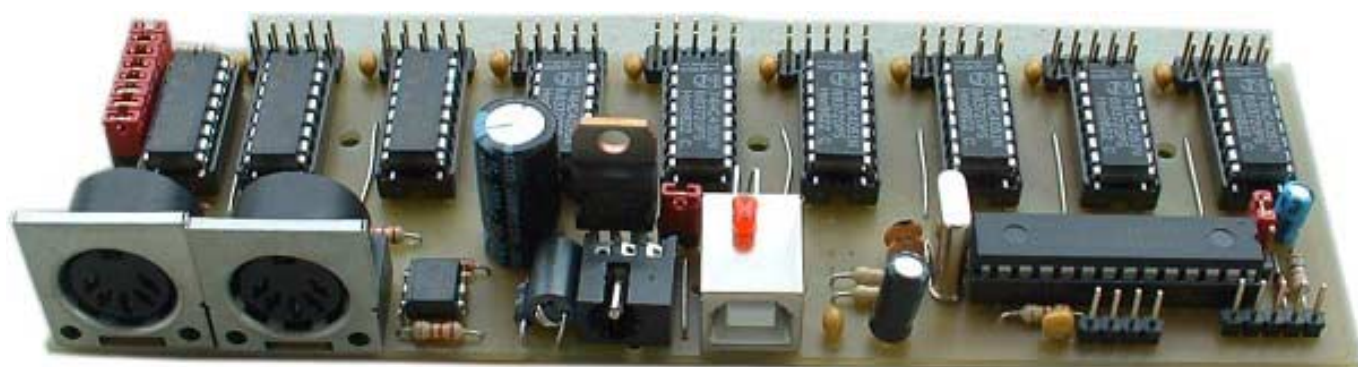


DOEPFER MUSIKELEKTRONIK GMBH



USB64

**Universal Control Electronics
with Midi and USB Output**

Installation and User's Guide

V1.3

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Table of contents

Table of contents.....	2
Electrical safety / EMC compatibility.....	3
Warranty	4
Introduction	5
Connection and Installation	6
Midi In Socket (1).....	6
Midi Out Socket (2).....	6
Power Supply (3)	6
USB connector (4)	7
USB connector (4)	8
Connectors for the 64 controls (5)	8
(6) Pin header JP9.....	11
(7) Pin headers JP10, JP11, JP14, JP12, JP15.....	13
JP10 / 14.....	13
JP12 / JP15.....	14
JP11.....	14
(8) Pin header JP13.....	15
(9) Control LED.....	15
Mounting	16
Dimensions	17
Check list.....	18
Extent of delivery.....	19

Electrical safety / EMC compatibility

USB64 is a so-called **OEM product** (OEM original equipment manufacturer) that cannot be used independently but has to be combined with additional electrical or electronical equipment to become a working device (e.g. potentiometers, switches, power supply, case/housing). The manufacturer of **USB64** does not know the final assembly of the complete device in which the **USB64** is used as a part of the complete device. The final responsibility with regard to **electrical safety** and **electromagnetic compatibility** is up to the user who is assembling the complete device.

Electronic basic knowledge is required to install USB64 and to connect the controls resp. control voltages. If you are not sure whether your knowledge is sufficient please consult an expert. We cannot take back modules that became defective because of wrong installation or wrong connection of the controls or voltages.

Please pay attention to the following items:

The **power supply** used in combination with the **USB64** has to be a closed type (in Germany a power supply with VDE approval is required). Normally an AC adapter with plastic case is used. It is not allowed to use **open power supplies** which open **mains voltage** access (e.g. via mains lead, pcb tracks, electronic parts).

On the **USB64 preventing measures** against **electromagnetic radiation** are taken (e.g. an RF filter at the power supply input). But it is impossible to estimate to what extend the **components added by the user** affect the **EMC properties** of the complete assembly. Therefore the **complete device** has to be **shielded** against **electromagnetic radiation** (incoming and outgoing). These demands are normally met by a closed metal case that covers the complete assembly. The metal case should be connected to GND of the **USB64**.

Warranty

- Applying any negative voltage ($< 0V$) or positive voltage above $+5V$ ($> +5V$) to one of the 64 analog inputs (JP1 – JP8) will destroy the circuit !
- If potentiometers and/or switches are connected between GND and $+5V$ of *USB64* as described in this manual no problems will occur.
- When external control voltages are connected to *USB64* the user has to pay attention that the voltages applied are strictly within GND and $+5V$ referenced to GND of *USB64* !
- Do not solder directly to any of the pin headers but use female connectors to make the connections between *USB64* and the potentiometers, switches or voltages. A cable set that contains all required connectors and cables is included with *USB64*.
- Carry out all connections in the off-state of *USB64* (i.e. when powered-off only) !
- Do not power on *USB64* before all 64 analog inputs are connected. Do not leave analog inputs unconnected !
- *USB64* electronics is an electrostatic sensitive device. Avoid any electrostatic charges ! Do not touch the inputs with your fingers !
- Avoid short circuits !
- Ignoring any of these items will cause warranty loss !
- We are not responsible if devices connected to the *USB64* connector (e.g. computers) are damaged because one or more of these remarks have been ignored. In particular one has to pay attention to make no short circuit at the USB connector (e.g. by screws or other conductive material).
- Return of the *USB64* within the 2 weeks return time limit (valid only in Germany) is only possible if all these items have been met. Return of used cable sets is not possible. We also cannot take back modules that have been soldered by the user.

