

Relay_12V -- Overview

Interfacing 12V Relay with Arduino



OBJECTIVES

After performing this lab exercise, learner will be able to:

- Design and construct the transistor driver circuit for 5 volts and 12 volts electromagnetic relays.
- Automate the relay control by programming a Arduino.

EQUIPMENT REQUIRED

- TBS1KB - Digital Oscilloscope from Tektronix
- Relay - 5V / 12 V
- Resistor (1K-Ohm) – 2 Nos.
- Resistor (100K-Ohm) – 3 Nos.
- Diode (IN4007) – 2 Nos.
- 2N3906 NPN Transistor – 2Nos.
- DSO Probe
- USB Pendrive.

THEORY

- Relays are components which allow a low-power circuit to switch a relatively high current on and off, or to control signals that must be electrically isolated from the controlling circuit itself.
- To make a relay operate, you have to pass a suitable 'pull-in' and 'holding' current (DC) through its energizing coil. And generally relay coils are designed to operate from a particular supply voltage often 12V or 5V, in the case of many of the small relays used for electronics work.
- In each case the coil has a resistance which will draw the right pull-in and holding currents when it's connected to that supply voltage. So the basic idea is to choose a relay with a coil designed to operate from the supply voltage you're using for your control circuit (and with contacts capable of switching the currents you want to control), and then provide a suitable 'relay driver' circuit so that your low-power circuitry can control the current through the relay's coil. Typically this will be somewhere between 25mA and 70mA.
- Often your relay driver can be very simple, using little more than an NPN or PNP transistor to control the coil current. All your low-power circuitry has to do is provide enough base current to turn

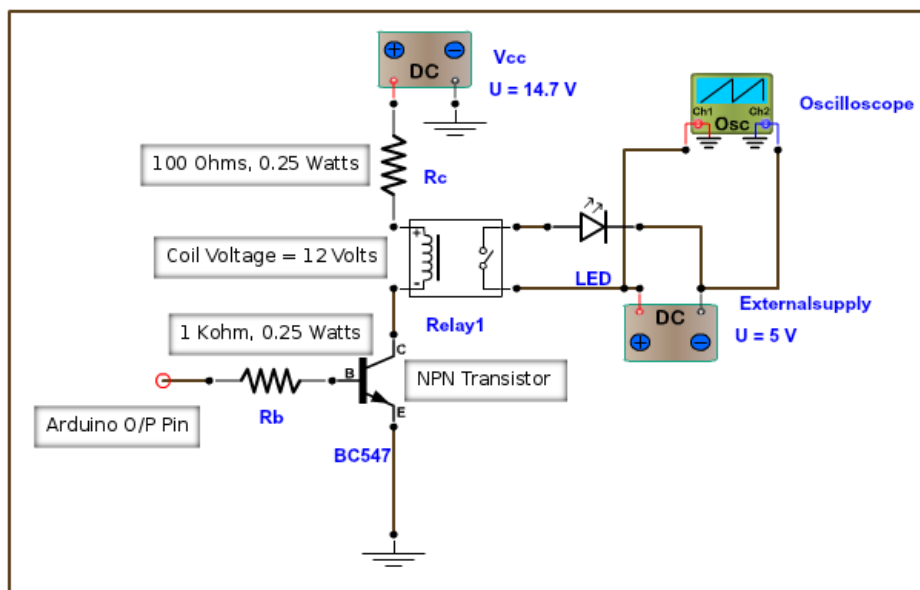
the transistor on and off.

- In A, NPN transistor Q1 (say 2N3904) is being used to control a relay (RLY1) with a 12V coil, operating from a +12V supply. Series base resistor R1 is used to set the base current for Q1, so that the transistor is driven into saturation (fully turned on) when the relay is to be energised. That way, the transistor will have minimal voltage drop, and hence dissipate very little power as well as delivering most of the 12V to the relay coil.

CIRCUIT DESIGN

- $R_b = (V_{CC} - V_{BE}) / I_B = (5 - 0.7) / (5 \times 10^{-3}) = 860 \Omega \approx 1K \Omega$
- $R_C = (V_{CC} - V_{CE}) / I_C = (9 - 5) / (73 \times 10^{-3}) = 54.79 \Omega$
- Power rating of collector resistance, $P_{RC} = I^2 R_C = (73 \times 10^{-3})^2 \times 55 = 0.2953 W$
- $P_{RC} \approx 0.25$ Watt is the best choice based on availability.

