Physical Computing

What We've Learned So Far @ITP

Tom Igoe

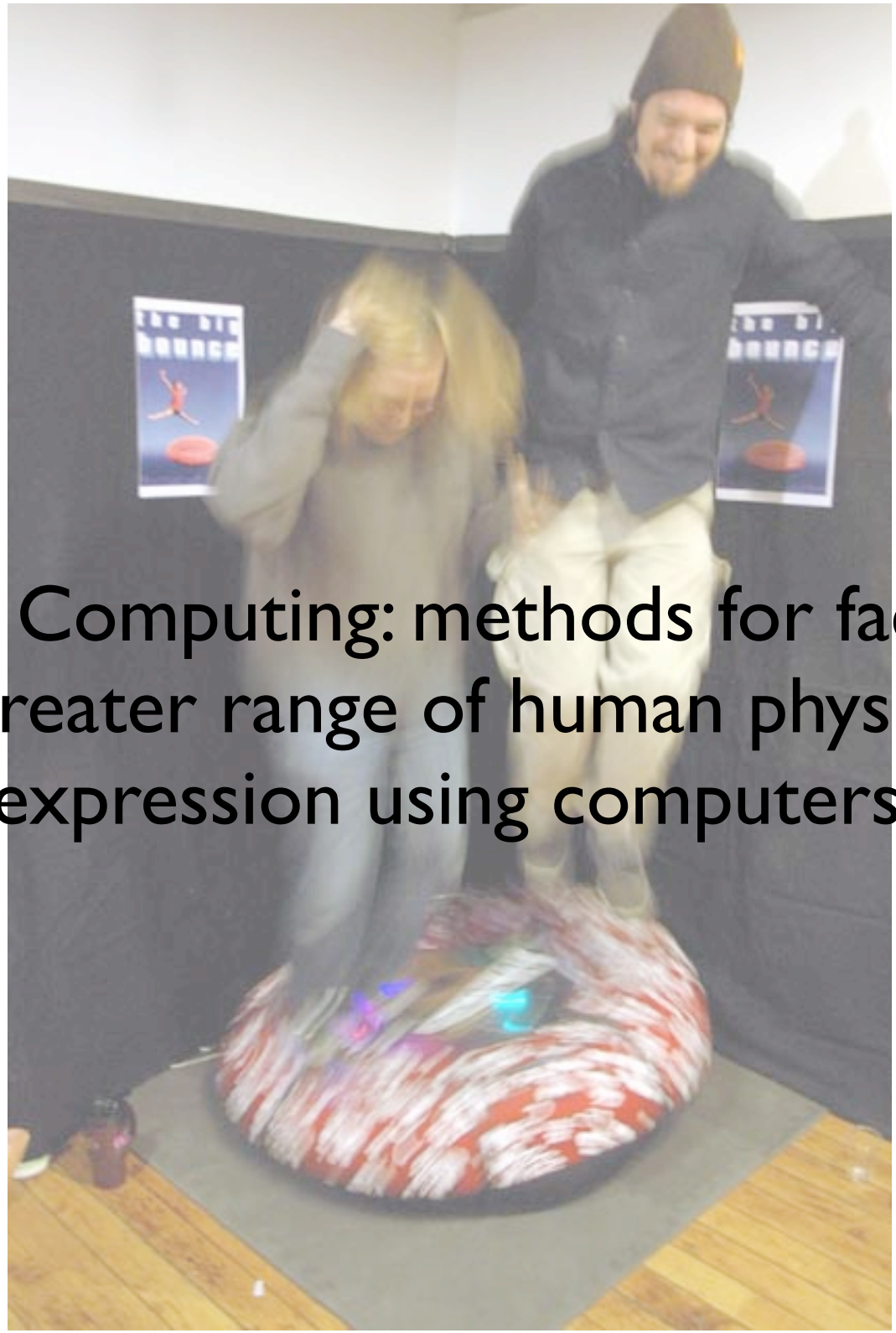
ITP

Tisch School of the Arts

NYU

ITP

- 2-year grad program, 230 students
- No technical requirements to admissions:
  - Artists, designers, musicians, dancers, chefs, therapists, sword swallowers, sandwich artists, engineers, butchers, bakers, candlestick makers, etc.
- Collaboration is central to the program
- A plurality of voices and a large community makes for better interactive design work



Physical Computing: methods for facilitating a greater range of human physical expression using computers.

EXIT

Sensor-to-Screen

Foosball

Dennis Crowley

Through the Looking Glass...

Gabriela Richard, Vanessa Khan, Tom Ainslie

Ramps

John Schimmel, Tristan Perich, Wlodek Koss

Standalone Objects

SmartHug

Heather Dewey-Hagborg
Vaishali Khandare

VOCquet

Jennifer Kirchherr

Therapy Incentives Through Play

Stephen Kerrigan, Mike Bukhin

Wireless Objects

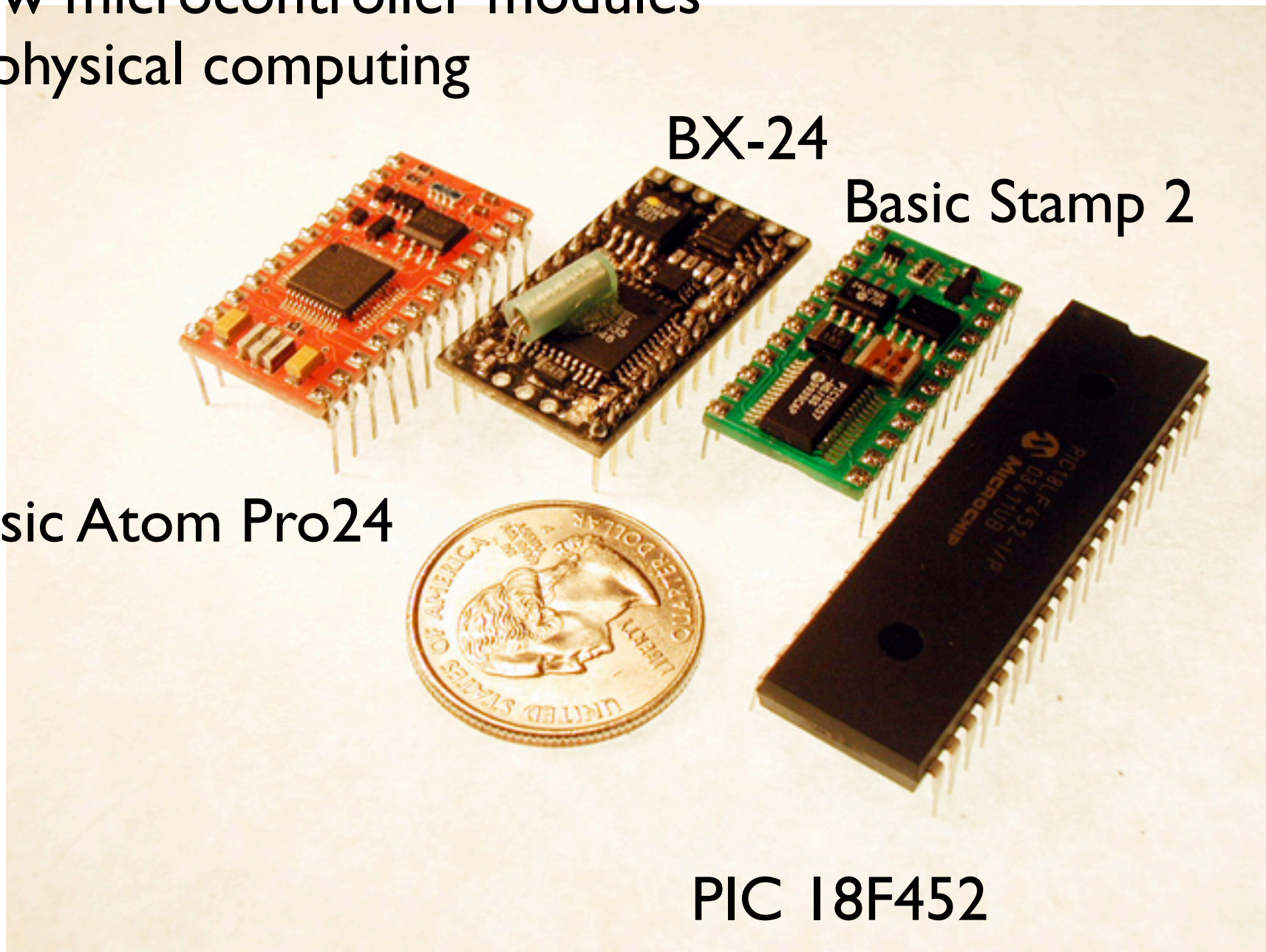
Needies

Brett Shulz, Daniel Perlin, Amos Bloomberg

2 Fast 4 Tracks

Chris Hall

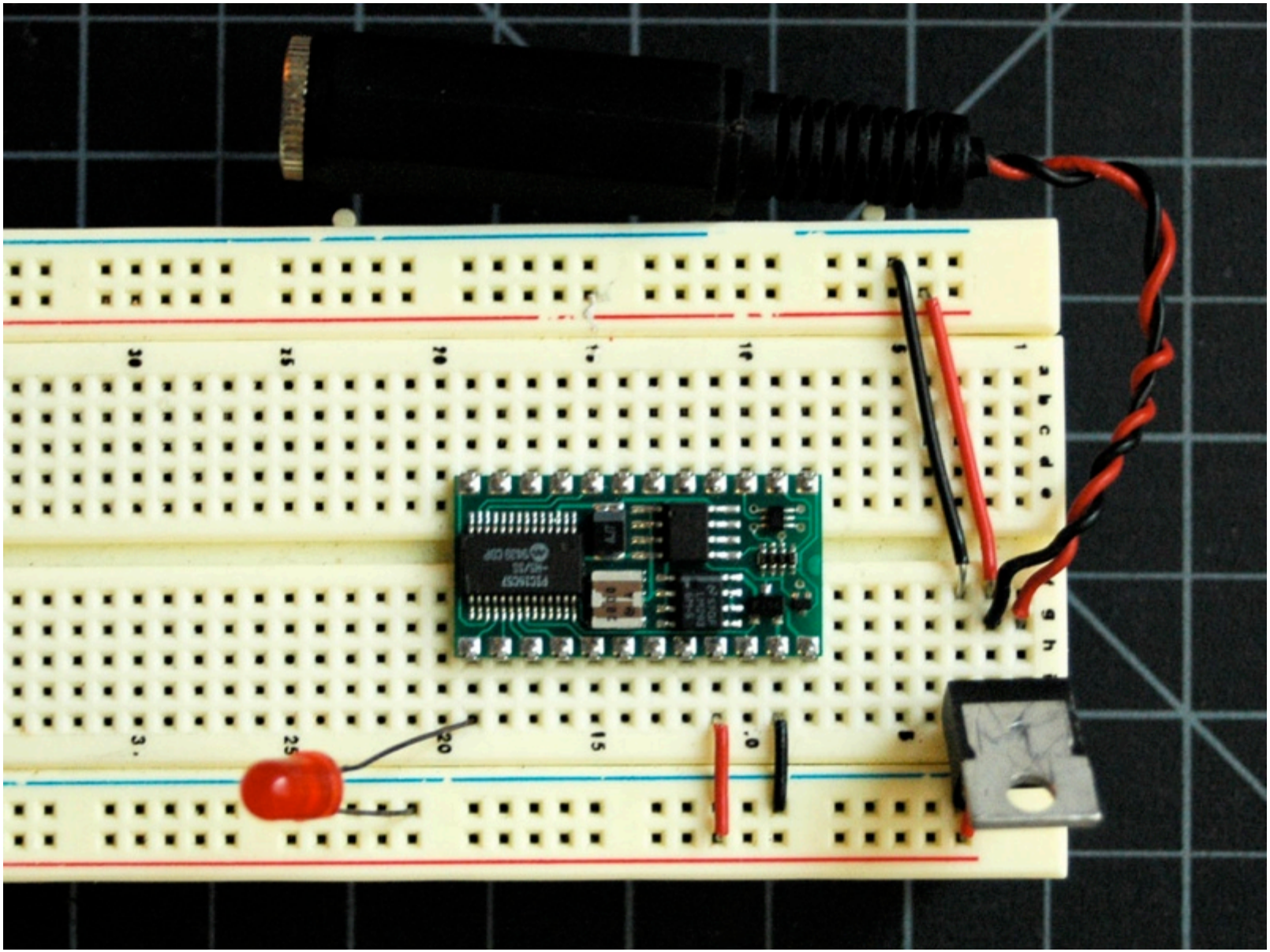
A few microcontroller modules for physical computing



