

Make an Arduino Temperature Sensor (Thermistor Tutorial)

[Circuit Basics](#) > [Arduino](#)

By [Scott Campbell](#)

Thermistors are simple, inexpensive, and accurate components that make it easy to get temperature data for your projects. Remote weather stations, home automation systems, and equipment control and protection circuits are some applications where thermistors would be ideal. They're analog sensors, so the code is relatively simple compared to digital temperature sensors that require special libraries and lots of code.

In this article, I'll explain how thermistors work, then I'll show you how to set up a basic [thermistor](#) circuit with an [Arduino](#) that will output temperature readings to the serial monitor or to an LCD.

BONUS: I made a quick start guide for this tutorial that you can [download](#) and go back to later if you can't set this up right now. It covers all of the steps, diagrams, and code you need to get started.

Watch the video for this tutorial here:

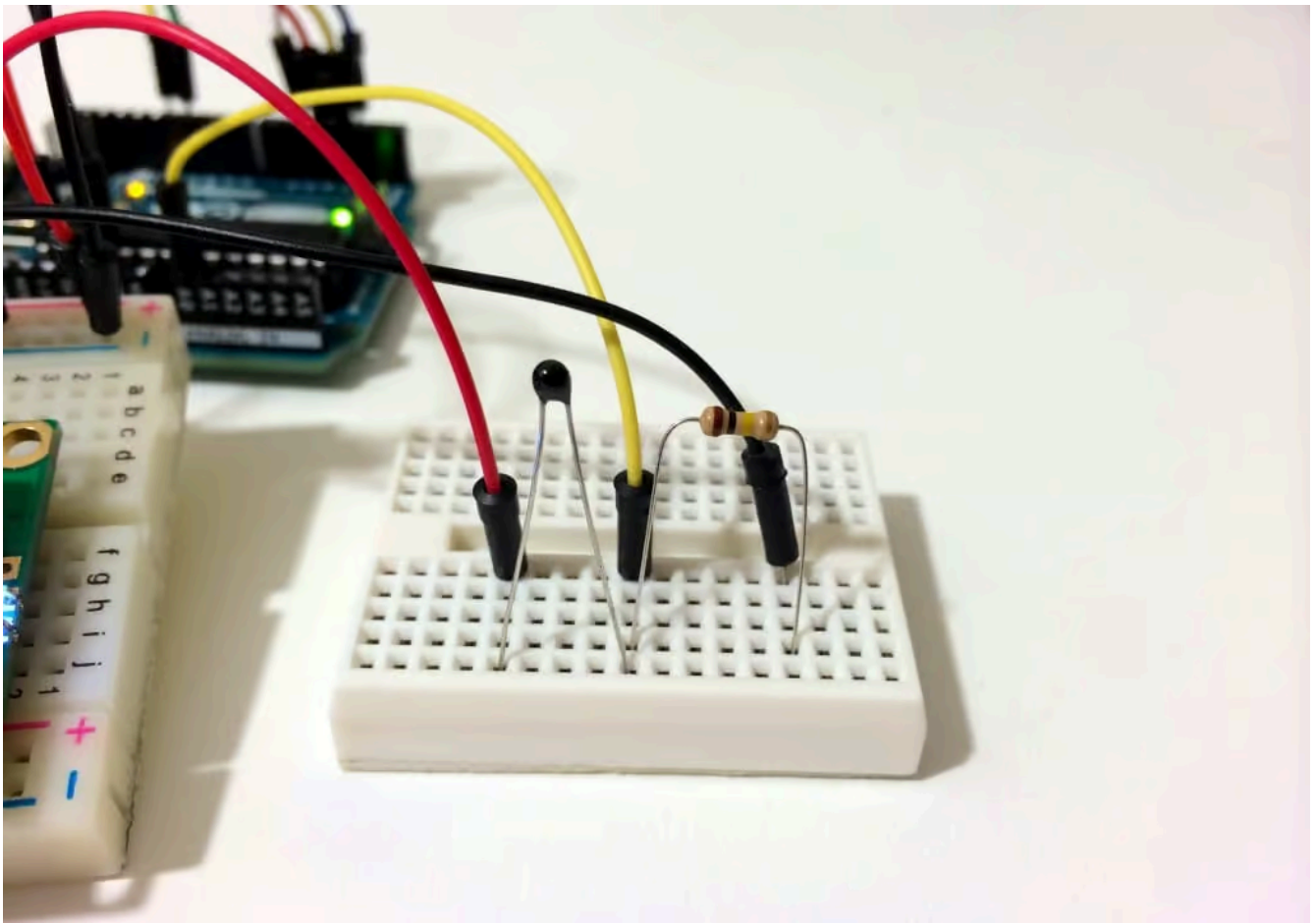
The [3-in-1 Smart Car and IOT Learning Kit](#) from SunFounder has everything you need to learn how to master the Arduino. It includes all of the parts, wiring diagrams, code, and step-by-step instructions for 58 different robotics and internet of things projects that are super fun to build!

How a Thermistor Works

Thermistors are variable resistors that change their resistance with temperature. They are classified by the way their resistance responds to temperature changes. In *Negative Temperature Coefficient (NTC)* thermistors, resistance decreases with an increase in temperature. In *Positive Temperature Coefficient (PTC)* thermistors, resistance increases with an increase in temperature.

NTC thermistors are the most common, and that's the type we'll be using in this tutorial. NTC thermistors are made from a semiconducting material (such as a metal oxide or ceramic) that's been heated and compressed to form a temperature sensitive conducting material.

The conducting material contains *charge carriers* that allow current to flow through it. High temperatures cause the semiconducting material to release more charge carriers. In NTC thermistors made from ferric oxide, electrons are the charge carriers. In nickel oxide NTC thermistors, the charge carriers are [electron holes](#).



A Basic Thermistor Circuit

Let's build a basic thermistor circuit to see how it works, so you can apply it to other projects later.

Since the thermistor is a variable resistor, we'll need to measure the resistance before we can calculate the temperature. However, the Arduino can't measure resistance directly, it can only measure voltage.

