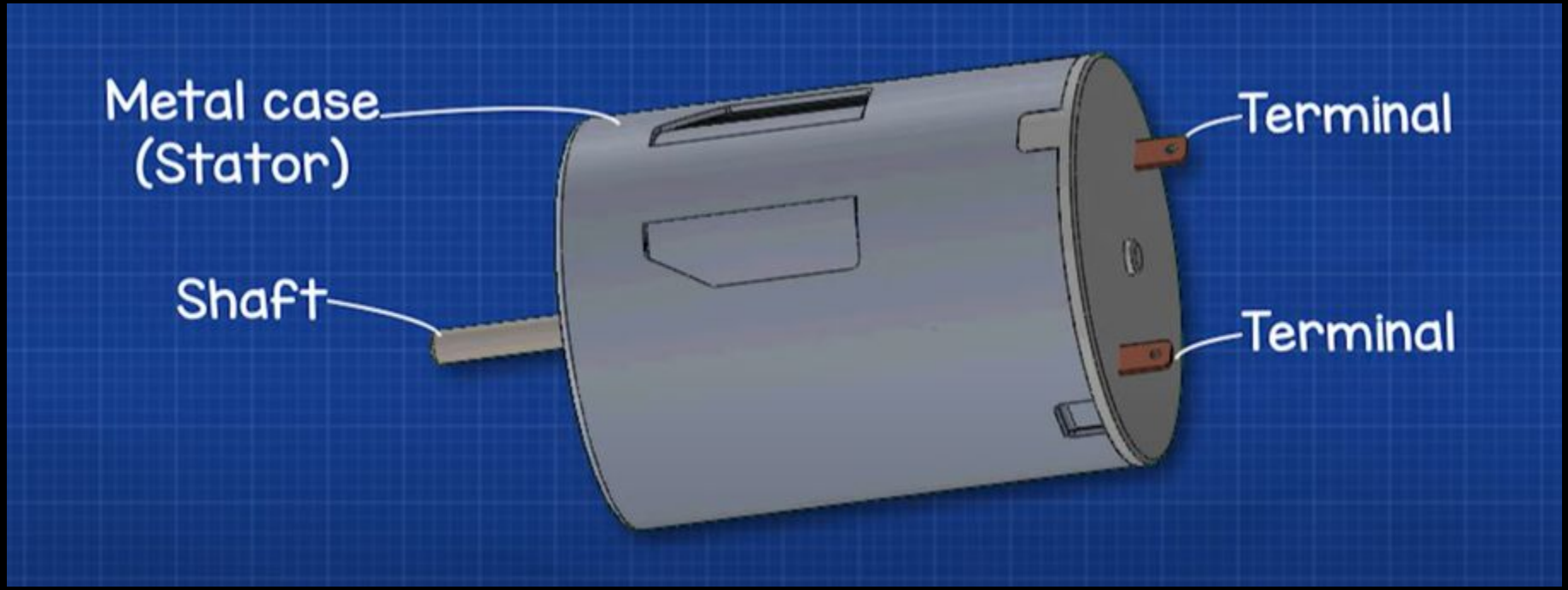
DC MOTORS

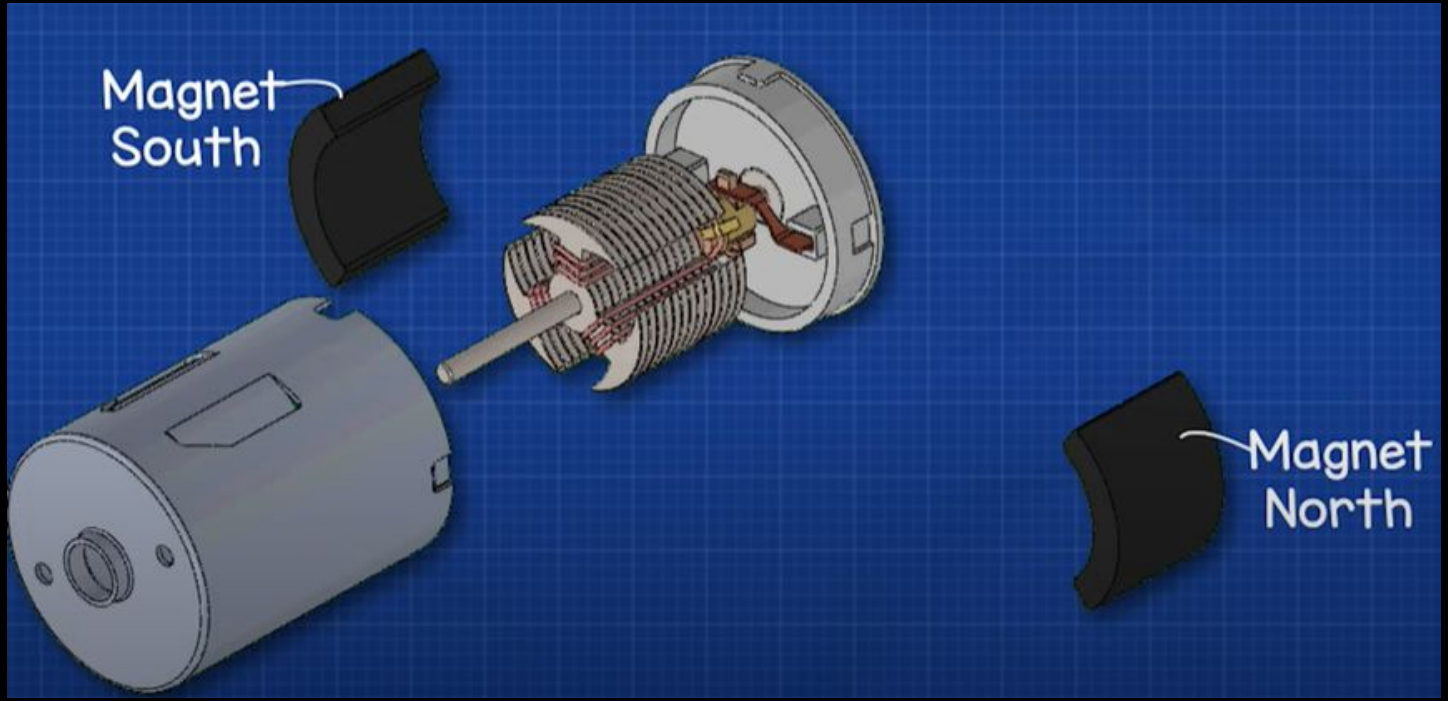
HOW THEY WORK?

