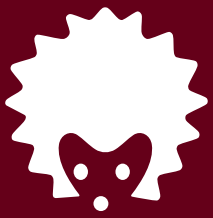

PINDSVIK
AUDIO

TLBX
MANUAL

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OVERVIEW

TLBX (toolbox) is a tiny and flexible utility module in 2HP that can mix, mult and is capable of simple maths.

TLBX uses tight tolerance components and is built to work with both audio signals and precise CV signals. All inputs and outputs are DC coupled.

Technical Specifications

- Width: 2HP
- Height: 3U
- Depth: 25mm
- Power: 15mA (+12V), 15mA (-12V)
- Power header can be plugged in either way

OVERVIEW

SECTIONS

TLBX consists of three sections:

MULT is a 1-to-2 multiple. If nothing is plugged into the input, the outputs will act as 1V and 5V voltage references.

MIX is a 2-to-1 mixer/adder. The second input is normalized to the first one, enabling it to be used as a precise 2x voltage multiplier.

DIFF is a 2-to-2 adder and subtractor. The first output is the sum of the inputs, the second the difference.

This section can also be used as a 1-to-2 multiple or as a inverter.

OVERVIEW

NORMALIZATION BETWEEN SECTIONS

All three sections of **TLBX** can be used independently from each other, but are also cleverly normalized from the top to the bottom.

MULT can influence both **MIX** and **DIFF** section.

MIX can influence the **DIFF** section.

Each section is normalized twice - both outputs and inputs are normalized.

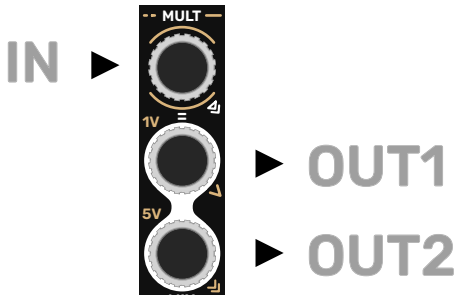
To break the output normalization, connect a cable to the respective output.

To break the input normalization, connect a cable to **any** input of a section - the normalization is section-wise.

BASIC OPERATION

MULT

The **MULT** section is a 1-to-2 multiple.



If **IN** is unconnected, **OUT1** and **OUT2** act as voltage references:

- **OUT1** will be 1V, accurate to < ±1mV
- **OUT2** will be 5V, accurate to < ±2.5mV

(At room temperature)

This reference is excluded from normalization!

If a cable is plugged into **IN**, a copy of the signal will appear at **OUT1** and **OUT2**.

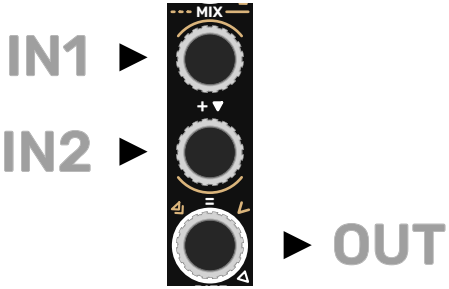
If **OUT1** is unconnected, a copy of the signal will be summed into the **MIX** output.

If **OUT2** is unconnected, a copy of the signal will be summed into both **DIFF** outputs.

BASIC OPERATION

MIX

The **MIX** section is a 2-to-1 mixer/adder.



If both **IN1** and **IN2** are unconnected, OUT will be a copy of the **MULT** input.

If both **IN1** and **IN2** are connected, OUT is the sum of both inputs.

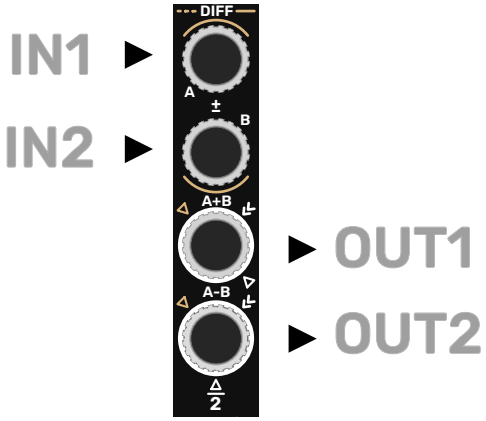
If **IN1** is connected but **IN2** is not, **OUT** will be **IN1** multiplied by 2.

If **OUT** is unconnected, the signal will be summed into the outputs of the **DIFF** section; Full (x1) into output 1, halved (x0.5) into output 2

BASIC OPERATION

DIFF

The **DIFF** section is a 2-to-2 adder/ subtractor.



If no cable is plugged into either **IN1** and **IN2**, a copy of the **MIX** output will be summed into **OUT1** and **OUT2**.

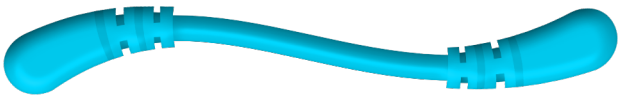
If both **IN1** and **IN2** are connected, **OUT1** will be the sum and **OUT2** the difference of the inputs.

If only **IN1** is connected, **OUT1** and **OUT2** are copies of **IN1**.

If only **IN2** is connected, **OUT1** is a copy and **OUT2** an inverted copy of **IN2**.

ADVANCED PATCHES

TLBX is very flexible, but the interactions between sections need to be understood to unlock its full potential. The following chapter shows advanced patching techniques and aims to aid this understanding.



Input

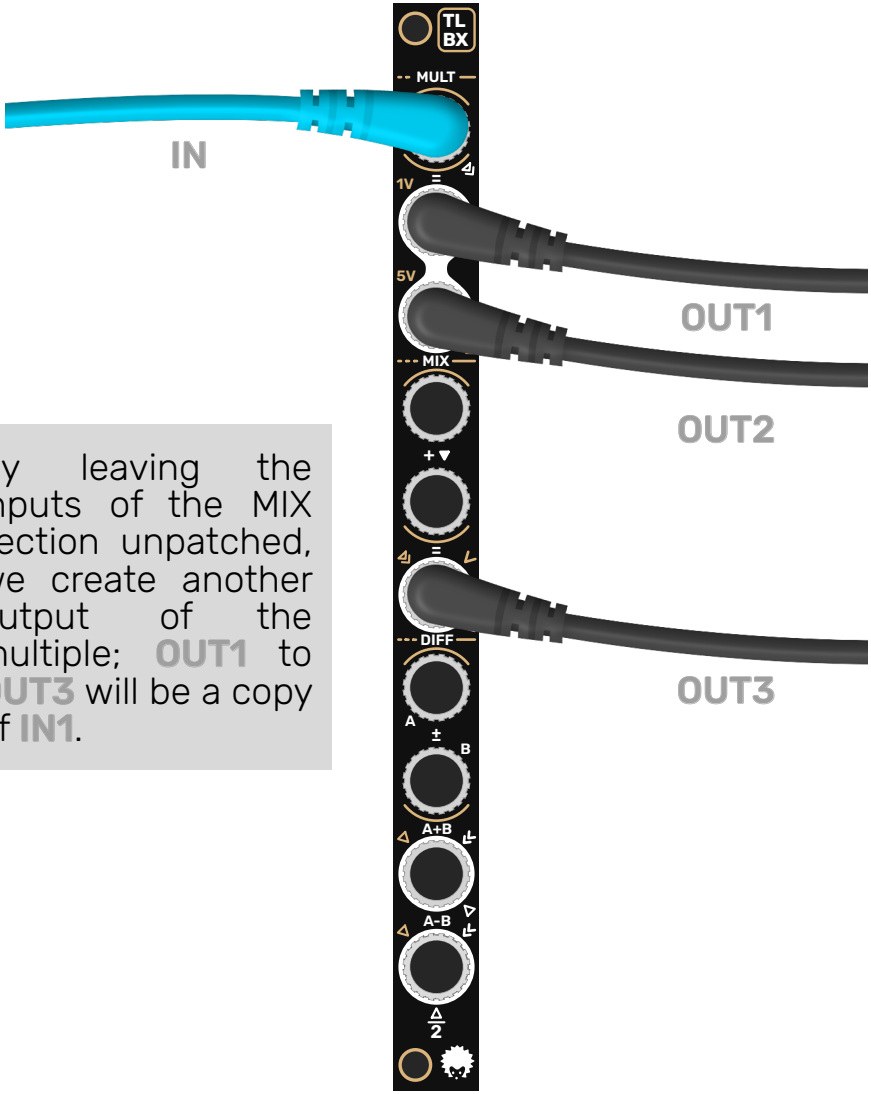
Output

Other

Legend: Cables connected to Inputs are cyan, cables from outputs are black. All other cables are white.

