Hauptwerk Hardware

System One

Full Organ Rebuild Solution

SYSTEM ONE
Hauptwerk Hardware

Motorized Stops Interfaces Installation & User Manual

Covers both 24 & 48 stop versions

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Table of Contents

A brief introduction to System ONE....3
What is System ONE?....3
Who is it for?....3
The Motorized Stops Interfaces....4
How draw-stops work....4
How the Stop Controller works....4
Daisy-Chaining....5
Connections....6
Configuration....7
Stops Calibration....7
Configuring your stops in Hauptwerk....8
Configuring your stops in Grand Orgue....14
Configuring other virtual organ software....17
Mounting....17
Our Hardware Ethos....17
Legal Disclaimer:....18
Warranty....18
Further Information....18
Contact Details....19

This manual should be read in conjunction with the System ONE Control Board user manual which is available from the downloads page of the website. See link below.

https://www.hauptwerkhardware.com/downloads_page/

A brief introduction to System ONE.

What is System ONE?

System One is an electronic system which comprises a main control board and a number of separate interface boards which connect to the various controls of an organ console. It is very versatile and can be used in the smallest organ right up to the largest. It copes with pretty much any type and combination of organ controls, including:-

- Matrix Keyboards
- Bus Keyboards
- Lighted Stops/Rocker Tabs
- **Motorized Stops**
- Lighted Pistons
- Basic Unlit Stops & Pistons
- Memory Level Display
- Swell & Other Pedal Controls
- Crescendo Indicators
- On Demand Re-scan of static controls (Transpose, Tuning etc.)

The system requires only two Midi connections to the computer running the Virtual Pipe Organ software and it works with Windows, MacOS and Linux operating systems. There is no programming required and it is simple to set up with your virtual pipe organ of choice.

It has been designed to meet the specific needs of the organ enthusiast as well as the professional, in that it addresses the unique requirements of the organ as opposed to the many other products already used in this field which are really just generic Midi devices which the builder then has to connect together to form their own 'system'. For more information on System ONE please refer to the Overview Document available from the downloads page of the Hauptwerk Hardware website.

Who is it for?

Hauptwerk Hardware System One is designed for both enthusiasts and professional users.

If you are planning an organ console build from scratch it is the ideal solution as you can plan each feature you want in your console and be certain that System One will cope with it easily. If you are rebuilding or 'Midifying' an existing console, System One will provide you with the easiest way to connect all the controls of your console and generate the required Midi signals to work with your computer without the need to perform any programming, only a few jumpers need to be set in order to tell the system what options you want to select.

It is ideal for use with Hauptwerk, Grand Orgue and any of the many other virtual organ software solutions available which use Midi as their input.

The Motorized Stops Interfaces.

How draw-stops work.

Scan the QR code to watch my detailed video explaining how motorized stops work or just follow this link, https://www.youtube.com/watch?v=nmUad92PJcE

For the purposes of this description I will use the term 'stop controller' to refer to the System ONE control board in conjunction with one or more System ONE Motorized Stops Interfaces.

In order to understand how the stop controller works it is necessary to first take a quick look at what happens to make a draw-stop operate. Inside a moving stop, whether it be of the draw-stop type or the tab type there are four main parts. These are the armature, that's the part of the stop that actually moves, the coil that makes the armature move to the on position, the coil that makes the armature move to the off position and the contact that signals whether the stop is in the on or off position.

When the operator moves the stop to the on position the contact will close and when the stop is moved to the off position the contact will open, just like a regular switch.

If the stop is in the off position and power is applied to the coil that turns the stop on, the armature will move into the on position, and as a result of this movement the contact will close, thus signalling that the stop is now on. If the stop was already in the on position when power was applied to the aforementioned coil, the stop would not move but the coil would still be energised and using power. The reverse happens if the stop is in the on position and power is applied to the coil that moves the armature to the off position.

When power is applied to the coil it will consume a significant amount of current, this will result in the coil heating up very quickly and it would soon burn out completely if power was not quickly removed. This is because it takes a relatively large amount of current to physically move the stop from one position to the other. Because the armature will move almost instantly once power is applied to the coil, we only need to apply that power for a very short time, typically less than ¼ of a second.

Since actual power, measured in Watts, is a product of work done in a specific period of time, the result of a large current flowing in the coil for a very short time is manageable and the stop will operate reliably without any problems. It is therefore obvious that stop motors can only tolerate, being powered in short bursts.

The same can be said of the electronics that actually control the power to the stop coils. They can control high power pulses, but not continuous power.

Because the power supply apparatus that is used to move the draw-stops has to be able to provide enough power to potentially energise all the stops at once, say when a general cancel signal is received, it is easily capable of supplying enough current to cause significant damage if a stop coil was left energised due to a failure somewhere in the system.

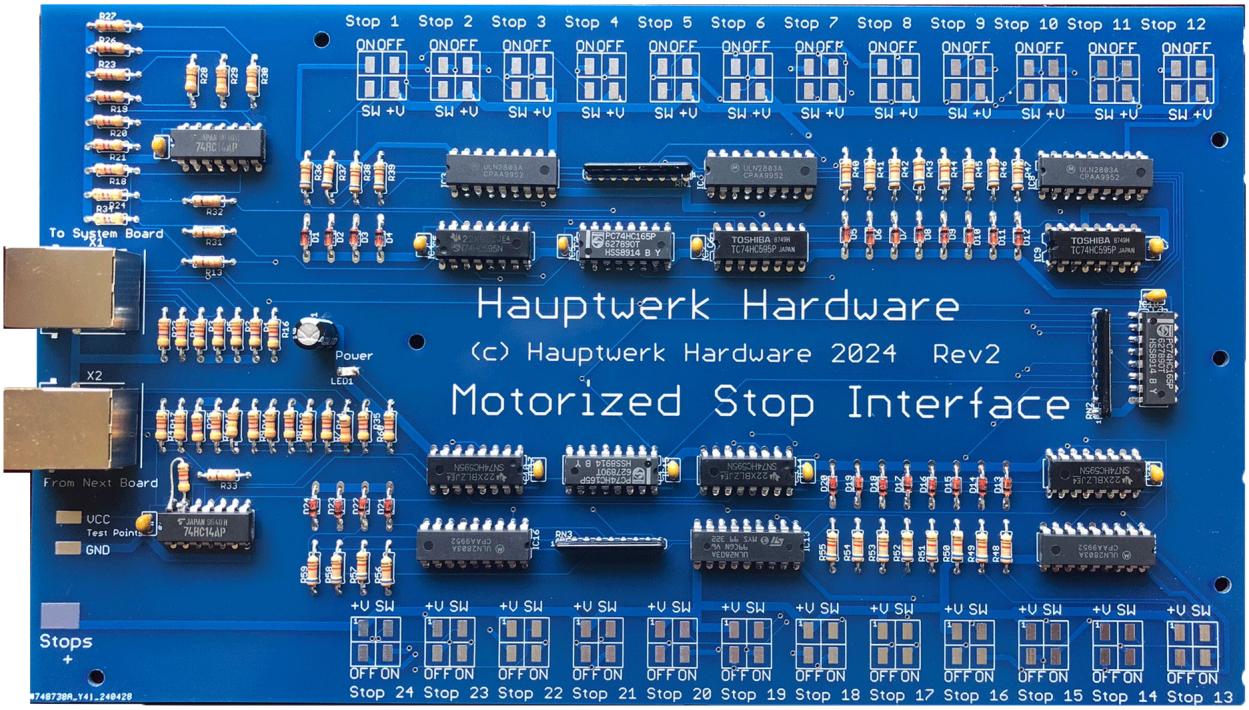
How the Stop Controller works.

