Hauptwerk Hardware

Single Bus Encoder

Installation & User Manual

Release 1.0 – August 2022

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Introduction

What is it?

The Hauptwerk Hardware Single Bus Encoder is a device designed to easily connect keyboards that have a single common connection (bus) running along one side of all the keys, and single wires coming from the other side of each key, originally connecting them to the organ electronics. It has the capacity for four keyboards as well as a single swell pedal. It is most suited for the smaller organ where it would usually have two manuals connected as well as a full pedal-board. This configuration then leaves 90 further inputs that can be used for stops and pistons.

What does it do?

It generates the necessary Midi signals as keys are pressed, stops operated etc. and transmits these to the computer or synth via USB as well as the legacy industry standard 5 pin DIN connection. It is a Class Compliant USB Midi Device, meaning that no 3rd party drivers are required when connecting it to a computer. It works natively with Windows, macOS and Linux.

Who is it for?

The Single Bus Encoder has been developed in order to eliminate the work involved in re-wiring and adding diodes to older keyboards. It is basically a drop-in replacement for all the original organ electronics, converting the organ to a MIDI console that can be used with any Midi sound generation system or virtual organ such as Hauptwerk or Grand Orgue. It is ideally suited to those who want to 'Midify' an existing console but do not want to spend a lot of time in changing the wiring schema or programming midi products to work with the console. It is very easy to use and suitable for anyone with a basic knowledge of electronics and capable of soldering to a reasonable standard.

Product Features.

- **Easy to install, all inputs marked with their respective notes.**
- **Has 4 x 61 inputs for up to 4 manuals or 3 manuals and pedals.**
- **Inputs can also be used for stops and pistons.**
- **Supports a single swell pedal.**
- **USB MIDI interface as well as legacy MIDI 5 pin DIN built-in.**
- **Class compliant MIDI device – No additional MIDI drivers required.**
- **Powered by USB - No other power source required.**
- **Solder pads for easy & reliable connection.**
- **Works with older keyboards which use a single wire (bus) connecting all the keys.**
- **No programming required, simply connect your keys, stops & USB – Done!**
- **No need for external diodes or grouping of notes – simply wire each key directly.**
- **Works with Hauptwerk, Grand Orgue and other Virtual Organ Software.**

Board dimensions (WxLxH): 405 x 125 x 25mm (16" x 5" x 1”).

Principle of Operation.

What Are Single Bus Keyboards?

This encoder is designed to work with single bus keyboards only. It does not work with keyboards that have any other configuration such as diode matrices.

So what are single bus keyboards? In older consoles the type of electronics used were referred to as analogue. This is as opposed to the modern digital type. Analogue electronics uses signals of different voltages to represent different things or states. Digital electronics only used two states, on & off, or full voltage and zero voltage.

Historically the sounds produced by an analogue organ were generated by circuits called VCOs or Voltage Controlled Oscillators. As their name suggests these circuits oscillate at different frequencies depending on the control voltage applied to them.

The way that the keyboards generated these control voltages was generally to have a network of resistors which set a certain voltage level. As each key was pressed more resistors were added into this network varying the voltage. One side of each key was connected to the power supply and when a key was pressed it added a measured amount of voltage to the output that controlled the VCO, thus varying the note played. The usual arrangement was for the voltage created by the keyboard to increase by 1 volt per octave. A lot of electronics is required to achieve a stable system of this type and that is why there is so much 'stuff' inside these old organs.

How the Single Bus Encoder Works.

Our Single Bus encoder works differently to the old analogue method previously described. It is a digital device, meaning that it only uses signals that are 'on' or 'off' that is at 5v or 0v, it is basically a small, self contained computer which 'writes' to each bus, and then 'reads' each key in turn.

As our encoder has the capability for four keyboards it has four 'Bus' connections, obviously one per keyboard. In addition to these Bus connections it has 61 'Key' connections for each keyboard. Each key input is labelled making it easy to connect the right wire for any specific key. The key inputs are connected to the microprocessor through a 61 x 4 diode matrix, that is why there are so many diodes on the board!

Each time the encoder senses a change of state of any key input or the swell pedal input, it generates the appropriate Midi signal and sends it out over both the USB connection as well as the 5 pin DIN socket.

