

# **MIDI Driver Board**

## **Model DC-96**

### **Instructions for Installation and Configuration**

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DTS Midi Systems  
DesignTech Systems, Inc.  
4332 Florance Ave.  
Downers Grove, IL  
USA

Telephone 630-324-8199

[www.dtsmidisystems.com](http://www.dtsmidisystems.com)

Email [info@dtsmidisystems.com](mailto:info@dtsmidisystems.com)

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## 1. Introduction

DesignTech Systems' DC-96 MIDI driver is designed to convert MIDI signals from software packages such as Hauptwerk into DC outputs. Outputs can be either continuous, for driving chest magnets or indicator lamps, or pulsed for driving Stop Action Magnets (SAMs).

DC-96 can drive up to 96 chest magnets or indicators, or 48 SAMs. DC-96 is available in common positive and common ground versions.

DIP switches are used to select between the following four modes:

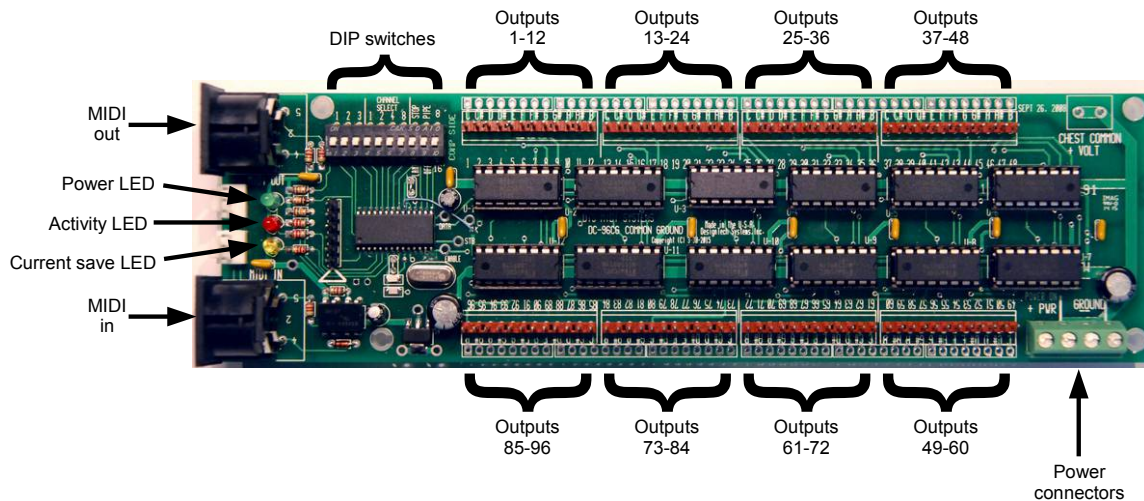
In *test mode*, each output is pulsed in turn. If the DC-96 is connected to stop action magnets, you should see each stop switch on-off, on-off in turn. If it connected to a pipe chest, you should hear a rising *marcato* chromatic scale.

In *pipe mode* or *lamp mode*, a MIDI “note on” message will cause an output line to turn on, and a “note off” message will cause the output line to turn off.

In *stop mode*, a MIDI “note on” message will cause an output “on” magnet to be energized for 150ms, and a “note off” message will cause the corresponding “off” magnet to be energized for 150ms. However, if used in combination with our encoder cards, DC-24 and DC-48 automatically implement *current save*. This means that they detect when a stop switch has moved and cut off the current to a coil as soon as that happens. This minimises power consumption and reduces wear on the SAM components.

When current save is used, the 150ms pulse length no longer applies. Instead, each magnet receives the minimum pulse required to move the switch. However, if the switch fails to move, the current is cut off after 500ms and the error is reported to Hauptwerk.

## 2. Connections



*Power in:* An 8v to 15v DC supply should be connected to the screw terminals provided, with the positive line to the left.

*MIDI in:* A standard MIDI-compliant input. MIDI “note on” and “note off” messages which match the channel and note range settings on the DIP switches will cause the outputs to be energized. Any other MIDI messages will be forwarded to the MIDI out port.

*MIDI out:* A standard MIDI output. Any MIDI information received which does not match the channel and note range set on the DIP switches is forwarded to MIDI out..

*Note that the MIDI in and out connections are also provided on 0.1” pitch headers, in case you prefer not to use 5-pin DIN plugs.*

*DIP switches:* These are used for configuring the DC-96 and selecting the MIDI channel. The DIP switches are described in detail below.

