

RELEASE NOTICE  
VERSION 6.0



# HAUPTWERK VI

VIRTUAL PIPE ORGAN



## Hauptwerk 6.0.0 Release Notice

### Contents

Overview .....	3
Licensing, Editions, Prerequisites, Installation, Technical Support, and Compatibility .....	4
Changes to Hauptwerk .....	6
Changes in version 6.0.0 above version 5.0.1 .....	6
'Favorite' organ, combination set, and temperament list changes, plus new 'utility functions menu' .....	6
Combination system changes .....	7
MIDI changes .....	11
Audio engine changes .....	12
Other changes .....	13
Bug fixes .....	14
Changes in version 5.0.1 above version 5.0.0 .....	15
Changes in version 5.0.0 above version 4.2.1 .....	18
Advanced Edition only: audio routing, multiple audio output perspectives, and associated voicing changes..	18
Advanced Edition only: native impulse response convolution reverb .....	21
Licensing changes .....	22
Advanced Edition only: other new rank voicing adjustment functionality .....	25
Performance and audio realism .....	25
Platform support and prerequisites changes .....	26
Novation Launchpad 'mark 2' model support .....	26
Changes for the Custom Organ Design Module ('CODM') .....	27

Hauptwerk 6.0.0 Release Notice

Changes for sample set developers .....	27
Other changes .....	28
Bug fixes .....	31
Known issues.....	32

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## Overview

Hauptwerk 6 is a major new version of Hauptwerk, superseding versions 1-5, including significant enhancements to the combination system, MIDI handling, optional improved audio engine quality, and many other smaller improvements. As for Hauptwerk version 5, Hauptwerk is licensed via the PACE iLok system (instead of the 'Hauptwerk USB key' HASP dongle system that was used for versions 2-4).

There are no changes to supported or required platforms, compared to version 5.

Please have a look through the *Changes to Hauptwerk* section to find out what's included. We hope you enjoy it!

The most current source of information about Hauptwerk is the Hauptwerk website: [www.hauptwerk.com](http://www.hauptwerk.com). Please have a look there too for updated information, downloads, tutorials, known bugs, and lots more.

## Licensing, Editions, Prerequisites, Installation, Technical Support, and Compatibility

Please first read the following sections in the current version of the main Hauptwerk user guide (available on the [Hauptwerk website](#), or on the Help menu in this version of Hauptwerk) if you are installing Hauptwerk for the first time, and especially even if you are upgrading from Hauptwerk versions 2-4:

- *Licensing, editions, and technical support.*
- *Hauptwerk prerequisites.*
- *Installation: background information.*
- *Installing Hauptwerk.*
- *Upgrading Hauptwerk.*

**Important:** if upgrading from Hauptwerk versions 2-4, then please also consult the following sections in this release notice, which cover some important changes to be aware of in v5+:

- [Licensing changes.](#)
- [Platform support and prerequisites changes.](#)

If upgrading from v2 and above, then your existing combinations and voicing will be preserved by default. If upgrading from v4+ then all settings will be preserved by default (although if upgrading from v4 you have the option to reset your audio/routing settings to defaults, so that you can reconfigure them optimally for v5+). (If upgrading directly from v2-v3, then please note that MIDI settings and audio engine preferences will no longer be migrated, although we strongly recommended resetting and reconfiguring MIDI settings for v4+ anyway, using right-click auto-detection on the relevant virtual controls.)

All sample sets that worked in v2 and above should work and perform in this version at least as well as they did in previous versions, the one important exception being that copy-protected sample sets that were created for v2-v4 cannot be loaded directly in this version (\*). Existing combinations, voicing, and settings should be preserved in either case (apart from MIDI settings specifically if upgrading directly from v2-v3, as above). Sample sets in Hauptwerk v1 format may be imported and used in this version too. It's our intention that all future Hauptwerk versions remain fully and seamlessly backwardly-compatible with this version.

In particular, if upgrading from v5 specifically, then all v5 settings, combinations, and voicing will be migrated, and sample sets (and sample set licenses) that were compatible with v5 will continue to work in v6.

Upgrades to, and subscription licenses for, v6 from v1-v5 may be purchased from the Hauptwerk on-line shop on the [Hauptwerk website](#) or from your re-seller.

For 'perpetual' (non-subscription) licenses, upgrades between minor Hauptwerk versions (for example between v6.0.0 and v6.0.1) are free to users with a valid license for v6, but a license upgrade must be purchased to upgrade between major versions (for example between v5 and v6), or between different Hauptwerk editions. All version upgrades (including this one) are included with subscription licenses (during the period for which the subscription has been paid for).

You can obtain the installers for the current version of the Hauptwerk software as a free download via the [Hauptwerk website](#). Whether the software functions as licensed software or as an evaluation is determined only by the presence or absence of a valid license.

We believe this version is better in every way than previous versions: it's easier to use, more powerful and flexible, with greater realism and better performance. Versions 1-4 are considered obsolete and are no longer available, developed, or supported in any way. Unless you have purchased (or have been supplied with) an upgrade to this version, v5.0.1 will continue to be supported for a maximum period of 12 months from the date you purchased a license for it (either a new license or an upgrade), but there will be no more v5 releases or development, and we reserve the right not to assist with issues that would be resolved by upgrading to the current version.

**Important note 1:** 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 un-installer'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.)

**Important note 2:** When installing this version, please make sure that you refer to, and follow, the instructions in either the '*Upgrading or re-installing Hauptwerk*' section of the main Hauptwerk user guide (if upgrading an existing installation), or the '*Installing Hauptwerk*' section (if performing a new/clean Hauptwerk installation). Those sections contain some essential steps, especially if upgrading from versions 2-4.

**Note 3:** The first time that you load any given organ in v6+, the organ's sample set cache will (re)generate, which may be slow, but subsequent loads should be as fast as previously.

**(\*) Additional important notes if specifically upgrading from Hauptwerk versions 2-4:**

- The previous 'Hauptwerk USB key' HASP dongle that was used for Hauptwerk v2-4 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 v5+ 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 before you use the menu function to migrate your pre-v5 sample set licenses.
- On macOS you must use Finder manually to delete your pre-v5 Hauptwerk installation completely before installing v5+, otherwise a corrupted installation will result. You can use Hauptwerk's backup/restore functions to retain your existing settings/combinations/voicing. The '*Upgrade/re-installation steps on an Apple Mac computer*' section in the main Hauptwerk user guide covers the necessary steps. (These steps are necessary since pre-v5 versions of Hauptwerk were installed in a way that isn't compatible with the security changes Apple have made in recent macOS versions.)

## Changes to Hauptwerk

All Hauptwerk releases since version 2 are cumulative, thus each includes all changes from previous Hauptwerk versions. Changes in version 4 and earlier aren't listed in this document, but can be found in the version 4.2.1 release notice (available separately) if needed.

### Changes in version 6.0.0 above version 5.0.1

#### 'Favorite' organ, combination set, and temperament list changes, plus new 'utility functions menu'

- The number of 'favorite' organ, combination set, and temperament slots have been increased from 32 to 64.
- 'Favorite' organ, combination set, and temperament lists may now be edited, so that it's longer necessary to load another item in order to re-assign it to any given existing entry. (It's still necessary to load an item in order to assign it initially.) The following editing functions are available for each favorite type:
  - *"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"*.

They can be found on the following submenus (which have been renamed slightly accordingly):

- *"Organ | Load favorite organ / edit favorites list"*.
- *"Registration | Load favorite combination set / edit favorites list"*.
- *"Pitch | Load favorite temperament / edit favorites list"*.

All of the new functions may also be triggered via MIDI, and/or be assigned to piston toolbar buttons. However, in order to avoid needing lots of additional MIDI pistons/buttons, as with loading/selecting/assigning favorites, there is also an equivalent set of editor functions for 'all types' of favorites.

Additionally, there is also a new 'utility functions' menu system, which allows less commonly-accessed functions (such as editor functions) to be selected and performed using just three MIDI pistons/buttons (function selection up/down, execute selected function), with the currently-selected function being shown on the computer screen and/or on MIDI-controlled LCD panels. These new functions can be found on the following new control panels:

- *"Cued favorites (all types) and utility functions menu"* large control panel.
- *"Cued favorites (all types) list editor"* mini control panel.
- *"Utility functions menu"* mini control panel.

All of those 'favorites list editor (all types)' and 'utility functions menu select/execute' functions may also be triggered via MIDI pistons/buttons, and/or assigned to piston toolbar pistons, thus making it conveniently possible to edit favorites lists (and/or to select/execute other less commonly-used functions) from 'headless' MIDI consoles (without the need for a computer screen, keyboard, or mouse). To facilitate that, the following means are available for displaying the relevant information:

- A new “*Utility functions menu cued function name*” LCD panel line format.
- New *UtilityFunctionsMenuCuedFunctionCode* and *UtilityFunctionsMenuCuedFunctionName* MIDI console status output system variables.

Please note: for the most user-friendly interface if editing favorite assignments (including organ favorites) via a computer keyboard and mouse (as opposed to using MIDI pistons), we recommend having an organ loaded, so that the full complement of control panels may be accessed, then using control panels to perform the editing, such as the “*Cued favorites (all types) and utility functions menu*” large control panel, or the two “*Cued favorites (all types) ...*” mini control panels. (Instead editing favorites via the menus is possible, but less convenient.)

