

# Circuit Monkey

500-0039-01  
*Potentiometer*  
Board

User Guide



**Version: 1.0**  
2010/01/15

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Illustrations and photographs by Mark J Koch  
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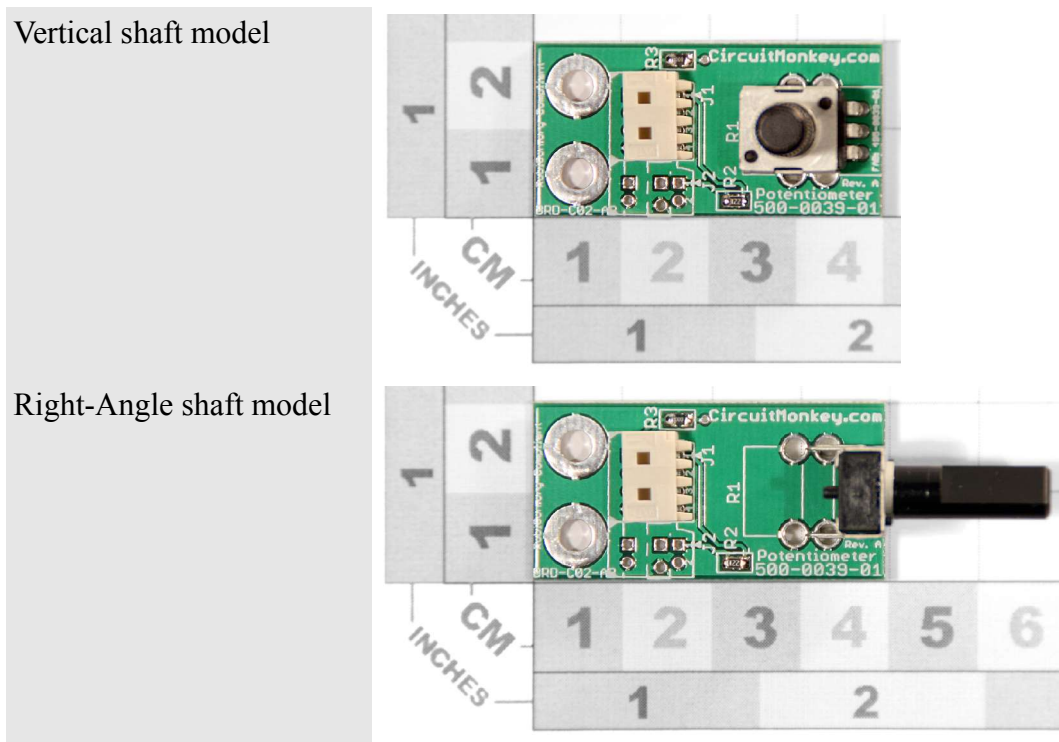
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## Table of Contents

Overview.....	4
Features.....	4
Block Diagram.....	5
Potentiometer.....	5
LED Indicator (Optional).....	6
Connectors.....	6
J1 – Main Connector.....	6
Alternate Configuration – Connector Types and Orientation.....	7
J2 – External LED.....	7
Alternate Configuration – Signal Passthrough.....	8
Applications.....	9
Potentiometer Test.....	9
Hookup.....	9
Potentiometer Test Code ( for Atmega328P – Nymph Compatible ).....	10
Schematic.....	12
Parts List.....	13
J1 Stuffing Options.....	13
J2 Stuffing Options.....	13
R1 Stuffing Options.....	13
SMT Resistors.....	13
Appendix A: References and Links.....	14
Links.....	14
Circuit Monkey.....	14
RobiCon.org.....	14
Atmel.....	14
Bourns.....	14
Mouser.com.....	14
DigiKey.com.....	14

## Overview

**Circuit Monkey** [ <http://circuitmonkey.com> ] presents part number **500-0039-01**, a potentiometer board based on the Bourns *PTV09* potentiometer. The *PTV09 Potentiometer* provides convenient analog rotation measurement or setting for a wide variety of applications. The signals on the potentiometer board are connected using *Molex 53015 (MicroBlade)* series for reliable and vibration resistant connections. These connectors are *RobiCon.org* compliant (*an open-source interconnect standard that we are proposing*). The board is 40mm x 20mm and features two mounting holes placed on a 10mm apart at one end of the board. The holes are plated and connected to logic ground and accept screws of size M3 or less (*M3, 6-32, M2.5, 4-40, etc.*).