*Power LED:* Green LED which lights to show that the board is supplied with power.

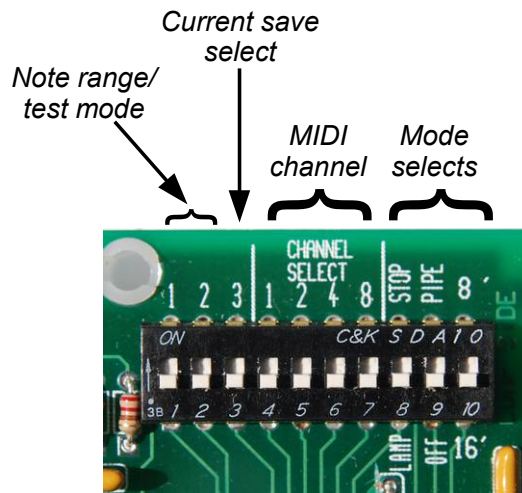
*Activity LED:* Red LED which flashes whenever a MIDI message is received. If the incoming message is a “note on” or “note off” message which matches the channel and note range selected on the DIP switches, you will see a clearly visible flash of about 50ms. If any other MIDI message is received, this will be forwarded to the MIDI out port and the LED will give a much shorter “wink” of about 8ms.

*Current save LED: (stop mode only)*

When the board is used in combination with an MIPC-1A or MK-03 encoder, and the encoder detects that the Stop Action Magnet (SAM) has moved in response to MIDI command, the DC-96 can be configured to turn off the magnet current immediately. When this happens, the yellow current save LED flashes.

Our encoders send periodic messages to inform the DC-96 of the position of each SAM. When a message of this type is received, you will see a short “wink” from the current save LED.

3. DIP switches



Mode select switches

*Pipe mode select (switch 9) and pitch select (switch 10):*

If this switch is on (with the slider nearest to the card edge), the DC-96 will operate as a pipe driver. When a MIDI “note on” message is received an output will be turned on and when a MIDI “note off” message is received the output will be turned off.

If the pitch select switch is set to 8', output 1 will correspond to MIDI note 36 (bottom C on an 8' rank). If the pitch select switch is set to 16', output 1 will correspond to MIDI note 24.

*Lamp / stop select (switch 8):*

If pipe mode is off (switch 9), the DC-96 will look at the lamp/stop select switch (switch 8).

If lamp mode is selected, the DC-96 will operate in a very similar way to pipe mode, with a MIDI “note on” message causing an output to be turned on and a MIDI “note off” message causing it to be turned off. However, output 1 will correspond to either MIDI note 0 or 96, depending on the position of switch 1 (see below).

If stop mode is selected, the DC-96 output lines should be connected to the “on” and “off” coils of stop action magnets (SAMs). Odd-numbered outputs should be connected to “on” coils and even-numbered outputs should be connected to “off” coils. The 96 outputs can therefore control up to 48 SAMs. When a MIDI “note on” message is received, a pulse of current will be sent to an “on” coil. When a MIDI “note off” message is received, a pulse of current will be sent to the corresponding “off” coil.

These current pulses are 150ms long by default, easily sufficient to move well-maintained stop magnets. However, if you are using DC-96 in conjunction with our MIPC-1A and MK-03 MIDI encoders, these can detect when the stop has moved and instruct the DC-96 to cut off the current immediately this happens. This *current save mode* is described in more detail below.

*Note range / test mode switches (switches 1 and 2)*

These switches are used to select the MIDI note range being used if the DC-96 is in stop mode or lamp mode. They are also used to put the DC-96 into test mode. The settings are shown below:

Switch		Note range (stop mode)	Note range (lamp mode)
1	2		
		0 - 47	0 - 95
X		48 - 95	96 - 127
	X	96 - 127	0 - 95
X	X	<i>Test mode</i>	

## *MIDI channel select switches*

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The MIDI channel select switches work as follows:

Switch				MIDI channel
1	2	4	8	
X				1
	X			2
X	X			3
		X		4
X		X		5
	X	X		6
X	X	X		7
			X	8
X			X	9
	X		X	10
X	X		X	11
		X	X	12
X		X	X	13
	X	X	X	14
X	X	X	X	15
				16

### 4. Output wiring

DC-96 can be supplied in either a “pull to ground” (a.k.a. “common positive”) or “pull to positive” (common ground) configuration. Each driver is rated at 50v and 500mA. The driver circuits incorporate freewheel diodes, so they can be safely connected to inductors (i.e. magnets). We recommend that the outputs for each card be connected to common via a slow-blow fuse of appropriate rating.