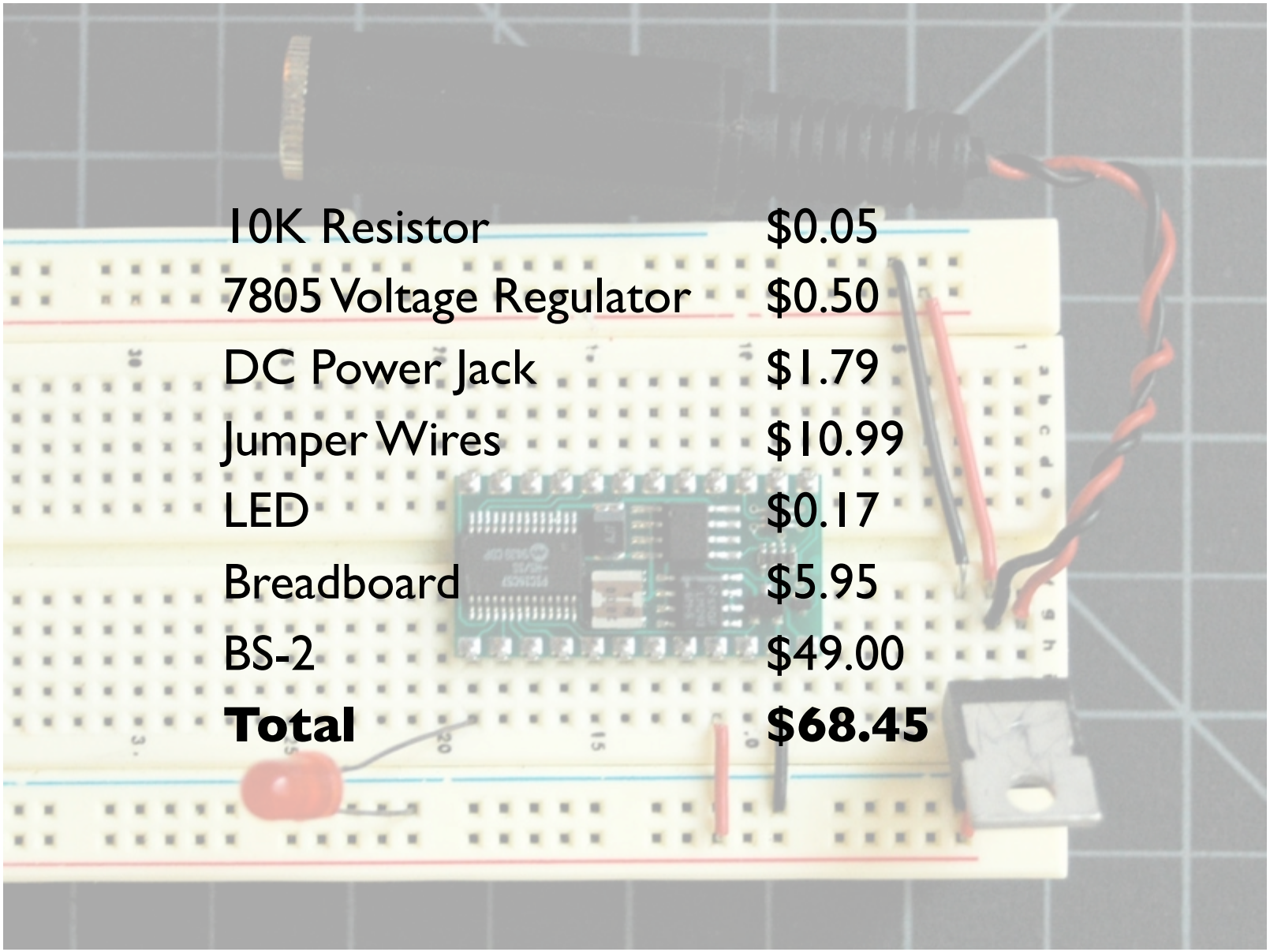
Hardware is Hard

- Keep setup cost really low
- Consider the cost of multiple controllers
- The fewer components, the better
- The things that seem most minor to experienced people are the most major stumbling blocks for beginners
- Abstract the housekeeping, focus on the interface

Basic Stamp 2

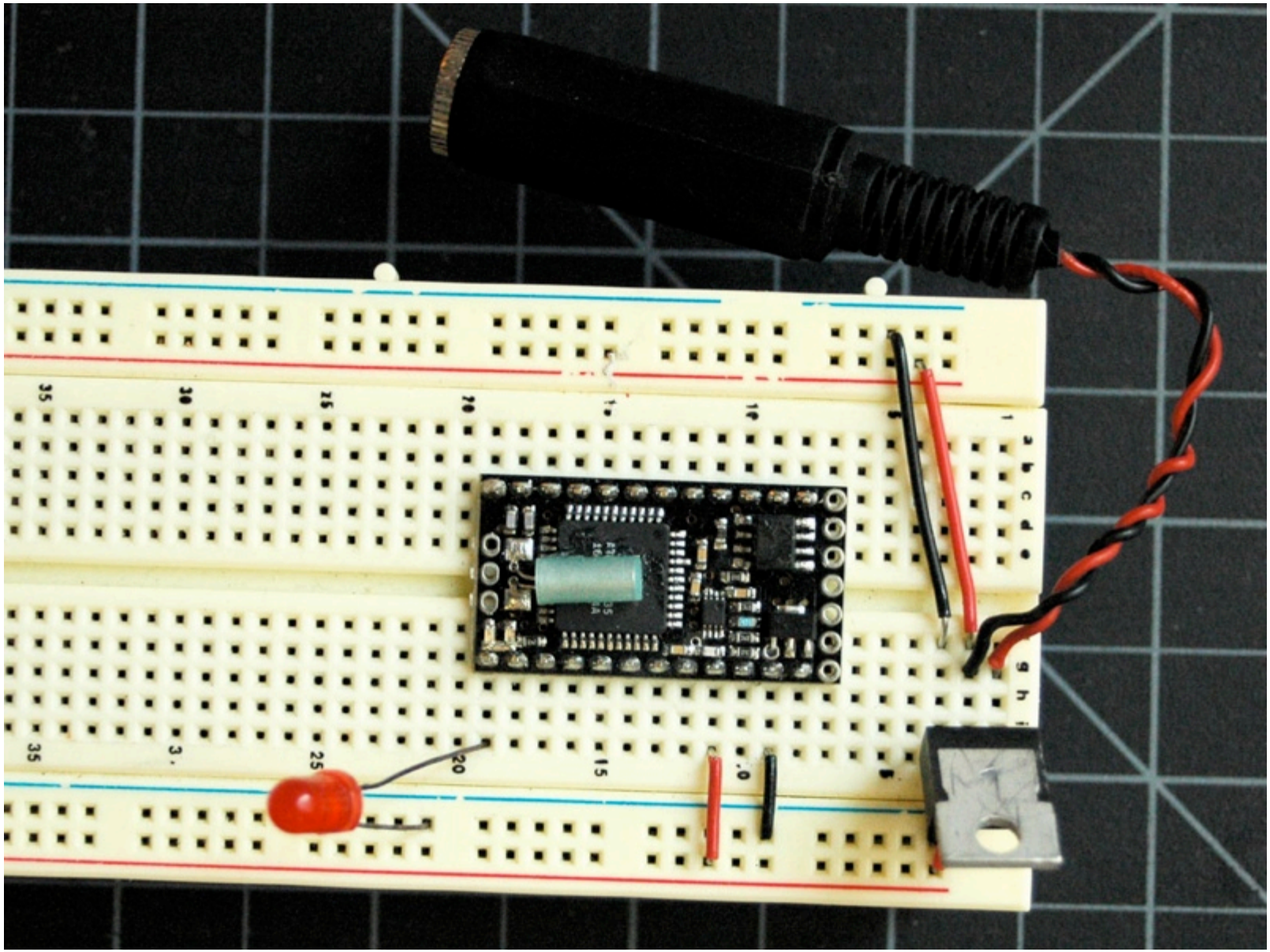


Basic Stamp 2

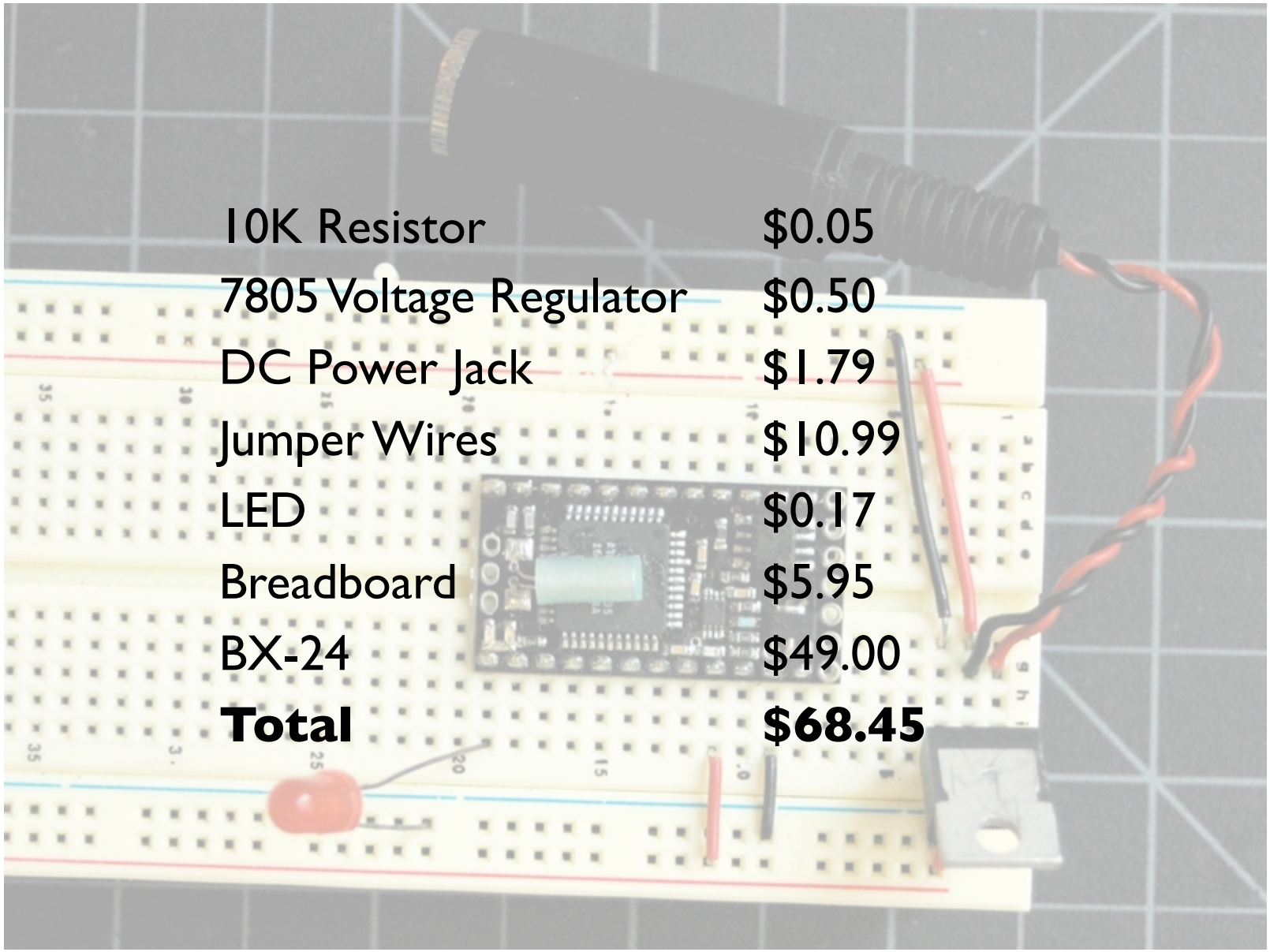


10K Resistor	$0.05
7805 Voltage Regulator	$0.50
DC Power Jack	$1.79
Jumper Wires	$10.99
LED	$0.17
Breadboard	$5.95
BS-2	$49.00
Total	**$68.45**

