

DC Motor Definitions

Armature

The rotating portion of the motor containing a laminated iron core with multiple turns of wire around it.

Base Speed

The rated speed obtained at the rated load (torque) and rated voltage. The base speed is found on the motor nameplate and corresponds with the motor rated horsepower.

Brush

Conducting material consisting of copper, graphite and/or electro-graphite materials which passes current from the motor terminals (A+, A-) to the rotating commutator.

Cogging

A term used to describe non-uniform angular velocity. It is found at low motor speeds and is caused by the motor "stepping" from pole piece to pole piece. The condition appears as a jerkiness.

Commutation

The action of steering currents or voltages to the armature phases so as to produce optimum motor torque. In brush motors, commutation is done via the brushes and commutator.

Commutator

A mechanical cylinder consisting of alternating segments of conductive and insulating material. The cylinder passes current from the brushes into the armature windings and provides commutation as the armature rotates.

Field Weakening

A method of extending the operating speed of a DC shunt motor. This is accomplished by reducing the field intensity, using current to decrease motor's magnetic field (reduce field current).

Field Wound Motor

DC motor that uses an electromagnetic field wired in parallel to the armature circuit. The shunt field can share the armature power supply or be connected independently.

Full-Load Current

The armature current of a motor operated at its full load torque.

Full-Load Speed

The speed that the output shaft of a DC motor obtains with rated torque connected and the drive providing rated output at rated speed.

No-Load Speed

The speed that the output shaft of a DC motor obtains with no external load connected and the drive providing rated output at rated speed.

PMDC Motors

A motor consisting of a permanent magnet (PM) stator and a wound iron-core rotor.

Stator

The stationary portions of the magnetic circuit and the associated windings and leads of a motor. It may include a frame, winding supports, ventilation circuits, coolers and temperature detectors.

Totally Enclosed Fan Cooled (TEFC)

Refers to the motor enclosure style. The motor is protected by the housing from all but the most severe falling water and dirt. The motor is cooled by a fan mounted on an armature shaft extension at the rear of the motor. The fan speed is governed by the motor speed.

Totally Enclosed Non-Ventilating (TENV)

Similar to a TEFC motor with the exception that the motor is designed so that no further cooling is required.

Tachometer

An electromagnetic generator typically coupled mechanically to the motor whose main function is to generate a voltage signal proportional to motor speed. The generator output is then electronically conditioned by the drive to control the motor speed regulation to within $\pm 1/2\%$ of set speed.

DC Drive Definitions

Acceleration/Deceleration Adjustment

The adjustable rate at which the motor increases or decreases in speed from zero to the motor's rated speed or rated speed to zero. Typical adjustment rates are 0.25 to 5 seconds.

Anti-plug Protection

An electronically controlled circuit to prevent motor reversal until motor speed has been reduced to near zero.

Current Limit Adjustment

An adjustment that prevents drives' output current from exceeding the motor's full load current rating. Values are most commonly expressed in percentage of nominal drive output ratings.

Dynamic Braking

A technique for stopping a permanent magnet or shunt wound motor. The motor windings are shorted together through a resistor which results in a motor braking with an exponential decrease in speed.

DC SCR Drives

A phase control rectifying system using SCRs for power conversion to supply the armature and/or shunt field circuits of a direct-current motor for providing adjustable and regulated speed control.

Form Factor

The ratio of RMS current to average current. Motor heating is a function of RMS current. NEMA CODE K form factor is typically 1.35 at base speed.

Full Wave Rectification

Rectifies both the positive and negative half cycles of the sinusoidal AC signal so that the DC output contains two half-sine pulses/cycle.

Half Wave Rectification

Rectifies only one-half of each incoming sinusoidal wave and does not pass the negative half-cycle.

IR (Drop) Compensation

An adjustable compensation for the IR losses across the armature resistance. This improves load regulation characteristics.

Master Drive

A drive that sets the reference input for one or several slave drives to follow.