### 5. MIDI connections

We recommend using a high quality, recognized brand device to convert between MIDI and USB. We have found two midrange units to be reliable in many different configurations: the Cakewalk UM-1G and the M-Audio MIDIsport 2x2. Both are available from most music retailers. We have no connection with either company.

In theory, it is possible to “daisy-chain” any number of DC-96 cards together by connecting the MIDI out port of one to the MIDI in port of the next. However, for best performance, we recommend that no more than two decoder cards be connected together in this way. If you use more cards than this, we recommend use of a multi-way MIDI converter such as an M-Audio MIDIsport 4x4.

#### 6. Current Save (*stop mode only*)

When operating in magnet mode, the default behavior is for DC-96 to send a 150ms pulse of current to the “on” magnet when a MIDI “note on” message is received, and a 150ms pulse to the “off” magnet when a “note off” message is received. Although this normally works well, a Stop Action Magnet (SAM) in good condition will normally operate much faster than this. Conversely, a badly worn SAM might require a longer pulse, or might not move at all.

It can be time-consuming to maintain dozens or hundreds of SAMs in good condition, especially if some or all were acquired secondhand in the first place. A more robust solution is to monitor the switch position and turn off the current to the coil shortly after the SAM has moved. This both minimises energy consumption and wear on good SAMs, and keeps tired ones operating until they can be serviced.

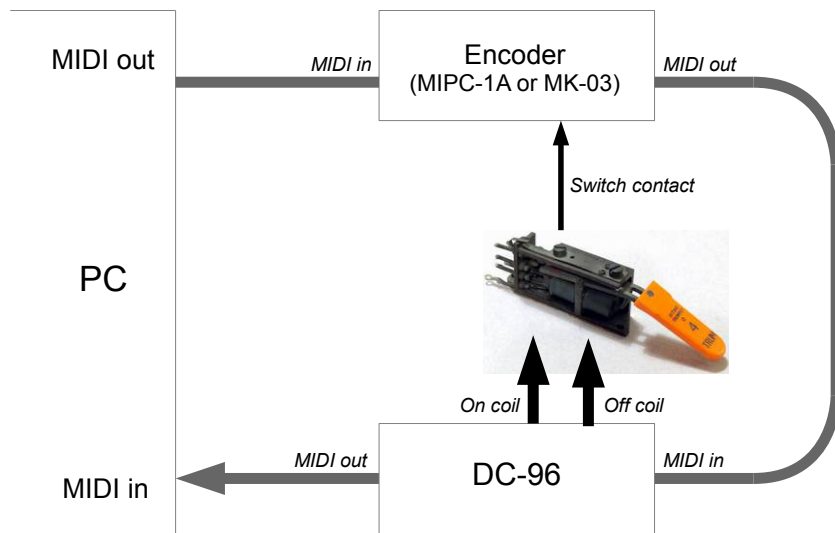
When used in conjunction with our MIPC-1A and MK-03 encoder boards, DC-96 implements exactly this type of “closed loop” system. To select current save mode, move DIP switch 3 to the “on” position.

Two conditions need to be met in order for current save to work.

1. The DC-96 needs to be able to “see” MIDI messages generated by the MIPC-1A or MK-03. Since MIDI is a unidirectional communications link, this means that the DC-96 needs to be connected “downstream” of the encoder.
2. The MIDI channel and note used to energize the magnets must be the same as the ones used to read the switch position. For example, if a particular stop switch is read as MIDI note 22 on channel 12, then the “on” and “off” coils must also be energized by MIDI “note on” and “note off” messages to note 22 on channel 12.

A recommended configuration to meet requirement (1) is shown below. When the encoder and decoder cards are correctly connected, you will see a periodic “wink” from the yellow LED on the decoder.

