

Solderless Breadboards

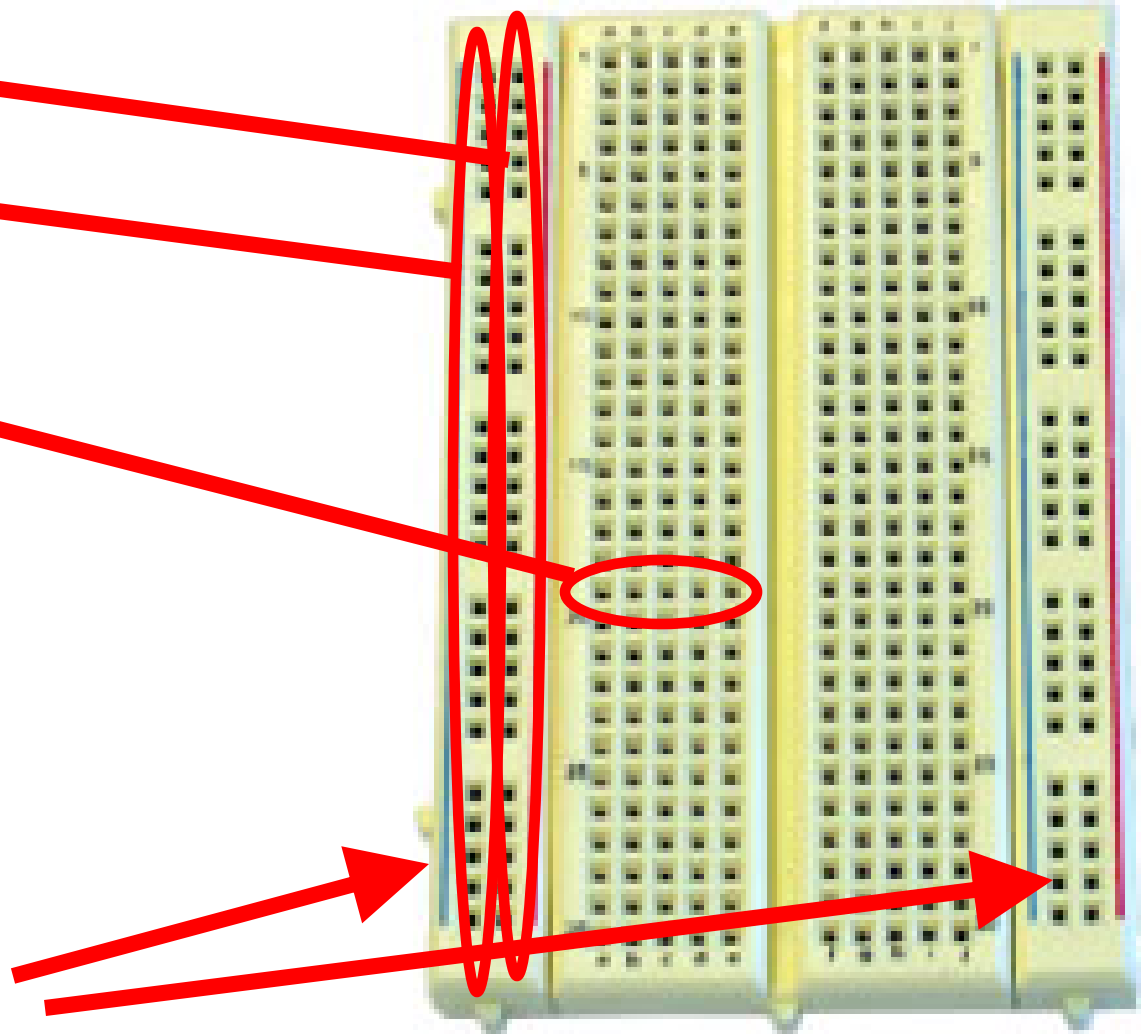
mbus.net

Power bus
(red)

Ground bus
(blue)