MULTIPLES & MIXING

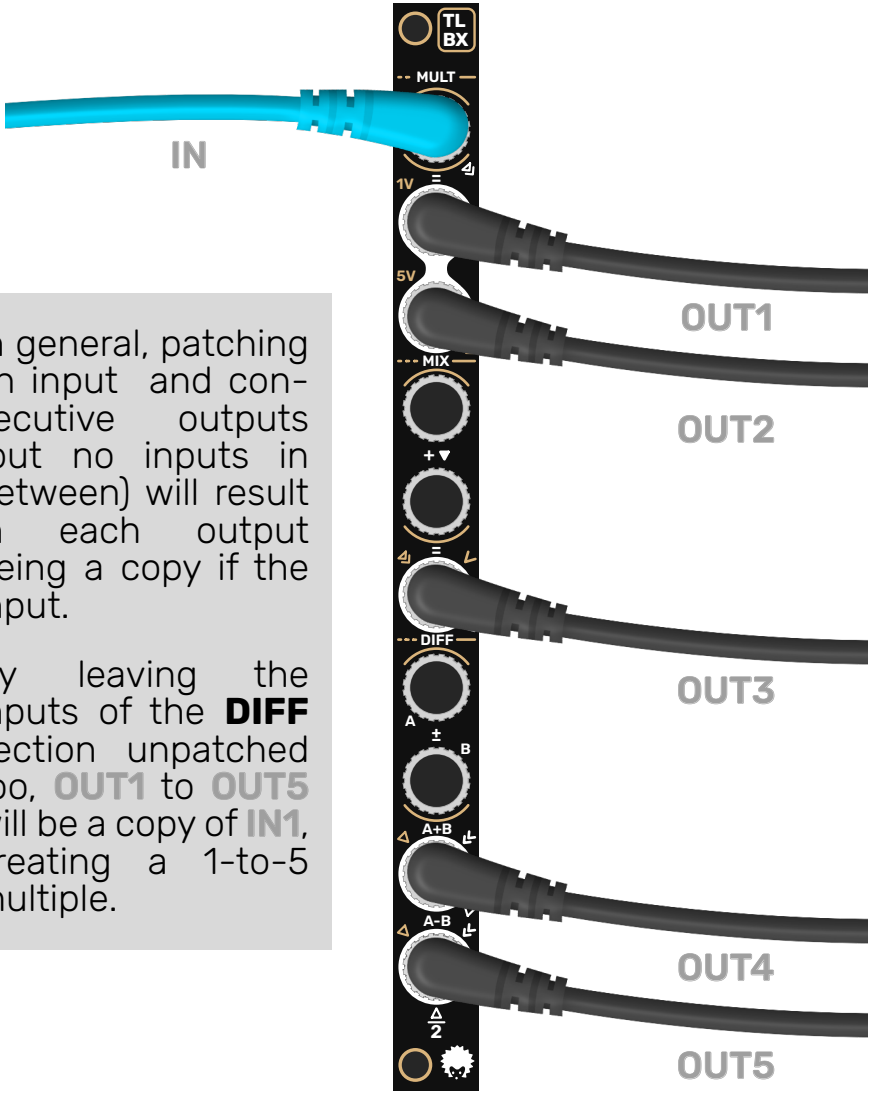
1-TO-3 MULTIPLE



By leaving the inputs of the MIX section unpatched, we create another output of the multiple; **OUT1** to **OUT3** will be a copy of **IN1**.

MULTIPLES & MIXING

1-TO-5 MULTIPLE

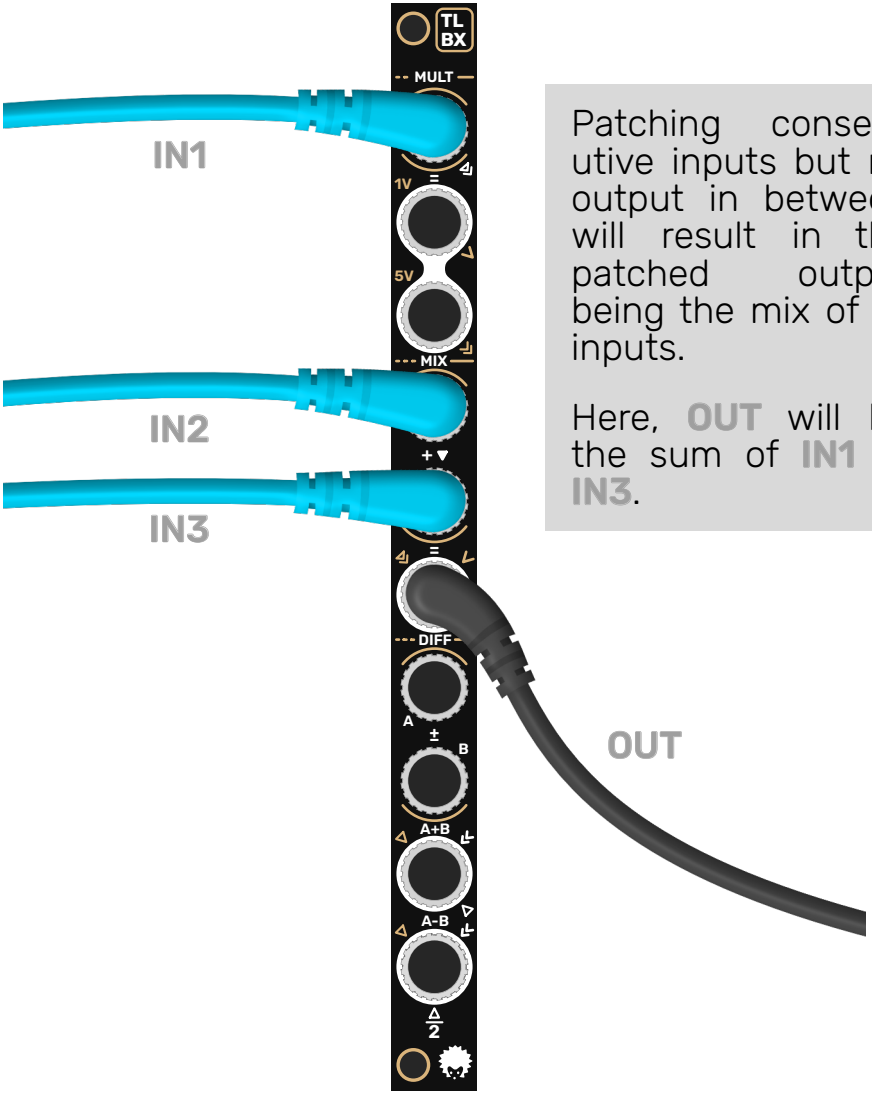


In general, patching an input and consecutive outputs (but no inputs in between) will result in each output being a copy if the input.

By leaving the inputs of the **DIFF** section unpatched too, **OUT1** to **OUT5** will be a copy of **IN1**, creating a 1-to-5 multiple.

