

CTM64

(Contact To Midi Converter)
Version 2

User's Guide

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Electrical safety / EMC compatibility

CTM64 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. keyboard, switches, buttons, potentiometers, power supply, case/housing). The manufacturer of CTM64 does not know the final assembly of the complete device in which the CTM64 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.

Please pay attention to the following items:

The **power supply** used in combination with the CTM64 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** with **open mains voltage** access (e.g. via mains lead, pcb tracks, electronic parts).

On the CTM64 electronics **preventing measures** against **electromagnetic radiation** are met (RF filters at the power supply input and the MIDI lines). But it is impossible to estimate to what extent 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 CTM64.

Warranty

- The 64 contact connectors (JP1, JP2, JP3, JP4) and the common connector for contacts (JP6) are allowed to be connected only to free contacts but not to voltages !
- Applying any voltage (including GND or +5V) to the 64 contact connectors (JP1, JP2, JP3, JP4) will destroy the circuit.
- Applying any negative voltage ($< 0V$) or positive voltage above +5V ($> +5V$) to the common connector for contacts (JP6) will destroy the circuit !
- Applying any negative voltage ($< 0V$) or positive voltage above +5V ($> +5V$) to the potentiometer connectors (ST1, ST2, ST3, ST4) will destroy the circuit !
- Applying any negative voltage ($< 0V$) or positive voltage above +5V ($> +5V$) to the sustain socket (BU4) will destroy the circuit !
- Applying any negative voltage ($< 0V$) or positive voltage above +5V ($> +5V$) to the jumper pin header (JP5) will destroy the circuit !
- Do not solder directly to any of the pin headers but use female connectors to make the connections between the CTM64 and your application. We offer a suitable cable set that contains all required connectors and cables.
- Carry out all connections in the off-state of the CTM64 (i.e. without power supply) !
- The CTM64 electronics is an electrostatic sensitive device. Avoid any electrostatic charges !
- Avoid short cuts !
- Ignoring any of these items will cause warranty loss !
- Return of the CTM64 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.

Contents

Electrical safety / EMC compatibility	2
Warranty	2
Contents	3
Introduction	4
<u>Connections</u>	6
Power supply (1)	7
Midi Out (3)	7
Midi In (2)	7
Control LED (4)	7
Sustain (5)	7
Potentiometer connectors (6,7,8,9)	8
Contact 1-64 (10) and Common (11)	9
Jumpers 1-8 (12)	9
Operation	10
Detailed function of the 8 jumpers of JP5	10
Midi channel (jumper 1,2,3,4)	10
Mode (jumper 5)	11
Note/program offset (jumper 8)	11
Octave offset (jumper 6/7, working only in note mode)	11
Control LED (4)	11
Factory setting of the jumpers	11
Check list	12
Appendix: Connection sketch	13
MTC64	14
Additional jumpers for pcb version 2 (from December 2002)	15
64 note offset	15

Introduction

CTM64 is an **universal MIDI Out kit**. Up to **64 free contacts** can be connected to generate MIDI note on/off or program change messages. CTM is suitable to **retrofit keyboards, switch panels, button arrangements** or any other contacts so that they are able to transmit MIDI data. Up to 4 **potentiometers** can be connected to generate **common MIDI controllers, pitch bend and after touch**. Additionally a 1/4 jack socket is available for connecting a **sustain pedal**.

Two different modes are selected with the first of 8 jumpers: **note on/off** or **program change**. In the note mode closing of a contact generates the corresponding MIDI note on message, opening generates note off - both without velocity (velocity is fixed to 100). In the program change mode closing of a contact leads to the corresponding MIDI program change message.

The **note offset** (i.e. the MIDI note number assigned to the first contact) can be set to 0 or 36 with the second jumper. With two more jumpers one can transpose up/down one octave, i.e. +12/-12 semitones. Instead of these jumpers a 3-position switch (1-0-1) working as an **octave switch** can be soldered to the corresponding pins of the jumper pin header. In this way the note offsets 0, 12, 24, 36 and 48 are available. If another note offset (e.g. 41) is required the contacts are displaced correspondingly and the unused contact terminals are left free.

In the **program change mode** the offset can be set to 1 or 64, i.e. setting the program number range to 1-64 or 65-128 (0-63 or 64-127 in MIDI code). With two daisy-chained CTM64 the whole program number range 1...128 is covered.