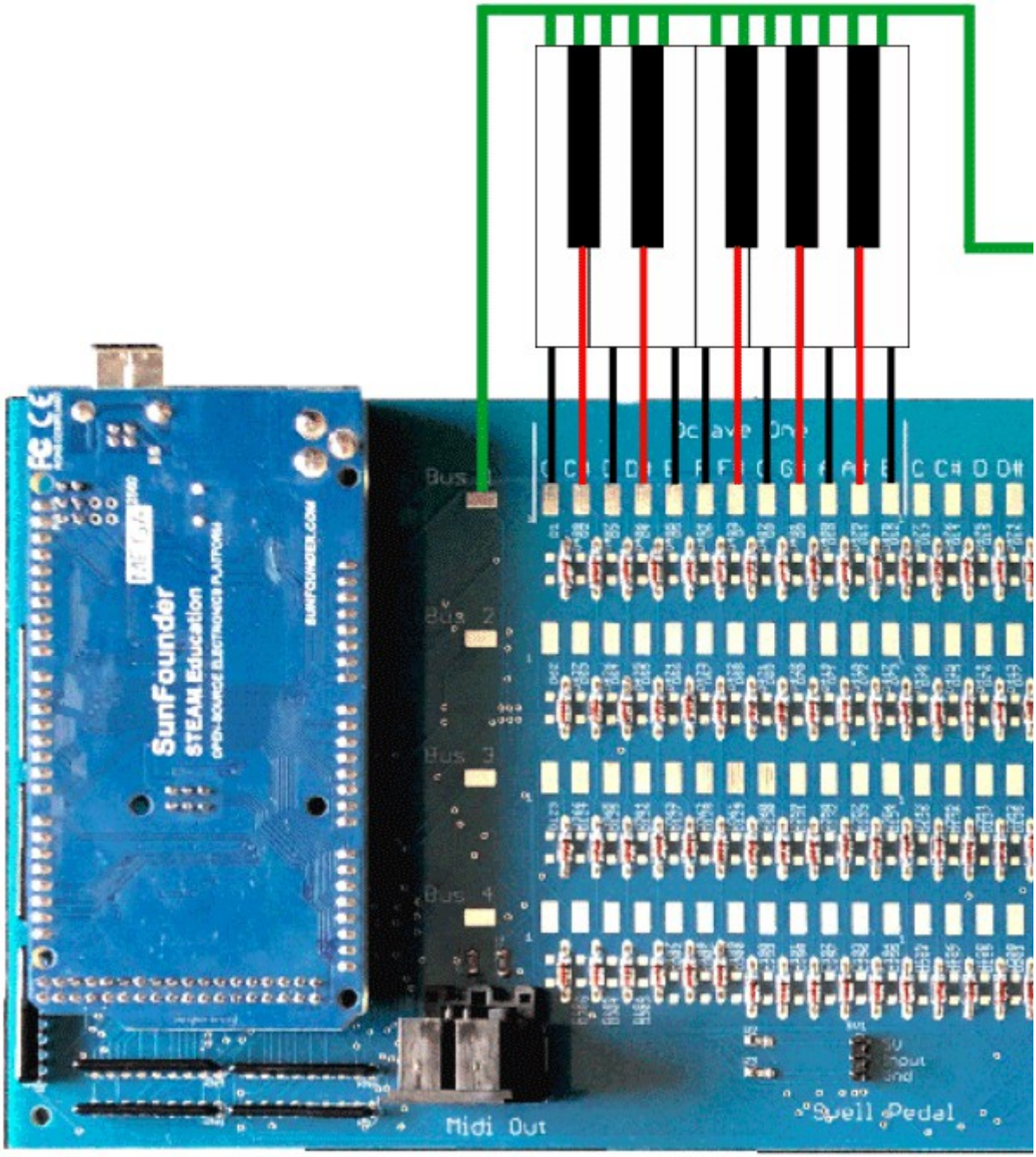
Installation and use.

General.

The Single Bus Encoder should be mounted where it can be easily reached from the rear of all the manuals and stops as you will have to run a wire from each key on each manual and each stop to the encoder.

