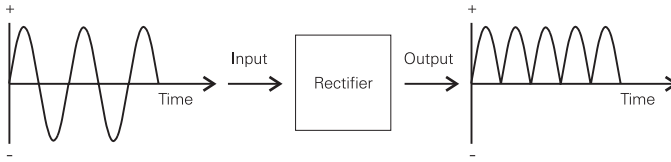


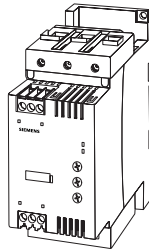
Rectifier

A device or circuit that converts alternating current to direct current.



Reduced-Voltage Controller

A type of motor starter that applies less than the full-line voltage to a three-phase induction motor while it is starting. A variety of types of reduced-voltage controllers exist including solid-state starters.



Resistance

A property of a material or circuit to oppose current flow. Resistance is symbolized by "R" and is measured in ohms.

Resistance Temperature Detector (RTD)

A device used to sense temperature that varies in resistance as temperature changes.

Resistor

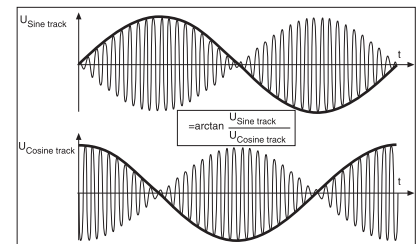
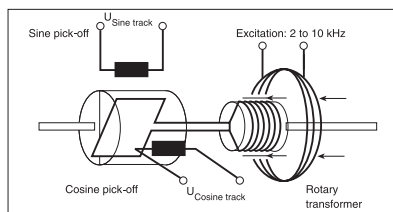
A device manufactured to have a specific amount of resistance.

$$R = \rho \frac{l}{A}$$

— Length
— Cross-Section Area
— Resistivity of Material

Resolver

An angular position sensing device that utilizes a rotating transformer with two secondary windings arranged at right angles to each other to provide angular position information. The amplitude of the wave induced into each stator winding depends on the angular position of the rotor winding. Since the amplitude variations available at the stator windings are 90° apart, one is called a sine signal and the other is called a cosine signal.



Root-mean-square or RMS Value

The *effective value* of a *current* or *voltage*. Root-mean-square is descriptive of the mathematical process used to calculate the effective value of a periodic current or voltage.

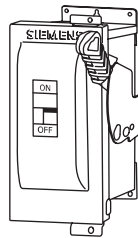
Rotor

The rotating elements of the magnetic circuit of a rotating machine such as a *motor*.



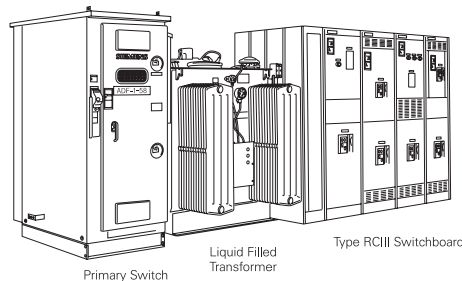
Safety Switch

A switch mounted in an *enclosure*. Fusible enclosed switches include provisions for *fuses* in the enclosure.



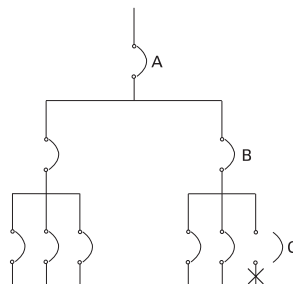
Secondary Unit Substation

A coordinated design consisting of one or more *transformers* mechanically and electrically linked to *switchgear* or *switchboard* assemblies with an outgoing *voltage* rated below 1000 *volts*.



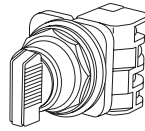
Selective Coordination

Applying *circuit breakers* in a manner that will minimize the extent of an outage in the event of a fault. Circuit breakers are typically installed in a branching arrangement. In the event of a fault, the breaker electrically closest to the fault should trip first. This can be accomplished by properly sizing and adjusting all breakers.



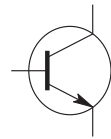
Selector Switch

A control device with two or more positions used to manually open and close contacts.



Semiconductor

A special type of material with more *resistance* than a *conductor*, but less than that of an *insulator*. Semiconductors can be manufactured to produce devices such as *diodes*, *transistors*, *thyristors*, etc.



