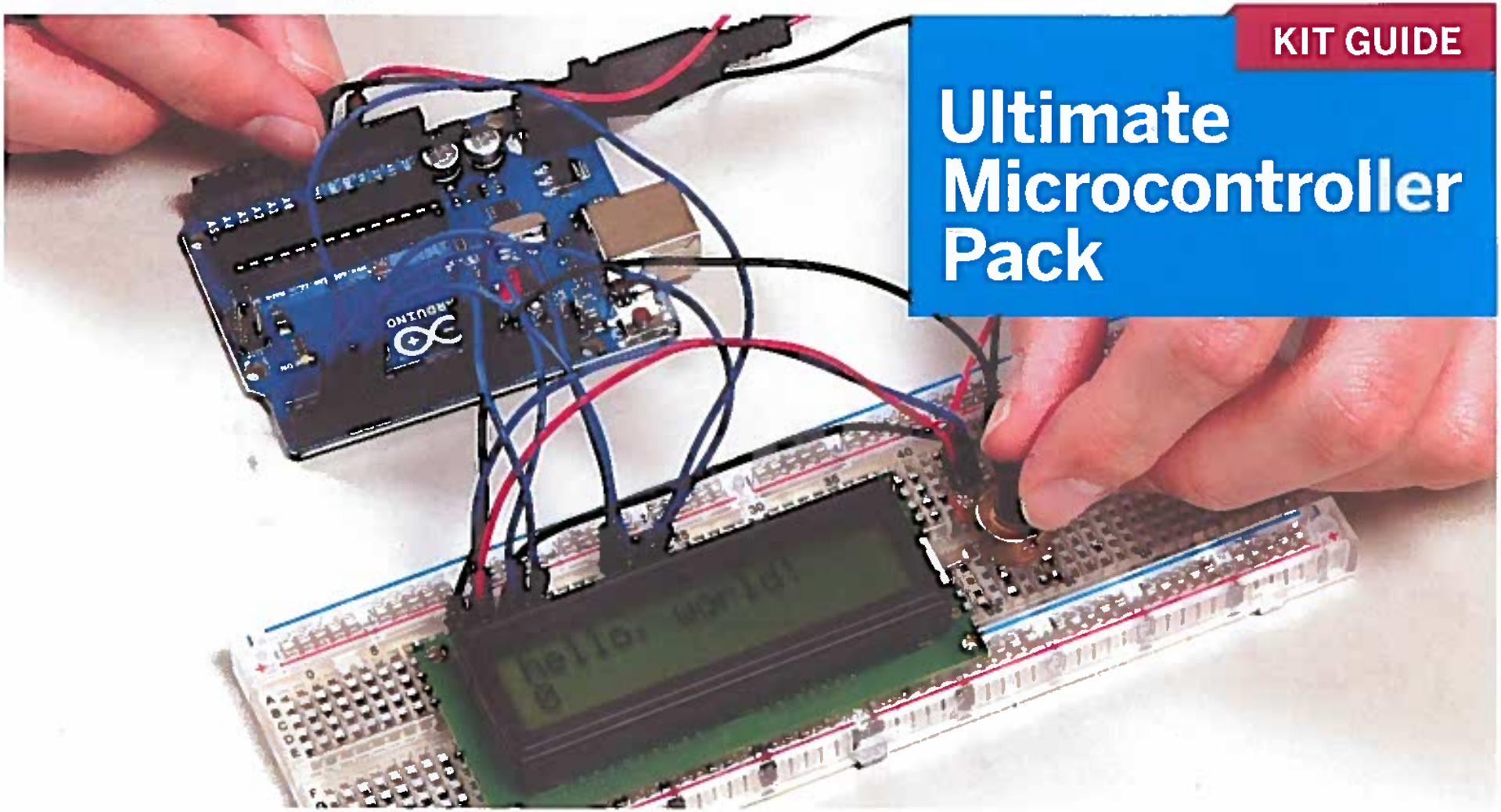
Make:



KIT GUIDE

Ultimate Microcontroller Pack

Get ready to dive into the world of microcontrollers!

The **Ultimate Microcontroller Pack** contains 100+ components to stock your workshop, from the basics, like breadboards, resistors, capacitors, LEDs, and jumper wires, to the fun stuff, like servos, switches, sensors, buttons, motors, a buzzer, a potentiometer, and an LCD screen — all hand-picked by the staff of MAKE to enable you to do a huge range of microcontroller projects.

This mini manual provides:

- A detailed list of everything in this box
- Background on microcontrollers and why they're so cool
- Fun project recommendations for all skill levels, from online tutorials to great books.