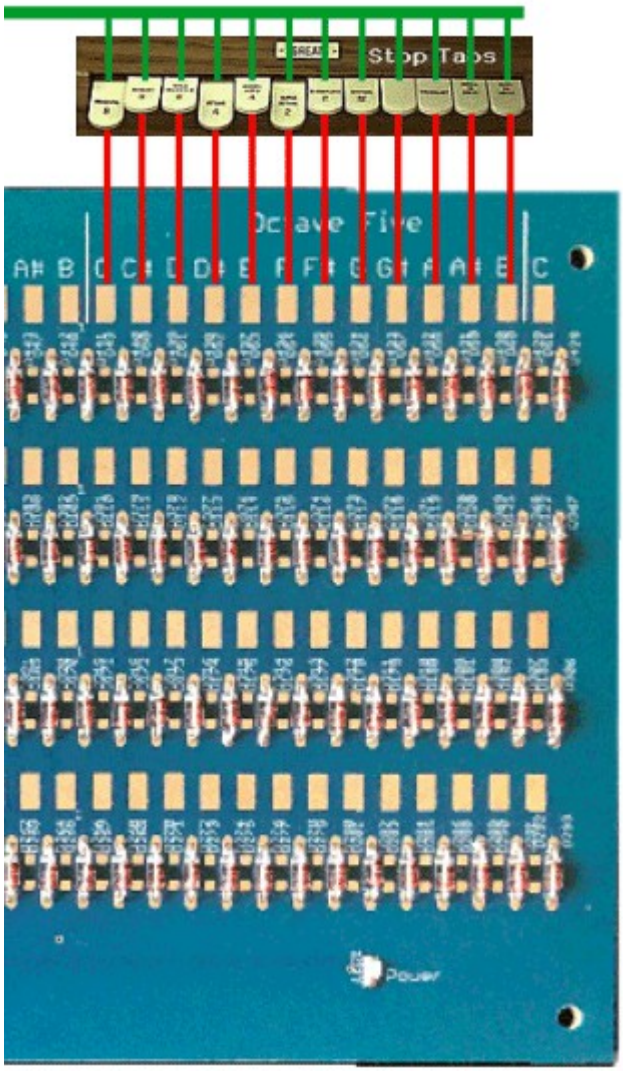
The wiring of this encoder is very simple and a diagram is shown below which shows exactly how each key is connected. For the sake of clarity I have only shown the connections for the first octave, but obviously the wiring is continued in the same way for all five octaves.

It is important to keep the wiring as neat as possible and to secure the resulting wiring loom carefully using zip ties or some similar cable restraint system. Do not create a birds nest of wiring or you will have a terrible time sorting it out if there is any problem after you're done installing it..!



In the picture above I have shown a keyboard connected to the encoder. Only a single octave is shown for clarity, but obviously you would connect all five octaves in this way. however you are not limited to using just keyboards. You can substitute stops or pistons for the keys in the above picture. So for example you could connect a keyboard to Bus1 & Bus2, your pedals to Bus3 and your stops and pistons to Bus4.

The picture over the page shows how you would connect some stop tabs.



Whatever type of control you connect they are always wired in the same way. For example, if you connect 36 stops to Bus4 you would wire one side of all 36 stops together and then connect this to the 'Bus 4' solder pad on the encoder. If you wanted to then add 20 pistons, you would connect one side of each of the pistons together and connect this wire to the same place as the 'Bus' that you created for the stops, i.e. the 'Bus4' solder pad. Finally you would connect a wire from each stop and piston to each input along Bus 4. Since you have 36 stops and 20 pistons you would end up with a total of 56 wires connecting to Bus 4. You would start at the left hand pad marked 'C' and finish at the 'G' in octave 5.

It doesn't matter that you are connecting stops and pistons to what are really 'Note' or 'Key' inputs because the encoder simply generates a Midi note number on or off for each input. Simply put this means that if you press middle C on the keyboard attached to Bus 1 then the encoder will send a Midi Note 60 on Channel 1. This Midi message would be assigned to the relevant keyboard in Hauptwerk or whatever virtual organ software you are using. Similarly if you press the piston attached to the 'C' in octave 3 of Bus 4, the encoder will send a Midi note 60 on channel 4 this time, as opposed to channel 1, and this Midi event would be assigned to the relevant piston in Hauptwerk.

