Low Cost Room Thermometer Using 16X2 LCD, Atmega328 Chip

This is an easy to build small size and low-cost room thermometer. The project consists of LM35 analog temperature sensor, 16x2 LCD, and an Atmega328 chip. This compact board is Arduino compatible and provided with an onboard connector for Boot-Loader burning and Arduino IDE programming. Board also has 2 additional connectors for analog input and digital I/O. Trimmer potentiometer PR1 helps you to adjust the contrast of the LCD. Example Arduino Code for the thermometer is available as a download to test the board. The example will display the temperature value in Celsius as well as Fahrenheit. The operating voltage of the circuit is 5V DC and it draws approx. 35mA of current with backlight LED ON. Scale factor/Output of LM35 is 10mV/Centigrade. This board can also be used in other Arduino applications that require a 16x2 LCD and I/O Pins.

Features
Supply 5V DC
Current Consumptions 35mA with LCD Backlite ON
Temperature Measurement Range 0 to 110 Centigrade
PCB Dimensions 41.43MM X 23.34MM

Arduino Pin configurations for Thermometer
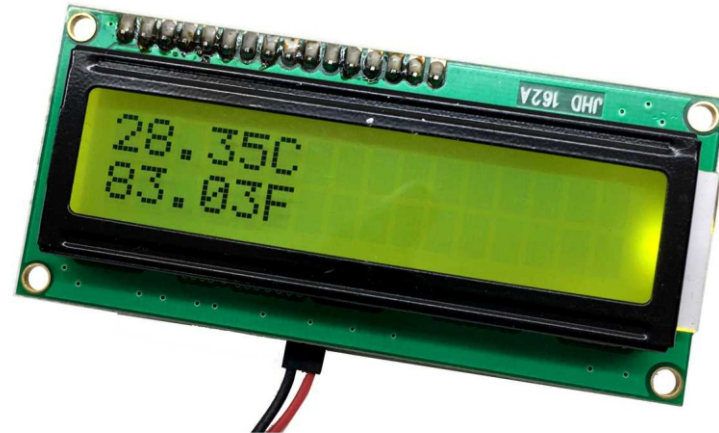LCD >>D12, D11, D5, D4, D3, D2
LM35 Temperature Sensor >> Analog Pin A1

Arduino Additional Pin Configurations
U3 >> VCC, Analog Pin A0, GND
CN2 >> VCC, GND, Analog Pin A2, Digital PWM Pin D9
CN1 >> Arduino Programming

Bootloader Burning and Arduino Programming

Once you assemble the board and use a new ATmega328 chip, you'll need to burn the bootloader onto it. You can do this using an Arduino board as an in-system program (ISP). Follow the link below for more information on programming and bootloader burning Atmega328 chip.

