Smart-Shox Suspension

GENERAL INFORMATION

It is important that you disconnect the ground cable before proceeding with any smart shock repair, failure to do so will cause a fault code.

To perform the first service on your smart suspension you will need (2) 5mm x 30mm Phillips head stainless screws with wax nuts.

01 General Information

General

The following tools are required to test most of the electrical components.

Fluke 115 Multimeter (P/N 529035868)	
SDCU Adapter Tool Gen 2 (P/N 529036531)	
Smart-Shox Sensor Adaptor (P/N 529036530)	

01

System Description (Features)

The Smart-Shox suspension is an electronic-controlled compression and rebound damping system integrated in front and rear shock absorbers.

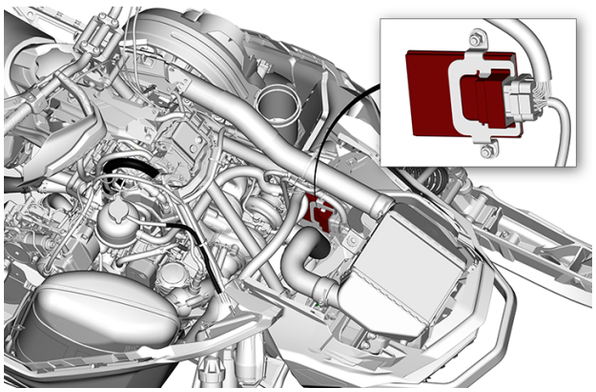
It is possible to choose between three modes of damping. These modes set the level of damping to match the rider's preferences.

The following Smart-Shox modes are preset in the vehicle.

SMART-SHOX MODE	
COMFORT	This mode provides maximum comfort. The suspension moves freely while controlling body movement to avoid regular bottoming out.
SPORT	This mode enhances handling and provides comfort in straight line. The suspension minimizes body movement during cornering, acceleration and braking while offering optimal calibration to face bumpy trails.
SPORT+	This mode is all about performance, forget comfort. In full stiffness all the time and ready to tackle the most extreme situations.

Suspension Damping Control Unit (SDCU)

The Suspension Damping Control Unit (SDCU) is the heart of the Smart-Shox system.



The SDCU receives inputs from several sensors and controls the bypass valve opening in each front and rear shock absorbers to adjust the compression and rebound damping.

SDCU INPUTS/ OUTPUTS		
INPUT	**USAGE**	**OUTPUT**
SPS (4)	These sensor signals (or parameters) are used by the SDCU to perform computations and to then act by providing the proper output to the shock absorbers.	Modulate shock bypass valve opening of proper shock absorber.
ECM		
SAS		
Mode switch		

Sensors

Suspension Position Sensor (SPS)

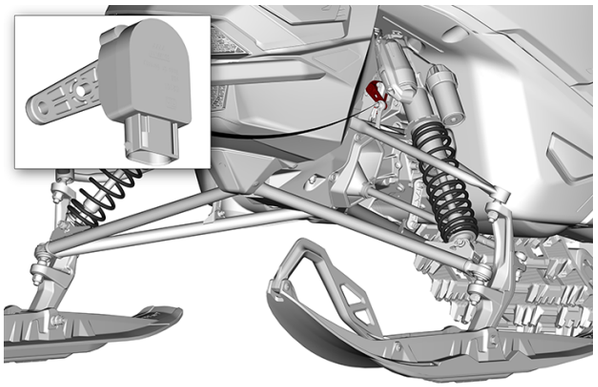
There are 4 suspension position sensors on the vehicle.

The front suspension sensors are mounted on the frame and linked to the suspension arms.

The rear suspension sensors are virtually linked to the suspension by a magnet located in the arm pivot with which it is aligned.

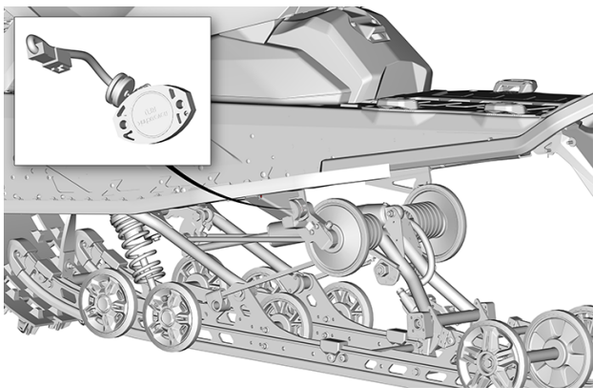
As the suspension moves, the sensors read the movement and send a signal to the SDCU to tell if the suspension is compressing or rebounding.

Figure 1. Front Suspension Arm



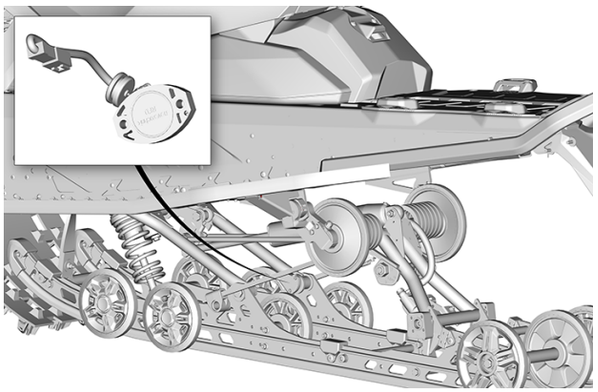
FRONT SUSPENSION ARM

Figure 2. Rear Suspension Arm



REAR SUSPENSION ARM

Figure 3. Middle Suspension Arm

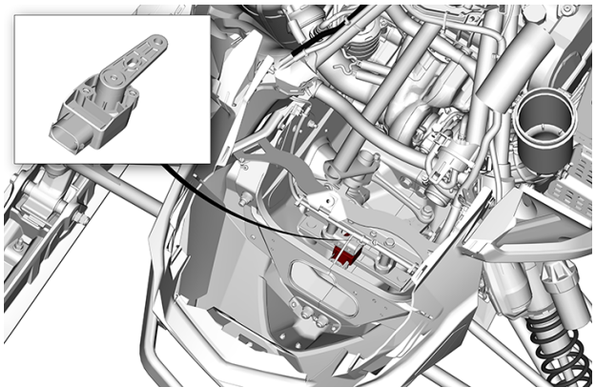


MIDDLE SUSPENSION ARM

Steering Angle Sensor (SAS)

The steering angle sensor is mounted on the frame and linked to the steering column.

