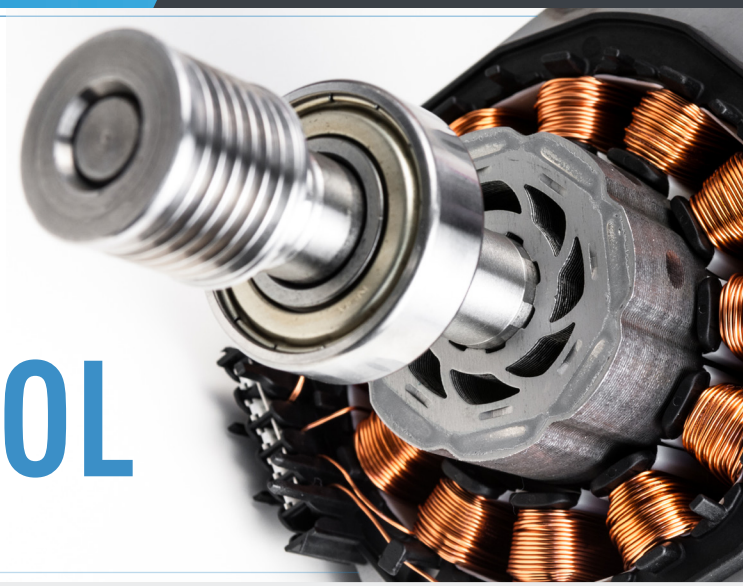


THE BASICS OF ELECTRIC MOTOR CONTROL

Most engineers and industrial technicians are quite familiar with electric motors – those devices that accept electrical input to generate mechanical (typically rotational) output. After all, much of the modern world is powered by them: Electric motors are found in everything from consumer-grade blenders to electric vehicles to heavy industrial equipment. But how are all these motors controlled?

Understanding the differences between motor control definitions (which often depend on context) can help engineers and plant personnel alike make better component and system selections for a given application.

What is Motor Control?

All motor controls (no matter their level of sophistication) serve to start and stop the motors to which they're connected. Some also precisely accelerate, decelerate, reverse, and electrically and mechanically protect the motor – and exact control over motor torque in some cases as well.

Though precision motor-based designs employing various dc motors, servomotors, and stepper motors technically rely on control of the motor for their high speed and positioning (motion control) operation, the phrase motor control generally implies a single or three-phase ac motor design for which speed and in some cases, torque are the primary concerns.

Electric motor with onboard controls.

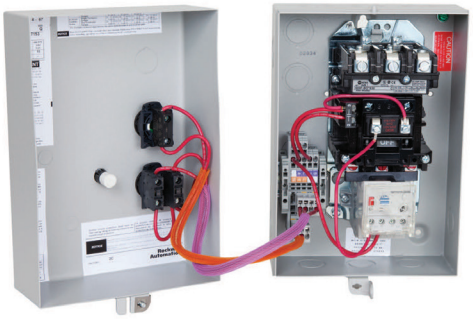
In fact, utility power directly connected (across-the-line) to these electric motors also constitutes a form of control via a wye (star) or delta configuration. Here too though, the term motor control doesn't typically apply. Electric power components such as contactors (at their core, high-voltage switches), relays, motor starters (at their core, contactors with overload relays), and fully-fledged motor drives are required to qualify an arrangement as motor control in most industrial contexts.

HOW MOTOR CONTROLS WORK

Manual motor starters (common on conveyor designs) are simple on-off toggles that make or break a mains supply connection with the motor. In contrast, magnetic motor starters (as in more exacting process equipment) control motors by accepting a machine signal (typically from a switch or relay) to trigger the power-connection make or break. Combination motor starters include both the automatic circuit and an electrical power switch or fuse break option.

More sophisticated motor controls than these options are reduced-voltage motor starters. These include primary resistor starters employing resistors and contactor arrays to supply various starting voltages. Disadvantages are low efficiency and low inductance for abrupt speed steps upward. In contrast, primary reactor starters control motors (typically high-voltage variations) via inductors for smooth and quite gradual accelerations to design speed. Costlier autotransformer starters add control over motor starting torque.