Introduction

- *USB64* is an universal electronics DIY kit to built your own Midi control box. Up to 64 controls can be connected to *USB64* transmitting Midi Control Change or note on/off or program change messages.
- Typical examples for controls that can be used are rotary potentiometers, fader/slider potentiometers, momentary switches, toggle switches, foot switches or foot controllers.
- The controls are not included but have to be added by the customer.
- *USB64* cannot be used with rotary encoders (sometimes even called endless potentiometers). For this application the *Dial Electronics* is available.
- Even voltages sources can be used instead of the controls provided that the voltages applied are strictly within the range 0...+5V (referenced to *USB64* GND)! Voltages beyond this range will destroy the electronics !
- The *USB64* configuration (i.e. the Midi channel, the type if Midi message, the number of the Midi controller/note/program assigned to the first input) is adjusted by jumpers.
- The 64 controls resp. control voltages are connected to double row pinheaders (10 pins each). To these headers eight 10 pin ribbon cables are put up. The terminals of the controls are soldered to the free ends of the ribbon cables. In this way the controls might be disconnected from the electronics very easily.
- *USB64* is equipped with Midi In/Out and USB.
- *USB64* is available only as an assembled and tested pc board (about 159 x 53 x 25 mm).
- *USB64* includes eight 10 pin ribbon cables (about 30 cm each) and a USB cable (type A-B)
- An external power supply (7-12VDC@min. 100mA) is required for the *USB64* if the device is not powered via USB. It is included for all shipments within Germany (230V version with European mains plug). For shipments outside Germany please ask your local representative or dealer.
- We do not offer a suitable housing as this would have to be completely different for various combinations of controls.
- Provided that a firmware redesign is available the update can be carried out by the customer. For this a PC with USB interface and Windows XP is required. Details can be found on our website www.doepfer.com in the download area as soon as an update is available.

Connection and Installation

Please pay attention to the following notes !

Electronic basic knowledge is required to install the USB64 electronics and to connect the controls resp. control voltages. If you are not sure whether your knowledge is sufficient please consult an expert. We cannot take back modules that became defective because of wrong installation or wrong connection of the controls or voltages. We also cannot take back modules or cables which have been soldered by the user.

Midi In Socket (1)

USB64 features a MIDI input. This input may be connected to another MIDI device. The incoming MIDI data are merged to the data generated by the USB64. At the first place the MIDI input is used for daisy-chaining several USB64. The MIDI input of USB64 is not suitable for large amounts of MIDI data (e.g. MIDI messages coming from a computer sequencer). In case of large amounts of incoming MIDI messages data loss or delay may occur. If the merge feature of the USB64 is not required the MIDI input may be left open. SysEx strings are not supported !

Midi Out Socket (2)

Provided that you want to use the Midi output to control the corresponding Midi device (e.g. Computer, Synthesizer, Midi expander) this socket has to be connected to Midi In of the device in question.

Power Supply (3)

USB64 does not have a built-in power supply. Instead it uses a plug-in type external power supply (AC adapter) or can be powered via USB. One reason for this feature is electrical safety. Keeping danger voltages (main) out of the *USB64* increases the electrical safety. Therefore an external power supply of high quality and safety should be used if the device is not powered via USB. If *USB64* is used in Germany the external power supply has to be VDE approved. Another reason for the external power supply is the fact that mains voltages and plug types vary considerably from country to country. Using a plug-in external supply *USB64* can be used anywhere with a locally purchased power supply, thus keeping the retail price down.

The power supply has to be able to deliver 7-12 VDC unstabilized voltage, as well as a minimum current of 100mA. *USB64* is switched ON by plugging the AC adapter into a wall outlet and connecting it to the appropriate jack on the *USB64* board. There is no separate ON/OFF switch.