The SAS informs the SDCU of the handlebar position in relation to the chassis.



SENSOR ACRONYM	DESCRIPTION	FUNCTION
SPS_FL	Front left suspension position sensor	Determines the position of the LH front suspension
SPS_FR	Front right suspension position sensor	Determines the position of the RH front suspension
SPS_Mid	Middle suspension arm position sensor	Determines the position of the middle suspension arm
SPS_Rear	Rear suspension arm position sensor	Determines the position of the rear suspension arm
SAS	Steering angle sensor	Determines the position of the handlebar in relation to the chassis

SDCU INPUTS / OUTPUTS		
INPUT	**USAGE**	**OUTPUT**
SPS (4)	These sensor signals (or parameters) are used by the SDCU to perform computations and to then act by providing the proper output to the shock absorbers.	Modulate shock bypass valve opening of proper shock absorber.
ECM		
SAS		
Mode switch		

Calibrating the SDCU

When replacing or removing any of the following parts, the learning procedure must be performed.

– Suspension Position Sensor (SPS) bracket
– Suspension Position Sensor Link
– Suspension Position Sensor (SPS)
– Suspension Damping Control Unit (SDCU)
– Shock absorbers
– Stabilizer bar
– Suspension arms
– Rear suspension
– Track

1. Connect the vehicle to the BRP diagnostic software (BUDS2). Refer to *COMMUNICATION TOOLS*.
2. Properly lift and support the rear of the vehicle.
   – The rear suspension must be fully extended.
   – The limiter strap must be in position #1.
3. In BUDS2, go to:
   – **Settings** page,
   – Select **SDCU** button from ECU tree
   – **Learn suspension setting**.
4. When the learning is done, lower rear of vehicle.
5. Properly lift and support the front of the vehicle. The front suspension must be fully extended.
6. Ensure the handlebar is perfectly centered.
7. In BUDS2, go to:
   – **Settings** page,
   – Select **SDCU** button from ECU tree
   – **Learn suspension setting**.

Always refer to the *WIRING DIAGRAM* when troubleshooting an electrical circuit.

It is recommended to use the power supply interface for any tests that involve a prolonged "key ON" period.

Power Supply Interface (P/N 515177223)	

It is recommended to turn off the headlights using the switch by pressing down 2 seconds.

NOTICE
Never force a multimeter probe into an electrical terminal.

Troubleshooting Tips

When a fault is detected due to a malfunction of the Smart-Shox system, depending of the defective component, front shocks, rear shocks or all shocks will become full stiff, even firmer than SPORT+.

Start troubleshooting by checking fault codes using BUDS2. Make sure fuses FB1-F5 and PB1-F4 on ACE engine vehicles and F5 and F4 for E-Tec engine vehicles are in good condition; follow the service actions of the fault in BUDS2.

Carry out the tests in this subsection according to the fault codes service actions. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

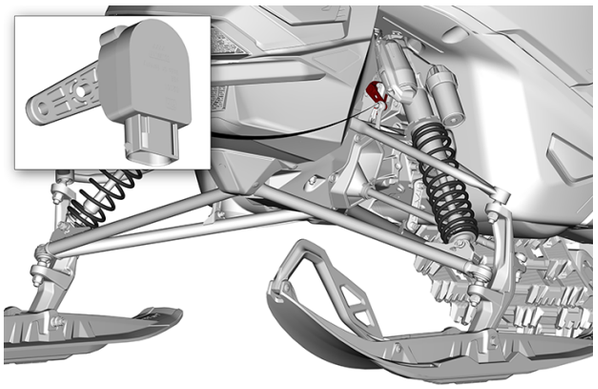
Suspension Position Sensor (SPS)

Before testing the SPS make sure that:

– Suspension position sensors and links are correctly fastened and undamaged.
– Sensor brackets are not bent, cracked or loose.

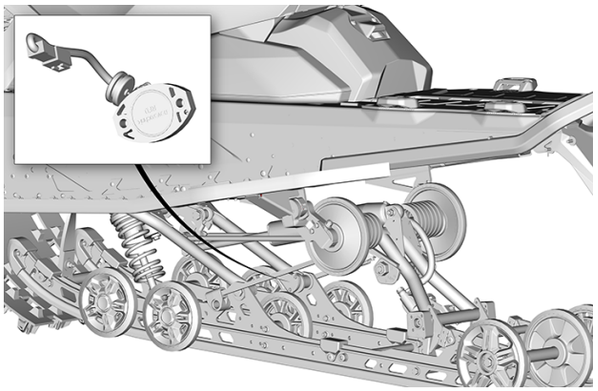
SPS Location

Figure 4. Front Suspension Arm



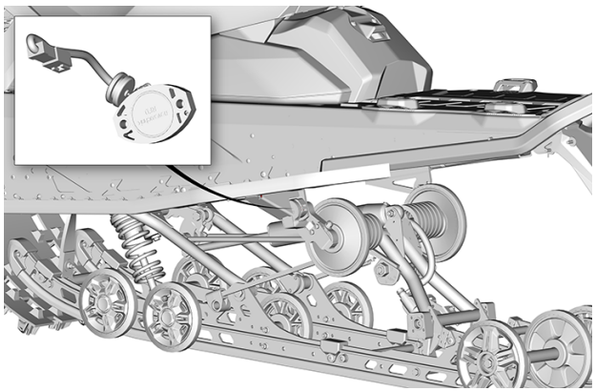
FRONT SUSPENSION ARM

Figure 5. Middle Suspension Arm



MIDDLE SUSPENSION ARM

Figure 6. Rear Suspension Arm



REAR SUSPENSION ARM

Testing the SPS with BUDS2

1. Connect vehicle to BUDS2.
2. In BUDS2, select the following:
   - **Scan** button
   - **Measurements** page
3. Rock the vehicle from right to left.
4. Look in BUDS2 to see if the corresponding sensor value changes.