Component
bus

Note that the two
sides are not
connected



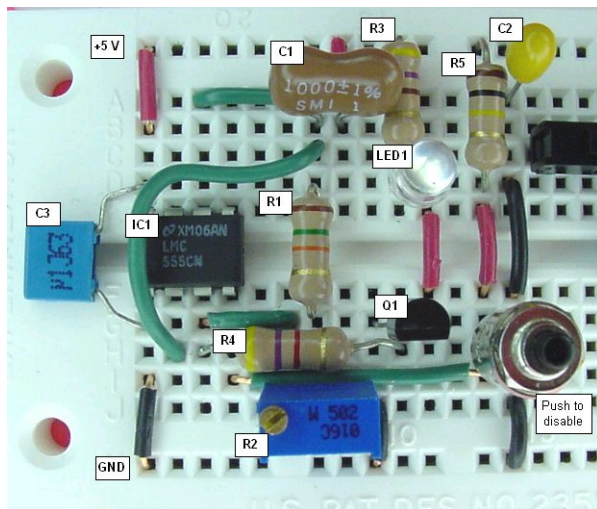
Wiring Standards

When possible, use wire colors for different types of signals:

- Black: ground
- Red: power
- Other: various signals

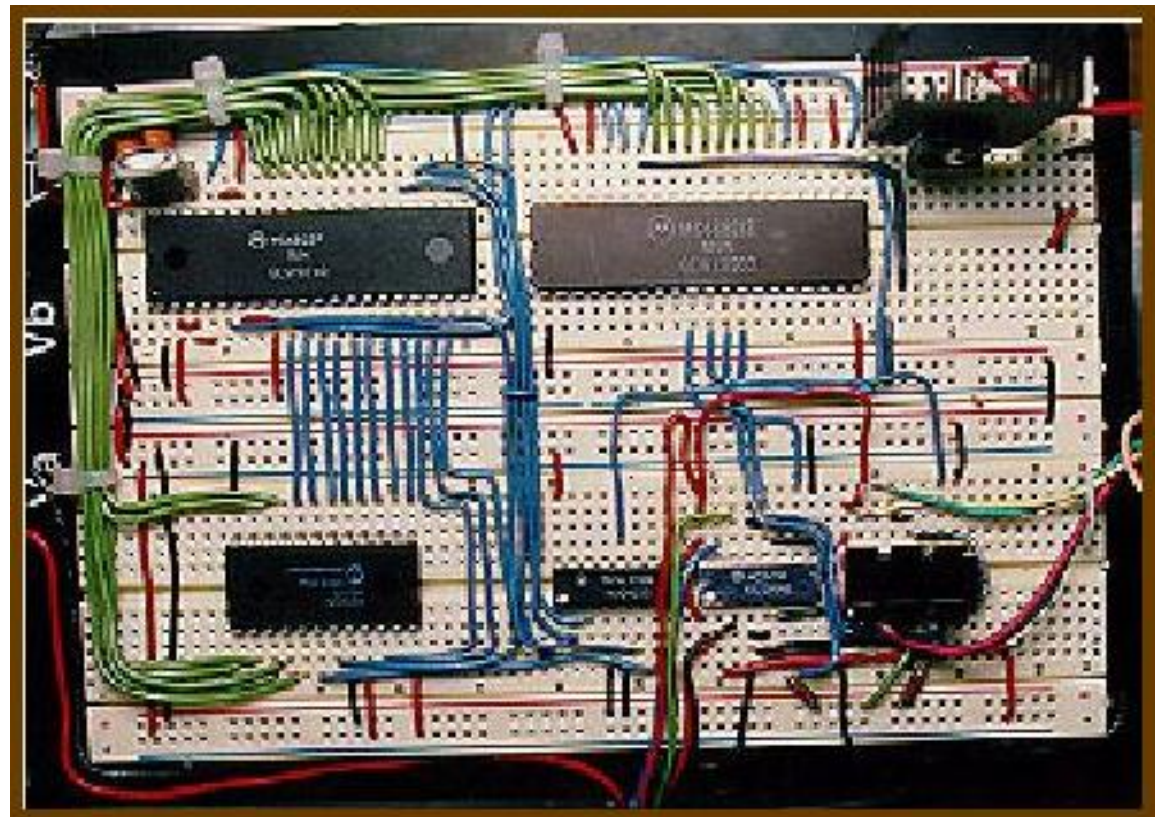
Clean Wiring

A clean breadboard will make debugging easier – and it makes circuits more robust



www.linefollowing.com

tangentsoft.net



Care with Power

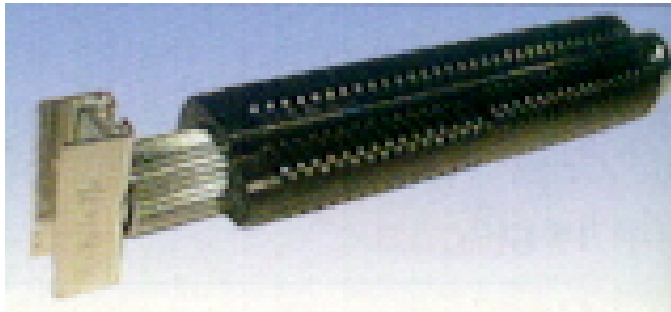
- Only insert components and wires into the breadboard when power is disconnected
- “Wire, check-twice, then power”
 - Never reverse power and ground (this is a very common mistake)
- Most chips that we will use expect +5V
 - More can destroy the chips
 - We will use DC/DC converters to step battery voltages down to +5V

