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**Music Technologies Group**

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**MTG Pro One Turbo CPU  
Installation Guide**

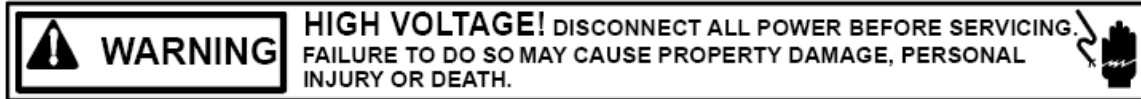
**Version 1.10  
August 2010  
(CV Section is Preliminary)**

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# 1: Introduction

## Precautions!



### **High Voltage Safety Warning**

*Turn the Pro One power switch OFF and disconnect the AC power cable before opening the Pro One.*

### **ESD Precautions and Proper Handling Procedures**

You should observe standard static-safe handling behavior when working with sensitive electronic equipment such as synthesizers:

- Avoid carpets in cool, dry areas. Leave the CPU module in its anti-static packaging until it is ready to be installed.
- Dissipate static electricity before handling any system components by touching a grounded metal object.
- If possible, use anti-static devices, such as wrist straps and floor mats.
- Always hold the CPU module by its edges. Avoid touching the contacts.
- Take care when connecting or disconnecting cables. A damaged cable can cause a short in the electrical circuit. Note the polarity and position for later re-installation.
- Prevent damage to the connectors by aligning connector pins before you connect the cable. Misaligned connector pins can cause damage to system components at power-on.
- When disconnecting a cable, always pull on the cable connector or strain-relief loop, not on the cable itself.

### **Tools Required (CPU only)**

- Standard flat-head screwdriver.
- Plastic ruler or straight edge for checking the module height in the socket.

## Additional Tools Required for MIDI

- Philips screw driver and small plyers.
- Soldering iron, solder.
- Tools necessary for mounting the MIDI and printed circuit board.

## Additional Tools Required for D-I-Y CV

- MCP4728EV quad DAC board.
- Pull-up resistors (2) and interface resistors (4).
- Soldering iron, solder and hook-up wire.
- Double-sided foamy tape or some other method of securing the PCB.

## 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 end 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.

## 2: Installation

### Preparation

Carefully remove all of the knobs on the front panel of the Pro One. You should also locate a small container to place the screws in while you work on the synth.

### Open the Pro One

Continue with the following steps, taken from the Pro One Operation Manual:

1. **Switch the power off and unplug the power cord.**
2. Remove the wooden side panels (2 screws each side).
3. Remove three screws along the front edge.
4. Carefully slide the top panel assembly forward. When the front edge is clear of the keys, lift it up just enough to allow clearance for your hand.
5. Note the position and polarity of the AC power connector. Mark the connector or take a photograph of it so that you can refer to it later.
6. Disconnect the AC power connector running from back panel to the underside of the printed circuit board (PCB), at right.
7. Note the position and polarity of the keyboard cable where it attaches to the PCB. Either mark the connector or take a photograph of it that you can refer to during reassembly. Disconnect the keyboard cable from the PCB.
8. Do the same for the bender wheel/mod wheel cable.

### Remove the Panel PCB

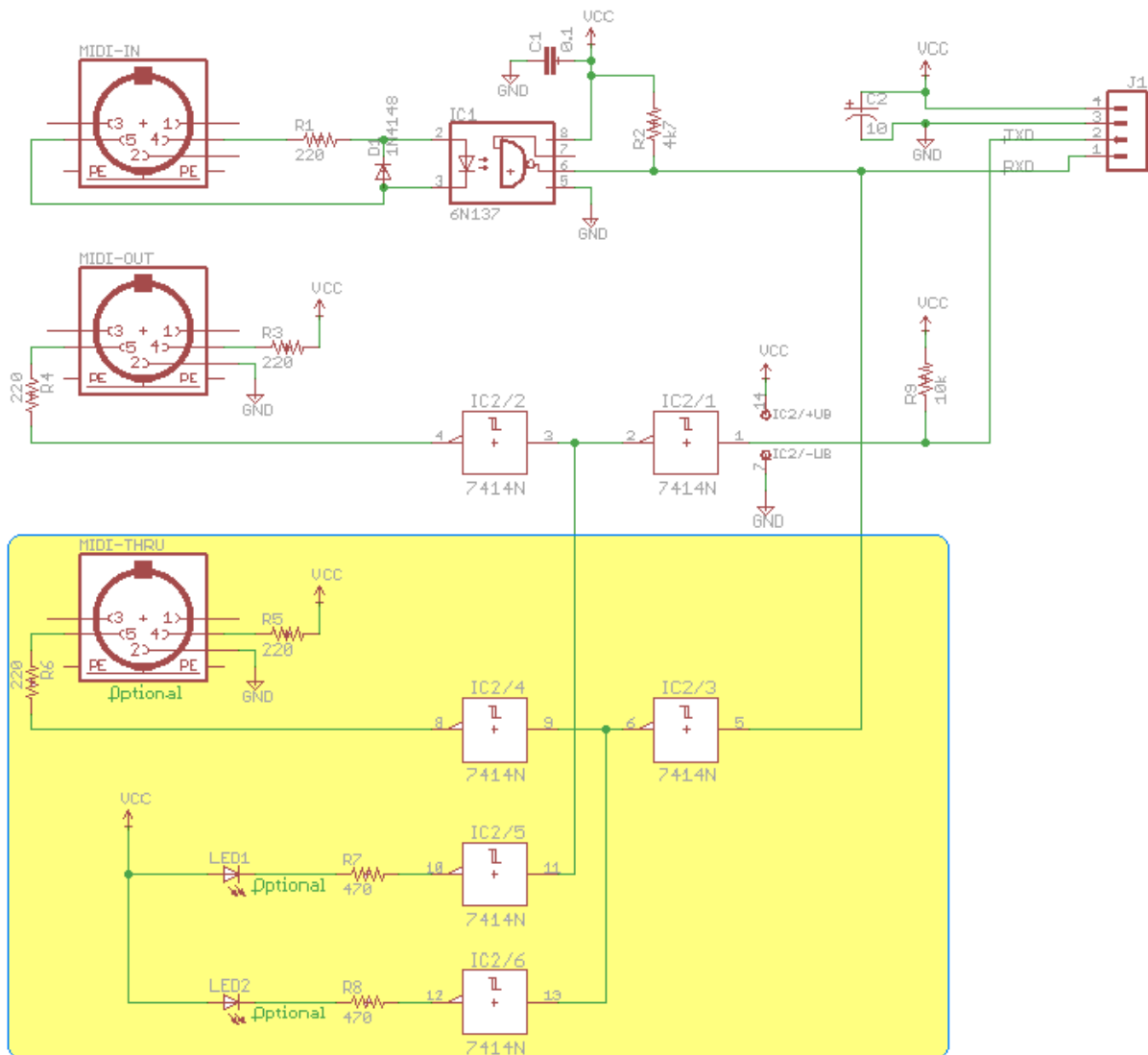
The number of screws used to attach the front panel PCB to the front panel varies by production year. Remove all screws carefully and take care not to stress the front panel PCB.



Set the panel PCB down on a static safe surface that provides uniform support for the PCB. Do not allow the PCB to flex unnecessarily.

## MIDI Board Installation (Optional)

Please read through this section at least once and **PLAN** your wiring before beginning. The schematic of the MTG Pro One MIDI board is shown below. The LEDs and MIDI Thru connector are not required.



This is one of many circuits that would do the job of converting the CPU's 3v TTL signals into the standard MIDI current loop.

