

## INTRODUCTION

The window comparator is a very useful circuit building block that is common in general electronics, but rarely found in modular synths. While a regular comparator activates when the input signal voltage is higher than a threshold level, a window comparator checks if the voltage is between two levels (these form the 'window').

Compare 2 combines two such comparators and a logic section in 8 HP. The result is an advanced tool for extracting gates and pulses from analogue signals in Eurorack synths.

The detection windows are defined by the shift and size parameters, which can be varied using the knobs and control voltage (CV) inputs. Complementary gate outputs are available, with big three-colour LEDs showing each comparator's status in real-time.

All inputs are normalised from the left section to the right, but the two comparators can also be used completely independently. On the bottom, the gates from both comparators are combined in various ways by the logic section, which also features LEDs.

You'll find a use for this truly multi-functional module in practically any patch, processing either CV or audio: complex rhythm generator, dual pulse width modulator, frequency multiplier/divider with PWM, digital 'ring modulator' with PWM, dynamic depth VCO synchronizer, voltage controlled swing, logic function array with adjustable thresholds, dual set/reset latch... and many more applications waiting to be discovered!

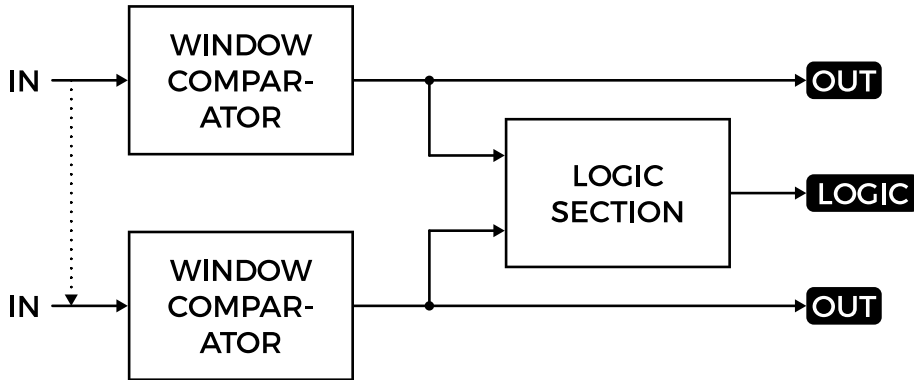
## CONTENTS

In the Compare 2 box, you'll find:

- Product card, stating serial number and production batch.
- 16-to-10-pin Eurorack power cable.
- Mounting hardware: two black M3 x 6 mm hex screws, two black nylon washers and a hex key.
- The Compare 2 module itself, in a protective cotton bag.

If any of these items are missing, please contact your dealer or [support@joranalogue.com](mailto:support@joranalogue.com).

## SIGNAL FLOW



| Input    Output    → Connection    ⋯▶ Normalised connection    Mixer

## CONTROLS & CONNECTIONS

### 1 SHIFT KNOBS

Each of the identical window comparators features a knob to offset the window's centre. The range is  $-5\text{ V}$  to  $+5\text{ V}$ , with  $0\text{ V}$  in the centre position.

### 2 SIZE KNOBS

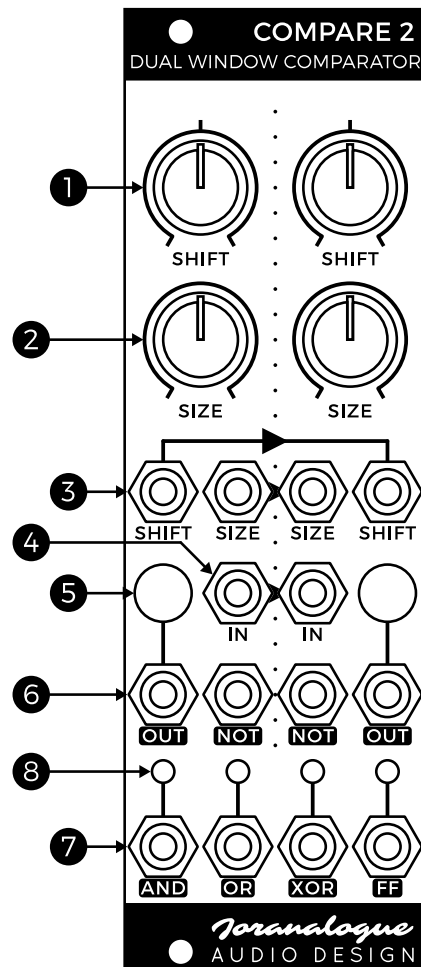
Each comparator also includes a size knob, which controls the distance between the window edges, from very small (a few mV) to  $10\text{ V}$  maximum.

### 3 SHIFT AND SIZE CV INPUTS

The windows can be independently modulated using these CV inputs. The modulation voltages are then added to the knob settings to generate the final detection windows.

The CVs of the left comparator are normalised to the right, so both comparators can be voltage controlled together.

Note that both CV inputs can process negative control voltages as well. In the case of the size parameter, this can cause the window to become negative, which simply means the comparator output will never become active.



#### **4 SIGNAL INPUTS**

Connect the analogue signals you want to extract gates and pulses from to these sockets. Both CV and audio can be processed. These sockets are also normalised left to right, so by default the same signal is sent to both comparators.

#### **5 COMPARATOR LEDS**

Compare 2's most striking feature are the two multi-colour LEDs, which visualise the status of each comparator. They light up blue when the input voltage is below the window, red when above and white when inside.