Care of Chips

- Use insertion and extraction tools: never your fingers
- Minimize your contact with pins: static electricity can destroy a chip
- Use a wrist strap when you handle chips



www.a7vtroubleshooting.com



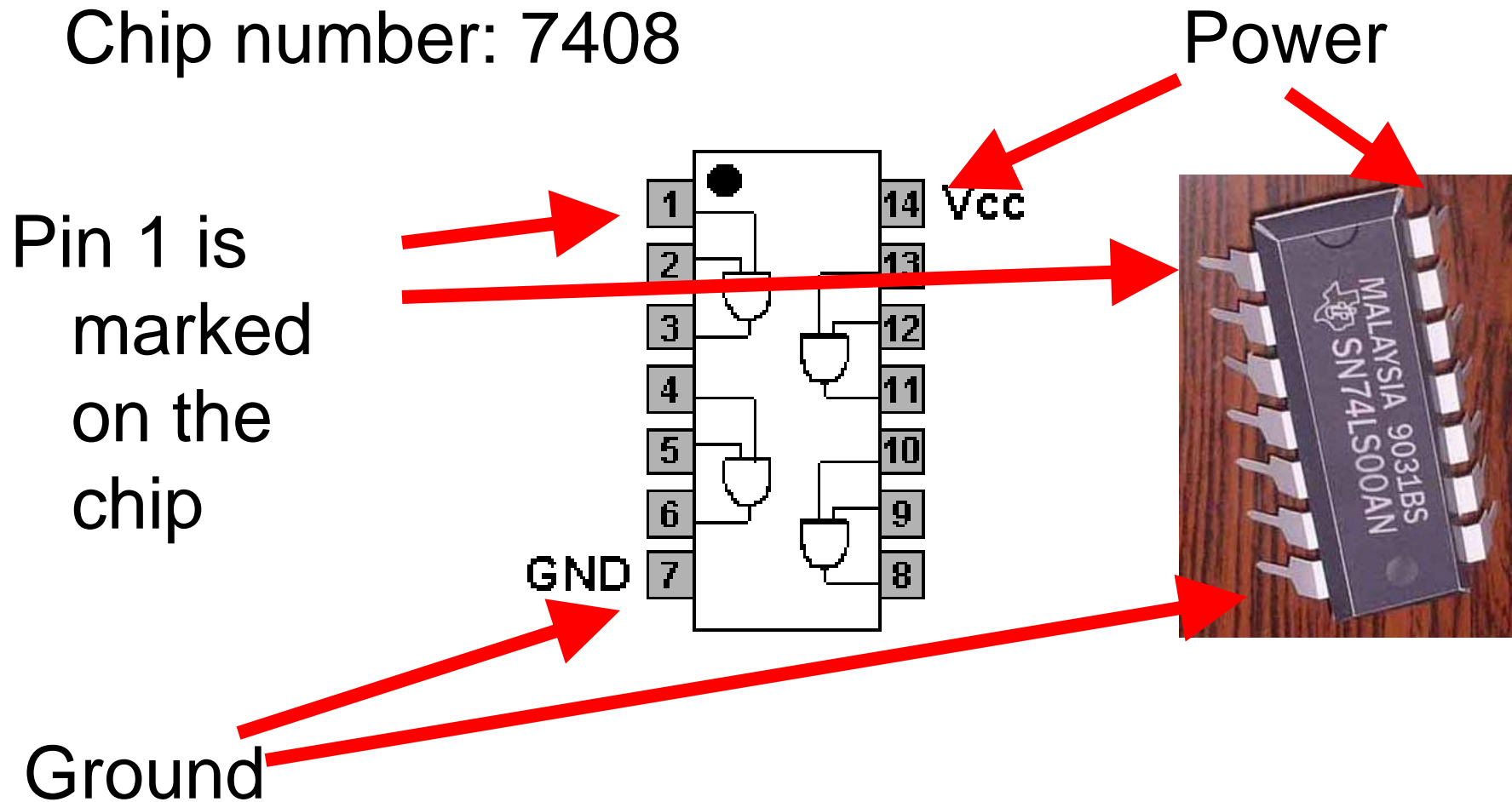
www.chantronics.com.au



www.hvwtech.com

TTL Chips: 2-Input AND Gates

Chip number: 7408



Constant Inputs

How do we configure a chip input as a constant?

