



**OPERATOR'S  
MANUAL**

# PRAGA HRAD

**VOLTAGE CONTROLLED STEREO MIXING CONSOLE  
& MIXING CONSOLE COMMANDER**

*Models of 1967*

*Praga: Intuitive volume control behaviour · Voltage control over volume and pan · Dedicated modes for unipolar and bipolar voltage control over volume · DC-coupled signal path · Channel level indicators · Two auxiliary sends with stereo returns · Clickless channel muting*

*Hrad: CV inputs for controlling AUX sends · Two stereo AUX return attenuators · Four insert points for AUX sends · Main volume control with level indicator · Switchable Euro/line level outputs · Headphone driver with additional cue input · Gate inputs for channel muting control*



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## PRAGA INSTALLATION

Salut! Thank you for purchasing this Xaoc Devices product. Praga [*praga*] is an expandable four-channel voltage controlled mixer featuring a stereo mixing bus, two auxiliary sends with stereo returns, clickless muting, dedicated modes for unipolar and bipolar voltage control over volume, DC-coupling, and a super-clean signal path obtained via high-quality VCA and opamp chips. We have carefully crafted Praga's voltage control response to achieve what we believe to be the optimal user experience found in an eurorack mixer. The design features an elaborate control circuit that combines the internal voltages generated by the panel potentiometers with external CV over volume and pan (fig. 1). The result is a natural attenuator response that constrains VCA gain to an usable range while minimizing distortion.

Hrad [*hrad*] is an expander for Praga that adds new functionality and enhancements. The module features a master section with stereo volume control over the overall mix with five-bar LED stereo level indicator, a stereo sum output that is switchable between Eurorack and line level, a headphone output with volume control that is independent of the main attenuator, a special **CUE** input that can be

auditioned with and without the mix, four control inputs for automated muting/unmuting of individual channels, four inputs for voltage control over the AUX send levels, four insert points in the aux sends, and two stereo attenuators for Praga's two AUX return pairs.

