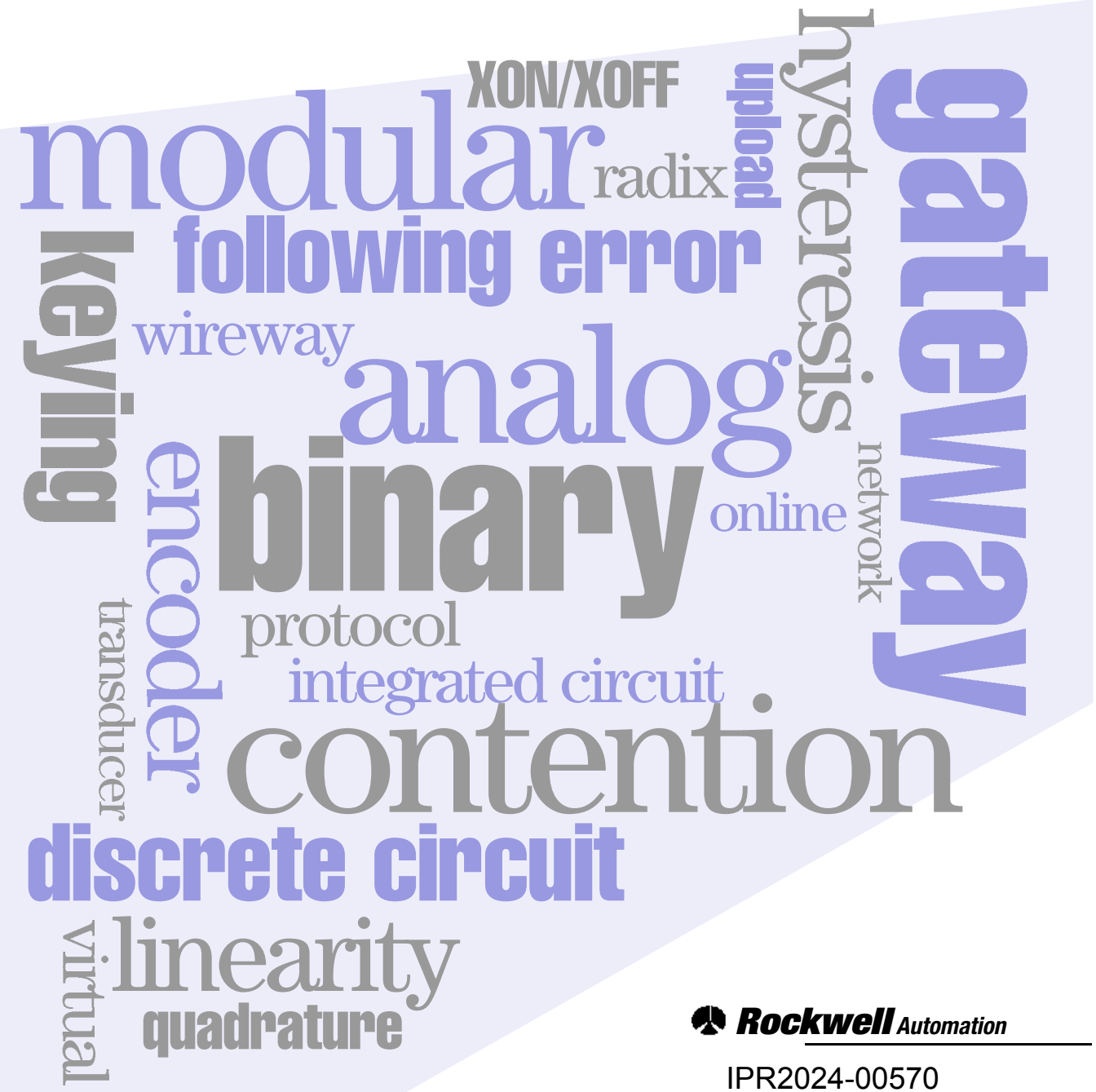
Industrial Automation Glossary

Fifth Edition



Rockwell Automation

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Using this Glossary

Organization

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Numerals

We have provided a section devoted to terms that begin with numerals. We have placed these terms at the beginning of the glossary (see page 1). When looking up terms that begin with numerals, check this section first.

Preferred Terms

In some cases, several terms have the same meaning. In those cases, we provide the definition under the term we prefer to use. If you look up a word that is not the preferred term, we provide a cross-reference to the preferred term. For example, if you look up *one-slot addressing* you will find:

one-slot addressing
See *1-slot addressing*.

By referring you to *1-slot addressing*, we imply that *1-slot addressing* is the preferred term where you will find the definition.

At Rockwell Automation, we strive to make our publications easy for you to read by standardizing on preferred terms.

Parts of Speech

In some cases, a term is listed once as one part of speech, and a second time as another part of speech. In that case, next to the term we give a single-letter abbreviation (in italic) for the part of speech:

- *a* — adjective
- *n* — noun
- *p* — preposition
- *v* — verb

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Definition of Terms

½-slot addressing (half-slot addressing)
A mode of addressing I/O in which each ½ I/O module slot of an I/O chassis is addressed as an I/O group. Each I/O module slot contains 2 I/O groups.

1-slot addressing (one-slot addressing) (single-slot addressing)
A mode of addressing I/O in which each I/O module slot of an I/O chassis is addressed as an I/O group. Each I/O module slot contains a single I/O group.

2-slot addressing (two-slot addressing) (double-slot addressing)
A mode of addressing I/O in which each even/odd pair of I/O module slots of an I/O chassis is addressed as an I/O group. Each I/O module slot contains ½ of an I/O group.

4-bit I/O module
An I/O module that uses 4 bits (1 nibble) of input and/or output image area.

8-bit I/O module
An I/O module that uses 8 bits (1 byte) of input and/or output image area.

16-bit I/O module
An I/O module that uses 16 bits (1 word) of input and/or output image area.

32-bit I/O module
An I/O module that uses 32 bits (2 words) of input and/or output image area.

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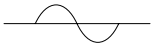
ABECOS™ software
An Allen-Bradley software product that assists in the design and configuration of PLC® systems. It provides assistance in quoting, engineering, and documenting using Allen-Bradley PLC systems.

absolute move
1) A move to a specified absolute position relative to a fixed zero position as a reference point. **2)** Contrasted with *incremental move* (page 52).

absolute position
1) Position referenced to a fixed zero position. **2)** Contrasted with *incremental position* (page 52).



ac
Alternating current.

ac contactor
An alternating current (ac) contactor is designed for the specific purpose of establishing or interrupting an ac power circuit.

ac-coupled amplifier
An amplifier with a capacitive-coupled input to filter out the dc component of the input signal. Therefore, the output signal is an amplification of only the ac component of the input signal. Also called “capacitive-coupled amplifier.”

ac input circuit
A circuit on an I/O module that converts ac signals from a machine/process switching device to backplane logic level dc signals. By definition, it is always a digital circuit (on/off). By implication, it usually has a direct relationship with the data table (i.e., a data table bit directly reflects its state).

ac input module
An I/O module that contains circuits that convert ac signals from machine/process switching devices to backplane logic level dc signals. By implication, they are direct digital inputs.

ac output circuit
A circuit on an I/O module that provides switching of ac power to a machine/process load device, based on backplane logic level dc signals. By definition, it is always a digital circuit (on/off). By implication, it usually has a direct relationship with the data table (i.e., a data table bit directly controls its state).

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ac output module
An I/O module that contains circuits that provide switching of ac power to machine/process load devices, based on backplane logic level dc signals. By implication, they are direct digital outputs.

ACC
See *accumulated value*.

acceleration
The rate of change of velocity. Negative acceleration is usually described as deceleration.

access
To read from and possibly write to an area of memory.

accumulated value (ACC)
The number of elapsed time intervals or counted events.

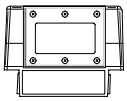
accumulator register
A register that accumulates the axis feed increments to indicate the current commanded position for the axis to follow.

Accu-Stop™ feature
An Allen-Bradley feature of an SMC™ smart motor controller, used in applications requiring controlled-position stopping.

ACK
See *acknowledgement.*

acknowledgment (ACK)
An ASCII control character used to acknowledge the reception and acceptance of a transmission block.

actuator (output device)
1) A device that converts an electrical signal into mechanical motion. **2)** In a general sense, any machine/process load device (e.g., transducer) of a controller output circuit.



AdaptaScan™ bar code reader
An Allen-Bradley bar code reader that combines an adjustable scanner and decoder in a compact NEMA type-4 enclosure.

adapter module
A module in an I/O chassis, that provides a communication interface between a scanner and the I/O modules in that I/O chassis. It reads input data from input circuits and transmits it to the scanner. It receives output data from the scanner and writes it to output circuits.

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adaptive control
A technique to allow control to automatically compensate for changes in system parameters such as load variations.

A/D conversion
See *analog-to-digital conversion* (page 5).

ADX
AutoMate Documentation Executive. An offline documenter for AutoMate™ ladder programs developed with APX.

address
1) A character string that uniquely identifies a memory location. **2)** A character string that uniquely identifies the physical location of an input or output circuit.

adjustable speed
The concept of varying the speed of a motor, either manually or automatically. The desired operating speed (set speed) is relatively constant regardless of load.

adjustable-speed drive *(electrical)*
A drive comprised of the motor, drive controller and operator's controls (either manual or automatic).

AIM *(bar code)*
Automatic Identification Manufacturers.

alarm programming
A continuously executed background program used to check for, and to report, alarm conditions in the controllers it monitors.

algorithm
A set of procedures used for solving a problem in a finite number of steps.

alphanumeric display
A device capable of displaying characters (letters, numbers, and symbols) but not graphics.

ambient light
Illumination of a light receiver not generated by its light source.

ambient temperature
The temperature of the medium (air, water, earth) into which the heat of the equipment is dissipated.

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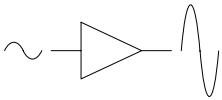
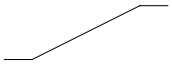
American wire gauge (AWG)
A standard system used for designating the size of electrical conductors. Gauge numbers have an inverse relationship to size; larger numbers have a smaller cross-sectional area. However, a single-strand conductor has a larger cross-sectional area than a multi-strand conductor of the same gauge so that they have the same current-carrying specification.



amplifier
A device which draws power from a source other than its input signal to produce an output that is a magnified reproduction of the input signal.



analog circuit
1) A circuit in which the signal can vary continuously between specified limits. **2)** A circuit that provides a continuous function. **3)** Contrasted with *digital circuit* (page 30).

analog gage
1) A measuring device/instrument that indicates the measurement result via analog signal. **2)** Contrasted with *digital gage* (page 31).

analog input module
An I/O module that contains circuits that convert analog dc input signals to digital values that can be manipulated by the processor. By implication, these analog inputs are usually direct (i.e., a data table value directly reflects the analog signal value).

analog output module
An I/O module that contains circuits that output an analog dc signal proportional to a digital value transferred to the module from the processor. By implication, these analog outputs are usually direct (i.e., a data table value directly controls the analog signal value).

analog-to-digital conversion (A/D conversion)
Production of a digital value whose magnitude is proportional to the instantaneous magnitude of an analog signal.

Angstrom
Unit of measure for the wavelength of light (10A = 1nm).

ANSI
American National Standards Institute. An organization that develops and publishes voluntary industry standards in the United States.

aperture
An opening to pass light or other form of radiation.

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application
A use to which something is put, or how it is used.

application program
A program written for or by a user to perform the functions needed for his application. Compare to *operating system* (page 79) and *utility software* (page 119).

APS™
1) AutoMate Programming System. A Reliance® DOS-based programming and documenting system for the AutoMate family of programmable controllers. **2)** Advanced Programming Software. A Rockwell Software programming support tool for programmable controllers.

APX
AutoMate Programming Executive. A Reliance DOS-based programming executive for the AutoMate family of programmable controllers.

arithmetic capability
The ability to do addition, subtraction, multiplication, division, or advanced math functions within a processor.

armature
The moving part of a magnetic circuit, such as the rotating part of a motor or generator or the movable iron part of a relay.

armature control
Abbreviated term for *armature voltage control* of a dc motor, which describes the usual method of changing the speed of a dc motor by controlling the magnitude of applied armature voltage.

armature current
The current required by a motor to produce torque and drive a load. The maximum safe, continuous current is stamped on the motor nameplate. This can only be exceeded for initial acceleration, and for short periods of time. Armature current is proportional to the amount of torque being produced; therefore, it rises and falls as the torque demand rises and falls.

armature-voltage feedback
Using armature voltage as the velocity feedback signal to an electronic speed regulator. This voltage is approximately directly proportional to motor velocity, assuming a constant motor field and ignoring IR drop. Armature-voltage feedback is used where the expense of a tachometer-generator for velocity feedback is not justified and a regulation accuracy of 2–5% is adequate.

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ASCII
American Standards Code for Information Interchange. It is a 7-bit code with an optional parity bit used to represent alphanumerics, punctuation marks, and control-code characters.

ASIC
Application-Specific Integrated Circuit. An integrated circuit designed for a specific application and often for a specific customer.

asynchronous
1) Lacking a regular time relationship; not related through repeating time patterns. **2)** Contrasted with *synchronous* (page 109).

asynchronous scanning
A scanning arrangement where two scans (I/O and user program) operate independently of each other with no synchronization, so that any relative timing between the two scans is totally random.

asynchronous shift register
A shift register that is loaded and/or unloaded based on external conditions and/or timing functions.

asynchronous transmission
A method of serial transmission where characters may be transmitted at unequal time intervals. It requires that each character contain start/stop timing elements (extra bits) so the receiver can properly detect the start and end of each character. **2)** Contrasted with *synchronous transmission* (page 109).

attended system *(bar code)*
1) A bar-code scanner/decoder combination that must be activated or attended by an operator. **2)** Contrasted with *unattended system* (page 118).

attenuation
The decrease in magnitude of a signal. The total attenuation on a fiber-optic cable is a function of the material and the length of the cable.

attribute
A means of characterizing data on a display device (e.g. intensifying, blinking).

autoload
In an SLC controller, the process of transferring contents of the memory module to the processor memory at power up.

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AutoMate controller
A family of programmable controllers and I/O produced by Reliance Electric. These include the AutoMate 15, Automate 20, AutoMate 30, AutoMate 40, and Rail I/O products.

AutoMax™ DCS
A distributed control system drive product that is based on the Multibus platform and used primarily by the Rockwell Automation Drive Systems Group. It is a multi-tasking multi-processing multi-language system designed specifically for control of large coordinated drive systems, but may be used for other applications as well.

AutoMax V2
A DOS-based programming executive for the AutoMax DCS product.

AutoMax V3
A Windows version 3.x-based programming executive for the AutoMax DCS product.

AutoMax V4
A Windows-based programming executive for the AutoMax DCS product.

AWG
See *American wire gauge* (page 5).

axis
A principal direction along which a movement of the tool or work piece occurs.

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back emf
See *cemf* (page 16).

back up *v*
To make a copy of some data so that the copy can be used in case the original is destroyed.

backbone link
The main type of link in a network that may have auxiliary links connected to nodes on the backbone link.

backlash
A relative movement between interacting mechanical parts, resulting from looseness.

back of a motor
The back of a motor is the end that carries the coupling or driving pulley (NEMA). This is sometimes called the drive end (D.E.) or pulley end (P.E.).

backplane
A printed-circuit board, at the back of a chassis, that provides electrical interconnection between the modules inserted into the chassis.

backup *n, a*
Pertaining to a device or system that is kept available to replace something that may fail in operation. See also *hot backup* (page 51).

balanced circuit
1) A circuit whose two sides are electrically alike and symmetrical to a common reference point, usually ground. **2)** Contrasted with *unbalanced circuit* (page 118).

bandwidth
The range of frequencies over which a system is designed to operate. The bandwidth is expressed in Hertz between the highest and lowest frequencies.

bar code
A printed bar-and-space representation of digital data configured to represent numeric or alphanumeric information.

barrier
A partition or separation used for the insulation or isolation of electric circuits or electric arcs (as defined in NEMA Standard Pub. No. ICS 2, 1988).

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base speed
Base speed is the manufacturer's nameplate rating where the motor will develop rated power at rated load and voltage. With dc drives, it is commonly the point where full armature voltage is applied with full-rated field excitation. With ac systems, it is commonly the point where 60Hz is applied to the induction motor.

baseband link
1) A communication link with only one channel, encoded by on/off switching. Examples: DH and DH+™ links. **2)** Contrasted with *carrier-band link* (page 10) and *broadband link* (page 13).

battery backup
A battery or set of batteries that will provide power to memory only when the main power source is off.

baud
A unit of signaling speed equal to the number of discrete conditions or signal events per second. Where one bit is encoded on each signaling event, the number of baud is the same as the number of bit/s. See *dibit* (page).

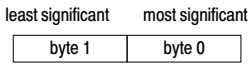
BCC
Block-Check Character. The 2's complement of the 8-bit sum (modulo-256 arithmetic sum) of all data bytes in a transmission block. It provides a means of checking the accuracy of each message transmission.

BCD
Binary Coded Decimal. A numbering system used to express individual decimal digits (0 thru 9) in 4-bit binary notation.

bending radius
The minimum radius to which a cable can be bent without damage.

bidirectional I/O module
An I/O module whose communication with the scanner or processor is bidirectional and therefore uses both input and output image areas.

bifurcated
Something that branches off into 2 branches (e.g., a bifurcated terminal).



big-endian *a*
1) Pertaining to the order of bytes within a word, such that the most-significant byte has the lowest address (big end first). **2)** Contrasted with *little-endian* (page 63).

binary
A base-2 numbering system (using only the digits 0 and 1).

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binary word
A related group of ones and zeros that has meaning assigned by position, or by weighted numerical value in the natural binary system of numbers.

bit
Binary digit. The smallest unit of information in the binary numbering system. Represented by the digits 0 and 1. The smallest unit of memory.

bit error rate
The ratio of the number of bits received with errors to the number of bits transmitted.

bit manipulation
The process of controlling data table bits (on or off) through user instructions or keyboard entry.

bit rate
The number of bits per second.

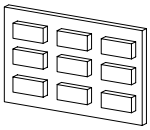
blank unit space
Unit space not equipped to accept a future unit (as defined in NEMA Standard Pub. No. ICS 2, 1988).

block
1) A set of words or bytes handled as a unit, but not addressable as a unit as with a file. A block is typically defined by the number of words in length and the starting word address within a file. **2)** See *I/O block* (page 56).

block diagram
A simplified drawing showing components as boxes or other simple shapes, and possibly using a single line to represent several interconnections to show basic functions and relationships.

block length
The total number of words or bytes in a block.

block-transfer
1) To transfer a block (64 words maximum) of data to or from an I/O module in one scan. **2)** Contrasted with *single-transfer* (page 103).



board (card)
1) A printed-circuit board. **2)** A printed-circuit-board assembly — in the sense that the (printed-circuit) board is physically the main component of a printed-circuit-board assembly.

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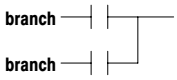
Boolean algebra

An algebraic method of manipulating logic equations.

braking

A method of stopping or reducing the time required to stop an ac or dc motor. Braking can be accomplished in several ways:

- **dc-injection braking (ac drives)** — A method that produces electromagnetic braking forces in the motor by removing 2 ac motor (stator) phases and injecting dc current. The result is a linear braking characteristic (i.e., ramp) that does not diminish with motor speed. Application is normally limited to 10 – 20% of rated motor speed due to increased heating in the rotor.
- **dynamic braking (ac drives)** — A method that produces electromagnetic braking forces in the motor by dissipating generated power into the dc bus through a resistive load. Braking force remains constant and is only limited by the thermal capacity of the resistors. The result is a linear braking characteristic (i.e., ramp) that does not diminish with motor speed.
- **dynamic braking (dc drives)** — A method that produces electromagnetic braking forces in the motor by dissipating generated power from armature/shunt field reaction into a resistive load. Braking force is determined by the field strength, armature voltage, and thermal capacity of the resistors. The result is a logarithmic braking characteristic (i.e., curve) that diminishes with motor speed.
- **regenerative braking** — A method that produces electromagnetic braking forces in the motor by electronically controlling the return of generated power to the ac supply. The result is a controllable linear braking characteristic (i.e., ramp) that does not diminish with motor speed.
- **motor-mounted or separately mounted holding brake** — A positive-action mechanical friction device. Normal configuration is such that when the power is removed, the brake is set. This can be used as a holding brake. (Note: A separately mounted brake is not one that is located on some part of the mechanical drive train other than the motor.)



branch

A parallel logic path within a ladder logic rung.

breakpoint

A location in a program at which execution is halted during debugging so that a programmer can examine information such as the program's status and the contents of variables.

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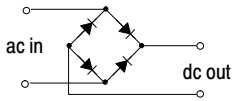
bridge *(communication)*
An interface between links in a communication network that routes messages from one link to another when a station on one link addresses a message to a station on another link.



bridge rectifier
A full-wave rectifier that conducts current in only one direction of the input current. AC applied to the input results in approximate dc at the output.

broadband link
1) A communication link that can have multiple channels. Each channel signal modulates its own carrier frequency. Example: LAN/1™ link.
2) Contrasted with *carrier-band link* (page 10) and *baseband link* (page 10).

brush
A conductor, usually composed of some element of carbon, serving to maintain an electrical connection between stationary and moving parts of a machine (i.e.,commutator of a dc motor). This brush is mounted in a spring-loaded holder and positioned tangent to the commutator segments against which it "brushes." Pairs of brushes are equally spaced around the circumference of the commutator.

