

Smart Suspension Troubleshooting Guide

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General Information

This guide is intended to provide information related to troubleshooting a properly installed smart suspension system and does not include provisions for identifying situations involving mis-installed components.

Product Overview

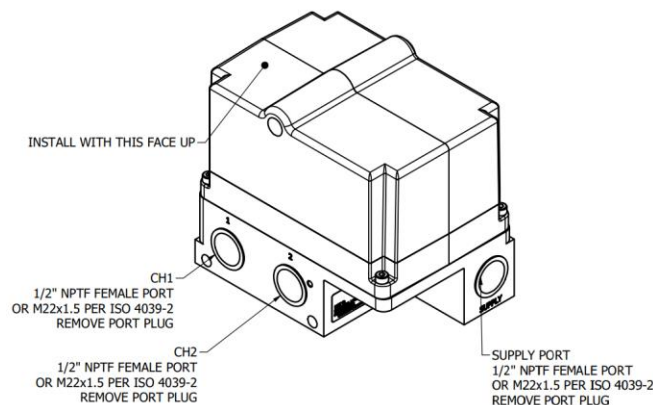
The Parker Smart Suspension is an electronically controlled air suspension system designed to work in conjunction with the bus suspension air springs, air spring height sensors, and wheelchair ramp sensor to provide the following functions:

- Improve ride control – As the bus maneuvers through corners, the system will minimize roll movement, potentially eliminating the need for a sway bar.
- Kneeling (full, front and right side) – Upon reaching a stop, the bus driver can lower the bus to the curb make entry and exit through the door easier.
- Over-raise - Raise ride height at all air spring positions (adjustable per customer spec) to allow for increased approach, break-over and departure angles for road conditions.
- Low-ride – Lower the ride height position based on vehicle speed.
- Wheelchair ramp system integration – The ride height will be adjusted (kneel) if the wheelchair ramp exceeds a predetermined angle.
- Custom height settings – Two additional height settings are also available based on end-customer needs.

System Components

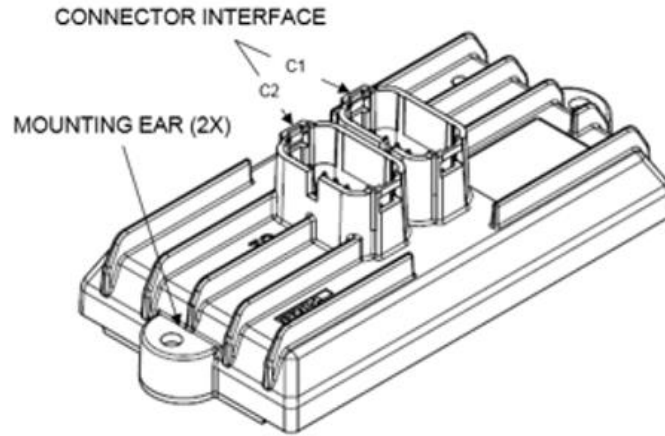
Pneumatic Control Unit (PCU)

The PCU provides independent control of the air springs' pressure based on the ride height sensor feedback. Incorporating Parker's proprietary direct acting proportional valve (DAV) design, the PCU offers high and low flow deflation/inflation performance.



Electronic Control Unit (ECU)

The Smart Suspension incorporates the CM-0711 platform ECU from Parker's Electronic Motion and Controls Division (EMC). Embedded software is developed in the MATLAB environment.



System Description

The Parker Smart Suspension™ system allows the driver to easily raise, lower, or side kneel the bus with the simple push of a dash switch, providing easy passenger loading and unloading. While the vehicle is in motion, the system independently adjusts the air spring pressures for various vehicle road and load conditions to maintain ride height.

The vehicle's existing air compressor provide the means for inflation. The PCU senses and directs the flow/pressure of air in the air springs. The PCU is controlled by the ECU which is the "brain" of the system. Height and pressure sensor inputs provide feedback to the ECU, which inflate or deflate to the appropriate target heights. Once the heights and pressures are satisfied, the Parker Smart Suspension™ monitors the height and pressures during operation to automatically adjust the air springs as needed.

The Parker Smart Suspension™ is also designed to detect system related issues, such as air spring leaks or sensor failures. Once detected, a service code is activated, and the system will automatically compensate (within the capability of the suspension system) to keep the vehicle operating smoothly until service can be provided. The driver will be notified of the fault via the dash display. Parker's specific list of service codes helps identify the source of the issue, allowing for quick repair and increased uptime.

Operating Modes

The Parker Smart Suspension System has three main operational modes during operation:

- **Normal Mode:** Full system function. Smart Suspension allows selection of ride heights, kneeling, etc. and then adjusts to the selection. All fault detection and associated service code logging is fully functional.
- **Diagnostic Mode:** Diagnostic control of system. All inputs and outputs are fully functional, but control of the system (inflating, deflating, etc.) is directed by Parker's PC based Diagnostic Tool. Fault detection and associated service codes are detected for sensor readings, data link messages, and solenoid control, however functional based codes (i.e., leaking bag, line leak, etc.) are not enabled. Note that if the system senses vehicle speed, or any height selection is requested, it will exit Diagnostic Mode and return to Normal Mode.
- **Shut Down:** The ECU has connections to both switched ignition and battery power and goes through a controlled shutdown process for up to 60 seconds following switched ignition being turned off. Note that any battery disconnect switch should not be used for a minimum of 60 seconds following key off.

Modes of Operation in Normal Mode (Degraded Modes)

When the Parker system encounters an active service code condition on a given axle, the suspension system will adjust suspension control on that axle to accommodate a reduced level of functionality. The possible levels of functionality, or degraded modes, are as follows:

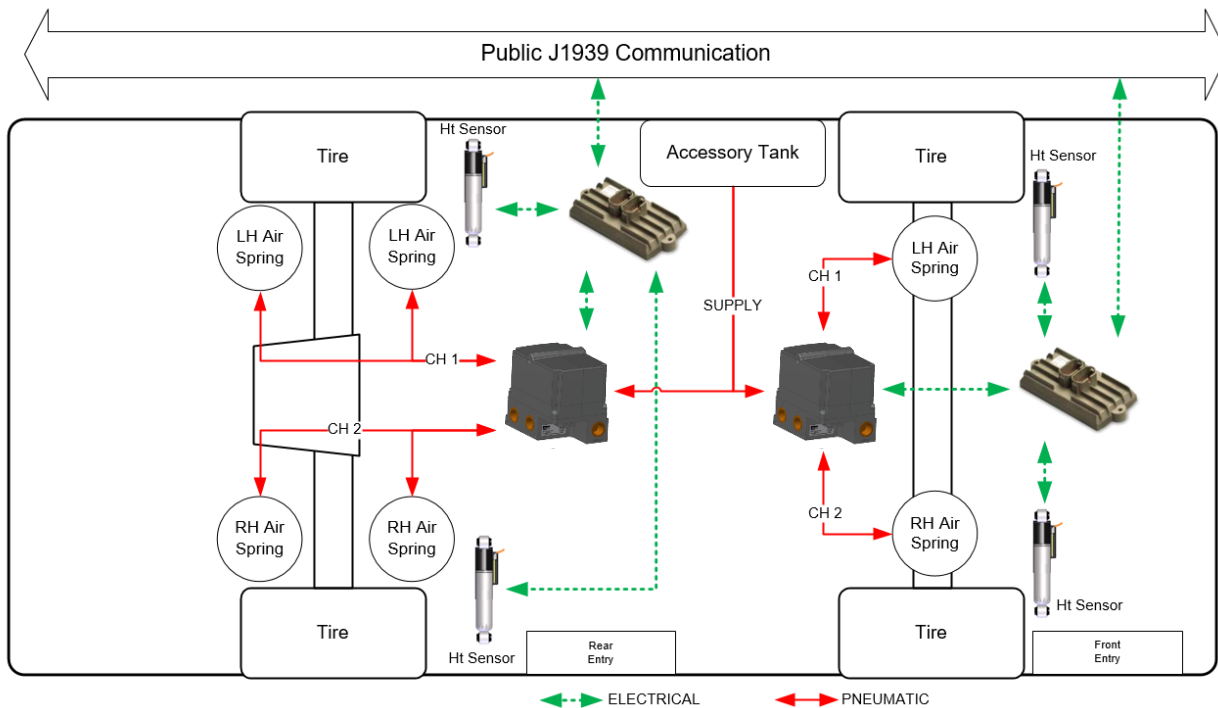
- **Normal Mode (No Degraded Mode):** The suspension system will continue to operate with no functional degradation.
- **Remain in Place:** The suspension system will remain at its current height on the axle where the active service code was detected. If two or more service codes are active on the same axle, the system will remain in place until cleared.
- **Return and Remain at Ride Height:** The suspension system located on the axle where the active service code detected will only allow driver-requested height adjustment requests that result in movement to the default ride height. Once at ride height, the suspension system will remain in place.
- **Height Balance:** The suspension system located on the axle where the active service code detected will allow height adjustment using the height sensors only.
- **Pressure Balance:** The suspension system located on the axle where the active service code detected will allow height adjustment using pressure balancing and the one remaining functional height sensor.

System Configuration

The Parker Smart Suspension System is designed to be modular meaning that a “system” (ECU and PCU) can be installed to manage air spring height and pressure at just one axle position (i.e. front axle) or be installed on all axle positions for full vehicle suspension control.

The **Appendix** contains additional information associated with a multiple system configuration as well as electrical interconnects and pinouts.

Simplified System Schematic (2-axle)



Safety Precautions

WARNING: This product uses compressed air which is a type of potential (stored) energy. User training and caution should be used when operating or servicing systems that contain compressed air.

Before starting a vehicle:


- Ensure vehicle has adequate fuel level.
- Sit in the driver’s seat.
- Confirm vehicle parking brake is set.
- Confirm Neutral is selected on the dash
- Confirm no one is near the engine or other moving parts of the vehicle.
- Do not operate the vehicle if Alternator light is lit or if gauges indicate low voltage.

When leaving the vehicle with engine running:

- Safely come to a complete stop.
- Continue to depress and hold the service brake.
- Select Neutral on the dash.
- Set vehicle parking brake and chock wheels.

When parking the vehicle:

- Select Neutral on the dash
- Set vehicle parking brake.

 **WARNING:** Troubleshooting Smart Suspension components or associated wiring while the engine is running may result in unexpected suspension height changes. When possible, troubleshoot with the engine off.

Diagnostics

The Parker Smart Suspension™ provides for easy troubleshooting utilizing PC-based software and industry standard tools. Computer-supported diagnostics improve troubleshooting and reduce maintenance time. The diagnostics provide for manual control of suspension test sequences and displays active and historic service codes.

Required Tools:

- Volt / Ohm meter
- PC-Based Suspension service tool
- RP1210B compatible interface box
- 9-Pin Deutsch diagnostic adapter

Dash Display Descriptions

The Parker Smart Suspension™ utilizes the OEM dash display to indicate the current state of the suspension. Either an amber or red service lamp will be illuminated in cases where the suspension system issues are present. The ECU will communicate status and service codes via the J1939 Data Link. Service lamps are displayed at the discretion of the customer.

Vehicle Service Lamps

Per SAE J1939 definition, Red and Amber service lamps indicate:

- Amber Lamp - This lamp is used to relay trouble code information that is reporting a problem with the vehicle system, but the vehicle need not be immediately stopped
- Red Lamp - This lamp is used to relay trouble code information that is of a severe enough condition that it warrants stopping the vehicle.

Diagnosing Wiring Problems

Wiring issues may occur in the OEM harness or associated wiring. When troubleshooting, keep in mind that wiring failures can be intermittent, making them difficult to identify.

Possible Causes for Wiring Issues

- Partially unseated connector
- Wiring shorted to ground, shorted to power, or open
- Bent, corroded, or loose terminals
- Missing or failed connector seals
- Wire damage – pinched, corroded, or rubbed

Visual Inspection

- Make sure all connectors are clean and tight.
- Inspect the length of wiring between connections looking for damaged wires.
- Inspect the connector for loose terminals, corrosion or bent pins.
- Clean connectors which have debris or contamination using OEM approved cleaning products.

Digital Multimeter Use

- Use a quality digital auto-ranging volt/ohm meter.
- Verify the meter's battery and fuse are in good working condition.
- Ensure the proper range is set for the measurement you are taking.
- Verify continuity function by holding leads together and checking that the reading shows zero ohms.
- Use correct pin adapter for connector being tested to ensure connector pin damage does not occur.
- When measuring resistance, ensure the ignition is off and the circuit is unpowered.

ECU LED Status

A status LED is located on the top of the ECU.

| ECU LED | ECU Status |
|---------|--|
| Green | Powered and executing normal functions |
| Orange | Storing Non-Volatile memory (retain over power cycles) |
| Red | Shutting down |
| None | Power off |

PC Diagnostic Tool

A free download of the diagnostic tool is available via the web. The tool, once installed and running on a PC can be used to:

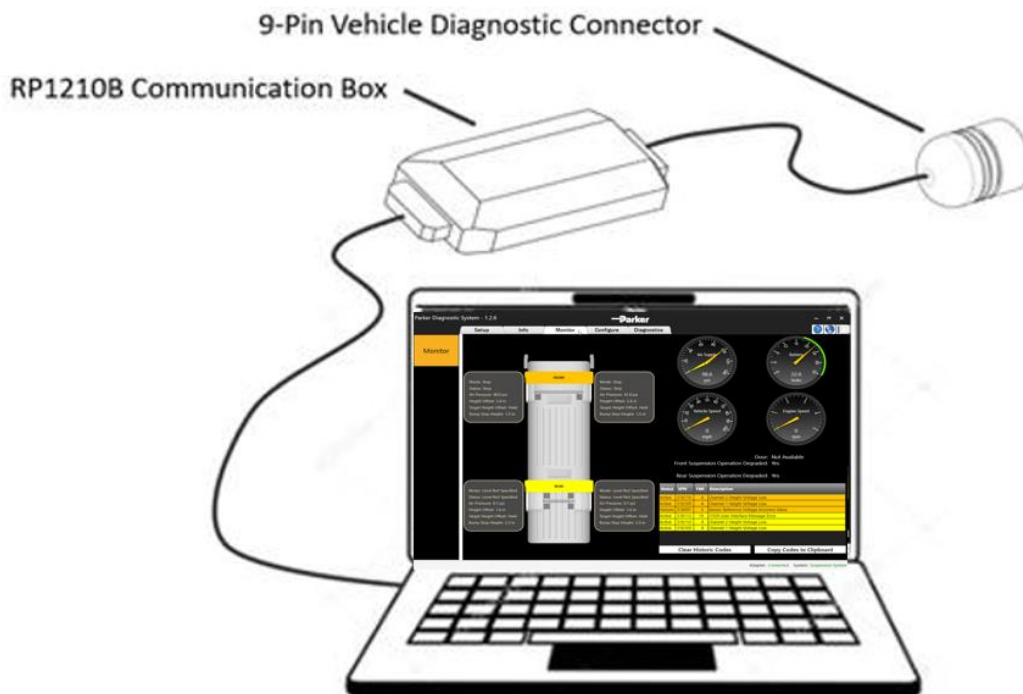
- View current system status
- Display system service codes
- Calibrate the system
- Manually raise/lower the suspension
- View configurable parameters
- Flash (re-flash) software to ECU's
- Record video Diagnostic Tool screen for Parker Engineering troubleshooting

Contact your Parker representative to gain access to the tool. To install the tool on a computer, administrative rights are typically required.

