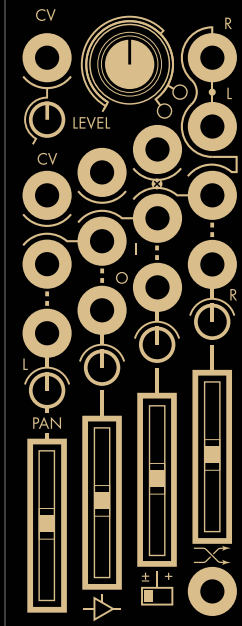
INSTRUO | SPECIALIST SYNTHESIZERS



càrn

Utility Mixer

User Manual

Contents

3
Description / Features

4
Installation / Specifications

5
Overview

6
Channels

10
Inputs & Outputs

13
Limiter

14
Normalling

15
AC/DC Coupling

16
Expansion

17
Patch Examples

- Voltage Controlled Panning
- Traditional VCA
- Ring Modulation
- Crossfader
- Stereo Audio Mixer
- Mono Control Voltage Mixer
- Unbalanced Amplitude Modulation

24
A Message from the Developer

Description

At its core, the Instruō **càrn** is a four channel signal processing utility with distinct functionality and individual outputs per channel. It is optimised for both audio and control voltage signals and offers a voltage-controlled panner with constant power panning, a VCA, a ring modulator, and a signal crossfader – all housed within a compact stereo mixer format.

As a mixer, **càrn** can function as a traditional end-of-chain summing stage with a built-in stereo VCA. It can also seamlessly expand to related stereo Instruō modules via its pair of stereo back jacks and included low profile stereo cable. **càrn** includes an optional stereo limiter that is perfect for everything between gentle signal softening to saturated drum bus distortion.

Whether you need a feature-dense signal processor, a hyper-compact summing mixer, or a soft-clipping signal mangler, **càrn** will meet the challenge.

Features

- AC & DC coupling options for audio and CV mixing
- Voltage-controlled constant power panning
- Two-quadrant linear VCA
- Four-quadrant VCA (Ring modulation)
- Final stage stereo VCA
- Signal crossfading
- Individual channel outputs with normalling options
- On-board limiting
- Back jack connectivity for expansion

Installation

1. Confirm that the Eurorack synthesizer system is powered off.
2. Locate 8 HP of space in your Eurorack synthesizer case.
3. Connect the 10 pin side of the IDC power cable to the 2x5 pin header on the back of the module, confirming that the red stripe on the power cable is connected to -12V.
4. Connect the 16 pin side of the IDC power cable to the 2x8 pin header on your Eurorack power supply, confirming that the red stripe on the power cable is connected to -12V.
5. Mount the Instruō **càrn** in your Eurorack synthesizer case.
6. Power your Eurorack synthesizer system on.

Note:

This module has reverse polarity protection.
Inverted installation of the power cable will not damage the module.

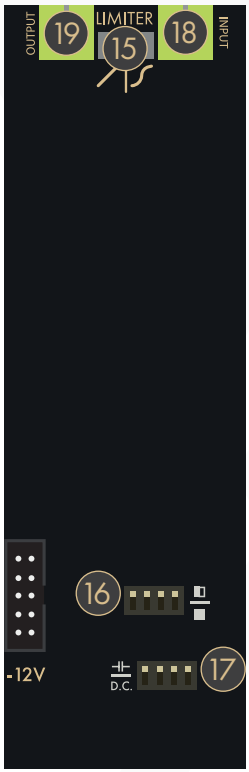
Specifications

- Width: 8 HP
- Depth: 27mm
- +12V: 180mA
- -12V: 180mA

càrn | ka:rnʲ | **verb** (structural) to gather, bring together, or accumulate piece by piece

Front

Back



Key

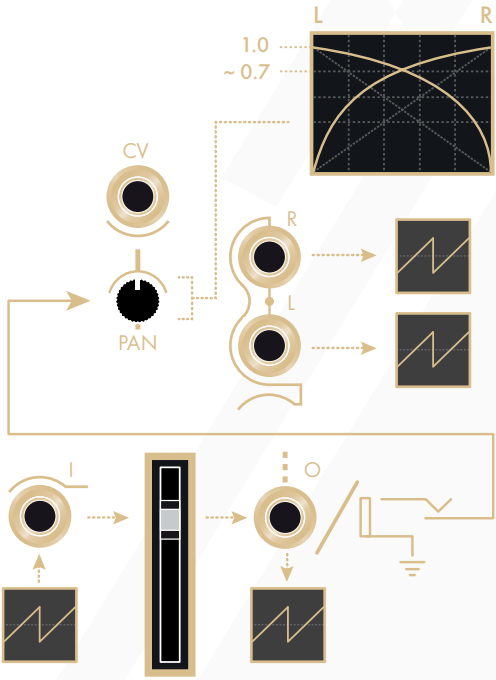
1. Channel 1
2. Channel 2
3. Channel 3
4. Channel 4
5. Primary Inputs
6. Secondary Inputs
7. Faders
8. Polarity Switch
9. Mono Outputs
10. Pans
11. Stereo Outputs
12. Level
13. Level CV Input
14. Level CV Attenuator
15. Limiter Switch
16. Normalling Switches
17. AC/DC Coupling Switches
18. Stereo Input Back Jack
19. Stereo Output Back Jack

Channels

Each channel of **càrn** functions in a unique and specific way offering four parallel complementary features.