BSC
Binary Synchronous Communication. A set of control character sequences for synchronous transmission of binary code data between stations in a data communication system. Also called "BISYNC."

buffer
1) In software terms, a register or group of registers used for temporary storage of data, to compensate for transmission rate differences between the transmitter and receiving device. **2)** In hardware terms, an isolating circuit used to avoid the reaction of one circuit with another.

build
A programming process that takes a user keyboard command (source code) and converts it into hexadecimal format to generate an object code for program execution.

bulk memory
A supplementary large volume memory.

burn
The process by which information is entered into PROM memory.

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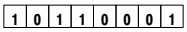
bus
A single path or multiple parallel paths for power or data signals to which several devices may be connected at the same time. A bus may have several sources of supply and/or several sources of demand.

bus structure
The description of a bus, including its size and the function of each line. Some standardized bus structures are Multibus I, Multibus II, VAX, Q-bus, IBM PC, and the STD BUS.

bus topology
A link topology in which all stations are connected in parallel to a medium. These stations are capable of concurrently receiving a signal transmitted by any other station connected to the medium.



byte
A string of 8 bits, operated on as a unit.

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C-face *(motor mounting)*
This type of motor mounting is used to close-couple pumps and similar applications where the mounting holes in the face are threaded to receive bolts from the pump. Normally C-face is used where a pump or similar item is to be overhung on the motor. This type of mounting is a NEMA standard design and available with or without feet.

cable tray system
A unit or assembly of units or sections, and associated fittings, forming a rigid structural system used to support cables and raceways. A cable tray system may include ladders, troughs, channels, solid-bottom trays, and other similar structures.

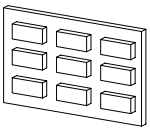
CAD
Computer-Aided Design. A computer-based systems developed to facilitate design of mechanical parts.

calibration
The process of comparing an instrument or device with a standard to verify its accuracy, to make adjustments to meet the standard, or to devise a corrected scale.

cam profile
A technique used to perform non-linear motion electronically, similar to that achieved with mechanical cams.

captive nut, screw, washer
Fastening components built to stay in position after disassembly to enhance ease of re-assembly.

CAR
See *custom application routine* (page 24).



card
1) A printed-circuit card (board). **2)** A printed-circuit-card (board) assembly — in the sense that the card (printed-circuit board) is physically the main component of a printed-circuit-card assembly.

CARDLOCK® solid-state logic
A set of Allen-Bradley products that provides basic logic functions and auxiliary devices in modules and chassis hardware specifically designed for industrial applications.

carrier
A continuous frequency capable of being modulated or impressed with a signal.

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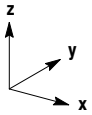
carrier-band link

1) A communication link with a single channel whose signal modulates a carrier frequency. Example: Data Highway II™ link. **2)** Contrasted with *broadband link* (page 13) and *baseband link* (page 10).

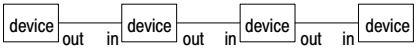


Cartesian coordinate system

A coordinate system in 2 or 3 dimensions made by using 2 or 3 axes that intersect each other at right angles at an origin, enabling any point to be identified by the distance from the origin along an axis.

cascade connection

A series connection of amplifier stages or links in which the output of one stage feeds the input of the next.



cascading timers/counters

A programming technique of using multiple timers and/or counters to extend the range of the timer or counter beyond the maximum values that may be accumulated in a single instruction.

catenet

A number of networks linked in series, through gateways, that pass information between each other by using a communication protocol.

CCD

Charge-Coupled Device. A semiconductor device consisting of an array of photo-sensors that generate an electrical charge proportional to the amount of light striking them.

CCITT

International Telegraph and Telephone Consultive Committee. An international standards organization responsible for a number of data communication conventions.

CD-ROM

Read-only memory on a compact disk.

cemf (back emf)

Counter electromotive force. A voltage developed in an inductive circuit by an alternating or pulsating current. The polarity of this voltage is at every instant opposite that of the applied voltage.

CEN

European Committee for Standardization.

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CENELEC
European Committee for Electrotechnical Standardization.

CENTERLINE® motor control center
An Allen-Bradley motor control center.

central processing unit (CPU)
1) The portion of a computer or programmable controller that controls the interpretation and execution of the user program stored in memory. **2)** The PLC or SLC™ processor.

CGA
Color Graphics Adapter. A video adapter board, introduced in 1981, capable of several character and graphic modes.

channel
A path for a signal. Several channels may share a common link.

channel time-out
The time a device allows between operations before terminating communication on a channel.

character
One symbol of a set of symbols that normally includes both alpha and numeric codes plus punctuation marks and other symbols that may be read, stored, or written.

character mode
In the Advisor system, the mode in which ASCII and graphic characters are presented to yield a resolution of 80 by 48 lines or columns.

chassis
A hardware assembly that houses devices such as I/O modules, adapter modules, processor modules, and power supplies.

check-sum character
A character placed at the end of a data block that corresponds to the binary sum of all characters in that block. Used for error detection.

CIM
Computer-Integrated Manufacturing.

circular interpellation
A motion control function for generating data points between the starting point and the end point on two axes so that simultaneous motion of the axes is in a circular path (a circle or arc).

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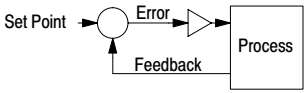
circulating current
In a motor, the current in armature conductors that are short-circuited during commutation.

clear
To set to the zero (0) state (a single bit or an entire memory).

clearance
The shortest distance through air between conducting parts, or between a conducting part and the outer surface of the insulating enclosure considered as though metal foil were in contact with the accessible surfaces of the enclosure (as defined in NEMA Standard Pub. No. ICS 2, 1988).

clock
1) A pulse generator that synchronizes the timing of various logic circuits.
2) Circuitry used to measure time.

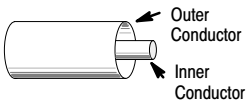
clock rate
The rate at which bits or words are transferred from one internal element to another.



closed-loop system
A control system involving one or more feedback control loops, which combine functions of controlled signals and commands, to keep stable the relationships between the two. Contrasted with *open-loop system* (page 77).

CMOS
Complementary Metal-Oxide Semiconductor. See *MOS* (page 70).

CNC
See *computerized numerical control* (page 21).



coax
Coaxial cable. A transmission line in which one conductor is centered inside and insolated from a metal tube that serves as the second conductor.

cogging
A condition in which a motor does not rotate smoothly, but “steps” or “jerks” from one position to another during shaft revolution. Cogging is most pronounced at low speeds and can cause objectionable vibrations in the driven machine.

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combinational logic
Logic in which the state of each output is controlled only by the states of inputs and the switching-transition delays encountered in the logic path. Compare *sequential logic* (page 19).

combinatorial logic
See *combinational logic.*

combination motor control unit
A control unit that includes a means of disconnecting an externally operable circuit, motor branch-circuit overcurrent protection, and a magnetic motor controller with associated auxiliary devices (when used). The disconnecting means and motor branch-circuit overcurrent protection consist of a fusible disconnecting device or circuit breaker. If the latter is used, it is either an inverse-time (thermal-magnetic or dual magnetic) or an instantaneous magnetic type circuit breaker. The motor controller includes motor overload protection unless equivalent protection is otherwise provided. Two sets of externally operable circuit disconnection means, each with branch-circuit overcurrent protection and a magnetic motor controller, can be mounted in a single compartment to form a dual unit (as defined in NEMA Standard Pub. No. ICS 2, 1988).

command-reply pair
The combination of messages normally occurring on a communication network; the first message is a command for work to be done, the second message is a reply (from the station receiving the command message) gives information on the status of the work. If the work is completed successfully, the reply message contains any data requested; if completed unsuccessfully, it indicates the reason for the failure.

comment
Text included within a program that does not affect the operation of the program; it is used to explain what the program is doing.

common-mode rejection
The ability of a differential analog input to cancel a common-mode signal, expressed in dB.

common-mode voltage
A voltage that appears in common at both input terminals of a differential analog input with respect to ground.

common-mode voltage range
The largest voltage allowed at either input terminal of a differential analog input with respect to ground.

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communication control character
A function character intended to control or facilitate transmission over data networks.

communication rate (data transmission rate)
The rate at which data is transmitted across a link (in bit/s).

communication scan
A part of the SLC CPU's operating cycle in which communication takes place with other devices, such as APS on a personal computer.

commutation
Reversing the current in an armature coil as the coil moves from one pole to another. For a dc motor, this is done mechanically with brushes and a mechanical commutator that is an integral part of the armature assembly. For a brushless servo motor, commutation is done electronically with a feedback signal from a rotary position feedback element (such as an encoder) attached to the motor shaft.

commutator *(mechanical)*
The commutator is a cylindrically shaped assembly that is fastened to the motor shaft and is considered part of the armature assembly. It consists of segments of "bars" that are electrically connected to two ends of one (or more) armature coils. Current is from the power supply through the brushes, to the commutator and hence through the armature coils. The arrangement of commutator segments is such that the magnetic polarity of each coil changes as the armature rotates.

comparator
A device that compares one signal to another, usually the process signal compared to the set point or command signal.

compatibility
1) The ability of various specified units to replace one another, with little or no reduction in performance. **2)** The ability of units to be interconnected and used without modification.

compensation
Adjustment or alteration of a control system to improve performance. A compensator may be an electrical, mechanical, hydraulic, or pneumatic device.

complementary I/O addressing
An I/O configuration in which an input module in one slot location and an output module in another slot location are given the same location address. It is complementary because one uses only the input image and the other uses only the output image.

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complementary output
An output circuit with dual output switching devices such that when one is on the other is off.

computerized numerical control (CNC)
A numerical control system where a computer is used to perform some or all of the basic numerical control functions.

configuration
The arrangement and interconnection of hardware components within a system, and the hardware (switch and jumper) and software selections that determine the operating characteristics of the system.

consecutive message control
A programming technique that allows reports to be printed sequentially, in an orderly fashion, regardless of how quickly they are requested through the user program.

constant-horsepower range
A range of motor operation where motor speed is controlled by field weakening. In this range, motor torque decreases as speed increases. Since horsepower is speed times torque (divided by a constant), the value of horsepower developed by the motor in this range is constant.

constant-torque range
A speed range in which the motor is capable of delivering a constant torque subject to cooling limitations of the motor.

constant-voltage range *(ac drives)*
The range of motor operation where the drive's output voltage is held constant as output frequency is varied. This speed range produces motor performance similar to a dc drive's constant horsepower range.

contact histogram
A feature that allows a display (or printout) of the on and off times for any selected data table bit.

contact reversing
A method of reversing motor rotation by use of two separate contactors, one of which produces rotation in one direction and the other produces rotation in the opposite direction. The contactors are electrically (and mechanically) interlocked so that both cannot be energized at the same time.

contention
A condition on a communication channel where two or more stations try to transmit at the same time.

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contiguous
A description of two or more areas, each of which is adjacent to another so that there is no separation between any parts of the total.

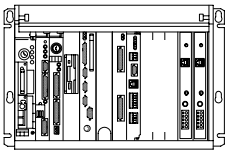
continuous-duty *a*
Operation at a substantially constant load for an indefinite duration. Most commonly used in the context of a continuous-duty current rating. Often expressed simply as *"continuous."*

contouring
A motion control operation in which simultaneous control of multiple axes is used to control the path as well as the end point.

control
1) To cause a machine or process to function in a predetermined manner.
2) To energize or de-energize an output, or to set a data table bit to on or off, by means of the user program.

control variable
See *manipulated variable* (page 66).

controlled variable (C)
In a control loop, the quantity or condition of the controlled system that is sensed to originate a feedback signal for the controller.



controller
A unit, such as a programmable controller or relay panel, that controls machine or process elements.

controller gain (K_c)
The overall gain for a control loop with dependent PID control action. It affects the integral and derivative terms as well as the proportional term.

ControlNet™ network
An open control network that uses the producer/consumer model to combine the functionality of an I/O network and a peer-to-peer network, while providing high-speed performance for both functions.

control panel
A panel that may contain instruments, controllers, or operator interface devices that allow an operator to access and control plant operations.

ControlView™ software
A modular set of Allen-Bradley software products that in one industrial information package integrates data acquisition, supervisory control, and information management.

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converter
1) A device for changing ac to dc. This is accomplished through use of a diode rectifier or thyristor rectifier circuit. **2)** A device for changing ac to dc to ac (e.g., adjustable frequency drive). A "frequency converter," such as that found in an adjustable-frequency drive, consists of a rectifier, a dc intermediate circuit, an inverter, and a control unit.

core memory
A non-volatile type of memory that uses ferrite cores to store information.

CPU
See *central processing unit* (page 17).

CRC
Cyclic redundancy check. An error detection scheme where all of the characters in a message are treated as a string of bits representing a binary number. This number is divided by a predetermined binary number (a polynomial) and the remainder is appended to the message as a CRC character. A similar operation occurs at the receiving end to prove transmission integrity.

critical damping
1) The value of damping that provides the most rapid transient response without overshooting. **2)** Operation between underdamping and overdamping.

cross-talk
The signal on one circuit emerging on an adjacent circuit as interference.

CRT terminal
A terminal containing a cathode ray tube.

CS3000
Windows-based software for configuring GV3000 and FlexPak™ 3000 standard drives.

CSA
Canadian Standard Association.

CTS
Clear-to-send. A signal that tells the transmitting device to start transmitting data.

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current limiting
An electronic method of limiting the maximum current available to the motor. This limit is adjustable so that the motor's maximum current can be controlled. It can also be preset as a protective device to protect both the motor and control from extended overloads.

cursor
The intensified or blinking element in a video display. A means for indicating where data entry or editing occurs.

cursored rung
The rung on which the cursor is currently located.

custom application routine (CAR)
A subroutine custom-designed for a specific type of application. It is called up by a custom instruction in the ladder logic program.

custom drawings
Manufacturer's drawing made to meet user custom requirements (as defined in NEMA Standard Pub. No. ICS 2, 1988).

CVIM™ module
A configurable vision input module for inspection applications.

cycle
1) A sequence of operations that is repeated regularly. **2)** The time it takes for one sequence of operations to occur.

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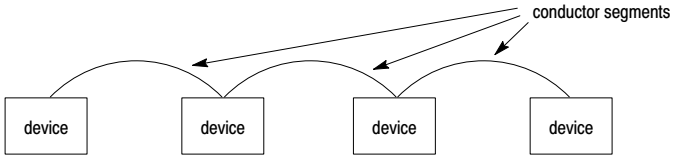
D/A conversion
See *digital-to-analog conversion* (page 31).

D-flange *(motor mounting)*
A type of motor mounting used when the motor is built as part of the machine. The mounting holes of the flange are not threaded. The bolts protrude through the flange from the motor side. Normally D-flange motors are supplied without feet since the motor is mounted directly to the driven machine.

daisy-chain configuration *(for parallel connection)*
1) In a linear arrangement of parallel (bus) connections, a physical configuration such that each device is connected on the bus at the junction of two conductor segments, with no drop-line between the device and the junction of the conductor segments. **2)** Contrasted with a *star configuration* (page 106) and a *trunk-line/drop-line configuration* (page 116).



damping
The reduction in amplitude of an oscillation.

dark operate
Pertaining to a control that energizes its output when the light intensity on the photo detector reaches a sufficiently low level.

data
1) A general term for any type of information. **2)** In a more restricted sense, data refers to the end-use information in the particular context; thereby excluding the protocol information used to get the end-use information.

data initialization
A function performed by the processor that sets starting data values.

data link
The data path established for one or more channels between two or more stations.

data segment
The portion of memory or auxiliary storage that contains the data needed by a program.

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Data-Set™ setpoint transfer utility
An Allen-Bradley software product that provides to a computer the capability to read and save a set of parameter values from one PLC data table and to later download that set of values to another PLC data table.

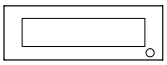
data table
The part of processor memory that contains I/O values and files where data is monitored, manipulated, and changed for control purposes.

data terminal
1) A device used only to send or receive data. **2)** A peripheral device that can load, monitor, or dump memory data. This includes CRT devices and line printers.

data transmission rate
See *communication rate* (page 20).

database
The entire body of data that has to do with one or more related subjects. Typically, it consists of a collection of data files.

DataDisc™ CD-ROM information library
An Allen-Bradley product that uses CD-ROM to store manuals for easy access to product publications.



Dataliner™ message display
An Allen-Bradley product for displaying messages.

DātaMyte DataTruck® data collector
A portable Allen-Bradley device used to harvest data from fixed-station DātaMyte data collectors. See *DātaMyte data collector* (a DātaMyte product).

DātaMyte® data collector
An Allen-Bradley device designed to automatically collect and analyze data gathered by gages (a DātaMyte product).

dc
Direct current.

dc contactor
A contactor specifically designed to establish or interrupt a direct-current power circuit.

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dc input circuit
A circuit on an I/O module that converts dc signals from a machine/process switching device to backplane logic level dc signals. By definition, it is always a digital circuit (on/off). By implication, it usually has a direct relationship with the data table (a data table bit directly reflects its state).

dc input module
An I/O module that contains circuits that convert dc signals from a machine/process switching device to backplane logic level dc signals. By implication, they are direct digital inputs.

dc output circuit
A circuit on an I/O module that provides switching of dc power to a machine/process load device based on backplane logic level dc signals. By definition, it is always a digital circuit (on/off). By implication, it usually has a direct relationship with the data table (a data table bit directly controls its state).

dc output module
An I/O module that contains circuits that provide switching of dc power to machine/process load devices based on backplane logic level dc signals. By implication, they are direct digital outputs.

DCD
Data-carrier Detect. A signal that indicates the carrier is being received.

DCE
Data Communication Equipment. **1)** Equipment that provides the functions required to establish, maintain, or terminate a connection. **2)** The signal conversion and coding required for communication between data terminal equipment and data circuits. DCE may or may not be an integral part of a computer.

DCS-Net
A high-speed (875k bit/s) deterministic (2.99ms/drop) coax-based master-slave drive control network used in the AutoMax DCS system.

DDCMP
Digital Data Communication Message Protocol. Logic that controls the transmission of data between stations in a point-to-point or multi-point data communications system. The method of physical data transfer used may be parallel, series synchronous, or series asynchronous.

DDE
Dynamic Data Exchange. A form of inter-process communication. When two or more programs that support DDE are running simultaneously, they can exchange information and commands.

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DDL
Data Definition Language. A language, usually part of a database management system, that is used to define all attributes and properties of a database — especially record layouts, field definitions, key fields, file locations, and storage strategy.

dead band
The range of values through which a system input can be varied, upon reversal of direction, without causing a corresponding change in system output.

dead time
The interval of time between initiation of an input change or stimulus and the start of the resulting observable response.

debugging
The process of detecting, locating, and correcting errors in hardware or software.

debug monitor
A portion of an on-line operating system that allows the system to respond to a set of on-line commands during a debug operation.

decimal
Pertains to the base-10 numbering system.

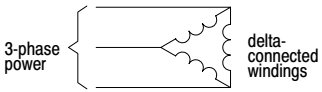
decoder
A device that converts coded information into a more usable form (e.g., Gray code to natural binary).

definite-purpose motor
Any motor design listed and offered in standard ratings with standard operating characteristics from a mechanical construction for use under service conditions other than usual or for use on a particular type of application (NEMA).

definition
Software entries that reflect the hardware configuration of the system.

delimiter
A character that separates items of data. When placed before and/or after a string of data, causes the data to be interrupted in a predetermined manner.

delta connection



1) A 3-phase connection where windings are connected in series with the power applied to or taken from the junctions. **2)** Contrasted with *Y* or *star connection* (page 106).

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demagnetization
When a permanent-magnet dc motor is subjected to high current pulses, the magnets may become slightly demagnetized, resulting in a lower torque constant.

derivative control
See *proportional, integral, derivative control* (page 88).

desktop
An on-screen work area that uses icons and menus to simulate the top of a desk. Its intent is to make software easier to use by enabling the user to move pictures of objects and start tasks in much the same way as they would on a physical desktop.

detent torque
The maximum torque that can be applied to the shaft of a de-energized stepper motor before it begins to rotate.

deviation
See *error* (page 39).

DeviceNet™ network
A global industry-standard open communication network designed to provide an interface through a single cable from a programmable controller processor directly to “smart” devices such as sensors, push buttons, motor starters, simple operator interfaces, and drives.

DeviceLink™ cable
A cable assembly that includes a status indicator and filtering to interface a hard-contact or solid-state sensor to a DeviceNet network.

DF1 protocol
A peer-to-peer link-layer protocol that combines features of ANSI X3.28-1976 specification subcategories D1 (data transparency) and F1 (two-way simultaneous transmission with embedded responses).

DHII™ link
Data Highway II™ link. An Allen-Bradley token-passing carrier-band link for a local area network.

DH-485 link
Data Highway 485 link. An Allen-Bradley token-passing baseband link for a local area network based on the RS-485 standard.

DH link
Data Highway link. An Allen-Bradley floating-master baseband link for a local area network.

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DH+™ link
Data Highway Plus™ link. An Allen-Bradley token-passing baseband link for a local area network.

di/dt
The instantaneous rate of change in current over time. Line reactors and isolation transformers can be used to provide the impedance necessary to reduce high di/dt, and the harmful effects it can have.

diagnostic command
Allows a computer to change or monitor the status of an interface module.

diagnostic program
A user program designed to help isolate hardware malfunctions in the programmable controller and application equipment.