- There are three new general preferences to define the maximum cued favorite slot numbers before the increment functions/pistons wrap back to 1 (for organs, combination sets, and temperaments).
- There is a new general preference (which defaults to unticked) “*Last-used favorites remain lit if cued favorite numbers changed?*”. If ticked, (for each of: organ, combination set, and temperament) the last-selected/assigned 'favorite' item remains ticked on the menu (and lit/on, if its slot is assigned to be triggered directly from a MIDI piston/button/switch), even if the cued favorite number has since changed.
- There are two new general preferences: “*Auto-load favorite combination sets when cued?*” and “*Auto-load favorite temperaments when cued?*” (both unticked by default). If ticked, cued favorite combination sets and/or temperaments load automatically as their cued favorite number is incremented/decremented. Note: used in that way, you could consider the favorite combination sets simply as 'memory levels', as found on some real/digital organs, with the increment/decrement pistons selecting the current 'memory level' directly.

### Combination system changes

- The combination stepper now allows a full 3-digit frame number to be cued, with new '*cue +/-1*', '*cue xxN*', and '*trigger xxx*' functions available via the menu, control panels, piston toolbars, MIDI pistons, LCD panels, and the MIDI console status output system. This makes it possible to use the stepper to jump directly from one 3-digit frame to another without the need for so many pistons, if so desired. (For example, you could use the stepper conveniently (and in full) from just six MIDI pistons: '*+1*', '*cue -10*', '*cue +10*', '*cue -1*', '*cue +1*' and '*trigger xxx*'.)
- Based on a new general preference “*Stepper cue digit +/- pistons wrap to higher digits?*” (which defaults to ticked), stepper '*cue +/-1*' and '*cue +/-10*' functions optionally increment/decrement the higher digits when the ends of their ranges are exceeded, thus avoiding the need for additional MIDI pistons for the '*cue +/-100*' and/or '*cue +/-10*' functions, if so desired. For example, if the preference is ticked and frame 099 is currently cued, then pressing the '*cue +10*' piston will change cued frame number to 109 (instead of 009).

- MIDI-controllable pistons/buttons have been added for triggering stepper frames x00-x99. They work in the same way as the existing xx0-xx9 trigger pistons, except that there are 100 of them and they trigger the corresponding frame number within the cued 100s digit (ignoring the cued 10s digit). For example, pressing the x61 piston while 4xx (e.g. 453) is cued will jump to frame 461. They also potentially allow the stepper frames to be used as ten banks of 100 'generals', through which the stepper steps, if so desired (similar to a 'simple stepper', found on some pipe/digital organs, which just steps through the general pistons). All ten banks of ten are available via new mini control panels ("*Combination stepper xNN trigger pistons*"), and via a new "*Combination stepper (all)*" large control panel. They are also accessible via the Registration menu, and can be assigned to piston toolbar buttons.
- The number of MIDI-controllable master generals has been increased from 20 to 100. The first twenty are (still) included on the "*Registration*" large control panel, and all ten banks of ten are available via new mini control panels, and via a new large control. They are also accessible via the Registration menu, and can be assigned to piston toolbar buttons. (So as to maintain compatibility with existing MIDI files, only the first 60 can be triggered directly by MIDI program changes within Hauptwerk's MIDI player MIDI implementation.)
- There is a new general preference (which defaults to ticked) for last-used master generals and stepper trigger pistons to remain lit (and shown as current on any LCD panels), even if the current registration no longer matches their stored registrations.
- There are new general preferences "*Cancel setter (capture mode) automatically whenever capturing to a combination?*" and "*Cancel scope (range) mode automatically whenever scoping a combination?*" for whether to cancel SET and/or SCOPE automatically when capturing/scoping a combination.
- The combination stepper now has a comprehensive set of editor functions. The following functions are available via the (slightly renamed) "*Registration | Cue/trigger/increment/edit stepper combinations*" submenu:
  - "*Insert N blank frames at cued*" (where 'cued' denotes the cued stepper frame number).
  - "*Delete N frames at cued*".
  - "*Clear (blank) N frames at cued*".
  - "*Copy N frames at cued*".
  - "*Cut N frames at cued*".
  - "*Paste N frames (overwriting) at cued*".
  - "*Paste N frames (inserting) at cued*".
  - "*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*".
  - A set of 10 "*Set cued 1s digit=N (cued frames xxN)*" functions.
  - A set of 10 "*Set cued 10s digit=N (cued frames xNx)*" functions.
  - A set of 10 "*Set cued 100s digit=N (cued frames NxN)*" functions.

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 now make it possible for blocks of frames to be copied/moved (via the stepper editor's new 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.

The '*set cued ... digit=N*' functions allow the 3-digit cued number to be 'typed' directly for speed via three rows of ten pistons/buttons.

All of the new functions may be triggered via MIDI, and/or assigned to piston toolbar pistons. They are also available via the following new control panels:

- "*Combination stepper (all)*" large control panel.
- "*Combination stepper 2*" mini control panel.
- "*Combination stepper editor (all)*" mini control panel.
- "*Combination stepper editor (basic)*" mini control panel.

There is also an additional new mini control panel:

- "*Combination stepper xx0-xx9 trigger pistons*"

... for convenient use with the "*Combination stepper 2*" mini control panel, thus avoiding the need for the "*Combination stepper 1*" mini control panel also to be used for its xx0-xx9 trigger pistons (which would duplicate many of the functions from "*Combination stepper 2*" mini control panel unnecessarily, wasting screen space).

For detailed information about what each new function does, please either hover with the mouse over the relevant function button on a control panel (which shows pop-up 'tool tip' help), or consult the user guide.

For MIDI output/display (e.g. from 'headless' MIDI consoles) the following are available:

- A new "*Stepper editor*" LCD panel line format.
- A new *CombStepperEditorBlockSize* MIDI console status output system variable.

The editor functions can also be accessed conveniently (using just three MIDI pistons) via the new MIDI-controllable/display-able 'utility functions menu' (described in the preceding section in this release notice), which can be found on the following control panels:

- "*Utility functions menu*" mini control panel.
- "*Cued favorites (all types) and utility functions menu*" large control panel.

There is also a new general 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*".

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.

- There is a new *“All pistons trigger stepper +1”* function (a.k.a. 'all pistons next'), accessible via MIDI, the *“Registration”* large control panel, the *“Setter, general cancel, hand registration and utils”* mini control panel, piston toolbars, and the *“Registration”* menu. When on, triggering any master combination piston (except for the setter, scope, master general cancel, stepper -1, and stepper 000 pistons) or optionally any organ divisional or organ general combination piston (depending on the following organ preference), increments Hauptwerk's stepper frame number (instead of the performing the piston's usual function).

There is also a new organ preference *“All pistons trigger stepper +1 mode only affects master combinations?”* (which is ticked by default, since some organs may have combinations that cause unexpected behavior if this option is unticked and *“All pistons trigger stepper +1”* mode is used).

The MIDI console status output system has a new variable: *IsAllPistonsStepperPlus1ModeOn*, and the LCD system *“Combination states”* line format now also shows whether the system is in *“All pistons trigger stepper +1”* mode.

(Please note that the *“Setter, general cancel, hand registration and utils”* mini control panel is now wider than before to accommodate the new button, so if you previously had it docked then you might need to reposition it within your screen layout.)

- **Important:** master scoped (ranged) pistons now behave differently if the setter and/or scope mode are turned on:
  - 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).
- There are three additional MIDI-mappable inputs for the combination stepper '+1/increment' and '-1/decrement' functions, so that it's now possible to have up to ten distinct MIDI pistons for the '+1' function, and up to ten for the '-1' function.
- When loading a combination set the stepper cued and current frame numbers, the master crescendo, the last-used/lit master general (if any) and last-used master combination states sent via LCD panels and the MIDI console status output system, are all now reset.
- The existing *“Registration | Stepper (registration frame) general combinations”* submenu has been renamed to *“Registration | Cue/trigger/increment stepper frame general combination”*.
- The existing *“Stepper +/- pistons also synchronize cued frame?”* general preference now affects all three digits of the cued stepper frame number.

## MIDI changes

- The MIDI ports screens, and the way that MIDI ports are handled internally (and are auto-detected and stored for virtual controls) has been redesigned. Now, 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, and virtual controls auto-detect/store those. 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 to 'logical' MIDI ports, 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. Likewise, if your computer unexpectedly renames any USB-MIDI devices (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 recommended) give meaningful 'aliases' to each of the logical MIDI ports (rows) to identify the MIDI hardware that you have connected to them. For example, for "Console MIDI IN 1" you might specify 'My digital organ console' if that's the MIDI hardware that you have connected to that particular logical port (row). 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.

Any existing (Hauptwerk v5 or v4) MIDI settings will normally be migrated automatically. [**Important:** however, note that at most 32 MIDI IN ports (and at most 32 MIDI OUT ports) can be enabled simultaneously in Hauptwerk version 6+, so *before* migrating to v6+ please ensure that you don't have more than 32 MIDI IN ports, or 32 MIDI OUT ports, enabled, otherwise any MIDI settings for the additional ports will be cleared during the migration, with corresponding warnings logged.]