The job of the stop controller is to control the power to the stop coils and to communicate, via MIDI, with the computer. The controller scans all the stop switches to see which are on and which are off. Internally it remembers the status of each stop and then looks for any changes to their position as well as listening out for any incoming MIDI messages from the computer. If a MIDI message arrives requesting a change of state for any particular stop, the controller first looks at the

current state of that stop, and if it already matches the requested condition it will do nothing. However if the requested state is different to the current state it will send a pulse to the relevant coil to change the state of that stop. Once that has been done it will check that the stop has actually changed state. If it has then all is well and the controller goes back to its usual listening and scanning mode. If for any reason the stop didn't move then the controller will send a MIDI message back to the requesting computer causing the computer to reset the stop to its previous condition. This is necessary in order to prevent physical stops becoming 'out of sync' with the ones on the computer screen. As well as listening for incoming MIDI messages the controller continually scans the stops for any change of state. If it sees a stop has changed state it will update its internal state memory and then send a MIDI message to the computer saying that a particular stop has been operated. The computer will then change the state of that stop in the virtual organ software.

There are two variants of the motorized stop interface available. One is for up to 24 stops and the other is for up to 48 stops. System ONE supports a total of 120 motorized stops which can be made up of any combination of the two board sizes.

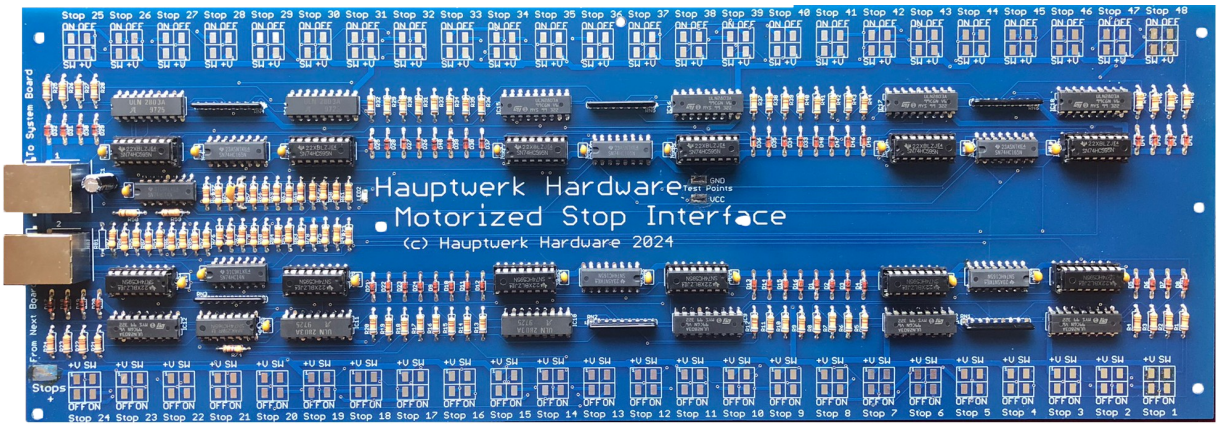
Below is a picture of the System ONE 24 stop Interface.



Daisy-Chaining.

Motorized stop interfaces, like most all other System ONE interfaces are able to be daisy-chained together Motorized stop interfaces can be daisy-chained together up to a maximum of 120 motorized stops and stop 1 on the first board in the chain, that is the one nearest the controller, is designated as stop 1 by the stop controller. Likewise the first stop on the next board, if fitted will be assigned the number stop 25 or stop 49 depending on whether the first interface is a 24 stop or 48 stop one. This is easily done by simply plugging each board's 'To Encoder' socket into the previous boards 'From Next Board' socket. There is no programming required, the system will automatically 'see' all you interfaces and configure itself accordingly at boot time.

Below is a picture of the System ONE 48 stop interface.

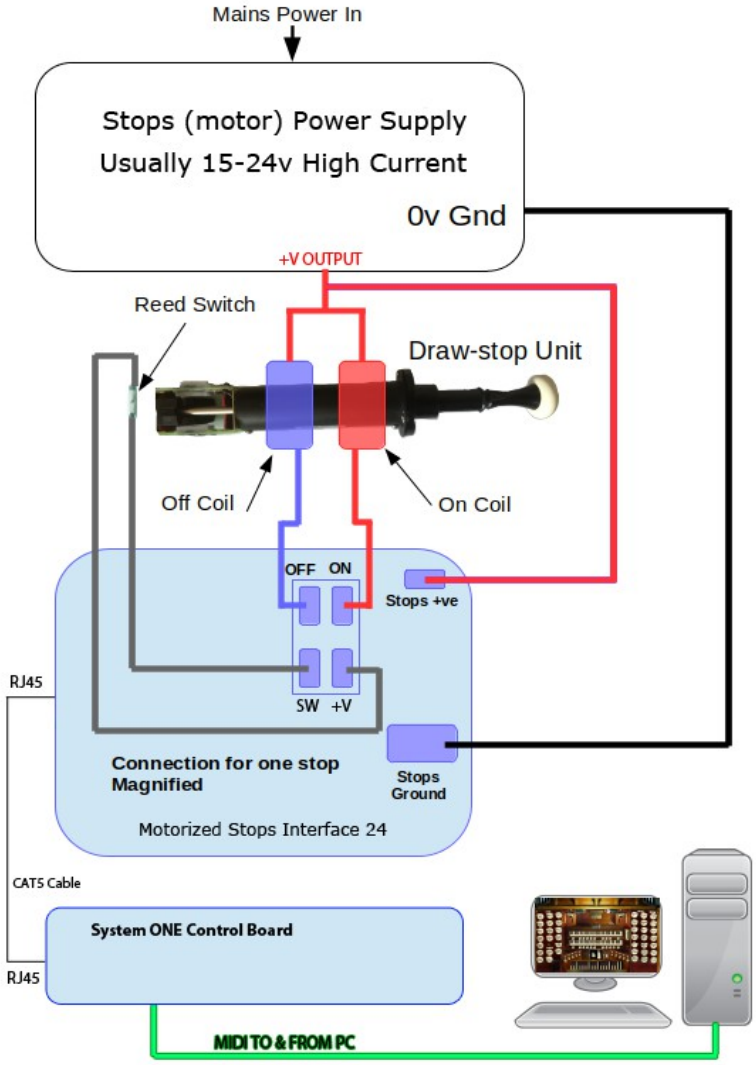


Connections.

The physical layout of the solder pads on the interfaces is consistent across the two board variants and provides for easy an intuitive connection. Each motorized stop is given 4 connections which can all be carried by a single 4 core cable. 4 core burglar alarm cable has proved useful and cheap for this purpose!

There are a couple ways that one can wire the motor supply; either the +v can be connected to the coils (common) on all the stops using heavy gauge wire, with a thinner gauge wire then connecting the +v to the Motorized Stop Interface 'Stops +ve' solder pad. Alternatively one can use a heavy gauge wire to connect the power supply +v output to the 'Stops +ve' solder pad, and thinner wires to connect each stops coils (common) to the +V pad of each stop's set of pads on the interface.

Either way will work BUT it is imperative that the 'Stops +ve' pad on the interface is always connected to the motor supply, as this provides protection for the switching elements within the interface. If stops are controlled without this connection instant irreparable damage will occur to the interface. This type of damage is not covered under the warranty, so please be certain to ensure this connection is present before operating the unit.



