
Music Technologies Group

**MTG Pro One Turbo CPU
User Guide**

**Version 1.40
April 2015**

CONTENTS

1: Introduction	4
CPU Features	4
CPU+MIDI Features	4
CPU+MIDI+CV Features	4
Condition of Pro One	5
2: Operation	6
Power-On Key Map	6
MIDI Channel	7
Clock Source and Rate	7
LFO/Ext Clock Start Mode (Sys Ex Param 02)	8
MIDI Clock Enable and Rate (Sys Ex Param 07)	9
Sequencer Specific	10
Sequence Memory	10
Sequence Tie	10
Sequence Tie Enable (Sys Ex Param 05)	11
Sequence Stop Mode (Sys Ex Param 0A)	11
Arpeggiator Specific	12
Arpeggio Gate Time	12
Arpeggio Up/Down Modes	13
Arpeggio Gate Time (Sys Ex Param 04)	13
Arpeggio Up/Down End Notes (Sys Ex Param 03)	13
Arpeggio Down Mode (Sys Ex Param 09)	14
MIDI Delays	15
MIDI Delays	15
MIDI Delay (Sys Ex Param 08)	15
MIDI Note Priority (v1.40+)	15
MIDI Note Priority (Sys Ex Param 11)	15
MTG Factory Defaults	16
Bootloader Launch	16
3: CV Option	17
Introduction	17
Pitch Bend (Default: DAC1)	19
Mod Wheel/LFO2 (Default: DAC2)	20
Manual 1 (Default: DAC3)	22
Manual 2 (Default: Off)	22
MIDI Note-on Velocity (Default: Off)	22
Other CV Defaults	23

4: Windows Software	24
Introduction.....	24
Make it Go	24
Main Settings	25
Sequencer	26
CV (DAC).....	27
Firmware Upgrade	28
Appendix A: MIDI Implementation Summary	29
BootLoader	29
Synthesizer.....	29
Appendix B: System Exclusive Implementation	30
Command Types	30
General Form	30
Default Responses.....	31
Restart Command.....	32
Get Port Command	32
Get/Set Global Parameter List	33
Get Global Parameter Command.....	34
Set Global Parameter Command.....	35
Get Sequence Data.....	36
Set Sequence Data.....	37
Write LFO2/CV Settings (removed).....	38

1: Introduction

CPU Features

The Pro One Turbo CPU module can be used to replace a missing or damaged 8021. It also offers larger sequence memory and non-volatility. Here are the key features:

- Drop-in replacement using standard tools. Plug-n-Play. No soldering required.
- Supports the original functionality including the sequencer and arpeggiator.
- Each sequence can be up to 256 steps (compared to total of 40 steps on the original).
- Sequences are retained in memory even after power-down. The CPU module does not use a battery.
- Power-on settable parameters for clock start mode, arpeggio up/down end notes, arpeggio down mode and arpeggio gate time.
- New Sequence Tie mode allows for a variety of sequence note lengths.

CPU+MIDI Features

Using the MTG MIDI circuit, or one of your own, adds the following features:

- Firmware update (“re-flashing”) over MIDI.
- Settable MIDI channel.
- Monophonic MIDI in and output (arpeggiator and sequencer data).
- Selectable receive Note Priority over MIDI (*v1.40+*).
- Polyphonic MIDI output of keyboard data.
- Arpeggiator and sequencer sync-able to MIDI Sync in (settable clock rate).
- Load/Save sequence data over MIDI.
- Optional MIDI Thru (hardware included).
- Optional MIDI activity LEDs (hardware included).

CPU+MIDI+CV Features

An inexpensive DIY (do it yourself) add-on that adds the following features:

- Four 12-bit, 4v, Digital-to-Analog Converters.
- Receive MIDI Pitch Bend, Mod Wheel and other Continuous Controllers.
- Control OSC 1 and OSC 2 pitch as well as Filter Cutoff and Resonance.
- LFO2 with multiple waveforms (Square, Saw, Triangle, Sine, S&H, etc).
- LFO2 range from 0.1Hz to 10Hz (10 seconds/cycle to .1 seconds/cycle).
- Receive MIDI velocity and assign it to one of the DACs (*v1.30+*).

Condition of Pro One

While the Pro One Turbo CPU will replace the functionality of a damaged or missing CPU, it will not correct other problems your vintage synthesizer may have. It is recommended that the synth be in otherwise good condition before beginning the installation. For instance,

- The keyboard bushings will need to be replaced on units that have never had them replaced before (they dry out over time and become very brittle).
- Keyboard contacts should be attended to as required according to the procedure in the Pro One owner's manual.
- Finally, the two sockets at the ends of the keyboard flat cable are of poor quality and are also prone to oxidation over time. This makes the key contacts more critical. Consider having the sockets replaced. The same is true of the CPU socket on occasion.

For the latest news, please see www.musictechnologiesgroup.com .

2: Operation

The operation of the Turbo CPU is almost identical to the original. A few changes have been made that take advantage of modern microcontroller technology (i.e. flash memory). For the most part, the CPU (original or new) has limited control over the Pro One's sound generation electronics. However some enhancements can be made, even without carving up the existing electronics.

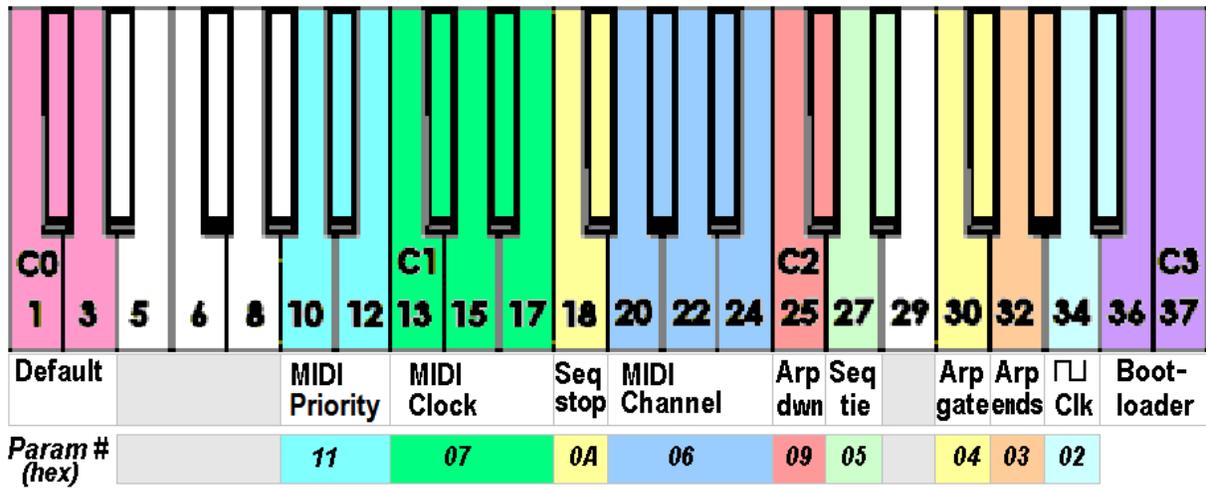
The features described in this section are configurable in two ways.

- The first way is to use MIDI System Exclusive commands (see the appendix for implementation details). A simple Windows application, **TurboCPU.exe**, is available that sets the configuration over MIDI using Sys Ex.
- The second (non-MIDI) way is to use power-on keyboard key combinations.

NOTE: Because of method 2, it is important to keep your hands off the keys when powering the unit up unless you plan on changing the configuration!

Power-On Key Map

When reading about the power-on key combinations, refer to the following diagram:



MIDI Channel

MIDI Channel and MIDI Note Priority (v1.40+) affect how the TurboCPU+MIDI reacts to incoming MIDI Note On/Off and Continuous Controller messages.

MIDI Channel (Sys Ex Param 06)

The MIDI Channel is by default Ch 1 (hex 00).

To change the channel using the keyboard, follow these steps. Turn the Pro One off. Hold the G1 key down along with the MIDI Channel # keys (G#1, A1, A#1 and B1, keys 20 through 24) then turn the power on.

Refer to the table below:

MIDI Ch	Hex	G1 (20)	G#1 (21)	A1 (22)	A#1 (23)	B1 (24)
1	00	Down	Up	Up	Up	Up
2	01	Down	Up	Up	Up	Down
3	02	Down	Up	Up	Down	Up
4	03	Down	Up	Up	Down	Down
5	04	Down	Up	Down	Up	Up
6	05	Down	Up	Down	Up	Down
7	06	Down	Up	Down	Down	Up
8	07	Down	Up	Down	Down	Down
9	08	Down	Down	Up	Up	Up
10	09	Down	Down	Up	Up	Down
11	0A	Down	Down	Up	Down	Up
12	0B	Down	Down	Up	Down	Down
13	0C	Down	Down	Down	Up	Up
14	0D	Down	Down	Down	Up	Down
15	0E	Down	Down	Down	Down	Up
16	0F	Down	Down	Down	Down	Down

You can also set and read the current MIDI channel using the appropriate System Exclusive command or the Windows application. See Chapter 4.

