

Summary

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1. About electrical drives

1.1 Introduction

A power drive system is a system which converts electric energy into mechanical energy, by making use of power electronic apparatuses, following an input function (and according to established programme). [CEI 301-1]

Electric drive systems are used in different industrial fields and may have powers that range from a few hundred of [W] to a few tens of [MW].

Among them, typical applications are:

- ⇒ traction:
 - rail (urban transport and suburban railway lines)
 - road
- ⇒ the steel industries: steel production and rolling
 - power P : 200 kW ÷ 6 MW
 - speed Ω : 0 ÷ 300 rpm
- ⇒ the paper industry
- ⇒ fluid handling
 - pumps: $P = 1000 \div 25000$ kW; $\Omega = 4000 \div 7000$ rpm
 - fans: $P = 500 \div 5000$ kW; $\Omega = 1000 \div 1500$ rpm
- ⇒ compressors: $P = 500 \div 30000$ kW; $\Omega = 4500 \div 25000$ rpm
- ⇒ lifting loads
- ⇒ machine tools
 - spindle: torque $T = 30 \div 600$ Nm; $P = 20 \div 250$ kW; $\Omega = 3000 \div 12000$ rpm
 - axis: $T = 2 \div 60$ Nm; $P = 2 \div 30$ kW
- ⇒ the processing of plastics and rubber industries

1.1.1 Structure and components

An electrical drive can be represented simply as in Figure 1-1.

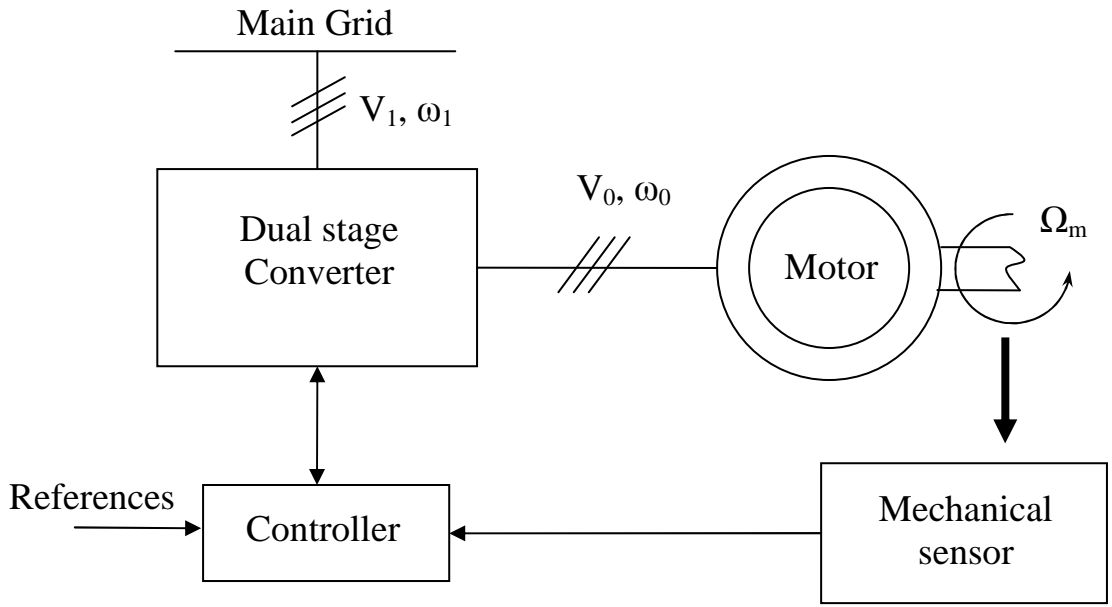


Figure 1-1 Power converter

the following interactions with the outside world may be identified:

- with the mains, through the power terminals
- with the mechanical load through the shaft
- with the operator or with the control external devices, through the human ↔ machine interface or through electrical control signals
- the surrounding environment through the heat exchange phenomena, electromagnetic and other environmental interactions.