Configuration.

The System ONE Control Board uses midi channel 7 for motorized stops. There is no configuration required on the part of the installer or end user so far as the System ONE hardware is concerned and the operation of the motorized stops is straightforward. Basically when the controller senses that a stop is operated it will send a midi note on event on channel 7 with the note number being equal to the stop number in the chain as discussed above. When the controller receives a midi event on channel 7 it will determine the current state of the stop that matches the note number of that event and if the stop state differs the controller will operate the motor and move the stop to the state specified in the received midi event. There is no other configuration required and it will work straight out of the box with in the manner just described.

Stops Calibration.

There is a configuration feature available whereby one can 'calibrate' the connected stops, but in my opinion this is unnecessary and can cause reliability issues when the stops are installed in an environment with varying temperature and humidity such as a church or other venue which is

largely unheated. I have included this 'feature' simply because it is standard on other top end stop controllers. Calibration of the stops is used to try and reduce the noise made when many stops move at once, particularly when they are turned off, such as in a general cancel of a large registration. As the stops are retracted they tend to make a bit of a thump as the moving part of the stops come to rest on the frame of each stop. As the stops are all mounted on stop jambs these very jambs can become something of a sound board and create a noise which some organists find irksome.

In an attempt to fix this someone came up with the idea of 'stop calibration' whereby the amount of power, usually defined as full power but applied for a configurable length of time, is applied to the stops and the actual time taken for the stop to retract and extend fully is measured and recorded. Future operations of that stop will then be made using that time plus a small safety margin. This ensures that all stop movements are achieved using the minimum of power which results in less noise.

The problem with this is that if the environment changes, or the console is moved at all the power required to operate each stop is likely to change slightly. If it changes such that slightly more power is required to operate a stop then that stop will become unreliable until a further calibration is performed. Since calibration is not really a task of the end user it is likely that it will never be done and the enjoyment of playing an instrument with unreliable draw stops is likely to be much reduced!

On top of all this commercial organs have no such facility to 'calibrate' stops and they have worked just fine in all environments for many tens of years. Therefore in my opinion calibration is an unnecessary 'feature' likely to cause more trouble than it fixes. This is just my opinion though and the System ONE hardware does have the facility to calibrate the stops. Simply sending a midi note on event on channel 7 for note 125 will trigger the calibration routine. During the calibration routine the controller will attempt to calibrate all 120 possible draw-stops whether present or not so it can take a while as it times out for each coil of each unconnected stop. During calibration you will see the stops operate, changing state in order. Once calibrated the controller will use the pulse durations determined during the calibration.

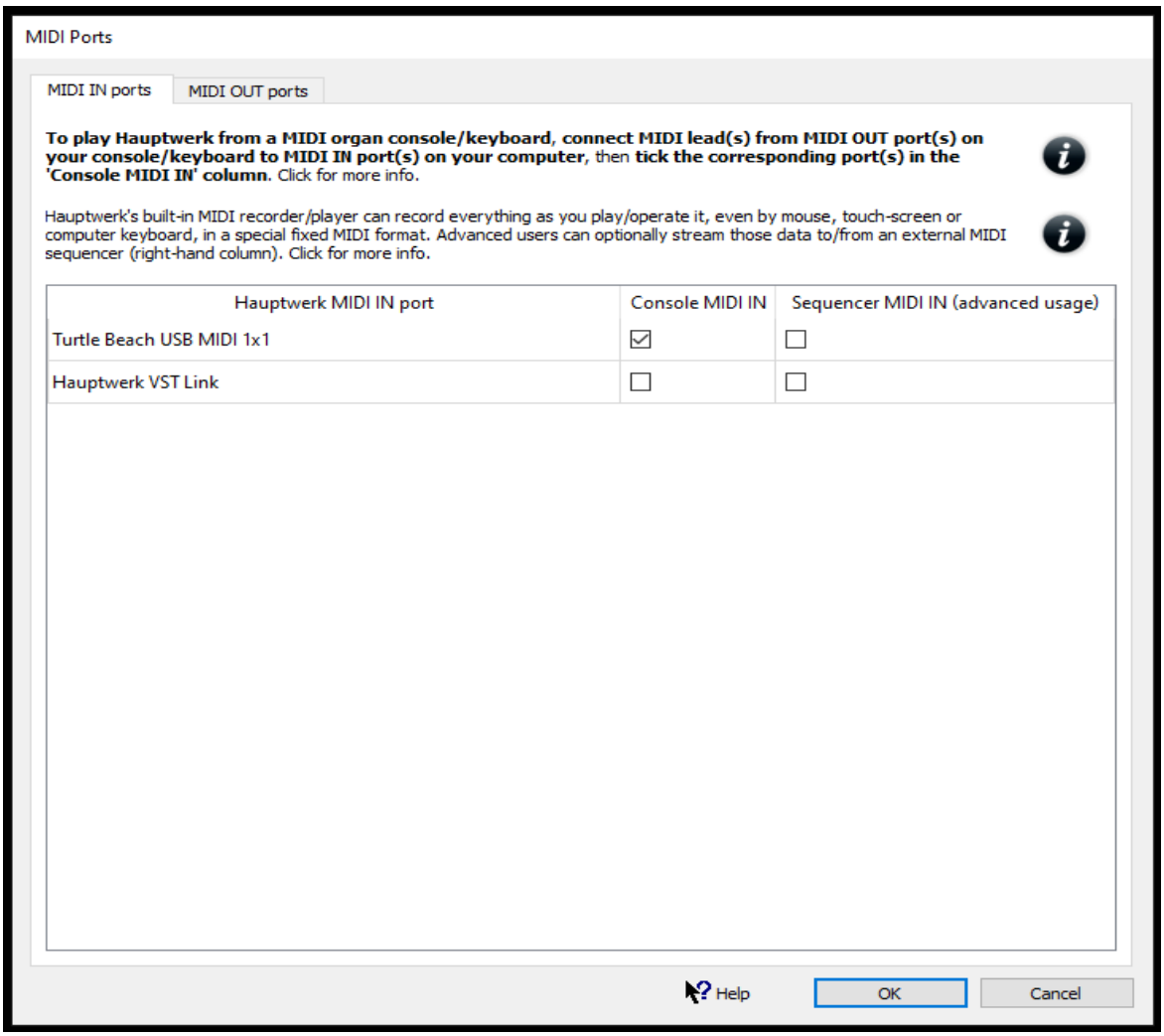
If you want to erase the calibration results and revert to the factory default pulse durations then simply send a midi note on event on channel 7 for note 127 and the 'safe' times will be restored.

Configuring your stops in Hauptwerk.

In the following examples I have used a 'Turtle Beach USB Midi 1x1' 5 pin DIN to USB adaptor.

You will remember from the 'System ONE Control Board' user manual that there are two midi connectors on the board. One is USB midi which carries midi from the manuals only, and the other is a legacy 5 pin DIN interface which carries the midi for everything else. This is the one to use for the motorized stops.