Clock Source and Rate

The sequencer and arpeggiator share a common clock. The clock signal can be selected from three sources:

- The internal LFO.
- An external clock-in (voltage pulse such as from a vintage drum machine).
- MIDI Clock (AKA MIDI Sync).

In addition, when using the internal LFO as the clock source (and to a lesser degree the external clock-in) you can also choose when the sound starts by setting "Clock Start Mode":

- Sync to User
- Sync to Clock

When using MIDI clock the clock start mode is always Sync to Clock.

You must also take care when using the RETRIG switch and the REPEAT/EXT switch. If you move these switches in the wrong direction you can alter the sound or stop it entirely. If you are experiencing odd behaviour, try adjusting these switches.

LFO/Ext Clock Start Mode (Sys Ex Param 02)

By default, the Pro One begins a sequence or arpeggio as soon as you set the mode (by using the switches and/or playing the keyboard). The LFO which drives the seq/arp starts its cycle fresh at that point. While this is fine when playing solo on the synth, it is not desirable when the syncing the Pro One to another device such as a drum machine. In this case the drum machine should provide the master clock and the Pro One should follow. Unfortunately the Pro One does not always behave as you would like. By changing the Clock Start Mode you can force the Pro One to wait for the clock before sounding any notes.

***NOTE:** This setting has no effect if a MIDI Clock Rate value is selected. If a MIDI Clock Rate is selected then the sequencer and arpeggiator always wait for the first clock after a MIDI start command.*

► Sync to User

This is the default behaviour of the Pro One (both stock and the MTG Turbo CPU). To set this mode, power the Pro One off. Hold the A2 key down (key 34). With the key still held down, turn the Pro One on.

► Sync to Clock

In this mode the arpeggiator and sequencer wait until the next rising edge of the LFO or external clock-in before sounding the first note. This allows for dependable and repeatable synchronization to a clock. To set this mode, power the Pro One off. Hold the A2 and the A#2 keys down (keys 34 and 35). With the keys still held down, turn the Pro One on.

MIDI Clock Enable and Rate (Sys Ex Param 07)

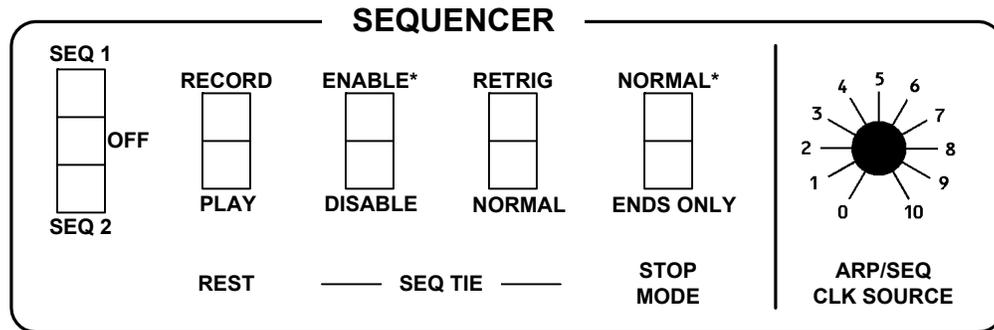
The Pro One will accept MIDI Clock (F8), MIDI Start (FA) and MIDI Stop (FC) for driving the sequencer and the arpeggiator. To use an external MIDI clock, choose any setting from the table below except the first one (the first one disables the MIDI clock and uses the LFO/External Clock instead). When a MIDI clock value is chosen, the LFO/External Clock will be disabled as a clock source for the sequencer and arpeggiator. **Remember to keep the Repeat/Ext switch in the lower (NORMAL) position.**

The default clock rate is MIDI Clock DISABLED. To set the MIDI Clock Rate, follow these steps. Turn the Pro One off. Hold the C1 key down along with the MIDI Clock Rate keys (C#1, D1, D#1 and E1, keys 13 through 17), then turn the power on. Refer to the table below and the key map shown previously:

Hex	Clocks per Quarter Note	Time Value	C1 (13)	C#1 (14)	D1 (15)	D#1 (16)	E1 (17)
00	DISABLED	Uses internal LFO clock instead	Down	Up	Up	Up	Up
01	3	1/32 note	Down	Up	Up	Up	Down
02	4	Dotted 1/32 note	Down	Up	Up	Down	Up
03	6	1/16 note	Down	Up	Up	Down	Down
04	8	Dotted 1/16 note	Down	Up	Down	Up	Up
05	12	1/8 note	Down	Up	Down	Up	Down
06	16	Dotted 1/8 note	Down	Up	Down	Down	Up
07	24	Quarter note	Down	Up	Down	Down	Down
08	32	Dotted quarter note	Down	Down	Up	Up	Up
09	48	Half note	Down	Down	Up	Up	Down
0A	64	Dotted half note	Down	Down	Up	Down	Up
0B	96	Whole note	Down	Down	Up	Down	Down
0C	128	Whole note + $\frac{1}{4}$ note	Down	Down	Down	Up	Up
0D	144	Whole note + $\frac{1}{2}$ note	Down	Down	Down	Up	Down
0E	168	Whole note + dotted $\frac{1}{2}$	Down	Down	Down	Down	Up
0F	192	Two whole notes	Down	Down	Down	Down	Down

Please note that in this mode **you are free to use the onboard LFO for modulation effects independent of the MIDI clock.** Also, when using MIDI clock **you need turn the REPEAT/EXT switch off (NORMAL).**

Sequencer Specific



Sequence Memory

The original Pro One sequences were lost on power down. The memory depth was only 40 notes for BOTH sequences. Sequence 1 and Sequence 2 had to share the 40 notes.

The Turbo CPU maintains the two sequences in separate 256-byte banks of flash. The sequences are retained throughout power cycles.

Sequence data can be saved or loaded using System Exclusive, even while a sequence is playing!

Sequence Tie

The original Pro One sequencer offered two events: note and rest. Since each note included retriggering of the envelope (assuming the RETRIG switch was up) there was only one note length.

The Turbo CPU records the position of the RETRIG switch along with the note value. **Thus by lowering the RETRIG switch you can record a note with no attack/decay phase.** If the first note has been recorded with RETRIG up, then another note follows it (same pitch but RETRIG off) then the note sounds only as an extension of the previous note (assuming the same key is played). Essentially the note length is doubled. The Roland JX3P uses this technique to great effect. You can also record an entirely new note value with no attack/decay phase if you find that to be musically useful.

The factory Pro One has a sequencer gate time of 50%. As of version 0.13, if Sequence Tie is enabled, the sequencer gate time is 100%. This improves the effect of lengthening notes, however repeating the same note is less prominent. **Also, here again you should keep the Repeat/Ext switch in the lower (Normal) position.**

Sequence Tie Enable (Sys Ex Param 05)

As described above, the sequencer can now record quarter notes, half notes, whole notes, whatever length you want because **the sequencer records the position of the RETRIG switch with each key**. This then makes the RETRIG switch nonfunctional during sequence playback. If you prefer the stock behaviour of the original Pro One, you can set that here.

► Sequence Tie Enabled

This is the default behaviour of the MTG Turbo CPU but not the stock Pro One. To set this mode, turn the Pro One off. Hold the D2 key down (key 27). While holding the key down, turn the Pro One on.

► Sequence Tie Disabled

If you do not wish to use the Sequence Tie, but do want to use the RETRIG switch live during sequence playback, follow these steps. **This is the default behaviour of the SCI stock Pro One.** Power the Pro One off. Hold the D2 and D#2 keys down. While holding the keys down, turn the Pro One on.

Note: The Sequential sequence gate time is 50%. As of v0.13, when Sequence Tie is enabled, the sequence gate time is 100%. This improves longer note events.

Sequence Stop Mode (Sys Ex Param 0A)

The stock Pro One stops playing the current sequence as soon as you move the SEQ1/SEQ2 switch to the OFF position. If you set the Sequence Stop Mode to Sequence-End-Only then after you turn the sequencer off, it will continue to play until the end of the sequence data table then stop. This also means that you can switch to the other sequence (chain) in a live situation and the sequencer will switch over smoothly at the end of the current sequence.

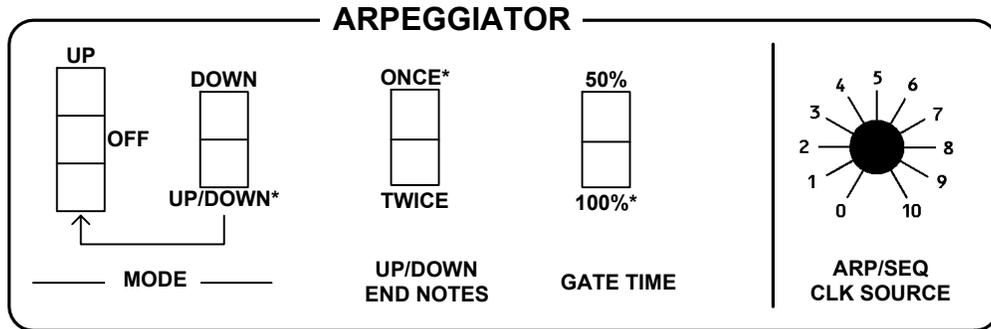
► Sequence Stop Mode Normal

This is the default behaviour of the stock Pro one as well as the MTG Turbo CPU. To set this mode, turn the Pro One off. Hold the F1 key down (key 18). While holding the key down, turn the Pro One on.

