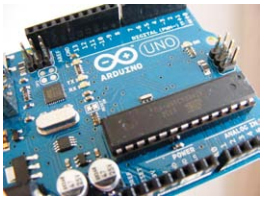
COMPONENTS GUIDE

Here's a guide to the components you'll use, with a few details that you might find useful.

Arduino Uno R3

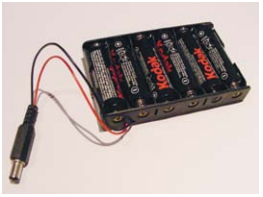
The Arduino Uno R3 is the main component for the book and the brain for all our projects.



- Quantity: 1
- Connections: 14

9V Battery Pack

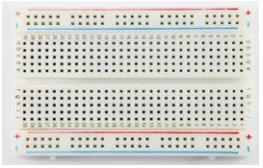
The 9V battery pack plugs into the Arduino to power your projects. You connect the batteries and plug the jack into the port in the Arduino, as discussed in "Power" on page 3. Note that the Arduino can also be powered through the USB cable.



- Quantity: 1
- Connections: 1

Breadboard

The breadboard is a prototyping board used to connect components and create your projects. See "Breadboards" on page 4 for more information.



- Quantity: 2 full-size boards, 1 half-size board, 1 mini board
- Connections: 940 on a full board, 420 on a half board, 170 on a mini board

LED

An LED emits light when a small current is passed through it. It looks like a small light bulb with two legs. The longer leg is the positive connection. LEDs generally require a resistor or they may burn out. LEDs are polarized, meaning current flows only in one direction.

- Quantity: 40 (10 each of red, blue, yellow, green)
- Connections: 2

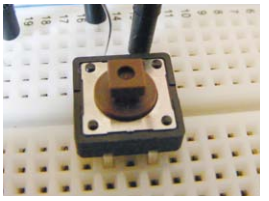
Resistor

Resistors restrict the amount of current that can flow through a circuit to prevent components from overloading. They look like cylinders with colored bands and a wire from either end. The value is indicated by a color code—see “Decoding Resistor Values” for more details. Check this carefully, as it can be easy to choose the wrong value. Resistors come in two-, four-, and five-band varieties, so be aware that, for example, a four-band 220-ohm resistor can look slightly different from a five-band resistor of the same value.

- Quantity: 30 220-ohm, 10 330-ohm, 1 10k-ohm, 1 1m-ohm resistors
- Connections: 2

Pushbutton

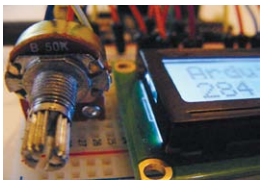
The pushbutton is a simple switch that makes a connection when pushed. This switch connects a circuit when pushed in, but will spring back when released and break the connection. It is also known as a momentary switch. Pushbuttons vary in size, but most will have four pins.



- Quantity: 4
- Connections: 4

Potentiometer

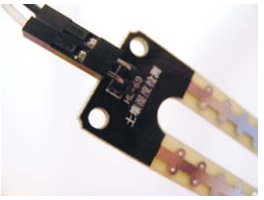
A potentiometer is a resistor whose value you can vary to manipulate the voltage flowing through it. It has a knob that you can turn and three pins at the bottom. The center pin is the control pin, with power to either side (it doesn't matter which way they are connected). It's commonly used to control an output such as the volume on a radio.



- Quantity: 1 50k-ohm potentiometer
- Connections: 3

HL-69 Soil Sensor

A soil sensor measures the moisture content of soil. It has two prongs and two pins at the top. The sensor used in the book is the HL-69 soil hygrometer. It comes with a driver module that you connect to your Arduino, rather than connecting straight to the sensor.



- Quantity: 1
- Connections: 2

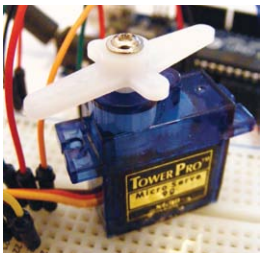
Piezo Buzzer

The piezo buzzer is a very basic speaker. A pulse of current causes it to click extremely quickly, and a stream of pulses will emit a tone. It often looks like a small black box with two wires. Taken out of the case, it looks like a small gold disc. It's very cheap and used in inexpensive toys for noise generation (in sirens, for instance). It can also be used as a noise sensor, as shown in Project 9.

