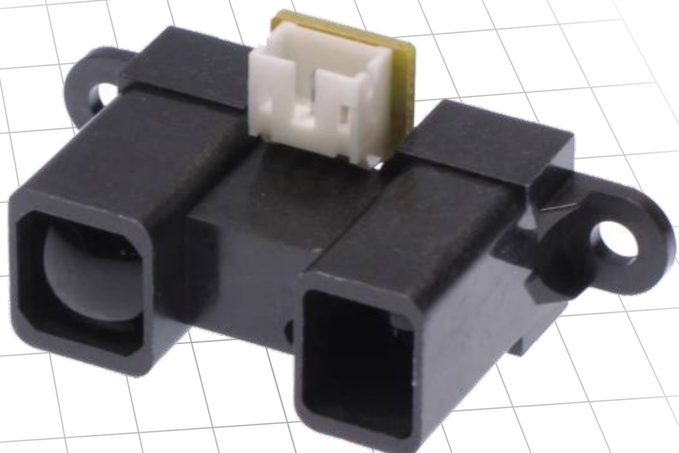
AIRRSv2

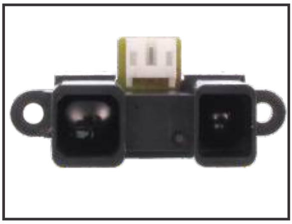
Analog Infra-Red Ranging Sensor

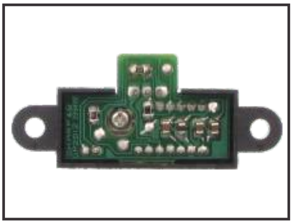
Sharp GP2Y0A02YK0F Sensor



The GP2Y0A02YK0F is a well-proven, robust sensor that uses angle-of-reflection to measure distances. It's not fooled by bright light or different coloured targets!

- Simple to use (analog 0 to 2.5V output)
- Small (4.5 x 2.2 x 1.9 cm)
- Connects directly to any microcontroller with A/D
- 20 cm to 150 cm (8 to 79") range





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AIRRS™ is a low-cost, short-range Infrared (IR) alternative to ultrasonic range-finding systems. Usable detection range is 10 cm to 80 cm (approximately 4” to 31.5”).

The Analog Infra-Red Ranging System consists of the Sharp GP2Y0A02YK0F Distance Measuring Sensor and a custom cable assembly. The GP2Y is a compact, self-contained IR ranging system incorporating an IR transmitter, receiver, optics, filter, detection, and amplification circuitry. The unit is highly resistant to ambient light and nearly impervious to variations in the surface reflectivity of the detected object.

Unlike many IR systems, AIRRS™ has a fairly narrow field of view; making it easier to get the range of a specific target. The field of view changes with the distance to an object (see the graph at the end of this document), but is no wider than 5 cm (2.5 cm either side of centre) when measuring at the maximum range.

Connecting to the AIRRS

A custom cable assembly is included with the AIRRS™ kit. The miniature connector is keyed so that it may only be inserted one way. The following table shows the necessary connections:

Pin	Symbol	Wire Colour	Connect To
1	Vcc	Red	+ 5 V DC
2	GND	Black	Ground
3	V_{out}	Blue	Input pin of microcontroller or A/D