If the window size is negative, and the signal is within this 'negative window', the LED will turn off rather than turn white.

#### **6 GATE OUTPUTS**

When a comparator detects the input signal inside the window, the corresponding main gate output, labelled 'OUT', will be active (+5 V). Otherwise, it is inactive (0 V).

The NOT output is logically inverted, so it is active whenever the main output is inactive and vice versa.

#### **7 LOGIC SECTION OUTPUTS**

The outputs from both comparators are sent to the logic section, where additional signals are derived. AND will be active only when both comparators are active, OR when one or both are active and XOR only when one is active. Rising edges of the XOR signal also toggle a flip-flop ('FF'). All these outputs are +5 V active, 0 V inactive.

#### **8 LOGIC SECTION LEDS**

Each logic output has a corresponding LED which lights up whenever it is active.

## PATCH IDEAS

### COMPLEX RHYTHM GENERATOR

Patch a LFO signal to the left comparator input. Now, different gate signals will be generated on the logic outputs at different points in the LFO cycle, depending on the knob settings. These can be used to trigger envelopes, drum modules, sequencers etc. Change the rhythms by turning the parameter knobs or using the CV inputs.

### DUAL PULSE WIDTH MODULATOR

Compare 2 can also be used at audio frequencies. Connect an analogue waveform from a VCO (preferably triangle) to a comparator's input. Connect the gate output to a mixer, line output module etc. so you can hear it. A pulse waveform is generated, controlled by the shift and size parameters. Unlike a regular pulse, the frequency can transition between fundamental and +1 octave. Phase modulation is also possible, by modulating the shift parameter with a narrow window size. Each comparator can function as an independent pulse width modulator.

### FREQUENCY MULTIPLIER/DIVIDER

This patch idea is similar to the dual pulse width modulator, except the same signal is sent to both comparators and the XOR output is used. Depending on the window parameters, the output signal's frequency can now transition between fundamental, +1 and +2 octave shift, with various complex pulse waveforms. Use the FF output for -1/0/+1 octave shift.

### DIGITAL RING MODULATOR

By connecting signals with two different frequencies to both comparator signal inputs and using the XOR as an audio output, digital ring modulation-type sounds can be generated. The knobs and CV inputs allow these sounds to be pulse width-modulated.

### DYNAMIC DEPTH OSCILLATOR SYNC

Using Compare 2, any VCO can be given soft-synchronization capability with dynamic depth. Connect one of the to-be sync'ed VCO's outputs to input 1, and the sync source signal (usually another VCO) to input 2. Now patch the XOR output to the VCO's FM input. This input should have a dedicated modulation depth knob.

Listen to one of the VCO's outputs. The sync timbre will depend on the frequencies of the VCO and sync source, the FM depth and Compare 2 parameters. Send the FM signal through a VCA for voltage control over the sync depth.

### LOGIC FUNCTION ARRAY

If you just need logic functions to combine gate signals in a particular patch, Compare 2 can be used for that as well. In this case, you'll want to ensure the comparators are inactive when the input signal is 0, and active when it is +5 V. Set the shift knob to maximum and size to the centre position. The window's edges will now be set at +2.5 V and +7.5 V, reliably activating the comparator on gate signals as long as they do not exceed +7.5 V. Now just patch the outputs as needed.

The shift and size CV inputs can function as additional gate inputs, giving AND or OR functions in combination with the signal input, depending on the window settings. This means a total of 6 gate input signals can be processed for complex logic functions.

### SET/RESET LATCH

Each of Compare 2's window comparators can be used as a set/reset latch. Assuming +5 V gate/trigger signals are used for set and reset, turn the shift knob to its minimum position and size to 3 o'clock. Next, connect the output to the size input. A rising edge applied to the shift CV input will set the latch, while one on the signal input will reset it.

## **SPECIFICATIONS**

### **MODULE FORMAT**

Doepfer A-100 'Eurorack' compatible module  
3 U, 8 HP, 30 mm deep (inc. power cable)  
Milled 2 mm aluminium front panel with non-erasable graphics

### **MAXIMUM CURRENT DRAW**

+12 V: 20 mA  
-12 V: 15 mA

### **POWER PROTECTION**

Reverse polarity (MOSFET)

### **I/O IMPEDANCE**

All inputs: 100 k $\Omega$   
All outputs: 1 k $\Omega$

### **OUTER DIMENSIONS (H X W X D)**

128.5 x 40.3 x 43 mm

### **MASS**

Module: 95 g  
Including packaging and accessories: 180 g

## **SUPPORT**

As all Joranalogue Audio Design products, Compare 2 is designed, manufactured and tested with the highest standards, to provide the performance and reliability music professionals expect.

In case your module isn't functioning as it should, make sure to check your Eurorack power supply and all connections first.

If the problem persists, contact your dealer or send an email to [support@joranalogue.com](mailto:support@joranalogue.com). Please mention your serial number, which can be found on the product card or on the module's rear side.

## **REVISION HISTORY**

Revision D: no functional changes.

Revision C: initial release.

With compliments to the following fine people,  
who helped to make Compare 2 a reality!

Björn Jauss   Boris Uytterhaegen

Gregory Delabelle   Jan D'Hooghe

Jean Rochet   Jens Van Daele

Lieven Stockx   Olivier Carlier

Everyone at Wired Electronics

Compare 2 User Manual  
version 2023-06-26

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AUDIO DESIGN

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Designed & made in Belgium