# S3 – Sensor Scanning System

## Kit Assembly, Tuning and Example Programs

CrustCrawler Inc.

## WARRANTY

CrustCrawler warrants its products against defects in materials and workmanship for a period of 30 days. If you discover a defect, CrustCrawler will, at its option, repair, replace, or refund the purchase price. Simply call for a Return Merchandise Authorization (RMA) number, write the number on the outside of the box and send it back to CrustCrawler. Please include your name, telephone number, shipping address, and a description of the problem. We will return your product, or its replacement, using the same shipping method used to ship the product to CrustCrawler.

## 14-DAY MONEY BACK GUARANTEE

If, within 14 days of having received your product, you find that it does not suit your needs, you may return it for a full refund. CrustCrawler will refund the purchase price of the product, excluding shipping / handling costs. This does not apply if the product has been altered or damaged. Please refer to our web site for the latest warranty information.

## COPYRIGHTS AND TRADEMARKS

This documentation is copyright 2003 by CrustCrawler, Inc. BASIC Stamp is a registered trademark of Parallax, Inc. If you decided to use the name BASIC Stamp on your web page or in printed material, you must state that "BASIC Stamp is a registered trademark of Parallax, Inc." Other brand and product names are trademarks or registered trademarks of their respective holders.

## DISCLAIMER OF LIABILITY

CrustCrawler, Inc. is not responsible for special, incidental, or consequential damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, goodwill, damage to or replacement of equipment or property, and any costs or recovering, reprogramming, or reproducing any data stored in or used with CrustCrawler products. CrustCrawler is also not responsible for any personal damage, including that to life and health, resulting from use of any of our products. You take full responsibility for your BASIC Stamp and robotic application, no matter how life-threatening it may be.

## INTERNET ACCESS

We maintain internet systems for your use. These may be used to obtain software, communicate with members of CrustCrawler, and communicate with other customers. Access information is shown below:

E-mail: Support@CrustCrawler.com
Web: http://www.CrustCrawler.com

## INTERNET BASIC STAMP DISCUSSION LIST

Parallax maintains two e-mail discussion lists for people interested in BASIC Stamps (subscribe at http://www.Parallax.com under the technical support button). The BASIC Stamp list server includes engineers, hobbyists, and enthusiasts. The list works like this: lots of people subscribe to the list, and then all questions and answers to the list are distributed to all subscribers. It's a fun, fast, and free way to discuss BASIC Stamp issues and get answers to technical questions. This list generates about 40 messages per day. The Stamps in Class list is for students and educators who wish to share educational ideas. To subscribe to this list go to http://www.Parallax.com/sic and look for the E-groups list. This list generates about 5 messages per day.

Version 2.0

CrustCrawler Inc.

## REQUIRED TOOLS

- Phillips Screwdriver
- Needle-nose pliers
- 1/8" drill bit
- Grease

## S3 INVENTORY

### Aluminum Parts:

- (1) sensor bracket
- (1) tilt bracket
- (1) base circle
- (1) base

### Nuts, Bolts, Washers and Screws

- (2) 5/16" nylon spacers
- (2) thumbscrew knobs
- (4) 5/16" #4 screws
- (2) ¼" #4 screws
- (4) #4 lock washers
- (4) #4 nuts
- (2) lock nuts
- (4) #6 3/8" screws
- (4) #6 lock washers
- (4) #6 nuts
- (2) SAE ¼" washers
- (1) S3 mounting kit

### Electronics:

- (2) Hitec HS-322 HD servos
- (2) 18" servo wire extensions

CrustCrawler Inc.

## PREPARING THE SERVOS

1. Remove the aluminum body parts from their protective bags and lay them loosely on your work surface.

2. Remove the riser tabs from both sides of the (2) servos as shown in figure 1. The removal of this plastic riser will allow the servo to sit flush against the tilt bracket and base. These servos will be installed in the next few steps of the construction process.



**Figure 1**

3. Using a 1/8" drill bit, drill out the center hole of the 3-hole pattern on the round servo arm of both servo horns as shown in figure 2 (with the servo horn still mounted on the servo). Remove the servo horn when the holes are completed.
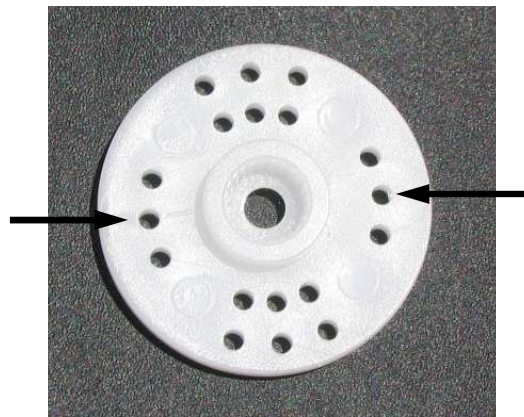


**Figure 2**

CrustCrawler Inc.

