

SwitchMix™

True Summing Patch Matrix

Operating Manual

HINTON
INSTRUMENTS

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SwitchMix Specification

FORM FACTOR	3U Eurocard Rack panel, 42 HP or 36 HP width. Stainless steel front panel.
POWER	±12 V to ±15 Vdc, 120 mA max
FRONT PANEL CONNECTIONS	Signal Inputs and Outputs: 3.5 mm Jack (unbalanced) 4.4 mm (Bantam/TT) Jack (balanced)
REAR CONNECTIONS	Signal I/O: DB25S balanced DC Power: Eurorack bus 16 pin header and 4 way KK 0.156" header Gate Output: 3 way KK 0.1" header
ELECTRICAL	Input Impedance: General purpose inputs: 100 kΩ. Audio only inputs: 10 kΩ Output Impedance: Standard: 470 Ω. Precision: 100 Ω. Maximum Signal before clipping: 12 V power rails: ±9 Vpk (+18 dBm). 15 V power rails: ±10.5 Vpk (+19.5 dBm) . Bandwidth: DC to 20 kHz: +0/-0.2 dB. 90 kHz: -3 dB. Total Harmonic Distortion: < 0.02% @ 1 kHz, +17 dB Output Noise: (30 kHz filter) Cut: -93 dBm All Inputs routed: -77 dBm DC Accuracy: Standard: ±2%. Precision: ±0.2%.

This specification and the information presented in this document may change without notice in the interests of continuing product improvement. While every effort is made to make this document accurate, Hinton Instruments cannot accept any responsibility for the interpretation of the information provided or any liability for any injury, loss, or damage, direct or consequential, caused by application or inability to use the equipment or information provided.

SwitchMix Installation

GENERAL

SwitchMix requires a regulated complimentary power supply in the range from ± 12 Vdc to ± 15 Vdc and dissipates a maximum of 4 W. Protection circuitry is incorporated to protect against reverse- and over-voltage.

The unit is cooled only by natural convection, so it is necessary to allow adequate space around the unit to ensure that air flow is not obstructed.

Please take the normal precautions for siting an electronic instrument. Do not place on a source of direct heat, in direct sunlight, or near another instrument that may result in interference with either's operation.

SwitchMix may be installed in either a 3U Eurocard Rack or a "Eurorack" with 42 HP of available space. Suitable fixing bolts are provided, either M3 or M2.5 as specified when ordering. Use the washers provided to protect the panel.

The panel finish is brushed stainless steel and should only be cleaned with a soft, barely damp cloth. Sharp objects may permanently mark the finish. Do NOT write on labels with a ball point pen or use knife blades to remove labels.

STATUTORY INFORMATION



SwitchMix is an analogue audio frequency device and contains no digital circuitry, however this does not guarantee that radio interference will not occur when connected to other devices that may be emitting interference. If interference is experienced after installation of this equipment suspect faulty screening in connecting cables. If interference is still experienced try to correct the situation by one or more of the following measures:

- **Relocate either SwitchMix and its associated equipment and cabling or the equipment affected by the interference.**
- **Utilise different mains power outlets. Try installing a filter in the mains lead of SwitchMix or the other equipment.**
- **In the case of radio interference where 300 ohm ribbon antennas are used, try changing to 75 ohm coaxial cable.**

If for any reason you should need additional information relating to radio and TV interference, you may find a booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio/TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington D.C. 20402, Stock #004-000-00345-4.



This product is not subject to the European EMC Directive 89/336/EEC which applies to apparatus which is "liable to cause electromagnetic disturbance or is itself liable to be affected by such disturbance".

This product may contain nuts.

EARTHING

The 0 V power supply is connected to the front panel and **must be grounded for safety**. The ground reference should be provided via the mains inlet or via a chassis terminal in countries that normally use a two pin mains connector. Do not remove the ground from the mains connector.

For installations that have separate safety and technical earth systems please consult with Hinton Instruments before proceeding.

WARNING: Failure to observe this practise may result in hazard to life or damage to connected equipment.

CONNECTING POWER

SwitchMix may be powered from either a Eurorack distribution bus board via a 16-way ribbon cable or a separate power supply via a 4-way 0.156" connector (MOTM compatible). Both pcb connectors are polarised, but the other end of the cable may not be, so check carefully. Pin 1 of the cable, which is the -12 V end, has a red stripe.

Connect the appropriate connector and turn power on. Check that some switches light on or off when pressed, if not turn off immediately and double check the power connection.

