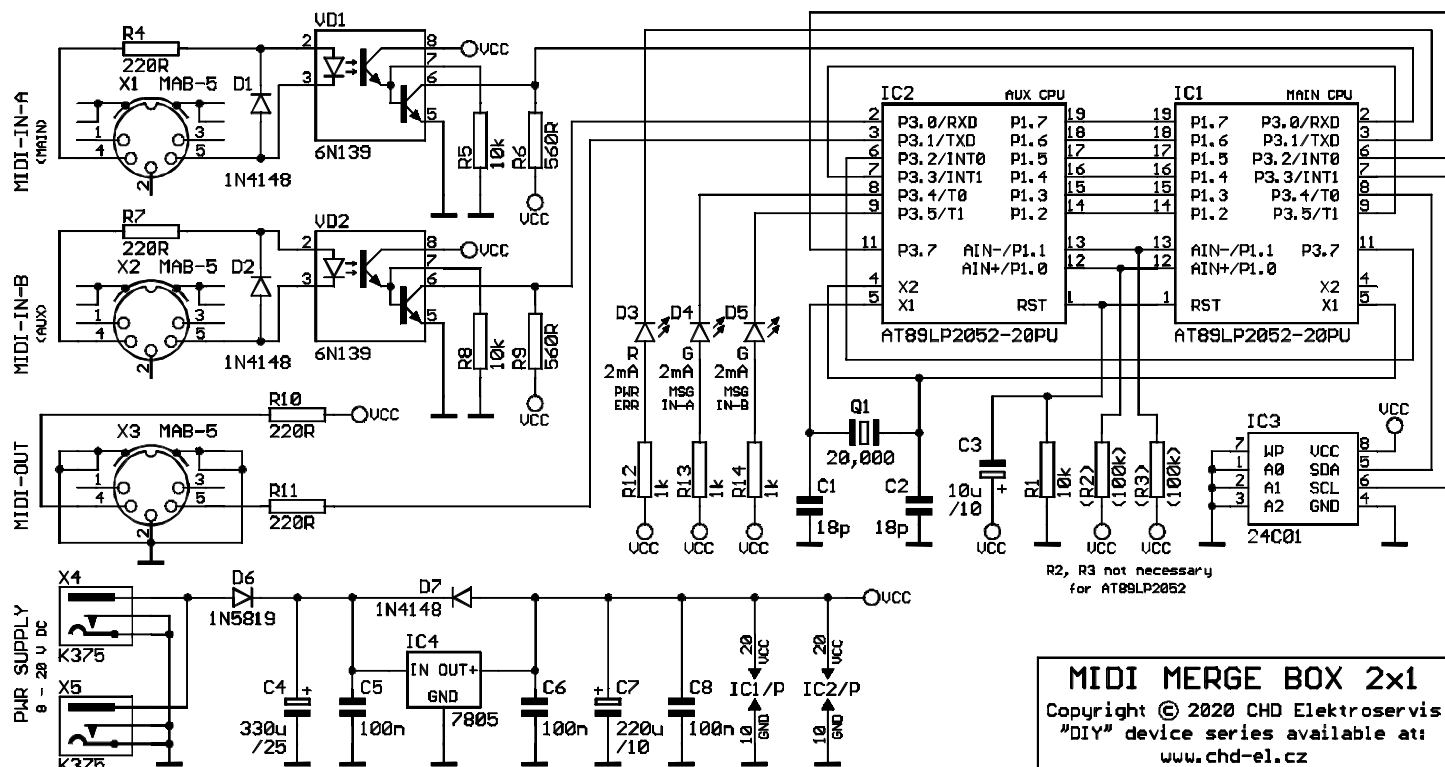


## 1 DESCRIPTION

MIDI Merge Box 2x1 is tool what merges MIDI data from two inputs to one output. The known fact is that it is impossible to merge the data directly as a logical sum of the MIDI data. That solution generates nonsensical data. So it is necessary to use special algorithm for the data merging. This can guarantee only processing by a microcomputer.

Schematic diagram of the merge box shows picture 1. The circuit is as simple as possible. All activities control microcomputers (IC1, IC2). Device functions are controlled by parameters stored in non-volatile memory (IC3). Actual status of device operation indicate three LEDs (D3, D4, D5). Both MIDI inputs are isolated by optocouplers (VD1, VD2). The IC4 voltage stabilizer enables the device to be connected to power supply voltage with large range (from 8 to 20 volts DC). D4 diode protects the device against reverse polarity of the supply voltage. Current consumption of the device is about 30 mA.