Constant Inputs

How do we configure a chip input as a constant?

- For a constant 0: connect to ground
- For a constant 1: use a pull-up resistor to +5V (e.g., 10K ohm)

Wiring Procedure (Suggested)

- Power supply
- Power/ground buses
- Insert primary components
- Wire power/ground for components
- Add signals and remaining components
- Test incrementally

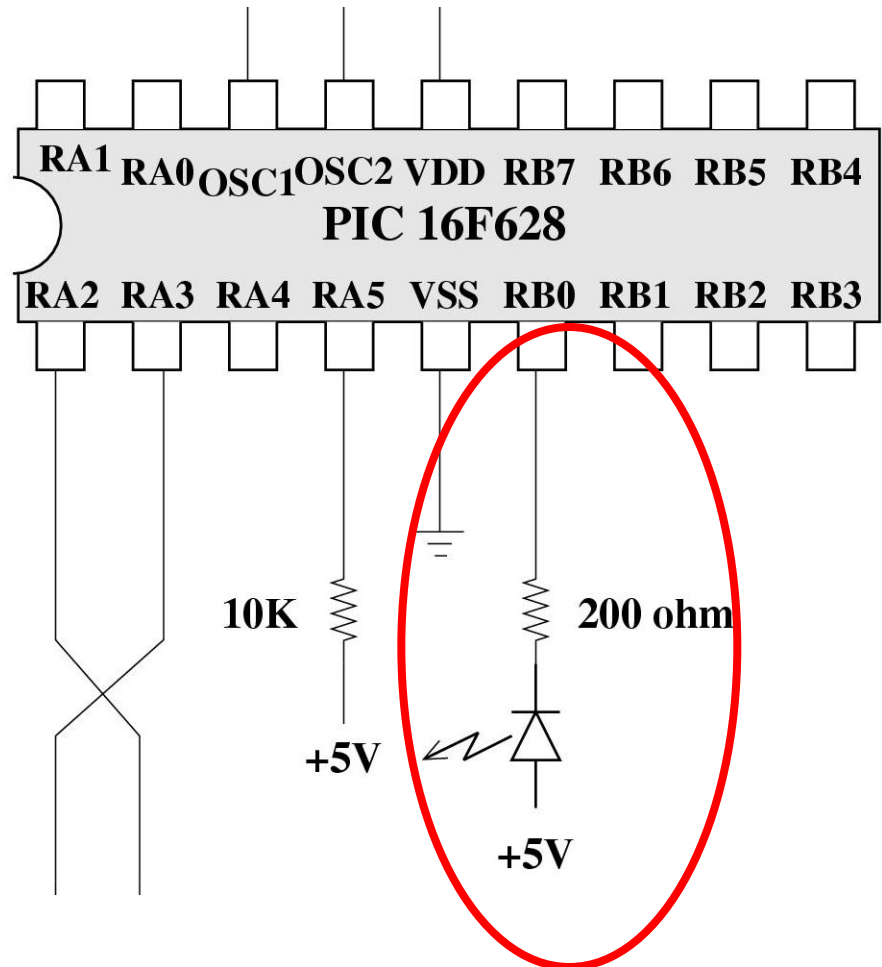
Debugging Techniques

- Multimeter:
 - Use *voltage mode* to check logic levels
 - Use *continuity mode* to confirm connections (but never with power turned on!)
- Oscilloscope:
 - View voltage as a function of time on 2 channels
- Test incrementally
- Test intermediate sub-circuits

Debugging Techniques

Wire in LED to indicate logic level on a line

- For most components, do not allow the line to be driven by more than 20mA (check the specs if in doubt)
- Note that in this circuit, the LED turns on when logic level is LOW

