

Chapter 2: Your Boe-Bot's Servo Motors

Vocabulary words used in this lesson.

- **Argument** in computer science is a value of data that is part of a command. Also data passed to a procedure or function at the time of call. The term parameter is often used to refer to the variable as found in the function definition, while argument refers to the actual input passed.
- **BASIC Stamp** is a microcontroller with a small, specialized **BASIC** interpreter (**PBASIC**) built into Read Only Memory (ROM).
- **Battery** a container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.
- **Binary Numbers** A method of representing *numbers* that has 2 as its base and uses only the digits 0 and 1.
- **Bit** (short for binary digit) is the smallest unit of data in a computer. When a variable is declared as Bit, then it has a single binary value, either 0 or 1.
- **Breadboard** A thin plastic board with small holes in a grid pattern used to hold electronic components (transistors, resistors, chips, etc.) that are wired together.
- **Byte** is a unit of data that is eight binary digits long, with a value of 0 to 255. A *byte* is the unit most computers use to represent a character such as a letter, number or typographic symbol. When a variable is declared as Byte it can contain values of 0 to 255.
- **Calibrate** to determine, check, or rectify the graduation of (any instrument giving quantitative measurements). The comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. The outcome of the comparison can result in no significant error being noted on the device under test, a significant error being noted but no adjustment made, or an adjustment made to correct the error to an acceptable level.
- **Circuit** the complete path of an electric current, including the generating apparatus, intervening resistors, or capacitors. An electrical circuit is a network consisting of a closed loop, giving a return path for the current.
- **Comments** are notes in programs that describe what is happening, to document the code. In PBASIC, comments begin with an apostrophe '.
- **Continuous Rotation Servo** is a **servo** (motor) that does not have a limit on its range of motion. Instead of having the input signal determine which position the servo should rotate to, the continuous rotation servo relates the input to the speed of the output and direction.
- **Counter Clockwise** Rotation can occur in two possible directions. A clockwise (typically abbreviated as CW) motion is one that proceeds in the same direction as a clock's hands: from

the top to the right, then down and then to the left, and back up to the top. The opposite sense of rotation or revolution is counterclockwise (CCW): from the top to the left, then down and then to the right, and back up to the top.

- **Current** the rate of flow of an electric charge, in the direction that a positive moving charge would take and having magnitude equal to the quantity of charge per unit time: measured in amperes. An electric current is a flow of electric charge. In electric circuits this charge is often carried by moving electrons in a wire.
- **Diagnostic** the practice or techniques of diagnosis. Diagnosis is the identification of the nature and cause of a certain phenomenon. Diagnosis is used in many different disciplines with variations in the use of logic, analytics, and experience to determine "cause and effect". In systems engineering and computer science, it is typically used to determine the causes of symptoms, mitigations, and solutions.
- **Diode** a semiconductor device with two terminals, typically allowing the flow of current in one direction only.
- **DO...LOOP** A section of computer code in which an instruction or group of instructions is executed repeatedly depending on the value of a Boolean condition; either of a *for loop* or a *while loop*.
- **Duration** continuance in time; the time during which something exists or lasts.
- **Electric Resistance** of an *electrical* conductor is a measure of the difficulty to pass an *electric* current through that conductor. Electrical resistance shares some conceptual parallels with the notion of mechanical friction. The SI unit of electrical resistance is the ohm (Ω). Substances in which electricity can flow are called conductors. A piece of conducting material of a particular resistance meant for use in a circuit is called a resistor.
- **Electric Charge** the physical property of matter that causes it to experience a force when placed in an electromagnetic field. There are two types of electric charges: positive and negative (commonly carried by protons and electrons respectively).
- **Electrons** a stable subatomic particle with a charge of negative electricity, found in all atoms and acting as the primary carrier of electricity in solids.
- **LED** A *light-emitting diode (LED)* is a semiconductor device that emits visible *light* when an electric current passes through it.
- **Math Operators** in computer programs are (+) addition, (-) subtraction, (*) multiplication, (/) division. Math operators are used in program commands to perform math functions with numbers or variables.

