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

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This system will actually speak the current barometric pressure and inside temperature when you push a button.

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.

Normally the SCP1000 would be difficult for the hobbyist to work with due to its small size and form factor, but a company called Sparkfun Electronics has provided a special breakout board

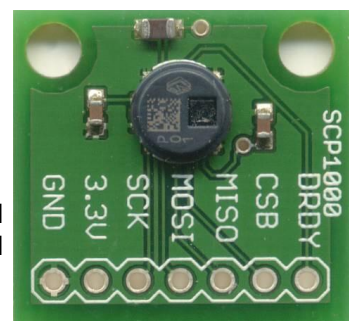
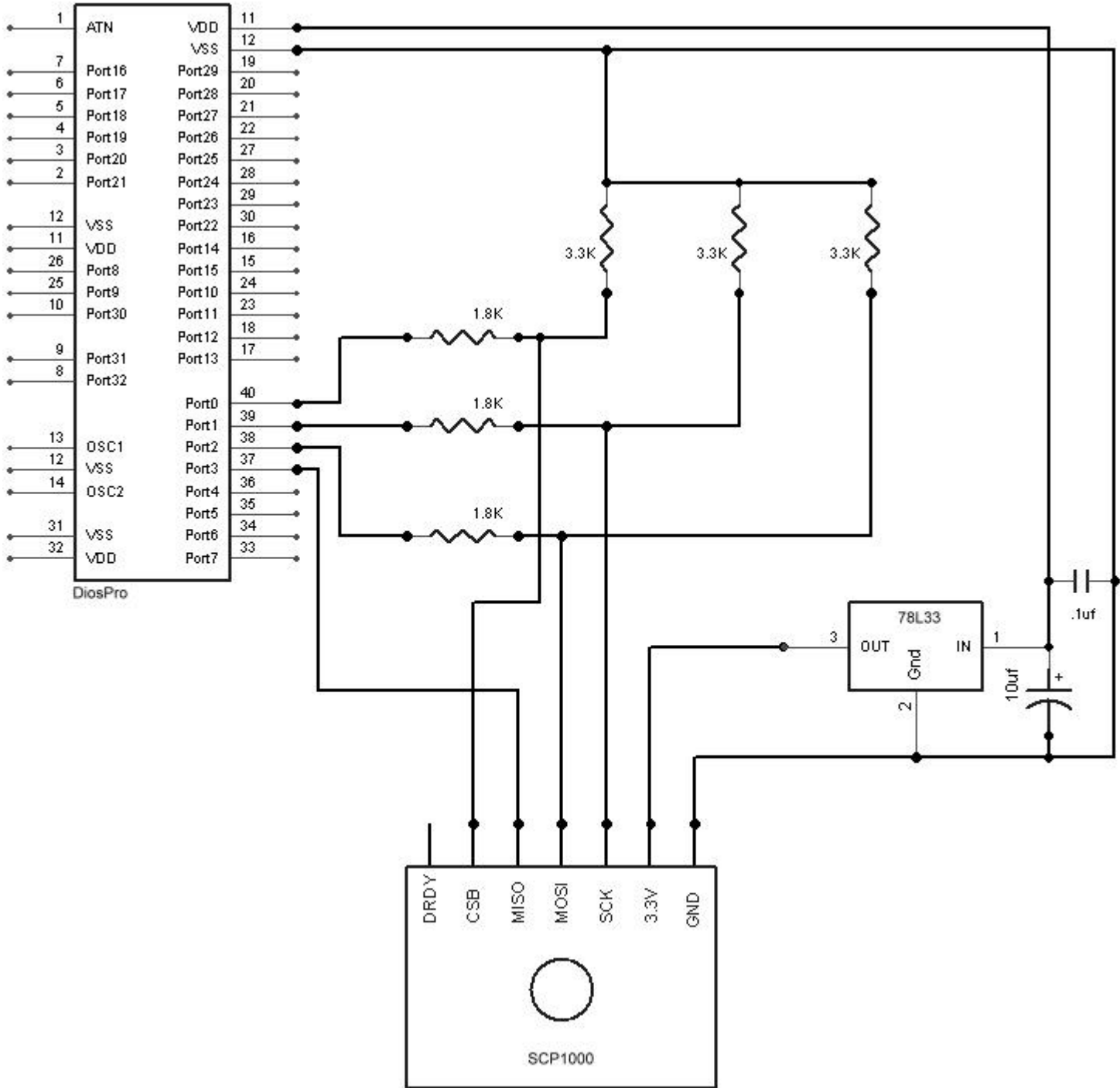