The Arduino will measure the voltage at a point between the thermistor and a known resistor. This is known as a voltage divider. The equation for a voltage divider is:

$$V_{out} = V_{in} \times \left(\frac{R2}{R1 + R2} \right)$$

In terms of the voltage divider in a thermistor circuit, the variables in the equation above are:

V_{out} : Voltage between thermistor and known resistor

V_{in} : V_{cc} , i.e. 5V

$R1$: Known resistor value

$R2$: Resistance of thermistor

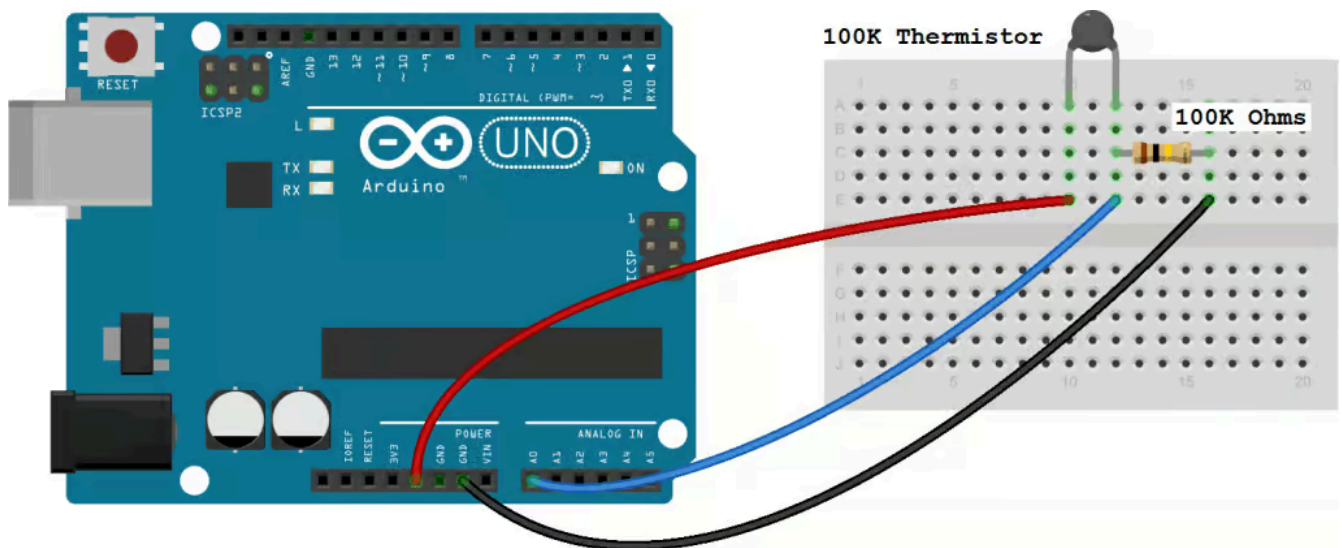
This equation can be rearranged and simplified to solve for $R2$, the resistance of the thermistor:

$$R2 = R1 \times \left(\frac{V_{in}}{V_{out}} - 1 \right)$$

Finally, the [Steinhart-Hart equation](#) is used to convert the resistance of the thermistor to a temperature reading.

Connect the Circuit

Connect the thermistor and resistor to your Arduino like this:



The value of the resistor should be roughly equal to the resistance of your thermistor. In this case, the resistance of my thermistor is 100K Ohms, so my resistor is also 100K Ohms.

The manufacturer of the thermistor might tell you it's resistance, but if not, you can use [a multimeter](#) to find out. If you don't have a multimeter, you can make an Ohm meter with your Arduino by following our [Arduino Ohm Meter](#) tutorial. You only need to know the magnitude of your thermistor. For example, if your thermistor resistance is 34,000 Ohms, it is a 10K thermistor. If it's 340,000 Ohms, it's a 100K thermistor.

Code for Serial Monitor Output of Temperature Readings

After connecting the circuit above, upload this code to your Arduino to output the temperature readings to the serial monitor in Fahrenheit:

```
int ThermistorPin = 0;
int Vo;
float R1 = 10000;
float logR2, R2, T;
float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;

void setup() {
  Serial.begin(9600);
}

void loop() {

  Vo = analogRead(ThermistorPin);
  R2 = R1 * (1023.0 / (float)Vo - 1.0);
  logR2 = log(R2);
  T = (1.0 / (c1 + c2*logR2 + c3*logR2*logR2*logR2));
  T = T - 273.15;
  T = (T * 9.0) / 5.0 + 32.0;

  Serial.print("Temperature: ");
  Serial.print(T);
```

```

    Serial.println(" F");
    delay(500);
}

```

To display the temperature in degrees Celsius, just comment out line 18 by inserting two forward slashes (“//”) at the beginning of the line.

This program will display Celsius and Fahrenheit at the same time:

```

int ThermistorPin = 0;
int Vo;
float R1 = 10000;
float logR2, R2, T, Tc, Tf;
float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;

void setup() {
  Serial.begin(9600);
}

void loop() {

  Vo = analogRead(ThermistorPin);
  R2 = R1 * (1023.0 / (float)Vo - 1.0);
  logR2 = log(R2);
  T = (1.0 / (c1 + c2*logR2 + c3*logR2*logR2*logR2));
  Tc = T - 273.15;
  Tf = (Tc * 9.0) / 5.0 + 32.0;

  Serial.print("Temperature: ");
  Serial.print(Tf);
  Serial.print(" F; ");
  Serial.print(Tc);
  Serial.println(" C");

  delay(500);
}

```

Code for LCD Output of Temperature Readings

To output the temperature readings to a [16X2 LCD](#), follow our tutorial, [How to Set Up an LCD Display on an Arduino](#), then upload this code to the board:

```

#include <LiquidCrystal.h>

int ThermistorPin = 0;
int Vo;
float R1 = 10000;
float logR2, R2, T;
float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  Serial.begin(9600);
}

void loop() {

  Vo = analogRead(ThermistorPin);
  R2 = R1 * (1023.0 / (float)Vo - 1.0);
  logR2 = log(R2);
  T = (1.0 / (c1 + c2*logR2 + c3*logR2*logR2*logR2));
  T = T - 273.15;

```

```
T = (T * 9.0) / 5.0 + 32.0;

lcd.print("Temp = ");
lcd.print(T);
lcd.print(" F");

delay(500);
lcd.clear();
}
```

Here's a video of the temperature sensor so you can watch me set it up and see how it works:



Well, that's about it. Just leave a comment below if you have any questions about this project. And if you like our articles here at Circuit Basics, subscribe and we'll let you know when we publish new articles. Also, feel free to share this if you know anyone that would find it helpful!

Related Posts

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5. Switch Case

```
switch (condition) {
  case 1:
    body;
  case 2:
    body;
  default:
}
```

Using Switch Case Statements in Arduino Programming



How to Use Functions in Arduino Programming

Arduino

How to Setup 9-Axis Sensors on the Arduino

Leave a Comment

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Write a comment...