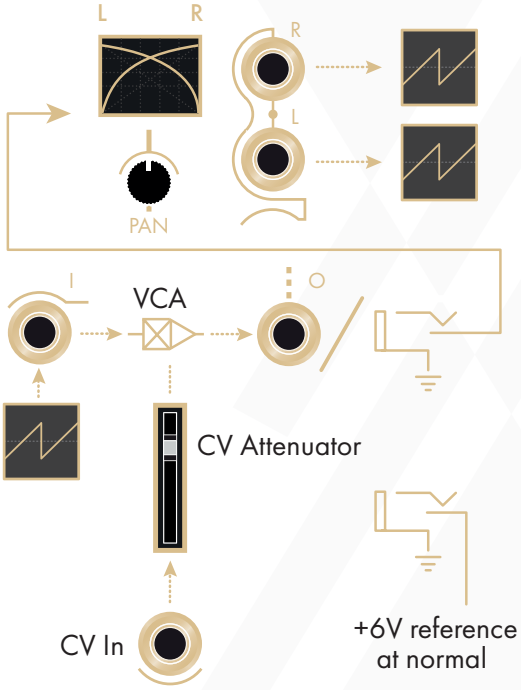
Channel 1: Functions as a mono attenuator and channel of the stereo output with voltage-controlled panning capability.

- **Channel 1** can be used for slow automated animation across the stereo field, as well as pan modulation into full range audio rates.
- The voltage-controlled panning circuitry closely matches standard equal loudness contours which results in a consistent perceived loudness of audio as it's placed across the stereo field via control voltage.



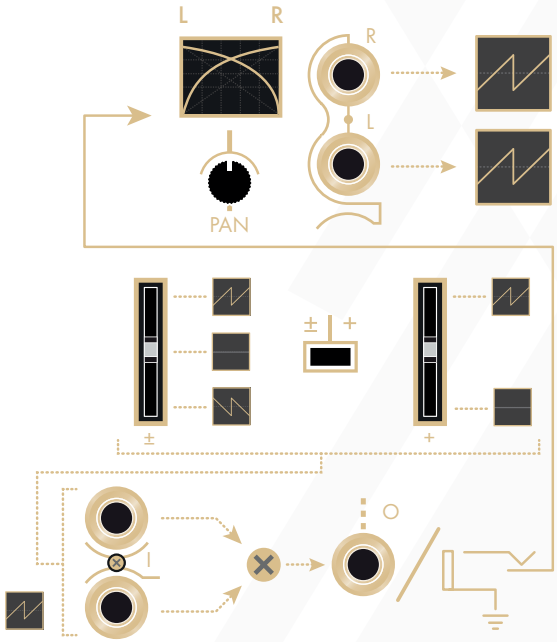
Channel 2: Functions as a traditional linear two-quadrant VCA and channel with panning functionality to the stereo output.

- **Channel 2** can be used for traditional amplitude modulation using unipolar positive control voltage.
- The panning circuitry features equal loudness contours which results in a consistent perceived loudness of audio as it's placed across the stereo field.



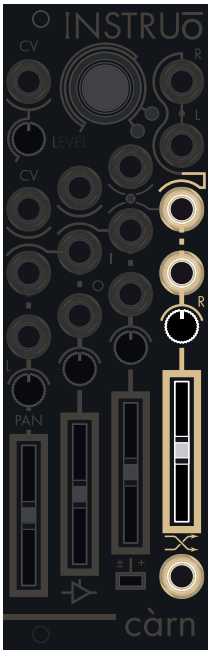
Channel 3: Functions as a four-quadrant VCA and channel with panning functionality to the stereo output.

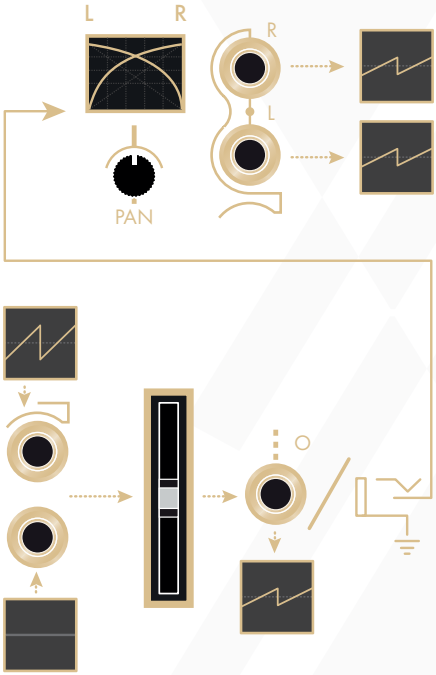
- **Channel 3** can be used for balanced amplitude modulation/signal multiplication, typical of a traditional ring modulator.
- The fader can be used as a unipolar positive attenuator or a bipolar attenuverter.
- The panning circuitry features equal loudness contours which results in a consistent perceived loudness of audio as it's placed across the stereo field.



Channel 4: Functions as a crossfader between two inputs and a channel with panning functionality to the stereo output.

- **Channel 4** can be used as a signal attenuator or as a crossfader which can mix between two signals.
- The panning circuitry features equal loudness contours which results in a consistent perceived loudness of audio as it's placed across the stereo field.