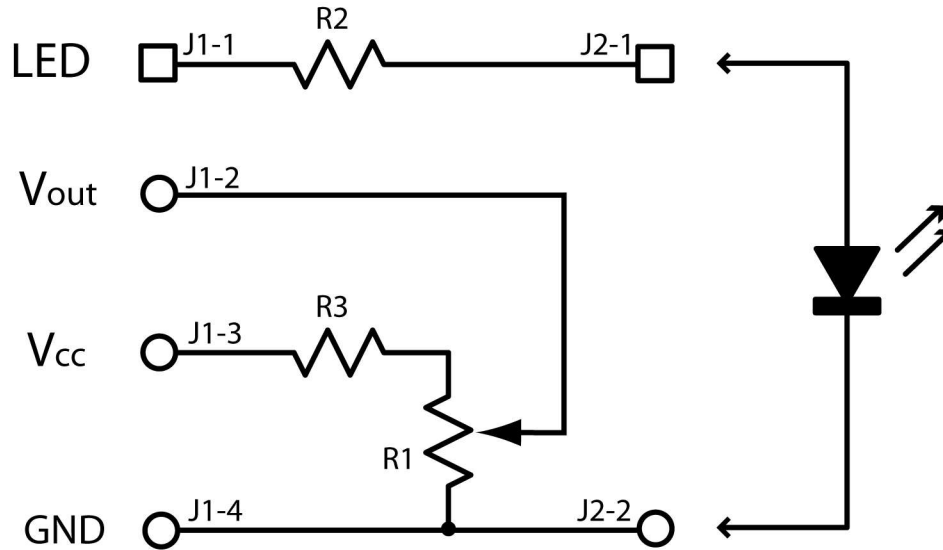


## Features

- Power supply voltage; VCC = 3.3-5V.
- RobiCon.org compliant (*Molex MicroBlade*) connector, 4-pin.
- RobiCon.org compliant board outline and mounting.
- Board Dimensions: 40mm x 20mm (WxD) – 1.57"W x 0.79"D
- Height and Width varies with potentiometer part used.

## Block Diagram

A block diagram representing the potentiometer board is shown below.



### Potentiometer

The potentiometer consists of .

The output of the potentiometer is an analog value measuring 0V up to  $V_{cc}$ . Resistor  $R3$  Can be configured to limit the maximum output of the signal to match the input range of your analog input measuring device.

$$V_{out(max)} = \frac{R1}{R3+R1} \cdot V_{cc}$$

For a given potentiometer value ( $R1$ ), you can re-calculate  $R3$  to yield a desired maximum output voltage.

$$R3 = \frac{R1 \cdot V_{cc}}{V_{out(max)}} - R1$$

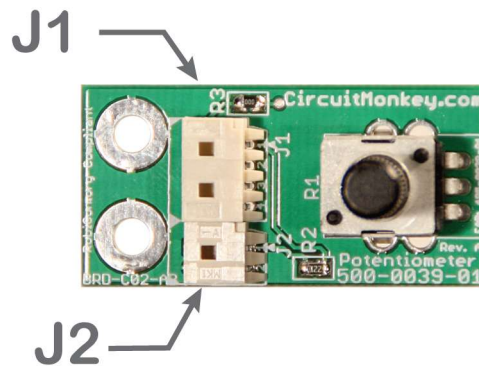
Our **default model** ships with  **$R3$**  value of zero ohms.  $V_{out(max)}$  therefore equals  $V_{cc}$ . Contact *Circuit Monkey* for custom configurations at little to no extra cost.

### LED Indicator (Optional)

The on-board LED indicator is an independent component on the board and is not logically connected to the potentiometer. The LED is actuated by an arbitrary I/O pin from the user's hardware.

An LED can be connected in a variety of ways including direct mounting, wire mounting and detachable cable harness. The default model comes with a *330 ohm* resistor at location **R2**, which will light most LEDs at a modest brightness (*when  $V_{cc} = 5V$* ). Contact *Circuit Monkey* for custom configurations.