   If one of the sensor gauges does not respond to suspension movement, refer to *TESTING SPS WIRING CONTINUITY*.

Testing SPS Wiring Continuity

1. Disconnect the SPS connector to be tested and install the sensor adaptor.
2. Disconnect SDCU connector and connect it to the SDCU adapter tool.
3. Set multimeter to Ω.
4. Measure wiring resistance as follows.

SPS WIRING CONTINUITY TEST			
SPS	SENSOR ADAPTER PIN	SDCU ADAPTER PIN	SPECIFICATION
Front LH	1	11	Close to 0 Ω (continuity)
	2	12	
	3	20	
Front RH	1	7	
	2	8	
	3	16	
Mid Arm	6	15	
	7	23	
	8	31	
Rear Arm	6	14	
	7	22	
	8	31	

If continuity test failed, repair wiring or connectors.

If continuity test succeeded, try a new SPS.

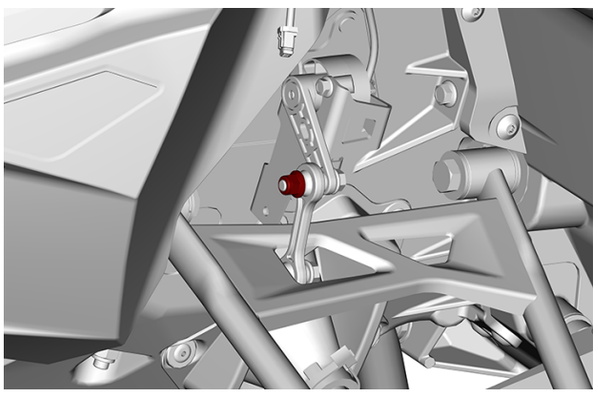
If problem persists, try a new SDCU.

Replacing the SPS

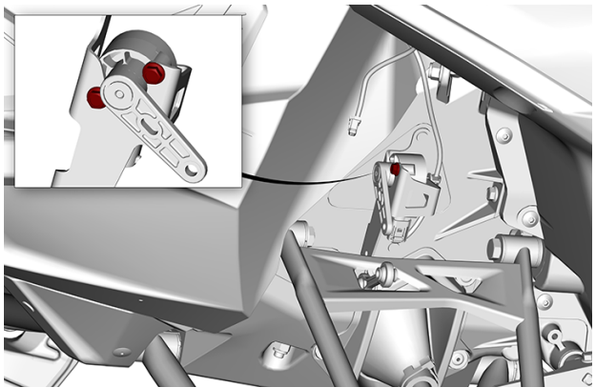
When replacing a SPS, a SDCU learning must be performed. Refer to the procedure in this subsection.

Removing the Front SPS

1. Disconnect the sensor connector.
2. Remove the shock absorber. Refer to *Removing the Shock Absorber* in the *Front Suspension* subsection.
3. Remove link rod screw, discard nut.



4. Remove the sensor retaining screws.



5. Remove the sensor.

Installing the Front SPS

The installation is the reverse of the removal procedure. However, pay attention to the following.

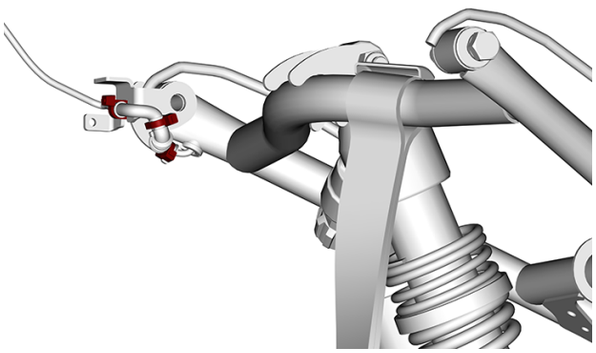
1. Install a new link rod nut.

Tightening Torque	
Sensor retaining screws	5 ± 1Nm (44 ± 9 lbf-in)
Link rod nut	

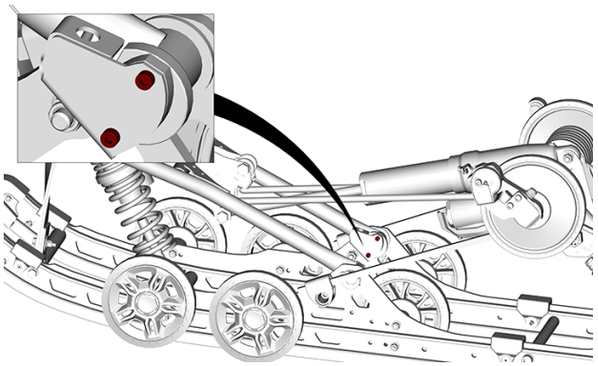
2. Install shock absorber. Refer to *Installing the Shock Absorber*.

Removing the Middle SPS

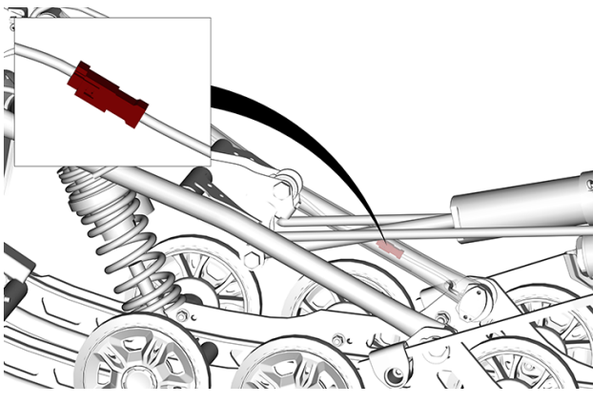
1. Remove the rear suspension. Refer to *Removing Rear Suspension Assembly* in this subsection.
2. Remove locking ties holding the harness to the suspension arm bracket. Ensure not to damage the harness.