Table 1 - GP2Y0A02YK0F Pinout

Operation

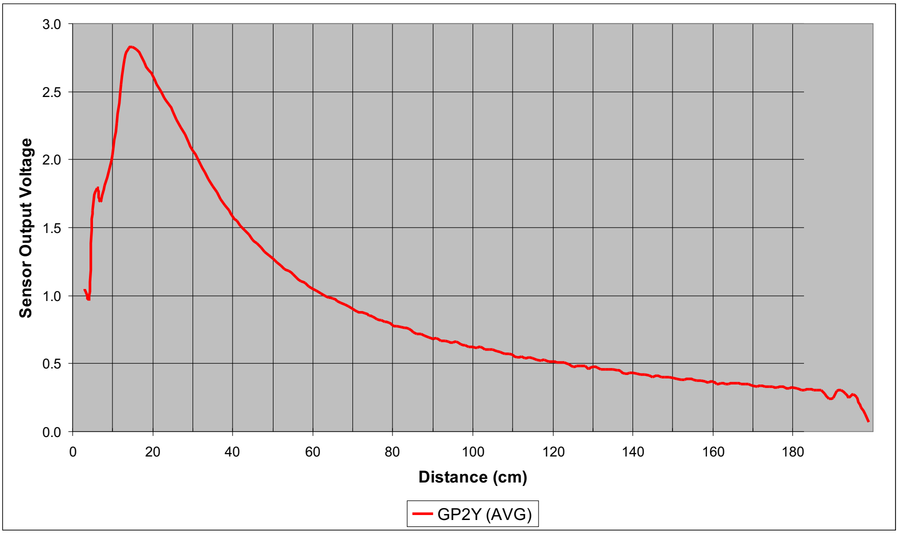
Since the GP2Y makes continuous analog measurements. The module does not require a trigger to initiate a measurement. The distance to an object is returned as an analog voltage level. By reading the voltage level produced a threshold can be set or a distance calculated. By attaching the AIRRS™ cabling to a suitable Analog to Digital converter or microcontroller with onboard A/D, the AIRRS™ can be incorporated into many systems.

Calibration

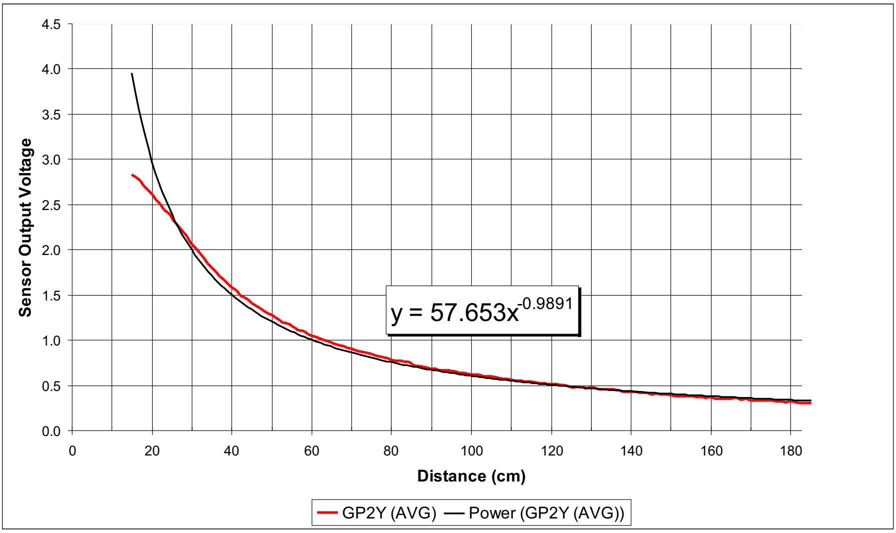
The calibration of the AIRRS™ module is dependent on how the data is used in your code. For threshold type applications, calibration involves determining the distance required and measuring the voltage at that distance, allowing for some variations in measurement. In distance measuring applications the relation between voltage level and distance is non-linear, either a "look up" table or a suitable algorithm must be used. The voltage levels (representing distance) will vary slightly from unit to unit. A small survey of randomly selected devices was done and the following data was gathered. The columns 'Distance' and 'Average Voltage' in the sample data provided can be used as a look up table. This data is shown below (graph 1).

Distance (cm)	Sample #1	Sample #2	Sample #3	Average Voltage
10	2.040	2.054	2.008	2.034
15	2.797	2.852	2.840	2.830
20	2.590	2.634	2.606	2.610
25	2.327	2.372	2.350	2.350
30	2.036	2.087	2.067	2.063
35	1.777	1.831	1.810	1.806
40	1.555	1.607	1.587	1.583
45	1.384	1.442	1.406	1.411
50	1.253	1.292	1.274	1.273
55	1.118	1.179	1.164	1.154
60	1.024	1.081	1.047	1.051
65	0.952	1.005	0.971	0.976
70	0.876	0.932	0.902	0.903
75	0.822	0.868	0.847	0.846
80	0.752	0.799	0.789	0.780
85	0.687	0.761	0.751	0.733
90	0.621	0.718	0.703	0.681
95	0.627	0.677	0.666	0.657
100	0.586	0.645	0.636	0.622
105	0.570	0.626	0.608	0.601
110	0.532	0.569	0.590	0.564
115	0.509	0.562	0.545	0.539
120	0.508	0.517	0.525	0.517
125	0.452	0.498	0.489	0.480
130	0.448	0.498	0.489	0.478
135	0.431	0.478	0.471	0.460
140	0.392	0.444	0.452	0.429
145	0.353	0.421	0.429	0.401
150	0.342	0.407	0.432	0.394
155	0.333	0.401	0.411	0.382
160	0.353	0.386	0.371	0.370
165	0.335	0.364	0.369	0.356
170	0.295	0.364	0.355	0.338
175	0.296	0.344	0.351	0.330
180	0.281	0.341	0.341	0.321
185	0.266	0.318	0.329	0.304
190	0.139	0.295	0.310	0.248

