



*Protector*<sup>TM</sup>

## **Robotic Collision Sensor SR-131, SR-176, SR-221**

U.S. Patent Nos. 6069415 and 6690208

### Switch Replacement Instruction Manual



**Document #9610-60-1009-02**  
June 2008

*Engineered Products for Robotic Productivity*

*Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com*



**CAUTION:** This manual describes the function, application and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product, otherwise damage to the product or unsafe conditions may occur.

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**Sales, Service and Information about other ATI products:**

**ATI Industrial Automation**

1031 Goodworth Drive  
Apex, NC 27539 USA  
www.ati-ia.com  
Tel: 919.772.0115  
Fax: 919.772.8259  
E-mail: info@ati-ia.com

**Technical support and questions:**

**Application Engineering**

Tel: 919.772.0115, Option 2, then option 2  
Fax: 919.772.8259  
E-mail: mech\_support@ati-ia.com

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## **Glossary of Terms**

<b>Term</b>	<b>Definition</b>
Body	Cylindrical aluminum housing and air pressure chamber. An interface plate to the user's robot is usually attached here.
Cam	A hardened steel ring mounted inside the cover on which the hardened steel balls mounted to the stem are nested.
Collision	The accidental impact between the end-of-arm tooling and some obstruction in its path.
Cover Plate	Disk-shaped aluminum cover for Protector™ Body.
Crash	The result of a disturbance that displaces the Protector™ components from their standard working position.
Interface Plate	Optional component used to adapt the Protector™ Body or Stem to the user's robot or tooling.
Nano Connector	8mm electrical connector mounted in block attached to the side of the Body.
Reset	The ability of the Protector™ to return to its working position when a disturbing force or displacement is removed.
Stem	Round tapered post containing tapped holes and dowel pins. An interface plate to the user's tooling is usually attached here.

# 1. General Maintenance Instructions



**CAUTION:** The customer should lock out and discharge all energy to the work cell prior to working on any Protector™ system.



**CAUTION:** In all instances where the Protector™ is to be examined, installed, or removed from service, insure that air pressure has been vented from the unit, that electrical current is not supplied to the Protector's™ signal circuit, and that the robot is in a safe, locked-out condition, consistent with local and national safety standards.

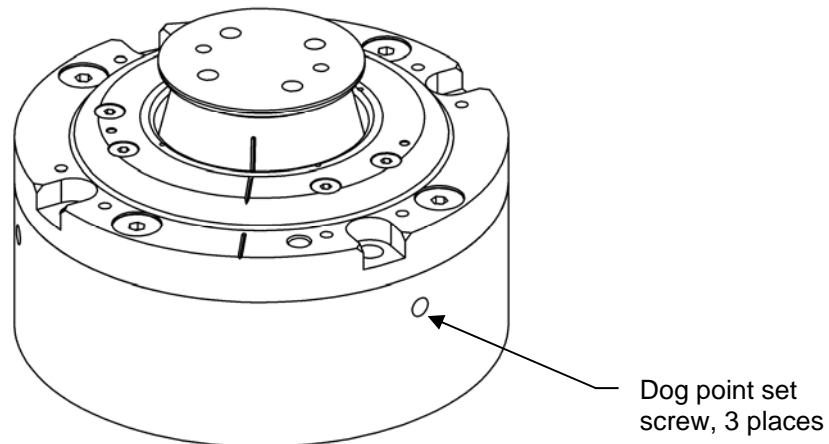


Figure 1.1—Location of Set screws



**CAUTION:** Do not adjust or remove any of the three (3) set screws installed in the wall of the Body. Doing so may result in personal injury and/or damage to the unit.

## 2. Switch Replacement

### 2.1 Removal of Connector Block Assembly and Switch Wiring

1. Remove the mounting screw and nylon washer using a 2.5mm hex key.
2. Pull the Connector Block Assembly away from the Protector™ as shown in Figure 2.1 and cut the wires as shown in Figure 2.2.
3. Unplug the wires and connector from PCB Header and discard the connector and wires.
4. Remove and discard the wire channel gasket (see Figure 2.1).

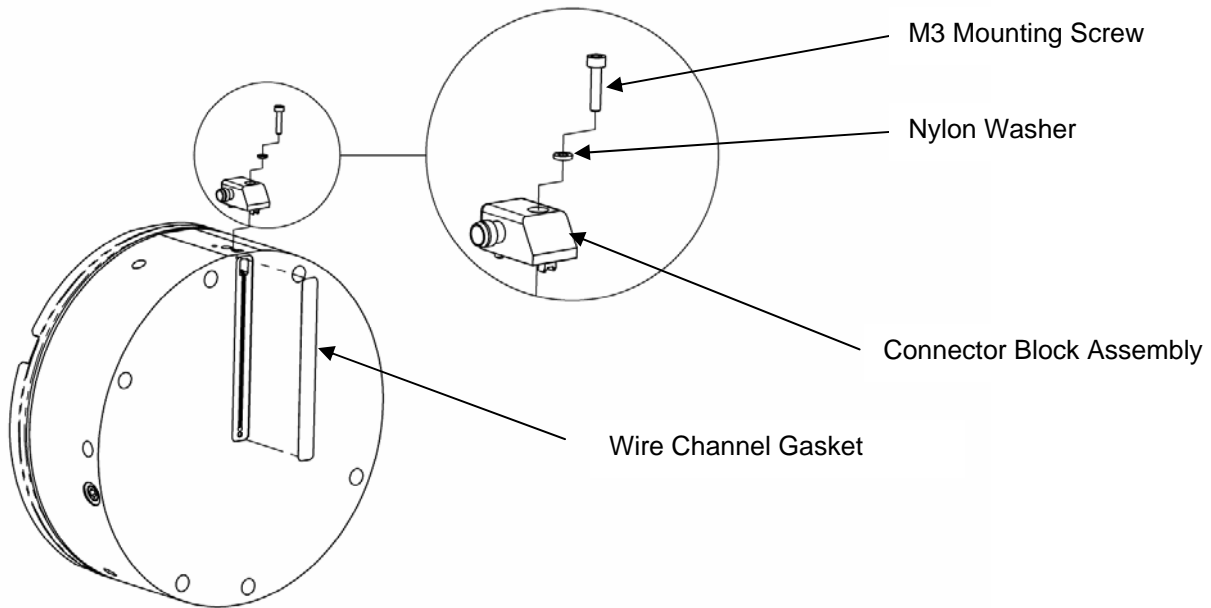


Figure 2.1—Removal of Connector Block Assembly and Switch Wiring

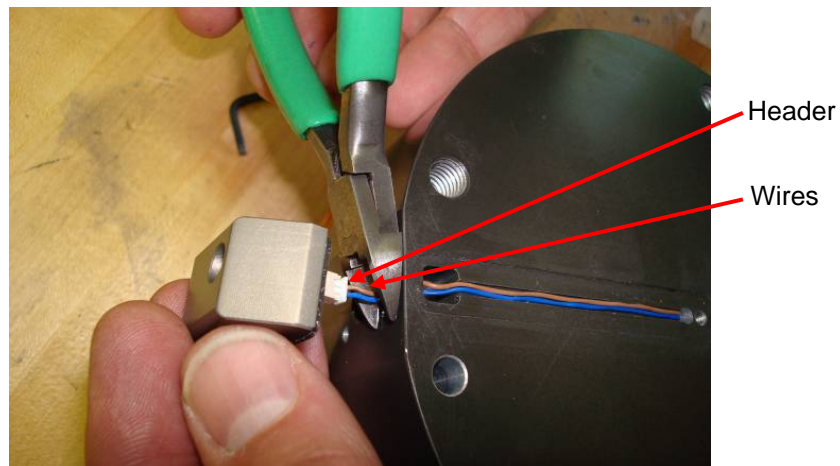


Figure 2.2—Cutting the wires.