► Sequence Stop on Sequence End Only

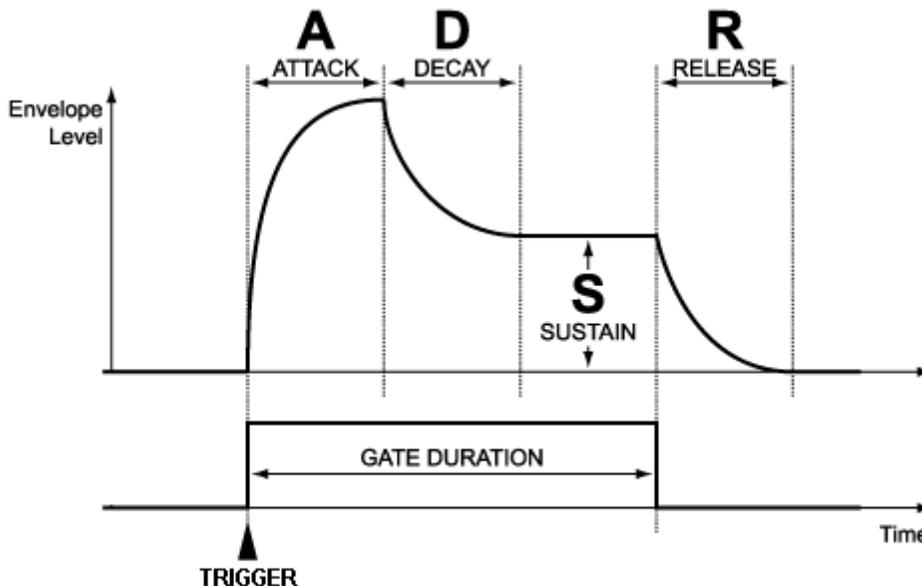
To set this mode, turn the Pro One off. Hold the F1 and F#1 keys down (keys 18 and 19). While holding the keys down, turn the Pro One on.

Arpeggiator Specific



Arpeggio Gate Time

This is a fairly subtle change from the original Pro One. The LFO clock has a 50% duty cycle. That means the LFO square wave is high for half the period and low for half the period. The Sequential Pro One leaves the gate on the whole time an arpeggio runs (100% gate time). The attack/decay sound is generated by a separate short trigger pulse that occurs on every note. The Arpeggio Gate Time setting allows you to turn the gate time off half-way through the LFO clock (50% gate time). Depending on the patch you are using, it can provide a slightly different sound as the patch can enter the Release portion of the ADSR cycle. For a factory Pro One you would have to lower the Sustain and extend the Decay value for a similar effect.



Arpeggio Up/Down Modes

There are two settings that affect the arpeggiator when the Up/Up+Down switch is in the lower Up+Down position. The first setting determines whether the end notes are heard once (the default), or twice. The other setting changes the Up/Down mode to Down-only.

Arpeggio Gate Time (Sys Ex Param 04)

▶ Arpeggio Gate 100%

This is the default behaviour of the Pro One (both stock and the MTG Turbo CPU). To set this mode, turn the Pro One off. Hold the F2 key down (key 30). With the key still held down, turn the Pro One on.

▶ Arpeggio Gate 50%

To set this mode, power the Pro One off. Hold the F2 and the F#2 keys down (keys 30 and 31). With the keys still held down, turn the Pro One on.

Arpeggio Up/Down End Notes (Sys Ex Param 03)

When playing an Up/Down Arpeggio the Pro One only sounds the highest and lowest notes once. If you prefer for these end notes to each sound twice, you can change the mode using this procedure.

▶ End Notes Once

This is the default behaviour of the Pro One (both stock and the MTG Turbo CPU). To set this mode, power the Pro One off. Hold the G2 key down (key 32). With the key still held down, turn the Pro One on.

▶ End Notes Twice

To set this mode, power the Pro One off. Hold the G2 and the G#2 keys down (keys 32 and 33). With the keys still held down, turn the Pro One on.

Arpeggio Down Mode (Sys Ex Param 09)

The factory Pro One allows for changing the Up/Down mode to Down by modifying a diode on the circuit board. Here you can make the same change but much more easily.

► Up/Down Mode

This is the default behaviour of the Pro One (both stock and the MTG Turbo CPU). To set this mode, power the Pro One off. Hold the C2 key down (key 25). With the key still held down, turn the Pro One on.

► Down Mode

To set this mode, power the Pro One off. Hold the C2 and the C#2 keys down (keys 25 and 26). With the keys still held down, turn the Pro One on.

MIDI Delays

Some older MIDI synths do not react well to MIDI note-off's followed immediately by note-on's (especially the same note). This is exactly what happens in some sequences or arpeggiations (depending on mode). For this reason the MTG Pro One CPU will insert a short delay (default is 10ms) in the MIDI Out key data when these problematic situations occur. This delay is not global; it only appears when it absolutely has to.

MIDI Delay (Sys Ex Param 08)

You can shorten or lengthen the MIDI Delay using System Exclusive commands (or the free Windows PC Editor). Please see Chapter 4 or Appendix B for more information.

MIDI Note Priority (v1.40+)

The TurboCPU+MIDI lets you choose from several MIDI Note Priority schemes. There is a 10 note stack that maintains the state of keys held down. The available priorities are Last (default), High, Low and One Note (no stack). This only affects MIDI, not the local keyboard.

In addition, the Last, High and Low Note priorities read the **RETRIG switch** to determine whether a new envelope is triggered on subsequent MIDI keys down or not (legato).

MIDI Note Priority (Sys Ex Param 11)

The default MIDI Note Priority is LAST. To set the MIDI Note Priority, follow these steps. Turn the Pro One off. Hold the A0 key down along with the MIDI Note Priority keys as desired (A#0, and B0, keys 11 and 12), then turn the power on. Refer to the table below and the key map shown previously:

Priority	Hex	A0 (10)	A#0 (11)	B0 (12)
Last Note	00	Down	Down	Down
High Note	01	Down	Up	Down
Low Note	02	Down	Down	Up
One Note*	03	Down	Up	Up

* One Note just refers to the original method the TurboCPU+MIDI used before version 1.40. There was no note stack. The Last note is played and there is no legato style.

You can of course use System Exclusive commands or the Windows software to make these changes.

MTG Factory Defaults

If you wish to restore the Pro One to the MTG factory default settings shown here,

- Clock Start Mode is Sync to User
- Arpeggio Up/Down is set to End Notes Once
- Arpeggio Gate is 100%
- Sequence Tie is Enabled
- MIDI Channel is channel 1
- MIDI Clock is Disabled
- Arpeggio Up/Down mode is Up/Down
- Sequence Stop Mode is Normal
- MIDI Delay time is 10ms
- CV (Pitchbend/LFO/etc) settings to their defaults
- MIDI Note Priority is set to Last Note.

then follow these steps. Turn the Pro One off. Hold the lowest three notes down (C0, C#0 and D0). Turn the Pro One on. There is also a button on the Firmware page of the Windows application that can be used with TurboCPU's that are v1.32 or higher.

Bootloader Launch

If you have installed the MIDI hardware you can utilize the built-in MIDI bootloader to upgrade the firmware. To launch the bootloader, start with the Pro One turned off. Hold the two highest notes down (B2 and C3, keys 36 and 37). While holding them down, power on the Pro One. The bootloader will emit several short notes. After that the bootloader remains in control of the synth.

Follow the instructions in the **Installation Manual** Appendix A or use the Windows application to upgrade your firmware.

3: CV Option

Introduction

The optional Control Voltage (CV) option is a do-it-yourself analog DAC + wires add-on that brings additional analog control to the Pro One Turbo CPU.

Note: The elements are all controlled by MIDI so the MIDI circuitry is required for the CV module to operate. This version of the manual refers to firmware v1.30+.

There are 5 sources and 3 destinations. Each source can be assigned to an individual destination or disabled. You cannot combine sources so there will always be at least two sources unused.

Sources:

- Pitch Bend Wheel
- Modulation Wheel (Continuous Controller #1) / LFO2
- Manual Control #1 (Continuous Controller #71)
- Manual Control #2 (Continuous Controller #74)
- MIDI Note-On Velocity

Destinations:

- OSC1/OSC2 Pitch
- Filter Cutoff
- Filter Resonance

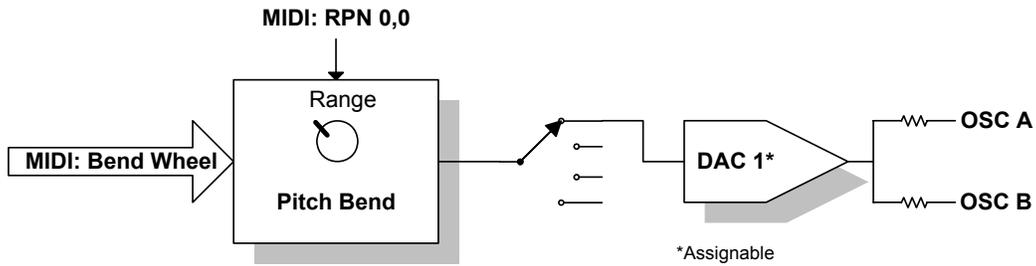
The board uses an inexpensive yet flexible quad 12-bit DAC (digital to analog converter) board. The four CV modules are fully programmable and routable. The fourth DAC is unassigned and is left for expert DIY-ers to experiment with.