The **4 potentiometer** plugs are used to connect up to 4 potentiometers (e.g. rotary, slider, wheels or others) generating the MIDI messages **pitch-bend, modulation (controller #1), volume (controller #7) and monophonic after touch**.

The 1/4" jack socket can be used to insert a sustain pedal (contact type "closed at rest" is required) generating the MIDI **sustain** message (controller #64).

The **MIDI channel** for all messages transmitted by the CTM64 is set with the last 4 jumpers.

The **64 contacts** are connected to four **double row pin headers** with 16 pins each. 16 pin socket-connectors (female) with flat cable can be connected to these pin headers (not included with the CTM64). Additionally there is one common pin for all contacts. Pay attention that only free contacts can be used. This means that the contacts are not allowed to be connected with another electronics or connected with a fixed voltage (e.g. GND).

For the potentiometer four male pcb connectors with 3 pins (GND, slider, +5V) are available. Suitable female connectors with assembled cables can be connected to these pin headers (not included with the CTM64).

CTM64 is equipped with **MIDI In** and **MIDI Out**. The incoming MIDI messages are **merged** to the data generated by the CTM64. In this way **several CTM64 can be linked** together (e.g. 3 CTM64 required for 2 keyboards with 61 keys and one basepedal with 32 keys, or switch boards with more than 64 switches).

CTM64 is available only as an **assembled and tested pc board**. The pc board measures are about 90 x 105 mm. Four mounting holes with 3 mm diameter are available for mounting the pc board to a suitable base e.g. with distance sleeves or spacers and screws.

The configuration of CTM64 (i.e. MIDI channel, mode, note offset and so on) is made by the customer with 8 jumpers - as described above.

We do not offer a suitable housing as the CTM64 is normally installed into the housing of the keyboard or switch board. An **external power supply** (7-12VDC@min. 250mA) is required. It is not included with the CTM64 and has to be ordered additionally if required.

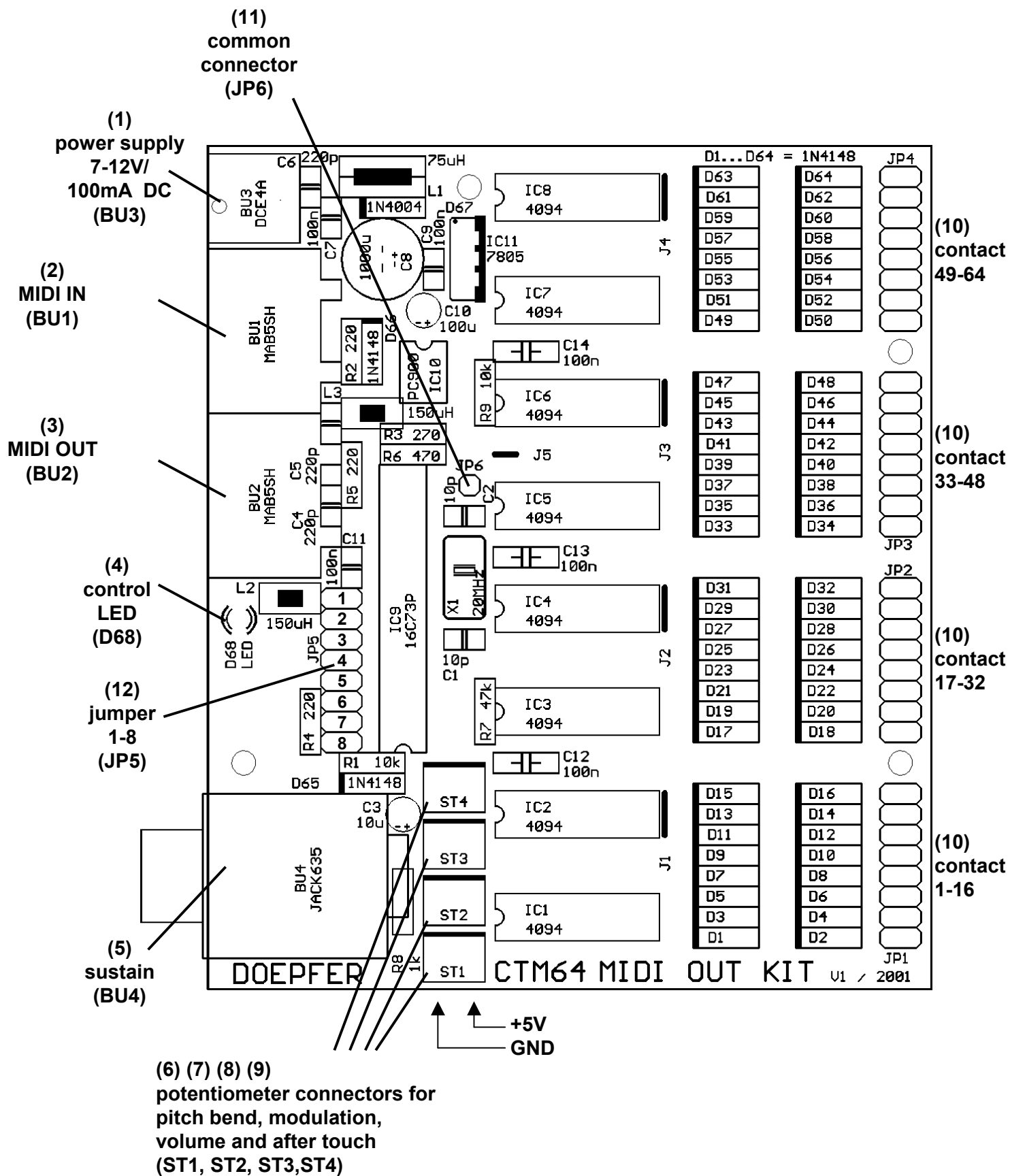
We offer a connector set at 50.- DM (about 25.- US\$). This includes four 16 pin flat cables with 16 pin socket connectors (female) pressed to the cables at one end (length about 50cm) and four 3 pin female connectors with assembled cables for the potentiometers (length about 30cm, potentiometers are not included). We also offer a suitable power supply (mains input: 90-240VAC with European type connector, output: 9V DC/800mA) with CE and VDE approval at 35.- DM (about 17.50US\$).

