

## GLOSSARY OF TERMS

**Absolute Positioning** – Refers to a motion control system employing position feedback devices to maintain a given mechanical location.

**Acceleration** – The time rate of change of velocity with respect to a fixed reference frame. The commanded step rate is started at a base velocity and accelerated at a slew velocity at a defined and controlled rate or rate of changes.

**Accuracy** – The measured difference between the expected position and actual position of a motor or mechanical system. The accuracy of a step motor is usually specified as an angle representing the maximum deviation from the expected position.

**ACME Screw** – The most common type of lead screw found in machine tool applications. The ACME thread is a particular type of thread. Compared to a ball screw, ACME lead screws have very high friction and backlash, both of which are undesirable attributes for high performance applications.

**American Standard Code for Information Interchange (ASCII)** – This code assigns a number of electrical signals to each number and letter of the alphabet. In this manner, alphanumeric information can be transmitted between machines as a series of binary numbers.

**Application Specific Integrated Circuit (ASIC)** – an integrated circuit designed to perform a particular function by defining the interconnection of a set of basic circuit building blocks drawn from a library provided by the circuit manufacturer.

**Arc Minute** – An angular measurement equal to 1/60<sup>th</sup> of a degree.

**Axial Play** – The axial displacement of the shaft due to a reversal of an axial force.

**Back Electro-Motive Force (Back EMF)** – The reversed bias generated by rotation of the magnetic field across a stator's windings. Sometimes referred to as counter EMF.

**Backlash** – Backlash is any kind of unexpected play in an axis due to clearance or looseness of mechanical parts. When the axis is commanded to move, the drive motor may turn briefly before movement begins.

**Ballscrew** – Ballscrews are highly efficient low friction and low backlash lead screw devices that use ball bearings rolling in a channel cut into the screw. The low friction and backlash attributes are extremely valuable for precision applications where they are used to drive the axes of the machine.

**Baud Rate** – The number of times per second a signal in a communications channel could change states.

**Bipolar Motors** – These motors are composed of two windings and have four wires with no center taps. Current flow is bidirectional and runs through an entire winding at a time instead of just half of the winding. As a result, bipolar motors produce more torque than unipolar motors of the same size.

**Brushless Motors** – Brushless Motors are a class of motors that operate using electronic commutation of phase currents, rather than electromechanical (brush-type) commutation. Brushless motors typically have a permanent magnet rotor and a wound stator.

**Control Area Network (CAN)** – Is a serial bus system, which was originally developed for automotive applications in the early 1980's. The CAN protocol was internationally standardized in 1993 as ISO 11898-1 and comprise the data link layer of the seven layer ISO/OSI reference model.

**CANopen** – CANopen is a CAN-based higher layer protocol. It was developed as a standardized embedded network with highly flexible configuration capabilities. CANopen was designed motion oriented machine control networks, such as handling systems. It is used in many various fields, such as medical equipment, off-road vehicles, maritime electronics, public transportation, building automation, etc.

**Closed Loop System** – In motion control, this term describes a system wherein a velocity or position (or both) sensor is used to generate signals for comparison to desired parameters. For cases where loads are not predictable, the closed loop feedback from an external encoder to the controller may be used for stall detection, position maintenance or position verification.

**Constant Current Drive** – A control or device for adjusting the voltage to force or maintain design current in the winding when switching from one winding to another.

**Daisy Chain** – This term is used to describe the linking of several devices in sequence, such that a single signal stream flows through one device and on to another.

**Data Communications Equipment (DCE)** – A device that establishes, maintains and terminates a session on a network. It may also convert signals for transmission. It is typically a modem. Contrast with DTE.

**Data Terminating Equipment (DTE)** – A communications device that is the source or destination of signals on a network. It is typically a computer or terminal. Contrast with DCE.

**Dead Band** – A range of input signals for which there is no system response.

**Detent Torque** – The periodic torque ripple resulting from the tendency of the magnetic rotor and stator poles to align themselves to positions of minimal reluctance. The measurement is taken with all phases de-energized.

**Dongle** – Also called USB key, an electronic key that is used to copy protect software such as CAD or CAM software. The software will not operate unless the dongle is in place on the machine trying to run the software.

**Duty Cycle** – For a repetitive cycle, the ratio of on time to total cycle time.

**Electromagnetic Interference (EMI)** – An electromagnetic disturbance, phenomenon, signal or emission that causes or can cause undesired response of electrical or electronic equipment.