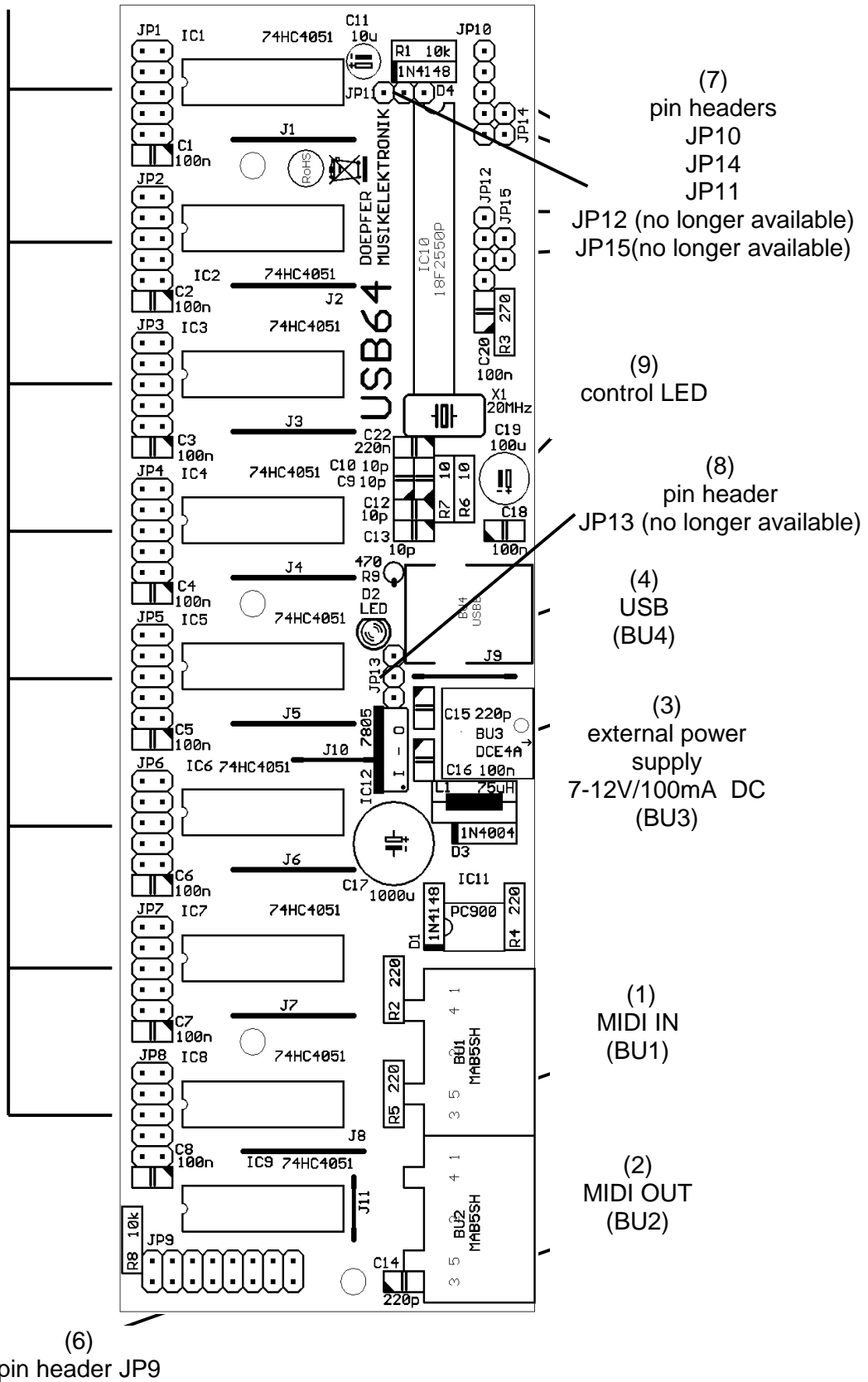
If the polarity of the power supply is incorrect, *USB64* will not function. However, there is no danger of damage to the circuitry since it is protected by a diode. The correct polarity is: outside ring = GND, inside lead = +7...12V. A power supply for 230V mains voltage with European type mains plug is included with the *USB64* (valid only within Europe, for other countries ask your local Doepfer representative or dealer).

If *USB64* is powered via USB the external power supply has to be removed.

Overview: USB64 Connections

(5)

pin headers for connection of the potentiometers or switches (JP1 ... JP8)



USB connector (4)

If the data generated by USB64 has to be transmitted via USB the socket (4) is connected to the USB socket of the receiver (normally that's a computer with USB interface). The operating system of the computer has to support the so-called *generic USB device class driver for Midi devices*. This driver is supported by Windows XP (SP2 recommended), Vista and Mac OSX operating systems. Consequently older Windows or Mac operating systems that do not include this driver cannot be used. In this case the Midi output of the USB64 has to be used.

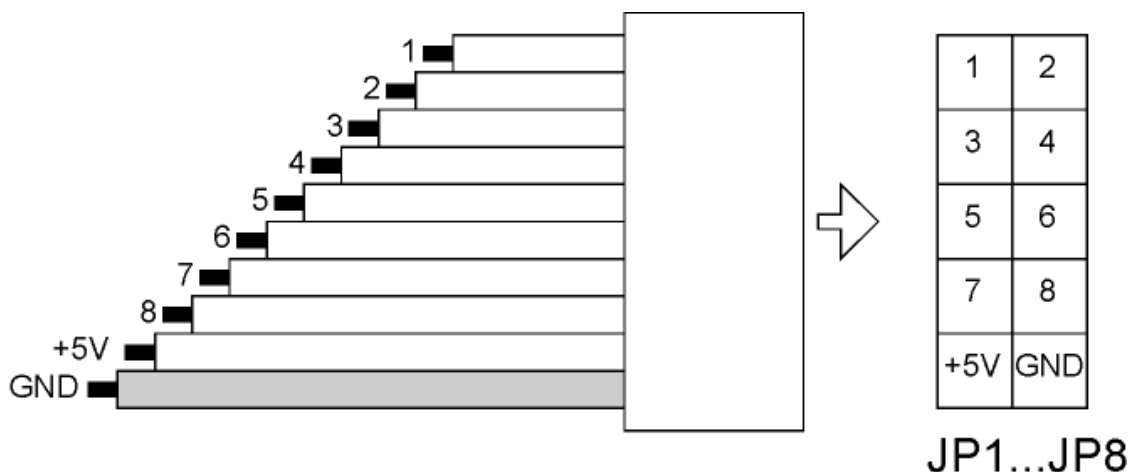
Provided that the operating system does support the *generic USB Midi device class driver* the USB64 is recognized by the computer as soon as USB64 is connected to the computer. Then the corresponding driver is activated and normally an acoustic notification is made. This maybe complemented by information bubbles in the task bar (e.g. Windows XP). After that a new Midi in/output named *USB audio device* is available in the corresponding programs. If another message appears (e.g. *USB device not recognized*) the required driver is not available or damaged or does not work for other reasons. As this behaviour depends upon the computer and the operating system we cannot give any support as the reasons can be manifold and do not depend upon the USB64 but the computer and the operating system installed on the computer.