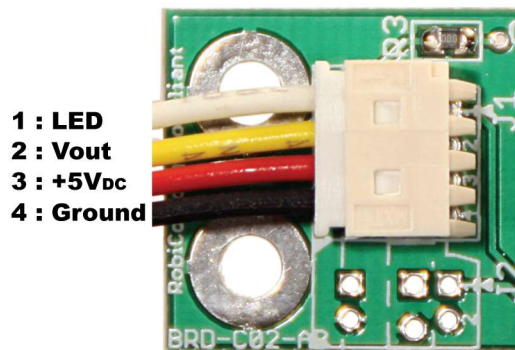
### Connectors



#### J1 – Main Connector

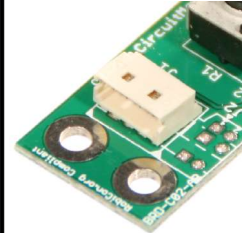
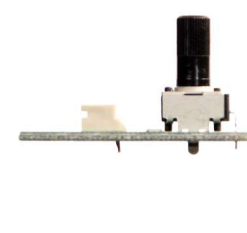
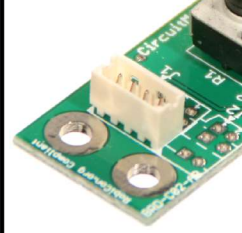



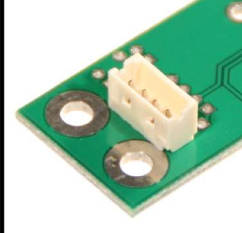
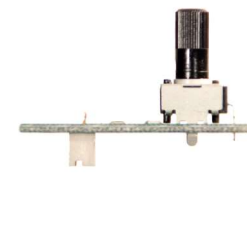
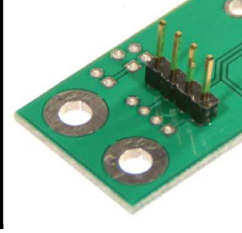

This connector features four contacts, LED, Potentiometer, +5V and Ground. For most applications, provide power to the board by hooking +5VDC to pin 3 and Ground on Pin 4. Connect pin 2 to your host processor. Connection of pin 1, is optional.

Pin	Description
1	LED Signal
2	Potentiometer - $V_{out}$
3	Vcc (+5VDC)
4	Ground



Alternate Configuration – Connector Types and Orientation

The PCB footprint for J1 and J2 features a combination of three connector row holes for various connector options show in this table below. Please note the position of pin 1 (the square-shaped pad) regardless of configuration.

<p>1. Right-Angle RobiCon – Top Mount – 2mm</p>		
<p>2. Vertical RobiCon – Top Mount - 2mm</p>		
<p>3. Pin Header – Top Mount – 2.54mm (0.1”)</p>		
<p>4. Vertical RobiCon – Bottom Mount – 2mm</p>		
<p>5. Pin Header – Bottom Mount – 2.54mm (0.1”)</p>		

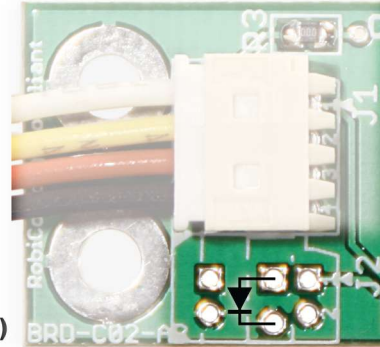
**J2 – External LED**

This connector features two contacts, LED (anode) and Ground (cathode). The LED anode pin (pin 2) is connected through a 330 ohm resistor from J1 pin 1. For most applications, hook the LED directly across pin 1 and 2. Configuration of this connector is optional. Notice that the J1 and J2

mounting holes are repeated here three times to accommodate a variety of connector/configuration options shown in the same manner above for the J1 description. Also note that pin 1's are the square pads. This pin is activated by the source device, usually an output pin on your microcontroller. J2 could also be configured as either a signal pass-through (described below) or even a switch or signal input.

Pin	Description
1	LED (Anode)
2	Ground (Cathode)

**1 : LED (anode)**  
**2 : Ground (cathode)**



### Alternate Configuration – Signal Passthrough

For some applications, the user may wish to pass the raw signal through from J1 pin 1 to J2 pin 1. In passthrough configuration, R2 would be replaced with a zero-ohm resistor.