See also: <http://www.midi.org/techspecs/electrispec.php>

## Mount the MIDI Connectors

Although the MIDI board supports PCB mount 5-pin DIN connectors, most people prefer the chassis mount connectors:



Chassis mount



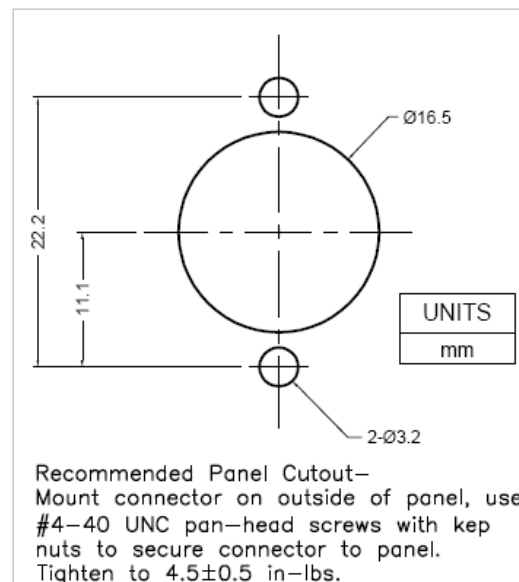
PCB mount

Remove the 37-key keyed assembly if required.

To mount the connectors in the metal chassis you will need to drill/punch holes for the connectors. Use the guide on the right for making the holes. A Greenlee punch can be used to make nice holes with a minimum of fuss. *Recommended!*

16.5 mm is approx 5/8"  
3.2mm is approx 4/32"

Make sure any metal residue is removed before reinstalling any electronics.



## Mount the PCB

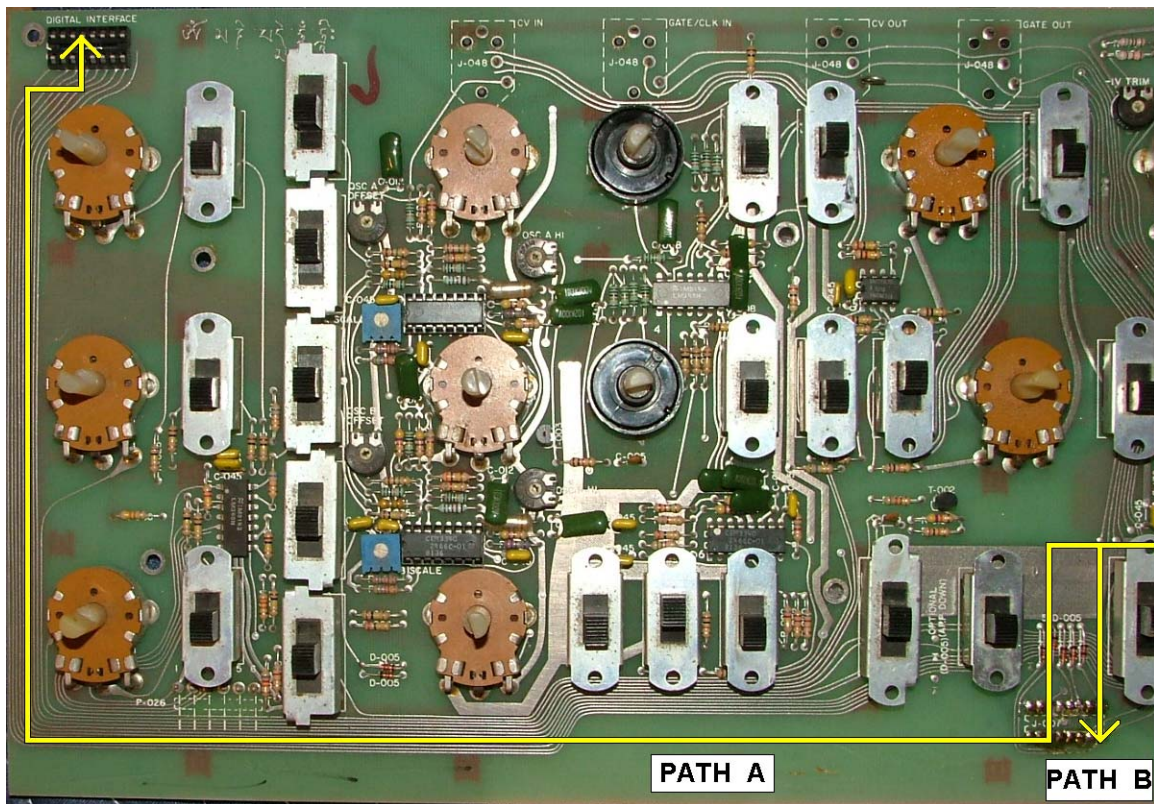
The PCB has 4 holes that can be used to fasten it to the chassis bottom or panel side. Ideally you should mount the PCB as far away from the sound generation electronics as feasible. In lieu of nuts and bolts you may use double-sided foamy tape or Velcro for installations that will not be subject to road trips.

Once the PCB and MIDI jacks are mounted, it is a simple matter to connect a few wires to the CPU module and jacks.



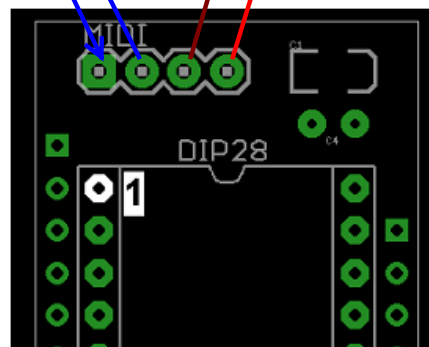
## CPU Module Wiring

Determine a path for the wiring from the jack PCB to the CPU module. If you run your wiring on top of the Pro One main board, then follow the signal path Sequential used for the expansion port. This keeps the MIDI signals away from the audio path. Alternatively run the wiring off the main PCB near the CPU module.



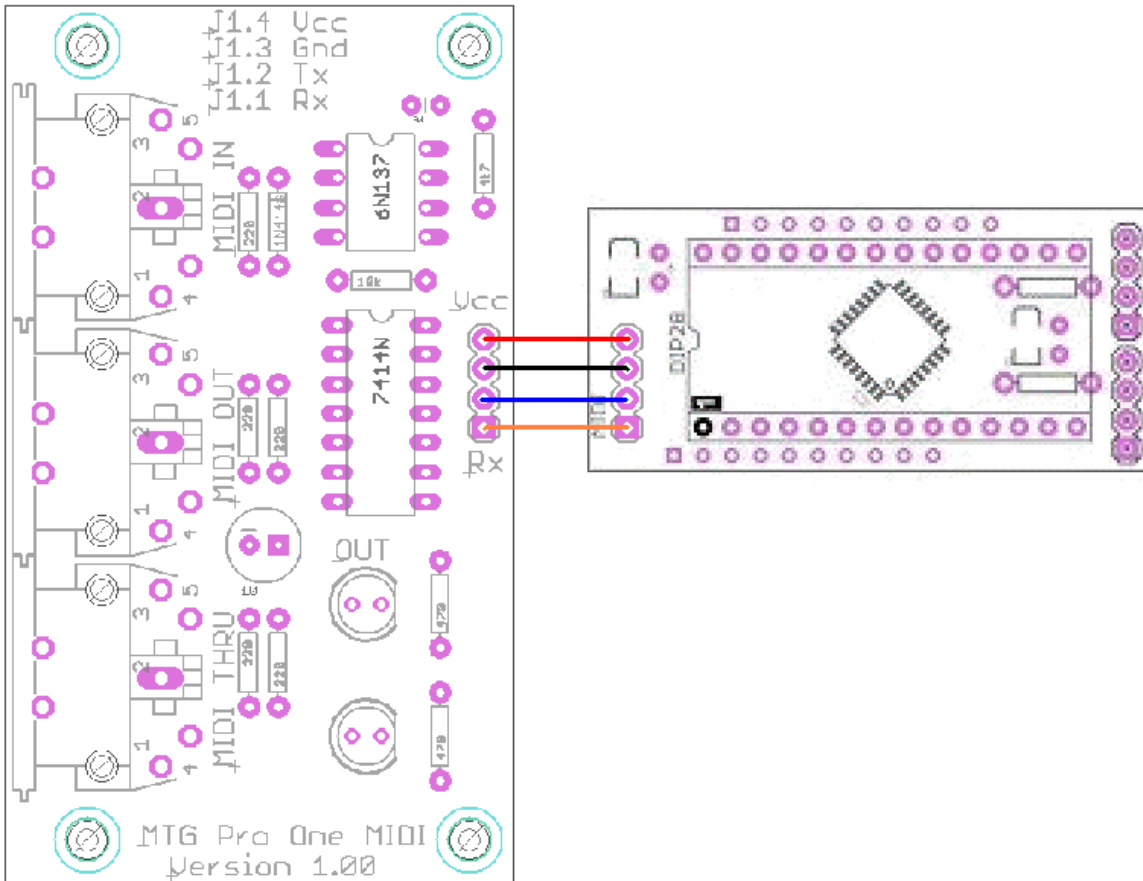
Using hookup wire, connect the four pins one-to-one between the CPU module and the jack board. Use the following two diagrams as a guide.