Inputs & Ouputs

Primary Inputs: The **Primary Inputs** are individual inputs for each of the **càrn**'s unique utility/mixer channels.

- **Channel 1** includes a signal input for the attenuator utility and/or mixer channel to the stereo output.
- **Channel 2** includes a carrier signal input for the two-quadrant VCA utility and/or mixer channel to the stereo output.
- **Channel 3** includes a carrier signal input for the four-quadrant VCA utility and/or mixer channel to the stereo output.
- **Channel 4** includes a primary signal input for the crossfader utility and/or mixer channel to the stereo output.

Secondary Inputs: The **Secondary Inputs** are individual multi-purpose inputs for each of the **càrn**'s unique utility/mixer channels.

Channel 1 includes a bipolar control voltage input for the pan parameter.

- Control voltage sums with the knob position.

Channel 2 includes a unipolar positive modulator input, typical of a traditional two-quadrant VCA.

- Control voltage is scaled by the **Channel 2 Fader**.
- If no signal is present at the **Channel 2 Secondary Input**, it is normalled to a +6V reference signal.

Channel 3 includes a bipolar modulator input, typical of a traditional four-quadrant VCA.

- Signal present at the **Channel 3 Secondary Input** is summed with the **Channel 3 Fader** position.

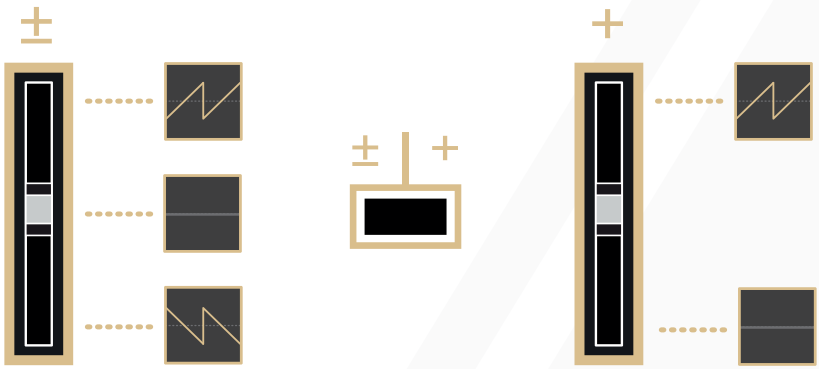
Channel 4 includes a secondary signal input which crossfades with the signal present at the **Channel 4 Primary Input**.

Faders: The **Faders** are individual multi-purpose level controls for each of the **càrn**'s unique utility/mixer channels.

- The **Channel 1 Fader** scales the signal present at the corresponding **Primary Input**. This fader has an audio taper response curve.
- The **Channel 2 Fader** scales the signal present at the corresponding **Secondary Input**. This fader has an audio taper response curve.
- The **Channel 3 Fader** produces a unipolar positive or bipolar offset which sums with the signal present at the corresponding **Secondary Input** (See the **Polarity Switch** section for more information). This fader has an audio taper response curve.
- The **Channel 4 Fader** crossfades between the signals present at the corresponding **Primary** and **Secondary Inputs**. This fader has a linear taper response curve.

Polarity Switch: Channel 3 includes a **Polarity Switch** which changes the range of the **Channel 3 Fader's** offset.

- If the switch is in the left position, the range of the **Fader** is bipolar and sums with the signal present at the **Channel 3 Secondary Input**.
- If the switch is in the right position, the range of the **Fader** is unipolar positive and sums with the signal present at the **Channel 3 Secondary Input**.



Mono Outputs: The **Mono Outputs** are individual outputs for each channel

- If **càrn** is set to **Half Normalled**, then connecting from a **Mono Output** will break the connection to the **Stereo Output** (post fader, pre pan).
- If **càrn** is set to **Normalled**, then connecting from a **Mono Output** will maintain the connection to the **Stereo Output**.
- See the **Normalling** section for more information.

Pans: The **Pan** knobs are individual pan controls for each of **càrn**'s unique utility/mixer channels.

Stereo Outputs: The **Stereo Outputs** are the summed post fader, post pan outputs of all four channels.

Level: The **Level** knob determines the amplitude of the **Stereo Outputs**.

- Turning the knob anticlockwise will decrease the output amplitude.
- Turning the knob clockwise will increase the output amplitude.

Level CV Input: The **Level CV Input** is a bipolar control voltage input for the **Level** parameter.

- Control voltage is summed with the **Level** knob position and scaled by the **Level CV Attenuator**.

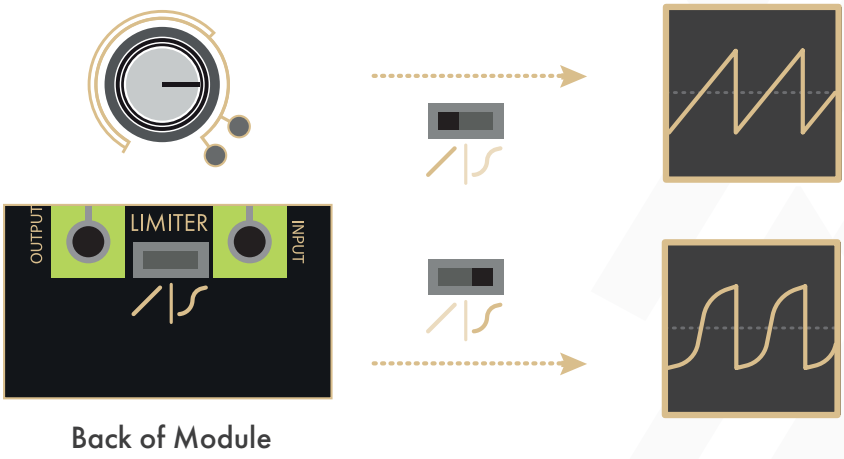
Level CV Attenuator: The **Level CV Attenuator** determines the depth of external CV modulation applied to the **Level** parameter.

