

Electrical Engineering Terms

Accuracy	The deviation between the actual position and the theoretical position.
ActiveX	Microsoft's toolkit for Web developers, using OLE and incorporating Sun's Java language. ActiveX helps in building software to integrate with Microsoft's Internet Explorer, or any ActiveX container such as programs written with Microsoft's Visual Studio.
Actuator	In a closed-loop control system, that part of the final control element that translates the control signal into action by the control device. An example is a valve or cylinder.
Address	Number used to specify a storage location in memory.
Ambient Temperature	The temperature that naturally exists in the environment.
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).
ANSI (American National Standards Institute)	The American National Standards Institute (ANSI) has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for more than 80 years. ANSI does not itself develop American National Standards (ANSs); rather it facilitates development by establishing consensus among qualified groups.
ASCII (American Standard Code for Information Interchange)	A coding system used to represent letters and characters. Seven-bit ASCII can represent 128 different combinations and Eight-bit ASCII can represent 256 different combinations.
Asynchronous communications	Method of communications that uses a series of bits to send data between devices. There is a start bit, data bits (7 or 8), a parity bit (odd, even none, mark, or space), and stop bits (1, 1.5, or 2). One character is transmitted at a time.
AS-I (Actuator-Sensor Interface)	A low-cost electromechanical connection system designed to operate over a two-wire cable carrying data and power over a distance of up to 100m, or more if repeaters are used. Visit www.as-interface.com for more information.
Automation	The condition of being automated; any system or method that uses self-operating equipment, electronic devices, etc. to replace human beings in doing routine or repetitive work actions.
Backplane	The communication and power bus in the back of a PLC chassis. It is a printed circuit board with sockets that accept various I/O modules.
Baud rate	Speed of serial communications. The number of bits per second transmitted. For example, RS-232 is normally used with a baud rate of 9600. This would be about 9600 bits per second. It takes about 10 bits in serial to send an ASCII character so that a baud rate of 9600 would transmit about 960 characters per second.
Bar Code	A series of horizontal stripes or bars of varying width which represent a string of characters that can be read by a bar code reader (scanner).
BEUG (BITBUS European Users Group)	BEUG is a nonprofit organization devoted to spreading the BITBUS technology and organizing a basic platform where people using BITBUS can share application experiences.
Bill of Materials (BOM)	A list of components, ingredients, or materials needed to manufacture a product; the hierarchy of materials or components making up a product or subassembly including the proper ratios of quantities of each item.
Binary	Base two number system. Binary is a system in which ones and zeros are used to represent numbers.
Binary-coded decimal (BCD)	A number system. Each decimal number is represented by four binary bits. For example, the decimal number 967 would be represented by 1001 0110 0111 in BCD.
Bit	Binary digit. The smallest element of binary data. A bit will be either a zero or a one.
BITBUS	It is one of the most widely used fieldbuses. It was promoted as a standard in 1990 by a special committee of the IEEE (standard IEEE-1118 1990).
Boolean	

Logic system that uses operators such as AND, OR, NOR, and NAND. This is the system that is utilized by PLCs, although it is usually made invisible by the programming software for the ease of the programmer.

Bounce This is an undesirable effect. It is the erratic make and break of electrical contacts.

Branch Parallel logic path in a ladder diagram.

Bridge A bridge is a device that connects two similar networks together. All messages are passed automatically. It is mainly used to increase the distance or number of devices a given type of network can handle.

Brushless Servomotor A class of servomotors which operates using electronic commutation of phase currents rather than electromechanical (brushes) commutation. Commutation is a function of rotor position. These motors typically have a permanent magnet rotor and wound stator.

Bus Data path that connects to a number of devices. A typical example is the bus a computer's circuit board or backplane. Memory, processor, and I/O devices may all share the bus to send data from one to another. A bus acts as a shared highway and is in lieu of the many devoted connections it would take to hook every device to every other device.

Byte Eight bits or two nibbles. (A nibble is 4 bits.)

CAD (Computer Aided Design) Programs used to design architectural, mechanical and electrical engineering drawings.

CAM (Computer Aided Manufacturing) Programs used to control manufacturing equipment.

Cascade Programming technique that is used to extend the range of timers and counters.

CENELEC European Committee for Electrotechnical Standardization. It develops standards which cover dimensional and operating characteristics of control components.

CIM (Computer Integrated Manufacturing) A term used for describing a high level of automation in a manufacturing enterprise.

CMOS (Complimentary Metal-Oxide-Semiconductor) Family of logic devices that uses p-type and n-type channel devices on the same IC. It has the advantage of offering medium speed and very low power requirements.

Color mark sensor Sensor that was designed to differentiate between two different colors. Differentiates the gray level contrast difference between colors.