Here is the **default configuration**:

- | | | |
|---------------------|---|---------------|
| • Pitchbend | ▶ | OSC1/2 Pitch |
| • Mod Wheel/LFO2 | ▶ | VCF Cutoff |
| • Manual Control #1 | ▶ | VCF Resonance |
| • Manual Control #2 | ▶ | Off |
| • Velocity | ▶ | Off |

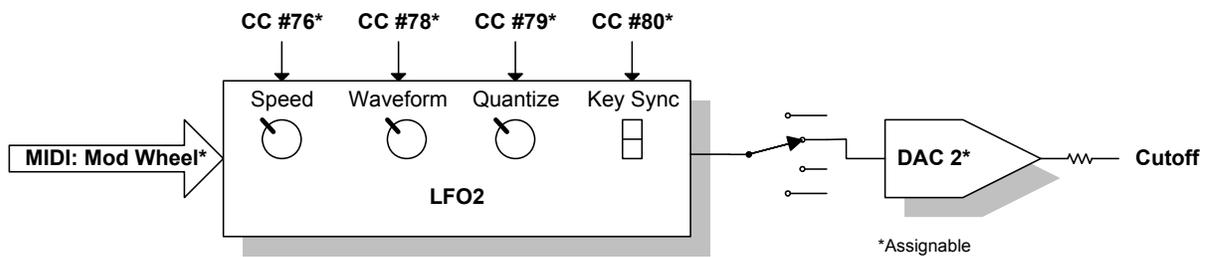
On the next page is a diagram that shows the overall default setup and how the parameters are controlled over MIDI.

CV1:



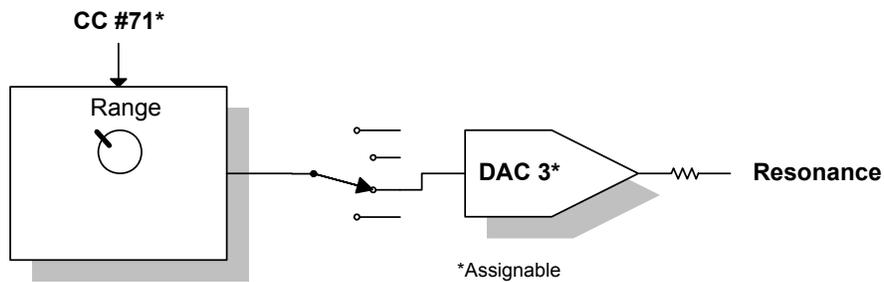
- Receives MIDI Pitch Bend and applies it to both OSC A and OSC B. The Pitch Bend range (sensitivity) is adjustable using Sys Ex or RPN.

CV2:



- Receives MIDI Modulation Wheel to control LFO2 (depth/amount).
- LFO2 then controls the Filter Cutoff value.
- The LFO2 rate is controllable via continuous controller #76.
- The LFO2 waveform is controllable via continuous controller #78.
- The LFO2 Quantization and Key Sync mode are controllable via continuous controllers #79 and #80 respectively.

CV3:



- Receives Resonance amount via continuous controller #71.

CV4:

- Spare (not used).

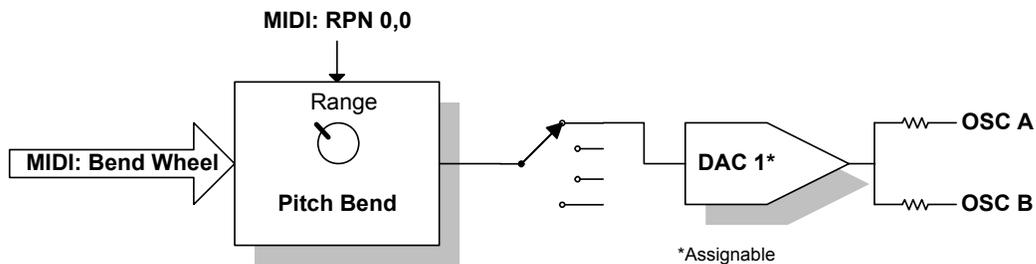
Important Points

By simply changing the DAC assignments, it is easy to apply the Mod Wheel /LFO2 to the oscillator frequency rather than the filter cutoff.

The four DACs are unipolar, each with a range of 0v to +4v. Most of the Pro One circuitry accepts this range quite handily, with the exception of Pitch Bend. Pitch Bend employs a simple technique that allows for pitch bend both up and down. See the next section for more information.

Each voltage, VCO Pitch Bend, VCF Cutoff or Resonance, is combined with other voltage sources on the Pro One front panel (the “knobs”). It may be necessary to dial back the contribution from the Pro One knobs in order to get the maximum effect from the CV module (and vice versa).

Pitch Bend (Default: DAC1)



Routing

The first CV module is assigned to MIDI Pitch Bend. It can be routed to any DAC (1 to 4) or disabled by setting its output to 0.

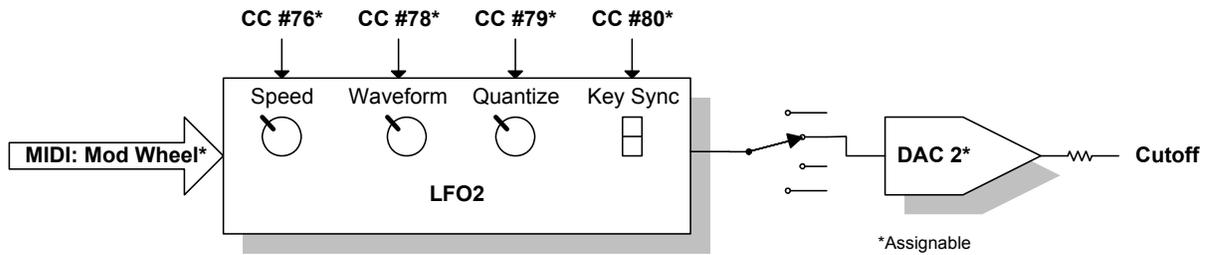
The output DAC is assigned by issuing a Sys Ex “set” command for parameter 12 (hex 0C). If assigned to a DAC, received 14-bit MIDI pitch bend data is scaled and converted to a 12-bit voltage output (standard one volt per octave).

Range

The range (number of semitones) is set by issuing the standard RPN 0 command or by issuing a Sys Ex “set” command for parameter 11 (hex 0B). The output is immediately offset by the range amount and the Master Tune must be adjusted down to compensate.

For instance, the default bend range is 1 whole tone (two semitones up and two semitones down). The DAC adds this amount to the pitch so you would need to tune to Master Tune down by a whole tone. This adjustment only needs to be performed when a different Pitch Bend Range is applied.

Mod Wheel/LFO2 (Default: DAC2)



Routing

The second CV module is assigned to the MIDI Modulation Wheel input and is then applied to the LFO2. By default the LFO2 output is set to DAC #2 (Filter Cutoff) but this is easily changed. It can be routed to any DAC (1 to 4) or disabled by setting its output to 0.

The output DAC is assigned by issuing a Sys Ex "set" command for parameter 13 (hex 0D).

Depth

The amount of LFO2 applied to DAC #2 is determined by the Mod Wheel position (also known as continuous controller #1).

Speed

The LFO2 speed/rate is adjustable from slow (10 seconds) to fast (10 Hz) using continuous controller #76.

Waveform

The LFO2 waveform is selected using continuous controller #78. These are the available waves:

Number	Wave	Name	Description
0		OFF	
1		Square	

2		Reverse Square	
3		Rising Saw	
4		Falling Saw	
5		Triangle	
6		Sine	
7		Random 1	Slow (sample & hold)
8		Random 2	Medium (noise)
9		Sequence 1	Data from SEQ1 notes
10		Sequence 2	Data from SEQ2 notes
11		Drum	<u>Single</u> ramp down

Remember that SEQ1 and SEQ2 can be loaded with data via Sys Ex so to some degree you can create your own LFO2 waveforms.