Figure 1

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>

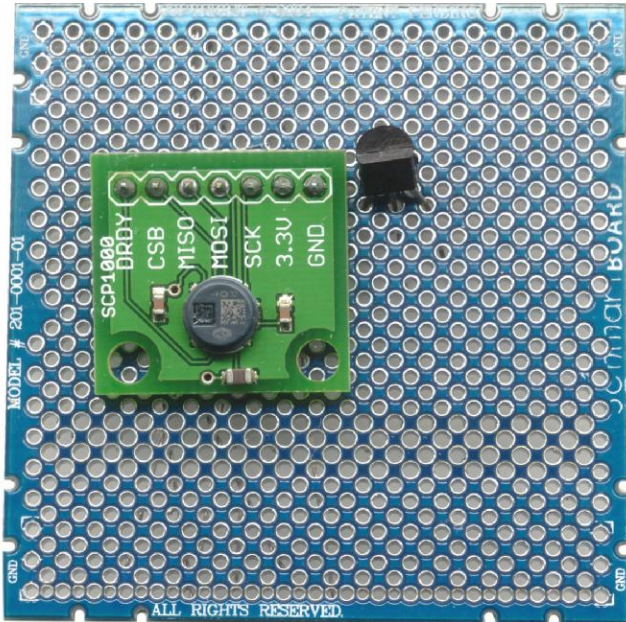


Figure 2

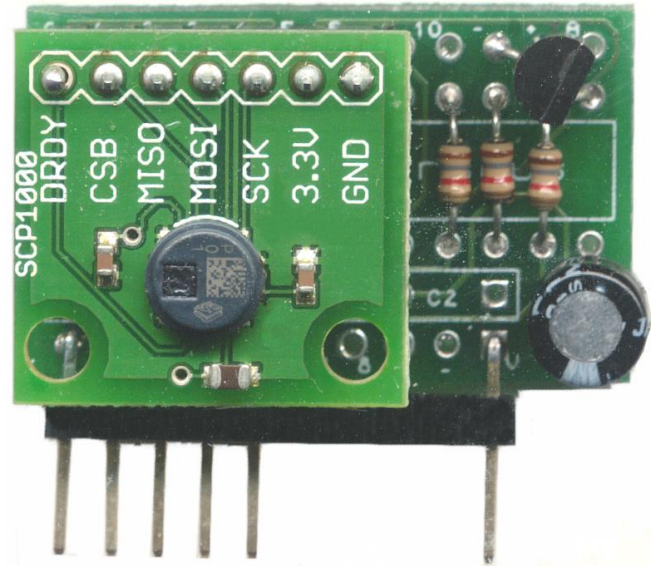


Figure 3

I wanted to keep things as simple as possible, so we will take the modular approach on this project. I will take various boards that are readily available, both assembled and in kit form, and create a talking barometer shown in Figure 4.



Figure 4

Pressure Talker Construction

If you can solder then you can build this project. Even if you can't, you can probably get someone to assemble the various modules. Let's take a look at each one in detail so you can get an idea on how the project is put together.

Sound Module

I will use the SoundGin sound chip from Savage Innovations to create speech. The SoundGin chip is capable of creating music, sound effects, and a set of phonetic variations called Allophones. The chip itself requires a filter and amplifier so you need a development board. Savage Innovations makes such a board and it includes everything you need to create speech and other sound effects. You will need to add a 2-pin header to the pads shown in Figure 5. Unfortunately, the pads are all filled with solder so you will have to remove it in order to install the header. Refer to the small inset as it shows pin placement on the board.