Pic. 1 – Circuit diagram

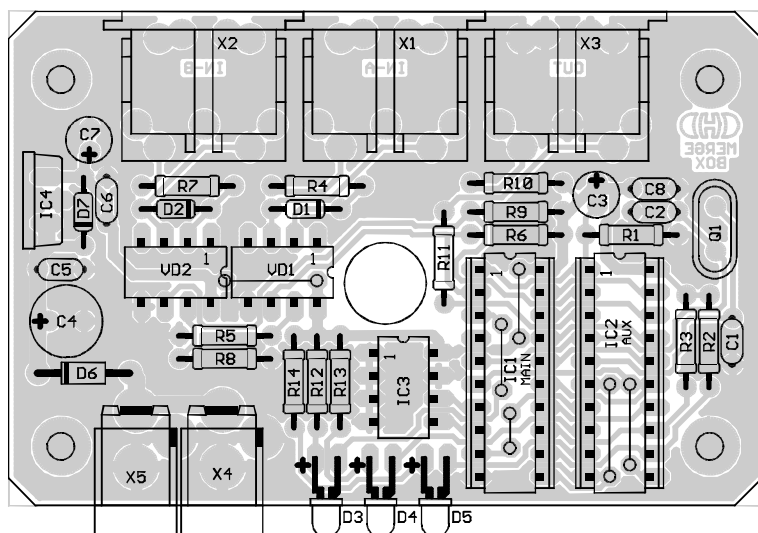


## 2 MANUFACTURING PROCESS

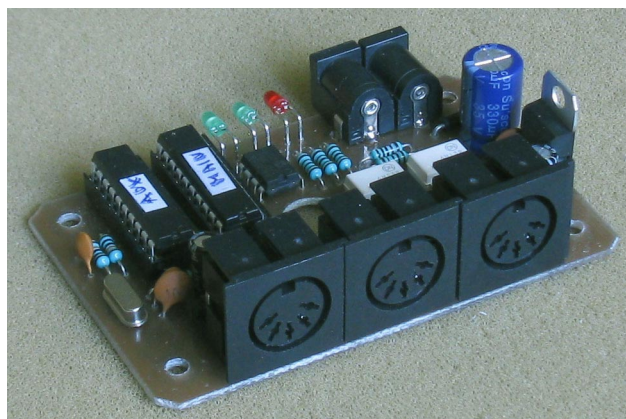
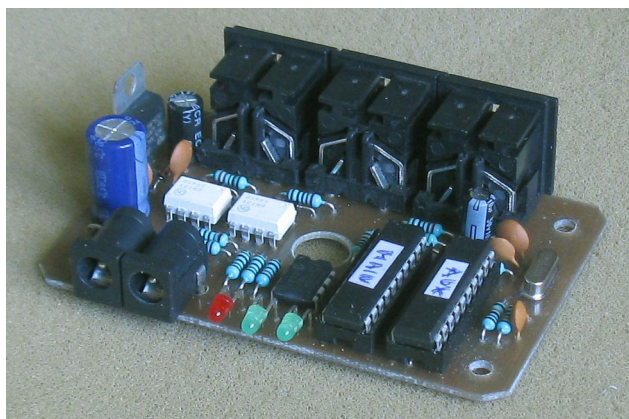
All components of the device are placed on one printed circuit board (see picture 2). No problems should occur during mounting the PCB. Note that there are six wire jumpers on the board (one under VD1, three under IC1 and two under IC2). They must be soldered before the VD1, IC1 and IC2 placement! Usage of DIL20 sockets is recommended for the IC1 and IC2. Leads of the D3, D4 and D5 LEDs are bended and the LEDs are soldered to the board so that their axis are 4 mm over the board surface.

The records for the printed circuit board manufacturing are attached in the "midi\_merge\_box.zip" archive (Gerber and Excellon files, layout images, etc.).

