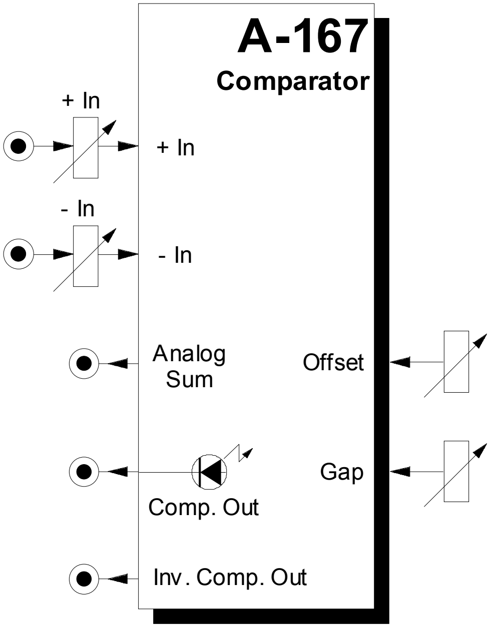


1. Introduction

Module A-167 **compares analog voltages** and derives a **gate signal**. The **state** of the gate output (low/ high) depends upon which of the voltages is higher.

It is possible to **compare two external voltages** (+In and -In) **or** an **external voltage** (+In or -In) **with a manually adjustable value** (Offset control). Both analog inputs +In and -In are equipped with an **attenuator**.

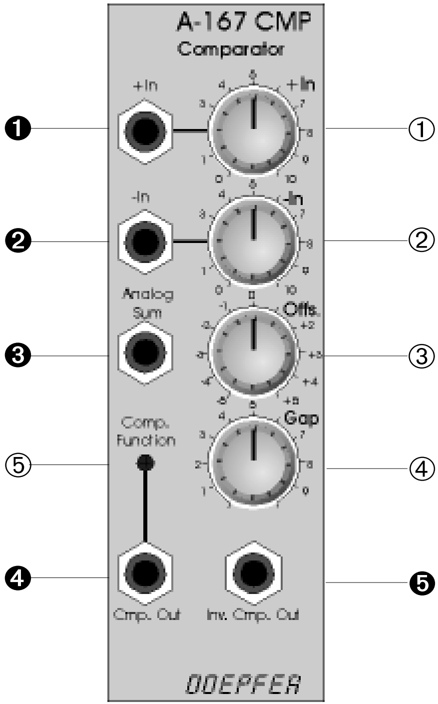
A **LED** shows the current state of the gate output.

The **Gap** control is used to adjust a so-called "**hysteresis**". As long as this control is set to zero the switching levels for both on and off state of the gate signal are identical. As soon as the Gap control is turned up the switching levels for on and off state fall apart and a so-called hysteresis appears.

Normal and inverted gate outputs are available.

In addition the **internal voltage a1*(+In) - a2*(-In) + Offset** is available at the Analog Sum socket. Consequently the module can be used as **subtractor** and **offset generator** too.

2. Overview



Controls:

① **+ IN** : Attenuator for voltage at input ❶

② **- IN** : Attenuator for voltage at input ❷

③ **Offs.** : Offset control

④ **Gap** : Control to adjust the hysteresis

⑤ **Comp. Function** : Gate indicator (LED)

In- / Outputs:

❶ **+ In** : Non-inverting voltage input

❷ **- IN** : Inverting voltage input

❸ **Analog Sum** : Analog voltage output, makes available the internal voltage:

a1*(+In) - a2*(-In) + Offset

❹ **Cmp. Out** : Gate output

❺ **Inv. Cmp. Out** : Inverted gate output

3. Basic principle

The module generates internally the voltage U_{SUM}:

$$U_{SUM} = a_1 \cdot In^+ - a_2 \cdot In^- + Offset$$

The factors a_1 and a_2 represent the manual attenuators of the inputs In^+ und In^-. According to the sign (+/-) of the resulting voltage U_{SUM} the gate output is activated:

$U_{SUM} > 0$: Gate = "high" (~ +10V)
$U_{SUM} \leq 0$: Gate = "low" (~ 0V)

The internal voltage U_{SUM} is available at the socket ❸. Consequently the module can be used to attenuate and subtract analog voltages and to add a fixed offset voltage to a voltage (similar to one of the sub-units of the Attenuator/Offset Generator A-129-3).

