HAUPTWERK

VIRTUAL PIPE ORGAN

INSTALLATION AND USER GUIDE

VERSION 8

User Guide

Version 8.0

Visit Hauptwerk on the Internet at www.hauptwerk.com.

Section I: About Hauptwerk

Hauptwerk is a computer program that takes full advantage of the enormous processing power of the latest home computers to provide very complex pipe organ modeling and per-pipe sound shaping, while maintaining the enormous polyphony necessary to model a pipe organ successfully.

At its core, Hauptwerk is a very powerful and high-performance specialist software sampler.

The system is built around the philosophy of using at least one large sample per pipe (typically 3-10 seconds), each including a release sample to record the decay of each pipe accurately, and recorded in CD quality or better. All samples are held in memory to achieve a much higher polyphony for a given hardware cost than is possible with disk/SSD-streaming, commonly used in software samplers. Unlike generic software or hardware samplers, Hauptwerk has complex physical and acoustical models specifically designed to reproduce the features and sound of a pipe organ, and is thus able to achieve much more realistic results. It is also designed for a much higher polyphony than generic samplers.

But Hauptwerk is much more than a sampler. It also models all of the physical controls and functional details of a pipe organ. The main console screen shows you a photo-realistic representation of the console, and allows you full control over the virtual organ in the same way that you would control the original instrument. Everything behaves as you would expect; stops, couplers, the programmable combination system, swell pedals, crescendo pedals, ventils, theatre organ second-touch, bass and melody couplers, and so on. You can also use up to four touch-screen monitors to make the virtual controls accessible in convenient locations relative to your MIDI console or MIDI keyboards. *(1)*

What's more, in Hauptwerk every control and function can be fully controlled by MIDI, and Hauptwerk can send MIDI output to control moving/illuminated draw-knobs/tabs, control real external ranks of pipes or hardware expanders, and even control LCD panels to show labels for each draw-knob and piston. If you wish, Hauptwerk can be fully integrated into a MIDI organ console and operate as its 'engine', with comprehensive real-time per-pipe voicing facilities, surround/3D sound or multi-channel audio output, real-time impulse response reverb, and many other features. *(1)*

But perhaps the biggest appeal to many of Hauptwerk's users is that you are not restricted to a single set of organ sounds. Have a look at some of the amazing sample sets available for Hauptwerk, listed on the Hauptwerk website. Some of the greatest organs in the world can be played virtually.

Hauptwerk is available for Macs as well as for Windows (PCs). Because Hauptwerk is designed to give incredible performance and realism, a fairly modern, powerful computer will give best results. We think that's a small price to pay for the results you will get.

However, you can still use Hauptwerk on older computers with excellent results and a huge polyphony by simply disabling some of the audio realism features. Even with only 2 GB of memory you can still use Hauptwerk very effectively with smaller sample sets, or by choosing to load only certain ranks of larger sample sets. Hauptwerk is designed to be very easy and intuitive to set up and use, even for people with little computer, MIDI or technical experience. It can automatically detect all of the necessary MIDI settings for most makes and models of MIDI organ consoles and hardware.

(1) Real-time voicing, surround/3D sound, multi-channel audio output, impulse response reverb, and multi-monitor support are only available in the Advanced Edition of Hauptwerk.

Who uses Hauptwerk and why?

We are fortunate to have a large and enthusiastic community of users who have supported Hauptwerk since the launch of version 1 in 2002. You can read about some of Hauptwerk's users on the Hauptwerk website forum by visiting www.hauptwerk.com/forum.

There are also plenty of third parties who produce many diverse and wonderful sample sets in Hauptwerk format, listed on the Hauptwerk website, ranging from famous historic baroque organs to romantic giants to theatre organs, harmoniums and even harpsichords.

Hauptwerk is most often used:

- For study and practice at home by organists, organ enthusiasts and music students.
- As an instrument on which to learn the organ in schools, music colleges, etc.
- In churches, theatres and concert halls to power digital organs and voice expanders.
- In commercial and home recording studios to provide the ultimate pipe organ sound.
- For music composition and arrangement.
- For historical organ and music study and research.
- For making playable documentary recordings of endangered or valuable pipe organs.
- To upgrade old digital/electronic organs to the latest audio technology and realism.

We aim to bring the pipe organ, king of instruments, to as many people as we can with the highest degree of realism possible on current home computer hardware.

However, we believe that, no matter how realistic or advanced, no model or imitation can ever equal a real pipe organ. We sincerely hope that Hauptwerk should never replace, or be considered as an alternative to, a real organ if space and finances permit.

Licensing, editions, and technical support

Hauptwerk is commercial software, and you must normally buy a separate license for each computer on which it will run simultaneously. Licenses may be purchased through the Hauptwerk on-line shop or via resellers. You can download the full Hauptwerk software (or order it on physical media) from our website: www.hauptwerk.com/download.

Hauptwerk is licensed via the PACE iLok system. You need to have an iLok account on https://www.ilok.com/ and you need to have the latest version of the iLok License Manager software (available for free download from that website) installed on your Hauptwerk computer. iLok License Manager is used for viewing/activating/deactivating/transferring/renewing licenses, as well as for logging into/out of iLok Cloud (see below). Some commercial Hauptwerk sample sets are also licensed via the iLok system, and licenses for them may viewed/activated/deactivated/transferred/renewed in iLok License Manager, in the same way as for licenses for Hauptwerk itself.

Whenever you have been sent an activation code for a license purchased (whether for Hauptwerk, or for a sample set), you can enter it in iLok License Manager using *Licenses | Redeem Activation Code* (then exit and re-launch Hauptwerk, if it was running). You can choose to use any given license in either of two ways:

- The license may be activated to an **iLok3/iLok2 hardware USB dongle**. This method requires no permanent Internet connection to the Hauptwerk computer, since licenses within the dongle may be activated/deactivated/transferred (and renewed, in the case of subscription licenses) by temporarily moving the dongle to a separate Internet-connected computer (which has the iLok License Manager software installed) whenever needed. The dongle may be moved freely around amongst several computers, provided that the dongle is attached to whichever computer has Hauptwerk running at the time. (Please make sure that you never attach or detach the dongle whilst Hauptwerk is actually running.) Hauptwerk will not run without the iLok dongle containing the Hauptwerk license attached. A dongle is the required 'licensing location' for computers that do not have a reliable always-on Internet connection (such as for most church installations, or for PCs for which an Internet connection is not used in order to avoid audio glitches). An iLok dongle is not provided with a Hauptwerk license, but iLok3 dongles may be purchased readily from musical equipment shops. If you already have an iLok2+ dongle then you can also use that dongle for Hauptwerk; licenses for multiple software products from different companies may be present within any given dongle. If you use Hauptwerk on a computer doesn't have an Internet connection at all, then you need to have iLok License Manager installed on your Hauptwerk computer *__and__* on an Internet-connected computer (so that you can move your iLok dongle temporarily to your Internet computer to use iLok License Manager on it whenever you need to add/update licenses within the dongle). Alternatively:

- You can instead use the license from any computer into which iLok License Manager is currently logged into an **iLok Cloud session**. This is termed 'iLok Cloud licensing'. The '*iLok Cloud*' FAQ covers how to log into/out from iLok Cloud: https://www.ilok.com/#!faq. When a license is used in this way no hardware dongle is needed, but a reliable always-on Internet connection is required. You can freely switch between using different computers by closing Hauptwerk and closing the iLok Cloud session (via iLok License Manager) on one computer, then opening an iLok Cloud session (via iLok License Manager) and launching Hauptwerk on another, with the iLok Cloud system ensuring that only one instance of the license can be in use at any given time.

(Hauptwerk doesn't allow dongle-less computer-locked licensing.)

You can move your license(s) freely around amongst iLok dongles and/or the iLok Cloud, and Hauptwerk licenses are neither computer-specific, nor platform-specific.

For Hauptwerk, and Milan Digital Audio's sample sets, and for some third-party producers' sample sets, you may also transfer/sell your licenses to other users, without any approval or actions needed on our part. The iLok License Manager software has the necessary functionality and documentation for moving/transferring licenses, in conjunction with the iLok website (https://www.ilok.com/), and PACE should be contacted directly (via the iLok website) for any support needed with moving or transferring licenses. Their '*Your Licenses*' FAQ covers how to transfer licenses to a different user (a different iLok account name): https://www.ilok.com/#!faq, for which PACE will charge an administrative fee to you directly (as covered in their FAQ).

If no activated license is present for Hauptwerk version 8 when Hauptwerk is launched, then the Hauptwerk software will run as a trial for up to 14 days (after which a license must be purchased in order to continue using it), whilst also providing an option each time on the launch screen to enter a license activation code.

Any given major version (such as version 8) of Hauptwerk may only be evaluated once per iLok account. If you use wish to evaluate Hauptwerk on a computer that isn't connected to the Internet, then you will need to buy (or already have) an iLok3 (or iLok2) dongle, and then to contact Milan Digital to obtain an activation code for a 14-day Hauptwerk trial (which you can then redeem via *Licenses | Redeem Activation Code* within iLok License Manager using an Internet-connected computer, activating the trial to your iLok dongle, then moving the dongle back to your Hauptwerk computer).

7-day trial activation codes are available for Milan Digital Audio's sample sets, and trial activation codes are available for some third-party producers' sample sets. Sample set trial activations may also be used when evaluating Hauptwerk itself.

There are two editions of Hauptwerk:

- The **Hauptwerk Advanced Edition** has the full set of available functionality, and places no restriction on polyphony (the number of virtual pipes that are allowed to sound at once).

- The **Hauptwerk Lite Edition** is identical, except for the following limitations (which are covered in more detail on the Hauptwerk website):

    o Polyphony is limited to at most 1024 simultaneous virtual pipes.
    o No pipe organ wind supply model.
    o No multi-channel audio output, or surround/3D-sound output. (It is limited to a single stereo audio output at a time.)
    o No per-pipe voicing adjustments.
    o No impulse response reverb functionality.
    o No multi-display support.
    o No VST/Audio Unit support.
    o At most one piston toolbar is allowed.
    o The Custom Organ Design Module is available to use, but no technical support is available from Milan Digital Audio for it.

Yearly subscription licenses (which will work for all versions from 5 onwards whilst the subscription remains valid) are available for the Hauptwerk Advanced Edition, and for the Hauptwerk Lite Edition, and perpetual Hauptwerk version 8-specifc licenses are available for the Advanced Edition. Any type of license (Advanced or Lite, subscription of perpetual) may be used on either an iLok3/iLok2 dongle, or with iLok Cloud. If using a subscription license on an iLok dongle then the subscription needs to be renewed, and then refreshed on the dongle, before it expires at the end of each subscription period (year or month), for which the dongle will need to be connected (at least temporarily) to a computer that has an Internet connection and iLok License Manager installed. An Internet connection is only required when refreshing the license on the dongle, and the refresh operation may be performed by moving the dongle temporarily to an Internet-connected computer that has iLok License Manager installed. Subscription licenses for Hauptwerk itself, and for Milan Digital Audio's samples sets, are available via the Hauptwerk website.

To upgrade from the Lite Edition to the Advanced Edition, or from an older Hauptwerk version to the current one, simply purchase the necessary license upgrade, and activate the new license in iLok License Manager. No Hauptwerk settings will be lost in the process.

Important note 1: If you use an iLok3/iLok dongle for your licenses, then please bear in mind that the licenses are contained within the dongle itself. Make sure that you don't lose it, since we cannot normally replace licenses that you had activated to it unless you pay for new licenses to replace them. If you are concerned about the possibility of losing a dongle, software or sample sets, then we recommend insuring them. PACE offer a dedicated insurance policy for the purpose called '*Zero Downtime with Theft and Loss Coverage*', details of which are available via the https://www.ilok.com/ website. Alternatively, specialist musical equipment insurance policies will usually provide cover for audio hardware, software and sample sets.

Important note 2: Any given computer (operating system partition) can only have one version of Hauptwerk installed on it at any one time. Once a new version has been installed (even if only for evaluation purposes) it isn't possible to revert to a previous version without uninstalling Hauptwerk completely (selecting the uninstaller's option to remove all settings and files) then re-installing the older version, which would wipe any existing settings. Hence there's no easy way to revert to an older version of Hauptwerk once this version has been installed. (In case you do subsequently decide you want to revert to a previous version, please do make sure that you use *File | Backup ...* within the previous version <u>before</u> you install the newer version.)

Important note 3: If upgrading from a Hauptwerk version 5, 6 or 7 Advanced Edition perpetual license: when activating the license upgrade to the current Hauptwerk version in iLok License Manager you will need to 'surrender' you Hauptwerk v5/v6/v7 license. (iLok License Manager will prompt you automatically to take you through the process, allowing you to choose the license to surrender.) Please note that once you have done so, it will not be possible to revert to running v5. However, versions 6.0.2 or 7.0 will accept a version 8 license as valid.

Additional important notes if upgrading from Hauptwerk versions 2-4:

- The previous 'Hauptwerk USB key' HASP dongle that was used for Hauptwerk versions 2-4 cannot be used for licensing this version of Hauptwerk, or for licensing sample sets.

- The current version of Hauptwerk isn't compatible directly with copy-protected sample sets that were created for pre-v5 versions, so please contact the makers of any such sample sets to obtain upgraded v5+ compatible versions if needed. If you have purchased an upgrade to v5+, once Hauptwerk v5+ has been installed, you will need to migrate any sample set licenses that you may have from your pre-v5 'Hauptwerk USB Key' HASP dongle (which will remove them permanently from that dongle, rendering it no longer usable), activate the replacement v5+ licenses for those sample sets in iLok License Manager, then use *File | Install …* to install the updated v5+ compatible versions of the sample sets. Your settings, voicing, and combinations for those sample sets shouldn't be lost in the process. When purchasing an upgrade to version 5+ you will be sent instructions for the sample set license migration process (which involves using a special menu function once, then submitting the resulting file via a website form).

- Once you have used the special menu function to migrate your pre-v5 Hauptwerk sample set licenses to v5+ there is no way to reinstate those pre-v5 sample set licenses, nor to reinstate your pre-v5 Hauptwerk license itself. Hence please make sure that you do indeed wish to upgrade <u>before</u> you use the menu function to migrate your pre-v5 sample set licenses.

Technical support

Technical support is available from Milan Digital Audio via Hauptwerk Technical Support Incidents raised via our website support ticket only. If your Hauptwerk license (or license upgrade) is purchased from Milan Digital Audio directly (not via a reseller), then some free support incidents are included, as follows. To receive support from Milan Digital Audio in other cases a Hauptwerk Technical Support Incident, or support plan, needs to be purchased from Milan Digital Audio. For further details please see the Hauptwerk license agreement on our website (or on the Help menu in this version of Hauptwerk), and Hauptwerk Technical Support Incident and support plan pricing on our website:

- Hauptwerk Advanced Edition perpetual licenses/upgrades: at most 4 free support incidents within the first 90 days from the date of license (or license upgrade) purchase.

- Hauptwerk Advanced Edition subscription licenses/upgrades: at most 4 free support incidents within the first 90 days from the date of first purchase in the first year, and at most 2 free support incidents within the first 90 days of each subsequent renewed year.

- Hauptwerk Lite Edition subscription licenses/upgrades: at most 1 free support incident within the first 90 days from the date of first purchase in the first year (and none in subsequent renewed years).

Section II: Installation

Hauptwerk prerequisites

This section lists the platforms and hardware supported for use with Hauptwerk.

Computer platforms and operating systems

Hauptwerk is supported on Apple Macs and PCs which meet the requirements listed below.

Apple Macs are popular amongst Hauptwerk users, since in general they tend to be easy to set up and use, and reliable for real-time audio and MIDI applications 'out of the box' (for which they're specifically developed and tested as complete units by Apple). There are far less variables than with PCs, so you can be more confident that you are buying a computer that should perform well for audio and MIDI, without needing to iron out compatibility, driver, or performance problems.

However, we support Windows platforms equally, as we have since Hauptwerk was first launched. If you don't have the technical inclination yourself, buying a PC that has been specifically built and tested by a specialist vendor for optimum 'pro' real-time audio/MIDI/Hauptwerk compatibility and performance, with a support/maintenance agreement, can be an equally good choice.

On the Mac platform, Hauptwerk is compatible with, and fully supported on, Macs running:

- macOS 'High Sierra' 10.13.6 and above.
- macOS 'Mojave' 10.14.6 and above.
- macOS 'Catalina' 10.15.7 and above.
- macOS 'Big Sur' 11.6.1 and above.
- macOS 'Monterey' 12.4 and above.
- macOS 'Ventura' 13.3 and above.

… with 64-bit Intel CPUs, or (running under Apple's Rosetta translator) with 'Apple silicon' (ARM-based M1/M2-series) CPUs. (A native ARM macOS port of Hauptwerk is not yet available, but we do aim to produce one in the future, and in the meantime the current Intel macOS version of Hauptwerk works and performs well on Apple-CPU Macs anyway.) Hauptwerk cannot be installed or used on OS X versions 10.12 or earlier, or on PowerPC Macs, or on 32-bit Macs.

On the PC platform, Hauptwerk is compatible with, and fully supported on, PCs with 64-bit Intel or AMD CPUs running either:

- 64-bit Windows 10 (Professional or Home editions).
- 64-bit Windows 11 (Professional or Home editions).

(Whilst we no longer fully support them, we understand that Hauptwerk still works on 64-bit Windows 7 or 8.1, and we'll provide support on them for issues that can be reproduced on one of our primary supported Windows platforms listed above, and that don't appear to be related to the platform. Hauptwerk cannot be installed or used on 32-bit versions of Windows, or on 32-bit PCs.)

Memory limits for the supported Windows versions are:

- 64-bit Windows 10 or 11 (Professional editions): 2 TB.
- 64-bit Windows 10 or 11 (Home editions): 128 GB.

Please ensure that drivers are available for all of your hardware on the operating system you wish to use.

Operating system patches

All current operating system updates, service packs and driver updates should be applied when they are available. Hauptwerk might not be able to install or run unless current operating system updates have been applied.

On Windows/PCs, also make sure that the latest drivers are installed for your motherboard and graphics card and that the latest BIOS is installed for the motherboard.

Processors

Hauptwerk is optimized for modern multi-core processors. Very roughly speaking, the more CPU cores, the more recent the processor model, the faster the processor's base frequency (its GHz speed), the more CPU cache, and the better the CPU AVX instruction set version it supports (AVX, AVX2, or Intel AVX-512), the larger the number of organ pipes that are likely be able to sound at once in Hauptwerk, and the better it should be able to handle large numbers of audio channels and real-time impulse response reverbs for the Hauptwerk Advanced Edition.

However, although larger numbers of CPU cores do potentially benefit Hauptwerk's audio and convolution reverb engines, note that per-core performance is very important for certain parts of Hauptwerk, especially the wind supply model, MIDI event processing, and organ loading speeds. CPUs with larger numbers of cores often have lower base clock speeds; we would advise being wary of opting for CPUs with large numbers of cores *if doing so involves also involves much of a trade-off in per-core performance* (base CPU clock speed). Also, when comparing CPU clock speeds, it is *base clock speed* that is the important figure (not maximum boost clock speed), since the CPU will not be able to sustain its maximum boost speed for long.

On both Mac and PC platforms, recent Intel processors in the i9, i7, or equivalent Xeon ranges of processors (with AVX2 or AVX-512 CPU instruction set support), with at least eight physical CPU cores, at least 16 MB of CPU cache, and a high base clock speed, are particularly recommended for best performance with large or complex organs in Hauptwerk, and for large numbers of audio channels and real-time impulse response reverbs for the Hauptwerk Advanced Edition.

On the PC platform, Hauptwerk is compatible with 64-bit Intel and 64-bit AMD (x64-architecture) processors.

Although fast modern processors enable large organs to be used, they are not requirements, and even a PC with dual-core processor should give sufficient performance for many small organs.

Memory

Hauptwerk deliberately does not stream samples from SSD/hard-disk in order to achieve the high polyphony necessary for a pipe organ, so it's important that you have sufficient free memory (RAM) in order to be able to load each organ that you intend to use within Hauptwerk fully into RAM.

An absolute minimum of 2 GB of memory is required to use Hauptwerk with the included St. Anne's organ. Most sample sets state the memory they require as a prerequisite. In order to be able to use a reasonable selection of current sample sets, 16 GB or more of memory is recommended. If you are buying a new computer specifically to run Hauptwerk, we recommend at least 32 GB.

Note that you can choose to load only some ranks of pipes into memory. Other per-rank memory-saving options are also available.

Storage (SSD or hard-disk) and file systems

An absolute minimum of 6 GB of free storage space is required to use Hauptwerk with the standard St. Anne's, Moseley organ sample set installed by default. Other sample sets will require additional space. We recommend ensuring that you have at least 100-500 GB free if you wish to use a number of different sample sets.

The speed of your storage only determines the time it will take Hauptwerk to load a sample set; real-time performance should not be affected once the sample set is loaded into memory. SSD drives or RAID 5 hard-disk arrays can be used if you want sample sets to load quickly. (RAID 5, RAID 1 or RAID 0+1 may also make your system more resilient to the failure of a hard disk.)

If you are installing Apple macOS from scratch (not usually required), we recommend using the default file system during installation, and avoiding the 'case sensitive' file system (a custom installation option) since some Hauptwerk sample sets might not be compatible with it. On Windows, the NTFS file system (which is the default) is required. (The older FAT32 file system doesn't support files larger than 4 GB and thus prevents some large sample sets from installing properly.)

Java

Hauptwerk's installer includes and uses Java internally (but Hauptwerk itself doesn't).

Audio interfaces

In principle, any audio or sound interface, which is supported by the manufacturer on your operating system and hardware, and has good drivers, should work. Professional or semi-professional audio interfaces with high-quality digital-to-analog converters and drivers are strongly recommended above consumer-level sound cards for best quality, reliability, performance and minimal delay between pressing a key and hearing the sound ('latency').

macOS has high-performance, professional-grade, low-latency real-time audio and MIDI support built in, so driver, performance or compatibility problems are uncommon (and even Macs' built-in audio outputs should perform well by default).

On the Windows/PC platform the quality and compatibility of the drivers and components is particularly important for reliable low-latency real-time audio and MIDI performance. Either ASIO or DirectSound drivers can be used, but good-quality manufacturer-supplied ASIO drivers are strongly recommended for best performance. The freeware ASIO4All driver sometimes makes it possible to get reasonable performance from PCs' built-in audio outputs and other consumer-level audio hardware if no ASIO driver is available from the manufacturer.

An audio interface and ASIO/Core Audio driver that natively supports power-of-two buffer sizes (128, 256, 512, 1024, 2048, or 4096) is recommended for lowest latency.

Any audio interface you use must natively support a sample rate of 48 kHz, and ideally also 96 kHz and 44.1 kHz.

Since it's impossible for us to test with all products, we recommend evaluating any candidate audio interface with Hauptwerk before purchasing it. Ensure that the interface is supported by its manufacturer on your computer platform and that you install the latest drivers for it, which can usually be downloaded from the manufacturer's website.

Current audio interfaces from the following ranges are popular with Hauptwerk users on both Macs and PCs:

- MOTU AVB, Thunderbolt, and USB interfaces.
- RME AVB and USB interfaces.
- Focusrite USB interfaces.
- M-Audio USB interfaces.
- PreSonus Thunderbolt and USB interfaces.

(Not all PCs support AVB natively, but the RME Digiface AVB interface allows AVB audio interfaces indirectly to connect via a PCs' USB 3 port. Likewise, not all PCs have Thunderbolt ports, but PC Thunderbolt cards and adapters are available. Please check with the maker of your audio interface and PC to ensure compatibility.)

If you want to use multi-channel audio output (Hauptwerk Advanced Edition) then the number of analog audio outputs that an audio interface provides will usually determine the maximum number of speakers that you will be able to use. Multiple AVB interfaces can usually be connected together and used at once for large numbers of audio channels.

MIDI interfaces

You will need a MIDI interface or USB music keyboard if you want to play Hauptwerk live (although you can evaluate it without one by clicking on the keys on the screen). Any MIDI interface supported by the manufacturer on your operating system and hardware should work with Hauptwerk. Good-quality professional or semi-professional MIDI interfaces are recommended above budget consumer-level USB-MIDI adapters for best performance and reliability, particularly for the avoidance of 'stuck notes'.

macOS has high-performance, professional-grade low-latency audio and MIDI support built in, so driver, performance or compatibility problems are uncommon.

On the Windows/PC platform the quality and compatibility of the drivers and components is particularly important for reliable audio and MIDI performance.

Many audio interfaces include MIDI IN and MIDI OUT ports anyway. If yours does, you probably won't not need a separate dedicated MIDI interface unless you need extra MIDI ports to connect several MIDI devices to the computer simultaneously (such as multiple MIDI keyboards, or complex MIDI organ consoles).

Since it's impossible for us to test with all products, we recommend evaluating any candidate MIDI interface with Hauptwerk before purchasing it. Ensure that the interface is supported by its manufacturer on your computer platform and that you install the latest drivers for it, which can usually be downloaded from the manufacturer's website.

On both Macs and PCs the following dedicated MIDI interfaces are popular and well-proven for Hauptwerk, all of which connect to the computer via USB:

- MOTU Micro Lite (USB): 5 MIDI input ports, 5 MIDI output ports.
- MOTU Express 128 (USB): 8 MIDI input ports, 8 MIDI output ports.
- M-Audio MIDISPORT 2x2 Anniversary Edition (USB): 2 MIDI input ports, 2 MIDI output ports.
- M-Audio MIDISPORT 4x4 Anniversary Edition (USB): 4 MIDI input ports, 4 MIDI output ports.

Details of the interfaces can be found on the MOTU and M-Audio websites.

Monitors and graphics cards

For traditional-DPI (non-'Retina') monitors: Hauptwerk requires a minimum display resolution of 1024 pixels horizontally by 900 pixels vertically for your (primary) monitor. For high-DPI monitors (such as Apple 'Retina' displays): Hauptwerk requires a minimum display resolution of 1536 pixels horizontally by 1350 pixels vertically for your (primary) monitor.

Some sample sets may require higher resolutions to display at their optimal resolutions but Hauptwerk can zoom them to fit your screen.

Touch-screens are very popular for use with Hauptwerk, since they provide a simple and effective interface to control Hauptwerk's stops, avoiding the need for MIDI draw-knobs/tabs, etc. or any complex MIDI configuration. Many Hauptwerk users use MIDI piston buttons to trigger Hauptwerk's combinations and a touch-screen to program those combinations, which is very simple to configure but convenient for performance. Hauptwerk's user interface is designed to support touch-screen use throughout.

The Advanced Edition of Hauptwerk has native support for up to four monitors, including touch-screens, allowing different virtual console windows to be shown on separate physical monitors. For example you could display stop jambs on either side of your MIDI keyboards using two monitors.

VST and Audio Unit hosts (Advanced Edition only)

The Hauptwerk Advanced Edition has native support for applying real-time impulse response reverb, so no external VST or Audio Unit hosts or plug-ins, or other software or hardware, are needed for that. However, if so desired, the Advanced Edition's Hauptwerk AU/VST Plug-in Link does allow you to stream audio to an external VST/AU host for applying VST/AU audio effects plug-ins, and/or to stream MIDI into Hauptwerk for MIDI sequencing/composing purposes.

On macOS the Hauptwerk VST Link is fully supported with the following VST hosts:

- Steinberg Cubase versions 8.x to 11.*x* (64-bit). *(2)*
- Cockos Reaper 6.*x* (64-bit).

On macOS the Hauptwerk AU Link is fully supported with the following Audio Unit hosts:

- Apple Logic Studio Pro 10.*x (1) (2)*
- Apple Garage Band 10.*x (1) (2)*
- Cockos Reaper 6.*x* (64-bit).

On Windows the Hauptwerk VST Link is fully supported with the following VST hosts:

- Steinberg Cubase versions 8.x to 11.*x* (64-bit). *(2)*
- Cockos Reaper 6.*x* (64-bit).

(1) This host doesn't support any MIDI output from plug-ins of this type (VST/AU), so can't be used to record MIDI output streamed directly from Hauptwerk via the Hauptwerk VST/AU Link. If you want to do that (which is uncommon), then instead you need to use a virtual MIDI cable to connect Hauptwerk to the host.

(2) This host doesn't support MIDI sys-ex with plug-ins of this type (VST/AU). If you want to do that, then instead you need to use a virtual MIDI cable to connect Hauptwerk to the host.

(The Hauptwerk VST/AU Links should in principle be compatible with the majority of other VST and Audio Unit hosts, but we'll only provide support on them for issues that can be reproduced on one of our primary supported hosts.)

Please note that we can't provide support with how to use or configure VST and Audio Unit hosts, plug-ins, or MIDI sequencers, beyond the information provided in this guide and on our website.

Other MIDI sequencer software

In principle, any MIDI sequencer software should be compatible with Hauptwerk. A 'virtual MIDI cable', or a physical MIDI cable and associated spare MIDI ports, are required to connect Hauptwerk to a non-VST/AU MIDI sequencer running on the same.

macOS includes virtual MIDI cable functionality natively, called the 'IAC Driver', but it's disabled by default. If you wish to use it, navigate to */Applications/Utilities/Audio MIDI Setup*, select *Show MIDI window* from its *Window* menu, double-click on the *IAC Driver* icon, ensure that its *Device is online* property is ticked, click the *Add* button to increase the number of ports to at least two, then click *Apply* and select *Audio MIDI Setup | Quit Audio MIDI Setup* from the menu.

On Windows platforms a third-party program is required, such as [loopMIDI](#).

Please note that we can't provide support with how to use or configure VST and Audio Unit hosts, plug-ins, or MIDI sequencers, beyond the information provided in this guide and on our website.

MIDI keyboards, organ consoles, MIDI controllers

To play Hauptwerk 'live' you need at least one MIDI keyboard, or a MIDI organ console, plus MIDI lead(s) to connect it to the computer's MIDI interface. Alternatively, you can use one or more USB music keyboards (or you can evaluate Hauptwerk just clicking on the keys on the screen). Hauptwerk is designed to be natively compatible with the MIDI implementations found in the majority of digital and electronic organs, so that MIDI draw-knobs, pistons, swell shoes and so forth can control Hauptwerk and be controlled by Hauptwerk where the hardware allows it, and Hauptwerk should be able to configure MIDI settings automatically. Please see the *MIDI implementation* and *Playing Hauptwerk live from a digital organ* sections of the user guide for details of the MIDI implementations supported by Hauptwerk.

As noted above, touch-screens are very popular for use with Hauptwerk, since they provide a simple and effective interface to control Hauptwerk's stops, avoiding the need for MIDI draw-knobs/tabs, etc. or any complex/expensive MIDI equipment. Many Hauptwerk users use MIDI piston buttons to trigger Hauptwerk's combinations and touch-screens to program those combinations, which is very simple to configure but convenient for performance. Hauptwerk has native support for up to four monitors *(1)*, including touch-screens, allowing different virtual console windows to be shown on separate physical monitors. For example you could display stop jambs on either side of your MIDI keyboards using two monitors.

(1) Multiple monitor support is only available with the Advanced Edition of Hauptwerk.

Novation Launchpads

Hauptwerk also has native support for Novation Launchpads (specifically, the "Launchpad X", "Launchpad Mark 2" model, and the original "Launchpad" mark 1 model), which are good, popular, similarly-easy and convenient alternatives to touch-screens. They have a grid of robust buttons with multi-color LEDs in them that Hauptwerk can control natively to show stop states and functional groupings (by color). You can assign any button to any stop or piston in Hauptwerk and select the LED color you prefer for each, separately for each virtual organ. Hauptwerk also natively supports multiple Launchpad units, so that you could use one for each stop jamb, for example. See the *Using Hauptwerk with Novation Launchpads* section for how to configure Launchpads with Hauptwerk.

Amplifiers, speakers and headphones

Hauptwerk produces audio output signals through the computer's audio interface(s). Amplifiers and loudspeakers or headphones will then be required to turn those signals into sound.

The quality of the audio amplifiers and speakers is very important; there's little point spending a lot of money on a computer and audio interface and then using computer speakers – the results will almost certainly be disappointing. At the very least, a good quality stereo hi-fi amplifier and pair of speakers should be used, or good quality hi-fi headphones. Recording studio monitor speakers are usually good alternatives. For amplification in large buildings, it's often better to have many smaller high-quality amplifiers and speakers than a few high-powered ones.

Hauptwerk fully supports multi-channel audio output *(1)*, so you can amplify different organ ranks, or parts of ranks, separately if you wish and have a multi-output audio interface. You can also distribute pipes within groups of available channels. This enables a three-dimensional sound to be created and helps to minimize some types of distortion inherent in loudspeakers. It is usually the preferred method of amplification with dry sample sets used in reverberant spaces.

(1) Multi-channel audio output is only available with the Advanced Edition of Hauptwerk.

iLok3/iLok2 dongle and spare USB port, or always-on Internet connection for iLok Cloud licensing

Hauptwerk is licensed either by means of an iLok3/iLok dongle, or via 'iLok Cloud' – you can choose to activate your license(s) to either, and you can freely move licenses around between them. Those licensing methods are covered in the *Licensing, editions, and technical support* section.

If you choose to use iLok Cloud then no hardware dongle is required, but your Hauptwerk computer must have a reliable Internet connection that's available all of the time that Hauptwerk is running.

If instead you prefer a hardware dongle, or if your Hauptwerk computer doesn't have a reliable always-on Internet connection, then you will instead need an iLok3 (or iLok2) USB dongle, and a spare USB port to which to attach it. An iLok dongle isn't included with Hauptwerk, but iLok3 dongles may be purchased readily (without licenses in them) from musical equipment shops for a modest cost. If you already have an iLok3/iLok2 dongle for another product, then you can also use that dongle for Hauptwerk; licenses for multiple software products from different companies may coexist within any given dongle. If you use an iLok3/iLok2 dongle, and if your Hauptwerk computer doesn't have an Internet connection at all, then licenses within the dongle may be updated by temporarily moving the dongle to a separate Internet computer (which has the iLok License Manager software installed) whenever needed. The dongle may be moved freely around amongst several computers, provided that the dongle is attached to whichever computer has Hauptwerk running at the time.

If you don't have sufficient spare USB ports on your computer itself, then we recommend only using good-quality USB hubs with dedicated power supplies to ensure that the iLok dongle (and any other USB hardware) functions reliably.

(Please note that the previous 'Hauptwerk USB key' HASP dongle that was used for Hauptwerk versions 2-4, cannot be used for licensing this version of Hauptwerk, or for licensing sample sets.)

iLok License Manager software and iLok account

In order to use Hauptwerk, you need to have the iLok License Manager software installed, and you need to have/create an iLok account. For both of those things, please visit https://www.ilok.com/. If you use Hauptwerk on a computer doesn't have an Internet connection at all, then you need to have iLok License Manager installed on your Hauptwerk computer *and* on an Internet-connected computer (so that you can move your iLok dongle temporarily to your Internet computer to use iLok License Manager on it whenever you need to add/update licenses within the dongle).

Adobe Acrobat Reader

Hauptwerk's documentation is in Adobe PDF format. macOS and Windows 11 and 10 can display PDF documents natively, but on Windows 7 you need to make sure that you have the latest version of Adobe Acrobat Reader installed. It can be downloaded from Adobe's website.

General notes about hardware and software compatibility

Important note 1: Since it is not possible for us to test with all combinations of hardware and third-party software, we would recommend testing Hauptwerk as an evaluation, and/or evaluating any candidate hardware, with your system before purchasing.

Important note 2: Milan Digital Audio does not make or sell computer hardware. We hope you find any recommendations we give useful as reference but we cannot guarantee that any given combination of hardware components or drivers will work or perform well together, regardless of whether some of them follow our recommendations. We are sorry we cannot provide a significant level of help or advice for computer hardware, beyond the recommendations made in the user guide and on our website. If you need help or support with building PCs, using computers, or buying, installing or using PC components, then please make sure that you have a support contract with a company that can provide that support. If you are considering buying a computer to run Hauptwerk and you do not have much experience with building computers, diagnosing driver and hardware compatibilities, and so forth, then we would recommend either buying an Apple Mac (Apple Macs should give reliable performance 'out of the box') or buying a PC from a company that offers ready-made high-performance PCs specifically designed, tested and supported for use with Hauptwerk. The MIDI hardware section on our website may be found by visiting www.hauptwerk.com/hardware and lists several such companies.

Installation: background information

Licenses, iLok License Manager, and iLok account

Hauptwerk is licensed either by means of an iLok3/iLok dongle, or via 'iLok Cloud'. Please consult the ***Licensing, editions, and technical support*** section for details before installing Hauptwerk, and ensure that you have the iLok License Manager software installed, and that you have/create an iLok account (as covered in that section, and also in the ***Hauptwerk prerequisites*** section.)

Understanding the configurations

It is only possible to have one copy of Hauptwerk installed on a given computer (unless you have multiple operating system drive partitions). If the installer detects that Hauptwerk is already installed, it will only allow that copy to be upgraded or re-installed.

However, several independent Hauptwerk configurations will automatically be installed, each allowing its own entirely separate set of configuration settings within Hauptwerk, and launched via different short-cuts/aliases. Any settings you change within Hauptwerk in one configuration will not affect the other three.

Sample sets, temperaments, licenses, combination sets and organs created with the Custom Organ Design Module are automatically shared between all four.

The primary configuration is launched via the icon labeled '*Hauptwerk*' on your desktop (or Windows Start screen/menu). The others are launched via the icons labeled '*Hauptwerk (alt config 1)*' (short for 'alternative configuration 1') to '*Hauptwerk (alt config 3)*' on your desktop (or Windows Start screen/menu).

The four configurations are identical and completely interchangeable (except that their settings are independent). For example, you might wish to use the main Hauptwerk configuration for normal playing, and another (such as 'alt config 1') for testing out different settings (such as voicing in the Hauptwerk Advanced Edition), without affecting the settings in your 'main' configuration.

Copying settings between configurations

You can copy settings between the configurations if you wish using Hauptwerk's native backup/restore functionality, covered later in this guide. The backup/restore functionality also allows you to copy your settings, organ combinations and other 'user' data from one computer (or operating system drive partition) to another.

Planning installation locations

During installation, it is possible to choose to install different groups of Hauptwerk's files into different locations. The files are grouped according to their size and backup requirements.

There are two 'installation sets' from which you will be able to choose during installation: *Standard* and *Custom*.

The *Standard* set installs all files into default folders on your computer's main drive, and is recommended for most people, especially if you only have one drive installed in the computer.

On macOS, the Standard option installs the Hauptwerk software itself into */Applications/Hauptwerk Virtual Pipe Organ* and all data files into a *Hauptwerk* folder within your computer account's home folder. On Windows, the Standard option installs the Hauptwerk software into *\Program Files\Hauptwerk Virtual Pipe Organ* and all data files into a *Hauptwerk* folder within your computer account's home folder.

It is the *Custom* option that allows the data file groups to be installed to separate locations, and you may wish to choose this option if you are an experienced computer user and have more than one drive or more than one RAID array, across which you wish to optimize drive access or space usage. If you decide that you wish to use the Custom installation set, you should plan how you wish to lay out the folders before running the installer. If you are building a new computer, you may wish to lay out the file systems or RAID arrays at this stage. Once Hauptwerk has been installed, the installation locations cannot be changed without re-running Hauptwerk's installer.

The groups of files, whose installation folders can be adjusted are:

- **_User data_**. Files and folder containing your settings, organ combinations and other user data. Reliable storage should be used. Hauptwerk's native backup/restore functionality can be used to back them up regularly. Recommended size for growth: 2 - 25 GB.
- **_Sample sets and components_**. Organs, sample data, temperament files, impulse response reverbs, and other shared installable components. Place this folder on a large drive. Storage need not be secure, since all data can be re-installed. Recommended size for growth: 100 - 500 GB.
- **_Internal working data_**. Processing and analysis are performed the first time a virtual organ is loaded. The resulting data are stored in a 'sample set data cache' for the virtual organ within this folder so that it can load much more rapidly subsequently. Ideally these files should be placed on a large, fast drive to minimize organ loading times. Storage need not be secure, since all data can be regenerated. An SSD, or fast RAID array, is ideal. Recommended size for growth: 100 - 500 GB.

Important: You must never choose to put any those installation folders inside the computer operating system's special folders, such as in _C:\Program Files_, _C:\Windows_, _/Applications_, _/System_ or _/Library_, otherwise you would prevent Hauptwerk and its installer from being to work properly in the future. Unless you specifically wish to place Hauptwerk's folders on separate drives, we recommend leaving the Hauptwerk installation folders at their defaults. Please also ensure that your computer account is allowed to write to any custom folders that you might select, otherwise installation might fail.

On Windows only, for both Simple and Custom installation sets, you will also need to select a folder into which the VST plug-ins will be installed. If you use a VST host program, such as Steinberg Cubase or Cuckos Reaper, you can optionally select the special VST plug-ins folder used by the host program. If you don't have a VST host program, simply leave the installation option at its default and Hauptwerk's installer will install the plug-ins to an appropriate default location.

(Note that the installer places all files for a given group within a sub-folder of the folder you select for the group, named accordingly for the group. For example, a sub-folder named HauptwerkUserData will be created for the user data files within the folder you select for the user data files group. The VST plug-ins folder is an exception, in that the VST plug-ins are installed directly within the folder you select.)

Multiple computer accounts

Important: If your computer has more than one computer account, then please make sure that you always use the same account for running Hauptwerk that you do/did when installing/upgrading it, otherwise files and folders might not be found, and/or file/folder permissions might prevent Hauptwerk or its installer from being able to function correctly.

In special cases where you might have more complex multi-user configuration or security requirements, for example in a school or music college, please contact Milan Digital Audio to discuss your installation requirements.

Multiple Hauptwerk versions

Any given computer (operating system partition) can only have one version of Hauptwerk installed on it at any one time. Once a new version has been installed it isn't possible to revert to a previous version without uninstalling Hauptwerk completely (selecting the uninstaller's option to remove all settings and files) then re-installing the older version, which would wipe any existing settings. Hence there's no easy way to revert to an older version of Hauptwerk once a newer version has been installed. (In case you do subsequently decide you want to revert to a previous version, please do make sure that you use _File | Backup ..._ within the previous version <u>before</u> you install a newer version.)

Installing Hauptwerk

These instructions apply when you install Hauptwerk on a computer for the first time. If you have already installed Hauptwerk version 2 or above on the computer, then please instead see the *Upgrading or re-installing Hauptwerk* section.

Note that you don't need to re-install Hauptwerk if you have previously been using this version of Hauptwerk as an evaluation and then subsequently buy a license for Hauptwerk; simply use *Licenses | Redeem Activation Code* within iLok License Manager to activate your new license, then re-launch Hauptwerk.

Installation steps on an Apple Mac computer

Step 1. First ensure that your system meets the *Hauptwerk prerequisites*, and that all available macOS updates have been applied.

Step 2. Make sure that your audio and MIDI interface hardware is attached to the computer, powered up, and that you have installed the most recent drivers available from the manufacturer(s).

Step 3. Make sure that you are logged onto macOS with a computer account that has administrator privileges (such as the default computer account). If not, log out and log on again using such an account. (In future, once Hauptwerk is installed, please always make sure you log onto your computer using the same account when you want to run Hauptwerk itself.)

Step 4. As covered in the *Hauptwerk prerequisites*, make sure that you have the current version of iLok License Manager installed on your Hauptwerk computer (and also on an Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet), and that you have/create an iLok account. For both of those things, please visit https://www.ilok.com/.

Step 5. If you wish to use Hauptwerk via an iLok3/iLok2 dongle (which is necessary unless your Hauptwerk computer has a reliable always-on Internet connection), then make sure that you have bought an iLok3/iLok2 dongle and that it's attached to a spare USB port on your Hauptwerk computer (or temporarily on your Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet).

Step 6. If you have purchased a license for Hauptwerk (or have obtained an activation code for a 14-day Hauptwerk trial), then use iLok License Manager to log into your iLok account, and then use *Licenses | Redeem Activation Code* within iLok License Manager to enter the license activation code that you were sent. (Alternatively, if applicable, Hauptwerk will prompt you to enter the activation code when you first launch Hauptwerk.) Please note that iLok License Manager needs an Internet connection whenever activating a license, so if you use Hauptwerk on a non-Internet-connected computer then you will need to use an Internet-connected computer temporarily (with iLok License Manager installed on it) to redeem your activation code, activating it to an iLok3/iLok2 dongle. You can then move your iLok dongle back to your (non-Internet-connected) Hauptwerk computer.

Step 7. Make sure that you have downloaded the current version of Hauptwerk from https://www.hauptwerk.com/. On your Hauptwerk computer, navigate to your downloaded file. (By default, it will have been placed on your desktop or in your *Downloads* folder.)

Step 8. In Finder, if macOS hasn't already done it automatically for you, double-click on the downloaded file (*InstallHauptwerk… .dmg/.zip*) to open/extract it. (If any checksum or other errors are reported, then please try downloading the file again.)

Step 9. Right-click on the resulting Hauptwerk installer application (*InstallHauptwerk...*) and select *Open*, launching Hauptwerk's installer. Then follow the instructions in the installer to complete the installation process. (We recommend leaving all options within the installer at their defaults, since default installation locations are compatible with current/recent operating system versions.) Reboot the computer.

Please now follow the *Section III: Quick start* section in this guide to start using Hauptwerk. Note that the first time you launch Hauptwerk it will automatically install the St. Anne's organ, which might take a few minutes. (**Important**: Please also make sure that you download and install the current 'Hauptwerk licensing packages', as covered in that *Section III: Quick start* section.)

Installation steps on Windows

Step 1. First ensure that your system meets the *Hauptwerk prerequisites*, and that all available Windows updates have been applied.

Step 2. (**optional, for computer experts**): Especially with recent Windows 10 versions, disabling Windows' page file can allow organs to load faster, and unload much faster. However, doing so will prevent Windows and other applications from being able to use more (virtual) memory than your PC actually has RAM, so might adversely affect the performance of the computer when used for purpose other than Hauptwerk. Hence if your PC is used exclusively or mainly for Hauptwerk, or if you have plenty of RAM, you might wish to disable the Windows page file, for best Hauptwerk performance. To do so in Windows 10: go to Windows' *Settings* via the Start menu, select *System*, select *About*, click *System info*, then click on the *Performance | Settings* button on the *Advanced* tab. Select *Adjust for best performance*, then click the *Advanced* tab. Click *Virtual memory: Change* and ensure that *No paging* file is selected (for each drive, if your PC has more than one), then click *Set*. Finally click *OK* on all of the windows and re-boot the computer if you changed any settings.

Step 3. Make sure that your audio and MIDI interface hardware is attached to the computer, powered up, and that you have installed the most recent drivers available from the manufacturer(s).

Step 4. Make sure that you are logged onto Windows with a computer account that has administrator privileges (such as the default computer account). If not, log out and log on again using such an account. (In future, once Hauptwerk is installed, please always make sure you log onto your computer using the same account when you want to run Hauptwerk itself.)

Step 5. As covered in the *Hauptwerk prerequisites*, make sure that you have the current version of iLok License Manager installed on your Hauptwerk computer (and also on an Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet), and that you have/create an iLok account. For both of those things, please visit https://www.ilok.com/.

Step 6. If you wish to use Hauptwerk via an iLok3/iLok2 dongle (which is necessary unless your Hauptwerk computer has a reliable always-on Internet connection), then make sure that you have bought an iLok3/iLok2 dongle and that it's attached to a spare USB port on your Hauptwerk computer (or temporarily on your Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet).

Step 7. If you have purchased a license for Hauptwerk (or have obtained an activation code for a 14-day Hauptwerk trial), then use iLok License Manager to log into your iLok account, and then use *Licenses | Redeem Activation Code* within iLok License Manager to enter the license activation code that you were sent. (Alternatively, if applicable, Hauptwerk will prompt you to enter the activation code when you first launch Hauptwerk.) Please note that iLok License Manager needs an Internet connection whenever activating a license, so if you use Hauptwerk on a non-Internet-connected computer then you will need to use an Internet-connected computer temporarily (with iLok License Manager installed on it) to redeem your activation code, activating it to an iLok3/iLok2 dongle. You can then move your iLok dongle back to your (non-Internet-connected) Hauptwerk computer.

Step 8. Make sure that you have downloaded the current version of Hauptwerk from https://www.hauptwerk.com/. On your Hauptwerk computer, navigate to your downloaded file.

Step 9. In File Explorer (Windows Explorer), double-click on the Hauptwerk installer application (*InstallHauptwerk...*). (If any checksum or other errors are reported, then please try downloading it again.)

Step 10. Once the main installer screen has appeared, simply follow the instructions in the installer to complete the installation process. (We recommend leaving all options within the installer at their defaults, since default installation locations are compatible with current/recent operating system versions.) Reboot the computer.

Please now follow the *Section III: Quick start* section in this guide to start using Hauptwerk. Note that the first time you launch Hauptwerk it will automatically install the St. Anne's organ, which might take a few minutes. (**Important**: Please also make sure that you download and install the current 'Hauptwerk licensing packages', as covered in that *Section III: Quick start* section.)

Upgrading or re-installing Hauptwerk

These instructions apply if you already have Hauptwerk version 2 or above installed on your computer. If not, then please instead see the *Installing Hauptwerk* section. You can check the version currently installed by selecting *Help/Hauptwerk | About Hauptwerk* from the Hauptwerk menu.

Note that you don't need to re-install Hauptwerk if you have previously been using this version of Hauptwerk as an evaluation and then subsequently buy a license for Hauptwerk; simply use *Licenses | Redeem Activation Code* within iLok License Manager to activate your new license, then re-launch Hauptwerk.

Any given computer (operating system partition) can only have one version of Hauptwerk installed on it at any one time. Once a new version has been installed (even if only for evaluation purposes) it isn't possible to revert to a previous version without uninstalling Hauptwerk completely (selecting the uninstaller's option to remove all settings and files) then re-installing the older version, which would wipe any existing settings. Hence there's no easy way to revert to an older version of Hauptwerk once this version has been installed. (In case you do subsequently decide you want to revert to a previous version, please do make sure that you use *File | Backup ...* within the previous version before you install the newer version.)

Your settings, voicing, and combinations should not be lost by upgrading or re-installing, provided that you follow the following instructions.

Important note 1: If your license is for versions 2-4 and you don't upgrade your license to version 8 and activate the license in iLok License Manager before installing, then Hauptwerk will revert to running in evaluation mode, but allow you to activate the license upgrade at any time (via iLok License Manager's *Licenses | Redeem Activation* Code) to restore full licensed functionality.

Important note 2: If upgrading from a Hauptwerk version 5, 6 or 7 Advanced Edition perpetual license: when activating the license upgrade to the current Hauptwerk version in iLok License Manager you will need to 'surrender' you license for your previous Hauptwerk version. (iLok License Manager will prompt you automatically to take you through the process, allowing you to choose the license to surrender.) Please note that once you have done so, it will not be possible to revert to running version 5, although versions 6.0.2 or 7.0 will accept a version 8 license as valid.

Upgrade/re-installation steps on an Apple Mac computer

Step 1. First ensure that your system meets the *Hauptwerk prerequisites*, and that all available macOS updates have been applied.

Step 2. Make that sure that the latest drivers are installed for your audio/MIDI interface(s). Check their manufacturers' websites for the latest versions.

Step 3. Make sure that you are logged onto macOS with a computer account that has administrator privileges (such as the default computer account). If not, log out and log on again using such an account. (In future, once Hauptwerk is installed, please always make sure you log onto your computer using the same account when you want to run Hauptwerk itself.)

Step 4. **Very important**: If you currently have Hauptwerk installed on the computer then please use *File | Backup …* within your existing version of Hauptwerk to make a backup, saving the resulting backup file somewhere safe. *In particular, making a backup is essential if upgrading from a pre-5 Hauptwerk version on a Mac, since a pre-5 installation of Hauptwerk can't automatically be upgraded directly to a 5+ version* (due to changes in Apple's security requirements for recent macOS versions).

Step 5. Exit Hauptwerk (if it's currently running).

Step 6. **Very important**: **If upgrading from a pre-5 Hauptwerk version**, use Finder to make sure that all of the following folders are completely deleted, if they exist (you may be prompted for your password):

1. */Applications/Hauptwerk Virtual Pipe Organ*
2. */Users/Shared/Relocated Items/Hauptwerk*
3. */Hauptwerk*

(The latter folder is at the very top-level of your computer's SSD/hard-drive. In order to be able to find it, make sure that the *Sidebar | Devices | Hard disks* option is ticked in Finder's preferences.)

Step 7. As covered in the *Hauptwerk prerequisites*, make sure that you have the current version of iLok License Manager installed on your Hauptwerk computer (and also on an Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet), and that you have/create an iLok account. For both of those things, please visit https://www.ilok.com/.

Step 8. If you wish to use Hauptwerk via an iLok3/iLok2 dongle (which is necessary unless your Hauptwerk computer has a reliable always-on Internet connection), then make sure that you have bought an iLok3/iLok2 dongle and that it's attached to a spare USB port on your Hauptwerk computer (or temporarily on your Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet).

Step 9. **If upgrading from a pre-8 Hauptwerk version**: If you have purchased a license for Hauptwerk (or have obtained an activation code for a 14-day Hauptwerk trial), then use iLok License Manager to log into your iLok account, and then use *Licenses | Redeem Activation Code* within iLok License Manager to enter the license activation code that you were sent. (Alternatively, if applicable, Hauptwerk will prompt you to enter the activation code when you first launch Hauptwerk.) Please note that iLok License Manager needs an Internet connection whenever activating a license, so if you use Hauptwerk on a non-Internet-connected computer then you will need to use an Internet-connected computer temporarily (with iLok License Manager installed on it) to redeem your activation code, activating it to an iLok3/iLok2 dongle. You can then move your iLok dongle back to your (non-Internet-connected) Hauptwerk computer.

Step 10. **If upgrading from a pre-5 Hauptwerk version**: Download the latest version of the (pre-v5) 'Hauptwerk USB Key' (dongle) driver from the *Support | Licensing* section of https://www.hauptwerk.com/. Install it on your Hauptwerk computer, leaving all options in the driver's installer at their defaults. Make sure that your pre-v5 'Hauptwerk USB Key' HASP dongle is attached to the computer. (If you use an iLok dongle for licensing the current version of Hauptwerk, then both dongles need to be attached to the computer in order to migrate your licenses to v5+ in step 18 below.) Reboot the computer.

Step 11. Make sure that you have downloaded the current version of Hauptwerk from https://www.hauptwerk.com/. On your Hauptwerk computer, navigate to your downloaded file. (By default, it will have been placed on your desktop or in your *Downloads* folder.)

Step 12. In Finder, if macOS hasn't already done it automatically for you, double-click on the downloaded file (*InstallHauptwerk… .dmg/.zip*) to open/extract it. If any checksum or other errors are reported, then please try downloading the file again.

Step 13. Right-click on the resulting Hauptwerk installer application (*InstallHauptwerk...*) and select *Open*, launching Hauptwerk's installer. Then follow the instructions in the installer to complete the installation process. (We recommend leaving all options within the installer at their defaults, since default installation locations are compatible with current/recent operating system versions, and when upgrading an existing v5+ installation your existing installation's installation locations will be used by default, regardless of whether you select the 'Standard' or 'Custom' options in the installer.) Reboot the computer.

Step 14. Launch Hauptwerk. (Note that the first time you launch Hauptwerk it will automatically install the St. Anne's organ, which might take a few minutes.)

Step 15. **If you are upgrading from a pre-5 version <u>and</u> you wish to retain your previous settings/combinations/voicing**: The General Configuration Wizard will run automatically. Simply dismiss the wizard and any subsequent screens for now (since any settings would be overwritten in the next action anyway). Now use *File | Restore ...* in Hauptwerk to restore the pre-v5 backup that you made (in step 4 above). Leave all options at their defaults in the backup restoration wizard and complete the wizard, allowing the backup to be restored when prompted. Once a message appears indicating that the backup has been restored successfully, OK the message, at which point Hauptwerk will exit. Re-launch Hauptwerk.

Step 16. **If upgrading from a pre-5 version**: The General Configuration Wizard will run automatically (again). Follow the instructions in the wizard to complete it, choosing any options you desire in it, and confirming your devices if prompted. (If you restored a pre-5 settings backup in the previous step then your existing pre-5 settings/combinations/voicing can be retained and migrated if you wish.)

Step 17. Download the current 'Hauptwerk licensing packages' Hauptwerk component package file from Milan Digital Audio: https://www.hauptwerk.com/licensingpackages. Use *File | Install …* from the menu in Hauptwerk to navigate to and select the downloaded file, then just click OK to install it (leaving all other options at their defaults). (The 'Hauptwerk licensing packages' are needed in order to be able to load any iLok-licensed sample sets.)

Step 18. **If upgrading from a pre-5 version**: The current version of Hauptwerk isn't compatible directly with copy-protected sample sets that were created for pre-v5 versions, so please contact the makers of any such sample sets to obtain upgraded v5+ compatible versions if needed. If you have purchased an upgrade to v5+, you will need to migrate any sample set licenses that you may have from your pre-v5 'Hauptwerk USB Key' HASP dongle (which will remove them permanently from that dongle, rendering it no longer usable), activate the replacement v5+ licenses for those sample sets in iLok License Manager, then use *File | Install …* to install the updated v5+ compatible versions of all of your sample sets. Your settings, voicing, and combinations for those sample sets shouldn't be lost in the process. When purchasing an upgrade to version 5+ you will be sent instructions for the sample set license migration process (which involves using a special menu function once, then submitting the resulting file via a website form).

Step 19. **If upgrading from a pre-5 version**: Once you have migrated your pre-v5 licenses (in step 18), you can detach your pre-v5 'Hauptwerk USB Key' HASP dongle from the computer permanently; it is no longer needed.

The current version of Hauptwerk is now ready to use. (Please note that it might take longer to load each organ the first time after some upgrades, since the sample set data caches need to be regenerated for some new versions.)

Upgrade/re-installation steps on Windows

Step 1. First ensure that your system meets the *Hauptwerk prerequisites*, and that all available Windows updates have been applied.

Step 2. (**optional, for computer experts**): Especially with recent Windows 10 versions, disabling Windows' page file can allow organs to load faster, and unload much faster. However, doing so will prevent Windows and other applications from being able to use more (virtual) memory than your PC actually has RAM, so might adversely affect the performance of the computer when used for purpose other than Hauptwerk. Hence if your PC is used exclusively or mainly for Hauptwerk, or if you have plenty of RAM, you might wish to disable the Windows page file, for best Hauptwerk performance. To do so in Windows 10: go to Windows' *Settings* via the Start menu, select *System*, select *About*, click *System info*, then click on the *Performance | Settings* button on the *Advanced* tab. Select *Adjust for best performance*, then click the *Advanced* tab. Click *Virtual memory: Change* and ensure that *No paging* file is selected (for each drive, if your PC has more than one), then click *Set*. Finally click *OK* on all of the windows and re-boot the computer if you changed any settings.

Step 3. Make sure that your audio and MIDI interface hardware is attached to the computer, powered up, and that you have installed the most recent drivers available from the manufacturer(s).

Step 4. Make sure that you are logged onto Windows with a computer account that has administrator privileges (such as the default computer account). If not, log out and log on again using such an account. (In future, once Hauptwerk is installed, please always make sure you log onto your computer using the same account when you want to run Hauptwerk itself.)

Step 5. **Important**: If you currently have Hauptwerk installed on the computer then please use *File | Backup …* within your existing version of Hauptwerk to make a backup, saving the resulting backup file somewhere safe.

Step 6. Exit Hauptwerk (if it's currently running).

Step 7. As covered in the *Hauptwerk prerequisites*, make sure that you have the current version of iLok License Manager installed on your Hauptwerk computer (and also on an Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet), and that you have/create an iLok account. For both of those things, please visit https://www.ilok.com/.

Step 8. If you wish to use Hauptwerk via an iLok3/iLok2 dongle (which is necessary unless your Hauptwerk computer has a reliable always-on Internet connection), then make sure that you have bought an iLok3/iLok2 dongle and that it's attached to a spare USB port on your Hauptwerk computer (or temporarily on your Internet-connected computer, if your Hauptwerk computer isn't connected to the Internet).

Step 9. **If upgrading from a pre-8 Hauptwerk version**: If you have purchased a license for Hauptwerk (or have obtained an activation code for a 14-day Hauptwerk trial), then use iLok License Manager to log into your iLok account, and then use *Licenses | Redeem Activation Code* within iLok License Manager to enter the license activation code that you were sent. (Alternatively, if applicable, Hauptwerk will prompt you to enter the activation code when you first launch Hauptwerk.) Please note that iLok License Manager needs an Internet connection whenever activating a license, so if you use Hauptwerk on a non-Internet-connected computer then you will need to use an Internet-connected computer temporarily (with iLok License Manager installed on it) to redeem your activation code, activating it to an iLok3/iLok2 dongle. You can then move your iLok dongle back to your (non-Internet-connected) Hauptwerk computer.

Step 10. **If upgrading from a pre-5 Hauptwerk version**: Download the latest version of the (pre-v5) 'Hauptwerk USB Key' (dongle) driver from the *Support | Licensing* section of https://www.hauptwerk.com/. Install it on your Hauptwerk computer, leaving all options in the driver's installer at their defaults. Make sure that your pre-v5 'Hauptwerk USB Key' HASP dongle is attached to the computer. (If you use an iLok dongle for licensing the current version of Hauptwerk, then both dongles need to be attached to the computer in order to migrate your licenses to v5+ in step 17 below.) Reboot the computer.

Step 11. Make sure that you have downloaded the current version of Hauptwerk from https://www.hauptwerk.com/. On your Hauptwerk computer, navigate to your downloaded file.

Step 12. In File Explorer (Windows Explorer), double-click on the Hauptwerk installer application (*InstallHauptwerk...*). (If any checksum or other errors are reported, then please try downloading it again. Please note that in case you get a Windows Defender SmartScreen warning that the application is unrecognized, the warning can safely be ignored via SmartScreen's '*More info*' button; Windows Defender SmartScreen simply warns about applications that have only recently been released, until it considers them proven for period of time.)

Step 13. Once the main installer screen has appeared, simply follow the instructions in the installer to complete the installation process. (We recommend leaving all options within the installer at their defaults, since when upgrading an existing installation your existing installation's installation locations will be used by default, regardless of whether you select the 'Standard' or 'Custom' options in the installer.) Reboot the computer.

Step 14. Launch Hauptwerk. (Note that the first time you launch Hauptwerk it will automatically install the St. Anne's organ, which might take a few minutes.)

Step 15. **If upgrading from a pre-5 version**: The General Configuration Wizard will run automatically. Follow the instructions in the wizard to complete it, choosing any options you desire in it, and confirming your devices if prompted. (Your existing pre-5 settings/combinations/voicing can be retained and migrated if you wish.)

Step 16. Download the current 'Hauptwerk licensing packages' Hauptwerk component package file from Milan Digital Audio: https://www.hauptwerk.com/licensingpackages. Use *File | Install …* from the menu in Hauptwerk to navigate to and select the downloaded file,

then just click OK to install it (leaving all other options at their defaults). (The 'Hauptwerk licensing packages' are needed in order to be able to load any iLok-licensed sample sets.)

Step 17. **If upgrading from a pre-5 version**: The current version of Hauptwerk isn't compatible directly with copy-protected sample sets that were created for pre-v5 versions, so please contact the makers of any such sample sets to obtain upgraded v5+ compatible versions if needed. If you have purchased an upgrade to v5+, you will need to migrate any sample set licenses that you may have from your pre-v5 'Hauptwerk USB Key' HASP dongle (which will remove them permanently from that dongle, rendering it no longer usable), activate the replacement v5+ licenses for those sample sets in iLok License Manager, then use *File | Install …* to install the updated v5+ compatible versions of all of your copy-protected sample sets. Your settings, voicing, and combinations for those sample sets shouldn't be lost in the process. When purchasing an upgrade to version 5+ you will be sent instructions for the sample set license migration process (which involves using a special menu function once, then submitting the resulting file via a website form).

Step 18. **If upgrading from a pre-5 version**: Once you have migrated your pre-v5 licenses (in step 17), you can detach your pre-v5 'Hauptwerk USB Key' HASP dongle from the computer permanently; it is no longer needed.

The current version of Hauptwerk is now ready to use. (Please note that it might take longer to load each organ the first time after some upgrades, since the sample set data caches need to be regenerated for some new versions.)

Uninstalling Hauptwerk

Hauptwerk has a native uninstaller, which can be found in */Applications/Hauptwerk Virtual Pipe Organ/Uninstaller* in Finder on macOS or by going to *Apps* from Windows' *Settings* via the Windows Start menu, then selecting Hauptwerk from the list, then clicking *Uninstall* on Windows.

If you want to remove Hauptwerk for any reason, **it's essential that you uninstall it using its native uninstaller**, rather than simply deleting some or all of its files, otherwise the installer might not be able to repair the installation properly if you try to install it again in the future.

Changing installation locations

If you have Hauptwerk installed but you want to change the locations you installed it to, you will need to re-run Hauptwerk's installer, selecting the *Custom* option in the installer, which allows you to choose where to install. The installer will attempt to move your existing installation's folders to your newly-selected locations and update Hauptwerk accordingly.

We strongly recommend using Hauptwerk's native backup functionality (*File | Backup your Hauptwerk settings and personal data*, covered in the *Backing up and restoring your settings and data* section), and making sure you have the original installation media for all sample sets to hand, prior to re-running the installer to move folders, in case anything goes wrong during the moving process (for example, in case storage space runs out, or some sample set files or folders can't be moved because of insufficient permissions, or the computer 'times out' some part of the process, or the computer goes to sleep).

Backing up and restoring your settings and data

Overview

Hauptwerk has built-in functionality to backup your settings and personal Hauptwerk data and to restore them again. If you use the backup function periodically then you should be able to get your settings and data back easily in the future in case your computer's storage fails and needs to be replaced, or if your computer gets a virus, or if your computer needs to be re-installed for any other reason. The backup/restore functions can also be used to copy your settings from one computer or Hauptwerk configuration to another.

The backup and restore functions are found on the *File* menu in Hauptwerk. *File | Backup your Hauptwerk settings and personal data* always makes a backup copy of *all* of your Hauptwerk settings and other personal data (organ combinations, voicing, Custom Organ Design Module organs and logs) into a single compressed file, which can be written to removable media (such as a USB stick) or emailed easily. If you ever need to, you can then restore that backup at a later date by using the *File | Restore your Hauptwerk settings or personal data from a backup* menu function.

Important: **Please use the backup function periodically**, and especially once you have configured Hauptwerk as you want it, and then whenever you have made a significant number of changes to your settings, organ combinations, voicing or other personal data in the future. Please store any backup files you make securely somewhere external to your computer, in case your computer's storage needs to be replaced or re-installed for any reason. For example, write any backup files you make to physical media (such as a USB stick) and keep them in a safe place. You should then easily be able to get all of your Hauptwerk settings and personal data back again at any point in the future. Make sure you give the backup files meaningful names when prompted so that you can easily identify when they were made.

Hauptwerk does not back up the sample sets themselves (although it does back up your settings that relate to them), so please also make sure that you keep the original installation media for any third-party sample sets, as well as for Hauptwerk itself. You will need those if you ever need to re-install your computer.

This section gives step-by-step instructions for the most common backup/restore operations. Some other backup/restore operations are possible using the *Advanced* restore mode.

(Please note that although we make every effort to ensure that Hauptwerk's backup/restore functionality works reliably, we would always recommend also making your own independent backups of your data for maximum possible safety.)

Automatic backups

By default, Hauptwerk will also make backups automatically once each week to the *Hauptwerk* sub-folder within your computer account's home folder. You can change that behavior using the *General options | General preferences* screen if you wish, although we recommend keeping periodic automatic backups enabled, in addition to any backups you make manually, for maximum data security. You shouldn't rely on automatic backups alone, since they would probably be lost in the event that your computer's hard-drive failed. If you are short on space on your hard-drive you can delete older automatic backups manually from time to time.

How to make a backup

Step 1. Select *File | Backup your Hauptwerk settings and personal data* from the Hauptwerk menu:
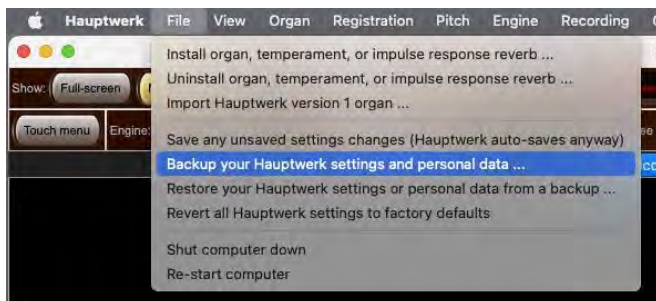
Step 2. A *Save as* window will appear. Use it to navigate to a location in which you want the backup file to be created. For example, choose an attached USB memory stick. Type a meaningful name for the backup file, so that you will be able to identify and find it later, in case you ever needed to restore it, and then click the *Save* button:
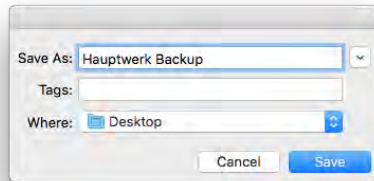
Step 3. After a few moments a message should appear, indicating that your backup has been created successfully, similar to this:
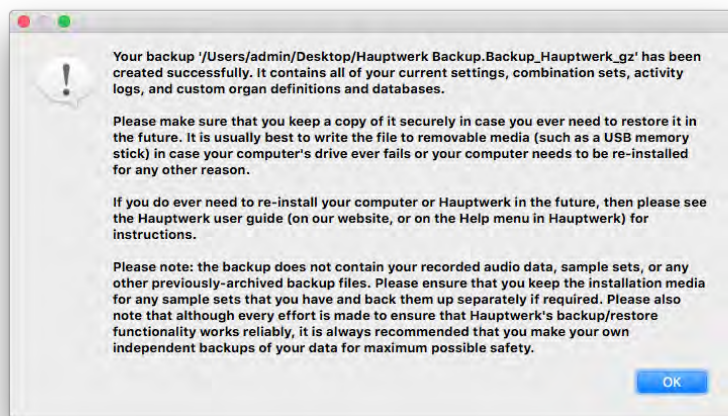
Click the *OK* button to dismiss the message.

If you don't see a success message, then please start again and make sure you type a name for the file when prompted, and that you select a folder that you are allowed to write to.

Moving your settings to a new/different computer or restoring them to your existing computer

If either:

- You want to install Hauptwerk on a different computer, or:

- You need to re-install Hauptwerk from scratch on your existing computer (for example if its storage needed to be replaced or you had to wipe the drive and reinstall the operating system because of a computer virus), or:

- You want to install a new operating system on a different drive or partition

... and you want to restore your Hauptwerk settings and personal data from a backup you made previously, so that you don't have to configure Hauptwerk again from scratch, then please follow these instructions:

Step 1. Now install the latest version of Hauptwerk for which you have a license, following the Hauptwerk installation instructions. You can download the latest version of Hauptwerk from the Hauptwerk website. There's no reason to install an old version and then upgrade in separate steps, even if you were using an older version previously. Just install the latest version directly.

Step 2. If applicable, attach/insert the media containing the most recent backup you made of your Hauptwerk settings and personal data.

Step 3. Launch Hauptwerk. Select *File | Restore your Hauptwerk settings or personal data from a backup* from the Hauptwerk menu:
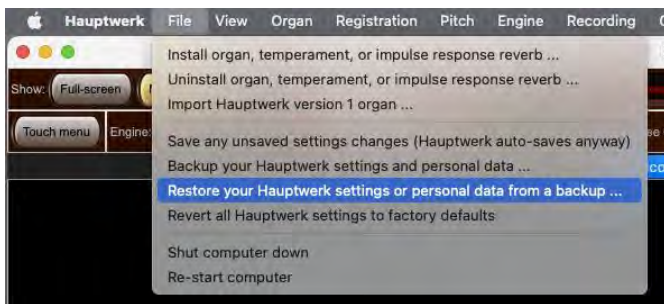
Step 4. When prompted for the file to restore, navigate to and select your backup file. Click *Open* to restore the selected backup file.

Step 5. A screen ('wizard') similar to the following should appear:
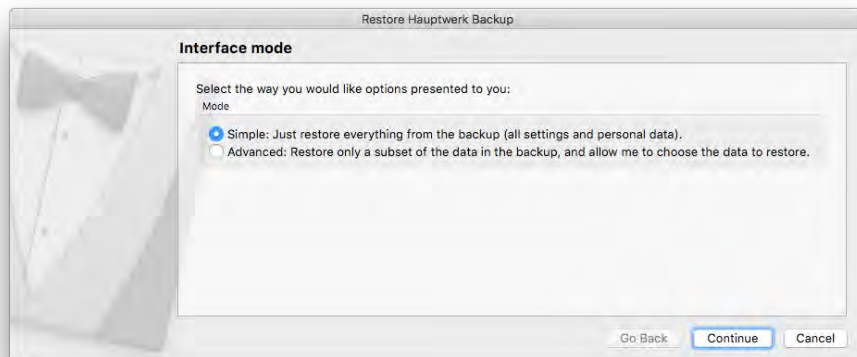
Click the **Continue** button.

Step 6. A screen similar to the following should appear:
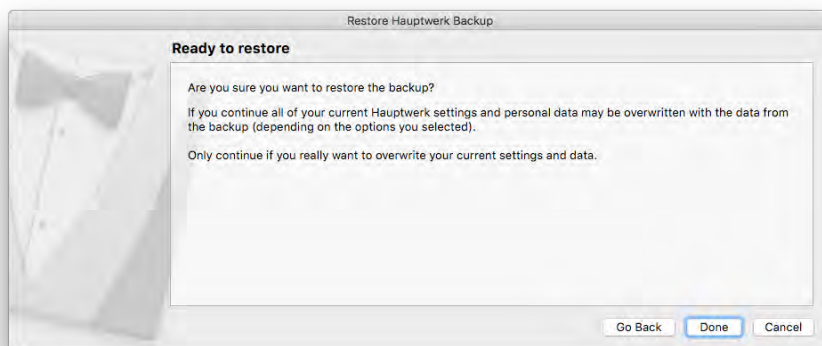
Click the **Done** button.

Step 7. Now Hauptwerk will restore the backup of your previous settings that you originally selected. After a few moments a message should appear, indicating that the backup has been restored successfully, similar to this:
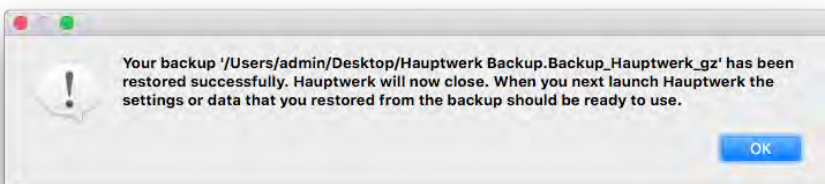
Click **OK**. Hauptwerk should close.

Step 8. Launch Hauptwerk again. Hauptwerk will perform any necessary computer/configuration or platform-specific migrations automatically. Look at some of the settings screens to verify that your previous settings have now been restored properly.

Step 9. Select the appropriate audio and MIDI devices for your new computer on the *General settings | Audio device and channels* and *General settings | MIDI ports* screens.

Step 10. Re-install each third-party sample set that you have using Hauptwerk's component installer.

Step 11. Load each virtual organ and fine-tune its polyphony limit and any other performance settings for your new computer, as described in the ***Performance tuning*** section, and check that everything is working as expected.

Copying your settings from one configuration to another on the same computer

Several independent Hauptwerk configurations are automatically created when Hauptwerk is installed, each allowing its own entirely separate set of configuration settings within Hauptwerk, and launched via different icons on the desktop, such as the main *Hauptwerk* icon and the *Hauptwerk (alt config 1)* icon. For more information, please see the *Installation: background information* section.

You can use Hauptwerk's backup/restore functionality to copy your settings from one configuration to another. To do so:

Step 1. Launch the Hauptwerk configuration that you want to copy settings to. For example, open Hauptwerk using the *Hauptwerk (alt config 1)* icon on your desktop. Create a backup of your settings and personal data using *File | Backup your Hauptwerk settings and personal data* from the Hauptwerk menu, as described in the *How to make a backup* instructions above (although you might choose not to bother writing the backup to removable media in this case). Backups always contain data for all configurations, so you don't need to use the source configuration separately to create the backup.
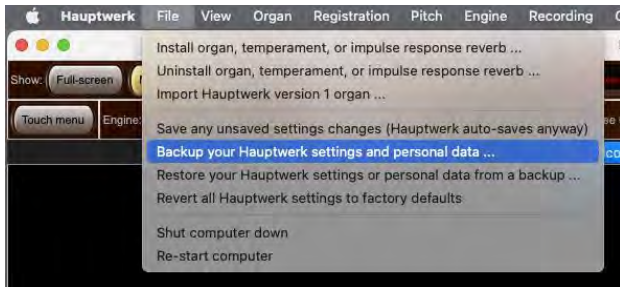
Step 2. Select *File | Restore your Hauptwerk settings or personal data from a backup* from the Hauptwerk menu:
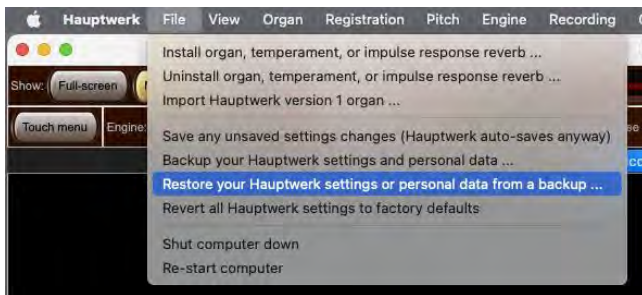
Step 3. When prompted for the file to restore, navigate to and select the backup file you created in step 1.

Step 4. A screen ('wizard') similar to the following should appear:
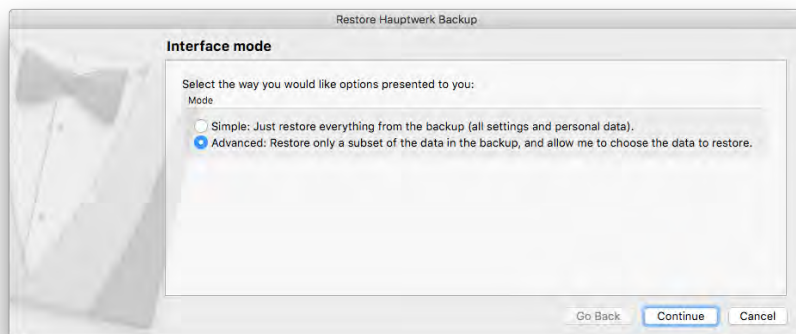
Change the mode from *Simple* to *Advanced* then click the **Continue** button.

Step 5. A screen similar to the following should appear:
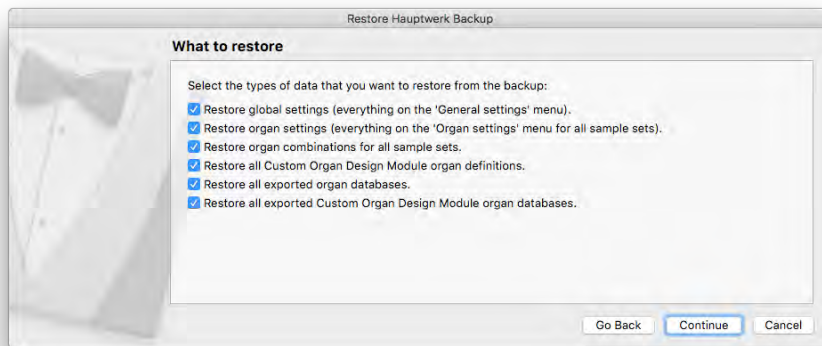
Un-tick the options *Restore organ combinations for all sample sets* and *Restore all Custom Organ Design Module organ definitions*, and both of the *Restore all exported … databases* (since those types of data are shared between all configurations anyway, so there is no need to restore them in this case), but leave the *Restore global settings …* and *Restore organ settings …* options ticked (since those types of data are stored separately for each configuration). Click the *Continue* button.

Step 6. A screen similar to the following should appear:
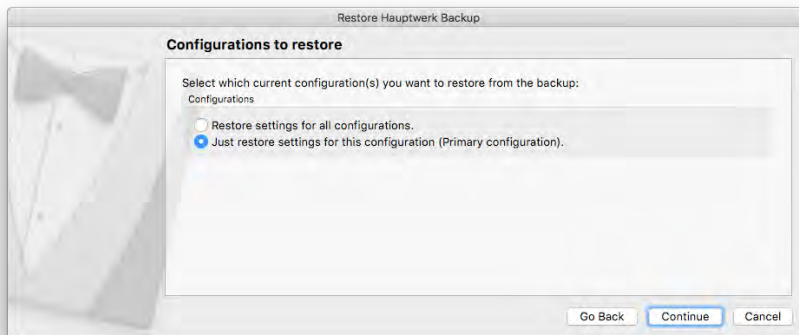
Change the selection to *Just restore settings for this configuration ...* . Click the **Continue** button.

Step 7. A screen similar to the following should appear:
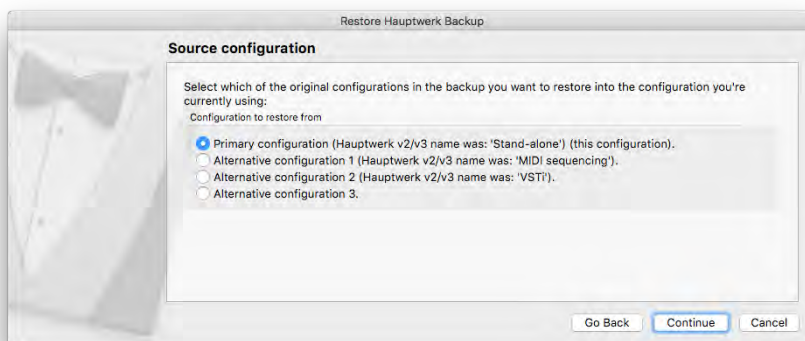
Change the selection to the configuration you want to restore your settings from. Click the **Continue** button.

Step 8. A screen similar to the following should appear:

Click the **Done** button.

Step 9. Now Hauptwerk will restore the backup, copying the settings from your chosen source configuration into this configuration. After a few moments a message should appear, indicating that the backup of your configuration has been restored successfully, similar to this:

Click **OK**. Hauptwerk should close.

Step 10. Launch the target configuration of Hauptwerk again. Hauptwerk will perform any necessary computer/configuration or platform-specific migrations automatically. Look at some of the settings screens to verify that your previous settings have now been restored properly.

Section III: Quick start

Quick-start

Follow these instructions if you will be playing Hauptwerk 'live' from MIDI/USB music keyboards or an external MIDI organ console.

Make sure that you have followed all of the installation steps in the **_Installing Hauptwerk_** section. Make sure that your MIDI interface or USB music keyboard(s) and audio interface are properly connected to the computer and powered up, and that your Hauptwerk license has been activated in iLok License Manager if you have purchased a license for Hauptwerk.

Connect the audio output from your audio interface to some form of external amplification, such as a hi-fi system or headphones.

Connect MIDI OUT port(s) on any MIDI keyboard(s) or organ console to the MIDI IN port(s) on your computer. Make sure that MIDI OUT is enabled on your MIDI keyboard or organ console, if applicable.

Hauptwerk shortcut icon and Hauptwerk (alt config 1-3) icons

Launch Hauptwerk by double-clicking on the main *Hauptwerk* icon on your desktop, or on the icons for any of the alternate configurations 1-3. The alternate configurations allow you to customize a total of four separate complete sets of Hauptwerk settings, each independent from the other. For example, you might want to use the main Hauptwerk configuration for normal playing, and another (such as 'alt config 1') for testing out different settings (such as voicing in the Hauptwerk Advanced Edition) without affecting the settings in your 'main' configuration.
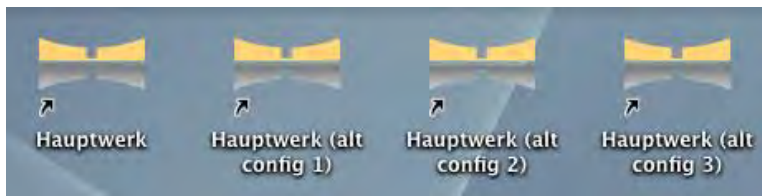
General Configuration Wizard

The *General Configuration Wizard* will run the first time that you launch Hauptwerk (if you want to re-run it in the future go choose *General settings | General configuration wizard* on the menu). Follow the on-screen instructions to select your console type, audio interface and channels, and MIDI port(s). The wizard will then configure your device settings and general options with basic defaults appropriate for your hardware:
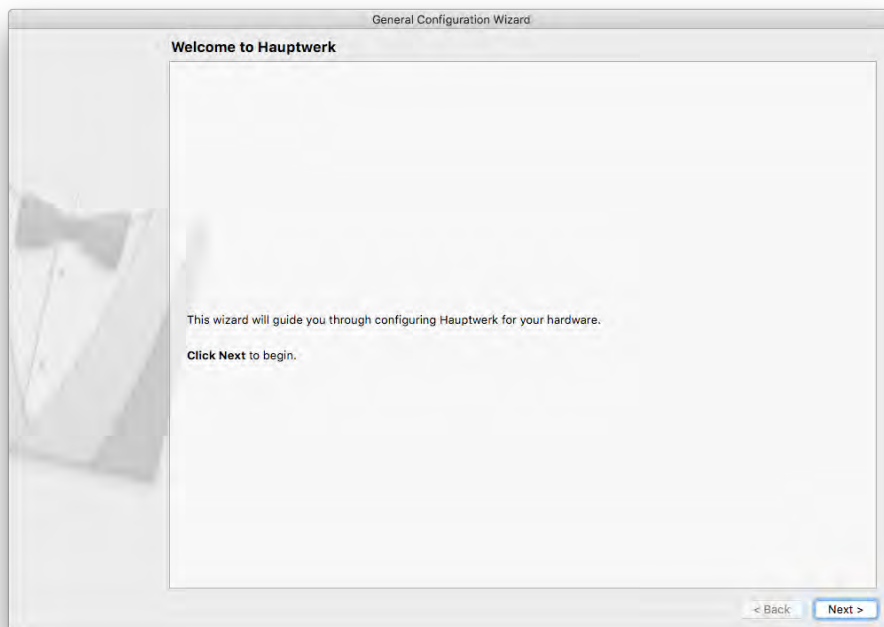
- Click **Next**.

- From the drop-down list choose a configuration that most closely matches your system:
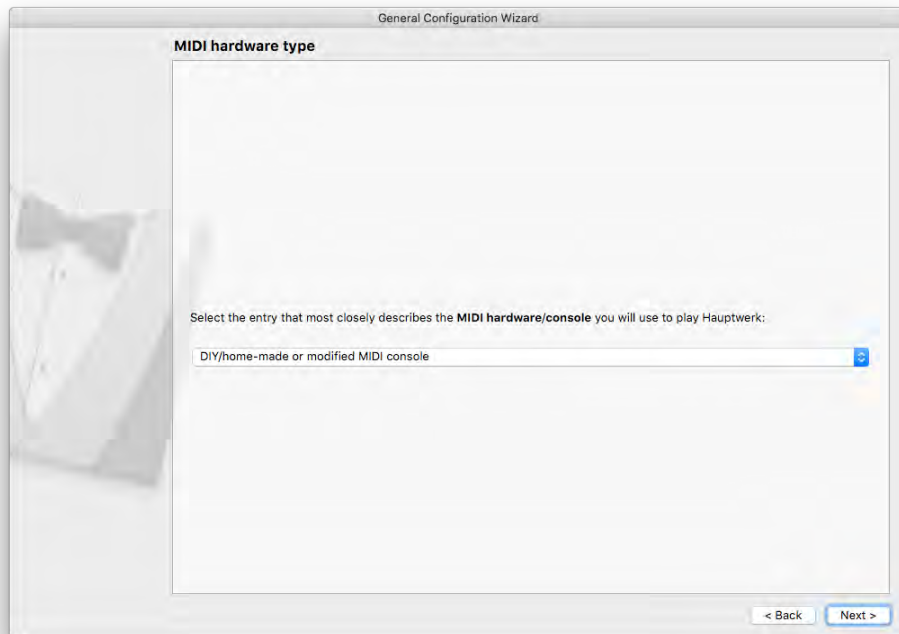
- Click **Next**.

- Choose whether or not to enable MIDI output from Hauptwerk. By default this is set to '*No*'. Only set this option to '*Yes*' if you have a digital/MIDI organ console with solenoid-actuated/illuminated stops, or will be controlling external MIDI hardware or other advanced MIDI applications from Hauptwerk. If you're unsure then leave it set to *No* (you can always enable MIDI output later using the *General settings | MIDI ports* screen):
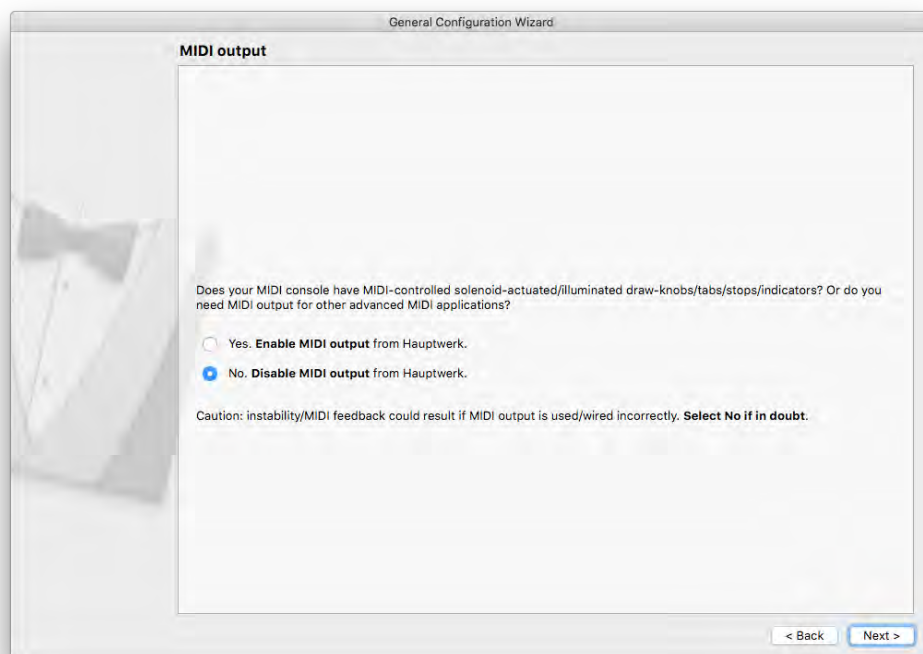
- Click **Next**.

- Tick all of the MIDI input port(s) to which your digital/MIDI organ console, or MIDI keyboards/hardware (if any), are connected, ticking one distinct MIDI IN port (column) in each successive '*Console MIDI IN*' row, until you've ticked all of the MIDI IN ports that you use with Hauptwerk (in a diagonal line, for example). The tick-box grid maps physical MIDI ports (columns) to 'logical' MIDI ports (rows). You can have at most one tick in any given row and column:
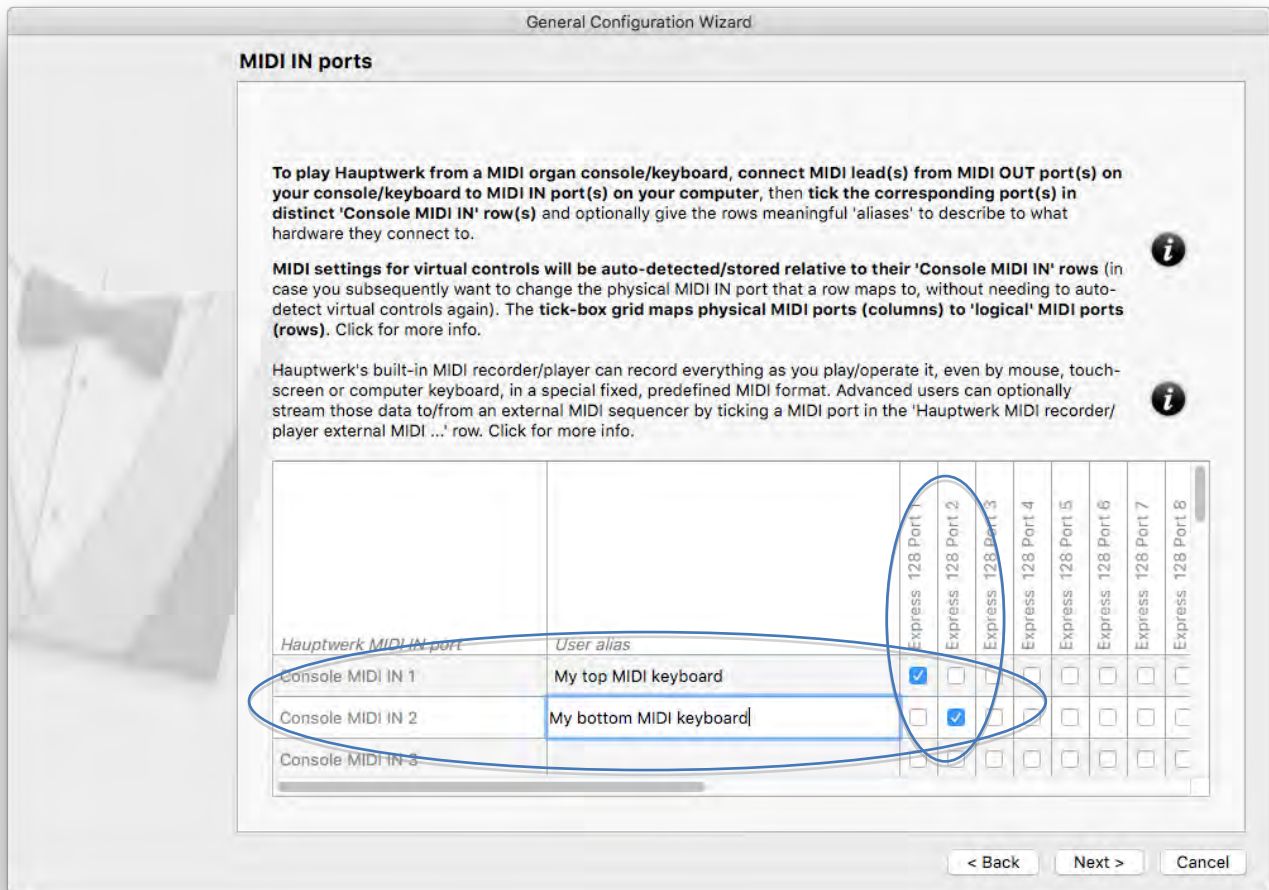
We highly recommend also typing meaningful 'user aliases' for the ticked rows. For example, suppose that you have two separate MIDI keyboards (each with its own separate MIDI or USB-MIDI connection to the computer), and that your upper MIDI keyboard's MIDI IN port is ticked in the '*Console MIDI IN 1*' row; you could then specify something like '*My upper MIDI keyboard*' for the '*User alias*' for that particular row.

Tip: *specifying meaningful user aliases is especially helpful in case you ever want to change your MIDI connections around in the future (or change your MIDI hardware in any other way) – you would then be able to see which MIDI settings relate to them easily, and simply change which physical MIDI port (column) is ticked for the relevant row if needed (thus avoiding the need to auto-detect all virtual controls again).*

Leave the remaining columns and rows unticked (including the '*Hauptwerk MIDI recorder/player external MIDI IN*' row, which is covered in the *MIDI sequencing, the Hauptwerk AU/VST Link and applying external real-time effects plug-ins* section in this guide).

- Click **Next**.

- Now a screen will appear informing that you are done and that you should then set up your audio interface settings on the following settings screen. Click **Finish**:
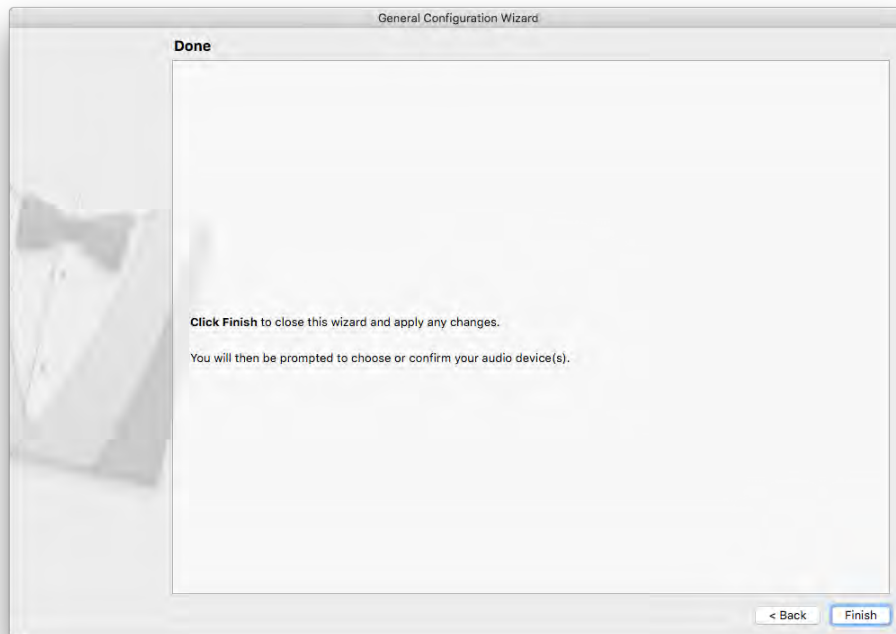
Configuring audio

The first time you run Hauptwerk you will be prompted to select your audio interface and confirm other audio-related settings:
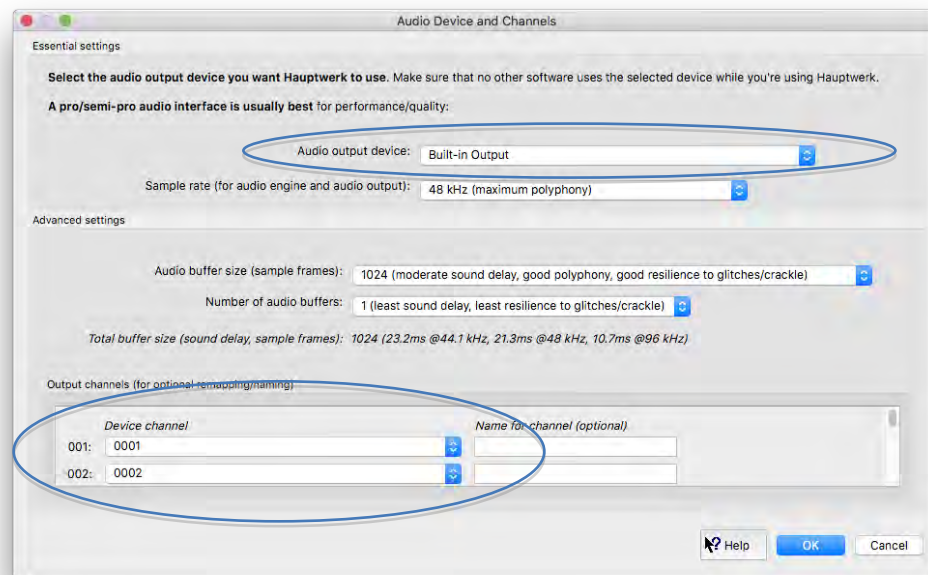
- Make sure that your audio interface is selected in the '*Audio output device*' drop-down list. **If using Windows with an ASIO-compatible audio interface, choose its manufacturer-supplied ASIO driver, rather than any Direct Sound driver, for best performance.**

- • If you have a very powerful computer and a good-quality audio interface, you could set the 'Sample rate …' setting to 96 kHz, which gives the lowest distortion and best audio quality (especially if raising any organs' pitches significantly). However, 96 kHz is very CPU-intensive, so about 50% less virtual pipes would then be able to sound at once (about 50% less achievable polyphony on any given computer hardware). In other cases, leave it set to the default 48 kHz option, which gives very good quality in most circumstances anyway.

- • **If you're using the Hauptwerk Lite Edition**, for the 'Device channel' 0001 and 0002 settings make sure that the device's audio output connections to which you've connected your speakers or headphones are selected. Leave all other settings at their defaults for now then click **OK** to close the screen.

- • **If instead you're using the Hauptwerk Advanced Edition (and if you plan to use anything beyond a single basic stereo output)**, then OK the *Audio Device and Channels* screen (and cancel the option to load an organ, if it then appears), then open the *General settings | Audio mixer* screen, then select the "*Master mix 1 'Stereo mix 1 (main/recording)*'" entry in the left-hand browse list (which is the first entry, and is within the '*Mixer buses for mixer preset 1*' node, which is expanded by default). In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your main stereo pair of speakers, then OK the screen. (The mixer allows more powerful and complex routing to be configured, including surround/3D-sound, sub-woofer aux sends, and multi-channel audio, and the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* section covers how to use the audio mixer screen in more detail.)
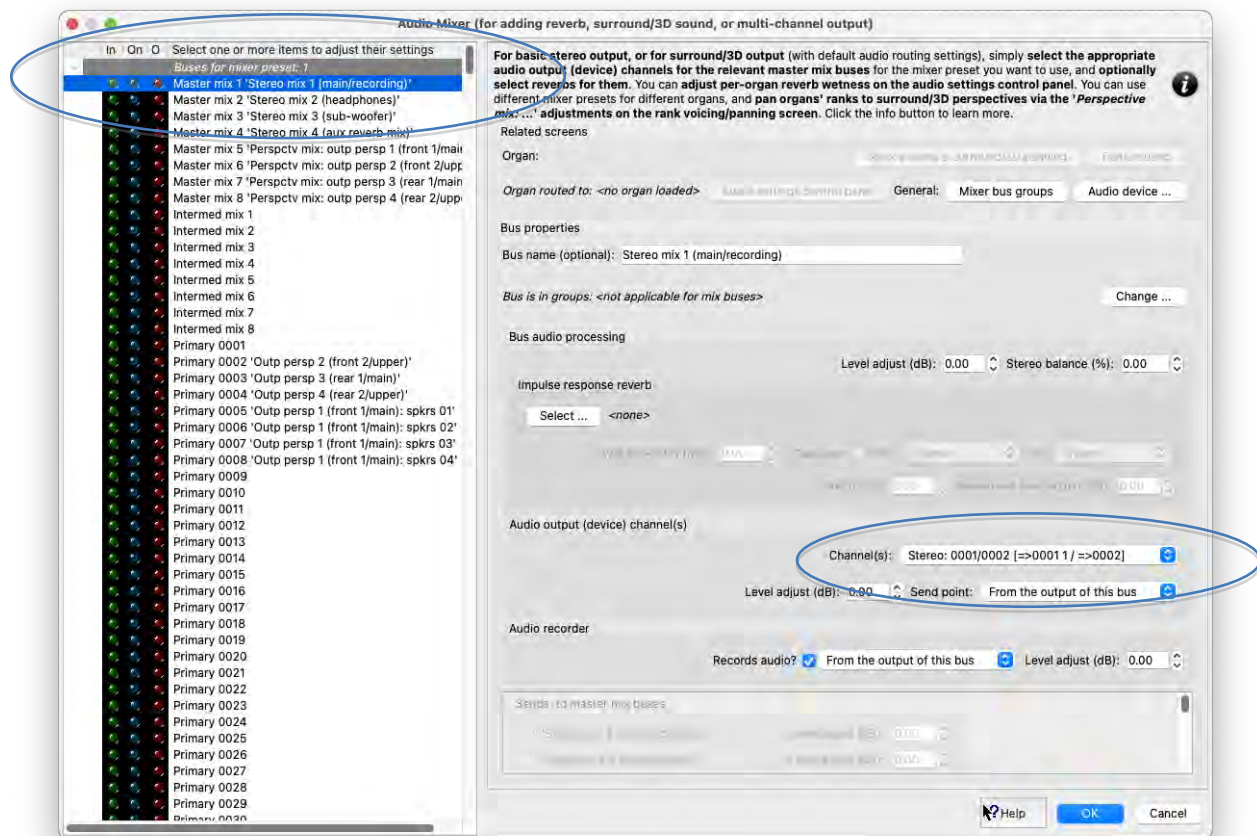
Installing the Hauptwerk latest licensing packages

Download the current 'Hauptwerk licensing packages' Hauptwerk component package file from Milan Digital Audio: https://www.hauptwerk.com/licensingpackages. Use *File | Install …* from the menu in Hauptwerk to navigate to and select the downloaded file, then just click OK to install it (leaving all other options at their defaults).

(The 'Hauptwerk licensing packages' are needed in order to be able to load any iLok-licensed sample sets.)

Once these steps are completed, you're ready to load an instrument in Hauptwerk.

Loading an instrument in Hauptwerk

If you aren't automatically prompted to select and load an organ now, then select use *Organ | Load organ* from the menu:
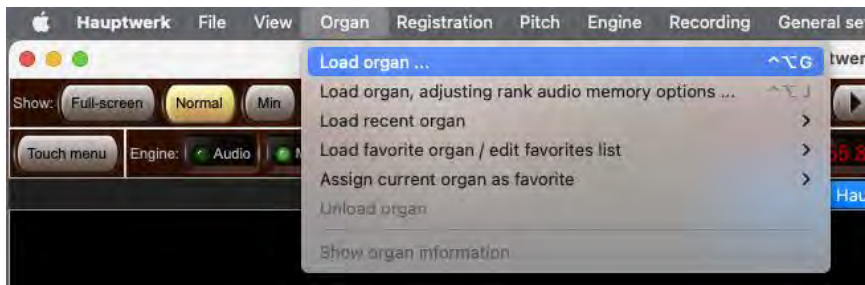
Click on the *StAnnesMoseley* entry and then click *OK*. After a brief pause a screen entitled *Rank Audio Memory Options* should appear:
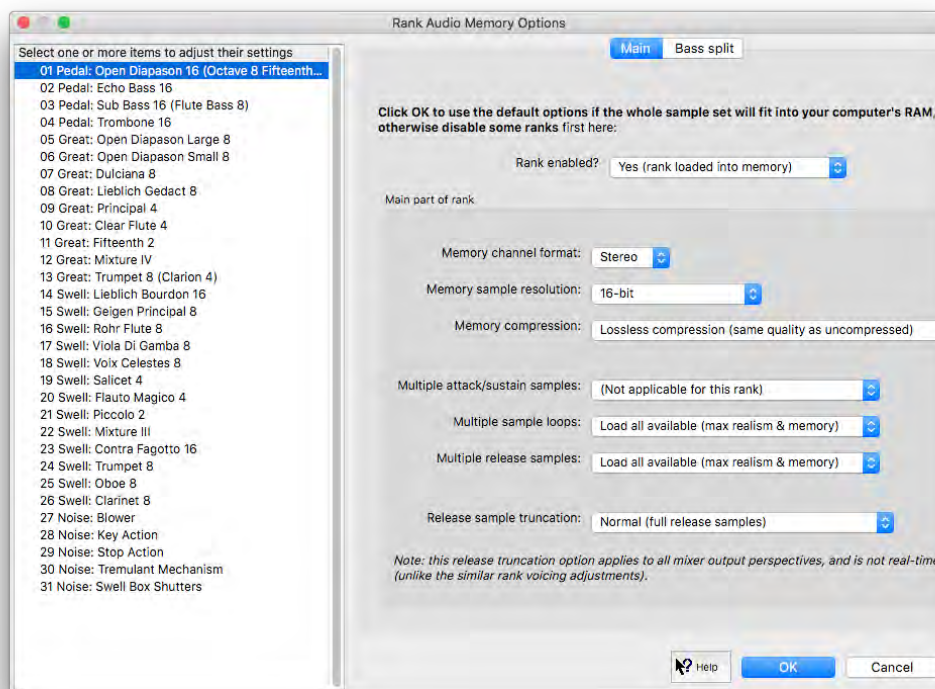
click *OK* to accept the default settings.

The virtual organ should now load, which may take a few minutes, depending on the speed of your computer. **The first time that each organ is loaded, analysis and processing of its sample data are performed, the results of which are saved to a special 'sample set data cache', so that each subsequent load is many times faster.** (Note that subsequently changing per-rank options via *Organ | Load organ, adjusting rank audio memory options* will cause the sample set data cache to be regenerated automatically for the selected organ.)

As soon as the sample set has finished loading, Hauptwerk will automatically attempt to start the audio and MIDI drivers/interfaces. If any errors occur relating to unsupported audio formats or buffer sizes, change the audio device (or its settings) as needed for your audio interface via the *General settings | Audio device and channels* screen.

Organ configuration wizard

Once the audio and MIDI systems are started successfully, the *Organ Configuration Wizard* will appear. Just click through the wizard screens (accepting the default audio options for engine processing quality, etc.):
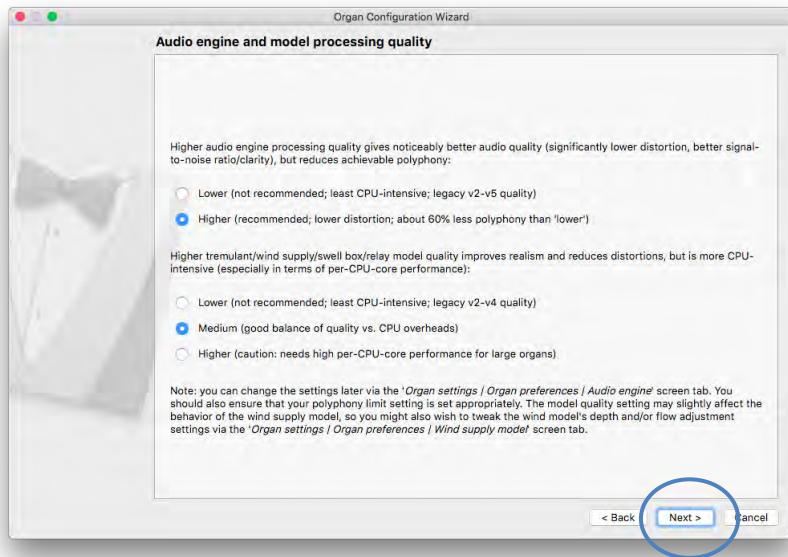
… then click *Finish*:
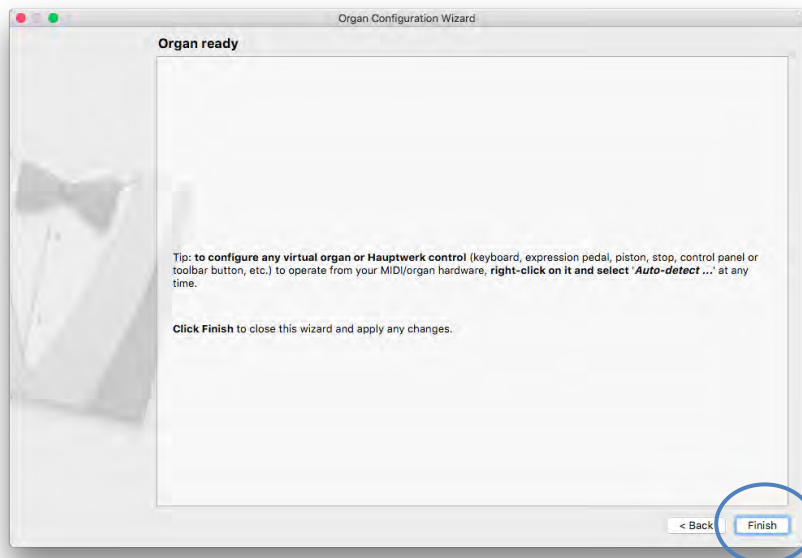
This wizard runs each time you load an organ for the first time, or you can use it at any other time to reset your settings for the organ using *Organ settings | Organ configuration wizard*.

The St. Anne's organ console should then appear:
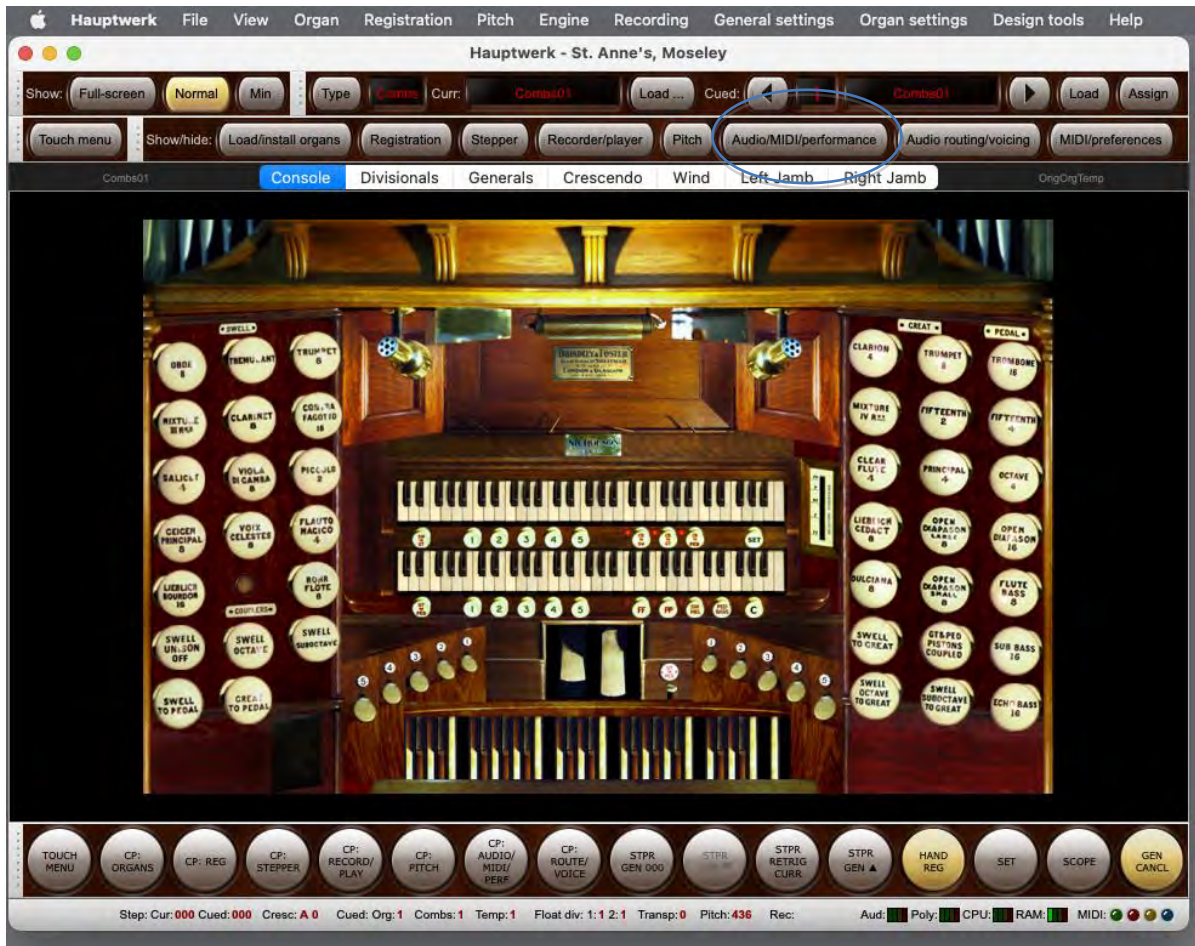
Click on the *Audio/MIDI/performance* button near the top of the screen to open the *Audio, MIDI and Performance* large control panel:
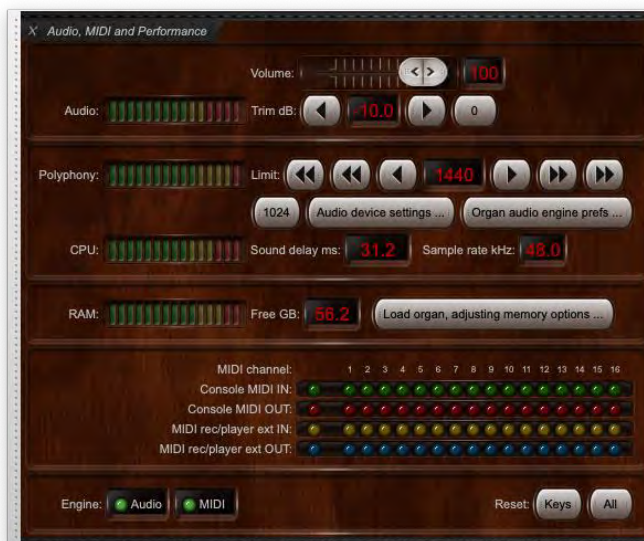
(You can alternatively open the control panels again via the *View | Large floating control panels (for this organ)* menu, or from the piston toolbar buttons at the bottom of the screen.)

Click and drag the gray bar at the side of the *Audio, MIDI and Performance* control panel to move it to one side, so that you can see the St. Anne's virtual keyboards and Great stops on the right-hand side of the console. Click on the 'OPEN DIAPASON LARGE 8' stop on the right-hand side of the console to engage it:
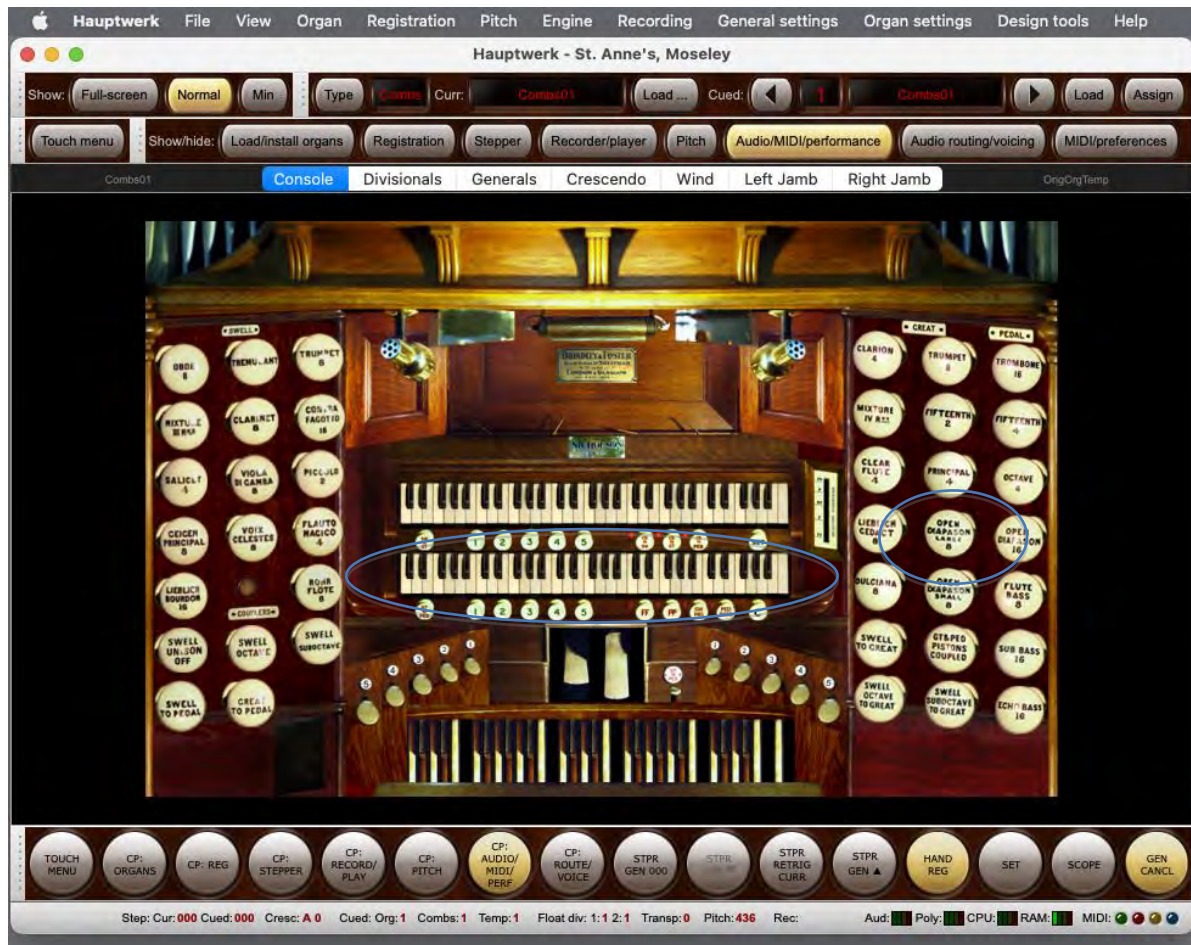
Now click on a key on the lower of the two virtual manuals (keyboards), and hold it down. You should be able to hear the corresponding pipe sounding. If not, check that the 'Audio' signal meter shows activity on the *Audio, MIDI and Performance* control panel when you press the key (which indicates that Hauptwerk is producing audio output) and check your audio cables, that the amplifier is turned up, and, if necessary, check the settings on the *General settings | Audio device and channels* screen to make sure you have the correct audio device selected. (You can open the screen via the main menu, or via the *Audio device settings* button on the *Audio, MIDI and Performance* control panel.) Once you can hear the pipe correctly, release the virtual key.

If the sound is breaking up or crackling whenever any pipe sounds, then first check that the audio connections and wiring are good. If so, with the virtual organ still loaded, go to *General settings | Audio device and channels*. Make sure that the manufacturer-supplied driver is selected as the audio output device (choose ASIO on Windows). If that doesn't solve it, try larger audio buffer size settings. The buffer size setting determines the delay between pressing a key and hearing the sound, termed the latency. Buffer sizes in the region of 1024 samples (the default) usually work well for Macs and for Windows ASIO drivers, but you can use smaller buffer sizes to give a faster response (lower latency) if your hardware allows it, usually at the expense of a little polyphony (number of organ pipes that can sound simultaneously). Most professional audio interfaces can manage a buffer size of 512 samples without a significant reduction in polyphony.

Note: on Windows some DirectSound drivers work well with certain specific small buffer sizes but not others. In general, manufacturer-supplied ASIO drivers, which are almost always available on professional audio interfaces, are to be preferred. Note also that some ASIO drivers only allow the buffer size to be adjusted via the manufacturer-supplied ASIO control panel. If Hauptwerk's buffer size setting is having no effect, click on the *Show device control panel* button and try adjusting the buffer size there.

❖   **Note: the driver and the buffer size setting determine the latency, rather than Hauptwerk itself**.

Once audio is working properly, close the *Audio, MIDI and Performance* control panel again, either by clicking on the small 'x' icon at its top-left, or by clicking on the *Audio/MIDI/performance* button near the top of the screen again.

MIDI learn (settings auto-detection)

Hauptwerk features 'MIDI learn' throughout, making it quick and easy to set up MIDI organ consoles or other MIDI hardware to interface with Hauptwerk, with little or no knowledge of MIDI required. MIDI learn is referred to in Hauptwerk as "auto-detect" since it may also apply to non-MIDI devices (such as computer keyboards, which don't send MIDI). When activated Hauptwerk will "listen" for the incoming messages for a particular virtual control and then apply that information to the selected control, with no further manual intervention. This means that you can set up a complete console in a matter of minutes, without needing to know or configure the MIDI messages that your MIDI hardware sends.