## 2.2 Removal of Cover Plate, Stem, and Cover O-ring

1. Remove the four (4) socket head cap screws securing the Cover Plate assembly to the Body.

**Note:** During factory assembly, Loctite<sup>®</sup> is applied to the screws to prevent them from coming loose in operation. As a result, it may be necessary to use a hot air gun to individually heat the screws (and the immediate areas of the Body) in order to soften the Loctite<sup>®</sup> and allow the screws to be removed.



**CAUTION:** Do not attempt to pry or wedge the Cover Plate assembly and Body apart. Doing so can damage the mating surfaces and may render the parts unusable.

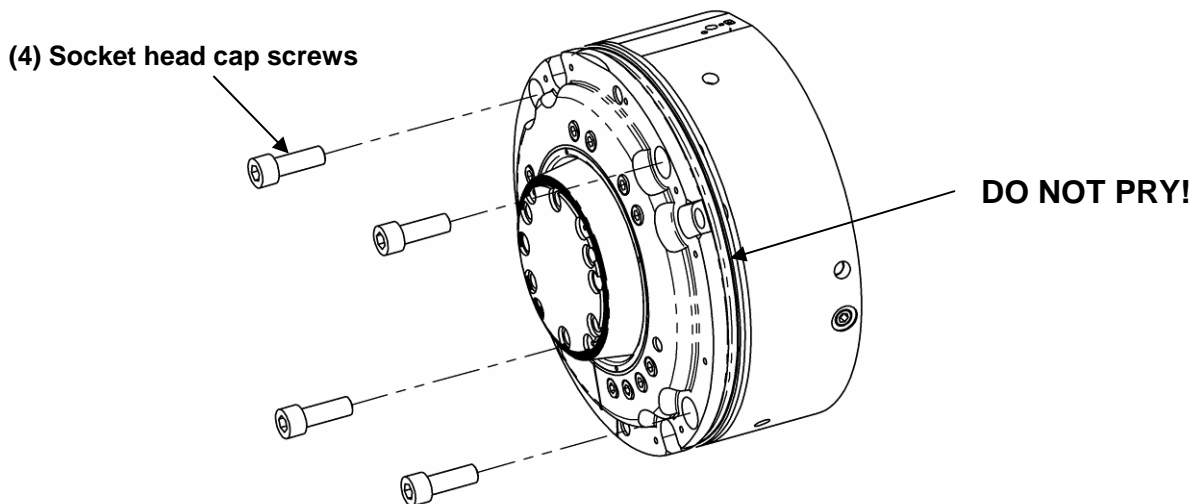


Figure 2.3—Removal of Cover Plate

2. Remove the Cover Plate assembly by carefully pulling it straight up and off of the Body. This may be difficult due to the close fit of the dowel pins used to align the parts. It may be necessary to hold the unit up by the Cover Plate and lightly tap on the Stem with a rubber or plastic mallet.

**Note:** The dowel pins are pressed into the Cover Plate and are a slip fit into the Body.

3. Remove the stem assembly and cover o-ring and set aside (see Figure 2.4).



**CAUTION:** The Cover Plate assemblies and Stem assemblies are factory assembled as matched parts. Do not allow either of these assemblies to be mixed with those from other units.

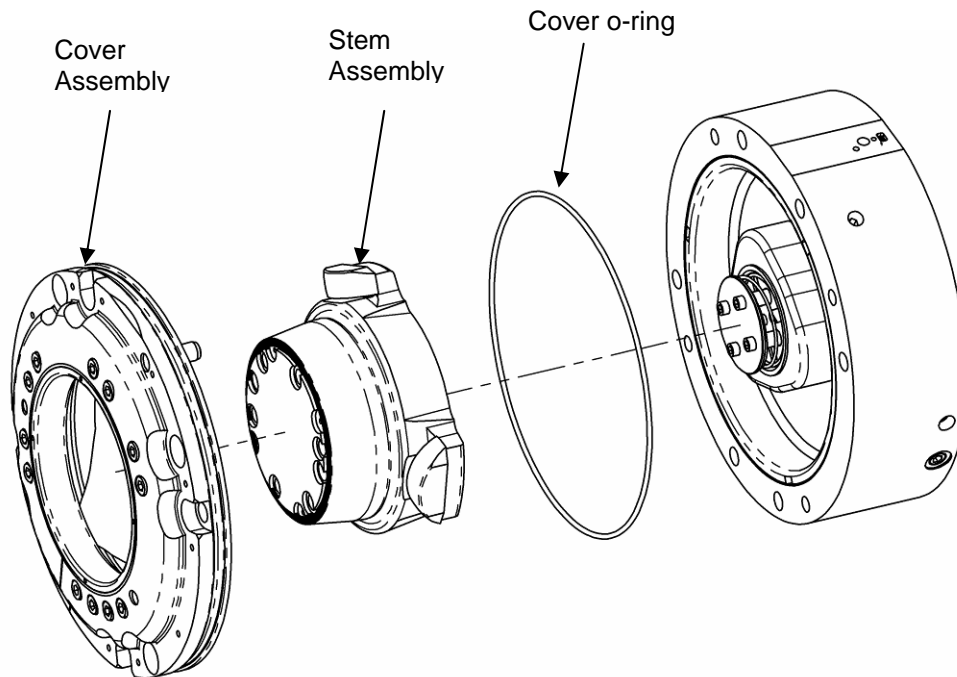


Figure 2.4—Removal of Cover Plate, Stem Assembly, and O-ring

### 2.3 Removal of Switch Actuator Mechanism

1. Remove the Screws, Spring Plate, Spring, Actuation Plate, and Stand offs.

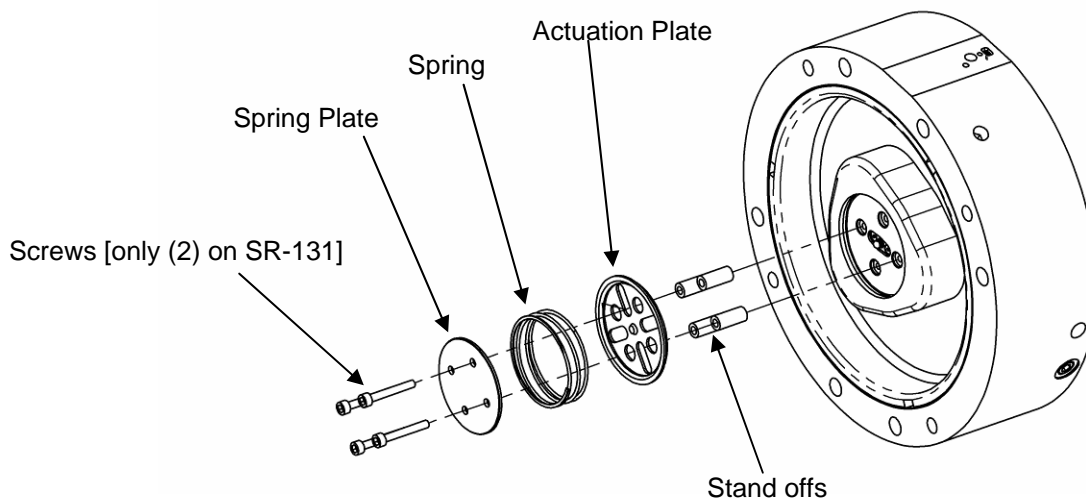


Figure 2.5—Removal of Switch Actuator Mechanism



### 3. Switch Removal

1. Remove the (2) Flat Head Screws using a 1.5mm hex key.
2. Remove the Spring Stop.
3. Remove the Switch Carrier Spring and the Switch Assembly.
4. Discard all of the parts removed in steps 1 through 3.