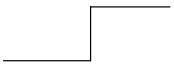
diagnostics
Pertains to the detection and isolation of an error or malfunction.

dialog box
A box that appears on the screen displaying available options for the menu item that was just selected. Dialog boxes may contain editable text fields, check boxes, list boxes, action buttons, and radio buttons.

dibit
A group of two bits. In four-phase modulation, each possible dibit is encoded as one of four unique carrier phase shifts. The four possible states for a dibit are 00, 01, 10, 11.

differential *a*
1) Pertaining to a method of signal transmission through two wires. The transmission always has opposite states. The signal data is the polarity difference between the wires; when one is high, the other is low. Neither wire is grounded. The circuit may be either a balanced circuit, a floating circuit, or a circuit with a high-impedance path to ground from either end. Usually used in reference to encoders, analog I/O circuits, and communication circuits. **2)** Contrasted with *single-ended* (page 103).

diffuse reflection (proximity reflection)
A photoelectric scanning method in which the light emitted by the light source hits the target surface and is then diffused from the surface in all directions.



digital circuit
1) A switching circuit that has only two states: on and off. **2)** A circuit that provides a step function. **3)** Contrasted with *analog circuit* (page 5).

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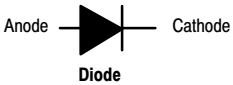
digital gage
1) A measuring device/instrument that indicates the measurement result via digital signal. **2)** Contrasted with *analog gage* (page 5).

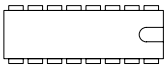
digital-to-analog conversion (D/A conversion)
Production of an analog signal whose instantaneous magnitude is proportional to the magnitude of a digital value.

digitize
To convert an analog measurement of a physical variable into a numerical value, thereby expressing the value in numerical form.

DIN
Deutche Industrie Normenausshus. A European standards organization.



diode
A solid-state unidirectional conductor.



DIP
Dual In-line Package. A configuration in which printed-circuit components are built with 2 parallel rows of pins.

Direct Drive™ relay
An Allen-Bradley relay construction designed to maintain non-overlapping operation between normally-open and normally-closed contacts.

direct I/O module
1) An I/O module for which each input or output that has an individual connection that corresponds directly to a data table bit or word that stores the value of the signal at that I/O circuit (digital or analog). This allows the ladder logic to have direct access to the I/O values. **2)** Contrasted with *intelligent I/O module* (page 54).

disable
To inhibit logic from being activated.

discrete
1) Having an individually distinct identity. **2)** Contrasted with *integrated* (page 53).

discrete circuit
1) A circuit built from separate components that were manufactured individually. **2)** Contrasted with *integrated circuit* (page 54).

discrete I/O module
See direct I/O module.

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disk cache
A portion of a computer's RAM set aside for temporarily holding information read from disk. A disk cache does not hold entire files. Instead, it holds information that has recently been requested from disk or written to disk. The purpose of holding this information in RAM is to try to avoid reading it from disk multiple times.

disk drive
The device that writes data to or reads data from a disk.

disk file
An organized collection of records stored on a disk.

disk storage
A supplementary data storage area on a disk.

diskette (floppy disk)
A thin flexible disk, coated with magnetic oxide and used to store data.

display
The image that appears on a CRT screen or on other image projection systems.

display menu
The list of displays from which you select specific information for viewing.

distributed processing system
A system containing multiple hardware units located at different physical locations; individual hardware units do stand-alone processing, but can also be interconnected to share data with other locations or with a central facility. This may include terminals, programmable controllers, or intelligent I/O modules.

dither
A small oscillation signal superimposed on a velocity signal to overcome the effect of static friction that would otherwise occur at zero velocity. Without a dither, a low-velocity signal may be unable to overcome the static friction.

DLE
Data-Link Escape. An ASCII control character used to provide supplementary line communication signals. There are two characters in the sequence: the first character is DLE, the second character varies according to the function desired and the code used.

DMA
Direct Memory Access. The process of one intelligent device accessing the memory of another, bypassing the other processor's general registers.

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DNC
Direct Numerical Control. Using a direct communication link to transmit part programs from a computer to a numerical control system.

documentation
An orderly collection of recorded hardware and software data such as tables, listings, reports, program comments, and diagrams to provide reference information for operation and troubleshooting.

DOS
Disk Operating System.

double-slot addressing
See *2-slot addressing* (page 1).

download
See *upload/download* (page 119).

DPS
Distributed Power System. A family of drives (including the SD3000, SA3000, SF3000, SB3000, and SA500) used by the Rockwell Automation Drive Systems Group. This entire family of drives is controlled with the AutoMax DCS system.

drift
A slow change in some characteristic of a device. For a drive, it is the deviation from the initial set speed with no load change over a specific time period. Normally the drive must be operated for a specified warm-up duration at a specified ambient temperature before drift specifications apply. Drift is normally caused by random changes in operating characteristics of various control components.

drip-proof
Pertaining to a machine constructed in a way to guard against liquid or solid particles falling on it vertically or at a specified small angle (within 15° of vertical) causing interference with satisfactory operation.

drive controller (drive) (servo amplifier)
An electronic device that can control the speed, torque, horsepower, and direction of an ac or dc motor.

- **analog drive** — a motor drive in which parameters are set with potentiometers.
- **linear drive** — a motor drive in which the output is directly proportional to either a voltage or current input. Normally both inputs and outputs are analog signals.

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- **motor drive** — a power amplifier used to interface low-level control signals to motors to create motion.
- **PWM drive** — a motor drive using pulse-width modulation techniques to control power to the motor. A high-efficiency drive used for high-response applications.
- **SCR drive** — a motor drive that uses SCRs as the power control elements. Usually used for low-bandwidth high-power applications.
- **servo drive** — a motor drive that uses internal feedback loops for motor current and/or velocity.
- **vector drive** — an ac static motor drive using power-control techniques that produce motor performance similar to dc static drives.
- **VVI drive** — a type of ac adjustable-frequency drive that controls the voltage and frequency to the motor to produce variable-speed operation. The VVI-type drive controls the voltage in a section other than the output section where frequency generation takes place. The frequency control is accomplished by an output bridge circuit that switches the variable voltage to the motor at the desired frequency.

driver *(hardware)*
1) A source output; when turned on, it supplies a positive dc current to its load. **2)** Contrasted with *puller* (page 88).

driver *(software)*
A software subroutine that handles the logic for communicating with a specific type of external device.

drop (drop cable) (drop line)
A cable connecting a station to a tap on a trunk line.

DSR
Data Set Ready. A signal that indicates the modem is connected, powered up, and ready for data transmission.

DST field
Destination field. Identifies the address of the station to which a network packet is delivered.

DTAM
Data-Table Access Module.

DTE
Data-Terminal Equipment. Equipment that is attached to a network to send or receive data, or both.

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DTL™ software
See *INTERCHANGE™ software* (page 54).

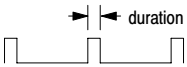
DTR
Data Terminal Ready. A signal that indicates the transmission device (terminal) is connected, powered up, and ready to transmit.

dumb terminal
1) A data terminal that has no internal processing capability (µprocessor) for manipulating data. **2)** Contrasted with *intelligent terminal* (page 54).

dump
To generate a copy of all or part of memory contents through a data terminal.

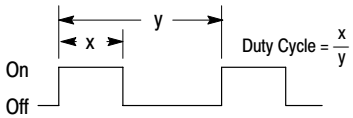
duplex (full duplex)
See *two-way simultaneous* (page 117).

duplicate I/O addressing
A method of expanding the number of I/O by assigning the same location address to 2 different I/O modules.



duration
1) The time during which something exists or lasts. For example, the length of time that a signal is high may be described as the duration of a pulse. **2)** Compare *interval* (page 55) and *period* (page 83).

duty cycle
1) The ratio of working time to total time for an intermittently operating device. Usually expressed as a percentage. **2)** The ratio of pulse width to the interval between like portions of successive pulses. Usually expressed as a percentage.



dv/dt
The instantaneous rate of change in voltage over time.

dwell
A time delay of programmed or established duration, not an interlock or hold.

dynamic braking
See *braking* (page 12).

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EAN
European Article Numbering system. A standard bar code type for retail food packaging in Europe. See *UPC* (page 118).

EC
European Community. Now known as European Union. See *EU* (page 40).

echo
A portion of the transmitted signal returned to the source with sufficient magnitude and delay to cause interference.

EDC
Error Detection and Correction. With extra error-detection bits included in each word of data bits, a memory system can detect and correct most errors.

eddy current
Currents induced in components from the movement of magnetic fields. Eddy currents produce waste heat and are minimized by lamination of the components.

edit
To deliberately modify a program or file.

EEPROM
Electrically-Erasable PROM. A type of PROM that can be erased and re-programmed by electrical signals. As with all PROMs, it is non-volatile random-access memory. (See *PROM*, page 88; *EPROM*, page 39; and *UV-erasable PROM*, page 119.)

efficiency
Ratio of output to input indicated by a percentage. In a motor, it is the effectiveness with which the motor converts electrical energy into mechanical energy. In a power supply, it is the effectiveness with which the power supply converts ac power into dc power.

EFTA
European Free Trade Association.

EGA
Enhanced Graphics Adapter. A video display adapter board introduced in 1984. The EGA is capable of emulating the CGA (Color Graphics Adapter) and the MDA (Monochrome Display Adapter), as well as providing several additional video modes.

EIA
Electronics Industries Association. An American agency that sets electrical/electronic standards.

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electro-optical coupler
See *optical coupler* (page 80).

element
Usually something that provides a logical function. **1)** Relays and motor starters controlled by outputs (control elements). **2)** Switches and sensors connected to inputs (feedback elements). **3)** The matrix items of a ladder logic rung, reflecting the results of executing program instructions (ladder logic elements). **4)** In a general sense, anything that can be identified as a part of a larger entity — as with a data element being any addressable unit of data as long as it can be identified as a sub-unit of a larger unit of data (a bit as a data element of a word, structure or file; a word as a data element of a structure or file; a structure as a data element of a file).

emf
Abbreviation for electromotive force. The force that causes electricity to flow when there is a potential difference between two points. Expressed in units of volts. The voltage applied to a motor armature from a power supply is the emf and the voltage generated by the motor is the counter-emf or cemf.

emi
Electromagnetic interference. Any electromagnetic disturbance that interrupts, obstructs, or otherwise impairs the performance of electronic equipment.

enable
To activate logic by the removal of a suppression signal.

enclosure
The housing in which equipment is mounted. They are available in designs for various environmental conditions. Refer to NEMA standard for specifications of different types of enclosures.

encoder
Any feedback element that converts linear or rotary position (absolute or incremental) into a digital signal.

- **linear encoder** — is a feedback element that directly converts linear position (absolute or incremental) into a digital signal.
- **rotary encoder** — is a feedback element that converts rotary position (absolute or incremental) into a digital signal. Often, the directly measured rotary position is used to determine a linear position through gearing.
- **absolute encoder** — is a feedback element that generates a digital code that is unique for each absolute position (linear or rotary). An absolute encoder usually provides the digital feedback signal in a Gray code to minimize errors.

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- **incremental encoder** — is a feedback element that generates a digital signal to indicate each incremental change of position (linear or rotary). An incremental encoder usually provides the digital feedback signal in quadrature form to indicate direction of motion.

encoder bandwidth
An expression for maximum encoder speed in Hz. May also refer to the maximum rate at which the control loop can accept encoder signals. The actual bandwidth of the encoder and the capability of the controller to process encoder signals may not be the same.

encoder line count
The number of cycles (lines) per revolution on an encoder channel.

encoder marker
A once-per-revolution signal provided by some incremental encoders to specify a reference point within that revolution. Also known as *zero reference signal*.

encoder multiplication
A technique by which encoder resolution can be raised above the encoder line count. Normally 2 or 4 times the line count.

encoder resolution
A measure of the smallest positional change that can be detected by the encoder. For a rotary encoder, the number of lines per revolution times the encoder multiplier.

Encompass™ program
A program that offers a structured relationship with Rockwell Automation by promoting partner companies' products that complement Rockwell Automation products.

end of transition (EOT)
An instruction required on the last rung of a transition file of a sequential function chart.

end of transmission (EOT)
An ASCII control character that indicates the end of a transmission.

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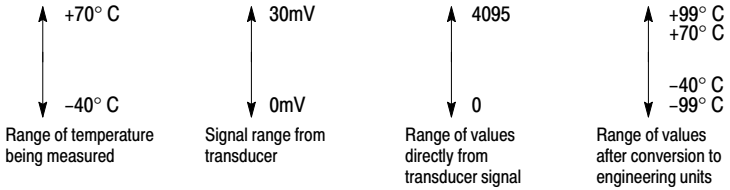
engineering units

Units of measurement (such as pounds, pounds per square inch, degrees Celsius) relative to the process. An input signal is often a percentage of the full-scale range (such as ± 5 Volts, or 4–20mA) of direct measurement that must then be converted, through scaling, into engineering units. See *scaling* (page 99).



entity

An active element within an OSIRM layer. See *OSIRM* (page 80).

environment

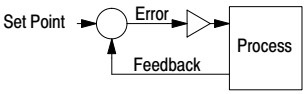
In a systems context, the environment is anything that is not a part of the system itself. Knowledge about the environment is important because of the effect it can have on the system or because of possible interactions between the system and the environment.

EOT

1) See *end of transition* (page 38). **2)** See *end of transmission* (page 38).

EPROM

Erasable Programmable Read-only Memory. A PROM that can be erased, usually with ultraviolet light, then re-programmed with electrical signals. As with all PROMs, it is non-volatile random-access memory. (See *PROM*, page 88; *EEPROM*, page 36; and *UV-erasable PROM*, page 119.)



error (deviation)

In any control loop, the difference between the set-point signal and the feedback signal. An error is necessary before a correction can be made in the controlled system. In a positioning loop, the difference between the instantaneous position command signal generated by the summation of the feedrate, and the actual position signal generated by the summation of the feedback (e.i., following error).

error signal

The difference between a feedback signal and its corresponding command signal.

ESSI

A part programming format originally developed by the Central Institute for Industrial Research in Norway. A commonly used format in Europe and with ship-building industry world wide.

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Ethernet™ network
A local area network with a baseband communication rate of 10M bit/s.

ETSI
European Telecommunications Standards Institute.

EU
European Union.

executable program
A program that is ready to run. The term usually refers to a compiled program that has been translated into machine code in a format that can be loaded into memory and run; however, for interpreted languages it can simply refer to source code in the proper format.

execution
The performance of an operation that is accomplished through processing an instruction, a series of instructions, or a complete program.

execution time
The total time required for the execution of one specific operation.

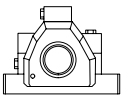
executive (software)
1) Reliance-development software used to create application programs. **2)** In a numerical control system, software that controls execution of the application programs. (See operating system, page 79.)

EXPERT™ vision system
A stand-alone programmable Allen-Bradley vision system.

export
To transfer information from one system or program to another. This typically involves conversion to ASCII format.

extended local I/O
I/O connected to a processor across a parallel link, thus limiting its distance from the processor. (See *local I/O,* page 63 and *processor-resident local I/O,* page 87.)

extended local I/O link
A parallel link for carrying I/O data between a PLC or SLC processor/scanner and extended local I/O adapters.



EZLINK™ bearing monitor
A monitor for bearings and speed reducers that connects directly to a DeviceNet network.

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factory wiring
1) Wiring completed before the product was shipped from the factory in which it was built. **2)** Contrasted with *field wiring* (page 43).

false
Pertaining to a signal or indicated condition that is not what it seems to be (i.e., bogus, not real). A false signal could result from noise induced on a line or an echo due to an improperly terminated line. See also *not true* (page 75).

false-pulse protection
Circuitry designed to protect against false pulses during power-up or power-down action.

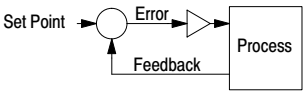
FAN® network
A flexible unwired Allen-Bradley network for statistical quality control, consisting of DataMyte data collectors, DataTruck products, and FAN II software (a DataMyte product).

fault
Any malfunction that interferes with normal system operation.

fault zone
An area in the program that alters the operation if a rack fault occurs. Each fault zone is delimited by fence codes.

FDX (full duplex)
See *two-way simultaneous* (page 117).

feedback
The signal or signals returned from a controlled machine or process to denote its response to the command signal.



feedback control loop
A closed signal path in which feedback is compared with the commanded value to obtain a corrective error signal.

feedback device
See *feedback element*.

feedback element (feedback device)
In a control system, an element (transducer) that converts motion, position, pressure, flow, or temperature to an electrical signal for comparison to the command signal.

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feedback resolution
The smallest increment of change that the feedback element can distinguish and reproduce as an electrical output.

feedback signal
The measurement signal indicating the value of a directly controlled variable, which is compared to the commanded value to obtain the corrective error signal.

feeder tap unit
A unit that includes an externally operable circuit disconnecting means and branch-circuit overcurrent protection, principally used for non-motor loads. Two sets of externally operable circuit means, each with branch-circuit overcurrent protection, may be mounted in a single compartment to form a dual unit (as defined in NEMA Standard Pub. No. ICS 2, 1988).

feedforward control action
Control action in which information concerning upstream conditions is converted into corrective commands to minimize the deviations of the controlled variable.

fence codes
Special program instructions that control and delimit specific program areas such as fault zones.

ferrule
Tip or termination of a fiber-optic bundle.

field
The stationary electrical part of a dc motor.

field control
A method of controlling dc motor speed by varying the field current in the shunt field windings.

field economy
A circuit design feature of a dc motor shunt field supply that reduces the supply voltage output after a predetermined period of time. On many field supplies, this means a 50% reduction in output voltage 2 to 3 minutes after machine shutdown (idle). A field economy circuit serves to reduce standby power consumption and prolong the insulation life of the motor field windings.

field forcing
Temporarily over-exciting a motor shunt field to overcome the L/R time constant, increase the rate of flux change and rapidly reverse the direction of shunt motor field current.

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field range
The range of motor speed from base speed to the maximum rated speed.

field reversing
One method for producing regeneration. It is accomplished by changing the direction of current through the motor field, which reverses the polarity of the motor cemf to account for generator action.

field weakening
The process of reducing the shunt field excitation on a dc motor to a level lower than its rated hot field current value. This is typically done dynamically while the motor is running under regulator control to allow motor speeds higher than the motor's base speed. The motor's torque capability decreases as the field is weakened, which allows constant horsepower to be delivered to the load at a given armature current level.

field wiring
1) Wiring connected by the user after the user receives the product.
2) Contrasted with *factory wiring* (page 41).

FIFO
See *first-in first-out* (page 44).

file
A complete block of words or structures addressable as a unit.

file creation
Establishing or writing records for a file into some storage device to provide later access by the processor or operator.

file extension
See *file type* (page 44).

file maintenance
1) Adding, deleting, or changing the contents of records in a file.
2) Reorganizing the structure of a file to improve access to records or to change the storage space required.

file management
1) A term that defines the functions of creation, insertion, deletion, or updating of stored files and records in files. **2)** The operations that are performed on files.

file name
A symbolic name identifying a file on a disk or in a controller or processing device.

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file organization
A method of ordering data records stored as a file, while also providing a way to access stored records.

file type
1) A mnemonic used as an extension of a file name to identify the type or contents of a file. **2)** The method of data representation used for a file.

filter
A device that passes a signal or a range of signals and eliminates all others.

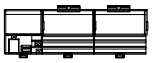
firmware
Logic stored in read-only memory.

first-in first-out (FIFO)
A method of ordering data items stored, so that the order in which data items are retrieved is the identical order in which they were originally received and stored.

flag
A marker of some type used in processing or interpreting information; a signal indicating the existence or status of a particular condition. Flags are used in such areas as communication, programming, and information processing. A flag can be a code, embedded in data, that identifies some condition, such as the beginning or end of a word or a message; or it can be one or more bits set internally by hardware or software to indicate an event of some type, such as an error or the result of a comparison of values.

flag bit
A processor memory bit, controlled through firmware or a user program, used to signify a certain condition (e.g., battery low).

flash memory
Programmable non-volatile random-access memory.



FLEX I/O™ assembly
An Allen-Bradley compact modular assembly comprising I/O modules, terminal bases, and an adapter/power-supply.

FlexPak 3000 drive
A Reliance family of standard user-configurable digital dc drives.

floating
The condition of a device or circuit that is not grounded and not tied to any established potential.

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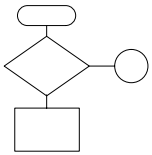
floating ground
An electrical circuit common that is not at earth ground potential or the same ground potential as circuitry with which it interfaces. A voltage difference can exist between the floating ground and earth ground.

floating master
A type of communication protocol where mastership changes from station to station on an event basis. Mastership contention is resolved with a polling technique.

floating-point format
A data storage format that includes the location of the decimal point by expressing the power of the base.

floppy disk
See *diskette* (page 32).



flowchart
A graphic representation for the definition, analysis, or solution of a problem. Symbols used to represent a process or sequence of decisions and events.

flowmeter
An instrument that measures and indicates the rate of flow of a liquid or gas.

fluidics
A type of control technology that uses logic elements based on the interaction of jets of fluid.

FM
Factory Mutual (an approval agency).

following error
See *error* (page 39).

force-off function
A function that allows the user to turn off an input image bit regardless of the state of the input circuit, or to turn off an output circuit regardless of the state of the output image bit.

force-on function
A function that allows the user to turn on an input image bit regardless of the state of the input circuit or to turn on an output circuit regardless of the state of the output image bit.

