Motion Control and Motor Interfacing

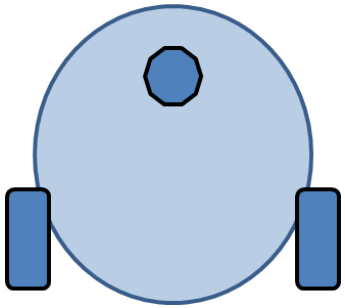
e-Yantra Team

Embedded Real-Time Systems (ERTS) Lab
Indian Institute of Technology, Bombay

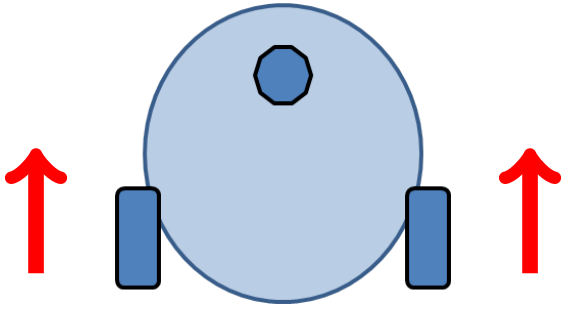
Agenda for Discussion

1. Basic Movements of Robot
   - Motions of Robot
   - Understanding L293D IC
2. Motor Interfacing on Firebird V
   - Pin connections
   - Logic Table

Various Motions



Various Motions



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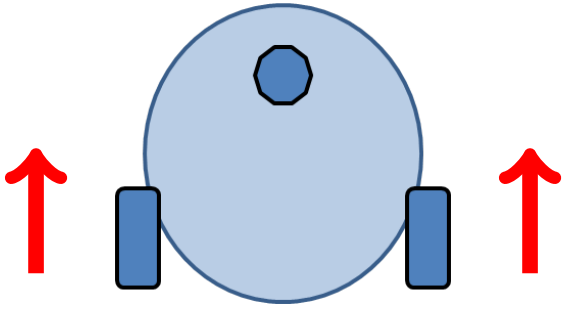

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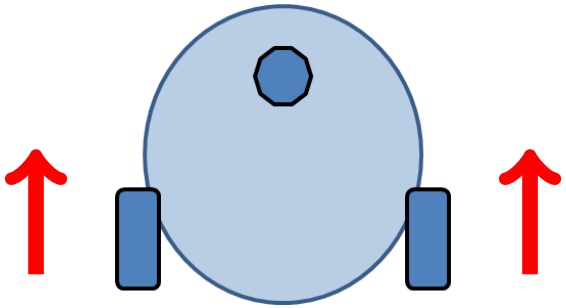

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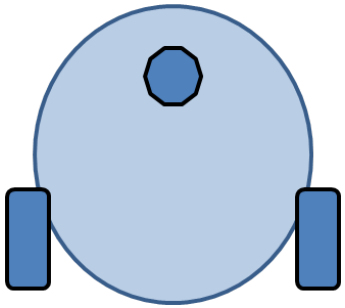

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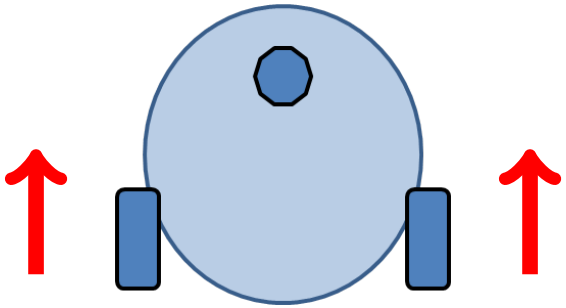

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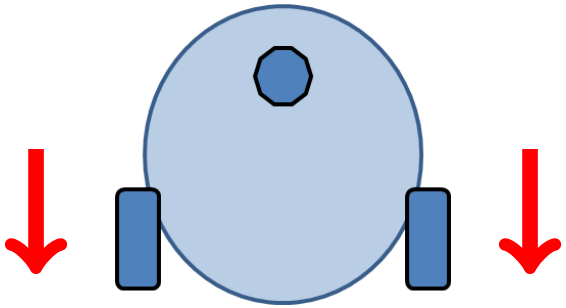

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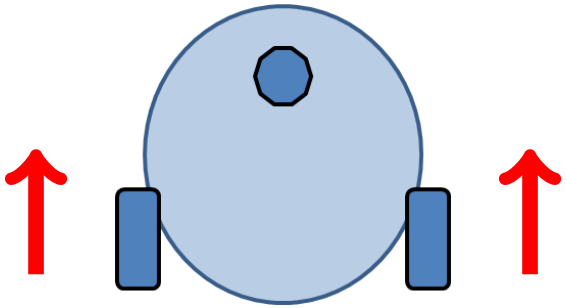
Various Motions



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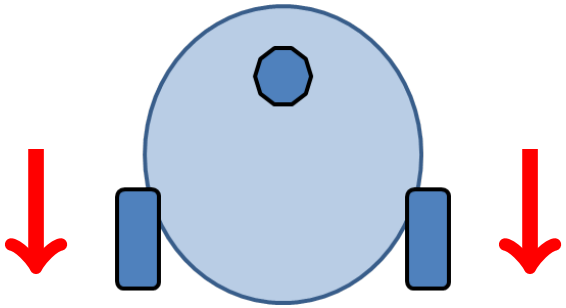

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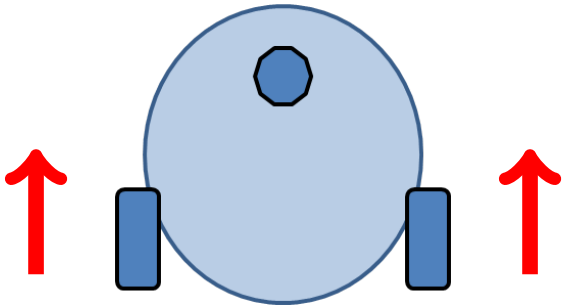

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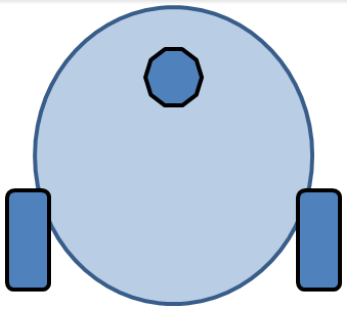