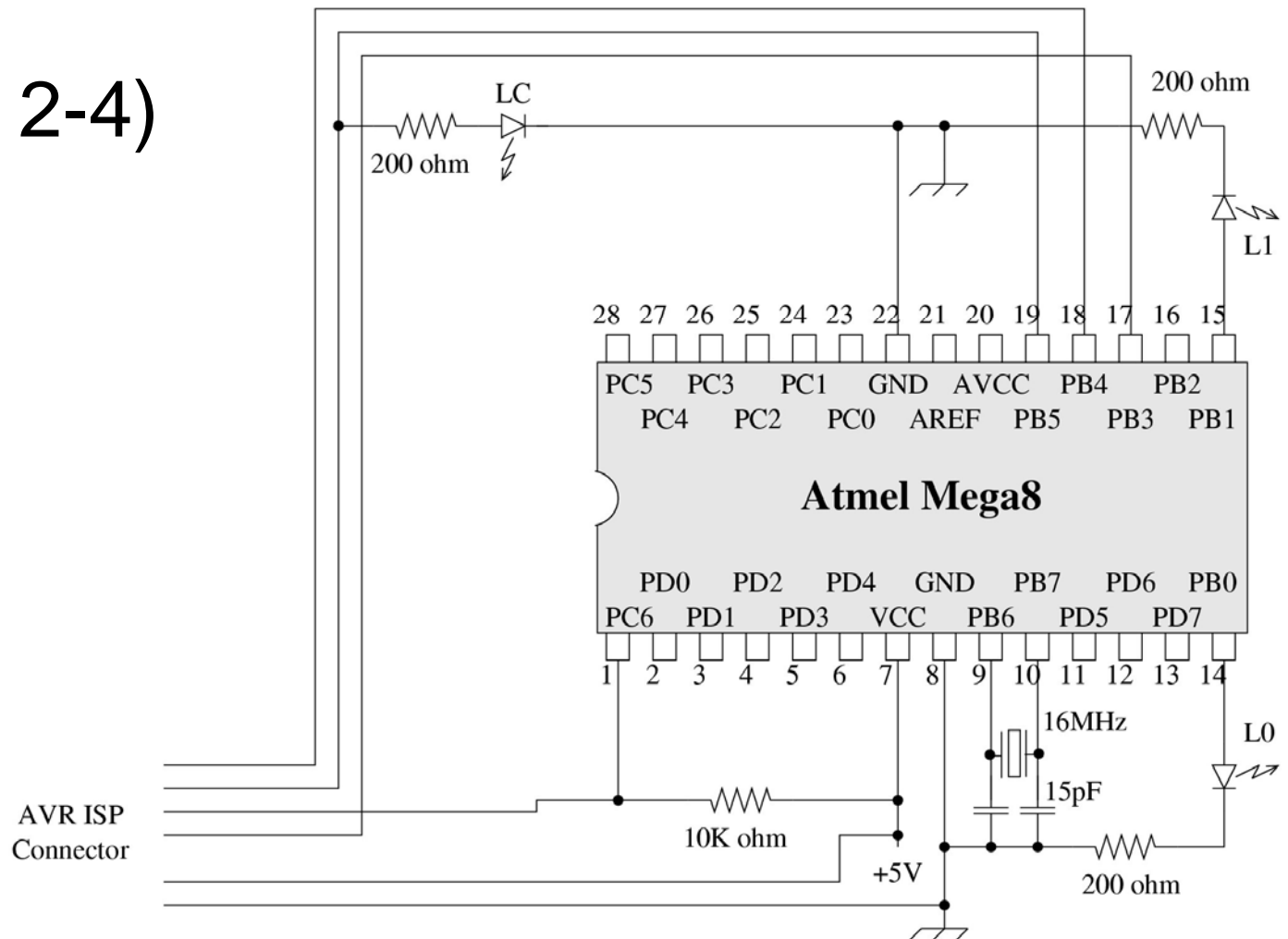


Debugging/Safety Hints

- Start by testing your circuit prior to connecting motor power
- Before connecting power: position arms so that they are near their default positions (middle of the joint ranges)
- You can test the wheel control with the robot up “on blocks” (so that the wheels are not touching the ground)