Installation of the CTM64 requires some electrical/electronic knowledge by the user. Please leave the installation of CTM64 to an expert if you are not familiar with electronics. We take back only CTM64 modules in the original state, i.e. without solder residues, without scratches and so on.

The counterpart to CTM64 (MTC64) that converts 64 succeeding note messages into 64 0/+5V signals is planned for early in 2001. With suitable drivers relays, lamps or electromagnetic valves can be controlled via MIDI.

Please pay attention to the warranty notes on page 1. Ignoring these notes causes warranty loss and the right to return the goods.

Connections



Power supply (1)

The CTM64 does not have a built-in power supply. Instead it uses a plug-in type external power supply (AC adapter). One reason for this feature is electrical safety. Keeping danger voltages (main) out of the CTM64 increases the electrical safety. Therefore an external power supply of high quality and safety should be used. If the keyboard is used in Germany the external power supply has to be VDE approved. Another reason for the external power supply is the fact that line voltages and plug types vary considerably from country to country. Using a plug-in external supply the CTM64 can be used anywhere with a locally purchased power supply, thus keeping the retail price down.

The power supply must be able to deliver 7-12 VDC unstabilized voltage, as well as a minimum current of 100mA. The CTM64 is switched ON by plugging the AC adapter into a wall outlet and connecting it to the appropriate jack on the CTM64 board. There is no separate ON/OFF switch. If the polarity of the power supply is incorrect, the CTM64 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. The power supply is not included with the CTM64 and has to be purchased separately.

Midi Out (3)

Connect the MIDI-OUT jack with MIDI-IN of the device(s) to be controlled (i.e. Expander, Sequencer, Synthesizer, etc. or a second CTM64) via a suitable MIDI-cable. If you want to control more than one MIDI device you have to use daisy chain MIDI THRU/MIDI IN connection of the devices or use an external MIDI THRU BOX.

Midi In (2)

The CTM64 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 CTM64. At the first place the MIDI input is used for daisy-chaining several CTM64. The MIDI input of CTM64 is not suitable for large amounts of MIDI data (e.g. SysEx strings or MIDI messages coming from a computer sequencer) as the MIDI in buffer is only 48 bytes. In case of large amounts of incoming MIDI data data loss or delay may occur. If the merge feature of the CTM64 is not required the MIDI input may be left open.

Control LED (4)

The **LED** is used to display any MIDI out activity. After power on the LED is permanently on. As soon as a MIDI out event occurs the LED turns off for a short time thus indicating MIDI activity.