WARNING: The diagnostic tool can be used to access suspension variables when the vehicle is moving or is stationary. If the vehicle is stationary, it's important to take the necessary safety precautions to protect individuals that may be working on or near the vehicle when commanding changes to suspension height.

Once the diagnostic tool software has been successfully downloaded onto a computer, connect to the vehicle using a RP1210B compliant communication box equipped with a 9-pin diagnostic adapter.

With the ignition on, select the Parker diagnostic tool icon on the computer screen. Once the program is running, tabs at the top of the screen will allow access to information specific to the connected system. A brief description of each tab is included below.

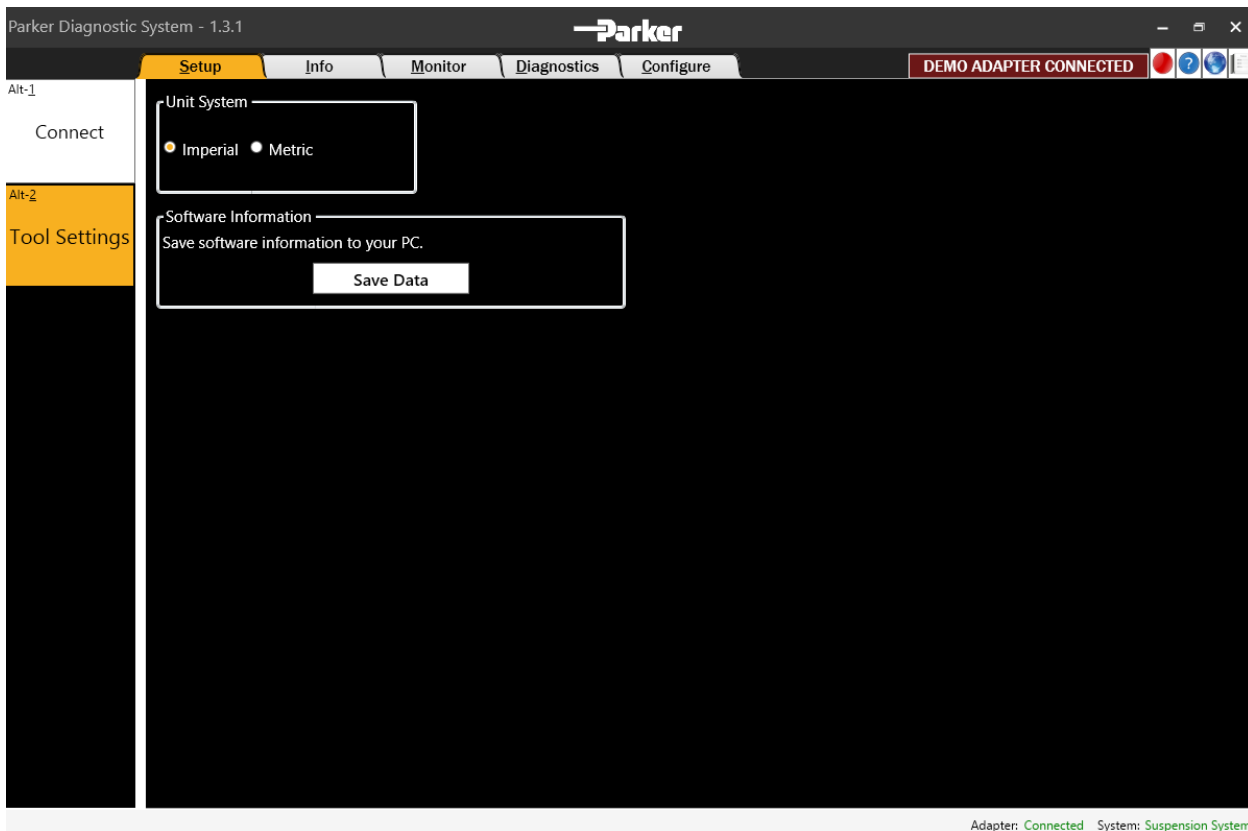


Setup Tab (default screen)

This is the first page displayed when starting the diagnostic tool program. Under Adapter Selection pull-down, select the RP1210B adapter tool. DEMO mode is useful for learning about the tool while offline. Next select baud rate (i.e. 250k, 500k, Auto) and select the CONNECT button on the right.

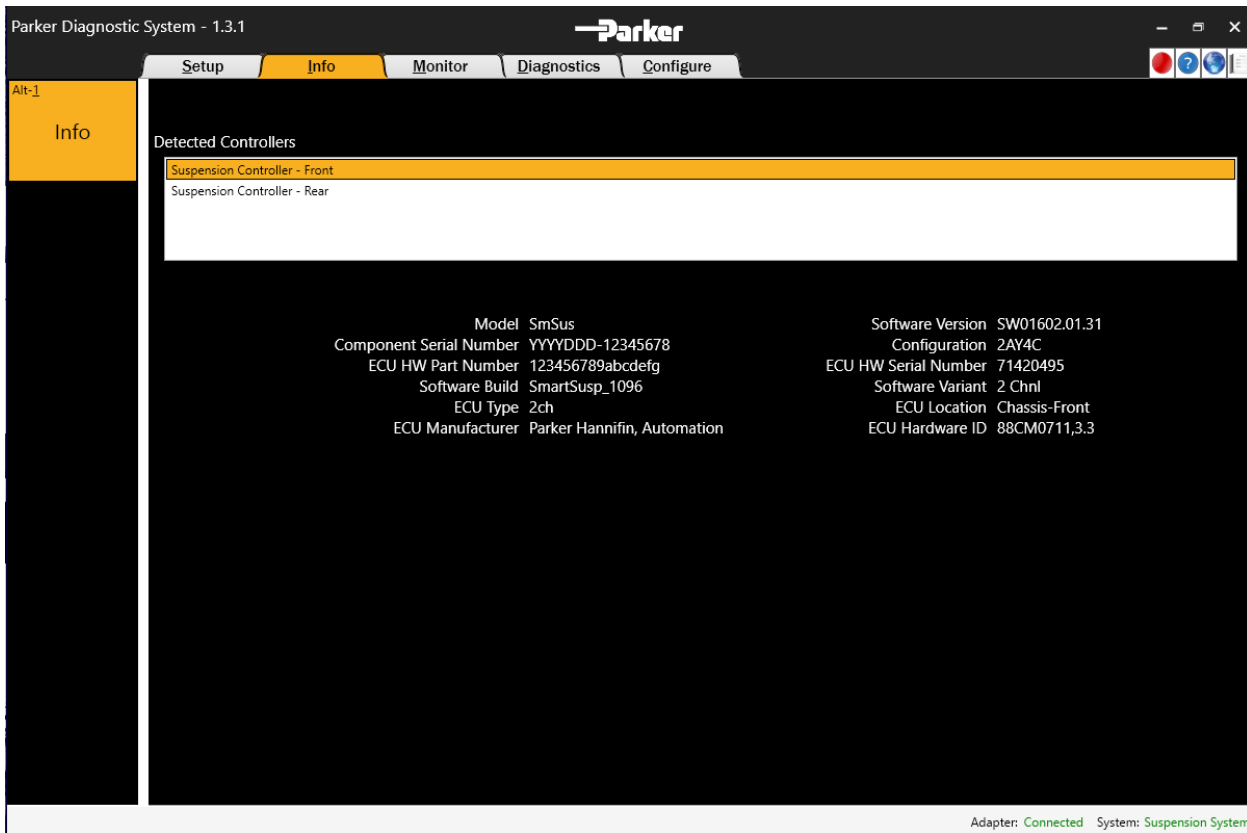
The systems that are on the link will be displayed under System Selection. Also note that three Icons are located to the top right of every screen. These provide access to help, Parker Web pages, and linked troubleshooting manuals to support connected products.

