New crystal

User Manual

Table of Contents

This user manual describes all aspects of the crystal mk3 console. It contains information for users, technicians and system integrators.

1 crystal - General Information

Before you start working with crystal, please read the following information.

- crystal - About this Documentation
- crystal - Important Safety Instructions
- crystal - Important Cleaning Instructions

1.1 crystal - About this Documentation

This documentation represents the latest state of information. Subject to availability, manuals covering former versions are provided via the Lawo Download-Center (after login).

General Safety & Important Notes

When working with our hardware components, it is important to read and observe all of the instructions provided in the "General Safety Information for Lawo Equipment" booklet delivered with your devices.

The same symbols are used in the product documentation so please look out for them as follows. The letter in brackets before the signal word denotes the language version: e.g. (E) = English.

> ⚠ **(E) WARNING** - warnings or mandatory actions.
>
> These instructions **must always be observed** to ensure the personal safety of the user, and to protect your system and the work environment from potential damage.

> ⚠ **(E) IMPORTANT NOTE** - important information for proper functioning.

Other Informational Icons

When reading about our software or the general operation, you may also see the following icons.

> ℹ General information and points of clarification. Please take note.

> ✅ Useful tips and shortcuts. Feel free to follow if you like.

> ⚠ Notes. To avoid getting stuck, make sure you follow.

> ❌ Important actions. To keep the system operational, you should always follow.

Further Information

Mechanical drawings and data sheets (including weights and dimensions) are available from the Lawo Download-Center (after login). We also recommend that you carefully observe the release notes for your product/system.

Lawo User Registration

For access to the Lawo Download-Center, and to receive regular product updates, please register at: www.lawo.com/registration.

Contact Details

If you need further assistance, the Lawo Support Department can be contacted by email at support@lawo.com, or by telephone during normal working hours - please visit the Support area of the Lawo website for the most up-to-date contact details.

1.2 crystal - Important Safety Instructions

When working with our hardware components, please read and observe all of the instructions provided in the "General Safety Information for Lawo Equipment" booklet delivered with your devices.

Click on the link below to read or download the booklet as a pdf.

1.3 crystal - Important Cleaning Instructions

Before cleaning your Lawo devices, please read and observe all of the following instructions.

> ⚠️ **(E) ATTENTION**
>
> DO NOT spill liquids into any system components!
>
> DO NOT clean the front panels or operational surfaces with sharp instruments.

> ⚠️ **(F) ATTENTION**
>
> NE PAS renverser de liquides dans les composants du système!
>
> NE PAS nettoyer les panneaux avant ou les surfaces opérationnelles avec des instruments pointus.

> 🔳 **(E) IMPORTANT NOTE**
>
> **General Cleaning / Disinfecting Requirements**
>
> Lawo hardware products are made from a variety of different materials, and each material might have specific cleaning requirements. Therefore, a general allowance for the disinfection of product surfaces with disinfectants containing alcohol cannot be given.
>
> Our front panels and operational surfaces are not entirely approved for treatment with chemical cleaning agents and disinfectants. Component surfaces, buttons and electronics can be permanently damaged by treatment with such agents and the lifespan can be dramatically shortened. Please note that some substances can lead to discoloration of surfaces.
>
> Lawo is not responsible for damage caused by the unauthorized use of disinfectants on our products and surfaces. Damages caused by unspecified treatment of modules and components are not covered by regular or extended warranties or SLA regulations.
>
> This is a general instruction and recommendation for cleaning that applies to all Lawo products:
>
> - Before cleaning the device, unplug all external power sources.
> - Clean the device with a soft cloth, dipped lightly in warm to hot soapy water.
> - Do not use any liquid cleaning agents or spray cleaners that may contain flammable materials.
> - Do not get moisture into any openings.
> - Do not use aerosol sprays, bleaches, or abrasives.
> - Do not spray cleaners directly onto the item.
>
> The above information and our technical application advice are given to the best of our knowledge.

Cleaning the crystal Surface

To clean a Lawo control surface please use a cleaning cloth with the following properties:

- Antistatic
- Fluff-free
- Without emery pieces

2 crystal - Getting Started

If you are new to crystal, then please read the following topics to get started.

- crystal - Powering On
- crystal - Fader Strip Control
- crystal - Central Controls
- crystal - Fader Strip Assign
- crystal VX - Operating Principles

3 crystal - Hardware

This chapter describes the crystal frame and its hardware components.

- [crystal - Surface Description](#)
- [crystal - Surface Configurations](#)
- [crystal - Multi-frame Surfaces](#)
- [crystal - Frames](#)
- [crystal - Control Surface Modules](#)
- [crystal - Virtual Extension](#)
- [crystal - Connectivity](#)
- [crystal - Power Supplies](#)
- [crystal - Grounding](#)

3 crystal - Hardware

3.1 crystal - Surface Description

crystal can be ordered either as a complete console (with Power Core) or on its own as an Open Sound Controller (OSC) device. In each case, you will need to specify the frame type and its modules.

Frames and Modules

Each crystal frame is fitted with either a Main or Fader module (for the physical controls) plus, optionally, a Virtual Extension module in the overbridge.

- The **Main module** provides 6 fader strips plus central controls.
- The **Fader module** provides 8 fader strips.
- The **Virtual Extension (VX)** module provides visual feedback and touch-screen operation.

All frames and modules are offered in a choice of **surface finishes** (light or dark). For each finish, there are two **mounting versions** (tabletop or countersunk).

The **Virtual Extension** is optional and can be integrated into the frame or delivered as a stand-alone unit. If the Virtual Extension is integrated, then the VX module slots directly into the frame at a fixed viewing angle.

6-fader crystal (light)	*6-fader crystal with VX (dark)*

Console Size (Number of Faders)

When operating with Power Core, a crystal surface can comprise either one or two frames. The (standard) **Console Compact** license supports three configurations:

- 6-fader crystal = a single frame (with 1x Main module).
- 8-fader crystal = a single frame (with 1x Fader module).
- 14-fader crystal = two frames (with 1x Main module + 1x Fader module).

Please note:

- The maximum number of fader strips supported by Power Core is 14; a 16-fader surface is not supported.
- An 8-fader surface can be operated with VisTool (for the central control functions).
- If a **Console MAX** license is installed, then up to four crystal surfaces can share the resources of a single Power Core device (up to 3x 14-fader + 1x 6-fader).

The images below show the smallest and largest surface supported by Power Core. For more information, see crystal - Surface Configurations.

| *6-fader crystal (light)* | *14-fader crystal with VX (light)* |

Key Facts

- Frame width = 352mm. The depth and height vary (depending on the frame type).
- Frame options: light or dark finish, tabletop or countersunk mounting, Virtual Extension (VX) integration.
- Module options: either Main or Fader plus VX. The VX module can be integrated or stand-alone.
- Each frame is powered from an external DC power supply. If the Virtual Extension is included, then a second PSU is required.
- The frame is convection cooled. There are no fans inside the surface or VX modules.
- The frame must be populated; there are no blanking panels.

Components

Each frame has the following user-serviceable components:

- Control surface modules: Fader, Main and VX.
- External DC power supply.

Ordering Information

To order crystal as a complete console (with Power Core), there are a number of bundles that include the surface, Power Core, I/O cards and so on.

To order crystal as a surface-only, you will need to specify the frame type and its module(s).

For more information, see crystal - Frames and crystal - Control Surface Modules.

Further Information

For dimensions, weight, power, etc. see the crystal - Technical Specification and crystal - Power Supplies.

For installation information, see crystal - Installing the Frame.

Additional information can be found in the **crystal datasheet** available from the Lawo Download-Center (after login).

3.2 crystal - Surface Configurations

This topic describes the configuration rules that apply to the crystal surface.

Considerations

crystal support two exclusive modes of operation: either Power Core or Open Sound Controller (OSC) mode.

Power Core Licensing

To operate with Power Core, the system requires one of two licenses: either Console Compact or Console Max.

The **Console Compact** license supports the following configurations:

- 1x 6-fader crystal (single frame)
- 1x 8-fader crystal (single frame)
- 1x 14-fader crystal (in split-frames).

If a **Console Max** license is installed, then up to four crystal surfaces can share the resources of a single Power Core device. In this instance, the following configurations are supported:

- 4x 6-fader crystal (single frames).
- 3x 14-fader crystal (in split-frames) + 1x 6-fader crystal (single frame).
- any combination in-between, including virtual interfaces.

Important: all of the physical surfaces must be the same type: all crystal, all diamond or all ruby. You cannot connect different surface types to a single Power Core MAX device.

Controller Mode

If a crystal frame runs as an OSC controller, then it can communicate with an external OSC device such as a DAW. In this instance, more than one frame can be combined (to fit the OSC application).

Important: Power Core cannot be controlled as an OSC device.

Cabling

If the surface comprises more than one frame, then it is important to consider the cabling options for the additional frame(s).

To connect the surface to Power Core, there are two possibilities:

- Connect one frame to Power Core via IP, and then daisy-chain the second frame to the first (using an external CAN bus cable),
- Or, connect each frame individually to Power Core via IP.

In controller mode, each frame must connect to the IP network; a CAN bus daisy-chain is not supported.

Frame Type

In each case, the frame(s) are available in light or dark; tabletop or countersunk; and with or without the VX integration.

Please note:

- The frame construction (finish, mounting and VX) must be specified at the time of order; there is no possibility to convert the frame later.
- The Main and Fader modules are a standard size, and so these can be exchanged later if required.
- Each frame accepts either a Main or Fader module. To fit a VX module, the Virtual Extension integration must be specified.
- Each frame must be populated; there are no blanking panels.

Surface Configurations (no VX)

The following configurations are possible for a surface with physical controls only (and no touch-screen integration).

6-fader crystal (light and dark)

The 6-fader surface comprises a single frame fitted with 1x Main module.

Main module (light)

Main module (dark)

8-fader crystal (light and dark)

The 8-fader surface comprises a single frame fitted with 1x Fader module.

Fader module (light)

Fader module (dark)

14-fader crystal (light and dark)

The 14-fader surface comprises two frames with 1x Main module and 1x Fader module.

Fader module (light)   +   *Main module (light)*

Fader module (dark)   +   *Main module (dark)*

16-fader crystal and upwards

The largest surface supported by Power Core is the 14-faders (as described above).

In controller mode, it is possible to build a larger surface using a mixture of Main and/or Fader module frames (e.g. 3x Fader module frames for 24 faders).

Surface Configurations (with VX)

The same fader configurations are then possible, but with the touch-screen (VX) integration.

The rules for combining frames are identical and so here we show the images only. Remember that the largest variant supported by Power Core is 14 faders.

6-fader crystal with VX (light and dark)

Main module with VX (light)   *Main module with VX (dark)*

8-fader crystal with VX (light and dark)

Fader module with VX (light)   *Fader module with VX (dark)*

14-fader crystal with VX (light and dark)

Fader module (light)   +   Main module (light)

Fader module (dark)   +   Main module (dark)

3.3 crystal - Multi-frame Surfaces

This topic describes the options for combining more than one crystal frame.

When operating with Power Core, the number of frames/surfaces is dependent on the Power Core license: either **Console Compact** or **Console MAX**.

Increasing the Fader Count
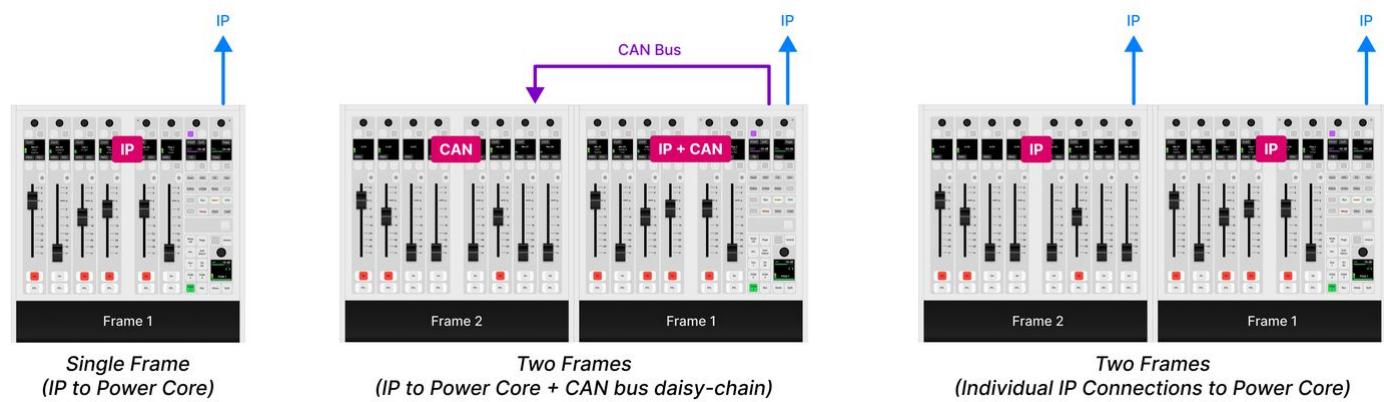
With a **Console Compact** license, the number of faders can be increased by installing two frames side-by-side, or in a wrap-around layout.

In this instance, the two frames must be fitted with 1x Main module + 1x Fader module = 14-faders (maximum).

To connect the surface to Power Core, there are two possibilities:

- Connect one frame to Power Core via IP, and then link the second frame to the first (using an external CAN bus cable),
- Or, connect each frame individually to Power Core via IP.

In each case, the communication mode for each module must be set to match the external wiring. How to do this is explained later. The image below shows the communication modes (in pink) for each option.

Single Frame
(IP to Power Core)

Two Frames
(IP to Power Core + CAN bus daisy-chain)

Two Frames
(Individual IP Connections to Power Core)

Creating a Multi-studio Solution

If a **Console MAX license** is installed, then up to four crystal surfaces can share the resources of a single Power Core device.

In this instance, the following configurations are supported:

- 4x 6-fader crystal (single frames).
- 3x 14-fader crystal (in split-frames) + 1x 6-fader crystal (single frame).
- any combination in-between, including virtual interfaces.

Important: all of the physical surfaces must be the same type: all crystal, all diamond or all ruby. You cannot connect different surface types to a single Power Core MAX device.

Each "console" works independently with separate Access Group functions. This means that each operator can control their own Function Keys (for independent DSP parameter control, bus assignment, etc). Each console can be physical or virtual.

The image below shows an example system.

ℹ️ **When configuring Power Core Max…**

Please note that the real-time input measurement for the channel in ACCESS is supported by Access Group 1 only, and not Access Groups 2 to 4. This affects the dynamic signal level visualizations on the GUI such as the bouncing balls in the Dynamics 'Source Parameter' dialog box. So, in the example above, these visualizations are available for Studio 1 only, and not Studios 2 to 4.

For this reason, it is recommended to use Access Group 1 for the most important surface / the surface with a Virtual Extension.

3.4 crystal - Frames

This topic describes the options for the crystal frame.

Frame Options

Each crystal frame is offered with three options:

- Surface finish - light or dark.
- Mounting version - tabletop or countersunk.
- Virtual Extension (VX) Integration.

The frame construction must be specified at the time of order; there is no possibility to convert the frame later.

Please note: each frame can accept either a Main or Fader module (and these can be exchanged later if required). To fit a VX module, the Virtual Extension integration must be specified.

Surface Finish

All frames and modules are offered in a choice of surface finishes: light or dark. There are no functional differences between the versions and so a light module will work in a dark frame, and vice versa.

The **light edition** follows the traditional design used by Lawo's on-air consoles. It is ideal for natural light environments.

The **dark edition** has been developed specifically for TV production rooms, which are often darker, to help focus attention on the video content. In this environment we want to reduce bright, distracting objects, and minimize reflections.

Main module (light)   *Main module (dark)*

Mounting Version

For each finish, there are two mounting versions: tabletop or countersunk. Each can accept either a Fader or Main module and is available with or without VX integration.

The **Tabletop** version is designed for tabletop placement. This version includes a leather hand rest and stylish side/rear profiles.

The **Countersunk** version is designed to fit flush within your studio furniture. This version comes with different front, rear and side profiles.

Tabletop frame   Countersunk frame

Virtual Extension Integration

For each finish and mounting type, you can specify the **Virtual Extension integration**. This allows a VX module to slot directly into the frame above the physical controls (at a fixed viewing angle).
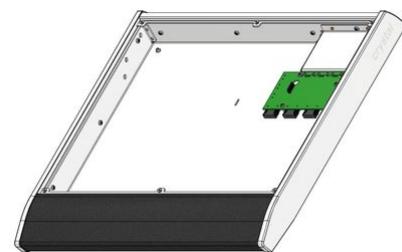
Ordering Information

In total, there are eight frame types to choose from.
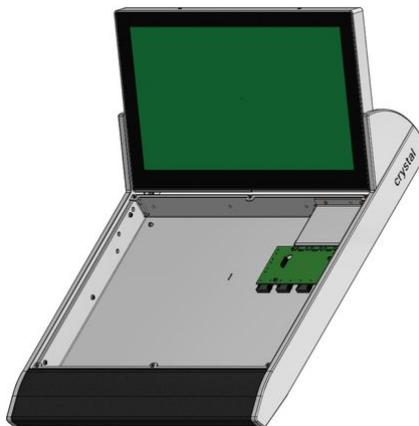
- crystal Tabletop Light: 715/30-10
- crystal Tabletop Dark: 715/30-30
- crystal Tabletop with VX Light: 715/31-10
- crystal Tabletop with VX Dark: 715/31-30
- crystal Countersunk Light: 715/30-20
- crystal Countersunk Dark: 715/30-40
- crystal Countersunk with VX Light: 715/31-20
- crystal Countersunk with VX Dark: 715/31-40

Please note: The part numbers specify the frame only (with no modules fitted). The Main, Fader and VX modules must be ordered separately.
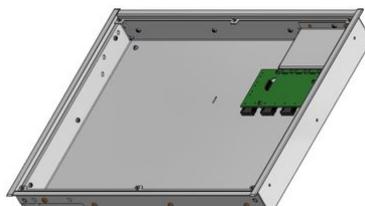
All frames are available in either light or dark finish. For simplicity, the images below show the light editions only.

crystal Tabletop Frame
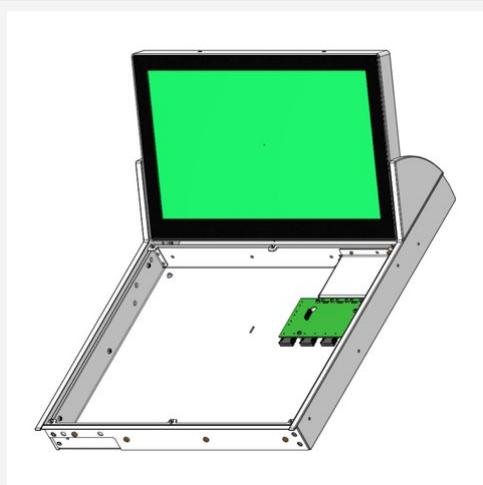
	Light	Dark
Part Number	715/30-10	715/30-30

crystal Tabletop Frame with VX

	Light	Dark
Part Number	715/31-10	715/31-30

crystal Countersunk Frame

	Light	Dark
Part Number	715/30-20	715/30-40

crystal Countersunk Frame with VX

	Light	**Dark**
Part Number	715/31-20	715/31-40

Mechanical Data

For dimensions and mechanical drawings, see crystal - Installing the Frame.

3.5 crystal - Control Surface Modules

This topic describes the control surface modules.

Module Options

crystal is offered with three control surface modules: Main, Fader and VX.

- The **Main module** provides 6 fader strips plus central controls.
- The **Fader module** provides 8 fader strips.
- The **Virtual Extension (VX)** module provides visual feedback and touch-screen operation.

All modules are offered in a choice of **surface finishes** (light or dark). There are no functional differences between the versions and so a light module will work in a dark frame, and vice versa.

The **Main** and **Fader modules** are a standard size and can be fitted to any frame type. When populating a frame, please observe the surface configuration rules explained .

Main module (light)   *Fader module (light)*

The **VX module** can be fitted to any of the VX frame types. It slots directly into the VX frame at a fixed viewing angle.

Ordering Information

In total, there are six control surface modules available.

- crystal Main Module Light: 715/20-L
- crystal Main Module Dark: 715/20-D
- crystal Fader Module Light: 715/10-L
- crystal Fader Module Dark: 715/10-D
- crystal VX Module Light: 711/30
- crystal VX Module Dark: 711/30-D

Please note: The part numbers specify the module only. The crystal frame must be ordered separately.

Specifications

The Main and Fader modules are a standard size: 336mm (w) x 286mm (d).

The VX module is 336mm (w) x 226mm (d).

Mechanical drawings for all modules are available from the Lawo Download Center (after login). Please use the part numbers listed below to locate the correct information.

The following generation information applies to the physical controls:
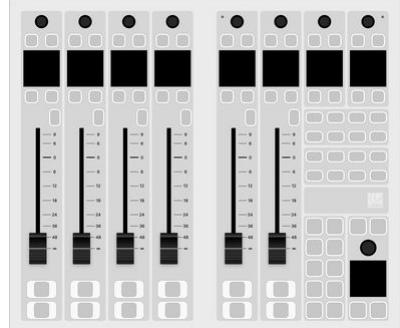
- All faders are touch-sensitive and motorized.
- All control keys can be configured to light in a range of colors and states. Some keys are labelled by the TFT displays and others use foil-printed labels.

The module specifications are as follows.

crystal Main Module
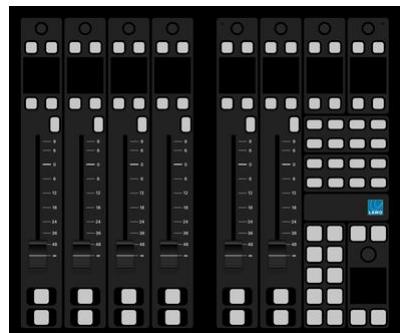
Main Module Light (715/20-L) • 6 x 100mm faders (touch-sensitive and motorized) • 9 x rotary encoders • 9 x TFT displays • 80 control keys • 2 x ambient light detectors • Dimensions: 336mm (w) x 286mm (d)	
Main Module Dark (715/20-D) • as for 715/20-L	
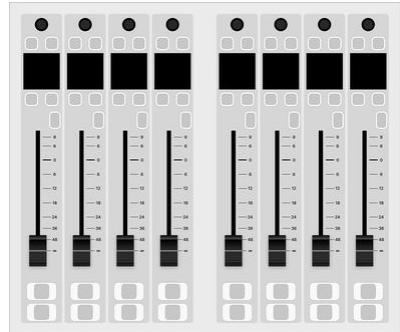
crystal Fader Module
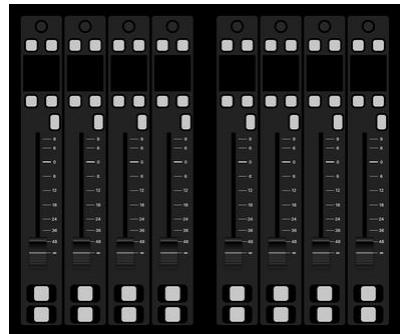
Fader Module Light (715/10-L)

- 8 x 100mm faders (touch-sensitive and motorized)
- 8 x rotary encoders
- 8 x TFT displays
- 56 control keys
- Dimensions: 336mm (w) x 286mm (d)

Fader Module Dark (715/10-D)

- as for 715/10-L

crystal VX Module

VX Module Light (711/30)

- 1 x 13.3" touch-screen display
- Full HD, 1920 x 1080 resolution
- Anti-reflective surface
- Industrial Grade Components
- Dimensions: 336mm (w) x 226mm (d)

VX Module Dark (711/30-D)

- as for 711/30 with dark finish.

3.6 crystal - Virtual Extension

The **Virtual Extension** is optional and can be integrated into the frame or delivered as a stand-alone unit. It provides visual feedback and parameter control. The functionality is defined by the configuration.

If the Virtual Extension is integrated, then the VX module slots directly into the frame at a fixed viewing angle. If the integration is not included, then similar functionality can be achieved by running the **Desktop App** on an external display.

The VX modules are available in both light and dark editions (to match the frame). The example below shows how a 14-fader crystal surface can be created from two VX frames.

Host PC Requirements

The VX software runs on a Windows PC that must be supplied by the customer. A license to run the standard configuration (for the Virtual Extension or Desktop App) is included with every console.

A single host PC can support multiple displays, depending on its specification. If you wish to run more than 6 displays (e.g. for Power Core MAX), then it is recommended to install a second host PC. The following document contains more information about the PC requirements: Vistool PC Configuration Guide.pdf.

Physical Connections

Each VX module is powered by its own external DC power supply (of the same type as the crystal frame).

The host PC connects to Power Core via the IP network and to each VX module via Display Port and USB. To connect more than one VX module, the host PC must support multiple Display Port and USB connections.

For more information about how to connect and setup the VX display, see crystal - Configuring the Virtual Extension.

Ordering Information

There are two versions of the VX module (to match the finish of the crystal frame):

- crystal VX Module Light: 711/30
- crystal VX Module Dark: 711/30-D

Please note: The part numbers specify the module only. The crystal frame must be ordered separately.

The modules can be fitted to any of the VX frame types described earlier. Frames ordered with the Virtual Extension integration come with special side profiles to accept the VX module.

There is no difference, technically, between the light and dark versions and so they may be exchanged (if required).

VX Module Specification

VX Module Light (711/30)

- 1 x 13.3" touch-screen display
- Full HD, 1920 x 1080 resolution
- Anti-reflective surface
- Industrial Grade Components
- Dimensions: 336mm (w) x 226mm (d)

VX Module Dark (711/30-D)

- as for 711/30 with dark finish.

Virtual Extension Stand Alone
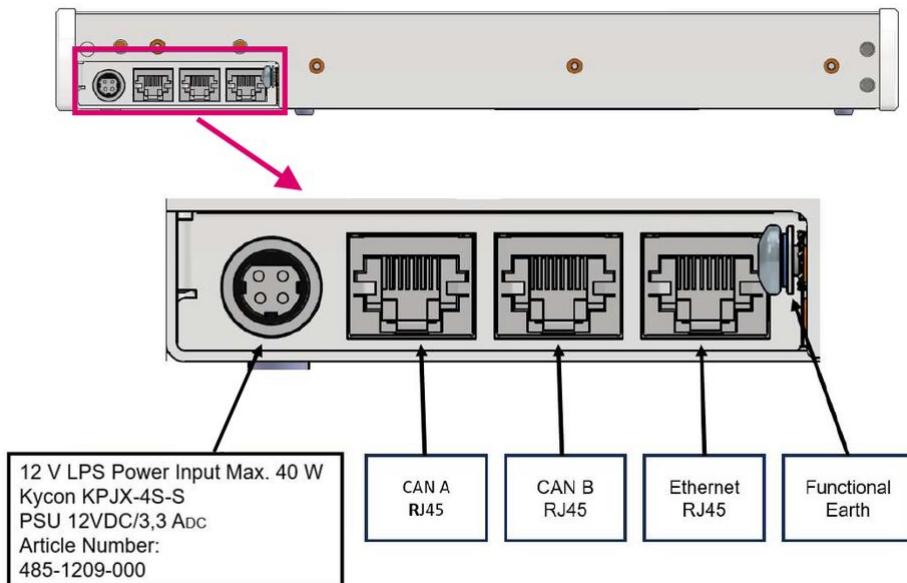
The Virtual Extension can also be ordered as a stand-alone unit. This is a single screen in its own frame/housing. The stand-alone unit is available in light finish (only) and can be used with any VisTool product.

- Virtual Extension Stand Alone: 711/33

3.7 crystal - Connectivity

All plug-in connectors are located on the frame's rear connector board and at the rear of the VX module.
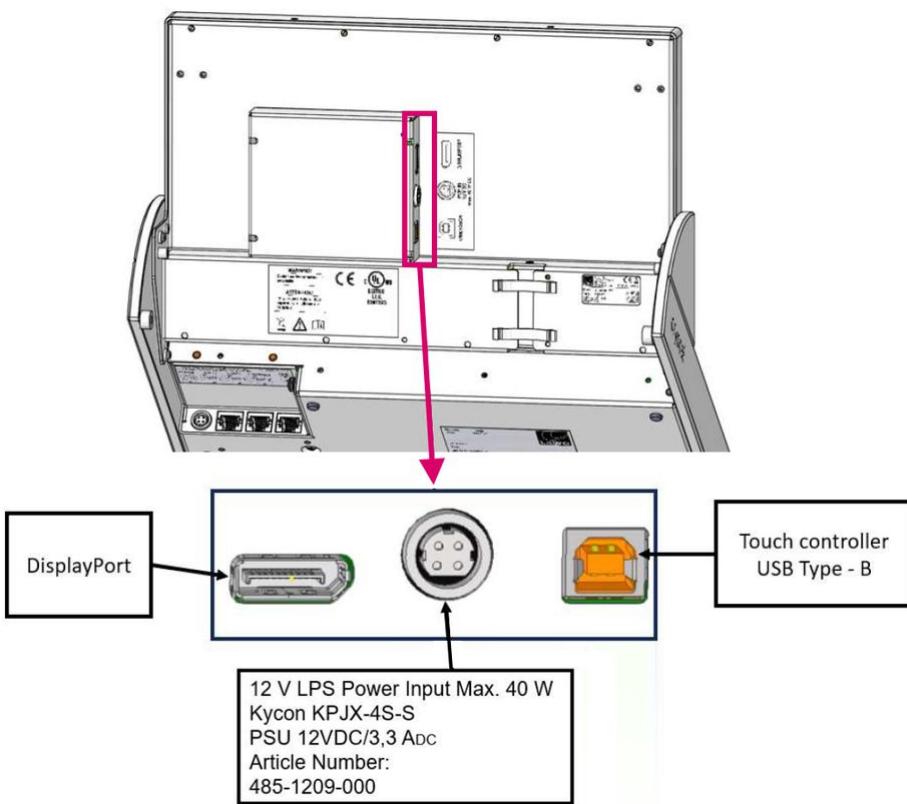
crystal Frame (rear view)

On the rear of the crystal frame, there are five connectors:

- **Power In** (Kycon) - connects to the external DC power supply.
- **CAN A** (high speed, 1Mb/s) - can be used in Power Core mode to connect to a second crystal frame (optional).
- **CAN B** (low speed, 500Kb/s) - can be used in Power Core mode to connect a Lawo KSC or GPIO panel (optional).
- **Ethernet** (100 Mb/s) - connects to either Power Core or the Open Sound Controller device via the IP network.
  - The control transport can be either Multicast or Unicast IP, LAN or WAN.
  - A built-in Web UI is used for setup parameters and maintenance. The access can be secured using HTPPS if required.
- **Functional Earth** (M4 x 10mm screw) - must be used to ground the frame.

For more information about the connectors and cabling requirements, see crystal - Wiring.

crystal VX Module (rear view)

On the rear of the VX display, there are three connectors:

- **Power In** (Kycon) - connects to the external DC power supply.
- **Display Port** - connects to the host PC (for graphics).
- **USB** (Type B) - connects to the host PC (for touch-screen control).
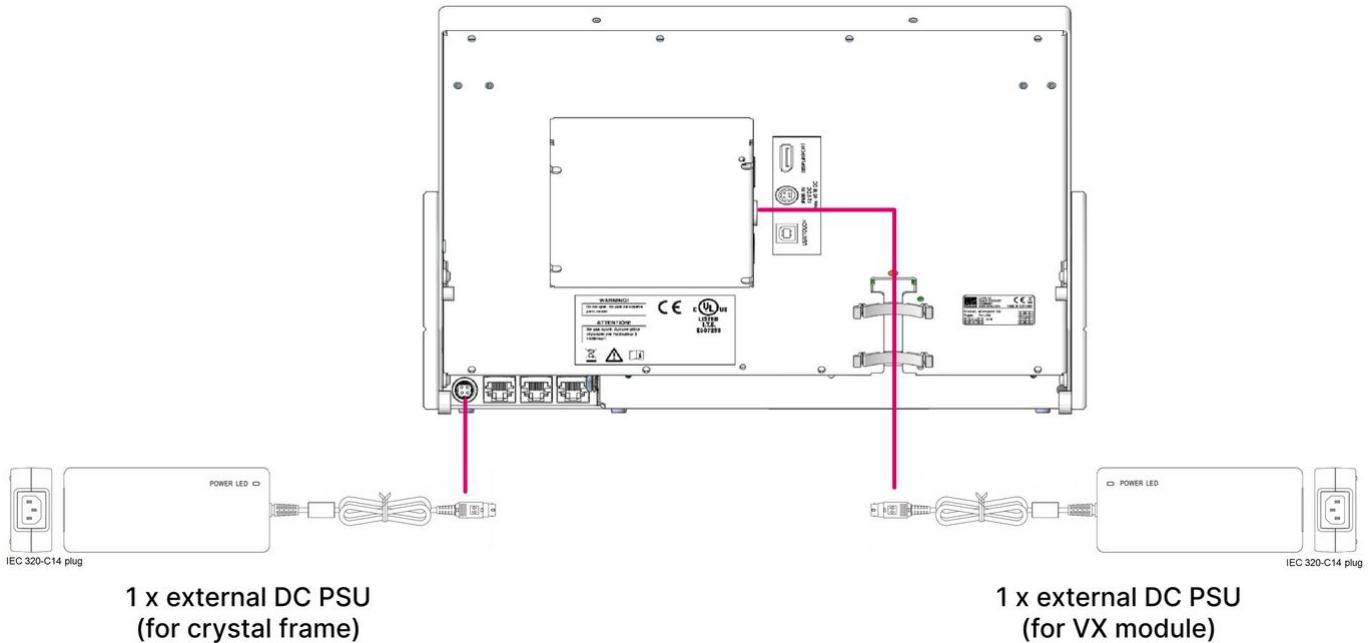
The VX module requires its own external DC power supply (of the same type as the crystal frame).

For more information about how to connect and setup the VX display, see crystal - Configuring the Virtual Extension.

3.8 crystal - Power Supplies

Each crystal frame is powered by an external DC power supply. If the Virtual Extension is included, then a second PSU is required. The PSUs are identical and so you can use the crystal frame PSU to power the VX module, or vice versa.

The image below shows the rear view of a crystal frame with VX integration.

Ordering Information

For a new system, the power supplies are included with the delivery. To order a spare part, please use the following article number.

- 1 x **485-1209-000** - external DC power supply (for crystal frame or VX module).

One PSU per frame and per VX module are required.

Specification

The following information is extracted from the **crystal datasheet** available from the Lawo Download-Center (after login).

External DC power supply (Article Number: **485-1209-000**).

- General description: PSU desktop, ATS050T-P120; LPS 12VDC / 3,3A
- Max power: 40W
- Input Connector: IEC (country-specific).
- Input Voltage: 100-240V, 50-60Hz
- Input Current: 1,2A
- Output Connector: Kycon KPJX-4S-S
- Output Voltage: 1x 12V DC (nominal)
- Output Current: 3,3A (max.)
- Indicators: 1x status LED (power applied)

IEC Power Cables

Each external DC power supply is delivered with an IEC power cable that is country-specific. The table below describes all permitted options.

Name	Part Number	Description
IEC Lock Schuko	436-7206-000	Power Cord with European connector for e.g. D, AU, F, Benelux.
IEC Lock Open Ends	436-7207-000	Power Cord with open wire ends.
IEC Lock US	436-7208-000	Power Cord with connector for USA.
IEC Lock UK	436-7209-000	Power Cord with connector for United Kingdom.
IEC Lock AUS	436-7218-000	Power Cord with connector for Australia.
IEC Lock JPN	436-7219-000	Power Cord with connector for Japan.

Using the DC Power Supplies

Before connecting power to the surface, please read and observe all of the instructions in the "General Safety Information for Lawo Equipment" booklet delivered with your devices.

> ⚠ **(E) WARNING**
>
> The AC input(s) MUST be connected to the mains using the power cable(s) supplied with the system.
>
> Disconnect all power sources to completely disconnect power from the system. e.g. before you open the unit for maintenance and service.
>
> Take care that the protective earth (PE) connection of each PSU is individually connected to the PE connection of the building installation (e.g. wall socket). It is forbidden to use IEC Y-cables, or connect both PSUs to the same multiple-socket outlet. This measure guarantees that there is no shared PE connection (whose failure would lead to a summation of the leakage current from both PSUs to the housing).

> ⚠ **(F) AVERTISSEMENT**
>
> La ou les entrées CA DOIVENT être connectées au secteur à l'aide du ou des câbles d'alimentation fournis avec le système.
>
> Déconnectez toutes les sources d'alimentation pour couper complètement l'alimentation du système, par exemple avant d'ouvrir l'unité pour la maintenance et l'entretien.
>
> Veillez à ce que la connexion de terre de protection (PE) de chaque PSU soit connectée individuellement à la connexion PE de l'installation du bâtiment (par exemple, une prise murale). Il est interdit d'utiliser des câbles en Y IEC, ou de connecter les deux PSU à la même prise multiple. Cette mesure garantit qu'il n'y a pas de connexion PE partagée (dont la défaillance entraînerait une sommation du courant de fuite des deux PSU vers le boîtier).

Cabling instructions

Starting with the frame:

1. Connect the external power supply to the DC input on the rear connector panel.
2. Using the IEC cable provided, connect your AC mains to the PSU.
3. The PSU has an LED that lights (green) when mains power is detected.

If the Virtual Extension is included, repeat the steps above to connect power to the VX display.

The frame and VX module have no on/off switch and start automatically when power is applied. What happens next is described later. See Powering On & Starting the GUI.
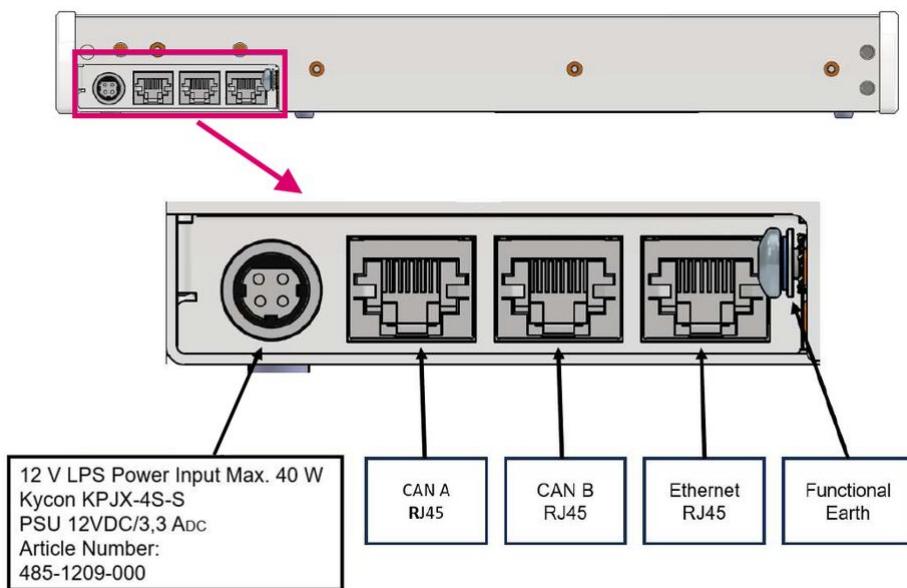
3.9 crystal – Grounding

Each crystal frame must be grounded for EMC reasons and to ensure the correct operation of the physical controls.

If the frame is not properly grounded, then you may see some odd behaviours once the console is operational. For example, the faders do not move as expected.

Grounding Instructions

A grounding screw is provided on the connector panel (at the rear of the frame).

To ground the frame, please read and observe all of the instructions in the "General Safety Information for Lawo Equipment" booklet delivered with your devices.

> ⚠️ **(E) CAUTION**
>
> Each frame must be on the same potential as all other system devices.
>
> ALWAYS use a grounded mains connection, to prevent the device from being grounded through Ethernet or other signal connections.
>
> The device must be connected to an additional fixed protective ground if it is conductively connected with more than 20 other devices. i.e. more than 20 copper I/O connections. For more information, please refer to the "General Safety Information for Lawo Equipment" booklet delivered with your devices.

Use the M4 x 10mm screw to fasten the grounding cable to the housing. You should use a Torx T20 driver for this purpose.

If the surface includes more than one frame, then it is important to ground each frame.

4 crystal - Installation

This chapter describes how to install the crystal control surface.

> ⓘ When operating with Power Core, you must install both the control surface and core. The installation of Power Core is covered separately in the "Power Core - User Manual" (available [here](#)).

- crystal - Installation Instructions
- crystal - Unpacking
- crystal - Installing the Frame
- crystal - Mounting a VX Module
- crystal - Wiring
- crystal - MF Key Labels

4.1 crystal - Installation Instructions

We recommend that you read all of this chapter in full before starting the installation. Any product-specific tools, such as Torx drivers, can be found in the Lawo tool case delivered with your system.

Mechanical drawings and data sheets (including weights and dimensions) are available from the Lawo Download-Center (after login).

⚠️ **(E) WARNING**

Please read and observe ALL of the Lawo - Important Safety Instructions BEFORE installing or servicing any component.

⚠️ **(F) AVERTISSEMENT**

Veuillez lire et respecter TOUTES les consignes de sécurité importantes AVANT d'installer ou d'entretenir un composant.

Once you are ready to begin, it is recommended to complete the tasks in the following order.

- Unpack
- Install the Frame
- Mount the VX Module (if applicable)
- Connect the Cables
- Exchange the MF Key Labels (if applicable)

If you need further assistance, the Lawo Support Department can be contacted by email at support@lawo.com, or by telephone during normal working hours - please visit the Support area of the Lawo website for the most up-to-date contact details.

4.2 crystal - Unpacking

Each crystal frame is delivered in its own box with all included accessories. The Fader or Main module is pre-installed. For Virtual Extension frames, the VX module is shipped separately.

Please check the contents of the shipping boxes, and in the event of any transport damage, contact your local Lawo representative or email support@lawo.com.

A list of serial numbers for all components is included with the shipment. Please keep this list for your records.

Packing List

The contents of the shipment will vary depending on the component(s) ordered.

Included

The following items are included with each frame:

- 1 x desktop power supply (485-1209-000) - to power the frame.
- 1 x 2m IEC power cable (country-specific) - to connect mains to the desktop power supply.
- Printed sheet with foil-printed labels - to re-label the MF Keys.

For the Virtual Extension option, each VX module comes with the following items:

- 1 x desktop power supply (485-1209-000) - to power the VX display.
- 1 x 2m IEC power cable (country-specific) - to connect mains to the desktop power supply.

Not Included

The following items are not included and must be provided by the customer or installer:

- Ethernet cable(s) - to connect the control surface frame(s) to Power Core, either directly or via the network.
- CAN bus cable(s) - to connect additional control surface frame(s) or external KSC or GPIO panels.

For the Virtual Extension option, the following items are also required:

- Windows 64-bit host PC - to run the Lawo GUI application VisTool.
- 1 x Display Port cable - to connect the VX module to the host PC.
- 1 x USB cable - to connect the VX module to the host PC.

> ℹ️ The following document contains more information about the host PC requirements:
>
> Vistool PC Configuration Guide.pdf.

4.3 crystal - Installing the Frame

Tabletop frames should be mounted on a flat, horizontal surface.

Countersunk frames are designed to fit flush within your studio furniture:

* The frame has rounded-off edges so that it will fit smoothly into holes cut by a wood milling machine.
* All cables can be hidden in the cable tray and connected to the console inlets at the rear of the frame.
* If the Virtual Extension is included, then the cables to the VX module can be secured behind the display.
* All countersunk frames have flat side parts without edges. Therefore, the installer must provide some kind of support onto which the surface will rest.
* Please refer to the mechanical drawing for the frame variant for details.

In both cases, all plug-in connectors are located on the frame's rear connector board and at the rear of the Virtual Extension displays. When installing, please leave enough room for the cables (and sufficient airflow around the frame for cooling).

The external connections for the surface are described in crystal - Wiring. In particular, **the crystal frame must be properly grounded**.

For Virtual Extension frames, the VX module is shipped separately. This must be mounted into the frame before the frame is installed/connected. See crystal - Mounting a VX Module.

Airflow Requirements

The frame is designed for normal studio installation and needs no special air conditioning. You must make sure that there is sufficient airflow around the frame for cooling.

Power Consumption and Electrical Voltage

See crystal - Power Supplies.

Dimensions and Weight

The dimensions are as follows:

* Modules (Main and Fader): 336mm (w) x 286mm (d)
* Tabletop frame (without VX): 352mm (w) x 383mm (d) x 53mm (h)
* Tabletop frame (with VX): 352mm (w) x 493mm (d) x 216mm (h)
* Countersunk frame (without VX), above/below desk: 352/345mm (w) x 307/293mm (d) x 14/43mm (h)
* Countersunk frame (with VX), above/below desk: 352/345mm (w) x 434/399mm (d) x 172/43mm (h)
* End-plates for counter-sunk mounting: 10mm each

The weight is from 3.3 kg to 4.6 kg, depending on the frame and module type. Please refer to the **crystal datasheet** for specific information.
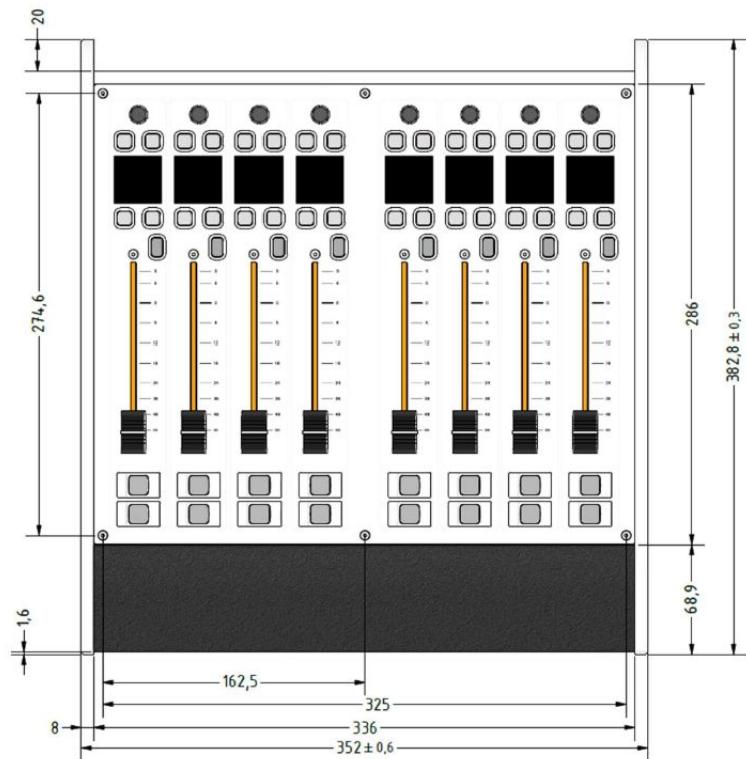
Mechanical drawings for all frame types are available from the Lawo Download Center (after login).

The following images are extracted from the drawings. For simplicity, only the light editions are shown.

* crystal Tabletop Frame: 715/30-10 or 715/30-30
* crystal Tabletop Frame with VX: 715/31-10 or 715/31-30
* crystal Countersunk Frame: 715/30-20 or 715/30-40
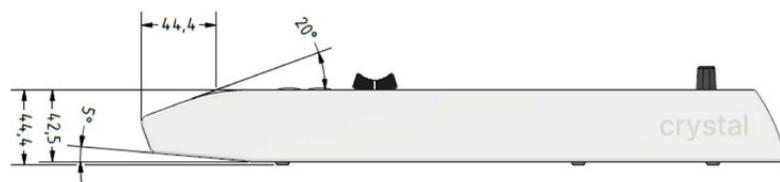* crystal Countersunk Frame with VX: 715/31-20 or 715/31-40
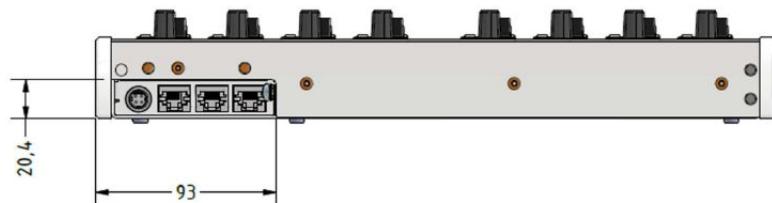
crystal Tabletop Frame

Top view:

Side view:

Front view:
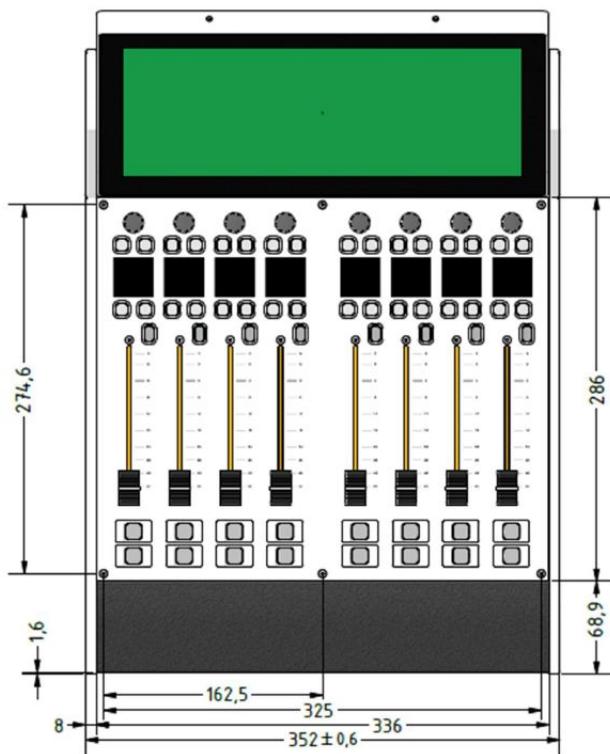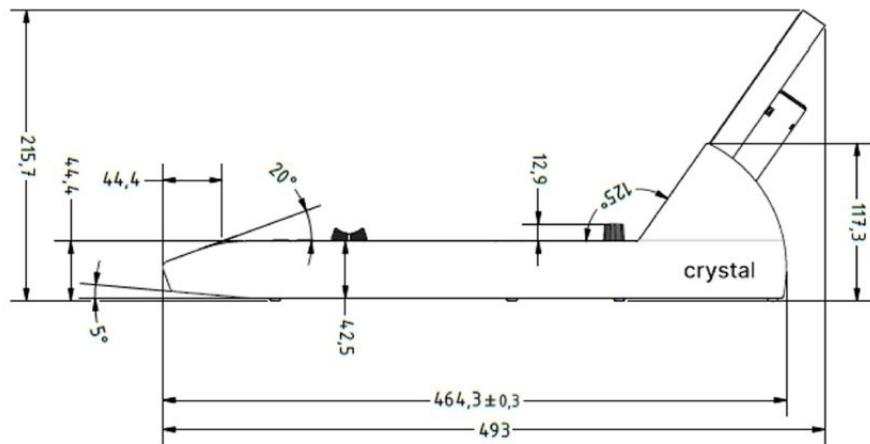
Back view:

crystal Tabletop Frame with VX

Top view:

Side view:
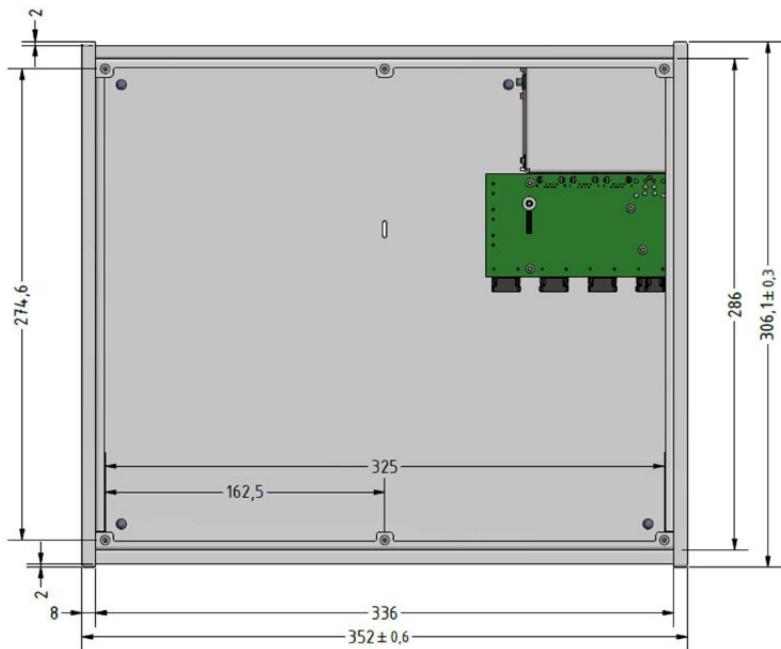
Front view:

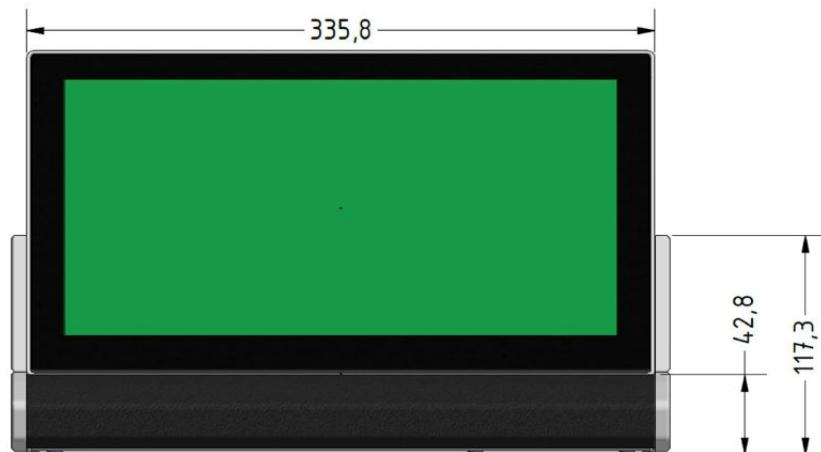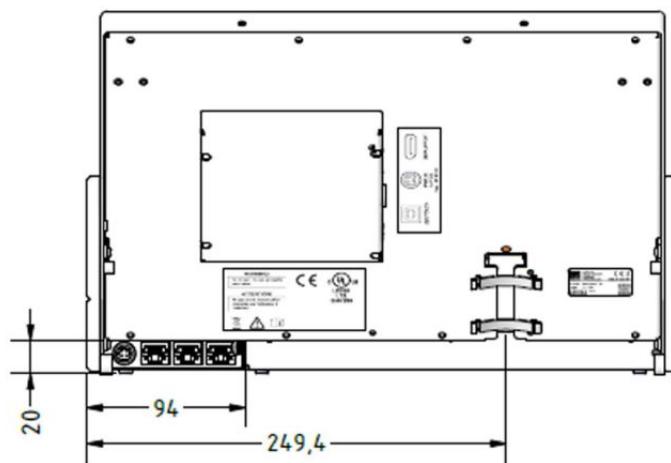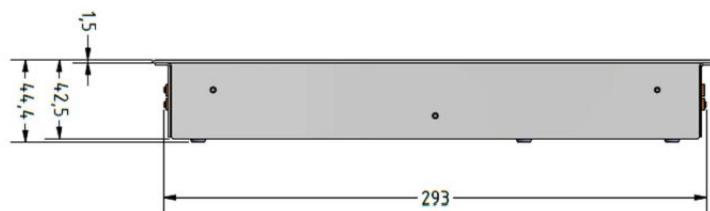
Back view:

crystal Countersunk Frame
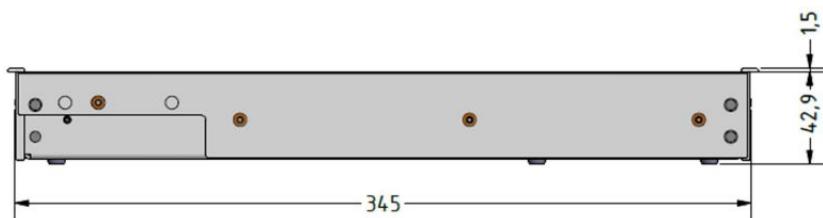
Top view:

Side view:
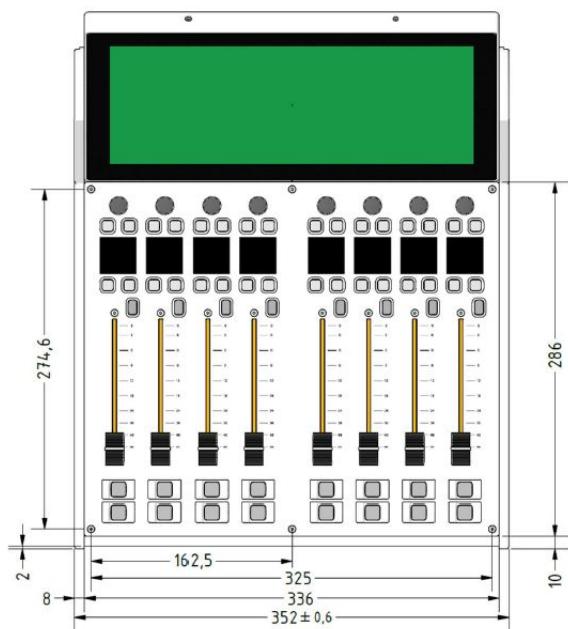
Front view:
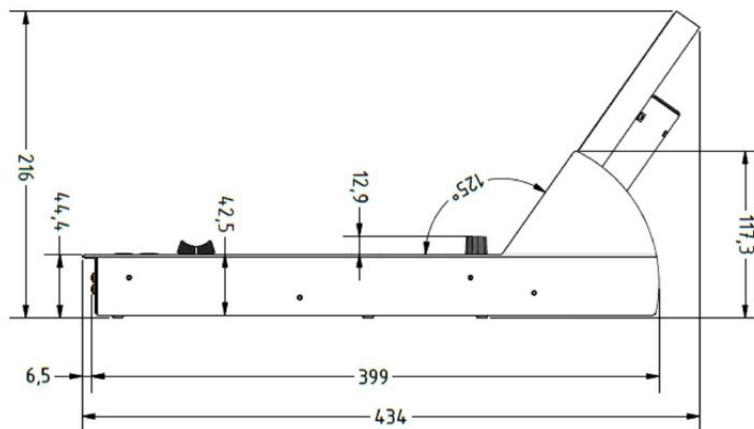
Back view:

crystal Countersunk Frame with VX
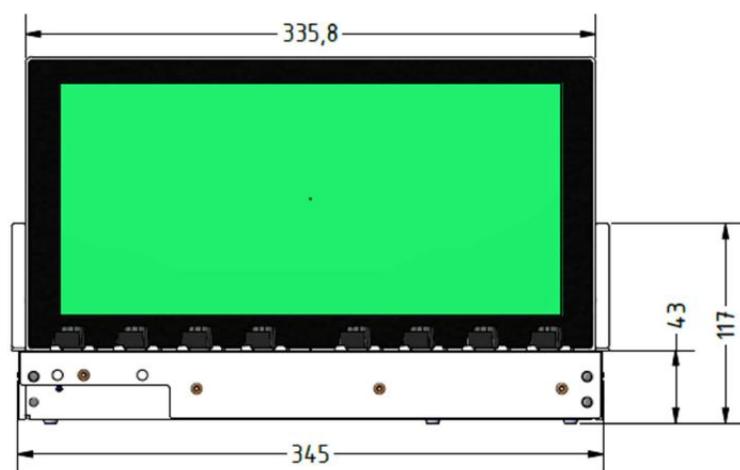
Top view:
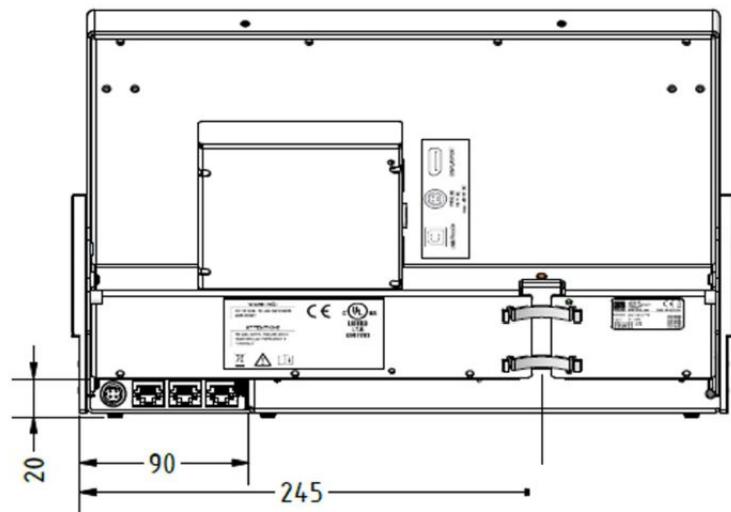
Side view:

Front view:

Back view:

4.4 crystal - Mounting a VX Module

For Virtual Extension frames, the VX module is shipped separately. This must be mounted into the frame as described below.