Sustain (5)

The 1/4" jack socket is used to connect a foot switch for the MIDI sustain function (MIDI controller #64). Do not connect the footswitch unless the CTM64 is switched OFF. While power on the CTM64 electronics checks the level of the foot switch and assumes that this level is the "off" state. So do not operate the foot switch while turning power on. This feature allows the use of foot switches with contacts open at rest as well as those closed at rest. The foot switch is not included with the CTM64 and has to be ordered separately if required (e.g. the VFP2). The CTM64 will work without the foot switch, although the function Sustain will not be available in that case.

Potentiometer connectors (6,7,8,9)

The four 3-pin connectors (6,7,8,9) are used to connect up to four potentiometers (rotary potentiometers, faders, wheels). The middle pin of each connector is the slider pin (or control voltage pin), the left one is GND, the right one is +5V. The CTM64 connector set includes 4 suitable female connectors with assembled cables to connect the potentiometers (length about 30cm, potentiometers are not included).

The four connectors are assigned to the following MIDI events:

- ST1 pitch bend (with middle plateau around MIDI data 64)
- ST2 modulation (MIDI controller #1)
- ST3 volume (MIDI controller #7)
- ST4 monophonic after touch

The actual control voltage range used for ST1 and ST2 is 0... +2.5V. 0V corresponds to MIDI data 0, +1.25V corresponds to MIDI data 64 (middle position) and +2.5V corresponds to MIDI data 127. This voltage range was chosen as in case of wheel potentiometers usually not the whole rotation angle is available but only about 50%. If the full voltage range 0...+5V would be used the wheels could not cover the complete MIDI data range 0...127 but only a small fraction (e.g. 30...100). If a standard potentiometer with whole rotation angle is used a pre-resistor with the same value as the potentiometer should be used (see appendix: "connection sketch" for details) to obtain a control voltage range of 0...+2.5V. For pitch bend there is a small plateau around +1.25V (MIDI data 64) so that it is easier to find the neutral position of the pitch bender. For most of the spring-loaded pitch bend wheels this plateau is required as the mechanical neutral position slightly differs depending on the resetting direction.

The control voltage range for ST3 and ST4 is 0 ... +5V. 0V corresponds to MIDI data 0, +2.5V corresponds to MIDI data 64, +5V corresponds to MIDI data 127. This voltage range was chosen as for these controls usually standard potentiometers with the whole rotation angle are used.

Unused potentiometer connectors have to be jumpered to GND (*factory setting*). Senseless MIDI data will be sent if one of the potentiometer connectors is left open. If a potentiometer connector is not used it has to be jumpered to GND, i.e. a jumper has to be installed in the left position (in direction to the 14" jack socket).

The resistor values for the potentiometers used should be in the range of about 5k...250k. Instead of the usage of potentiometers also control voltages may be applied to the middle pins of ST1...4 provided that the applied voltages are in the range of 0....+5V.

Attention: Negative control voltages (< 0V) or voltages higher than +5V applied to middle pins of ST1...4 will destroy the CTM64 ! Please pay attention to the warranty notes on page 1. Ignoring these notes causes warranty loss and the right to return the goods.

The scan rate for the potentiometers (i.e. how often a new value is transmitted via MIDI out) is fixed to a suitable value so that each control change is recognized very fast but the MIDI line is not blocked by too many data. From our experience many MIDI devices would have problems to process the incoming MIDI data in case of a too high scan rate.

We are planning an additional small hardware that converts voltages being not in the required range to the necessary 0...+2.5V range (e.g. +2...+4V → 0...2.5V). Please ask if you are interested in this supplement board to CTM64. It will probably be available early in 2001 and consists of a small pc board with 2 trimming potentiometers that are used to adjust voltage offset and scale/amplification. One side of the board will be connected to ST1 (or ST2), the other side to the controller that outputs the voltage range.

Contact 1-64 (10) and Common (11)

The **64 contacts** are connected to four **double row pin headers** with 16 pins each. 16 pin socket-connectors (female) with flat cable can be connected to these pin headers (not included with the CTM64). Additionally there is one common pin (11) for all contacts. Pay attention that only free contacts can be used. This means that the contacts are not allowed to be connected with another electronics or connected with a fixed voltage (e.g. GND).

Please pay attention to the warranty notes on page 1. Ignoring these notes causes warranty loss and the right to return the goods.

Two different modes are available for the contacts: **note on/off** or **program change**. In the note mode closing of a contact generates the corresponding MIDI note on message, opening generates note off - both without velocity (velocity is fixed to 127). In the program change mode closing of a contact leads to the corresponding MIDI program change message.

