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Connecting a 12V Relay to Arduino

By homunkoloss (/member/homunkoloss/) in Technology (/technology/) > Arduino (/technology/arduino/)

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To connect a 12V relay to the Arduino you need the following things:

- 1 Arduino

- 1 diode for example 1N4007

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- 1 NPN transistor for example 2N2222 (in the US) or BC548 (in Europe)

- 1 relay for example one with coil voltage 12V and switching voltage 125VAC/10

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Step 1: Measure the Coil Resistance



We are going to measure the coil resistance to calculate the current.

First we must find the coil:

On some relays the pins are labeled so you can just measure at pin 2 & 5.

Otherwise you have to measure at every pin:

Between two pins you should have between 100 and 10 000 Ohm. Remember that value. That are the two terminals of the coil. The coil is not polarized so its not important which one goes to V+ or GND.

If you have found those there are only three left. Between two should be a connection (if you measure a few Ohm its okay but everything above 50Ohm is too much). One of them is NC and one is COM. To find out which is which let one probe connected and connect the other to the pin that's left over. If you connect the coil to 12V DC it should make a clicking noise. If your multimeter now shows a low resistance you have found COM and NO. The one probe you didn't move is COM the other is NO.

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Step 2: Calculate How Much Current Will Flow

The formula you need is a simple one:

advertisment $U = R * I$

OK, but we want the current "I" right ? So just divide through the Resistance "R".

$$U = R * I / :R$$

$$I = U/R$$

For my relay that would be:

$$I = 12V / 400Ohm$$

$$I = 0.03 A \Rightarrow 30 \text{ mA} \text{ (That is } I_c)$$

The Arduino can handle up to 20mA but its better to use a transistor even if your current is only 20mA. So for 30mA you definitely need one.

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Step 3: Choose Your Transistor

First find the Datasheet of your transistor. For example search for "2N2222 datasheet".

Your transistor should comply to the following things:

- It has to be NPN not PNP !!
- I_c should be bigger than the value you calculated in step 2
- V_{ceo} should be bigger than the supply voltage

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Step 4: Calculating R1

You can find the value of h_{fe} in your datasheet:

Mine says for BC548 its 75 at 10mA at 10V. Its not very precise cause its very difficult to build transistor with a accurate h_{fe} .

I_b = I_c / h_{fe}

For BC548:

$$I_b = 0.03 \text{ A} / 75$$

$$I_b = 0.0004 \text{ A} \Rightarrow 0.4 \text{ mA}$$

Due to Ohms Law:

$$R_1 = U / I_b$$

$$R_1 = 5V / 0.0004 \text{ A}$$

$$R_1 = 12500 \text{ Ohm}$$

This is not very accurate so we use 10kOhm.

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Step 5: Choosing Your Diode

The diode is needed cause the voltage will rise high if you suddenly change the voltage at the inductor. The formula for the voltage is:

$$U_L = -L * \frac{\Delta i}{\Delta t}$$

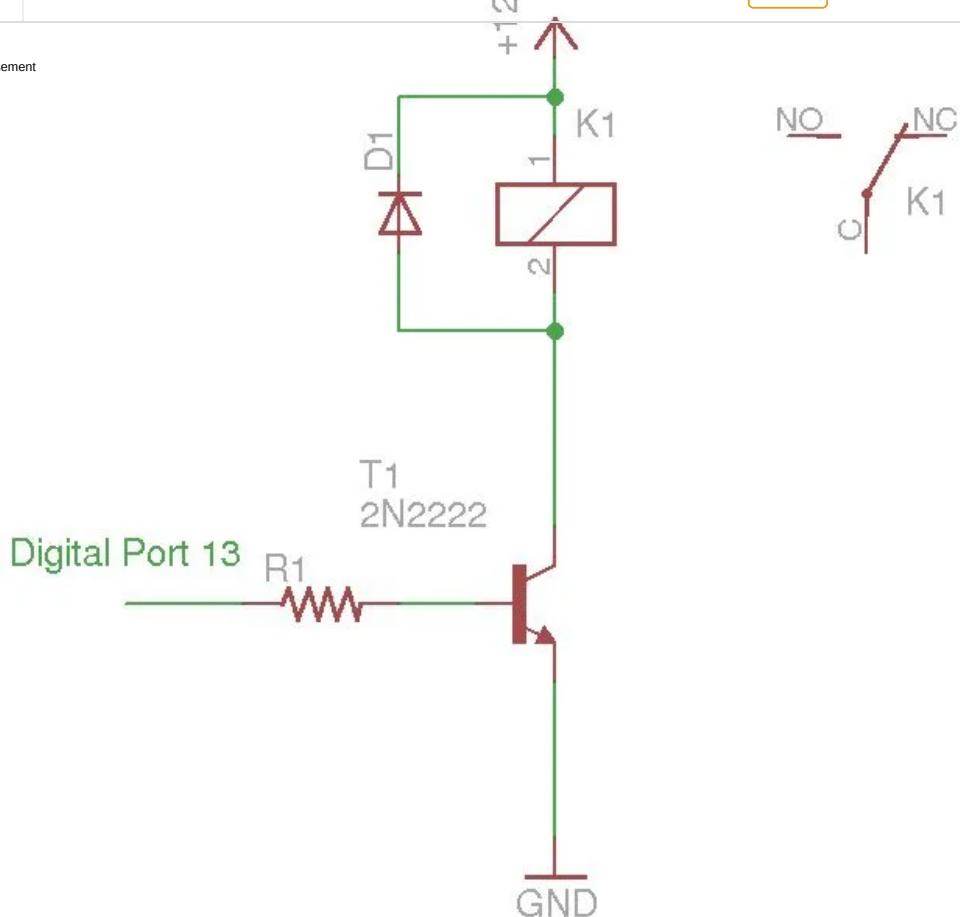
So theoretically if Δt equals zero U will be infinite.

But due to the minus in front you can add a diode in the "false direction" parallel to the relay. So the current can flow till its zero so the voltage is also zero.

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Step 6: The Schematic

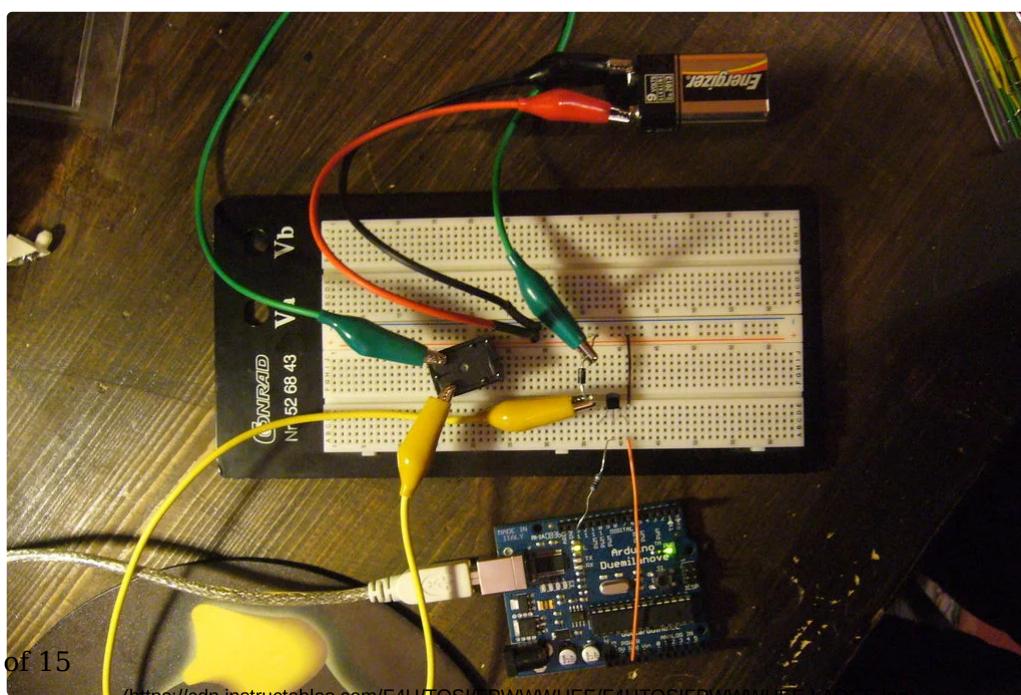
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Finally here is the schematic:

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Step 7: Assembling the Circuit



Before you connect your Arduino connect a 4.5V Batteries negative terminal to GND and its positive terminal to R1. The relay should make a clicking noise if not, check your circuit.

