



Koninklijk Conservatorium

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MidiToVolt (mtv) Manual

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Introduction

This manual explains how you can build the Midi To Volt Lab, or mtv-lab. The mtv-lab converts incoming midi (musical Instrument Digital Interface) into voltage change. So with this interface you can drive all kind of processes with computer or instrument.

In combination with the Microlab all kind of interactive setups can be realised.

Important Note : *This is a relatively short technical manual, without explanation of basic "how to built my first circuit board"-techniques. If this is the first time you ever built a PCB and you have never soldered before, get some technical advice first!*

1. General description

The Mtv-lab can convert 16 midi controllers at the same time. The output voltage can be set to change between 0-5V or between 0-10V. The resolution is 10 bit.

The midi controller messages are 7 bit. To create the resolution of 10 bit, the standard midi solution is used: send two midi controller messages. The first databyte is the MSB (Most Significant Byte) and the second one will be the LSB (Least significant Byte).

The standard MIDI solution uses an offset of 32. This means that when the MSB is sent on midicontroller 0 (zero), the LSB of that same number is sent on midicontroller 32.

The mtv lab can also receive midi messages on all midi channels; this has to be setup with jumper settings, or (it's just HOW you build it) with dip switches.

2. Building the PCB.

It is quite easy to build and complete the PCB. Just double-check everything you do before soldering the components onto the PCB. If you are NOT sure, do NOT solder, but first think again. **It's a nasty job to remove soldered components!**

2.1 The resistors

Mount the resistors flat on the PCB. Place the resistors on the component side (see PCB) and solder them on the soldering side! General: The resistors do NOT have polarity! So, it does not matter how you place a resistor; it works both ways the same. This doesn't count for the array. The array has a common pin; pin 1, indicated with a black dot.

A1 (Array)	10k (see remarks)
P1	10K (see remarks)
R1	33K
R2	220E
R3, R4, R5, R6, R12 t/m R20, R22, R24, R26, R28, R30, R32, R34 , R36 t/m R44, R46, R48, R50, R52, R53, R56, R58	10k
R10	470E (Ohm)
R21, R23, R25, R27, R29 R31, R33, R35, R45, R47, R49, R51, R54 R55, R57, R59	100E (Ohm)

The Resistor array A1 consists of 4 resistors with one common pin; means this array has five pins. Be sure to place it the right way. The pin with the black dot (or stripe) is the pin 1 indication!

P1 is a potentiometer. With this potentiometer the voltage needed for the DA convertor (TLC1452) can be adjusted. It should be adjusted to 2.5V. This can be done when the PCB is finished.

When you are sure all resistors are placed on the right location, solder all the pins and cut them off on the soldering side.

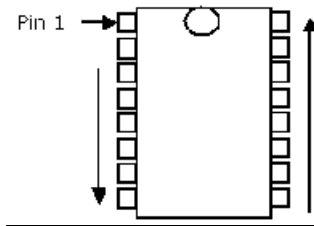
2.2 Capacitors

Unlike the resistors, some of the capacitors used on the MTV lab do have polarity! The plus sign is indicated on the Tantalum. In general values less than 1uF (value \ll 1uF) do not have polarity (this is NOT always true, but in this case it is).

C1, C2	33 pF
C3	3.3 uF (tantalum, polarity!)
C4, C9, C10	10 uF (tantalum, polarity!)
C5	2u2F (tantalum, polarity!)
C6, C7, C8	100 nF

2.3 Semiconductors

The most vital component on the PCB is the processor, the PIC16F84. It is necessary to place this processor in a socket, which is soldered on the PCB. Do NOT solder the processor itself on the PCB, otherwise it is not possible to re-program the chip. Very important with mounting Integrated Circuits (IC's) on the PCB is to check pin 1 of the chip. On every chip the counting of the pin numbers is anti-clockwise. See figure below:



U0	PIC16F628* (place in Socket!)	<i>Even the socket has got a pin 1 indication. This is to remind you how the processor is placed on the pbc.</i>
U1	LM358 (Opamp)	<i>This opamp creates the reference voltage for the sixteen DA convertors. It can be adjusted with P1</i>
U2	6N138 (Opto Coupler)	<i>The incoming MIDI is connected to the OptoCoupler, so the MIDI signal is electrically divided from the circuit (no problems with connecting a lot of MIDI devices)</i>
U3 t/m U18	LTC1452 (12 bit DA convertor)	<i>Serial input 12-bit DA convertor.</i>
U19 t/m U26	TLC272 (Dual opamp)	<i>These opamps create the 0- 10V.</i>
U27	7805 (Voltage regulator)	
D1	1N4148 (Diode)	
D2,D3	1N4001(4) (Diode)	<i>Diodes D2 and D3 are placed for safety reasons; if the power supply is connected the wrong way, the MTV lab will not blow up.</i>

*** Wait with placing the processor in it's socket, untill you reach step 4 of the testing part!**

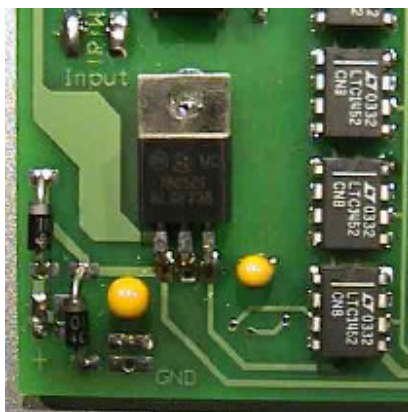
2.4 Misc

X1	10MHZ	<i>The Xtal or Crystal oscillator is placed near the processor and generates a 10MHz clock</i>
J1, J2	4 pins. header	
J3 t/m J39 JP1 t/m JP16	2 pins. header	
MIDI1	Connection MIDI	<i>Midi in is connected without ground! The ground is only used with Midi out.</i>
MIDI2	Connection MIDI	

Jumper / Headers:

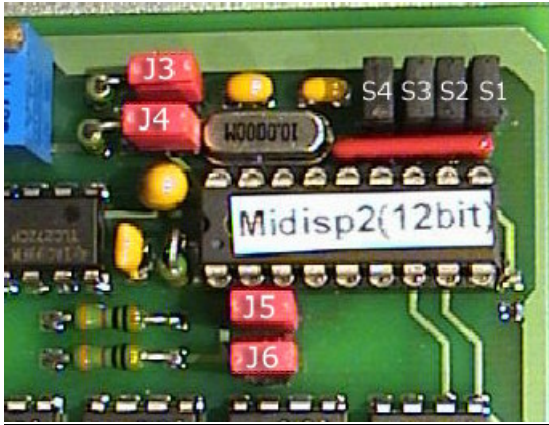
The headers are used for two things: To connect (solder)the wires and to place a jumper. A jumper is just a shortcut between two pins of a header. With the jumpers you can set whether the output is 0-5V or 0-10V

2.5 Powersupply



External adapter, min 12V; max 18V. The component on the picture left is a voltage regulator, 7805. When you apply capacitors (C4 and C5) to avoid oscillation, this device will always generate a clean +5V, also called VCC. The diodes connected to the powersupply input are there for safety reasons.

2.6 Jumper Settings



During start up (power on), the initialisation of the processor takes place. All in- en outputs are defined. It also checks which pins are 'high' (+5V connected to the pin) or 'low' (pin connected to ground). The setting of the jumpers determines the midi channel and midi-controller offset:

Components J1 and J2 consist of 4 pins each. In the table underneath it split up in S4, S3, S2 and S1. Take a look at the photo above!

S4	S3	S2	S1	Midi Channel
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

The midi controller offset means: the starting midi controller. From that number it will increase +15 (0-15) controllers.
Example:

Offset= 32 (J6=0, J5=1, J4=0, J3=0)

The mtv lab will convert incoming controller midi numbers 32-47 into voltage change

J6	J5	J4	J3	MIDI cntrl number (offset)
0	0	0	0	0
0	0	0	1	8
0	0	1	0	16
0	0	1	1	24
0	1	0	0	32
0	1	0	1	40
0	1	1	0	48
0	1	1	1	56
1	0	0	0	64
1	0	0	1	72
1	0	1	0	80
1	0	1	1	88
1	1	0	0	96
1	1	0	1	104
1	1	1	0	112
1	1	1	1	120