Jumpers 1-8 (12)

The CTM64 configuration (MIDI channel, mode, note offset) is defined with 8 jumpers. The jumpers are put on the double row pin header JP5.

The **jumpers 1-4** (next to the control LED) are used to set the **MIDI channel**.

Jumper 5 defines the **mode** (**note** or **programm change**).

In **note mode** the **jumper 8** is used to select the **note offset**, i.e. the MIDI note number assigned to the first contact (= contact no 1). Two different settings are possible: 0 or 36. 0 is the lowest note than can be generated with MIDI. 36 is the lowest "C" on a standard 5 octave keyboard. Additionally the **jumpers 6 and 7** can be used to **transpose one octave up or down** (± 12 semi tones). Instead of the jumpers 6 and 7 also a toggle switch with middle position (1-0-1 type) can be used. In this case the terminals of the switch are connected to the corresponding pins of the double row pin header JP5. Consequently the note offsets 0, 12, 24, 36 and 48 are available. In case that another note offset is required the contacts are displaced correspondingly and the unused contact terminals are left free. If for example a note offset 41 is required the note offset 36 is selected and the terminals 1-5 (corresponding to the note numbers 36-40) are left open and the first contact is connected to terminal 6 (corresponding to note number 41).

When the **program change mode** is selected the closing of a contact causes the transmission of a MIDI program change message on the selected MIDI channel. In this mode **jumper 8** sets the **program change offset** to 0 or 64. Using two daisy-chained CTM64 with 64 buttons each the complete program number range 0...127 is available. It is also possible to use a toggle switch instead of jumper 8 to switch between the program number areas 0-63 and 64-127. The jumpers 6 and 7 have no function in the program change mode.

Pay attention that there are 2 ways of counting of the program numbers: "1-128" or "0-127". If the counting mode "1-128" is used one has to subtract "1" to obtain the corresponding program change number in the counting mode "0-127". It depends upon the manufacturer of a MIDI device (synthesizer, expander, sampler ...) if the counting "1-128" or "0-127" is used.

Operation

CTM64 is switched ON by plugging the AC adapter into a wall outlet and connecting it to the appropriate jack (1) on CTM64 pc board. There is no separate ON/OFF switch.

After power on the LED on the CTM64 will light up. Otherwise the AC adapter used is not suitable, has the wrong polarity or does not work.

Now the CTM64 electronics is permanently checking out the following:

- if one of the 64 contacts is connected to the common pin (JP6) the corresponding MIDI message is transmitted to MIDI Out (note or program change)
- if one of the potentiometers is turned the corresponding MIDI message is transmitted to MIDI Out (pitch bend, modulation, volume or after touch)
- if the position of the sustain pedal connected to the jack socket is changed the corresponding MIDI message is transmitted to MIDI Out
- if the setting of one of the jumpers (1-8) is changed the corresponding parameter (MIDI channel, mode, offset/transpose) is changed
- if a MIDI message appears at MIDI In the message is transmitted to MIDI Out and merged with the MIDI data of CTM64

It is possible to use switches or buttons instead of the jumpers 1-8. E.g. a hexadecimal coded rotary switch can be used to select the MIDI channel, or toggle switches can be used as octave switch, offset switch or mode switch.

If note mode is selected one has to pay attention that none of the 64 contacts is closed while MIDI channel or offset/transpose is altered ! In this case the note off event (when opening the contact) would be transmitted on another MIDI channel or note than the preceding note on event thus leading to suspending notes !

Detailed function of the 8 jumpers of JP5

Midi channel (jumper 1,2,3,4)

jumper	channel	jumper	channel	jumper	channel	jumper	channel
1	1	1	2	1	3	1	4
2		2		2		2	
3		3		3		3	
4		4		4		4	
jumper	channel	jumper	channel	jumper	channel	jumper	channel
1	5	1	6	1	7	1	8
2		2		2		2	
3		3		3		3	
4		4		4		4	

jumper	channel	jumper	channel	jumper	channel	jumper	channel
1	9	1	10	1	11	1	12
2		2		2		2	
3		3		3		3	
4		4		4		4	
jumper	channel	jumper	channel	jumper	channel	jumper	channel
1	13	1	14	1	15	1	16
2		2		2		2	
3		3		3		3	
4		4		4		4	

If a jumper is **set** the corresponding number is printed **bold**. E.g. for MIDI channel 1 all jumpers 1-4 have to be installed. This is the factory setting.

