By Michael Simpson

Barometric Pressure Plotter
as seen in
July 2007 of Nuts & Volts Magazine

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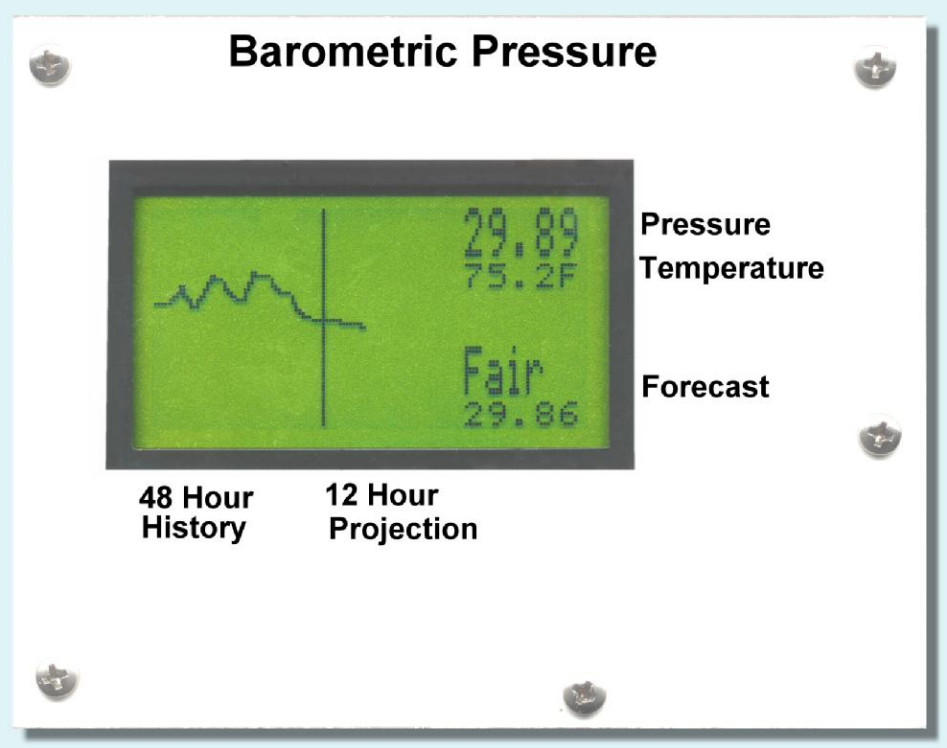


The graphical plotting display will keep track of nearly 20 days of hourly readings and give you a 12 hour weather prediction.

The heart of the pressure plotter is the SCP1000 pressure sensor. The SCP1000 is an absolute pressure sensor that requires no calibration and will give up to 9 readings a second. The sensor is the most accurate and stable pressure sensor I have ever used. The resolution is so fine that it can register a change in pressure when the sensor has been raised a foot or so off the table.