Transistor



Diode

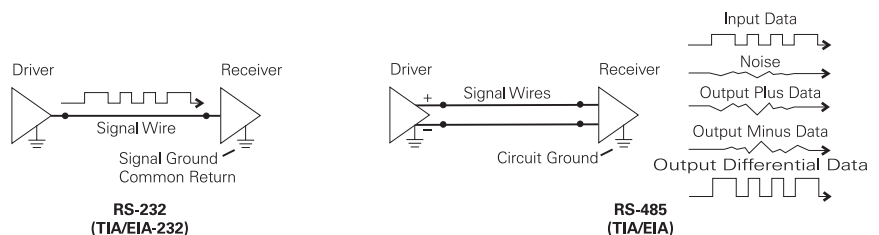
Sensing Switch

A device, often called a sensor, used to provide information on the presence or absence of an object. Examples include a *limit switch*, *photoelectric sensor*, *inductive proximity sensor*, *capacitive proximity sensor*, and *ultrasonic proximity sensor*.

Sensor	Advantages	Disadvantages	Applications
Limit Switch	<ul style="list-style-type: none"> High Current Capability Low Cost Familiar "Low-Tech" Sensing 	<ul style="list-style-type: none"> Requires Physical Contact with Target Very Slow Response Contact Bounce 	<ul style="list-style-type: none"> Interlocking Basic End-of-Travel Sensing
Photoelectric	<ul style="list-style-type: none"> Senses all Kinds of Materials Long Life Largest Sensing Range Very Fast Response Time 	<ul style="list-style-type: none"> Lens Subject to Contamination Sensing Range Affected by Color and Reflectivity of Target 	<ul style="list-style-type: none"> Packaging Material Handling Parts Detection
Inductive	<ul style="list-style-type: none"> Resistant to Harsh Environments Very Predictable Long Life Easy to Install 	<ul style="list-style-type: none"> Distance Limitations 	<ul style="list-style-type: none"> Industrial and Machines Machine Tool Senses Metal-Only Targets
Capacitive	<ul style="list-style-type: none"> Detects Through Some Containers Can Detect Non-Metallic Targets 	<ul style="list-style-type: none"> Very Sensitive to Extreme Environmental Changes 	<ul style="list-style-type: none"> Level Sensing
Ultrasonic	<ul style="list-style-type: none"> Senses all Materials 	<ul style="list-style-type: none"> Resolution Repeatability Sensitive to Temperature Changes 	<ul style="list-style-type: none"> Anti-Collision Doors Web Brake Level Control

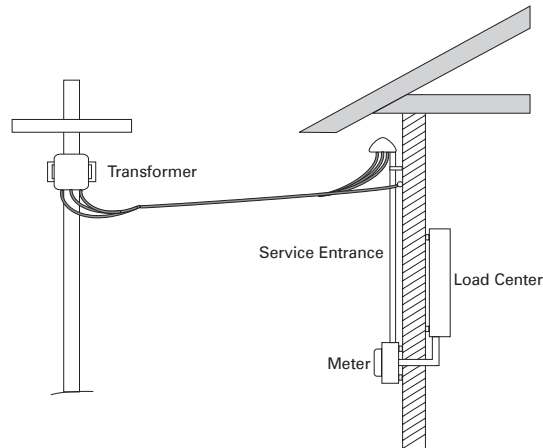
Serial Communication

Intelligent devices, such as computers, communicate with each other by sending bits of data in a series of *binary* signals to each other. RS-232 and RS-485 are specifications commonly used in serial communication.



Service Entrance

The place where power is brought into a building. Also used to describe equipment at the service entrance.

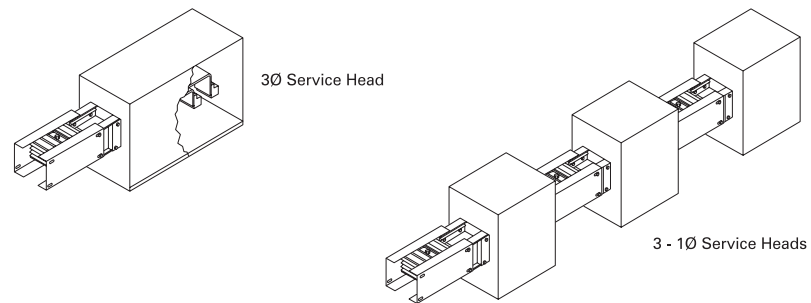


Service Factor

A numerical value that is multiplied by a motor's rated horsepower to determine the maximum horsepower at which the motor should be operated.