Connectors for the 64 controls (5)

The eight pin headers JP1 – JP8 are used to connect the 64 controls. All pin headers have available these signals: GND, +5V and 8 control voltage inputs (range 0...+5V).

Remark: In the following the terms GND (= abbreviation of ground) and 0V (zero volts) are used synonymous.

The control voltages are normally generated by rotary or fader potentiometers that are connected between GND and +5V. In this case the wiper of the potentiometers outputs a voltage in the range 0...+5V while the potentiometer is operated. Another possibility is the connection of momentary switches or toggle switches.

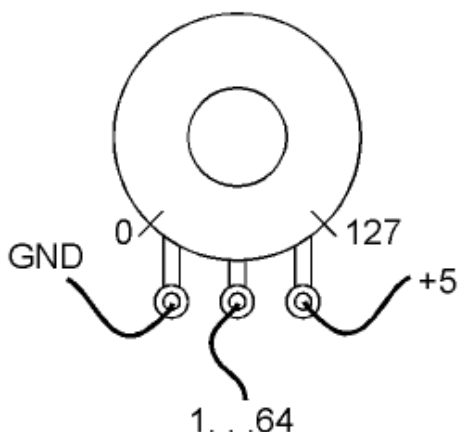


The above sketch shows the pinout of each pin header JP1 – JP8. The orientation is the same as in the picture on the previous page. The pins labelled 1 ... 8 are the eight control voltage inputs of the corresponding pin header. The upper pin header (JP1) is assigned to the inputs 1...8, the second (JP2) to 9...16 and so on until JP8. This is assigned to the inputs 57...64.

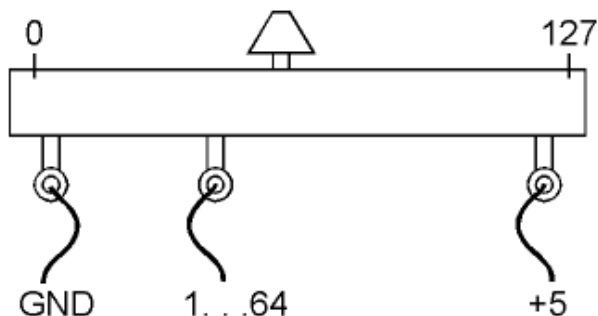
The right part of the sketch shows the pin out of the pin headers. Normally 10 pin female connectors with ribbon cables are plugged to the pin headers JP1 – JP8. Eight female connectors with ribbon cables are included with the *USB64*. The controls (e.g. potentiometers or switches) are soldered to the open ends of the ribbon cable. The left part of the sketch shows the pinout of the 10 wires of the ribbon cables. We strictly recommend this type of wiring but not to solder the wires directly to the pin headers JP1 – JP8. Usage of the ribbon cables with female connectors allows to disconnect the controls from the electronics very easily.

Rotary or slider potentiometers are connected in this way:

- lower resp. left end terminal to GND
- wiper / middle terminal to one of the analog inputs 1 ... 64
- upper resp. right end terminal to +5V



Connection of a rotary potentiometer



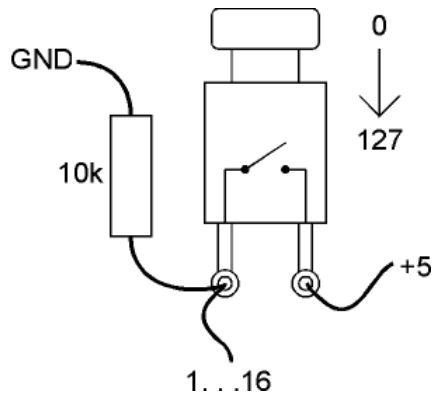
Connection of a slider potentiometer

Potentiometers with resistance values in the range 4k7 ... 100k can be used. We recommend 10k (linear).