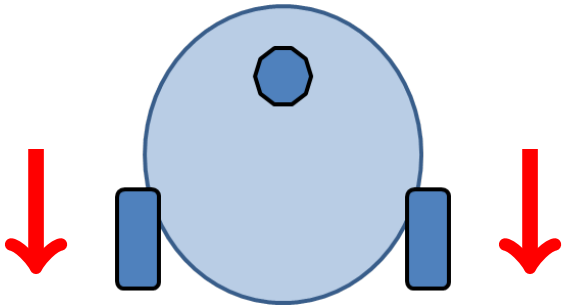

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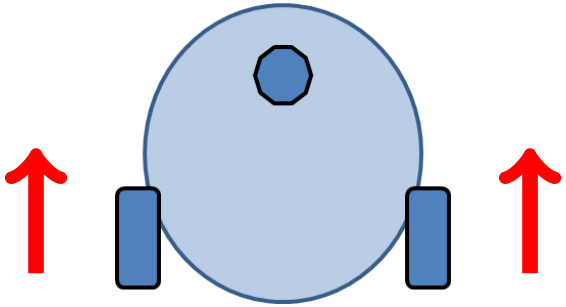

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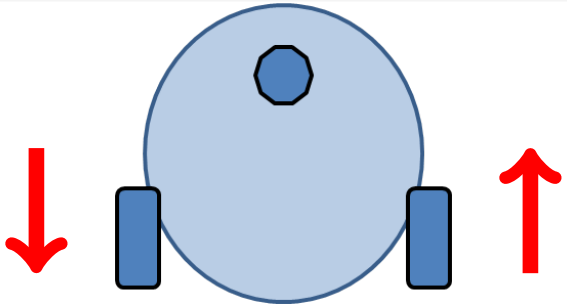

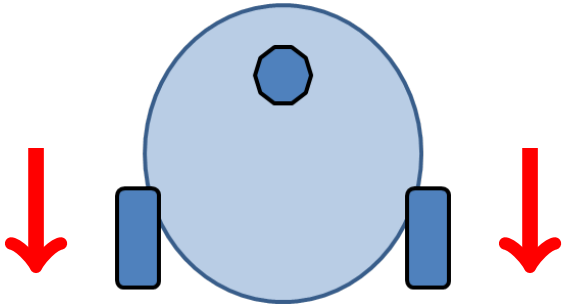

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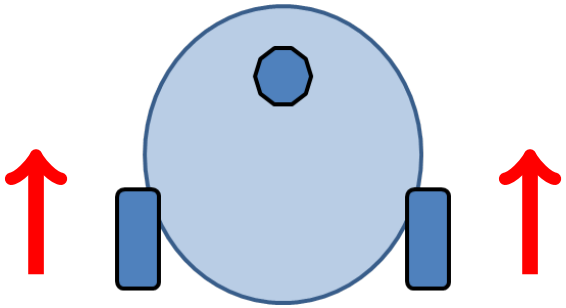

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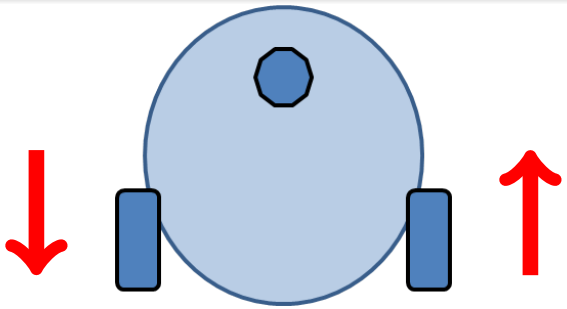

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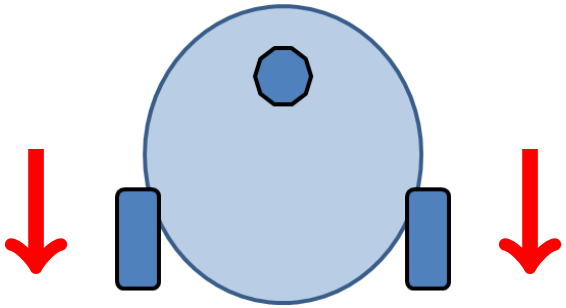

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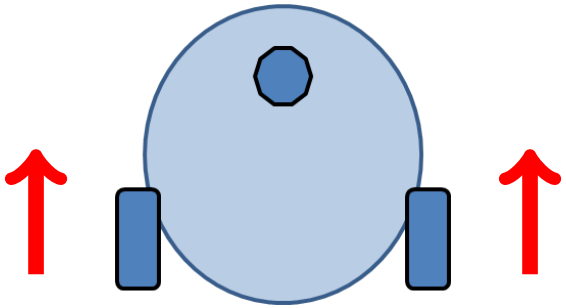

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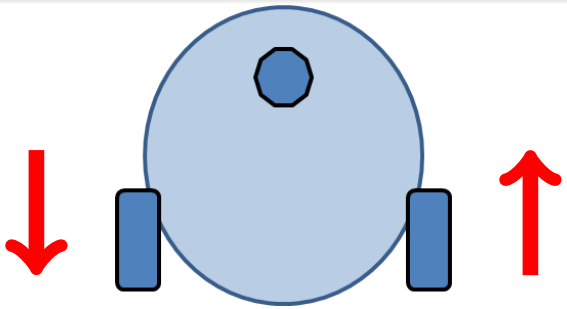

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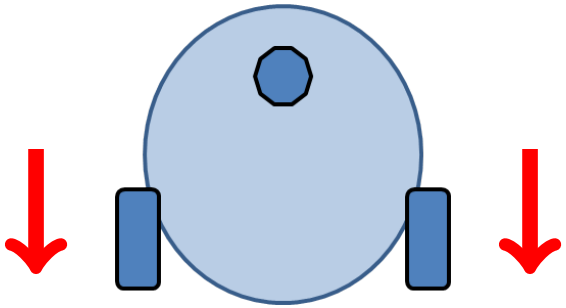

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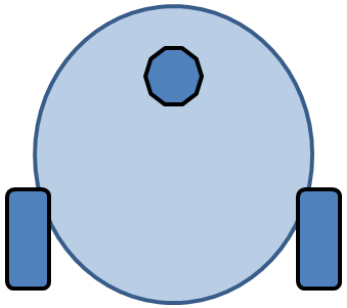

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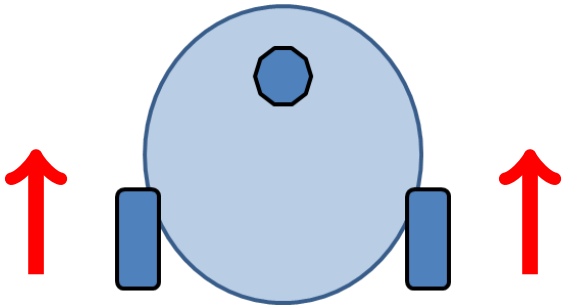

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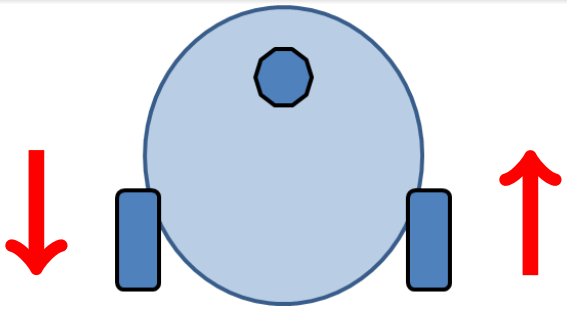