The main elements, that characterize a drive, are a controlled power supply and an actuator (motor).

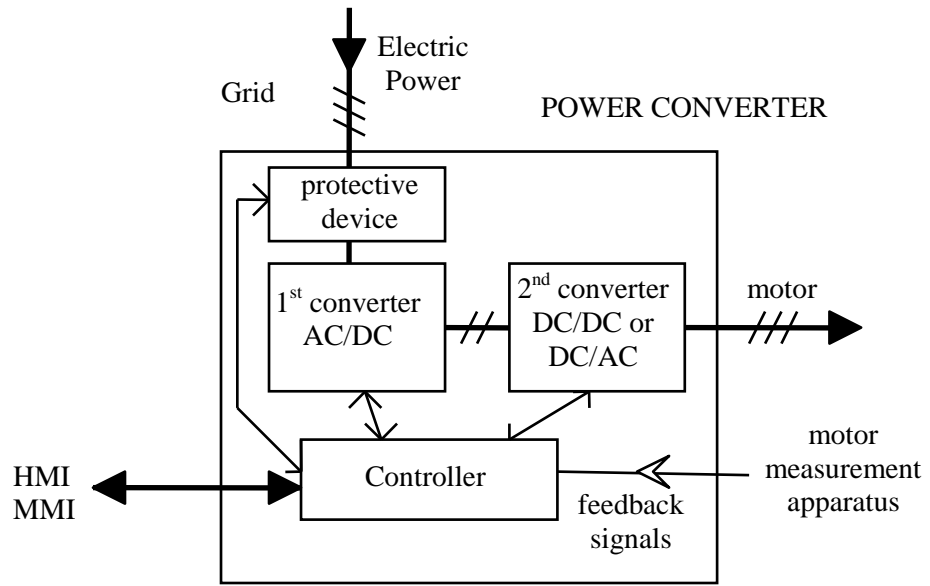


Figure 1-2 Power converter structure

As shown in Figure 1-2, a power supply is made by:

- one or more static power converters
- a control system
- protection and auxiliary devices for the proper functioning of the drive.

The words "static converter" refer to an apparatus consisting of a set of power semiconductor switches, connected each other, installed with the necessary equipment for the heat dissipation, and by the auxiliary circuits (eg. circuits for generating pulse power with a proper controlled shift, filters,...), and whose function is to transfer energy between two power grids, characterized by two different voltage and / or frequency.

The elements that characterize an electric drive are:

- characteristics of the power semiconductor switches
- structures of electronic converters AC/DC, DC/AC and DC/DC
- actuators: models of DC, induction and permanent magnet motors
- control architectures for DC and AC drives
- software for electrical drives

1.1.2 Standards

In the wide field of technical legislation, the electricity sector is particularly complex because of the strong interdependence between the rules adopted in relation to different products: electrical equipment, for example, often consists of a set of electrical devices each of which can be considered as a separate product built in accordance with specific rules; on the other hand all electrical equipment is normally inserted into a larger system, under which it must operate in compliance with other regulations. With the spread of electronic equipment, new needs for coordination rise, not only related to the high complexity of the equipment and the functions they can perform, but also to the possibility of noise transmitted through the electromagnetic fields.

The main issues, subject of technical standards relating to electrical drives, can be grouped into the following categories:

- a common communication language: terminology, measurement units, quantities and symbols associated with them, the graphic symbols for electrical circuits, the general theoretical background, etc..
- methods for defining the benefits and corresponding test procedures: this is done to allow an agreement between product and device manufactures and their customers in the definition of the provision, and during the verification that the order specifications match the provision
- rules for the human safety
- rules regarding the minimum level of performance or quality
- rules relating to electrical and mechanical interchangeability.

In the field of electrical and electronic products, the international body, entrusted with the task of treating the issue of standards, is IEC (International Electrotechnical Commission).

The National Committee member of the IEC in Italy is the CEI (Comitato Elettrotecnico Italiano).