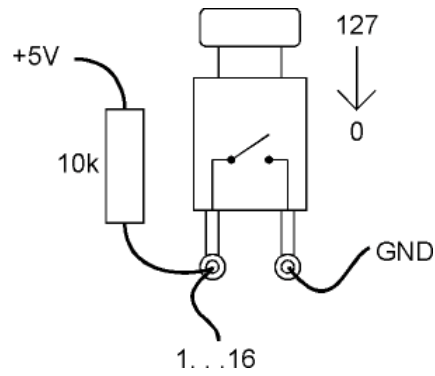
Momentary or toggle switches can be used in two different ways:

	state of rest		active state	
	Midi data	voltage	Midi data	voltage
version 1	0	0V	127	+5V
version 2	127	+5V	0	0V

Simple momentary switches (one contact, open at rest) or simple toggle switches (one contact on/off) are required. According to the desired behaviour (version 1 or 2 in the above table) the switch has to be wired correspondingly:



Connection of a momentary or toggle switch (version 1)



Connection of a momentary or toggle switch (version 2)

In both cases an additional resistor is required (possible range 4k7 to 100k) to pull the analog input to a defined state during the switch is open.

- Version 1: The resistor is soldered between GND and the control voltage input. This way the input is pulled to GND (=0V corresponding to Midi data 0) as long as the switch is left open. When the switch is closed the voltage jumps to +5V corresponding to Midi data 127.
- Version 2: The resistor is soldered between +5V and the control voltage input. This way the input is pulled to +5V (corresponding to Midi data 127) as long as the switch is left open. When the switch is closed the voltage jumps to 0V corresponding to Midi data 0.

64 resistors (range 4k7 ... 100k) are enclosed with each *USB64* delivery. Suitable resistors are available in each electronic shop too (value: ~ 10k, power: ¼ W, tolerance: 5%, material: carbon).

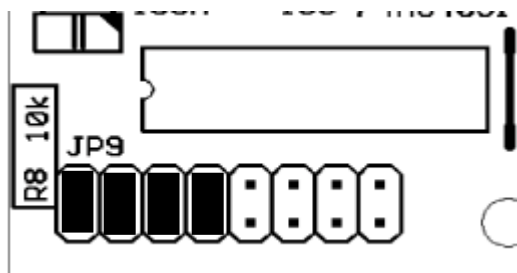
Unused inputs have to be connected to GND or +5V. Avoid open inputs ! An open input will cause the transmission of random Midi data causing undesirable side effects at the Midi receiver (e.g. Midi overflow or random parameter fluctuations).

Configuration of the USB64

The configuration of the USB64 is carried out by several jumpers that have to be put on pin headers. *Configuration* means in this context the adjustment of the parameters that define the behaviour of USB64: e.g. Midi channel, type of Midi event, controller/note/program number assigned to the first input, supply via external power supply or USB, USB active/inactive and so on.

(6) Pin header JP9

The jumper area JP9 is made of a double row pin header with 16 pins that can be used to install up to 8 jumpers. The jumpers 1...4 are used to adjust the Midi channel. With the jumpers 5...8 one of the presets is selected.



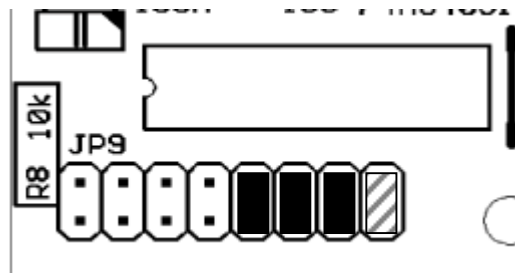
The following table shows the relation between the settings of the jumpers 1...4 of JP1 and the corresponding Midi channels:

jumper #				Midi channel
1	2	3	4	
■	■	■	■	1
	■	■	■	2
■		■	■	3
		■	■	4
■	■		■	5
	■		■	6
■			■	7
			■	8
■	■	■		9
	■	■		10
■		■		11
		■		12
■	■			13
	■			14
■				15
				16

■ = = jumper installed

The factory setting is shaded grey (Midi channel 1).


The following table shows the relation between the settings of the jumpers 5...8 of JP1 and the corresponding preset:



Preset #	Jumper #				Configuration / Preset description
	5	6	7	8	
1	■	■	■	■	control change 0 – 63 (analog)
2		■	■	■	note 0 - 63 (digital)
3	■		■	■	programm change 0-63 (digital)
4			■	■	polyphonic aftertouch 0-63 (analog)
5	■	■		■	control change 0 – 31, note 0-31 (analog/digital mixed)
6		■		■	control change 32 – 63, note 32-63 (analog/digital mixed)
7	■			■	unused
8				■	unused
9	■	■	■		control change 64 – 127 (analog)
10		■	■		note 64 – 127 (digital)
11	■		■		programm change 64-127 (digital)
12			■		polyphonic aftertouch 64-127 (analog)
13	■	■			control change 64 – 95, note 64-95 (analog/digital mixed)
14		■			control change 96 – 127, note 96-127 (analog/dig. mixed)
15	■				unused
16					unused

⊙ = jumper installed

The factory setting is shaded grey (preset # 1).

Jumper 8 

works as an offset that adds 64 to the control change, note or program change numbers (i.e. range 0–63 turns into 64 –127).

Remarks:

- Preset #1 is the standard preset (factory setting). It is planned to connect 64 potentiometers (rotary or slider) or switches to generate the Midi control change messages in the range 0 – 63 with a continuous data range 0–127.
- Preset #2 is planned to connect 64 switches to generate the Midi note messages 0 – 63. According to the type of switch connection (please refer to page 10 for details) one position of the switches generate note on messages with velocity 127 and note off messages in the other position. Instead of switches even analog controls can be connected. The control voltage threshold between note on and off is about +2.5V.