TEJ4M

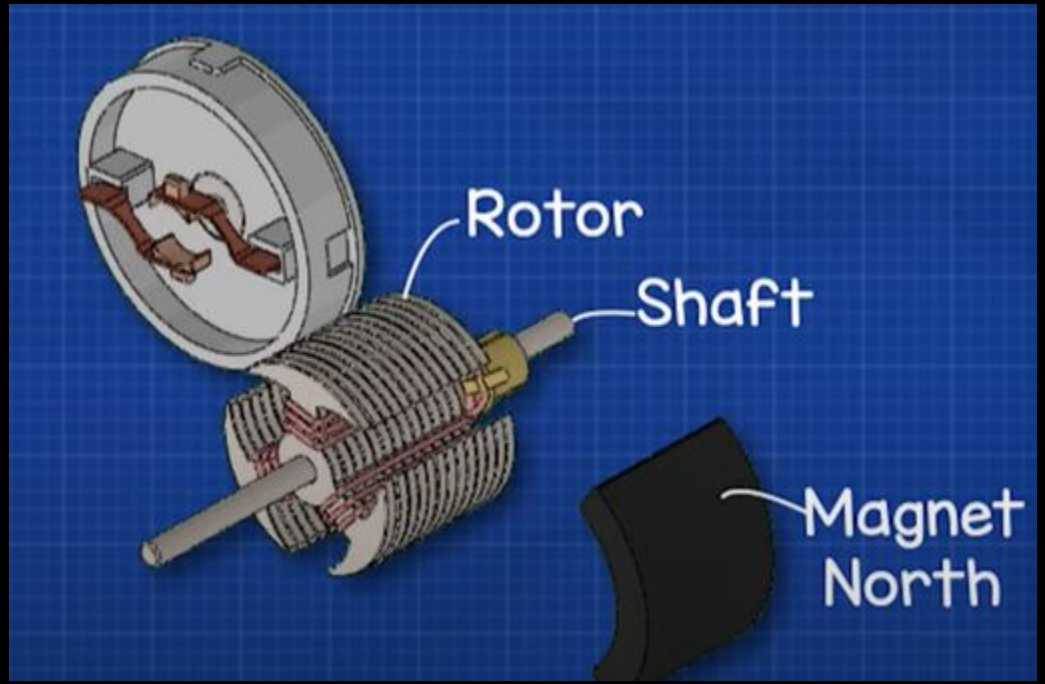
OUTSIDE PARTS



INSIDE PARTS

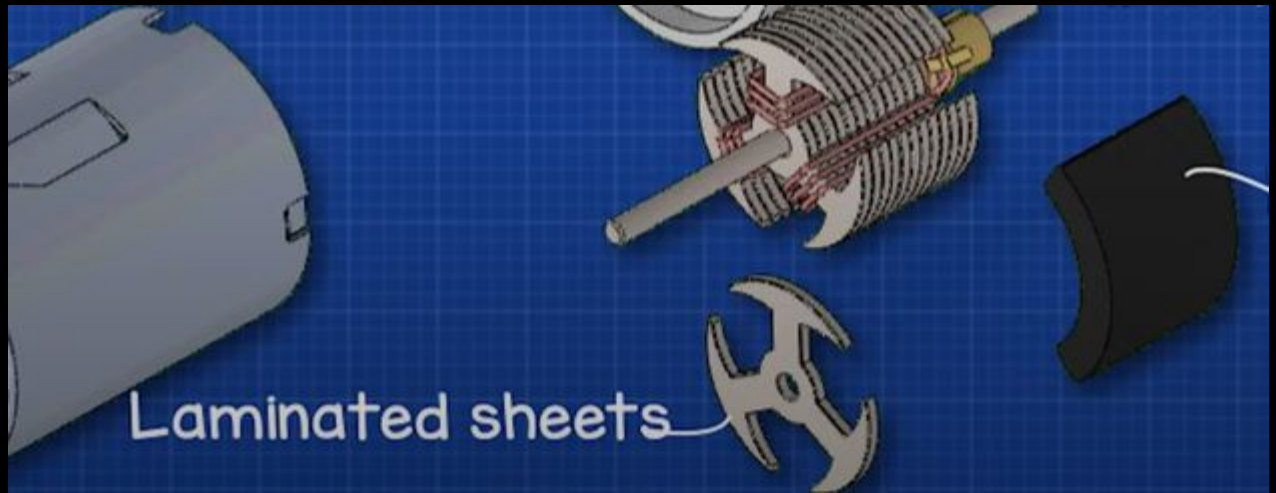


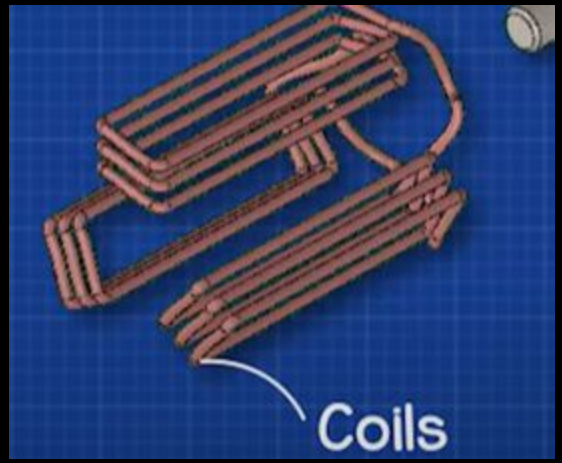
INSIDE PARTS



INSIDE

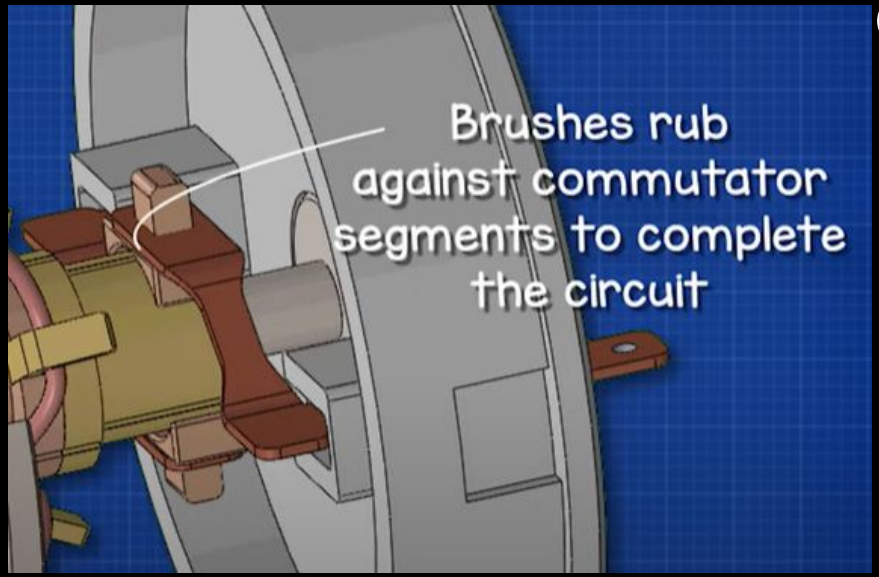
ELECTRICITY IS PASSED THROUGH THE COILS GENERATING A MAGNETIC FIELD THAT THEN PULLS AND/OR