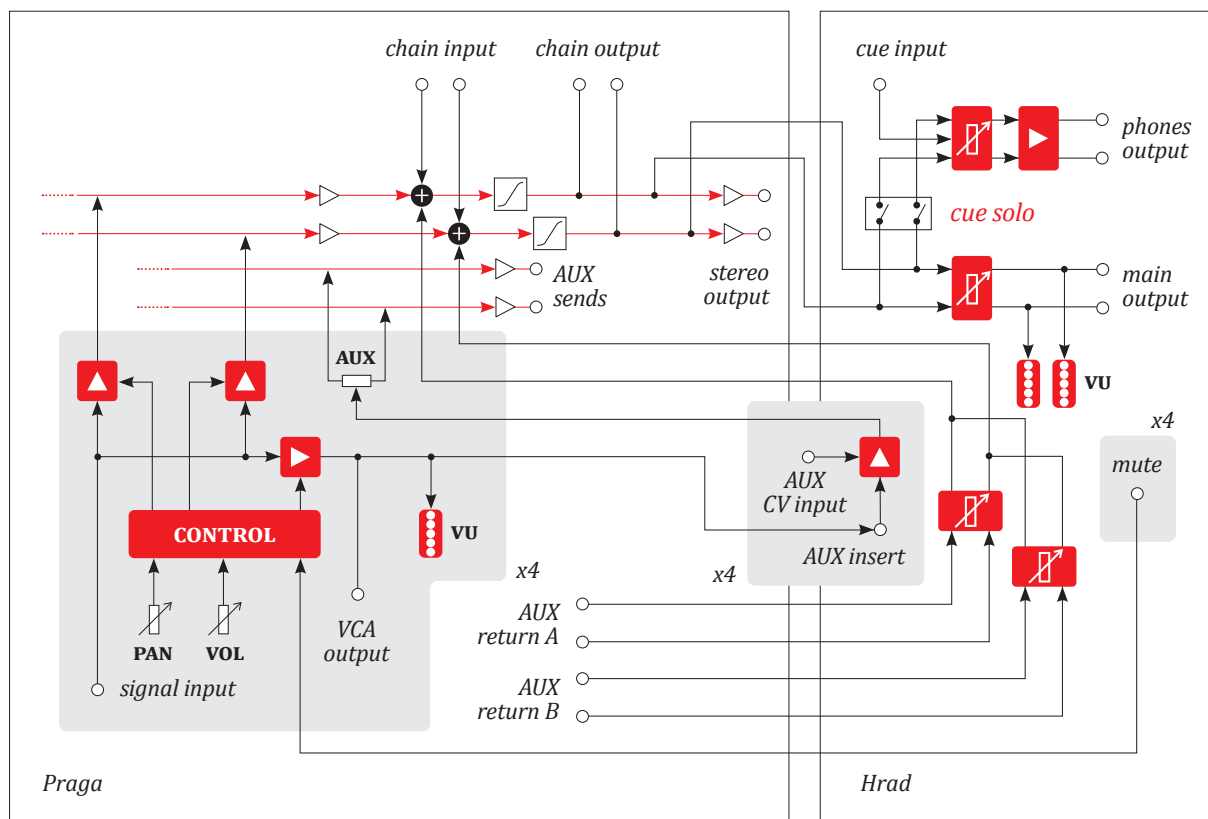
## PRAGA INSTALLATION

The module requires 20hp worth of free space in the eurorack cabinet. The ribbon type power cable must be plugged into the bus board, paying close attention to polarity orientation. The red stripe indicates the negative 12V rail and should align with the dot, **-12V** or **RED STRIPE** marks on both the unit and the bus board. The module itself is protected against reversed power connection, however reversing the 16-pin header **MAY CAUSE SERIOUS DAMAGE** to other components of your system by short-circuiting the +12V and +5V power rails.

## HRAD INSTALLATION

Hrad module requires 10hp worth of free space in the Eurorack cabinet and it is best located next to your Praga. Hrad does not have its own separate

fig. 1: PRAGA & HRAD SIGNAL FLOW



## HRAD INSTALLATION

power connection as it draws power from Praga and adds its own 50mA to what Praga consumes. **ATTENTION: NEVER CONNECT ANY POWER CABLE TO ANY PIN HEADER ON THE BACK OF YOUR HRAD—IT WILL DESTROY THE UNIT!**

