

# DC Motors

## A brief introduction

# Motors produce motion by harnessing the interaction between stable and changing magnetic fields.

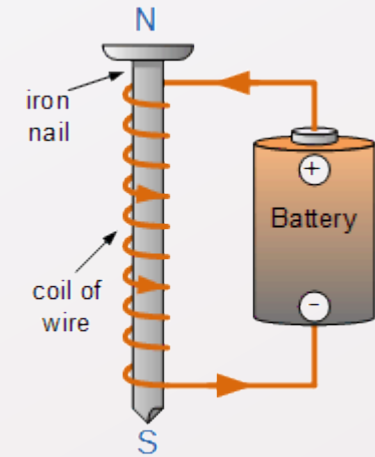
The changing field is produced by an electromagnet (coil)

Field strength and direction is determined by current flow through the magnet coil

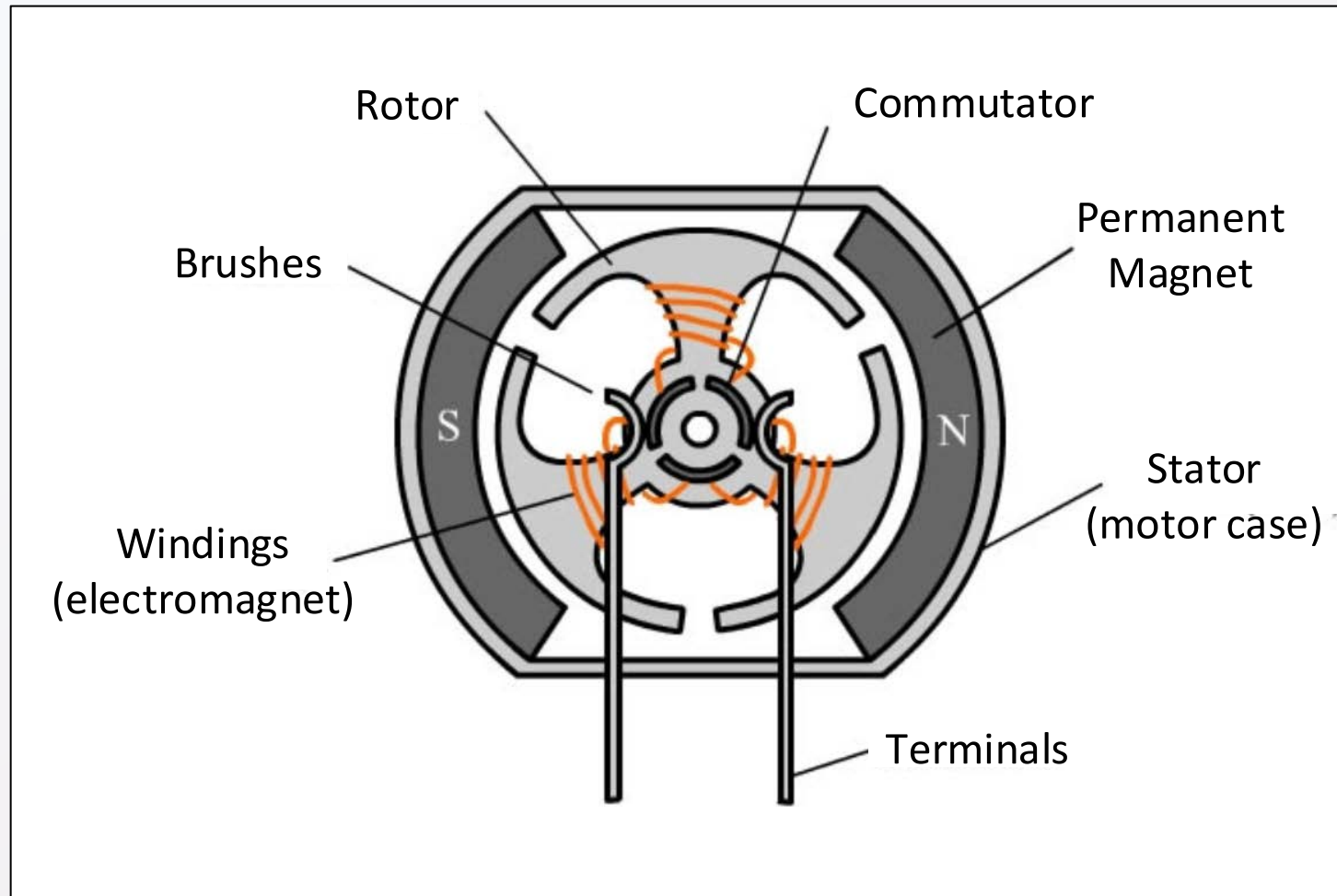
Field strength determines motor rotational force, or torque