PUSHES FROM THE TWO MAGNETIC PLATES. THIS FORCES THE CORE (ROTOR/ARMATURE) TO SPIN WHICH ROTATES THE SHAFT.



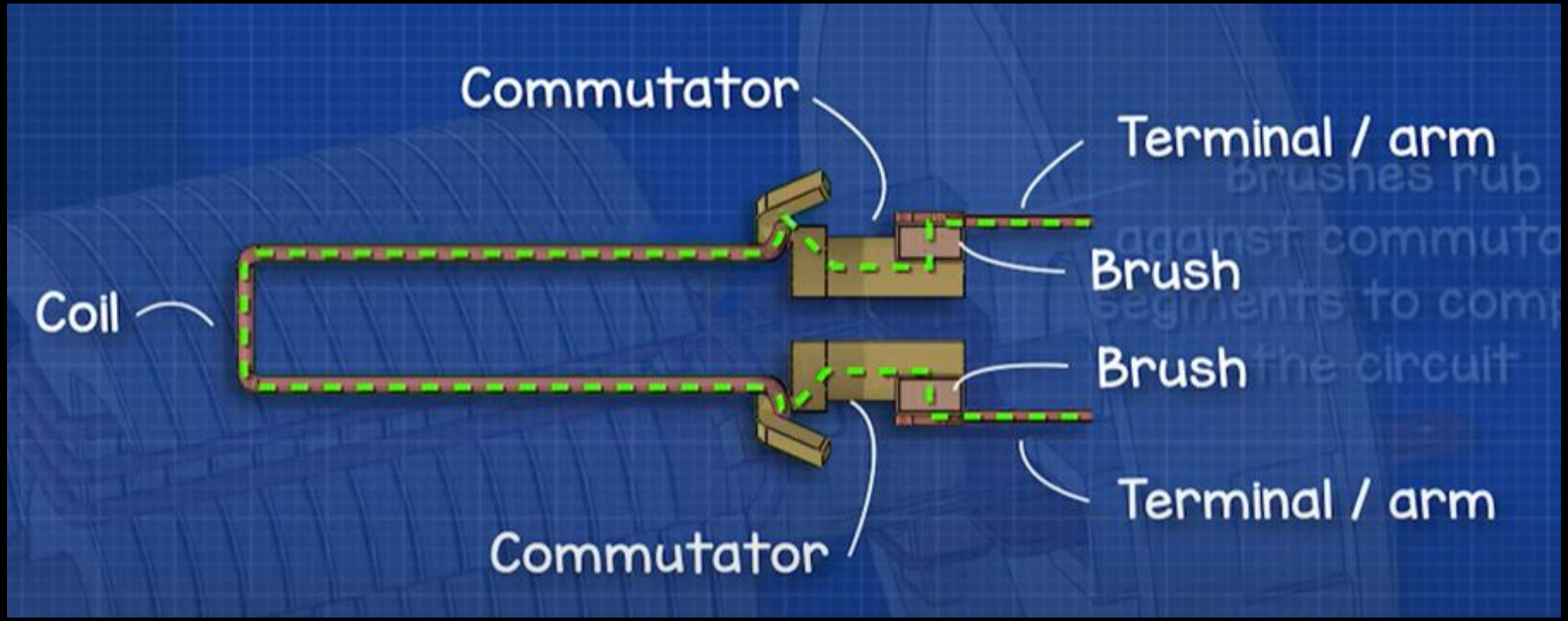


INSIDE

AT THE BACK IS A COMMUTATOR THAT IS IN CONTACT WITH BRUSHES THAT ARE CHARGED VIA THE TERMINALS. THE CHARGE PASSES THROUGH THE COMMUTATOR AND INTO THE COILS.