Hrad connects to Praga using the two 16-pin ribbon cables **1** supplied with the unit (see fig. 2). **NOTE:** these cables are deliberately short and should not be replaced with longer ones for the sake of safety as well as keeping interference and noise to a minimum. Prior to making the connection, you must remove all jumpers from the lower pin header **2** of your Praga (you will have to put them back if you ever decide to use your Praga without Hrad, otherwise the unit will not work properly). Next, carefully connect the cable going from the upper and lower headers of Hrad to the upper and lower headers of Praga paying attention to not mix them up or rotate them as **THIS WOULD SERIOUSLY DAMAGE BOTH UNITS!** Locate the jumper labeled **PRAGA REVISION** on the back of Hrad **6** (see fig. 3) and set

fig. 3: HRAD JUMPER SETTING

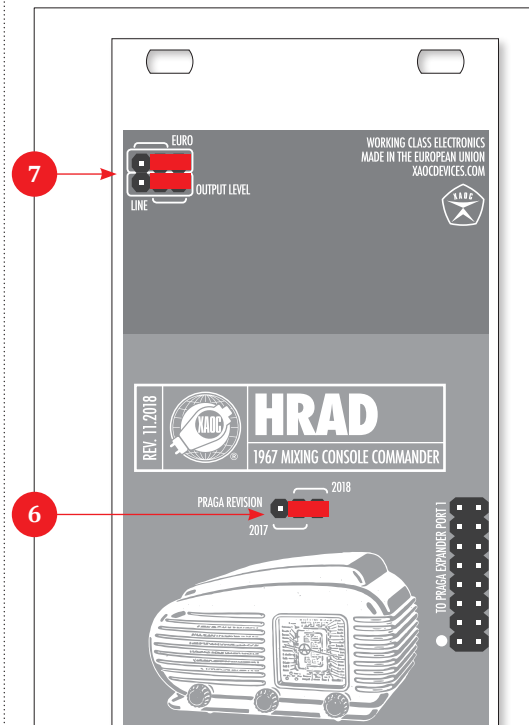
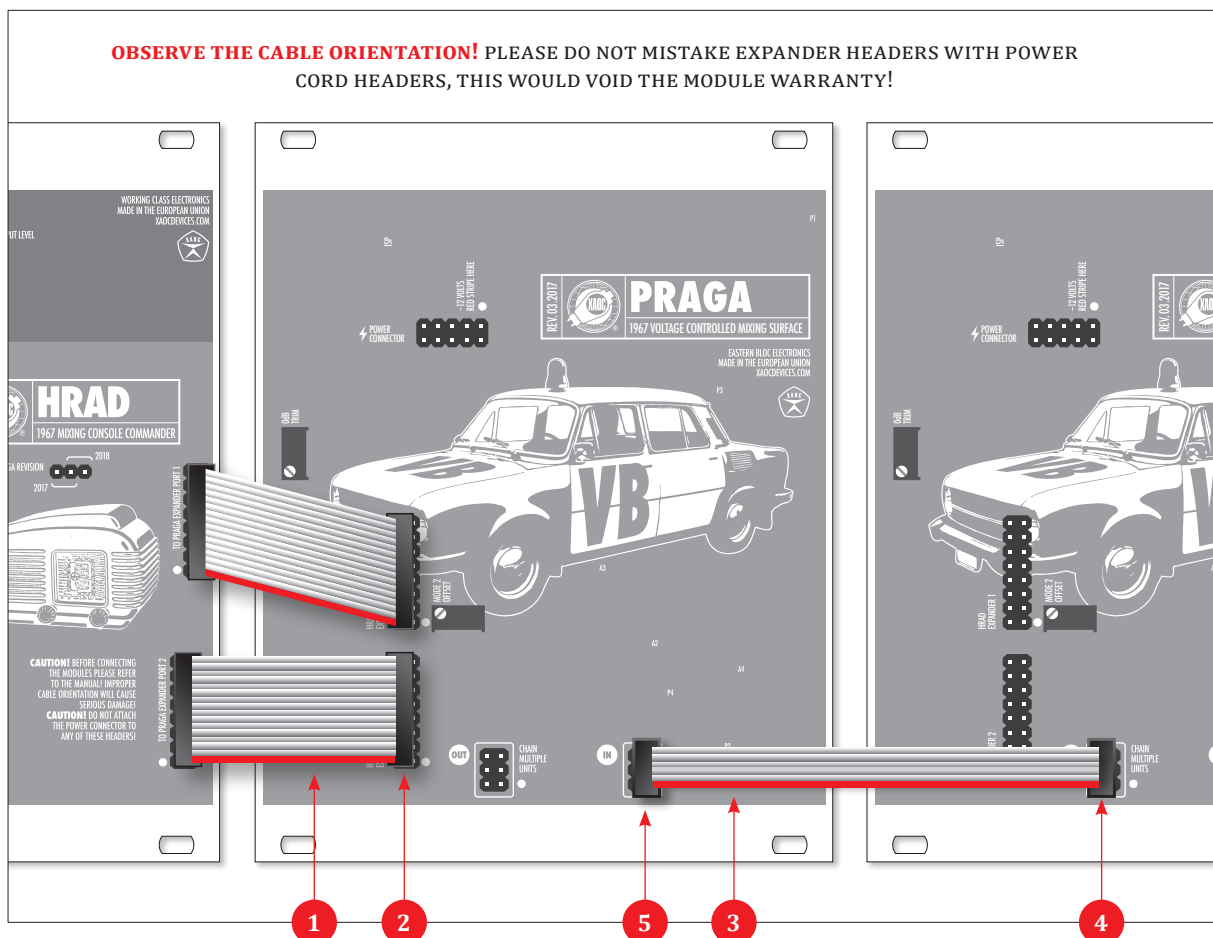