The Gap control ④ is used to adjust the so-called "hysteresis" voltage. As long as this control is set to zero the switching levels for both on and off state of the gate signal are identical. As the Gap control is turned up the switching levels for on and off state fall apart and a so-called *hysteresis* appears. In this case after a state change of the gate output the internal voltage U_{SUM} has to vary at the hysteresis amount before the gate state will change back.

Fig. 1 illustrates the Gap resp. hysteresis function by means of a triangle LFO input signal.

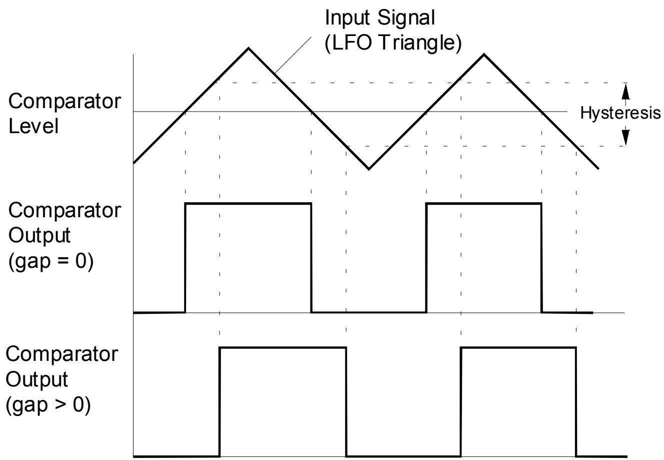


Fig. 1: Effect of the Gap control on the gate signal

4. Controls

① + In • ② - In

The controls ① and ② are the attenuators for the voltages fed to the sockets ❶ resp. ❷.

③ Offs.

This control **adds** a manually adjustable **Offset voltage**, i.e. a fixed value is added to the internally calculated voltage difference $a_1 \cdot In^+ - a_2 \cdot In^-$. The adjustable offset range is approximately -10 V (fully counterclockwise) to +10 V (fully clockwise). In the middle position the offset is approximately 0 V.

If only one of the inputs is used the module works as an **offset generator** (and attenuator); the attenuated and - if input ❷ is used - inverted voltage with offset is available at the Analog Sum socket ❸ (see fig. 2 and chapter 6).

④ Gap

This control is used to adjust the **hysteresis** (see chapter 3 for details).

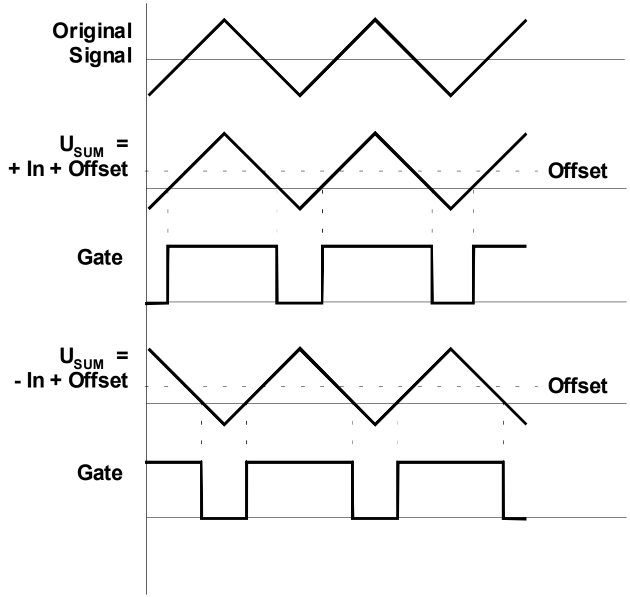


Fig. 2: A-167 as attenuator / offset generator

⑤ Comp. Function

LED ⑤ lights up if the internal voltage U_{SUM} is positive (> 0V) and consequently the Gate output is "high" (~ +10V).