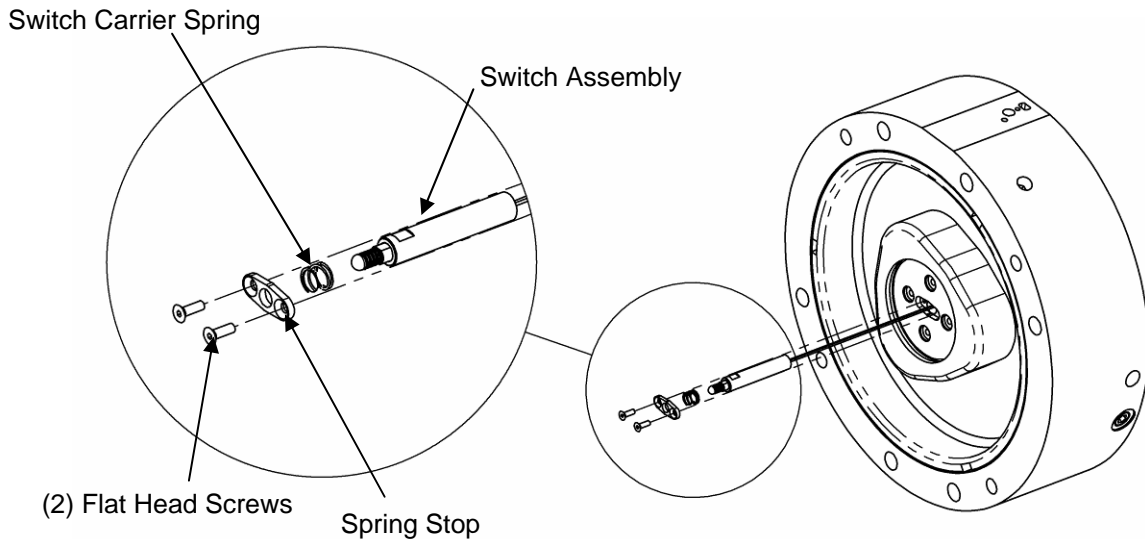


Figure 3.1—Removal of Switch

#### 3.1 New Switch Installation

1. Insert the wires of the new Switch Assembly through the body post. Slide the Switch Assembly into position. Twisting the Switch wires (as shown below) will simplify insertion of the wires into the Body Post.

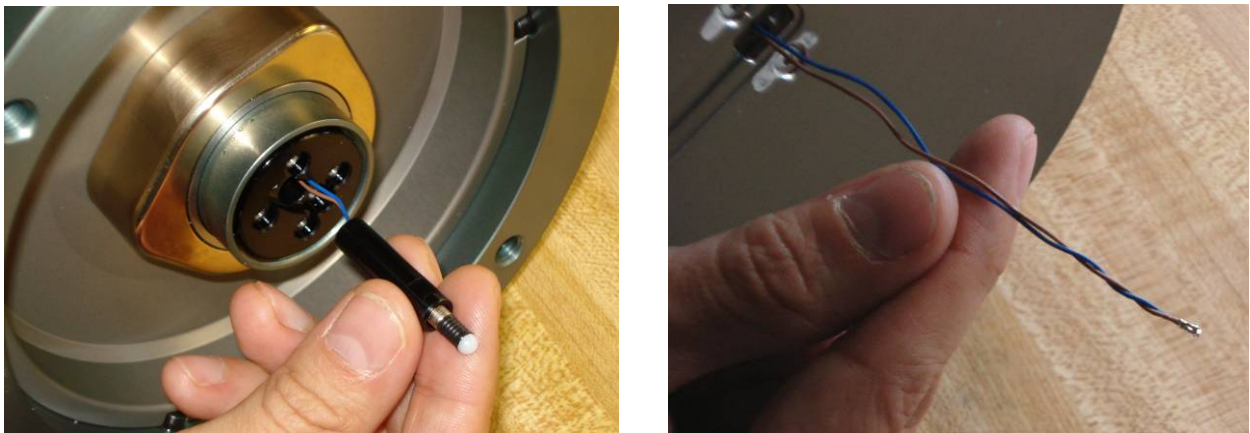


Figure 3.2—Inserting New Switch

2. Untwist the wires and feed them through the slot leading to the cavity on the side of the Body. Ensure that the wires will lie side-by-side in the channel once the assembly has been completed. To prevent damage to the wires, temporarily apply masking tape to the channel once the wires are correctly positioned.

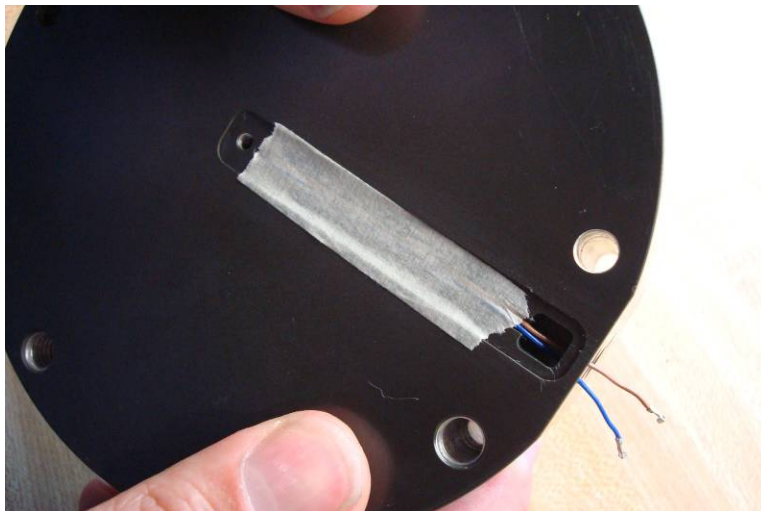


Figure 3.3—Wire Routing

3. Insert the Wire Connectors into the Micro Header Socket with the Locking Tang of the Wire connectors facing the Locking Ribs on the Micro Header Socket. Grip each wire with needle-nose pliers just behind the Wire Connector and push it firmly into the Micro Header Socket. Check to be sure that the Wire Connectors are locked into place and will not pull out accidentally.