MIDI OUT ←  
MIDI IN ←      Ground  
                                 +5v



The wiring should run **under** the **MTG CPU** board, not on top of it. There is very little vertical space above the CPU board for anything (about a tenth of an inch). Therefore, when connecting the wires from the CPU board to the MIDI jack board, run the wires beneath the CPU board, to the bottom pads on the CPU

board and solder on top. Trim the wires neatly on top so that they do not short against the front panel when closed.



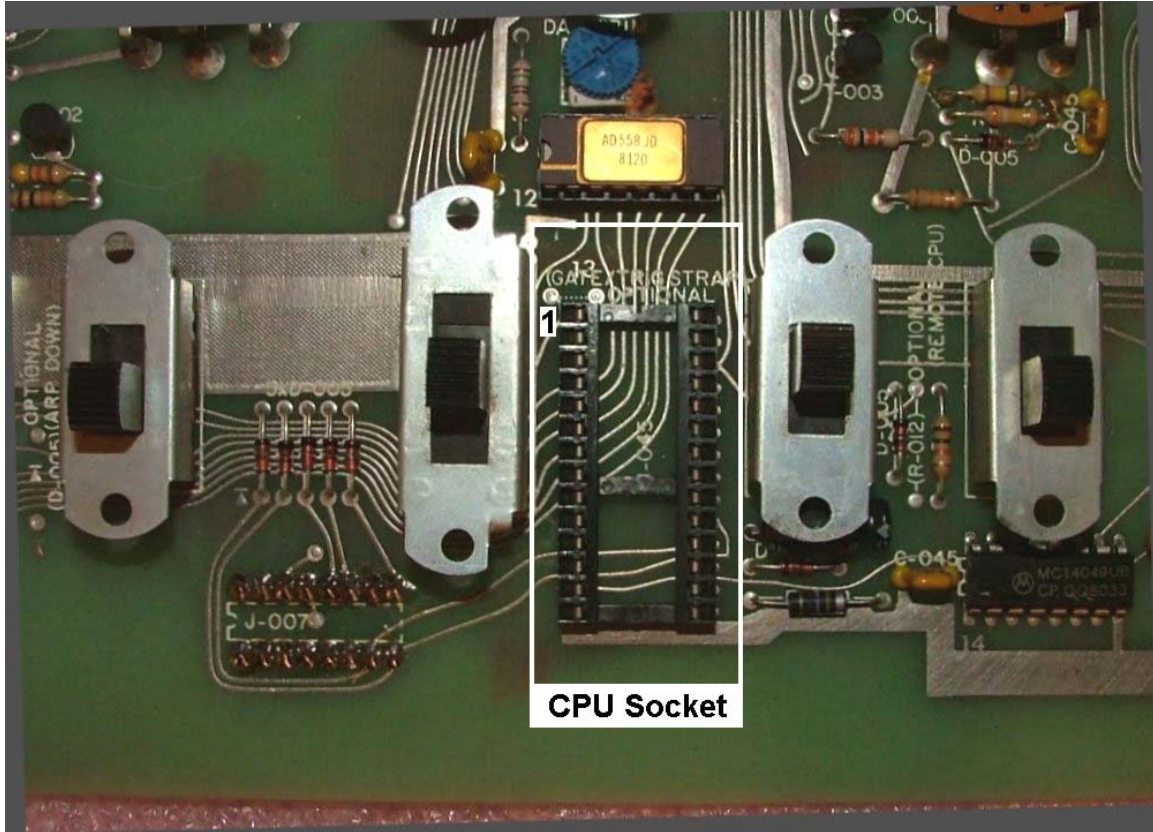
### Another Wiring Option

A third wiring option is to run the cabling outside of the Pro One to an external box or board. If you notice the top edge of the rear panel, there is a small gap near the modulation section. This was originally intended to route external cabling for the DIP “expansion” socket. It can easily be used to run a flat cable outside the Pro One to an external box.



## CPU Module Installation

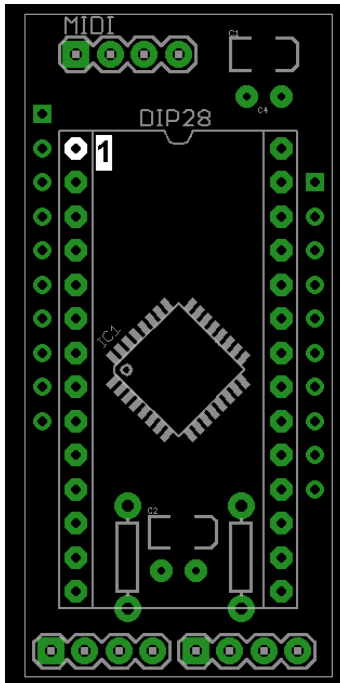
Inspect the area around the existing 8021 CPU (or socket). To the left and right of the CPU are switches. Just “above” it is the Digital-to-Analog converter (DAC) chip facing sideways. The DAC is located at the Pin 1 end of the CPU socket. Make sure you know which pin on the CPU socket is Pin 1. The new module will use up almost the entire area bordered by the DAC and the two switches.



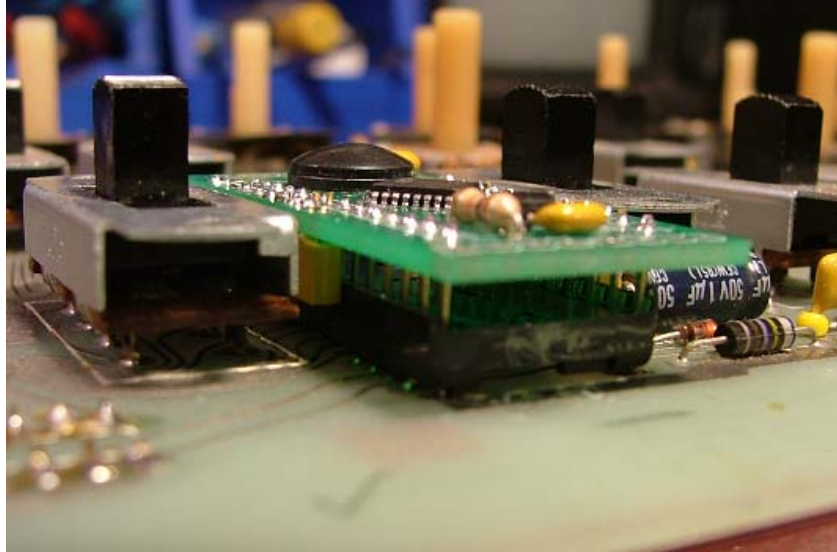
When installed, the module electronics must not sit higher than the height of the metal on the switches because the metal front panel resets approximately on the switches. A small rubber pad has been placed on the new CPU module to keep it secure and insulate it from the front panel.