MULTIPLES & MIXING

3-CHANNEL MIXER

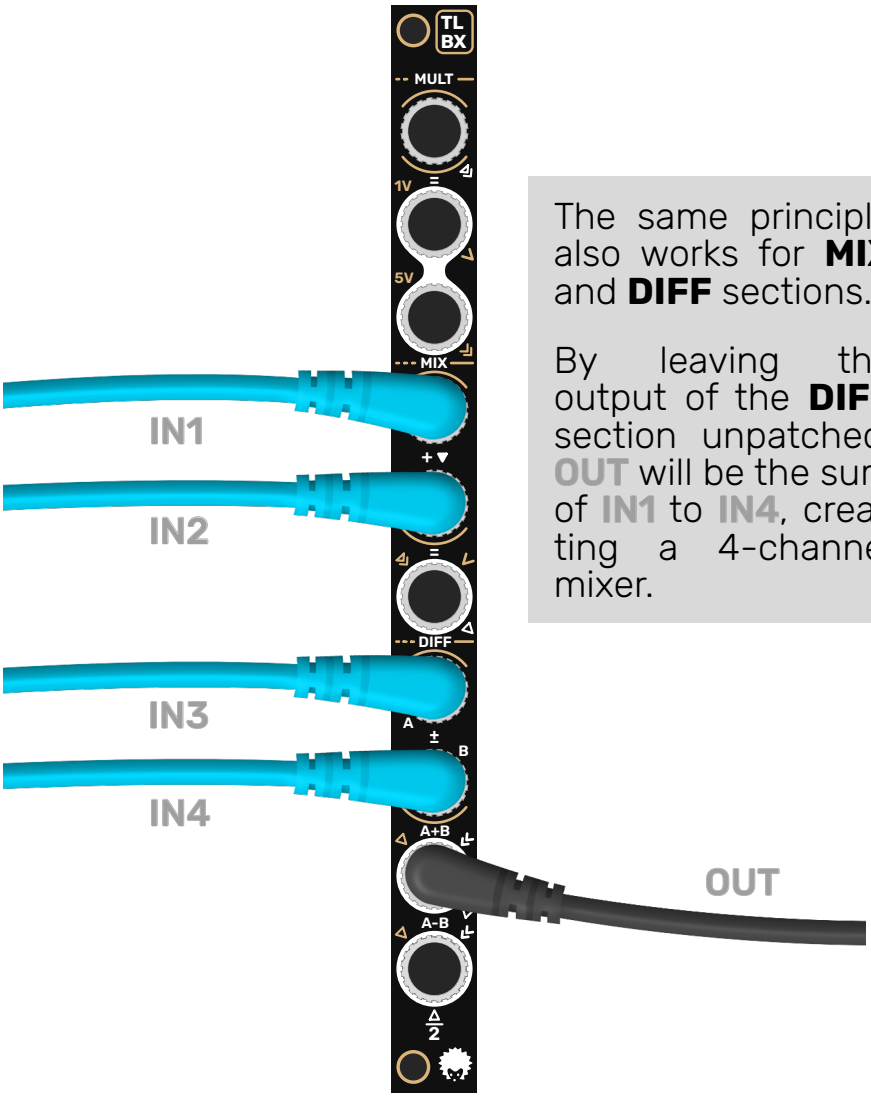


Patching consecutive inputs but no output in between will result in the patched output being the mix of all inputs.

Here, **OUT** will be the sum of **IN1** to **IN3**.

MULTIPLES & MIXING

4-CHANNEL MIXER

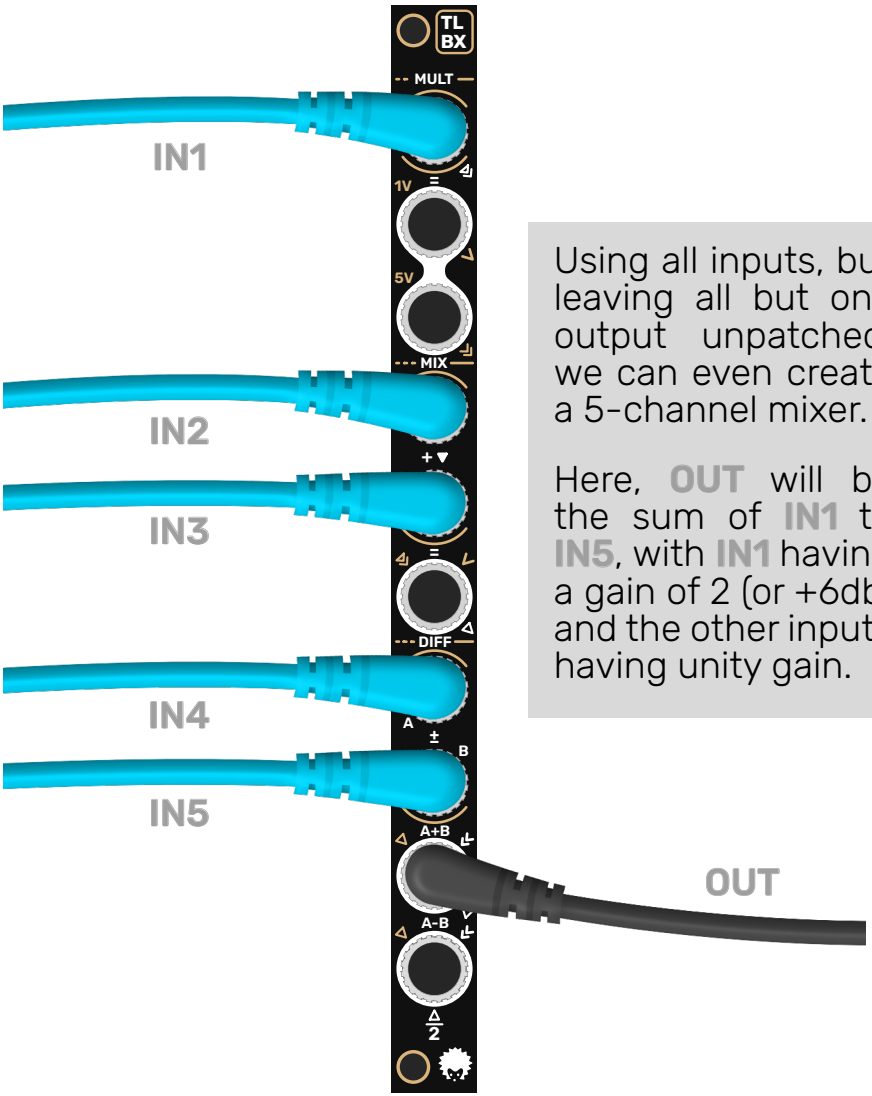


The same principle also works for **MIX** and **DIFF** sections.

By leaving the output of the **DIFF** section unpatched, **OUT** will be the sum of **IN1** to **IN4**, creating a 4-channel mixer.

MULTIPLES & MIXING

5-CHANNEL MIXER

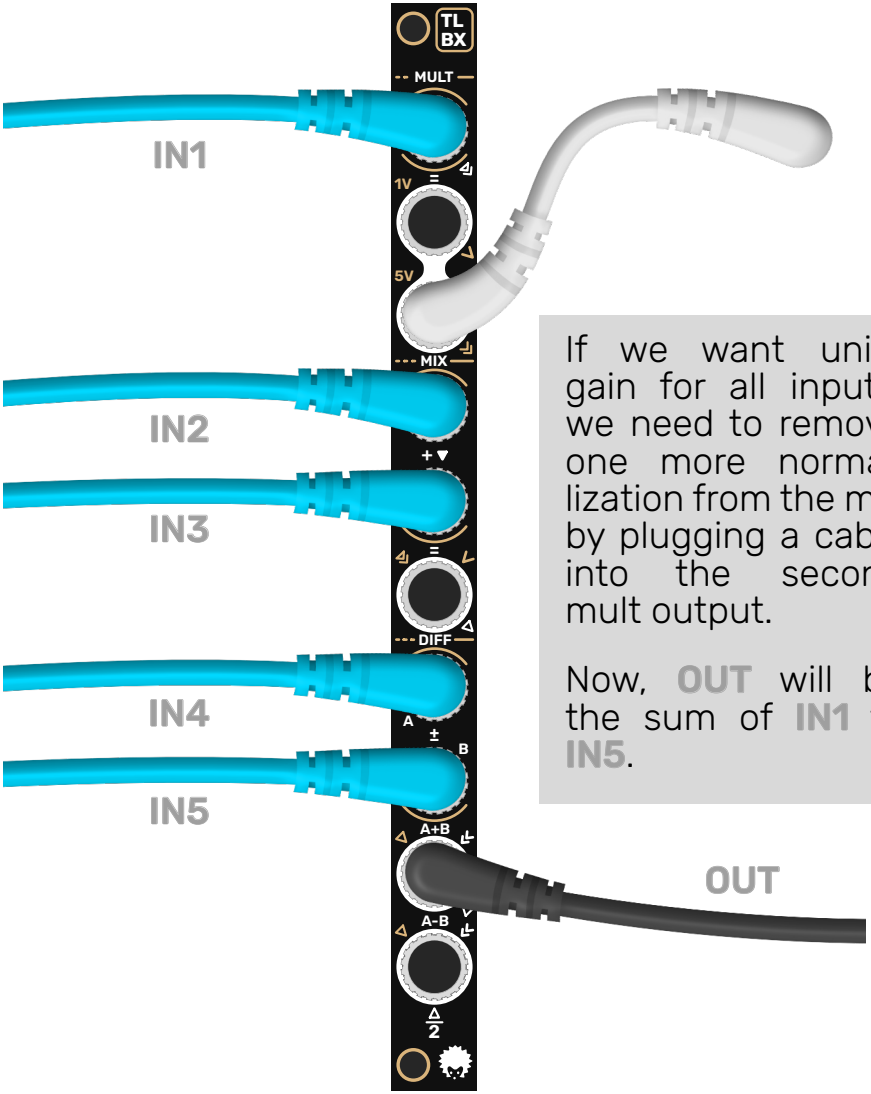


Using all inputs, but leaving all but one output unpatched, we can even create a 5-channel mixer.

