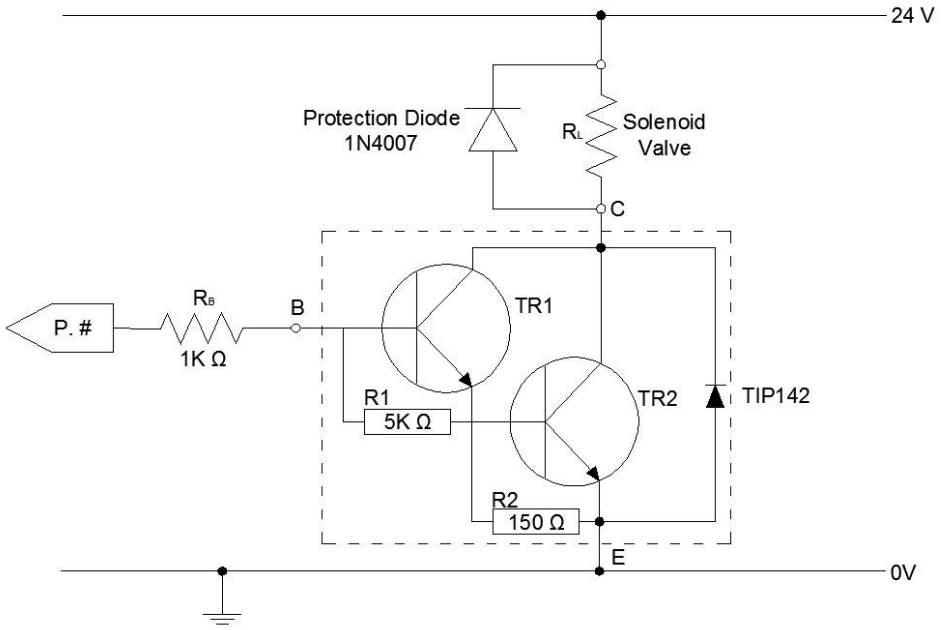
Smith Team WHOI
3/13/2011

Solenoid Valve Circuit Diagram



Liaison's suggestion

For example, get a TIP142. Connect the valve between the TIP142 collector and supply +24V. Connect supply ground to the emitter of the TIP142. Connect your micro's GPIO pin to the TIP142 base with 1K ohms in series to limit current to 5 mA. Ground microcontroller to the 24V ground. Then when micro puts 5 mA into the TIP142, the TIP142 will multiply it by 1000 and sink 5 A from the valve

Components

Solenoid Valve – TIP142

- Power supply from 24 VDC wall-wart
- Resistance (measured) - 78Ω
- Current - 0.29 A (doesn't specify if min or max)

Transistor TIP142 – Darlington pair power transistor

- H_{FE} = 1000 for I_C = 5A and V_{CE} = 4 V
- Collector Peak Current – 20 A

Protection Diode 1N4007

- V_{RRM} = 1000
- $I_{F(AV)}$ average rectified forward current = 1.0 A
- I_{SFM} non-repetitive peak forward surge current = 30 A

Example calculations for choosing NPN Transistor

Reference: http://www.kpsec.freeuk.com/trancirc.htm

1. Choose resistor that meets these requirements: Ic(max) and h_{FE}(min).

2. The transistor's maximum collector current Ic(max) must be greater than the load current Ic.

$$\text{load current Ic} = \frac{\text{supply voltage Vs}}{\text{load resistance } R_L}$$

3. The transistor's minimum current gain h_{FE}(min) must be at least **five** times the load current Ic divided by the maximum output current from the IC (chip)

$$h_{FE}(\text{min}) > 5 \times \frac{\text{load current Ic}}{\text{max. IC current}}$$

4. Calculate an approximate value for the base resistor:

$$R_B = \frac{Vc \times h_{FE}}{5 \times Ic}$$

where Vc = IC supply voltage
(in a simple circuit with one supply this is Vs)

Example Calculations:

$I_C = 24V / 78\ \Omega = 0.307\ A$

$h_{FE} = 5 \times (0.307\ A / 5\ A) = 0.307$

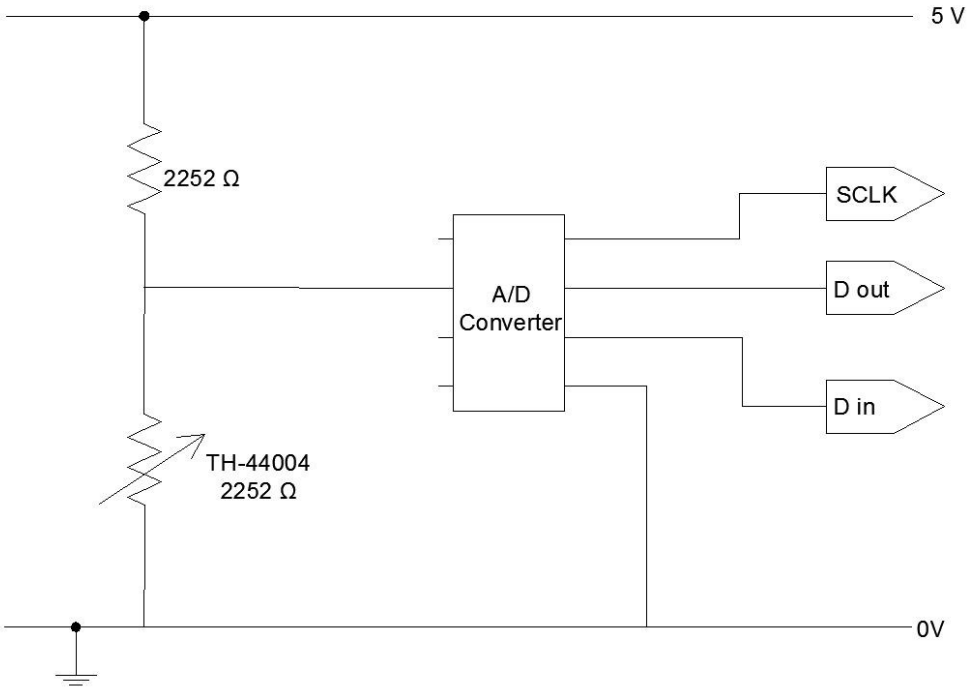
$$R_B = \frac{(24) \times (1000)}{5 \times (5)} = 960\ \Omega$$

* Suggested to use h_{FE} of 1000

Questions

- Were incorrect methods or values used for calculating I_C (max) and h_{FE} (min)?
- Does the size of the diode only depend on peak current of the solenoid valve?

Temperature Sensor
Circuit Diagram



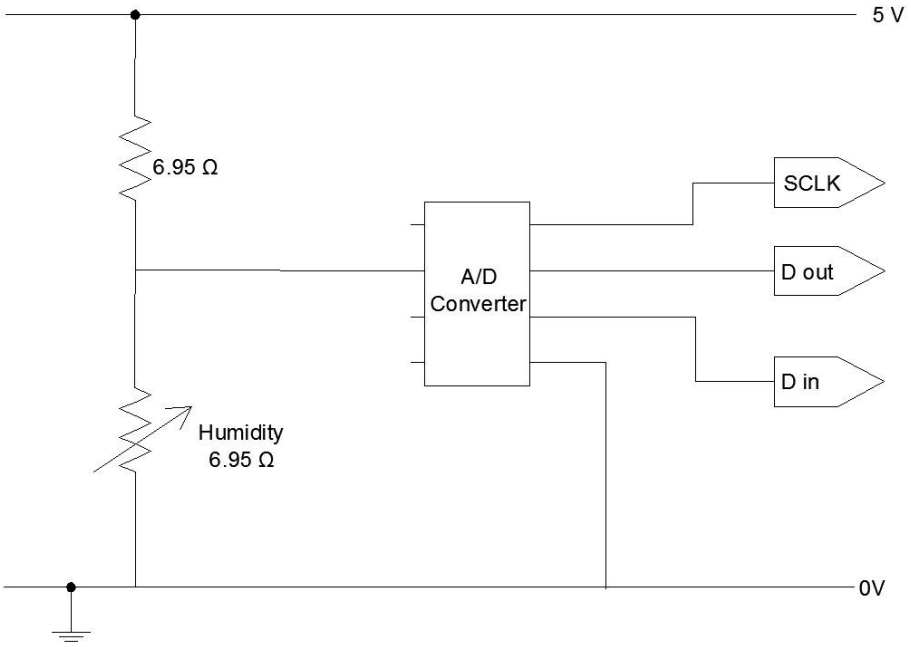
Temperature Sensor TH-44004

- Resistance = 2252 Ω

A/D Converter

- 12-bit resolution
- +/- 1 LSB max DNL
- Serial interface (modes 0,0 and 1,1)
- 4 input channels
- Power requirements: 2.7V to +5.5 VDC

Humidity Sensor
Circuit Diagram



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Wall-wart

Output- 24V , 2.5A