- Turning the knob anticlockwise will decrease the depth of amplitude modulation.
- Turning the knob clockwise will increase the depth of amplitude modulation.

Limiter

Limiter Switch: There is a **Limiter Switch** on the back side of **càrn** that engages a global limiter for the **Stereo Outputs**.

- If the switch is set to the left, the limiter is disengaged and the signal present at the **Stereo Outputs** will be linear, regardless of the setting of the **Level** knob.
- If the switch is set to the right, the limiter is engaged, and the signal present at the **Stereo Outputs** will be limited by a stereo analogue soft clipping circuit.

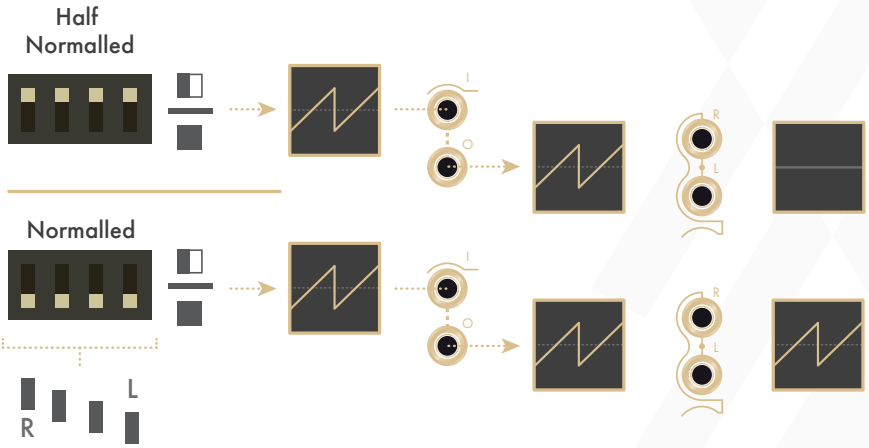


Back of Module

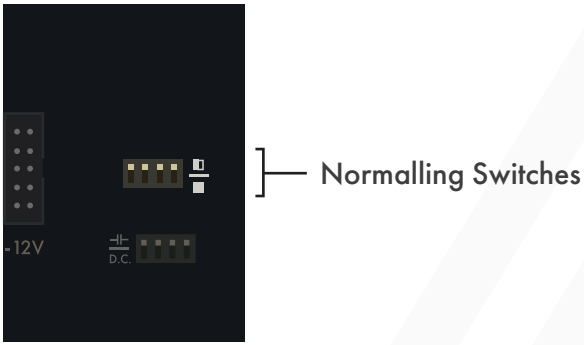
Normalling

Normalling Switches: There is a set of four dip switches on the back side of **càrn** that will set the individual normalling setting of each channel.

- If a **Normalling Switch** is set to its upward position, the corresponding channel is set to **Half Normalled**. This means that connecting from a **Mono Output** will break the connection to the **Stereo Output** (post fader, pre pan).
- If a **Normalling Switch** is set to its downward position, the corresponding channel is set to **Normalled**. This means that connecting from a **Mono Output** will maintain the connection to the **Stereo Output**.



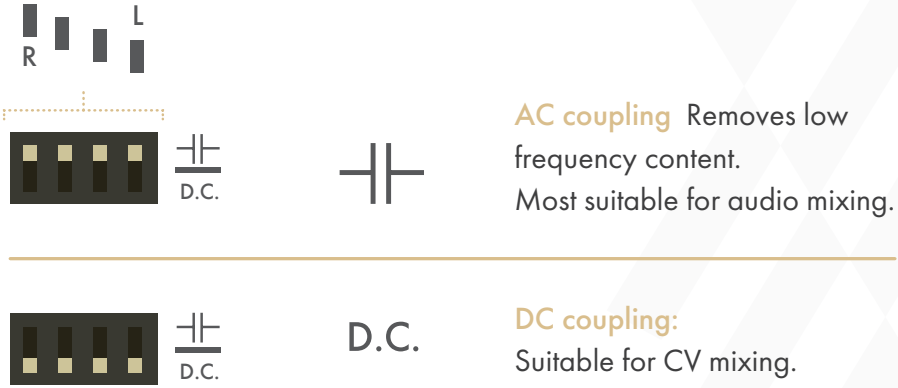
Back of Module



AC/DC Coupling

Coupling Switches: There is a set of four dip switches on the back side of **càrn** that will set the individual coupling setting of each channel.

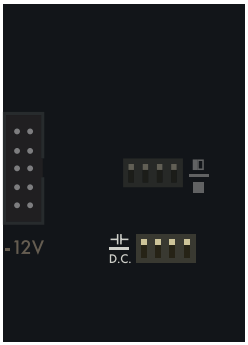
- If a **Coupling Switch** is set to its upward position, the corresponding channel is set to **AC Coupled**. This setting removes DC offsets from signals and is most suitable for audio mixing.
- If a **Coupling Switch** is set to its downward position, the corresponding channel is set to **DC Coupled**. This setting maintains DC offsets in signals and is most suitable for control voltage mixing.



