Bill of Materials

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 cell-phones. 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 1/4W. 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)
Semi-conductor 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).

Datasheets available at makeprojects.com/v/msump
Bill of Materials, cont.

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

**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).

**Headers, female, 8-pin stackable (3)** Headers, female, 8-pin (5)

**Headers, male, 40-pin breakaway (2)** Headers, male, dual 40-pin breakaway (1)

**Heat-shrink tubing, ½” 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.

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

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**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)**

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