Name*

Email*

Post Comment

gasour says:

January 17, 2016 at 5:47 am

thank you very much

Reply

→ *Isra* says:

June 25, 2018 at 8:12 am

Is connecting wires mean arduino 40 pin female to female jumper connector?

Reply

Phil says:

January 26, 2016 at 8:48 am

Hi,

I've seen your Videos on Youtube and came to your website. Great!

I tried to do make the circuit with the Thermistor (81210W26) and had a strange problem.

I followed the instructions and put the same resistance as the thermistors resistance worth but the Temperature goes down instead to increase when I warm it up. I tried to invert the Thermistor and gained the knowledge that this doesn't effect it. The temperature of the room is displayed correctly (I have 25°C and the Thermistor displays 25°C)

Also the Temperature goes down to slowly. Exemple: if I have 25°C in the room and take the thermistor in the hand, it decreases only 2°C although I'm still alive. :o)

Have you got an Idea where I have to search for the problem?

Thank you very much for your help.

Phil

Reply

→ *Kannan* says:

June 25, 2019 at 6:59 am

I'm also facing similar problem. When hold the thermistor is temperature getting reduced. Have u find the solution to above issue

Reply

→ *billf* says:

March 14, 2019 at 2:34 am

line 14, change $R1 * (102... \text{ to } R1 / (102...$

Reply

→ *Jerry* says:

September 28, 2016 at 12:08 am

Perhaps a bit late, but I experienced the same problem. I reversed the + and – leads and this solved it, leaving the center lead the same. Not sure what that had to do with anything, but it worked for me.

Reply

→ *Bryce Bailey* says:

February 18, 2020 at 5:29 am

I was wondering in the video, how did you get the lcd to work without a potentiometer?

Reply

→ *Circuit Basics* says:

August 1, 2016 at 3:34 pm

Hi Phil,

I couldn't find any information on your specific thermistor, but it sounds like the problem could be related to if your thermistor is PTC (positive temperature coefficient) or NTC (negative temperature coefficient). The thermistor I used in this article is a NTC thermistor, so if you have a PTC thermistor, it could cause the temperature changes to become opposite from what you would expect. I don't have a PTC thermistor to experiment with, so I'm not sure what the code would look like for a PTC thermistor.

Reply

→ *Andrew* says:

November 3, 2016 at 10:50 am

Hello to everyone, a little help please? I want to build a thermistor temp sensor using arduino (as in above circuit) but then need to convert measured temperature in degrees centigrade to air flow in meters per second, and be able to display on screen, and record this via computer. Any help suggestions greatly appreciated.

regards

Andrew

Reply

→ *valid* says:

January 16, 2017 at 12:24 pm

only before line Number 8 put double slash (//) like that exmple
// Temp = (Temp * 9.0)/ 5.0 + 32.0;

Reply

→ *ranger4868* says:

January 19, 2017 at 7:48 pm

Jesus man thanks a lot you are savior :D :D

Reply

Krissy says:

January 28, 2016 at 5:26 pm

i need a heat temperature sensor but it is very expensive. i'm working on a project and i need to heat a metal up to 150 degrees to test it on my machine cooler project. Is this thermistor temperature sensor can measure up to 150 degrees? I am looking forward to your response. Thank you very much.

Reply

→ *Circuit Basics* says:

August 1, 2016 at 3:37 pm

Hi Krissy, the operating temperature range for this thermistor is -50 ~ +260°C

Reply

•

Sorin says:

February 1, 2016 at 10:07 pm

I tried the project with the LCD. The value read is double than the real value in the room. So on line 10 for LCD I did : " Temp = (Temp – 273.15)/2; " and I had the normal value that was supposed to be.

Probably I will have to study this equation.

Or maybe there is something else?

Reply

→ *Sohan* says:

May 29, 2018 at 12:18 pm

You might try to check the value of the resistor you are using!bc i was using a 220 ohm resistor. And by changing the "R" value you will get the correct readings without changing the calculation part of the program.

Reply

Taleh says:

February 23, 2016 at 11:06 pm

Hello, I math.h download? Where can I download it?

Reply

→ *Nevin* says:

August 28, 2016 at 4:37 pm

hello i have had the same question ,, but after some research i found out that you dont need to download it it and that it already comes with the arduino IDE ...hope this helped

Reply

ADC says:

March 3, 2016 at 4:45 pm

Eventhough im using math.h headfile in my test file im getting the error.

The error is

" /tmp/cc8vrcYJ.o: In function `ThermistorF':

test1.c:(.text+0x7c): undefined reference to `log'

/tmp/cc8vrcYJ.o: In function `ThermistorC':

test1.c:(.text+0x284): undefined reference to `log'

collect2: error: ld returned 1 exit status "

what is the solution for this problem. Im using the same concept for other controller. The code is littile bit different accroding to the controller but it showing error at reading log function from math.h.

What is the solution for this.

Give me reply ASAP.

Reply

•

ADC says:

March 4, 2016 at 5:04 am

I rectified that error. Now my problem is as im increasing the temperature the value which is showing on the LCD is decreasing im not getting why this is happening. Here i am using NTC (negative temperature coefficient) thermistor p103. Can any one tell me how to rectify this problem.

Reply

utpal597@gmail.com says:

March 15, 2016 at 8:18 pm

please help me
how can i add this alarm

Reply

ggb says:

March 22, 2016 at 7:18 am

Hi There!

it works brilliantly but could you suggest me how to put 2 thermistors that give 2 readings simultaneously in Celsius?

Reply

•

ssvvdeepak says:

March 24, 2016 at 5:52 pm

Hi

could you suggest me how to put 3 thermistors that give 3 readings simultaneously in Celsius?.. im trying to connect from 2 weeks but im not able to.please help me.

Reply

Miro016 says:

April 13, 2016 at 8:05 pm

Hello! I have a question about Steinhart-Hart equation. In the first code in the fifth line, here: $Temp = \log(10000.0 * ((1024.0 / RawADC - 1)))$; I don't understand why we have to use "RawADC-1"? Why we have to do that minus one? Can anyone give me a good answer? Thanks

Reply

→ *dhm77* says:

March 17, 2019 at 8:54 pm

First it's not "RawADC-1" but rather (1024.0/RawADC)-1 since the multiplication takes precedence over the subtraction.

Actually it should really be 1023 instead of 1024 since you can only read from 0 to 1023 from the port.

Or if you prefer it's (1023.0-RawADC)/RawADC which can directly be deducted from wiring the NTC to the 5V and R1 to the GND.