Service Head

A device used to connect busway at the service entrance.

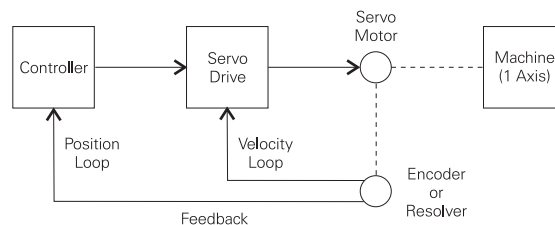


Service Section

The switchboard section connected to incoming power.

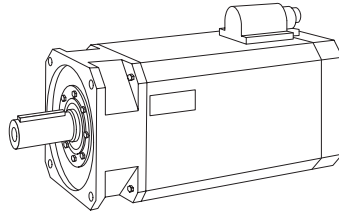
Servo Drive

Usually refers to an electronic device used to control the speed and torque of a servo motor as part of a closed-loop positioning control system.



Servo Motor

A motor designed with the dynamic response required for closed-loop positioning applications.

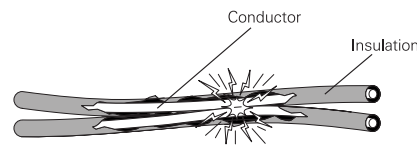


Set Point

The value used by a control circuit as desired value of a process variable.

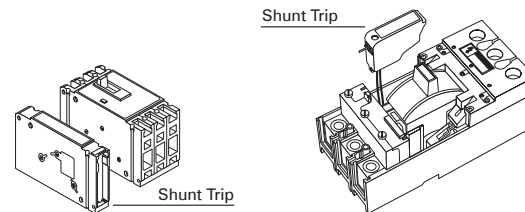
Short Circuit

A normally unintended low resistance path for current.



Shunt Trip

A device used to remotely trip a circuit breaker.



Single Quadrant Operation

Describes the operation of a variable speed drive that can provide torque to drive the motor, but cannot provide braking torque.

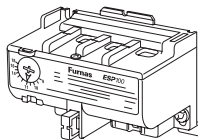
Slip

In a three-phase induction motor, slip is the difference between the synchronous speed and the rotor speed and is often expressed as a percentage.

$$\% \text{ Slip} = \frac{N_s - N_R}{N_s} \times 100$$

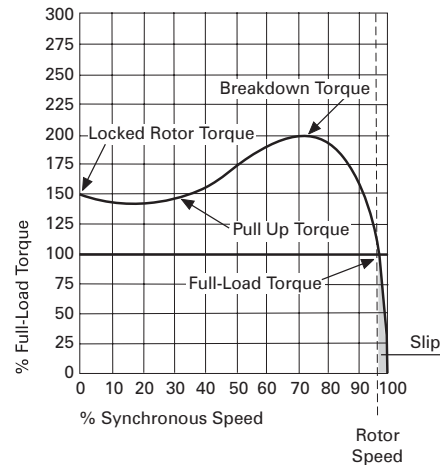
Solid-State

Used to describe equipment that contains semiconductor devices in an electronic circuit.



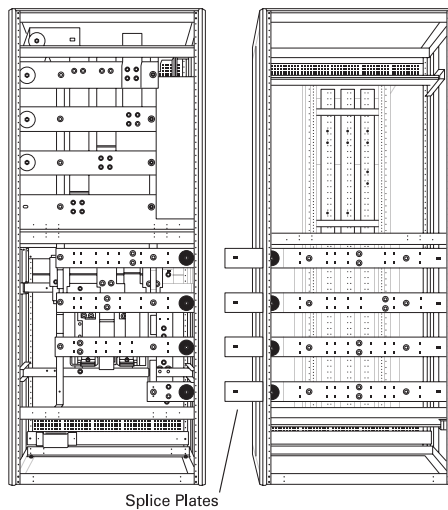
Speed-Torque Curve

A graphical representation of the torque provided by a motor over a range of speeds.



Splice Plates, Splice Bars

Plates used to join the horizontal bus bars of adjoining switchboard or motor control center sections.



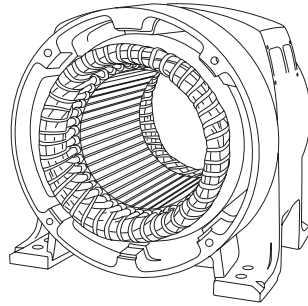
Starter Ratings

Motor Starters are rated according to size and type of load. NEMA and IEC rate motor starters differently. IEC-rated devices are rated according to maximum operational current. NEMA specifies sizes from size 00 to size 9.

