

## Composition

Soft-starters and electronic variable speed drives are composed of two modules which are generally grouped together in the same enclosure :

- a control module which manages the operation of the device,
- a power module which supplies the electricity to the motor.

### The control module

On all modern soft-starters and drives, all functions are controlled by a microprocessor which manages the settings such as commands transmitted by an operator or processing device, results of measurements such as speed, current, etc. From this information, the microprocessor controls the firing of the power components, the acceleration and deceleration ramps, the speed, current limiting devices, protection and safety.

The settings (speed reference, ramps, current limits, etc.) can be made, depending on the product, by potentiometers, keypads, or from a programmable controller or PC by means of a serial link.

The commands (start, stop, braking, etc.) can be controlled by man/machine dialogue terminals, programmable controllers, or PCs, etc.

Operating parameters, alarm and fault information can be displayed by lamps, light emitting diodes, 7 segment or liquid crystal displays, screens, etc.

The commonly used relays give information such as :

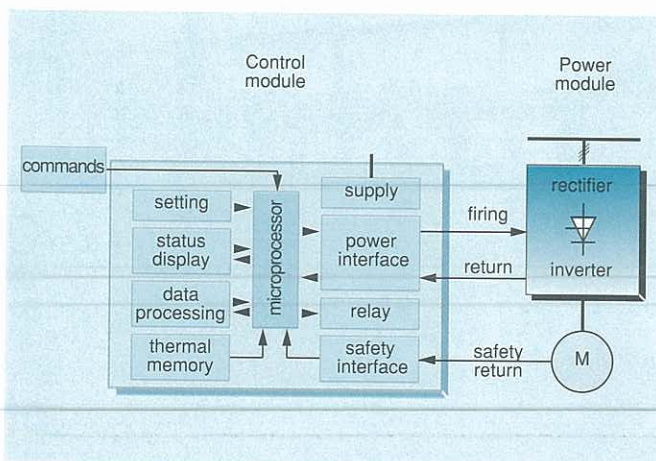
- fault (supply, thermal, product, sequence, overload, etc.),
- monitoring (speed threshold, pre-alarm, end of starting).

An isolated supply feeds the necessary voltages for the control and measurement circuits.

### The power module

The power module is principally composed of :

- power components,
- voltage and/or current interfaces,
- on large ratings, a ventilation unit.



General structure of a variable speed drive

The power components are semiconductors (see diagram on next page) operating in discrete mode (i.e. on or off), and are thus comparable to solid state switches which have two states, current passing or current blocking.

Bringing these components together in a power module constitutes a converter which, from a fixed voltage and frequency supply, can feed an electric motor with a variable voltage and/or frequency.

## The power components

### The diode

The diode is a non-controlled semiconductor comprising two regions P (anode) and N (cathode), which only lets current flow in a single direction, namely from anode to cathode. It conducts when the anode is at a higher voltage than the cathode, and so in this state acts like a closed switch. If the voltage at the anode becomes less positive than at the cathode, the diode blocks the current, and so acts as an open switch.

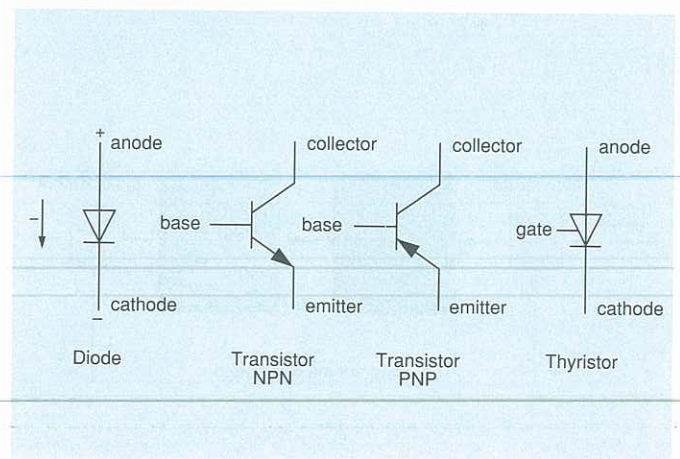
### The transistor

This is a controlled semiconductor comprising three alternate PNP or NPN regions. It only lets current flow in one direction : from the emitter to the collector in a PNP type transistor, and from the collector to the emitter in an NPN type transistor.

It normally acts as an amplifier. The value of the output current is a function of the input current at the base. However, the transistor can equally act as a solid state on-off switch : open when no current is applied to the base, closed when saturated. It is this second operating mode which is used in the power circuits of variable speed drives.

### The thyristor

This is a controlled semiconductor comprising four alternate PNPN layers. It acts as a solid state switch, the closing of which is controlled by applying an electrical pulse on a control electrode called the gate. This closing (or firing) is only possible if the anode is at a higher positive voltage than the cathode.



Power components