COM (Component Object Model) COM Component Object Model, is a family of Microsoft specifications and software that produces platform independent, object-oriented and scalable components. It is the "glue" that integrates the operating environment with plant applications and supports the inter-operability of applications, devices and systems. COM compliant interfaces are built into applications and "glued" together using the COM services and the Windows infrastructure.

Complement The complement is the inverse of a digital signal.

CMOS (complementary metal-oxide semiconductor) Integrated circuits that consume very little power and also have good noise immunity.

Compare instruction PLC instruction that is used to test numerical values for equal, greater than, or less than relationships.

Contact Symbol used in digital logic and programming PLCs. Used to represent inputs. There are normally open and normally closed contacts. Contacts are also the conductors in electrical devices such as starters.

Contactors Special-purpose relay that is used to control large electrical current.

CSA (Canadian Standards Organization) Develops standards, tests products and provides product certification for manufacturers.

CPU (Central processing unit) Microprocessor portion of the PLC. It is the portion of the PLC that handles the logic.

CNC (Computer Numerical Control) Allows the control of motion in an accurate and programmable manner through use of a dedicated computer within a numerical control unit, with a capability of local data input such that machine tools are freed from the need for "hard-wired" controllers.

ControlNet A real-time, control-layer network providing high-speed transport of both time-critical IO data and messaging data, including upload/download of programming and configuration data and peer-to-peer messaging, on a single physical media link.

Conveyor A horizontal, inclined or vertical device for moving or transporting bulk materials, packages, or objects in a path predetermined by the design of the device and having points of loading and discharge fixed, or selective.

Current sinking

Refers to an output device (commonly a NPN transistor). When the output is On, current flow is from the load into the device's output, then to ground. Output is Normally High. The sensor "sinks" current from the load through the sensor to ground. The load is connected between the positive lead of the supply and the output lead of the sensor.

Current sourcing
Refers to an output device (commonly a PNP transistor). When the output is On, current flow is from the device into the load. Output is Normally Low. The sensor "sources" current to the load. The load is connected between the output lead and the negative ground lead of the supply.

Client-Server Architecture
The underlying philosophy of centralized processing. In multiple computer systems it can be more efficient for only one computer (the server) to perform certain operations. When another computer requires the data, no processing or synchronization is required, the data is merely requested from the server.

Cycle time
Time required to perform the cycle. (ISO 8373)

CRC (Cyclic Redundancy Check)
A calculated value, based on the content of a communication frame. It is inserted in the frame to enable a check of data accuracy after receiving the frame across a network. BITBUS uses the standard SDLC CRC.

DAC (Digital-to-Analog Converter)
An electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current.

Dark Operate
Refers to the output of a photoelectric switch. The output is on if an object is not sensed.

Data Acquisition
A term commonly used for equipment or software that gathers data from devices through a communications channel.

Data Highway
A proprietary communications network that allows devices to communicate information to and from PLCs on a network or to and from host computers attached to the network.

Data Table
A consecutive group of user references (data) of the same size that can be accessed with table read/write functions.

DCS (Distributed Control System)
A global hardware and software solution to the requirements of a control system, usually provided by one manufacturer.

Debugging: Process of finding problems in a system.

Device Driver
A software component that permits a computer system to communicate with a device.

DeviceNet
A low-cost communication link that connects industrial devices to a network. It is based on broadcast-oriented communication protocol - the Controller Area Network (CAN). Visit www.odva.org for more information.

Digital input
An input that can have two states: on or off. These are also called discrete inputs.

Diagnostics
A routine that identifies problems or fault conditions in a device or system.

Differential Signaling
Most electrical signals are single-ended, comprised of a single wire and ground. Differential signals use two wires which are the inverse of each other -- when one swings positive, the other swings negative in equal magnitude. The receiving circuit looks only at the difference between the two, ignoring any common-mode voltage. This "push-pull" arrangement reduces the impact of electrical interference because external noise will affect both wires equally and the common-mode rejection will ignore the noise.
Examples: RS-422, RS-485, professional audio signal standards (especially for microphones), the signal lines employed by Ethernet, and the standard twisted-pair analog telephone (POTS) line.

Digital output
An output that can have two states: on or off. These are also called discrete outputs.

Distributed processing
The concept of distributed processing allows individual discrete devices to control their area and still communicate to the others via a network. The distributed control takes the processing load off the "host" system.

Distribution Center
Intermediate warehouse where products from different sources are assembled for shipment and distribution to specific customer locations.

Documentation
Documentation is descriptive paperwork that explains a system or program. It describes the system so that the technician can understand, install, troubleshoot, maintain, or change the system.

Downtime
Periods equipment or manufacturing systems are not available to perform work.

DLL (Dynamic Link Library)
A software module loaded into memory at execution time in order to access functions of that module.

