

Chapter 3: Assemble and Test your Boe-Bot

Vocabulary words used in this lesson.

- **Assembly** the act of connecting together the parts of something (such as a machine): the act of assembling something.
- **Brownout** a reduction in or restriction on the availability of electrical power in a particular area. When the voltage supply drops below the level a device needs to function properly.
- **Chassis** the base frame of a motor vehicle or other wheeled conveyance.
- **Circuit** An electronic circuit is composed of individual electronic components, such as resistors, transistors, capacitors, inductors and diodes, connected by conductive wires or traces through which electric current can flow. The combination of components and wires allows various simple and complex operations to be performed: signals can be amplified, computations can be performed, and data can be moved from one place to another.
- **Circuit Assembly** The act of creating a circuit with electronic and electrical components. Always disconnect power to your board before building or modifying circuits.
- **Cotter pin** a metal fastener with two tines that are bent during installation used to fasten metal together, like with a staple or rivet.
- **Continuous Rotation Servos** Motors that are designed to receive electronic signals. With standard servos the signal tells them what position to hold. Standard servos control the positions of radio controlled airplane flaps, boat rudders, and car steering. Continuous rotation servos receive the same electronic signals, but instead of holding certain positions, they turn at certain speeds and directions. Continuous rotation servos are ideal for controlling wheels and pulleys.
- **Current** refers to the rate at which electrons pass through a circuit. You will often see measurements of current expressed in amps, which is abbreviated A. The amount of current an electric motor draws is often measured in amps, for example 2 A, 5 A, etc.
- **DEBUGIN command** A PBasic command used to make the BASIC Stamp receive what you type into the Debug Terminal's Transmit windowpane and store it in one or more variables.
- **Duration** the time during which something continues.
- **Engineering** The process of utilizing knowledge and principles to design, build, and analyze objects. The application of mathematics, science, economics, and social and practical knowledge to invent, innovate, design, build, maintain, research, and improve structures, machines, tools, systems, components, materials, processes, solutions, and organizations.

- **FREQOUT command** A PBasic command that allows you to generate sine-wave tones for a duration of time that you can specify. The command sends precisely timed high/low signals to a speaker.
- **Frequency** the number of times something happens within a particular period.
- **I/O** stands for input/output. In computing, input/output or I/O (or, informally, io or IO) is the communication between an information processing system, such as a computer, and the outside world, possibly a human or another information processing system. Inputs are the signals or data received by the system and outputs are the signals or data sent from it.
- **I/O pins.** The BASIC Stamp 2 has 24 pins, 16 of which are I/O pins. Programs use I/O pins as **outputs** to make LED lights turn on/off, control the speed and direction the servos turn, make tones with a speaker, and prepare sensors to detect light and objects. Programs also use I/O pins as **inputs** to monitor sensors that indicate mechanical contact, light level, objects detected, and their distance.
- **Indicator Circuit** a circuit which uses an indicator such as an LED to announce which electrical circuit has been active, or to communicate information about the circuit.
- **Initialization Routine** An initialization routine consists of the lines of code that are used at the beginning of the program. These lines of code run each time the program starts from the beginning.
- **LED** A diode is a one-way current valve, and a light-emitting diode (LED) emits light when current passes through it. An LED has two terminals. One is called the anode, and the other is called the cathode. Usually, the longer lead is connected to the LED's anode, and the shorter lead is connected to its cathode. But sometimes the leads have been clipped to the same length, or a manufacturer does not follow this convention. Therefore, it is best to always look for the flat spot on the case. If you plug an LED in backwards, it will not hurt it, but it will not light up.
- **Machine screws** A screw is a type of fastener, typically made of metal, and characterized by a helical ridge, known as a male thread (external thread) or just thread. ASME standards specify a variety of "Machine Screws" in diameters ranging up to 0.75 in (19.05 mm). These fasteners are often used with nuts but also often driven into tapped holes (without nuts).
- **Modulation** is the process of adjusting a property of a signal that is being transmitted to make it convey certain information. With a servo, the property that is modulated is the pulse width, the amount of time the signal is high. The information it conveys is servo speed and direction.
- **Potentiometer** a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment.

- **Pulse Width Modulation** is a modulation technique for transmission, its main use is to allow the control of the power supplied to electrical devices, especially to inertial loads such as motors. A voltage that spends certain amounts of time in two different states can be considered as a series of resting states and pulses. The PWM command makes the BASIC Stamp create another form of pulse width modulation. This signal is a more rapid sequence of pulses that's especially useful for setting voltage across a capacitor through a resistor. The proportion of high time to cycle time (high + low time) is what controls the capacitor voltage, and it is called duty cycle. The PWM command's Duty argument controls the PWM signals' duty cycle.
- **PULSOUT** generates a pulse of length time. The PULSOUT command delivers high signals for precise amounts of time. These amounts of time are values you use in the Duration argument, and they are measured in units that are two millionths of a second. Pulse width is a common way to describe how long a pulse lasts. The reason it is called pulse "width" is because the amount of time a pulse lasts is related to how wide it is on a timing diagram. Pulses which last longer are wider on timing diagrams and pulses which last for short periods of time are narrow.
- **Reset** A reset is when the power is interrupted and the BASIC Stamp program starts running again from the beginning of the program.
- **Servo** an electromagnetic device that converts electricity into precise controlled motion by use of negative feedback mechanisms. A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.
- **Servo Horn** – a device on the output of the servo motor that turns when the motor turns. The horn shape has four blades like a fan. Other shapes are round or have gears.
- **Spacer** a mechanical device that separates two components. A standoff is a threaded separator of defined length used to raise one assembly above another. They are usually round or hex (for wrench tightening), often made of aluminum, brass, or nylon, and come in male-female or female-female forms. In electronics they are frequently used to raise a printed-circuit board above a surface.
- **Tone** a musical or vocal sound with reference to its pitch, quality, and strength.
- **Velocity** the speed of something in a given direction.
- **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). Volts

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is abbreviated V. That means 5 volts is abbreviated 5 V. When you apply voltage to a circuit, it's like applying electrical pressure.