Maximum Speed Adjustment

Adjustment used to set the fastest speed the motor will be allowed to run at when the (command signal) is set at 100%.

Minimum Speed Adjustment

Adjustment used to set the slowest speed the motor will run at when the (command signal) is set to zero.

Operating Overload

The drive's ability to withstand currents beyond its rating. Normally expressed in a percentage of full-load nominal current for a specified time.

Phase Control

The process on a DC drive of varying the point within the AC cycle to allow forward conduction through the SCRs. This is expressed as either the reduction in DC voltage or the angle of retard or advance.

Process Signal

A controlling input to the drive from a transducer providing a current or voltage reference to command a motor speed proportional to the signal input.

Regenerative (Four-Quadrant) Control

Regenerative DC drives are able to provide complete control of a DC motor's speed and torque simultaneously. A regenerative drive has the capability of producing torque in either braking or motoring modes, while operating a motor's speed in a consistent direction of rotation. The capability to provide braking torque is a result of the drive's ability to operate in all four quadrants of the motor's speed/torque curve.

Regulation

The amount of speed change from no-load to full-load conditions stated in a percentage of no-load speed.

$$\text{Regulation} = \frac{\text{No-Load Speed} - \text{Full-Load Speed}}{\text{No-Load Speed}} \times 100$$

Reversing

A technique to reverse motor shaft rotation by use of magnetic contractors or solid state devices reversing the DC polarity of the motor armature or field.

SCR (Silicon Controlled Rectifier)

A semiconductor device used to control motor power. A common application is their use for adjustable speed drives for PMDC motors.

Speed Adjustment Potentiometer

A three-terminal resistor with a sliding contact used as an adjustable voltage divider for commanding the motor speed or motor torque.

Speed Range

The ratio of the minimum and maximum speed where the published regulation is in effect, i.e., with a speed range of 50:1 and an 1800 RPM motor, the motor can maintain 36 RPM at constant torque and regulation.

Slave (Follower) Drive

A drive or drives connected in series or parallel to a master drive. The follower(s) respond in proportion maintaining the speed ratios when the master control calls for a speed change.

Speed Mode

Mode of operation on a DC drive where the input command, by a process signal or potentiometer, controls the motor speed output.

Torque Mode

Mode of operation on a DC drive where the input command, by a process signal or potentiometer, controls the motor torque output.

Transient Protection

Protection from transients that affect the performance or life of a motor drive system. Typical protection devices consist of transformers, surge suppressors, MOVs and RC filter networks.

Wiring Diagram

A diagram which locates and identifies electrical devices, terminals and interconnecting wiring in an assembly.

Load Definitions

Acceleration

The change in velocity as a function of time. This is commonly a positive rate at which the load travels from a lower to a higher speed.

Cycle Rate

A measure of total machine movement time plus any dwell time. Typically measured in cycles/minute.

Deceleration

The change in velocity as a function of time. Expressed as a negative rate at which the load travels from a higher to lower speed.

Horse Power

Work done. The product of torque and speed divided by a constant:

$$\text{HP} = \frac{\text{Speed (RPM)} \times \text{Torque (ft.lb)}}{5250}$$

Inertia

The property of an object to resist changes in velocity unless acted upon by an outside force. The greater the inertia, the more torque required to accelerate the load. Inertia calculations are based on the mass and shape of the object.

Overhauling Loads

A load that, under certain conditions, will actually move faster than the motor. This normally causes the motor to turn freely and is considered unacceptable.

Torque

The turning or twisting effort produced at the shaft of the motor. The torque is directly proportional to the force exerted on the rotor (magnetic repulsion) and the radial distance through which the forces act. Torque is usually measured in ft.lbs. Mathematically, torque (T) is equal to the product of force (F) trying to produce rotation times the distance from the center of rotation to the point of application of the force (radius R) such that:

$$T = F \times R$$

Torque can exist even if there is no rotation. If there is no rotation, no work can be performed; yet there can exist a torque trying to produce rotation.