NetMedia BX-24



NetMedia BX-24



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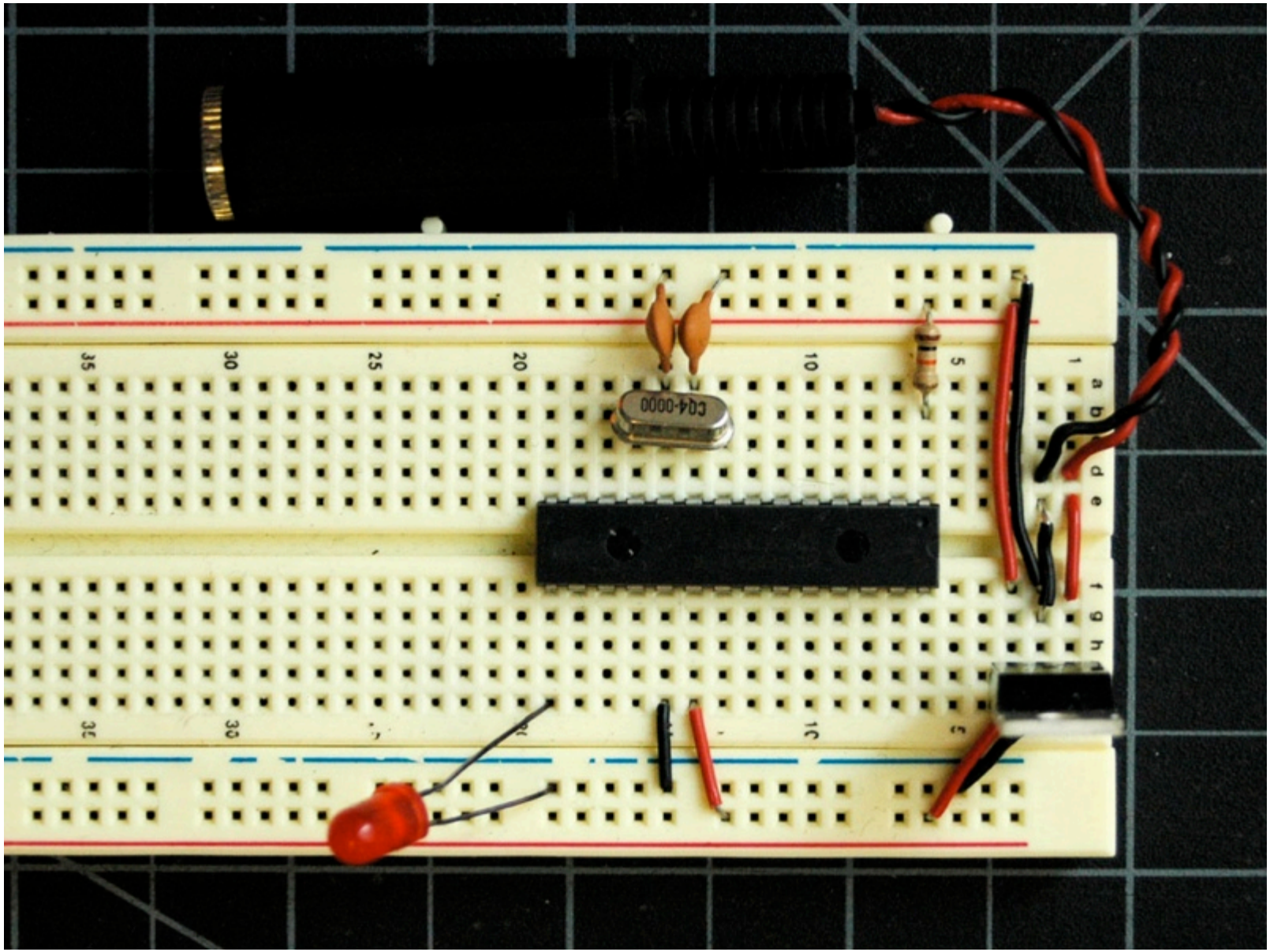
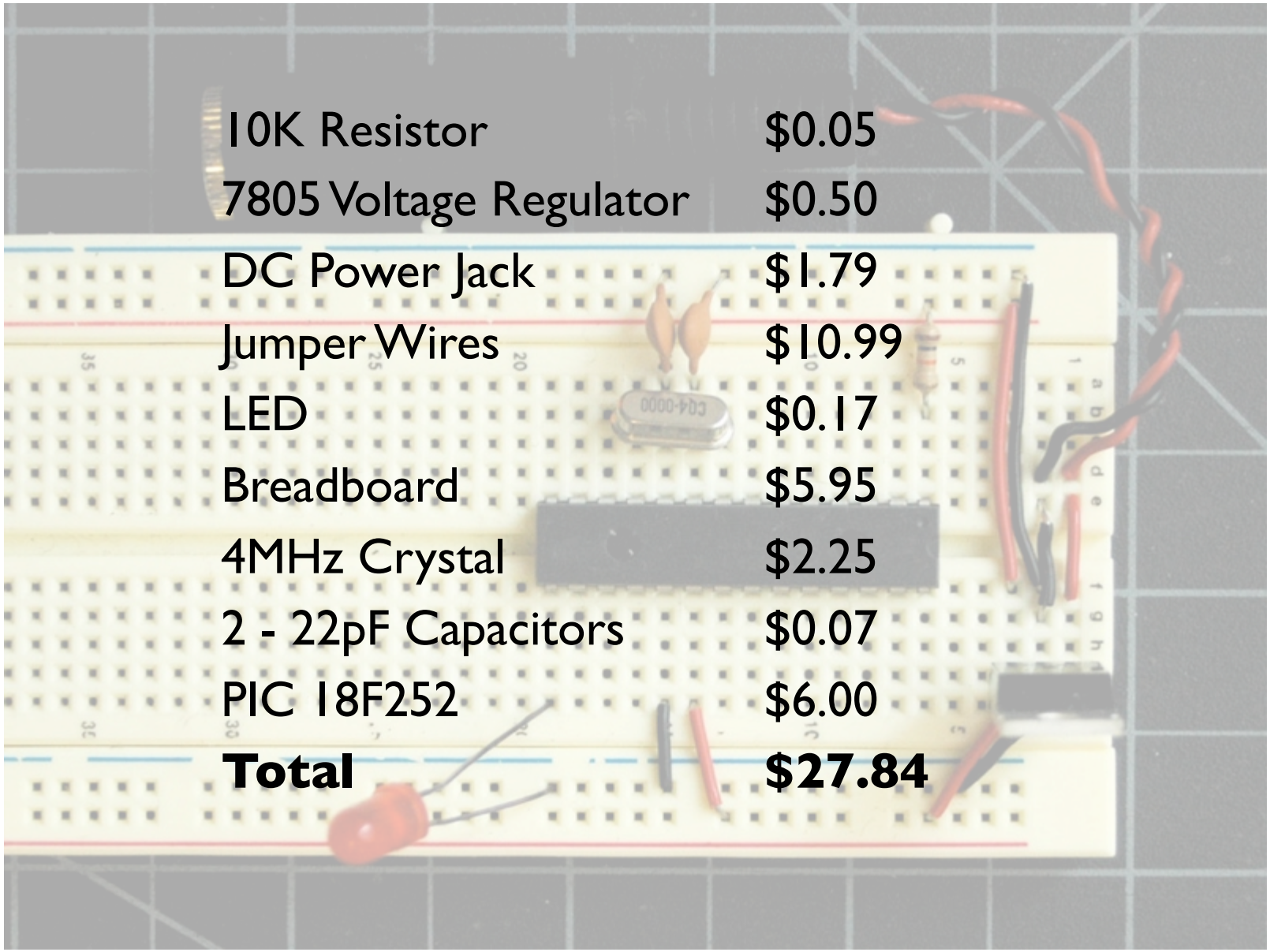
BX-24	$49.00
Total	**$68.45**

Microchip PIC 18F252



Microchip PIC 18F252



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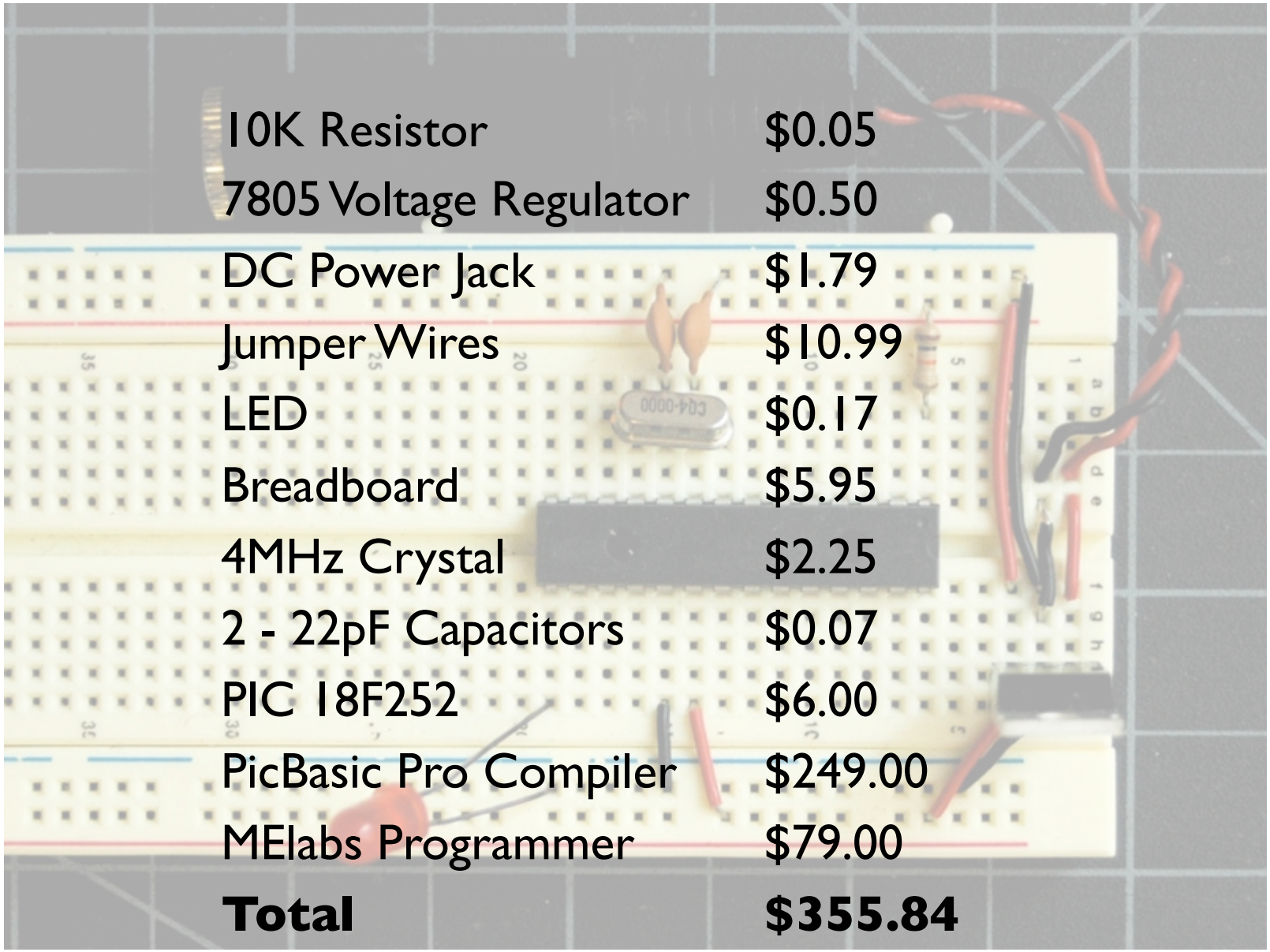
7805 Voltage Regulator	$0.50
DC Power Jack	$1.79
Jumper Wires	$10.99
LED	$0.17
Breadboard	$5.95
4MHz Crystal	$2.25
2 - 22pF Capacitors	$0.07
PIC 18F252	$6.00
Total	**$27.84**

Microchip PIC 18F252



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LED	$0.17
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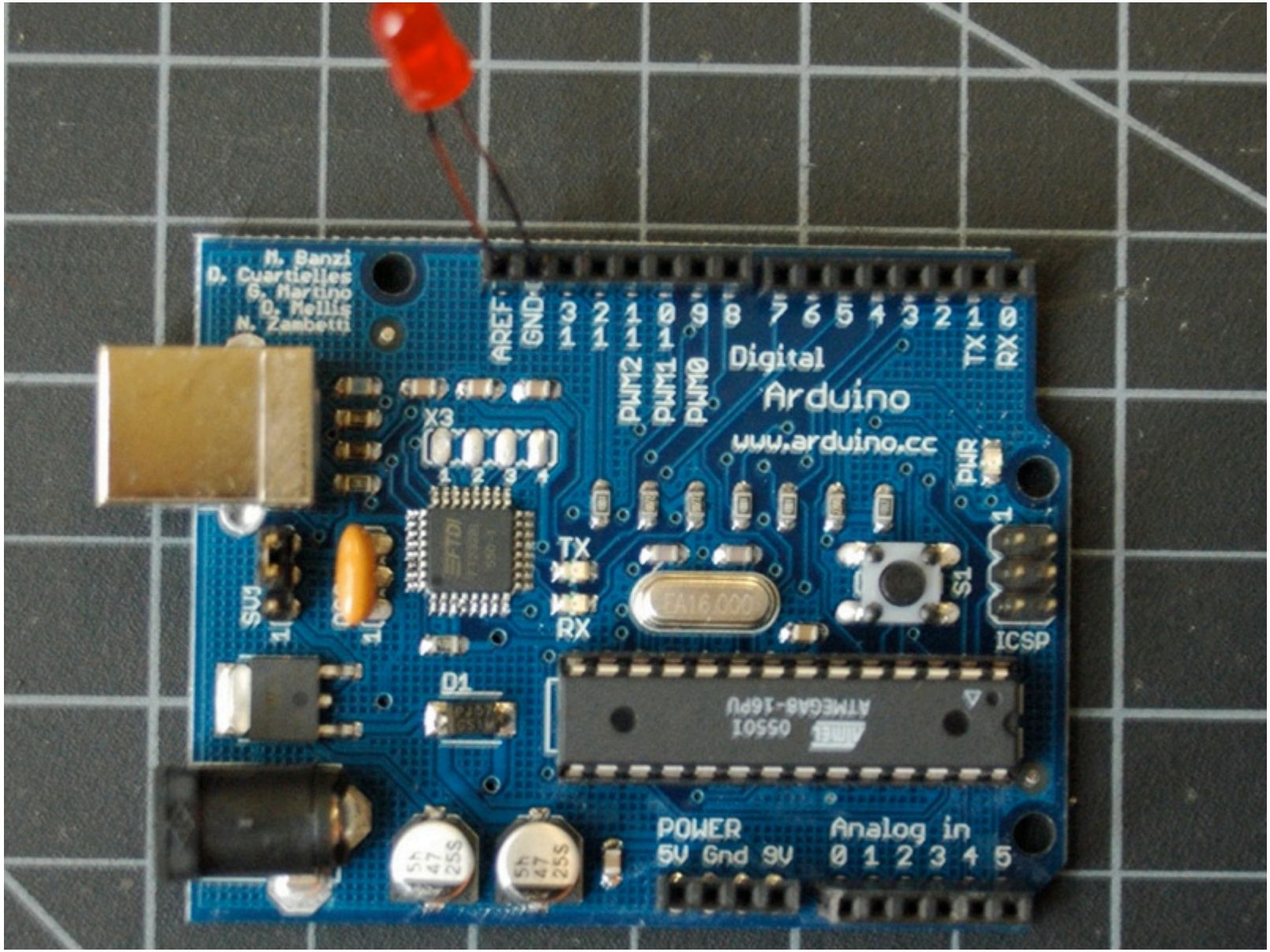
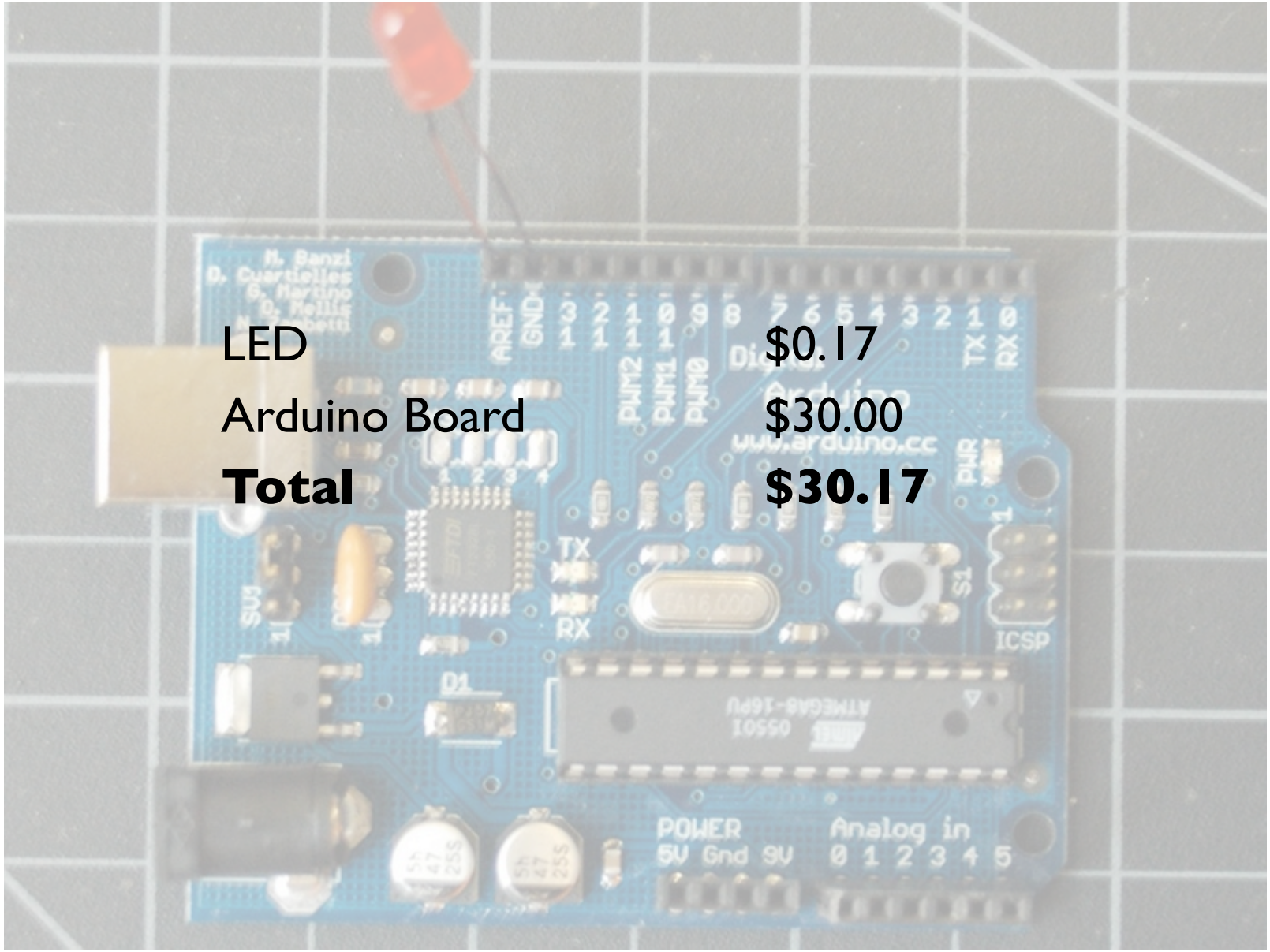
4MHz Crystal	$2.25
2 - 22pF Capacitors	$0.07
PIC 18F252	$6.00
PicBasic Pro Compiler	$249.00
MElabs Programmer	$79.00
Total	**$355.84**