3. Remove sensor protector screws, sensor protector and sensor.



4. Carefully route sensor connector out of the arm tube.



5. Disconnect sensor connector.

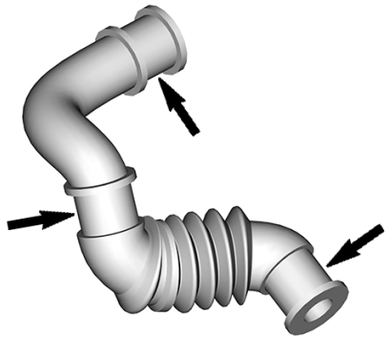
Installing the Middle SPS

The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Connect sensor connector.
2. Properly route harness connector back in the tube.
3. Make sure not to leave any tension in the harness between the sensor and the first locking tie.
4. Secure the harness on the suspension arm bracket as shown.

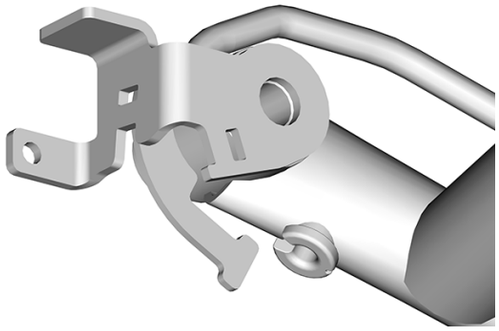
NOTICE
make sure to install the locking ties in the grooves of the harness protector in the exact same position.

Figure 7. Locking ties grooves



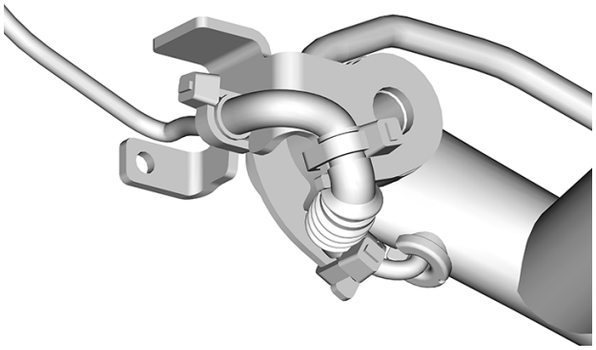
LOCKING TIES GROOVES

Figure 8. Installed bracket



INSTALLED BRACKET

Figure 9. Completed assembly



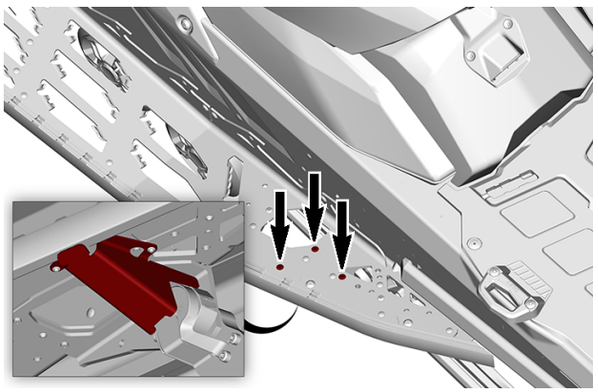
COMPLETED ASSEMBLY

5. Tighten sensor retaining screws to specification.

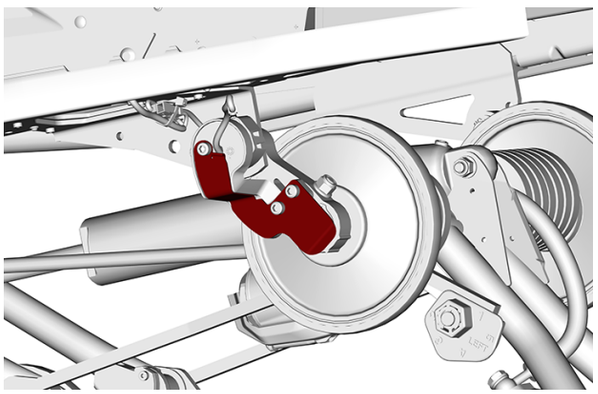
Tightening Torque	
Sensor retaining screw	2.5± 0.5 Nm (22 ± 9 lbf-in)

Removing the Rear SPS

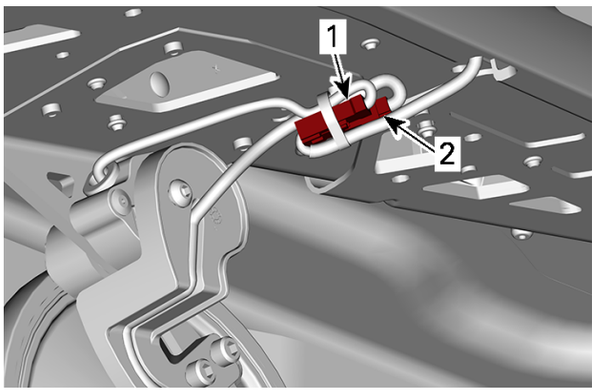
1. Remove sensor protector by drilling the rivets.



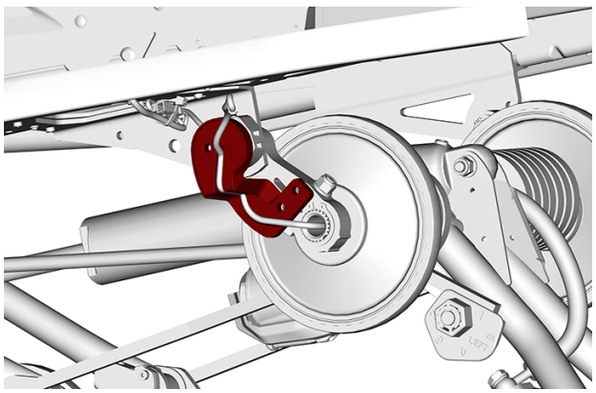
2. Remove protection plate.