DSP (Digital Signal Processor)

An integrated circuit designed for high-speed data manipulations. Used in audio, communications, image manipulation, and other data-acquisition and data-control applications.

ECP (Extended Capabilities Port)
An asynchronous, 8-bit-wide parallel channel defined by IEEE 1284-1944 that provides PC-to-peripheral and peripheral-to-PC data transfers.

EEPROM (Electrically Erasable Programmable Read-Only Memory)
ROM that can be erased with an electrical signal and reprogrammed.

EIA (Electronic Industries Alliance)
Among other things, the EIA sponsors electrical and electronic standards.

Embedded System
A combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a dedicated function. In some cases, embedded systems are part of a larger system or product, as is the case of an anti-lock braking system in a car. Contrast with general-purpose computer.
Defined by [Michael Barr, President, Netrino Consultants Network](#).

Encoder
A feedback device which converts mechanical motion into electronic signals. Usually an encoder is a rotary device that outputs digital pulses which correspond to incremental angular motion. The encoder consists of a glass or metal wheel with alternating clear and opaque stripes that are detected by optical sensors to produce the digital outputs.

Energize
Instruction that causes a bit to be a one. This turns an output on.

EPROM (Erasable Programmable Read Only Memory)
This sounds like a contradiction in terms as ROMs are Read only Memory that by definition cannot be erased by switching off the current. However, EPROM acts as ROM unless special action is taken. An EPROM contains charge in a transistor gate that holds it for up to 10 years. Applying ultraviolet light to the chip's surface dissipates the charge, erasing the memory content and allowing the reprogramming of the chip through the transistor gate using a higher voltage than is normally present on a PC board.

Ethernet
The standard for local communications networks developed jointly by Digital Equipment Corp., Xerox, and Intel. Ethernet baseband coaxial cable transmits data at speeds up to 10 megabits per second. Ethernet is used as the underlying transport vehicle by several upper-level protocols, including TCP/IP.

Expansion rack
A rack added to a PLC system when the application requires more modules than the main rack can contain. A remote rack is sometimes used to permit I/O to be remotely located from the main rack.

Fault
Failure in a system that prevents normal operation of a system.

Fault Tolerant
Able to withstand a considerable degree of error without crashing. This may involve copying data or mirroring data and having extra capacity. It is often achieved by using several separate processors, each monitoring the others and operating a voting system, so that if one fails, the others shut it down, call for human help and carry on operations.

FDDI (Fibre Distributed Data Interface)
A fiber-optic communication architecture/technology providing very fast data transfer even over large distances, and inherent redundancy capabilities.

Fiber Optics
A data transmission medium using light conducted through glass or plastic fibers. A fiber-optic cable has cores capable of conducting modulated light signals by internal reflection.

Fieldbus
Fieldbus is a generic term used to describe a common communications protocol for control systems and/or field instruments. Although some standard forms have been agreed for instruments, the DCS industry as a whole has so far no agreed fieldbus. Often, the Foundation Fieldbus is referred to simply as the Fieldbus.

Firmware
A series of instructions contained in read-only memory (ROM) that are used for the operating system functions. Some manufacturers offer upgrades for PLCs. This is often done by replacing a ROM chip. Thus the combination of software and hardware lead to it being called firmware.

Flash Memory
A RAM-ROM hybrid that can be erased and rewritten under software control. Such devices are divided into blocks, called sectors that are individually erasable. Flash memory is common in systems that require nonvolatile data storage at very low cost. In some cases, a large flash memory may even be used instead of a disk drive.

Flowchart
Used to make program design easier.

Force
Refers to changing the state of actual I/O by changing the bit status in the PLC. In other words, a person can force an output on by changing the bit associated with the real-world output to a 1. Forcing is normally used to troubleshoot a system.

Foundation FieldBus
A digital, two-way communication link among intelligent field-level and control devices that will replace the 4-20 mA standard.

Frame

Packet of bits that will be transmitted across a network. A frame contains a header, user data and an end of frame. The frame must contain all the necessary information to enable the sender and receiver(s) of the communication to decode the user's data and to ensure that this data is right.

Frequency
Defines number of events during a time period. Hertz (Hz) is a measurement of frequency.

Full duplex
Communication scheme where data flows in both directions simultaneous.

Gain
A term used in a PID loop calculation. It is the "P" in PID, since gain is the inverse of proportional band. Gain acts directly on the change in error since the last scan.

GMP (Good Manufacturing Practices)
A methodology of specification for a manufacturing process that ensures quality, safety, and engineering tolerances are met.

Ground
Direct connection between a device or a machine frame and earth ground.

Grounding
The intentional connection of sections of an electrical circuit to a common reference conductor called the ground. The ground is almost always at a potential of zero volts and serves as the reference for the other voltages in the circuit.

