



8. Motor Controls

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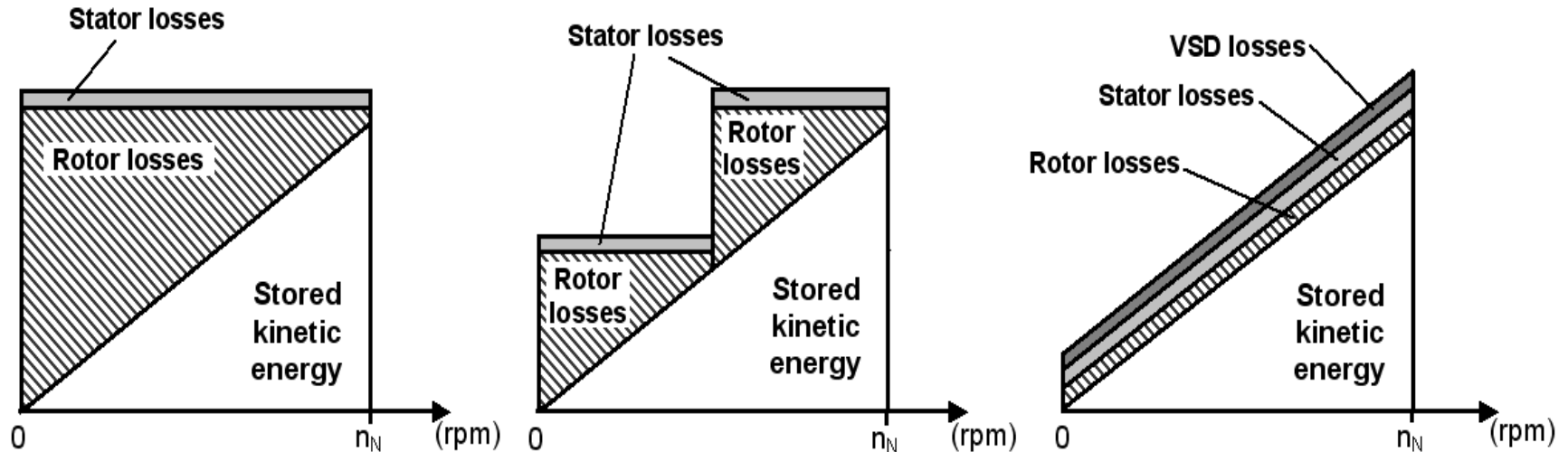


Discussed topics

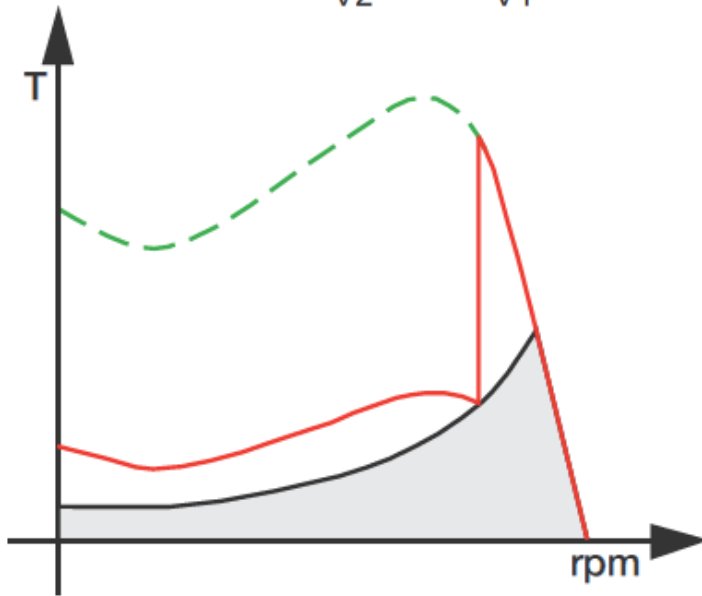
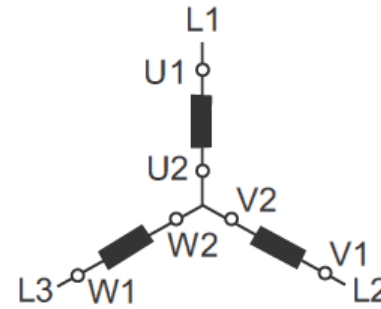
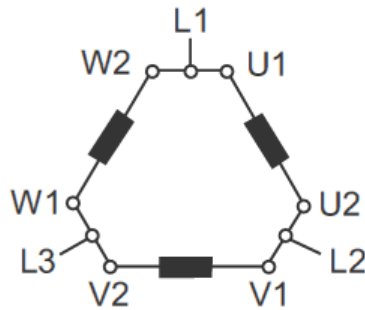
- Starting
- Soft-Starters
- Variable Speed Drives

