

**Interfacing**

**Lab30** • Interface motors to the 9S12,

- Interface optical and mechanical sensors
- Layered software,
- Design cycle,
- Team work.

**Port AD Digital Enable (ATDDIEN)**

- 0 is for analog input
- 1 is for digital input/output

**Port AD I/O Register (PTAD)**

**Port AD Data Direction Register (DDRAD)**

**Port M Pull Device Enable Register (PERAD)**

**Port M Pull Device Enable Register (PERM)**

**Port T Pull Device Enable Register (PERT)**

- configures whether a pull-up/down device is activated
- no effect if the port is used as output
- out of reset no pull device is enabled.
- 1 = pull-up/down is enabled
- 0 = pull-up/down device is disabled

**Port M Polarity Select Register (PPSAD)**

**Port M Polarity Select Register (PPSM)**

**Port T Polarity Select Register (PPST)**

- Selects whether pull-down or pull-up device is connected
- Active only if enabled in PERT and an input
- 1 = A pull-down is connected
- 0 = A pull-up is connected

**Port AD Reduced Drive Register (RDRAD)**

**Port M Reduced Drive Register (RDRM)**

**Port T Reduced Drive Register (RDRT)**

- configures the output drive strength
- ignored if input pin
- 1 = drives at about 1/3 of strength.
- 0 = Full drive strength at output.

**VOL is defined as the voltage at maximum IOL**

family	example	VOL	IOL
standard TTL	7405	0.4 V	16 mA
Schottky TTL	74S05	0.5 V	20 mA
Low Power Schottky	74LS05	0.5 V	8 mA
High speed CMOS	74HC05	0.33 V	4 mA
high voltage TTL	7406	0.7 V	40 mA
high voltage TTL	7407	0.7 V	40 mA

*Table 8.4. Output parameters for various open collector gates.*

Table A-6 5V I/O Characteristics

Conditions are  $4.5 < V_{DDX} < 5.5V$  Temperature from  $-40^{\circ}C$  to  $+140^{\circ}C$ , unless otherwise noted

Num	C	Rating	Symbol	Min	Typ	Max	Unit
1	P	Input High Voltage	$V_{IH}$	$0.65^*V_{DD5}$	-	-	V
	T	Input High Voltage	$V_{IH}$	-	-	$V_{DD5} + 0.3$	V
2	P	Input Low Voltage	$V_{IL}$	-	-	$0.35^*V_{DD5}$	V
	T	Input Low Voltage	$V_{IL}$	$V_{SS5} - 0.3$	-	-	V
3	C	Input Hysteresis	$V_{HYS}$		250		mV
4	P	Input Leakage Current (pins in high ohmic input mode) <sup>1</sup> $V_{in} = V_{DD5}$ or $V_{SS5}$	$I_{in}$	-1	-	1	$\mu A$
5	C	Output High Voltage (pins in output mode) Partial Drive $I_{OH} = -2mA$	$V_{OH}$	$V_{DD5} - 0.8$	-	-	V
6	P	Output High Voltage (pins in output mode) Full Drive $I_{OH} = -10mA$	$V_{OH}$	$V_{DD5} - 0.8$	-	-	V
7	C	Output Low Voltage (pins in output mode) Partial Drive $I_{OL} = +2mA$	$V_{OL}$	-	-	0.8	V
8	P	Output Low Voltage (pins in output mode) Full Drive $I_{OL} = +10mA$	$V_{OL}$	-	-	0.8	V

P: Those parameters are guaranteed during production testing on each individual device.

C: Those parameters are achieved by the design characterization by measuring a statistically relevant sample size across process variations. They are regularly verified by production monitors.

T: Those parameters are achieved by design characterization on a small sample size from typical devices. All values shown in the typical column are within this category.

D: Those parameters are derived mainly from simulations.

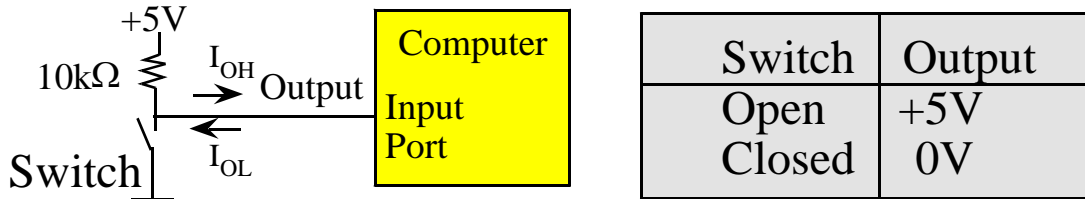


Figure 8.1. A simple switch interface.

