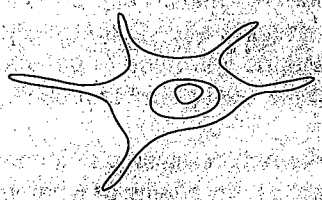
R93-SRF04



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Devantech SRF04 Ultrasonic Range Finder

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Contents

Introduction

The Devantech SRF04 Ultrasonic Range Finder offers precise ranging information from roughly 3 cm to 3 meters. This range, easy interfacing, and minimal power requirements make this an ideal ranger for robotics applications.

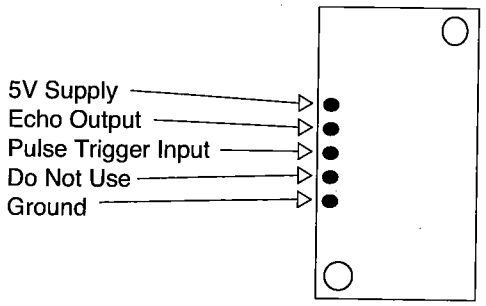
Theory of Operation

The ranger works by transmitting a pulse of sound outside the range of human hearing. This pulse travels at the speed of sound (roughly 0.9 ft/msec) away from the ranger in a cone shape. The sound reflects back to the ranger from any object in the path of this sonic wave. The ranger pauses for a brief interval after the sound is transmitted and then awaits the reflected sound in the form of an echo. The controller driving the ranger then requests a ping, the ranger creates the sound pulse, and waits for the return echo. If received, the ranger reports this echo to the controller and the controller can then compute the distance to the object based on the elapsed time.

Connections

The ranger requires four connections to operate. First are the power and ground lines. The ranger requires a 5V power supply capable of handling roughly 50mA of continuous output. The remaining two wires are the signal wires.

The connections can be made by soldering wire leads to the board or header pins/sockets depending on your needs.



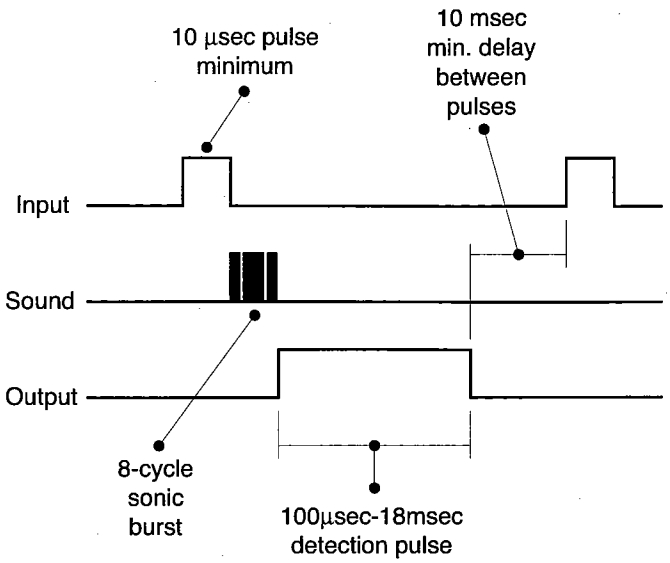
Basic Timing

There are a couple of requirements for the input trigger and output pulse generated by the ranger. The input line should be held low (logic 0) and then brought high for a minimum of 10µsec to initiate the sonic pulse. The pulse is generated on the falling edge of this input trigger. The ranger's receive circuitry is held in a short blanking interval of 100 µsec to avoid noise from the initial ping and then it is enabled to listen for the echo. The echo line is low until the receive circuitry is enabled. Once the receive circuitry is enabled, the falling edge of the echo

line signals either an echo detection or the timeout (if no object echo is detected).

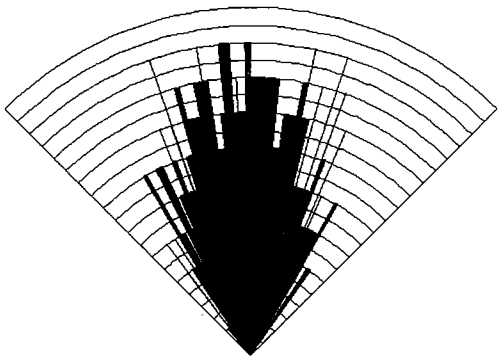
Your controller will want to begin timing on the falling edge of your trigger input and end timing on the falling edge of the echo line. This duration determines the distance to the first object the echo is received from.

If no object is detected, the echo pulse will timeout and return an echo at approximately 36 msec.



Beam Pattern

The SRF04 has a detection cone that is roughly 30 degrees wide. Testing in a 90 degree arc at Acroname revealed the following beam pattern:



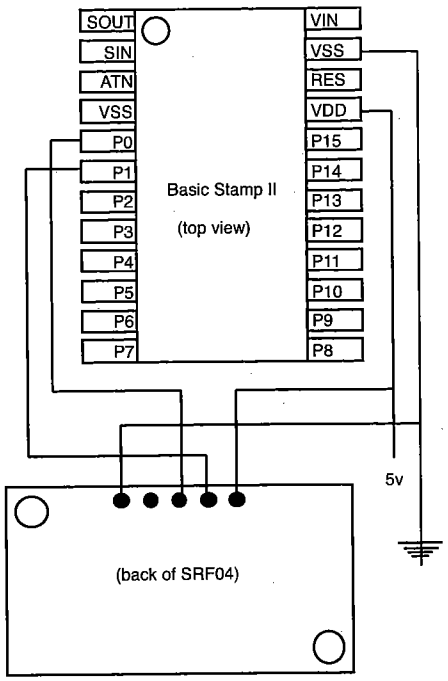
The radial lines indicate 6" distance increments.