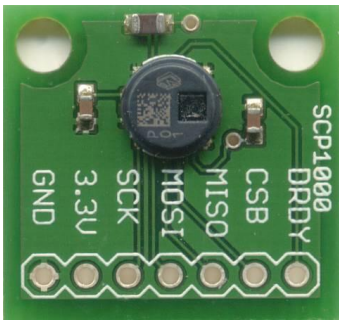


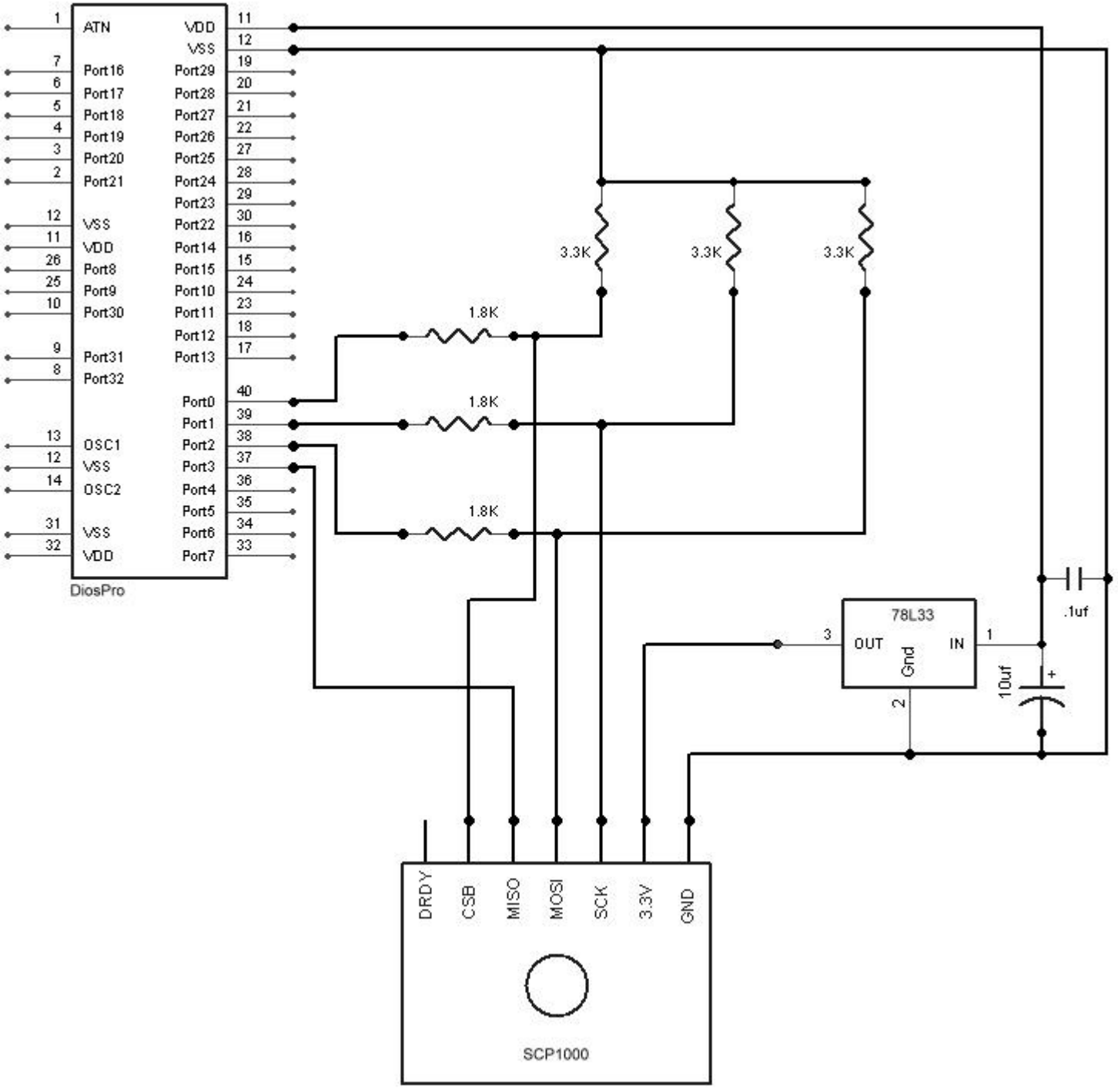
Figure 1

Normally the SCP1000 would be difficult for the hobbyist to work with due to its small size and

Kronos Robotics and Electronics
www.KronosRobotics.com

form factor, but a company called Sparkfun Electronics has provided a special breakout board shown in Figure 1. It has the sensor installed and a .1" header pad. The SCP1000 sensor itself comes in both SPI and I2c versions, but I found the SPI the easiest to interface. This is the sensor used on the Sparkfun breakout board.

The SCP1000 is a 3v device and needs a voltage of 2.4 to 3.3 volts to operate. This also means the interface leads cannot exceed the supply voltage. We will be using a 5v system so we will need to create a 5v interface for the sensor shown in Schematic 1.



Schematic 1

To wire this interface, you have a couple of options. First, you can use some sort of proto board like the Schmart Board shown in Figure 2.