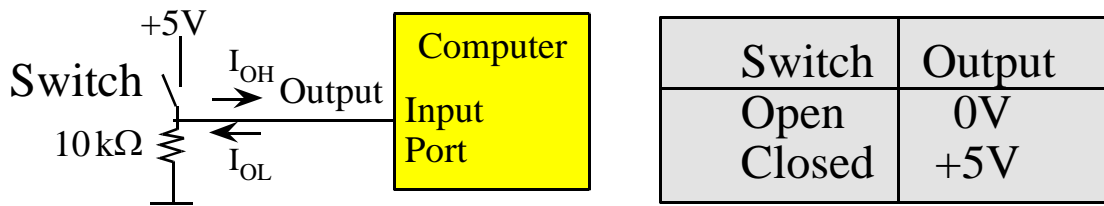


Figure 8.2. Another simple switch interface.

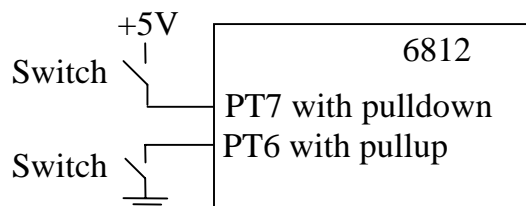


Figure 8.3. The 6812 supports internal pull-up or pull-down.

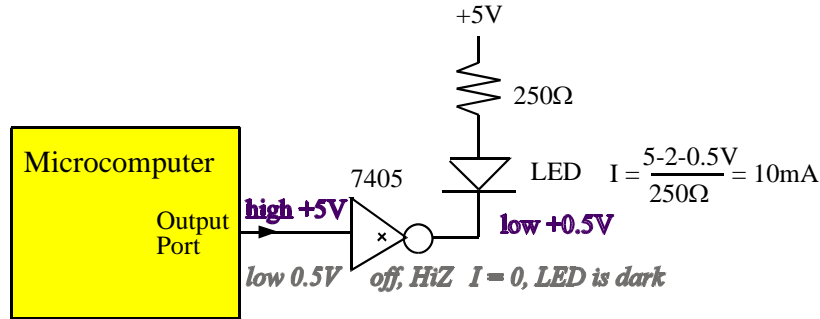


Figure 8.30. A single LED interface.

**Fairchild HLMP-1700**

$$R7 = \frac{5 - 2.2V}{1.5 mA} \text{ is about } 2k$$

QRB1133
QRB1134

PACKAGE DIMENSIONS

FUNCTION	WIRE COLOR
(C) COLLECTOR	WHITE
(E) EMITTER	BLUE
(K) CATHODE	GREEN
(A) ANODE	ORANGE

NOTES:  
 1. Dimensions for all drawings are in inches (mm).  
 2. Tolerance of ± .010 (.25) on all non-nominal dimensions unless otherwise specified.

**SCHEMATIC**

**Darlington TIP120 (NPN) TIP125(PNP)**

$h_{fe} = 1000$   
 $I_{CE}$  up to 3A

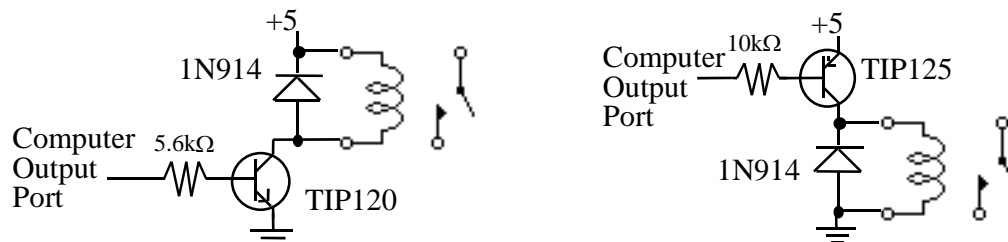


Figure 8.67. Two relay interfaces.  
 Also can be used to drive DC motor on/off

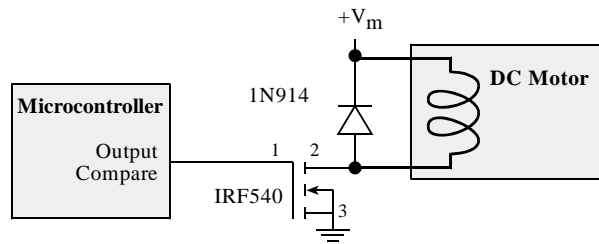


Figure 8.68. Motor interface using a high current MOSFET.

For more current, we can use the IRF540 MOSFET.