**Encoder** – An electromechanical device that translates mechanical motion into electronic signals used for monitoring position or velocity.

**Full Duplex** – The transmission of data in two directions simultaneously. For example, a telephone is a full-duplex device because both parties can talk at the same time.

**Full Step** – This means that the shaft will rotate 1.8 degree mechanically for each digital pulse received by the driver. In full step mode, the motor requires 200 digital pulses to move one shaft revolution – divide 360 degree by 1.8 degree.

**Gearbox** – A system of gears that transmits mechanical power from a prime mover – such as an electric motor – to a typically rotary output device at a lower momentum but at a higher torque.

**Graphical User Interface (GUI)** – A type of user interface that allows people to interact with a computer and computer-controlled devices which employs graphical icons, visual indicators or special graphical elements, along with text labels or text navigation to represent the information available to the user.

**Ground Loop** – A ground loop is any part of the DC return path (ground) that has more than one possible path between any two points.

**Half Duplex** – The transmission of data in just one direction at a time. For example, a walkie-talkie is a half-duplex device because only one party can talk at a time.

**Half Step** – This term means that the motor shaft will move a distance of 0.9 degree (400 steps per shaft revolution) instead of moving 1.8 degree per digital pulse.

**Holding Torque** – The maximum torque or force that can be externally applied to a stopped, energized motor without causing the rotor to rotate continuously. This is also called “static torque”.

**Hybrid Motors** – Hybrid Stepping Motors feature the best characteristics of PM and VR motors. Hybrid steppers are best suited for industrial applications because of high static and run torque, a standard low step angle of 1.8°, and the ability to Microstep. Hybrid step motors offer the ability to precisely position a load without using a closed-loop feedback device such as an encoder.

**Immediate Mode** – Commands are issued and executed directly to the controller by user input into the terminal window.

**Indexer** – In the context of stepper motor-based systems, the indexer is a device that provides step and direction control signals to a step motor driver. More sophisticated dedicated stepper motor controllers will also have I/O points and various other higher level functions and programmability similar to a PLC. In many cases a PLC may be used as an Indexer.

**Inductance** – The property that exists between two-current carrying conductors or coils when magnetic lines of force from one coil or conductor are linked with those of the other.

**Inertia** – A measure of an object’s resistance to a change in velocity. The larger an object’s inertia, the greater the torque required to accelerate or decelerate it. Inertia is a function of an object’s mass and shape. For the most efficient operation, the system-coupling ratio should be selected so that the reflected inertia of the load is equal to or no greater than 10 times the rotor inertia of the step motor.

**Inertia (Reflected)** – Inertia as seen by the step motor when driving through a speed change, reducer or gear train.

**Lead** – The linear distance a nut on a leadscrew travels during one revolution of the lead screw, e.g. in/rev.

**Lead Screw** – A device that converts rotary motion into linear motion.

**Limits** – A step motor system with sensors that alert the control electronics that a physical end of travel has approached and that the motion is not allowed in a specific direction.

**Linear Actuator** – A type of electric motor that develops force and motion linearly.

**Linear Slide** – Linear slides are precision products designed to turn motion or torque into straight-line movements. Linear slides are designed to move mounted mechanisms across a given axis. Complete slides normally consist of at least a base, a saddle, adjusting screw and a straight gib.

**Load** – Any external resistance (static or dynamic) to motion that is applied to the motor.

**Logic Ground** – The reference “zero” voltage that a group of control signals in a particular system are referenced.

**Microstepping** – A control electronic technique that proportions the current in a step motor’s windings to provide additional intermediate positions between poles. Produces smooth rotation over a wide range and high positional resolution. Typically, step resolutions range from 400 – 51,200 steps per shaft revolution.

**Multidrop** – A communications configuration in which several devices share the same transmission line, although generally only one may transmit at a time. This configuration usually uses some kind of polling mechanism to address each connected device with a unique address code.

**National Electrical Manufacturer’s Association (NEMA)** – The acronym for the organization that sets standards for motors and other industrial electrical equipment.

**Open Loop System** – An open loop motion control system is where no external sensors are used to provide position or velocity feedback signals, such as encoder feedback of position.

**Opto-Isolated** – A method of sending a signal from one piece of equipment to another without the usual requirement of common ground potentials. The signal is transmitted optically with a light source (usually a Light Emitting Diode) and a light sensor (usually a photo-sensitive transistor). These optical components provide electrical isolation.