GUI (Graphical User Interface)
A type of display format that enables the user to choose commands, start programs, and see lists of files and other options by pointing to pictorial representations (icons) and lists of menu items on the screen. Choices can generally be activated either with the keyboard or with a mouse.

Half duplex
Communication scheme where data flows in both directions but in only one direction at a time.

Hard contacts
Physical switch connections.

Hard copy
Printed copy of computer information.

HDLC (High-level Data Link Control)
Standard protocol of communication oriented in message transmission (frames). The user's data field in an HDLC-frame can be of a free number of bits. The SLDC is a subset of the HDLC that defines the whole protocol in more detail and is byte-oriented.

Hertz (Hz.)
A unit of measurement that measures how often a periodic event, such as a waveform, occurs. One hertz equals one cycle per second. Frequency is often measured in kilohertz (KHz, 1000Hz), megahertz (MHz, 1000 KHz), gigahertz (GHz, 1000MHz), or terahertz (THz, 1000 GHz).

Hexadecimal
Numbering system that utilizes base 16.

HMI (Human-Machine Interface)
The interface between the operator and the process machinery.

Host computer
One to which devices communicate. The host may download or upload programs, or the host might be used to program the device. An example would be a PLC connected to a microcomputer. The host (microcomputer) "controls" the PLC by sending programs, variables, and commands. The PLC controls the actual process but at the direction and to the specifications of the host.

Hot Swap
Exchange of components during operation.

Hysteresis
A dead band that is purposely introduced to eliminate false reads in the case of a sensor. In an encoder hysteresis would be introduced in the electronics to prevent ambiguities if the system happens to dither on a transition.

I/O Device
Refers to any control or monitoring hardware that conveys information to or from PLC's.

I/O Port
A channel through which data is transferred between an input or output device and the microprocessor. The port appears to the CPU as one or more memory addresses that it can use to send or receive data.

IEC (International Electrotechnical Commission)
Develops and distributes recommended safety and performance standards.

IEEE (Institute of Electrical and Electronics Engineers)
An organization of engineering and electronics professionals notable for developing the IEEE 802 standards for the physical and data-link layers of local area networks following the ISO Open Systems Interconnection model.

Image table
Area used to store the status of input and output bits.

Instruction set
Instructions that are available to program the PLC.

Interfacing
Connection of independent devices or systems.

Incremental

This term typically refers to encoders. Encoders provide logic states of 0 and 1 for each successive cycle of resolution.

Integrated Circuit
A collection of electronic devices working together.

Intelligent I/O
PLC modules that have a microprocessor built in. An example would be a module that would control closed-loop positioning.

IP rating
Rating system established by the IEC that defines the protection offered by electrical enclosures. It is similar to the NEMA rating system.

IPX/SPX (InterPacket eXchange/Sequential Packet eXchange)
Networking protocol used for some LAN operating systems.

ISA (Industry Standard Architecture)
An unofficial designation for the bus design of the IBM PC/XT, which allows various adapters to be added to the system by means of inserting plug-in cards into expansion slots.

ISDN (Integrated Services Digital Network)
A digital based communication technology supporting both voice and data.

Isolation
Used to segregate real-world inputs and outputs from the CPU. Isolation assures that even if there is a major problem with real-world inputs or outputs (such as a short), the CPU will be protected. This isolation is normally provided by optical isolation.

K
Abbreviation for the number 1000. In computer language it is equal to two to the tenth, or 1024.

Keying
Technique to ensure that modules are not put in the wrong slots of a PLC. The user sets up the system with modules in the desired slots. The user then keys the slots to assure that only a module of the correct type can be physically installed.

Ladder diagram
Programmable controller language that uses contacts and coils to define a control sequence.

LAN (Local Area Network)
A system of hardware and software designed to allow a group of intelligent devices to communicate within a fairly close proximity.

Latch
An instruction used in ladder diagram programming to represent an element that retains its state during controlled toggle and power outage.

Latency
The delay time between the end of one communication and the start of another. During this time, the processes associated with the communication are hung up and cannot continue. Software engineers work to reduce latency to a minimum.

Leakage current
Small amount of current that flows through load-powered sensors. The small current is necessary for the operation of the sensor. The small amount of current flow is normally not sensed by the PLC input. If the leakage is too great a bleeder resistor must be used to avoid false inputs at the PLC.

LED (light-emitting diode)
A solid-state semiconductor that emits red, green, or yellow light or invisible infrared radiation.

Legacy Systems
Computer systems or application programs which are outdated and incompatible with other systems, but are too costly to replace or redesign. They are often large, intimidating, and difficult to modify.

Light Operate
Refers to the output of a photoelectric switch. The output is on if an object is sensed.

Line driver
A line driver is a differential output driver intended for use with a differential receiver. These are usually used where long lines and high frequency are required and noise may be a problem.

Linear Output
An analog output that is proportional to the input over a range.