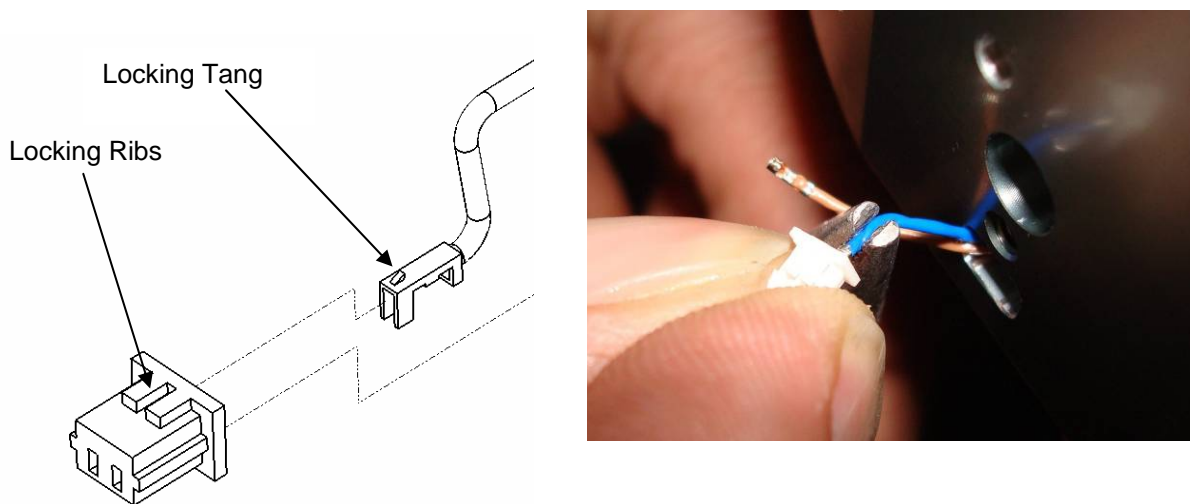


Figure 3.4—Inserting Wire Connectors

4. Place the Switch Carrier Spring into the Body Post on top of the Switch Assembly.
5. Apply 222MS Loctite to the two (2) M2.5 x 6mm Flat Head Screws and fasten the Spring Stop to the Body Post. Tighten the screws to 64 in-ozs.

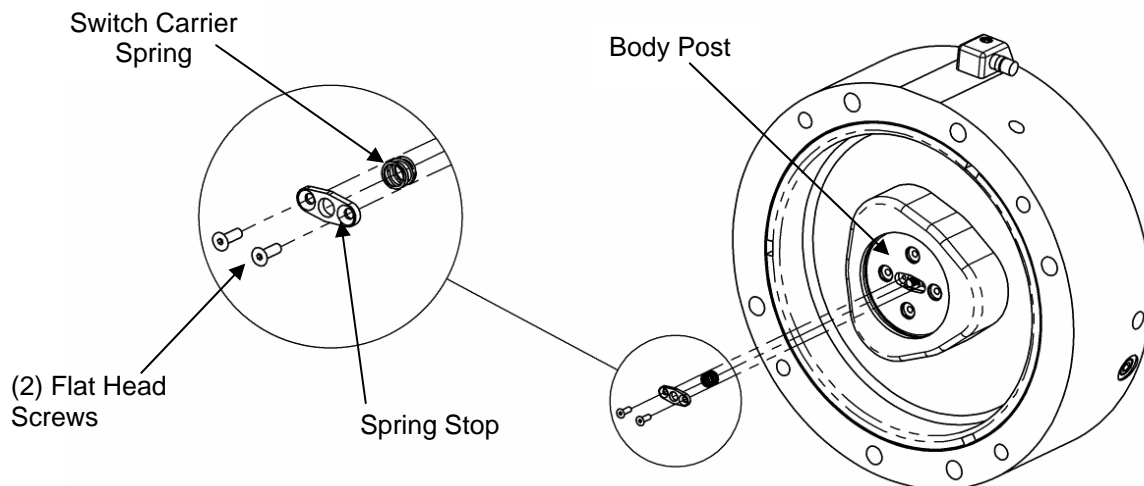


Figure 3.5—Reinstallation of Switch

### 3.2 Reassembly of Switch Actuator Mechanism

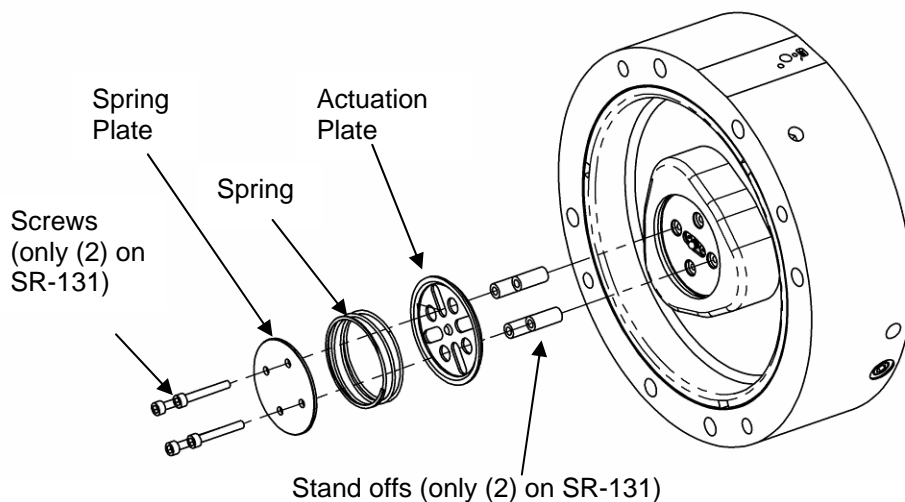
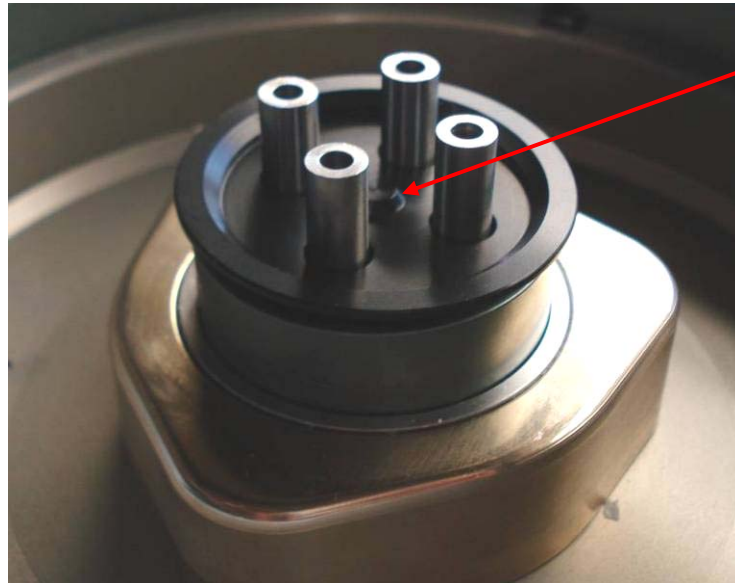


Figure 3.6—Reassembly of Switch Actuator Mechanism

1. Insert the Stand offs into the counterbores in the Body Post.
2. Place the Actuation Plate over the Stand offs. Must be oriented per Figure 3.7.