The same principles apply to both tabletop and countersunk frames. All VX modules are identical and so they can be mounted in any order (if you have more than one crystal frame).
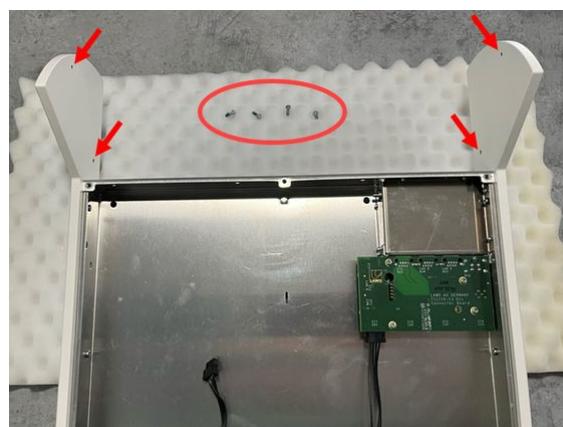
Overview

The VX module sits directly above the physical controls at a fixed viewing angle.

The VX frame comes with special side profiles that hold the VX module. Each profile includes two pre-drilled holes (for the screws that secure the module to the frame).

The image below shows the screw thread positions (from the front) in an empty frame. Note that, the frame is delivered with either a Fader or Main module fitted (and there is no need to remove the surface module).

To mount the VX module, you must place the crystal frame on one side. Slide in the VX module and secure the module to this side. Then turn over the frame and secure the opposite side.

The image below shows the four mounting screws (from the rear) once the VX module is installed.
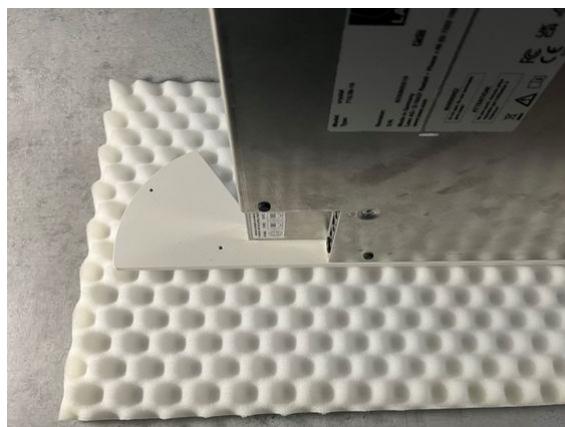
What you will need

- 1 x Torx10 driver.
- 1 x VX module (any type) - ordered using the part numbers listed <u>here</u>.
- 4 x VX module mounting screws (M3 x 8mm) - included with the VX module.

Instructions

1. Place the crystal frame on one side (either left or right is fine).

- To protect the surface finish, you should lay the frame on a piece of foam, or similar ESD-proof protective material.
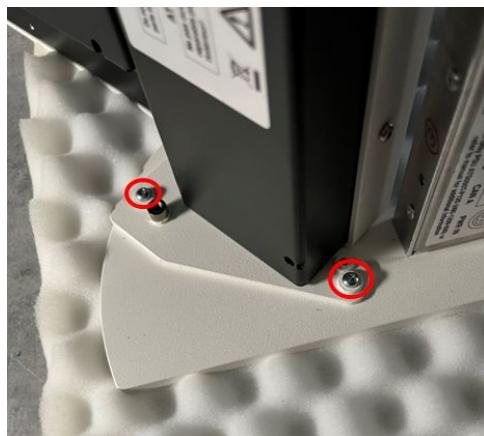
2.   Slide the VX module into the frame.

- Take the VX module out of its packaging and lay it down on a piece of foam, or similar ESD-proof protective material, beside the console.
- Carefully slide the VX module into the frame, so that the screw holes (in the module) and threads (in the frame) align. It helps to use the lower thread as a guide.
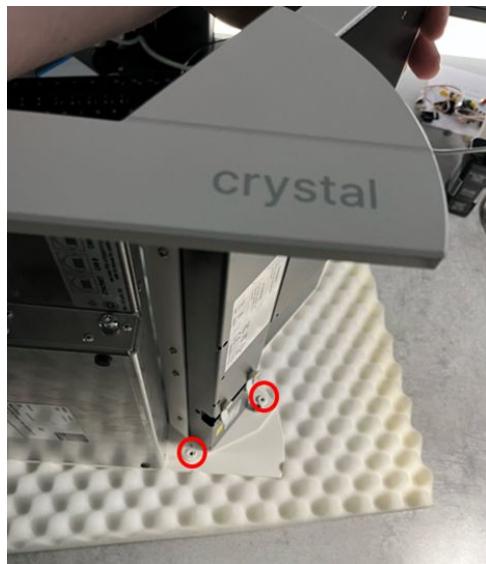
3.   Secure the VX module to the frame.

- Carefully, fit the first pair of mounting screws (M3 x 8mm), taking care to check the alignment.
- Using a Torx10 driver, tighten the screws until the VX module feels secure.

- Then lift and turn the frame onto its opposite side.
- Repeat the process using the second pair of mounting screws.

- Once all four screws are tightened, lift and turn the frame onto its underside (ready for mounting/cabling).

4. Check the mounting.

- If there is any looseness in the VX module, then tighten the four screws.
- This should be done before the frame is mounted in its final position.
- The screws can be accessed from the rear of the frame (as shown below) without needing to turn the frame onto its side.
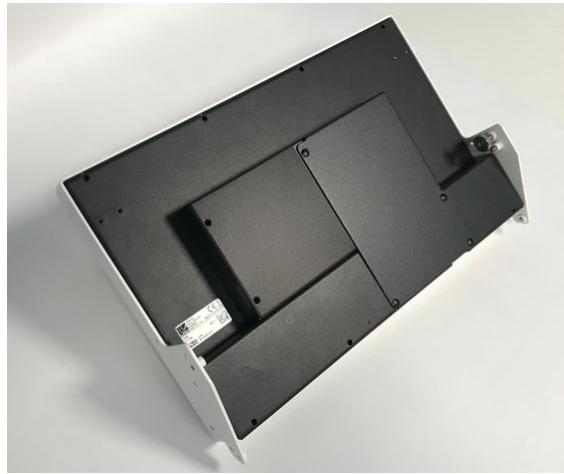
Fitting the Cable Cover

Optionally, a cable cover can be fitted to protect the connections and make the rear of the console look nicer. The cable cover is not included and must be ordered separately.

The cable cover should be fitted once the VX module is connected and the system is fully tested.

There are four plastic pins that hold the cover in place. The image below shows the rear of a VX module with the cable cover fitted.

Virtual Extension rear (with cable cover)
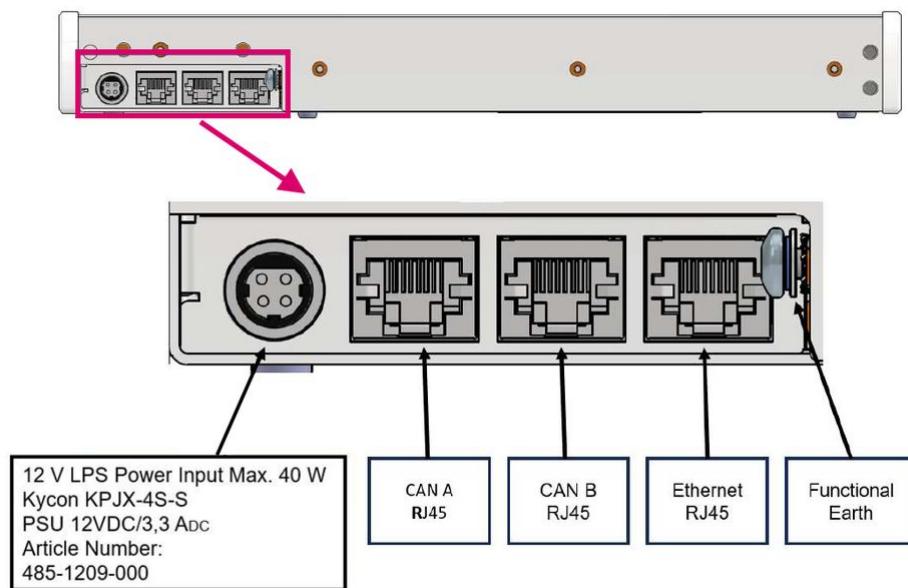
4.5 crystal - Wiring

This topic describes the wiring from the crystal frame.

If the frame includes a VX module, then please also refer to crystal - Configuring the Virtual Extension.

crystal Frame (Connections)

All plug-in connectors are located on the frame's rear connector board.

Power In (Kycon)

The **Power In** port connects to the external DC power supply (to power the frame).

See crystal - Power Supplies.

CAN A & CAN B (RJ45)

The crystal frame supports two CAN bus speeds: CAN A (high speed) and CAN B (low speed).

- **CAN A** operates at 1Mb/s. It can be used to connect a second crystal frame.
- **CAN B** operates at 500Kb/s. It is included to support products that cannot operate at a higher speed such as Lawo's KSC and GPIO panels.

All CAN bus connections must be point-to-point; a switch or hub is not allowed.

Use a standard (straight 1:1) network cable: STP-CAT 5e with RJ45 connectors.

> ❌ **Important:**
> - **The CAN A port on the crystal frame must be fitted with the terminator** (provided), unless you are linking another frame.
> - When linking two frames via CAN bus, **the CAN A cable length must not exceed 13 meters**.

The maximum CAN B (low-speed) cable length must not exceed 60 meters.

The CAN bus can be hot-plugged and so the cabling can be performed while the frames are powered.

ETHERNET (RJ45)

The **ETHERNET** port provides a network connection to the crystal IP module. It is used for the IP connection (to Power Core or OSC device) and for the crystal Web UI administration.

When connecting via a network, then this can be shared with other devices, such as in the regular "house network" of a typical broadcast facility. Routers are permitted as long as the minimum requirements of the network interfaces are met. By using routers, or similar devices, the latency of the communication will increase.

The control network interface in crystal operates at 100 BASE-T. This means that the network switch/router port used for the surface MUST meet the following requirements:

- **Speed = 100Mb/s**
- **Duplex mode = Full Duplex**

Choose an Ethernet cable that meets the following specification.

- Cable: CAT 5 or CAT 5e; straight (1:1) cable.
- Connector: RJ45.
- Speed: 1000 or 100 Base-TX LAN. 100 Base-TX (Fast Ethernet) is recommended.
- Length: up to 100m (to the network switch).

Functional Earth

The M4x10 grounding screw **must be used to ground the frame**. If not, then you may see some odd behaviours once the console is operational.

See crystal - Grounding.

4.6 crystal - MF Key Labels

When ordered with Power Core, the crystal surface ships with the correct MF key labels for the standard configuration. The labels for each control surface module can be viewed here.

If you change the MF key functionality, then you will need to exchange the foil-printed labels. Printed sheets with the most common labels are included with each frame.

Ordering Custom Labels

If you wish to order some custom labels, then edit the "new_crystal_project_key_labels.xlsx" spreadsheet and attach it in an email to tastenschilder@lawo.com.

Please remember to add the Customer name, Project name and shipping details.

The spreadsheet can be opened or downloaded using the link below:

https://lawo.com/Downloadery//20_Radio_Consoles/Documentation/Technical_Documentation/Key_Templates/new_crystal_project_key_labels.xlsx

Exchanging the MF Key Labels

1. First remove the button cap.

It helps to use a small screwdriver to lift up the button cap (as the caps are recessed). However, you must take care not to scratch the surface.

2. Insert the foil plate between the button body and the transparent button cap.

3. Fasten the button cap back onto the button body by pressing it!

crystal - User Manual

5 crystal - System Setup

This chapter describes how to set up the system once all of the hardware components are installed.

The topics here describe a system operating with Power Core. If you plan to use crystal as a controller only, see crystal - Controller Mode.

- crystal - Setup Instructions
- crystal - Configuration Tools
- crystal - Opening a Web UI Session
- crystal - Control Network Requirements
- crystal - Network Settings
- crystal - Control Interface Settings
- crystal - Communication Modes
- crystal - Slot IDs
- crystal - Configuring the Virtual Extension

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5.1 crystal - Setup Instructions

This topic describes how to setup a crystal surface to operate with Power Core.

Prerequisites

The connection between the surface and Power Core must be made via TCP/IP Ethernet, either directly or via a network (LAN or WAN).

When connecting via a network, it is expected that all switches/routers meet the control network requirements described here.

If the crystal surface consists of two frames, then you will need to decide how to connect the second frame: either via CAN bus (to the main frame) or via IP (to the network).

> ℹ️ The IP connection(s) to Power Core may use either a Multicast or Unicast IP address scheme. If you wish to use Unicast IPs for more than one frame, then this requires some additional configuration (in the ON-AIR Designer).

Requirements

Please make sure that you have all necessary applications and tools available before you start.

To setup the system, you will need a PC with a network interface card (NIC). The PC must be installed with Lawo's **ON-AIR Designer** and **SoP Explorer** software plus a suitable web browser. It is strongly recommended that the versions used are from the same release package. You can find information about the software versions and installers here.

To setup the crystal frame, you will need:

- 1 x desktop power supply (485-1209-000) - to power the frame.
- 1 x 2m IEC power cable (country-specific) - to connect mains to the desktop power supply.
- A network connection between the surface and Power Core - either via a network switch or point-to-point.

If the frame includes a VX module, then the following items are also required:

- 1 x desktop power supply (485-1209-000) - to power the VX display.
- 1 x 2m IEC power cable (country-specific) - to connect mains to the desktop power supply.
- Windows 64-bit host PC - to run the Lawo GUI application **VisTool**. This can be the same PC as used for the configuration software.
- 1 x Display Port cable - to connect the VX module to the host PC.
- 1 x USB cable - to connect the VX module to the host PC.

Please refer to the crystal Packing List for information about what is included with the shipment.

Connections
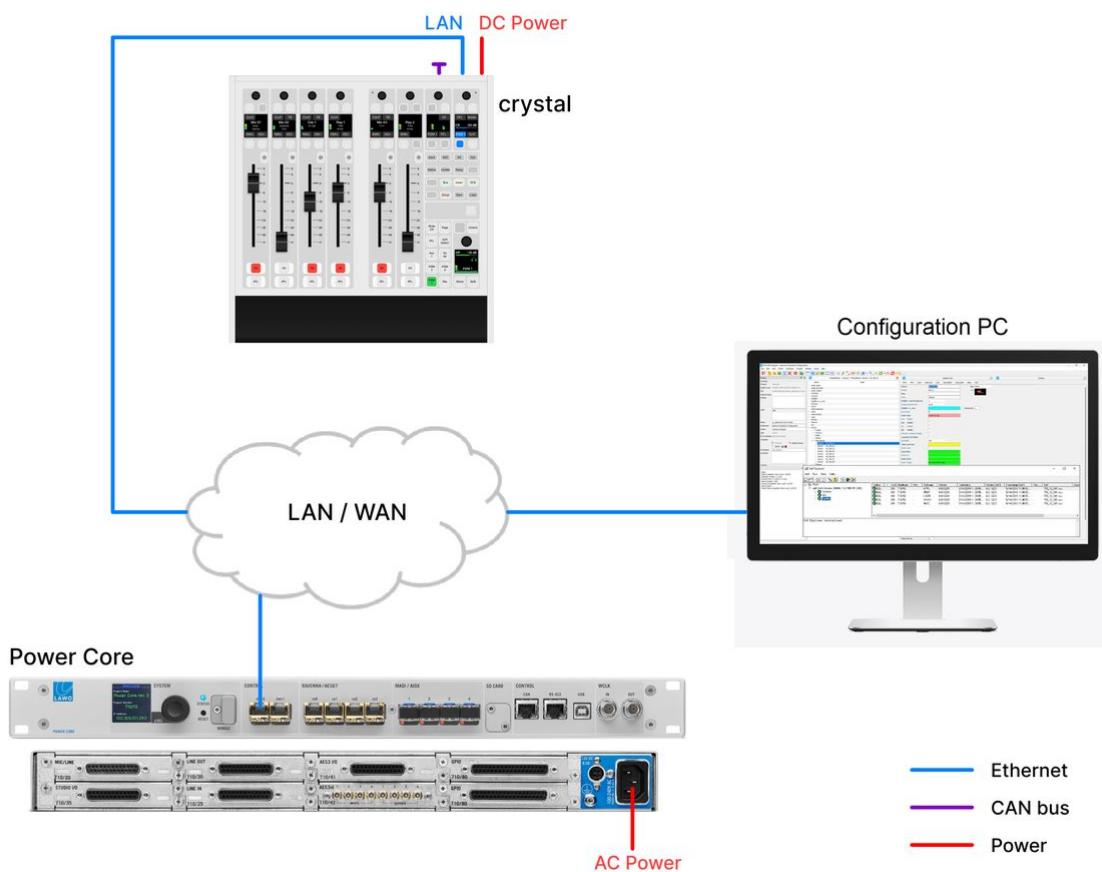
To boot and configure the system, the following connections must be made:

- The crystal frame must be grounded.
- The crystal frame must be connected via Ethernet to the network/Power Core.
- The crystal frame and Power Core must be powered.

The Ethernet connection can be made directly (point-to-point) but it is more usual to connect via a network (as shown below).

- To connect the crystal frame, use the ETHERNET port (on the rear of the frame).
- To connect Power Core, it is recommended to use the first control port: dwc0.

For more information about the connectors and cabling requirements, see crystal - Wiring and Power Core - Wiring.

> ❌ **Important:** The CAN A port on the crystal frame must be fitted with the terminator (provided), unless you are linking another frame.

Boot-Up
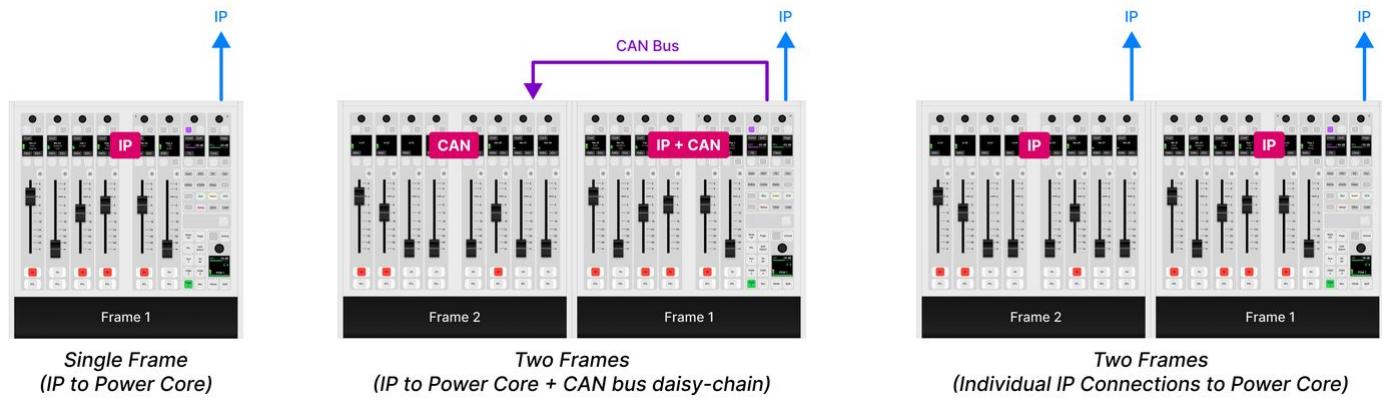
Once power is applied, the system boots in a few seconds:

- On the surface, the displays show information about the surface module and then, after a few seconds, the Lawo logo.
- On Power Core, the boot-up progress is shown on the front panel display.

While the crystal frame is booting up, check the communication mode shown on the surface module. There are three possible options: IP+CAN, CAN or IP.

- The **IP** mode should be used if there is a single module connecting to Power Core (via IP).
- The **IP+CAN** and **CAN** modes can be used if you are connecting a second frame using an external CAN bus cable. In this instance, choose **IP+CAN** for the first frame and **CAN** for the second frame.

The image below shows the communication modes (in pink) for each option.

Single Frame
(IP to Power Core)

Two Frames
(IP to Power Core + CAN bus daisy-chain)

Two Frames
(Individual IP Connections to Power Core)

If you need to reset a module's communication mode, then this can be done from the surface. See crystal - Communication Modes.

Configuration

1. Start the configuration by connecting your PC's LAN port directly to the crystal frame.

This is done using the frame's ETHERNET port.
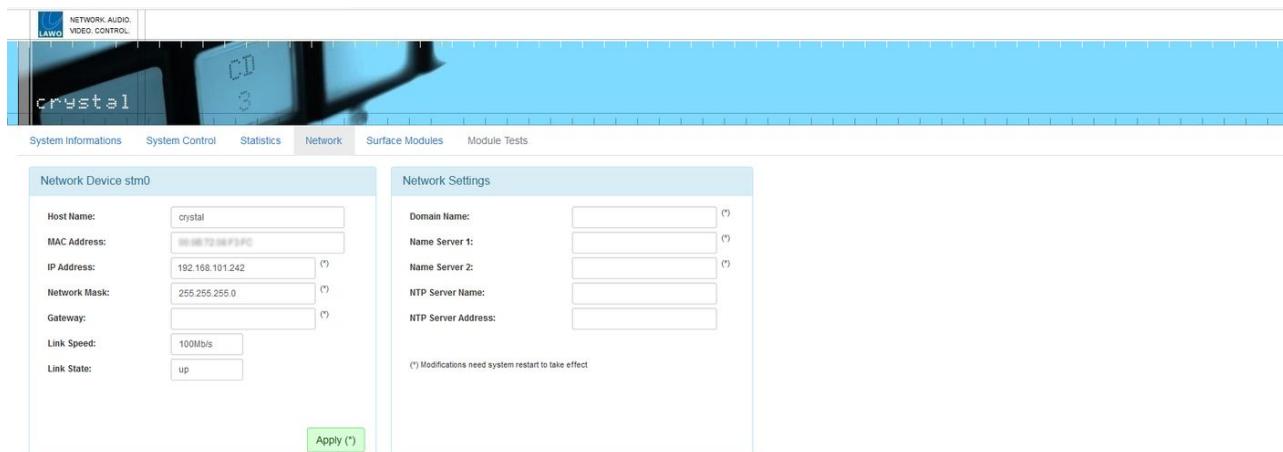
2. Configure the network settings for the frame's IP module.

This step is necessary if you wish to fit crystal into an existing network OR install more than one device (to avoid IP conflicts).

The settings are edited by opening a Web UI connection to the frame and adjusting the parameters in the "Network" tab.

- The Web UI can be reached by entering the current IP address. The default IPs are:
  ◦ **192.168.101.242** (for a Main module),
  ◦ **192.168.101.243** (for a Fader module).
- Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
- Open the "Network" tab and enter the required network settings.

The following fields can be edited: **IP Address, Network Mask** and **Gateway**. Type in the new value(s) and select **Apply** to save the changes.
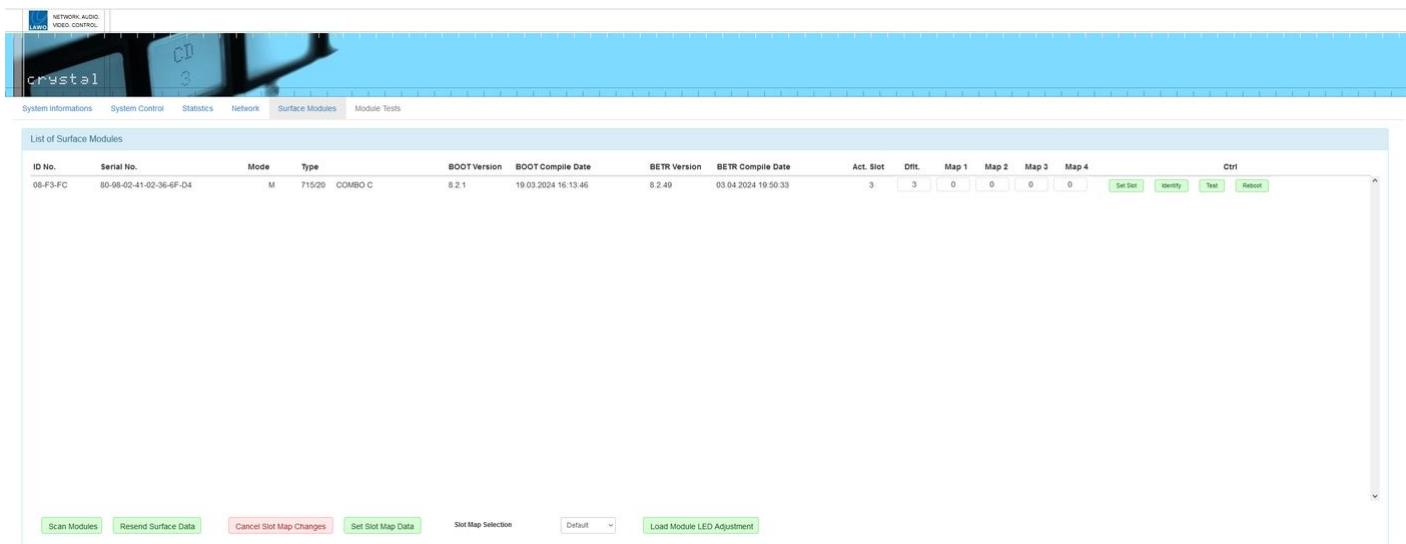
At this stage, you can reconnect your devices via the control network OR continue on (if you plan to connect the frame directly to Power Core).

It is recommended to check the network connection to your configuration PC by re-opening the crystal Web UI.

3. Configure the surface module(s).

This step ensures that the correct slot ID is assigned to the surface module(s) and that all modules are known to the IP module (if there is more than one frame).

Start by opening the "Surface Modules" tab in the crystal Web UI. Here you will see a list of all modules in the surface. If the list is empty, press the **Scan Modules** button (at the bottom of the page).

The **Mode** column can be used to identify the master (**M**) and slave (**S**) modules.

- The master (**M**) is the module that connects to Power Core via IP.
- The slaves (**S**) are all modules that are connected to the master via high-speed CAN.

For a single-frame surface, you will see one master module (**M**).

For a split-frame (14-fader) surface, where the second frame is connected via CAN, you will see two modules: one master (**M**) and one slave (**S**).

Please note: If the two frames connect individually to Power Core via IP, then each frame has a single master module which is addressed separately (via its own IP address).

If you need to reset a module's communication mode, then this can be done from the surface. See crystal - Communication Modes.

The **Act. Slot** column shows the module's active slot ID. This is important as it determines the functionality of the module (as explained later).

During the initial setup, you should use the **Dflt** value to assign the correct slot ID to each physical module.

- Start by entering the required slot ID into the **Dflt** field - the edited value and **Set Slot** button highlight in yellow.
- Press **Set Slot** to make the assignment.
- Wait for the **Act. Slot** field to update and check its value.
- Repeat these steps for each module.

Note that the alternate mappings (**Map 1** to **4**) can be used to change the slots ID during operation. For now, it is recommended to leave these values at **0**.

4. Check the control mode for the surface.

This step ensures that the frame is configured to communicate with Power Core (and not with a OSC device).

Open the "System → Control" tab in the crystal Web UI and check the **Module Control Mode** option (under "Control Functions"). This must be set to **PowerCore Control**.

If **OSC Control** is selected, then change the option (from the drop-down menu) and click on **Reboot System** (to switch the mode).

5. Configure the IP connection between the surface and Power Core.

This is done using the "Control Interface" parameters stored on each device.

To check or edit the settings, open a Web UI connection to both the crystal frame and Power Core, and log in as either Supervisor or Administrator. Then look for the "Control Interface" parameters (in the "System → Control" tab).

It is important to check both sides of the connection, so open a separate browser window for each device. In crystal, the parameters are labelled "PowerCore Control Interface" (to distinguish them from the "OSC Control Interface").

The **Mode** must be set to **CAN+IP** in Power Core and either **IP** or **CAN+IP** in crystal. (The **CAN+IP** option should be used if there is a CAN bus connection to a second frame.)

The **Target IP address** determines the IP address scheme.

*   To use Multicast, the **Target IP Addresses** in Power Core and crystal must be identical. So, enter a suitable IP address group in Power Core and then copy it to crystal. The default setting is 239.1.1.240
*   To use Unicast, you must enter the reciprocal IP addresses. So, enter the crystal control port IP address (in Power Core) AND enter the Power Core control port IP address (in crystal).

The other fields can be left at their default values.

If you make any changes to the "Control Interface" settings, then you must reboot the device(s).

The screenshots below shows an example of a multicast configuration using the default multicast IP address group.

If everything is correctly connected and configured, the surface synchronizes to Power Core once the IP connection is made.

Connecting a Second Frame (via CAN)

For a split-frame (14-fader) surface, where the second frame is connected via CAN, follow the steps above to setup the first frame.

In step 5, set the crystal **Mode** to **CAN+IP** (to support a CAN bus connection to the second frame) and reboot the surface.

Then use a CAT 5e cable to connect **CAN A** on the first frame to **CAN A** on the second frame. In this instance, the CAN bus is terminated automatically and so you can remove and store the terminators provided.

> ❌ **Important**: The CAN A cable length must not exceed 13 meters.

If everything is correctly connected and configured, the surface synchronizes to Power Core once the IP connection to the first frame is made.

Connecting Two Frames (via IP)

If you wish to connect more than one frame via IP, then each frame must be configured separately.

In step 5, set the crystal **Mode** to **IP** (for each frame) and choose the IP address scheme as follows.

- To use Multicast IPs, the **Target IP address** fields in the "Control Interface" settings must be identical.
- If you wish to use Unicast IPs, then this requires some additional configuration (in the ON-AIR Designer). More information will follow.

Take care to check each of the crystal IP frames and Power Core by opening a Web UI session to each device. Remember to reboot the devices if you make changes to the "Control Interface" settings.

For the wiring, when frames are connected via IP, there is no need for an external CAN connection and so **the CAN A ports must be terminated** (using the terminators provided).

If everything is correctly connected and configured, each frame synchronizes independently to Power Core, This happens as soon as each IP connection is made.

Connecting KSC or GPIO Panels

The **CAN B** port can be used to connect one or more KSC or GPIO panels in a daisy-chain manner.

- The first connection must be made from an Ethernet frame (connected to Power Core via IP).
- In total, the CAN B cable length must not exceed 60 meters.
- On the last KSC/GPIO panel in the chain, you must fit the CAN bus terminator (provided).

5.2 crystal - Configuration Tools

This topic describes how to prepare the configuration PC.

Overview

To set up the system, you will need a PC with a network interface card (NIC). The PC must be installed with Lawo's ON-AIR Designer software and a suitable web browser.

The Lawo software installs two applications:

- **ON-AIR Designer** is used to edit and upload a configuration to Power Core (to define the functionality of the system).
- **SoP Explorer** is used to check and update the firmware (for all hardware components).

It is strongly recommended that the software versions used are from the same release package. You can find information about the software versions and installers <u>here</u>.

The web browser is used to open the **Web UIs** for crystal and Power Core. These are used to edit the network settings (to add the devices to an existing network) and "Control Interface" settings (to configure their method of communication). The crystal Web UI is also used to setup the surface module.

Host PC Requirements

To install and run the ON-AIR Designer, your PC must meet the following requirements:

- Windows 10 or 11 operating system*
- Core-I5 (or higher) CPU
- 2GB RAM, minimum

*For the operating system, we recommend Windows 10 or Windows 11, although the ON-AIR Designer software will also run on Windows 7, 8 and 8.1.

If you are planning to install a VisTool application on the same machine, then please also refer to the VisTool MK2 requirements (in the <u>VisTool</u> documentation).

Installing the Software

The latest version of the **onair-designer.exe** installer is available from the <u>Lawo Download-Center</u> (after login).
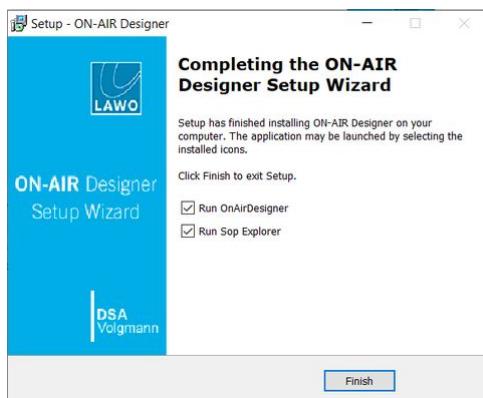
1. Copy the installer onto your PC and double-click on its icon to start the software setup wizard.

2. Follow the on-screen instructions, accepting the default options provided.

3. When you reach the 'Summary' window, check the options and click **Install** - the software is installed onto your computer; this may take a few minutes.

By default, files are installed in the location: 'C:\Program Files\OnAirDesigner'.

4. When the installation is complete, the following window appears.

5. It is recommended to leave the default "Run" options selected and click on **Finish**.

This launches the ON-AIR Designer and SoP Explorer applications. In both cases, the next step is to configure a valid network connection to the Lawo system.

Getting Connected

To establish a network connection to the Lawo system, you will need to configure the network settings for your PC's LAN port.

The **IP Address** must be unique and set within the same range as that of the port you are connecting to (i.e. the first three fields must match).

You can check the current network settings for Power Core on its front panel display, and those for crystal or diamond from the surface displays during boot-up.

The default IP addresses are:

- Power Core = 192.168.101.240
- crystal/diamond = 192.168.101.241

The **Subnet Mask** should be identical to that of the port you are connecting to.

The default subnet mask = 255.255.255.0

A **Default Gateway** setting is required if data packets are to be redirected. For example, if the computer is connected via a network switch with Layer 3 routing capability.

If redirection is not required, then the Default Gateway can be left blank.

To test the connection, open a web browser application and enter the system's IP address into the URL field. e.g. 192.168.101.240 - if the connection is successful, the Web UI "Login" screen appears.
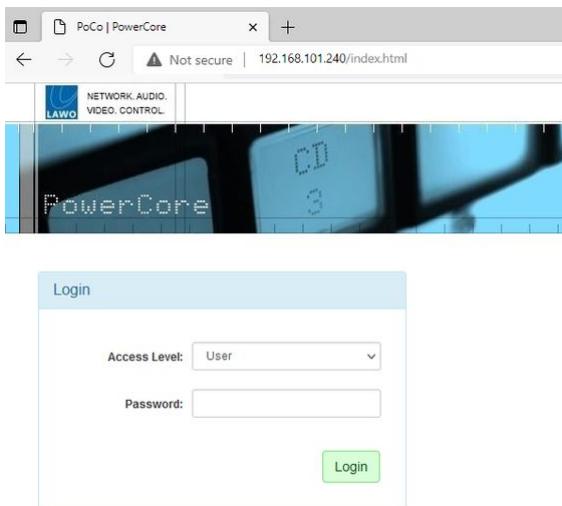
5.3 crystal - Opening a Web UI Session

This topic describes how to open a Web UI connection and log in.

1. Open a web browser application and enter the system's IP address into the URL field.

For example, enter **192.168.101.240** for Power Core or one of the following IPs for the crystal surface: **192.168.101.242** (for a Main module) or **192.168.101.243** (for a Fader module).

Following a successful connection, the "Login" screen appears. The example below shows the login screen for Power Core.

2. Select an Access Level and enter the Password.

There are three possible Access Levels.

- **User** (no password required, leave blank).

  Information is displayed as "read-only" with no editable fields.

- **Supervisor** (default password = *orion*).

  Allows pertinent fields to be edited, such as the IP settings in the "System → Network Devices" tab.

- **Administrator** (default password = *hydra*).

  As for Supervisor, but with access to Supervisor and Administrator passwords in the "System → Control" tab.

For security reasons, it is recommended to change the Administrator and Supervisor passwords from the defaults after the device is set up.

3. Click on the green **Login** button.

Following a successful login, the current information is loaded from the device, and the "System → Information" tab appears.

Power Core has many system parameters and so it will take a few seconds for the information to load. Some of the information is displayed as a "snapshot" of the current data, so it is only as current as the latest refresh.

5.4 crystal - Control Network Requirements

The crystal surface always connects to Power Core via TCP/IP Ethernet. This connection can be made either directly (point-to-point) or via a network (LAN or WAN).

When connecting via a network, then this can be shared with other devices, such as in the regular "house network" of a typical broadcast facility. Routers are permitted as long as the minimum requirements of the network interfaces are met. By using routers, or similar devices, the latency of the communication will increase.

The control network interface in crystal operates at 100 BASE-T. This means that the network switch/router port used for the surface MUST meet the following requirements:

- **Speed = 100Mb/s**
- **Duplex mode = Full Duplex**

The control network interfaces in Power Core can operate at 1000, 100 or 10 BASE-T, depending on the SFP. This means that the network switch/router port(s) used for Power Core MUST meet the following requirements:

- **Speed =** 1Gb/s, 100Mb/s or 10Mb/s; **1Gb/s is recommended**
- **Duplex mode = Full Duplex**

5.5 crystal - Network Settings

This topic describes how to configure the network settings for the crystal frame(s) and Power Core control ports.

Active Network Ports

Each crystal frame is equipped with a single ETHERNET port. The communication mode of the IP module determines whether the ETHERNET port is active.

- ETHERNET (active) when mode = IP or IP+CAN.
- ETHERNET (inactive) when mode = CAN.

Power Core is equipped with two control ports that are always active: dwc0 and dwc1.

Default Network Settings

By default, the network interfaces are assigned the following IP addresses. Note that Power Core can handle static IP addresses only; DHCP is not supported.

The default IP for crystal varies depending on whether the frame is fitted with a Main or Fader module.

Network Port	IP Address		Subnet Mask	Gateway
crystal - ETHERNET (Main module)	Static only	192.168.101.242	255.255.255.0	0.0.0.0
crystal - ETHERNET (Fader module)	Static only	192.168.101.243	255.255.255.0	0.0.0.0
Power Core - dwc0	Static only	192.168.101.240	255.255.255.0	0.0.0.0
Power Core - dwc1	Static only	192.168.102.240	255.255.255.0	0.0.0.0

Current Network Settings

You can check the current network settings as follows.

- For Power Core, the dwc0 settings are shown on is front panel display.
- For crystal, the IP module (ETHERNET port) settings are shown on the surface displays during boot-up. See crystal - Powering On.

On the crystal surface, you can reset the ETHERNET port to its default IP address by pressing the 3 upper left buttons on the IP module (during boot-up). Note that this also resets the communication mode of the module to **IP**.

Editing the Network Settings

The network settings can be edited by opening a Web UI connection to Power Core and then crystal. You will need to do this if you are installing more than one system (to avoid any IP conflicts).

1. For the initial setup, best practice is to connect your configuration PC directly to each device.

- For Power Core, it is recommended to use the first control port (dwc0).
- For crystal, use the ETHERNET port.

2. The Web UI can be reached by entering the IP address of the connected port.

For Power Core (dwc0 port), the default IP = 192.168.101.240

For crystal (ETHERNET port), the default IPs are:

*   192.168.101.242 (for a Main module),
*   192.168.101.243 (for a Fader module).

Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.

3. In the Power Core Web UI, select the "System → Control Network Devices" tab.

This page shows the settings for both of the control network interfaces: **Device dwc0** and **Device dwc1**.

> ⚠️ **Important**: After updating the system to a new version, it is recommended to clear the cache of the web browser (to avoid old information being displayed).

The editable fields are marked with an asterisk (*) and include the **IP Address**, **Network Mask** and **Gateway**.
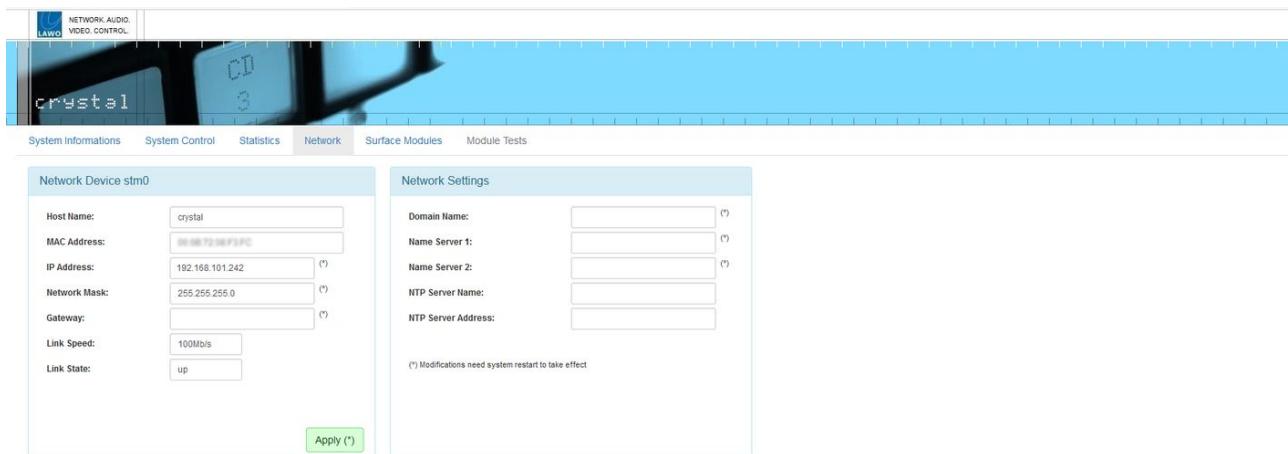
4. Type in the new value(s) and click **Apply** to save the changes.

IP address changes are made immediately, and so you will lose your browser connection once settings are applied. It is recommended to check the communication by re-opening the Web UI using the new IP address.

The configuration of the Power Core control port(s) is now complete.

> ℹ️ A Domain Name Server can be entered via the "System → Network Settings" tab.

5. In the crystal Web UI, select the "Network" tab.

In this instance, there is only one Network Device (for the ETHERNET port).

As before, you can edit the **IP Address**, **Network Mask** and **Gateway**. Remember to click **Apply** to save any changes, and re-open the Web UI to check a change of IP address.

The configuration of the crystal control port is now complete.

6. Once the correct network settings are in place, you can connect the devices to the control network.

7. To continue with the setup, enter the new IP addresses into your browser and log in again (as described above).

5.6 crystal - Control Interface Settings

This topic describes the "Control Interface" parameters that are used to configure the IP connection between the surface and Power Core.

The correct settings for your system will depend on whether the surface comprises one or two frames.

To check or edit the settings, open a Web UI connection to each device, log in as either Supervisor or Administrator, and look for the "Control Interface" parameters (in the "System → Control" tab). It is important to check both sides of the connection, so open a separate browser window for each crystal frame and Power Core.

If you make a change to the "Control Interface" settings, then you must reboot the device(s).

On Power Core...

On the Power Core side, there are four parameters: **Mode**, **Target IP Address**, **Target port number** and **Interface**.

Mode - sets the communication mode for the surface connection. There are three possible options: CAN+IP, CAN or IP.

- The default setting is CAN+IP. In this mode, Power Core can communicate with locally connected CAN bus panels (via its CAN port) and with crystal or diamond (via Ethernet).
- Choose CAN if there is no Ethernet connection to a surface or IP radio panel.
- Choose IP if there is no local CAN port connection to a CAN bus panel.

Target IP Address (Uni/Multicast) - sets the IP address for the surface connection.

- To use Multicast, the **Target IP Addresses** in Power Core and the surface must be identical. So, enter a suitable IP address group here and then copy it to crystal or diamond. The default setting is 239.1.1.240
- To use Unicast, you must enter the reciprocal IP address. So, enter the surface control port IP address here.

Target Port Number - sets the port number for the surface connection. The default is 6040.

Interface - selects the network interface for the surface connection.

- The default is dwc0.
- To use a different interface, choose an option from the drop-down menu: dwc0, dwc1, ra0, ra1, ra2 or ra3.

On crystal...

On the crystal side, start by checking the **Module Control Mode** option (under "Control Functions"). This must be set to **PowerCore Control** (and not **OSC Control**). If you need to change the mode, then a reboot is required.

Then configure the "PowerCore Control Interface" parameters: **Mode**, **Target IP Address** and **Target port number**.

Mode - sets the communication mode of the surface module. There are three possible options: CAN+IP, CAN or IP.

- The IP mode should be used if there is a single module connecting to Power Core (via IP).
- The CAN+IP and CAN modes can be used if you are connecting a second frame using an external CAN bus cable. In this instance, choose CAN+IP for the first frame and CAN for the second frame.

Note that the communication mode can also be reset from the surface (as described in the <u>next topic</u>).

Target IP Address (Uni/Multicast) - sets the IP address for the Power Core connection.

- To use Multicast , this **must match** the IP address group entered in Power Core. The default setting is 239.1.1.240
- To use Unicast, enter the reciprocal IP address. So, enter the Power Core control port IP address here.

Target Port Number - sets the port number for the Power Core connection. The default is 6040.

Note that there is no **Interface** field in crystal (as there is only one Ethernet interface per connector board).

Using a Different Network Interface on Power Core

It is possible to use any of the Power Core network ports for the IP connection to the crystal surface. For simplicity, it is recommended to use dwc0.

If you wish to configure a different network interface, then work through the following steps:

1. Start by connecting via dwc0 (to access the Power Core Web UI).
2. From here, edit the IP settings of the port you wish to use (via the "Network Devices" tab).
3. Then edit the **Interface** option (under "Control Interface" in the "System → Control" tab).
4. Reboot Power Core and check the communication.
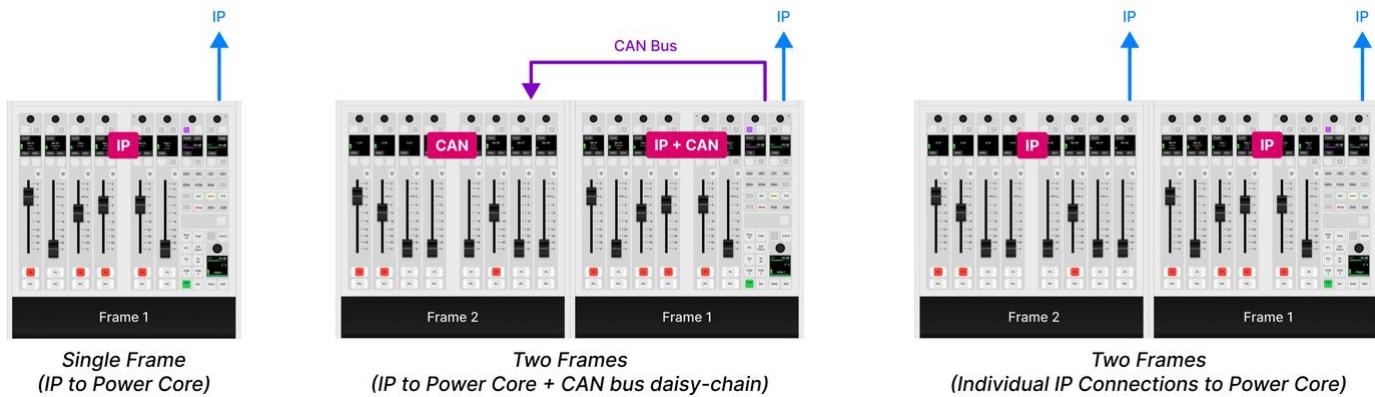
5.7 crystal - Communication Modes

As part of the system setup, a communication mode must be assigned to each control surface module.

There are three possible options: IP+CAN, CAN or IP.
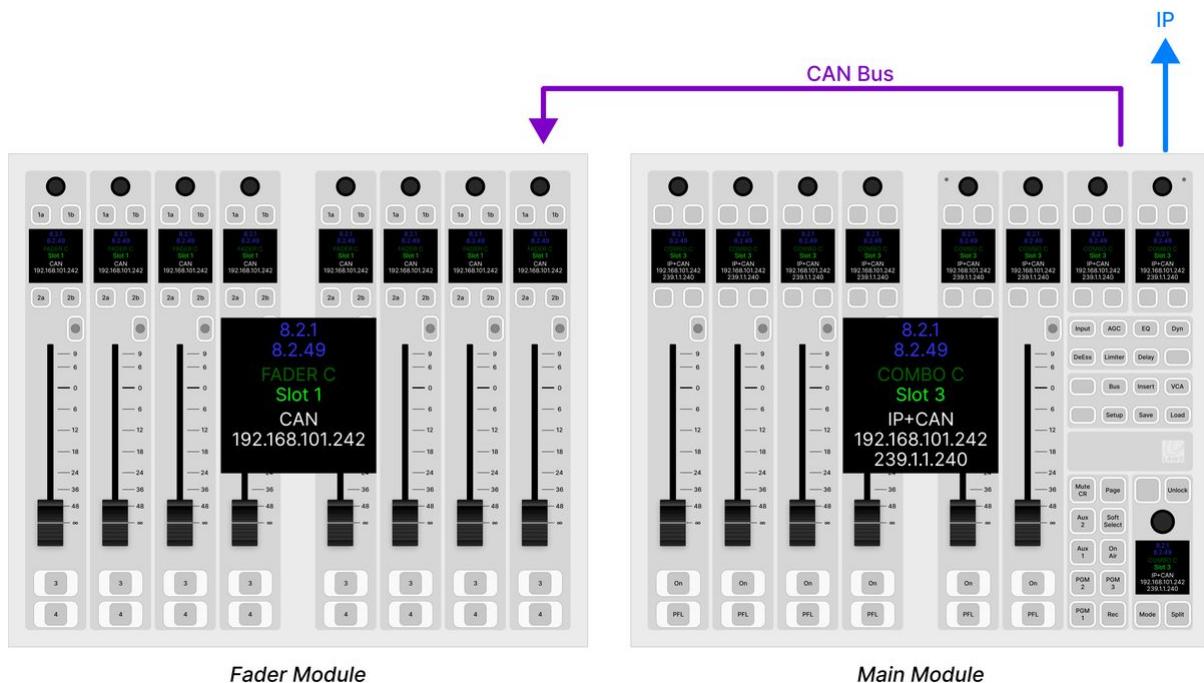
- The **IP** mode should be used if there is a single module connecting to Power Core (via IP).
- The **IP+CAN** and **CAN** modes can be used if you are connecting a second frame using an external CAN bus cable. In this instance, choose **IP+CAN** for the first frame and **CAN** for the second frame.

The image below shows the correct communication modes (in pink) for each cabling option.

Single Frame
(IP to Power Core)

Two Frames
(IP to Power Core + CAN bus daisy-chain)

Two Frames
(Individual IP Connections to Power Core)

The communication modes are shown on the surface displays during boot-up.

In the example below, the crystal surface comprises two frames. The first frame (on the right) connects to Power Core via IP and to the second frame via CAN. The second frame (on the left) connects to the first frame via CAN.

Fader Module

Main Module
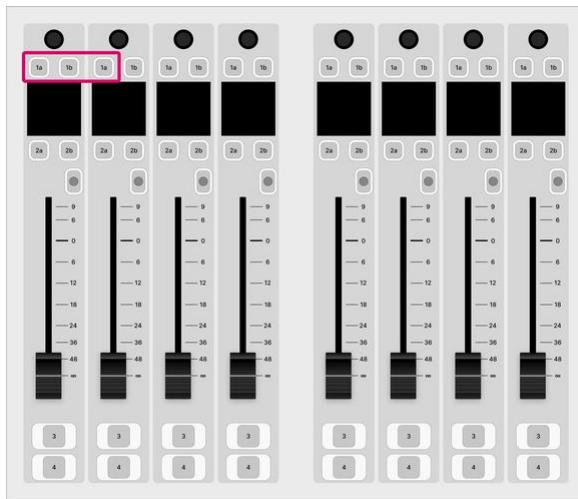
How to Reset the Communication Mode(s)
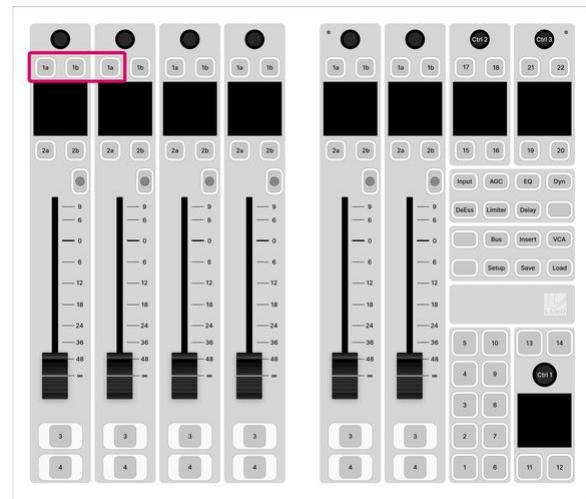
A module can be reset to either IP or CAN using the following key combinations (while the module is booting).

Reset to IP

To reset a module's communication mode to "IP" and IP address to the default (either 192.168.101.242 or .243), press and hold the 3 upper left keys (during boot-up). The image below shows the correct key combinations.
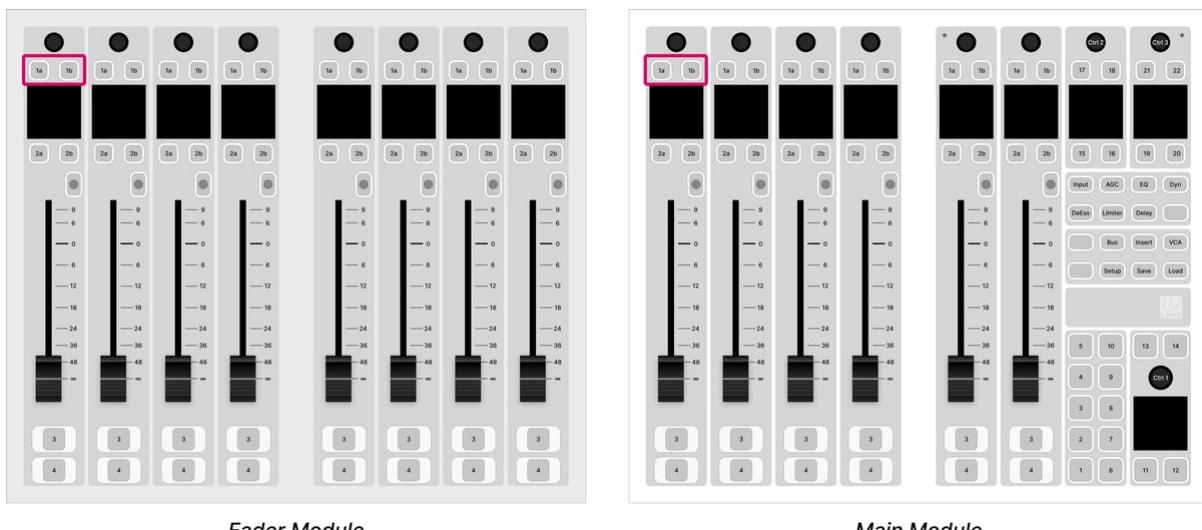
Fader Module

Main Module

Reset to CAN

To reset a module's communication mode to "CAN" and slot ID to "0", press and hold the 2 upper left keys (during boot-up). The image below shows the correct key combinations.

Fader Module   *Main Module*

Reset to IP+CAN

The mode IP+CAN can be assigned to an IP module by opening a Web UI connection and changing the **Mode** parameter in the "Control Interface" settings.

Practical Examples

In practice these operations can be used as follows.

To set up an IP module:

1. Press and hold the 3 upper left keys (during boot-up) - the communication mode is set to "IP".
2. Connect your configuration PC directly to the IP module (using the ETHERNET port on the underside of the frame).
3. Open a <u>Web UI connection</u> using the default IP address: 192.168.101.242 (for a Main module) or 192.168.101.243 (for a Fader module).
4. Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
5. Select the "System Control" tab and enter the correct **Mode** parameter in the "Control Interface" settings.: either **IP** or **CAN+IP**.
6. Reboot the IP module/frame (using the **Reboot System** button in the "System Control" tab).
7. Select the "Network" tab and enter the required network settings. See <u>crystal - Network Settings</u>.
8. You can now connect the crystal frame to the network.

To set up a CAN-bus module (linked to an IP frame):

1. Press and hold the 2 upper left keys (during boot-up) - the communication mode is set to "CAN".
2. Open a Web UI connection to the first crystal frame (using the network settings assigned to the IP module).
3. Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
4. Select the "Surface Modules" tab and enter the correct slot ID for the module. See <u>crystal - Slot IDs</u>.
5. In this instance, the module is ready for operation as soon as the correct slot ID is assigned. A reboot is not required.

5.8 crystal - Slot IDs

As part of the system setup, a slot ID must be assigned to each control surface module. This determines the functionality of the module according to the matching slot ID/address defined in the configuration.
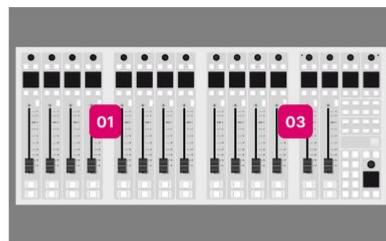
For a **Console Compact** license, there are two valid slot IDs (to support either a Fader or Main module):

- ID 01 = Fader module: faders 1 to 8.
- ID 03 = Main module: faders 9 to 14 + central controls.

Please note: in crystal, there are no even numbered slot IDs.

The image below shows how these should be assigned to an 8-fader, 6-fader and 14-fader surface. You can see the ON-AIR Designer 'Frame → Surface' configuration (at the top) and the console frames (below).

ON-AIR Designer: 'Frame → Surface' configuration

crystal Surface: Slot IDs

8-fader crystal (single frame)   6-fader crystal (single frame)   14-fader crystal (two frames)

> ⚠️ **Important**: each module's address must be unique. It is not permitted to assign the same slot ID to more than one module. If more than one module has the same slot ID, then you may see some odd behaviours once the console is operational.
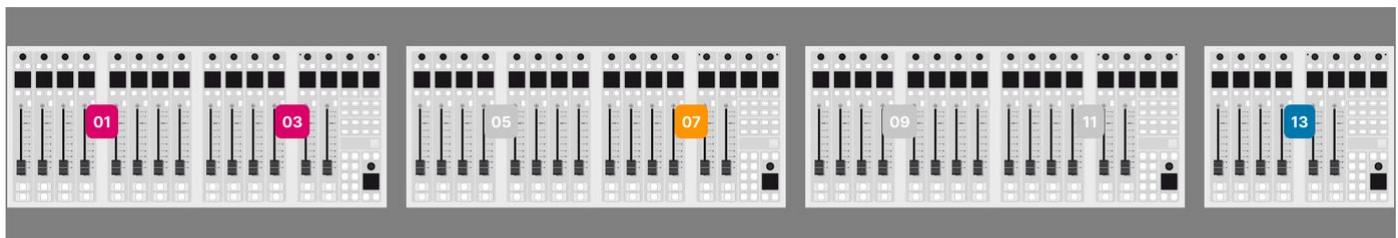
If Power Core is running a **Console MAX** license, then up to four Access Groups are supported (to share the resources of a single Power Core device).

In this instance, the active slot ID defines the functionality of the module; which fader numbers are controlled; and which access group the frame belongs to.

- ID 01 = Access Group 1, Fader module: faders 1 to 8.
- ID 03 = Access Group 1, Main module: faders 9 to 14 + central controls.
- ID 05 = Access Group 2, Fader module: faders 17 to 24.
- ID 07 = Access Group 2, Main module: faders 25 to 30 + central controls.
- ID 09 = Access Group 3, Fader module: faders 33 to 40.
- ID 11 = Access Group 3, Main module: faders 41 to 46 + central controls.
- ID 13 = Access Group 4, Main module: faders 49 to 54 + central controls.

In the example below, three surfaces are configured. The slot IDs are highlighted in different colors to show the different access groups. In this example, the third access group is unused (so that another 14-fader surface can be added later).