Using MIDI learn it is possible to configure an instrument in a matter of minutes.

MIDI learn can be initiated by right-clicking on any virtual control (on a virtual organ console or on a Hauptwerk control panel) and then choosing '*Auto-detect...*'. Below are short tutorials for how to set up MIDI connections for various controls on the virtual instruments. Your MIDI hardware must already be connected to the computer and functioning properly.

Auto-detecting MIDI keyboards

If you have any MIDI/USB-MIDI music keyboards or a digital organ MIDI console follow these steps to set up your keyboards and pedal boards to connect to the virtual keyboards for live playing:

- Right-click on a key on a virtual keyboard, such as the lower of the two St. Anne's virtual manuals (the Great).

- Select '*Auto-detect MIDI/trigger settings for keyboard...*':
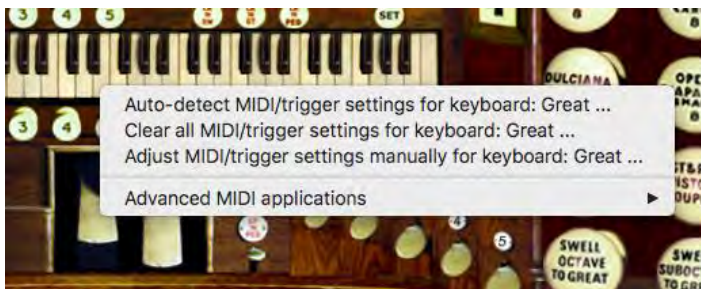
- Follow the instructions on the screen, pressing the appropriate keys as instructed.

- Click **Done**.
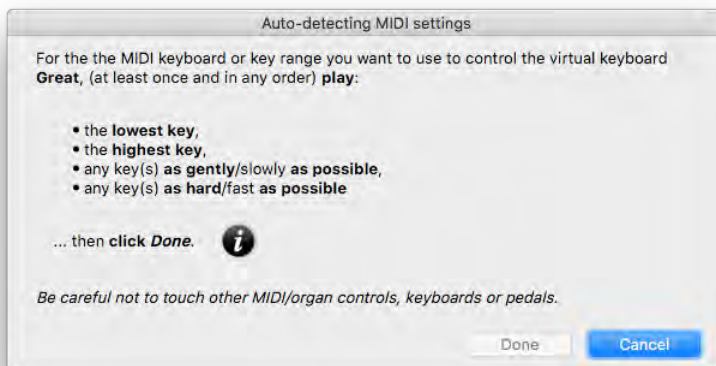
- Play some keys on your MIDI keyboard. The virtual keys on the virtual keyboard should now play (move on the screen) in response.

- Repeat this process for any other keyboards and pedal boards that you wish to configure.

- ❖ **Note: click the black "Info" icon for further details about MIDI learn**.

Auto-detecting MIDI expression pedals

If you have any MIDI/USB expression pedals, or other continuous controller sliders or knobs, follow these steps to set up your hardware to connect to virtual controls for live playing:

- Right-click on a virtual continuous control, such as the St. Anne's left expression pedal (the Swell pedal).

- Select '*Auto-detect MIDI/trigger settings...*':
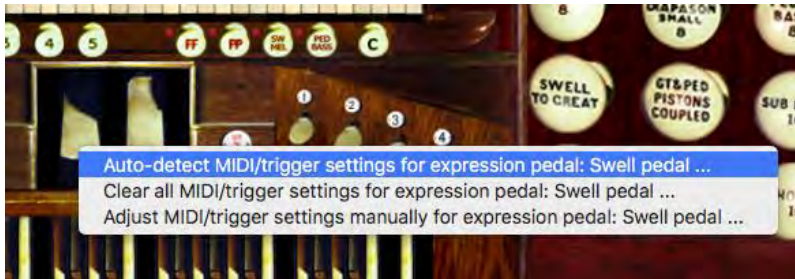
- Follow the instructions on the screen, moving the hardware controller as instructed.

- Click **Done**.
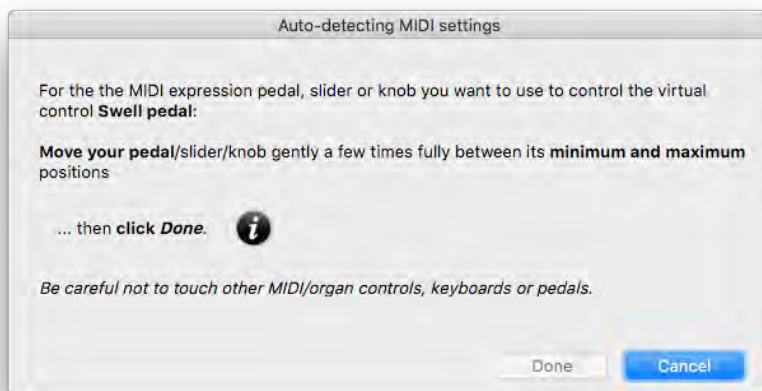
- Move your expression pedal up and down and you should now see the virtual expression pedal move in response.

- Repeat this process for any other expression pedals, crescendo pedals or sliders and knobs that you wish to configure.

- ❖ **Note: click the black "Info" icon for further details about MIDI learn**.

Auto-detecting MIDI stops, pistons and switches

If you have any MIDI/USB stops, pistons or other switch types (including computer keyboard keys) that you want to use to control Hauptwerk's virtual stops/pistons/switches, follow these steps to set up your hardware to connect to the virtual switches for live playing:

- Right-click on a virtual stop (such as the St. Anne's *Open Diapason Large 8*).

- Select '*Auto-detect MIDI/trigger settings for stop...*':
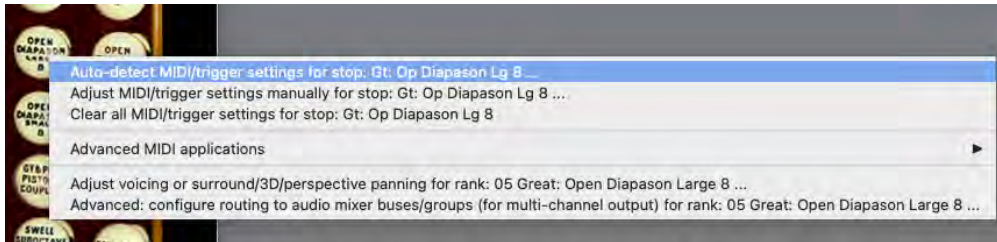
- Follow the instructions on the screen, activating your physical stop/piston/switch as instructed.

- Click **Done**.
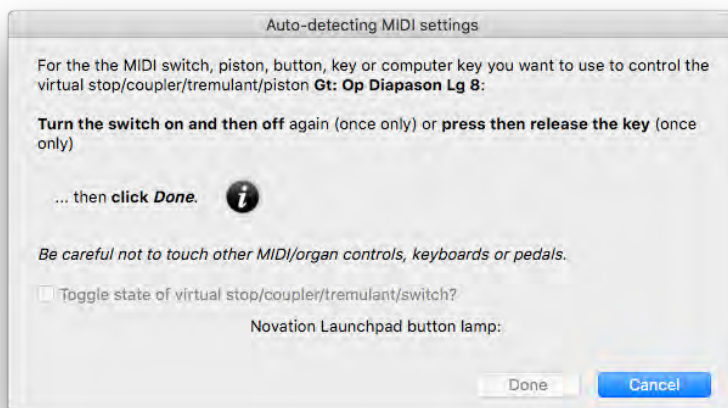
- Move your MIDI switch/piston in and out (or on and off) and you should now see the virtual switch move in response.

- Repeat this process for any other stops or pistons or other switches that you wish to configure.

- ❖ **Note: click the black "Info" icon for further details about MIDI learn**.

Important note for digital organ users: if you are configuring Hauptwerk to be played from a commercial digital organ that has its own built-in combination system then (assuming that the digital organ's stop and pistons send MIDI in formats that Hauptwerk can understand) you may either:

1. *Configure (auto-detect) Hauptwerk's virtual stops*/couplers/tremulants to respond to the digital organ's stops/couplers/tremulants, **then use the digital organ's built-in combination** system instead of Hauptwerk's, but **_don't_** configure (auto-detect) any of Hauptwerk's virtual combination pistons/buttons to respond directly to the digital organ's combination pistons, **_or_**:

2. *Configure (auto-detect) Hauptwerk's virtual combination pistons*/buttons to respond directly to the digital organ's combination pistons, then **use Hauptwerk's combination system** instead of the digital organ's built-in combination system, but **_don't_** configure (auto-detect) any of Hauptwerk's virtual stops /couplers/tremulants to respond to the digital organ's stops/couplers/tremulants.

It's very important that you never have **_both_** Hauptwerk's virtual stops/couplers/tremulants **_and_** its virtual combination pistons/buttons configured to respond directly to the digital organ's corresponding controls, otherwise Hauptwerk's combination system will inevitably 'fight with' the digital organ's combination system over the states of the stops/couplers/tremulants, usually leading to the stops/couplers/tremulants getting out of sync. or ending up in unpredictable states. If you do accidentally end up in that situation then you should decide on which of the two modes of use listed above you prefer, then use '*Organ settings | Organ configuration wizard*' to reset all MIDI/key trigger settings for the organ (so that the conflicting configuration is cleared), then auto-detect just the appropriate types of virtual controls.

A brief tour of a pipe organ

If you're unfamiliar with pipe organs and their terminology this section should give you a background sufficient to find your way around Hauptwerk.

A pipe organ has one or more keyboards, termed *manuals*, and usually a *pedalboard*, which is effectively another keyboard played by the feet. The *console* is the part of the organ with which the organist interacts, containing the keyboards and controls used to play the organ.

Different tones are produced by engaging sets of pipes, each with a particular tonal quality. Such a set of pipes is termed a *rank*, and usually has one pipe for each key on the keyboard or pedalboard. The rank is engaged and disengaged with a switch on the console called a *stop*. The stop switches on the console are usually physically either *draw-knobs* (push-off, pull-on) or *tabs*.

Each rank is usually attached to only one manual or the pedals. A manual (or the pedals) together with the set of stops (and hence ranks and pipes) that are attached to it is termed a *division*. Each division has a name and a particular overall tonal character. Of course, organs from different countries have different names for the divisions and traditions have led to differences in their tonal structure.

On an English pipe organ, there are usually between two and four manuals and a pedalboard:

- The *Pedal* division is used to play the bass parts and has the deepest sounds.

- The *Great* (bottom manual or second manual from the bottom) division has the main and loudest organ sounds (the *diapason chorus* or *principal chorus*).

- The *Swell* (second or third manual from the bottom) division has more orchestral and imitative sounds, such as oboes, clarinets and varieties of string-like sounds. Its tone is usually controlled by a *swell pedal*, which operates shutters on a box that encloses its pipes, allowing the sound volume and brightness to be increased or decreased.

- The fourth division usually found is the *Choir*, with its manual positioned below the Great manual. It contains softer, plainer stops for accompanying singers.

- If there is a fifth division, it is usually the *Solo*, positioned as the top manual and containing louder, prominent, solo stops.

The Choir and Solo divisions are sometimes enclosed in separate swell boxes operated by independent swell pedals.

The stops are designed to complement each other both in terms of timbre, volume, and the pitch at which they sound. The pitch of many stops is used to reinforce the harmonic content of other stops, when used in combination with them. The numbers on stops indicate their pitch in feet. The number indicates the length of the lowest C pipe in the stop, hence the lowest C pipe on an *Open Diapason 8* stop is 8 feet in length. 8' stops are the 'normal' (*fundamental*) pitch of the manuals. A 4' stop will sound exactly one octave higher than an 8' stop, hence engaging a 4' stop reinforces the second (octave) harmonic of the 8' tone. A 2' stop will reinforce the fourth harmonic, two octaves above the pitch of the 8' stop. The lowest stops usually found are 32', in the pedal divisions of very large pipe organs. Sounds below a 32' C are not audible to the human ear. The highest stops are commonly found are 1 $^1/_3$', again bordering on the human hearing range at the top of the manual.

Some stops have fractional lengths, such as the *Quint 2 $^2/_3$*. These are termed *mutations* and enforce harmonics that are not octaves of the 8' fundamental tone. For example, playing a C note on a 2 $^2/_3$' stop will sound a note approximately equal in pitch to playing a G note an octave and a half above the C on an 8' stop, reinforcing the third harmonic. A 1 $^3/_5$' stop will play two octaves and a major third above an 8' stop. These stops would not normally be played without their non-fractional counterparts, since they would effectively transpose the music played.

Most organs have one or more *mixture* stops. These have more than one pipe per key (and thus several ranks), and the number of pipes per key is indicated in the stop name; a *Mixture IV* has four pipes per key, for example. The intervals that separate the pipes comprising the mixture (the *mixture composition*) vary, and they often vary across the compass of the manual. Most frequently, they contain a 2' stop and various mutations (of the fundamental 8' tone) built around it. They are used to add a shrill sheen to the sound, and again are almost never used as solo stops.

The name of a stop (rank) also indicates its tonal qualities. There are four main tonal groups:

- *Diapasons* or *Principals* are of pure 'organ tone' and are rich in harmonics, with a full-bodied sound. These form the main *diapason chorus* on the Great, the backbone of the organ. Secondary, softer diapason choruses are often found on other manuals. They appear under various names - *Diapason*, *Principal*, *Octave*, *Fifteenth*, *Prestant*, *Montre*, and are usually also used for the mutations and mixtures.

- *Flutes* have less harmonic development, and are of a softer, purer sound. Some examples are the *Gedackt*, *Clear Flute*, *Harmonic Flute*, *Rohrflute*, *Hohl Flute* and *Bourdon*.

- *Reeds* produce sound in a different way to other pipes, in that a metal *reed* vibrates mechanically against a *resonator* tube. They are very rich in harmonic content and may be very loud and brilliant. Common examples are the *Trumpet*, *Clarion*, *Trombone*, *Clarinet*, *Oboe*, *Crumhorn* and *Contra Fagotto*. They may be used as solo stops or to add vibrance and presence to a chorus of other stops.

- *Strings* are (usually) strictly a subclass of the diapasons, but with a much narrower scale of pipe. They are harmonically rich and designed for their string-like qualities. Common examples are the *Viola*, *Gamba*, *Salicional*, *Viola di Gamba*, *Salicet*, *Geigen Principal* and *Violin Principal*. They are usually warm and soft in tone.

Some pipes are classified as *imitative*, in that they are designed to sound as close as possible to their orchestral namesakes. The *Clarinet* is one such stop.

Modern keyboards and synthesizers are almost always tuned to *equal temperament*, meaning that the musical interval between any two consecutive notes (a semitone) is constant across the whole keyboard. Although this is not musically 'perfect' (if you play a C and an E together, for example, you can hear a phasing because the harmonics are not perfectly tuned), it means that music can be transposed and progress through different keys and the tuning will sound exactly the same. It is a compromise. Alternative *temperaments* (tunings) are quite often found in organs, where the different effect of each key may be used to advantage, particularly with historical music.

A very few organ stops are deliberately tuned sharp or flat, relative to the other stops on the organ. The *Celeste* is the most common example, which is designed to produce a chorus effect when played with specific other stops, such as a *Viola di Gamba*. (The Encyclopedia of Organ Stops website is a useful reference for stop classification.)

Couplers are mechanical, pneumatic or electrical devices that link manuals or divisions together. Their controls usually have the same appearance as stops, in that they are usually controlled by draw-knobs or tabs. If the *Swell To Great* coupler is engaged, then playing a note on the Great manual will play the same note on the Swell manual, enabling their sounds to be combined and borrowed from other divisions. Note the order in which the manuals are listed in the name: the division appearing first in the name plays automatically when the second is played by the organist.

Couplers may link keyboard keys physically, so that pressing a key on one manual actually causes the corresponding key on the coupled keyboard to move. However, more usually, a coupler affects only the *key action*, being the way in which the keyboard is connected to the pipes, and so no additional keys are seen to move when the coupler is engaged.

Couplers may couple at *non-unison* pitch. For example, the *Swell To Great Octave* coupler will play a note on the Swell that is one octave higher than any note pressed on the Great. Non-unison couplers may also act upon the same division as the key pressed. For example, the *Swell Octave* coupler will play a note one octave higher on the Swell for each note on the Swell that is played by the organist. In this case, the couplers are used to increase the strength of the second and upper harmonics.

The *Unison Off* coupler prevents keys played directly from sounding at all, but allows coupled keys to sound. For example if you play a middle C on the Swell with the Swell Octave and Swell Unison Off couplers engaged, the middle C will not sound, but the C above it will.

Stops do not always have pipes for all notes on the keyboard for their division, although most do. If a stop only has pipes from the second C from the bottom of a 61-note keyboard (for reasons of economy when the organ was built), it is usually shown with a *TC* or *Tenor C* legend in the specification. Occasionally, the pipes for a division extend beyond the range accessible by the keys, so that non-unison couplers continue smoothly into the top or bottom octaves.

Sometimes stops or even parts of stops are *borrowed* from ranks from other divisions. A pedal *Trumpet 8 (Gt)* stop indicates that the pipes from the Great Trumpet 8 rank actually sound when the stop is engaged, even though the stop belongs to another division. This is a fairly common economy on the part of organ builders, and is usually indicated by the 'real' division appearing in brackets.

Organs that have a small number of pipe ranks, from which many stops are *derived* (borrowed) are termed *unified* or *unit* organs, the method being *unification*. In particular, *theatre/cinema organs* are constructed on this principle, with a small number of ranks from which a great number of stops are derived at many pitches, and it is a key aspect of their sound.

Couplers occasionally act upon only some stops in a division. For example the *Swell Reeds To Great* coupler only links the reed stops from the Swell to the Great.

Bass couplers are special in that they only couple the lowest note played. They are fairly common on smaller instruments, where the organist may not be competent in the use of the pedals, and allow the Pedal division to be played 'automatically' by the lowest note played on a manual. For Hauptwerk users without a MIDI pedalboard they are an especially useful inclusion. *Melody/Melodic couplers* are similar, but couple only the highest note played, thus emphasizing a solo melodic line.

A *ventil* is another (fairly uncommon) playing aid, which simply 'turns off' a set of ranks, usually by shutting a valve which prevents any air reaching their pipes.

A *tremulant* is a mechanical contrivance by which the air pressure supplied to the pipes is varied periodically, giving a 'tremble' to the sound. Its effect is to vary the pitch, amplitude and harmonic content of the sound of each pipe in complex ways, and with complex modulating waveforms. It is usually accomplished with a pneumatic motor venting air from the pipes' supply. It is another key aspect of the sound of a theatre/cinema organ. Tremulants are usually turned on and off by draw-knobs or tabs on the console.

Buttons on an organ are usually termed *pistons* due to the way in which they worked historically.

A *combination action* is a mechanism by which combinations of stops, couplers, tremulants and other controls can be memorized and recalled with a single piston button. These pistons are usually located below the manual and above the pedals and memorize controls for the corresponding division (*divisional combinations*), and sometimes also store combinations for all of the settings on the organ, regardless of division (*general combinations*).

A combination action may be *fixed* or *programmable/adjustable*. In Hauptwerk, all combinations can be programmed, and any current setting can usually be captured to any combination piston appropriate to the division. As do some pipe organs, Hauptwerk also has a *registration sequencer* comprising a series of programmable *combination frames*, which are general combinations that form a sequence, allowing all of the stop movements for a recital to be recorded and cycled through by pressing a single piston.

Note that some combination actions cause the associated draw-knobs or tabs to move physically when they are triggered, whereas others invisibly add to or replace the registration shown on the console, and have a 'state' (on or off), and may be grouped so that only one can be selected at any one time. The former system is more common in English organs, the latter in European organs.

The *FF*, *Tutti*, or *Full Organ* switch (piston, draw-knob or tab) is an example of 'stateful' combination, which turns on the main chorus stops and couplers to give a loud, full and majestic sound conveniently, without moving the stop and coupler switches physically, and usually adding to their registration.

Some organs have *combination couplers* that couple divisional combination buttons. For example, if the *Great Pistons To Pedal* coupler is engaged, pressing a Pedal combination piston also activates the corresponding Great piston.

Sometimes *reversible pistons* are available to provide convenient short-cuts for often-used couplers (or other controls). Each time they are pressed, they toggle the state of their associated coupler. The *Swell To Great* coupler often has such a reversible piston.

A *crescendo* is another playing aid, sometimes found on larger instruments. It is operated by an expression pedal (like a swell pedal), and engages and disengages combinations of stops as it is moved. It is usually programmable, and configured so that progressively louder stops are engaged as it is moved forward, and disengaged as it is moved backwards, thus giving a convenient crescendo or diminuendo while keeping the hands free.

Theatre organs often have *second touch* on their manuals, whereby pressing a key down further than normal causes additional (usually solo) stops to sound. The stops triggered in this way can usually be selected from separate stop switches on the console.

Some organs (especially theatre organs) also have *percussion stops*, such as *carillons* (bells), acoustic pianos, glockenspiels and so forth, struck by hammers when the corresponding keys are pressed. Sometimes non-tuned percussion stops are triggered from knee levers, or whenever any key is pressed regardless of its pitch, or by other devices. Sometimes also such percussion are *reiterated*; struck repeatedly while a key or piston is held down. A theatre organ drum roll is an example.

Theatre organs also have *effects traps*, which are usually pneumatic contraptions producing special effects sounds, such as sirens, surf and bird song, turned on and off from switches on the console, and originally used for the accompaniment of silent films.

All of the above mechanisms can be modeled in Hauptwerk.

There are many books available that describe the anatomy of pipe organs in great depth and some useful Internet sites with further information.

Section V: Using Hauptwerk

Virtual console

If you haven't already done so, follow the *Section III: Quick start* section in this guide. If it isn't loaded already, use *Organ | Load organ* on the Hauptwerk menu to load the St. Anne's, Moseley organ sample set. It should look approximately as follows:
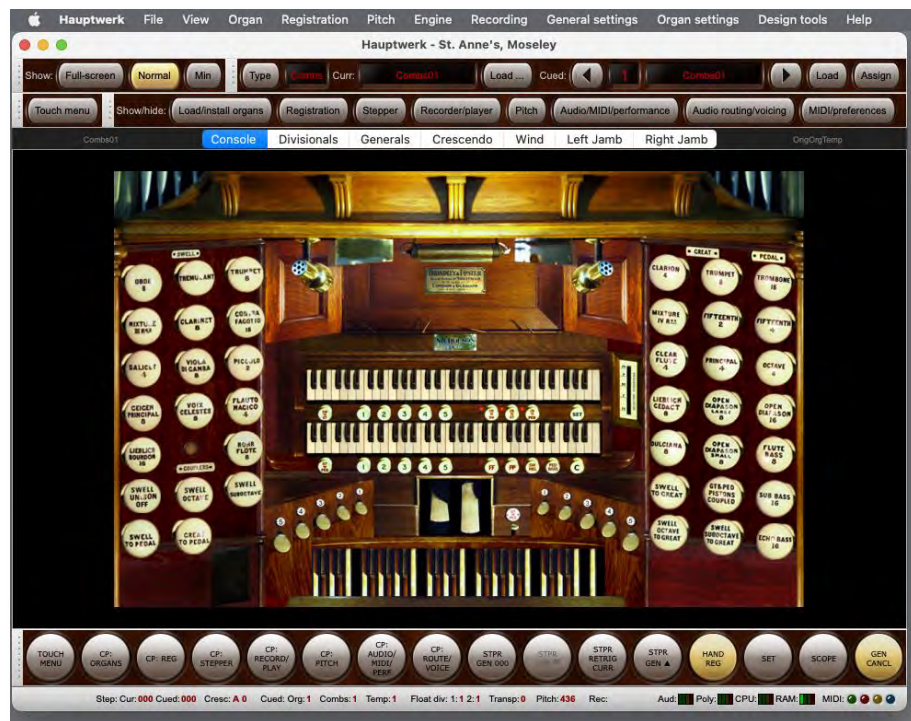
The left and right-hand panels on the screen are the *stop jambs* and contain the stops, couplers and tremulant virtual draw-knobs. As you have already seen, clicking on a virtual draw-knob toggles it between the off and on states. A draw-knob is *on* when it is pulled out. In fact, all *virtual switches* can be controlled by a mouse or touch-screen, where enabled within the sample set. A switch is either *latching* or *momentary*. Latching switches (such as draw-knobs) change state when clicked, while momentary switches (such as keys) turn on when you press the mouse button and turn off again when you release it.

Although you wouldn't normally operate the organ by clicking on virtual controls with the mouse, it is a quick and useful way to explore a virtual instrument initially. Touch-screen presses behave the same as mouse clicks.

The left-hand jamb has the stops and couplers for the Swell division, which is played from the upper of the two virtual manuals. The far-right column of draw-knobs has the stops for the Pedal division, which is played from the virtual pedal keyboard in the center at the bottom of the screen. The next two columns on the right-hand jamb are the Great stops and the Great and Pedal couplers. The Great division is played from the lower of the two virtual manuals.

You can click on any of the three virtual keyboards to play their keys. You must have at least one stop engaged for the relevant division in order to hear any pipes when you play a key. For example, turn on the Oboe 8 stop on the left-hand jamb, and then click on a key on the upper virtual manual, and you should hear the Oboe pipes sound.

Draw (engage) a stop on the Swell, such as the Oboe 8, but with none engaged on the Great. Click on a key on the Great manual. You should not hear the sound of any pipes. Now draw the Swell To Great coupler and click on a Great key again. You should now hear the corresponding Oboe pipe sound. Note, however, that the virtual keys on the Swell manual do not move because the coupling happens internally, within the key action, rather than between the manuals directly. Many Hauptwerk instruments however will couple at the key action level and as a result you will see the coupled manual's keys depress accordingly.

With the Oboe 8 still engaged, turn on the *Tremulant* at the top of the left-hand jamb. Click on a key somewhere in the middle of the Swell manual. You should hear that a gentle undulation is imparted to the sound. The effect varies for each rank, and across the compass of the manual. The Tremulant only affects the Swell ranks for the St. Anne's organ.

Above the virtual pedalboard are two large pedals. The left-hand one is the *swell pedal*. Click and drag the mouse downward on the virtual swell pedal and you should see it move. The virtual swell box is now closed. With a stop engaged on the Swell (such as the Oboe 8), play a

key on the virtual Swell manual and note how it sounds. Now click and drag the mouse on the swell pedal upward and you should see it move again. The swell box is now open. Play a key on the Swell manual again, and it should sound different.

The second, right-hand, large pedal is the crescendo pedal. It is moved in the same way as the swell pedal, by clicking and dragging vertically. Try different positions while playing keys on the Great manual each time. You should hear more pipes sound according to how far 'down' it is (how near to the top you've moved it). You won't see the virtual draw-knobs move, but note that the Brincradus indicator, immediately to the right of the two manuals, also moves to show its position.

These two pedals and the Brincradus indicator are examples of *virtual continuous controls*, in that they can be in any one of a continuous range of positions, rather than just on or off as with virtual switches. All virtual continuous controls can be operated in the same way by clicking and dragging, provided that the sample set allows it. Note that the Brincradus indicator is an example of a continuous control for which mouse control is *not* allowed, since it is not itself a user control, but merely an indicator of a state within the organ. The wind indicators (covered later) are further examples

Switches and continuous controls are the two possible types of *virtual controls* available in Hauptwerk.

Underneath the Swell (upper) manual and to the right are three latching pistons named *Cr To Ped*, *Cr To Gt* and *Cr to Sw*, each with a small red indicator lamp to show whether they are on or off. The indicator lamps are examples of switches which cannot be controlled by the mouse because they too are indicators and not user controls directly. These three pistons determine whether the crescendo pedal affects the Pedal, Great and Swell divisions respectively.

The *FF* piston underneath the Great (lower) manual is also latching with an indicator lamp. When engaged the *full organ* registration (tutti) is engaged, *adding* to whatever registration is shown on the draw-knobs. The *PP* piston is another playing aid, which entirely bypasses the draw-knob registration, *replacing* it with a soft registration.

On the far right, underneath the Great manual, the piston labeled *C* is the *general cancel*. Clicking on it causes all draw-knobs to be turned off, but does not affect the crescendo, FF or PP pistons.

The console display has multiple tabs. If you have the Advanced Edition of Hauptwerk you can open up to four tabs at once in separate windows using the *View | Console window 2,3 or 4* menu options:
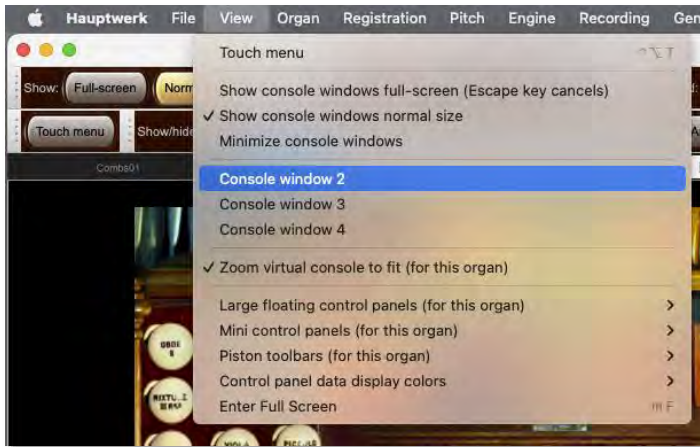
This is most useful if your computer has two or more touch-screen monitors attached to it. For example, you could display one window (display tab) on a monitor to the left of your MIDI keyboard(s) and another to the right to give a traditional organ console layout with some stops on either side of your MIDI keyboard(s) when using sample sets that have their virtual console tabs laid out in that way.

Click on the *Generals* tab:

You can use this screen to adjust the registrations set by the FF and PP pistons. Click on a switch to toggle its state, as normal for virtual switches. The switches on the screen are on when they are moved to the left.

Click on the *Crescendo* tab:
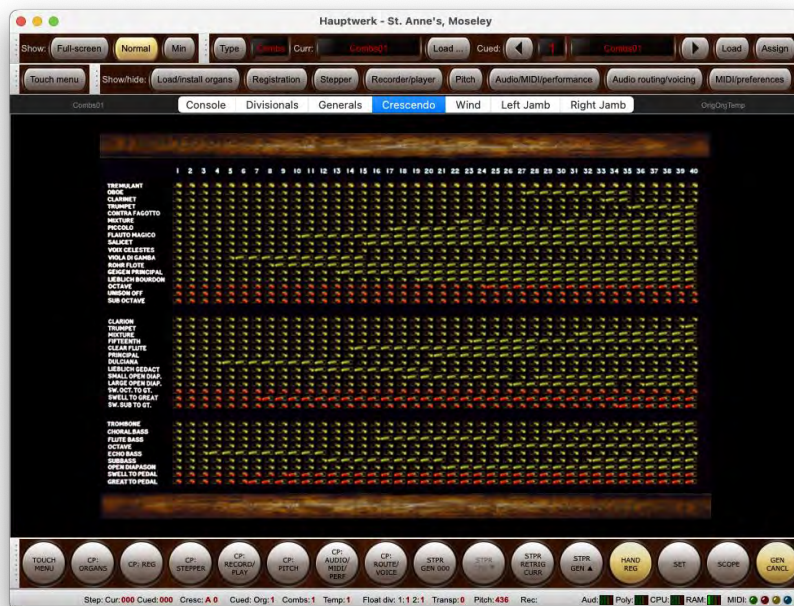
The switches control the registration at each of the forty possible crescendo pedal positions. When the pedal is fully up (off; dragged to the bottom of its image), the crescendo action will cause no additional stops to be engaged. When it's moved very slightly down (dragged upwards slightly with the mouse), the registration shown in the column labeled *1* will be added to whatever registration is shown on the draw-knobs. Slightly more, and it will be that from column *2*, and so forth until it is fully down, when column *40* will determine the registration added. As the pedal is moved backwards, the sequence is reversed.

As with the *Generals* tab, a switch is on when it is pointing to the left.

Go back on the main *Console* tab:
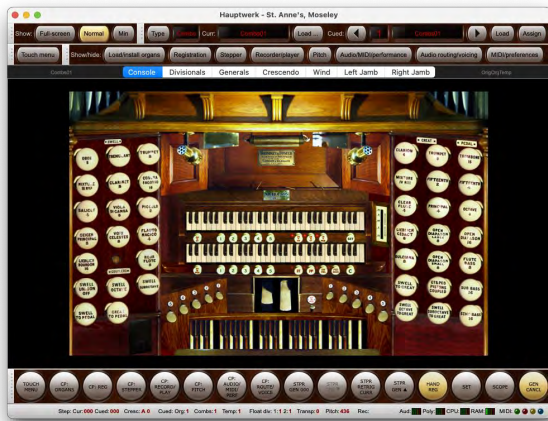
Immediately underneath the manuals and to the far left are reversible pistons for the Sw To Gt and Gt To Ped couplers. If you click on those pistons you will see the corresponding virtual draw-knobs move. Immediately to the right of the crescendo pedal is another reversible piston for the Gt To Ped coupler.

To the right of the PP piston are the *Sw Mel* and *Ped Bass* couplers. Both are latching switches with indicator lamps. The former causes only the highest key played on the Great manual to sound on the Swell division, while the latter causes the lowest key played on the Great manual to be duplicated on the Pedal division. The Ped Bass coupler may be particularly useful if you do not have a MIDI pedalboard.

The pistons numbered 1 to 5 underneath the Great manual are *divisional pistons*. If you click on them you will see the draw-knobs move for the Great stops and couplers as each of the stored registrations is recalled. The pistons labeled 1 to 5 underneath the Swell manual do likewise for the Swell stops, couplers and tremulant. For ergonomic convenience they are also duplicated by the foot pistons labeled 1 to 5 immediately above the pedalboard and on the left-hand side.

The pistons labeled 1 to 5 above and to the right of the pedalboard recall the Pedal divisional combinations. If the *Gt & Ped Pistons Coupled* draw-knob is drawn (near the bottom of the right-hand jamb), pressing a Pedal combination piston also causes the corresponding Great combination to be recalled. Likewise, pressing a Great combination piston causes the corresponding Pedal combination to be recalled.

Click on the *Divisionals* tab:

Here you can adjust the registrations recalled by each of the five pistons for each division.

The states of virtual controls can be remembered between unloading and loading an organ, defined by the creator of the sample set. However, on the St. Anne's organ all controls (draw-knobs, expression pedals, etc.) always return to their default states to avoid any confusion. The states of the switches on the three combination programmer boards are not remembered between loads because they are instead saved into combination sets (see below), which provides greater flexibility.

Next click on the *Wind* tab:

There are no controls on this tab that you can interact with directly. The indicators with numbered scales show the modeled air pressures in water column inches at various points within the virtual wind supply system. The indicators without numbered scales show the extensions of modeled regulator bellows for the system. Hauptwerk's complex wind supply physical model uses fluid dynamics principles and equations to model the movements of air through the air supply system, affecting the sound of each pipe individually as it fluctuates. Hence each pipe can interact subtly and realistically with every other pipe.

If you engage the FF piston on St. Anne's, then play and release a chord on the Great manual from a MIDI keyboard while looking at the *Wind* tab, you will see the needles move as the wind supply system adapts to the changes in demand and then stabilizes again.

(Please note: the wind supply model is only available in the Advanced Edition of Hauptwerk. In other editions the indicators will remain at zero.)

Combination setter

Go back on the main *Console* tab again:
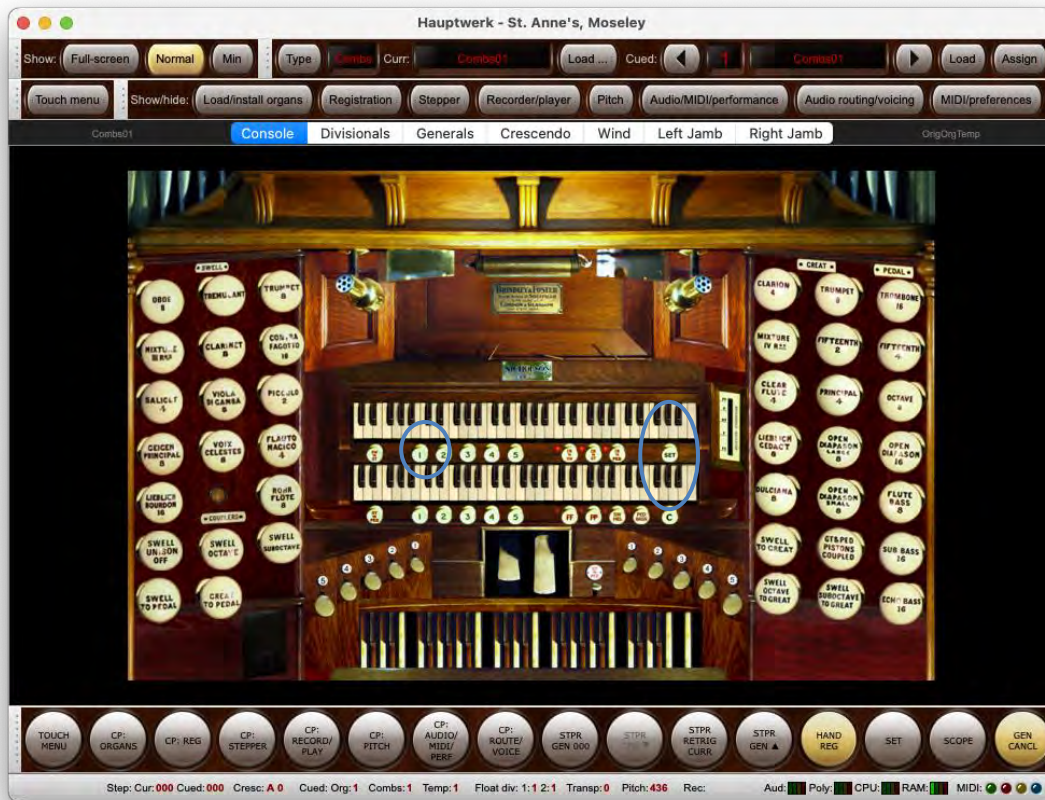
Underneath the Swell manual and to the far right is a piston marked *SET*. It is the *combination setter* or *combination capture* piston. It's a latching piston, but it doesn't have an indicator lamp. If you click on it several times, you'll see that it moves in and out, and stays in that position. When it's in the 'in' position (on), choose a registration on the Swell using the virtual draw-knobs. Then click Swell divisional combination piston 1. Instead of recalling the combination stored for the piston, your current registration will have been saved to the piston. Turn off the setter piston, and click on Swell pistons 2 and 1 to verify that your combination is now recalled by piston 1. You will also be able to see your updated combination on the *Divisionals* screen tab.

Note also that the word *Set* lights up in red in the status bar at the bottom-left of the Hauptwerk window when the setter function is on:

If you have the piston toolbar open (covered later) with the SET piston displayed this will also light up yellow to indicate when the setter function is activated.

The setter ('combination capture') is a special mode in Hauptwerk, which can also be controlled by toggling the *Registration | Setter (capture mode)* menu item:
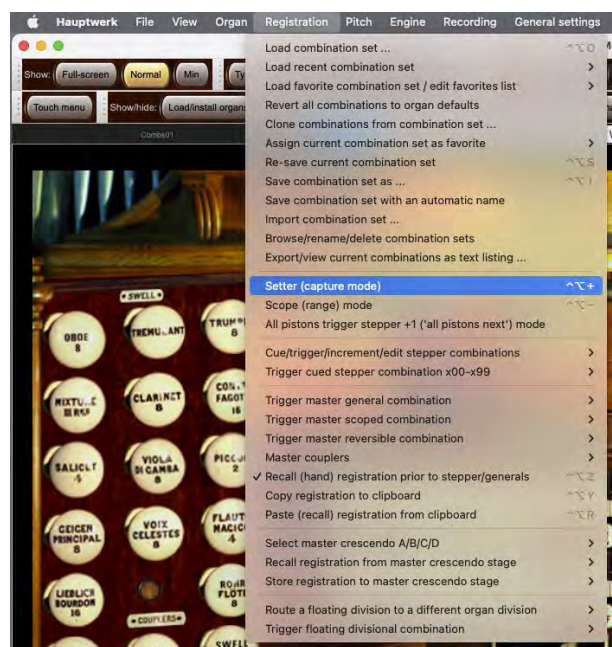
The menu item for the *Setter (capture mode)*, the setter pistons, and the setter buttons on control panels all perform the same function and work together in unison. The various menus are covered in depth in later sections of this guide.

Combination sets

For now, note that combinations can be saved to and loaded from *combination sets* (files), so that you could have different sets of combinations stored for different pieces in a recital, for example. The St. Anne's divisional and general combination settings are saved in such files, along with the crescendo settings, the combination stepper frames and master combinations (covered in later sections).

'Swiping' across virtual controls

When using a touch screen (or mouse) it's possible to 'swipe' (slide) your finger/mouse across multiple virtual stops, without lifting your finger/mouse between, to set them all to the same state. This is useful for rapid stop changes, adding several couplers, removing or adding tremulants on a theatre organ, etc. You aren't limited to straight lines; any virtual switches you slide your finger or mouse across will change to the same state as the first one you touched, if they aren't already in that state.

To swipe across a series of stops using a touch screen:

- Touch the first stop, coupler or tremulant to engage or disengage it.

- Without lifting your finger, slide it over the next virtual switch you want to set to that state, and then across any others.

- Lift your finger off the screen once you've finished engaging or disengaging the intended switches.

Note that switches will always follow the state of the first switch. Thus if you engage the first switch then only switches that are currently disengaged will be engaged. Conversely if disengaging the first switch then only switches that are engaged will be disengaged. This makes it impossible accidentally to change the states of switches that are already in the intended state.

To swipe across a series of stops using a mouse:

- Left-click the first stop, coupler or tremulant to engage or disengage it.

- Without releasing the mouse button, slide the mouse over the next virtual switch you want to set to that state, and then across any others.

- Release the mouse button once you've finished engaging or disengaging the intended switches.

Landscape and portrait screen orientations

For virtual instruments that support it, Hauptwerk can switch dynamically between multiple virtual console orientations or aspect ratios, according to the dimensions of the window area in which the console is displayed. In particular, that can be useful for displaying optimally laid-out stop jambs on touch-screens in portrait orientation.

The St. Anne's instrument features landscape and portrait orientations for both the left and right stop jamb displays.

To change console orientation:

- Go to the main 'Left Jamb' St. Anne's virtual console page (tab).

- Make sure that the *View | Zoom virtual console to fit* option is ticked on the menu.

- Float any docked control panels or toolbars (drag their left-hand gray handles to move them), or close them, so that they don't prevent the window from being able to shrink.

- Click on the lower right-hand corner of the main Hauptwerk window and drag the window left and downwards, so that the main window is taller than it is wide.

Landscape mode:

Click and drag the window corner to resize the screen.

Portrait mode:

Settings screens

Almost all of the settings screens have the same basic layout and are navigated in the same way. As an example, with the St. Anne's organ loaded, select *Organ settings | Keyboards...* from the menu:
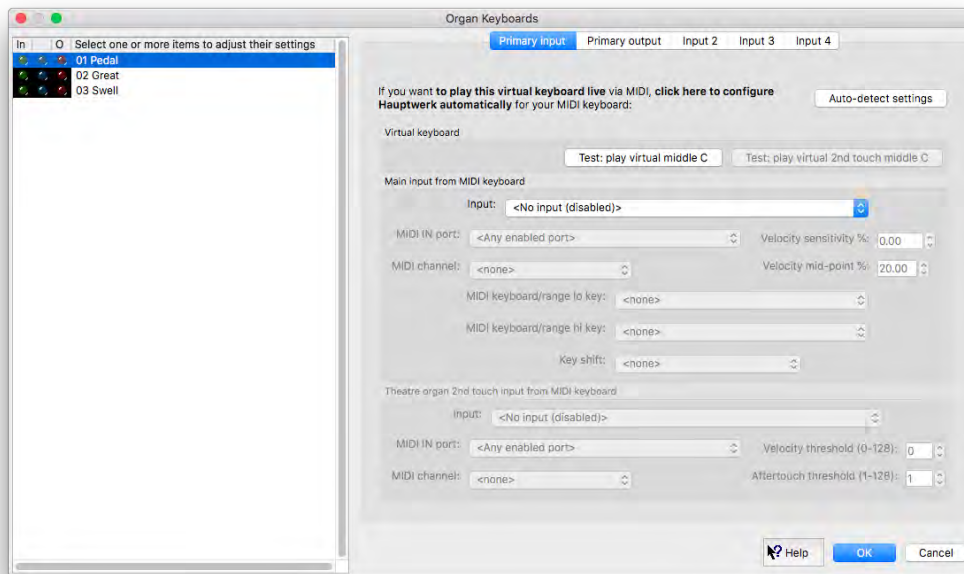
Many of the menu screens allow the properties of multiple *objects* to be browsed. For example, each object on the *Organ keyboards* screen is a logical representation of one of the organ's virtual keyboards, allowing you to view or change its MIDI setting properties, so that Hauptwerk knows how to communicate with it.

The left-hand pane is a browse list of the objects currently available.

The right-hand pane of each settings screen specifies the properties of the object currently selected in the object browse list. For example, in the screenshot of the *Organ Keyboards* screen above, the '01 Pedal' object is selected in the left-hand pane, and the properties of that object are shown on the right, where you may view or adjust them. Some screens have multiple tabs for their right-hand panes.

Some screens allow you to create new objects and delete existing ones using *Insert* and *Delete* buttons underneath the browse list.

Some screens also allow you to give each new object a unique name, or 'alias', so that the object can be identified uniquely in the browse list, and so that you can refer to it from other screens. We recommend always using meaningful names, for clarity.
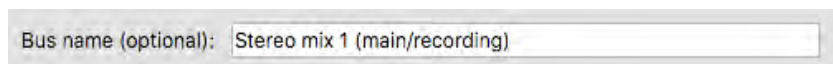
Whenever you move to a different object in the browse list, or click *OK*, Hauptwerk will check that the settings are valid for the object that you're leaving, and if not valid give an error message, preventing you moving to the new object. When you click *OK* on a screen, the uniqueness of object properties is validated, where applicable.

Note that some settings are enabled and disabled (grayed out) depending on your selections for other settings, or are always disabled if they are for information only. Note also that you can press the *INSERT* or *DELETE/BACKSPACE* keys as short-cuts to insert or delete objects respectively.

You can always click *Cancel* to discard the changes made since you opened the screen, regardless of whether the data on the screen are valid.

Working with multiple selections

Most settings screens that have object browse lists also allow multiple objects to be selected and manipulated at once, which allows you to change large numbers of settings very easily and quickly. For example:
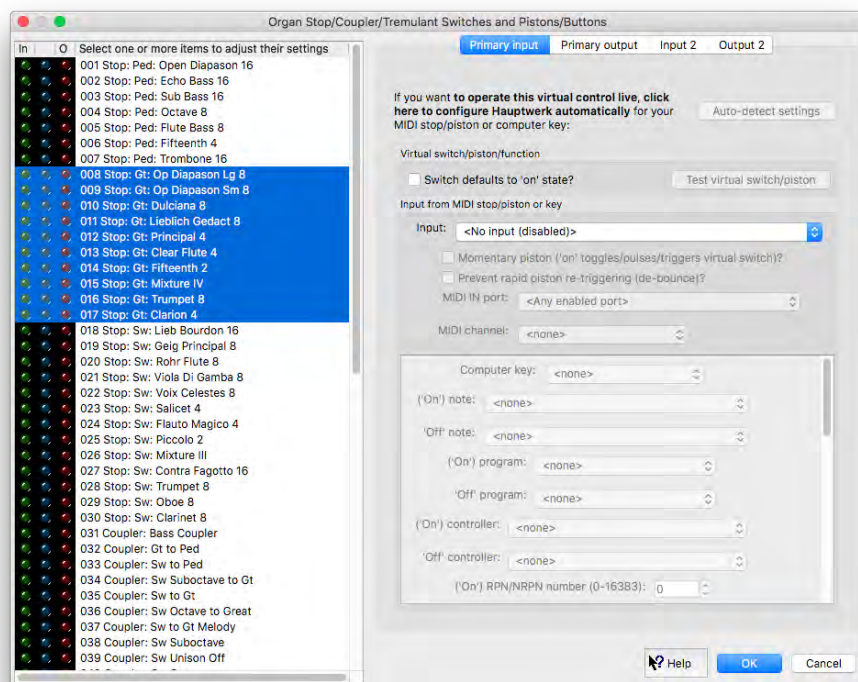
You can select multiple objects in a screen's left-hand browse list in any of the following ways:

- Drag the mouse across the range of objects you wish to select, if the objects are sequential.

- Highlight the first object, then hold down *SHIFT* and click on another object to select all of the objects in-between.

- Hold down the *COMMAND* (macOS) or *CONTROL* (Windows) key while clicking on an object to add or remove it to/from the current selection.

- Press *COMMAND+A* (macOS) or *CONTROL+A* (Windows) to select all objects.

Even if more than one object is selected, (only) one of the selected objects (usually the last one you selected) is the *current* object, and the right-hand pane shows its properties. However, if a given property has several different values for the various selected objects, then the property is shown in ***bold italic text***. When multiple objects are selected, you can change a property for all selected objects at once by simply changing the property in the right-hand pane.

For example, on the *Organ keyboards* screen you could change the MIDI port used for all virtual keyboards at once by simply highlighting all of the entries in the left-hand pane and then changing the MIDI port setting in the right-hand pane.

Getting help with settings screens and settings

Just to the left of the *OK* button on each screen is a pointer/question-mark 'Help' icon:
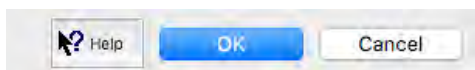
Click on that icon. The appearance of the mouse pointer will then change to a pointer/question-mark or hand. Now click on a blank part of the settings screen. The mouse pointer will change back to its normal appearance but detailed help for the screen will pop up. You can also get detailed help on any specific setting by using the same procedure to click on the setting in question. We do not describe all of the settings in this guide, and merely give an overview of functional areas and screens; <u>you must use the question-mark help in conjunction with this guide since this guide does not contain detailed help for the settings screens</u>. A brief pop-up hint is also displayed for some settings when your hover over them with the mouse.

Menus

Overview

Almost all of Hauptwerk's menu functions can be configured to be triggered by MIDI or assigned to computer keys. (Those that require browsing for a file or a prompt are the exceptions, together with the settings screens.) For example, you could set up a MIDI push-button to load a particular organ, select a particular temperament or set of combinations, or shut the computer down. Thus, you can operate Hauptwerk fully without the need for a computer monitor, mouse or keyboard.

Almost all menu functions have corresponding controls on the control panels (accessible via the *View* menu). Right-click on control panel controls and select '*Auto detect ... settings ...*' to configure the associated menu functions to be controlled by MIDI (or by computer keystrokes):

You can choose (via the right-click menu) to auto-detect most functions either on a per-organ basis ('*for this organ only*'), or '*for all organs, unless overridden*'. Use the latter unless you specifically want to assign the corresponding MIDI piston/key differently for the particular organ that you currently have loaded, compared to other organs.

> ***Background information, for advanced users:*** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger <u>both</u> one or more global ('for all organs') menu/master functions, <u>and also</u> one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.
>
> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.
>
> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for … master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments).

You can alternatively use the following screens to configure MIDI/key input to Hauptwerk's (menu/control panel) functions manually:

- *General settings | MIDI/key triggers for master pistons and menu functions (for all organs, unless overridden).*

- *Organ settings | MIDI/key triggers for master pistons and menu functions (for this organ).*
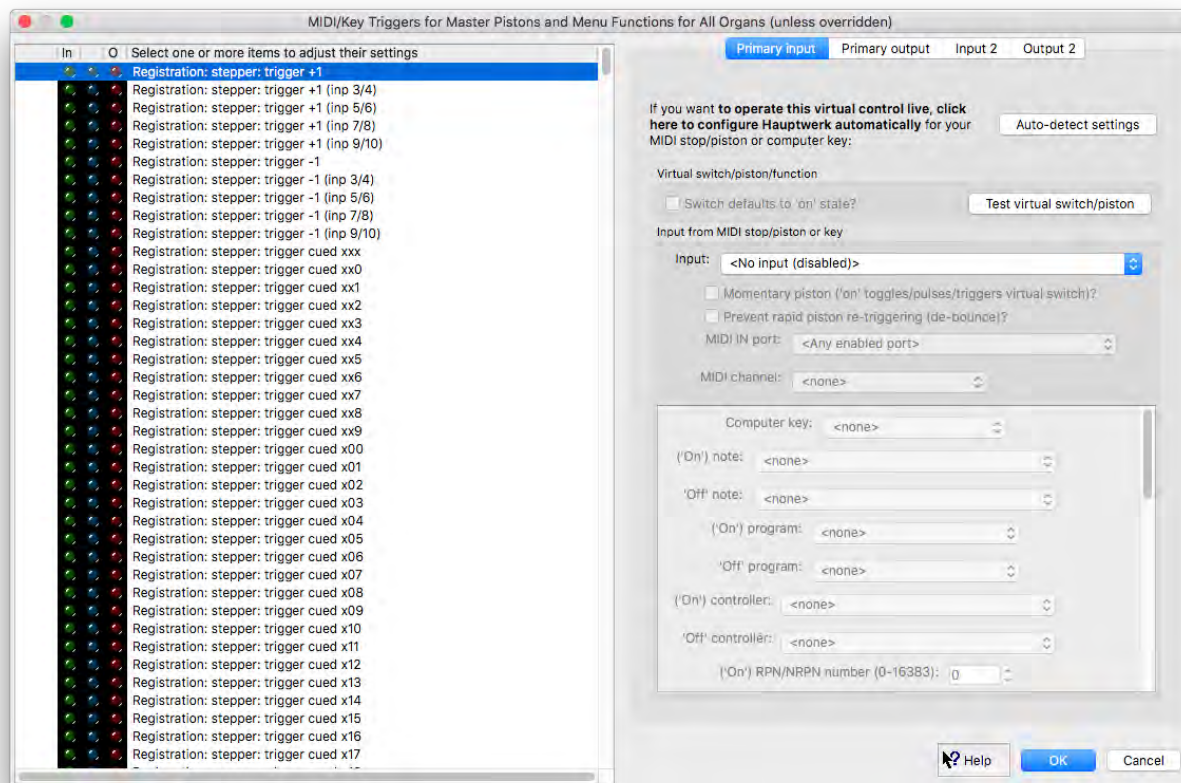
Using the '*Input 2*' tab on the screens, you can optionally assign up to two MIDI controls to operate any given menu function. This might be useful, for example, for combination stepper controls, where you might want a toe piston and a thumb piston both to be able to trigger the 'next frame' (trigger +1) function.

You can also get to the those screens by right-clicking on a control panel button (or piston toolbar piston) and selecting *Adjust manually* … .

Short-cut keys

Finally, the commonly-used menu functions also have 'accelerator key combinations'. These are additional fixed short-cut key combinations that can always be used to trigger the menu functions from the computer keyboard. Each key combination is shown to the right of its associated menu item:
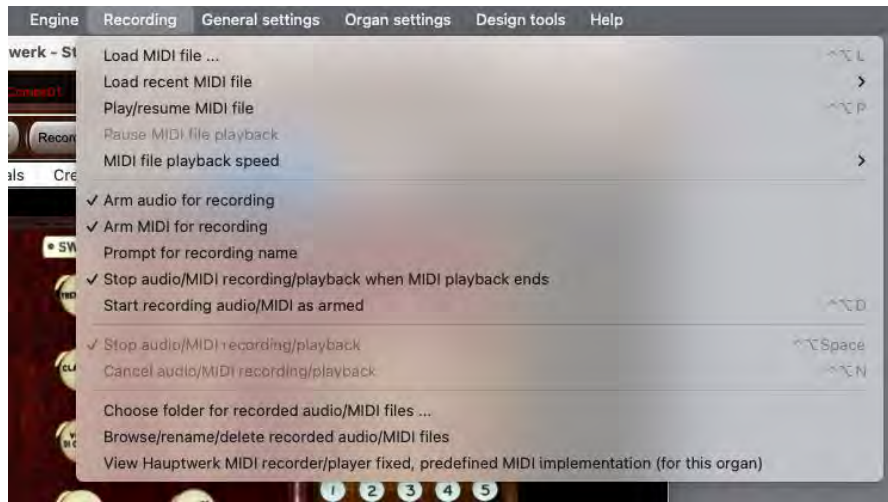
On macOS, the *Control* and *Alt* (*Option*) keys are used in combination with another standard key. For example, *Control + Alt + F1* loads the first stand-by organ. On Windows the *Ctrl* key is instead used in combination with the short-cut key. Most screen-shots in this guide, including that of the *Recording* menu above, show Hauptwerk running on macOS.

Getting help with menus

Click on the pointer/question-mark Help icon immediately to the left of a screen's *OK* button:
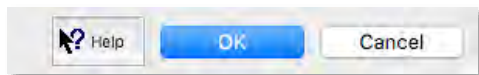
... then click onto the screen background or a specific setting for a detailed explanation of its function.

Control panels and piston toolbars

Overview

Hauptwerk provides lots of graphical control panels, as well as several piston toolbars, which allow you to use and learn Hauptwerk easily and intuitively. They're especially suitable for controlling Hauptwerk via touch-screens.

The control panels make all of Hauptwerk's key functions readily accessible by touch and give clear visual feedback of all associated statuses. There are many 'mini' dock-able control panels, with all control panel window positions being stored separately for each organ, so you can lay them out optimally according to the features and layout most appropriate for each particular virtual organ. There are also 'large' control panels, which float on top of the main Hauptwerk window(s) and can be opened and closed conveniently 'on the fly' whenever you need access to their controls. The individual control panels are covered throughout this guide.

There are also customizable, dock-able 'piston toolbars', to which you can assign menu/master functions.

Large floating control panels

The large floating control panels include all of the commonly-used Hauptwerk functions, and are designed to make it quick and easy to learn, use, and configure Hauptwerk, by bringing all related functions and statuses together so that relationships between them can be seen clearly. Large control panels can't be docked, but always float on top of the main Hauptwerk window.

Large control panels may be opened and closed via the *View | Large floating control panels* menu:
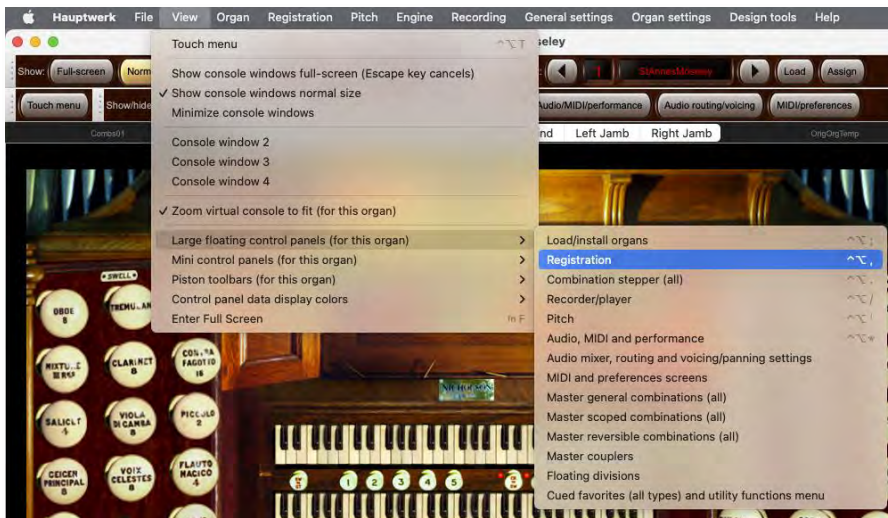
... and may also be closed by clicking the small white '*X*' in the top-left of the control panel:
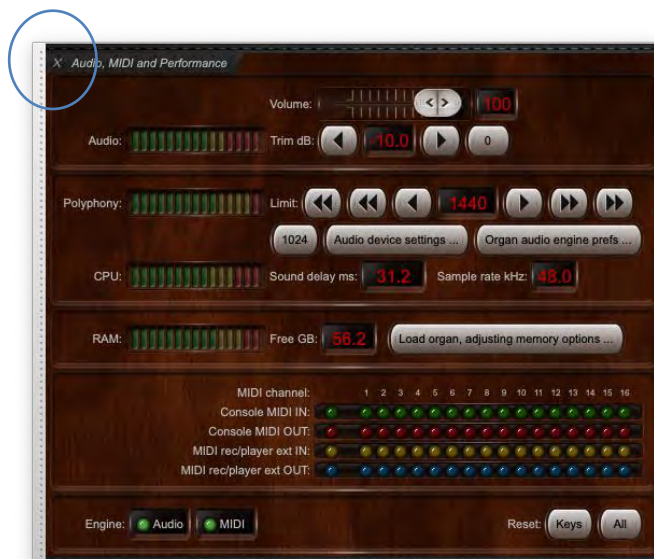
... or by right-clicking on their wood background areas (or on some of their controls) and selecting '*Close this ...*':

You can alternatively open or close (show/hide) large control panels using the buttons on the *Show/hide large floating control panels 1* and *Show/hide large floating control panels 2* mini control panels. The first of those two (which has buttons for the most commonly-used large control panels) is docked by default at the top of the main Hauptwerk window for convenient access (and you can always open those mini control panels via the *View* menu):
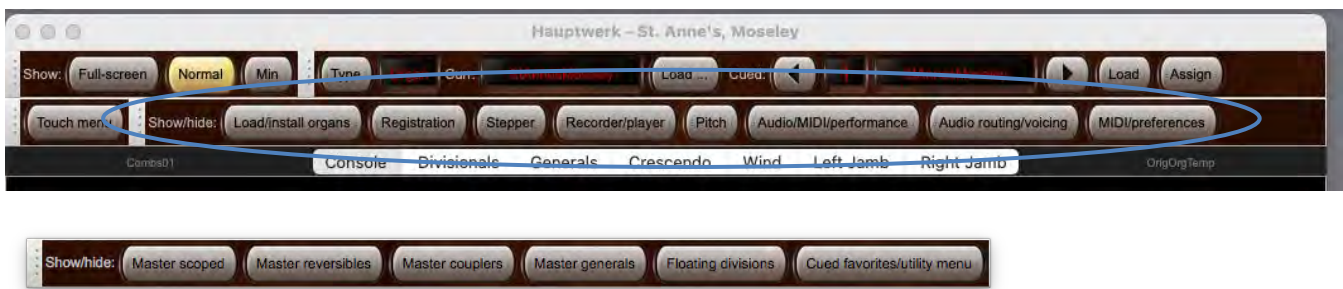
Also, by default the functions to show/hide the most commonly-used large control panels are assigned to buttons on the primary piston toolbar, which is docked (by default) at the bottom of the main Hauptwerk window:
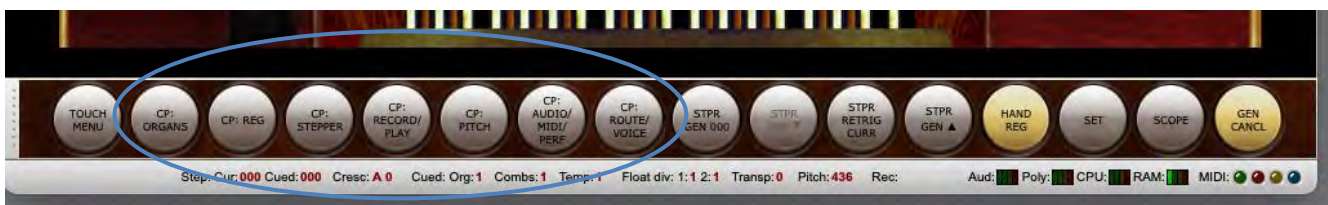
You can thus quickly and easily open or close any of the large control panels 'on the fly' whenever you need them, using just a single touch-screen touch or mouse click, thus allowing you to use the large control panels as a convenient alternative (especially for touch-screen users) to Hauptwerk's menu system. Also, by right-clicking on those 'show/hide' buttons you can auto-detect them to MIDI pistons or computer keys:

Nearly all control panel buttons can be configured to accept MIDI. To auto-detect a MIDI piston/key to a control panel button, right-click on it:

You can choose (via the right-click menu) to auto-detect most functions either on a per-organ basis ('*for this organ only*'), or '*for all organs, unless overridden*'. Use the latter unless you specifically want to assign the corresponding MIDI piston/key differently for the particular organ that you currently have loaded, compared to other organs.

> **Background information, for advanced users:** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger both one or more global ('for all organs') menu/master functions, and also one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.
>
> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.
>
> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for … master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments).

The positions of open large control panels are remembered separately for each organ, but the *When opening large control panels, recall their positions …* and *When opening a large control panel, close all others?* options on the *General settings | General preferences* screen allow you to choose what happens when you open or reopen them.

Mini control panels

The mini control panels duplicate the functions available via the large control panels, but are designed to be small so that you can choose to have just the specific functions that you use the most occupying your valuable screen space. They can be docked at the top or bottom of the main window (only), or floated like the large control panels.

To open or close a mini control panel use the *View | Mini control panels* menu and tick or un-tick the desired control panel:
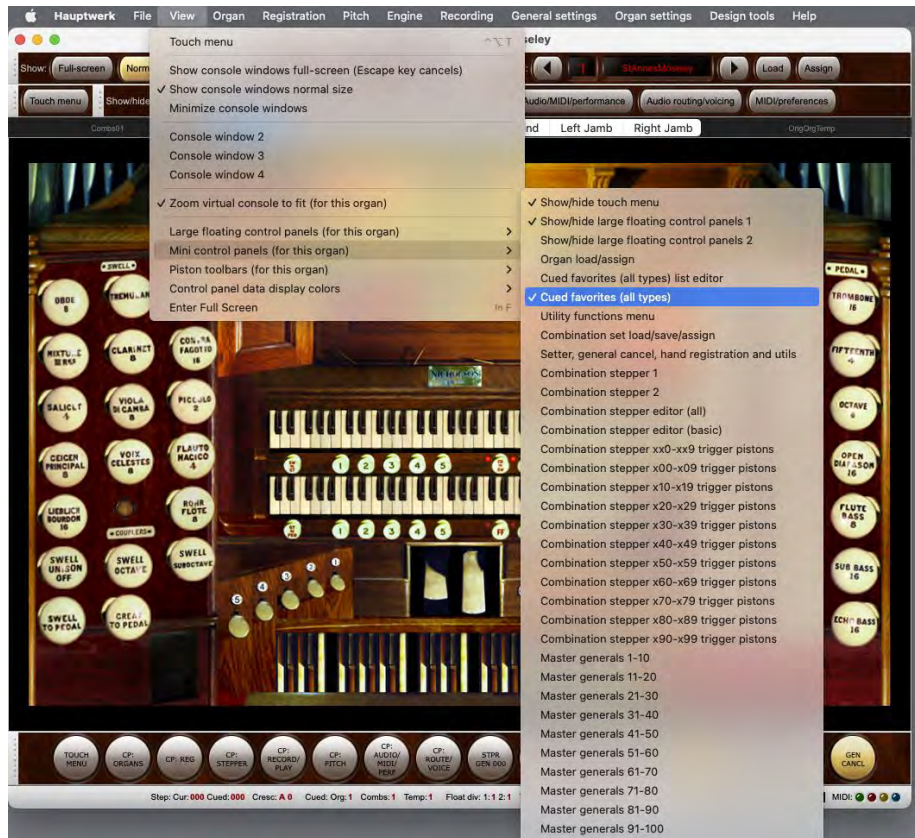
You can also close them by right-clicking on their wood background areas (or on some of their controls) and selecting '*Close this ...*':

Nearly all control panel buttons can be configured to accept MIDI. To auto-detect a MIDI piston/key to a control panel button, right-click on it:

You can choose (via the right-click menu) to auto-detect most functions either on a per-organ basis ('*for this organ only*'), or '*for all organs, unless overridden*'. Use the latter unless you specifically want to assign the corresponding MIDI piston/key differently for the particular organ that you currently have loaded, compared to other organs.

> **Background information, for advanced users:** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger <u>both</u> one or more global ('for all organs') menu/master functions, <u>and also</u> one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.
>
> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.
>
> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for … master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments).

The states and screen positions of all mini control panels are remembered separately for each virtual organ, allowing you to make best use of touch-screen space according to the functions that you use most frequently for each instrument.

Piston toolbars

To open or close a piston toolbar use the *View | Piston toolbars* menu and tick or un-tick the desired toolbar. Up to four toolbars (Advanced Edition only) may be opened for each of the console windows, provided that the corresponding console window is also open.
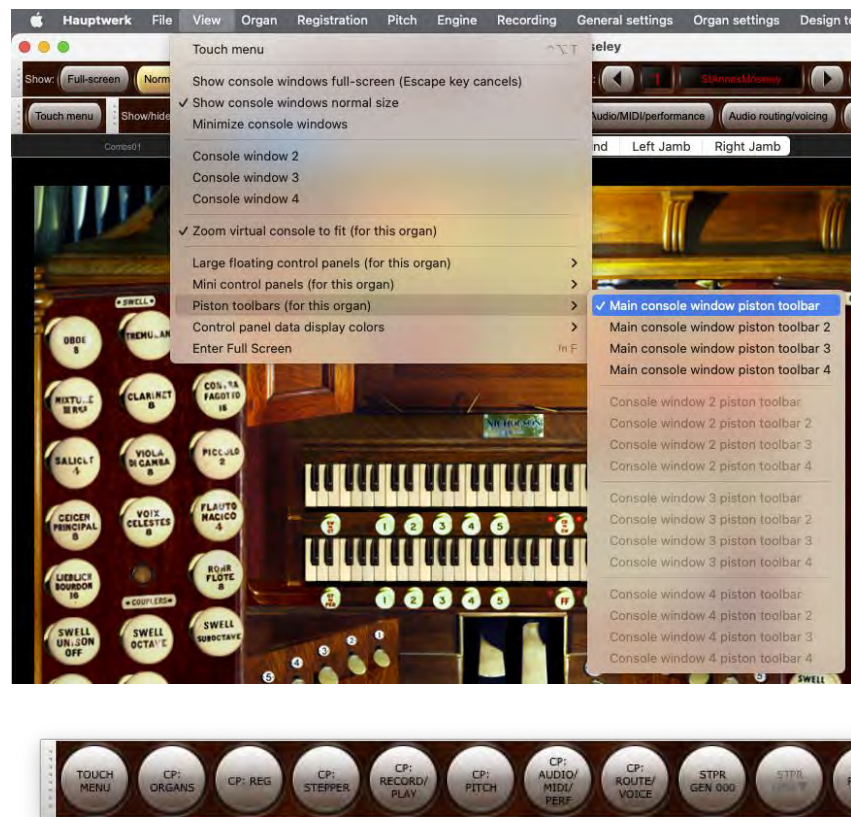
The states and screen positions of piston toolbars are remembered separately for each virtual organ.

Changing piston toolbar function assignments

You can assign almost any of Hauptwerk's menu/master functions to any of the virtual pistons on any of the piston toolbars by right-clicking on the toolbar piston and selecting the desired function from the submenu. When assigning a function to a piston, you can do it either:

- Globally ('for all organs, unless overridden'), in which case by default that same function would be assigned to that same toolbar piston (for example, the first virtual piston on the main window's first piston toolbar) for all organs:

Or:
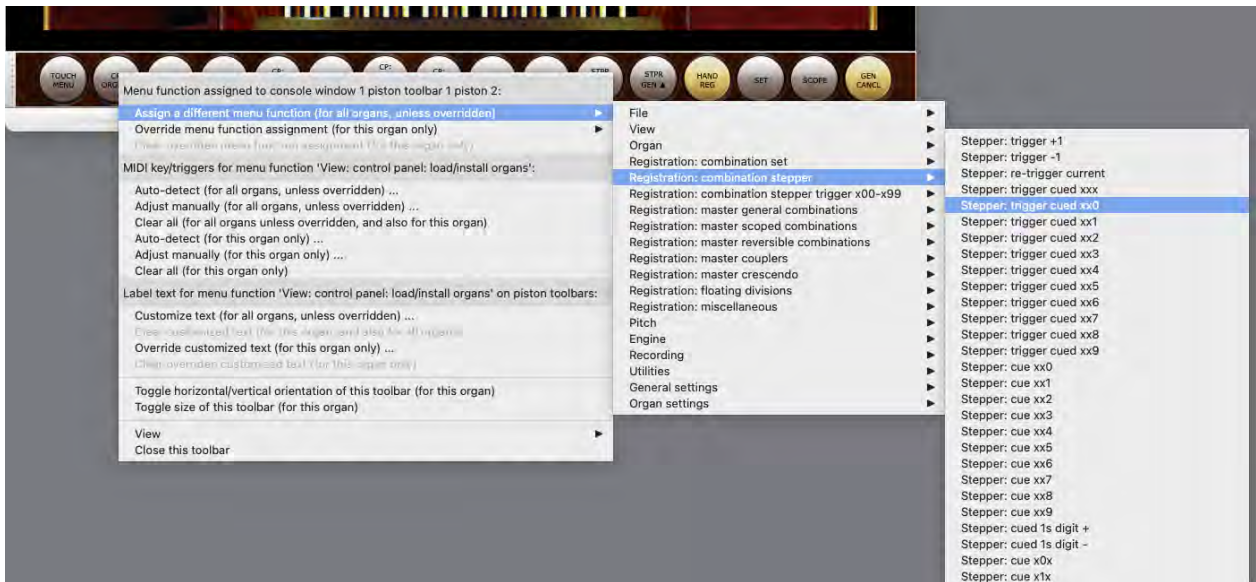
- 'For this organ only', in which case the assignment won't affect the piston toolbars for any other organs, but for the currently-loaded organ it will override any global assignment to that same toolbar piston:
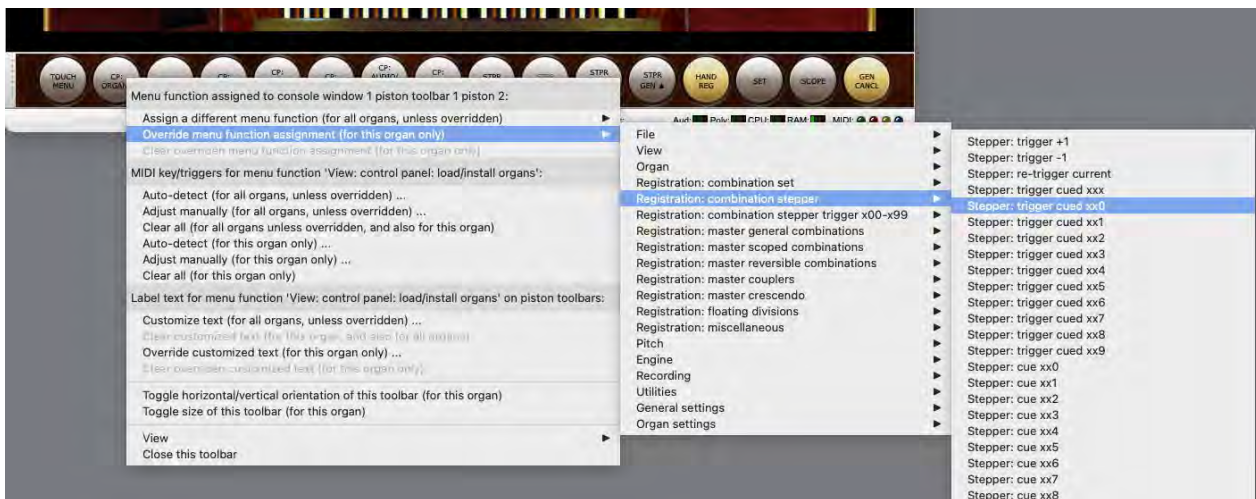
This two-level approach avoids the need to duplicate the same function assignment for every organ, in cases where you usually (or always) want the same function to be available on a given toolbar piston, whilst still allowing you to customize (override) the assignment in case you want to do that for certain organs.

By default, when loading a new organ for the first time (ever), global assignments are not overridden for it, i.e. the global assignments apply by default.

Note: if you wish to clear all piston toolbar function assignments (reverting them to their defaults), you can do that via *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments).

Auto-detecting MIDI via piston toolbars

You can auto-detect MIDI pistons/keys to trigger whichever function you currently have assigned to any given toolbar piston by right-clicking on it:

Note that doing so configures MIDI to trigger whichever menu function is currently assigned to that virtual piston directly – it doesn't configure MIDI to trigger the toolbar piston itself. Toolbar pistons are just shortcuts to trigger menu functions. Hence if, for example, you auto-detected a MIDI piston to trigger a toolbar piston's currently assigned menu function, and you then changed which function was assigned to that particular toolbar piston, your MIDI piston would still trigger the original menu function.

You can choose (via the right-click menu) to auto-detect most menu functions either on a per-organ basis ('*for this organ only*'), or '*for all organs, unless overridden*'. Use the latter unless you specifically want to assign the corresponding MIDI piston/key differently for the particular organ that you currently have loaded, compared to other organs.

> **Background information, for advanced users:** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger <u>both</u> one or more global ('for all organs') menu/master functions, <u>and also</u> one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.
>
> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.
>
> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for …master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments).

Note: it makes no difference whether you auto-detect MIDI to any given menu function by right-clicking on its button on a control panel, or by right-clicking on a toolbar piston to which the menu function is currently assigned, or by using the *Auto-detect settings* button on one of the two *MIDI/key triggers for master pistons and menu functions …* screens on the *General settings* or *Organ settings* menus.

Changing the label text displayed on piston toolbars

The label text that is shown on a toolbar piston depends on the menu function that's assigned to it. Each menu function has its own default text label for that purpose, but you can customize it by right-click on any toolbar piston to which the menu function is currently assigned. You can customize the label text either:

- Globally ('for all organs, unless overridden'), in which case by default your customized text would apply to that menu function wherever the function is assigned to any toolbar piston, for any organ:

Or:
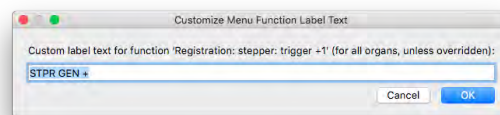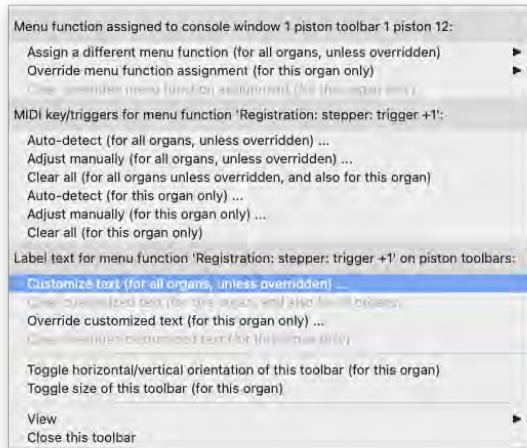
- 'For this organ only', in which case your customized label text won't affect any other organs, but for the currently-loaded organ it will override any global label text customization that you might have made for that same menu function:
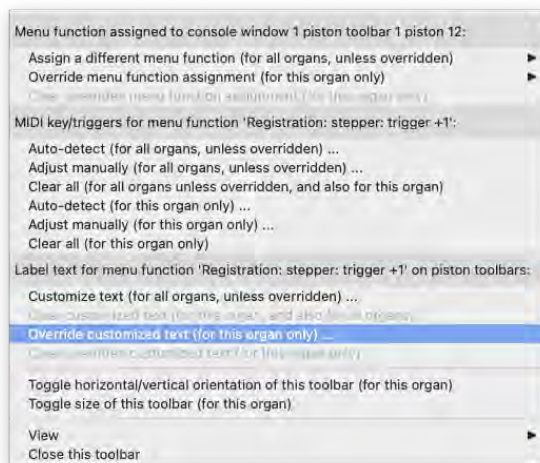
Note that label text is customized for whichever menu function is currently assigned to the toolbar piston, not directly for the individual toolbar piston itself. Hence if, for example, you had assigned the same menu function to several toolbar pistons, and you then customized its label text, the customization would automatically apply to all of the piston toolbar pistons to which you had assigned that particular menu function.

Overriding label text on a per-organ basis might be particularly useful for master couplers or master scoped combinations (covered later in this user guide), for example, so that you could label them appropriately according to which divisions they affected on the relevant organ.

The function's default label text is used if you clear the customized label text entirely. No label text is customized or overridden by default. Note: if you wish to clear customized label text for all menu functions (reverting them to their defaults), you can do that via *General settings | General configuration wizard* (for all global customizations) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' customizations).

Changing piston toolbar layouts

Piston toolbars may be viewed in four possible layouts:

- *Horizontal Large*
- *Horizontal Small*
- *Vertical Large*
- *Vertical Small*

To change the size or orientation simply right click anywhere on the piston toolbar and select the desired option:
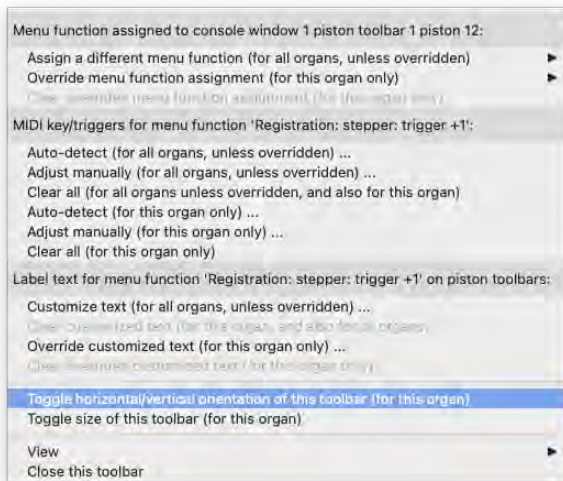
- *Toggle horizontal/vertical orientation of this toolbar:* changes orientation between horizontal or vertical.
- *Toggle size of this toolbar:* changes size between large and small.

Horizontal layout:

Vertical layout:

The piston toolbars may be docked or floating, regardless of the horizontal/vertical orientation or size. Note that the white handle will change position depending on the orientation you have chosen.

Floating and docking control panels and piston toolbars

The large control panels are labeled '*floating*' since they can't be docked into the Hauptwerk window, unlike the mini control panels and piston toolbars. Clicking and dragging the gray handle on the left side of a control panel allows you to 'float' (un-dock) it and position it anywhere on your screen. The positions of all open control panels and piston toolbars are remembered separately for each virtual organ.

Mini control panels and piston toolbars allow docking. By default, a newly-opened mini control panel or piston toolbar will be docked. A docked panel or toolbar will automatically expand to fit the width of the screen and will sit within the top area of the main Hauptwerk window.

Here is an example with five mini control panels at the top of the screen and two piston toolbars at the bottom, as they appear docked by default:

By clicking and dragging their gray handles they will become un-docked and may be placed anywhere on the screen:
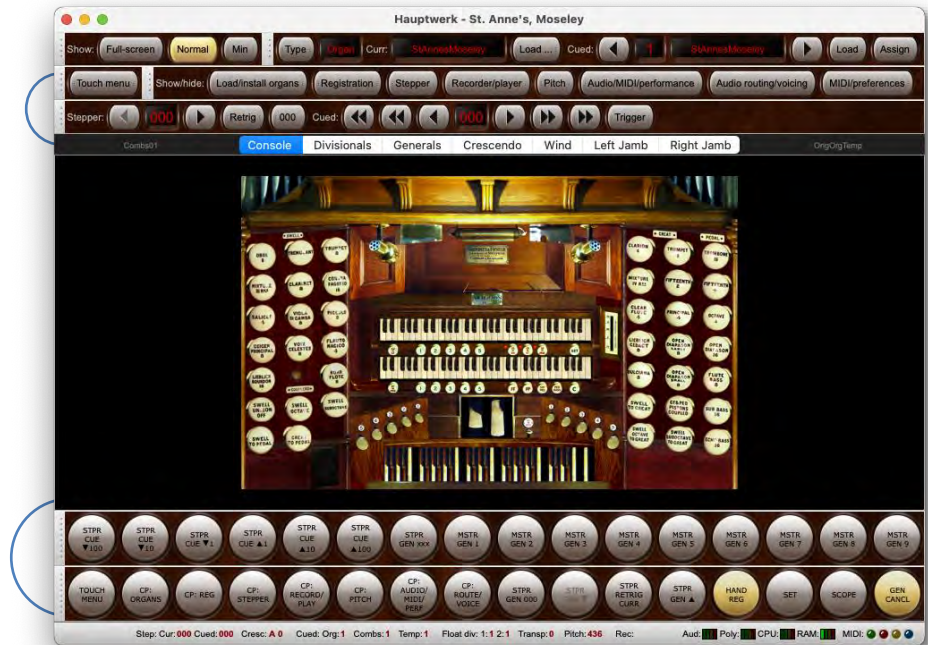
To dock a mini control panel or toolbar drag it near the center of the screen at the top or bottom of the main Hauptwerk window. An open space will appear then release the mouse button or touch-screen to allow Hauptwerk to dock it again.

Dragging to center:

Docked:

The same method is used for docking piston toolbars. Extra background area will automatically be added to fill the extra width or height of your display and the main virtual console display will shrink if necessary (if zoom is enabled).

Note that control panels can only be docked to, and will only float over, the primary Hauptwerk window. Only piston toolbars can be docked to non-primary Hauptwerk console windows.

Touch menu

Hauptwerk also has a 'Touch Menu' window, which has a tabbed interface designed specifically for convenient use from touch-screens. It provides buttons and sliders to access almost all of the items on Hauptwerk's main menu and control panels, and can be used as an alternative to them:
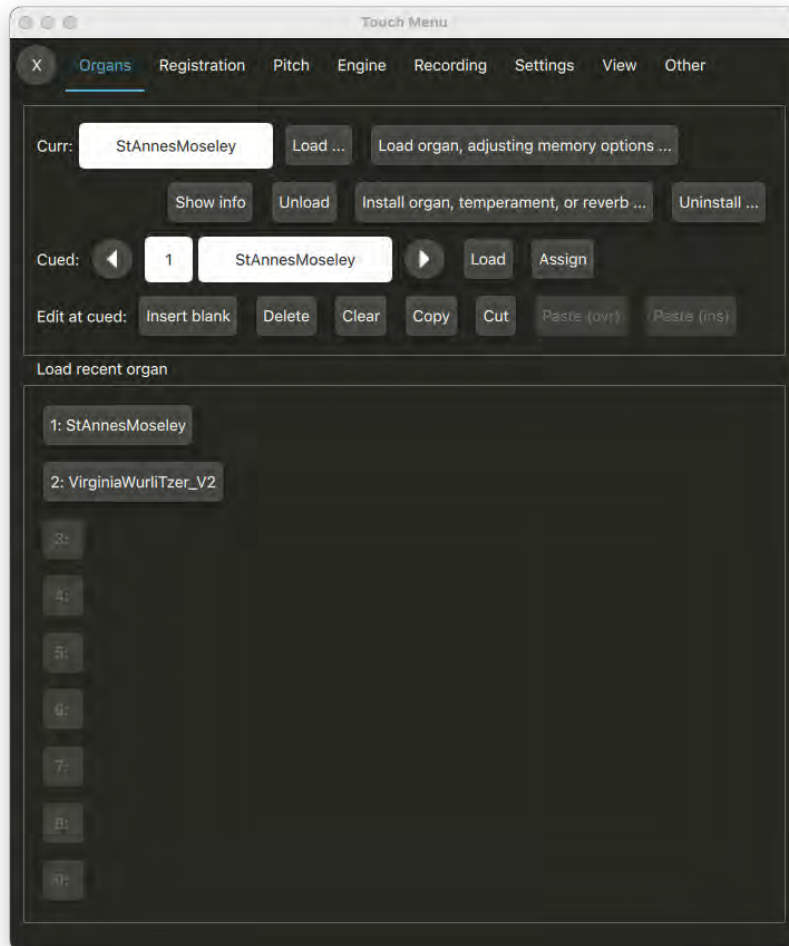
It can be opened or closed via any of the following:

- "*View | Touch menu*" from the main menu:
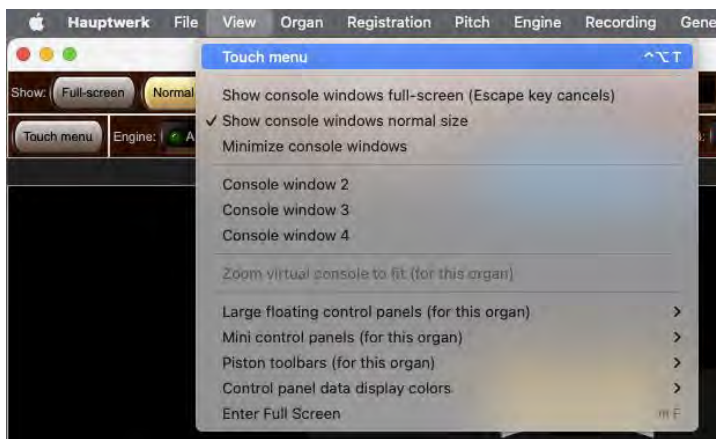
- The button on the 'Touch Menu' mini control panel, which is docked at the top of the main window when no organ is loaded. It's also docked there by default when an organ is loaded for the first time.

If you have an organ loaded but don't have that button then you can open the mini control panel via "*View | Mini control panels … | Show/hide touch menu*" from the main menu:
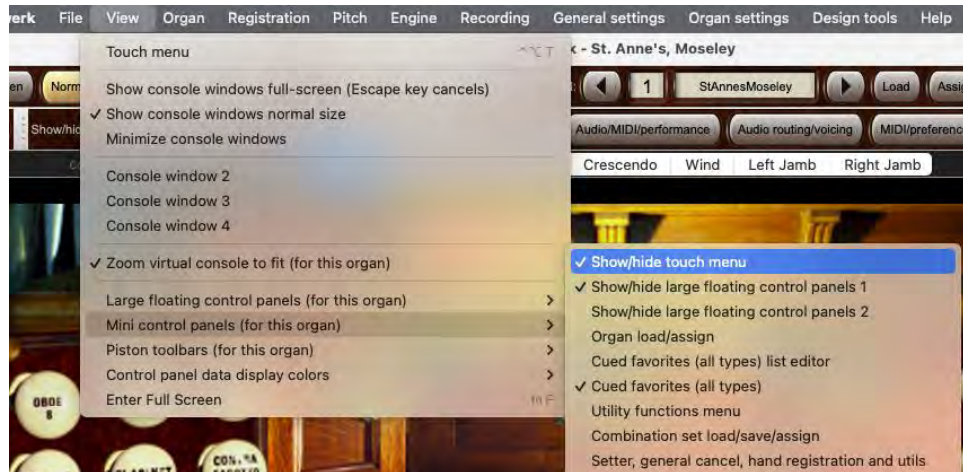
- The function can also be assigned to any of the virtual pistons on Hauptwerk's piston toolbars (by right-clicking on their buttons), and it's assigned to the piston toolbar that's shown by default for new Hauptwerk installations:

- A keyboard shortcut (as shown on the main *View* menu).

- Assigning it to a MIDI piston/button (by right-clicking on its button, or via "*General settings | MIDI/key triggers for master pistons and menu functions*" from the main menu):
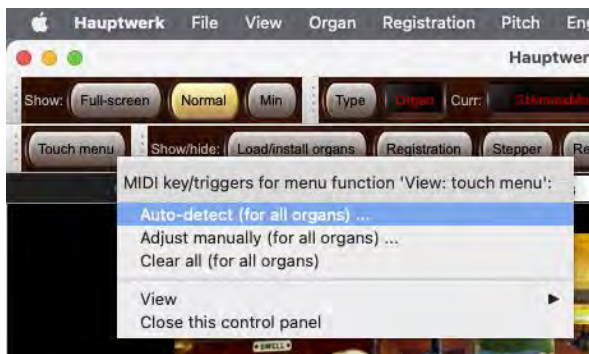
You can also close the Touch Menu by clicking on the round 'X' button near-its top-left:
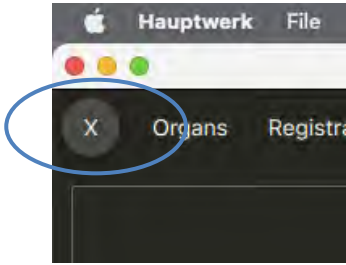
The Touch Menu window can be resized and remembers its position, size, and whether it was open or closed when launching Hauptwerk. Hence if you have several computer monitors you might wish to keep it open on one of them, or to open/close it whenever needed from its mini control panel button (for example). *[Note: on macOS, please avoid using the small round green 'full-screen' button in its title bar, since you may not then be able to close it easily, due to a compatibility issue.]*

If its window is resized larger than its contents need then its contents are automatically zoomed in:
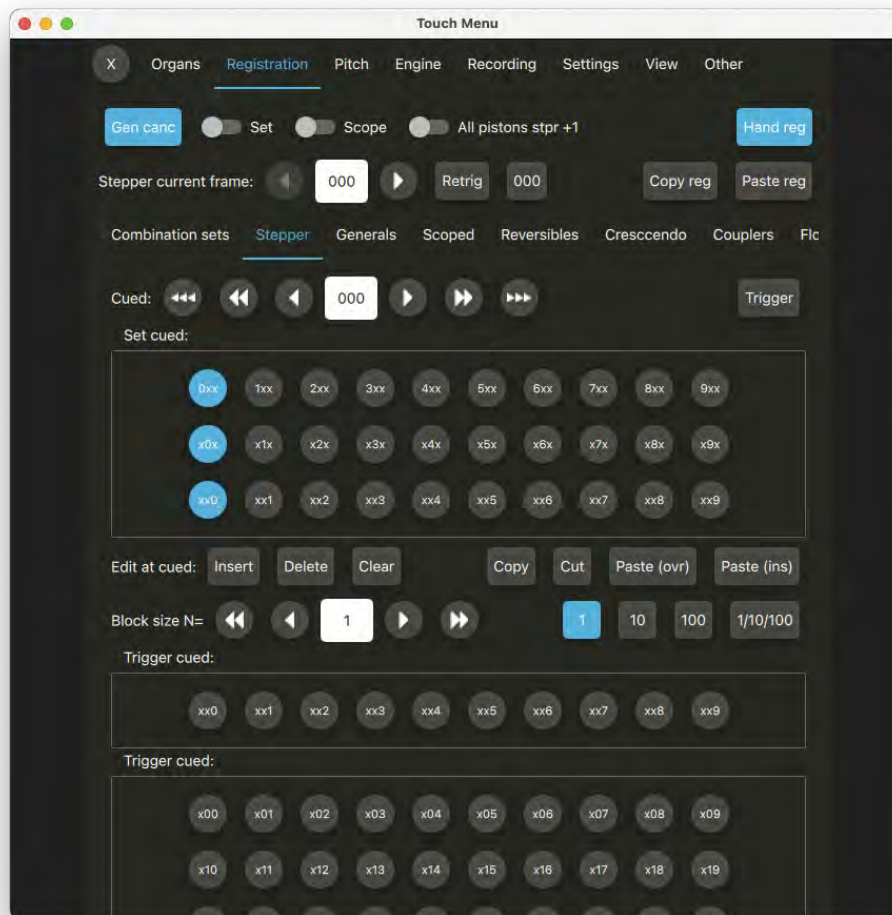
To change the tab (and/or sub-tab) that's displayed on the Touch Menu, simply touch (or click on) the name of the tab:
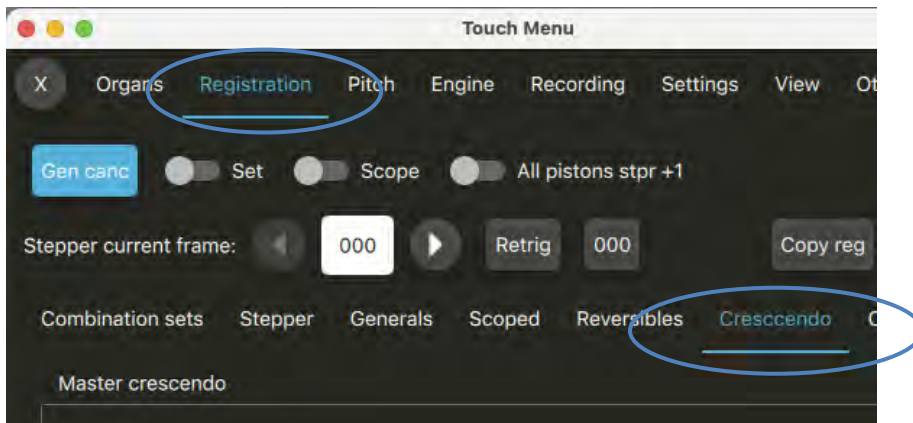
Many of its controls support hold-clicking (or right-clicking) to auto-detect them to MIDI pistons:
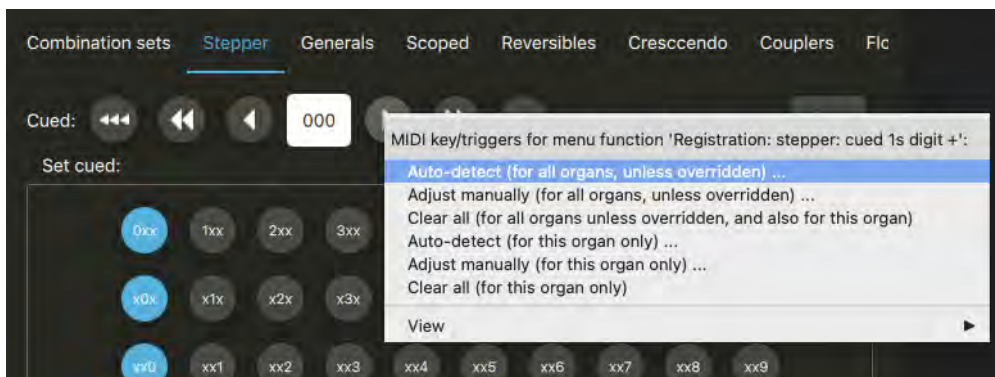
Most of this user guide describes Hauptwerk's functions (such as its combination system) with reference to the controls on control panels. However, you can use the equivalent controls on the Touch Menu instead if you prefer. In most cases, you can also use the Touch Menu as an alternative to Hauptwerk's main menu (at the top of the primary Hauptwerk console screen).

File menu

Although Hauptwerk uses various types of files, most are handled transparently using options found under other menus, so there are only a few items within the *File* menu:
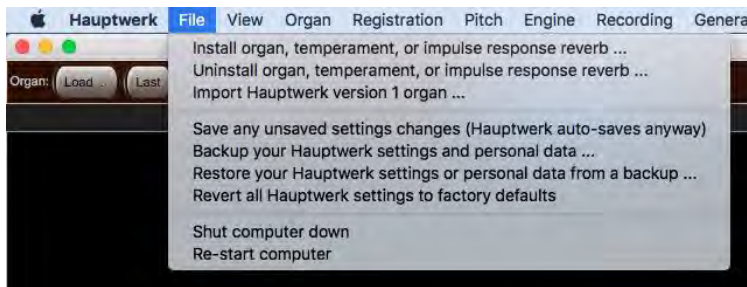
Component installation/import functions

Install organ, temperament, or impulse response reverb and the corresponding *Uninstall* option are used to access Hauptwerk's component installer, which reliably and safely handles installation, upgrading, re-installation and de-installation of all third-party components in Hauptwerk version 2 format and above, such as additional Hauptwerk sample sets. It also ensures that dependency requirements are met. It is the subject of the *Installing/uninstalling/upgrading organs, temperaments, or reverbs (the component installer* section of this guide.

The *Import Hauptwerk version 1 organ* function is covered in the *Importing Hauptwerk version 1 organs* section of this guide.

Settings save/backup/restore and diagnostic file functions

It should never be necessary to use the *Save any unsaved settings (Hauptwerk auto-saves periodically anyway)* function. Hauptwerk always saves any unsaved data when it exits anyway, and also when you load or unload a sample set, and also before performing any other action that might risk a computer problem being encountered, such as starting an audio or MIDI driver or loading a large amount of data into memory. This menu function is provided just in case you want to force any settings changes to be saved immediately, rather than waiting for the next point at which Hauptwerk would save them, for example if you were worried about the possibility of a power failure after having made a lot of voicing changes.

On some PCs, saving data may risk an audio glitch, which is why Hauptwerk normally waits until you unload a sample set (or deactivate audio/MIDI) before saving any data. To emphasize: any changes you make will always be saved anyway, without needing to use this function. The function just allows you to force them to be saved immediately.

The *Backup your current Hauptwerk settings and personal data* function makes a backup copy of all of your Hauptwerk settings and other personal data (organ combinations, voicing/panning, Custom Organ Design Module organs, databases and logs) into a single compressed file, which can be saved to a USB memory stick (or removable backup drive, or similar) or emailed easily. You can then easily restore that backup at a later date if you ever need to by using the *Restore your current Hauptwerk settings or personal data from a backup* menu function. Please see the *Backing up and restoring your settings and data* section of this guide for full details and instructions to make or restore backups.

Important note: **please use the backup function periodically**, and especially once you have configured Hauptwerk as you want it, and then whenever you have made a significant number of changes to your settings, organ combinations, voicing/panning or other personal data in the future. Please store any backup files you make securely somewhere external to your computer, in case your computer's storage needs to be replaced or re-installed for any reason. For example, save any backup files you make to USB memory stick (or removable backup drive, or similar) and keep them in a safe place. You should then easily be able to get all of your Hauptwerk settings and personal data back again at any point in the future.

Revert all Hauptwerk settings to factory defaults might be useful if want to start re-configuring Hauptwerk for a clean slate.

Exit and shut-down functions

The *Shut computer down*, *Re-start computer* and *Exit* (*Hauptwerk | Quit Hauptwerk* on macOS) are self-explanatory. The first two of them are included mainly so that they can be triggered by MIDI when Hauptwerk is used from a MIDI organ console without a computer monitor.

View Menu

The View menu provides options for controlling the console views and access to the Hauptwerk control panels and piston toolbars.
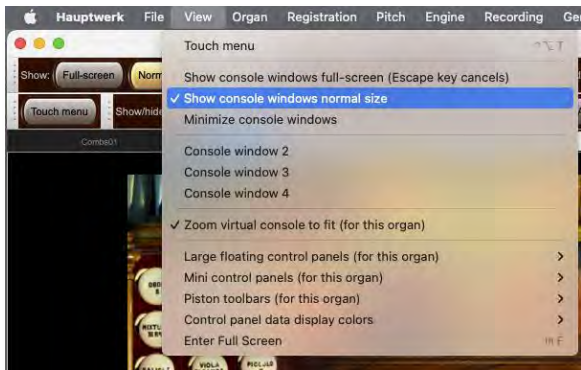
Full-screen mode

To view the virtual console in full-screen mode select the option *Show console windows full-screen (Escape key cancels).* The Hauptwerk window will fill the entire screen and scale the virtual console to fit. Note the aspect ratio of the enlarged (or reduced) console will be maintained (so that circular draw-knobs remain circular, etc.), with any additional space at the sides or top filled by black background. Full-screen mode applies to all open console display windows.

When in full-screen mode it will look like this:
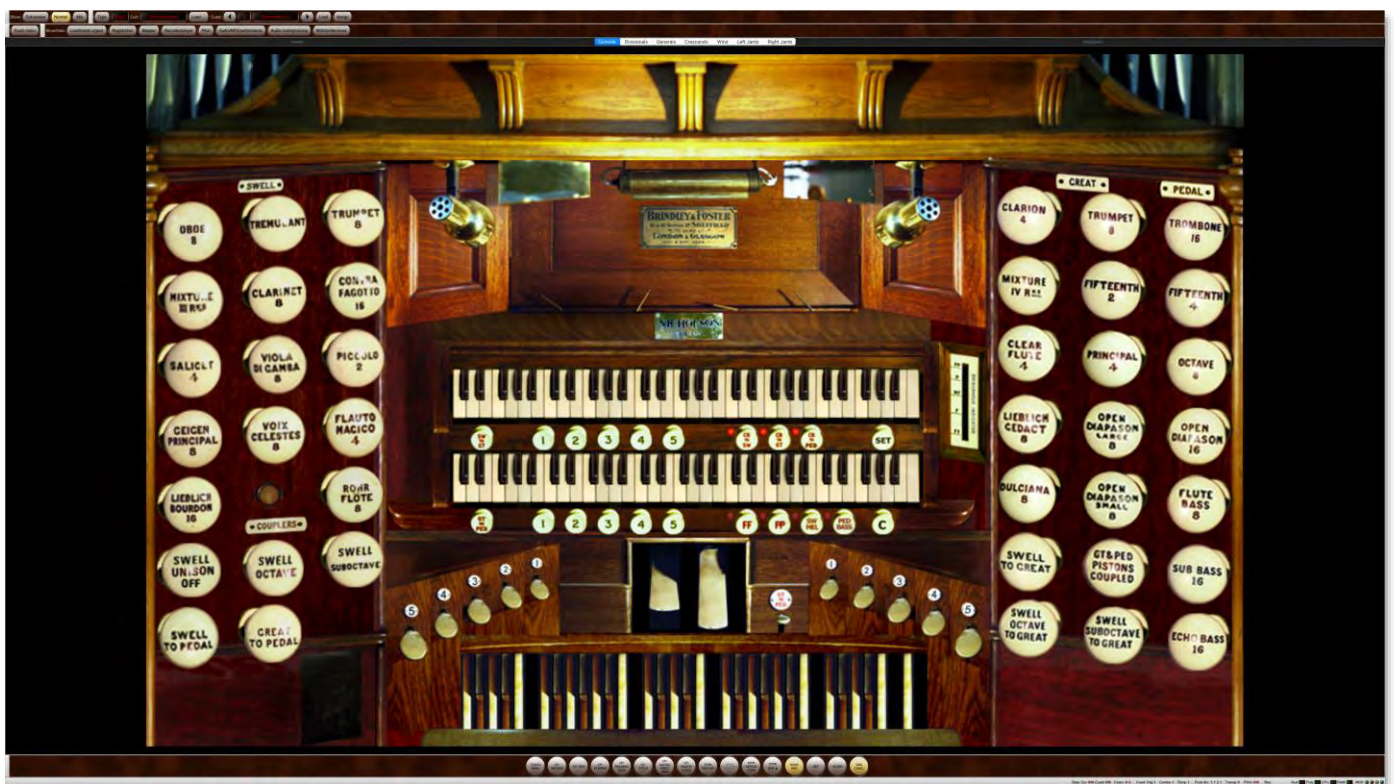
To leave full screen mode use your computer keyboard's ESC key. You can also use MIDI/key triggers to toggle between full-screen and normal size via the functions on the '*Console window size*' mini control panel.

You can minimize the Hauptwerk window and any additional Hauptwerk console windows using the 'Min' button.

In full-screen mode on Windows the main console display page includes the main Hauptwerk menu bar at the top, as well as the bottom status bar. On macOS the top menus will auto-hide and may be accessed by hovering the mouse at the top of your screen. If you're using Windows and don't wish to see the Hauptwerk menu options you can open another console view from the View menu (See the *Additional console windows* section below) then enter full-screen mode. This will also omit the bottom status bar in both Windows and macOS.

Additional console windows

If you have the Advanced Edition of Hauptwerk you can open up to four virtual console display tabs (pages) at once in separate windows using the *View | Console window 2, 3 or 4* menu functions:
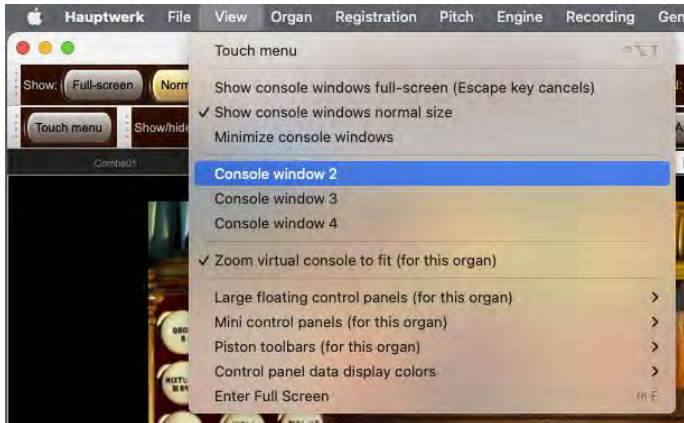
When selected a new Hauptwerk window will be displayed:

This is most useful if your computer has two or more touch-screen monitors attached to it. For example, you could display one window (display tab) on a monitor to the left of your MIDI keyboard(s) and another to the right to give a traditional organ console layout with some stops on either side of your MIDI keyboard(s) when using sample sets that have their virtual console tabs laid out in that way.

Console zoom

By default, Hauptwerk will automatically zoom the virtual console to fit your screen. Clicking and dragging the lower right corner of the main Hauptwerk window allows real-time re-sizing of the console. Note the aspect ratio of the enlarged (or reduced) console will be maintained (so that circular draw-knobs remain circular, etc.), with any additional space at the sides or top filled by black background.

If you want to retain the original console size as designed by the sample set's creator then you can disable zooming by un-ticking the *View | Zoom virtual console to fit* option.

Note that if zooming is disabled when viewing full-screen mode the console will remain at its original size and the remaining screen area will be padded with black.

Without zoom the main St. Anne's console will look something like this:
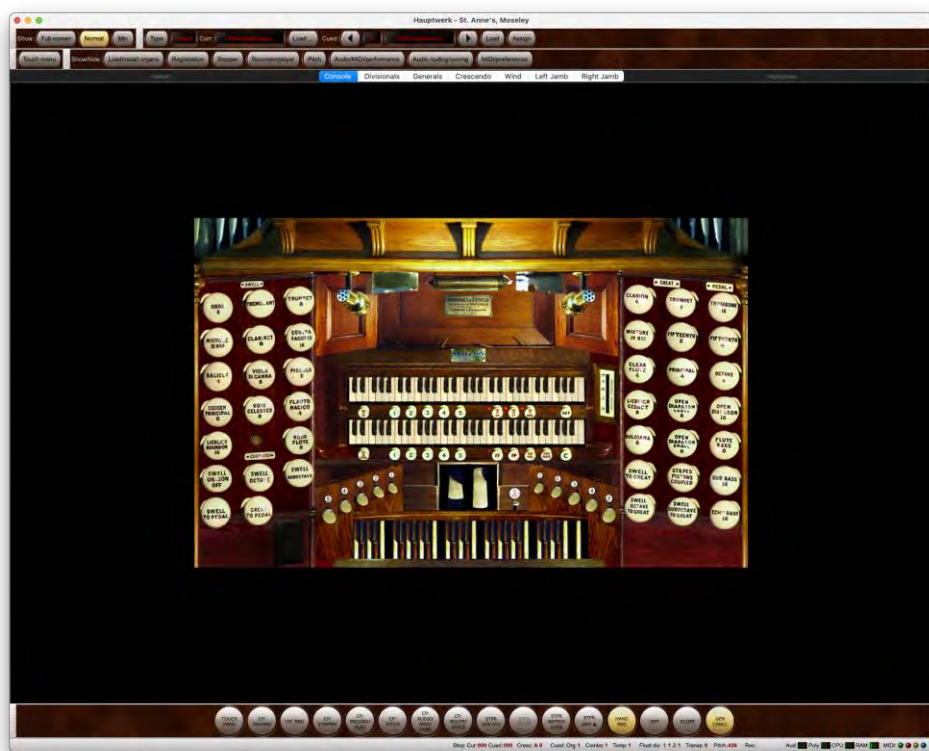
Control panels, piston toolbars and the Touch Menu

The large and mini control panels, as well as piston toolbars, have been discussed in the *Control panels and piston toolbars* section in this user guide, and the Touch Menu in the *Touch menu* section.

Organ menu

Loading organs

The *Organ* menu is used to load and unload virtual instruments (sample sets):
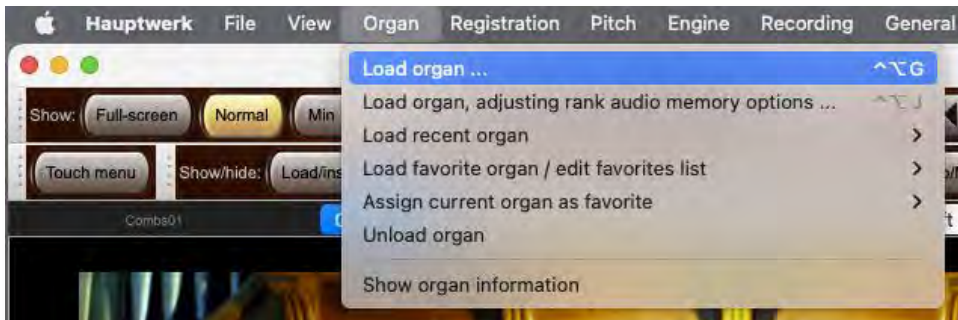
In order to be able to play Hauptwerk, a sample set must be installed and loaded.

The St. Anne's, Moseley organ sample set is installed automatically with Hauptwerk, but you can purchase or download many other superb additional sample sets from third-parties (see the Hauptwerk website for an extensive listing at www.hauptwerk.com/instruments). Before you can load any such additional sample sets, you must install them using Hauptwerk's component installer via the *File | Install organ, temperament, or impulse response reverb* menu option. The component installer is covered in the *Installing/uninstalling/upgrading organs, temperaments, or reverbs (the component installer* section of this guide. *(*Hauptwerk version 1 sample sets must instead be imported, which is covered in the *Importing Hauptwerk version 1 organs* section*.)*

The main function used to load a sample set is the *Load organ* menu option. When selected, you are presented with a list of all installed instruments, so that you can choose which to load.

The 'Organ load/assign' mini control panel may instead be used:

- *Load...*: shows the organ selection screen for manual selection of which organ to load.
- *Last*: loads the last-used organ.

… or (if an organ is already loaded) you can use the *Load/install organs* large control panel:
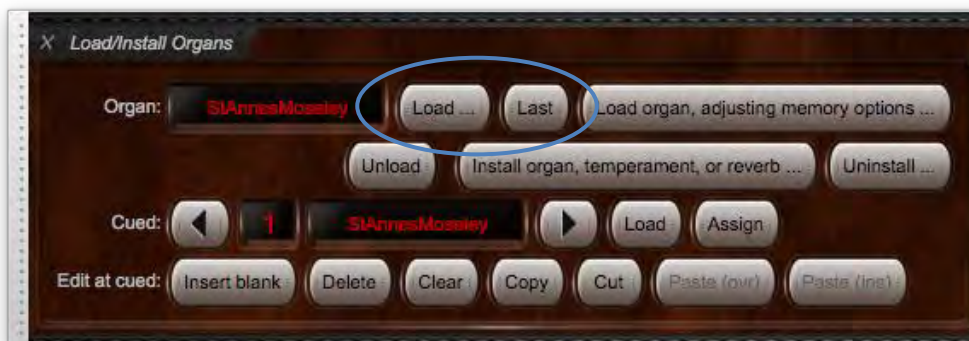
On either of those two control panels, the '*Cued*' (decrement and increment arrows), *Load* and *Assign* buttons mirror the same functions as the '*Cued favorites (all types)*' mini control panel covered below in the *Loading and assigning favorite organs* section.

As always, the Touch Menu may be used as an alternative to the control panels – it brings all of their functions together in one place for convenience (especially so for touch-screen users). The Touch Menu may be opened using *View | Touch menu* from the main menu, or from the *Touch menu* button that's docked by default near the top-left of the main Hauptwerk window:
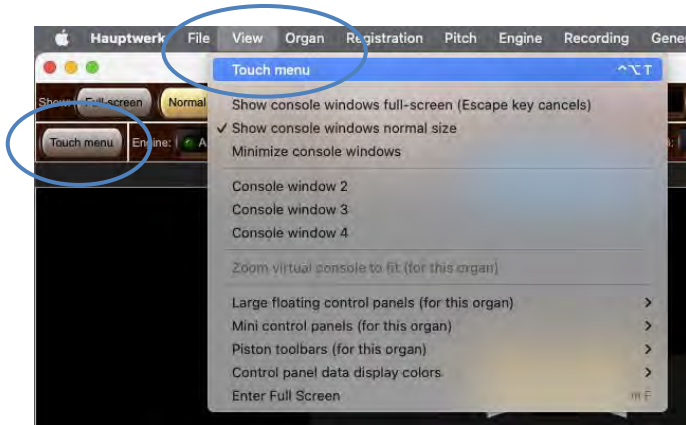
The Touch Menu's *Organs* tab duplicates the functionality available via Hauptwerk's main *Organ* menu:
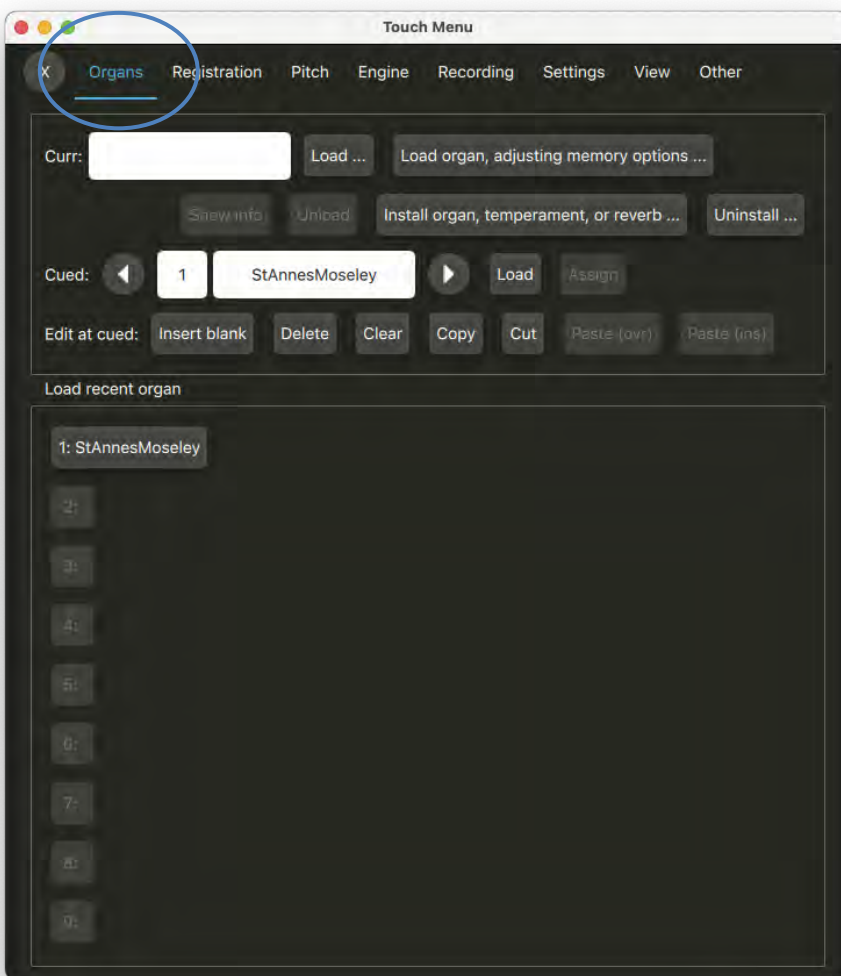
The first time you load any given instrument, you will be presented with the *Rank Audio Memory Options* screen:
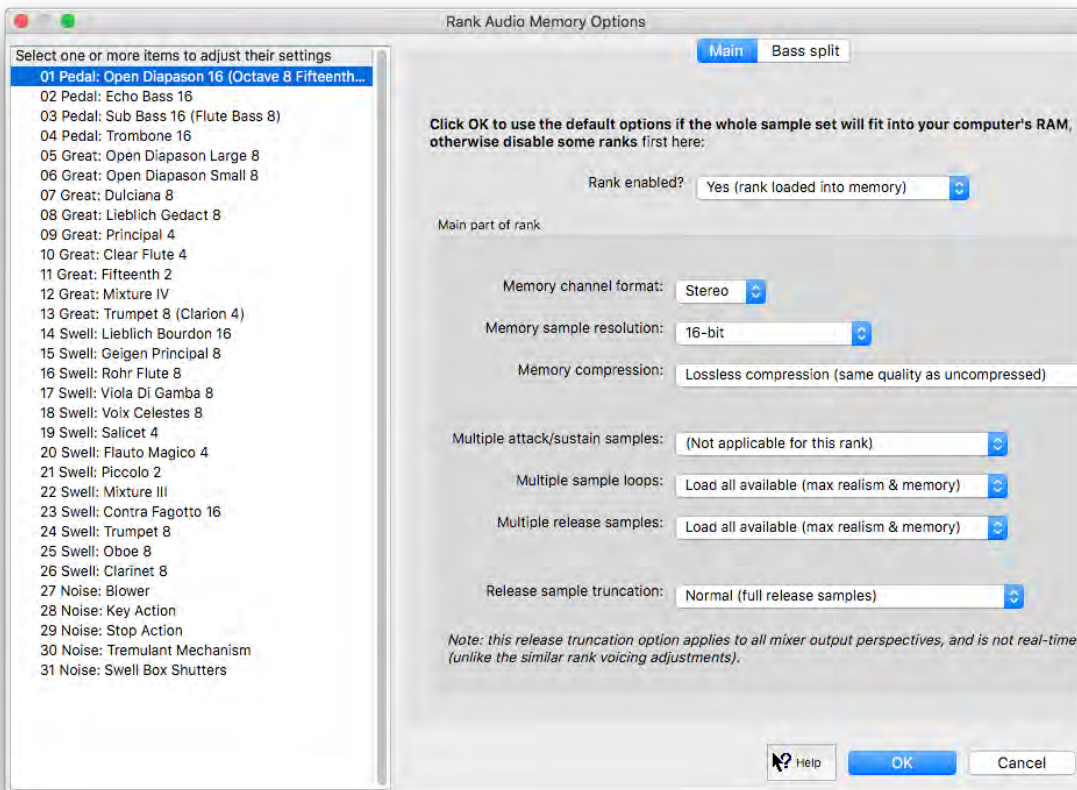
By default, the screen will not appear again the next time you load the same organ. However, if you wish to change any of the settings subsequently, simply use the *Organ | Load organ, adjusting rank audio memory options* option instead, and the screen will appear prior to loading, as it did the first time.

This screen can be used to tell Hauptwerk how, and if, each given rank should be stored in memory, and through which of the computer's physical audio outputs it should sound. By setting *Rank enabled?* to 'No', the rank will not be loaded into memory. It is thus possible to load only part of a sample set if you don't have sufficient available computer memory to load all of it.