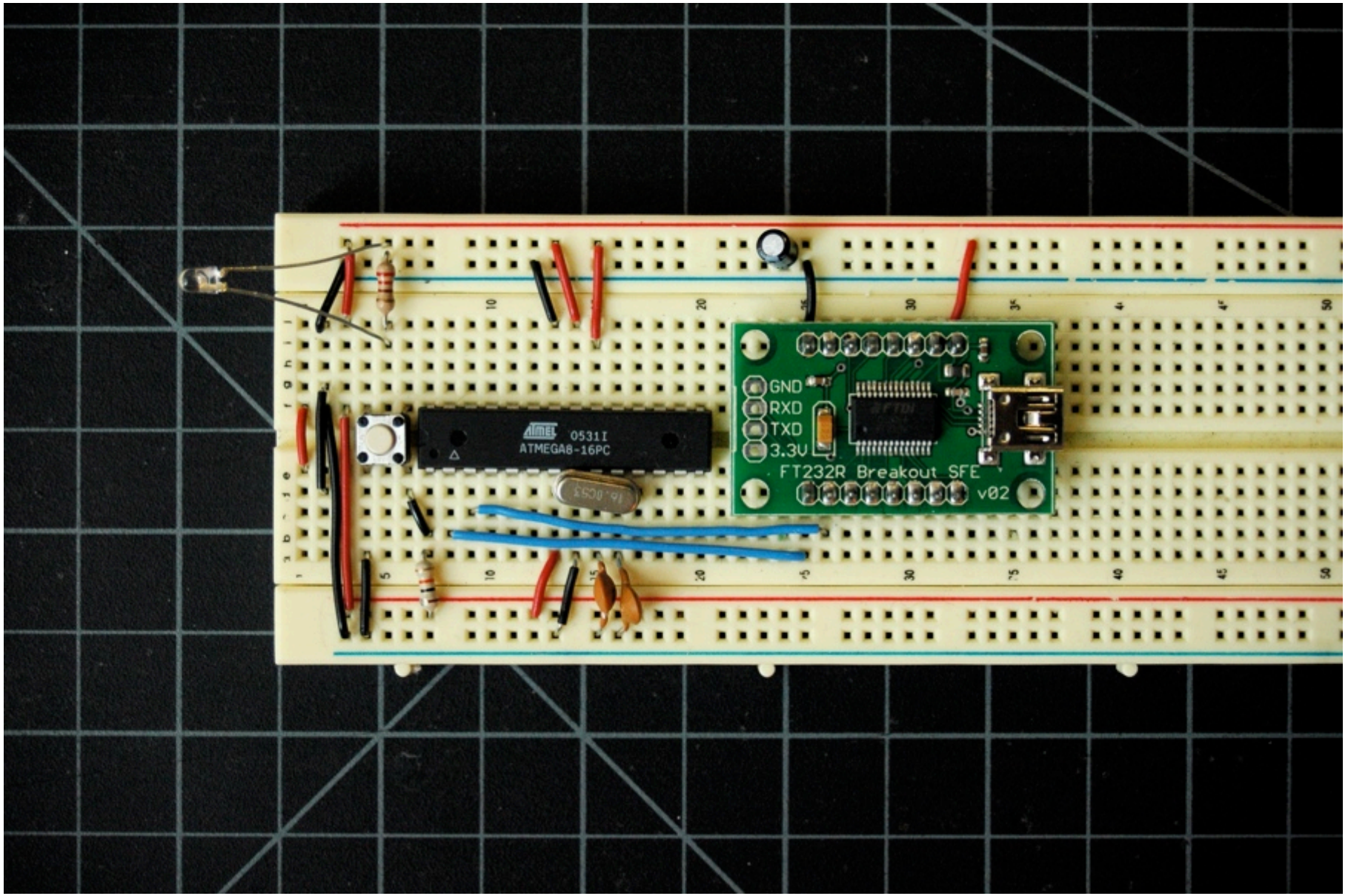
Arduino


M. Banzi
D. Cuartielles
G. Martino
D. Mellis
N. Zambetti
AREF
GND
3 2 1 0 9 8 7 6 5 4 3 2 1 0
1 1 1 1
PWM2
PWM1
PWM0
Digital
Arduino
www.arduino.cc
TX
RX
X3
1 2 3 4
PWR
TX
RX
S1
ICSP
SV1
D1
ATMEGA8-16PU
POWER
5V Gnd 9V
Analog in
0 1 2 3 4 5