Mode (jumper 5)

Jumper 5 installed: note mode (*factory setting*)
Jumper 5 removed: program change mode

Note/program offset (jumper 8)

Jumper 8 installed: offset = 0 (*factory setting*)
Jumper 8 removed: offset=36 (in note mode), resp. 64 (in program mode)

Octave offset (jumper 6/7, working only in note mode)

Jumper 6 installed: offset = - 12 semitones (minus one octave) (*factory setting*)
Jumper 6 removed: offset = 0 (no transposition)
Jumper 7 installed: offset = + 12 semitones (plus one octave) (*factory setting*)
Jumper 7 removed: offset = 0 (no transposition)

If both jumpers are installed there is no transposition (+12-12 = 0).

Control LED (4)

The **LED** is used to display any MIDI out activity. After power on the LED is permanently on. As soon as a MIDI out event occurs the LED turns off for a short time thus indicating MIDI activity.

Factory setting of the jumpers

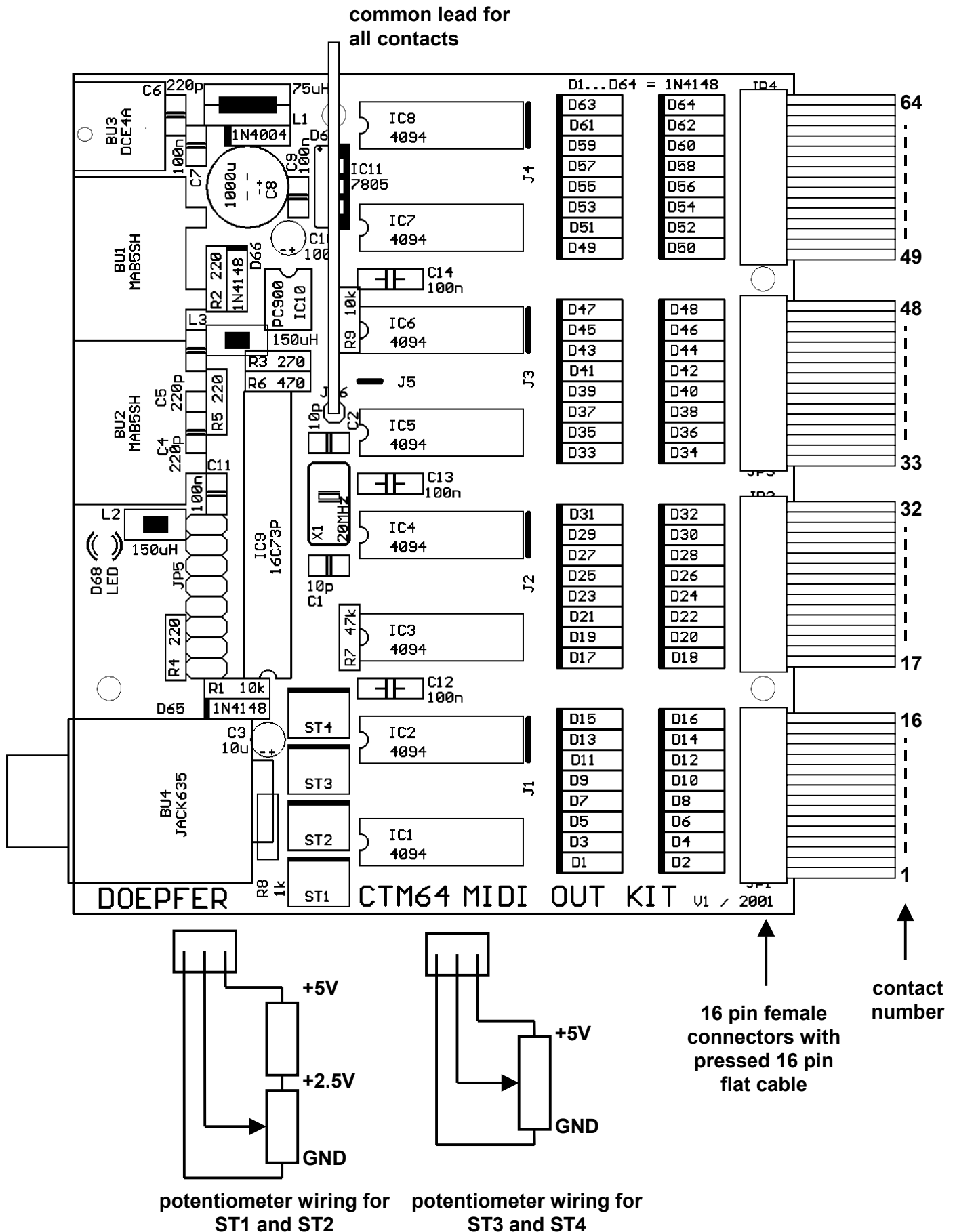
In the factory all jumpers of JP5 are installed. This means: MIDI channel 1, note mode, offset = 0, no transpose (+12 - 12 = 0). The potentiometer connectors ST1...ST4 are equipped with jumpers too so that the inputs are connected to GND (i.e. no function).