- All Hauptwerk master pistons and other menu functions that were previously auto-detected/configured on a per-organ basis may now alternatively be auto-detected/configured globally (for all organs), or per-organ (as before). Right-clicking on a control panel button or piston toolbar piston presents menu options for each method. This avoids the need for you to auto-detect master pistons/functions separately for each organ individually, in case you prefer to use the same MIDI pistons for those purposes for all organs.

N.B. As with Hauptwerk v4/v5, it's important that you should normally assign any given MIDI control (physical MIDI switch/stop/piston, etc.) *either* to a global ('for all organs') function *or* to a per-organ ('for this organ') function, *but not to both*; a MIDI assignment to an organ function (or to any of the organ's virtual controls) will not automatically override any global MIDI function assignment. Hence you need to decide whether any given MIDI control will always be assigned globally or per-organ before configuring it (otherwise it would trigger both functions, which may give unintended results); global assignments cannot be changed/ignored for some organs and not others.

Also, the corresponding screen on the "General settings" menu has been renamed accordingly to "General settings | MIDI/key triggers for master pistons and menu functions (for all organs) ...", and, likewise, the option on the General Configuration Wizard to reset those settings has been renamed. Clearing settings for any given virtual control clears them at both levels.

(Diagnostics: also, whenever a virtual control is auto-detected, Hauptwerk logs whether it has been auto-detected on a per-organ basis, or for all organs.)

- All LCD panel line formats that were previously available only via the “*Organ settings*” menu, are now also available via the “*General settings*” menu, to avoid the need for you to configure LCD panels separately for each organ unless you specifically want to customize them on a per-organ basis. (The only exceptions are the “*Organ expression pedal/slider/knob ...*” and “*Fixed, user-defined label text*” line formats, which are inherently organ-specific, and so remain per-organ only.)

### Audio engine changes

- There is a new organ preference “*Audio engine | Real-time audio pitch-shifting quality*”. The “*Standard*” option uses the same quality pitch-shifting (interpolation) as previous versions, but there is also a new “*Higher definition*” option. Higher-quality pitch-shifting is more CPU-intensive (and requires slightly more memory), sacrificing achievable polyphony (typically about 50%) for higher audio definition. However, it gives significantly better signal-to-noise ratio (much less distortion, and better clarity), which may be noticeable and is always beneficial, but especially so for larger pitch shifts and deep tremulants. It is recommended if you have sufficient spare computer processing power.

To hear the difference that the setting makes, try playing a single pipe whist raising and lowering the pitch slider on the *Pitch* large control panel. With the “*Standard*” option you may hear some distortion appear as you raise/lower the pitch (even though the pitch change is less than a semitone), which the “*Higher definition*” option avoids. (Some pipes/ranks may show it more clearly than others.)

There is also a new “*Sample rate (for audio engine and audio output)*” setting on the “*General settings | Audio device and channels*” screen, which contains options for 48 kHz (the default), 96 kHz, and “*Use organ's default sample rate*”. The latter gives the same behavior as previous Hauptwerk versions. The new 96 kHz option is more CPU-intensive, sacrificing achievable polyphony (typically about a further 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). (It also has other smaller sonic benefits, even if not raising the pitch.) It is recommended, especially if you raise the base pitch of any organs, provided that you have ample spare computer processing power. The same sample rate will be used for audio output and audio recording, to avoid any further slight distortions that would occur by down-sampling.

To hear the difference that the setting makes to aliasing distortion, try raising an organ's base pitch to 600 Hz and then play a scale on a pure high-pitched rank (such as a flute rank); you will probably hear strange dissonant 'aliasing' tones on some (seemingly arbitrary) high notes without the 96 kHz option. As well as the degree to which the pitch is being raised, how beneficial it is also depends on where the sample set producer has applied an anti-aliasing filter within the samples. Hence, without the 96 kHz option, for some sample sets aliasing might occur even with smaller pitch increases.

(Real-time per-pipe anti-aliasing filters aren't used in Hauptwerk, since the CPU overheads of doing so would be about as much as simply running the audio engine at 96 kHz, whilst 96 kHz also gives other sonic benefits.)

If you choose both the “*Audio engine | Real-time audio pitch-shifting quality: Higher definition*” organ preference and the “*General settings | Audio device and channels | Sample rate: 96 kHz*” options then achievable polyphony is likely to be about 75% less than Hauptwerk version 5 (but audio quality will be noticeably higher than any previous version).

The first time that you load any given organ in Hauptwerk v6, the Organ Configuration Wizard will run to ask you how you prefer the “*Audio engine | Real-time audio pitch-shifting quality*” preference to be set. (For installations upgraded from a pre-v6 version, the preference will default to its 'standard quality' option, for the same performance as v5, but for new installations higher-quality pitch shifting is selected by default.)

(Please note that if you use the Hauptwerk AU/VST Link for audio output, then you should ensure that your AU/VST host project's sample rate corresponds to whatever value you select via the "*Sample rate (for audio engine and audio output)*" setting on the "*General settings | Audio device and channels*" screen.)

- Other minor sonic and fidelity improvements have been made.

### Other changes

- "*Advanced audio ...*" submenus have been removed from the "*Organ settings*" and "*General settings*" menus, with their items moved up a level. Likewise, the items that were on the "*General settings | Advanced MIDI ...*" menu have been moved up a menu level, and the LCD panel screen on the "*Organ settings | Advanced MIDI ...*" submenu has been moved up a level. (This also ensures that the menus display properly on recent macOS versions within a horizontal screen resolution of 1024 pixels.)
- An organ's cache file is no longer marked for regeneration in the specific circumstance that a license for it is temporarily unavailable (e.g. due to an Internet connection interruption if using iLok Cloud).
- Performance: the performance of background models and pipe key processing have been improved slightly.
- Audio: Hauptwerk has been made compatible with the behavior of the MOTU AVB Windows ASIO driver when changing its sample rate between 96 kHz and lower values.
- Audio: Windows ASIO drivers that change the numbers of channels they present when changing sample rates between 96 kHz and lower values are now handled without the need to re-launch Hauptwerk.
- Audio: the "*Disable interpolation (use fixed-pitch sample play-back)*" organ preference has been removed (now that very high-quality pitch shifting is available, and since the existence of the preference had a slight impact on achievable polyphony even when not ticked). (Sample set developers: the corresponding `_General.AudioEngine.EnablePlayingWithoutInterpolation` organ definition attribute has also been removed.)
- MIDI: the names of all LCD line formats have been clarified (but the text that they display on LCD panels remains unchanged, except for the addition of the 'all pistons next' indicator to the "*Combination system states*" line format, as covered previously.)
- MIDI: previously, if a combination set was longer than 12 characters, it was truncated to 10 characters, with '..' appended, when displayed on LCD panels. Now it is instead simply truncated to 12 characters (thus effectively allowing two extra characters to be used).
- MIDI: to help avoid confusion, the General Configuration Wizard has been changed so that selecting a hardware console type of either "*I don't yet have any MIDI hardware*" or "*I won't be playing Hauptwerk live; only controlling it from a sequencer*" no longer in itself causes any MIDI settings to be reset. Also, if one of those options is selected then the MIDI ports wizard page(s) are still shown.
- MIDI: the '*General settings | MIDI ports*' screen and General Configuration Wizard are now also resizable on macOS (as they were previously on Windows), so that they can be made larger if desired, especially for users with many MIDI ports.
- Sample set developers: exporting to a SQLite database is now much faster (especially on Windows, which previously was slow). Timing is also now logged, for diagnostic purposes.
- A progress indicator is now shown whilst the "*General settings | Audio device and channels*" screen is being opened, since it could take a few seconds to appear.

- Diagnostics: brief summary results of each MIDI auto-detection event are now always logged, even if the advanced general preference to log MIDI is not ticked (whereas previously they were only logged if the preference was ticked). Also/likewise, summary auto-detection results are logged when auto-detecting MIDI to ranks directly (previously they were never logged, irrespective of the preference).
- Diagnostics: if an error occurs while attempting to add a file to a backup, more comprehensive details are now logged.
- Diagnostics: messages are logged to indicate when settings screens have been OKd after settings have been changed on them. (The exception is the MIDI ports screen, since any changes made there will be evident from other log entries.)

### Bug fixes

- The pitches at which harmonic-shaping filters were being applied weren't taking into account any non-default user-specified base-pitch adjustments, or other user-specified tuning (overall, or per-pipe) adjustments (since v4.0.0). Please note that if you had adjusted an organ's tuning significantly from its default then this may slightly affect overall sound (compared to v4-v5), perhaps making some voicing tweaks (e.g. to pipes' 'brightness') desirable to compensate.
- Cancelling the "*Do you want to save your current combinations?*" prompt would cause the background models (wind, tremulants, etc.) to hang (since v4.0.0).
- Bug-fix: if an impulse response reverb file was invalid due to its sample rate being incorrect then the error message (ERR:2492) that Hauptwerk (correctly) logged could fail to report the required rate correctly (since v5.0.0).
- The presence of an invalid zero-length source file (e.g. a configuration, combination, or database file) would prevent a backup from created (since v3).
- If an error occurred when trying to add a file to a backup, the error message (ERR:0055) could fail to show to show the backup filename.
- Some spurious progress indicators that would normally be open behind other user screens/prompts have been removed, since they caused problems on a few computers/platforms whereby occasionally they could somehow end up in front of the window awaiting user interaction.
- Combination elements for which the sample set creator didn't specify memory switches, and didn't designate their combinations as allowing capture, would incorrectly always default their initial states to disengaged, even when their default states were specified as being engaged (since v4.0.0).
- Custom Organ Design Module (CODM): since v5.0.0, across the compass of any given rank, the virtual pipe diameters (and thus normal flow rates) were unintentionally being compiled to slightly different values compared to Hauptwerk v4. They were still valid, and this would have had no adverse effects for the user of the compiled custom organ definition, but the CODM has been changed to compiled them to the same values that v4 would, for consistency.
- Sample set developers: certain values in an organ definition that were invalid due to violating a unique key could fail to be reported in an (unusual) circumstance when loading the organ via "*Design tools | Load organ with design options*" (since v2).