AC coupling Removes low frequency content.
Most suitable for audio mixing.

DC coupling:
Suitable for CV mixing.

Back of Module



Coupling Switches

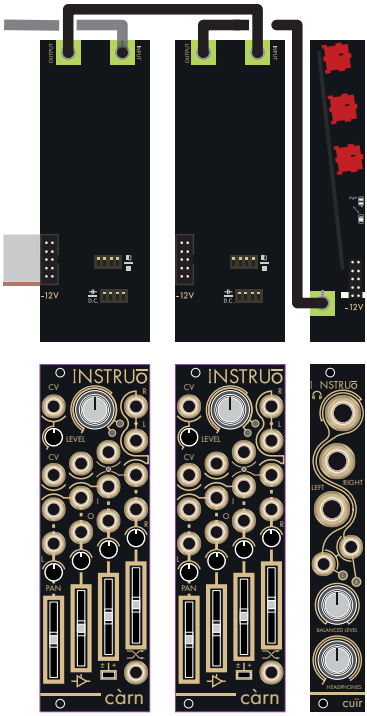
Expansion

Stereo Input Back Jack: The **Stereo Input Back Jack** is an external stereo input mounted to the back of **càrn**.

- Modular level stereo output jacks mounted on the back of secondary modules can be connected to **càrn** via an 1/8" (3.5mm) stereo cable.
- Inputs are 100KΩ impedance and sum at unity gain with the stereo mix of the receiving **càrn** at the **Stereo Output.**

Stereo Output Back Jack: The **Stereo Output Back Jack** is an external stereo output mounted to the back of **càrn**.

- Modular level stereo input jacks mounted on the back of secondary modules can be connected to **càrn** via a 1/8" (3.5mm) stereo cable.

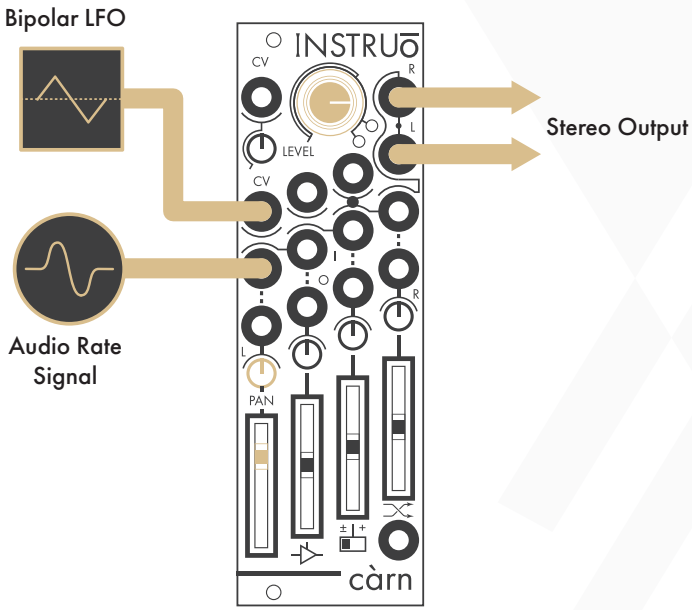


Stereo cable included for chaining modules.

Patch Examples

Voltage-Controlled Panning:

Summary: A signal is connected to **Channel 1** while a bipolar LFO controls the signal's placement within the stereo field.



Audio Path:

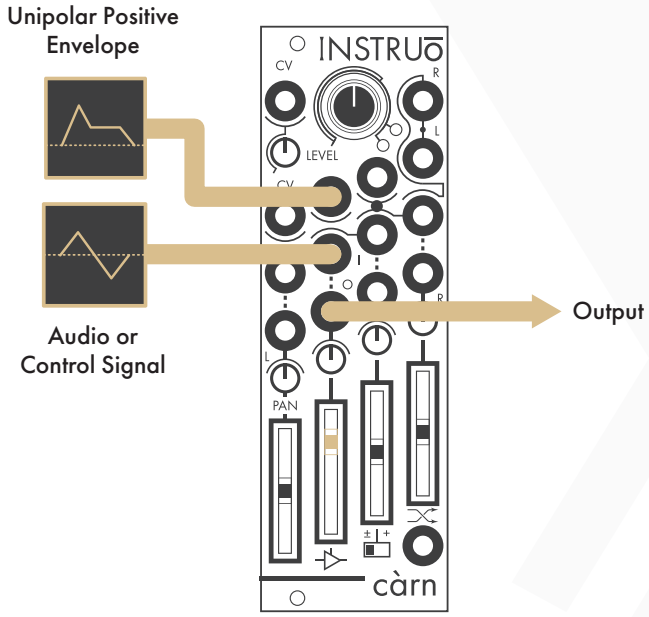
- Connect an audio rate signal to the **Primary Input** of **Channel 1**.
- Monitor the **Stereo Outputs**.
- Set the **Level** knob to a desired position.
- Set the **Fader** to just under its maximum position.
- Set the **Pan** knob to its centre position.

Control Path:

- Connect a bipolar LFO signal to the **Secondary Input** of **Channel 1**.