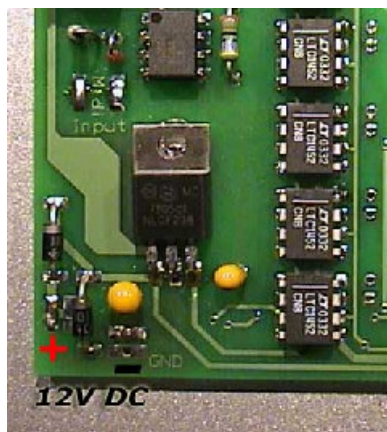
Jumpers J3-J6 determine the offset.

3. Testing the MTV-lab

Step 1:

First: check the position of all the components placed on the printed circuit board (pcb). Check all the IC's (Integrated Circuits). Is pin 1 on the right position?

Step 2:

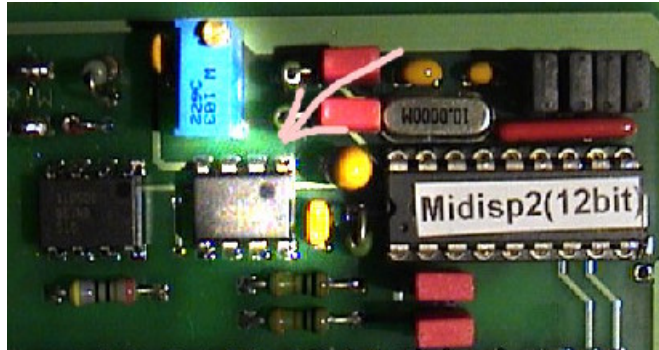


Apply a voltage of 12V DC to the plus (+) and minus (-) of the PCB. The right pin of U27 (Voltage regulator 7805) should be +5V now. If this is not the case, shut down the power immediately! Check the wires again. If the power is ok (+5V, or VCC) continue with the test.

Always use good wire when connecting the power supply. Make sure that the ground wire is thick enough; low impedance!

Step 3:

Take a voltmeter and connect it to pin 1 (or pin 2) of U1. This is the output of an opamp. This voltage should be adjusted to exact 2.5V. The voltage can be adjusted with potentiometer P1. Look at the figure below. The potentiometer and chip are highlighted.

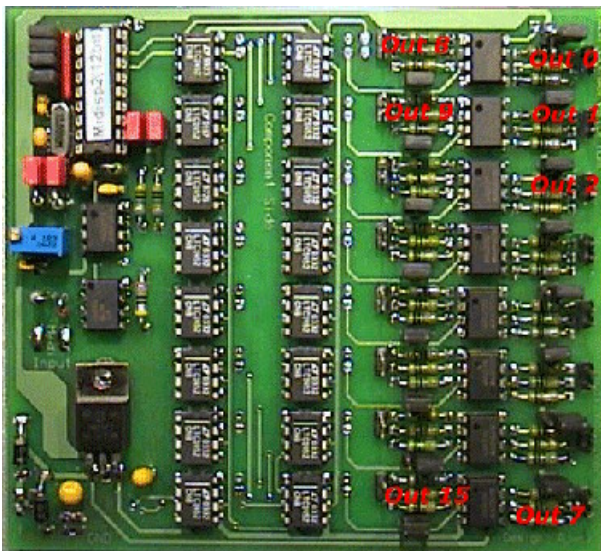


Step 4:

Place the processor in it's socket.
Be aware of pin 1. Push the processor in real good;

Step 5:

Connect a midi signal from a computer (or other device) and generate midicontroller number 0, on midi channel 0. Adjust all the jumpers placed at the processor (J3-j6 and S1-S4) to zero. If possible generate a midi signal with slowly changing data, so the voltage change on the output is easy to measure.



On output zero (right upper corner) the voltage should change. The jumper located near the output of the opamp determines whether the output changes from 0-5Volts or 0-10Volts. If the jumper is connected (connection to ground or zero), the output changes between 0-10 Volts. **No jumper means 0-5 Volts**

5. Comments and ideas

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