Arduino



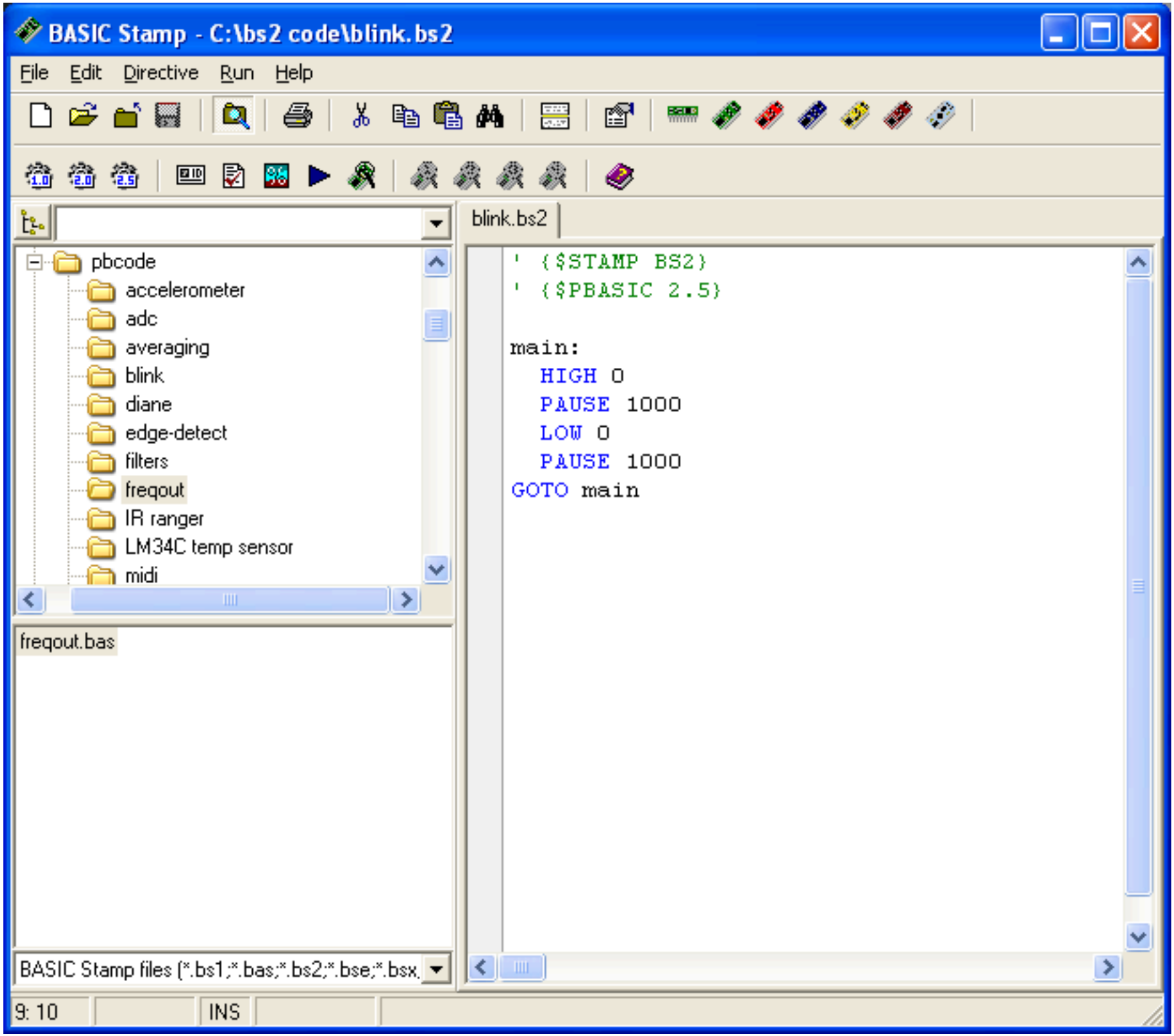
Arduino

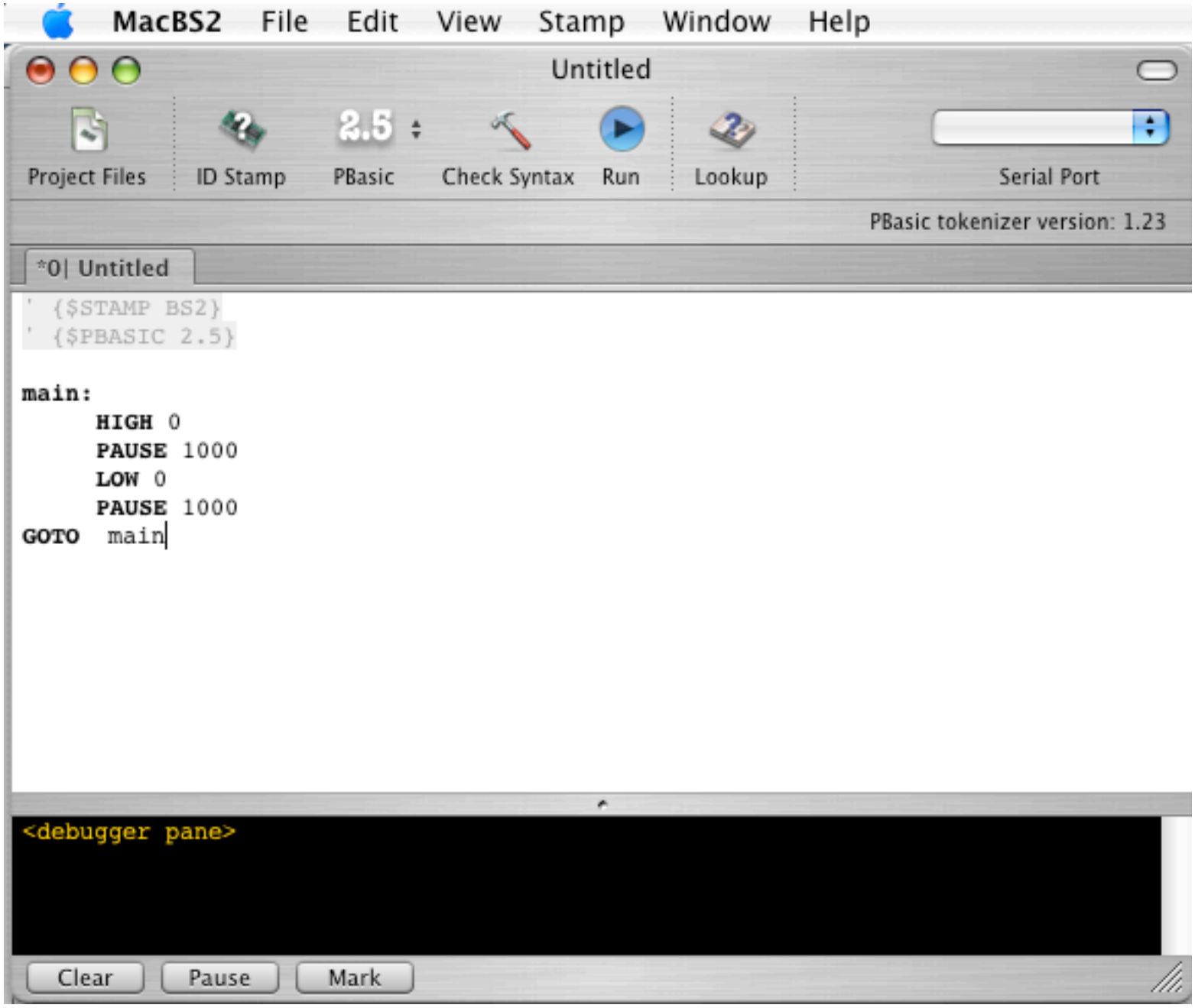


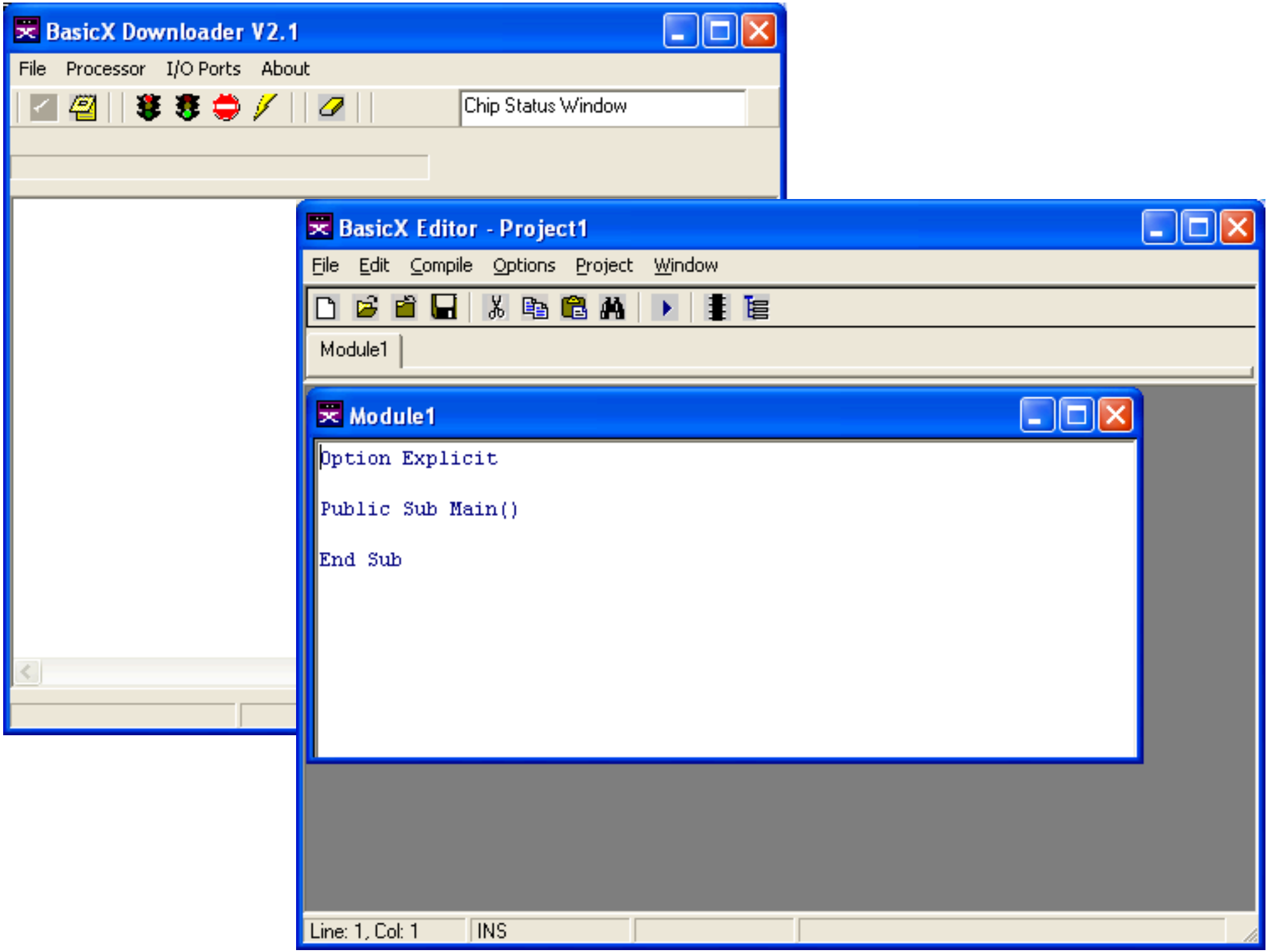
Software Must Be Soft

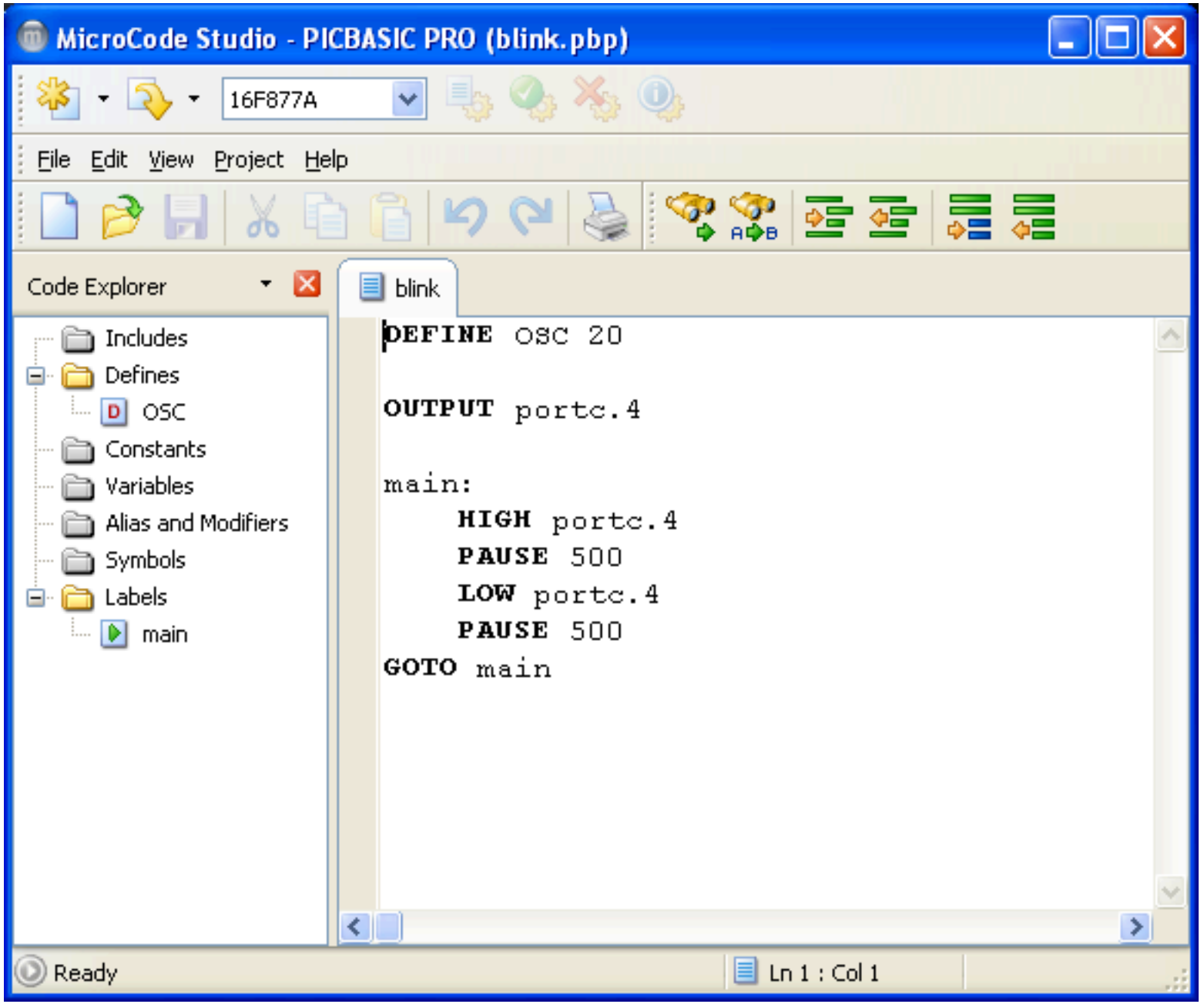
(Because Hardware is Hard)

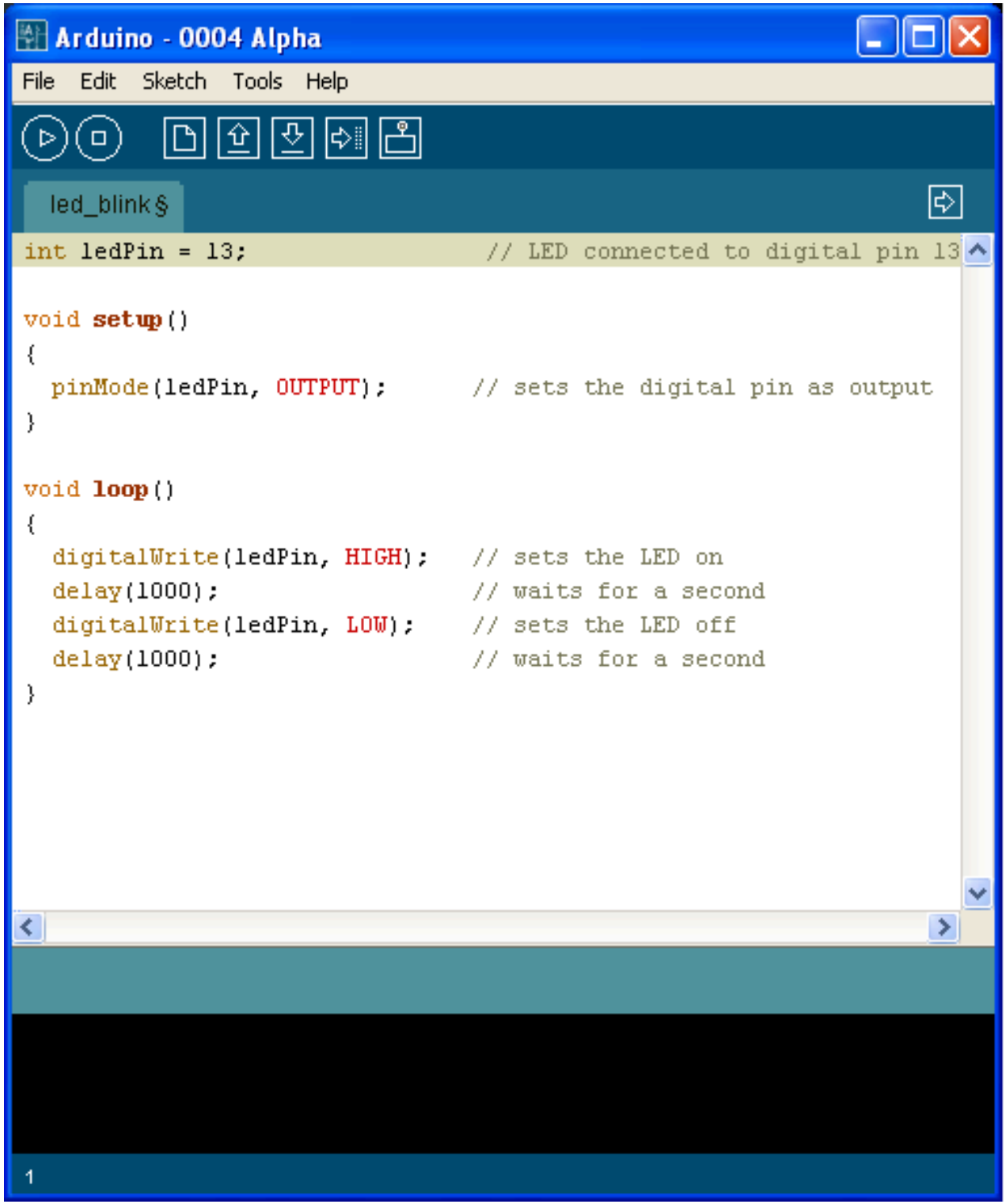
- Simple interface is important
- Simple language is important
- Big function/feature list isn't so important
- Minor language elements are major stumbling blocks
- Abstract the housekeeping, focus on the interface


BASIC Stamp - C:\bs2 code\blink.bs2
File Edit Directive Run Help
pbcode
accelerometer
adc
averaging
blink
diane
edge-detect
filters
freqout
IR ranger
LM34C temp sensor
midi
freqout.bas
BASIC Stamp files (*.bs1;*.bas;*.bs2;*.bse;*.bsx
blink.bs2
' {$STAMP BS2}
' {$PBASIC 2.5}
main:
HIGH 0
PAUSE 1000
LOW 0
PAUSE 1000
GOTO main
9: 10
INS