Motor Controls - Starting

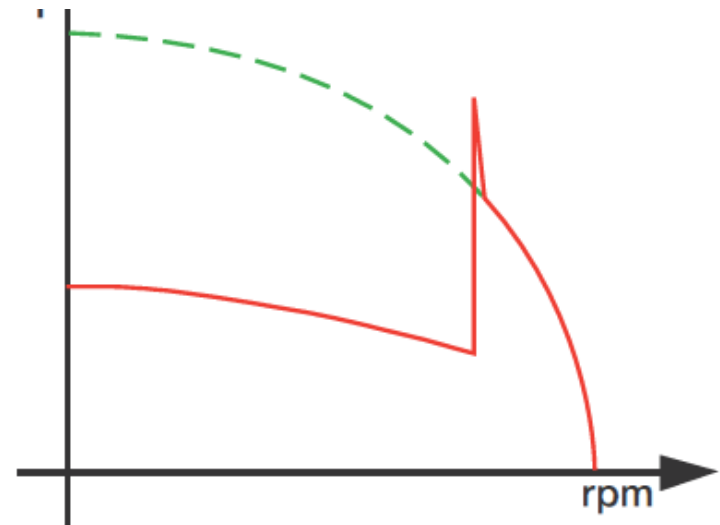
Energy-Consumption for an Acceleration Period: (a) Standard Motor; (b) Pole Changeable Motor; (c) Variable Speed Drive (VSD).



Star / Delta Start



Torque/speed curve at Star-Delta start



Current curve at Star-Delta start

Soft Starter

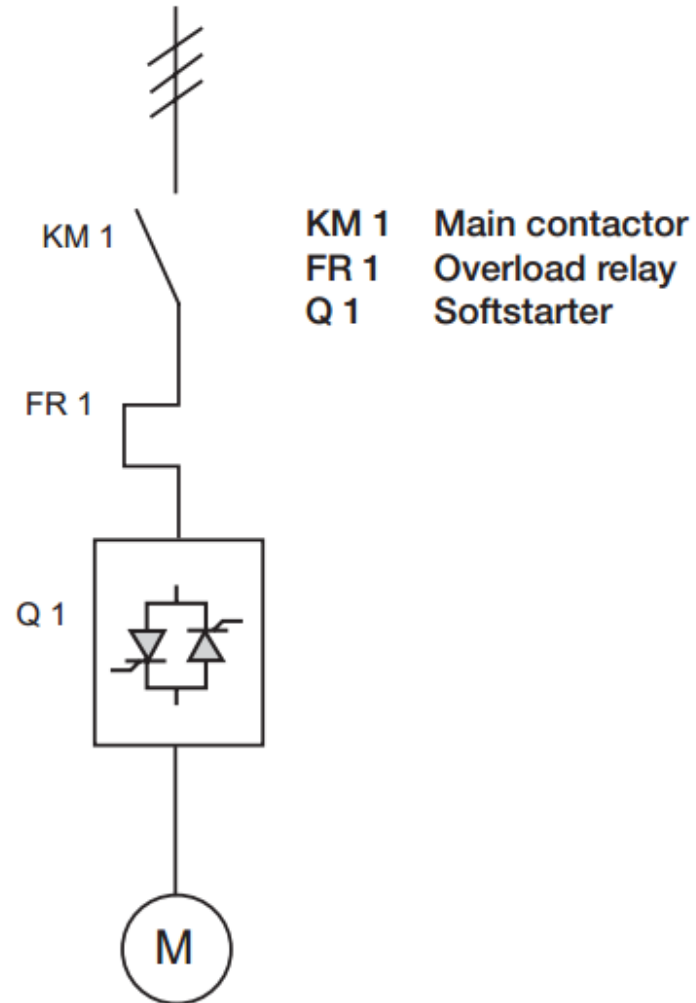
- A soft starter has different characteristics to the other starting methods. It has thyristors in the main circuit, and the motor voltage is regulated with a printed circuit board. The softstarter makes use of the fact that when the motor voltage is low during start, the starting current and starting torque is also low.
- During the first part of the start the voltage to the motor is so low that it is only able to adjust the play between the gear wheels or stretching driving belts or chains etc. In other words, eliminating unnecessary jerks during the start.