## Applications

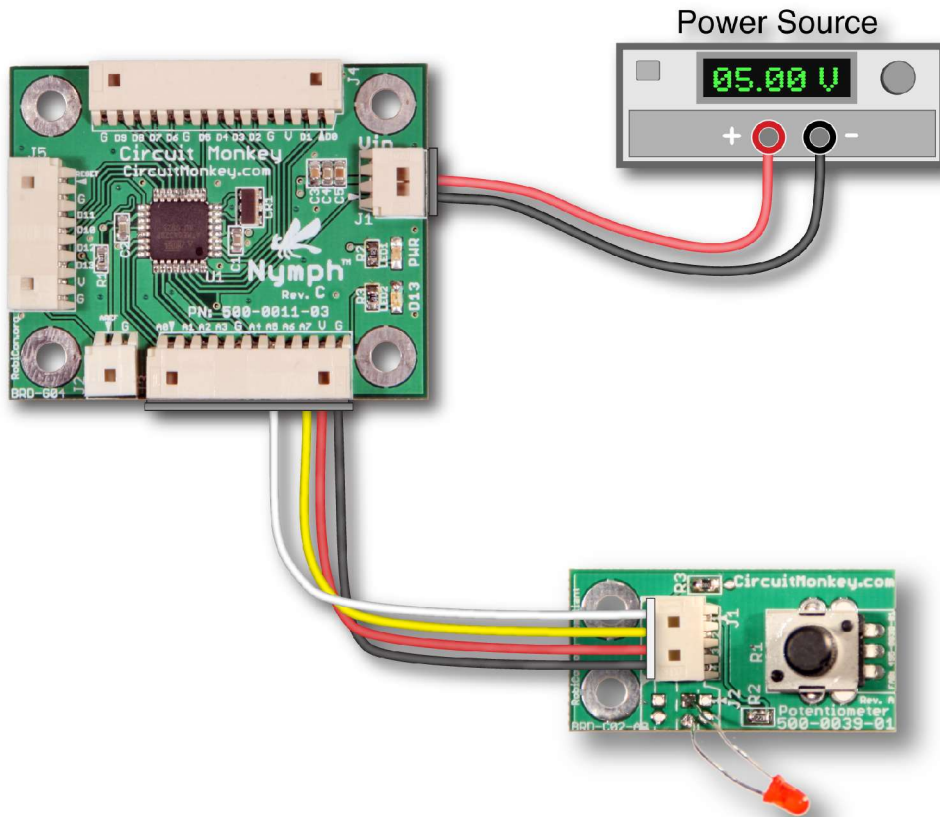
### Potentiometer Test

This test is designed to do the following:

- Read the potentiometer.
- Clockwise brightens the LED. Counter Clockwise dims the LED.

### Hookup

Our actual test hook-up is shown here. Test code follows in the next section.



Potentiometer Board J1 Pin	Description	Nymph Controller J3 Pin	Atmega328P Signal
1	LED Signal	7	PC5
2	Vout (potentiometer)	9	ADC7
5	+5V (Vcc)	10	
6	Ground	11	

Potentiometer Test Code ( for Atmega328P – Nymph Compatible )

Using the preceding hook-up diagram, one can test the functionality of the potentiometer board with the following code. It was designed to run on a *ATmega168/328* board. We tested with our own *Nymph* product but this code should also run on an *Arduino/Freduino* or similar board, as they are also *Atmel AVR* based.

```

/**
 Circuit Monkey
 500-0039-01 -- Potentiometer Board Test

 Designed for Nymph (ATmega328) Microcontroller

 Author: Mark J Koch

 Description: The 500-0039-01 Potentiometer board features a potentiometer
 and LED on a RobiCon.org compliant printer circuit board (PCB). The board
 features a 4-pin RobiCon compliant connector which supplies Ground, Power
 (+5VDC), digital LED signal and analog potentiometer value.

 500-0039-01 Pin-out:
 1 - LED -- PC5
 2 - Potentiometer -- ADC7
 3 - Vcc (+5VDC)
 4 - GND

 The potentiometer board may also come in configurations with only a 3-pin
 connector which does not actuate the LED.
=====
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SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS
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ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE
POSSIBILITY OF SUCH DAMAGE.
=====
**/
#include <avr/io.h>
#include <stdio.h>
#include <util/delay.h>