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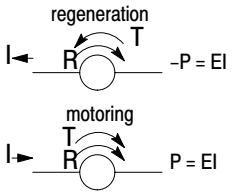
form factor
A figure of merit that indicates how much rectified current deviates from pure (non-pulsating) dc. A large departure from unity form factor (pure dc) increases the heating effect of the motor. Mathematically, it is expressed as I_{rms}/I_{av} (motor-heating current/torque-producing current).

four-quadrant operation


In reference to a regenerative drive, the four combinations of forward and reverse rotation and forward and reverse torque. The four combinations are:

- forward rotation/forward torque (motoring)
- forward rotation/reverse torque (regeneration)
- reverse rotation/reverse torque (motoring)
- reverse rotation/forward torque (regeneration)

frame *(communication)*
The unit exchanged at the data link layer of a communication network.

frame size
The physical size of a motor, usually consisting of NEMA-designed D and F dimensions at a minimum. The D dimension is the distance in quarter inches from the center of the motor shaft to the bottom of the mounting feet. The F dimension relates to the distance between the centers of the mounting feet holes.

frequency
The number of periodic cycles per unit of time.

front of a motor
The end opposite the coupling or driving pulley (NEMA). This is sometimes called the opposite pulley end (O.P.E.) or commutator end (C.E.).

FSK
Frequency-shift Keying. A signal modulation technique in which the modulating signal shifts the carrier frequency between predetermined values.

full-duplex (FDX)
See *two-way simultaneous* (page 117).

full scale
The maximum level that can be measured. For example, in an analog input circuit the maximum allowable voltage or current level is called full scale because any increase beyond that level cannot be measured.

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function keys
Keys on a keyboard labeled F1, F2, F3, etc. The function of each of these keys is defined by software and a key may have a different function for each menu display.

functional-block instruction set
A set of instructions that moves, transfers, compares, or sequences blocks of data.

future-unit space
Unit space specified and equipped to accept a future unit (as defined in NEMA Standard Pub. No. ICS 2, 1988).

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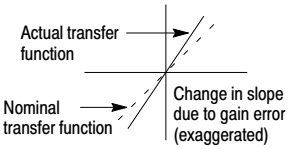
GA Basic
The name of the report-generation programming language used for programming the 1775-GA Peripheral Communication Module.

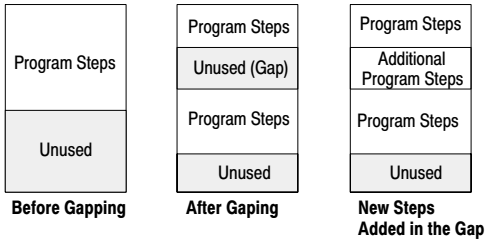
gage
A measuring device or measuring instrument.

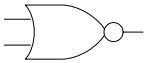
gain
The ratio of the magnitude of the output signal with respect to that of the input signal.

gain error


The "gain" of an analog input or output is the scale factor that provides the nominal conversion relationship. Typically, this is the slope of the line when analog voltage or current is plotted versus the corresponding digital values. Gain error is the deviation of the scale factor or slope of the line from the ideal or nominal gain value. Gain error is expressed in percent of the input or output value.

gapping
Separating memory contents into 2 parts to create a "gap" so that new memory items can be stored in the "gap."





gate
1) A logic element that blocks or passes a signal, depending on the status of specified input signals. **2)** The control element of an SCR or of some other solid-state devices.

gateway
A protocol translator.

GML™ language
An Allen-Bradley programming language for motion control that uses icons to represent motion functions. It lets you generate a program by first laying out the logic by placing icons in a diagram — and then filling in details through windows.

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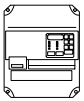
grafcet
A European equivalent of a sequential function chart. See *SFC* (page 102).

GRAFIX® language
The name of the programming language used for programming color graphics displays.

Gray code
A binary numbering system that is coded such that sequential numbers are represented by expressions that differ in only one bit, to minimize errors that could otherwise occur during transitions in a natural binary system.

Decimal	Natural Binary	Gray
0	000	000
1	001	001
2	010	011
3	011	010
4	100	110
5	101	111
6	110	101
7	111	100

GTO
Gate Turn-Off or Gate Turn-On power semiconductor device.



GV3000™ drives
A Reliance family of standard user-configurable ac drives that use either vector or volts/Hz regulation.

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half-duplex (HDX)
See *two-way alternate* (page 117).

half-slot addressing
See *½-slot addressing* (page 1).

hard contacts
Any type of physical switching contacts.

hard copy
Any form of a printed document such as a ladder diagram program listing.

hard disk
1) A disk storage device for storing relatively large amounts of data.
2) Contrasted with *diskette* (page 32).

hardware
Mechanical, electrical, and electronic components and assemblies.

HDLC
High Level Data-link Control. A communication protocol sanctioned by the International Standards Organization (ISO) that defines procedures for the data link and physical protocol layers.

HDX (half-duplex)
See *two-way alternate* (page 117).

header
1) A portion of a protocol data unit that contains protocol control information and precedes the start of data, if present. **2)** In data storage, a file header identifies the file by name, size, and time and date of creation or revision.

header rung
The first rung of a communication zone required in a ladder diagram program for a 1774 PLC or PLC-2® processor on the Data Highway network.

hexadecimal numbering system
A base-16 numbering system which uses the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F for numerals.

high byte
The 8 most-significant bits of a 16-bit word.

high nibble
The 4 most-significant bits of a byte.

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high = true
1) A signal type where the higher of two voltages indicates a logic state of on (1). **2)** Contrasted with *low = true* (page 65).

HIM
Human Interface Module.

home position
A reference position for all absolute positioning movements. Usually defined by a home limit switch and encoder marker. Normally set at power up and retained as long as the control system is operational.

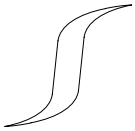
horsepower
A unit of power: 1hp = 33,000 ft-lb/min. = 746 watts.

host
1) A central controlling computer in a network system. **2)** Any device on a network system that provides a controlling function to another device on the network. **3)** Any intelligent device for which another device is providing a communication interface to a network.

host interface
The communication interface to the host computer.

hot backup
A programmable controller system configuration consisting of a primary and a backup (secondary) processor. If the primary processor fails, the backup processor takes over operations automatically.

hunting
Undesirable fluctuations in motor speed that can occur after a step change in speed reference (either acceleration or deceleration) or load.

hysteresis

1) The effect of residual magnetism whereby the magnetization of a ferrous substance lags the magnetizing force because of molecular friction. **2)** The property of magnetic material that causes the magnetic induction for a given magnetizing force to depend upon the previous conditions of magnetization. **3)** A form of nonlinearity in which the response of a circuit to a particular set of input conditions depends not only on the instantaneous values of those conditions, but also on the immediate past of the input and output signals.

hysteresis loss
The power loss in an iron-core transformer or other ac device because of magnetic hysteresis.

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IBP
Independent Background Program. In ladder logic programming, a program without a time limit and independent of the main ladder logic program. It can be used for such background tasks as time-consuming computations and data manipulations, or fault recording and reporting.

IC
See *integrated circuit* (page 54).

IDP
Identification protocol. An extended application layer protocol used by Allen-Bradley intelligent sensing devices to communicate with other devices and host processors. IDP commands and responses are inserted as data within the PCCC layer.

I.E.C.
International Electrotechnical Commission.

IEEE 488
A standard for parallel communication interfaces. Sometimes known as HPIB.

IEEE 802
A family of standards specified by the American **Institute of Electrical and Electronic Engineers** for data communication over local and metropolitan area networks.

immediate-access reply
In a token-passing ring communication system, a station normally waits for the token before sending a reply. However, an immediate reply is sent while the station sending the command is still holding the token. Compare with *reply* and *acknowledgement.*

import
To bring information from one system or program into another. This typically involves conversion from ASCII format.

incremental move
1) A move to a specified incremental position. **2)** Contrasted with *absolute move* (page 2).

incremental position
1) A position expressed in reference to the current position. Usually expressed in reference to a move that is an increment from the current position. **2)** Contrasted with *absolute position* (page 2).

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indexer
A hardware or software system that produces motion (i.e., index) profiles. Usually the index profile is trapezoidal, but can be rectangular, triangular, parabolic, or sinusoidal.

inertia
A measure of a body's resistance to changes in velocity, whether the body is at rest or moving at a constant velocity. The velocity can be either linear or rotational. The moment of inertia (WK^2) is the product of the weight (W) of an object and the square of the radius of gyration (K^2). The radius of gyration is a measure of how the mass of the object is distributed about the axis of rotation. WK^2 is usually expressed in units of lb-ft^2.

information
The meaning assigned to data by known conventions.

infrared
Invisible light radiation starting at a wavelength of 690 nm (6900 A).

input device
See *sensor* (page 101).

instability
The state or property of a system where a change occurs in the output that does not correspond to input command or feedback.

instruction
An action statement. Ladder logic has input and output instructions. Each time the program scan reaches a rung, its input instructions are executed to examine whether specific conditions are true. If this results in an unbroken path of true input elements, the output instruction is enabled.

integer
Any positive or negative whole number or zero.

integral control
See *proportional, integral, derivative control* (page 88).

integral horsepower motor
A motor that has a continuous rating of 1 HP or more, built into a frame.

integrated
A type of design in which two or more basic components or functions are physically and electrically combined — usually in a single chassis.
2) Contrasted with *discrete* (page 31).

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integrated circuit (IC)

1) A solid-state device that includes combinations of circuit elements (resistors, capacitors, transistors) that are fabricated on or within a single continuous substrate (supporting semiconductor for the circuit).
2) Contrasted with *discrete circuit* (page 31).

intelligent I/O module

1) An I/O module that provides some on-board processing of input values to control some output values without going through the data table for control by the ladder logic. An intelligent I/O module may have digital I/O circuits, analog I/O circuits, or both. **2)** Contrasted with *direct I/O module* (page 31).

- **motion-control modules** — digital position-feedback and analog velocity-feedback input values are processed on the module to control the analog velocity output value.
- **PID modules** — analog process-variable input value is processed on the module to control the analog control-variable output value.
- **communication modules** — interface with other devices such as loop controllers and DLI counters/ratemeters.

intelligent terminal (smart terminal)

1) A data terminal that has some internal processing capability (a Microprocessor) for manipulating data. **2)** Contrasted with *dumb terminal* (page 35).

interactive computing

The type of processing where the user of the system communicates directly with the system to perform certain checks on the data and to handle certain kinds of transactions.

INTERCHANGE™ software

Allen-Bradley application-programming interface software through which an application program on a host computer can access information in PLC controller memory (formerly *DTL software*).

interface *n*

A shared boundary. This could be a hardware circuit. This could also be software that enables communication.

interface *v*

1) To connect by means of an interface. **2)** To serve as an interface.

interface event

The interaction that takes place between OSIRM layers to request service of a particular layer, or to signal another layer.

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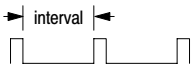
interference
Any undesired electrical signal induced into a conductor by electrostatic or electromagnetic means.

interlock
1) A switch or other device that prevents activation of a piece of equipment when a protective door is open or some other hazardous condition exists. **2)** Software that inhibits execution of other software logic unless certain defined conditions exist.

intermittent duty
(INT) Pertaining to a motor that never reaches equilibrium temperature (equilibrium) because it is permitted to cool down between operations. For example, a crane, hoist, or machine tool motor is often rated for 15% or 30% duty cycle.

International Standards Organization (ISO)
An organization established to promote development of international standards.

internet
Abbreviation for internetwork. A set of networks — possibly dissimilar — joined by gateways that handle data transfer and conversion of messages from the sending network to the protocol of the receiving network.



interval
1) The length of time between events or states. For example, the length of time between when a signal is high may be described as the interval between pulses. **2)** Compare *duration* (page 35) and *period* (page 83).

intrinsic safety
A design technique applied to electrical equipment and wiring for hazardous locations. It is based on limiting electrical and thermal energy to a level below that required to ignite hazardous atmospheric mixtures.

intrinsic safety barrier (passive barrier)
A barrier that, when a dangerous voltage is coming from the safe area, shunts fault current through zener diodes toward ground until a fuse breaks to maintain an open-circuit “safe” voltage toward the hazardous location.

intrinsic safety isolator (active barrier)
A power supply or signal conditioner that transmits or receives signals from a hazardous location in an isolated way.

intrinsically safe connection
A connection (e.g., for an I/O circuit) from which wires can be routed into a hazardous location.

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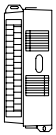
intrinsically safe product
A product that can be located in a hazardous location.

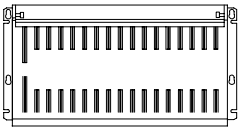
inverter
1) An ac adjustable-frequency drive. **2**) A particular section of an ac drive. This section uses the dc voltage from a previous circuit stage (intermediate dc circuit) to produce a pulse-width-modulated or stepped ac current or voltage waveform that has characteristics similar to the desired sine-wave frequency. **3**) A circuit whose output signal is the inverse of its input (a positive-going pulse is inverted to a negative-going pulse, and vise versa).

I/O
Input(s) and/or output(s).



I/O block
1) An assembly containing a chassis, a power supply, an adapter, and I/O circuits in a single integrated package. **2**) Contrasted with *I/O module*.

I/O channel
A channel of a data transmission link between a processor scanner module and an I/O adapter module.



I/O chassis
A chassis for I/O modules and either a processor to control the I/O modules, or an adapter to interface a scanner to the I/O modules.

I/O group
A group of input and/or output circuits that corresponds to a word each in the input and output image tables.

I/O image table
An area in memory with addresses corresponding to each input and output module.

I/O link
A data transmission link between a processor scanner port and one or more I/O adapter ports.

I/O module
1) In a programmable controller system, a module (interchangeable plug-in item within a larger assembly) that interfaces directly through I/O circuits to the sensors and actuators of the machine/process. **2**) Contrasted with *I/O block.*

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I/O module group
Adjacent I/O modules whose inputs and/or outputs correspond to a word in the input and output image table. (This term has been replaced by the term *I/O group*.)

I/O rack
An I/O addressing unit that corresponds to 8 input image table words and 8 output image table words. A rack can contain a maximum of 8 I/O groups for a maximum of 128 I/O with unique addressing of I/O modules or 256 I/O with duplicate addressing of I/O modules.

I/O scan time
The time required for the processor to scan all I/O modules, writing output data and reading input data. For local I/O, the I/O scan is typically in sequence with the program scan, in one overall scanning sequence. For remote I/O, the I/O scan is separate from the program scan; it is either left asynchronous to the program scan or is synchronized to the program scan by buffering input data from the I/O scan to write it into the input image table only immediately before the start of each program scan.

I/O terminal
A terminal (on an I/O module, I/O block, or fixed-I/O controller) to provide a connection point for an I/O circuit.

IR compensation
A way to compensate for the voltage drop across resistance of the ac or dc motor circuit and the resultant reduction in speed. This compensation also provides a way to improve the speed regulation characteristics of the motor, especially at low speeds. Drives that use a tachometer generator for speed feedback generally do not require an IR compensation circuit because the tachometer will inherently compensate for the loss in speed.

ISO
See *International Organization for Standards* (page 55).

isolated I/O module
A module that has each input or output electrically isolated from every other input or output on that module.

isolation transformer
1) A transformer that provides noise isolation between the primary and secondary by such means as a Faraday shield. **2)** A transformer that provides dc isolation from other equipment not connected to that transformer secondary.

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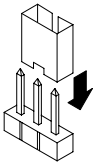
jog
To generate motion (continuous or incremental) whenever an operator-activated switch is closed.

joule
1) The work done by the force of 1 newton acting through a distance of 1 meter. **2)** The energy required to transport 1 coulomb between two points having a potential difference of 1 volt.



jumper
A short conductor with which you can connect 2 points.

jump instruction
An instruction that causes the processor to deviate from executing instructions in order, by jumping to another place in the program.

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K
1K = 2^{10} = 1024. A prefix used as a multiple for bits, bytes, or words in denoting size of a block of data or memory. Example: 2K bytes = 2048 bytes.

k
Kilo. A prefix used with units of measurement to designate a multiple of 1000.

keying
Devices that allow only selected pairs of mating connectors to be plugged into each other.

kinetic energy
The energy of motion of a moving body.

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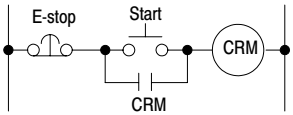

ladder diagram
An industry standard for representing relay control logic.

ladder diagram program
A program written in a format similar to a relay ladder diagram.

ladder logic
See *ladder diagram program*.

LAN
Local Area Network. A network limited to a local geographical area such as an office or a factory.

LAN/1™ link
An Allen-Bradley broadband link with interfaces to auxiliary RS-232-C links in a local area network.

LAN/3™ link
An Allen-Bradley broadband link that interfaces to a variety of links in a local area network.

LAN/PC™ link
An Allen-Bradley broadband link that links personal computers in a local area network.

language
A set of symbols and rules used for representing and communicating information.

laser
Light Amplification by Stimulated Emission of Radiation. A device that converts input power into a very narrow beam of coherent light (light that is all a single frequency and in phase).

latching relay
A relay that maintains a given position by mechanical or electrical means until released mechanically or electrically.

layer
A group of sub-layers and/or entities in the OSIRM that provides services to the layer above and requests services from the layer below.

LCD
Liquid Crystal Display. A reflective visual readout device commonly used in digital watches and laptop computers.

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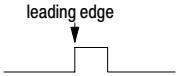
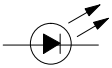
lead
The distance an axis travels each revolution of its lead screw. If the lead screw has only one thread, the lead is equal to the pitch. See *pitch* (page 84).



leading-edge triggering
A programming technique of triggering some step by means of an off-to-on transition of an input signal. The off-to-on transition is considered the leading edge of the input pulse.

leakage current
In a switching device, the current that continues despite the fact that the device is turned off. This occurs with solid-state switching devices and filters for hard-contact switching devices.



LED
Light-Emitting Diode.

light operate
Pertaining to a control that energizes its output when the light intensity on the photodetector reaches a sufficiently high level.

limit switch
An electrical switch actuated by some part and/or motion of a machine or equipment contacting the switch.

line
Conductor or set of conductors for carrying signals or power.

linear acceleration/deceleration (LAD)
A circuit that controls the rate at which a motor is allowed to accelerate to a set speed or decelerate to zero speed. On most drives, this circuit is adjustable and can be set to accommodate a particular application.

linear interpolation
A motion control function for generating data points between the starting point and the end point on two or more axes so that simultaneous motion of the axes is in a linear path.

linearity
A measure of how closely a characteristic follows a straight-line function.

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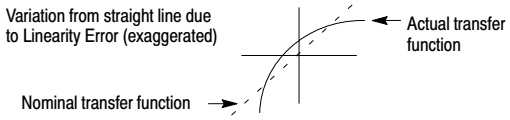
linearity error
A deviation from a straight line expressed in percentage of full scale. For an ideal A/D or D/A conversion, a graph of the digital values plotted against the corresponding analog values form a straight line.



line driver
A circuit specifically designed to transmit signals over extended distances.

line receiver
A circuit specifically designed to receive signals sent by a line driver.

link *n*
See *data link* (page 25).

link *v*
To produce an executable program from compiled modules (programs, routines, libraries) by merging the object code of the program and resolving internal connecting references (such as a library routine called by the program).

link efficiency
The ratio of the non-link information transferred to the potential information transfer on the communication link.

link-level acknowledge
An immediate response transmission from a station after receiving a transmission, without requiring the station to acquire the token. Reception of a positive acknowledgment indicates successful reception of the original transmission; absence of a positive acknowledgment, or reception of a negative acknowledgment, indicates failure of the original transmission and a need for some recovery procedure.

link-level reply
A reply message that is immediate because the message data is available at the link level.

link response time
The elapsed time from when a message is ready for processing by the transmitting station, to when the receiving station has completed processing.

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link turnaround time
The time between the end of a frame transmitted by one station to the start of the next frame transmitted by another station, as referenced by the signals on the bus. For example, from the last bit of an end flag to the first bit of a start flag.

LIST
A function that allows access to a series of displays, each containing a menu, used to select or establish operating parameters for a particular application.

list organization
A set of records stored in one order and linked in a different logical order by insertion of pointers in each record. In a list, the logical order or sequence of records is different from the physical order.

most significant	least significant
byte 1	byte 0

little-endian *a*
1) Pertaining to the order of bytes within a word, such that the least-significant byte has the lowest address (little end first). **2)** Contrasted with *big-endian* (page 10).

LLC
Logical Link Control. Part of the data link layer. See *open-system interconnect reference model* (page 79).

load *n*
The power or current used by a machine or apparatus.

load *v*
1) To place data into an internal register under program control. **2)** To place a program from an external storage device into central memory under operator control.

load regulation
Steady-state decrease in the value of a specified variable due to a specified increase in the load, generally from no load to full load.

local I/O
1) I/O connected to a processor across a backplane or a parallel link, thus limiting its distance from the processor. See *extended local I/O* (page 40) and *processor-resident local I/O* (page 87). **2)** Contrasted with *remote I/O* (page 93).

locked-rotor current
Steady-state current taken from the line with a rotor at standstill (at rated voltage and frequency). This is the current when starting the motor and load.