**Permanent Magnet Motors** – Permanent Magnet Motors are typically not used in industrial applications. PM motors generally have a high step angle, are low torque, low cost and used in high volume consumer applications such as printers, fax machines and toys.

**Pitch** – The distance from any point on one thread of the screw to a corresponding point on the next successive thread, e.g. rev/in.

**Prime Ratio Stepper** – A “Prime Ratio Stepper” is a hybrid step motor that has an increased stator to rotor tooth ratio. Where a standard step motor has 40 stator teeth to 50 rotor teeth, a ratio of 4:5, a prime ratio motor has 48 stator teeth to 50 rotor teeth, a ratio of 4.8:5. This difference means 16% more area of the face of the stator.

**Program Mode** – This mode is used to input user program into the motion controller.

**Programmable Logic Controller (PLC)** – A specialized device used to provide high speed, low-level control of a process.

**Pull-In Torque** (also called Starting Torque) – This is the maximum torque the stepper motor can develop when instantaneously started at that speed.

**Pull-Out Torque** (also called Slewing Torque) – This is the maximum torque that the stepper can develop once an acceleration profile has been used to “ramp” it to the target speed.

**Pulse Width Modulation (PWM)** – The method of controlling the average current in a motor phase winding by varying the duty cycle of an applied voltage.

**Recommended Standard 232 (RS-232)** – The standard for serial transmission between a DTE (computer) and a DCE (modem, mouse, etc.). This is a single-ended (unbalanced) hardware configuration that employs a method of communicating digital information in which the data bits are transmitted sequentially over one line. The typical transmission speed of an RS-232 connection is 9600 bps over a maximum distance of 50ft (15m).

**Recommended Standard 422 (RS-422)** – The standard for serial data communication protocol which specifies 4 wire, full duplex, differential line, multi-drop communications. It provides for balanced data transmission with unidirectional/non-reversible, terminated or non-terminated transmission lines. With a transmission rate of 9600 bps, RS-422 can be used at distances up to 4,000 feet (1,275 meters).

**Recommended Standard 485 (RS-485)** – This standard is an enhanced version of RS-422 with the added capability to allow up to 32 devices (transmitters and receivers) that share the same serial data communication lines. It uses a 2 wire, half duplex, multipoint serial connection.

**Resolution** – The smallest positioning increment that can be achieved.

**Resonance** – The frequency that a step motor system may begin to oscillate. Primary resonance frequency occurs at about one revolution per second. This oscillation will cause a loss of effective torque and may result in loss of synchronism. The designer should consider reducing or shifting the resonance frequency by utilizing half step or micro-step techniques or work outside the primary resonance frequency.

**Rotor** – The moving part of the motor, consisting of the shaft and the magnets. These magnets are similar to the field winding of a brush type DC motor.

**Rotor Inertia** – The rotational inertia of the rotor and shaft.

**Serial Peripheral Interface Bus (SPI)** – Is a synchronous serial data link that operates in full duplex mode. Devices communicate in master/slave mode where the master device initiates the data frame. Multiple slave devices are allowed with individual slave select lines.

**Shaft** – The portion of the rotor that lies on the spin axis of the rotor and is the rotor interface to the stator portion of the magnetic bearings and motor generators.

**Sinking Current** – Refers to the current flowing into the output of the chip. This means that a device connected between the positive supply and the chip output will be switched on when the output is low.

**Slew** – The position of a move profile where the motor is operating at a constant velocity.

**Sourcing Current** – Refers to the current flowing out of the output of the chip. This means that a device connected between the chip output and the negative supply will be switched on when the output is high.

**Stator** – The stationary part of the motor. Specifically, it is the iron core with the wire winding in it that is pressed into the shell of the frame. The winding pattern determines the voltage constant of the motor.

**Torque** – A measurement of the amount of force acting on an object that causes the object to rotate.

**Unipolar Motors** – These motors are composed of two windings, each with a center tap. The center taps are either brought outside the motor as two separate wires or connected to each other internally and brought outside the motor as one wire, resulting in 5 or 6 wires.

**Variable Reluctance Motor** - Variable Reluctance Motors have no permanent magnet, thus the rotor spins freely as there is no detent torque. The step angle of a VR motor is in the medium range, generally 5 to 15 degrees. This type of motor is also used in non-industrial applications where a high degree of torque is not required.