fig. 2: CHAINING MULTIPLE PRAGA UNITS & CONNECTING THE HRAD EXPANDER



## PRAGA OVERVIEW

it according to what is printed on the PCB of your Praga. Improper setting of this jumper is not dangerous, however, the AUX channels will not work as designed. While you are there, you may also decide to set the output level of your Hrad. If Praga is the last stage of your Eurorack system, it may be reasonable to switch the pair of **OUTPUT LEVEL** jumpers from **EURO** (default) to **LINE** position 7.

Both Praga and Hrad should be fastened by mounting the supplied screws before powering up. To better understand the device, we strongly advise the user to read through the entire manual before using the module.

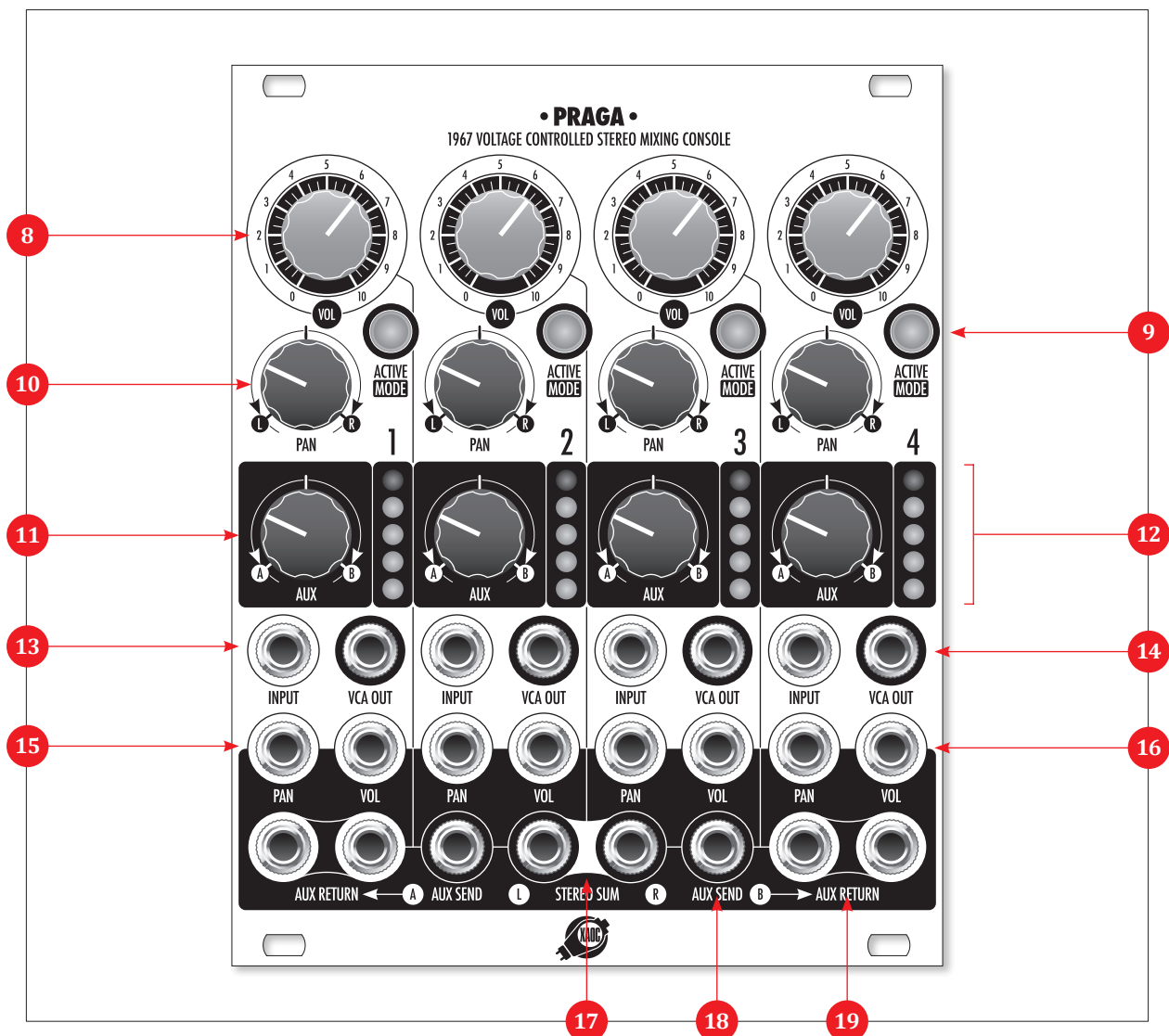
### PRAGA OVERVIEW

Praga's front-panel topology (see fig. 4) resembles

a typical mixer with four identical channels.

The **VOL** knobs 8 allow for manual control of each channel's respective level. Each channel's response depends on the selected control mode (see: "Volume Control" later in this manual). The illuminated **ACTIVE|MODE** button 9 allows the user to mute the channel or switch between the two control modes. The **PAN** knob 10 adjusts the channel's position in the stereo panorama. The bipolar **AUX** knob 11 adjusts the amount of signal sent to either auxiliary channel. The five-bar LED level indicator 12 displays the channel's post-fader level, while the lower section contains the sockets for signal **INPUT** 13, direct **VCA OUT** 14, CV inputs for **PAN** 15 and **VOL** control 16.

fig. 4: PRAGA FRONT PANEL LAYOUT AND CONTROLS



## OPERATIONAL MODES

The bottom row of sockets is common to all four channels and consists of a pair of **STEREO SUM** outputs 17, two **AUX SEND** outputs 18 and two pairs of stereophonic **AUX RETURN** inputs 19.

### VOLUME CONTROL

Praga offers two modes of combining incoming control voltages with attenuator settings. The mode is selected individually in each channel by a long press of the illuminated **ACTIVE|MODE** button. Mode switching is also possible while the channel is muted, confirmed by a short blink.

### UNIPOLAR MODE

Unipolar mode (button lit green) is designed for unipolar control voltages commonly found in envelope generators. In this mode, the attenuator knob controls offsets to the incoming CV, allowing the dynamic response to CV to be retained regardless of attenuator position (fig. 5a, 5b). With attenuators at maximum, a CV of 8V opens the chan-

nels to 0dB, while closing the attenuators allows silencing the channels to -85dB. Control voltages above 8V are well-tolerated, however, the gain response is strongly tempered above 0dB, offering only up to +3dB so as to minimize distortion. This behavior affects the sound in a way similar to dynamic compression, however lowering the attenuators diminishes the effect, eventually bringing it down to a non-compressed operation.