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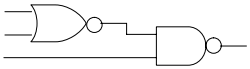
logic
General term for digital circuits and programmed instructions to perform required decision-making and computational functions.



logic diagram
A diagram that represents logic elements and their interconnections.

logic level
The voltage magnitude associated with signals in logic circuits.

logical read
1)To read from memory based on a logical address. **2)** See *physical read* (page 93).

logical ring
The apparent ring formed by passing the token between stations of a link, without regard for physical topology.

logical write
1) To write to memory based on a logical address. **2)** See *physical write* (page 84).

loop
A sequence of instructions that is executed repeatedly until a terminating condition is satisfied.

loop bandwidth
The maximum rate at which a control loop can respond to any change in any control parameters. This refers to either the position or velocity command as well as the measured value for either. This is different from the rate at which the control can accept information.

loop resistance
The total resistance of two conductors measured at one end (i.e., conductor and shield, twisted pair, conductor and armor).

low byte
The 8 least-significant bits of a 16-bit or 32-bit word.

low nibble
The 4 least-significant bits of a byte.

Low Profile™ proximity switch
An Allen-Bradley self-contained proximity switch.

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low = true
1) A signal type where the lower of two voltages indicates a logic state of on (1). **2)** Contrasted with *high = true* (page 51).

LRC
Longitudinal Redundancy Check. An error-checking technique based on an accumulated exclusive-OR of transmitted characters. An LRC character is accumulated at both the sending and receiving stations (similar to *CRC*, page 23).

LSB
Least Significant Bit. The bit that represents the smallest value within a string of bits.

LSD
Least Significant Digit. The digit that represents the smallest value within a string of digits.

LUN
Logical Unit Number. Concerns the various numbers assigned to peripheral units during auto-load or system generation time. Such numbers can be altered, in contrast with physical unit numbers.

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M
1) Mega. A prefix used with units of measurement to designate a multiple of 1,000,000. **2)** 1M = 2^{20} = 1,048,576. A prefix used as a multiple for bits, bytes, or words in denoting size of a block of data or memory.
Example: 2M bytes = 2,097,152 bytes.

MACLIB
MACro LIBrary. A set of macros stored together in a single file.

macro
An instruction set made up of several micro instructions.

magnetic core memory
See *core memory* (page 23).

magnetic disk
A flat disk with a magnetic surface on which data can be stored by selective polarization.

malfunction
Any incorrect function within electronic, electrical, or mechanical hardware. See *fault* (page 41).

management information
A type of data derived from operational conditions. It may be displayed or printed as reports, which may be used in making decisions relative to the application. This data can include up-time records, production summaries, operating conditions, or a variety of other categories to aid in the MIS (Management Information System) effort.

manipulated variable (M) (control variable)
A quantity or condition that is varied (by the controller) as a function of the actuating error signal so as to change the value of the controlled variable. A quantity or condition that the controller applies to the controlled system.

manipulation
The process of controlling and monitoring data table bits, bytes, or words by means of the user program to vary application functions.

mask
A binary value with its bits set to a pattern to selectively screen out or let through certain bits in a data value to specify which of those bits are to be operated on in generating a masking result value.

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master
A device used to control secondary devices. On a communication link, the station that can initiate communication.

master control relay (MCR)
A mandatory hard-wired relay that can be de-energized by any series-connected emergency stop switch. Whenever the master control relay is de-energized, its contacts open to remove the power source from all I/O circuits, sensors and actuators.

master-control reset (MCR)
A ladder logic instruction used to delimit MCR zones.

master file
A file of data containing the history or current status of a factor or entity of interest to an organization. A master file must be updated periodically to maintain its usefulness.

master/slave communication
1) A form of communication in which one station has master status, which allows it to initiate communication with any other station on the link; while each of the other stations has slave status such that it can only send replies to commands from the master, and send command messages to the master in response to being polled by the master. **2)** Contrasted with *peer-to-peer communication* (page 83).

MATH-PAK™ memory card
An Allen-Bradley memory card for a CVIM module that lets the user mathematically process inspection results as well as specify more sophisticated pass/fail criteria.

MCC
See *motor control center* (page 71).

MCR
1) See *master control relay.* **2)** See *master-control reset*, above.

MCR zones
Ladder logic program areas where all non-retentive outputs can be turned off simultaneously. Each MCR zone must be delimited and controlled by MCR fence codes (MCR instructions).

MDA
Monochrome Display Adapter. A video adapter, introduced in 1981, capable of only one character mode.

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MDI
Manual Data Input. The means by which the control operator can manually enter data via the operator panel.

medium
The material through which data is transmitted or on which data is stored. Examples of transmission media: twisted pairs, coaxial cables, and optical fibers. Examples of storage media: a disk, volatile semiconductor RAM, and non-volatile ROM. The plural is *media*.

Megger test
A test used to measure an insulation system's resistance. This is usually measured in megohms by applying a high voltage.

membrane keypad
An operator-interface device that uses flat-panel switch contacts. They are usually sealed and very sturdy.

memory
A group of circuit elements that can store data.

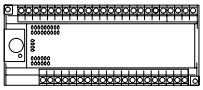
memory map
A diagram showing a system's memory addresses and what programs and data are assigned to each section of memory.

menu
A list of options, on a screen, from which a user can select.

message
1) A meaningful combination of alphanumeric characters that establishes the content and format of a report. 2) In a communication network, the unit of exchange at the application layer.

message switching
A method of handling messages over a communication network. The entire message is transmitted to an intermediate point, stored, and then transmitted again to its final destination. The destination of each message is indicated by an address contained in the message.

microfloppy diskette
A 3-1/2 inch, magnetic disk used for data storage. Also called a "diskette."



MicroLogix™ controller
A very compact Allen-Bradley programmable controller with 16 or 32 fixed digital I/O. See *programmable controller* (page 87).

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microprocessor
A central processing unit that is manufactured on a single integrated circuit (or on only a few integrated circuits) by utilizing large-scale integration technology.

MMI
Man/Machine Interface. A term for operator interface software that lets the operator monitor real-time data and perform real-time control functions.

MML™ language
An Allen-Bradley programming language that uses English-like statements to command a full range of motions and actions for coordinated and independent multi-axis motion control.

MMS
Manufacturing Message Specification. An ISO/IEC 9506 standard.

mnemonic
A term that is simple and easy to remember — used to represent a complex or lengthy set of information.

mnemonic codes
A code in which information is represented by symbols or characters.

mode
A selected method of operation. Example: run, test, or program.

modem
Modulator/**dem**odulator. Equipment that connects data terminal equipment to a communication line.

modem handshaking
A signaling protocol used for transferring information between devices in a synchronized manner at a rate acceptable to both devices. It may be accomplished by hardware or software.

modular
Being made up of smaller units, or modules, each of which can be developed, tested, and finished independently before being combined with the others in the modular unit. Modularity provides the ability to be reconfigured by easily replacing one module type with another. Modularity also provides the ability to correct a failure by easily replacing a faulted module with a known good module.

modulated LED control
A photoelectric control that operates on light puses rather than on constant light intensity.

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module *(hardware)*
An interchangeable plug-in item within a larger (modular) assembly.

module *(software)*
A collection of routines and data structures that performs a particular task or implements a particular abstract data type.

module addressing
The method of identifying the I/O modules installed in chassis.

module slot
A location for installing a module. In typical modular construction, modules plug into a backplane; each module slides into a slot that lines it up with its backplane connector.

modulo
A mathematical operation whose result is the remainder of a division operation.

monitor *n*
A video display.

monitor *v*
To observe.

monitoring controller
Used in an application where the process is continually checked to alert the operator of possible application malfunctions.

MOS
Metal-Oxide Semiconductor. A semiconductor device in which an electric field controls the conductance of a channel under a metal electrode called a gate.

motor
A device that converts some other form of energy into mechanical energy.

- **ac motor** — a device that converts (single or multiple phase) alternating electrical current into mechanical energy. It requires no commutation devices such as brushes.
- **ac synchronous motor** — a type of ac motor that rotates at a speed proportional to the frequency of the applied ac.
- **brushless servo motor** — a type of motor that uses electronic commutation to convert dc into the ac that is applied directly to the motor so that brushes are not needed. This type of motor can provide the good stall torque of a dc motor, but without the problems of mechanical commutation.

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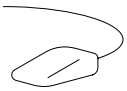
- **dc motor** — a device that converts direct electrical current into mechanical energy. It includes a commutation device, such as brushes.
- **dc permanent-magnet motor** — a type of dc motor that uses permanent magnets to produce a magnetic field. It has linear torque-speed characteristics.
- **general-purpose motor** — A motor that has a continuous Class-B rating and design, listed and offered in standard ratings with standard operating characteristics and mechanical construction for use under unusual service conditions without restriction to a particular application or type of application (NEMA).
- **multispeed motor** — an induction motor that can obtain 2, 3 or 4 discrete (fixed) speeds by the selection of various stator winding configurations.
- **servo motor** — a motor used in closed-loop positioning control. This type of application usually requires high linearity.
- **special-purpose motor** — a motor with special operating characteristics or special mechanical construction or both, designed for a particular application and not falling within the definition of a general purpose or definite purpose motor (NEMA).
- **stepper motor** — a specialized dc motor that allows discrete positioning without feedback.

motor control center (MCC)

A floor-mounted assembly of one or more enclosed vertical sections having a horizontal common power bus and principally containing combination motor control units. These units are mounted one above the other in the vertical sections. The sections normally incorporate vertical buses connected to the common power bus, thus extending the common power supply to the individual units. Power may be supplied to the individual units by bus-bar connections, by stab connection, or by suitable wiring (as defined in NEMA Standard Pub. No. ICS 2, 1988).

motor controller, motor starter

A device or group of devices that serve to govern, in a predetermined manner, the electrical power delivered to a motor.



mouse

A pointing device that when positioned by hand on a desk surface, translates that physical position into a cursor position on a screen.

MOV

1) Metal-Oxide Varistor. **2)** Motor-Operated Valve. **3)** Move instruction mnemonic.

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MRP systems
Materials or Manufacturing Resource Planning systems. Usually computerized programs to manage flow of materials and labor for manufacturing operations.

MSB
Most Significant Bit. The bit representing the greatest value within a string of bits.

MSD
Most Significant Digit. The digit representing the greatest value within a string of digits.

MTB
Machine Tool Builder.

multi-drop link
1) A link that has more than 2 stations. **2)** Contrasted with *point-to-point link* (page 84).

multi-processing
Running multiple processors in a system at once to increase computing capability and speed.

multi-tasking
The ability of a processor or system to run multiple software tasks (programs) apparently at once, usually priority-scheduled and/or interrupt-driven.

Multibus™
An open-architecture backplane (bus) developed by Intel Corporation. It is used as the base platform for the AutoMax DCS system.

multiple-rung display
A feature that allows a number of rungs within a ladder logic program to be displayed simultaneously on a terminal.

multiplexing
1) The time-shared scanning of a number of data lines into a single channel. Only one data line is enabled at any time. **2)** The incorporation of 2 or more signals into a single wave from which the individual signals can be recovered.

Multiprogramming™ software
An Allen-Bradley motion control software product that coordinates multiple part programs running at the same time.

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NAK
Negative Acknowledgment. An ASCII control character transmitted by a receiver as a negative response to the sender.

nanometer (nm)
A length of 10^{-9} meter.

natural binary

2^6 2^5 2^4 2^3 2^2 2^1 2^0

64 32 16 8 4 2 1

A number system to the base (radix) 2, in which the value of each bit is weighted in a binary progression by relation to its position in the binary word.

NBE *(bar code)*
Narrow Bar Element.

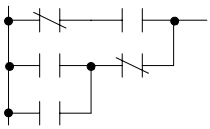
NBS
National Bureau of Standards. Now known as National Institute of Standards and Technology. See *NIST* (page 74).

NC
See *numerical control* (page 75).

NEC
National Electrical Code. A set of regulations governing the construction and installation of electrical wiring and apparatus, established by the National Fire Protection Association and suitable for mandatory application by governing bodies exercising legal jurisdiction. It is widely used by state and local authorities within the United States.

negative feedback
Feedback that is subtractive from the input reference signal. Negative feedback forms the basis for closed-loop control systems.

NEMA standards
Consensus standards in the United States for electrical equipment approved by the members of the National Electrical Manufacturers Association (NEMA).



nest
1) To embed a subroutine or block of data into a larger routine or block of data. **2)** On a ladder logic rung, to have one branch begin or end within another branch.

network
A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

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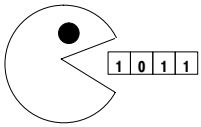
network access time
The time it takes for a station to gain access to the medium.

network communication time
The length of time transmissions are active.

network efficiency
The ratio of non-network information transferred to the potential information transfer of the communication channel.

network layer
The 3rd layer of the ISO open-system-interconnect reference model. It provides routing and relaying services associated with all of the layers of that station and is responsible for setting and resetting control parameters and obtaining reports of error conditions.

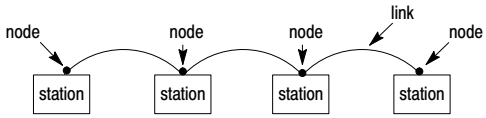
network response time
The elapsed time between the point that a communication command from the application layer is interpreted to the point that a communication-complete reply is available to the application layer.



nibble
A string of 4 bits, operated on as a unit.

NIST
National Institute of Standards and Technology. An organization under the United States Department of Commerce responsible for developing and disseminating federal standards in many areas.

node
The connection point at which media access is provided.



node processing time
1) The time it takes for a station to prepare a message for transmission across the network once it interprets the command. **2)** The time it takes to deliver a message to the application layer after it is received by the station.

node response time
The time required to receive and reply to a message on the network.

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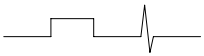
node throughput
The number of messages of a given size and/or type passing through the station per unit of time.

noise
Unwanted disturbances imposed upon a signal that tend to obscure its data content.

noise immunity
The measure of a product's ability to function in the presence of noise.

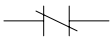


noise spike
A noise disturbance of relatively short duration.

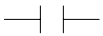
non-privileged command
Allows a computer or other controllers limited access to areas of memory.

non-retentive output instruction
1) A rung-output instruction that continuously controls the state of the output. Whenever the rung changes state (to true or not true), the output turns on or off. **2)** Contrasted with a *retentive output instruction* that only controls the output state when the rung is true (page 95).

non-volatile memory
1) A memory that is designed to retain its data while its power supply is turned off. **2)** Contrasted with *volatile memory* (page 121).



normally closed contacts
A set of contacts on a relay or switch that is closed when the relay is de-energized or the switch is de-activated; they are open when the relay is energized or the switch is activated.



normally open contacts
A set of contacts on a relay or switch that is open when the relay is de-energized or the switch is de-activated. (They are closed when the relay is energized or the switch is activated.)

not true
1) On a ladder logic rung, the state of a logic element of a conditioning instruction when the condition for which it is examining is not detected. **2)** Contrasted with *true* (page 116).

numerical control (NC)
The automatic control of axis positioning in response to stored numerically coded commands.

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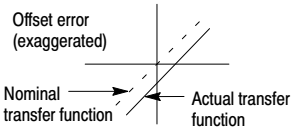
octal numbering system
A base-8 numbering system which uses only the digits 0 thru 7.

OEM
Original Equipment Manufacturer. The maker of a piece of equipment. An example would be a machine tool manufacturer who buys programmable controller components, sensors, and actuators — then integrates them with his machine tool to produce the complete system for sale to the end user.

off
1) A term used to designate the 0 state of a bit; the inoperative state of a device; the state of a switch or circuit that is open. Designated by the symbol 0. **2)** Contrasted with *on*.

off line
1) Describes equipment or devices not under direct control and not directly controlling. When equipment is either idle, undergoing repair, or performing a task under its own direction, it is said to be "off line." **2)** Contrasted with *on line*.

offset
The steady-state deviation of a controlled variable from a fixed set point.



offset error
1) For A/D conversion, the digital value generated by a zero analog signal. **2)** For D/A conversion, the digital value that generates a zero analog signal.

offset-error drift
The change in offset error due to change in temperature. As temperature varies from +25°C, the possible offset error increases. The offset error drift is specified in LSB/°C of full scale.

on
1) A term used to designate the 1 state of a bit; the operative state of a device; the state of a switch or circuit that is closed. Designated by the symbol 1. **2)** Contrasted with *off*.

one-shot
A programming technique that sets a bit for only one program scan.

one-slot addressing
See *1-slot addressing* (page 1).

on line
1) Refers to equipment or devices that are in direct interactive communication. **2)** Contrasted with *off line*.

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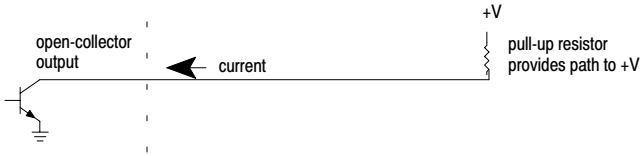
online data change
Using a peripheral device to change various data table values in a programmable controller while the ladder logic program is running.

online editing
Editing a ladder logic program in a programmable controller while the program is running.

op amp
An operational amplifier. A high-gain stable linear dc amplifier that is designed to be used with external circuit elements.

opaque
1) The characteristic of an object that blocks light from passing through.
2) Contrasted with *translucent* (page 115).

open-collector output
An output circuit that provides a path to ground through a transistor (by connection to its collector) but does not provide a corresponding path to +V through a built-in pull-up resister or other means. Without an external pull-up, this collector circuit is open. Therefore, a pull-up resister must be provided by a load.



open-loop system
1) A control system that has no means of comparing a feedback input to a command generating the output control signal. One example of an open-loop system is one with a stepper-motor output. **2)** Contrasted with *closed-loop system* (page 18).

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open machine *(motors)*

A machine with ventilating openings that permit passage of external cooling air over and around the windings of the machine (NEMA Standard).

- **drip-proof machine** — is an open type machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle from 1 to 15 degrees downward from vertical.
- **guarded machine** — is an open machine in which all openings giving direct access to live metal or rotating parts (except smooth rotating surfaces) are limited in size by the structural parts or by the screens, baffles, grills, expanded metal or other means to prevent accidental contact with hazardous parts. Openings giving direct access to such live or rotating parts shall not permit the passage of a cylindrical rod 0.75 inch in diameter.
- **open externally ventilated machine** — is one that is ventilated by means of a separate motor driven blower mounted on the machine enclosure. This machine is sometimes known as a blower-ventilated or a force-ventilated machine.
- **open pipe-ventilated machine** — is basically an open machine except that openings for admission of ventilating air are so arranged that inlet ducts or pipes can be connected to them. Air may be circulated by means integral with the machine or by means external to the machine (separately forced ventilated).
- **semiguarded** — is an open machine in which part of the ventilating openings in the machine, normally in the top half, are guarded as in the case of a “guarded machine” but the others are left open.
- **splashproof** — is an open machine in which the ventilating openings are so constructed that successful operation is not interfered with when drops of liquid or solid particles strike or enter the enclosure at any angle not greater than 100 degrees downward from vertical.
- **weather-protected machine** — is an open enclosure divided into two types:
  - **Type 1** — have ventilating passages constructed to minimize the entrance of rain, snow, airborne particles and prevent passage of a 0.75-inch diameter cylindrical rod.
  - **Type 2** — provide additional protection through the design of their intake and exhaust ventilating passages. The passages are so arranged that wind and airborne particles blown into the machine can be discharged without entering directly into the electrical parts of the machine. Additional baffling is provided to minimize the possibility of moisture or dirt being carried inside the machine.

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open system

A network designed to incorporate all devices — regardless of manufacturer or model — that can use the same communication facilities and protocol in compliance to some established standard(s).

open-system interconnect reference model (OSIRM)

Layer 7 — Application
Layer 6 — Presentation
Layer 5 — Session
Layer 4 — Transport
Layer 3 — Network
Layer 2 — Data Link
Layer 1 — Physical

A standard means of communication between open systems proposed by the ISO. It is a 7-layer model that represents network architecture. The 7 layers and the services they provide are as follows:

- **Layer 7 — Application:** User application processes and management functions.
- **Layer 6 — Presentation:** Data interpretation, format, and code transformation.
- **Layer 5 — Session:** Administration and control of sessions between two entities.
- **Layer 4 — Transport:** Transparent data transfer, end-to-end control, multiplexing, and mapping.
- **Layer 3 — Network:** Routing, switching, segmenting, blocking error recovery, and flow control.
- **Layer 2 — Data Link:** Establish, maintain, and release data links; error detection and flow control.
- **Layer 1 — Physical:** Electrical, mechanical, and functional control of data circuits.

operating cycle

The sequential order of operations performed by a programmable controller when in the run mode.

operating/service deviation

A means of specifying the speed regulating performance of a drive controller. The performance is expressed in percent of base speed.

operating system

The software responsible for controlling the allocation and usage of hardware resources such as memory, CPU time, disk space and peripheral devices. The operating system is the foundation upon which application programs are built. Compare to *application program* (page 6) and *utility software* (page 119).

operator interface device

A terminal or panel from which an operator can monitor and possibly affect aspects of the machine or process control.

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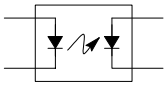


optical coupler (electro-optical coupler)
1) A light-emitting diode and a light-detecting device sealed together in an integrated package. Because they are only coupled optically, the input circuit and output circuit are electrically isolated. **2)** A device that provides coupling between 2 electrical circuits by using a light circuit to signal between the 2 electrical circuits.