Quantize

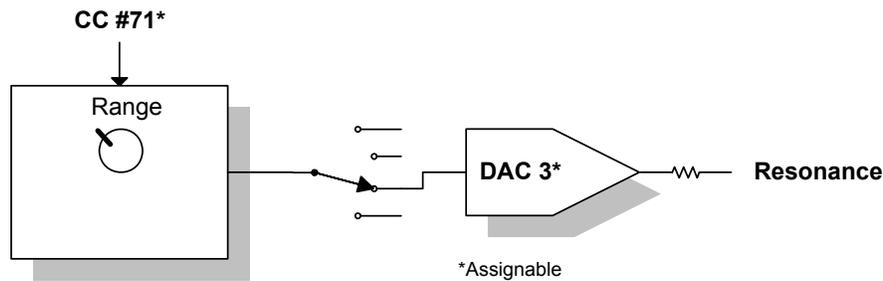
The LFO2 CV output can be quantized to “approximate” equally tempered output (or fractional values) using continuous controller #79. The quantize values are as follows:

Number	Description
0	No quantization
1	1 semitone
2	1/2 semitone
3	1/3 semitone
4	1/4 semitone
5	1/5 semitone

Key Sync

The LFO2 waveform can be set to retrigger on key down (note on). This allows for predictable synth drum sounds and repeatable LFO2 based arpeggios. The sync setting can be turned on (1) and off (0) using continuous controller #80.

Manual 1 (Default: DAC3)



Manual1 is set to simply accept a continuous controller amount and apply the corresponding voltage to a DAC, if assigned. This allows you to assign filter cutoff or resonance to a pot on a MIDI controller if desired.

By default the Manual1 output is set to DAC #3 (Filter Resonance) but this is easily changed. It can be routed to any DAC (1 to 4) or disabled by setting its output to 0. Manual1 amount is controlled by continuous controller #71

Manual 2 (Default: Off)

Manual2 is set to simply accept a continuous controller amount and apply the corresponding voltage to a DAC, if assigned. This allows you to assign filter cutoff or resonance to a pot on a MIDI controller if desired.

By default the Manual2 output is OFF. It can be routed to any DAC (1 to 4) or disabled by setting its output to 0. Manual2 amount is controlled by continuous controller #74.

MIDI Note-on Velocity (Default: Off)

Velocity data is received with every MIDI Note-On message. The key velocity is scaled down by the Amount (range) setting. With the Amount set to maximum the maximum voltage swing is available from the DAC. If you reduce the Amount, then the voltage swing is reduced and the velocity effect is lessened. This makes the velocity more practical and controllable.

By default the Velocity in not assigned to a DAC. It can be routed to any DAC (1 to 4) or disabled by setting its output to 0.

The Amount (range) is adjustable using continuous controller #81. In addition the velocity parameter can be inverted (more velocity provides less voltage). This setting is turned on or off using continuous controller #82.

The last velocity received is remembered until the next MIDI Note-On is received. If you wish to "cancel" the voltage you can change one of the Pro One panel keyboard mode switches (Sequencer or Arpeggiator), change the DAC assignments, cycle the power or send a very weak note-on.

Other CV Defaults

When you power on the synth, the DAC assignments are remembered from the last session. The same is true of the Pitch Bend Range setting. The voltages are zeroed except for the Pitch Bend which is "centered" depending on the range selected.

All of the other CV controls are "live" in that they take on real time values received over MIDI. Here are the initial conditions for the remaining elements of the CV option:¹

Defaults:

- LFO2 Depth (mod wheel amount) is set to 0.
- LFO2 Rate is set to a medium speed (60).
- LFO2 Wave is set to 4 (falling saw).
- LFO2 Quantization is OFF.
- LFO2 Key Sync is ON.
- Velocity Range is set to medium (64).
- Velocity Invert is OFF.

As mentioned previously, the DAC assignments are configured using MIDI System Exclusive messages and a simple Windows application is provided to take care of these and other non-volatile settings.

¹ In previous firmware versions there was a way to load and store initial conditions. This has been removed for now pending further input from end users.

4: Windows Software

Introduction

A simple Windows software package is available as a free download that enables you to set and test the various TurboCPU+MIDI and TurboCPU+MIDI+CV parameters. TurboCPU.exe uses the System Exclusive commands described in Appendix B. The main features are:

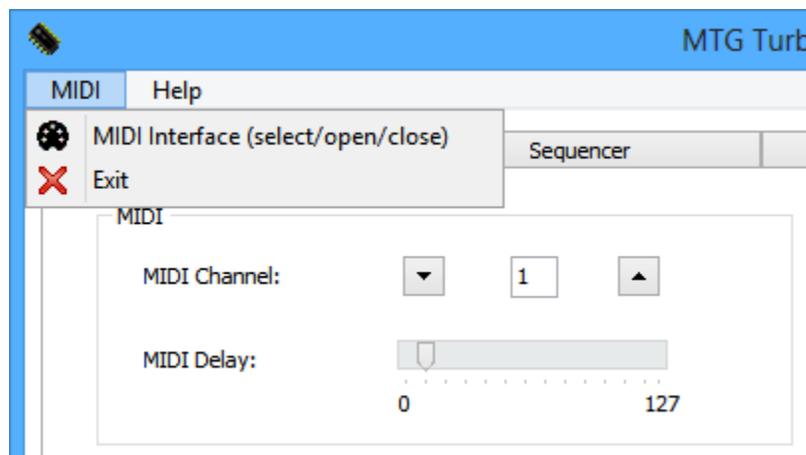
- You can read or set any of the parameters adjustable via the power-on keypress method described at the very beginning of this manual.
- You can save and load sequences, even while the sequencer is running.
- You can setup and test the various CV parameters.
- You can upgrade or downgrade the firmware. The CPU can be placed into "bootloader" mode or Factory Reset at the click of a button.

You will of course need a Windows PC and a standard MIDI interface. For some testing you might find it helpful to merge the TurboCPU.exe output with a MIDI keyboard, but this is not required. Much of the CV testing can be done by using the Drone mode on the Pro One or using the Test buttons in the program.

Make it Go

Launch the provided software on your PC. Make sure everything is hooked up because the software will refuse to function if a TurboCPU is not found.

From the main menu click on **MIDI**. This is where the MIDI connection is turned on and off.

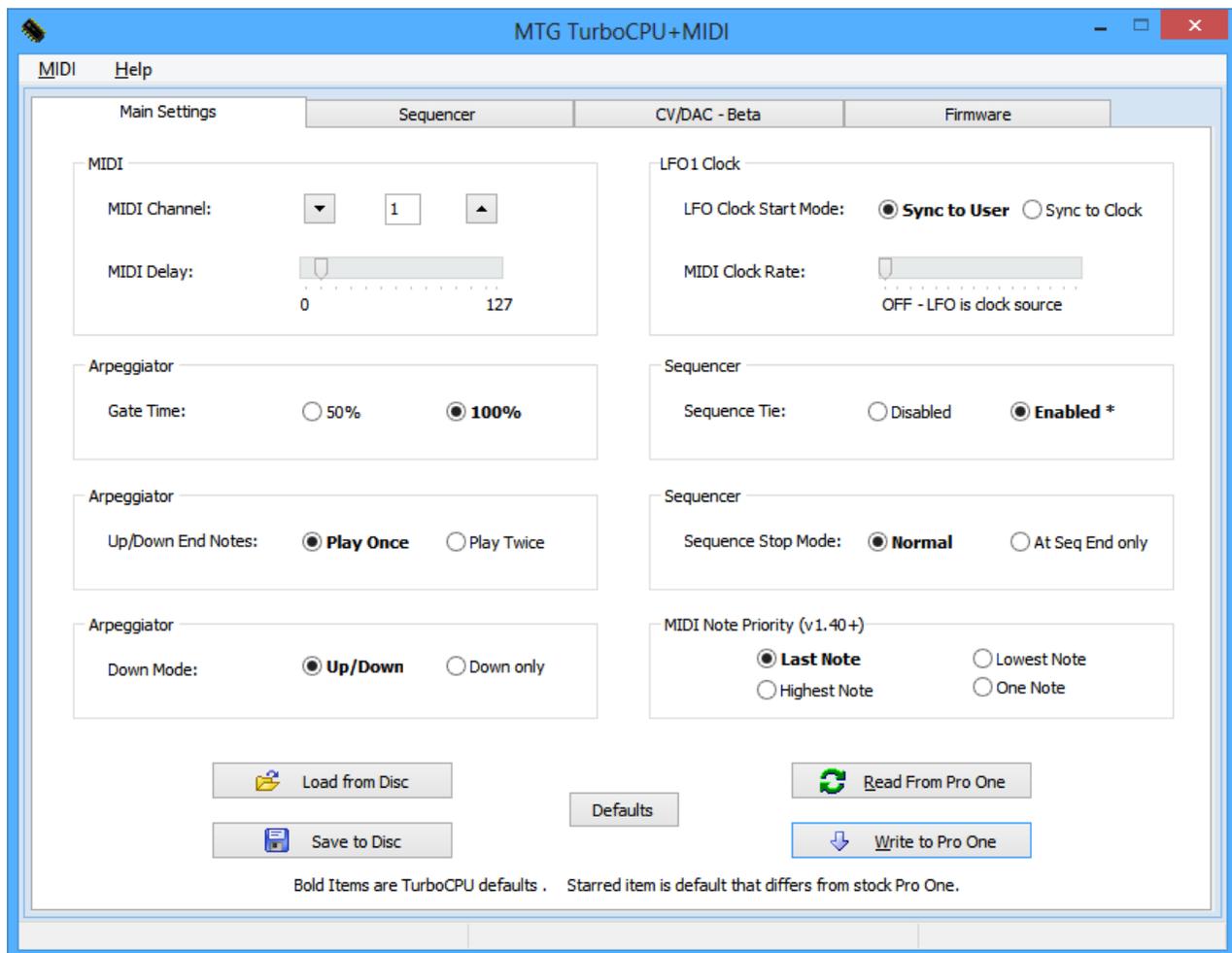


Click on **MIDI Interface** and a box should appear with choices for input **and** output. Choose the appropriate Input **and** Output device then click **OK**. If the software can communicate with the TurboCPU you are good to go.

