

**USER MANUAL
FOR
H-BRIDGE (TRANSISTOR)
FUNCTIONAL MODULE**

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1. INTRODUCTION

H-Bridge is a method used to control the activation and output rotational direction of a motor. The H-Bridge uses the four transistors to control the directional flow of current through the motor. Two of the transistors are used to close circuits from a 5V power source to the motor while the other two transistors are used to close the circuit to ground. Figure 1 shows the circuit diagram for a single-directional motor.

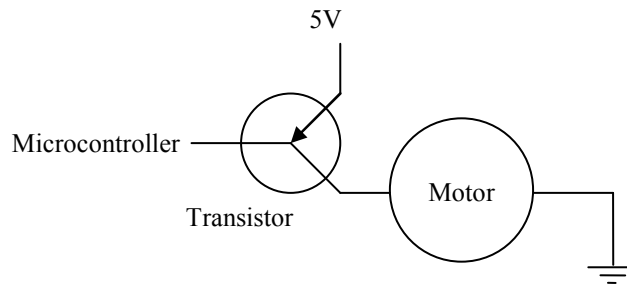


Figure 1: Single-Directional Motor Circuit Diagram

If a high signal from the microcontroller is sent to the transistor then 5V will be sent to the motor and the motor will activate. A more elaborate circuit (an H-bridge) must be used if the operator desires a circuit which will allow the motor output to rotate clockwise and counter-clockwise. Figure 2 shows the circuit diagram for an H-bridge controlled dual-directional motor. In this situation diodes should be used in order to protect the transistors from back voltage generated by the motor when power is cut on and off. Back voltage can be several times higher than the voltage from the power source.