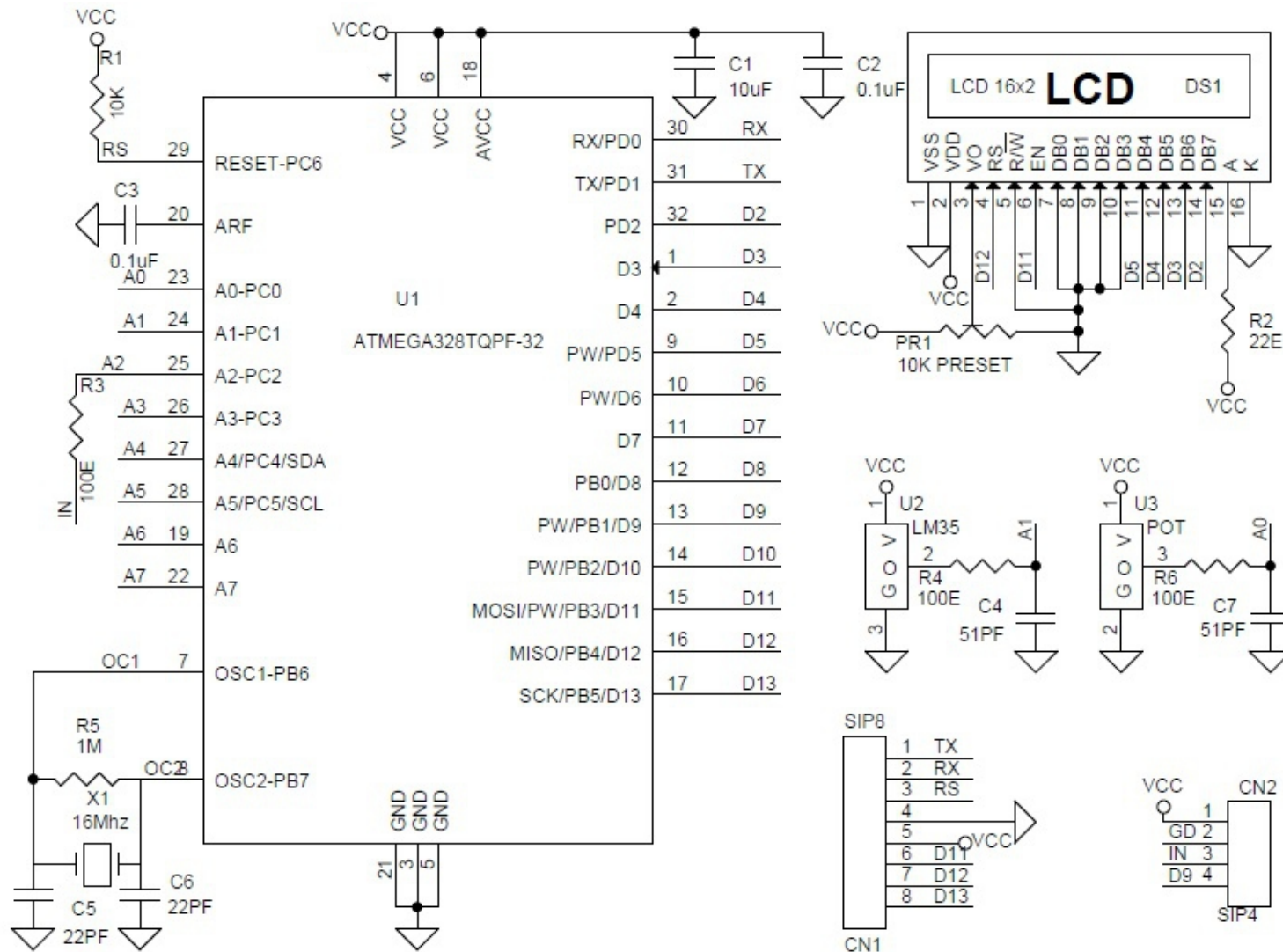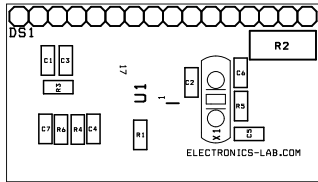https://www.arduino.cc/en/Tutorial/ArduinoToBreadboard

To burn the bootloader, follow these steps:

- Upload the ArduinoISP sketch onto your Arduino board. (You'll need to select the board and serial port from the Tools menu that correspond to your board.)
- Wire up the Arduino board and LCD microcontroller board as shown in the diagram.
- Select "Arduino UNO or Nano w/ ATmega328" from the Tools > Board menu.
- Select "Arduino as ISP" from Tools > Programmer
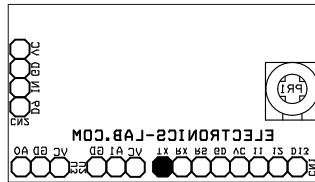- Run Tools > Burn Bootloader

You should only need to burn the bootloader once. After you've done so, you can remove the jumper wires connected to pins 10, 11, 12, and 13 of the Arduino board. This board can be program using Arduino IDE with easy connection with Arduino UNO (without Micro-Controller on it) or FTDI USB to serial module.

The **LM35** series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 μA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package.

