Hauptwerk Hardware

System One

Full Organ Rebuild Solution

SYSTEM ONE
Hauptwerk Hardware

Matrix Keyboard Interface Installation & User Manual

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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 USB Midi as their input.

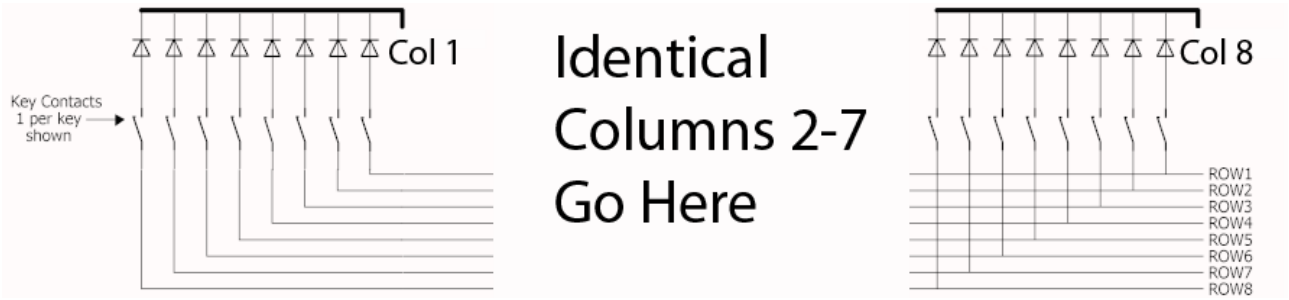
The Matrix.

What exactly is a Matrix?

A matrix configuration means that the key switches are wired into separate groups, usually there are either 8 or 12 keys (notes) per group but occasionally manufacturers may use a different number of keys for their groups, but 8 keys per group is the most popular.

If there is more than one single group then each key in the group requires a diode fitted in line with the key switch. Each key then has a wire leading from it, which in matrix terminology is called a **Row**. Finally, each group has it's own 'common' connection – this is the connection to the other side of all the keys in the group. This common connection goes by the name of a C**olumn** in matrix terminology.

In a regular 5 octave plus 1 note (61 note) keyboard there would be 8 groups of 8 notes. The Rows of each group are connected together so that the entire matrix terminates in 8 note wires **Rows,** and 8 group common wires **Columns**. Consequently a keyboard matrix will have 16 wires or connections, 8 rows and 8 columns which is known as an 8 by 8 matrix. This is shown in the diagram below.



This arrangement is also often used for the pedal-board, where there would be 8 Rows but only 4 columns. This is because there are only 32 (or less) pedal notes to cater for. Four groups of 8 notes gives us the 32 we require and still fits with our schema of 8 rows. A typical pedal-board matrix would be known as an 8 by 4 matrix.

Why use a Matrix?

The number of possible keys (or inputs) is given by multiplying the number of rows by the number of columns. So an 8x4 matrix would provide 32 inputs, where an 8x8 matrix would provide 64 inputs. Similarly the number of wires required to connect to a matrix is given by adding the number of rows to the number of columns. Therefore an 8x4 matrix would require 12 wires and an 8x8 matrix will require 16 wires.

From the description above you can see that the number of wires required to connect a 61 note keyboard is only 16, considerably less than would be required if the keyboard were wired in a bus configuration, where 62 wires would be needed. That is 61 notes plus one for the common bus. The same is obviously true for a pedal-board where 12 wires are needed to connect a full 32 note pedal-board as opposed to 33 wires if it were wired as a bus configuration.