Increased voltage across coils increase current, which increases torque

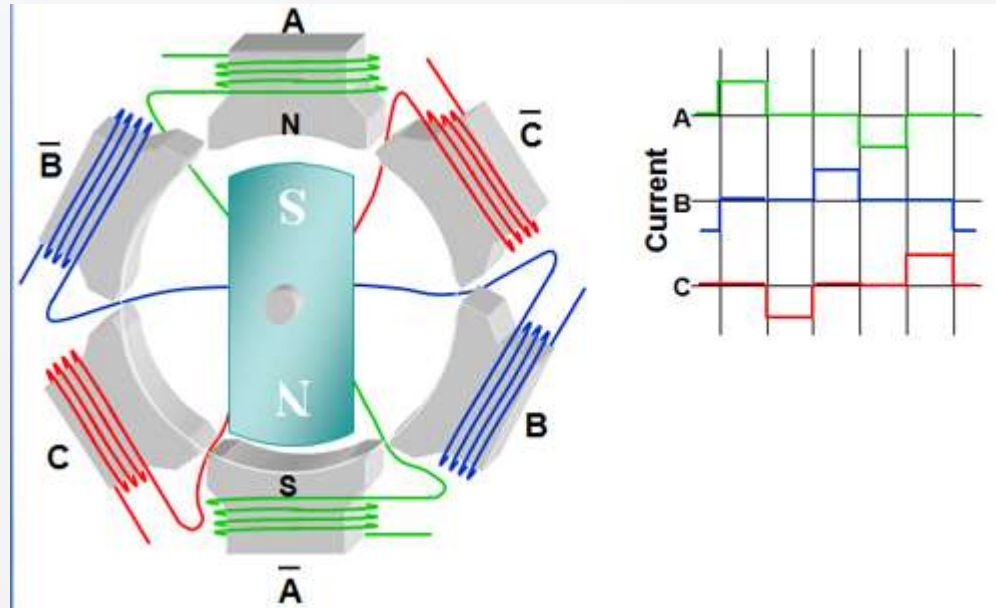
*Want to know more? Go read about the Lorentz force and Laplace force...*



