four program groups with 16 options per group. The table below describes the functions controlled by this arrangement.

Once the option is programmed, its current state is stored in a non-volatile memory and will be restored the next time the module is powered. One of the program options can be selected to return all settings to the factory defaults.

Within a group, to select the option to be programmed, turn the mode selector switch to the appropriate number and then press the toggle switch to the right (PGM) position for approximately two seconds or until the LED stops flashing and remains lit. Then release the toggle switch. The LED will go off after

approximately one second indicating successful programming of the option. Rotate the Mode selector switch back to the operation mode that was being used.

PROGRAMMABLE CONTROLS GRID

POS	FUNCTION	GROUP 1 Gate1	POS	FUNCTION	GROUP 2 Gate2
1	1/96 24ppqn rate (not implemented)		1	Pitchbend range +- ½ semitone	
2	1/48 clock div		2	Pitchbend range +- 1 semitone	
3	1/48 dotted clock div (not implemented)		3	**Pitchbend range +- 2 semitone (default)**	
4	1/32 clock div		4	Zero volts at C4	
5	1/16 clock div		5	Zero volts at C3	
6	1/16 dotted clock div		6	Zero volts at C2	
7	**1/8 clock div (default)**		7	**Zero volts at C1 (default – Q104 mode)**	
8	1/8 dotted clock div		8	**Disable Pitchbend for mode 7&8 (default)**	
9	1/4 clock div		9	Enable Pitchbend for mode 7&8	
10	1/4 dotted clock div		10	**Disable continuous MIDI clock (default)**	
11	1/2 clock div		11	Enable continuous MIDI clock	
12	1/2 dotted clock div		12	**Disable RUN/STOP pulse mode (default)**	
13	1/1 clock div		13	Enable RUN/STOP pulse mode	
14	Not used		14	**Auxiliary gate outputs disabled (default)**	
15	Disable MIDI clock note control		15	Auxiliary gate outputs enabled	
16	Enable MIDI clock note control		16	Reset system defaults	
POS	FUNCTION	GROUP 3 Trig1	POS	FUNCTION	GROUP 4 Trig2
14	Save Zero and Span calibration to default			Coming soon	
16	Return Zero and Span to factory settings				

INTERNAL GATE CONNECTIONS

There are four internal gate output connections that can be used as gates or triggers depending on the current operating mode setting. This picture shows their location:
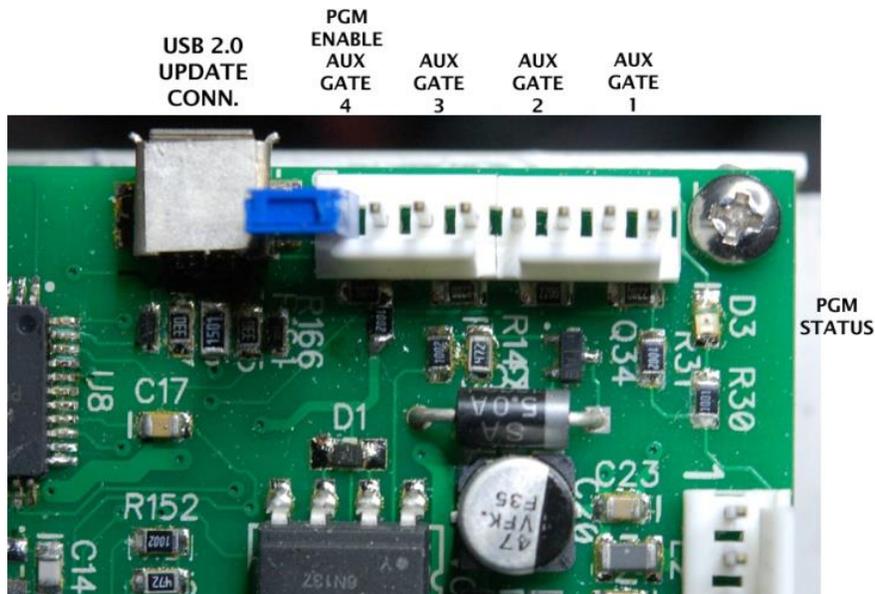
As an example of the use of these outputs, in the four independent channel with common gate and trigger mode, these outputs could be used to gate each voice through a VCA corresponding to it. Then the VCA outputs could be mixed and fed through a common VCA controlled by an envelope generator gated and triggered by the common gate and trigger outputs on the front panel.

RUN/STOP REALTIME MESSAGES AND MIDI NOTE CONTROL

An external control line on the ring of the MIDI CLK connector supplies a 0-5 V pulse or level waveform that can be used to gate an external clock or sequencer. The line can be set by programmable switch to be high from the time the RUN realtime message or MIDI note command is received until the STOP realtime message or MIDI note command is received. The output can be set to be either a level or pulse depending on the needs of the controlled device. By using this line and the MIDI clock signal on the tip of the same connector, the external device can be synchronized with software sequencers.