4. Using (2), #6 screws, lock washers and nuts, install the HS322-HD servo to the base with the servo's spindle oriented to the front and center of the base as shown in figure 3.



**Figure 3**

5. Install (2), 5/16" nylon spacers using (2) thumbscrew knobs into the (2) pem nuts as shown in figure 4. Hand tighten the thumb screw knobs, do not use a hand tool. Apply a small amount of grease to the top of each of the thumb screw knobs.



**Figure 4**

6. Using (2) #4, 5/16" screws, lock washers and nuts, install the servo arm to the base circle as shown in figure 5. Ensure that the #4 lock washers and nuts are installed on the servo arm side of the base circle.



**Figure 5**

7. Using (2) #4 – ¼" screws and lock nuts, install the tilt bracket to the base circle as shown in figure 6.
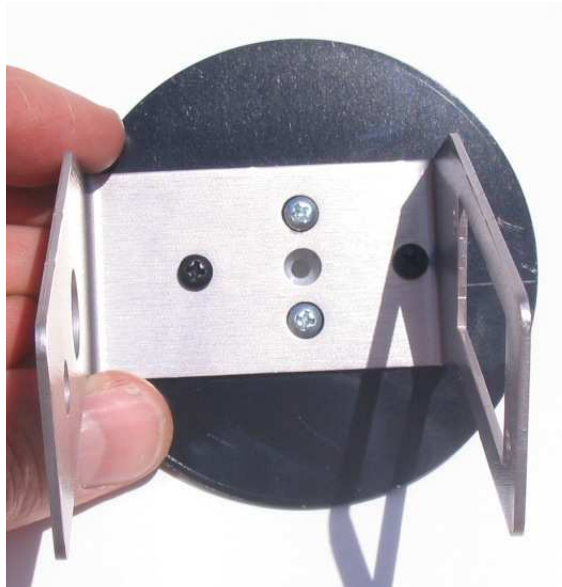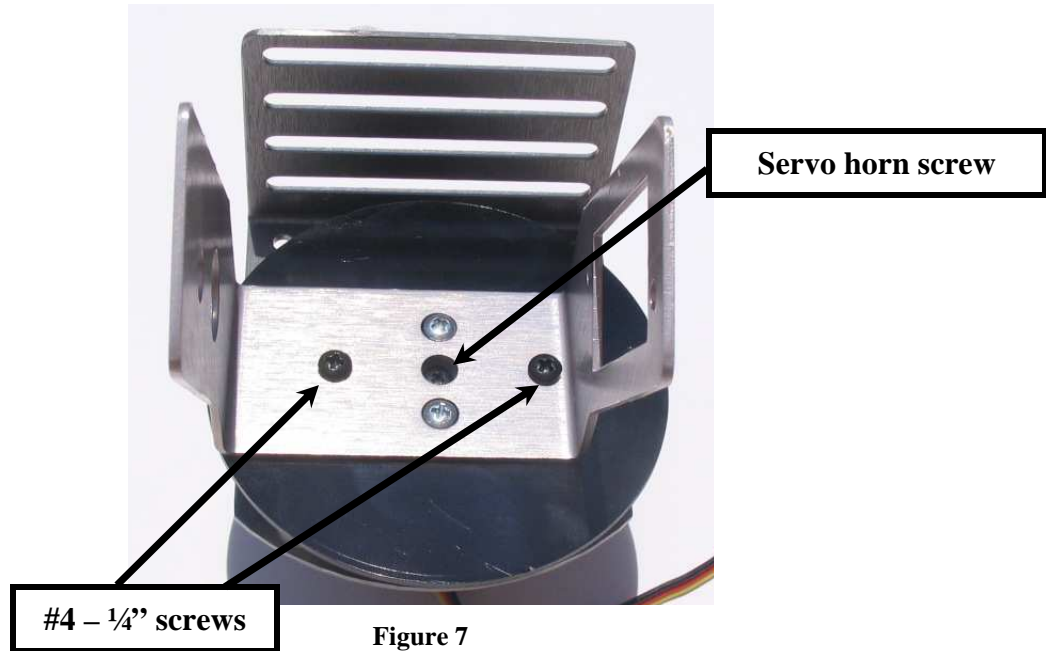


**Figure 6**

8. Install the tilt bracket assembly from figure 6 to the top of the base servo with the tilt bracket oriented forward as shown in figure 7. <u>Do not install the servo horn screw at this time</u>. Be sure that the tilt bracket assembly can rotate 90 degrees in either direction from center before installing the servo horn screw. Once adjusted, install the servo horn screw.

