Laboratory 7
DC Motor Driver, Matrix Keypad and Liquid Crystal Display (LCD)

Purpose
To introduce the L293D quad channel push-pull driver chip for bi-direction DC motor control

Introduction
DC Motor Driver

![Figure 7.1 Datasheet of the L293D]

The L293D (see Figure 7.1) is quadruple high-current half-H drives and it is designed to provide bidirectional drive currents of up to 600mA at voltages from 4.5V to 36V. The L293D is designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors. The L293D needs +5 V (VCC1) to operate and VCC2, where VS must be between 4.5V and 36 V (We will use VCC2 =+12 V). The channels are enabled by applying +5 V to the pin 1 (1,2EN). If a logic high is applied to pin 2 (1A), pin 3(1Y) will go high (to about 1.4 V lower than VCC2). If a logic
low is applied to pin 2 (1A), pin 3 (1Y) will go low (to about 1.2 V above ground). Pins 7 (2A) and 6(2Y) operate in like fashion.

The pin 1 (1,2EN) of L293D is the enable input for the channels 1 and 2. When pin1 (1,2EN) is taken to logic high, the pair of channels is “enabled,” meaning that they are made operational. When pin1 is taken to logic low, the two channels are “disabled,” which means that the outputs effectively disconnected from the circuit and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

![Diagram of L293D and DC motor connections]

**Figure 7.2**

Components

(1) OEM Basic Stamp 2 microcontroller
(3) 4.7kΩ resistors
(4) 1kΩ resistors
(1) Serial LCD
(1) DC motor
(1) L293D
(1) Matrix Keypad
(3) SPDT switches or NO buttons
Procedure

DC Motor Driver:
1. Connect the Basic Stamp 2SX to the L293D, the DC Motor and the tact switches as shown in Figure 7.3. Set VCC2 =+12 V.

![Figure 7.3 Connections to the Basic Stamp 2, the L293D and the tact switches.](image)

2. Design a simple reset switch circuit and connect a reset switch to the RES pin of your Basic Stamp 2SX.

3. Test the circuit shown in Figure 7.3 by entering and running the following program:

```plaintext
' {$STAMP BS2sx}
' {$PBASIC 2.5}
' DC Motor Driver
' Put you name here
```
'Put the date here

MAX_DUTY    CON 253
MIN_DUTY    CON 50
DUTY        VAR Byte
CYCLES      VAR Byte

DIRS=$00FF
DIRH=$0000
DUTY = 100
CYCLES = 250

DIR:
    OUT1=1
    OUT0=0

DO
    BRANCH (IND>>2), [Emergency, FASTER, SLOWER, SAME]
LOOP

SAME:
    DEBUG "SAME", CR
    DEBUG ? DUTY
    PWM 2, DUTY, CYCLES
    RETURN

FASTER:
    DUTY=DUTY+2
    IF DUTY<=MAX_DUTY THEN SKIP_HI_LIM
       DUTY = MAX_DUTY
    DEBUG "MAX SPEED", CR
    RETURN

SKIP_HI_LIM:
    DEBUG ?DUTY
    PWM 2, DUTY, CYCLES
    RETURN

SLOWER:
    'DEBUG IBIN IND, CR
    DUTY=DUTY-2
    IF DUTY>MIN_DUTY THEN SKIP_LO_LIM
       DUTY = MIN_DUTY
    DEBUG "Min SPEED", CR
    RETURN

SKIP_LO_LIM:
    DEBUG ?DUTY
    PWM 2, DUTY, CYCLES
    RETURN

Emergency:
    LOW 2
4. To verify the behavior of the DC motor, enter the values and leave comments into the following table. High = +5V and Low = 0V.

<table>
<thead>
<tr>
<th>OUT0 (P0)</th>
<th>OUT1(P1)</th>
<th>(P3)</th>
<th>(P14)</th>
<th>(P15)</th>
<th>Comment on the DC motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Rotate Clockwise</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Rotate Anticlockwise</td>
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<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Increase Speed</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Decrease Speed</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Stop</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 DC Motor Controller