Soft Starter

- Gradually, the voltage and the torque increase so that the machinery starts to accelerate. One of the benefits with this starting method is the possibility to adjust the torque to the exact need, whether the application is loaded or not. In principle the full starting torque is available, but with the big difference that the starting procedure is much more forgiving to the driven machinery, with lower maintenance costs as a result.
- Another feature of the softstarter is the softstop function, which is very useful when stopping pumps where the problem is water hammering in the pipe system at direct stop as for star-delta starter and direct-on-line starter. The softstop function can also be used when stopping conveyor belts to prevent material from damage when the belts stop too quickly.

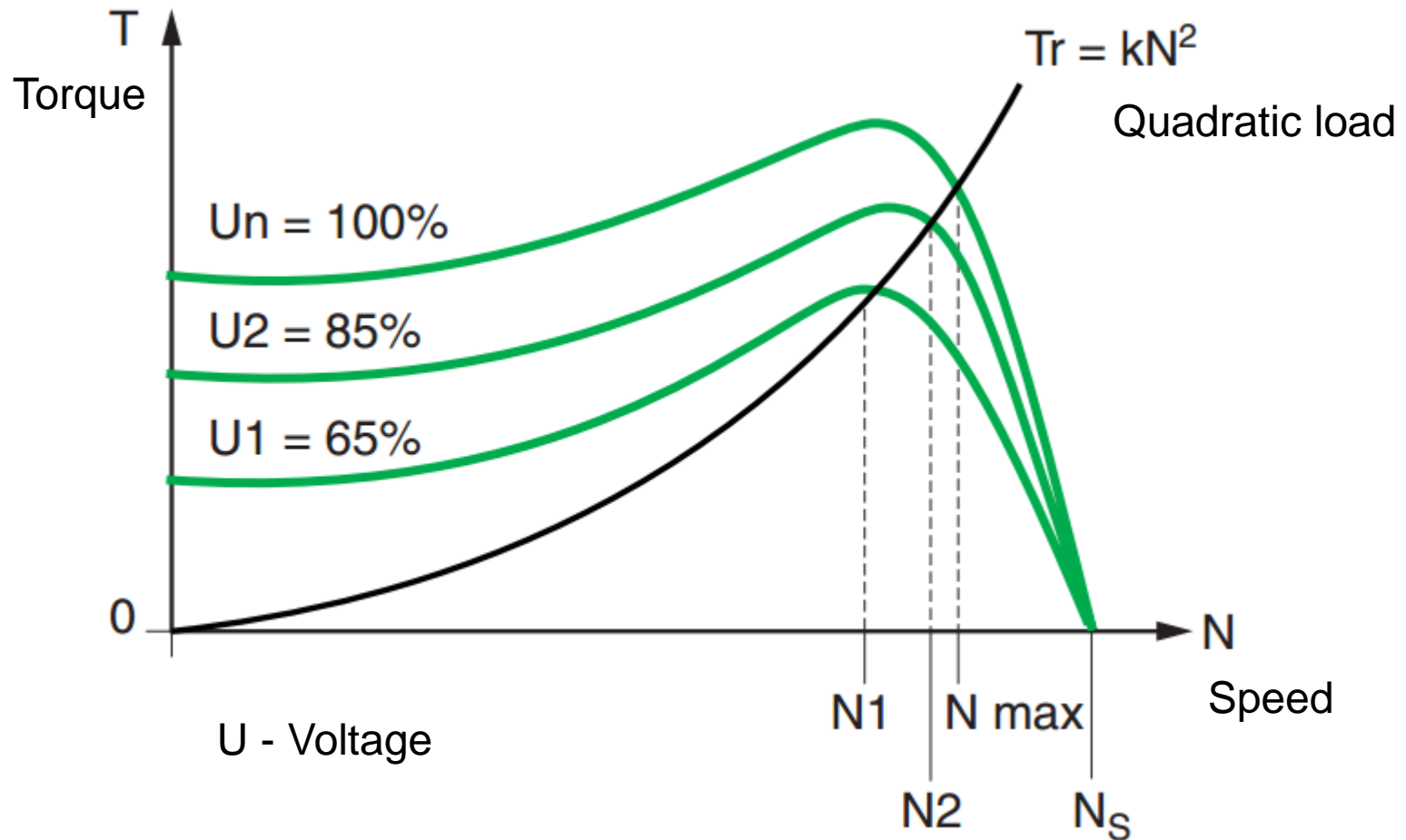
Soft Starter

Circuit to control the voltage
In each phase



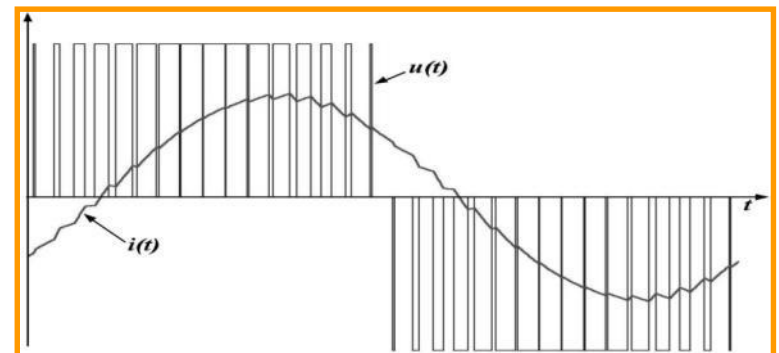
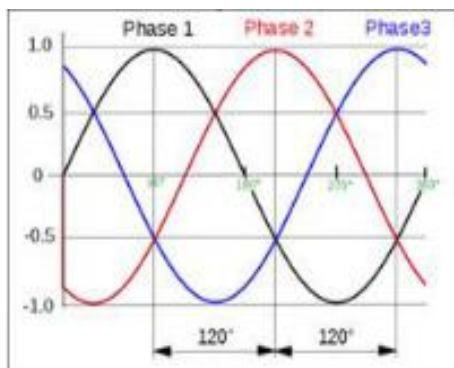
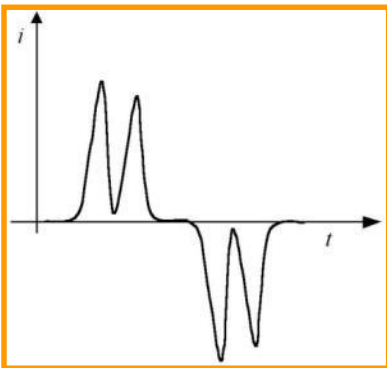
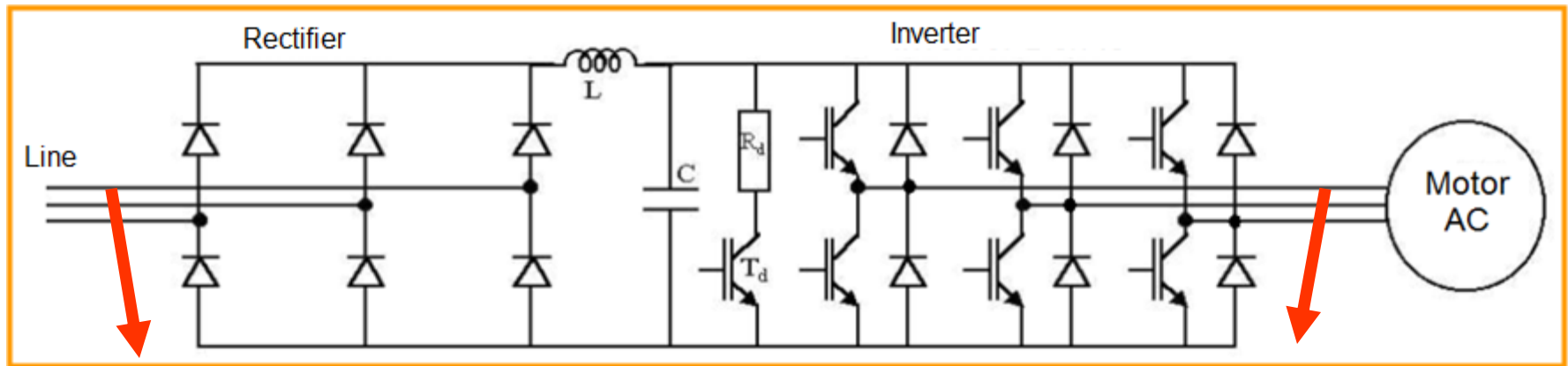
Single line diagram for a softstarter

