

# Glossary



**Accuracy** – The closeness between the value indicated by a measuring instrument and the corresponding true value. Sensor accuracy is based on US NIST (NBS) standards.

**Accumulated value** – The number of counted events or timed intervals from a reference time or event mark.

**Actual value** – The present value of the controlled variable.

**Actuator** – A device connected to an output module, which is able to regulate the behavior of a controlled process variable.

**Alternating current (AC) I/O** – An I/O module that converts AC signals originating or received by a field device to appropriate PLC processor logic level signal.

**Address** – A numerical identifier for a controller when used in computer communications.

**Alarm (process alarm)** – A warning that process values exceed the process alarm setting, a fixed value independent of set point.

**Algorithm** – A procedure for problem solving, which is characterized by its time and space complexity as function of the problem size.

**Analog device** – An apparatus that measures or generates a continuous signal, typically voltage or current. Its accuracy depends on the resolution of the apparatus.

**Analog input module** – An input circuit that employs an analog-to-digital converter to map measured continuous signal to a digital count that can be used by the processor.

**Analog output module** – An output circuit that employs a digital-to-analog converter to map processor generated digital count to continuous signal that can be used by the connected analog device.

**Analog signal** – A continuous signal that changes smoothly in a defined range, rather than changing suddenly between certain levels as in digital signals.

**Analog-to-digital (A/D) converter** – Electronic hardware that converts an analog signal like voltage, electric current, temperature, or pressure into a digital number that a computer can process and interpret.

**Analog transmission** – The transmission of data as a continuous signal, as opposed to an on/off digital signal.

**Anti-reset windup** – A feature of the PID controller that prevents the integral component (reset action) from operating when the controlled variable is outside the proportional band.

## **B**

**Binary** – A base-2 number system used in digital computers to represent information, data, and program code.

**Binary bit** – The smallest unit of information in the binary numbering system. Also known as binary digit, which can carry a value of either 0 or 1.

**Block diagram** – A method used to represent the functional blocks and decision points of a system or an algorithm.

**Boolean data type** – A data type that stores the state of a single bit to either 0 (OFF) or 1 (ON).

**Boolean algebra** – A mathematical system that expresses logic functions and associated logic operations.

**Branch** – A parallel logic path within a ladder logic network or rung.

**Byte** – A group of 8 adjacent bits categorized as one unit during the processor's three operations: fetch, read, or write cycles.

## **C**

**Calibration offset** – An adjustment to eliminate the difference between the indicated value and the actual value.

**Cascade control** – Control in which the output of one controller is the set point for another.

**Celsius** – Formerly known as centigrade, a commonly used temperature scale in which water freezes at 0°C and boils at 100°C.

**Central processing unit (CPU)** – The very large integrated circuit that controls all PLC activities. It also manages all hardware and software resources and interfaces.

**Clock** – A circuit that generates timing pulses, which are used to synchronize the PLC, computer, or digital system operations.

**Closed loop** – A control system that utilizes feedback from the process to regulate the system behavior.

**Code** – A set of programmed instructions defined for a given processor.

**Coil** – A presentation of the PLC output, which, when energized, changes the status of the associated contacts.

**Contact** – A presentation of the PLC input or logic condition, which controls the propagation of current through the ladder logic network or rung.

**Control cycle** – The rate at which the output signal is updated.

**Control mode** – The output form or type of control action used by a controller to control a process: ON/OFF, PI, PID, or Manual.

**Controlled variable** – The process variable that is regulated in time and kept near the set point or desired value.

**Control relay** – A relay used to control a task or a sequence of events.

**Cycle** – A sequence of operations repeated regularly in order to complete or regulate a task.

## **D**

**Dead band** – A region selected around the set point where control is withheld.

**Dead time** – The amount of time that it takes for the controlled variable to start changing after the controlling variable changes.

**Debug** – The process of locating and correcting errors in software, hardware interconnections, configurations, and communication.

**Diagnosis** – Detection and isolation of errors and device faults.

**Derivative** – The rate of change of a process variable in time.

**Deviation** – The difference between the value of the controlled variable and the set point.

**Digital device** – A device that accepts and processes discrete electric signals.

**Digital signal** – A signal that changes suddenly between certain levels, typically 0 (OFF) and 1 (ON).

**Direct action** – An output control action in which an increase in the controlling variable causes an increase in the controlled variable.

**Digital-to-analog (D/A) converter** – An electric circuit that converts binary count to continuous analog signal.

**Distributed control** – A method of control that divides a large system into a number of integrated subsystems.

**Done bit** – A bit that is set to 1 once the instruction completes its task, such as reaching a pre-defined preset value.