Note that you can select multiple ranks at the same time (see the *Settings screens* section in this guide), which makes it very quick and easy to change many settings at once. For example:
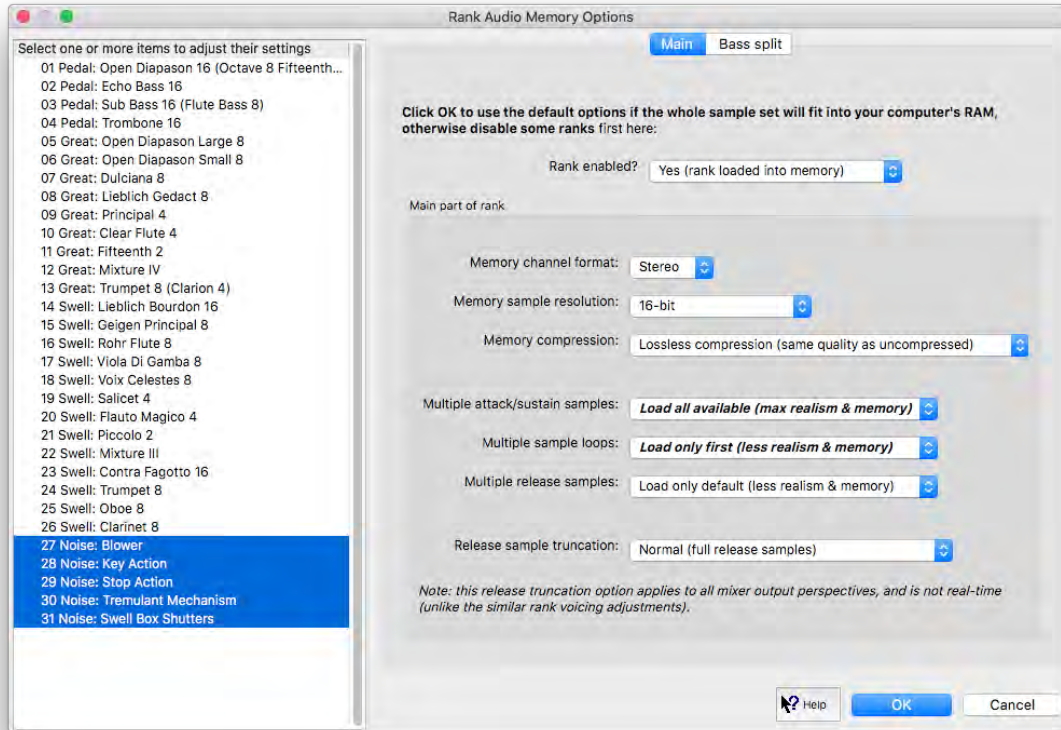
Organ loading settings: memory channel format

If a sample set uses stereo samples, changing the *Memory channel format* to 'Mono', will cause the samples to be converted to mono when loading. They will then automatically be panned back into stereo in real-time (although in the Advanced Edition of Hauptwerk you may choose to route them to mono speakers – see the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* section). Thus the setting provides a means to reduce memory requirements drastically, although usually significantly at the expense of realism.

Organ loading settings: memory sample resolution

If *Memory sample resolution* is set to 20-bit or 24-bit then samples will be loaded 32-bit aligned in memory, consuming twice as much memory as 16-bit samples. Note that Hauptwerk's internal audio signal processing and mixing resolution is always 32-bit, and audio output always happens in the highest resolution supported by the computer's audio interface, so even if all ranks are loaded in 16-bit, the effective resolution is usually still much higher. 20-bit resolution only offers any advantages if memory compression is enabled, since it compresses more than 24-bit respectively, thus saving a large amount of memory.

The 20-bit option is especially useful since it gives most of the audible benefits of a 24-bit resolution, but without using much more memory than loading in 16-bit without compression.

Organ loading settings: memory compression

The *Memory compression* setting allows you to turn off loss-less memory compression for some or all ranks, typically increasing the memory required for a given rank by between 40 and 60 percent. Memory compression is enabled by default for all ranks when you load an organ for the first time. Disabling memory compression has *absolutely no effect at all on audio quality*, although if your computer has a fast SSD drive then disabling memory compression might allow organs to load faster.

Organ loading settings: multiple attack/sustain samples

Multiple attack/sustain samples are used in some sample sets to model a pipe organ tracker-action response, to select samples randomly to reduce repetition, to give more realistic attacks to a pipe that sounds immediately after it has stopped speaking, and to give other improvements in realism. The *Multiple attack/sustain samples* setting allows you to choose only to load the default attack/sustain samples, potentially saving a significant amount of memory. If you don't have sufficient memory to load the whole sample set, it's generally best to disable multiple attack/sustain samples or multiple loops in preference to disabling multiple release samples, since multiple release samples have the most obvious effect on realism.

Organ loading settings: multiple sample loops

Hauptwerk supports samples containing multiple loops, which it plays in a complex sequence to reduce perceived repetition. For the most realistic results, keep *Multiple sample loops* set to 'Load all available loops (max realism & memory)' if you have enough memory to load the whole sample set, so that all loops available in the rank's samples are used. The setting has no effect on samples with only one loop. If you select '*Load only loop which ends first (less realism & memory)*' then usually considerably less memory is required if the samples contain several loops. If a sample set is only slightly too large to fit into memory, try loading only the first loop for the least frequently-used or least prominent ranks. Multiple loops are most beneficial for pipes that you are likely to sustain for long periods of time, such as pedal ranks.

Organ loading settings: multiple release samples

Hauptwerk also allows a sample set to include multiple real release samples for each pipe, which gives extremely realistic handling of releases, especially when playing fast passages. For the most realistic results, always leave *Multiple release samples* set to '*Load all available samples (max realism & memory)*' if you have enough memory to load the whole sample set, so that all release samples included in the sample set are used. If you select '*Load only default sample (less realism & memory)*' then usually considerably less memory is required if the sample set contains multiple release samples, but the virtual acoustic of the organ might sound much less convincing ('harp-like' or lacking clarity) when playing short notes, so it is recommended that you only disable multiple release samples as a last resort.

Organ loading settings: release sample truncation

Release sample truncation causes Hauptwerk to truncate release samples artificially as it loads them into memory, using specially-shaped frequency-dependent decays, to simulate 'dry' or 'semi-dry' samples (with no reverb, or less reverb). With very 'wet' sample sets, which have long release samples, this can save a considerable amount of memory. It can also allow such sample sets to be played in reverberant spaces and helps to reduce noticeable differences in acoustics when using sample sets containing samples drawn from several different sources. However, the results are never completely the same as using true dry or semi dry-recorded samples, mainly because a room acoustic also affects the attack and sustaining portions of the sound, which simple truncation of releases cannot model. True dry or semi-dry samples are thus highly preferable to using this option, and it is recommended that it only be used as a last resort. The licenses for some sample sets don't allow modification of samples in this way, and this option is disabled for such sample sets. Truncation times range from 5 seconds down to 120 milliseconds.

(Note that the Advanced Edition of Hauptwerk also has a separate, and independent, per-rank/pipe voicing adjustment that allows you to truncate releases in real-time, once the organ has been loaded. That voicing adjustment also allows independent real-time truncation for up to four output perspectives from each rank/pipe, but it doesn't save any memory. Please see the ***Voicing facilities*** section for further details.)

Individual rank options are disabled automatically if they are not relevant for the rank being loaded. For example, the multiple release samples option will be disabled if the sample set only has single release samples for the selected rank.

Click on the Help pointer/question-mark icon immediately to the left of a screen's *OK* button:
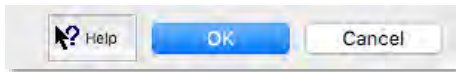
... then click onto the screen background to get additional help information about the screen as a whole, or onto any given setting for help on that setting. The same is true of almost all screens in Hauptwerk.

Loading recent organs

The *Organ | Load recent organ* sub-menu will list the organs most recently accessed, providing a convenient short-cut to recall them.
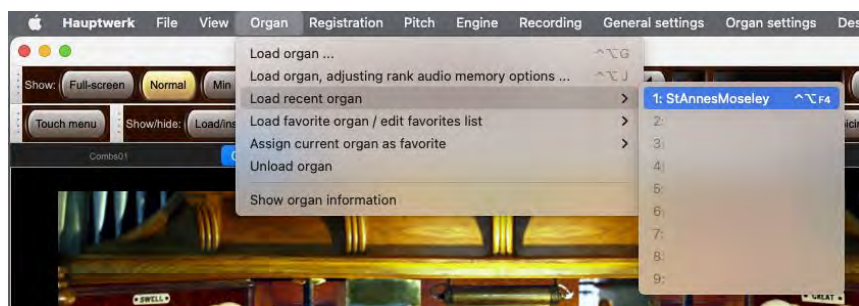
For convenience for touch-screen users, there are also dedicated buttons for them on the Touch Menu:
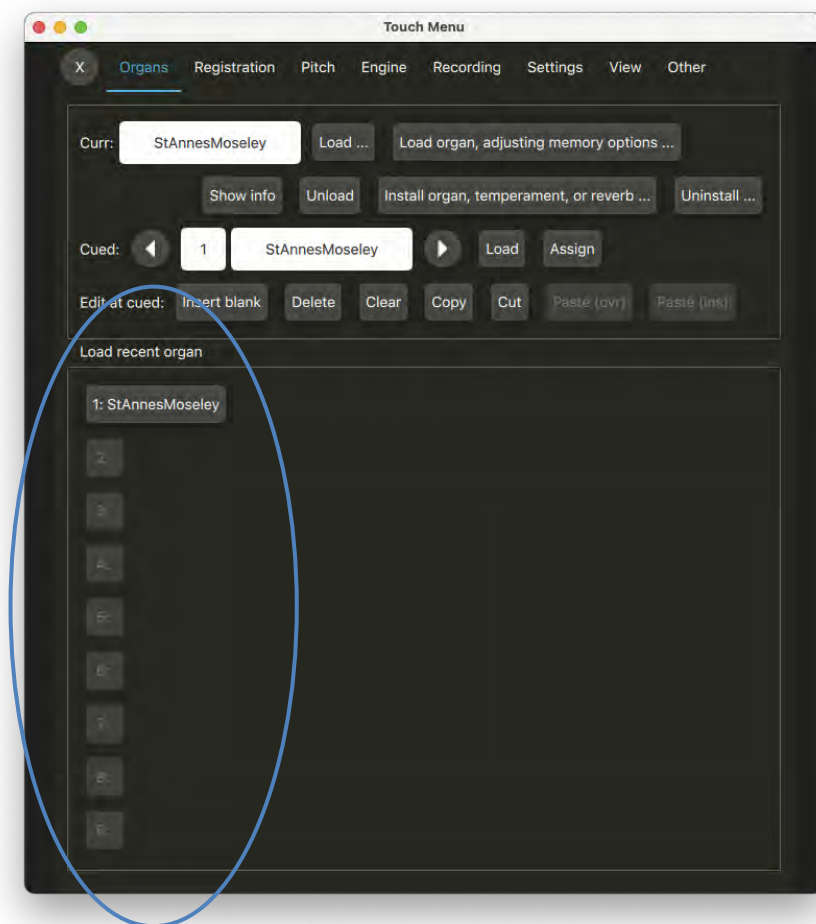
Loading and assigning favorite organs

There are sixty-four 'favorite organ' slots to which you can assign organs, so that you can recall them quickly and conveniently, either via a computer screen (control panel) or from MIDI pistons. At any one time, one of the sixty-four is designated the 'cued' favorite, allowing you to scroll through them and select the desired (cued) one.

Any of the following control panels can be used:

- '*Load/install organs*' large control panel:
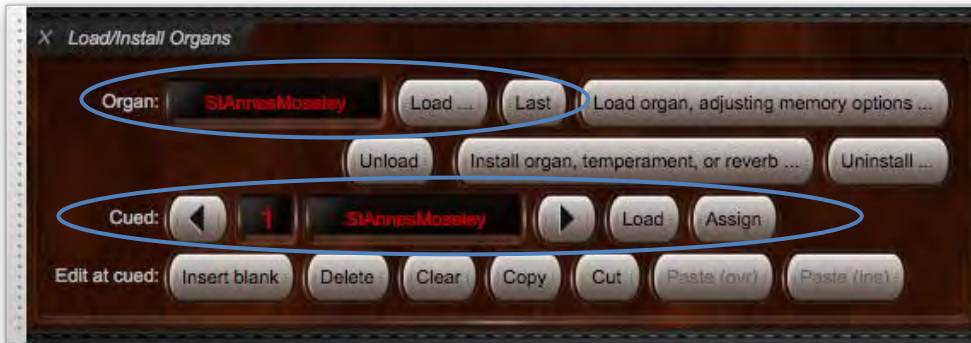
- '*Organ load/assign'* mini control panel:

- '*Cued favorites (all types)'* mini control (with 'Organ' selected for the type):

- '*Cued favorites (all types) and utility functions menu'* large control panel (with 'Organ' selected for the type):

The left and right arrow buttons on the control panels scroll the 'cued' entry through the list of all sixty-four favorites, the *Load* button loads the cued (selected) item, and the *Assign* button assigns the currently-loaded combination set as the cued favorite number, overwriting the previous entry in that slot.

The *Organ | Load favorite organ …* and *Organ | Assign current organ as favorite* menus duplicate the functionality via the menu, and all of the relevant functions may also be found on the Touch Menu.

To assign a favorite organ via one of those four control panels:

- Load the organ you wish to assign as a favorite.

- Make sure the desired control panel is displayed, opening it via the relevant *View | … control panels | …* submenu (for example) if needed. In the case of the *Load/Install organs* large control panel (pictured above) you could alternatively open it by clicking on the *Load/install organs* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default:
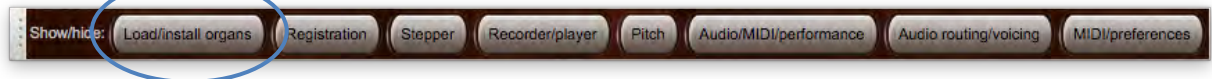
- If instead using one of the '*… (all types)*' control panels then verify its type option on the left is set to *Organ*. (This step is not needed for the other two control panels.)

- Click the left or right arrow buttons to select which favorite slot (1-64) to assign the organ to.

- Click the *Assign* button to finish.

Repeat the above steps for each organ you wish to assign as a favorite *making sure you select a unique favorite slot number for each organ*, otherwise a previously-saved favorite will be overwritten.

To load a favorite organ via one of those four control panels:

- If an organ is already loaded, make sure the desired control panel is displayed, opening it via (for example) the relevant *View | … control panels | …* submenu if needed. (If no organ is loaded you would need to use the *Organ Load/assign* mini control panel, which is docked at the top of the main window.)

- If using the *Cued favorites (all types)* mini control panel then verify the *Type* option on the left is set to *Organ*. (This step is not needed for the other two control panels.)

- Use the left (decrement) or right (increment) arrows to select (cue) the favorite organ you want to load.

- Click the *Load* button.

- Once loaded the organ name will be displayed on the control panel as well as in the title bar of the main Hauptwerk window.

These buttons may also be assigned to MIDI switches to allow external switches to be used for selecting and loading organs.

Editing favorite organ assignments

You can overwrite any given favorite assignment simply by loading the desired organ and assigning it to the desired favorite slot as covered above, thus overwriting whatever assignment you might previously have made to that slot.

However, Hauptwerk also has editor facilities so that it isn't necessary to load an already-assigned favorite organ solely for the purpose of reassigning it to a different slot. You can also insert, delete, or clear favorites list entries. If an organ is currently loaded, the editor functions can be accessed via the *Load/install organs* large control panel:

… or (if an organ is currently loaded) via the *Cued favorites (all types) and utility functions menu* large control panel (with 'Organ' selected for the type):

… or via the *Organ | Load favorite organ / edit favorites list* menu:

(There are also mini control panels which have the necessary functions on them.)

However, since some of the control panels are only available once an organ is loaded, we'll instead describe how to use the stepper editor facilities via the Touch Menu.

To edit favorite organ assignments via the Touch Menu:
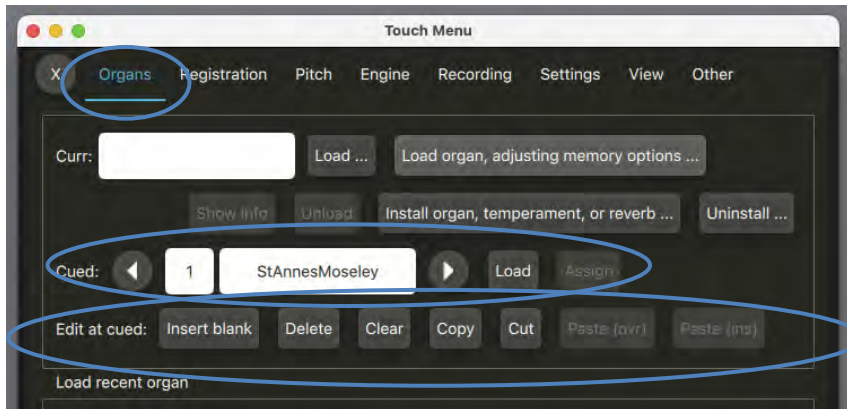
- Make sure the Touch Menu (pictured above) is displayed, otherwise open it by (for example) selecting *View | Touch menu* from the main menu (or via the *Touch Menu* mini control panel, which is docked at the top of the main Hauptwerk window by default.

- Make sure its *Organs* tab is selected.

- Use the left (decrement) or right (increment) arrows to select (cue) the favorite slot number at which you wish to make the edit.

- Use the appropriate function button to perform the desired one of the following available functions in the *Edit at cued* section on the selected cued favorite slot number:

    o *Insert blank list entry at cued* (where 'cued' denotes the current cued favorite number).
    o *Delete list entry at cued*.
    o *Clear (blank) list entry at cued*.
    o *Copy list entry at cued*.
    o *Cut list entry at cued*.
    o *Paste list entry (overwriting) at cued*.
    o *Paste list entry (inserting) at cued*.

Unloading an organ

In the *Organ* menu, the *Organ | Unload organ* menu is used to unload the instrument, freeing up the memory it occupied. Hauptwerk will automatically unload an organ when loading a different organ or when closing the application. Normally you will not need to use this function unless you specifically want to free up computer memory for some special purpose (such as for using other software temporarily), while leaving Hauptwerk running.

Showing organ information

When a sample set is loaded, the *Organ | Show organ information* option opens documentation specific to the instrument that has been provided by the creator of the sample set. Typically, this will include usage instructions, photographs of the original recorded instrument, history and other background information.

Registration menu: overview and control panels

The *Registration* menu contains many functions used to control Hauptwerk's very powerful combination system and other playing aids. Most of its commonly-used functions are also available via the *Registration* large control panel. The panel can be opened via (for example) the *Registration* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default (or via *View | Large floating control panels (for this organ) | Registration* on the menu):

The panel is specifically designed to make it quick and easy to learn and use Hauptwerk's combination system, by bringing all of the main related functions together in one place, showing their logical relationships clearly:

To aid understanding, we recommend keeping the *Registration* large control panel open when learning to use Hauptwerk's combination system.

Tip: use MIDI learn to assign your MIDI hardware to control these functions by right-clicking on them on the control panels (or on the Touch Menu) and choosing *Auto-detect*.

Other less commonly-used *Registration* menu functions are available on the *Floating Divisions* and *Master Couplers* large control panels, also found on the *View | Large floating control panels (for this organ)* menu:

The *Master general combinations (all)*, *Master scoped combinations (all)* and *Master reversible combinations (all)* large control panels offer the same master general, scoped and reversible functions respectively that are included on the main *Registration* control panel, but also include additional ones of each type, giving the full available complement (to keep the size of the main *Registration* control panel manageable):

Likewise, although the core functions for Hauptwerk's stepper are available on the *Registration* control panel, the full set are available via the *Combination stepper (all)* control panel:

All of the functions on the large control panels are also available in subsets via the mini control panels: *View | Mini control panels (for this organ)*, so that you can, if you wish, lay your screen out optimally with just the functions you want to use for each instrument.

There are two key general points to remember about Hauptwerk's combination system:

- For most virtual instruments, the 'master' combinations (stepper, master general combinations, master scoped combinations, master reversible combinations and master crescendo) available on the control panels, *Registration* menu and piston toolbars, are completely independent of, and additional to, any combinations that the virtual instrument includes natively on its virtual console screen. (However, a few recent instruments embed pistons natively on their virtual consoles to trigger Hauptwerk's corresponding master combinations, instead of implementing separate or additional combination systems of their own).

- In general, a master piston lights up automatically whenever the virtual instrument's registration matches the registration that's stored to it (regardless of whether you used the piston to draw the registration), provided that the registration stored to it isn't blank (all-off). (There are a few special cases, such as the master reversibles, which are covered in depth in the following sections, and for the master generals and stepper pistons that behavior is optional.)

In the following sections we will primarily describe the combination system functions in terms of the control panels, but you can also access them via the *Registration* menu, or assign them to piston toolbars, if you prefer.

As always, the Touch Menu may be used as an alternative to the control panels – it brings all of their functions together in one place for convenience (especially so for touch-screen users). The Touch Menu may be opened using *View | Touch menu* from the main menu, or from the *Touch menu* button that's docked by default near the top-left of the main Hauptwerk window:
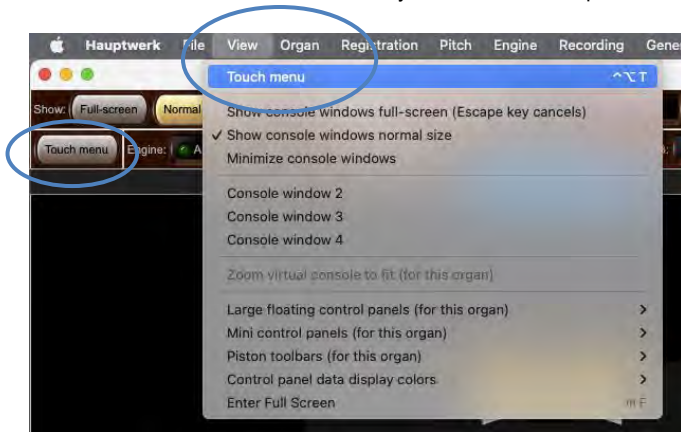
The Touch Menu's *Registration* tab and its sub-tabs duplicates the functionality available via Hauptwerk's main *Registration* menu:
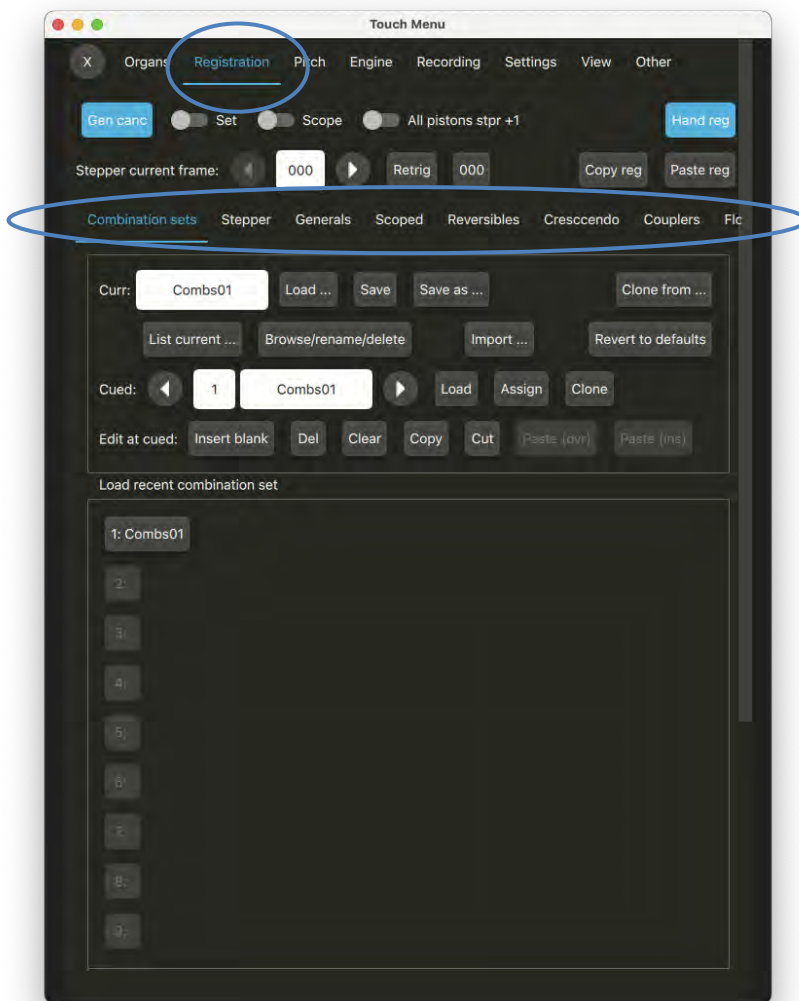
Registration menu: programming and canceling registrations

Programming combinations: combination setter (capture)

Combinations are programmed and recalled ('captured') in the same way that they are on most pipe organs: triggering a combination piston (such as a divisional, general or stepper frame) while the setter pistons/buttons/functions are in/on causes the current registration to be stored to that combination piston, whereas triggering the combination piston when the setter pistons/buttons/functions are *not* turned on causes the registration stored for that piston to be recalled.

Example: programming a combination:

- Load the St. Anne's organ.

- Engage the desired stops, couplers and tremulants you want to capture.

- Turn on the setter function (either on the virtual organ console, or on a control panel, or using a piston toolbar, or using the *Registration | Setter (capture mode)* menu function).

- Click on the general, divisional, stepper or other combination piston to capture the current registration to the piston.

- Turn off the setter function again. (Alternatively, there is an option on the *General settings | General preferences* screen for the setter to cancel itself automatically after capturing.)

Repeat the above steps for each combination to be set for individual pistons as required.

In addition to the instrument's native *SET* piston (if included as part of the instrument), the *SET* function may also be controlled via the *Registration* large control panel:
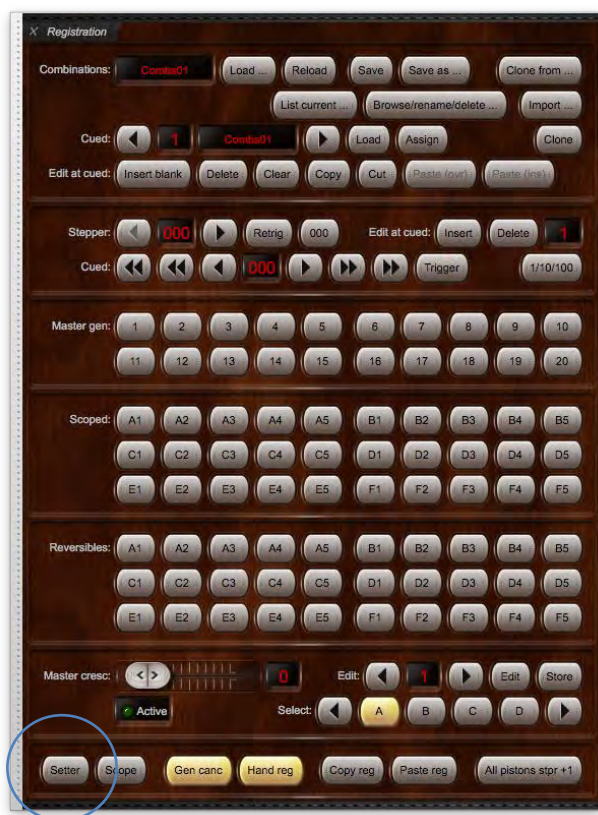
... and is also assigned by default to the primary piston toolbar:

Tip: use MIDI learn to assign a MIDI piston to control the setter function by right-clicking on (any) one of the setter pistons/buttons on the control panels (or on the Touch Menu) and choosing *Auto-detect*.

General cancel

The general cancel piston is available on the *Registration* large control panel:

... and is also assigned by default to the primary piston toolbar:

Tip: use MIDI learn to assign a MIDI piston to control the general cancel function by right-clicking on (any) one of the general cancel pistons/buttons on the control panels and choosing *Auto-detect*.

The general cancel function sets the current registration back to its initial, default state. (Unless you've selected clears some virtual stops to default to 'on') it will turn off all stops, couplers and tremulants. It lights up automatically whenever the current registration matches that initial state.

Registration menu: combination sets

Overview

Combinations can be saved to *combination sets* (files) so that many different full sets can be stored, appropriate for different pieces of music or recitals, for example, and loaded back into the virtual organ when needed. Each combination set contains the set of registrations stored for all of the virtual combinations provided natively by the virtual organ (usually divisional and general combination pistons plus possibly a crescendo), as well as the registrations stored for all of Hauptwerk's 'master' combination system functions.

Each combination set could be thought of as a 'bank' of combination memories. Note that combination sets are not themselves combinations; loading a combination file will not affect the registration immediately. You must still trigger a combination piston, or select a stepper frame, or activate a crescendo for the registration to be affected.

The *Registration* menu and associated control panels are used to load and save these combination sets, and to access Hauptwerk's combination system functions, and are only enabled when an instrument is loaded. Use of an instrument's native combinations (divisionals, generals, etc.) is covered in the ***Virtual console*** section.

You can use (for example) the *Registration* large control panel to select and save combination sets or assign them as favorites:

Combination sets are specific to their virtual instrument. You will only be shown sets that are appropriate for the instrument when loading a combination set.

Saving and loading combination sets

Load an instrument, such as St. Anne's, and program some combinations (using the setter function, covered previously). The *Save as...* and *Save* buttons on the *Registration* large control panel are used to save all combinations to a combination set (file):

The *Save* button overwrites the original combination set (the one you last loaded) with the new combinations, keeping the same name. This function can be triggered from MIDI pistons.

The *Save as...* button allows you to specify a new name for the combination set and makes that the current combination set. This function can't be triggered from MIDI (since you need to type a filename), but it's probably the most useful if you have a computer monitor or touch-screen attached.

The *Save combination set with an automatic name* menu function (not duplicated on any control panels) saves the combinations with a generated name (rather than overwriting the original) and makes that the current combination set. It can be triggered from MIDI pistons.

Having saved a combination set, try loading it back into Hauptwerk using the control panel's *Load...* button:

You can subsequently use the *Registrations | Load recent combination set* sub-menu as a short-cut to it if you wish. The *Registration* tab on the Touch Menu also has dedicated buttons for loading recent combinations:
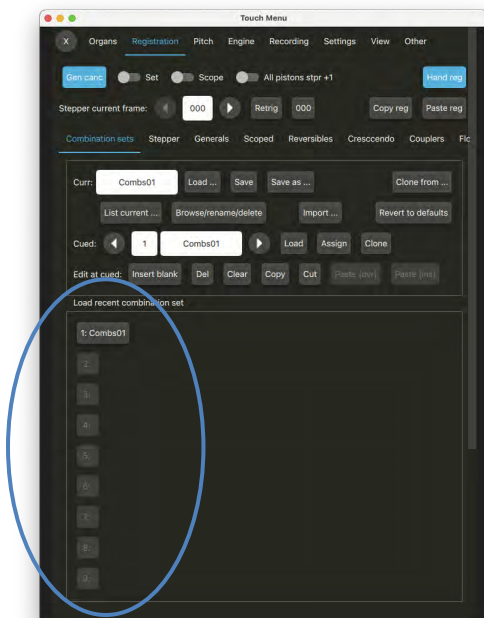
Note that the combination set you used last for any given instrument loads automatically with the instrument by default. Note also that it might take a few seconds for a very large combination set to load so you should not attempt to load a set while actually playing a piece of music; load it between pieces instead. However, most combination sets load almost instantaneously.

Assigning and loading favorite combination sets

There are sixty-four 'favorite' slots to which you can assign combination sets, so that you can recall them quickly and conveniently, either via a computer screen (control panel) or from MIDI pistons. At any one time, one of the sixty-four is designated the 'cued' favorite, allowing you to scroll through them and select the desired (cued) one.

To access the favorite combination sets, use (for example) the *Registration* large control panel:

... or the *Cued favorites (all types)* mini control panel (with 'Combs' select as the type):

The left and right arrow buttons on the control panels scroll the 'cued' entry through the list of all sixty-four favorites, the *Load* button loads the cued (selected) item, and the *Assign* button assigns the currently-loaded combination set as the cued favorite number, overwriting the previous entry in that slot.

To assign a favorite combination set via the *Registration* large control panel:

- Load the organ and create (save) a combination set you wish to assign as a favorite.

- Make sure the *Registration* control panel is visible (e.g. via *View | Large floating control panels (for this organ) | Registration*).

- Click the left or right arrow buttons to select to which favorite slot (1-64) to assign the combination set.

- Click the *Assign* button to finish.

Repeat the above steps for each combination set you wish to assign as a favorite *making sure you select a unique favorite slot number for each combination set*, otherwise previously saved favorites will be overwritten.

To load a favorite combination set in the control panel:

- Use the left (decrement) or right (increment) arrows to select (cue) the favorite combination set you want to load.

- Click the *Load* button.

- Once loaded the combination set name will be displayed in the *Curr.* text display, as well as in the upper-left area of the main Hauptwerk window:

Editing favorite combination set assignments

You can overwrite any given favorite assignment simply by loading the desired combination set and assigning it to the desired favorite slot as covered above, thus overwriting whatever assignment you might previously have made to that slot.

However, Hauptwerk also has editor facilities so that it isn't necessary to load an already-assigned favorite combination set solely for the purpose of reassigning it to a different slot. You can also insert, delete, or clear favorites list entries. The editor functions can be accessed via the *Registration* large control panel:

… or via the *Cued favorites (all types) and utility functions menu* large control panel (with 'Combs' selected as the type):

(There are also mini control panels which have the necessary functions on them, and, as always, they can also be accessed via the Touch Menu.)

To edit favorite combination set assignments via the *Registration* large control panel (for example):
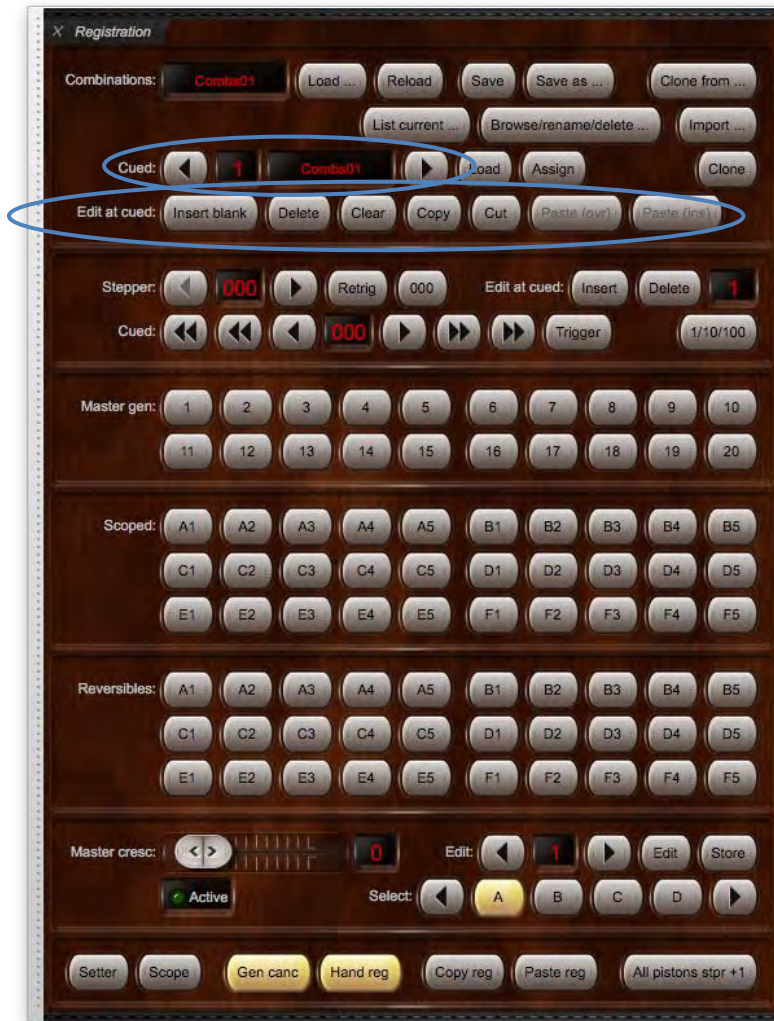
- Make sure the Registration control panel is visible (e.g. via *View | Large floating control panels (for this organ) | Registration*).

- Use the left and right arrow buttons to select which favorite slot (1-64) you want to edit.

- Finally use the appropriate function button in the *Edit at cued* section to perform the desired one of the following available functions on the selected cued favorite slot number:

  - *Insert blank list entry at cued* (where 'cued' denotes the current cued favorite number).
  - *Delete list entry at cued*.
  - *Clear (blank) list entry at cued*.
  - *Copy list entry at cued*.
  - *Cut list entry at cued*.
  - *Paste list entry (overwriting) at cued*.
  - *Paste list entry (inserting) at cued*.

Reverting combinations to organ defaults

To undo all of the combination changes made during the course of playing an instrument and revert back to the original combinations included with the instrument you can use the *Registration | Revert all combinations to organ defaults* menu option. If you have previously saved your custom combination settings to a combination set then those settings can still be loaded by back as normal. (Note that not all instruments include combinations; if the organ does not have any default combinations then this function will revert to empty, all-off, combinations).

Cloning combination sets

The clone functions offer a quick and easy method for copying a complete combination set without needing manually to re-save a new combination set. You can find the functions on the *Registration* large control panel (for example):

To clone a combination set in the *Registration* large control panel:

- Make sure the *Registration* control panel is visible (*View | Large floating control panels (for this organ) | Registration*).

- Click the *Clone from...* button.

- Select the combination set you wish to clone.

- Click *OK* to complete.

Cloning a cued combination set directly is also possible from the *Cued* combination set using the far right-hand *Clone* button. For instance, in the above examples we have *Combs01* loaded (the currently-active combination set) and the *Combs32* combination set is cued. Clone the *Combs32* to *Combs01* simply by clicking the *Clone* button. All registrations from *Combs32* will overwrite those currently stored in *Combs01*.

Importing combination sets

Importing combination sets between different editions of the same organ

Hauptwerk allows combination sets to be imported from organs that share the same internal combination system but use different internal organ IDs (typically different editions or variations of the same instrument). Use the *Import …* button on the *Registration* large control panel (or the *Registration | Import combination set...* menu function) to import a previously-saved combination set from one edition of an organ to another. Verify with the producer of the instrument whether this is possible, and the organ IDs to import from/to, since the function will not work properly with instruments unless the instrument producer has specifically designed editions of the instrument to have compatible combination sets for this purpose.

Sharing combination sets with other users

It's also possible to share combination sets with other users of the same instrument using this function. Save a combination set obtained from another person to your computer then use the *Import …* button on the *Registration* large control panel (or the *Registration | Import combination set...* menu function) to browse for the file, then click *Open* to import it. The combination set will then be available to load as normal (for example via the *Registration | Load combination set* menu function).

Browsing/renaming/deleting combination sets

Clicking the *Browse/rename/delete …* button on the *Registration* large control panel (or selecting the *Registration | Browse/rename/delete combination sets* menu function) opens the folder on your computer in which Hauptwerk stores the combination set files for the currently-loaded organ. Use your computer's browser window and features to rename files, or delete them as needed.
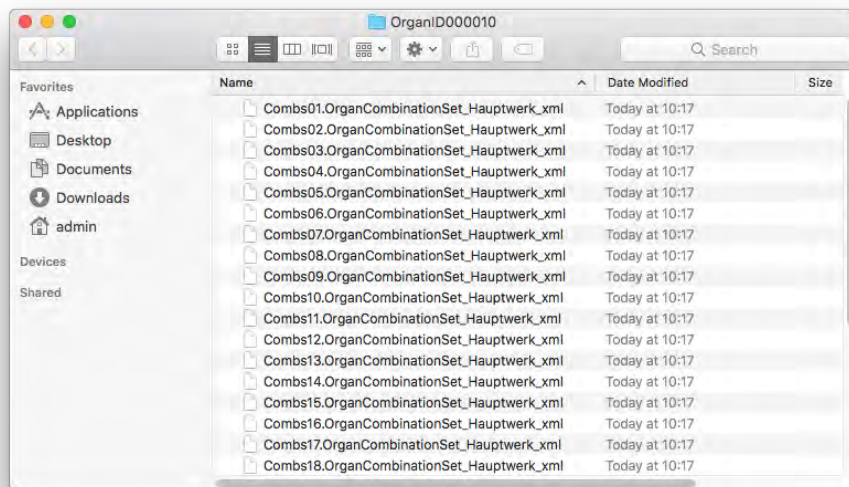
Note: it's very important that you don't modify the file extension of a file, otherwise Hauptwerk will no longer be able to load it.

For example, on macOS:
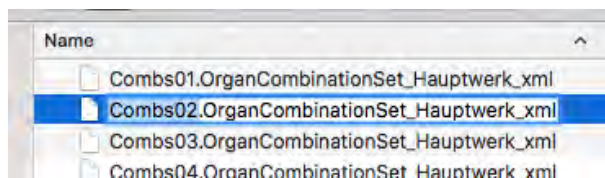
Only "*Combs02*" (for example) should be highlighted and renamed, leaving the rest of the text (the file extension) unmodified.

Registration menu: combination stepper (registration sequencer)

Overview

Hauptwerk has a 1000-frame fully random-access combination stepper (registration sequencer) in addition to any combinations or functionality a virtual instrument might include natively. It's designed so that you can navigate from any one of the 1000 frames to any other with the minimum possible number of piston presses (a maximum of 3 piston presses if you use 30 pistons for the stepper, or a maximum of 19 presses if you use 14 pistons for the stepper), without any intermediate combination frames being triggered.

The stepper is fully programmable, and its combinations are stored in combination sets along with all other combinations.

The stepper's core controls can be found on the *Registration* large control panel:
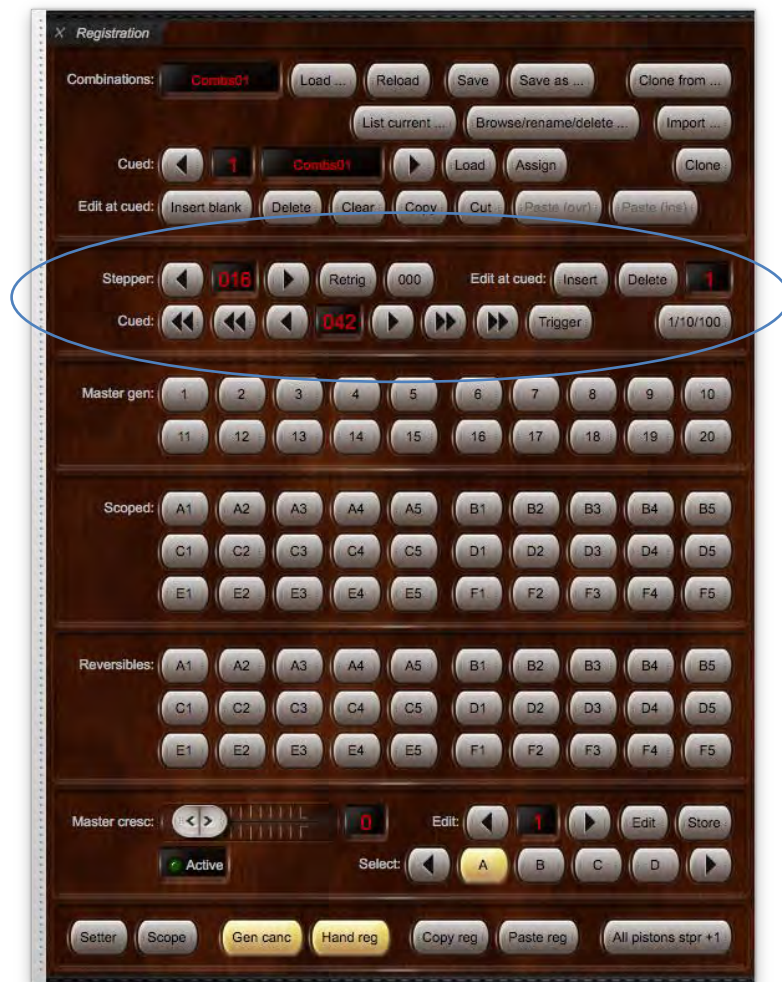
... and on the *Combination stepper 1* mini control panel:

... and on the *Combination stepper 2* mini control panel:

... and on the *Combination stepper xx0-xx9 trigger pistons* mini control panel:
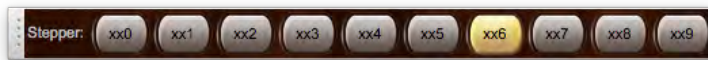
... and are on the *Registration | Cue/trigger/increment/edit stepper combinations* main menu sub-menu.

The full set of stepper controls are available via the *Combination stepper (all)* large control panel:

… and on the *Registration | Stepper* tab on the Touch Menu.

Tip: use MIDI learn to assign MIDI pistons to control these functions by right-clicking on them on one of the control panels (or on the Touch Menu) and choosing *Auto-detect*.

The first number displayed in each of the control panels is the current (active) frame number (0-999) and the second is the 'cued' frame (000-999). The cued frame is used during the process of navigating to another desired frame, without triggering the intermediate frames, i.e. without making any of the intermediate frames the current frame. Both frame numbers are also displayed in the status bar at the bottom of the main Hauptwerk window:
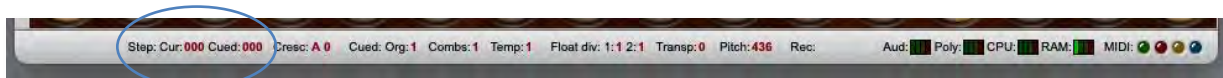
The frame numbers can also be displayed on LCD units on your MIDI console, if you have the necessary hardware (covered below).

When an instrument is first loaded all stepper frames contain empty (all-off) registrations. You will need to program registrations to the stepper frames before using them for playing.

Navigating stepper frames sequentially

The following example will illustrate how to use the stepper buttons to navigate through the frames sequentially (in consecutive frame number order), using the *Combination stepper (all)* large control panel. (The *Registration* large control panel, and the *Combination stepper 1* and *Combination stepper* 2 mini control panels, and the Touch Menu, have the same functions and may be used instead, in the same way.)

- Begin by pressing the *000* button to reset the stepper to the first frame (current and cued):

- To move forward to frame 001 simply press the right (increment) arrow button:

- Repeat to continue moving in single frame increments:

For convenience while performing (especially if solely using the stepper for registration), as an alternative to using the dedicated 'stepper increment' (right-arrow) function, you can temporarily turn on the '*All pistons stpr +1*' function via the button at the bottom-right of the *Registration* large control panel (which can also be found on the *Setter, general cancel, hand registration and utils* mini control panel):

Whilst that function is on (lit), triggering any master combination piston (except for the setter, scope, master general cancel, stepper -1, and stepper 000 pistons) or organ divisional or general combination piston (depending on an organ preference), increments Hauptwerk's master general stepper frame number, instead of the piston's usual function.

Navigating stepper frames non-sequentially (random-access)

To jump straight to a non-consecutive frame, without triggering the intermediate frames, you can then either:

- **Method 1: 1-based cueing and triggering:** For this method, use either the *Combination stepper (all)* large control panel (shown below), or the *Combination stepper 2* mini control panel, or the *Registration* large control panel:

   Use the double-arrow and single-arrow buttons around the *Cued* value display to select the desired 3-digit frame number, then use the *Trigger* button to perform the jump, making the three-digit cued frame current. For example, if the cued frame shows 538 and you click the *Trigger* piston then the stepper's current frame will immediately become 538 too, jumping directly from whatever the current frame was previously.

   Tip: this is conceptually the simplest method, and if used from a MIDI organ console this method requires the least number of MIDI pistons, but it potentially involves the most button/piston presses.

   Alternatively:

- ***Method 2: 10-based cueing and triggering:*** For this method, use either the *Combination stepper (all)* large control panel (shown below), or the *Combination stepper 1* mini control panel:

  First use the outer and inner double-arrow buttons around the *Cued* value display to select the desired hundreds and tens digits respectively:

  Now use one of the ten *xxN* buttons, which selects the desired ones digit. That digit is automatically appended to the cued frame's hundreds and tens digits to form the full 3-digit frame number. The pressed *xxN* button also performs the jump immediately, making that 3-digit frame number current. For example, if the cued frame shows 530 and you click the *xx8* button then the stepper's current frame will immediately become 538, jumping directly from whatever the current frame was previously.

  If used in this way, you could think of the stepper's frames as being organized in 100 banks of 10 frames.

  Tip: this is the way that most people prefer to use the stepper. It requires less button/piston presses, but if used from a MIDI organ console you would normally need to have ten MIDI pistons available to assign to the ten *xx0* to *xx9* buttons.

  Alternatively:

- ***Method 3: 100-based cueing and triggering:*** For this method, use the *Combination stepper (all)* large control panel (shown below). (Alternatively, you can use the *Combination stepper 2* mini control panel as well as some or all of the ten *Combination stepper xN0-xN9 trigger pistons* mini control panels):

First use the outermost double-arrow buttons around the *Cued* value display to select the desired hundreds digit:

Now use one of the one hundred *xNN* buttons, which selects the desired tens and ones digits simultaneously. Those digits are automatically appended to the cued frame's hundreds digit to form the full 3-digit frame number. The pressed *xNN* button also performs the jump immediately, making that 3-digit frame number current. For example, if the cued frame shows 500 and you click the *x38* button then the stepper's current frame will immediately become 538, jumping directly from whatever the current frame was previously.

If used in this way, you could think of the stepper's frames as being organized in 10 banks of 100 frames. It is also ideal if you prefer to consider (some or all of) the one hundred *xNN* buttons simply as general combination pistons, through which the stepper steps sequentially, akin to a 'simple stepper' found on some pipe/digital organ consoles.

Tip: this method requires the least button/piston presses of all, but if used from a MIDI organ console then you would normally need to have lots of MIDI pistons available to assign to (some or all of) the one hundred *xNN* buttons.

Whichever of the three methods you prefer, note that the current (active) frame will not change when using the cued arrow buttons alone; they are a means for pre-selecting ('cueing') a new frame in readiness, so that you can make the frame current (active) with a single piston press at exactly the point in time you want it.

Once the new frame has been reached you can jump straight to another frame, or continue in single digit frame increments or decrements from that point by using the arrow buttons around the current frame number display. (You don't need to reset the frame to 000 each time.)

The *000* button may be used at any time to reset the stepper frame numbers, returning instantly to the first frame and resetting the cued frame to *000*.

Two preferences can be found on the *General settings | General preferences* screen which affect the behavior of the cued frame number:

- "*Stepper +/- pistons also synchronize cued frame?*": If ticked, then as you increment/decrement the current frame number the cued frame number is also changed accordingly to match it.

- "*Stepper cue digit +/- pistons wrap to higher digits?*": If ticked (as it is by default), then as you increment/decrement the cued frame's 1s and 10s digits beyond 0 or 9, the higher-order digits will also be changed accordingly. For example, with the option ticked, if your cued frame number was 290 and you incremented the 10s digit then the new frame number would become 300 (otherwise it would become 200, since the 10s digit would simply wrap back to zero without affecting the other digits).

The stepper functions can of course all be triggered from MIDI pistons (right-click on the corresponding control panel buttons and select 'auto-detect'), and, together with the setter, are probably the most useful functions to assign to MIDI pistons for playing convenience:
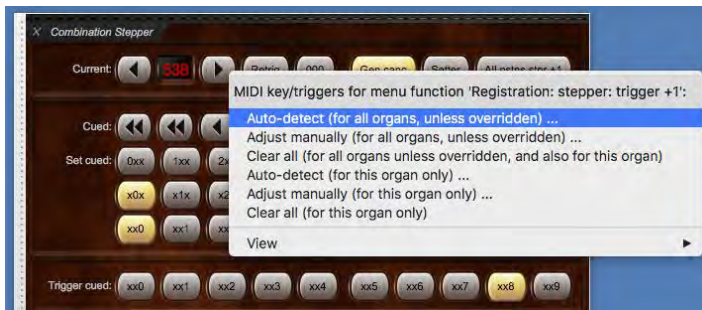
When the pistons light up

How the stepper buttons/pistons light up is determined by the "*Last-used master generals and stepper trigger pistons remain lit?*" preference on the *General settings | General preferences* screen:

- **If the preference _is_ ticked** (as it is by default): the stepper trigger pistons (and the 000 piston) will be illuminated while (and only while) both of the following are/remain true:

    o   The last type of master combination that you triggered was a stepper frame, and:

    o   Their 'number' corresponds to the current stepper frame number.

    For example, the *xx3* piston will be illuminated if (and only if) the ones digit of the current frame number is a '3', and you haven't triggered any other type of master combination since you last triggered a stepper frame number.

- **If the preference is _not_ ticked**: the stepper trigger pistons (and the 000 piston) will be illuminated while (and only while) all three of the following are/remain true:

    o   Their 'number' corresponds to the current stepper frame number, and:

    o   The current registration matches the current frame's stored registration, and:

    o   The current frame's stored registration is non-blank.

Programming stepper frames using the Combination Stepper large control panel

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure that either the *Combination stepper (all)* large control panel, or the *Registration* large control panel, is visible.

- Turn on the setter function (press the *Setter* button on the control panel, so that it lights up).

- Engage the desired stops, couplers and tremulants you want to capture.

- Trigger the stepper frame to which you want to capture (for example frame number 001), using the navigation procedures described previously. For example, if your current frame was 000, and you wanted to store your registration to frame 001 then use the right arrow for the current frame to increment it (thus triggering frame 001 and making it current):

  As the new frame number is triggered (navigated to), your registration will be stored to that new frame number (because the setter is on).

- Repeat the last few steps for each other frames you want to program, then turn the setter off again if needed. (There is an option on the *General settings | General preferences* screen for the setter to cancel itself automatically after capturing.)

Instead using the stepper as a basic 'simple stepper' which steps sequentially through a set of general pistons

Some digital organs have a 'simple stepper' which just steps sequentially through their general pistons. If you don't need the full flexibility of Hauptwerk's stepper, and just want something quick and easy instead, you can set it up in this way if you prefer:

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure that the *Combination stepper (all)* large control panel is visible (e.g. via *View | Large control panels …* from the menu, or via the *Stepper* button on the *Show/hide large floating control panels 1* mini control panel, which is docked at the top of the main Hauptwerk window by default):
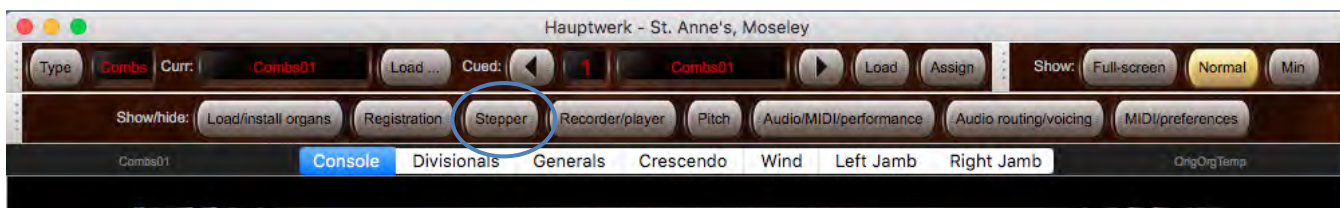
- Use right-click auto-detection to detect your MIDI console's general pistons to the corresponding number of '*Trigger cued: xNN*' buttons on the control panel. For example, if your MIDI console has 20 general pistons then auto-detect them to the *x00*, *x01*, …, *x19* buttons on the control panel:

… **not** to the *xx0*, …, *xx9* buttons, or to Hauptwerk's master generals. (If you'd already done that, right-click on those controls and select the '*Clear all …*' option to clear those MIDI connections.)

- Also auto-detect your MIDI console's 'next' piston to the right-arrow to the right of the '*Current*' frame number on the control panel:
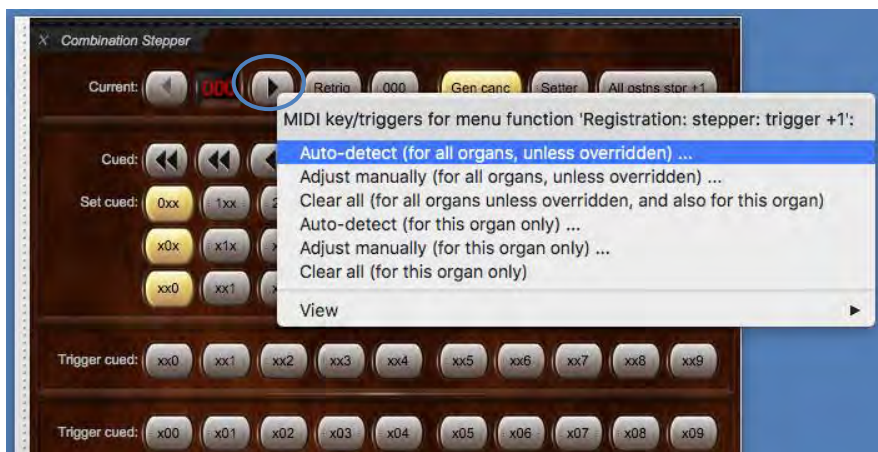
- Turn on the setter function (press the *Setter* button on the control panel, so that it lights up).

- Engage the desired stops, couplers and tremulants you want to capture to your first MIDI general piston (stepper frame 000).

- Click on the x00 button on the control panel (or press your first MIDI general piston) to trigger that frame, thus capturing to it (since the setter is on).

- Repeat the last 2-3 steps to programme registrations to each of your remaining MIDI general pistons (stepper frames), then turn the setter off again if needed. (There is an option on the *General settings | General preferences* screen for the setter to cancel itself automatically after capturing.)

Now you can use those MIDI pistons as though they were conventional generals (they will in fact be triggering stepper frames x00 to x19 directly, where 'x' is the cued 100s digit) and use your MIDI 'next' piston to step through them whenever desired.

Changing the sequence of stepper frame increments

When using 10-based cueing and triggering, by default the stepper requires ten trigger pistons (*xx0-xx9*), working on a ten-based number system. The single-frame increment function cycles from 000 to 009 and then continues to 010, for example. However, if you have less than ten MIDI pistons available to use as trigger pistons for the stepper (eight, for example) then you can set the number accordingly with the *Number of stepper general trigger pistons (3-10)* setting on the *General settings | General preferences* screen. When using the single-frame increment/decrement functions Hauptwerk will then skip any extra pistons that are not used and move to the next frame for which you have a MIDI trigger piston. For example, if you have eight pistons and 007 is the current frame then when you press the single-frame increment button Hauptwerk will move the current frame to 010, skipping frames 008 and 009.

Editing stepper frames

The combination stepper has a comprehensive set of editor functions. You can find the full set on the *Combination stepper (all)* large control panel:

... or on the *Combination stepper editor (all)* mini control panel:

… or via the *Utility functions menu* mini control panel:
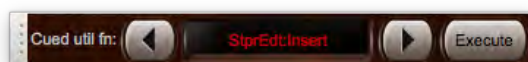
… or via the *Cued favorites (all types) and utility functions menu* large control panel:

A subset of the functions (just the most commonly used ones) can also be found on the *Registration* large control panel:

... or on the *Combination stepper editor (basic)* mini control panel:
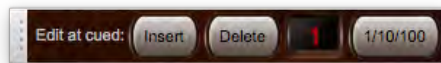
The full set of editor functions (as named on the *Registration | Cue/trigger/increment/edit stepper combinations* menu) are as follows:

- "*Insert N blank frames at cued*" (where 'cued' denotes the cued stepper frame number): Inserts a block of N blank stepper frames at the cued frame number (C), moving existing frame numbers >=C upwards accordingly. (Note: existing frames numbered >(999-N) will be discarded, as the others are moved upwards.)

- "*Delete N frames at cued*": Deletes a block of N stepper frames, starting from the cued frame number (C), moving all frame numbers >=(C+N) downwards accordingly. (Frames 999-N to 999 will be cleared.)

- "*Clear (blank) N frames at cued*": Clears (blanks) a block of N stepper frames, starting from the cued frame number, overwriting the existing frames there.

- "*Copy N frames at cued*": Copies a block of N stepper frames to the stepper editor's clipboard, starting from the cued frame number.

- "*Cut N frames at cued*": Cuts a block of N frames to the stepper editor's clipboard, starting from the cued frame number (C), moving all frame numbers >=(C+N) downwards accordingly. (Frames 999-N to 999 will be cleared.)

- "*Paste N frames (overwriting) at cued*": Pastes a block of N stepper frames from the stepper editor's clipboard, starting at the cued frame number, overwriting the existing frames there.

- "*Paste N frames (inserting) at cued*". Pastes a block of N stepper frames from the stepper editor's clipboard, starting at the cued frame number (C), moving existing frame numbers >=C upwards accordingly. (Note: existing frames numbered >(999-N) will be discarded, as the others are moved upwards.)

- "*Increment editor block size by 1*".

- "*Decrement editor block size by 1*".

- "*Increment editor block size by 10*".

- "*Decrement editor block size by 10*".

- "*Set editor block size to N=1 frame*".

- "*Set editor block size to N=10 frames*".

- "*Set editor block size to N=100 frames*".

- "*Cycle editor block size N=1/10/100*".

The block size functions allow a block size 'N' to be selected, determining the number of cued frames upon which the various editor functions operate. For example, you could insert 100 blank frames simultaneously at the cued frame number by setting the block size to 100, then using the '*Insert ...*' function. The copy/cut/paste functions also make it possible for blocks of frames to be copied/moved (via the stepper editor's dedicated clipboard) from one combination set (file) to another, whilst the organ remains loaded. For example, you could consider a block of 100 frames (say frames 100-199) as a template within a 'template' combination set (file), then copy/paste/reorder them into a separate combination sets for individual named pieces of music.

When using the editor functions, it's important to remember that they operate at the **cued frame number** (not the current frame number). Hence you must set the cued frame number to the desired value, and make sure that the block size is set to the desired value, before performing an edit operation.

It's also important to be clear that **the total number of stepper frames always remains at exactly 1000**, and that frame numbering and ordering always remains unchanged (000, followed by 001, followed by 002, etc.). **Inserting, deleting, cutting or paste-inserting frames simply moves the contents of existing higher-numbered frames up or down accordingly**. Hence if, for example, you inserted one frame at frame number 228 then frame 228 would then become blank and frame 229 would contain the stored registration that 228 contained previously (and so on upwards, for all higher numbered frames); no additional frame (such as '228A' or '228.1') would actually be created *between* frame numbers 228 and 229.

One the *General settings | General preferences* screen, there is also a preference "*Prompt for confirmation before combination stepper edits?*", with options for "*Never prompt*", "*Always prompt*" (the default), and "*Prompt if block size is >1*". To avoid accidental edits, you may prefer to be prompted for confirmation before such edits are made. If using Hauptwerk 'headless' (with no computer mouse or keyboard), you should set this to "*Never prompt*".

Stepper editor example: deleting 3 frames

As an example of using the stepper editor, let's suppose that you wanted to delete frame numbers 321, 322 and 323, moving all higher-numbered frames (frames 324 onwards) down accordingly by 3 frames:

- Make sure that the *Combination stepper (all)* large control panel is visible (or one or more of the other stepper control panels that allow you to cue and edit stepper frames).

- Use the double-arrow and single-arrow buttons around the *Cued* value display to select the desired 3-digit frame number at which you want to perform the edit operation, i.e. frame 321 in this example:

- Using its arrow buttons, adjust the stepper editor's block size to the desired value, i.e. 3 in this example:
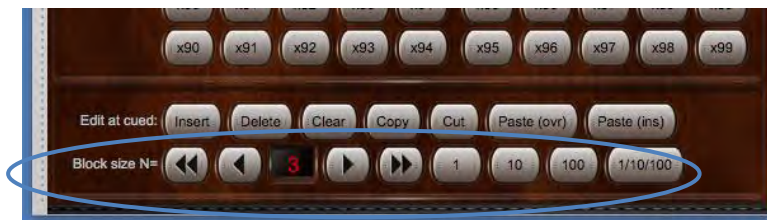
- Now click the stepper editor's *Delete* button to perform the actual edit:
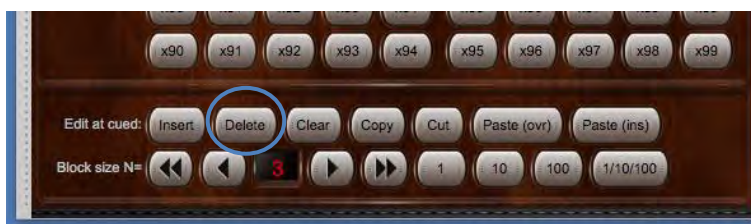
   (You may be prompted for confirmation, depending upon how you have the relevant general preference set.)

The 3 frames starting from the cued frame number (321) will then be deleted, and all higher-numbered frames (frames 324 onwards) will be moved down accordingly by 3 frames, with the top-numbered 3 frames (frames 997, 998 and 999) becoming blank. Thus frame 321 will contain the registration that frame 324 contained previously, frame 322 will contain the registration that frame 325 contained previously, and so on all the way upwards.

Displaying the stepper status on an LCD panel

Hauptwerk can optionally display the stepper frame numbers (current and cued) on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer):

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to *General settings | MIDI LCD panel control (for all organs).*

- Click the *Insert* button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the *'Stepper curr and cued frames …'* option for the *Display info/format for LCD line 1* setting.

- Click *Test: send text now* to verify that it's working.

- Click *OK* to exit.
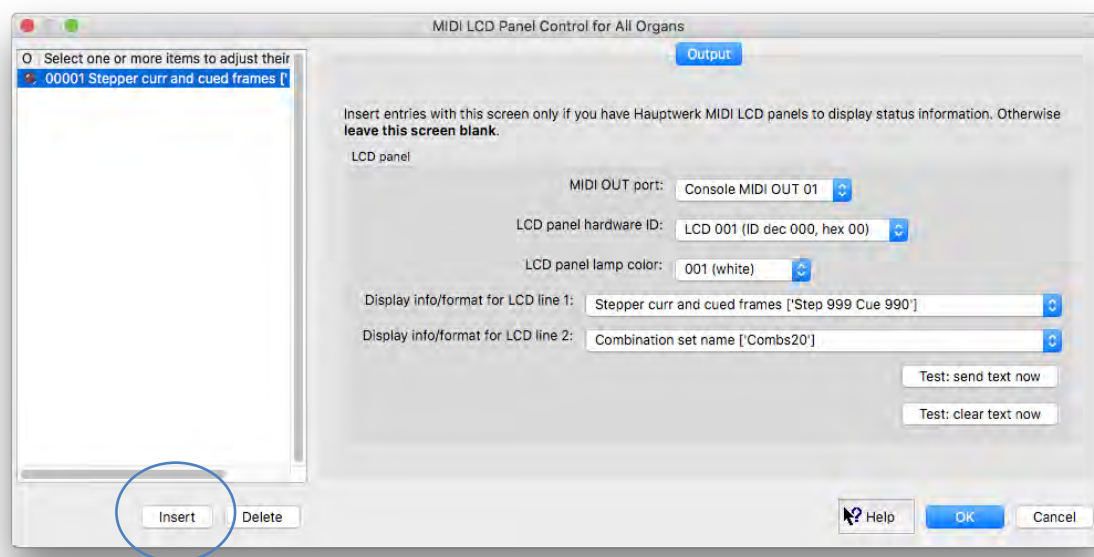
The first line of the LCD display will now show the stepper frame numbers, and will be updated automatically whenever they change:

Additional line formats are available similarly for the stepper editor, and the utility functions menu.

Registration menu: master crescendo

Overview

Hauptwerk's master crescendo allows any instrument to have a 31-stage, 4-bank crescendo system, in addition to any crescendo functionality a virtual instrument might include natively. Four separate crescendos/banks (A, B, C and D) are available.

The crescendo is fully-programmable and its combinations are stored in combination sets along with all other combinations.

The crescendo's controls can be found on the *Registration* large control panel:

... and on the *Master crescendo* mini control panel:

... and are on the *Registration* main menu, and on the *Registration | Crescendo* tab on the Touch Menu.

Tip: you can use MIDI learn to assign a MIDI expression pedal and MIDI pistons to control these functions by right-clicking on them on one of the control panels (or on the Touch Menu) and choosing *Auto-detect*.

Programming the master crescendo

The crescendo's registration is programmed using the draw-knobs/tabs on the virtual console display.

The following example demonstrates how to program the first few stages of the master crescendo bank A, using the *Master crescendo* mini control panel as an example. The *Registration* large control panel has exactly the same functions and may be used instead, in the same way.

- Make sure the crescendo slider and editor stage number are set to 0 and 1 respectively (their defaults).
- Click on the *A* button to make sure that bank A (the default) is selected as the current bank.

- Engage the desired stops, couplers and tremulants you want to store to the first crescendo stage, using the virtual console display.
- Press the *Store* button, which stores the selected registration to the selected editor stage, i.e. to the crescendo stage number shown to the right of *Edit* (1 in this case).
- Click the editor stage increment (right-arrow) button to move to editor stage 2, then follow the above steps again to store the desired registration for this stage.

You can now test the crescendo by slowly dragging the slider from 0 to 31. The registration on the virtual console will change according to the registration that you stored to each of the stages 0-31.

Note that the master crescendo will never turn off stops that it didn't turn on, so if you have some hand registration drawn then even if you move the crescendo slider fully to stage 31 and then fully back to stage 0 your hand registration will remain untouched.

The *Active* indicator LED lights up whenever the master crescendo has actively turned some stops on (that weren't already on by some other means).

Editing a crescendo stage

Once you've programmed the crescendo stages you can edit any of them at any time. Simply select the stage to be edited using the editor increment/decrement arrows then press the *Edit* button.

The registration on the virtual console will be changed to reflect the registration stored for that stage. Now update the registration as you wish, then press the *Store* button to store the updated registration back to that stage number. Alternatively, you can store it to a different stage number (making it possible to copy registrations between stages).

Selecting different master crescendo banks

To select a new 'bank' for the master crescendo use the A, B, C or D buttons (or their associated arrow buttons). Each of the four banks can be programmed independently.

Displaying the master crescendo status on an LCD panel

Hauptwerk can optionally display the current crescendo stage number and bank and editor stage number on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer):

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to *General settings | MIDI LCD panel control (for all organs)*.

- Click the *Insert* button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the '*Crescendo curr and cued stages …*' option for the *Display info/format for LCD line 1* setting.

- Click *Test: send text now* to verify that it's working.

- Click *OK* to exit.
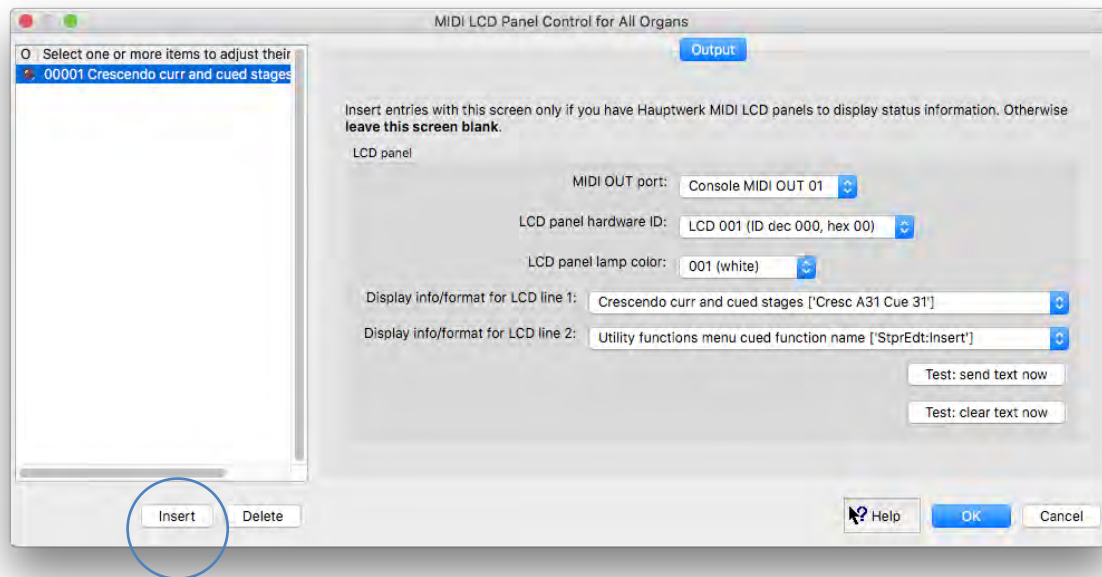
The first line of the LCD display will now show the crescendo status, and will be updated automatically whenever it changes.

Registration menu: master generals

Overview

Hauptwerk provides 100 master general combinations in addition to any combinations or functionality a virtual instrument might include natively.

The master generals are programmable and are stored in combination sets along with all other combinations. They're programmed in the same way as conventional combinations, capturing the virtual console's registration when the setter function is on and recalling when the setter is off.

A subset of 20 master generals can be found on the *Registration* large control panel:
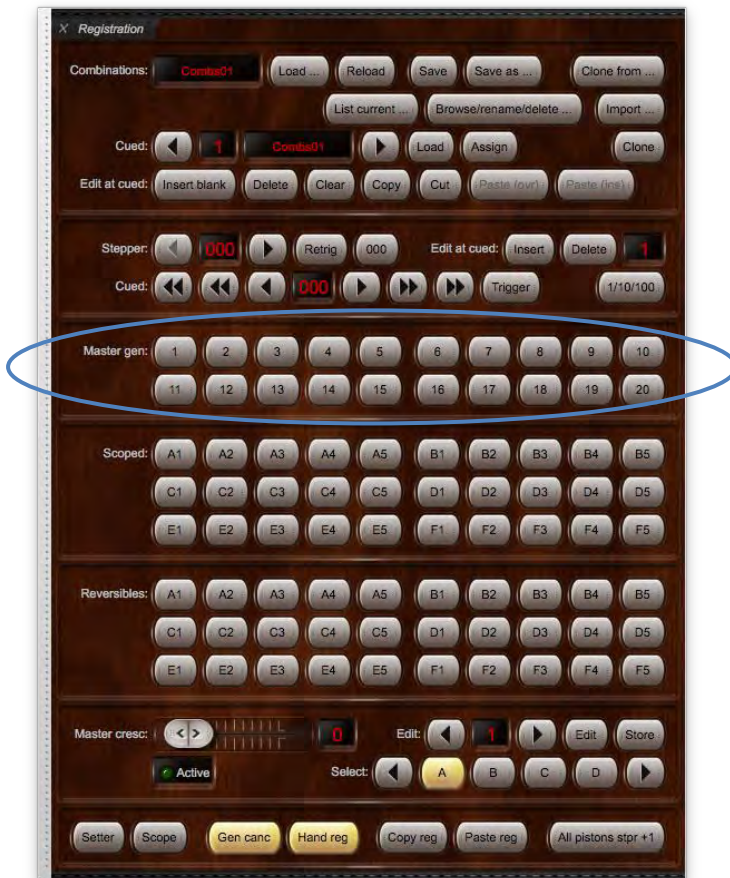
... and on the *Master generals 1-10* and *Master generals 11-20, …* mini control panels:
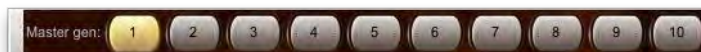
... and are on the *Registration | Trigger master general combination* main menu sub-menu, and on the *Master general combinations (all)* large control panel, and on the *Registration | Generals* tab on the Touch Menu.

When an instrument is first loaded all master generals contain empty (all-off) registrations. You will need to program registrations to them before using them for playing.

Note: that the stepper does not step through the master general pistons; if you prefer that behavior, then use some or all of the stepper's one hundred *xNN* pistons (available via the *Combination stepper (all)* large control panel), instead of using the master generals themselves.

Programming master generals using the Registration large control panel

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure the *Registration* control panel is visible (e.g. via *View | Large floating control panels (for this organ) | Registration*).

- Turn on the setter function (press the *Setter* button on the control panel, so that it lights up):

- Engage the desired stops, couplers and tremulants you want to capture.

- Press the master general you want to capture to, e.g. 1:

- Repeat the last few steps for each other master general you want to program, then turn the setter off again if needed. (There is an option on the *General settings | General preferences* screen for the setter to cancel itself automatically after capturing.)

When master general pistons light up

How the master general buttons/pistons light up is determined by the "*Last-used master generals and stepper trigger pistons remain lit?*" preference on the *General settings | General preferences* screen:

- ***If the preference is ticked*** (as it is by default): any given master general piston will be illuminated while (and only while) both of the following are/remain true:

  o   It was the last master general triggered.

  o   No master combination of any other type has been triggered since.

- ***If the preference is not ticked***: any given master general piston will be illuminated while (and only while) both of the following are/remain true:

  o   The current registration matches the master general's stored registration, and:

  o   Its stored registration is non-blank.(Note that several master general pistons may light up simultaneously, if you have programmed the same registration to each of them.)

  (Note that several master general pistons may light up simultaneously, if you have programmed the same registration to each of them.)

Displaying the master general status on an LCD panel

Hauptwerk can optionally display the last-triggered master general number (if any, and while the registration matches its stored registration) on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer):

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to *General settings | MIDI LCD panel control (for all organs).*

- Click the *Insert* button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the '*Combination system states …*' option for the *Display info/format for LCD line 1* setting.

- Click *Test: send text now* to verify that it's working.

- Click *OK* to exit.
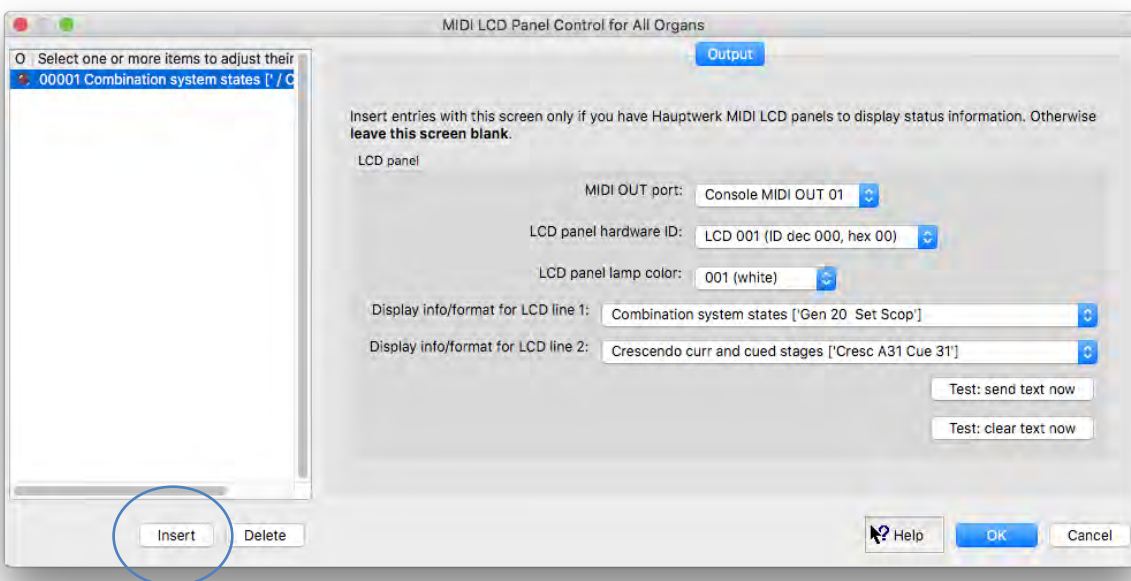
The first line of the LCD display will now show the general combination system status, including the master general number (if that was the last master combination to be triggered) and will be updated automatically whenever the status changes:

Registration menu: master scoped combinations

Overview

Hauptwerk provides 60 master 'scoped' pistons (also sometimes referred to as 'ranged' pistons) in addition to any combinations or functionality a virtual instrument might include natively. You can configure each of them to affect any range (subset) of stops you wish, so you can make them behave as divisionals, generals, or perform any other special functions you wish (such as 'all trems off', for example). They are thus extremely flexible and useful playing aids.

It's important to understand the difference between the master scoped pistons and the master generals: a master general will always affect the states of <u>all</u> stops/couplers/tremulants (whether turning them on or off), whereas a master scoped piston may be programmed ('scoped') so that it leaves the states of some stops/coupler/tremulants unaffected.

The scoped pistons are fully-programmable and are stored (both their registrations and scopes) in combination sets along with all other combinations.

A subset of 30 scoped pistons can be found on the *Registration* large control panel:
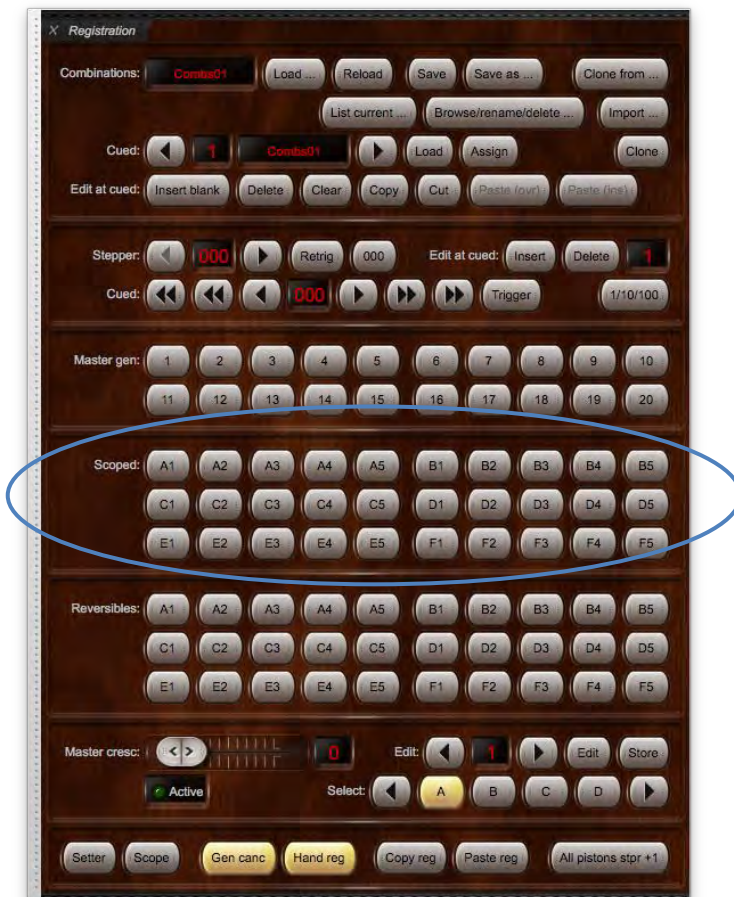
The full set of 60 can be found on the *Master scoped combination bank A...F* mini control panels:

… and the *Master scoped combinations (all)* large control panel:

… and on the *Registration | Scoped* tab on the Touch Menu.

When an instrument is first loaded all master scoped combination contain empty (all-off) registrations and are scoped as generals. You will need to set their scopes (unless you want them to behave as generals) and also program registrations to them before using them for playing.

Tip: use MIDI learn to assign MIDI pistons to control these functions by right-clicking on them on one of the control panels (or on the Touch Menu) and choosing *Auto-detect*.

Defining the scopes of the scoped pistons ('scoping')

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure the *Registration* control panel is visible (*View | Large floating control panels (for this organ) | Registration*).

- Click on the *Scope* button to turn it on, and do likewise for the *Setter*, so that both are lit up.
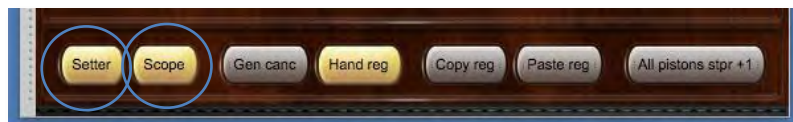
- Engage all of the desired stops, couplers and tremulants that you want the first scoped piston to affect. For example, if you want to make the piston a divisional combination for the Great division then turn on all stops/couplers/tremulants on the Great.
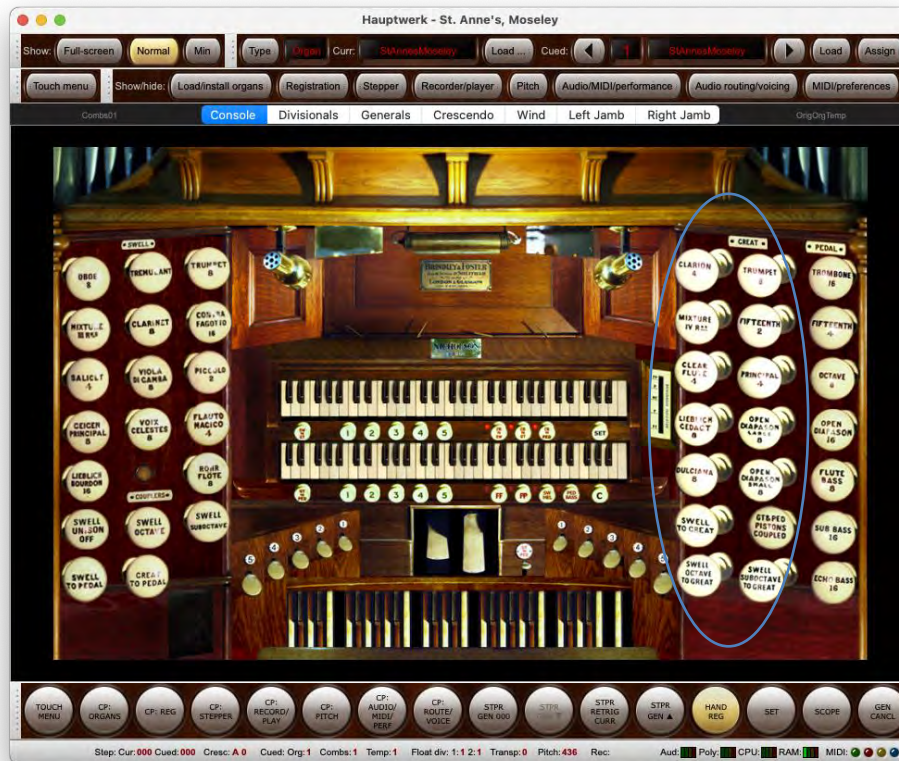
- Press the first scoped piston to set its scope to the match the stops/couplers/tremulants that are currently turned on.

- Repeat for each other scoped piston.

- Click on *Scope* and *Setter* buttons to turn them off again when you've finished. (Alternatively, there are options on the *General settings | General preferences* screen for the setter and scope mode to cancel themselves automatically after capturing.)

Programming ('setting') the scoped pistons' registrations

Once the scopes of the pistons have been defined you can use them in the same way as any other piston, using the setter function to capture registrations to them:

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure the *Registration* control panel is visible (e.g. via *View | Large floating control panels (for this organ) | Registration*).

- Turn on the setter function (press the *Setter* button on the control panel, so that it lights up), and make sure that the *Scope* button is *not* turned on (lit):

- Engage the desired stops, couplers and tremulants you want to capture.

- Press the scoped piston you want to capture to, e.g. A1:

- Repeat the last few steps for each other scoped piston you want to program, then turn the setter off again if needed. (There is an option on the *General settings | General preferences* screen for the setter to cancel itself automatically after capturing.)

Viewing the current scopes of the scoped pistons

With the *Scope* button/mode turned <u>on</u>, but the *Setter* turned <u>off</u>, triggering a scoped piston will recall its current scope, so that you can view it (and subsequently change it, if desired):

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Make sure the *Registration* control panel is visible (e.g. via *View | Large floating control panels (for this organ) | Registration*).

- Turn on the *Scope* function (press the *Scope* button on the control panel, so that it lights up), and make sure that the *Setter* button is *not* turned on (lit).

- Press the scoped piston whose scope you wish to recall (view).

- Turn off the *Scope* function when finished.

Summary: how the states of the setter and scope functions affect scoped pistons' behavior

- If both the setter and scope mode are on, then triggering a scoped piston will set its scope;

- If the setter is on, but scope mode is off, then triggering a scoped piston will set its stored registration (within its currently-defined scope);

- If the setter is off, but scope mode is on, then triggering a scoped piston will recall (show) its current scope;

- If neither the setter, nor scope mode, are on, then triggering the scoped piston will recall its stored registration (within its currently-defined scope).

When master scoped pistons light up

A master scoped piston automatically lights up whenever the current registration matches the registration stored to it _within its scope_, provided that the stored registration isn't blank.

Note that several master scoped pistons may light up simultaneously, if you have programmed the same registration to each of them or if their scopes are different.

Displaying scope and setter modes statuses on LCD panels

Hauptwerk can optionally display the current scope and setter mode statuses on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer):

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to _General settings | MIDI LCD panel control (for all organs)._

- Click the _Insert_ button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the '_Combination system states …'_ option for the _Display info/format for LCD line 1_ setting.

- Click _Test: send text now_ to verify that it's working.

- Click _OK_ to exit.
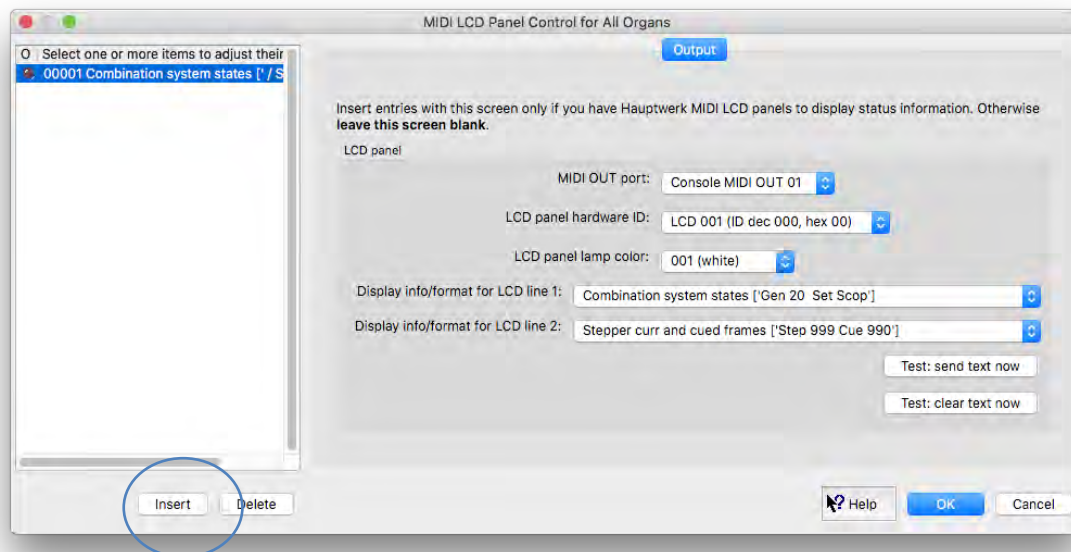
The LCD display will now show whether or not the setter and scope functions (modes) are active, and will be updated automatically whenever the statuses changes:

Scope function active:
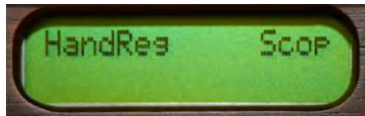
Setter function active:

Registration menu: master reversible combinations

Hauptwerk provides sixty master 'reversible' combinations in addition to any combinations or functionality a virtual instrument might include natively.

Any or all of them can be configured to function as simple traditional reversible pistons, each toggling the state of one virtual switch (stop, coupler or tremulant), which can be useful if you have sufficient spare MIDI pistons. When configured in that way, a piston will be lit whenever the switch it controls is on.

However, any master reversible combination piston can instead be configured to control several virtual switches simultaneously, which provides an extremely powerful and flexible new way to register organs. This is what happens if you do that:

1. If you press the piston when it isn't lit then it will always turn on all of the virtual switches it controls that that aren't already on. Hence pressing a reversible when it isn't lit will always ensure that all of the switches it controls are on.

2. If you press it again (now that it's lit) it will turn those virtual switches off again. However, it won't turn off switches that it didn't turn on, so if you'd turned some of its switches on by hand before you used the piston to turn on the remainder in point 1, then your original hand-registered stops would remain on after you'd pressed the piston again this time (to turn it off). Hence this allows you to use a reversible as a 'stateful', 'blind' additive combination, such as a tutti.

3. If you had used the piston to turn some stops on then it will remain lit until you press it to turn them off again, as long as it has some stops to turn off, even if you turn some (but not all) of its stops off by hand in the meantime. Thus the rule is that a reversible being lit means that pressing it will cause some (or all) of the stops it's configured to control to be turned off.

4. There's one special exception to the rule in point 2: if the reversible isn't already lit (meaning that it has no switches to turn off) and you turn on all its switches by some other means (by hand, for example), then it will light up so that you have a quick convenient short-cut to turn them all off again. In that special case pressing the piston will turn all of its switches off, even though it didn't actually turn any of them on. This allows it to work like a traditional reversible piston on a pipe organ when you have it configured to control only a single switch, for example.

It may sound a little complicated at first, so it's probably worth re-reading the above list a couple of times before trying to use the master reversibles for the first time. However, once familiar with the list the reversibles quickly become very intuitive, and extremely powerful tools.

The reversible pistons are fully-programmable and are stored in combination sets along with all other combinations. To define which virtual switches you want a reversible to affect, simply turn on (only) those switches, then use the setter to store the registration to it.

A subset of 30 reversible pistons can be found on the *Registration* large control panel:

The full set of 60 can be found on the six *Master reversible combination bank A...F* mini control panels:

… and the *Master reversible combinations (all)* large control panel:

… and on the *Registration | Reversibles* tab on the Touch Menu.

Tip: use MIDI learn to assign MIDI pistons to control these functions by right-clicking on them on one of the control panels (or on the Touch Menu) and choosing *Auto-detect*.

Registration menu: master couplers

Hauptwerk includes a comprehensive set of common 'master couplers', independent of, and in addition to, any couplers a virtual instrument may provide natively. These allow you to have, for example, a *Swell to Great* or *Bass Coupler*, even if using a historical sample set that doesn't have those couplers natively. Master coupler states are stored in the master generals, stepper, scoped and reversible combinations and master crescendo (but not within a virtual organ's native combinations), which are themselves stored in combination sets.

The master couplers allow coupling between each of up to six standard divisions (five manuals and Pedal) at sub (16'), unison (8'), super (4') pitches and with melody (highest-note) and bass (lowest-note) coupling.

Note that a small number of virtual organs aren't currently compatible with the master couplers and the couplers are disabled for those organs.

The master couplers can be found on the *Master Couplers* large control panel:

... and on the five *Master couplers: ...* mini control panels (one for each division):

… and on the *Registration | Couplers* tab on the Touch Menu:
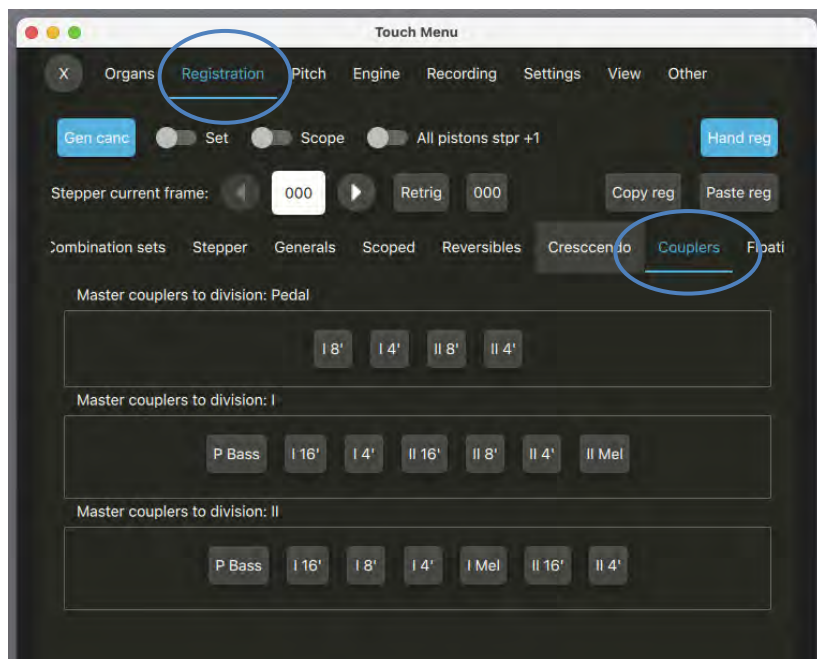
Tip: use MIDI learn to assign MIDI stop switches to control the master couplers by right-clicking on them on one of the control panels (or on the the Touch Menu) and choosing *Auto-detect*.

Only those couplers that connect between divisions that a virtual instrument includes are available (enabled); all others are disabled (grayed out on the control panels, and not shown on the Touch Menu). For example, the St. Anne's organ has two manuals and a pedalboard, so the master couplers only enable coupling for the first two manual divisions and the Pedal division with that organ:

When engaged the couplers illuminate as follows:

If a virtual instrument has three manuals then the *Div III* row of couplers will also be enabled; if an instrument has four manuals then the *Div IV* row will also be enabled, and so on.

In the case of the St. Anne's organ the master coupler division names correspond as follows:

- *Ped*: St. Anne's Pedal division.
- *Div I*: St. Anne's Great division.
- *Div II*: St. Anne's Swell division.

Each coupler row's label indicates the division that the row's master coupler buttons couple <u>to</u> and the division designations on the master coupler buttons indicate the divisions <u>from</u> which coupling occurs. For example, the *II 8′* master coupler button in the *Div I* row behaves like the native St. Anne's *Swell to Great* coupler.

The coupler buttons are named as follows:

- *P Bass* - Pedal bass coupler, which couples the Pedal division to the corresponding manual, only allowing the lowest played note to sound.
- *I 16′* - division 1 at 16' pitch.
- *I 8′* - division 1 at 8' pitch.
- *I 4′* - division 1 at 4' pitch.
- **II 16'** - division 2 16' pitch
- ...
- *I Mel* - division 1 melody coupler, which couples division 1 to the corresponding division, only allowing the highest played note to sound.
- … etc.

Note: the *P Bass* master couplers are particularly useful for playing Hauptwerk live if you don't have a MIDI pedalboard.

Registration menu: floating divisions

Overview

Floating divisions allow you to control more virtual keyboards than you have physical MIDI keyboards and allow you to swap the order in which your MIDI keyboards are assigned to virtual keyboards in real-time (while playing). You can configure at most five MIDI keyboards in this way and flip some or all of them dynamically between virtual keyboards at a time with piston presses.

If you want to use any given MIDI keyboard to play floating divisions then you must first configure (auto-detect) its MIDI settings using the *Organ settings | Advanced MIDI applications | Floating division MIDI keyboards* screen, <u>instead of</u> the *Organ settings | Keyboards* screen:
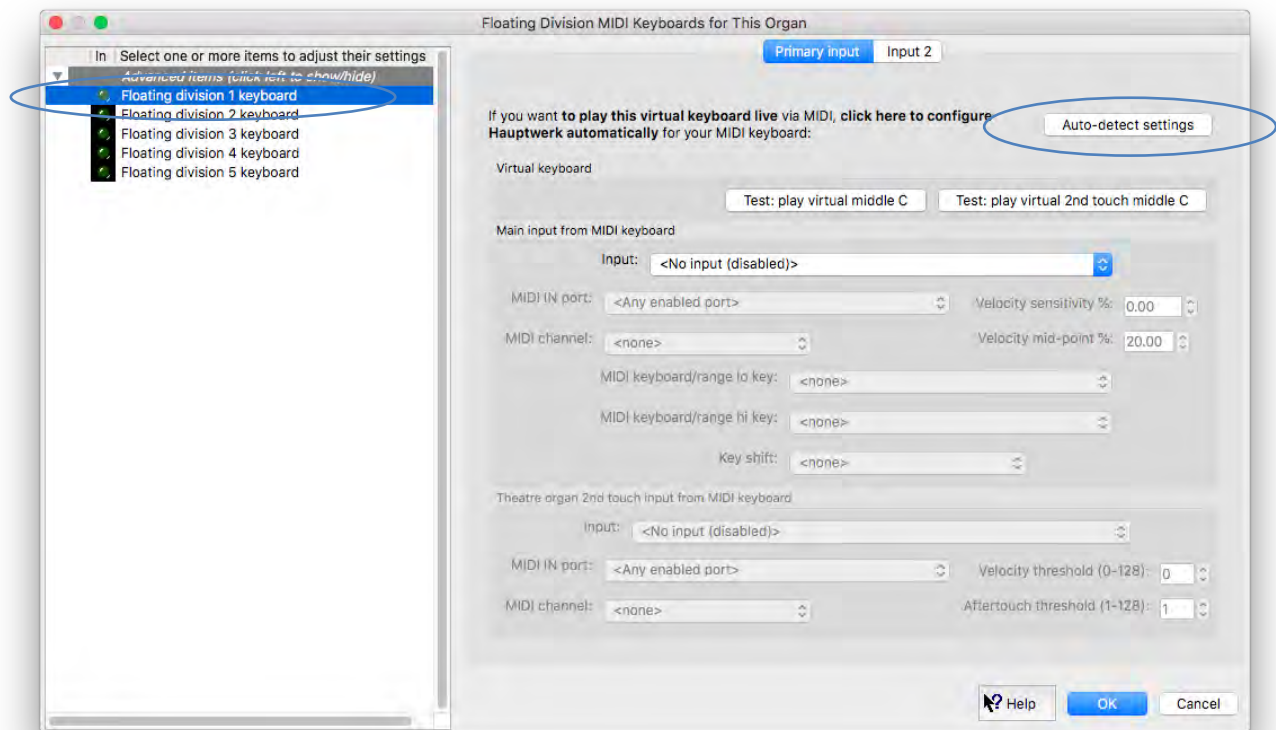
Then on the *Organ settings | Keyboards* screen you need to use select the '*Indirect MIDI input via floating division X, route Y*' entries for input on the desired input screen tabs to map floating division routes to the desired virtual keyboards. Each floating division allows at most four routes, so there are four 'input' tabs on the screen to allow for that:
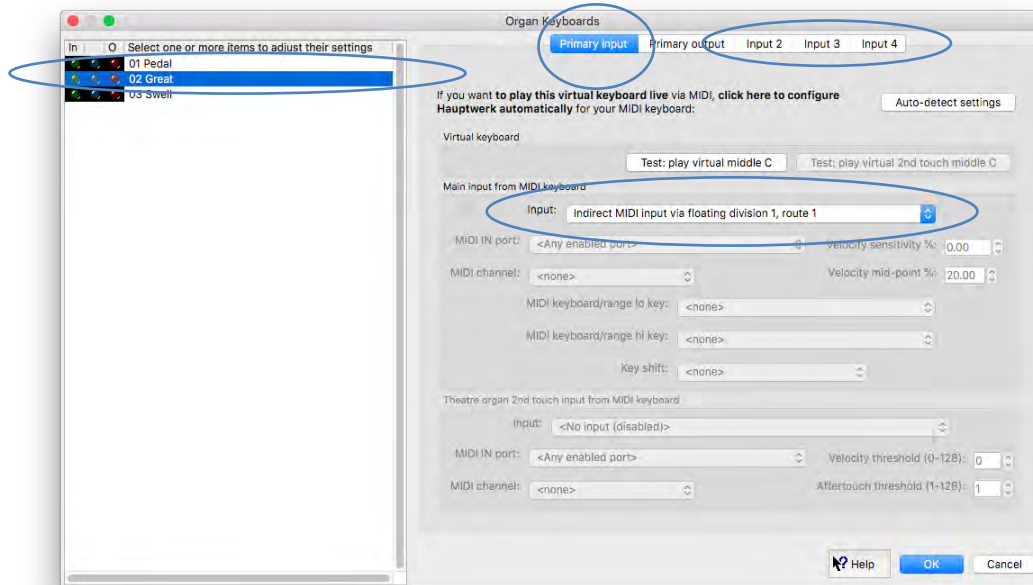
Once configured, the *Floating Divisions* large control panel (or *Floating division ...* mini control panels, or the *Registration* menu or piston toolbars, or the *Registration | Floating divisions* tab on the Touch Menu) can be used while playing to select the routes dynamically, flipping the keyboard assignments amongst the routes you defined:

To visualize, imagine each of the five 'division' rows on the screen as one of your MIDI keyboards and each of the four possible routes (represented by the 1/2/3/4 button columns, with the buttons in the '2' column lit up in the screenshot) as routes, each of which you have previously mapped to a virtual keyboard. The screen thus defines a matrix of MIDI keyboards vs. routes. In the screenshot above the rows for floating divisions (MIDI keyboards) 1 and 2 are circled, along with their four route columns.

The following sections elaborate by way of an example.

Example: swapping the St. Anne's keyboards dynamically

As an example, the following demonstrates how to use floating divisions to swap two MIDI keyboards dynamically between the St. Anne's organ's Great and Swell virtual keyboards.

- Go to the *Advanced MIDI applications | Floating division MIDI keyboards* screen.

- Highlight the *Floating division 1 keyboard* entry in the left-hand pane.

- Click the *Auto-detect settings* button to detect the MIDI settings for your first MIDI keyboard:
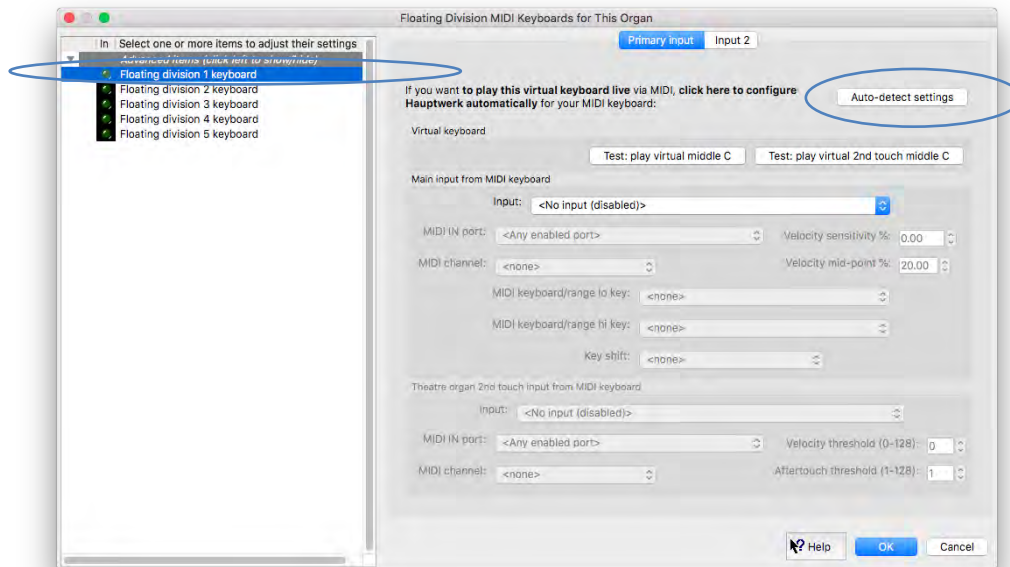
- Repeat the last two steps, this time for the *Floating division 2 keyboard* entry in the left-hand browse list and for your second MIDI keyboard:
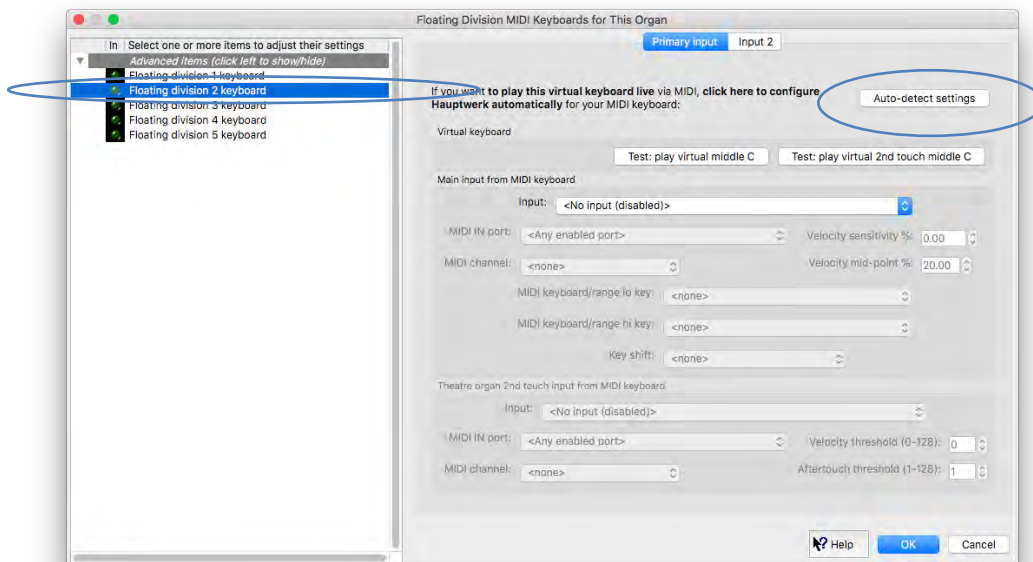
- *OK* the screen.

- Go to the *Organ settings | Keyboards* screen.

- Highlight the *Great* entry in the left-hand pane.

- Keeping the default *Primary input* tab selected, select *Indirect MIDI input via floating division 1, route 1* for its *Input* setting in the right-hand pane:
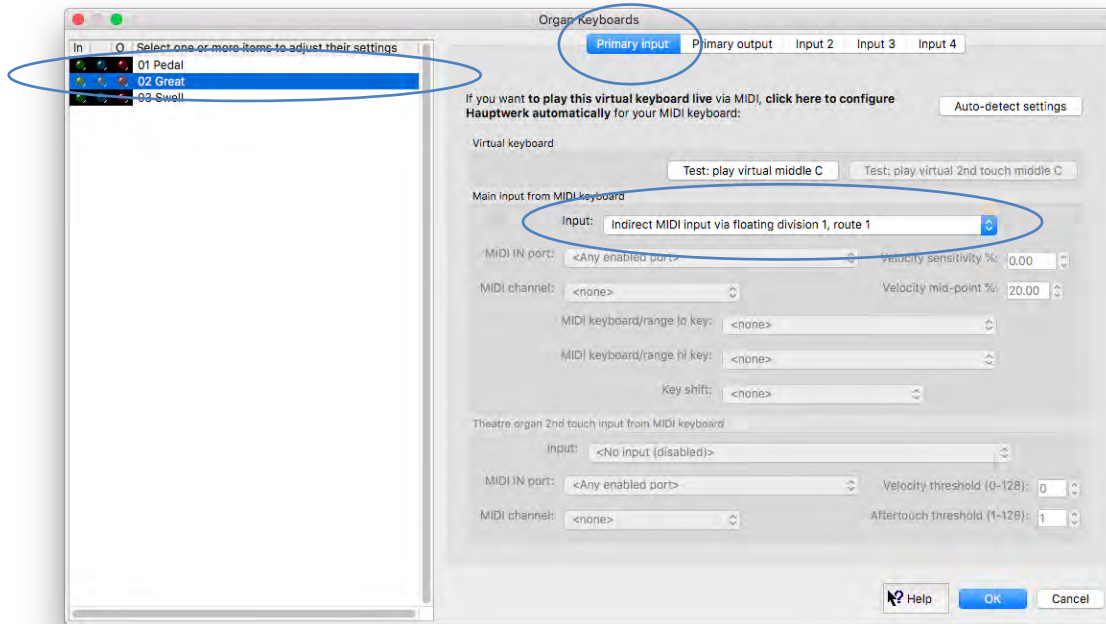
- Now, keeping the *Great* entry highlighted in the left-hand pane, select the *Input 2* tab and select *Indirect MIDI input via floating division 2, route 2* for its *Input* setting:
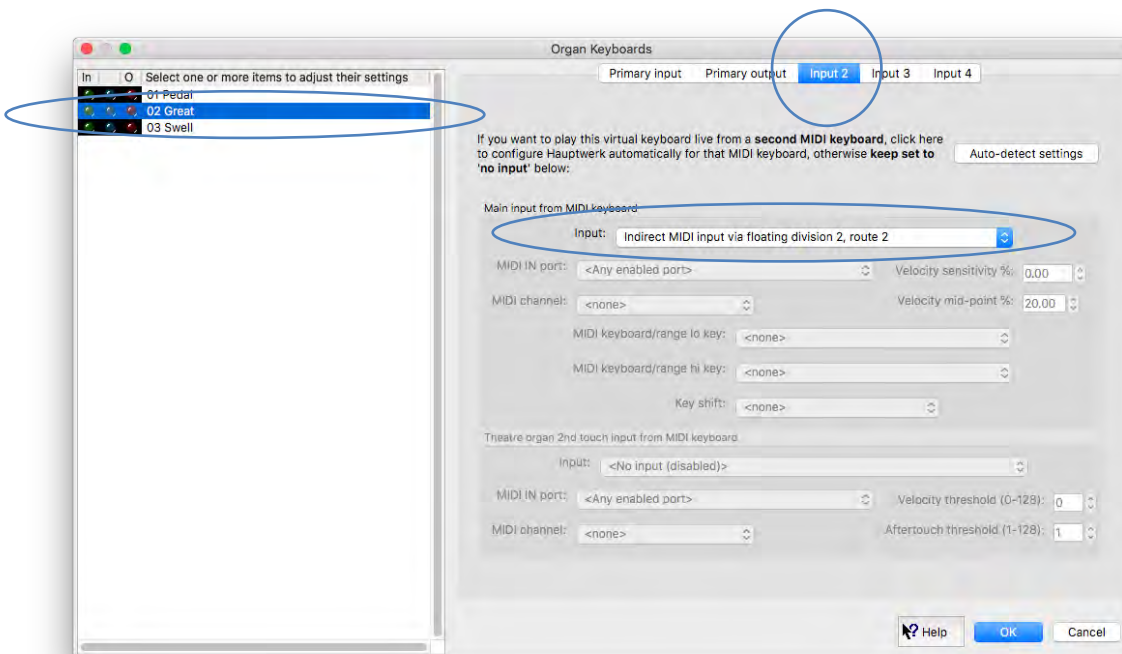
- Now highlight the *Swell* entry in the left-hand pane, go back to the *Primary input* tab and select *Indirect MIDI input via floating division 1, route 2* for its *Input* setting:
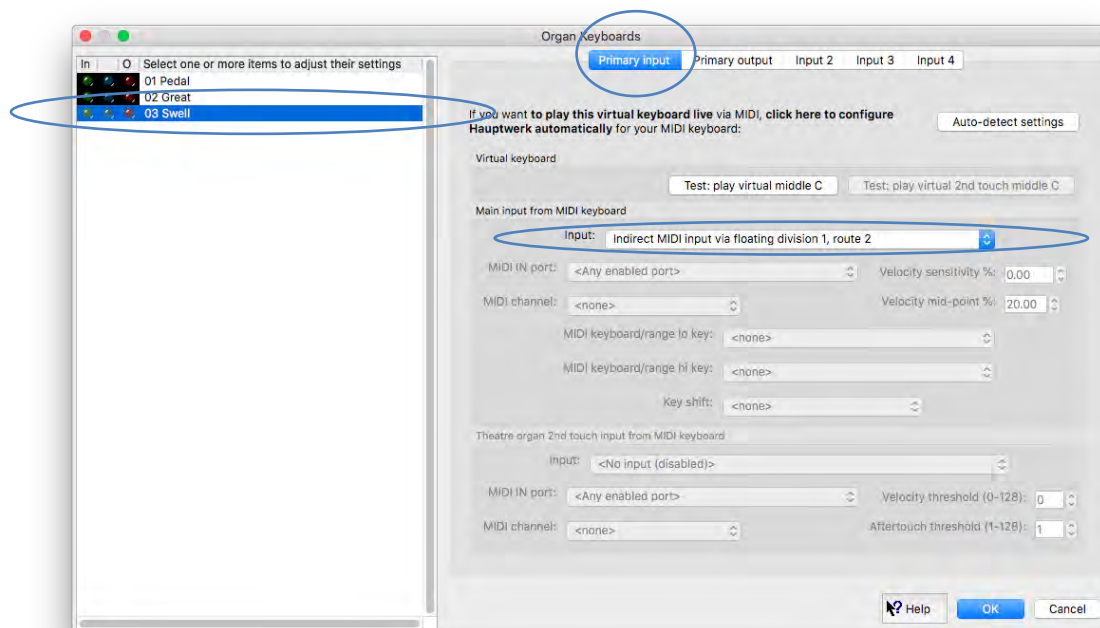
- Finally, keeping the *Swell* entry highlighted in the left-hand pane, select the *Input 2* tab and select *Indirect MIDI input via floating division 2, route 1* for its *Input* setting:
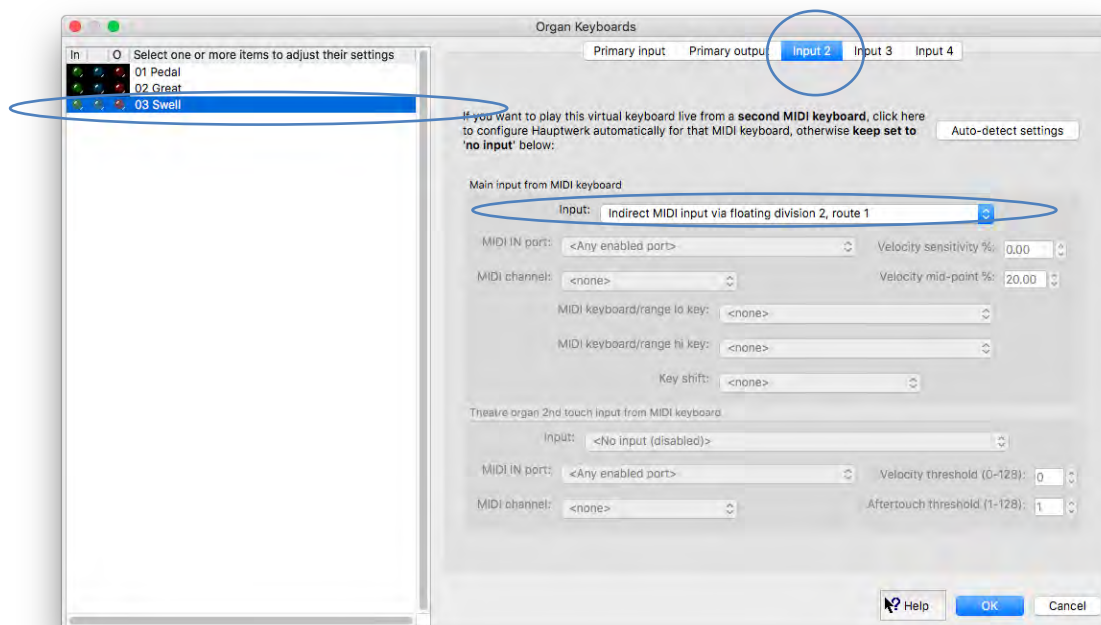
- Make sure the *Floating Divisions* large control panel is visible (use *View | Large floating control panels (for this organ) | Floating divisions* to show it if not). Note that with the '*1*' route buttons pressed (as they are by default), the floating division 1 row shows that it's currently mapped to the St. Anne's virtual Great keyboard and the floating division 2 row shows that it's currently mapped to the St. Anne's virtual Swell keyboard:
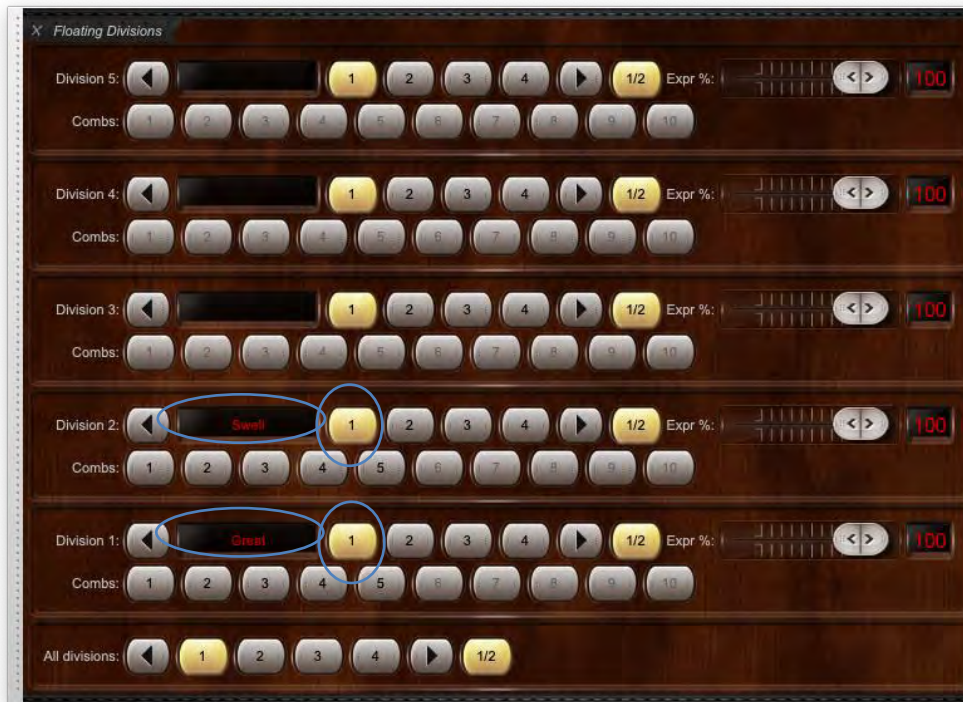
- Now press the '2' route buttons for both the division 1 and division 2 rows and you should see the current virtual keyboards swap for those two floating divisions (MIDI keyboards):
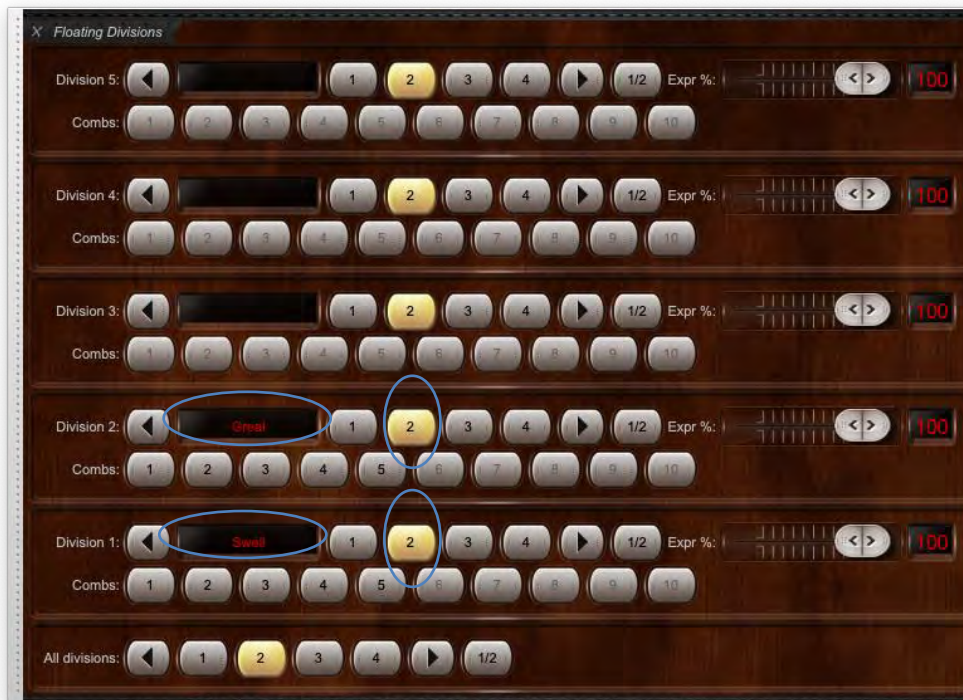
- The *'All divisions'* set of buttons at the bottom of the control panel are included for convenience, which change the routes for all five floating divisions simultaneously. (These would normally be the preferred choice for connecting to MIDI pistons, especially if you're using the floating divisions to swap keyboard assignments.) Play on your MIDI keyboards and verify that they both now swap dynamically between the St. Anne's Great and Swell virtual keyboards when you press the '1' and '2' 'all divisions' buttons on the control panel. Since swapping back and forth between just two destination divisions is a common requirement, there are also dedicated buttons labelled '1/2' specifically for the purpose of toggling between routes 1 and 2:
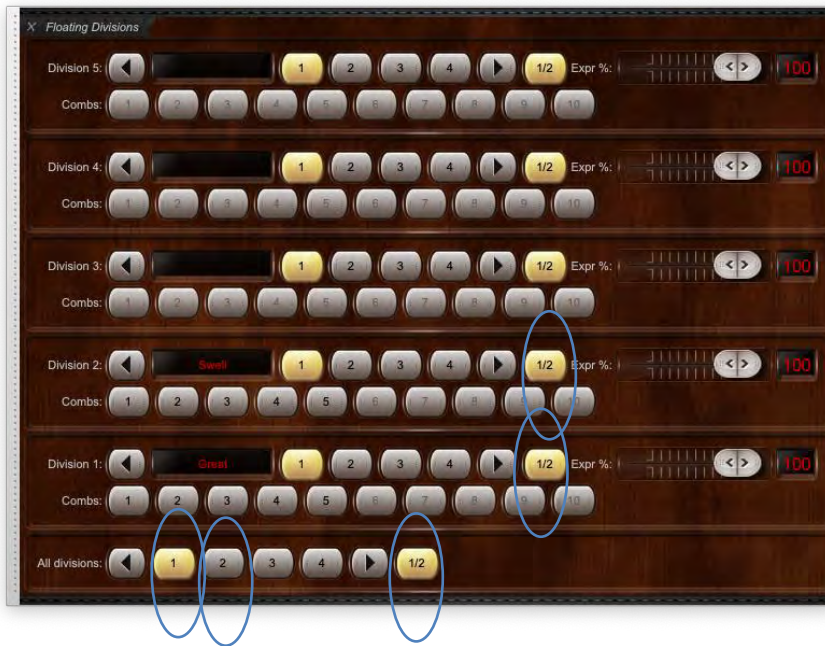
Expression with floating divisions

Floating divisions can optionally take MIDI expression pedals with them as their routes flip between virtual divisions. However, unenclosed virtual divisions will remain unenclosed.

