

A Glossary of Terms Commonly Used in Data Acquisition and Control



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A

A/D

Analog-to-digital.

A/D Channel List Start

Signal used to start the A/D acquisition of channels in the channel list. The triggering edge of this signal (falling edge) enables the ADC Conversion Start signals.

A/D Conversion

The process of converting a single analog input to a digital value.

A/D Conversion Start

Signal used to start the conversion process of an analog input to a digital value. The source of this signal can be either an internal ADC synchronous clock or an external asynchronous signal. This signal causes the stepping in the Channel List.

AC - Alternating Current

Electric current that varies in amplitude and direction. The usual waveform of ac is a sine wave, but can be triangular, or square.

ADC - Analog-to-Digital Converter

(a.k.a. simply an "A/D")

An electrical circuit that converts analog voltage into a binary number. A/D converters perform the measurements in all data acquisition systems

Alias

A false lower frequency image of a high-frequency component that appears in sampled data acquired at too low a sampling rate

Alumel

A brand name for a magnetic nickel alloy containing small amounts of manganese, aluminum, and silicon. Used in thermocouples and thermocouple extension wire.

Ampere (A)

SI unit of electric current.

Amplifier

A device for increasing the power of a signal by taking power from a power supply and controlling the output to match the input signal shape but with a larger amplitude.

Amplitude

The size or magnitude of a signal.

Analog Input

An analog input is an infinitely variable signal. In most data acquisition systems this signal is connected to an input amplifier and then to an A/D converter.

Analog Output

A waveform or control signal generated as a continuous function of the measured parameter.

Analog Trigger

A trigger that occurs at a user-selected point on an incoming analog signal. Triggering can be set to occur at a specific level on either an increasing or a decreasing signal (positive or negative slope).

Anti-alias filter

A low pass filter that allows the desired low frequency component of the input waveform through, but stops the higher frequency components that can lead to aliasing errors (See Alias).

Argument

An Input parameter to a program.

ARINC 429

An avionics interface protocol which is the standard communications link in virtually all modern commercial aircraft.

ASCII

American Standard Code for Information Interchange. Coding for text files.

Assembler

A program that translates assembly language instructions into machine language instructions.

Assembly Language

A machine oriented language in which mnemonics are used to represent each machine language instruction for a particular CPU.

ASTM

American Society for Testing and Materials.

Asynchronous

(1) Hardware - A property of an event that occurs at an arbitrary time, without synchronization to a reference clock.

(2) Software - A property of a function that begins an operation and returns prior to the completion or termination of the operation.

B

B-Type Thermocouple

Platinum-rhodium thermocouple with a temperature range of 600 to >1700 °C.

Backbone

The primary-level of a hierarchical computer network connected to lower-level nodes in the hierarchy.

Background Acquisition

Background Data Acquisition refers to data that is acquired while another program or processing routine is running in the foreground without apparent interruption

Background Noise

Interfering signals that can cause disturbance affecting a signal that may distort the intended signal.

Base Address

A memory address that serves as the starting address for programmable registers. All other addresses are located by adding to the base address.

Batch process

Any process on which operations are carried out on a limited number of articles, as opposed to continuous process.

Bipolar

A signal range that includes both positive and negative values (for example, -5 V to +5 V).

Bit

One binary digit (either 0 or 1).

Block Mode

A high-speed data transfer in which the address of the data is sent followed by a specified number of back-to-back data words.

Burst Mode

A high-speed data transfer in which the address of the data is sent followed by back-to-back data words while a physical signal is asserted.

Bus

The group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the ISA and PCI buses.

Bus Master

A type of a plug-in board or controller with the ability to read and write devices on the computer bus, without using the host CPU.

Byte

Eight related bits of data, an eight-bit binary number. Also used to denote the amount of memory required to store one byte of data. A byte may represent 256 unique numbers (typically from 0 to 255 in the decimal system)

C

Cache

High-speed processor memory that buffers commonly used instructions or data to increase processing throughput.

Calibration

The process of determining the relationship between the output of a measurement device, and the input data, and comparing it against a measurement standard. In most cases, the term calibration also includes the process of adjusting the output of the

measurement device to comply with the measurement standard.

Capacitance

The amount of a stored (or separated) electrical charge for a given electrical potential, measured in farads (F).

CE

Conformite Europeene. A mark designating product's compliance with all applicable European Union legal requirements.

Channel List

A variable length list of channels and their associated gains specifying which analog input channels to convert to digital values. In continuous A/D acquisition mode, the list wraps around to the first channel after it reaches the end. The channels need not be in any particular order.