When correct, SwitchMix may be fastened in the rack. Fold the power cable into the rack so that it will not be pinched. The module is quite heavy so take care to support it when tightening the fixing bolts. If the rack can be positioned horizontally there is no risk of it dropping. Use a 1 pt Pozidriv screwdriver or bit (not a Philips) and support the tip so that it does not slip and scratch the panel. Alternatively, Schroff plastic clip-in fastenings may be used in the elongated holes.

CONNECTING SIGNALS

SwitchMix may be configured with either 3.5 mm jacks, TT Bantam jacks or a custom mixture. There is no standard for 3.5 mm jacks and many manufacturers' products vary, particularly in the shape of the plug tip, which may cause incompatibility problems. We have selected a good quality Switchcraft type and rumours of this being problematic is typical Internet misinformation. Some plug types will not activate the break contact, but this is not used. We recommended the use of plugs that have a tip shaped like a 1/4" jack plug, rather than the cheap trapezoid types. Do not use stereo 3.5 mm plugs.

The front panel jacks are wired to a DB25 connector on the rear circuit board. The DB25 has balanced I/O in the Tascam format. When wired to an unbalanced jack the "cold" side of the signal must be connected to the shield ground.

CHECKING

Next check some signal paths. Patch an audio signal, e.g. from a VCO, to one of the inputs and use the corresponding small buttons in each row to route it to each output. When the Cut button is off the Output LEDs should glow both red and green or amber (depending on viewing angle), brighter with more signal level. If your VCO has a Low range select that, otherwise patch a slow LFO to the input instead and observe that the LEDs vary between red when positive and green when negative.

Now patch an audio signal and an LFO to two inputs, mix them to one output and observe how the LED changes. The final test is to check that each output is working by patching each output to your system so that it may be heard.

All SwitchMix outputs are unity gain except G, which is intended as the main Pitch CV. It is shipped set to x1, but has a trimmer to adjust exactly to your modules. See the section on Tuning 1 V/Oct.

If you experience any difficulty with the above operations or require any further information, please contact Hinton Instruments: support@hinton-instruments.co.uk.

More reference information and contact details are available on our website.

MAINTENANCE

If the front panel gets dirty with finger marks, simply wipe with a barely damp soft cloth. Do not use abrasive cleaners which may scratch the panel or switch caps.

SwitchMix should give years of fault free operation—many Hinton Instruments products have been in continuous use for over ten years or used on major international tours and events—but it has been designed for ease of servicing in the event of any component failure.

Spare components and sub assemblies are available for critical maintenance applications. Please enquire if you need this support.

All the op amps are accessible in sockets on the rear board. If one fails it should be replaced with the same type or equivalent. Hinton Instruments can supply spares.

The switches should give years of use under normal conditions. Caps may become damaged by accident and spares are available. If a switch becomes faulty contact Hinton Instruments, do not attempt to replace without advice.

If you spill any drinks over SwitchMix, switch off immediately and remove the unit from the rack. Fast damage limitation is necessary. Dab off as much liquid as possible with a paper towel. If liquid has entered the switch holes rinse with running water under a cold tap. Cola drinks are particularly corrosive, but any drink should be removed before it dries. After rinsing, shake and leave it to dry out thoroughly and contact Hinton Instruments for advice **before reinstalling**. **Repairs for beverage damage are not covered under warranty**, but removing the liquid may reduce the cost of replacement.

LABELLING

SwitchMix may be provided with optional labelling strips which are fitted using the two left hand fixing bolts. The bolt heads require a 2 mm Allen hex key. The white plastic strip is for use with a fine dry wipe pen. The clear strip is for covering printed paper labels (a pdf template is available).

For temporary labelling, we recommend 3M Post-it Cover-up and Labelling Tape as a superior alternative to common masking tape. Do not write on any labels with a ball point pen or use knife blades to remove as the stainless steel finish may be damaged.

For semi-permanent labels Brother P-Touch tapes are recommended.

USE WITH SILENT WAY OR VOLTA

Both these systems use a direct coupled balanced audio interface as a control voltage to a VCO and provide a software calibration loop. Typical audio outputs do not have a large voltage range, often nominally ± 2.5 V, giving only a 5 V range when used unbalanced. By using SwitchMix's balanced inputs with a balanced cable the range will be doubled. This feature will be lost if interfacing via 3.5 mm jacks.