Soft - Starter

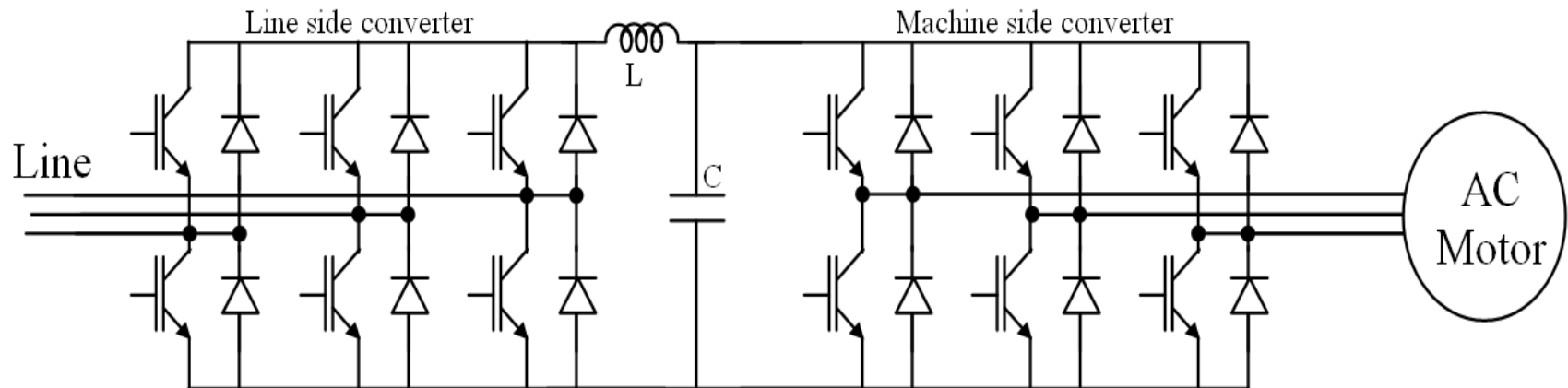


Variable Speed Drives – VSDs