To see this in action for the above example, try moving the *Expr %* sliders for divisions 1 and 2 on the control panel. Either of them should move the St. Anne's virtual swell pedal, but only when *Swell* shows for the slider row's current route. They will do nothing when the current route is anything other than Swell, since only the Swell division is enclosed on the St. Anne's organ:
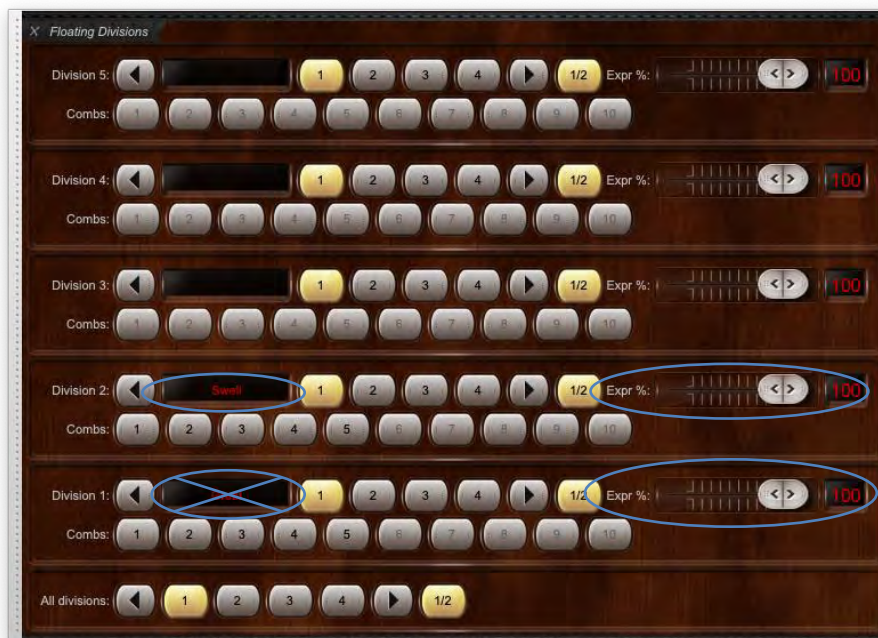
If you want to configure MIDI expression pedals to work in that way, right-click on the *Expr %* sliders and use auto-detect to connect your MIDI expression pedals to them. As with floating division MIDI keyboards you should connect any given MIDI expression pedal *either* to a floating division expression pedal, or to a virtual expression pedal directly, but not both (otherwise the MIDI pedal will remain connected to the virtual pedal).

(Note that there are no 'indirect input' entries on the settings screens for virtual expression pedals (as there are with virtual keyboards): the sample set creator will already have defined which virtual expression pedal relates to which virtual division and virtual keyboards, so no manual step is necessary in that case.)

Divisional combination pistons with floating divisions

Floating divisions can optionally also take up to ten MIDI divisional combination pistons with them as their routes flip between virtual divisions. It works analogously to the floating division expression, and the floating divisionals are triggered via the '*Combs*' row of buttons (right-click on them to auto-detect MIDI settings if you want to use them from MIDI pistons, as usual).

As with floating expression pedals, floating divisional pistons can only be used with a virtual division if the virtual instrument natively includes corresponding divisional combinations for the division. In the following screenshot (only) the first five floating divisional pistons are enabled because the St. Anne's virtual organ (only) has five native divisional combinations per division:

Storing/recalling floating division route numbers via combinations

On the *General settings | General preferences | Main 2* screen tab, there is an option "*Stepper and master general combinations store/recall current floating division route numbers?*" which defaults to not ticked. If ticked, the current route numbers for each of the floating divisions are stored in, and recalled from, stepper and master general combinations.

Please note: if the preference was not ticked when any given combination was captured then recalling that stored combination won't affect floating division routes, even if the preference is subsequently turned on; in order to do so you would need to capture the combination again (e.g. after recalling it, then setting the floating division routes as desired). Likewise, the default (all-off) combinations stored within automatically-generated default combination sets don't affect floating divisions if recalled.

Displaying floating division statuses on LCD panels

Hauptwerk can optionally display the current floating division routes and expression pedal positions on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer). For the preceding example with two MIDI keyboards you could configure the LCD panel output as follows:

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to *Organ setting | MIDI LCD panel control (for this organ).*

- Click the *Insert* button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the *'Floating division 1 route and expression …'* option for the *Display info/format for LCD line 1* setting.

- Select the *'Floating division 2 route and expression …'* option for the *Display info/format for LCD line 2* setting.

- Click *Test: send text now* to verify that it's working.

- Click *OK* to exit.
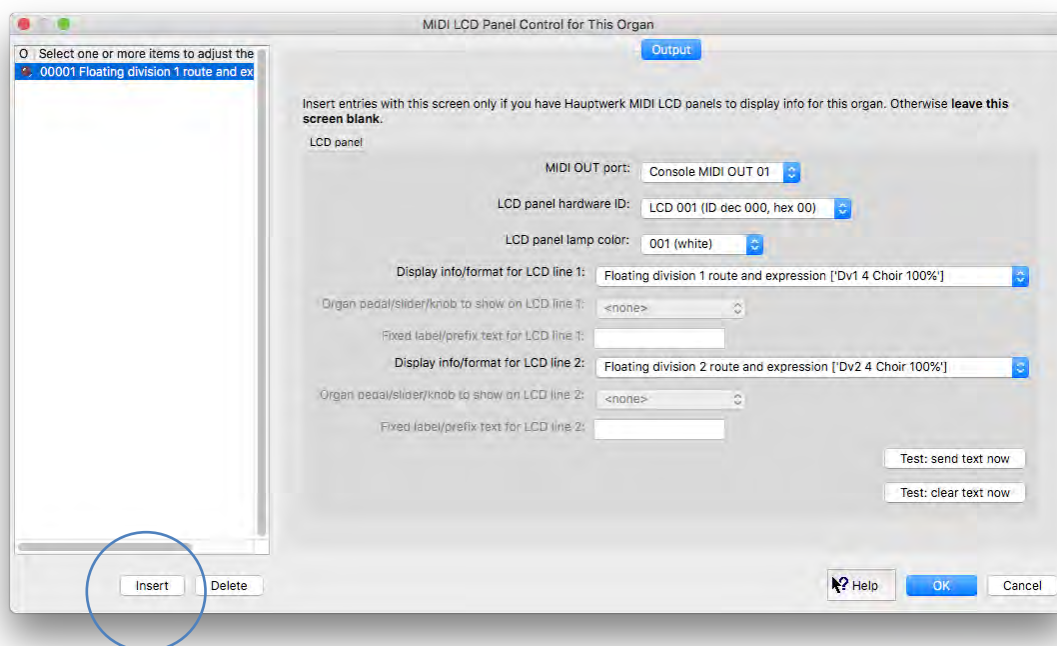
The two LCD display lines will now show the current routes and expression pedal positions for the floating divisions 1 and 2, and will be updated automatically whenever they change:

Registration menu: miscellaneous utility functions

Hand registration

When not already lit, pressing the *Hand reg* button on the *Registration* large control panel (or *Setter, general cancel, hand registration and utils* mini control panel) restores your previous draw-knob/tab registration to the point immediately prior to triggering your last stepper, master general, master scoped combination, master reversible combination or master crescendo action:

It allows Hauptwerk's stepper, master generals and master scoped combinations to be used in a 'stateful' (modal) way by allowing you to use them temporarily and then to revert instantly to the point before you used them. In effect it cancels the stepper, master generals, master scoped combinations, master reversible combinations and master crescendo. (However, note that the master reversible combinations are natively able to provide more flexible and intelligent 'stateful'/additive actions, such as tuttis, and of course the master crescendo is natively 'stateful'/additive too.)

Tip: use MIDI learn to assign a MIDI piston to control the hand registration function by right-clicking on it on one of the control panels (or on the Touch Menu) and choosing *Auto-detect*.

Copying and pasting registration

The *Copy reg* and *Paste reg* buttons on the *Registration* large control panel (or *Setter, general cancel, hand registration and utils* mini control panel) are convenience functions, allowing you temporarily to hold a general registration on an internal 'clipboard' for any purpose:
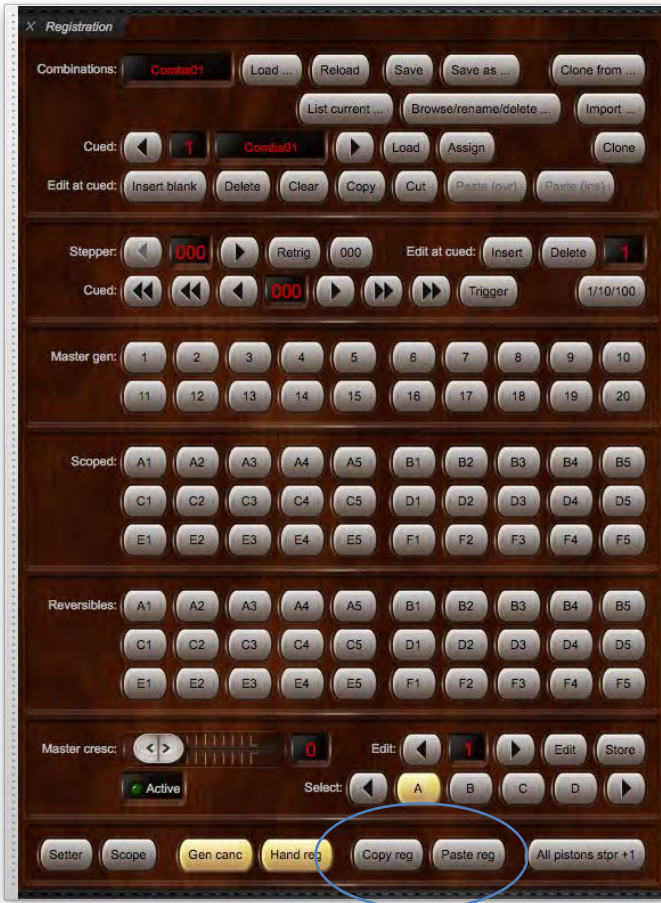
In particular, apart from virtual draw-knobs/tabs themselves, the copy and paste functions currently provide the only means by which you can transfer individual registrations between multiple combination sets.

Alternatively, you could use them when playing effectively as an 'undo' function for temporary hand registration changes.

Exporting/viewing your current combinations as a text listing

The *List current …* button on the Registration large control panel (*Registration | Export/view current combinations as text listing* menu function) generates a file and displays it in your computer's web browser, listing the non-empty registrations that you currently have saved to each of your combinations (both combinations that the virtual organ includes natively, as well as Hauptwerk's 'master combinations', such as the stepper).
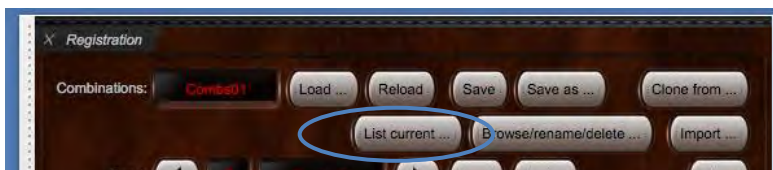
Being able to see the combinations in a convenient, human-readable format can be useful in various situations, for example:

- Perhaps you haven't loaded a particular combination set for a while and have forgotten what's programmed into its combinations.
- You can use it to check that you've programmed the combinations as you intended, or to see which combinations you might want to overwrite.
- If you publish a recording on the Internet or on a CD you could use it to list your registrations along with the recording.
- You could use a combination listing from one organ or piece as a reference for setting up your combinations for a different piece, or for the same piece on a different organ.

Pitch menu (including temperaments)

Overview

Hauptwerk allows its overall tuning (pitch) to be adjusted so that it can be played with acoustic instruments, or other instruments that cannot easily be re-tuned. For example, the master tuning adjustment makes it possible to integrate Hauptwerk with real organ pipework, the tuning of which will change with temperature, and to adjust Hauptwerk's tuning to match.

A temperament is a scheme by which the organ is tuned, and determines the pitch intervals between the pipes for successive notes on the keyboard. With *equal temperament* the interval between each successive note is constant, and so pieces of music can be played in any or several keys while the psychoacoustic effect remains constant. However, other tuning schemes give different effects and may be better suited to different types of music, particularly historical music which often was written for different temperaments.

Hauptwerk allows different temperaments (tunings) to be installed via the component installer, and to be selected and applied to any sample set via the *Pitch* menu:
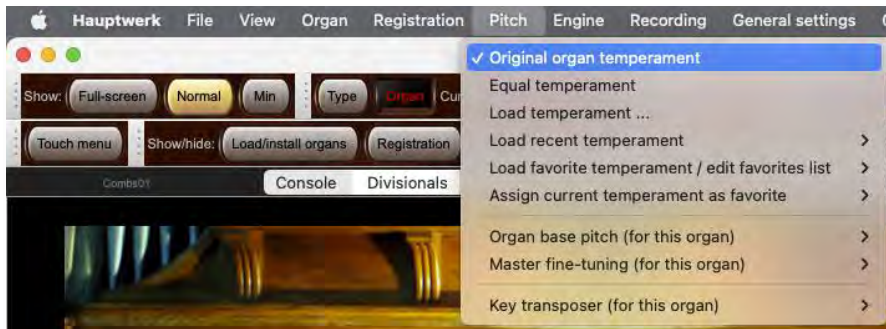
The menu is only enabled when an instrument is loaded. Temperaments and pitch are both found on the menu and function completely independently from each other. In particular, temperaments never affect the overall pitch of the organ; they only affect the intervals between notes. Temperament and pitch selections are also remembered separately for each virtual instrument.

All changes to temperament and pitch occur in real-time, making changes possible while playing.

Temperament and pitch can be controlled via the *Pitch* large control panel:

... or via the *Temperament load/assign* and *Organ base pitch* and *Master fine-tuning* and *Key transposer* mini control panels:

... or via the *Pitch* menu, or via the *Pitch* tab on the Touch Menu. You can of course also assign the functions to piston toolbars, if you wish.

To aid understanding, we recommend keeping the *Pitch* large control panel open when learning to use Hauptwerk's temperament and pitch functions and in the following sections we will primarily describe the functions in terms of that control panel. The panel can be opened via (for example) the *Pitch* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default (or via *View | Large floating control panels (for this organ) | Pitch* on the menu):

Selecting temperaments

You can load alternative temperaments (tunings) with *Pitch | Load temperament...* from the menu or with the *Load* button on the *Pitch* large control panel. A number of temperaments are installed with Hauptwerk:
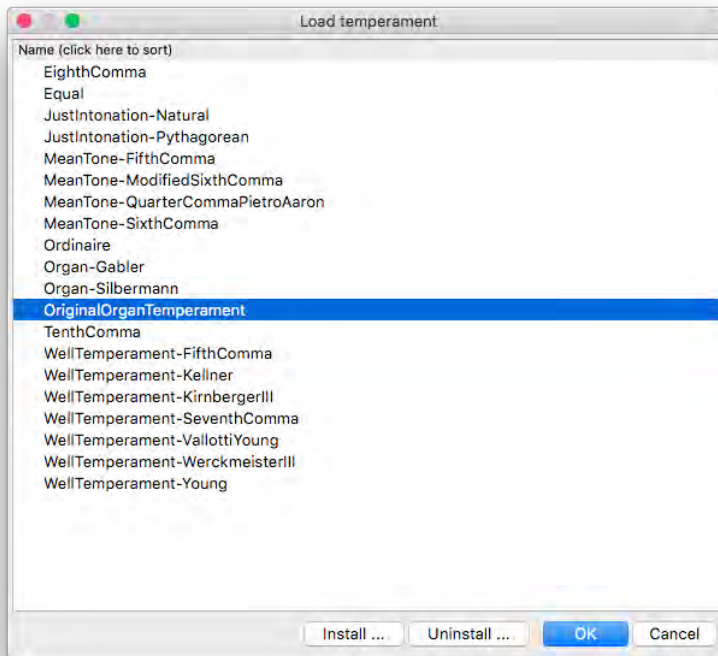
The *Pitch | Load recent temperament* sub-menu and sixty-four 'favorite' slots work in the same way as their equivalents on the *Organ* menu; if a temperament is currently loaded it can be assigned as a favorite by selecting the *Assign* button in the control panel, and a previously-assigned favorite temperament can be loaded by using the 'cued' arrow buttons to select the desired favorite temperament and then pressing the *Load* button to select and load it:

If you try playing a chord with equal temperament and then the same chord with another temperament, such as $1/4$-Comma Meantone, you should clearly be able to hear the difference that the temperament makes.

An abbreviated name for the selected temperament is shown at the top-right of the main window and also in the relevant control panels:
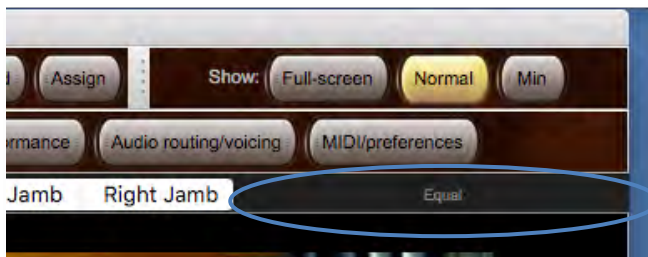
Note that some sample sets are intended only to be heard exactly as they were recorded and have licenses which explicitly disallow any temperament adjustments. For such sample sets the temperament menu functions aren't enabled.

Original organ tuning

Some sample sets support playback with all pipes individually sounding at their original recorded pitches, as an alternative to using a fixed temperament. For such sample sets (which includes St. Anne's), original organ tuning is selected by default, and is recommended for maximum realism. Original organ tuning is only meaningful if the samples have been kept tuned to their original pitches, and were all recorded from a single organ.

It can be re-selected at any point by loading the special *OriginalOrganTemperament* 'temperament' (or with the *Organ's orig* button on the *Pitch* large control panel).

Base pitch

Hauptwerk separates the base (overall) pitch of an instrument from the temperament (relative tuning between the notes), allowing the overall pitch to be maintained or changed as desired, independently of any temperaments you load. This separation of temperament and pitch offers great flexibility for tuning schemes.

The current overall base pitch selection is displayed in the *Pitch* large control panel:

... as well as in the status bar at the bottom of the main Hauptwerk window:

When you first load a virtual instrument the base pitch is detected automatically from its samples. For example, the St. Anne's organ has a (default) base pitch of A=436.5 Hz. If you load the *Equal* temperament then the organ will remain at A=436.5, rather than being re-pitched to A=440 and the temperament scaling ratio (only) will be updated to equal temperament.

Convenience buttons allow returning to original organ tuning (the *Orig* button) or concert pitch of A=440 Hz (the *440* button).

Master fine tuning

The *Fine-tune cents* slider and buttons facilitate small overall pitch adjustments (relative to the selected base pitch) by cents (percent of a semitone) for special situations, such as matching tuning with acoustic instruments which may not easily be tuned, like pianos, or to compensate for tuning drift as a result of temperature fluctuation with real pipe working.

Use the up and down buttons to adjust the fine-tuning if needed, or connect a MIDI controller to the slider (right-click on it and select 'auto-detect') to adjust fine tuning in the range +/-64 cents. Press the *0* button to revert to the exact selected base pitch:

Key transposer

Hauptwerk has a transposer, which adds to or subtracts from the note numbers of incoming MIDI keyboard key messages. It thus enables you to hear pieces of music in keys other than that in which you play them, which may be useful if you wish to accompany singers but do not wish to transpose by sight, for example.

Note that the transposer only raises or lowers the pitch of what you play by whole note increments, and that the playback pitch of the virtual pipes is not altered in any way, since the increment is applied at the incoming MIDI note message level. Thus if you play a bottom C note with the transposer set to +1, Hauptwerk will actually make the bottom C# pipe sound. Bear this in mind, since it can mean that keys at the ends of the keyboard no longer sound pipes when the transposer is used. However, by incrementing the note number rather than adjusting the playback pitch of the pipes, the pipes continue to sound absolutely natural, and any real external pipework or voice modules being driven by Hauptwerk will automatically be affected equally.

The transposer allows up to +/-12 semitones of transposition.

Note: there is a general preference for "*Reset transposer when organ resets?*", which defaults to ticked.

Editing favorite temperament assignments

You can overwrite any given favorite assignment simply by loading the desired temperament and assigning it to the desired favorite slot as covered above, thus overwriting whatever assignment you might previously have made to that slot.

However, Hauptwerk also has editor facilities so that it isn't necessary to load an already-assigned favorite temperament solely for the purpose of reassigning it to a different slot. You can also insert, delete, or clear favorites list entries. The editor functions can be accessed via the *Pitch* large control panel:

… or via the *Cued favorites (all types) and utility functions menu* large control panel (with 'Temp selected as the type):

(There are also mini control panels which have the necessary functions on them, and, as always, they can also be accessed via the Touch Menu.)

To edit favorite temperament assignments via the *Pitch* large control panel:

- Make sure the *Pitch* large control panel (pictured above) is displayed (e.g. via *View | Large floating control panels* … from the menu).

- Use the left and right arrow buttons to select which favorite slot (1-64) you want to edit.

- Finally use the appropriate function button in the *Edit at cued* section to perform the desired one of the following available functions on the selected cued favorite slot number:

    - *Insert blank list entry at cued* (where 'cued' denotes the current cued favorite number).
    - *Delete list entry at cued*.
    - *Clear (blank) list entry at cued*.
    - *Copy list entry at cued*.
    - *Cut list entry at cued*.
    - *Paste list entry (overwriting) at cued*.
    - *Paste list entry (inserting) at cued*.

Displaying temperament and pitch information on LCD panels

Hauptwerk can optionally display the pitch, temperament and transposer states on Hauptwerk-compatible LCD panels (connected to MIDI OUT ports on your computer). For example:

- Make sure the relevant organ is loaded (for example, St. Anne's).

- Go to *General settings | MIDI LCD panel control (for all organs).*

- Click the *Insert* button located near the lower-left of the screen.

- Select the MIDI output port and LCD panel hardware ID that your LCD unit is configured to use.

- Select the *'Temperament name …'* option for the *Display info/format for LCD line 1* setting.

- Select the *'Base pitch, fine-tuning and transposer …'* option for the *Display info/format for LCD line 2* setting.

- Click *Test: send text now* to verify that it's working.

- Click *OK* to exit.
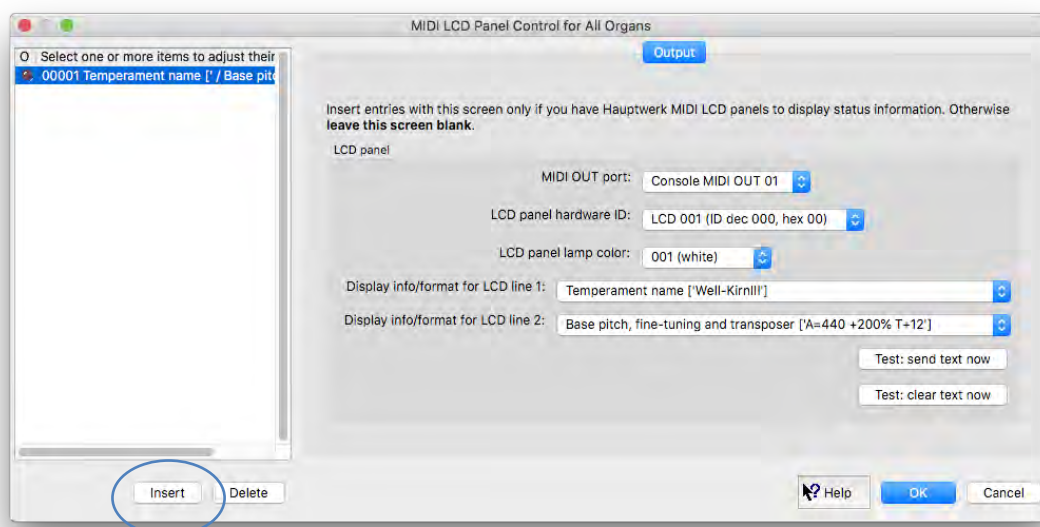
The LCD display will now show the temperament, pitch, master fine-tuning and transposer states, and will be updated automatically whenever their statuses change:

MIDI Master Fine Tuning sys-ex support for external temperature-sensing hardware

Hauptwerk also supports the '*MIDI master fine-tuning*' system exclusive-standard message format, allowing compatible external MIDI hardware to control Hauptwerk's base pitch setting directly in real-time. The functionality is enabled via the *General settings | General preferences | Advanced preferences | Allow MIDI Master Fine Tuning sys-ex messages to tune Hauptwerk* preference.

Primarily this function allows Hauptwerk to be used in conjunction with real pipework and temperature-sensing MIDI hardware units (available from organ hardware companies, such as Classic Organ Works), to allow the virtual instrument's pitch to remain matched to that of the real pipework as the ambient temperature changes (which causes changes to the pitch of real pipework).

- ❖ **Note: MIDI master fine tuning sys-ex messages control Hauptwerk's base pitch adjustment, and are thus independent from Hauptwerk's *Fine-tune cents* adjustment.**

Engine menu

Overview

The functions on the *Engine* menu control Hauptwerk's audio and MIDI 'engines' and drivers, allowing you to tune their performance, to diagnose problems, and to reset them in emergencies (for example, if your MIDI hardware loses a MIDI message resulting in a note being stuck on):
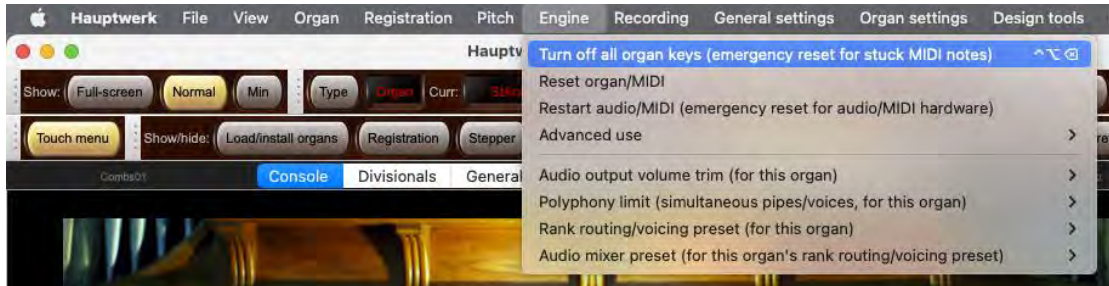
The main functions can also be found on the *Audio, MIDI and Performance* large control panel:
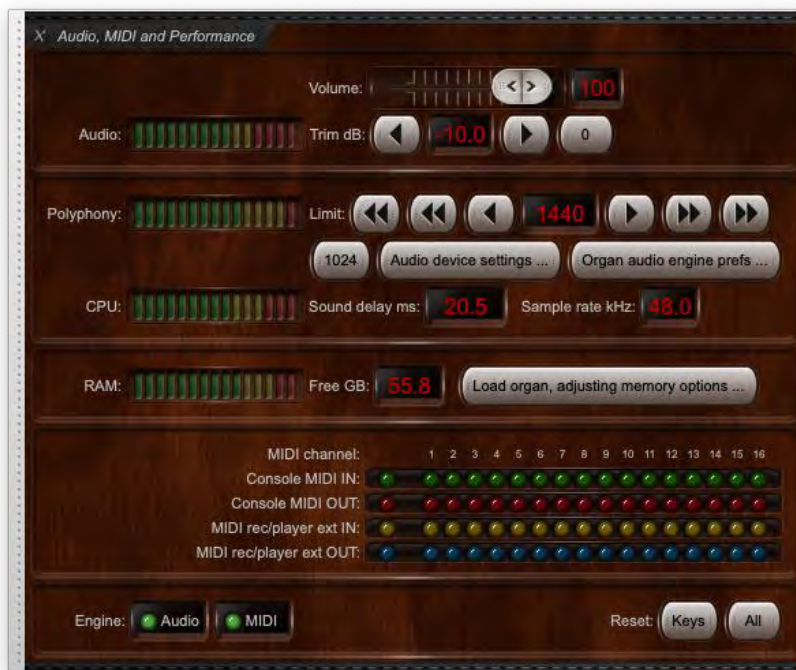
... and on the *Audio output level* and *Polyphony (voices/pipes)* and *Memory (RAM) usage* and *CPU load* and *Sound delay and sample rate* and *Engine status and reset* mini control panels:
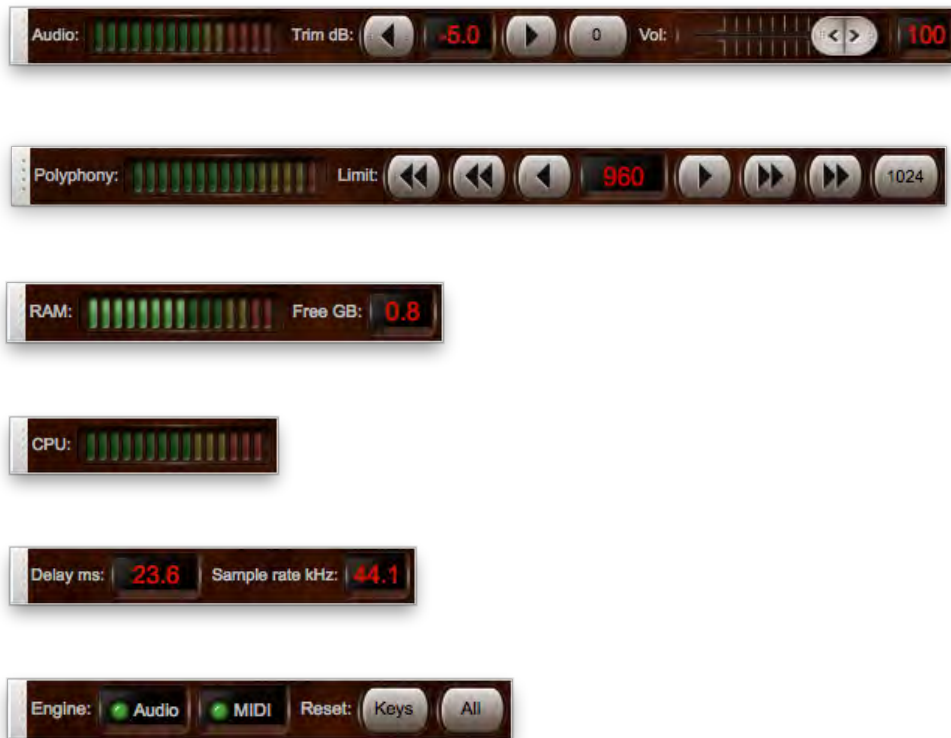
... or via the *Engine* tab on the Touch Menu.

Menu options
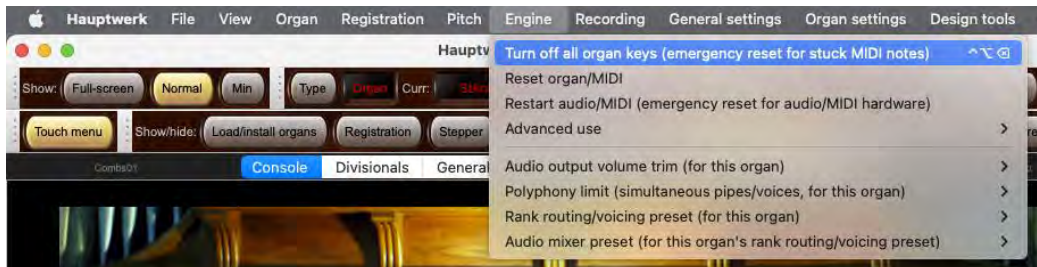
- *Turn off all organ keys* - Resets all virtual keyboard keys, without resetting the entire 'engines'.

- *Reset organ/MIDI* - Resets the entire virtual organ but doesn't restart the audio and MIDI interface drivers.

- *Restart audio/MIDI* - Resets the entire virtual organ and also stops and then restarts your audio and MIDI interface drivers.

- *Advanced use | Start/Stop audio MIDI -* Allows you to stop and start your audio and MIDI interface drivers manually (to allow you temporarily to switch to using an audio/MIDI application other than Hauptwerk, for example).

- *Audio output volume* trim - Adjusts global output levels up or down in 1 decibel increments.

- *Polyphony limit -* Adjusts the polyphony limit (number of pipes that are allowed to sound at once) in 32 or 256 voice increments.

Audio, MIDI and Performance large control panel

The *Audio, MIDI and performance* duplicates all of the commonly-used functions from the *Engine* menu and also shows real-time performance and diagnostic information relating to Hauptwerk's engines, making it quick and easy to tune Hauptwerk so that it performs well on your computer, and to help to diagnose MIDI or performance problems easily.

The panel can be opened via (for example) the *Audio/MIDI/Performance* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default (or via *View | Large floating control panels (for this organ) | Audio, MIDI and performance* on the menu):

Using the control panel to tune performance and diagnose problems is covered in depth in the **Performance tuning** section of this guide. Please consult that section if needed; we only give a brief description of the functions found on the control panel here:
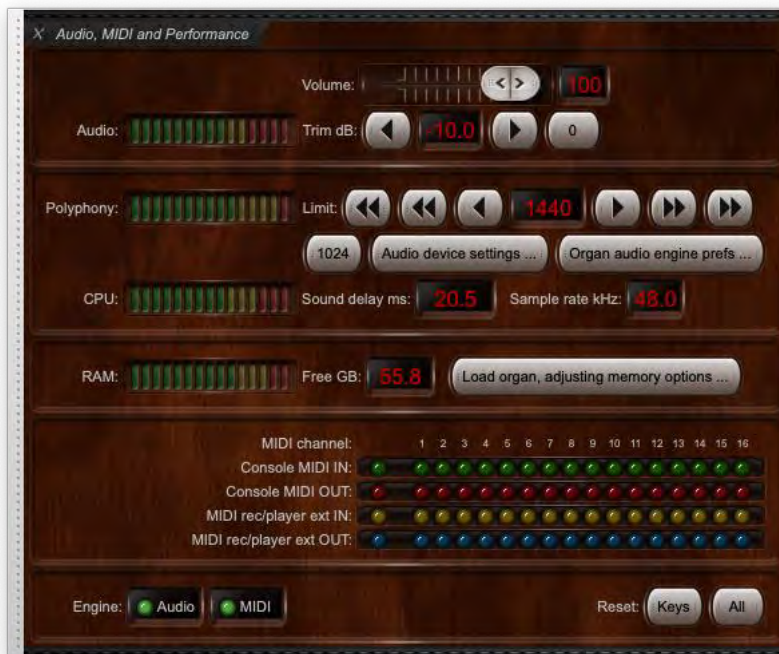
- *Volume* - Use the slider if you want to adjust the overall audio level in real-time (100=0 dB and 0=-24 dB). Right-click on the slider and select '*Auto-detect ...*' if you want to control Hauptwerk's volume from a MIDI knob or expression pedal.

- *Audio* - The meter shows the audio output level (the peak level of all channels). Always avoid going into the red to ensure that nasty 'crackles' (audio distortion, 'clipping') don't occur.

- *Trim dB* - The buttons adjust audio levels by 1 decibel in the +/-24 dB range (0 dB is 'normal' level). The *0* button resets the trim to 0 dB. Use these trim buttons to turn the audio level down if the *Audio* meter is going into the red, causing distortion (clipping).

- *Polyphony* - The meter shows the number of voices/pipes sounding, as a fraction of your polyphony limit setting. If it's going into the red then some release are being faded/dropped (which isn't necessarily indicative of a problem).

- *Limit* - The buttons adjust the polyphony limit setting in increments of 32 (single arrow), 256, or 1024 (double arrow) voices. Make sure the polyphony limit is set low enough that the *CPU* meter doesn't go into the red (which indicates a risk of audio glitches) but no lower than needed, so that pipes aren't faded out/dropped (indicated by the *Polyphony* meter going into the red) more than necessary.

- *CPU* - The meter indicates the approximate estimated peak audio CPU load/stress. Red indicates audio CPU overload or audio driver synchronization issues and likelihood of audio glitches (try reducing the polyphony limit, increasing the audio buffer size, checking for updated audio drivers, or selecting 'standard' quality audio pitch-shifting via the *Organ settings | Organ preferences | Audio engine* screen tab, or avoiding using 96 kHz for the audio engine/output via the *General settings | Audio device and channels* screen – you can open those screens via the corresponding buttons on the control panel). More specifically, the meter shows the amount of time that Hauptwerk is taking to calculate each chunk of audio as a fraction of the amount of time the audio driver has allowed Hauptwerk to do it. Note: the meter doesn't show the same thing as the operating system's overall CPU usage figures. Hauptwerk's CPU meter is specifically designed to show the risk of audio glitches, which is heavily dependent on audio driver performance and the low-latency performance of other computer hardware/driver components, as well as overall loads on the computer's CPU(s).

- *Sound delay ms* - Displays your audio interface's audio latency. You can change the buffer size and sample rate (and thus latency) via the *General settings | Audio device and channels* screen (which you can open via the corresponding button on the control panel).

- *Free GB* - Hauptwerk's rough estimate of the amount of your computer's usable physical memory remaining that Hauptwerk might potentially safely be able to use before audio glitches or other performance issues become likely (even though other applications might currently be using some or all of it). Please be aware it's only an estimate – it's best always to keep at least a few GB showing as 'free'. The *RAM* meter will reach its red zone when the *Free GB* figure reaches zero. If the *Free GB* figure is very low, or if you're experiencing performance problems, try reloading the organ via the *Load organ, adjusting memory options* button and disabling a few ranks (or selecting memory-saving options for them).

  Important note 1: Note that Hauptwerk's memory usage figures won't usually correspond to the memory usage figures that macOS's Activity Monitor or Window's Task Manager show. Hauptwerk's figures are specifically designed to show the risk of audio glitches (or other performance issues) in Hauptwerk, rather than the performance of the computer for other applications, or the computer's performance as a whole. Hence the figures shown by Hauptwerk are the ones that should be most relevant and useful for Hauptwerk purposes.

  Important note 2: if you're using other real-time performance-sensitive applications at the same time as Hauptwerk, such as MIDI sequencer software, then it's important to be aware that Hauptwerk's memory figures won't take their memory usage into account, and that those other applications might start to perform poorly if you load an organ in Hauptwerk that fills up too much of the computer's memory, taking memory away from those other applications (even if Hauptwerk's *RAM* meter hasn't yet reached its red zone). Hence you should ensure that you leave sufficient memory free for them, if applicable.

- *RAM* - The meter shows the approximate amount of memory (RAM) currently in use by Hauptwerk, relative to the total amount of physical memory that Hauptwerk might potentially safely be able to use before audio glitches or other performance issues become likely (even though other applications might currently be using some or all of it). The *RAM* meter will reach its red zone when the *Free GB* figure reaches zero. (See the notes for the *Free GB* figure above for more details.)

- *MIDI channel:*

    - *Console MIDI IN* - Green LEDs display all incoming MIDI message activity from your MIDI console (for live playing).

    - *Console MIDI OUT* - Red LEDs display all outgoing MIDI message activity to your MIDI console (for live playing).

    - *MIDI rec/player ext IN* - Yellow LEDs display all incoming MIDI message activity from an external MIDI sequencer (via Hauptwerk's *'Hauptwerk MIDI recorder/player external MIDI IN*' port, which uses a special fixed MIDI implementation, covered in depth in the ***MIDI sequencing, the Hauptwerk AU/VST Link and applying external real-time effects plug-ins*** section of this guide).

    - *MIDI rec/player ext OUT* - Blue LEDs display all outgoing MIDI message activity to an external MIDI sequencer (via Hauptwerk's *'Hauptwerk MIDI recorder/player external MIDI OUT* ' port, which uses the same special fixed MIDI implementation).

- *Engine* - Indicates whether or not the audio and MIDI drivers are active.

- *Sample rate kHz* - Displays the audio engine sample rate, which is also the sample rate that Hauptwerk is using for your audio interface. You can change it via the *General settings | Audio device and channels* screen (which you can open via the corresponding button on the control panel). Using 96 kHz is more CPU-intensive, sacrificing achievable polyphony (typically about 50%) for higher audio quality. It gives better signal-to-noise ratio (less distortion, and better clarity), especially for larger upward pitch shifts and deep tremulants (which might otherwise introduce 'aliasing' distortion).

- *Reset | Keys* - Resets all virtual keyboard keys, without resetting the entire 'engines'.

- *Reset | All* - Resets the entire virtual organ but doesn't restart the audio and MIDI interface drivers.

Recording menu

Overview

Hauptwerk can record both audio and MIDI files from live performances. Hauptwerk audio recordings are saved in .WAV format and these files can be opened and played back in any audio editor or audio player that supports that format (which nearly all do). Choose between 16-bit recordings (required for normal audio CDs) or 32-bit recordings for a higher fidelity. Hauptwerk MIDI recordings are saved in standard .MID file format and may be opened and edited in a MIDI sequencer program of your choice. Hauptwerk can also play back MIDI files that were recorded from the same organ in Hauptwerk. (Hauptwerk doesn't play audio files.)
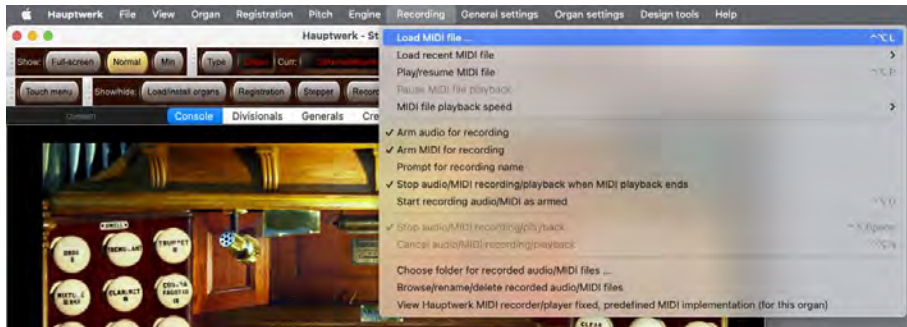
About recording audio

The built-in audio recording system provides a simple means to record the sound output produced by Hauptwerk, while still allowing it to be heard and played as normal.

When you start recording, Hauptwerk creates one or more stereo audio .WAV files with unique filenames in the recording folder specified with the *Recording | Choose folder for recorded audio/MIDI files* menu option. From that moment onwards, until you stop recording, all audio output will be written to the file(s). You must not open the file(s) until you have stopped Hauptwerk recording.

Using the *General settings | General preferences* screen, you can select whether the files will be written with a 32-bit or 16-bit resolution:
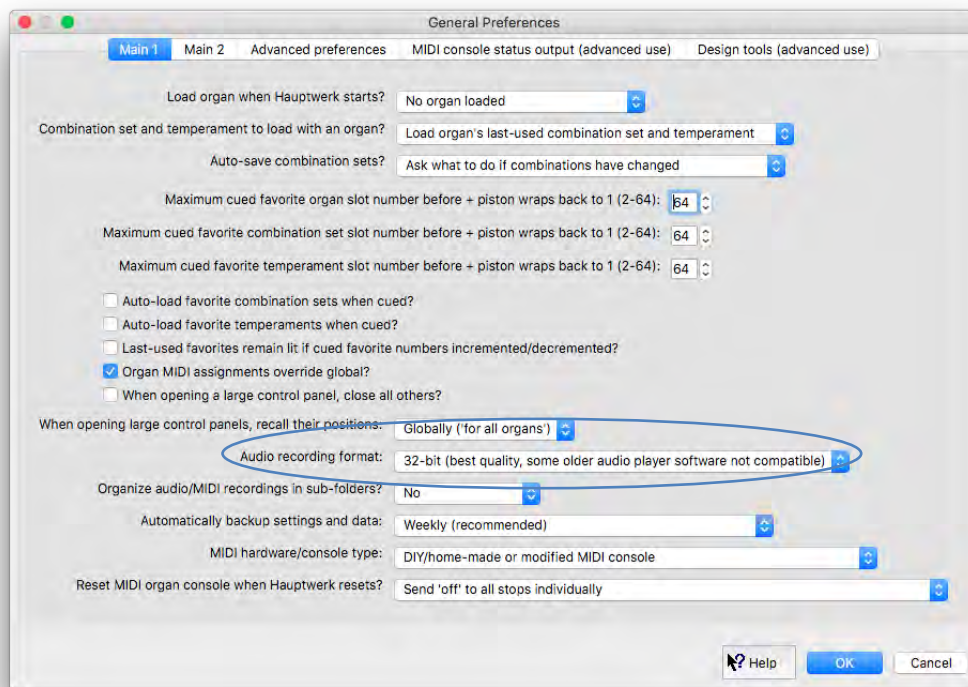
32-bit is the default, and gives better quality, but some CD-writing and audio editing software can't open 32-bit audio, so you should select 16-bit if you find your software falls into that category.

If you're using the Hauptwerk Advanced Edition, you can enable/disable audio recording on a per-bus basis on the *General settings | Audio mixer* screen. By default it's enabled only for the first 'master mix bus' (which is conventionally used as the main stereo mix if using surround/3D sound or multi-channel audio output; see the *Audio routing and impulse response reverb part 2 (Advanced Edition only): multi-channel audio, multi-channel virtual acoustics, and routing concepts for advanced use* section for further details):
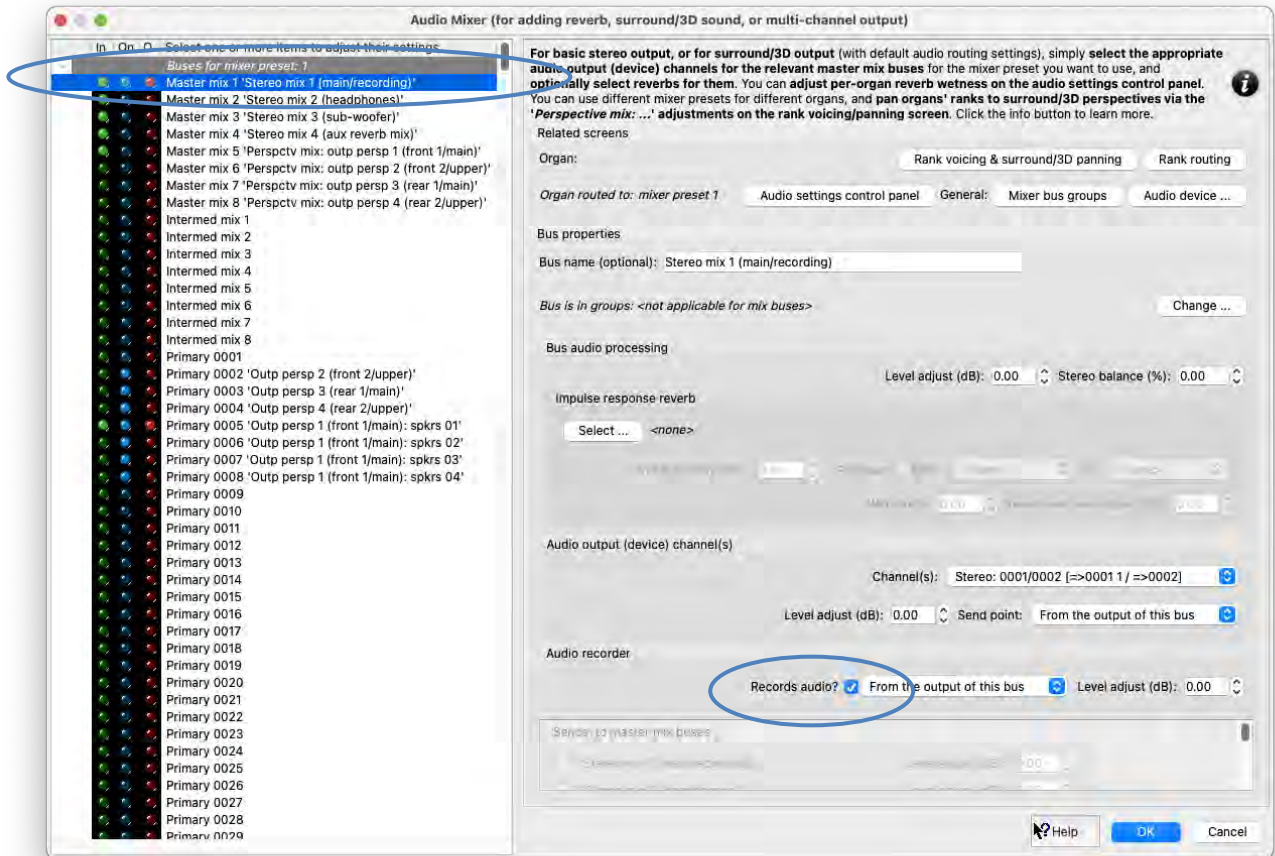
To record an audio file, make sure an organ is loaded (St. Anne's, for example) and that the *Recorder/Player* large control panel is open. The panel can be opened via (for example) the *Recorder/player* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default (or via *View | Large floating control panels (for this organ) | Recorder/player* on the menu):

(Alternatively, you could use the *Recording* tab on the Touch Menu.)

Transport controls

Hover over any control for a brief description of its function.

All three of these controls affect audio and MIDI recording. The stop button does too, but it also affects MIDI playback:

These controls only affect MIDI playback:

The double-arrow buttons rewind and fast-forward MIDI playback at 4x speed, and the triple-arrow buttons at 16x.

To record audio

- Make sure the *Recorder/Player* large control panel is open (or the *Recording* tab on the Touch Menu).

- Make sure you have sufficient drive space prior to recording large audio files to avoid the risk of losing your recordings or crashing the computer due to insufficient storage space.

- Ensure *Arm audio recording* is ticked in the lower left-hand side of the control panel to arm audio recording.

- Press the *Record* button to begin recording.

- Begin playing your music.

- Press the *Stop* button when you've finished recording.

- If you wish, browse to the recorded audio file(s) using the *Browse ..* button (or the equivalent *Recording | Browse/rename/delete recorded audio/MIDI files* menu function) and open it in a third-party audio editor or audio player program. You can also rename the file to give it a more meaningful filename, or delete or move it if you wish:
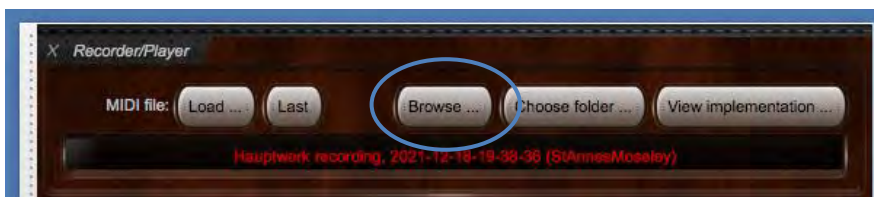
An automatic filename will be assigned to each recording unless the *Prompt for name* option is ticked. This option allows you to specify custom names for your recordings (affecting both audio and MIDI recordings). If the option is not selected filenames will have the format '*Hauptwerk recording, 2023-01-15-23-44-44 (StAnnesMoseley)*', where the numbers represent *Year-Month-Day-Hour-Minutes-Seconds*, with the organ name in brackets. (If using the Advanced Edition, and if recording is enabled for more than one audio mixer bus, then one audio file will be recorded from each, with the name of its mixer bus appended to each file, so that you can tell file was recorded from which mixer bus.)

About MIDI file recording and playback

To record or play back a MIDI file, make sure an organ is loaded (St. Anne's, for example) and that the *Recorder/Player* large control panel is open. The panel can be opened via (for example) the *Recorder/player* button on the '*Show/hide large … control panels 1*' mini control panel, which is docked at the top of the main Hauptwerk window by default (or via *View | Large floating control panels (for this organ) | Recorder/player* on the menu):

(Alternatively, you could use the *Recording* tab on the Touch Menu.)

Hauptwerk can natively record and play back MIDI files, completely independently of any MIDI settings or hardware, allowing you to record a MIDI performance using whatever MIDI or touch-screen hardware you have and send it to any other user of the same virtual organ, and it will play back exactly as intended, regardless of his or her hardware or settings. It uses a specially-designed, fixed, hardware-independent MIDI implementation for its MIDI files to make that possible. It also records stop/coupler/tremulant on/off messages directly, so its MIDI files will play back correctly, regardless of what combination set you have loaded.

The special, fixed MIDI implementation is covered in full in the *Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation* section of this guide. The *MIDI sequencing, the Hauptwerk AU/VST Link and applying external real-time effects plug-ins* section also provides more detailed background information, which might be relevant if you're planning to use a MIDI sequencer to edit or play the MIDI files that Hauptwerk has recorded. You can see the MIDI implementation that Hauptwerk's recorder/player uses and requires for the currently-loaded organ by clicking on the *View implementation …* button:
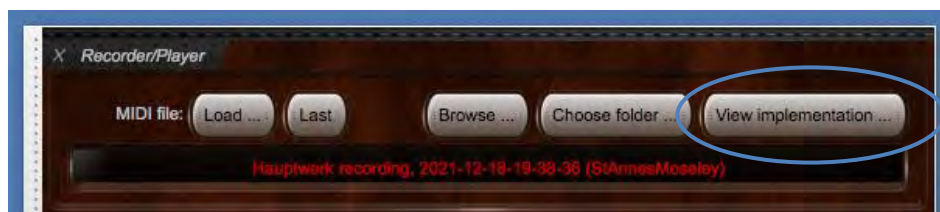
Hauptwerk includes a demo MIDI file for the St. Anne's organ. To listen to the MIDI file play the organ, simply click the *Play* button with St. Anne's loaded:

To record a MIDI file

- Make sure the *Recorder/Player* large control panel is open (or the *Recording* tab on the Touch Menu).

- Ensure *Arm MIDI recording* is ticked in the lower left-hand side of the control panel to arm MID recording.

- Press the *Record* button to begin recording.

- Set your registration. Note that the organ always resets when you start recording or playing a MIDI file to ensure that the file always starts from the same (all-off) registration, so that all of your subsequent registration changes are recorded into the file.

- Begin playing your music.

- Press the *Stop* button when you've finished recording. The MIDI file will be saved at this point. (Or press the *Cancel* button if you instead decide you want to discard the take.)

- If you wish you can also browse to the recorded MIDI file using *Recording | Browse/rename/delete recorded audio/MIDI files* and rename the file to give it a more meaningful filename, or delete or move it:

As for audio recordings, an automatic filename will be assigned to each recording unless the *Prompt for name* option is ticked. This option allows you to specify custom names for your recordings (affecting both audio and MIDI recordings). If the option is not selected filenames will have the format '*Hauptwerk recording, 2023-01-15-23-44-44 (StAnnesMoseley)*', where the numbers represent *Year-Month-Day-Hour-Minutes-Seconds*, with the organ name in brackets.

As soon as you stop recording, the recorded file will automatically become the 'current' file and will be loaded, ready for playback.

To play back a MIDI file

- Make sure the *Recorder/Player* large control panel is open (or the *Recording* tab on the Touch Menu).

- Press the *Load...* button, select the MIDI file you want to play, then click *Open*. Alternatively, you can press the *Last* button to load the MIDI file you used last. (Note that the MIDI file you load must have been recorded from the same organ within Hauptwerk, or must use the MIDI implementation shown via the *View implementation* … button, otherwise it might not play back on the intended divisions/registration.) The name of the selected MIDI file will appear in the display.

- Press the *Play* button to begin playback of your MIDI recording.

Overdubbing MIDI recordings

It's possible to record a new 'take' over the top of a previously-recorded MIDI file. This allows you to study pieces of music by recording one part at a time, then playing back that part while recording a new part. For example, you could record the right-hand part of an organ score by itself, then play it back while recording a new part for the left hand, then again for the pedal part, etc.

To overdub a MIDI recording:

- Follow the steps above to record and save a MIDI recording. (It's recommended you give it a meaningful name so that you can easily tell the original and overdubbed files apart.)

- Load the recorded MIDI file (the previous recording will already be loaded already if you just recorded the file).

- Press the *Record* button to start recording the new (overdubbed) file. (Again, it's recommended you give it a meaningful name so that you can easily tell the original and overdubbed files apart.)

- Press the *Play* button to start playback of the original file (which will still be the 'current' file). Hauptwerk will now be playing your previous MIDI file at the same time as recording a new MIDI part to your new MIDI file.

- Press the *Stop* button when finished to complete your MIDI recording.

- Repeat as required to add further new parts.

The *Record* and *Play* buttons will remain illuminated during the recording/overdubbing process.

General settings menu

Items on the *General settings* menu apply to all organs.

General configuration wizard

Run this wizard if you want to reset some or all of your global-level settings (those found on the *General settings* menu) for any reason. You will be guided through the set-up procedure again, as when you first installed and launched Hauptwerk. Follow the steps to complete the wizard.
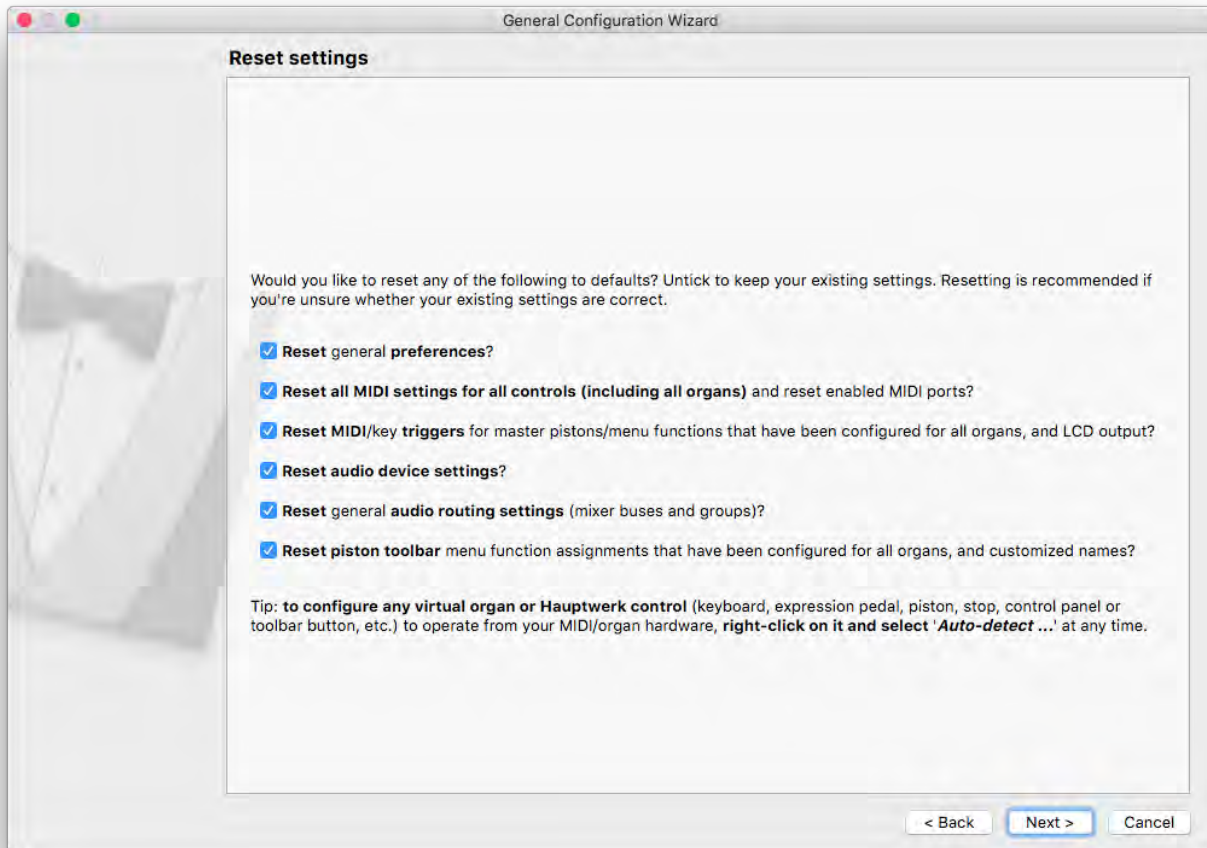
General preferences

The *General preferences* screen has various options for customizing your Hauptwerk experience. Hover over any given setting with the mouse for a brief pop-up tip that explains what it does, or use the on-screen help, which may give a more detailed explanation.

***Main 1* tab**
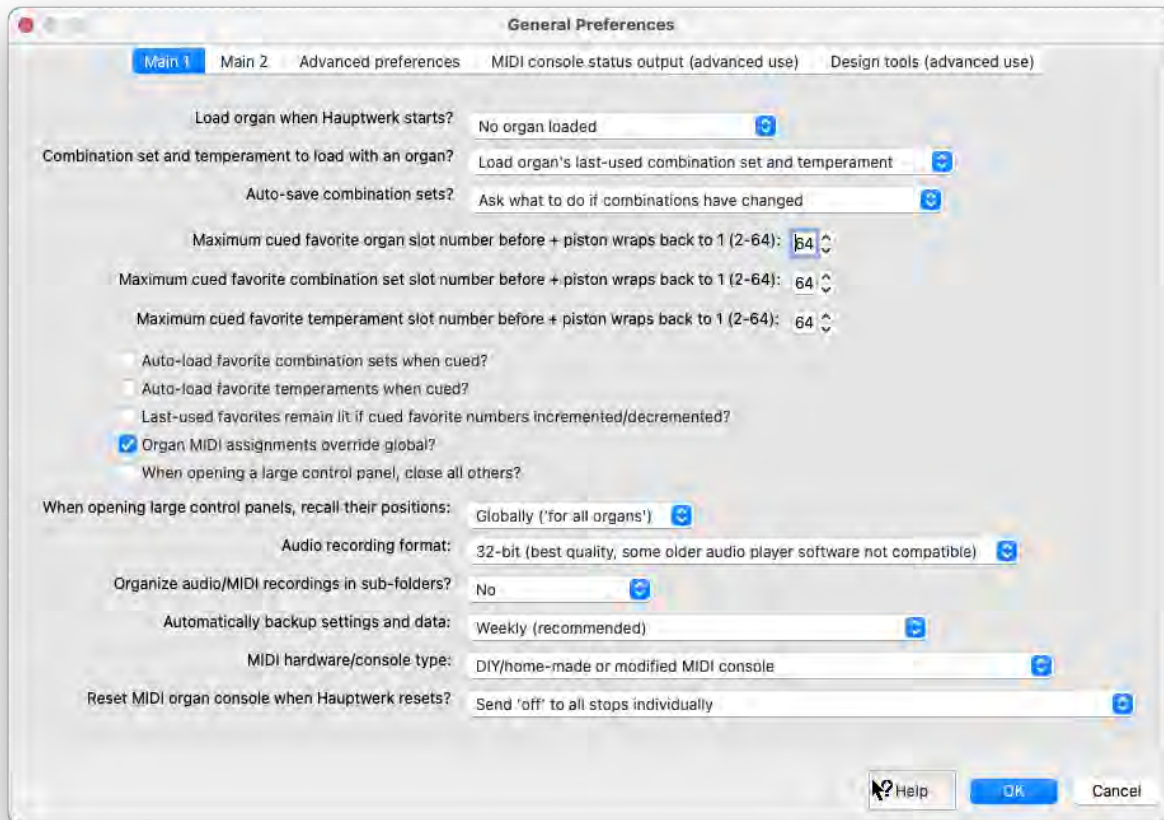
Main 2 tab
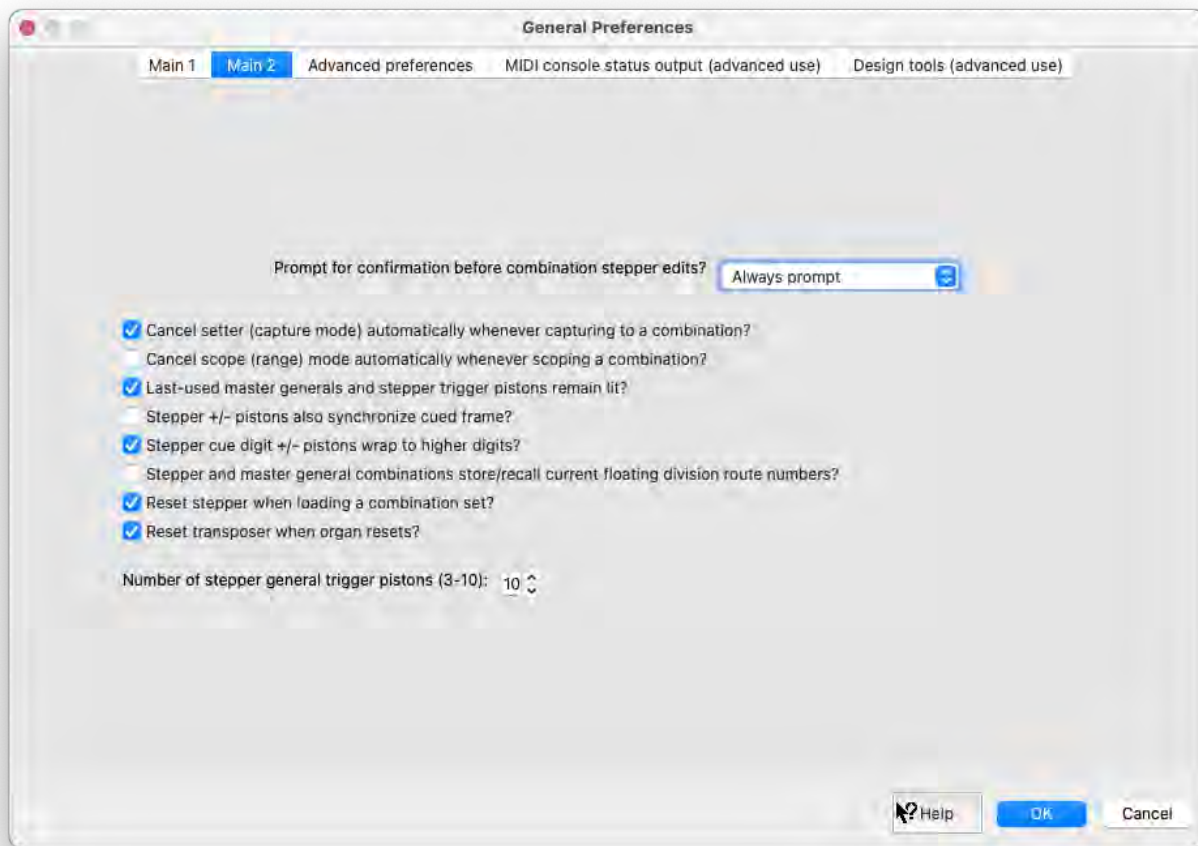
Advanced preferences tab
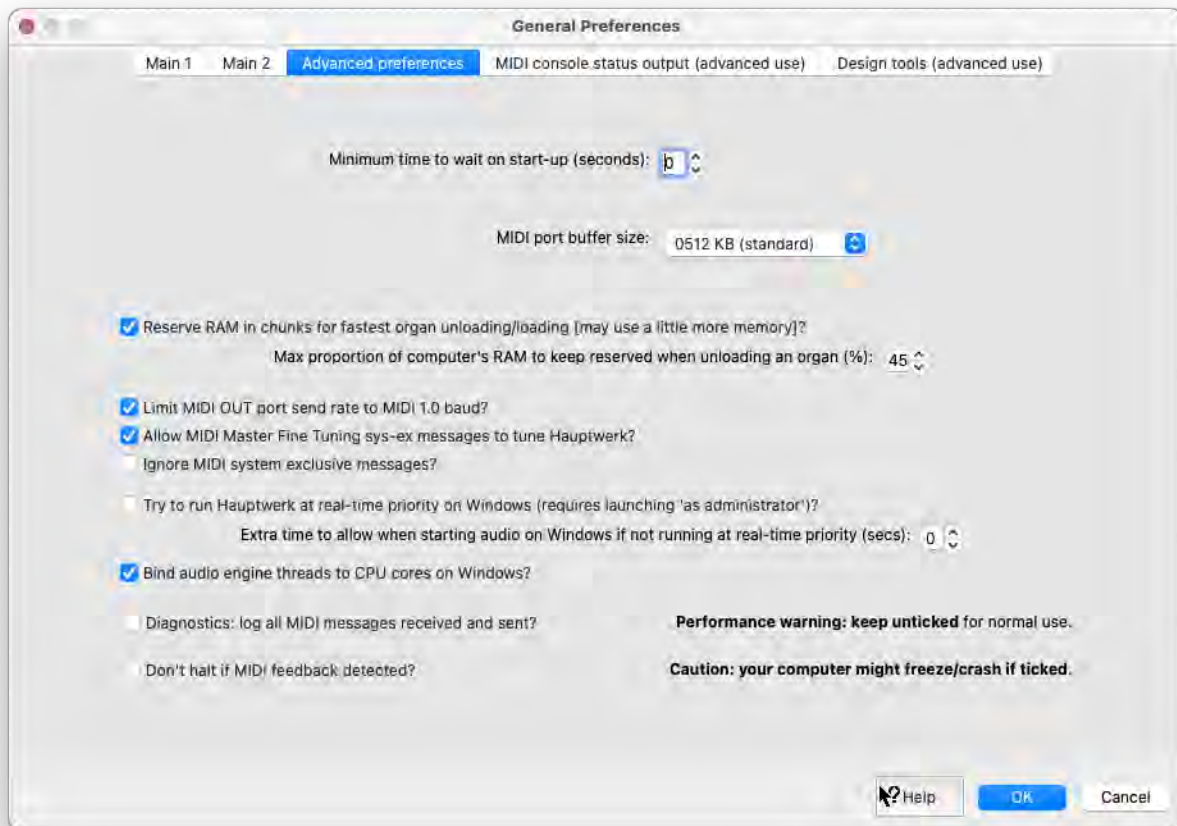
***MIDI console status output (advanced use)* tab**
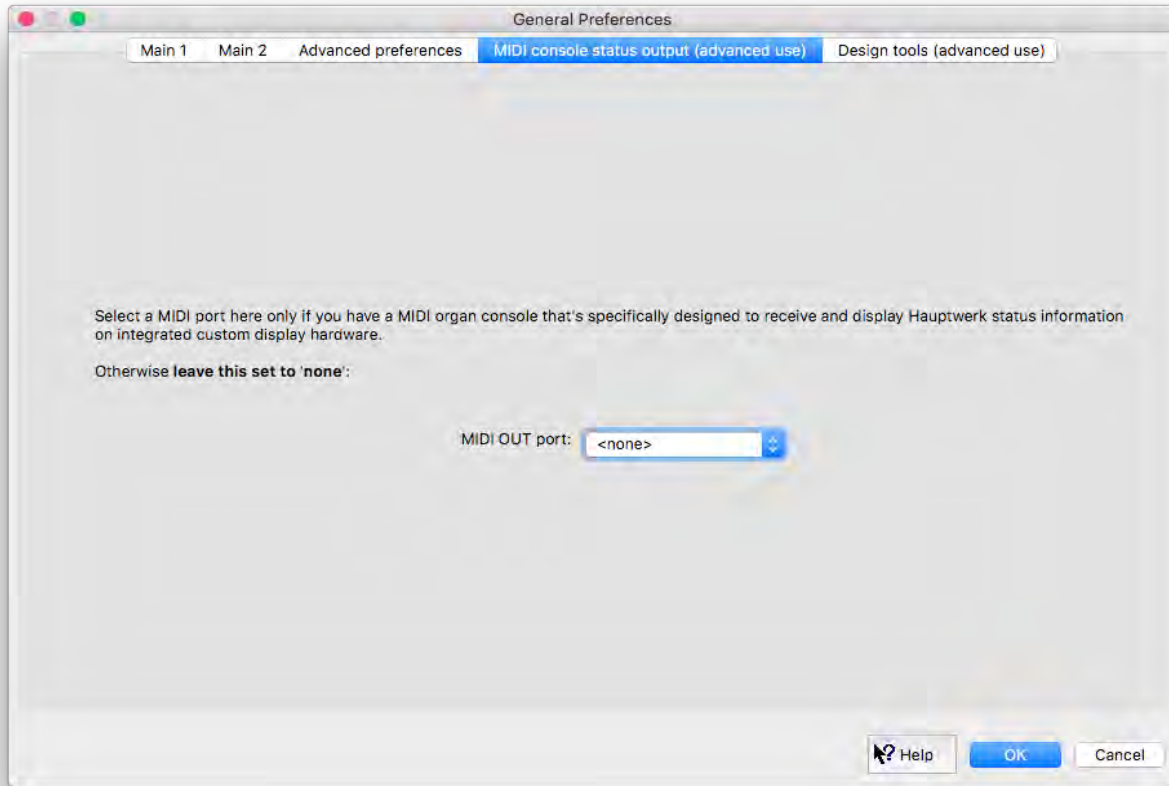
Hauptwerk's status information can be sent in a raw form via MIDI to custom hardware designed to can interpret and display it. Select the MIDI output port to be used only if you have such hardware, otherwise keep *<none>* selected.

Note: this is not the same as Hauptwerk's 32-character LCD panel control system.

***Design tools (advanced use)* tab**
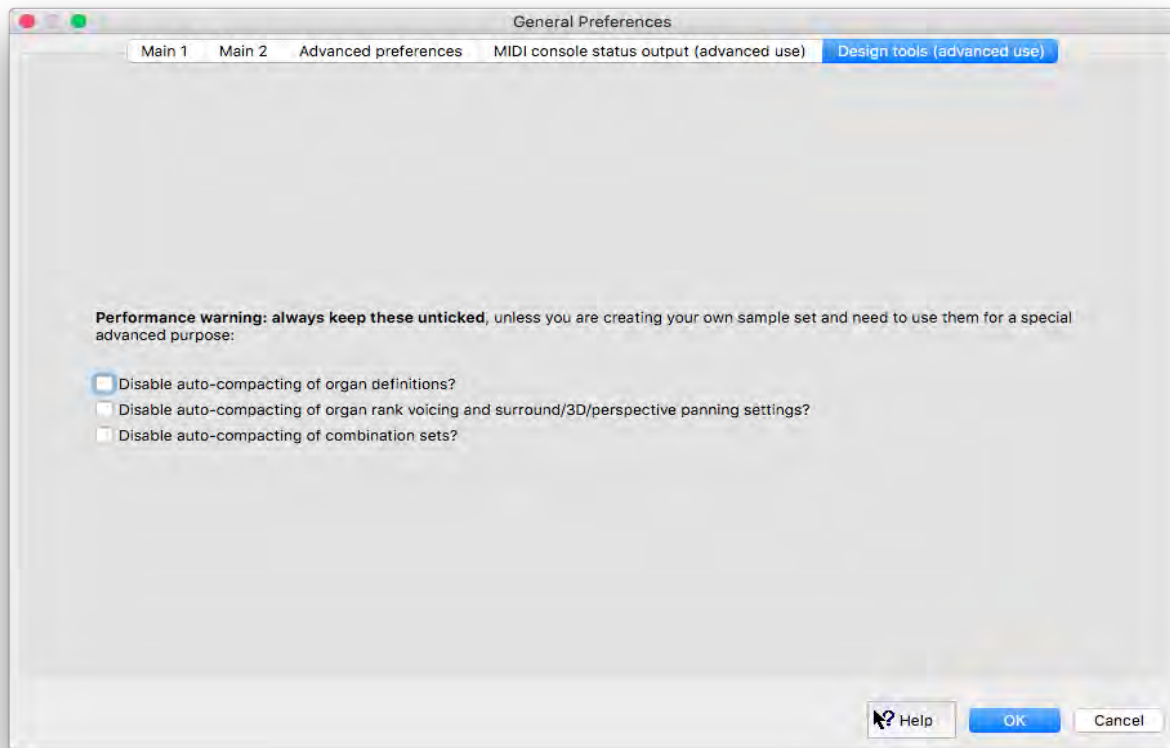
This tab has options for disabling auto-compacting of organ definitions, organ voicing/panning settings and combination sets. These options are normally only used for sample set development purposes. For normal use leave these un-ticked for fastest loading times.

Audio device and channels

This screen is used to select and configure your computer's audio interface/driver, and optionally to rename or re-map its audio channels audio channels. See the *Section III: Quick start* section in this guide for basic use, as well as the on-screen help.
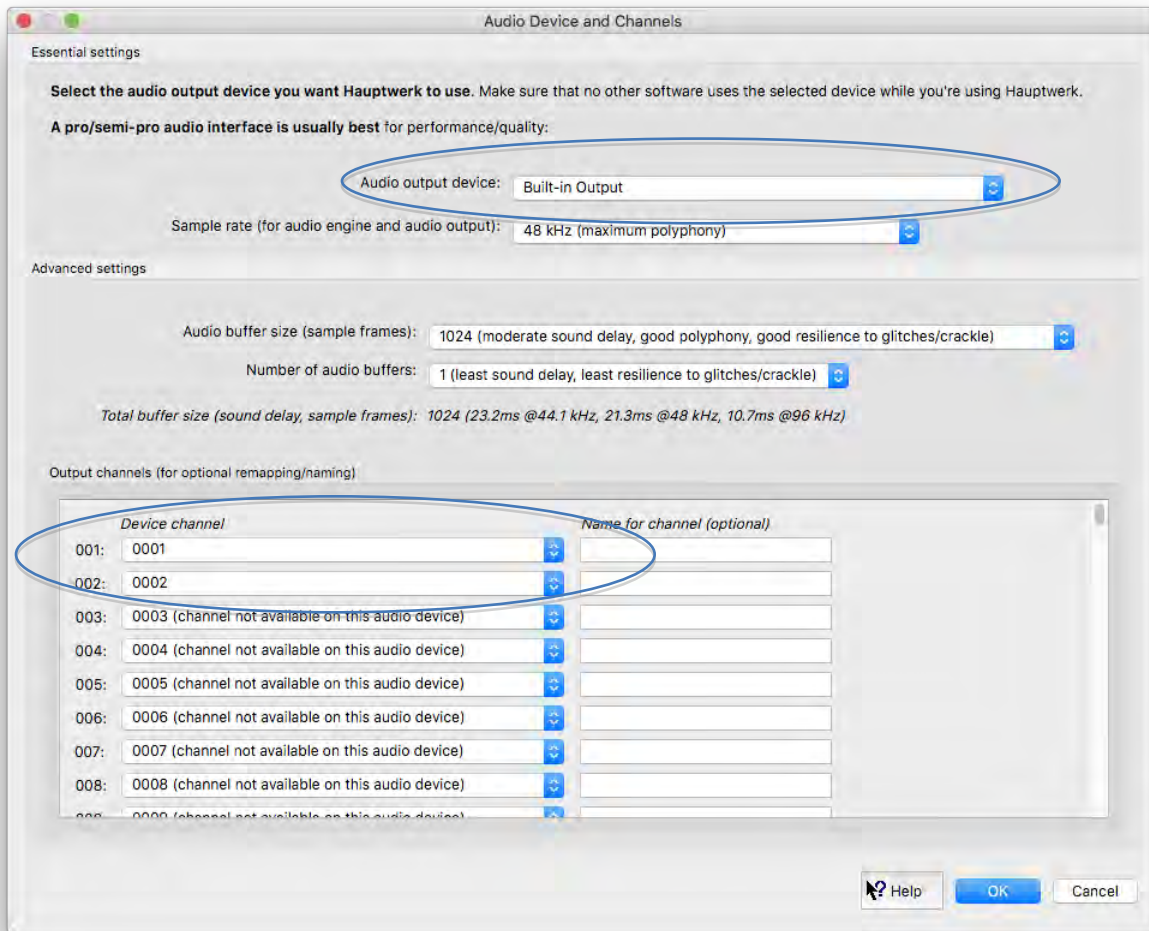
Note that the *'Sample rate'* setting determines both the audio engine sample rate, and the audio output sample rate. Using 96 kHz is more CPU-intensive than 48 kHz, sacrificing achievable polyphony (typically about 50%) for higher audio quality (better signal-to-noise ratio, less distortion, and better clarity). However, provided that you keep the '*Audio engine processing quality*' set to '*Higher*' on the *Organ settings | Organ preferences | Audio engine* screen tab (which very significantly benefits audio quality), the additional benefit of 96 kHz above 48 kHz is unlikely to be significant enough to be audible, so 48 kHz is usually sufficient and recommended.

The *Performance tuning* section also covers tuning the audio device settings for best performance.

Audio mixer (Advanced Edition only)

The screen is also used to configure audio routing, such as surround/3D sound or multi-channel audio, and optionally also impulse response reverb. See the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* section of the guide for more details.

Audio mixer bus groups (Advanced Edition only)

The screen is also used to configure audio routing for multi-channel audio. See the *Audio routing and impulse response reverb part 2 (Advanced Edition only): multi-channel audio, multi-channel virtual acoustics, and routing concepts for advanced use* section of the guide for more details.

MIDI ports

Use this screen to tell Hauptwerk which of your computer's MIDI input and output ports connect to/from your MIDI organ console/hardware. See the *Section III: Quick start* section in this guide for basic use. The on-screen help and information icons give more detailed information.
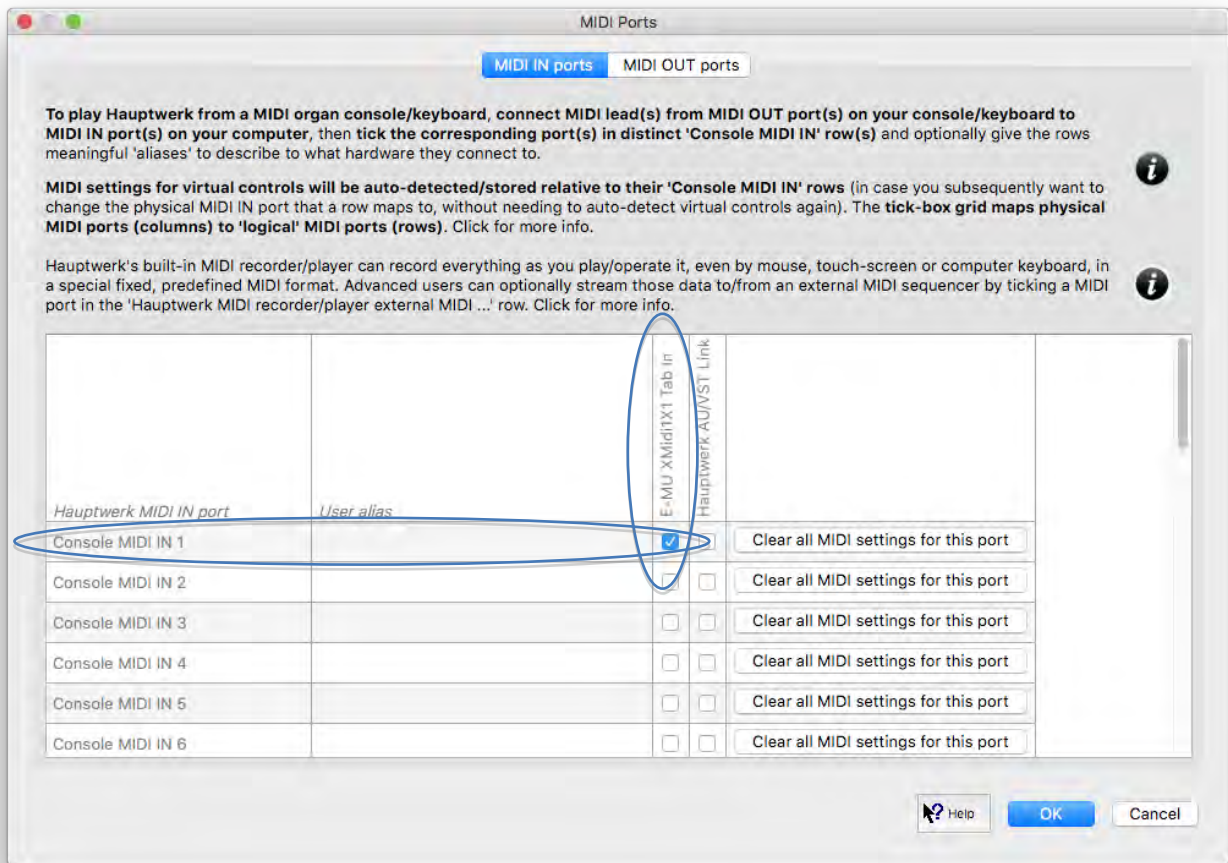
Instead of (physical) MIDI ports being auto-detected/stored directly for virtual controls, there are 32 'logical' '*Console MIDI IN*' ports, and 32 'logical' '*Console MIDI OUT*' ports. Virtual controls auto-detect/store the 'logical' MIDI ports, not the physical MIDI ports. These 'logical' MIDI ports ('*Console MIDI IN/OUT*' entries) are shown as rows on the MIDI ports screen, with 'physical' MIDI ports (MIDI devices) shown as columns. Any row (logical MIDI port) may have at most one column (physical MIDI port) ticked, and likewise at most one row may be ticked for any one column.

These grids of tick-boxes thus map 'physical' MIDI ports (columns) to 'logical' MIDI ports (rows), so that if you subsequently change the physical MIDI interface/port to which a particular piece of MIDI hardware (MIDI keyboard, MIDI organ console, etc.) is connected, you can easily change the mapping (by simply changing which column is ticked for the relevant row) without needing to auto-detect MIDI settings again for all virtual controls that used the previous physical MIDI port. You can do likewise if your computer unexpectedly renames any USB-MIDI devices at some point in the future (as can sometimes happen if you change any USB connections, especially if you have multiple USB-MIDI devices of identical makes/models connected).

You can also (optionally, but highly recommended) give meaningful 'aliases' to each of the logical MIDI ports (rows) to identify the MIDI hardware that you have connected to them. Doing so makes it easier to see which logical MIDI ports (rows) connect to what, especially in case you need to change their physical MIDI port connections (or in case the computer unexpectedly renames the physical MIDI port) in the future. For example, suppose that you have two separate MIDI keyboards (each with its own separate MIDI or USB-MIDI connection to the computer), and that your upper MIDI keyboard's MIDI IN port is ticked in the '*Console MIDI IN 1*' row; you could then specify something like '*My upper MIDI keyboard*' for the '*User alias*' for that particular row.

If using Novation Launchpads with Hauptwerk, please see the *Using Hauptwerk with Novation Launchpads* section for how to configure them.

(See the *MIDI sequencing, the Hauptwerk AU/VST Link and applying external real-time effects plug-ins* section for details about how to connect and use external MIDI recorders/players/sequencers with Hauptwerk.)

MIDI/key triggers for master pistons and menu functions (for all organs, unless overridden)

This screen can be used if you want to configure MIDI input to trigger 'global' menu functions, such as those that relate to selecting/loading organs, and for functions to which you wish to assign the same MIDI pistons for all (or most) organs. Highlight the desired function in the left-hand pane and use the *Auto-detect settings* button to configure it to be triggered from a MIDI piston or computer key:
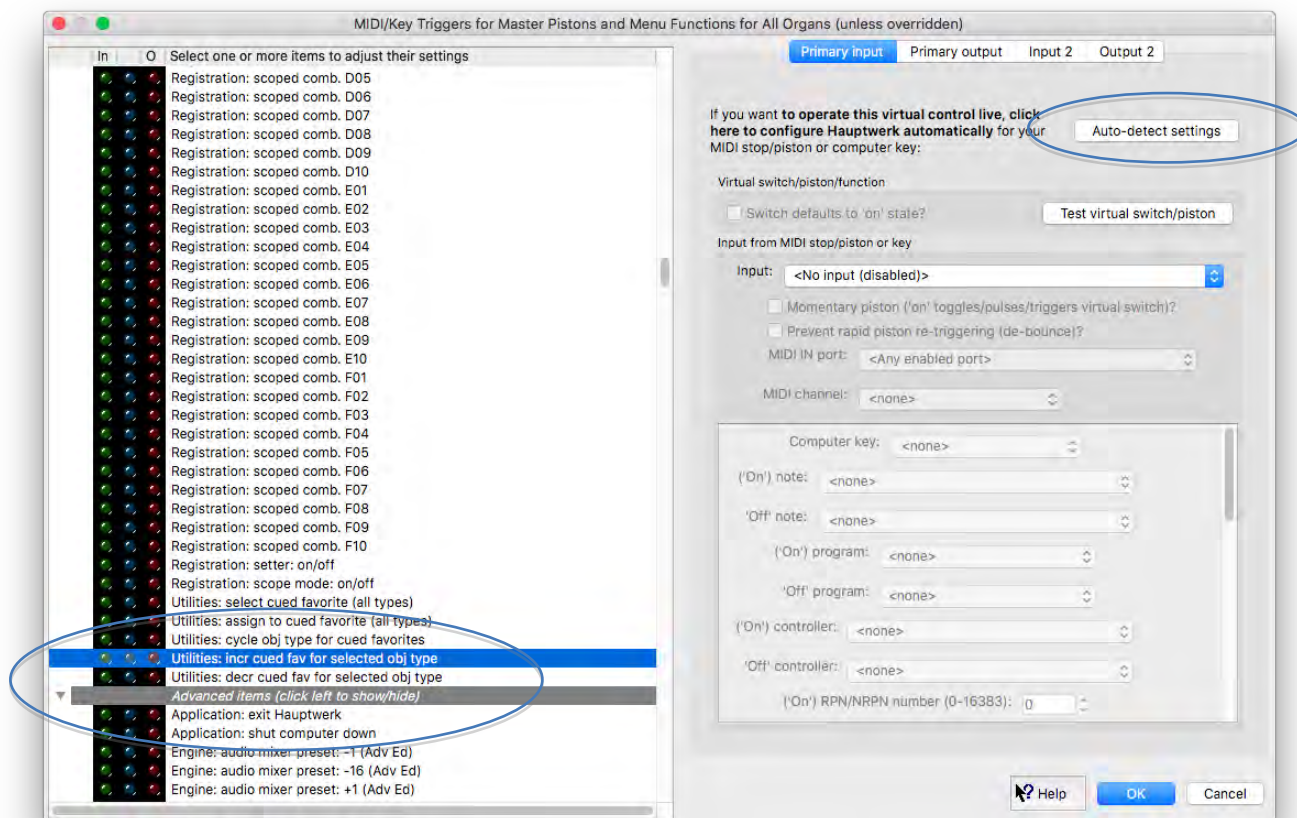
For example, the following functions are especially useful to assign to MIDI pistons because together they allow you to select, load and assign any favorite organs, combinations sets and temperaments from only five pistons:

- *Utilities: cycle obj type for cued favorites*

- *Utilities: incr cued fav for selected obj type*

- *Utilities: decr cued fav for selected obj type*

- *Utilities: select cued favorite (all types)*

- *Utilities: assign to cued favorite (all types)*

The settings in the right-hand pane of this screen are used in the same way as those of the *Organ settings | Stop/coupler/tremulant switches and pistons/buttons* screen.

The buttons on control panels and Touch Menu duplicate nearly of the available menu functions, so you could alternatively auto-detect them by right-clicking on the corresponding control panel or Touch Menu buttons (without needing to use this screen at all).

Note: you could instead auto-detect MIDI to trigger any given menu function on a per-organ basis, e.g. via the equivalent 'for this organ only' screen on the *Organ settings* menu. If you did that, it would only affect the currently-loaded organ, and if you had also auto-detected the same MIDI control (MIDI piston/key/etc.) to trigger a global ('for all organs, unless overridden') function, then by default the global assignment would be ignored for that particular organ (overridden by the 'for this organ only' assignment).

> **Background information, for advanced users:** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger <u>both</u> one or more global ('for all organs') menu/master functions, <u>and also</u> one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.

> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.

> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for … master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments)

MIDI LCD panel control (for all organs)

Hauptwerk can control 32-character LCD display panels to display Hauptwerk's status on a MIDI console. Custom MIDI system-exclusive messages are sent to control the panels, requiring Hauptwerk-compatible MIDI LCD units, which are available from third parties. The *MIDI implementation* of this guide covers the MIDI message format used.

Use this screen to specify settings for any LCD panels which you wish to be configured identically for all organs, inserting an entry for each.
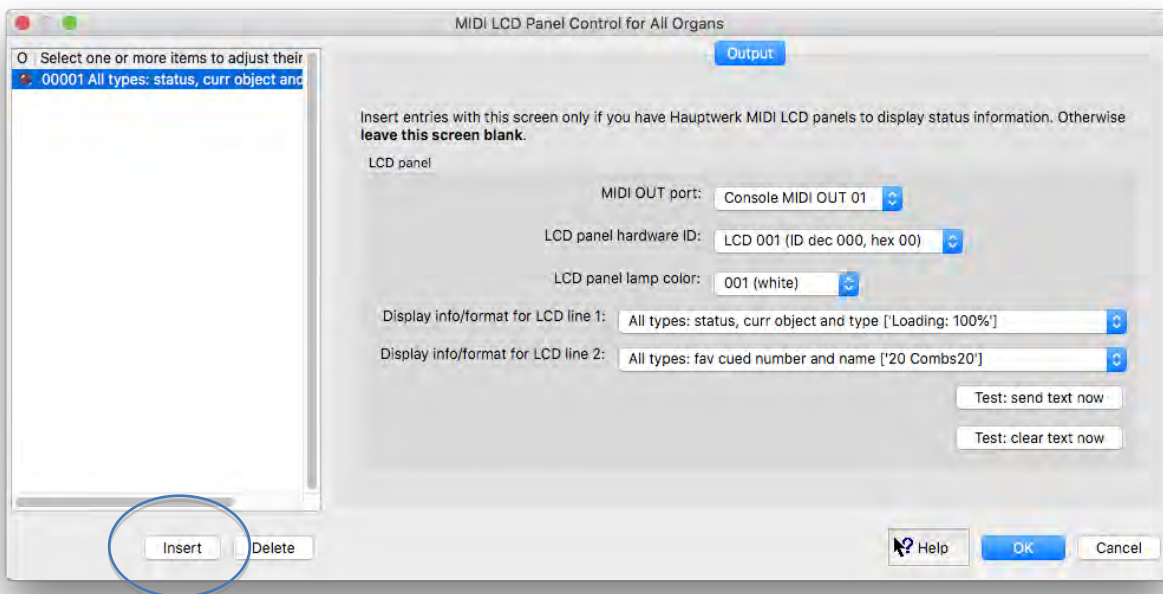
[Alternatively, for any LCD panels that you specifically wish to configure differently for different organs, instead use the *Organ settings | MIDI LCD panel control (for this organ)* screen. N.B. It's important that you configure any given physical MIDI LCD panel <u>either</u> globally ('for all organs') <u>or</u> per-organ ('for this organ'), <u>but not both</u>; a MIDI LCD panel configured per-organ will not automatically override any globally-configured MIDI LCD panels. Hence you need to decide whether any given physical MIDI LCD panel will always be configured globally or per-organ before configuring it (otherwise they will conflict, giving undefined/unexpected behavior); global assignments cannot be changed/ignored for some organs and not others.]

You can choose which items of information you want to display on each of the two lines on each LCD panel:

Status, organ name ['Loading: 100%']
Organ cued number and name ['20 StAnnesMose..']
✓ All types: status, curr object and type ['Loading: 100%']
All types: curr object and type ['Cmb Combs20']
All types: fav cued number and name ['20 Combs20']
Utility functions menu cued function name ['StprEdt:Insert']
Combination set name ['Combs20']
Combination set cued number and name ['20 Combs20']
Temperament name ['Well-KirnIII']
Temperament cued number and name ['20 Well-Kellner']
Combination system states ['Gen 20 Set Scop']
Stepper curr and cued frames ['Step 999 Cue 990']
Stepper editor ['Cue 990 BlSz 1']
Crescendo curr and cued stages ['Cresc A31 Cue 31']
MIDI player position and file length ['0:00:00 /0:00:00']
MIDI player position and states ['0:00:00 >>> 100%']
MIDI player states and core recording states ['>>> 100% Rec: AM']
Audio/MIDI recorder/player preferences ['Arm: AM End: S']
Floating division 1 route and expression ['Dv1 4 Choir 100%']
Floating division 2 route and expression ['Dv2 4 Choir 100%']
Floating division 3 route and expression ['Dv3 4 Choir 100%']
Floating division 4 route and expression ['Dv4 4 Choir 100%']
Floating division 5 route and expression ['Dv5 4 Choir 100%']
Base pitch, fine-tuning and transposer ['A=440 +200% T+12']
Volume pedal/knob and trim ['Vol 100% +24 dB']
Hauptwerk v2/v3 line 2 format ['CRT+99 Equal 999']
Leave line blank ['']

For example, the following line formats allow you to view, select, load and assign any favorite organs, combinations sets and temperaments with a single LCD panel:

- *'All types: status, curr object and type …'.*

- *'All types: fav cued number and name …'.*

Getting help with settings screens

Click on the pointer/question-mark Help icon immediately to the left of a screen's *OK* button:
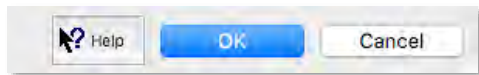
... then click onto the screen background or a specific setting for a detailed explanation of its function.

Organ settings menu

Overview

The *Organ settings* menu is only available when an organ is loaded, and all settings on all screens on the *Organ settings* menu relate specifically and only to whichever organ you have loaded when you use them.

Organ configuration wizard

Run this wizard if you want to reset some or all of your organ-level settings (those found on the *Organ settings* menu) for any reason. Follow the steps to complete the wizard.
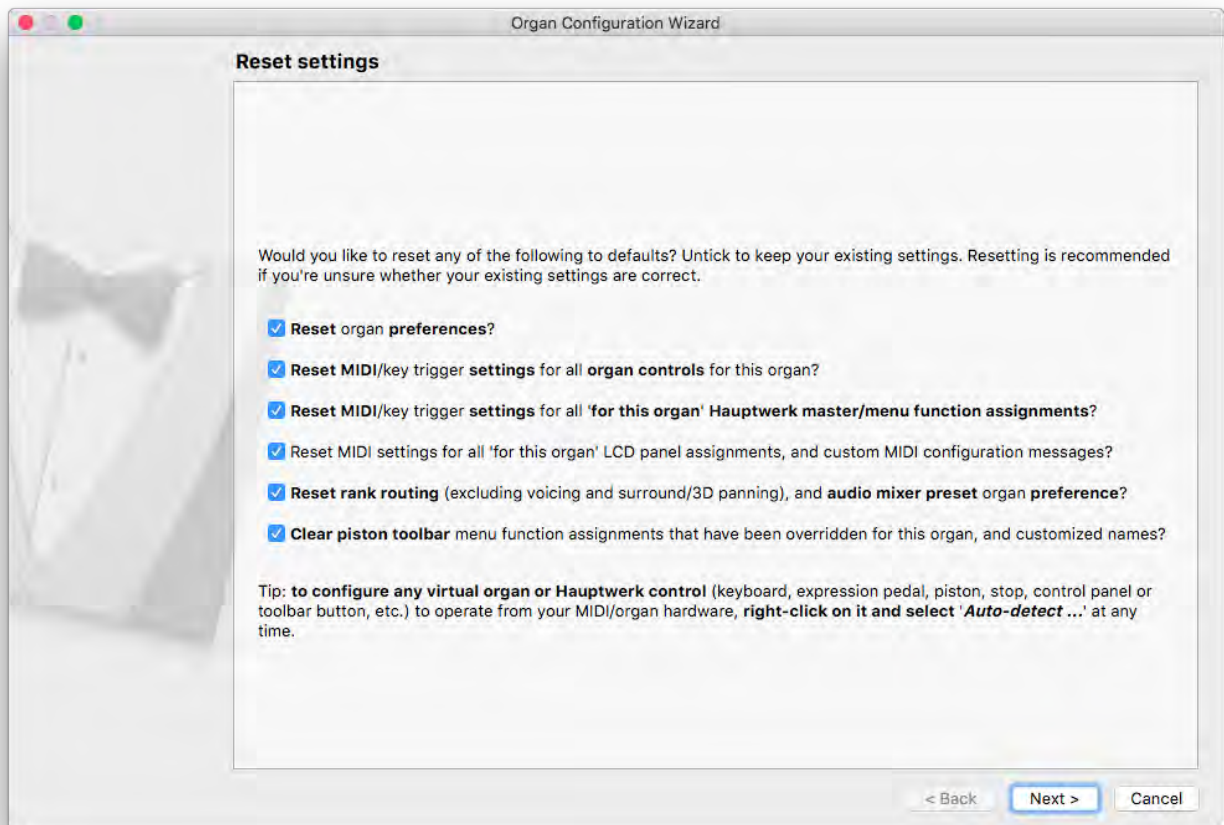
If you reset your MIDI settings then you can quickly, easily, and correctly re-configure MIDI for virtual organ controls by simply right-clicking on them and selecting '*Auto-detect settings*'.

Organ preferences

The *Organ preferences* screen has various options for customizing your Hauptwerk experience. Hover over any given setting with the mouse for a pop-up tip that explains what it does, or use the on-screen help.

Main tab

***Audio engine* tab**

- The '*Audio engine processing quality*' preference offers the following two choices:

  o '*Lower (not recommended; least CPU-intensive; legacy v2-v5 quality)*'.

  o '*Higher (recommended; lower distortion; about 60% less polyphony than 'lower')*'.

  We recommend always using the 'higher' option if your computer can manage it – it will give noticeably better audio quality (less distortion, and thus greater clarity), but is more CPU-intensive (typically allowing the computer to achieve about 60% less polyphony than it could with the 'lower' option). The 'higher option enables very high-quality pitch-shifting (interpolation) and higher-quality processing for the per-pipe real-time filters. If changing the preference, you may need to adjust your polyphony limit setting for the organ accordingly.

  Please note: in the lower mode, dynamic modulation of the harmonic-shaping filters is disabled for deep bass pipes (to avoid potential filter distortions that can occur, especially at 96 kHz). That isn't necessary for the much lower-distortion filters enabled by the 'higher' mode, so dynamic filter modulation of deep bass pipes is enabled in the 'higher' mode.

  The sonic benefits of the 'higher' mode may be particularly easy to hear on modeled tremulants (especially modeled deep tremulants, as found on some theatre organ sample sets) and on organs with very dynamic wind supplies, or if raising or lower an organ's pitch significantly, relative to its original recorded pitch.

- The '*Tremulant/wind supply/swell box/relay model quality*' preference offers the following three choices:

  o '*Lower (not recommended; least CPU-intensive; legacy v2-v4 quality)*'.

  o '*Medium (good balance of quality vs. CPU overheads)*'.

  o '*Higher (caution: needs high per-CPU-core performance for large organs)*'.

  It controls the time resolution at which Hauptwerk's tremulant, wind supply, swell box, and relay models are processed, and thus their quality, accuracy, smoothness, realism, and response. Higher settings are more CPU-intensive, but give noticeably better results and overall clarity, provided that your computer has sufficient processing power to handle it. Per-CPU-core performance (especially CPU base clock speed) is particularly important for the models, even if your CPU has lots of cores. For the 'higher' option to work well with very large organs your CPU will need to have very high per-CPU-core performance, as well as plenty of CPU cores. Hence the 'medium' mode is the default.

  Because processing the wind supply model at different resolutions may slightly affect the behavior of the wind supply, in the Hauptwerk Advanced Edition there is a '*Wind model organ pipe flow adjustment*' preference on the '*Wind supply model*' screen tab, allowing you to reduce the amount of air that each organ pipe draws from the wind system when it sounds, in case the wind system is too unstable or 'wobbly'.

  In general, we recommend selecting the 'higher' mode only if:

  o The organ is a theatre organ, or:

  o The organ is reasonably small (without an excessively demanding wind supply model), or:

  o Your CPU has very high per-core performance (including a very high CPU base clock speed).

  In other cases, we recommend selecting the 'medium' option, and if in doubt, select the 'medium' option.

  The sonic benefits of the 'higher' mode may be particularly easy to hear on modeled tremulants (especially modeled deep tremulants, as found on some theatre organ sample sets).

- (With the exception of the harmonic-shaping filters), ticking some or all of the '*Disable ...*' options will often allow a computer to manage higher polyphony (simultaneous pipes), but at the expense of realism and at the expense of voicing flexibility (for the Advanced edition). We recommend keeping the filters enabled.

- You can exaggerate or suppress Hauptwerk's randomization models (which help to give movement to the sound) via the percentage adjustments. 100% is the default for each.

***Wind supply model* tab (Advanced Edition only)**
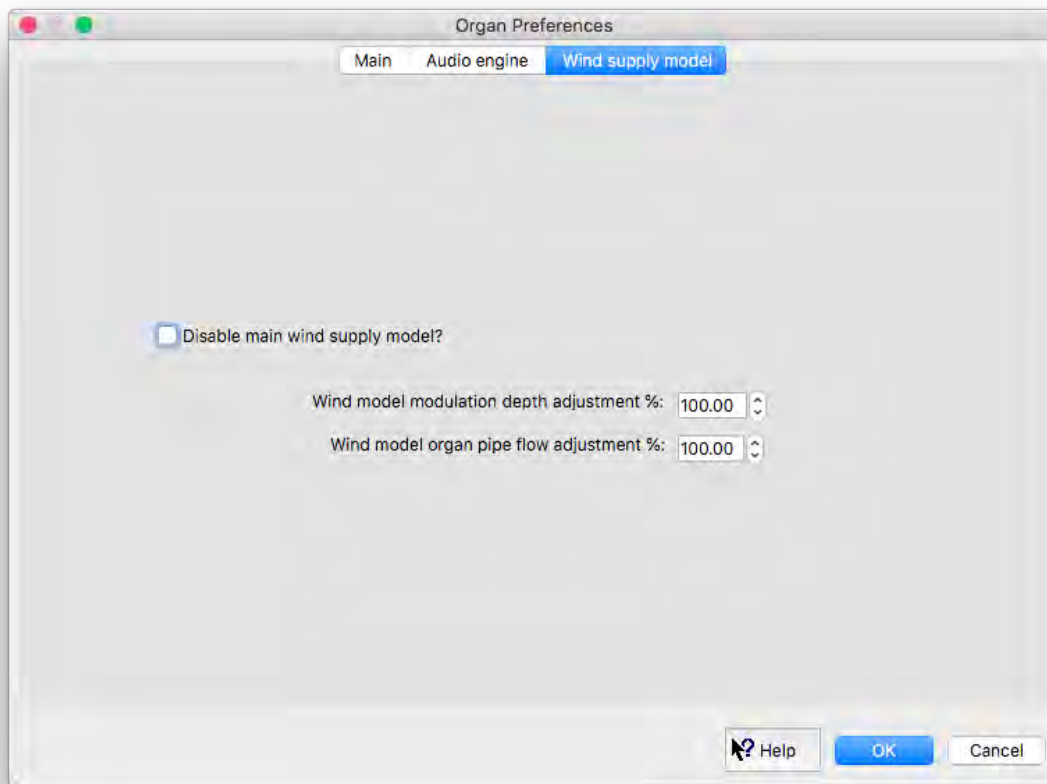
Hauptwerk's wind supply model uses fluid dynamics principles and equations to model the movements of air through a model of the wind supply system for an organ. The effects are to cause complex fluctuations and interactions in pipe speech and interactions between mechanical parts of the organ, such as its pipes, regulators and wind-chests.

The overall effects of the model can be emphasized or suppressed here. In particular, for some organs you may need to reduce the '*Wind model organ pipe flow adjustment*' if using the 'higher' option for the '*Tremulant/wind supply/swell box/relay model quality*' audio engine preference, to avoid the wind supply model becoming too unstable or 'wobbly'.

The model can also be disabled entirely for the organ, usually to reduce processing load.

❖   **Note: Hauptwerk's wind supply model, and this tab, are only available in the Advanced Edition of Hauptwerk.**

Keyboards

If a virtual organ keyboard is included on the virtual console display, just **right-click on the virtual keyboard and select *Auto-detect MIDI/trigger settings for this keyboard*** to configure it automatically to play from one of your MIDI keyboards:
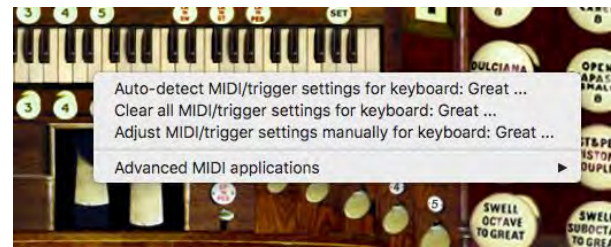
Follow the instructions by playing your MIDI keyboard then click ***Done***:

Now play your MIDI keyboard and you should see the virtual keyboard's corresponding keys move. Turn on a virtual stop for that division and you should hear its sound when playing. Repeat to auto-detect the MIDI settings for each other virtual keyboard for which you have a MIDI keyboard.

If you want to play a virtual organ keyboard that isn't included on the virtual console display, or if you want to configure or adjust the MIDI settings manually, you can use the *Organ settings | Keyboards* screen:
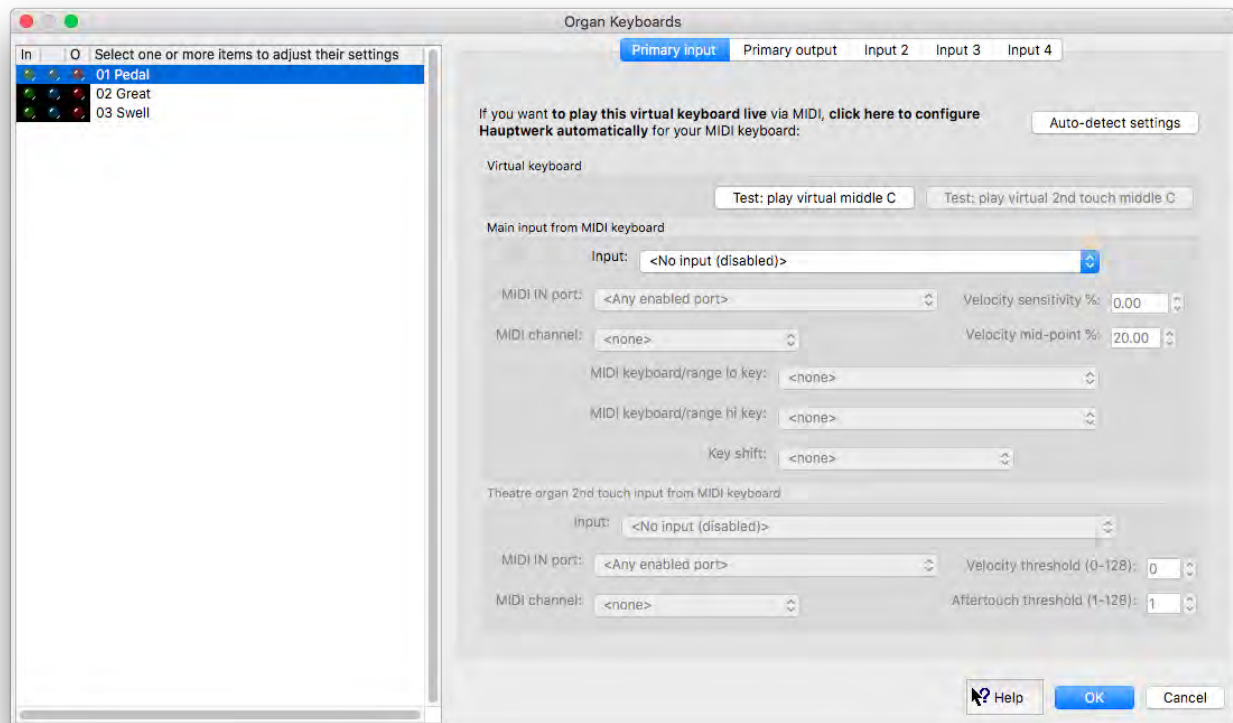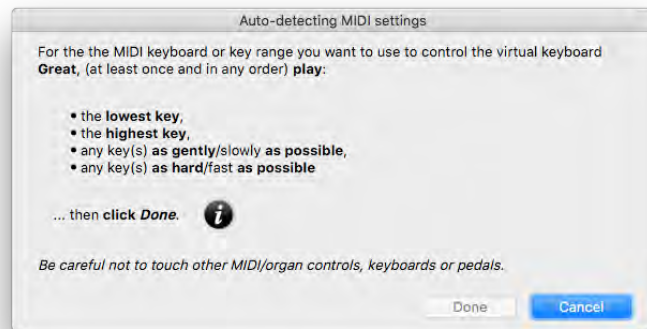
Hover over any of the settings/controls on the screen in Hauptwerk for a description of what the setting does, or use the on-screen question-mark help for more details.

The *Primary input* and *Input 2* screen tabs allow you to configure any given virtual keyboard to be played from up to two MIDI keyboards. All four input tabs also allow indirect input via floating divisions MIDI keyboards, which are covered in *Registration menu: floating divisions* section of this guide.

The *MIDI implementation* section of this guide covers the supported MIDI event types.

The *Primary output* tab can optionally be used to give MIDI output at the keyboard level for special purposes (such as to control MIDI sound expander units):
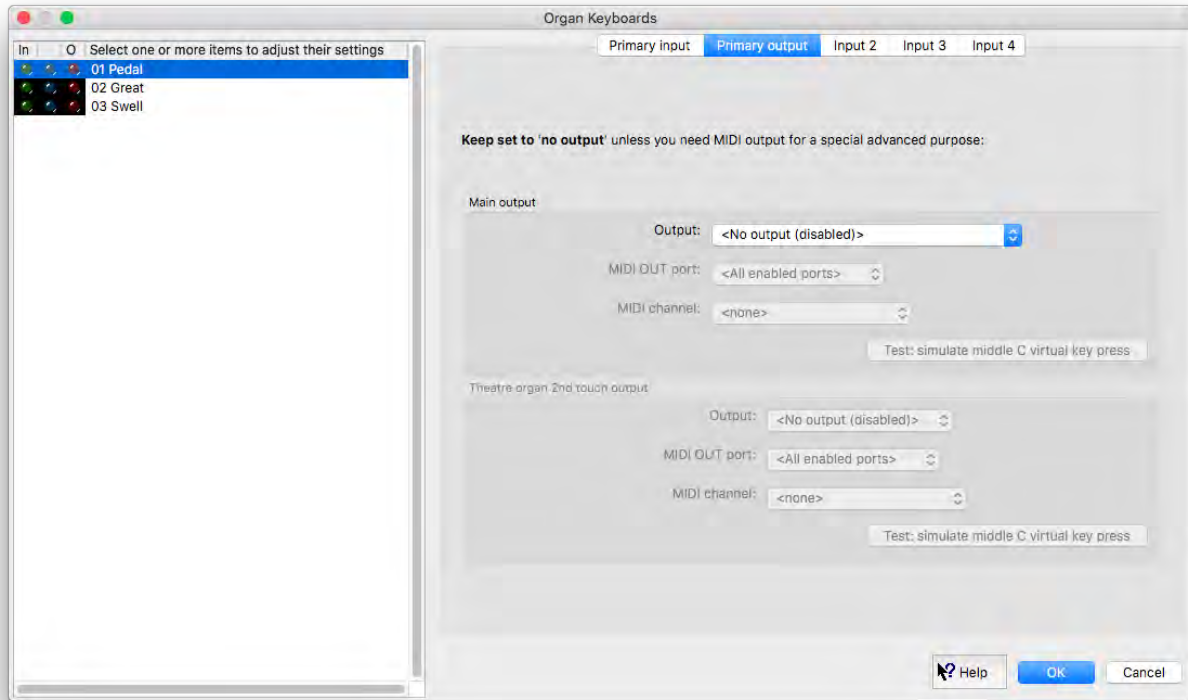
Expression/crescendo pedals and sliders/knobs

If a virtual organ expression/crescendo pedal or slider/knob ('continuous control') is included on the virtual console display, just **right-click on it and select *Auto-detect MIDI/trigger settings* ...** to configure it automatically to respond to one of your MIDI controller pedals/knobs/sliders:
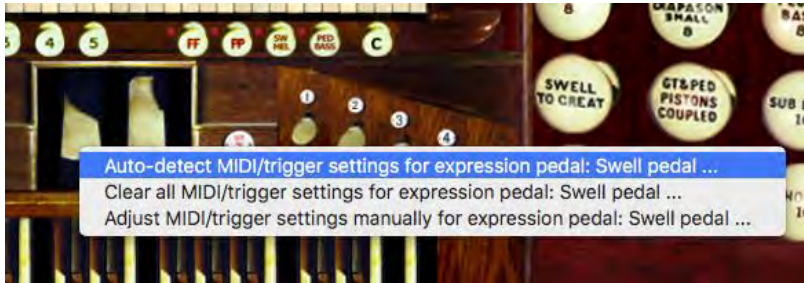
Follow the instructions by moving your MIDI controller then click ***Done***:
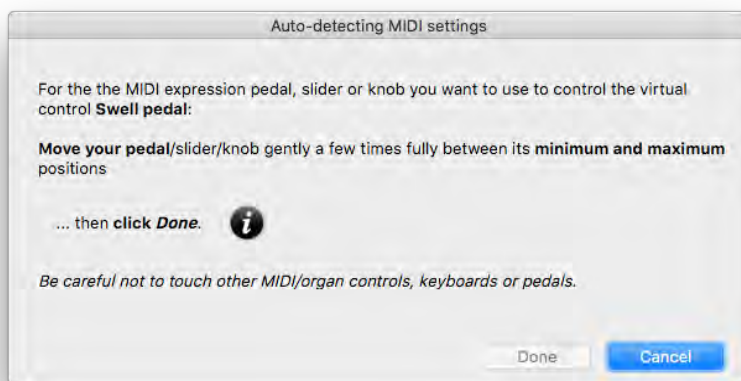
Now move your MIDI controller and you should see the virtual control move. Repeat to auto-detect the MIDI settings for each other virtual continuous control for which you have a MIDI controller pedal/slider/knob.

If you want to play a virtual organ continuous control that isn't included on the virtual console display, or if you want to configure or adjust the MIDI settings manually, you can use the *Organ settings | Expression/crescendo pedals and sliders/knobs* screen:
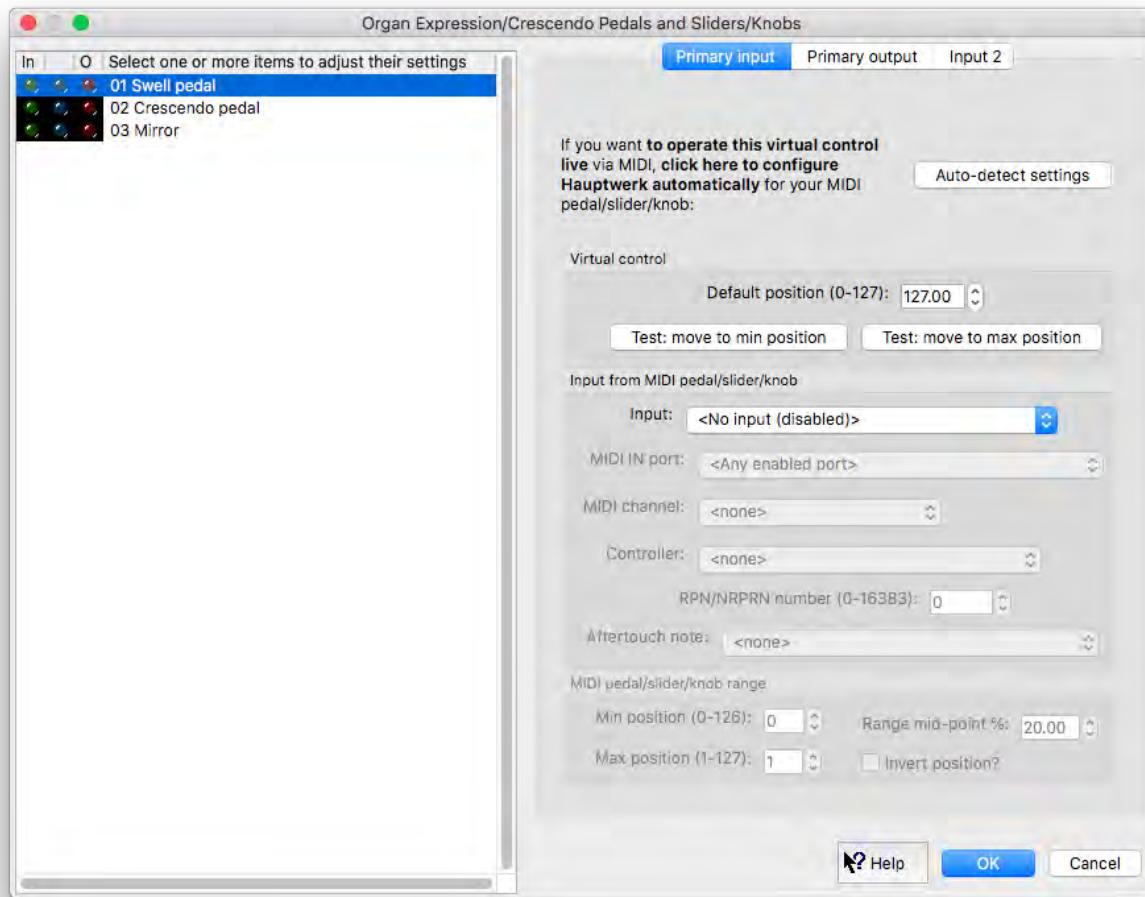
Hover over any of the settings/controls on the screen in Hauptwerk for a description of what the setting does, or use the on-screen question-mark help for more details.