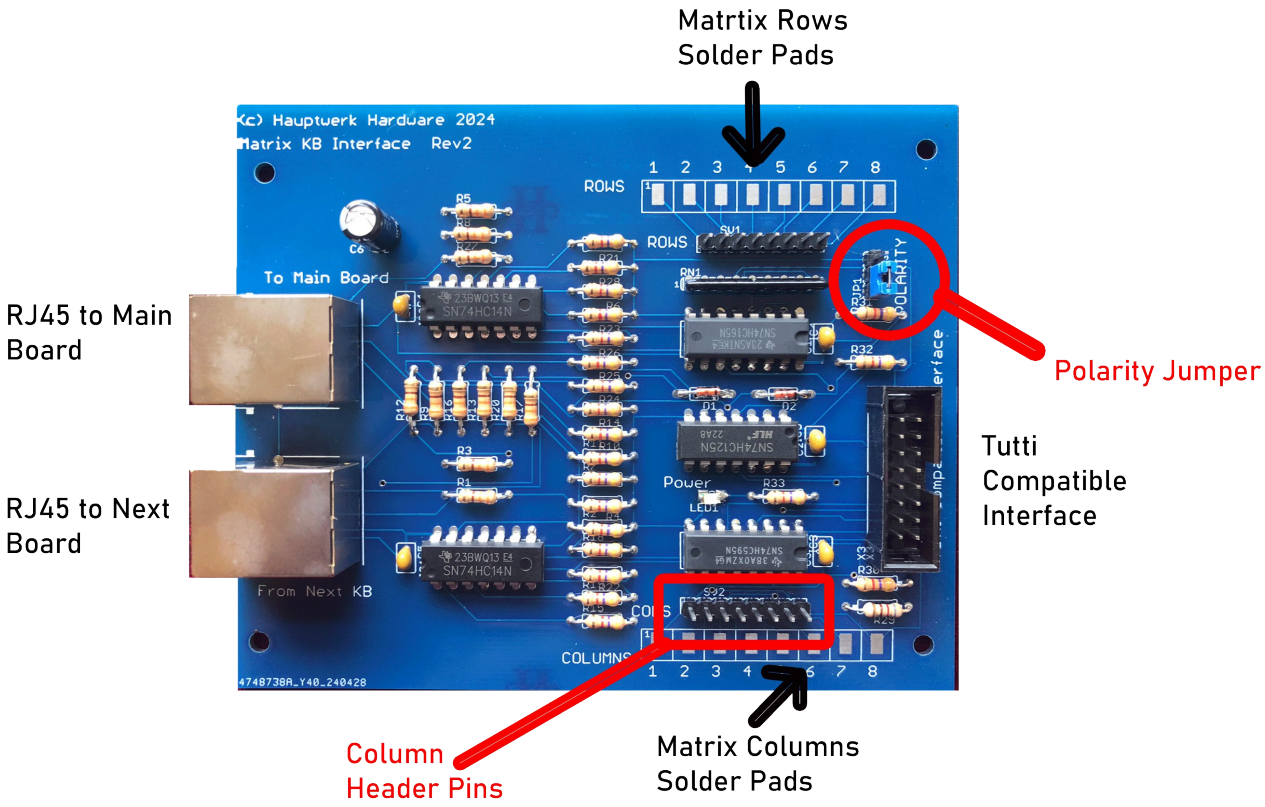
The advantage to using a matrix is clear; far less wiring is required within the console. The downside to a matrix is that you have to add a diode to each input as well as arrange the inputs into groups. As a matrix is designed to be scanned by a computer of some sort it will only be found in

digital instruments which precludes 'Real' pipe organs, where a bus arrangement is almost always used.

The System ONE Matrix Interface Board.

As it's name suggests the System ONE Matrix Keyboard Interface is for use with keyboards which are wired in a 'matrix' configuration.

Connecting the Matrix Interface.



Above is a picture of the System ONE Matrix Interface.

From the previous description we can appreciate that a 61 note keyboard will require an 8x8 matrix, that is 8 rows by 8 columns. Looking at the Matrix Interface we can see that there are solder pads for exactly that. 8 Row connections along the top of the board and 8 column connections along the bottom of the board. That is all that is required for an 8x8 matrix. If you are using an 8x4 matrix then you would connect all 8 rows but only the first four columns. The rest of the connections really just provide optional ways to connect your matrix.

Inboard from the solder pads are standard 2.54mm pitch male header pins that can be used instead of the solder pads should you wish to use DuPont style header leads. This feature is included for those who want a quick, easy and unreliable method of connecting their keyboards! Please note that I see these as a temporary connection method and strongly recommend soldering your connections to the solder pads instead...

Along the right hand side of the board is a 16 way box header which accepts a standard IDC plug and ribbon cable. It is marked as Tutti Compatible, which means that it is wired in exactly the same way as the connectors on our Tutti Encoder. This facilitates the use of Tutti add-ons such as the

Fatar Keyboard Splits as well as the Tutti Connection Strips which you can plug directly into this socket. The relevant user manuals for these products can be found from the Downloads page of the website. Having this socket makes it easy to upgrade from a Tutti Encoder based build to System ONE as might be desirable when adding functionality for moving or lighted stops as well as all the other functions provided by System ONE.

Polarity Selection.

At the top right of the board there is a jumper link which is labelled as 'Polarity'. This refers to the direction that the diodes within your matrix are facing. Usually in a matrix from a commercially manufactured instrument the diodes face towards the columns. That is the anode of the diode is connected, either through the key switch or directly, depending on the design, to the column wire.

Occasionally this will not be the case and the diode will be reversed, having it's cathode connected to the column line. If the diodes are the 'wrong' way round then the entire matrix will not work once connected to the Matrix Interface Board. The polarity jumper solves this problem. By moving the jumper cap into the other position the Interface will now work with diodes 'facing' the other way. Therefore, if after connecting your matrix nothing appears to work, simply move the jumper to the other position.

RJ45 Connections.

The System ONE Matrix Interface Board has two RJ45 sockets. These are used to connect the board to the System ONE Control Board.

In the above picture the top RJ45 socket would be connected to the control board using a regular Cat 5 Ethernet cable. Clearly the protocol in use here is NOT Ethernet, but this type of cable is eminently suitable for this use case being cheap, readily available in any length, and above all reliable.

The bottom RJ45 socket is used to connect the next Bus Interface board in the chain to this one.

Daisy-Chaining.

Matrix Keyboard interfaces can be daisy-chained together up to a maximum of 7. 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.

The maximum number of keyboards allowed for the entire system is 7. This can be made up of any number of both Bus and Matrix keyboards.

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.

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