Main Settings

The Main Settings panel (tab) lets you read and/or set the parameters discussed in Chapter 2 of this manual. By clicking **Read from Pro One** you can get the current state of your synth. You can make changes then send those changes by clicking **Write to Pro One**.

You can also save and load these settings to your PC if you like. The defaults buttons simple resets the form values to the factory default settings. For your convenience, the factory default settings are shown in bold on the form.

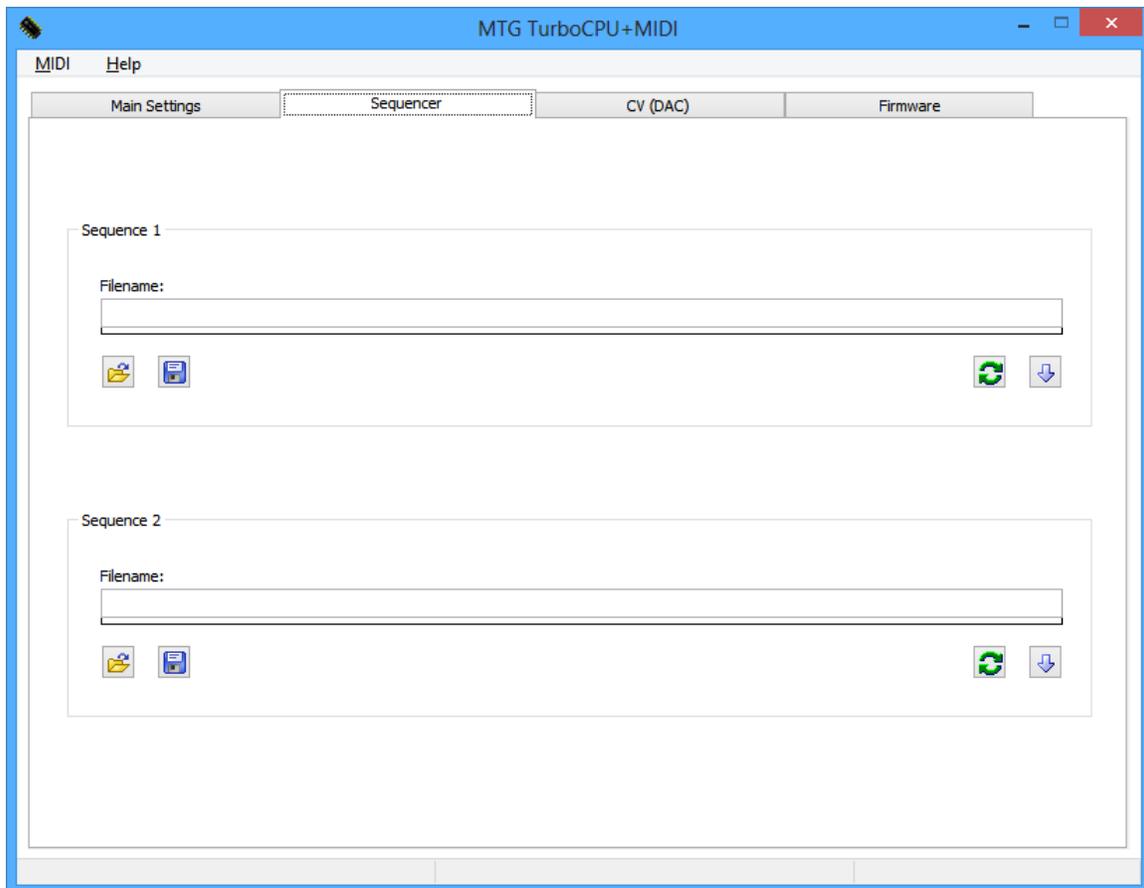


Sequencer

The Sequencer panel (tab) allow you to read or write sequence 1 and sequence 2 between the software and the TurboCPU. You can also save to or load the data from your PC. The data is stored in System Exclusive format as described in the appendix.

There is a small bargraph under each filename that gives you a visual indication of how much sequencer data is being used up by the sequence. Each sequence can be up to 256 bytes.

At this time there is no editor or conversion software that allows you to modify or convert the sequence notes, but it may be possible in the future. The data format is explained elsewhere in this manual.

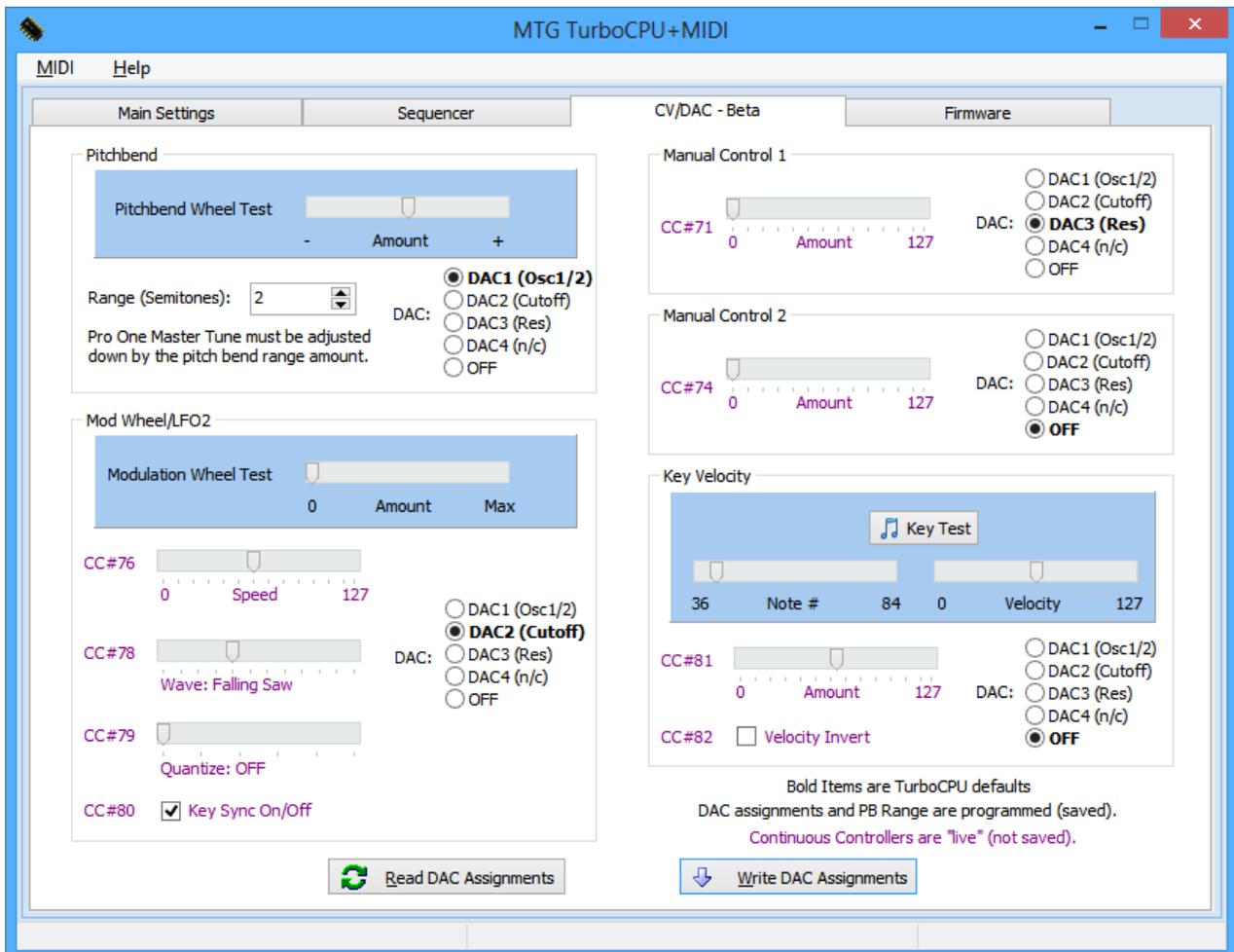


CV (DAC)

This panel is used for configuring the 5 voltage sources (Pitch Bend, Mod Wheel/LFO2, Manual1, Manual 2 and velocity) and 3 destinations (OSC1/2, Cutoff and Resonance).

The DAC assignments and Pitchbend Range are saved to non-volatile memory on the Pro One. You can also read these values back out of the synth and onto the screen.