VCC
R1
10K
RS 29

C3
20 ARF
0.1uF

A0 23 A0-PC0
A1 24 A1-PC1
A2 25 A2-PC2
R3
A3 26 A3-PC3
A4 27 A4/PC4/SDA
IN 100E
A5 28 A5/PC5/SCL
A6 19 A6
A7 22 A7

OC1 7 OSC1-PB6
R5
1M
OC2 8 OSC2-PB7
X1
16Mhz
C5 C6
22PF 22PF

RESET-PC6

U1
ATMEGA328TQPF-32

VCC VCC AVCC
4 6 18

RX/PD0 30 RX
TX/PD1 31 TX
PD2 32 D2
D3 1 D3
D4 2 D4
PW/PD5 9 D5
PW/D6 10 D6
D7 11 D7
PB0/D8 12 D8
PW/PB1/D9 13 D9
PW/PB2/D10 14 D10
MOSI/PW/PB3/D11 15 D11
MISO/PB4/D12 16 D12
SCK/PB5/D13 17 D13

GND GND GND
21 3 5

VCC
C1 C2
10uF 0.1uF

LCD 16x2 LCD DS1

VSS VDD VO RS R/W EN DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 A K
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

VCC D12 D11 D5 D4 D3 D2

VCC
PR1
10K PRESET
R2
22E
VCC

VCC
U2
LM35
V G O
R4 A1
100E C4
51PF

VCC
U3
POT
V G O
R6 A0
100E C7
51PF

SIP8
1 TX
2 RX
3 RS
4
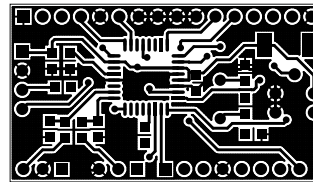5 VCC
6 D11
7 D12
8 D13
CN1

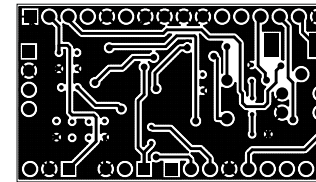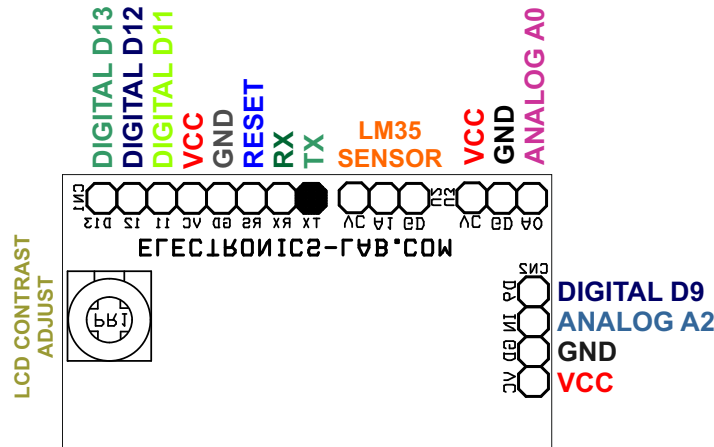VCC CN2
1
GD 2
IN 3
D9 4
SIP4