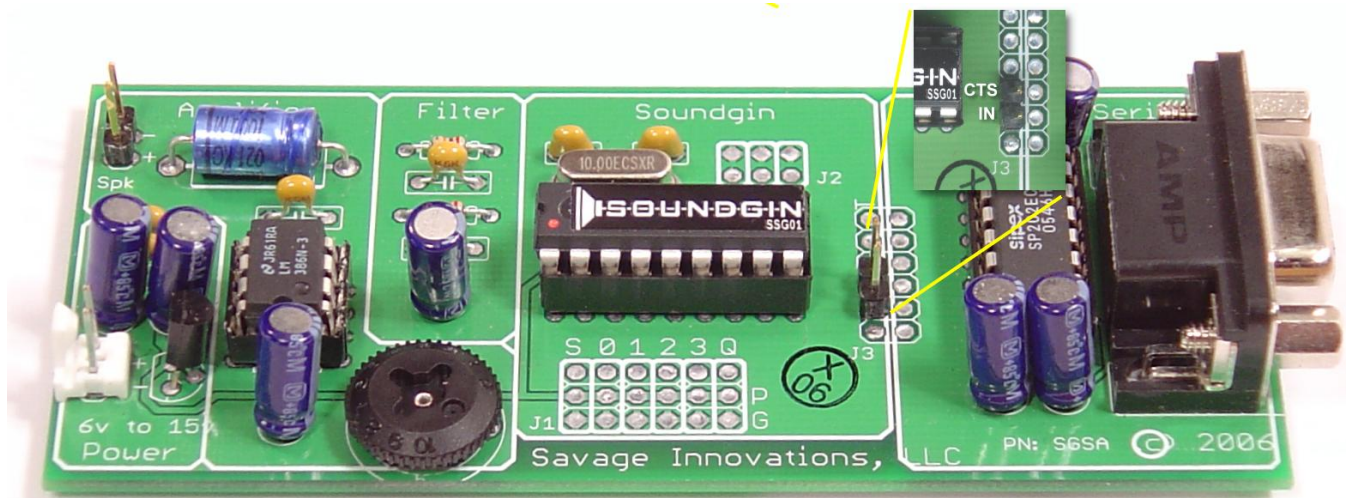


Figure 5

Regulator Module

The module shown in Figure 6 is a simple and inexpensive 5v regulator that can be purchased in kit form, or assembled, from Kronos Robotics. The board also has a header to give you access to the VIN power directly from the Coax. We need this to power the Sound Module. The Voltage regulator requires the use of an AC adapter with an output of 6.5 to 14 VDC. This is applied to the 2.1 coax connector, center positive. You can purchase one of these from RadioShack. I have also provided a Jameco part number in the parts list.

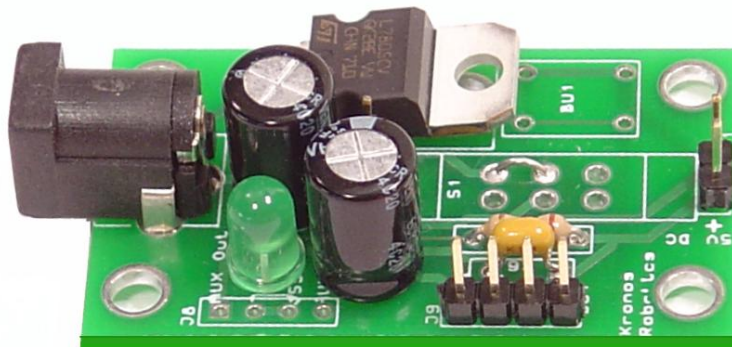


Figure 6

When you assemble this board, you have the option to install the 2-pin headers on the bottom of the board for use with a breadboard. For our application, install them on the top of the board so that we can use wire jumpers to connect to the other modules.

Dios Carrier 1 Module

The Dios Carrier 1 module shown in Figure 7 is a small carrier that accepts the DiosPro 28-pin chip. It is also available in both kit and assembled form from Kronos Robotics.