Chromel

A 90% nickel alloy with about 10% chromium, used with Alumel in K-type thermocouples.

CMRR

Common-Mode Rejection Ratio. A measure of an instrument's ability to reject interference from a common-mode signal, usually expressed in decibels (dB).

Code Generator

A software program, controlled from an intuitive user interface, that creates syntactically correct high-level source code in languages such as C or Basic.

Cold-Junction Compensation

Compensation for ambient temperature when a thermocouple is used in a data acquisition system.

COM port

A serial device connectivity port on a PC, often RS-232.

Common-Mode Range

The input range over which a circuit can handle a common-mode signal.

Common-Mode Signal

The mathematical average voltage, relative to the computer's ground, of the signals from a differential input.

Component Software

An application that contains one or more component objects that can freely interact with other component software. Examples include OLE enabled applications such as Microsoft Visual Basic and OLE Controls for virtual instrumentation in Component Works.

Control Register(s)

Registers containing bits that initiate control signals for various onboard subsystems.

Conversion Time

The time elapsed, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available.

Counter/Timer

A circuit such as the Intel 8254 device that counts external pulses or clock pulses (timing).

Coupling

The manner in which a signal is connected from one location to another.

Crosstalk

An unwanted signal on one channel induced by signal activity on another nearby channel.

Current Drive Capability

The amount of current a digital or analog output channel is capable of sourcing or sinking while still operating within voltage range specifications.

Current Sinking

The ability of a DAQ board to dissipate current for analog or digital output signals.

Current Sourcing

The ability of a DAQ board to supply current for analog or digital output signals.

D

D/A

Digital-to-analog

DAC

Digital-to-analog converter. An integrated circuit that converts a digital number into a corresponding analog voltage or current.

DAC Conversion Start

Signal used to start the conversion process of digital value to an analog output. The source of this signal can be either an internal DAC synchronous clock or an external asynchronous signal. This is a common signal fed to both DACs.

Data Acquisition

(1) The process of automatically collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) Collecting and measuring the same kinds of electrical signals with A/D and/or DIO boards plugged into a PC, and possibly generating control signals with D/A and/or DIO boards in the same PC.

Data Logger

A stand alone data acquisition device that acquires data and stores it in local memory from which it may then be downloaded to a computer for subsequent analysis and display.

Data Recorder

Another name for a data logger, though data recorders are typically higher performance and offer higher sample rates than a typical data logger.

DAQ

An abbreviation for Data acquisition.

dB

Decibel. The unit for expressing a logarithmic measure of the ratio of two signal levels: $\text{dB} = 20 \log_{10} V_1/V_2$, for signals in volts.

Differential Input

An analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured.

DIO

Digital input/output.

DLL

Dynamic Link Library. A software module in Microsoft Windows containing executable code and data that can be called or used by Windows applications or other DLLs. Functions and data in a DLL are loaded and linked at run time when they are referenced by a Windows application or other DLLs.

DMA

Direct memory access. A method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.

DNL

Differential Non-linearity. A measure in LSB of the worst-case deviation of code widths from their ideal value of 1 LSB.

Drivers

Software that controls a specific hardware device, such as DAQ boards.

DSP

Digital Signal Processor. A specialized microprocessor for digital signal processing.

Dual-Ported Memory

Memory that can be simultaneously accessed by more than one controller or processor.

Dynamic Range

The ratio of the largest signal level a circuit can handle to the smallest signal level it can handle (usually taken to be the noise level), normally expressed in dB.

E

EEPROM

Electrically erasable programmable read-only memory. ROM that can be erased with an electrical signal and reprogrammed.

Embedded Controller

A control device built into (embedded in) a host device. Monitoring and control are handled by the same CPU as general system operation.

Encoder

A device that converts linear or rotary displacement into digital or pulse signals. The most popular type of encoder is the optical quadrature encoder, which uses a rotating disk with alternating opaque areas, a light source, and a photo detector to indicate a rotary position.

EPROM

Erasable programmable read-only memory. ROM that can be erased (usually by ultraviolet light exposure) and reprogrammed.

Events

Signals or interrupts generated by a device to notify another device of an asynchronous event. The contents of events are device-dependent.

External Trigger

A voltage pulse from an external source that triggers an event such as A/D conversion.

F

FIFO

First-In First-Out Memory Buffer. The first data stored is the first data sent to the acceptor.

Filter

A device that allows certain parts of a signal to pass through while blocking others. In data acquisition systems, the most common type of filter used is a low pass, anti-aliasing filter.