07005

SILK SCREEN TOP

SILK SCREEN BOTTOM

TOP LAYER

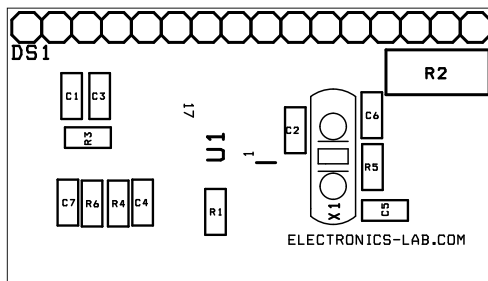BOTTOM LAYER

PCB DIMENSIONS 41.43MM X 23.34MM

DIGITAL D13
DIGITAL D12
DIGITAL D11
VCC
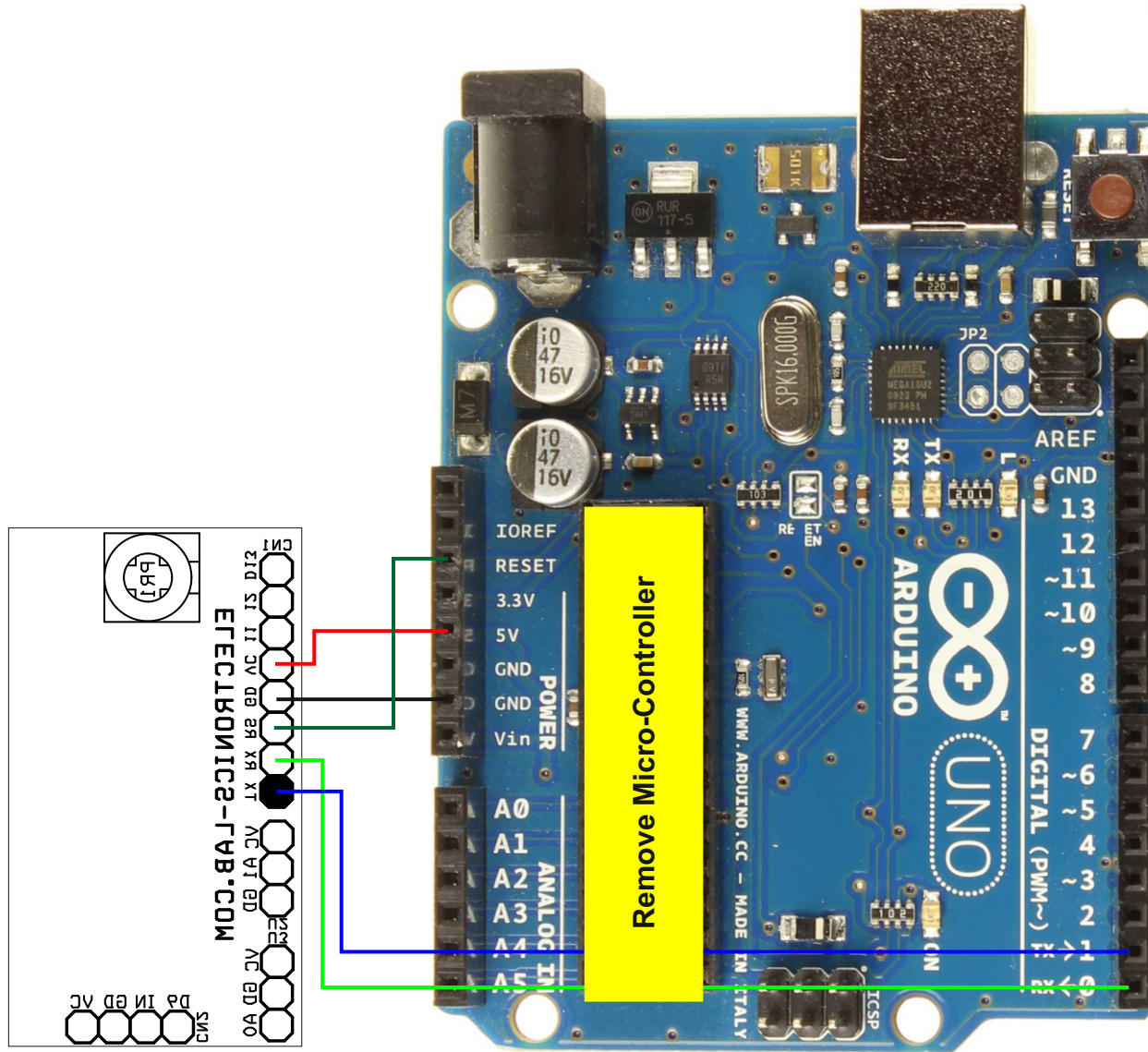GND
RESET
RX
TX
LM35 SENSOR
VCC
GND
ANALOG A0

LCD CONTRAST ADJUST

DIGITAL D9
ANALOG A2
GND
VCC

LCD 16X2

BOM			
SR.	QNTY.	REF.	DESC.
1	1	CN1	8 PIN MALE HEADER 2.54 MM
2	1	CN2	DNP
3	1	C1	10uF/10V SMD 0805
4	2	C2,C3	0.1uF/50V SMD 0805
5	2	C4,C7	51PF SMD 0805 OPTIONAL
6	2	C5,C6	22PF SMD 0805
7	1	DS1	LCD 16x2
8	1	PR1	10K PRESET
9	1	R1	10K 5% SMD 0805
10	1	R2	22E SMD 2510
11	3	R3,R4,R6	100E SMD 0805
12	1	R5	1M
13	1	U1	ATMEGA328TQPF-32
14	1	U2	LM35 TO92
15	1	U3	DNP
16	1	X1	16Mhz

