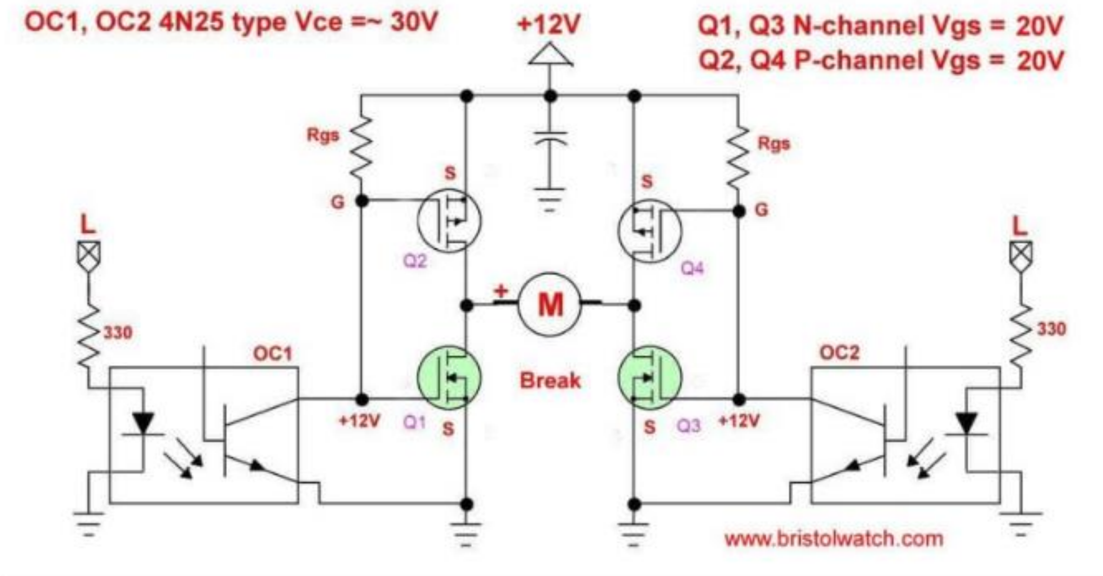
H bridge using MOSFET



We discuss some points in the circuit;

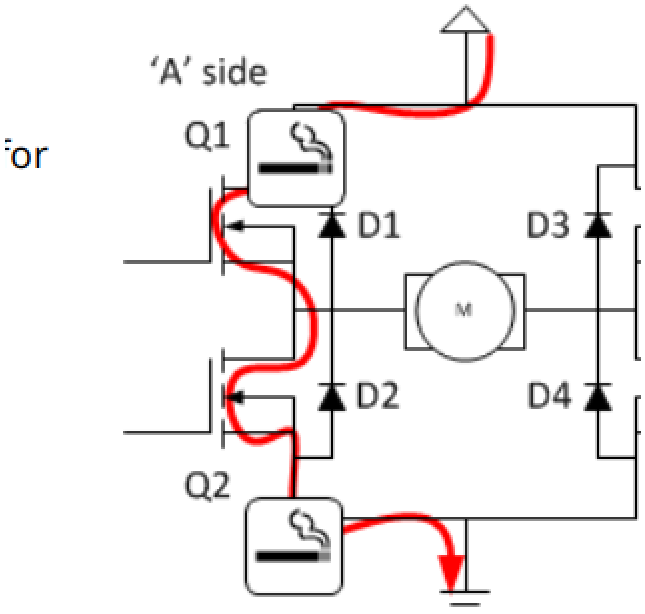
Truth table of the circuit:

Truth Table

Input		Output		
OC1	OC2	M (+)	M (−)	
L	L	L	L	(Note)
H	L	L	H	
L	H	H	L	
H	H	OFF (high impedance)		(Note)

This table show the condition and its result in each case, due to there is no ideal cases occur in practical world there are some issues , because it is impossible for any circuit to turn on and off at exactly at the same time ,there is bit early or late that cause problems:

1-If in the same side 2 mosfet are on that generate path of low resistance for current to follow this problem called (shoot through)