**Servo horn screw**

**#4 – ¼" screws**

**Figure 7**

9. Using (2), #6, 3/8" screws, lock washers and nuts install the servo to the tilt bracket with the servo spindle oriented towards the top of the tilt bracket as shown in figure 8.
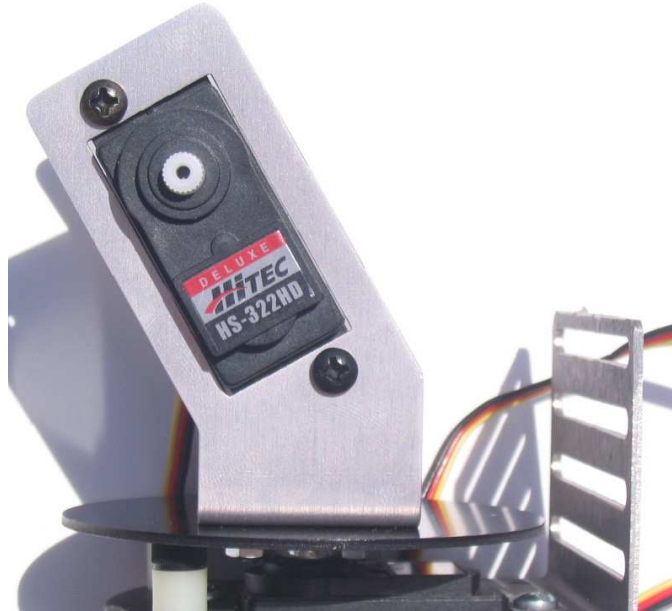


**Figure 8**

10. Using (2) #4, 5/16" screws, lock washers and nuts, install the servo horn to the inside of the sensor bracket as shown in figure 9.



**Figure 9**

CrustCrawler Inc.

11. Install the (2), ¼" SAE washers to the pem spacer as shown in figure 10. Apply a small amount of grease to the outside of the washer as shown in figure 10.
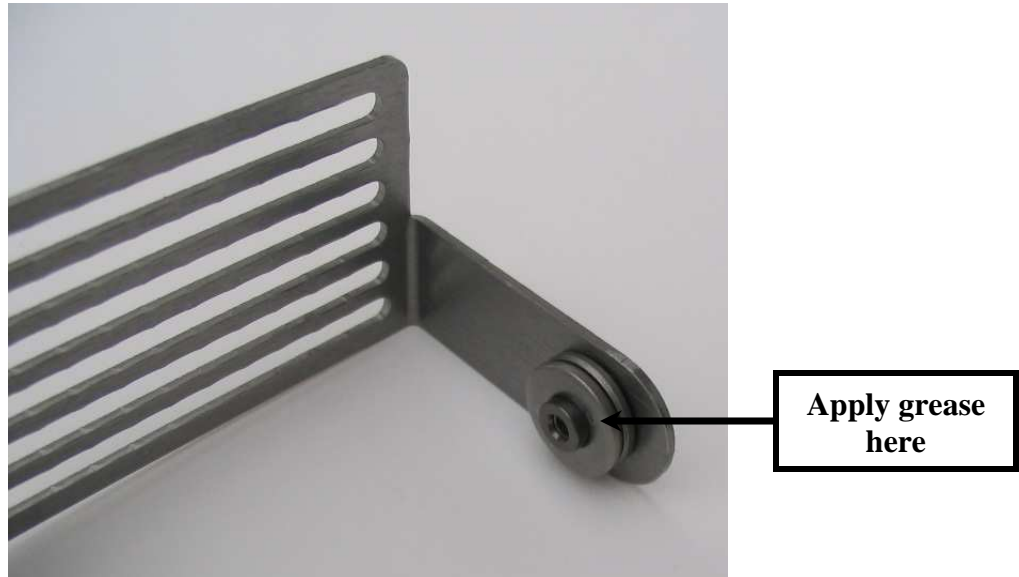