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Step 8: The Program

The test program is just an edited version of the "Blink" example:

```
/*
 * relaytest |
 * Author: gandalfsz |
 * Date: 18 Jan 2009 |
 * Function: Toggles Pin 13 every 10 Seconds |
 */

int outPin = 13;

void setup()
{
    pinMode(outPin, OUTPUT);
}

void loop()
{
    digitalWrite(outPin, HIGH);
    delay(10000);
    digitalWrite(outPin, LOW);
    delay(10000);
}
```

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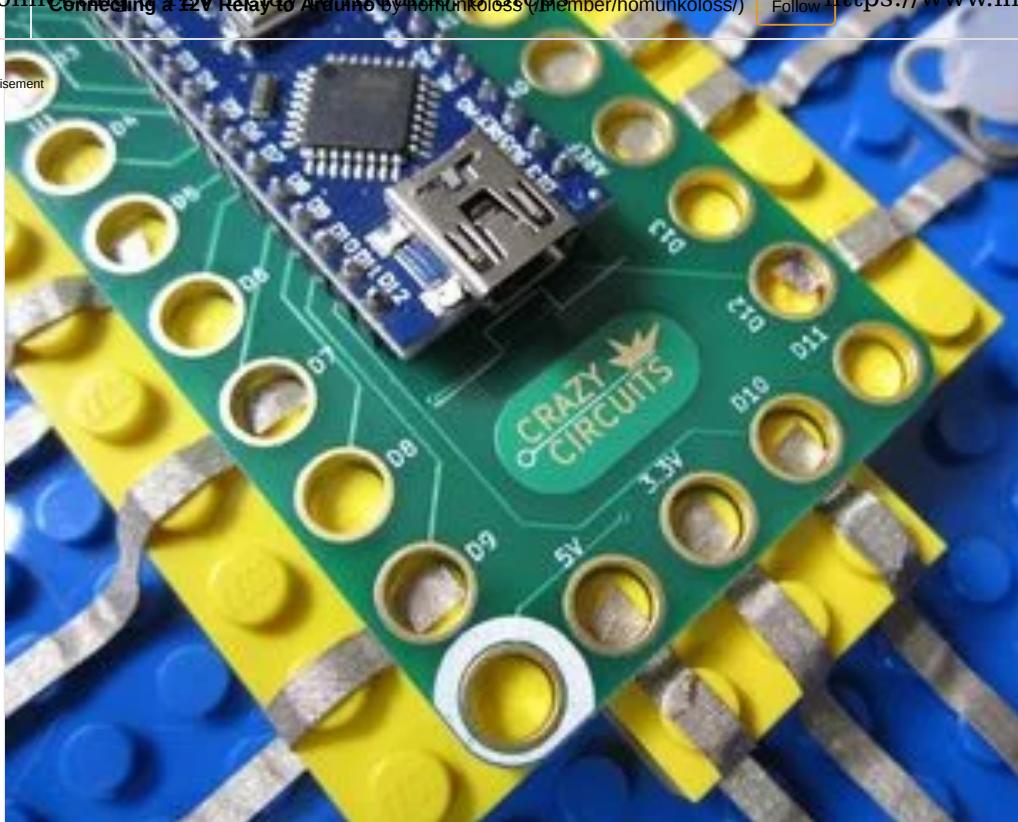