```

```

#define F_CPU 16000000UL // 16MHz

// Misc Defines
#define OFF 0
#define ON 1
#define ADC_VREF_TYPE 0x40 // AVcc pin ( +5V on Nymph)

// Facade for _delay_us
// Helps reduce binary size since _delay_us needs a float value
// and we want to use an int value. Calling the float version
// all over your code would bloat your hex binary.
void delayUs(unsigned int us)
{
    while(us) {
        _delay_us(0.97);
        us--;
    }
}

void initADC(void) {
    ACSR=0x80;
    ADMUX=ADC_VREF_TYPE;
    ADCSRA=0x85;
}

unsigned int readADC(unsigned char channel) {
    ADMUX=channel|ADC_VREF_TYPE;
    ADCSRA|=0x40; // Start the AD conversion
    while ((ADCSRA & 0x10)==0); // Wait for the AD conversion to complete
    ADCSRA|=0x10; // Stop the conversion
    return ADCW;
}

void initLED() {
    DDRC |= (1<<DDC5); // PC5
    PORTC &= ~(1<<DDC5); // UnSet the bit
}

void setLED(int b) {
    if ( b ) {
        PORTC |= (1<<DDC5); // Set the bit
    } else {
        PORTC &= ~(1<<DDC5); // UnSet the bit
    }
}

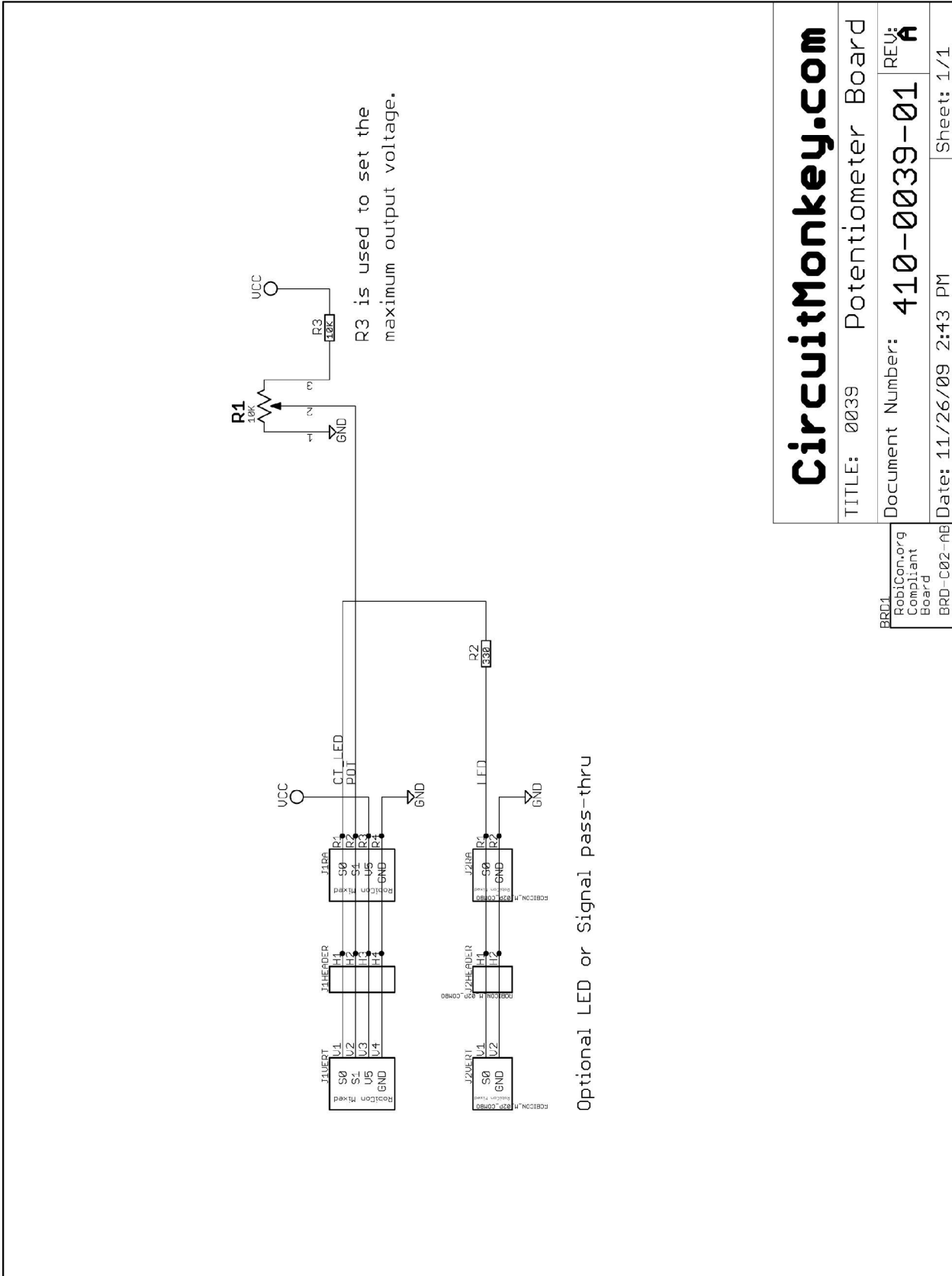
int main(void)
{
    int adc;

    initLED();
    initADC();

    while (1) {
        adc = readADC(7); // Pin ADC7
        setLED(ON);
        delayUs(10*adc);
        setLED(OFF);
        delayUs(10*(1024-adc));
    }
    // Never gets here.
    return(0);
}