**Down counter** – A counter that starts at a preset value and counts down to 0.

**Download** – Loading data (configuration or programs) from one computer to another networked intelligent device such as HMIs and PLCs.

## **E**

**Edit** – The process of ladder logic program modification to eliminate errors, change system operation, or optimize code.

**Emergency shutdown (ESD) relay** – A relay that associated contacts use to inhibit electric power flow to control system PLC in an emergency situation.

**Energize** – Physically connect electric power to a device in order to initiate an action such as running a motor.

**Error** – The error is defined as the (set point – controlled variable).

**Error signal** – A signal proportional to the difference between the actual process variable and its desired value.

**Ethernet** – A common network protocol that uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access control.

**Exclusive OR (EXOR)** – A logic element producing a true output only when its two inputs are different values.

**Execution time** – The total time required for the completion of a program, an instruction, or a sequence of instructions.

## **F**

**Fahrenheit** – The temperature scale that sets the freezing point of water at 32°F and its boiling point at 212°F. The formula for conversion to Celsius is:  $^{\circ}\text{C} = 5/9 * (^{\circ}\text{F} - 32)$ .

**False** – A disabling logic state resulting from an unsatisfied condition.

**Fault** – A malfunction that interferes with normal system operation.

**Feedback** – A correcting signal fed back to the controller to produce desired regulation of the process.

**Floating point** – A numbered representation of integers, fractions, or mixed real numbers.

**Flowchart** – A graphical representation of the steps, events, sequences, calculations, logic, and decisions used in an algorithm.

**Force function** – An instruction that allows the operator to override the processor logic and control the state of a device.

**Function keys** – Graphical keys on a computer or HMI, or hard keys on a panel or keyboard, which can be programmed according to a predefined operator user interface protocol.

## **G**

**Gate** – A logic circuit with one or more inputs and one output. The output is a function of all gate inputs.

**Ground** – A conducting connection between a circuit or equipment chassis and the earth ground.

## **H**

**Hardwired** – Connected by electrical wires or cables.

**Hex-decimal** – A base-16 numbering system, which uses the digits 0 to 9 and A to F to represent decimal values from 0 to 15.

**HMI** – Human-Machine Interface.

**Hysteresis** – A band of change in a controlled variable around the set point requiring no control action.

## **I**

**Image table** – A PLC dedicated memory area for input/output data. Ones and zeroes represent I/O on and off conditions, respectively.

**Input** – Process variable information that is supplied by the instrument.

**Input scaling** – Converting input readings to the engineering units of the process variable.

**Input type** – The type of signal that is connected to an input, such as a thermocouple or a switch.

**Integer** – A positive or negative whole number.

**Integral** – The function in a PI or PID controller that adjusts the controlled variable based on its error history.

**Interlock** – A mechanism for preventing one output device or input action from being on while another is on.

**Inverter** – A digital circuit that performs inversion.

**I/O** – Input/output; either analog or discrete.

**I/O address** – A unique number assigned to each input/output device that corresponds to the device's location in the rack enclosure.

**I/O module** – A plug-in assembly, which contains two or more identical input or output circuits that provide the connection between a processor and the connected devices.

**I/O scan time** – The time required by the processor to monitor all inputs and control all outputs.

**I/O update scan** – The process of revising the bits in a PLC's I/O tables, which are based on the latest results from reading the inputs and processing the outputs according to the control program.

**IP address** – A unique Internet protocol address assigned to every networked device.

## **J**

**Junction** – The point where two dissimilar metal conductors join to form a thermocouple.

**Jump instruction** – A conditional or unconditional deviation from the sequential execution flow of a program.

## **K**

**K** – A measure used to express memory size in bits, bytes, or words. One K is equivalent to 1,024.

**Kilo (k)** – A prefix used to quantify measurements in multiples of 1,000.

## **L**

**Label** – A name given to a membership function.

**Ladder diagram** – A graphical set of instructions that represents relay logic control systems.

**Ladder relay instructions** – Computer codes that implement relay coils and contacts and their corresponding functions in a PLC.

**Latch instruction** – The first half of an instruction pair, latch and unlatch. The PLC latch instruction energizes a specific output or internal coil until de-energized by the matching unlatch instruction.

**Least significant bit (LSB)** – The bit that carries the least weight in a byte or a word of arbitrary size.

**Limit switch** – An electric switch, which is activated through motion or contact.

**Load** – The demand on a process, expressed in power, current, resistance, or torque.

**Local area network (LAN)** – A system of hardware and software that allows smart devices to communicate and exchange data within a small geographical area.

**Logic diagram** – A drawing that uses interconnected AND, OR, and NOT logic symbols to graphically convey a system's operation or control.