If you connect it backward (NTC to GND and R1 to 5V) then the equation would be

$R2 = R1 * \text{RawADC} / (1023.0 - \text{RawADC})$ however, in this case you might want to use 1024 to avoid dividing by zero if your NTC opens up or get disconnected.

Reply

→ *adam* says:

August 16, 2016 at 6:35 pm

It has do with the math... check out Adafruit's page on thermistors

<https://learn.adafruit.com/thermistor/using-a-thermistor>

Reply

Mad Alex says:

June 18, 2016 at 12:04 am

Muhamed Boshra Serag Eldin

Reply

•

Rafi Rafsan says:

August 2, 2016 at 2:44 pm

didnt understand line 5 and 6.can anyone explain whats going on there?

Reply

mitch says:

August 5, 2016 at 5:51 am

hi, I am using a 100k glass bead thermistor (meant for 3d printing), and wired it up like you showed and uploaded the code. when i visit the serial monitor the temperature given there is negative and makes no sense whatsoever . Please tell me what is happening.

Reply

→ *Nomad* says:

March 22, 2021 at 5:29 pm

I had the same problem, just for the heck of it, I tried moving the vin from 3.3 volts to 5 volts and suddenly it all began working. where I was getting 456 F I am now getting 74 F Perhaps these

glass rod sensor's are very voltage sensitive.

Reply

→ *Chris* says:

April 26, 2018 at 12:24 pm

hi, if you are still interested use 100K thermistor and use the following co-efficiency $c_1 = 0.7203283552e-3$ $c_2 = 2.171656865e-4$ and $c_3 = 0.8706070062e-7$. You can also calculate your own three resistors values and put the on the following link it will calculate the co-efficiency for you <http://www.thinksrs.com/downloads>

Reply

→ *balkanhosting* says:

August 17, 2016 at 8:23 pm

Same here.....

Reply

Huỳnh Ngọc Thương says:

August 20, 2016 at 5:37 am

hi , can this sensor mesure temperature for health ???
sorry about my bad english ! thanks

Reply

•

I says:

August 23, 2016 at 9:07 am

NTC-MF52AT 10K 3950 equation matching range:
http://www.rixratas.ee/jaga/jaga.php?fn=NTC_MF52AT_10K.jpg

Reply

Steven S. says:

September 1, 2016 at 5:21 pm

Hello, Yesterday I did it correctly and temperature went up upon touch nevertheless, today The measurement goes down when touched, any idea of what could have happened? I have been using the same resistors and thermistor

Reply

jm says:

September 27, 2016 at 12:53 pm

what do you call the digital monitor that is small in the video

Reply

•

Jerry says:

October 1, 2016 at 1:12 am

Thanks a million for the video and sketch. I am building a temp sensor for our local paranormal group (no I am not into ghosts, but my niece is, so this is for her.) So what I need to do, is store the initial temp in a variable, then check the subsequent temps against that temp, and besides reporting the temp, report on the next line weather temps rise or fall, as well as light a red LED if the temp rises, a blue LED if it falls, and a green LED if it remains the same. Should be easy to set this up by editing your sketch, I think, oh and a main switch to turn this unit off and on, as well as hooking up say a 9v battery for power to the unit, again simple, but as I go on, it seems to be more and more complicated.

Reply

Naren Ka Nnan says:

October 1, 2016 at 2:03 pm

Arduino: 1.6.11 (Windows 10), Board: "Arduino/Genuino Uno"

Sketch uses 4,176 bytes (12%) of program storage space. Maximum is 32,256 bytes.

Global variables use 222 bytes (10%) of dynamic memory, leaving 1,826 bytes for local variables. Maximum is 2,048 bytes.

avrdude: ser_open(): can't open device "\\.\COM1": The system cannot find the file specified.

Problem uploading to board. See <http://www.arduino.cc/en/Guide/Troubleshooting#upload> for suggestions.

This report would have more information with

"Show verbose output during compilation"

option enabled in File -> Preferences.

Reply

Ilija Grba says:

October 13, 2016 at 12:14 pm

I need help.

I want to know which is the maximum operating temperature resistors and capacitors for Arduino uno?

Reply

•

Stuart Durston says:

November 9, 2016 at 12:33 am

To add more thermistors keep adding the following code and change the analogue read pin. Note that you cannot connect your additional thermistors to the same voltage supply unless you change the mathematical equation as you will change the resistance of the circuit each time you add a thermistor.

```
valF=analogRead(1);
```

```
tempF=ThermistorF(valF);  
valC=analogRead(1);  
tempC=ThermistorC(valC);  
Serial.print("Temperature = ");  
Serial.print(tempC);  
Serial.println(" C");  
delay(1000);
```

```
valF=analogRead(2);  
tempF=ThermistorF(valF);  
valC=analogRead(2);  
tempC=ThermistorC(valC);  
Serial.print("Temperature = ");  
Serial.print(tempC);  
Serial.println(" C");  
delay(1000);
```

```
valF=analogRead(3);  
tempF=ThermistorF(valF);  
valC=analogRead(3);  
tempC=ThermistorC(valC);  
Serial.print("Temperature = ");  
Serial.print(tempC);  
Serial.println(" C");  
delay(1000);
```

Reply

jalal niazi says:

November 30, 2016 at 12:16 pm

In your video you have used 100k ohm resistor with thermister but in the other part of the video you have used two other resistors with 16x2 lcd !! So my problem is that you have not declare the resistor's quality and its number in the start of video !! so plz mention the type of these two resistors quickly because it is my project THANKYOU !!

Reply

→ **Scott** says:

January 6, 2017 at 8:50 am

Hi, those resistors set the lcd's backlight brightness and contrast. They can be a range of values, but potentiometers are probably best to use there. Check out this article for more info:

<https://www.circuitbasics.com/how-to-set-up-an-lcd-display-on-an-arduino/>

Reply

Kristof says:

January 22, 2017 at 3:59 pm

Great tutorial. I wonder if it is possible to use a potmeter instead of a thermistor, so I could simulate the temperatures ?

Reply

→ *Circuit Basics* says:

May 11, 2017 at 4:41 pm

Absolutely, thermistors are basically just variable resistors, like potentiometers. Instead of using the voltage divider, just connect the signal wire to the center pin, and the positive and negative wires to the outside pins...

Reply

•

Nguyenthanh Chinh says:

February 4, 2017 at 5:34 am

Please tell me: why this code can not compile with Energia?