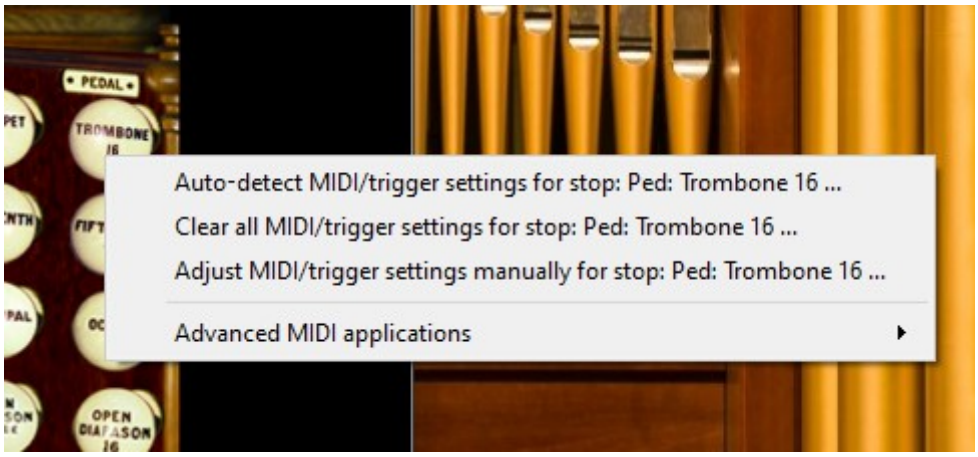
Once you have your midi interface connected, the first thing to do is to tell Hauptwerk that you want to use the midi from your System ONE Control Board to control the virtual controls on your computer. Open Hauptwerk and from the 'General Settings' menu select 'Midi Ports'. That will open a window that looks like the one below.



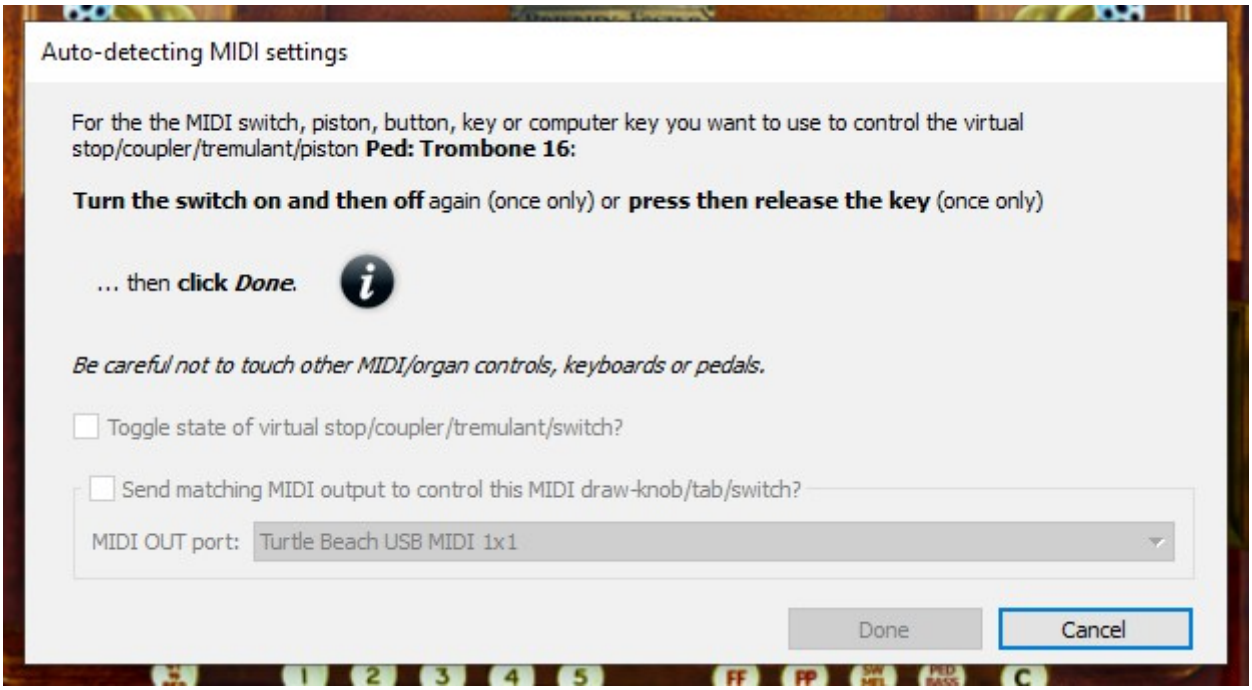
Tick the box for 'Console MIDI IN' for your USB Midi adaptor, as shown above. Then click the second tab at the top of the window labelled 'MIDI OUT ports'. This will reveal an almost identical screen but this time click the 'Console MIDI OUT' box. Once done click the 'OK' button.

You have now told Hauptwerk that you want to use your USB Midi adaptor for both incoming and outgoing midi commands. Everything is ready to proceed, so now load an organ – I have used the 'St Annes Moseley' organ that is bundled with the Hauptwerk software. Once the organ has loaded continue as below.

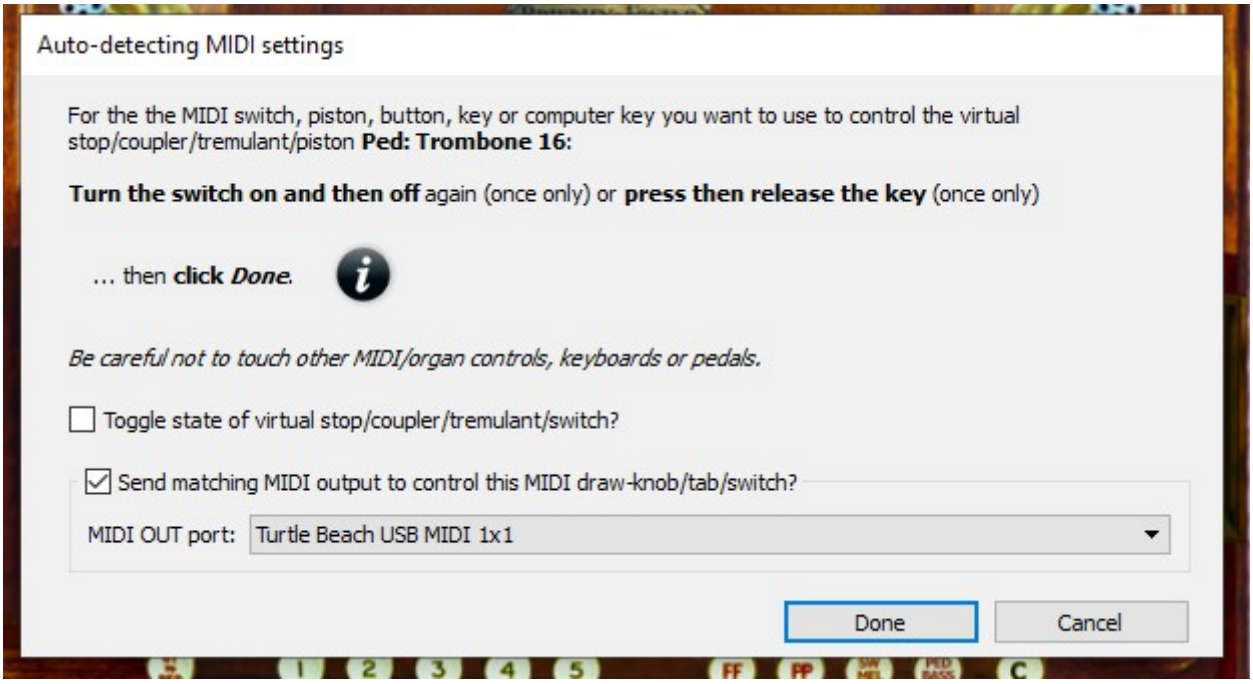
For this example I am going to use the Trombone 16 from the Pedal Division. First right click the Trombone stop and you will be presented with a menu as shown in the picture below.