To make things even easier Kronos Robotics has a 3.3v to 5v interface kit. The kit has an application note that gives you step-by-step instructions on how to build the small interface board shown in Figure 3. To use the board you attach one of the included header to the SCP1000 breakout board and plug it into the interface board. You will find the application note here: http://www.kronosrobotics.com/Projects/SCP1000.shtml

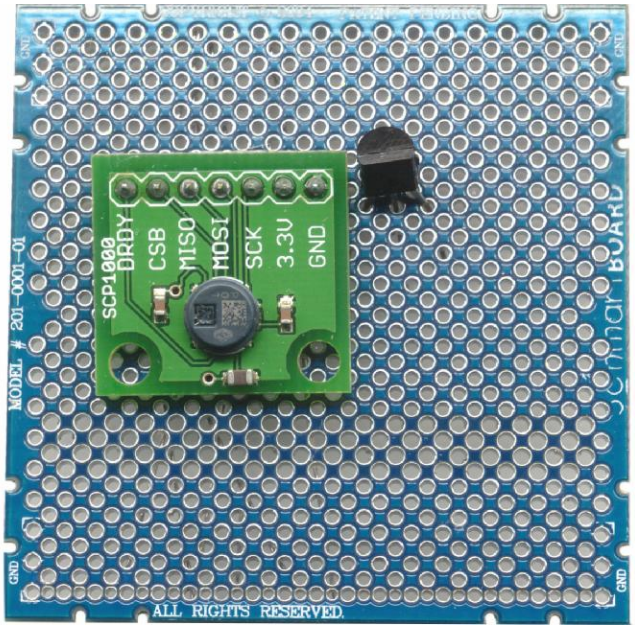


Figure 2

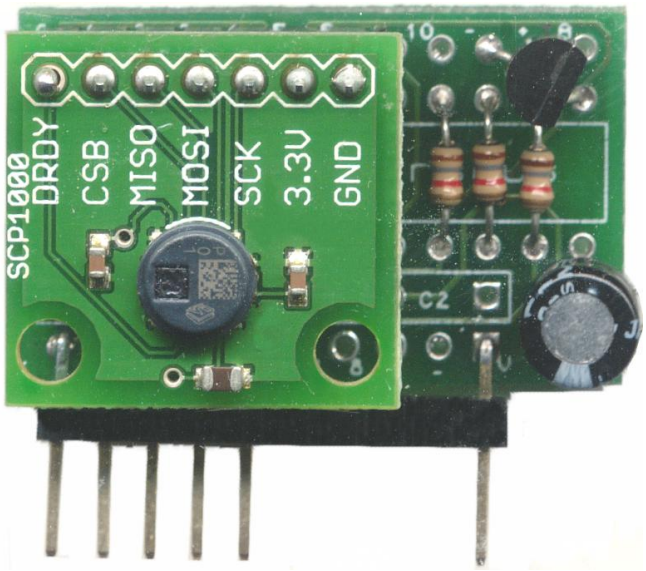


Figure 3

To plot and display the barometric pressure we will be using another Sparkfun product. Sparkfun sells a graphic LCD display for under $20. This is a 128x64 (B&W) display with backlight shown in Figure 5. Note that I added the 20-pin header.

The LCD uses a parallel interface and is connected to the DiosPro microcontroller as shown in Schematic 2. While this may seem a bit complicated, to make things real simple, Kronos Robotics has a carrier board called the "Dios Universal LCD Carrier" shown in Figure 6. We will be using this carrier with a DiosPro to collect and store data from the SCP1000 sensor. This data will be analyzed and then plotted on the graphic LCD.