The *Primary input* and *Input 2* screen tabs allow you to configure any given virtual continuous control to be played from up to two MIDI controllers.

The *MIDI implementation* section of this guide covers the supported MIDI event types.

The *Primary output* tab can optionally be used to configure Hauptwerk to control motorized expression pedals or for other special purposes (such as compatible MIDI continuous control value indicators):
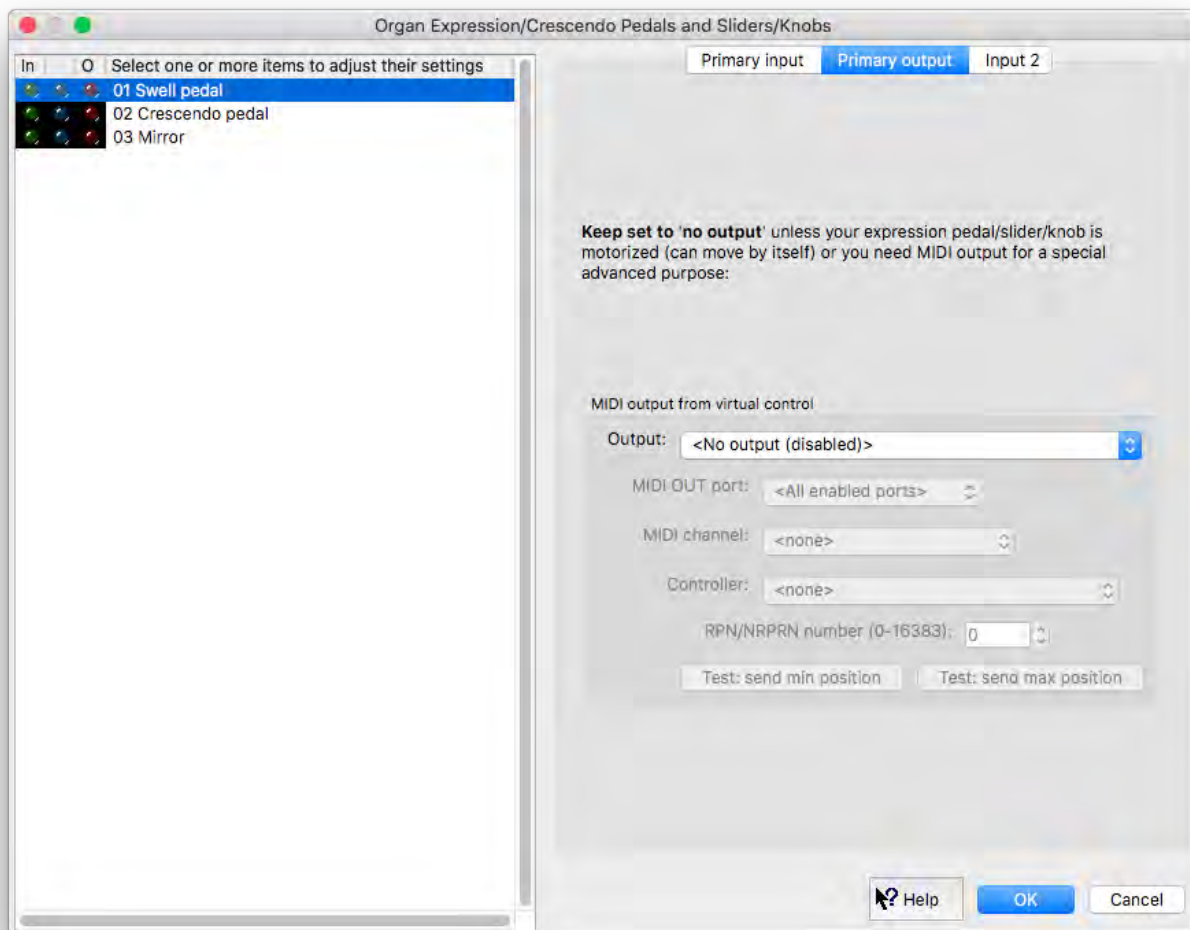
Stop/coupler/tremulant switches and pistons/buttons

If a virtual switch/button is included on the virtual console display, just **right-click on the virtual switch/button and select** *Auto-detect MIDI/trigger settings* ... to configure it automatically to respond to one of your MIDI switches/pistons or computer keys:
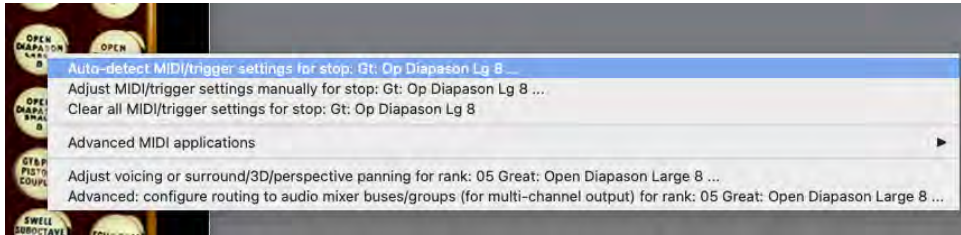
Follow the instructions by playing your MIDI switch/piston or computer key then click **Done**.
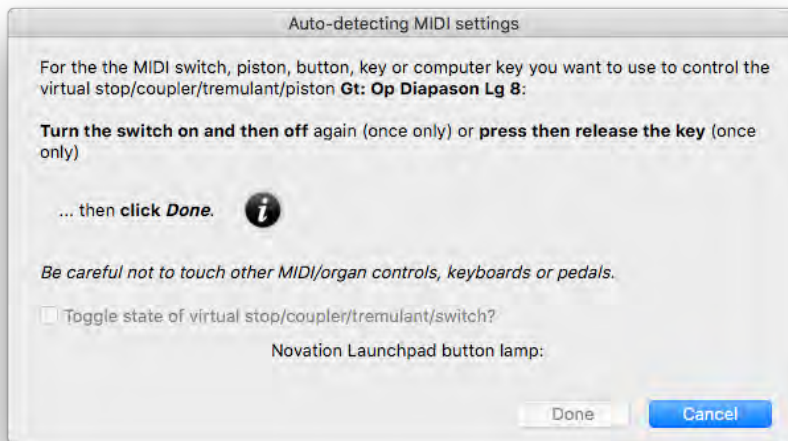
Now operate your MIDI switch/piston or computer key and you should see the virtual switch/piston respond. Repeat to auto-detect the MIDI settings for each other virtual switch/piston that you want to control via MIDI or from a computer key.

If you want to operate a virtual organ switch/piston that isn't included on the virtual console display, or if you want to configure or adjust the MIDI settings manually, you can use the *Organ settings | Stop/coupler/tremulant switches and pistons/buttons* screen:
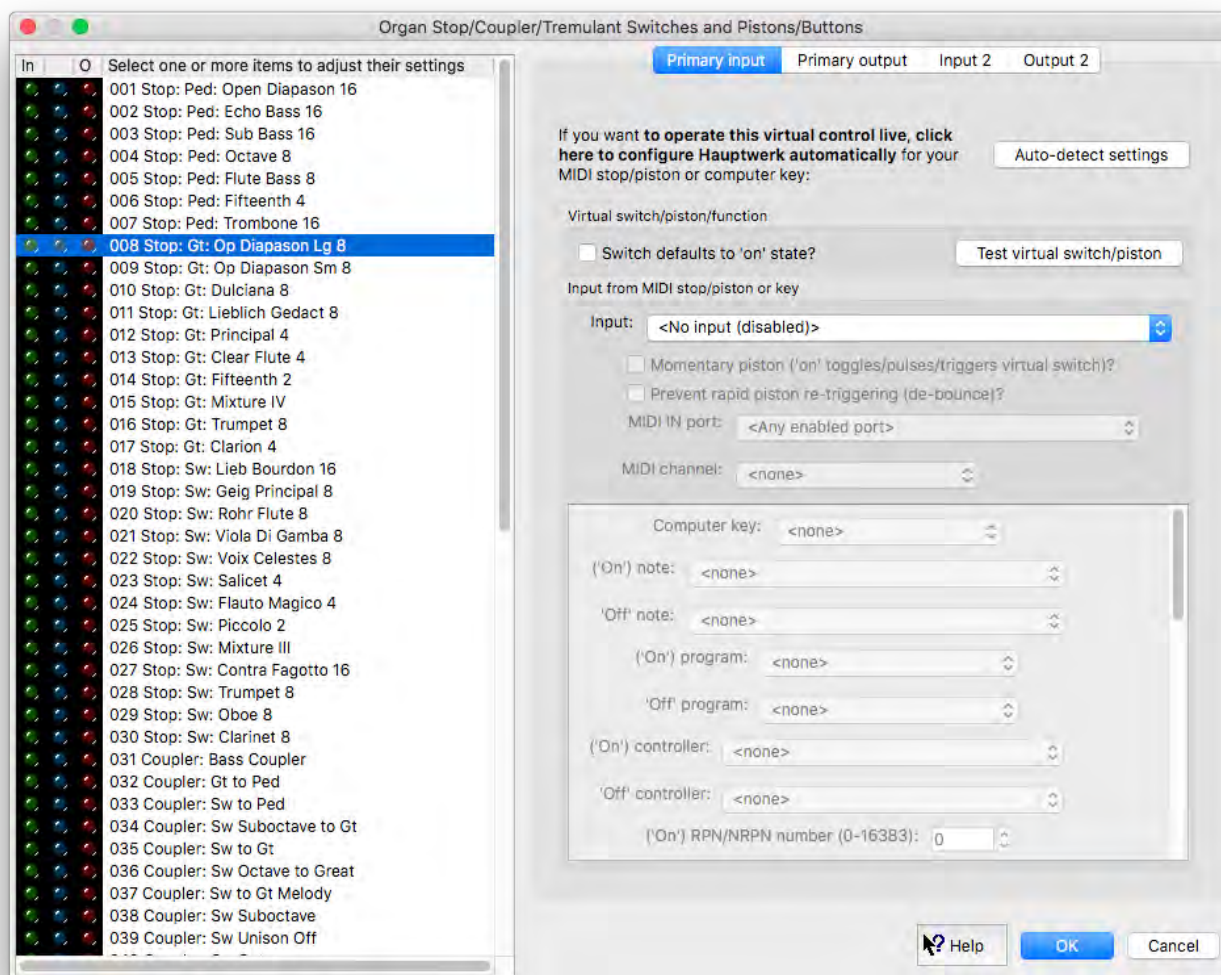
Hover over any of the settings/controls on the screen in Hauptwerk for a description of what the setting does, or use the on-screen question-mark help for more details.

The *Primary input* and *Input 2* screen tabs allow you to configure any given virtual switch/piston to be played from up to two MIDI switches/pistons.

The *MIDI implementation* section of this guide covers the supported MIDI event types:

```
✓ <No input (disabled)>
  Notation piston/toggle: prg ch
  Notation piston/toggle: CC, val=127
  Notation piston/toggle: CC=14
  Notation piston/toggle: CC=15
  Notation stop or hold-piston: CC, val=127/0
  Notation stop or hold-piston: CC20=on, CC110=off
  Notation stop or hold-piston: CC21=on, CC111=off
  Notation stop or hold-piston: CC22=on, CC112=off
  Notation stop or hold-piston: CC23=on, CC113=off
  Notation stop or hold-piston: CC24=on, CC114=off
  Notation stop or hold-piston: CC25=on, CC115=off
  Notation stop or hold-piston: CC26=on, CC116=off
  Notation stop or hold-piston: CC27=on, CC117=off
  Notation stop or hold-piston: CC28=on, CC118=off
  Notation stop or hold-piston: CC29=on, CC119=off
  Notation stop or hold-piston: CC50=on, CC70=off
  Notation stop or hold-piston: CC51=on, CC71=off
  Notation stop or hold-piston: CC52=on, CC72=off
  Notation stop or hold-piston: CC53=on, CC73=off
  Notation stop or hold-piston: CC54=on, CC74=off
  Notation stop or hold-piston: CC55=on, CC75=off
  Notation stop or hold-piston: CC56=on, CC76=off
  Notation stop or hold-piston: CC57=on, CC77=off
  Notation stop or hold-piston: CC58=on, CC78=off
  Notation stop or hold-piston: CC59=on, CC79=off
  Notation stop or hold-piston: CC60=on, CC90=off
  Computer key
  Momentary piston: MIDI program change
  Momentary piston: MIDI note-on
  Momentary piston: MIDI NRPN-on
  Momentary piston: MIDI CC-on
  Momentary piston: Johannus 9/11-byte sys-ex
  Momentary piston: Hoffrichter with indep LED
  Momentary piston: Hoffrichter general cancel
  Momentary piston: alternating MIDI note-on/offs
  Momentary piston: MIDI CC-on and/or CC-off
  Stop or hold-piston: MIDI NRPN-on/off (eg Allen)
  Stop or hold-piston: MIDI note-on/off
  Stop or hold-piston: MIDI control change-on/off
  Stop: Rodgers Pre-Infinity bitfield
  Stop: Rodgers Infinity+ bitfield: speaking stop
  Stop: Rodgers Infinity+ bitfield: other control
  Stop: Johannus/Makin/Wyvern/Musicom toggling prg ch
  Stop: Content/Wyvern/Eminent control ch bitfield
  Stop: Content/Wyvern key aftertouch bitfield
  Stop: Viscount 6-byte constant sys-ex msgs
  Stop: Ahlborn Organum/Praeludium varying NRPNs
  Stop: Ahlborn control ch 70
  Stop: Ahlborn control ch 73/74
  Stop: Makin prog ch sequences
  Stop: Phoenix/Wyvern prog ch (off using chan+1)
  Novation Launchpad MIDI note-on/off button
  Novation Launchpad MIDI CC-on/off button
  Generic MIDI prog ch (excl Johannus/Makin/Wyvrn/Musicom)
  Generic MIDI control changes
  Generic MIDI RPNs
  Generic MIDI NRPNs
  Generic MIDI sys-ex constant messages
  Generic MIDI key aftertouch (some Hoffrichter)
  X-Keys one-shot character code
```

The output tabs are typically used to allow Hauptwerk to control solenoid-actuated/illuminated MIDI draw-knobs/tabs:

Important note for digital organ users: if you are configuring Hauptwerk to be played from a commercial digital organ that has its own built-in combination system then (assuming that the digital organ's stop and pistons send MIDI in formats that Hauptwerk can understand) you may either:

1. *Configure (auto-detect) Hauptwerk's virtual stops*/couplers/tremulants to respond to the digital organ's stops/couplers/tremulants, *then use the digital organ's built-in combination* system instead of Hauptwerk's, but *don't* configure (auto-detect) any of Hauptwerk's virtual combination pistons/buttons to respond directly to the digital organ's combination pistons, *or*:

2. *Configure (auto-detect) Hauptwerk's virtual combination pistons*/buttons to respond directly to the digital organ's combination pistons, then *use Hauptwerk's combination system* instead of the digital organ's built-in combination system, but *don't* configure (auto-detect) any of Hauptwerk's virtual stops /couplers/tremulants to respond to the digital organ's stops/couplers/tremulants.

It's very important that you never have *both* Hauptwerk's virtual stops/couplers/tremulants *and* its virtual combination pistons/buttons configured to respond directly to the digital organ's corresponding controls, otherwise Hauptwerk's combination system will inevitably 'fight with' the digital organ's combination system over the states of the stops/couplers/tremulants, usually leading to the stops/couplers/tremulants getting out of sync. or ending up in unpredictable states. If you do accidentally end up in that situation then you should decide on which of the two modes of use listed above you prefer, then use 'Organ settings | Organ configuration wizard' to reset all MIDI/key trigger settings for the organ (so that the conflicting configuration is cleared), then auto-detect just the appropriate types of virtual controls.

Master crescendo/expression pedals and slider/knobs (for this organ only)

Hauptwerk includes a master crescendo, a master fine-tuning control, a master volume control and floating division expression pedals in addition to any controls that an organ may include natively.

To configure them to operate from MIDI expression pedals/sliders/knobs, just **right-click on them on the relevant control panel control and select *Auto-detect*... .**

If you want to configure or adjust the MIDI settings manually, you can use the *Organ settings | Master crescendo/expression pedals and slider/knobs (for this organ only)* screen. The settings in the right-hand pane of this screen are used in the same way as those of the *Organ settings | Expression/crescendo pedals and sliders/knobs* screen.
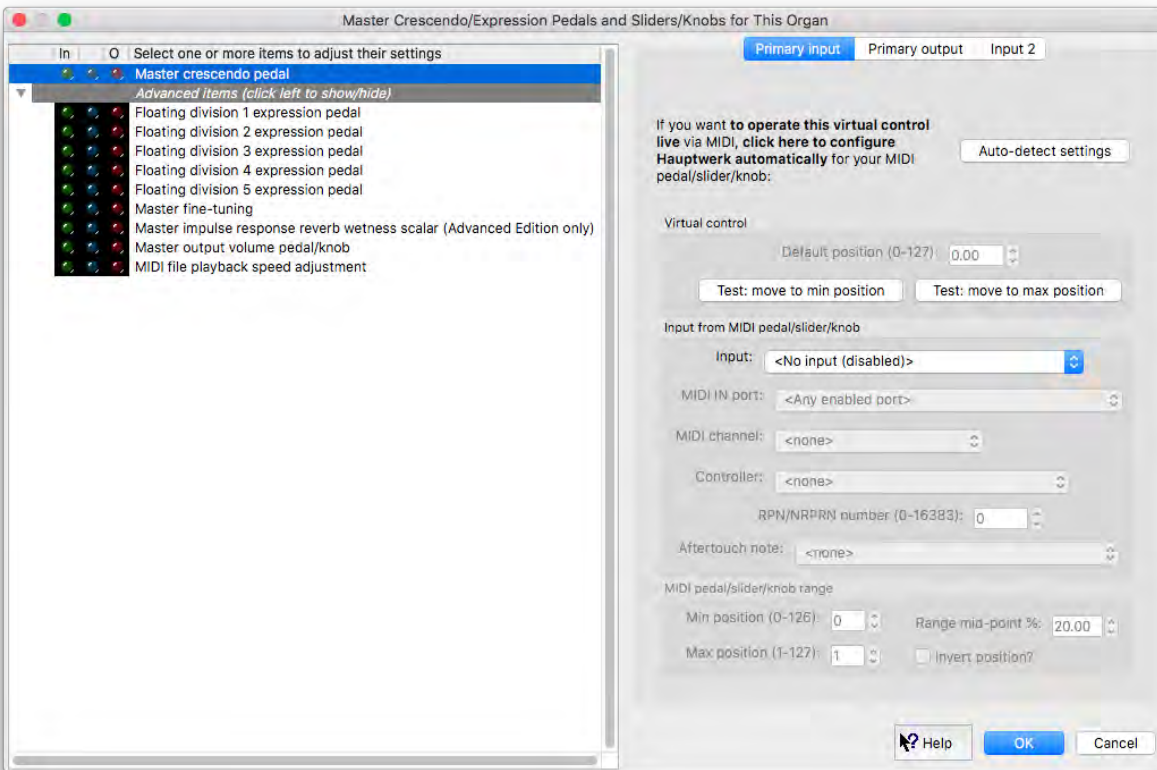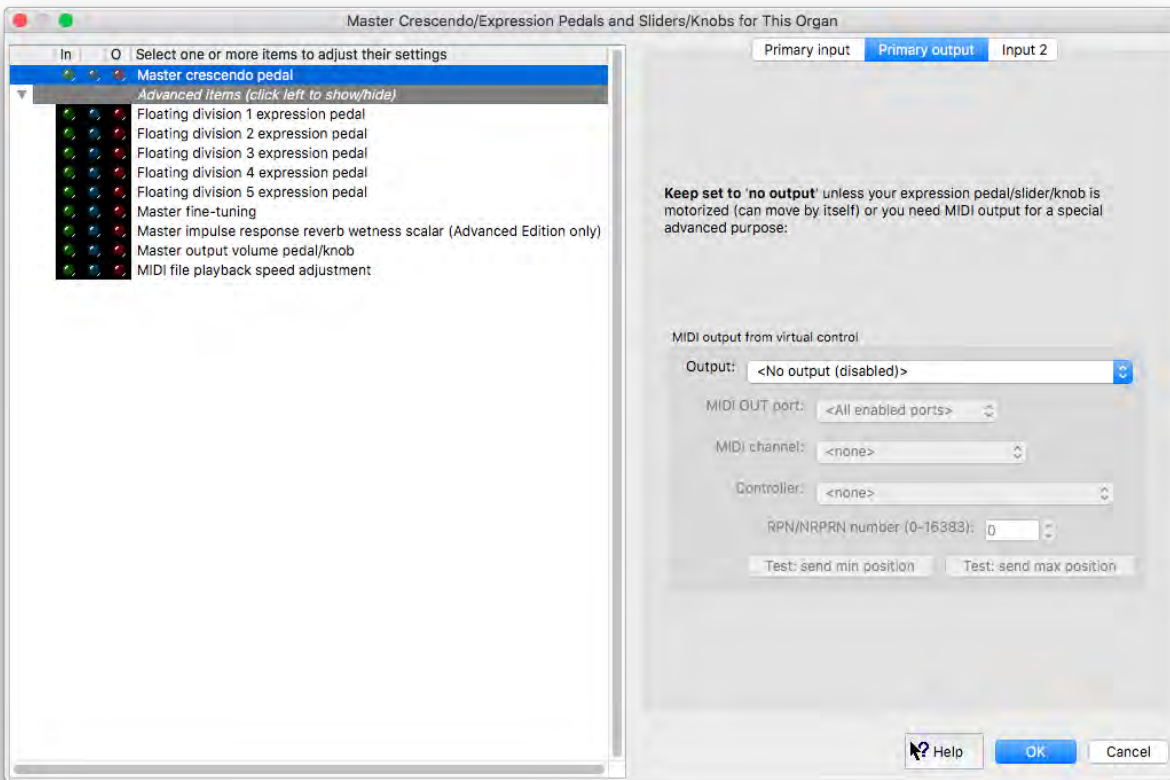
MIDI/key triggers for master pistons and menu functions (for this organ only)

This screen can be used if you want to configure MIDI input to trigger functions which you specifically wish to configure differently for this particular organ. Highlight the desired function in the left-hand pane and use the *Auto-detect settings* button to configure it to be triggered from a MIDI piston or computer key.

The buttons on control panels and Touch Menu duplicate nearly of the available menu functions, so you could alternatively auto-detect them by right-clicking on the corresponding control panel or Touch Menu buttons (without needing to use this screen at all).

If you instead prefer to trigger the relevant functions from the same MIDI pistons/keys for all (or most) organs, then instead configure them via the *General settings | MID/key triggers for master pistons and menu functions (for all organs, unless overridden)* screen, or via the corresponding right-click option on their control panel buttons.

> ***Background information, for advanced users:*** For any given organ, if you have auto-detected/assigned any given MIDI control (MIDI piston, MIDI draw-knob/tab/button, etc.) or computer key to trigger both one or more global ('for all organs') menu/master functions, and also one or more organ-level ('for this organ') menu/master functions (and/or the organ's native controls, such as virtual stops), then only the organ-level assignment(s) will be triggered when the MIDI/key event is received [with the global assignment(s) being ignored for that MIDI/key event]. This allows any organ-level MIDI/key assignments to override global assignments, for example allowing you to assign a given MIDI piston to trigger an organ's native divisional piston if present for the organ, but to revert to using a globally-configured Hauptwerk master scoped combination if not.

> Note 1: the preceding paragraph assumes that the *Organ MIDI assignments override global?* general preference remains ticked, as it is by default. To avoid confusion, we recommend always leaving that preference ticked so as to avoid the situation where both a global-level and an organ-level assignment might both be configured for some organs, and thus unintentionally be triggered simultaneously.

> Note 2: if you wish to clear all MIDI assignments to menu/master functions, you can do that via the *Reset MIDI/key triggers for … master pistons/menu functions …* option on the *General settings | General configuration wizard* (for all global assignments) and/or *Organ settings | Organ configuration wizard* (for all overridden 'for this organ' assignments)

The settings in the right-hand pane of this screen are used in the same way as those of the *Organ settings | Stop/coupler/tremulant switches and pistons/buttons* screen.

MIDI LCD panel control (for this organ only)

Hauptwerk can control 32-character LCD display panels to display Hauptwerk's status on a MIDI console. Custom MIDI system-exclusive messages are sent to control the panels, requiring Hauptwerk-compatible MIDI LCD units, which are available from third-parties.

Use this screen to specify information that you want Hauptwerk to display on any LCD panels <u>which you specifically want to configure differently for this particular organ</u>, inserting an entry for each.
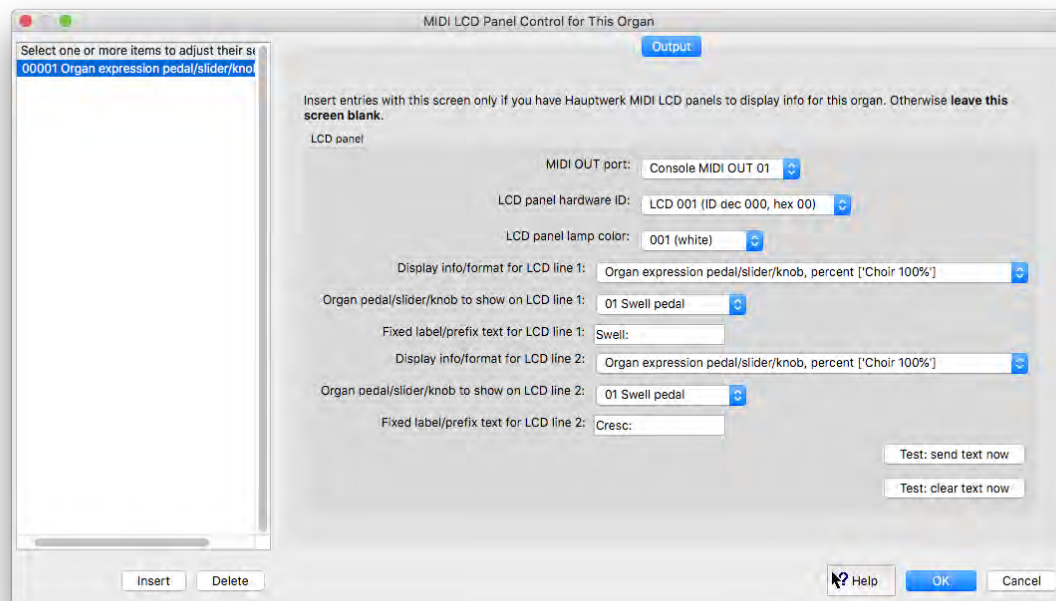
Important note: you can alternatively configure LCD panels for all organs via the '*General settings | MIDI LCD panel control (for all organs)*' screen, which many people may prefer. It's important that you configure any given physical MIDI LCD panel <u>either</u> globally ('for all organs') <u>or</u> per-organ ('for this organ'), <u>but not both</u>; a MIDI LCD panel configured per-organ will not automatically override any globally-configured MIDI LCD panels. Hence you need to decide whether any given physical MIDI LCD panel will always be configured globally or per-organ before configuring it (otherwise they will conflict, giving undefined/unexpected behavior); global assignments cannot be changed/ignored for some organs and not others.

You can choose which items of information you want to display on each of the two lines on each LCD panel:

For example, the 'Organ expression ...' line formats allow you to display the positions of the virtual organ's native expression/crescendo pedals on LCD panels, giving them user-defined prefix text:

The 'Open Diapason 8' (fixed, user-defined label text) can be used to label MIDI stops or pistons, for example.

The **MIDI implementation** section of this guide covers the LCD message formats used by Hauptwerk.

Advanced MIDI applications: Floating division MIDI keyboards (for this organ only)

Please see *Registration menu: floating divisions* section of this guide for explanations of Hauptwerk's floating divisions and how they're used. These settings are identical to those of the *Organ settings | Keyboards* screen (but apply to floating division MIDI keyboards, rather than the organ's native virtual keyboards directly).
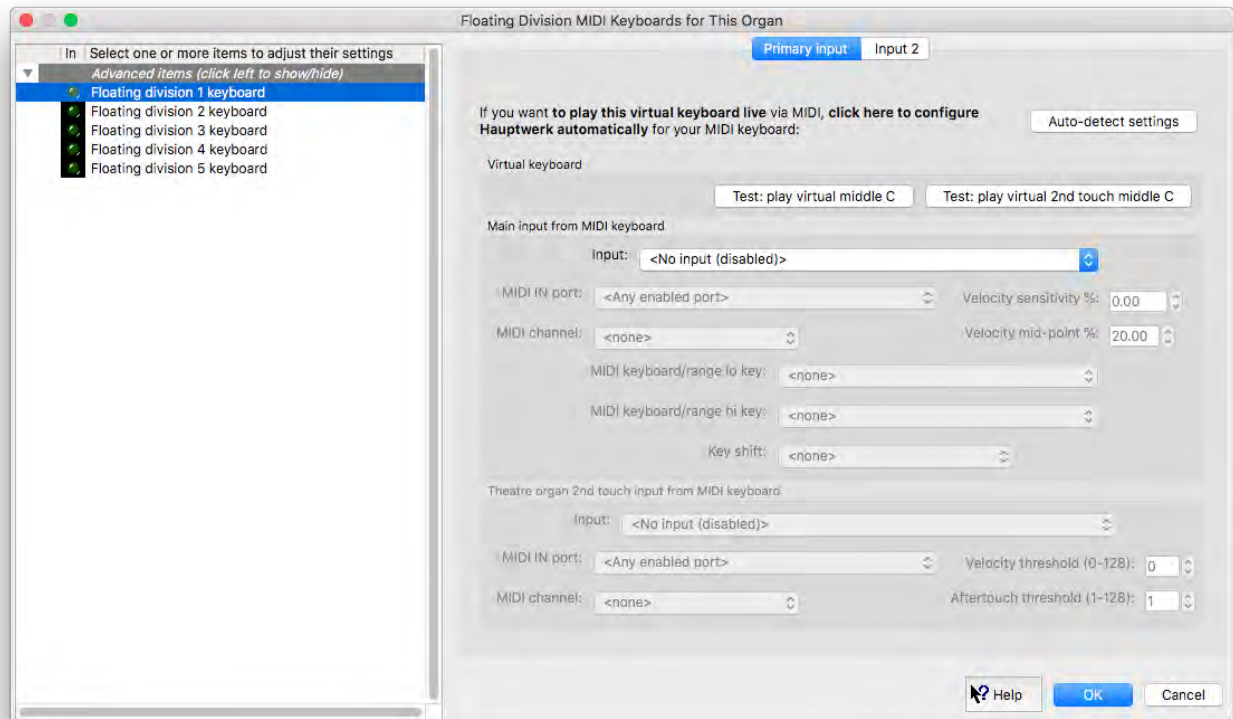
Advanced MIDI applications: Direct MIDI input/output for ranks/pipes

This screen's input tab allows you to use Hauptwerk as a 'box of ranks', controlling Hauptwerk's ranks/pipes directly from an external hardware organ relay with MIDI note-on/off messages, bypassing Hauptwerk's native relay and combination system. The output tab allows you to use Hauptwerk's native relay and combination system to control real external pipework or an external MIDI voice expanders, so that they play directly in response to Hauptwerk's individual virtual ranks:
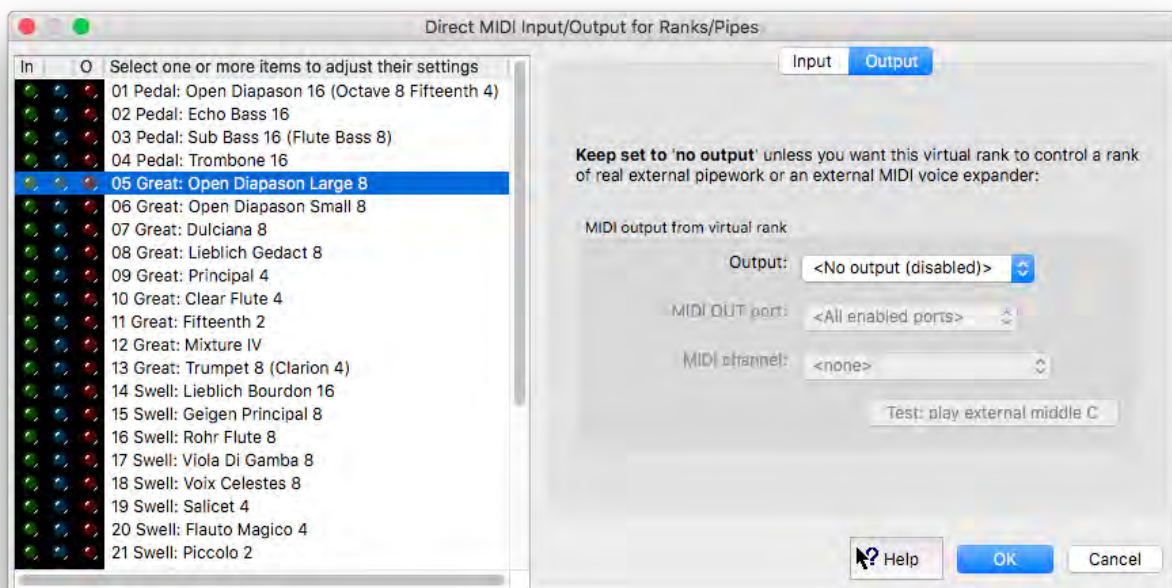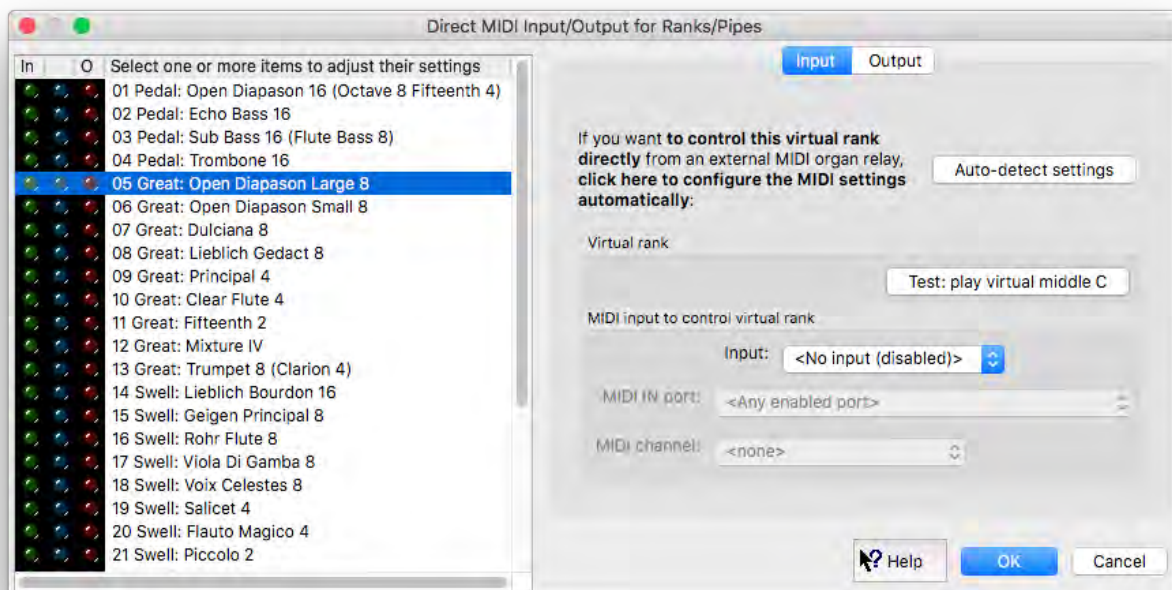
Note that using Hauptwerk in these ways (with external hardware relays or external voices) is fairly uncommon; most people instead use Hauptwerk's built-in relay and pipework.

Advanced MIDI applications: Direct MIDI output from divisions

This screen provides another method for controlling real external pipework or external voice expanders. Use this screen only if you have such hardware and need MIDI note-on/off output at the division (post-coupling, but pre stop-action), rather than rank, level:
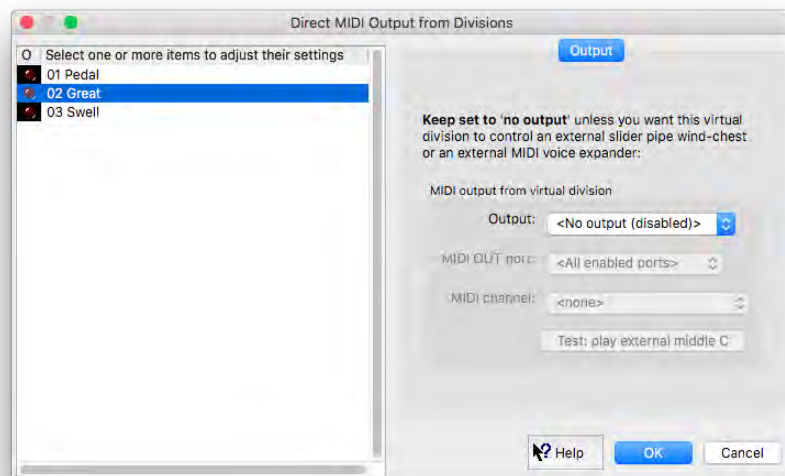
Advanced MIDI applications: Custom MIDI configuration messages to send

Some external MIDI devices/consoles need specific MIDI messages to configure them appropriately for use with Hauptwerk. For example, a MIDI sys-ex message might be needed to turn off the internal voice generators in a digital organ. You can specify such messages by giving the exact sequence of bytes using this screen. Click *Insert* to add as many as you need. Note: multiple messages might be sent in any order:
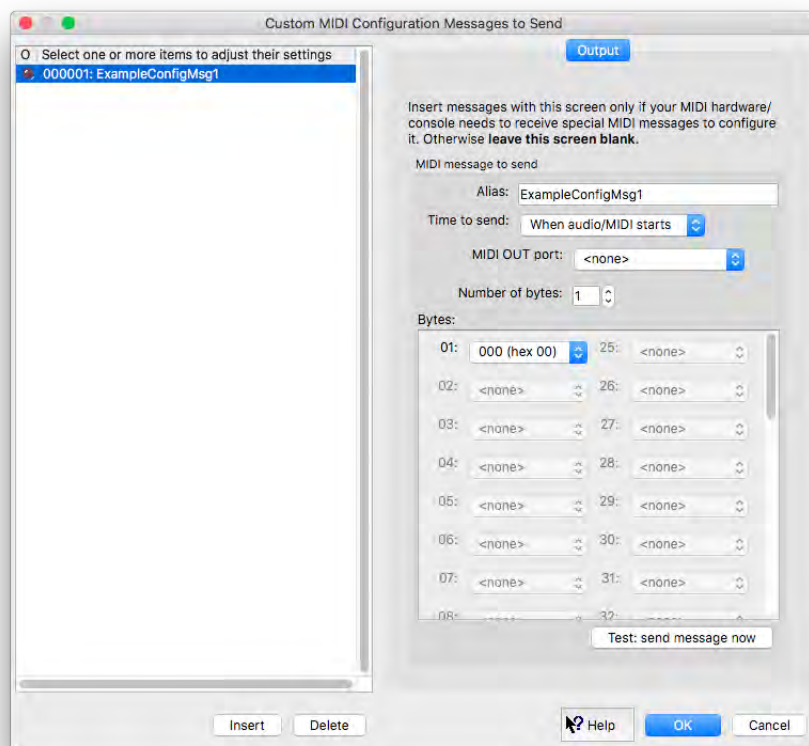
Note that this is an uncommon use of Hauptwerk; most people don't need to use this screen.

Rank voicing and surround/3D/perspective panning (Advanced Edition only)

The screen is used to adjust the sound ('voicing') of the individual virtual pipes or ranks, and also for positioning (panning) them virtually for surround/3D sound audio output, as covered in the *Voicing facilities* and the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* sections of the guide.

Rank routing to audio mixer buses/groups (Advanced Edition only)

The screen is also used to configure audio routing, such as surround/3D sound, or multi-channel audio. See the *Audio routing and impulse response reverb part 2 (Advanced Edition only): multi-channel audio, multi-channel virtual acoustics, and routing concepts for advanced use* section of the guide for more details.

Tremulant rate voicing adjustment (Advanced Edition only)

The screen is also used to adjust the rates of any virtual modeled tremulants that the organ might include, as covered in the *Voicing facilities* section of the guide.

Getting help with settings screens

Click on the pointer/question-mark Help icon immediately to the left of a screen's *OK* button:
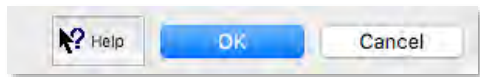
... then click onto the screen background or a specific setting for a detailed explanation of its function.

Design tools menu

The *Design tools* menu has functions to assist with creating sample sets, organ definitions, temperaments, or impulse response reverbs for Hauptwerk:
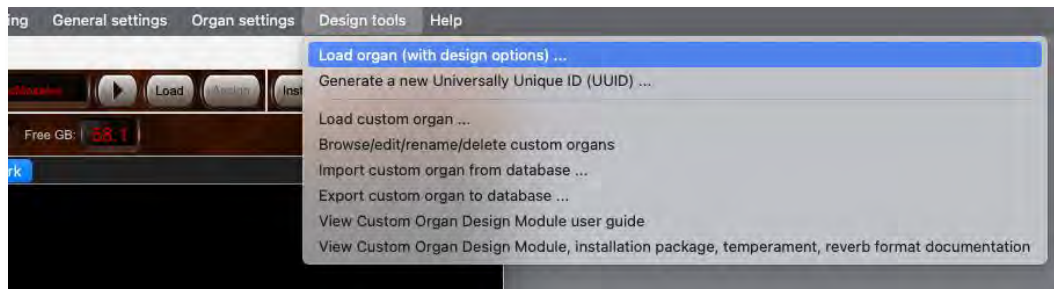
It also contains the *Design tools | Load custom organ* function, which forms the core of the Custom Organ Design Module. Using this option, you can create your own organs fairly quickly and easily (if you have a reasonable level of computer technical experience), utilizing existing ranks of samples in Hauptwerk version 2 format and above, by creating a custom organ definition file in a text or XML editor (or by exporting/importing to/from a SQLite database using the *Export/Import custom organ to/from database* functions, then editing the exported data within the SQLite database with a third-party SQLite editor). The *Design tools | Load custom organ* menu option (or *Import custom organ from database*) loads such a custom organ definition file, compiles it into a standard Hauptwerk organ definition file, and then loads it as normal.

The *Custom Organ Design Module User Guide* is a separate manual, available on *Design tools* menu, which covers the module and its use in depth. Please consult that manual if you are interested in using the module.

The *Design tools | View Custom Organ Design Module, installation package, temperament, and reverb format documentation* function also has detailed format documentation for those wishing to create and/or distribute publicly, Custom Organ Design Module organs, and/or temperaments, and/or impulse response reverbs for Hauptwerk.

The *General settings | General preferences* screen also has a tab called *Design tools*:

By default, whenever Hauptwerk saves an XML file it automatically does so in a special compacted format. Doing so makes an XML file much smaller and allows it to load much faster. However, if you're a sample set developer and want to edit the XML files using a text or XML editor then tick the *Disable auto-compacting ...* options so that the files are saved in a readable format. Leave the options un-ticked in all other cases, since ticking them can make loading organs, combination sets and settings much slower.

Note also that the *Design tools | Load organ (with design options)* menu option has various important utility functions for developing sample sets.
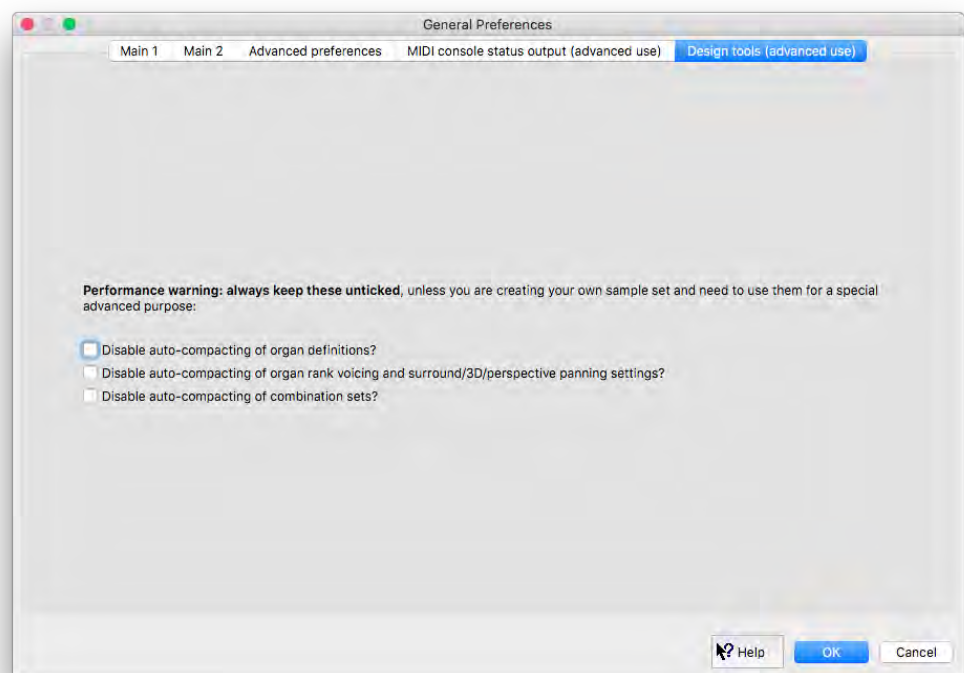
Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use

We recommend reading this chapter in its entirety, and in order, if you plan to use more than just a single stereo audio output from Hauptwerk, and/or if you plan to use impulse response reverb within Hauptwerk.

Introduction and some terminology

Firstly, in order to use more than just a single stereo audio output from Hauptwerk you need an audio interface/driver that provides at least the appropriate number of audio output channels. (It isn't possible to use several different audio interfaces or drivers simultaneously directly within Hauptwerk, which is a necessary limitation in order to ensure proper audio synchronization without adding additional latency. However, some special drivers exist that allow multiple different audio devices to be aggregated together within a single driver, provided that they are properly synchronized. macOS 'aggregate devices' are one such example.)

The Hauptwerk Advanced Edition gives you extensive control over how each virtual rank is routed to audio output channels on your audio interface, and it allows you to apply impulse response (convolution) reverb, with control over how virtual ranks are routed to any such reverb processing, and any how such processing is routed to audio output channels on your audio interface.

For example, you might wish to:

1. ***Position virtual pipework virtually between a 'front' stereo pair of speakers and a 'rear' stereo pair of speakers for 'surround sound', or between four pairs of speakers (main-front, upper-front, main-rear, upper-rear) for '3D sound'***. Some sample sets include recordings of each real rank from several different 'perspectives' (microphone positions within the real original building), specifically for the purpose of routing the various different 'perspectives' separately to corresponding stereo pairs of speakers. Such sample sets are termed 'surround' sample sets, and their various perspectives are usually provided as separate virtual ranks (for example with both a 'front stereo' and 'rear stereo' virtual rank for each real rank). You might also wish to blend those different perspectives in different proportions when routing them to your surround/3D speakers. Sample sets that aren't 'surround' are usually simply termed 'stereo', but you might want to position them virtually amongst your surround/3D speaker pairs too, by sending them in different proportions to the various stereo pairs of your surround/3D speaker system. Any of ***these types of uses are termed 'surround/3D sound audio output'***.

2. ***Route virtual pipework differently, and/or apply impulse response reverb differently, for different organs, or different types of sample set***. For example, you might want to configure your speakers one way and/or apply impulse response reverb, when using 'dry'/'semi-dry' sample sets (those recorded with little or none of their real original buildings' reverb within their samples), but configure your speakers a different way and without applying impulse response reverb when using 'wet surround sample sets' or 'wet stereo sample sets' (those recorded with their real original buildings' reverb within their samples).

3. ***Route any given organ's virtual pipework differently, and/or apply impulse response reverb to it differently, and/or voice it differently for several different situations***. You might, for example, sometimes want to use a particular sample set on headphones, with it routed and voiced appropriately for that, and at other times you might want to use it with a surround/3D speaker set-up, with it routed and voicing differently for that, and to be able to switch quickly back and forth between the two.

4. ***Mix the audio that's being sent to your various speakers (e.g. surround/3D speakers) down to mixed stereo signals***, for example to ***feed a sub-woofer***, and/or ***headphones***, and/or to ***record*** the mixed audio in stereo, and/or to feed an additional pair of speakers to which you're adding ***additional reverb*** (an 'aux reverb mix').

5. ***Distribute virtual pipework around automatically or manually amongst many/several pairs of speakers*** (or speakers individually), so that the virtual pipework is distributed around within your listening room, interacting with the natural acoustics/reverb of your listening room for a realistic spatial effect, as real organ pipework would in a reverberant space. This is especially effective for 'dry' or 'semi-dry' sample sets, and within larger/reverberant listening rooms. ***This type of use is termed 'multi-channel audio output'***.

6. ***Distribute the virtual pipework around automatically or manually amongst a set of several different impulse response reverbs so as to create a 'multi-channel virtual acoustic'***. (You can do that even if you're just using a single stereo pair or speakers or headphones for audio output from Hauptwerk.) This works best if the various impulse response reverbs were specifically created to reproduce various different source positions virtually within a single acoustic space. This is essentially a special case of multi-channel audio output (and works best for 'dry'/'semi-dry' sample sets), except that instead the additional different impulse response reverbs fulfill the roles of the additional physical speakers.

All of things are possible in Hauptwerk, and Hauptwerk's default audio routing settings are designed to make the most common configurations of each type especially quick and easy to set up.

This chapter covers cases 1-4 above, which take only a few clicks to configure, whereas cases 5 and 6 (multi-channel audio) are considered more advanced use, and are covered in detail (along with the full additional details of how Hauptwerk's audio routing works internally) in the next chapter (which also covers case 4 in more depth).

About impulse response (convolution) reverb in Hauptwerk

The Hauptwerk Advanced Edition has a native, very high-performance impulse response convolution reverb engine built in, allowing high-quality real-time reverb to be added easily and natively, with no additional hardware or software needed. In itself, Hauptwerk's reverb engine adds no additional latency (sound delay). It's a 'true stereo' (four-channel) convolution reverb engine, and is designed to be able to handle large numbers of simultaneous instances with low CPU load (especially with modern multi-core CPUs), thus even allowing realistic 'multi-

channel virtual acoustics' optionally to be configured, with many virtual sound sources to distribute pipes/ranks within virtual space. (Multi-channel virtual acoustics are covered in the next chapter.)

A selection of high-quality impulse response reverbs is included (pre-installed) with Hauptwerk, and additional impulse response reverbs can be installed using *File | Install …* from the menu within Hauptwerk (as covered in the *Installing/uninstalling/upgrading organs, temperaments, or reverbs (the component installer* section):
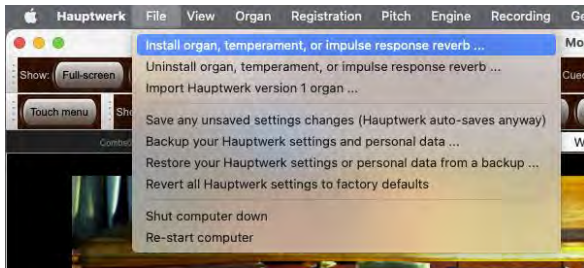
They need to be in Hauptwerk format, and plenty of reverbs are available from sample set developers. (Sample set/reverb developers: please use the *Design tools | View ... reverb format documentation* menu function in Hauptwerk for details of the necessary format.)

Once installed, you can apply any reverb to any of the buses on the *General settings | Audio mixer* **screen**, which we'll cover in the next sub-section. For example, for basic use, you could just apply a single reverb to Hauptwerk's overall stereo output via an appropriate 'master mix bus':
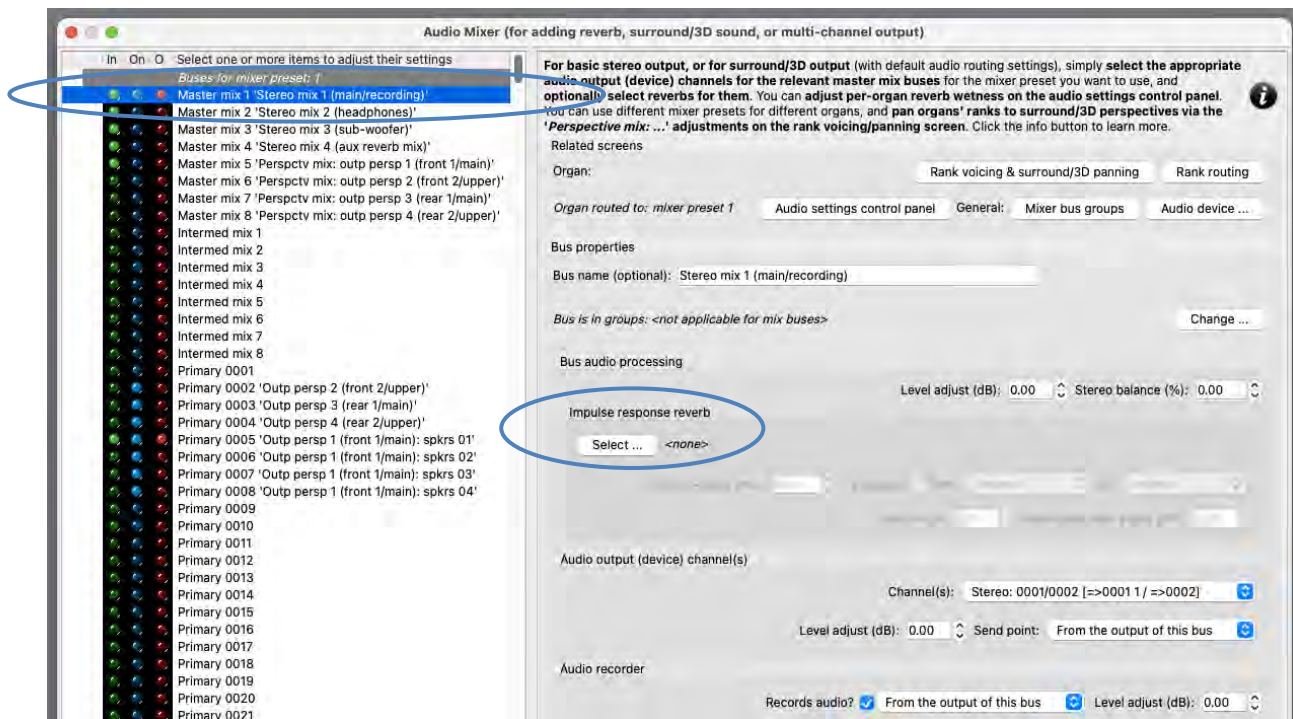
Routing overview and key concepts for basic use

The following sections assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you can reset them back to their defaults using *General settings | General configuration wizard* and *Organ settings | Organ configuration wizard* respectively.

In order to illustrate Hauptwerk's audio settings and their concepts, start by loading the St. Anne's organ (since that's included with Hauptwerk) and then open both of the following screens and position them so that they don't overlap (if you have sufficient space):

1. *Organ settings | Rank voicing and surround/3D/perspective panning*.

2. *General settings | Audio mixer*.

Both screens can be open and used at the same time, so that you can immediately see how any settings changes made on the voicing/panning screen affect the audio mixer screen. Settings changes you make on them will take effect immediately, in real-time. The mixer screen shows real-time visual feedback via the virtual audio activity LEDs down its left-hand side. There is a convenience button on the mixer

screen to open the voicing/panning screen and, as always, the on-screen help on the mixer screen provides detailed information and usage hints. (There is also a control panel [*View* | *Large floating control panels … | Audio mixer, routing and voicing/panning settings*] that has convenience buttons to open the two screens, as does the *Settings | Audio mixer, routing and voicing/panning settings* sub-tab on the Touch Menu.)

(For the cases covered in this chapter, and with default audio routing settings), these are the two screens that control how audio is routed within Hauptwerk (in addition to the *General settings | Audio device and channels* screen, on which you would have selected the audio device/driver that Hauptwerk will use).

Conceptually, a pipe/rank's audio flows through both of the two screens in the order above, i.e.:

Rank voicing and surround/3D/perspective panning screen -> Audio mixer screen

(… and then to the *General settings | Audio device …* screen.)

There are 128 independent and complete sets of settings termed 'mixer presets' for the audio mixer screen, which can be found and configured via the nodes its left-hand browse list. To navigate between mixer presets, click on the nodes to show/hide (expand/collapse) their contents:
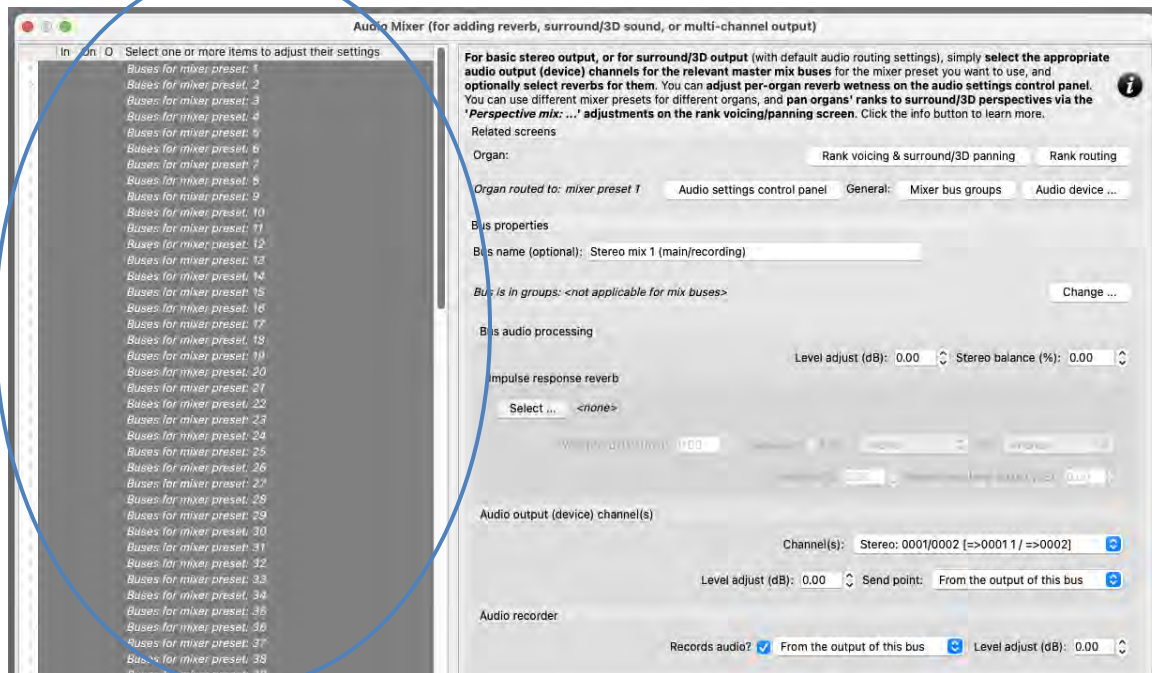
You can (re)name any mixer preset by right-clicking on its node and selecting *Rename this preset*:
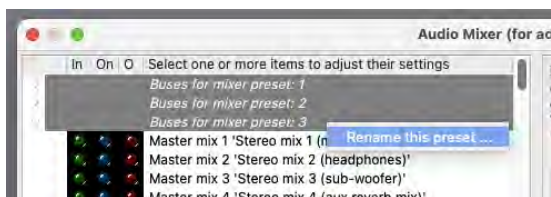
… then typing a name for it (up to 16 characters in length):
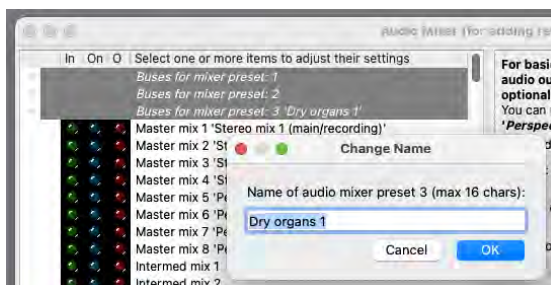
You can select which of the 128 mixer presets should apply to each individual organ via the *Audio Mixer, Routing and Voicing/Panning Settings* **large control panel** (which can be opened via *View | Large … control panels (for this organ) | Audio … settings* from the main menu, or via the *Audio routing/voicing* convenience button on the *Show/hide large control panels 1* mini control panel):

This allows you to apply different audio routings and impulse response reverbs to different organs. For example, you could set up one preset for wet stereo organs, another for wet surround organs, and another for dry organs (for adding impulse response reverb).

On the mixer screen you simply need to select the appropriate audio output (device) channels for the relevant 'master mix buses' for the mixer preset you want to use in the left-hand browse list:
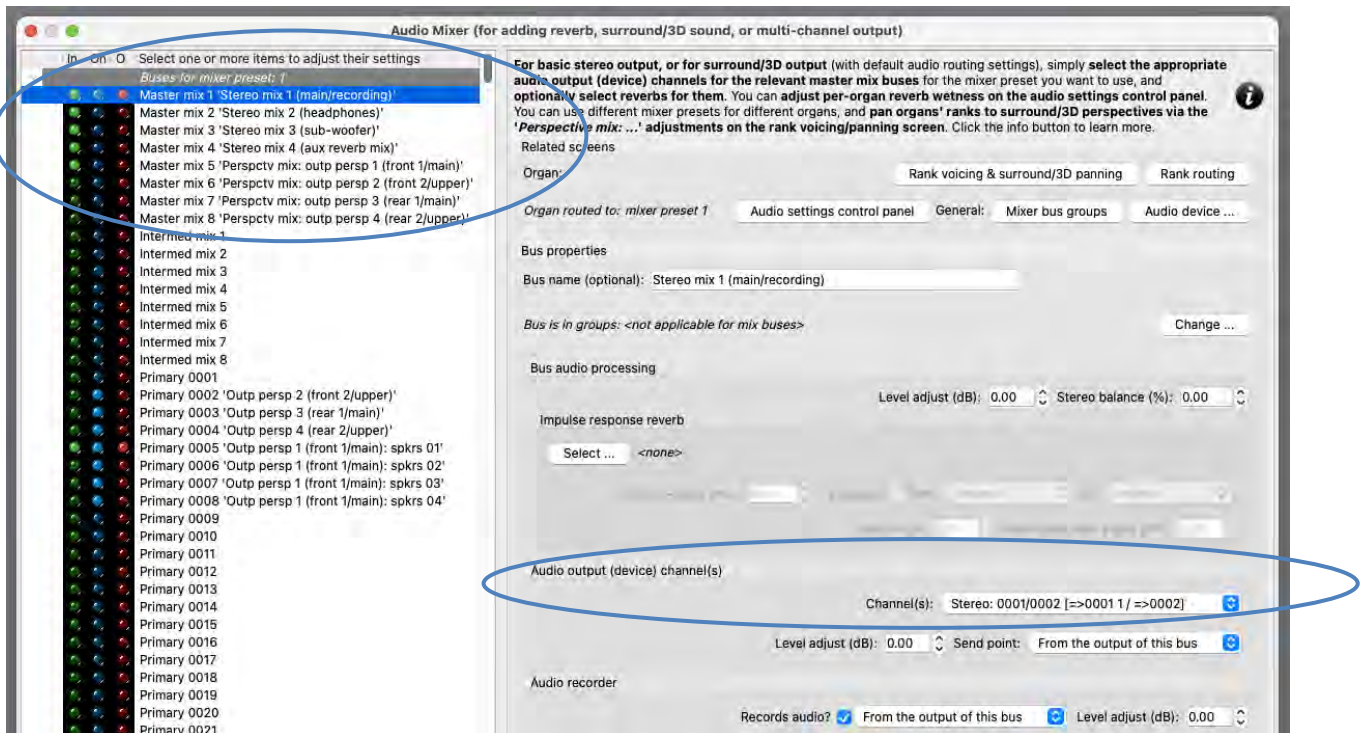
… **and optionally select reverbs for them** (using the '*Impulse response reverb: Select …*' button). You can also optionally adjust the other reverb settings on the screen (wet/dry mix, wet level, pre-delay, fade-in/out) to tweak the reverb.
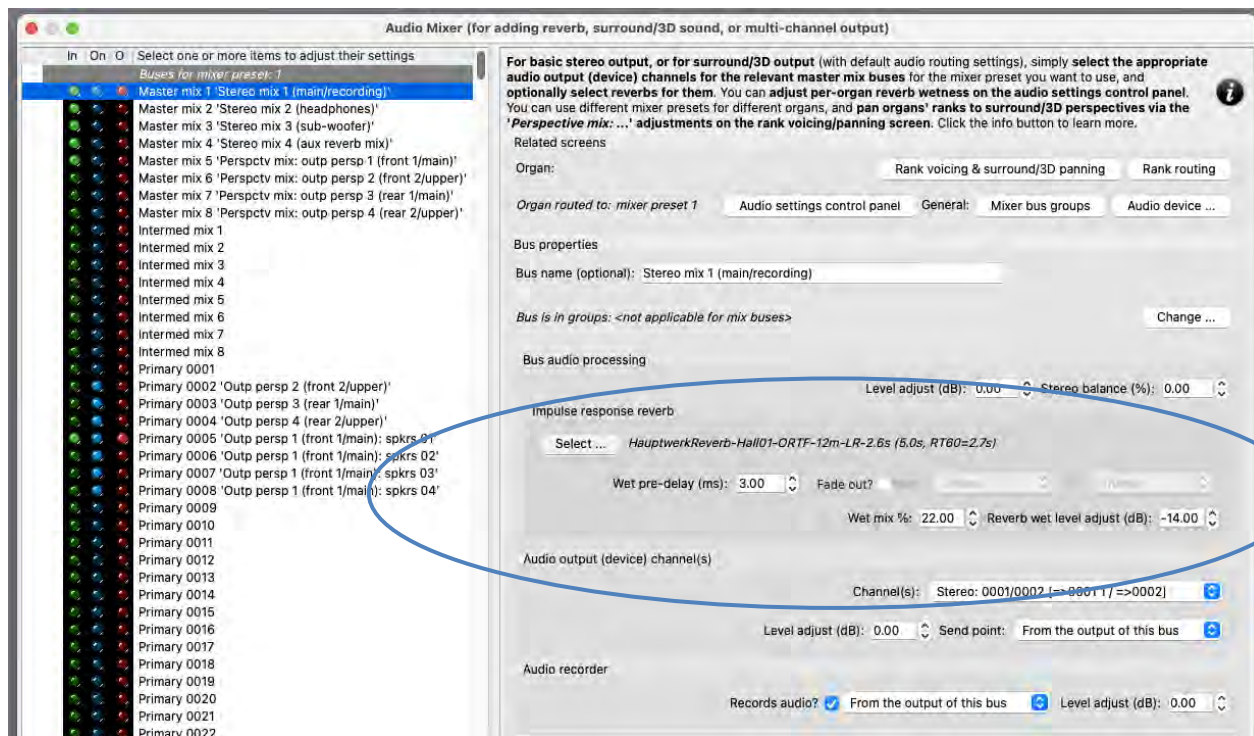
For example, if you want to feed an audio mix to a sub-woofer, then for the '*Master mix 3 … (sub-woofer)*' bus (entry in the left-hand browse list) select the desired channel(s) on your audio interface using the '*Audio output (device) channel(s): Channel(s)*' setting in the right-hand pane. **For 2D surround sound, you would select device channels for master mix buses 5 (*front 1/main*) and 7 (*rear 1/main*) and clear the device channel setting for master mix bus 1** (the default stereo output)**, and for 3D surround you would also select device channels for master mix buses 6 (*front 2/upper*) and 8 (*rear 2/upper*)**.

You can also **adjust** (scale) **the 'wetness' of any impulse response reverbs you might have applied on the mixer** overall, on a **per-organ basis**, via the *Audio Mixer, Routing and Voicing/Panning Settings* large control panel:

This provides a very simple and quick means to **tweak reverb wetness, and/or disable reverb, on a per-organ basis**. If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them). (As above, 'Mixer presets' can also be used to set up different reverbs for different organs.)

For surround/3D output, you then use the voicing/panning screen's '*Perspective mix: source persp to output persp 1/2/3/4 …*' adjustments to 'pan' (route/mix) **ranks/pipes amongst the desired surround/3D speaker pairs**:
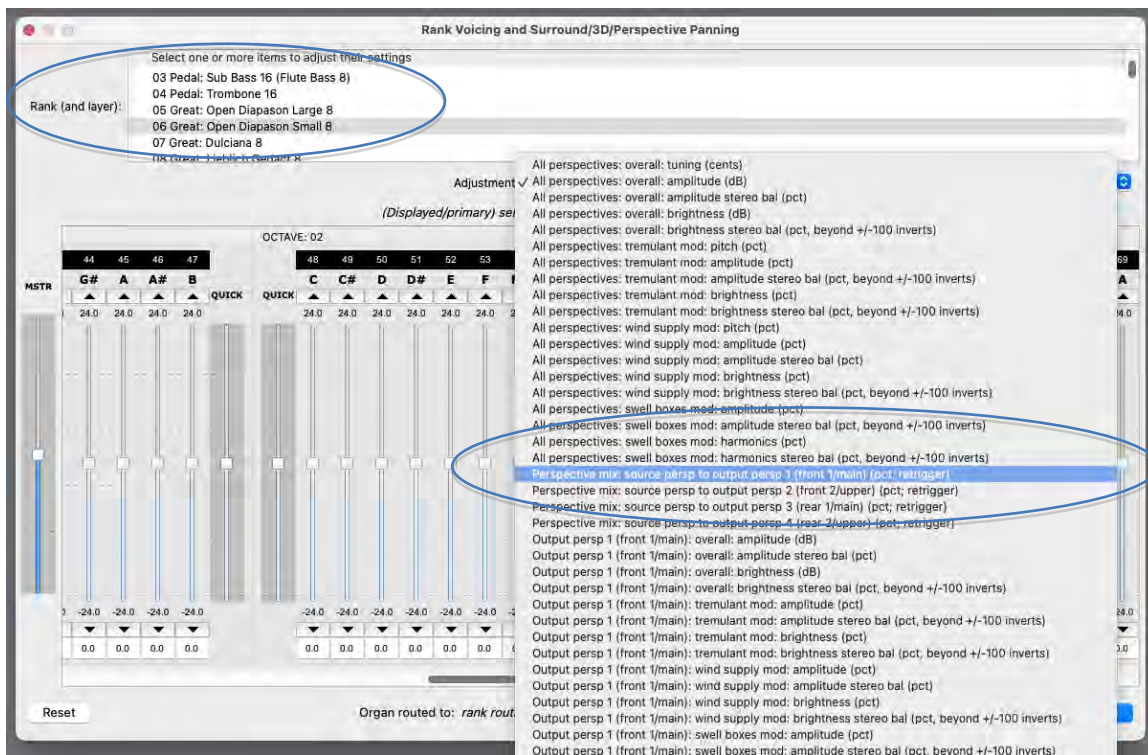
The audio from those surround/3D 'perspectives' feeds into the corresponding '*Perspctv mix: …*' master mix buses on the audio mixer screen:

For example, **to route one or more virtual ranks** entirely **to a 'rear' surround pair of speakers**, all that you would need to do is to **select the rank(s) on the voicing/panning screen (you can select multiple ranks at once, to change their routing simultaneously)**, then:

1. **Select the '*Perspective mix: source persp to output persp 1 (front 1/main)*' adjustment,** then **use the 'MSTR' slider** to **set all of the** adjustment's pipe **sliders to 0%** (rather than the adjustment's default of 100%, since all ranks are routed entirely to the 'front' by default), and:
2. **Select the '*Perspective mix: source persp to output persp 3 (rear 1/main)*' adjustment,** then **use the 'MSTR' slider** to **set all of the** adjustment's **pipe sliders to 100%** (rather than the adjustment's default of 0%).

The values don't have to be fully 100% or 0%; in-between values can be used to position ranks/pipes virtually 'between' the relevant speakers. You could optionally then also voice each rank/pipe separately for the perspectives (surround/3D speakers), via the corresponding '*Output persp 1/2/34 …*' adjustments, perhaps making the pipe brighter in the front speakers than in the rear (for example).

Also, the '*Output persp 1/2/3/4 …: release tail truncation length (msec, 0=no truncation; retrigger)*' voicing adjustments allow real-time, per-output-perspective, release tail truncation, which can help to make a wet sample set seems a little 'drier' than it would normally:

(Note that you need to retrigger any held notes to hear changes, and that real-time release truncation doesn't save any memory.) Using them you could, for example, shorten the release tails for the pipe for a front pair of surround speakers (using '*Output persp 1 (front 1/main): release tail truncation length …*') but leave the release tails un-shortened for a rear pair of surround speakers (using '*Output persp 3 (rear 1/main): release tail truncation length …*'). It could then sound simultaneously through both front and rear speakers with different lengths of release tails, making it seem 'drier' from the front than from the rear.

Note also that instead of right-clicking on its node on the mixer screen, you can also (re)name the currently-select mixer preset by right-clicking on the *Audio Mixer, Routing and Voicing/Panning Settings* large control panel:
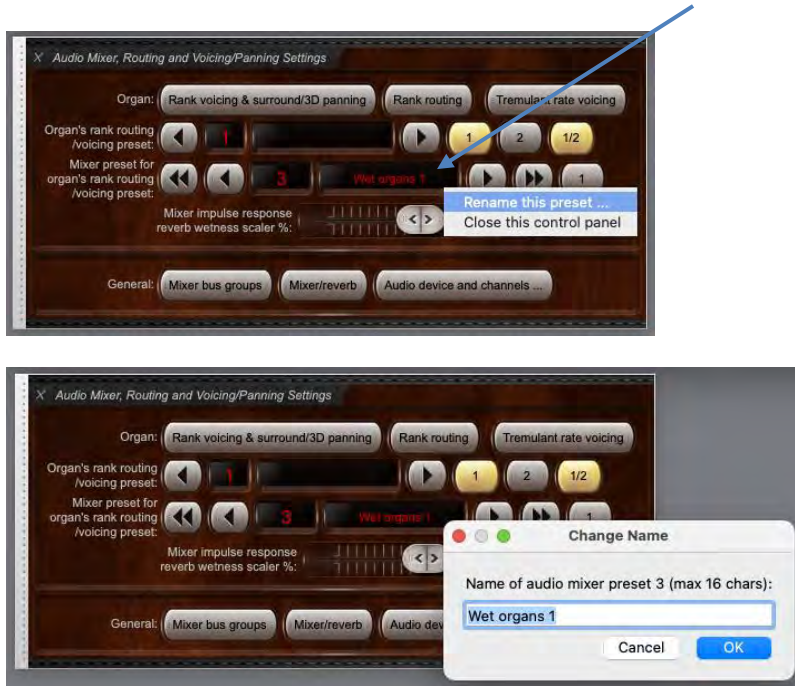
Rank routing/voicing presets

In addition to the 128 audio '*mixer presets*' (which aren't themselves organ-specific), Hauptwerk has 4 per-organ '*rank routing/voicing presets*'. Each one defines:

- Which of the 128 mixer presets of it should route to.

- A complete set of rank voicing, as defined by the *Organ settings | Rank voicing and surround/3D panning* screen, with expandable nodes in its rank list for the four rank routing/voicing presets.

- [Also: a complete set of rank routing, as defined by the *Organ settings | Rank routing to audio mixer buses/groups* screen, with expandable nodes in its left-hand rank list for the four rank routing/voicing presets, which will be covered in the next chapter on advanced routing.]

For example, for any given organ you could configure one rank routing/voicing preset optimally for listening to the organ on headphones, and another for listening via surround/3D speakers. And/or you might choose to use one for experimenting with different routing and/or voicing without affecting the one(s) you normally use for that organ.

The rank routing/voicing preset that the currently-loaded organ should use is specified via the *Audio Mixer, Routing and Voicing/Panning* Settings large control panel (which also allows the mixer preset to be specified that the currently-selected rank routing/voicing preset should route to). The Touch Menu also has those settings.

For example, let's say that we're using a dry organ, and that our (real) listening room is reverberant. We might sometimes want to listen to the organ on speakers, in which case we probably wouldn't want any additional reverb to be added (because our real listening room's acoustic would be wet enough), but sometimes we might instead want to practice on headphones with added reverb. Let's say that, on the mixer screen, mixer preset 1 has no reverb added but has our speakers selected as audio output device channels, and that we've set up mixer preset 7 with some reverb that would be appropriate for a dry sample set such as this organ, this time with the headphones' audio device channels selected (instead of those for our speakers).

In the following screenshots, when the organ's rank routing/voicing preset number is set to 1 (of 4), mixer preset 1 (of 128) has been selected, whereas when that organ's rank routing/voicing preset number is set to 2, mixer preset 7 has been selected:

Now all we would need to whenever we wanted to switch back and forth between listening on speakers vs. headphones would be to change the organ's current rank routing/voicing preset number, e.g. from a MIDI piston auto-detected to its '1/2' button (which toggles between presets 1 and 2), and the mixer preset would change accordingly too (between 1 and 7):
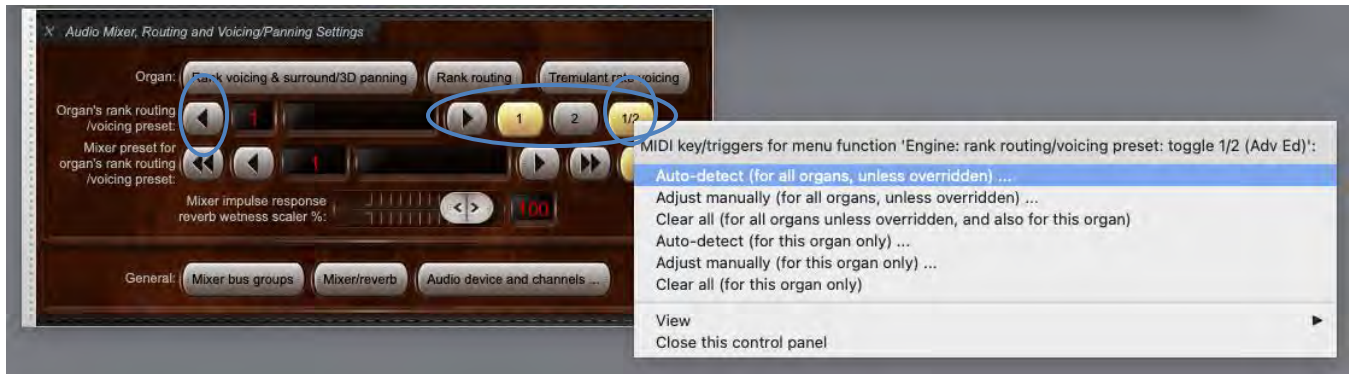
On the *Organ settings | Rank voicing and surround/3D panning* screen, by selecting and adjusting the organ's ranks within the node for rank routing/voicing preset 1, we could optionally voice and/or route the organ's ranks appropriately for our speakers:
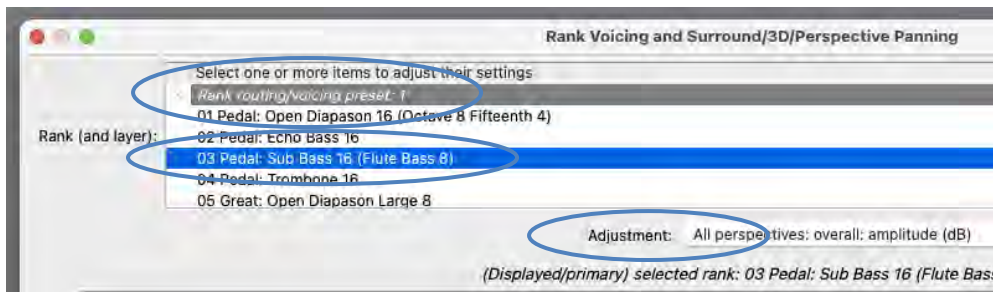
… and then optionally voice or route its ranks differently for our headphones by instead selecting and adjusting the organ's ranks within the node for routing/voicing preset 2:
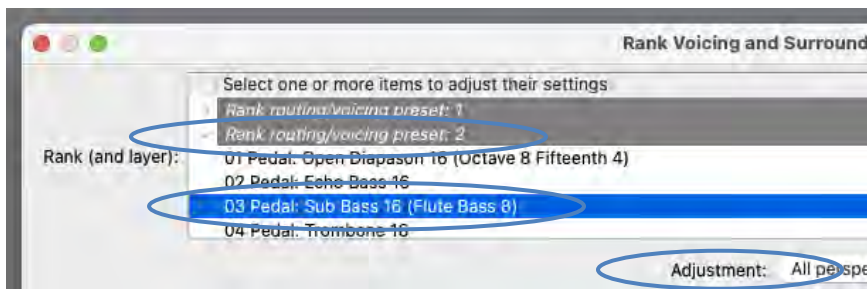
Note that you can (re)name rank routing/voicing presets by right-clicking on their nodes on the *Organ settings | Rank voicing and surround/3D panning* screen:
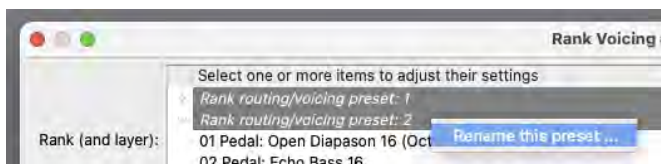
… or rename the currently-selected rank routing/voicing preset by right-clicking on the control panel:
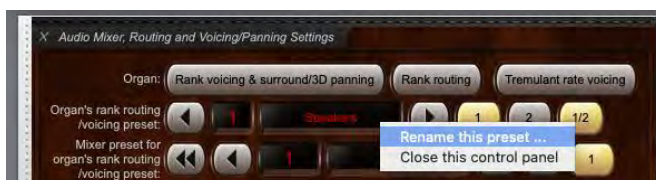
Example 1: basic stereo output, optionally plus a sub-woofer, optionally with the same overall reverbs added for all organs (which can be bypassed, or their wetnesses adjusted, on a per-organ basis)

(The following steps assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard*, and then *Organ settings | Organ configuration wizard* with each applicable organ loaded in turn, respectively.)

Let's say you use a variety of organs (sample sets), including:

- 'Wet' organs (those recorded in real reverberant acoustics), to which you don't want to add impulse response reverb.
- 'Dry' or 'semi-dry' organs (those with little or no reverb recorded in the samples), to which you want to add an overall impulse response reverb, and that you're happy to use the same reverb for each of them, but perhaps varying its 'wetness' (depth of reverb applied) on a per-organ basis.

… and that you want to use a basic stereo audio output in each case, perhaps with an additional mono sub-woofer fed as a mix-down. We can do all of that using just a single mixer preset, so we'll use mixer preset 1 (which is the default), for simplicity. (If you only use wet organs, and/or don't want to add reverb, then simply skip the steps that relate to selecting/adjusting reverb.)

First (if applicable) make sure that you've installed the impulse response reverb you want to use via '*File | Install …*' in Hauptwerk:

Load one of your fully dry (as opposed to semi-dry) organs. Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) make sure that the currently-loaded organ is using (for this example) mixer preset 1:

Now open the *General settings | Audio mixer* screen. Make sure that the '*Mixer buses for mixer preset 1*' node is expanded in the left-hand browse list:

[Example continues on next page.]

Select the following entry (mixer bus) in the left-hand browse list:

- [Within the mixer preset 1 node]: *Master mix 1 'Stereo mix 1 (main/recording)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your main stereo pair of speakers.

Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use (for dry/semi-dry organs), if any, for your main stereo speakers:
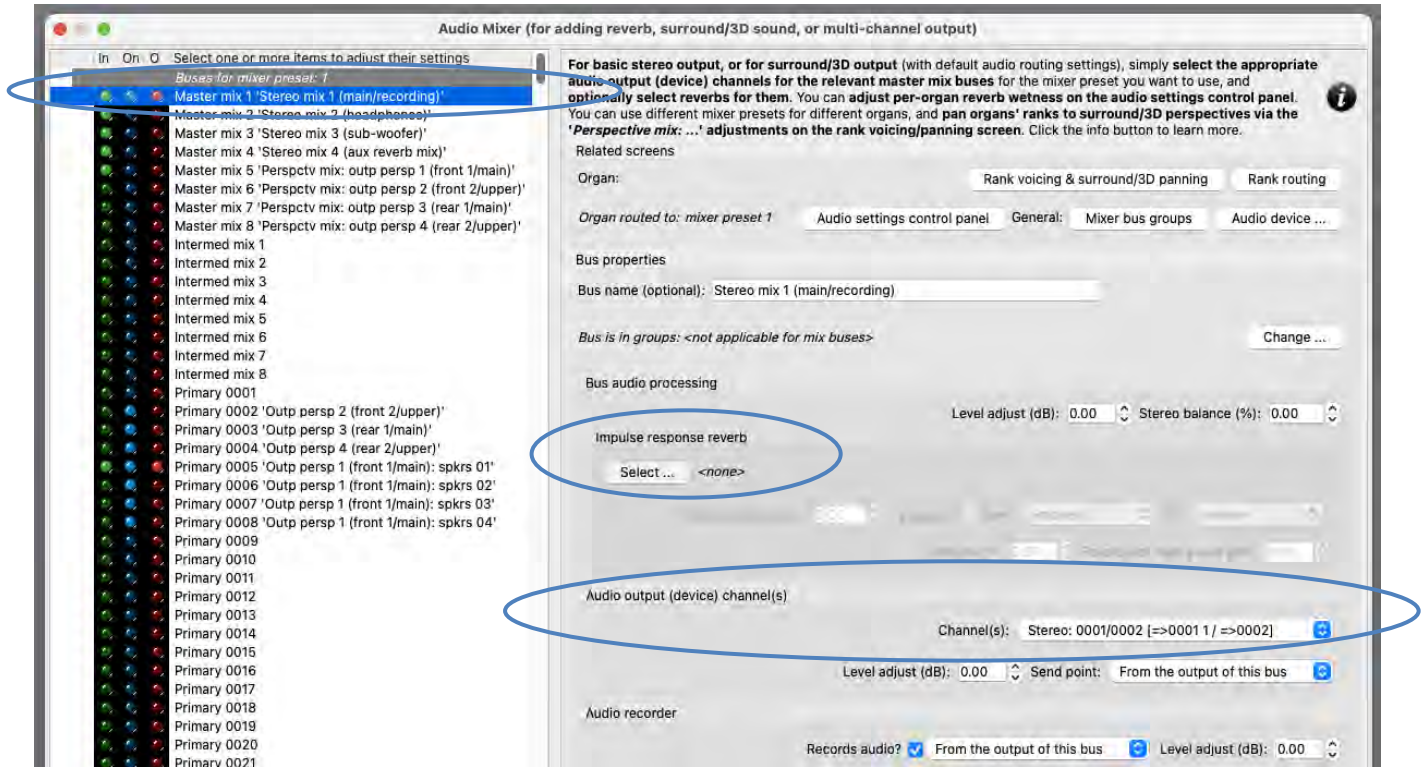
[Example continues on next page.]

If you also want to use a mono sub-woofer (that's connected to a separate audio device channel), then:

Select the following entry in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 3 'Stereo mix 3 (sub-woofer)'*.
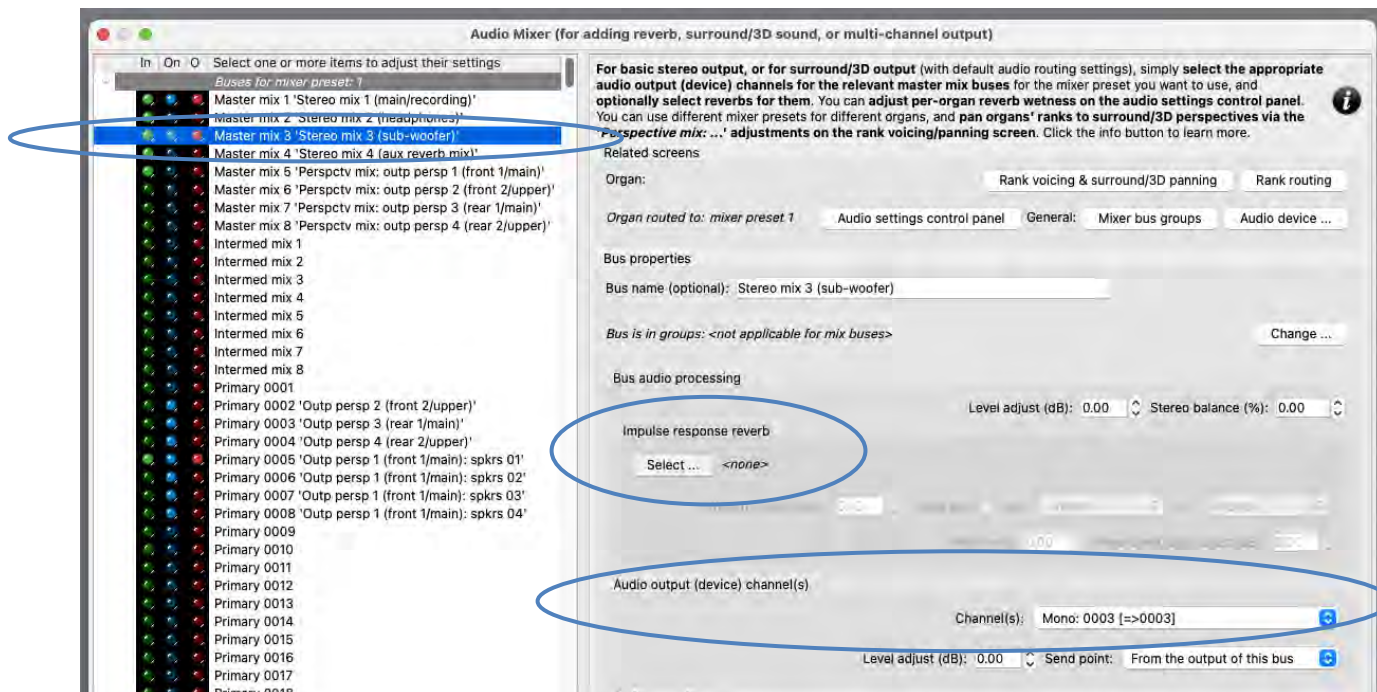
… and in the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the mono audio device channel that you want to use for your sub-woofer. (Mono channels can be found near the end of the drop-down channel list, after the stereo pairs.) Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use (for dry/semi-dry organs), if any, for your sub-woofer. (You can use the same reverb as for the main stereo output if you wish.)

As you play the organ (with some stops drawn, of course), you should now hear that it has the intended reverb for your main stereo pair of speakers (and also the intended reverb for your sub-woofer, if applicable). If you wish, you can fine-tune the reverb settings via the relevant mixer bus(es) on the mixer screen. Bear in mind that any changes you make there will affect all organs (since the audio mixer is on the *General settings* menu, and since we're using the same mixer preset for all organs).

OK the mixer screen.

Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) you can then optionally reduce (scale) the reverb 'wetness' for just this organ, via the '*Mixer impulse response reverb scaler %*' slider:

If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them).

Load any other organs you may have and use the audio settings control panel to tweak their reverb wetnesses (or disable reverb completely), by adjusting the '*Mixer impulse response reverb scaler %*' slider. For example, you might want to set the slider to 0% for wet organs, leave it at 100% for fully dry organs, and set it somewhere in-between for semi-dry organs.

Example 1b: basic stereo output, optionally plus a sub-woofer, with different overall reverbs added for different types/groups of organs

If you want to use different sets of reverbs for different organs (or for different types/groups of organs), you need to use a different one of the available 128 mixer presets for each one of the distinct sets of reverbs that you'll be adding. This is what you need to do:

1. Follow the steps in 'Example 1' above to set up mixer preset 1 using your first set of reverbs (one for the main stereo master mix bus, and optionally one for the sub-woofer master mix bus), but configuring the reverb wetness scalers only for whichever of your organs should use that particular set of reverbs (mixer preset 1):

2. Repeat those steps from 'Example 1' again, but this time setting up mixer preset 2 (instead of mixer preset 1):
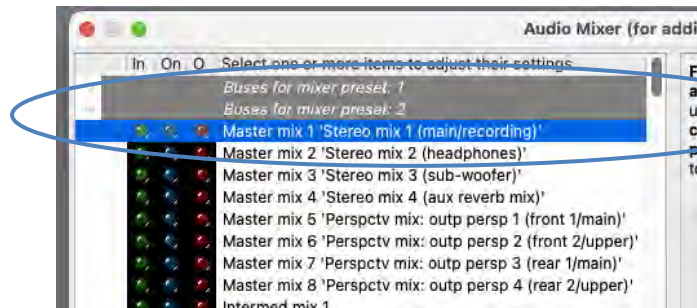
    … and using your second set of reverbs (for the main stereo master mix bus, and optionally for your sub-woofer master mix bus):
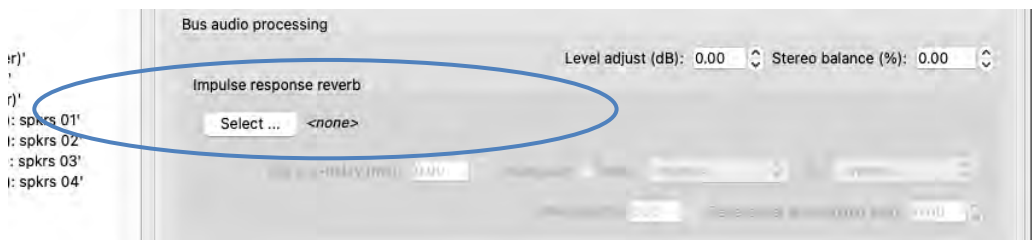
    … then when loading the organs which should use that set of reverbs, select mixer preset 2 for them on the audio settings control panel (instead of mixer preset 1), and optionally tweak their reverb wetnesses:

3. If you have other sets of reverbs that you'd like to use for other organs then repeat all of step 2 above again, once per distinct set of reverbs (setting up mixer preset 3 for the 3rd reverb set, setting whichever organs you wish to use mixer preset 3, and so on).

Example 2: surround/3D sound output, optionally plus a sub-woofer, optionally with the same added overall reverbs for all organs (which can be bypassed, or their wetnesses adjusted, on a per-organ basis)

(The following steps assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard*, and then *Organ settings | Organ configuration wizard* with each applicable organ loaded in turn, respectively.)

Let's say you use a variety of organs (sample sets), including:

- 'Wet' organs (those recorded in real reverberant acoustics), to which you don't want to add impulse response reverb.
- 'Dry' or 'semi-dry' organs (those with little or no reverb recorded in the samples), to which you want to add an overall impulse response reverb, and that you're happy to use the same reverb for each of them, but perhaps varying its 'wetness' (depth of reverb applied) on a per-organ basis.

… and that you want to use two pairs of speakers (one front pair, and one rear pair) for surround sound output, or four pairs of speakers (main-front, upper-front, main-rear, upper-rear pairs) for 3D sound output, for all of the above types of organs, perhaps with an additional mono sub-woofer fed as a mix-down. We can do all of that using just a single mixer preset, so we'll use mixer preset 1 (which is the default), for simplicity. (If you only use wet organs, and/or don't want to add reverb, then simply skips the steps that relate to selecting/adjusting reverb.)

First (if applicable) make sure that you've installed the impulse response reverb you want to use via '*File | Install …*' in Hauptwerk:

Load one of your fully dry (as opposed to semi-dry) organs. Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) make sure that the currently-loaded organ is using (for this example) mixer preset 1:

Now open the *General settings | Audio mixer* screen. Make sure that the '*Mixer buses for mixer preset 1*' node is expanded in the left-hand browse list:

[Example continues on next page.]

Select the following entry (mixer bus) in the left-hand browse list:

- [Within the mixer preset 1 node]: *Master mix 1 'Stereo mix 1 (main/recording)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to '*<none>*':

Now instead select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 5 'Perspctv mix: outp persp 1 (front 1/main)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your main front stereo pair of speakers. Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use (for dry/semi-dry organs), if any, for your main front stereo pair of speakers:
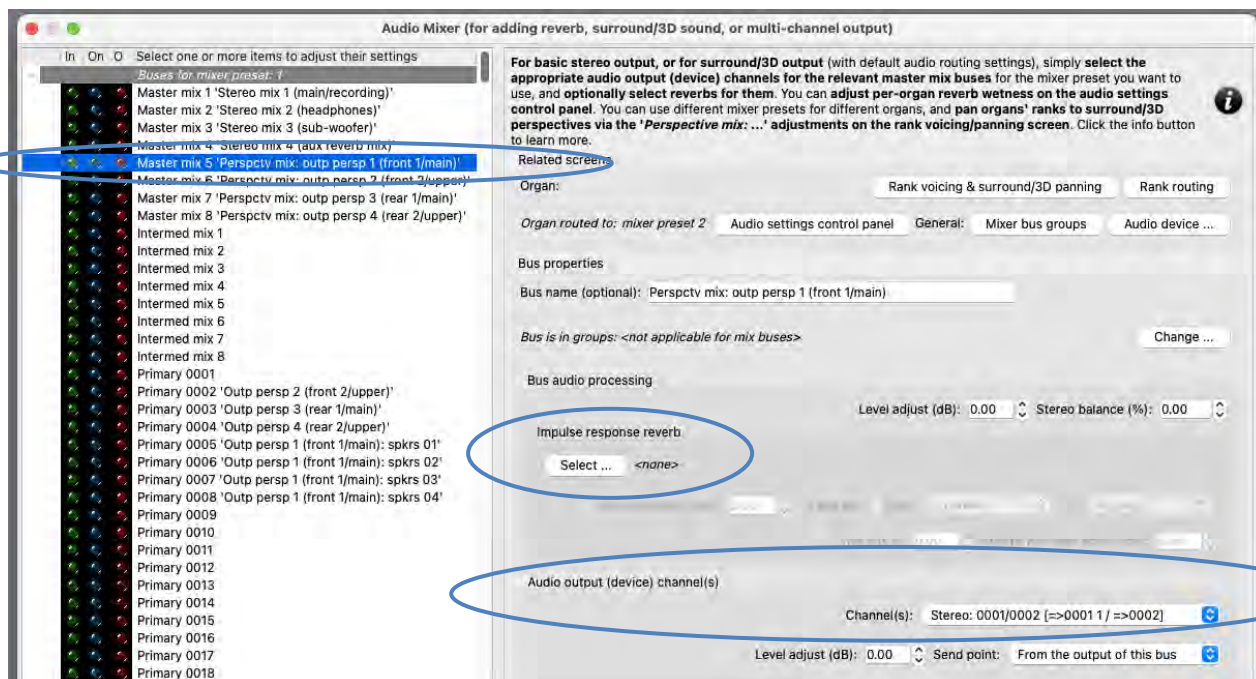
[Example continues on next page.]

Now instead select the following mixer bus in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 7 'Perspctv mix: outp persp 3 (rear 1/main)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your main rear stereo pair of speakers. Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use (for dry/semi-dry organs), if any, for your main rear stereo pair of speakers (you can use the same reverb as for the main front stereo output, if you wish):
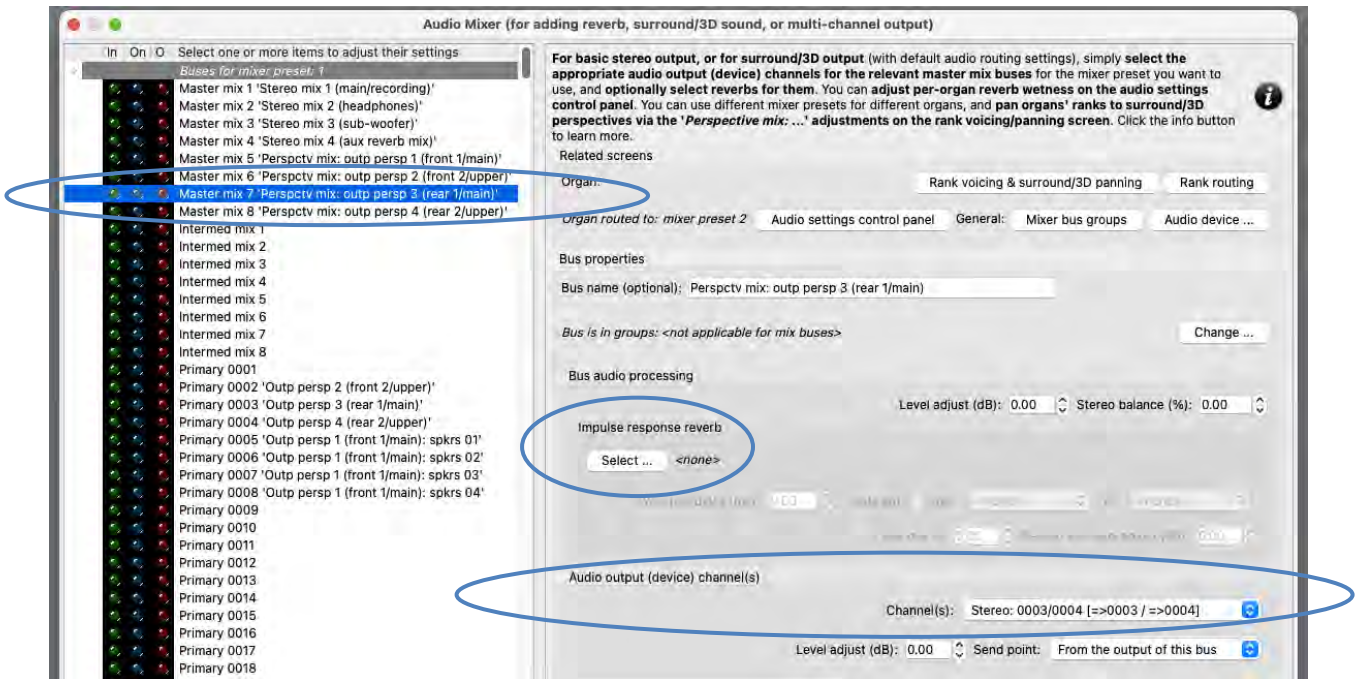
If you use want to use full 3D sound output, then:

Also select the corresponding device channels for your front-upper and rear-upper speaker pairs for the following two buses respectively, and optionally also select reverbs for them:

- [Still within the mixer preset 1 node]: *Master mix 6 'Perspctv mix: outp persp 2 (front 2/upper)'*.
- [Still within the mixer preset 1 node]: *Master mix 8 'Perspctv mix: outp persp 4 (rear 2/upper)'*.

If you also want to use a mono sub-woofer (that's connected to a separate audio device channel), then:

Also select the corresponding device channel for it for the following mixer bus, and optionally select a reverb for it:

- [Still within the mixer preset 1 node]: *Master mix 3 'Stereo mix 3 (sub-woofer)'*.
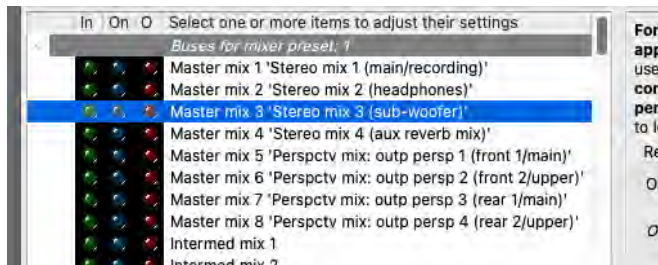
(Note: mono channels can be found near the end of the drop-down channel list, after the stereo pairs.)

OK the mixer screen.

[Example continues on next page.]

Now on the *Organ settings | Rank voicing and surround/3D/perspective panning* screen, for each of the relevant '*Perspective mix: …*' adjustments (in the drop-down list at the top-right of the screen) in turn, use the *MSTR* ('master') slider to 'pan' each of the organ's virtual ranks (within the '*Rank routing/voicing preset: 1*' node in the rank list) as desired to/between your corresponding pairs of surround/3D speakers:

For example, to route one or more virtual ranks entirely to a 'rear' surround pair of speakers, all that you would need to do is to select the rank(s) on the voicing/panning screen (you can select multiple ranks at once, to change their settings/routing simultaneously), then:

1. Select the '*Perspective mix: source persp to output persp 1 (front 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 0% (rather than the adjustment's default of 100%, since all ranks are routed entirely to the 'front' by default), and:
2. Select the '*Perspective mix: source persp to output persp 3 (rear 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 100% (rather than the adjustment's default of 0%).

The values don't have to be fully 100% or 0%; in-between values can be used to position ranks/pipes virtually 'between' the relevant speakers.

As you play the organ (with some stops drawn, of course), you should now hear that it has the intended reverb(s) for your surround/3D stereo pairs of speakers (and also the intended reverb for your sub-woofer, if applicable). If you wish, you can fine-tune the reverb settings via the relevant mixer bus(es) on the *General settings | Audio mixer* screen. Bear in mind that any changes you make there will affect all organs (since the audio mixer is on the *General settings* menu, and since we're using the same mixer preset for all organs).

[Example continues on next page.]

Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) you can then optionally reduce (scale) the reverb 'wetness' for just this organ, via the '*Mixer impulse response reverb scaler %*' slider:

If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them).

Load any other organs you may have and, in the same way, 'pan' their ranks as desired, and use the audio settings control panel to tweak their reverb wetnesses (or disable reverb completely) if desired, by adjusting the '*Mixer impulse response reverb scaler %*' slider. For example, you might want to set the slider to 0% for wet organs, leave it at 100% for fully dry organs, and set it somewhere in-between for semi-dry organs.

Example 2b: surround/3D sound output, optionally plus a sub-woofer, with different overall reverbs added for different types/groups of organs

If you want to use different sets of reverbs for different organs (or for different types/groups of organs), you need to use a different one of the available 128 mixer presets for each one of the distinct sets of reverbs that you'll be adding. This is what you need to do:

1. Follow the steps in 'Example 2' above to set up mixer preset 1 using your first set of reverbs (one for each of the used surround/3D master mix buses, and optionally one for the sub-woofer master mix bus), but configuring the reverb wetness scalers only for whichever of your organs should use that particular set of reverbs (mixer preset 1):

2. Repeat those steps from 'Example 1' again, but this time setting up mixer preset 2 (instead of mixer preset 1):
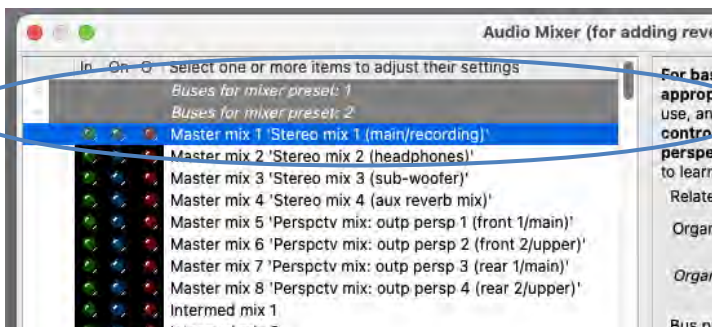
   … and using your second set of reverbs (for the used surround/3D master mix buses, and optionally for your sub-woofer master mix bus):
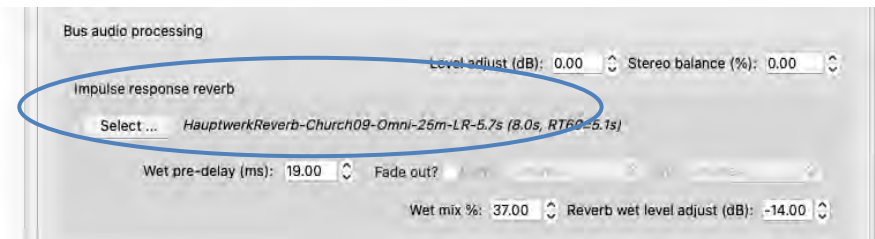
   … then when loading the organs which should use that set of reverbs, select mixer preset 2 for them on the audio settings control panel (instead of mixer preset 1), and optionally tweak their reverb wetnesses:

3. If you have other sets of reverbs that you'd like to use for other organs then repeat all of step 2 above again, once per distinct set of reverbs (setting up mixer preset 3 for the 3rd reverb set, setting whichever organs you wish to use mixer preset 3, and so on).

Audio routing and impulse response reverb part 2 (Advanced Edition only): multi-channel audio, multi-channel virtual acoustics, and routing concepts for advanced use

We recommend reading the previous chapter in its entirety first, and then also reading this chapter in its entirety, and in order, if you plan to use multi-channel audio output or multi-channel virtual acoustics. This chapter covers how Hauptwerk's audio routing works and is used in greater depth.

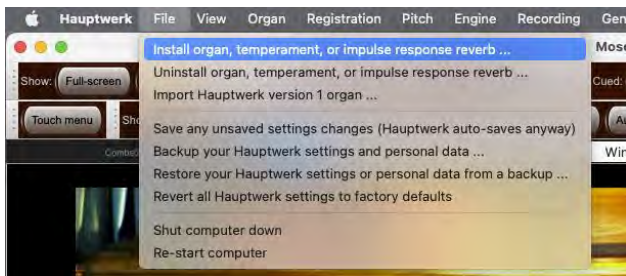## Overview and key concepts for advanced use

The following sections assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard* and *Organ settings | Organ configuration wizard* respectively.

To illustrate Hauptwerk's audio settings and their core concepts, start by loading the St. Anne's organ. Now open all of the following screens and position them so that they don't overlap (if you have sufficient space):

1. *Organ settings | Rank voicing and surround/3D/perspective panning*.

2. *Organ settings | Rank routing to audio mixer buses/groups*.

3. *General settings | Audio mixer bus groups*.

4. *General settings | Audio mixer*.

These are the four screens that control fully how audio is routed within Hauptwerk (in addition to the *General settings | Audio device and channels* screen, on which you would have selected the audio device/driver that Hauptwerk will use). (In the previous chapter we ignored screens 2 and 3 for simplicity, since their defaults are correct for what we needed.)

All of the above four screens can be open and used at the same time, so that you can immediately see how any settings changes made on one screen affect any other, and any settings changes you make on them will take effect (almost) immediately, in real-time. The last three of the above four screens also show real-time visual feedback via their virtual activity LEDs down their left-hand sides, again so that it's easy to see what's being routed where, as you play or change settings.

There are convenience buttons on the last three of the above four screens to open the others and, as always, the on-screen help on each of the screens provides detailed information and usage hints. The audio settings control panel (*View | Large floating control panels … | Audio mixer, routing and voicing/panning settings*) also has convenience buttons to open the screens.

Also, all four of the above screens allow multi-selection (i.e. you can select several items at once), so that you can change the settings quickly for multiple objects at once.

Conceptually, a pipe/rank's audio flows through all four of the above screens in the order above, i.e.:

Rank voicing/panning -> Rank routing to audio mixer buses/groups -> Audio mixer bus groups -> Audio mixer

… or (since routing via mixer bus groups is optional):

Rank voicing/panning -> Rank routing to audio mixer buses/groups -> Audio mixer

… and, in either case, then to the *General settings | Audio device …* screen.

With a single stop drawn, play different notes and watch how the virtual activity LEDs flash down the left-hand sides of the (last three) screens to see how pipes are being routed as you play, and as you change settings on the screens. (Note that the activity LEDs on the *Rank Routing …* and *Audio Mixer Bus Groups* screens only flash momentarily as you press each key, whereas those on the *Audio Mixer* remain lit whilst a bus is receiving any audio signal.)

The 128 available 'mixer presets' (which allow you to apply different sets of settings to different organs, as covered in the last chapter) actually apply to both the *General settings | Audio mixer* and the *General settings | Audio mixer bus groups* screens, with each preset representing a complete set of mixer and mixer bus group settings together. Mixer preset 2's mixer bus groups route audio to mixer preset 2's mixer buses, for example.

The Audio Mixer screen

Let's consider the *General settings | Audio mixer* screen first, which is central to Hauptwerk's audio routing. Imagine it as like a recording studio mixing desk (turned sideways): the items in the left-hand browse list are 'buses', and in the right-hand pane you can change the settings for the selected bus(es). A Hauptwerk mixer bus together with its settings is akin to a channel strip on a recording studio mixer. All mixer buses are always stereo (but you can optionally select a mono audio output device channel for any of them, in which case a down-mixed mono signal will be sent to the chosen device channel).
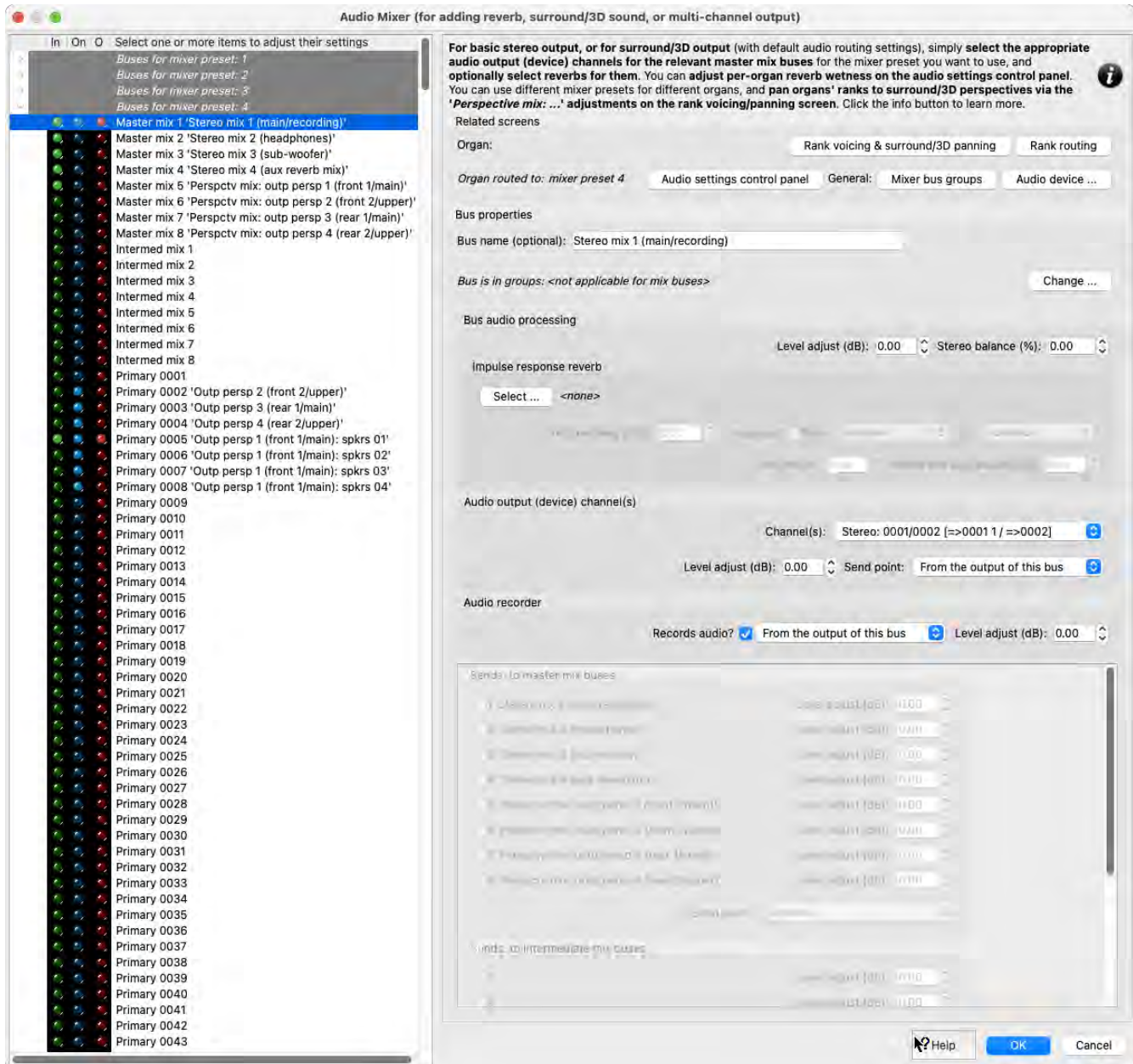
You can optionally give each bus a name, to help identify it easily, near the top of the right-hand pane. Some buses have default names to indicate what they do with Hauptwerk's default audio settings:
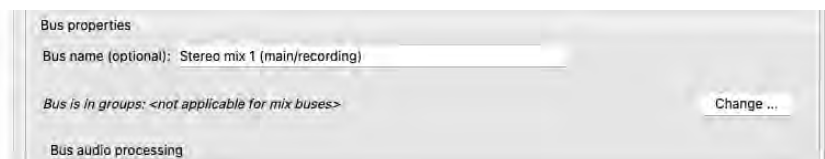
However, **it's important to appreciate that the names and initial routing settings are just defaults; you can freely change those names, and you can freely change any of the other bus settings, or routing settings/names on other screens; there is no fixed routing at all**. The defaults are just there to help make the common ways in which people use Hauptwerk as quick and easy as possible to set up.

There are three different types of buses: *primary buses*, *intermediate mix buses*, and *master mix buses*, as indicated by their prefixes in the left-hand bus list. The number of buses of each type (for each of the 128 mixer presets) is fixed (1024 primary buses, 8 intermediate mix buses, 8 master mix buses), but their names, and what you use them for, are up to you. Primary buses and intermediate buses would normally be adjusted only for multi-channel audio or for multi-channel virtual acoustics (since their defaults are already set correctly for other types of use).

For multi-channel audio, the core concept is that virtual pipe ranks are routed (optionally via mixer bus groups) to the mixer's primary buses, and that mixer buses may optionally output audio to audio device channels directly, and/or to other 'mix buses' (either master mix buses, or intermediate mix buses, akin to aux sends routing to aux buses on a mixing desk). You can enable/disable sends from a bus to the various mix buses (and adjust their send levels) near the bottom-right of the screen. Primary buses can send to master mix buses and/or to intermediate mix buses, whereas intermediate mix buses can only send to master mix buses, and master mix buses can't send to any other mix buses. Hence buses can only send to mix buses 'higher up' the hierarchy (thereby avoiding any risks of infinite audio loops and feedback).
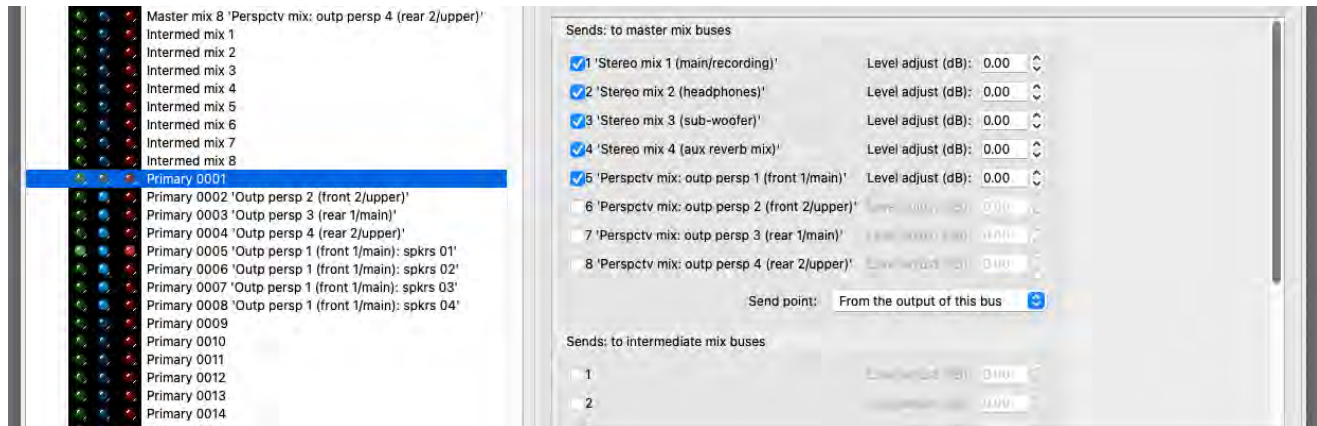
The purpose of the mix buses is to allow you to mix audio from multiple primary buses together (either directly to master mix buses, or indirectly via intermediate mix buses).

For example, people commonly use multi-channel audio output (routing ranks amongst several pairs of speakers), but also want all of that audio to be mixed together down to a single combined stereo feed, for example for audio recording purposes, and/or to feed for a sub-woofer and/or headphones, and/or to apply an overall reverb. You could use any of the mix buses for any of those purposes. However, since they're such common requirements, Hauptwerk defaults the names of the first four master mix buses accordingly, and defaults all of the primary buses to send to all four of those master mix buses. Hence with the default settings, if (for example) you wanted to feed a sub-woofer then all that you would need to do is to select the appropriately-named master mix bus (master mix bus 3) in the left-hand bus list, then select the channel(s) you want to use for it on your audio device (either a stereo pair, or a single mono channel) using its '*Audio output (device) channel(s) | Channel(s)*' setting on the right-hand pane. (Mono channels can be found after all of the stereo channel pairs in the drop-down list.)
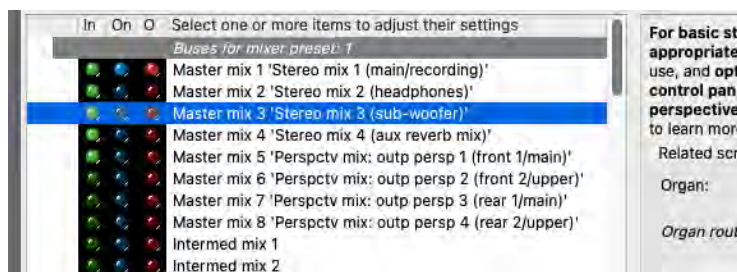
Note that in the '*Audio output (device) channel(s)*' section of the screen you can adjust the level that's being sent to any audio output (device) channels. Also, you can also adjust the levels being sent from each of the primary buses individually (and/or intermediate mix buses individually) to the mix buses (via the primary buses' '*Sends: to … mix buses*' section of the screen). Hence you could feed a different mix of primary bus levels to a sub-woofer (and/or to an overall reverb mix) than you would to your headphones, for example.