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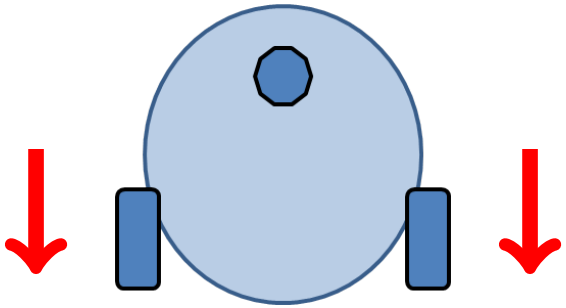

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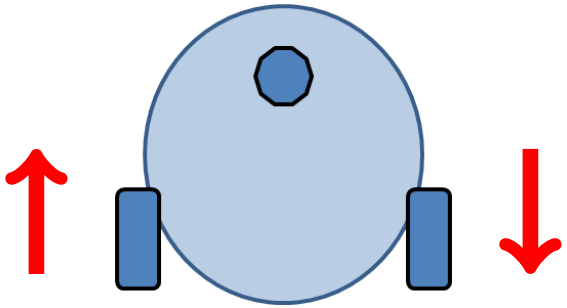

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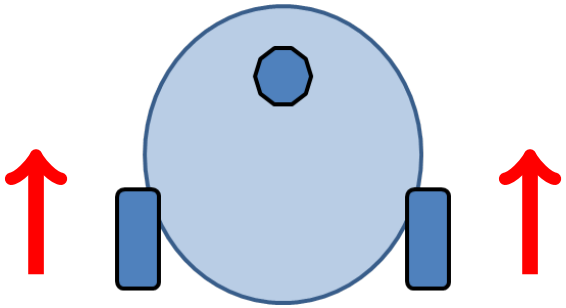

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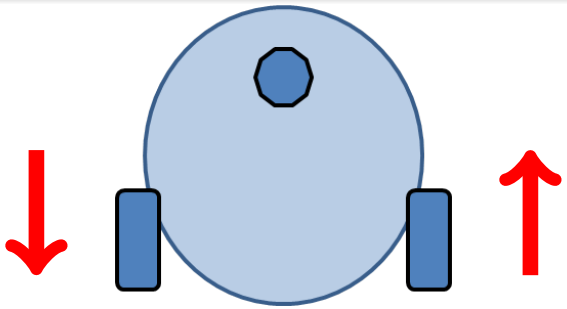

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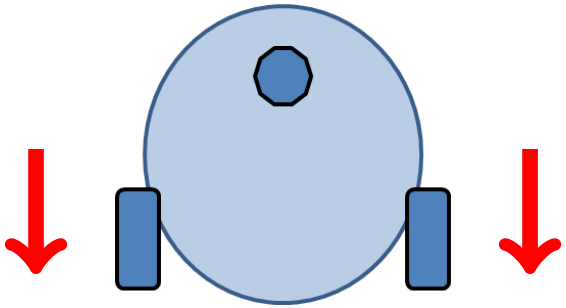

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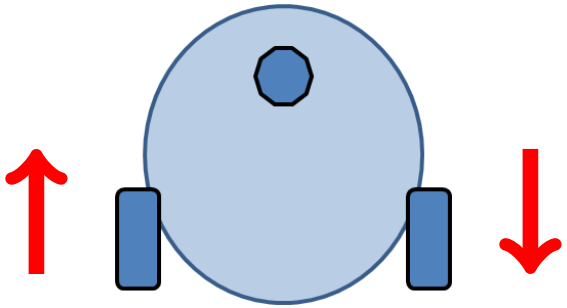

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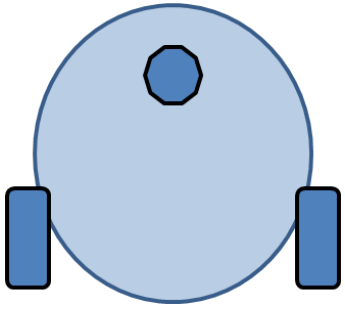
Various Motion (Contd..)



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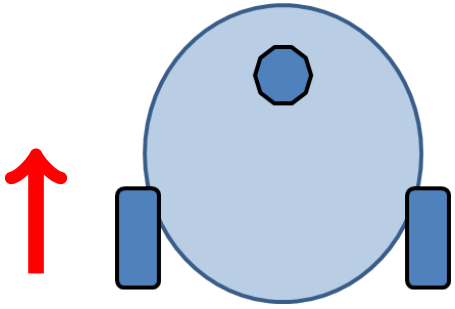

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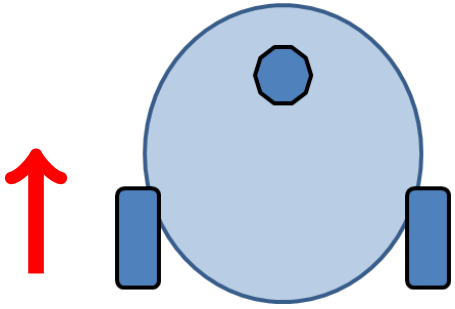

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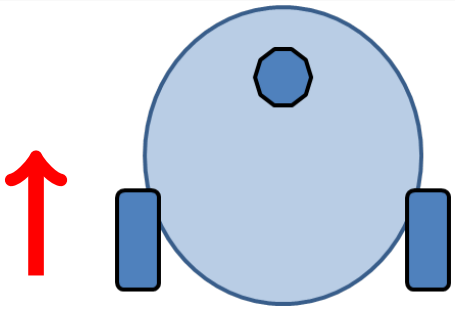

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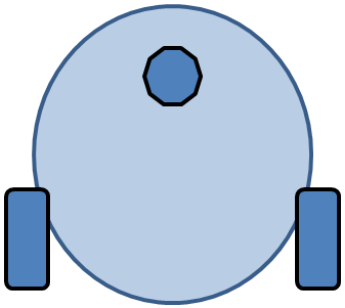
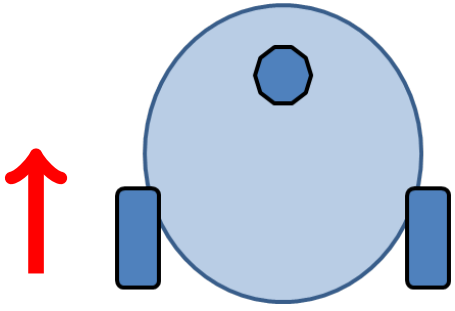


Various Motion (Contd..)