MacBS2 File Edit View Stamp Window Help
Untitled
Project Files
ID Stamp
2.5
PBasic
Check Syntax
Run
Lookup
Serial Port
PBasic tokenizer version: 1.23
*0| Untitled
' {$STAMP BS2}
' {$PBASIC 2.5}
main:
HIGH 0
PAUSE 1000
LOW 0
PAUSE 1000
GOTO main
<debugger pane>
Clear
Pause
Mark


BasicX Downloader V2.1
File
Processor
I/O Ports
About
Chip Status Window
BasicX Editor - Project1
File
Edit
Compile
Options
Project
Window
Module1
Module1
Option Explicit
Public Sub Main()
End Sub
Line: 1, Col: 1
INS


MicroCode Studio - PICBASIC PRO (blink.pbp)
16F877A
File Edit View Project Help
Code Explorer
Includes
Defines
OSC
Constants
Variables
Alias and Modifiers
Symbols
Labels
main
blink
DEFINE OSC 20
OUTPUT portc.4
main:
HIGH portc.4
PAUSE 500
LOW portc.4
PAUSE 500
GOTO main
Ready
Ln 1 : Col 1

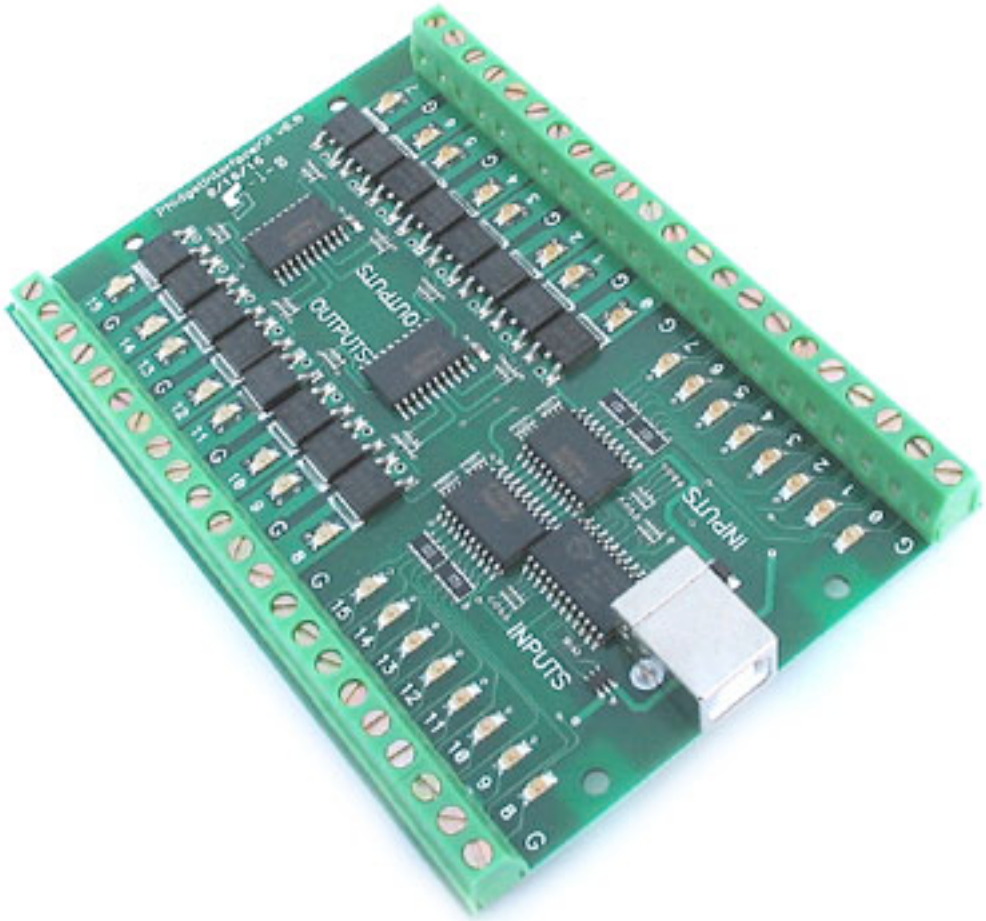

Arduino - 0004 Alpha
File Edit Sketch Tools Help
led_blink §
int ledPin = 13; // LED connected to digital pin 13
void setup()
{
pinMode(ledPin, OUTPUT); // sets the digital pin as output
}
void loop()
{
digitalWrite(ledPin, HIGH); // sets the LED on
delay(1000); // waits for a second
digitalWrite(ledPin, LOW); // sets the LED off
delay(1000); // waits for a second
}
1

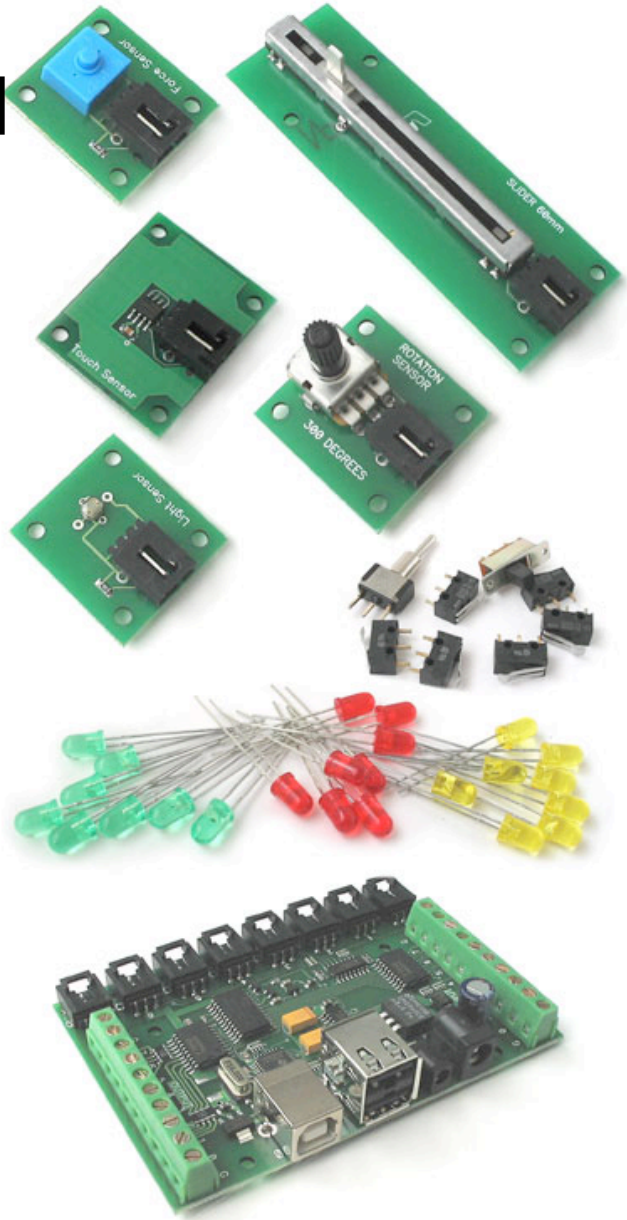
Arduino File Edit Sketch Tools Help
Arduino - 0004 Alpha
sketch_060621a §
void setup() {
pinMode(2, OUTPUT);
}
void loop() {
digitalWrite(2, HIGH);
delay(1000);
digitalWrite(2, LOW);
delay(1000);
}
Auto Format finished.
1

Arduino File Edit Sketch Tools Help
Arduino – 0004 Alpha
sketch_060621a §
void setup() {
pinMode(2, OUTPUT);
}
void loop() {
digitalWrite(2, HIGH);
delay(1000);
digitalWrite(2, LOW);
delay(1000);
}
millis() !!!!!
Auto Format finished.
1

Phidgets

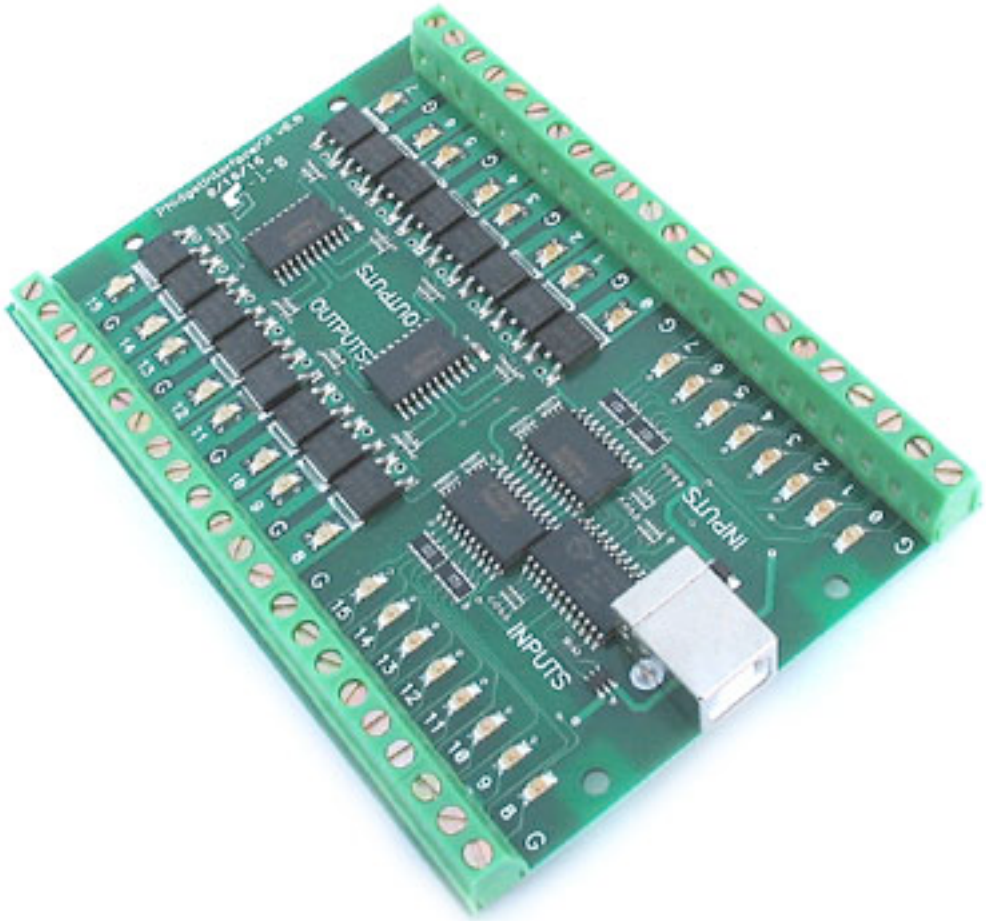
- Love that there's no need to program hardware