Fixed-Point

A format for processing or storing numbers as digital integers.

Floating-Point

A format for processing or storing numbers in scientific notation (digits multiplied by a power of 10).

Function

A set of software instructions executed by a single line of code that may have input and/or output parameters, that returns a value when executed.

G

Gain

The factor by which a signal is amplified, sometimes expressed in dB.

Gain Accuracy

A measure of deviation of the gain of an amplifier from the ideal gain.

GPIB

General Purpose Interface Bus. Also known as IEEE-488, the GPIB was originally developed by Hewlett Packard and called the HPIB.

GPS

Global Positioning System. A series of satellites is used to provide accurate location and velocity information to both ground based and land based devices. A powerful and often ingored benefit in data acquisition applications is the ability of a GPS system to generate extremely accurate timing information. One microsecond accuracy is available with inexpensive units and much tighter specifications are available from some vendors.

Ground

In terms of data acquisition systems, a ground is typically where system current is returned. In single ended systems the negative terminal of the sensor is typically connected to ground.

Ground Loop

Many measurements are made between an input signal and ground. However, ground is not an absolute reference point and current flowing in wires between various ground connections can cause the potential at different "ground" points in the system to be at different potentials. These differences then manifest themselves as errors in the measurement.

GUI

Graphical User Interface. An intuitive, easy-to-use means of communicating information to and from a computer program by means of graphical screen displays. GUIs can resemble the front panels of instruments or other objects associated with a computer program.

H

Handler

A device driver that is installed as part of the operating system of the computer.

Hardware

The physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, cables, and so on.

I

I/O

Input/Output. The transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.

ICP® (piezoelectric vibration sensor)

A simple yet powerful 2-wire interface developed by PCB Piezo Electronics® to facilitate connection of Piezo Crystal based vibration sensors to data acquisition systems. Also referred to as IEPE.

IMD

Intermodulation Distortion. The ratio, in dB, of the total rms signal level of harmonic sum and difference

distortion products, to the overall rms signal level. The test signal is two sine waves added together according to the following standards:

INL

Integral Non-linearity. A measure in LSB of the worst-case deviation from the ideal A/D or D/A transfer characteristic of the analog I/O circuitry.

Input Bias Current

The current that flows into the inputs of a circuit.

Input Impedance

The measured resistance and capacitance between the input terminals of a circuit.

Input Offset Current

The difference in the input bias currents of the two inputs of an instrumentation amplifier.

Instrumentation Amplifier

A circuit whose output voltage with respect to ground is proportional to the difference between the voltages at its two inputs.

Integral Control

A control action that eliminates the steady-state offset inherent in proportional control.

Integrating ADC

An ADC whose output code represents the average value of the input voltage over a given time interval.

Interpreter

A software utility that executes source code from a high-level language such as Basic, C, or Pascal, by reading one line at a time and executing the specified operation.

Interrupt

A computer signal indicating that the CPU should suspend its current task to service a designated activity.

IPC

Interprocess Communication. Protocol by which processes can pass messages. Messages can be either blocks of data and information packets, or instructions and requests for process to perform actions. A process can send messages to itself, other processes

on the same machine, or processes located anywhere on the network.

Isolation Voltage

The voltage that an isolated circuit can normally withstand, usually specified from input to input and/or from any input to the amplifier output, or to the computer bus.

J

K

k

Kilo, the standard metric prefix for 1,000, or 10³, used with units of measure such as volts, Hertz, and meters.

K (computer)

Kilo, the prefix for 1,024, or 2¹⁰, used with byte in quantifying data or computer memory.

kbytes/s

A unit for data transfer that means 1,000 or 10³ bytes/s.

L

LabVIEW™

A popular data acquisition programming language developed by National Instruments®

Linearity

The adherence of device response to the equation $R = KS$, where R = response, S = stimulus, and K = a constant.

LSB

Least significant bit. In terms of data acquisition and measurement systems, the LSB is the smallest change in input that can be detected by the system's A/D converter.

LXI

Designed as the Successor to GPIB, LXI is a standard developed by the LXI Consortium, and is an abbreviation for LAN eXtensions for Instrumentation. More information can be found at the LXI Standard Website

M

M

(1) mega, the standard metric prefix for 1 million or 10⁶, when used with units of measure such as volts and Hertz;

(2) mega, the prefix for 1,048,576, or 2²⁰, when used with byte to quantify data or computer memory.

Mbytes/s

A unit for data transfer that means 1 million or 10⁶ bytes/s.