The other values, shown in purple, are adjusted in real time ("played"). All of the continuous controller values can be manipulated on this screen. There are some blue "Test" boxes for mimicking a Pitch Wheel, a Mod Wheel and a Note-On with Velocity.

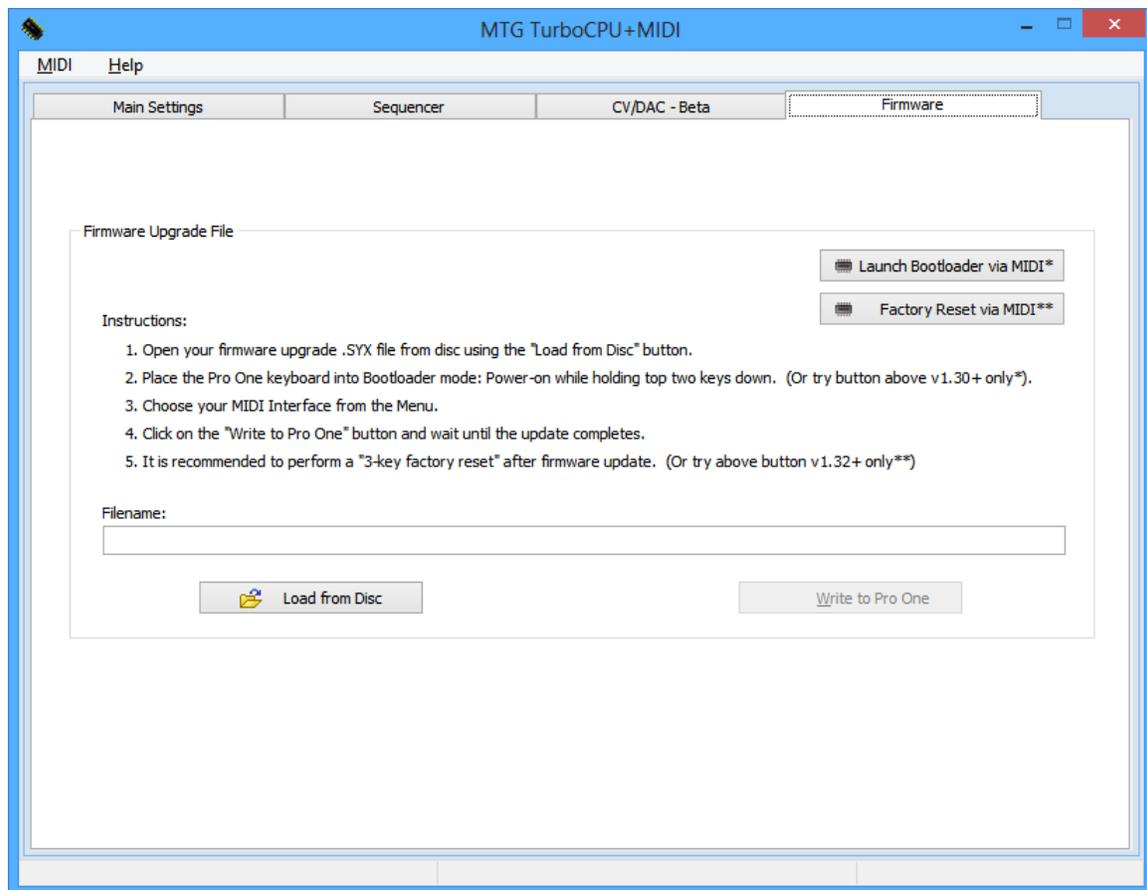


Firmware Upgrade

This panel (tab) allows you to re-flash the TurboCPU's firmware. This means you can take a file you have downloaded from the web and upgrade your TurboCPU with it.

Follow the directions on the screen to upgrade the CPU. If you have any settings or sequence data that you want to save, do so **before** the firmware update.

With later versions of the firmware you can put the synth in bootloader mode by clicking the Launch Bootloader via MIDI button. For earlier versions you will need to use the power-on keypress method described earlier in this manual.



It is recommended that you perform a factory reset-to-defaults procedure any time you upgrade your firmware. This will wipe out your settings and possibly your sequences. This is described in the section "MTG Factory Defaults" at the end of Chapter 2.

Appendix A: MIDI Implementation Summary

The following abbreviated MIDI Implementation charts describe the Pro One CPU upgrade MIDI as of this writing for the bootloader and the Pro One synth. The bootloader and synthesizer are separate MIDI devices.

BootLoader

Function	Tx	Rx	Remarks
System Exclusive	o	o	
Everything Else	x	x	

o : implemented
x : not implemented

Synthesizer

Function		Tx	Rx	Remarks
Basic Channel	Default	1-16	1-16	Set by power-on key combinations and SysEx
	Changed	x	x	
Mode	Default	x	[1]	Note priority settable
	Messages	x	x	
Note Number		36-72	36-86	TBD (limited by DAC)
	True Voice	36-72	36-72	
Velocity	Note On	x	o [2]	CV option
	Note Off	x	x	
Pitch Bender		x	o [2]	CV Option
Control Change		x	o	CV Option
System Exclusive		o	o	See next appendix
Real Time	Clock	x	o	MIDI Sync Start, Stop
	Commands	x	o	
Everything Else		x	x	

o : implemented
x : not implemented

[1]: OMNI OFF, MONO. Note priority settable using Sys Ex or keyboard power-on.

[2]: Receive pitch bend and velocity if CV unit installed. Velocity as of v1.30.

Please note that the synth transmits the arpeggiator and sequencer note data in monophonic form. In normal keyboard mode, the synth outputs polyphonic MIDI key data.

Appendix B: System Exclusive Implementation

The Sys Ex engine in the MTG Pro One CPU runs in the background while the CPU performs its normal duties. Generally this means you can alter parameters at the same time the synth is being used to make music. For instance you can download a new sequence while the sequencer is running.

Command Types

The table below shows the system exclusive commands supported by the MTG Pro One CPU. A “Get” command implies reading data from the Pro One. A “Set” command implies writing data to the Pro One. The Sent and Recv’d columns refer to how many bytes are sent from a PC (or other device) to the Pro One and then how many bytes are received in response.

Command Type (hex)	Description	Sent (# bytes)	Recv’d (# bytes)
04	Restart	5	7 (ACK)
05	Get Port	5	6
21	Get a Global Parameter	8	8
22	Set a Global Parameter	8	7 (ACK)
23	Get Sequence 1 Data	5	Variable
24	Set Sequence 1 Data	Variable	7 (ACK)
25	Get Sequence 2 Data	5	Variable
26	Set Sequence 2 Data	Variable	7 (ACK)
28	Write LFO2/CV Settings	5	7 (ACK)
--	Universal Device Inquiry	6	24

The Universal Device Inquiry response includes the MTG Pro One CPU firmware version number.

General Form

(hex)	F0	System Exclusive
	<id>	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	<cmd>	Command type byte (from table above).
	(addr)	Parameter number byte (if applicable).
	(data)	Data (if any) in nibble pairs.
	F7	End of System Exclusive

Default Responses

A few of the commands to the MTG Pro One CPU return standard “yes” (**ACK**nowledge) or “no” (**Not ACK**nowledge) response. Here is the general form of those responses.

ACK:

(hex)	F0	System Exclusive
	<id>	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	<cmd>	Echo of whatever the command was.
	(addr)	Echo of whatever the parameter # was.
	41	ACK – ACKnowledge (parameter or value accepted)
	F7	End of System Exclusive

NACK:

(hex)	F0	System Exclusive
	<id>	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	<cmd>	Echo of whatever the command was.
	(addr)	Echo of whatever the parameter # was.
	4E	NACK – Not ACKnowledge (parameter or value was out of range, or error)
	F7	End of System Exclusive

You should receive an ACKnowledge when setting a parameter. If you receive a NACK instead, then there is something incorrect in your command.

Restart Command

You can command the MTG Pro One CPU to reboot by issuing this command. If you are connected using USB, then you may need to close and reopen the ports in your MIDI software.

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	04	Command type.
	F7	End of System Exclusive

Received:

ACK packet (then the MTG Pro One CPU reboots)

Get Port Command

You can query the MTG Pro One CPU to determine if it is connected using 5-pin DIN MIDI or USB-MIDI (for now only 5-pin DIN MIDI is supported).

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	05	Command type.
	F7	End of System Exclusive

Received:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	4D or 55	4D = 'M' = MIDI 55 = 'U' = USB (future feature)
	05	Command type.
	F7	End of System Exclusive

Get/Set Global Parameter List

The following table describes the Parameter # and valid data values for the Get/Set Global Parameter commands. The Value byte is split into two nibble pairs for transmission over MIDI.