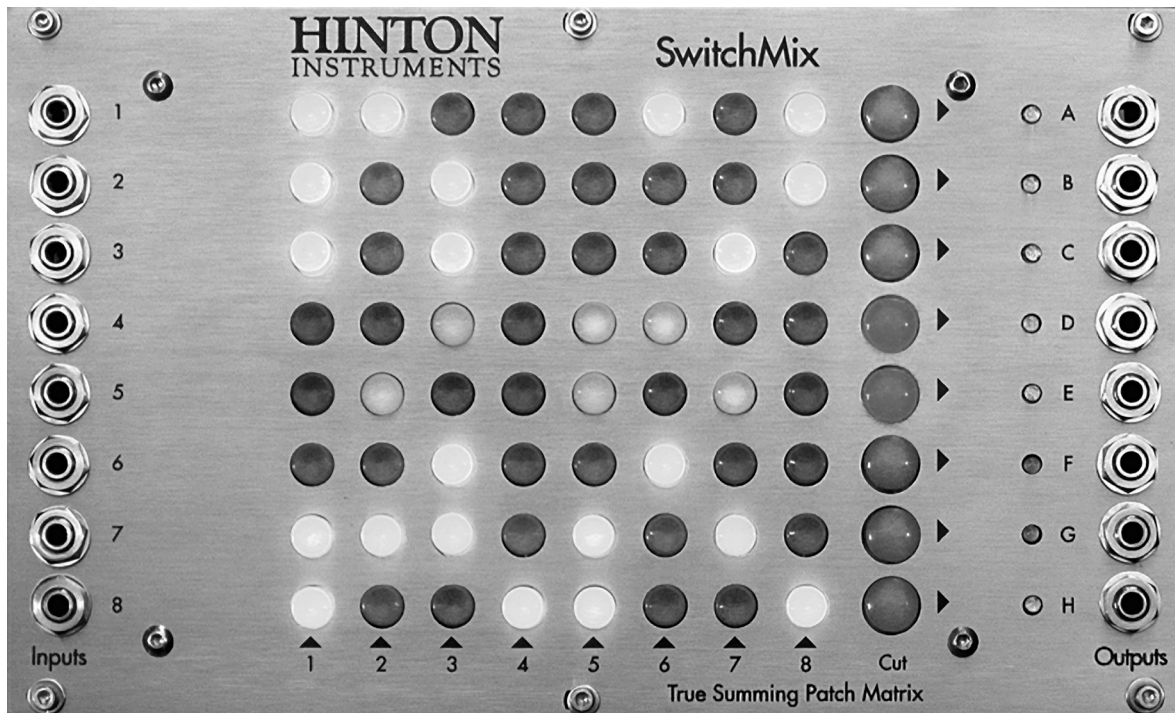
The calibration routine learns what voltage to send to obtain the required frequency and this will correct nonlinearities in a VCO's response. However for adding with other control voltages it is recommended that the VCO and the other CV sources are calibrated first.