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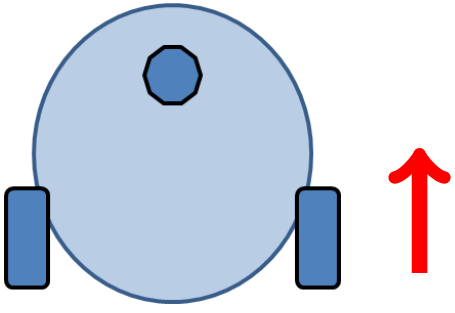

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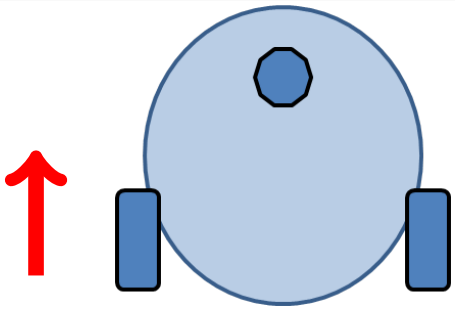

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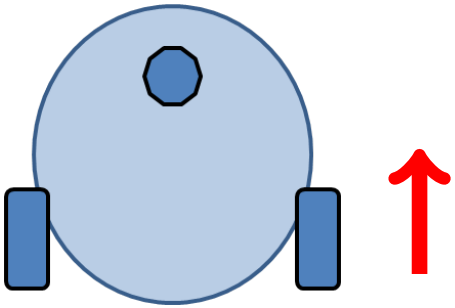

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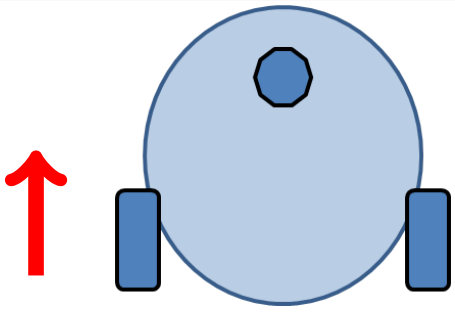

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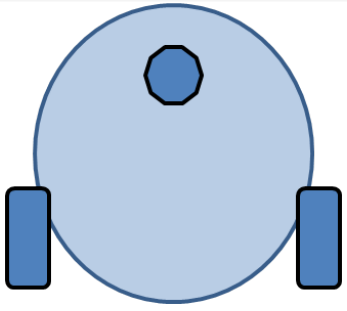

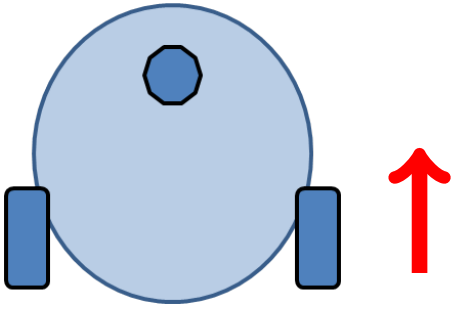

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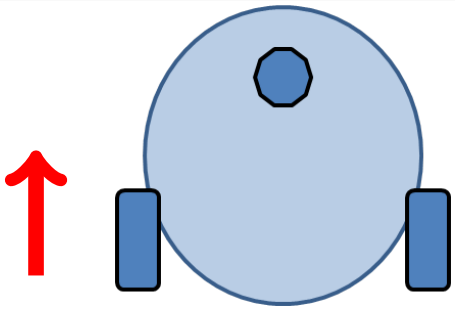
Various Motion (Contd..)



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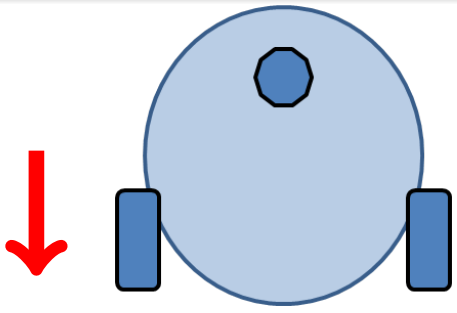
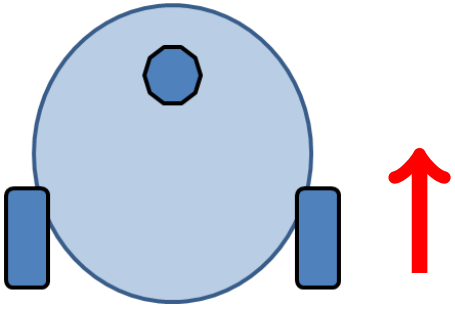
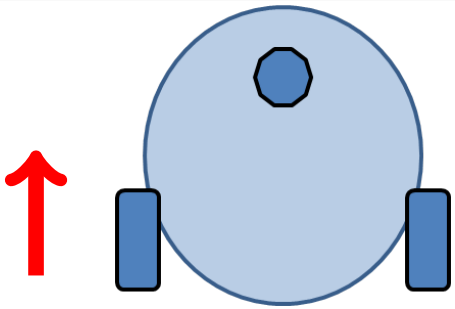




Soft-Left

Various Motion (Contd..)



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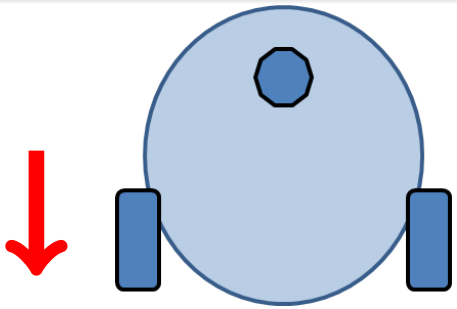

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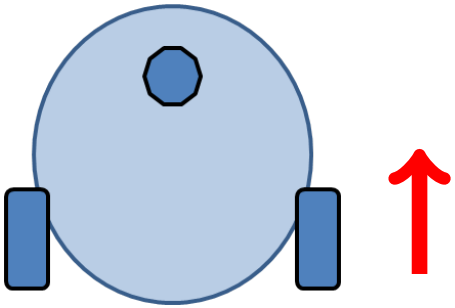
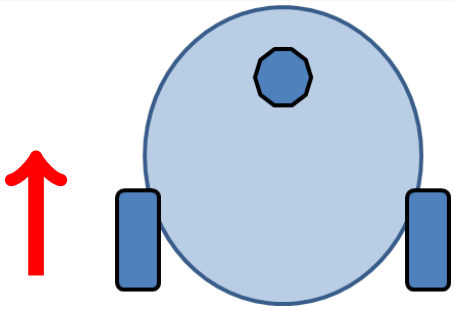


Soft-Left

Various Motion (Contd..)