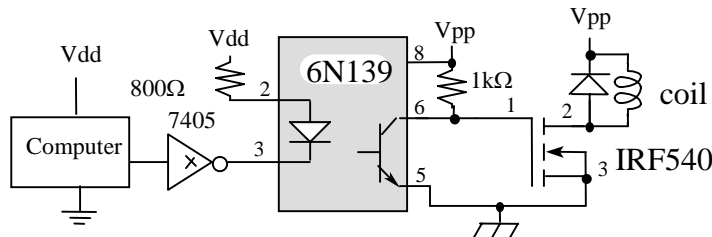


Figure 8.71. Another high-current isolated motor interface using a 6N139 and a MOSFET.

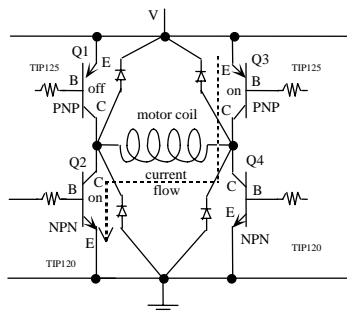
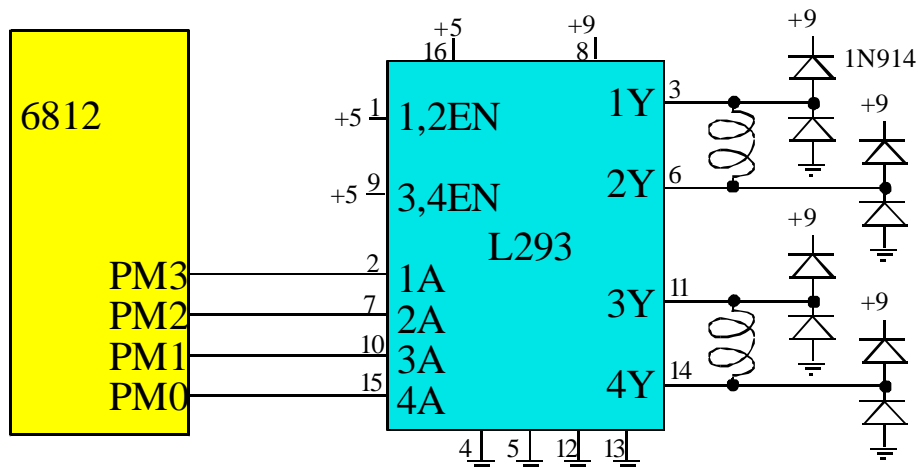


Figure 8.72. An H-bridge is used to drive current in both directions.

Outputs: two 4-wire bipolar stepper motors



Bipolar stepper motor interface using an L293 driver

DC motor interface to drive forward/backward/off

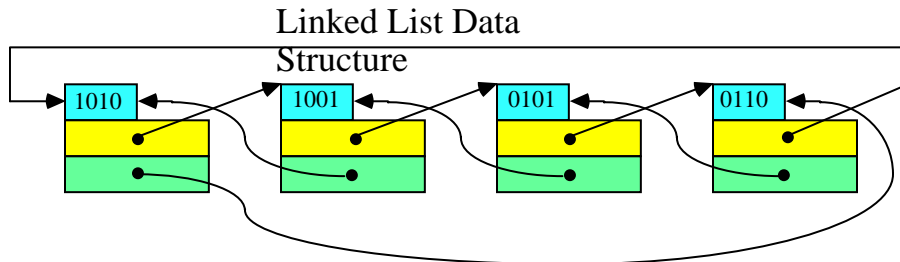


Figure 8.80. A double circular linked list used to control the stepper motor.

```

const struct State
{
    unsigned char Out; // Output for this state
    const struct State *Next[2]; // CW or CCW
};
typedef const struct State StateType;
unsigned char Position;
/* between 0 and 199 representing shaft angle */
#define CW 0 /* Next index*/
#define CCW 1 /* Next index*/
StateType fsm[4]={
    {10, {&fsm[1], &fsm[3]}},
    { 9, {&fsm[2], &fsm[0]}},
    { 5, {&fsm[3], &fsm[1]}},
    { 6, {&fsm[0], &fsm[2]}}
};
StateType *Pt; /* Current State */
void ClockWise(void){
    Pt = Pt->Next[CW]; // circulates
    PTM = Pt->Out; // step motor
    Position++; // shaft angle
    if(Position==200){
        Position = 0;
    }
}
void CounterClockWise(void){
    Pt = Pt->Next[CCW]; // circulates
    PTM = Pt->Out; // step motor
    if(Position==0){
        Position = 200;
    }
    Position--; // shaft angle
}

```