PITCH CV AND GATE LINKS

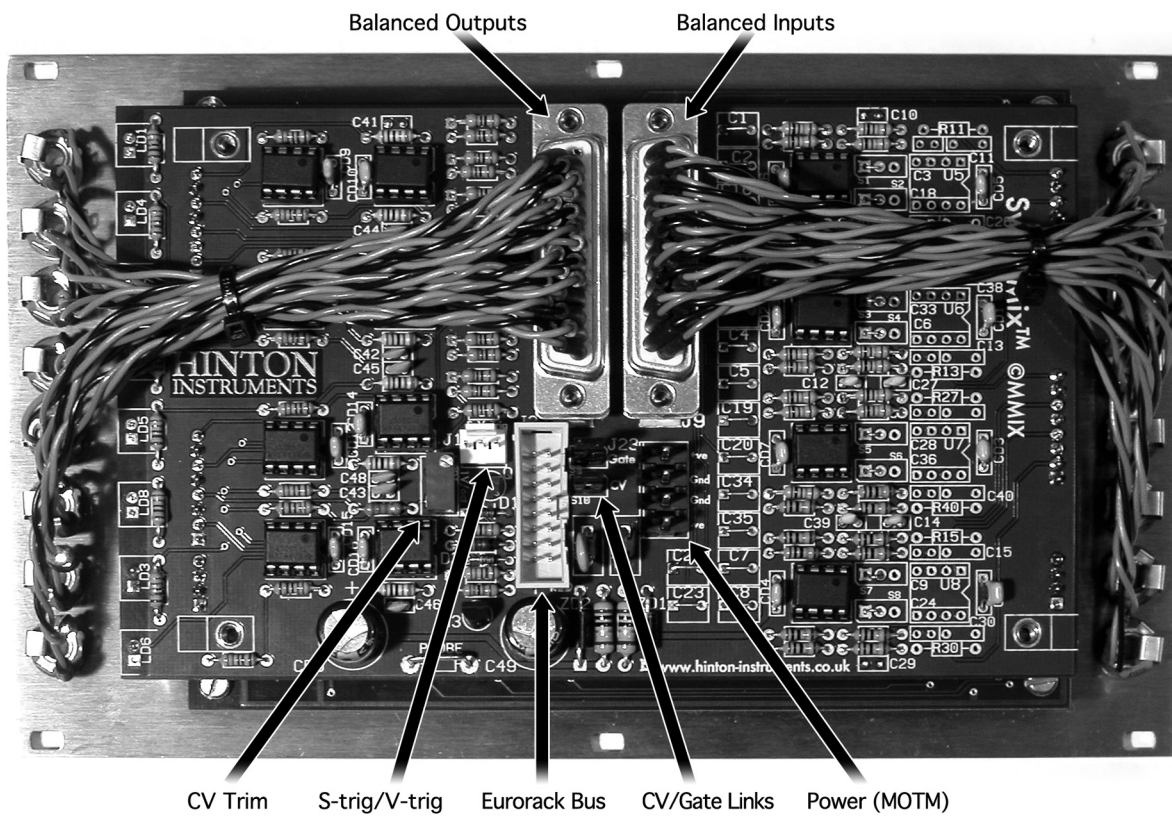
There are two jumper links situated in the centre of the rear board, which connect Outputs G and H to feed the Eurorack bus system CV and Gate. If these are used, first check that no other module output is connected to these buses.

Output G has a trimmer that may alter the voltage level by $\pm 20\%$. This may be used to tune the System CV.

Output H has a dedicated comparator for deriving Gate signals from the analogue sum. Any voltage over about 1 V will turn the Gate on. This is available on the three way header as a low asserted S-trigger (Moog compatible) and a full level >10 V V-trigger (ARP compatible). A special cable is needed to use these signals externally. The Gate level to the system bus is nominally +5 V.



Front Panel



Back View

SwitchMix Operation

IN USE

SwitchMix is a matrix mixer, with each Output giving the true algebraic sum of all the selected inputs on a row. This works both with DC control voltages and audio signals. Like any mixer, the output has to be within the power supply range or the signal will be clipped. **Large signals may need to be attenuated before SwitchMix. If two +10 V voltages are summed the result will not be +20 V because the upper power rail is only +12 V.** If a sequencer is outputting a pattern between -1 V and +1 V and a keyboard CV of +2 V is added, the sequence will be transposed 2 octaves and vary between +1 V and +3 V.

Signals and control voltages are routed to an Output bus when the matrix switches are lit and in the raised position. Similarly the Output buses are muted when the Cut switches are lit and in the raised position. This makes it easier to feel active routing paths without seeing the panel.

The output level is shown on a bicolour LED near the Output jacks. If this is very bright the output voltage is near its limit. Positive voltages are shown as red and negative as green. Audio signals will show as both or amber, depending on the viewing angle.

The switches are low bounce time types, but this does not mean that routing changes will be click free. Any clicks are dependent on where a signal is interrupted in its waveform, like any mechanical contact system. Declicking signals requires a control element which would also introduce distortion and inaccuracy as well as control system side effects.

TUNING ACCURACY IN MODULAR SYNTHESIZERS

There are two conflicting standards used in modular synthesizers: 1 V/oct pitch control voltages and 1 k Ω outputs/100 k Ω inputs.