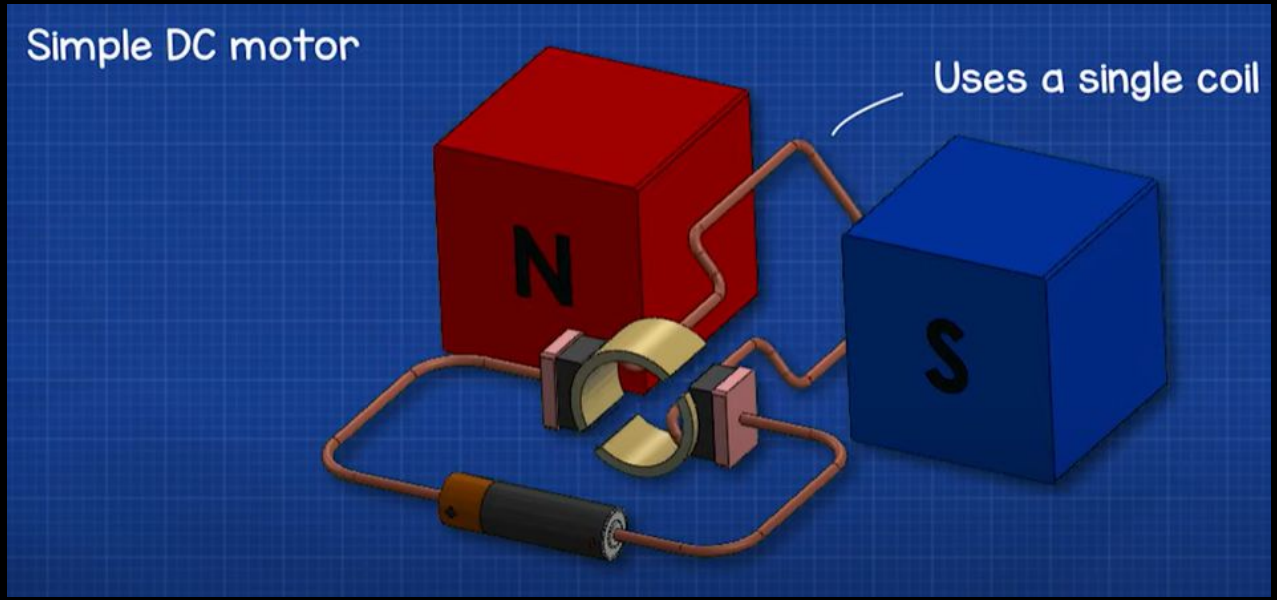


INSIDE
ELECTRICAL FLOW



SIMPLE VIEW

AS ELECTRICITY PASSES FROM THE + SIDE OF THE BATTERY IT GOES THROUGH THE BRUSH INTO THE COMMUTATOR AND THEN INTO THE COIL. ELECTRONS MOVING THROUGH A CONDUCTOR CREATE A MAGNETIC FIELD. THE MAGNETIC FIELD CREATED IS OPPOSITE TO THE MAGNETIC PLATE WHICH REPULSES IT FORCING IT TO SPIN. REVERSING THE POLARITY OF THE ELECTRICAL CURRENT REVERSES THE REPULSION AND THE SHAFT SPINS IN THE OPPOSITE DIRECTION.



SPECS

THERE ARE A SERIES OF COMMON SPECIFICATIONS LISTED WITH MOST DC MOTORS THAT YOU SHOULD UNDERSTAND.

NOMINAL VOLTAGE-THE VOLTAGE THE MOTOR WAS DESIGNED TO RUN THE MOST EFFICIENTLY AT

NO LOAD RPM-THE FASTEST SPEED THE SHAFT WILL ROTATE GIVEN THAT NOTHING IS T=ATTACHED TO IT. IT IS PROPORTIONAL TO THE VOLTAGE APPLIED. LOWER VOLTAGE=LOWER RPM.

STALL TORQUE-THIS REFERS TO THE MAXIMUM ALLOWABLE TORQUE THE SHAFT CAN APPLY. DAMAGE CAN OCCUR IF THE MOTOR IS SUBJECT TO THIS FOR LONGER THAN A FEW SECONDS. NORMALLY YOU SHOULD NOT FORCE THE MOTOR TO USE MORE THAN ⅓ OF ITS STALL TORQUE.

STALL CURRENT-THIS IS THE MAX CURRENT DRAWN WHEN THE STALL TORQUE IS ACHIEVED. THIS IS AN IMPORTANT VALUE TO CONSIDER WHEN DETERMINING THE WIRE SIZES AND MOTOR DRIVER CAPABILITIES.

WIRES

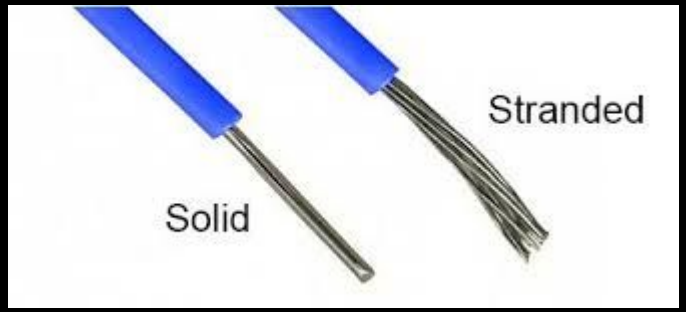
GAUGES-THE SMALLER THE GAUGE THE LARGER THE WIRE THE LARGER THE CURRENT IT CAN HANDLE