ON-AIR Designer: 'Frame → Surface' configuration

crystal Surface: Slot IDs

| Studio 1 (production) | Studio 2 (news) | Studio 3 (DJ) |

> ℹ️ **When configuring Power Core Max...**
>
> Please note that the real-time input measurement for the channel in ACCESS is supported by Access Group 1 only, and not Access Groups 2 to 4. This affects the dynamic signal level visualizations on the GUI such as the bouncing balls in the Dynamics 'Source Parameter' dialog box. So, in the example above, these visualizations are available for Studio 1 only, and not Studios 2 to 4.
>
> For this reason, it is recommended to use Access Group 1 for the most important surface / the surface with a Virtual Extension.
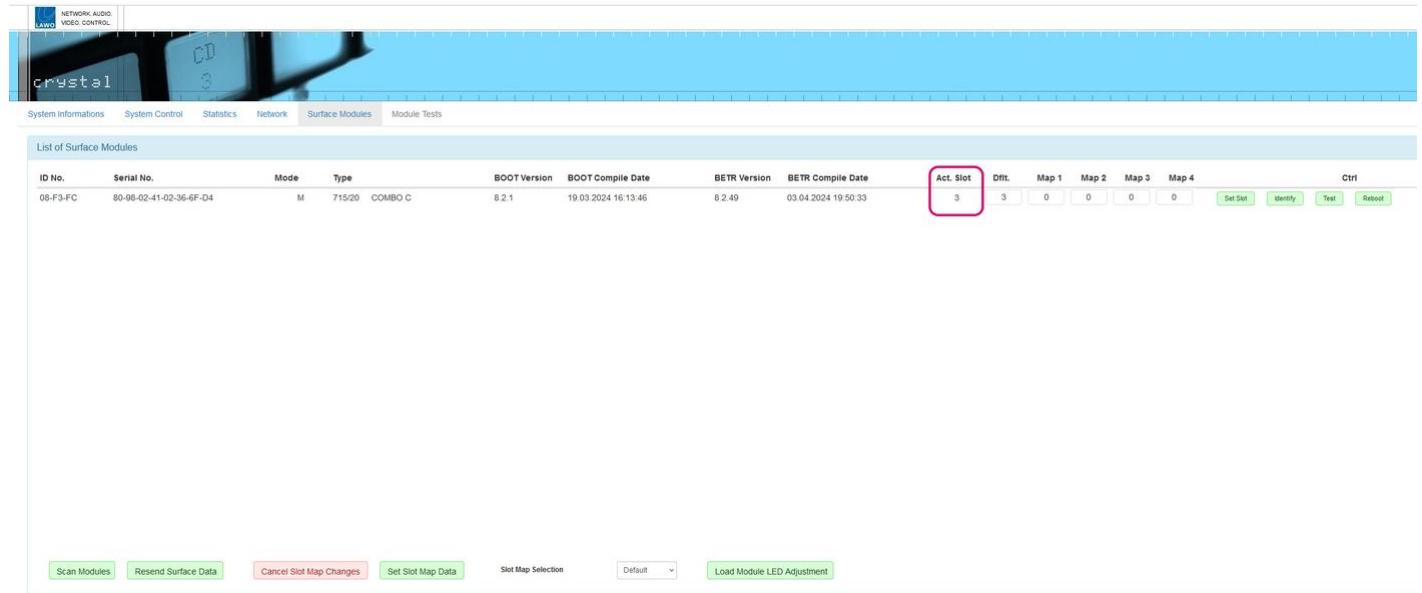
For more information about the 'Frame → Surface' configuration, please refer to ON-AIR Designer User Manual. Here we deal with the assignment of the slot IDs to the surface modules.

How to Check and Assign the Slot ID(s)

The active slot IDs are shown on the surface displays during boot-up, and are configured using the "Surface → Modules" tab in the Web UI.

To check the settings:

1. Open a Web UI connection to the crystal frame.
2. Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
3. Select the "Surface Modules" tab and look at the **Act. Slot** values - these show the active slot ID for each module.

The active slot ID can be changed either, permanently, by editing the **Dflt** (default) value or, temporarily, by loading one of the alternate mappings (**Map 1** to **4**).

Editing the Default Slot IDs

During the initial setup, you should use the **Dflt** value to assign the correct slot ID to each physical module (e.g. for a 6-fader surface, assign 03 to the Main module).

This is done as follows.

1. Type the required slot ID into the **Dflt** field - the edited value and **Set Slot** button highlight in yellow.
2. Press **Set Slot** to make the assignment.
3. Wait for the **Act. Slot** field to update and check its value.
4. Repeat these steps for each module.

The screenshot below shows how the Web UI looks when a default value is changed but not yet saved.
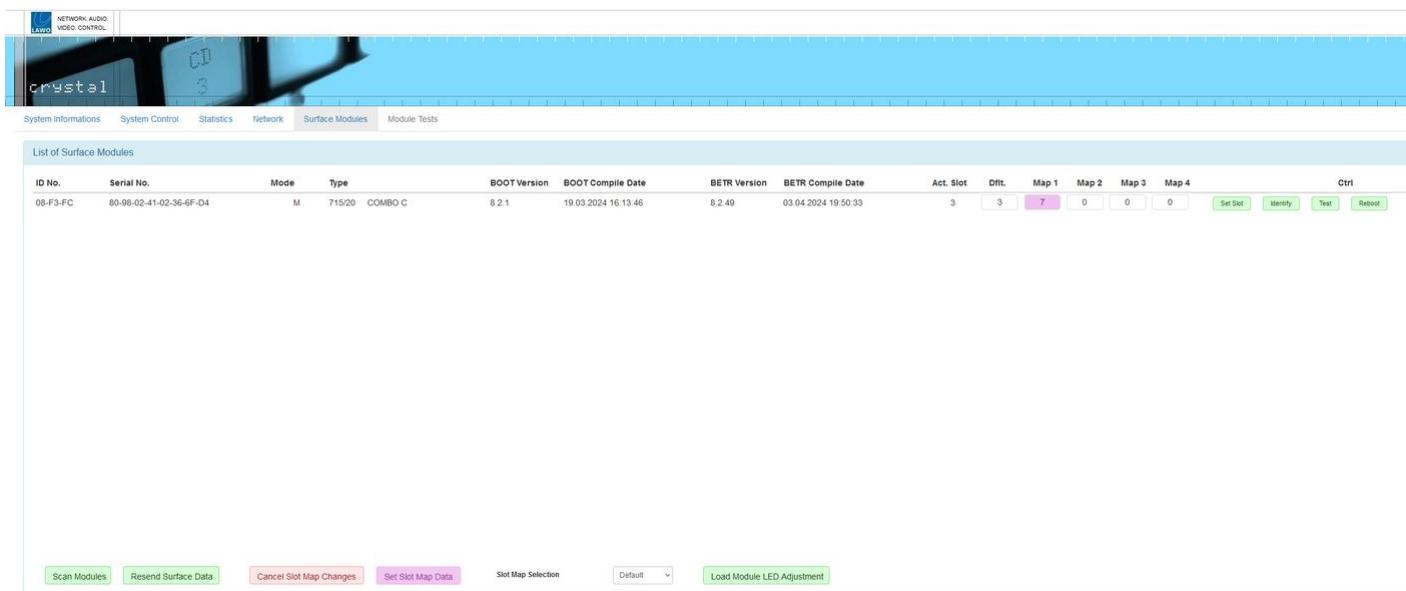
Using the Alternate Mappings

The alternate mappings (**Map 1** to **4**) can be used, during operation, to provide access to different sets of faders and/or central controls. In this instance, the mapping data is stored globally and recalled using the **Slot Map Selection** option (at the bottom of the page) or via Ember+ (for more convenient control).

1. Start by entering the required slot IDs into the **Map #** fields - the edited values and **Set Slot Map Data** button highlight in magenta.
2. To save all of the changed values, press the **Set Slot Map Data** button. (Or to cancel all changes, press **Cancel Slot Map Changes**).
3. To load a mapping, click on **Slot Map Selection** and choose an option from the drop-down menu. You can choose any of the four alternate mappings (**Map 1 to 4**) or revert to the **Default** slot IDs (defined in the **Dflt** fields).
4. Wait for the **Act. Slot** fields to update and check their values. Note that all zero (0) values are ignored.

The screenshot below show how the Web UI looks when one of the mapping values is changed but not yet saved.

The screenshot below shows the options in the **Slot Map Selection** menu. Once an option is selected, the active slot IDs update to match. So, in this example, the **Act. Slot** and **Dflt** values should be the same.
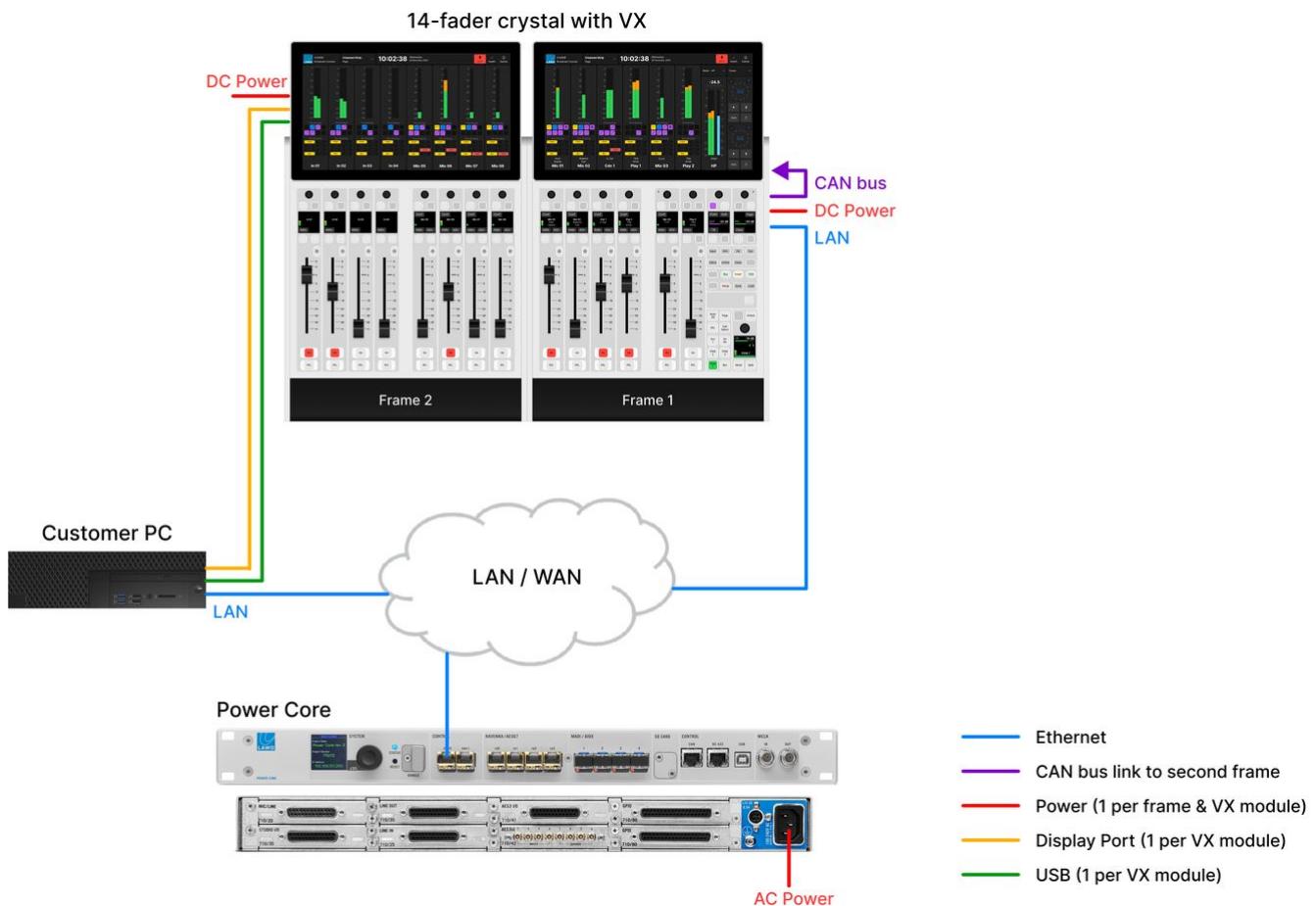
5.9 crystal - Configuring the Virtual Extension

If the console includes the Virtual Extension option, then the GUI software runs on a host PC that must be provided by the customer. The host PC connects to Power Core via the IP network. Each VX module connects to the host PC via Display Port and USB. A single host PC can support up to 6 VX displays.

The example below shows a 14-fader crystal surface with two VX modules.

14-fader crystal with VX

The instructions below describe how to configure the host PC and make the connections.

1.   The crystal VX software runs on a Windows PC that must be supplied by the customer.

A single PC can support multiple displays, depending on its specification. For information about the host PC requirements, please read the following document: Vistool PC Configuration Guide.pdf.
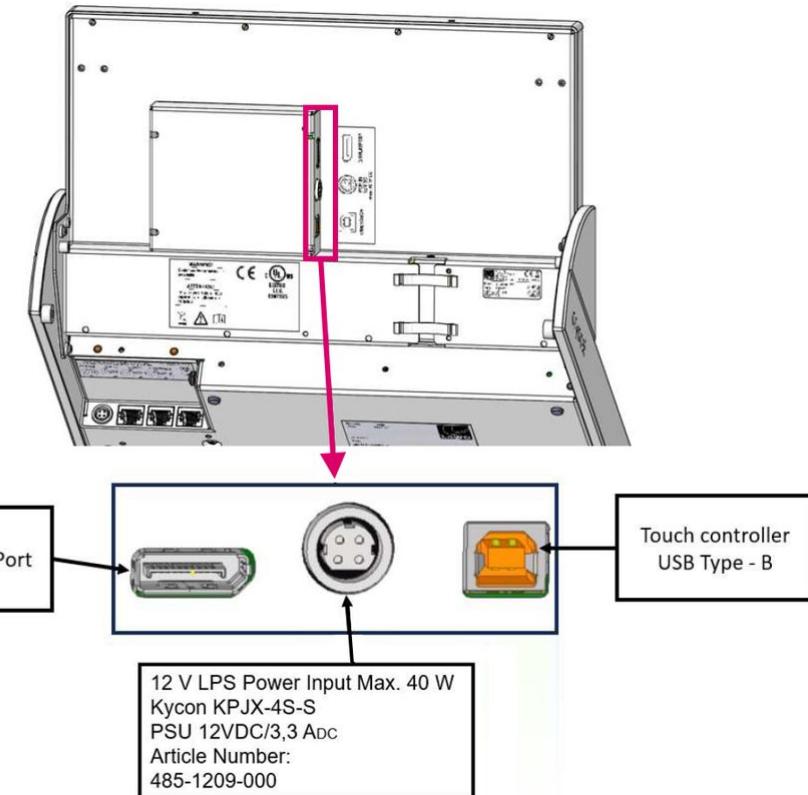
If you wish to run more than 6 displays (across multiple frames) then it is recommended to install a second host PC (with an additional license).

2.   The host PC must connect to Power Core via the control network.

To configure the system, you will need to know the IP address of the Power Core control port. This is described in crystal - Network Settings.

3.   Each VX display connects to the host PC via Display Port and USB, and is powered by its own external DC power supply.

For more information about the DC power supply, see crystal - Power Supplies.

On the rear of the VX display, there are three connectors:

- **Power In** (Kycon) - connects to the external DC power supply.
- **Display Port** - connects to the host PC (for graphics).
- **USB** (Type B) - connects to the host PC (for touch-screen control).

If the control surface is fitted with more than one VX display, then the host PC must support multiple Display Port and USB connections.

4.   On the host PC, you must install the VisTool software and generate a runtime session from either the standard configuration ("vis_crystal_SC") or a custom project.

Please refer to the VisTool documentation for how to do this.

5.   Before you can launch the VisTool session, you must install and activate the VisTool license. A license for the standard configuration is included with the system.

See License Activation for instructions.

6.   Once everything is installed and connected, the crystal VX app can be launched from the host PC.

See crystal - Powering On.

6 crystal - Operation

This chapter describes the operation once the system is installed and configured.

The topics here describe a system operating with Power Core. If you plan to use crystal as a controller only, see crystal - Controller Mode.

Where applicable, the examples used describe the standard configuration. If your surface or GUI looks different, then you may be running a custom configuration. You can learn more about how to customize the console, using ON-AIR Designer, in crystal - Configuration.

- crystal - Control Surface Overview
- crystal - Fader Strip Control
- crystal - Source-Specific Functions
- crystal - Central Controls
- crystal - Powering On
- crystal - Fader Strip Assign
- crystal - Input Gain and Pan
- crystal - Auto Gain
- crystal - Stream Selection
- crystal - Bus Assign
- crystal - Source Parameters
  - crystal - Input and Pan Parameters
  - crystal - Automatic Gain Compensation
  - crystal - EQ
  - crystal - Dynamics
  - crystal - De-Esser
  - crystal - Limiter
  - crystal - Relative System Level and the Dynamics Processing
  - crystal - Delay
- crystal - Insert Sends and Returns
- crystal - Sum Bus Parameters
- crystal - Metering
- crystal - Monitoring
- crystal - PFL and AFL
- crystal - Talkback
- crystal - Conference and N-1
- crystal - VCA Grouping
- crystal - Snapshots
  - crystal - Snapshot Settings
  - crystal - Using the System Snapshots
  - crystal - Using the GUI Snapshots
- crystal - The Setup Menu

6.1 crystal - Control Surface Overview

Each **crystal** frame is fitted with either a Main or Fader module (for the physical controls) plus, optionally, a Virtual Extension module in the overbridge.

- The **Main module** provides 6 fader strips plus central controls.
- The **Fader module** provides 8 fader strips.
- The **Virtual Extension (VX)** module provides visual feedback and touch-screen operation.

When operating with Power Core, two frames can be combined to increase the fader count (up to 14-faders).

The rest of this topic (and chapter) assumes that the surface is operating with Power Core. If you are running crystal as an OSC device, please see crystal - Controller Mode.

The images below show the smallest and largest surface (supported by Power Core). For more information, see crystal - Surface Configurations.

| 6-fader crystal (light) | 14-fader crystal with VX (light) |

Configurable Functions
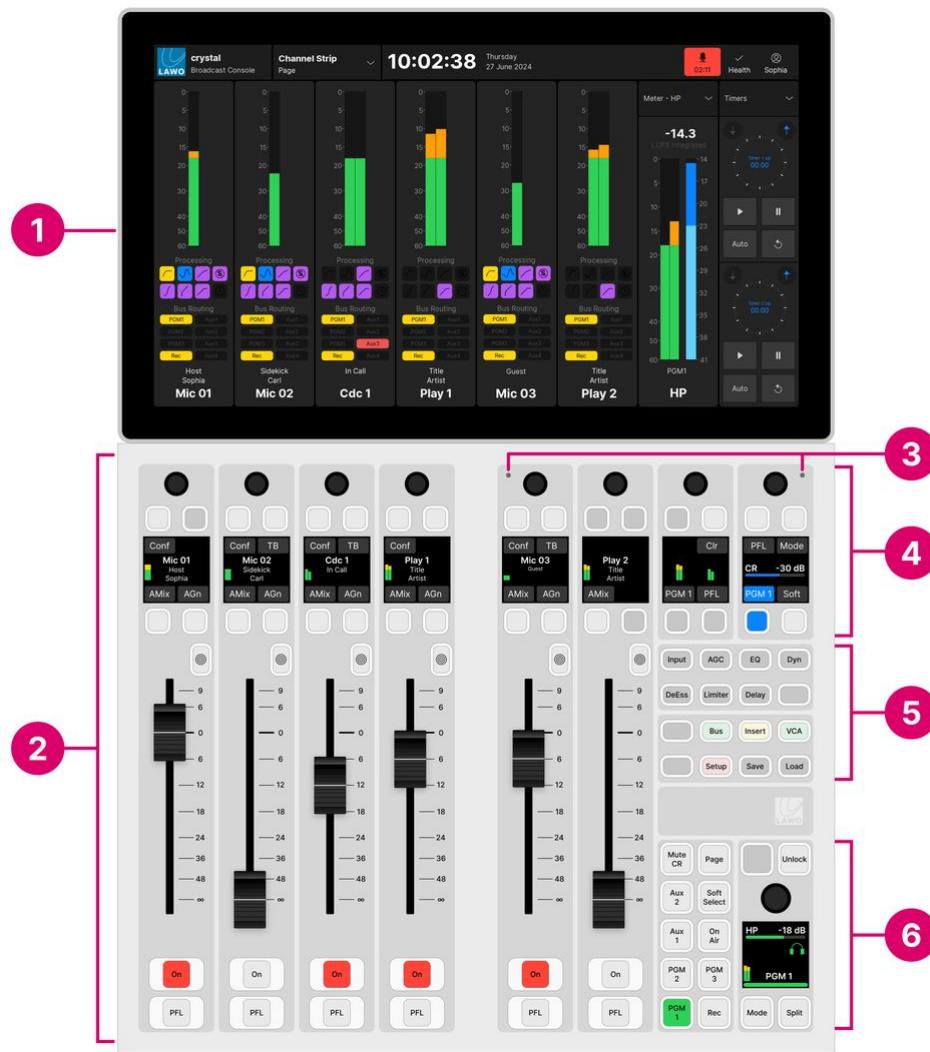
For the surface module (Main or Fader), some of the functionality is fixed and some is configurable.

All configurable functions are defined by the system configuration. This is stored on Power Core and read during boot-up. A **standard configuration** is included with every console. The configuration can be edited using the ON-AIR Designer software and uploaded to Power Core via the network. The configuration possibilities are extensive and include the definition of audio inputs and outputs; sources and sum busses; signal processing; logic; and control key functions.

Control keys that are configurable are known as MF (Multi-Function) keys. In most cases, the small MF keys are labeled by the electronic displays while the large MF keys use foil-printed labels. By default, the control surface ships with the correct labels for the standard configuration functions. If you change the MF key functionality, then you will need to exchange the foil-printed labels. See Exchanging the MF Key Labels.

Front Panel Controls

The front panel controls vary depending on the modules fitted to the console. In the example below, the surface is fitted with a Main and VX module.

The controls are divided into the following areas:

1. Virtual Extension (optional) - visual feedback and touch-screen operation. The functionality is defined by the configuration.

2. Fader Strips - dedicated mixing controls for each channel. Some of the functionality is fixed and some is configurable.

3. Ambient Light Detectors - automatic adjustment of the surface brightness. This function can be disabled by the configuration.

4. Central (Small) Rotary Controls - two sets of rotary controls that are dual-purpose:

- When all Function Keys (5) are off, the controls are configurable. The functionality is defined by the configuration.
- When a Function Key (5) is selected, the controls update to adjust the selected function. For example, press **Input** to adjust the input parameters for the channel in access. In this mode, the functionality is system-defined, and the controls work in the same way regardless of the configuration.

5. Central Function Keys - 16 control keys for central functions. These functions are system-defined and include source parameter control, bus/insert/VCA assign, setup options and snapshot save/load.

6. Central MF Keys & Large Rotary Control - configurable MF keys and a large rotary control. The functionality is defined by the configuration.

> ℹ To use an external keyboard for naming operations, such as editing user labels, connect the keyboard to the host PC (running the Lawo GUI application VisTool).

Fader Module

If the surface includes a Fader module, then this supports the fader strips (2) and optional VX (1).

If a surface consists of a Fader module only, then the central control functions can be operated from the GUI (using a custom VisTool configuration).

Virtual Extension (VX) Option

The Virtual Extension is optional and can be integrated into the frame or delivered as a stand-alone unit. If the Virtual Extension is integrated, then the VX module slots directly into the frame at a fixed viewing angle.
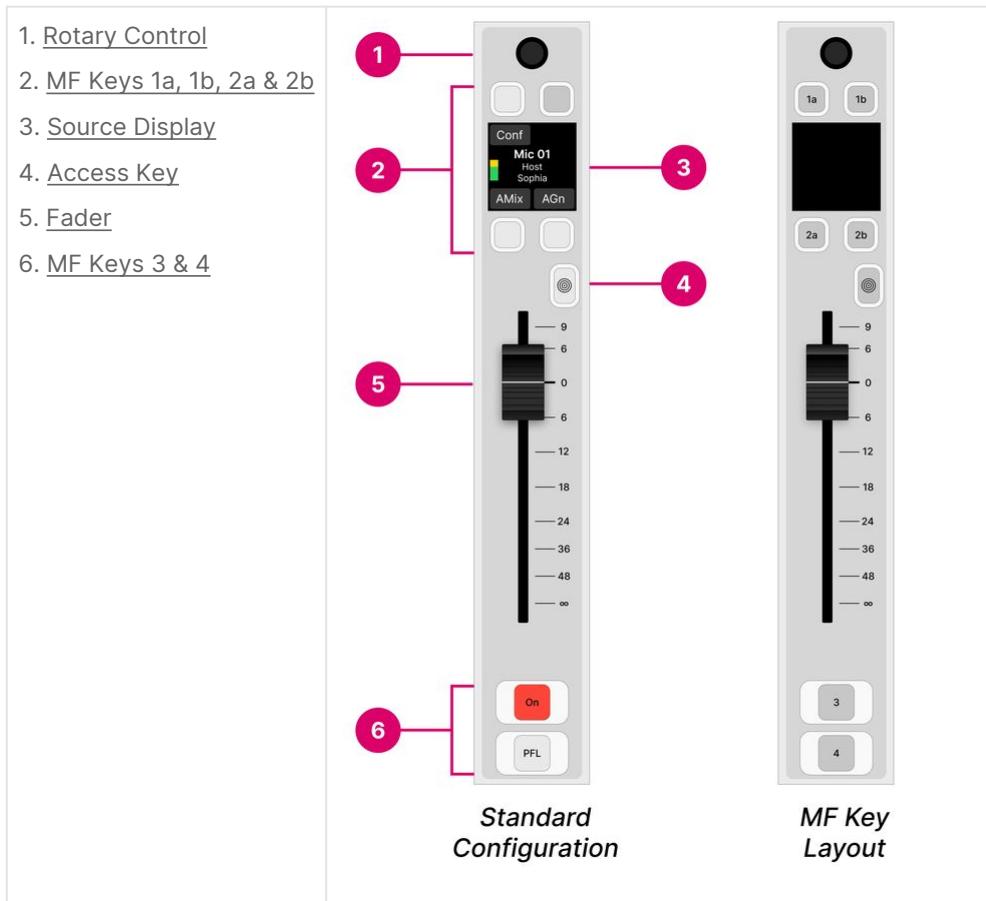
If the Virtual Extension is not included, then similar functionality can be achieved by running the Desktop App on an external display.

6.2 crystal - Fader Strip Control

Any fader strip on crystal can control any type of source and, depending on the configuration, supports fader mapping. This enables lots of signals to be controlled by very few physical faders.

Controls Overview

Each fader strip is divided into the following areas.

1. Rotary Control
2. MF Keys 1a, 1b, 2a & 2b
3. Source Display
4. Access Key
5. Fader
6. MF Keys 3 & 4

The operation of the following controls is system-defined: rotary control (1), source display (3), Access key (4) and fader (5). The MF keys (2 and 6) are defined by the configuration.

Operation

Rotary Control

The rotary control at the top of the fader strip adjusts the microphone gain, channel input gain and pan (plus stream selection for Ravenna sources). The operation is system-defined and provides the same fixed functionality regardless of the configuration.

Press down on the rotary control to step through the available parameters and turn to adjust the current value. The parameter name and value appear briefly in the display.
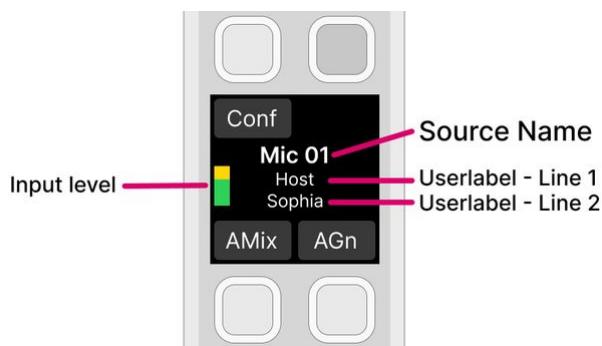
The available parameters vary depending on the type of source. See Input Gain & Pan and Stream Selection.

MF Keys 1a, 1b, 2a, & 2b

The four small MF keys are labelled by the display. They are programmed by the configuration and are defined per source. Typical functions include **Conf** (Conference), **AMix** (Automix) and **AGn** (Auto Gain).

Source Display

The central area of the display shows the name/labels of the source controlled by the fader strip and its input level.

The input meter shows either one or two vertical bargraphs according to the format of the source: mono or stereo.

In the standard configuration, the two user label lines can be enabled or disabled from the 'Settings → Surface' dialog box (on the GUI). The text can be edited by opening the user labels editor.

For Ravenna sources, the two user label lines show the Group and Stream name of the incoming stream. If a streaming connection is in progress, then you will see its status: pending, tuning, etc.

The source name can be edited using the ON-AIR Designer (under "Sources → Source Parm"): Source Name = the "Display Name" field.

Access Key

The **Access** key sits above the fader and has a concentric rings symbol. It is used to select a source (for parameter control) or activate strip assign mode. These operations are system-defined and provide the same fixed functionality regardless of the configuration.

The key has four possible states. The colors used can be modified by the ON-AIR Designer (under "System → Definition → Colors"). The following colors are used in the standard configuration:

- Off (unlit) = there is no source assigned to the fader strip.
- Dim white = a source is assigned to the fader strip but is not in access.
- Full white = a source is assigned to the fader strip and is selected (for source parameter control).
- Full yellow = the fader strip is in source assign mode.

The operation is as follows.

Press **Access** once (full white) to place the source in access. The Source Parameter Control keys in the centre section update accordingly and the 'Source Parameter' dialog box appears on the GUI. For more details, see Source Parameters.

Press **Access** twice in quick succession (full yellow) to activate strip assign mode. The 'Assign Source' dialog box appears on the GUI. From here you can touch an available source to make an assignment. Alternatively, turn the fader strip rotary control (1) to select a source and then press the **Take** key (2). For more details, see Fader Strip Assign.

Fader

The fader adjusts the channel level from -∞ to +9dB.

The fader is motorized and touch-sensitive. It also has a notch that is set to 0dB and an overpress function that is triggered when you pull back on the fader.

The notch and overpress can be enabled or disabled, by the operator, from the Setup menu.

The overpress function is programmed by the configuration and is defined globally for all fader strips. In the standard configuration, it triggers **PFL** (pre-fader listen).

MF Keys 3 & 4

The two large MF keys are programmed by the configuration and are defined per source. Typically, they are used to turn the channel **ON** and activate **PFL** (pre-fader listen).

6.3 crystal - Source-Specific Functions

The MF keys on each crystal fader strip are programmed by the configuration and are defined per source. They can be used to customize the functionality of the console. For example, to have PFL on a large or small MF key.
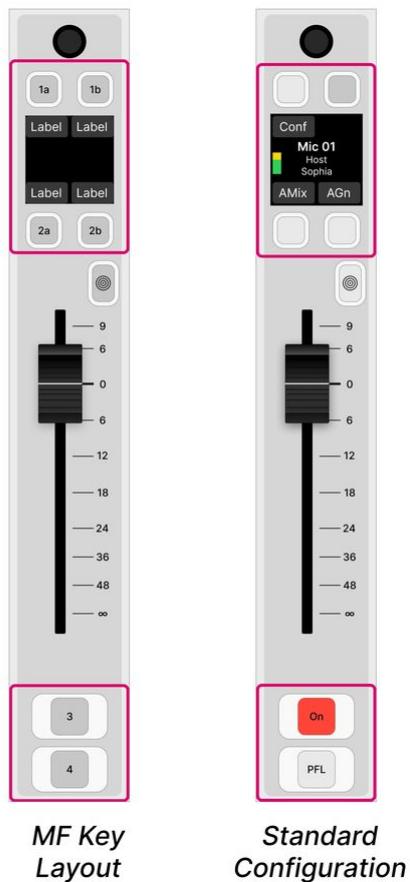
This topic describes the available keys and their most common functions.

MF Key Locations

Each fader strip has 6 MF keys:

- The upper (small) MF keys 1a, 1b, 2a and 2b are labeled by the display. This makes them suitable for functions that vary depending on the type of source.
- The lower (large) MF keys 3 and 4 are labeled by foil-printed inserts and so, usually, they are configured for the same function for all sources.

The image below shows MF key numbering and the default functions for a mic source in the standard configuration.

MF Key Layout   *Standard Configuration*

Typical Functions

Depending on the configuration, you may have access to some or all of the following functions.

Conf (Conference)

This key assigns the source onto the conference bus. Once **Conf** is enabled on more than one source, an N-1 mix is created. This can be routed back to the source (e.g. to their earpiece) so that they can hear the conference mix minus themselves while off-air.

The **Conf** key has four possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = conference off.
- Dim yellow = conference on for one source (Conf active).
- Full yellow = conference on for more than one source (Conf audio).
- Full green = conference on and fader open (Conf prepare).

"Conf prepare" occurs if you select **Conf** on an open fader. Nothing happens until you close the fader; once the fader is closed, **Conf** becomes active.

The conference system is described in more detail later. See Conference & N-1.

AMix (Automix)

This key enables automixing. Once **AMix** is enabled on more than one source, the mix levels are adjusted automatically.

The **AMix** key has two possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = automix off.
- Full yellow = automix on.

In diamond, up to 4 independent automix groups can be configured. The group number, and other parameters, are adjusted from the **AGC** controls when a source is in access.

The automix parameters are described in more detail later. See Automix.

AGn (Auto Gain)

This key enables auto gain (on mic sources). It can be used to set the analog (mic preamp) gain automatically.

The **AGn** key has two possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = autogain off.
- Flashing yellow = autogain adjustment is in process.

How to use auto gain is described later. See Using Auto Gain.

TB (Talkback)

This key talks to the source via its N-1 return.

In the standard configuration, the operation is momentary so press and hold the **TB** key to activate talkback.

The **TB** key has two possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = talkback off.
- Full red = talkback on (active).

ON (Channel On/Off)

This key turns the channel on or off.

The **ON** key has two possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = channel off.
- Full red = channel on.

In the standard configuration, the channel "on" state is conditional on the fader position. This allows you to open and close a fader automatically as follows:

- To quickly turn on a channel, press the **ON** key - it lights in red and the fader opens to 0dB.
- To quickly turn off a channel, press the **ON** key again - the light goes out and the fader closes.
- To fade the level in or out, move the fader - the channel **ON** key indicates the on/off status.

PFL (Pre-Fader Listen)

This key assigns the source to the PFL bus. It can be used to listen to a source before opening its fader.

The **PFL** key has three possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = PFL off.
- Full green = PFL on and fader closed (PFL active).
- Dim green = PFL on and fader open (PFL prepare).

"PFL prepare" occurs if you select **PFL** on an open fader. Nothing happens until you close the fader; once the fader is closed, **PFL** becomes active.

In the standard configuration, the PFL bus is switched to the headphone (HP) monitoring whenever a PFL is active. The previous monitor source is re-instated once all active PFLs are cleared.
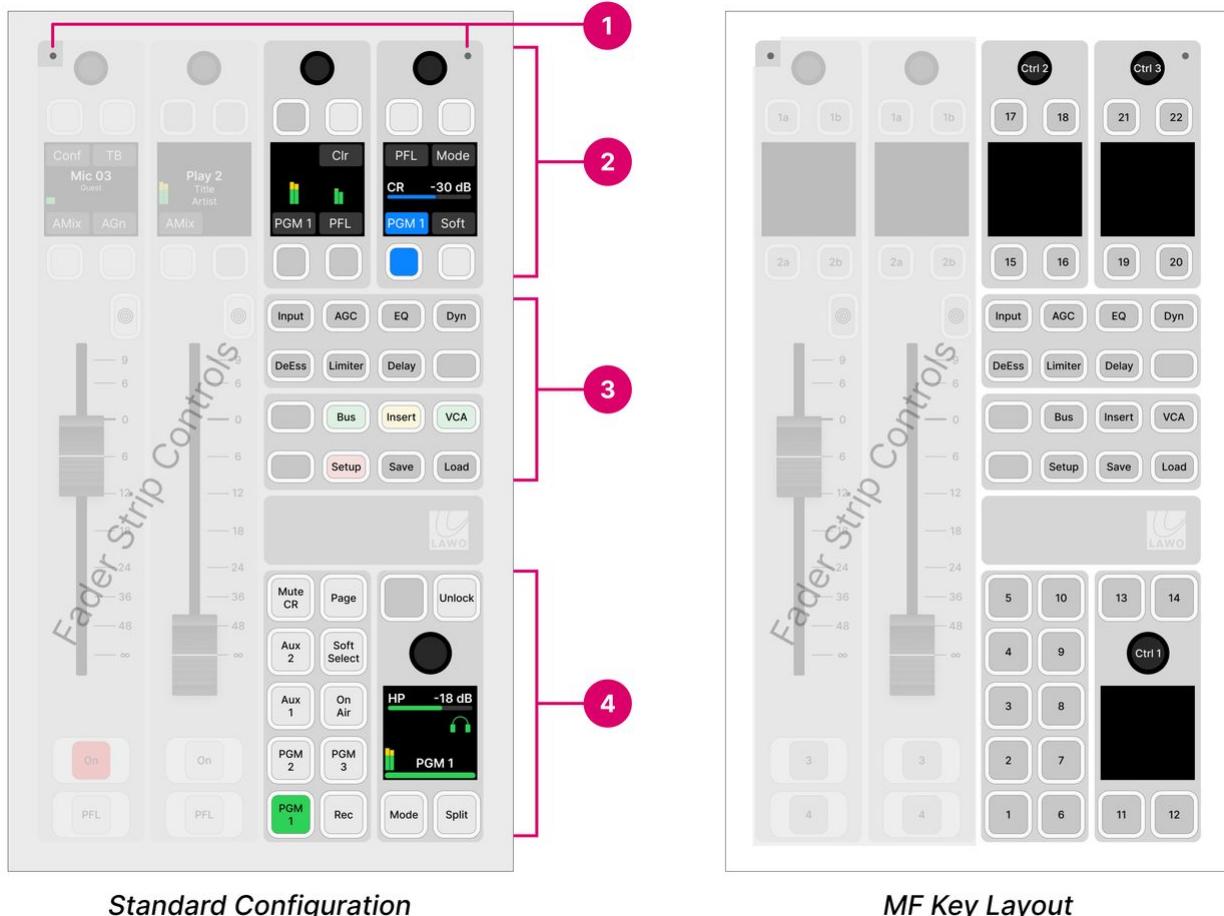
The PFL system is described in more detail later. See PFL.

6.4 crystal - Central Controls

On crystal, the Main module provides six fader strips plus the central controls. The image below shows the right-hand side of the module (with two fader strips and the central controls).

Controls Overview

The central controls are divided into the following areas.

Standard Configuration   *MF Key Layout*

1. Ambient Light Detectors

2. Central Rotary Controls

3. Central Function Keys

4. MF Keys & Rotary Controls

The operation of the Ambient Light Detectors (1) and Central Function Keys (3) are system-defined. The MF keys and rotary controls (4) are defined by the configuration. The Central Rotary Controls (2) are configurable (when all Function Keys are off) and system-defined (when a Function Key is selected).

Operation

Ambient Light Detectors

The two detectors at the top of the module provide automatic adjustment of the surface brightness according to the ambient light levels. The detector receiving the most light always wins. So if something covers just one of the detectors by accident, this is ignored.

This function can be disabled by the configuration. In the standard configuration, it is enabled or disabled using the **Surface Ambient Light Sensor** option in the 'Settings → Surface' dialog box (on the GUI).

Central Rotary Controls

Each of the upper rotary controls comes with a display and four small MF keys. The controls are labelled by the display and have two modes of operation:

- When all Function Keys (3) are off, the controls are configurable.
- When a Function Key (3) is selected, the controls update to adjust the selected function. For example, press **Input** to adjust the input parameters for the channel in access. In this mode:
  - The functionality is system-defined, and the controls work in the same way regardless of the configuration.
  - The upper controls from the two adjacent fader strips are borrowed (to provide four sets of Central Rotary Controls).

Metering & PFL/CR Monitoring

In the standard configuration, when all Function Keys are off, the Central Rotary Controls are defined for metering and monitoring.

On the left, the display shows two stereo meters: **PGM 1** and **PFL**.

- The two lower keys are used to label the meters and have no function.
- The **Clr** key (above the PFL meter) clears all active PFL selections.
- The rotary control has no function.

On the right, the controls adjust the control room (**CR**) monitor output.

- The rotary control adjusts the monitor level. It is color-coded for easy identification: blue = CR.
- The **PGM 1**, **PFL** and **Soft** keys select the monitor source.
- The **Mode** key changes the monitoring mode (e.g. to mono or left/right reverse).
- Both the **Soft** and **Mode** keys work in conjunction with the GUI (as described later).

> ✅ The **Mute CR** key on the lower panel (4) can be used to quickly mute the control room monitor output.

Central Function Keys

The 16 function keys are system-defined and work in the same way regardless of the configuration.

The first 8 keys provide source parameter control for the channel in access. The second 8 keys are used for global functions. With the exception of VCA and Snapshot Management, the function keys work in conjunction with the Central Rotary Controls (2). Please follow the links below for more information.

- **Input**, **AGC**, **EQ**, **Dyn**, **DeEss**, **Limiter**, **Delay** - press to adjust source parameters for the channel in access.
- **Bus** - press to select a bus assign page.
- **Insert** - press to select the insert assign page.
- **VCA** - press to select a VCA assign page.
- **Setup** - press **Setup** to adjust the surface setup options.
- **Save**, **Load** - press and hold **Unlock** + **Save** (or **Load**) to save (or load) a system snapshot memory.

MF Keys & Rotary Controls

The remaining MF Keys and rotary controls are defined by the configuration. If you are running the standard configuration, then the controls provide master functions and monitoring.

Master Functions

The top row of keys provide master functions:

- **Mute CR** - mutes the control room monitor output.
- **Page** - press to toggle the VX GUI page between 'Playout' and 'Channel Strip'. This key has no function if you are working with the Desktop App.
- MF key 13 has no function. It may be configured by the customer (using ON-AIR Designer).
- **Unlock** - press and hold to unlock the **Save** and **Load** keys in the Central Functions area (3).

HP Monitoring

The remaining keys and large rotary control adjust the headphone (**HP**) monitor output.

- The rotary control adjusts the monitor level/balance; turn for level; press down and turn for balance. It is color-coded for easy identification: green = HP.
- The surrounding MF keys provide monitor source selection and other options. For more details, see Monitoring.

6.5 crystal - Powering On

To get the system operational, you will need to power on the hardware and start the GUI application. This topic describes the most efficient procedure and how to power off / shutdown.

Powering On

1.   Turn on power to each of the control surface components and Power Core.

- Each control surface frame and Virtual Extension is powered by its own external DC power supply. See crystal - Power Supplies.
- Power Core comes with dual power feeds: AC and DC. Both connections can be found at the rear of the frame. See Power Core - Power Supplies.

2.   Once power is applied, the system boots in a few seconds.

- On the surface, the displays show information about each module and then, after a few seconds, the Lawo logo.
- On Power Core, the boot-up progress is shown on the front panel.

To learn more about the boot-up information, please read the FAQs (below).

3.   At the end of the boot-up, Power Core loads the latest settings (stored at shut-down). This is known as the warm start data.

- On the surface, the Lawo logos are replaced by operational displays. The console is now ready for operation.

If the control surface is powered after Power Core, then it synchronizes to the latest settings once the IP connection to Power Core is made. In this instance, you will see the surface reset once the connection is made.

If you see the message "Not Connected" on the surface displays, then there is a problem with the network connection to Power Core. Please follow the Troubleshooting steps (below).

4.   To start the Virtual Extension (VX) GUI, turn on the host PC and double-click on the **Start crystal** desktop icon.

If the surface is not fitted with the Virtual Extension option, then similar functionality can be achieved by starting the Desktop App.

- The session loads and connects to the hardware. Providing there are no error messages, the GUI is ready for operation.

The image below shows the complete process.

| *Surface booting* | *Power Core Booting* | *Surface ready* | *VX host PC booted* | *VX session starting* | *VX ready* |

Troubleshooting

The message "Not Connected" appears on the surface displays.

This message appears if there is a problem with the network connection to Power Core.

- Check the network cabling and IP addresses of the surface and Power Core.
- Check the "Control Interface" settings in both the surface and Power Core.
- Check that the Module Control Mode (in crystal) is set to **PowerCore Control** (and not **OSC Control**).
- Check that the module above the frame's connector board is fitted correctly, with all screws tightened. If the screws are not fixed properly, then the module may not be plugged fully into the connector board underneath. This can lead to an intermittent network connection.

The displays on the surface look blank.

This can happen if there are no sources assigned to the fader strips. Either load a snapshot (to recall an existing setup) or assign some sources manually to the fader strips.

The correct pages do not appear on the GUI display(s)

If the correct pages do not appear on the GUI, then there could be a problem with the start script. Check the settings prepared in VisTool Admin.

The message "No License Found" appears on the GUI display(s).

If a software license is not found when you start the GUI, then this error message appears. Follow the online activation procedure to activate your license. If the license is installed onto a USB dongle, then check that the dongle is connected to the host PC!

The message "Not Connected" appears on the GUI display(s).

This message appears if the host PC loses its network connection to Power Core. You should check the network cabling from the host PC, and the IP addresses of the host PC and Power Core.

FAQs

Q: What information is shown on the surface displays during boot-up?

A: The following information is shown on the control surface modules during boot-up:

- Firmware revision
- Module Type (e.g. COMBO C).
- Module ID (e.g. Slot 3).
- Method of Communication to the Control Interface (e.g. IP).
- IP Address of the Control Interface. This is the control IP for the surface.
- Multicast Address group for the Control Interface. This is shown on the frame's IP module only.

Q; What information is shown on Power Core during boot-up?

A: The Power Core front panel changes shows the boot-up progress as follows:

- First, the display and **STATUS** LED are black and unlit.
- Then, the Lawo logo appears and the **STATUS** LED lights in white.
- As soon as boot-up is complete, the **Welcome** page appears and the **STATUS** LED starts to blink; its color reflects the sync status.

If the **STATUS** LED does not start to blink, then the device has an internal problem. Please reboot the device as a first step.

Q: What is a warm start?

A: When Power Core loads its warm start data, it means that the system returns to whatever the settings were at the last power off.

Please note:

- The last known PTP Master/Slave mode may not be reinstated if Power Core is set to operate as PTP Slave only.
- If you perform a cold start, then the system ignores the warm start data and resets to the default values stored in the configuration.
- If this is the first time you have powered the device "out of the box", then the system loads a very basic configuration that allows Power Core to boot. To get the system operational, you will need to upload the standard configuration or a custom configuration using the ON-AIR Designer.

Q: Why does the message "System has been restarted" appear on the GUI display(s)?

A: If Power Core restarts while the GUI application is running, then the message "System has been restarted" appears. Touch or click on the message to clear it.

Powering Off / Shutdown

There is no special shutdown procedure for the hardware. So, to power down the control surface components and Power Core, turn off the mains power.

To close the GUI application, click on the User menu (top right) and select **Close App**.
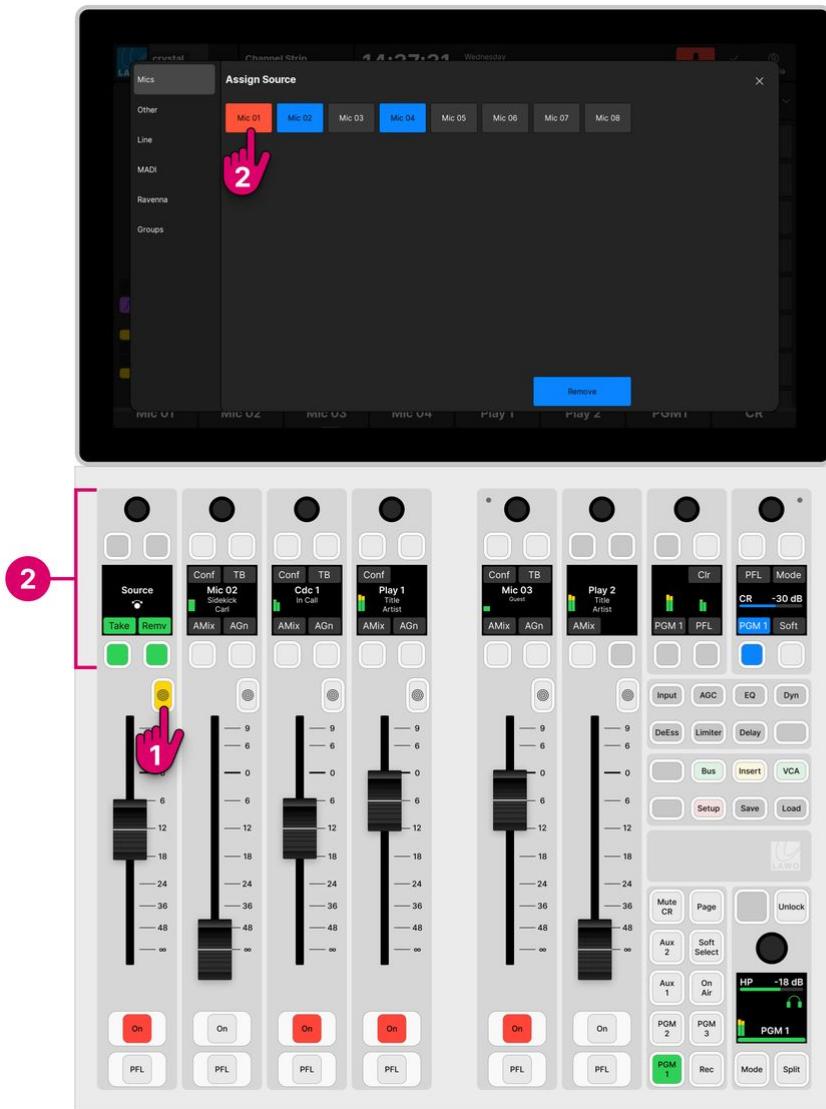
6.6 crystal - Fader Strip Assign

Any available source can be assigned to any fader strip. This allows you to choose which sources are active in the mix.

The list of available sources is defined by the configuration and may include any source, sum bus or VCA master.

Operation

The steps below describe the **Access** key colors and available sources defined in the standard configuration. These aspects may vary if the configuration is customized.

1.   Select the fader strip you wish to assign by pressing an **Access** key twice in quick succession (double-press). This is the key above the fader with the concentric rings symbol.

The **Access** key lights (full yellow), the fader strip switches into "strip assign" mode and the 'Assign Source' dialog box appears on the GUI.

In the standard configuration, the available sources are grouped into pages, and the buttons are color-coded to show which sources are already assigned to the surface:

- **Red** = the source is assigned to a fader strip and the fader is open.
- **Blue** = the source is assigned to a fader strip and the fader is closed.
- **Grey** = the source is not assigned to the surface.

2.   Select a source using either the fader strip controls or on-screen buttons.

On the fader strip...

- Turn the rotary control to scroll through the available sources, and press **Take** to assign the selected source.
- Alternatively, press **Remv** to remove the current source (and leave a blank fader strip).
- To cancel out of strip assign mode without changing the current assignment, press the **Access** key once - it returns to low white (the default mode).

On the GUI...

- Select a page (e.g. **Mics**) and touch an available source to assign it to the fader. If you choose a red or a blue source, then it is moved to the new fader strip at its current level.
- Alternatively, select **Remove** to remove the current source (and leave a blank fader strip).
- Select **X** to close the dialog box and cancel out of strip assign mode without changing the current assignment.

3.   Once an assignment is made, the fader strip updates and you should see the new source name/label in the Source Display (on the surface and GUI).

The fader strip controls return to their default functions, and the 'Assign Source' dialog box closes.

If a Ravenna source is selected, then it is possible to select a stream from the network (as described in crystal - Stream Selection).

Source Pages (on the GUI)

In the standard configuration, the available sources are grouped into six pages:

- **Mics** - microphone inputs (connected directly to Power Core).
- **Other** - other audio inputs (connected directly to Power Core).
- **Line** - line-level inputs (connected directly to Power Core).
- **MADI** - MADI inputs (connected directly to Power Core).
- **Ravenna** - RAVENNA inputs (connected to the IP network). Each input is configured as a stereo stream receiver.
- **Groups** - VCA masters.

6.7 crystal - Input Gain and Pan

The quickest way to adjust input gain, or the left/right pan position, is to turn the fader strip rotary control.
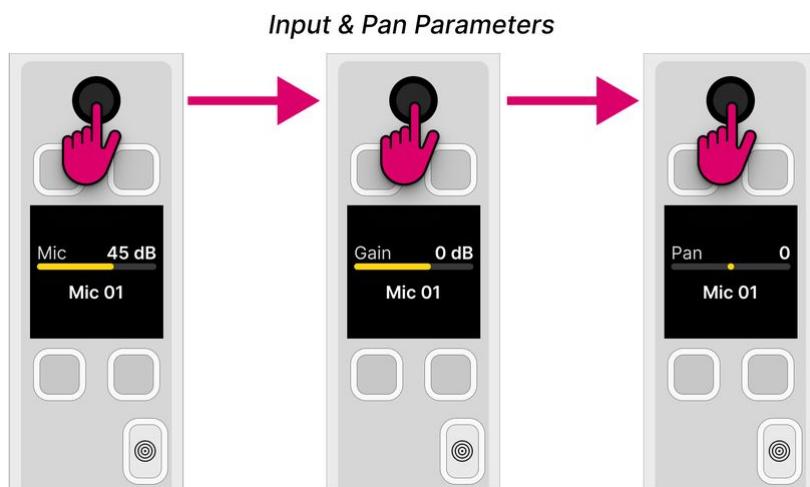
For a microphone source, two separate input gains are available: mic gain in the analog domain (before the A–D converter) and channel gain in the digital domain (after the converter). For other source types, only the channel gain is available.

For a mono source, you can adjust the left/right pan position. This changes to input balance on a stereo source.

The gain ranges and other input parameters are described later. See Input & Pan Parameters.

Operation

The steps below describe how to adjust input gain and pan from the fader strip rotary control.

Input & Pan Parameters

1. Turn the fader strip rotary control to adjust the first parameter.
   You will see both the parameter name (e.g. **Mic** gain) and value (e.g. **45dB**) in the display (above the Source name).
2. Press down on the rotary control to step to the next parameter (e.g. channel **Gain**).
3. Press down again to reach the next parameter (e.g. left/right **Pan**).
4. If you keep tapping down, then the sequence repeats.
5. To cancel out of the sequence, press the **Access** key once.

On a Ravenna source, the parameter sequence is extended to include the stream selection for the receiver.

> ✅ **Tip**: To interrogate parameters without making a change, press down on the rotary control - the display shows each parameter and its current value.

6.8 crystal - Auto Gain

Auto Gain is available for all mic sources. It can be used to set the analog (mic preamp) gain automatically.
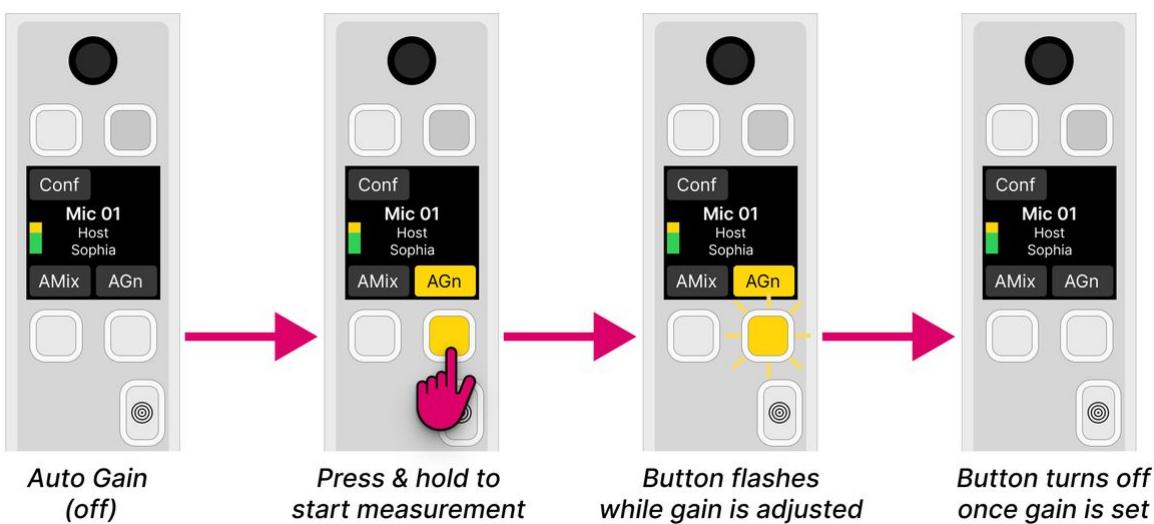
The system works by measuring the incoming signal level over a period of 5 seconds. Using an average of that measurement, it then sets the mic gain value automatically.

Please note:

- The gain adjustment happens automatically and so it is best to enable Auto Gain before the channel goes on-air. Otherwise, the signal may distort while Auto Gain finds the ideal level.
- To use the system effectively you will need to ask the talent to speak into the microphone at their intended "on-air" level.

Operation

The steps below describe how to use the Auto Gain feature.

| *Auto Gain (off)* | *Press & hold to start measurement* | *Button flashes while gain is adjusted* | *Button turns off once gain is set* |

1.   Start by asking the talent to speak and then turn on Auto Gain for the Mic source.

The simplest method is to use the **AGn** soft key on the source's fader strip. Alternatively, you can put the Mic source into access and enable **Auto Gain** from the Input page on the GUI.

In both cases, you must press and hold the button for more than one second.

2.   The measurement now takes place and the Auto Gain value is adjusted.

During this time, the **AGn** button flashes in yellow to indicate that automatic gain adjustment is in progress. If the channel is turned **ON**, then you will hear the gain changing.

3.   After 5 seconds, the Auto Gain value is applied.

The **AGn** button turns off showing that the process is complete. The mic source is now ready for your talent to speak on-air.

> ℹ️ At any time, you can use the fader strip rotary control to adjust the **Mic** gain manually. If you do this while Auto Gain is active, then the automatic gain adjustment is canceled.

6.9 crystal - Stream Selection

On a Ravenna source, it is possible to select a stream from the network using the fader strip rotary control and soft keys. This allows you to change which streams are active in the mix quickly and easily.

Stream Naming & Organization

To support this feature, streams must be announced to the network using the following naming convention: "Group:Stream". When using dynamic input switching, this provides a two-step navigation process: first select the Group, and then browse through all available Streams within that Group. Both the Group and Stream labels can be up to 8 characters.

By default, the labels are retrieved automatically from the network. Streams with the same Group name are combined into a single Group even if they are provided by different devices. The list presented to the operator is updated automatically so that newly discovered streams are added, and streams that can no longer be detected are erased.
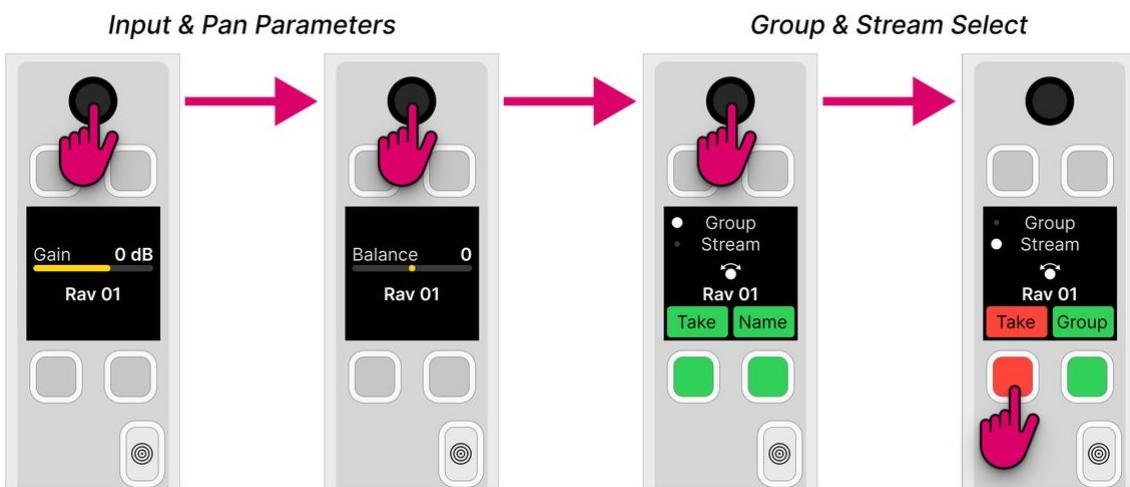
To prevent access to certain streams, filters can be applied in the configuration.

In cases where streams cannot be named using the above convention, it is possible to map specific streams to pre-configured labels. In this instance, the list of streams presented to the operator is fixed and is independent of stream availability.

Operation

1.   On a Ravenna source, press down on the fader strip rotary control to step through the gain and balance parameters until you reach the group and stream selection.