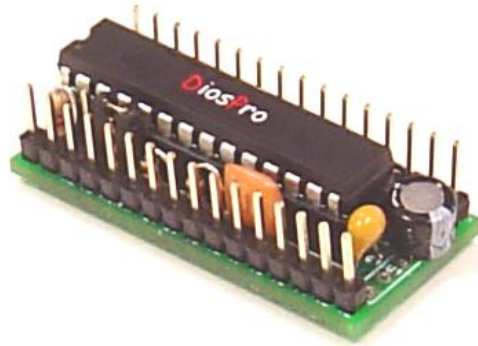


Figure 7

The 12-pin headers needs to be installed on the top of the board as shown in Figure 12 so that we can use wire jumpers. This board does not include the PC interface needed to program the chip like the Universal LCD carrier does, so we need to use an EZRS232 module.

EZRS232 Module

In order to program a DiosPro used in a Carrier 1 you need an EZRS232 module shown in Figure 8. Again, this is a very inexpensive module available from Kronos Robotics in both kit and assembled form.

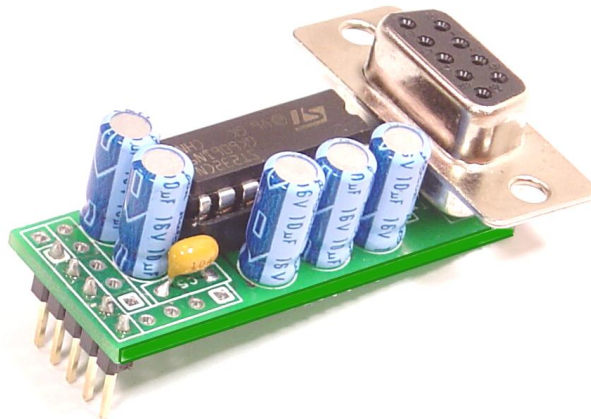


Figure 8

To plug the EZRS232 driver directly into the Carrier 1 board. You need to create a small 5-pin female-to-female header. This can be done by soldering two 5-pin headers together as shown in Figure 9. You can also use 5 jumper wires to connect the EZRS232 driver to the carrier. The EZRS232 driver gets its power from the carrier board.

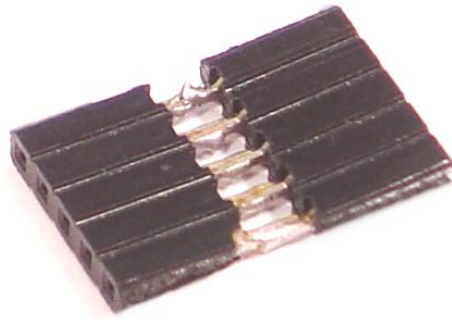


Figure 9

SCP1000 Interface Module

I have already gone over the SCP1000 interface module available from Kronos Robotics shown in Figure 3. This module will allow you to plug the Sparkfun SCP1000 directly into our 5v system.

Project Assembly

All the modules are connected together using schmartboard jumpers shown in Figure 10. The complete schematic is shown in Schematic 2.