- Quantity: 1
- Connections: 2

Servomotor

A servomotor is a motor with an arm that you can position to specific angles by sending the servo a coded signal. It is a small box with three wires and an output shaft, which can have an attachment (known as a horn). The red wire is POWER or +5V, the black/brown wire is GROUND or GND, and the orange/white wire is SIGNAL, which connects to your Arduino analog pin. The Tower Pro 9g servos will turn 180 degrees, but others are continuous and can turn the full 360 degrees.



- Quantity: 2
- Connections: 3

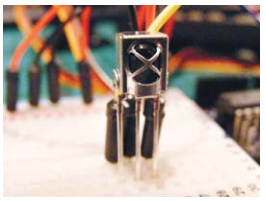
Joystick

A joystick records an analog input that can then be read to give a digital output. It's basically two potentiometers supplying a signal for two axes: left/right and up/down. It has lots of applications, like gaming or controlling a servomotor.

- Quantity: 1
- Connections: 5

Infrared LED Receiver

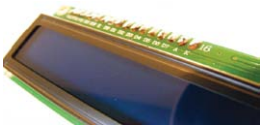
An infrared (IR) LED receiver picks up infrared signals from, for example, a remote control. It is an LED in a small casing with three legs: OUT, GND, and +5V (positive power). It's polarized so it needs to be connected in the right way. Check the data sheet for your receiver, just in case the connections are different.



- Quantity: 1
- Connections: 3

LCD Screen

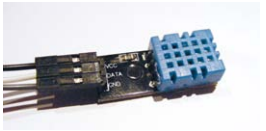
An LCD screen is a display screen for outputting characters. Screens come in various dimensions. The one shown here is an HD44780 (16 characters × 2 lines) and has 16 connections. An LCD screen consists of two sheets of polarizing material with a liquid crystal solution between them; current passing through the crystal creates an image.



- Quantity: 1
- Connections: 16

DHT11 Humidity Sensor

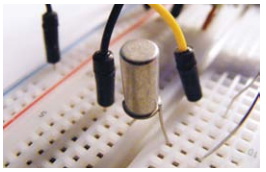
The DHT11 sensor measures humidity and temperature. It is a small blue or white plastic box with four pins, though it's sometimes mounted on a module board that has only three pins. This book uses the DHT11 sensor, and we use only three of the pins: +5V, DATA, and GND.



- Quantity: 1
- Connections: 4 (but we'll use only 3)

Tilt Ball Switch

A tilt ball switch is a casing with a metal ball inside that makes a connection when in an upright position. Tilt the switch, and the connection is broken.



- Quantity: 1
- Connections: 2

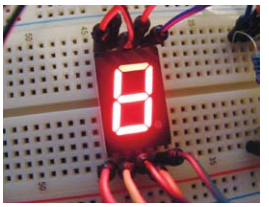
RGB LED

An RGB LED module is three colors in one—red, green, and blue. By combining the colors, you can make any color of the rainbow. It is a clear LED with four legs, sometimes mounted on a module with built-in resistors, as shown. You will need to use resistors to limit the current or the LED will burn out. The longest leg will be either the common cathode or anode.

- Quantity: 1
- Connections: 4

Seven-Segment LED Display

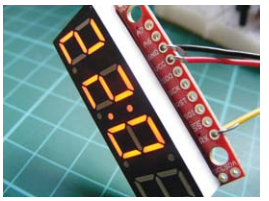
A seven-segment LED display shows a digit or character using LED segments. They're often used to display numbers for counters, clocks, or timers. You can get single-digit to eight-digit displays, and four-digit displays are commonly used for digital clocks.



- Quantity: 1
- Connections: 10–12

Four-Digit, Seven-Segment Serial Display

This is a four-digit version of the seven-segment LED, with an additional built-in circuit so it can be controlled with very few connections. This serial module is the SparkFun version and comes in different colors. There are 10 connections, but it can be used with only 3 (VCC, GND, and RX) on the Arduino.