https://www.jst.fr/doc/jst/pdf/current_rating.pdf

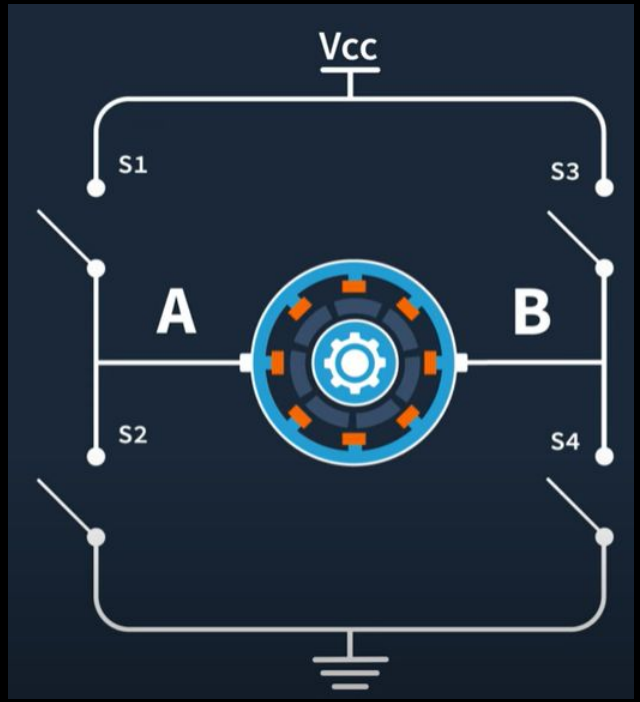
WIRES

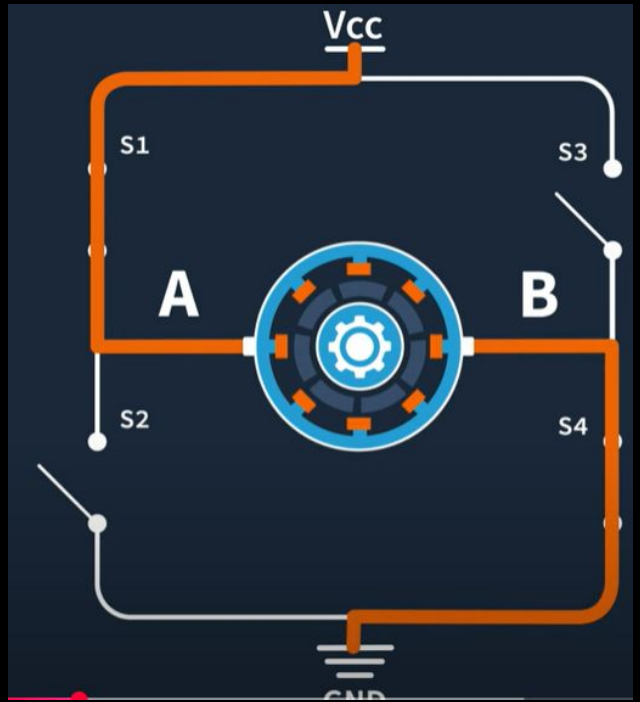
BREADBOARD WIRES-22 AWG SOLID CORE

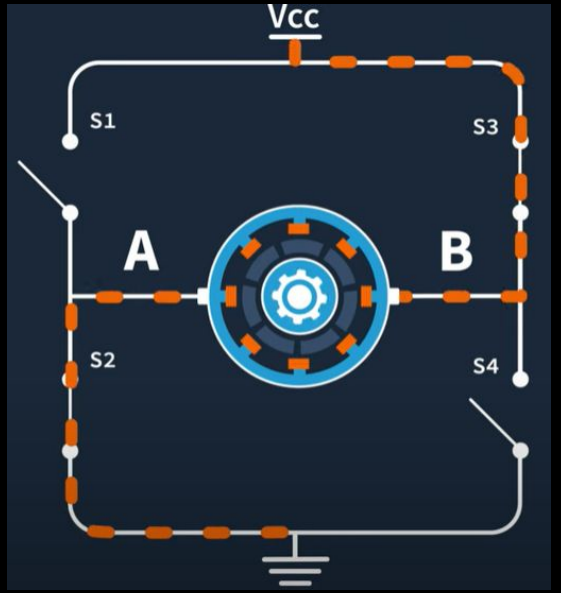
STRANDED CORE BETTER FOR SOLDERING