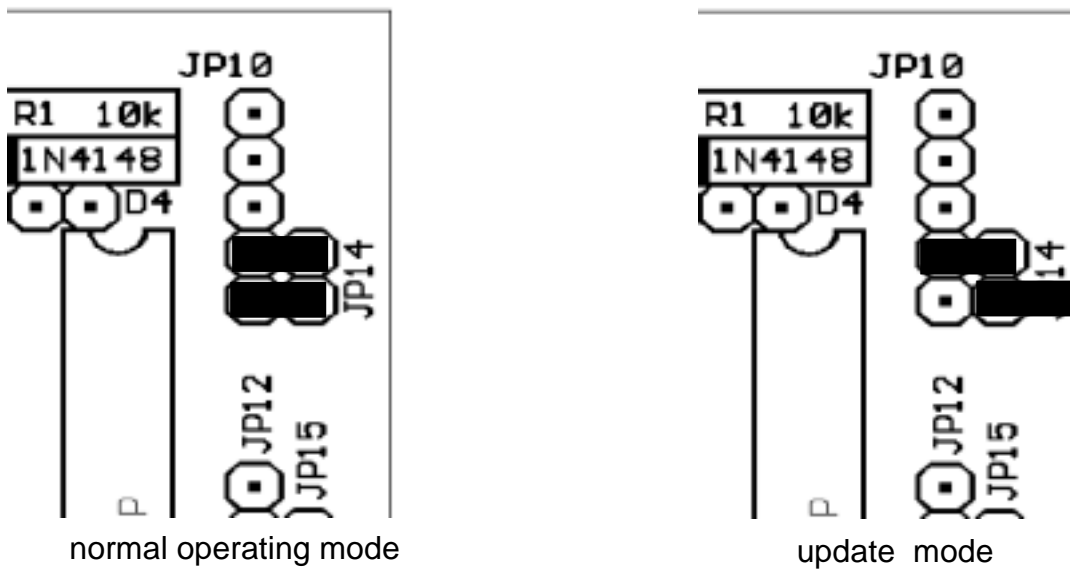
As the scanning of the 64 inputs is analog even in this mode (i.e. analog-to-digital conversion) the scanning is not as fast as e.g. for a Midi keyboard. It is planned to control functions that are triggered by Midi note messages (e.g. for Ableton Live) but not as a Midi keyboard. For Midi keyboard applications the scanning is not fast enough. We recommend the OEM/DIY electronics CTM64 for this application.

- Preset #3 generates Midi programm change messages in the range 0 – 63. Pay attention that some manufacturers count 1–64 instead of 0–63.
- Preset #4 is very similar to preset #1. But instead of Midi control change polyphonic aftertouch messages are sent.
- Presets #5 und #6 are combinations of the presets #1 and #2. Analog and digital messages are mixed to enable the simultaneous usage of analog controls (e.g. potentiometers) and digital controls (e.g. switches).
- Preset #7 and #8 are not yet used. They may be used in firmware updates.
- The presets #9 to #16 are equivalent to the presets #1 to #8 but the control change/ note/ program change numbers 64–127 are used.

(7) Pin headers JP10, JP11, JP14, JP12, JP15

JP10 / 14

The pin headers JP10 and JP14 are used to choose between the normal operating mode and the firmware update mode.



Normal operating mode:

This is the usual working mode. In this mode the LED flashes for about 2 seconds after power on and then stays lit. As soon as Midi messages are generated by the USB64 the LED flashes to indicate the Midi out activity of USB64. Consequently the LED can be used to check the fundamental function of USB64.

Update Mode:

The update mode is used to update the firmware of the USB64. For this these devices are necessary:

PC compatible computer with USB interface and Microsoft Windows 98, Second Edition (98SE), Windows 2000 Desktop oder **Windows XP (bevorzugt)**

Remark: A firmware update via Midi is not possible.

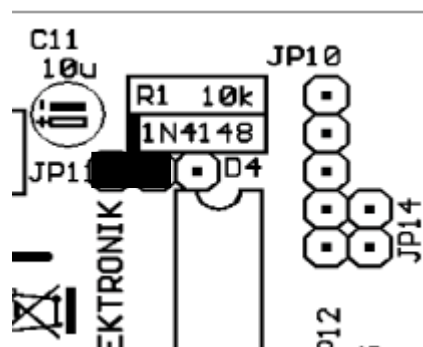
Additional information concerning an possible update is available on our website www.doepfer.com in the DOWNLOAD area.

Attention: *The upper three pins of JP10 have to remain unconnected at all events !*

JP12 / JP15

No longer available

JP11



Please leave this jumper in the factory setting (see picture). It is used for the internal reset of the circuit. If the jumper is removed or changed to the other position USB64 will not work !

(8) Pin header JP13

JP13 was used to choose the type of power supply. If an external power supply was used to run the USB64 the jumper had to be in the lower position (towards the voltage regulator 7805). If USB64 was powered via USB the jumper had to be in the upper position (towards the LED) and the external power supply had to be removed. This was the situation till version V1.2.