## Changes in version 5.0.1 above version 5.0.0

- Compatibility: the proportion of RAM that Hauptwerk v5.0.0 asked Windows to allow it to use resulted in stability problems on a few Windows 10 PCs. The amount of RAM that Hauptwerk always avoids using has also been increased a little, to reserve a little more for the operating system, drivers, background processes, etc.
- Bug-fix: Hauptwerk could freeze if the demand for instantaneous polyphony exceeded the number of free voice generators (i.e. if the polyphony demand would completely overload the polyphony limit setting).
- Bug-fix: Hauptwerk could crash when starting audio/MIDI with certain sample sets if the Hauptwerk AU/VST Link was selected for audio (but not MIDI) output.
- Bug-fix: Hauptwerk would freeze if stopping audio recording if the 'prompt for filename' option was ticked and the 'record MIDI' option was not ticked.
- Bug-fix: a click could be audible with certain pipes when cross-fading to release samples (especially if the harmonic-shaping/brightness filters were turned up significantly).
- Bug-fix: a crash occurred on a few computers when exiting Hauptwerk after successfully performing any of the following: restoring a backup, reverting all settings to factory defaults, cancelling launching Hauptwerk if any audio/MIDI devices were missing, or via 'Exit', 'Shut computer down' or 'Re-start computer' from the File menu.
- Memory usage for the Advanced Edition's audio mixer/routing has been significantly reduced, compared to v5.0.0. (However, when audio/MIDI is active, v5 does still need to use a bit more memory than v4 for its voice generators, which are 8-channel surround-capable in v5 whereas v4's were stereo.)
- Compatibility: since a few PCs have performance/stability issues if running Hauptwerk at real-time priority, the '*Try to run Hauptwerk at real-time priority on Windows*' advanced general preference now defaults to un-ticked. (However, running at real-time priority does give more reliable and better audio/MIDI performance on most PCs.)
- Compatibility: very large values in organ definitions for inertia linkages' acceleration/damping that yielded numeric overflows were being handled differently in v5.0.0 compared to v4, resulting in Inspired Acoustics' native combination steppers not working. Inertia linkages have now been changed to yield the same results in such circumstances, for compatibility with those sample sets.
- Platforms: macOS 10.15 is now listed as supported. However, please note that there are currently some known minor compatibility issues, which are listed in the '*Known issues*' section in this release notice.
- Bug-fix: a crash (or menu action being ignored) was possible with a particular (unusual) combination of settings when stopping audio.
- Bug-fix: a crash was occasionally possible (since v3) if clicking the OK button multiple times on a settings screen immediately after changing a drop-down setting that enabled/disabled other settings on the screen (as the v5 '*General settings | Audio device and channels*' screen's audio device setting does if changing between two devices of different driver types).
- Bug-fix: any pipes' perspectives routed to empty audio mixer bus groups would incorrectly sound through audio mixer primary bus 1.
- If audio settings have been migrated from Hauptwerk v4, newly-installed organs' ranks are now routed by default to the migrated v4 default audio mixer bus group (provided that the group is still non-empty).
- To help avoid confusion, when the General Configuration Wizard runs automatically upon first launch after upgrading from a pre-v5 version, the (recommended) options to discard/reset migrated Hauptwerk v4 audio settings/routing are no longer ticked by default if you previously had more than one audio output group configured in your previous Hauptwerk version. Likewise for the option to reset (migrated)

rank routing when the Organ Configuration Wizard runs automatically when first loading each organ after upgrading from a pre-v5 version. Also, the 'enable MIDI output' option on the General Configuration Wizard now defaults to 'yes' if any MIDI OUT ports were previously enabled for console MIDI output. Also, the '*Assorted MIDI or USB music keyboards/synths*' MIDI hardware console type has been changed to allow MIDI output (so that it behaves in the same way as the '*DIY/home-made or modified MIDI console*' console type). Also, a note has been added to the General Configuration Wizard to emphasize that saying 'no' when asked whether to enable MIDI output will clear MIDI settings for any virtual controls for which MIDI output is already configured.

- For convenience (and consistency with Hauptwerk v4), the '*All perspectives: overall amplitude (dB)*' adjustment is now selected by default on the '*Organ settings | Rank voicing ...*' screen.
- For convenience, when loading a newly-installed organ for the first time, if the default audio mixer bus group (group 5: 'Front 1/main', with default settings) has since been emptied by the user, then output perspective 1 of each of the organ's ranks is now routed by default to the first non-empty group (excluding groups 2-4, which are used for surround/3D audio with default settings).
- The default for the '*Extra time to allow when starting audio on Windows if not running at real-time priority*' advanced general preference has been reduced from 7 seconds to 3. (As with v5.0.0, you can still set the setting to 0, for no delay, if you prefer.)
- The '*Console Windows Size*' mini control panel is now positioned at the bottom (instead of the top) of the main window when no organ is loaded (as it was in Hauptwerk v4), to keep the width of main window less than 1024 on macOS, especially for compatibility with portrait-orientation 1920x1080 touch-screens.
- The maximum MIDI note for bass splits on the Rank Routing to Audio Mixer Primary Bus Groups screen increased from 60 to 84.
- An 'x' close-window button has been added to the title bars of the two voicing screens on Windows (in addition to the existing 'Close' button, and keyboard shortcuts for closing the window), for consistency with macOS and Hauptwerk v4.
- Whilst an organ is loading, triggering any of the functions via MIDI to change/select the cued favorite organ, select a recent organ, or change/select the cued favorite object (of all types), now cancels the organ loading (as was technically possible in v4).
- Bug-fix: organs that specified original organ pitches outside of the range 380-500 Hz (as with Piotr Grabowski's recent Erfurt sample set) would sometimes give a confusing error message (since v4.0.0). The range of the user 'Base pitch Hz' setting has now been expanded to 300-600 Hz (the same as the allowed range for the corresponding organ definition original organ pitch attribute) to avoid that.
- Bug-fix: switching off an organ's virtual blower switch (if available) could result in played pipes continuing to be audible after the wind pressure had fallen to zero.
- Diagnostics: a more-detailed error message is now reported if an operation fails due to the active connection to iLok Cloud or an iLok dongle having been lost.
- Diagnostics: memory usage statistics are logged whenever stopping audio/MIDI or creating a diagnostic file. Additional memory statistics are also logged on Windows.
- The installation/upgrade instructions sections in the user guide have been expanded.
- Compatibility: for Macs, by default, Hauptwerk's installer is now provided for download within a .ZIP file (instead of a .DMG file), to try to make it easier for those wishing to try using Hauptwerk on older macOS versions that are less than the minimum officially supported version of macOS 10.13.6. (Please note that Hauptwerk version 5 will definitely not work on OS X version 10.10 or earlier.)
- The set of Hauptwerk licensing packages (current at the time that the Hauptwerk version was built) are now installed included within, and automatically installed by, Hauptwerk's installer, to try to maximize the

## Hauptwerk 6.0.0 Release Notice

chances of Hauptwerk being able to load any given licensed sample set for people who accidentally omit the step in the installation instructions to install them. (However, it's still important to follow that installation instruction step, since additional packages for new sample sets may have been released since this version of Hauptwerk was built.)

- Various other minor changes and fixes.

## Changes in version 5.0.0 above version 4.2.1

(Please note: where menu names have changed for subsequent v6+ versions, the new v6+ menu names are shown in the following.)

### Advanced Edition only: audio routing, multiple audio output perspectives, and associated voicing changes

Hauptwerk's audio routing, and associated settings screens, have been re-designed from the ground up to be massively more powerful and convenient to use.

(With the exception of changing the main audio driver itself, or its settings):

- All audio/routing settings changes can be made fully in real-time without re-starting audio/MIDI.
- Audio/routing settings changes take effect and can be heard immediately.
- Audio/routing screens show real-time visual feedback so that it's easy to see what's being routed where as you play or change settings.
- The audio/routing settings screens can be open and used simultaneously, so that you can immediately see how changes made on one screen affect any other.
- Audio/routing screens allow multi-selection, so that you can change the settings quickly for multiple objects at once.