### BIPOLAR MODE

Bipolar mode (button lit red) is designed for bipolar control voltages commonly found in LFOs. In this mode, the attenuators act by scaling the CV together with an internally generated offset voltage. Therefore the depth of amplitude modulation (in dB) decreases as the channel is lowered. The response is optimized for control voltage in the range of -5V to +5V, whereby a fully-open attenuator offers 0dB at +5V and turning it fully counterclockwise yields an attenuation of -56dB with no modulation (see fig. 6a, 6b).

fig. 5a: UNIPOLAR (GREEN) MODE GAIN VS. CV FOR DIFFERENT ATTENUATOR SETTINGS

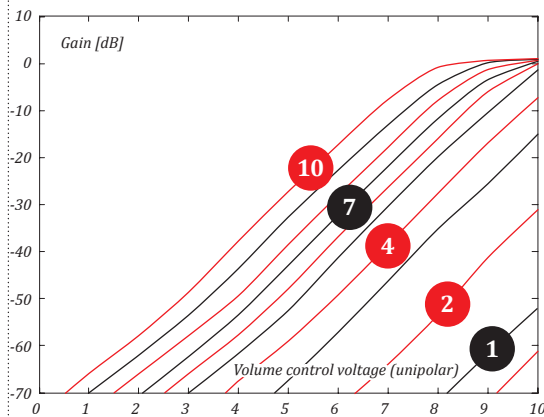


fig. 5b: UNIPOLAR (GREEN) MODE GAIN VS. ATTENUATOR SETTINGS FOR DIFFERENT CV

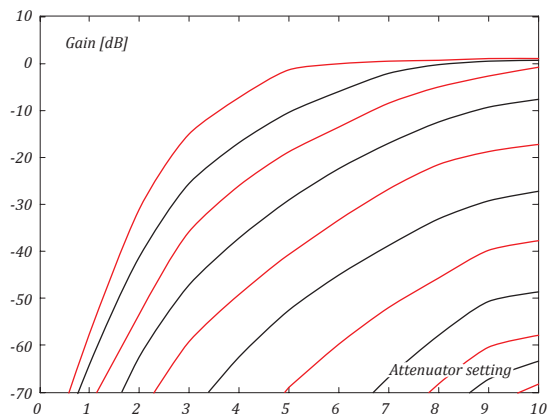


fig. 6a: BIPOLAR (RED) MODE GAIN VS. CV FOR DIFFERENT ATTENUATOR SETTINGS

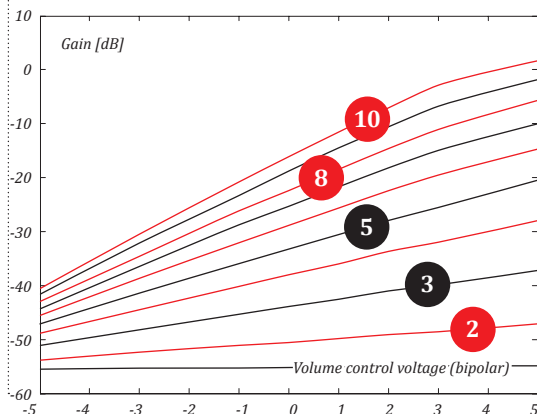
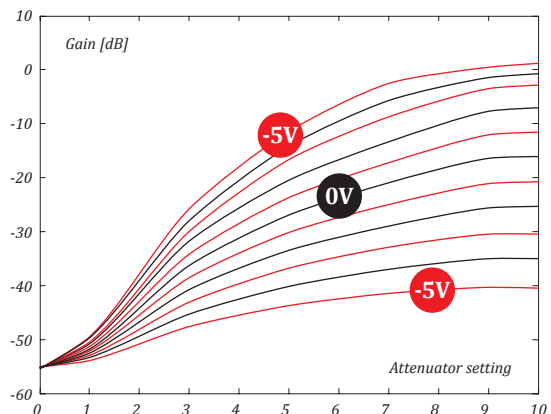


fig. 6b: BIPOLAR (RED) MODE GAIN VS. ATTENUATOR SETTINGS FOR DIFFERENT CV



Again, higher amplitudes of the CV are well-tolerated, however, the response is strongly compressed above 0dB.

### CHANNEL MUTING

Regardless of the current mode, a short-press on the **ACTIVE|MODE** button silences the corresponding channel. This state is indicated by the deactivation of the corresponding LED. Clickless action is achieved by introducing a few-millisecond fade-out to near -90dB. Pressing the button again brings the channel back through a similar clickless fade-in and reactivates the LED.

### PAN CONTROL

Praga offers both manual and CV control over the position of each channel in the output stereo panorama. The **PAN** knobs act as offsets to the **PAN** input control voltages which are expected in the range of -5V to +5V.

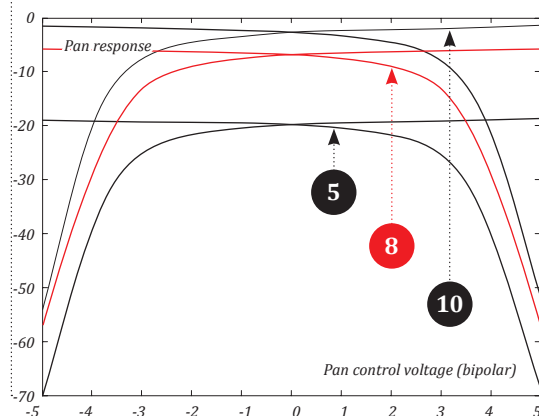
The response of the combined controls provides equal loudness in a near-field monitoring setup (3dB pan law), however as channel gain approaches 0dB, the response is slightly compressed so as to prevent an increase of loudness (see fig. 7).