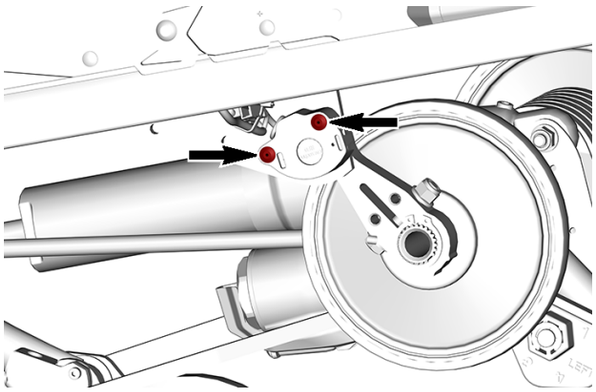
3. Disconnect sensor and Smart-Shox connectors



   1. Smart-Shox connector
   2. Sensor connector
4. Remove sensor lever.



5. Remove sensor support by drilling the rivets.

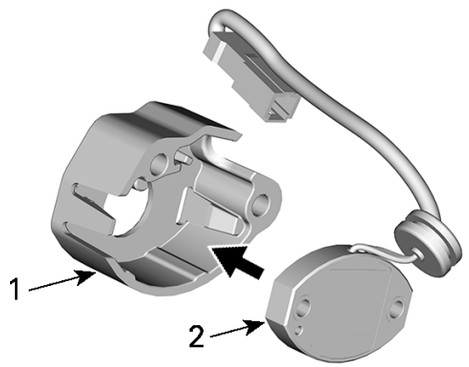


6. Remove sensor from sensor support.

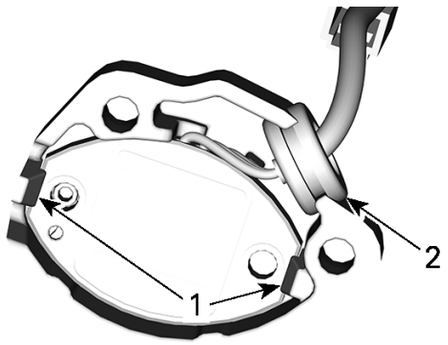
Installing the Rear SPS

The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Properly install the sensor in sensor support as shown before proceeding.