Here, **OUT** will be the sum of **IN1** to **IN5**, with **IN1** having a gain of 2 (or +6db) and the other inputs having unity gain.

MULTIPLES & MIXING

5-CHANNEL MIXER (UNITY GAIN)

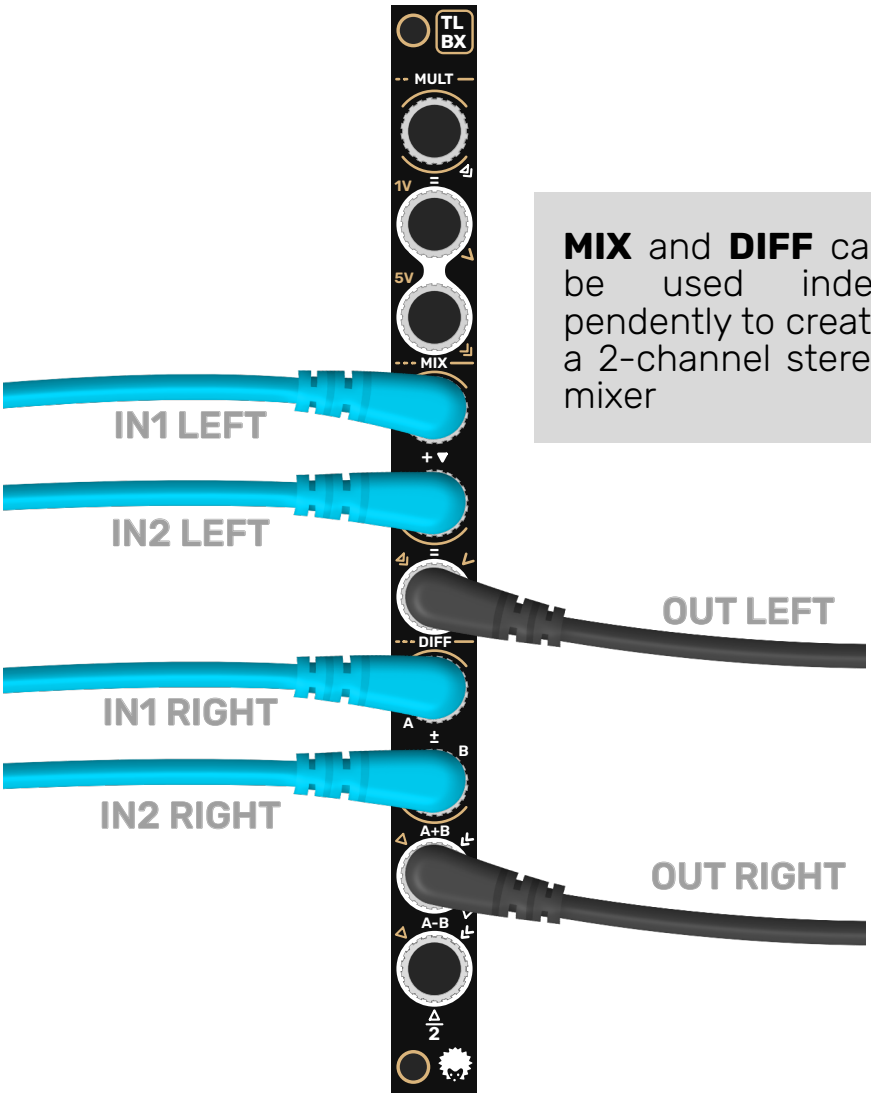


If we want unity gain for all inputs, we need to remove one more normalization from the mix by plugging a cable into the second mult output.

Now, **OUT** will be the sum of **IN1** to **IN5**.