### VCA OUTPUTS

A direct **VCA OUT** on each channel uses a separate VCA chip to provide a pure copy of the attenuated signal unaffected by the **PAN** control.

The purpose of these outputs is to offer individual mix components for multitracking, as well as to offer insert functionality with the Hrad expander.

fig. 7: PAN CONTROL RESPONSE



### AUXILIARY OUTPUTS

Two **AUX SEND** outputs, together with two pairs of stereo **AUX RETURN** sockets allow the user to patch two send effects. A dedicated bipolar **AUX** knob in each channel allows for manual control of the sends. By turning the knob to the left or right of center, the signal is sent to auxiliary channel A or B respectively. Sends are post-fader only, as they are derived from the **VCA OUT** signals.

### LEVEL INDICATORS AND MIXING BUS LEVELS

Each of Praga's channels features an individual post-fader level indicator. The five LEDs show the state of a standard volume detector with thresholds at -32dB, -20dB, -12dB, -6dB and 0dB referenced to a 10Vpp signal. Bear in mind that eurorack electronic circuits cannot handle voltages greater than 10V, therefore it is impossible to mix four signals of 10Vpp without serious distortion.

It is recommended to keep your attenuators between 50% and 80% of the full range (unless your sources are very quiet). The mixing bus in Praga features a soft clipping circuit that offers a gentle overdrive for signals exceeding 16Vpp. This solution prevents the harsh sounding distortion resulting from hard clipping should the sum of your signals exceed the dynamic range of the output stage.

### EXPANDABILITY: CHAINING MULTIPLE UNITS

Multiple Praga units may be chained to provide a cascaded sub-mix setup such that the content of the mix bus of all upstream units is injected 1:1 into the mix bus of every subsequent unit appearing at its **STEREO SUM** outputs. The chaining headers at the back of the module (fig. 2) should be connected with a 6-pin ribbon cable ③ so that the **OUT** header ④ of the preceding unit goes into the **IN** header ⑤ of the following unit. The **IN** header of the first unit and the **OUT** header of the last unit should remain unconnected. Our other stereo mixer Ostrawa is also compatible with this chaining solution.

### EXPANDABILITY: HRAD EXPANDER MODULE

Hrad may be used alongside a single Praga unit. If you have more than one Praga chained, it is best to pair with the last Praga in the chain. Please bear

## HRAD OVERVIEW

in mind that all features related to AUX channels and muting will refer to the Praga that is connected to Hrad. It is also possible to connect a separate Hrad to every Praga in the chain so as to have access to the extra functionalities in every unit. However, please take into account the substantial power requirements of such a complex setup.

Hrad's front panel topology (see fig. 8) resembles the master section of a small mixer. The **MAIN LEVEL** knob **20** controls the stereo sum signal at the **MAIN OUTPUT** **21**. The final signal level is shown by the 5-bar LED indicator **22**. The headphone volume at the **PHONES** output **23** is set by the **PHONES LEVEL** knob **24**. The **CUE INPUT** **25** allows auditioning of an additional signal in your headphones, with or without the main mix

as selected by the **CUE SOLO** button **26**. The four **ACTIVE** inputs **27** offer remote muting and unmuting of Praga's four individual input channels. The two **AUX RET** knobs **28** offer attenuation of signals plugged into Praga's **AUX RETURN** pairs. The four **AUX CV** inputs **29** offer voltage control over Praga's AUX send levels. The four **AUX INS** inputs **30** are insert points for Praga's individual AUX sends.

### VOLUME CONTROL

The **MAIN LEVEL** attenuator controls the stereo signal at the output of Hrad without affecting the **STEREO SUM** on Praga. **NOTE:** it is possible to overload the **SUM** output in Praga when several hot audio signals are mixed with high **VOL** settings. If this happens, you can simply lower Hrad's **MAIN** level attenuator to achieve a clean signal thanks to the additional 12dB of headroom provided by Hrad's internal connection to Praga.

The output level on Hrad can be switched between the normal Eurorack (+20dBu) and studio line (+4dBu) using a pair of jumpers at the back of the unit (see fig. 2).

### HEADPHONE OUTPUT

The dedicated stereo **PHONES** output on Hrad can drive a wide range of studio and consumer grade headphones with a dual high-quality OPA2134 per channel. Note that the maximum loudness and low-frequency range may vary with impedance. The recommended headphone impedance is 80 to 300 Ohm.