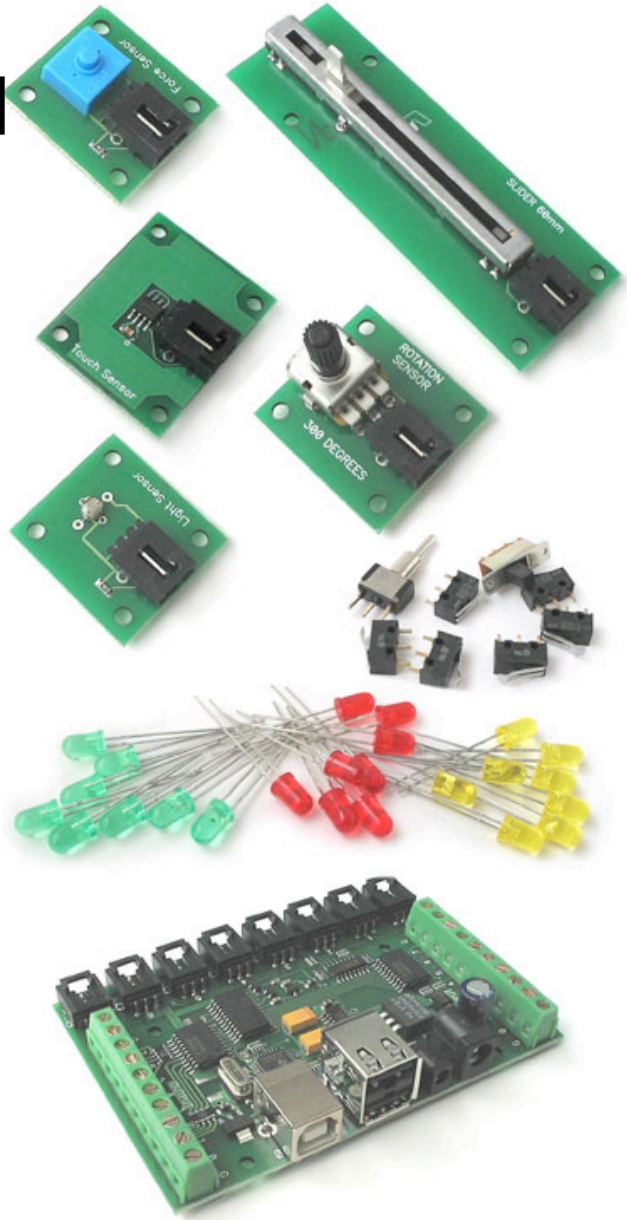




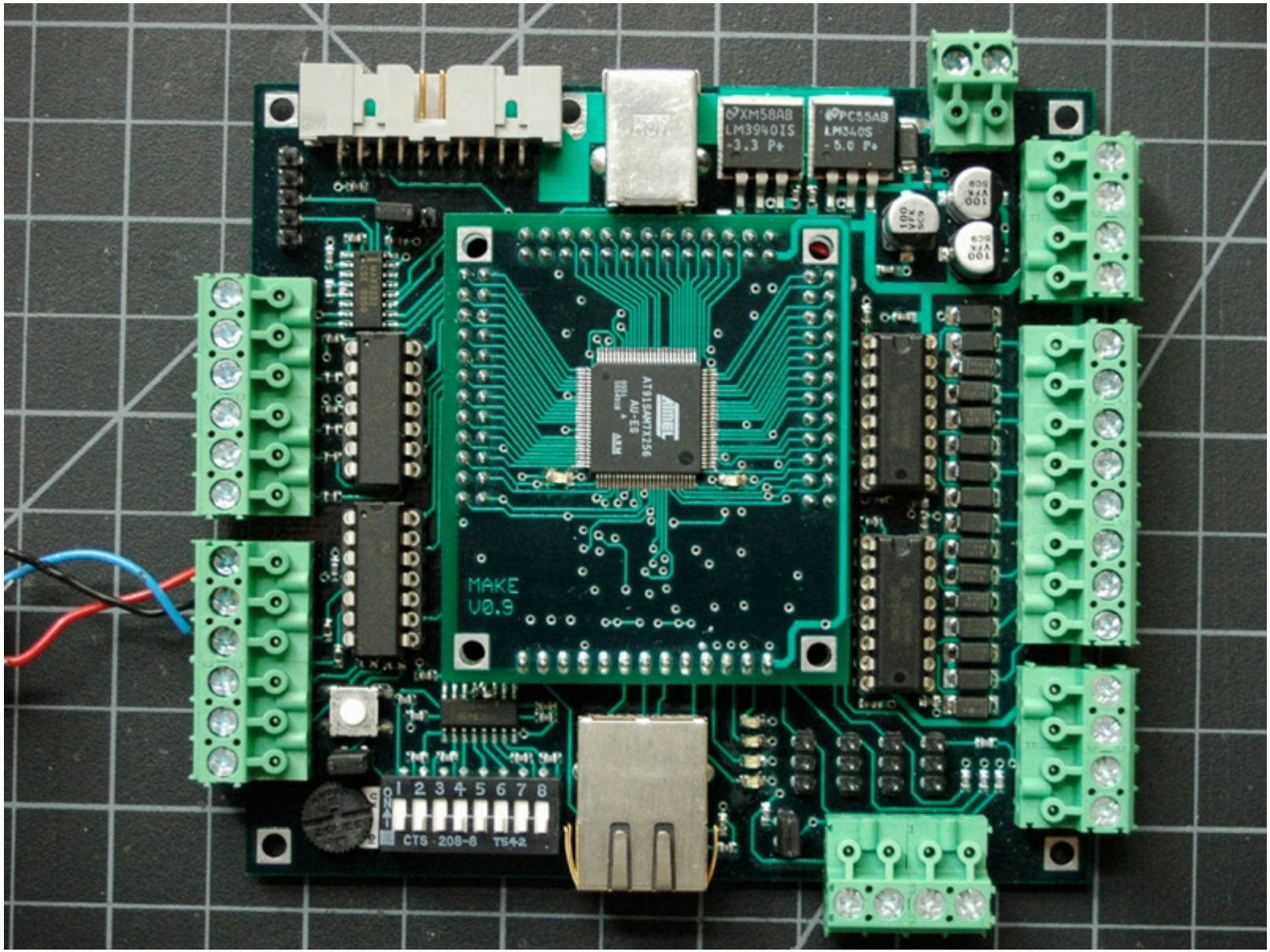
Phidgets

- Love that there's no need to program hardware
- Standalone?





Make Controller



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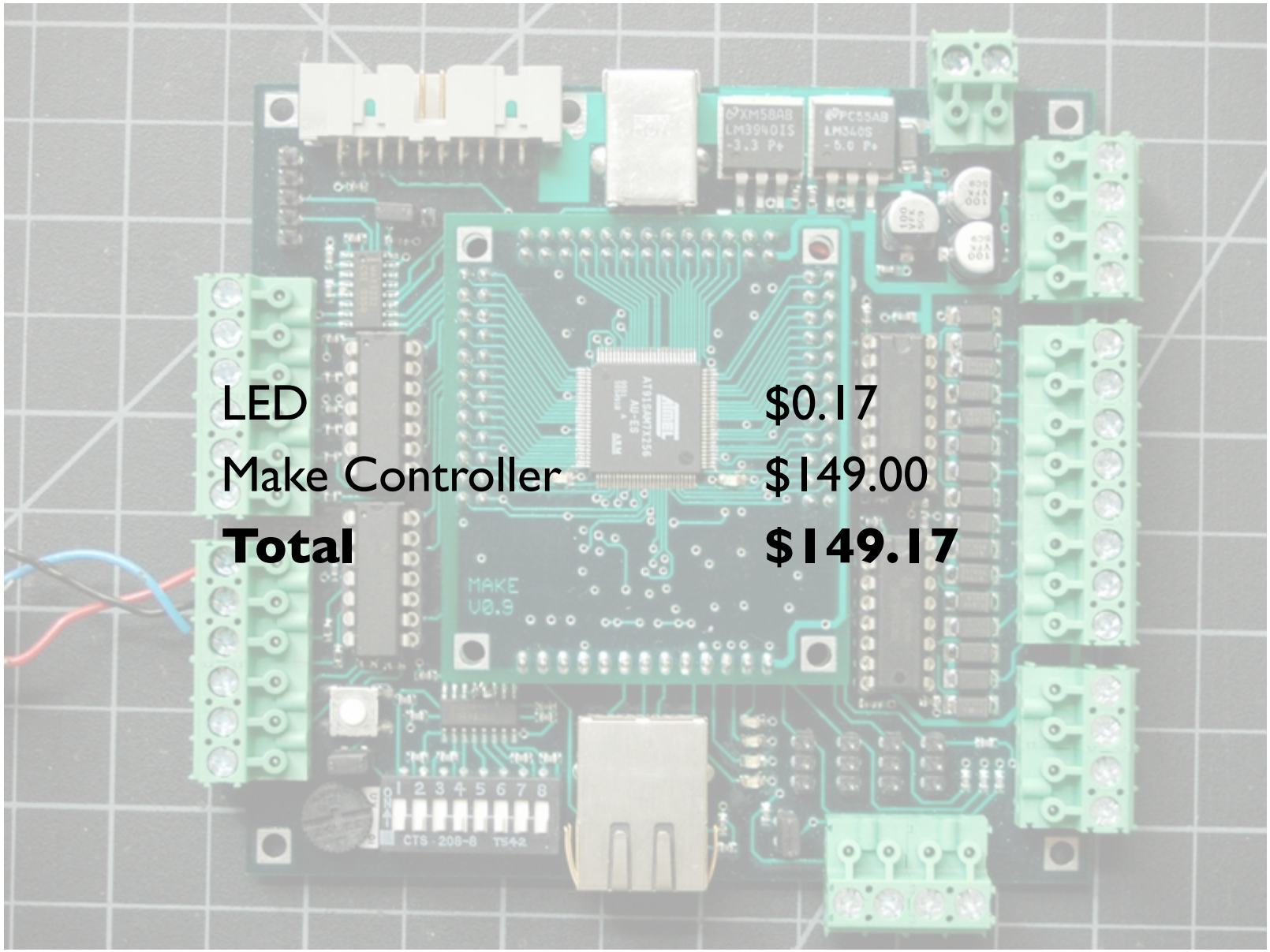

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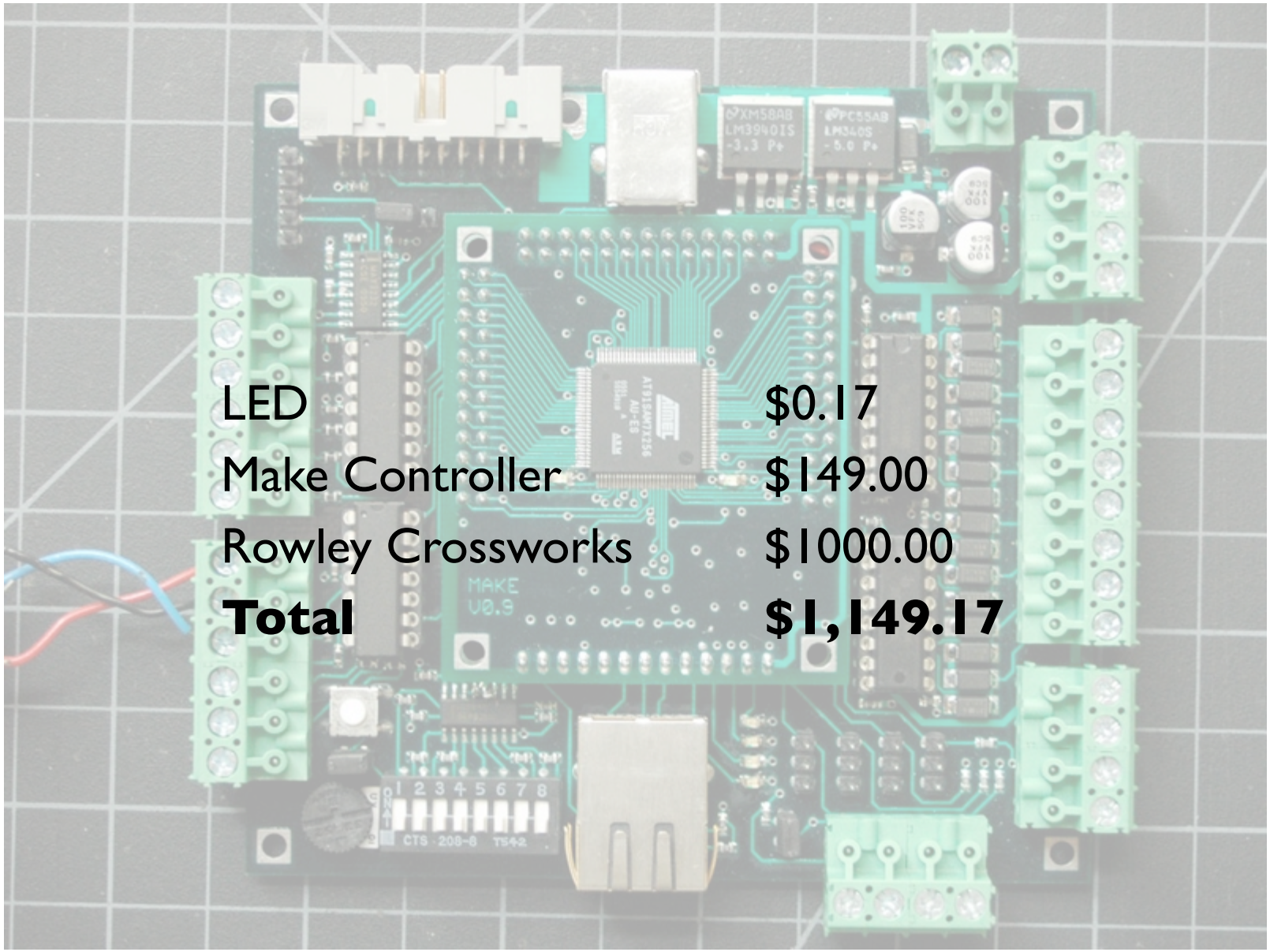
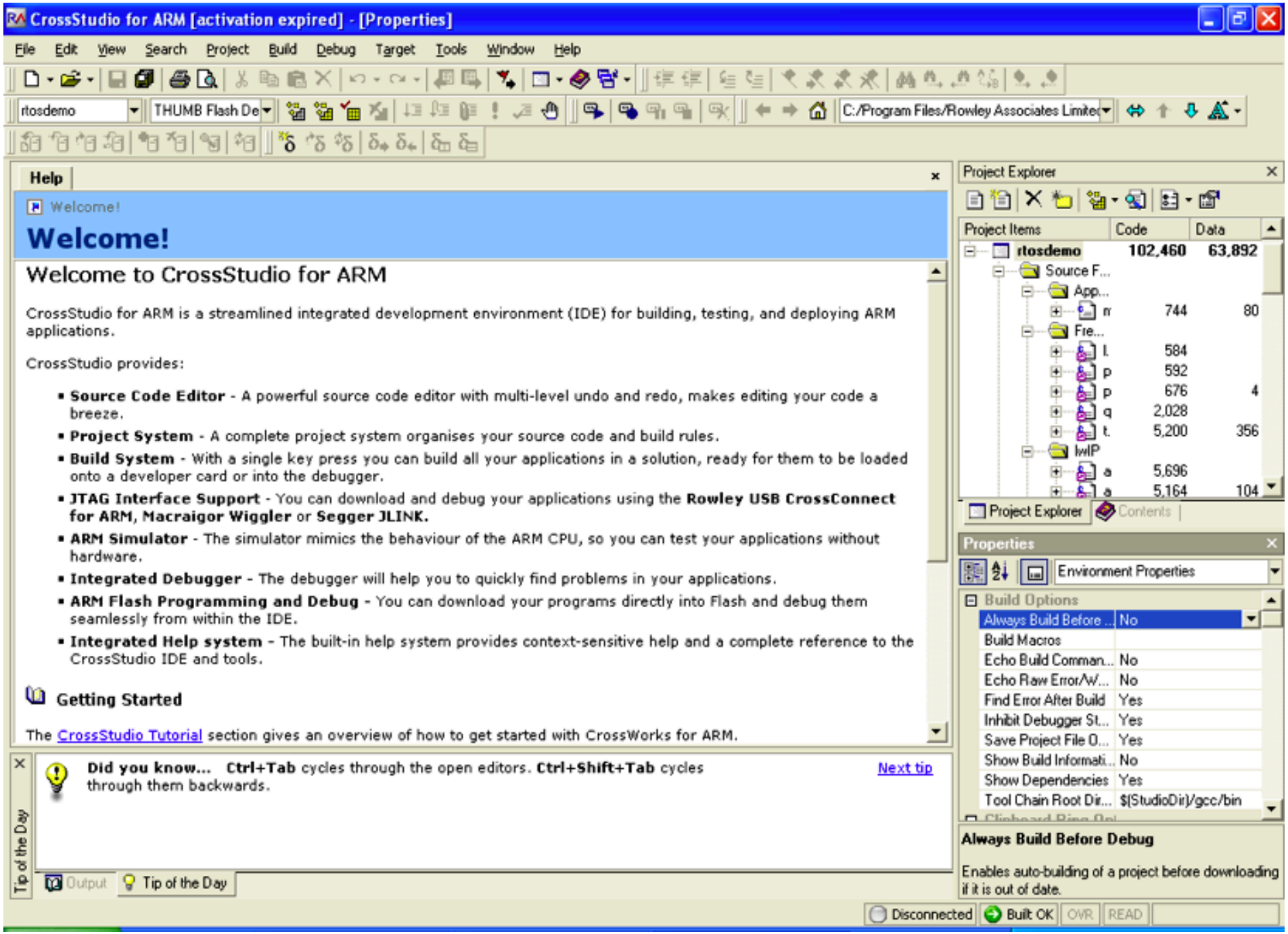
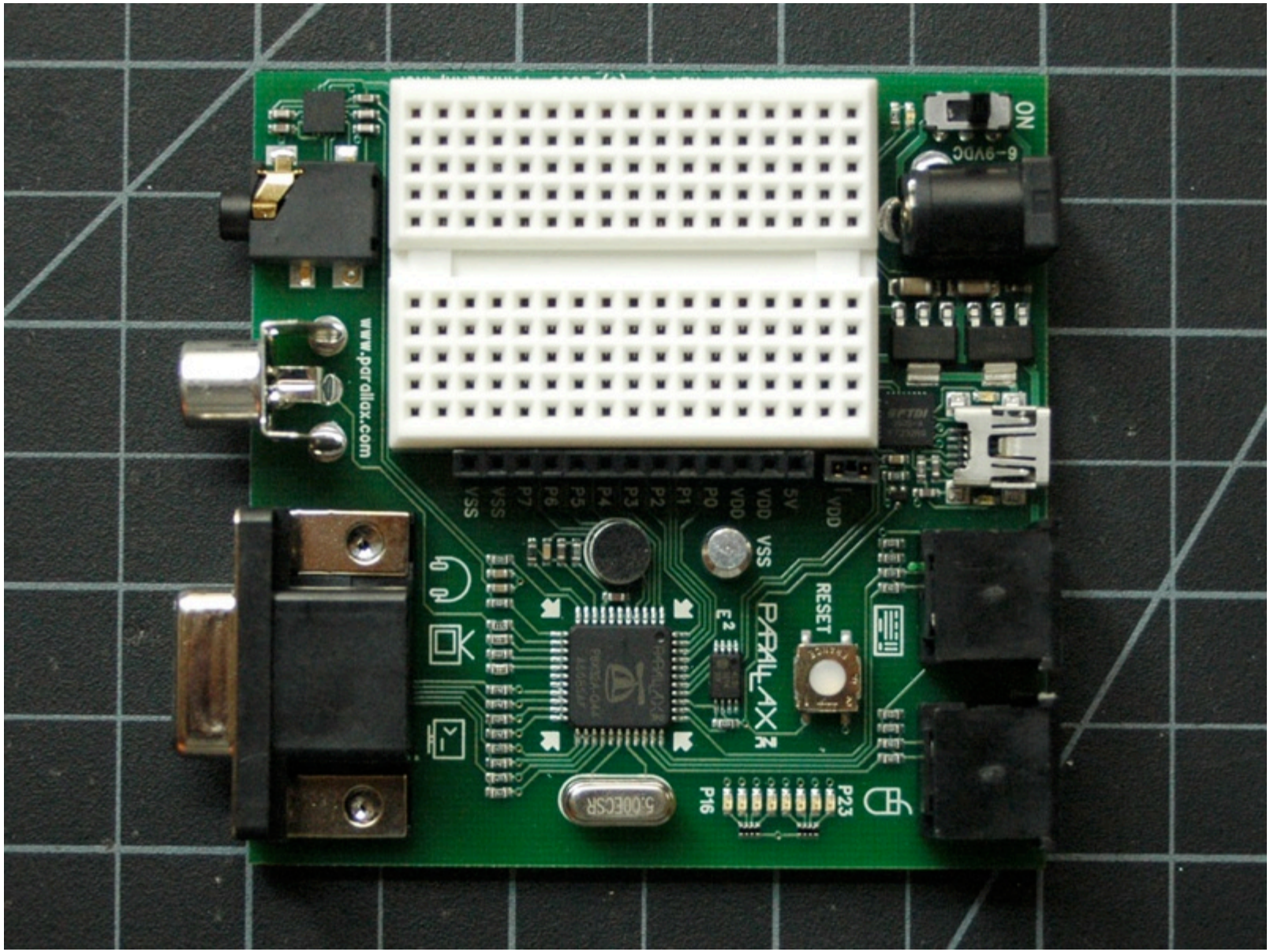