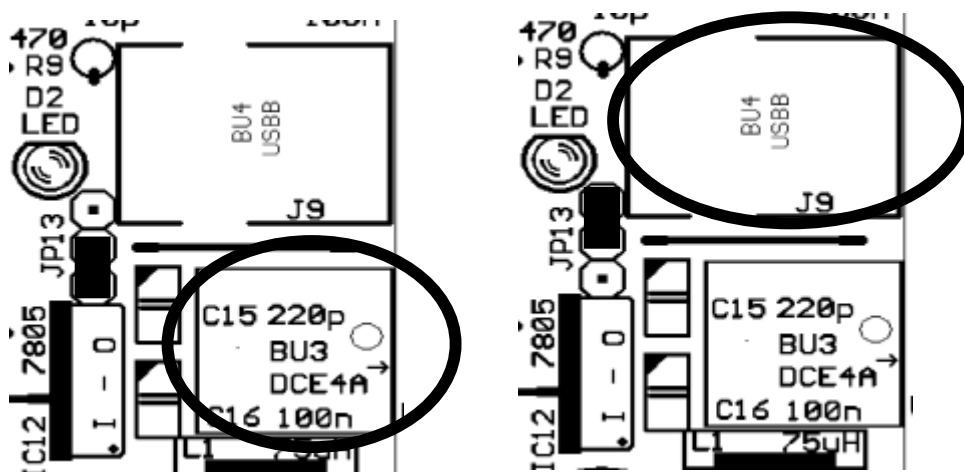
Now in V1.3 this is made automatic by two diodes BAT42, which are assembled instead of JP13 and the jumpers.

But in some situations it could be necessary to choose the type of power supply manually again.

F.e. if your potentiometers and/or switches that are connected need more power your USB port can offer (USB64 itself need 30 mA). Than you maybe want to use the external power supply interface from USB64 together with USB connected to your computer.

So you had te reassemble the old JP13 situation by removing the diodes and reassemble JP13 / wire this direct on the board at the position of former JP13.

But you also can use an external powered USB Hub between your computer and USB64, if you need more power that the USB port on your computer can supply.



supply via external wall outlet power supply

supply via USB

(9) Control LED

The LED flashes for about 2 seconds after power on and then stays lit. If this does not happen f.e. the external power supply connected to BU3 could be defective.

As soon as Midi messages are generated by the USB64 the LED flashes to indicate the Midi out activity of USB64. Consequently the LED can be used to check the fundamental function of USB64.

In addition the LED displays each change of the jumper settings of JP9.