Graph 1: AIRRS Calibration Sample Data



Graph #2: AIRRS Calibration Average Voltage Best Fit Equation



Some Observations on the Effect of Different Kinds of Light

Ambient Light:
Tests have shown Sharp sensors to be highly immune to ambient light levels. Incandescent, fluorescent, and natural light don't appear to bother it. The only instance where we were able to get it to falsely measure was when a flashlight was pointed *directly* into the sensor's receiver; even a few degrees off-centre is enough for the sensor to ignore it.

IR Light:
The GP2Y uses a modulated IR beam to guard against false triggering from the IR component of incandescent, fluorescent, and natural light. Tests with several kinds of IR remote controls have shown that even with 2 or 3 remotes pointed at the GP2Y, the unit still functions normally.

Laser Light:
Tests with a laser pointer had results similar to the flashlight; only a beam aimed straight into the sensor's receiver would cause a false reading. If the beam comes from even a few degrees off-center, it has no effect.

How Does it Work ?

Figure 1 shows how the GP2Y uses an array of photodiodes (called a Position Sensitive Detector, or PSD) and some simple optics to detect distance. An infra-red diode emits a modulated beam; the beam hits an object and a portion of the light is reflected back through the receiver optics and strikes the PSD. Object A is closer and therefore the reflected light from it enters the receiver's lens at a greater angle than does light from object B.

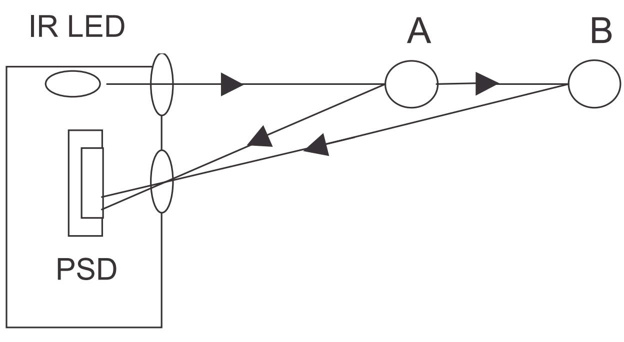


Figure 1

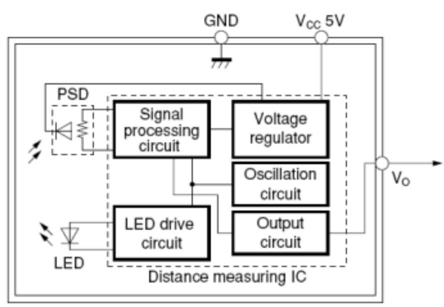
Figure 1 shows object A located at the limit of the PSD's range (about 15 cm away). Notice how that if it were any closer, the light would not hit the PSD at all. Similarly, if B were moved farther away, its' light would eventually go past the 'top' of the PSD and would not be seen either (at about 180 cm). This explains the limits of the GP2Y.

Think of the PSD as a resistor with a large number of taps (wires coming out at various points along the resistor). When light hits the PSD, it hits one of the 'taps' and causes current to flow out each end of the resistor, forming a voltage divider. As an object moves closer or farther from the sensor, incoming light hits a different 'tap' causing the current coming out each end of the resistor to change. These currents are compared and a voltage proportional to the position of the 'tap' (and the distance of the object) is generated.