To change unit system settings, the Tool Settings provides a method to update units on the other tabs.



Info Tab

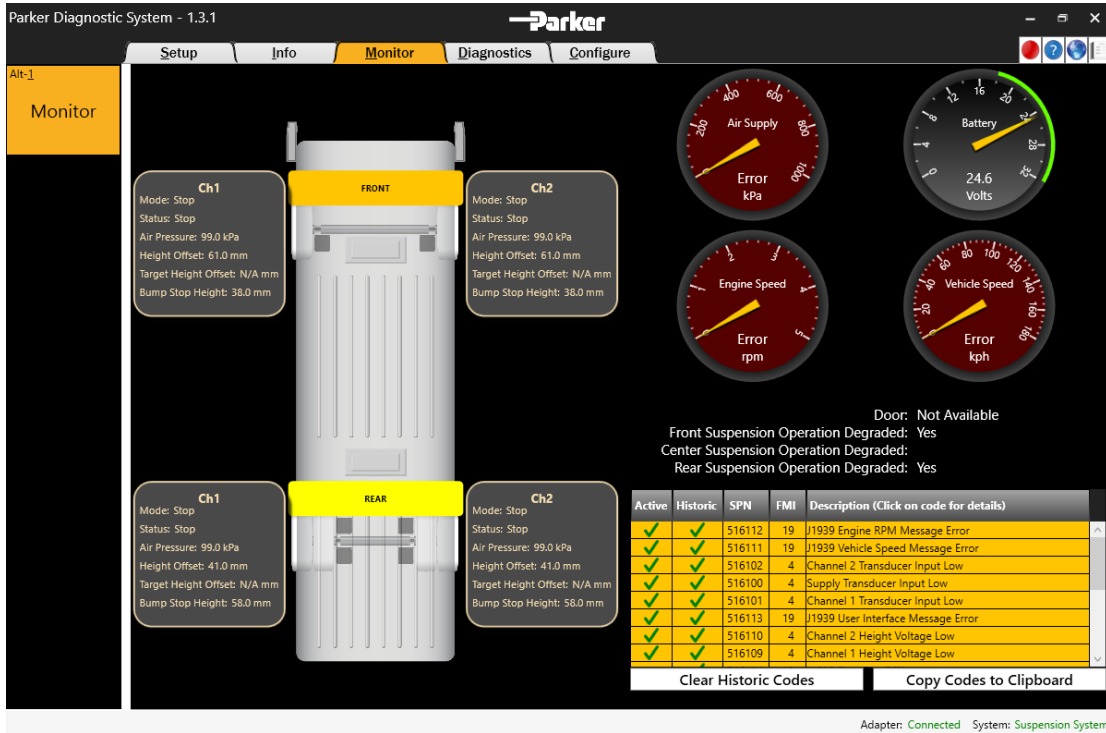
Useful information, such as software version, ECU hardware serial number, and component serial number, will be shown for each ECU selected.



Monitor Tab

The monitoring page displays air spring information as well as gauges for supply pressure, battery voltage, vehicle and engine speed. In the lower, right corner, both active (current) and historical (in-active) service codes are displayed. The historical service codes can be cleared by the “Clear Codes” button at the bottom of the page. Please note that historical codes will automatically clear after 25 power cycles of a given service code not recurring.

| Definition of Parameters | |
|--------------------------|---|
| Mode | Current operation selected |
| Status | Current operation status |
| Air Pressure | Suspension bag pressure |
| Height Offset | Actual height from bump stop |
| Target Height Offset | Requested height from bump stops |
| Bump Stop Height | Baseline height reference (bump stops after height calibration) |



NOTE:

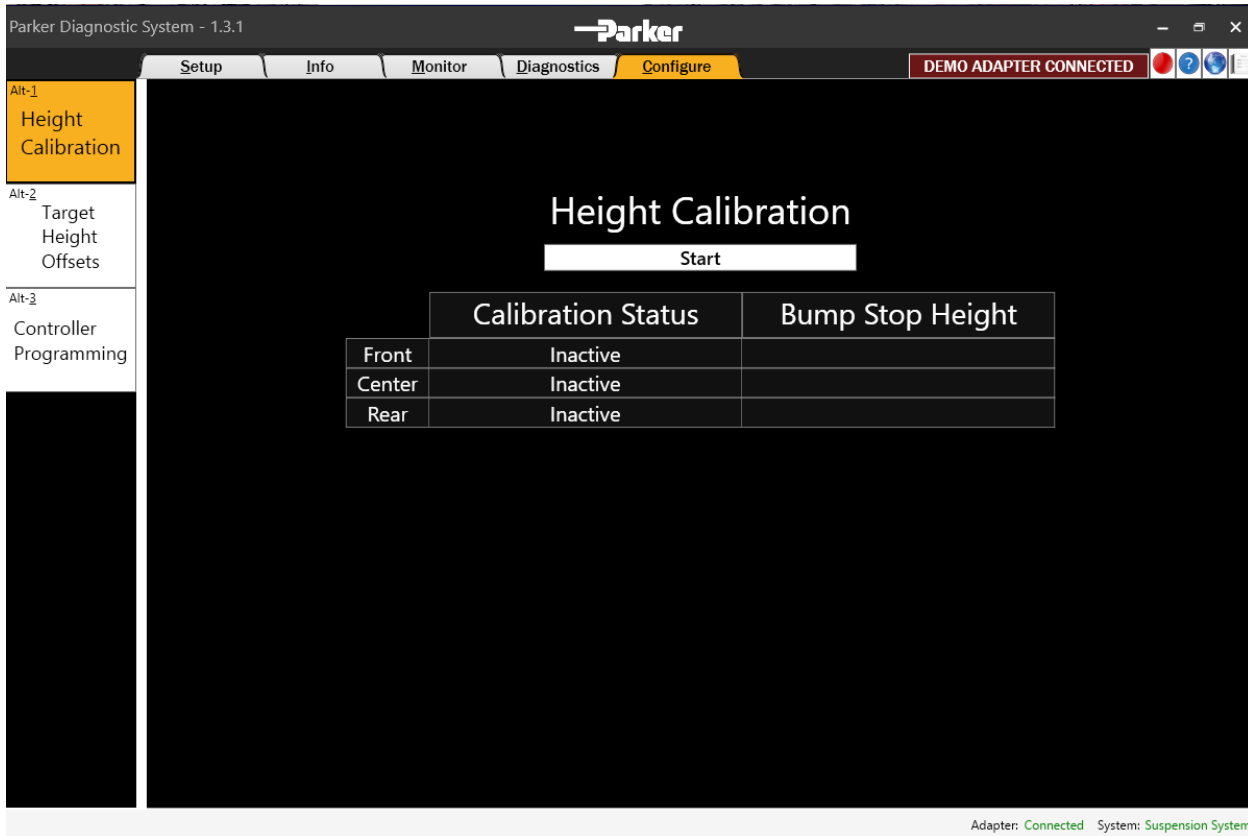
The diagnostic tool provides a feature to record a video file of the active diagnostic tool tabs. This is helpful troubleshooting tool to provide others with a clear picture of the situation. To do so, just select the record button. You will be asked for a file location and recording will begin. When finished click the stop button (same location as record button). Navigate to the file folder to retrieve the recording.