The display shows either the current Group and Stream name, or the text "not in pool".
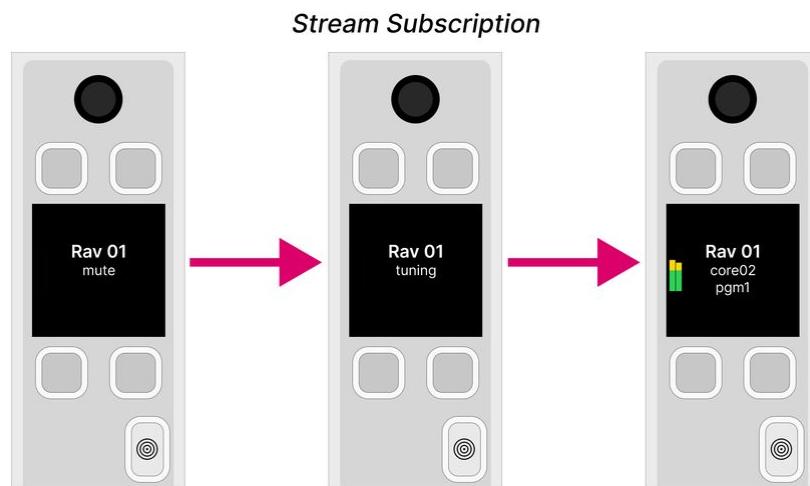
The stream selection is done in two parts: first, select a Group and then a Stream. The dot beside the Group (or Stream) name shows which page is selected.

- You can press the **Name** (or **Group**) soft key to toggle between the pages.
- Or, press down on the rotary control to step through the parameter sequence.

2.   From the Group page, turn the rotary control to scroll through the available Groups and press down to make a selection.

3.   Then turn the rotary control again to scroll through all available Streams with that Group.

- If your network supports dynamic stream detection, then the list of available streams updates automatically.
- The **Take** key turns red once a different stream is selected.
- If you need to return to the Group page, press the **Group** soft key.

- To cancel out of the stream selection, without making a change, press the **Access** key once.

4. To proceed with the stream selection, press the **Take** key to start the subscription process.

There will be a brief pause in the audio while the streaming connection is configured. During this time, the connection status is shown below the source name. The meaning of each message is described in the table below.

If a stream is being received for the first time, then the tuning process can take a couple of seconds. The initial tuning information is then re-used whenever you select the same stream, thereby speeding up all subsequent connections.

Stream Subscription

Once the subscription is successful, you will see the Group and Stream names below the Source name (in the user label lines). For example:

- Rav 01 = the Source name (defined in the system configuration).
- core02 = the Group name (detected from the network).
- pgm1 = the Stream name (detected from the network).

If signal is present, then you will see the input level on the meter (beside the Source name).

Stream Subscription: Status Messages

Whenever you subscribe to a stream, the user label lines (below the Source name) report back on the status of the connection.

Under normal circumstances, the expected sequence of messages is as follows:

```
Mute -> (Pending) -> Tuning -> (Unstable) -> <Stream-Name>
```

Note that messages shown in () may or may not appear. The table below explains the meaning of each message.

Status Message	Meaning
`Mute`	This indicates that no stream is connected to the Ravenna input.
`Pending`	Appears if the connected stream is not available. In this instance, the console will wait for the stream announcement to appear on the network, and then automatically initiate the subscription process. Typically, this message does not appear when selecting a stream from a RAVENNA source pool, as the list presented to the operator is constantly updated (in the background). The message can appear if the source has been configured using a default subscription. For example, if a stream is connected via VSM, or following a warm start (while restoring the last known connection).

Status Message	Meaning
`Tuning`	Appears while the console measures the streaming quality, and sets its stream receiving parameters to ensure correct audio playback.
	During the tuning cycle the audio input is muted, and then unmuted once the task is complete.
	If a stream is being received for the first time, then the tuning process can take a couple of seconds. This initial tuning information is stored in permanent memory. It is then used whenever you select the same stream, thereby speeding up all subsequent connections.
`Unstable`	Appears if the stream jitter is extremely high and cannot be dealt with; if the stream stops for some reason; or if the PTP clock information is missing. You can open the RAVENNA pages (in the Web UI) to view additional information on specifics.
	In this instance, the console will attempt to heal itself, and mute the audio input until the stream reaches stable conditions.
	Typically, it is very rare to see this message during the subscription phase.
	If an unstable stream is due to a PTP problem, then the console will start a new "Tuning" cycle before the audio input is unmuted.
`<Stream-Name>`	Once the subscription is successful, the name of the connected stream is displayed.
On rare occasions, the following error messages may also appear.	
`PoolErr`	Appears if there is a problem connecting to the stream.
	This can occur if the selected stream is not available on the network any longer, but is still presented in the console's list of streams. Since this list is updated cyclically, the problem should not persist.
	If you see this error, please repeat the subscription process. If the issue persists, check your network settings.
	The audio input will be muted while the error message is displayed.
`RavErr`	Appears if there is an invalid combination of status flags for the RAVENNA stream.
	Since the flags are updated cyclically, the error should heal itself. If the issue persists, then check the RAVENNA pages (in the Web UI).
	The audio input will be muted while the error message is displayed.

6.10 crystal - Bus Assign

Once a source is assigned to the surface, it can be routed to any of the available summing buses.

The list of available summing buses is defined by the configuration. Up to 32 buses are supported, where each one can be mono, stereo or 5.1. The configuration defines the name of each bus plus whether the bus can be assigned pre or post-fader, or post-fader only; and which page the bus assignment is made from.

Up to eight bus assign pages can be configured, where each page can access up to four buses.

From each source, the operator can adjust:

- Bus assign on/off and pre/post (if the bus is configured for pre or post-fader assignments).
- Bus send level - from -120dB to +9dB.

Operation

The standard configuration defines 8 stereo summing buses and two bus assign pages: PGM and Aux.
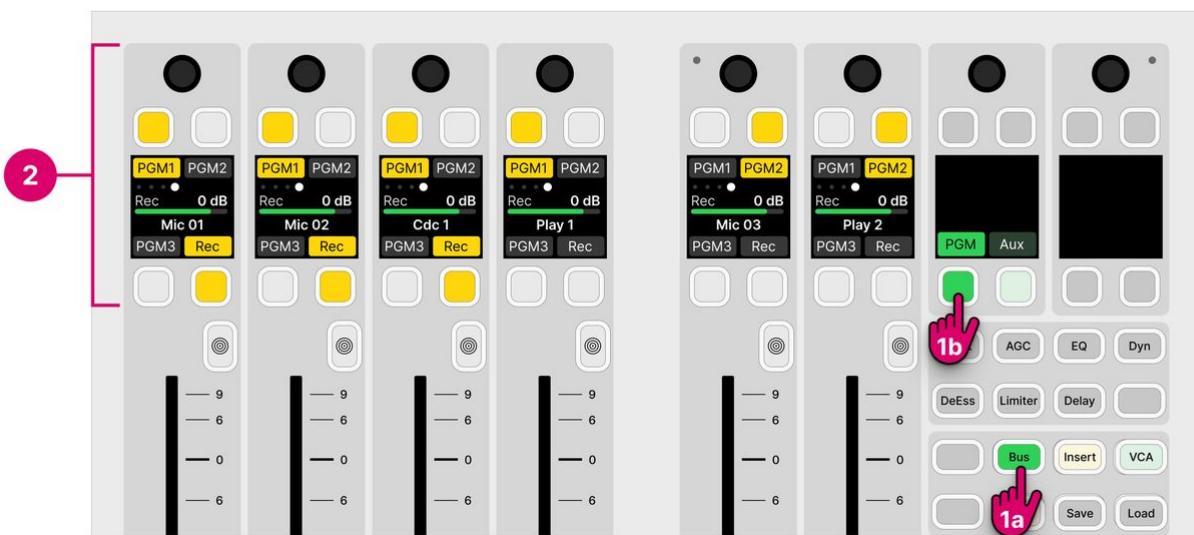
- Page 1 (**PGM**) - handles the assignments to the four main buses: PGM 1 to 3 & REC.
- Page 2 (**Aux**) - handles the assignments to the four auxiliary buses: Aux 1 to 4.

The assignments can be either pre- or post-fader for Aux 1 to 4, and post-fader only for PGM 1 to 3 & REC.

The 'Channel Strip' page (on the GUI) provides the best overview of the current assignments. Note that this page is for information only; you cannot edit the bus assignments from here.

To edit the assignments, you can use either the surface or 'Source Parameter' dialog box as follows.

On the surface...

1. From the central controls, press **Bus** and select a page (e.g. **PGM**).

The upper controls on each fader strip switch into "bus assign" mode. The four soft key labels show the name of the available buses. If a soft key has no label, then there is no bus allocated (in the configuration).

The soft key colors show the assignment status:

- Dim white = source is not assigned (off).
- Yellow = source is assigned (post-fader).
- Red = source is assigned (pre-fader).

At any time, you can select a different page to access more assignments. If a page key is unlit, then there are no buses allocated to the page (in the configuration).

crystal - User Manual
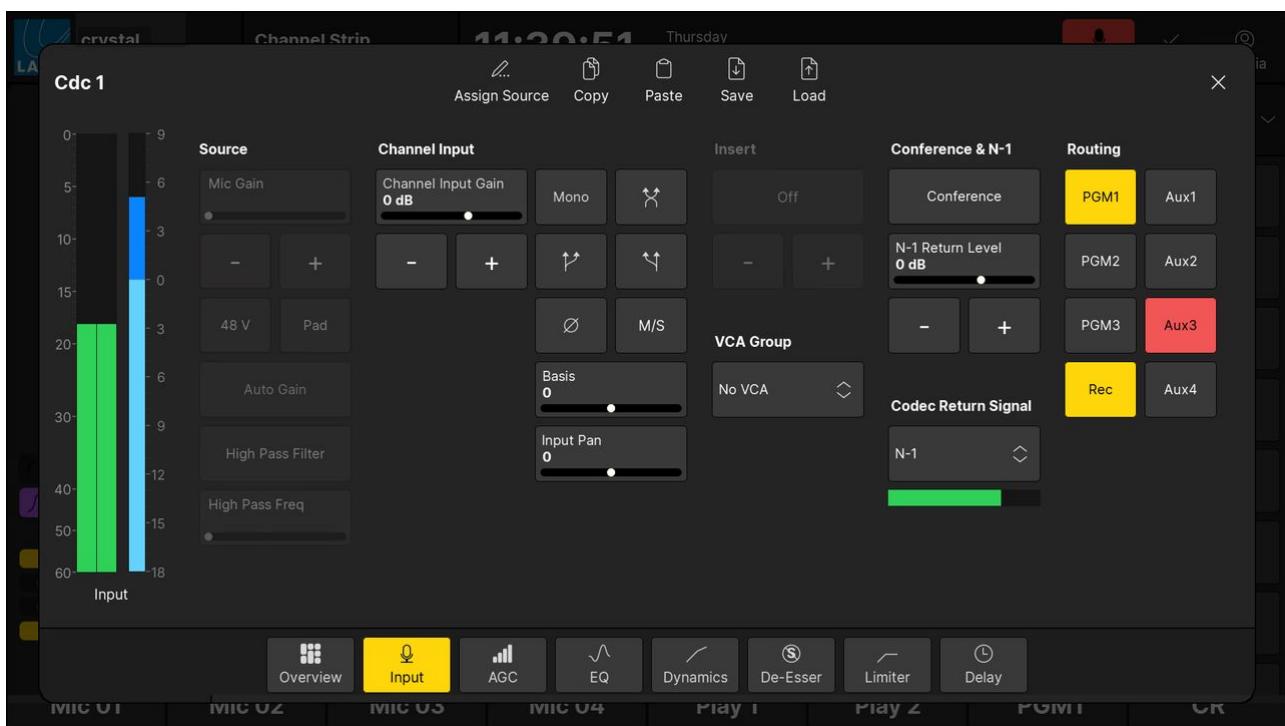
2. Use the fader strip soft keys (and rotary control) to change the assignments (and adjust the send levels).

- To toggle an assignment, press the soft key.
  - If a bus is configured for both pre and post-fader assignments, then there are three possible states: on (pre-fader), on (post-fader) and off.
  - The order of the pre/post states is defined by the ON-AIR Designer configuration, and so also possible is: on (post-fader), on (pre-fader) and off.

3. When you have finished editing the assignments, deselect **BUS** (on the central controls module).

The fader strip controls return to their default functions.

On the GUI...

Open the 'Source Parameter' dialog box by pressing a fader strip **Access** key, and choose the **Input** page.

1. Use the buttons under 'Routing' to change the bus assignments.

2. If a bus supports both pre and post-fader assignments, then keep pressing to cycle through the options.

The button colors are the same as on the surface:

- Grey = source is not assigned (off).
- Yellow = source is assigned (post-fader).
- Red = source is assigned (pre-fader).

Connecting a Bus to an Output

Usually, the configuration defines some default audio connections from the summing buses. This can be checked or edited using the ON-AIR Designer (under "Audio Output → <I/O> Out → Default Audio"). The default audio connections are described later in the Standard Configuration Specification.

If you are running the standard configuration, then you can also use the 'Routing' page (on the GUI) to connect a bus to a destination:

1. Select **Routing** (from the GUI page menu) to open the 'Routing' page.
2. Under 'Sources', select the **Busses** tab and choose a bus (e.g. **Rec**) - the selection flashes in blue.

3. Under 'Destinations', select an output category (e.g. **Ravenna Outputs**) and choose an output (e.g. **Rav Out 02**) - the selection flashes in blue.

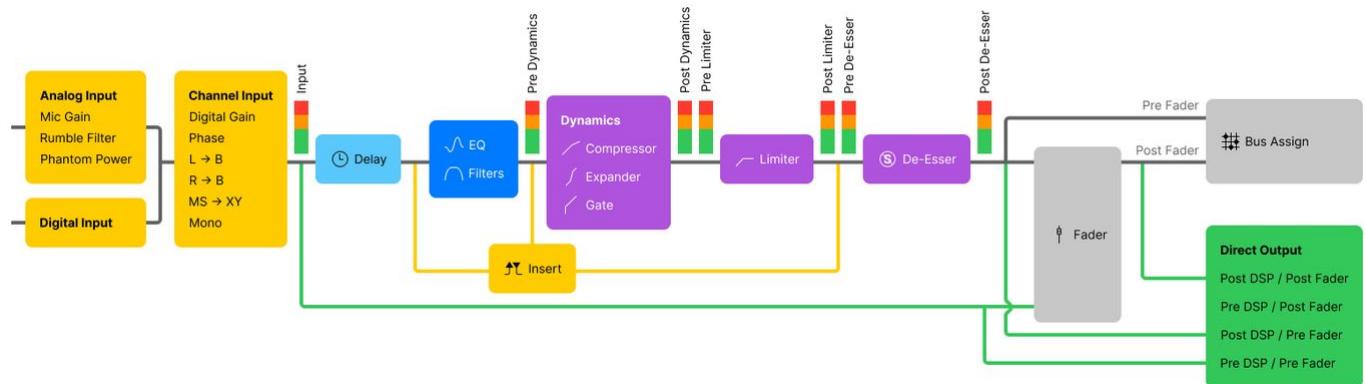4. Press **Connect** - the connection is made.

6.11 crystal - Source Parameters

The number of available sources, and whether 5.1 is supported, is determined by the Power Core license. Note that a stereo source uses 2 resources and a 5.1 source uses 6 resources.

By default, all source channels come with a full complement of DSP. If you wish to simplify the operation, then it is possible to disable the individual DSP blocks (per source). This is done by editing the system configuration using the ON-AIR Designer (under "Source → Parm").

Signal Flow

The diagram below shows the signal flow for a crystal source.

The signal processing blocks are:

- **EQ**: 3-band parametric EQ plus 2-band filters.
- **Dynamics**: Compressor, Expander and Gate.
- **Limiter**: independent Limiter.
- **Delay**: up to 5.3 seconds, adjustable in ms, meters or frames.
- **De-Esser**: gain reduction for sibilant frequencies.
- **AutoMix**: automatic level adjustment for a group of sources.

In addition, the source's **insert point** can be used to insert an external device. This works by assigning one of the 16 available inserts defined by the configuration. Thus, at any one time, up to 16 external inserts are possible.
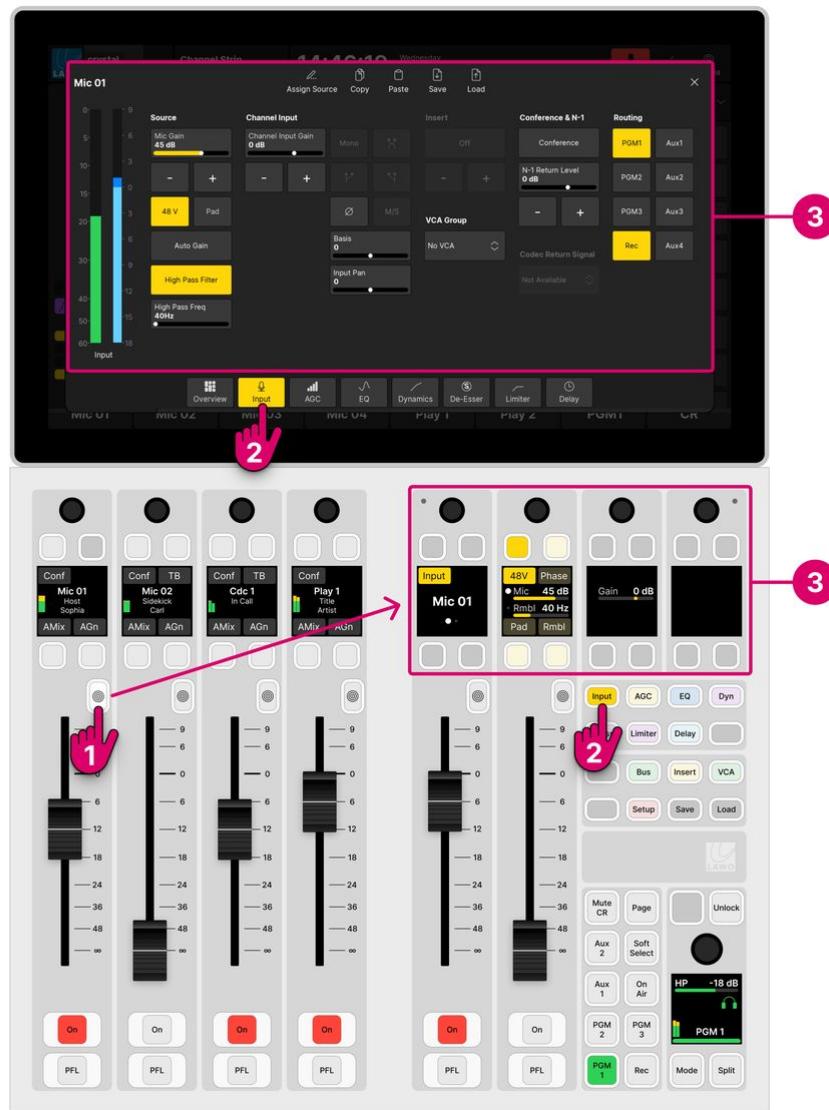
Every source channel also includes an **input section** and **metering**, plus a **direct out** is available for each fader. The pick-up points for these elements are as follows:

- **Input meter** - is fixed and comes after the input section and before all processing. This meter is shown in the fader strip display (beside the source name) and on the GUI Channel Strip page (in the standard configuration).
- **Pre/Post Dynamics & Limiter meters** - are fixed and show the level at the input and output of the Dynamics and Limiter sections. The meters are used on the GUI Source Parameter pages (in the standard configuration).
- **External insert point** - can be switched to one of three positions by the operator:
  - pre-EQ
  - post-EQ
  - post Dynamics (or post Dynamics and Limiter if both are configured)
- **Direct out** - is defined per fader (and not per source). Its position is defined by the configuration and remains fixed during the operation. There are four possible options:
  - post-processing + post-fader
  - pre-processing + post-fader
  - post-processing + pre-fader
  - pre-processing + pre-fader

Operating Principles

To adjust the parameters for a source, it must be placed in access.

The steps below describe the **Access** key colors and GUI pages defined in the standard configuration. These aspects may vary if the configuration is customized.

1.   Select a source by pressing a fader strip **Access** key (with the concentric rings symbol). Take care to press once and not twice to avoid entering strip assign mode.

The **Access** key lights (full white) and the Central Rotary Controls switch into "source parameter" mode. On the GUI, the 'Source Parameter' dialog box opens to the last viewed page.

2.   Choose the parameters you wish to adjust by pressing a Central Function Key (on the surface) or a page button (on the GUI).

For example, press **Input** to adjust the input and pan parameters.

There are seven DSP functions to choose from. The controls use the Lawo LUX color-coding for easy identification: **Input** (yellow), **AGC** (yellow), **EQ** (blue), **Dyn** (magenta), **DeEss** (magenta), **Limiter** (magenta) and **Delay** (cyan).

The surface and GUI pages are selected independently. This allows you to adjust different parameters in parallel - for example, EQ on the surface and Dynamics on the GUI. If a DSP block is disabled in the configuration, then the corresponding controls are unlit (on the surface) and greyed out (on the GUI).

The **Overview** page appears only on the GUI and is for information only. If you touch something on the **Overview**, then the corresponding parameter page opens.

DSP parameters can be protected so that only certain users can make changes. If this is the case, then you must be logged in (with DSP parameter rights) in order to open the relevant pages. The rights can be edited by an administrator of the user access rights system.

3. Adjust the parameters from either the surface or GUI (as described below).

4. At any time you can press an **Access** key on a different fader strip to adjust the parameters for another source.

5. When you have finished adjusting the parameters, deselect the **Access** key (with a single press).

The surface controls return to their default functions, and the 'Source Parameter' dialog box closes.

> ✅ You can quickly check which DSP sections are enabled by looking at the 'Processing' area on the GUI 'Channel Strip' page.

Please note:

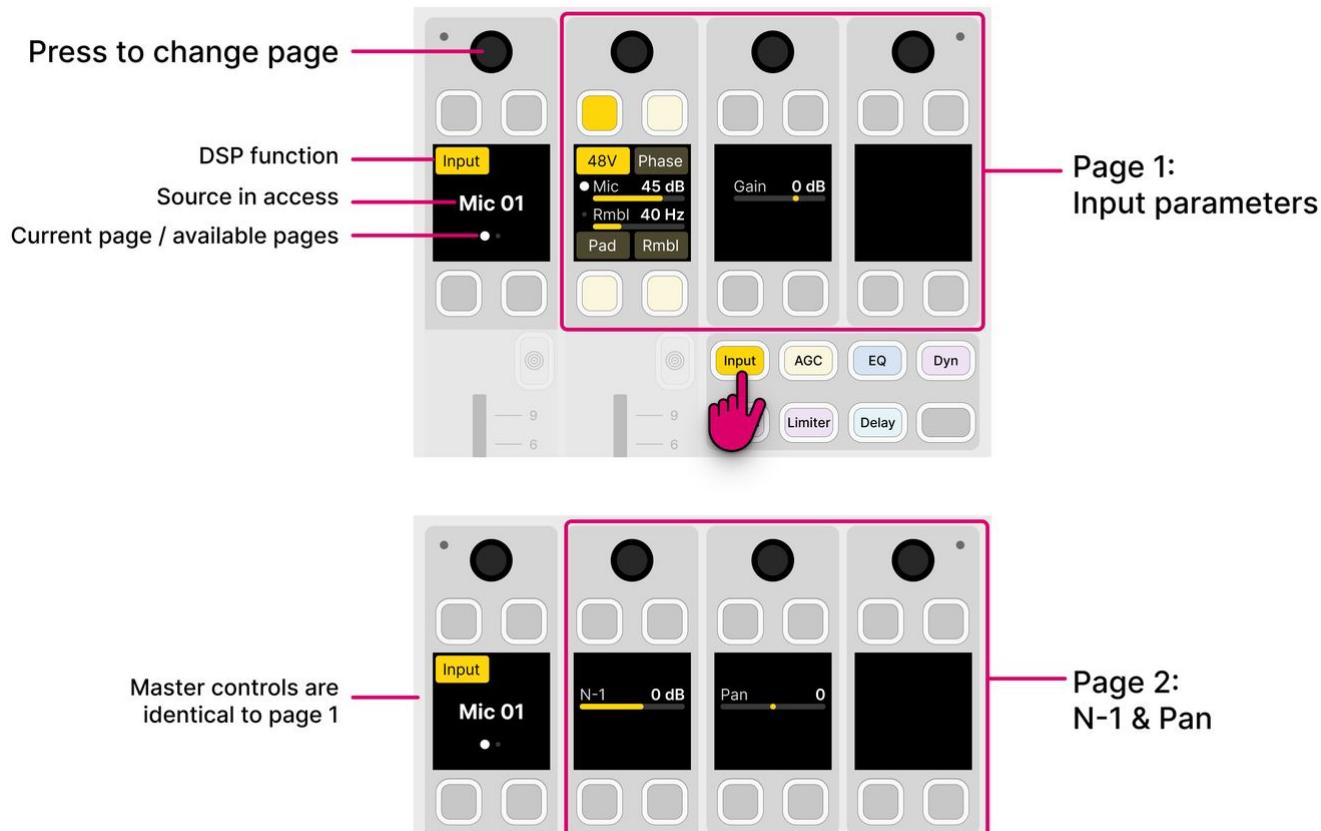- While a source is in access, you will lose the upper rotary control and four soft key functions on the fader strips adjacent to the central controls. The remaining controls operate as normal (and so you can place these sources in access, adjust their level, etc).
- To return the fader strips to their normal mode of operation, cancel the "source in access" (by turning off the selected **Access** key).

Source Parameter Control

Once a source is in access, its parameters can be adjusted from either the surface or GUI as follows.

On the surface...

Press a Central Function Key to choose the parameters. For example, press **Input** to adjust input and pan. The available parameters appear on the four sets of upper rotary controls (on the Main module).

The master controls (on the left) provide information and page switching:
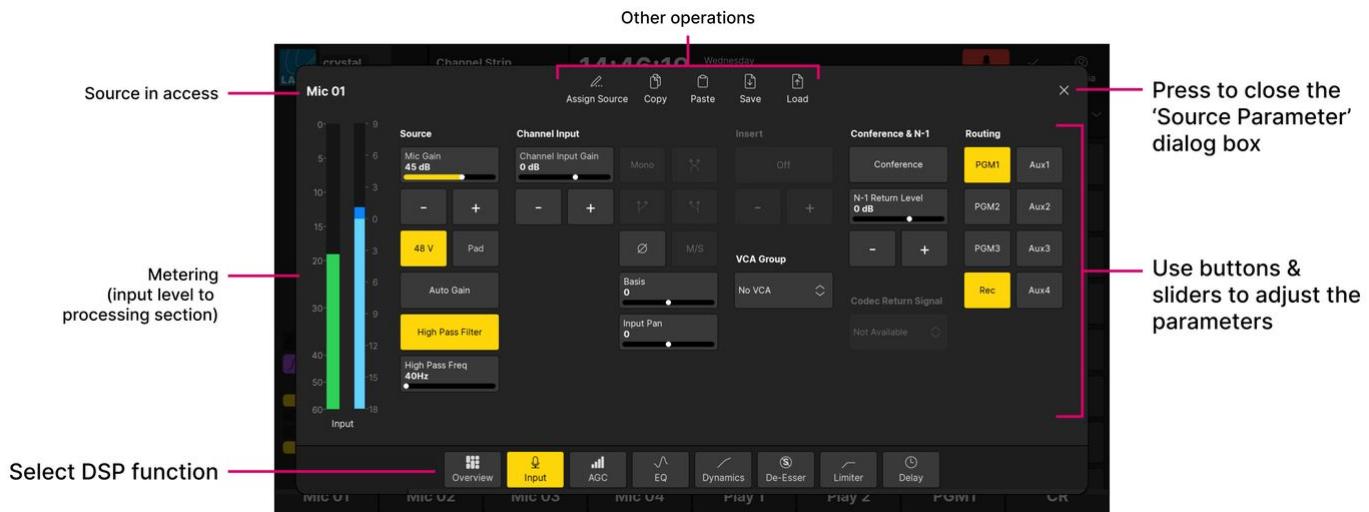
- The display shows the selected function (e.g. **Input**) and source (e.g. **Mic 01**).
- If the processing section has a master on/off key, then this also appears here. (Applies to all DSP functions except Input).
- If there is more than one page of parameters, then a dot appears below the source name. This indicates the current page and the number of available pages. Press down on the rotary control to step through the pages.

The remaining controls are used to adjust the parameters:

- For switched parameters, press the soft key to turn the option on or off: lit (full) = on; lit (dim) = off.
- For variable parameters, turn the rotary control to adjust the value - the current value is shown in the display. If a second parameter is available, then push down and turn to adjust the second function. The dot indicates the current function.
- If a rotary control or soft key is unlit, then it has no function.

On the GUI...
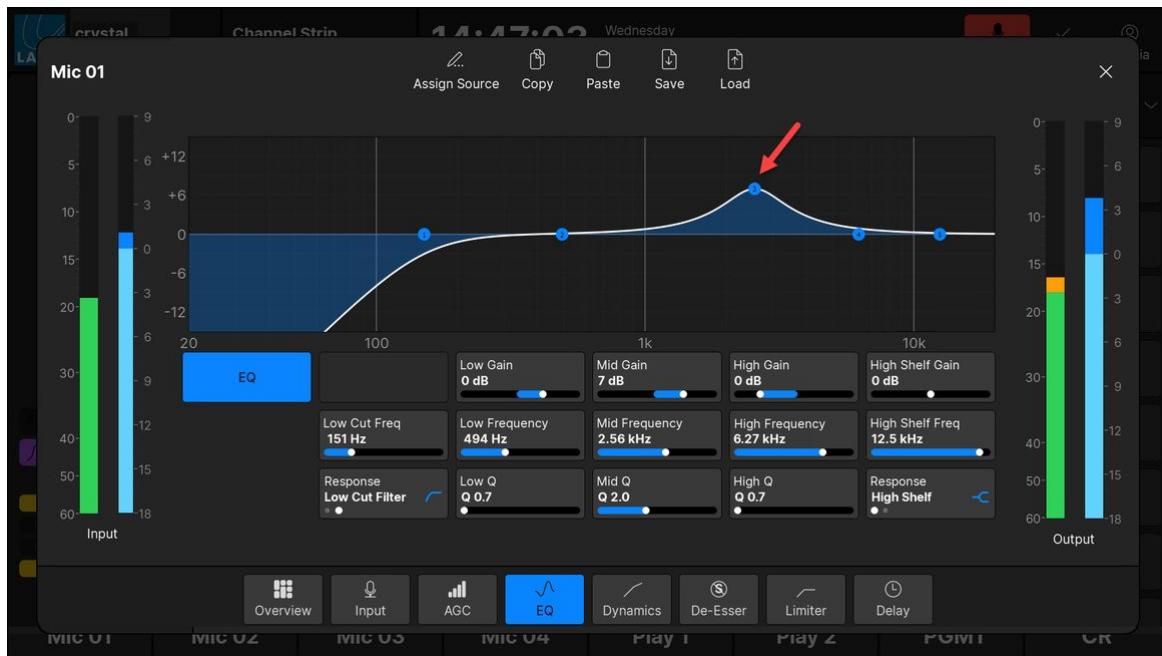
Press a page button to choose the parameters (e.g. **Input** for input and pan).

All of the parameters are shown on a single page:

- For switched parameters, touch the button to turn the option on or off: lit = on; unlit = off.
- For variable parameters, touch and drag anywhere inside the parameter box: either left/right or up/down. Or use the on-screen **+** and **-** buttons.
- If an option is greyed out, then the parameter is not available. For example, the stereo input options are not available for a mono source.
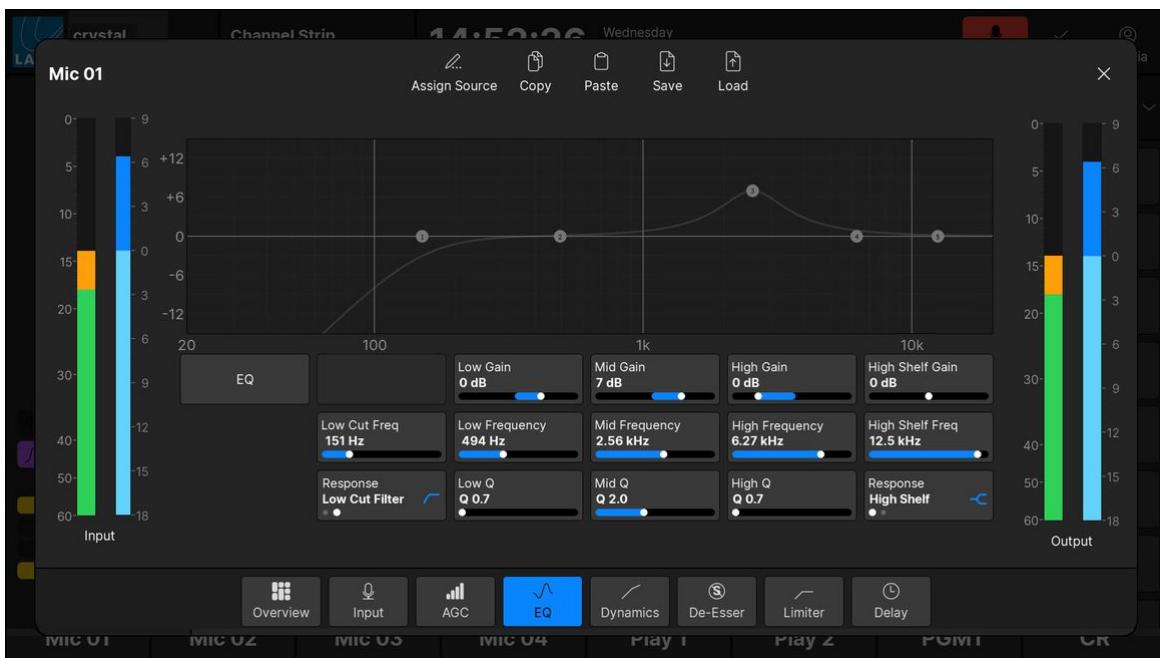
On the **EQ** page, you can touch and drag the numbered points on the EQ curve to adjust the gain and frequency of each band.

On the **EQ** and **Dynamics** pages, the curve provides an easy way to check if the processing is turned on or off:

- Curve (filled) = processing on.
- Curve (not filled) = processing off.

In the example below, the EQ is turned off.

For convenience, the following operations can be accessed from the top of every page:

- **Assign Source** - press to open the 'Assign Source' dialog box. From here you can assign a different source to the selected fader strip.
- **Copy** - press to copy settings from the source in access to the clipboard.
- **Paste** - press to paste settings from the clipboard to the source in access.
- **Save** - press to open the 'Save Snapshot' dialog box.
- **Load** - press to open the 'Load Snapshot' dialog box.

When using **Copy** and **Paste**, note that all of the parameter sections are included and not just the one in view.

Parameters

The rest of this section describes each set of parameters in more detail.

- crystal - Input and Pan Parameters
- crystal - Automatic Gain Compensation
- crystal - EQ
- crystal - Dynamics
- crystal - De-Esser
- crystal - Limiter
- crystal - Relative System Level and the Dynamics Processing
- crystal - Delay

crystal - Input and Pan Parameters

Input and pan parameters are available for all sources. The exact parameters depend on the format of the source and how it is connected.

Mono Sources

For a microphone source, you can adjust input parameters in the analog domain (before the A-D converter) AND in the digital domain (after the converter). For other source types (line-level, IP, AES3, MADI), only the digital domain parameters are supported.

The analog (mic preamp) section includes:

- **Mic** - mic preamp gain from +0dB (or -20dB with Pad) to +70dB.
- **48V** - 48V phantom power.
- **Pad** - 20dB Pad (reduces the mic gain by 20dB). When the Pad is active, the Mic gain value updates accordingly.
- **High Pass Filter** - a high pass 'rumble' filter to roll-off subsonic frequencies. The roll-off point can be set to 40Hz, 80Hz or 140Hz.

In the digital domain, you can adjust:

- **Phase** - phase reverse.
- **Gain** - channel gain from -30dB to +18dB.
- **Pan** - left/right panning onto the stereo buses.

Stereo Sources
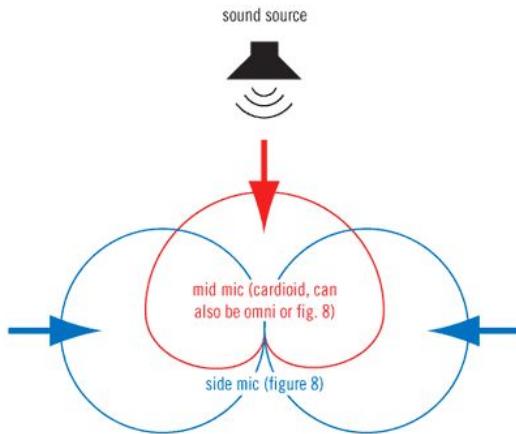
For a stereo source, there are some additional parameters to deal with changes to the incoming audio. For example, if there is no signal present at the right input, you can turn on L->B (Left to Both).

The complete parameter list is as follows:

- **Phase** - phase reverse for the left input.
- **Gain** - channel gain from -30dB to +18dB.
- **Basis** - left/right width.
- **Stereo** or **M/S** - changes the mode of operation from normal stereo to MS->XY decoding (described below).
- **L→B** - the left input is routed to both sides of the stereo channel.
- **R→B** - the right input is routed to both sides of the stereo channel.
- **Mono** - left and right inputs are summed with a -3dB gain offset.
- **Side** - the left input and right input are reversed (left input to right side of channel, and right input to left side of channel).
- **Pan** - left/right panning (balance) onto the stereo buses.

M/S Decode

M/S is a stereo recording technique that uses two coincident microphones, one pointing to the front (Middle) and the other (bi-directional) at right angles to provide the stereo ambience (Side). The system provides M-S to X-Y decoding to turn a Middle and Side signal into normal Left and Right stereo.

The incoming M/S signal should be connected to a stereo source:

- Left Input - from the Middle (M) signal.
- Right Input - from the Side (S) signal.

When the M/S stereo mode is active, the following calculations are applied:

- Left channel = L+R (M+S)
- Right channel = L-R (M-S)

By adjusting the **Pan** (Balance) control, you can vary the ratio of Middle to Side, and thereby adjust the width of the stereo field.

Surround Panning

If surround panning is enabled for a source, then the pan parameters are extended as follows:

- **LCR Pan** - left/center/right pan position.
- **F/B Pan** - front/back pan position.
- **Slope** - from 0.0 to 1.0.
- **LFE** - low-frequency effect (subwoofer) level, from -120 to +9 dB.

The **Slope** adjusts signals feeding the discrete center channel within the surround field. It may be used to balance between discrete and phantom center signals. To see the effect, position the source at front center, and adjust the slope to a setting of 1.0; the signal feeds only the discrete center output. Now set the slope to a value of 0.0; the signal feeds only left and right (phantom center).

On a stereo source, you can adjust the left/right balance, front/rear pan and LFE level. Center slope is not available.

On a surround source, you can adjust LFE level only; the surround source is assigned directly to the surround bus (e.g. left to left, center to center, etc.)

If a surround source is assigned to a stereo bus, then the source is mixed onto the bus according to the surround downmix parameters set within the configuration. If a surround source is assigned to a mono bus, then the stereo downmix is converted to mono by subtracting 3dB from, and then summing, the L and R channels.

Operation
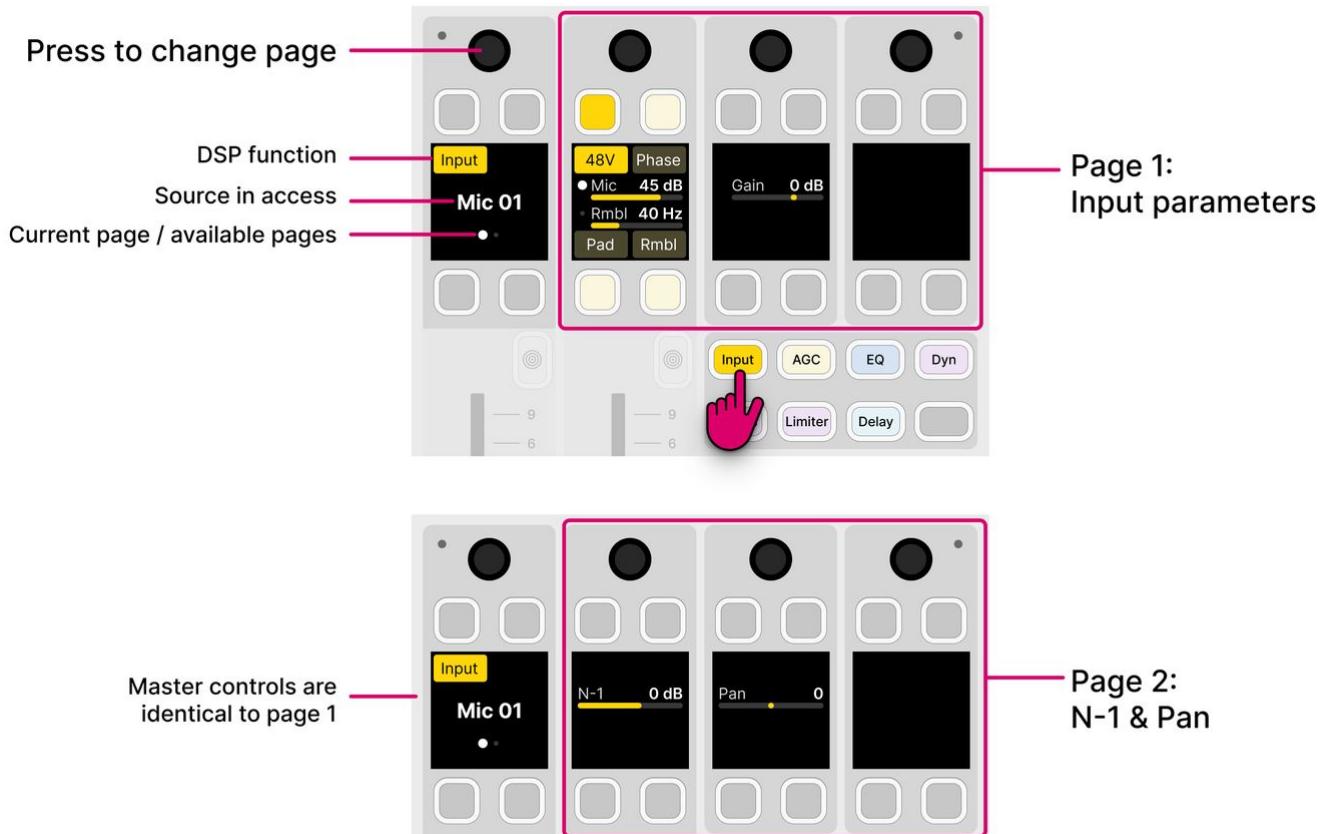
To access the parameters, press an **Access** key (on the fader strip) followed by **Input** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.

On the surface...
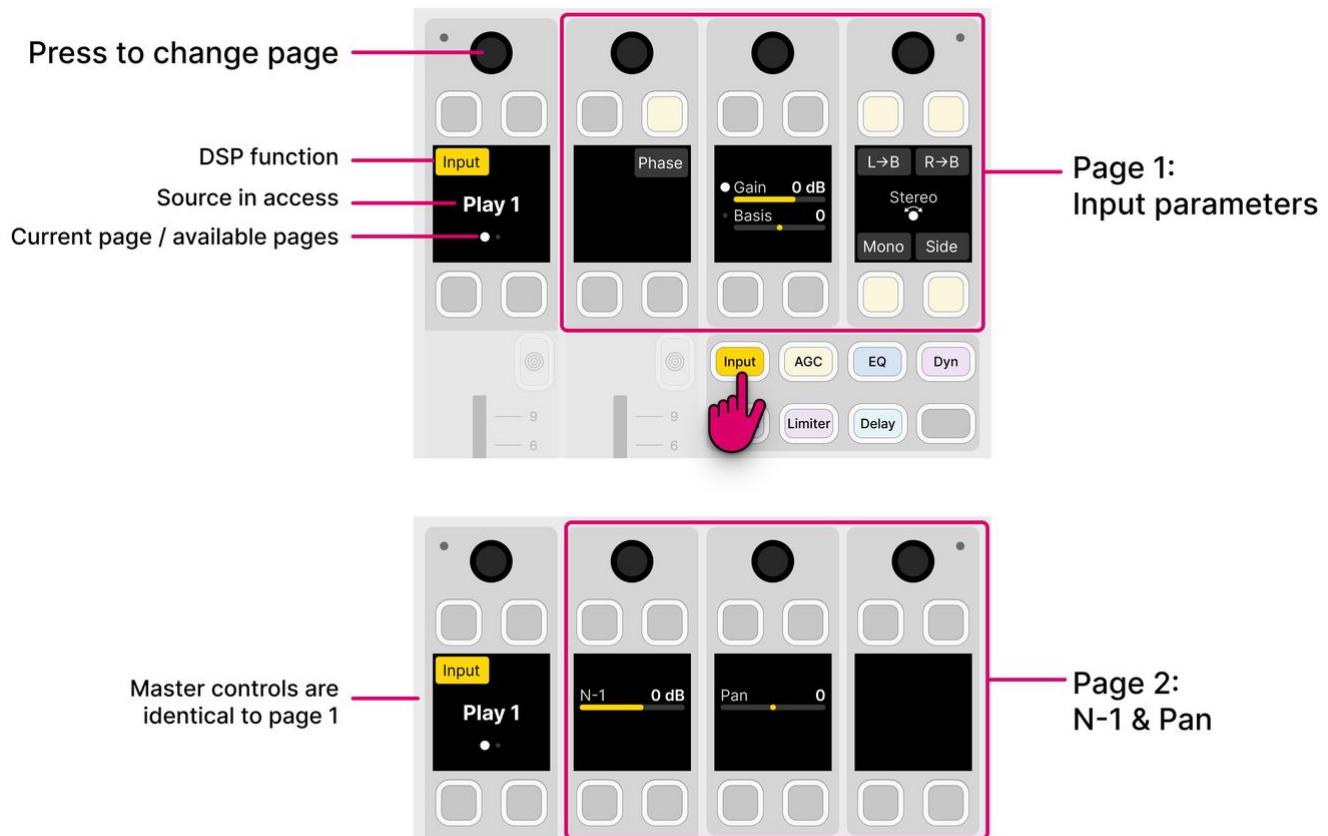
There are two pages of parameters: one for the input section and one for pan.

The example below shows the parameters for a mono mic source.

- Press down on the left (master) rotary control to toggle between the input and pan pages.
- For the Mic/Rmbl control: turn to adjust Mic gain; press down and turn to adjust the rumble filter cut-off frequency.
- For convenience, the second page includes the N-1 level. This sets the level of the N-1 return to the source. See Conference & N-1.
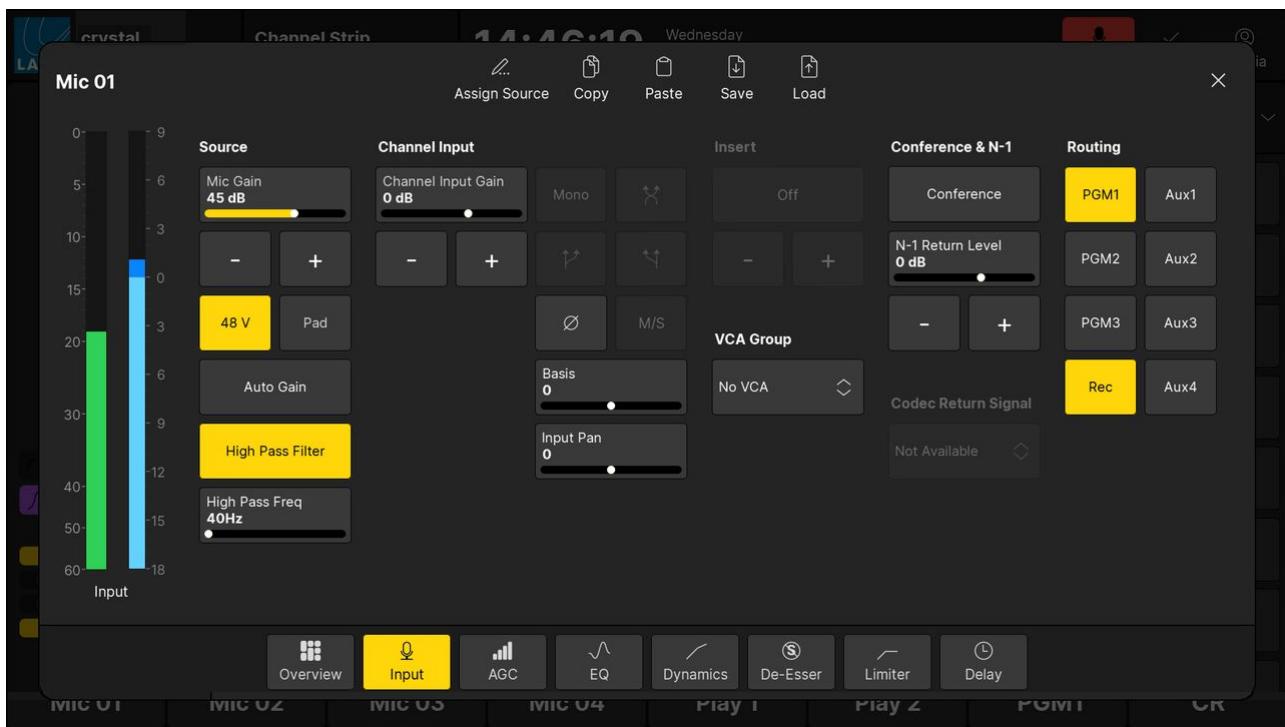
When a stereo source is in access, the parameters are as follows.

Press to change page

DSP function
Source in access
Current page / available pages

Input
Play 1

Phase

● Gain   0 dB
Basis   0

L→B   R→B
Stereo
Mono   Side

Page 1:
Input parameters

Input   AGC   EQ   Dyn
Limiter   Delay

Master controls are
identical to page 1

Input
Play 1

N-1   0 dB
Pan   0

Page 2:
N-1 & Pan

- For the Gain/Basis control: turn to adjust channel Gain; press down and turn to adjust Basis (width).
- To change the mode from **Stereo** to **M/S**, turn the rotary control.

On the GUI...

All of the parameters are shown on a single page.

'Source Parameter' dialog box (mono mic source)

- If an option is greyed out, then the parameter is not available. For example, the stereo compatibility options are not available for a mono source.
- For convenience, the page includes input and pan parameters plus the following functions: Auto Gain (on/off), Insert (on/off and send level), VCA Group (assign), Conference (enable), Codec Return Signal (selection) and Routing (bus assign).

> ✓ When adjusting input gain, use the input meter (on the GUI) to help set a good input level. If the meter turns red repeatedly, then the input level is overloading and you should reduce the Mic gain (or channel Gain) value.

crystal - Automatic Gain Compensation

The Automatic Gain Compensation (**AGC**) page provides access to the automix parameters. The number of available automixers is determined by the Power Core license. At maximum capacity, up to 4 independent automix groups can be configured.

Automix

Automix can be enabled for any collection of mono and stereo sources. Once enabled, an internal algorithm monitors the signal power of each channel, and then automatically adjusts the mix levels accordingly. For example, if there are three guests and a host, the algorithm automatically mutes the guest sources while the host is speaking. The feature is ideal for balancing active and inactive microphones, such as in a panel discussion, or creating an automated voice-over.

For each source, there are four parameters:

- **Group** - assigns the source to an automix group (from 1 to 4).
- **AMix** - enables (or disables) the automix function. When disabled, the mix level is adjusted manually from the source fader.
- **Weight** – sets the weighting factor of the source, from +9 to -9 with a default midpoint = 0.
- **Speed** – sets the "smoothness" of the automixing, in milliseconds (ms).

Sources with a higher weight value get priority in the mix; those with the same weight are mixed equally; those with a lower value get reduced priority. For example, in a panel discussion, you might want to give the host leading the discussion a higher weight value than that of the guests. Or, to create an automated voice-over, adjust the weight of the playout material to a much lower value than that of the voice.

The speed defines how quickly a signal returns to its normal mix level after its gain has been suppressed. A short speed fades signals in and out quickly, but could result in "pumping" if several guests are talking in parallel. A longer speed will be smoother but may generate audible fades in and out. The ideal value depends on the material.
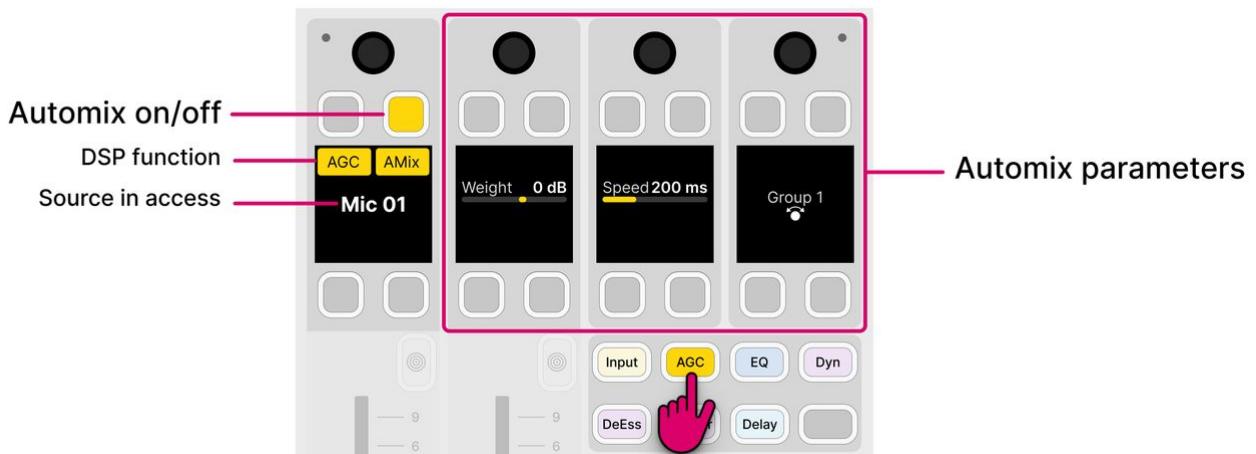
Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **AGC** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.

On the surface...

There is one page of parameters.

- Turn the **Group** rotary control to choose the automix group.
- Enable the **AMix** soft key to turn on the automixing.
- Turn the **Weight** and **Speed** rotary controls to adjust the behavior.

On the GUI...

All of the parameters are shown on a single page.

'Source Parameter' dialog box (AGC)

- Press the **+** and **-** buttons to choose the automix group.
- Enable the **Automixer** button to turn on the automixing.
- Touch and drag the **Weight** and **Speed** parameter values to adjust the behavior.

crystal - EQ

EQ processing is available for all sources. The EQ section includes a 3-band parametric EQ plus 2-band filters.

Parametric EQ

There are three bands of parametric EQ: Low, Mid and High. Each band can operate across the full frequency range and is set independently. The following parameters can be adjusted:

- **Gain** - from -15dB to +15dB.
- **Frequency** - from 20Hz to 18kHz.
- **Q** - from 0.7 to 15.

Filters / Shelving EQ

For the 2-band filters, each band can operate either as a fixed slope filter (High Pass/Low Pass) or as a shelving EQ (Low Shelf/High Shelf).

In High Pass/Low Pass mode, the filter slope is fixed at 12dB per octave. The cut-off frequency can be adjusted from 20Hz to 18kHz.

In Low Shelf/High Shelf mode, the slope of the shelving EQ is defined by the gain value. Thus, there are two parameters that can be adjusted: gain (from -15dB to +15dB) and frequency (from 20Hz to 18kHz).

Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **EQ** (on the Central Function Keys and/or GUI).

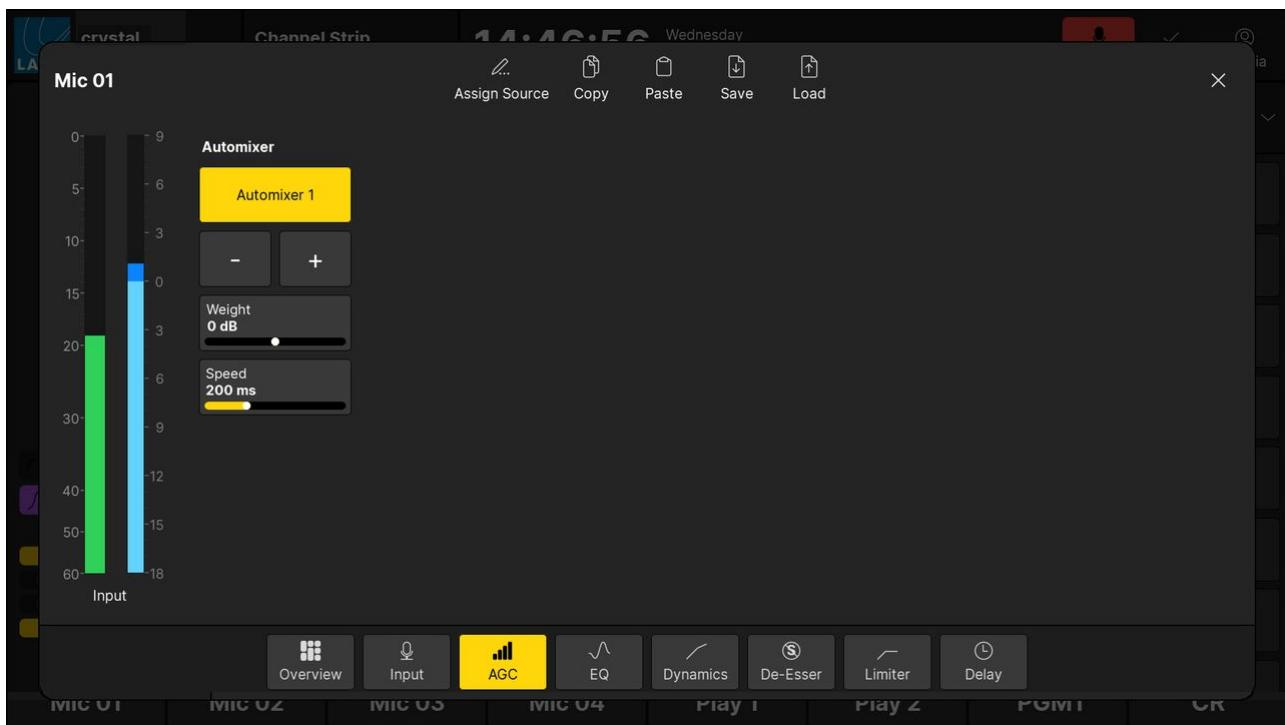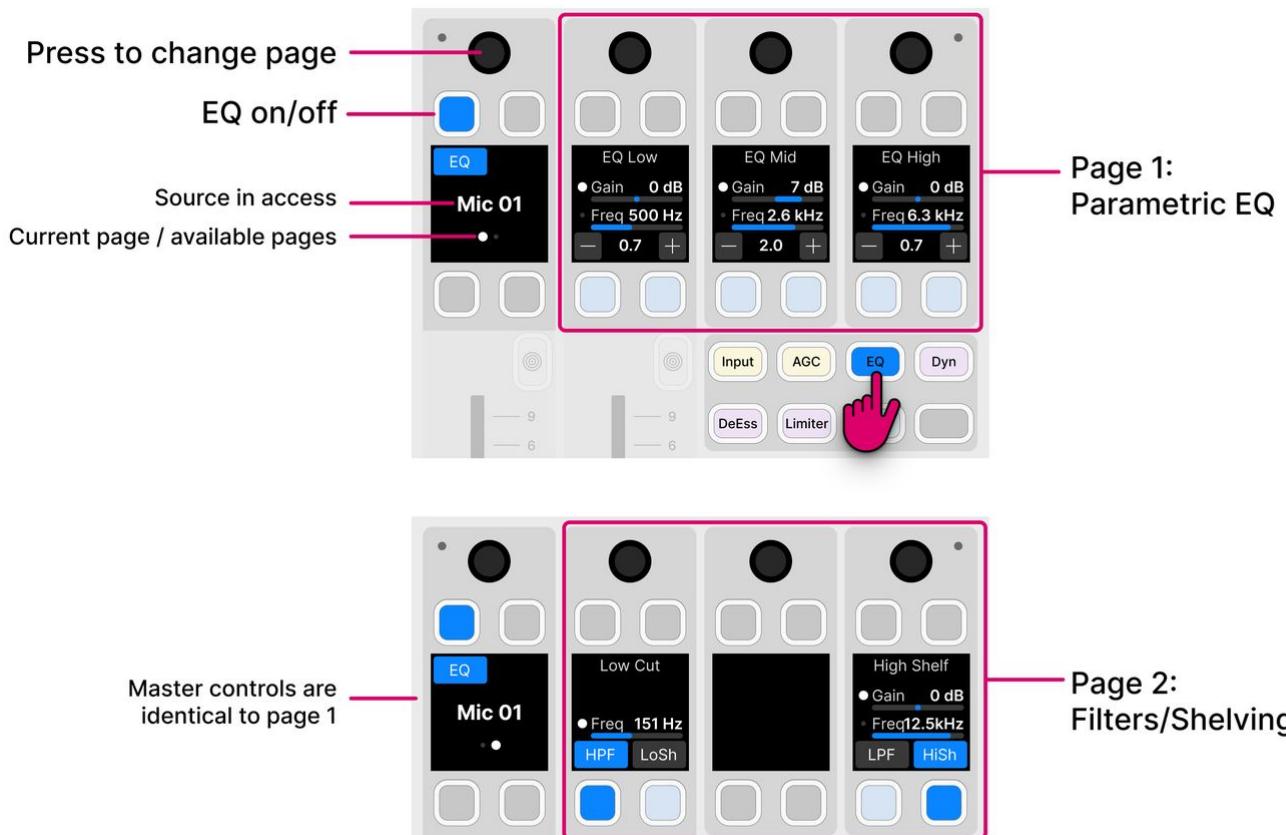Then adjust the parameters from either the surface or GUI.
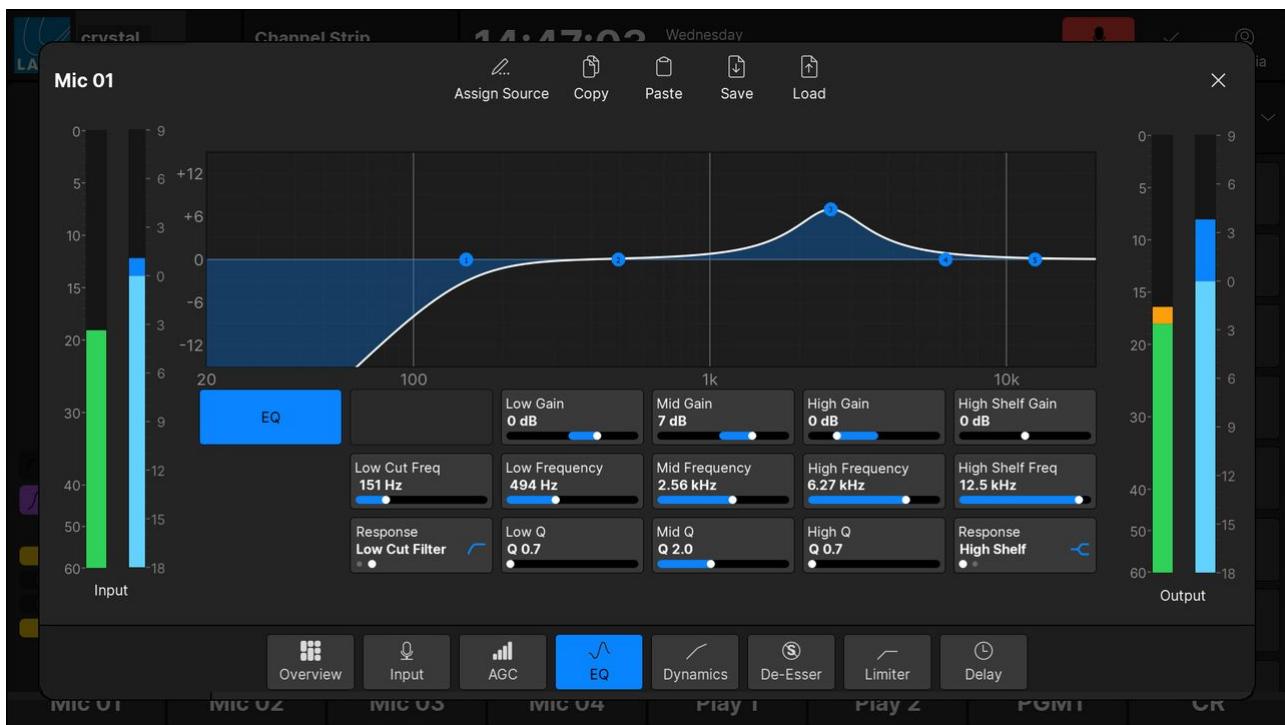
On the surface...