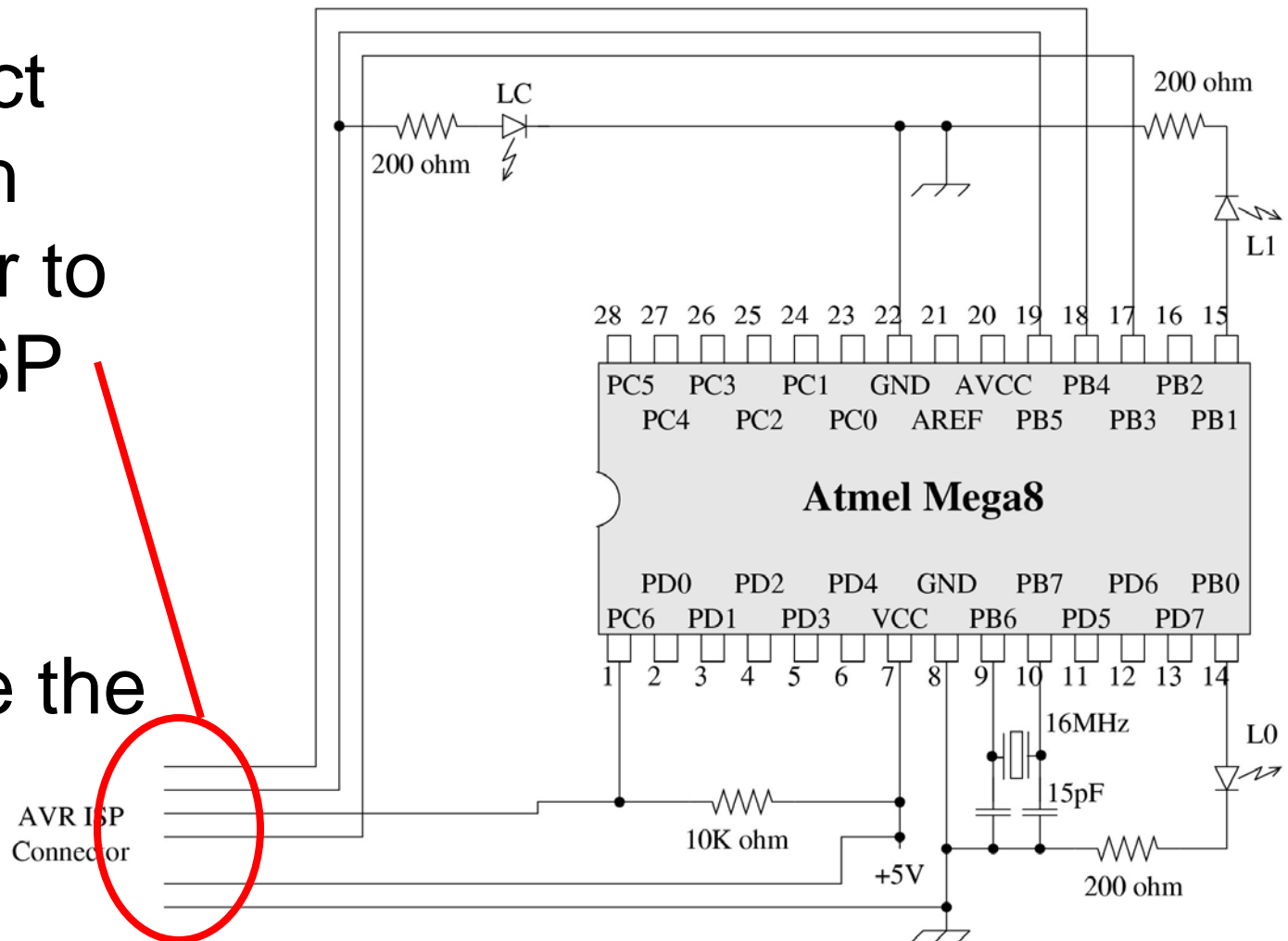
A Basic Circuit

(Projects 2-4)