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- **Microcontroller** is a computer presented in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well as a processor.
- **Microsecond** is a millionth of a second. It's abbreviated μs .
- **Milliamp** a unit of electric current equal to one thousandth of an ampere.
- **Millisecond** one thousandth of a second.
- **Mitigate** as to make something less severe
- **Motor** a machine designed to convert one form of energy into mechanical energy. Electric motors convert electrical energy into mechanical motion, pneumatic motors use compressed air, and clockwork motors in wind-up toys use elastic energy.
- **Nib** (often nybble or nyble to match the spelling of byte). When a variable is declared as Nib, it means it can store values of 0 to 15. A Nib is four bits, also known as half-byte. A nibble can be represented by a single hexadecimal digit and called a hex digit. Four-bit computer architectures use groups of four bits as their fundamental unit. Such architectures are used in microprocessors, pocket calculators and pocket computers.
- **PAUSE** a temporary stop.
- **Pulse** a single vibration or short burst of sound, electric current, light, or other wave.
- **Pulse train** a series of pulses.
- **PULSOUT command** generates a pulse of a given length time.
- **Revolutions Per Minute (RPM)** The number of full circles something turns in a minute.
- **Resistor** a device having a designed resistance to the passage of an electric current. A piece of conducting material of a particular resistance meant for use in a circuit. The amount of resistance is measured in Ohms (Ω), and colored stripes are used to indicate the ohms of a resistor.
- **Schematic** a sketch which shows a system in a simple way. A representation of the elements of a system using abstract, graphic symbols rather than realistic pictures. A schematic usually omits all details that are not relevant to the information the schematic is intended to convey, and may add unrealistic elements that aid understanding.
- **Subsystem testing** is the practice of testing the individual components before they go into the larger device. A subsystem is one part of the whole system. It's a valuable strategy that can help you win robotics contests. It's also an essential skill used by engineers worldwide to develop everything from toys, cars, and video games to space shuttles and Mars roving robots. Especially

in more complex devices, it can become nearly impossible to figure out a problem if the individual components haven't been tested beforehand.

- **Timing Diagram** is a representation of a set of signals in the time domain. With Boe-Bot it is a graph that relates high (V_{dd}) and low (V_{ss}) signals to time. A timing diagram can contain many rows, usually one of them being the clock. It is a tool that is commonly used in digital electronics, hardware debugging, and digital communications. Besides providing an overall description of the timing relationships, the digital timing diagram can help find and diagnose digital logic hazards.
- **Variable** is a holding place for data in a program, which is given a unique name. A variable can be used in commands to allow data to be incremented or decremented, or operated on with math statements. Variables are initialized and assigned a name and type of data. If you do not initialize a variable, the program will automatically start by storing the number zero in that variable, called the variable's default value. In some computer languages, variables must be defined as holding strings (text) or integers (numbers).
- **V_{dd}** The supply voltage for a circuit is often given as V plus a double-letter suffix. V_{dd} stands for High or positive. When you connect the circuit to V_{dd}, it's like connecting it to the positive terminal of a 5 V battery.
- **Voltage** an electromotive force or potential difference expressed in volts. The voltage between two points is equal to the work done per unit of charge against a static electric field to move the test charge between two points. This is measured in units of volts (a joule per coulomb). Voltage can be caused by static electric fields, by electric current through a magnetic field, by time-varying magnetic fields, or some combination of these.
- **Voltage battery pack (VBP)** A package of batteries which is wired in series so that a single voltage is supplied. For example, four 1.5 Volt batteries in a battery pack provides 6 Volts of power.
- **Voltage Regulator** is designed to automatically maintain a constant **voltage** level. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.
- **Volts** the difference in electric potential between two points of a conducting wire when an electric current of one ampere dissipates one watt of power between those points. The volt (symbol: V) is the derived unit for electric potential, electric potential difference (voltage), and electromotive force. It is named after the Italian physicist Alessandro Volta (1745–1827).

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- **Vss** The supply voltage for a circuit is often given as V plus a double-letter suffix. Vss stands for Low or negative. When you connect the circuit to Vss, it's like connecting it to the negative terminal of a battery, which results in 0.
- **Width Modulation** is a modulation process or technique used in most communication systems for encoding the amplitude of a signal right into a pulse width or duration of another signal, usually a carrier signal, for transmission.
- **Wiring Diagram** is a simplified conventional pictorial representation of an electrical circuit. It shows the components of the circuit as simplified shapes, and the power and signal connections between the devices. A wiring diagram is often used to troubleshoot problems and to make sure that all the connections have been made and that everything is present.
- **Word** is a unit of data that is sixteen binary digits long, with a value of 0 to 65535. When a variable is declared as Word, it means that it can store numbers from -32768 to + 32767.

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