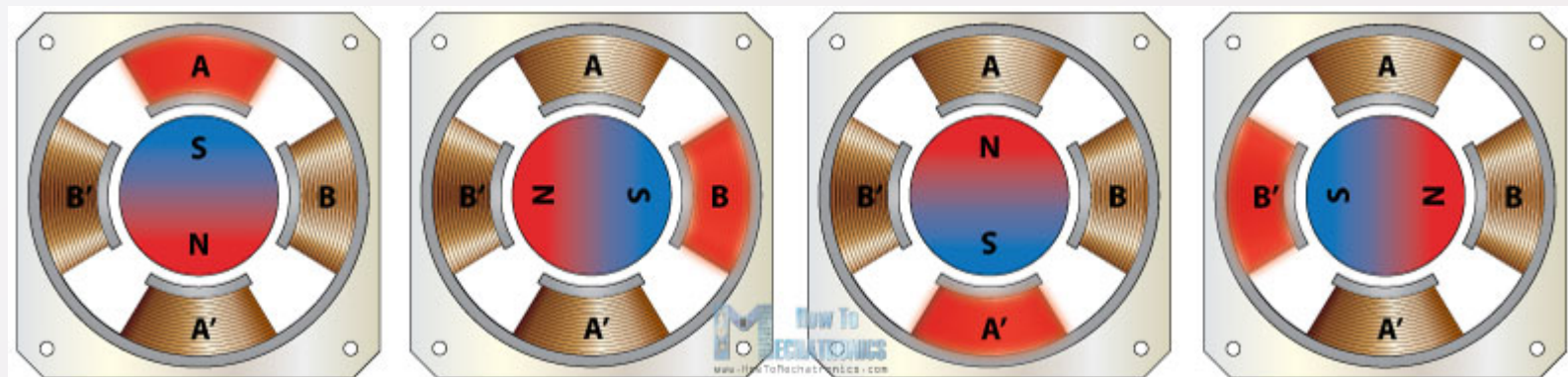
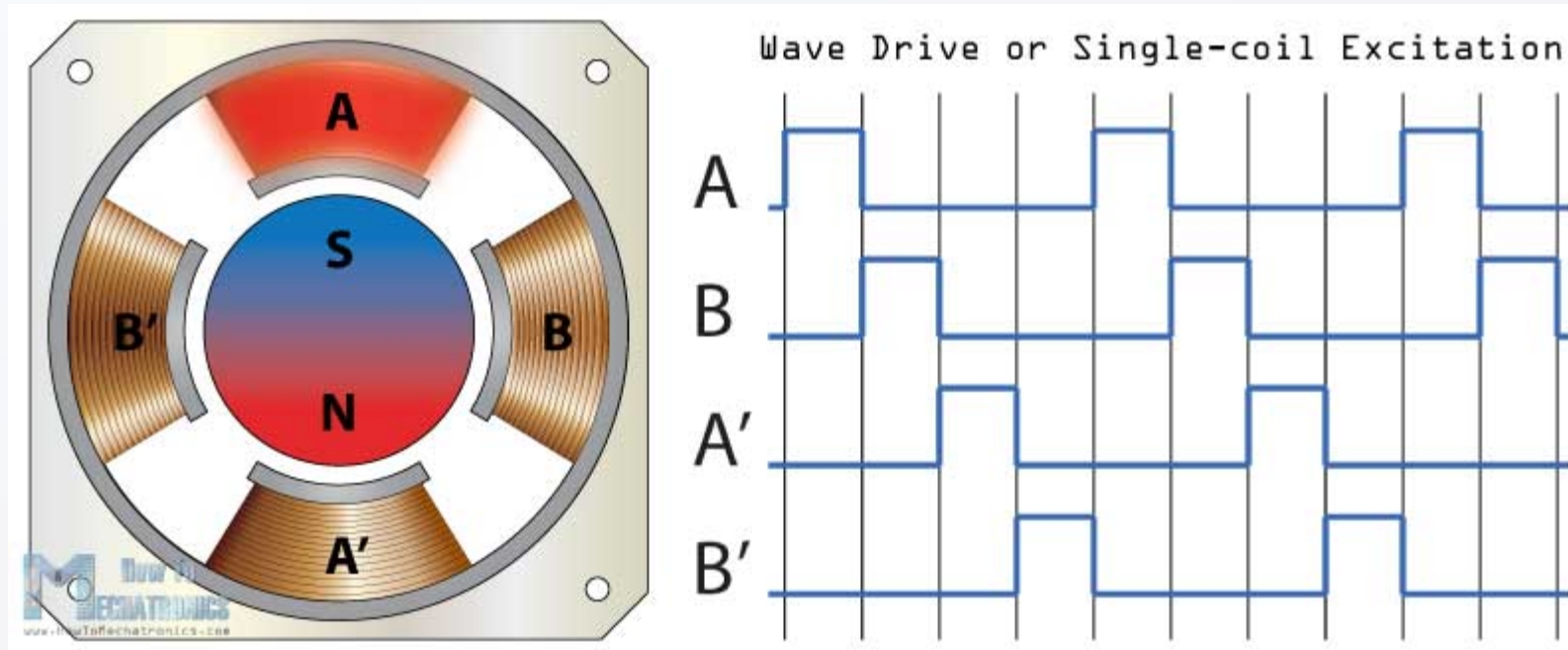
# Ordinary brushed DC motor (hobby motor)