WHY MICROCONTROLLERS?

Microcontrollers are a fun and easy way to make your projects smart. They're cheap, versatile, and user-friendly enough to have found their way into cool projects of staggering diversity.

WHAT ARE THEY?

A microcontroller (or MCU) is basically a computer on a single chip that's used to create devices that sense and interact with the world. The processor, memory, clock, and input/output capabilities are all stuffed into one integrated circuit.

WHAT CAN THEY DO?

Programmable microcontrollers usually come on a printed circuit board that breaks out many functions and makes it easier to connect power, cables, motors, sensors, and other devices.

They can take input signals from a variety of sensors (light, motion, sound, temperature, etc.) or from the internet, then process that data (using a program that you write on your computer and download onto the chip) and output a signal to control components such as motors, buzzers, lights, solenoids, and computers.

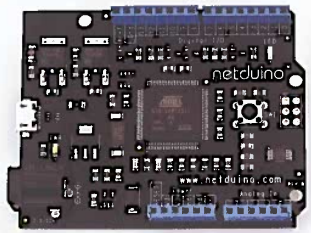
bit.ly/msump

Learn more about all the great stuff you can make with this pack at: **makeprojects.com/v/msump**.
For support questions, email **help@makershed.com**.

Arduino Uno

The Arduino Uno microcontroller is inexpensive, open source, beginner-friendly, and has a huge code base to help you get started making gadgets fast. An awesome tool for physical computing, the Arduino platform consists of a microcontroller board, plus the free Arduino software development environment.

Netduino



The Netduino is an open source electronics platform using the .NET Micro Framework. The board features a 32-bit microcontroller and a rich development environment, making it a perfect solution for engineers and hobbyists alike. Plus it's compatible with many of the add-on "shield" boards developed for the Arduino.

Microcontroller Projects to Get You Started

Here are some of our favorite online projects that you can build using this pack. Find links and more details at makeprojects.com/v/msump.

For even more Arduino projects and resources, visit makezine.com/arduino.

Easy

» Turn the lights on — learn to blink an LED
» Control potentiometers and servos
» Create your own LCD birthday card

Intermediate

» Drive a 7-segment LED display
» Take control of your TV
» Make your own Kitty Twitty, a cat toy that tweets
» Geek out your garden with Garduino
» Enjoy hassle-free, homemade yogurt with the Yobot
» Use Netduino to create the Colorimeter
» Make a Pinewood Derby track timer

bit.ly/msump

COLLABORATE ON

Make: Projects
makeprojects.com

Bill of Materials

Datasheets available at makeprojects.com/v/msump

Microcontroller (optional): Arduino Uno or Netduino (1) See page 2 for overviews. See arduino.cc and netduino.com for specs, pinouts, and more.

MakerShield prototyping shield kit (1) Stacks on the Arduino/Netduino. User-definable components, 3.3V or 5V signals. makeprojects.com/project/h/432.

Servomotors, micro (2) Servos don't spin, they turn to precise positions. These are rated 4.2–6V, operating speed 0.10sec/60° (at 4.8V), stall torque 1.8kg/cm.

Motor, mini DC (1) Rated at 1.3V, 35mA, it spins at 16,000rpm. Housing measures just 16mm×6mm diameter.

Motor, vibration (1) The kind found in cellphones. It buzzes about 50 decibels (dB) loud at 3V, 90mA, and will kick in at just 2V.

Force-sensitive resistors (pressure sensors) (2) Variable resistors that decrease in resistance when pressed with as little as 2 grams of force.

Tilt sensors (2) Tiny switches with a metal ball inside that, when tilted 30°, connects the contact points, closing the circuit. Rated at max 6mA/24V DC.

Photoresistors (light sensors) (2) Variable resistors that decrease in resistance as light intensity increases. Rated 150V, 100mW, 16kΩ–2MΩ.

Thermistors (temperature sensors) (2) Also variable resistors, NTC-type thermistors decrease in resistance as temperature rises. Rated at 50mW, 20kΩ–1MΩ.

Speaker, 8Ω, with leads (1) This tiny loudspeaker measures just 13mm in diameter, so it'll fit into almost any project or prototype.

Buzzer, piezoelectric, 12mm (1) Rated at 5V, 28mA, it puts out 85dB at 2.3kHz. Piezos vibrate when current is applied. In reverse, they generate a voltage when vibrated!

LCD alphanumeric display screen, 16×2 (1) Has 2 lines of 16 characters, in blue pixels over a yellow-green LED backlight, and measures 80mm×36mm×15.8mm.

