H-Bridge

1,4 on
2,3 off

1,4 off
2,3 on

Switch types
relays
transistors

PWM input

V

$V_{avg}$

75% duty cycle

t

$25\%$ duty cycle

t

$V_{avg}$

$t_{on}$ $T_{period}$
Inductive Load Switching

\[ v = L \frac{dT}{dt} \]

flyback diode

H-Bridge MOSFET implementation
Servo (Hobby)

~ 5V operation  stall ~ 1A

PWM control

1-2ms per 20ms \(\Rightarrow\) \(\Rightarrow\)

1 end \(\Rightarrow\) other end

\(\Rightarrow\) position determined by internal rotary potentiometer
Encoders

"ticks"

L "event": rising/falling edges

IR reflective sensor

slots

QUADRATURE ENCODER

A

1 3 5 7 9 11 13

B

2 4 6 8 10 12

Forward
A B
0 0
1 0
1 1
0 1
0 0

Backward
A B
1 0
0 0
0 1
1 0

90° out of phase
Encoders (Continued...)

Encoder w/ index ← channel that pulses once per revolution

\underline{ABSOLUTE ENCODER}
- has coded disk
- outputs absolute angular position
- # of channels → resolution
- output via parallel or serial interface

Figure 1  Gray Code

Figure 2  Natural Binary
Power Considerations

? Isolate Controller to its own power source

? External Drive Motor Power

? External Servo Power

? External sensor Power

⇒ Use of 5v regulator may be required for some sensors
H-Bridges

1 Amp H-Bridges (on Handy Board) (right: stacked chips with heat sink)

3 Amp H-Bridge

H-Bridge with discrete components
Servos
Encoders