Also:

- (As covered separately in the next section) very high-performance impulse response reverb can be applied natively within Hauptwerk, without any third-party software or hardware needed.
- **Hauptwerk's default audio routing settings are pre-configured so that surround/3D-sound, adding overall reverbs, sub-woofer mixes, and stereo recording mixes require just a very few clicks to configure, with no need to use or understand Hauptwerk's underlying multi-channel audio functionality or associated screens. For any of these purposes, make sure you reset your audio routing settings when prompted when you first run Hauptwerk v5, then simply follow the instructions on the 'General settings | Audio mixer' screen to select the appropriate device channels for the relevant 'master mix' buses (and optionally to select reverbs for them), and (for surround/3D-sound) then use the 'Organ settings | Voicing and surround/3D/perspective panning' screen's 'Perspective mix: ...' adjustments to pan ranks to your surround/3D speaker pairs.**
- You can optionally configure up to 8 independent 'mixer presets' (complete sets of global audio routing and impulse response reverb settings) and apply different ones to different organs (via the 'Organ settings | Organ preferences' screen).
- 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 new 'View | Large ... control panels (for this organ) | Audio ... settings' control panel. This provides a very simple and quick means to tweak reverb wetness, and/or disable reverb, on a per-organ basis.
- Virtual pipe ranks can be panned in real-time amongst the stereo pairs within surround/3D speaker setups, and voiced separately for those pairs.
- (As covered separately in the voicing section) the rank voicing screen now allows multiple ranks to be voiced/routed/panned simultaneously.
- It's now possible even for very complex audio routing to be configured quickly, in real-time, and much more easily.

- Changing an audio routing setting will never now cause an organ to re-load, or for its data cache to be regenerated.

In order to take best advantage of Hauptwerk v5's capabilities, we strongly recommend resetting your audio configuration when prompted when first launching v5, and then adjusting/configuring it as desired (although any existing v2/v3/v4 audio settings will be migrated where possible if you don't choose that reset option). If you do wish to migrate your v2/v3/v4 audio settings then please make sure that your audio interface is connected and turned on before launching v5 for the first time, so that its channels can be queried as needed for the migration. The '*General settings | General configuration wizard*' and '*Organ settings | Organ configuration wizard*' functions may also be used to reset audio routing back to defaults.

The audio device/driver is now selected via the new '*General settings | Audio device and channels*' screen. The screen optionally allows you to rename or remap channels, and has a new option for additional internal audio buffering, which might help on some PCs prone to audio glitches. Only a single device/driver can now be in use (which is necessary to ensure audio synchronization), but Windows ASIO devices and Mac CoreAudio devices with up to 1024 channels are now supported (although only the first 128 allow renaming/remapping on the '*General settings | Audio device and channels*' screen). (Windows DirectSound drivers aren't recommended, since they don't usually perform as well, and they only allow a single pair of channels in Hauptwerk.) [\*]

By default, audio routing settings are configured with appropriate mixer buses and groups for basic stereo output, as well as for 2D-surround (front and back stereo pairs of speakers) and for 3D-surround output (front/back upper/lower stereo pairs), and for multi-channel output with four pairs of speakers in the single (main) group, so that everything is defaulted appropriately for basic stereo output, and simultaneously also for surround output, and simultaneously also for four-stereo-pair multi-channel output. This makes it extremely quick and easy to configure Hauptwerk for those purposes, as well as for applying overall impulse response reverbs, avoiding any need to use or understand most of Hauptwerk's routing or multi-channel audio screens or settings.

There are eight independent and complete sets of mixer/group settings for the '*General settings | Audio mixer*' and (for multi-channel audio) '*General settings | Audio mixer bus groups*' screens. These independent sets of settings are termed 'mixer presets', and can be found and configured via the left-hand browse lists on those screens. You can select which of the eight mixer presets should apply to each individual organ via the '*Organ settings | Organ preferences | Audio mixer preset*' screen tab. 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). [Unlike Hauptwerk v4, it is no longer necessary to use the '*Hauptwerk (alt config N)*' desktop shortcuts for that purpose.]

As always, the on-screen help on each of the new screens provides more detailed information and hints. For convenience, there's also a new '*Audio Mixer, Routing and Voicing/Panning Settings*' large control panel (available via the View menu) for opening the relevant screens, as well as convenience buttons on the relevant screens themselves to show the others that relate to them. As mentioned above, the new control panel also allows you to adjust (scale) the 'wetness' of any impulse response reverbs that you might have applied on the mixer overall, on a per-organ basis. This provides a very simple and quick means to tweak reverb wetness, and/or disable reverb, on a per-organ basis.

**Please consult the '*Audio routing and impulse response reverb*' sections in the main Hauptwerk user guide (on the Help menu in Hauptwerk) for full details about Hauptwerk's new audio routing capabilities and how to use them, including step-by-step tutorials for the most common modes of use (including 2D/3D surround, multi-channel audio, etc.).**

The remainder of this section describes in detail the changes relating to multi-channel audio (whereby ranks are distributed automatically or manually amongst multiple speakers for purposes other than surround/3D-sound). **You can skip all of the following unless you plan to use multi-channel audio specifically:**

Central to the new design are the new '*General settings | Audio mixer ...*' screen (which replaces Hauptwerk version 4's '*General settings | Audio outputs*' screen), and the new '*General settings | Audio mixer bus groups ...*' screen (which replaces Hauptwerk v4's '*General settings | Audio output groups*' screen).

(Similar to Hauptwerk v4), the core underlying concept is that virtual pipe ranks are routed via groups to primary mixer buses, and that mixer buses may output audio to audio device channels and/or to other 'mix buses' (akin to aux sends routing to aux buses on a mixing desk). Ranks are now routed to groups using the new '*Organ settings | Rank routing ...*' screen (whereas in v4 the '*Organ | Load organ, adjusting rank ...*' screen needed to be used prior to loading an organ). The screen can usually also be reached by right-clicking on the desired stop on the virtual console.

It's now also possible optionally to route any given pipe rank to up to four different groups simultaneously using the four new 'output perspectives' on the (renamed) '*Organ settings | Rank voicing and surround/3D/perspective panning*' screen, and the corresponding 'output perspective' settings on the '*Organ settings | Rank routing ...*' screen. The new '*Perspective mix: source ... to output ... 1-4 ...*' voicing 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. 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 the your listening room, optionally also voicing it differently for the various speaker pairs. (Alternatively, for example, you could use one of the perspectives for a rear 'reverb' mix, adjusting the levels and voicing sent to it independently for each rank.) For surround/3D sound use it is thus no longer necessary to route ranks manually to separate groups – instead (with the default audio routing settings) you simply pan each virtual rank as appropriate via the voicing/panning screen.

(For each mixer preset) the audio mixer has a fixed number of 1024 'primary buses' (to which ranks can be routed, via groups), 8 'intermediate mix buses', and 8 'master mix buses'. It allows primary buses optionally to be routed to any or all of the mix buses (of either type), and the 'intermediate mix buses' optionally to be routed to any or all of the 'master mix buses'. For example, you might route some ranks to a group of several stereo speaker pairs, whilst simultaneously sending the audio from all of those pairs' primary buses to a mix bus used for adding reverb.

All mixer buses are stereo, but you can still choose to load ranks in mono (via the '*Organ | Load organ, adjusting rank audio memory options*' screen). You can also output any or all buses to any stereo pair of audio device channels (speaker pairs), or to mono device channels (speakers). Hauptwerk's built-in audio recorder can also record any or all mixer buses (in stereo).

It's now possible for any primary mixer bus to be a member of more than one bus group, and to include any given bus in multiple groups, and any given audio device channel may be used for any number of mixer buses.

As with Hauptwerk v4, when a rank is routed to a group that contains more than one bus, a 'bus allocation algorithm' is used to define how individual pipes in the rank get routed to the individual mixer buses within the group. However, unlike v4, the algorithms can now be specified at the per-rank level (instead of the per-group level), via the new '*Organ settings | Rank routing ...*' screen, thus allowing different algorithms to be used for different organs and/or ranks when routing to any given group, if so desired.

There are also a number of new algorithms, including 'dynamic' ones, which allocate pipes to mixer buses in a group on a per-key-press basis, such that any given pipe is allowed to move around within the group for subsequent key presses. (Dynamic algorithms might not strictly be realistic acoustically, but they do potentially allow more even load balancing for any given number of speakers.) It's also now possible to specify algorithm note offsets manually, so that (for non-dynamic algorithms) you have full control over which pipe in a rank will end up being allocated to which specific mixer bus/speaker, whereas previously that was usually determined by the creator of the organ (sample set) being used. As with Hauptwerk v4, the lower/bass part of any given rank may optionally be routed differently from its upper/main part.

To help familiarize yourself with the way the new multi-channel audio routing works, with an organ loaded, we recommend opening all of the following screens at the same time:

1. 'Organ settings | Rank voicing and surround/3D/perspective panning'.
2. 'Organ settings | Rank routing ...'.
3. 'General settings | Audio mixer bus groups ...'.
4. 'General settings | Audio mixer ...'.

Conceptually, a pipe/rank's audio flows through all of those screens in the order above, i.e.:

**Rank voicing/panning -> Rank routing to audio mixer bus groups -> Audio mixer bus groups -> Audio mixer**

(... and 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. (Please note that the activity LEDs on the 'Organ settings | Rank routing ...' and 'General settings | Audio mixer bus groups ...' screens only flash momentarily as you press each key, whereas those on the 'General settings | Audio mixer ...' remain lit whilst a bus is receiving any audio signal.)