**NOTE  
ORIENTATION**

Figure 3.7—Orientation of Actuator Plate

3. Place the Actuation Spring into the Actuation Plate.
4. Place the Spring Plate on top of the Stand offs while lining up the screw holes. Apply Loctite 222MS to the threads of the Screws. Slide the Screws through the Spring Plate and Stand offs and screw into the Body Post. Tighten per the following chart:

Model	Screw Size / Type	Recommended Torque
SR-131	M3 x 20 SHCS	12 in-lbs
SR-176	M3 x 25 SHCS	12 in-lbs
SR-221	M4 x 30 SHCS	25 in-lbs

### 3.3 Reattaching the Connector Block

1. Plug the Micro Header Socket into the PCB Header in the Connector Block.

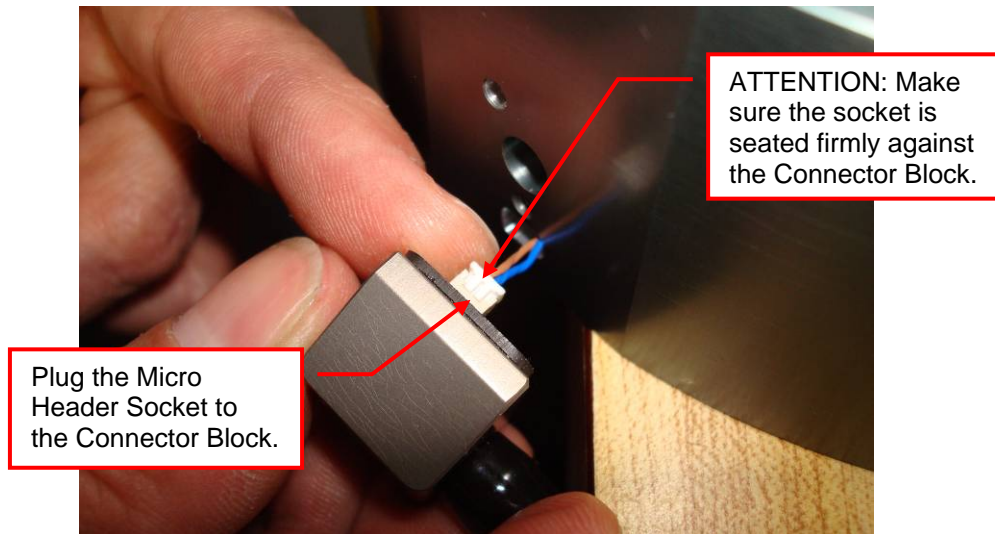


Figure 3.8—Reattaching the Connector Block

2. Place the Nylon Washer on M3. Apply Loctite 222MS to the Connector Block's M3 mounting screw and thread it into the Body and torque to 64 in-ozs. To avoid bunching of the wires in the channel, work any slack in the wires into the slot leading to the cavity on the side of the Body.

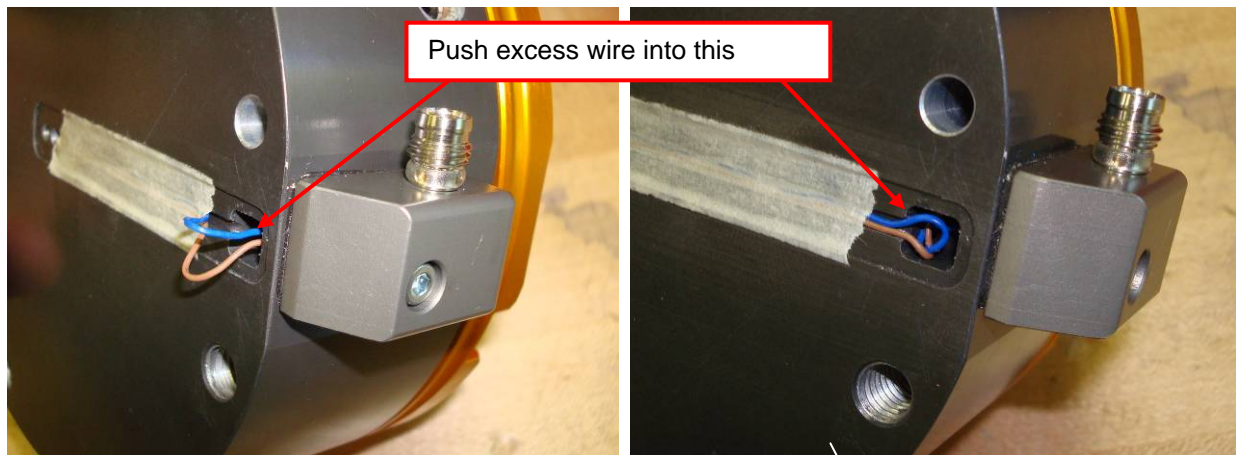


Figure 3.9—Reattaching the Connector Block

3. To avoid bunching of the wires in the channel, work any slack in the wires into the Body cavity indicated above.



### 3.4 Reassembly of Stem, Cover Plate, and Cover O-ring

1. Apply Magnalube to the o-ring Cover Seal and insert into the groove in the Cover Plate.



Figure 3.10—O-ring in Cover

2. With the Stem assembly upright, set the Cover Plate assembly onto it. Make certain that the alignment grooves are properly aligned.

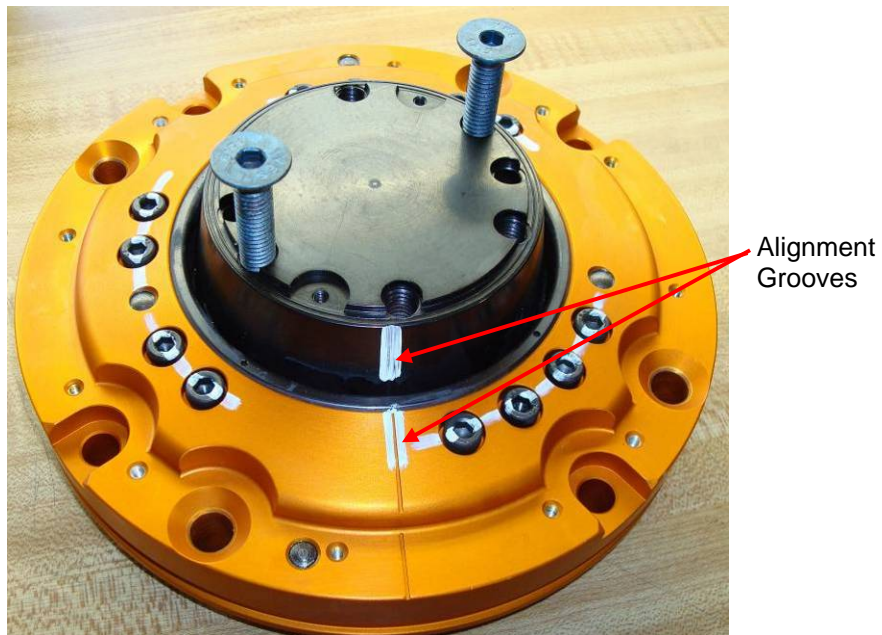


Figure 3.11—Orientation of Stem in Cover

3. Place the Stem and Cover Plate together onto the Body. Make certain that the dowel pins in the Cover Plate are aligned with the holes in the Body and that the alignment grooves in the Cover Plate and the Stem are still aligned.
4. Press the Cover Plate down onto the Body. Apply Loctite 222MS to the four (4) screws and thread them into the Body.

**Note:** On units with the Spring Assist Option it is necessary to use two opposing screws to evenly pull the Cover Plate down against the Body. Tighten the screws per the following table:

Model	Screw Size / Type	Recommended Torque
SR-131	M6 X 25 SFHCS	70 in-lbs
SR-176	M8 x 40 SFHCS	175 in-lbs
SR-221	M10 x 30 SHCS	420 in-lbs

### 3.5 Switch Adjustment

1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Protector™ returns to its Reset or Working position with the stem fully extended and the alignment mark on the stem in line with the alignment mark on the cover plate.
2. Set a volt-ohm meter to ohms or continuity and connect it between the black and brown wires of the cord (see wiring diagrams below) connected to the Nano connector on the switch housing.