When using the MIDI note command to control the external control line, the internal logic will only respond to MIDI note messages sent on the MIDI channel which is one channel above the highest MIDI channel used by the current mode. For example, if Mode 1 is selected, the module responds to MIDI channels one and two to produce the CV and velocity signals and to MIDI channel 2 channels higher than the value set on the front panel MIDI channel selector switch for the RUN/STOP note commands. If mode 5 is selected, the RUN/STOP note commands should be sent on a MIDI channel 4 channels higher than the value set on the front panel MIDI channel selector switch.

GMS-742AMU CV CALIBRATION PROCEDURE

The MIDI to CV converter module has the ability to calibrate each output channel converter. The calibration allows the octave scaling of each channel to be adjusted so that the midi note value can be aligned with the scale octaves and the span of voltage change between each note can be set for the scale that is desired, typically one Volt per octave. The calibration process can also be used to compensate for modules such as voltage controlled oscillators with less than accurate octave scaling to be brought into compliance with the desired scaling by applying a frequency calibration method that will be described later.

The calibration process is performed using the DIN MIDI input. The Calibration mode is entered by rotating the 16 position rotary switch to position 15. Calibration MIDI note messages can be sent to the module on any MIDI channel. This will cause the GATE1 lamp to light. This indicates that the calibration entered will affect converter 1. To select one of the other converters for calibration, briefly click the panel toggle switch to the right. This should cause the GATE2 lamp to light indicating channel 2, then the TRIG1 lamp indicating channel 3, and TRIG2 lamp indicating channel 4. Clicking again will wrap around to GATE1.

Voltage calibration method

The basic calibration involves setting the voltage values at the calibration points. To do this, connect a digital voltmeter to the CV output of the channel being calibrated. A 4 ½ digit accuracy meter will work but a 5 ½ digit DVM is preferred. The current calibration points are between C3 and C5. The default values for these calibration points for the +-5 Volt are +-1.0000 Volts. Calibration values two octaves apart are generally accurate enough to guarantee tracking over the full 10 octave range of the channel.

Setting up and using MIDIOX and computer keyboard

The easiest way to generate the MIDI note commands if you have a Windows based system is to use MIDIOX, a MIDI routing, patching, and filtering utility. Download and install the utility. If you are using a linux or MAC based system, you will need to use a DAW or loopback program to route the output of an external MIDI controller to output DIN MIDI commands to the module. The alternative would be to use the module DIN MIDI input for calibration using the DIN MIDI output of a keyboard or controller.

Once MIDIOX is installed and running, in MIDIOX, go to OPTIONS/MIDI Devices. Under MIDI Outputs, you should see the name of the MIDI interface providing output to the module. Click on it and it should appear under Port Mapping with a plus sign next to it. If you click on the plus sign, you should see MIDI-OX Events under the entry. This is the event that allows the computer keyboard to enter "note" values. Close the device screen by click on the OK. Now go to the Actions tab and click on Keyboard. This will enable the computer keyboard as a note input device. Keyboard events will only be routed to MIDIOX when the window has focus. If you don't see MIDI note events being generated when keyboard keys are pressed, click on the frame of the MIDIOX window to give it focus.

Any MIDI channel can be used for output

Pressing and holding the C key associated with the zero or span calibration being

performed enables it. Holding the C3 key down enables zero calibration. Holding the C5 key down enables the span calibration. Then, by pressing the next lower or upper adjacent key, the value can be decremented or incremented. On the computer keyboard, the enable key for zero calibration would be the "Z" key which corresponds to C3. This key is at the end of a row and does not have an adjacent lower key. This problem can be resolved by shifting the C3 key up an octave to the "," key by first pressing function key F5. In MIDIOx the function keys shift the keyboard up and down by octave increments. The default, with C4 on the "," key is obtained by pressing F6.

Once the keyboard has been shifted by pressing the F5, then zero calibration can use the "," key to enable, the "M" key to decrement the value and the "." key to increment the value.

Next adjust the span of the scale. First, press the F6 key to return the keyboard to the default position. The span enable is C5, the "I" key. In the keyboard default position, there are keys on both sides for decrement and increment.

By repeating the zero and span calibration several times, it will be possible to achieve proper scaling between the two calibration points. To check the calibration, return to the run mode and try different Cs to be sure that they fall on integer volt values within +- 2 mV (approximately plus or minus two cents).

Setting up and using MIDIOX with external controller

An external keyboard controller can be routed to the converter module to perform calibration by using MIDIOX. Open the OPTIONS/MIDI Devices tab. Click the name of the converter module under MIDI Outputs to cause it to appear under Port Mapping. If the external controller was shown under MIDI Inputs and the "Automatically attach inputs to outputs during selection" was checked, the external keyboard should be added as a source under the module name in the Port Mapping list. If the external controller is attached to and detected by the computer after MIDIOX is started, MIDIOX will need to be restarted in order to be aware of the new USB devices.