Line-powered sensor
Normally, three-wire sensors, although four-wire sensors also exist. The line-powered sensor is powered from the power supply. A separate wire (the third) is used for the output line.

Load
Any device that current flows through and produces a voltage drop.

Load-powered sensor
A load-powered sensor has two wires. A small leakage current flows through the sensor even when the output is off. The current is required to operate the sensor electronics.

Load resistor
A resistor connected in parallel with a high-impedance load to enable the output circuit to output enough current to ensure proper operation.

Local Area Network
A local area network (LAN) supplies networking capability to a group of computers in close proximity to each other such as in an office building, a school, or a home. A LAN is useful for sharing resources like files, printers,

games or other applications. A LAN in turn often connects to other LANs, or a (WAN) Wide Area Network (e.g. the Internet).

Lockout
The elimination of a electro-mechanical hazard.

Lockout-Tagout (LOTO) or lock and tag
A safety procedure that is used to ensure that dangerous machines are properly shut off and not started again prior to the completion of servicing work. It requires that hazardous power sources be "isolated and rendered inoperative" before any servicing work is started. "Lock and tag" works in conjunction with a lock usually locking the device or the power source with the hasp, and placing it in such a position that no hazardous power sources can be turned on. The procedure requires that a tag be affixed to the locked device indicating that it should not be turned on.

Lockout device
A device that utilizes a positive means such as a padlock, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

LSB
Least significant bit.

Machine language
Control program reduced to binary form.

MAP (manufacturing automation protocol)
"Standard" developed to make industrial devices communicate more easily. Based on a seven-layer model of communications.

Master
The master on a network is the device that controls communication traffic. The master of a network usually polls every slave to check if it has something to transmit. In a master-slave configuration, only the active master can place a message on the bus. The slave can reply only if it receives a frame from the master that contains a logical token that explicitly enables the slave to reply.

Master Control Relay (MCR)
Hardwired relay that can be deenergized by any hardwired series-connected switch. Used to deenergize all devices. If one emergency switch is hit it must cause the master control relay to drop power to all devices. There is also a master control relay available in most PLCs. The master control relay in the PLC is not sufficient to meet safety requirements.

Material Handling
The movement, storage, control, and protection of materials and products throughout the process of their manufacture, distribution, consumption and disposal.

Mbps
Million bits per second.

Memory map
Drawing showing the areas, sizes, and uses of memory in a particular PLC.

Microsecond
A microsecond is one millionth (0.000001) of a second

Millisecond
A millisecond is one thousandth (.001) of a second.

Mnemonic codes
Symbols designated to represent a specific set of instructions for use in a control program. An abbreviation given to an instruction: usually an acronym that is made by combining the initial letters or parts of words.

ModBus
A communication protocol originally developed by Modicon.

Modulation (Pulse Modulation)
Turning a light source on and off at a very high frequency. In sensors the sending unit pulse modulates the light source. The receiver only responds to that frequency. This helps make photo-sensors immune to ambient lighting.

MSB
Most significant bit

NEMA (National Electrical Manufacturers Association)
Develops standards that define a product, process, or procedure. The standards consider construction, dimensions, tolerances, safety, operating characteristics, electrical ratings, etc., of motors, electrical cabinets, and other end use applications of electricity.

Network
A system of connected devices or computers for communication purposes.

NetBEUI (NetBios Extended User Interface)
A Microsoft implementation extending NetBIOS.

NetBIOS (NETwork Basic Input Output System)
A fundamental instruction set providing network access.

Node
Point on the network that allows access.

Noise
Unwanted electrical interference in a programmable controller or network. It can be caused by motors, coils, high voltages, welders, and so on. It can disrupt communications and control.

Non-retentive coil
A coil that will turn off upon removal of applied power to the CPU.

Non-retentive timer
Timer that loses the time if the input enable signal is lost.

Nonvolatile memory
Memory in a controller that does not require power to retain its contents.

Normally Closed
An electrical contact whose natural and unenergized state is closed.

Normally Open
A electrical contact whose natural and unenergized state is open.

Octal
Number system based on the number 8, utilizing numbers 0 through 7.

ODBC (Open DataBase Connectivity)
A Microsoft standard designed for relational database interfacing.

OEM (Original Equipment Manufacturer)
Builds and supplies the production equipment used in a variety of industrial applications. Control products are often included as part of the package.

Off-delay timer
This is a type of timer that is on immediately when it receives its input enable. It turns off after it reaches its preset time.

Off-line programming
Programming that is done while not attached to the device. For example, a PLC program can be written for a PLC without being attached, and downloaded later when attached.

OLE DB
Superceding ODBC as Microsoft's universal data access method. It allows users to view data from a wide range of devices, databases, Web data sources, applications and relational mainframes as if the data resided at a single source. It is the infrastructure component that ensures complete access to system data by all "clients".