- Quantity: 1
- Connections: 10 (but we'll use only 3)

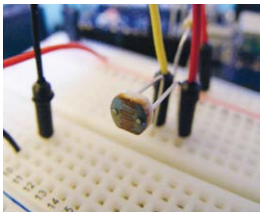
Ultrasonic Sensor

An ultrasonic sensor sends out a signal (often referred to as a *ping*), which bounces off an object and is returned to the sensor. Distance is calculated from the time the signal takes to return. The sensor used in this book is the HC-SR04 ultrasonic sensor. It is a module board with two round sensors and four pins.

- Quantity: 1
- Connections: 4

Photoresistor

A photoresistor, also referred to as a light-dependent resistor or diode, produces a variable resistance depending on the amount of light falling on it and is used to detect light levels. There are different styles, but it's usually a small, clear oval with wavy lines and two legs. You will need to calibrate it to determine light levels before using it in a program.



- Quantity: 1
- Connections: 2

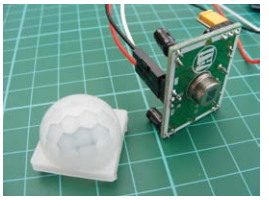
RC V959 Missile Launcher

Produced for radio-controlled helicopters, the WLToys RC V959 missile launcher is a mini Gatling gun that can fire six plastic rockets in quick succession. It has four wires, but we use only the yellow and white for continuous firing.

- Quantity: 1
- Connections: 4 (but we'll use only 2)

PIR Sensor

The PIR (passive infrared) sensor detects movement within its range. The book uses the HC SR501, the most commonly available PIR sensor. The module pictured has a golf ball–type lens on the front and three connections: +5V, OUTPUT, and GND. The orange cubes are potentiometers that change the distance range and output timing.



- Quantity: 1
- Connections: 3

Keypad

A 4×4 keypad is basically a series of switches. The example shown here has 16 pushbuttons connected in series; a 12-button version is also available. Of the eight connections, four control the rows and four control the columns. The Arduino will replicate the number of the pressed button.

- Quantity: 1
- Connections: 8

RFID Reader

An RFID (radio frequency identification) module reads RFID cards and key fobs to allow or deny actions depending on the access level of the card. It is a small board with eight pins and a built-in antenna. The module used in the book is the Mifare RFID-RC522 module, which usually comes with a card and fob.

- Quantity: 1
- Connections: 8

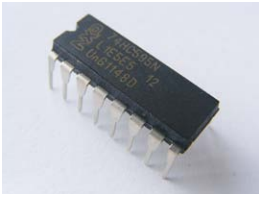
RGB Matrix

An 8×8 RGB matrix is a series of 64 LEDs that can change through red, green, and blue to create the colors of the rainbow. There are 32 pins on the matrix: 8 are for the common anode of each LED, 8 control the color red, 8 control green, and 8 control blue. Resistors are required for each pin controlling a color.

- Quantity: 1
- Connections: 32

Shift Register

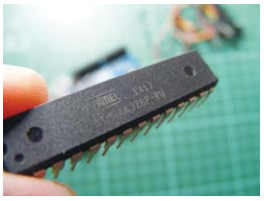
A shift register is a small integrated circuit and sequential logic counter that allows the Arduino to make more connections by "shifting" and storing data. It's a small black chip with 16 legs. At one end, you'll find a dot or semicircle—pin 1 is to the left of this marker. The electronic die in Project 16 uses a 74HC595 shift register.



- Quantity: 1
- Connections: 16

ATmega328p Chip

The ATMEL ATmega328p chip is the brain of the Arduino; it carries out the instructions from an uploaded sketch. It's a small black chip with 32 legs. At one end you'll find a dot or semicircle—pin 1 is to the left of this marker.



- Quantity: 1
- Connections: 32

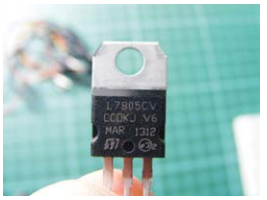
16 MHz Crystal Oscillator

The 16 MHz crystal oscillator allows the Arduino to calculate time. It is a small metal casing with two legs and requires a capacitor on each leg to help smooth voltage to the crystal. The frequency of the crystal is printed on the front.