LED	$0.17
Make Controller	$149.00
Rowley Crossworks	$1000.00
Total	**$1,149.17**

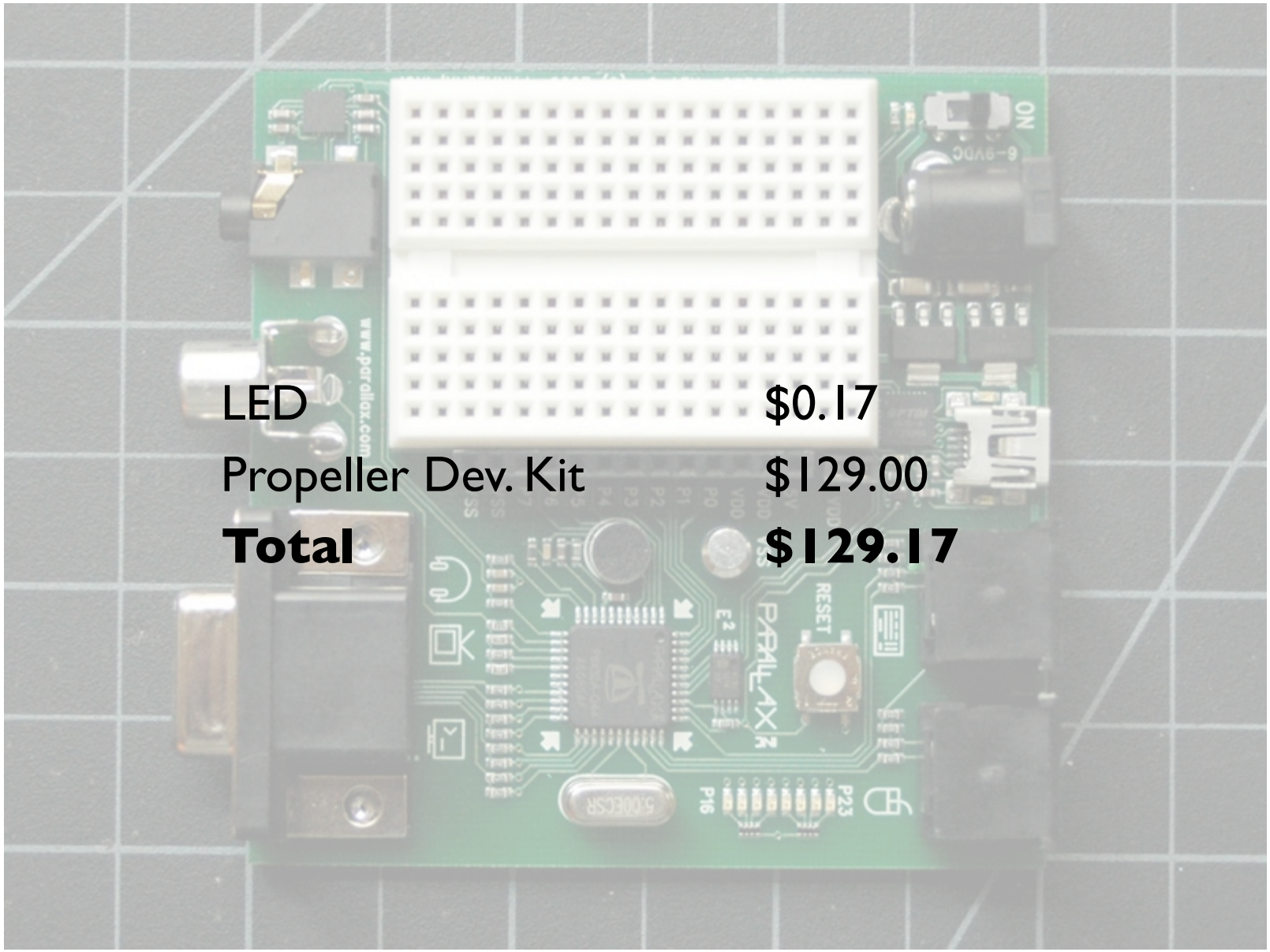
Make Controller



Parallax Propeller

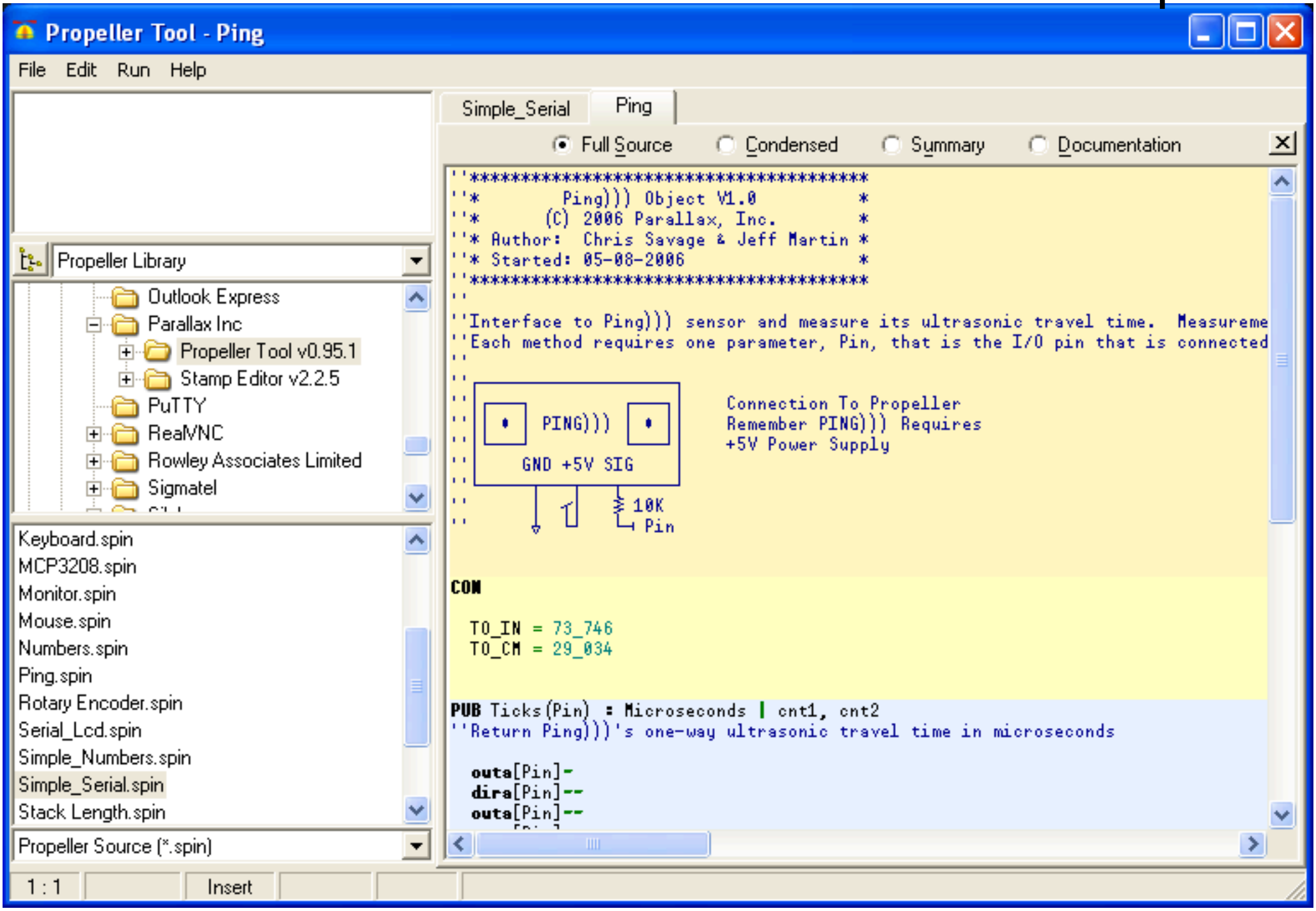


Parallax Propeller



LED	$0.17
Propeller Dev. Kit	$129.00
Total	**$129.17**

Parallax Propeller


Propeller Tool - Ping
File Edit Run Help
Simple_Serial
Ping
Full Source
Condensed
Summary
Documentation
''***
''*   Ping))) Object V1.0   *
''*   (C) 2006 Parallax, Inc.   *
''* Author: Chris Savage & Jeff Martin *
''* Started: 05-08-2006   *
''***
''
''Interface to Ping))) sensor and measure its ultrasonic travel time. Measureme
''Each method requires one parameter, Pin, that is the I/O pin that is connected
''
''
''

The Future

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http://itp.nyu.edu
http://tigoe.net/pcomp/