background info - see http://homepage.cs.uiowa.edu/~jones/step/ for full story

Bipolar Motors

Figure 1.3

1a ⊸0000⊸ 1b
2a ⊸0000⊸ 2b
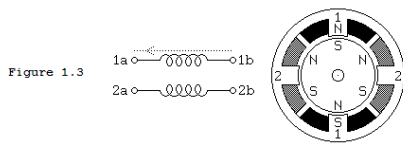
Bipolar permanent magnet and hybrid motors are constructed with exactly the same mechanism as is used on unipolar motors, but the two windings are wired more simply, with no center taps. Thus, the motor itself is simpler but the drive circuitry needed to reverse the polarity of each pair of motor poles is more complex. The schematic in Figure 1.3 shows how such a motor is wired, while the motor cross section shown here is exactly the same as the cross section shown in Figure 1.2.

The drive circuitry for such a motor requires an *H-bridge* control circuit for each winding; these are discussed in more detail in the section on Control Circuits. Briefly, an H-bridge allows the polarity of the power applied to each end of each winding to be controlled independently. The control sequences for single stepping such a motor are shown below, using + and - symbols to indicate the polarity of the power applied to each motor terminal:

```
Terminal 1a +---+---+---+---   ++--++--++--++--
Terminal 1b --+---+---+---+-   --++--++--++--++
Terminal 2a -+---+---+---+--   -++--++--++--++-
Terminal 2b ---+---+---+---+   +--++--++--++--+
             time --->
```

Note that these sequences are identical to those for a unipolar permanent magnet motor, at an abstract level, and that above the level of the H-bridge power switching electronics, the control systems for the two types of motor can be identical.

Note that many full H-bridge driver chips have one control input to enable the output and another to control the direction. Given two such bridge chips, one per winding, the following control sequences will spin the motor identically to the control sequences given above:

```
Enable     1 1010101010101010  1111111111111111
Direction  1 1x0x1x0x1x0x1x0x  1100110011001100
Enable     2 0101010101010101  1111111111111111
Direction  2 x1x0x1x0x1x0x1x0  0110011001100110
             time --->
```
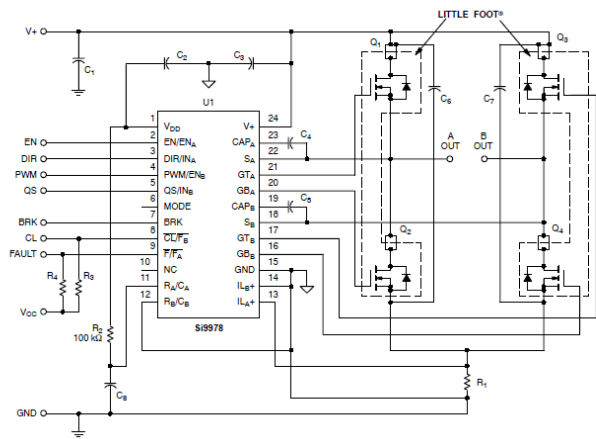

Figure 6.3

take step
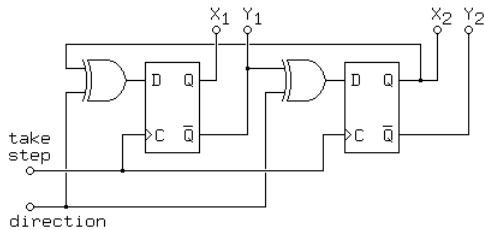
direction

ckt for step+direction signals to X1,Y1,X2,Y2 coil signals

(X1,Y1,X2,Y2 are the 'left' and 'right' ends of coils 1,2)

si9978 hbridge ckt

X	Y	enable	dir
0	0	0	dontcare
0	1	1	0
1	0	1	1
1	1	0	dontcare

X,Y signals converted to enable, dir signals (which si9978 wants as input)
note enable=XOR(X,Y) and dir=X

using this I convert from step+direction to enable, dir commands in the following ckt:

coil 1

coil 2

Figure 6.3

take
step

direction

X₁ Y₁   X₂ Y₂