None of these options though outperform motor soft starters. They incorporate solid-state thyristor or SCR (silicon controlled rectifier) electronics for tight control of voltage into the motor windings (and therefore torque) upon startup.



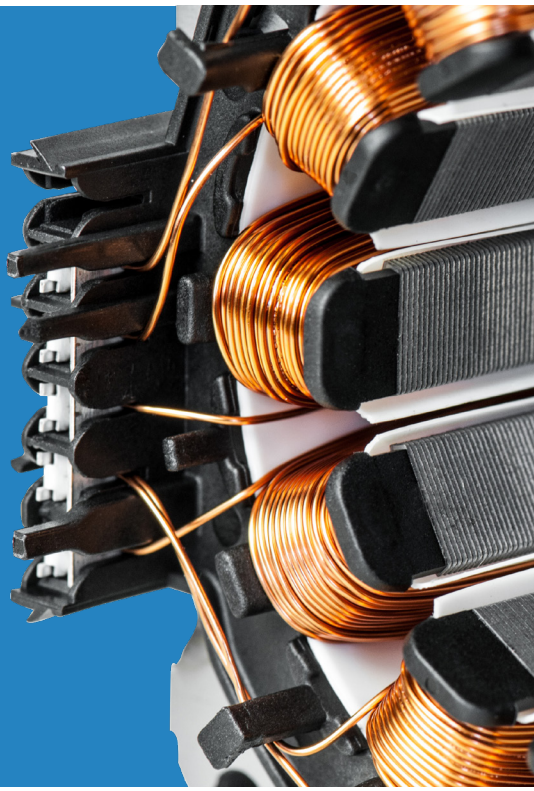
Non-reversing motor starter.

MOTOR CONTROLS

The most sophisticated motor controls (again, as the automation industry most commonly uses the term) are motor drives. These shape electrical power into a motor's windings for exceptionally precise control over both motor speed and torque. Adjustable speed drives (ASDs) and variable frequency drives (VFDs) do this by accepting ac line voltage, temporarily storing rectifier-converted power on capacitors, and then releasing that power via insulated gate bipolar transistors or IGBTs as rapidly switched (off and on) power into the motor windings at precise intervals.

This in turn yields motor output with a precisely controlled:

- **Rotation speed** (rpm)
- **Direction** (whether the motor output shaft turns clockwise or counterclockwise)
- **Torque** (as rotational force generated to apply to the load)
- **Efficiency** (as energy consumed for a given power output)



MOTOR CONTROL PROTECTION

Motor-protection components prevent voltage spikes, short circuits, phase failures, and overloads (even locked-rotor conditions) from damaging the electric motor and its power supply or drive. That in turn also prevents the development of certain conditions hazardous to machine operators and other employees.

FUSES IN A MOTOR-POWER INSTALLATION

work like fuses in any other electrical application. For motor control protection, the most common are current-limiting fuses.

THERMAL OVERLOAD RELAYS

directly react to temperature changes. They can either mount on power contactors or (in the case of VFDs) connect to output leads.

ELECTRIC-MOTOR CIRCUIT BREAKERS

sometimes integrated into a common component with thermal overload relays – primarily impart protection against the detrimental effects of line faults. They remove the electrical input into a motor; some are capable of automatically resetting and reconnecting the motor as well.

Current-limiting Fuses

Thermal Overload Relays

Electric Motor Circuit Braker

CONCLUSION

Motor controls abound for all types of discrete and process automation applications — and supplying these controls and complementary components and accessories is a big part of what we do here at **Electrical.com**. Email **support@electrical.com** or call us at **877-999-7077** to chat with one of our motor-control experts today.

We've developed strong relationships with component makers and manufacturing partners to ensure we can consistently provide design engineers with the highest quality products at competitive pricing.

877-999-7077

Electrical.com®