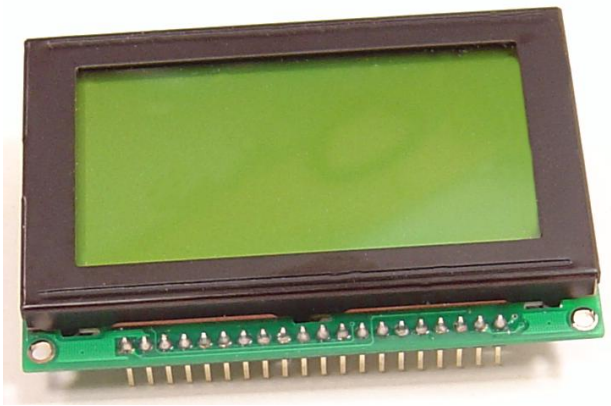


Figure 5

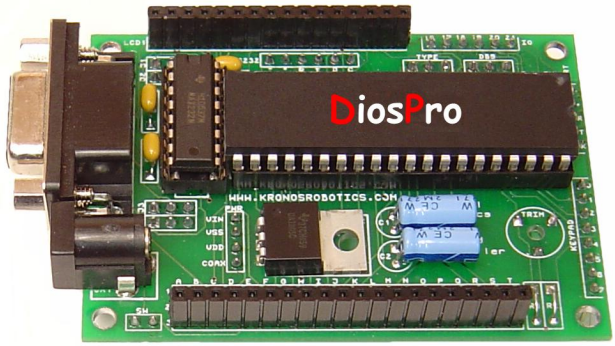
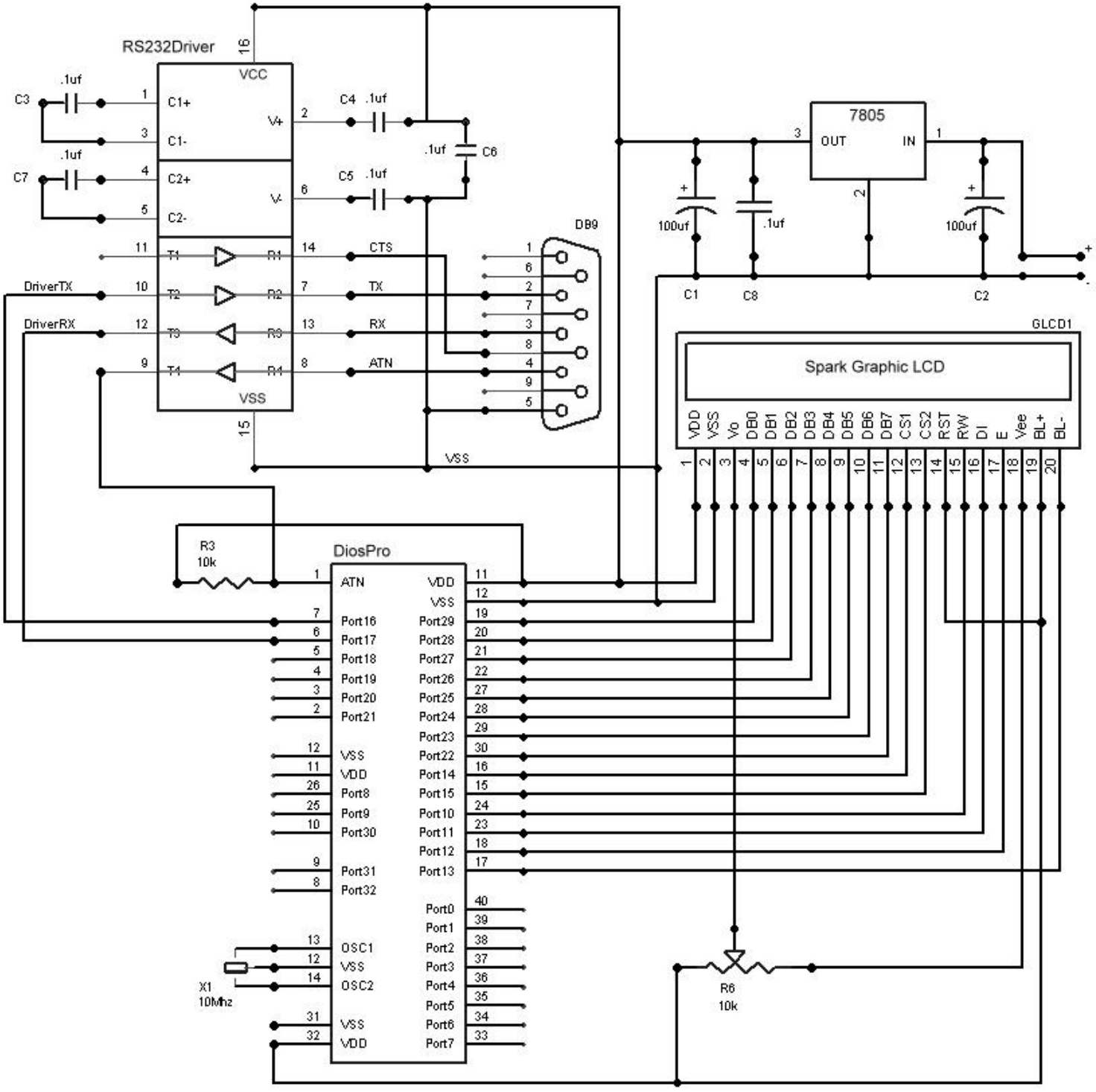