If the original 8021 CPU is present, remove it using a small flat head screwdriver. Take care not to bend the leads. Place the 8021 on anti-static foam in case you ever want to re-install it or sell it. If the CPU is defective, throw it away. Really.

Take the Turbo CPU Module out of its anti-static packing and locate pin 1 on the module. Pin 1 is located at the top left end of the board where the white silkscreen notch is printed. For verification, this end has a single 4-pin header. At the other end, near pins 14 and 15, there are two 4-pin headers.

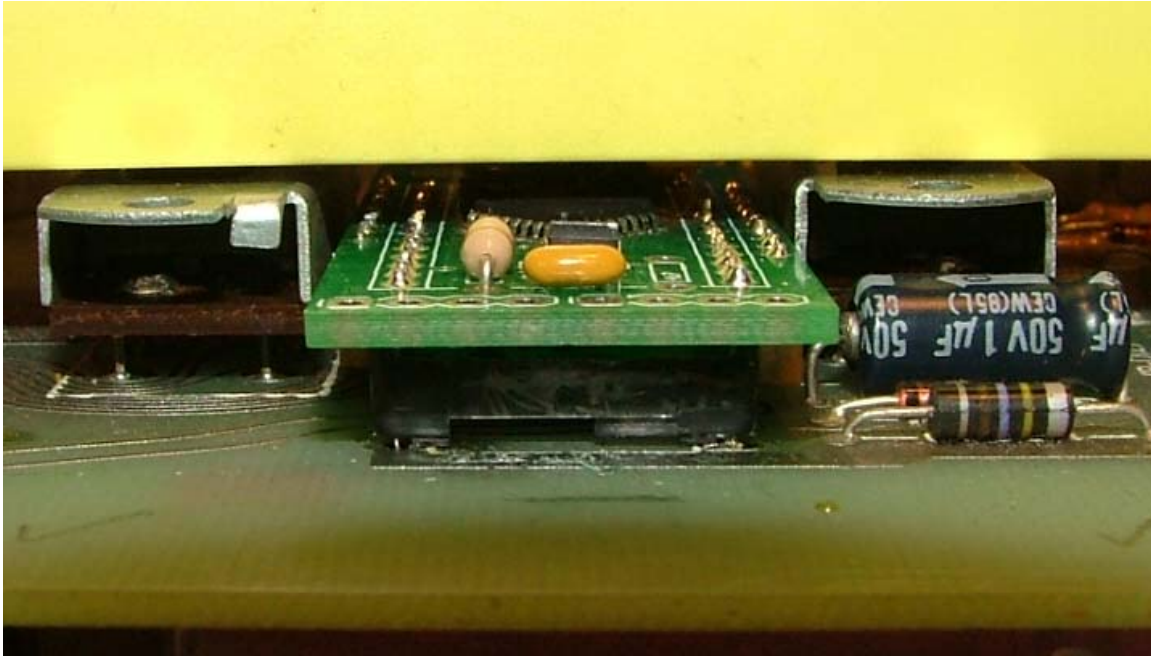


Carefully align the 28 pins of the module directly above the vacant CPU socket.



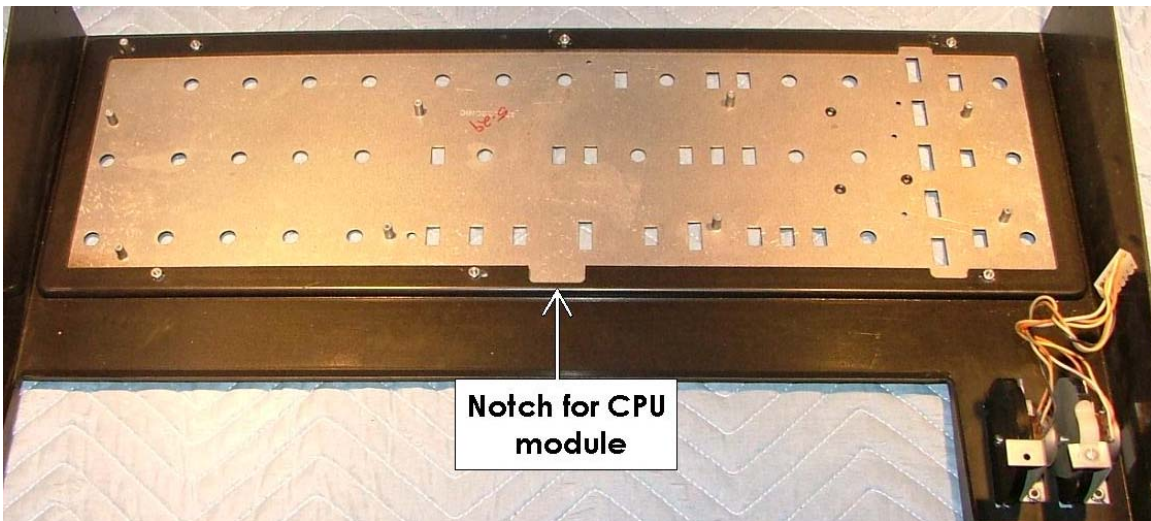
Press the module firmly and evenly into place as low as it will go. The two yellow resistor packs on each underside should either touch the panel PCB or be very near to it.

Verify that there are no electrical parts on the CPU module that extend above the line where the front panel will rest (on top of the switches).



Carefully reassemble the unit in reverse order.

Make sure the new CPU module fits cleanly in the pre-existing notch that Sequential has provided in the plastic front panel. In the unlikely event that the plastic front panel hits the CPU module, you may need to loosen all of the front panel hex nuts and adjust the position of the plastic panel versus the metal front panel.



## Test

After carefully reassembling the unit, plug the Pro One power in and connect an amplifier. Turn the Pro One on. Verify that the module has been installed properly and is functioning. Any problems are likely to be as a result of improper pin alignment when installing the module in the CPU socket.

Sometimes the original CPU socket is in poor condition and a new dual-wiping socket is recommended. Make sure that any replacement socket is low profile.



## 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 Appendix A.

### 3: CV Module Installation (Preliminary)

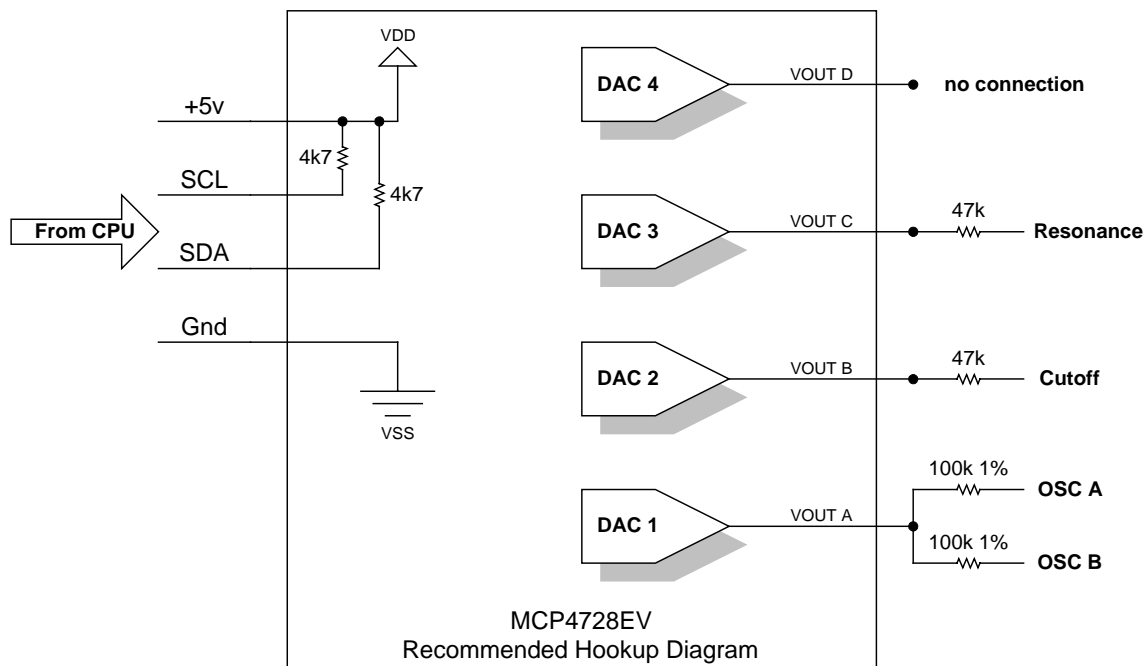
The CV Quad DAC board is an inexpensive do-it-yourself option that allows for greater control of the Pro One from an external MIDI device (keyboard, sequencer, etc.). While the installation is fairly simple (much easier than the MIDI board for instance), it still requires some electronics knowledge and soldering skills. Improper installation could damage your Pro One. We accept no responsibility for the work you perform on your Pro One. Read over the following installation description and if you feel you are not capable of the work required, turn the project over to a qualified technician.