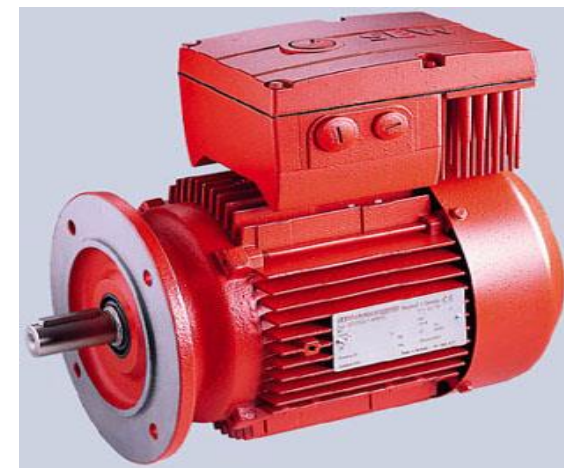
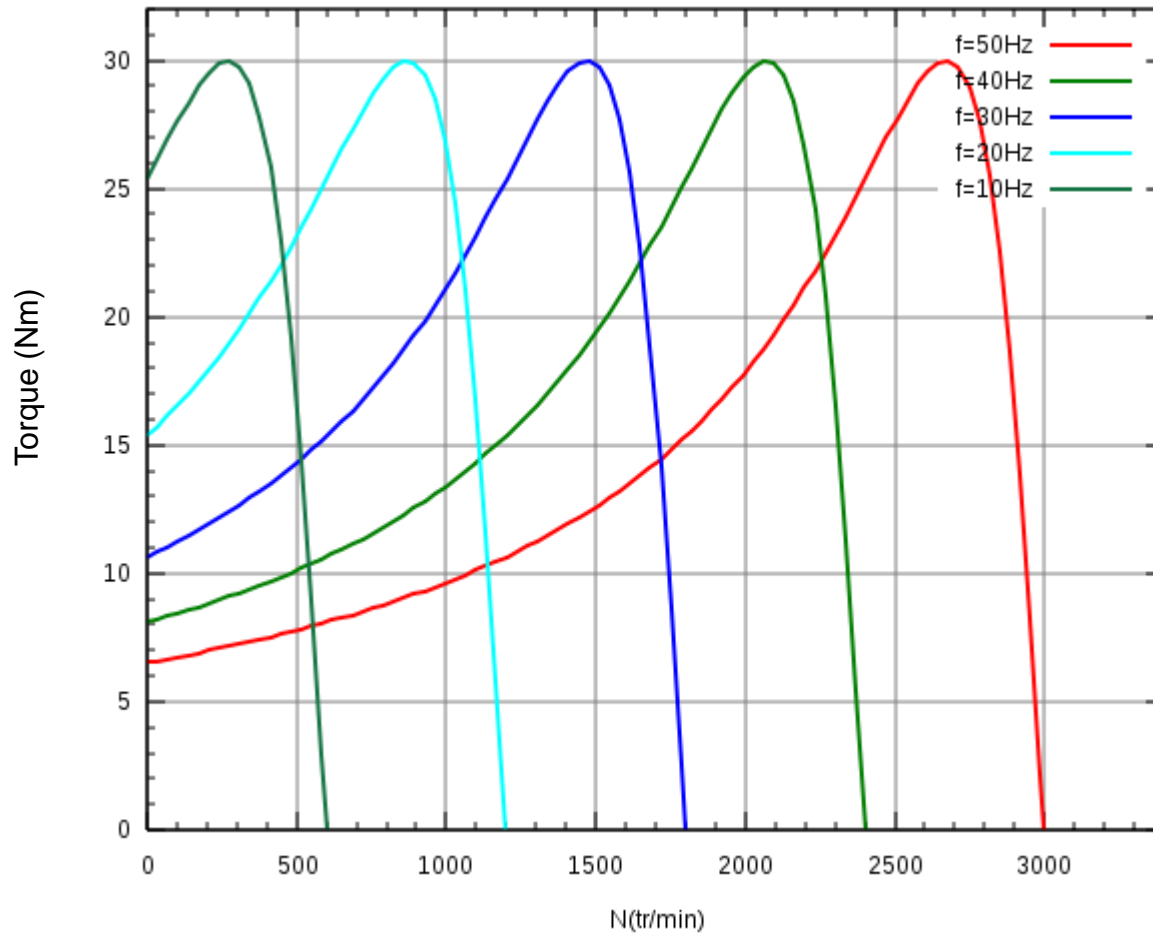
For Induction Motors



