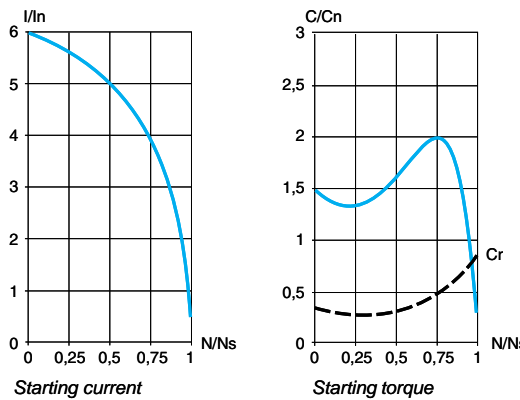


Soft starters

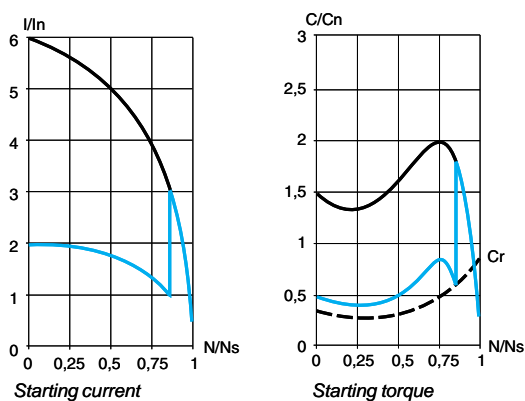
Conventional starting of three-phase asynchronous motors

Direct starting



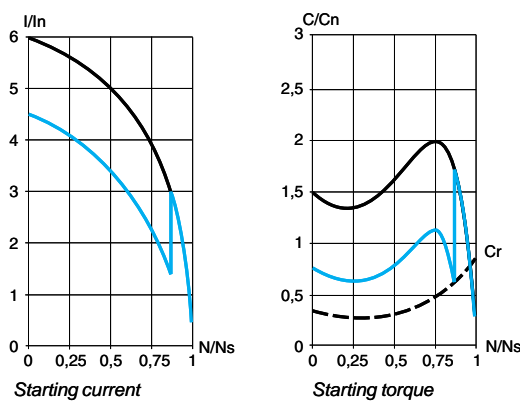
- Starting current: 4 to 8 times the nominal current.
- Starting torque: 0.5 to 1.5 times the nominal torque.
- Characteristics:
 - motor with 3 terminals, low and medium power,
 - on-load starting,
 - high current peak and voltage drop,
 - simple device,
 - sudden starting for the mechanism.
- No parameter adjustment.

"Star-delta" starting



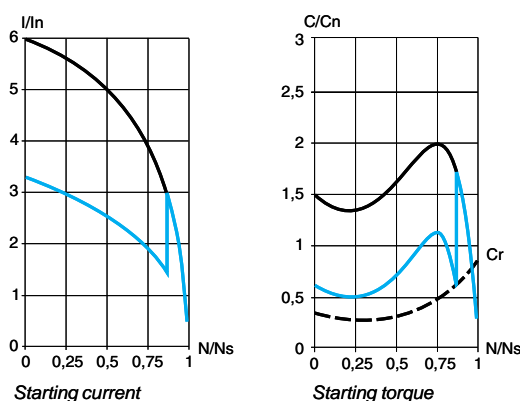
- Starting current: 1.8 to 2.6 times the nominal current.
- Starting torque: 0.5 times the nominal torque.
- Characteristics:
 - motor with 6 terminals,
 - no-load or low resistive torque starting,
 - high current peaks and torque when changing to "star-delta" mode,
 - a device requiring maintenance,
 - subject to mechanical stress when starting.
- No parameter adjustment.

Rheostatic stator starting



- Starting current: 4.5 times the nominal current.
- Starting torque: 0.5 to 0.75 times the nominal torque.
- Characteristics:
 - motor with 3 terminals, high power,
 - starting with increasing resistive torque,
 - high current peak,
 - a large, bulky device requiring maintenance,
 - subject to mechanical stress when starting.
- No parameter adjustment.

Auto transformer starting

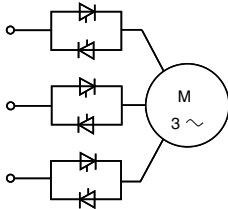


- Starting current: 1.7 to 4 times the nominal current.
- Starting torque: 0.4 to 0.85 times the nominal torque.
- Characteristics:
 - motor with 3 terminals, high power,
 - large voltage drop and current peak when connected at full voltage,
 - a complex, bulky device requiring maintenance,
 - subject to mechanical stress when starting.
- No parameter adjustment.

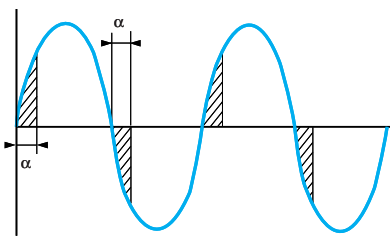
Soft starters

Progressive starting of three-phase asynchronous motors

Conventional electronic starting with variable voltage and current limiting



Schematic diagram



Firing angle

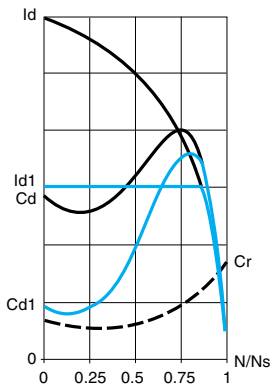


Figure 1

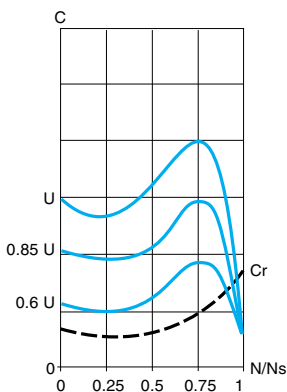


Figure 2

- A controller with 6 thyristors connected head to tail in each line phase is used to power the three-phase asynchronous motor by gradually increasing the voltage on start-up.
- Depending on the firing time and angle of the thyristors, it can be used to supply a voltage which will gradually increase at a fixed frequency.
- The gradual increase in the output voltage can either be controlled by the acceleration ramp, or by the value of the limiting current, or linked to both parameters.

- Figure 1 shows the behaviour of the torque in relation to the starting current.
 - Limiting the starting current I_s to a preset value I_{s1} will reduce the starting torque T_{s1} to a value which is almost equal to the ratio of the square of currents I_s and I_{s1} .
- Example**
On a motor with the following characteristics: $T_s = 2 T_n$ for $I_s = 6 I_n$, current limiting at $I_{s1} = 3 I_n$ or $0.5 I_s$ results in a starting torque: $T_{s1} = T_s \times (0.5)^2 = 2 T_n \times 0.25 = 0.5 T_n$.

- Figure 2 shows the torque/speed characteristic of a squirrel cage motor in relation to the supply voltage.
- The torque varies like the square of the voltage at a fixed frequency. The gradual increase in the voltage prevents the instantaneous current peak on power-up.

Advantages of starting with the Altistart 48

- Conventional electronic starting
 - To rectify problems caused by:
 - mechanical stress when starting,
 - hydraulic transients during acceleration and deceleration in pump applications.
- Conventional electronic starting requires the use of several current limits or the switching of several voltage ramps. The settings become complicated and must be modified every time the load changes.
- Starting with the Altistart 48
 - The Altistart 48 torque control enables starting without mechanical stress and the smooth control of hydraulic transients with a single acceleration ramp.
 - The settings are simple and effective, whatever the load.