*Note: The elements are all controlled by MIDI so the MIDI circuitry is required for the CV module to operate. The CV Module requires firmware v1.10 or newer.*

#### Parts List

Here are the items you will need (the resistors are all through-hole):

- (1) MCP4728EV - Microchip MCP4728 Evaluation Board or equivalent.
- (2) 4.7k ohm ¼ watt resistors (for I2C pull-ups).
- (2) 100k ohm 1% ¼ watt resistors (for OSCA/OSCB control voltage).
- (1) 47k ohm ¼ watt resistor (for Filter Cutoff control voltage).
- (1) 47k ohm ¼ watt resistor (for Filter Resonance control voltage).
- Double-sided foam tape or Velcro to fasten the PCB.
- Hook-up wire.



## Tasks

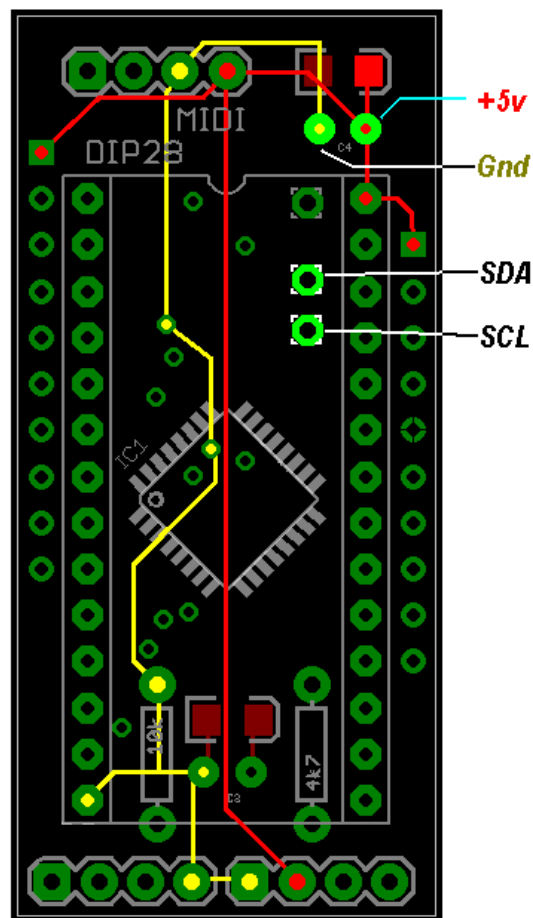
Here are the required major tasks for the left side of the diagram above:

1. Hook up the +5v, Ground, SCL and SDA signals from the Turbo CPU to the MCP4728 board.
2. Add the two 4.7k pull-up resistors in parallel with the existing ones on the MCP4728 board. These resistors in parallel with the existing ones on the MCP4728 will allow the Turbo CPU to drive the I2C lines much faster.

Here are the recommended major tasks for the right side of the diagram above:

3. Connect the two 100k 1% resistors from VOUT\_A to the CV summing points for OSCA and OSCB.
4. Connect the 47k resistor from VOUT\_B to the CV summing point for the Filter Cutoff.
5. Connect the 47k resistor from VOUT\_C to the Filter Resonance chip.

## CPU-to-CV Hookup





## Pull-ups

In order to increase the speed of the I2C signals (SDA and SCL) it is necessary to add two 4.7k resistors in parallel with the two surface mount resistors already on the MCP4728 board. Refer to the block diagram at the beginning of this chapter. In each case, solder one resistor between the I2C line (SDA or SCL) and  $V_{DD}$ . JP1 is a convenient location for attaching them to  $V_{DD}$ .

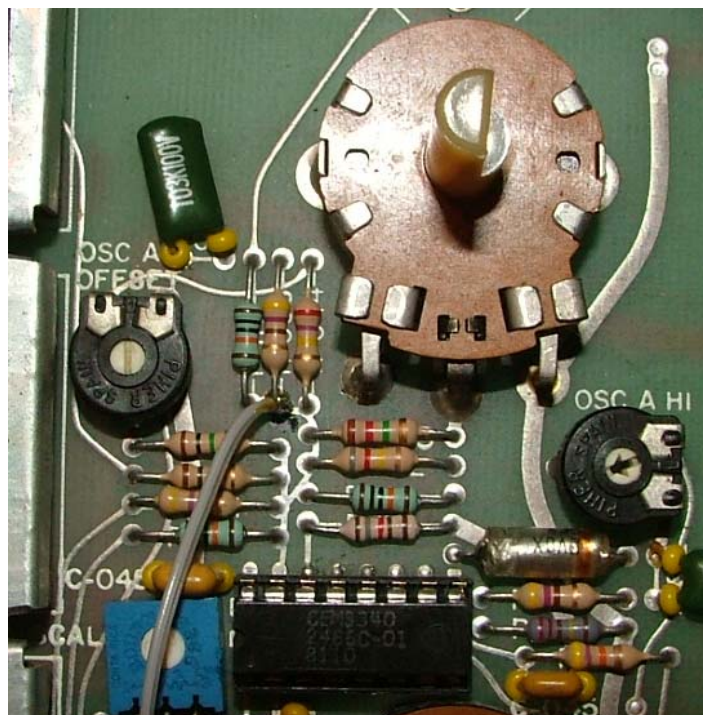
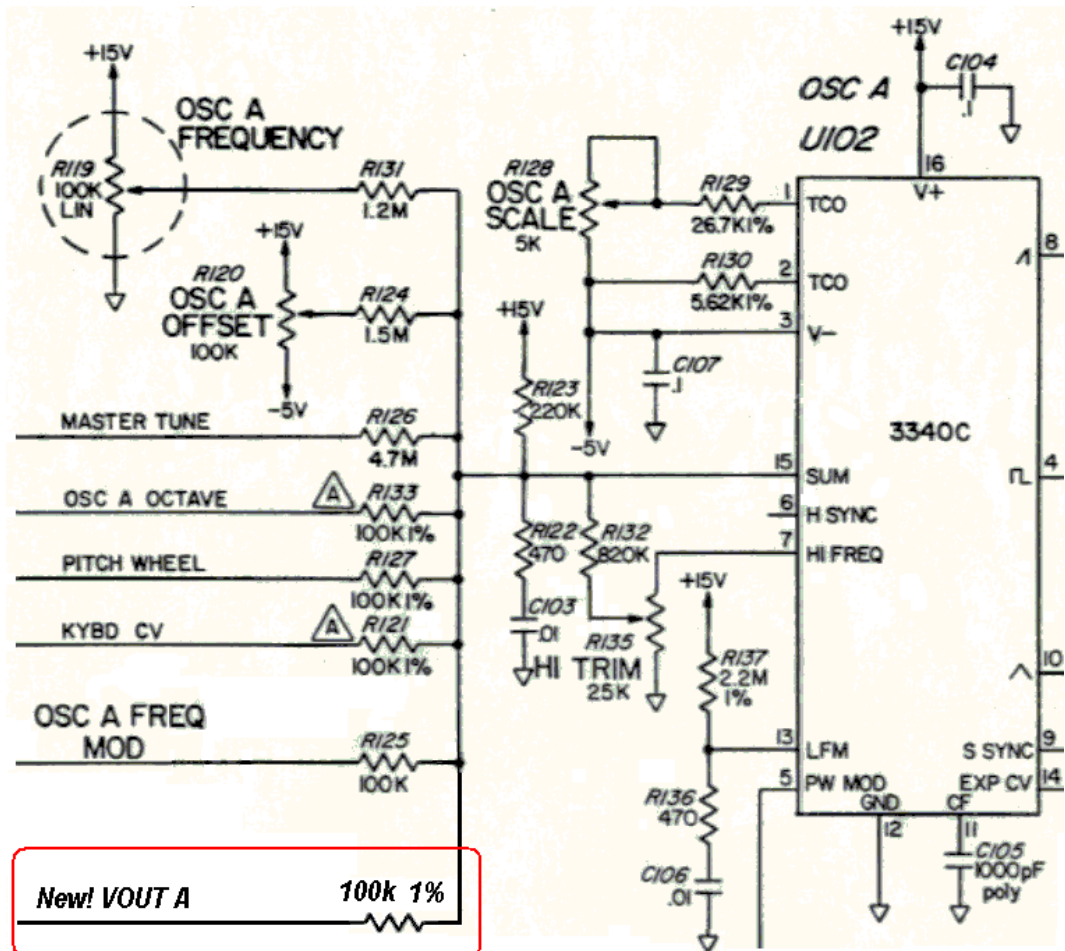
## CV-to-Synth Hookup