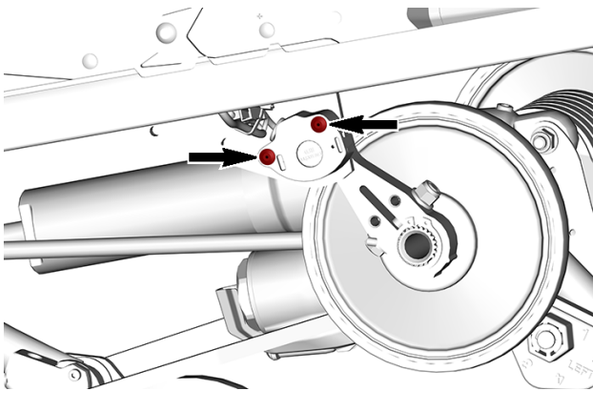


1. *Sensor support*
2. *Sensor*

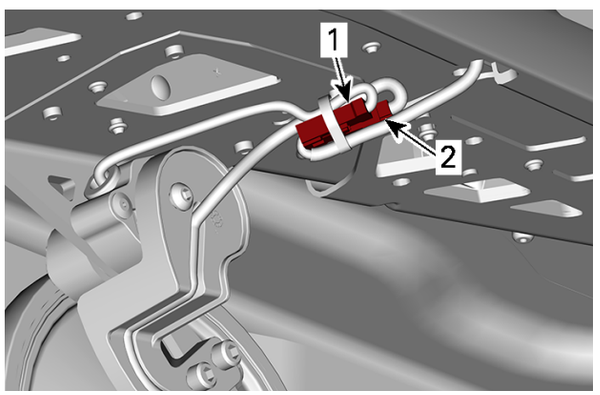


1. *Fully inserted in tabs*
2. *Wire grommet fully seated*

2. Install and secure the sensor assembly on the suspension anchor using new rivets.

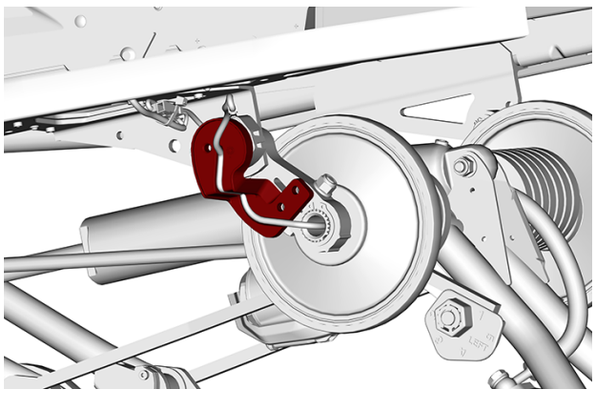


3. Connect the sensor and Smart-Shox connectors.

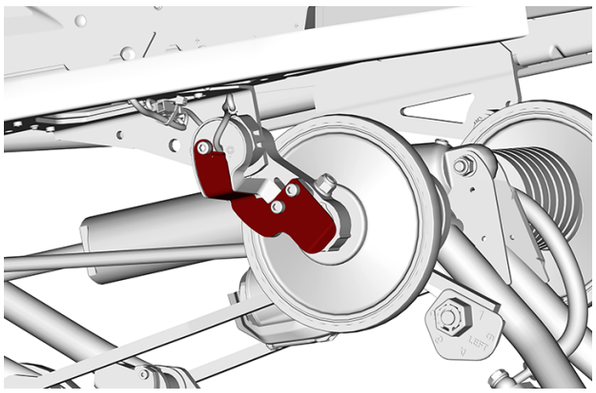


1. Smart-Shox connector
2. Sensor connector

4. Install sensor lever.

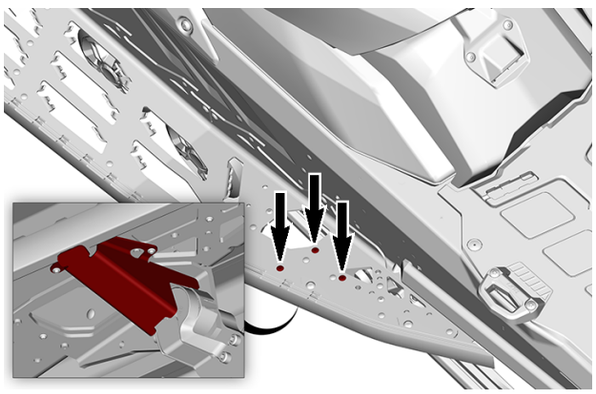


5. Install the Smart-Shox harness protection plate.



Tightening Torque	
Protection plate screw	5 ± 1Nm (44 ± 9 lbf-in)

6. Install sensor protector and secure using new rivets.

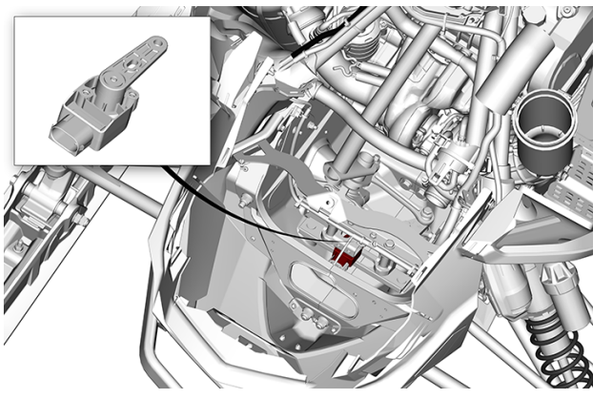


Steering Angle Sensor (SAS)

Before testing the SAS make sure that:

– Steering angle sensor and link is correctly fastened and undamaged.
– Sensor bracket is not bent, cracked or loose.

SAS Location



Testing SAS Wiring Continuity

1. Disconnect the SAS connector to be tested and install the connector adapter.
2. Disconnect SDCU connector and connect it to the adapter tool. Refer to *SDCU CONNECTOR ACCESS* in this subsection.
3. Set multimeter to Ω.
4. Measure wiring resistance as follows.

NOTICE
To avoid damaging the connector, probe only the terminal tip.

VAS WIRING CONTINUITY TEST		
SENSOR CONNECT.	SDCU CONNECT.PIN	SPECIFICATION
1	13	Close to 0 Ω (continuity)
2	21	
3	30	

If continuity test failed, repair wiring or connectors.

If continuity test succeeded, try a new SAS.

If problem persists, try a new SDCU.

Replacing the SAS

When replacing the SAS, a SDCU learning procedure is required. Refer to *Calibrating the SDCU* in this subsection.

Tightening Torque	
SAS screw	5 ± 1 Nm (44 ± 8.5lbf-in)

Suspension Damping Control Unit (SDCU)

SDCU Troubleshooting

NOTICE
Never probe directly on the SDCU harness connector. This could change the shape or enlarge the terminals and create intermittent or permanent contact problems.

A SDCU failure is not likely to occur. These modules have proven to be very reliable. Prior to replacing a suspected SDCU, take the following into account.

The problem can be related to a sensor malfunction. Check the following:

– Sensor correctly fastened,
– Sensor brackets are in good condition,
– SPS link are in good condition.

The problem can be related to an electric function, check the following:

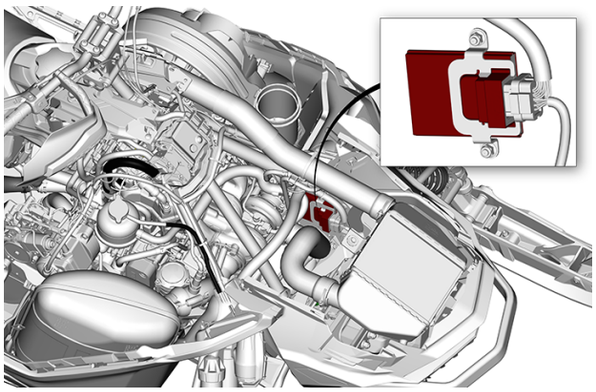
– Fault codes,
– Sensors and SDCU electrical connector,
– Wiring harness condition.

If pins or terminals are not clean, check SDCU harness connector seal condition and ensure connector mechanism properly locks connector seal against SDCU.

Try disconnecting and reconnecting the SDCU connector to see if it “cures” the problem.

As a final test, try a new SDCU.

SDCU Location



Testing the SDCU Input Voltage

1. Disconnect SDCU connector and connect it to the SDCU adaptor tool.
2. Start engine.
3. Test for input voltage as follows:

SDCU INPUT VOLTAGE TEST		
SDCU ADAPTER PIN	BATTERY	SPECIFICATION
2	Negative post	Battery voltage

If voltage is not good, check fuse, relay, wiring and connectors from battery to SDCU harness connector. Refer to WIRING DIAGRAM.

If voltage is good, test for input voltage as follows:

Ignition switch can be either ON or OFF.

SDCU INPUT VOLTAGE TEST		
SDCU ADAPTER PIN	BATTERY	SPECIFICATION
3	Negative post	Battery voltage

If voltage is not good, check the fuse, wiring and connectors from battery to SDCU harness connector. Refer to WIRING DIAGRAM.

If voltage is good, carry out the TESTING THE SDCU GROUND CIRCUIT in this subsection.

Testing the SDCU Ground Circuit

1. Check the ground circuit as per the following

SDCU GROUND CIRCUIT		
SDCU ADAPTOR PIN	BATTERY	SPECIFICATION
1	Positive (+) Post	Battery voltage

If ground circuits are not good, check wiring from SDCU harness connector to chassis ground located on the RH rear part of the frame. Refer to *POWER DISTRIBUTION AND GROUNDS*.