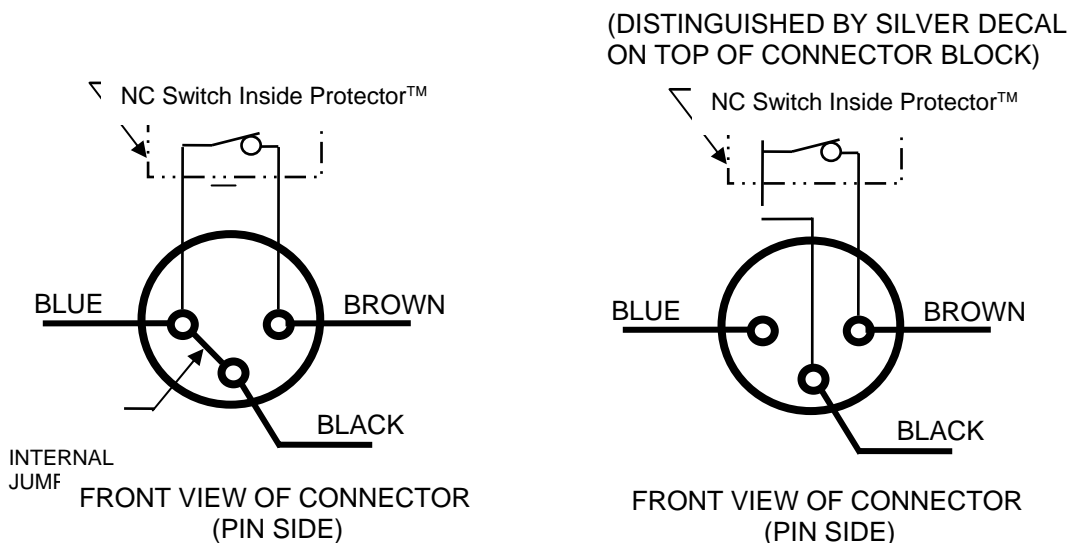


Figure 3.12—Protector™ Wiring

3. Attach an Interface Plate to the stem of the Protector™.
4. Center the Protector™ under the Press Ram of an Arbor Press (see Figure 3.13).

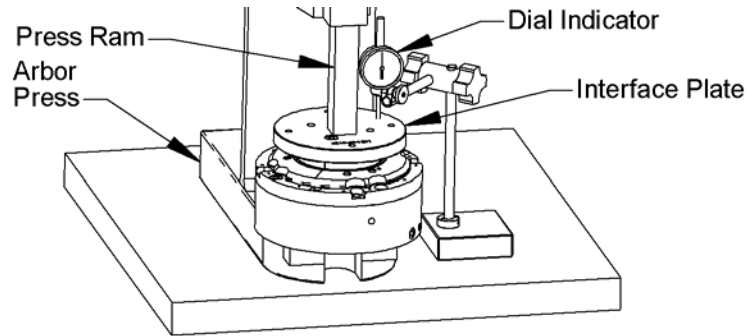


Figure 3.13—Checking Switch Height Adjustment

5. Set a Dial Indicator in contact with the Interface Plate and adjust it so that the probe is vertical. Set the Dial Indicator height so that it can read at least 0.10” stroke. Set the dial ring to zero. Factory default setting is 0.020”.
6. Push on the press handle until the switch circuit opens and check the distance traveled on the Dial Indicator.
7. If the distance traveled before the switch turns off is greater than desired, turn the Adjusting Screw clockwise. If the distance traveled is less, turn the Adjusting Screw counterclockwise. (Use a 1.5mm hex key.)

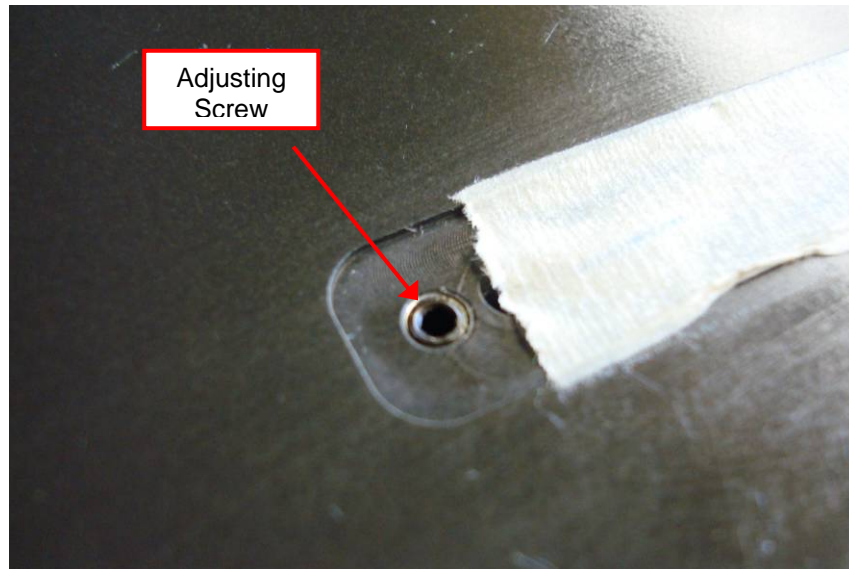


Figure 3.14— Location of Adjusting Screw

### 3.6 Wire Channel Gasket

Remove the masking tape covering the Wire Channel. Peel the paper backing off of the Wire Channel Gasket and apply the gasket to the shallow recess straddling the wire channel. Be sure that the wires are laying side-by-side in the channel before smoothing the gasket into place. Also, be sure that the Gasket resides completely within the shallow recess and that the wires are not twisted or bunched up under the Gasket.