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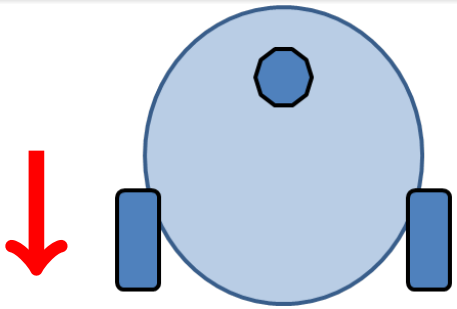

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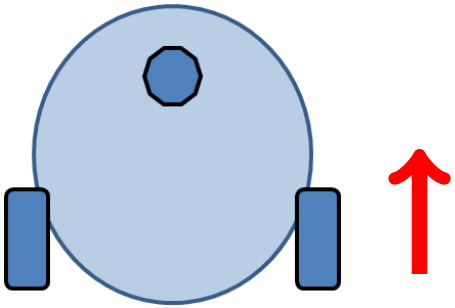

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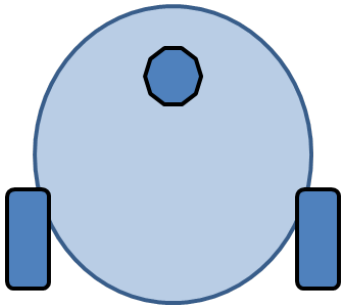
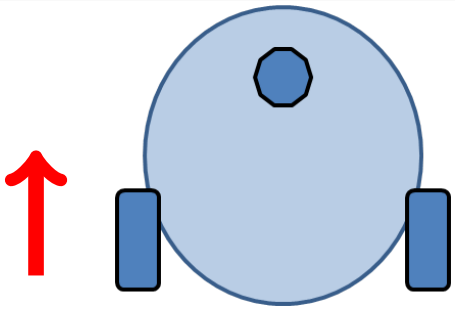


Various Motion (Contd..)



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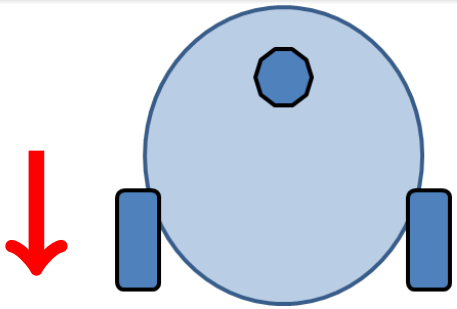

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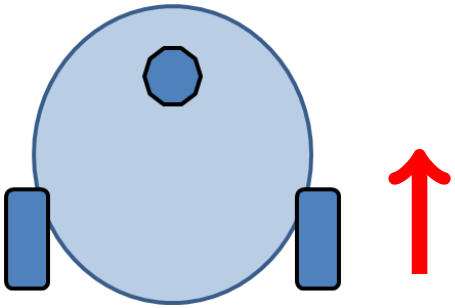

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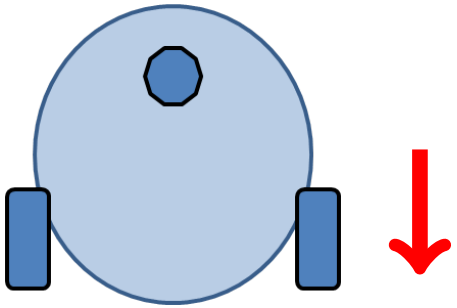
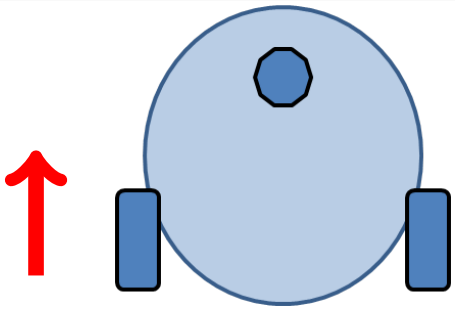
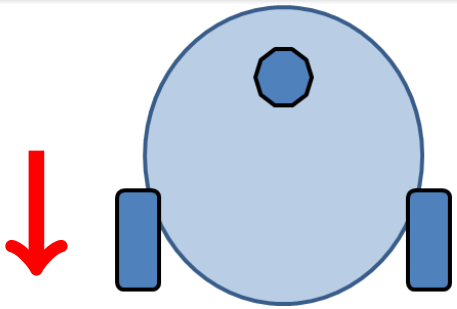


Backward Right

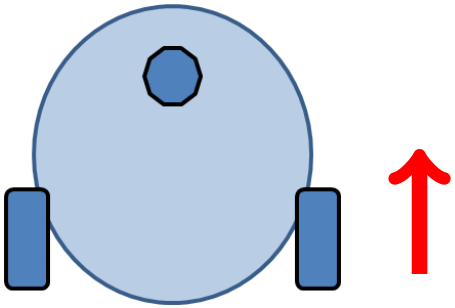
Various Motion (Contd..)



