Block 23 — Comparator Circuits

Student Group

First Name	Surname	Matrikel Nr.

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Learning objectives

> After this 90-minute block, you can
>
> - …

Preparation at Home

Well, again

- read through the present chapter and write down anything you did not understand.
- Also here, there are some clips for more clarification under 'Embedded resources' (check the text above/below, sometimes only part of the clip is interesting).

For checking your understanding please do the following exercises:

- …

90-minute plan

1. Warm-up (x min):
    1. ….
2. Core concepts & derivations (x min):
    1. …
3. Practice (x min): …
4. Wrap-up (x min): Summary box; common pitfalls checklist.

Conceptual overview

> 1. …

Core content

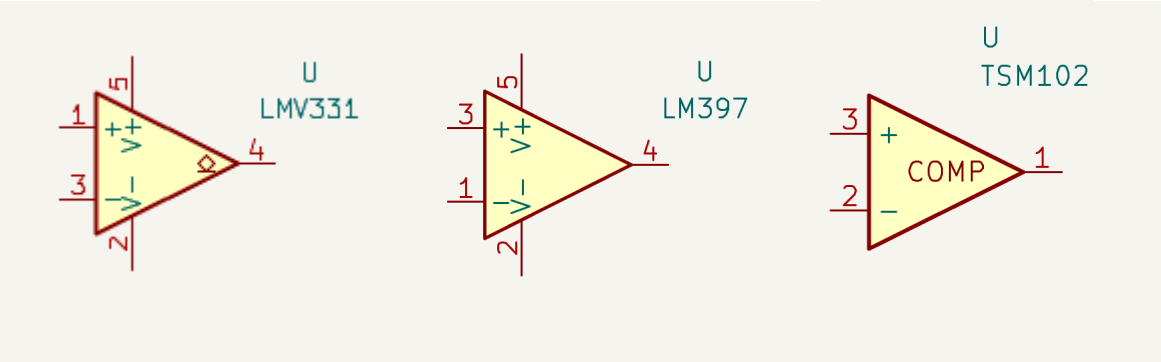
Comparator

Up to now we focussed on operational amplifier, which is only usable in a closed-loop setup. However, it also as a “special brother”, the **comparator**.
The differences form the comparator in contrast to the operational amplifier are:

1. It is **only used in positive feedback**. It should never be used in negative feedback.
2. It is optimized for **fast switching**

3. It only outputs **in saturation**, which means it only has two possible outputs, see details below.

The symbol is related to the op-amps triangular shape - often the exact same symbol is used.



So, but what is the output, now? For this, it helps to have a look onto the simulation below.
There are two types of comparators:

1. **comparators with open-collector output**:
   This type outputs the minimum value, when the non-inverted input is bigger than the inverted one.
   Otherwise, the output is **high-ohmic** or **undefined**.
   This is sometimes shown by a diamond shape ◇ on the output.
   $$U_{\rm O,OC}= \biggl\{ \begin{array}{l} &&\text{undefined} &&\text{for} &&U_{\rm p}>U_{\rm n}\\ &&U_{\rm sat, min} &&\text{for} &&U_{\rm p}<U_{\rm n} \end{array}$$
2. **comparators with push-pull output**:
   This type outputs the minimum value, when the non-inverted input is bigger than the inverted one.
   Otherwise, it outputs the maximum value.
   $$U_{\rm O, PP}= \biggl\{ \begin{array}{l} &&U_{\rm sat, max} &&\text{for} &&U_{\rm p}>U_{\rm n}\\ &&U_{\rm sat, min} &&\text{for} &&U_{\rm p}<U_{\rm n} \end{array}$$

Common pitfalls

- …

Exercises

Worked examples

…

Embedded resources

Longer tutorial on Schmitt trigger