www.electronics-lab.com   Author Rajkumar Sharma

07005
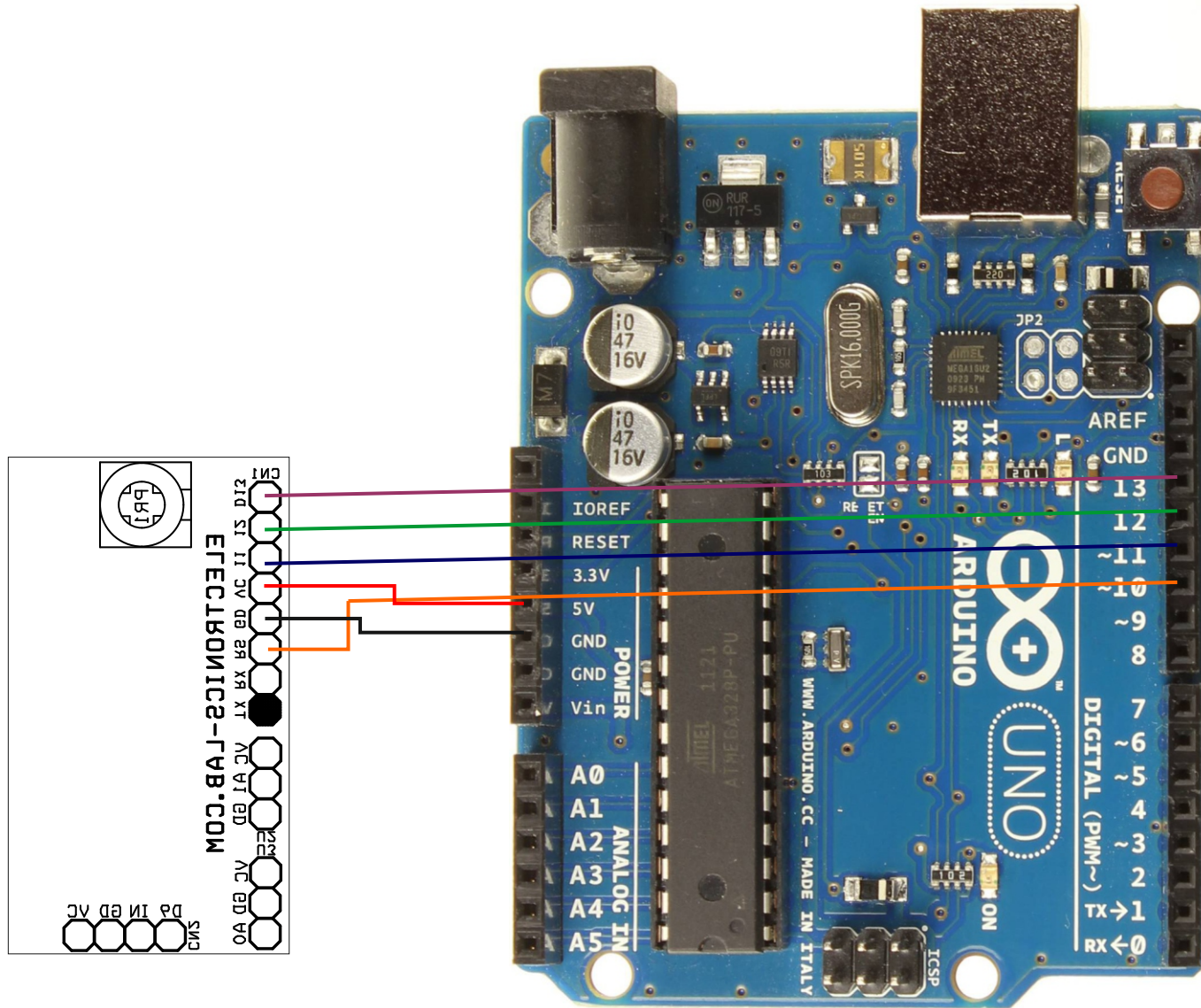
Burning the Bootloader Connections

Arduino Programing Connections