**Logic level** – The voltage magnitude associated with the 0 and 1 states in a digital binary system.

**Loop tuning** – The process of determining the proportional, integral, and derivative constants that will allow a PID controller to perform optimally.

## **M**

**Manual mode** – The mode in which the user observes the process and sets the output.

**Mode** – Auto, manual, or remote. In auto mode, the controller calculates the output based on the error behavior. In manual mode, the user sets the output. In remote mode, the controller is actually in auto mode but it gets its command from another controller.

**Master control relay (MCR)** – A hardwired or software relay instruction that will de-energize its associated I/O devices when the instruction is de-energized.

**Master rack** – The enclosure containing the CPU or processor module.

**Memory** – The part of a programmable controller that stores data, instructions, and the control program.

**Memory map** – A diagram showing a system's memory addresses, as well as which programs and data are assigned to each section of memory.

**Microprocessor** – A large-scale integrated central processing unit on one chip.

**Microsecond** – One millionth of a second.

**Millisecond** – One thousandth of a second.

**Module** – An interchangeable, plug-in item containing electronic components.

**Most significant bit (MSB)** – The bit representing the greatest value of a nibble, byte, or word.

**Most significant digit (MSD)** – The digit representing the greatest value of a byte or word.

**Motor starter** – A special relay designed to provide power to motors, consisting of a contactor and an overload relay connected in series. The contactor relay de-energizes under overload conditions.

**Motor control center** – A control system utilizing variable speed drives by regulating voltage, current, or the frequency supplied to the motors.

**Move instruction** – A PLC instruction that moves data from one location to another.

## **N**

**Nested branch** – A branch that begins and ends within another branch in a ladder logic network.

**Network** – A set of devices or computers connected through a communication medium.

**Nibble** – A group of four bits.

**Node** – A station, such as a personal computer, a PLC, or an HMI, that is connected to a network and can communicate through the network.

**Noise** – Unwanted electrical signals that usually produce signal interference in sensors and sensor circuits.

**Nonvolatile memory** – Memory designed to retain its stored information while the power source is turned off.



**NOR** – A logic gate which produces a 1 (on) output only when both of its two inputs are held at the 0 (off) state.

**Normally closed contact** – A contact that is conductive only when its operating coil is not energized.

**Normally open contact** – A contact that is conductive only when its operating coil is energized.

**NOT** – A logic operation that produces the inverse of its input.



**OFF-DELAY timer (TOF)** – An electromechanical relay with contacts that change state after a predetermined time from the point where power is removed from its coil.

**Offline programming** – The safest mode for developing PLC programs, in which the operation of the processor is stopped and all output devices are switched off.

**ON-DELAY timer (TOD)** – An electromechanical relay with contacts that change state after a predetermined time from the point where its coil is energized.

**Online** – The state of being in continuous communication with the PLC processor.

**Online programming** – The mode in which a PLC processor and a programming terminal are able to make program changes while the processor is running.

**ON/OFF control** – A method of control in which the controller acts as a switch, turning the final control element either ON or OFF.

**Open loop control** – A control system that does not receive process feedback.

**Optical isolation** – A state in which there is no electrical continuity between two electronic networks; they are connected through a light emitting diode and a photoelectric receiver.

**OR** – A logic operation that produces a 0 (off) output only when both inputs are held at 0 (off).

**Output** – Process variable changes that are supplied by the PLC.

**Output image table** – The area of a PLC's memory where information about the status of output devices is stored.

**Output type** – The type of PLC output, such as relay, voltage pulse, or analog.

**Overflow** – A condition exceeding the defined range for a number representation, a timer, or a counter preset value.

**Overload** – A loading condition exceeding the value a device is designed to handle.

**Overload relay** – A special type of relay designed to protect devices like motors by disrupting power flow under excessive overload conditions.

**Overshoot** – The amount by which a controlled variable exceeds the set point before reaching a steady state.

**Over-damped response** – A controlled variable response that overshoots the set point and then slowly settles back to it.

## **P**

**Parallel circuit** – A circuit in which two or more connected components or contacts are connected to the same terminals.

**PB** – Proportional band.

**PC** – Personal computer.

**Peripherals** – External devices, such as printers, disk drives, recorders, or other devices that are connected to a PLC.

**PID control** – A three-mode control action in which the controller has proportioning, integral (reset), and derivative (rate) action.

**PLC** – Programmable Logic Controller.

**Potentiometer** – A simple transducer that measures displacement based on resistance changes due to the movement of a wiper arm.

**Power supply** – The unit that supplies the necessary voltage and current to all the circuitry of a system.

**Precision** – The closeness of a setting, indication, calibration, or control to the actual value of the quantity being measured, usually expressed as a percentage of full scale.