There are two pages of parameters: one for the parametric EQ and one for the filters.

- Press down on the left (master) rotary control to toggle between the pages.
- The **EQ** soft key acts as the master on/off for the complete section: 3-band parametric EQ + 2-band filters. This key appears in the same position on both pages.
- For the Gain/Freq controls: turn to adjust Gain; press down and turn to adjust Frequency.
- To adjust the Q, press the + or – soft keys to increase or decrease the Q value.
- On the second page, use the soft keys to set the EQ type for the filter bands:
  - Lower band - select either **HPF** (High Pass Filter) or **LoSh** (Low Shelf).
  - Higher band - select either **LPF** (Low Pass Filter) or **HiSh** (High Shelf).

On the GUI...

The parameters for all five bands are shown simultaneously, and there is a visualization that shows the overall frequency response.

'Source Parameter' dialog box (EQ)

- The **EQ** button acts as the master on/off for the complete section: 3-band parametric EQ + 2-band filters.
- The EQ curve provides an easy way to check if the processing is turned on or off:
  - Curve (filled) = EQ on.
  - Curve (not filled) = EQ off.
- To adjust each of the five bands, you can either touch and drag a numbered point on the EQ curve, or touch and drag the values inside the parameter boxes:
  - Band 1 = Low Cut (High Pass) Filter or Low Shelf.
  - Band 2 = Low band Parametric EQ.
  - Band 3 = Mid band Parametric EQ.
  - Band 4 = High band Parametric EQ.
  - Band 5 = High Cut (Low Pass) Filter or High Shelf.
- For the two filter bands, use the **Response** parameter to set the EQ type.
- The meters show the levels at the input and output of the EQ section.

crystal - Dynamics

Dynamics processing is available for all sources. The dynamics section includes a compressor, expander and gate. (Limiting can be applied via the independent limiter.)

Each processor has its own on/off, plus there is a master on/off for the complete section. The on/off status is best checked by looking at the GUI (where you can see the **Dynamics** on/off plus the on/off for the individual sections: **Compressor**, **Expander** and **Gate**).

Compressor

The following parameters are available for the compressor:

- **Threshold** - threshold in dBr, range is dependent on RSL.
- **Ratio** - ratio from 1:1 to 1:16.
- **Attack** - attack time from 0.16ms to 82ms.
- **Release** - release time from 10ms to 5000ms.
- **Gain** - makeup gain from -12dB to 0dB.

The characteristic of the compressor is optimized for radio on-air operation. The ratio pivot point moves around the working point according to the input signal level and not around a fixed threshold. This allows the ratio to adapt without having to change the level considerably.

Expander

The following parameters are available for the expander:

- **Threshold** - threshold in dBr, range is dependent on RSL.
- **Ratio** - ratio from 1:1 to 1:0.1.

Gate

The following parameters are available for the gate:

- **Threshold** - threshold in dBr, range is dependent on RSL.
- **Attack** - attack time from 0.16ms to 82ms.
- **Release** - release time from 10ms to 5000ms.

> ℹ️ The dynamics elements of Power Core use relative decibels, or dBr, as opposed to dBFS. So when you are using the dynamics elements (compressor, expander, gate, limiter, de-esser), the threshold values for those elements are in dBr, not dBFS. What this means in practice is explained in more detail later. For now, it is useful to know that the threshold range will vary depending on the Relative System Level (RSL) defined in the ON-AIR Designer.
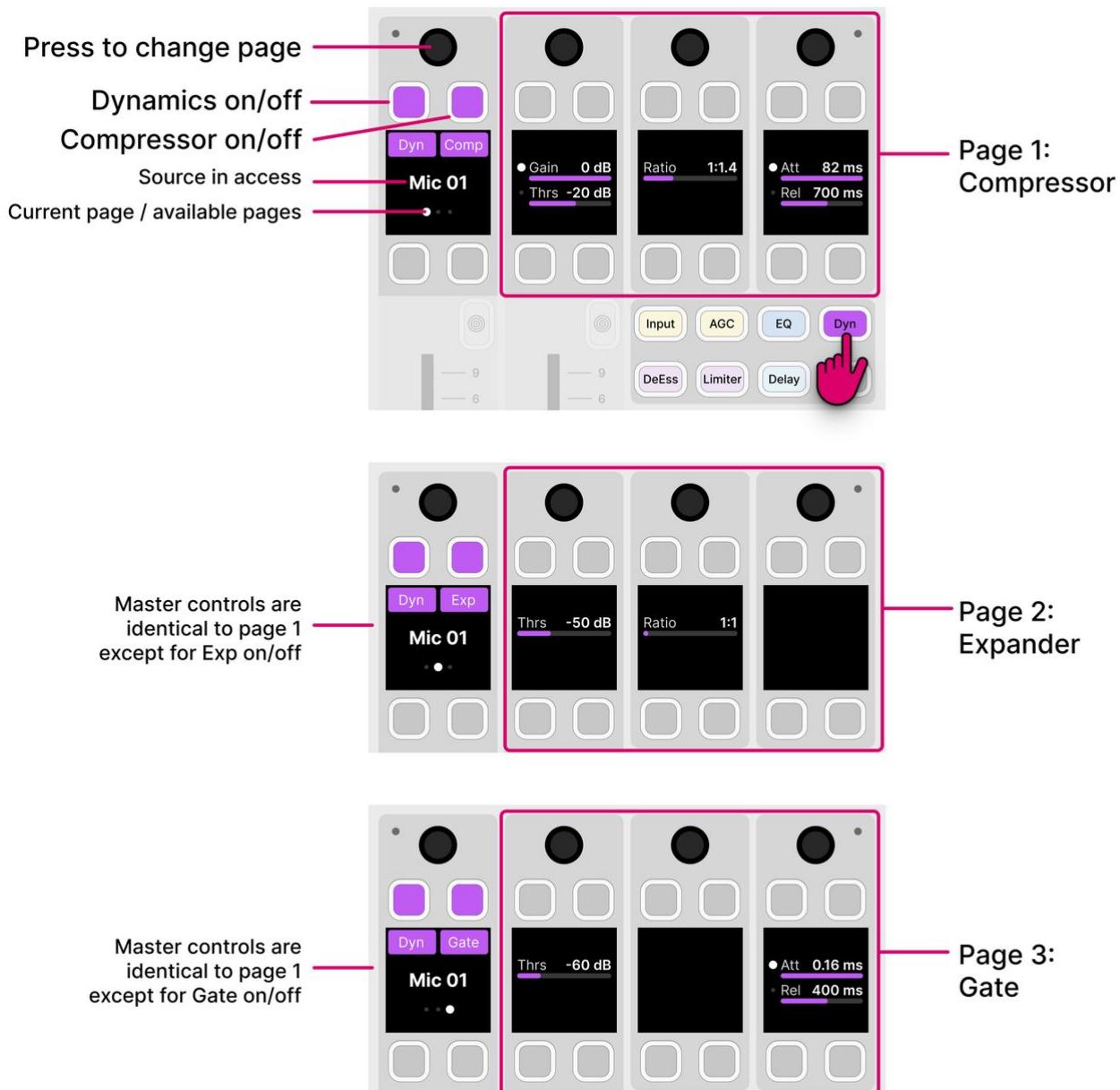
Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **Dynamics** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.

On the surface...

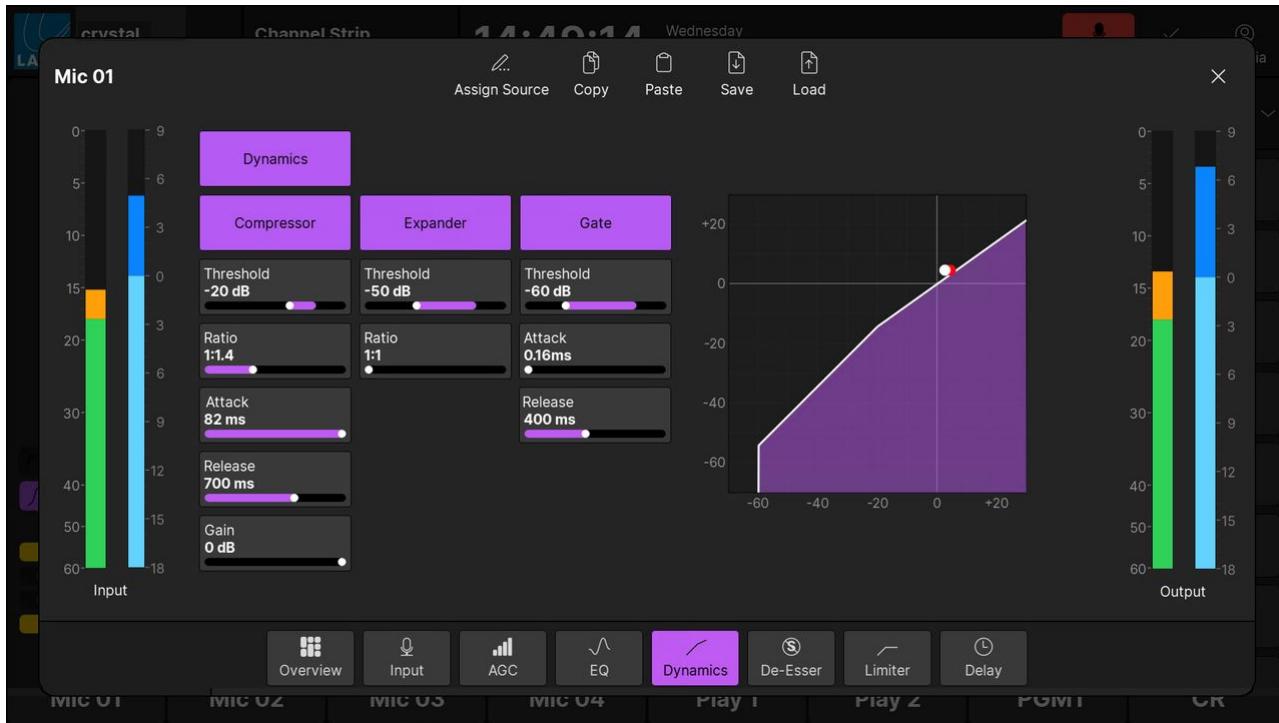There are three pages of parameters: one for each processor.

- Press down on the left (master) rotary control to step through the pages.
- The **Dyn** soft key acts as the master on/off for the complete section. This key appears in the same position on all pages.
- The **Comp**, **Exp** and **Gate** soft keys allow you to enable (or disable) each individual processor. For a processor to be active, the master **Dyn** key must also be enabled.
- For the Gain/Thrs control: turn to adjust Gain; press down and turn to adjust Threshold.
- For the Att/Rel controls: turn to adjust the Attack time; press down and turn to adjust the Release time.

On the GUI...

All of the dynamics parameters are shown simultaneously, and there is a visualization that shows the overall response (input versus output level).

The visualization includes a white ball that represents the output level of the dynamics section (Compressor, Expander and Gate). This changes dynamically as the signal level varies. If a red ball is also visible, then this represents the output level of the de-esser. The balls can be extremely helpful when adjusting parameters, as you can see which part of the curve is active as the signal level changes.

'Source Parameter' dialog box (Dynamics)

- The **Dynamics** button acts as the master on/off for the complete section.
- The **Compressor**, **Expander** and **Gate** buttons allow you to enable (or disable) each individual processor. For a processor to be active, the master **Dynamics** button must also be enabled.
- The dynamics curve provides an easy way to check if the processing is turned on or off:
  - Curve (filled) = Dynamics on.
  - Curve (not filled) = Dynamics off.
- The meters show the levels at the input and output of the dynamics section.

crystal - De-Esser

A de-esser is available for all sources. It can be used to apply gain reduction for sibilant frequencies, and is a useful tool for dealing with human speech.

De-esser Parameters

The following parameters are available for the de-esser:

- **Reduction** – is the amount of gain reduction applied to the sibilant frequencies:
  - Values from 1 to 6 reduce the gain of the unwanted frequencies; the higher the value, the more gain reduction.
  - Above 6, the gain reduction remains at its maximum, and the affected frequency range broadens.
- **Type** – changes the center frequencies affected by the de-esser. There are two possible options: either female or male. Each option is optimized for either female or male voices.
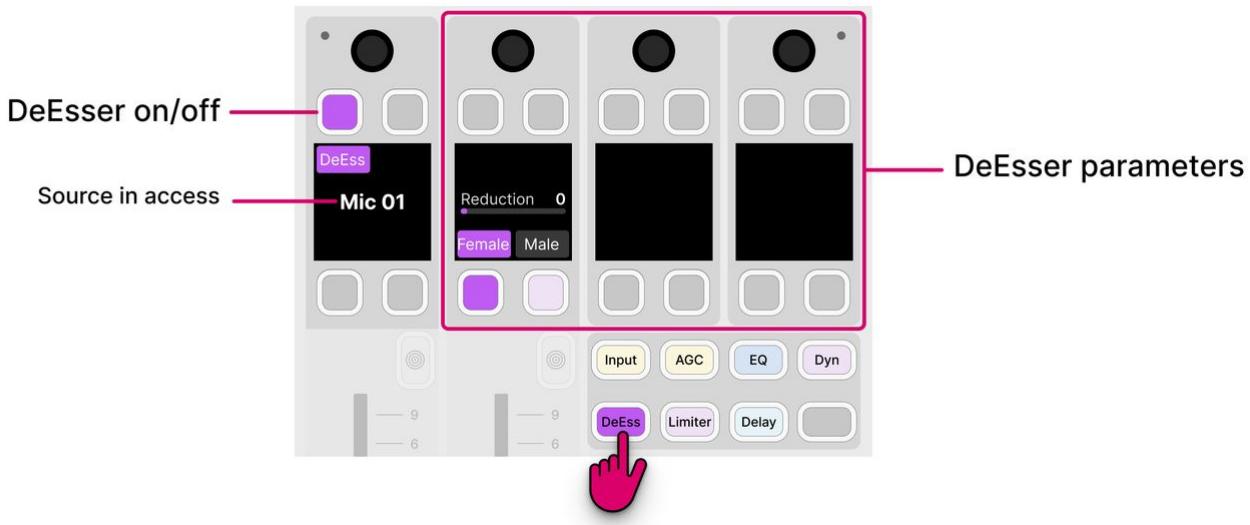
Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **De-Esser** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.

On the surface...
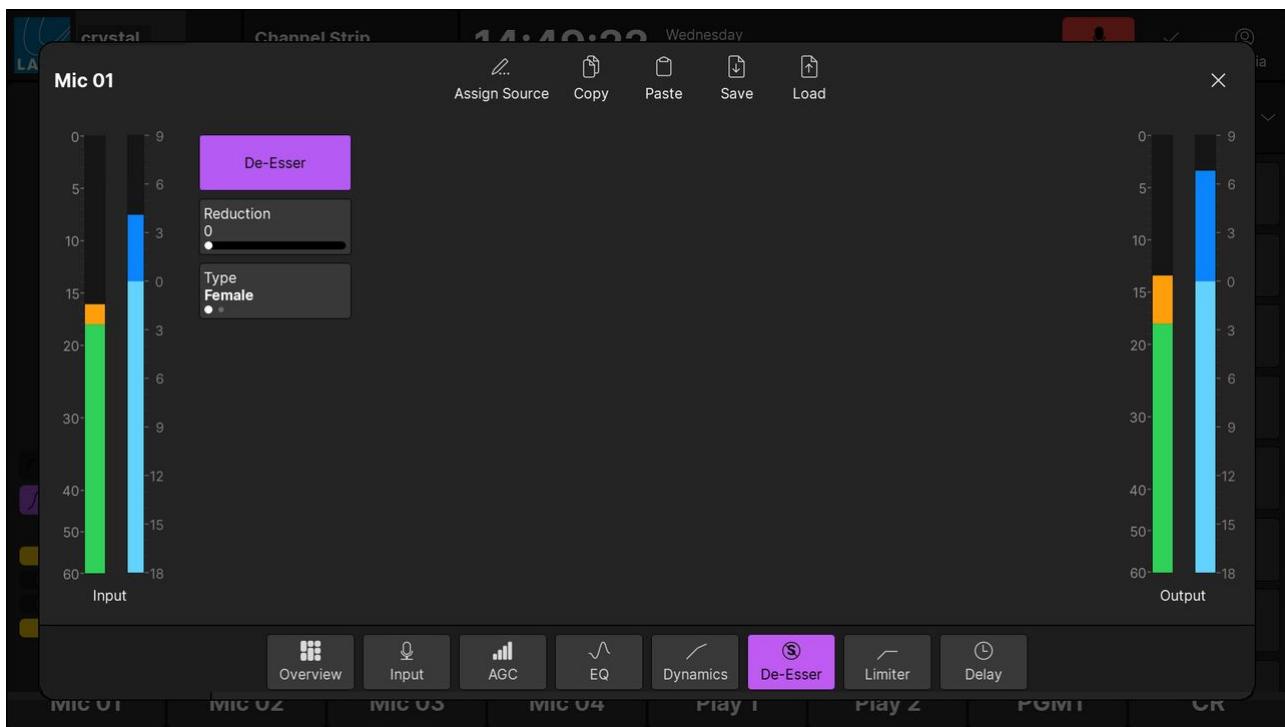
There is one page of parameters.

- Enable the **DeEss** soft key to turn on the processing.
- Select either the **Female** or **Male** soft key to set the voice type.
- Turn the **Reduction** rotary control to increase (or decrease) the amount of gain reduction.

The behavior of the de-esser can be seen by looking at the Dynamics page on the GUI. If the de-esser is enabled, then a red ball appears on the dynamics graph. This represents the output level of the de-esser, and changes dynamically as the signal level varies.

> ✅ If you select the **Dynamics** page (on the GUI) and **DeEss** (on the surface), then you can adjust the de-esser parameters while looking at the dynamics graph.

On the GUI...

All of the parameters are shown on a single page.

'Source Parameter' dialog box (De-Esser)

- Enable the **De-Esser** button to turn on the processing.
- Touch and drag the **Type** parameter to set the voice type.
- Touch and drag the **Reduction** parameter to increase (or decrease) the amount of gain reduction.
- The meters show the levels at the input and output of the de-esser.

crystal - Limiter

In addition to the dynamics processing, a separate limiter is available for all sources.

Limiter Parameters

The following parameters are available for the limiter:

- **Threshold** - threshold in dBr, range is dependent on RSL.
- **Release** - release time from 10ms to 5000ms.

> ℹ The dynamics elements of Power Core use relative decibels, or dBr, as opposed to dBFS. So when you are using the dynamics elements (compressor, expander, gate, limiter, de-esser), the threshold values for those elements are in dBr, not dBFS. What this means in practice is explained in more detail later. For now, it is useful to know that the threshold range will vary depending on the Relative System Level (RSL) defined in the ON-AIR Designer.
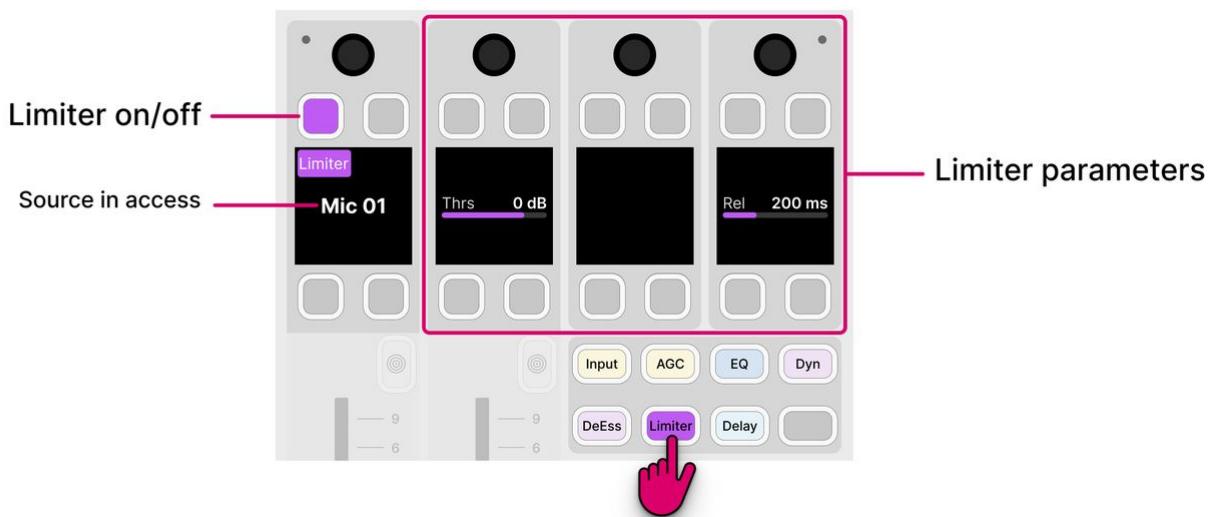
Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **Limiter** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.
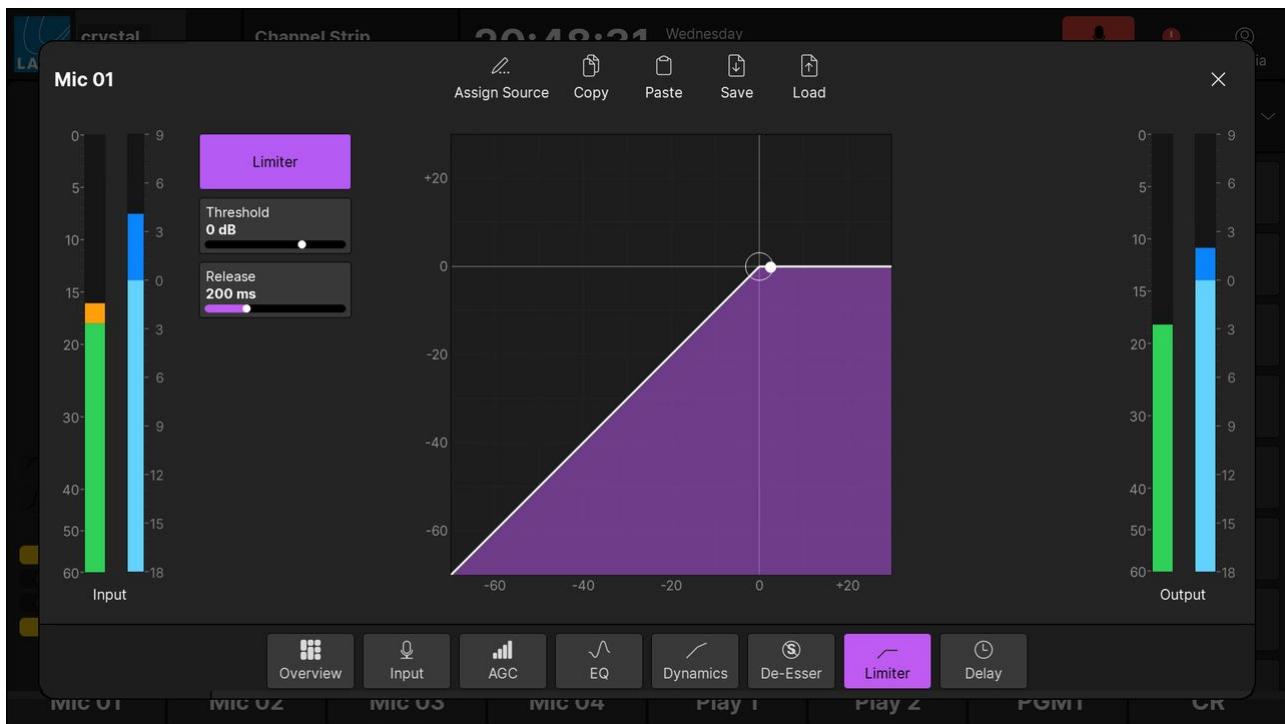
On the surface...

There is one page of parameters.

- Enable the **Limiter** soft key to turn on the processing.
- Turn the rotary controls to adjust the behavior.

On the GUI...

All of the parameters are shown on a single page, and there is a visualization that shows the overall response (input versus output level).

The visualization includes a white ball that represents the output level of the limiter. This changes dynamically as the signal level varies. The ball can be extremely helpful when adjusting parameters, as you can see which part of the curve is active as the signal level changes.

'Source Parameter' dialog box (Limiter)

- Enable the **Limiter** button to turn on the processing.
- The limiter curve provides an easy way to check if the processing is turned on or off:
  - Curve (filled) = Limiter on.
  - Curve (not filled) = Limiter off.
- Touch and drag and parameter values to adjust the behavior.
- The meters show the levels at the input and output of the limiter section.

crystal - Relative System Level and the Dynamics Processing

This topic explains how the Relative System Level, defined by the ON-AIR Designer configuration, affects the operation of the dynamics processing.

Overview

The dynamics elements of the Power Core use relative decibels, or dBr, as opposed to dBFS. So when you are using the dynamics elements (compressor, expander, gate, limiter, de-esser), the threshold values for those elements are in dBr, not dBFS.

How dBr is referenced to dBFS is dependent on the value you choose for the Relative System Level (RSL) in ON-AIR Designer. This value is calculated using the following formula:

- RSL = working point - 18dBFS

The working point (or reference level, or alignment level), is a level that represents a normal audio level. In the US, the SMPTE RP155-2004 standard specifies that the working point should be -20dBFS. In Europe, EBU R68-2000 specifies the working point should be -18dBFS, and in Germany the working point is -9dBFS.

The -18dBFS offset exists because the Power Core has an additional 18dB/3bits of digital headroom in the DSP section. This allows the user to compensate for very dynamic input signals that require low gain to avoid clipping the microphone pre-amp. It is very important that the level of the signal is reduced below 0dBFS before being connected to an audio output.

RSL Values

The default Relative System Level is set to -27, which corresponds to a working point of -9dBFS, which is valid for German broadcasters.

For the US, if you want to adhere to the SMPTE RP-155-2004 standard, you should choose an RSL of -38dBFS. This will ensure that your working point, or 0dBr, is at -20dBFS. This will also ensure that the level of the internal tone generator is set to 0dBR/-20dBFS.

For Europe, if you wish to adhere to EBUR68-2000, you should choose an RSL of -36dBFS.

What this means in practice

As a practical example, if you set the threshold of the limiter to -10dBr on a source using the internal tone generator, you have a pre-limiter level of -20dBFS, and post-limiter level of -30dBFS.

If the RSL is set to -38dBFS, then the dynamics processors have a maximum threshold of +38dBr/+18dBFS; this is because of the additional 18dB of headroom available within the DSP processor.

The de-esser uses a fixed threshold of 0dBr. This means it will activate anytime a signal reaches 0dBr/-20dBFS or greater.

The compressor in the Power Core operates slightly differently to traditional compressors. In a traditional compressor, the output gain of the signal will be reduced anytime the input signal level is above the desired threshold. This reduces the dynamic range of the signal, but also means that the overall level of the signal is lower, and therefore you must apply makeup gain to compensate.

Power Core also reduces the output gain of a signal anytime the input level is above the specified threshold. However, if the threshold is set below the working point of the system, the Power Core Compressor automatically increases the output gain anytime the input level is below the working point of the system (in correlation with the ratio). Practically speaking, this allows a user to very quickly and easily compress a signal without dramatically changing the on-air sound. Additionally, it ensures that the output signal level will always be automatically compressed around the defined working point of the system.

crystal - Delay

Delay can be added to all sources.

The delay time can be adjusted in milliseconds (ms), meters (m) or frames (frs). The maximum delay time is 5.3 seconds.

Delay Parameters

For a 48kHz, PAL system, the values can be adjusted as follows:

- Delay time (in ms) = 0 to 5300
- Delay time (in meters) = 0 to 1749
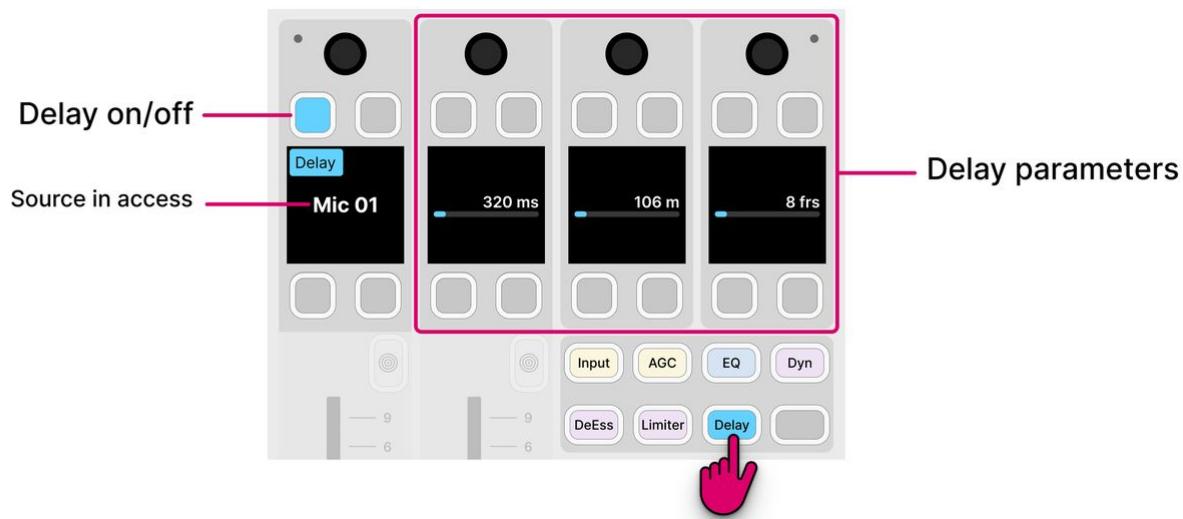- Delay time (in frames) = 0 to 132

Operation

To access the parameters, press an **Access** key (on the fader strip) followed by **Delay** (on the Central Function Keys and/or GUI).

Then adjust the parameters from either the surface or GUI.
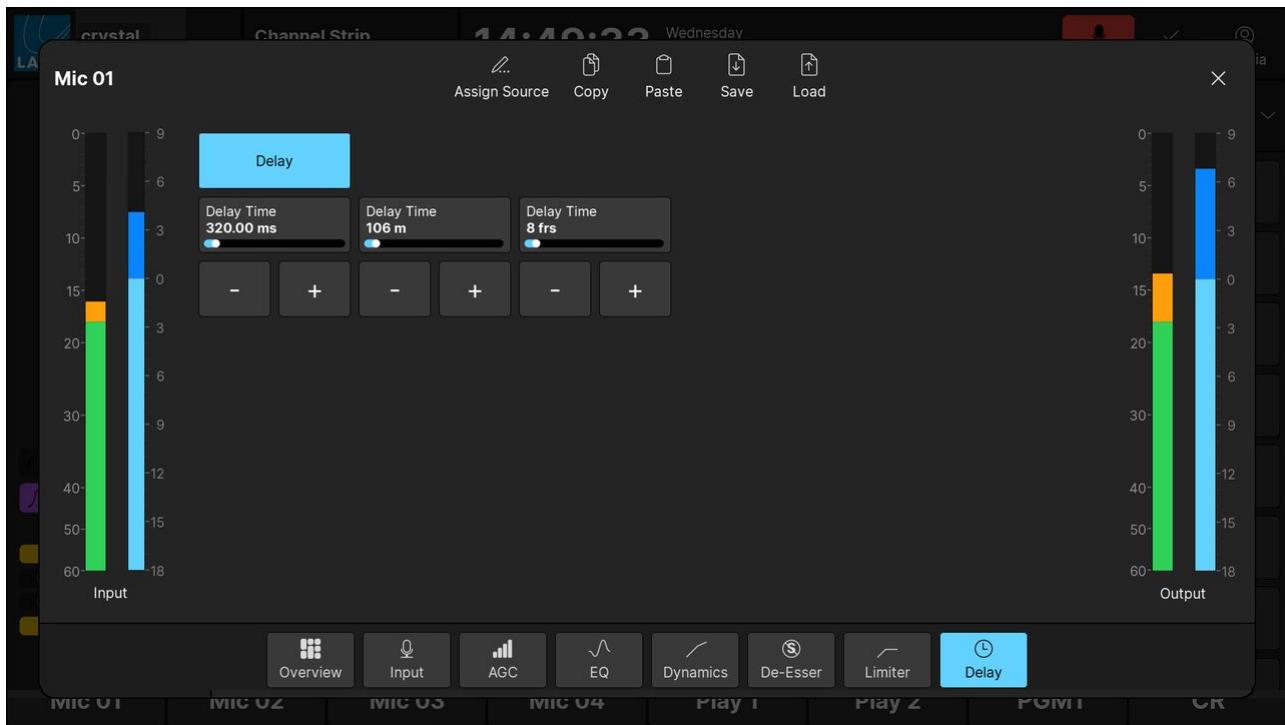
On the surface...

There is one page of parameters.

- Press the **Delay** soft key to switch the prepared delay time in or out of circuit.
- Turn any of the three rotary controls to set the delay time.

On the GUI...

All of the parameters are shown on a single page.

'Source Parameter' dialog box (Delay)

- Press the **Delay** button to switch the prepared delay time in or out of circuit.
- Touch and drag any of the three parameter values, or use the on-screen + and - buttons, to set the delay time.
- The meters show the levels at the input and output of the delay section.

6.12 crystal - Insert Sends and Returns

The system supports up to 16 mono or stereo insert points that can be assigned to a source. They can be used to apply signal processing (using an external device) or create a separate send from the source.

Overview

To use this feature, the inserts must be defined in the configuration using the ON-AIR Designer (under "System -> Definition -> Parameter = Insert"). The configuration defines the name, format and I/O for each insert device.

Once the configuration is in place, the available inserts can be assigned to sources from the fader strip controls. The assignments are flexible as long as the following conditions are observed:

- Up to 16 external inserts can be configured, where each one can be either mono or stereo.
- A mono insert must be assigned to a mono source.
- A stereo insert can be assigned to either a mono or stereo source. If a stereo insert is assigned to a mono source, then only the left channel is used.
- If you select an insert that is used elsewhere, its connections are removed from the current source and replaced by the new assignment.
- Inserts are not supported by summing buses.

During the assignment process, the user decides where to place the insert in the channel signal flow. There are three possibilities:
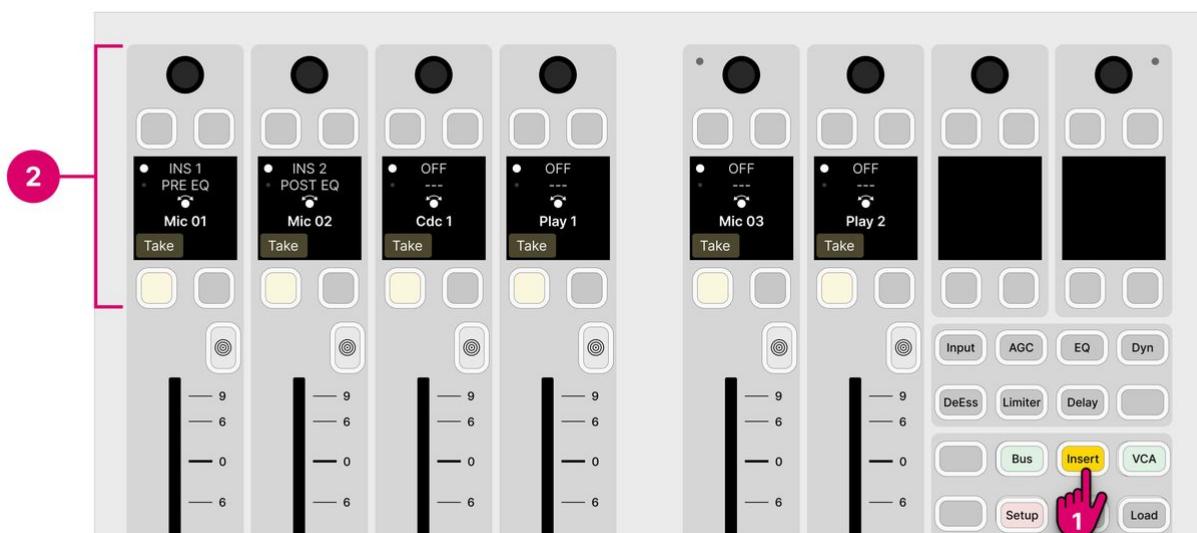
- Pre EQ
- Post EQ
- Post Dynamics (or post Dynamics and Limiter if both are configured)

Once an assignment is made, the insert send is always active, while the insert return can be enabled or disabled.

The rest of this topic describes how to check and assign the insert points, and then control the insert return on/off.
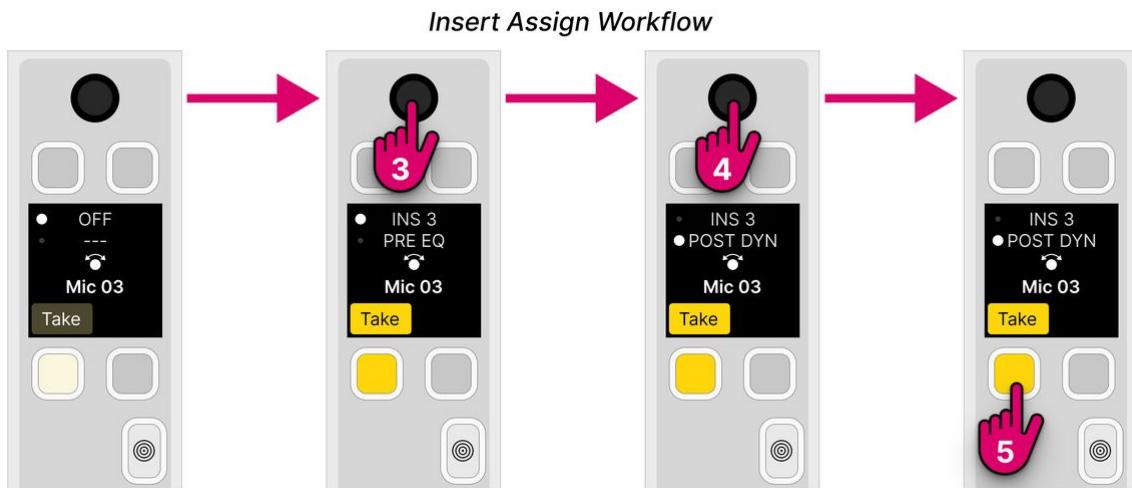
Insert Assignment

The current assignments can be checked from the surface as follows.

1. Press the **Insert** key (on the central controls module).

2. The upper controls on each fader strip switch into "insert assign" mode.

- The fader strip displays show whether a device is assigned and its position in the channel signal flow.

- In our example, the insert points are numbered but the naming depends on the configuration. If the top line shows OFF, then there is no insert assigned.
- The dots beside the insert name and position show which page is currently selected. You can press down on the rotary control to toggle between the pages.

You can assign a different device, or change the insert position, using the fader strip controls.

Insert Assign Workflow

3. On the first page, turn the rotary control to scroll through the available devices, and press down to make a selection.

The **Take** key turns bright yellow once a different device (or position) is selected.

If you turn the rotary control and nothing happens, then there are no inserts defined in the configuration.

4. Now, turn the rotary control again to choose the signal flow position (e.g. **POST DYN**).

5. Once you are happy with the selections, press the **Take** key to confirm. (Or, press the **Access** key to cancel).

The insert send is always active and so, once an insert is assigned, the external device should be receiving audio (if the device is connected and signal is present).

Please note: If you select an insert that is already in use, then it will be removed from the current source and connected to the new one.
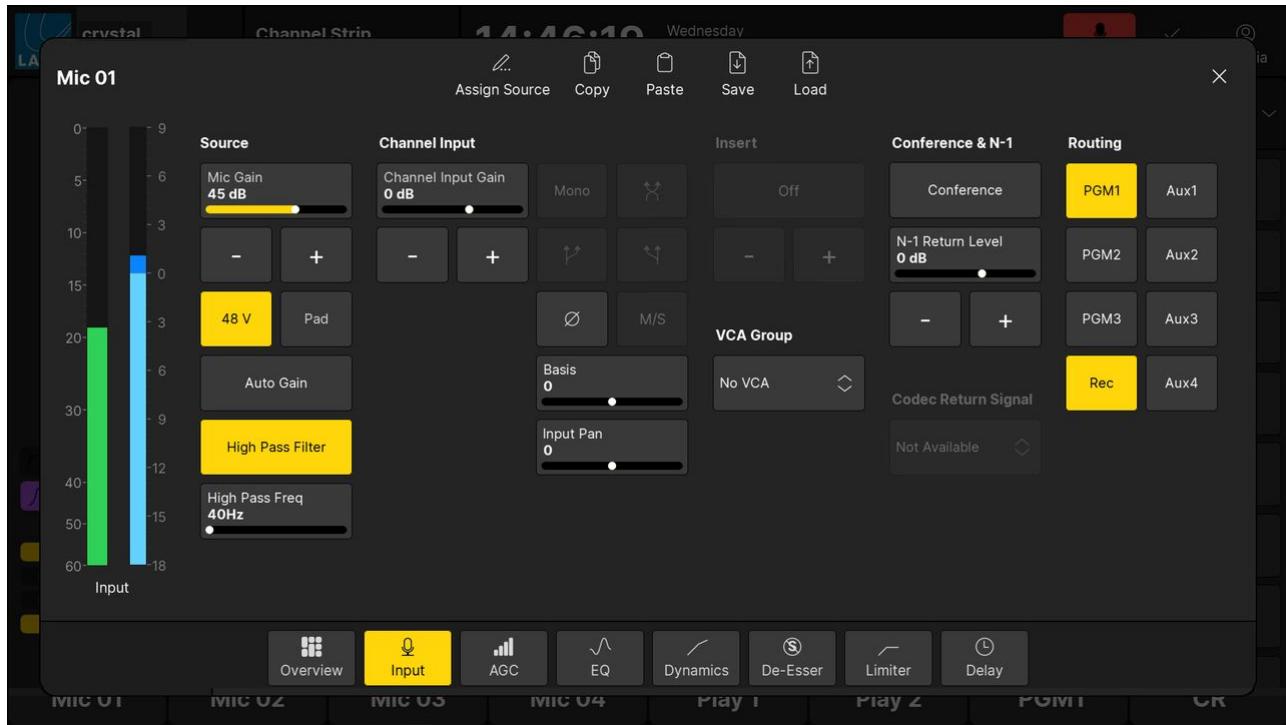
5. When you have finished editing the insert assignments, deselect **Insert** (on the central controls module).

The fader strip controls return to their default functions.

Insert On/Off

The insert return can be enabled or disabled from an MF key (on the surface) or touch-screen button (on the GUI). In the standard configuration, an 'Insert' area is prepared on the GUI as follows.

1. Open the 'Source Parameter' dialog box by pressing a fader strip **Access** key, and choose the **Input** page.

2. Touch the **On**/**Off** button under 'Insert' to switch the insert return: yellow = On; grey = Off.

3. The **+** and **-** buttons can be used to cycle through the available devices.

If there is no inserts defined in the configuration, then the 'Insert' buttons are not available (and are greyed out).

6.13 crystal - Sum Bus Parameters

The number of available sum buses, and whether 5.1 and DSP are supported, is determined by the Power Core license. Note that a stereo bus uses 2 resources and a 5.1 bus uses 6 resources.

By default, all sum buses come with DSP disabled. The individual DSP blocks are enabled by editing the system configuration using the ON-AIR Designer (under "Sum Bus → Parm").

Depending on the license, up to 32 DSP blocks (EQ, Dyn, Lim) and Delay are supported.

Signal Flow

The signal flow is identical to that of a source, except there is no input section or external insert point.

For each sum bus, the signal processing blocks are:

- **EQ**: 3-band parametric EQ plus 2-band filters.
- **Dynamics**: Compressor, Expander and Gate.
- **Limiter**: independent Limiter.
- **Delay**: up to 5.3 seconds, adjustable in ms, meters or frames.

Operation

The operation and parameters are identical to those of a source.

See crystal - Source Parameters.
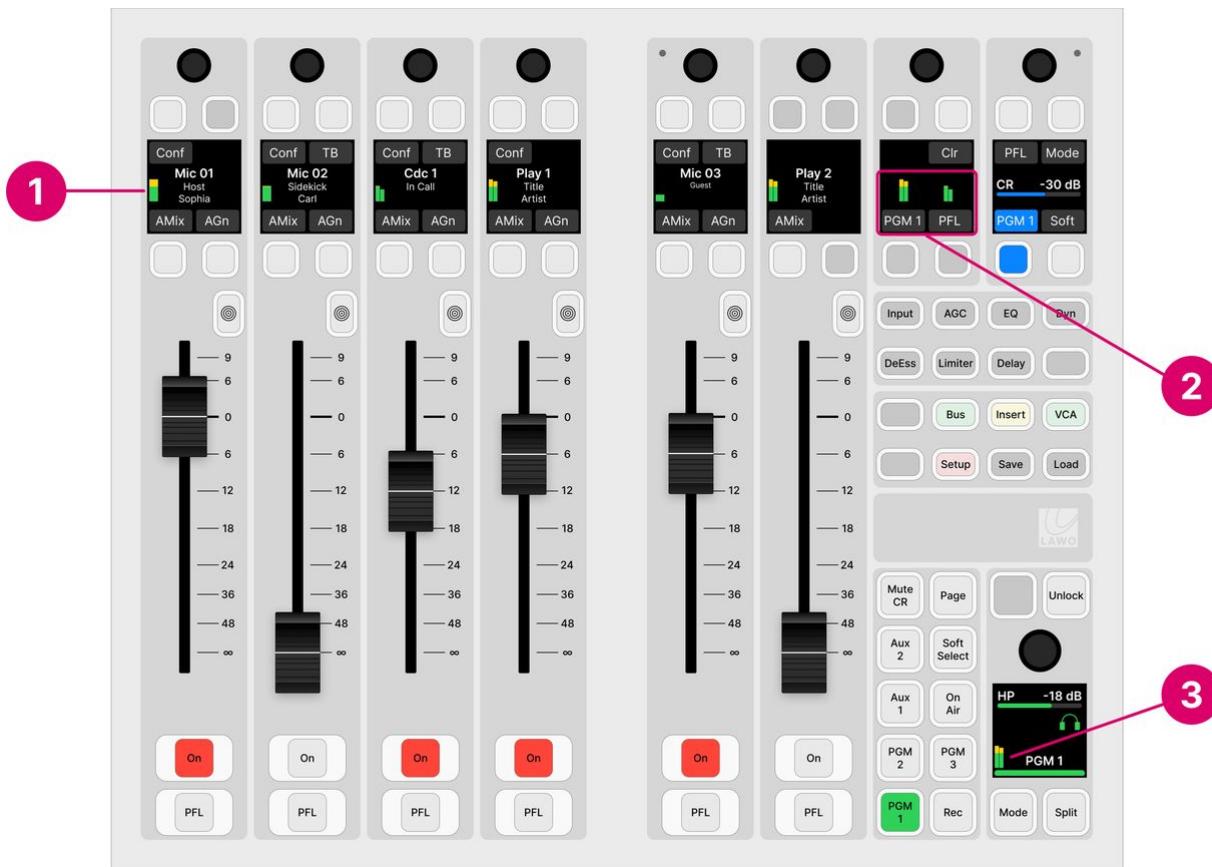
6.14 crystal - Metering

crystal supports a number of metering elements that can be used to configure input and output metering. The number and design of the meters are determined by the configuration. Options include the meter type, source, scale and color-coding.

Metering Locations

The crystal surface includes a signal present meter on every fader strip. All other meters are optional according to the configuration.

The information below describes the metering defined in the standard configuration. The operation may vary if the configuration is customized.

Metering on the Surface

1. Fader Strip Meters

crystal includes a signal present meter on every fader strip that shows the input level of the source. The meter is mono or stereo according to the format of the source.

The metering point is fixed and comes after the source's input section and before all processing.

2. Central Rotary Control Meters

One or more meters can appear in the displays below the central rotary controls. These meters are defined by the configuration and so their operation may vary.

In the standard configuration, the left-hand display shows two stereo meters: for PGM 1 and PFL.

3. Large Rotary Control Meter

The meter in the lower display on the Main module follows the definition of the large rotary control.

In the standard configuration, it shows the level of the HP monitor output. The metering point comes after the monitor source selector and before the volume (including mute/dim).

Metering on the GUI

Channel Strip Meters

In the standard configuration, the 'Channel Strip' page provides dedicated metering for every fader strip. The metering point is fixed and comes after the source's input section and before all processing.

The user can decide to show peak metering, momentary loudness or both (using the **Channel Strip** option in the 'Settings → Meters' dialog box). Note that there is no integrated loudness measurement for a source.
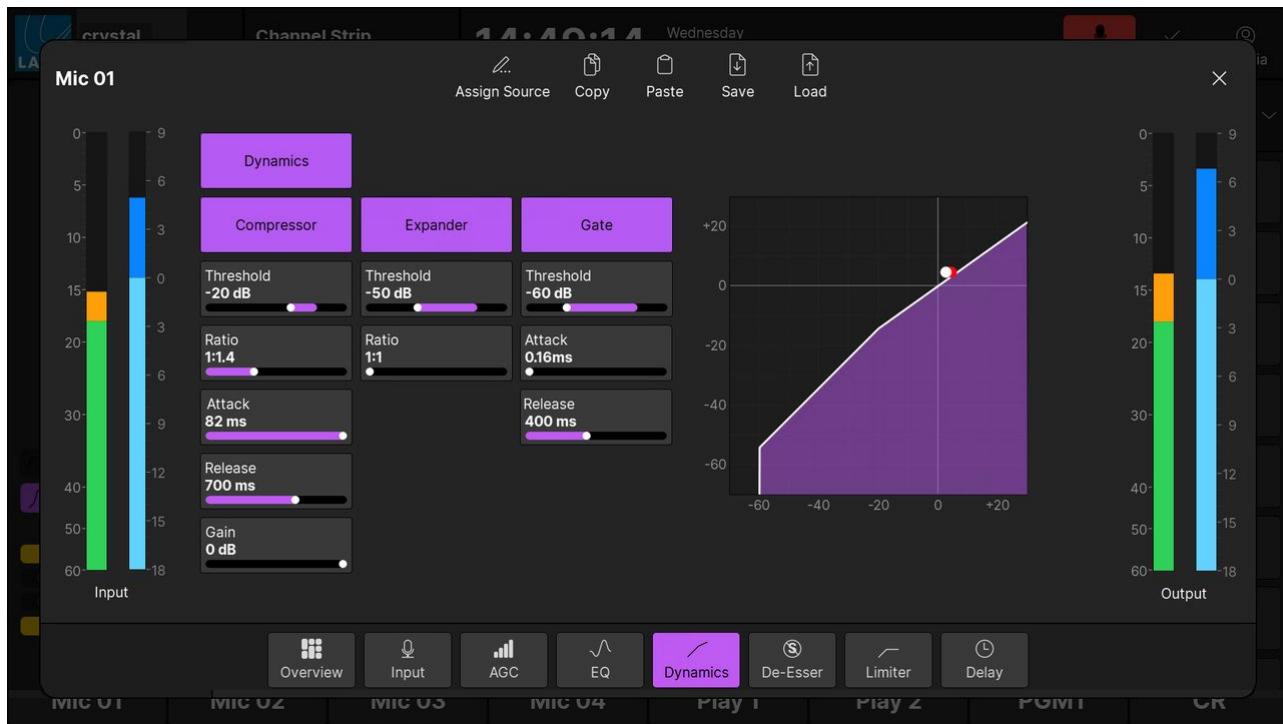
Master Slot Meters

Either of the master slots on the 'Channel Strip' page can be assigned to an output meter. This allows you to meter the main bus outputs and/or a monitoring section. For the bus outputs, the metering point comes after all processing including the fader. For the monitoring outputs, the metering point comes after the monitor source selector and before the volume (including mute/dim).

There are no user options for the output meters, so both peak and momentary loudness bargraphs are always displayed. The numerical readout shows the integrated loudness measurement (in LUFS).

Source Parameter Dialog Box

In the standard configuration, the 'Source Parameter' dialog box includes meters that show the level at the input and output of the processing section. The metering points are shown on the signal flow diagram for a source.

To open the dialog box, press an **Access** key (on the fader strip) followed by a page option (on the GUI) - e.g. **Dynamics**.

Peak Metering

In the standard configuration, all of the peak meters are dynamic Peak Program Meters (PPMs). The number of individual bargraphs is defined automatically by the format of the source/bus: 1 for mono; 2 for stereo.

The meters use a digital scale relative to 0dBFS, and provide three color-coded areas: green, orange and red. When signals peak within the orange area, they are at a good operating level. If a meter turns red, then the signal level is overloading.

Loudness Metering

The system provides loudness metering conforming to the ITU-R BS1770. There are two types of measurement: momentary and integrated.

In the standard configuration, both measurements are shown for all outputs, while momentary loudness can be enabled or disabled for all sources.

Momentary Loudness (Bargraphs)

A single blue bargraph represents the average energy of the summed component channels: mono, stereo or surround. The average is measured using either a Momentary (400ms sliding window) or Short term (3s sliding window) integration time.

The color indicates whether loudness is above or below the Target Level:

- Light Blue = equal to, or below, the Target Level.
- Dark Blue = above the Target Level.

The scale markers indicate a tolerance of +/- 1 LU.

Integrated Loudness Measurement (Text Readout)

The integrated loudness measurement is very useful for measuring loudness over a longer period.

The measurement is displayed in LUFS (Loudness Units Full Scale).

The integrated loudness measurement is always on, for all outputs, once the GUI App starts. To comply with the ITU standard, the signal's loudness must be greater than -70 LUFS before an integrated measurement is registered. From hereon, the reading will continue to update over time and represents the average loudness of the output since the start.

The integrated loudness measurement for all outputs can be reset by touching the LUFS value (on any meter) for more than one second.

Compliance with Metering Standards

Version 1.0 of the standard configuration is compliant with EBU meters and levels. Other variants will follow to support SMPTE and other regions. The table below describes the relevant parameters.

Standard Configuration, Version 1.0	Europe	North America
Standard	EBU	SMPTE
PPM meter scale	dBFS	dBFS
PPM mark low	-18	-20
PPM mark high	-9	-3 (+17 dBR)
Loudness meter (channel, access and slots)	LU EBU +9 (short)	LU EBU +9 (short)
Loudness value LUFS (slots)	LUFS -23 (integrated)	LUFS -23 (integrated)
Relative System level (OAD)	-36	-38
Analog Ref Level (OAD)	18	24
Operating Level (analog)	0 dBU	+4 dBU
Operating Level (digital)	-18 dBFS	-20 dBFS

- For the PFL output, there is a single soft key to clear all active PFLs.

Most of the monitoring functions are operated from the surface. In some cases, pressing a key on the surface opens an overlay box on the GUI. The GUI also provides metering for the CR and HP outputs (via the master slots on the 'Channel Strip' page).

> ℹ By default, the PFL output is switched automatically to the headphones (HP) whenever a PFL is active. The previous monitor source is re-instated once all active PFLs are cleared. If **PFL** is selected (as a Control Room monitor source), then PFL is switched to both outputs: HP and CR.
>
> The Control Room output mutes automatically when the Mic Open status is active (i.e. a Mic source fader is open). It can also be muted manually using the **Mute CR** button.
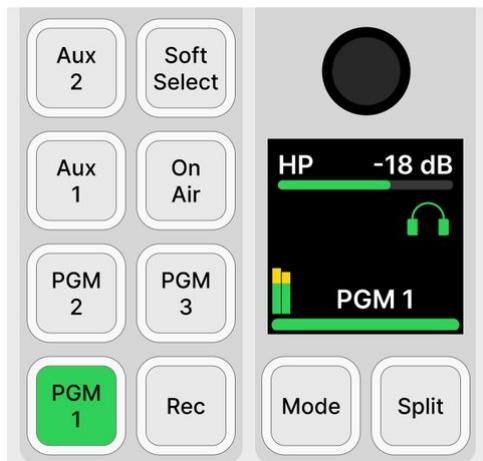
Audio Connections

The default audio connections are described later in the Standard Configuration Specification. The connections can be edited using the ON-AIR Designer (under "Audio Output → <I/O> Out → Default Audio").

If you are running the crystal VX app, then you can use the 'Routing' page (on the GUI) to connect a monitor output to a destination:

- Select **Routing** (from the GUI page menu) to open the 'Routing' page.
- Under 'Sources', select the **Monitor Outputs** tab and choose a monitor section (e.g. **Mon PFL**) - the selection flashes in blue.
- Under 'Destinations', select an output category (e.g. **Slot 1**) and choose an output (e.g. **Line Out 03**) - the selection flashes in blue.
- Press **Connect** - the connection is made.