Configure Tab

The Configure page will be used when either a calibration, height target configuration, or a software update is needed.

On the Configure tab, found on the Height Calibration page (on the left), there is a single-click button to calibrate all the systems found on the vehicle.



NOTE:

Calibration is necessary at the time of installation on the vehicle OR when a height sensor is replaced.

Prior to calibration, consider the following:

1. Initiating a calibration should only be carried out if the vehicle is on level ground. Calibration on unlevel ground can generate a calibration service code.
2. Once the calibration process has completed, an ignition cycle is required to save the default calibration values.
3. If the calibration fails, the vehicle can still be driven as default values will be used. A suspension service message will be displayed until the source of the issue is resolved (i.e. suspect height sensor or unlevel ground calibration) and successful calibration is completed.

On the Configure tab, found on the Target Height Offsets page, the user can actively change the target height offsets for each mode and velocity rate limit for each of the available axles. Once the new values are entered and updated, an ignition cycle will store the values in the ECU. **Note:** Depending on the customer, after an ignition cycle, new target heights or velocity rate limits may be overwritten back to values requested by customer J1939 messaging.

The screenshot shows the Parker Diagnostic System interface. The 'Configure' tab is active, displaying the 'Target Height Offset Calibration' screen. A table lists various calibration parameters for Front, Center, and Rear axles. The 'Center' column contains red warning icons, indicating that the current values are not being updated or are invalid. An 'Update' button is located below the table.

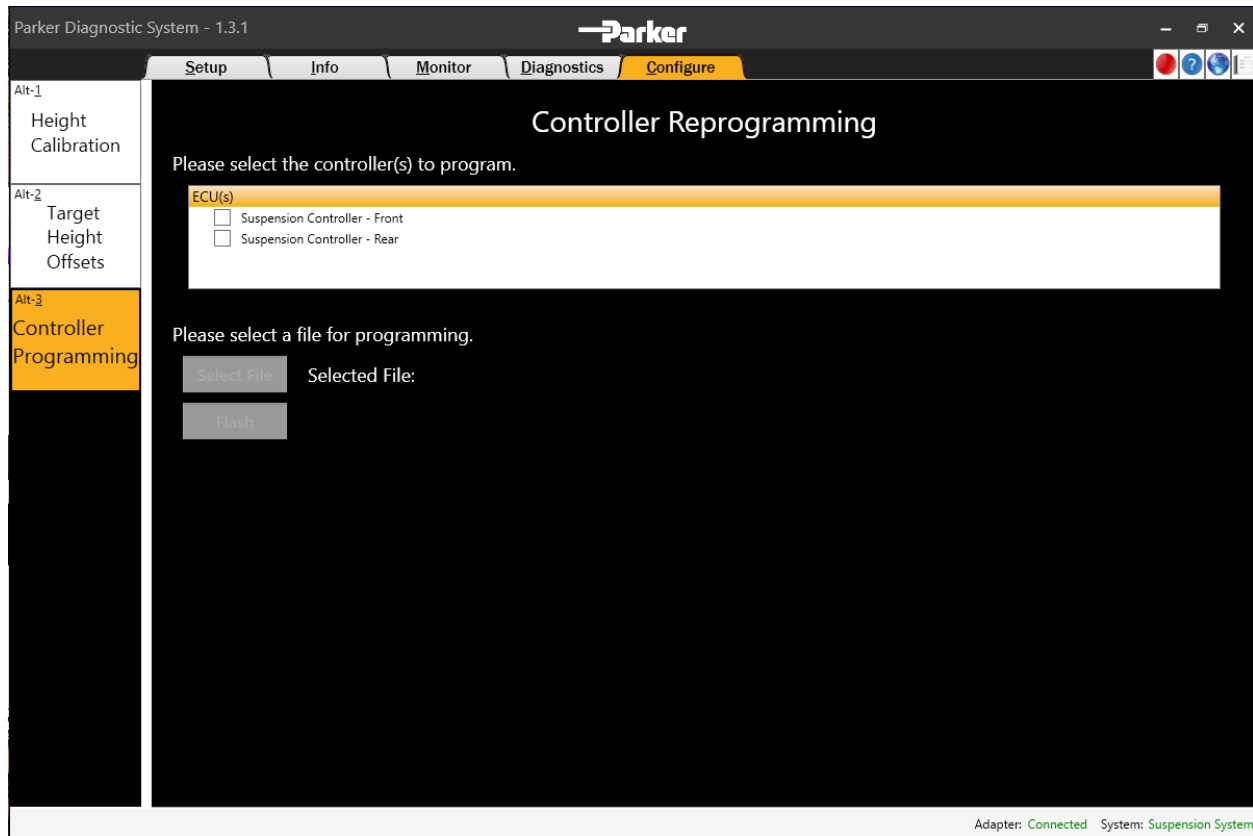
| | Front | Center | Rear |
|--|-------|--------|------|
| Kneel Target Height (0-200mm) | 3 | --- ⚠ | 3 |
| Low Ride Target Height (0-200mm) | 40 | --- ⚠ | 35 |
| Normal Ride Target Height (0-200mm) | 101 | --- ⚠ | 96 |
| High Ride Target Height (0-200mm) | 152 | --- ⚠ | 147 |
| Customer Level Target Height (0-200mm) | 0 | --- ⚠ | 0 |
| Velocity Rate Limit (0-102mm/sec) | 32 | --- ⚠ | 32 |

Update

Adapter: Connected System: Suspension System

To update (reflash) the software to the suspension controllers, select the controllers to program and select the Select File button. Navigate to the *.rpg file needed and then the Flash button. **NOTE:** More than one controller

can be selected to flash. The diagnostic tool will flash controllers one at a time.