Interface Examples

Basic Stamp II Example

This example demonstrates the SRF04 interface to a Basic Stamp II.

This example uses the Basic Stamp II carrier board and debug output capability to take continuous readings from the SRF04 and display them in the debug console of the Stamp development environment.



Example Code:

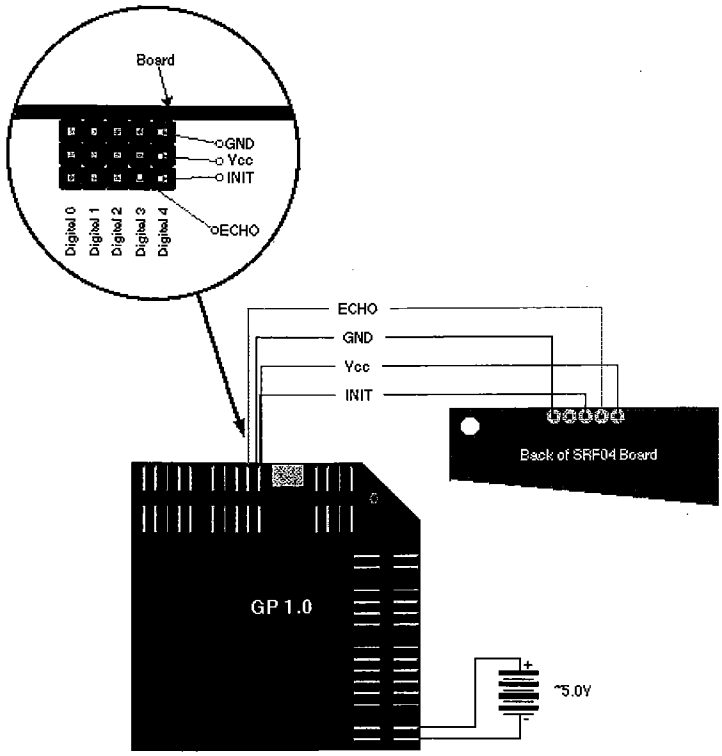
```
'
' Devantech SRF04/Basic Stamp II Example
'
wDist   var     word
INIT    con     0
ECHO    con     1

' CONVERSION FACTORS
'
' The PULSIN command returns the round-trip
' echo time in 2us units which is equivalent to
' the one-way trip time in 1us units.
'
' distance = (echo time) / (conversion factor)
'
' use 74 for inches       (73.746us per 1 in)
' use 29 for centimeters  (29.033us per 1 cm)

convfac con     74      ' use inches

main

        gosub sr_sonar
        debug dec wDist, cr
        pause 200
        goto mainsr_sonar:

        pulsout INIT, 5         ' 10us init pulse
        pulsin ECHO,1,wDist     ' measure echo time
        wDist = wDist/convfac ' convert to inches
        pause 10
        return

sr_sonar_2:
```

```
pulsout INIT, 5      ' 10us init pulse
output INT           ' dummy command(delay)
rctime ECHO,1,wDist    ' measure echo time
wDist = wDist/convfac ' convert to inches
pause 10
return
```

The execution time of the **pulsin** instruction will be slightly different for different pins. If you change the pin assignments, the **pulsin** command in the **sr_sonar** subroutine listed above may miss the rising edge of the ECHO input and return some readings of 0. Using **rctime** instead of **pulsin** may fix this problem. Another trick is to introduce a small delay with a dummy command before measuring the echo time with the **rctime** command. This is illustrated in the alternate subroutine **sr_sonar_2**. You may need to experiment to determine the best code for your application.

BrainStem Example

This example demonstrates the SRF04 interface to the BrainStem®. The BrainStem tells the sonar module to emit a "ping" and measure the time it takes to receive an



echo. It reveals the distance as a raw time in increments of the timer's resolution which is 1.6 uSec. In the above schematic, two digital I/O pins of the BrainStem are configured to handle the ECHO and INIT lines of the ranging module. The circuit is powered by 4 NiMH AA batteries.

Source Code

This code uses the TEA language which is obviously very similar to ANSI C. It is compiled using the BrainStem Console with the steep command.

```
/* SRF04_Example.tea                          */

/* included for the display routines          */
#include <aCore.tea>
#include <aPrint.tea>

/* set which pins control the SRF04           */
#define  aSRF04_INIT    4
#define aSRF04_ECHO     3

/* now include the SRF04 driving routines     */
#include <aSRF04.tea>

void main()
{
  int num = 0;
  int reading;

  aSRF04_Setup();

  while (1) {
    reading = aSRF04_ReadInt();

    aPrint_String("Reading ");
    aPrint_IntDec(num++);
    aPrint_String(" = ");
    aPrint_IntDec(reading);
    aPrint_Char('\n');

    aCore_Sleep(10000);
  }
}
```

This program utilizes the built-in library for handling Devantech SRF04 Rangers and specifies which BrainStem digital I/O lines are being used before including the library for the SRF04 drivers. The program then sets up the module using the aSRF04_Setup routine before taking multiple readings using the aSRF04_Read_Int command.

This and many other interface examples can be found on our website at:

www.acroname.com/robotics/info/examples/examples.html

Specifications

Voltage	5v only required
Current	30mA Typ. 50mA Max.
Frequency	40KHz
Max Range	3 m
Min Range	3 cm
Sensitivity	Detect 3cm diameter broom handle at > 2 m
Input Trigger	10uS Min. TTL level pulse
Echo Pulse	Positive TTL level signal, width proportional to range.

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Thanks for selecting Acroname Inc.