Parameter # (addr in hex)	Value (binary)	Description
02	0000 000x	Clock Start Mode 0 = Sync to User* 1 = Sync to (Ext) Clock
03	0000 000x	Arpeggio Up/Down End Notes 0 = End notes once* 1 = End notes twice
04	0000 000x	Arpeggio Gate Time 0 = 50% 1 = 100%*
05	0000 000x	Sequence Tie Enable 0 = Disabled 1 = Enabled*
06	0000 nnnn	MIDI Channel Default is 0000* (channel 1, see table)
07	0000 cccc	MIDI Clock Rate Default is 0000* (disabled, see table)
08	0ddd dddd	MIDI off/on note delay (for old synths) Default is 10ms* Range is 0ms to 127ms
09	0000 000m	Arpeggio Up/Down Mode 0 = Up/Down* 1 = Down
0A	0000 000m	Sequencer Stop Mode 0 = Normal* 1 = Stop on sequence end (wrap) only
0B	0000 rrrr	Pitchbend range (semitones). Also settable by RPN 0,0
0C	0, 1 to 4	Pitchbend DAC. 0 = Off, 1 to 4 = DAC #
0D	0, 1 to 4	LFO2 DAC. 0 = Off, 1 to 4 = DAC #
0E	0, 1 to 4	Velocity DAC. 0 = Off, 1 to 4 = DAC #
0F	0, 1 to 4	Manual1 DAC. 0 = Off, 1 to 4 = DAC #
10	0, 1 to 4	Manual2 DAC, 0 = Off, 1 to 4 = DAC #
11	0 to 3	MIDI Note Priority 0=Last*, 1=High, 2=Low, 3=One

* Default setting

Note: This table was revised slightly for v1.30. Parameter 11 (hex) was added in v1.40.

Get Global Parameter Command

By sending a Get Global Parameter Sys Ex command from a host device, the user can query the settings in the CPU. In this implementation one parameter byte is read at a time from the table listed above. Byte addresses outside of the parameter list range are ignored.

The command reads a single byte from the CPU, but the data value is received as two bytes over MIDI. The first byte is the most significant nibble of the data. The second byte is the least significant nibble of the data.

Request:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	21	Command (get global parameter).
	<addr>	Parameter # from parameter list table.
	F7	End of System Exclusive

Example: Read the active MIDI Channel.

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	21	Command type (get global parameter).
	0C	Parameter # from parameter list table.
	F7	End of System Exclusive

Received:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	21	Command type (get global parameter).
	06	Parameter # from parameter list table.
	00	Most significant nibble of the value 0F.
	0F	Least significant nibble of the value 0F.
	F7	End of System Exclusive

In the above example the result, 0F, is MIDI Channel 16. MIDI channels 00 to 0F are called 1 to 16 normally.

Set Global Parameter Command

By sending a Set Global Parameter Sys Ex command from a host device, the user can change the settings that normally require power-on key combinations. In this implementation one parameter byte is changed at a time from the parameter list table. Byte addresses outside of the parameter list range are ignored (the CPU may NACK the command attempt).

The command writes a single byte into the CPU, but the new data value is transmitted as two bytes. The first byte is the most significant nibble of the data. The second byte is the least significant nibble of the data.

Command:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	22	Command type (set global parameter).
	<addr>	Parameter # from parameter list table.
	<msn>	Most significant nibble of the new value.
	<lsn>	Least significant nibble of the new value.
	F7	End of System Exclusive

Example: Set the MIDI Clock to 24 = Quarter Note = table hex value 07.

MIDI Clock Rate table excerpt:

07	24	Quarter note	Down	Up	Down	Down	Down
----	----	--------------	------	----	------	------	------

The parameter number is also 07 for setting the clock rate.

Parameter List table excerpt:

07	0000 cccc	MIDI Clock Rate Default is 0000 (disabled, see table)
----	-----------	--

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	22	Command type (set global parameter).
	07	Parameter # from parameter list table.
	00	Most significant nibble of the table value 07.
	07	Least significant nibble of the table value 07.
	F7	End of System Exclusive

Received:
ACK packet

This command switches the arpeggiator and sequencer from LFO/Ext clock mode to MIDI clock mode. Make sure the Repeat/Ext switch is in the down (off) position.

Get Sequence Data

The sequence data is stored internally in a very simple format. Each byte contains a keyboard note value (0 to 36) that is played out when a clock-in is received (from either the LFO, an external pulse or MIDI). The TRIG switch information is encoded along with the note number in case you use the Sequence Tie Enable mode for extending note values (in normal mode this information is ignored).

REST	TRIG	n	n	n	n	n	n
b7	b6	b5	b4	b3	b2	b1	b0

- nnnnnn – This is the note number information.
- TRIG – This is the associated TRIG switch position.
- REST – A rest is special byte value 80 (in hex).

End-Of-Sequence is special byte value FF (in hex). This byte should be included when sending sequence data from a PC to the Pro One.

You can actually include key values beyond 36. The encoding above accepts values of 0 to 63 (decimal). The DAC in the Pro One is also limited to 6 bits, where each LSB represents a semi-tone.

Commands 23 and 25 (hex) read out the data stored in the Pro One's Sequence 1 and Sequence 2 banks (respectively). The data uses the encoding shown above, but the data bytes are split into nibble-pairs for transport over MIDI.

Request:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	23/25	Command type (set global parameter).
	F7	End of System Exclusive

Received:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	23/25	Command echo.
	<	
	:	Byte pairs of sequence data.
	>	
	F7	End of System Exclusive

Set Sequence Data

Commands 24 and 26 (hex) write new data into the Pro One's Sequence 1 and Sequence 2 banks (respectively). The data uses the encoding in the previous command, but the data bytes are split into nibble-pairs for transport over MIDI. If you use a Get Sequence Data command first you can simply modify the Command byte value and it becomes a Set Sequence Data command.

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable – default is 7D.
	23	Device ID for the MTG Pro One CPU.
	24/26	Command type (write seq1 or write seq2).
	<	
	:	Byte pairs of sequence data.
	>	
	F7	End of System Exclusive

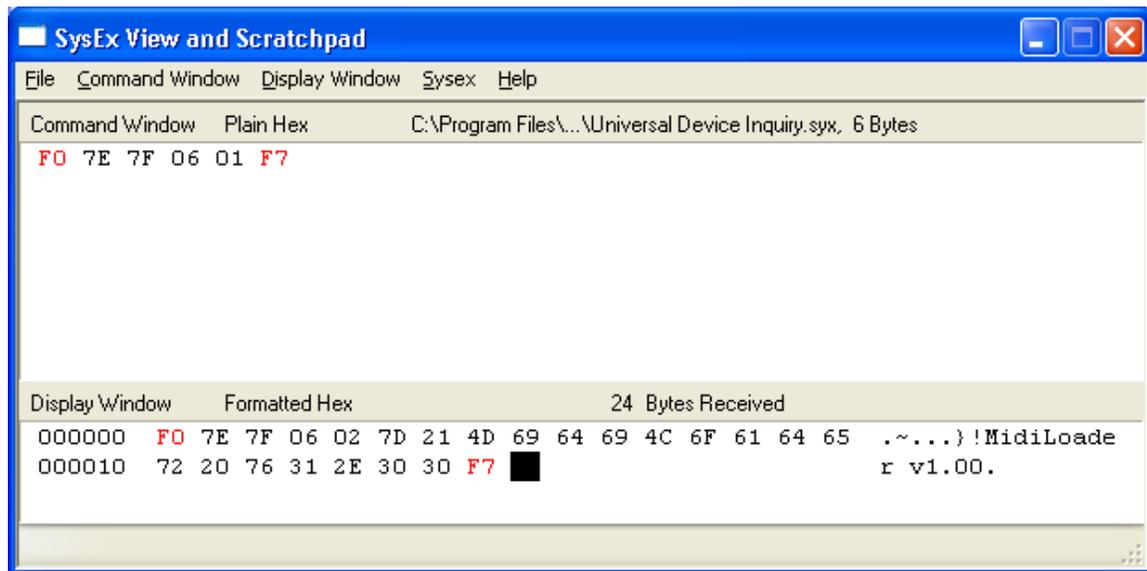
Received:
ACK packet

Universal Device Inquiry

In response to the Universal Device Inquiry command (F0 7E 7F 06 01 F7), the TurboCPU keypad responds with a 16-character ASCII string indicating the product name and version. For example:

- "ProOne CPU v1.40" for the TurboCPU, or
- "MidiLoader v1.00" for the Bootloader.

The complete response looks something like this:



~~Write LFO2/CV Settings (removed)~~

~~Once you have set the LFO2/CV parameters to your liking, simply issue this command and they will be remembered by the Pro One the next time you turn the synth on. It's recommended that you set the LFO2 depth parameter (for instance the mod wheel amount) to zero when you issue this command unless you want the LFO2 applied immediately. Here are the settings that are memorized:~~

- ~~○ LFO2 Depth (amount)~~
- ~~○ LFO2 Rate~~
- ~~○ LFO2 Wave~~
- ~~○ LFO2 Quantization~~
- ~~○ LFO2 Key Sync~~

- CV3 “Cutoff” Level
- CV4 “Resonance” Level

Transmitted:

(hex)	F0	System Exclusive
	7D	Manufacturer ID. User settable — default is 7D.
	23	Device ID for the MTG Pro One CPU.
	28	Command type.
	F7	End of System Exclusive

Received:

ACK packet