Error compiling: undefined reference to 'log'

collect2: ld returned 1 exit status

Thanks so much!

Reply

Alen Kalati says:

February 6, 2017 at 8:00 pm

Finally, a good quality video, and no BS waste of time, on Arduino setup and programming. Thanks!

Reply

youbi says:

February 17, 2017 at 1:09 pm

Hello I do not have the data sheet of my thermistor how to dO MY PROGRAM?

Reply

•

hana says:

April 21, 2017 at 7:06 am

hi...anyone please help me...hopefully there is someone who can tell me...

can I know what is the actually thermistor sensor....it is sensor for human body temperature or environment

Reply

→ *Circuit Basics* says:

May 11, 2017 at 4:38 pm

The thermistor used in this article is mainly used for sensing environmental temperatures. It could be used for human body temperatures, but it depends on how you want to measure the body temperature. Since the human skin acts as a thermal insulator, the temperature of the skin isn't an accurate representation of actual body temperature. That's why most body temperatures are taken with an oral thermometer. The problem with using this thermistor orally is that the exposed leads of the thermistor would be partially shorted by the saliva in the mouth. But that said, I have seen some thermistors that have the leads insulated with plastic so those could be used in aqueous environments. Also, you could use this thermistor to take body temperature from the armpit, which is pretty close to the actual body temperature. Hope that helps!

Reply

Pol says:

April 24, 2017 at 6:59 pm

Hi.

I have just made it and is working very well and very fast.

Now i will try to put together with a lcd keypad shield nad a relay and make a thermostat.

But i would like to ask if its possible to the

change the thermometer value with the shield buttons .

So if i want to make any changes i will not need the use of a pc or laptop.

Than you for all tutorials.

Great presentation.

Pol

Reply

Gustavo alonso says:

April 28, 2017 at 12:03 am

¿Se puede cambiar ese termistor por un RTD de platino (WZP – PT100) de 100ohms?

Reply

•

Twmaster says:

May 14, 2017 at 1:15 am

Most excellent tutorial. Exactly what I needed to complete my project to read temperature and display on a little OLED display.

Reply

Akash Singh says:

May 26, 2017 at 6:15 pm

What if I want to use more than one thermistor to sense different temperatures, say 10.
How will the schematic and code change? Any ideas for the new circuit?

Reply

Luis says:

June 13, 2017 at 1:46 pm

And if you want to connect more than one sensor, what code you will need to write?

Reply

•

marcos says:

July 4, 2017 at 1:39 pm

hi

$R1=10000$ in your example. is not wrong because you are used 100k resistor? if you use 100k resistor $R1$ must be = 100000?

thank you

Reply

→ *Viswendra nath* says:

September 17, 2017 at 9:01 am

I too have the same doubt

Reply

→ *Chris* says:

April 26, 2018 at 12:27 pm

hi, if you are still interested use 100K thermistor and use the following co-efficiency $c1 = 0.7203283552e-3$ $c2 = 2.171656865e-4$ and $c3 = 0.8706070062e-7$. You can also calculate your own three resistors values and put the on the following link it will calculate the co-efficiency for you <http://www.thinksrs.com/downloads>
cheers

Reply

→ *Ronald* says:

December 30, 2019 at 9:43 pm

unfortunately the link does not work anymore.

via wikipedia you can find an online and offline calculator.

for standart 100K 3d printer thermistors you can use the following settings:

float $c1=0.003517835373043556$, $c2=-0.0002577063055439601$,

$c3=0.000001766946404565146$; //c values berekend op

<https://sanjit.wtf/Calibrator/webCalibrator.html>

the included link is to the online calculator.

Reply

→ *Larry Dighera* says:

June 28, 2022 at 5:16 pm

Steinhart-hart calculator URL updated June 28, 2022:

<https://www.thinksrs.com/downloads/programs/Therm%20Calc/NTCCalibrator/NTCcalculator.htm>

Reply

Astha Singh says:

August 30, 2017 at 1:41 pm

We want to have a continuous record of body temperature instead of room temperature. Which thermistor should we use and how to connect it with arduino?

Reply

Teymur says:

October 13, 2017 at 7:32 am

thanks for this article

Reply

•

S ALOKA PATRO says:

November 3, 2017 at 5:28 am

how did u write 10k instead of 100k?

Reply

454ss says:

November 10, 2017 at 6:34 am

I followed the above steps exactly, however the numbers I get are negative 459 Fahrenheit and does not change at all. the only difference in the parts used is the thermistor. I believe its resistance is 24000 ohms and my resistor is 10kohms.

Reply

LastJoesph says:

January 25, 2018 at 3:05 pm

I have noticed you don't monetize your website, don't waste your traffic, you can earn additional cash every month because you've got hi quality content. If you want to know how to make extra money, search for: Mertiso's tips best adsense alternative

Reply

•
LEE YUNIS says:

February 10, 2018 at 9:28 pm

Can an one help me plzzz? I need to add a Bluetooth transmitter to my temp sensor program to inform me when the temp increases to 60 degrees . an help would be really appreciated. thanks

Reply

Santhamoorthy says:

February 20, 2018 at 3:08 am

Good

Reply

Al says:

April 25, 2018 at 5:36 pm

Any answer to the 10000 vs 100000 R1 resistor value in equation? I' built it with This part, as you part is out of stock:

https://www.amazon.com/dp/B06XR1TG5N/ref=sspa_dk_detail_2?psc=1

I'd like to find coefficients for it. Would they be the same?

Thanks, nice article!

Reply

→ *Chris* says:

April 26, 2018 at 12:45 pm

hi, if you are still interested use 100K thermistor and use the following co-efficiency $c_1 = 0.7203283552e-3$ $c_2 = 2.171656865e-4$ and $c_3 = 0.8706070062e-7$. You can also calculate your own three resistors values and put the on the following link it will calculate the co-efficiency for you
<http://www.thinksrs.com/downloads>
it works for me

Reply

→ *Larry Dighera* says:

June 29, 2022 at 6:04 pm

Here is the current URL:

<https://www.thinksrs.com/downloads/programs/Therm%20Calc/NTCCalibrator/NTCcalculator.htm>

Vishay also provides an on-line Steinhart-Hart calculator:

<https://www.vishay.com/en/thermistors/ntc-rt-calculator/>

Reply

→ *Yossi* says:

January 7, 2019 at 5:37 pm

The link does not work

Do you have an updated link?