Notice how (for each mixer preset) the '*Audio recorder: Records audio?*' option is ticked by default for master mix bus 1 (which is fed a combined mix or all primary buses by default), but not for any of the other buses. Hence master mix bus 1 is configured by default to record a stereo (.WAV file) mix of all of the (mixer preset's) primary buses whenever you start Hauptwerk's built-in audio recorder recording (e.g. via the *Recorder/Player* large floating control panel), but the primary buses themselves aren't set to record separate audio files individually. However,

you can change that if you prefer, or configure any or all buses to record their own audio (.WAV) files by ticking that option for them. You can also adjust the recording levels for the files in the '*Audio recorder*' section of the mixer screen:
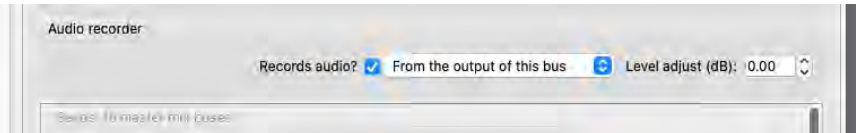
The '*Impulse response reverb*' section of the mixer screen allows you optionally to apply an impulse response reverb to the selected mixer bus. For example, if you only use a single stereo audio output from Hauptwerk and you want to apply reverb to it, then with the default settings you could select just master mix bus 1 (which is fed a stereo mix of all primary buses by default) for the desired mixer preset, then simply select a reverb to apply to it. Alternatively, if, for example, you instead use multi-channel audio output from Hauptwerk (routing ranks amongst several pairs of speakers) and you want to apply a reverb to a combined stereo mix for sending to a separate pair of speakers (an 'aux reverb mix') then with the default settings you could, for example, select just (the mixer preset's) master mix bus 4 (which is fed a stereo mix of all primary buses by default), then select a reverb to apply to it and select the appropriate pair of audio output device channels for it.

As covered in the previous chapter, you can also adjust (scale) the 'wetness' of any impulse response reverbs you might have applied on the mixer overall, on a per-organ basis, via the audio settings large control panel ('*View | Large … control panels (for this organ) | Audio … settings*'). This provides a very simple and quick means to tweak reverb wetness, and/or disable reverb, on a per-organ basis. If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them).

The '*Audio output (device) channel(s)*' section of the screen allows you optionally to make any buses feed their audio signals to any desired channels on your audio interface (either in stereo or mono – the mono entries can be found after all of the stereo entries in the drop-down list). With the default settings, (for each mixer preset) just master mix bus 1 (which is fed a stereo mix of all primary buses by default) has audio output (device) channels selected it for (channels 1 and 2, as a stereo pair).

(Note that it's technically allowable for any given audio output channel to be used by more than one mixer bus, in which case a mix of the relevant mixer buses will be sent to that audio output channel. However, in practice it's unlikely that most people would want to do that, especially since there are plenty of primary buses and bus groups, and since buses can be members of multiple groups, which we'll cover shortly. Note also that the left and right audio output channel numbers selected for any given mixer bus when stereo must be consecutive, i.e. the right channel number must be one higher than the left, to keep things. However, if you really have to use non-consecutive audio device channels for stereo output then channel orders can optionally be remapped manually via the *General settings | Audio device and channels* screen.)

With the default audio settings master mix buses 5 and 7 (for each mixer preset) are set up appropriately as outputs for 'front' and 'rear' surround-sound speaker pairs. To make use of them (instead of the default single stereo output) you simply need to select the desired audio output (device) channels for each of them (for the desired mixer preset), then set the audio output (device) channel to '*<none>*' for master mix bus 1. Likewise, master mix buses 5-8 are also set up appropriately for 3D-sound output (front/main, front/upper, rear/main, rear/upper

speaker pairs respectively), so if you wish to make use of them then simply select the appropriate audio output (device) channels for each, and set master mix bus 1's audio output (device) channel to '*<none>*'.
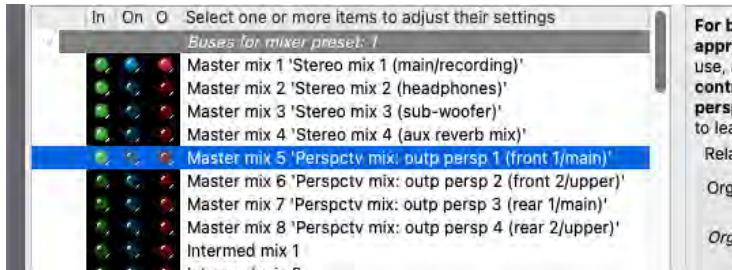
With default settings, primary buses 0005-0008 (which are all in a group together) send audio to master mix bus 5 (front/main), and primary buses 0002-0004 (each of which is in its own separate group) send audio to master mix buses 6-8. They are configured this way so that by default you can easily route ranks (and/or rank output perspectives) to the front/main, front/upper, rear/main, rear/upper speaker pairs as appropriate (using the *Organ settings | Rank voicing and surround/3D/perspective panning* screen, and, in the case of multi-channel audio specifically, also using the *Organ settings | Rank routing …* screen – covered below).
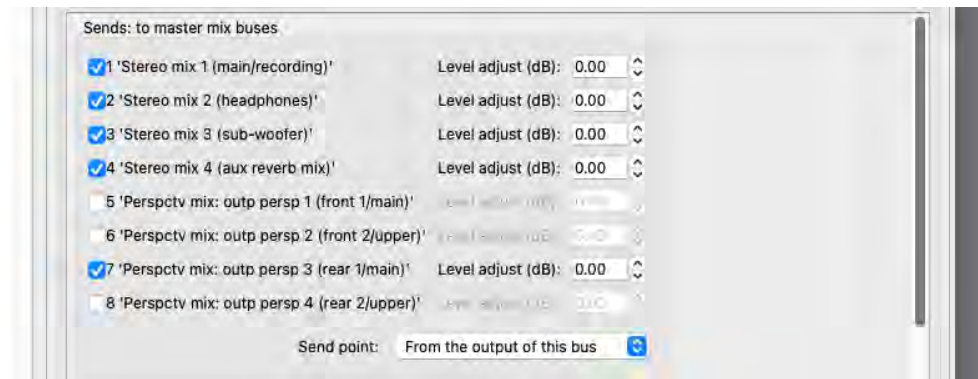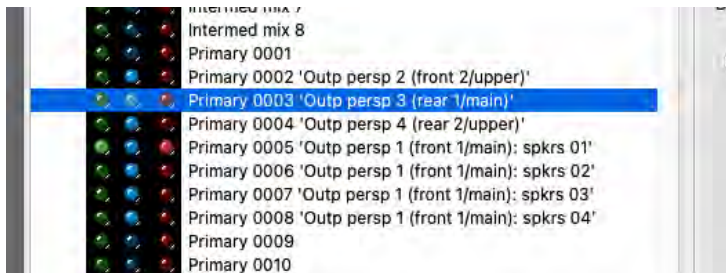
If an organ is loaded, the mixer screen's virtual activity LEDs in the left-hand pane are useful tools for troubleshooting audio routing:

- A bus's green and red virtual activity LEDs indicate whether audio is currently being sent to, or from, the bus, respectively.

- A bus's blue virtual LED indicates whether the bus is currently configured potentially to be audible. Specifically: the blue indicator LED will be lit (only) if an organ is currently loaded, *and* the bus belongs to the organ's currently-selected mixer preset, *and* anything is routed to the bus (if a primary bus: if any ranks are routed directly to it, or if it belongs to any groups – even if no ranks are routed to those groups; or if a mix bus: if any buses send to it), *and* the output of the bus is routed anywhere (to audio device channels directly, or indirectly via mix buses). Hence if an organ is currently loaded and if the blue LED is *not* lit, then nothing will be able to be heard through the bus.

The Audio Mixer Bus Groups screen (for multi-channel output)

Let's consider the *General settings | Audio mixer bus groups* screen. (Keep the Audio Mixer screen open at the same time, to help see how the two screens interact and relate to each other.) This screen is only used for multi-channel output specifically, since default settings are appropriate for standard stereo/surround/3D sound output. Also, you don't actually have to use this screen at all if all you want to do is to route ranks to individual stereo speaker pairs directly, since any given rank can optionally be routed to a primary mixer bus directly, instead of via a bus group.
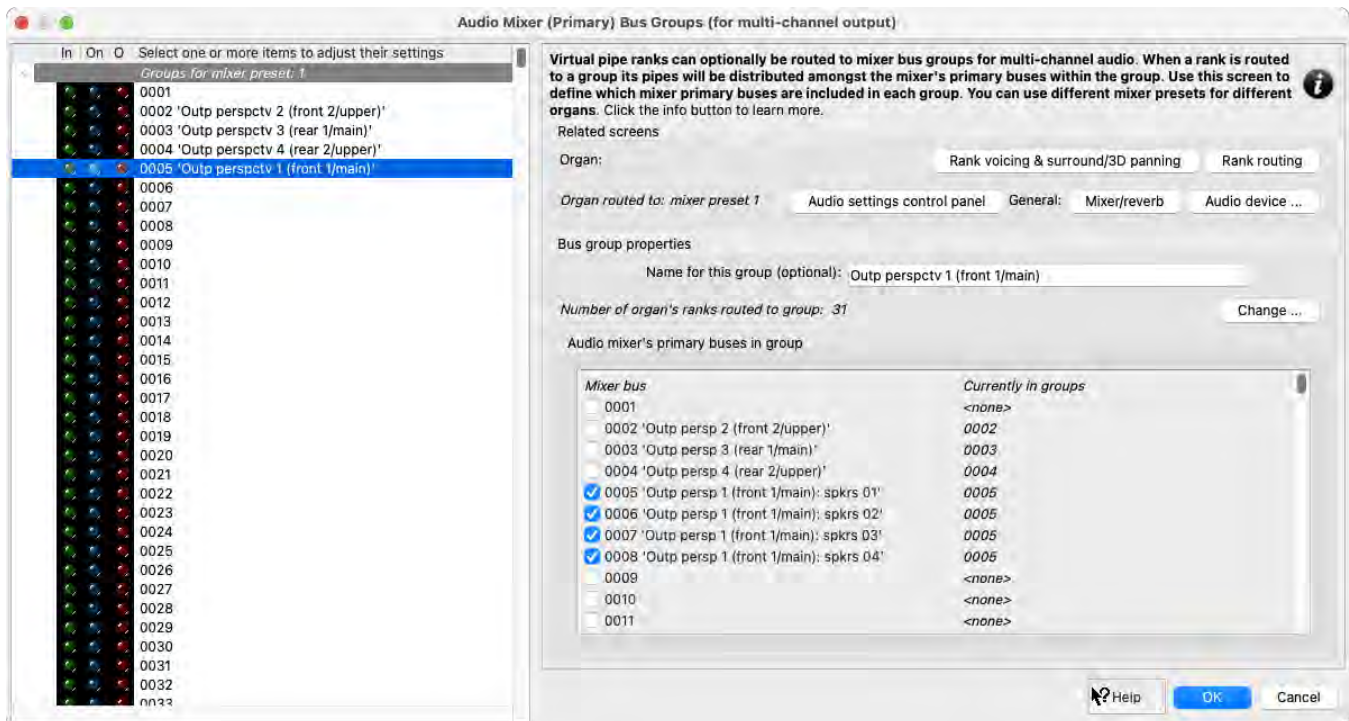
Bus groups (by way of this screen) are used purely to define groupings of the audio mixer's <u>primary</u> buses. Virtual pipe ranks (and/or rank output perspectives) can optionally be routed to bus groups (using the *Organ settings | Rank routing to audio mixer buses/groups* screen – covered in the next sub-section). Bus groups don't, in themselves, output or process any audio directly; they're simply used by Hauptwerk to decide to which primary mixer bus any given virtual pipe (and its output perspectives) will be routed whenever the virtual pipe starts to speak. If a rank is routed to a bus group, **whenever a virtual pipe starts to speak, Hauptwerk sees which group its rank is routed to, then chooses a primary mixer bus within that group, and then plays the virtual pipe's audio directly through that mixer bus**. (Hauptwerk uses the algorithm selected for the rank on the *Organ settings | Rank routing …* screen when choosing the specific bus within the group – covered in the next sub-section.) It's important that any group to which you route a rank contains at least one bus, otherwise you won't hear the rank (since its audio will never be fed to a mixer bus).

When deciding how to allocate your available speakers to groups, we recommend using the same make and model of speakers for all speakers within any given group, since Hauptwerk will allocate different pipes within a rank to different speakers (or pairs of speakers) within any given group, so if your speakers were physically different within a group then ranks routed to that group would be likely to sound uneven across their compasses.

In the screen's left-hand browse list are all of the available bus groups (1024 per mixer preset), and in the right-hand pane you can select which primary mixer buses (if any) you want the selected group(s) to contain. Any of the 1024 primary mixer buses may be a member of any of the 1024 groups, and any of the groups may contain any of the primary mixer buses. Hence, it's allowable for a primary mixer bus to be a member of multiple groups (or none), if you wish. For example, if you use multi-channel audio output (routing ranks amongst several pairs of speakers), then your primary mixer buses would be used for your various multi-channel speakers, and any given speaker (by way of its primary mixer bus) could be a member of multiple groups, if you so wished.

You can optionally give each group a name to help identify what you're using it for. We recommend doing so for any non-empty groups, so that it makes it easier to decide which group to route each rank to (when using the *Organ settings | Rank routing …* screen). As with the mixer screen, some groups have default names to indicate how they're used with Hauptwerk's default audio routing settings, but it's important to appreciate that the names and default routing are just defaults, which can freely be changed; there is no fixed routing.
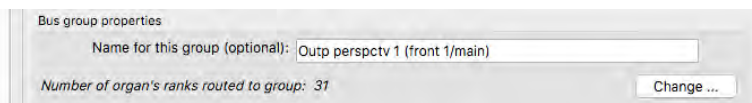
With the default audio routing settings, group 0005 contains primary buses 0005-0008, and is appropriately set up by default either for simple stereo output, or for routing to the front/main stereo speaker pair for surround-sound or 3D-sound (as described in the previous sub-section), or for multi-channel audio output with four stereo speaker pairs with the virtual pipework distributed automatically amongst those four pairs. For the latter case, (for the desired mixer preset) you simply need to select the appropriate audio output (device) channels on the *General settings | Audio mixer* screen for each of primary buses 0005-0008, and set master mix bus 1's audio output (device) channels to '*<none>*'.

Also (with the default audio routing settings) groups 0002-0004 each contains just the primary bus of the same number, in case you want to route surround/3D perspectives via bus groups, instead of directly to primary buses (the latter is the default for Hauptwerk version 8 and above). (Note that we made the group numbers correspond to the primary bus numbers in the default settings purely to aid clarity; we could equally have chosen any other numbers, provided that the intended bus numbers were ticked within the intended groups.)
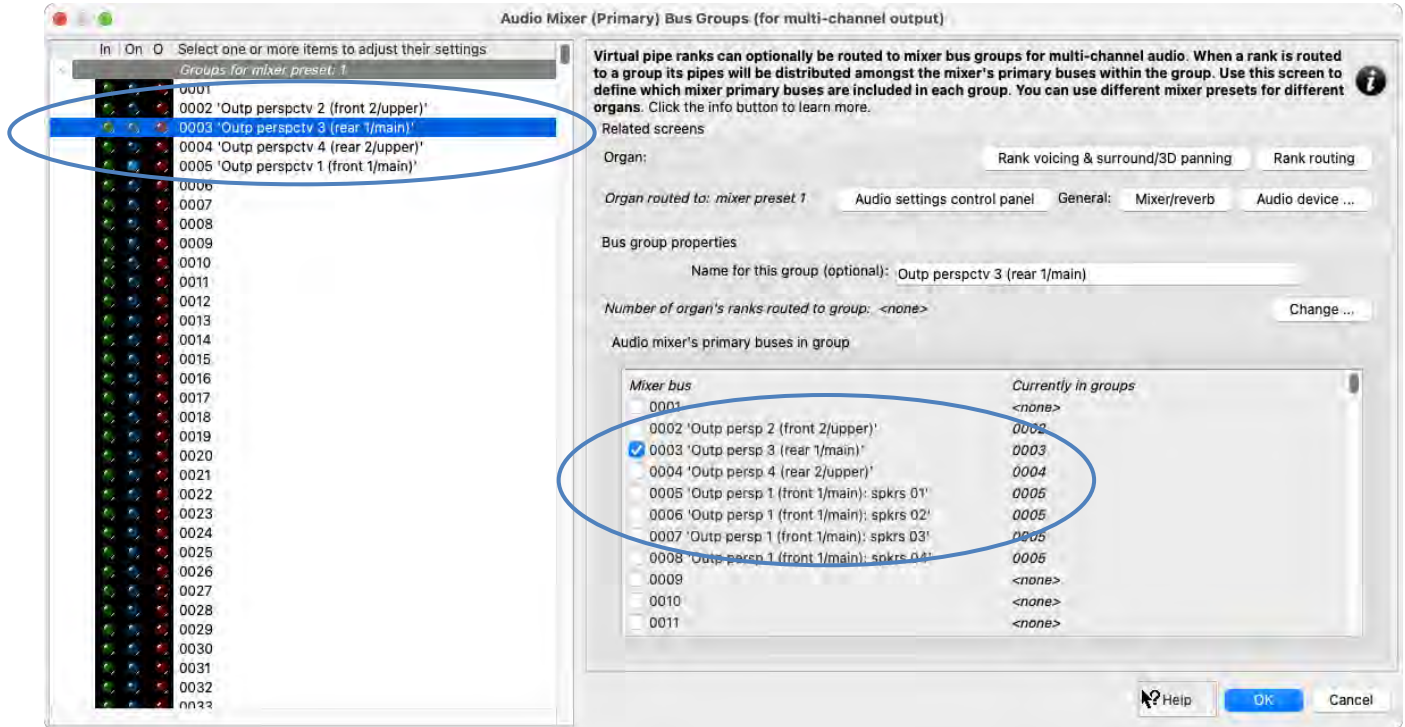
If an organ is loaded, the virtual activity LEDs in the left-hand pane are useful tools for troubleshooting audio routing:

- A group's green and red virtual activity LEDs indicate whether audio is currently being sent to, or from, the group, respectively. However, note that they flash only momentarily as you press a key whose virtual rank(s) are routed to that group; they don't stay lit if the pipe(s) continue to sound (since groups are only used at the point in time that each virtual pipe starts to sound, and purely for the purpose of allocating the pipe to a primary mixer bus, as above). Note also that you must re-trigger any sounding pipes to hear any routing changes.

- A group's blue virtual LED indicates whether the group is currently configured potentially to be audible. Specifically: the blue indicator LED will be lit (only) if an organ is currently loaded, _and_ the group belongs to the organ's currently-selected mixer preset, _and_ any ranks are routed to the group, _and_ the group is non-empty (contains any buses). Hence if an organ is currently loaded and if the blue LED is _not_ lit, nothing will be able to be heard through the group.

The Rank Routing to Audio Mixer Buses/Groups screen, and the Rank Voicing/Panning screen

First, draw an organ stop on the virtual console, such as the St. Anne's Great Open Diapason Large 8. Now make sure that both the *Organ settings | Rank routing to audio mixer buses/groups* screen and the *Organ settings | Rank voicing and surround/3D/perspective panning* screen are open and positioned so that they don't overlap (if you have space), for clarity.
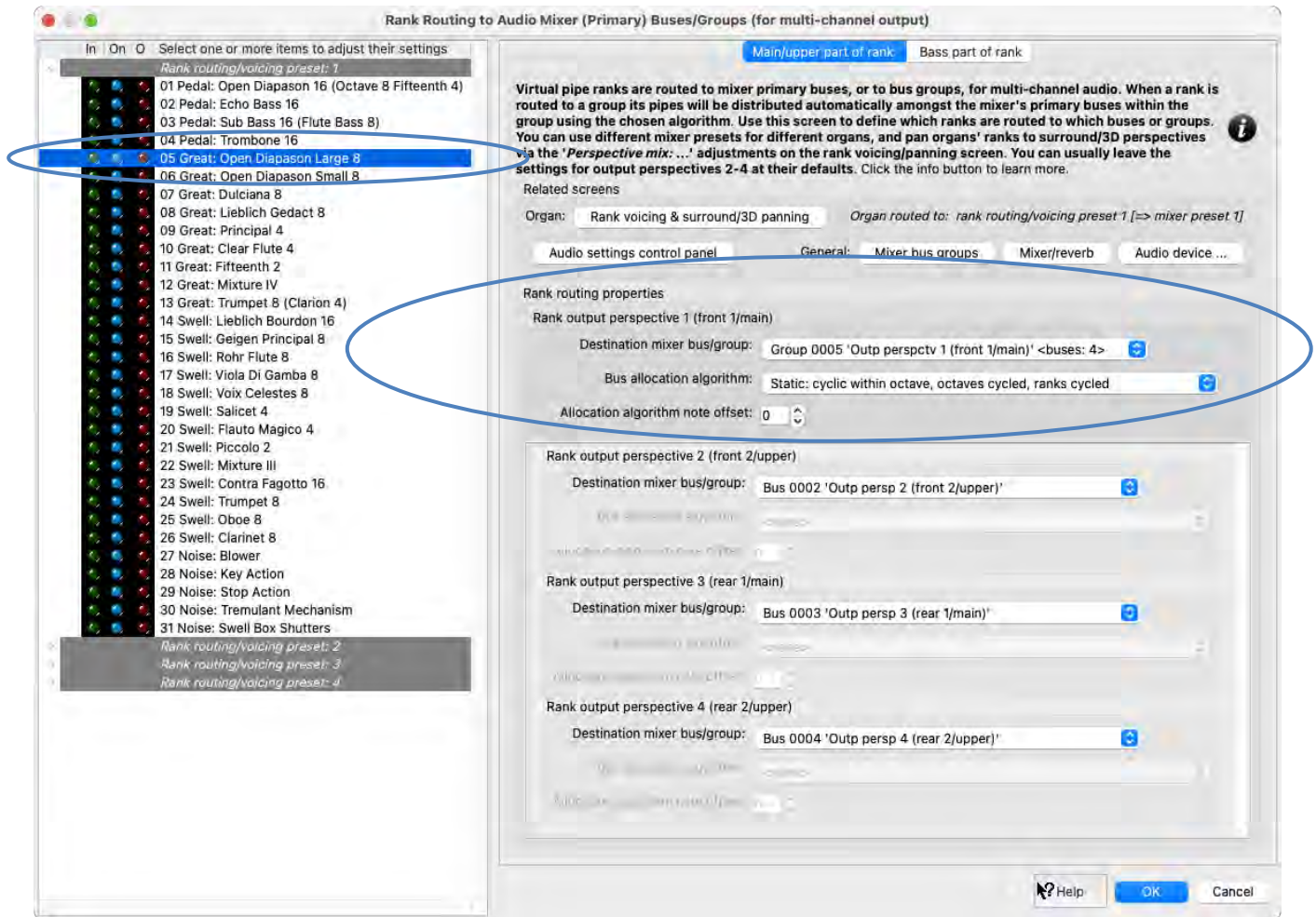
The *Organ settings | Rank routing …* screen has a list of virtual ranks in its left-hand browse list, and its right-hand pane has settings that determine how the selected rank(s) are routed – either to mixer bus groups, or to mixer primary buses directly. The *Organ settings | Rank voicing …* screen has a selector for the virtual ranks at its top left. (On both screens the ranks are organized within nodes for 'rank routing and voicing presets', which were covered in the **Rank routing/voicing presets** section. In this section, we'll simply assume that you're using rank routing/voicing preset 1.)

Select the Great Open Diapason Large 8 rank on each of the two screens, so that we can look at how it's being routed. (Note also that each of the two screens can usually also be reached be right-clicking on the desired stop on the virtual console.)

If an organ is loaded, the virtual activity LEDs in the left-hand pane of the *Organ settings | Rank routing …* screen are useful tools for troubleshooting audio routing:

- A rank's green and red virtual activity LEDs indicate whether a rank's pipes are sounding.

- A rank's blue virtual LED indicates whether the rank is currently configured potentially to be audible. Specifically: the blue indicator LED will be lit (only) if the rank is currently loaded into memory *and* the rank is routed to at least one non-empty bus group or to a mixer bus directly. Hence if the blue LED is *not* lit, the rank will not be audible.
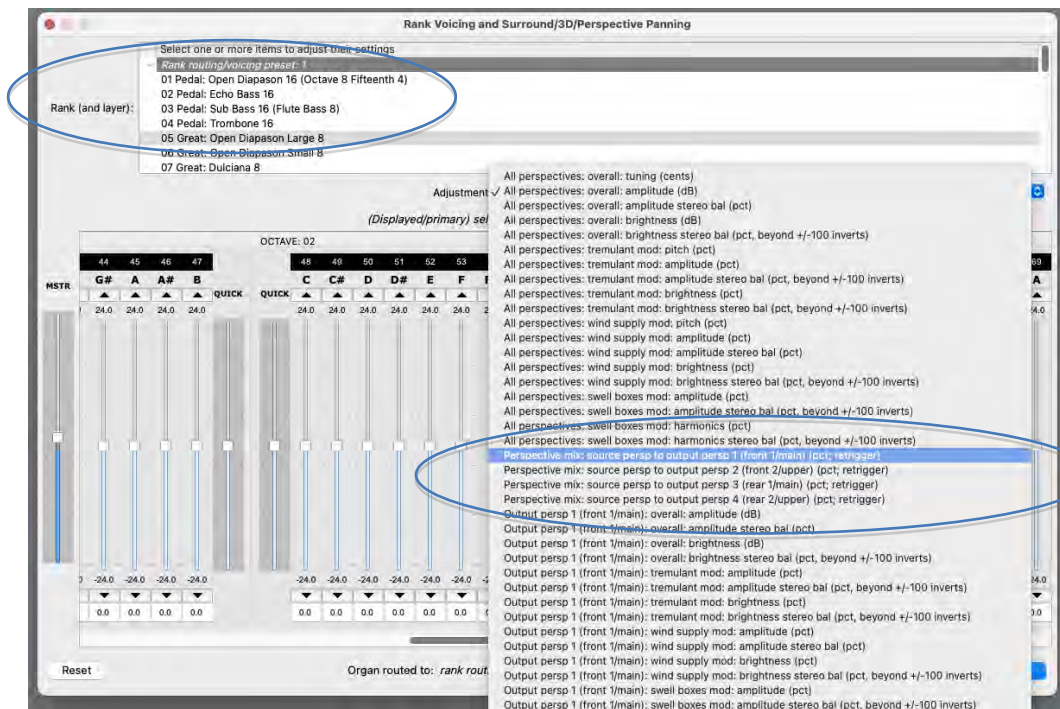
In the voicing/panning screen's '*Adjustment*' drop-down list (near the top-right of the voicing screen), the '*Perspective mix: source persp to output persp 1/2/3/4 …*' adjustments allow you to route the pipe separately via four 'output perspectives' to four destinations (via the rank routing screen) simultaneously – either audio mixer bus groups, or primary buses directly. The '*Output persp 1/2/3/4: …*' voicing adjustments then allow you optionally to adjust the voicing independently for each of those four output perspectives. (Note that you can select multiple ranks at once on the voicing/panning screen, to change their settings/routing simultaneously.)

With the default audio routing settings, the four output perspectives are intended to be used (and are routed by default) as follows, so that they're suitable simultaneously for surround-sound, and also for 3D-sound, and also for multi-channel audio (routing ranks amongst several pairs of speakers), and also for simple stereo-only output:

- **Output perspective 1 (front 1/main): main stereo output, and/or surround-front, and/or 3D-front/main, and/or multi-channel output.**
- **Output perspective 2 (front 2/upper): 3D-front/upper.**
- **Output perspective 3 (rear 1/main): surround-rear, and/or 3D-rear/main.**
- **Output perspective 4 (rear 2/upper): 3D-rear/upper.**

For almost all purposes, we would recommend retaining this scheme for simplicity. (However, you are free to use the four perspectives for other purposes if you really want to. For example, you might instead use one of the perspectives for a separate 'reverb' mix, adjusting the levels and voicing sent to it independently for each rank.)

'*Perspective mix: source persp to output persp 1 …*' defaults to 100%, whereas each of '*Perspective mix: source persp to output persp 2/3/4 …*' default to 0%. Hence **with the default settings, all that you need to do in order to route any given rank to surround/3D speakers is to increase its corresponding '*Perspective mix: source persp to output persp 2/3/4 …*' voicing adjustment's master slider, and also decrease its '*Perspective mix: source persp to output persp 1 (front 1/main) …*' slider. You will then effectively be 'panning' the rank to the desired area of the surround/3D field**. Values don't have to be fully 100% or 0%; in-between values can be used to position it virtually 'between' the relevant speakers. You could optionally then also voice the pipe separately for the perspectives (surround/3D speaker pairs), via the corresponding '*Output persp 1/2/34 …*' adjustments, perhaps making the pipe brighter in the front speakers than in the rear (for example).

Also, the '*Output persp 1/2/3/4 …: release tail truncation length (msec, 0=no truncation; retrigger)*' voicing adjustments allow real-time, per-output-perspective, release tail truncation, which can help to make a wet sample set seems a little 'drier' than it would normally. (Note that you need to retrigger any held notes to hear changes, and that real-time release truncation doesn't save any memory.) Using them you could, for example, shorten the release tails for the pipe for a front pair of surround speakers (using '*Output persp 1 (front 1/main): release tail truncation length …*') but leave the release tails un-shortened for a rear pair of surround speakers (using '*Output persp 3 (rear 1/main): release tail truncation length …*'). It could then sound simultaneously through both front and rear speakers with different lengths of release tails, making it seem 'drier' from the front than from the rear.

If used in the ways described in the preceding paragraphs, **for surround-sound use, and/or 3D-sound use, and/or simple stereo-only output, and/or applying overall reverbs, no adjustments at all are then necessary on the *Organ settings | Rank routing …* screen or the *General settings | Audio mixer bus groups* screen** (since the defaults are already set appropriately).

For non-surround/3D use we recommend simply ignoring output perspectives 2, 3 and 4 entirely on both the *Organ settings | Rank voicing …* screen and the *Organ settings | Rank routing …* screen (leaving the settings for them at their defaults, in which case no audio will be routed through them anyway), and just using output perspective 1.

Let's turn our attention now to the *Organ settings | Rank routing …* screen. As above, output perspectives 2, 3 and 4 would normally only be used for surround/3D-sound purposes, and their defaults are already appropriate for those, so we will simply ignore their settings on this screen from now on, and concentrate only on the settings within the '*Rank output perspective 1 (front 1/main)*' sections of the screen's right-hand pane. Similarly, since the screen is already configured appropriately by default for stereo-only output, we'll concentrate on multi-channel audio output (being the only case in which you should normally need to use this screen at all).
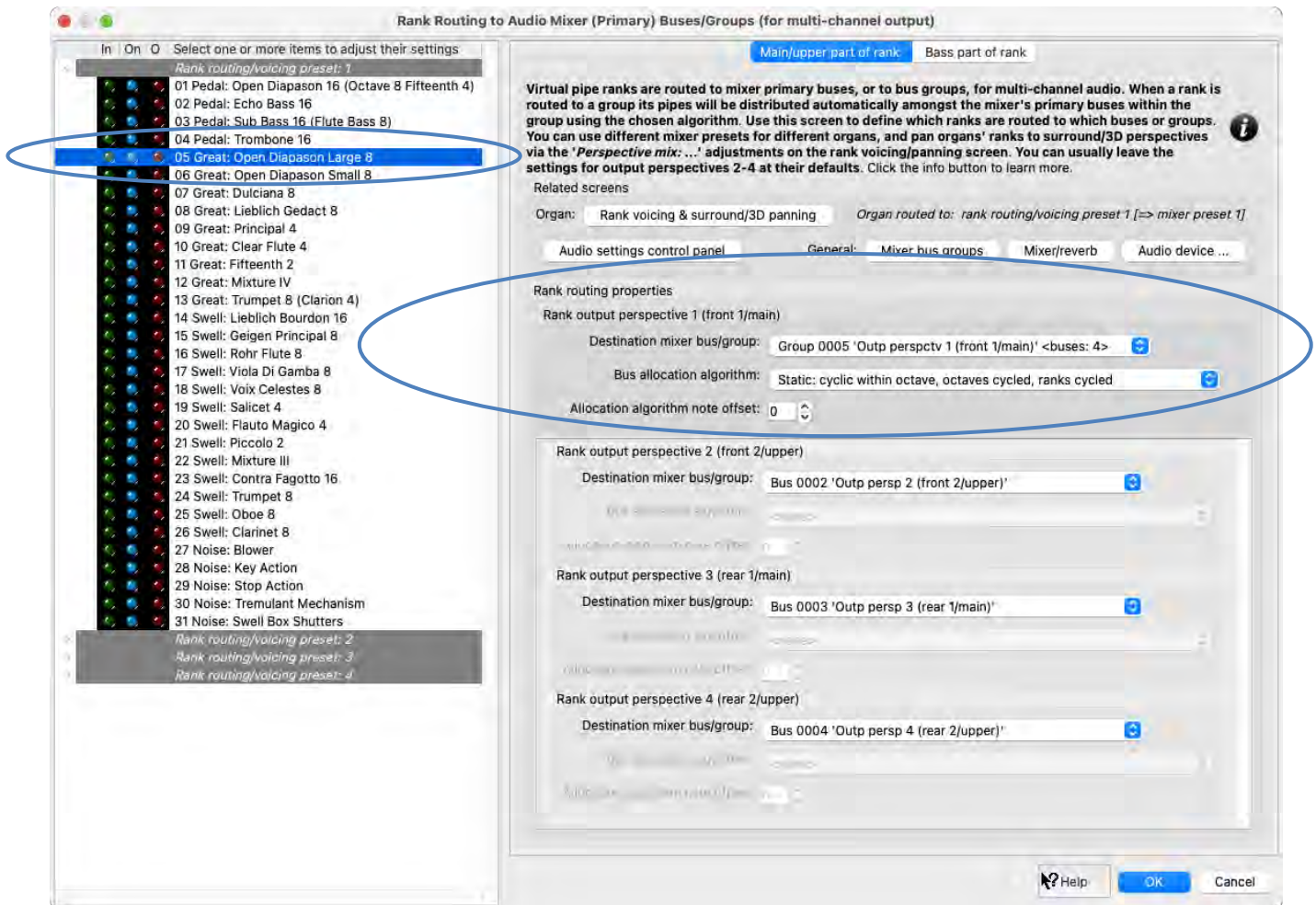
The rank routing screen is for multi-channel audio output specifically (and multi-channel virtual acoustics) **and its core purpose is to define which primary mixer bus, or bus group** (each output perspective of) **each virtual rank will be routed to**, and how the virtual rank's pipes will be allocated to primary mixer buses within that group (if routing to a group, and if the group contains more than one bus).

The main settings are on the '*Main/upper part of rank*' screen tab, within the '*Rank output perspective 1 (front 1/main)*' section. The '*Destination mixer bus/group*' setting is used to choose which primary mixer bus, or bus group you want to route the selected rank to, and, if routing to a group, the '*Bus allocation algorithm*' and '*Allocation algorithm note offset*' are used to choose how you want Hauptwerk to pick a primary mixer bus within that group whenever a pipe starts to sound (if the mixer bus group contains more than one bus). In most cases, you can just leave the two algorithm settings at their defaults.

Static algorithms ensure that any given pipe will always sound through the same bus (speaker/speaker pair), whereas dynamic algorithms may allocate the pipe to a different bus (speaker/speaker pair) when it next sounds. The (default) '*Static: cyclic within octave, octaves cycled, ranks cycled*' is the static algorithm that usually balances the load on the mixer buses (speakers) most evenly, and so is recommended for most cases. The cyclic algorithms allocate pipes to primary buses in the group cyclically, based on the key number (MIDI note number) of each pipe (with offsets added according to the rank and octave number for some algorithms, such as the default one). For example, if your group contains four primary buses, and you played bottom C on a particular rank and it sounded through the second of the group's primary buses (speaker/speaker pair), then the rank's bottom C# would sound through the third of the group's primary buses (speaker/speaker pair).

Whenever an allocation algorithm is allocating a pipe to a mixer bus, the algorithm will first add the '*Allocation algorithm note offset*' number to the pipe's key number (MIDI note number), then use the resulting number to choose the bus number within the bus group. By setting this offset to different (positive) numbers for different ranks you can affect which ranks will sound together through the same mixer buses (speakers). For example, if you want two ranks to sound through exactly the same speakers (for a 'ranks constant' algorithm) then you could set their offset numbers to the same values. Numbers greater than (or equal to) the number of buses in the group will 'wrap around'. For example, if your group currently has 5 buses in it, then specifying an offset number of 5 would have the same effect as specifying an offset number of 0.

The '*Bass part of rank*' screen tab allows you optionally to route the lower part of the rank separately from the upper. For example, you might conceivably want to use separate (perhaps more powerful/larger) speakers for the bottom octave of a 16' rank, so that bass frequencies don't distort or overload the speakers used for the main/upper part of the rank. The settings on this screen tab are identical to those on the main tab, except that you have options to enable such a split and specify the split point within the rank (MIDI note number).
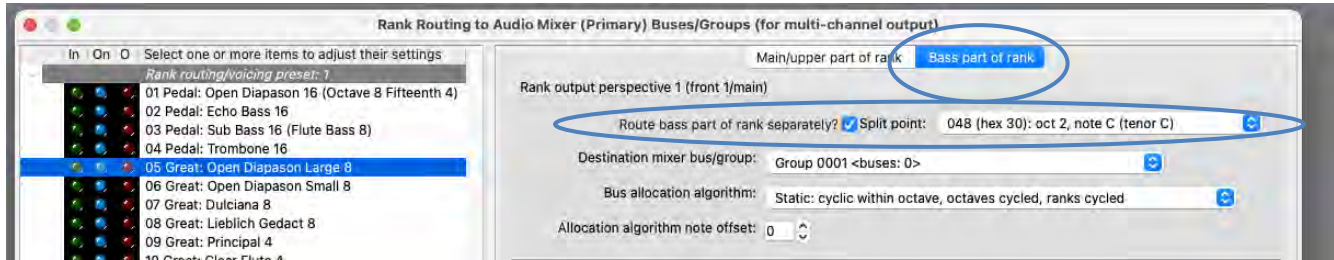
Open the *General settings | Audio mixer* **screen**, **watch the virtual audio activity LEDs to see which specific primary mixer buses each of a rank's pipes gets allocated to as you play keys, and as you try different routings and algorithms**, thus making it quick to see how everything works and fits together, and to troubleshoot any routing issues.

Note that you must re-trigger any sounding pipes to hear any routing changes.

Summary and approaches for multi-channel audio

Some key points, in summary:

- **For surround**/**3D output, use** the *Organ settings | Rank voicing and surround/3D/perspective panning* screen's '*Perspective mix: …*' adjustments **to** '**pan**' (route/mix) **ranks**/pipes **amongst** the **desired surround**/**3D speaker pairs**. (Note that you can select multiple ranks at once, to change their settings/routing simultaneously.)
- **For multi-channel audio, virtual pipe ranks are routed** using the *Organ settings | Rank routing* … screen – **either directly to primary mixer buses, or via mixer bus groups**. (Here too you can select multiple ranks at once, to change their routing simultaneously.)
- **Use** the *General settings | Audio mixer bus groups* screen **to define which primary mixer buses are in each group**.
- **If a rank is routed to a group its pipes will be distributed amongst the mixer's primary buses within the group** (using the allocation algorithm and note offset specified for the rank).
- **Mixer buses** are configured using the *General settings | Audio mixer* screen, and may **optionally output to audio device channels (speakers) directly, and/or to other 'mix buses'** (e.g. for sub-woofers, or for stereo recording, or for aux reverb sends).
- Impulse response **reverbs can be applied to any mixer buses.**
- **There are 128 'mixer presets'** (independent, **complete sets of mixer buses and groups**), and you **define which of them should apply to each individual organ via** the *Audio Mixer, Routing and Voicing/Panning Settings* **large control panel**. This allows you to apply different audio routings and impulse response reverbs to different organs.
- **There are also 4 'rank routing/voicing presets' for each organ**, allowing you to route and voice the organ in up to four different ways if you wish, and switch back and forth between them easily.

The following is a simple general approach to follow when configuring Hauptwerk for multi-channel audio:

1. **Decide which of the 128 mixer presets you want to set up** (bearing in mind that you can use different presets for different types of organs, or even one per organ).
2. **Determine how many speakers you have available**. (You will need at least that many audio output channels on your audio interface.)
3. **Decide whether you want to use any of them for overall stereo mixes** (e.g. **sub-woofers**, **aux reverb sends**) and, if so, **select their device channels** for the preset's corresponding '**master mix buses**' **on the mixer screen**.
4. **Decide whether you want to use the remaining speakers as stereo pairs or as mono outputs**. Stereo is usually preferred unless you are using 'dry' samples sets and have a large number of speakers available.
5. **On the mixer screen**, **assign them to** the appropriate number of (the preset's) **primary mixer buses**, giving those buses meaningful names and **selecting their device channels**. E.g. for 16 speakers as stereo pairs, you would use 8 primary buses, whereas for mono output you would use 16 primary buses.
6. **Decide whether you want to route ranks directly to individual primary mixer buses** (speakers/stereo speaker-pairs)**, or via groups, and how you want the primary buses to be grouped** in the latter case (bearing in mind that all speakers within any given group should be of the same make and model for best results), and (if using groups) **configure groups accordingly on the mixer bus groups screen**, naming the groups meaningfully, and ticking the desired primary bus entries within each, to put the buses into the desired groups.
7. Load an appropriate organ and **use the** *Audio Mixer, Routing and Voicing/Panning Settings* **large control panel to select the mixer preset for the organ**.
8. **Use the rank routing screen to assign the organ's ranks to the desired primary mixer buses or bus groups**.
9. Verify that everything is being routed as intended, referring to the screens' virtual activity LEDs for troubleshooting if needed.
10. If desired, **select reverbs for the relevant primary and/or master mix buses on the mixer screen**.

Multi-channel virtual acoustics

If you use just a single stereo audio output from Hauptwerk (such as for headphones), then you can still obtain most of the benefits 'virtually' that multi-channel audio would bring (in terms of perceived spatial distribution of pipes/ranks around an acoustic space, and increased perceived clarity as a result of it) by configuring Hauptwerk exactly as you would for conventional multi-channel audio output (as described in the previous sub-sections), but not actually selecting any audio device channels for the primary mixer buses, and instead selecting different impulse response reverbs for each of them, preferably with those reverbs having been created for different virtual sound source positions within a single (real or modeled) acoustic space. You will then be positioning the primary mixer buses (and thus pipes routed to them) accordingly within the virtual acoustic space. In that case, you would just select device channels for master mix bus 1 (which is fed a stereo mix from all primary buses by default).

Example 3: simple multi-channel audio with 8 (or more) speakers configured as stereo pairs all in a single group, optionally plus a sub-woofer, optionally plus an additional pair of 'rear' speakers for surround-sound, optionally plus an additional pair of speakers as an 'aux reverb mix' with added reverb (which can be bypassed, or its wetness adjusted, on a per-organ basis)

(The following steps assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard*, and then *Organ settings | Organ configuration wizard* with each applicable organ loaded in turn, respectively.)

This example is particularly easy to set up, because Hauptwerk's default settings are already configured appropriately, apart from actually selecting the desired audio interface channels. However, we can also use it as a useful illustration.

First decide which of the 128 mixer presets you want to configure, and which rank routing/voicing preset. We'll assume 1 for both (the default) for simplicity.

Load an organ (e.g. St. Anne's). Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) make sure that the currently-loaded organ is using (for this example) mixer preset 1:

Now open the *General settings | Audio mixer* screen. Make sure that the '*Mixer buses for mixer preset 1*' node is expanded in the left-hand browse list:

Select the following entry (mixer bus) in the left-hand browse list:

* [Within the mixer preset 1 node]: *Master mix 1 'Stereo mix 1 (main/recording)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to '*<none>*'.

If you want to use a mono sub-woofer (that's connected to a separate audio device channel), then:

Select the following entry in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 3 'Stereo mix 3 (sub-woofer)'.*

… and in the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the mono audio device channel that you want to use for your sub-woofer. (Mono channels can be found near the end of the drop-down channel list, after the stereo pairs.)

If you also want to set up an additional stereo pair of 'rear' speakers for surround-sound, then:

Select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 7 'Perspctv mix: outp persp 3 (rear 1/main)'.*

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your 'rear' stereo pair of surround speakers.

If you also want to set up an 'aux reverb mix' through an additional pair of speakers, then:

Select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 4 'Stereo mix 4 (aux reverb mix)'.*

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your reverb stereo pair of speakers. Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use for them.

[Example continues on next page.]

Now in the left-hand browse list select each of primary buses 0005-0008 in turn and use the '*Audio output (device) channel(s): Channel(s)*' setting to select the appropriate stereo channel pairs for them, assigning a distinct pair of your main speakers (device channels) to each of those four primary buses.
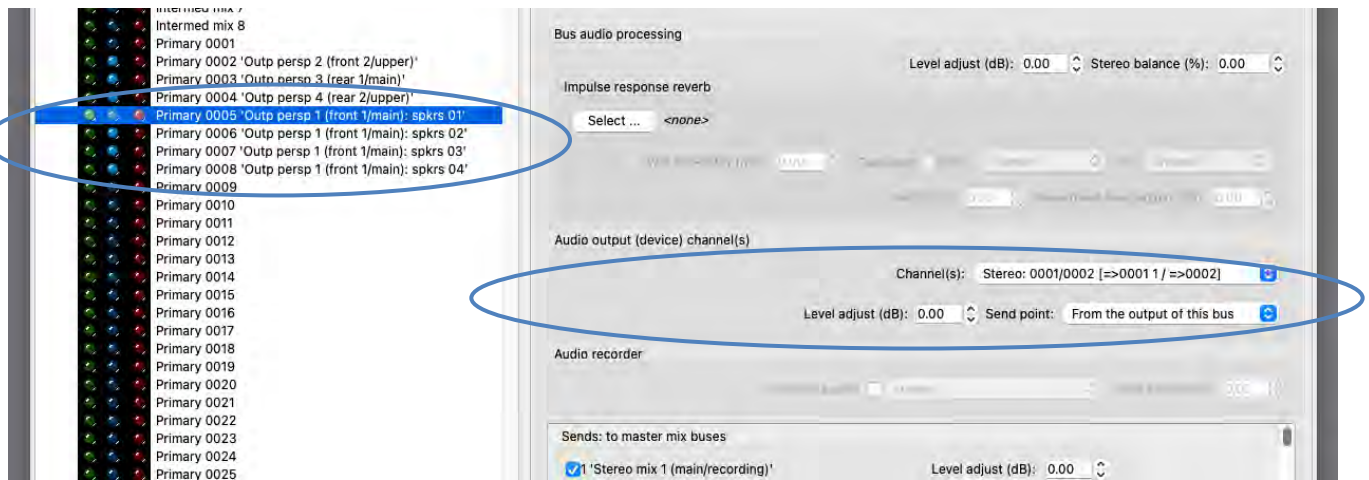
Go to the *General settings | Audio mixer bus groups* screen and simply note how the mixer preset's group 0005 contains just those four primary mixer buses (0005-0008) with the default settings. Hence when we route ranks to that group the pipes within the rank will be distributed automatically amongst those four primary mixer buses (speaker pairs).
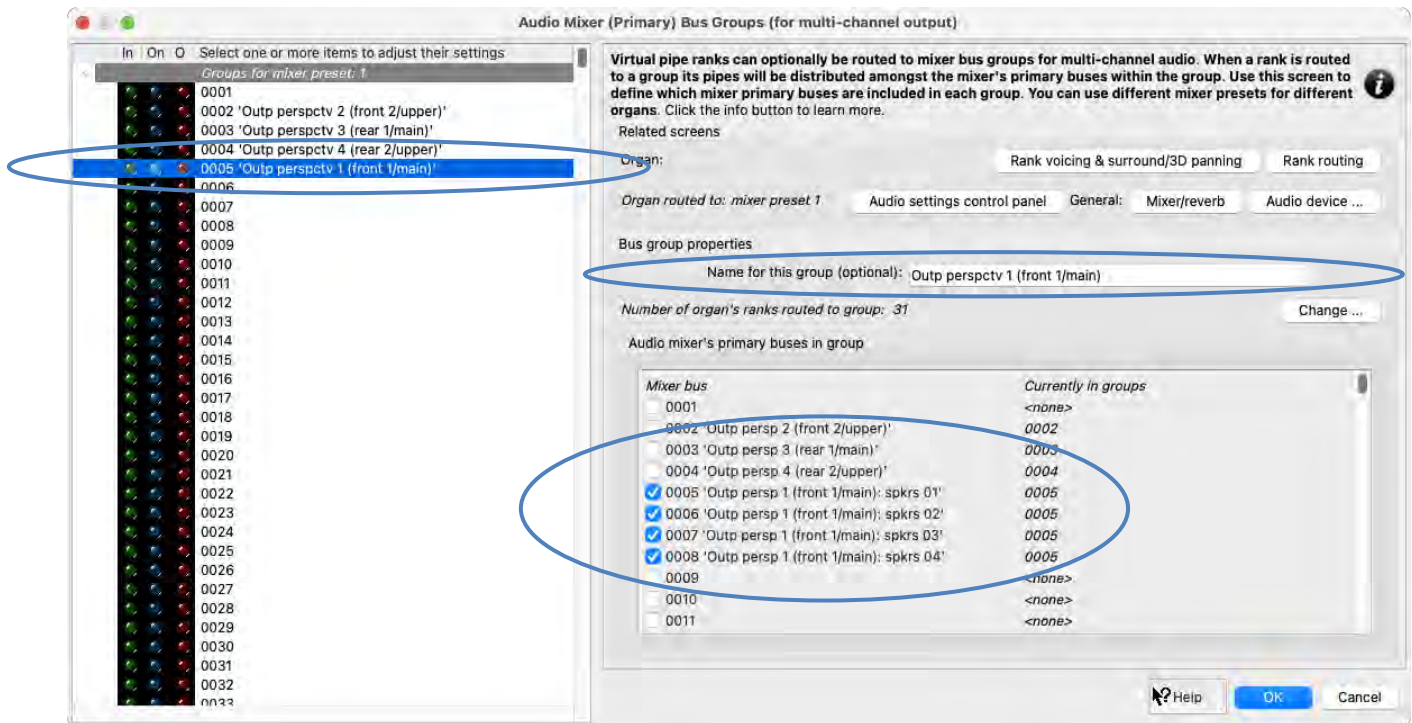
Note how primary mixer buses 0005-0008 and bus group 0005 have meaningful names on their respective screens, to help indicate what they're used for, but feel free to change those names if you wish. If you have more than four main speaker pairs then you could simply select their device channels for additional primary mixer buses (0009, 0010, etc.) on the mixer screen, name those buses meaningfully, and use the groups screen to add those buses into bus group 0005.

[Example continues on next page.]

Go to the *Organ settings | Rank routing …* screen and select a rank in the left-hand browse list. Simply note how the rank has its '*Rank output perspective 1 (front 1/main): Destination mixer bus/group*' setting set to group 0005 (with default settings). Hence the rank will be routed to that group, and thus the rank's pipes will be assigned amongst the primary mixer buses that are members of that particular group (i.e. amongst primary buses 0005, 0006, 0007 and 0008).
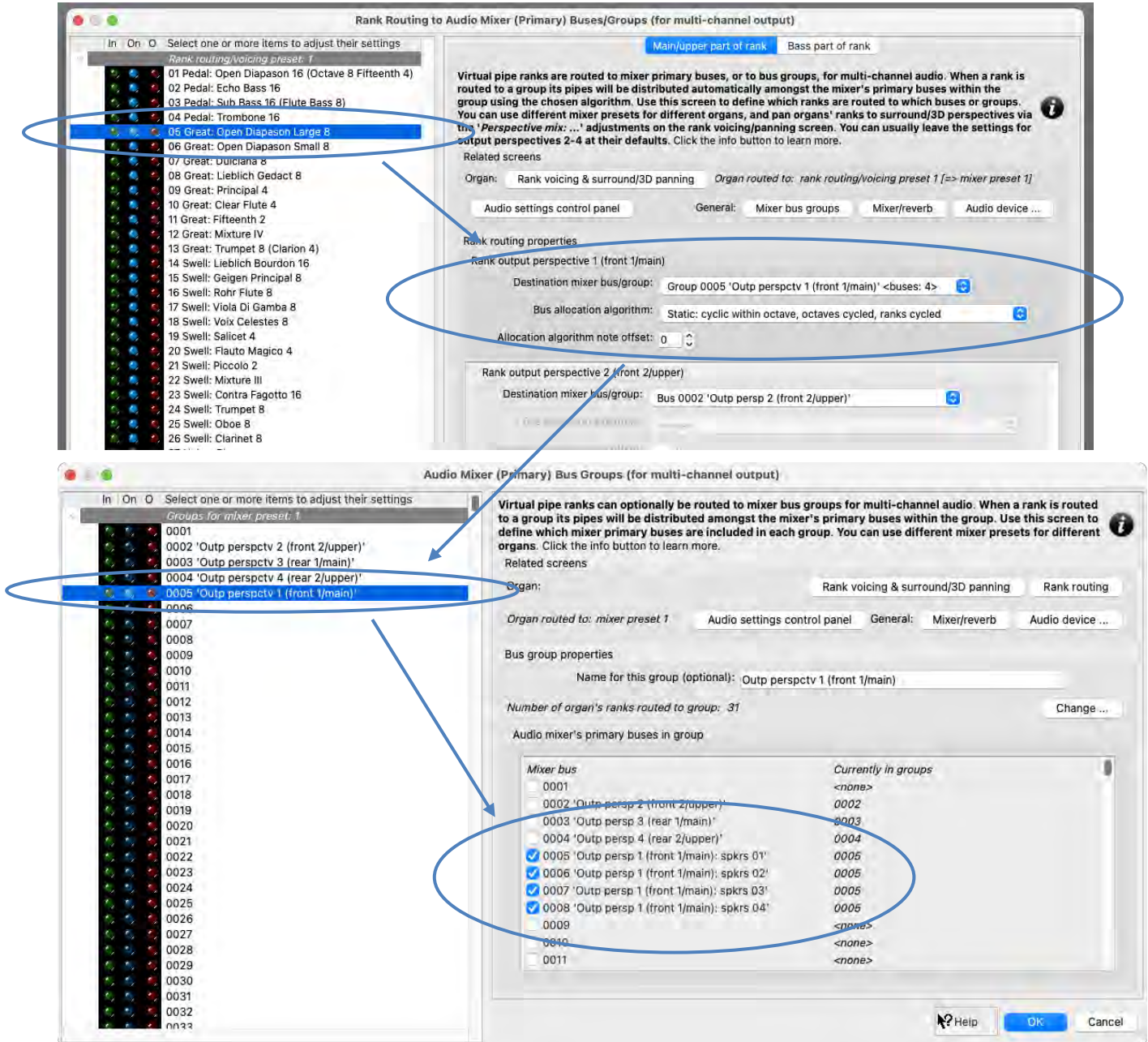
(Also, on the *Rank routing …* screen, simply note how all of the ranks have their '*Rank output perspective 3 (rear 1/main): Destination mixer bus/group*' setting set to primary bus 0003, which is configured correctly by default for a 'rear' surround mix.)

Draw a single virtual stop and play a chromatic scale. You should hear successive pipes allocated (cyclically) to different pairs of speakers. On the mixer screen, note how the virtual audio activity LEDs illuminate for the corresponding primary mixer buses – a useful aid for troubleshooting routing, if needed.

[Example continues on next page.]

If you have also configured a stereo pair of speakers for 'rear' surround-sound output, then now on the *Organ settings | Rank voicing and surround/3D/perspective panning* screen, for each of the two relevant '*Perspective mix: …*' adjustments (in the drop-down list at the top-right of the screen) in turn, use the *MSTR* ('master') slider to 'pan' each of the organ's virtual ranks (within the '*Rank routing/voicing preset: 1*' node in the rank list) as desired to/between your multi-channel group of speaker pairs (output perspective 1) and your stereo 'rear' pair of surround-sound speakers (output perspective 3):
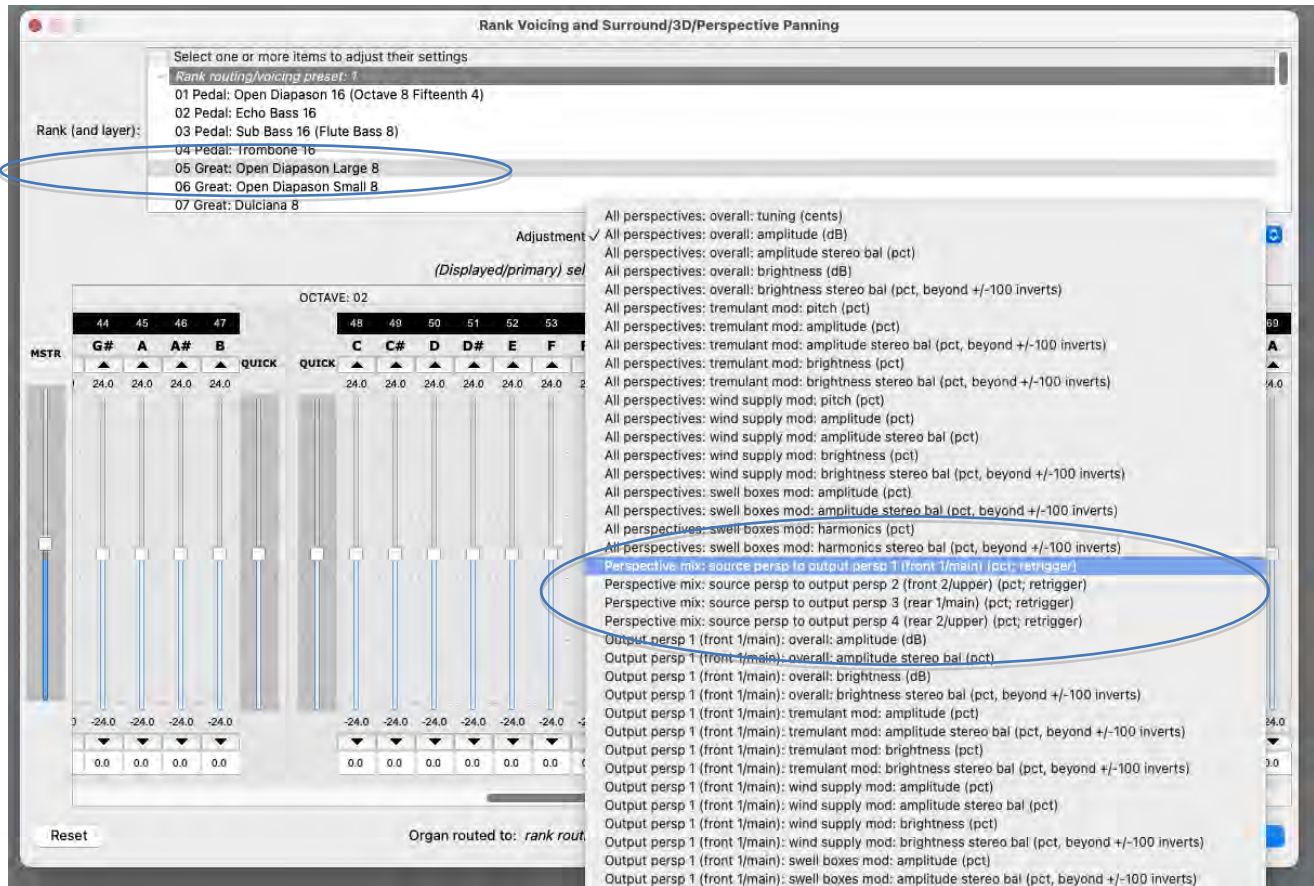
For example, to route one or more virtual ranks entirely to a 'rear' surround pair of speakers (rather than your multi-channel group of speaker pairs), you would need to select the rank(s) on the voicing/panning screen (you can select multiple ranks simultaneously), then:

1. Select the '*Perspective mix: source persp to output persp 1 (front 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 0% (rather than the adjustment's default of 100%, since all ranks are routed entirely to output perspective 1 by default, which we're using for our multi-channel group of speaker pairs in this example), and:

2. Select the '*Perspective mix: source persp to output persp 3 (rear 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 100% (rather than the adjustment's default of 0%).

(The values don't have to be fully 100% or 0%; in-between values can be used to position ranks/pipes virtually 'between' the relevant speakers.)

[Example continues on next page.]

If you had also configured an 'aux reverb send' in the above steps, then you should hear the selected reverb through its pair of speakers. If you wish, you can fine-tune the reverb settings via the relevant mixer bus ('*Master mix 4 'Stereo mix 4 (aux reverb mix)'*') on the *General settings | Audio mixer* screen. Bear in mind that any changes you make there will affect all organs that are set to use mixer preset 1. However, using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) you can then optionally reduce (scale) the reverb 'wetness' for just this organ, via the '*Mixer impulse response reverb scaler %*' slider. Load any other organs you may have and use the audio settings control panel to tweak their reverb wetness (or disable reverb completely) if desired. For example, you might want to set the slider to 0% for wet organs, leave it at 100% for fully dry organs, and set it somewhere in-between for semi-dry organs.

If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them). Hence bear in mind that if the wetness scaler is set to less than 100% then the output of an 'aux reverb send' mixer bus ('*Master mix 4 'Stereo mix 4 (aux reverb mix)'*' in this example) will have some 'dry' signal mixed into it.

Example 4: multi-channel audio with 8 (or more) speakers configured as stereo pairs, with whole organ divisions routed directly to individual stereo pairs, optionally plus a sub-woofer, optionally plus an additional pair of 'rear' speakers for surround-sound

(The following steps assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard*, and then *Organ settings | Organ configuration wizard* with each applicable organ loaded in turn, respectively.)
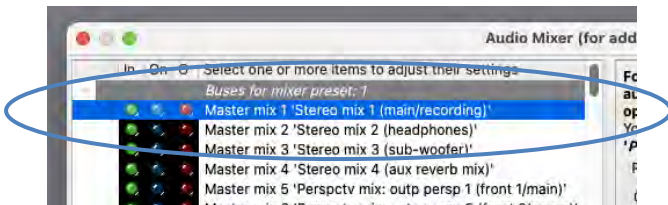
Let's refer to your four speaker pairs as '*Division A speaker pair*', '*Division B speaker pair*', ..., '*Division D speaker pair*' (using letters instead of numbers, so as to avoid any confusion with the mixer bus numbers).

First decide which of the 128 mixer presets you want to configure, and which rank routing/voicing preset. We'll assume 1 for both (the default) for simplicity.

Load an organ (e.g. St. Anne's). Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) make sure that the currently-loaded organ is using (for this example) mixer preset 1.

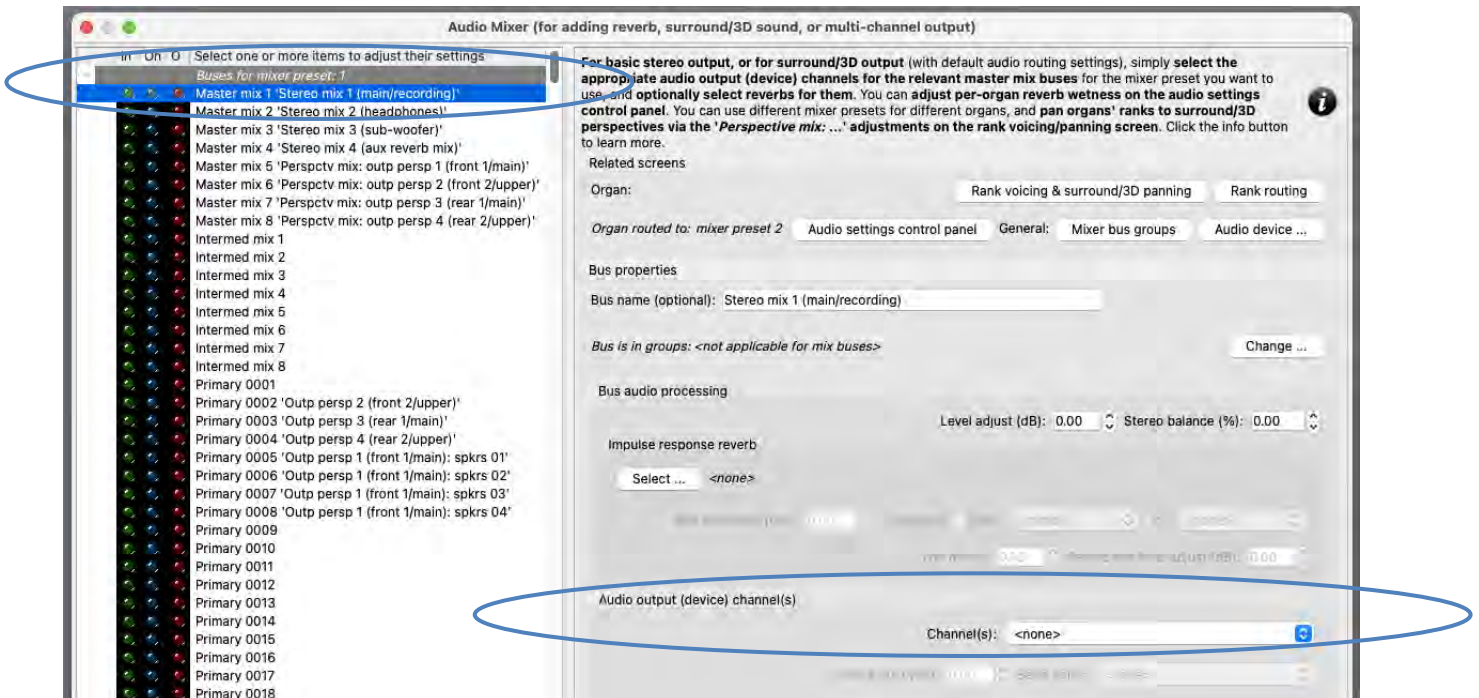Now open the *General settings | Audio mixer* screen. Make sure that the '*Mixer buses for mixer preset 1*' node is expanded in the left-hand browse list:

Select the following entry (mixer bus) in the left-hand browse list:

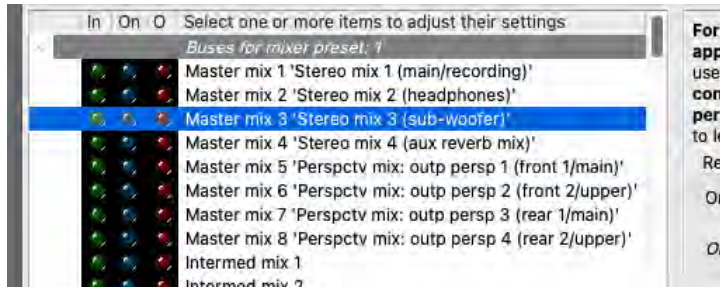- [Within the mixer preset 1 node]: *Master mix 1 'Stereo mix 1 (main/recording)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to '*<none>*'.

If you want to use a mono sub-woofer (which is connected to a separate audio device channel), then:

Select the following entry in the left-hand browse list:

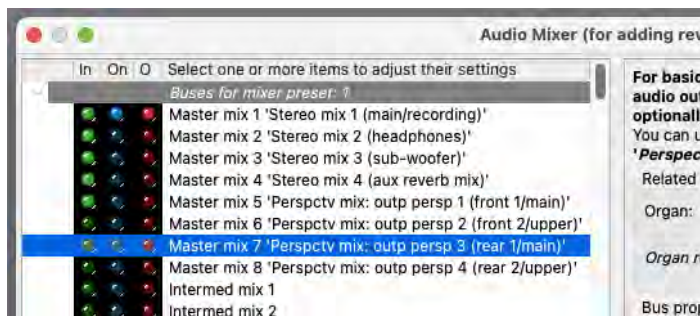- [Still within the mixer preset 1 node]: *Master mix 3 'Stereo mix 3 (sub-woofer)'*.

… and in the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the mono audio device channel that you want to use for your sub-woofer. (Mono channels can be found near the end of the drop-down channel list, after the stereo pairs.)

If you also want to set up an additional stereo pair of 'rear' speakers for surround-sound, then:

Select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 7 'Perspctv mix: outp persp 3 (rear 1/main)'*.
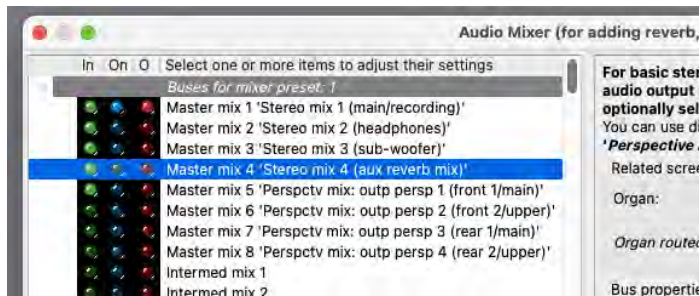

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your 'rear' stereo pair of surround speakers.

We'll uses primary buses 0010-0013 for your four main speaker pairs. Hence first select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Primary 0010*.

Use the '*Audio output (device) channel(s): Channel(s)*' setting to select the appropriate stereo channel pair for your first pair of speakers. Also change its '*Bus name*' setting to something appropriate, such as '*Division A speaker pair*'. (Names are optional and have no functional effect, but they do make it easier to see what's happening when configuring and troubleshooting routing.)
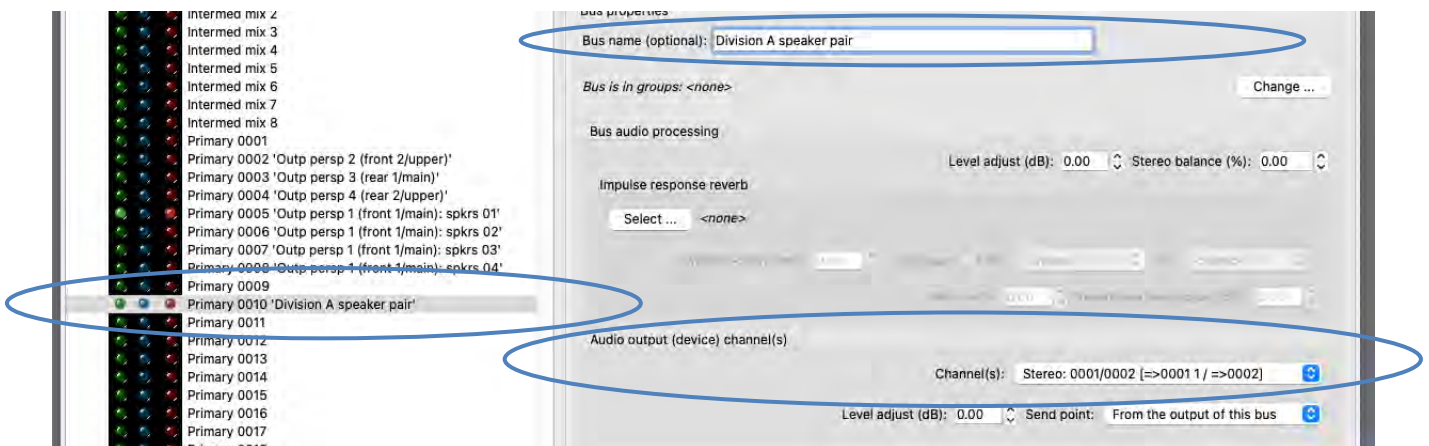
[Example continues on next page.]

Now select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Primary 0011.*

For it, select the device channels for your second pair of speakers. Also change its '*Bus name*' setting to (for example) '*Division B speaker pair*'. Do likewise for primary buses 0012 and 0013, selecting the device channels for your third and fourth pairs of speakers respectively and naming them '*Division C speaker pair*' and '*Division D speaker pair*' respectively.
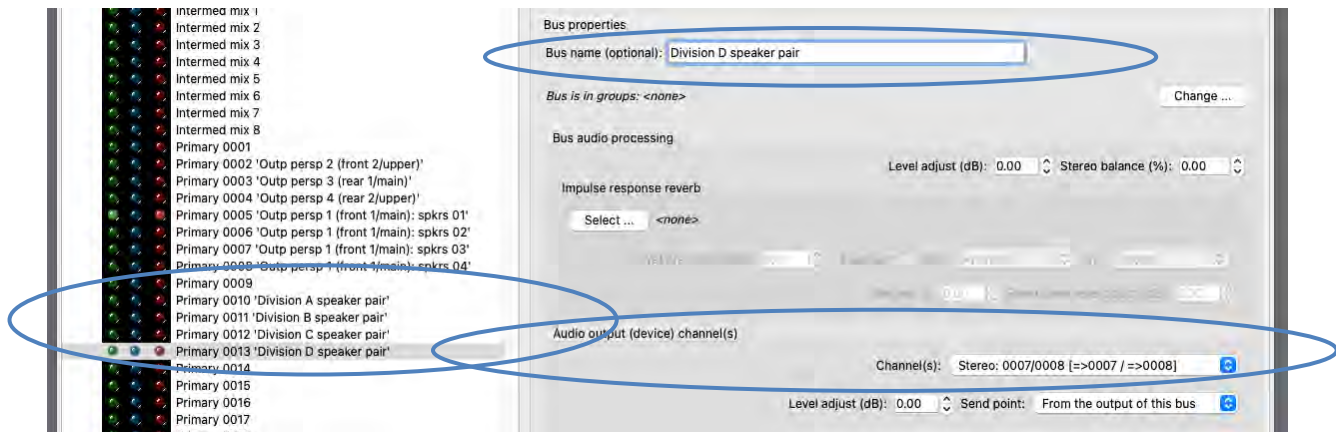
We won't be using mixer bus groups (or the *General settings | Audio mixer bus groups*) screen at all for this example, since groups exist solely to distribute individual pipes within a rank around amongst several speakers/pairs within the group, whereas in this example we'll be routing ranks (divisions) as a whole to individual speaker pairs. Hence although we could theoretically use groups, there would only be one mixer bus (stereo speaker pair) in each group anyway, and so there would be no advantage in using the group – routing directly to the mixer bus (as we will be doing) would be simpler to set up and would give exactly the same result.

[Example continues on next page.]

Go to the *Organ settings | Rank routing* … screen. For each rank listed in the left-hand list, use the '*Rank output perspective 1 (front 1/main): Destination mixer bus/group*' setting to route the rank to the desired one of your four primary mixer buses (0010 '*Division A speaker pair*', 0011 '*Division B speaker pair*', 0012 '*Division C speaker pair*', or 0013 '*Division D speaker pair*') according to the rank's division. For example, you might choose to route all the organ's Pedal ranks to '*Division A speaker pair*', its Great ranks to '*Division B speaker pair*', and so on. (Note that you can highlight multiple ranks at once in the left-hand list, in order to change their settings simultaneously.)
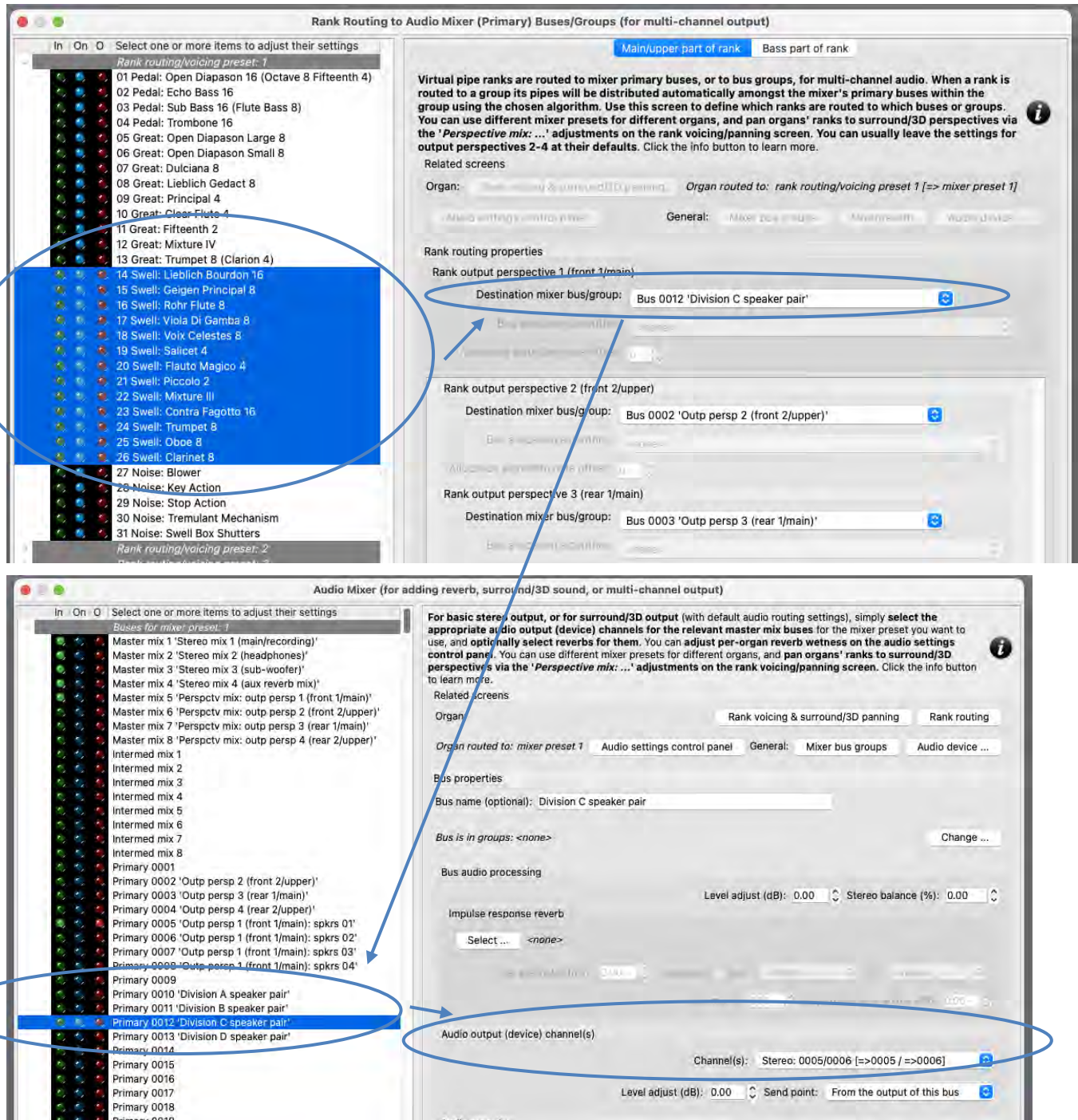
Draw a single virtual stop and play it. You should hear pipes sounding through the pair of speakers (primary bus) to which you routed the stop's rank. On the mixer screen, note how the virtual audio activity LEDs illuminate for the corresponding primary mixer buses – a useful aid for troubleshooting routing, if needed.

[Example continues on next page.]

If you have also configured a stereo pair of speakers for 'rear' surround-sound output, then now on the *Organ settings | Rank voicing and surround/3D/perspective panning* screen, for each of the two relevant '*Perspective mix: …*' adjustments (in the drop-down list at the top-right of the screen) in turn, use the *MSTR* ('master') slider to 'pan' each of the organ's virtual ranks (within the '*Rank routing/voicing preset: 1*' node in the rank list) as desired to/between your multi-channel speaker pairs (all of which will use output perspective 1) and your stereo 'rear' pair of surround-sound speakers (output perspective 3):

For example, to route one or more virtual ranks entirely to a 'rear' surround pair of speakers (rather than your multi-channel speaker pairs), you would need to select the rank(s) on the voicing/panning screen (you can select multiple ranks at once, to change their settings simultaneously), then:

1. Select the '*Perspective mix: source persp to output persp 1 (front 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 0% (rather than the adjustment's default of 100%, since all ranks are routed entirely to output perspective 1 by default, which we're using for our multi-channel speaker pairs in this example), and:

2. Select the '*Perspective mix: source persp to output persp 3 (rear 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 100% (rather than the adjustment's default of 0%).

The values don't have to be fully 100% or 0%; in-between values can be used to position ranks/pipes virtually 'between' the relevant speakers.

Load any other organs you may have and use the *Organ settings | Rank routing …* screen to assign their ranks to the desired bus groups.

Example 5: multi-channel audio with 24 (or more) speakers configured as stereo pairs in 3 groups of 4 pairs each, with different organ divisions routed to different groups, optionally plus a sub-woofer, optionally plus an additional pair of 'rear' speakers for surround-sound, optionally plus an additional pair of speakers as an 'aux reverb mix' with added reverb (which can be bypassed, or its wetness adjusted, on a per-organ basis)

(The following steps assume that your audio configuration and rank routing settings are at their defaults initially, but if they aren't, then you could optionally reset them back to their defaults using *General settings | General configuration wizard*, and then *Organ settings | Organ configuration wizard* with each applicable organ loaded in turn, respectively.)

Let's refer to your three planned groups as A, B and C (so as to avoid any confusion with the group numbers). (In practice, you might instead prefer to give them names that reflect where they're located in your room, or perhaps the organ division names that you would normally route to them.)

First decide which of the 128 mixer presets you want to configure, and which rank routing/voicing preset. We'll assume 1 for both (the default) for simplicity.

Load an organ (e.g. St. Anne's). Using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) make sure that the currently-loaded organ is using (for this example) mixer preset 1.

Now open the *General settings | Audio mixer* screen. Make sure that the '*Mixer buses for mixer preset 1*' node is expanded in the left-hand browse list:

[Example continues on next page.]

Select the following entry (mixer bus) in the left-hand browse list:

- [Within the mixer preset 1 node]: *Master mix 1 'Stereo mix 1 (main/recording)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to '*<none>*'.

If you want to use a mono sub-woofer (that's connected to a separate audio device channel), then:

Select the following entry in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 3 'Stereo mix 3 (sub-woofer)'*.

… and in the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the mono audio device channel that you want to use for your sub-woofer. (Mono channels can be found near the end of the drop-down channel list, after the stereo pairs.)

If you also want to set up an additional stereo pair of 'rear' speakers for surround-sound, then:

Select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 7 'Perspctv mix: outp persp 3 (rear 1/main)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your 'rear' stereo pair of surround speakers.

If you also want to set up an 'aux reverb mix' through an additional pair of speakers, then:

Select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Master mix 4 'Stereo mix 4 (aux reverb mix)'*.

In the right-hand pane, set its '*Audio output (device) channel(s): Channel(s)*' setting to the stereo pair of audio device channels that you want to use for your reverb stereo pair of speakers. Then use the '*Impulse response reverb: Select …*' button to select the impulse response reverb that you want to use for them.

We'll uses primary buses 0005-0008 for the four speaker pairs in your group A, 0009-0012 for those in your group B, and 0013-0016 for the those in your group C. Hence first select the following entry (mixer bus) in the left-hand browse list:
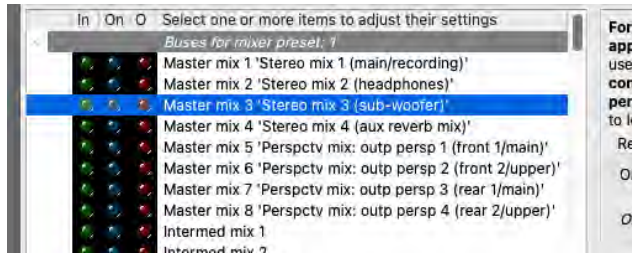
- [Still within the mixer preset 1 node]: *Primary 0005 … .*

Use the '*Audio output (device) channel(s): Channel(s)*' setting to select the appropriate stereo channel pairs for your first pair of speakers in your group A. Also change its '*Bus name*' setting to something appropriate, such as '*Group A: speaker pair 01*'. (Names are optional and have no functional effect, but they do make it easier to see what's happening when configuring and troubleshooting routing.)
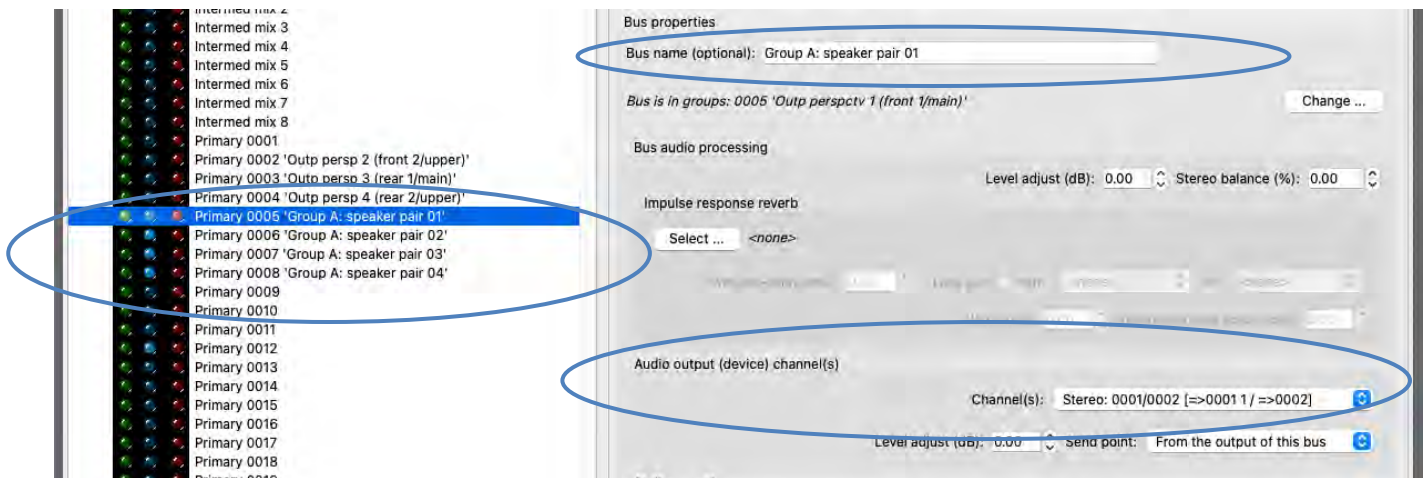
[Example continues on next page.]

Now select the following entry (mixer bus) in the left-hand browse list:

- [Still within the mixer preset 1 node]: *Primary 0006 … .*

For it, select the device channels for your second pair of speakers in group A. Also change its '*Bus name*' setting to something appropriate, such as '*Group A: speaker pair 02*'. Do likewise for primary buses 0007 and 0008, selecting the device channels for your third and fourth pairs of speakers respectively in your group A, and naming them (for example) '*Group A: speaker pair 03*' and '*Group A: speaker pair 04*' respectively.

Do likewise for primary buses 0009-0012, selecting the device channels for your pairs of speakers respectively in your group B, and naming them (for example) '*Group B: speaker pair 01*', …, '*Group B: speaker pair 04*' respectively.

Do likewise for primary buses 0013-0016, selecting the device channels for your pairs of speakers respectively in your group C, and naming them (for example) '*Group C: speaker pair 01*', …, '*Group C: speaker pair 04*' respectively:

Now go to the *General settings | Audio mixer bus groups* screen. We'll use bus group 0005 for your group A, 0006 for group B, and 0007 for group C. Hence start by selecting the following entry in the left-hand list of groups:

- [Within the mixer preset 1 node]: *0005 … .*

Change its name to something meaningful, such as '*Group A*'. In its list of primary buses within the group, make sure that just the entries for primary buses 0005 (your '*Group A: speaker pair 01*') through to 0008 (your '*Group A: speaker pair 04*') are ticked, thus making (just) those four primary mixer buses (pairs of speakers) members of the group. (Note how having given the buses meaningful names above has made this clearer.)
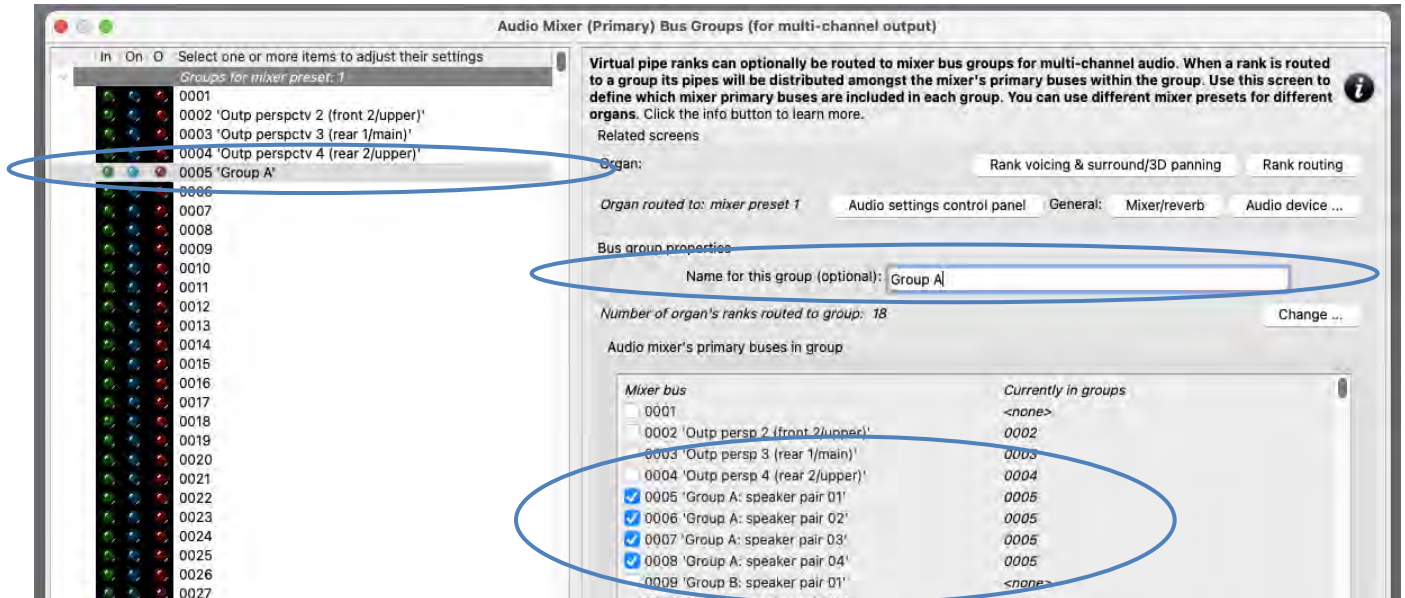
*[Example continues on next page.]*

Now select the following entry in the left-hand list of groups:

- [Still within the mixer preset 1 node]: *0006 … .*

Change its name to something meaningful, such as '*Group B*'. In its list of primary buses within the group, make sure that just the entries for primary buses 0009 (your '*Group B: speaker pair 01*') through to 0012 (your '*Group B: speaker pair 04*') are ticked, thus making (just) those four primary mixer buses (pairs of speakers) members of the group.

Do likewise for bus group 0007, naming it (for example) '*Group C*' and making sure that just your primary buses 0013 (your '*Group C: speaker pair 01*') through to 0016 (your '*Group C: speaker pair 04*') are ticked for it:
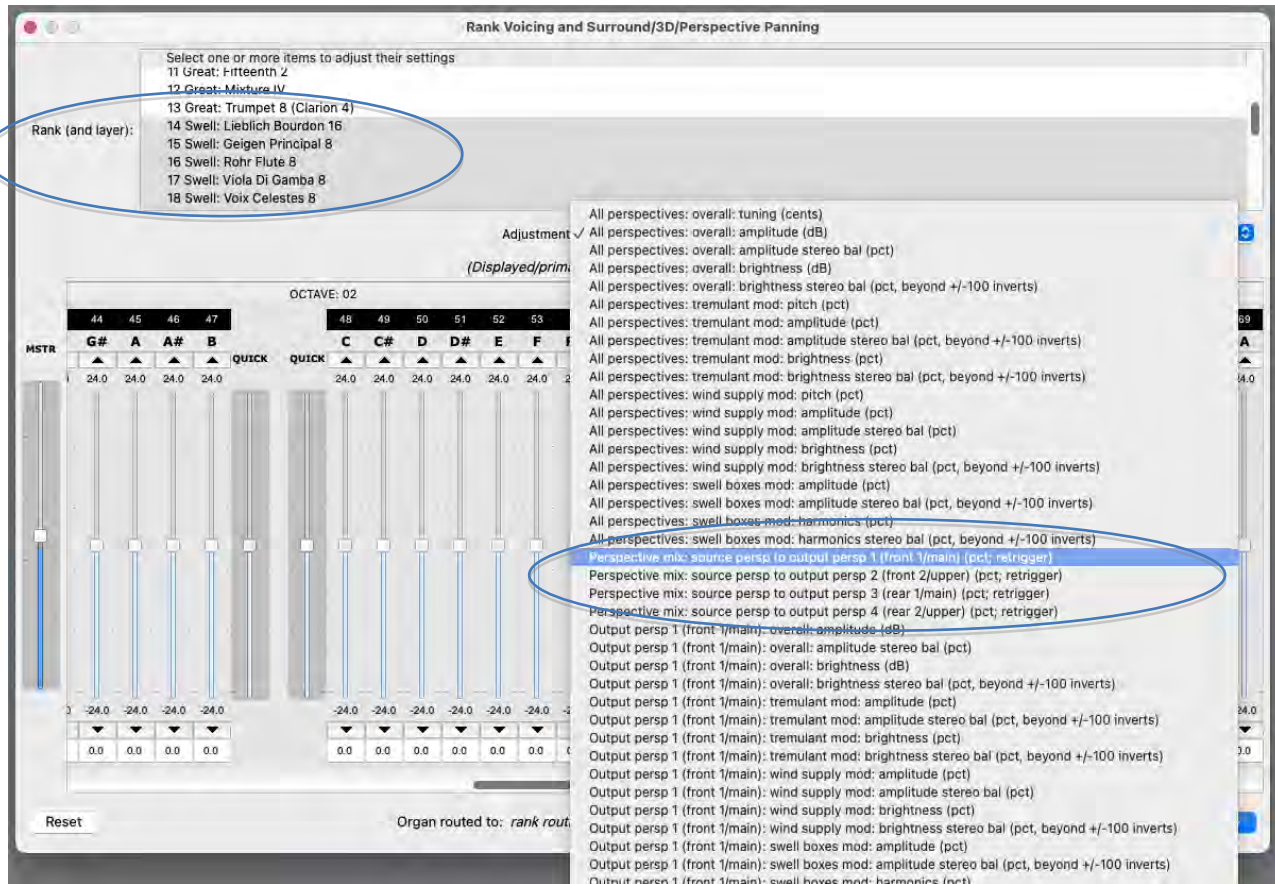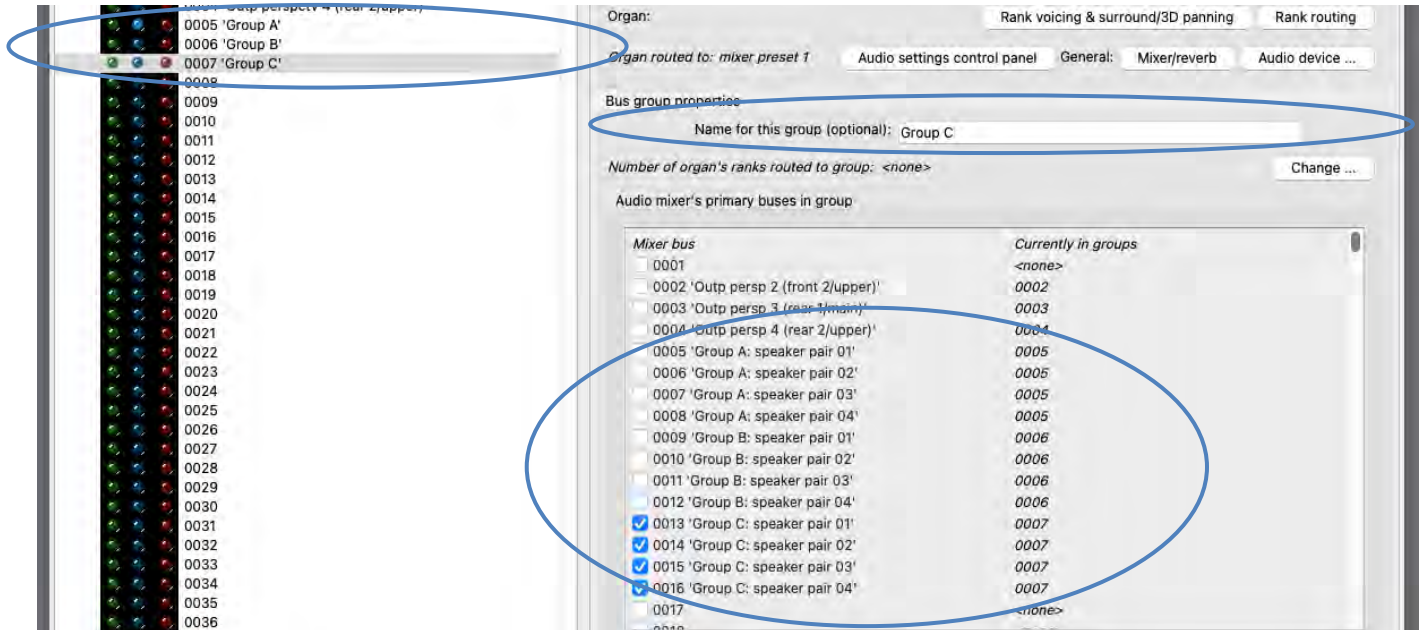

[Example continues on next page.]

Go to the *Organ settings | Rank routing* … screen. For each rank listed in the left-hand list, use the '*Rank output perspective 1 (front 1/main): Destination mixer bus/group*' setting to route the rank to the desired one of your three groups (0005 '*Group A*', or 0006 '*Group B*', or 0007 '*Group C*'). For example, you might choose to route all the organ's Pedal ranks to group A, its Great ranks to group B, and its Swell ranks to group C. Hauptwerk will then distribute a rank's pipes automatically amongst the stereo pairs of speakers (primary mixer buses) within the chosen group, based on the '*Rank output perspective 1 (front 1/main): Bus allocation algorithm*' setting. (Note that you can highlight multiple ranks at once in the left-hand list, in order to change their settings simultaneously.)
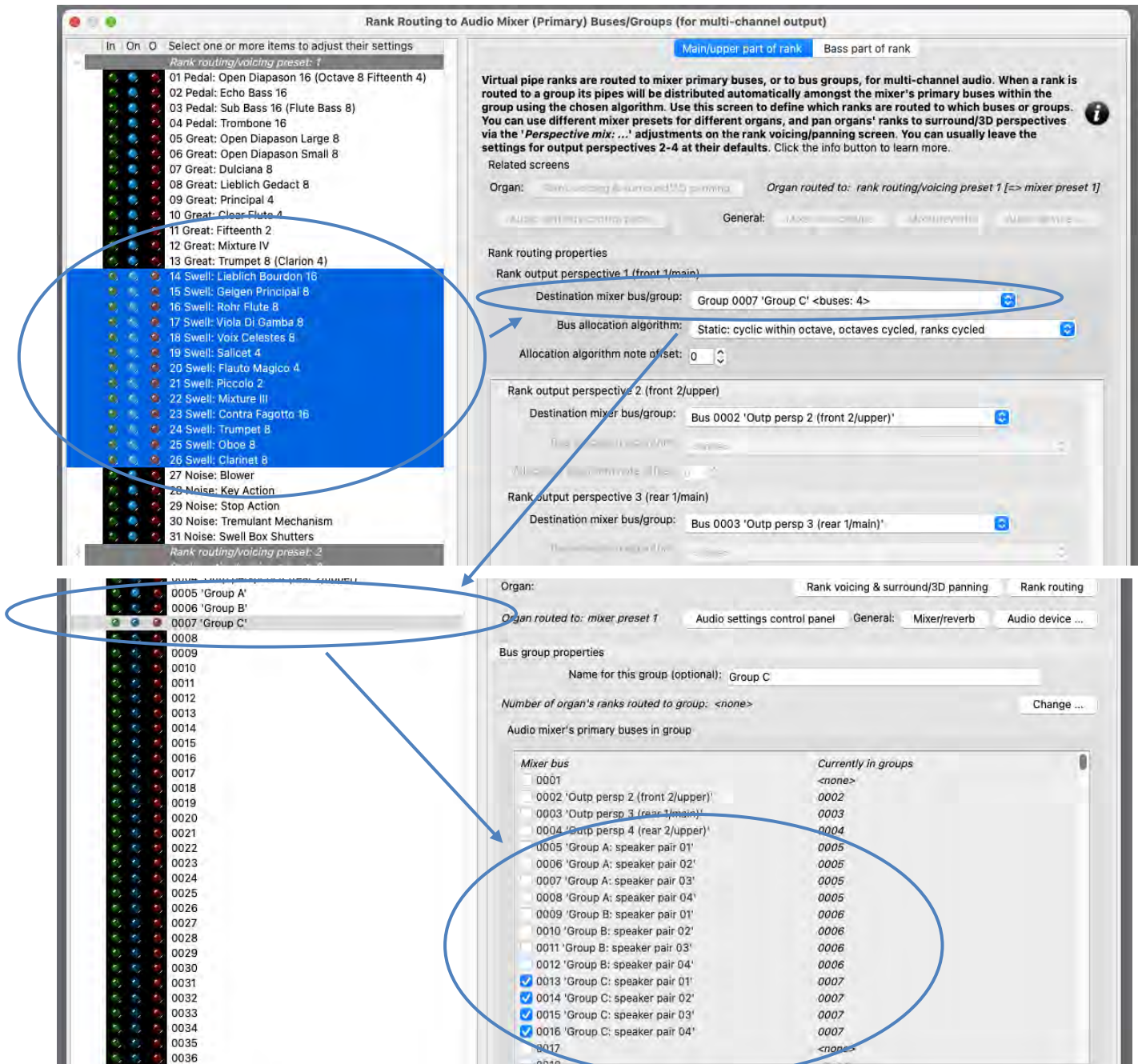
Draw a single virtual stop and play a chromatic scale. You should hear successive pipes allocated (cyclically) to different pairs of speakers (assuming you use the default algorithm) within the group to which you routed the stop's rank. On the mixer screen, note how the virtual audio activity LEDs illuminate for the corresponding primary mixer buses – a useful aid for troubleshooting routing, if needed.

[Example continues on next page.]

If you have also configured a stereo pair of speakers for 'rear' surround-sound output, then now on the *Organ settings | Rank voicing and surround/3D/perspective panning* screen, for each of the two relevant '*Perspective mix: …*' adjustments (in the drop-down list at the top-right of the screen) in turn, use the *MSTR* ('master') slider to 'pan' each of the organ's virtual ranks (within the '*Rank routing/voicing preset: 1*' node in the rank list) as desired to/between your multi-channel groups of speaker pairs (all of which will use output perspective 1) and your stereo 'rear' pair of surround-sound speakers (output perspective 3):

For example, to route one or more virtual ranks entirely to a 'rear' surround pair of speakers (rather than your multi-channel groups of speaker pairs), you would need to select the rank(s) on the voicing/panning screen (you can select multiple ranks at once, to change their settings simultaneously), then:

3.　Select the '*Perspective mix: source persp to output persp 1 (front 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 0% (rather than the adjustment's default of 100%, since all ranks are routed entirely to output perspective 1 by default, which we're using for our multi-channel groups of speaker pairs in this example), and:

4.　Select the '*Perspective mix: source persp to output persp 3 (rear 1/main)*' adjustment, then use the 'MSTR' slider to set all of the adjustment's pipe sliders to 100% (rather than the adjustment's default of 0%).

The values don't have to be fully 100% or 0%; in-between values can be used to position ranks/pipes virtually 'between' the relevant speakers.

[Example continues on next page.]

If you had also configured an 'aux reverb send' in the above steps, then you should hear the selected reverb through its pair of speakers. If you wish, you can fine-tune the reverb settings via the relevant mixer bus ('*Master mix 4 'Stereo mix 4 (aux reverb mix)"*') on the *General settings | Audio mixer* screen. Bear in mind that any changes you make there will affect all organs that are set to use mixer preset 1. However, using the audio settings control panel (*View | Large … control panels (for this organ) | Audio … settings*) you can then optionally reduce (scale) the reverb 'wetness' for just this organ, via the '*Mixer impulse response reverb scaler %*' slider.

If the control panel's wetness scaler is set to 0% for an organ then impulse response reverb processing is entirely bypassed for that organ (thus avoiding any real-time CPU overheads from it), and the output of any mixer buses will be fully 'dry' (even if reverbs are assigned to them). Hence bear in mind that if the wetness scaler is set to less than 100% then the output of an 'aux reverb send' mixer bus ('*Master mix 4 'Stereo mix 4 (aux reverb mix)"* in this example) will have 'dry' signal mixed into it.

Load any other organs you may have and use the *Organ settings | Rank routing* … screen to assign their ranks to the desired bus groups. If you set up an aux reverb send, then also use the audio settings control panel to tweak reverb wetness (or disable reverb completely) for them if desired. For example, you might want to set the slider to 0% for wet organs, leave it at 100% for fully dry organs, and set it somewhere in-between for semi-dry organs.

MIDI LCD panel displays

Hauptwerk is able to control 32-character LCD panels using custom MIDI system exclusive messages to show any of its dynamic status information (for example, the name of the organ, temperament or combination set loaded or cued, organ loading progress, or the combination stepper frame number) or to show static user-specified label text, for example allowing you to label each MIDI stop switch with an appropriate name depending on which virtual organ is loaded.

Appropriate off-the-shelf 32-character LCD display hardware units, designed specifically for use with Hauptwerk, are available from third-party MIDI hardware suppliers, making it easy to display Hauptwerk status information on home-built MIDI consoles, without the need for any do-it-yourself electronics or specialist expertise.

Each hardware LCD panel can be controlled from any MIDI output port, and should be programmed with a unique ID. Up to 32 characters can be sent to each display, with the text data being sent as raw ASCII (7-bit) byte sequences. A color code is also sent to each panel so that it can be back-lit or otherwise associated with a color to indicate its broad function (stop, coupler, etc.) or grouping (division, etc.).

Please see the *MIDI implementation* section of this guide if you need details of the custom MIDI system exclusive message format Hauptwerk uses to control LCD panels.

There are two menu options for configuring LCD panels with Hauptwerk.

- *General settings | MIDI status display LCD panel control (for all organs)*, which allows you to configure LCD panels the same for all organs:

- *Organ settings | MIDI LCD panel control (for this organ)*, which allows you to configure additional LCD panels separately for the organ currently loaded. This may be useful for showing per-organ static label text, for example, or for other inherently organ-specific information (such as organ virtual expression pedal states). Various examples have been shown throughout this user guide. Static label text allows each individual instrument to display its particular stop names according to the layout of the organ, for example.

Installing/uninstalling/upgrading organs, temperaments, or reverbs (the component installer)

Hauptwerk includes a native installer that is used to install Hauptwerk sample sets, organs, temperaments, and impulse response reverbs that are available separately from Hauptwerk itself and from third parties. The installer also has the ability to upgrade such components, apply patches, and uninstall components, while ensuring that all components are automatically installed into the correct locations on all supported operating systems and platforms, and ensuring that dependencies are satisfied.

You should always use the component installer when you wish to install, upgrade or remove any Hauptwerk components provided in Hauptwerk version 2 format or above. (Hauptwerk version 1 sample sets must instead be imported, which is covered in the *Importing Hauptwerk version 1 organs* section.)

Components (such as additional sample sets) are supplied in Hauptwerk *component packages*, which are files with a filename extension *.CompPkg_Hauptwerk_rar*, (or *.HauptwerkOrgan* or *.CompPkg.Hauptwerk.rar*).

We assume that you have downloaded such a component package, or that it has been supplied to you on a USB memory stick (or DVD, or similar).

Important note 1: Please always use Hauptwerk's native component installer to install such packages, rather than attempting to extract or install them manually using third-party RAR extraction software. Using Hauptwerk's component installer will ensure that they are installed properly.

Important note 2: Commercial copy-protected sample sets that were created for Hauptwerk versions 2-4 cannot be installed or used in the current version of Hauptwerk. If you had purchased any previously, and the producer of any such sample set hasn't contacted you already, then please contact him/her if needed to get a download for the current version of the sample set (with compatibility for Hauptwerk version 5 onwards) and a license activation code for it.

Installing a new component

When installing a new Hauptwerk sample set (organ) or set of impulse response reverbs, it's important to do things in the correct order, as follows:

1. If it's a copy-protected product that's licensed via the iLok system, then you need to make sure that the license(s) are activated for it within iLok License Manager first. If you purchased it new then you should have been sent activation code(s) for it by the vendor, which you need to activate using *License | Redeem Activation Code* in iLok License Manager. [If instead you bought, or were given, the product second-hand (and assuming the product's license agreement allows transferring licenses) then you need its previous owner to transfer its license(s) to you, and you need to activate them in iLok License Manager. How to transfer licenses, and the cost involved is covered in the '*Your Licenses*' FAQ here: https://www.ilok.com/#!faq. If you need help with it then please contact PACE via the iLok website directly; Milan Digital Audio has no involvement in the process, and we aren't able to assist.] Once the license(s) have been activated successfully in iLok License Manager, exit and re-launch Hauptwerk if was running.

2. If it's a copy-protected product that's licensed via the iLok system, then download the current 'Hauptwerk licensing packages' Hauptwerk component package file from Milan Digital Audio: https://www.hauptwerk.com/licensingpackages. Use *File | Install …* to install it (in the way covered beneath this numbered list of steps). [The 'Hauptwerk licensing packages' link between Hauptwerk and Hauptwerk's iLok-based licensing system. They aren't licenses in themselves. The (master) 'Hauptwerk licensing packages' component package file contains the current versions of the licensing packages for *all* current copy-protected iLok-licensed sample sets (from all makers) and is hosted 'centrally' for download from Milan Digital Audio.]

3. If the product has multiple files that need to be installed in Hauptwerk, then make sure that they're all download to (or contained within) a single folder, such as your computer account's *Downloads* folder. (This is very important for 'multi-part' packages, otherwise installation will fail with an error in Hauptwerk.)

4. Also, if you downloaded the file(s), then it's best to check that they all download in full and without errors, for good measure (otherwise installation will fail with an error). For example, if the vendor has listed the expected file sizes and/or MD5 codes, then (if you know how to do it), you could use those to verify the download files.

5. If the product has several separate component package files to install which are **_not_** all parts of the same 'multi-part' package ('multi-part' packages have filename extensions of *… .partN.CompPkg_Hauptwerk_rar*), then make sure that you install *all* of them, one-by-one (using *File | Install …* in Hauptwerk to install each, in the way covered beneath this numbered list of steps) before you try to load the organ (via *Organ | Load organ …*, for example, or if Hauptwerk asks you). The organ won't usually be able to load until *all* of necessary packages have been installed. If instead the files **_are_** all parts of a single 'multi-part' package (with filename extensions *… .partN.CompPkg_Hauptwerk_rar*), then you should install just the first part (*… .part1.CompPkg_Hauptwerk_rar*) and the remainder will be installed automatically.

To install each component package in Hauptwerk (one-by-one):

Select *File | Install organ, temperament, or impulse response reverb* from the menu:
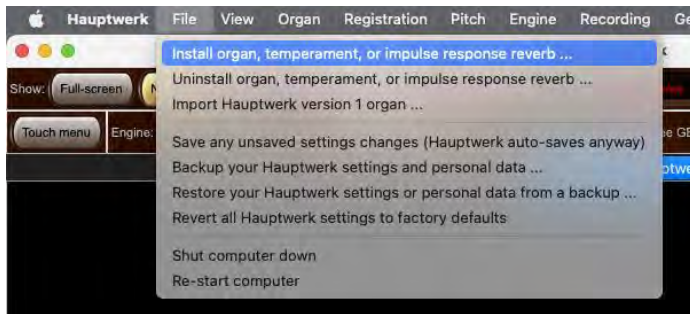
Alternatively, you could click on one of the *Install …* buttons on various control panels, such as the *Load/install Organs* large control panel:
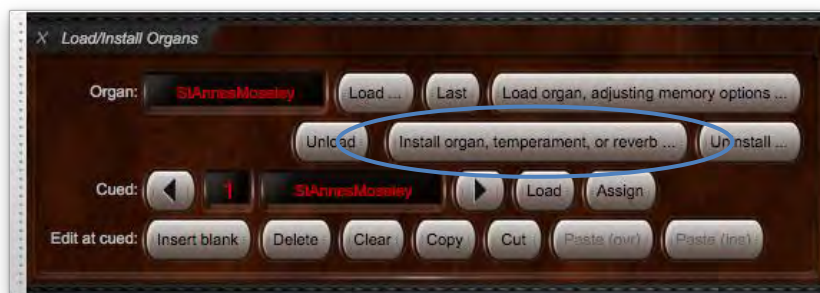
… or on the *Install …* buttons on the screens for selecting organs, or temperaments, or impulse response reverbs:
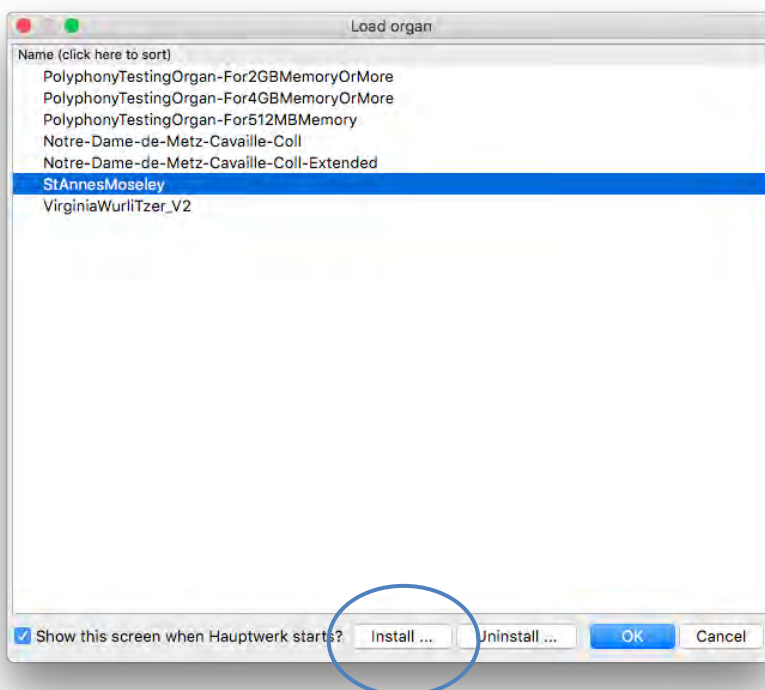
… or via the Touch Menu.

Navigate to the component package and select it. After a pause, the package should be extracted and analyzed by Hauptwerk's component installer, and the following screen should appear:
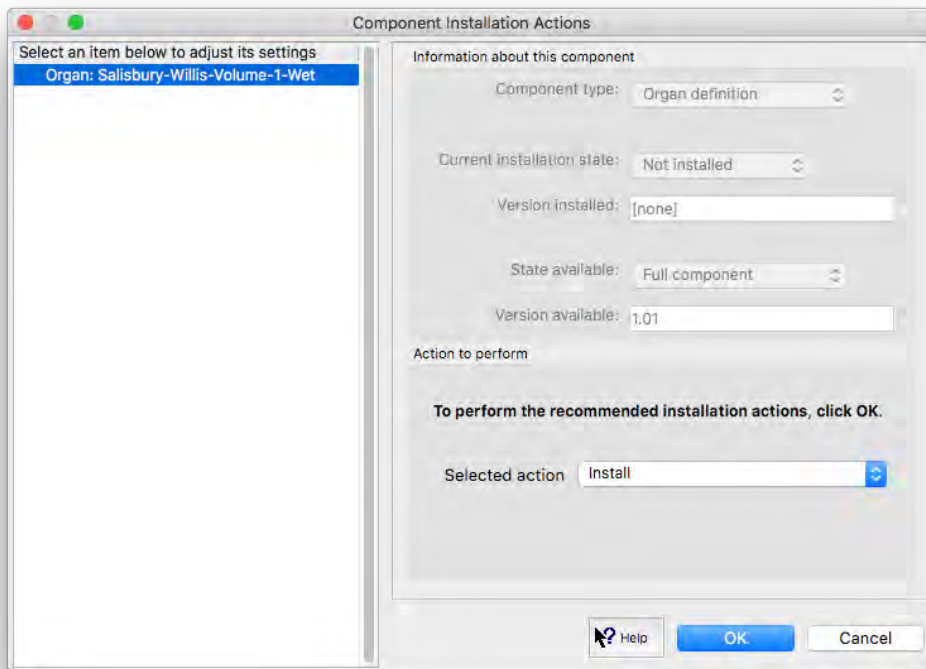
One item will be listed in the left-hand browse list for each component available in the package, and the right-hand pane will show its version, whether it is already installed, and the version installed if so.

A package may include several components of various types, which are identified by their prefixes in the left-hand browse list on Hauptwerk's component installer screen as follows:

- *Licensing package*: These components link between Hauptwerk and Hauptwerk's licensing system (which is based on PACE's iLok system). They aren't licenses in themselves. **Before installing any copy-protected iLok-licensed sample set, make sure that you have installed the current version of Hauptwerk's (master) 'Hauptwerk licensing packages' component package file (using '*File | Install …*' within Hauptwerk), and have activated the necessary license for the sample set (within iLok License Manager)**. The (master) 'Hauptwerk licensing packages' component package file contains the licensing packages for *all* current copy-protected iLok-licensed sample sets (from all makers) and is hosted 'centrally' for download from Milan Digital Audio: https://www.hauptwerk.com/licensingpackages. Make sure you install that package before installing any others. It doesn't hurt to have licensing packages installed for products that you don't have – they are harmless and tiny. Both the installed licensing packages (via Hauptwerk) *and* an activated license (via iLok License Manager) for the copy-protected sample set need to be present before Hauptwerk will be able to read, install, or load the relevant protected product itself.

- *Data*: These components are packages of audio sample files, images, and similar files that make up a sample set. Often, sample sets are split into several 'Data' packages, and *all* of the necessary packages for any given sample set will need to have been installed before you can load the associated organ (via *Organ | Load organ* … , for example). The sample set producer may provide several separate (non-'multi-part') component package files for a sample set which all need to be installed before trying to load the organ; please consult the producer's installation instructions for the sample set to verify which files need to be installed. In themselves, 'Data' packages are the only type of components that occupy a significant amount of drive space.

- *Organ*: These are the 'organ definitions', each of which defines the structure and functionality of an organ, as well as which audio samples it needs to load. Each 'Organ' will refer to one or more 'Data' packages, all of which must have been installed before the organ itself can be loaded. If you try to load an organ without having its necessary 'Data' packages installed, Hauptwerk will report an error, indicating which package(s) are missing.

- *Temper*: These are temperaments.

- *Reverb*: These are impulse response reverbs, for use on the *General settings | Audio mixer* screen in the Hauptwerk Advanced Edition.

As with Hauptwerk's setting screens, click on the pointer/question-mark icon immediately to the left of a screen's *OK* button:
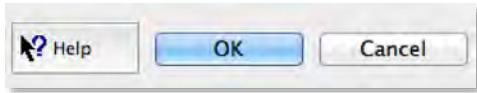
... then click onto the screen background or a specific setting for a detailed explanation of its function.

For each item in the component list, verify or adjust the *Selected action* in the right-hand pane (the default action is always to install, upgrade or re-install a component, as appropriate for whatever you already have installed). Click *OK* to perform the selected actions for all components in the list at once. The component(s) should then be installed and be ready to use.

If you have been supplied with several packages, for example to install a large sample set which spans multiple media or several downloads, then repeat the process to install each of them. Make sure you install <u>all</u> of the packages provided by the sample set producer before trying to load the organ (via *Organ | Load organ …* , for example).

Upgrading or patching a component

The process is identical for upgrading/patching. Where upgrading or patching is possible, the *Selected action* will include an option for it, which will be selected by default. Simply check the selected actions and then click *OK* to perform them.

Uninstalling a component

To remove a component, select *File | Uninstall organ, temperament, or impulse response reverb* from the menu.
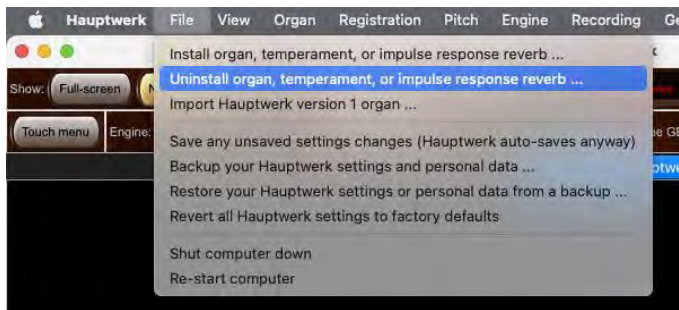
Alternatively, you could click on one of the *Uninstall …* buttons on various control panels, such as the *Load/install Organs* large control panel:

… or on the *Uninstall …* buttons on the screens for selecting organs, or temperaments, or impulse response reverbs:
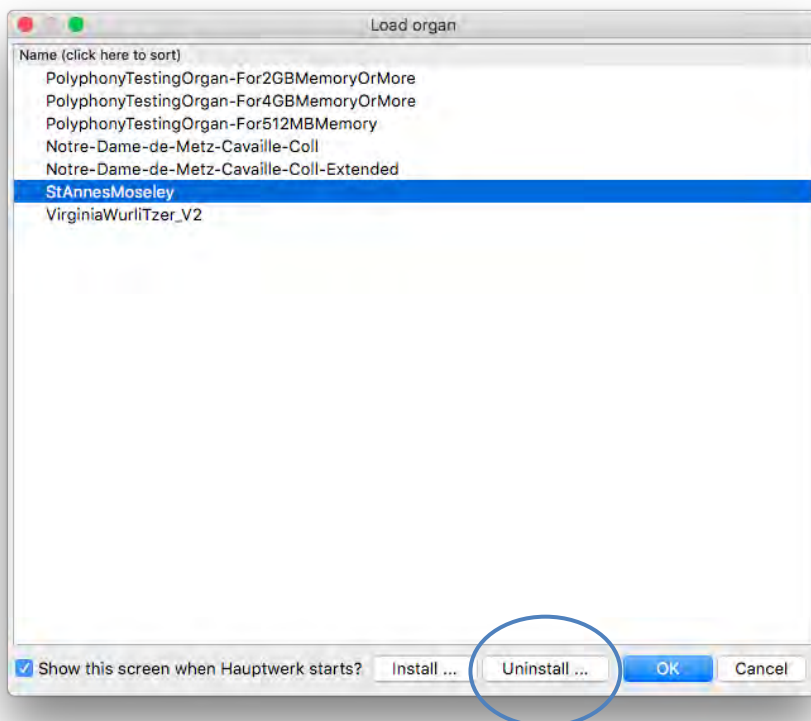
… or via the Touch Menu.