Traditional VCA:

Summary: A signal is connected to **Channel 2** and is amplitude modulated by a secondary unipolar positive signal.



Audio Path:

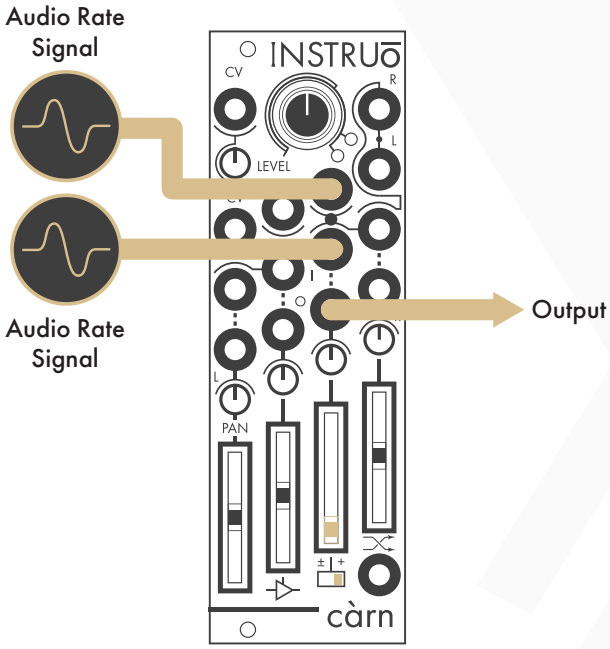
- Connect a bipolar or unipolar positive signal to the **Primary Input** of **Channel 2**. This is considered the carrier signal.
- Monitor the **Mono Output** of **Channel 2**.

Control Path:

- Connect a unipolar positive envelope signal to the **Secondary Input** of **Channel 2**. This is considered the modulator signal.
- Increase the **Fader** to set the depth of amplitude modulation.

Ring Modulation (Balanced Amplitude Modulation):

Summary: A bipolar audio rate signal is connected to **Channel 3** and is ring modulated by a secondary bipolar audio rate signal.



Audio Path:

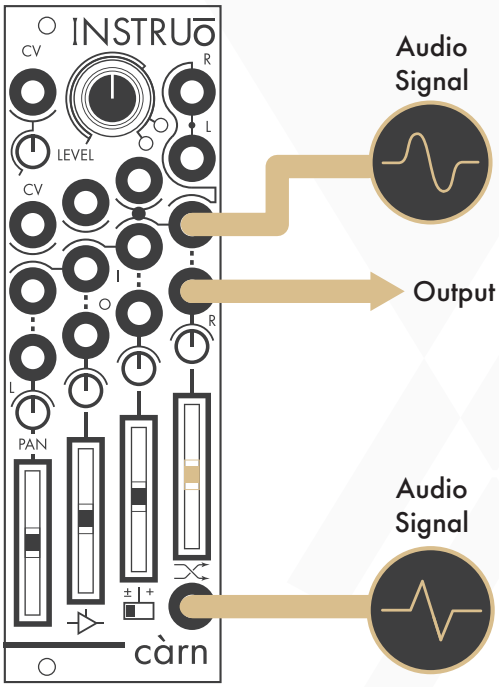
- Connect a bipolar audio rate signal to the **Primary Input** of **Channel 3**. This is considered the carrier signal.
- Monitor the **Mono Output** of **Channel 3**.

Control Path:

- Connect a secondary bipolar audio rate signal to the **Secondary Input** of **Channel 3**. This is considered the modulator signal.
- Set the **Polarity Switch** to its right position.
- The **Fader** can be used to offset the symmetry of the signal multiplication.

Crossfader:

Summary: Two signals present at the inputs of **Channel 4** are crossfaded between each other.

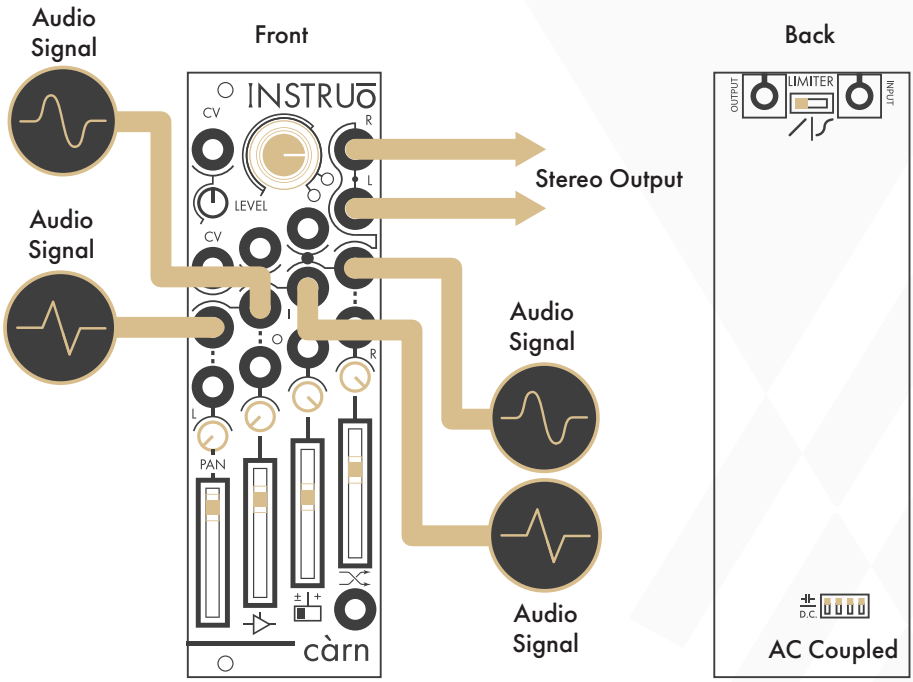


Audio Path:

- Connect a signal to the **Primary Input** of **Channel 4**.
- Connect a secondary signal to the **Secondary Input** of **Channel 4**.
- Monitor the **Mono Output** of **Channel 4**.
- Set the **Fader** to the desired crossfade amount.