Reply

→ *Ronald* says:

December 30, 2019 at 9:48 pm

unfortunately the link does not work anymore.

via wikipedia you can find an online and offline calculator.

for standart 100K 3d printer thermistors you can use the following settings:

float c1=0.003517835373043556, c2=-0.0002577063055439601,

c3=0.000001766946404565146; //c values berekend op

<https://sanjit.wtf/Calibrator/webCalibrator.html>

the included link is to the online calculator.

Reply

•

pblanos says:

April 26, 2018 at 10:24 am

Hi, how do you connect a capacitor to the circuit above ? Will this make the thermistor more stable?

Reply

Ben says:

May 7, 2018 at 6:54 pm

The rearranged formula for R2 seems to be incorrect. I believe the X (multiplication) should be a / (division).

Reply

→ *Ben* says:

May 14, 2018 at 3:11 pm

Actually the rearranged formula works fine assuming R2 is the thermistor. My confusion was caused by the misalignment of the voltage divider formula, which measures voltage across R2, and the rearranged formula, which measures voltage across R1. Algebraically you can't rearrange the 1st formula to get the 2nd.

Reply

→ *Alvin* says:

June 21, 2018 at 5:16 pm

I think that if $V_{out} = V_{in} * R2 / (R1 + R2)$, then $R2 = R1 * V_{out} / (V_{in} - V_{out})$, not $R2 = R1 * (V_{in} / V_{out} - 1)$ as indicated above. Had me confused for a while, but then I realised that $R1 = R2 (V_{in} / V_{out} - 1)$. However, R1 is not the unknown. If we make R1 the unknown, then we

end up with $R1 = R2 * V_{out} / (V_{in} - V_{out})$. I may actually build a circuit to see if this works.
Thanks.

Reply

→ Steve says:

August 2, 2019 at 6:22 pm

Alvin is correct. From the equation: $V_{out} = V_{in}(R2/(R1+R2))$, the R2 resistor is the one that connects to ground and R1 connects to 5V (or 3.3V). It appears you have the thermistor in the R1 position connected to 5V, but in your code comments you say R2 is the thermistor. If you swap the power and ground on the resistor circuit, then everything should work.

Reply

tika says:

May 28, 2018 at 4:06 am

There is only one problem with this circuit. Recommended max impedance for the atmega 328 analog inputs is 10K. The circuit will work fine if using only one analog input, but the adc readings will not be stable if using another analog input.

Reply

→ Ben says:

May 30, 2018 at 11:47 pm

Can you please elaborate? I don't understand why there is a max impedance on the analog inputs. Shouldn't they read any voltage value as it is? I was planning on using A0, A1, A2, and A3 for 4 different temperature sensors.

Reply

•

Zul says:

May 30, 2018 at 10:04 am

Hi. I'm working on a project where I have to avoid a certain temperature range. The range I'm avoiding is from 5 degree Celcius to 60 degree Celcius. What I really want is to add a condition that would display the words "Danger Zone" when the temperature is anywhere in between the said range. I was thinking along the lines of adding an if else statement with the following.

if

$T > 5 \parallel T < 60$;

lcd.print("Danger Zone");

else

Please can anyone correctly insert this line at the right spot and send me the whole code because I can't seem to make it work. I have to submit this project in the next two days so please if anyone is reading this, help a brother out. Thanks

Reply

k swetha says:

July 4, 2018 at 2:22 am

will you send me the schematic circuit diagram for which shown in the video

Reply

Coda says:

July 30, 2018 at 12:29 am

so when i start code it says that the temp is -459.67 degrees F how do I fix this

Reply

→ *Mihai* says:

October 1, 2018 at 1:06 pm

Hi,

I built the circuit as well and get the same result (-459.67 deg F). Were you able to determine what the problem is?

Thanks

Reply

•

dmm says:

September 1, 2018 at 7:51 pm

Hi,

How do you setup a chain of thermistors?

Arduino has a limited number of ports.

Reply

Anon says:

October 11, 2018 at 5:47 am

hello, how much did this project cost you?

Reply

Adriel says:

October 20, 2018 at 5:26 pm

How can I get rid of the decimal so the LCD only displays a whole number like 76 F instead of 76.12 F?

Reply



Philipp says:

November 14, 2018 at 7:35 pm

Not sure if this works, but try `Serial.print(T, 0);`

Reply

•

Aaron says:

November 13, 2018 at 6:45 pm

I've got a 10K thermistor and 10K resistor hooked up, I am getting values but, for example, when I hold the thermistor the temp goes up but it goes slowly and maxes out at 83ish F. Do I need to change something because of my 10K components?

Reply

Philipp says:

November 14, 2018 at 7:33 pm

Your R1 value in sketch reads 10000, shouldn't it be 100000 for a 100k resistor or am I missing something?

Reply

Duane Sorlie says:

December 20, 2018 at 3:34 am

Thanks to all the folks who participated in this circuit review and discussion, it was very helpful. I purchased 100K thermistors from <http://www.taydaelectronics.com> and needed to do some tweaking of the coefficients. I was amazed at how little a change it took to change the temperature reading. The part number I purchased is the A-410. These thermistors are manufactured by Thinking Electronics from Taiwan . Here are the numbers I changed in the code: `c1=0.7904710802e-3`, `c2=2.251846924e-4`, `c3=0.87060700625e-7`

Reply



saeed says:

November 12, 2019 at 12:48 am

what are c1 c2 and c3 and how do u calculate them

Reply



Rob says:

October 24, 2021 at 10:34 pm

<https://www.thinksrs.com/downloads/programs/therm%20calc/ntccalibrator/ntccalculator.html>

Reply

•

ROANNE says:

December 27, 2018 at 4:18 am

Hi! can i replace the thermistor with a peltier module?

Reply

tom birch says:

December 29, 2018 at 9:12 pm

hi my problem is that comes up with -999.00 for my temperature reading.How do you fix this?

Reply

→ *tom birch* says:

December 31, 2018 at 12:53 pm

fixed it:D

Reply

Chinmya says:

February 2, 2019 at 12:36 pm

Is this method able to measure negative temperatures (like below 0 deg C), I failed to measure negative temperatures using LM35 and DHT 11.

Reply

•

James says:

February 16, 2019 at 1:01 pm

What is the code if i add in 3 resistors instead of 1

Reply

Courtney says:

April 6, 2019 at 7:35 pm

I am having an issue with my thermistor outputting Fahrenheit as 198.73 at room temp... I cannot seem to figure out what the issue is but it is calculating F to C correctly. The values are just way too high.