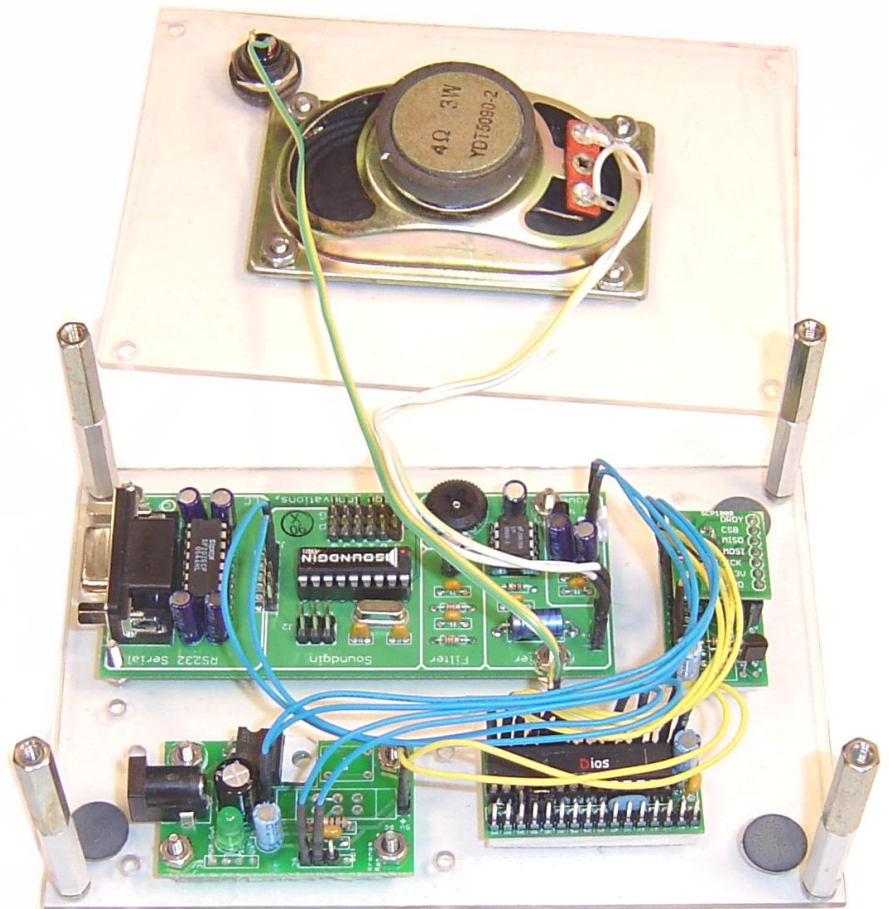
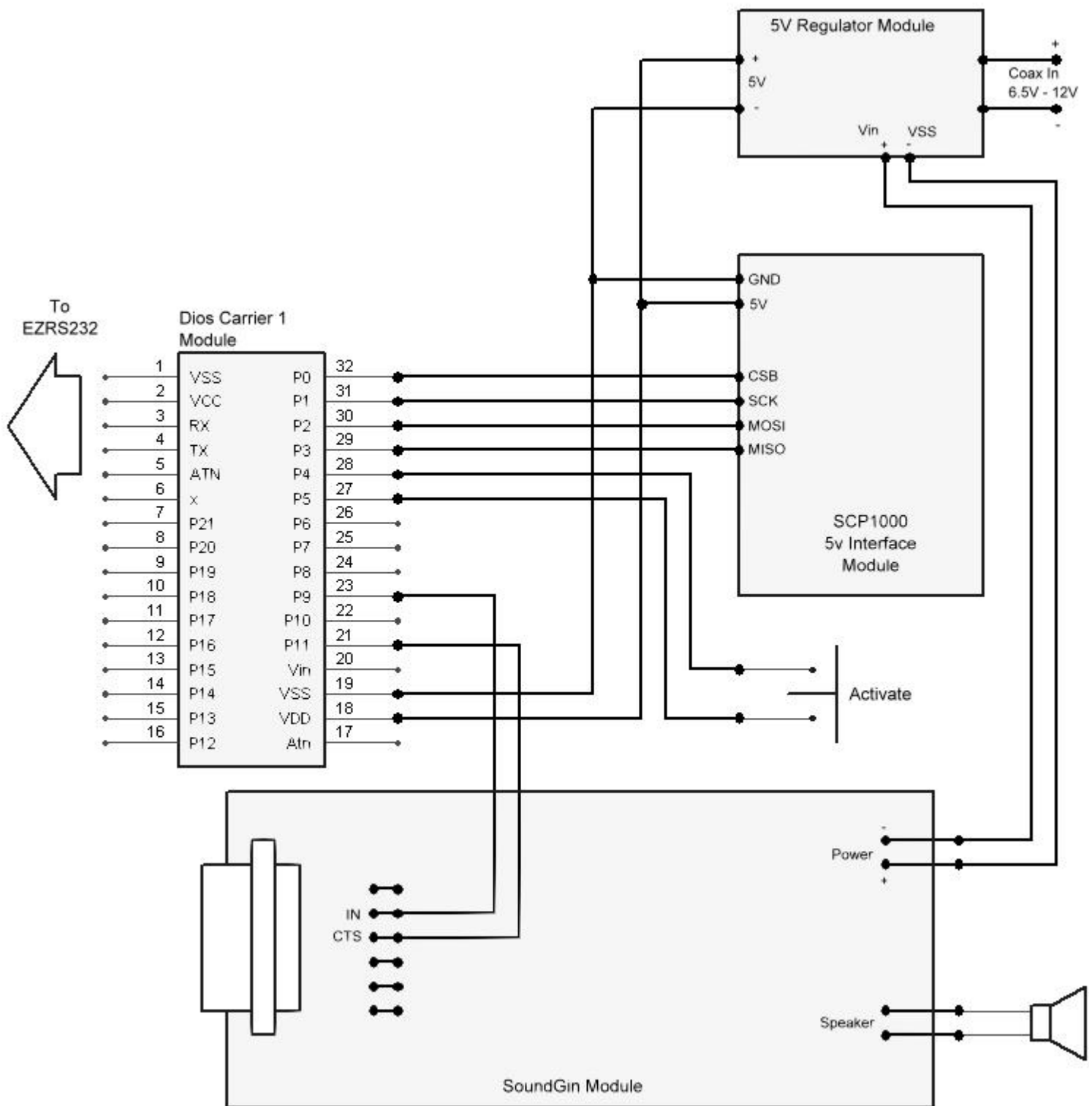