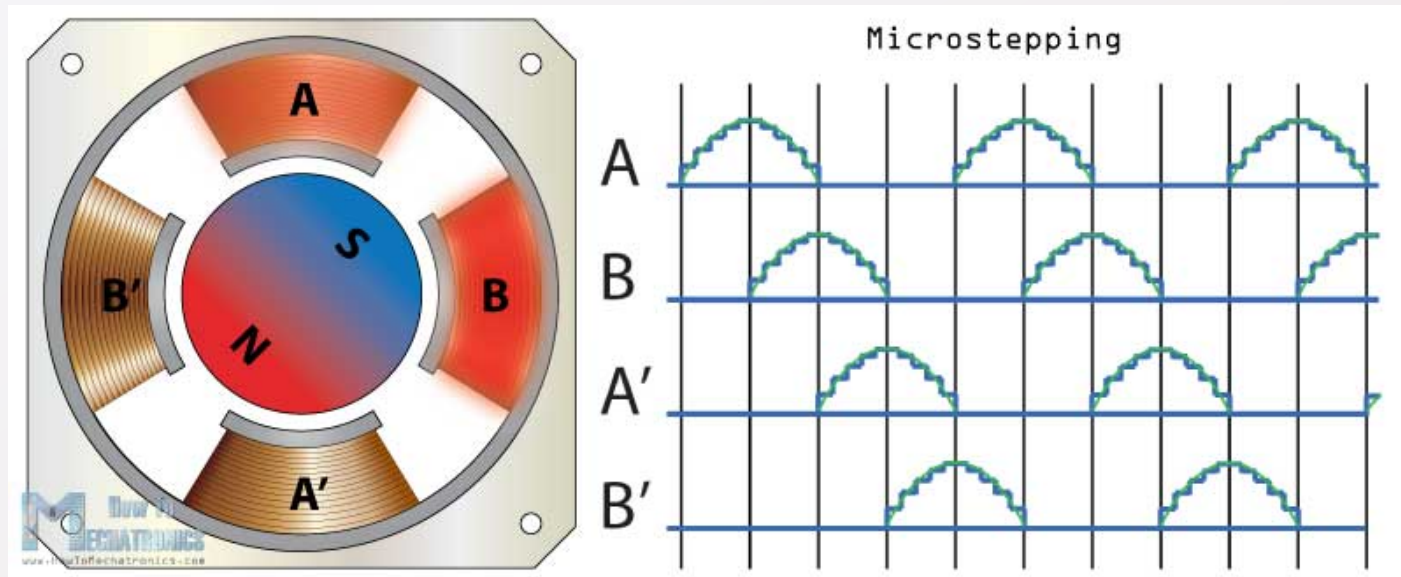