To avoid that make sure that two switches be on at the same time

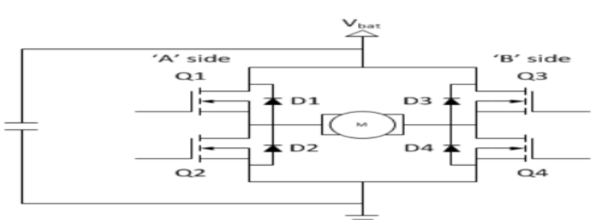
2- if 2 MOSFET are off there is no path for current to flow the voltage of motor will jump as high it need to create a path for current to flow

To avoid the role of catch diode to provide a path for the current in open circuit switching period delay

Second

We use a capacitor between input terminal to handle the reverse current properly to soak up the current of the bridge and will release its extra charge back into the motor when the current flows to proper direction

*The value of capacitor = (.5*Imotor average)/(Vbattary ripple *Tcycle)*



Switching element

MOSFET acts as switch some important parameter

*1-$R_{ds\ on}$ control the losses of the mosfet as p=I^2*R*

N mosfet has lower $R_{ds\ on}$ than p mosfet and p mosfet is slower than it

*2-thermal resistance R_0 --→›› T= R_0*P*

3-gate capacitance limits the speed by which the element can be turned on or off in the datasheet known as input capacitance

4- important feature is the intrinsic diode in mosfet that act as catch diode and its parameter determine in datasheet so check if it require your calculation

Talk about 4 first and 3 in parameter

Intrinsic diode its advantage it reduce the size of board and be on the same heatsink with mosfet

But it can't meet our requirement so use external diode

And external diode must be has V_f smaller than intrinsic diode to flow the current through it

Due to wide of pn junction there is a capacitance in diode that delay on of state

So we provide a capacitor on motor terminal to conduct in this delay

Its recommended that use shottky diode that fast switching

Let's talk about 3

Gate capacitance and the drive current determine how fast MOSFET switch

To determine turn on and off time we detect two things

1. *Gate voltage that turn the mosfet on should be in linear region to be low resistance*
2. *How fast charge and discharge the gate capacitance*