**Figure 10**

Apply grease here

12. Install the completed sensor bracket to the tilt bracket by orienting the pem spacer to the tilt bracket first and then installing the servo horn to the servo. **<u>DO NOT</u>** push the servo horn onto the servo as illustrated in figure 11. Push the servo horn onto the servo as illustrated in figure 12 only! Do not install the servo horn screw at this time.
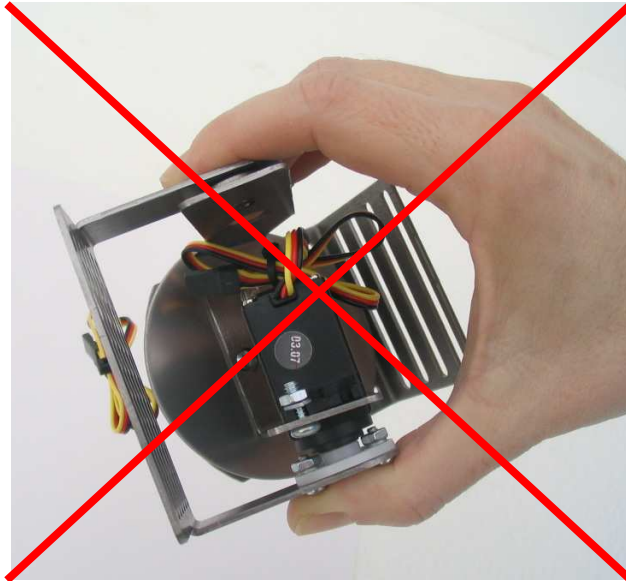


**Figure 11 – Incorrect method**



**Figure 62 – Correct method**

13. Tilt and re-adjust the sensor bracket so that it can swing freely as illustrated in figure 13 (approximately 11 o'clock to the 6 o'clock position). Once the bracket has been adjusted correctly, install the servo horn screw. The assembly is now complete.
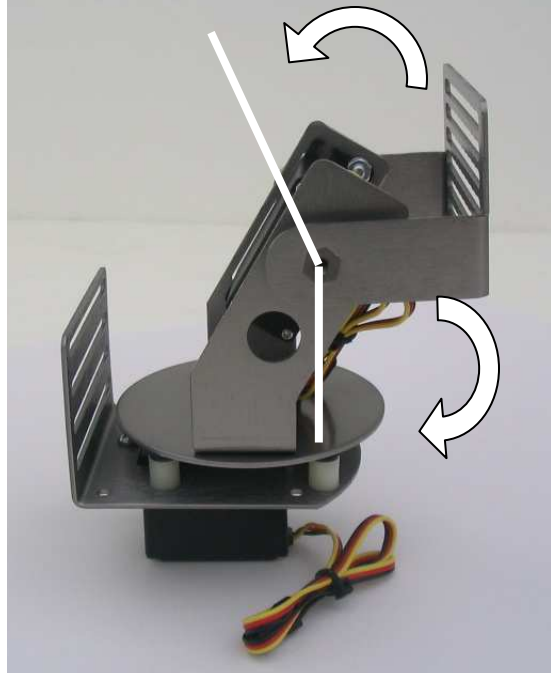


**Figure 73**

CrustCrawler Inc.

# S3 Programmatic Centering and Scanning Sample Program

The following program will allow you to determine and adjust the center of the (2) S3 servos without having to physically adjusting the center point after construction. Be sure to read through the program comments in detail before using the code.

```
'---- [S3_Demo.BS2] --------------------------------------------------------
'{$STAMP BS2}
'{$PBASIC 2.5}
'
'   File....... S3_Demo.BS2
'   Purpose.... Center the S3 X and Y servos.  Execute a
'               simple scan routine.
'   Author..... CrustCrawler Inc. (Mike Gebhard)
'   E-mail..... support@crustcrawler.com
'   Started.... 5 January 2005
'   Updated.... 5 January 2005
'
'   Hardware
'   (1) S3 Tilt Pan System
'   (1) Parallax Basic Stamp 2
'   (1) Parallax Board of Education (BOE)
'   (1) Parallax Servo Controller (PSC)
'
' Run the S3_Demo.bs2 programs to
' 1. Physically center the X and Y servos
' 2. Programmatically center the X and Y servos
' 3. Execute a simply scanning routine.
'
'=========================================================================
' Getting Started
'=========================================================================
' 1. SERVO CONNECTIONS
' This program assumes that the s3's X (horizontal) servo is connected
' to PSC channel 12 and the Y (vertical) servo is connected to
' channel 13.  To change the default servo connections, find
' the X_Servo and Y_Servo constant declarations in the code below
' under the [I/O Definition] section. Change the constants to
' match your S3 servos to PSC channel connections.
'
' 2. X AND Y SERVO CENTER POSITIONS (DEFAULT program)
' The default setting for servo center in 750 or  1.5ms pulses
' from the PSC.  Use this center to physically adjust your S3
' according to the S3 assembly guide.
'
' 3. PROGRAMMATIC X AND Y SERVO CENTER
' After physically adjusting the S3 servos during construction, you might have found
' that the S3 is not exactly centered.  Adjust the X_ServoCenter
' and Y_ServoCenter constants in the [S3 Constants] section to
' programmatically center the S3.
'
' 4. RUNNING THE SIMPLE SCAN
' Find the [Main Routine] section below.  Remove the comment from
' 'ptrEEPROM = Scan and run the program. This will cause the S3 to
' scan left, right, up, and down.
'
'-------------------------------------------------------------------------
'
' -----[ I/O Definitions ]-------------------------------------------------
#IF ($stamp = BS2SX) OR ($stamp = BS2P) #THEN
  Baud  CON    1021                    ' 2400 baud
#ELSE
  baud  CON    33164                   ' 2400 baud
#ENDIF
PSC             PIN    15              ' PSC module
```