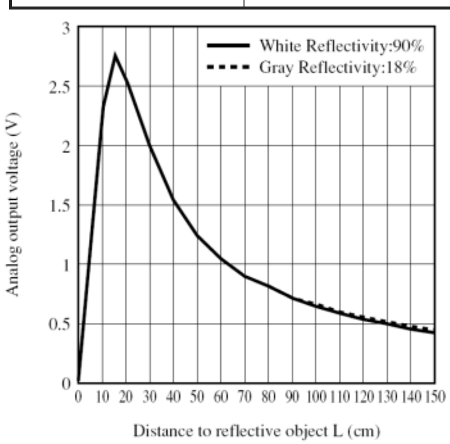
CAUTION: The sensor is a precision device.
Do Not attempt to open the unit.
Doing so will ruin the delicate alignment of the optics

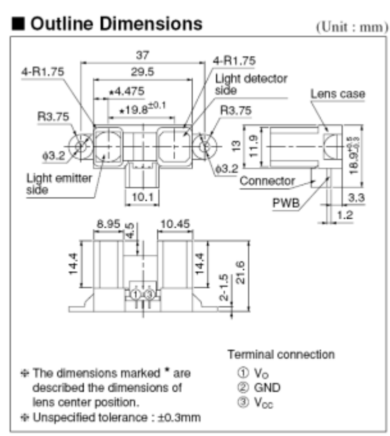
Technical Specifications

Block Diagram



Operating Voltage	4.5~5.5V
Operating Current	33mA
Output Signal	0.3-2.8 VDC
Dimension	4.5x2.2x1.91mm
Detection Angle	10°
Detection Distance	20-150 cm





Example Code

Coded for the CCS PCM C-Compiler and used in the PIC16F877

```
/////////////////////////////////////////////////////////////////////////////////////
////                                                                            ////
////                     AIRSDEM.C for the PIC16F877                            ////
////                                                                            ////
///           Analog Infra-Red Range-finding System (AIRRS)                     ////
////                           Demo Program                                     ////
////                                                                            ////
////                  HVW Technologies, March 2000                              ////
 ///                  http://www.HVWTech.com                                    ////
////                                                                            ////
////      Program uses A/D Channel 1 (pin 3) to read the AIRRS                  ////
////      module output(blue wire). Sends analog value to Matrix                ////
////       Orbital LCD module on port b5 (pin 38) at 19200 baud.                ////
////                                                                            ////
////                  Coded for the CCS PCM C-Compiler                          ////
////                                                                            ////
/////////////////////////////////////////////////////////////////////////////////////
#include <1 6 F877.h>                       //Include Standard CCS header file
#fuses xt,nowdt,noprotect                   //Configuration bits specific to demo board used
#use delay(clock=4000000)                   //Oscillator = 4 MHZ
#use rs232(baud=19200, xmit=pin_b5, rcv=pin_b4,invert)
                                            //Remove 'invert' option if using MAX232 or similar
                                            //When communicating to the Matrix Orbital LCD
long value;                                 //Define variable Long integer
Main()
{
setup_ADC_ports(ALL_Analog);                //Setup all analog pins as only analog
setup_ADC(ADC_CLOCK_INTERNAL);              //Configure D converter to use internal oscillator
set_ADC_CHANNEL(1);                         //Set pin_A1 to measure analog voltage

While(TRUE)
        {
        delay_ms(500);                      //Pause for 0.5 seconds for LCD to update
        value=READ_ADC();                   //Take analog and wait for conversion
        putc(0xfe);                         //Command Prefix
        putc('X');                          //Clear Screen Command
        printf("Analog= %Lu",value);        //Formatted printing of Analog result
        }
}
```

Technical Support

Technical support is available if you are having problems. If you need help, please provide as much detailed information as possible.

E-mail: support@HVWTech.com
Phone: (403) 730-8603 (Monday - Friday 9am – 5pm Mountain time)

IR Distance Measurement Made Easy

- *Proven* and very reliable object sensor
- Simple 5V Connection
- Analog signal easily processed by any microcontroller's A2D pin

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Stamp Stack II: The ultimate BASIC Stamp II prototyping tool. A complete BASIC Stamp II on a board that mounts onto a solderless breadboard. Includes a serial connector, reset switch and a "bullet-proof" power supply. Easy to build, simple to use.

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