After a brief pause the component installer screen will show a list of all components currently installed:
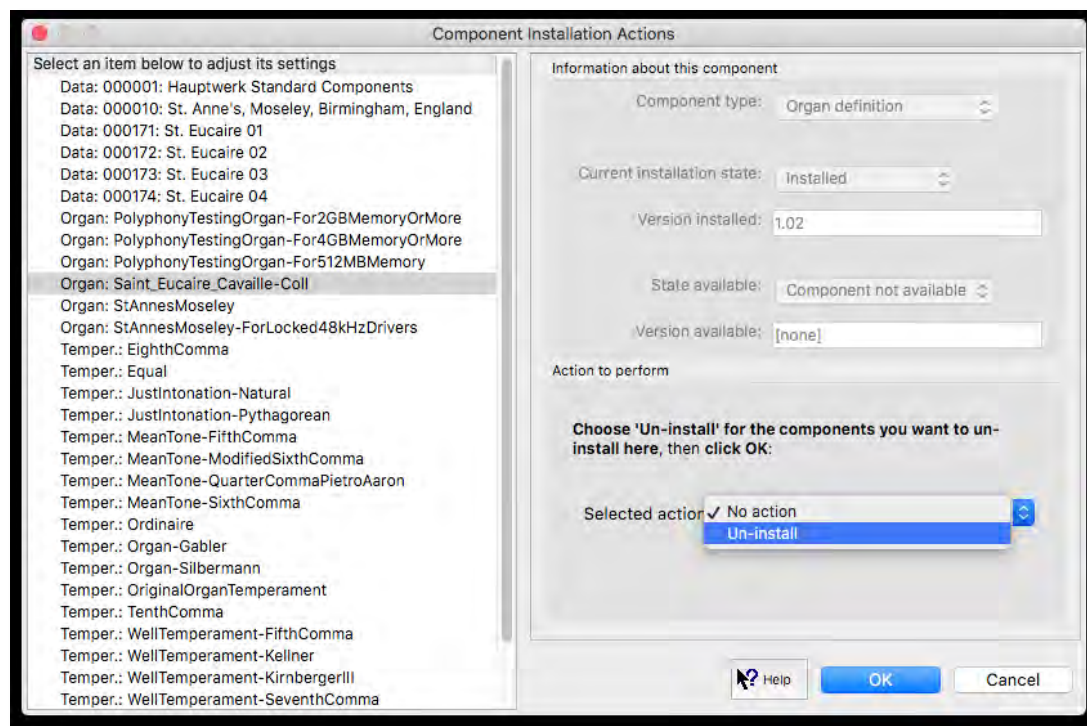
Simply select the component you wish to remove from the browse list, and change its *Selected action* to 'Uninstall'. Repeat for all components that you no longer require, then click *OK* to perform the de-installation.

Be careful not to uninstall '*Data*' or '*Organ*' components that belong to an organ that you want to keep installed, otherwise the organ will no longer load (until you install the relevant components again).

(Note that the St. Anne's sample set that's included with Hauptwerk is required and can't be uninstalled. Also, '*Licensing packages*' can't be uninstalled and aren't listed when using *File | Uninstall …* in Hauptwerk.)

Importing Hauptwerk version 1 organs

The *File | Import Hauptwerk version 1 organ* menu function allows the current version of Hauptwerk to use Hauptwerk version 1 sample sets for backwards compatibility:
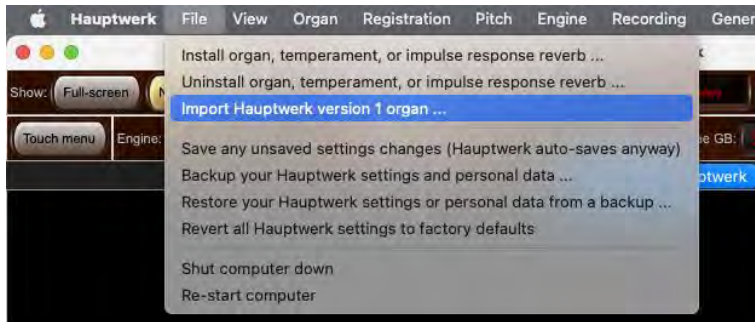
Hauptwerk cannot load or install version 1 sample sets directly, so this importing stage is necessary before a version 1 sample set can be used.

During the importing process, Hauptwerk automatically 'compiles' the version 1 organ definition file to the format required by the current version and installs its samples into appropriate folders. Once imported, the sample set will behave fully as a normal native sample set, and can be loaded from the options on the *Organ* menu as with any other sample set.

Note that Hauptwerk version 1 was a much less powerful and less realistic system than the current version, and its organ definition files contained only a tiny fraction of the information held in the current file formats. Because the information for many current features (such as the shapes of tremulant waveforms for each pipe and the wind supply model parameters) was simply not available in version 1 sample sets, Hauptwerk can only use simple defaults when importing.

Imported sample sets will look and function much as they did in version 1. They will sound much better because of the core improvements in audio quality and sample playback inherent in the current version, but they won't be nearly as functional or realistic as native sample sets for later Hauptwerk versions.

It is thus highly preferable to obtain an official upgrade of a sample set to version 2 format or above from its supplier to simply importing its Hauptwerk 1 version in this way, since an official upgrade should contain the necessary extra media and data to take best advantage of the features available in later versions of Hauptwerk. Official upgrades are available for the vast majority of version 1 sample sets from their suppliers. Please contact the supplier of your sample sets for this information and for upgrade pricing. An extensive list of Hauptwerk sample sets is also maintained on the Hauptwerk website.

If you have a Hauptwerk version 1 sample set that you wish to use, then the process is as follows:

First, if you have a computer running Windows, and you have not already installed the sample set, install the version 1 sample set into a temporary folder using the instructions supplied with it. The default installation folder for version 1 sample sets was *C:\Program Files\Hauptwerk\Organs* or *C:\Program Files\Hauptwerk Version 1\Organs*:
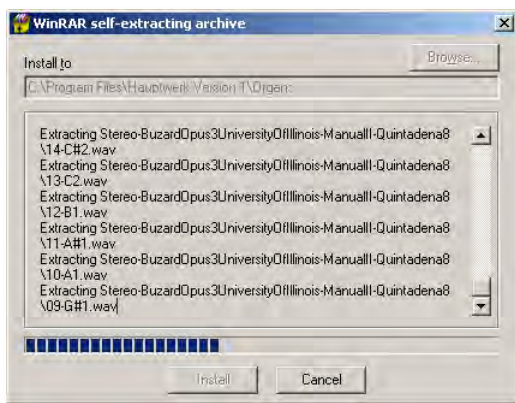
Note that Hauptwerk version 1 had no native component installer and the appearance of the installer and installation method may vary between sample sets. If you have any problems installing a version 1 sample set, please contact its supplier for advice.

Important: Hauptwerk version 1 was available for Windows only. Since, unlike the current version, it had no native multi-platform component installer, many of the original third-party version 1 sample set installers will not run directly on macOS. To import such sample sets you would either need to install them temporarily onto a Windows computer, then save the resulting extracted sample set to a USB memory stick (or similar) that could be read from your Mac and import from there, or contact the supplier of the sample set to see if the version 1 sample set can be supplied in a format that can be read by a Mac, such as a ZIP file. Once the version 1 sample set has been extracted so that it is readable on a Mac, it can be imported in Hauptwerk as normal.

Check that no installation or extraction errors occurred during the installation process.

Now use *File | Import Hauptwerk version 1 organ* in the current version of Hauptwerk to navigate to the folder into which you installed the version 1 sample set and select its organ definition file, which will have a file extension of *.organ*:
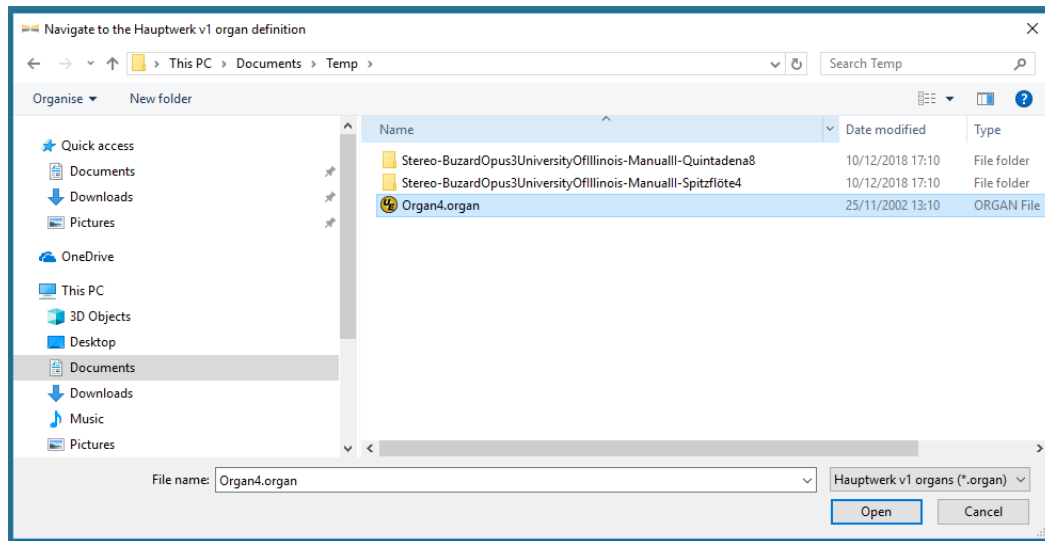
Wait until the importing process has completed.

Now load the sample set as normal using (for example) *Organ | Load organ* in the current version of Hauptwerk to verify that it is working and has been imported successfully:
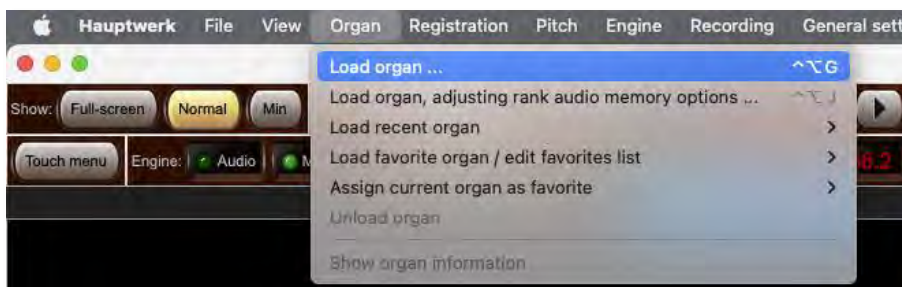
Finally, you can delete the version 1 sample set files from wherever you installed them temporarily. The original version 1 files are no longer needed once the sample set has been imported.

Voicing facilities and rank surround/3D panning (Advanced Edition only)

About voicing pipe organs

When a real pipe organ is installed it is necessary to make detailed adjustments to the sound of each pipe, a process termed voicing. This is primarily because the acoustic of the room in which it is installed will respond differently to different frequencies depending on the position from which the sound is produced (the location of the pipe) and the position of the listener, as well as for aesthetic reasons.

For example, if a pipe with a fundamental frequency of 440 Hertz is placed at a point in the building that strongly amplifies that particular frequency (termed a node), then that pipe might sound much louder than its neighbors in the rank. The same applies to any of the frequencies (harmonics) present in the pipe sound, so the character of the sound can change very noticeably across the compass of a rank, due to the way that the room naturally accentuates and attenuates particular frequencies.

The pipe organ voicer needs to adjust the speech of each pipe so that these effects are minimized from the point of view of the listener. The voicer also has the very important artistic role of adjusting the tonal qualities of the pipes so that all of the ranks sit well together aesthetically.

Voicing in Hauptwerk

Most houses and domestic listening environments have relatively 'dead' acoustics, which color the sound only minimally. (Headphones are acoustically 'deadest' of all.) Thus, when listening to an organ sample set at home (or on headphones) that has been recorded 'wet' (including the real organ's original acoustic), often no adjustment to the sound of the sample set is necessary to be able to hear the instrument almost exactly as it sounds in its original environment.

However, if Hauptwerk is used in a reverberant space, or if 'dry' samples are used, then the ranks will usually benefit very significantly from being re-voiced to some degree, just as with a real pipe organ.

The Hauptwerk Advanced Edition has comprehensive per-pipe voicing facilities that allow different aspects of the sound of each pipe to be fine-tuned in real-time. The rates of modeled tremulants may also be adjusted. The voicing facilities are also used for panning ranks/pipes virtually amongst stereo pairs of speakers when Hauptwerk is used for surround/3D sound output (as covered in more depth in the the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* section).

Note that some sample sets are intended only to be heard exactly as they were recorded and have licenses that explicitly disallow any voicing adjustments. For such sample sets the voicing/panning menu functions are not enabled.

Using the voicing/panning facilities

Hauptwerk stores voicing/panning information separately for each organ. With an organ loaded and active the voicing/panning facilities are accessed by functions on the *Organ settings* menu:
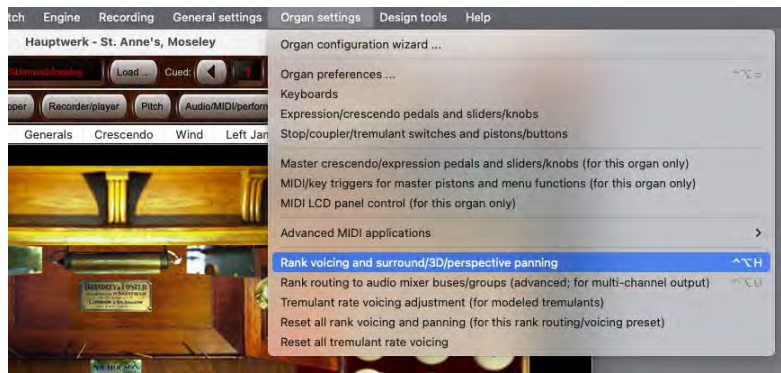
Selecting the *Reset all voicing and rank surround/3D/perspective panning (for this rank routing/voicing preset)* restores all voicing/panning stored for the organ to its default for whichever rank routing/voicing preset is currently selected (see the *Rank routing/voicing presets* section). If you select that function you will be prompted for confirmation.

Voicing/panning ranks and pipes

The main pipe voicing screen is accessed from the *Organ settings | Rank voicing and surround/3D/perspective panning* menu option:
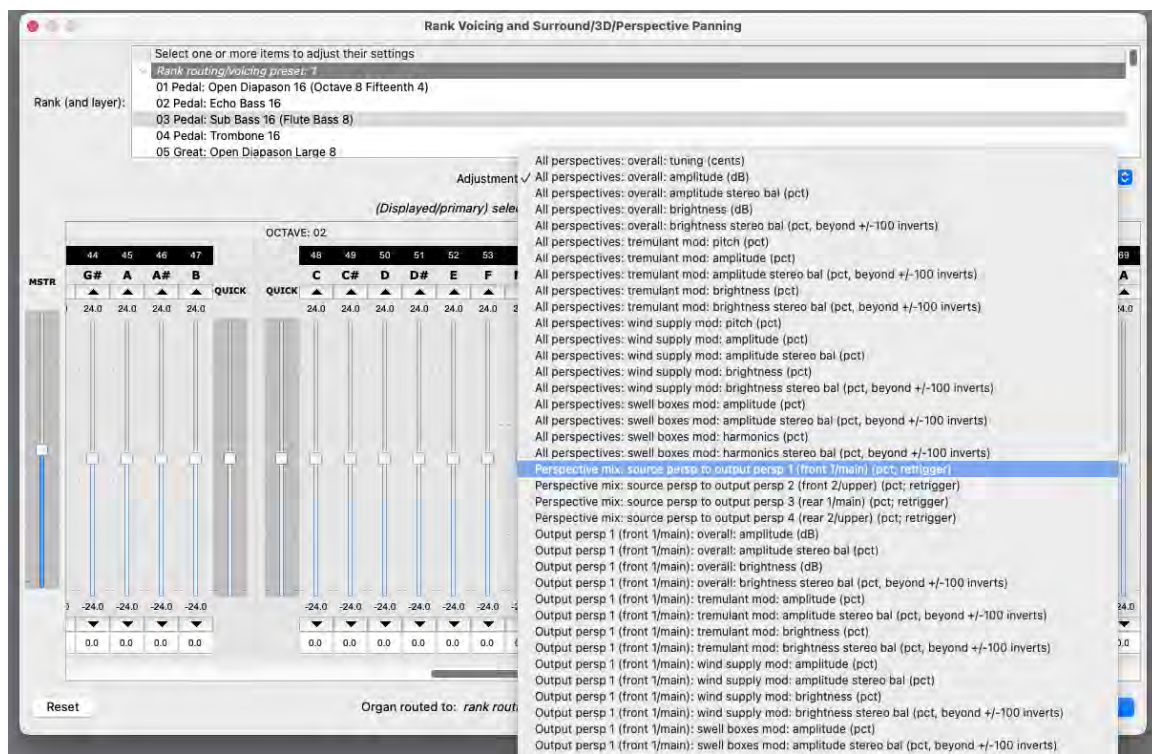
Before opening the screen, engage a stop for a rank that you wish to voice/pan, so that you can hear the effects of adjustments you make. Then open the voicing screen from the menu.

Select the rank (and layer, whose name will be shown as a suffix to the rank name if applicable) that you wish to adjust at the top-left of the screen. (Only ranks that are loaded into memory are shown.) You can select multiple ranks/layers at once to adjust their settings simultaneously; for example, if you wished to turn up the level of all ranks in a particular division then you would highlight all of the division's ranks at once in the list.

There are four independent *rank routing/voicing presets* available for each organ, allowing you to route and/or voice the organ in up to four different, independent ways, and switch easily between them. For example, you might decide to use one of those presets for routing and voicing the organ optimally for headphones listening, and another for routing and voicing it optimally for your multi-channel speaker system. You could then quickly switch between them whenever needed. See the *Rank routing/voicing presets* section for more details. The ranks within the rank-list are organized within nodes according to their rank routing/voicing preset. You can also rename a preset by right-clicking on its node:
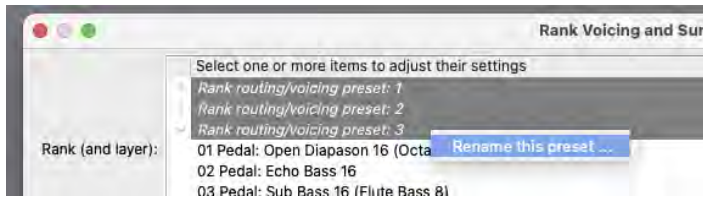
Note that you can engage and disengage stops while the voicing screen is open, and that most sample sets support right-clicking on stops to open the voicing/panning screen with the appropriate rank pre-selected (as a convenience short-cut).

Next select the particular aspect of the rank(s)' sound that you want to adjust using the *Adjustment* setting. For example, select the '*All perspectives: overall: amplitude (dB)*' option if you wish to turn the overall level of the selected rank(s) up or down. (Note that if you have disabled any of Hauptwerk's audio engine features using the *Organ settings | General preferences screen* then any adjustments that require those features will not appear in the list.)

The bank of sliders controls in the middle of the screen will then move to show the value of that adjustment parameter for each note in the (primary) selected rank whose name is shown above the bank of sliders.

A unique note number at the top identifies the pipes within the rank, and the octave number and key name is also shown for clarity. Middle C is always note number 60. The lowest C on a rank of 61-note compass is number 36, and the highest is 96. Some ranks have larger or smaller compasses, and each slider is only enabled if a pipe exists in the rank with that note number.

Press middle C and listen to its amplitude (for this example). Move the note 60 slider (middle C) up half-way to the top of its travel and re-trigger the note. It should now sound about 12 decibels louder (about four times as loud). Note that some parameters require the note to be re-triggered to take effect, but most do not. You can use the up and down arrow buttons above and below the slider to fine-tune the position of the slider, or type a value directly (to one decimal place) in the text box below it.

Drag the slider to the left of the octave marked *QUICK* downwards. You will see it move all sliders for the octave, incrementing their positions proportionally to how close they are to the slider. When you let go of the slider it will spring back to its center position, but the individual pipe sliders will remain where they were are. The *QUICK* slider to the right of the octave behaves in the same way, with the right-hand end of the octave being affected most strongly. Together, these special sliders allow the response of a rank as a whole to be shaped very quickly. Often it is best to use these to shape the rank's response roughly at first, then fine-tune each pipe using its dedicated slider.

To the far left of the screen is a slider labeled *MSTR* (short for *master*). This slider works in the same way as the *QUICK* sliders, but moves *all* of the note sliders equally for the whole rank, rather than just affecting one octave. This slider is a very convenient tool for initial adjustment of the basic sound of each rank as a whole (and thus the organ as a whole), prior to fine-tuning the parameters at the octave or individual pipe levels with the other sliders.

Note/*MSTR*/*QUICK* slider adjustments are relative to their current parameter values unless the *ALT* key is held down, in which case value adjustments are absolute. For example, if you hold down the *ALT* key and move the *MSTR* slider to +2 dB then the adjustment value (amplitude, in this example) of all notes will be set exactly to +2 decibels, instead of adding 2 decibels to their current values.

A note slider will be highlighted in yellow if (and only if) you have more than one rank selected, and the adjustment parameter values for that note for ranks other than the displayed (primary) selected rank differ from that of the displayed (primary) selected rank. Thus if a note slider is highlighted in yellow then it indicates that the parameter value of the note is currently set differently for the various selected ranks, and that moving the slider will adjust those various values (relative to their current parameter values, if the *ALT* key is *not* held down, or setting them all to the displayed slider value, if the *ALT* key *is* held down).

(Provided that the associated audio engine features are enabled), the following real-time adjustments are available for each pipe (and layer):

- All perspectives: overall: tuning (cents).
- All perspectives: overall: amplitude (dB).
- All perspectives: overall: amplitude stereo bal (pct).
- All perspectives: overall: brightness (dB).
- All perspectives: overall: brightness stereo bal (pct, beyond +/-100 inverts).
- All perspectives: tremulant mod: pitch (pct).
- All perspectives: tremulant mod: amplitude (pct).
- All perspectives: tremulant mod: amplitude stereo bal (pct, beyond +/-100 inverts).
- All perspectives: tremulant mod: brightness (pct).
- All perspectives: tremulant mod: brightness stereo bal (pct, beyond +/-100 inverts).

- All perspectives: wind supply mod: pitch (pct).
- All perspectives: wind supply mod: amplitude (pct).
- All perspectives: wind supply mod: amplitude stereo bal (pct).
- All perspectives: wind supply mod: brightness (pct).
- All perspectives: wind supply mod: brightness stereo bal (pct, beyond +/-100 inverts).
- All perspectives: swell boxes mod: amplitude (pct).
- All perspectives: swell boxes mod: amplitude stereo bal (pct, beyond +/-100 inverts).
- All perspectives: swell boxes mod: harmonics (pct).
- All perspectives: swell boxes mod: harmonics stereo bal (pct, beyond +/-100 inverts).
- Perspective mix: source persp to output persp 1 (front 1/main) (pct; retrigger).
- Perspective mix: source persp to output persp 2 (front 2/upper) (pct; retrigger).
- Perspective mix: source persp to output persp 3 (rear 1/main) (pct; retrigger).
- Perspective mix: source persp to output persp 4 (rear 2/upper) (pct; retrigger).
- Output persp 1 (front 1/main): overall: amplitude (dB).
- Output persp 1 (front 1/main): overall: amplitude stereo bal (pct).
- Output persp 1 (front 1/main): overall: brightness (dB).
- Output persp 1 (front 1/main): overall: brightness stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): tremulant mod: amplitude (pct).
- Output persp 1 (front 1/main): tremulant mod: amplitude stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): tremulant mod: brightness (pct).
- Output persp 1 (front 1/main): tremulant mod: brightness stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): wind supply mod: amplitude (pct).
- Output persp 1 (front 1/main): wind supply mod: amplitude stereo bal (pct).
- Output persp 1 (front 1/main): wind supply mod: brightness (pct).
- Output persp 1 (front 1/main): wind supply mod: brightness stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): swell boxes mod: amplitude (pct).
- Output persp 1 (front 1/main): swell boxes mod: amplitude stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): swell boxes mod: harmonics (pct).
- Output persp 1 (front 1/main): swell boxes mod: harmonics stereo bal (pct, beyond +/-100 inverts).
- Output persp 1 (front 1/main): lo/hi EQ: transition freq (kHz; retrigger).
- Output persp 1 (front 1/main): lo/hi EQ: transition width (pct of trans freq; retrigger).
- Output persp 1 (front 1/main): lo/hi EQ: high freq boost (dB; retrigger).
- Output persp 1 (front 1/main): lo/hi EQ: high freq boost stereo bal (pct, beyond +/-100 inverts; retrigger).
- Output persp 1 (front 1/main): release tail truncation length (msec, 0=no truncation; retrigger).
- ...
- Output persp 4 (rear 2/upper): …

For all of the adjustments calibrated in decibels (dB), the slider specifies a value *relative to the pipe's default value*. For example, if you adjust the '*All perspectives: overall: brightness (dB)*' value to -6, then the strength of the pipe's third and higher harmonics (brightness) will be reduced by about half, relative to their original strengths. (A value of -6 dB corresponds approximately to a halving.) For percentage values, 100% represents the default value specified by the sample set's creator, 50% represents half, and so on.

'*… mod: … (pct)*' adjustments adjust the *depths of the modulations* that Hauptwerk's various models (tremulants, wind supply mode, and swell boxes) apply to the pipe, relative to the depths specified by the sample set's creator. For example, reducing the '*All perspectives: tremulant mod: pitch (pct)*' adjustment from its default (100%) to 50% will halve the depth of pitch modulations that any tremulants apply to the pipe, so the tremulant will affect the pitch of the pipe half as much.

Of course, for tremulant modulation depth adjustments to be audible, you must also have the relevant tremulant (if any) engaged. Likewise, swell box modulation depth adjustments have no effect if the rank is not enclosed in a swell box.

Most modulation depth adjustments also allow negative values, which invert the polarity of their modulations. For example, setting '*All perspectives: tremulant mod: pitch (pct)*' to a negative value (such as -100%) will make the tremulant increase the pipe's pitch at times that it would normally be decreasing it.

The stereo balance of most modulation depths/filters can be adjusted too. For example, you might choose to make a modeled tremulant modulate the amplitude of a rank more strongly in the right-hand channel (using the '*All perspectives: tremulant mod: amplitude stereo bal (pct, beyond +/-100 inverts)*' adjustment), whilst making it affect its harmonic content more strongly in the left-hand (using the '*All perspectives: tremulant mod: brightness stereo bal (pct, beyond +/-100 inverts)*' adjustment), thus giving a dynamic stereo effect. These stereo-balance modulation depth adjustments also allow values beyond +/- 100 percent, with such values progressively inverting the polarity of modulations.

The '*All perspectives: overall: amplitude stereo bal (pct)*' adjustment is different, in that a value of -100% means that the left channel will be heard at twice its normal amplitude, and the right channel will not be heard at all. +100% percent is the opposite, and the default value of 0 percent means that the two stereo channels will be heard at the default amplitudes defined by the creator of the sample set you're using.

The '… *lo/hi EQ: …*' adjustments allow you to apply a simple low-pass or high-pass parametric EQ (shelf filter) to the pipe, adjusting its balance between bass and treble. The transition frequency specifies the center-point between the bass and treble bands. The transition width determines the steepness of the frequency response curve in the transition region between the bass and treble, and is specified as a percentage of the transition frequency. Generally it is best to avoid very low values for the transition width, since they will give a very steep frequency response and higher 'filter ripple' (an effect where the frequencies either side of the transition are boosted or attenuated excessively in a narrow band, compared to the rest of the frequency response). Equivalent parameters can be specified within the virtual organ by its creator, and the default values for the EQ parameters are taken from the virtual organ definition. Any adjustments to these EQ parameters *override* those specified by the organ's creator.

Adjustments with '*retrigger*' in brackets indicate that changing their values won't affect the sound until the pipe next starts to sound – it won't affect any keys that you might currently be holding down.

The '*Perspective mix: source persp to output persp 1/2/3/4 …*' adjustments are used to route the output from any given pipe rank to any or all of the four 'output perspectives', and the four perspectives may be voiced independently using the '*Output persp 1/2/3/4: …*' adjustments. These output perspectives would normally be used for (and are configured by default for) surround/3D-sound use, allowing you to control the mix sent from each virtual rank/pipe to each of your surround/3D set-up's stereo speaker pairs (front/main, front/upper, rear/main, rear/upper), thus effectively positioning the rank virtually within your listening room. Please consult the ***Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use*** section for further details.

The '*Output persp 1/2/3/4 …: release tail truncation length (msec, 0=no truncation; retrigger)*' adjustments also allow real-time, per-output-perspective, release tail truncation (optionally in addition to the non-real-time release tail truncation available via the '*Organ | Load organ, adjusting rank audio memory options*' screen), which can help to make a wet sample set seems a little 'drier' than it would normally. (Please note that the real-time truncation functionality doesn't reduce the memory required for the organ, and you need to retrigger any held notes to hear changes.) Using these real-time release truncation adjustments, you could, for example, shorten the release tails for the pipe for a front pair of surround speakers (using '*Output persp 1 (front 1/main): release tail truncation length …*') but leave the release tails un-shortened for a rear pair of surround speakers (using '*Output persp 3 (rear 1/main): release tail truncation length …*'). It could then sound simultaneously through both front and rear speakers with different lengths of release tails, making it seem 'drier' from the front than from the rear.

Adjusting tremulant rates

If a virtual organ has tremulants and if it uses Hauptwerk's native tremulant model to provide them (as opposed to playing samples recorded with the real tremulant engaged) then the *Organ settings | Tremulant rate voicing adjustment (for modeled tremulants)* screen allows their rates (speed) to be adjusted:
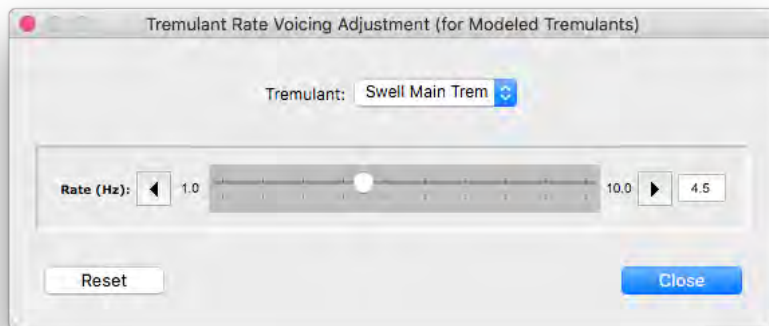
Simply select the tremulant whose rate you wish to adjust at the top of the screen then move the slider to change its rate. If you wish, you can play the rank while doing so to hear your changes in real-time.

Note that most sample sets also allow you to right-click on a tremulant, or on a rank affected by a tremulant, to open the tremulant rate voicing screen with the tremulant pre-selected (as a convenience short-cut).

Playing Hauptwerk live from a digital organ

Compatibility with digital organs

Hauptwerk has native support, including 'MIDI learn' (settings auto-detection) for most of the types of controls found on most makes and models (current and historical) of commercial digital organs that have MIDI. Hence a digital organ can make a convenient and effective MIDI controller from which to play Hauptwerk in real-time.

Second-hand older digital organs with MIDI can often be purchased relatively inexpensively, making them a popular option. Similarly, Hauptwerk can be used as a 'sound engine upgrade' for older MIDI-compatible digital organs.

In general, we would expect (but we don't guarantee) that Hauptwerk should work with most of the controls (including keyboards, stops/couplers/tremulants and expression pedals) on current and recent models by major digital organ manufacturers, including Allen, Rodgers, Johannus, Viscount, Content, Ahlborn, Makin and Wyvern.

However, there are a great many models of digital organs and it's impossible for us to test with all of them, so we recommend testing with Hauptwerk to determine compatibility before either buying a digital organ for use with Hauptwerk, or before buying a license for Hauptwerk to use with a digital organ that you may already have. We're sorry, we're not in a position to be able to guarantee, or advise on, compatibility with specific makes/models of digital organ in advance. Hauptwerk can be downloaded for free for evaluation, so if possible we recommend simply installing it and trying it with the digital organ in question: use right-click auto-detection to see whether Hauptwerk can detect the digital organ's various types of controls.

If your organ has MIDI then it will almost certainly be possible to play Hauptwerk's virtual keyboards from your digital organ's keyboards. However, the MIDI implementation used for stops, combination pistons/buttons and expression pedals varies widely between makes and models. We try to make Hauptwerk's MIDI implementation as flexible as possible to cater for most of them, but there may be some cases in which it isn't compatible.

Stops, pistons and combination systems

Important: (assuming that your digital organ's stop and pistons send MIDI in formats that Hauptwerk can understand) you may choose to use the digital organ with Hauptwerk in either of two modes:

1. ***Configure (auto-detect) Hauptwerk's virtual stops***/couplers/tremulants to respond to the digital organ's stops/couplers/tremulants, ***then use the digital organ's built-in combination*** system instead of Hauptwerk's, but ***don't*** configure (auto-detect) any of Hauptwerk's virtual combination pistons/buttons to respond directly to the digital organ's combination pistons, ***or***:

2. ***Configure (auto-detect) Hauptwerk's virtual combination pistons***/buttons to respond directly to the digital organ's combination pistons, then ***use Hauptwerk's combination system*** instead of the digital organ's built-in combination system, but ***don't*** configure (auto-detect) any of Hauptwerk's virtual stops /couplers/tremulants to respond to the digital organ's stops/couplers/tremulants.

It's very important that you never have ***both*** Hauptwerk's virtual stops/couplers/tremulants ***and*** its virtual combination pistons/buttons configured to respond directly to the digital organ's corresponding controls, otherwise Hauptwerk's combination system will inevitably 'fight with' the digital organ's combination system over the states of the stops/couplers /tremulants, usually leading to the virtual and physical stops/couplers/tremulants getting out of synchronization with each other, or ending up in unpredictable states. If you do accidentally find yourself in that situation then you should decide on which of the two modes of use listed above you prefer, then use '*Organ settings | Organ configuration wizard*' to reset all MIDI/key trigger settings for the organ (so that the conflicting configuration is cleared), then auto-detect just the appropriate types of virtual controls.

In summary, you must choose which of the two combination systems (the digital organ's or Hauptwerk's) to use, but it isn't reliably possible to use both connected in parallel.

Touch-screens and Novation Launchpads are popular means for controlling Hauptwerk's virtual stops/couplers/tremulants individually, which might be worth considering as options if you choose to use 'mode 2' (Hauptwerk's combination system, triggered from the digital organ's MIDI pistons). Note also that using Hauptwerk in that way may provide more flexibility if you plan to use several virtual instruments (sample sets), since the dispositions of the virtual instruments can then be entirely unrelated to each other, and unrelated to the disposition of the digital organ (given that you would not be using the digital organ's physical stops to control Hauptwerk's virtual stops).

Connecting the digital organ

Any digital organ with MIDI capability will have a MIDI OUT port, which should be connected to a MIDI IN port on your computer's MIDI interface. Some digital organs actually have two MIDI OUT ports, one of which may be labeled 'MIDI OUT' and the other 'MIDI SEQ' (short for 'sequencer'), or similar. On such organs it's usually the port labeled 'MIDI SEQ' that you need to use, instead of the one labeled 'MIDI OUT', since it's the MIDI SEQ port that sends MIDI output from the digital organ's physical controls directly (intended by its manufacturer for recording and playing them back via a MIDI sequencer). Please refer to the digital organ's documentation if in doubt.

If the digital also has a MIDI IN port, and if you want Hauptwerk to control its physical stop/coupler/tremulant states, then also connect a MIDI lead from the computer's MIDI OUT port to the digital organ's MIDI IN port.

If your digital organ has an auxiliary audio input socket, and if you want to use its amplifiers/speakers for Hauptwerk's sound output, then connect an audio lead from the audio output socket on your computer's audio interface to that auxiliary audio input. Note, however that you would usually need to disable the digital organ's built-in sounds (which not all digital organs allow), otherwise you may hear Hauptwerk's sounds simultaneously with the digital organ's own voices. Note also that the digital organ's amplifiers and speakers might not be optimal for audio quality when used with Hauptwerk sample sets (especially 'wet' sample sets), so using separate, hi-fidelity, speakers or studio monitors may be preferable.

Configuring the digital organ

If you chose to use Hauptwerk's combination system, controlling it form the digital organ's MIDI pistons (instead of using the digital organ's combination system and stops, as covered above), then some digital organ makes/models require you to select a 'piston mode' (or similar) setting, so that its pistons send MIDI output individually (rather than only affecting the states of its built-in stops via its own combination system).

If you are planning to use the digital organ's built-in amplifiers/speakers for Hauptwerk's audio output then you might need to enable its audio auxiliary input and also to disable its internal voices.

Please refer to the digital organ's documentation if in doubt.

Configuring Hauptwerk

In Hauptwerk, ensure that the '*MIDI hardware/console type*' setting on the '*General settings | General preferences*' screen is set to the '*Unmodified MIDI digital/electronic organ: …*' entry appropriate for the digital organ's make/model, which may be necessary for Hauptwerk to be able to communicate properly with the organ.

If you have a Johannus or post-2000 Makin organ, or if you're using your digital organ's MIDI stops/couplers/tremulants to control Hauptwerk's virtual stops but those MIDI stops can't be controlled from Hauptwerk, then also set the '*Reset MIDI organ console when Hauptwerk resets?*' general preference to '*Prompt me to reset my MIDI organ console manually*', otherwise set it to '*Send "off" to all stops individually*'.

On the *'General settings | MIDI ports'* screen make sure that you have the MIDI IN port on your computer (to which you connected the MIDI lead from the 'MIDI OUT' or 'MIDI SEQ' port on your digital organ) selected in the **_left-hand_** ('*Console MIDI IN*') column on the *MIDI IN ports* screen tab. (Although the MIDI port might be named 'MIDI SEQ' on the digital organ itself, it's very important that you don't have this selected in the right-hand '*Hauptwerk MIDI recorder/player external MIDI IN*' column on Hauptwerk's MIDI IN ports screen, since that's for a different purpose and it wouldn't work properly.)

If you connected a lead from your computer's MIDI OUT port to a MIDI IN port on your digital organ (so that Hauptwerk can control the states of its stops/couplers/tremulants) then also select the corresponding MIDI OUT port on your computer in the **_left-hand_** ('*Console MIDI OUT*') column on the *MIDI OUT ports* tab of the *'General settings | MIDI ports'* screen.

You may alternatively use the General Configuration Wizard ('*General settings | General configuration wizard'*) to configure all of these settings.

Once done, load the virtual organ then use right-click auto-detection ('MIDI learn') as normal to configure Hauptwerk's virtual controls for the desired MIDI controls on your digital organ, being careful to avoid configuring both its stops and pistons as covered above.

Using Hauptwerk with Novation Launchpads

Hauptwerk has dedicated support for the following models from Novation's Launchpad series:

- "Launchpad X" (which is a 'mark 3' model). (The "Launchpad Mk3 Mini" may also work, but we don't support it officially.)
- "Launchpad Mk2".
- Their original ('mark 1') "Launchpad".

They act as MIDI devices; their buttons can be auto-detected to any of Hauptwerk's virtual switches/buttons/pistons that allow MIDI control (such as virtual stops or pistons, or buttons on Hauptwerk's control panels), and Hauptwerk will control the states of their buttons' lamps.

If using one of those models with Hauptwerk, you don't need to install any driver (or other) software from Novation. If you have installed any for other reasons, then make sure it isn't running when using Hauptwerk. No manual configuration of the hardware is needed, except that if you have several Launchpads of the same model (e.g. several Launchpad X units) we do recommend configuring the "Device ID" setting of each of the units to unique values, as described in the "Settings" chapter in the Launchpad X's user guide, so that the computer can tell them apart reliably.

Make sure the Launchpad(s) are connected to the computer before launching Hauptwerk. (It's important that you don't plug in or unplug any audio, MIDI or USB devices whilst Hauptwerk is actually running; it doesn't support 'hot-plugging' devices.)

Now launch Hauptwerk and go to the *General settings | MIDI ports* screen, which will open automatically if Hauptwerk hasn't 'seen' your Launchpad(s) before. Make sure that each Launchpad's column is ticked on both the *MIDI IN ports* screen tab and the *MIDI OUT ports* screen tab. (Each Launchpad needs to be enabled for both MIDI input and output.) In the case of a Launchpad X model, on the *General settings | MIDI ports* screen within Hauptwerk, you specifically need to tick the following MIDI port entries (columns):

- On Windows: on the "*MIDI IN ports*" screen tab: "*MIDIIN2 (LPX MIDI)*" (N.B. not "*LPX MIDI*"), and also:

- On Windows: on the "*MIDI OUT ports*" screen tab: "MIDIOUT2 (LPX MIDI)" (N.B not "*LPX MIDI*").

- On macOS: on the "*MIDI IN ports*" screen tab: "Launchpad X LPX MIDI In" (N.B. not "*... LPX DAW ...*"), and also:

- On macOS: on the "*MIDI OUT ports*" screen tab: "Launchpad X LPX MIDI Out" (N.B. not "*... LPX DAW ...*").

Give the rows in which you ticked the Launchpad(s) appropriate aliases for convenient future reference, such as "*My left-hand Launchpad*".

After OK-ing the screen, the Launchpad's LED lamps should then clear automatically, and you should then be able to right-click on virtual pistons/buttons/stops/switches to auto-detect then to any of the Launchpad X's buttons. When doing so you should be able to select the desired color for the Launchpad button's LED, for which you should choose one of the "*Launchpad Mk2+: ...*" entries (unless you're using an original "Launchpad" mark 1 model).

MIDI sequencing, the Hauptwerk AU/VST Link and applying external real-time effects plug-ins

Recording and playing back live solo performances: the built-in MIDI recorder/player and its fixed, predefined MIDI implementation

Hauptwerk has a basic MIDI recorder/player built in, designed to allow you to record live performances as MIDI files, play them back, and easily to exchange the resulting MIDI files between any other users of the same virtual instrument. You can also record a MIDI file while playing another back, allowing you to 'overdub'. Hauptwerk's built-in audio recorder can also be used at any time, for example allowing you to 'bounce down' a MIDI file to audio.

Hauptwerk's MIDI recorder/player is designed to use a completely fixed, predefined MIDI implementation, regardless of what MIDI hardware or MIDI settings you may have. It records actions that you perform in Hauptwerk (for example virtual registration changes), rather than the means by which you triggered those actions (for example, MIDI messages from your MIDI organ console or touch-screen presses). It's also designed not to record combination system actions directly, but instead to record the *results* of those actions (for example, it records the registration changes that result from triggering a combination piston, rather than the fact that the combination piston was triggered).

The fixed MIDI implementation is covered in full in the ***Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation*** section in this guide. Note that you can also view the implementation that Hauptwerk will use specifically for whichever organ you currently have loaded using the *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ)* menu function.

Hauptwerk uses this special, fixed, predefined, combination set-independent and hardware-independent, MIDI implementation very intentionally, so that:

- Any user of a given virtual instrument (sample set) can exchange a MIDI file with any other user of the same virtual instrument and it will immediately play back perfectly, without any particular MIDI hardware being required, without any MIDI settings changes at all being needed, and without any particular combination sets (files) being required.

- If you change your MIDI console hardware or MIDI settings then all of your MIDI files will still work perfectly.

- Likewise, if you change your combination sets, then all of your MIDI files will still work perfectly.

- Even if you use a MIDI organ console for live playing that has complex MIDI implementation, then the MIDI files you record from Hauptwerk will still use a MIDI implementation that's simple, readable and easily-editable in most MIDI sequencer software. For example, some MIDI organ consoles use MIDI 'bit-field' MIDI implementations for their stops, which couldn't be edited readily in a MIDI sequencer if recorded in their raw form, and some digital organs rely on the previous states of their stops being remembered and recalled in particular sequences.

- Actions performed from touch-screens, mouse clicks, or computer key presses are recorded in exactly the same way as actions triggered via MIDI hardware.

- If you just want to use Hauptwerk to play MIDI files that other people have recorded for the particular Hauptwerk virtual instrument then you can do that straight away after installing it, without needing any MIDI hardware, and without needing to configure any MIDI settings.

Hauptwerk AU/VST Link plug-in (Advanced Edition only): for routing audio/MIDI

The Hauptwerk AU/VST Link comprises a set of 64-bit and 32-bit VST (Windows) and 64-bit VST and Audio Unit (macOS) plug-ins that allow you to route audio and MIDI between Hauptwerk and an AU/VST-compatible MIDI sequencer/host ('AU/VST host'). The Hauptwerk AU/VST Link is only available in the Advanced Edition of Hauptwerk.

Unlike most conventional virtual instrument software, Hauptwerk itself doesn't actually run as a plug-in instrument entirely within the AU/VST host. Instead, Hauptwerk always runs as a stand-alone application, optionally allowing audio and MIDI to be routed between Hauptwerk and an AU/VST host (MIDI sequencer) by selecting the *Hauptwerk AU/VST Link* entry as an audio output device and/or as a MIDI IN or MIDI OUT port in Hauptwerk:

The *General settings | Audio device and channels* screen with the Hauptwerk AU/VST Link selected as the audio output device:
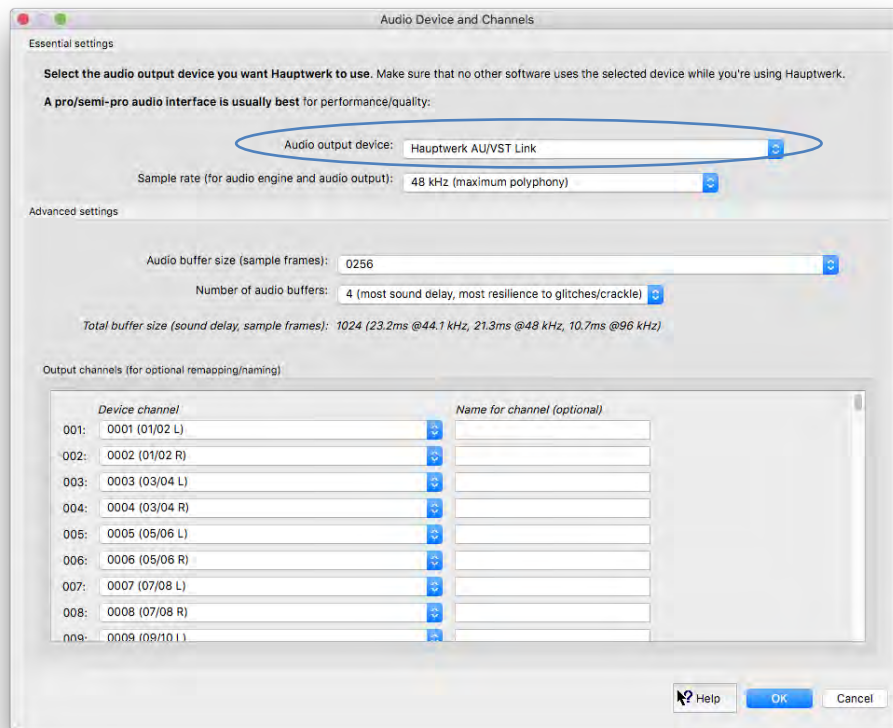
MIDI ports screen with the Hauptwerk AU/VST Link selected for conventional ('Console MIDI IN') MIDI input from a MIDI sequencer:
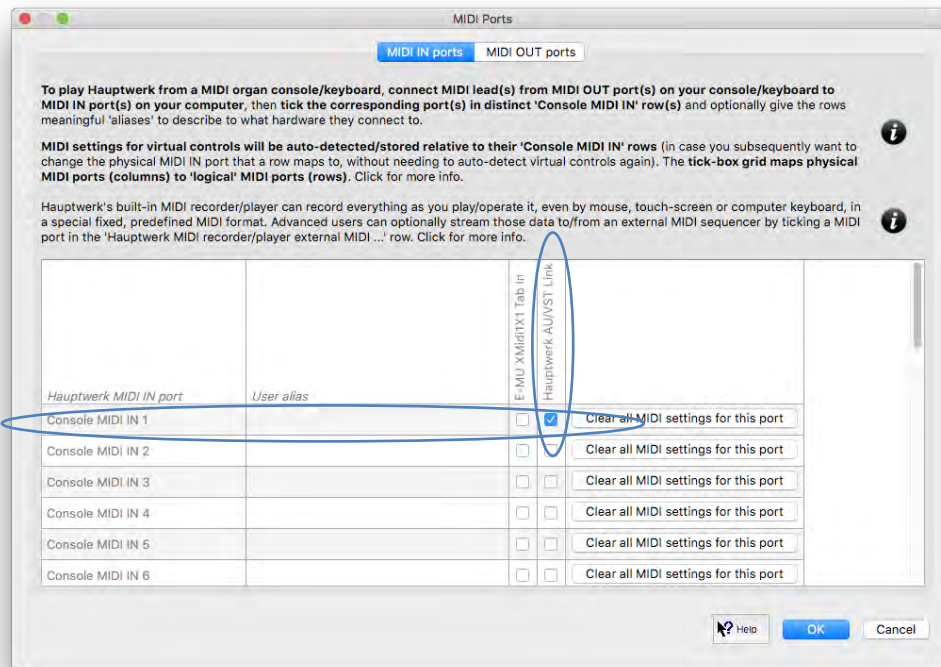
The *Hauptwerk AU/VST Link* allows audio/MIDI to be routed between 64-bit Hauptwerk and 64-bit or 32-bit sequencers/hosts.

Note that you can use the Hauptwerk AU/VST Link solely for audio if you wish, regardless of whether you intend to do MIDI sequencing. For example, you can very easily use a VST host like Reaper via the Hauptwerk AU/VST Link to apply external effects plug-ins to Hauptwerk's audio output(s).

Some important things to bear in mind when using the AU/VST link:

- **You need to load the appropriate organ in Hauptwerk** for your sequencer/host project; it won't load automatically with the project.

- If you're using the Hauptwerk AU/VST Link to route audio from Hauptwerk then **make sure the sequencer/host project's sample rate matches the sample rate selected on Hauptwerk's** *General settings | Audio device and channels* **screen**, otherwise the organ will sound at the wrong pitch. 48 kHz is the default for Hauptwerk's sample rate setting.

- You must **only have one instance of the Hauptwerk plug-in loaded within your sequencer's project, _not_ separate Hauptwerk plug-in instances on separate tracks**. Consult your sequencer's documentation for how to achieve that. For example, in Cubase, you must load the Hauptwerk plug-in within Cubase's instrument rack, and then set tracks to output to it via the instrument rack, rather than loading the plug-in directly within each track. In Logic Pro X you would insert the first track as a software instrument, then highlight the track and use '*Track | Other | New track with next/same MIDI channel*' to create any desired additional tracks that use the same plug-in instance as the first track.

- The Hauptwerk AU/VST Link does not support off-line (non-real-time) processing. Any audio rendering must be done at normal speed.

- If routing audio via the Hauptwerk AU/VST Link, audio buffer sizes should also be specified within Hauptwerk (since Hauptwerk requires its buffers' sizes to be powers of two and of a constant size, so that zero-latency impulse response reverb is possible within Hauptwerk). For good performance, the individual buffer size set in Hauptwerk should be no larger than the AU/VST host's buffer size and the total amount of Hauptwerk buffering (Hauptwerk individual buffer size multiplied by number of buffers) should be at least at much as the AU/VST host's buffer size. If you are certain that the host's buffer size will always be exactly the same as the buffer size set in Hauptwerk then you can set the number of buffers in Hauptwerk to 1, which should give the best possible performance and lowest latency. For the AU/VST Link the default Hauptwerk buffer values (size=256, number=4) should be reliable for any host buffer size in between 256 and 1024, giving a reasonable balance of performance.

The Hauptwerk AU/VST Link was designed to work the way it does (with Hauptwerk running as a stand-alone application), rather as a conventional plug-in (in which the whole application would run within the plug-in and within the AU/VST host) because:

- Hauptwerk is typically a processor-intensive and memory-intensive application, and running as a plug-in within a sequencer sometimes significantly limits the performance that Hauptwerk could achieve.

- Host sequencers, as well as the VST and Audio Unit architectures, are typically designed around single-pane user interfaces for plug-ins, and sometimes make it difficult or impossible for plug-ins to provide the rich and complex user interface features that Hauptwerk requires (multiple touch-screen support, floating/docking control panels, menus, wizards, etc.).

- It allows you to run 64-bit Hauptwerk (so that you can load very large sample sets into memory), with 32-bit sequencers/hosts and/or with 32-bit effects plug-ins.

If you configure Hauptwerk with an external MIDI sequencer dedicated to Hauptwerk specifically (and only) for recording, playing back and editing live solo organ performances (which is fairly uncommon) then the following advantages may additionally apply:

- Since MIDI goes directly between Hauptwerk and your MIDI/digital organ console a level of seamless integration with the MIDI hardware can be achieved that would be impossible with many digital organs if MIDI instead went via the sequencer.

- All of the benefits of the MIDI recorder/player's fixed implementation apply (portability of MIDI files, independence of MIDI files from MIDI hardware/settings, independence of MIDI files from combination sets, touch-screen, mouse-click and computer key compatibility, etc.).

- Bi-directional integration is possible between Hauptwerk and the sequencer. For example, the results of touch-screen, mouse click or computer key events can be recorded in exactly the same way as those triggered via MIDI.

AU and VST plug-in locations (Advanced Edition only)

macOS

macOS has standard fixed locations for Audio Unit and VST plug-ins, in which Hauptwerk's installer automatically installs the necessary components. All Mac sequencers/hosts should automatically scan for and find the Hauptwerk plug-ins when launched, and no manual steps are needed to select locations for them.

Windows

When installing Hauptwerk on Windows you are prompted for the folder into which the Hauptwerk VST Link plug-ins should be installed. By default they will be installed into: *C:\Program Files\Hauptwerk Virtual Pipe Organ VST Link Plug-In*. If you wish, you can instead select your VST sequencer/host's VST plug-ins folder so that the sequencer/host will find them automatically, otherwise you will need to add the Hauptwerk VST folder to its VST plug-ins search path.

If you do choose a non-default folder for installation of the VST plug-ins, please never try to move the Hauptwerk VST plug-ins manually, otherwise Hauptwerk's installer might not be able to find or upgrade them in the future, potentially leading to older versions of the VST plug-in remaining and having compatibility problems with newer versions of Hauptwerk. If you wish to change the location of the plug-ins, just re-run the Hauptwerk installer and it will move them to wherever you specify (no settings should be lost in the process).

MIDI sequencers and AU/VST hosts (Advanced Edition only)

Hauptwerk's native MIDI recorder/player's controls are very basic: it doesn't provide any facilities for editing MIDI recordings, since there are lots of powerful and popular existing third-party MIDI sequencer applications for that, such as Cubase, Logic and Reaper for general sequencing, or Sibelius, Finale or Dorico for notation.

If you want to edit MIDI recordings, then you will need to use third-party MIDI sequencer software alongside Hauptwerk to do it. The Hauptwerk prerequisites list the MIDI sequencers and versions that we've tested Hauptwerk with and fully support (although Hauptwerk will probably work with most others).

Note that MIDI sequencers are often large and complex pieces of software that require a reasonable level of MIDI and technical expertise to use. Hence MIDI sequencing is considered a fairly advanced topic.

Please also note that beyond the broad guidance in this user guide (and any additional tutorials that might be provided on our website) we cannot normally offer advice or support for using or configuring third-party software. Should you require such help please contact the makers of that software for technical support.

Using an AU/VST host to apply real-time effects to Hauptwerk's output (Advanced Edition only)

If you just want to apply real-time reverb to Hauptwerk's audio output, then there's no need to use any additional software, plug-ins or hardware for that, since the Hauptwerk Advanced Edition has native high-performance impulse response (convolution) reverb functionality built-in. To use it, please instead see the *Audio routing and impulse response reverb part 1 (Advanced Edition only): adding overall reverbs, surround/3D sound, stereo-only sound, and routing concepts for basic use* section.

However, if you wish to apply real-time third-party software effects plug-ins (such as EQs for listening room acoustic correction) to Hauptwerk's output, then all you need to do is route Hauptwerk's audio output to external AU or VST host software (such as Reaper) via the Hauptwerk AU/VST Link, with an appropriate effects plug-in loaded in the AU/VST host and assigned to the output of the Hauptwerk AU/VST Link plug-in.

Using the *General settings | Audio device and channels* screen, select the Hauptwerk AU/VST Link for audio output in Hauptwerk:
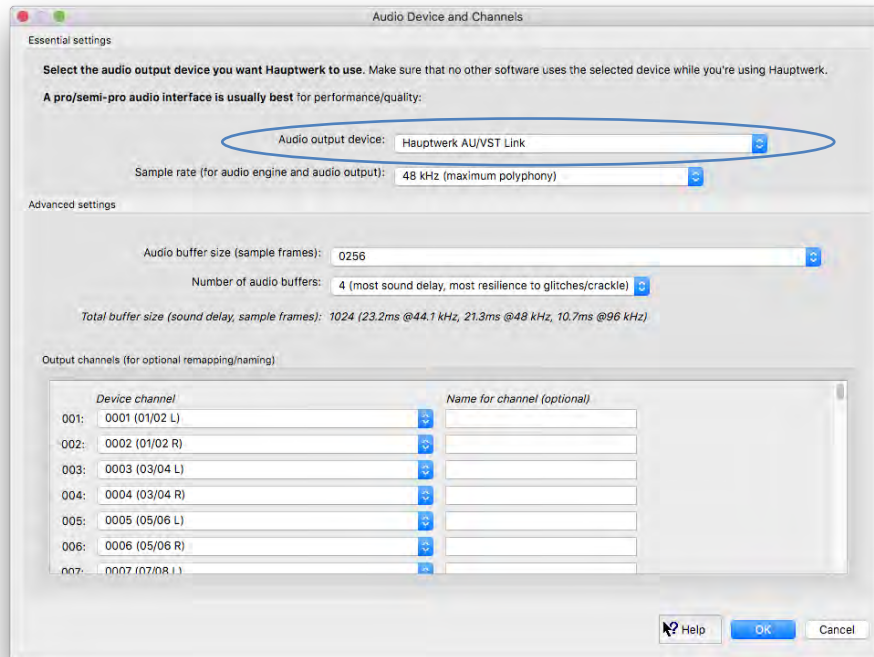
Configure your AU/VST host software to output its audio to your main audio interface (preferably using manufacturer-supplied low-latency audio drivers for best performance).

Your MIDI ports should be configured in the standard way for Hauptwerk (as covered throughout this guide, for example in the *Section III: Quick start* section), so that MIDI from your MIDI keyboards or MIDI organ console goes directly to Hauptwerk (not via the AU/VST host software).

Ensure that *all MIDI IN and MIDI OUT ports are disabled* in your AU/VST host software, otherwise you may get freezes or crashes due to MIDI feedback, or that software may conflict with Hauptwerk over the use of the MIDI ports.

Create a project in your AU/VST host software for use with Hauptwerk, and ensure that its sample rate is set to the same sample rate that you have selected on the *General settings | Audio device and channels* screen in Hauptwerk (otherwise the organ may sound at the wrong pitch). 48 kHz is the default for Hauptwerk's sample rate setting.

Now load the Hauptwerk AU/VST Link plug-in within the host's project, load an effect plug-in, and assign that plug-in to the output of the Hauptwerk AU/VST Link plug-in. You should then hear the effect on Hauptwerk's output. Please consult your AU/VST host software for help with those things if needed.

Composing pieces off-line from a MIDI sequencer configured conventionally, method 1: using Hauptwerk's fixed, predefined MIDI implementation (Advanced Edition only)

(Hauptwerk as a 'slave' MIDI device)

In any of the following situations:

- The MIDI sequencer needs to control multiple virtual instruments simultaneously, as in a conventional recording studio, or:

- MIDI parts need to be recorded or entered by hand directly within the MIDI sequencer (for example, when composing pieces), or:

- The MIDI sequencer is sometimes used with real or virtual instruments other than Hauptwerk (since it probably wouldn't then be convenient to reconfigure it before and after using Hauptwerk each time).

… we recommend configuring Hauptwerk and the MIDI sequencer in the way covered in this section (or the *Composing pieces off-line from MIDI notation software* section, if applicable instead), *not* in the way covered in the *Recording, playing back and editing live solo performances with a MIDI sequencer dedicated exclusively to Hauptwerk* section.

In our experience, nearly all MIDI sequencer users prefer to use Hauptwerk and the MIDI sequencer in the way covered in this section, so this is the method we would normally recommend.

If you also sometimes play Hauptwerk live/stand-alone, we recommend configuring and using one of the '*Hauptwerk (alt config N)*' configurations (desktop shortcuts) for use with your MIDI sequencer, instead of the primary configuration (the main '*Hauptwerk*' desktop shortcut). The four available configurations have completely independent settings, so you can safely configure one of them as covered in this chapter without affecting your primary Hauptwerk configuration's MIDI and audio settings. To switch between configurations, exit Hauptwerk and then relaunch it via the appropriate one of the desktop shortcuts. For this chapter, we'll assume you want to use 'alternate configuration 1'.

Exit Hauptwerk if it's running.

Relaunch it via the '*Hauptwerk (alt config 1)*' desktop shortcut:

This chapter assumes that your MIDI sequencer supports Audio Unit or VST plug-ins (otherwise you will need to use real or virtual MIDI cables to route MIDI instead, and you will need to use a different audio output device for Hauptwerk from the one your MIDI sequencer is using).

[Instructions continue on next page.]

On the *General settings | MIDI ports | MIDI IN ports* screen tab (which you will be shown automatically within the General Configuration Wizard if you haven't used '*Hauptwerk (alt config 1)*' before), make sure that the '*Hauptwerk AU/VST* Link' column is ticked in the '*Hauptwerk MIDI recorder/player external MIDI IN*' row (which is the very bottom row in the furthest right-hand column – you may need to scroll to see them):
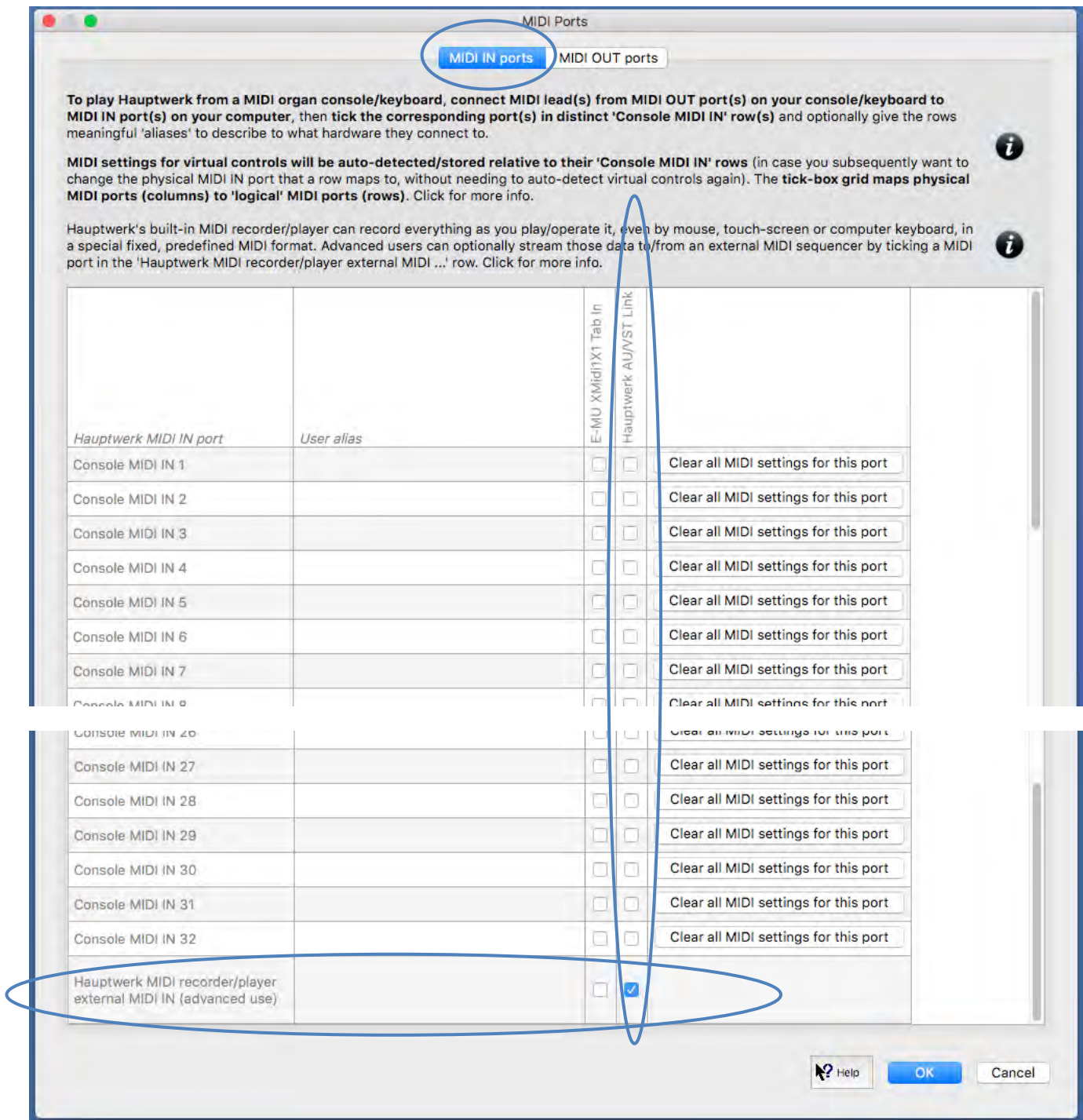
Make sure that <u>no other ports are enabled</u> in any other rows or columns on the screen (otherwise you might get MIDI feedback, freezes, or conflict with the MIDI sequencer over the use of the ports).

[Instructions continue on next page.]

For the same reasons, on the *General settings | MIDI ports | MIDI OUT ports* screen tab also make sure that <u>no ports at all are selected in any rows or columns</u>:

OK the screen (or finish the wizard, as applicable).

[Instructions continue on next page.]

Now, using the *General settings | Audio device and channels* screen, select the Hauptwerk AU/VST Link for audio output:

Set the sample rate to whatever sample rate you want to use in MIDI sequencer/DAW's project (either 48 or 96 kHz). OK the screen.

Now within your MIDI sequencer/DAW software:

- If you are using any MIDI keyboards or other pieces of MIDI hardware, then make sure the MIDI IN ports to which they're connected are enabled as MIDI IN ports in your MIDI sequencer software (*not* in Hauptwerk). Thus any MIDI from MIDI hardware should go to your MIDI sequencer (rather than to Hauptwerk directly), with Hauptwerk acting simply as a conventional 'slave' plug-in.

- Make sure your MIDI sequencer project's sample rate matches the value of the sample rate setting on Hauptwerk's *General settings | Audio device and channels* screen (otherwise the organ will sound at the wrong pitch).

- Make sure that one, and **_only one_, instance of the Hauptwerk AU/VST Link plug-in is loaded within your sequencer's project, _not_ separate plug-in instances on separate tracks**. Consult your sequencer's documentation for how to achieve that. For example, in Cubase, you must load the Hauptwerk plug-in within Cubase's instrument rack, and then set tracks to output to it via the instrument rack, rather than loading the plug-in directly within each track. In Logic Pro X you would insert the first track as a software instrument, then highlight the track and use '*Track | Other | New track with next/same MIDI channel*' to create any desired additional tracks that use the same plug-in instance as the first track.

[Instructions continue on next page.]

Now in Hauptwerk, load the St. Anne's organ (for example).

Select *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ)* from the menu, and use it as reference for which MIDI channels and event types you need to use within your MIDI sequencer project in order for it to play back properly to Hauptwerk.

For example, as you'll see from that document, for St. Anne's if you were to set a track within your sequencer project to play on MIDI channel 3 then MIDI notes within that track would play on the St. Anne's virtual Swell keyboard. Also (for example), if you wanted to trigger Hauptwerk's master general number 5 then within your sequencer project you would insert a MIDI program change within program number 5 on MIDI channel 8.

Note that combinations sets are shared between all four configurations (desktop shortcuts), so if you overwrite any combination sets from within this Hauptwerk configuration (desktop shortcut) then they will potentially affect your primary configuration too. Hence you might want to save any combination sets with distinct names.

Composing pieces off-line from a MIDI sequencer configured conventionally, method 2: specifying your own MIDI implementation manually (Advanced Edition only)

(Hauptwerk as a 'slave' MIDI device)

If you also sometimes play Hauptwerk live/stand-alone, we recommend configuring and using one of the '*Hauptwerk (alt config N)*' configurations (desktop shortcuts) for use with your MIDI sequencer, instead of the primary configuration (the main '*Hauptwerk*' desktop shortcut). The four available configurations have completely independent settings, so you can safely configure one of them as covered in this chapter without affecting your primary Hauptwerk configuration's MIDI and audio settings. To switch between configurations, exit Hauptwerk and then relaunch it via the appropriate one of the desktop shortcuts. For this chapter, we'll assume you want to use 'alternate configuration 2'.

Exit Hauptwerk if it's running.

Relaunch it via the '*Hauptwerk (alt config 2)*' desktop shortcut:

This chapter assumes that your MIDI sequencer supports Audio Unit or VST plug-ins (otherwise you will need to use real or virtual MIDI cables to route MIDI instead, and you will need to use a different audio output device for Hauptwerk from the one your MIDI sequencer is using).

[Instructions continue on next page.]

On the *General settings | MIDI ports | MIDI IN ports* screen tab (which you will be shown automatically within the General Configuration Wizard if you haven't used '*Hauptwerk (alt config 2)*' before), select (enable) the Hauptwerk AU/VST Link in a <u>*Console MIDI IN*</u> row (<u>not</u> the *Hauptwerk MIDI recorder/player external MIDI IN* row, in this case) on the *General settings | MIDI ports | MIDI IN ports* screen tab:
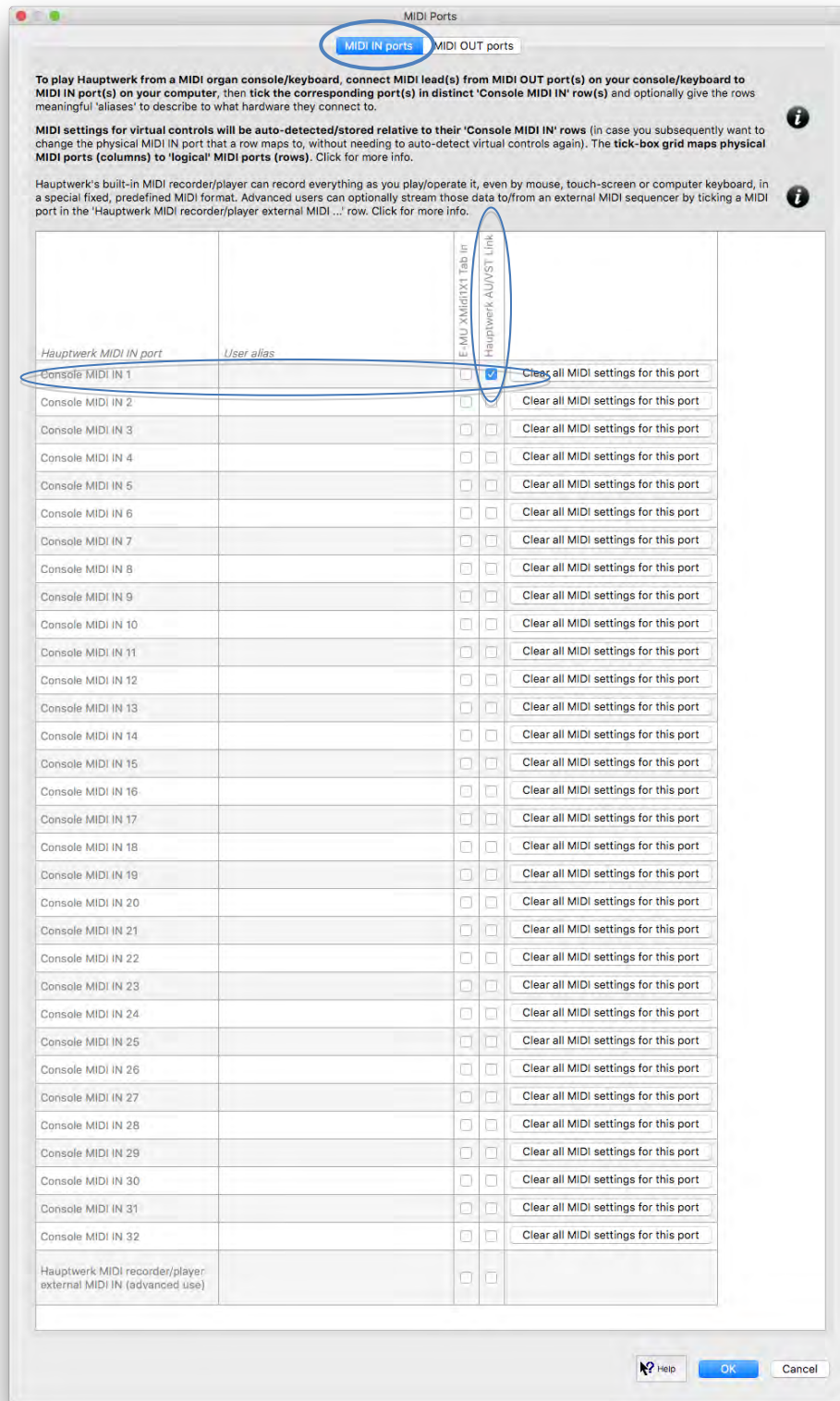
Make sure that <u>*no other ports are enabled*</u> in any other rows or columns on the screen (otherwise you might get MIDI feedback, freezes, or conflict with the MIDI sequencer over the use of the ports).

For the same reasons, on the *General settings | MIDI ports | MIDI OUT ports* screen tab also make sure that <u>no ports at all are selected in any rows or columns</u>:

OK the screen (or finish the wizard, as applicable).

[Instructions continue on next page.]

Now, using the *General settings | Audio device and channels* screen, select the Hauptwerk AU/VST Link for audio output:

Set the sample rate to whatever sample rate you want to use in MIDI sequencer/DAW's project (either 48 or 96 kHz). OK the screen.

Now within your MIDI sequencer/DAW software:

- If you are using any MIDI keyboards or other pieces of MIDI hardware, then make sure the MIDI IN ports to which they're connected are enabled as MIDI IN ports in your MIDI sequencer software (*not* in Hauptwerk). Thus any MIDI from MIDI hardware should go to your MIDI sequencer (rather than to Hauptwerk directly), with Hauptwerk acting simply as a conventional 'slave' plug-in.

- Make sure your MIDI sequencer project's sample rate matches the value of the sample rate setting on Hauptwerk's *General settings | Audio device and channels* screen (otherwise the organ will sound at the wrong pitch).

- Make sure that one, and **only one**, **instance of the Hauptwerk AU/VST Link plug-in is loaded within your sequencer's project,** **not** **separate plug-in instances on separate tracks**. Consult your sequencer's documentation for how to achieve that. For example, in Cubase, you must load the Hauptwerk plug-in within Cubase's instrument rack, and then set tracks to output to it via the instrument rack, rather than loading the plug-in directly within each track. In Logic Pro X you would insert the first track as a software instrument, then highlight the track and use '*Track | Other | New track with next/same MIDI channel*' to create any desired additional tracks that use the same plug-in instance as the first track.

Now in Hauptwerk, load the St. Anne's organ (for example).

[Instructions continue on next page.]

In Hauptwerk, in turn right-click on each of the virtual controls (such as virtual keyboards, virtual expression pedals and virtual combination pistons/buttons) that you want to control from your sequencer's project, select '*Adjust MIDI/trigger settings manually …*', then manually configure its MIDI settings so that it will respond to the specific event types and values that you wish to enter for it in your sequencer project. For ease of configuration, always keep the MIDI port settings set to its default of '*<Any enabled port>*' (since Hauptwerk will only be receiving MIDI via its virtual Hauptwerk AU/VST Link port anyway, or the relevant real or virtual MIDI cable that you're using to connect the MIDI output from your MIDI sequencer to MIDI input in Hauptwerk).

As an example, suppose that you want MIDI channel 1 to play the virtual Great keyboard in Hauptwerk. To do that in Hauptwerk you would right-click on the virtual Great keyboard and select '*Adjust MIDI/trigger settings manually …*':
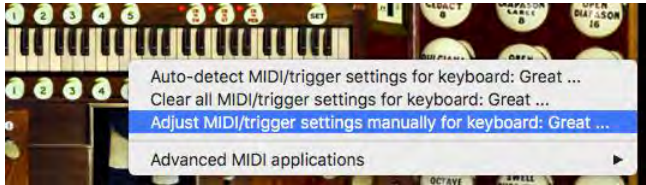
Set the *Input* (event type) setting to '*Direct input from your MIDI organ console/keyboard/sequencer*', then ensure that the *MIDI IN port* setting is (still) set to its default of '*<Any enabled port>*' and that the *MIDI channel* setting is set to channel 1 (being the channel you want to use for it in your sequencer project in this example):
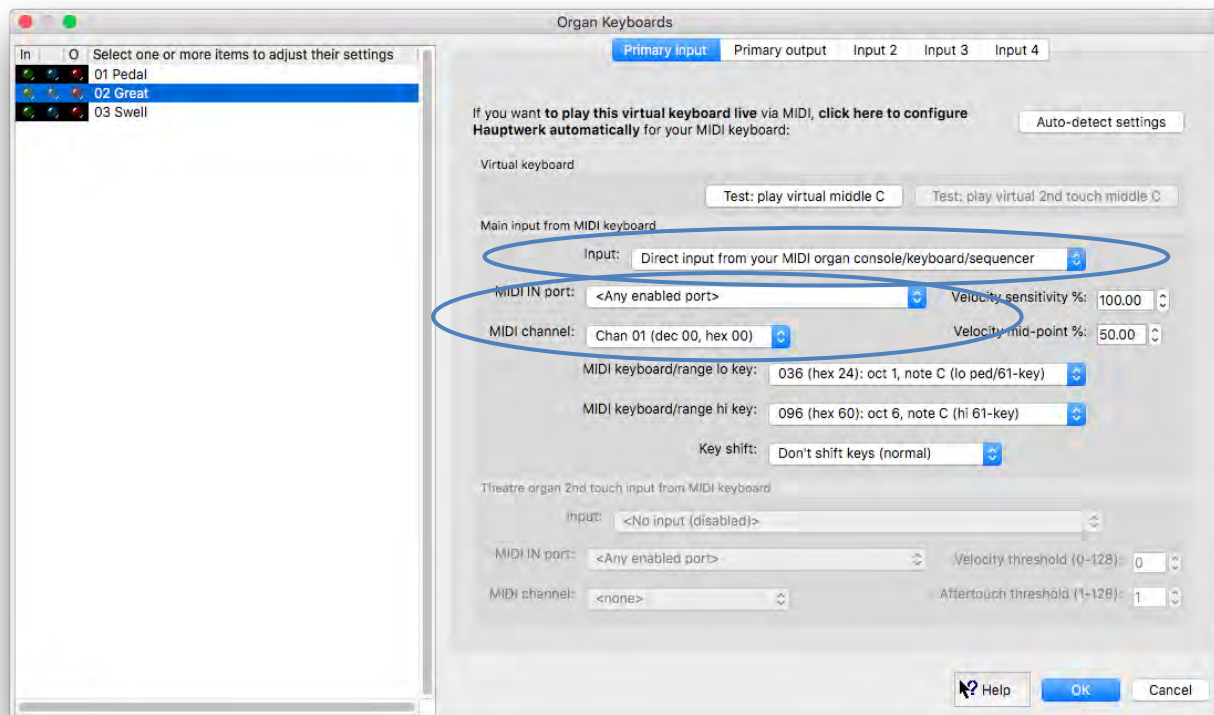
Now in your sequencer project, record the desired part(s) into a sequencer track whose MIDI output is set to the *Hauptwerk AU/VST Link* (or the relevant real or virtual MIDI cable that you're using to connect the MIDI output from your MIDI sequencer to MIDI input in Hauptwerk) and whose MIDI channel is set to 1. You should hear the virtual Great keyboard play the part in Hauptwerk.

[Instructions continue on next page.]

For expression, you may find it most convenient to use MIDI control change messages, since they are usually the easiest types of such events to enter and edit in MIDI sequencers.

For example, suppose that you wanted to use MIDI controller 11 (conventionally used for expression) on MIDI channel 2 to control the organ's virtual swell pedal, then you would right-click on the virtual Swell pedal and select '*Adjust MIDI/trigger settings manually …*':
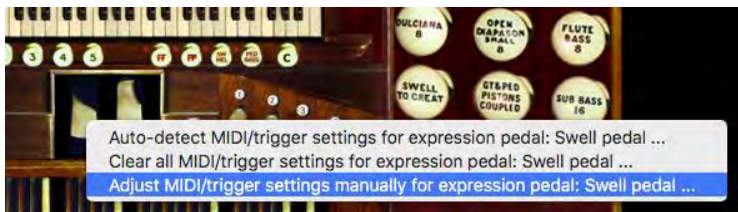
Then set the *Input* (event type) setting to '*MIDI control changes …*', then ensure that the *MIDI IN port* setting is (still) set to its default of '*<Any enabled port>*' and that the *MIDI channel* setting is set to channel 2 and that the *Controller* setting is set to 11 (being the channel and controller number that you want to use for it in your sequencer project in this example):
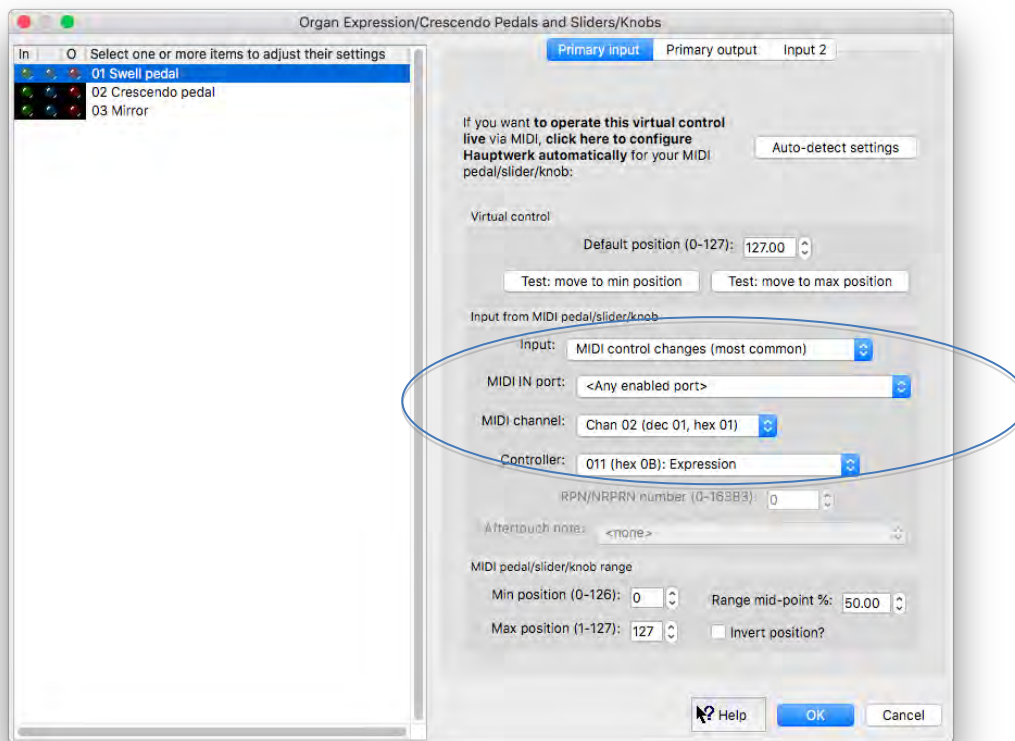
Now in your sequencer project, record (or enter/draw) the desired controller events into a sequencer track whose MIDI output is set to the *Hauptwerk AU/VST Link* (or the relevant real or virtual MIDI cable that you're using to connect the MIDI output from your MIDI sequencer to MIDI input in Hauptwerk) and whose MIDI channel is set to 2, using controller number 11. You should see the virtual Swell pedal in Hauptwerk respond.

[Instructions continue on next page.]

To effect registration changes you may either choose to enter individual stop/coupler/tremulant on/off events in your sequencer project, or instead to enter combination piston events. The latter is potentially simpler to configure (since you need only configure settings for a small number of virtual pistons, or master combination system buttons), but if triggering the combination system then you will need to ensure that the appropriate registrations are saved to a combination set and that subsequently that the appropriate combination set is always loaded when using the sequencer project.

As an example, if you wanted to use MIDI program change 3 on MIDI channel 1 to trigger Hauptwerk's third master general combination, then you would right-click on the master general 3 on the *Registration* large control panel (*View | Large control panels … | Registration*) and select '*Adjust MIDI/key trigger settings manually … (for all organs, unless overridden)*':

Then set the *Input* (event type) setting to '*Momentary piston: MIDI program change*', then ensure that the *MIDI IN port* setting is (still) set to its default of '*<Any enabled port>*' and that the *MIDI channel* setting is set to channel 1 *('On') program* setting is set to 3 (being the channel and program number that you want to use for it in your sequencer project in this example):
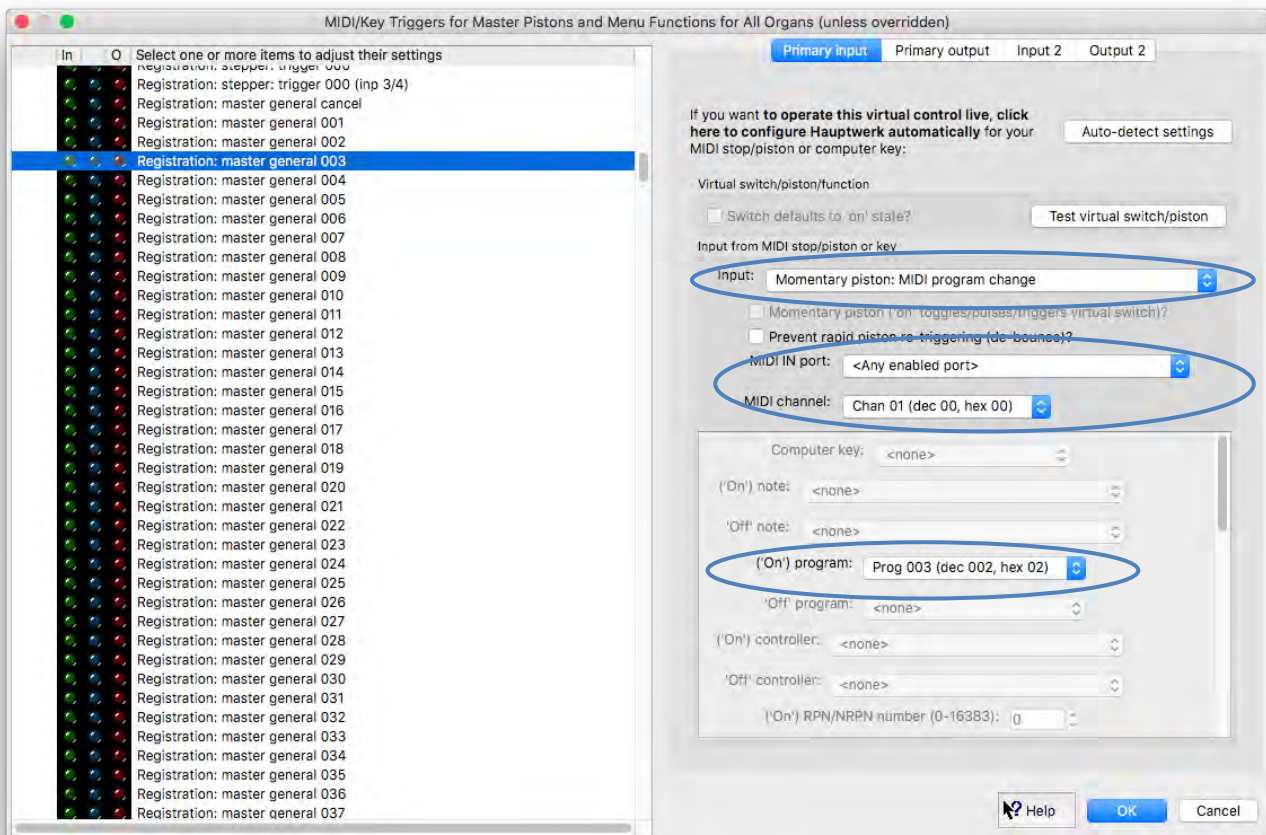
Now whenever you enter a MIDI program change 3 event in your sequencer project into a sequencer track whose MIDI output is set to the *Hauptwerk AU/VST Link* (or the relevant real or virtual MIDI cable that you're using to connect the MIDI output from your MIDI sequencer to MIDI input in Hauptwerk) and whose MIDI channel is set to 1 you should find that Hauptwerk triggers master general 3.

If you prefer to enter stop/coupler/tremulant on/off events instead (thus avoiding any dependency between the sequencer project and Hauptwerk's combination sets), then the process is similar, right-clicking on the desired virtual stops to configure their settings and choosing whichever MIDI event types and parameters you prefer (which will probably be determined by which types of on/off events are most convenient to enter and edit by hand in your particular MIDI sequencer software).

Composing pieces off-line from MIDI notation software (Advanced Edition only)

If you wish to use notation software (such as Sibelius, Finale or Dorico) then the method usually preferred is essentially identical to that described in the *Composing pieces off-line from a MIDI sequencer configured conventionally, method 2: specifying your own MIDI implementation manually (Advanced Edition only)* section. Please consult and follow that section, except in the ways noted below.

The most notable relevant difference between general-purpose MIDI sequencer software and notation software is that notation software typically has a much more limited and semi-fixed MIDI implementation. In particular:

- Usually each musical staff sends MIDI output on a fixed constant MIDI channel.

- Expression events may use fixed MIDI channels and/or MIDI controller numbers.

- MIDI program changes and MIDI control changes are usually the only other types of MIDI events that can be entered manually. Such events usually need to be entered by inserting special hidden codes within text events placed in the score on the appropriate staves associated with the appropriate MIDI channels.

Since each staff is fixed to a particular MIDI channel, and since traditionally in organ music there are two manual staves, whereas the organ manuals on which parts should play may change throughout the course of a piece, rather than configuring Hauptwerk's virtual manuals to respond directly to particular MIDI channels, you may instead prefer to configure two of Hauptwerk's 'floating division MIDI keyboards' (*View | Large floating control panels … | Floating divisions*):

… to respond to the two MIDI channels for the two manual staves:
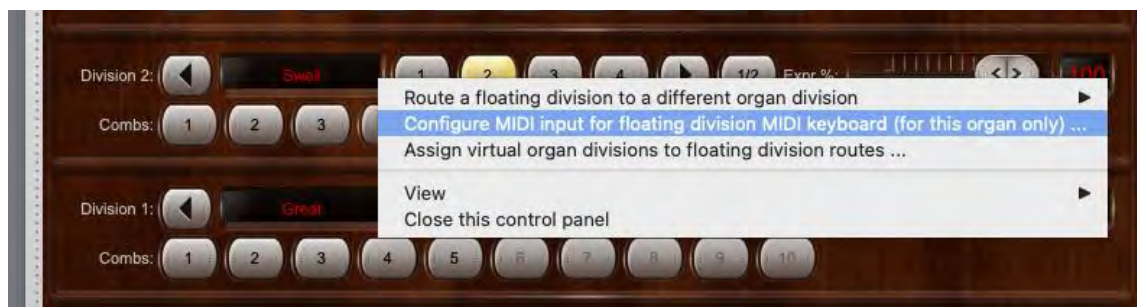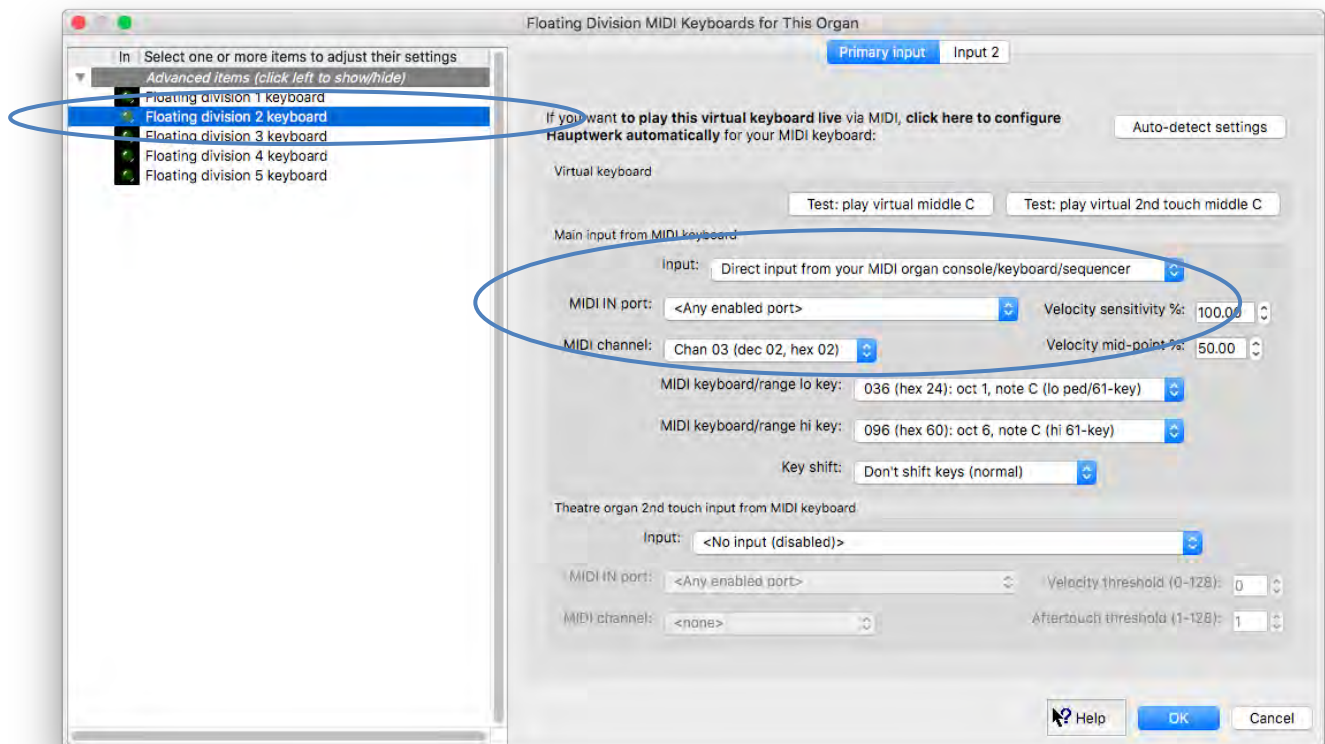
You could then map the floating division routes to the various virtual manuals:
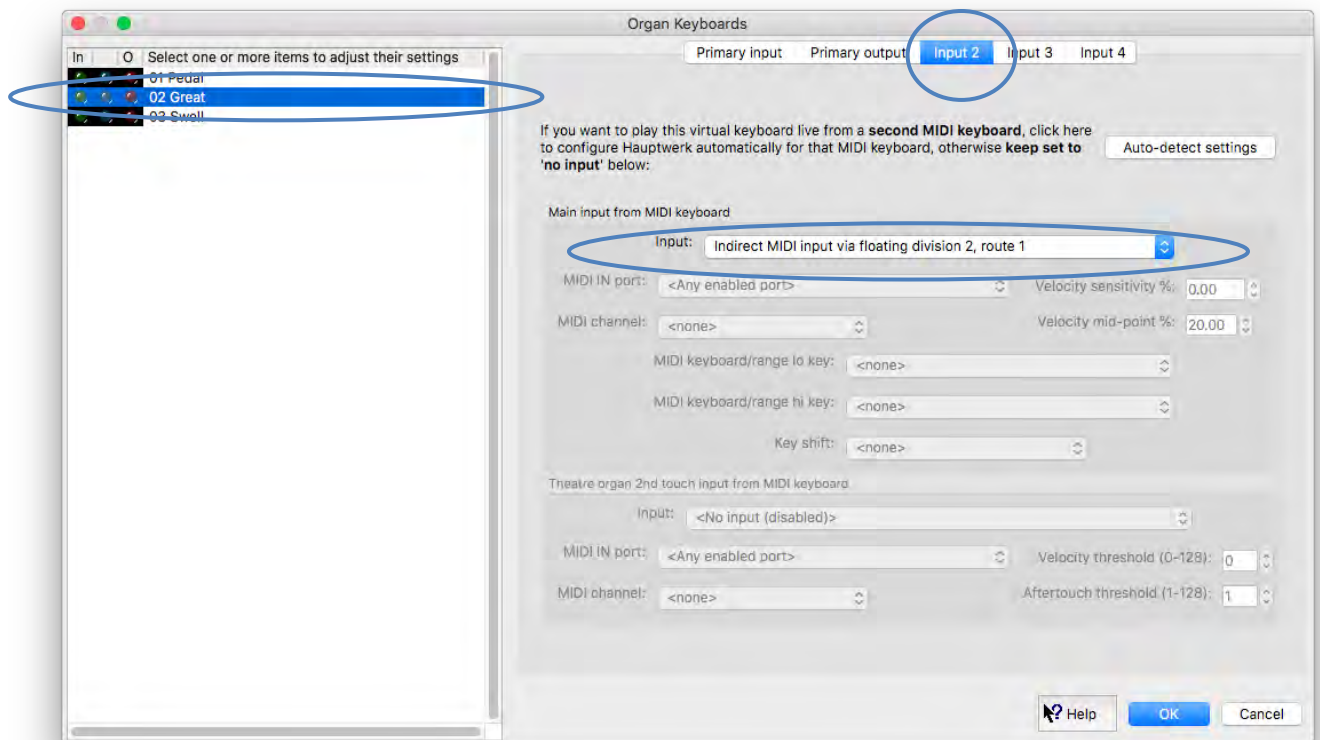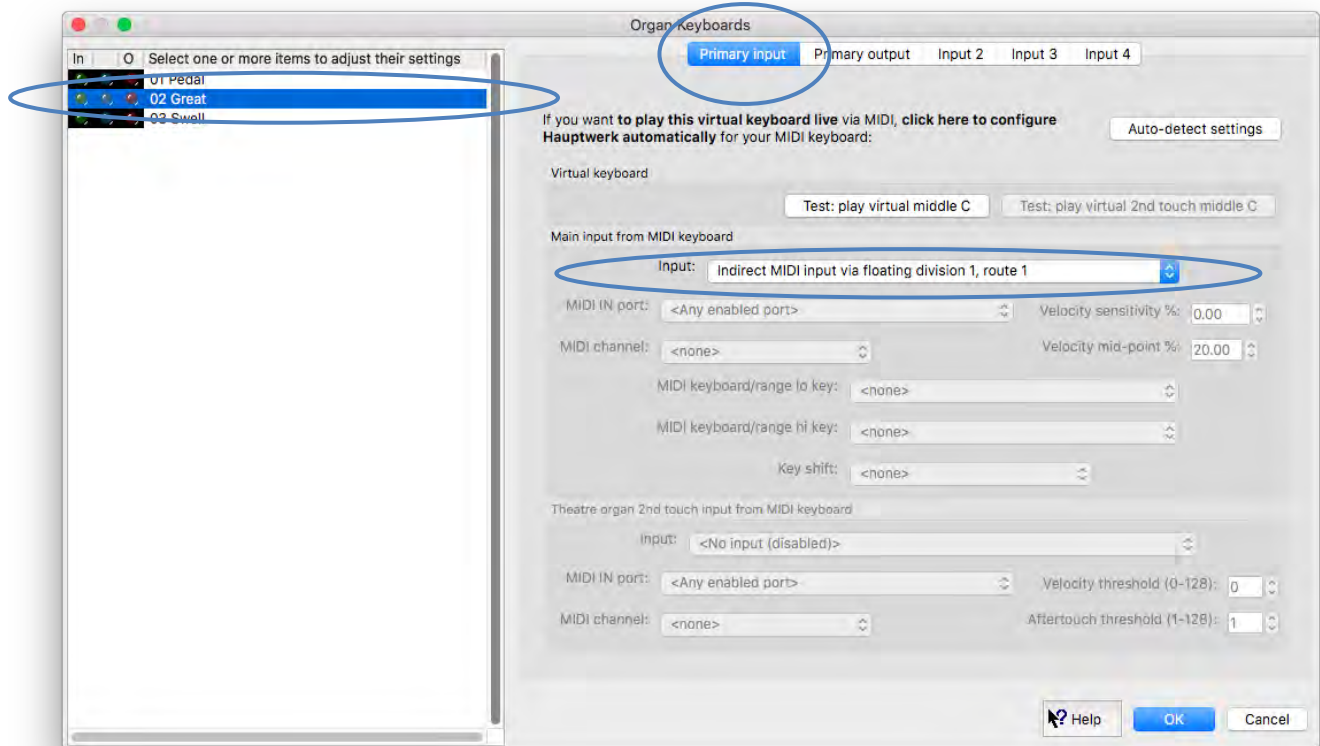
… and configure the route-selection buttons to be controlled from MIDI program changes:
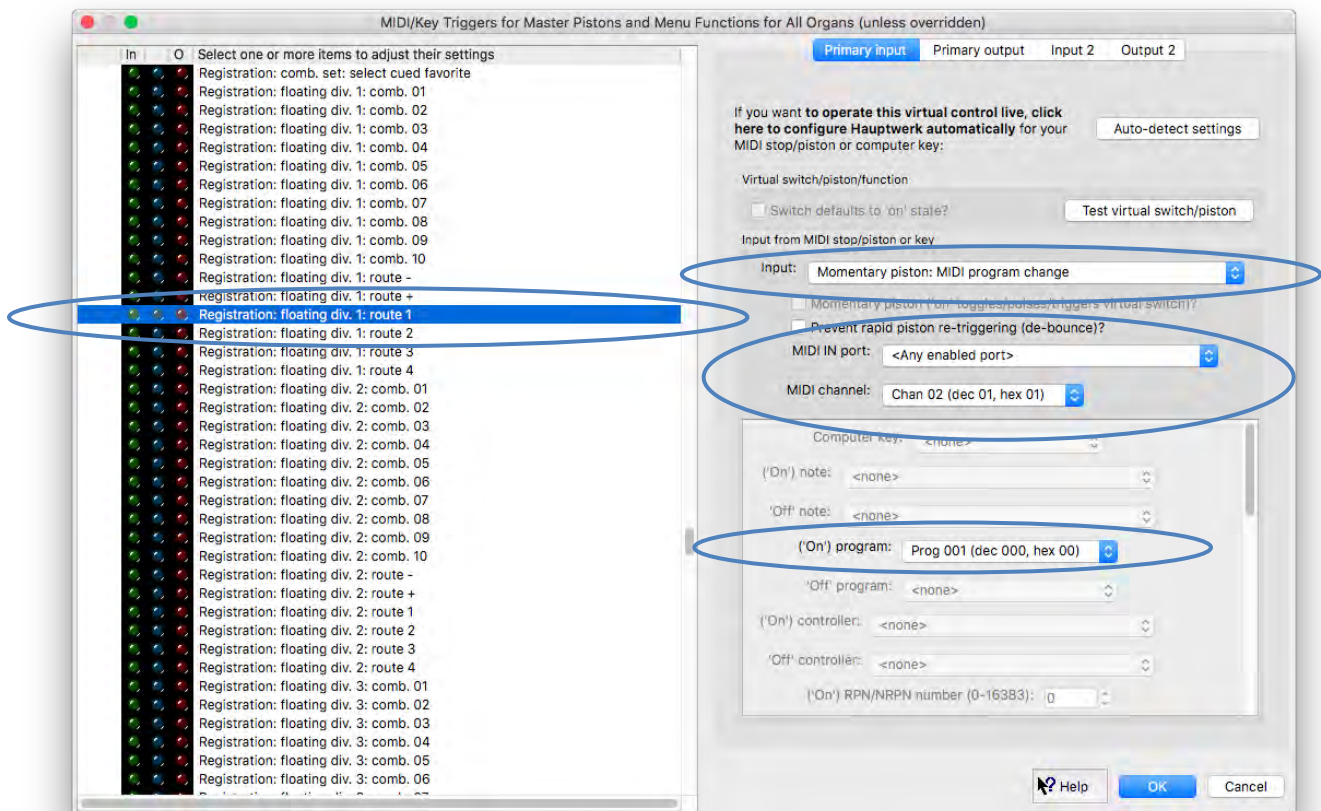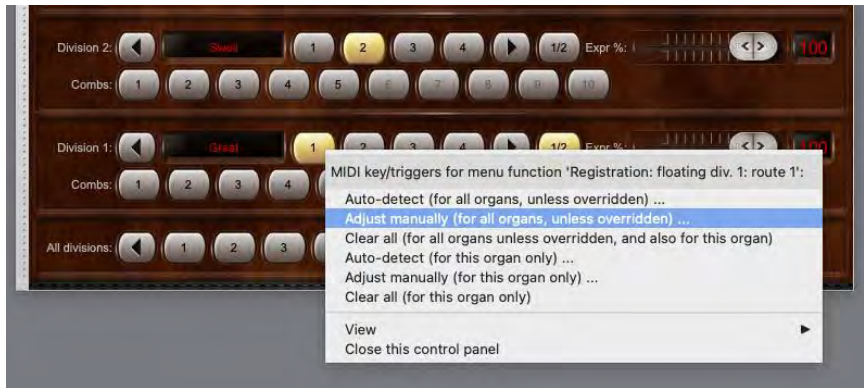
… which you could trigger when appropriate by embedding corresponding (hidden) MIDI program change messages in text events in the score. Please see the *Registration menu: floating divisions* section for more information on floating divisions in general.

Embedding MIDI program change messages in the score could also trigger combination events (with the appropriate virtual pistons or master combination buttons configured to respond to the corresponding MIDI events, in the same way that was covered in the *Composing pieces off-line from a MIDI sequencer configured conventionally, method 2: specifying your own MIDI implementation manually (Advanced Edition only)* section). For example, you could store your registrations for the piece to master generals 1-60 and configure those master generals to be triggered from MIDI program change numbers 11-70 (in case you are already using program change numbers 1-4 to trigger floating division route selections) on the appropriate MIDI channel.

If instead you prefer to use stop/coupler/tremulant on/off events directly within your score (thus avoiding any dependency between the sequencer project and Hauptwerk's combination sets), and since there are relatively few distinct MIDI program change numbers and MIDI controller numbers, then you may wish to embed MIDI control change events within the score, identifying stops by using different controller values for each. There are several 'convenience' event types designed to make configuring the settings for such a scheme quicker, prefixed with 'Notation stop or hold-piston: …':
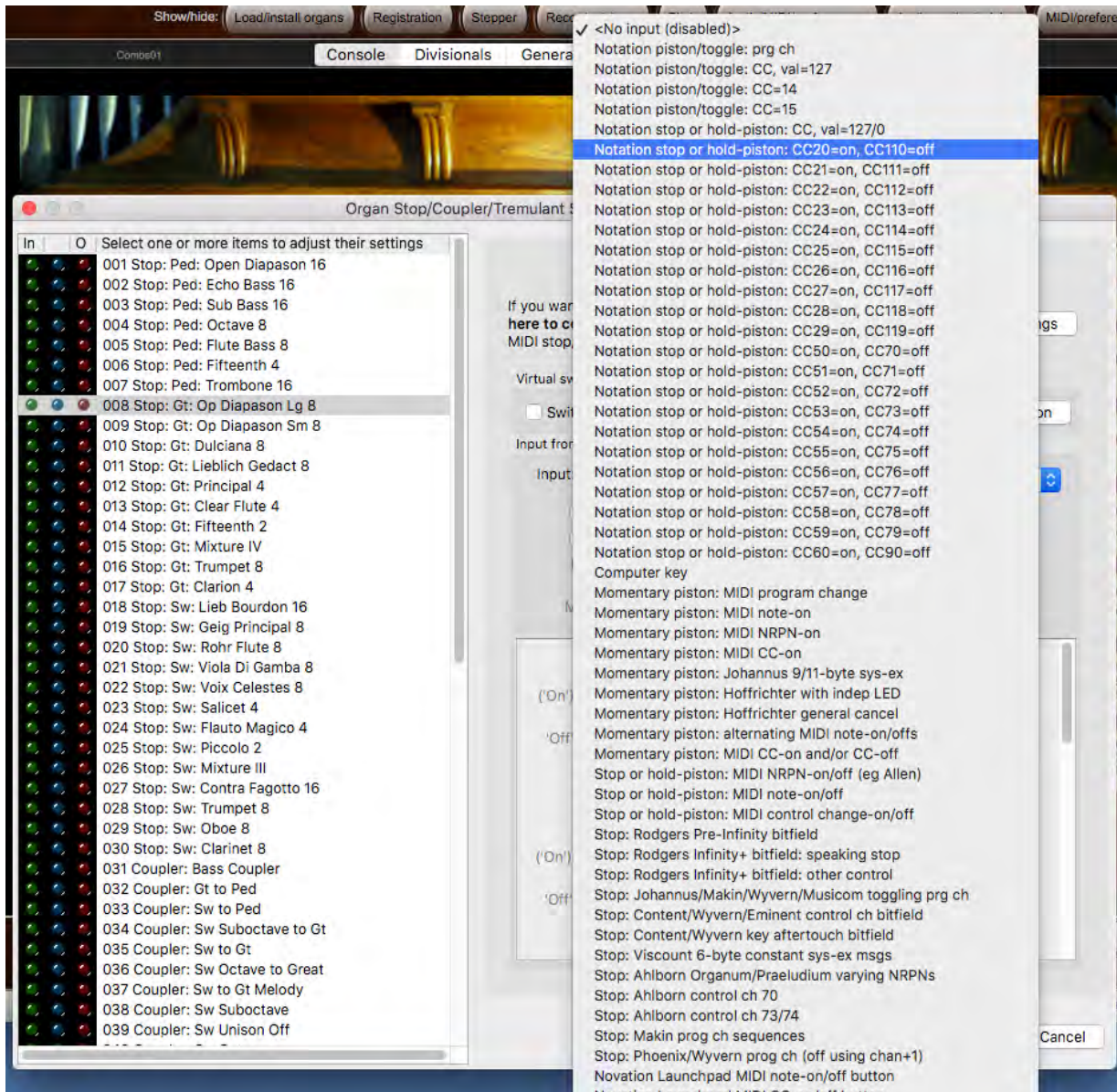
With these event types the event type itself determines the MIDI controller numbers (one for the 'on' event, and a different one for the 'off' event) and you set the controller *value* (rather than number) to identify the stop/coupler/tremulant uniquely. For example, you might choose to use the '*Notation stop or hold-piston: CC20=on, CC110=off*' event type for all stops on the virtual Great, and the '*Notation stop or hold-piston: CC21=on, CC111=off*' event type for all stops on the virtual Swell, assigning event values individually to the stops themselves using a scheme that you find convenient to remember (perhaps based on their positions on the virtual console).

Recording, playing back and editing live solo performances with a MIDI sequencer dedicated exclusively to Hauptwerk (Advanced Edition only)

(Bi-directional control of the sequencer from Hauptwerk)

This section covers how you can set up Hauptwerk with a MIDI sequencer specifically for recording and playing live solo organ performances in a similar way to Hauptwerk's built-in MIDI recorder/player, and using the same special, fixed, combination set-independent and hardware-independent MIDI implementation, for the reasons covered in the *Recording and playing back live solo performances: the built-in MIDI recorder/player and its fixed, predefined MIDI implementation* section. This type of configuration, and the associated fixed MIDI implementation, are intended to be appropriate specifically for solo organists playing live and then replaying and editing their performances. To be able to achieve this you need to configure your MIDI sequencer in a particular, and non-conventional, way (covered below), which wouldn't normally be appropriate for other uses.

In particular, this type of configuration *would not* normally be appropriate if:

- The MIDI sequencer needs to control multiple virtual instruments simultaneously, as in a conventional recording studio, or:
- MIDI parts need to be recorded or entered by hand directly within the MIDI sequencer (for example, when composing pieces), or:
- The MIDI sequencer is sometimes used with real or virtual instruments other than Hauptwerk (since it probably wouldn't then be convenient to reconfigure it before and after using Hauptwerk each time).

In any of those situations, we recommend *not* configuring Hauptwerk and the MIDI sequencer in the way covered in this section, but instead configuring them in the (more conventional) way covered in the applicable one of the two sections: *Composing pieces off-line from a MIDI sequencer configured conventionally, method 1: using Hauptwerk's fixed, predefined MIDI implementation (Advanced Edition only)* or *Composing pieces off-line from MIDI notation software*.

In our experience, the approach covered in this section is appropriate for very few people, so we normally recommend referring to one of those other two sections instead.

Everything following in this section assumes that you do indeed wish to configure your MIDI sequencer in such a way that it is dedicated exclusively to Hauptwerk and will be used exclusively for recording, playing back and editing live solo organ performances (thus allowing the greatest level of integration for those purposes).

When using a MIDI sequencer in this way it's essential to understand that MIDI to/from your MIDI organ console always goes directly to/from Hauptwerk, not via the MIDI sequencer. The sequencer is effectively side-chained via a MIDI loop (using the Hauptwerk AU/VST Link or real/virtual MIDI cables), unlike conventional software instruments, where MIDI to/from the MIDI organ console conventionally would go via the sequencer to the software instrument (with the software instrument effectively being a slave device to the sequencer).

The MIDI sequencer effectively becomes a (temporary) replacement for Hauptwerk's native MIDI recorder/player. Hauptwerk uses exactly the same MIDI implementation with a MIDI sequencer that it does for its native MIDI recorder/player, and for the same reasons (portability of MIDI files, independence of MIDI files from MIDI hardware/settings, independence of MIDI files from combination sets, touch-screen compatibility, etc.).

The MIDI stream that Hauptwerk sends to such a MIDI sequencer is exactly identical to the MIDI stream that it records with its native MIDI recorder, and the format of a MIDI stream that Hauptwerk understands from a MIDI sequencer is exactly identical to the format of a MIDI stream it would be able to play back with its native MIDI player. The MIDI streams that would normally go to/from Hauptwerk's native MIDI recorder/player are (temporarily) also redirected to/from the MIDI sequencer software.

That special, fixed, predefined, combination set-independent and hardware-independent, MIDI implementation is covered in full in the *Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation* section in this guide. Note that you can also view the implementation that Hauptwerk will use specifically for whichever organ you currently have loaded using the *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ)* menu function.

Hauptwerk's bi-directional sequencer integration (for organists recording, editing and playing back live solo organ performances with a MIDI sequencer dedicated to Hauptwerk) was designed to work this way so that:

- All of the benefits of the MIDI recorder/player's fixed implementation apply (portability of MIDI files, independence of MIDI files from MIDI hardware/settings, independence of MIDI files from combination sets, touch-screen compatibility, etc.).
- You can easily create any event in the sequencer by simply playing/clicking the relevant virtual control in Hauptwerk, without needing to find out the specific MIDI implementation that particular virtual control uses, and without needing to enter it manually, and without needing any detailed knowledge of MIDI.
- No settings need to be configured differently in Hauptwerk for sequencing with different virtual instruments (sample sets) or with different tracks.

As previously covered, combination events are never recorded by Hauptwerk, so that MIDI files remain independent of combination sets by default. However, if you don't intend to exchange your MIDI files with other Hauptwerk users, and if independence from combination sets isn't important to you, then you can optionally use your MIDI sequencer to insert events manually into MIDI files to trigger virtual combinations and/or Hauptwerk's master combination system functions (stepper, master generals, master scoped combinations, master crescendo, etc.).

The appropriate MIDI events to enter are detailed via the *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ)* menu function. If you prefer to work that way then you will probably prefer to delete the stop/coupler/tremulant on-off events (NRPNs and sys-ex) from recorded MIDI files before inserting your combination events. Manually-entered combination events may also provide a convenient way to adapt a MIDI file recorded with one organ for use with another.

When setting up Hauptwerk for use with a dedicated MIDI sequencer you need to tell Hauptwerk which MIDI ports to use to connect to/from the sequencer by ticking them in the '*Hauptwerk MIDI recorder/player external MIDI IN*' and '*Hauptwerk MIDI recorder/player external MIDI OUT*' (right-hand) rows on the *General settings | MIDI ports* screen in Hauptwerk. Ticking ports in those rows tells Hauptwerk to redirect its MIDI recorder/player MIDI streams to/from your MIDI sequencer:
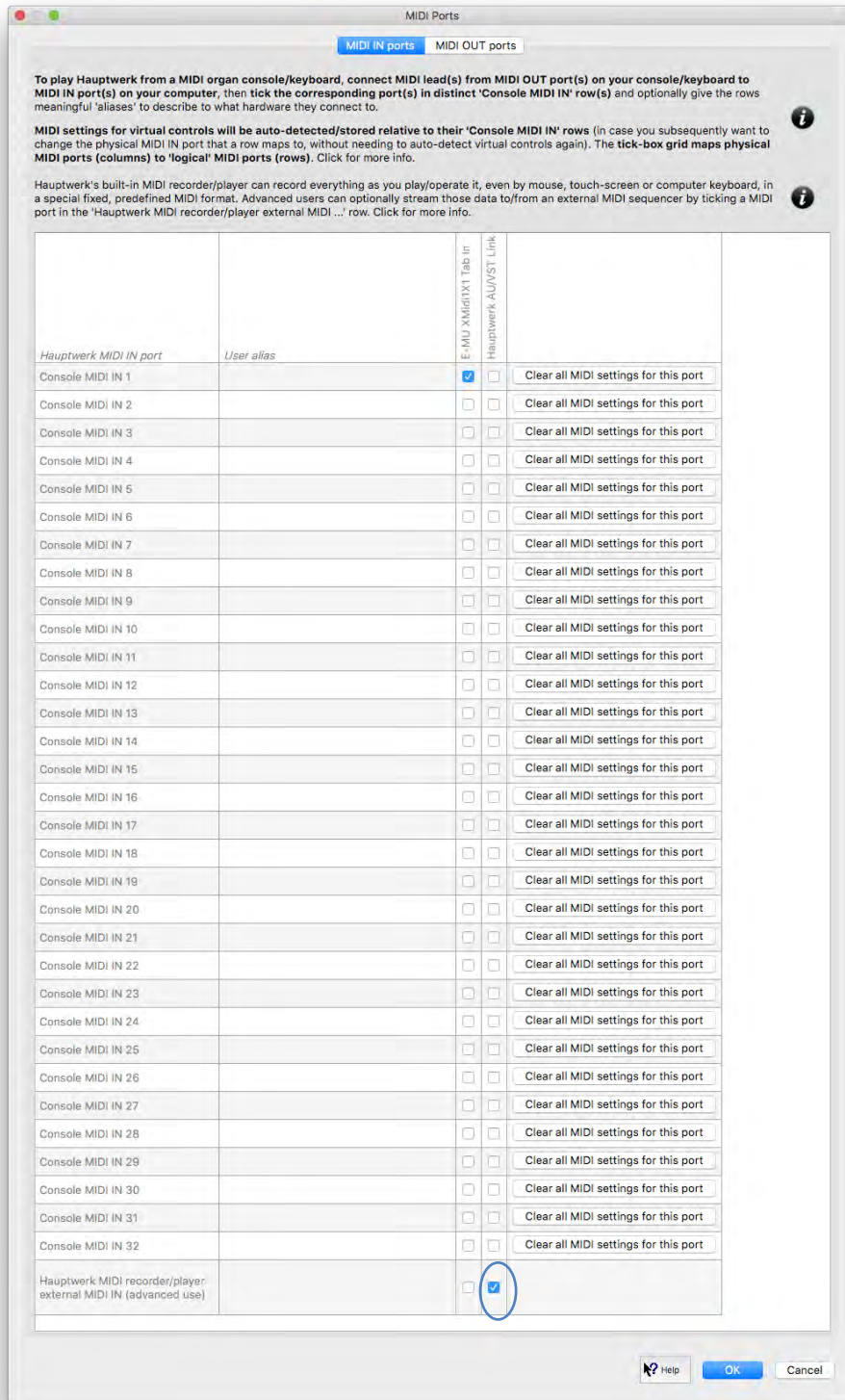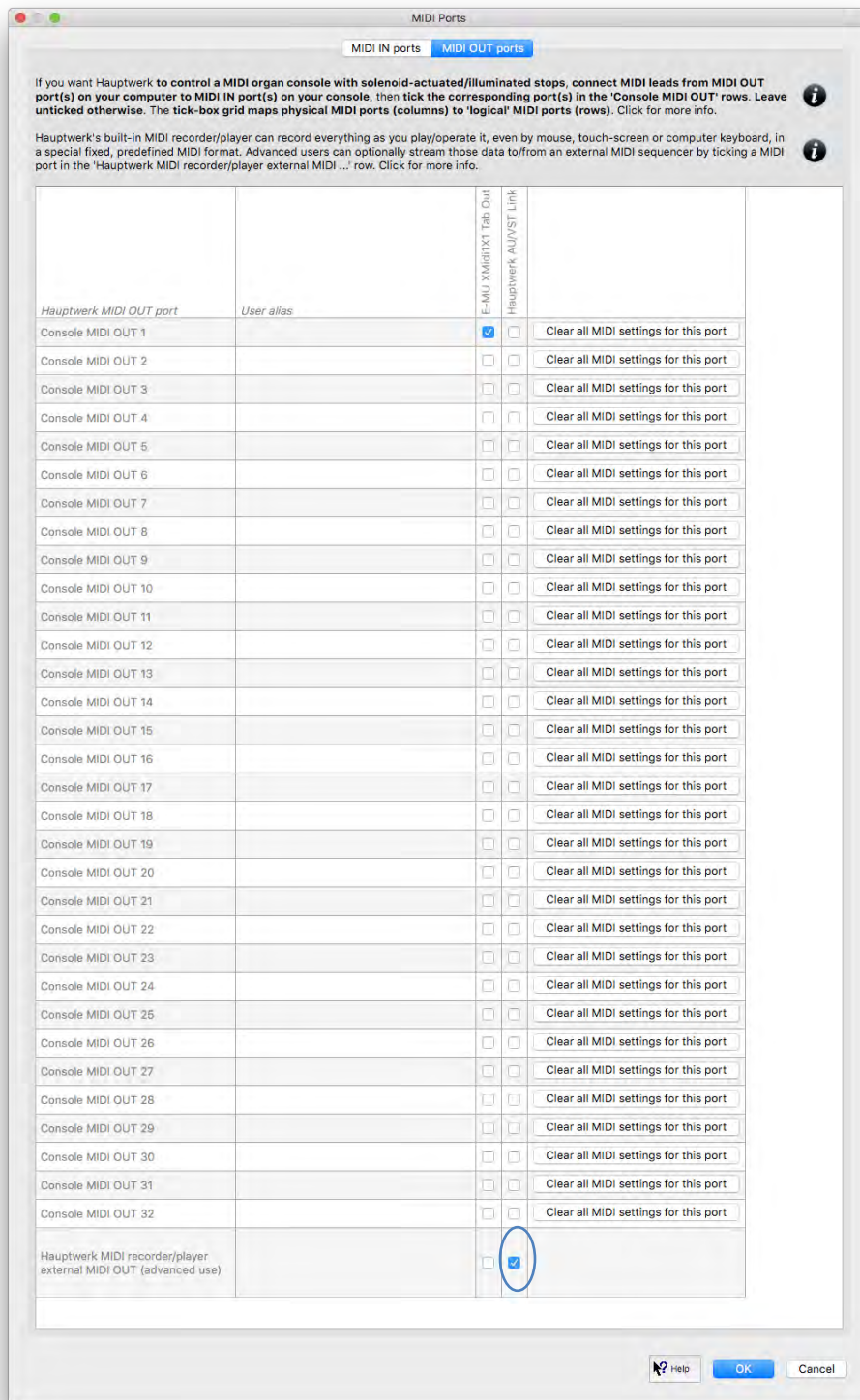
In the '*Console MIDI IN*' and '*Console MIDI OUT*' rows you should always keep the MIDI ports ticked that connect to/from your MIDI organ console (if you have one) and/or MIDI keyboards and/or other MIDI organ hardware (so that your MIDI hardware can still interact directly and fully with Hauptwerk).