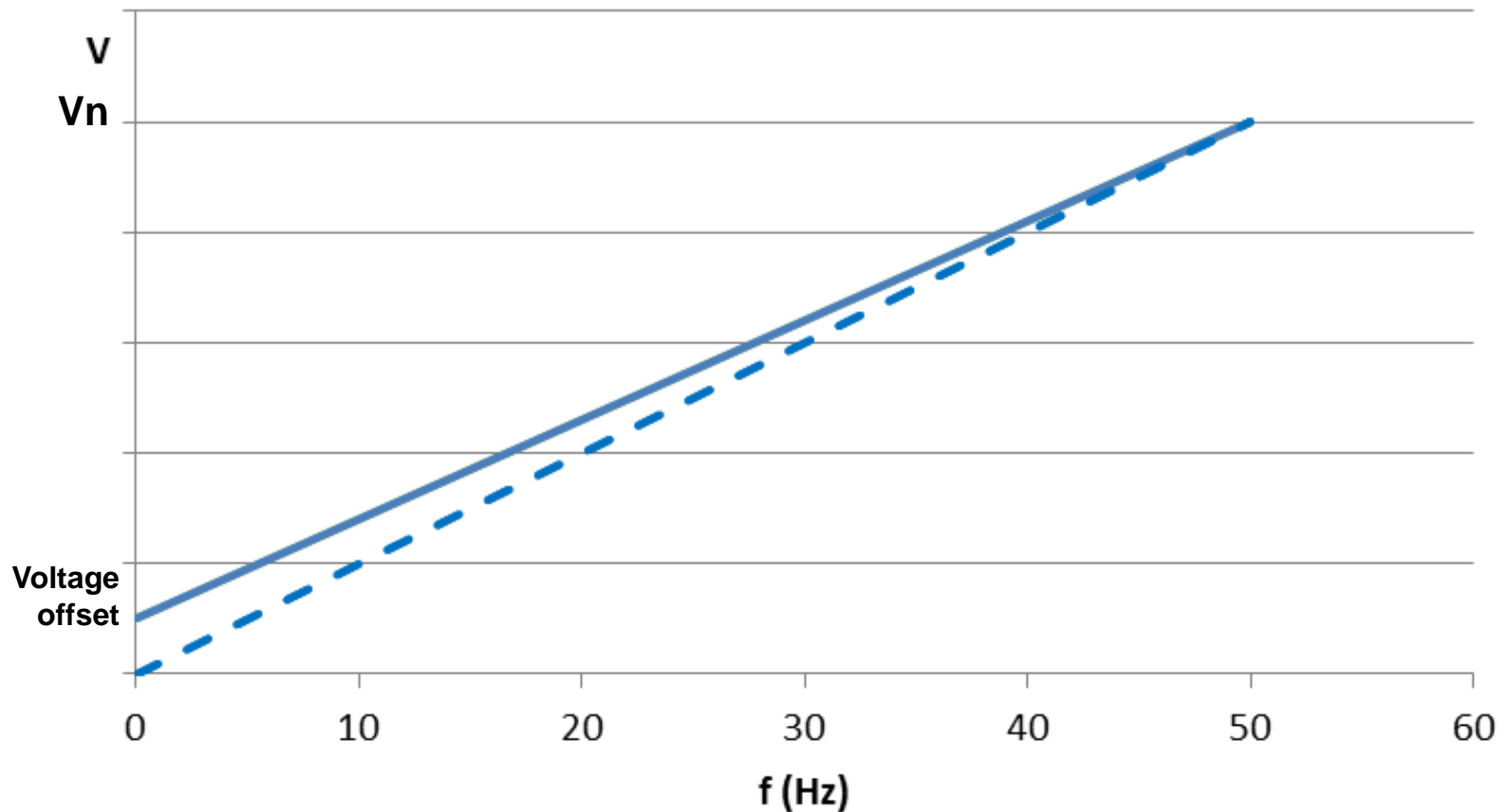
VSDs - Regeneration



Variable Speed Drives – VSDs



Voltage Variation with Frequency



Advantages of the VSDs

- Energy savings associated to the speed control;
- Improvement of the dynamic performance of induction motors;
- High efficiency of the VSDs (96-98%) and high reliability;
- High power factor (if active front end is used);
- Small size and location flexibility;
- Soft starting (savings!) And controlled/regenerative braking;
- Motor protection features;
- Lower acoustic noise and improvement of the process control;
- Less wear maintenance needs of the mechanical components.

Possible Disadvantages of VSDs

- Inject harmonic distortion in the network
- Voltage spikes leading to failure of insulation in windings of old motors
- Bearing current leading to premature failure