On-delay timer
Timer that does not turn on until its time has reached the preset time value.

One-shot contact
Contact that is only on for one scan when activated.

OOA (Object Oriented Analysis)
Developing software engineering requirements and specifications that expressed as a system's object model (which is composed of a population of interacting objects), as opposed to the traditional data of functional views of systems.

OOD (Object Oriented Design)
Developing of Object Oriented model of a software system to implement the identified requirements.

Open Loop
Control system with no self-correcting action for misses of desired operational condition, as there is in a closed-loop system. Also refers to a controller in manual mode.

Open Loop Control
A control system with no feedback signal from the sensor.

Open Systems
Those systems that can be supplied by hardware components from multiple vendors, and whose software can be operated from different platforms. They are opposite to closed or proprietary systems.

Operating system
The fundamental software for a system that defines how it will store and transmit information.

Optical isolation
Two electronic networks that are connected through an LED (light emitting diode) and a photoelectric receiver. There is no electrical continuity between the two networks.

Oscilloscope
A Hardware debugging tool that allows you to view the voltage on one or more electrical lines. For example, you might use an oscilloscope to determine if a particular interrupt is currently asserted.

Parallel communication
A method of communications where data is transferred on several wires simultaneously.

Parallel interface
A parallel interface (as distinguished from a serial interface) is one in which data is sent on several wires (or several wireless channels) at once. Examples: GPIB, byte-wide parallel interfaces to data converters, memory and data buses on computer boards and backplanes. In contrast, a serial interface uses one wire or wire-pair or wireless channel (or one in each direction).

Parity
Bit used to help check for data integrity during a data communication.

PCI (Peripheral Component Interconnect)
A high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and workstations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.

PCM (Pulse Coded Modulation)
A method of encoding information in a signal by varying the amplitude of pulses. The most common method of encoding an analog signal into a digital bit stream, usually 16 bits per sample.

Peer-to-peer

This is communication that occurs between similar devices. For example, two PLCs communicating would be peer-to-peer. A PLC communicating to a computer would be device-to-host.

PID Loop
An I/O element used to drive an analog input toward a particular value (called the setpoint) and to keep the input very close to that value. PID loops include a gain term (abbreviated P for proportional, which is the inverse of gain), an integral term (I), and a derivative term (D). Temperature control is a typical application for a PID.

PLC
Programmable logic controller.
Programmable Logic Controller (PLC)
A class of industrially hardened devices that provides hardware interface for input sensors and output actuators. PLCs can be programmed using relay ladder logic to control the outputs based on input conditions and / or algorithms contained in the memory of the PLC.

PPR (Pulses per revolution)
This refers to the number of pulses an encoder produces in one revolution.

Priority Inversion
An unwanted software situation in which a high-priority task is delayed while waiting for access to a shared resource that is not even being used at the time. For all practical purposes, the priority of this task has been lowered during the delay period.

Profibus
Vendor-independent open fieldbus standard for use in manufacturing and building automation as well as process control. Utilizes a non-powered two-wire (RS485) network. PROFIBUS is standardized under the European Fieldbus Standard EN 50 170. Includes 3 versions - FMS, DP and PA. Visit www.profibus.com for more information.

PROM (Programmable Read-Only Memory)
A type of ROM that can be written (programmed) with a device programmer. These memory devices can be programmed only once, so they are sometimes referred to as write-once or one-time programmable devices.

Pulse Width Modulation (PWM)
A switch-mode control method used in amplifiers and drivers to control motor voltage and current to obtain higher efficiency than linear control. PWM refers to variable on/off times (or width) of the voltage pulses applied to the transistors.

PWM (Pulse Width Modulation)

Quadrature
A technique that separates signal channels by 90° (electrical) in feedback devices. It is used with encoders and resolvers to detect direction of motion.

Rack
PLC chassis. CPU, I/O, motion, communication, and other application specific modules are installed in the rack to control the machine or process.

Radio Frequency Identification (RFID)
Communications technology in which there is a transmitter/receiver and tags. The transmitter/ receiver can read or write to the tags. There are active and passive tags available. Active tags are battery powered. Passive tags are powered from the RF emitted from the transmitter. Active tags have a much wider range of communication. Either tag can have several K of memory.

RAM (random access memory)
Normally considered user memory.

RDBMS (Relational DataBase Management System)
A standard designed to control interfacing with rigid relational database structures.

Redundancy
The capacity to switch from primary equipment to standby equipment automatically without affecting the process under control.

Register
Storage area. It is typically used to store bit states or values of items such as timers and counters.