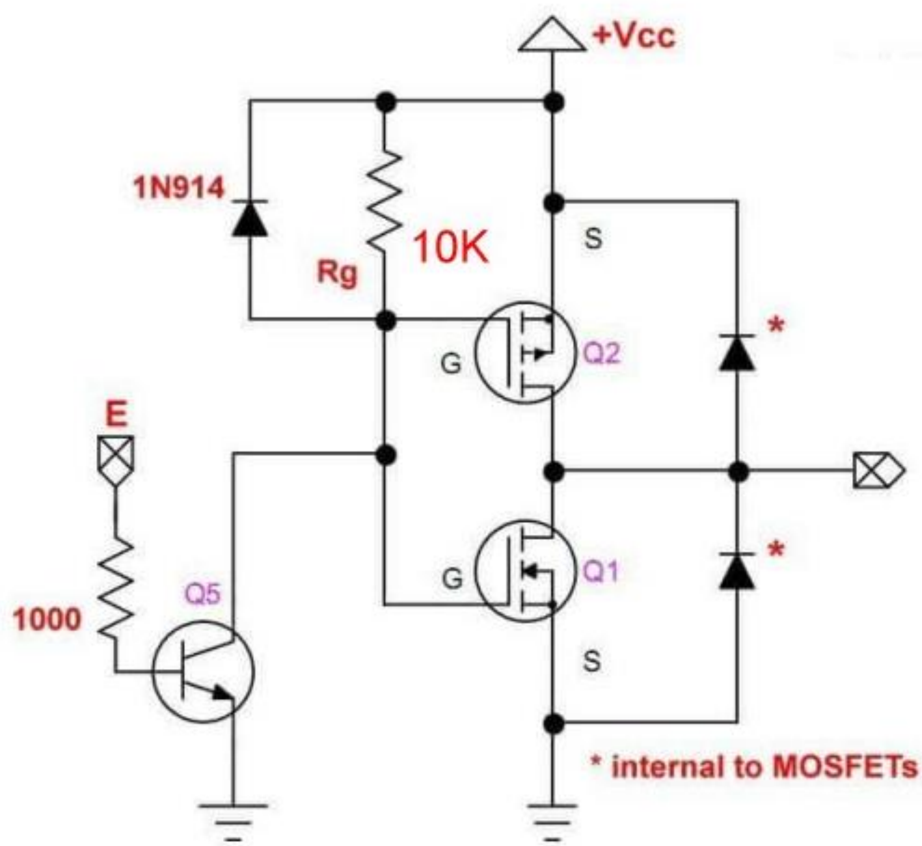
T_{on}= (V_{gate}*C_{gate}) /I source

Another form

T_{on}= (R_{source}*C_{gate})/(ln1-Vgate/Vsource)

R source in series with gate

$T_{off} = (-R_{sink} * C_{gate}) / (\ln V_{th} / V_{source})$ R sink that gate discharge in it



That modifies on side only

That's for

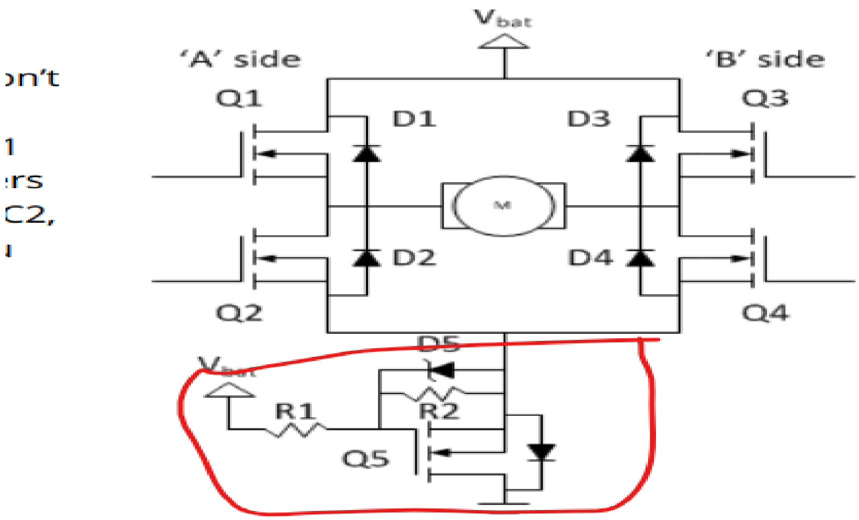
1-Rg serves to discharges the gate-source circuit to turn off Q2. In the past I used a 10K resistor, it can be dropped to 1000 ohms. This can result in faster turn off.

2-Thediode across Rg suppresses any gate-source discharge noise with Rg

3-we can use a NPN transistor instead of an opto-couple because its slow rather than transistor due to pn junction width cause capacitance

Last thing for more safety we use circuit protection

For inverse polarity of battery case



The idea is that when the battery is connected with normal polarity, it will forward bias the body-diode of Q5, driving its source to V .When that happens, the grounded gate will close Q5 (it's a P-channel device), making it capable of handling large(er) currents.When the battery is connected in reverse, the diode is reverse-biased, leaving the gate and the source of Q5 at the same potential,keeping the Q5 open, and the rest of the system un-powered.The value of R1 should be high (100k or so) because in normal operation it's connected between V and GND. Finally, if V can be higher than the maximum allowed V for Q5 (15-20V normally) limiting the gate-source voltage will be needed: under normal operation D5 will limit V to be within safe limits with some current flowing through R1. In reverse operation, R2 ensures that Q5 can't close. The value of R1 should be select to set the appropriate zener current (a few mA). R2 should be large enough so it doesn't interfere with the voltage limiting effect of D5 under normal circumstances. All these circuits used a PMOS device to achieve reverse-battery protection. If you want to use an NMOS device to take advantage ofits lower r , you have to put it on the lowside of the bridge

For our circuit we choose

9540 p mosfet price 8 pound

540 n mosfet price 8 pound.

BJT 2n222

Resistors

Shottky diode

Leds

Block terminal

Note

And to avoid spike we design two h bridge each one for side of motor

Protection circuit will be in power distribution circuit