Figure 6


RS232Driver
VCC
C1+
C1-
C2+
C2-
V+
V-
T1
T2
T3
T4
R1
R2
R3
R4
VSS
C3 .1uf
C7 .1uf
C4 .1uf
C5 .1uf
C6 .1uf
DB9
CTS
TX
RX
ATN
DriverTX
DriverRX
7805
OUT
IN
100uf
.1uf
C1
C8
C2
GLCD1
Spark Graphic LCD
VDD VSS Vo DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 CS1 CS2 RST RW DI E Vee BL+ BL-
R3 10k
DiosPro
ATN
Port16
Port17
Port18
Port19
Port20
Port21
Port31
Port32
OSC1
OSC2
Port29
Port28
Port27
Port26
Port25
Port24
Port23
Port22
Port14
Port15
Port10
Port11
Port12
Port13
Port0
Port1
Port2
Port3
Port4
Port5
Port6
Port7
X1 10Mhz
R6 10k

Schematic 2

Construction

If you use the Universal Carrier and the SCP1000 interface shown then the display assembly is quite simple to build.

Step 1
I assembled the Dios Universal LCD carrier. I placed the IO, Keypad, UART and SW headers on the top of the board and bent them slightly so they would not interfere with the LCD when installed.

Step 2
I assembled the interface board for the SCP1000 using the application note found here:
http://www.kronosrobotics.com/Projects/SCP1000.shtml

I installed the 7-Pin header on the top of the board and bent the pins as shown in Figure 7.

Step 3
I cut two pieces of compressed PVC to 4.5" x 3.5" to be used as the base and top. You can use acrylic or just about any material. Acrylic can be purchased at most home centers. The nice thing about using acrylic is that you don't need to cut a hole for the display since it's transparent.

Keep in mind that the dimensions are given just as a guide. You may want to use a different size if your layout is different.

Step 4
I attached the Universal LCD Carrier to the lower base as shown in Figure 7. Make sure you leave some room for standoffs.

Step 5
I attached the SCP1000 and interface to the base as shown using some double stick foam tape.

Step 6
I marked and drilled holes for the 5, 1" standoffs shown. Before installing the standoffs I placed the base over the top piece and marked the holes so I could duplicate them for the **standoffs.**

Step 7
Using 5 jumpers, I connected the sensor interface to the Universal LCD Carrier. I prefer using the Schmartboard jumpers. In this case I used the Blue 2" and Red 3" jumpers.

Step 8
I attached the LCD to the Universal Carrier then attached the top cover to the standoffs. If you are not using transparent material you will have to add a cutout for the display. To mark this, I attached the cover, then with a fine point marker I marked the position of the display on the underside of the board.

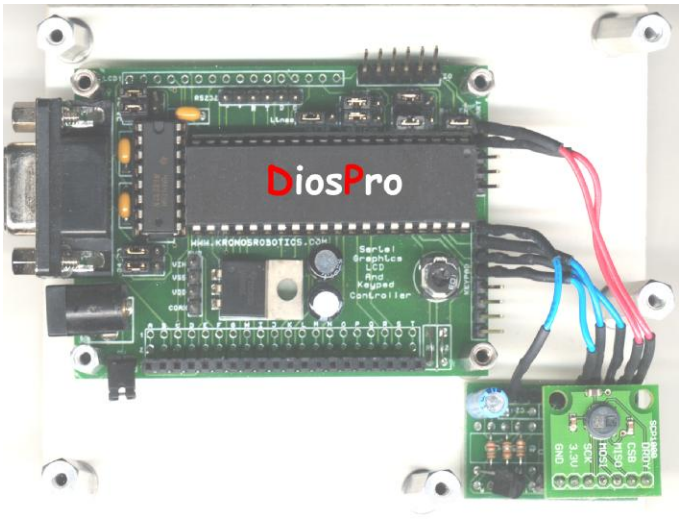


Figure 7

Testing the Display

To program the DiosPro you need to install the free compiler and connect the Universal Carrier to your PC with a 9-Pin serial cable and plug an DC power source into the 2.1 coax. Refer to the carrier instruction manual for more details.

To test the interface to the SPC1000, load and run Program 1. This will display the pressure reading in Pascal units on debug terminal.

```
'SCP1000-D01 Test
func main()
  dim pressure as float
  SCPinitD01(0,1,2,3)
  SCPsetmodeHR()

loop:
  pressure = SCPreadpressure()
  print {7.0} pressure
  goto loop

endfunc

include \lib\SCP1000.lib
```

Program 1

I have also included a second program called Program2.txt that will display the temperature.

