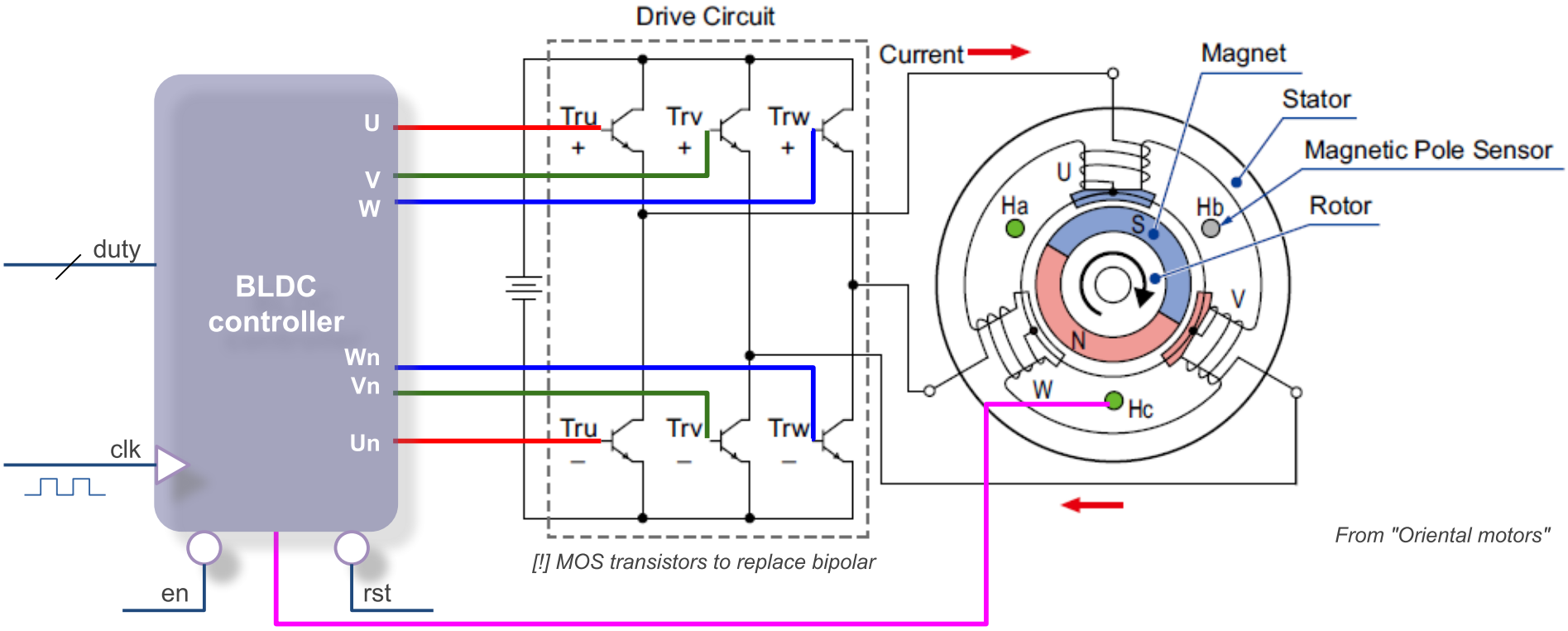
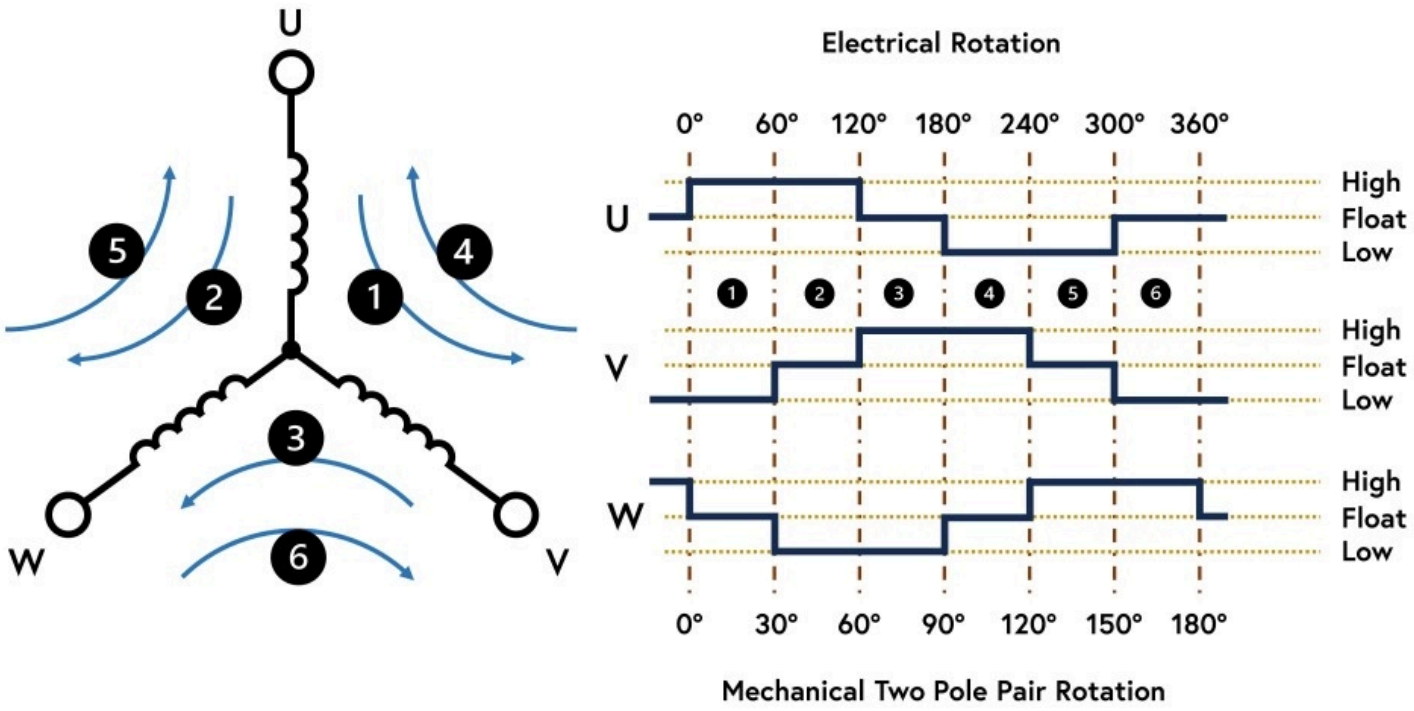
TP8 - BLDC controller