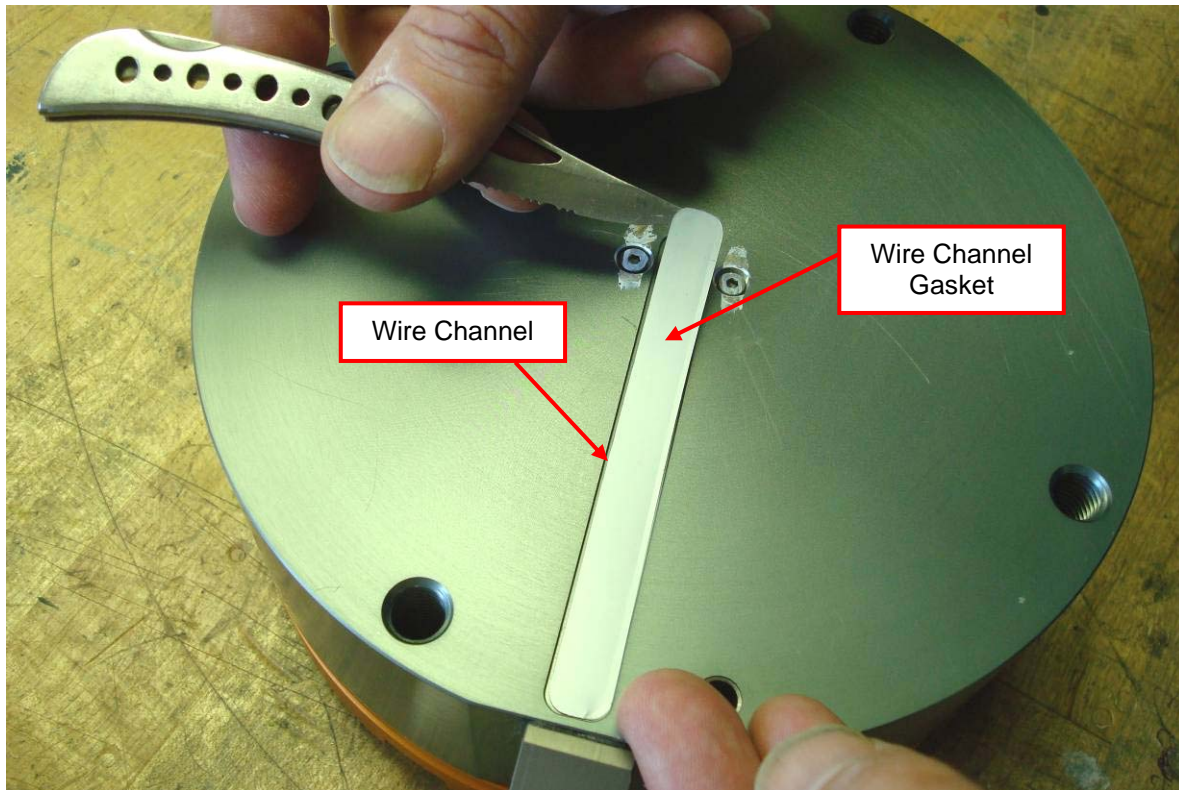


Figure 3.15—Applying Wire Channel Gasket

# 4. Drawings

## 4.1 SR-131 Replacement Parts—General

ITEM NO.	QTY.	PART NO.	DESCRIPTION	Rev.	Description	Author	Date
1	4	3500-1265025-15	M6 x 25mm SFHCS	3	ECO-6542 (110) (Rev. 3)	JAW	4/23/2008
2	1	9160-STEMCOVKIT-131*	Cover Plate Sub-assembly				
3	1	(Includes Items 1 & 4)	Stem Sub-assembly				
4	1	3410-0001202-01	Cover O-ring				
5	2	3500-10688020-15A	M3 x 20 SFHCS, Metric Blue NID Microspheres				
6	1	3700-60-1698	Spring Plate				
7	1	3510-1902601-20	Actuation Spring				
8	2	3700-60-1702	3mm X 12mm Stencoff				
9	1	3700-60-1699	Actuation Plate				
10	2	9160-SWITCHKIT-131	M2.5 x 6mm SFHCS, Black Oxide				
11	1	(Includes Item 16)	Spring Stop				
12	1		Switch Carrier Spring				
13	1		Switch Assembly				
14	1	3450-0001009-01	1/8" Pipe Plug, Air Supply Port				
15	1	3450-0001021-01	1/8" Pipe Plug, Air Supply Port				
16	1	3500-1968006-12E	M3 x 6 SFHCS, Black Oxide, Nylon Patch				
17	1	3700-60-1908	Wire Channel Gasket				
18	1	3700-60-1653	Molded Wire Channel Gasket (Use with C1, C3 and C5 Boats)				
19	1	9160-CON-1**	Connector Block Assembly				

\* For units with grey covers add ".S" to end of part number.  
 \*\* Units with grey covers use 9160-CON-2.

**Notes:**

1. See sheet 2 for optional boots and shields.
2. Apply the specified grade of Loctite / tighten fasteners to the specified torque.

**ATI INDUSTRIAL AUTOMATION**

1031 Goodworth Drive, Apex, NC 27539, USA  
 Tel: +1 919.772.0115 Email: info@ati-ia.com  
 Fax: +1 919.772.8259 www.ati-ia.com  
 ISO 9001 Registered Company

DATE: 3/1/2008	BY: D. Wagner	DATE: 4/23/2008	TITLE: SR-131 Collision Sensor Assembly
SCALE: 1:2	SCALE: B	SCALE: B	SCALE: 9230-60-1132-01
PROJECT: 9230-60-1132-01	PROJECT: 9230-60-1132-01	PROJECT: 9230-60-1132-01	PROJECT: 9230-60-1132-01
ASSEMBLY: 2/1	ASSEMBLY: 2/1	ASSEMBLY: 2/1	ASSEMBLY: 2/1

PAGE 1 OF 2

### 4.2 SR-131 Replacement Parts—Boots and Shields

ITEM NO.	QTY.	PART NO.	DESCRIPTION	Rev.	Description	Date
1	1	NSS	Upper Boot Retainer		See Sheet 1	
2	14	NSS	M3 x 8 SFHCS, Metric Blue, Microspheres Epoxy			
3	1	NSS	Lower Boot Retainer			
4	1	3700-60-1307	Boot			
5	1	3410-0001202-01	O-Ring, .105mm ID x 2mm			
6	1	NSS	Weld Splatter Shield			
7	1	NSS	EDPD Rubber Seal			
8	2	NSS	Garter Spring			
9	1	3700-60-1563	Flexible Boot			
10	1	3700-60-1663	Molded Wire Channel Gasket			

NSS - Not sold separately - purchase the appropriate repair kit.

**9160-BOOT-131**  
(Repair Kit for C1 - IP65 Boot)

**9160-FLEXBOOT-131**  
(Repair Kit for C5 Coolant Protection Boot)

NOTE: UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN MILLIMETERS  
DIMENSIONS IN PARENTHESIS ARE IN INCHES

SCALE: 1:1

DATE: 5/8/2008

DRAWING NUMBER: 9230-60-1132-01

PRODUCT CODE: 070517-2 DATE: SHEET 2 OF 2

DRAWN BY: W. B. 5/8/2008

CHECKED BY: D. WAGNER 4/25/2008

DESIGNED BY: W. B. 5/8/2008

TITLE: SR-131 Collision Sensor Assembly

1031 Goodworth Drive, Apex, NC 27539, USA  
Tel: +1 919.772.0115 Email: info@ati-ia.com  
Fax: +1 919.772.8259 www.ati-ia.com  
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### 4.3 SR-176 Replacement Parts—General

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	4	3500-126040-15	M8 x 40mm SFHCS
2	1	9760-STEMCOVKIT-176*	Cover Plate Sub-assembly
3	1	(Includes Items 1 & 4)	Stem Sub-assembly
4	1	3410-0001206-01	Cover O-ring
5	4	3500-1058025-12E	M3 x 25 SFHCS, Zinc Plated, Nylon Patch
6	1	3700-60-1662	Spring Plate
7	1	3610-8201501-20	Actuation Spring
8	4	3700-60-1666	6mm x 15mm Standoff
9	1	3700-60-1663	Actuation Plate
10	2	9760-SWITCHKIT-176	M2.5 x 6mm SFHCS, Black Oxide
11	1	(Includes Item 16)	Spring Stop
12	1		Switch Cammer Spring
13	1		Switch Assembly
14	1	3490-0001009-01	1/8" Pipe Plug, Air Supply Port
15	1	3490-0001021-01	Rc. 1/8" Pipe Plug, Air Supply Port
16	1	3500-1968008-12E	M3 x 8 SHSS, Black Oxide, Nylon Patch
17	1	3700-60-1264	Wire Channel Gasket
	1		Molded Wire Channel Gasket (Use with C1, C3 and C5 Boats)
	1	9760-CONN-1**	Connector Block Assembly

\* For units with grey covers add "S" to end of part number.  
 \*\* Units with grey covers use 9160-CONN-2.