*[Please note that when loading any given organ for the first time in Hauptwerk v5, the organ's internal data cache will need to be (re-)generated, which might be slow, but subsequently the organ should load faster.]*

*[\* Please also note that technically Hauptwerk v5's audio configuration also has the following limitations compared to v4: a maximum of 16 total mixer 'mix' buses (the equivalents of v4's aux mix-down outputs) is allowed, and the left and right device channels selected for any given mixer bus (v4 audio output) when stereo should usually be consecutive (although if you really want to use non-consecutive channels then channel orders can be remapped manually via the 'General settings | Audio device and channels' screen).]*

#### **Advanced Edition only: native impulse response convolution reverb**

Hauptwerk now 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.

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 that support AVX CPU instruction sets), thus allowing realistic 'virtual acoustics' optionally to be configured (with many virtual sound sources to distribute pipes/ranks within virtual space). In fact, for small organs, and with a powerful computer, even per-pipe convolution (with a separate impulse response applied for each pipe's mixer bus individually) should be possible. In itself, Hauptwerk's reverb engine adds no additional latency (sound delay).

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 ...' within Hauptwerk. They need to be in Hauptwerk format, and we anticipate that plenty of reverbs will be available from sample set developers and others over time. (Sample set/reverb developers: please use the new '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. For example, for basic use, you could just apply a single reverb to Hauptwerk's overall stereo output via an appropriate 'master mix bus', or for more complex use you could apply different reverbs to individual mixer buses.

Reverb wet/dry mix, wet level, and wet pre-delay may all be adjusted via the mixer screen. An impulse response reverb may also optionally be faded out (truncated), to help reduce CPU load and/or to help make it seem 'drier'.

As mentioned in the previous section, 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 new '*View | Large ... control panels (for this organ) | Audio ... settings*' control panel. This provides a very simple and quick means to tweak reverb wetness, and/or disable reverb, on a per-organ basis. 'Mixer presets' can also be used to set up different reverbs for different organs.

### Licensing changes

- Hauptwerk is now licensed via the PACE iLok system (instead of the 'Hauptwerk USB key' HASP dongle that was used for v4).
- To use or evaluate Hauptwerk, you need to have/create an account on <https://www.ilok.com/>, and to have installed the current version of iLok License Manager, which may be downloaded there. 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. 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.
- You are able to 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).
- There is a new edition of Hauptwerk, named the Hauptwerk Lite Edition, which is available on a subscription basis (only). It supersedes the previous Hauptwerk v4 Basic Edition, and has the same functional limitations that the v4 Basic Edition had (compared to the v4 Advanced Edition), except that:
  - It places no limit on the amount of memory an organ is allowed to use (instead of v4's 3 GB). (Polyphony remains limited to 1024, as for the v4 Basic Edition.)
  - The Hauptwerk AU/VST Link (and AU/VST support) is not available.
  - No technical support is available for the Custom Organ Design Module (although the module may still be used within it).
- The Basic and Free editions of Hauptwerk are no longer available.
- Yearly subscription licenses (which will work for all versions from 5 onwards) are available for the Hauptwerk Advanced Edition, and for the Hauptwerk Lite Edition, and perpetual Hauptwerk v5-specific licenses are available for the Advanced Edition (only). Any type of license (Advanced or Lite, subscription or 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 each year, 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.
- The Public Installation License has been discontinued, and any v5 license type (Advanced or Lite, perpetual or subscription) may now be used/installed in public installations, without additional licensing requirements.
- The new audio routing and impulse response convolution reverb functionality is available in the Advanced Edition only. In the Lite Edition, only a single stereo audio output is supported, as for v4.

- Technical support is now available from Milan Digital Audio via Hauptwerk Technical Support Incidents raised via our website support ticket only. If your Hauptwerk v5 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 v5-specific 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).
- If upgrading Hauptwerk from v2-4, then please note that the previous 'Hauptwerk USB key' HASP dongle that was used for v2-4 cannot be used for licensing this version of Hauptwerk, or for licensing sample sets.
- If upgrading Hauptwerk from v2-4, then please note that 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). **Important:** 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 before you use the menu function to migrate your pre-v5 sample set licenses.
- Before subsequently installing any new copy-protected iLok-licensed sample set (or impulse response reverb set), you should download the current 'Hauptwerk licensing packages' Hauptwerk component package file from Milan Digital Audio: <https://www.hauptwerk.com/licensingpackages>. Use *'File | Install ...'* in Hauptwerk to install it. [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.]
- Hauptwerk v5 may be evaluated only once (for any given iLok account), and evaluation is limited to 14 days. During that period Hauptwerk will have the full functionality of the Advanced Edition (without any periodic triangle chime, audio muting, or any other functional limitation).
- 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.

- For further details about the new iLok-based licensing system, please see the following section in the main Hauptwerk user guide (on our website (or on the Help menu in this version of Hauptwerk):
  - *Licensing, editions, and technical support.*
  - *Hauptwerk prerequisites.*
  - *Installing/un-installing/upgrading organs, temperaments, or reverbs (the component installer).*

#### Advanced Edition only: other new rank voicing adjustment functionality

On the (renamed) '*Organ settings | Rank voicing and surround/3D/perspective panning*' screen you may now select multiple ranks/layers at once to adjust their settings simultaneously. The bank of sliders controls will then show the value of that adjustment parameter for each note in the (primary) selected rank whose name is shown above the bank of 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. 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).

The voicing screen also now has settings to allow the stereo balance of most modulations/filters to be adjusted. For example, you might make a modeled tremulant or swell box modulate the amplitude of a rank more strongly in the right-hand channel, whilst making it affect its harmonic content more strongly in the left-hand, thus giving a dynamic stereo effect. These new stereo-balance voicing adjustments also allow values beyond +/- 100 percent, with such values inverting the polarity of modulations. Most other modulation depth adjustments also now allow negative values, for polarity inversion.

The voicing screen also allows real-time, per-output-perspective (for surround/3D-sound), release tail truncation (in addition to the existing 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 seem 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.)

#### Performance and audio realism

- Performance (polyphony that can potentially be achieved, subject to the polyphony limit of the Hauptwerk edition) on a given computer should be a little better in general, and significantly so with stereo or surround sample sets. (Please note the standard polyphony testing organs are mono, but stereo organs should now achieve very nearly the same levels of performance as mono organs.)
- Additionally, performance on a given computer should be significantly better on CPUs that support the AVX, AVX-2, or AVX-512 instruction sets (such as most mid/higher-end CPUs made since about 2011).
- There should no longer be a significant difference in polyphony from loading ranks with memory compression enabled.
- Hauptwerk's background models (modeled tremulants, relay, and the Advanced Edition's wind supply model) should be smoother, improving overall quality and realism.
- Playing with multiple stops drawn should sound a little more realistic.
- PCs: organs should unload much faster on recent Windows 10 versions if Windows' page file is completely disabled (as a work-around to a performance bug relating to locked memory in recent Windows 10 updates, which Microsoft is aware of and aims to address properly in the longer-term).

- Hauptwerk should be a bit more resilient to audio glitches and CPU load spikes on Windows in general (although the PC still needs to be working well enough to handle real-time low-latency audio in general, as reported by utilities such as Resplendence Software's LatencyMon).

### Platform support and prerequisites changes

- Macs: Hauptwerk fully supports, and is now only officially supported on, macOS 'Mojave' 10.14 and macOS 'High Sierra' 10.13.6 and later. (It might possibly still work on OS X 10.12 or 10.11, but we don't test or officially support them. It definitely won't work on 10.10 or earlier.)
- PCs: Hauptwerk fully supports current/recent 64-bit versions of Windows 10, and is now only officially supported on 64-bit Windows 10 and 64-bit Windows 7. (It might possibly still work on some other 64-bit pre-Windows 10 versions of Windows, but we don't test or officially support them. It definitely won't work on 32-bit versions of Windows, or on 32-bit PCs.)
- Basic support has been added for automatic screen scaling for 'high-DPI' screens, such as Mac 'Retina' and similar laptops. (Hauptwerk's screens should now scale automatically on high-DPI screens.)
- 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.
- A CPU that supports at least the SSE2 instruction set is still required (as for Hauptwerk v4), but in order to make best use of the new functionality in the Advanced Edition we strongly recommend a CPU with AVX, AVX2, or Intel AVX-512 (such as a recent Intel i9 or modern i7 processor made since about 2011).
- 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.
- The Hauptwerk AU/VST Link (Advanced Edition only) is supported with current versions of Cubase (10.x), Logic Pro X (10.4.x), Reaper (5.9x), and Garage Band (10.3.x).
- The amount of RAM a given sample set needs might be slightly different (in some cases higher, in others lower), compared to Hauptwerk version 4.
- To use or evaluate Hauptwerk, you need to have/create an account on <https://www.ilok.com/>, and to have installed the current version of iLok License Manager (which may be downloaded from there) on your Hauptwerk computer.
- If you wish to license Hauptwerk via a dongle (as opposed to via iLok Cloud) then you will need to have/buy an iLok3 (or iLok2) dongle, and have a spare USB port to which to attach it. Alternatively, if you wish to use iLok Cloud for licensing, then your Hauptwerk computer will need a reliable always-on Internet connection. Please see also the [Licensing changes](#) section above for further details.