H-BRIDGE CIRCUITS ALLOW US TO CONTROL THE DIRECTION OF A MOTOR

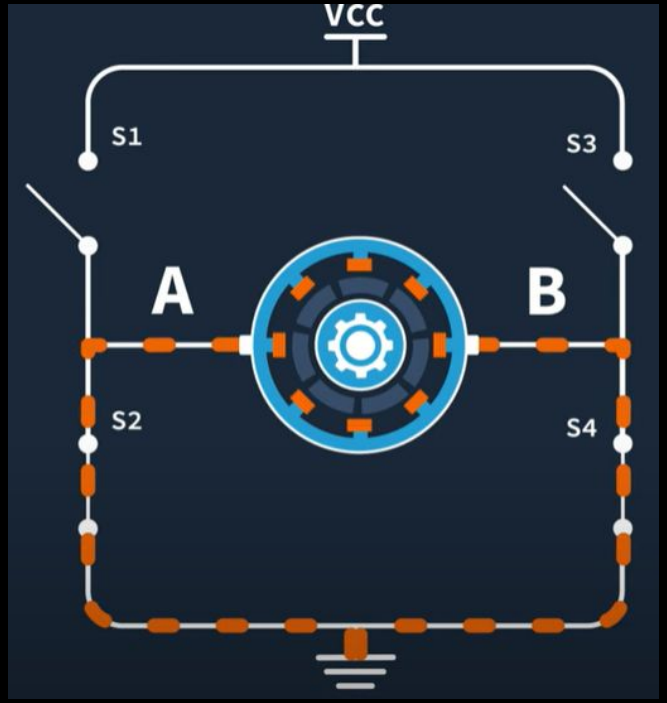


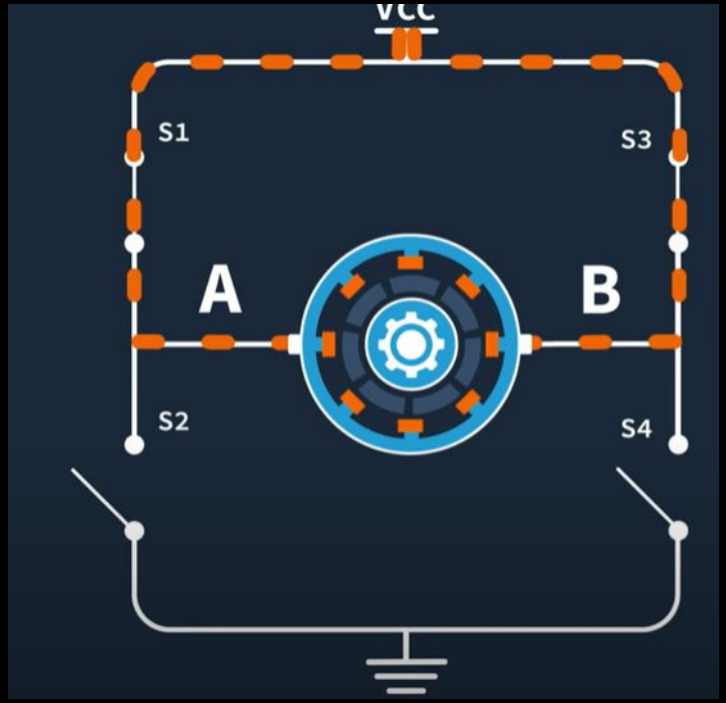




H-BRIDGE CIRCUITS

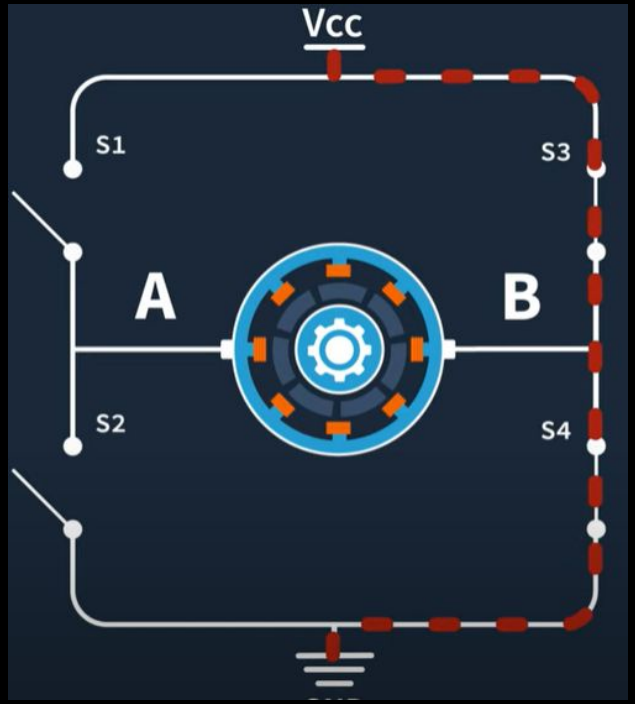
ALLOW US TO STOP THE MOTOR IMMEDIATELY-POWER BRAKING

