

## What We're Doing:

What's the next phenomena we will measure with our Arduino? Temperature. To do this we'll use a rather complicated IC (integrated circuit) hidden in a package identical to our P2N2222AG transistors. It has three pins ground, signal and +5 volts, and is easy to use. It outputs 10 millivolts per degree centigrade on the signal pin (to allow measuring temperatures below freezing there is a 500 mV offset eg. 25° C = 750 mV, 0° C = 500mV). To convert this from the digital value to degrees we will use some of the Arduino's maths abilities. Then to display it we'll use one of the IDE's rather powerful features, the debug window. We'll output the value over a serial connection to display on the screen. Let's get to it.

One extra note, this circuit uses the Arduino IDE's serial monitor. To open this, first upload the program then click the button which looks like a square with an antennae.

The TMP36 Datasheet:  
<http://tinyurl.com/plbx38>

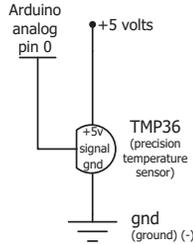


## The Circuit:

### Parts:

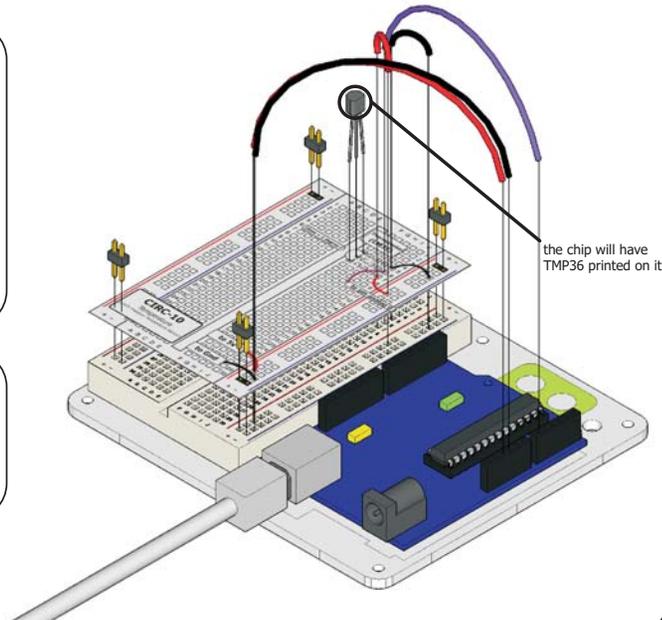
CIRC-10 Breadboard sheet x1  
 2 Pin Header x4  
 TMP36 Temperature Sensor x1  
 Wire

### Schematic:



### The Internet

.:download.:  
 breadboard layout sheet  
<http://tinyurl.com/ctdjod>  
 .:view.:  
 assembling video  
<http://tinyurl.com/d85jyx>



## Code

(no need to type everything in just)

Download the Code from (<http://tinyurl.com/dfj8rs>)

(copy the text and paste it into an empty Arduino Sketch)

```

/*
 * | Arduino Experimentation Kit Example Code |
 * | CIRC-10 .: Temperature .: |
 * |-----|
 *
 * A simple program to output the current temperature
 * to the IDE's debug window
 * For more details on this circuit:
 * http://tinyurl.com/c89tvd */

//TMP36 Pin variables
int temperaturePin = 0; //the analog pin the TMP36's
                        //Vout pin is connected to
                        //the resolution is
                        //10 mV / degree centigrade
                        //(500 mV offset) to make
                        //negative temperatures an option

void setup()
{
  Serial.begin(9600); //Start the serial connection
                    //with the copmuter
                    //to view the result open the
                    //serial monitor
                    //last button beneath the file
                    //bar (looks like a box with an
                    //antennae)
}

void loop()          // run over and over
again
  {
    float temperature =
    getVoltage(temperaturePin);
    //getting the voltage reading from the
    //temperature sensor

    temperature = (temperature - .5) * 100; //converting from 10 mv
    //per degree wit 500 mv offset to
    //degrees ((voltage - 500mv) times 100)
    Serial.println(temperature); //printing the result
    delay(1000); //waiting a second

    /*
    * getVoltage() - returns the voltage on the analog input
    * defined by pin
    */
    float getVoltage(int pin){
      return (analogRead(pin) * .004882814); //converting from a 0
      //to 1024 digital range
      //to 0 to 5 volts
      //each 1 reading equals ~ 5 millivolts
    }
  }
}

```

## Not Working?

(3 things to try)

### Nothing Seems to Happen

This program has no outward indication it is working. To see the results you must open the Arduino IDE's serial monitor. (instructions on previous page)

### Gibberish is Displayed

This happens because the serial monitor is receiving data at a different speed than expected. To fix this, click the pull-down box that reads "\*\*\* baud" and change it to "9600 baud".

### Temperature Value is Unchanging.

Try pinching the sensor with your fingers to heat it up or pressing a bag of ice against it to cool it down.

## Making it Better

### Outputting voltage:

This is a simple matter of changing one line. Our sensor outputs 10mv per degree centigrade so to get voltage we simply display the result of getVoltage().

```
delete the line   temperature = (temperature - .5) * 100;
```

### Outputting degrees Fahrenheit:

Again this is a simple change requiring only math. to go degrees C ----> degrees F we use the formula.

$$(F = C * 1.8) + 32)$$

```
add the line
temperature =
(((temperature - .5) * 100)*1.8) + 32;
before Serial.println(temperature);
```

### More informative output:

Lets add a message to the serial output to make what is appearing in the Serial Monitor more informative. To do

this first revert to the original code then change:

```
Serial.println(temperature);
```

```
---->
```

```
Serial.print(temperature);
```

```
Serial.println(" degrees centigrade");
```

The change to the first line means when we next output it will appear on the same line, then we add the informative text and a new line.

### Changing the serial speed:

If you ever wish to output a lot of data over the serial line time is of the essence. We are currently transmitting at 9600 baud but much faster speeds are possible. To change this change the line:

```
Serial.begin(9600); ----> Serial.begin(115200);
```

Upload the sketch turn on the serial monitor, then change the speed from 9600 baud to 115200 baud in the pull down menu. You are now transmitting data 12 times faster.

## More, More, More:

More details, where to buy more parts, where to ask more questions.

<http://tinyurl.com/c89tvd>