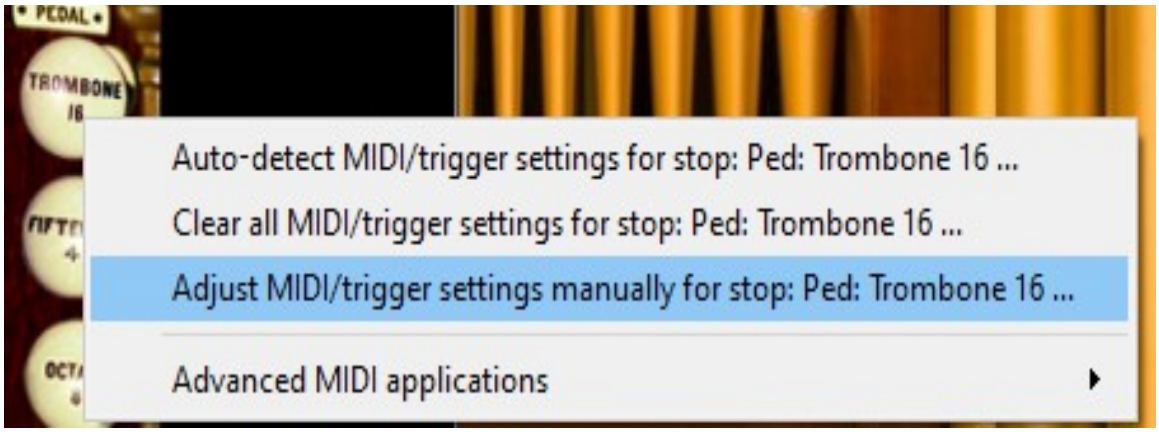
Select the first option 'Auto-detect...' This will open a new dialogue box as in the next picture.



Once you see this box you will notice that the 'Done' option is greyed out, along with other options. This is because Hauptwerk is waiting for you to operate the stop. Put the stop into the on position and you will see that the 'Done' button becomes available, i.e. no longer greyed out. Now put the stop back into it's off position and you will see that all the options in the box are now active. Notice the last option 'Send matching MIDI output...' Make sure that this is ticked and select the 'MIDI OUT port' to be your USB to Midi adaptor. Once you have done this your screen should look like the next picture.

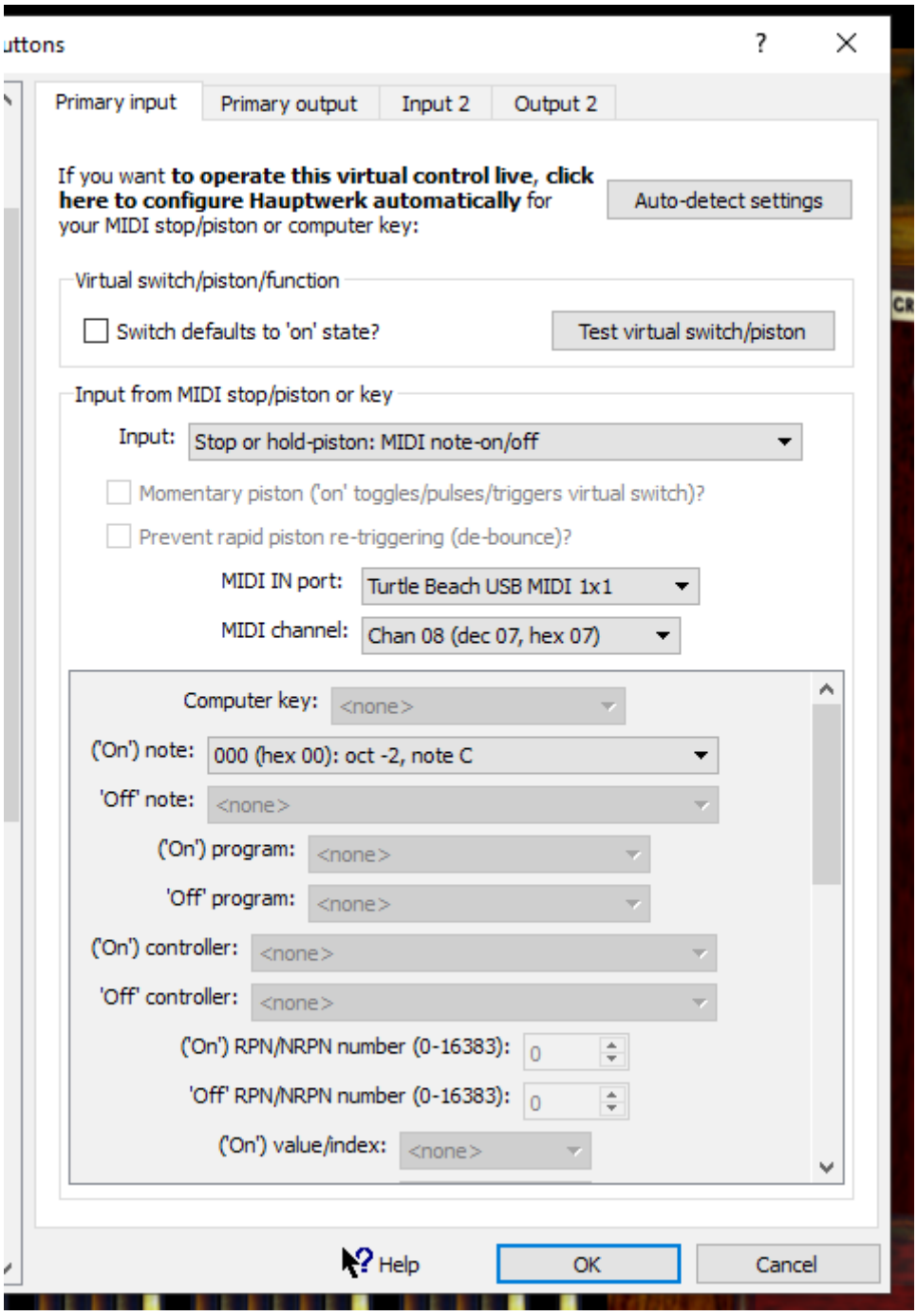


Click the 'Done' button and then, once again right click the Trombone stop. This time select the third option – 'Adjust MIDI/trigger settings manually for stop: ped:Trombone 16...'