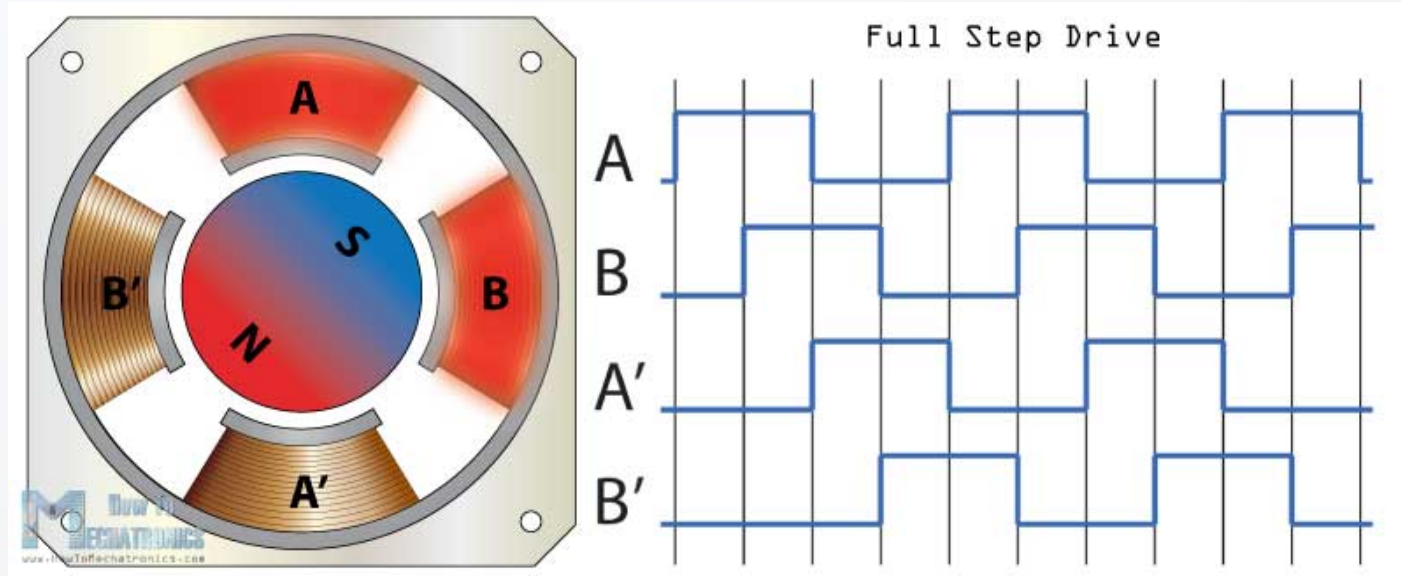
# Brushless DC motors