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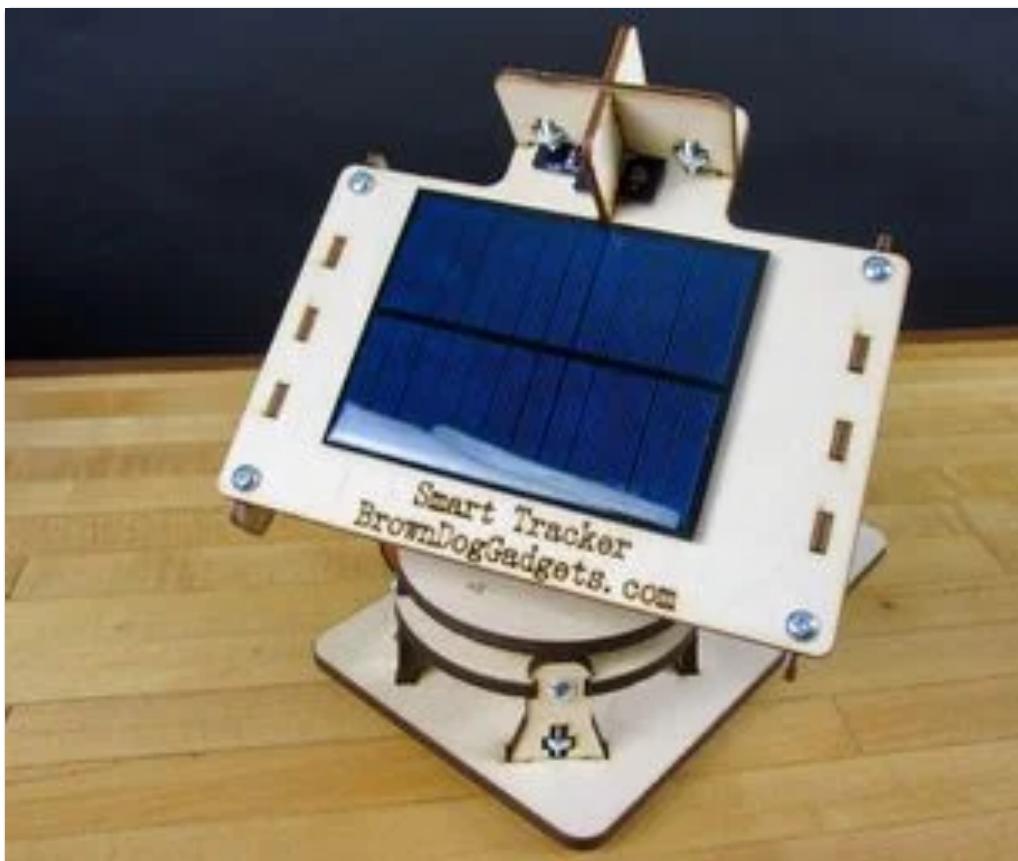
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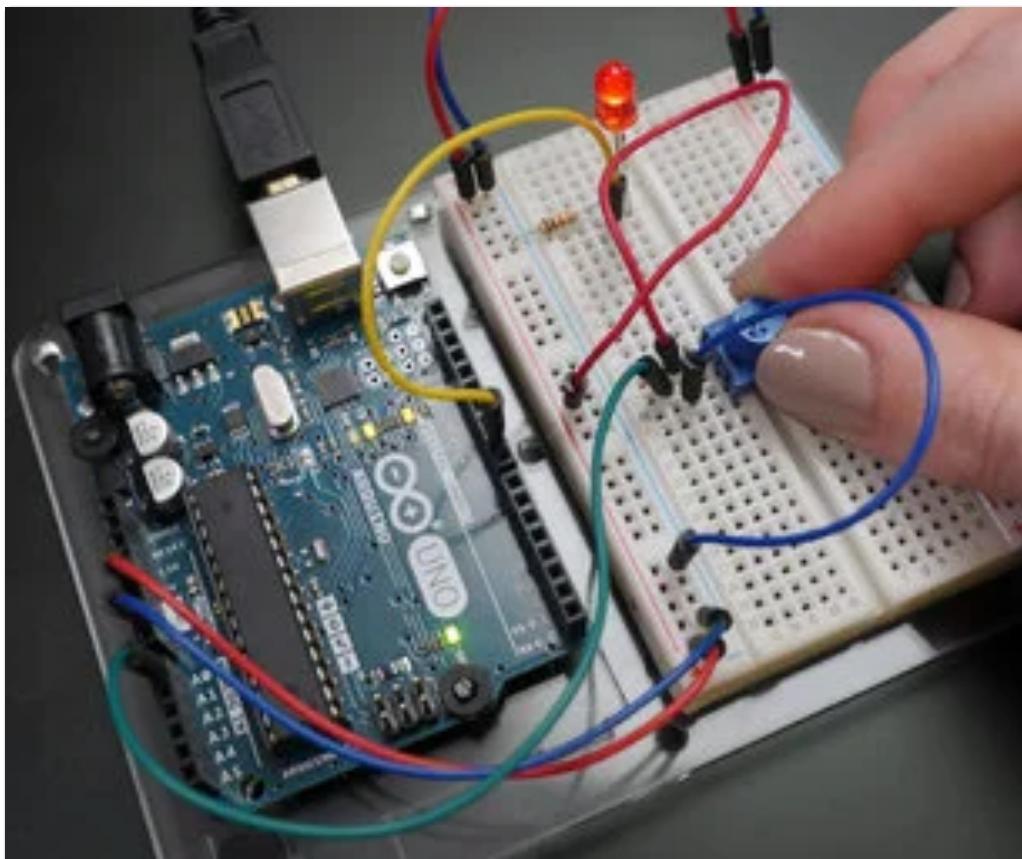
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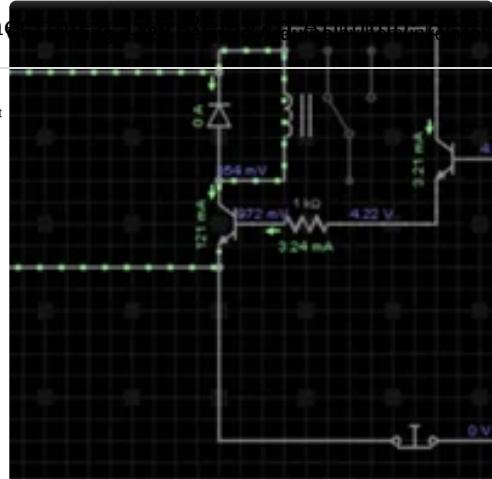
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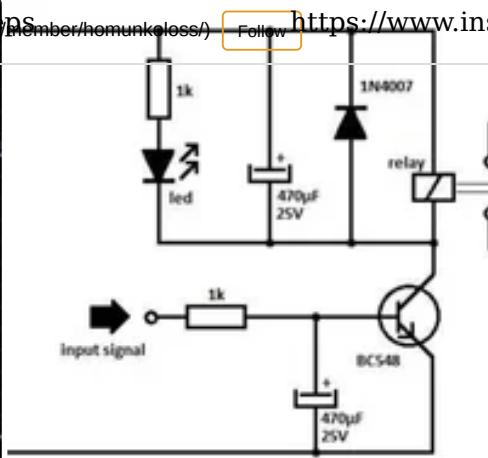
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[\(/member/AmineS25/\)](/member/AmineS25/) AmineS25 [\(/member/AmineS25/\)](/member/AmineS25/) Question 6 months ago