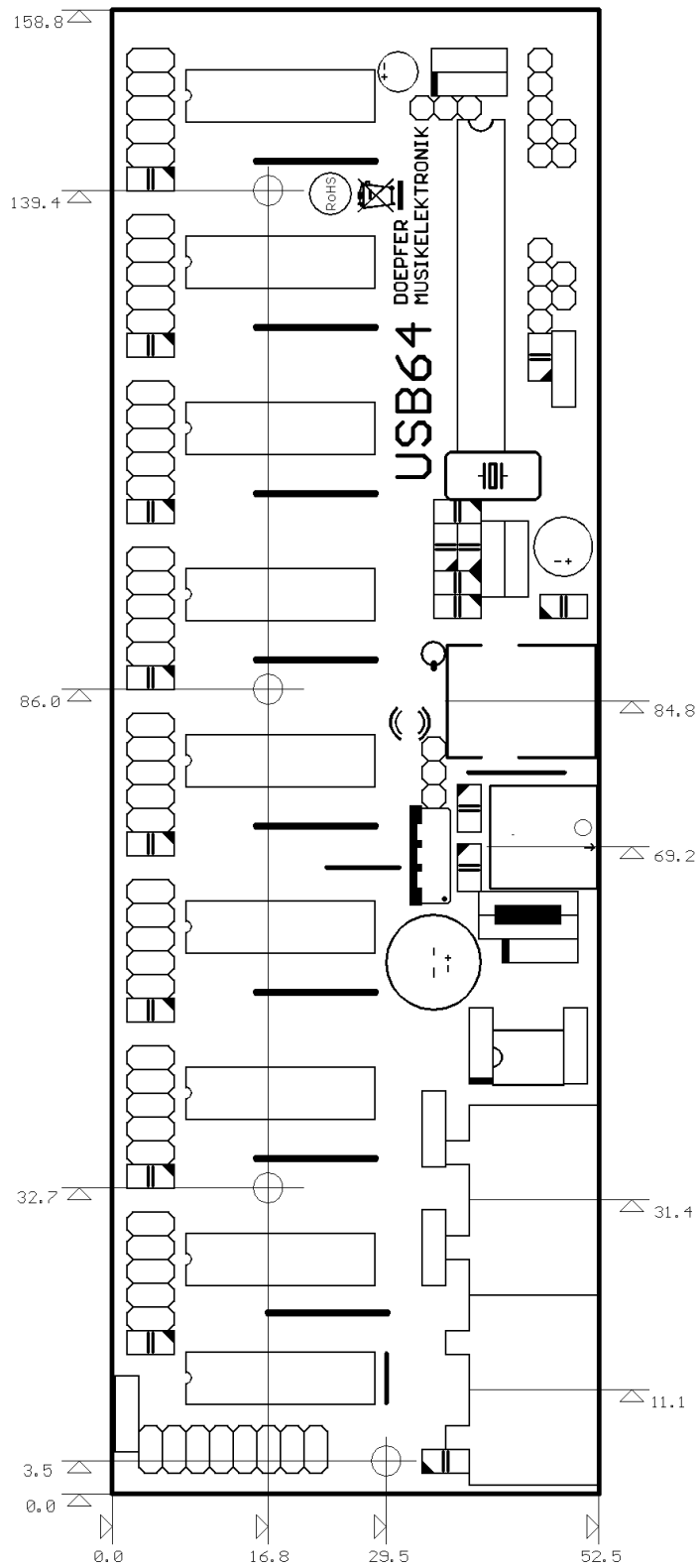
Mounting

Before **USB64** is put into operation the board has to be fixed on a suitable support and built into a metal case together with the controls (refer to EMC notes on page 3). The metal case has to be connected to GND of **USB64**. We recommend to use the metal plate of the voltage regulator 7805/IC12 or the GND terminal of the power supply socket for this connection.

The board measures about 159 x 53 x 25 mm. Four mounting holes with 3 mm diameter are available for mounting the board inside the case e.g. with distance sleeves or spacers (> 5 mm in length) and suitable screws. Pay attention that no short circuits are made – neither on the top of the board (electronic parts) nor on the bottom (solder points or pcb tracks). In case of doubt use isolating plastic parts (e.g. plastic screws, nuts and washers) for mounting.

Important remark: On the bottom of the board below the USB socket are the connections of the USB interface, i.e. the USB data and supply terminals. Pay attention that no short circuit of these pins is made as this may destroy the computer connected to the USB64 or the USB hub. Remove any kind of conductive parts (e.g. screws, nuts, washers or any other metallic part) before you connect the USB64 to your computer.

Dimensions



Dimensions USB64

Check list

In case that your **USB64** installation does not work at the first go please check the following items:

- Does the power supply work correctly ?
- Does the LED behave after power on as described ?
- Pay attention to the correct setting of JP13 for the desired power supply type, if you did not use the automatic power selection with the diodes assembled instead of JP13 !
- Are the controls connected correctly as described in this manual ?
- Was no short circuit made (neither in the wiring nor mounting) ?
- If the diode D3 and the voltage regulator IC12 become hot probably a short circuit between GND and +5V was made !
- If momentary or toggle switches are used: are the resistors (4k7...100k) soldered accordingly?
- Are unused analog inputs connected to GND or +5V? When the LED is flickering permanently without operating one of the controls probably one or more of the analog inputs is left open !
- Are the Midi connections between USB64 and the other Midi devices installed correctly ? Midi Out of USB64 has to be connected to Midi In of the Midi device controlled by USB64. Especially when computers are used Midi In and Out are very often mixed up by the user. Once again: Midi Out → Midi In (not Midi Out → Midi Out nor Midi In → Midi In).
- Please use only cables that are suitable for Midi.
- When a PC with sound card is used only high quality multimedia cables should be used. Low cost multimedia cables without optocouplers for Midi In and without drivers for Midi Out very often cause Midi data problems.
- Is the right Midi channel selected with the jumpers 1...4 of JP9 ?
- Is the right preset number selected with the jumpers 5...8 of JP9 ?
- The USB connection between USB64 and computer should be established or interrupted only if no application (e.g. VST PlugIn) is running that uses the USB Midi port ! Otherwise the application may lock while the USB connection is established or interrupted, or the Midi ports will no longer function. In this case the computer should be re-booted.
- If the USB connection has been established already (and the USB Midi port was in use already) it may take a very long time (up to several minutes) if the USB connection is interrupted and established again. In such case no Midi program should be started as otherwise the Midi port cannot be re-opened again !
- We recommend the usage of Windows XP with service pack 2 as with this operating system most of the problems mentioned above have been solved.
- So far we have no experience with USB64 and Windows 7 and cannot offer any support for this combination.

Extent of delivery

The USB64 delivery contains the following parts:

- USB64 pc board, assembled and tested
- Power Supply (230V mains voltage, European type mains plug, output voltage range 7...12V, current min. 100 mA) *included only for shipments within Germany, for shipments outside Germany please contact your local representative or dealer*
- This USB64 user's guide
- Eight 10 pin ribbon cables with double row female connectors, cable length about 30 cm each
- USB cable, type A – B
- 64 resistors 4k7...100k (5% carbon)

Controls that can be connected to USB64 (e.g. rotary or slider/fader potentiometers, momentary or toggle switches, foot controllers, foot switches, joy sticks and so on) are not included and have to be purchased in addition. Suitable parts can be found on our website www.doepfer.com. Please use the link *accessories and spare parts* of the product overview page. Prices can be found in the price list. But even electronic shops (e.g. www.mouser.com, www.radioshack.com) have a variety of suitable controls available.

Doepfer

Musikelektronik

www.doepfer.com

Doepfer Musikelektronik GmbH
Geigerstr. 13
D-82166 Graefelfing / Germany
Phone 49 89 89809510
Fax 49 89 89809511
Email: sales@doepfer.de