The program called bargraph1.txt is the main plotting program. While the program is a bit lengthy to present here I will describe a few of the details that you may want to change in the program.

Station Pressure
At the very beginning of the program is a statement where I assign a constant called offset. This is a value that will allow you to change the absolute pressure value to the station pressure. This value is added to the absolute value. You should change this value so that your pressure gauge reads the same as your local forecast.

Default EEProm
The first portion of the plot is the last 48 hour history. This data is saved into the first 96 eeprom locations. When you program the DiosPro, the data statements at the beginning of the program to initialize these locations. You can comment these statements out if you want to experiment with your exiting data so that they won't get cleared.

Data Dump
Once you have programmed the DiosPro and have verified that it is working properly, you can configure the program port to connect to the onboard hardware UART by setting the DB9 jumpers. The small bit of code following the loop label tests for a character value of 65 at each pass. If this value is received, the complete 20 day history will be sent out the UART at 9600 baud. The data is dumped with the low order byte first, then the high order byte. Each byte pair represents one hour of data with a total 460 hours. The first pair is the current hour index at the time of the dump.

The Display
The display has a vertical line near the center of the display shown in Figure 8. The plot to the left of this line represents the last 50 hours of pressure readings. The plot to the right of this line is a 12 hour projection. On the upper right hand side of the display is the current barometric pressure and inside temperature. On the lower right hand side is the 12 hour forecast and pressure.

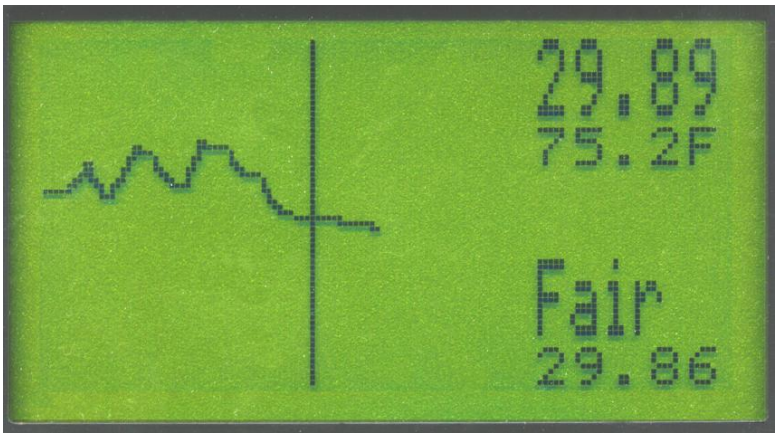


Figure 8

How Well Does it Work?

I have been using this pressure sensor for the last couple months and it works pretty well. It has accurately predicted the weather for most changes in my area. For instance, while I was writing up this article today the display indicated that a change in the weather was going to occur in the next 12 hours. My grass was getting tall and if it were to rain I would have to wait another week to cut it, so I stopped everything and took out my mower. Sure enough about 13 hours later it started to rain.

I prefer the SCP1000 pressure sensor over the 1wire sensors that I have used, as it seems to give a more reliable reading and does not require 14v to operate.

Going Further

All that is needed to make this display wireless is to add a Zigbee unit. I will look into doing just that when I build the wireless station next month.

I had experimented with the SCP1000 for use in other projects like my RC helicopter and found that in order to get the high resolution needed you need to read the SCP1000 about once every 1.8 seconds. This is too long for this type application; however I have read where others have taken two SCP1000's and alternated the readings in order to double the sample rate. This also gives you some redundancy in case of a failure.

Kronos Robotics

DiosPro 40 Chip
http://www.kronosrobotics.com/xcart/customer/product.php?productid=16428

Dios Universal LCD Carrier
http://www.kronosrobotics.com/xcart/customer/product.php?productid=16410

3.3v to 5v Interface Kit
http://www.kronosrobotics.com/xcart/customer/product.php?productid=16537

SparkFun

SCP1000
http://www.sparkfun.com/commerce/product_info.php?products_id=8161

Graphic LCD
http://www.sparkfun.com/commerce/product_info.php?products_id=710

SchmartBoard

Proto Board
http://www.schmartboard.com/index.asp?a=11&id=24