Headphone Monitoring (HP)

Monitor Level

The rotary control can adjust two parameters: turn to adjust the first (monitor level); push down and turn to adjust the second (monitor balance).

The display shows the control's function and current value, plus a media icon (to help with identification); output metering (pre-volume); and the current monitor source (e.g. PGM 1).

Monitor Source Selection

For the Headphone output, there are 16 monitor sources available. The current selection lights in green.

The first six sources can be selected directly from the surface: **PGM 1**, **PGM 2**, **PGM 3**, **Rec**, **Aux 1** and **On Air**. The **Soft Select** key provides access to the other sources via the GUI (as described later).

By default, the PFL output is switched automatically to the headphones (HP) whenever a PFL is active. The previous monitor source is re-instated once all active PFLs are cleared.
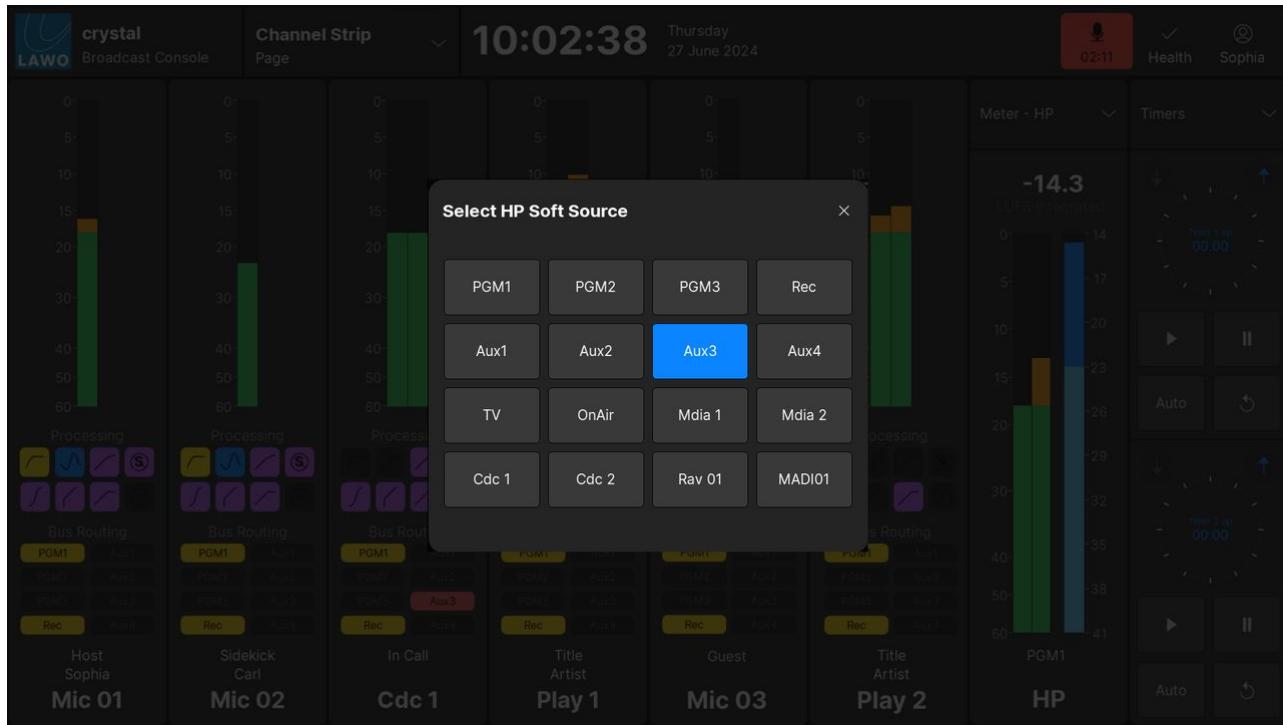
Other Functions

The remaining keys are for other headphone functions:

- Press **Mode** to change the monitoring mode (to mono the output, check the phase, etc). This key works in conjunction with the GUI (as described later).
- Press **Split** to listen to different signals in the left and right ears of the headphones: left = the selected monitor source (in mono); right = the PFL bus (in mono). You can use this to keep listening to a monitor source (e.g. PGM 1) while cueing up another source.

Using the Soft Select Key

The **Soft Select** key can be used to listen to a pre-selected monitor source. It works in conjunction with the GUI as follows.

1. Press and hold the **Soft Select** key to open the assignment window (on the GUI) - the key turns yellow to indicate that "assign mode" is active.

2. Choose an option using the on-screen buttons and then touch **X** to close the window.

3. Press the **Soft Select** key quickly to monitor the assigned source - the key turns green to indicate that the monitor source is selected.
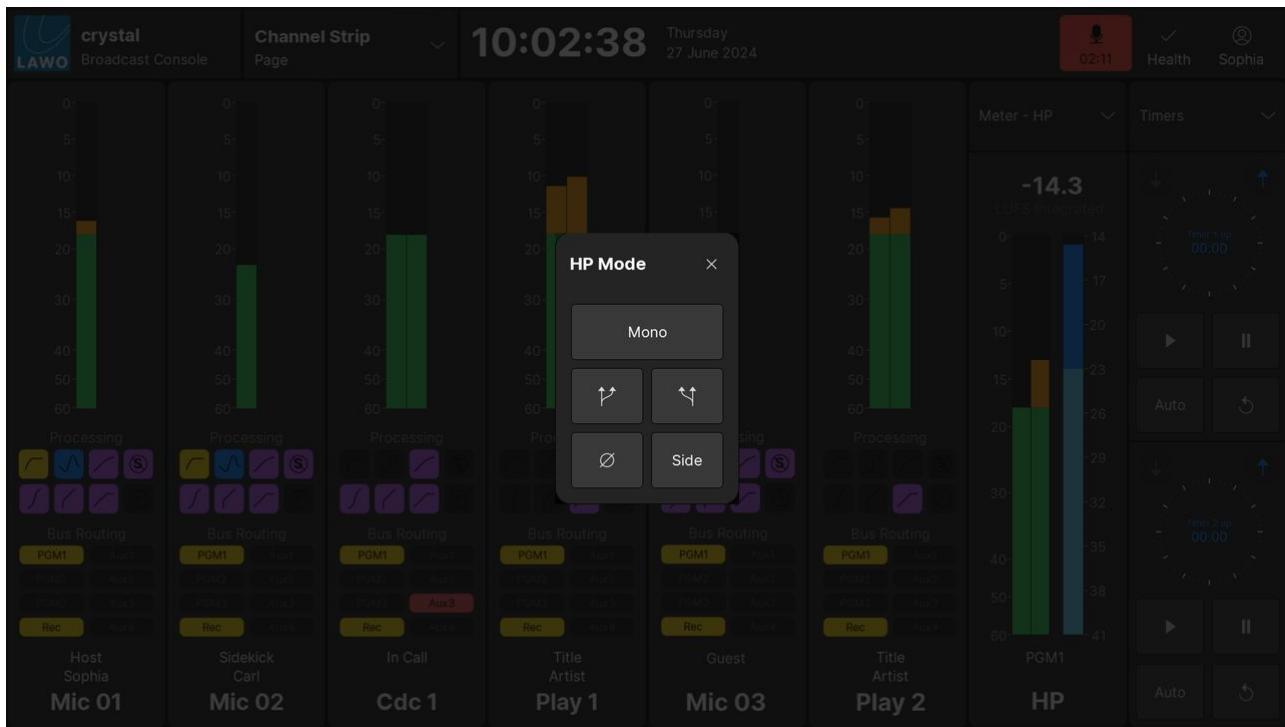
The current selection is stored in the system's warm start data. This means that the **Soft Key** monitor source is reinstated after a restart, unless you perform a cold start.

The 16 monitor sources are defined by the configuration. See Standard Configuration Specification for details.

Using the Mode key

The **Mode** key can be used to mono the monitor output, check the phase, etc. It works in conjunction with the GUI as follows.

1. Press the **Mode** key to open the HP mode options (on the GUI).

2. Choose an option using the on-screen buttons and then touch **X** to close the window.

The following options are possible (and options may be combined except for Left to Both, Right to Both and Side).

- **Mono** - the left and right inputs are summed with a -3dB gain offset.
- **L→B** - the left input is routed to both sides of the matrix.
- **R→B** - the right input is routed to both sides of the matrix.
- **Phase** - reverses the phase of the left input.
- **Side** - the left input and right inputs are reversed (left input to right side of matrix, and right input to left side of matrix).

The current selections are stored in the system's warm start data. This means that the **HP Mode** is reinstated after a restart, unless you perform a cold start.

Control Room Monitoring (CR)

For the Control Room (CR) output, the rotary control adjusts a single parameter: monitor level. The display shows the control's function and current value. The current monitor source is highlighted in blue (e.g. PGM 1).

There are two monitor source select keys: **PGM 1** or **Soft**. The **Soft** select key works in the same way as for the HP output: press and hold to pre-select a monitor source (from the GUI); press quickly to monitor the assigned source.

The **Mode** key can used to mono the output, check the phase, etc. It works in the same way as for the HP output: press to open the CR mode options (on the GUI) and choose an option.

> ℹ The Control Room output mutes automatically when the Mic Open status is active (i.e. a Mic source fader is open). It can also be muted manually using the **Mute CR** button (above the HP monitor section).

PFL Monitoring

In the standard configuration, the PFL output is switched automatically to the headphones (HP) whenever a PFL is active. The previous monitor source is re-instated once all active PFLs are cleared. If **PFL** is selected (as a Contol Room monitor source), then PFL is switched to both outputs: HP and CR.

If **Split** is active, then you will hear different signals in the left and right ears of the headphones: left = the selected monitor source (in mono); right = the PFL bus (in mono). You can use this to keep listening to a monitor source (e.g. PGM 1) while cueing up another source.

The **Mon PFL** output can be connected to a separate PFL speaker, either by editing the default audio connections (using ON-AIR Designer) or by making a connection from the 'Routing' page (on the GUI).

You can use the PFL controls (at the top of the Main module) to check that signal is present and **Clear** all active PFLs.

6.16 crystal - PFL and AFL

crystal supports up to five monitoring buses that can be used to configure PFL and AFL.

- PFL (Pre-Fader Listen) can be used to listen to a source while its fader is closed (off-air). This allows you to check an incoming signal before opening the fader.
- AFL (After-Fader Listen) can be used to listen to a source in isolation (at its mix level).

What is possible?

Up to five PFL/AFL buses can be configured (using the ON-AIR Designer). The number of available PFL/AFL buses is determined by the Power Core license. Usually, a single PFL bus is sufficient. If independent PFL outputs are required, or you need both PFL and AFL monitoring, then multiple buses can be defined. This is explained in more detail later. For now, it is useful to know that:

- Each source can feed up to two monitoring buses simultaneously. For example, to feed both PFL and AFL.
- On each fader strip, the PFL 1 bus can be swapped with another listen bus (from 2 to 5). This is useful if the surface has multiple operating stations, as you can configure independent PFL outputs from each set of faders.
- The PFL mode defines how the surface keys operate: as PFL, AFL, or a combination. The PFL mode can be changed by an operator (from the Setup menu).
- Each PFL/AFL bus can feed a dedicated speaker or be switched to the main monitoring automatically when a PFL (or AFL) is active.

The rest of this topic describes how PFL is defined in the standard configuration. The operation may vary if the configuration is customized.

Operation

In the standard configuration, PFL can be selected by pressing MF Key 4 (on the source's fader strip) or pulling back on a fader (to activate the overpress).
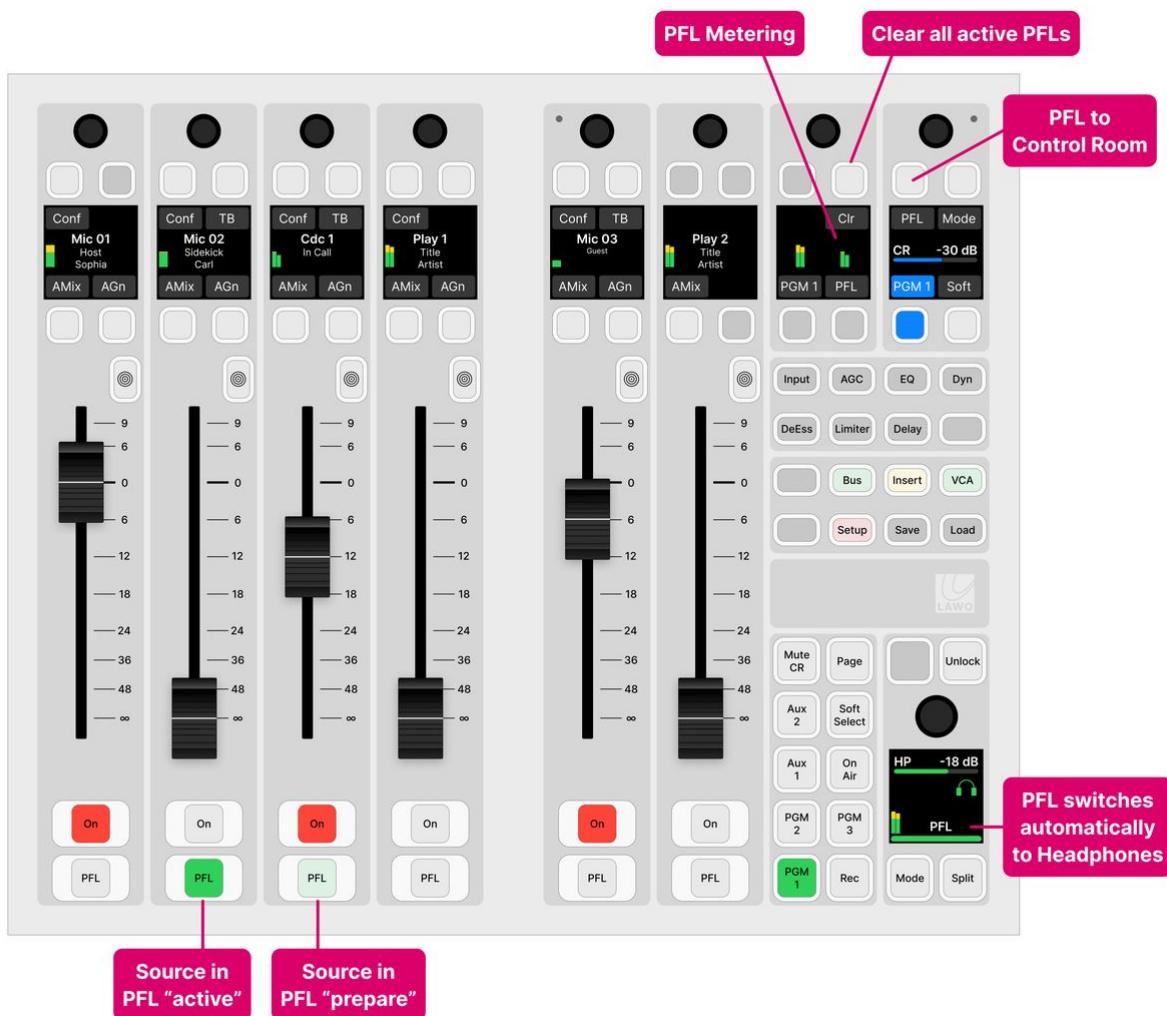
All sources feed a single PFL bus (PFL 1) and the default mode is "PFL SUM". This means that:

- Multiple PFLs can be selected.
- Where faders are closed, sources are summed onto the PFL bus.
- When a fader opens, PFL is cancelled.
- Where faders are open, sources are put into "PFL prepare". In this instance, nothing happens until the fader is closed. Once the fader is closed, PFL becomes active.

The **PFL** key has three possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = PFL off.
- Full green = PFL on and fader closed (PFL active).
- Dim green = PFL on and fader open (PFL prepare).

In the example below, the source **Mic 02** is in "PFL active", while **Codec 1** is in "PFL prepare".

Fader Overpress / Backstop PFL

The fader overpress can be enabled or disabled from the Setup menu. When enabled, the operation is momentary:

- Pull back on a fader to activate **PFL**.
- Release the fader to cancel **PFL**.

PFL Monitoring

In the standard configuration, the PFL output is switched automatically to the headphones (HP) whenever a PFL is active. The previous monitor source is re-instated once all active PFLs are cleared. If **PFL** is selected (as a Contol Room monitor source), then PFL is switched to both outputs: HP and CR.

If **Split** is active, then you will hear different signals in the left and right ears of the headphones: left = the selected monitor source (in mono); right = the PFL bus (in mono). You can use this to keep listening to a monitor source (e.g. PGM 1) while cueing up another source.

The **Mon PFL** output can be connected to a separate PFL speaker, either by editing the default audio connections (using ON-AIR Designer) or by making a connection from the 'Routing' page (on the GUI).

You can use the PFL controls (at the top of the Main module) to check that signal is present and **Clear** all active PFLs.

PFL Modes

The PFL mode defines how the surface keys operate: as PFL, AFL, or a combination.

The default PFL mode is "SUM", but this can be changed by editing the configuration (using the ON-AIR Designer). The PFL mode can also be changed by an operator (from the Setup menu).

The table below describes all possible options.

1	**SUM** (default)
	Multiple PFLs can be selected. Where faders are closed, sources are summed onto the PFL bus. When a fader opens, PFL is canceled. Where faders are open, sources are put into "PFL Prepare". In this instance, nothing happens until the fader is closed. Once the fader is closed, PFL becomes active.
2	**SUM R**
	Known as SUM Recurring. Identical to SUM mode, but PFL recurs if you open and then close the fader. In this mode, you must turn off PFL by deselecting the **PFL** key.
3	**PFL**
	Identical to SUM mode, but the PFL keys inter-cancel. This means that only one source can ever be in "PFL Active" or "PFL Prepare".
4	**PFL R**
	Known as PFL Recurring. Identical to PFL mode, but PFL recurs if you open and then close the fader. In this mode, you must turn off PFL by deselecting the **PFL** key.
5	**PFL A**
	Known as PFL Always. Identical to SUM mode, except that sources are always put into "PFL Active" even if their faders are closed. i.e. there is no "PFL Prepare".
6	**PFL AR**
	Combines PFL Always and PFL Recurring. Sources are always put into "PFL Active", and PFL recurs if you open and then close the fader.
7	**PFL PUSH**
	Changes the operation of the PFL keys from latching to momentary. In this instance, you must press and hold a key to make PFL active. PFL cancels when you release the key.
8	**PFL DJ**
	A special mode for DJs that can be used to prepare a fader level before the source goes on-air. Start by pressing PFL to monitor the source and adjust the fader level. Then deselect PFL and press channel ON (to put the source on-air) - the fader jumps to the prepared level. Note that the prepared level is applied only once. So, if you take the fader off-air, and then press channel ON again, the fader jumps to 0dB as normal.
9	**AFL**
	Changes the operation of the PFL keys from pre-fader listen to after-fader listen. In this mode, multiple AFLs can be selected. AFL must be turned off by deselecting the **AFL** key.
10	**AFL/PFL**
	Combines AFL and PFL operation. The PFL keys operate as AFL when a fader is open and PFL when a fader is closed.

6.17 crystal - Talkback

The **TB** or **Talk** keys can be used to talk to a source or monitor output. The number of talkback keys, and their operation, is determined by the configuration. The configuration possibilities are explained later. For now, it is useful to know that:

- Up to 8 talkback sources can be configured (to support more than one talkback mic).
- A central rotary control can be configured to adjust talkback level.
- The operation of the talkback keys can be either momentary or latching.
- While talkback is active, the main signal can be either dimmed or muted.

The rest of this topic describes how talkback is defined in the standard configuration. The operation may vary if the configuration is customized.

Operation

In the standard configuration, the following operations are possible.

Talk to Source

Press and hold **TB** on a fader strip to talk to a source. This function is supported for all sources with an N-1 return. i.e. all microphone and codec sources.

The **TB** keys are always momentary so press and hold for as long as you wish to speak. In each case, the main signal is dimmed by 20dB while talkback is active.

Each key has two possible states. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = talkback off.

- Full red = talkback on (active).

Talkback Level

The talkback level is set to 0dB. This can be changed by editing the configuration (using the ON-AIR Designer).

Talkback Source

The talkback source is defined as Mic Input 1 (from the Studio I/O card). This can be changed by editing the configuration (using the ON-AIR Designer).

6.18 crystal - Conference and N-1

The number of N-1/mix minus returns is determined by the configuration.

By default, each source's N-1 is generated from the programme bus so that the source hears PGM 1 minus themselves.

The conference system allows one or more conference buses to be configured for particular sources. Each source added to the conference then receives an automatically switched mix-minus feed:

- When a conference member is on-air, they hear PGM 1 minus themselves.
- When two or more conference members are off-air, they hear the conference bus minus themselves. This allows the sources to hear each other before they go on-air.

The rest of this topic describes the N-1s and conference system defined in the standard configuration. The operation may vary if the configuration is customized.

Operation

In the standard configuration, each of the following sources supports an N-1 return: Mic 1 to 8, Tel 1 & 2, Codec 1 to 6.
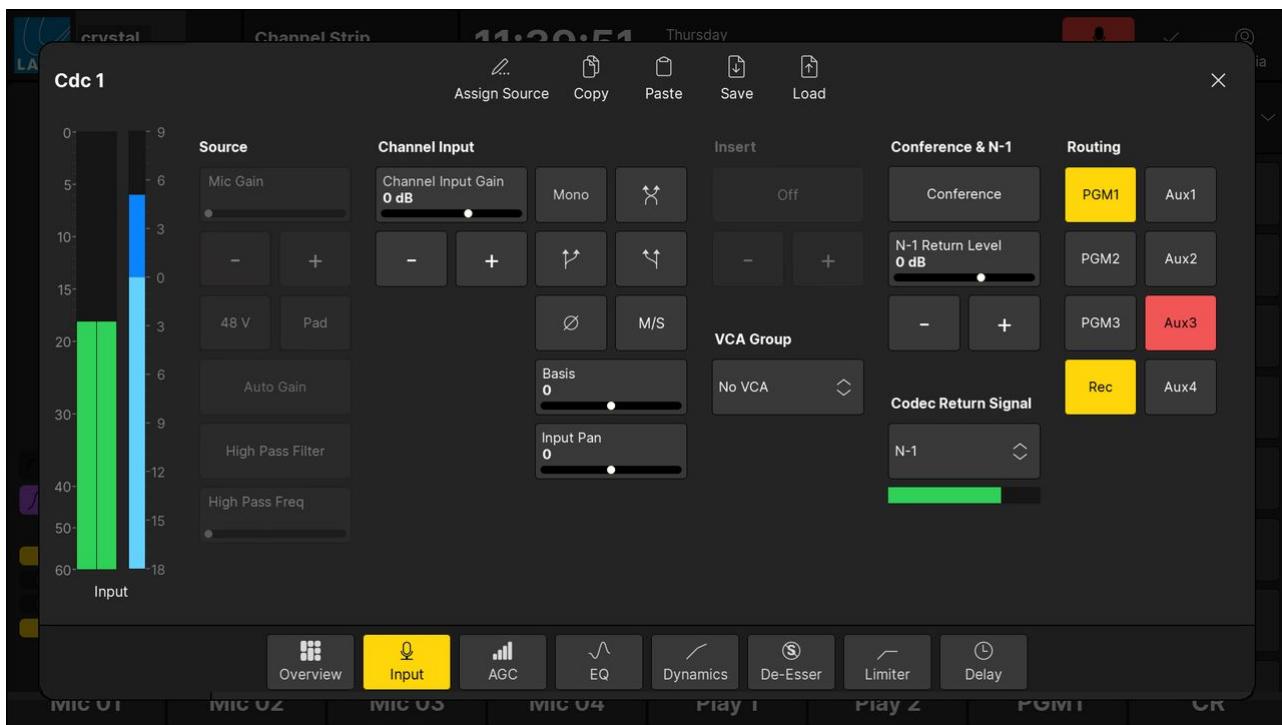
By default, each source receives PGM 1 minus themselves. Sources can be added to the conference system using the **Conf** keys (on the fader strips) or **Conference** buttons (on the GUI).

The N-1 return level can be adjusted (from the GUI), or you can talk to a source, via its N-1 return, by pressing the fader strip **TB** key.

Note that, for each codec source, it is possible to change the return signal (from the GUI). This allows you to send a sum bus or internal tone instead of the N-1 signal.

On the GUI...

1. Open the 'Source Parameter' dialog box by pressing a fader strip **Access** key, and choose the **Input** page.

2. Use the buttons under 'Conference & N-1' as follows. If an option is greyed out, then the parameter is not available.

- **Conference** - touch this button to add or remove the source from the conference system. The button colors are the same as on the surface (described below).
- **N-1 Return Level** - touch and drag anywhere inside the parameter box to adjust the N-1 level: either left/right or up/down. Or use the on-screen **+** and **-** buttons.
- **Codec Return Signal** - touch this field to select a signal from the dialog box. The following options are supported: N-1, PGM 1 to 3, REC, AUX 1 to 4 and Tone. The on-screen meter can be used to confirm that signal is present.

On the surface...

The **Conf** key assigns a source onto the conference bus. What the source receives depends on the status of the source fader and that of the other conference members.

The **Conf** key color indicates the current state. The colors used can be modified by the ON-AIR Designer. The following colors are used in the standard configuration:

- Dim white = conference off. Source receives PGM 1 minus themselves.
- Full green (Conf prepare) = conference on and fader open. Source receives PGM 1 minus themselves.
- Dim yellow (Conf active) = conference on and fader closed on a single source. Source receives PGM 1 minus themselves.
- Full yellow (Conf audio) = conference on and fader closed on more than one source. All conference members receive the conference bus minus themselves.

Conference System Example
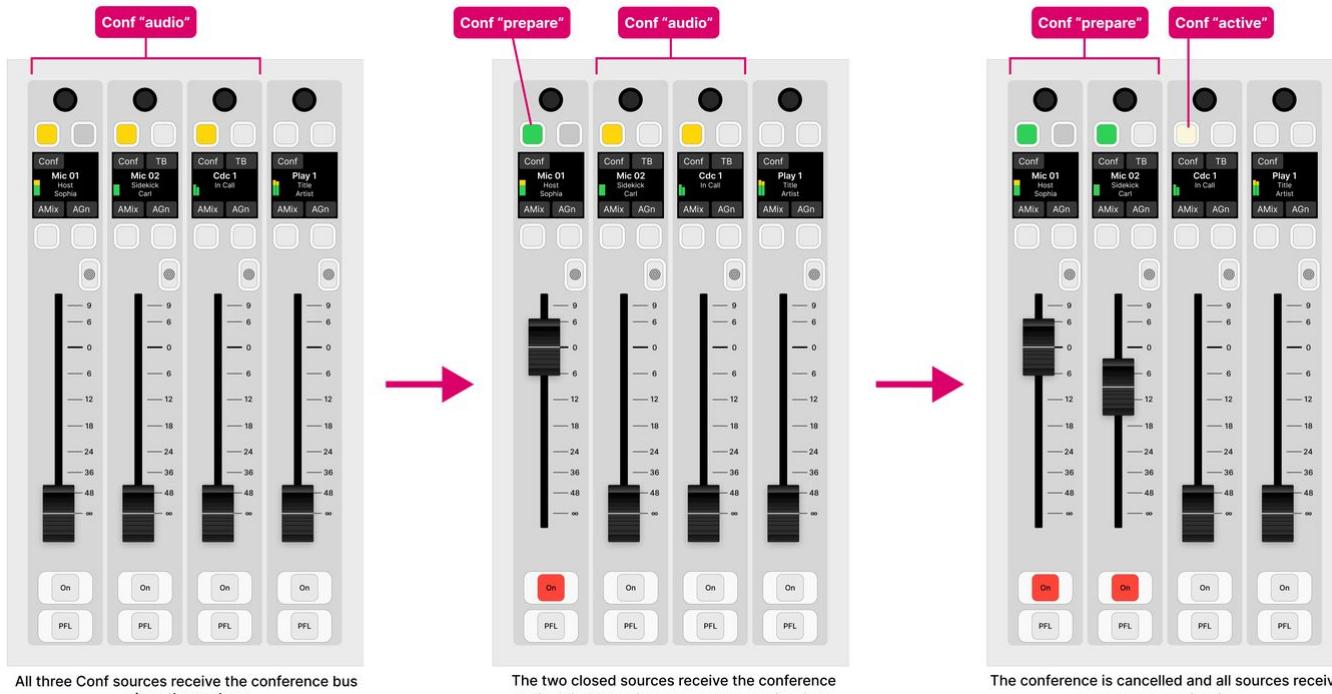
In the example that follows, there are three conference members: Mic 01 (the host), Mic 02 (a studio guest) and Codec 1 (a phone-in guest).

When all three source faders are closed, the **Conf** keys turn full yellow and the sources receive the conference bus minus themselves. In other words, they can hear each other, but not themselves, and chat off-air.

If you open the Mic 1 (host) fader, the source goes on-air. The **Conf** key turns full green, to indicate that this source is in "Conf prepare", and the source's N-1 is switched back to a programme mix minus. The other two sources remain in "Conf audio". This allows the studio and phone-in guest to continue their off-air conversation. At any time you can close the Mic 1 fader so that the host can rejoin the off-air conference.

If you open the Mic 1 (host) and Mic 2 (studio guest) faders, then two out of the three sources go on-air. The **Conf** keys turn full green, to indicate "Conf prepare", and each source's N-1 is switched back to a programme mix minus. In this instance, there are less than two active conference members and so the conference is canceled. The Cdc 1 source's N-1, for the phone-in guest, is switched back to a programme mix minus and its **Conf** key turns dim yellow to indicate "Conf active".

The image below shows how this looks on the surface.

All three Conf sources receive the conference bus minus themselves.

The two closed sources receive the conference audio. Mic 01 receives a programme mix minus.

The conference is cancelled and all sources receive a programme mix minus.

At any time you can remove a source from the conference by deselecting its **Conf** key. The key turns dim white and the source's N-1 switches back to a programme mix minus.

6.19 crystal - VCA Grouping

A VCA group can be used to control the level of several sources or summing buses from a single fader.

Up to 8 VCAs can be configured (using the ON-AIR Designer). The number of available VCAs is determined by the Power Core license.

In the standard configuration, a single VCA is defined. More VCAs can be added by editing the configuration (using the ON-AIR Designer). The configuration possibilities are explained later. For now, it is useful to know that:

- Each VCA group can control any number of faders.
- A fader cannot be assigned to more than one VCA.
- VCA groups cannot be nested. i.e. VCA 2 cannot be assigned to VCA 1.
- VCA groups use non-moving faders.

Setting Up a VCA Group

To set up a VCA group, there are two steps. First, assign the VCA group to a fader strip. Then, assign the VCA group members.
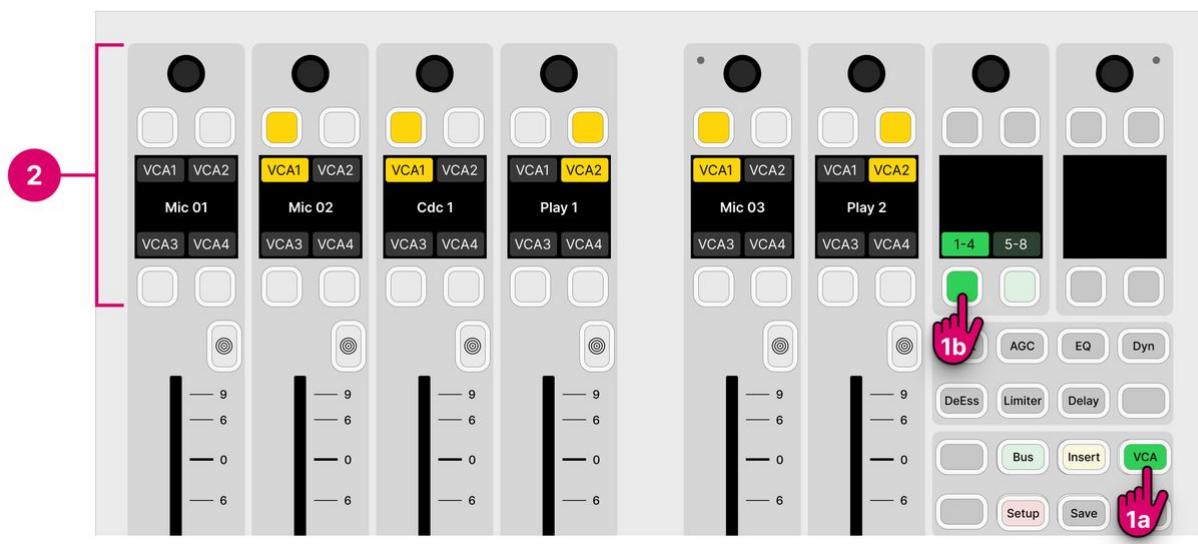
VCAs are available as sources when you activate source selection from a fader strip. This means that you can assign a VCA group to any fader strip in the usual manner, see Fader Strip Assign. Once assigned, the fader strip 'Source Display' updates to show the name and icon defined in the configuration. In the standard configuration, there is a single VCA group called VCA 1.

To make the VCA assignments, you can use either the surface or 'Source Parameter' dialog box as follows.

On the surface...

If your system supports at least one VCA group, then the **VCA** key (on the central controls module) opens the VCA assign pages. The number of pages depends on the number of VCAs defined in the configuration. If all eight VCAs are configured, then there are two pages: **1-4** and **5-8**. The page labels can be edited using the ON-AIR Designer (via the "System → Definition → AccessGrp → VCA Group Menu" options in the 'Tree Definition').

The assignments work in a similar manner to the bus assign pages.

1. From the central controls, press **VCA** and select a page (e.g. **1-4**).

The upper controls on each fader strip switch into "VCA assign" mode. The four soft key labels show the name of the available VCAs. If a soft key has no label, then there is no VCA defined (in the configuration).

The soft key colors show the assignment status: yellow = assigned (on); dim white = not assigned (off).
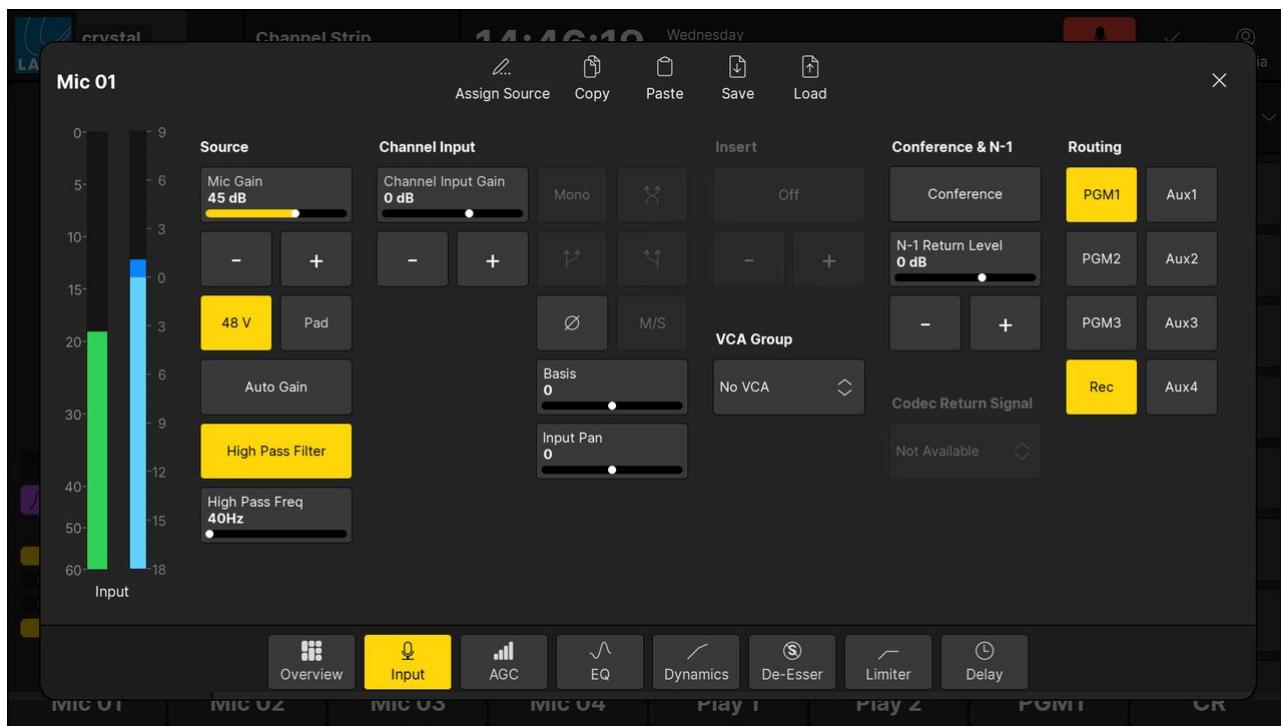
If more than four VCAs are defined (in the configuration), then press **5-8** to access the second page.

2. Press the fader strip soft keys to toggle the assignments (on/off).

3.   When you have finished editing the assignments, deselect **VCA** (on the central controls module).

The fader strip controls return to their default functions.

On the GUI...

1. Open the 'Source Parameter' dialog box by pressing a fader strip **Access** key, and choose the Input page.

'Source Parameter' dialog box (Input)

2. Touch the button under 'VCA Group' to open the 'VCA assign' overlay.

3. Touch a button to toggle the assignments (on/off).

- Yellow = assigned (on).
- Grey = not assigned (off).

4. Touch **X** to close the 'VCA Assign' overlay.

The button under 'VCA Group' updates to show either the name of the VCA group or "No VCA" (if there is no group assigned).

VCA Group Operation

The VCA grouping applies to the fader level and channel on/off status.

In Lawo radio systems, VCA groups use non-moving faders. This means that when you move a VCA group, its member faders remain stationary even though their level is changing.

If you press the channel **ON** key on the VCA group, then the channel **ON** keys on the group members follow accordingly. This allows you to close a VCA group and adjust its mix levels while the group is off-air.

6.20 crystal - Snapshots

Snapshots can be used to reset the console by storing and recalling settings.

There are eight system snapshots (stored on Power Core) plus an unlimited number of GUI snapshots (stored on the host PC or in a datacenter database).

The eight system snapshots are managed from the surface using the **Save** and **Load** keys (on the central controls module). They always save and load settings globally, and are ideal for tasks such as resetting the console to a default starting point. Usually, an **Unlock** key is configured to prevent accidental save or load snapshot operations.

The GUI snapshots are managed by the Lawo application VisTool. Two types of snapshot are supported: full snapshots (to save all settings) and source snapshots (to save settings for the source in access). The operation is determined by the configuration. Optionally, the User Access Rights system can be used to manage the snapshot access for different users. In the standard configuration, there are save and load buttons in the user menu (for full snapshots) and in the 'Source Parameter' dialog box (for source snapshots); users must be logged in to save and load full snapshots.

The rest of this section describes the snapshot settings and operation.

- crystal - Snapshot Settings
- crystal - Using the System Snapshots
- crystal - Using the GUI Snapshots

crystal - Snapshot Settings

This topic describes what is saved and loaded by snapshots.

What's Stored in a Snapshot?

The following settings are saved in all snapshots:

- **Fader Strip Assignments** – the assignment of sources and buses to all fader strips.
- **User Labels** – the two user label text lines for all sources and buses.
- **Stream subscriptions** – the AoIP stream subscriptions handled by a RAVENNA pool.
- **Input Parameters** – mic gain, 48V, etc. for all sources.
- **DSP Parameters** – EQ, Dynamics, etc. for all sources and buses.
- **Fader Levels** – the fader levels for all sources and buses.
- **Bus Assignments** – the assignment of sources to summing buses and their send levels.
- **Insert Assignments** – the assignment of insert devices.
- **VCA Assignments** – the assignment of slave faders to VCA groups.
- **Logical States** (optional) – up to 32 logical states defined by the ON-AIR Designer configuration (via "System -> Definition -> Parameter = Logic Snapshot").
- **Matrix Connects** (optional) – up to 128 matrix connections defined by the ON-AIR Designer configuration (via "System -> Definition -> Parameter = Matrix Snapshot").

Snapshot Recall Options

The following options control what happens when a snapshot loads. They can be used to protect fader levels, isolate fader strips, or make the loading of source parameters dependent on the fader status.

All options apply to both the system and GUI snapshots. They are set by the system configuration and can be edited using the ON-AIR Designer.

Production Mode (Save Value)

This option determines whether fader levels are reset by a snapshot load. It can be reached using the **Treedefinition path**: "System → Definition → Parameter = Fader".

- **Production Mode (disabled)** = fader levels are ignored (not loaded). Recommended for on-air systems.
- **Production Mode (enabled)** = fader levels are loaded. Recommended for production systems.

Load max. Fader No., Load Audio Always

The "Load max. Fader No." option can be used to isolate all fader strips above a certain number. This can be useful if there is more than one operator and you wish to use snapshots to reset some faders and not others. It can be reached using the **Treedefinition path**: "System → Definition → Parameter = Snapshots".

- **Load max. Fader No.** - defines the maximum fader number you wish to reset. Any fader above this number is excluded from snapshot loads. Leave the field blank to apply snapshot loads to all faders.
- **Load Audio Always** - overrides the "Load max. Fader No." option for audio-related parameters. This allows audio parameters to be reset for all faders while fader strip assignments are excluded above the "Load max. Fader" number.

SnapLoad disable

This option can be used to isolate specific fader strips. It can be used as an alternative, or in addition, to the "Load max. Fader No.". It can be reached using the **Treedefinition path**: "Surface -> Fader Module" (via Snapshots tab).

- **SnapLoad disable (Default Map)** - when active, snapshot loads are disabled for the fader strip.

Enable Load Groups Logic

This option can be used to make the loading of source parameters dependent on the fader status. For example, to allow snapshots to reset input parameters only if source faders are closed. It can be reached using the **Treedefinition path**: "System → Definition → Parameter = Snapshots".

When the "**Enable Load Groups Logic**" option is ticked, all snapshot loads become dependent on the fader status. By default, all parameters load if source faders are closed, and do not load if source faders are open. You can modify this behavior by assigning control signals to the **FC: Disable...** and **FO: Enable...** fields. For example, if **FC: Disable Input Load** is set to active, then input parameters are not loaded if source faders are closed.

In each case, FC = Fader Closed and FO = Fader Open, and control signals can be applied to each of the following source parameter groups:

- Input - input parameters (mic gain, 48V, etc).
- DSP - EQ, Dynamics, Limiter and Delay.
- Bus - summing bus assignments.
- Insert/VCAGrp - insert and VCA Group assignments.

Note that the **FC: Disable...** and **FO: Enable...** fields are hidden until the "Enable Load Groups Logic" option is enabled (ticked).

crystal - Using the System Snapshots

The eight system snapshots are stored on Power Core and are managed from the surface using the **Save** and **Load** keys (on the Main module). They always save and load settings globally, and are ideal for tasks such as resetting the console to a default starting point.

In the standard configuration, an **Unlock** key is configured to prevent accidental operation. This option can be disabled by editing the configuration (via the "System -> Definition -> Parameter = Snapshots" branch of the 'Tree Definition'). In the examples below, it is assumed that "Snap Unlock" is enabled.

Saving a Snapshot

The steps below describe how to save a system snapshot.

1.   Press and hold **Unlock** followed by **Save**.
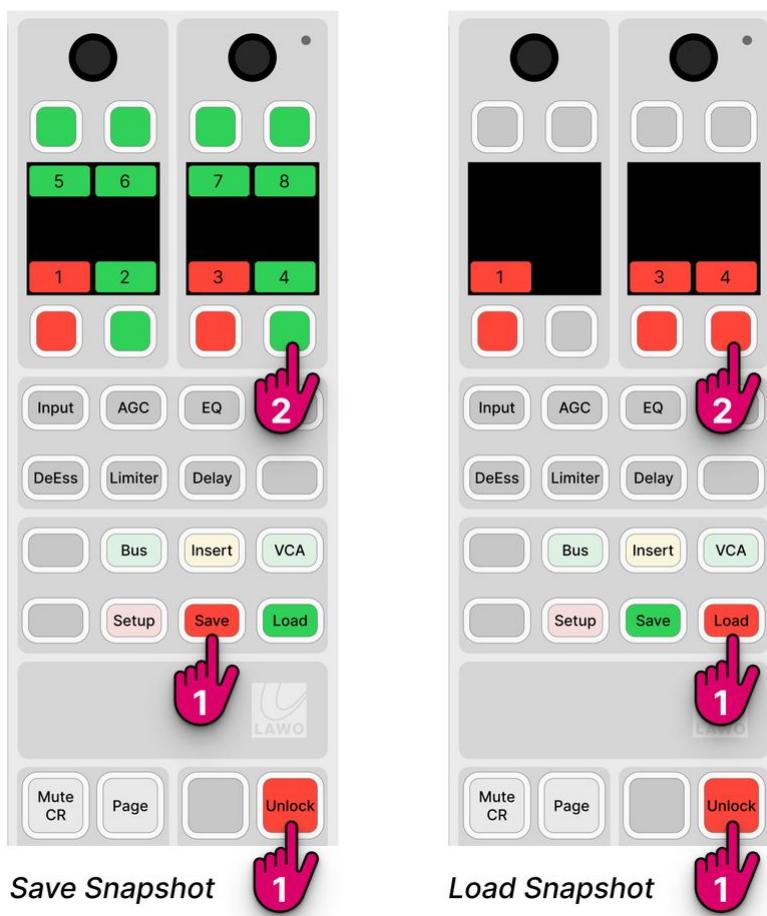
The eight soft keys light up to show which memories are used:

- Red = used.
- Green = empty.

In the example below, snapshots 1 and 3 contain existing settings, while the others are free to use. If you select a used memory, then its contents are overwritten.

2.   Keep holding **Save** and select a memory number - e.g. **4**.

The **Save** button flashes magenta to indicate a successful operation.

Save Snapshot   *Load Snapshot*

Loading a Snapshot

The steps below describe how to load a system snapshot.

1. Press and hold **Unlock** followed by **Load**.

You can see which memories contain data by looking at the color of the numbered soft keys:

- Red = contains settings.
- Black (unlit) = the memory is empty.

2. Keep holding **Load** and select a red memory number to load its contents - e.g. **4**.

The **Load** key flashes magenta to indicate a successful operation and the console resets according to the snapshot recall options (described earlier).

Clearing a Snapshot Memory

The steps below describe how to clear a system snapshot memory.

1. Press and hold **Unlock** followed by both **Save** AND **Load**.

You can see which memories contain data by looking at the color of the numbered soft keys.

2. Keep holding **Save** and **Load** and select a red memory number - e.g. **4**.

The snapshot memory is cleared.

You can check the success of the operation by pressing and holding **Unlock** followed by **Load** - the relevant soft key should now be black (unlit) to show that the memory is empty.

crystal – Using the GUI Snapshots

The GUI snapshots are managed by the Lawo GUI application VisTool. They are stored in the "Visconfigurations.mdb" file defined in VisTool Editor's 'Global Settings'. Usually, this is located on the host PC so that there is one set of GUI snapshots for each VisTool instance. If you wish to allow different VisTools to access the same snapshots, then a centralized database can be specified. The setup for this is described later in the VisTool MK2 documentation.

There is no limit on the number of GUI snapshots and two types are supported: full snapshots (to save all settings) and source snapshots (to save settings for the source in access). The operation is determined by the configuration. Optionally, the User Access Rights system can be used to manage the snapshot access for different users. In the standard configuration, there are save and load buttons in the user menu (for full snapshots) and in the 'Source Parameter' dialog box (for source snapshots); users must be logged in to save and load full snapshots.

The rest of this topic describes the GUI snapshot operation defined in the standard configuration. The operation may vary if the configuration is customized.

- Saving a Full Snapshot
- Loading a Full Snapshot
- Saving a Source Snapshot
- Loading a Source Snapshot
  - Loading Settings to the Source in Access
  - Loading Settings to the Original Source
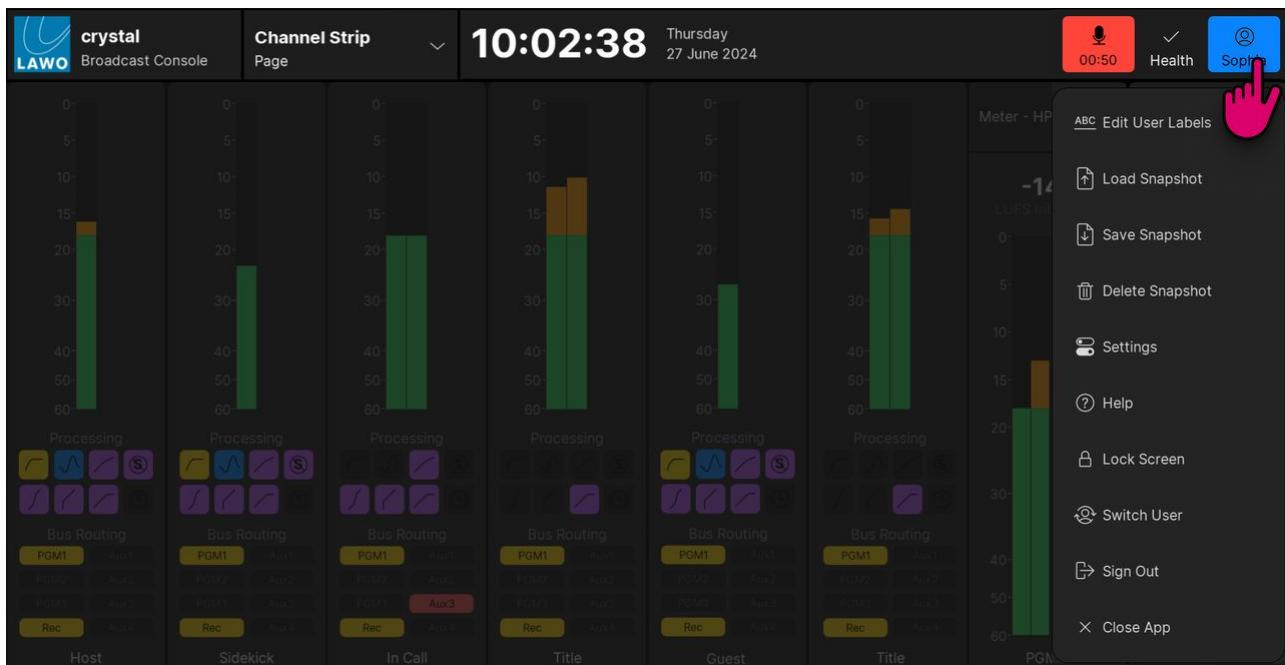
> ℹ️ Full snapshots save all of the settings described earlier plus the functions and position of the master slots on the 'Channel Strip' page.

Saving a Full Snapshot
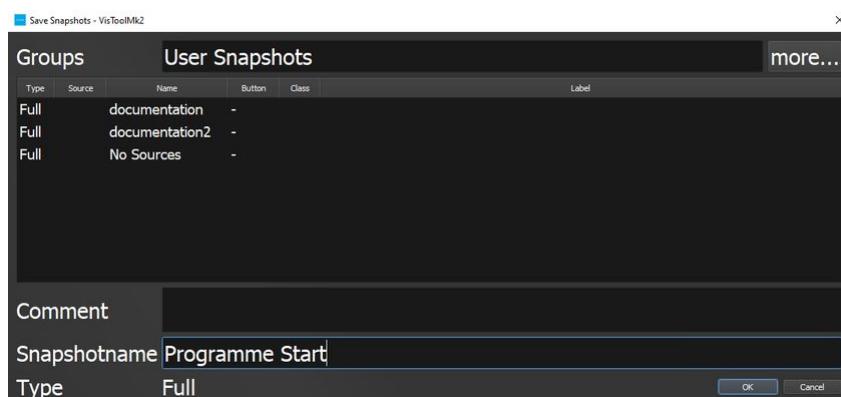
In the standard configuration, you must be logged in to save and load full snapshots.

1. Select **Sign In** (from the user menu) and login in the usual manner.

Following a successful login, you can select your username (top right) to access the **Load Snapshot** and **Save Snapshot** buttons.

2. Choose **Save Snapshot** to open the 'Save Snapshots' dialog box.

3. Enter a snapshot name and, optionally, a comment. Then select **OK**.
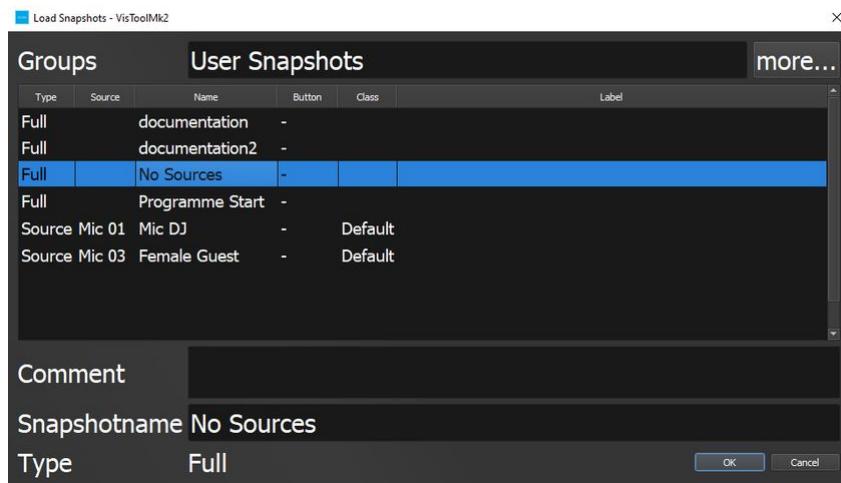
The dialog box closes and the settings are saved.

If you enter the same name as an existing snapshot, then a confirmation box appears - select **Yes** to overwrite or **No** to cancel.

> ℹ️ By default, all snapshots are saved into the "User Snapshots" group. If other groups are available, then these can be selected via the **more...** button (top right). If this button is greyed out, then it is not available to the current user.
>
> The access to snapshot groups is determined by the User Access Rights system (described in the VisTool MK2 documentation).

Loading a Full Snapshot

1. Select **Load Snapshot** (from the user menu) to open the 'Load Snapshots' dialog box.

Here you will see all of the snapshots stored in the "User Snapshots" group. If your system supports other snapshot groups, then these can be selected via the **more...** button (top right).

The 'Type' column shows the type of snapshot, either **Full** or **Source**.

2. Select a full snapshot and select **OK**.

The dialog box closes and the console resets according to the snapshot recall options (described <u>earlier</u>).
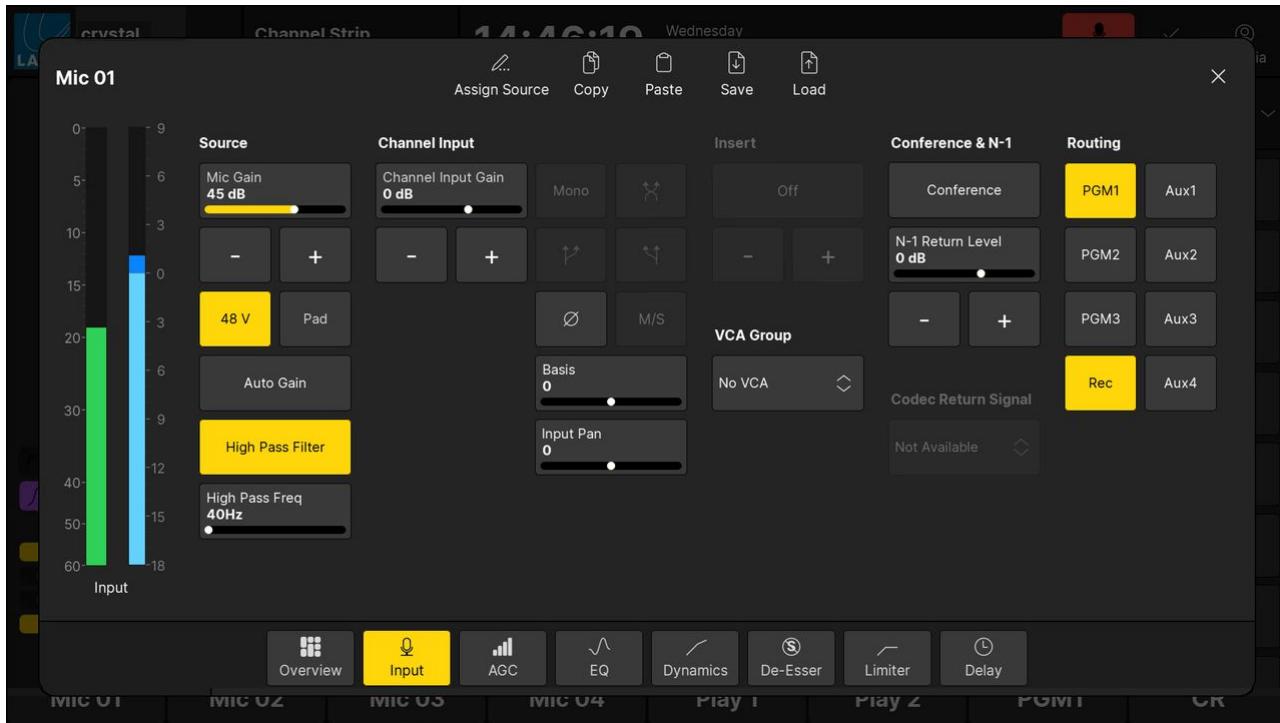
> ⓘ If you load a source snapshot when no source is in access, then its settings are loaded to the original source (shown in the 'Source' column). For example, loading the snapshot named "Mic DJ" will reset the Mic 01 source.

Saving a Source Snapshot
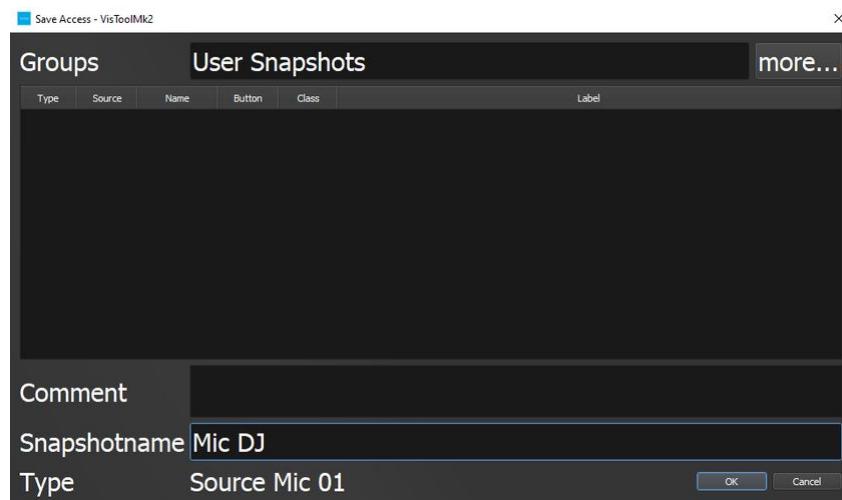
In the standard configuration, source snapshots are saved from the 'Source Parameter' dialog box. This opens automatically when a source is in access.

1. On the surface, press a fader strip **Access** key to select the source you wish to save.

The 'Source Parameter' dialog box opens on the GUI.

2. Select **Save** (from the top row of buttons) to open the 'Save Access' dialog box.

3. Enter a snapshot name and, optionally, a comment. Then select **OK**.

The dialog box closes and the settings are saved.

If you enter the same name as an existing snapshot, then a confirmation box appears - select **Yes** to overwrite or **No** to cancel.