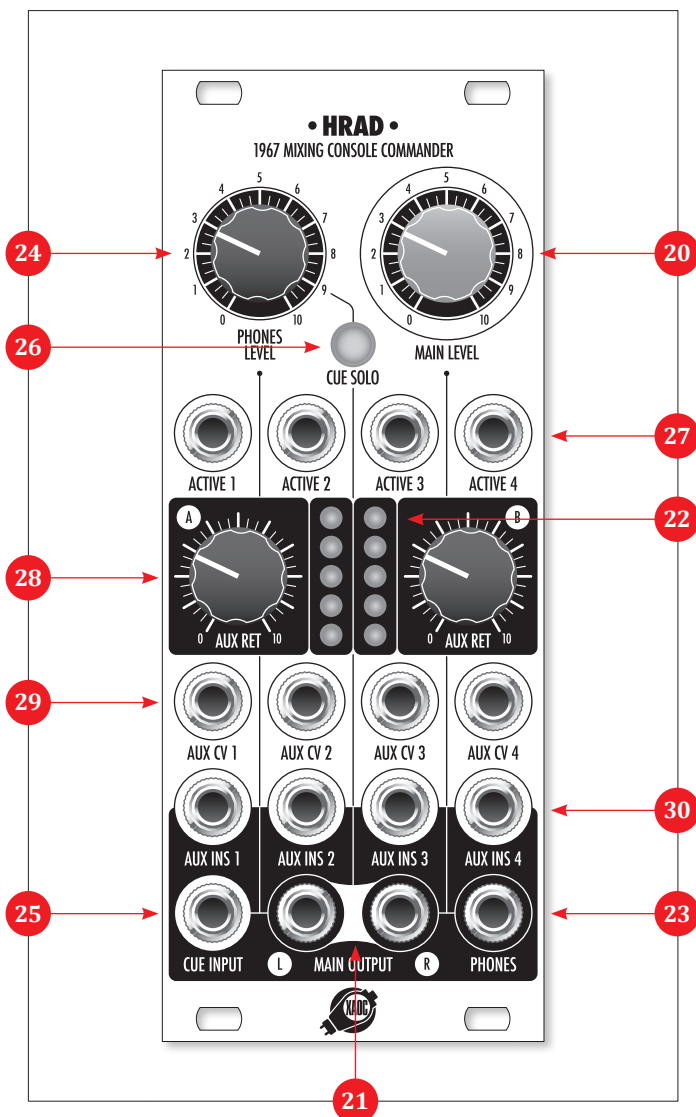
The **PHONES LEVEL** knob is independent of the **MAIN LEVEL** attenuator, hence you can hear your mix before your audience does.

The **CUE INPUT** allows you to audition an additional center-panned mono signal in the context of your mix or alone (after pressing the **CUE SOLO** button). Note the amplitude of this input is attenuated for your listening comfort.

### MUTE/ACTIVITY INPUTS

By feeding gate signals to the four **ACTIVE** inputs in Hrad it is possible to remotely control the opening/closing of each individual channel in Praga exactly in the same way as clicking its front panel

fig. 8: HRAD FRONT PANEL LAYOUT AND CONTROLS



## PATCH EXAMPLES

buttons. A gate-on signal (about +2.4V or more) activates the channel, while gate-off (0V) mutes it (in a clickless way). Note that even with the gate signal plugged in, the panel buttons still remain operational, however unplugging the signal will leave your channel muted.

### SIGNAL PATH OF AUX CHANNELS

The pair of Praga and Hrad features an unorthodox signal path offering maximum flexibility with minimum footprint. Fig. 4 shows the diagram of a single AUX path from a single input channel in Praga.

The signal passes through the three VCA cores in parallel—two of them form the stereo pair that is mixed at the summing bus. The third core forms the direct signal which is delivered to the **VCA OUT** socket in Praga. This same signal is used for the auxiliary send (post fader). However, before the **A/B** knob on Praga, it may be replaced by its processed version (or any other signal) thanks to the **AUX INS** inputs in Hrad. It then goes through one of the four additional VCA cores (one per Praga channel) where the send level can be controlled by the external CV plugged into the corresponding **AUX CV** input. The voltage response of this VCA is the same as in Praga (please refer to its manual for details). The CV inputs are internally normalized to 8V.

From the VCA, the signal passes through the bi-

polar **AUX** attenuator on Praga where one of the auxiliary channels (**A** or **B**) may be selected, and the amount of send may be set manually. The mixed aux send signal from all four channels is available at the **AUX SEND** socket in Praga.

When a return signal from external processing is plugged into the stereo **AUX RETURN** pair in Praga, it goes again to Hrad, where it may be attenuated with the corresponding **AUX RET** (**A** or **B**) knob. From the attenuator, the signal is routed to the stereo summing bus in Praga.

### PATCH EXAMPLES

- **STANDARD (POST-FADER) OPERATION:** When using your Praga and Hrad in a traditional setup, you can add two external effects (e.g. a reverb and delay) with the auxiliary channels (post-fader). Patch the **AUX SEND** signal to your effect processor input, and patch its outputs back to the **AUX RETURN** pair. Now, you can decide on the amount of the effect being mixed to your audio via the corresponding **AUX RET** attenuator. By using additional modulation plugged into the **AUX CV** you can dynamically control which parts of the audio will have the reverb or delay added to them.