Datasheets available at makeprojects.com/v/msump

LEDs, 3mm: green (5) and red (5) Light-emitting diodes are polarized, with a longer positive lead (anode) and shorter negative lead (cathode).

LEDs, 5mm, tricolor RGB (3) Combines red, green, and blue LEDs to reproduce a spectrum of colors. These have 4 leads, sharing a positive (+) lead (anode).

Resistors: 330Ω (10), 10kΩ (10), and 1kΩ (10) Resistors limit current and divide voltage. Their leads aren't polarized (no + and –). Colored bands indicate *resistance value* in ohms (Ω) and *power rating* in watts (W). These are all ⅛ W. See page 7 for the color codes.

Capacitors, ceramic: 10nF (10) and 100nF (10) Like a temporary battery, capacitors store electrical charge. They have a max *voltage rating* and a *capacitance value* that's rated in farads (F) and typically printed on the capacitor itself. See page 7 for the number codes.

Capacitors, electrolytic, 100µF (5) Electrolytic capacitors are polarized, with one positive (+) and one negative (–) lead. They resemble little barrels.

Potentiometer, rotary (1) Pots are variable resistors with a preset range of resistance that can be adjusted. They're also rated by power (W) and voltage (V).

Transistor, NPN (1) This semiconductor allows or restricts current, like a normally open switch activated by electricity. Has 3 leads: emitter, base, collector. 20V, 500mA.

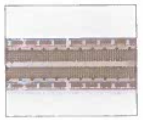
Diode, 1N4004 (1) Semiconductor that allows current to flow only in one direction, so it protects against voltage spikes. Polarized, with (+) and (–) leads, rated 1 amp.

Switches, mini SPST, momentary push-button, normally open, 12V, 15mA (5) Closes (connects) a circuit temporarily when pushed. Otherwise it's open.

Switches, mini DPDT (3) It's *double-throw* (has 2 closed positions, with 1 open position between) and *double-pole* (can open/close 2 different circuits).

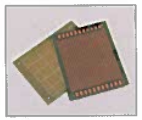
Bill of Materials, cont.

Datasheets available at makeprojects.com/v/msump



Solderless breadboard, clear, full-size (1) Transparent plastic, adhesive-backed. 2.14"×6.5", 830 tie points: a terminal strip (630) and 2 distribution strips (100 each).

Solderless breadboard, mini (1) Has 170 tie points, measures just 1.4"×1.6" (3.5cm×4.5cm), and fits perfectly on our MakerShield.

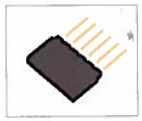


Protoboards, 7cm×9cm (2) These blank circuit boards have 30×24 holes indexed with letters and numbers, copper-backed for soldering, plus soldering tabs on 2 edges.

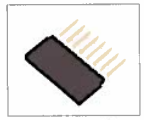
9V battery case with DC plug (1) Includes a sliding cover, switch, 6" 26AWG lead wires, and a 2.1mm×5.5mm×9.5mm DC plug that fits Arduino (easy assembly required).

Deluxe Jumper Wire Pack (1) 65 multi-color, flexible, stranded jumper wires that can be used over and over, with molded barrels and ⅜" (1cm) stripped ends.

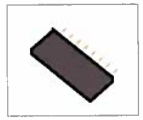
Heat-shrink tubing, ⅛" dia., 30" Insulates and protects wire connections from abrasion and the elements. Slip it on, heat with a hair dryer or heat gun to shrink in place.



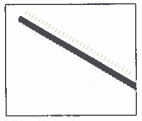
Header, female, 6-pin stackable (1)



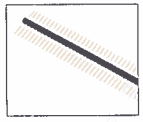
Headers, female, 8-pin stackable (3)



Headers, female, 8-pin (5)



Headers, male, 40-pin breakaway (2)

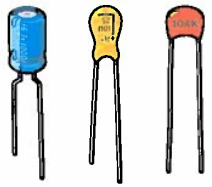


Headers, male, dual 40-pin breakaway (1)

Component storage box (1) Double-sided, 6-compartment case that contains most of the smaller components on this list.

Pin headers allow you to plug and unplug components. We chose this assortment to fit the Arduino/Netduino perfectly.

CAPACITOR TYPES

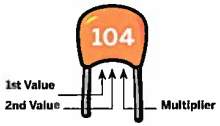


ELECTROLYTIC CAPACITOR
These polarity-sensitive capacitors (caps) are the easiest to figure out. Their value, measured in farads (F), and their maximum voltage are listed on the metal component "can." The negative (–) side is usually clearly marked and the negative lead is shorter.