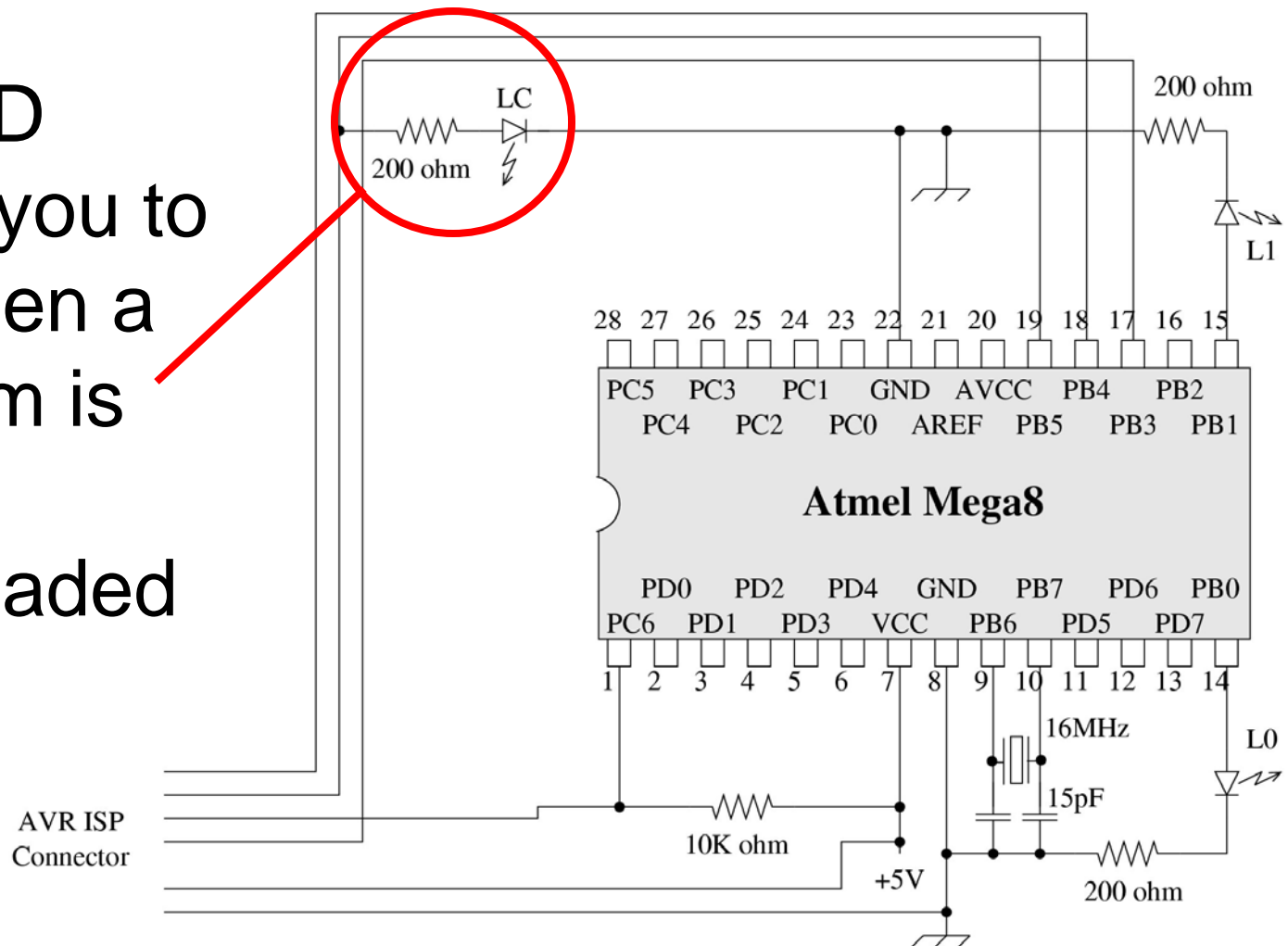
A Basic Circuit

- Connect through adapter to AVR ISP
- Do not reverse the pins!