Figure 10



Schematic 2

Step 1

Let's start assembly by cutting the base and top pieces. I used acrylic here so others could see the inside of the project, but any material can be used. I used 4" x 8" pieces for mine, but they could be larger if you need the space.

Once cut, place 5/32" holes into each corner of the base and top for the standoffs.

Step 2

Place your speaker in the center of the top piece and mark the mounting holes. Trace the speaker as well to give us an outline so you can drill a series of holes for the sound.

Step 3

Drill the sound holes as shown in Figure 4. You also need to drill the hole for the button. For the Jameco button shown in the parts lists you need a 1/2" hole. Once all the holes are drilled, install the speaker and button. If your speaker does not have mounting holes use hot glue to attach it to the top by running a bead around the speaker. For better adhesion, score a couple lines around the speaker.

Step 4

You will need to attach 2 wires to the speaker and 2 wires to the button as shown in Figure 10. Attach a 2-pin female header to the opposite end of each of these. These headers will be used to connect to the modules.

Step 5

Attach the modules in the positions shown in Figure 5. The easiest way to mount the boards is with double stick foam tape available from most department stores. If you want to, you can drill holes in the SoundGin board and use machine screws to mount it.

Step 6

Attach a 1" MF standoff to a 1" FF standoff, then attach it to the base with a #6 machine screw. Do this with each of the 4 corners on the base.

Step 7

I used Smartboard 5" and 7" jumpers to attach the modules. Refer to the boards, as well as the module documentation, for the actual locations.

Yellow 5" Jumpers

Regulator + (Header closest to the Carrier 1) to Carrier 1 + (Closest to Cap)

Regulator - (Header closest to the Carrier 1) to Carrier 1 - (Closest to Cap)

Carrier 1 Port0 to SCP1000 CSB

Carrier 1 Port1 to SCP1000 SCK

Carrier 1 Port2 to SCP1000 MOSI

Carrier 1 Port3 to SCP1000 MISO

Blue 7" Jumpers

Regulator + (Header closest to Coax) to SCP1000 5v

Regulator - (Header closest to Coax) to SCP1000 Gnd

Regulator Vin (4-Pin header) to SoundGin Power +

Regulator Vss (4-Pin header) to SoundGin Power -

Carrier 1 Port9 to SoundGin IN (Added Header)

Carrier 1 Port11 to SoundGin CTS (Added Header)

Speaker Header to SoundGin SPK header

Button Header to Carrier1 Port4 and Port5

Step 8

Attach the top base to the 4 standoffs with 4 #6 machine screws. You will want to attach some rubber feet to the bottom base so that the machine screws don't scratch anything. You can purchase these at most department stores or home centers. I also listed a part number for a set from Jameco.