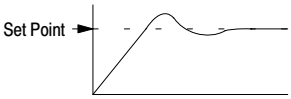
OSIRM
See *open-system interconnect reference model* (page 79).

output data
Data transferred from programmable controller data table words to output circuits to control actuators.

output device
1) For a computer, a CRT terminal or printer. **2)** For a programmable controller, see *actuator* (page 3).

overflow bit
A bit that is set to indicate the result of an operation is more than the maximum value that can be contained in a register.

overload capacity
The ability of the drive to withstand currents beyond the system's continuous rating. It is normally specified as a percentage of full load current for a specified time period. Overload capacity for "standard industrial dc motors" is defined by NEMA as 150% of rated full load current for one minute.



overshoot
The amount that a controlled variable exceeds the desired value after a change of input.

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packet
The transmission unit exchanged at the network layer.

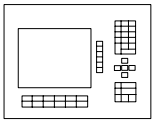
packet size
The number of bytes that can be transmitted as one independent group on a physical medium. The size may vary, with the maximum packet size being determined by the implementation.

packet switching
The transfer of data by means of addressed packets where interim point-to-point channels are available based on a connection-oriented protocol. The channel then becomes available for the transfer of packets from the same or other channels when the protocol dissolves the connection.

PAL™ logic
A feature in an Allen-Bradley CNC system that provides auxiliary function control with ladder logic programming.

palette
In paint programs, a collection of drawing tools, such as geometric shapes, patterns, colors, brush shapes, and line widths, from which the user can choose.

PanelBuilder™ software
An Allen-Bradley off-line development software package used to create fully interactive screens for PanelView™ operator terminals.



PanelView operator terminal
An Allen-Bradley industrial CRT terminal designed for operator panel applications. They can communicate with PLC scanners on an Allen-Bradley universal remote I/O link.

parallel operation
1) A type of information transfer where all bits within bytes, or words are handled simultaneously. **2)** Contrasted with *serial operation* (page 101).

parallel output
1) Simultaneous availability of two or more bits, channels, or digits. **2)** In ladder logic, branched output instructions.

parallel output addressing
Two output modules having the same address. Each output on the one module is controlled by the same output image table bit as the corresponding (parallel) output on the other module.

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parity bit
An additional non-data bit attached to a binary word to provide a check of the data integrity by making the sum of the number of ones in a word always even or odd.

parity check
A check of the sum of the parity bit plus all of the data bits in each word to determine whether the sum is even or odd. A failure of the parity check indicates that a data bit has been corrupted.

parse
To decode an external program statement based on the specified syntax and semantics of the programming language.

password
A security measure used to restrict access to a system, a specific function, or sensitive files. A password is typically a unique string of characters that a user types in as an identification code.

path
In communication, a path is a link between two nodes in a network. In other contexts, a path is a route through a structured collection of information as in a database, a program, or files stored on a disk.

PathFinder™ software
An Allen-Bradley interactive program that uses detailed graphics to guide plant-floor employees through troubleshooting, operation and programming procedures for Allen-Bradley automation control products.

PC
1) Personal Computer. **2)** Programmable Controller. **3)** Printed Circuit.

PC board
See *printed circuit board* (page 86).

PC3000
An ISA-bus-compatible controller based on the AutoMax DCS family of controllers. It includes an AutoMax processor, a DCS-Net port, and an Allen-Bradley Universal Remote I/O port.

PCCC
Programmable Controller Communication Commands. An application-level command set that Allen-Bradley programmable controllers use to communicate across networks.

PCMCIA
Personal Computer Memory Card International Association.

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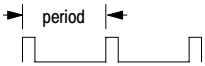
PCO software
Process Configuration and Operation software. A set of Allen-Bradley software tools that simplify the development of PLC code for process control, as well as the integration of the PLC processor and MMI in a process control application.

PDU
Protocol Data Unit. Information that is delivered as a unit between peer entities of a network. It may contain control information, address information, or data.

peer-to-peer communication
1) A form of communication in which messages are exchanged between entities having equal access to the medium. **1)** Contrasted with *master/slave communication* (page 67).



period
1) The length of time for a cyclical operation to complete one full cycle. For example, the length of time from one point in a cyclical wave form to the same point in the next cycle of the wave form.
2) Compare *duration* (page 35) and *interval* (page 55).

peripheral equipment
In a programmable controller system, units that communicate with the programmable controller, but are not part of the programmable controller (e.g., a programming device or printer).

photoelectric sensor
A transducer that generates an electrical signal in response to a detected change in light intensity.

PHOTOSWITCH® sensor
An Allen-Bradley photoelectric sensor.

physical file
The data contained on one storage device such as a magnetic tape or disk.

physical link
A set of cables and ports that provides a channel for communication between stations.

physical read
1) To read from memory based on a physical address. **2)** See *logical read* (page 64).

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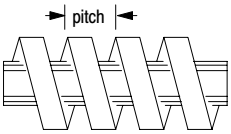
physical write
1) To write to memory based on a physical address. **2)** See *logical write* (page 64).

PI
See *Pyramid Integrator™ system* (page 89).

PID module
See *proportional, integral, derivative control* (page 88).

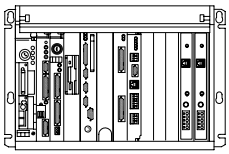
PII
Processor Input Interrupt. A hardware interrupt that triggers a single scan execution of a PII program whenever an interrupt signal is detected at an input circuit of a PLC processor module.

pilot circuit
The portion of a control circuit that carries the controlling signal for a device which, in turn, controls the primary current.



pitch
The linear distance from one peak of a screw thread to the next. If a lead screw has only one thread, the pitch is equal to the lead. See *lead* (page 61).

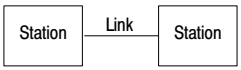
pixel
Picture element. An element in a digitized image array.



PLC controller
1) An Allen-Bradley programmable controller. **2)** An Allen-Bradley programmable controller with a name that has the prefix PLC. See *programmable controller* (page 87).

plugging
A type of motor braking provided by reversing either line voltage polarity or phase sequence so that the motor develops a counter torque that exerts a retarding force to brake the motor.

point-to-point control system
A system that controls motion only to reach a given end point, but exercises no path control during the transition from one end point to the next.



point-to-point link
A link between two stations only.

polarized beam retroreflective control
A retroreflective photo-electric control that uses visible light, polarizing filters, and a prismatic reflector to avoid sensing false signals from shiny surfaces.

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polling
A systematic method of interrogating each station on a communication link to determine which ones are in need of servicing.

port *n (communication link)*
The logic circuitry (such as a UART) or software at a station that determines its communication parameters for a particular communication channel.

port *n (mechanical)*
An opening in an enclosure, housing, or block.

port *v*
To convert software into a different form for use in an environment different from that for which it was originally generated.

position loop
A feedback control loop in which the controlled parameter is mechanical position. The position loop compares position feedback with the position command to modify the velocity output signal to correct for any position error.

position readout
A display of absolute axis position as derived from a position feedback element.

position transducer
A feedback element (e.g., encode or resolver) that measures incremental or absolute position and converts this measurement into a feedback signal convenient for transmission.

positive feedback
A feedback signal from the output that is added to the input signal.

power
Work done per unit of time. Measured in horsepower or watts:
1hp = 33,000 ft-lb/min = 746 watts.

power factor
A measurement of the time phase difference between the voltage and current in an ac circuit. It is represented by the cosine of the angle of this phase difference. Power factor is the ratio of real power (in watts) to apparent power (in volt-amperes).

power supply
A device that converts available power to a form that a system can use — usually converts ac power to dc power.

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PR
Preset Value. The number of time intervals or events to be counted.

pressure switch
A switch that is activated at a specified pressure.

primary processor
A processor that controls all the I/O, but has a backup (secondary) processor to take over system operation in case it fails.

printed-circuit board (PC board)
A board (card) made up of a non-conductive layer sandwiched by conductive layers that are etched to form circuit connections between connection points where components can be mounted.

privilege
1) In a communication network, an ability granted to a station in regard to accessing another station. For example, one station may grant read-only privileges for a certain area of its memory to a second station; and it may grant both read and write privileges for that same area of its memory to a third station. **2)** In software use, an ability granted to a user in regard to accessing functions. For example, one user may be granted the privilege to change the configuration and another user may be granted only the privilege to monitor the configuration values.

Pro-Set™ software
An Allen-Bradley operator interface software for injection molding applications.

Pro-Spec™ software
An Allen-Bradley operator interface software for fastening system applications.

process *n (production)*
Regular (continuous or batch) production executed in a definite uninterrupted manner.

process *n (software)*
A program or part of a program; a coherent sequence of steps undertaken by a program (e.g., a data transfer operation).

process variable (PV)
Any variable of the process, including the manipulated variable and the controlled variable.

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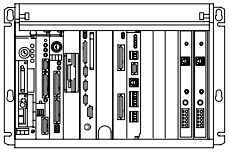
processor
The decision-making and data storage sections of a programmable controller or computer.

processor overhead
The part of the operating cycle used for housekeeping and setup purposes.

processor-resident local I/O
I/O connected to a processor across a backplane. See *local I/O* (page 63) and *extended local I/O* (page 40).

producer/consumer model
A communication model in which data is identified by its content rather than by its source or destination. Devices that need the data (consumers) recognize the data they need and consume it. Therefore, data only needs to be sent out on the network in a single message no matter how large the number of nodes to which it needs to go.

program
A set of instructions used to control a machine or process.



programmable controller
A solid-state control system that has a user-programmable memory for storage of instructions to implement specific functions such as I/O control, logic, timing, counting, report generation, communication, arithmetic, and data file manipulation. A controller consists of a central processor, input/output interface, and memory. A controller is designed as an industrial control system.

programming device
A device for creating and editing programs.

programming plug
See *jumper* (page 58).

program mode
On a programmable controller, a mode in which ladder logic is not executed and all outputs are held off.

program scan time
The time required for the controller to execute the instructions in the program. The program scan time may vary depending on the instructions and each instruction's status during the scan.

program storage
The portion of memory reserved for saving programs, routines, and subroutines.

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PROM
Programmable Read-only Memory. A type of ROM that requires an electrical operation to store data. In its usual operation, bits or words are read on demand but not changed. As with all ROMs, it is non-volatile random-access memory.

proportional band
The range of values of the controlled variable (such as temperature or shaft rotation) that corresponds to full operating range of the final control element (such as a valve or servo motor).

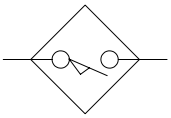
proportional, integral, derivative control (PID)
An intelligent I/O module or program instruction providing automatic closed-loop operation of process control loops. For each loop, this module or instruction can perform proportional control and optionally integral control, derivative control, or both:

- **Proportional control** — causes an output signal to change as a direct ratio of the error signal variation.
- **Integral control** — causes an output signal to change as a function of the integral of the error signal over the time duration.
- **Derivative control** — causes an output signal to change as a function of the rate of change of the error signal.

protected memory
Memory areas into which you are unable to write.

protocol
A set of conventions governing the format and timing of data between communication devices.

proximity reflector
See *diffuse reflection* (page 30).



proximity switch/sensor
A switch/sensor that is actuated when an actuating device is moved near it, without physical contact.

puller
1) A sink output; when turned on, it supplies a negative dc current to its load.
2) Contrasted with *driver* (page 34).

pulse
A momentary sharp change in voltage, current, or light from its quiescent condition.

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push-wheel switch

A multi-position rotary switch that is stepped forward or backward with a pushbutton ratcheting mechanism.

PWM

Pulse-Width Modulation. A technique for generating a dc voltage level from a higher constant dc voltage. The constant input voltage is chopped to produce pulses at a constant period and constant amplitude. Modulating the pulse width (duration) controls the average voltage of the output.

Pyramid Integrator system (PI)

An Allen-Bradley system that closely couples programmable control, machine vision, and information processing functions by configuring them on a common backplane bus that provides high-speed communication between them.

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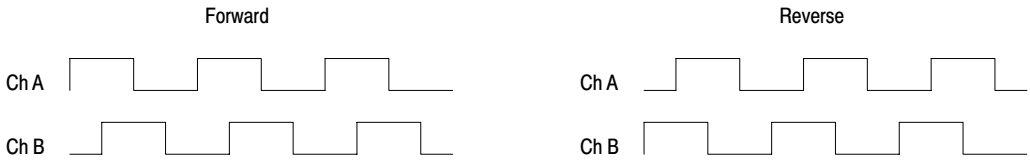
quadrature
Separation in phase by 90°. Used on signal channels of feedback devices such as encoders and resolvers to detect the direction of motion.



quantization
The process of breaking up a continuous variable into discrete quanta or parts.

quantization error
The inherent fixed error associated with digitizing an analog variable where a continuous form of data is being replaced by non-continuous increments.

queue
A logical structure that keeps track of items waiting for processing whenever the system is unable to process each item immediately. It controls the order in which the waiting items are ultimately processed.

quiescent
At rest — specifically, the condition of a circuit when no input signal is applied to it.

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R-2R ladder
The resistive ladder network used in a CMOS D/A converter that divides the input current into currents that represent binary-weighted counts.

R-Net™ network
A high-speed (800k bit/s) token-passing industrial network used in the AutoMate programmable controller family.

raceway
An enclosed channel used to hold and protect wires, cables or busbars. A raceway may be made of either metal or insulating material. Raceways include conduit, tubing, and wireways.

rack
See *I/O rack* (page 57).

radix (base)
The quantity of characters for use in each of the digital positions of a numbering system; the octal radix is 8; the decimal radix is 10; the hexadecimal radix is 16.

Rail I/O
A family of digital and analog I/O modules used with AutoMate products and for remote I/O with the AutoMax products.

RAM
Random Access Memory. The type of memory in which each storage location is by X/Y coordinates, as in core or semiconductor memory. (Tape or bubble memory cannot be random access.) Thus, the data access time is independent of the location of the data. Unless stated otherwise, RAM usually implies read/write and volatile.

RCVR
See *receiver* (page 92).

reactance
Pure inductance or capacitance, expressed in ohms, in a circuit. It is the component of impedance to alternating current that is not resistance.

read
To acquire data from somewhere (memory, an input, another station).

read/write memory
A memory where data can be stored (write mode) or accessed (read mode). The write mode replaces previously stored data with current data; the read mode does not alter stored data.

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readout
1) A device or set of devices used to visually present output information. **2)** The visual presentation of output information.

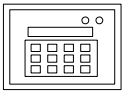
real time
1) Having to do with the actual time during which physical events take place. **2)** The performance of a computation during the actual time that the related physical process transpires so that the results of the computations are useful in guiding the physical process.

reassembling
A function performed by an entity to map multiple protocol data units into one data unit to provide a service.

receiver (RCVR)
Receives data, then translates it into a meaningful form for the user.

record *n*
A group of related data items treated as a unit. See *file* (page 43).

rectifier
A device that conducts current in only one direction, thereby transforming alternating current to direct current.



RediPANEL™ operator modules
Allen-Bradley panel modules for operator interface. They communicate with PLC scanners on an Allen-Bradley Universal remote I/O link.

redundancy
The duplication of devices for the purpose of enhancing the reliability or continuity of operations.

redundant system
A system in which two or more devices actively control the outputs of a system. Each device in the system votes on every control decision.

regeneration
1) For dc drives — the characteristic of a motor to act as a generator when the cemf is larger than the drive's applied voltage. **2)** For ac drives — when the rotor synchronous frequency is greater than the applied frequency.

regenerative control
A regenerative drive contains the inherent capability and/or power semiconductors to control the flow of power to and from the motor.

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register
A memory word or area used for temporary storage of data used within mathematical, logical, or transferral functions.

regulation
The ability of a control system to hold a speed once it has been set. Regulation is given in percentages of either base speed or set speed. Regulation is rated upon two separate sets of conditions:

- **line regulation** — is the percentage of speed change with a given line voltage change, assuming all other parameters to be constant.
- **load regulation (speed regulation)** — is the percentage of speed change with a defined change in load, assuming all other parameters to be constant. Speed regulation values of 2% are possible in drives utilizing armature voltage feedback, while regulation of 0.01% is possible using digital regulator schemes.

relay-type instructions
Program instructions that perform logic functions similar to that of relay logic.

remote I/O
1) I/O connected to a processor across a serial link. With a serial link, remote I/O can be located long distances from the processor. **2)** Contrasted with *local I/O* (page 63).

remote I/O link
A serial link for carrying I/O data between a PLC or SLC processor/scanner and remote I/O adapters.

remote I/O scanner
A separate module (of a multi-module PLC processor) or a built-in component (of a single-module PLC processor) that provides communication with remote I/O adapters across a remote I/O link.

remote mode selection
A feature that lets you select or change processor modes of operation with a peripheral device from a remote location.

remote programming
Programming from a remote location by communicating across a network.

repeatability
1) The ability of a system to return to the same state for many repetitious operating cycles. **2)** More generally, the closeness in agreement among repeat measurements of the same variable, under the same operating conditions.

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reply
1) A message transmitted in reply to a command message.
2) See *command-reply pair* (page 19).

report
An application data display or printout containing information in a user-designed format. Reports could include operator messages, part records, and production lists.

report generation
The printing or displaying of user-formatted application data by means of a data terminal. Report generation can be initiated by means of either a user program or a data terminal keyboard.

reset position
See *home position* (page 51).

resolution
1) The smallest distinguishable increment into which a quantity can be devised (e.g., position or shaft speed). **2)** The degree to which nearly equal values of a quantity can be discriminated. **3)** For rotary encoders, it is the number of unique electrically identified positions occurring in 360 degrees of input shaft rotation. **4)** For D/A or A/D conversion, may be expressed as the number of bits in the digital value that corresponds to a full-scale analog value.

resolver
A transducer using magnetic coupling to measure absolute rotary position (within one revolution). It generates an analog output and requires special conditioning electronics.

response
1) A quantitative expression of the output of a device or system as a function of the input. **2)** On a communication link, a signal of a condition such as the acknowledgment of a message being received.

response time
1) In a network, the elapsed time between the generation of the last character of a message at a terminal and the receipt of the first character of the reply. It includes terminal delay, network delay, and service node delay. **2)** In a photoelectric control, the time to translate a change in light level to a change in electrical output status.

restore
1) To return a word to its initial value. **2)** To download a copy of a memory file to a programmable controller to overwrite one that had been altered.

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retentive output instruction

1) A rung-output instruction that sets the state of the output only when the rung is true. Whenever the rung is not true, it does not control the state of the output. **2)** Contrasted with a *non-retentive output instruction* that continuously controls the state of the output (page 75).

retroreflective

A scanning mode for a photoelectric control where a prismatic reflector is used to assure that the reflected light is sent directly back to its source.

re-try

Repeat attempting to send a transmission from one point to another. A re-try is executed when the original transmission is unsuccessful. Re-tries are executed repeatedly until the transmission is successful or a maximum limit is reached.

reverse-polarity protection

Using a diode in a circuit to protect against damage in case polarity of the power supply should be accidentally reversed.

reversing

Changing the direction of rotation of the motor armature or rotor. A dc motor is reversed by changing the polarity of the field or the armature, but not both. An ac motor is reversed by reversing the connections of one leg on the 3-phase power line or by reversing the leads on a single-phase power line. The reversing function is performed in one of the following ways:

- **(dc) contactor reversing** — changing the phase rotation of an ac motor or the polarity of a dc motor armature with switching contactors. The contactors are operated by momentary pushbutton and/or limit switches to stop the motor and change directions. A zero-speed (antiplugging) circuit is associated with this system to protect the motor and control.
- **(dc) field reversing** — changing the dc polarity to the motor shunt field. This type of reversing can be accomplished with dc-rated contactors or by means of an electronically controlled solid-state field supply.
- **(dc) manual reversing** — reversing the dc polarity to the motor armature by changing the position of a single switch. The switch is usually detented to give a degree of mechanical antiplugging protection. Limit switches and remote stations cannot be used with this system. Dynamic braking is recommended.
- **(ac or dc) static reversing** — reversing the dc polarity of the dc motor armature or phase rotation of an ac motor with no mechanical switching. This is accomplished electronically with solid-state devices. Solid-state antiplugging circuitry is generally a part of the design.

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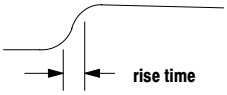
rfi
Radio-Frequency Interference. Radio-frequency energy of sufficient magnitude to have a possible influence on the operation of other electronic equipment. Often caused by improper grounding, plasma, and unsuppressed inductive loads switched by hard contacts.

ring topology
A network where signals are transmitted from one station and relayed through each subsequent station in the network.

ripple %
The percentage of ac left on a dc signal after rectifying. Measured peak-to-peak of the ac component.



rise time
The time it takes to raise an analog voltage or current output level from 10% to 90% of maximum.

rms
Root Mean Square. The effective value of an alternating current, corresponding to the dc value that produces the same heating effect. The rms value is computed as the square root of the average of the squares of the instantaneous amplitude for one complete cycle. For a sine wave, the rms value is 0.707 times the peak value.

ROM
Read Only Memory. A type of memory with data content that cannot be changed in normal mode of operation. In use, bits and words are read on demand, but not changed.

routine
A sequence of instructions that monitors and controls a specific application function.

RS-232-C
An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits in a point-to-point link.

RS-244-B
An EIA standard for character and tape punch codes used for numerical control. These codes are different than ASCII codes.

RS-274-D
An EIA standard for programming formats used for contouring and positioning with numerically controlled machines. A common format for U.S. machine tools.