TANTALUM CAPACITOR
Like electrolytic caps, these brightly colored "gumdrop" caps usually have the capacitance value, maximum voltage rating, and polarity printed right on the component package. Tantalums are polarity-sensitive, and the positive lead is longer than the negative.

MONOLITHIC CAPACITOR
Little "chiclet" shaped caps in lots of fruit flavors (colors, anyway). Mono caps are non-polar, so the leads are equal length and can be installed in either direction. The chart at right shows you how to determine their value using the three-number-plus-letter code found on most monolithic caps.

CAPACITOR NUMBER CODE



NOTE: For capacitors less than 100pF, only a two-digit number is printed on the capacitor, or a two-digit number followed by a "0". For example, a 55pF capacitor may be marked as "55" or "550".

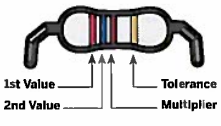
TO DETERMINE THE VALUE OF A CAPACITOR:

The multiplier stands for how many zeros to add to the first two values.

The result is the *capacitance value* in picofarads (pF).

SHOWN HERE:
10 with a multiplier of 4 (adding 4 zeros) = 100,000pF or
0.1µF (microfarads).

RESISTOR COLOR CODE



The color of the first band indicates the first digit, and the color of the second band indicates the second digit. The third band indicates the value that the first two digits need to be multiplied by.

SHOWN HERE: The first is 2, the second 6, multiplied by 10: 26×10 = 260Ω resistor. The fourth band is the tolerance or precision of the resistor.

	Value	Multiplier	Tolerance
■	0	1	–
■	1	10	±1%
■	2	100	±2%
■	3	1K	–
■	4	10K	–
■	5	100K	±0.5%
■	6	1M	±0.25%
■	7	10M	±0.1%
■	8	100M	±0.05%
■	9	1000M	–
■	–	1/10	±5%
■	–	1/100	±10%
■	–	–	±20%

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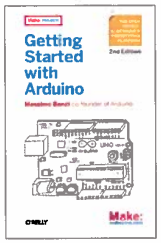
DIY KITS + TOOLS + BOOKS + FUN

Books

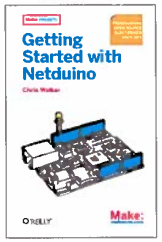
To learn more about microcontrollers, their design, and how they function with hands-on introductory projects, we suggest:

9781449309879 $15



Getting Started with Arduino, 2nd Edition
This valuable little book offers a thorough introduction to the open source electronics prototyping platform. By Massimo Banzi, co-founder of the Arduino Project.

9781449302450 $20



Getting Started with Netduino
Build Netduino projects with this easy-to-follow, hands-on guide. By Netduino inventor Chris Walker.

To network microcontrollers and build projects with more complicated inputs and outputs, we suggest:

9781449393571 $20

Getting Started with the Internet of Things
Use microcontrollers to interface with the real world and bring the internet to life by connecting your Netduino Plus to the cloud. By Cuno Pfister.

9781449392437 $35

Making Things Talk, 2nd Edition
Get your Arduinos, computers, and smartphones talking, with you and your environment. Perfect for people with little technical training but a lot of interest. By Tom Igoe.

Maker Shed is MAKE's online store. Our staff selects the best kits, books, components, and tools from around the world. Visit us at makershed.com when you're ready to start your next project.

*Prices and availability subject to change.

Microcontrollers

If your project requires a tiny microcontroller, or more power than a standard microcontroller provides, we have you covered.

MKSB012 $37

Ardweeny
Tiny Arduino-compatible board for breadboards and small projects.

MKND03 $30

Netduino Mini
Netduino's tiny sibling for breadboards and small projects.

MKSP5 $65

Arduino Mega
Arduino's big sibling has 54 digital I/Os, 16 analog inputs, and more.

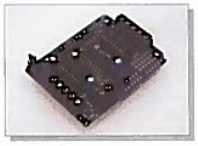
MKND02 $60

Netduino Plus
This version of the Netduino adds a micro-SD card slot and Ethernet.

Shields

Circuit boards that plug into your microcontroller to provide additional functionality. Check out Maker Shed's product pages to see more information.

MKAD7 $20



MotorShield
Full-featured motor board, great for making robots.

MKSP7 $55

Arduino Ethernet Shield
Connect an existing Arduino to the internet.

MKSKL3 $46

Voice Shield
Plays analog audio sound.

MKGX01 $28

DrinkShield Breathalyzer
Breathalyzer — for entertainment purposes only!

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