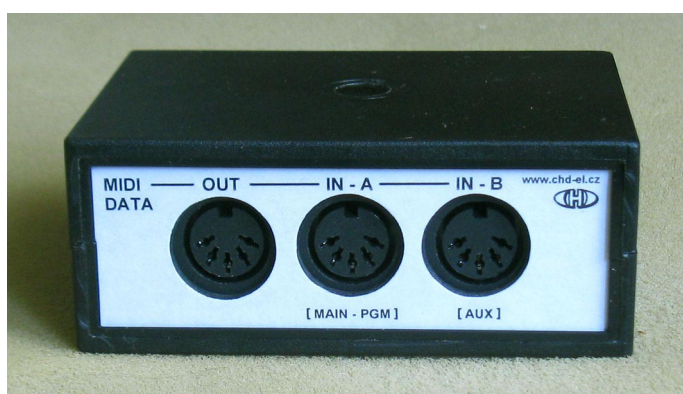
Pic. 2 – PCB: placement of components



Pic. 3 – Fitted PCB

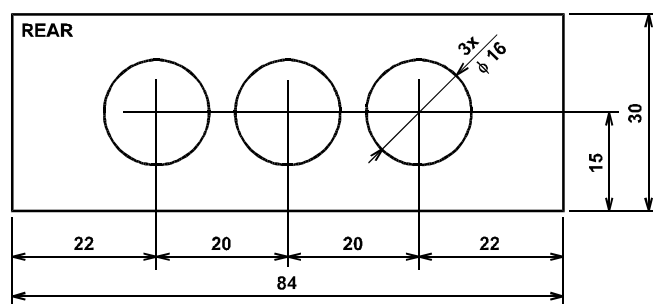
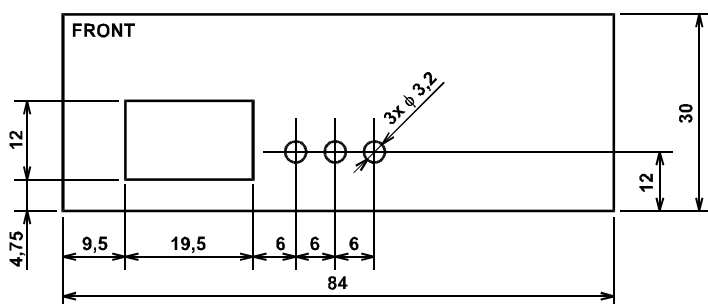


Pic. 4 – Finished device



The PCB is designed for placement into KM-35B type plastic box (pic. 4). It is necessary to make (to drill) some holes to the box panels as shown on pic. 5. The panel elements should be labeled (see pic. 4). You can use a self-adhesive foil printed before for example.

Pic. 5 – Holes in panels



All necessary supplemental files with data for the device manufacturing are in "midi\_merge\_box.zip" archive available at [www.chd-el.cz](http://www.chd-el.cz) web site. The archive contains:

"documents" folder:

merge-box-2x1\_schema.pdf = schematics diagram  
merge-box-2x1\_pcb.pdf = pcb appearance  
merge-box-2x1\_panels.pdf = device panels appearance

"excellon" folder:

mb-2x1.pth = data for drilling - view from component side  
mb-2x1.drl = drill list  
mb-2x1\_pth.txt = report text file

"gerber" (format RS-274-X) folder:

mb-2x1.bot = data for layout - view from component side  
mb-2x1\_bot.txt = report text file for layout  
mb-2x1.stp = data for stop mask - view from component side  
mb-2x1\_stp.txt = report text file for stop mask

"img" folder:

merge-box-2x1\_layout.pdf = vector layout image - view from solder side  
merge-box-2x1\_layout.tif = bitmap layout image (600 dpi resolution) - view from solder side

"pgm" folder:

MB\_main.hex = Intel hex form of program list for IC1  
MB\_main.bin = binary form of program list for IC1  
MB\_aux.hex = Intel hex form of program list for IC2  
MB\_aux.bin = binary form of program list for IC2