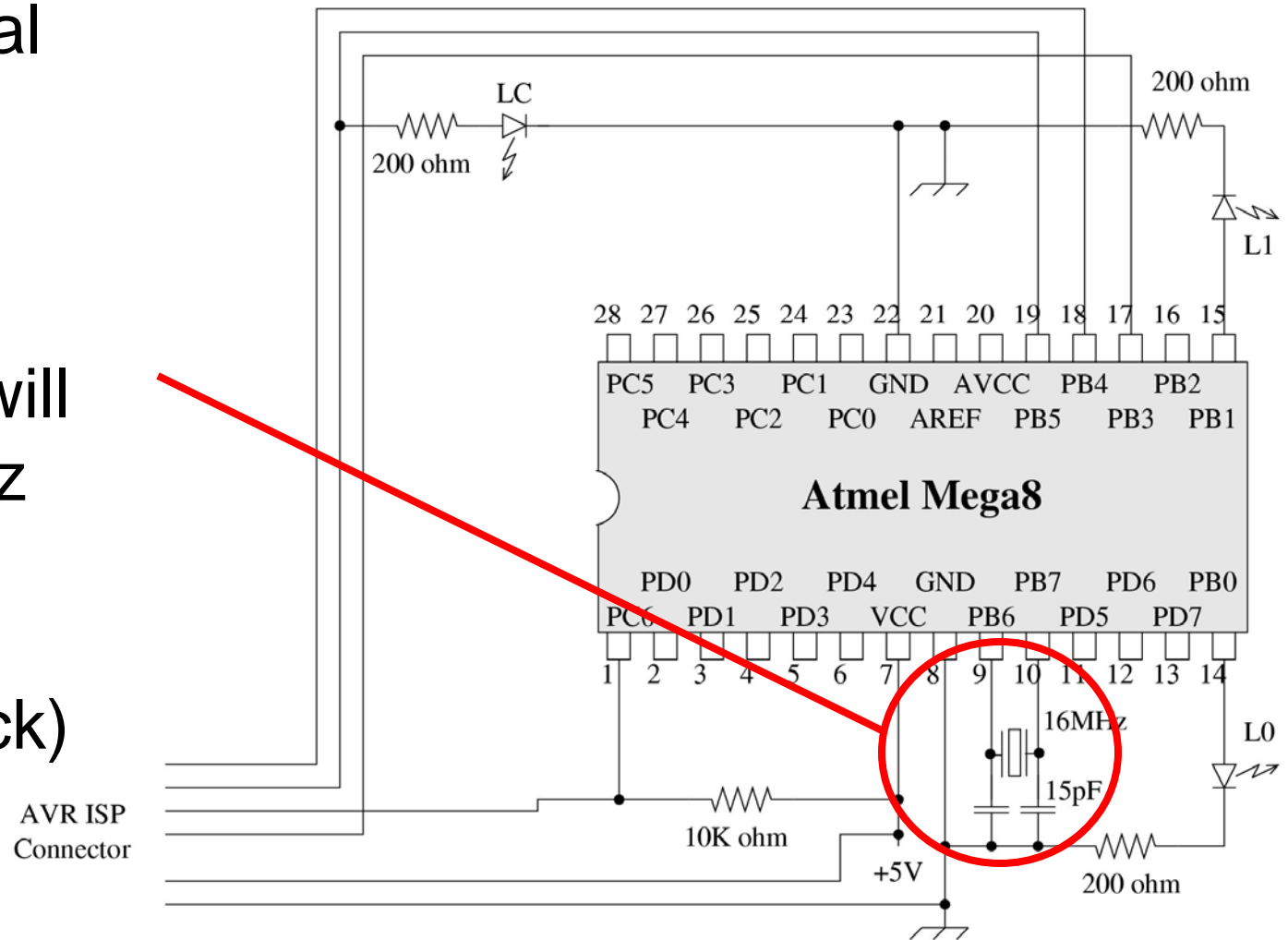
A Basic Circuit

Extra LED
allows you to
see when a
program is
being
downloaded



A Basic Circuit

- 16 MHz crystal
- Optional!
- Without it, your processor will run at 1MHz (in general, we will use 16MHz clock)



Mega8 Wierdnesses

- The programmer relies on the clock being used by the mega8
 - The programmer speed must be no greater than $\frac{1}{4}$ of this clock (lower is safer)
- Out of “the box,” this clock is the internal one (1 MHz)
 - Set the programmer to operate at ~100KHz
 - Configure the “fuse bits” to use the external crystal
 - Set programmer back to 1-4 MHz

Configuring the Clocks

AVR Studio (after you are connected to the programmer):

- Programmer frequency:
 - Board menu
 - Set ISP frequency
 - Write
- Chip clock configuration:
 - Fuses menu
 - Select last option: high freq crystal/resonator;
16K CK + 64 ms
 - Program

Configuring the Clocks

AVRdude users:

- See the Atmel HOWTO

Lab Procedures

- No food or drink are allowed in the lab.
- Before leaving the lab, please be sure to clean up your workspace.
- Because some equipment may be in short supply, please coordinate with others who will need these resources
- Never place dead components back into the stock (instead – place them in the ‘graveyard’)

Lab Procedures

- No equipment or supplies may leave the lab without the permission of the monitor.
- No books may leave the lab.
- Please clear all guests with the lab monitor.
- Unless you have prior permission, please do not handle the projects of other class members.

Lab Procedures

- Always check your wiring before you power up your circuit (especially your power and ground connections).
- When removing chips from breadboards, always use an appropriate tool (not your fingers!).
- If you break something, please report it (don't just put it away).
- You are expected to supply and configure your own laptop computers for project use