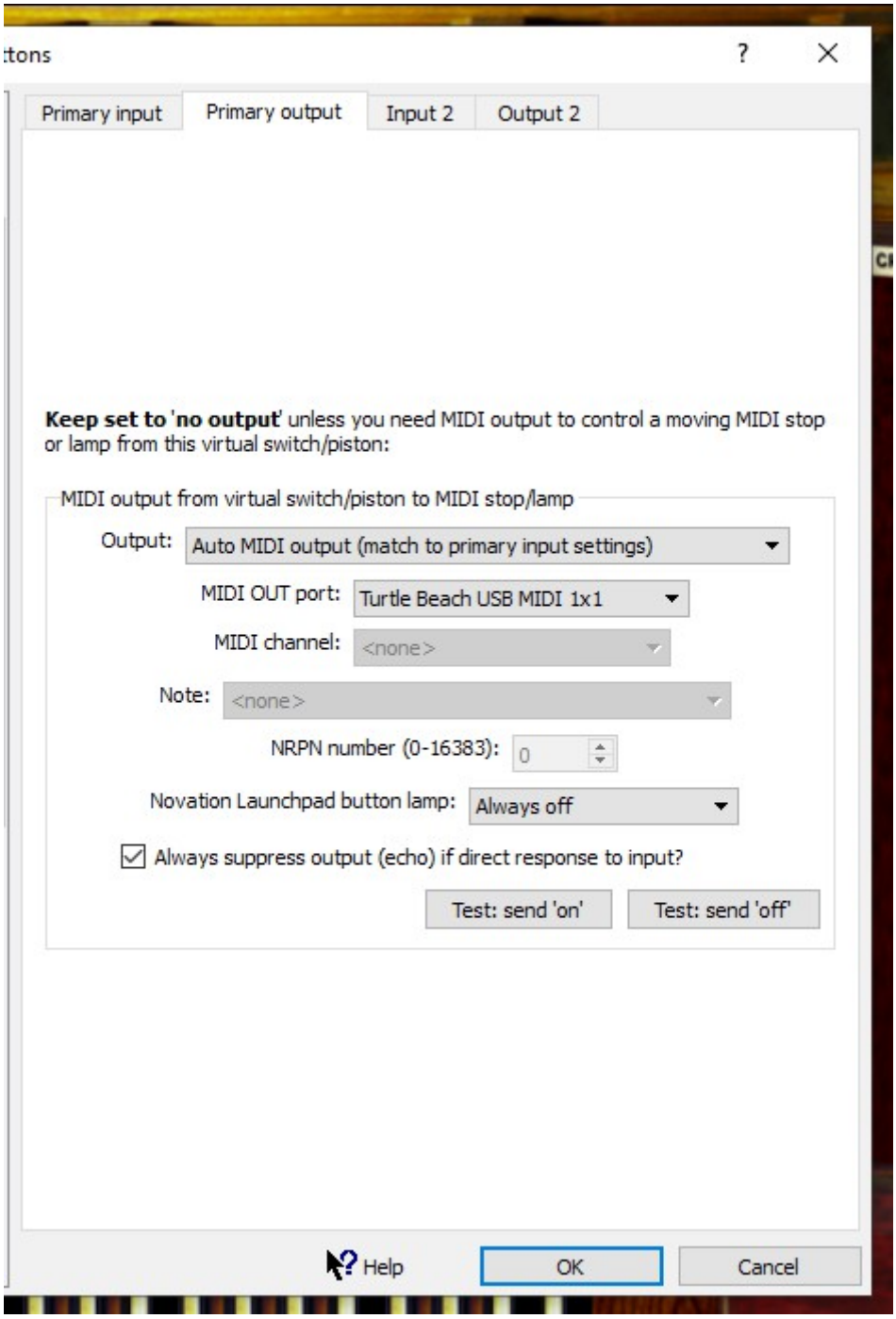


This will open a window like the one below. Only the right half of the window is shown in the picture simply for the sake of saving space and making the relevant part big enough to read. From this window you can see what settings Hauptwerk has chosen and make sure they look correct.

There are two tabs at the top of the window. First check the info on the 'Primary input' tab. The important bits are: 'Input' should read 'Stop or hold-piston: MIDI note-on/off'. MIDI IN port: should read 'The name of your USB Midi adaptor'.



Once you have satisfied yourself that the information on the 'Primary input' tab is correct click the 'Primary output' tab. This will display a screen like the one in the next picture.


tons
Primary input
Primary output
Input 2
Output 2
Keep set to 'no output' unless you need MIDI output to control a moving MIDI stop or lamp from this virtual switch/piston:
MIDI output from virtual switch/piston to MIDI stop/lamp
Output:
Auto MIDI output (match to primary input settings)
MIDI OUT port:
Turtle Beach USB MIDI 1x1
MIDI channel:
<none>
Note:
<none>
NRPN number (0-16383):
0
Novation Launchpad button lamp:
Always off
Always suppress output (echo) if direct response to input?
Test: send 'on'
Test: send 'off'
Help
OK
Cancel

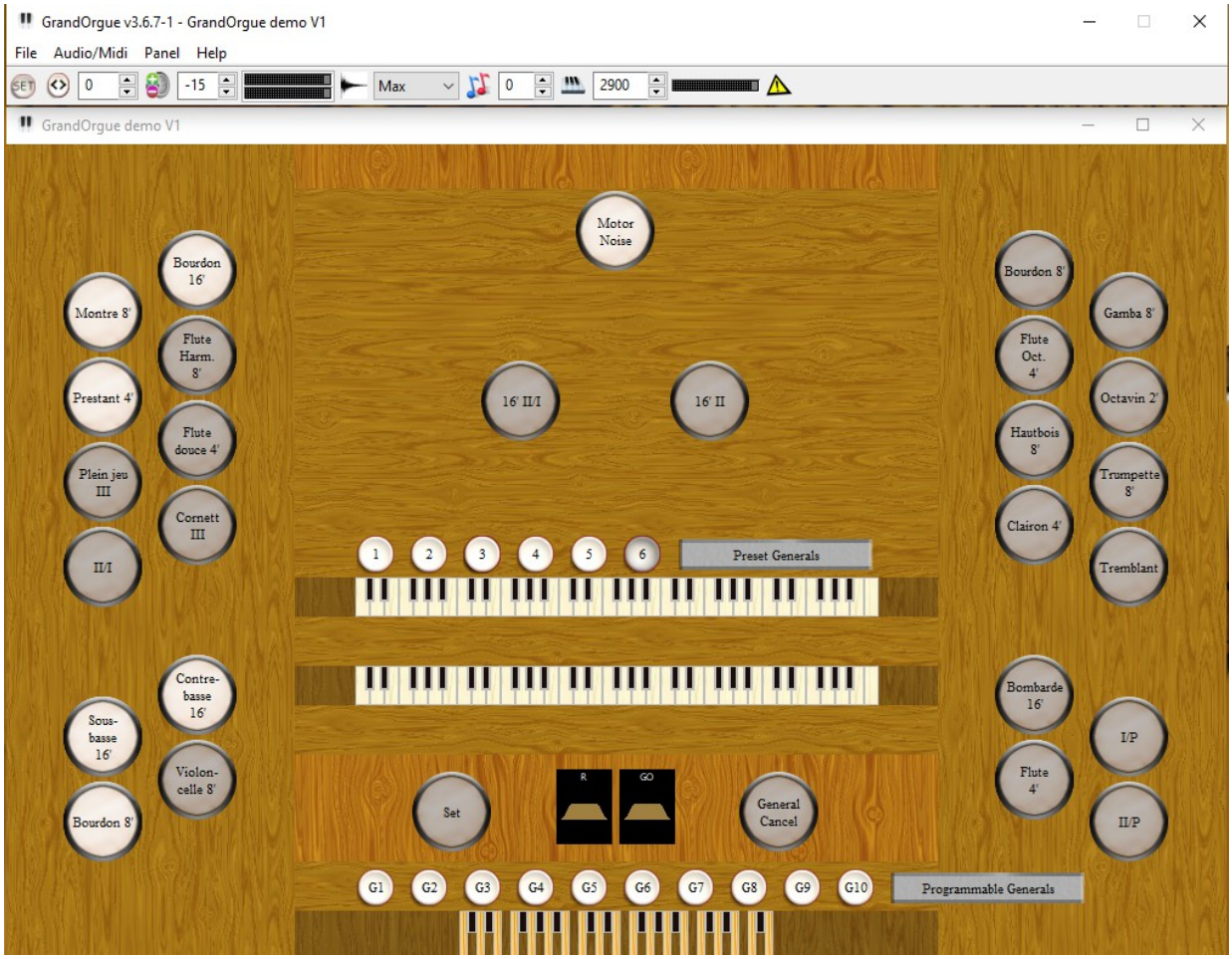
It is important to make sure that the box labelled 'Always suppress output (echo) if direct response to input?' is ticked. If this box is left unticked it can cause the stop to keep flipping between on and off in certain circumstances AND according to Murphy's law those circumstances will be during a recital!