Table 1 – Bill of material

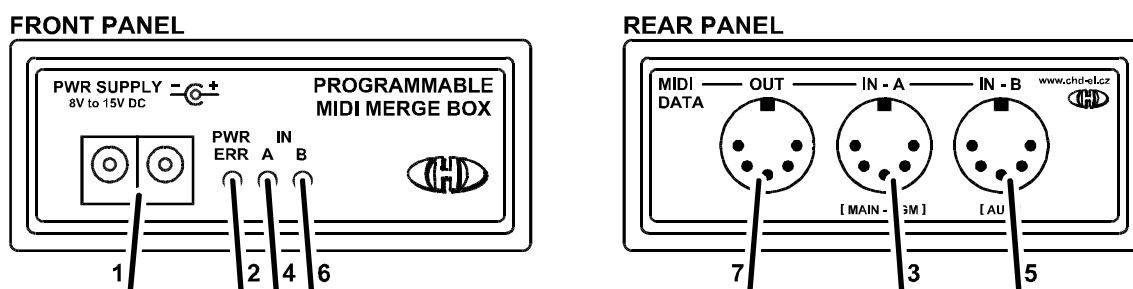
Amount	Designation	Type	Value	Remarks
4 pcs	R4, R7, R10, R11	Resistor, metal, 0207 size	220 $\Omega$	
2 pcs	R6, R9	Resistor, metal, 0207 size	560 $\Omega$	
3 pcs	R12, R13, R14	Resistor, metal, 0207 size	1 k $\Omega$	
3 pcs	R1, R5, R8	Resistor, metal, 0207 size	10 k $\Omega$	
(2 pcs)	(R2, R3)	(Resistor, metal, 0207 size)	(100 k $\Omega$ )	Not necessary for AT89LP2052 type of IC1, IC2
2 pcs	C1, C2	Ceramic capacitor, RM=5,08	18 pF	
3 pcs	C5, C6, C8	Ceramic capacitor, RM=5,08	100 nF	
1 pc	C3	Electrolytic capacitor, RM=2,54	10 $\mu$ F / 10 V	
1 pc	C7	Electrolytic capacitor, RM=2,54	220 $\mu$ F / 10 V	
1 pc	C4	Electrolytic capacitor, RM=3,81	330 $\mu$ F / 25 V	
1 pc	Q1	Crystal HC49/U	20,0000 MHz	
3 pcs	D1, D2, D7	Diode 150 mA	1N4148	
1 pc	D6	Diode 1 A	1N5819	
1 pc	D3	LED, 3 mm, red, 2 mA	HLMP1700	
2 pcs	D4, D5	LED, 3 mm, green, 2 mA	HLMP1790	
2 pcs	VD1, VD2	Optocoupler, DIL	6N139	
2 pcs	IC1, IC2	Microprocessor, 8051 series, DIL	AT89LP2052-20PU	
2 pcs	(for IC1, IC2)	Socket, DIL20		
1 pc	IC3	Serial EEPROM 128x8 bit, IIC, DIL	24C01 (24LC01)	
1 pc	IC4	Voltage stabilizer +5V/1A, TO220	7805	
3 pcs	X1, X2, X3	DIN-5 socket, 180°	MAB-5	e.g. HIRSCHMANN: 931744500 MAB 5 SH SW
2 pcs	X4, X5	Power supply socket, barrel type, 5,5 / 2,1 mm	K-375 type	e.g. LUMBERG: NEB 21 R
1 pc	-	Printed circuit board		See documentation
1 pc	-	Plastic box	KM-35B type	e.g. MASZCZYK: KM-35B BK
-	-	Coupling elements	Screws, etc.	As necessary

## 3 USAGE

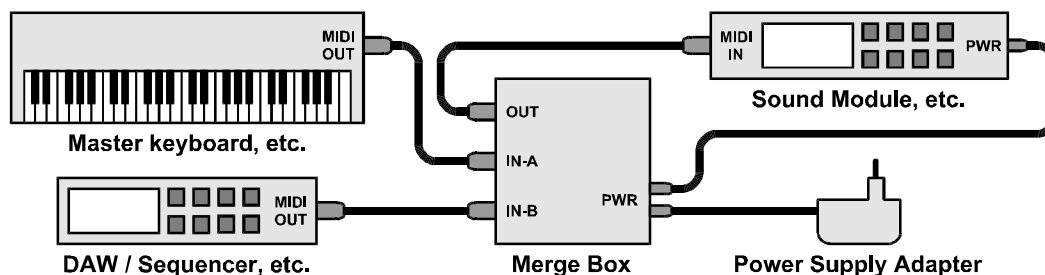
### 3.1 CONNECTORS AND INDICATORS

The device has two MIDI inputs (“A” [3] and “B” [5]) for data transmitters and one MIDI output [7] for data receiver – see pic. 6 and 7. The device is powered from external DC voltage source connected to any of “PWR SUPPLY” [1] plugs. The second plug can be used for supplying of a next device from the same power supply unit<sup>1</sup>. The “PWR/ERR” [2] LED indicates on status or an error status of the device. The “IN-A” [4] and “IN-B” [2] LEDs indicate MIDI data on inputs.