DETAIL D  
SCALE 1 : 1

**Notes:**

1. See sheet 2 for optional boots and shields.
2. Apply the specified grade of Loctite / tighten fasteners to the specified torque.

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Rev. 01 Description ECO-6599; Initial Version Date 4/14/2008 Initiator DAW

1031 Goodworth Drive, Apex, NC 27539, USA  
 Tel: +1.919.772.0115 Email: info@ati-ia.com  
 Fax: +1.919.772.8259 www.ati-ia.com  
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ATI INDUSTRIAL AUTOMATION

SR-176 Collision Sensor Assembly

SCALE 3:8 SIZE B DRAWING NUMBER 9230-60-1126-01

PRODUCT RELEASE # 070517-2 DATE: SHEET 1 OF 2

### 4.4 SR-176 Replacement Parts—Boots and Shields

Rev.	Description	Initiator	Date
	See Sheet 1		

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 NOT TO BE REPRODUCED IN ANY MANNER EXCEPT ON  
 ORDER OR WITH TRACK WRITTEN AUTHORIZATION OF ATI

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	NSS	Upper Boot Retainer
2	14	NSS	M3 x 8 SFHCS, Metric Blue, Microsphere Epoxy
3	1	NSS	Lower Boot Retainer
4	1	3700-967-288	Boot
5	1	3410-0007-208-01	5.985 ID X .070 W O-RING
6	1	NSS	Weld Splatter Shield
7	1	NSS	Weld Splatter Shield
8	1	NSS	Weld Splatter Shield
9	2	NSS	Gate Spring
10	1	3700-967-1581	Flexible Boot
11	1	3700-967-1664	Molded Wire Channel Gasket

NSS - Not sold separately - purchase the appropriate repair kit.

**9160-FLEXBOOT-176**  
 (Repair Kit for C5 Coolant Protection Boot)

**9160-BOOT-176**  
 (Repair Kit for C1 - IP65 Boot)

**9160-SHIELD-176**  
 (Repair Kit for C2 Weld Splatter Shield)

NOTES: UNLESS OTHERWISE SPECIFIED  
 DO NOT SCALE DRAWING. DRAWN IN SOLIDWORKS.  
 ALL DIMENSIONS ARE IN MILLIMETERS.

3rd ANGLE PROJECTION

**ATI INDUSTRIAL AUTOMATION**

1031 Goodworth Drive, Apex, NC 27539, USA  
 Tel: +1 919 772.0115 Email: info@ati-ia.com  
 Fax: 919 772.8259 www.ati-ia.com  
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SR-176 Collision Sensor Assembly

DATE: 4/14/08  
 DRAWN BY: D. Wagner

SCALE: 1:4  
 WEIGHT: B  
 DRAWING NUMBER: 9230-60-1126-01

PRODUCT RELEASE #: 070517-2 DATE:      SHEET 2 OF 2

### 4.5 SR-221 Replacement Parts—General

REV.	QTY.	PART NO.	DESCRIPTION	INITIATOR	DATE
01	4	3500-1070030-15A	M10 x 30mm SHCS MB w/Microspheres	DAW	4/14/2008
	1	9160-STEMCOVKIT-221*	Cover Plate Sub-assembly		
	1	(Includes Items 1 & 4)	Stem Sub-assembly		
	4	3410-0001145-01	Cover O-ring		
	4	3500-1062030-15A	M4 x 30mm SHCS MB w/Microspheres		
	1	3700-60-1676	Spring Plate		
	1	3610-2304400-20	Actuation Spring		
	4	3700-60-1681	8mm x 18mm Standoff		
	1	3700-60-1677	Actuation Plate		
	2	9160-SWITCHKIT-221	M2.5 x 6mm SFHCS, Black Oxide		
	1	(Includes Item 16)	Spring Stop		
	1		Switch Carrier Spring		
	1		Switch Assembly		
	1	3490-0001009-01	1/8" Pipe Plug, Air Supply Port		
	1	3490-0001021-01	1/8" Pipe Plug, Air Supply Port		
	1	3500-1865008-12E	M3 x 8 SHCS, Black Oxide, Nylon Patch		
	1	3700-60-1346	Wire Channel Gasket		
	1	3700-60-1665	Modded Wire Channel Gasket (Use with C1, C3 and CS Bores)		
	1	9160-CON-1**	Connector Block Assembly		

\* For units with grey covers add "-S" to end of part number.  
 \*\* Units with grey covers use 9160-CON-2.

**Notes:**

1. See sheet 2 for optional boots and shields.
2. Apply the specified grade of Loctite / tighten fasteners to the specified torque.
3. Screw in until touching bottom of groove in piston and then back out 1/2 turn.

**ATI INDUSTRIAL AUTOMATION**

1031 Goodworth Drive, Apex, NC 27539, USA  
 Tel: +1 919 772 0115 Email: info@ati-ia.com  
 Fax: +1 919 772 8259 www.ati-ia.com  
 ISO 9001 Registered Company

TITLE: SR-221 Collision Sensor Assembly  
 DRAWN BY: D. Wagner, 4/14/08  
 CHECKED BY: WB 4/16/08  
 WEIGHT LBS: \*\*\*\*\*  
 ASSEMBLY P/E: \*\*\*\*\*  
 SCALE: 1:3 USE B DRAWING NUMBER: 9230-60-1127-01  
 PRODUCT RELEASE #: 070517-2 DATE: SHEET 1 OF 2

### 4.6 SR-221 Replacement Parts—Boots

Rev.	Description See Sheet I	Initiator	Date

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	4	NSS	M3 x 8 SFFCS, Metric Blue, Microspheres Epoxy
2	1	NSS	Upper Boot Retainer
3	12	NSS	M4 x 8 SFFCS, Zinc
4	1	NSS	Lower Boot Retainer
5	1	3700-60-1356	Boot
6	1	3410-0001145-01	O-Ring AS568-168
7	1	3700-60-1665	Molded Wire Channel Casket
8	2	NSS	Garner Spring
9	1	3700-60-1585	Flexible Boot

PROPERTY OF ATI INDUSTRIAL AUTOMATION, INC.  
 NOT TO BE REPRODUCED IN ANY MANNER EXCEPT ON  
 ORDER OR WITH PRIOR WRITTEN AUTHORIZATION OF ATI.

**9160-BOOT-221**  
 Repair Kit for C1-IP65 Boot

**9160-FLEXBOOT-221**  
 (Repair Kit for C5 Coolant Protection Boot)

NOTES: UNLESS OTHERWISE SPECIFIED  
 DO NOT SCALE DRAWING. DRAWN IN SOLIDWORKS.  
 ALL DIMENSIONS ARE IN MILLIMETERS.

DRAWN BY: D. Wagner, 4/14/08  
 CHECKED BY: WB 4/16/08  
 WEIGHT LBS: \*\*\*\*\*  
 ASSEMBLY REF: \*\*\*\*\*

TITLE: SR-221 Collision Sensor Assembly  
 SCALE: 1:5  
 DRAWING NUMBER: 9230-60-1127-01  
 PRODUCT RELEASE # 070517-2 DATE: SHEET 2 OF 2

**ATI INDUSTRIAL AUTOMATION**  
 1031 Goodworth Drive, Apex, NC 27539, USA  
 Tel: +1.919.772.0115 Email: info@ati-ia.com  
 Fax: +1.919.772.8259 www.ati-ia.com  
 ISO 9001 Registered Company

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