### Novation Launchpad 'mark 2' model support

Hauptwerk now has native support for the Novation Launchpad 'mark 2' model (whilst remaining compatible with the original 'mark 1'). Novation Launchpads are popular and cost-effective means for controlling Hauptwerk's virtual stops and pistons, allowing stop states to be seen by way of the assigned Launchpad buttons' internal lamps.

(As for Hauptwerk version 4), to use a Launchpad with Hauptwerk, please ensure that the Launchpad is connected to the computer before launching Hauptwerk, then ensure that it's enabled in the left-hand '*Console MIDI ...*' columns on both of the '*MIDI IN ports*' and the '*MIDI OUT ports*' tabs of the '*General settings | MIDI ports*' screen. Then, with your organ loaded, use standard right-click auto-detection to assign the Launchpad's buttons as desired to virtual stops/pistons/switches. You should see an option on the auto-detection screen allowing you to select the desired behavior for the Launchpad button's internal lamp.

### Changes for the Custom Organ Design Module ('CODM')

- Hauptwerk now has native functionality (on the '*Design tools*' menu) to export/import CODM organ definitions to/from SQLite databases, for easier manipulation of their data via the power of the SQL language. Please see the CODM user's guide (also via the '*Design tools*' menu) for details.
- The CODM organ definition format documentation is now available in HTML format via a new '*View / Custom Organ Design Module ... format documentation*' menu function (instead of within the CODM's main user guide). Changes to the CODM organ definition format in each Hauptwerk version are now documented via this new menu function, and may be found by searching the resulting HTML document for '*HWvx.x.x*' (or appropriate sub-strings, where each 'x' represents a numerical version digit). Please search the document for '*HWv5.0.0*' to see the full list of changes for v5.0.0 (although, there are no major changes to the CODM organ definition format itself in this version).
- The CODM's user guide has been converted to portrait format, and is now available via the '*Design tools*' menu (instead of the Help menu).
- The maximum font size allowed within CODM organ definitions has been increased, to allow for 'high-DPI' ('Retina') displays.
- There is a new option on the '*Design tools | Load organ ...*' screen to reset user rank routing options.
- No technical support will be available for the Custom Organ Design Module for the Basic and Free editions (although the module may still be used in them).
- Bug-fix: percussive disengaging key action noises for divisions wouldn't work properly unless the *PercussiveEngagingKeyActionNoise\_ChooseMIDINoteNumRandomly* CODM organ definition attribute was Y (since Hauptwerk v4.0.0).
- Bug-fix: the CODM example St. Anne's Moseley organ definitions had too much 'wind supply wobble' (since v3.0.0).

### Changes for sample set developers

- Hauptwerk now has native functionality (on the '*Design tools*' menu) to export/import 'full-format' organ definitions to/from SQLite databases, for easier manipulation of their data via the power of the SQL language. **[\*\*]**
- The organ 'full-format' definition format is now documented in HTML format via a new menu function on the '*Design tools*' menu. Changes to the organ definition format in each Hauptwerk version are now documented via this new menu function, and may be found by searching the resulting HTML document for '*HWvx.x.x*' (or appropriate sub-strings, where each 'x' represents a numerical version digit). Please search the document for '*HWv5.0.0*' to see the full list of changes for v5.0.0. **[\*\*]**
- The organ definition format now allows pipe modulations with inverted polarity, and for modulation depths to be adjusted within the stereo field, in accord with the corresponding voicing adjustments. (Please see the format documentation for details.)

- Native component installer support has been added for multi-part archives in WinRAR v5's default (v5) archive format. To create multi-part RARs, please now select the default 'RAR' (not 'RAR4') archive format in WinRAR, specify the desired volume size, do *not* select the 'Old style volume names' option, let WinRAR generate the files, then rename them to '... .part1.CompPkg\_Hauptwerk\_rar', ..., '... .partN..CompPkg\_Hauptwerk\_rar'.
- The maximum font size allowed within organ definitions has been increased, to allow for 'high-DPI' ('Retina') displays.
- The minimum output sample rate is now 44.1 kHz.
- It is no longer necessary for a dummy wind compartment linkage to exist if the organ doesn't use the wind supply model.
- There is a new option on the '*Design tools / Load organ ...*' screen to reset user rank routing options.
- The previous general preference to disable auto-compacting of organ settings has been renamed to clarify that it only does so for voicing data.
- There is a new '*Design tools / Generate a new ... UUID*' screen (which is currently relevant only for packaging impulse response reverbs).
- The maximum number of allowed console display tabs has been increased to 32.
- Bug-fix: *ThreePositionSwitchImage* organ definition objects weren't been working properly (since v2.0.0).
- Specifying an invalid value of 0 for *WindCompartmentLinkage.MassFlowRateKilogramsPerSecAtReferencePressureDiff* in an organ definition file would be accepted by Hauptwerk (causing it to be rounded it to the nearest valid value of 1e-32), but rejected by SQLite if exporting to a database. 1e-32 is now used as a default for the attribute for compatibility to allow such organ definition files to continue to load, and to export without error.
- **Important:** since v5+ cannot load copy-protected sample sets for pre-v5 versions, it is imperative that all pre-v5 protected sample sets should be re-protected for v5+, and made available for download to their end-users (and/or publicly), as a matter of the highest possible priority. If you are a sample set developer who uses Hauptwerk's sample set copy-protection system, then please contact us privately for the necessary details (if we haven't contacted you already).

[\*\*] Please see the current version of the *Creating Sample Sets for Hauptwerk guide* for details. The guide, and the relevant '*Design tools*' menu functions, are made available to licensed *Advanced Edition* users upon request.

### Other changes

- The bit-depth used by Hauptwerk's built-in audio recorder is now set via the '*General settings / General preferences*' screen, and defaults to 32-bit floating-point format (which default audio players on current operating systems should be able to play).
- The '*Sequencer MIDI IN/OUT*' ports have been renamed to '*Hauptwerk MIDI recorder/player external MIDI IN/OUT*' ports, to help to avoid confusion. The menu function that shows their documentation is now named '*Recording / View Hauptwerk MIDI recorder/player fixed, predefined MIDI implementation (for this organ)*'. Also, the MIDI sequencing and MIDI recorder/player MIDI implementation reference sections in the main Hauptwerk user guide have been reworked to make it clearer which sub-sections would be appropriate for most MIDI sequencer/DAW users.
- Changing the '*Reduce relay/MIDI/tremulant/model response/accuracy/quality for max polyphony*' organ preference no longer requires an organ to re-load.
- Changing any of the following no longer requires held notes to be re-triggered: voicing amplitude levels, voicing pans, and audio level trim.

- There is a new 'Clock' mini control panel (accessible via the View menu) that shows the computer's current time, particularly for the benefit of those who use Hauptwerk in full-screen mode. (Hauptwerk doesn't transmit that time via MIDI output, in order to avoid excessive MIDI traffic.)
- Macs: the Hauptwerk AU/VST Link (Advanced Edition only) Mac Audio Unit plug-in now provides 16 stereo outputs (rather than a single 32-channel output), for better multi-channel audio compatibility with Logic and Reaper. In order that Logic detects the changed configuration after upgrading: close any Logic projects, then use '*Logic Pro X | Preferences | Plug-in Manager*', highlight the Milan Digital Audio '*Hauptwerk AU Link*' plug-in, and click the '*Reset and Rescan Selection*' button. Logic should report '*AU validation succeeded*'.
- Installer: to help avoid issues with file/folder permissions, by default for new installation the Hauptwerk installer now installs its data files into a *Hauptwerk* folder within your computer account's home folder (instead of at the top level of your computer's main drive). As before, the 'Custom' option in the installer allows those default locations to be changed (but please do ensure that your computer account is allowed to write to any folders you may select). When upgrading, your existing installation locations will be used.
- Installer: for best compatibility with recent macOS versions, on Macs (only), the installer no longer requires you to enter your computer account's password, and will no longer run with administrator privileges (so please do ensure that your computer account is allowed to write to any folders you may select). Also, the Hauptwerk AU/VST Link plug-ins are now installed within your computer account's private plug-ins library (the */Library/Audio/Plug-ins* within your computer account's home folder, as opposed to the system-wide one, */Library/Audio/Plug-ins*). IMPORTANT: If upgrading from version 4 or earlier, please note that plug-ins from the earlier version won't be removed by this version's installer, so please make sure you use the current plug-in versions (if applicable).
- Installer: on macOS Apple's Java for OS X (Java 6 run-time) is no longer required. (Hauptwerk's installer instead now installs its own private installation of the Java 8 run-time, which is needed and used only by the installer and un-installer.) Please note that on some Macs a spurious 'HauptwerkJavaRuntime' entry might appear in macOS' Launchpad application, which should be ignored.
- For Windows ASIO and Mac Core Audio drivers, and for the Hauptwerk AU/VST Plug-in Link, audio buffer sizes of 128 sample frames (about 2.7 ms of latency at 48 kHz), 2048 frames, and 4096 frames, are all now supported (whereas previously the smallest allowed was 256 frames, and the largest 1024).
- For the Hauptwerk AU/VST Plug-in Link, audio buffer sizes must also now 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.
- An organ may no longer be loaded in 14-bit resolution. (16-bit is now the minimum.)
- A new advanced general preference '*Try to run Hauptwerk at real-time priority on Windows*' has been added. On some PCs, running at real-time priority gives the most reliable audio/MIDI performance on Windows. 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.)