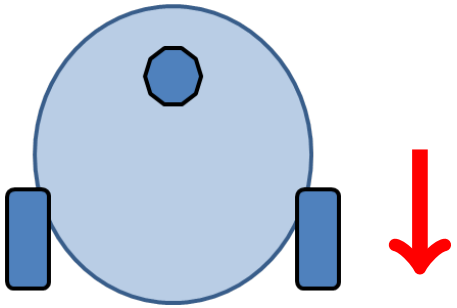
Soft-Right



Backward Left



Soft-Left

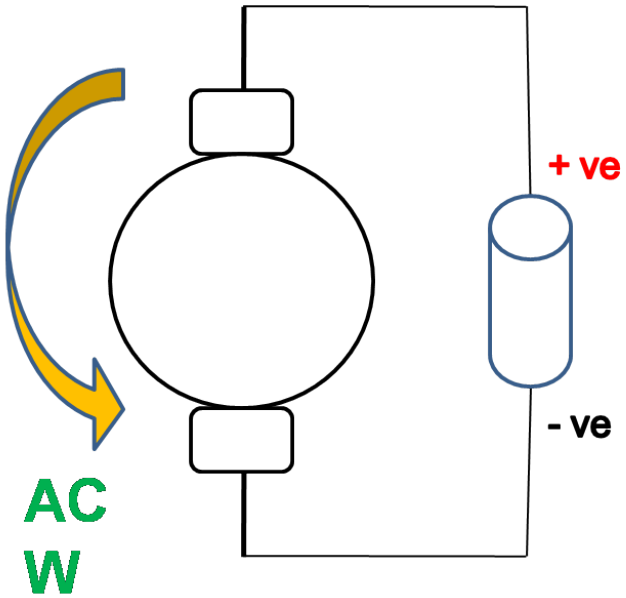


Backward Right

Direction Control of DC Motor

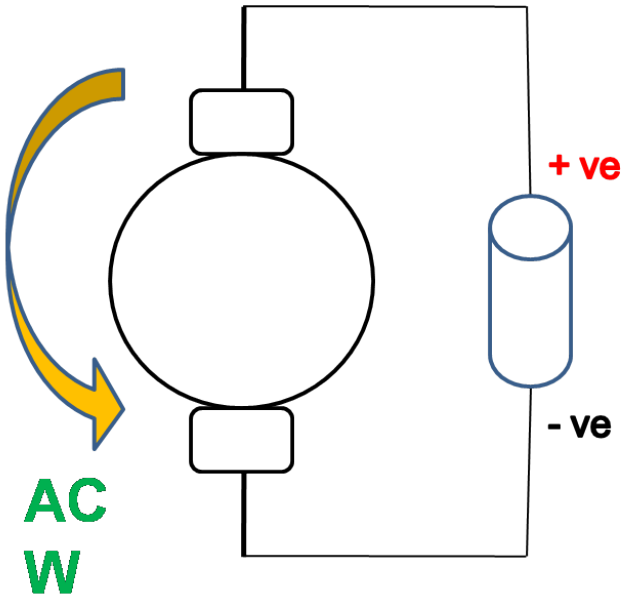
Direction Control of DC Motor

Anti-Clockwise Motion



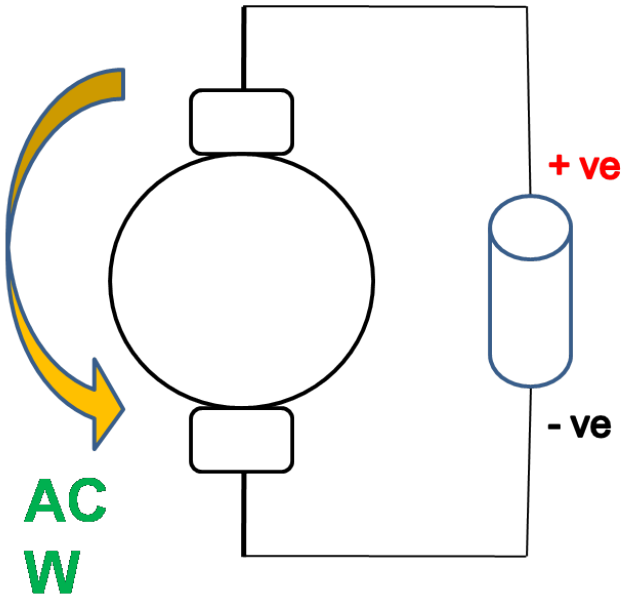
Direction Control of DC Motor

Anti-Clockwise Motion

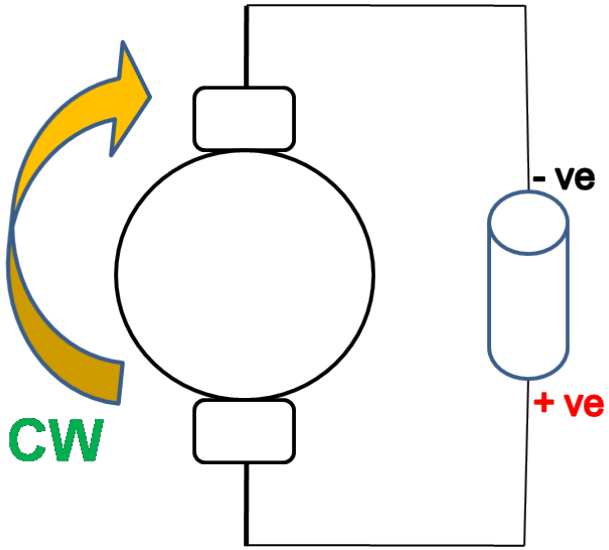


Direction Control of DC Motor

Anti-Clockwise Motion



Clockwise Motion



Need of L293D IC

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1. Maximum current that a port pin can source / sink is 20mA

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4. For this additional current, a Motor driver is required.