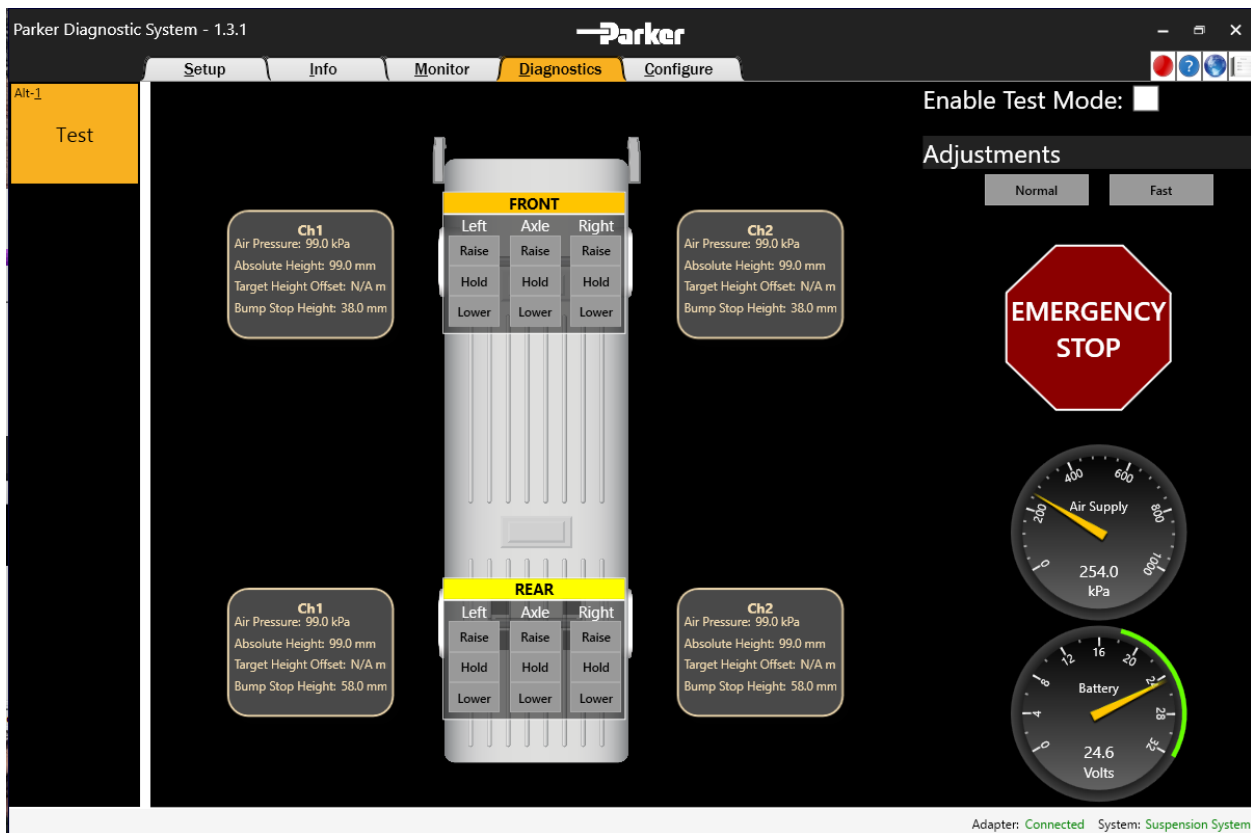


Diagnostic Tab

In some scenarios, it may be necessary to use the Diagnostic page to manually adjust the suspension heights up or down. Prior to using this tool, consider the following:

1. Only use this test mode if authorized to do so.
2. To manually adjust heights, first check the Enable Test Mode box. Once checked, either an individual air spring or axle can be raised or lowered by selecting the associated button.
3. To stop movement, the same check box needs to be deselected to stop filling or exhausting.
4. Checking the Adjustments Fast box ahead of raising or lowering will more quickly fill or exhaust.
5. A STOP button is provided on the right side of the screen to cease any suspension movement.
6. Uncheck the Enable Test Mode when testing is complete or simply select another tab.

Note: While in diagnostic mode, if the user selects a mode on the vehicle dash or starts to drive, then the diagnostic mode will be disabled automatically.



Service Codes

The service code summary table and details below are provided to aid in troubleshooting Smart Suspension System related issues. During the troubleshooting process, there may be occasions where several unrelated service codes are present at the same time, leaving little to no Smart Suspension functionality. In this circumstance, there is a high likelihood the source of all the service codes is a connector that is not seated correctly with its mate.

SPNs and FMIs

This product uses a Suspect Parameter Number (SPN) and Failure Mode Identifier (FMI) to identify service issues. Refer to the SPN Summary for more detailed information on troubleshooting.

There may be a point in the troubleshooting process where all reasonable attempts to resolve the service code are unsuccessful. In that case, replacement of the ECU or PCU may be necessary. Contact your OEM representative for information and warranty coverage details where appropriate.

FMI Table

| FMI | Description | FMI | Description | FMI | Description |
|-----|-------------------------------------|-----|---------------------------------------|-----|------------------------------|
| 0 | High – most severe (3) | 8 | Abnormal Freq, Pulse Width, or Period | 16 | High – moderate severity (2) |
| 1 | Low – most severe (3) | 9 | Abnormal Update Rate | 17 | Low – least severe (1) |
| 2 | Erratic, Intermittent, or Incorrect | 10 | Abnormal Rate of Change | 18 | Low – moderate severity (2) |
| 3 | Voltage Above Normal | 11 | Other Failure Mode | 19 | Data Error |
| 4 | Voltage Below Normal | 12 | Failure | 20 | Data Drifted High |
| 5 | Current Below Normal | 13 | Out of Calibration | 21 | Data Drifted Low |
| 6 | Current Above Normal | 14 | Special Instruction | 31 | - |
| 7 | Not Responding Properly | 15 | High – least severe (1) | | |

SPN Summary

| SPN | FMI | Type | Description |
|--------|-----|-----------|---|
| 516096 | 0 | Input | Battery Voltage High |
| 516096 | 1 | Input | Battery Voltage Low |
| 516097 | 3 | Input | Sensor Reference Voltage High |
| 516097 | 4 | Input | Sensor Reference Voltage Low* |
| 516097 | 5 | Input | Sensor Reference Common Open |
| 516099 | 2 | Input | ECU ID Error - incorrect/no tag |
| 516100 | 3 | Input | Supply Pressure Sensor Input High |
| 516100 | 4 | Input | Supply Pressure Sensor Input Low* |
| 516100 | 5 | Input | Supply Pressure Sensor Common Open |
| 516101 | 3 | Input | Channel 1 Pressure Sensor Input High |
| 516101 | 4 | Input | Channel 1 Pressure Sensor Input Low* |
| 516102 | 3 | Input | Channel 2 Pressure Sensor Input High |
| 516102 | 4 | Input | Channel 2 Pressure Sensor Input Low* |
| 516109 | 1 | Logic | Channel 1 Height Sensor Input – Low Valid Range |
| 516109 | 3 | Input | Channel 1 Height Sensor Input High |
| 516109 | 4 | Input | Channel 1 Height Sensor Input Low* |
| 516109 | 5 | Input | Channel 1 Height Sensor Common Open |
| 516110 | 1 | Logic | Channel 2 Height Sensor Input – Low Valid Range |
| 516110 | 3 | Input | Channel 2 Height Sensor Input High |
| 516110 | 4 | Input | Channel 2 Height Sensor Input Low* |
| 516110 | 5 | Logic | Channel 2 Height Sensor Common Open |
| 516111 | 19 | Data Link | J1939 Vehicle Speed Message Error |
| 516112 | 19 | Data Link | J1939 Engine RPM Message Error |
| 516113 | 19 | Data Link | J1939 User Interface Message Error |
| 516114 | 19 | Data Link | J1939 Data Bus Offline |
| 516120 | 3 | Input | Tow Mode Input High |
| 516121 | 2 | Output | Channel 1 Supply Solenoid |
| 516122 | 2 | Output | Channel 2 Supply Solenoid |
| 516131 | 2 | Output | Channel 1 Vent Solenoid |
| 516132 | 2 | Output | Channel 2 Vent Solenoid |
| 516141 | 2 | Output | Channel 1 Solenoid Common |
| 516142 | 2 | Output | Channel 2 Solenoid Common |