MULTIPLES & MIXING

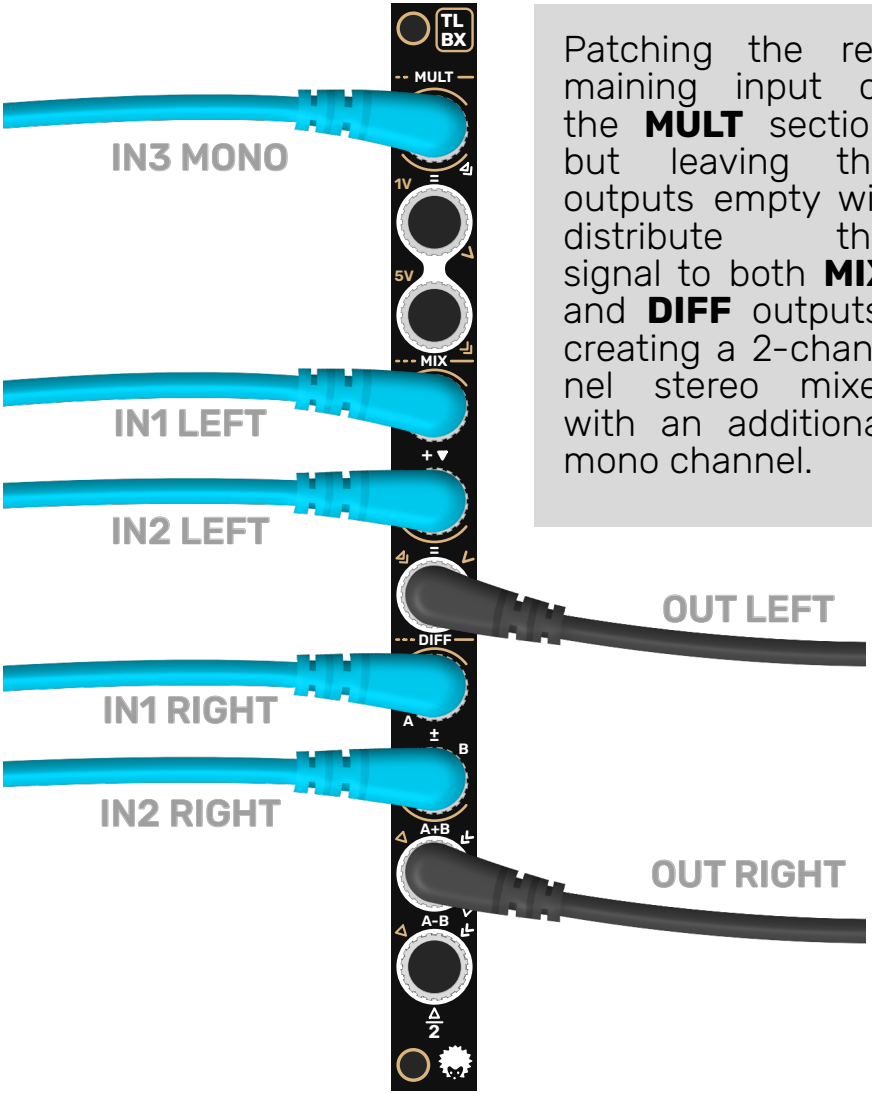
2-CHANNEL STEREO MIXER



MIX and **DIFF** can be used independently to create a 2-channel stereo mixer

MULTIPLES & MIXING

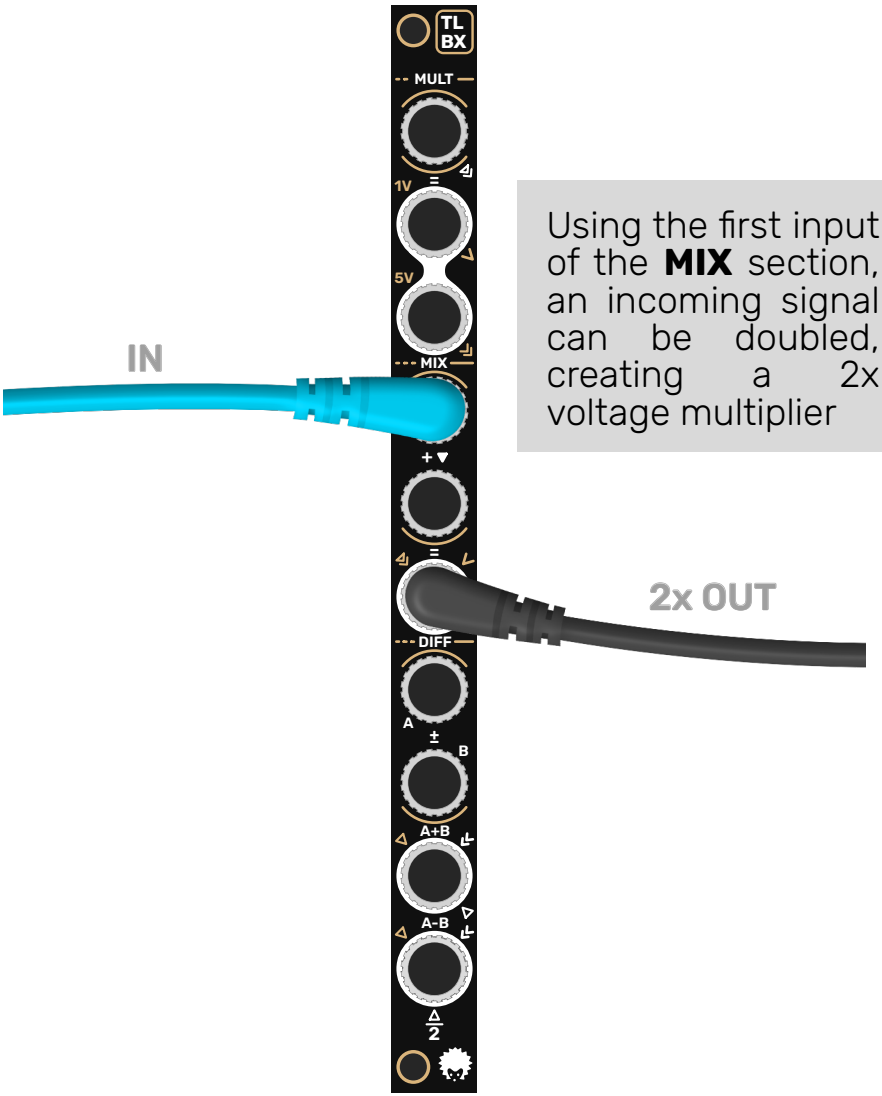
2.5-CHANNEL STEREO MIXER WITH MONO CHANNEL



Patching the remaining input of the **MULT** section but leaving the outputs empty will distribute the signal to both **MIX** and **DIFF** outputs, creating a 2-channel stereo mixer with an additional mono channel.

VOLTAGE MULTIPLICATION

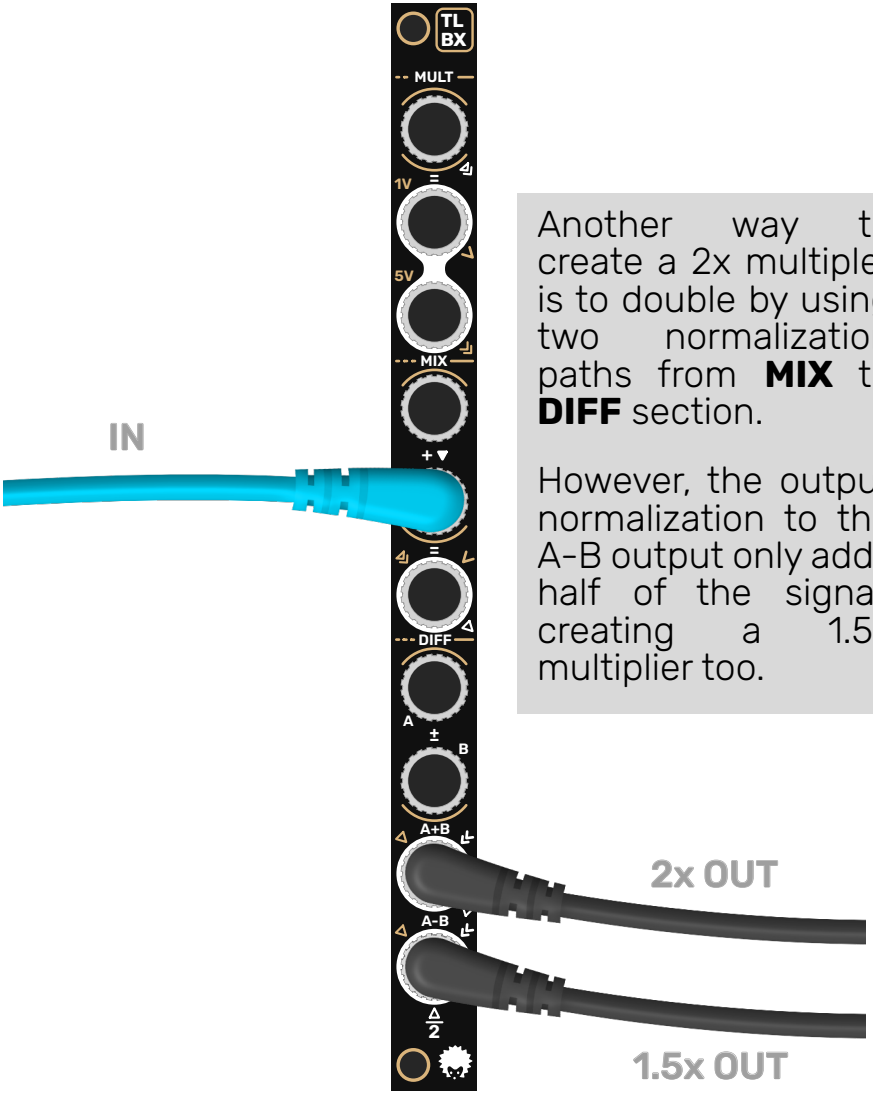
2X VOLTAGE MULTIPLIER



Using the first input of the **MIX** section, an incoming signal can be doubled, creating a 2x voltage multiplier

VOLTAGE MULTIPLICATION

1.5X VOLTAGE MULTIPLIER

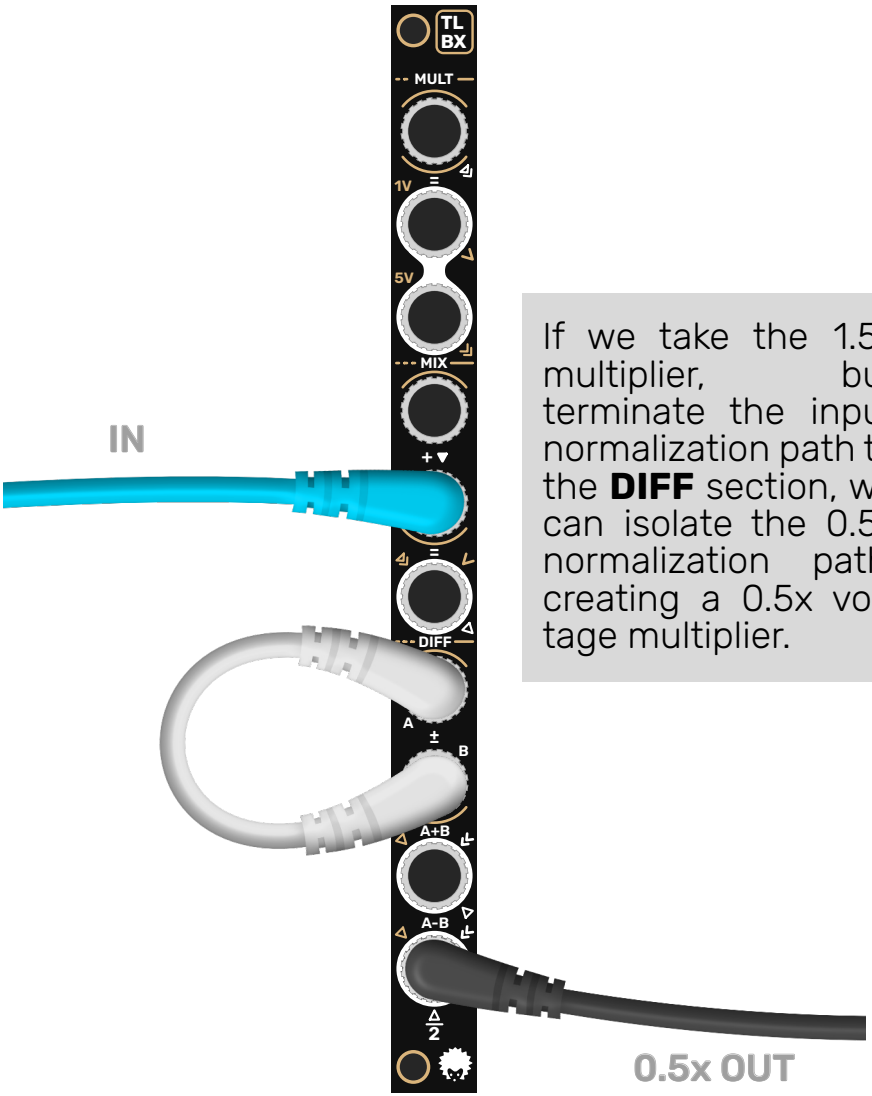


Another way to create a 2x multipler is to double by using two normalization paths from **MIX** to **DIFF** section.