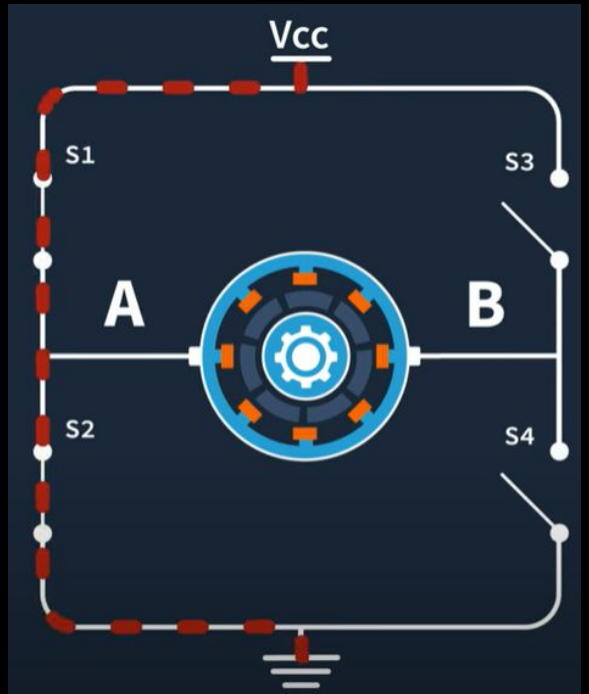


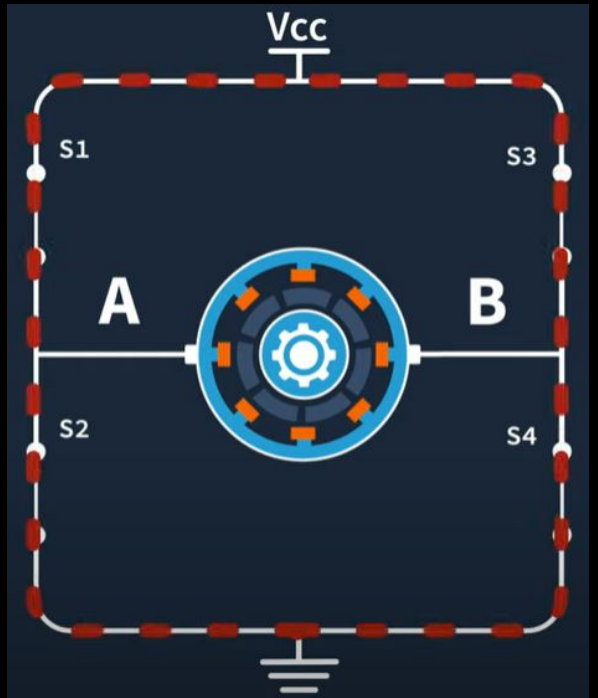


H-BRIDGE CIRCUITS

DANGERS

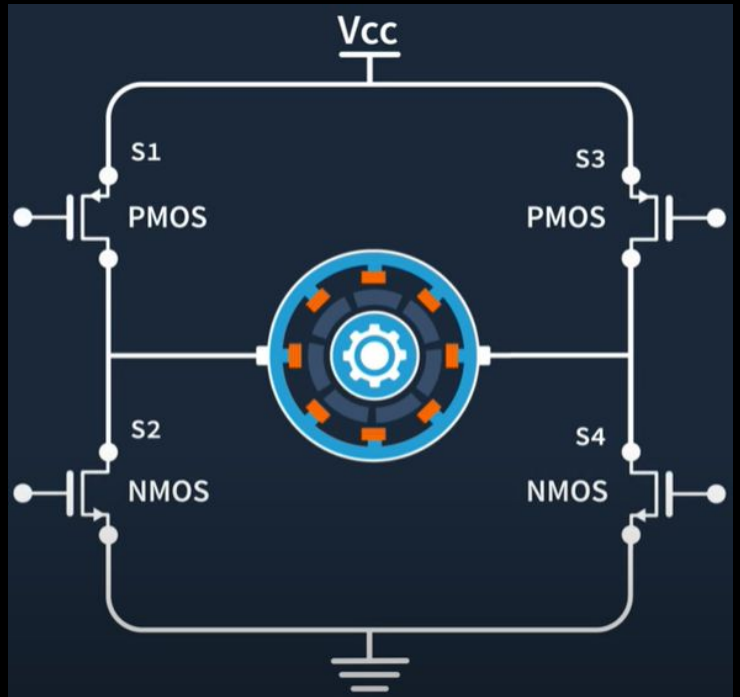


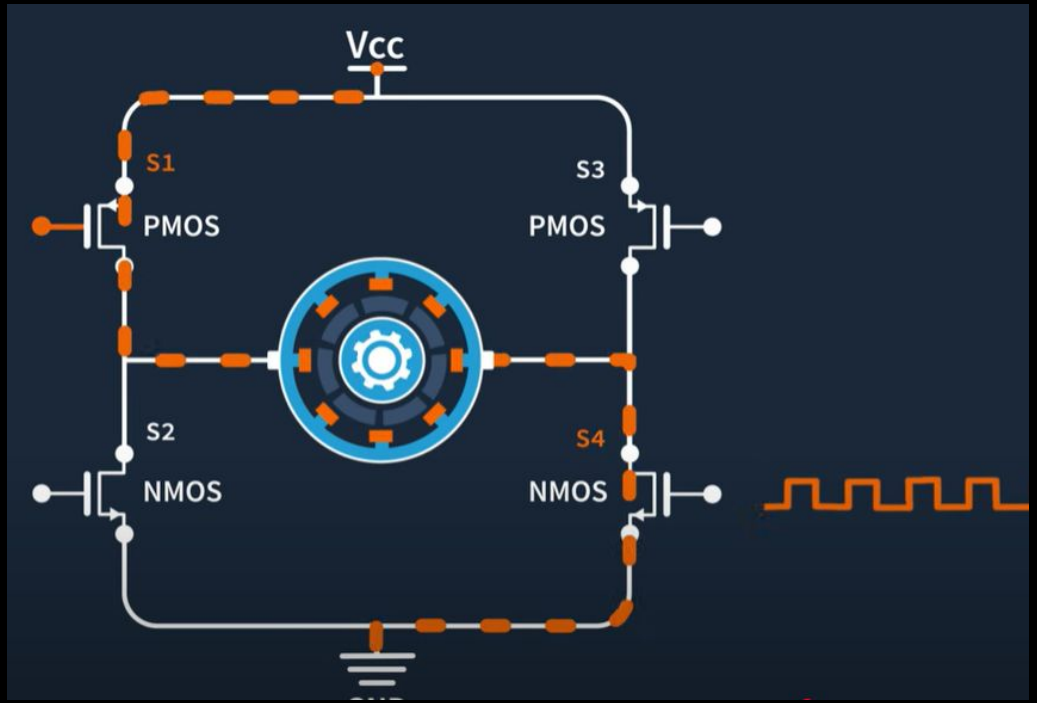




H-BRIDGE CIRCUITS

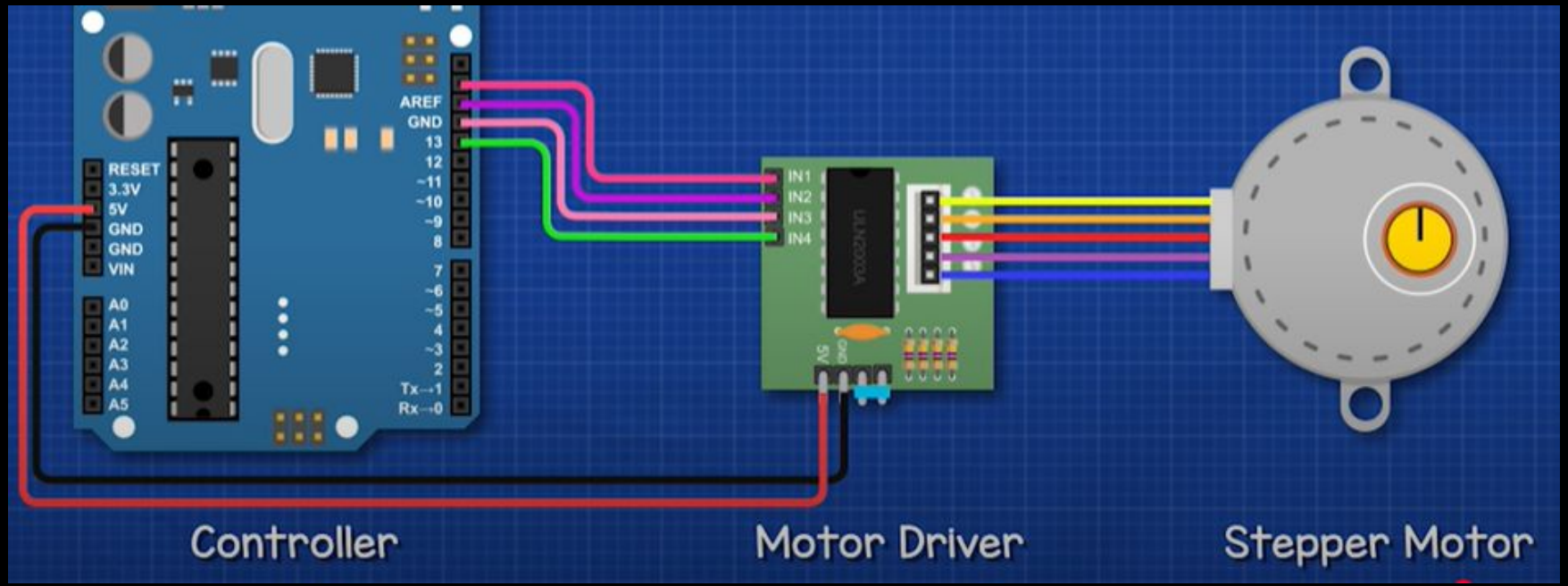
SPEED CONTROL VIA MOFSETS





MOTOR DRIVERS

CONTAIN H-BRIDGE MOFSET CIRCUITS



QUESTION #1

IN TINKERCAD CREATE A SIMPLE DC MOTOR CIRCUIT WHEREBY A MOTOR IS TURNED ON AND OFF VIA A SINGLE PUSH BUTTON. USE A 12V POWER SUPPLY.

QUESTION #2

IN TINKERCAD CREATE A SIMPLE DC MOTOR CIRCUIT WHEREBY A MOTOR'S DIRECTION IS CONTROLLED BY A SIMPLE H-BRIDGE CIRCUIT USING A DIP SWITCH. USE A 12V POWER SUPPLY.

QUESTION #3

WHAT GAUGE WIRE SHOULD YOU USE ON A MOTOR THAT DRAWS A PEAK 5 AMPS?

Answer: Use 16 AWG wire for short runs (under 10 feet). If your wire run is longer, consider using 14 AWG to minimize voltage drop and heat.

QUESTION #4

BELOW ARE THE SPECS FOR A SMALL N20 DC MOTOR. WHAT DOES IT MEAN BY NO LOAD CURRENT?

SKU: 2835				
No-load speed @ 6V:	100	RPM		
No-load current @ 6V:	40	mA		
Resistivity:	29	ohm		
Stall Torque @ 6V:	48.9	N-mm	6.92	Ounce-in
Stall Current @ 6V:	210	mA		
Stall Power @ 6V:	1.26	W		

"No load current" is the amount of current the motor draws when it's running freely without any mechanical load. It indicates how much power the motor uses just to overcome internal friction and inertia.

QUESTION #5

BASED ON THE MOTOR SPECS FROM THE LAST SLIDE WHAT SIZE WIRE SHOULD BE USE TO ATTACH TO THE 2 TERMINALS ON THE MOTOR? EXPLAIN YOUR ANSWER.

Based on N20 motor specs, the stall current is typically less than 1 amp, so 22 AWG or 24 AWG wire is suitable. These are thin enough to fit the terminals and can safely carry the current.

QUESTION #6