- Quantity: 1
- Connections: 2

5V Regulator

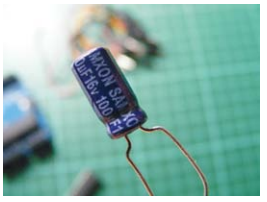
The L7805cv 5V regulator takes a voltage between 7 and 11 volts and steps it down to a constant 5 volts.



- Quantity: 1
- Connections: 3

Capacitor

Capacitors can store a small amount of electricity for later use and can be used to smooth voltage output and flow. They look like small cylinders with two legs, and the value is usually printed on the side. Capacitors have polarity and need to be inserted correctly. The long leg is positive, and the short leg is negative; this is generally indicated on the cylinder. There are various types available; the one shown here is an aluminum 100µF electrolytic capacitor.



- Quantity: 2
- Connections: 2

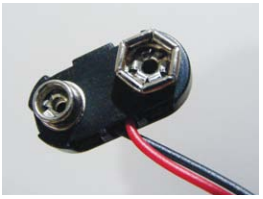
Disc Capacitor

The 22pf disc capacitor is another type of capacitor that can store a small amount of electricity for later use. It looks like a small disc with two legs, and the value is usually printed on the front. There are various types available; the one shown here is a ceramic version.

- Quantity: 2
- Connections: 2

Battery Clip

The PP3 9V battery clip is a simple connector for a 9V battery. It's a small black clip that has two wires: black for ground and red for positive.

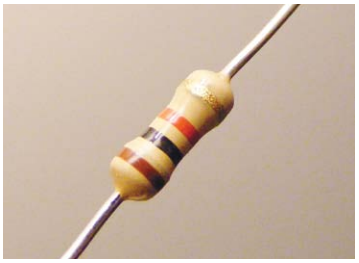


- Quantity: 1
- Connections: 2

DECODING RESISTOR VALUES

In most of projects in this book we've used *resistors*, electrical components that limit the amount of current allowed through a circuit (measured in ohms). They are used to protect components, like LEDs, from overloading and burning out. The value of a resistor is identified by colored bands on the body. Resistors can have four, five, or six colored bands.

It's important to be able to determine the value of a resistor so that you know you're using the correct one in your project. Let's try to determine the value of the four-band resistor shown in Figure.



Viewing the resistor with the silver or gold band on the right, note the order of the colors from left to right. If the resistor has no

silver or gold band, make sure the side with the three colored bands is on the left.

Use Table to determine the value of the resistor.

COLOR	FIRST BAND	SECOND BAND	THIRD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	+/–1%
Red	2	2	2	100Ω	+/–2%
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	+/–0.5%
Blue	6	6	6	1MΩ	+/–0.25%
Violet	7	7	7	10MΩ	+/–0.10%
Gray	8	8	8		+/–0.05%
White	9	9	9		
Gold				0.1Ω	+/–5%
Silver				0.01Ω	+/–10%

NOTE

The band that denotes the tolerance is most commonly silver or gold, though it can be any color that has a percentage listed in the Tolerance column. If you have a resistor with a tolerance band that isn't silver or gold, there should be a small gap between the value bands and the tolerance band so you can tell them apart.

The values that correspond to the first and second bands give you the numerical value, the third band tells you how many zeros to add to that number, and the fourth band tells you the *tolerance*—that is, how much the actual value can vary from the intended value. For the resistor in Figure:

- First band is brown (1) = 1.
- Second band is black (0) = 0.
- Third band is red (2) = 00 (2 is the number of zeros).
- Fourth band is gold, so the tolerance (accuracy) is +/– 5 percent.

So this resistor is 1,000 ohms or 1 kilohm, with a tolerance of 5 percent, meaning that the actual value can be up to 5 percent more or less than 1 kilohm. We can do the same calculation for a five- or six-band resistor.

If you're ever unsure of a resistor's value, a quick online search of the colored bands on the resistor's body will help; just make sure to list the colors in the correct order, reading them from left to right, with the tolerance band on the right.