As covered in the *Hauptwerk AU/VST Link plug-in (Advanced Edition only): for routing audio/MIDI* section, the '*Hauptwerk AU/VST Link*' entry is a special kind of 'MIDI port' that allows MIDI to be sent between Hauptwerk and an AU/VST-compatible MIDI sequencer via AU/VST, rather than via a conventional real or virtual MIDI cable.

Although it's the easiest way to connect Hauptwerk with such MIDI sequencers, unfortunately many MIDI sequencers have limited support for MIDI sent via AU/VST, so you might need to use real or virtual MIDI cables instead. For example, at the time of writing, Logic doesn't support any MIDI output from AU plug-ins, and Cubase and Sonar don't support MIDI sys-ex via VST (which Hauptwerk needs to use for a few virtual controls, such as the St. Anne's crescendo pedal). However, Reaper does fully support MIDI, including sys-ex, via AU/VST on macOS and Windows.

For sequencers that don't have full bi-directional support for MIDI via AU/VST you instead need to use two separate real or virtual MIDI cables:

- One to connect from Hauptwerk's '*Hauptwerk MIDI recorder/player external MIDI OUT*' port to the (only enabled) MIDI IN port in your MIDI sequencer software and:

- Another to connect from your MIDI sequencer software's (only enabled) MIDI OUT port to Hauptwerk's '*Hauptwerk MIDI recorder/player external MIDI IN*' port.

If using real physical MIDI cables, doing this will of course require two spare physical MIDI IN ports and two spare physical MIDI OUT ports between which to connect the cables.

macOS includes native virtual MIDI cable functionality (the *IAC Driver*), which works very well. On Windows free third-party utilities such as loopMIDI can be used. Alternatively, two real physical MIDI cables, attached to associated spare real physical MIDI ports.

If routing MIDI between Hauptwerk and your MIDI sequencer via the Hauptwerk AU/VST Link you must disable all MIDI IN and all MIDI OUT ports in your MIDI sequencer, otherwise Hauptwerk and the MIDI sequencer will 'fight over' the MIDI ports or data and you may get freezes or crashes.

If routing MIDI between Hauptwerk and your MIDI sequencer via virtual or real MIDI cables then:

- You must use two separate virtual/real MIDI cables, as above.

- You must have one of those cables enabled as the '*Hauptwerk MIDI recorder/player external MIDI OUT*' port in Hauptwerk and that same cable enabled as the MIDI IN port in your MIDI sequencer.

- You must have the other of those cables enabled as the '*Hauptwerk MIDI recorder/player external MIDI IN*' port in Hauptwerk and that same cable enabled as the MIDI OUT port in your MIDI sequencer.

- All other MIDI IN and MIDI OUT ports must be disabled in your MIDI sequencer, otherwise you will get freezes/crashes (since they would form a MIDI feedback loop).

- In particular, you must not have any given virtual/real MIDI cable enabled for both input and output in your MIDI sequencer.

As an example, to route MIDI bi-directionally between Hauptwerk and Cubase on macOS, using macOS's built-in IAC Driver virtual MIDI cable functionality you would have MIDI ports enabled and disabled in Hauptwerk and Cubase as shown in the following screenshots:
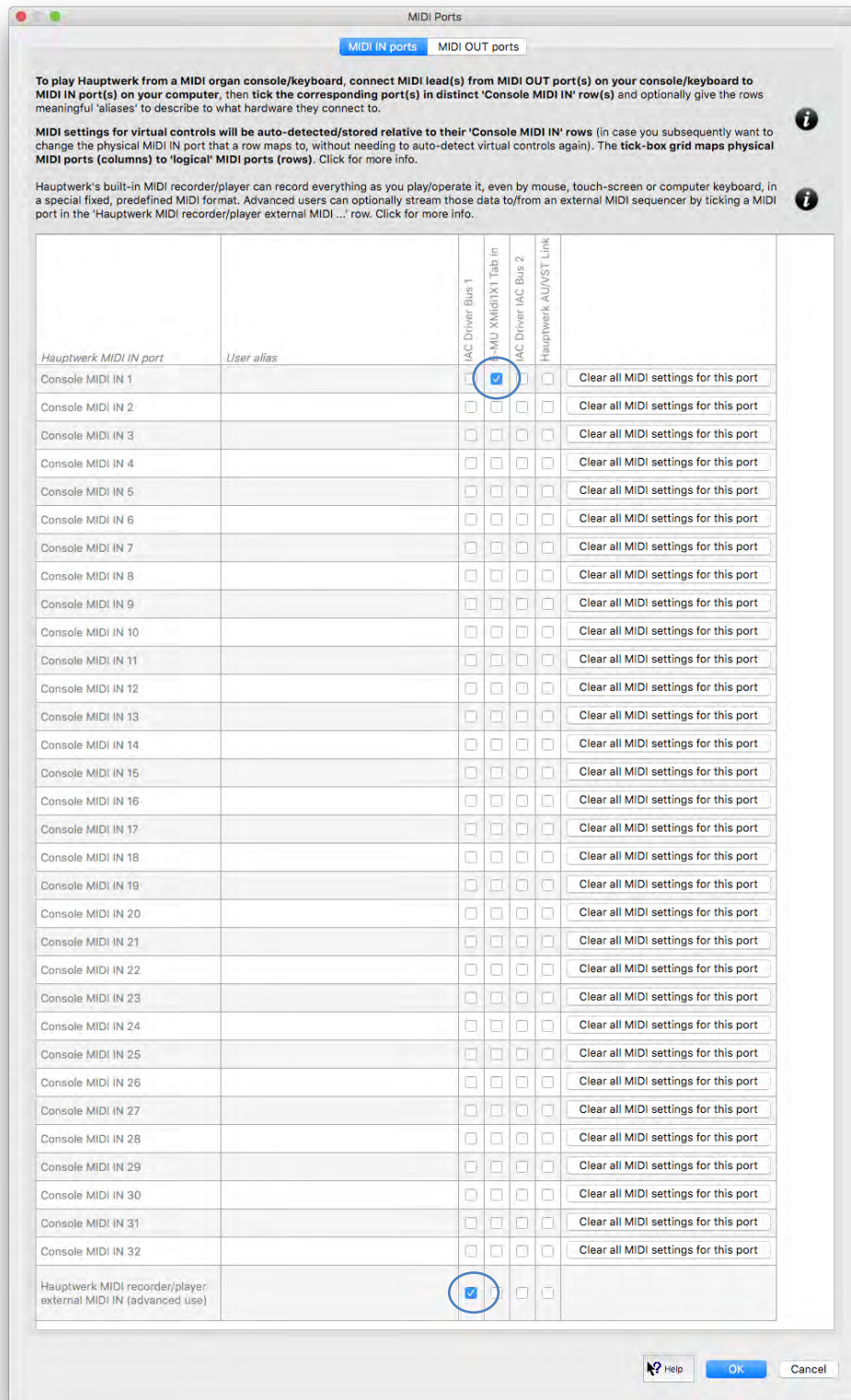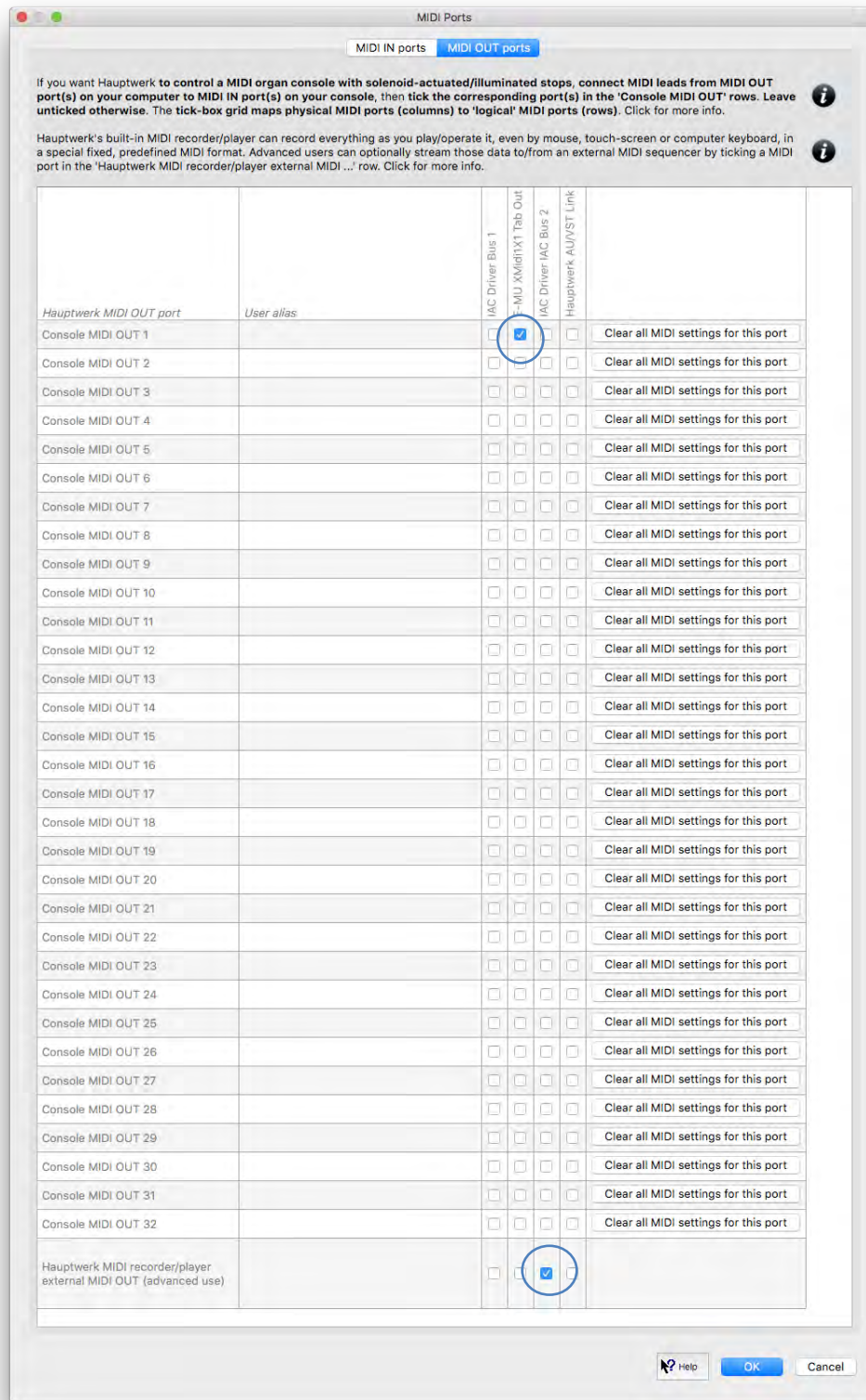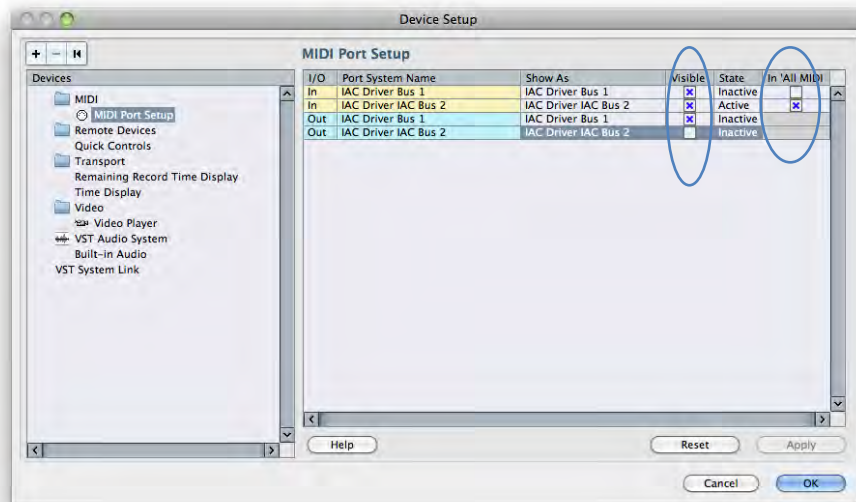
If using Hauptwerk with a MIDI sequencer (for organists recording, editing and playing back live solo organ performances with a MIDI sequencer dedicated exclusively to Hauptwerk), here are some settings that you might commonly need to verify or adjust in your MIDI sequencer:

- Make sure that 'MIDI thru' (or 'MIDI echo') is disabled (globally for the sequencer, and/or for the project, and/or for the *Hauptwerk AU/VST Link* plug-in, and/or for each MIDI track).

- Make sure that MIDI NRPNs and MIDI sys-ex are not disabled or set to be filtered out, otherwise Hauptwerk registration changes might not be recorded.

- If the sequencer performs any transformation/re-interpretation of MIDI NRPN or MIDI sys-ex messages, make sure that behavior is disabled (otherwise Hauptwerk registration changes might not be recorded/replayed properly).

- If the sequencer has options to reset MIDI controllers or NRPNs before or after playback or recording, make sure that behavior is disabled (otherwise some of Hauptwerk's registration might reset unexpectedly).

- Make sure no MIDI 'program' is selected for the MIDI tracks (otherwise combination pistons or menu functions might unexpectedly be triggered in Hauptwerk).

- Make sure that 'all MIDI channels' is selected for both MIDI input and MIDI output for each MIDI track, since Hauptwerk will record and replay events on multiple MIDI channels simultaneously.

- If the sequencer has an option to enable/disable MIDI output from AU/VST plug-ins, make sure it is set to allow MIDI output from the *Hauptwerk AU/VST Link* plug-in.

Section VII: Reference

Performance tuning

There are several key goals when optimizing Hauptwerk and its computer:

- **Eliminating audio glitches**. If the computer becomes overloaded, or if you try to load too much data into memory, a digital instrument may be unable to calculate the audio output fast enough, and unpleasant audible glitches may occur in the output. Hauptwerk has mechanisms designed to eliminate this problem, but it's important to tune Hauptwerk and the computer appropriately in order that they can work properly. Hardware or hardware driver problems can also cause audio glitches.

- **Setting audio levels optimally**. To produce the best quality audio output, the levels should be set as high as possible, without allowing clipping to occur. Clipping causes unpleasant audio distortion (loud 'crackles').

- **Eliminating background noise**. Audio interfaces can sometimes produce background digital crackling due to hardware or software resource contention, which should be eliminated.

- **Maximizing polyphony**. The (static) polyphony is the approximate number of pipes that Hauptwerk can sound simultaneously without being overloaded. For a full discussion of polyphony, please see the *Determining and limiting polyphony* section below, and also the *Hauptwerk prerequisites* section. Note especially that 'wet' (reverberant) sample sets need higher polyphony than dry since each release sample (reverb tail) continues to consume a voice of polyphony until it has completely died away.

- **Minimizing latency**. Latency is the delay between pressing a key on the MIDI keyboard and hearing the corresponding sound from Hauptwerk. All digital audio instruments require a certain amount of latency since the audio output is generated in small chunks, and time is required to calculate them. When playing Hauptwerk live, you would normally want Hauptwerk to be as responsive as possible (for pipes to sound within a small number of milliseconds). For MIDI sequencer use latency is usually much less important.

- **Maximizing audio quality and realism**. Many sample sets optionally support high-resolution 24-bit audio, and some of Hauptwerk's processor-intensive models and audio engine options can be disabled to improve polyphony at the expense of realism. Similarly, options exist to try to make a sample set usable within a limited amount of memory.

- **Minimizing sample set loading times**.

Audio interface and drivers

The quality of the audio interface affects the quality of the sound you will hear from Hauptwerk. Especially on Windows, it also has an enormous effect on audio performance (both polyphony and latency). For example, with some high-quality professional-grade audio interfaces it's even possible to play twice as many pipes at once in Hauptwerk compared to some PC motherboard onboard audio outputs. Similarly, the difference in overall latency usable in Hauptwerk can differ from 3-4 milliseconds for a good professional-quality interface to 100 milliseconds for a PC's built-in sound output.

Spending a large amount of money on a fast computer to run Hauptwerk and then economizing on the audio interface, which is perhaps the most crucial component in the system, is likely to be a false economy. Simple basic pro/semi-pro audio interfaces will usually give very good results and are not particularly expensive. Good-quality amplifiers and speakers or headphones are of course important too.

Before attempting to optimize Hauptwerk's performance in any other way, we strongly recommend ensuring that you have the latest operating system updates applied, and the latest version of your audio interface's drivers. Driver versions can make a big difference to the latency that can be achieved and can also eliminate background crackle and other problems.

macOS has native professional-grade high-performance audio and MIDI drivers built-in, and Macs have Thunderbolt/USB ports/controllers that are usually free from compatibility issues with audio/MIDI interfaces, hence audio/MIDI interface compatibility or performance issues are rare on the Mac platform, and performance should be very good (even with a Mac's built-in audio output).

For Windows/PC platforms: ASIO drivers usually give massively better performance than DirectSound drivers, and are available with all professional audio interfaces. (Except possibly for some Creative Audigy sound cards, whose ASIO drivers do not support some sample rates that one may wish to use in Hauptwerk), if a native (manufacturer-supplied) ASIO driver is available we'd strongly recommend using it. ASIO drivers should also make all of an interface's audio channels available to Hauptwerk, whereas DirectSound drivers are limited to one stereo output only in Hauptwerk. The freeware ASIO4All driver sometimes makes it possible to get reasonable performance from PCs' built-in audio outputs and other consumer-level audio hardware if no ASIO driver is available from the manufacturer.

Hauptwerk's audio driver can be changed using the *General settings | Audio device and channels* screen. Ensuring that you have the latest driver installed for your audio interface, and have selected the correct entry for it on that screen, are absolutely essential first steps for obtaining good performance from Hauptwerk.

Try to avoid having USB/FireWire audio interfaces sharing a USB/FireWire port or USB/ FireWire controller with other devices. If possible, try to ensure that an audio interface doesn't share any resources with any other device at all. Try USB/ FireWire audio interfaces in each possible USB/ FireWire port and PCIe cards in each possible slot, and try to ensure that a USB/ FireWire audio interface is connected directly to a port on the computer, rather than via a hub or another device. If you do need to use a USB hub, then make sure it's a good-quality model, with its own dedicated power supply.

If you have problems with general crackling, disconnect all unnecessary hardware from the computer, such as spurious USB/FireWire devices to see whether that eliminates the problem.

Buffer sizes, latency, and audio sample rate

The audio output is calculated in very small chunks at regular time intervals. The *buffer size* determines the size of these chunks and hence, together with the sample rate, the amount of constant delay that is introduced between pressing a note and its sound being heard through your audio interface, termed the *latency*.

Smaller buffer sizes give smaller latencies, and thus make the virtual organ more responsive for playing in real-time. However, below a certain limit, smaller buffer sizes also increase the load on the computer's processor(s), which can lead to a lower polyphony being achievable. A balance must thus be struck.

Note that the audio interface hardware, its driver, and your buffer size and sample rate settings determine the latency, not Hauptwerk itself. Professional audio interfaces (e.g. from RME and MOTU) are specially designed to give high performance even at very low latencies.

With an organ loaded in Hauptwerk, you can see latency that your audio interface's driver is reporting on the *Audio, MIDI and Performance* large control panel (which can be opened via *View | Large floating controls panels (for this organ) ...* from the menu, for example):
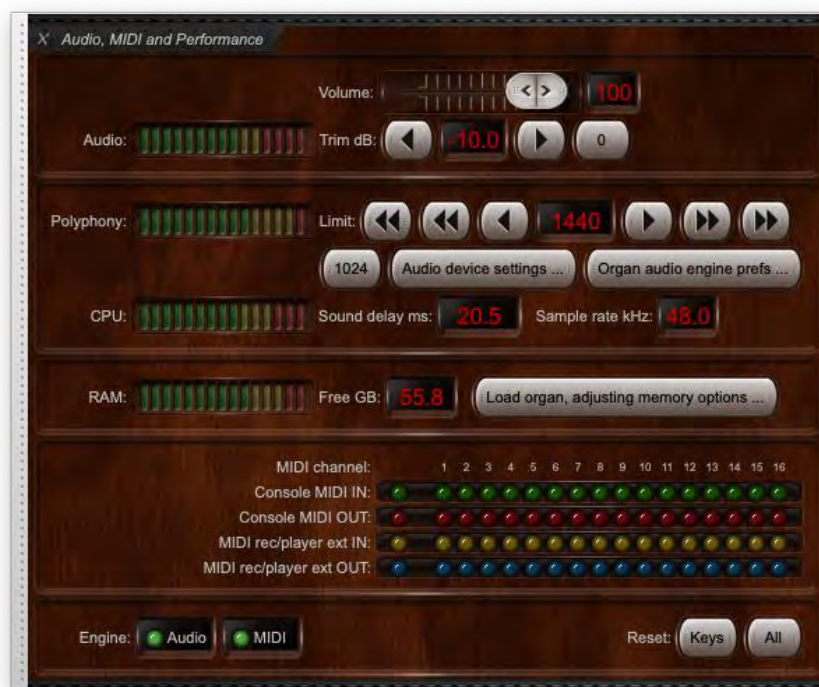
The buffer size and sample rate are adjusted on the *General settings | Audio device and channels* screen (which can alternatively be opened by clicking on the *Audio device settings …* button on the control panel):
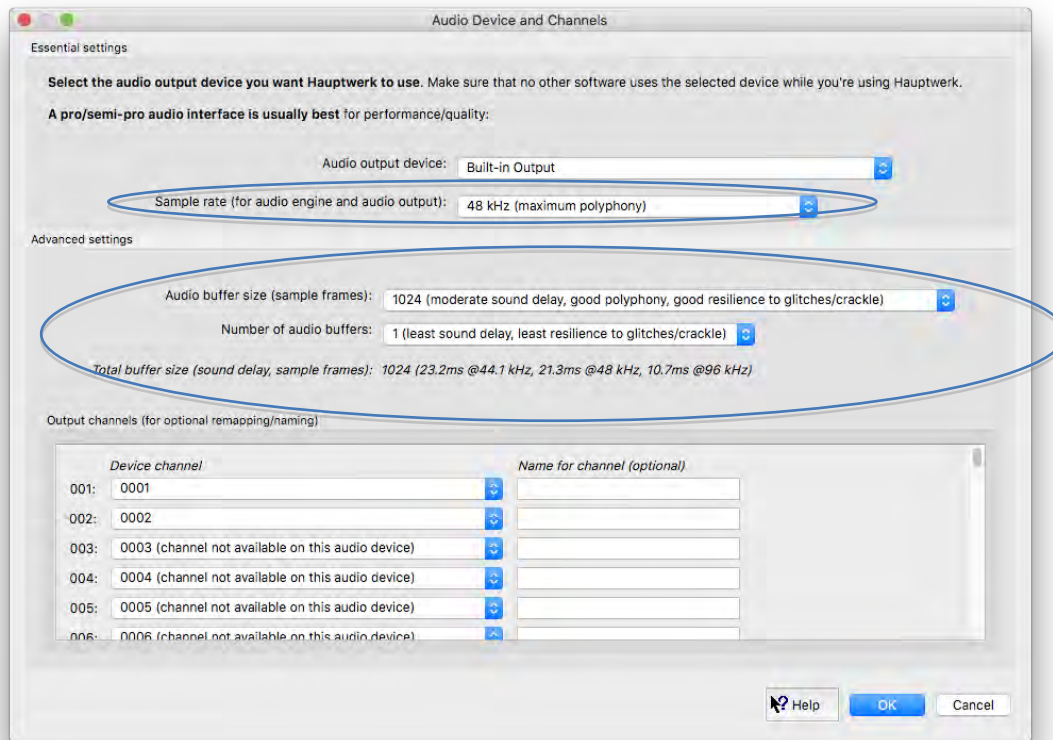
(Before adjusting the buffer size, make certain that you have the correct and most-current manufacturer-supplied driver selected on the screen, as discussed above.) Note that some Windows ASIO drivers only allow the buffer size to be adjusted via the manufacturer-supplied ASIO control panel. If Hauptwerk's buffer size setting is having no effect, click on the *Show device control panel* button and try adjusting the buffer size there:
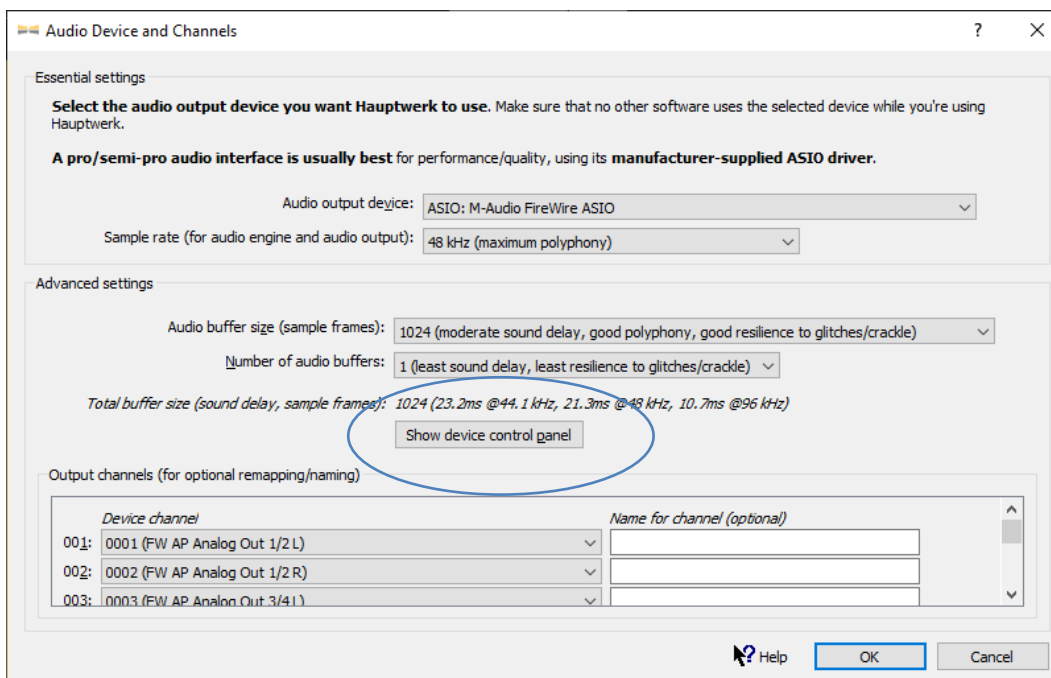
For direct audio output (as opposed to via the Hauptwerk AU/VST Link) on Macs, and with good ASIO drivers on Windows, you should usually leave the '*Number of buffers*' setting at '1', so that the buffer size alone determines the total buffering (thus minimizing latency and maximizing polyphony). (Increasing the '*Number of buffers*' setting might help on some PCs prone to audio glitches, at the expense of additional latency, but, with most audio drivers, using a single larger buffer is likely to be more resilient to audio glitches than several smaller ones.)

Look at the *Audio, MIDI and Performance* control panel (or activity log) to see the effect on latency that any buffer size change made. (With Windows DirectSound drivers, note, however that DirectSound itself and the drivers often introduce considerable additional 'invisible' latency, which cannot be queried, so the true latency might sometimes be as much as twice the value indicated by Hauptwerk.)

On macOS, or Windows with ASIO drivers, we would normally recommend a buffer size of 1024 samples (21 milliseconds at 48 kHz) as a starting point, which should give reliable operation with almost all audio interfaces. You can then try smaller buffer sizes to give a faster response (lower latency) if your driver and computer can handle it without audio glitches, usually at the expense of a little polyphony when the buffer size falls below a certain threshold. Most professional/semi-pro audio interfaces can work well with a buffer size of 512 samples (11 milliseconds at 48 kHz) without a noticeable drop in polyphony, or 256 (5 ms) with some drop in polyphony. An audio interface and ASIO/Core Audio driver that supports power-of-two buffer sizes (128, 256, 512, 1024, 2048, or 4096) is recommended for lowest latency. With most macOS or Windows ASIO drivers, a single larger buffer (e.g. 512) is likely to perform better (yielding better resilience to audio glitches) than several smaller buffers with the same total amount of buffering (e.g. two 256 buffers).

For the Hauptwerk AU/VST Plug-in Link, audio buffer sizes should also be specified within Hauptwerk (since Hauptwerk requires its buffers' sizes to be powers of two and of a constant size, so that efficient zero-latency impulse response reverb is possible within Hauptwerk). For good performance, the individual buffer size set in Hauptwerk should be no larger than the AU/VST host's buffer size and the total amount of Hauptwerk buffering (Hauptwerk individual buffer size multiplied by number of buffers) should be at least as much as the AU/VST host's buffer size. If you are certain that the host's buffer size will always be exactly the same as the buffer size set in Hauptwerk then you can set the number of buffers in Hauptwerk to 1, which should give the best possible performance and lowest latency. For the AU/VST Link the default Hauptwerk buffer values (size=256, number=4) should be reliable for any host buffer size in between 256 and 1024, giving a reasonable balance of performance.

The '*Sample rate*' setting on the *General settings | Audio device and channels* screen contains options for 48 kHz (the default), 96 kHz, and '*Use organ's default sample rate*'. The 96 kHz option is more CPU-intensive than 48 kHz, sacrificing achievable polyphony (typically about 50%) for higher audio quality (better signal-to-noise ratio, less distortion, and better clarity). However, provided that you keep the '*Audio engine processing quality*' set to '*Higher*' on the *Organ settings | Organ preferences | Audio engine* screen tab (which very significantly benefits audio quality and is always strongly recommended), the additional benefit of 96 kHz above 48 kHz is unlikely to be significant enough to be audible, so 48 kHz is usually sufficient and recommended.

Memory and rank memory options

Hauptwerk needs to keep all audio sample data in memory in order to achieve the very high polyphony for which it is designed, and which is necessary to model a pipe organ effectively. It does not stream samples from storage (SSDs/hard-disks), since that approach isn't presently able to provide sufficient performance in most cases without a very high expenditure on many drives, resulting in higher overall hardware cost than using memory.

When loading a sample set, Hauptwerk constantly monitors the amount of the computer's usable physical memory remaining and tries to detect when that usable physical memory is nearly exhausted, as well as showing an estimate of the amount of memory that Hauptwerk is using, as a proportion of the usable physical memory.

Before and during loading an organ, this proportion is shown as a real-time graphical meter in the mini control panel docked at the top of the main window, as well as in a miniature meter on the status bar at the bottom of the screen, both labeled '*RAM*':

The *Free GB* figure shown at the top-right of the screen is Hauptwerk's estimate of the amount of your computer's usable physical memory remaining that Hauptwerk might potentially safely be able to use before audio glitches or other performance issues become likely (even though other applications might currently be using some or all of it). The *RAM* meter will reach its red zone when the *Free GB* figure reaches zero.

Important note 1: Note that Hauptwerk's memory usage figures won't usually correspond to the memory usage figures that macOS's Activity Monitor or Window's Task Manager show. Hauptwerk's figures are specifically designed to show the risk of audio glitches (or other performance issues) in Hauptwerk, rather than the performance of the computer for other applications, or the computer's performance as a whole. Hence the figures shown by Hauptwerk are the ones that should be most relevant and useful for Hauptwerk purposes.

Important note 2: if you're using other real-time performance-sensitive applications at the same time as Hauptwerk, such as MIDI sequencer software, then it's important to be aware that Hauptwerk's memory figures won't take their memory usage into account, and that those other applications might start to perform poorly if you load an organ in Hauptwerk that fills up too much of the computer's memory, taking memory away from those other applications (even if Hauptwerk's *RAM* meter hasn't yet reached its red zone). Hence you should ensure that you leave sufficient memory free for them, if applicable.

Once an organ has been loaded, you can also view the same memory information via the *Audio, MIDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*):
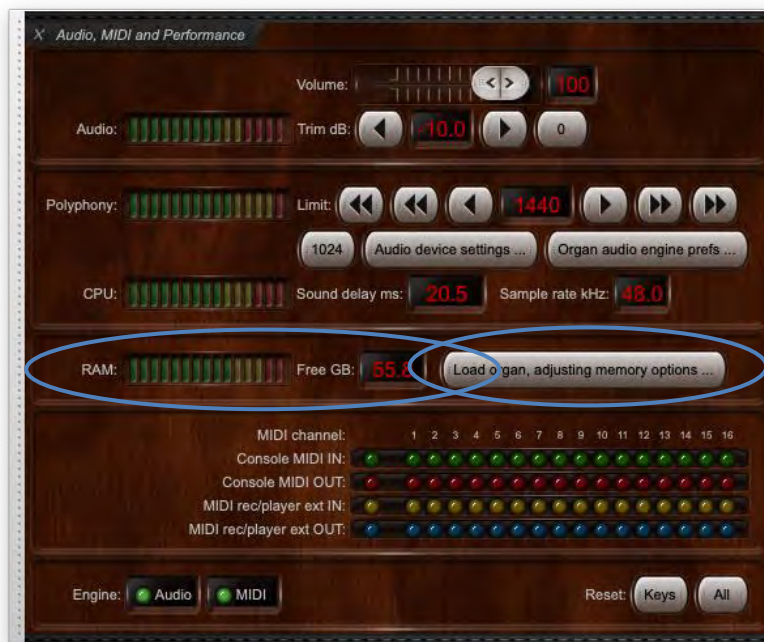
The *Action if memory (RAM) full when loading* setting on the *Organ settings | Organ preferences* screen determines what Hauptwerk does when the RAM meters go into the red, i.e. when all of the memory that could safely be used by Hauptwerk appears to have been used up:
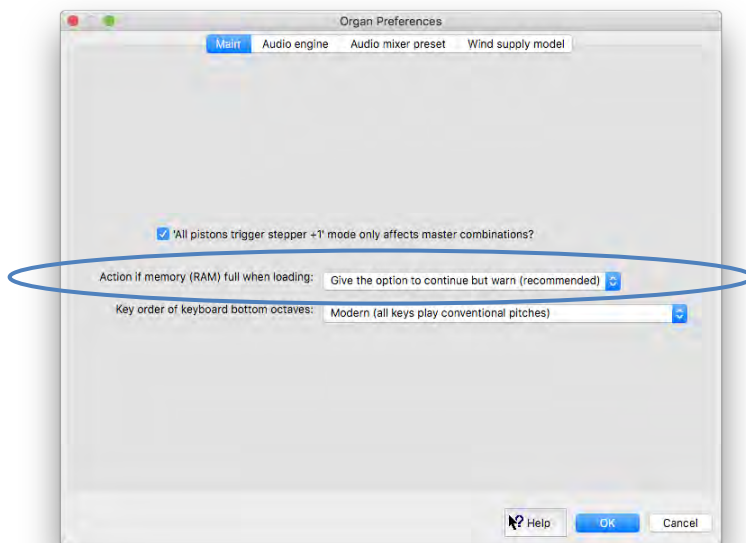
By default, Hauptwerk will warn you and ask whether you want to continue loading. Continuing to load in such circumstances gives a high risk of audio glitches and poor performance, and the computer, and any other applications running, are likely to become unresponsive. Always make sure you have sufficient free memory for the sample set you're loading.

By selecting *Organ | Load organ, adjusting rank audio memory options* from the menu (or by clicking on the *Load organ, adjusting memory options …* button on the *Audio, MIDI and Performance* large control panel) you can choose not to load some ranks to save memory, thus allowing a larger sample set to be loaded (in part) than your computer memory would normally allow, or to adjust the quality/realism at which some or all ranks will be loaded into memory:
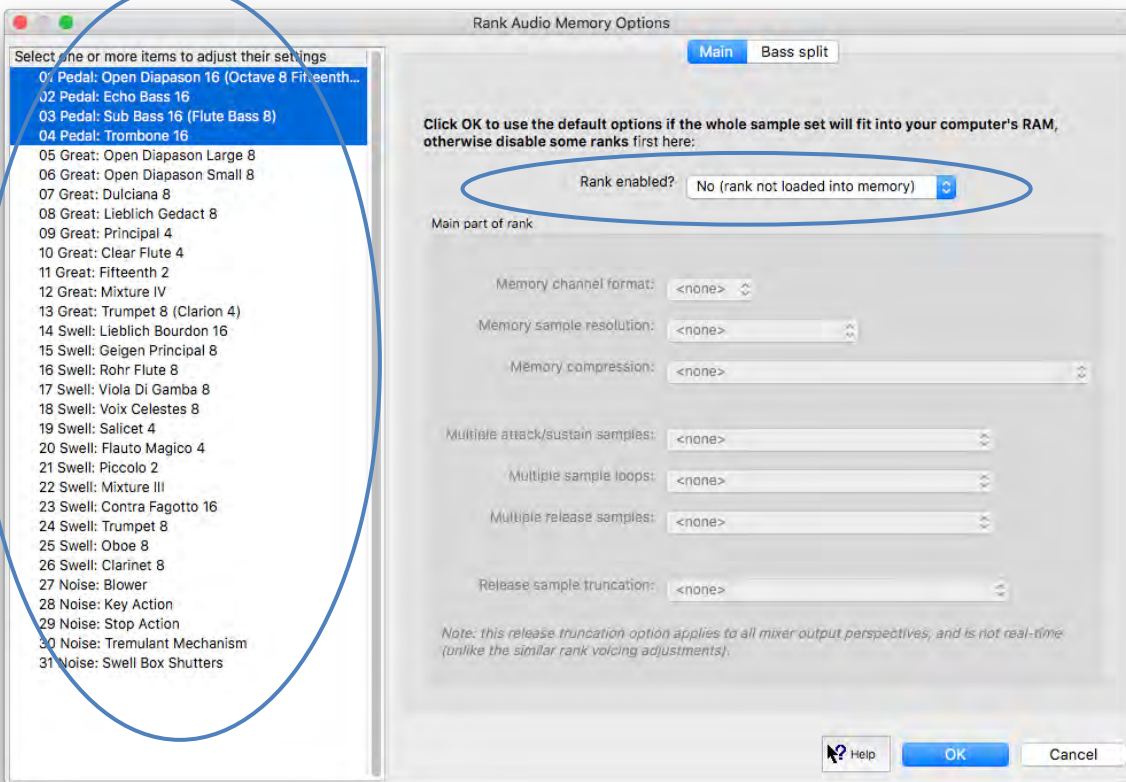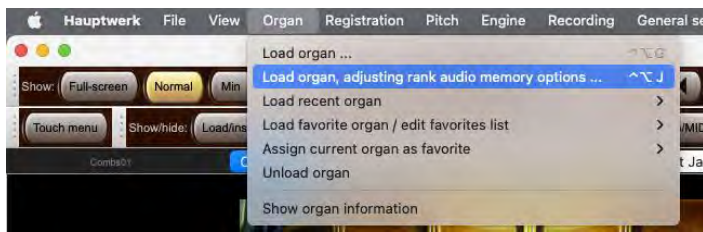
Note that no automatic indication of total memory required is currently given; please consult the documentation provided with your sample sets for guidelines. Please see the *__Loading organs__* section in this guide for explanations of the various rank options. Also consult the documentation included with a sample set for its memory requirements and recommendations, and ensure that you never attempt to load more than will fit into your computer's memory.

Selecting audio engine processing quality, or disabling Hauptwerk's models

You can adjust some of Hauptwerk's models and realism features via the *Organ settings | Organ preferences | Audio engine* screen tab:
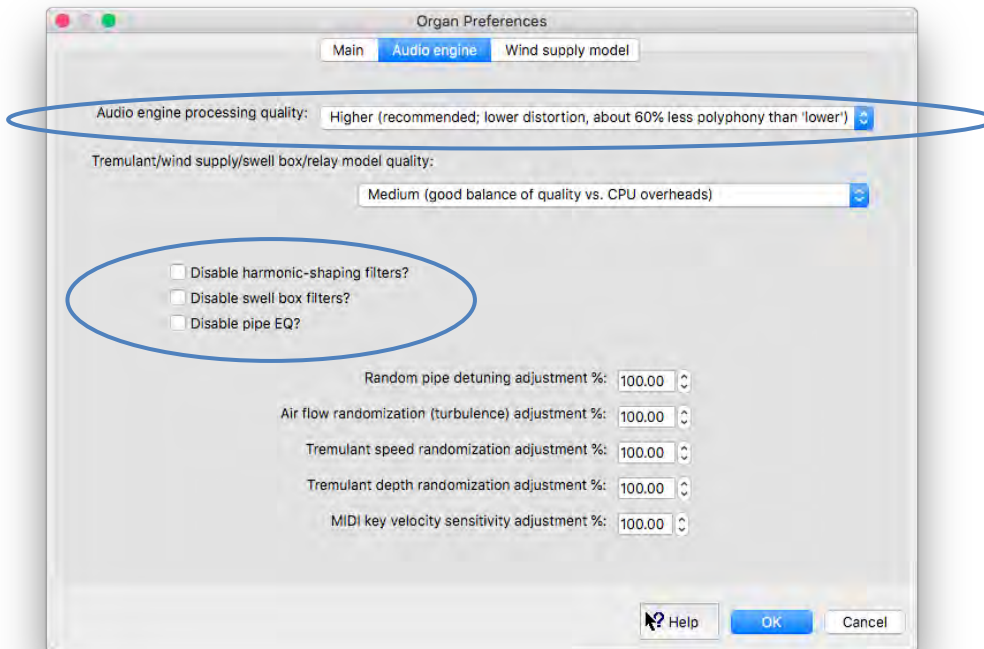
- The '*Audio engine processing quality*' preference offers the following two choices:

  - '*Lower (not recommended; least CPU-intensive; legacy v2-v5 quality)*'.

  - '*Higher (recommended; lower distortion; about 60% less polyphony than 'lower')*'.

  We recommend always using the 'higher' option if your computer can manage it – it will give noticeably better audio quality (less distortion, and thus greater clarity), but is more CPU-intensive (typically allowing the computer to achieve about 60% less polyphony than it could with the 'lower' option). The 'higher option enables very high-quality pitch-shifting (interpolation) and higher-quality processing for the per-pipe real-time filters. If changing the preference, you may need to adjust your polyphony limit setting for the organ accordingly.

  Please note: in the lower mode, dynamic modulation of the harmonic-shaping filters is disabled for deep bass pipes (to avoid potential filter distortions that can occur, especially at 96 kHz). That isn't necessary for the much lower-distortion filters enabled by the 'higher' mode, so dynamic filter modulation of deep bass pipes is enabled in the 'higher' mode.

  The sonic benefits of the 'higher' mode may be particularly easy to hear on modeled tremulants (especially modeled deep tremulants, as found on some theatre organ sample sets) and on organs with very dynamic wind supplies, or if raising or lower an organ's pitch significantly, relative to its original recorded pitch.

- (With the exception of the harmonic-shaping filters), ticking some or all of the '*Disable ...*' options will often allow a computer to manage higher polyphony (simultaneous pipes), but at the expense of realism and at the expense of voicing flexibility (for the Advanced edition). We recommend keeping the filters enabled.

- The '*Tremulant/wind supply/swell box/relay model quality*' preference offers the following three choices:

  o '*Lower (not recommended; least CPU-intensive; legacy v2-v4 quality)*'.

  o '*Medium (good balance of quality vs. CPU overheads)*'.

  o '*Higher (caution: needs high per-CPU-core performance for large organs)*'.

  It controls the time resolution at which Hauptwerk's tremulant, wind supply, swell box, and relay models are processed, and thus their quality, accuracy, smoothness, realism, and response. Higher settings are more CPU-intensive, but give noticeably better results and overall clarity, provided that your computer has sufficient processing power to handle it. Per-CPU-core performance (especially CPU base clock speed) is particularly important for the models, even if your CPU has lots of cores. For the 'higher' option to work well with very large organs your CPU will need to have very high per-CPU-core performance, as well as plenty of CPU cores. Hence the 'medium' mode is the default.

  Because processing the wind supply model at different resolutions may slightly affect the behavior of the wind supply, in the Hauptwerk Advanced Edition there is a '*Wind model organ pipe flow adjustment*' preference on the '*Wind supply model*' screen tab, allowing you to reduce the amount of air that each organ pipe draws from the wind system when it sounds, in case the wind system is too unstable or 'wobbly'.

  In general, we recommend selecting the 'higher' mode only if:

  o The organ is a theatre organ, or:

  o The organ is reasonably small (without an excessively demanding wind supply model), or:

  o Your CPU has very high per-core performance (including a very high CPU base clock speed).

  In other cases, we recommend selecting the 'medium' option, and if in doubt, select the 'medium' option.

  The sonic benefits of the 'higher' mode may be particularly easy to hear on modeled tremulants (especially modeled deep tremulants, as found on some theatre organ sample sets).

Note that if you choose both the '*Audio engine | Audio engine processing quality: Higher*' organ preference and the '*General settings | Audio device and channels | Sample rate: 96 kHz*' options then achievable polyphony is likely to be about 80% less than if neither is chosen.

Determining and limiting polyphony

Most sample sets play one sample for each virtual pipe, although a few use multi-layered playback, where several samples play at the same time when a virtual pipe sounds to allow independent control of several aspects of the sound. Each layer consumes one voice of polyphony while it is sounding. Hence for single-layered sample sets (the most common type), one voice of polyphony is consumed per pipe while the pipe is sounding.

A pipe (layer) continues to consume a voice of polyphony until its sound has entirely died away. Thus, for sample sets with long reverberation recorded into the samples, each pipe may continue to consume a voice of polyphony for several seconds after its key has been released.

Apart from latency, the *static polyphony* is the most important basic measure of Hauptwerk's performance on a given computer. It is the number of virtual pipes that can be sustained at once without overloading the computer and without releasing and re-triggering any pipes (which would cause additional release samples to play, making accurate benchmarking difficult).

To measure the static polyphony, first ensure that the audio device/driver, audio buffer size, and sample rate are set to the values you wish to use on *General settings | Audio device and channels* (bearing in mind that very small buffer sizes and/or 96 kHz will reduce the polyphony that can be achieved, as covered previously):
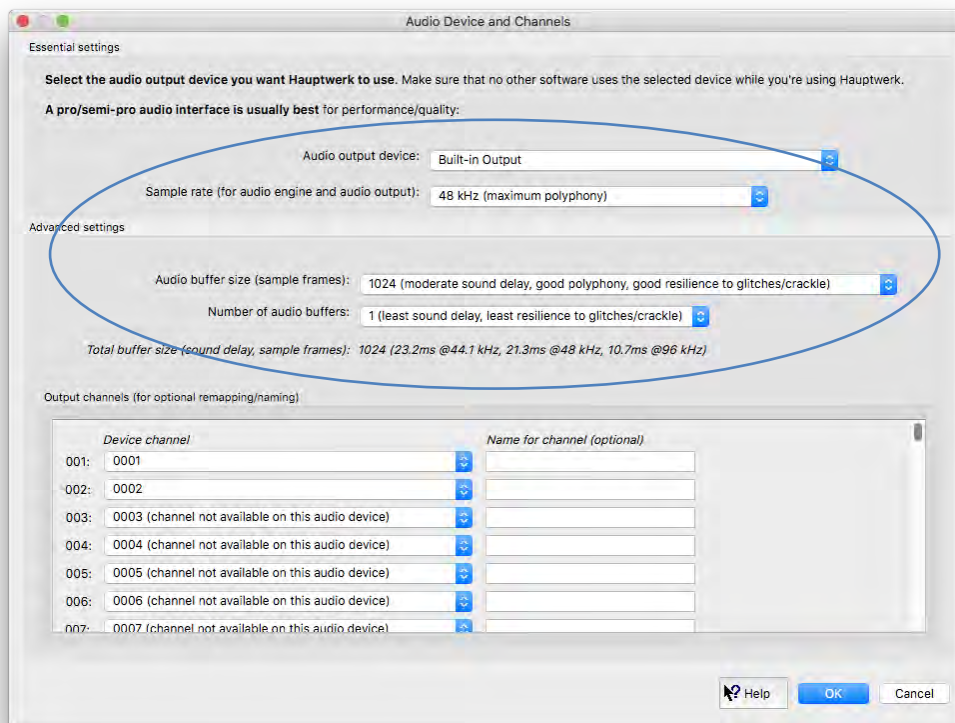
Make sure that no programs other than Hauptwerk are running on the computer. Now load one of the 'polyphony testing organs' using *Organ | Load organ* from the Hauptwerk menu. These organs use ranks from the St. Anne's, Moseley sample set to create a very large instrument with up 30,500 virtual pipes, just for the purpose of testing polyphony. There are three variants of the polyphony testing organ for computers with different amounts of memory. If you have:

- 4 GB or more of installed memory, load the organ named *PolyphonyTestingOrgan-For4GBMemoryOrMore*.

- 2 GB or more of installed memory, load the organ named *PolyphonyTestingOrgan-For2GBMemoryOrMore*.

- 512 MB or more of installed memory, load the organ named *PolyphonyTestingOrgan-For512MBMemoryOrMore*.

Once the 'organ' has loaded, on the *Organ settings | Organ preferences | Audio engine* screen tab, set the '*Audio engine processing quality*' setting to the same value that you would typically wish to use for other organs ('higher' is recommended), then OK the screen:

Now change the number of pipes per key selection on the right-hand side of the screen to 50, or the highest number shown on the list if it is less than that:

Using your arm or some books or other large objects, slowly and gently press and hold down each key successively from the bottom of the MIDI keyboard you use to play the virtual keyboard. Be careful not to release any keys so that no release samples are triggered, and to add keys one at a time.

As soon as the audio starts to break up, release all keys and count how many you had pressed. (Check that you can see all of the virtual keys pressed that you have pressed physically on your MIDI keyboard, since some MIDI keyboards have a limit on the number of keys that can be pressed at once.) Multiply by the number of pipes per key setting to give the static polyphony. For example, if you had been able to press 54 keys before the audio began to break up, and had selected 50 pipes per key, then your static polyphony would be 54 x 50 = 2700.

If you could press all 61 keys at once, then increase the number of pipes per key and repeat until you reach the point where the audio breaks up. Similarly, you can repeat the test with less pipes per key to obtain a more accurate measure if required.

Once you have an initial measurement, repeat the test a few times to verify the result.

Watch the *CPU* meter on Hauptwerk's *Audio, MIDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*). Usually the audio should start to break up very approximately at the point that the CPU meter goes into the red:
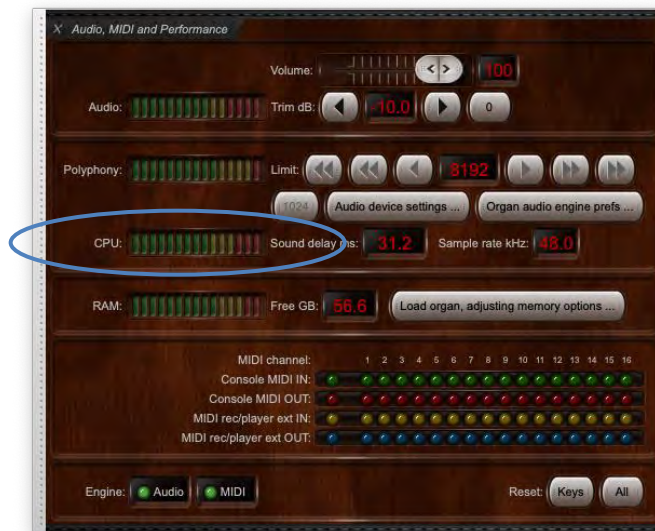
Note that the Hauptwerk's CPU meter doesn't show the same thing as the macOS's Activity Monitor or Windows' Task Manager CPU load graphs: Hauptwerk's CPU meter monitors the amount of time that Hauptwerk's audio engine took to calculate each chunk of audio, as a fraction of the amount of time that the audio driver allowed it. Hence Hauptwerk's CPU meter is specifically designed to show the likelihood of audio glitches ('buffer under-runs'). If your audio interface hardware and drivers are performing well, there should be a good general correlation between Hauptwerk's CPU meter and the operating system's CPU meters. However, driver or hardware timing or performance issues (for example PC DPC latency) could give an increased risk of audio glitches, which Hauptwerk's CPU meter should indicate more usefully (often visible as spikes in the Hauptwerk CPU graph) than the operating system's CPU graphs.

Note that the static polyphony measurement is made using *unenclosed samples* (being the type of samples and pipes used in the polyphony testing organ), but with the harmonic-shaping filters enabled. Hauptwerk automatically makes adjustments for enclosed pipes when applying the polyphony limit. (Very approximately, playback of enclosed pipes, gives a reduction in polyphony of 25-30%.) Hauptwerk's polyphony limit setting is also specified for *unenclosed* samples.

When a pipe ceases to speak, Hauptwerk performs a brief phase-aligned cross-fade from the main sustaining part of the sample to the release sample. During this cross-fade, processing overheads increase momentarily, giving a further brief reduction in achievable polyphony of about 25 percent. However, provided that the computer is broadly powerful enough for the sample set being used, it is extremely unlikely that a significant proportion of pipes will cease to speak at exactly the same moment. You can test the exact polyphony that can be achieved when all pipes start and stop speaking at the same time using the polyphony testing organ by simply pressing and releasing all of the keys in question simultaneously, again multiplying the number of keys of by the number of ranks to obtain the final value.

Now load the organ that you wish to use, for example St. Anne's. Go the *Audio, MIDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*) and adjust the polyphony limit to between about 30 and 40 percent of the static polyphony value that you had calculated (assuming that you are using the same audio engine processing quality settings on the *Organ settings | Organ preferences | Audio engine* screen tab for this organ that used for the polyphony testing organ). For example, if your static polyphony was 4480, then you could set the value between 4480 x 0.3 = 1344 and 4480 x 0.4 = 1792:
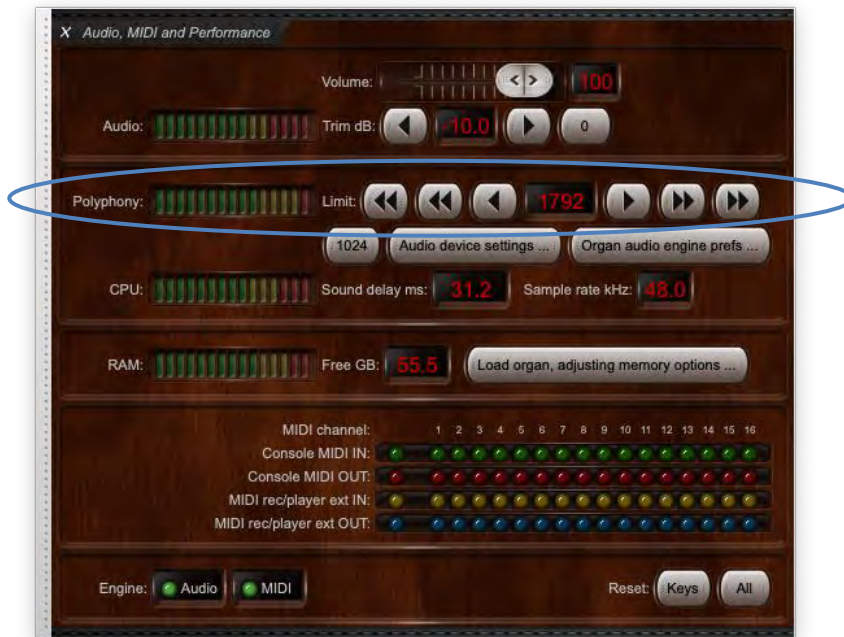
From now on, when this polyphony value is reached, Hauptwerk will start to fade out specially-selected release samples (reverb tails) to minimize any noticeable interruption or loss of pipes, while preventing the computer's processor(s) becoming overloaded and the audio breaking up. For powerful computers, a limit of about 35 percent of the static polyphony is often appropriate for the polyphony limit setting. However, for smaller computers or for theatre organ sample sets, it might be better to set the limit lower (perhaps 30 percent), since there is a greater chance that a significant proportion of the pipes will cease to speak at exactly the same time.

Provided that the limit is set correctly and that the computer is broadly powerful enough for the sample set under average load, then Hauptwerk's polyphony management algorithms can be relied upon to cope safely and unobtrusively with heavy loads, giving an appearance of unlimited polyphony. Regardless of the computer's power, if the limit is set correctly, it should never be possible for the audio to break up. The worst that can happen is that the organ may sound slightly more 'dry' in times of extreme load (if many release samples must be dropped) or, in the most extreme cases, that new pipes will not be allowed to sound.

Having set the limit, with the organ still loaded, engage as many stops as you would ever realistically use, and play it as fast as you would ever want to. You should not be able to hear the audio crackling or breaking up, and you shouldn't see the *CPU* meter on Hauptwerk's *Audio, MIDI and Performance* large control panel go into the red. If you can, reduce the limit a little lower and repeat the test until you cannot. If the realism of the tremulants or speed of response of the physical models (such as the wind supply model) are noticeably degraded when many pipes are sounding, also try reducing the limit and repeating the test.

The real-time *Polyphony* meter on the *Audio, MIDI and Performance* large control panel (and the '*Poly*' miniature meter in the status bar at the bottom of the main Hauptwerk window) show how much polyphony is being consumed, relative to the polyphony limit setting. When the polyphony meter goes into the red region pipes will start to be dropped, which may be noticeable in extreme cases (although Hauptwerk tries to do it as unobtrusively as possible). Hence it's best not to have the polyphony limit set lower than is actually necessary, but the most important thing is not to set the value too high (so as to ensure that audio glitches are avoided).

The polyphony limit setting is stored separately for each organ, allowing you to fine-tune the limit along with other performance-related options (especially the '*Audio engine | Audio engine processing quality*' organ preference) separately for each organ individually, as well as allowing you to set the limit more or less conservatively depending on the way in which you typically play and register each particular organ.

For example, suppose you had several smaller sample sets that could easily be used on your computer with all audio engine features enabled, thus giving the highest possible degree of realism. However, suppose you also owned one very large sample set that pushed the computer to its limit, but that you wanted to be able to use a higher polyphony to get the full 'tutti' sound from that particular sample set. You might then perhaps consider setting the *Audio engine processing quality* to 'lower' and/or disabling the enclosure (swell box) filters or per-pipe EQ filters, just for that sample set, and so would be able to set the polyphony limit correspondingly higher just for that sample set:
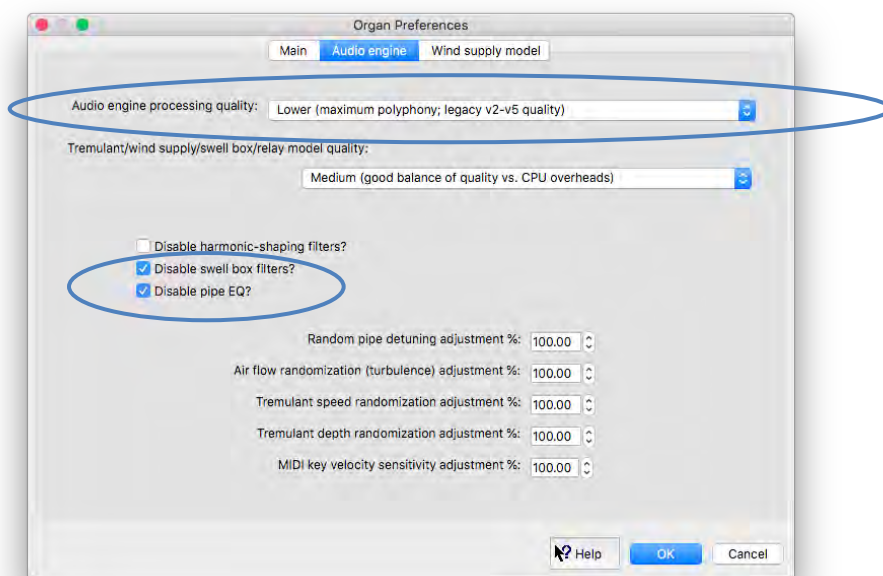
Apart from allowing Hauptwerk's polyphony management system to ensure glitch-free audio at all times, setting the polyphony limit to the correct value for your computer is advisable because higher polyphony limit settings consume a little more memory, so having the polyphony limit set unnecessarily high wastes some memory, very slightly reducing the size of sample set that you can load.

Setting the audio output level

With an organ loaded in Hauptwerk, the *Audio, MIDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*) shows the audio output signal level via the real-time *Audio* meter:
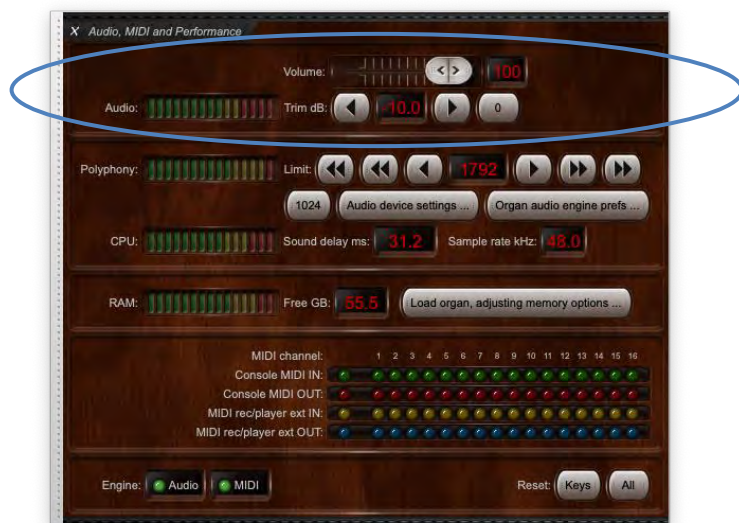
The meter always shows the highest (peak) level of all audio channels. If it goes into the red region then loud 'crackles' (severe audio distortion, 'clipping') are highly likely and you should use the *Trim dB* adjustments to reduce the level until the meter no longer goes into the red. Having the output level set too low loses a little audio quality/resolution, so it's best to adjust the trim setting so that the meter very occasionally just goes into the yellow when playing with the loudest registration you use, but never into the red.

The level is remembered separately for each organ, so you can compensate for differences in the levels with which different sample sets were recorded, as well as for the different ways in which you might want to use them.

The miniature meter labeled '*Aud*' on the status bar at the bottom of the screen also indicates whether the audio output is clipping (showing red if so).

Summary: quick guidelines for troubleshooting audio or performance problems

If you have any kind of audio or performance issues, the first thing to do is to look at the *Audio, MIDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*). See whether any of the meters are going into their red regions. If they are then it probably indicates a problem (or at least something to be aware of):
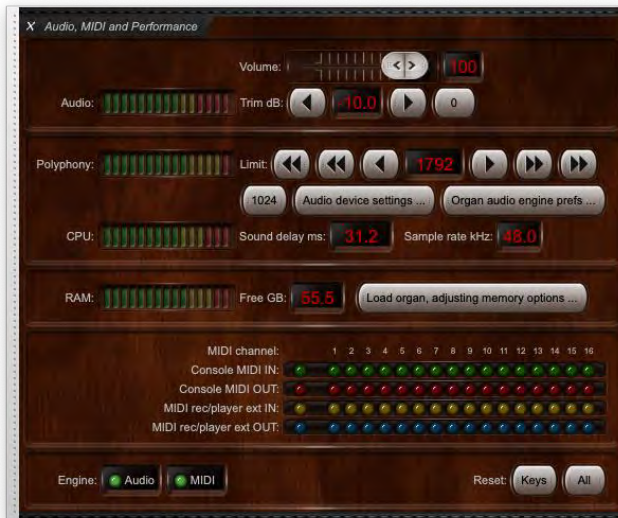
- If the *Audio* meter is showing red, then loud crackles are likely to be heard; use the *Trim dB* buttons to reduce the level until it only occasionally peaks in the yellow, never red.

- If the *RAM* meter is showing red (which will correspond to the *Free GB* figure having fallen to zero), then audio glitches or other performance issues (in Hauptwerk and any other applications running) are highly likely; you need to load less ranks, or change some rank options so that the ranks you're loading use less memory, or install more memory in your computer (if possible). You can click on the *Load organ, adjusting memory options …* convenience button on the control panel to reload the organ and disable some ranks.

- If the *CPU* meter is showing red then audio glitches are highly likely; make sure you're using a good-quality audio interface and have the latest manufacturer-supplied driver (ASIO on Windows) installed for it and selected on the *General settings | Audio device and channels* screen (which can be accessed by clicking on the *Audio device settings …* convenience button on the control panel), and that the audio buffer size isn't set too small (1024 or 512 should be safe), and that the number of buffers is set to 1, and that the sample rate is set to 48 kHz. If the problem persists then try selecting 'lower' for the audio engine processing quality via the *Organ settings | Organ preferences | Audio engine* screen tab (also accessible via the *Audio engine prefs …* button on the control panel), or try using the adjustment buttons to reduce the polyphony limit on the control panel. If you're using a PC/Windows, then make sure that your PC is performing sufficiently well to handle real-time audio, using a utility such as Resplendence Software's LatencyMon.

- The *Polyphony* meter going into the red doesn't necessarily indicate a severe problem, but the organ will sound 'drier' than it should, due to release samples being faded out. You can try increasing the polyphony limit, provided that the CPU meter doesn't go into the red. Beyond that you will either need to disable some audio engine realism options, or get a more powerful computer. Note also that the Hauptwerk Lite Edition allows a maximum polyphony of 1024.

Other operating system and computer optimizations and diagnostics

On both macOS and Windows we recommend having as few other programs and background processes running at the same time as Hauptwerk as possible, since all running programs and processes will take processing resources away from Hauptwerk to some extent (and can sometimes interrupt audio by accessing the Internet or storage on some PCs).

We also recommend disabling any power saving modes, such as hibernation / sleeping, screen savers or drive sleeping. On notebook computers this needs to be done only for the times when the mains power supply is connected (when conserving power would be less important anyway), and you should always have the mains power supply connected when using Hauptwerk. If the computer hibernates / sleeps, or enters a power-saving mode while Hauptwerk is running, then you might experience extreme performance issues, especially if the operating system needs to re-read all memory back from storage when waking.

No other operating system optimizations are usually needed on Apple Macs running macOS, since they have reliable high-performance professional-grade audio and MIDI support built-in, 'out of the box'.

For Windows/PCs, the following are some things to try (in addition to those mentioned previously) if you have problems with audio glitches:

- Make sure that you have the latest BIOS installed for the PC's motherboard. Check on its manufacturer's website for the latest version, and how to install it, if relevant. That's very important, and can solve all manner of performance issues.

- Make sure that you have all power-saving functions in the BIOS disabled, if relevant.

- Make sure that all current operating system updates are installed. (Use Windows Update to check for updates, apply all available, reboot, then keep repeating until there are no more. Note that you might need to click the 'check for updates' button twice before Windows actually performs the check.)

- Make sure that you have the latest versions of the drivers and firmware installed for all of your hardware, and especially for your audio/MIDI interface(s) and graphics card, checking on the manufacturers' websites.

- Make sure you're using the latest version of Hauptwerk, which is always available for download from the downloads page on our website. The version of Hauptwerk can be check using *Help | About Hauptwerk* within Hauptwerk.

- Download and install the current version of iLok License Manager from https://www.ilok.com/. (It doesn't hurt to re-install it if you aren't sure whether you already have the current version.)

- Disable all Windows power-saving functions, including the options for putting USB ports/devices to sleep. For example, on Windows 10 you would use '*Windows Control Panel | System | Power and sleep | Additional power settings*', select the '*High performance*' power plan, then click its '*Change plan settings | Change advanced power settings*', then make sure that the settings are set as follows:
  Sleep: Hibernate after = Never (for 'plugged in' if present)
  USB settings: USB selective suspend setting = Disabled (for 'plugged in' if present)
  PCI Express: Link state power management = Off (for 'plugged in' if present)
  Processor power management: Minimum processor state = 100% (for 'plugged in' if present), or set the minimum and maximum states to the same value less than 100% if necessary to avoid overheating (such as 65%).
  Hard disk: Turn off hard disk after = Never (for 'plugged in' if present)
  ... then OK all of the screens.

- Make sure you have the latest manufacturer-supplied ASIO driver installed and selected in Hauptwerk for your audio interface (*General settings | Audio device and channels*).

- Try running Resplendence Software's LatencyMon utility, which is free for non-commercial use. Download and install it, launch it, click the green 'play' arrow button, then leave it running for at least half an hour, with no other software running. At the end of that time, LatencyMon needs to report that '*your system appears to be suitable for handling real-time audio and other tasks without dropouts*'. If not, then you have a hardware/driver performance issue within the PC that **must** be resolved before Hauptwerk (or any other real-time audio software) will be able to work reliably without audio glitches. For good measure, also try the same test when Hauptwerk is running and has an organ loaded (but without actually playing any keys in Hauptwerk), so that the system is tested when the audio driver is running. Troubleshooting low-level PC hardware/driver performance issues of the type for which LatencyMon tests can be a technically involved task. Although we (Milan Digital Audio) aren't usually able to help with that (beyond the information in this document, and on our forum), detailed one-to-one assistance with PC technical issues is available from some third-parties, such as HauptwerkConsultant.

- Check that none of the real-time meters is going into the red on the *Audio, MDI and Performance* large control panel (*View | Large floating controls panels (for this organ) ...*). See the ***Summary: quick guidelines for troubleshooting audio or performance problems*** section for remedial actions if they are.

- Try audio buffer sizes of 1024 and 512 in Hauptwerk on the *General settings | Audio device and channels* screen, with the number of buffers set to 1, and the sample rate set to 48 kHz. Note that some audio interface drivers ignore the buffer size that an application (such as Hauptwerk) requests, and instead always use the buffer size set in their ASIO control panel. Hence you might instead need to adjust the buffer size via their ASIO control panel, which can be accessed by clicking the *Show device control panel* button on the *General settings | Audio device and channels* screen in Hauptwerk. You can determine which buffer size setting the driver is using by looking for the buffer size shown in the Hauptwerk log (use *Help | View activity log* in Hauptwerk), or by looking on the *Audio, MIDI and Performance* large control panel.

- See whether the problem occurs with just a small sample set loaded, such as St. Anne's (or with all-but-one ranks of a larger set disabled), and when just a single pipe is sounding. If so, then the problem is probably not due to insufficient memory or an incorrect polyphony limit setting.

- Make sure that no other applications are running at the same time as Hauptwerk, especially applications that might try to produce any audio/sounds. In particular, check that nothing unnecessary is running in the Windows System Tray, such as media/MP3/video players or messaging applications.

- Running Hauptwerk at real-time priority often gives the most reliable audio/MIDI performance on Windows. There is a '*Try to run Hauptwerk at real-time priority on Windows*' preference for the purpose on the '*General settings | General preferences | Advanced …*' screen tab in Hauptwerk. However, automatically running at real-time priority usually requires that Hauptwerk be launched with Windows administrator privileges, in which case Hauptwerk's PDF documentation might not be accessible. (Running at real-time priority might possibly cause performance problems with other software running at the same time on the computer. The setting currently has no effect on other platforms.)

- Also, if Hauptwerk isn't set to (or isn't allowed to) run at real-time priority, then some PCs are prone to audio an audio glitch/CPU-spike straight after starting audio. The '*Extra time to allow when starting audio on Windows if not running at real-time priority*' preference on the '*General settings | General preferences | Advanced …*' screen tab in Hauptwerk setting usually guards against that, but makes starting audio slower. Specifically: when not running at real-time priority, Windows sometimes takes several seconds to move audio threads around amongst CPU cores, which might result in audio glitches. The setting makes Hauptwerk allow time for that to have happened before it starts streaming audio. We found about 3-7 seconds to work reliably on most PCs. Running Hauptwerk at real-time priority (either manually via Windows settings, or allowing Hauptwerk to do it automatically by running Hauptwerk with Windows administrator privileges, keeping the '*Try to run Hauptwerk at real-time priority on Windows*' advanced Hauptwerk general preference ticked) should avoid the issue entirely, and usually gives more stable audio/MIDI overall anyway.

- If you are using multiple audio interfaces of the same make or model then under some circumstances you might need to synchronize their hardware clocks together via Word Clock cables in order to avoid audio glitches or crackling. Check the documentation for your audio interfaces if in doubt.

- Disconnect any hardware devices that are not absolutely essential for Hauptwerk and the computer to function, to see whether that eliminates the problem. For example, disconnect all USB cameras, printers, scanners, modems, touch-screens, external hard-drives and USB hubs.

- Try your audio interface with each possible connection (for example, attached to each possible USB, Thunderbolt, or FireWire port, or in each possible PCI/PCIe slot, depending upon its connection type).

- If you need to use a USB hub, then make sure it's a good-quality model from a reputable brand, with its own dedicated power supply (not a 'bus-powered' model).

- Try disabling your motherboard's onboard audio, either in its BIOS or in Device Manager (in the Windows Control Panel). Motherboard audio devices sometimes conflict with professional audio interfaces/drivers.

- Make sure that all Windows sounds are disabled (*Control Panel | Hardware and Sound | Sound | Sounds* and set the sound scheme to 'No sounds').

- If possible, set Windows to use a device other than your main audio interface as its default device for playback and recording (*Control Panel | Hardware and Sound | Sound | Playback/Recording*) to try to prevent Windows or another application from trying to access the audio interface while Hauptwerk is streaming audio to it.

- Try running another 'pro audio' application that uses ASIO, apart from Hauptwerk, to determine whether the problem is specific to Hauptwerk. For example Native Instruments make the free Kontakt Player, which uses ASIO in stand-alone mode. Make sure that you select the same ASIO driver that you are using for Hauptwerk, and try the same audio/ASIO buffer size.

- Check that no hardware resources are shown as conflicting in Device Manager (in the Windows Control Panel).

- Also check that no hardware resources, such as interrupts (IRQs), are being shared between your audio interface (or the USB/Thuderbolt/FireWire controller to which it's connected, if applicable) and any other key system hardware, such as the graphics card. You can check hardware resource assignments by selecting *View | Resources by type* in Device Manager (in the Windows Control Panel). If your audio interface or USB/Thunderbolt/FireWire controller are sharing any hardware resources then try moving the audio interface or graphics card (or whichever other device is sharing the resource) to a different PCI/PCIe slot, or see if your motherboard's BIOS allows the resources to be reassigned manually.

- Try temporarily disabling all network adapter devices, Bluetooth devices and wireless networking devices in Device Manager (in the Windows Control Panel). Network/wireless devices/drivers are a common cause of Windows audio performance problems.

- Try keeping any network leads and Internet connections disconnected while using the computer for audio. This prevents other Internet or 'auto updater' applications (such as Windows Update or virus scanner updaters) from updating while Hauptwerk is running, and potentially causing the network drivers to take processing time away from audio or from the audio interface's drivers.

- If you're connecting your audio interface to a PC motherboard FireWire port, try installing a separate good-quality FireWire controller card (PCI, PCIe, etc.) based on a Texas Instruments FireWire controller chipset and connecting the audio interface to that instead. Some FireWire audio interfaces have performance issues with some FireWire controller chipsets, and Texas Instruments FireWire controller chipsets are often recommended by audio interface manufacturers for maximum compatibility (check with your audio interface manufacturer for recommendations).

- Similarly, if you're connecting your audio interface to a PC motherboard USB port, try installing a separate good-quality USB controller card (PCI, PCIe, etc.). Some motherboard USB controller chipsets might not give reliable performance with all USB audio interfaces.

- If you have previously manually adjusted Windows processor scheduling (priorities) to favor background processes, which is sometimes seen recommended on websites, then we recommend making sure that the *Adjust for best performance of* setting is set specifically back to *Programs* (<u>not</u> *Background services*) using *Control Panel | System and Security | System | Advanced system*

settings and selecting the *Advanced* tab. Finally click *OK* on all of the windows and re-boot the computer if you changed any settings. (Hauptwerk is a program, not a background service, and Hauptwerk already runs at the priorities needed for best performance, whereas forcing other background processes to run at higher priorities may cause audio glitches or other performance problems, depending on the specific combination of hardware, drivers and processes. Background processes, drivers and other applications should normally already be designed to run at the priorities they need with the default Windows scheduling settings.)

- Similarly, please ensure that you haven't manually changed any Windows priorities for any application, process or thread, since doing so is likely to cause audio, or other, performance problems.

- Disable Windows' drive indexing for all hard-drives (right-click on each drive icon, select *Properties*, then un-tick *Allow files on this drive to have contents indexed in addition to file properties*, then select the option to apply to all sub-folders/files when prompted).

- Disable Windows' scheduled hard-drive defragmentation (you will then instead need to defragment any hard-disk(s) manually periodically). To do so, right-click on each hard-drive icon, select *Properties*, select the *Tools* tab, click the *Optimize* or *Defragment Now*, button, click the *Scheduled optimization | Change settings* or *Schedule | Configure schedule* button, un-tick *Run on a schedule ...* and reboot.

- Many people have reported to us that they needed to disable Windows' Sysmain service (which was previously known as Superfetch) in order to get reliable low-latency audio with their computers, in order to avoid occasional audio glitches from its activity. In recent Windows versions you can disable the Sysmain/Superfetch Windows service as follows: use *Start | Administrative Tools | Services*, double-click on the *Sysmain/Superfetch* entry, then change its *Startup type* setting to *Disabled*, click *OK,* then reboot. Alternatively (and in older Windows versions), you can disable the service by editing your registry to change the following registry value to 0 (zero) then rebooting: *HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management\PrefetchParameters\EnableSuperfetch* . Please be extremely careful if you try to edit your Windows registry, since a mistake could prevent your computer from being able to boot. Any registry edits are at your own risk and should probably only be attempted as a last resort.

- Similarly, some people have reported to us that they needed to disable Windows System Restore in order to get reliable low-latency audio with their computer, otherwise the background storage accesses it causes (System Restore makes periodic system backups in the background when it believes the computer is idle) gave them occasional audio glitches. Please beware that disabling System Restore might prevent your computer being able to recover if Windows becomes corrupted in the future, and is attempted at your own risk. System Restore can be disabled by using *Control Panel | System and Security |System*, clicking *System protection*, clicking *Protection Settings: Configure ...* then selecting to disable system protection, then clicking *Apply* and *OK*ing all of the screens.

- Especially with recent Windows 10 versions, disabling Windows' page file can allow organs to load faster, and unload much faster. However, doing so will prevent Windows and other applications from being able to use more (virtual) memory than your PC actually has RAM, so might adversely affect the performance of the computer when used for purpose other than Hauptwerk. Hence if your PC is used exclusively or mainly for Hauptwerk, or if you have plenty of RAM, you might wish to disable the Windows page file, for best Hauptwerk performance. To do so in Windows 10: go to Windows' *Settings* via the Start menu, select *System*, select *About*, click *System info*, then click on the *Performance | Settings* button on the *Advanced* tab. Select *Adjust for best performance*, then click the *Advanced* tab. Click *Virtual memory: Change* and ensure that *No paging* file is selected (for each drive, if your PC has more than one), then click *Set*. Finally click *OK* on all of the windows and re-boot the computer if you changed any settings.

- A few PCs have problems due to other high-priority software/processes using particular CPU cores heavily whilst Hauptwerk is running (as has been the case on certain AMD-based systems), resulting in audio glitches in Hauptwerk. If possible, we highly recommend identifying the relevant process and avoid running it when using Hauptwerk. If that isn't possible, as a test, you could try un-ticking the "*Bind audio engine threads to CPU cores on Windows?*" option on Hauptwerk's *General settings | General preferences | Advanced …* screen tab. However, only un-tick that option as a last resort, since in general it will reduce Hauptwerk performance, and make occasional audio glitches likely (due to Windows moving audio threads around between cores, and since Windows may then run audio threads on the same CPU cores as Hauptwerk's background models).

- If you're still having problems after trying all of the above suggestions, you could try contacting the company that built or supplied your computer for advice. Alternatively, detailed one-to-one assistance with PC technical issues is available from some third-parties, such as HauptwerkConsultant. There is also a useful free guide to troubleshooting PC audio problems available from Cantabile Software: https://www.cantabilesoftware.com/glitchfree/. We're sorry that we can't provide formal support for computer hardware/performance issues beyond the suggestions in this section, and on our forum.

Minimizing sample set loading times

Hauptwerk has a fast sample set loading mechanism that's designed to take advantage of multi-core computers, SSD drives and RAID arrays (RAID 1 or RAID 5 are probably best and safest). Fastest possible results should be achieved with computers that have six CPU cores (or more), fast SSD drives, and plenty of memory. However, loading should still be fast even with older computers.

Extensive performance and diagnostic information relating to the loading of each sample set is written to the log file (*Help | View activity log*).

The first time that you load a sample set, or if you change its rank audio memory options, the sample set will still be slow to load because Hauptwerk will need to regenerate its cached version of the sample set data. However, subsequent loads should then be extremely fast.

MIDI implementation

This section is intended for those building, buying or converting MIDI organ consoles for use with Hauptwerk.

Hauptwerk's MIDI system is extremely flexible, designed to be compatible with most of the implementations found in digital/electronic/MIDI organs, and with any scheme by which a do-it-yourself MIDI organ console conversion is likely to have been wired for MIDI. The MIDI implementation is also backwardly compatible with hardware built for all previous Hauptwerk versions.

Hauptwerk can detect and configure all required MIDI settings automatically for most makes/models of digital/electronic/MIDI organs and for most MIDI hardware commonly used with Hauptwerk.

Keyboards

Hauptwerk's virtual keyboards (virtual manuals, pedalboards and floating division keyboards) respond to MIDI note-on/off messages with no restrictions on MIDI port or MIDI channel.

Keyboard splits/ranges are also supported, allowing separate parts of any MIDI keyboard to play separate virtual keyboards, each with an adjustable key-shift. You can also use spare MIDI keys (or key connections on MIDI encoder hardware) to control virtual switches/pistons/buttons by defining (restricting) the note range that should play the virtual keyboard.

For virtual theatre organs that support it, theatre organ second-touch can be triggered by either:

- A second set of key contacts, sending MIDI note-on/off messages on a separate MIDI port or channel (the ideal method).

- Polyphonic (key) after-touch. Second-touch turns on when a MIDI key's polyphonic after-touch (pressure) exceeds a specified threshold and turns off again when the pressure falls below the threshold again (the second-best method, but very few MIDI keyboards support polyphonic/key after-touch).

- Channel after-touch and/or key velocity, with after-touch affecting all notes. Second-touch turns on for all pressed keys when the MIDI channel's after-touch (pressure) exceeds a specified threshold and turns off again for all of them when the channel pressure falls below the threshold again. Alternatively, if a key is played on a velocity-sensitive MIDI keyboard with its note-on velocity exceeding a specified threshold, then the key will also sound with second-touch. Either threshold (after-touch or velocity) can be set to 128 to disable the associated method of triggering (after-touch or velocity).

- Channel after-touch and/or key velocity, with after-touch affecting only notes that were held at the point that after-touch turned on. This is identical to the last method of triggering, but once after-touch has exceeded the specified threshold (and thus turned on second-touch for the sounding keys), newly-played keys will not sound with second-touch unless their velocity also exceeds the specified velocity threshold.

All keyboard settings (including key ranges and second-touch) are detected automatically, with the exception of key-shifts and second-touch velocity/after-touch threshold values, which can be adjusted manually if needed.

Some virtual instruments are able to respond to key velocity. Hauptwerk provides a tracker action model which enables key velocity to be used to adjust the initial speech of pipes, or to select pipe samples dynamically amongst several different-velocity samples, where such functionality is included in a virtual instrument. However, velocity-sensitive keyboards are not a requirement.

Hauptwerk allows the velocity 'curve' to be adjusted separately for each virtual keyboard, making it possible to compensate for differences in velocity response between MIDI keyboards of different models and between differences in response between different virtual instruments.

Up to four MIDI keyboards, or floating division routes, can be connected simultaneously to any one virtual keyboard. The third and fourth inputs only allow floating division routes.

Hauptwerk can produce MIDI output from virtual keyboards using standard note-on/off messages, again with no restriction on MIDI port or channel for a keyboard as a whole. Key on and off velocity is sent, but not after-touch. Theatre organ second-touch can be sent as note-on/off messages (only).

Keyboard input and output happens before any coupling (key actions).

Continuous controls (expression/crescendo pedals, sliders/knobs)

Hauptwerk's virtual continuous controls can respond to any of the following MIDI event types:

- MIDI control changes (most common).
- Ahlborn 9-stage crescendo (program changes 64h-6Dh).
- Ahlborn 11-stage crescendo (program changes 64h-6Fh).
- Ahlborn 24-stage crescendo (program changes 64h-7Ch).
- Generic MIDI varying program changes.
- MIDI RPNs (including support for 'high-resolution values sent as MSB/LSB pairs).
- MIDI NRPNs (including support for 'high-resolution values sent as MSB/LSB pairs).
- MIDI key after-touch (some Hoffrichters).
- MIDI channel after-touch.

All of those event types can be detected and configured automatically by Hauptwerk (right-click on a virtual expression/crescendo pedal or slider/knob, or on a control panel slider, and select '*Auto-detect ...*').

There are no restrictions on the MIDI port, MIDI channel, or other parameters for any particular control. For example, any expression pedal can use any MIDI channel and/or MIDI controller number.

The default position (when the organ is loaded or reset) of each virtual control is defined by the sample set developer, but you can override it.

Many MIDI expression pedals don't transmit the full range of values so Hauptwerk allows the value range to be specified and detects it automatically. You can also adjust the 'response curve' for each control, for example to compensate for differences in travel/response between different models of MIDI expression pedal and between differences in response between different virtual instruments.

MIDI output is supported only for MIDI control changes, NRPNs and RPNs. If the MIDI channel and MIDI controller/NRPN/RPN number for MIDI output match those for MIDI input then Hauptwerk can configure MIDI output automatically.

If you are building a new MIDI organ console or new MIDI hardware for Hauptwerk then we recommend that MIDI expression pedals, sliders and knobs use MIDI control change messages (or NRPNs if high-resolution support is needed) and that if a MIDI expression pedal/slider/knob supports MIDI output (for example, if it is motorized or has graphical position display hardware) then we recommend that it should receive identical MIDI messages to those it sends (thus making it possible for Hauptwerk to configure MIDI output to it automatically).

Ranks and divisions

Hauptwerk's virtual ranks (but not divisions) can respond to MIDI note-on/off messages directly, with no restriction on MIDI port and MIDI channel for a rank as a whole. Hauptwerk can produce MIDI output from virtual ranks or divisions using standard note-on/off messages, again with no restriction on MIDI port or channel for a rank or division as a whole. Key on and off velocity is sent, but not after-touch.

Division output is post-coupling, i.e. may be affected by any virtual couplers engaged.

Rank output relates to individual virtual ranks, and is thus inherently are also post-coupling.

Rank input is entirely optional, and provides an alternative to input at the keyboard level. It allows for Hauptwerk to be used as a voice expander ('box of ranks') in conjunction with an external hardware or software organ relay.

MIDI input at the keyboard level is the more commonly-used alternative (allowing Hauptwerk's native virtual organ relay to be used).

Switches (stops, couplers, tremulants, pistons, menu function triggers, buttons, etc.)

Hauptwerk's virtual switches can be turned on and off by any of the following types of events:

- Computer key.
- Momentary piston: MIDI program change.
- Momentary piston: MIDI note-on.
- Momentary piston: MIDI NRPN-on (value=127).
- Momentary piston: MIDI control change-on (value=127).
- Momentary piston: Johannus 9/11-byte MIDI sys-ex.
- Momentary piston: Hoffrichter program change piston with independent LED (LED output on channel 6, LED off=PRG+10).
- Momentary piston: Hoffrichter general cancel (outputs program changes 64/128 on channel 6).
- Momentary piston: alternating MIDI note-on/offs.
- Momentary piston: MIDI control change-on or alternating on/offs (values=127 or 0).
- Stop or hold-piston: MIDI NRPN-on/off (e.g. Allen), on value=127, off value=0.
- Stop or hold-piston: MIDI note-on/off.
- Stop or hold-piston: MIDI control change-on/off, on value=127, off value=0.
- Stop: Rodgers pre-Infinity bitfield.
- Stop: Rodgers Infinity+ bitfield: speaking stop.
- Stop: Rodgers Infinity+ bitfield: other control.
- Stop: Johannus/ Makin/Wyvern/Musicom toggling MIDI program changes.
- Stop: Content/Wyvern/Eminent MIDI control change bitfield.
- Stop: Content/Wyvern MIDI key after-touch bitfield.
- Stop: Viscount 6-byte constant MIDI sys-ex messages.
- Stop: Ahlborn Organum/Praeludium varying MIDI NRPNs.
- Stop: Ahlborn MIDI control change 70.
- Stop: Ahlborn Archive MIDI control changes 73/74.
- Stop: Makin MIDI program change sequences.
- Stop: Phoenix/Wyvern MIDI program changes (off using same program as on, but on next MIDI channel).
- Novation Launchpad MIDI note-on/off button.
- Novation Launchpad MIDI control change-on/off button, on value=127, off value=0.
- Generic MIDI prog changes (excluding Johannus/Makin/Wyvern).
- Generic MIDI control changes.
- Generic MIDI RPNs.
- Generic MIDI NRPNs.
- Generic MIDI sys-ex constant messages (up to eight bytes in length).
- Generic MIDI key after-touch (some Hoffrichter).
- X-Keys one-shot character code.
- Notation piston/toggle: MIDI program change (you specify the program number).
- Notation piston/toggle: MIDI control change, value=127 (you specify the CC number).
- Notation piston/toggle: MIDI control change CC=14 (you specify the value).
- Notation piston/toggle: MIDI control change CC=15 (you specify the value).
- Notation stop or hold-piston: MIDI control change-on/off, on value=127, off value=0 (you specify the CC number).
- Notation stop or hold-piston: MIDI control changes: on CC=20, off CC=110 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=21, off CC=111 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=22, off CC=112 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=23, off CC=113 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=24, off CC=114 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=25, off CC=115 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=26, off CC=116 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=27, off CC=117 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=28, off CC=118 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=29, off CC=119 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=50, off CC=70 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=51, off CC=71 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=52, off CC=72 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=53, off CC=73 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=54, off CC=74 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=55, off CC=75 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=56, off CC=76 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=57, off CC=77 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=58, off CC=78 (you specify the value).
- Notation stop or hold-piston: MIDI control changes: on CC=59, off CC=79 (you specify the value).

Apart from the 'notation' events (which are intended for configuration by hand to match hand-entered MIDI events in notation software), all of those event types can be detected and configured automatically by Hauptwerk (right-click on a virtual stop/coupler/tremulant/switch/piston/button, or on a control panel button, and select '*Auto-detect ...*').

(Except for the special 'alternating' event types), engaging and disengaging events must be 'symmetrical'. For example, if an engaging event is a MIDI note-on message, then the disengaging event must be a note-off message for the same MIDI note number, MIDI port and MIDI channel. However, there are no restrictions on the MIDI port, MIDI channel, or other parameters for any particular virtual switch or menu function. For example, any stop or any piston can use any MIDI channel.

If you use a momentary MIDI piston or computer key to control a virtual latching switch (such as a stop), then it will be configured automatically to toggle the state of the latching switch by default. If a MIDI switch sends a message when disengaged (as well as when engaged), and you use it to control a virtual latching switch (such as a stop), then you have the option for it to toggle the latching switch's state, or to set its state directly.

Hauptwerk has an option for basic 'contact de-bounce' functionality for piston event types, for which it ignores subsequent presses for any given piston if the MIDI piston sends several identical messages very rapidly in a row (due to the MIDI piston's hardware contact 'bouncing').

If a virtual switch is latching, then its default state (when the organ is loaded or reset) is defined by the sample set developer, but you can override it.

MIDI output is supported for all MIDI switch event types (not computer key presses), with the MIDI messages sent being identical to those received (which is conventional for digital/MIDI organ console MIDI implementations), and Hauptwerk can configure MIDI output automatically in that case.

If you need MIDI output messages from a virtual switch that are *different* from the MIDI input messages the virtual switch receives, then (only) the following MIDI output event types are allowed:

- MIDI NRPN-on/off (on value=127, off value=0).
- MIDI note-on/off.

If you are building a new MIDI organ console or new MIDI hardware for Hauptwerk then we recommend that MIDI switches and pistons use MIDI NRPN-on/off messages (on value=127, off value=0) and that if a MIDI switch supports MIDI output (for example, if it is solenoid-actuated or illuminated) then we recommend that it should receive identical MIDI messages to those it sends (thus making it possible for Hauptwerk to configure MIDI output to it automatically during auto-detection).

If you are building a new MIDI organ console for Hauptwerk using MIDI encoder circuitry that doesn't support NRPNs, then we recommend instead using MIDI note-on/off messages for switches and pistons, again ensuring that each MIDI switch receives identical MIDI messages to those it sends (if the MIDI switch supports MIDI output).

LCD panel system

Hauptwerk is able to control 32-character LCD panels using custom MIDI system exclusive messages to show any of its dynamic status information (for example, the name of the organ, temperament or combination set loaded or cued, organ loading progress, or the combination stepper frame number) or to show static user-specified label text, for example allowing you to label each MIDI stop switch with an appropriate name depending on which virtual organ is loaded.

You can select the format and information used for each of two 16-character lines on status display LCD panels.

Appropriate off-the-shelf 32-character LCD display hardware units, designed specifically for use with Hauptwerk, are available from third-party MIDI hardware suppliers, making it easy to display Hauptwerk status information on home-built MIDI consoles, without the need for any do-it-yourself electronics or specialist expertise.

Each hardware LCD panel can be controlled from any MIDI output port, with no restrictions, and should be programmed with a 2-byte identifier, which identifies it uniquely. Up to 32 characters can be sent to each display, with the text data being sent as raw ASCII (7-bit) byte sequences. A color code is also sent to each panel so that it can be back-lit or otherwise associated with a color to indicate its broad function (stop, coupler, etc.) or grouping (division, etc.).

The format of the system exclusive messages (for hardware developers) is:

- Byte 1: 0xf0 - system exclusive start.
- Byte 2: 0x7d - fixed manufacturer ID.
- Byte 3: 0x01 - message type code for Hauptwerk LCD output message.
- Byte 4: destination panel unique ID byte 1 (7-bit LSB).
- Byte 5: destination panel unique ID byte 2 (7-bit MSB).
- Byte 6: color code 0-127 (0=off/black, 1=white, 2=red, 3=green, 4=yellow, 5=blue, 6=magenta, 7=cyan, others user-defined).
- Bytes 7-38: the 32 ASCII (7-bit) bytes for the text to display.
- Byte 39: 0xf7 - end of system exclusive message.

If you are building a new MIDI organ console for Hauptwerk then incorporating about five (or even seven) 32-character LCD panels should allow most key Hauptwerk status information to be displayed conveniently on the MIDI console.

Custom MIDI output messages

Custom MIDI output messages can optionally be sent from Hauptwerk whenever MIDI/audio is activated and/or deactivated. These messages can each be sent to any MIDI port without restriction, and are specified as a sequence of up to 48 raw MIDI bytes so that any custom type of message that may be required by your hardware can be sent, including system exclusive messages.

MIDI console status output system

In addition to the LCD panel system, Hauptwerk can optionally output all of its main status information *(*)* in a raw and non-configurable form, using a fixed MIDI sys-ex implementation so that custom-designed display hardware/circuitry can be developed to display status information in whatever form is desired. To enable that, select a MIDI output port on the '*General settings | General preferences | MIDI console status output*' screen tab. However, please note that it will generate a significant amount of MIDI traffic.

(Note that the MIDI console status output system messages are in a different format from the LCD panel system, and cannot be used to drive 32-character Hauptwerk-compatible LCD panel units.)

(*) The states of individual master couplers, master general combinations, master scoped combinations and master reversible combinations aren't currently sent via the MIDI console status output system, but hardware MIDI controls can be connected to the relevant virtual controls directly, as for organ stops, for example.

Each time a system status variable changes in Hauptwerk, a MIDI sys-ex message is sent for it in one of the following formats, depending on the variable's type:

7-bit unsigned integer variable status sys-ex message format:

- Byte 1: 0xf0 - system exclusive start.
- Byte 2: 0x7d - fixed manufacturer ID.
- Byte 3: 0x1b - message type code for Hauptwerk 7-bit unsigned integer variable status message.
- Byte 4: variable ID (see list below).
- Byte 5: variable value (0-127).
- Byte 6: 0xf7 - end of system exclusive message.

Boolean status sys-ex message format:

The 7-bit unsigned integer format is used, with a value of 1 for true/on and 0 for false/off.

28-bit signed integer variable status sys-ex message format:

- Byte 1: 0xf0 - system exclusive start.
- Byte 2: 0x7d - fixed manufacturer ID.
- Byte 3: 0x1a - message type code for Hauptwerk 28-bit signed integer variable status message.
- Byte 4: variable ID (see list below).
- Byte 5: variable value byte 1 (most significant 7 bits).
- Byte 6: variable value byte 2.
- Byte 7: variable value byte 3.
- Byte 8: variable value byte 4 (least significant 7 bits).
- Byte 9: 0xf7 - end of system exclusive message.

Floating-point variable status sys-ex message format:

The floating-point number is multiplied by 10, rounded to the nearest integer, and then sent using the 28-bit signed integer message format. (Thus the original floating-point value is sent with a resolution of one decimal place.)

High-resolution continuous control variable status sys-ex message format:

The continuous controller's position is sent using the 28-bit signed integer message format, with values in the range 0 to 16383.

16-character string variable status sys-ex message format:

- Byte 1: 0xf0 - system exclusive start.
- Byte 2: 0x7d - fixed manufacturer ID.
- Byte 3: 0x19 - message type code for Hauptwerk string variable status message.
- Byte 4: variable ID (see list below).
- Byte 5: variable value 7-bit ASCII character 1.
- Byte 6: variable value 7-bit ASCII character 2.
- Byte 7: variable value 7-bit ASCII character 3.
- Byte 8: variable value 7-bit ASCII character 4.
- Byte 9: variable value 7-bit ASCII character 5.
- Byte 10: variable value 7-bit ASCII character 6.
- Byte 11: variable value 7-bit ASCII character 7.
- Byte 12: variable value 7-bit ASCII character 8.
- Byte 13: variable value 7-bit ASCII character 9.
- Byte 14: variable value 7-bit ASCII character 10.
- Byte 15: variable value 7-bit ASCII character 11.
- Byte 16: variable value 7-bit ASCII character 12.
- Byte 17: variable value 7-bit ASCII character 13.
- Byte 18: variable value 7-bit ASCII character 14.
- Byte 19: variable value 7-bit ASCII character 15.
- Byte 20: variable value 7-bit ASCII character 16.
- 0xf7 - end of system exclusive message.

Note 1: strings are always padded with spaces to the full 16 characters, with no zero-value string terminator byte.

Note 2: non- 7-bit ASCII characters (for example, in filenames) are converted to question-mark characters.

Status variable IDs:

Decimal variable ID number	Name	Type	Range
0	CurrOrganShortName	String	
1	CuedFavOrganNum	7-bit unsigned integer	1-32
2	CuedFavOrganShortName	String	
3	LastOrganShortName	String	
4	CurrCombSetShortName	String	
5	CuedFavCombSetNum	7-bit unsigned integer	1-32
6	CuedFavCombSetShortName	String	
7	CurrTemperShortName	String	
8	CuedFavTemperNum	7-bit unsigned integer	1-32
9	CuedFavTemperShortName	String	
10	FloatingDiv1RouteNum	7-bit unsigned integer	1-4
11	FloatingDiv1KbdShortNameList	String	
12	FloatingDiv2RouteNum	7-bit unsigned integer	1-4
13	FloatingDiv2KbdShortNameList	String	
14	FloatingDiv3RouteNum	7-bit unsigned integer	1-4
15	FloatingDiv3KbdShortNameList	String	
16	FloatingDiv4RouteNum	7-bit unsigned integer	1-4
17	FloatingDiv4KbdShortNameList	String	
18	FloatingDiv5RouteNum	7-bit unsigned integer	1-4
19	FloatingDiv5KbdShortNameList	String	
20	CurrCombStepperFrameNum	28-bit signed integer	0-999
21	CuedCombStepperFrameBankNum	28-bit signed integer	0-999
22	LastTriggeredMasterGeneralCombNum	7-bit unsigned integer	1-100 (0=none)
23	LastTriggeredMasterRegObjType	7-bit unsigned integer	1=HandReg, 2=CombinationStepper, 3=MasterGeneralCombination, 4=MasterCrescendo, 5=MasterScopedCombination, 6=MasterReversibleCombination
24	CurrMasterCrescNum	7-bit unsigned integer	A=1, B=2, C=3, D=4

25	CuedMasterCrescStage	7-bit unsigned integer	1-31 (stage 0=crescendo off)
26	TransposerIncSemitones	28-bit signed integer	-12 to +12
27	OrganBasePitchHz	Floating-point	
28	MasterTuningIncCents	28-bit signed integer	-200 to +200
29	OrganAudioLevelTrimDecibels	Floating-point	-24.0 to +24.0
30	PolyphonyLimitSetting	28-bit signed integer	256-32768
31	SampleRateHz	28-bit signed integer	
32	LatencyMs	Floating-point	
33	IsSetterModeOn	Boolean	
34	IsScopeModeOn	Boolean	
35	IsRecordingAudio	Boolean	
36	IsRecordingMIDI	Boolean	
37	IsPlayingMIDI	Boolean	
38	IsOrganAndAudioAndMIDIReady	Boolean	
39	IsInErrorState	Boolean	
40	OrganLoadingProgressIndicatorPct	7-bit unsigned integer	0-100
41	MasterOutputLevelCCPct	7-bit unsigned integer	0-100
42	FloatingDiv1ExprPedCCPct	7-bit unsigned integer	0-100
43	FloatingDiv2ExprPedCCPct	7-bit unsigned integer	0-100
44	FloatingDiv3ExprPedCCPct	7-bit unsigned integer	0-100
45	FloatingDiv4ExprPedCCPct	7-bit unsigned integer	0-100
46	FloatingDiv5ExprPedCCPct	7-bit unsigned integer	0-100
47	MasterCrescPedCC	7-bit unsigned integer	0-31
48	AudioLevelClipping	7-bit unsigned integer	0=green/normal, 1=orange, 2=red/clipping
49	PolyphonyClipping	7-bit unsigned integer	0=green/normal, 1=orange, 2=red/clipping
50	CPUClipping	7-bit unsigned integer	0=green/normal, 1=orange, 2=red/clipping
51	RAMClipping	7-bit unsigned integer	0=green/normal, 1=orange, 2=red/clipping
52	CurrObjShortNameAllTypes	String	
53	CuedFavNumAllTypes	7-bit unsigned integer	1-32
54	CuedFavShortNameAllTypes	String	
55	AllTypesObjType	7-bit unsigned integer	1=Organ, 2=CombinationSet, 3=Temperament
56	LastTriggeredMasterScopedCombNum	7-bit unsigned integer	1=A1, …, 60=F10 (0=none)
57	LastTriggeredMasterReversibleCombNum	7-bit unsigned integer	1=A1, …, 60=F10 (0=none)
58	IsMasterCrescendoActive	Boolean	
59	IsHandRegCurrent	Boolean	
60	IsCurrCombStepperFrameRegCurrent	Boolean	
61	IsLastTriggeredMasterGeneralCombRegCurrent	Boolean	
62	IsLastTriggeredMasterScopedCombRegCurrent	Boolean	
63	IsLastTriggeredMasterReversibleCombRegCurrent	Boolean	
64	MasterCrescPedalRawCCVal	High-resolution controller	
65	MasterOutputLevelRawCCVal	High-resolution controller	
66	FloatingDiv1ExprPedCCPct	High-resolution controller	
67	FloatingDiv2ExprPedCCPct	High-resolution controller	
68	FloatingDiv3ExprPedCCPct	High-resolution controller	
69	FloatingDiv4ExprPedCCPct	High-resolution controller	
70	FloatingDiv5ExprPedCCPct	High-resolution controller	
71	MasterTuningRawCCVal	High-resolution controller	
72	IsAudioRecordingArmed	Boolean	
73	IsMIDIRecordingArmed	Boolean	
74	StopAllRecAndPlaybackOnMIDIFilePlayEnd	Boolean	
75	IsMIDIPlaybackPaused	Boolean	
76	IsMIDIPlaybackRewindingAtSpeed2	Boolean	
77	IsMIDIPlaybackRewindingAtSpeed1	Boolean	
78	IsMIDIPlaybackFastForwardingAtSpeed1	Boolean	

79	IsMIDIPlaybackFastForwardingAtSpeed2	Boolean	
80	MIDIPlayerPlayPosOffsetFromStartSeconds	28-bit signed integer	
81	MIDIPlayerFileLengthSeconds	28-bit signed integer	
82	MIDIPlaybackSpeedAdjustmentPct	Floating-point	
83	IsReadyForUserInput	Boolean	
84	IsOrganLoaded	Boolean	
85	IsOrganLoading	Boolean	
86	IsMIDIReady	Boolean	
87	MasterReverbWetnessScalerRawCCVal	High-resolution controller	0=0%, 127=100% mixer wetness
88	IsAllPistonsStepperPlus1ModeOn	Boolean	
89	CombStepperEditorBlockSize	7-bit unsigned integer	
90	UtilityFunctionsMenuCuedFunctionCode	28-bit signed integer	
91	UtilityFunctionsMenuCuedFunctionName	String	
92	AudioMixerBusesAndGroupsPresetCode	28-bit signed integer	1-128
93	AudioMixerBusesAndGroupsPresetName	String	Max length 16 characters
94	RankRoutingAndVoicingPresetCode	28-bit signed integer	1-4
95	RankRoutingAndVoicingPresetName	String	Max length 16 characters

Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation

Hauptwerk's built-in MIDI recorder/player uses a completely fixed, predefined MIDI implementation (for portability of MIDI files, independence of MIDI files from MIDI hardware/settings, independence of MIDI files from combination sets, touch-screen, mouse click and computer key compatibility, etc.).

To load a MIDI file in Hauptwerk's native MIDI recorder/player, or to play a file from an external MIDI sequencer/player into Hauptwerk via the '*Hauptwerk MIDI recorder/player external MIDI IN*' port, the file must use that fixed MIDI implementation.

The easiest way to create MIDI files with the appropriate implementation is simply to play live into Hauptwerk, while recording MIDI via its native MIDI recorder/player (or via its '*Hauptwerk MIDI recorder/player external MIDI OUT*' port). You can then easily see or edit the appropriate events in the resulting MIDI file when the MIDI file is opened in an external sequencing program.

However, if you want to create or edit MIDI file events from scratch or by hand in your MIDI sequencer then to see the exact MIDI implementation used for any given virtual organ (for example which NRPN number each particular virtual stop uses) then please use the *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ) ...* menu function when the organ is loaded.

Important: that MIDI implementation is intended for MIDI files and MIDI sequencers, and for that organ only. It isn't a requirement or recommendation for MIDI organ consoles/hardware in general. You shouldn't normally use the *'Hauptwerk MIDI recorder/player external MIDI IN/OUT'* **ports for connecting conventional MIDI organ consoles/hardware to/from Hauptwerk.**

Note that if you load a MIDI file into Hauptwerk's native MIDI player that was saved with a different virtual organ (sample set), then only the keys will play; registration changes and other controls recorded in the file will be ignored because in general there is no reliable way to map them automatically in a meaningful and artistic way between different organs.

Format used for MIDI sys-ex messages

MIDI note-on/off, MIDI NRPN and MIDI control change messages are used in preference for most virtual keyboards and controls, as covered via the *Recording | View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ) ...* menu function, since they are easy to view and edit in most MIDI sequencers.

However, since the MIDI standard allows for only a relatively small number of distinct messages of those types, Hauptwerk defaults to sending MIDI sys-ex messages as a last resort for virtual controls for which the sample set developer hasn't specified one of the Hauptwerk standard control 'role codes' (assignment codes). (Note that some sequencers ignore MIDI sys-ex messages from AU/VST plug-ins and that some Windows virtual MIDI cable software doesn't work reliably with MIDI sys-ex messages.)

The sys-ex messages have the following format:

Byte number	Byte hex value	Meaning
1	F0	Sys-ex start (fixed).
2	7D	Manufacturer ID (fixed).
3	39	Device ID (fixed).
4	72	Model ID (fixed).
5	[*cc*]	Command ID (variable): see below.
6-9	[*oo oo oo oo*]	Raw object ID from organ definition (variable): 28-bit unsigned integer, with 7 bits per byte and most significant byte first. For example, organ definition SwitchID for switches, ContinuousControlID for CCs, KeyboardID for keyboards, RankID for ranks, OrganID for MIDI file start.
10	[*nn*]	MIDI note number (variable), if relevant for command type, Hauptwerk MIDI file format version for MIDI file start.
11	[*vv*]	Velocity or controller value 7-bit MSB (variable), if relevant for command type, organ major version for MIDI file start.
12 (if CC)		Controller value 7-bit LSB (variable) if command type is 'organ continuous control'. For other command types this byte is omitted when sent. Note: when receiving/playing, Hauptwerk allows this byte to be missing, for backward compatibility.
13 (if CC) or 12 (if not CC)	F7	Sys-ex end (fixed). If the command type is 'organ continuous control' this is sent as byte 13, but for all other command types it is sent as byte 12. Note: when receiving/playing, Hauptwerk allows this to be received as byte 12 even for organ continuous control commands, for backward compatibility.

The command IDs are:

Command	Decimal ID value
Organ switch on	16
Organ switch off	17
Organ continuous control	18
Organ keyboard key on	19
Organ keyboard key off	20
Organ keyboard key 2nd touch on	21
Organ keyboard key 2nd touch off	22
Organ rank note on	23
Organ rank note off	24
MIDI file start with OrganID	28
MIDI file end	29

Hauptwerk version 3 MIDI sequencing MIDI implementation

MIDI files that were recorded using the default MIDI settings from the Hauptwerk version 2 or version 3 'MIDI sequencing' configuration should also play correctly, for backward compatibility. However, any new files you record from Hauptwerk will use the current implementation.

However, the only version 3 menu function triggers supported are those to navigate and select registration sequencer (now stepper) frames.

Troubleshooting

Errors, warnings and logs

If Hauptwerk encounters a problem, an error or warning message will be displayed on the screen. Each message has a unique code, shown below the message. If you need to contact your support provider for support, this code helps him or her to locate its cause.

All errors, warnings and information messages shown on the screen are also written to a log so that you can refer back to them later, and so that they can easily and accurately be sent to your support provider if you need assistance. To view the log file select *Help | View activity log* from the Hauptwerk menu:
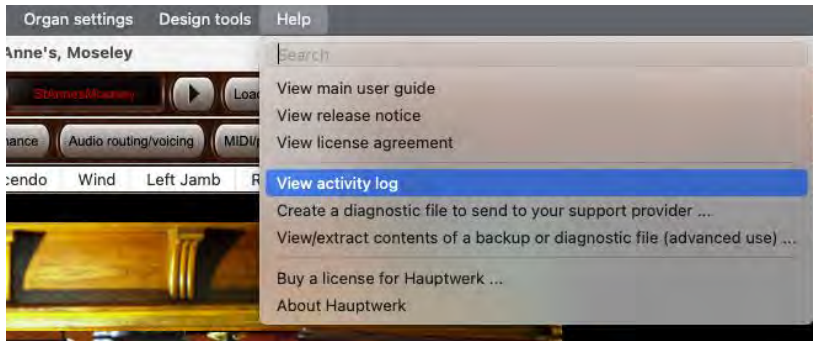
It should open in your web browser and automatically scroll to the end of the log.

Note that you must re-open the log via *Help | View activity* log if you want to refresh it; using your web browser's refresh function alone won't update the log to show entries added since you opened it from Hauptwerk (the log is regenerated by Hauptwerk each time you open it).

Additional diagnostic information is sometimes written to the log file, which you may wish to examine on occasion. For example, the total audio latency is recorded, along with timing information when loading sample sets, and some errors that are not critical and could interrupt the audio output if reported on the screen, such as failures to send MIDI system exclusive messages. Hence it's worth checking the log occasionally.

What to do if an error occurs

First of all, make absolutely certain that you have carefully read the message displayed by Hauptwerk. Usually the message will contain all of the information necessary to fix the problem. If you want to refer back to the messages, use *Help | View activity log*.

Please also make sure that you have read this user guide and at least the FAQ section on the Hauptwerk website before contacting your support provider for support. If you're having problems with a setting on one of the settings screens, then make sure that you have tried clicking on the pointer/question-mark icon immediately to the left of a screen's *OK* button, then clicking onto the setting to see if the on-line help gives you the necessary information. Most of the on-line help isn't duplicated in this user guide. Hovering over a setting will also give you a usage hint.

Also make sure that you have all current operating system and driver updates applied, and especially that you have the latest drivers installed for your audio/MIDI interface(s).

If you still don't know how to solve the problem, and provided that you are on a supported Hauptwerk version and computer platform, and are within your technical support agreement terms (or have arranged for additional support), then you can of course contact your support provider for support. Please initially contact the vendor from whom you bought Hauptwerk, who will advise you who to contact. If you purchased a license for Hauptwerk directly from Milan Digital Audio then please see the Hauptwerk website to contact us. You can also try posting details of your problem to our on-line forum if you don't need a solution urgently.

Important: If you do need to contact your support provider about a problem, then please always try to **describe the problem as accurately and concisely as possible** and then use the instructions in the *How to send a diagnostic file* section to **send a diagnostic file** attached with the support request. That will allow him or her to see your logs, your relevant Hauptwerk settings and other relevant Hauptwerk files and system information that are essential for diagnosing most problems quickly and easily.

How to send a diagnostic file

Step 1. Select *Help | Create a diagnostic file to send to your support provider* from the Hauptwerk menu:
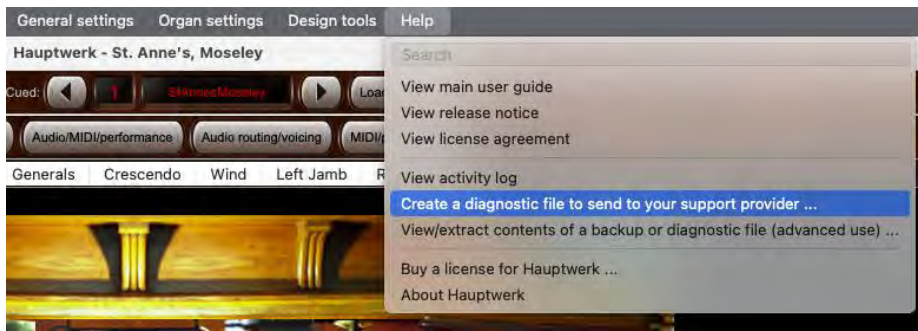
A button to create a diagnostic file is also provided on the message window when Hauptwerk displays an error message. Clicking that button has the same effect as using the menu function.

Step 2. A *Save as* window will appear. Use it to navigate to a location in which you want the file to be created. For example, choose your desktop or your *Documents* folder. Type a meaningful name for the file, so that you will be able to identify and find it in order to attach it to an email, then click the *Save* button.

Step 3. After a few moments a message should appear, indicating that the diagnostic file has been created successfully.

Note down the name you gave the file and the folder in which you saved it, so that you can attach it to an email in the next step. Now click the *OK* button to dismiss the message.

If you do not see a success message, then please start again and make sure you type a valid name for the file when prompted, and that you select a folder that you are allowed to write to, such as your desktop folder or your *Documents* folder.

Step 4. Now use your email software or web browser to attach the diagnostic file to an email or support request to your support provider. Please make sure you also try to describe the problem as accurately and concisely as possible. (Please see your email software's documentation if you need help on how to send email attachments if needed.)

Common problems and how to fix them

If the audio is breaking up, or the delay between pressing a key and hearing the sound is too long, then please see the *Performance tuning* section, which covers the settings you need to adjust to prevent these problems.

If nothing appears to happen when you double-click on the Hauptwerk icon, then it's likely that you have a corrupted audio driver that is freezing when Hauptwerk queries it during start-up, leaving Hauptwerk waiting for the driver to respond. Make sure that you uninstall any audio drivers for hardware that you no longer use. If the problem persists, please contact your Hauptwerk support provider (if applicable) for advice.

If an audio or MIDI device is configured for use with Hauptwerk, and is in use by another program when you attempt to load an organ or activate Hauptwerk's audio/MIDI (for example, by loading an organ), then errors will be reported. Hauptwerk must have exclusive access to all devices configured for use with it.

Backup configuration files

Hauptwerk stores all of its settings in several configuration files, which are saved each time that you exit Hauptwerk or unload a sample set. Although it is extremely unlikely, if your computer was turned off or crashed at exactly the moment that the files were being saved, they could be corrupted. This could also happen if you tried to run two or more instances of Hauptwerk at the same time, which is why Hauptwerk attempts to prevent you from doing so.

To insure against such events, Hauptwerk automatically keeps a backup of the last known good configuration and silently restores it if it finds the corresponding settings file to be corrupted. A warning is written to the log file to alert you to the possibility that some of your recent settings changes may have been lost.

Creating sample sets

Creating a sample set or organ definition for Hauptwerk is a skilled and complex task, which requires a considerable investment of time and effort. We would only recommend undertaking the creation of a full sample set or organ definition if you are able to invest that time and have a reasonable level of technical expertise.

For the creation of custom organ specifications for personal use, using samples from existing sample sets, the Custom Organ Design Module is provided, which is quick and simple to use, and is recommended for most users. You can find the Custom Organ Design Module User Guide on Hauptwerk's *Design tools* menu.

Unless specifically advised to do so by the creator of a sample set, you must **never attempt to edit any part of an existing sample set directly**, including its audio samples, organ definition files, images and other components. For St. Anne's and the core Hauptwerk components editing a component can:

- Prevent the Hauptwerk software's main installer from being able to uninstall or upgrade the components properly, and possibly thus Hauptwerk as a whole.

- Prevent Hauptwerk's component installer from functioning properly.

- Prevent Hauptwerk's Custom Organ Design Module from working properly.

- Prevent the St. Anne's sample set from loading properly.

- Prevent Hauptwerk's internal sample caching, configuration storage and other mechanisms from working for the edited sample set and potentially also others.

Most Hauptwerk audio and tremulant waveform samples contain special information which is not handled properly by some audio editors (multiple sample loops, stored pitch information, etc.), and making changes to a sample in such audio editors may corrupt that information, preventing the sample from working properly with Hauptwerk.

Editing Hauptwerk's core components is also explicitly disallowed by the Hauptwerk license agreement. License agreements for some third-party sample sets also explicitly disallow editing of their contents.

HAUPTWERK

VIRTUAL PIPE ORGAN
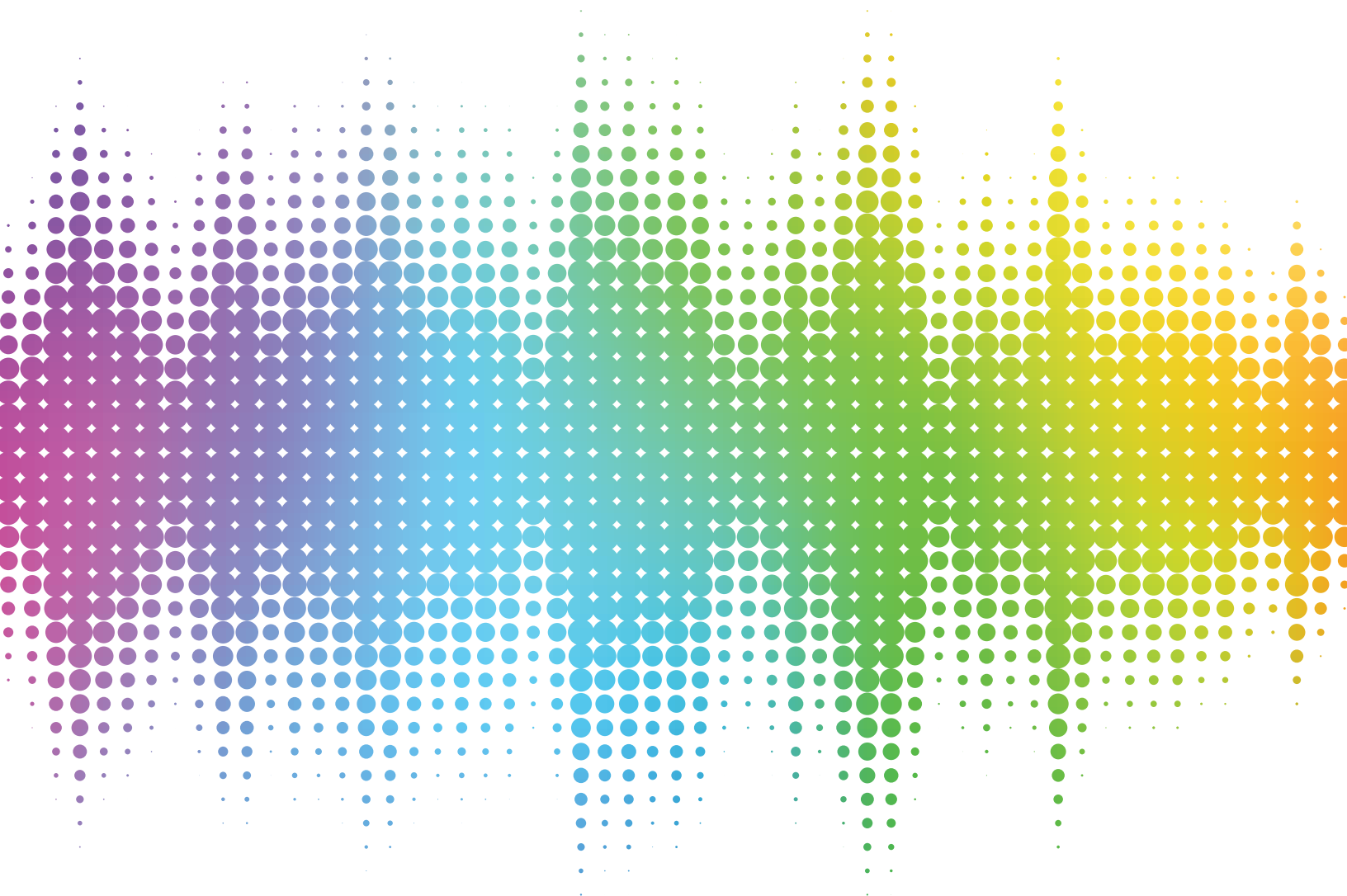
For more information or to order visit

www.hauptwerk.com