Need of L293D IC

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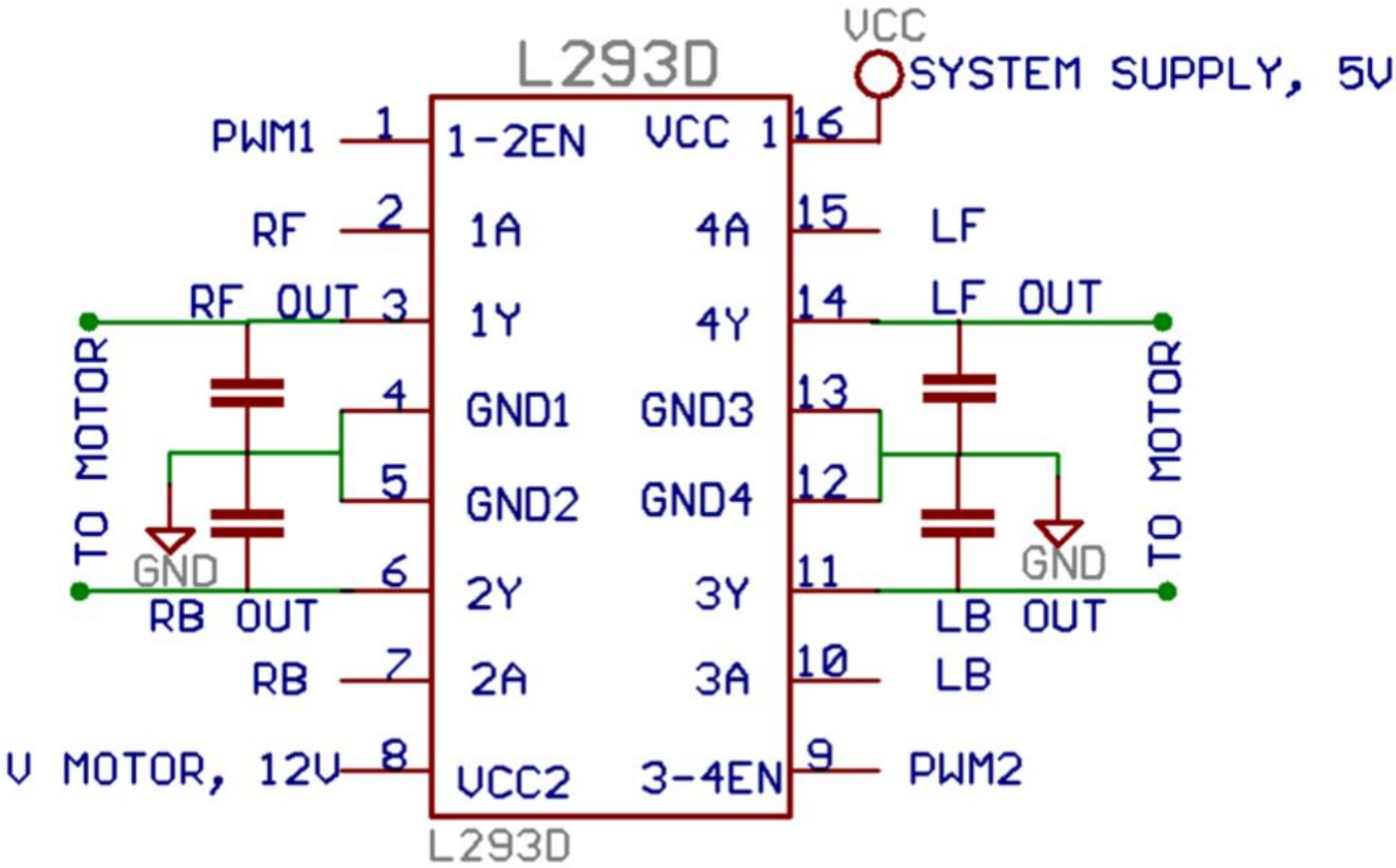
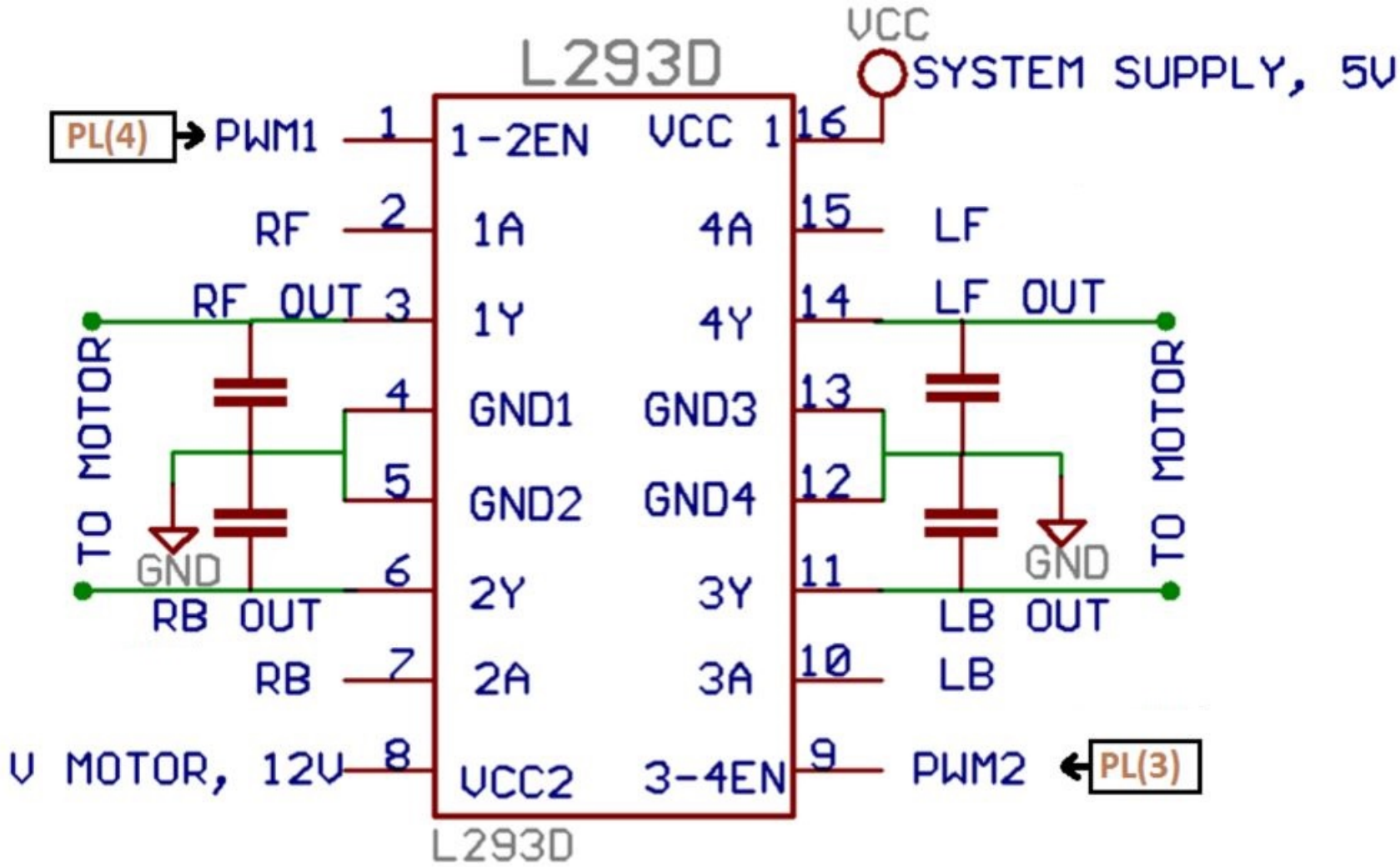
2. These currents are too low for Motors to run.
3. DC Motor with the output load requires a current of up to 500mA to attain maximum speed.
4. For this additional current, a Motor driver is required.
5. One such suitable driver is the L293D Motor driver.