MMI

Man-Machine Interface, also Human-Machine Interface(HMI): The means by which an operator interacts with an industrial automation system; often a GUI.

Modbus

A defacto standard communications protocol used in a wide variety of Industrial Control and DAQ (data acquisition) systems industrial control and monitoring equipment. Modbus was developed by Modicon in 1979 as a means to facilitate communication in their programmable controller products.

Multitasking

A property of an operating system in which several processes can be run simultaneously.

Mux

Multiplexer. A switching device with multiple inputs that sequentially connects each of its inputs to its output, typically at high speeds, in order to measure several signals with a single analog input channel. Most data acquisition systems utilize multiplexers to allow a single A/D converter to measure or monitor multiple inputs.

N

Noise

An undesirable electrical signal. Noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors.

O

OLE

Object Linking and Embedding. A set of system services, developed by Microsoft, that provides a means for applications to interact by linking and embedding document objects. Based on the underlying Component Object Model, OLE is object-enabling system software. Through OLE Automation, an application can dynamically identify and use the services of other applications, to build powerful solutions using packaged software. OLE also makes it possible to create compound documents consisting of multiple sources of information from different applications.

Operating System

Base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices.

Optical Isolation

The technique of using an optoelectric transmitter and receiver to transfer data without electrical continuity to eliminate high-potential differences and transients.

Output Settling Time

The amount of time required for the analog output voltage to reach its final value within specified limits.

Output Slew Rate

The maximum rate of change of analog output voltage from one level to another.

Overhead

The amount of computer processing resources, such as time and/or memory, required to accomplish a task.

P

PAC

See Programmable Automation Controller

Paging

A technique used for extending the address range of a device to point into a larger address space

PCI

Peripheral Component Interconnect. A high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It offers a theoretical maximum transfer rate of 132 Mbytes/s. More information can be found at the PCI-SIG Website

PID Control

A three-term control mechanism combining proportional, integral, and derivative control actions. Also see proportional control and integral control.

Pipeline

A high-performance processor structure in which the completion of an instruction is broken into its elements so that several elements can be processed simultaneously from different instructions.

PLC

See Programmable Logic Controller.

Plug and Play ISA

A specification prepared by Microsoft, Intel, and other PC-related companies intended to create PCs with plug-in boards that can be fully configured in software, without jumpers or switches on the boards.

Port

A communications connection on a computer or a remote controller.

Posttriggering

The technique used on a DAQ board to acquire a programmed number of samples after trigger conditions are met.

Potentiometer

An electrical device of which the resistance can be manually adjusted; used for adjustment of electrical circuits and as a transducer for linear or rotary position.

Programmable Automation Controller

Also commonly referred to as a PAC, these are stand-alone controllers that perform a function similar to a Programmable Logic Controller, but are programmed in standard programming languages (e.g. C or Visual Basic) rather than the Ladder Logic programming language used by most PLCs.

Programmable Logic Controller

Also commonly referred to as a PLC, these are highly reliable special-purpose computers used in industrial monitoring and control applications. PLCs typically have proprietary programming and networking protocols, and special-purpose digital and analog I/O ports.

Pretriggering

The technique used on a DAQ board to keep a continuous buffer filled with data, so that when the trigger conditions are met, the sample includes the data leading up to the trigger condition.

Programmed I/O

The standard method a CPU uses to access an I/O device-- each byte of data is read or written by the CPU.

Propagation Delay

The amount of time required for a signal to pass through a circuit.

Proportional Control

A control action with an output that is to be proportional to the deviation of the controlled variable from a desired set point.

Protocol

The exact sequence of bits, characters and control codes used to transfer data between computers and peripherals through a communications channel, such as the GPIB.

PXI

A modular instrumentation platform used for building test equipment and automation systems promoted by the PXI Systems Alliance (PXISA) and is an abbreviation that stands for PCI eXtensions for Instrumentation

Q

Quadrature Encoder

A device used to measure rotation. The most popular type of encoder is the optical quadrature encoder, which uses a rotating disk with alternating opaque areas, a light source, and a photo detector. Each time the photo detector crosses an bright (or dark) as signal is generated. These signals are then turned into rotational information by a quadrature encoder input devices.

Quantization Error

The inherent uncertainty in digitizing an analog value due to the finite resolution of the conversion process.

R

Real Time

A property of an event or system in which data is processed as it is acquired instead of being accumulated and processed at a later time.

Relative Accuracy

A measure in LSB of the accuracy of an ADC. It includes all non-linearity and quantization errors. It does not include offset and gain errors of the circuitry feeding the ADC.