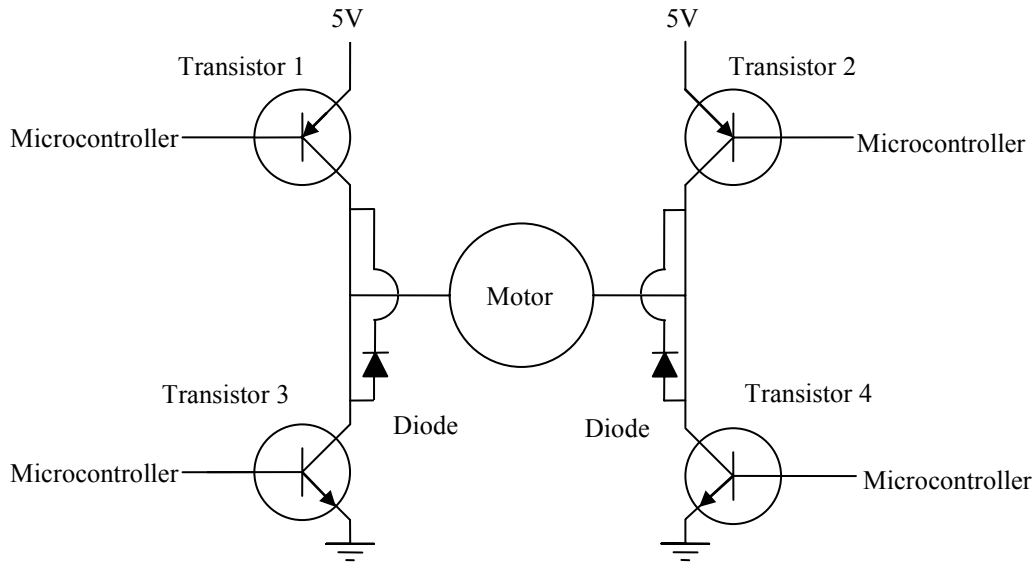
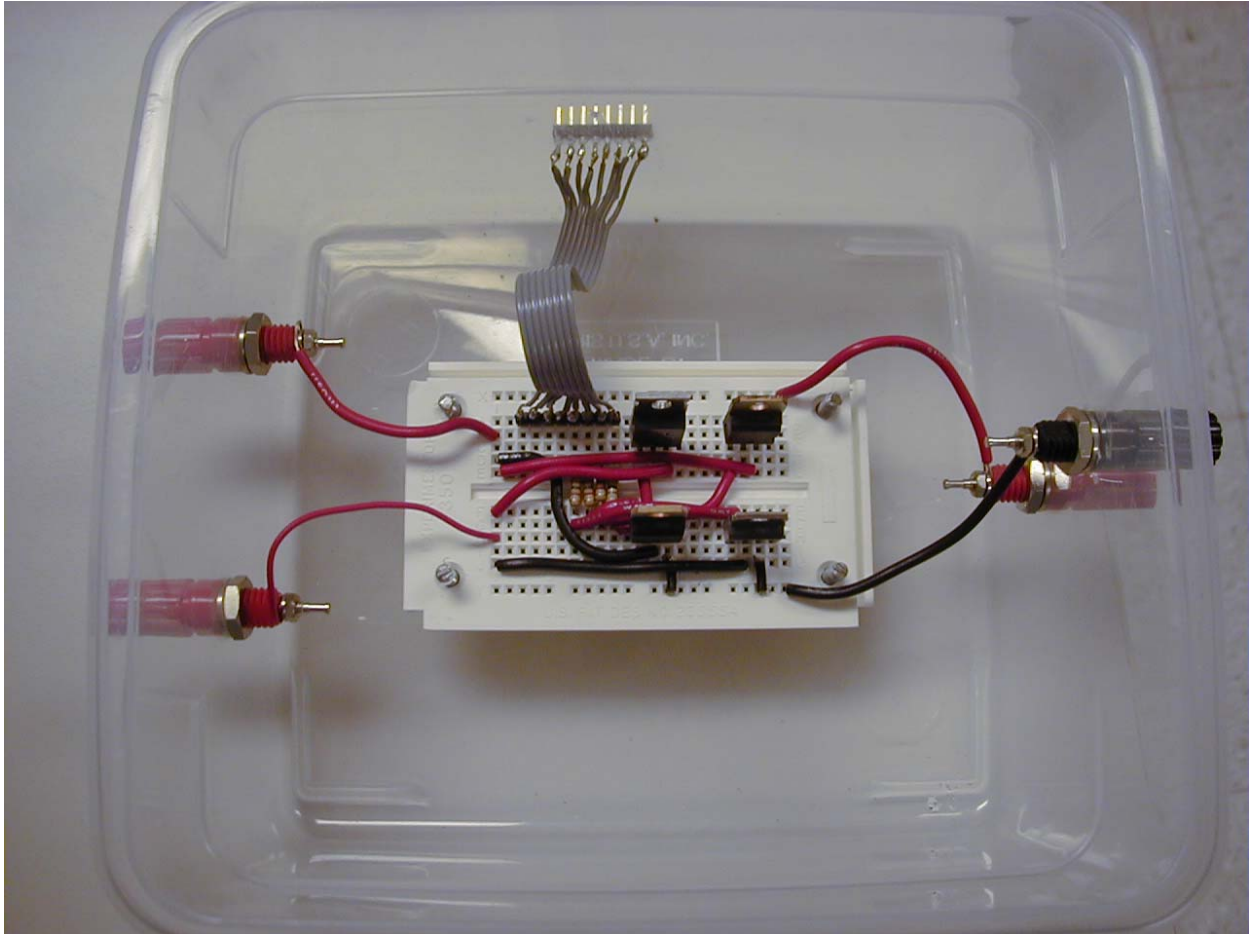


Figure 2: Picture of H-Bridge Wiring Diagram

Transistors 1 and 2 will need to be PNP transistors and transistors 3 and 4 will need to be NPN transistors.

If a high signal from the microcontroller is sent to the 5V transistor on one side of the bridge and a high signal from the microcontroller is sent the ground transistor on the other side of the bridge the motor will spin. If a high signal from the microcontroller is sent to either both ground transistors or both 5V transistors the motor will stall (and possibly be damaged). If a high signal from the microcontroller is sent to the ground and 5V transistors on one side of the H-bridge then the circuit will burn and smoke will result.

2. DESCRIPTION OF THE H_BRIDGE TRANSISTOR FUNCTIONAL MODULE



3. WIRING INSTRUCTIONS

The assignment of terminal and diode labels (either left or right) can be made arbitrarily but must remain consistent for wiring or the circuitry will be damaged. The pin assignments for the Transistors and the orientation for the diodes are given in figure 3. The instructions for the wiring of the H-Bridge are given in table 1.