> ℹ️ As before, the snapshot is saved into the "User Snapshots" group. If other groups are available, then these can be selected via the **more...** button (top right).
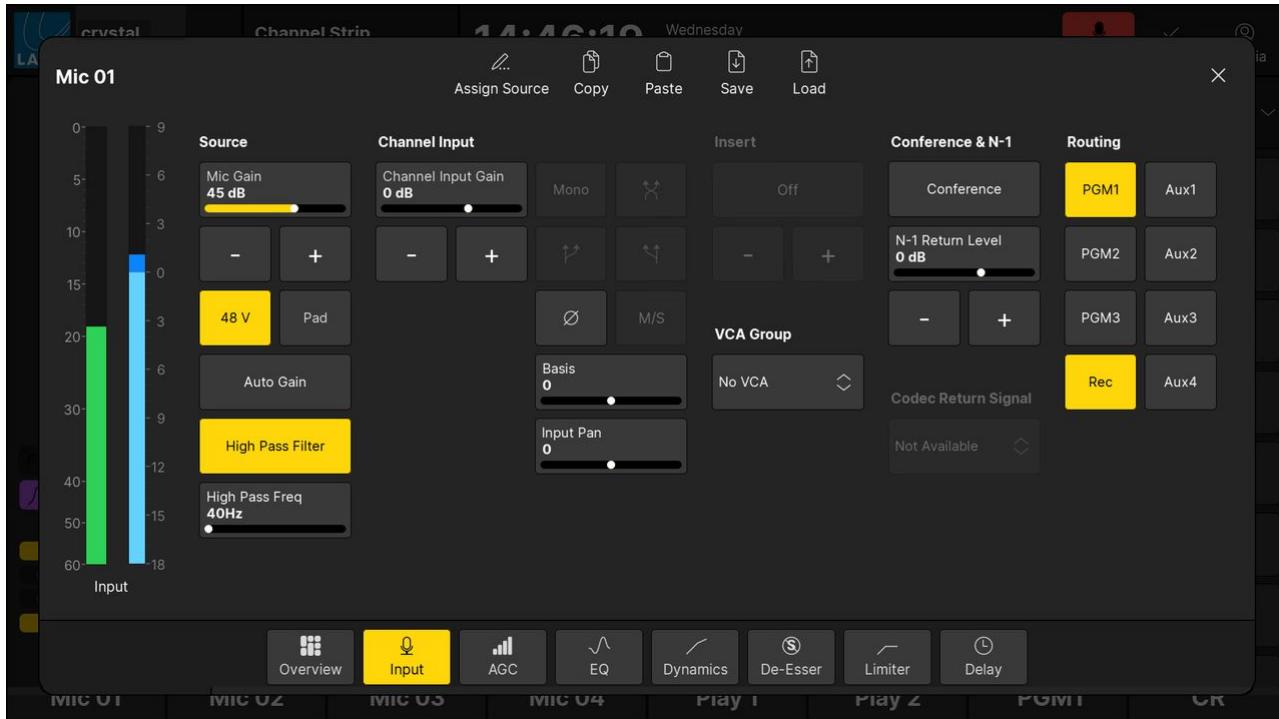
Loading a Source Snapshot

Source snapshots can be loaded either to the source in access or to the original source. The first option is particularly useful if you have saved a library of source snapshots, or wish to copy and paste settings between sources.
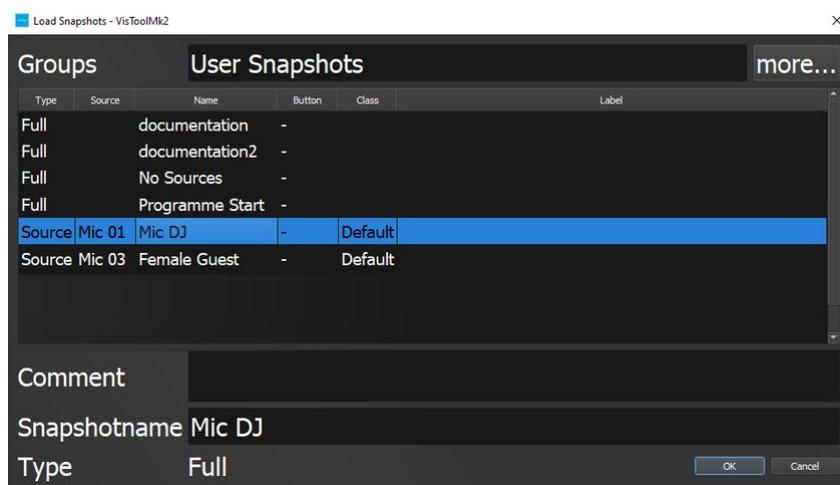
Loading Settings to the Source in Access

1. On the surface, press a fader strip **Access** key to select the source you wish to reset.

The 'Source Parameter' dialog box opens on the GUI.

2. Select **Load** (from the top row of buttons) to open the 'Load Snapshots' dialog box.

3. Select a source snapshot and select **O**K.

The dialog box closes and the source in access resets according to the snapshot recall options (described underlined earlier).

4. Turn off the fader strip **Access** key to close the 'Source Parameter' dialog box and return the surface controls to their default functions.

Loading Settings to the Original Source
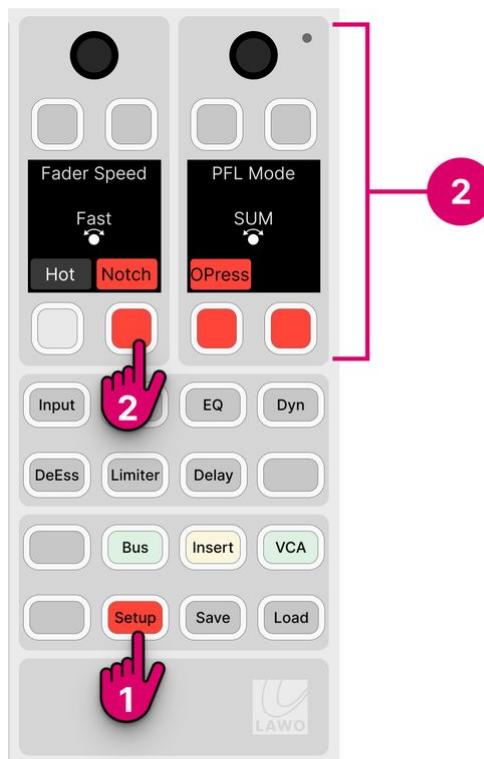
1. Select **Load Snapshot** (from the user menu) to open the 'Load Snapshots' dialog box.

2. Select a source snapshot and select **O**K.

In this instance, there is no source in access and so the snapshot settings are loaded to the original source (shown in the 'Source' column). For example, loading the snapshot named "Mic DJ" will reset the Mic 01 source.

6.21 crystal - The Setup Menu

The **Setup** menu can be used to change the fader options or PFL mode. The current values are stored in the system's warm start data (on Power Core). This means that any changes affect all users and remain in place until the next cold start.

The options are adjusted from the Central Rotary Controls as shown below.

1. To open the menu, press the **Setup** key on the central controls module.

The Central Rotary Controls update to show the available options.

2. Turn a rotary control to adjust the adjust fader speed or PFL mode. Press a soft key to enable or disable 'Hot' faders, the fader **Notch** or the fader **OPress** (Overpress).

Fader Options

There are four options for the faders: speed, hot mode, notch and overpress. Each one affects all faders across the surface.

Fader Speed

This option sets the speed at which the faders move in response to a snapshot load or external control signal such as a fader start. Only the physical movement of the faders is affected (and not the response time of the audio).

There are three possible values: Slow, Medium or Fast.

Fader Hot Mode

This option determines whether the faders move, or remain stationary, in response to the channel on/off state.

There are two possible values:

- Hot Faders (disabled) = the fader motors are active; faders open and close automatically in response to the channel on/off.
- Hot Faders (enabled) = the fader motors are inactive; the channel on/off state can be changed without faders moving. This allows you to position a fader to the desired level before turning the channel on.

Fader Notch

This option enables or disables the fader notch. When the notch is enabled, you will feel a small resistance at 0dB when you move a fader.

The initial state (notch on/off) can be modified by the ON-AIR Designer (under "System → Definition → AccessGrp → Faders").

Fader OverPress

This option enables or disables the fader overpress. When enabled, you can pull back on a fader to trigger the overpress function (e.g. PFL). Note that the faders move up (or down) slightly when the option is turned on (or off).

The overpress function is programmed by the configuration and is defined globally for all fader strips. The initial state (overpress on/off) and function can be modified by the ON-AIR Designer (under "System → Definition → AccessGrp → Faders").

PFL Mode

The PFL mode defines how the "PFL" keys operate (as described earlier).

The table below describes all possible options.

1	**SUM** (default)
	Multiple PFLs can be selected. Where faders are closed, sources are summed onto the PFL bus. When a fader opens, PFL is canceled. Where faders are open, sources are put into "PFL Prepare". In this instance, nothing happens until the fader is closed. Once the fader is closed, PFL becomes active.
2	**SUM R**
	Known as SUM Recurring. Identical to SUM mode, but PFL recurs if you open and then close the fader. In this mode, you must turn off PFL by deselecting the **PFL** key.
3	**PFL**
	Identical to SUM mode, but the PFL keys inter-cancel. This means that only one source can ever be in "PFL Active" or "PFL Prepare".
4	**PFL R**
	Known as PFL Recurring. Identical to PFL mode, but PFL recurs if you open and then close the fader. In this mode, you must turn off PFL by deselecting the **PFL** key.
5	**PFL A**
	Known as PFL Always. Identical to SUM mode, except that sources are always put into "PFL Active" even if their faders are closed. i.e. there is no "PFL Prepare".
6	**PFL AR**
	Combines PFL Always and PFL Recurring. Sources are always put into "PFL Active", and PFL recurs if you open and then close the fader.
7	**PFL PUSH**
	Changes the operation of the PFL keys from latching to momentary. In this instance, you must press and hold a key to make PFL active. PFL cancels when you release the key.

8	**PFL DJ**
	A special mode for DJs that can be used to prepare a fader level before the source goes on-air. Start by pressing PFL to monitor the source and adjust the fader level. Then deselect PFL and press channel ON (to put the source on-air) - the fader jumps to the prepared level. Note that the prepared level is applied only once. So, if you take the fader off-air, and then press channel ON again, the fader jumps to 0dB as normal.
9	**AFL**
	Changes the operation of the PFL keys from pre-fader listen to after-fader listen. In this mode, multiple AFLs can be selected. AFL must be turned off by deselecting the **AFL** key.
10	**AFL/PFL**
	Combines AFL and PFL operation. The PFL keys operate as AFL when a fader is open and PFL when a fader is closed.

7 crystal VX - Operation

This chapter describes how to operate the crystal VX GUI.

The topics here describe a system operating with Power Core. If you plan to use crystal as a controller only, see crystal - Controller Mode.

The examples used in this chapter describe the standard configuration delivered with every system. If your GUI looks different, then you may be running a custom configuration. You can learn more about how to customize the GUI, using VisTool Editor, in the "VisTool User Guide" (available here).

- crystal VX - First Steps
- crystal VX - Operating Principles
- crystal VX - Channel Strip Page
- crystal VX - Playout Page
- crystal VX - Browser Page
- crystal VX - Routing Page
- crystal VX - System Health
- crystal VX - Timer Operation
- crystal VX - User Menu
- crystal VX - Login and Logout
- crystal VX - Edit User Labels
- crystal VX - Snapshot Management
- crystal VX - Settings
- crystal VX - Help
- crystal VX - Initial Settings

7.1 crystal VX - First Steps

The Virtual Extension provides visual feedback and touch-screen operation. It can be integrated into the frame or delivered as a stand-alone unit. If the Virtual Extension is integrated, then the VX module slots directly into the frame at a fixed viewing angle.

The functionality of the GUI is defined by the configuration. This chapter describe the standard configuration (included with every console). The operation may vary if the configuration is customized.

Prerequisites

The VX software runs on a Windows 64-bit PC that must be supplied by the customer. A license to run the standard configuration is included with every console.

It is expected that the customer has prepared and connected the host PC. How to do this is described in crystal - Configuring the Virtual Extension.

If the surface has more than one VX module, then all of the displays should be connected to the host PC and powered.

Starting the Software

The VX runtime app is started by double-clicking on the start script icon. This starts the Main and Fader sessions (according to the initial settings defined in VX Admin).

In each case, the session loads and connects to the hardware. Providing there are no error messages, the VX display is ready for operation.

If the display does not look operational, then try the troubleshooting tips in crystal - Powering On.

Session Mapping

Once the sessions are running and connected to the hardware, check the configuration of the 'Channel Strip' page.
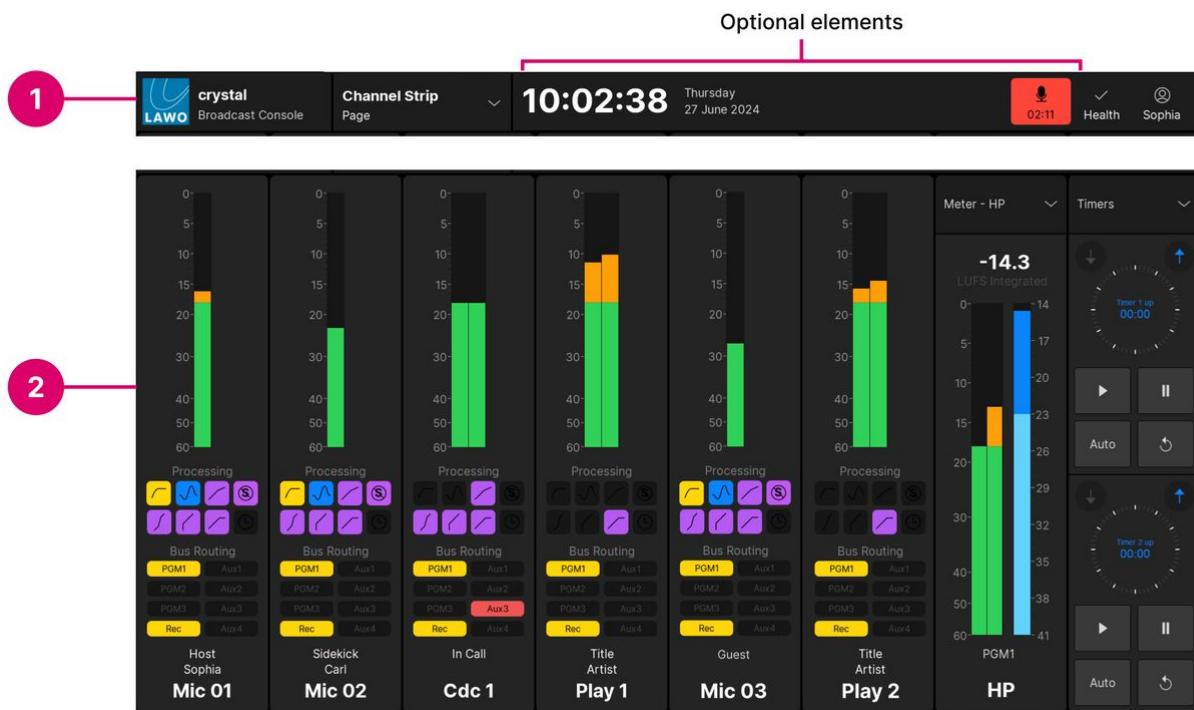
The number of channel strips and master slots should match the controls on the surface modules. For crystal, there are two possible layouts: a Fader session (with 8 channel strips) or a Main session (with 6 channel strips plus 2 master slots).

If there is a mismatch, then correct the mapping of the sessions to the displays (using the "Screens" area in VX Admin).

7.2 crystal VX - Operating Principles

Each VX display is divided into two areas. The top bar (1) is always visible, while the main working area (2) is switched between different pages.

1. Top Bar

The top bar includes some elements that are always displayed and some that are optional. Each of the optional elements can be enabled (or disabled) from the 'Settings → Top Bar' dialog box.

Working from left to right, the elements are:

- **LAWO logo** and product name (**crystal Broadcast Console**) - for information only.
- **Current page name** (e.g. Channel Strip). Touch the **Page** button to change the page.
- **System Clock** (optional) - for information only. The system clock shows the time and date running on the host PC. This can be transferred to Power Core using SoP Explorer (as described later).
- **Mic Timer** (optional) - for information only. The indicator lights in red and counts up from 00:00 whenever a Mic source fader is open. The timer resets to 00:00 once all Mic source faders are closed.
- **Health indicator** - shows the health of the system. A white tick shows that everything is ok. If there is a problem, then an exclamation mark appears. In each case, touch the indicator to view more information.
- **User name** (e.g. Sophia). Touch the user name to open the user menu.
  - From here you can sign in (or sign out) and close the VX App.
  - Once logged in, the following functions become available: edit user labels, load/save/delete snapshot, adjust settings and lock screen.

2. Current Page

The main working area can be switched to one of four pages.

To change the page, touch the **Page** button (below the current page name) and choose an option from the drop-down menu.

There are four pages as follows.

- Channel Strip - visual feedback for the sources assigned to the fader strips and/or central functions.
- Playout - a specific web page.
- Browser - web browser including bookmarks.
- Routing - control of the system's output routing.

If your console is fitted with more than one VX module, then you can show a different page on each display.

Dialog Boxes (Overlays)

The following dialog boxes appear automatically in response to an operation from either the surface or GUI. In each case, the dialog box appears on top of the current page (as an overlay).

Dialog Box Name	Function	How to Open
Source Parameters	View and control parameters for the source in access.	Press a fader strip **Access** key once.
Assign Source	Assign a source to a fader strip.	Press a fader strip **Access** key twice in quick succession.
Select Mon Source	Select a monitor source.	Press and hold the **Soft Select** key (for CR or HP).
Select Mon Mode	Change the monitoring mode.	Press the **Mode** key (for CR or HP).
User Login	Access protected functions (by logging in).	Select **Login** from the GUI user menu.
User Labels Editor	Edit the user labels for any source.	Select **Edit User Labels** from the GUI user menu.
Load/Save/Delete Snapshot	Load, save or delete a GUI snapshot.	Select **Load**/**Save**/**Delete Snapshot** from the GUI user menu.
Settings	Customize the operation for the current user.	Select **Settings** from the GUI user menu.
Help	Open the user manual on docs.lawo.com.	Select **Help** from the GUI user menu.

7.3 crystal VX - Channel Strip Page

The 'Channel Strip' page is divided into 8 vertical strips that provide an extension of the surface controls.

Two types of strip are supported: channel strips (above the faders) and master slots (above the central controls).

Channel Strip Elements

Each channel strip provides visual feedback for the source assigned to the fader.

Working from top to bottom, there are four areas: input metering, processing, bus routing and the source name / user labels. For security reasons, it is not possible to change settings from these elements. For example, you cannot turn off an EQ by touching its icon.

Input Metering

This area provides dedicated input metering for every fader strip. The user can decide to show peak metering, momentary loudness or both using the **Channel Strip** option (in the 'Settings → Meters' dialog box).

For more information about the metering scales and characteristics, see crystal - Metering.

Processing

This area shows the on/off status of each DSP module: unlit = off, lit = on. The icons use the Lawo LUX color-coding as follows:

High Pass Filter	EQ	Compressor	De-Esser
Expander	Gate	Limiter	Delay

To turn a module on/off, or adjust its settings, press a fader strip **Access** key to open the Source Parameters and then choose the relevant page.

Bus Routing

This area shows the assignments to the 8 summing buses (defined in the standard configuration). The icons are color-coded to indicate the current status:

- Unlit = source is not assigned (off).
- Yellow = source is assigned (post-fader).
- Red = source is assigned (pre-fader).

To change the bus assignments, press **Bus** and a page number from the central controls, or press a fader strip **Access** key to open the Source Parameters.

For more information on editing the bus assignments, see crystal - Bus Assign.

Source Name & User Labels

This area shows the source name (in large text) and user label lines (in small text).

The text can be edited by the user labels editor. In each case, up to 8 characters are supported.

Master Slots

Each master slot is assigned by touching the arrow (at the top right of the slot) and choosing an option.

The following functions are supported:

- **Meter - PGM x** - output metering for a programme bus.
- **Meter - Rec** - output metering for the record bus.
- **Meter - CR** - output metering for the control room monitoring.
- **Meter - HP** - output metering for the headphone monitoring.
- **Meter - PFL** - output metering for the PFL bus.
- **User Keys** - 8 programmable user keys (requires configuration).
- **Timers** - two count-up/count-down timers.

Output Metering

There are no user options for the output meters and so both peak and momentary loudness bargraphs are always displayed. The numerical readout shows the integrated loudness measurement (in LUFS).

For each of the main bus outputs, the metering point comes after all processing including the fader. For the monitoring outputs, the metering point comes after the monitor source selector and before the volume (including mute/dim).

For more information about the metering scales and characteristics, see crystal - Metering.

User Keys

The 8 user keys are defined by the configuration. In the standard configuration, nothing is programmed and so the functions must be configured using VisTool Editor and the ON-AIR Designer.

Timers

Each timer has two modes of operation: count-up or count-down, and can be triggered either automatically or manually. The full operation is described later in Timer Operation.

7.4 crystal VX - Playout Page

The 'Playout' page displays a specific web page where the "web address" is defined by the configuration. Typically, it is used to access the studio's playout server. An example is shown below.

Playout Sessions

It is possible to define up to four 'playout' page sessions.

The web address and label for each session are defined in the "Emberdefault.ini" file.

7.5 crystal VX - Browser Page

The 'Browser' page opens a generic web browser where you can open any web page. The operation is controlled using two elements: the navigation bar (at the top) and bookmarks (on the left).

Navigation Bar

Working from left to right, the navigation bar provides the following functions:

- **<** and **>** buttons - navigate forward or backward to the next or previous page.
- **Refresh** button - reloads the current page.
- **Address Bar** - displays the web address (URL) of the page. A new address can be entered from the keyboard. For touch-screen operation (with no physical keyboard), open the on-screen keyboard to enter an address.
- **+** and **-** buttons - zoom in or out on the current page.
- **Show Keyboard**- select this icon to open the on-screen keyboard.
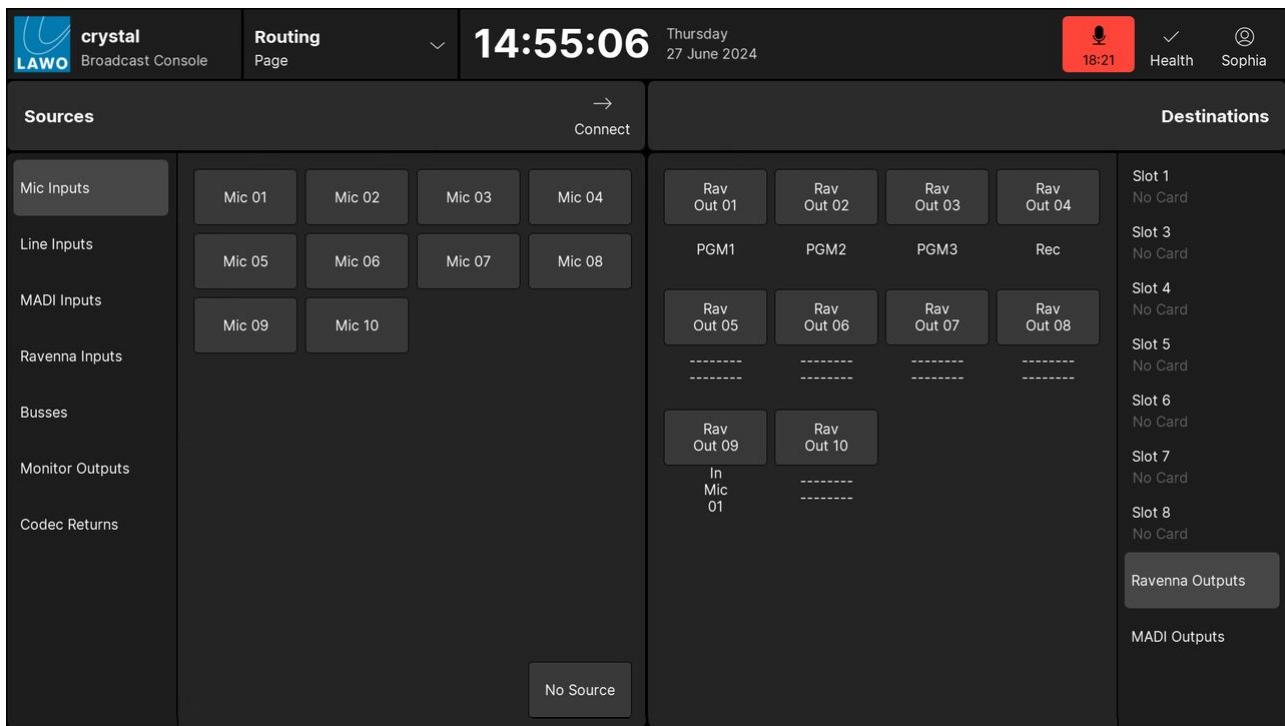
Bookmarks

The eight bookmarks (on the left) provide fast access to a pre-configured page. Select a bookmark to load the page.

The web address and label for each bookmark are defined in the "Emberdefault.ini" file.

7.6 crystal VX - Routing Page

The 'Routing' page can be used to edit the audio connections to the Power Core outputs. The page is divided into two halves: Sources (on the left) and Destinations (on the right). The available sources and destinations are defined by the configuration and are divided into categories using the side panel tabs.

To interrogate the existing connections:

1. Under 'Destinations', select an output category (e.g. Ravenna Outputs).
2. If a destination is connected, then the source name appears below the output. For example, PGM1 is connected to Rav Out 01.
3. If a destination has no source, then you will see two dashed lines.

To make a connection:

1. Under 'Sources', select an input category and choose a source - the selection flashes in blue.
2. Under 'Destinations', select an output category and choose an output - the selection flashes in blue.
3. Press **Connect** - the connection is made.

To disconnect an output:

1. Under 'Destinations', choose the output you wish to disconnect - the selection flashes in blue.
2. Under 'Sources', select **No Source**.
3. Press **Connect** - the source is removed.
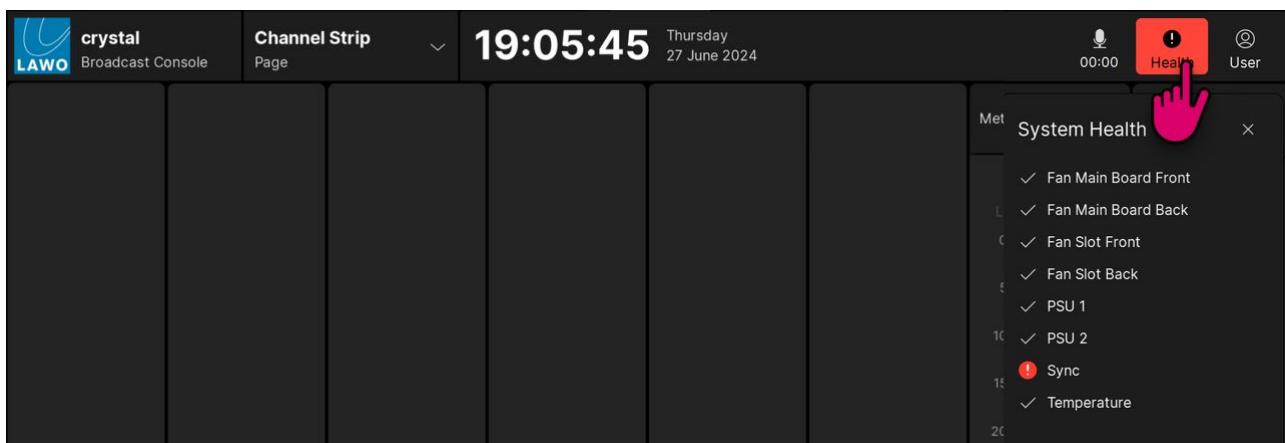
7.7 crystal VX - System Health

The **Health** indicator shows the health of the system. A white tick shows that everything is ok. If there is a problem, then a red exclamation mark appears.
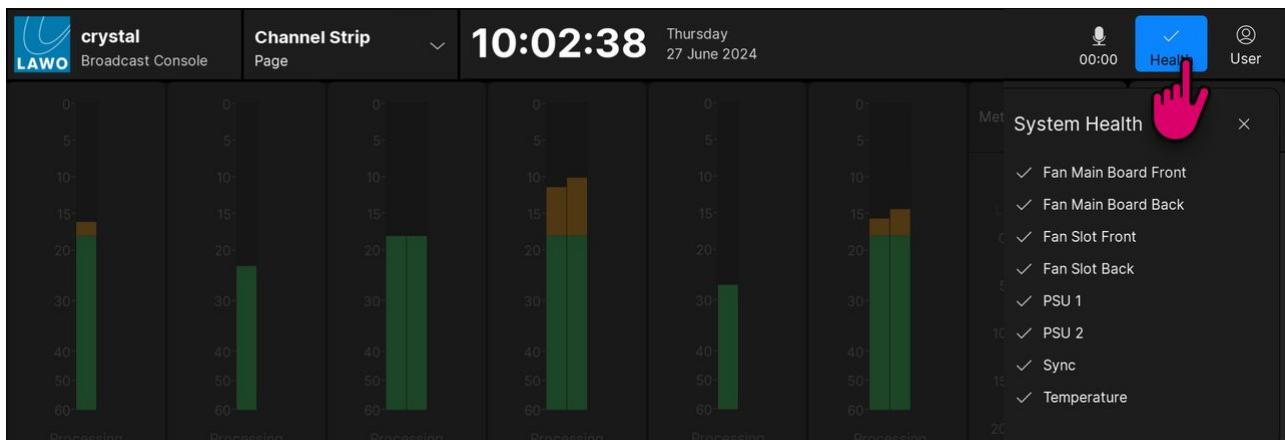
1. In each case, touch the **Health** indicator to show more information (in the 'System Health' dialog box).

In the following example, there is a synchronization error.

In the next example, the system health is ok.

The individual components are named as follows:

- **Fan Main Board** & **Fan Slot** - the four cooling fans inside Power Core. A health error is triggered by a reduction in the fan speed.
- **PSU 1** & **PSU 2** - the dual power feeds to Power Core: PSU 1 = the AC input; PSU 2 = the DC input. A health error is triggered by a drop in the input voltage.
- **Sync** - the sync signal connected to Power Core. In the standard configuration, Power Core is set to operate as a PTP slave, and so a health error indicates a problem with the incoming PTP signal. The sync source can be modified by editing the configuration (using the ON-AIR Designer). For more information, see Power Core - Synchronization.
- **Temperature** - the status of the temperature inside Power Core. A health error is triggered when the internal temperature exceeds 71° Celsius.

2. Touch the **X** (top right) to close the 'System Health' dialog box.
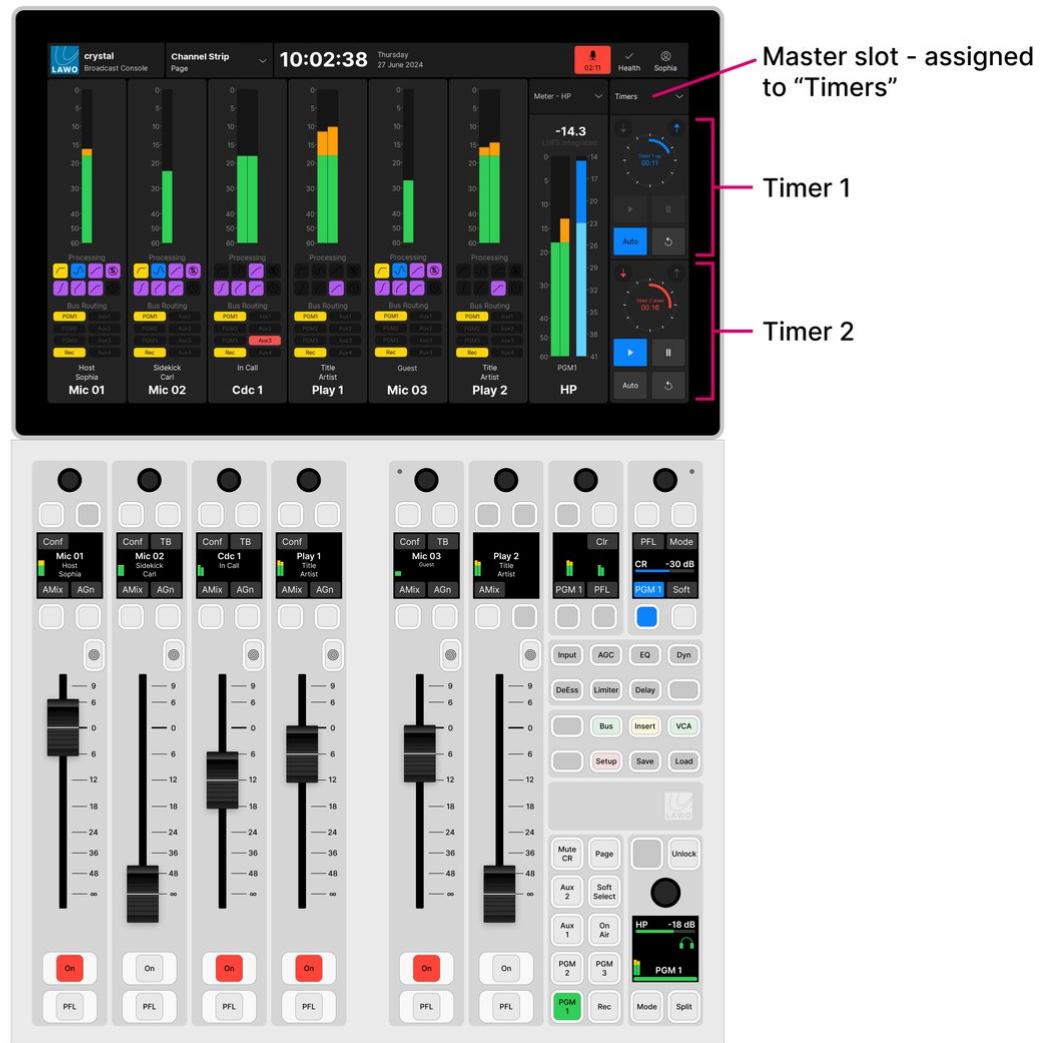
7.8 crystal VX - Timer Operation

The standard configuration supports two independent timers: Timer 1 and Timer 2. Both timers can be displayed on the GUI's 'Channel Strip' page by assigning one of the master slots to **Timers** (as described underlined earlier).

Each timer has two modes of operation: count-up or count-down, and can be triggered either automatically or manually. When a timer is triggered automatically, the operation is defined by the **Timer x Auto Mode** option (in the 'Settings → Timer' dialog box). There are two possibilities:

- **Mic Only** = the timer counts only when a Mic source fader is open (applies to all Mic sources).
- **All Faders** = the timer counts when any fader is open (applies to all faders).

The operation is handled from the GUI's touch-screen (for both timers).

Setting the Timer Mode
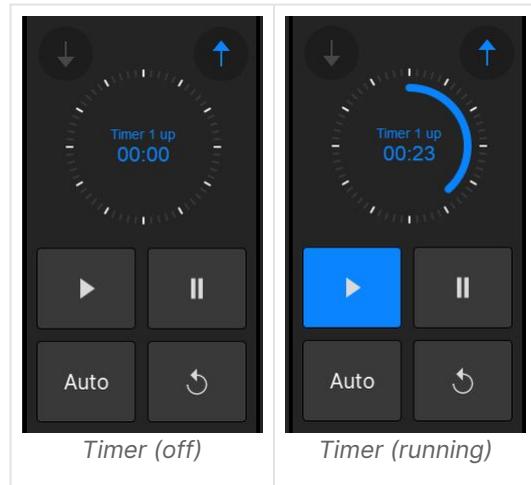
The count-up or count-down mode is selected from the GUI using the arrows above each timer:

- Touch the up arrow (top right) to choose count-up mode.
- Touch the down arrow (top left) to choose count-down mode.

The color of the arrow and timer label indicate the mode: blue = count-up; red = count-down.

Count-up Mode

In count-up mode, the timer counts up from 00:00 and continues counting until the timer is stopped or reset.

Timer (off)   *Timer (running)*
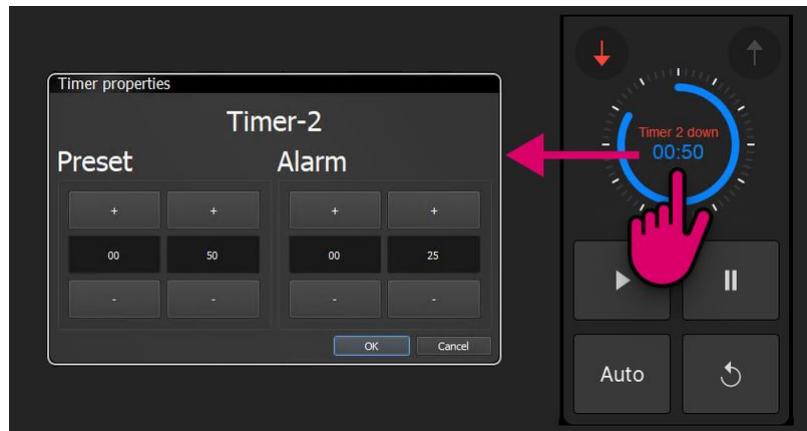
Count-down Mode

In count-down mode, the timer counts down from a starting value (called the **Preset** time) and turns red once a mid-point (the **Alarm** time) is reached. If the count-down reaches 00:00, then the timer starts to count back up. This shows how long the timer has been overrunning! In this instance, the Alarm status remains active until the timer is reset.

Timer (off)   *Timer (running)*   *Timer (alarm on)*

PresetAlarm

Type a number into the minute and second fields, or touch the **+** and **-** buttons to increase and decrease the current values. Then select **OK** to confirm.

To set the and times, touch the current time value to open the 'Timer Properties'.

Setting the Triggering Method

The triggering method is selected using the **Auto** button (on the GUI):

- **Auto** on (lit) = automatic start/stop.
- **Auto** off (unlit) = manual start/stop.

Manual Timer Operation

To use a timer manually:

1. First make sure that the **Auto** button is turned off (unlit).

2. Then set the count-up or count-down mode using the up and down arrows.

In count-up mode, the timer counts up from 00:00. In count-down mode, the timer counts down from the **Preset** time (described earlier).

3. Use the start, stop and reset buttons (on the GUI) to operate the timer as follows.

- **Start** - starts the timer from the last stop position/time.
- **Stop** - stops the timer. The current time remains on-screen until the timer is restarted or reset.
- **Reset** - resets the timer, either to 00:00 (count-up) or to the **Preset** time (count-down).

In count-down mode, the timer value turns red once the **Alarm** time is reached. If the count-down reaches 00:00, then the timer starts to count back up.

Automatic Timer Operation

To trigger the timer automatically:

1. First make sure that the **Auto** button is turned on (lit).

2. Then open the 'Settings → Timer' dialog box (from the user menu).

3. Use the **Timer Auto Mode** option to set which faders are used:

- **Mic Only** = the timer counts only when a Mic source fader is open (applies to all Mic sources).
- **All Faders** = the timer counts when any fader is open (applies to all faders).

Note that this option only becomes active once **Auto** mode is enabled. If **Auto** is turned off, then the timer operation is manual.

4. Now set the count-up or count-down mode using the up and down arrows.

In count-up mode, the timer counts up from 00:00. In count-down mode, the timer counts down from the **Preset** time (described earlier).
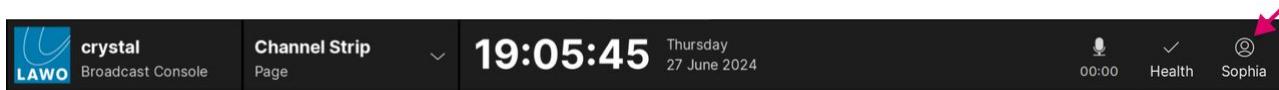
5. Start and stop the timer by opening and closing the faders on the surface.

In our example, **Mic Only** is selected (in step 3) and so the timer starts automatically when a Mic source fader opens. If another Mic source fader opens, then the timer continues to run. The timer stops once all Mic source faders are closed.

6. To reset the timer, press the **Reset** button.

7.9 crystal VX - User Menu

The user icon shows the name of the current user. In the example below, the user "Sophia" is signed in. If no one is signed in, then the icon shows the text "User".
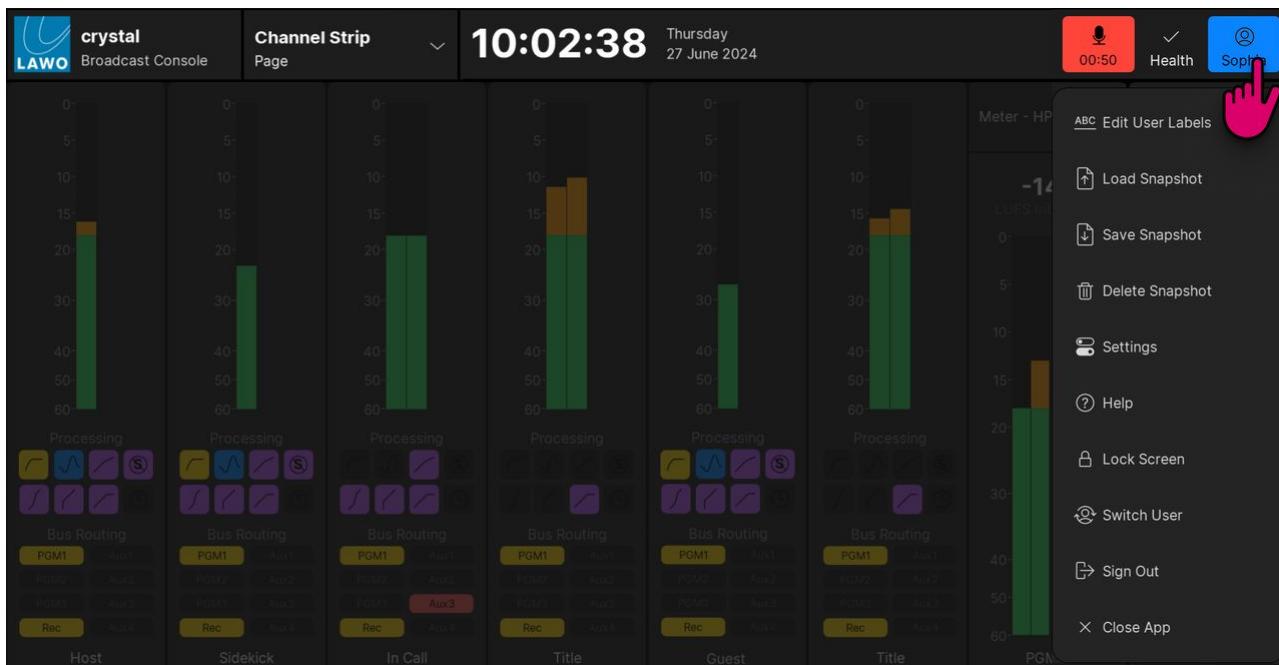
In each case, touch the icon to open the user menu. The available functions depend on the sign-in status.

User Menu (signed out)

If no one is signed in, then there are only two functions: **Sign In** and **Close App**. Choose **Sign In** to open the 'Login' dialog box where you can enter your username and password.

User Menu (signed in)

After a successful login, the following functions become available:

- **Edit User Labels** - open the user labels editor.
- **Load, Save & Delete Snapshot** - load, save or delete a full snapshot.
- **Settings** - open the 'Settings' dialog box.
- **Help** - open the 'Help' dialog box to access docs.lawo.com.
- **Lock Screen** - lock the screen. This function can be used to protect the touch-screen for a short period of time. The screen is unlocked by swiping the "unlock" slider.
- **Switch User** - open the 'Login' dialog box to switch user or change the current user password.
- **Sign Out** - sign out.
- **Close App** - close the crystal VX app.

7.10 crystal VX - Login and Logout

In the standard configuration, some functions are protected by the User Access Rights system. This means that you must be logged in before they become available.
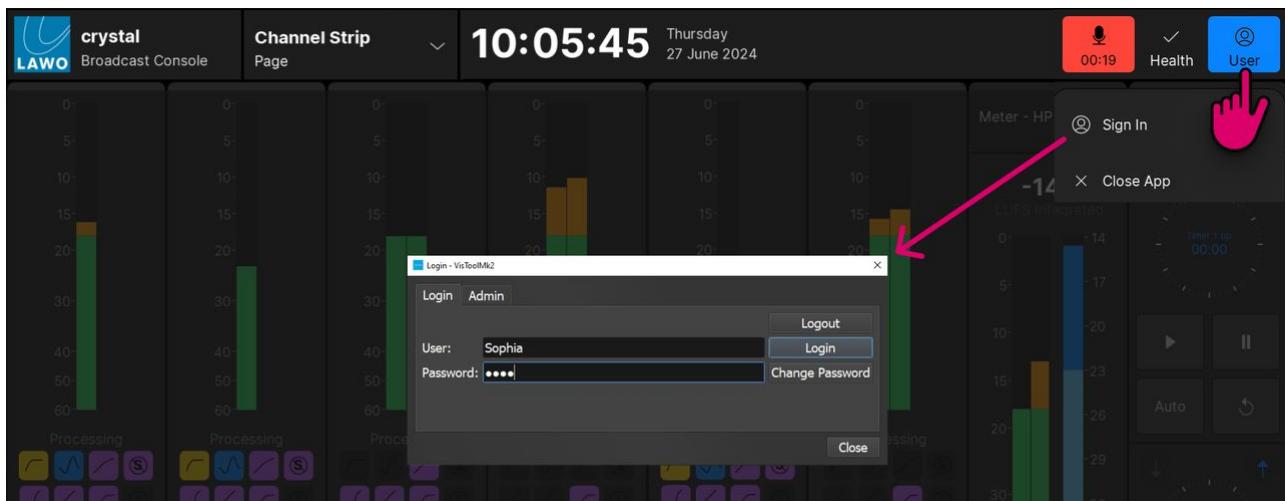
By default, every system comes with a single "admin" user. Once the "admin" user is logged in, they can add more users from the 'Admin' pages. The user setup is described in more detail in the VisTool MK2 documentation. For now, it is useful to know that:

- Usernames and passwords are NOT case sensitive.
- If you have forgotten your password, then an administrator can reset it to "0000".
- The initial administrator username = "admin" and password = "default".

Logging In

The steps below describe how to log in. When a new user logs in for the first time, the password = "0000".

1. Touch the user icon and select **Sign In** (from the user menu).

Alternatively, if someone else is already signed in, touch the user icon and select **Switch User**.

2. Enter your username and password, and select the **Login** button.

Providing the credentials are accepted, you will see the message "Login successful!".

3. Select **OK** (to acknowledge the message) and then either **OK** or **Close** (to close the dialog box).

> ℹ️ The 'Login' dialog box has two tabs: **Login** and **Admin**.
>
> - From the **Login** tab, you can logout, switch user or change your password.
> - From the **Admin** tab, you can open the 'Admin' pages (if you have administrator rights). If the page options are greyed out, then they are not available to the current user.

Logging Out

The steps below describe how to log out. It is recommended to log out before leaving the system unattended.

1. Touch the user icon and select **Sign Out** (from the user menu).

2. You are asked to confirm - select **Sign Out** to continue.
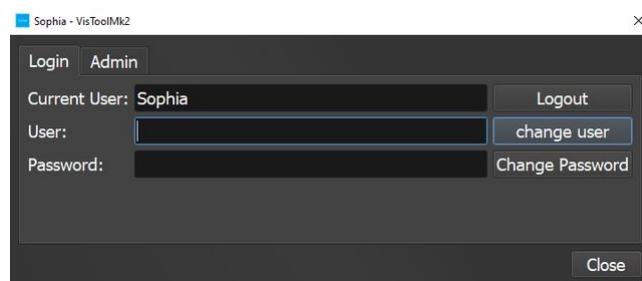
After a successful logout, the user icon updates to show the text "User" and the user menu functions are restricted.

Changing Your Password
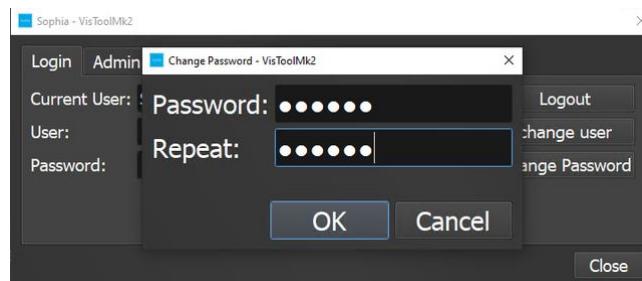
After a successful login, you can change your password as follows.

1. Re-open the 'Login' dialog box by touching the user icon and selecting **Switch User** (from the user menu).

The dialog box shows your username as the 'Current User'.

2. Select **Change Password** to open the 'Change Password' dialog box.

3. Enter a new password into both the 'Password' and 'Repeat' fields, and select **OK**.

There are no restrictions on the characters used, but it is recommended to keep passwords short and memorable!

4. Test the new password by logging out and logging in.

After a successful login, you should have access to all of the user menu functions.
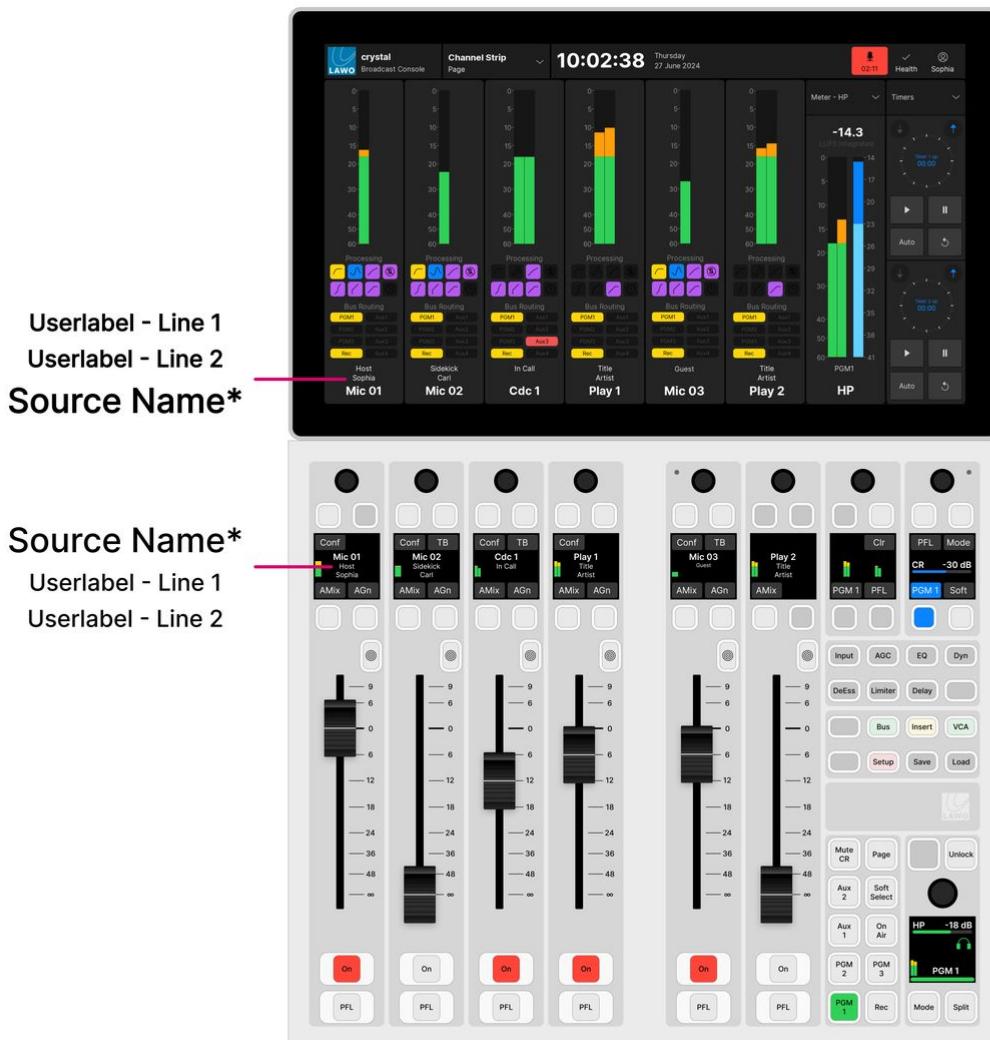
7.11 crystal VX - Edit User Labels

The user labels editor can be used to edit the system name and user labels for each source and summing bus. Note that you must be <u>logged in</u> to access the editor.

Where are User Labels displayed?

Each source and bus is identified by three lines of text: a source name that is always present and two user label lines that are optional. The text lines are displayed on the GUI (in the ' <u>Channel Strip</u>' page) and on the surface (in the fader strip ' <u>Source Display</u>'). You can choose to show (or hide) the two user label lines by changing the **Show Userlabels** option (in the ' <u>Settings</u> → Surface' dialog box).

The image below shows how the editor's text fields are displayed on the surface. Each line can show up to 8 characters.

*The Source Name shows the "Display" name unless a "System" name is entered in the editor.

Source Name

By default, each source and summing bus is identified by its "Display" name, unless a "System" name is entered in the editor. The "Display" name is defined by the configuration and can only be edited using the ON-AIR Designer. Therefore, if you wish to change the source name there are two options: enter a "System" name in the editor OR edit the source's "Display" name in the configuration (using the ON-AIR Designer).

Note that each source and summing bus must have a "Display" name and so the source name is never empty.

Userlabel Line 1 & 2
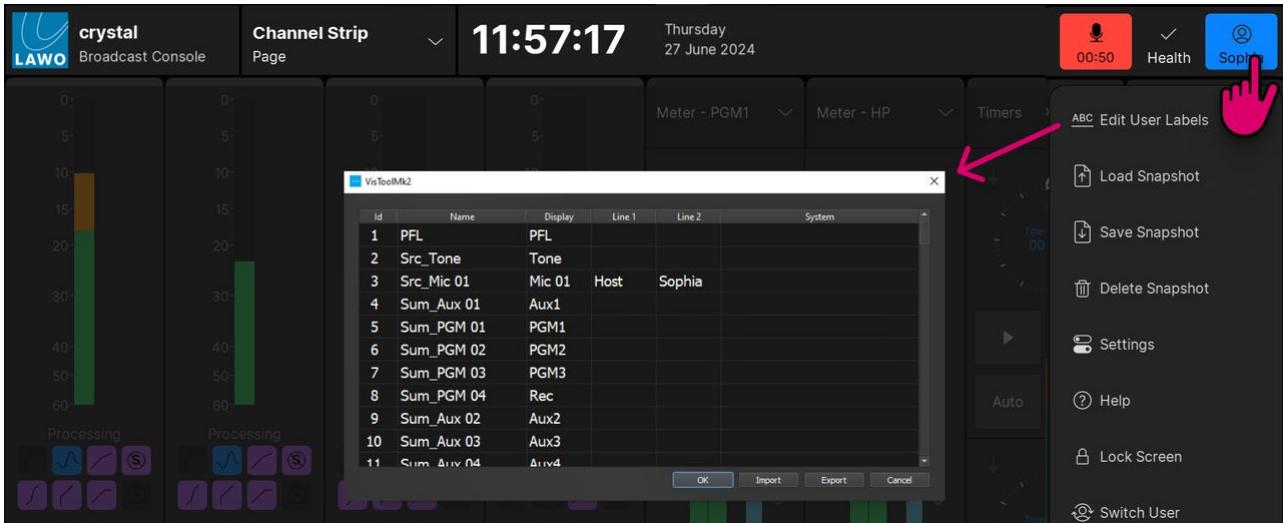
The two userlabel lines are optional and can be completed as required. Remember to turn on the **Show Userlabels** option in the 'Settings → Surface' dialog box to see the labels on the surface and GUI.

Editing a User Label

The steps below describe how to edit the system names and user labels.

1. Touch the user icon and select **Edit User Labels** (from the user menu).

You must be logged in to access the **Edit User Labels** button.

The user labels editor shows every source and summing bus defined in the configuration. This allows you to prepare all of the user labels before assigning sources to the surface.

The "Id", "Name" and "Display" fields are defined by the configuration and cannot be changed. The "Line 1" and "Line 2" fields define the two user label lines. The "System" field defines the source name (in place of the "Display" name) until such time as the "System" field is cleared.

2. Edit the "Line 1", "Line 2" and "System" fields as follows.

- To overwrite the current text, touch or click once and then start typing.
- To edit the existing text, touch or click twice in quick succession.
- Press Enter or select another field to confirm the current entry - the field highlights in red to show that changes have been made but are not yet transferred.

3. Repeat for each source and summing bus you wish to edit.

4. To confirm all of the entries (highlighted in red), select **OK**.

The dialog box closes and the new labels are transferred to the GUI and surface. Alternatively, select **Cancel** to close the editor and discard all changes.

How to Transfer or Backup User Labels

The **Export** button saves the contents of the editor into a ".xml" file. This can be used to transfer user labels to another system or create a backup that is stored independently from snapshots.

To transfer user labels to another system:

- Select **Export** to save the contents of the editor into a ".xml" file.
- Copy the ".xml" file to the VisTool host PC (connected to the other system).
- Open the user label editor and select **Import** and then the ".xml" file. The imported text fields are applied to all sources and summing buses with an identical "Name".

- Check the changes and select **OK** to confirm.

Saving & Loading User Labels

The contents of the editor are saved and loaded by all <u>snapshots</u>. This allows you to save different sets of labels for different applications or programmes.

7.12 crystal VX - Snapshot Management

The **Load**, **Save** and **Delete Snapshot** buttons (in the <u>user menu</u>) can be used to load, save or delete a full snapshot. These functions are described later. See <u>Using the GUI Snapshots</u>.
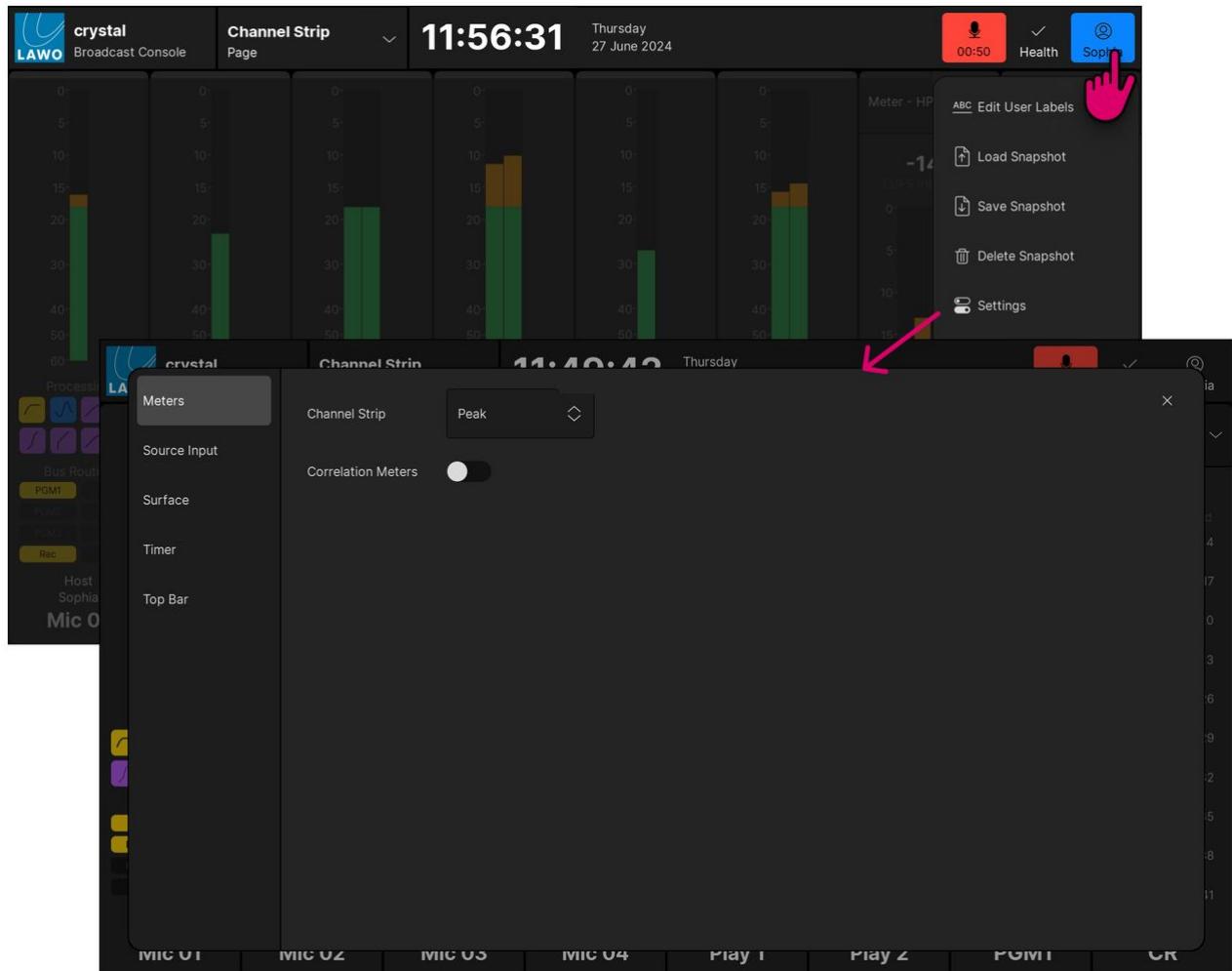
7.13 crystal VX - Settings

The 'Settings' dialog box can be used to customize the operation for the current user.

Please note that any changes made are not persistent, and are reset to the default values once the app restarts. The default values can be changed by editing the "Emberdefault.ini" file (as described later).

1. To open the dialog box, touch the user icon and select **Settings** (from the user menu).

You must be logged in to access the **Settings** button.