The following information describes how to connect the analog voltages from the MCP4728 board to the Pro One synth engine.

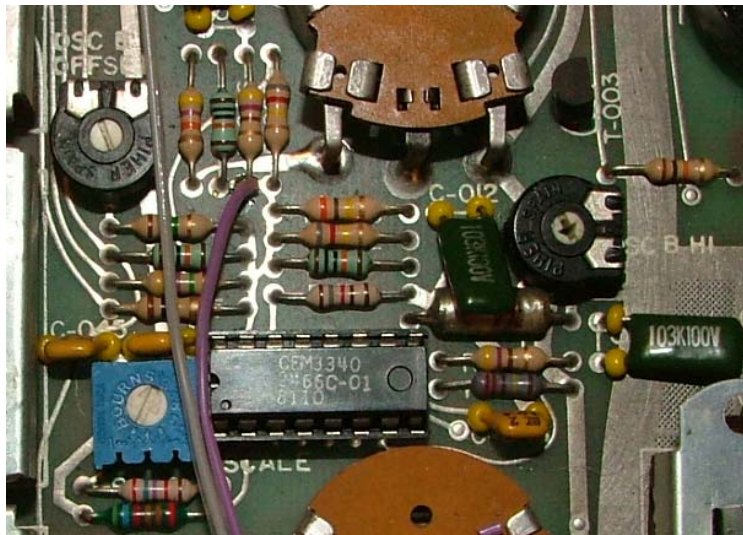
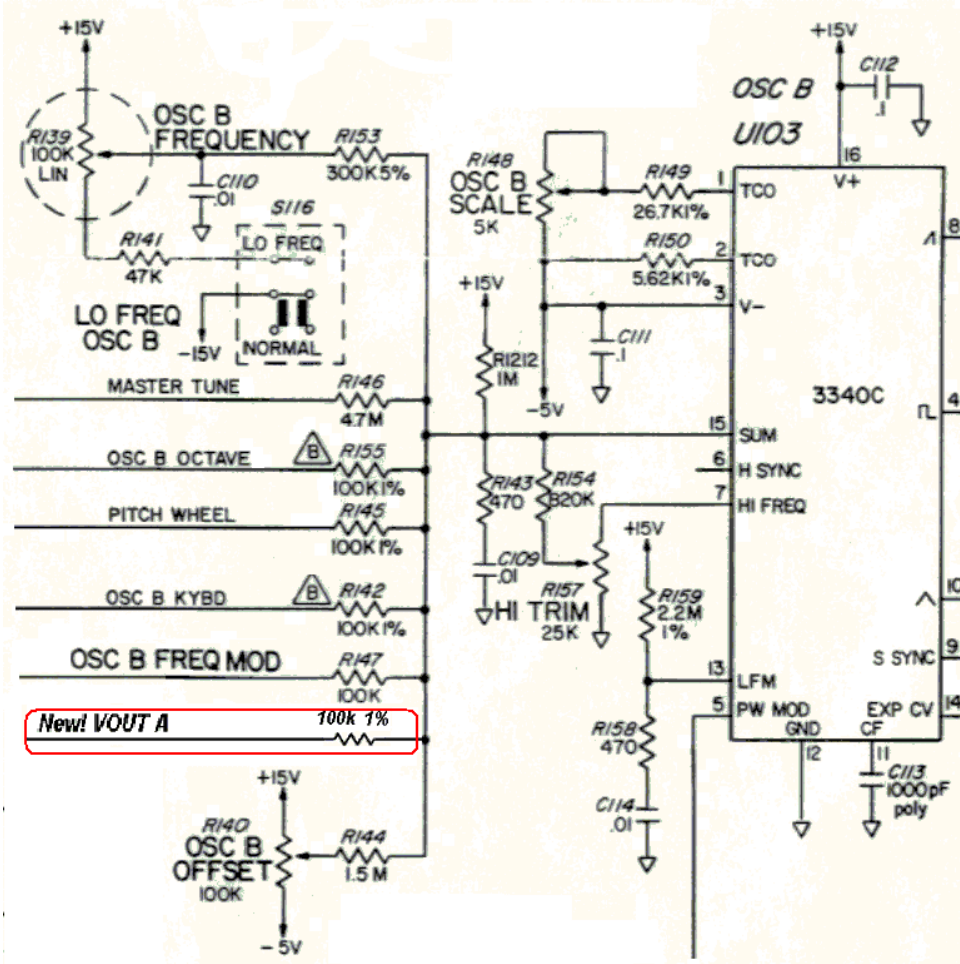
### CV1: VOUT<sub>A</sub> to OSC A

Using a 100k 1% metal film resistor, connect CV1 (VOUT A) to OSCA. Each oscillator **requires** its own series resistor! Refer to the block diagram at the beginning of this chapter.