```

# Schematic



**CircuitMonkey.com**

TITLE: 0039	Potentiometer Board
Document Number: 410-0039-01	REV: A
Date: 11/26/09 2:43 PM	Sheet: 1/1

BRD1  
RobiCon.org  
Compliant  
Board  
BRD-C02-AB

## Parts List

### J1 Stuffing Options

Part	Description
<i>Molex 53014-0410</i>	Vertical <i>RobiCon</i>
<i>Molex 53015-0410</i>	Right-Angle <i>RobiCon</i>
<i>Molex 22-28-4045</i>	Straight Pin Header, 4-pin

### J2 Stuffing Options

Part	Description
<i>Molex 53014-0210</i>	Vertical <i>RobiCon</i> , 2-pin
<i>Molex 53015-0210</i>	Right-Angle <i>RobiCon</i> , 2-pin
<i>Molex 22-28-4025</i>	Straight Pin Header, 2-pin
<i>Kingbright WP63ID (or similar)</i>	LED, Through Hole type. The on-board 330ohm dropping resistor is calculated to run the LED at ~10mA. If you need more brightness consider a more optimal resistor value for your application. We'll be happy to stuff any other resistor value you want at no charge (if we have it in stock).

### R1 Stuffing Options

Part	Description
<i>Bourns PTV09A-*</i>	<i>Bourns</i> PTV09A Series 9mm Potentiometer

All variants of the Bourns PTV09A series potentiometers should mount to this board. We can sell you bare or partially stuffed boards upon request. Please note that most distributors only stock a few variants/values of this part. Our selection is limited to what we can readily order.

### SMT Resistors

These resistors are 0805 (0.08" x 0.05") type surface mount. You will need a fine point soldering iron and some skill to change these parts. However, there are many tutorials on the web describing techniques for unsoldering and soldering these small components. *Circuit Monkey* is happy to change the values to your specifications when you order. If you already have a board, we'll do it for free if you pay the return postage (usually first class in the USA). Contact us first to arrange this.

## Appendix A: References and Links

### ***Links***

#### Circuit Monkey

<http://www.circuitmonkey.com>

#### RobiCon.org

A proposed open standard for Robotics Interconnect. Currently lead by the owner of *Circuit Monkey*.

<http://www.robicon.org>

#### Atmel

Manufacturers of the *AVR/ATmega* microcontroller chips.

<http://atmel.com/products/AVR/>

#### Bourns

Manufacturers of potentiometers and other electronic components.

<http://bourns.com>

#### Mouser.com

A popular parts distributor.

<http://mouser.com>

#### DigiKey.com

Another popular parts distributor.

<http://digikey.com>