| | | | |
|--------|----|--------|---|
| 516147 | 1 | Logic | Low Air Supply |
| 516147 | 10 | System | Supply pressure – Line open (during operation) |
| 516151 | 7 | System | Channel 1 Major Line/Seal Leak (at startup) |
| 516151 | 10 | System | Channel 1 Major Line/Seal Leak (during operation) |
| 516152 | 7 | System | Channel 2 Major Line/Seal Leak (at startup) |
| 516152 | 10 | System | Channel 2 Major Line/Seal Leak (during operation) |
| 516211 | 17 | System | Channel 1 Leak Down - Minor |
| 516211 | 20 | System | Channel 1 Leak Up - Minor |
| 516212 | 17 | System | Channel 2 Leak Down - Minor |
| 516212 | 20 | System | Channel 2 Leak Up - Minor |
| 516235 | 7 | Logic | PCU Cover Pressure |
| 516300 | 7 | System | Height Calibration Routine Failed |
| 516300 | 13 | System | Bump Stop Calibration Error |

Detailed List of SPNS

SPN 516096

Service Code: Battery Voltage High/Low

| FMI | Description | Set | Degraded Mode | Clear | Possible Causes |
|-----|-----------------------|-------------------|------------------|--------------------|-------------------------------------|
| 0 | Voltage above maximum | >32V (1 sec.) | Remain in place. | <=32V (5 sec.) | Vehicle charging system output high |
| 1 | Voltage below minimum | < 18V (1 sec.) | Remain in place. | >= 18V (5 sec.) | Vehicle battery output low |

Description:

The system monitors the battery voltage at the suspension ECU. If the system detects voltage out of range, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 0: Battery voltage is greater than 32V.

FMI 1: Battery voltage is less than 18V.

Degraded Modes:

Suspension system to remain in place (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

The service code will clear when the battery voltage in range for a minimum of 5 sec.

Possible Causes:

FMI 0: Vehicle jump-started improperly or charging system failure

FMI 1: Weak or dead battery

Poor power connection to ECU (verify integrity of wiring, connections, and splices).

SPN 516097

Service Code: Sensor Reference Voltage High/Low or Common Open (All sensors)

| FMI | Description | Set | Degraded Mode | Clear | Possible Causes |
|-----|-------------------------------------|---|------------------|--|---|
| 3 | Voltage above maximum | > 5.25V (250 msec.) | Remain in place. | <= 5.25V | Wiring / connection between ECU and PCU |
| 4 | Voltage below minimum | < 4.75V (250 msec.) | Remain in place. | >= 4.75V | Wiring / connection between ECU and PCU |
| 5 | Sensor reference return open at ECU | All transducers reading above 133 psi (> 4 sec.) | Remain in place. | Any transducer reading < 133 psi (> 1 sec.) | Wiring / connection on ECU |

Description:

The ECU supplies power to both the height sensors and PCU pressure sensors. If the power supplied to the sensors is interrupted, shorted or grounded or open, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 3: Sensor reference voltage is greater than 5.25V for greater than 250 milliseconds.

FMI 4: Sensor reference voltage is less than 4.75V for greater than 250 milliseconds.

FMI 5: Sensor reference return open for more than 4 seconds.

Degraded Modes:

FMI 3,4: Suspension system to remain in place (Unlatched, Latched after 5 counts per drive cycle).

FMI 5: Suspension system to remain in place (Latched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle is moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Repair and complete a power cycle. Check diagnostic tool for service code after power returns.

Possible Causes:

FMI 3: 5V sensor supply partially shorted to battery or switched ignition on ECU connector C1, pin 6

FMI 4: Corrosion or defective component. Contact your OEM for any height sensor that exceeds 18 mA OR PCU with sensor supply (pin 5 on PCU) that exceeds 9 mA.

FMI 5: 5V sensor supply ground wire open at ECU connector C1, pin 11

SPN 516099

Service Code: ECU ID Error

| FMI | Description | Set | Degraded Mode | Clear | Possible Causes |
|-----|--------------------------|----------------------------|------------------|--|---|
| 2 | Incorrect or missing tag | Unknown ID Tag at power-up | Remain in place. | Repair harness; Cycle switched ignition | Missing ECU ID resistor; Wiring / connection between ECU and ECU ID resistor |

Description:

Each suspension ECU on the J1939 datalink is identified by a resistor installed in the harness supplied by the vehicle manufacturer. If the system detects resistance out of range, the service code and associated degraded mode is set for the affected axle(s).

Conditions:

At power up, resistive tag voltage is out of range.

Degraded Modes:

Suspension system to remain in place (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

Repair harness ID tag resistor and then ignition cycle (system only detects ID tag during start-up routine).

Possible Causes:

- ECU connector not seated properly.
- Pin corrosion
- Incorrect or missing address ID tag resistor on ECU harness connector C1; pins 13 and 14.

SPN 516100

Service Code: Supply Pressure Sensor Input High/Low or Common Open

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|--|-----------------------------------|--------------|---|
| 3 | Signal shorted above reference voltage | > 5.25V (250 msec.) | Return and Remain at Ride Height. | <= 5.25V | Wiring / connection between ECU and PCU |
| 4 | Signal open/shorted to ground or no ref. voltage | < 0.25V (250 msec.) | Return and Remain at Ride Height. | >= 0.25V | Wiring / connection between ECU and PCU |
| 5 | Voltage valid but incorrect (floating common) | All sensors at "fixed" reading (4 sec.) | Return and Remain at Ride Height. | Check wiring | Wiring / connection at PCU (sensor common open) |

Description:

The system incorporates a pressure sensor in the PCU to measure supply pressure. If the sensor input to ECU is shorted or open, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 3: Sensor input voltage is greater than 5.25V for greater than 250 milliseconds.

FMI 4: Sensor input voltage is less than 0.25V for greater than 250 milliseconds.

FMI 5: Sensor common ground open for greater than four (4) seconds.

Degraded Modes:

FMI 3,4: Suspension system to return and remain at ride height (Unlatched).

FMI 5: Suspension system to remain in place until a driver-initiated recovery is requested. Upon request, the suspension system shall return and remain at ride height using height leveling only (Latched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

FMI 3,4: The service code will clear when the voltage returns to normal operating levels.

FMI 5: Repair and complete a power cycle. Check diagnostic tool for service code after power returns.

Possible Causes:

FMI 3: Pressure sensor signal shorted to power between ECU connector C2, pin 8 and PCU connector pin 5.

FMI 4: Pressure sensor power open / signal open or short to ground between ECU connector C2, pin 8 and PCU connector pin 5.

FMI 5: PCU ground wire open on PCU connector pin 2.