To select the zero calibrate enable, press and hold the C3 on the keyboard. If the keyboard has a limited range such as a typical 37 key midi controller where there is no key to the left of C3, use the octave shift keys on the controller to move the C3 key upscale an octave. When setting the span on C5, it may be necessary to move the keyboard range downscale again using the octave shift key.

Frequency calibration method

The frequency calibration method can be used to correct for anomalies in the scaling of a VCO. The relationship between the midi to cv converter is relative and the goal of the method is to bring the oscillator frequencies into correspondence with the correct MIDI note that is being played. It has the further advantage in that it does not require a high precision DC voltmeter. As long as a means of measuring frequency (pitch) is available, this method can be used. This may be a frequency counter, a tuner, or a pitch reading application for a cellphone.

Any of the note input devices already mentioned will work with this method. Press the zero calibration C3 key (130.8 Hz) and adjust the oscillator to output the correct pitch. Now press the span calibration C5 key (523.24 Hz). Using the adjacent decrement and increment keys while holding down the C5 key, try to bring the frequency to the desired value. This adjustment will interact with the zero calibration so you might need to repeat adjusting the two calibration points to achieve the correct frequency values. After the first setting of the oscillator frequency for the zero value, use the keyboard decrement and increment keys to change the zero value rather than the oscillator adjustment.

Once the calibration process reaches an acceptable set of values go into run mode and test other C octave values and make any changes to the calibration values to minimize any tracking errors. It may not be possible to achieve a perfect value at every octave due to non-linearity in the voltage tracking of the VCO. Try to get the values closest to C4 to have the minimum errors and the rest will add to the color of the music.

Calibration process using the DIN MIDI input

The DIN MIDI input on the module can be used to perform channel calibration without a computer. Connect an external keyboard controller with DIN MIDI output to the input on the module. Select the 16 position rotary switch to position 15. Set the channel to be calibrated by using the toggle switch to move to the desired channel. Calibration note commands can be sent on any MIDI channel.

Saving and reloading calibration

The module can store and recall up to 16 sets of calibration tables including zero and span calibration values for the -5 V - +5V range. The set of tables stored in the default location will be loaded as the module default each time the module is powered.

To save a set of calibration tables, enter the programmable parameter mode. To do this, press and hold the toggle in the PGM position for approximately 2 seconds. This will cause the GATE1 lamp to light and start flashing to indicate the program mode. To use the calibration save function, move to program group 3 by briefly pressing the toggle switch to the PGM position twice. The TRIG1 lamp should now be flashing. Now move the sixteen position rotary switch to position 14 (save zero and span to default memory). Press and hold the toggle in the PGM position for approximately two seconds. The TRIG1 lamp will stop flashing and remain on to indicate the storage cycle. Release the toggle after this occurs. The lamp will go out after about a second and the module will return to normal operation. Again, the calibration information loaded in memory position 1 will be used as the default table when the module is powered up. The memory information is stored in an internal non-volatile memory.

The module can be caused to load the original factory calibration settings by entering the programmable parameter mode by holding the toggle in the PGM position for approximately 2 seconds, moving to program group 3, setting the rotary switch to position 16 (zero and span to factory settings) and holding the toggle in the PGM position for 2 seconds to initiate an erase cycle. This returns all converter settings to the original default values.

INSTALLING PROGRAM UPDATES

The process for installing program files in the GMS-742a MIDI to CV module using the Microchip HID

bootloader client is described below:

1. Move the entire folder called "usb_bootloader_client_win" to the host machine. It is not necessary to install the bootloader client.

2. The module must be powered and the miniB USB connector on the module main board must be accessible.

3. Move the jumper block on pin 8 of the 8pin MTA-100 connector in the upper left corner of the main board so that pins 7 and 8 are connected. This enables the on-board programming mode.

4. Power up the module. The LED D3 should light steadily to indicate the module is ready to communicate with the HID bootloader client.

5. Open the bootloader client folder and find the file HIDBootloader. Double click this file to run it.

6. Connect a USB type A cable from the host computer and plug the miniB end of the cable into the USB connector on the module. There may be some preliminary communication and installation of drivers. Eventually, a message should appear on the status window of the bootloader client indicating that a device has been detected and is ready to install files. The LED D3 on the module will flash periodically to indicate that it is ready.

7. Click on the file menu tab and select Import Hex file option.

8. When a file dialog window opens, navigate to the location of the module hex file to be loaded.

9. Once the file is successfully imported, click on the Program tab and select the Erase, Program, Verify option.

10. Status messages indicating the progress of the transfer should appear.

11. Once the transfer is completed, power down the module.

12. Move the jumper from pins 7 and 8 to pin 8.

13. Power up the module and the new program version should start running.