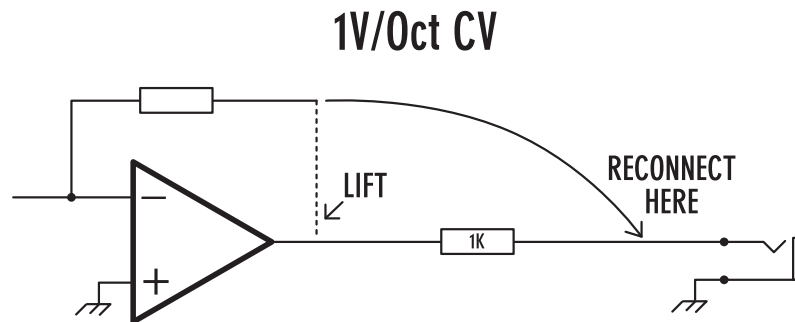
At every patch point the 1 k Ω output resistors cause a 1% signal loss, so only 99% is seen at the next module. This accumulates at every mult or mixer, so introducing Switchmix into a patch will result in a further 1% loss than was happening already. In audio terms this is only a 0.087 dB loss, but in pitch terms this is 1 cent flat per semitone or 60 cents flat at the top of a five octave keyboard. The question is what exactly should be set to 1 V/oct, the source module or the destination module? The answer depends on how many independent tuning trimmers are provided within the VCOs, which is often not enough.

VCOs usually have two main adjustments: a 1 V/oct trim and an initial frequency offset. If the 1 V/oct trim is used to adjust to a 1 V/oct CV it may also effect front panel controls unless they have independent calibration. FM CV inputs will also be affected, but they may not be exact due to pot end resistance errors anyway. If a VCO has an unattenuated pitch control input, connect the SwitchMix output to that.

There are several ways to overcome this problem. The simplest, as was used in most classic modular systems, was to have fine tuning available at the source, usually on a keyboard. The output is tuned to be a little bit more than 1 V/oct to compensate the losses introduced along the whole CV path. Keyboard outputs often did not have a protection resistor which also solves the problem, but of course are then not protected from an incorrect patching either.

Within modern modular synthesizers there are many sources of pitch CVs which may need to be summed: sequencers, quantisers, MIDI to CV converters; many of these do not have user adjustable trimming. We could give the SwitchMix input buffers a slight gain to compensate the 1% loss, but that would not be correct if the input CV were patched to other inputs via mults, as that would cause further drops, or if it was correct in the first place.

The most reliable solution would be to modify the CV sources, not by removing the 1 k Ω resistors, but by incorporating them into the feedback stage of the output amp as shown:



This will produce indeterminate results if two such outputs are connected together via a mult, but CVs would be not normally be mixed in this way.

By presenting SwitchMix with correct control voltages an accurate sum will be produced which should be fed to the device under control using a fixed single input and the device should be tuned to that control voltage. Other module inputs should not be used for pitch critical controls.

SwitchMix may be used with Output G as the main Pitch CV and there is a trimmer to adjust this. It is factory set to exactly x1 to match the other outputs. Output G may be linked to source the system CV and the output protection is nominally 100 Ω to give 0.1% error into 100 k Ω .

The precision version of SwitchMix has 0.1% matched resistors (instead of 1%) throughout the mix matrix to achieve closer tracking when driving multiple VCOs. This should keep tracking errors <6 cents over a 5 octave keyboard. It also has 100 Ω resistors on all outputs (whereas the standard version has 470 Ω).

Appendix

CONNECTORS

Input/Output: DB25S

For unbalanced usage connect Cold and Screen together on jack.

	13	(not used)	
25		Input 1/Output A	Screen
	12	Input 1/Output A	Cold
24		Input 1/Output A	Hot
	11	Input 2/Output B	Screen
23		Input 2/Output B	Cold
	10	Input 2/Output B	Hot
22		Input 3/Output C	Screen
	9	Input 3/Output C	Cold
21		Input 3/Output C	Hot
	8	Input 4/Output D	Screen
20		Input 4/Output D	Cold
	7	Input 4/Output D	Hot
19		Input 5/Output E	Screen
	6	Input 5/Output E	Cold
18		Input 5/Output E	Hot
	5	Input 6/Output F	Screen
17		Input 6/Output F	Cold
	4	Input 6/Output F	Hot
16		Input 7/Output G	Screen
	3	Input 7/Output G	Cold
15		Input 7/Output G	Hot
	2	Input 8/Output H	Screen
14		Input 8/Output H	Cold
	1	Input 8/Output H	Hot

Eurorack Bus: 0.1" DIL header

16	15	Gate
14	13	CV
12	11	(+5 V not used)
10	9	+12 V
8	7	0V
6	5	0V
4	3	0V
2	1	-12 V

Power: KK 0.156"

1	+12 V to +15 V
2	0V
3	0V
4	-12V tp -15V

Gate: KK 0.1"

1	0V
2	V-Trig (>10 V asserted)
3	S-Trig (0 V asserted)