# Stepper motors

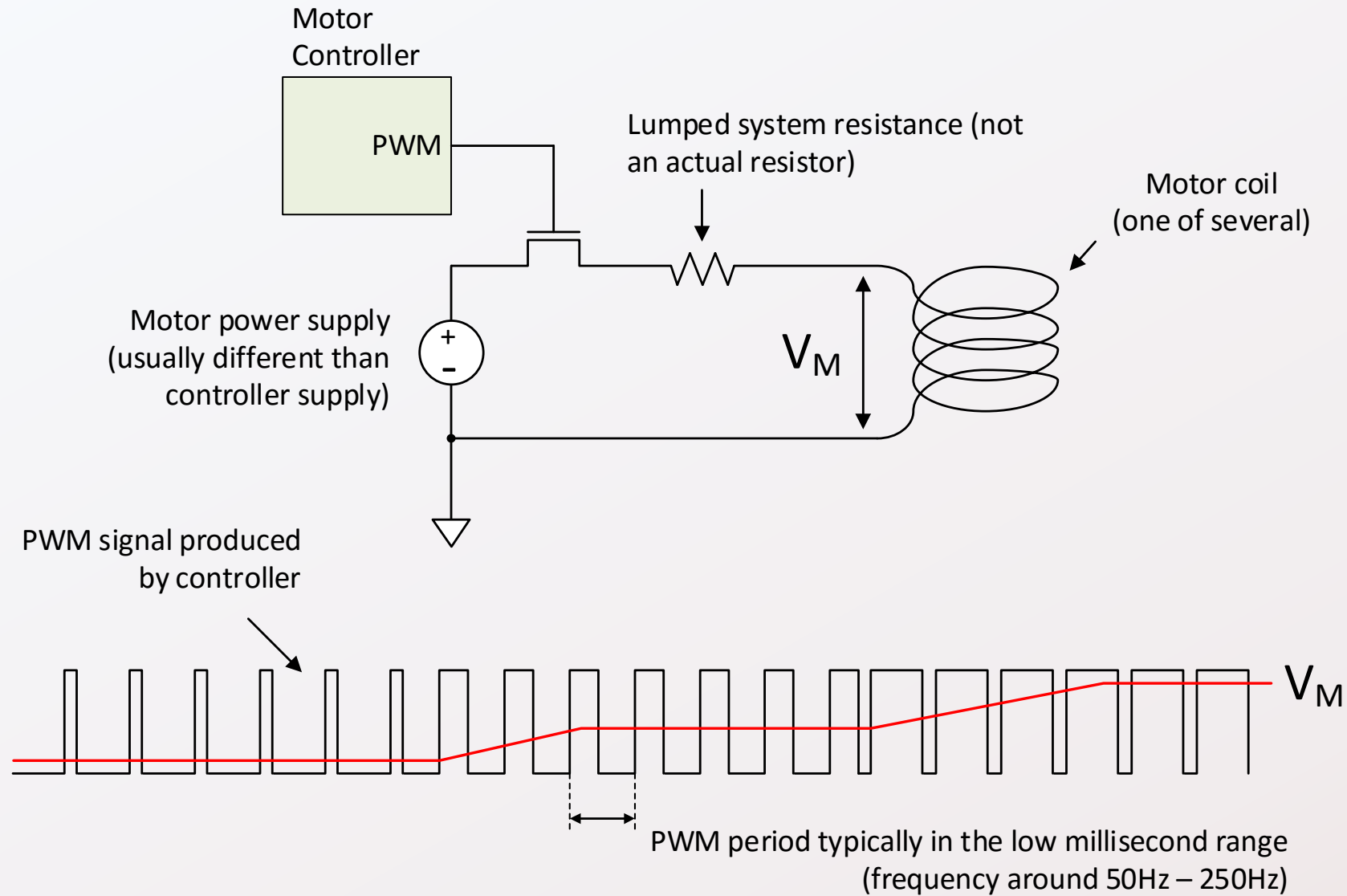


# Stepper motors

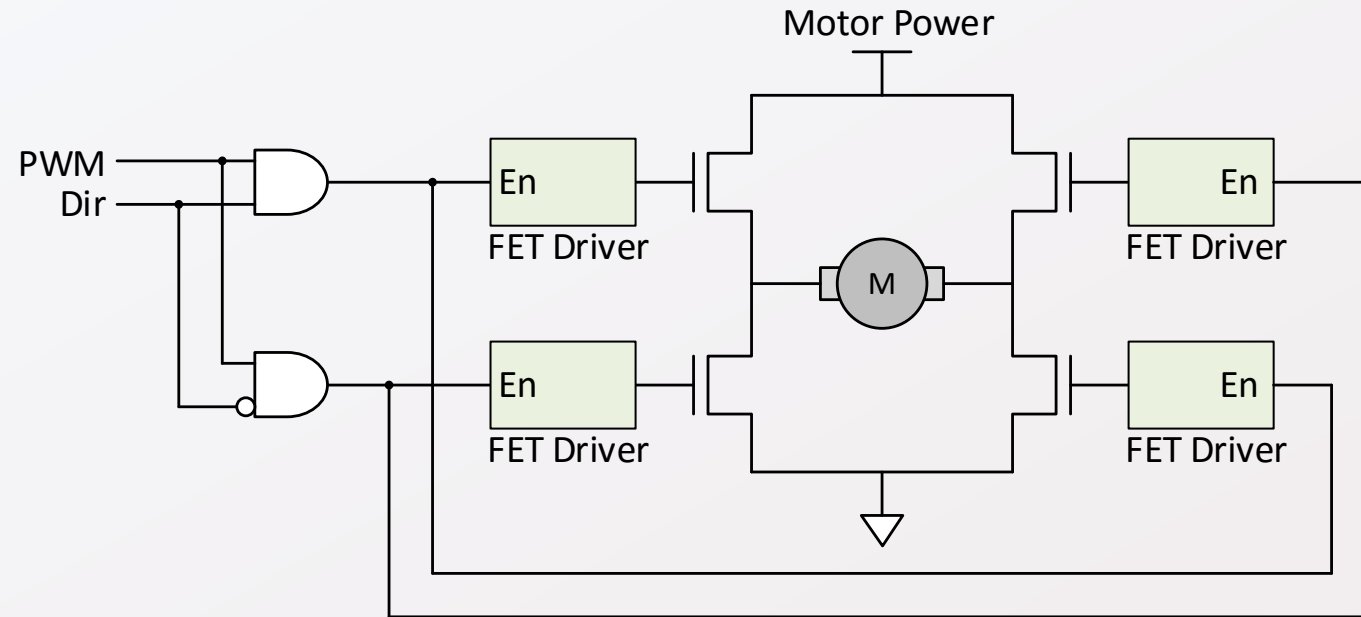




# DC motor controller: Constant voltage vs. PWM



# DC motor controller: H-bridge





# Servomotor

Typically small brushed DC motor with gearbox and controller in plastic housing

Hobby Servo



Image from [www.feetechrc.com](http://www.feetechrc.com)

Inside a  
hobby servo

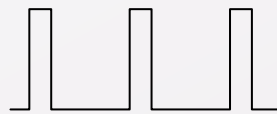
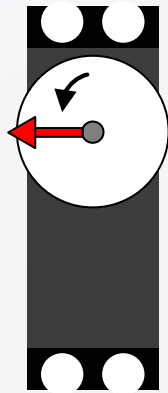


Image from [www.sparkfun.com](http://www.sparkfun.com)

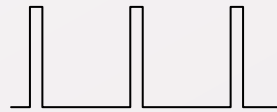
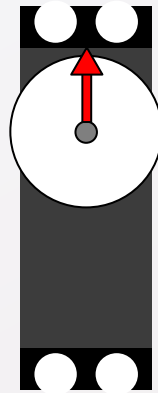
# Servomotor control

Many processes need precise times, or need regular interval service

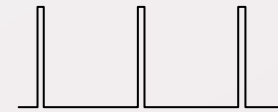
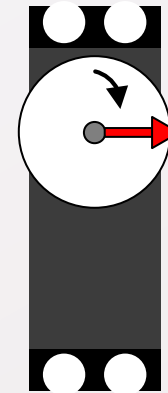
Top-down view of hobby servomotors