Stereo Audio Mixer:

Summary: Four audio rate signals are mixed at the **Stereo Outputs**.

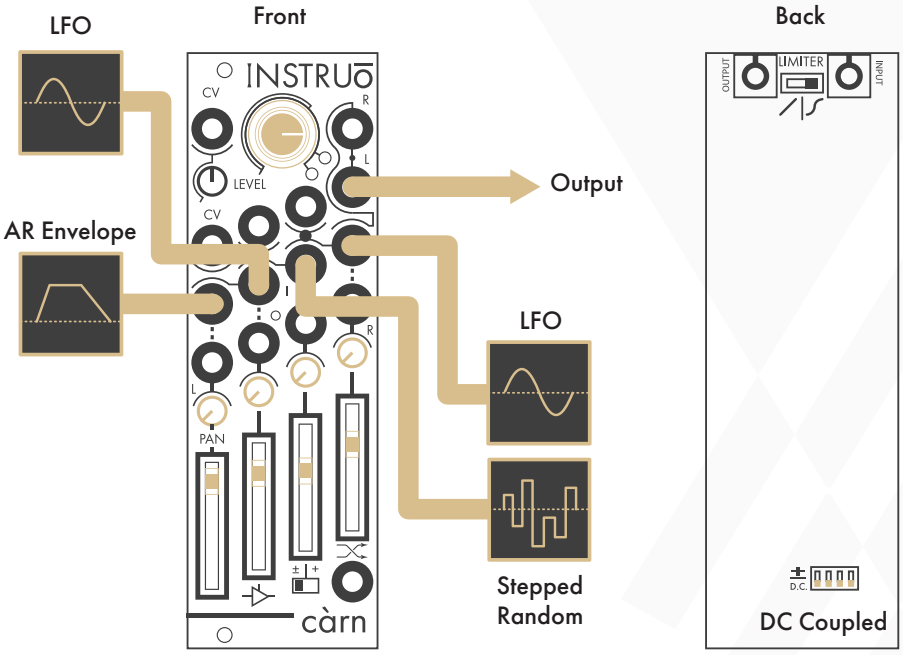


Audio Path:

- Ensure that **càrn** is set to **AC Coupled** on all four **Channels**.
- Connect audio rate signals to the **Primary Inputs** of all four **Channels**.
- Monitor from the **Stereo Outputs**.
- Set the **Level** knob to a desired position.
- Set all **Faders** to desired positions.
- Set all **Pan** knobs to desired positions.

Mono Control Voltage Mixer:

Summary: Four control voltage signals are mixed at the **Stereo Outputs**.

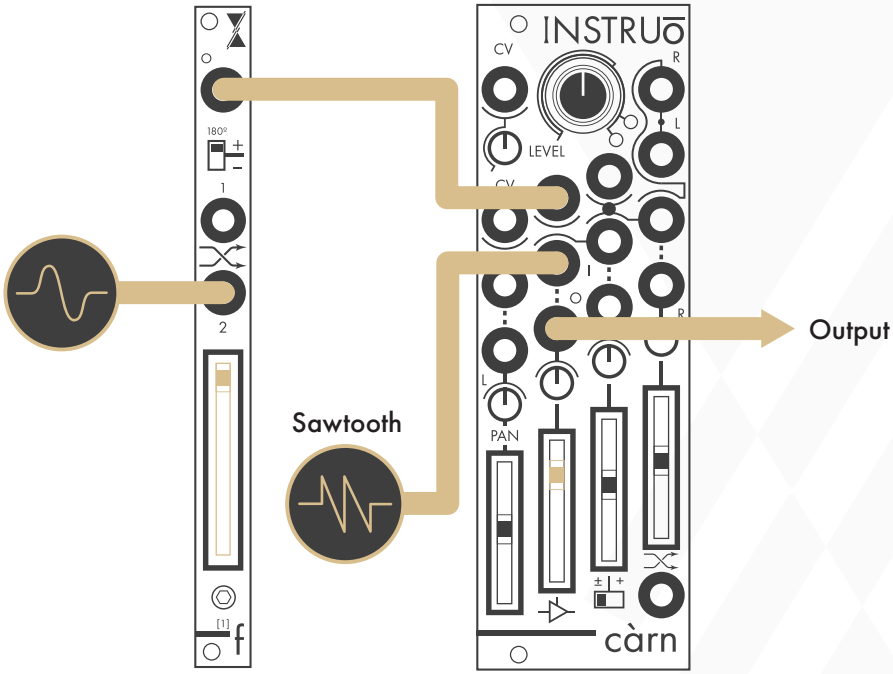


Audio Path:

- Ensure that **càrn** is set to **DC Coupled** on all four **Channels**.
- Connect control voltage signals to the **Primary Inputs** of all four **Channels**.
- Output from the left **Stereo Output**.
- Set the **Level** knob to a desired position.
- Set all **Faders** to desired positions.
- Set all **Pan** knobs fully anti-clockwise.