5. In - / Outputs

❶ + IN

The **input signal** fed into this socket is attenuated with control ① and **added** to the internal voltage (U_{SUM}).

❷ - IN

The **input signal** fed into this socket is attenuated with control ② and **subtracted** from the internal voltage (U_{SUM}).

❸ Analog Sum

At this socket the **internal voltage U_{SUM}** is available (see chapter 3).

❹ Cmp. Out • ❺ Inv. Cmp. Out

The **Gate output ❹** is "high" (~ +10V) if the internal voltage U_{SUM} is positive. Otherwise it is "low" (~ 0V). The **inverted Gate output ❺** always has the opposite state of the normal gate output ❹. Consequently this output is "low" if the internal voltage U_{SUM} is positive. Otherwise it is "high".

6. User examples

The main application of module A-167 is the **generation of gate signals depending upon analog voltages**, e.g. a gate signal that depends upon the present value of a LFO (triangle), ADSR or random signal can be generated and used to control a voltage controlled switch that on the other hand switches different control voltages or audio signals. More examples shows the following table:

Signal at + In	Signal at - In	Offset	Meaning concerning U_{SUM} at ❸
•		> 0	(positive) offset generator
•		< 0	(negative) offset generator
	•	> 0	(positive) inverting offset generator
	•	< 0	(negative) inverting offset generator
•	•	0	subtractor
•	•	> 0	subtractor + (positive) offset generator
•	•	< 0	subtractor + (negative) offset generator

The module can even be used to add the **free-running mode** to each **ADSR** (e.g. A-140 or A-141) similar to a LFO but with separate controls for rising and falling edge and exponential waveforms - in contrast to the linear waveforms of a LFO.

In the patch of fig. 3 the *ADSR-LFO* is **gated** by means of the gate input of the A-140 (e.g. with another LFO or a gate signal controlled by a keyboard or MIDI interface). This means that the "ADRS-LFO" oscillates only as long as the gate input of the A-140 is "high". The waveform and frequency of the ADSR-LFO is determined by the controls Attack, Decay, Sustain and Release of the A-140, and Offset and +In of the A-167. The Gap setting of the A-167 is irrelevant.

☞ Only certain control settings lead to an "ADSR-LFO" (especially Offset, +In and Sustain) !

The patch in fig. 4 shows another *ADSR-LFO*. Waveform and frequency are deterrmined by the parameters Attack and Release of the A-140, and Offset, Gap and +In of the A-167. Decay and Release of the A-140 are irrelevant.

☞ Even in this patch only certain control settings lead to an "ADSR-LFO" (Offset, +In and Gap) !

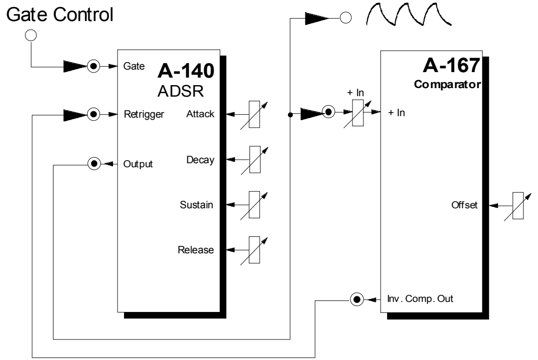


Fig. 3: *ADSR-LFO 1*

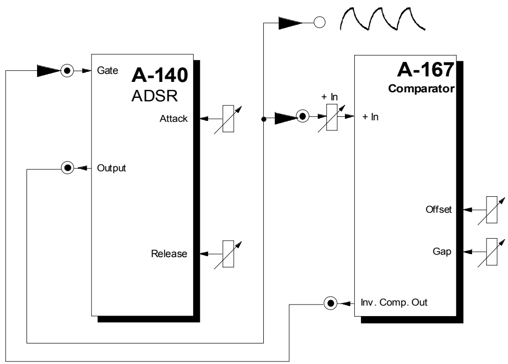


Fig. 4: *ADSR-LFO 2*