2ms pulse every 20ms  
Fully counterclockwise



1.5ms pulse every 20ms  
Centered

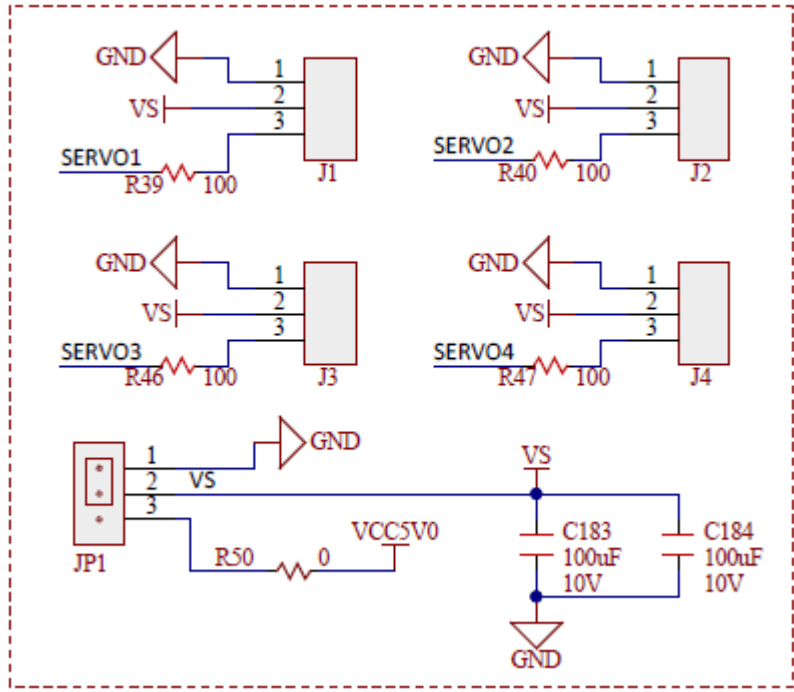


1ms pulse every 20ms  
Fully clockwise

# Servomotors on Blackboard

Four servo connectors; 1-3 are connected to TTC waveform outputs by Blackboard hardware definition

## SERVO MOTOR CONNECTORS



Power supply...

BANK 35		G14	SERVO3
IO L1P T0 AD0P 35	IO 0 35	C20	JB3 P
IO L1N T0 AD0N 35		B20	JB3 N
IO L2P T0 AD8P 35		B19	JB4 P
IO L2N T0 AD8N 35		A20	JB4 N
IO L3P T0 DQS_AD1P 35		E17	JA4 P
IO L3N T0 DQS_AD1N 35		D18	JA4 N
IO L4P T0 35		D19	JB1 P
IO L4N T0 35		D20	JB1 N
IO L5P T0 AD9P 35		E18	JA3 P
IO L5N T0 AD9N 35		E19	JA3 N
IO L6P T0 35		F16	JA1 P
IO L6N T0 VREF 35		F17	JA1 N
IO L7P T1 AD2P 35		M19	SERVO4
IO L7N T1 AD2N 35		M20	GYRO_INT1_A/G
IO L8P T1 AD10P 35		M17	SSEG_CE
IO L8N T1 AD10N 35		M18	SSEG_AN2
IO L9P T1 DQS_AD3P 35		L19	GYRO_INT M
IO L9N T1 DQS_AD3N 35		L20	GYRO_DRDY M
IO L10P T1 AD11P 35		K19	SSEG_AN0
IO L10N T1 AD11N 35		J19	GYRO_SDA
IO L11P T1 SRCC 35		L16	SSEG_AN3
IO L11N T1 SRCC 35		L17	GYRO_SDO M
IO L12P T1 MRCC 35		K17	GYRO_CS_A/G
IO L12N T1 MRCC 35		K18	SSEG_DP
IO L13P T2 MRCC 35		H16	PL_CLK
IO L13N T2 MRCC 35		H17	SSEG_AN1
IO L14P T2 AD4P SRCC 35		J18	SSEG_CC
IO L14N T2 AD4N SRCC 35		H18	SSEG_CG
IO L15P T2 DQS_AD12P 35		F19	JB2 P
IO L15N T2 DQS_AD12N 35		F20	JB2 N
IO L16P T2 35		G17	SERVO1
IO L16N T2 35		A10	CBEAKER
IO L17P T2 AD5P 35		J20	GYRO_SDO_A/G
IO L17N T2 AD5N 35		H20	GYRO_SCL
IO L18P T2 AD13P 35		G19	JA2 P
IO L18N T2 AD13N 35		G20	JA2 N
IO L19P T3 35		H15	SSEG_CB
IO L19N T3 VREF 35		G15	SERVO2
IO L20P T3 AD6P 35		K14	SSEG_CA
IO L20N T3 AD6N 35		J14	GYRO_DEN_A/G
IO L21P T3 DQS_AD14P 35		N15	M_CLK
IO L21N T3 DQS_AD14N 35		N16	SW3
IO L22P T3 AD7P 35		L14	M_DATA
IO L22N T3 AD7N 35		L15	SW6
IO L23P T3 35		M14	BTN3
IO L23N T3 35		M15	SW7
IO L24P T3 AD15P 35		K16	GYRO_CS_M
IO L24N T3 AD15N 35		J16	SSEG_CF
IO L25P 35		J15	SSEG_CD
IO L25N 35			