Reply

→ *mark* says:

March 28, 2021 at 8:55 pm

Make sure you use a resistor that matches the resistance of the thermistor. Measure thermistor's resistance with a multimeter and choose a resistor to match. I wired 10k and 12k resistors in series to get 12k to match the approx. 12k of the thermistor's resistance.

Reply

bARRY says:

April 10, 2019 at 2:42 am

The conversion from centigrade to F might be more readable if it were written $F = C * (9/5) + 32$. Maybe, I'm OCD about math.

Reply

•

peyman says:

May 3, 2019 at 8:55 am

hi, Why R1 is 1000? Should not be 100,000? you use 100k ntc and 100k resistor

Reply

Daniel says:

May 9, 2019 at 12:03 am

Hi, i followed all the steps in the video, but im not getting any LCD output. Can anyone plz help?

Reply

→ *oias* says:

May 30, 2019 at 8:06 am

Same issue bro.... may I know which resistors you used ??

Reply

Ojas says:

May 30, 2019 at 8:05 am

Your explanation was good but you should atleast tell what resistor value are you using ??
I have built the exact same circuit but its not running (probably the resistors are issue)

Reply

•

cfurku says:

July 6, 2019 at 1:49 pm

Great article.. helped me a lot with my project.

although i get accurate readings from room temp. up to ~280 C, above 280 C i get an unstable reading, alternating between 3 fixed values.. 370.30 | 307.53 | -273.15 (same thing happens if i replace my thermi. with a 220 ohm resistor)..

so i assume the code can't handle R2 values below a certain resistance..

any idea if i need to change c1, c2, c3 values ? or anything else..

(i'm using a HT-NTC100K that can handle up to 350 C)

thanks

Reply

Bryan Boyd says:

July 24, 2019 at 12:18 am

Hello, I have a question is there was any way to display the voltage of the thermistor at any given time along with it's temperature.

Reply

James says:

September 4, 2019 at 2:22 pm

Just tried the temp sensor with LCD. Works great, but wondering how to get it to use only whole numbers. I don't want to use up the extra 2 digits and the decimal point, how do I tell it to stick to whole numbers?

Reply

→ *Josef* says:

September 19, 2019 at 2:19 pm

set the variable T as an int instead of a float.

Great compliments, this website is awesome! Everything is clearly explained, great thanks!

Reply

•

KULEKE CLIFFORD says:

September 20, 2019 at 7:03 pm

please can any one help me write a code of humidity sensor range between 80-85

Reply

Chandru says:

October 9, 2019 at 5:56 pm

Hay man tanks for the code it works but a slight problem when it is like cold or when i gave some cold air the temperature doesn't comes below 29,28 it shows some Chinese,japanes languages on the display on the other when i heat the thermistor the temperature rises & displays 70,80,90 thats not a issue

So how do i display lower readings??

Reply

liam says:

October 20, 2019 at 8:52 pm

The equation derived for R2 looks wrong. Try plugging known variables into the voltage divider equation to get Vo, then plug these values back into the second equation and you'll get a new (and therefore incorrect) R2 value. Instead, it should be $R2 = (V_o / (V_i - V_o)) * R1 = R2$

Reply

•

saeed says:

November 12, 2019 at 12:46 am

what is c1,c2 and c3 and how do u calculate them

Reply

fallour says:

December 14, 2019 at 10:24 pm

Hello,

the code works perfectly for arduino, but it does not give me the good values with a ESP8266 :(
Is it a formula problem?

Thanks

Reply

→ *Mick* says:

January 13, 2025 at 12:44 pm

Has anyone worked out the Math for an ESP32? I built this with an Arduino UNO and it worked perfectly. Now I'm doing it on an ESP32 and the temperatures are running around 200 degrees. I like to keep my house warm in the winter but not quite that toasty. Can anyone shed any light on this??

Thanks!!

Reply

Mike says:

January 26, 2020 at 3:18 am

Hi,

I tried this project with an NTC 47D-15 thermistor. The resistance of this thermistor at room temp is about 45 ohm according to datasheet and my multimeter. I used a 220 ohm resistor. Also, I used the coefficients in your sketch. The temperatures returned by the sketch were in excess of 400! I'm sure I made some type of mistake although I feel confident about the wiring. I looked at the datasheet for my thermistor and didn't find

a listing of coefficients. Apparently, those can be determined by experimentation, but that sounds like a major project in itself. Would appreciate any suggestions.

Mike

Reply

•

Hailey Holt says:

February 10, 2020 at 7:48 pm

Hello,

can anyone assist me? I am using a different thermistor and LCD screen than shown here. I have managed to modify the code to output the temp display in C on the LCD screen I am using, however, it is not accurate. I produced a 3-point calibration curve and have a linear trendline displaying the equation. Can I modify this code with my calibration equation?

My calibration equation is $y=0.2194x-50.589$

Attached is my code.

```
#include
int ThermistorPin = 0;
int Vo;
float R1 = 10000;
float logR2, R2, T;
float c1 = 1.009249522e-03, c2 = 2.378405444e-04, c3 = 2.019202697e-07;
// Attach the serial enabled LCD's RX line to digital pin 11
SoftwareSerial LCD(10, 11); // Arduino SS_RX = pin 10 (unused), Arduino SS_TX = pin 11
void setup()
{
  LCD.begin(9600); // set up serial port for 9600 baud
  delay(500); // wait for display to boot up
}
void loop() {
  Vo = analogRead(ThermistorPin);
  R2 = R1 * (1023.0 / (float)Vo - 1.0);
  logR2 = log(R2);
  T = (1.0 / (c1 + c2*logR2 + c3*logR2*logR2*logR2));
  T = T - 273.15;
  // T = (T * 9.0) / 5.0 + 32.0;
  // move cursor to beginning of first line
  LCD.write(254);
  LCD.write(128);
  LCD.print("Temp = ");
  // move cursor to
  LCD.write(254);
  LCD.write(133);
  LCD.print(T);
  // move cursor to
  LCD.write(254);
  LCD.write(139);
  LCD.print(" C");
  delay(500);
  LCD.write(" ");
```

```
delay(1000);  
}
```

Reply

→ *Ronald* says:

February 10, 2020 at 8:11 pm

Look a bit higher up in the comments. Find the comment by Ronald and use the link to find your c-factors. Put those in place of the given ones and voila it works.

If your resistance rises as temperature increases you've got a ptc and it won't work with this setup.

I do not understand your equation for the resistance with the y and x.

What did you calculate here and how?

The resistance/temp coordinates you use for the calculation should be as far apart as possible I.e. freezer boiling water and room temp.