**Preset value** – The number of time intervals or events to be counted.

**Pressure switch** – A switch that is activated at a pre-specified pressure.

**Process** – A continuous chemical or manufacturing operation.

**Process variable** – The thing you are trying to control, such as temperature, pressure, flow, composition, pH, etc. Also called the measurement.

**Program** – A sequence of instructions to be executed by the processor.

**Programmable controller** – An intensive I/O computer designed to handle real-time requirements and equipped with software tools to implement industrial control.

**Program scan** – The PLC processor executes and resolves every network/rung of the ladder logic program during each program scan.

**Proportional band** – The area around the set point where the controller output is neither fully ON nor fully OFF for the entire time cycle;  $PB = 100/\text{Gain}$

**Proportional gain (Gain)** – The "P" of PID control;  $\text{Gain} = 100/PB$ .

## R

**Rack** – Housing used to hold modules and associated interconnections.

**Random access memory (RAM)** – A memory system allowing random access of any location during read, write, or fetch cycles.

**Range** – The area between two limits in which a quantity or value is quantified, represented, or measured. Usually described in terms of lower and upper limits.

**Read-only memory (ROM)** – A memory system allowing random read only of any location. Information is written in the ROM using a special device before use.

**Real number** – A number consisting of both integer and fraction parts.

**Relay** – An electro-mechanical device that switches electric circuits.

**Relay contact** – A relay contact is either normally open or normally closed relative to its coil de-energized state.

**Relay logic** – representation of logic in a format suitable for relays operation.

**Remote I/O** – An I/O system located at any distance from the processor, with which it exchanges information through a communication medium.

**Remote set point** – A feature that allows set point setting from a remote location.

**Resolution** – The smallest quantifiable increment in a range of values defined for a given signal or entity.

**Response time** – The time duration required for a process or a device to respond to a change or a request.

**Retentive timer** – A timer which counts when it receives power and maintains its count when power is lost.

**RTD** – Resistance Temperature Detector.

**Run** – The continuous execution of a program by the PLC processor.

**Rung (network)** – A group of PLC instructions that controls an output, modifies storage values, or performs other functions.

## S

**Sampling rate** – The rate at which input data is polled for information.

**SCADA** – Supervisory Control And Data Acquisition; a type of industrial control system.

**Scan time** – The time required to update / activate an output connected to a PLC. It includes the updating of I/O image tables, execution of the program, and all diagnostic tasks.

**Sensor** – A device used to generate measurements of a physical value typically as an electric signal.

**Set point** – The desired value of a controlled variable.

**Significant digit** – A digit that contributes to a represented value.

**Step response** – The system's response to a sudden change in the controlling variable.

**Steady state** – A state in which the error in a process control system is zero or within the error dead band.

**Storage bit** – A memory bit that can be set or reset but is not associated with any input or output device.

**Subroutine** – A program that executes only when it is called on by the PLC logic, which helps implement structured programs by eliminating code repetition.

## T

**Tag** – A unique text name assigned to a variable or a data constant stored in a memory area.

**Terminal address** – The text address assigned to a particular input or output point connection.

**Thermocouple** – The junction of two dissimilar metals, which has a voltage output proportional to the difference in temperature between the hot and the cold junction connected to the sensor.

**Time base** – A time unit generated from the microprocessor clock and used by the PLC timer instructions.

**Toggle switch** – An on/off panel-mounted switch with an extended movable lever.

**Transducer** – A device that converts a physical quantity such as pressure or temperature to an electric signal.

**Transitional contact** – A contact programmed to be on for one program scan for every selected transition from 0 to 1 or 1 to 0.

**Transmitter** – A primary device that translates a process measurement into a current, voltage, or pneumatic signal.

**Triac** – A solid-state device used to switch alternating currents.

**True** – An on, 1, or enabled state.

**Truth table** – A table listing the truth value of a given output as function of all input variables state combinations.

## U

**Unlatch instruction** – The second half of an instruction pair, latch and unlatch. The PLC unlatch instruction emulates the unlatching function of a latching relay.

**Undershoot** – The amount by which a controlled variable falls below the set point before reaching steady state.

**Up counter** – A counter that counts up, typically from 0 to the preset count value.

## V

**Validation** – The process of validating and correcting input measurements and user inputs based on user-defined rules.

**Variable** – A process or system entity that can be measured, altered, or controlled.

**Variable data** – Numerical information that can be altered during program execution.

**Volatile memory** – A memory structure that loses its content once power is removed.



**Watchdog timer** – A timer that is reset with every scan and monitors the processor operation.

**Word** – A group of adjacent bits treated as one unit, typically measured in 2 or 4 bytes.



**Zone** – A section of PLC ladder logic program that can be enabled or disabled by a control function.