Unbalanced Amplitude Modulation:

Summary: A bipolar audio rate signal is connected to **Channel 2** and is amplitude modulated by a secondary unipolar positive audio rate signal.



Audio Path:

- Connect an audio rate signal to the **Primary Input** of **Channel 2**. This is considered the carrier signal.
- Monitor the **Mono Output** of **Channel 2**.

Control Path:

- Connect a secondary bipolar audio rate signal to input 2 of [1]f and offset the bipolar signal to unipolar positive by using the [1]f fader.
- Connect the output of [1]f to the **Secondary Input** of **Channel 2**. This is considered the modulator signal.
- Increase the **Fader** to set the depth of amplitude modulation.

A Message from the Developer

Hello!

I would like to thank you for your support of Instruō in these recent years.

Times have been very trying across the globe and I do feel very fortunate to be operating within a niche industry that has generally been able to sustain operations throughout the pandemic.

The semiconductor shortage has been a farther setback globally and has more substantially affected many manufacturers within our creative industry.

It is because of your continued support that I've had the opportunity to expand and grow Instruō into the creative collective it has become.

On behalf of myself and the whole team, Thank you.

We will continue to make these things so that we can make sounds with the things that we make to make sounds with!

I'm very excited to share the **càrn** utility mixer module with you. It's honestly not something I expected to design, and it really stemmed more from the mindset behind some of my older utility modules ([1]f and [2]f).

The audio mixing aspect naturally grew from its origin as a series of parallel utilities. Much in the same way as the older, elusive '*Neonach*' prototypes that many Instruō followers are aware of.

The **càrn** can very much be considered an expansion of that design lineage. I think it adds a lot of capabilities that were missing from the existing Instruō range. There are a couple of specific details that I would like to draw some attention to as a means of preempting some form of future F.A.Q. documentation for the **càrn**:

The **càrn** is constructed in a format that encourages audio mixing in a vaguely traditional configuration, and I'm very happy with the performance of it in these roles!

However, it is quite atypical in comparison to other modules that exist solely with the designed intent as audio mixers.

Fundamentally I developed the **càrn** to serve as a versatile utility processor module: amplitude control, attenuversion, crossfading and panning.

Audio signal management features naturally made sense within these contexts - 'a signal is just a signal.'

The specific curation of stereo audio mixing capabilities developed organically and became an exciting prospect as a parallel ability of the module. Through this, my intent has always remained as being a utility first and mixer second.

Because of this design intention I was able to work with a greater focus prioritising certain more quirky features.

There is a diode based soft clipping limiter implemented by default on the stereo bus. The nature of this circuit retains a generous range of signal linearity before the nonlinear waveshaping is applied past its threshold.

Mixing audio directly into a limiter may seem presumptuous, but I highly recommend it in the context of patching and curating compositional sub-mixes that form the foundation voices within a patch.

The limiting provides a natural and almost "automatic" mix of combined signal amplitudes/loudness. In practice, it can be much easier to achieve a musical sounding mix, with less micromanagement over discrete signal amplitude combinations.

The limiter utilises many discrete components that produce its nonlinear waveshaping responses. The feature can introduce a small foundation level of DC offset at the stereo output jack signals. This is to be expected and will have negligible impact on any audio signals produced. The stereo output LED indicators are matched per module with regards to polarity orientation. This is to ensure an 'off ' state when output level is reduced. Due to this, the signal polarity used to indicate amplitude may vary between **càrn** modules.

Each of the four channels on the **càrn** feature fundamentally different circuit architectures and feature sets. By design, each channel is unique in capability from the others.

The bipolar/bi-coloured fader LEDs will depict positive amplitude in white and negative amplitude in yellow. The nature of these coupled LED colours will result in quite different apparent brightnesses between the polarities. Do not be concerned if higher frequency bipolar signals display more prominently as white. The white element will readily overpower the yellow in brightness.

It may also not be too uncommon for a module's fader LEDs to produce a minimum lit brightness in white. This is normal and will vary between builds and environmental influences such as tolerances in the system's -/+ power supply rail symmetry.

White LEDs will tend to light with the slightest breeze! It's quite common for them to light simply from the electrostatic charge at the tip of a soldering iron! (Although I have not personally ruled out this occurrence as being supernatural in nature.)
Analogue circuitry and component tolerances will have their limits in all situations. The LED drivers are actually configured parallel to the signal path and simply provide a ballpark reference visually over amplitude.

When patching, care should be taken when choosing which channel will be optimum for specific jobs. Each channel has its own strength which may dictate the optimum choice and patching approach used.

I hope this module serves you well in whatever context you place it. It may not be the most impressive module to behold, but I'm confident it will contribute greatly to any system it's added to.

All the very best and again, thank you!

Jason H. J. Lim

Manual Author: Collin Russell
Manual Design: Dominic D'Sylva

CE This device meets the requirements of the following standards: EN55032, EN55103-2, EN61000-3-2, EN61000-3-3, EN62311.