Reply

MamatArduino says:

April 6, 2020 at 1:51 pm

Hi, thanks for this help, because I can now read the temperature of a 3d printer's hotbed with my arduino !

Reply

Marcy says:

April 13, 2020 at 2:21 pm

Hello and thank you for this excellent tutorial.

I have a question about defining Vo as an integer. Will that make a difference in this command?

Vo = analogRead(ThermistorPin)

Wouldn't it make more sense to define Vo as a float, or does it not matter?

Thank you!

-Marcy

Reply

→ *Marcy Beard* says:

April 14, 2020 at 7:33 pm

Ah nevermind! Vo is an integer in the range of 0 to 1023, I forgot that part. Actual readings for our thermistor are 218 to 237, which are then converted to resistance R2. Got it.

-Marcy

Reply

•

robiance says:

August 6, 2020 at 6:11 am

really nice and cool post

Reply

Yannis says:

October 25, 2020 at 6:40 pm

Hello,

why you declare $R1=10000$ in program and in your circuit the resistor has value 100K Ohms?

Thanks in advance

Reply

Tasin Hannan says:

November 28, 2020 at 7:46 pm

I wired everything correctly, i double checked and everything was fine, but its showing negative stats, like "Temp = -32.47 F". And its really low to, on my thermostat it says 75 F. How to fix this

Reply

•

Jerry says:

December 7, 2020 at 9:16 pm

I found this article a long time ago, and since I had a lot of thermistors (pack of 25 for some strange reason!) I decided to hard wire one together to just have around in case I wanted to use it for some reason. Well I found it today and was trying to figure out how the heck I had it wired up, did a search and took me back to this article. It made things quite easy and I have it up and running again. Still don't know what the hell I am going to do with 25 thermistors, or even the one I built up on a strip board, but they are fun to tinker with. I have a niece who is a ghost hunter, and I think that was what I had in mind when I ordered the lot, I have built her several EDF meters from a simple one transistor to a very complicated Arduino based with 12 LED's to indicate how strong the EDF field was. I even made her one that talked, but it scared the hell out of her hunting club on an outing to a haunted hotel in Deadwood, so she brought it back so I could part it out. They say a sudden drop in tempature is present when a spirit is in the room, that was the thought behind using several of these thermistors in, say a strip so you could measure the temp change in say one yard or even just a foot or so. Indeed, that was IT ! Think I will get back on that project now that I figured it out once more. Thanks a million for jogging my 70 year old mind back to ground level, it has been rather sluggish after sitting with my wonderful wife of 51 years as cancer took her from me, just 4 days after our 51st wedding anniversary. What do you get your wife for that occasion? Well I got her 6 red roses, 5 for the 50 and a pink one for the 51st. She loved it. I buried her with a gold plated rose in her hand, wearing the same dress she wore on that day in 1969 when we joined our souls for life.

Reply

robin says:

June 22, 2021 at 9:43 am

Thank you Sir.

Can we use RTD Or Thermocouple in place of NTC?

Regards

Reply

marco says:

January 14, 2022 at 11:54 am

An improvement regarding NTC temperature calculation if you use a 100k ohm resistor and a 100k ohm @25°C NTC in the voltage divider: you should change values with the follows:

float R1 = 100000; // 100k Ohm voltage divider resistor

float c1 = 6.66082410500E-004; // Steinhart-Hart C1

float c2 = 2.23928204100E-004; // Steinhart-Hart C2

float c3 = 7.19951882000E-008; // Steinhart-Hart C3

Other values can be calculated here:

<https://www.thinksrs.com/downloads/programs/therm%20calc/ntccalibrator/ntccalculator.html>

:~)

Reply

•

Filip says:

May 6, 2022 at 5:11 pm

There is a wrong R2 equation. $R2=R1*(Vout/(Vin-Vout))$.

You have $R2=R1*(Vin/Vout - 1)$.

Reply

Bob says:

May 17, 2022 at 7:57 am

Anyone know of a way to assign an IP address to access the temp reading? Ive seen many other codes that will add the wifi ability but they don't show the proper temperature like this code does. I would love any help. THANKS!!!!

Reply

Mimi says:

June 28, 2022 at 7:05 am

Hi, what if i have a 500 000 kilo ohm thermistor value.What resistor value should i use? Thank you

Reply

•

italiancodingnoob says:

November 16, 2022 at 2:10 pm

Hi there.

I just tried to make this circuit and everything works perfectly except one detail: the temperature is in fahrenheit but i need it in celsius. what do i have to change on the code for it to display temperature in celsius?

Reply

→ *Ronald* says:

November 16, 2022 at 5:04 pm

The second set of code given is an answer to this question

Reply

Lukáš Varga says:

December 19, 2022 at 9:00 pm

hello, i have some problem and I can't deal with it. There is still just a one value on my lcd. Still -17,78°C (I have converted it into this type of units). Can anyone help me please ?

Reply

→ *mamatArduino* says:

December 22, 2022 at 10:47 pm

Hi, can you check if your thermistor works with an ohmmeter ?

And if it's fully linked to the motherboard ?

Otherwise the value can't be read.

What value have you received before conversion ?

Reply

Tony says:

April 24, 2024 at 11:43 am

Works perfectly and i have a question,

I want to try it out and apply this on my fridge but i'm struggling with something i want to add.

I want to send a signal to Shield SIM800F and send a TEMP HIGH SMS if the temperature is higher than 10°C and another SMS TEMP HIGH if the freezer is higher than 13°C.

Can you help me?

Reply

•

PURJalicious says:

July 19, 2024 at 3:32 pm

Hi guys, I am having a hard time following an equation conversion shown above. When converting myself, I get a different result for the final equation.

Here's the starting equation:

$$V_o = V_i (R_2 / (R_1 + R_2))$$

And here we go...

$$V_o / V_i = R_2 / (R_1 + R_2)$$

$$V_i / V_o = (R_1 + R_2) / R_2 = (R_1 / R_2) + 1$$

$$(V_i / V_o) - 1 = R_1 / R_2$$

$$R_2 = R_1 / ((V_i / V_o) - 1)$$

Note the only difference is that the multiplication of R_1 with the rest in the solution shown in the above article, is now division. Am I forgetting how to do algebra with fractions, or is this a mistake from the author? It shows up in the code as well.

Reply

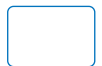
Muhammad Haris Hameed says:

April 21, 2025 at 9:53 pm

Can someone help me?

I have connected the wires but still I only see boxes on my LED. No text output..

Reply



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