However, the output normalization to the A-B output only adds half of the signal, creating a 1.5x multiplier too.

VOLTAGE MULTIPLICATION

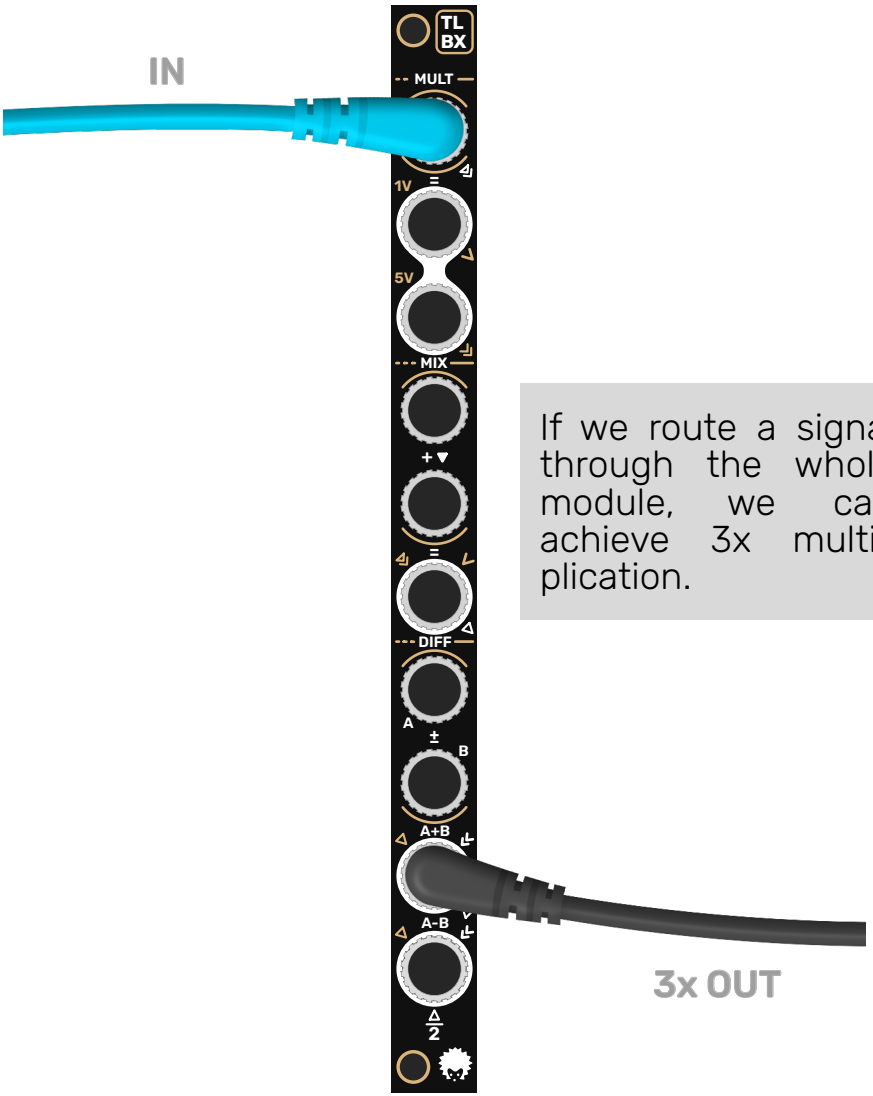
0.5X VOLTAGE MULTIPLIER



If we take the 1.5x multiplier, but terminate the input normalization path to the **DIFF** section, we can isolate the 0.5x normalization path, creating a 0.5x voltage multiplier.

VOLTAGE MULTIPLICATION

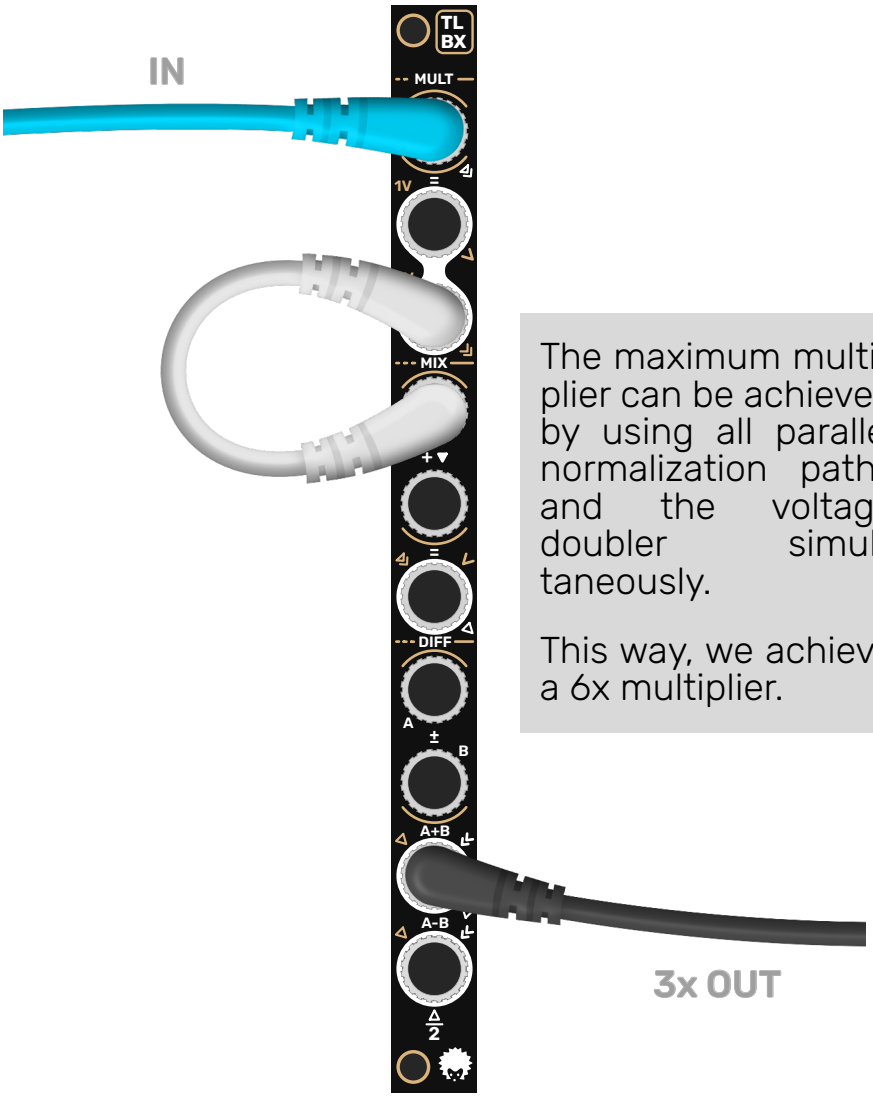
3X VOLTAGE MULTIPLIER



If we route a signal through the whole module, we can achieve 3x multiplication.