- A new advanced general preference '*Extra time to allow when starting audio on Windows if not running at real-time priority*' has been added. On Windows, 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. This 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*' preference ticked) should avoid the issue entirely, and usually gives more stable audio/MIDI overall anyway. (The setting currently has no effect on other platforms.)
- The method used to determine whether sample set data caches need to be regenerated no longer depends upon timestamps (to make it resilient to failing computer clock batteries).
- For users with multiple iLok dongles (or iLok Cloud accounts) each containing valid/active Hauptwerk sample set licenses: swapping dongles/accounts (when Hauptwerk isn't running) no longer causes sample set caches to be regenerated. (However, the dongle/account must still have a valid/active license for any sample set being loaded.)
- Macs: Hauptwerk attempts to prevent macOS putting it to sleep via App Nap (which could potentially cause performance issues and lack of responsiveness to MIDI and dropped USB/MIDI connections).
- Spurious progress indicators now shouldn't normally open behind other windows, which sometimes caused confusion with file browsers that remember their positions in recent operating system versions.
- When auto-detecting switches, any incoming MIDI sys-ex messages that originated from Hauptwerk are now ignored (for compatibility with MIDI hardware that requires a feedback loop).
- If upgrading from Hauptwerk versions 2 or 3 directly, MIDI settings will no longer be migrated. (We strongly recommended resetting all MIDI settings when upgrading to v4 anyway.) Likewise, v2/v3 audio engine preferences and organ preferences are no longer migrated.
- Documentation: tables of contents have been added to generated combination set text listings and MIDI recorder/player MIDI implementation documents.
- The polyphony testing organs now allow filters to be disabled, and allow rank memory options to be accessed/changed (via the usual '*Organ | Load organ, adjusting rank audio memory options*' screen), for performance testing. (Previously all ranks were fixed at 16-bit, uncompressed, single loops.)
- PCs: if necessary, Hauptwerk will wait and re-try briefly for an ASIO audio driver's sample rate to change asynchronously, before logging a warning, for compatibility with the current MOTU AVB ASIO driver.
- The MIDI piston/switch contact de-bouncing function time interval has been increased a little, for better compatibility with some types of MIDI pistons/switches.
- The MIDI console status output system has a new Boolean variable (parameter ID 86) *IsMIDIReady*, and *IsOrganReady* has been renamed to *IsOrganAndAudioAndMIDIReady*. *IsOrganAndAudioAndMIDIReady* and *IsReadyForUserInput* are now always sent first, and all of them now explicitly send 'off' messages when deactivating.
- The MIDI console status output system has a new CC variable (parameter ID 87) *MasterReverbWetnessScalarRawCCVal* (0=0%, 127=100%) for the corresponding control's value on the '*Audio Mixer, Routing and Voicing/Panning Settings*' large control panel.
- Disabling interpolation no longer saves additional CPU overheads, and neither does having no filters at all enabled (compared to having one filter enabled).

- PCs: support has been added for an ASIO driver audio stream format which we understand is needed by Marian audio interfaces' ASIO driver.
- The toggling MIDI program change stop switch MIDI event type (as used by Johannus/Makin/Wyvern) has been extended for compatibility with Musicom systems.
- Documentation: the LCD panel MIDI implementation section in the Hauptwerk user guide has been clarified regarding 7-bit character sets.
- Diagnostics: the computer's primary display's size, resolutions and DPI settings are now logged.
- PCs: Hauptwerk's installer no longer includes an option to configure Windows to start Hauptwerk automatically when the computer boots (since the preferred method in Windows 10 is for the user to control that directly from Task Manager).
- The 'MIDI hardware/console type' setting on the General Configuration Wizard now defaults from its corresponding general preference when the latter has previously been set.
- The 'master' and 'quick' sliders on the rank voicing screen now always 'zero' to their center positions (instead of to the default value for the selected adjustment).
- Selecting a menu item to open a real-time settings screen or voicing screen now always brings the screen to the foreground if it's already open.
- Various other minor cosmetic/usability improvements to settings screens, screen names, and menu function names.

### Bug fixes

- Slightly too much 'free' RAM could be reported on some computers (mainly Macs), resulting in Hauptwerk allowing the RAM to be over-filled, potentially allowing the computer to become sluggish or freeze.
- Multiple loops with identical starting positions within a sample could cause a crash (since v2.0.0), notably with the original version of the OrganArt Media Steinkirchen sample set.
- If a floating control panel or piston toolbar had input focus then computer key presses mapped to functions didn't work (since v4.0.0).
- MIDI Master Fine-Tuning MIDI sys-ex messages weren't being interpreted correctly (since v4.1.0).
- LCD system: if very large numbers of LCD panels were used, some could fail to be cleared when stopping MIDI drivers (since v2.0.0, but more noticeable with v4.2.0+).
- Loading a pre-v4 combination set for the first time that also had last been loaded in an older/different organ definition (with the same OrganID) could cause a crash (since v4.0.0).
- Combination sets that hadn't been saved since upgrading to v.4.2+ could be slow to load.
- Under some circumstances the large floating control panels incorrectly allowed docking at the top/bottom of the main window.
- Selecting a View menu item by right-clicking on certain display items on the Audio, MIDI and Performance large control panel could incorrectly open the settings screen relating to the other items on that menu (since v4.0.0).
- Lengths of cross-fades to release samples could incorrectly depend slightly upon user-selected pitch/temperament/tuning when the sample set's cache was last generated (since v2.0.0).
- Various other minor fixes.

## Known issues

- macOS 10.13 and later: if you close Hauptwerk when in full-screen mode, then the windows might not get restored properly to full-screen when next launching Hauptwerk. As a work-around, if you want to use full-screen mode, then please always exit full-screen mode before closing Hauptwerk, then re-enter it when next launching Hauptwerk. (This is a confirmed high-priority compatibility issue with macOS 10.13+ in the multi-platform library that we use internally for Hauptwerk. We need to await a fix from the makers of that library.)
- macOS 10.15: selecting a different reverb on the '*General settings | Audio mixer*' sometimes doesn't result in the text and controls on the screen initially being redrawn properly. There are some other similar circumstances in which settings screens occasionally don't get redrawn properly on macOS 10.15. (We aim to move to the latest version of the development tools/libraries for the next Hauptwerk maintenance release, which we hope should address any such remaining macOS 10.15 compatibility issues.)
- macOS 10.15: you need to launch Hauptwerk's installer by right-clicking on it and selecting 'Open' (since the installer isn't yet 'notarized' by Apple, which macOS 10.15 requires by default in order to be able to launch it by double-clicking on it).
- macOS 10.13 and later: if the primary Hauptwerk window is smaller than a certain size and positioned near to the right-hand edge of the computer screen then message boxes/prompts may sometimes be positioned partly off the right-hand edge of the window and screen, instead of centered over the main window. (This is either a compatibility issue between the version of the multi-platform library that we use internally for Hauptwerk and macOS 10.13+, or conceivably a bug in macOS itself.)
- If you want your computer's operating system to launch Hauptwerk automatically when the computer boots, and if, on your computer, you find that doing so results in a 'license not found' error when the operating system launches Hauptwerk (due to the operating system launching Hauptwerk before the iLok system has finished starting), then you may instead need to launch Hauptwerk via a script/batch file that (for example) waits for a few seconds before it launches Hauptwerk.
- Hauptwerk v5+ should use a similar amount of memory for the data for any given organ itself, compared to v4, but v5+ does need to use some additional RAM for its surround/3D-capable audio engine and native reverb capabilities (with the exact figure depending on various factors, especially the polyphony limit setting and whether any reverbs are loaded), compared to v4. Typically, the v5+ Advanced Edition is likely to need around 200-250 MB more memory than v4 did. Hence if certain organs were almost filling your computer's memory in v4 then you will need to reduce their memory requirements via the '*Organ | Load organ, adjusting rank audio memory options*' screen (by disabling some ranks, or by setting them to load in lower audio resolutions, or with multiple loops or releases disabled, for example). As with any Hauptwerk version, it's extremely important not to over-fill your computer's, otherwise you may risk system instability.
- If you previously upgraded from pre-v5 version to v5.0.0 (as opposed to upgrading from a pre-v5 version directly to v5.0.1 or later) and in v5.0.0 you retained/migrated your pre-v5 audio settings/routing, and you had installed and loaded any new organs in v5.0.0 (and/or in v5.0.0 you had subsequently used the General Configuration Wizard to reset your audio settings, but not also used the Organ Configuration Wizard to reset your rank audio routing for some organs), then (due to a bug that existed in v5.0.0) you might find that you hear no audio from those organs. In that case, with each of those organs loaded in turn, please simply use the '*Organ settings | Organ Configuration Wizard*' from the menu in Hauptwerk, keeping just the '*Reset rank routing ...*' option ticked. (Alternatively, or additionally, if you wish you could use the '*Organ settings | Rank routing ...*' screen to select your desired audio mixer bus group for output perspective 1 for each rank.)