i found this and i am confused



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(/member/runjan56/) ranjan56 (/member/runjan56/) 2 years ago

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why is the 2n2222 transistor used? can we connect the output pin directly to relay?

3 replies [▼](#)



1 (/member/kizzar/) kizzar (/member/kizzar/) Question 1 year ago on Step 4

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What about the Vbe drop usually around 0.7 ?

1 answer [▼](#)



(/member/OsvaldoR13/) OsvaldoR13 (/member/OsvaldoR13/) 1 year ago

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I used the nte123a transistor (NTE equivalent of 2n2222a) and it would not work for me. Datasheet for it gives the same hfe value of 75 @ 10ma @ 10v. But what did work was using the hfe value on the package (200) instead and recalculating. So I ended up using a 33k resistor



(/member/chemgreec./) chemgreec. (/member/chemgreec./) 2 years ago

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Hello everyone, I am new to electronics and I am puzzled by something at the moment. I want to use my arduino to latch on a relay. I use a 9v battery to power the relay and I want to control it with a 5v arduino mini pro. So while I was building the circuit (similar to this but with a latch on addition) the trigger from the arduino was not working. I realized that I have not connected the arduino ground to the battery ground. But then I was really confused. What would the consequence be if you connect two separate arbitrary grounds? What if their relative state is different and there is flow of current from one to the other? I made an hydraulic parallel to understand that and I concluded that we should not be doing that at all. Let me explain: Imagine having two water tanks and we know that one has 9 meters of water in it and the other one has 3 meters of water in it. BUT we don't know at which height the tanks are.. so if you just connect their bottoms together we could potentially blow them up imagine if one tank with 3m in it is lets say 1km up on a mountain and the other tank with 9m of water in it is at sea level. If you join their bottoms the flow would be so high that would crash the bottom tank!! How do we avoid this with circuits that have different voltages? Please help it really bugs me!!