Relay Ladder Logic
This programming language expresses a program as a series of "coils" and "contacts", simulating the operation of electromechanical relays. The resultant program is the equivalent of a boolean equation, which is executed continuously in a combinatorial manner. The advantage of this language is the familiarity many electricians have with the simple operation of relays. Disadvantages include the complexity of large, cross-connected programs, and the difficulty of expressing such non-binary functions as motion control and analog I/O.

Remote Access
Access to a network in another location.

Repeatability
The ability to repeat mechanical movements or repeat electrical measurements. Repeatability is unrelated to resolution, and is different than accuracy.

Resolution
A measure of how closely a device can measure or divide a quantity. For example, the resolution of a digital encoder is defined by its pulses per revolution. For an analog to digital card it would be the number of bits of resolution. For example, the resolution of a 12-bit analog card can divide the analog signal into 4096 steps.

Retentive coil
A coil that will remain in its last state, even though power has been removed.

Retentive timer

Timer that retains the present count even if the input enable signal is lost. When the input enable is active again, the timer begins to count again from where it left off.

Ribbon Cable

A flat cable in which the conductors are arranged side-by-side. Also called flat-ribbon cable.

ROM (read-only memory)

This is operating system memory. ROM is nonvolatile. It is not lost when the power is turned off.

RS232 (Recommended Standard-232)

A TIA/EIA standard for serial transmission between computers and peripheral devices (modem, mouse, etc.). Using a 25-pin DB-25 or 9-pin DB-9 connector, its normal cable limitation of 50 feet can be extended to several hundred feet with high-quality cable.

RS-232 defines the purpose and signal timing for each of the 25 lines; however, many applications use less than a dozen. RS-232 transmits positive voltage for a 0 bit, negative voltage for a 1. In 1984, this interface was officially renamed TIA/EIA-232-E standard (E is the current revision, 1991), although most people still call it RS-232.

**Pin Settings for Plug
(Reverse order for socket.)**

1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23 24 25

1 2 3 4 5
6 7 8 9

25 pin	9 pin
1 - PG Protective ground	
2 - TD Transmitted data	3
3 - RD Received data	2
4 - RTS Request to send	7
5 - CTS Clear to send	8
6 - DSR Data set ready	6
7 - SG Signal ground	5
8 - CD Carrier detect	1
9 - + voltage (testing)	
10 - - voltage (testing)	
11 -	
12 - SCD Secondary CD	
13 - SCS Secondary CTS	
14 - STD Secondary TD	
15 - TC Transmit clock	
16 - SRD Secondary RD	
17 - RC Receiver clock	
18 -	
19 - SRS Secondary RTS	9 pin
20 - DTR Data terminal ready	4
21 - SQD Signal quality detector	
22 - RI Ring indicator	9
23 - DRS Data rate select	
24 - XTC External clock	
25 -	

RS422 (Recommended Standard-422)

RS-485 and RS-422 are serial interface standards in which data is sent in a differential pair (two wires, or twisted pair cable), which allows greater distances and higher data rates than non-differential serial schemes such as RS-232. RS-485 and RS-422 can be configured for full-duplex or half-duplex bus systems.

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RTD (Resistance temperature detectors)

RTDs are made of coils or films of metals (usually platinum). When heated, the resistance of the metal increases; when cooled, the resistance decreases.

RTOS (Real-Time Operating System)

An operating system designed specifically for use in real-time systems that respond to external events within a short and predictable time frame.

Rung

Group of contacts that control one or more outputs. In a ladder diagram it is the horizontal lines on the diagram.

Sampling Rate

The frequency with which samples of a physical variable, such as sound are taken. The higher the sampling rate, the more closely the digitized result resembles the original.

Scan Time
The time to completely execute a PLC program once, including I/O update.

SCADA (Supervisory Control and Data Acquisition)
The level of applications that monitor and control devices such as programmable controllers. These systems are usually PC or workstation based.

SDS (Smart Distributed System)
An advanced bus system for intelligent sensors and actuators developed by Honeywell Inc., Micro Switch Division. The SDS specification covers physical layer and application layer. Smart Distributed System devices have advanced device-level functions, system and device diagnostics.

Sensitivity
Refers to a device's ability to discriminate between levels.

Sensor
A device used to detect change. The outputs of sensors change state when they detect change. Sensors can be analog or digital.

SERCOS (SERIAL Real-time COmmunications System)
The standard (IEC-61491) for interfacing between controllers, digital servo drives, and I/O devices. The SERCOS interface is implemented with fiber optic cable that increases the reliability and noise-immunity of a multi-axis control system.

Sequencer
Instruction type that is used to program a sequential operation.

Serial communication
Sending of data one bit at a time. The data is represented by a coding system such as ASCII.

Serial Interface
A serial interface (as distinguished from a parallel interface) is one in which data is sent in a single stream of bits, usually on a single wire-plus-ground, wire-pair, or single wireless channel (or two sets, one for each direction). Examples include USB and RS-232. By contrast, a parallel interface sends several bits at once, on separate wires.