VOLTAGE MULTIPLICATION

6X VOLTAGE MULTIPLIER

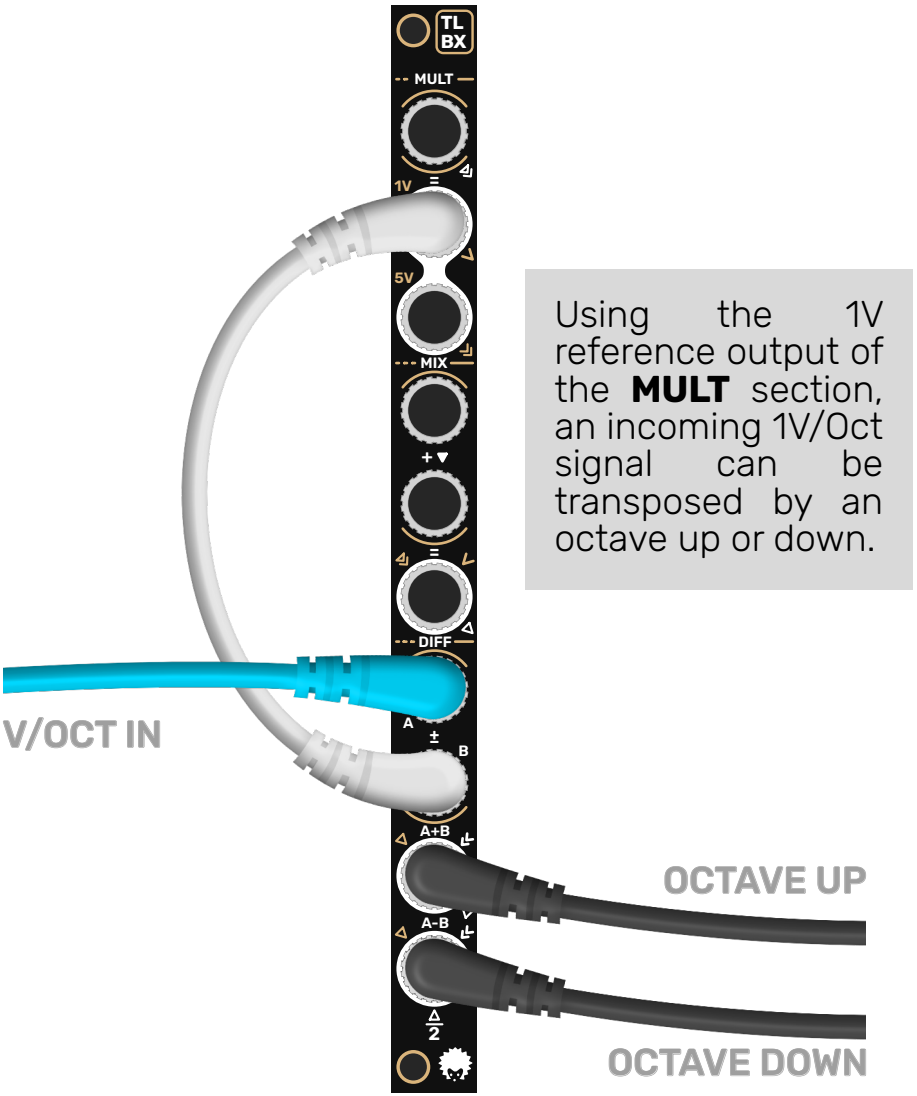


The maximum multiplier can be achieved by using all parallel normalization paths and the voltage doubler simultaneously.

This way, we achieve a 6x multiplier.

VOLTAGE TRANSPOSITION

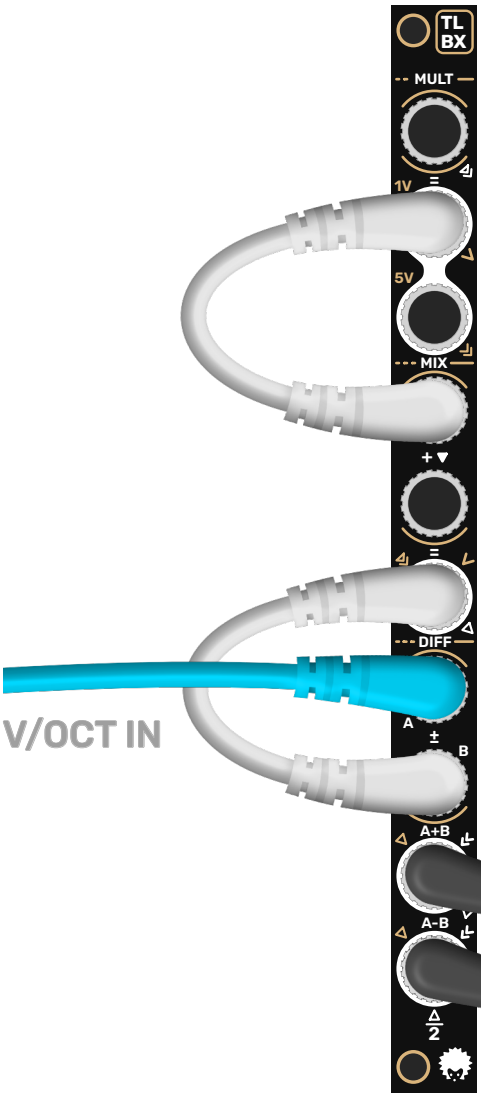
1-OCTAVE TRANSPOSER



Using the 1V reference output of the **MULT** section, an incoming 1V/Oct signal can be transposed by an octave up or down.

VOLTAGE TRANSPOSITION

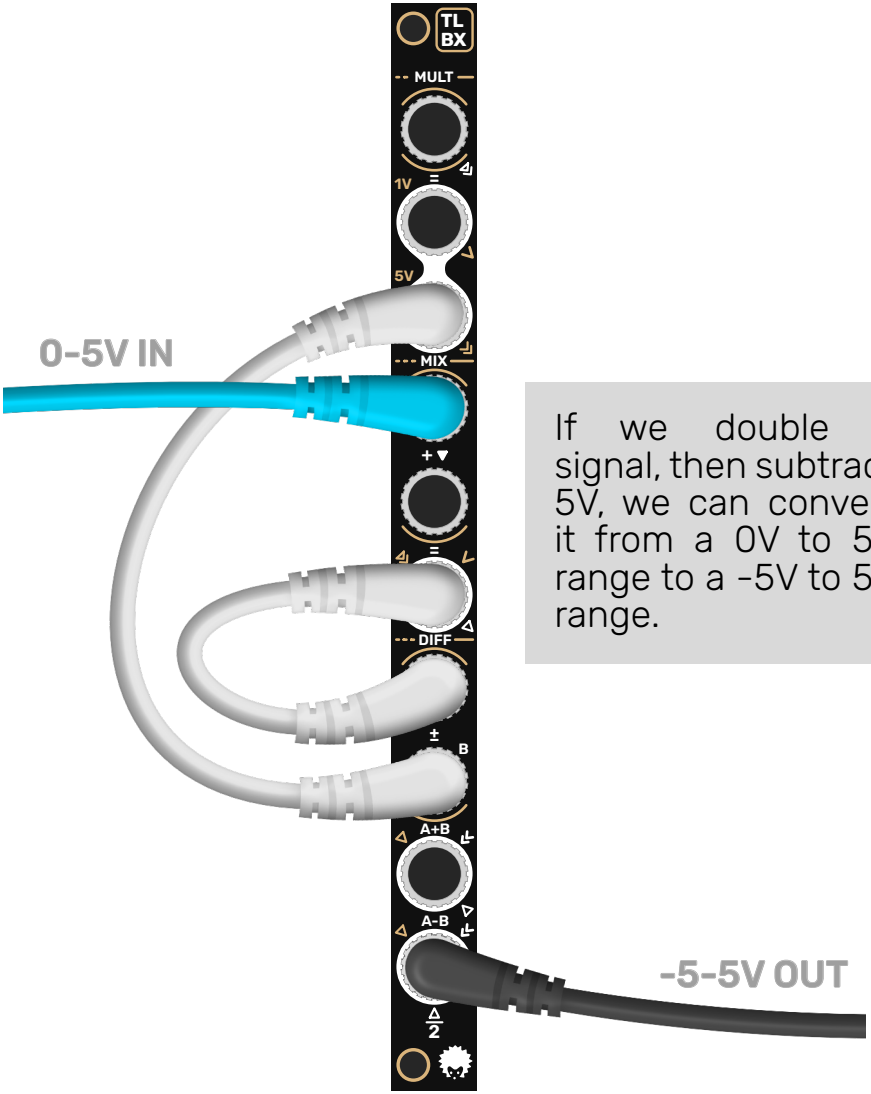
2-OCTAVE TRANSPOSER



Using the 1V reference output of the **MULT** section and doubling it using the **MIX** section, an incoming 1V/Oct signal can be transposed by two octaves up or down.