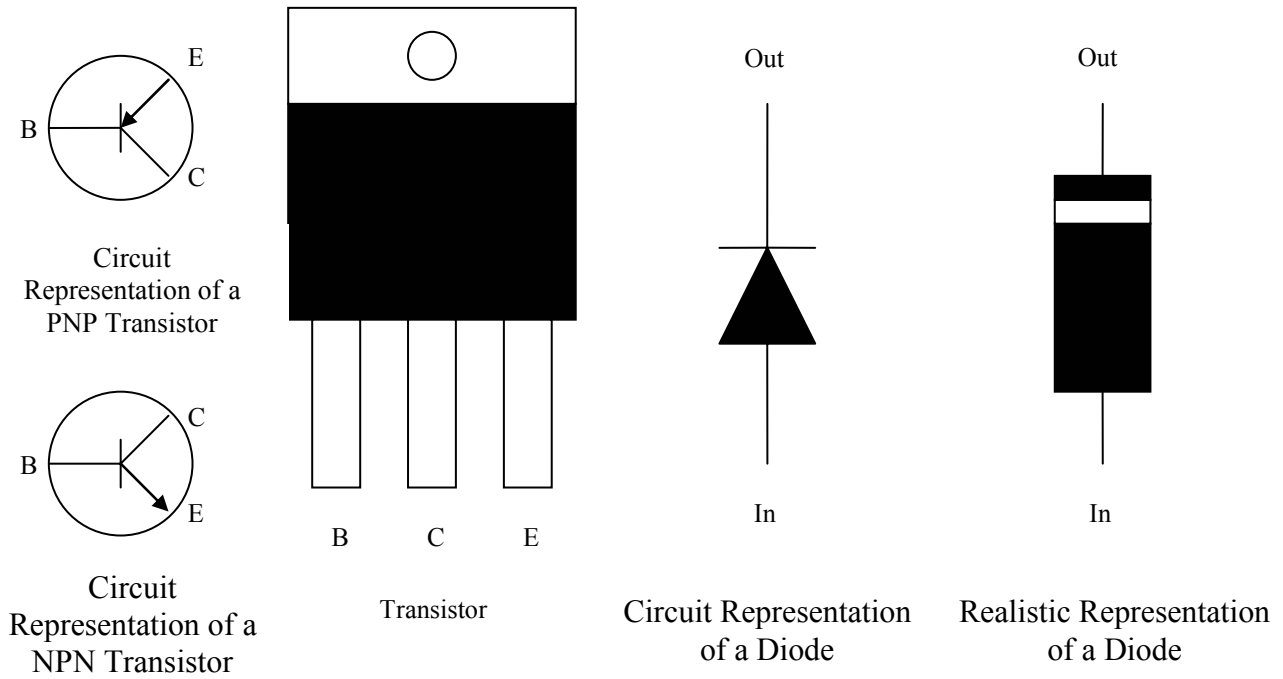


Figure 3: Picture of Pin Assignment for Transistors and Orientation Assignment of Diodes

Table 1: Wiring of H-Bridge Transistor Motor

Red	V_{in} (5V) to Transistor 1 (pin E) V_{in} (5V) to Transistor 2 (pin E) Transistor 1 (pin C) to motor (left terminal) Transistor 2 (pin C) to motor (right terminal)
Black	Transistor 3 (pin E) to ground (0V) Transistor 4 (pin E) to ground (0V) Transistor 3 (pin C) to motor (left terminal) Transistor 4 (pin C) to motor (right terminal)
Yellow	Port C (pin 0) to Transistor 1 (pin B) Port C (pin 1) to Transistor 2 (pin B) Port C (pin 2) to Transistor 3 (pin B) Port C (pin 3) to Transistor 4 (pin B)

4. APPARATUS

Table 2: Apparatus Needed for Testing

Power source
Voltage box, with ground (0V) and 5V outlets

Microcontroller

5. TESTING SEQUENCE

The motor is capable of running in either a clockwise or counter clockwise manner. The direction of rotation will depend upon the name assignment of the motor terminals. The Port C pin assignments given in table 3 should yield the corresponding results also given in table 3.

Table 3: Port C Pin Assignments and their results

Pin 0	Pin 1	Pin 2	Pin 3	Results
1	1	0	0	The motor will stop (brake)
1	0	1		The circuit will burn (smoke)
1	0	0	1	The motor will spin (forward)
0	1	1	0	The motor will spin (reverse)
0	1	0	1	The circuit will burn (smoke)
0	0	1	1	The motor will stop (brake)

6. LIST OF PARTS

Table 4: List of Required Components

Motor
4 Transistors (2 PNP and 2 NPN)
Red Wire
Black Wire
Yellow Wire
Bread Board
Microcontroller

7. REFERENCES

BROWN, Jim. (1998) *Brief H-Bridge Theory of Operation*. Revised (2000) by Bob Jordan. Dallas Personal Robotics Group. <http://www.dprg.org/tutorials/1998-04a/>. May 24, 2004.