Serial Port
A computer interface for connecting to external drives where data is transferred serially.

Servo
A servomechanism, or servo is an automatic device which uses error-sensing feedback to correct the performance of a mechanism. The term correctly applies only to systems where the feedback or error-correction signals help control mechanical position or other parameters. For example an automotive power window control is not a servomechanism, as there is no automatic feedback which controls position—the operator does this by observation. (However, if the operator and the window motor could be considered together, perhaps they as an entity could be said to operate via a servomechanism.) By contrast the car's cruise control uses closed loop feedback, which classifies it as a servomechanism.

Slave
On a master-slave configured network, there is usually one master and several slaves. The slaves are nodes of the network that can transmit information to the master only when they are polled (called) from it.

Sorter
A conveyor that receives mixed unit loads and discharges them to segregated spaces or conveyors in response to an automatic dispatch control.

SQL (Structured Query Language)
A standard language that can be applied to query and update data sources that support the ODBC standard.

System Integration
The process of connecting systems, devices, and programs together in a common architecture so as to share and exchange data.

Tagout
See Lockout Tagout

Tagout Device
A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

TCP/IP (Transmission Control Protocol/Internet Protocol)
A protocol suite which has been widely adopted for a number of applications, including the Internet and PLC communications.

Thermocouple
Thermocouples produce a small output voltage generated by the temperature differential between the junctions of two dissimilar metal wires.

Thumbwheel
Device used by an operator to enter a number between 0 and 9. Thumbwheels are combined to enter larger numbers. Thumbwheels typically output BCD numbers.

Timer
Instruction used to accumulate time until a certain value is achieved. The timer then changes its output state.

Transitional contact
A contact that changes state for one scan when activated.

TTL (Transistor-Transistor Logic)
A class of digital circuits built from bipolar junction transistors (BJT), and resistors. It is called transistor-transistor logic because both the logic gating function (e.g., AND) and the amplifying function are performed by

- transistors (contrast this with resistors and diodes). TTL is notable for being a widespread integrated circuit (IC) family used in many applications such as computers, industrial controls, test equipment and instrumentation, consumer electronics, etc. The designation TTL is sometimes used to mean TTL-compatible logic levels, even when not associated directly with TTL integrated circuits.
- Turnkey**
A type of outsourcing method that turns over to the subcontractor all aspects of manufacturing including material acquisition, assembly and testing. Its opposite is consignment, where the outsourcing company provides all materials required for the products and the subcontractor provides only assembly equipment and labor.
- Twinaxial Cable**
A transmission line made up of a twisted pair of insulated conductors centered inside and insulated from a conductive shield.
- UART (Universal Asynchronous Receiver/Transmitter)**
A module composed of a circuit that contains both the receiving and transmitting circuits required for asynchronous serial communication.
- UL (Underwriters Laboratory)**
Organization that operates laboratories to investigate systems with respect to safety.
- Universal Serial Bus (USB)**
A standard port that enables the connection of external devices (such as digital cameras, scanners, keyboards, and mice) to computers. The USB standard supports data transfer at three rates: low speed (1.5MBps), full speed (12Mbps) and high speed (480 MBps).
- UPS (Uninterruptible Power Supply)**
A series of batteries through which the main supply is passed. Should the main supply fail, the batteries ensure continuity of power to the computer for a short time, allowing the computer to shut down in an organized way and avoiding corrupted or incomplete data files.
- USB (Universal Serial Bus)**
- User memory**
Memory used to store user information. The user's program, timer/counter values, input/output status, and so on, are all stored in user memory.
- Velocity loop**
A feedback control loop in which the controlled parameter is motor velocity. Usually uses a tachometer for a feedback device.
- Volatile memory**
Memory that is lost when power is lost.
- WAN (Wide Area Network)**
See Wide Area Network
- Watchdog timer**
Timer that can be used for safety. For example, if there is an event or sequence that must occur within a certain amount of time, a watchdog timer can be set to shut the system down in case the time is exceeded.
- Wide Area Network (WAN)**
A WAN spans a large geographic area, such as a state, province or country. WANs often connect multiple smaller networks, such as local area networks (LANs) or metro area networks (MANs). The world's most popular WAN is the Internet.
- Word**
Length of data in bits that a microprocessor can handle. For example, a word for a 16-bit computer would be 16 bits long, or two bytes. A 32-bit computer would have a 32-bit word.
- WMS (Warehouse Management System)**
Software that integrates activities performed mechanically and by humans with an information system to effectively manage warehouse business processes and direct warehouse activities.
- X10 Protocol**
A powerline carrier protocol that allows compatible devices throughout the home to communicate with each other via the existing 220V or 110V wiring in the house. Visit www.x10.org for more information.
- 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.