VOLTAGE RANGE CONVERSION

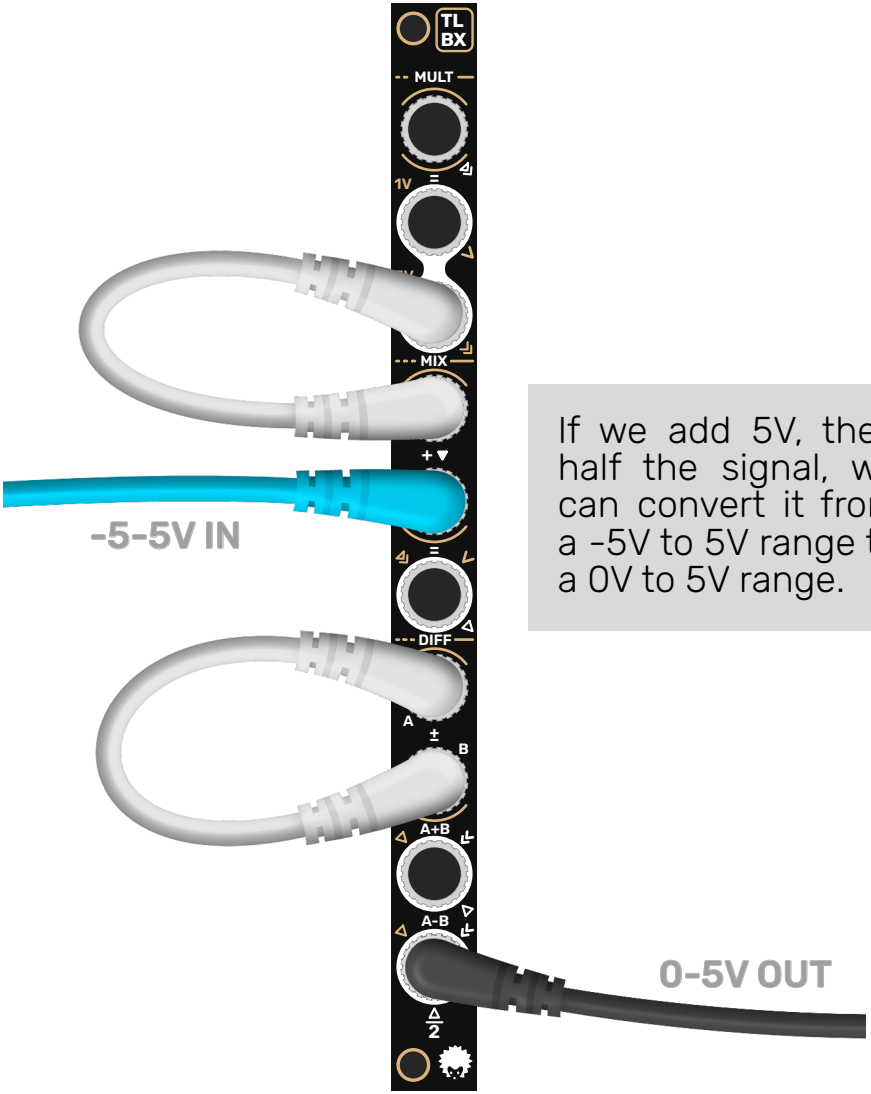
0-5V TO -5-5V



If we double a signal, then subtract 5V, we can convert it from a 0V to 5V range to a -5V to 5V range.

VOLTAGE RANGE CONVERSION

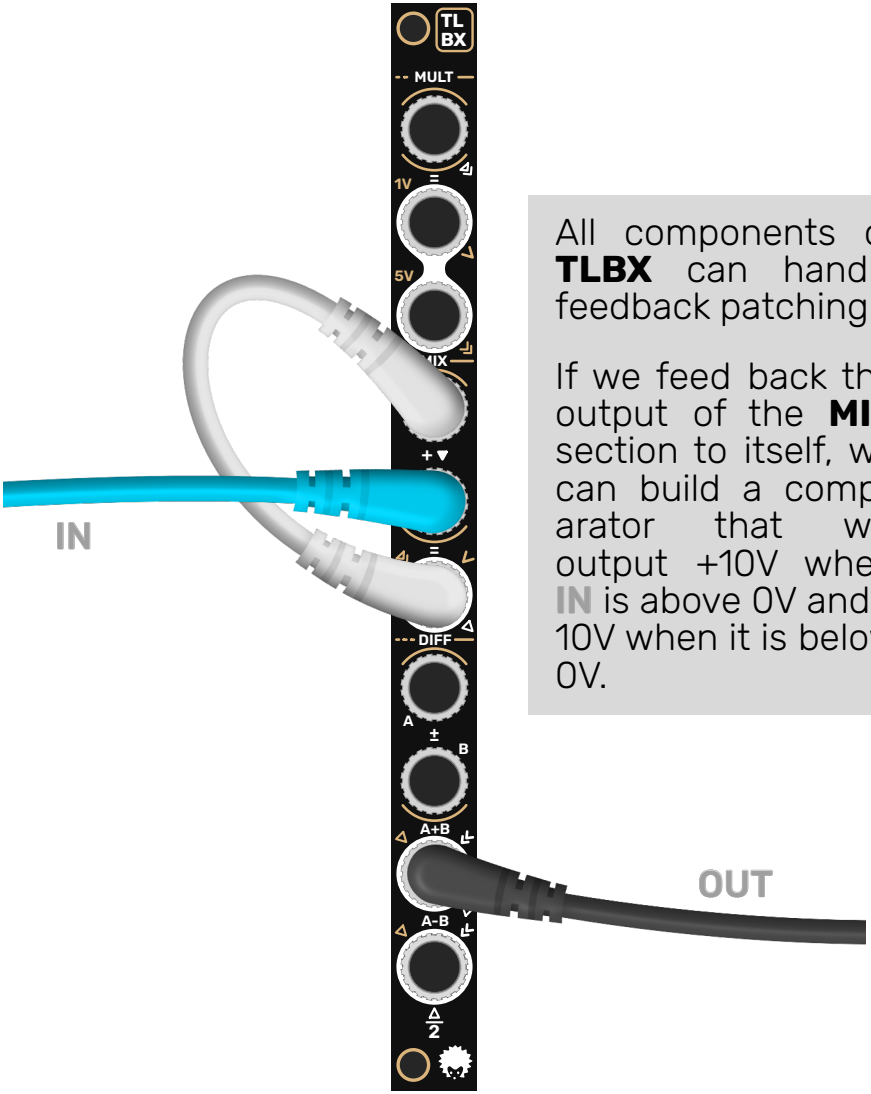
-5-5V TO 0-5V



If we add 5V, then half the signal, we can convert it from a -5V to 5V range to a 0V to 5V range.

FEEDBACK PATCHES

COMPARATOR



All components of **TLBX** can handle feedback patching.

If we feed back the output of the **MIX** section to itself, we can build a comparator that will output +10V when **IN** is above 0V and -10V when it is below 0V.

REFERENCE CALIBRATION

The voltage references of **TLBX** come calibrated out of the factory - 1V to an accuracy of <±1mV and 5V to <±2.5mV at room temperature.

Usually, calibration at home should not be necessary. However, certain factors can alter the calibration, such as humidity or physical stress.

To re-calibrate the references, follow these steps:

1. Remove the module from the case
2. Connect a power cable and turn it on - make sure to handle it carefully and not short any contacts!
3. Connect a cable to the 5V output and attach a multimeter with sufficient precision to it
4. Using a philips screwdriver, slowly and carefully turn the SMD trimmer on the back of the module in the top left corner
5. Check the value displayed on the multimeter until it is sufficiently close to 5V
6. Connect the cable to the 1V output instead and check the displayed value. Repeat the previous steps until you are satisfied
7. Turn off power, remove all cables and put the module back into its case!

SAFETY INSTRUCTIONS

- Make sure to handle the module carefully.
- Do not use force when installing the module.
- Only connect this module to power supplies conforming to the Eurorack standard. The recommended voltage for the rails is +12/-12V. Voltages higher than ±12V can harm the module.
- Do not expose the module to water, other liquids or conducting substances.
- Do not expose the module to temperatures below -20°C and above +50°C. Operating the module outside these specifications might harm it.
- This device complies with EU guidelines and is manufactured without the use of lead, mercury, cadmium or chrome according to RoHS.
- Do not dispose this module in standard household waste. Please dispose it as e-waste according to your local implementation of WEEE.

This module is designed and assembled by Pindsvik Audio in Germany.

If you have questions or requests, please send a mail to **support@pindsvikaudio.com**