L293D IC

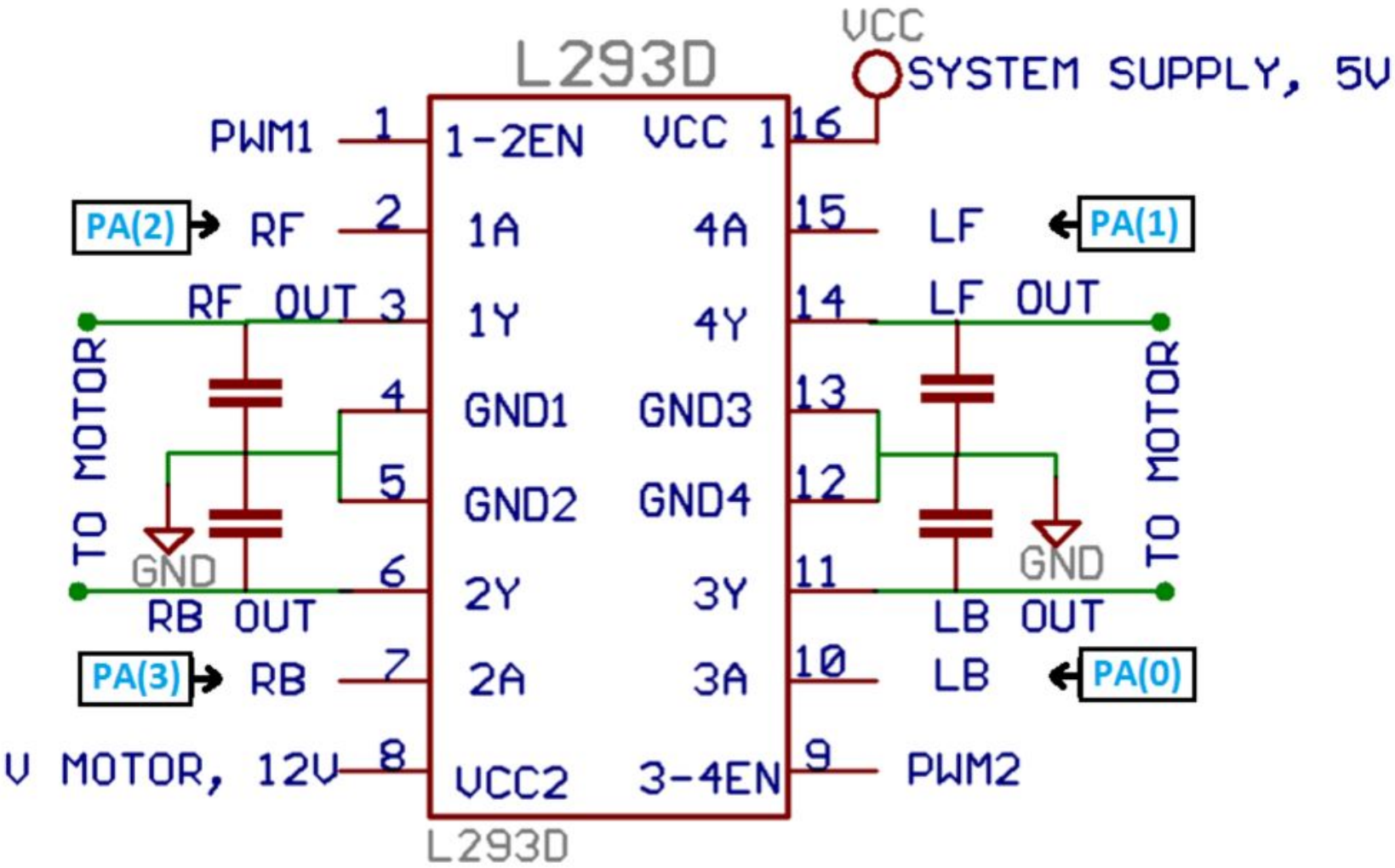
L293D IC


L293D
VCC
SYSTEM SUPPLY, 5V
PWM1
1
1-2EN
VCC
1
16
RF
2
1A
4A
15
LF
RF OUT
3
1Y
4Y
14
LF OUT
TO MOTOR
4
GND1
GND3
13
5
GND2
GND4
12
TO MOTOR
GND
GND
6
2Y
3Y
11
RB OUT
LB OUT
RB
7
2A
3A
10
LB
V MOTOR, 12V
8
VCC2
3-4EN
9
PWM2
L293D

L293D IC


L293D
VCC
SYSTEM SUPPLY, 5V
PL(4)
PWM1
1
1-2EN
VCC
1
16
RF
2
1A
4A
15
LF
RF OUT
3
1Y
4Y
14
LF OUT
TO MOTOR
4
GND1
GND3
13
TO MOTOR
5
GND2
GND4
12
GND
GND
6
2Y
3Y
11
RB OUT
LB OUT
RB
7
2A
3A
10
LB
V MOTOR, 12V
8
VCC2
3-4EN
9
PWM2
PL(3)
L293D

L293D IC


L293D
VCC
SYSTEM SUPPLY, 5V
PWM1
1
1-2EN
VCC 1
16
PA(2)
RF
2
1A
4A
15
LF
PA(1)
RF OUT
3
1Y
4Y
14
LF OUT
TO MOTOR
4
GND1
GND3
13
TO MOTOR
5
GND2
GND4
12
GND
GND
6
2Y
3Y
11
RB OUT
LB OUT
PA(3)
RB
7
2A
3A
10
LB
PA(0)
V MOTOR, 12V
8
VCC2
3-4EN
9
PWM2
L293D

Motor Pin Connection

Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A

Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A

Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A
   a. PA0 - Left Motor Control
   b. PA1 - Left Motor Control
   c. PA2 - Right Motor Control
   d. PA3 - Right Motor Control

Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A
   a. PA0 - Left Motor Control
   b. PA1 - Left Motor Control
   c. PA2 - Right Motor Control
   d. PA3 - Right Motor Control
2. Two Pins for Enabling Motor Driver IC is connected at PORT L

Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A
   a. PA0 - Left Motor Control
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   d. PA3 - Right Motor Control
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Motor Pin Connection

1. Four Pins for Direction control is connected at PORT A
   a. PA0 - Left Motor Control
   b. PA1 - Left Motor Control
   c. PA2 - Right Motor Control
   d. PA3 - Right Motor Control
2. Two Pins for Enabling Motor Driver IC is connected at PORT L
   a. PL3 - Left Channel Enable
   b. PL4 - Right Channel Enable

Logic Table

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0
Stop				

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB
Forward	0	1	1	0
Backward	1	0	0	1
Left	0	1	0	1
Right	1	0	1	0
Soft Left	0	1	0	0
Soft Right	0	0	1	0
Stop	0	0	0	0

Logic Table

Direction	PA(3) RB	PA(2) RF	PA(1) LF	PA(0) LB	Hex value
Forward	0	1	1	0	0x06
Backward	1	0	0	1	0x09
Left	0	1	0	1	0x05
Right	1	0	1	0	0x0A
Soft Left	0	1	0	0	0x04
Soft Right	0	0	1	0	0x02
Stop	0	0	0	0	0x00

Syntax for C program

#include

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```
#include <avr/io.h>
#include <util/delay.h>
```

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```

Main Program

Syntax for C program

#include

```
#include <avr/io.h>
#include <util/delay.h>
```

Main Program

```
int main()
{
  motion_pin_config();
  while(1)
  {
    forward();
    _delay_ms();
    stop();
    _delay_ms();
  }
}
```

Syntax for C program (Contd..)

Pin Configuration

Syntax for C program (Contd..)

Pin Configuration

```
void motion_pin_config()
{
   DDRA = 0x0F;     // Output port
   PORTA = 0x00;    // Initially motor stop
   DDRL =           // Enable pins
   PORTL =          // Initially low
}
```

Syntax for C program (Contd..)

Pin Configuration

```
void motion_pin_config()
{
   DDRA = 0x0F;     // Output port
   PORTA = 0x00;    // Initially motor stop
   DDRL =           // Enable pins
   PORTL =          // Initially low
}
```

Functions

Syntax for C program (Contd..)

Pin Configuration

```
void motion_pin_config()
{
   DDRA = 0x0F;     // Output port
   PORTA = 0x00;    // Initially motor stop
   DDRL =           // Enable pins
   PORTL =          // Initially low
}
```

Functions

```
void forward()
{
   PORTA = 0x06;
}
```

```
void stop()
{
   PORTA = 0x00;
}
```

Syntax for C program (contd..)

Define all motion related functions and include in main function:

1. backward();

Syntax for C program (contd..)

Define all motion related functions and include in main function:

1. backward();
2. right();

Syntax for C program (contd..)

Define all motion related functions and include in main function:

1. backward();
2. right();
3. left();

Syntax for C program (contd..)

Define all motion related functions and include in main function:

1. backward();
2. right();
3. left();
4. soft_right();

Syntax for C program (contd..)

Define all motion related functions and include in main function:

1. backward();
2. right();
3. left();
4. soft_right();
5. soft_left();

Thank You!

Post your queries on: support@e-yantra.org