Testing the Pressure Talker

Apply power to the Pressure Talker by plugging an AC adapter into the voltage regulator. If the green LED does not light or is dim, then remove the power and recheck your wiring.

Plug the EZRS232 into the carrier 1 by using a 5-pin double header as shown in Figure 11. Install the free Dios compiler and connect the PC to the EZRS232 using a 9-pin straight cable. The DiosPro chip is already programmed with a test program, so once you run the compiler and power up the Pressure Talker it should display test data in the debug terminal.

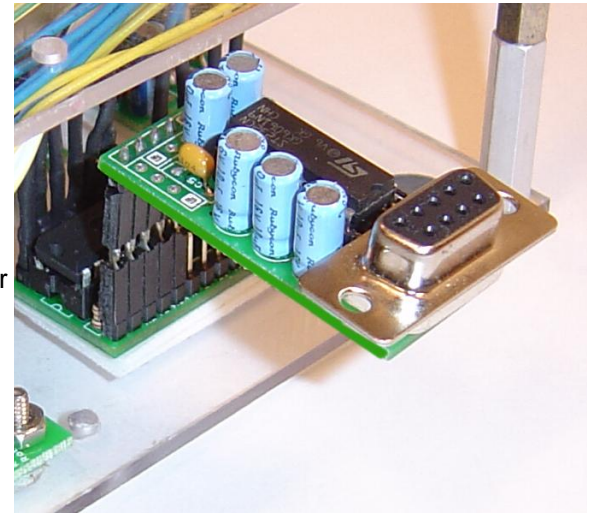


Figure 11

Test 1

First you need to test the pressure sensor by loading and programming Program 1 found in the download files. This will display pressure data in the debug window.

Test 2

Next, load up the program called PressureTalket1.txt. This program will say the word "Barometer" when started and will say it when the button is pressed.

Main Program

Load the program called PressureTalker2.txt and program it into the DiosPro chip. Once programmed, the pressure talker will speak the indoor temperature and pressure each time the button is pressed. The pressure and temperature is constantly displayed in the debug window.

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.

The SoundGin chip uses Allophones to define the speech. Each word that the Pressure Talker speaks is made up of these Allophones. They are defined as table entries at the beginning of the program. You may change these if you like. You can download special software from the SoundGin website and that will help you define these. Just make sure the table entry starts with a label and ends with a 0.

Use the SGplay command to display your new word by passing the lable.

How well does it work?

I recently took the SoundGin to the RobotFest. About 50% of the individuals could not understand the voice. It does take a little getting used to. However I will say that a couple of visually impaired individuals had no problems with the speech.

Parts

Kronos Robotics

DiosPro 28 Chip

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16429>

Dios Carrier 1

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16170>

3.3v to 5v Interface Kit

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16537>

EZRS232 Module

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16167>

DiosPro 28 Starter Kit 2

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16448>

36-Pin Female Snap able Header

<http://www.kronosrobotics.com/xcart/customer/product.php?productid=16291>

SparkFun

SCP1000

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

SchmartBoard

Proto Board

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

2" Jumpers

<http://www.schmartboard.com/index.asp?a=11&id=112>

3" Jumpers

<http://www.schmartboard.com/index.asp?a=11&id=41>

5" Jumpers

<http://www.schmartboard.com/index.asp?a=11&id=42>

7" Jumpers

<http://www.schmartboard.com/index.asp?a=11&id=43>

Other

SoundGin Development board. Available at www.speechchips.com

<http://www.speechchips.com/shop/item.aspx?itemid=14>

Double Stick Foam Tape

Available at most department stores.

Acrylic (Plexiglas)

Available at most Home Centers.

Jameco

6-32 1" Hex Male/Female Standoffs (4 Needed)
#77650

6-32 1" Hex Female/Female Standoffs (4 Needed)
#77578

6-32 .5" Machine Screws
#42438

Rubber Feet
#651903

Push Button
#616850

AC Adapter 9V 500ma
#100853