Pic. 6 – Device panels



Pic. 7 – Connection to MIDI system



<sup>1</sup> This is allowed due to galvanic insulation of MIDI devices by optocouplers on their MIDI inputs.

### 3.2 OPERATION

The device has no switch. It works immediately when it is connected to power supply unit. No user attendance is necessary during the device operation – it works fully automatically. The method of MIDI data processing is given only by the parameters stored in the device's memory (see below).

Operational readiness is indicated by continuous lighting of "PWR/ERR" [2] LED. Whenever an acceptable MIDI data comes to input "IN-A" or "IN-B", corresponding LED "IN-A" or "IN-B" blinks shortly.

If an error occurs during MIDI data processing, the device stops its operation and the "PWR/ERR" [2] LED starts blink. Number of blinks indicates the error type.

### 3.3 PROGRAMMING

The device processes the MIDI data in dependence on parameters stored in its memory. The parameters have to be programmed as you require before the device first usage. The parameters are set via MIDI System Exclusive messages sent to "IN-A" MIDI input<sup>2</sup>.

Available parameters and their values / meaning are described in table 2.

Table 2 – Device parameters				
Byte	Name	Value	Meaning	Remarks
<b>d1</b>	Transport Source (factory reset = 1)	0	MIDI transport commands are ignored on both inputs "A" and "B"	MIDI transport commands are "Clock" [F8], "Start" [FA], "Continue" [FB] and "Stop" [FC] real time synchronization commands
		1	MIDI transport commands are accepted only on input "A"	
		2	MIDI transport commands are accepted only on input "B"	
<b>d2</b>	Transport Indicator (factory reset = 0)	0	MIDI transport commands are not indicated	The commands are indicated by green LED of MIDI input on which they are received.
		1	MIDI transport commands indication is enabled	
<b>d3</b>	Not used	0	n/a	Reserve for upgrade
<b>d4</b>	Not used	0	n/a	Reserve for upgrade
<b>d5</b>	Not used	0	n/a	Reserve for upgrade
<b>d6</b>	Not used	0	n/a	Reserve for upgrade
<b>d7</b>	Not used	0	n/a	Reserve for upgrade
<b>d8</b>	SysEx Messages Delay (factory reset = 48)	0 ~ 48	Sets max. allowed interval between bytes of SysEx Msg	Conforms to max. delay from 2 to 50 ms

Structure of the programming SysEx message is:

[hex]	[bin]	byte
<b>F0</b>	11110000	Start SysEx
<b>00</b>	00000000	Manufacturer ID (always 3 byte)
<b>20</b>	00100000	
<b>21</b>	00100001	
<b>7F</b>	01111111	Device ID ("Universal ID")
<b>02</b>	01111101	Model ID (i.e. Merge Box 2x1)
<b>7F</b>	01111101	Command (i.e. Programming)
<b>d1</b>	000000dd	Data Block (1 <sup>st</sup> byte – Transport Source Parameter – see table 2)
<b>d2</b>	000000dd	Data Block (2 <sup>nd</sup> byte – Transport Indicator Parameter – see table 2)
<b>d3</b>	00000000	Data Block (3 <sup>rd</sup> byte – Reserve)
<b>d4</b>	00000000	Data Block (4 <sup>th</sup> byte – Reserve)
<b>d5</b>	00000000	Data Block (5 <sup>th</sup> byte – Reserve)
<b>d6</b>	00000000	Data Block (6 <sup>th</sup> byte – Reserve)
<b>d7</b>	00000000	Data Block (7 <sup>th</sup> byte – Reserve)
<b>d8</b>	00ddddd	Data Block (8 <sup>th</sup> byte – SysEx Messages Delay Parameter – see table 2)
<b>xx</b>	0xxxxxxx	Checksum (7-bit complement of the sum of bytes from 'Model ID' to 'Data Block')
<b>F7</b>	11110111	End SysEx

This document and supplemental files are available at CHD Elektroservis web pages: [www.chd-el.cz](http://www.chd-el.cz)

<sup>2</sup> If a programming SysEx message is sent to the "IN-B" MIDI input, the device ignores it!