Testing the SDCU CAN Line Continuity

1. Check wiring resistance between diagnostic link connector and SDCU as per the following table.

SDCU CAN Line Continuity Test			
CAN*	SDCU ADAPTOR PIN	COM	SPECIFICATION
High	19	Pin 1	Close to 0 Ω (continuity)
Low	27	Pin 2	
*CAN: Controller Area Network			

If continuity is not good, check wiring and connectors from diagnostic link connector (COM) to SDCU connector. Refer to applicable *WIRING DIAGRAM*.

If everything tested good and SDCU does not work, try a new SDCU.

Removing the SDCU

1. Remove upper body module.
2. Disconnect SDCU connector.
3. Remove the SDCU retaining screws.
4. Remove SDCU from the vehicle.

Installing the SDCU

The installation is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
SDCU screw	5 ± 1 Nm (44 ± 9 lbf-in)

1. Perform a learning procedure. Refer to *CALIBRATING THE SDCU* in this subsection.
2. Clear all SDCU fault codes generated by this procedure.

Smart-Shox Absorbers

Testing the Smart-Shox Absorber Resistance (from the SDCU connector)

1. Disconnect SDCU connector and connect it to the SDCU adaptor tool.
2. Disconnect the Smart-Shox harness extension from the main harness.
3. Connect the Smart-Shox sensor adaptor to the main harness Smart-Shox connector.
4. Test for resistance as follows.

SMART-SHOX ABSORBER RESISTANCE TEST (from the SDCU connector)			
SHOCK POSITION	ECM ADAPTOR PIN	SENSOR ADAPTER CONNECT. PIN	SPECIFICATION
Front left	17	5	Close to 0 Ω (continuity)
	9	6	
Front right	1	5	
	10	6	
Rear	18	5	
	26	6	

If continuity is not to specification, check for wire or connector damage, and repair. If continuity is to specification, carry out a *SMART-SHOX ABSORBER RESISTANCE TEST (FROM THE SMART-SHOX)*

If everything tested good and SDCU does not work, try a new SDCU.

Testing the Smart-Shox Absorber Circuit Continuity

1. Disconnect SDCU connector and connect it to the SDCU adaptor tool.
2. Disconnect the Smart-Shox harness extension from the main harness.
3. Connect the Smart-Shox sensor adaptor to the main harness Smart-Shox connector.
4. Test for resistance as follows.

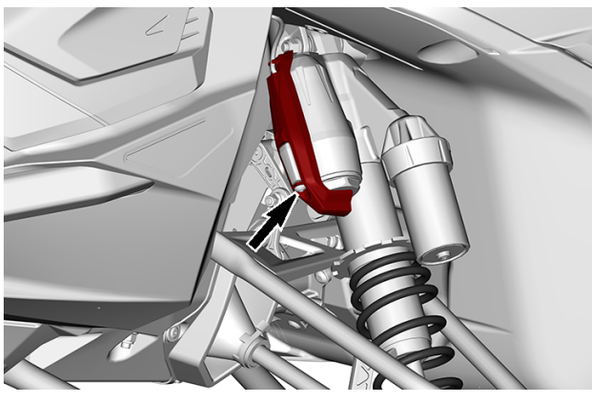
SMART-SHOX ABSORBER CIRCUIT CONTINUITY TEST			
SHOCK POSITION	ECM ADAPTOR PIN	SENSOR ADAPTER CONNECT. PIN	SPECIFICATION
Front left	17	5	Close to 0 Ω (continuity)
	9	6	
Front right	1	5	
	10	6	
Rear	18	5	
	26	6	

If continuity is not to specification, check for wire or connector damage, and repair. If continuity is to specification, carry out a *SMART-SHOX ABSORBER RESISTANCE TEST (FROM THE SMART-SHOX)*

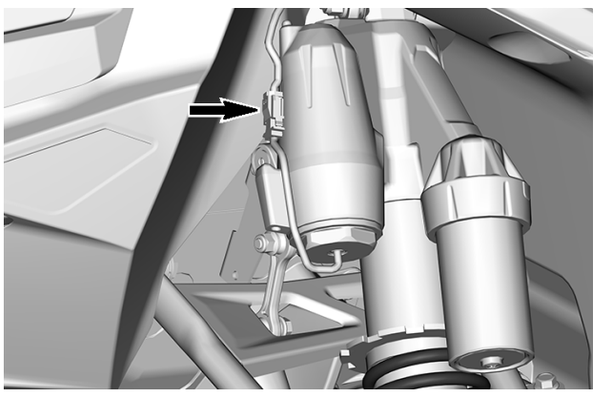
If everything tested good and SDCU does not work, try a new SDCU.

Testing the Smart-Shox Absorber Resistance (from the Smart-Shox absorber)

1. Remove the smart-Shox cover by removing the retaining screw.



2. Disconnect the Smart-Shox harness extension from the Smart-Shox absorber.



3. Test for resistance as follows.

SMART-SHOX ABSORBER RESISTANCE TEST (FROM THE SMART-SHOX ABSORBER)		
SMART-SHOX PIN		SPECIFICATION
1	2	4.3 Ω

If resistance is not to specification, replace the Smart-Shox.

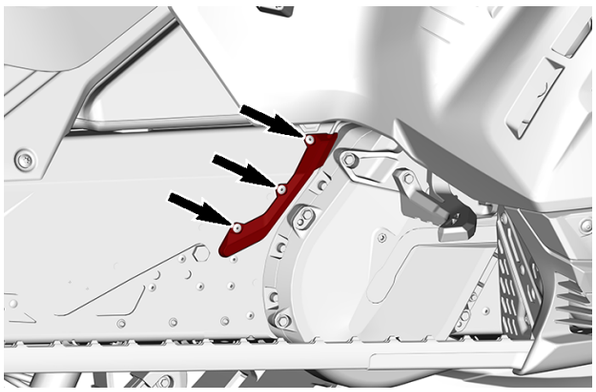
If resistance is to specification, replace the Smart-Shox harness extension.