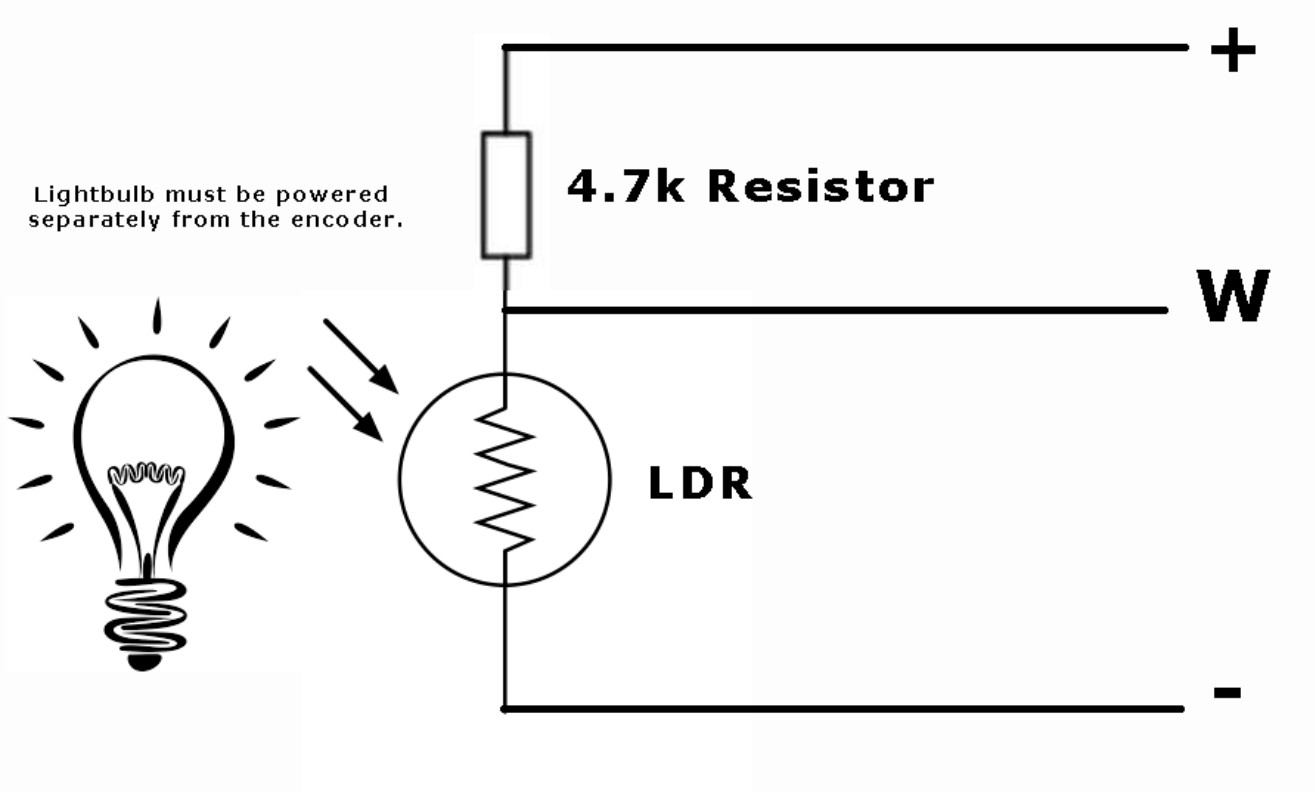
Connecting the Swell Pedal.

The swell input can be used for a swell or expression pedal. If you have a pedal that is fitted with a potentiometer you simply have to run three wires from the pot' to the Swell Pedal input. This input has three pins and they simply connect to the pot' in the way they are laid out. In other words the centre

pin of the input connects to the centre pin of the pot and the outer pins of the input connect to the outer connections of the pot', it does not matter which outer pin connects to which side of the pot' so long as the centre goes to the centre of the pot'. If the swell pedal operates 'backwards' then simply reverse the outer two wires!

There are other possibilities for connecting a swell pedal. Many older swell pedals have an optical arrangement containing a light bulb and a light dependant resistor separated by a plate which moves with the action of the pedal.

This is arranged so that more light is allowed to fall onto the LDR as the pedal is advanced. It is possible to use this type of pedal with the Single Bus Encoder but you need to add a resistor and ensure that the power supply for the light bulb is completely separated from the encoder wiring. The diagram below shows how to wire it up.



MOUNTING

The Single Bus Encoder has 6 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 both the board and the encoder itself. 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 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.

Notes.

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.