Once all the adjustments have been made you can click the 'OK' button which will return you to the usual organ console view in Hauptwerk. At this point you should be able to operate the physical stop and see the virtual on screen stop change in sympathy with the real one. The reverse should also happen, operate the virtual on-screen stop and the physical stop should move with it.

You can now repeat this procedure for the remaining connected stops.

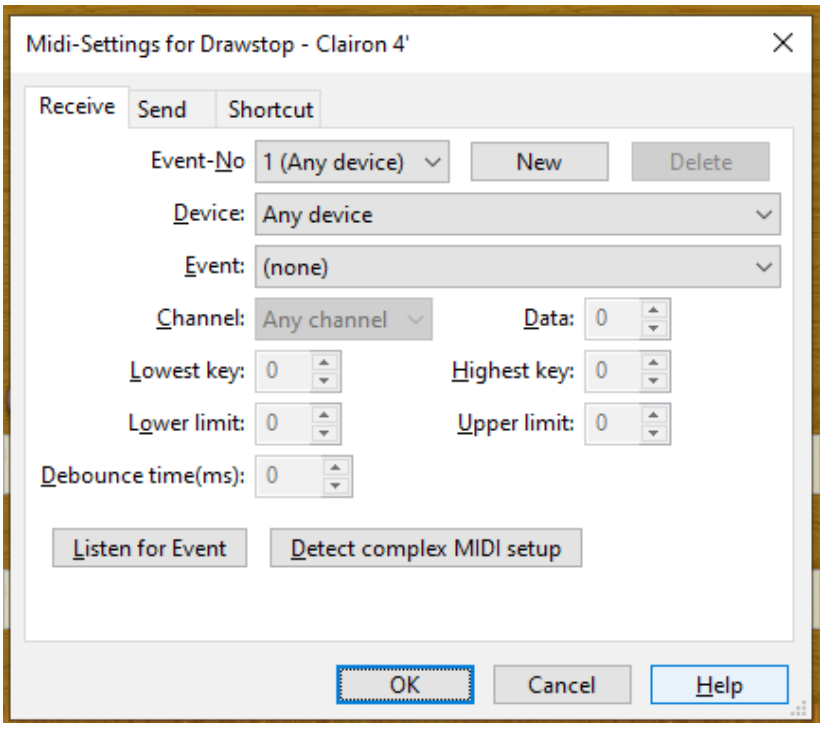
Configuring your stops in Grand Orgue.

Start by opening Grand Orgue and loading your desired organ. In this example I am going to use the default organ that is downloaded with the Grand Orgue windows installer. Once you have it installed and working you should see a window similar to the one below.

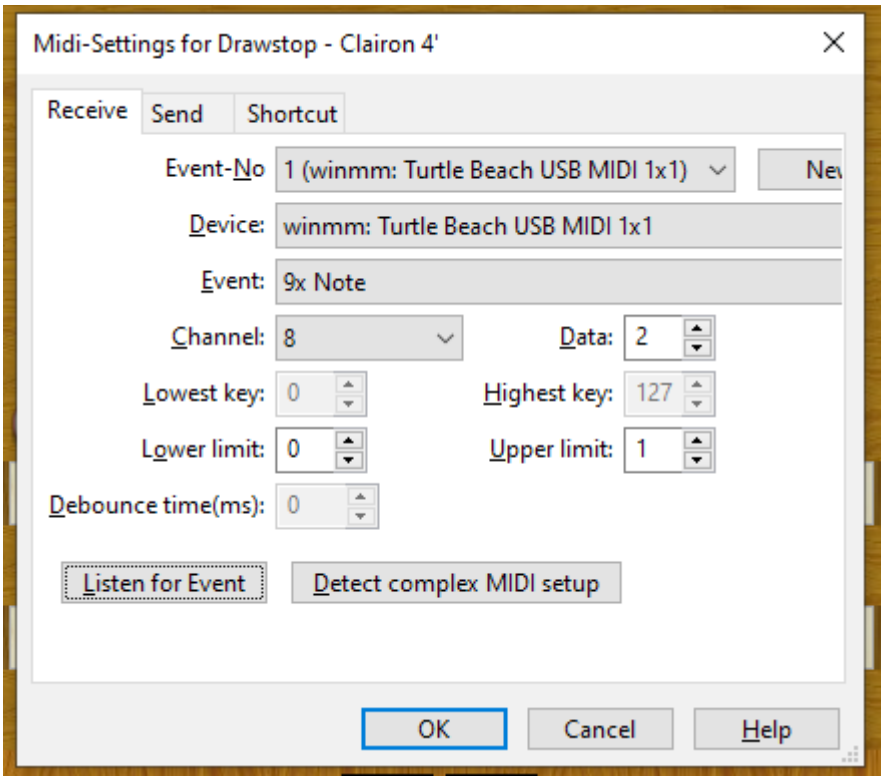


For this example I am going to use the Clarion 4' stop.

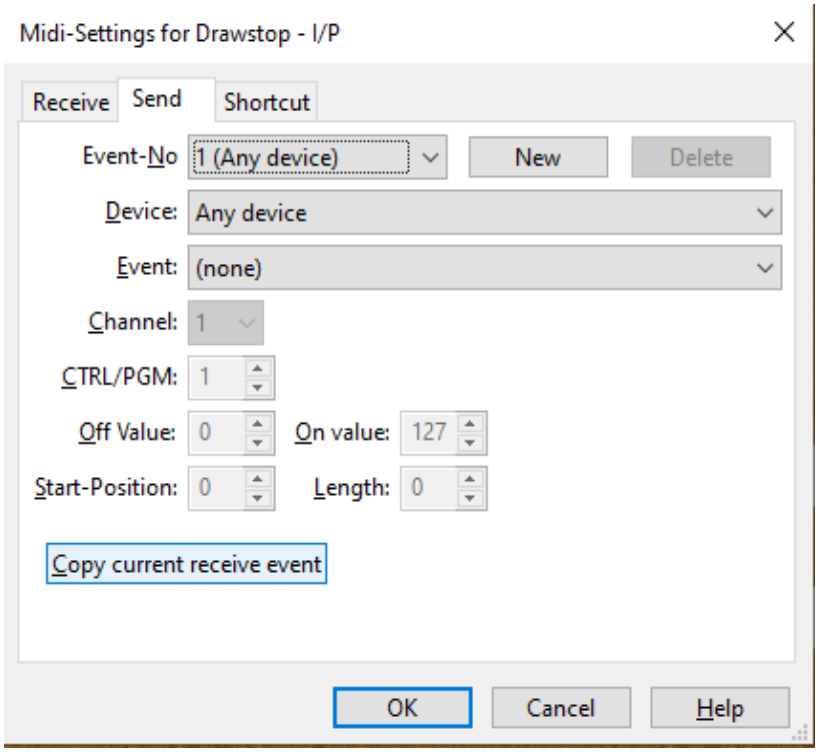
Right click the desired stop and immediately you should see a dialogue box like the one below. The important part here is the button marked as 'Listen for Event'. Click this and you will see the instruction 'Please press the MIDI element' appear underneath the button.