BELOW ARE THE SPECS OF A MOTOR DRIVER CALLED THE L298N. CAN IT BE USED TO DRIVE THE MOTOR WHOSE SPECS WE PROVIDED PREVIOUSLY?

Features & Specifications

- Driver Model: L298N 2A
- Driver Chip: Double H Bridge L298N
- Motor Supply Voltage (Maximum): 46V
- Motor Supply Current (Maximum): 2A
- Logic Voltage: 5V
- Driver Voltage: 5-35V
- Driver Current:2A
- Logical Current:0-36mA
- Maximum Power (W): 25W
- Current Sense for each motor
- Heatsink for better performance
- Power-On LED indicator

Yes. The L298N motor driver can handle up to 2A per channel (with heat sink), which is more than enough for the N20 motor. Just ensure the voltage range of the motor matches the L298N supply.

QUESTION #7

FIND LINKS TO 3 DIFFERENT DC MOTOR DRIVERS AND LIST THEM BELOW.

L298N Dual H-Bridge Motor Driver

DRV8833 Dual H-Bridge Motor Driver

TB6612FNG Dual Motor Driver Carrier

QUESTION #8

WE HAVE A DC GEAR MOTOR 37SG-520-810. SEARCH FOR THE DATASHEET ON THIS MOTOR. SEARCH FOR THE SPEC SHEET OF THE DRV8833 MOTOR DRIVER. EXPLAIN WHY WE CAN OR CAN NOT DRIVE THIS MOTOR WITH THIS DRIVER.

DRV8833 max current: ~1.5A continuous, ~2A peak

37SG-520-810 stall current: Often >3A

Conclusion: No, the DRV8833 is not suitable for the 37SG-520-810 if its stall current exceeds 2A, as it could damage the driver.

QUESTION #9

18650 LITHIUM ION BATTERIES ARE OFTEN USED IN PROVIDING POWER TO DC MOTORS IN ROBOTS. DO SOME RESEARCH AND EXPLAIN WHY. EXPLAIN WHY YOU MIGHT WANT TO AVOID USING THESE BATTERIES.

Pros:

High energy density (compact but powerful)

Rechargeable with good cycle life

High current output suitable for motors

Cons:

Can be dangerous if overcharged or shorted (risk of fire)

Require special charging circuits (e.g., BMS)

Voltage drops under heavy load if not properly rated