BLDC stands for "brushless direct current" and is related to a type of motor making use of permanent magnets on their rotor. These high reliability motors are intended for heavy duty purposes and can be found in drones, servers … and hard drives !

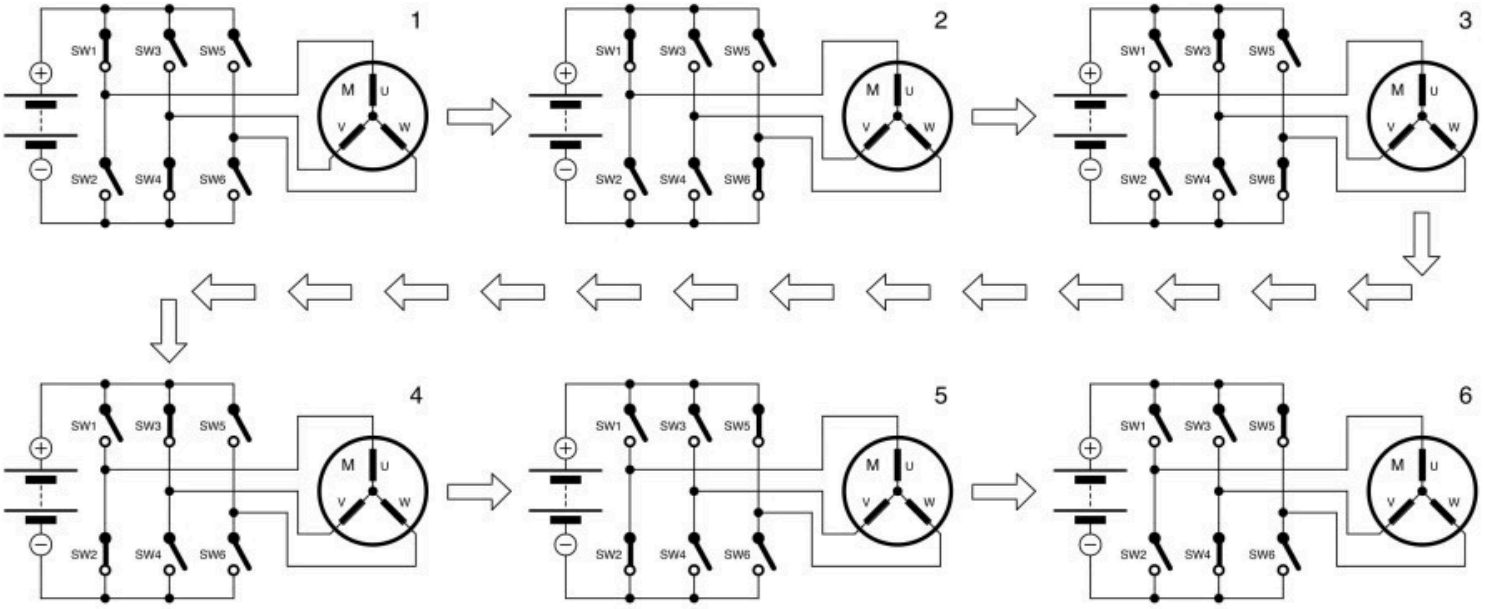


[!] MOS transistors to replace bipolar

Unlike DC motors, a BLDC motor requires 3 phases sequenced in a precise timing.
As shown above, your "*BLDC controller*" circuit will be in charge of driving the six transistors of the "*driver*" part of the system. It is worth mentioning that "*electrical speed*" may differ from "*mechanical speed*" (e.g startup phase with mechanical load), hence we'll make use of a feedback signal. This signal will either come from a hall effect sensor located within the stator … or (and probably easier to use) a simple optical signal that detects the position of the disk in the hard drive BLDC use case (see photos below).



Excerpt from Elektor magazine: "BLDC Guide du débuttant"



Excerpt from Elektor magazine: "BLDC Guide du débuttant"

Speed control

You'll make use of PWM control to adjust the speed of the brushless motor. Additionally, there will be a ramp UP and ramp DOWN effect to avoid high pulses of energy, exemple:

- motor is at stop and the speed control is set at its maximum … then you'll smoothly increase the speed up to the specified value.

BLDC controller

By means of a FPGA, we'd like you to implement the logical part of the controller as a component.
Unfortunately, this kind of controller requires a LOT of parameters … but to ensure your success as a first step undertaking such a device, we'll restrain ourselves to the following generic parameters:

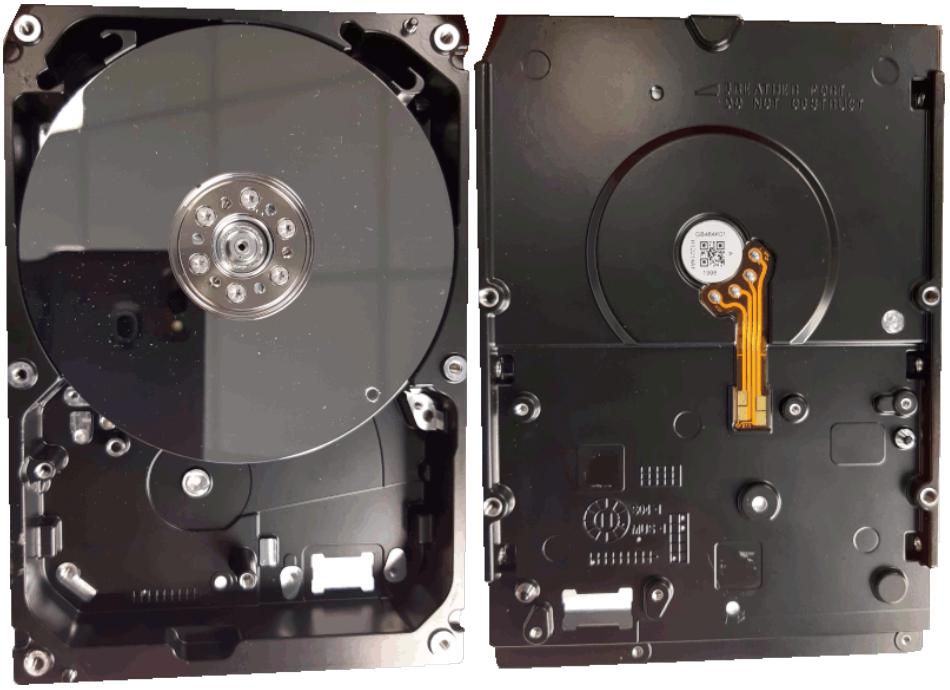
- **MAX_CPT** → defines a whole phase cycle expressed as number of ticks of the main clock

As an example, let's say our main clock has a 1MHz frequency. On the other end, our motor requires a 50Hz phase cycle ⇒ MAX_CPT will get set at (1MHz/50) at instantiation (or synthesis) time.

to be continued

Use case

In order to avoid destroying one of our electrical vehicles (!), we'll make use of specifically prepared hard drives for such an experiment.



to be continued

Links

[Elektor] BLDC newbies guide
https://www.elektormagazine.fr/articles/contr%C3%B4le-des-moteurs-bldc-guide-du-d%C3%A9butant