2. Use the tabs on the left to select a page of settings.

3. To close the dialog box, select the **X** icon (top right).

In the current release, there are five pages of settings.

- Settings → Meters
- Settings → Source Input
- Settings → Surface
- Settings → Timer
- Settings → Top Bar

'Settings → Meters'

This tab includes two options for the meters in the 'Channel Strip' page.

The **Channel Strip** option defines whether the input meters show peak metering, momentary loudness or both.
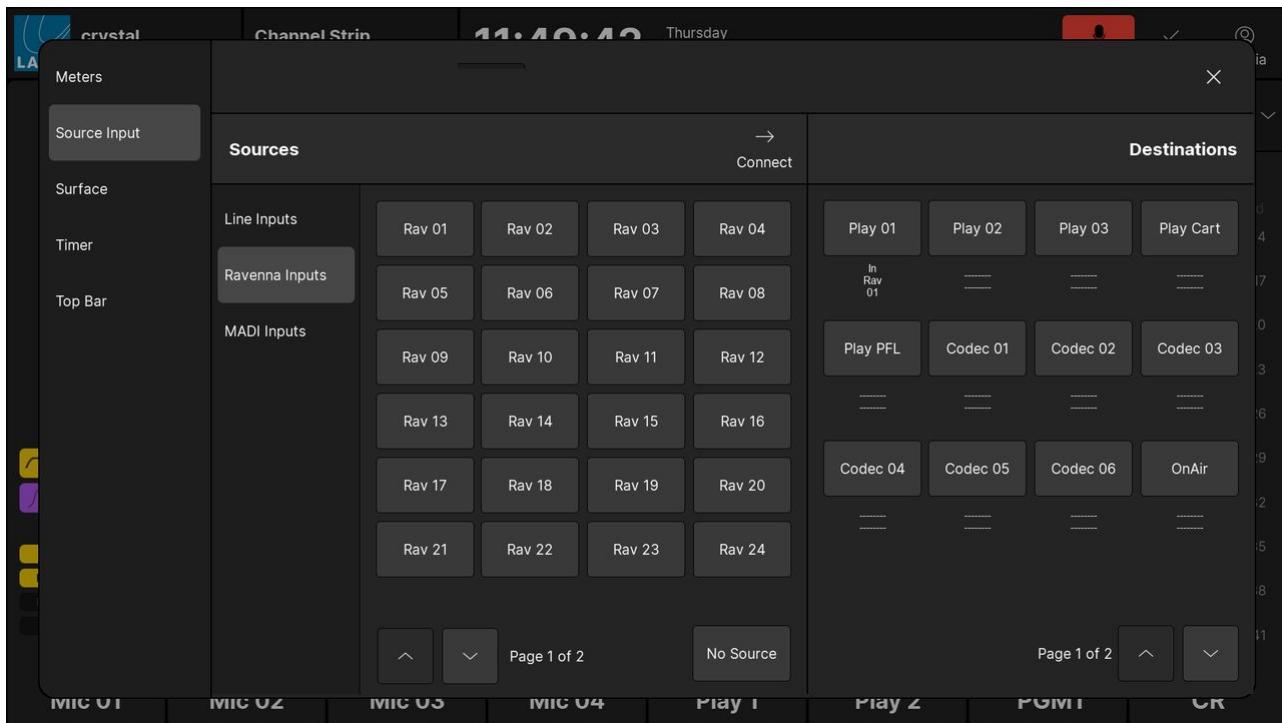
To make a change, touch the current value and select an option from the drop-down menu:

- Peak = peak metering only.
- Loudness = momentary loudness only.
- Peak & Loudness = peak metering + momentary loudness.

The **Correlation Meters** option enables (or disables) the correlation meters.

'Settings → Meters'

'Settings → Source Input'

This tab opens the 'Source Input' page. It can be used to assign a Power Core input to a source.

It is designed so that any Line, Ravenna or MADI input can be assigned to the more generic sources, such as Playouts and Codecs. The page is divided into two halves: Sources (on the left) and Destinations (on the right). The available sources and destinations are defined by the configuration. Note that, in this instance, the Sources are all Power Core inputs, and the Destinations are "sources" that can be assigned to a fader strip.

On the left, the Sources are divided into categories using the side panel tabs. On both sides, you can page through the available options using the up/down arrows beside "Page x of y".

To interrogate the existing connections:

1. Under 'Destinations', use the up/down arrow buttons to select a page.
2. If a destination is connected, then the source name appears below the output. For example, the Power Core input "In Rav 01" is connected to the source "Play 01".
3. If a destination has no source, then you will see two dashed lines.

To make a connection:

1. Under 'Sources', select an input category and page, and choose a source - the selection flashes in blue.
2. Under 'Destinations', select a page and choose an output - the selection flashes in blue.
3. Press **Connect** - the connection is made.

To disconnect an output:

1. Under 'Destinations', choose the output you wish to disconnect - the selection flashes in blue.
2. Under 'Sources', select **No Source**.
3. Press **Connect** - the source is removed.

'Settings → Surface'

This tab includes two options that affect the surface displays.

The first option can be used to show or hide the two user label lines in the fader strip 'Source Display'.

- **Show Userlabels** (on) - shows the two user label lines.
- **Show Userlabels** (off) - hides the two user label lines.

The second option changes the behavior of the ambient light detectors on the Main module:

- **Surface Ambient Light Sensor** (on) = surface brightness adjusts automatically according to the ambient light levels.
- **Surface Ambient Light Sensor** (off) = surface brightness remains the same.

'Settings → Timer'

This tab defines the trigger for each timer when **Auto** mode is enabled. The option can be set independently for Timer 1 and Timer 2. In each case, there are two possibilities:

- **Mic Only** = the timer counts only when a Mic source fader is open (applies to all Mic sources).
- **All Faders** = the timer counts when any fader is open (applies to all faders).

Note that this option only becomes active once **Auto** mode is enabled. If **Auto** is turned off, then the timer operation is manual.
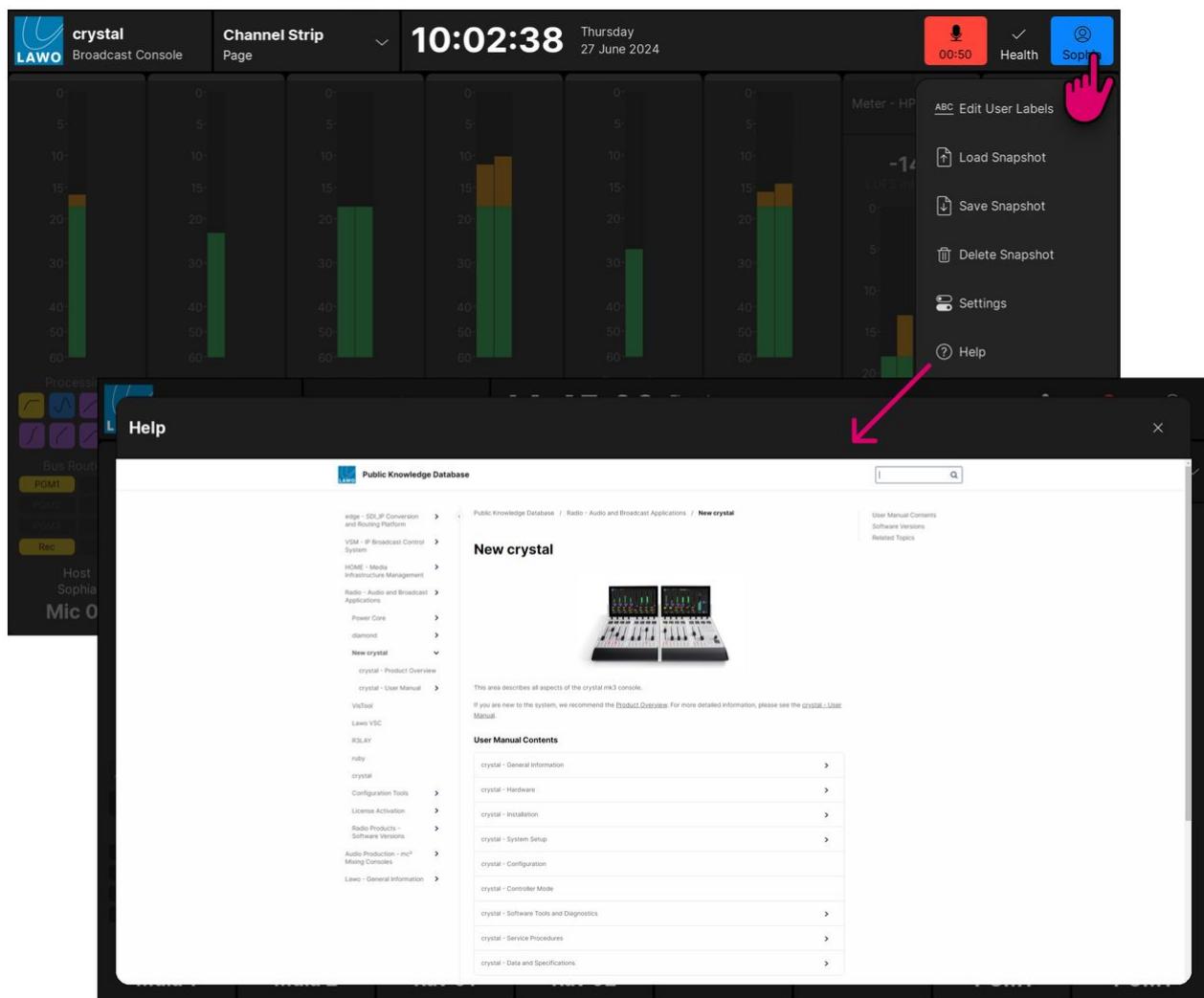
'Settings → Top Bar'

This tab controls what is visible in the top bar (of the GUI). Each option can be turned on or off independently.

- **Show Clock** - shows the system time and date.
- **Show Mic timer** - shows the mic timer. This lights in red and counts up from 00:00 once a Mic source fader is open.

7.14 crystal VX - Help

The **Help** option in the user menu opens the crystal user manual on docs.lawo.com. This allows you to access the manual directly from the console.

Once open, you can use the "Search" field (top right) or the table of contents on the landing page.

To close the dialog box, select the **X** icon (top right).
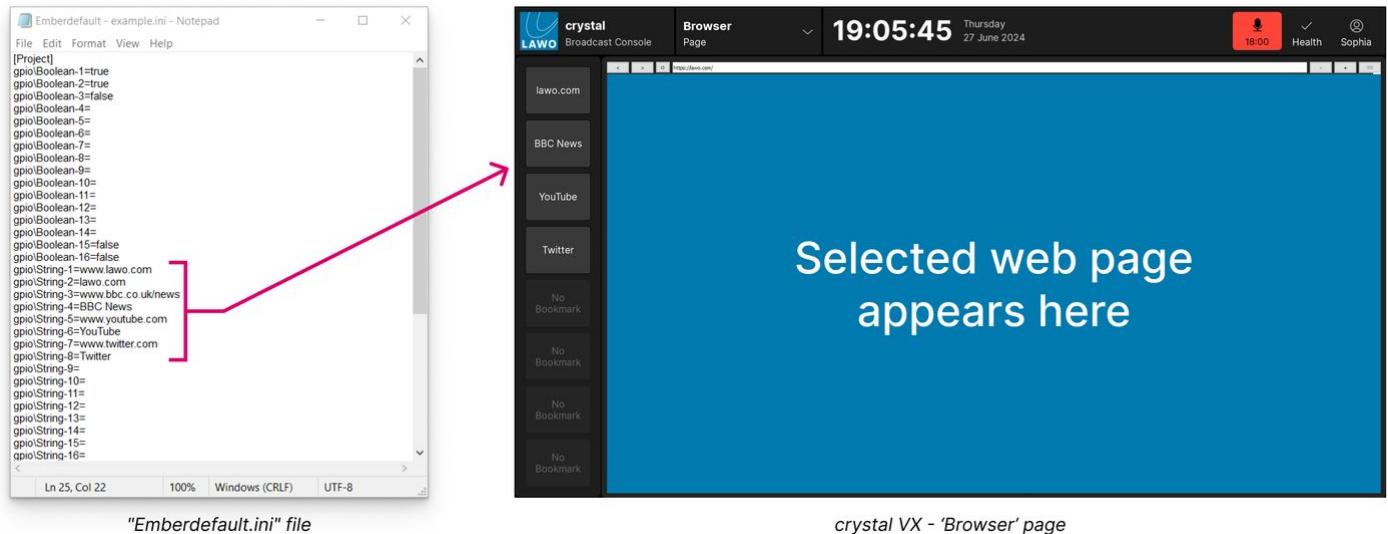
7.15 crystal VX - Initial Settings

The "Emberdefault.ini" file stores the initial settings for the crystal VX app. The settings load whenever the crystal VX app starts. This allows you to customize the operation by editing and saving the file, and then restarting the app.

After a standard install, the file is located at: C:\ProgramData\DSA

You can use any suitable text editor to edit the file.

The example below shows how to define the bookmarks on the 'Browser' page.

| "Emberdefault.ini" file | crystal VX - 'Browser' page |

The tables below describe the available parameters.

- Boolean Parameters
- String Parameters

Boolean Parameters

The following parameters can be set to a boolean value: either **true** or **false**.

Name	Description	Default	Additional Information
gpio/Boolean 1	Top Bar - Show Clock	true	-
gpio/Boolean 2	Top Bar - Show Mic Timer	true	-
gpio/Boolean 3	Top Bar - Show Notifications	false	-
gpio/Boolean 4 to 14	-	-	-

String Parameters

The following parameters can be used to enter a text string. For example, to define the 'Browser Page' bookmark URLs and labels.

Name	Description	Default	Additional Information
gpio/String 1	Bookmark 01 URL	-	-
gpio/String 2	Bookmark 01 Label	-	-
gpio/String 3	Bookmark 02 URL	-	-
gpio/String 4	Bookmark 02 Label	-	-
gpio/String 5	Bookmark 03 URL	-	-
gpio/String 6	Bookmark 03 Label	-	-
gpio/String 7	Bookmark 04 URL	-	-
gpio/String 8	Bookmark 04 Label	-	-
gpio/String 9	Bookmark 05 URL	-	-
gpio/String 10	Bookmark 05 Label	-	-
gpio/String 11	Bookmark 06 URL	-	-
gpio/String 12	Bookmark 06 Label	-	-
gpio/String 13	Bookmark 07 URL	-	-
gpio/String 14	Bookmark 07 Label	-	-
gpio/String 15	Bookmark 08 URL	-	-
gpio/String 16	Bookmark 08 Label	-	-
gpio/String 17 to 20	-	-	-
gpio/String 21	default URL Playout Session 01	-	-
gpio/String 22	default URL Playout Session 02	-	-
		-	-
		-	-
gpio/String 25	Default PPM View in Channel Overview	01	01 = PPM 02 = LU 03 = PPM + LU

Name	Description	Default	Additional Information
gpio/String 26	Sync between Sessions for PPM View	!! NO DEFAULT	this information is written in the session to sync Sessions. Not available for changes!
gpio/String 27	Topbar Line 01	diamond	
gpio/String 28	Topbar Line 02	Broadcast Console	
gpio/String 29			
gpio/String 30			
gpio/String 31	Default Slot 01	05	CR Meter
gpio/String 32	Default Slot 02	06	HP Meter
gpio/String 33 to 39	-	-	-
gpio/String 40	I/O Information for Routing Page Slot 01	!! NO DEFAULT	this information is written to the routing page of other sessions. Not available for changes!
gpio/String 41	I/O Information for Routing Page Slot 02	!! NO DEFAULT	"
gpio/String 42	I/O Information for Routing Page Slot 03	!! NO DEFAULT	"
gpio/String 43	I/O Information for Routing Page Slot 04	!! NO DEFAULT	"
gpio/String 44	I/O Information for Routing Page Slot 05	!! NO DEFAULT	"
gpio/String 45	I/O Information for Routing Page Slot 06	!! NO DEFAULT	"
gpio/String 46	I/O Information for Routing Page Slot 07	!! NO DEFAULT	"
gpio/String 47	I/O Information for Routing Page Slot 08	!! NO DEFAULT	"
gpio/String 48 to 64	-	-	-

8 crystal - Configuration

When operating with Power Core, the operation of the crystal console can be customized using the ON-AIR Designer, Lawo's configuration tool for radio on-air systems.

A new version of the ON-AIR Designer documentation is in progress. For now, please click here to read or download the current manuals as a PDF.

9 crystal - Controller Mode

This topic describes how to use the crystal surface in Open Sound Controller (OSC) mode.

9.1 What is Controller Mode?

If crystal is ordered as a surface only, then it can communicate with an external OSC device such as a DAW. Typical applications include workstation control or integration with Lawo's mc² consoles.

Please note:

- The external device must support the Open Sound Control (OSC) protocol.
- The crystal frame can be fitted with either a Fader or Main module.
- Each crystal frame must connect independently to the IP network; **a CAN bus daisy-chain** (for a second frame) **is not permitted**.
- The OSC syntax is fixed. An OSC mapping table is being prepared and will be added in the future.

9.2 Integration with mc^2 Consoles

In controller mode, up to 4 crystal modules (Fader or Main) can control each virtual mixer slice (in the A__UHD Core). So, for example, if there are 8 virtual mixer slices, then these can support up to 32 crystal frames/modules.

For more information about how to configure crystal with a mc² system, please contact your local Lawo sales representative.

9.3 Configuration Steps

On the crystal side, each frame must be configured to operate in OSC control mode. This is done by opening a Web UI connection to the crystal frame and adjusting the parameters in the "System → Control" tab.

The Web UI can be reached by entering the current IP address. The default IPs are **192.168.101.242** (for a Main module), or **192.168.101.243** (for a Fader module).

Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.

Then open the "System → Control" tab and perform the following steps.

1. The **Module Control Mode** option (under "Control Functions") must be set to **OSC Control**.
2. Use the "OSC Control Interface" settings to configure the network communication to and from the OSC device.
   ◦ For the receive port, enter the port number (that will be used by crystal to listen for OSC messages).
   ◦ The two send ports can be used to transmit OSC messages to two separate devices. In each case, enter the IP address (of the external device) and a suitable port number.
3. The **Upload Firmware** button can be used to upload a new firmware to the module. At the end of the upload, the module reboots.

Providing everything is correctly configured, the crystal is ready to communicate with the OSC device. You can use the Web UI to change or modify the settings if you need.

To return to Power Core mode, set the **Module Control Mode** option back to **PowerCore Control** and then reboot.

10 crystal – Software Tools and Diagnostics

This chapter describes the tools available for fault finding and diagnostics.

- crystal – Software Revisions and Updates
- crystal – Restarting the System
- crystal – Web UI

10.1 crystal - Software Revisions and Updates

It is important that all system components are running the correct firmware. After downloading and installing a new version of ON-AIR Designer, you can check and update the system using the firmware update tool SoP Explorer.

For information about the current release, including the release notes and installers, please see Radio Products - Software Versions.

10.2 crystal - Restarting the System

This topic describes how to restart the system.

The crystal frame(s) and Power Core are restarted separately.

For the surface, there is a single **Restart System** option (for each crystal frame that connects via IP).

For Power Core, you can choose to perform either a warm or cold start which affects what is loaded after the reboot. A warm start returns to the latest settings (stored at shutdown), while a cold start loads the settings stored in the configuration.

How to Restart the Surface

The crystal frame(s) have no on/off switch and start automatically when power is applied. They can also be restarted remotely using the Web UI as follows.

1. Open a Web UI connection to the crystal Ethernet port.
2. Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
3. Select the **System → Control** tab and look for the **Reboot System** button (at the bottom of the "Control Functions" area).
4. Click on **Reboot System** (to reboot the frame's IP module).
5. During this time you will see the "boot-up" screen on the IP module and "Connection Lost" on all other modules (connected via CAN).
6. Once the reboot is complete, all modules refresh and the controls return to their former positions/state.

How to Restart Power Core

Power Core has no on/off switch and starts automatically when power is applied. The system can also be restarted remotely using the Web UI as follows.

1. Open a Web UI connection to the Power Core control port.
2. Log in as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.
3. Select the **System → Control** tab and look for the **Reboot (Coldstart)** and **Reboot (Warmstart)** buttons (at the bottom of the "Control Functions" area).

Reboot (Warm Start)

By default, the system performs a warm start whenever you apply power, press the recessed **RESET** button (on the front panel), choose **Reboot (Warmstart)** from the Web UI or type "sys_rb" into a Telnet session.

The boot-up progress is shown on the front panel:

1. First, the SYSTEM display and **STATUS** LED are black and unlit.
2. Then, the Lawo logo appears and the **STATUS** LED lights in white.
3. As soon as boot-up is complete, the **Welcome** page appears and the **STATUS** LED starts to blink; its color reflects the sync status.

If the **STATUS** LED does not start to blink, then the device has an internal problem. Please reboot the device (using the RESET button) as a first step.

At the end of the boot-up, Power Core loads the latest settings (stored at shut-down). This is known as the warm start data, and it means that the system returns to whatever the settings were at the last power off.

There are two exceptions: PTP parameters that have been edited using the Web UI and output stream parameters that are changed during runtime via Ember+. In this instance, the changes are not warm start persistent and the parameters reset to the values stored in the configuration.

Please note:

- If you perform a cold start, then the system ignores the warm start data and resets all settings to the default values stored in the configuration.
- If this is the first time you have powered the device "out of the box", then the system loads a very basic configuration that allows Power Core to boot. To get the system operational, you will need to upload the standard configuration or a custom configuration using the ON-AIR Designer.

Reboot (Cold Start)

As explained above, a cold start ignores the warm start data, and resets all internal logic states and audio parameters to the default values stored in the configuration.

A cold start happens automatically whenever you transfer a new configuration to Power Core (using ON-AIR Designer) or update its firmware (using SoP Explorer). It can also be triggered manually using the **Reboot (Coldstart)** button on the Web UI.

Reboot (Default Mode)

If Power Core boots in default mode, then it loads a very basic configuration stored on the SD card. This can be useful if the customer's configuration is stopping the system from booting (e.g. there is a loop in the ON-AIR Designer configuration and you need to exit out of the loop).

To activate default mode:

1. Press and hold the encoder on the front panel and, while holding, press the RESET button.
2. Once the Lawo logo appears, you can release the encoder - the device now boots up in default mode.
3. Once boot-up is complete, you can use SoP Explorer to reload all system firmware and ON-AIR Designer to transfer a different configuration.

10.3 crystal – Web UI

The **crystal Web UI** can be used to provide status information about the surface components and perform a number of administrative and diagnostic tasks.

It can be reached by entering the IP address or hostname of the crystal frame into a web browser (e.g. **192.168.101.242** or **.243** if the default IPs are in use). The computer you use must be connected to the same network as the crystal frame. For more information, see crystal – Configuration Tools and Opening a Web UI Session.

> ℹ️ If the surface has more than one frame connected via IP, then each frame's IP module has a different IP address. In this instance, you will need to open a separate Web UI session to each frame.

In User mode, information is displayed as "read-only" with no editable fields. If you wish to edit or access the permitted options, then you must login as either Supervisor or Administrator. The default passwords are *orion* for Supervisor and *hydra* for Administrator.

Once you have opened a connection and logged in, you will see the available pages/tabs. In the current release, there are six pages/tabs.
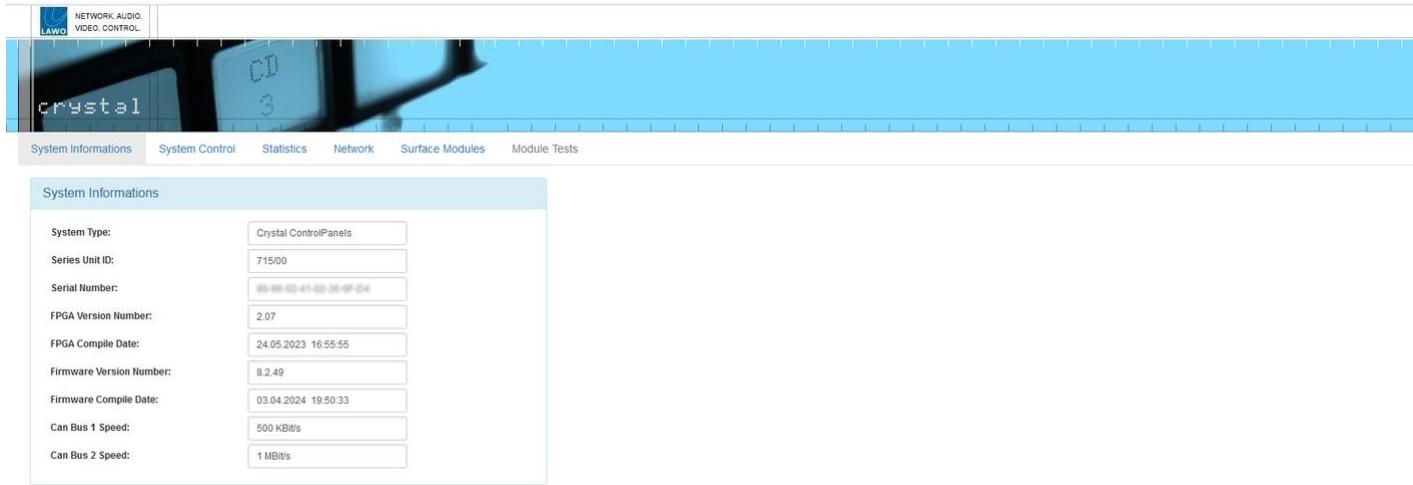
- System Information
- System Control
- Statistics
- Network
- Surface Modules
- Module Tests

Quick Links

The table below provides quick links to some of the most useful functions.

How to...	
Check the status of the surface modules.	Open the "Surface Modules" tab.
Test the keys, displays, faders and encoders.	Open the " Module Tests" tab.
Change the IP address of the frame's ETHERNET port	Edit the **IP Address** field in the " Network" tab.
Reboot the frame.	Press the **Reboot System** button in the "System Control" tab.
Reboot an individual module.	Press the **Reboot** button (for the module) in the "Surface Modules" tab.
Change the passwords (for Supervisor and Administrator)	Use the **Edit Access Passwords** area in the "System Control" tab.

System Information

The **System Information** tab is the first tab to be shown following a successful login. It displays basic information about the frame such as the serial number, software / firmware version numbers and speed of the two CAN bus connections. It is for diagnostic use only; there are no editable fields.

System Control

The **System Control** tab can be used to configure the device's external control options. For example, to define the mode of operation (Power Core or OSC), permit access via FTP, reboot the system, define the control interface settings and/or edit the passwords for the various user modes.

The options shown are determined by the current "Access Level". In User mode, this is the only section visible. In Supervisor mode, you will also see "Control Functions". In Administrator mode, there are more options in the "Control Functions" plus sections for the "Powercore Control Interface", OSC Control Interface", "WebUI Preferences" and "Edit Access Passwords".

Access Level

The current user mode is displayed in the **Actual Level** field.

To change the current access level, click on **Change** - this opens the Login screen. Select a different **Access Level** and enter the **Password**:

- **User** (no password required).
- **Supervisor** (default password = *orion*).
- **Administrator** (default password = *hydra*).

Now re-select the "System Control" tab to return to this page.

Control Functions

In Supervisor and Administrator modes, the "Control Functions" section becomes visible. Note that the **Enable FTP** option is only visible in Administrator mode.

- **Module Control Mode** - this option defines the mode of operation (or control mode). It can be set to either **PowerCore Control** or **OSC Control**. The current value determines which "Control Interface" parameters are used.
- **Suppress restart messages** - by default, an on-screen message appears whenever the surface restarts. You can turn the messages off by selecting this option.

- **Enable FTP** - by default, this option is turned on to allow file transfers to the surface via FTP. Turn this option off to prevent FTP access.

The **Reboot System** button at the bottom of this area can be used to reboot the frame's IP module. During this time you will see the "boot-up" screen on the IP module and "Connection Lost" on all other modules (connected via CAN). Once the reboot is complete, all modules refresh and the controls return to their former positions/state.

Power Core Control Interface

In Administrator mode, the "Powercore Control Interface" section becomes visible. These parameters define the IP connection to Power Core (as described <u>earlier</u>).

To use these parameters, the **Module Control Mode** must be set to **PowerCore Control**.

OSC Control Interface

In Administrator mode, the "OSC Control Interface" section becomes visible. These parameters define the IP connection to the device you wish to control (via OSC).

To use these parameters, the **Module Control Mode** must be set to **OSC Control**.

Web UI Preferences

In Administrator mode, the "Web UI Preferences" section becomes visible. These options adjust what is shown in the browser's "title" for the Web UI session. If nothing is selected, then the page address (URL) is shown. Any changes take affect after a refresh of the browser page.
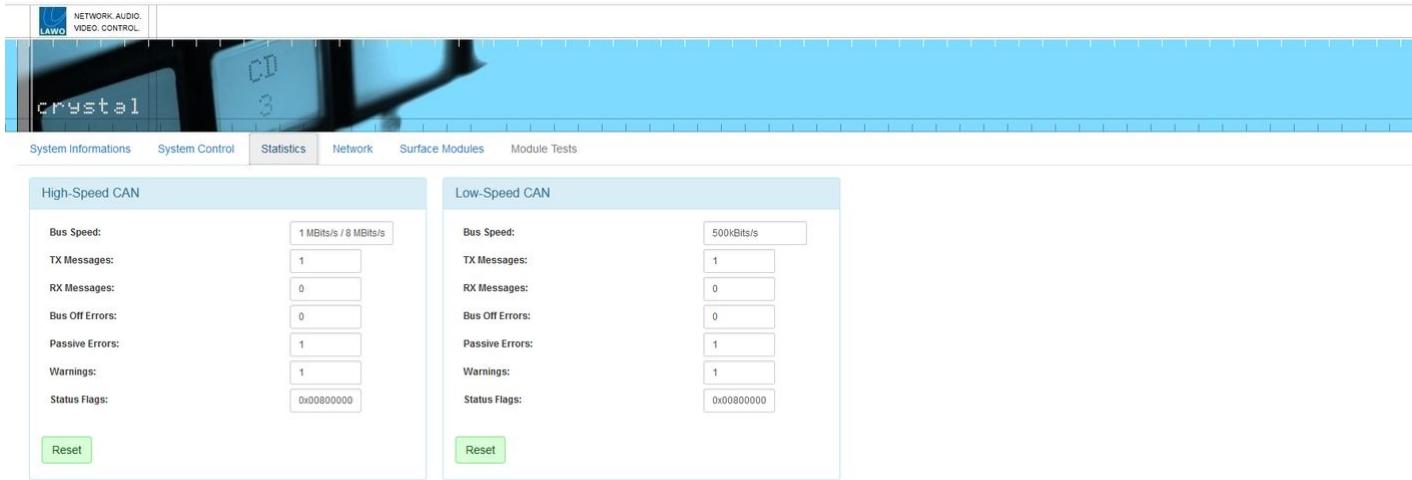
Edit Access Passwords

In Administrator mode, the "Edit Access Passwords" section becomes visible.

This area can be used to edit the passwords for the Supervisor and Administrator modes in the Web UI, and/or the device's Telnet login. In each case:

- Enter the current password into the "Recent Password" field, followed by the new password into the two "New Password" fields.
- The new password must meet the following requirements: minimum of 5 characters; maximum of 16 characters; permitted character range: ASCII 32..127.
- Click on **Submit** to apply the changes - an on-screen message appears to confirm (or deny) the operation.

Statistics

The **Statistics** tab shows information about the CAN bus. It can be used to analyse the number of messages sent and received, and if there are any TX or RX problems.

To reset all of the message/error/flag counters to zero, click on the **Reset** buttons at the bottom of the page.

Network

The **Network** tab provides access to the network settings for the frame's ETHERNET port.

Network Device

This section displays the port's Host Name (defined by the ON-AIR Designer configuration) and MAC address, plus the network IP Address, Network Mask and Gateway (if used). The Link Speed and State show the speed of the connection and its current status (up or down).
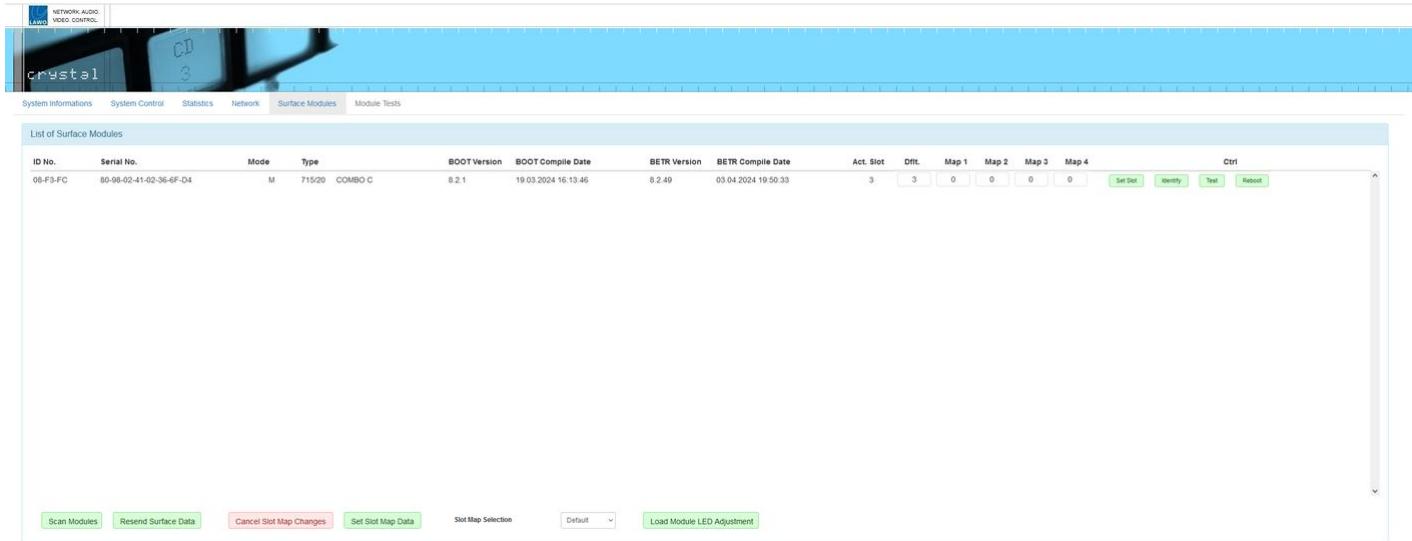
In User mode, all fields are non-editable. In Supervisor or Administrator mode, you can enter a new IP Address, Network Mask and/or Gateway. If any settings are changed, you must click **Apply** to save the changes. IP Address changes are made immediately and so you will lose your browser connection once the settings are applied. To continue with the system administration, enter the device's new IP address into your browser and login again (from the Login screen).

Network Settings

Using the fields in this area, you can enter the Domain Name of your network and DNS Name Server IP Addresses, plus the settings for your network's NTP server. As above, remember to click **Apply** to save the changes.

To configure a NTP server, either enter its name in the Server Name box, or its IP Address in the Server Address box. If you type "ntp.internal" in the Server Name box, the IP Address will be automatically filled.

Surface Modules

The **Surface Modules** tab lists all of the modules fitted to the surface and their firmware versions. The important fields are as follows.

Mode - can be either M or S:

- M - identifies the master module (connected to Power Core via IP).
- S - identifies the slave modules (connected, externally, via CAN).

Act. Slot - shows the module's active slot ID. This is important as it determines the functionality of the module (as described here).

The active slot ID can be changed either, permanently, by editing the **Dflt** (default) value or, temporarily, by loading one of the alternate mappings (**Map 1** to **4**). How to do this is described in crystal - Slot IDs.

Identify - click to identify a module - the top left button on the module flashes three times.

Test - opens the "Module Test" tab.

Reboot - reboots the module.

Module Tests

The **Module Tests** tab can be used to test the components on a module.

Module - enter a slot number to choose a module.

Keys/LEDs - click on a key to light its LED; click on **Test all LEDs** to light all keys; click on **AutoTest** to start the auto test sequence.

TFT Displays - click on an option to display an image on the module's displays.

Faders - choose either **From Panel** or **To Panel** to set the direction and then perform the test. For example:

- From Panel + move a fader on the surface = the on-screen fader should follow.
- To Panel + click Start / Stop = the fader on the surface should open / close.

You can use **Auto Test** or **Calibrate** to start the auto test sequence or fader calibration.

Incremental Encoders - works in a similar manner to the faders.

11 crystal - Service Procedures

This chapter describes the service procedures available for the crystal control surface.

> ⓘ The service procedures for Power Core are covered separately in the "Power Core - User Manual" (available here).

- crystal - Using the Service Procedures
- crystal - Replacing a Control Surface Module

11.1 crystal - Using the Service Procedures

This topic describes how to use the service procedures.

We recommend that you read each topic in full before starting a procedure.

> ⚠️ **(E) WARNING**
>
> Please read and observe ALL of the Lawo - Important Safety Instructions BEFORE installing or servicing any component.

> ⚠️ **(F) AVERTISSEMENT**
>
> Veuillez lire et respecter TOUTES les consignes de sécurité importantes AVANT d'installer ou d'entretenir un composant.

Mechanical drawings and data sheets (including weights and dimensions) are available from the Lawo Download-Center (after login).

The following procedures are covered in this chapter.

- crystal - Replacing a Control Surface Module

If you need further assistance, the Lawo Support Department can be contacted by email at support@lawo.com, or by telephone during normal working hours - please visit the Support area of the Lawo website for the most up-to-date contact details.
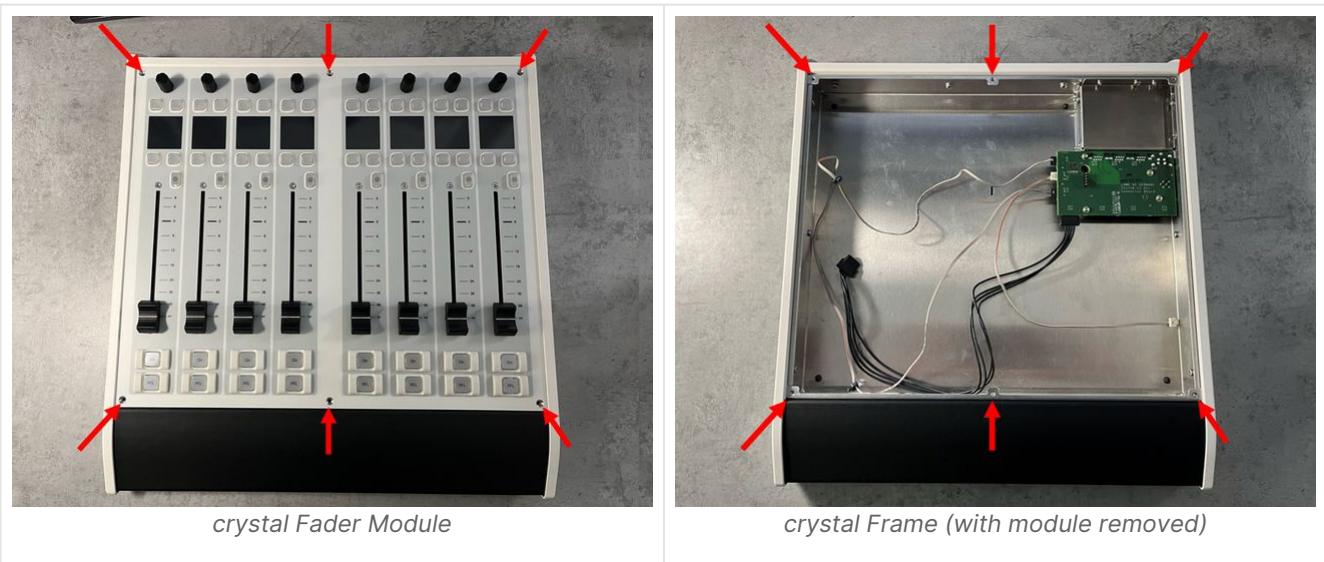
11.2 crystal - Replacing a Control Surface Module

This topic describes how to exchange a crystal control surface module. The same instructions can be applied to a Fader or Main module. In the example below, a Fader module is shown.

If you need to exchange a VX module, then this can be done using the instructions in <u>crystal - Mounting a VX Module</u>.
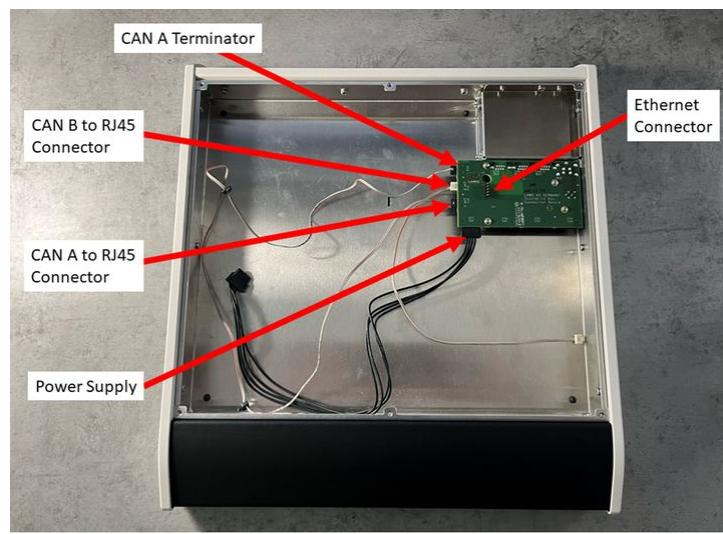
Overview

The control surface module is held in place by six screws that fix to the frame housing:

crystal Fader Module

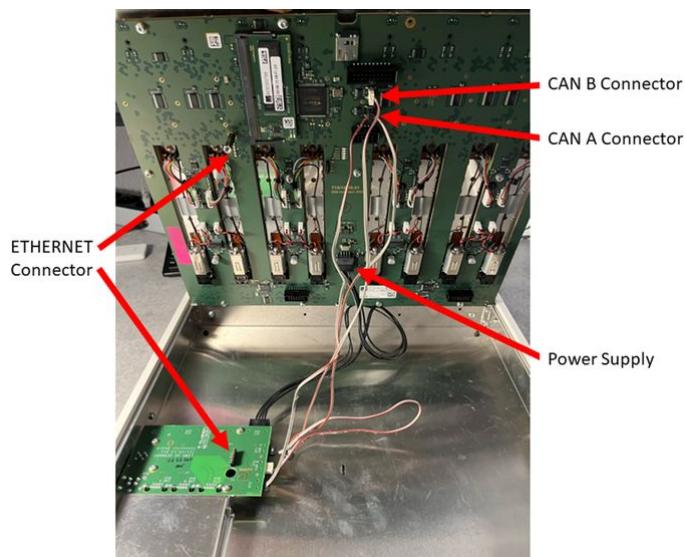

crystal Frame (with module removed)

Internally, the module connects to the frame's connector board using three wired connectors (1x power and 2x CAN) and a plugin connector (1x ETHERNET).

The image below shows the connector board components.

The image below shows the connections from the module to the connector board. In this view, the surface is rotated by 180 degrees and the module is lifted.

To exchange a module, you must loosen the fixing screw(s), lift the module and unplug the connectors. Then fit the replacement module in the reverse order.

What you will need

- 1 x Torx10 driver.
- 1 x replacement module, either Fader or Main (any type) - ordered using the part numbers listed here.

Instructions

Please read the following important safety information and then follow the step-by-step instructions.

> ⚠️ **(E) WARNING**
>
> Please read and observe ALL of the Lawo - Important Safety Instructions BEFORE installing or servicing any component.

> ⚠️ **(F) AVERTISSEMENT**
>
> Veuillez lire et respecter TOUTES les consignes de sécurité importantes AVANT d'installer ou d'entretenir un composant.
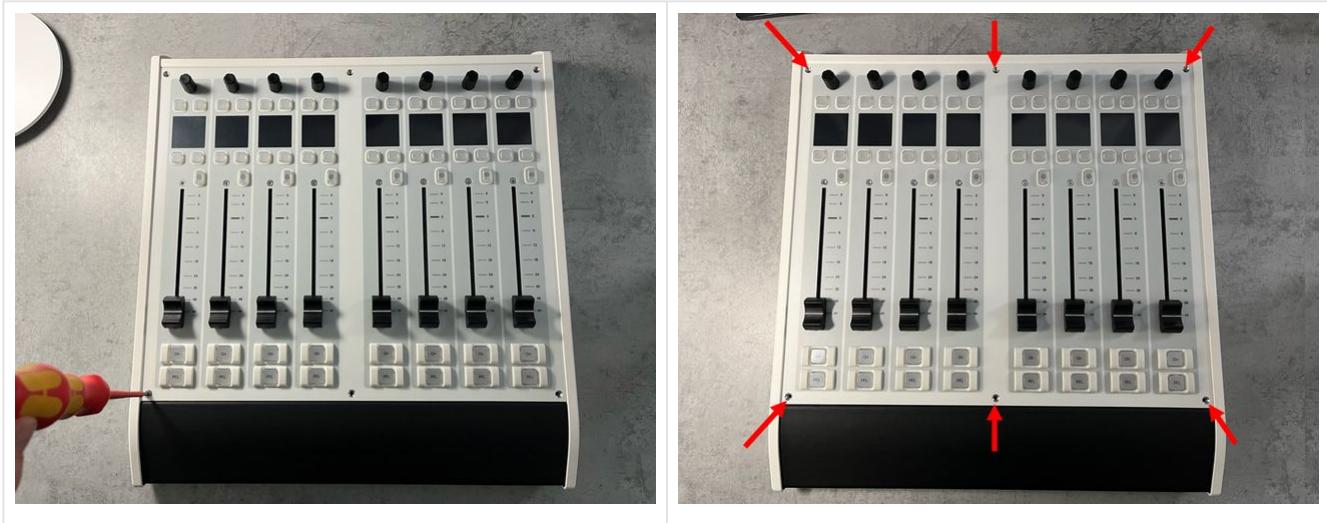
> ⚠️ **(E) CAUTION**
>
> For safety reasons, the frame must be populated with either a Fader or Main module (and not operated with an empty slot).

1. Power off and disconnect the surface.

- To power off, turn off the mains input to the external power supply.
- Then remove all cables from the connector board (at the rear of the frame).
- If the frame is fitted with a VX module, then this does not need to be removed, but should be powered off (by turning off the mains input to the VX power supply).
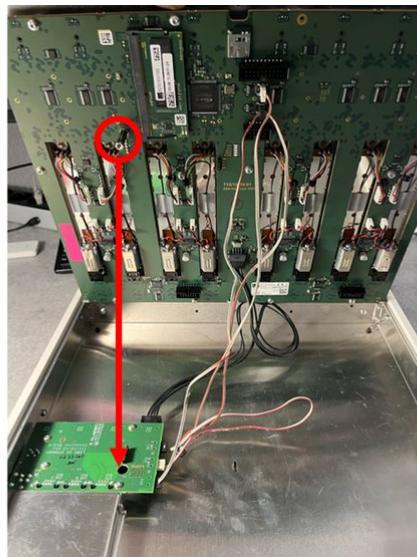
2.   Remove the screws that secure the module to the frame.

- There are 6 screws positioned along the top and bottom edges of the module: M3 x 5mm.
- You should use a Torx T10 driver for this purpose.
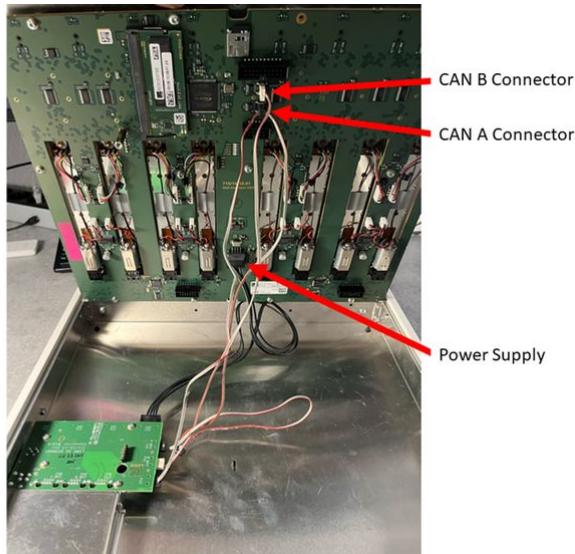- Take care to store the screws safely.

3.   From behind the frame, carefully lift the module (to reveal the connectors).

- You can use the rotary controls to help get a good grip.
- Take care not to crush any of the cables.
- The screw beside the Ethernet connector should slide out of the hole in the frame's connector board (to release the plugin connector).

4. Disconnect the module's connectors.

- There are three internal connector to unplug: 1x power and 2x CAN bus.
- For the CAN bus, take note of which cables are for CAN A and CAN B.

5. Remove the module from the frame.

- Carefully remove the module by lifting it out of the frame.
- Lay the module face-down on a piece of foam, or similar ESD-proof protective material, away from the console.

6. Fit the replacement module in the reverse order.

- Take the new module out of its packaging and lay it down on a piece of foam, or similar ESD-proof protective material, beside the console.
- Taking care not to crush the cables, position the module in the frame.
- From the rear, lift the module and plug in the wired connectors: 1x power and 2x CAN bus.
- Carefully lower the module into position.

Important: It is important that the screw beside the Ethernet connector slots through the hole in the connector board (to ensure that the Ethernet connection is correctly made).

7. Replace all of the fixing screws and tighten them securely.

- Tightening the screws ensures that the module's Ethernet connection to the connector board is secure.

8. Reconnect the external cabling and test the operation.

- Connect the cables to the rear connector board.
- Turn on the mains input to the external power supply.

What happens next is explained in crystal - Powering On.

12 crystal - Data and Specifications

This chapter contains data to work with such as specifications, drawings and schematics.

- crystal - Part Numbers
- crystal SC - Specification
- crystal - Technical Specification

Mechanical drawings and data sheets (including weights and dimensions) are available from the Lawo Download-Center (after login).

Please use the crystal - Part Numbers to locate the correct information.

12.1 crystal - Part Numbers

The tables below list the part numbers for the crystal surface and Power Core.

crystal Surface		Part Number	Description
Frames	crystal Tabletop Frame Light	715/30-10	Frame only; no modules.
	crystal Tabletop Frame Dark	715/30-30	
	crystal Tabletop Frame with VX Light	715/31-10	
	crystal Tabletop Frame with VX Dark	715/31-30	
	crystal Countersunk Frame Light	715/30-20	
	crystal Countersunk Frame Dark	715/30-40	
	crystal Countersunk Frame with VX Light	715/31-20	
	crystal Countersunk Frame with VX Dark	715/31-40	
Modules	crystal Main Module Light	715/20-L	6 fader strips + central controls
	crystal Main Module Dark	715/20-D	
	crystal Fader Module Light	715/10-L	8 fader strips
	crystal Fader Module Dark	715/10-D	
	crystal VX Module Light	711/30	touch-screen display
	crystal VX Module Dark	711/30-D	
Accessories	DC power supply	485-1209-000	for crystal frame or VX module
	Virtual Extension Stand Alone	711/33	touch-screen display (in its own frame)

Power Core		Part Number	Description
Frames	Main frame (revision 3)	710/13	See Power Core - Hardware Revisions.
	Main frame (revision 2)	710/11	See Power Core - Hardware Revisions.
I/O Cards	MIC / LINE IN	710/20	8 x mono mic/line in
	LINE IN	710/25	4 x stereo line in
	LINE OUT	710/30	4 x stereo line out
	STUDIO I/O	710/35	2 x mono mic/line in 1 x stereo line out 2 x stereo headphones out
	AES3 I/O	710/41	4 x stereo AES3 inputs with SRC 4 x stereo AES3 outputs Bit-transparent
		710/40	as for 710/41 but without bit transparency. This card is discontinued; existing cards can be replaced with the 710/41.
	AES3id I/O	710/42	as for 710/41 but with HD-BNCs
	MADI I/O	710/50	2 x MADI ports (64 I/O channels per port); can be configured for dual-redundant operation.
	MADI SRC I/O	710/60	1 x MADI port (64 I/O channels with SRC)
	DANTE I/O	710/55	2 x DANTE ports, dual-redundant (64 I/O with SRC)
	GPIO	710/80	8 x GPI (optocouplers) 8 x GPO (silent and self-healing relays) 2 x VCA (voltage-controlled inputs)
Software Licenses	RAVENNA Plus (RAV+) Add-on License	250-7130-000	See Power Core - Licensed Feature Sets.
Accessories	SFP modules	981/60-xx	See Power Core - SFP Transceivers.
	DC power supply	955/50-80	See Power Core - Power Supplies.
Spare Parts	USB dongle	250-5998-000	1 x LAWO USB dongle for Power Core.
	Replacement screws for I/O card	271A0106-000	2 x screws for new type I/O card/cover plate. See Power Core - Replacing an I/O Card.

12.2 crystal SC - Specification

This topic describes the specification of the crystal standard configuration. It applies when operating with Power Core.
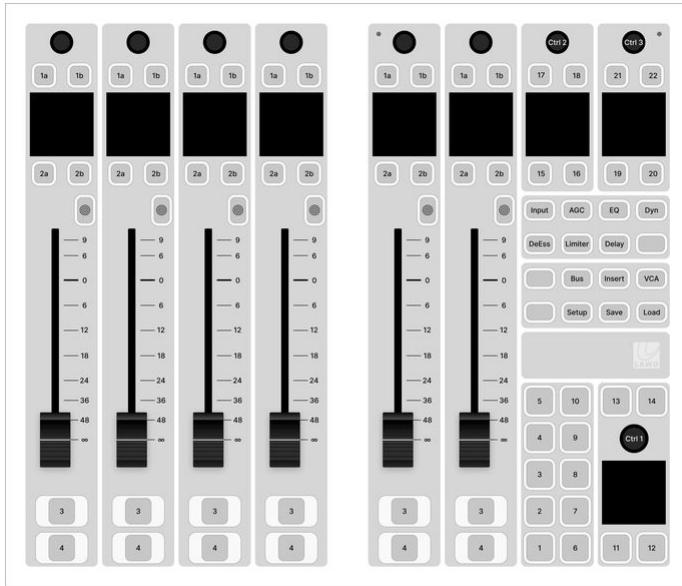
Metering

Version 1.0 of the standard configuration is compliant with EBU meters and levels. Other variants will follow to support SMPTE and other regions. The table below describes the relevant parameters.
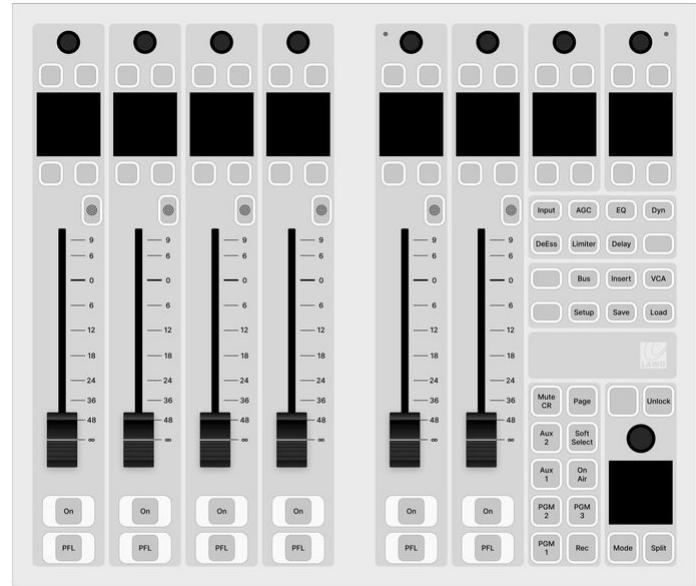
Standard Configuration, Version 1.0	Europe	North America
Standard	EBU	SMPTE
PPM meter scale	dBFS	dBFS
PPM mark low	-18	-20
PPM mark high	-9	-3 (+17 dBR)
Loudness meter (channel, access and slots)	LU EBU +9 (short)	LU EBU +9 (short)
Loudness value LUFS (slots)	LUFS -23 (integrated)	LUFS -23 (integrated)
Relative System level (OAD)	-36	-38
Analog Ref Level (OAD)	18	24
Operating Level (analog)	0 dBU	+4 dBU
Operating Level (digital)	-18 dBFS	-20 dBFS

MF Key Labels

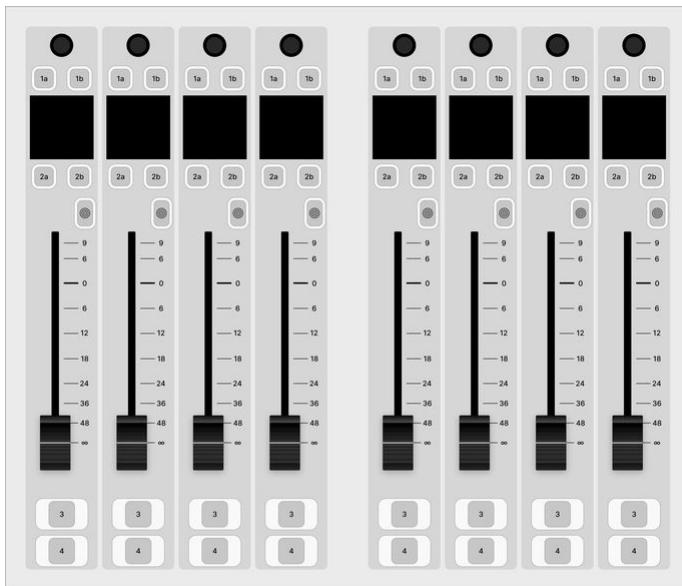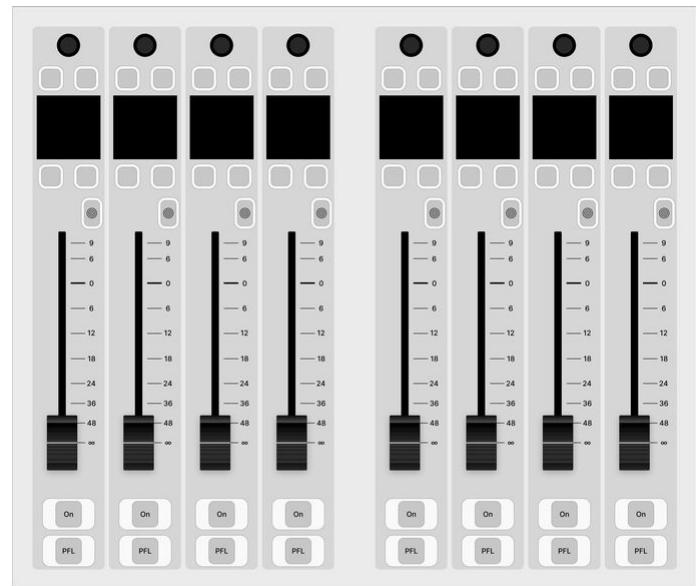**crystal Main module**

MF Key Numbering

Standard Configuration Labels

crystal Fader module

MF Key Numbering

Standard Configuration Labels

12.3 crystal - Technical Specification

This topic provides technical data for the crystal control surface.

- crystal Frame
  - Dimensions
  - Weight
  - Power
  - Environmental Specifications

Additional information can be found in the **crystal datasheet** available from the Lawo Download-Center (after login).

crystal Frame

Dimensions

- Modules (Main and Fader): 336mm (w) x 286mm (d)
- Tabletop frame (without VX): 352mm (w) x 383mm (d) x 53mm (h)
- Tabletop frame (with VX): 352mm (w) x 493mm (d) x 216mm (h)
- Countersunk frame (without VX), above/below desk: 352/345mm (w) x 307/293mm (d) x 14/43mm (h)
- Countersunk frame (with VX), above/below desk: 352/345mm (w) x 434/399mm (d) x 172/43mm (h)
- End-plates for counter-sunk mounting: 10mm each

See crystal - Installing the Frame for mechanical drawings.

Weight

From 3.3 kg to 4.6 kg, depending on the frame and module type. Please refer to the **crystal datasheet** for specific information.

Power

External DC power supply (Article Number: **485-1209-000**).

- General description: PSU desktop, ATS050T-P120; LPS 12VDC / 3,3A
- Max power: 40W
- Input Connector: IEC (country-specific).
- Input Voltage: 100-240V, 50-60Hz
- Input Current: 1,2A
- Output Connector: Kycon KPJX-4S-S
- Output Voltage: 1x 12V DC (nominal)
- Output Current: 3,3A (max.)
- Indicators: 1x status LED (power applied)

Environmental Specifications

- Ambient temperature: 0°C to +40°C
- Relative humidity: < 85% non-condensing
- Dissipating power of frame without VX module (excluding PSU): < 40W
- Dissipating power of VX module (excluding PSU): < 10W