Resolution

The smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244 percent of full scale.

Resource Locking

A technique whereby a device is signaled not to use its local memory while the memory is in use from the bus.

Ribbon Cable

A flat cable in which the conductors are side by side.

RTD

Resistance temperature detector. A metallic probe that measures temperature based upon its coefficient of resistivity.

S

S/H

Sample-and-Hold. A circuit that acquires and stores an analog voltage on a capacitor for a short period of time.

S/s

Samples per second. Used to express the rate at which a data acquisition system samples an analog signal.

SE

Single-Ended. A term used to describe an analog input that is measured with respect to a common ground.

Self-Calibrating

DAQ board that calibrates its own A/D and D/A circuits without external reference source.

Sensor

A device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal.

SNR

Signal-to-Noise Ratio. The ratio of the overall rms signal level to the rms noise level, expressed in dB.

Software Trigger

A programmed event that triggers an event such as data acquisition.

SPDT

Single-Pole Double Throw. A property of a switch in which one terminal can be connected to one of two other terminals.

SSH

Simultaneous Sampling and Hold. A property of a system in which each input or output channel is digitized or updated at the same instant.

Strain Gauge

A sensor whose resistance is a function of the applied force.

Subroutine

A set of software instructions executed by a single line of code that may have input and/or output parameters.

Successive-Approximation ADC

An ADC that sequentially compares a series of binary-weighted values with an analog input to produce an output digital word in n steps, where n is the bit resolution of the ADC.

Synchronous

A property of a function that begins an operation and returns only when the operation is complete.

System Noise

A measure of the amount of noise seen by an analog circuit or an ADC when the analog inputs are grounded.

T

Talker

A device on the General Purpose Interface Bus (GPIB) that sends data to the Listener on the GPIB.

TCP/IP

A set of standard protocols for communicating across a single network or interconnected set of networks. The Internet Protocol (IP) for the low-level service of taking data and packaging of components, and Transmission Control Protocol (TCP) for high-reliability data transmissions.

THD

Total harmonic distortion. The ratio of the total rms signal due to harmonic distortion to the overall rms signal, in dB or percent.

THD+N

Signal-to-THD Plus Noise. The ratio in decibels of the overall rms signal to the rms signal of harmonic distortion plus noise introduced.

Thermistor

A semiconductor sensor that exhibits a repeatable change in electrical resistance as a function of temperature. Most thermistors exhibit a negative temperature coefficient.

Thermocouple

A common type of temperature sensor used to convert thermal potential difference to electrical potential difference. More information on thermocouples can be found at the NIST ITS-90 Thermocouple Database

Throughput Rate

The data, measured in bytes/s, for a given continuous operation.

Transducer

A device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal.

Transfer Rate

The rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate.

U

UART

Universal Asynchronous Receiver/Transmitter. Used for translating data between parallel and serial interfaces by converting bytes of data to and from asynchronous start-stop bit streams.

Unipolar

A signal range that is always positive (for example, 0 to +10 V).

UPS

Uninterruptible Power Supply (or source). Designed to maintain electrical power to electronic devices in the event of utility power failure.

USB

Universal Serial Bus. Developed as a serial communications standard to replace Serial and Parallel devices.

V

V

The symbol for Volt

VAC

Voltage AC (alternating current)

Volt

The unit of measure for electrical potential difference across a conductor.

Voltage

The value of electrical potential difference across a conductor expressed in volts.

Voltage-to-Frequency Converter

A device that converts analog input voltage into a sequence of digital pulses at a frequency proportional to the analog input voltage.

W

WAN

Wide Area Network. A wide area network is typically made up of two or more Local area Networks, or LANs

Wheatstone Bridge

A network of four resistors that allows a data acquisition system to measure very small changes in the resistance of sensors such as strain gages, load cells, and similar measurement devices which change resistance in response to some external stimulus.

Wi-Fi

Wireless-Fidelity. Wi-Fi is a brand of high-frequency wireless local area network (WLAN) licensed by the Wi-Fi Alliance trade group, and is based on the IEEE 802.11 specifications.

X

x-axis

The horizontal axis on a graph

Y

y-axis

The horizontal axis perpendicular to the x-axis on a graph

Z

z-axis

The third axis in a three-dimensional coordinate graph perpendicular to the plane defined by the x and y axes.

Zero-Overhead Looping

The ability of a high-performance processor to repeat instructions without requiring time to branch to the beginning of the instructions.

Zero-Wait-State Memory

Memory fast enough that the processor does not have to wait during any reads and writes to the memory.