Check list

In case that your **CTM64** installation does not work at the first go please check the following points:

- Is the **power supply** working correctly ? After power on the LED has to be on ! Otherwise the AC adapter used is not suitable, has the wrong polarity or does not work. The correct polarity is: outside ring = GND, inside lead = +7...12V.
- Is the control LED flickering if one of the contacts is closed/opened or one of the potentiometers is operated ? It is very easy to simulate the contacts in the testing state by connecting one end of a wire to the common pin (JP6) and touch one or more of the contact pins 1...64 with the other end of the wire. The corresponding MIDI note or program changes messages should appear at the MIDI output of the CTM64 and the LED should flicker.
- Is the control LED flickering if incoming MIDI messages appear at the MIDI In of MTC64 ? (this check required only if MIDI In of CTM64 is used)
- Are the MIDI connections between CTM64 and the other MIDI devices installed correctly ? MIDI Out of CTM64 has to be connected to MIDI In of the MIDI device controlled by CTM64. 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 and not MIDI In → MIDI In). Please use only cables that are suitable for MIDI.
- Are the right MIDI channels selected (same for CTM64 and the device controlled by CTM64)
- Is the right note range selected ?

Appendix: Connection sketch

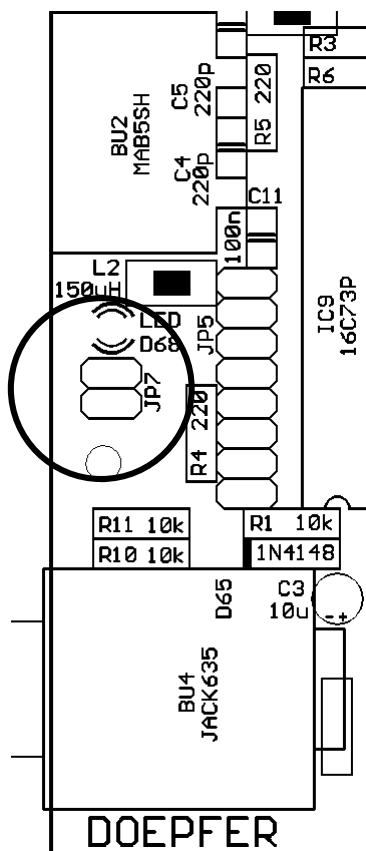


MTC64

The counterpart to CTM64 that converts 64 succeeding note messages into 64 0/+5V (TTL type) signals is called MTC64 (MIDI To Contact/Gate). With suitable drivers it is possible to control relays, lamps, electromagnets, electromagnetic valves, motors, dimmer packs or switch packs and so on via MIDI. The ideal control unit for the MTC64 is the CTM64. Closing a contact connected to CTM64 (e.g. buttons) leads to activate the corresponding element (e.g. lamp or electromagnet) via MTC64. It is also possible to record the CTM64/MTC64 activities with a computer sequencer so that the complete course of events can be recorded.

Additional jumpers for pcb version 2 (from December 2002)

From pcb version 2 two more jumpers are available. They are labelled JP7 and located near the LED between the MIDI out socket (BU2) and the foot switch socket (BU4):



The upper jumper (next to the LED) is relevant only in the note mode:

64 note offset

- Jumper installed: note offset as described above in this manual (*factory setting*)
- Jumper removed: note offset = 64

The jumper has no meaning in the program change mode. This new feature was added to cover all 128 MIDI note values 0...127 with two daisy-chained CTM64 (e.g. for remote control of certain programs, e.g. Ableton's Live sequencer).

The lower jumper has no meaning so far. It was planned in case that another function may be added in the future.

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