Rear Suspension Assembly

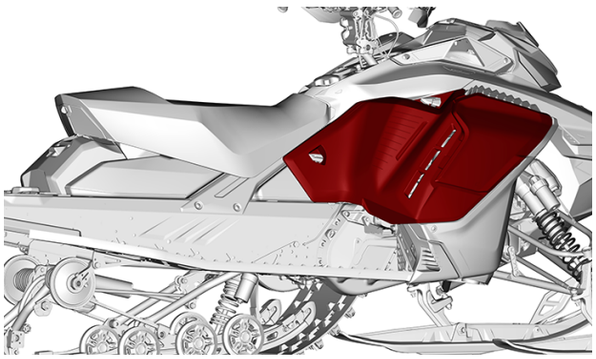
This procedure only covers the Smart Shox specific components. For complete information, refer to *rMotion Rear Suspension* subsection.

Removing the Rear Suspension Assembly

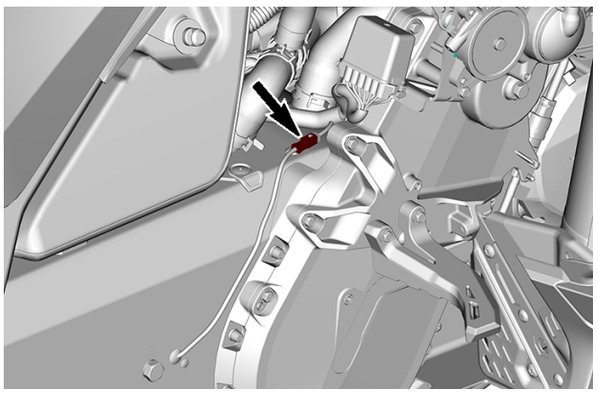
1. Lift rear of vehicle and support it off the ground.
2. Completely release track tension.
3. Remove harness protector by drilling the rivets.



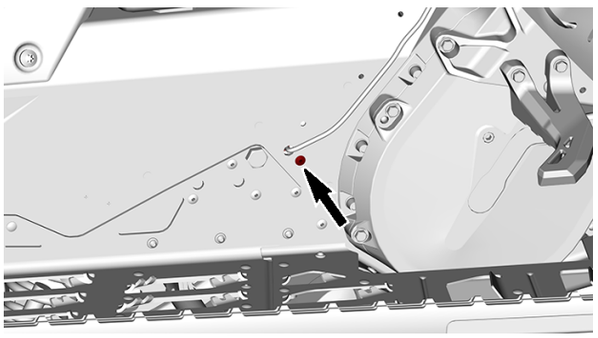
4. Remove the RH side panel.



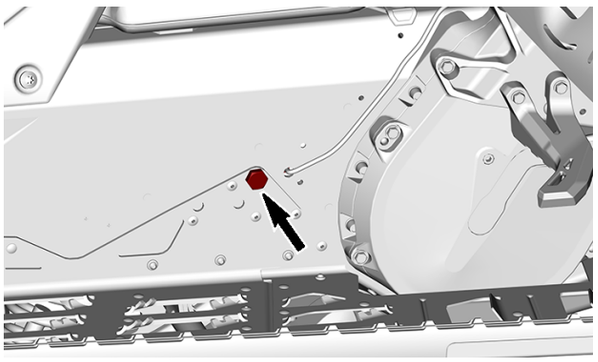
5. Disconnect the middle SPS connector.



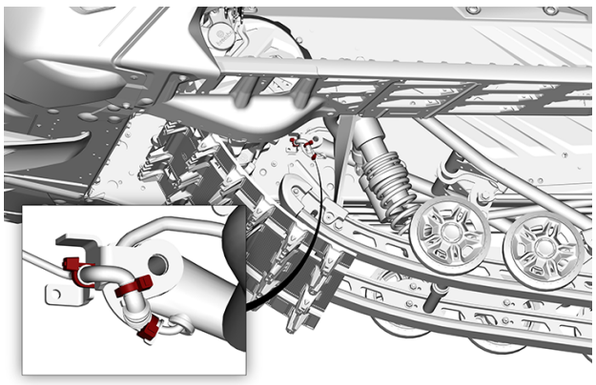
6. Drill rivet.



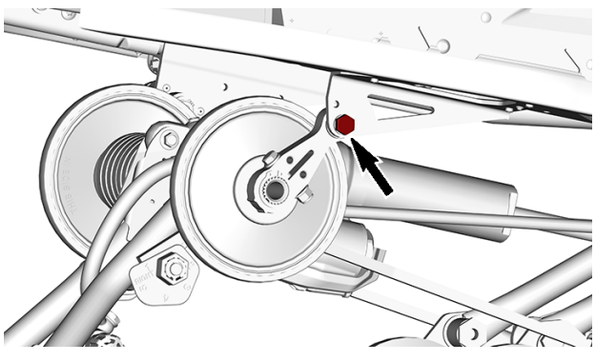
7. Route the mid sensor harness through the tunnel hole.
8. Remove the rear SPS. Refer to the procedure in this subsection.
9. Remove and discard front arm upper bolts.



Do not remove the locking ties if the mid SPS or the arm is not to be removed.



10. Remove and discard rear arm connecting rods retaining screws. Refer to *Rear Suspension* subsection.



11. Remove the suspension.

Installing the Rear Suspension Assembly

The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Refer to *Installing the Suspension Assembly* in *rMotion Rear Suspension* subsection for procedure and appropriate tightening torque.
2. Adjust track tension, refer to *Track* subsection.
3. Reinstall the rear arm sensor.
4. Route the mid SPS harness through the tunnel and reconnect.
5. Install harness cover and secure with new rivets.
6. Secure the mid sensor harness bracket with a new rivet.
7. If the locking ties were accidently cut or middle SPS was replaced, refer to *Installing the Middle SPS* for appropriate procedure.