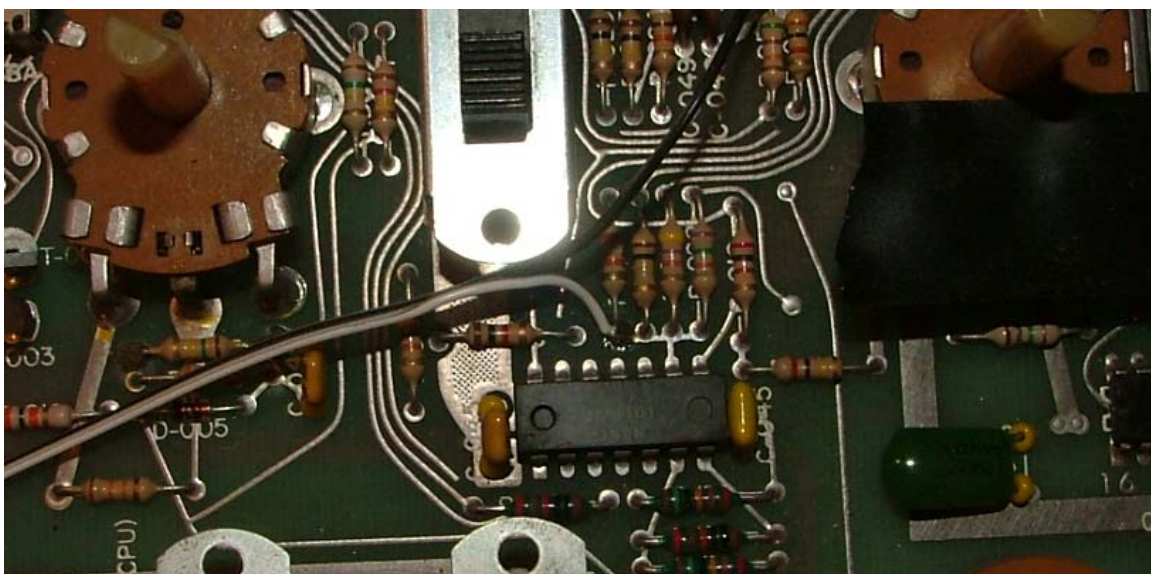
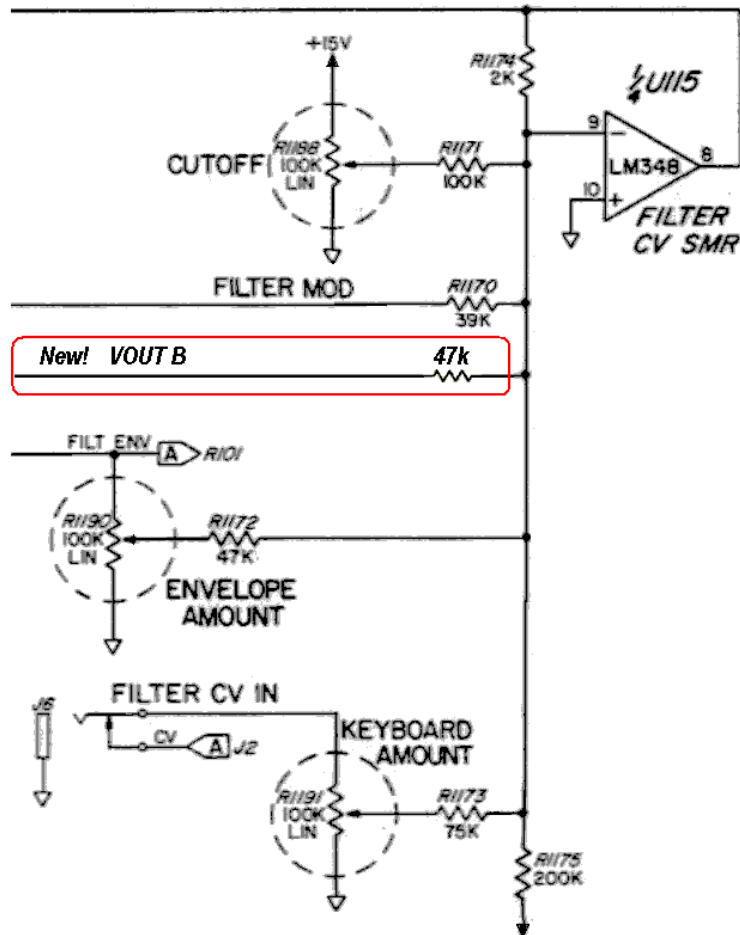
## CV1: VOUT<sub>A</sub> to OSC B

Using a 100k 1% metal film resistor, also connect CV1 (VOUT A) to OSCB. Each oscillator **requires** its own series resistor! Refer to the block diagram at the beginning of this chapter.



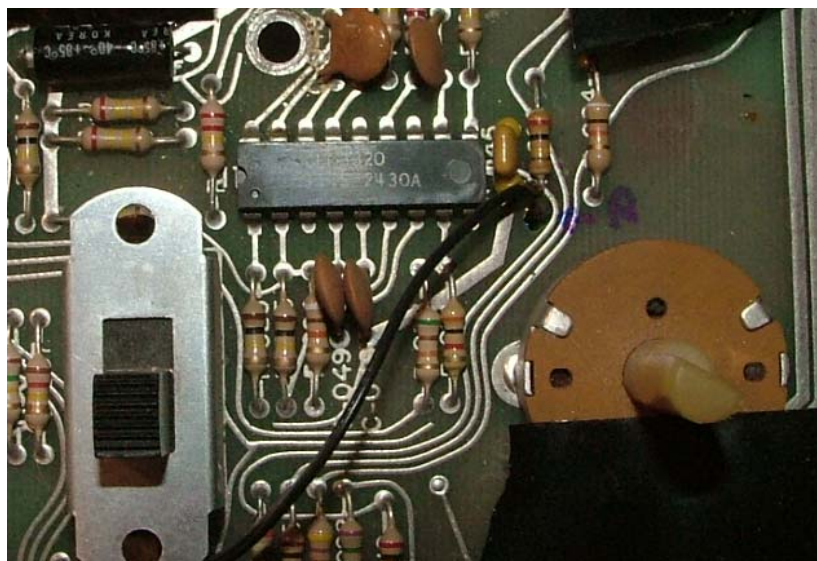
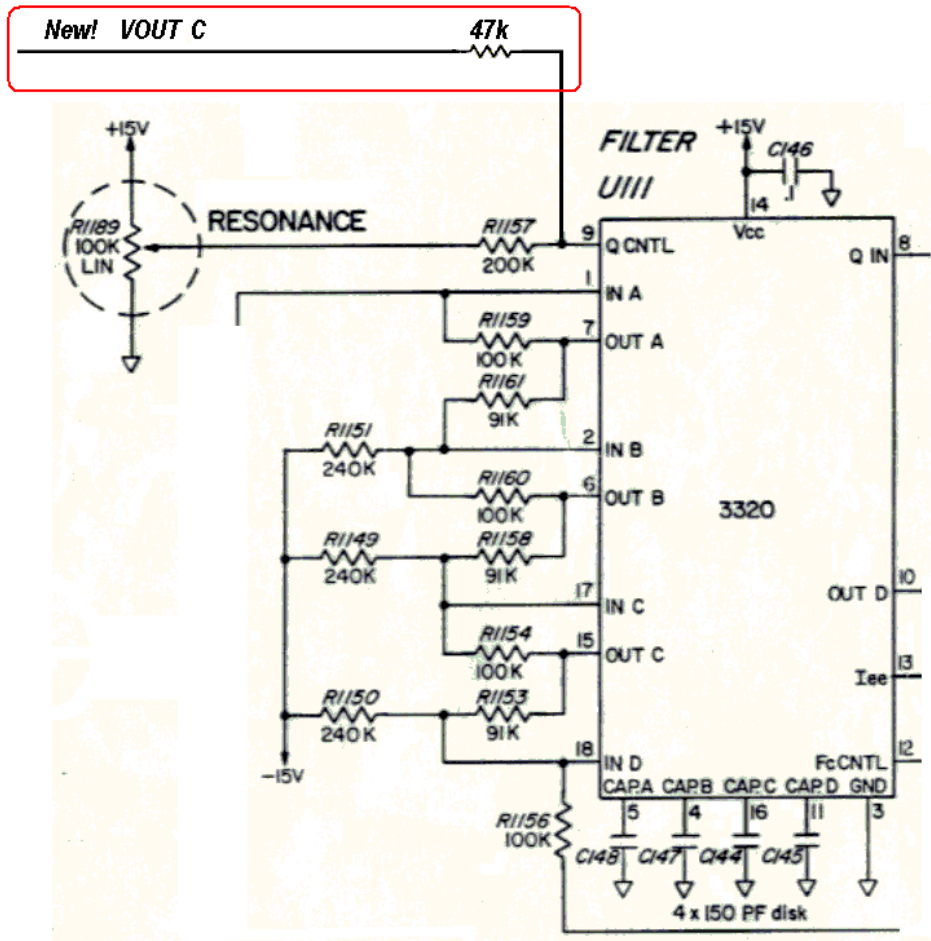
## CV2: VOUT<sub>B</sub> to Filter Cutoff

Using a 47k resistor, connect CV2 (VOUT B) to the Filter Cutoff summing point.