CIRCUIT DIAGRAM



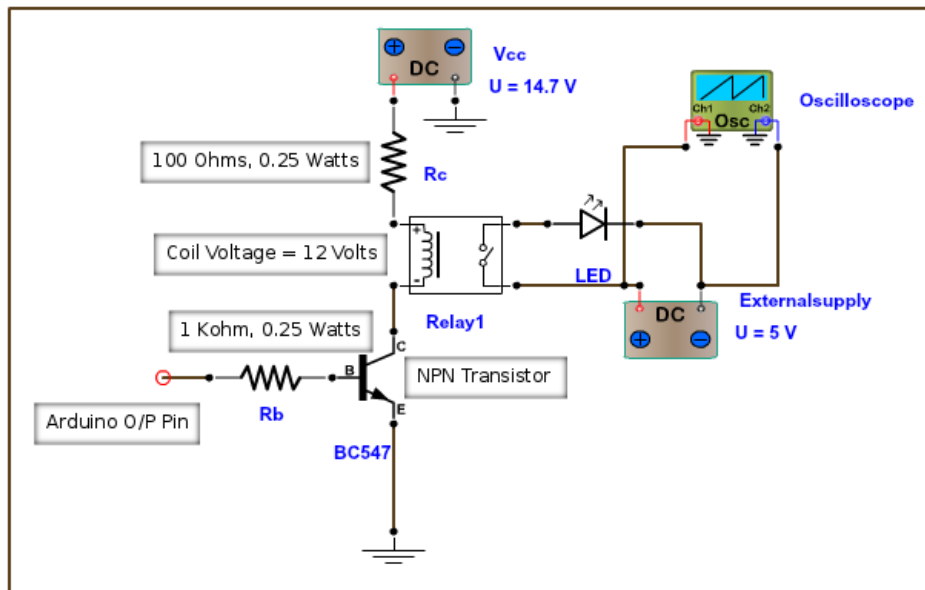
Relay_12V -- Procedures

Step 1

- Ensure you have Arduino IDE (software to program the Arduino board) installed on your computer.
- Connect the Arduino board to PC using USB cable.
- Program the Arduino board with code

Step 2

- Build the circuit connection as per the given circuit diagram.



Step 3

MEASUREMENT / SCOPE SETUP

- Power ON the oscilloscope.
- Connect the Channel 1 probe and Channel 2 probe of the oscilloscope across the relay contact terminals.

Step 4

- Acquire the signal(s) from circuit on oscilloscope for different time delays.

Step 5

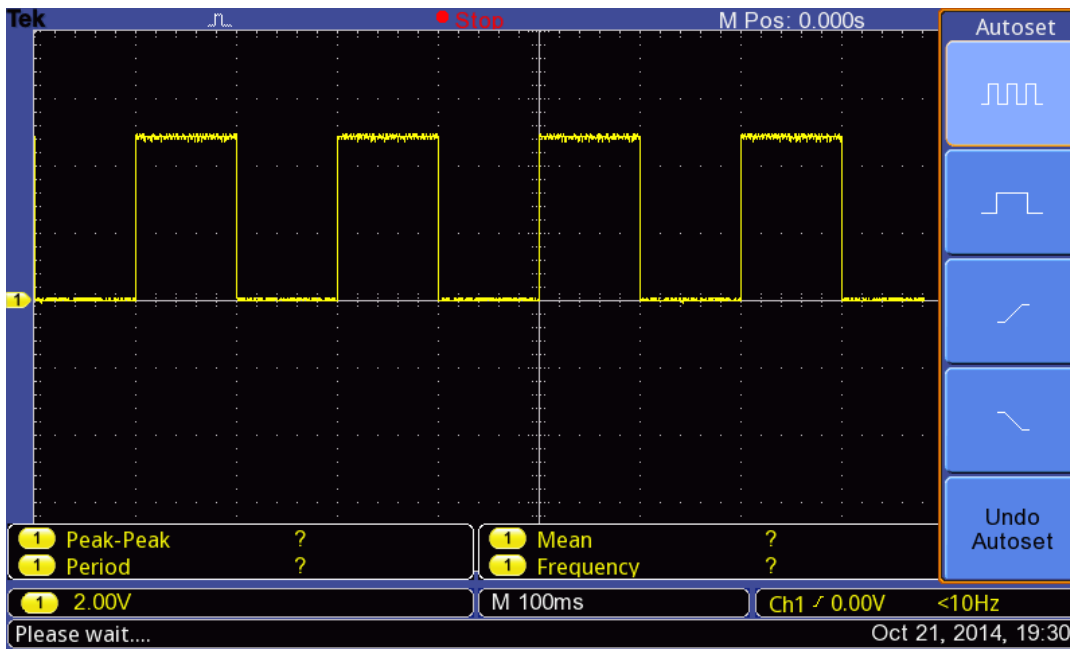
- Do the Autoset on the scope to efficiently capture and view the signal.
- If AUTOSSET feature is not enabled, then manually set the horizontal and vertical scale, and trigger condition to view waveform without any clipping.

Step 6

OUTPUT WAVEFORM

The output waveform would look like the following,

Time delay of 100 ms



Step 7

RESULT

Thus the design, construction and testing of transistor driver circuit to run relays (5V/12V) controlled by ARDUINO is completed successfully. The waveforms of the output voltage at different time delays were taken from the DSO.