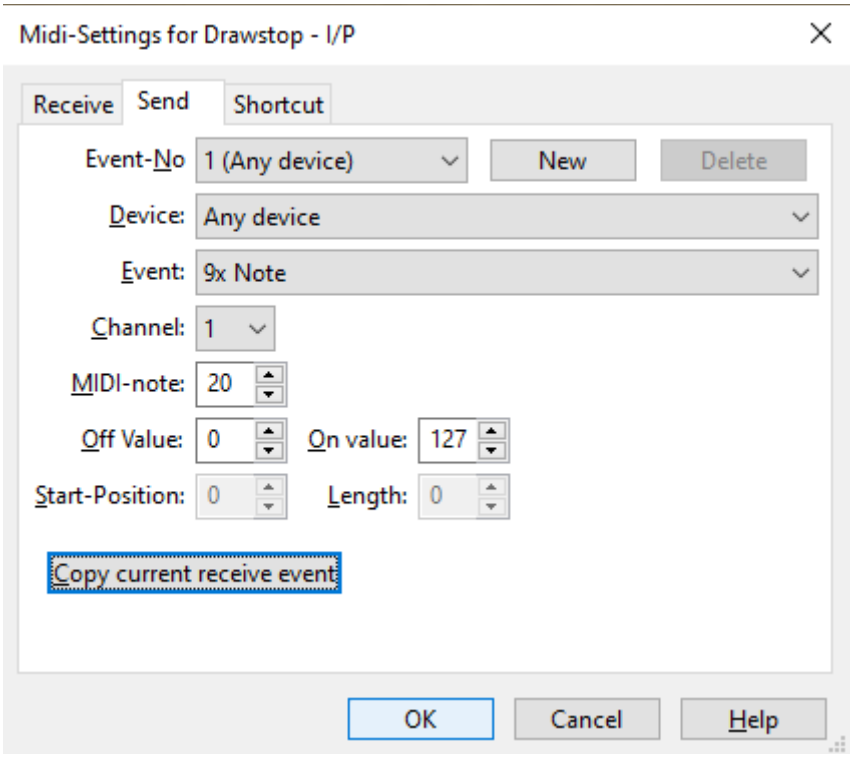
Now - operate the desired stop, move it to the 'ON' position, then back to the 'OFF' position. Once you have done this you will see that the information in the other fields is automatically populated with the MIDI information about the stop that you operated. This is shown in the picture below. At this point we have completed setting up the receive event. This means that, at this point, Grand Orgue will respond to the operation of that physical stop.



Next we have to complete the send setup of this stop. Click the 'Send' tab at the top of the dialogue box and you will see the 'Send' page as below.



Click the button marked 'Copy current receive event'. This will automatically populate the fields with the information required for Grand Orgue to send MIDI data to operate the physical stop, as shown in the picture below.



Now click the 'OK' button to complete the setup for that stop.

Now simply perform the above procedure for the rest of the stops you will be using. This completes the setup of the Grand Orgue software to work with your System ONE Motorized Stops Interface.

Configuring other virtual organ software.

The controller will work with any MIDI capable virtual organ software. Hauptwerk and Grand Orgue have the Midi Auto-detect feature which makes it easy to set them up. If you want to use the controller with software that does not have this feature you can easily input the information manually. The things that the software will require are:-

- Midi Device
- Midi Channel
- Midi Note On/off value

The Midi Device name will be 'USB MIDI Device', or whatever name your 5 pin MIDI to USB device enumerates as.

The Midi Channel will always be channel 8

The Midi Note On/Off value will be that of the stop you are using.

If you have a serial terminal connected to the USB Comms output from the System ONE Control board, then operating the desired stop will print on the screen the Midi Channel number along with the MIDI Note On/off number. It will also print the result of any received midi, so for example when you operate the stop on screen the System ONE Controller will print 'motorized stop x' on, and the same for when you return the on screen stop to the off position 'motorized stop x' off will be printed.

Now that you have this information you can simply enter it into the relevant spaces in your virtual organ software for each stop you are using.

Mounting

All System ONE boards have a number of mounting holes of 3mm diameter each. These are for mounting the board in a convenient place within your console. It is important to consider that the reverse of the board is made from copper and that parts of this copper surface carry the electrical signals to and from the encoder. It is therefore necessary to ensure that whatever mounting method you use does not allow the reverse of the board to come into contact with any conductive surface, as doing so may present a fire risk and or cause irreparable damage to the board. It is suggested that suitable insulating spacers be used in mounting the board leaving a gap of at least 5mm between the board and the mounting surface. The front surface of the board is also made from copper and the same advice applies.

The board is suitable for mounting at any angle in any plane. The board must be installed in a position where it will not suffer condensing moisture, water, physical shock or any contact with moving parts. It must be protected from any conductive items, parts or waste that may fall on it.

Our Hardware Ethos.

The hardware used in this controller is an Atmel AVR along with other components. Some of these

components are readily available as a ready assembled 'core' unit which can then be programmed with whatever firmware you wish. Hauptwerk Hardware buy these 'dev' boards and use them to build our products. These microprocessors exclusively use our own production firmware and contain no boot loaders or other third party code. This firmware remains our intellectual property. It is copyright and protected from being read from the AVR.

The logic behind using these 'dev' boards is that they are readily available and likely to remain so for some considerable time. Should any of our products ever fail in the future, it is easy to simply unplug the dev board and replace it with a new one, safe in the knowledge that one will still be available. This is in contrast to our competitors bespoke boards whose availability is entirely dependent on provisions made by that particular manufacturer at the time.

Legal Disclaimer:

It is the installers responsibility to ensure that they have familiarized themselves with this product and its documentation and have the necessary understanding and technical and practical competence to be able to install and use it correctly. Whilst every care has been taken in the design, testing and documentation of this product, Hauptwerk Hardware will accept no liability whatsoever for any physical or consequential damage or injury caused by the use of any of our products in any circumstances.

Warranty.

All equipment supplied by us will carry a 12 month warranty against faulty parts or workmanship. Extended warranties are available in some countries at an additional cost. Should any part of the new system fail within this period we will repair or replace it free of charge. It should be noted however that correct operation of the new system depends on the existing console controls such as keyboards, stops etc. continuing to work correctly, along with power supplies et al, especially in pipe organs. Any failure of these existing controls will obviously have an adverse effect on the operation of the new system, this type of issue will ***not*** be covered under the warranty.

Any faulty item must be returned to us for inspection & repair. Initially the customer will pay the shipping for any products returned. All returns from outside the UK **MUST BE CLEARLY MARKED AS "WARRANTY RETURN - ZERO COMMERCIAL VALUE"** as Hauptwerk Hardware will **NOT PAY** any import duty on returns and any packages not marked as above will be returned or destroyed by UK Customs **at their discretion**.

Once the return is received by Hauptwerk Hardware we will video it's unboxing and testing. If the product is found not to be faulty a testing charge* will be made and the customer will be invoiced for this as well as the return shipping. The testing video will be made available to the customer.

If the product is found to be faulty due to faulty manufacturing or premature component failure Hauptwerk Hardware will repair or replace it at our discretion. We will reimburse the customer for the shipping costs they incurred in returning it and we will send the replacement or repaired item to the customer with free shipping.

The same procedure applies to returns from within the UK save for need to mark the package as warranty return. The warranty does not cover damage caused by mishandling, inappropriate connection, incompetent or inappropriate installation.

Further Information.

If you require any further information or have any questions please feel free to call us on +44 (0)

333 577 2393 and we will be happy to clarify anything or provide any further information you may need. Business hours are 09:30 to 17:00 Monday – Friday UK Time.

Contact Details.

Hauptwerk Hardware

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