1 reply [▼](#)

12 of 15



(/member/hkfanatic/) hkfanatic (/member/hkfanatic/) 2 years ago

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2/19/19, 5:39 PM

Hi! Thanks for posting this--it's a huge help for beginners like me.

Connecting a 12V Relay to Arduino - 4 Steps

I've been researching on connecting relays to the Arduino and all of the examples I found either used a separate power supply for the 12-Volt relay (using a 9-volt battery) and the Arduino (using a USB cable) OR, the Arduino board itself supplies the power but the relay is only 5 Volts.

If I may ask, would it be possible to use only 1 power supply for the Arduino (via the DC crown jack) and three (3) 12-Volt relays (only 1 relay will operate at a given time)?



(/member/hkfanatic/) hkfanatic (/member/hkfanatic/) 2 years ago

Reply

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Hi. Thanks for posting this--it's a huge help for beginners like me.

I've been researching on connecting relays with the Arduino and the examples I found either uses a separate power supply for the 12-Volt relay (e.g. 9-Volt battery) and the Arduino (USB cable) OR the Arduino board itself supplies the power but the relay is a 5-Volt one.

If I may ask, would it be possible to use only 1 power supply (e.g. 12-Volts) to power both the Arduino (via the DC Crown Socket) and the 12-Volt relay (e.g. parallel mode)?



(/member/chintans/) chintans (/member/chintans/) 3 years ago on Introduction

Reply

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Can some1 post diagram on how to use the relay with arduino with 12V 1A power supply to Arduino and no different power source for the relay.

Also note the protection diode is needed.

I have made the relay work but not with the protection diode.

And engineers, please, in the diagram please display from with pin to which pin the diode is used for newbies like me.

Thank you.

1 reply ▾

(/member/exhibit29/) exhibit29 (/member/exhibit29/) 2 years ago

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I have a relay that has 12V DC spule, but its 6A/250VAC, can use it this circuit without changing other components? Thanks in advance.

(/member/mayur.phadte/) mayur.phadte (/member/mayur.phadte/) 2 years ago

Reply

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I used a 2N4401 and the transistor blew up. Checked all connections, could the transistor be at fault here ? Was an old one.

(/member/skumar231/) skumar231 (/member/skumar231/) 2 years ago

Reply

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Hi i make a video how to connect and use relay module with arduino uno.

Connecting a 12V Relay to Arduino: 8 Steps

Connecting a 12V Relay to Arduino by homunkoloss (Member/homunkoloss)

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codes and diagram is in link of video

(/member/ams31/) ams31 (/member/ams31/) 3 years ago

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The most commonly used 12 Volt cube relay (<http://www.dnatechindia.com/Cube-Relay.html>) has 400ohm coil resistance. So the current required is $12V/400 = 30ma$. But this is the holding current the pull in current is a bit larger than that so you normally design with assumption that current required atleast 1.5 times of calculated current.

You should use 1N4148 diode instead of 1N4007 as 4148 is a fast switching diode with maximum forward current of 300ma.

If you have relays with lesser coil resistance so the current required for relay is more then you can add a pull up resistor to the arduino pin. A pull up resistor is basically a resistor between the controller pin and the Vcc. If you use pullup resistor you can use the above relay driver circuit for interfacing with any microcontroller (<http://www.dnatechindia.com/Interfacing-Relay-to-Microcontroller.html>)

(/member/JohnN77/) JohnN77 (/member/JohnN77/) 3 years ago

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I have 5V relay with 70 OHM coil resistance, and i'm using 2N2222A transistor and it doesn't work with Arduino ???!!!! any help please???

(/member/ConnorN3/) ConnorN3 (/member/ConnorN3/) 3 years ago on Introduction

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Built it today, and it worked just as the author said it would. Only difference was that I substituted a different diode (1N4001) instead of the one suggested.

Thanks for the build!

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