CrustCrawler Inc.

```
X_Servo          CON    12               ' Horizontal Servo Address
Y_Servo          CON    13               ' Vertical Servo Address

'---- [S3 Constants] -----------------------------------------------------
'ServoCenter     CON     750             ' Servo Center
X_ServoCenter    CON    750              ' Horizontal servo center
Y_ServoCenter    CON    750              ' Vertical servo center
verticalIncr     CON    200              ' Vertical Increment
horizontalIncr   CON    400              ' Horizontal Increment

' Adjustable Values
lookLeft         CON    X_ServoCenter - horizontalIncr
lookRight        CON    X_ServoCenter + horizontalIncr
EOD              CON    $FF              ' End of Data
Ramp             CON    $A               ' Servo Speed

'---- [Servo Position Variables] -----------------------------------------
servoPosition    VAR    Word             ' Servo Position
ptrEEPROM        VAR    Word             ' EEPROM Pointer
servoAddr        VAR    Byte             ' Servo Addresses
S3Counter        VAR    Nib              ' Loop Counter

'---- [EEPROM data] ------------------------------------------------------
' EEPROM is read in 3 byte sections
' servo address | LOWBYTE servo position | HIGHBYTE servo position
Scan   DATA X_Servo, Word lookLeft,
            X_Servo, Word X_ServoCenter,
            X_Servo, Word lookRight,
            X_Servo, Word X_ServoCenter,
            EOD

Center DATA X_Servo, Word X_ServoCenter,
            Y_Servo, Word Y_ServoCenter,
            EOD

' Initialize counter
S3Counter = 0

'--- [ Main Routine ] ----------------------------------------------------
Main:
  ptrEEPROM = Center                     ' Center Servos
  'ptrEEPROM = Scan                      ' Simple Scan

  READ ptrEEPROM,servoAddr,servoPosition.LOWBYTE,servoPosition.HIGHBYTE
  DO WHILE servoAddr <> EOD              ' Loop while not end of EEPROM
    GOSUB PSC_Write                      ' Write to the PSC
  LOOP
  IF ptrEEPROM = Center + 6 THEN         ' End if center is selected
    END
  ELSE
    IF S3Counter < 4 THEN                ' Simple scan
      LOOKUP S3Counter,[Y_ServoCenter + verticalIncr,
             Y_ServoCenter, Y_ServoCenter - verticalIncr,
             Y_ServoCenter], servoPosition
      SEROUT PSC,Baud,["!SC",Y_Servo, Ramp,
             servoPosition.LOWBYTE,
             servoPosition.HIGHBYTE, CR]
      S3Counter = S3Counter+1
    ELSE
      S3Counter = 0
    ENDIF
  ENDIF
GOTO Main


'----- [ Sub Routines ] --------------------------------------------------
PSC_Write:
  SEROUT PSC,Baud,["!SC",ServoAddr, Ramp,
        servoPosition.LOWBYTE,
        servoPosition.HIGHBYTE, CR]
  ptrEEPROM = ptrEEPROM + 3
```

Version 2.0

CrustCrawler Inc.

```
  READ ptrEEPROM,servoAddr,servoPosition.LOWBYTE,servoPosition.HIGHBYTE
  PAUSE 1500
RETURN
```

Version 2.0