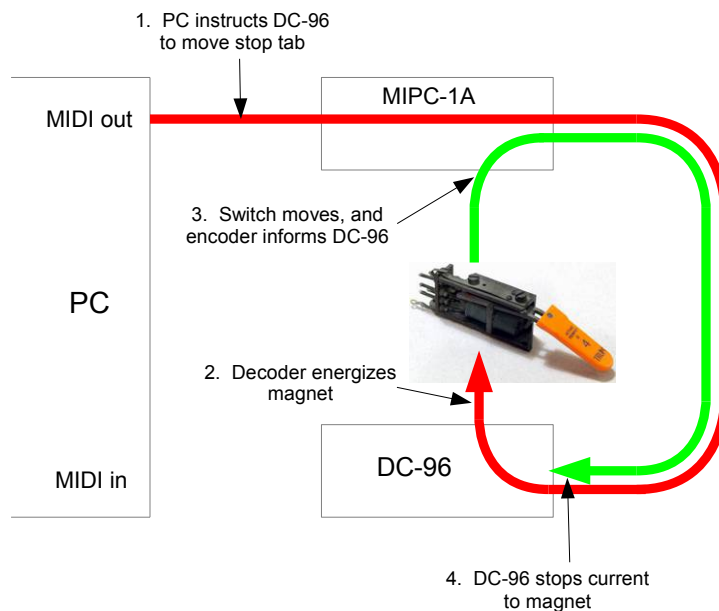




The Hauptwerk MIDI echo feature should preferably be turned off for each stop in turn, in order to minimise MIDI traffic.

The sequence of steps is as follows:

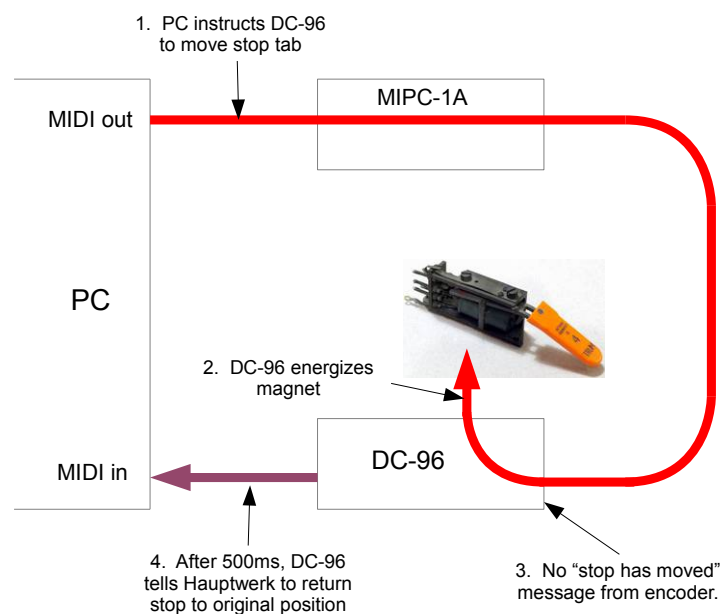
1. Hauptwerk sends a MIDI "note on" or "note off" message instructing the stop tab to move.
2. The DC-96 activates the "on" or "off" magnet, as appropriate.
3. The stop tab moves, and the MIPC-1A or MK-03 encoder generates a corresponding MIDI message.
4. The DC-96 receives this message as confirmation that the tab has moved, and turns off the magnet.



- When the decoder detects that the SAM has moved, the yellow LED will flash. If the stop tab fails to move, the DC-24/48 will turn the coil off after 500ms to prevent damage.

### *Error notification*

DC-96 can also inform Hauptwerk if a tab fails to move. If a tab fails to move after 500ms, the DC-296 will generate a MIDI "note off" or "note on" message opposite to one originally received from Hauptwerk. This will return the virtual tab on the computer screen to its original position, and ensure that the real and virtual stop positions do not get out of sequence. This is illustrated below.



### *When **not** to use current save*

If you refer to the diagram on page 9 showing how current save works, you will see that Hauptwerk sends a message to the DC-96 telling it to move a SAM (shown in red), and (all being well) a moment later the encoder (MIPC-1A or MK-03) will send a message to the DC-96 telling it that the SAM has moved (shown in green). These messages arrive on the same input, and DC-96 has to be able to tell between them. We use the *velocity byte* to carry this information.

Each MIDI message consists of three bytes. The first byte contains the command (in our case either "note on" or "note off" plus the channel. The second byte is the note number. The third byte is the velocity, intended for touch-sensitive keyboards and unnecessary in the context of moving organ stops.

When the MIPC-1A and MK-03 send “note on” and “note off” messages, they use a velocity value of 64. Most Hauptwerk sample sets use a velocity of 127 (the maximum). Therefore it is *usually* safe for DC-96 to assume that if it sees a MIDI message with velocity 64 then it is an MIPC-1A or MK-03 telling it that a stop tab has moved, and if it sees a message with any other velocity then it is Hauptwerk telling it to turn on a stop magnet.

In a very limited number of cases, Hauptwerk sample sets send “note on” and “note off” messages with velocity 64. In these cases, current save should be disabled by moving DIP switch 3 to the “off” position.