- **PRE-FADER OPERATION:** Split the signal going to an **INPUT** in Praga, and feed a copy of it to the corresponding **AUX INS** jack in Hrad (fig 9). This will bypass the **VOL** and **VCA** controls on Praga for your auxiliary send, which allows for pre-fader

fig. 9: PRE-FADER OPERATION

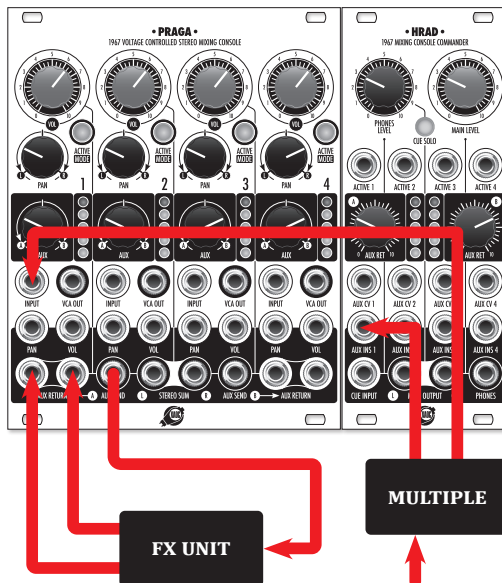
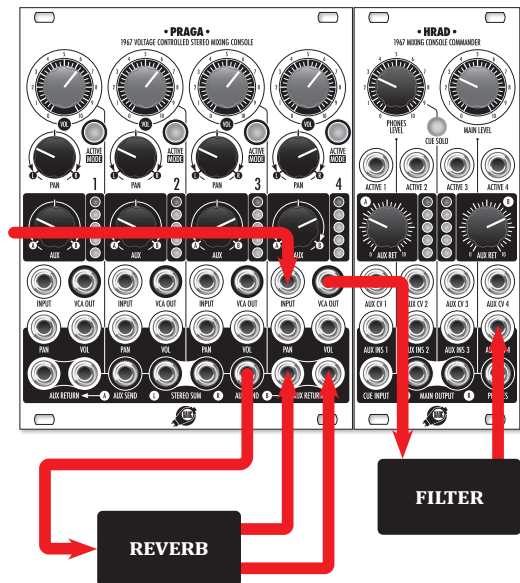


fig. 10: AUX CHANNEL INSERTS



operation. In other words, you can have an effect-  
ed portion of the signal audible while the separate  
dry signal is turned down. You can even plug any  
other signal into that socket, and have addition-  
al sounds added (under CV control) to your effect  
bus.

- **AUX CHANNEL INSERTS:** Take the **VCA OUT** signal from a channel in Praga and process it through an additional module (e.g. a filter, or bit crusher), and plug the result into the corresponding **AUX INS** input in Hrad (fig. 10). With this patch, you could have a reverb on high frequencies only, or distorted

echos of the sounds that are clean in the main mix.

- **EXTRA STEREO INPUT:** Sometimes you run out of input channels in Praga but don't need more than one send effect. You can plug a mono or a stereo pair into the unused **AUX RETURN** sockets, and its volume will be controlled by the **AUX RET** attenuator in Hrad.

### **ACCESSORY**

Our Coal Mine black panels are available for all Xaoc Devices modules. Sold separately. Ask your favourite retailer. •

**PRAGA  
TECHNICAL  
SPECIFICATION**

WIDTH	DEPTH TOTAL	CURRENT DRAW	REV. POWER PROTECT.
20hp	42mm (including cable bracket)	+210mA -180mA	protected

INPUTS		OUTPUTS	
INPUT 1-4	0 to 20Vpp, 10Vpp recommended	VCA OUT 1-4	0 to 18Vpp
PAN	-5V to +5V	AUX SEND A, B	0 to 18Vpp
VOL	0 to 10V (unipolar mode), -5V to +5V (bipolar mode)	STREO SUM	0 to 18Vpp
AUX RETURN A, B	0 to 20Vpp, 10Vpp recommended		

**HRAD  
TECHNICAL  
SPECIFICATION**

WIDTH	DEPTH TOTAL	CURRENT DRAW	REV. POWER PROTECT.
10hp	42mm (including cable bracket)	+50mA -35mA	not protected!

INPUTS		OUTPUTS	
ACTIVE 1-4	Any gate signal or a square wave (2.4V threshold)	MAIN OUTPUT L-R	0 to 18Vpp
AUX CV 1-4	0 to +8V	PHONES	100...300mW, depending on impedance
AUX INS 1-4	0 to 20Vpp, 10Vpp recommended		
CUE INPUT	0 to 20Vpp, 10Vpp recommended		

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