### CV3: $V_{OUT\ C}$ to Filter Resonance

Using a 47k resistor, connect CV3 ( $V_{OUT\ C}$ ) to the Filter Resonance pin.



## Appendix A: Firmware Upgrade

If you have installed a MIDI interface circuit, you can “reflash” the firmware in the Pro One CPU by carefully following the procedure outlined in this section. Obtain the latest firmware in .SYX format from the MusicTechnologiesGroup.com website. We show the process using MIDIOX, but you should be able to use any similar program.

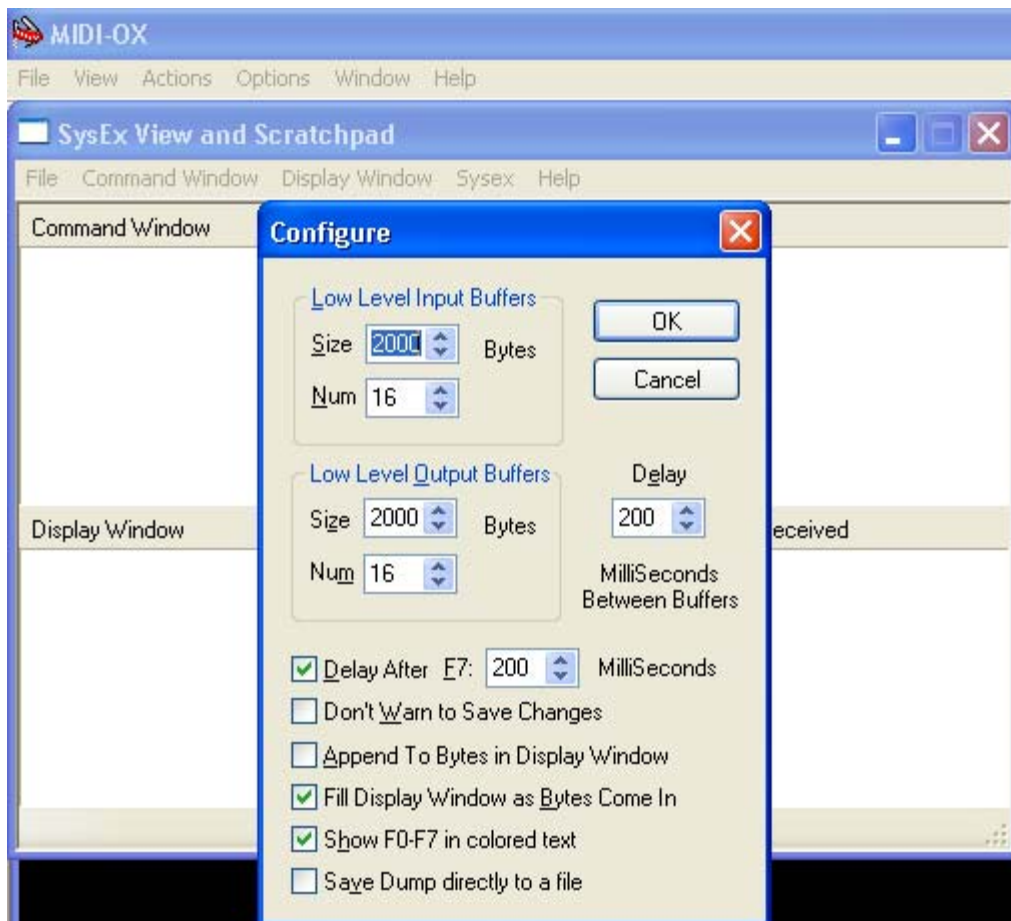
You may lose your sequencer data and user parameters as a result of a firmware upgrade.

### Configure MIDIOX

Set the Sys Ex properties of MIDIOX by clicking:

View->SysEx... and then SysEx->Configure

Use the minimum recommended setting shown here:



## Prepare the Pro One for Download

Hook up the MIDI connections to your computer and to the Pro One. Launch the Pro One in bootloader mode by turning off the Pro One, holding the two highest keys (B2 and C3) and then while holding those keys down, turning the Pro One on. You should hear several short notes that indicate the MIDI bootloader program is in control.

## Test the Communication

If you send a Universal Device Inquiry system exclusive packet to the Pro One, it will respond with the MidiLoader version packet. In MIDIOX, click:

View->SysEx...

Then from the SysEx menu click

Command Window->Load File...

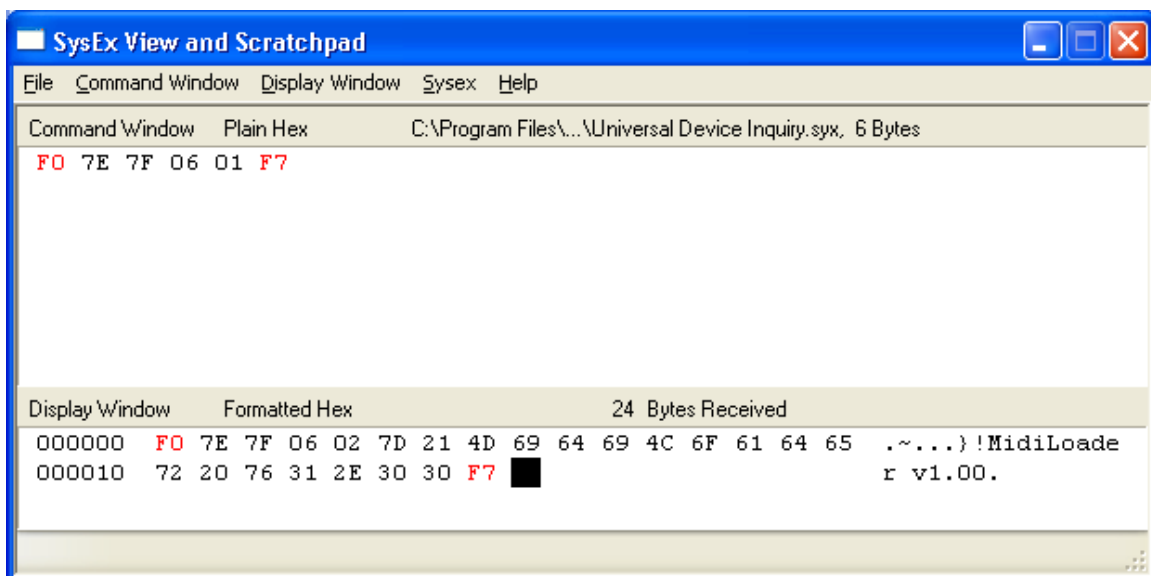
Choose the file **Universal Device Inquiry.syx** and click **open**. Click

Command Window->Send/Receive Sysex

The Pro One bootloader will respond with 24 bytes. Click on **Done**. Next click on

Display Window->Hex View Swap

You may have to enlarge the window a little, but you should see something like:



The message must say **MidiLoader** not **ProOne CPU**! If it does, you have not launched the bootloader properly. Repeat the above steps carefully. Once you verify the MidiLoader message you can proceed with the firmware upgrade.

## Firmware Upgrade

Close the SysEx View window and open it again to get an empty window. If you are prompted to save anything, click **No**. Open the new firmware file by clicking

Command Window->Load File...

Choose the file required for the upgrade (E.g. ProOne\_v1\_00.syx). You should see that a fairly large file is opened. Click on

Command Window->Send/Receive Sysex

The upgrade takes approximately 30 seconds. Do not touch the computer or Pro One during this time. At the end of the upgrade the Pro One will reboot. Also the MIDIOX screen will show a fairly large number of transactions. You can close MIDIOX (don't save anything) and begin using the updated Pro One.

If the Pro One doesn't reboot, verify that the Pro One is operational. If not, repeat the download. You are advised to perform an MTG Factory Defaults procedure on a newly reflashed CPU.