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RS-358-B
An EIA standard for character and tape punch codes used for numerical control. These codes are the same as ASCII codes and are more compatible with general computer systems than the RS-244-B codes.

RS-422
An EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in a point-to-point link.

RS-423
An EIA standard that specifies electrical characteristics of unbalanced voltage digital interface circuits in a point-to-point link.

RS-449
An EIA standard that specifies mechanical and functional characteristics for digital interface circuits. This standard is used in combination with either RS-422 or RS-423.

RS-485
An EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in a multi-point link.

RSLinx™ **software**
Rockwell Automation software that provides DDE communication between plant-floor devices and a range of applications.

RSServer™ **software**
Rockwell Automation software that provides a DDE interface for Reliance, AutoMax DCS, GE Fanuc Micro, GE Fanuc Series 90™ Protocol (SNP), Square D Sy/Max® programmable controllers, the A-B Bulletin 1400 Powermonitor module, or the GE Fanuc Genius™ I/O system.

RSServer **toolkit software**
Rockwell Automation software used to develop DDE servers.

RSSql software
Rockwell Automation industrial transaction system software that moves data from process control systems to related database information management systems.

RSTrend™ **software**
Rockwell Automation software for managing industrial process control recipes used with programmable controllers.

RSTune™ **PID Loop Tuner software**
Rockwell Automation software for tuning PID loops.

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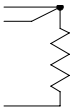
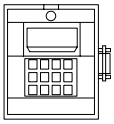
RSView™ **software**
Rockwell Automation software for monitoring, control, and data acquisition.



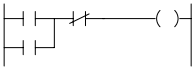
RTD
Resistance Temperature Detector. A resistor for which the electrical resistivity is a known function of the temperature.

RTS
Request To Send. A request from the module to the modem to prepare to transmit. It typically turns on the data carrier.



RTU
Remote Terminal Unit. A data-gathering and control element for SCADA systems.

run mode
On a programmable controller, a mode in which inputs are read, ladder logic is executed, and outputs are enabled.



rung
In a ladder diagram program, a rung-output instruction (possibly parallel output instructions) together with its conditional instructions, if any.

RXD
Received Data. A serialized data input to a module.

RXDRET
Received Data Return. The signal-return line for RXD.

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SA3000
A family of configurable ac drives available from the Rockwell Automation Drive Systems Group.

SA500
A family of configurable brushless drives available from the Rockwell Automation Drive Systems Group.

safe state
The state to which analog outputs must be set when the processor is not controlling the output. The user must select a state that is safe for the specific application.

SAM™
Software Application Module.

sampling period
The interval between observations in a periodic sampling control system.

saturation
1) An operational state in which a communication module is sending and/or receiving at maximum capacity. When the module receives more messages than it can process, it inhibits message entry. **2)** More generally, the condition of a device or system in which a further increase in input no longer results in an appreciable change in output.

save
The process of transferring data stored in memory to a computer or to a floppy disk or other mass storage media.

SB3000
A family of synchronous dc bus supplies available from the Rockwell Automation Systems Drives Group.

SBR
Subroutine area. A portion of memory where subroutines are stored.

SCADA
Supervisory Control And Data Acquisition.

scaling
The process of changing a quantity from one notation to another.

scanner
1) A photoelectric control that contains the light source and the detector in the same housing. **2)** See *remote I/O scanner* (page 93).

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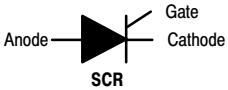
scan time
See *program scan time* (page 87) and *I/O scan time* (page 57).

scheduled transfers
Transfers that occur repeatedly at a regular specified interval, asynchronous to the program scan.



SCR
Silicon Controlled Rectifier. A solid-state uni-directional latching switch.

screen
1) The viewing surface on which data is displayed. **2)** The visual image on a screen.

scrolling
The vertical movement of data on a display screen caused by the dropping of one line of displayed data for each new line added at the opposite end.

SCSI
Small Computer System Interface. A standard high-speed parallel interface defined by the X3T9.2 committee of the American National Standards Institute (ANSI). An SCSI interface is used for connecting computers to peripheral devices, such as hard-disk drives and printers, and to other computers and local area networks requiring high-speed data transfer.

SD3000
A family of configurable dc drives available from the Rockwell Automation Drive Systems Group.

SDLC
Synchronous Data Link Control. A method of controlling the transfer of data between stations in a point-to-point, multi-point, or loop arrangement in which synchronous data transmission techniques are used.

search function
Allows the user to quickly find and display any instruction in the program.

self-contained scanner
A photoelectric control that contains the light source, receiver, power supply, and all electronics in the same housing.

self-diagnostic
A description of hardware and firmware that monitors its own operation and indicates any fault it can detect.

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semaphore
In programming, a signal that is used to govern access to shared system resources. A semaphore is a flag variable — an indicator — that helps maintain order among processes that are competing for use of such critical resources as microprocessor time and communication ports. See also *flag* (page 44).

sensing range
The maximum recommended distance between a sensor and object (standard target) at which the manufacturer guarantees all published operating characteristics.

sensor
A digital or analog transducer (a device such as a limit switch, push-button switch, pressure sensor, or temperature sensor) that generates an electrical signal through an input circuit to a controller.

sequential logic
Logic that produces outputs controlled by the previous state of the logic array, by the presence of a discrete timing interval, and by the input states and delays. Compare *combinational logic* (page 19).

serial
Pertaining to time-sequential transmission of, storage of, or logic operations on data, using the same facilities for successive parts.

serial access
A memory characteristic wherein all data is entered sequentially at a single input or retrieved sequentially from a single output.

serial operation
1) A type of information transfer where the bits are handled sequentially.
2) Contrasted with *parallel operation* (page 81).

service deviation
See *operating/service deviation* (page 79).

service factor
When used on a motor nameplate, a number that indicates how much above the nameplate rating a motor can be loaded without causing serious degradation (i.e., a motor with 1.15 S-F can produce 15% greater torque than one with 1.0 S-F).

servo amplifier
See *drive controller* (page 33).

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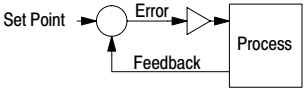

set point
In a feedback control loop, the commanded value of the variable being controlled.

set speed
The desired operating speed.

setup
See *configuration* (page 21).

SF3000
A family of configurable dc field regulators available from the Rockwell Automation Drive Systems Group.

SFC
Sequential Function Chart. A PLC programming method that lets you organize the individual machine operations of your process into steps and transitions. You then use ladder logic to implement the steps and control transitions.

Shark™ controller
A Reliance family of small programmable controllers; including Shark X, Shark LX, and Shark XLII controllers.

shield
A conductive barrier that reduces the effect of external electrostatic and electromagnetic fields.

shock load
The load seen by a clutch, brake, or motor in a system that transmits high peak loads. This type of load is present in crushers, separators, grinders, conveyors, winches, and cranes.

short-term trend display
A display that allows temporary storage of data for graphic presentation to the operator.

sigma-delta
The type of architecture used in an A/D converter that combines oversampling, noise-shaping, digital filtering, and decimation. The analog input signal is continuously sampled at a rate determined by a master clock and a selected gain. A charge-balancing A/D converter (sigma-delta modulator) converts the sampled signal into a digital pulse train with a duty cycle that represents the digital value.

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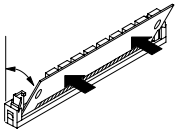
signal
The event or electrical quantity that conveys information from one point to another.

signaling speed
The number of discrete conditions or signal events per second (in baud).



SIMM
Single In-line Memory Module. A small memory module built with all pins in a single line; to be plugged into a mother board.

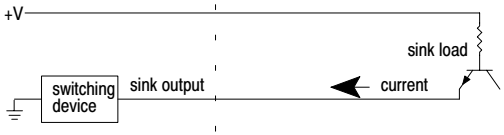
single-ended
1) Unbalanced, as when one side is grounded. (See *unbalanced circuit,* page 118.) **2)** Contrasted with *differential* (page 30).

single-slot addressing
See *1-slot addressing* (page 1).

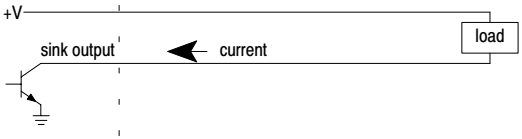
single-transfer
1) To transfer a single unit (8, 16, or 32 bits) of I/O data to/from each I/O module in an I/O chassis. The size of the unit of I/O data depends on the density of I/O addressing in the I/O chassis **2)** Contrasted with *block transfer* (page 11).

sink *(in communication)*
The part of the software (at the station receiving a message) that accepts from the receiver message packets addressed to the station.

sink load
1) A load with a current in the direction out of its input. A sink load must be driven by a current sink. **2)** Contrasted with *source load* (page 105).



sink output
1) An output that, when turned on, supplies a negative dc current to its load. **2)** Contrasted with *source output* (page 105).



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SIPROM™ feature
A feature in an Allen-Bradley CNC system that provides programmed auxiliary function control.

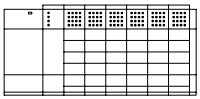
skew
1) In a motor, the arrangement of laminations on a rotor or armature to provide a slight angular pattern of their slots with respect to the shaft axis. This pattern helps reduce low-speed cogging in an armature and minimize induced vibration in a rotor, as well as reduce associated noise. **2)** In a split axis configuration, the difference between the positions of the two ball nuts of the split axis.

skewing
Refers to time-delay offset between any two signals in relation to each other.

slave *(communication)*
On a communication link, a station that cannot initiate communication. Only a master can initiate communication.

slave axis *(motion control)*
An axis that follows a master axis in an electronic gearing or position-lock cam application.

slave controller
An auxiliary drive controller used to provide control for additional axes or I/O. Normally interacts with operator only through a master relay. Has higher reliability and no moving parts



SLC™ controller
An Allen-Bradley programmable controller with a name that has the prefix SLC. See *programmable controller* (page 87).

slewing
An incremental motion of the motor shaft or machine table from one position to another at maximum speed without losing position control.

slip
The difference between rotating-magnetic-field speed (synchronous speed) and rotor speed of ac induction motors. Usually expressed as a percentage of synchronous speed.

slot
See *module slot* (page 70).

smart terminal
See *intelligent terminal* (page 54).

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SMB™ motor braking
An Allen-Bradley smart motor braking feature of an SMC™ smart motor controller.

SMC controller
An Allen-Bradley smart motor controller.

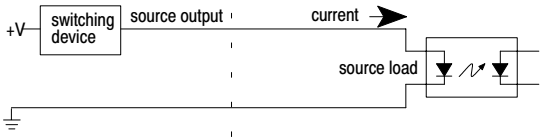
snap shot
A dump or list of pertinent variables and data structures gathered over a short time to be considered frozen; nothing changes during the dump.

software
Programs that control the processing of data in a processor.

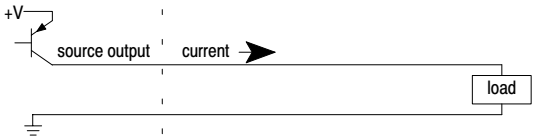
solicited message
1) To a station receiving a message, it is solicited if it is a reply to a command message sent previously by the station now receiving the message.
2) Contrasted with *unsolicited message* (page 118).

source *(in communication)*
1) The station sending the message. **2)** At the station sending the message, the part of the software that supplies message packets to the transmitter.

source load
1) A load with a current in the direction into its input. A source load must be driven by a current source. **2)** Contrasted with *sink load* (page 103).



source output
1) An output that, when turned on, supplies a positive dc current to its load.
2) Contrasted with *sink output* (page 103).



SPC
Statistical Process Control.

spectral response
A definition of all the wavelengths to which a photo detector responds.

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speed range
The speed minimum and maximum at which a motor must operate under constant or variable torque load conditions. A 50:1 speed range for a motor with top speed 1800 rpm means the motor must operate as low as 36 rpm and still remain within regulation specification. Controllers are capable of wider controllable speed ranges than motors because there is no thermal limitation; only electrical. Controllable speed range of a motor is limited by the ability to deliver 100% torque below base speed without additional cooling.

speed regulation
The variation in actual speed expressed as a percentage of set speed.

speed regulation constant
The slope of the motor speed-torque characteristic.

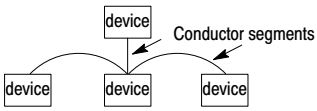
SPX
Shark Programming Executive. A DOS-based programming system for the Shark controller.

SQC
Statistical Quality Control.

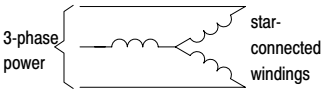
SQL
Structured Query Language.

SRC field
Source field. Identifies the address of the station that transmitted a network packet.

standard drawings
Arrangement drawings and wiring diagrams prepared with manufacturer's standard drawing sizes, device symbols, and identification and numbering designation (as defined in NEMA Standard Pub. No. ICS 2, 1988).



star configuration *(for parallel connection)*
1) In an arrangement of parallel (bus) connections, a physical configuration such that each device is connected on the bus at the same junction of conductor segments **2)** Contrasted with a *daisy-chain configuration* (page 25) or a *trunk-line/drop-line configuration* (page 116).



star connection (Y connection)
1) The arrangement of phase windings, in a polyphase circuit, in which one end of each phase winding is connected to a common junction. In a 3-phase circuit, it is sometimes called a Y connection **2)** Contrasted with *delta connection* (page 28).

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star topology
A network where all devices are connected to a central or master communication device that routes messages.

state
1) The condition of a circuit or system. **2)** The condition at the output of a circuit that represents logic 0 or 1.

station
An input or output point on a communication system.

status
The condition at a particular time of any of numerous entities within a system. These conditions may be represented by values in a status file.

steady rate
For a given network, all variables such as messages and stations are held constant for modeling and simulation purposes.

step function
A signal that has a zero value before a certain instant of time and a constant nonzero value immediately after that instant.

step-function response
The time variation of an output signal when a specified step-function input signal or disturbance is applied.

step response
For inputs, the time required for the analog input signal to reach 95% of its expected final value.

STI
Selectable Timed Interrupt. A time-driven interrupt that periodically interrupts program execution for a single-scan execution of an STI program.

stiffness
The ability of a device to resist deviation due to load change.

storage
See *memory* (page 68).

storage bit
A bit in a data table word that does not correspond directly with a physical I/O circuit.

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storage media
Materials on which data may be recorded.

storage word
A data table word that does not correspond directly with physical I/O circuits.

structure *n*
In some files, structure is the next lower addressable unit of data (below file) in the hierarchical ordering of data. A structure is made up of members which may be of different sizes and formats.

STS field
Status field. Used in reply messages for reporting either application or network errors.

subroutine
A series of program instructions that performs a specific task for the main program or other routines.

subsystem
1) A part of a larger system having the properties of a system in its own right.
2) A system within another system.

successive approximation
A method used in an A/D converter to approximate the input voltage. Starting with the most-significant bit, the method is extended *n* times for an *n*-bit converter. If the approximation exceeds a reference, the result is a 0 for that bit; if smaller, the result is a 1.

summing point
A mixing point where input signals are added algebraically to generate an output signal.

suppressor
See *surge-suppressor*, below.

surge
A transient wave of voltage, current, or power.

surge-suppression
The process of absorbing and clipping voltage transients on an incoming ac line or control circuit. MOVs (Metal-Oxide Varistors) and specially designed R-C networks are usually used to accomplish this.

surge suppressor
A device that attenuates the magnitude of electrical noise.

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SWINGAROUND™ terminals
An Allen-Bradley relay terminal construction designed to allow conversion of contacts without removal of the terminal screws.

synchronous
1) In step or in phase, as applied to two or more circuits, devices, or machines. **2)** Contrasted with *asynchronous* (page 7).

synchronous shift register
A shift register that shifts all data each time a shift signal occurs.

synchronous transmission
1) Transmission in which the sending and receiving stations operate continuously at the same frequency and are held in a desired phase relationship. **2)** Contrasted with *asynchronous transmission* (page 7).

synchronous speed
The speed of an ac induction motor's rotating magnetic field. It is determined by the frequency applied to the stator and the number of magnetic poles present in each phase of the stator windings. Mathematically, it is expressed as: Sync Speed (rpm) = 120 x Applied Freq. (Hz) / Number of poles per phase.

syntax
Rules governing the structure of a language.

system overshoot
The maximum value of system deviation between the control variable and the command.

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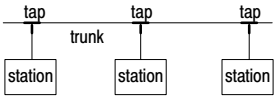
tachometer
A precision linear dc generator used to provide velocity feedback.

tag *(electronics)*
A device attached to a product as it passes through a production line to uniquely differentiate that type of product from other types of products that may pass through the same production line. The information encoded in the tag can be read by sensors for storage in a PLC data table so that the product can be processed appropriately based on that encoded information.

tag *(software)*
Information about a specific entity (an I/O chassis, an I/O module, an I/O). For example, an I/O definition file may contain a tag (definition) for each I/O. Each tag may consist of several items, each defining some aspect of the entity. At a minimum, a tag must include a tag name (a symbolic name) to establish that symbolic address to represent the physical or logical address of the data.

tag name *(software)*
A symbolic name used in a tag to identify a specific entity within a complete set of related entities. For example, an I/O definition file may contain a tag (definition) for each I/O — with each I/O definition containing a unique tag name by which the I/O can be addressed.



tap
A connection to a trunk cable. The tap allows part of the signal on the trunk to be passed to a station, and the signal transmitted by the station to be passed to the trunk.

task
A set of instructions, data, and control information capable of being executed by a CPU to accomplish a specific purpose.

TCAT
Timer/Counter Access Terminal.

TCP/IP
Transmission Control Protocol/Internet Protocol. A transport layer protocol and a network layer protocol developed by the Department of Defense. This is a commonly used combination for communication within networks and across internetworks.

terminal
1) A screw, solder, or other electrical connection point. (See *I/O terminal*, page 57) **2)** A peripheral device that provides access to a system.

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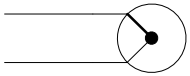
termination
A load connected to the end of a transmission line. To avoid signal reflections, it must match the characteristic impedance of the line.

thread speed
A fixed usually adjustable low speed supplied to provide a convenient method of loading and threading machines. May also be called a preset speed.



thermocouple
A temperature transducer comprising a closed circuit made of two different metals. If the two junctions are at different temperatures, an electromotive force is developed that is proportional to the temperature difference between the junctions.

throughput
The rate at which equipment processes or transmits data.

thumb-wheel switch
A multi-position rotary switch with a sprocket that is stepped forward or backward by using a finger or thumb to rotate it.

TNS field
Transaction field. A 16-bit field that indicates which message transaction is taking place.

toggle
To switch alternately between 2 possible selections.

toggle switch
A lever-action 2-position switch that snaps into either position.

token
1) A transmission from the present bus master that grants bus mastership to a station. Mastership is required for a station to originate communication.
2) The logical right to initiate communication.

token bus
A token-access procedure used with broadcast topology.

token passing
A media-access method for providing peer-to-peer communication between nodes of a bus. The nodes form a logical ring. The token is passed around the ring to each node on a regular schedule, thereby making throughput and response time predictable.

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Token Ring™ procedure
A token-access procedure used with physical ring topology.

token rotation time
The elapsed time between receiving a token by a station to the next receipt of the token by the same station. Usually, all stations will be passed the token during one token rotation time.

topology
The way a network is physically structured. Example: a ring, bus, or star configuration.

torque
A turning force applied to a shaft, tending to cause rotation. Torque is equal to the force applied, times the radius through which it acts.

- **breakdown torque** — The maximum torque an ac motor will develop with rated voltage applied at rated frequency.
- **continuous (rated) torque** — The maximum torque a motor can deliver continuously.
- **full-load torque** — The torque necessary to produce the rated horsepower at full-load speed.
- **hard-stop holding torque** — Torque applied to an axis to hold it steady against a mechanical stop. Applying torque in this way is used to prevent bounce due to backlash.
- **instantaneous (peak) max. torque** — The maximum torque a motor can deliver for a short specified duration with a specified interval between peaks.
- **locked-rotor torque** — The minimum torque that a motor will develop at rest for all angular positions of the rotor (with rated voltage applied at rated frequency).
- **pull-in torque** — The maximum constant torque at which a synchronous motor will accelerate into synchronism at rated voltage and frequency.
- **pull-out torque** — The maximum running torque of a synchronous motor.
- **pull-up torque** — The torque required to accelerate the load from standstill to full speed (where breakdown torque occurs), expressed in percent of running torque. It is the torque required not only to overcome friction, windage, and the attached load, but also to overcome the inertia of the machine. The torque required by a machine may not be constant after the machine has started to turn. This load type is characteristic of fans, centrifugal pumps, and certain machine tools.
- **stall torque** — The torque that the rotor of an energized motor produces when restrained from motion.