Size of Controller	Horsepower at 460 V/60 Hz
00	2
0	5
1	10
2	25
3	50
4	100
5	200
6	400
7	600
8	900
9	1600

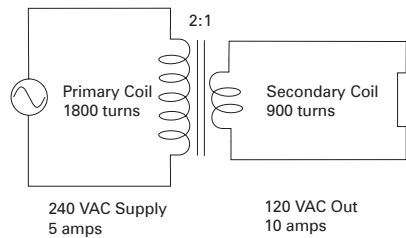
Stator

The stationary elements of the magnetic circuit of a rotating machine such as a motor.



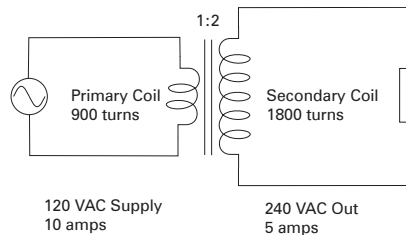
Step-down Transformer

A *transformer* with more turns of wire in its primary coil than in its secondary coil. The step-down transformer is used to step down the primary *voltage* to a lower secondary voltage.



Step-up Transformer

A *transformer* with fewer turns of wire in its primary coil than in its secondary coil. The step-up transformer is used to step up the primary *voltage* to a higher secondary voltage.

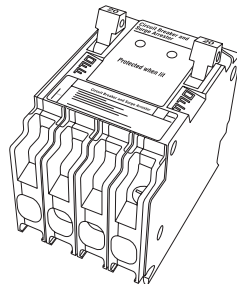


Surge

A transient increase in *current* and *voltage*.

Surge Protection

Used to describe equipment designed to prevent or limit damage resulting from a *surge*, provided that the surge does not exceed the capabilities of the protection devices.



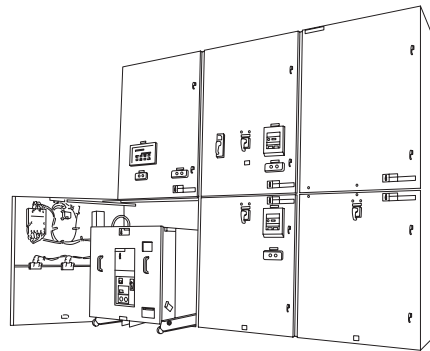
Switchboard

A large panel or assembly of panels containing switches, overcurrent protective devices, buses, and associated instruments.



Switchgear

A coordinated design consisting of switching and interrupting devices and associated equipment such as control and protective devices and metering.



Synchronous Speed

The speed of the rotating magnetic field in a three-phase motor. Synchronous speed is determined by the line frequency and the number of motor poles.

$$N_s = \frac{120f}{P}$$

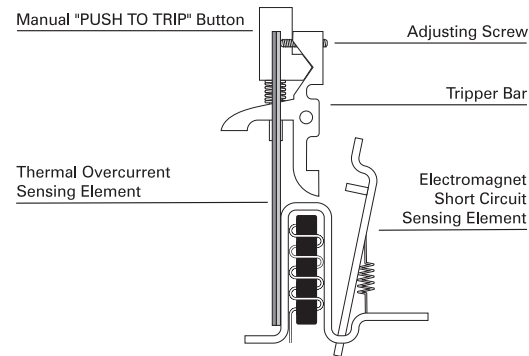
Frequency
No. of Poles
Synchronous Speed

Tachometer

A device used to provide a feedback signal representative of the speed of a rotating machine. Some tachometers are analog devices. Others provide a digital signal.

Thermal-Magnetic

Used to describe a device that uses both heat and magnetism as part of its operating principles. For example, a thermal-magnetic *circuit breaker* can be tripped either by heat or magnetic force resulting from excessive *current*.



Thermistor

A device used to sense temperature that varies in *resistance* as temperature changes.

Thermocouple

A device composed of two types of metal that produces a small *voltage* representative of the temperature at some point in a process.

Thyristor

A family of multi-layer *semiconductor* devices that includes silicon controlled rectifiers (SCR), triacs, and gate turnoff (GTO) thyristors. Thyristors are often used in *rectifier* or *power* switching circuits.