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- **starting (breakaway) torque** — The torque required to start a machine from standstill. It is always greater than the torque needed to maintain motion.

torque constant

For an electric motor, the ratio of the input current to the output torque. Often measured in inch-pounds/ampere.

torque control

A method of using current-limit circuitry to regulate torque instead of speed.

totally enclosed machine *(motor)*

A totally enclosed machine is one so enclosed as to prevent the free exchange of air between the inside and the outside of the case but not sufficiently enclosed to be termed airtight (NEMA standard):

- **totally enclosed fan-cooled machine** — is a totally enclosed machine equipped for exterior cooling by means of a fan or fans integral with the machine but external to the enclosing parts.
- **explosion-proof machine** — is a totally enclosed machine whose enclosure is designed and constructed to withstand an explosion of a specified gas or vapor that may occur within it, and to prevent the ignition by sparks, flashes or explosions of the specified gas or vapor that may occur near or within the machine casing.
- **dust-ignition-proof machine** — is a totally enclosed machine whose enclosure is constructed to exclude ignitable amounts of dust or amounts that might affect performance or rating, and constructed to not permit arcs, sparks, or heat otherwise generated or liberated inside the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specific dust on or in the vicinity of the enclosure.
- **waterproof machine** — is a totally enclosed machine so constructed that it will exclude a stream of water from a hose, except that leakage may occur around the shaft; provided it is prevented from entering the oil reservoir and provision is made for automatically draining the machine. The means for automatic draining may be a check valve or a tapped hole at the lowest part of the frame that will serve for application of a drain pipe.
- **totally enclosed water-cooled machine** — is a totally enclosed machine that is cooled by circulating water, the water or water conductors coming in direct contact with the machine parts.
- **totally enclosed water-air-cooled machine** — is a totally enclosed machine that is cooled by circulating air that, in turn, is cooled by circulating water. It is provided with a water-cooled heat exchanger for cooling the internal air and a fan or fans for circulating internal air.

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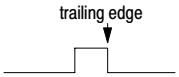
- **totally enclosed fan-cooled guarded machine** — is a totally enclosed fan-cooled machine in which all openings with direct access to the fan are limited in size by design of the structural parts or by screens, grills, or expanded metal, to prevent accidental contact with the fan. Such openings shall not permit the passage of a cylindrical rod 0.75 inch in diameter, and a probe shall not contact the blades, spokes, or other irregular surfaces of the fan.
- **totally enclosed air-over machine** — is a totally enclosed machine cooled only by a ventilating means external to the machine.

track
1) A path for recording one channel of information on a magnetic recording medium. **2)** A part of a secondary storage device that is accessed by one read/write head.

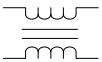


trailing-edge triggering
A programming technique of triggering some step by means of an on-to-off transition of an input signal. The on-to-off transition is considered the trailing edge of the input pulse.

transaction
In communication protocol, the procedure executed by the network to send a message designated at the application layer. This includes: station processing time, media access, transmission, and turn-around times for both stations until the reply is available at that application layer.

transceiver
A device that transmits and receives data.

transducer
A device that converts one form of energy to another (e.g., mechanical to electrical). When a transducer is actuated by signals from one system or medium, it can supply a related signal to the other system or medium. A transducer may be a sensor that converts mechanical energy to electrical energy. A transducer may be an actuator that converts electrical energy to mechanical energy.



transformer
A component that consists of 2 or more coils coupled by magnetic induction.

transient
A momentary deviation in an electrical or mechanical system.

transient overshoot
The maximum system deviation between a transient value of a controlled variable and the steady-state value of that variable.

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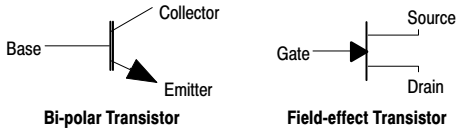
transistor
An active solid-state semiconductor device.



Bi-polar Transistor **Field-effect Transistor**

translator
A software program that operates on, or uses as data, other programs to translate higher level instructions into machine-executable instructions.

translator package
A computer program that allows a ladder diagram program (in binary) to be documented with comments and cross references.

translucent
1) The characteristic of a body that allows light to pass through it diffused.
2) Contrasted with *opaque* (page 77).

transmission line
A system of one or more electrical conductors used to transmit electrical signals or power from one place to another.

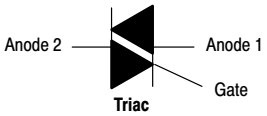
transmission time
The amount of time a station is sending data.

transmitter (XMTR)
A device that sends data.

transmitted beam
In a photoelectric control, a scanning mode in which the light source and the receiver are opposite each other so that the object being sensed breaks the beam.

trapezoidal profile
A motion profile in which the velocity-vs-time profile resembles a trapezoid. Characterized by constant acceleration, constant velocity, and constant deceleration.

trending
See *short-term trend display* (page 102).



triac
A solid-state bi-directional latching switch that provides full-wave control of ac power.

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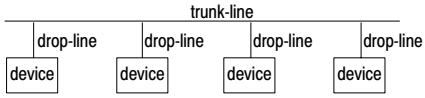
true
1) On a ladder logic rung, the state of a logic element of a conditioning instruction when the condition for which it is examining is detected.
2) Contrasted with *not true* (page 75).

trunk-line/drop-line configuration *(for parallel connection)*
1) In a linear arrangement of parallel (bus) connections, a physical configuration such that each device is connected to the bus at the end of a drop-line that is connected to a tap at the junction of two trunk-line segments. **2)** Contrasted with a *daisy-chain configuration* (page 25) or *star configuration* (page 106).



truth table
A matrix that describes a logic function by listing all possible combinations of inputs, and by indicating the outputs for each combination.

TSR
Terminate-and-Stay-Resident program. A program running under DOS that remains loaded in memory even when it is not running so that it can be quickly be invoked for a specific task performed while any other application program is operating.

TTL
Transistor-transistor Logic. An integrated circuit with its inputs and outputs directly tied to transistors.

TurboNET™ system
An Allen-Bradley system consisting of DataMyte data collectors and connecting hardware and cables, and IBM-PC compatible software to automate statistical quality control (a DataMyte product).

TurboSPC™ software
An Allen-Bradley quality-management software package for personal computers (a DataMyte product).

turn-around time
The time it takes a communication module to receive, interpret, act upon, and reply to an incoming message.

twinaxial cable
A transmission line made up of a twisted pair of insulated conductors centered inside and insolated from a conductive shield.

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two-slot addressing
See *2-slot addressing* (page 1).

two-way alternate (half-duplex) (HDX)
1) A mode of operation for a point-to-point or multi-point baseband link with two physical circuits, in which messages or transmission blocks can be sent in one direction or the other, but not both at the same time. **2)** Contrasted with *two-way simultaneous*.

two-way simultaneous (full-duplex) (duplex) (FDX)
1) A mode of operation for a point-to-point link with two physical circuits, in which messages or transmission blocks can be sent in both directions at the same time. **2)** Contrasted with *two-way alternate*.

TXD
Transmitted Data. An output that carries serialized data.

TXDRET
Transmitted-Data Return. The signal-return line for TXD.

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UART
Universal Asynchronous Receiver/Transmitter. An interface device for serial/parallel conversion, buffering, and adding check bits.

UL
Underwriters Laboratories (an approval agency).

unattended system *(bar code)*
1) A bar-code scanner/decoder combination that is triggered, or activated by an external source such as a computer, a programmable controller, or a switch operated automatically by some machine motion. **2)** Contrasted with *attended system* (page 7).

unbalanced circuit
1) A circuit whose two sides are electrically dissimilar, as when one side is grounded. **2)** Contrasted with *balanced circuit* (page 9).

underflow bit
A bit that is set to indicate that the result of an operation is less than the minimum value that can be contained in a register.

uni-directional I/O module
An I/O module whose communication with the scanner or processor is uni-directional and therefore uses only an input image area or an output image area.

UNIVERSAL™ proximity sensor
An Allen-Bradley family of induction proximity sensors. See *proximity switch/sensor* (page 88).

unsolicited message
1) To a station receiving a message, it is unsolicited if it is not a reply to a command message sent previously by the station now receiving the message **2)** Contrasted with *solicited message* (page 105).

unusable unit space
Unit space not suitable to accept a future unit (as defined in NEMA Standard Pub. No. ICS 2, 1988).

UPC *(bar code)*
Universal Product Code. A standard bar code type for retail packaging in the United States. See *EAN* (page 36).

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update time
1) For analog inputs, the time between updates to the memory in the analog module of the digital value representing the analog input signal. **2)** For analog outputs, the time from the digital value being received at the analog module to when the analog output signal corresponds to that digital value.

upload
See upload /download.

upload/download
Commonly refers to the reading/writing across a link of relatively large blocks of data from one device to another. Whether it is considered an upload or a download may depend upon whether it is a read or write and upon which device initiates the transaction. When data is transferred to a programming or bulk-storage device, it is considered an upload. When data is transferred from a programming or bulk-storage device, it is considered a download.

upper nibble
The four most-significant bits of a byte.

USART
Universal synchronous/asynchronous receiver/transmitter. A UART with the added capability for synchronous data communication.

utility software
A program or routine, such as an editor or debugger, designed to perform a particular function of general usefulness. Compare to *application program* (page 6) and *operating system* (page 79).

UV-erasable PROM
An EPROM that is erasable by ultra-violet light. (See *PROM*, page 88; *EPROM*, page 39; and *EEPROM*, page 36.)

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VAR
1) Value-Added Reseller. A company that acquires hardware and software in complete form and resells it to the public, adding value such as user support and service. **2)** Reactive volt-amps. The unit of apparent power consumed by a capacitor or inductor.

variable
A factor that can be altered, measured, or controlled.

variable data
Numerical information that can be changed during application operation. It includes timer and counter accumulated values, thumbwheel settings, and arithmetic results.

variable-speed drive
See *drive controller* (page 33).

varistor
A two-electrode semiconductor device with a voltage-dependant non-linear resistance that drops markedly as the applied voltage is increased. It is used to suppress transient voltage surges.

VDT
Video Display Terminal.

vector
A quantity that denotes both magnitude and direction. Vectors are commonly represented by a line segment with an arrow; the length represents the magnitude; the orientation in space and the placement of the arrow at one end of the line represents the direction.

vector quantity
A quantity that denotes both magnitude and direction in relation to a given frame of reference. Examples of quantities that are vectors are displacement, velocity, force, and magnetic intensity.

velocity
A vector quantity that denotes both magnitude (e.g., speed) and direction in relation to a given frame of reference.

velocity loop
A feedback control loop in which the controlled parameter is motor velocity. Usually uses a tachometer for a feedback device.

VFD
Variable-Frequency Drive.

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VGA
Video Graphics Adapter. A video adapter introduced in 1987. The VGA duplicates all video modes of the EGA (Enhanced Graphics Adapter) and provides several additional modes.

VIM™ module
A vision input module for inspection applications.

virtual
The logical or conceptual view of something, which implies some sort of mapping function to get from conceptual to physical.

volatile memory
1) A memory that loses its information if the power is removed. **2)** Contrasted with *non-volatile memory* (page 75).

VRC
Vertical redundancy check. An error-checking method that adds a check or parity bit to each character in a message so the number of 1 bits, including the parity bit, in each character is odd (odd parity) or even (even parity).

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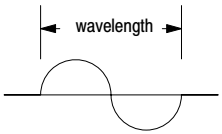
WACK
Wait before transmitting positive ACKnowledgment. In binary synchronous communications, this DLE sequence is sent by a receiving station to indicate that it is temporarily not ready to receive.

watchdog timer
A timer that monitors a cyclical process and is cleared at the conclusion of each cycle. If the watchdog runs past its programmed time period, it will cause a fault.



wavelength
The distance traveled by light (or other radiation) while completing one complete sine-wave cycle. It is expressed in nanometers (nm). Each color has a specific wavelength.

weighted value
The numerical value assigned to any single bit as a function of its position in a word.

window
A temporary, usually rectangular, bounded area on a CRT display that includes particular entities for entry, modification, or deletion.

WINtelligent™ LINX™ gateway software
Rockwell Automation software for Allen-Bradley processors that lets software communicating over a TCP/IP network access communication drivers in the LINX gateway station.

WINtelligent LINX software
Rockwell Automation software that lets Microsoft® Windows™ DDE-compliant application software exchange real-time plant-floor data with Allen-Bradley programmable controllers for display, logging, or trending.

WINtelligent RECIPE™ software
Rockwell Automation operator interface software (Microsoft Windows-based) for a visual graphics system that simultaneously modifies data values and uses state changes, bar graphs, numeric strings, color changes, embedded trends, and slider bars to animates data values.

WINtelligent VIEW™ software
Rockwell Automation operator-interface application software for managing industrial process control recipes used with programmable controllers.

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wireway
1) A trough, with hinged or removable covers; for housing and protecting electric wires and cables and in which conductors are laid in place after the wireway has been installed as a complete system. A wireway may be made of either sheet metal or of a flame-retardant nonmetallic material.
2) See also *raceway* (page 91).

word
A grouping or a number of bits in a sequence that is treated as a unit.

word length
The number of bits in a word. In a programmable controller, unless stated otherwise, a word has 16 data bits.

work
The magnitude of a force times the distance through which that force is applied. *(work = force x distance)*

work area
A portion of the data table reserved for specific processor functions.

workstation
1) A powerful stand-alone computer of the sort used in applications requiring considerable calculating or graphics capability. **2)** A combination of input, output, and computing hardware that can be used for work by an individual. **3)** A microcomputer or terminal connected to a network.

wrap around
In a display, when data is moved in one direction through the display, or a cursor is moved though the data, as the data displayed or the cursor position reaches one extreme end, it jumps to the other extreme end so that the movement can continue.

write
To load data into somewhere (memory, an output, another station).

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X axis
The axis of motion that is always horizontal and parallel to the work holding surface.

XMTR
Transmitter. A device that sends data.

XON/XOFF
An asynchronous communication protocol for the receiving station to control the flow of data from the transmitting station. When the receiving station cannot continue to receive any more data, as when its buffer is full, it transmits an XOFF (DC3) control character that tells the sender to stop. When the receiving station is again able to process more data, it transmits an XON (DC1) control character that tells the sender to resume transmission. This protocol is also referred to as software handshaking.

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Y axis
The axis of motion that is perpendicular to both the X and Z axes.

Y connection
See *star connection* (page 106).

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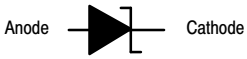
Z axis
The axis of motion that is always parallel to the principal spindle of the machine.

ZCL instruction
Zone-control last-state instruction. A user-programmed fence for ZCL zones.

ZCL zones
Assigned program areas that may control the same outputs through separate rungs, at different times. Each ZCL zone is bound and controlled by ZCL instructions. If all ZCL zones are disabled, the outputs in the zones would remain in their most recent controlled state.

zero *v*
To set to zero, the value of a word or other unit of memory.



zener diode
A diode that, above a certain reverse voltage (the zener value), has a sudden rise in current. The voltage across the diode remains essentially constant for any further increase in reverse current, up to the allowable dissipation rating.

ZIF connector
Zero-Insertion-Force connector. A connector for which male and female contacts do not initially touch each other while the connector halves are being engaged. Instead, the halves are physically positioned together, and then a turn of an actuating cam arrangement mates all the contacts at once.

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Ladder Logic Instructions

Mnemonic	Instruction		Mnemonic	Instruction
ABL	ASCII Test Buffer for Line		DTR	Data Transitional
ABT	Abort IBP (Independent Background Prog.)		DVF	File Divide
ACB	ASCII Characters in Buffer		END	End
ACI	ASCII String to Integer		EOT	End of Transition
ACN	ASCII String Concatenate		EQU	Equal to
ADF	File Add		FAL	File Arithmetic and Logic
ADD	Add		FBC	File Bit Comparison
AEX	ASCII String Extract		FFL	FIFO Load
AFI	Always False		FFU	FIFO Unload
AHL	ASCII Set or Reset Handshake Lines		FLL	Fill File
AIC	ASCII Integer to String		FOR	For
AND	Bit-wise AND		FRD	Convert From BCD
ANF	File AND		FSC	File Search and Compare
ARD	ASCII Read		GEQ	Greater Than or Equal To
ARL	ASCII Read Line		GMF	Get Minor Fault
ASC	ASCII String Search		GRT	Greater Than
ASR	ASCII String Compare		GSB	Go to Subroutine
AVE	Average		GTF	Global Timer Off
AWA	ASCII Write with Append		GTN	Global Timer On
AWT	ASCII Write		HSC	High-Speed Counter
BIN	Indexed Bit On		IBP	Independent Background Program
BIR	Indexed Bit Reset		IID	I/O Interrupt Disable
BIS	Indexed Bit Set		IIE	I/O Interrupt Enable
BRK	Break		IIM	Immediate Input with Mask
BSL	Bit-Shift Left		IIN	Immediate Input
BSR	Bit-Shift Right		INT	IInterrupt Subroutine
BTD	Bit Field Distribute		IOM	Immediate Output with Mask
BTR	Block-Transfer Read		IOT	Immediate Output
BTW	Block-Transfer Write		JMP	Jump
CLK	Set Clock		JSR	Jump to Subroutine
CLR	Clear		LBL	Label
CMF	Clear Minor Fault		LEQ	Less Than or Equal To
CMP	Compare		LES	Less Than
COP	Copy File		LFL	LIFO Load
CPT	Compute		LFU	LIFO Unload
CTD	Count Down		LIM	Limit Test
CTU	Count Up		MCR	Master Control Reset
DCD	Decode		MEQ	Masked Compare Equal To
DDT	Diagnostic Detect		MLF	File Multiply
DDV	Double Divide		MMF	Masked Move File
DIV	Divide		MOV	Move

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Mnemonic	Instruction		Mnemonic	Instruction
MSG	Send/Receive Message		SGN	Search Greater Than
MUL	Multiply		SLE	Search Less Than or Equal
MVF	Move File		SLS	Search Less Than
MVM	Masked Move		SMF	Set Major Fault
MVS	Move Status		SNE	Search Not Equal
NEG	Negate		SQC	Sequence Compare
NEQ	Not Equal To		SQF	File Square Root
NGF	File Negate		SQI	Sequencer Input
NOP	No Operation		SQL	Sequencer Load
NOT	Bit-wise NOT		SQO	Sequencer Output
NTF	File Not		SQR	Square Root
NXT	Next		SRT	Sort File
ONS	One-Shot		STD	Standard Deviation
OR	Bit-wise OR		STD	Selectable Timed Interrupt Disable
ORF	File OR		STE	Selectable Timed Interrupt Enable
OSF	One-Shot Falling		STS	Selectable Timed Interrupt Start
OSR	One-Shot Rising		SUB	Subtract
OTE	Energize		SUS	Suspect
OTL	Latch		SVC	Service Communication
OTU	Unlatch		TND	Temporary End
PID	Proportional/Integral/Derivative		TOD	Convert to BCD
REF	I/O Refresh		TOF	Timer Off Delay (non-retentive)
RES	Reset Timer or Counter		TON	Timer On Delay (non-retentive)
RET	Return From Subroutine		TPO	Time-Proportioning Output
RPI	Reset Pending I/O Interrupt		UID	User Interrupt Disable
RST	Reset Timer, Counter, or Sequencer		UIE	User Interrupt Enable
RTF	Retentive Timer Off		WIL	While
RTO	Retentive Timer On		XIC	Examine On (Examine Input Closed)
SBF	File Subtract		XIF	Examine Indexed Bit Off
SBR	Subroutine		XIN	Examine Indexed Bit On
SCL	Scale		XIO	Examine Off (Examine Input Open)
SDS	Smart Directed Sequencer		XOF	File Exclusive OR
SEQ	Search Equal		XOR	Bit-wise Exclusive OR
SFR	Sequential-Function-Chart Reset		ZCL	Zone-Control Last-State
SGE	Search Greater Than or Equal			

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Contrasting Terms

This Term	Contrasts With This Term(s)
absolute encoder	incremental encoder
absolute move	incremental move
absolute position	incremental position
analog circuit	digital circuit
analog gage	digital gage
asynchronous	synchronous
asynchronous transmission	synchronous transmission
attended system	unattended system
balanced circuit	unbalanced circuit
baseband link	broadband link, carrier-band link
block-transfer	single-transfer
broadband link	baseband link, carrier-band link
carrier-band link	baseband link, broadband link
closed-loop system	open-loop system
daisy-chain configuration	star configuration, trunk-line/drop-line configuration
delta connection	star connection (Y connection)
differential	single-ended
digital circuit	analog circuit
digital gage	analog gage
direct I/O module	intelligent I/O module
discrete	integrated
discrete circuit	integrated circuit
download	upload
driver	puller
factory wiring	field wiring
field wiring	factory wiring
high = true	low = true
I/O block	I/O module
I/O module	I/O block
incremental encoder	absolute encoder

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This Term	Contrasts With This Term(s)
incremental move	absolute move
incremental position	absolute position
intelligent I/O module	direct I/O module
integrated	discrete
integrated circuit	discrete circuit
local I/O	remote I/O
low = true	high = true
master/slave communication	peer-to-peer communication
multi-drop link	point-to-point link
non-retentive output instruction	retentive output instruction
non-volatile memory	volatile memory
not true	true
off	on
on	off
opaque	translucent
open-loop system	closed-loop system
parallel operation	serial operation
peer-to-peer communication	master/slave communication
point-to-point link	multi-drop link
puller	driver
remote I/O	local I/O
retentive output instruction	non-retentive output instruction
serial operation	parallel operation
single-ended	differential
single-transfer	block-transfer
sink load	source load
sink output	source output
solicited message	unsolicited message
source load	sink load
source output	sink output
star configuration	daisy-chain configuration, trunk-line/drop-line configuration
star connection (Y connection)	delta connection
synchronous	asynchronous
translucent	opaque
true	not true
trunk-line/drop-line configuration	daisy-chain configuration, star configuration

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This Term	Contrasts With This Term(s)
two-way alternate	two-way simultaneous
two-way simultaneous	two-way alternate
unattended system	attended system
unbalanced circuit	balanced circuit
upload	download
volatile memory	non-volatile memory

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