SPN 516101

Service Code: Channel 1 (Left Side) Pressure Sensor Input High/Low

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|------------------------|-------------------------------------|----------|---|
| 3 | Signal shorted above reference voltage | > 5.25V (250 msec.) | Height Balance (Sensor =14.4psi) | <= 5.25V | Wiring / connection between ECU and PCU |
| 4 | Signal open/shorted to ground or no ref. voltage | < 0.25V (250 msec.) | Height Balance (Sensor =14.4psi) | >= 0.25V | Wiring / connection between ECU and PCU |

Description:

The system incorporates a pressure sensor in the PCU to measure left side (Ch 1) pressure. If the sensor input to ECU is shorted or open, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 3: Sensor input voltage is greater than 5.25V for greater than 250 milliseconds.

FMI 4: Sensor input voltage is less than 0.25V for greater than 250 milliseconds.

Degraded Modes:

Suspension system to remain in place until a driver-initiated recovery is requested. Upon request, the suspension system shall level axle heights only (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

FMI 3,4: The service code will clear when the voltage returns to normal operating levels.

Possible Causes:

FMI 3: Pressure sensor signal shorted to power between ECU connector C2, pin 12 and PCU connector pin 4.

FMI 4: Pressure sensor power open / signal open or shorted to ground between ECU connector C2, pin 12 and PCU connector pin 4.

SPN 516102

Service Code: Channel 2 (Right Side) Pressure Sensor Input High/Low

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|------------------------|-------------------------------------|----------|---|
| 3 | Signal shorted above reference voltage | > 5.25V (250 msec.) | Height Balance (Sensor =14.4psi) | <= 5.25V | Wiring / connection between ECU and PCU |
| 4 | Signal open/shorted to ground or no ref. voltage | < 0.25V (250 msec.) | Height Balance (Sensor =14.4psi) | >= 0.25V | Wiring / connection between ECU and PCU |

Description:

The system incorporates a pressure sensor in the PCU to measure right side (Ch 2) pressure. If the sensor input to ECU is shorted or open, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 3: Sensor input voltage is greater than 5.25V for greater than 250 milliseconds.

FMI 4: Sensor input voltage is less than 0.25V for greater than 250 milliseconds.

Degraded Modes:

Suspension system to remain in place until a driver-initiated recovery is requested. Upon request, the suspension system shall level axle heights only (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

FMI 3,4: The service code will clear when the voltage returns to normal operating levels.

Possible Causes:

FMI 3: Pressure sensor signal shorted to power between ECU connector C2, pin 4 and PCU connector pin 3.

FMI 4: Pressure sensor power open / signal open or shorted to ground between ECU connector C2, pin 4 and PCU connector pin 3.

SPN 516109

Service Code: Channel 1 (Left Side) Height Sensor Valid but Low, High/Low, or Common Open

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|---|------------------------------------|--------------------------------|---|
| 1 | Signal valid but low / erratic | Input reads < 10 mm or erratic (30 msec.) | Pressure Balance | Height reading >10mm (10 sec.) | Height sensor broken / magnet out of place |
| 3 | Signal shorted above reference voltage | > 4.9V (250 msec.) | Pressure Balance (Sensor =14.4psi) | <= 4.9V | Wiring / connection between ECU and height sensor |
| 4 | Signal open/shorted to ground or no ref. voltage | < 0.1V (250 msec.) | Pressure Balance (Sensor =14.4psi) | >= 0.1V | Wiring / connection between ECU and PCU |
| 5 | Voltage valid but incorrect (floating common) | Sensors "fixed" reading (3.25 sec.) | Pressure Balance | Check / fix wiring | Wiring / connection between ECU and height sensor. (sensor common open) |

Description:

The system receives a left side (Ch 1) height sensor input to the ECU. If the sensor input to ECU is shorted, open or below limit, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 1: Sensor input exhibits large erratic swings or is reading less than a prescribed out of operating range for greater than 30 milliseconds.

FMI 3: Sensor input voltage is greater than 4.9V for greater than 250 milliseconds.

FMI 4: Sensor input voltage is less than 0.1V for greater than 250 milliseconds.

FMI 5: Sensor input ground open ground for greater than 3.25 seconds.

Degraded Modes:

Suspension system to remain in place until a driver-initiated recovery is requested. Upon request, the suspension system shall adjust suspension height using pressure balancing in conjunction with the remaining functional height sensor (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

FMI 1: The service code will clear when the height value of service coded sensor returns to a stable value greater than a prescribed out of operating range value for 10 seconds.

FMI 3,4: The service code will clear when the voltage returns to normal operating levels.

FMI 5: The service code will clear when the suspect height sensor is communicating changing values.

Possible Causes:

FMI 1: Height sensor broken (forcing out of range high voltage) or out of position relative to its magnet.

FMI 3: Height sensor signal shorted to power between ECU connector C2, pin 3 and height sensor.

FMI 4: Height sensor power open / signal open or shorted to ground between ECU connector C2, pin 3 and height sensor.

FMI 5: Height sensor ground open along sensor wire between the ECU connector C1, pin 11 and sensor.

Note: In the event the height sensor is replaced, a system calibration is required.

SPN 516110

Service Code: Channel 2 (Right Side) Height Sensor Valid but Low, High/Low, or Common Open

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|---|------------------------------------|--------------------------------|---|
| 1 | Signal valid but low / erratic | Input reads < 10 mm or erratic (30 msec.) | Pressure Balance | Height reading >10mm (10 sec.) | Height sensor broken / magnet out of place |
| 3 | Signal shorted above reference voltage | > 4.9V (250 msec.) | Pressure Balance (Sensor =14.4psi) | <= 4.9V | Wiring / connection between ECU and height sensor |
| 4 | Signal open/shorted to ground or no ref. voltage | < 0.1V (250 msec.) | Pressure Balance (Sensor =14.4psi) | >= 0.1V | Wiring / connection between ECU and height sensor |
| 5 | Voltage valid but incorrect (floating common) | Sensors "fixed" reading (3.25 sec.) | Pressure Balance | Check / fix wiring | Wiring / connection between ECU and height sensor. (sensor common open) |

Description:

The system receives a right side (Ch 2) height sensor input to the ECU. If the sensor input to ECU is shorted, open or below limit, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 1: Sensor input exhibits large erratic swings or is reading less than a prescribed out of operating range for greater than 30 milliseconds.

FMI 3: Sensor input voltage is greater than 4.9V for greater than 250 milliseconds.

FMI 4: Sensor input voltage is less than 0.1V for greater than 250 milliseconds.

FMI 5: Sensor input ground open ground for greater than 3.25 seconds.

Degraded Modes:

Suspension system to remain in place until a driver-initiated recovery is requested. Upon request, the suspension system shall adjust suspension height using pressure balancing in conjunction with the remaining functional height sensor (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

FMI 1: The service code will clear when the height value of service coded sensor returns to a stable value greater than a prescribed out of operating range value for 10 seconds.

FMI 3,4: The service code will clear when the voltage returns to normal operating levels.

FMI 5: The service code will clear when the suspect height sensor is communicating changing values.

Possible Causes:

FMI 1: Height sensor broken (forcing out of range high voltage) or out of position relative to its magnet.

FMI 3: Height sensor signal shorted to power between ECU connector C2, pin 11 and height sensor.

FMI 4: Height sensor power open / signal open or shorted to ground between ECU connector C2, pin 11 and height sensor.

FMI 5: Height sensor ground open along sensor wire between the ECU connector C1, pin 11 and sensor.

Note: In the event the height sensor is replaced, a system calibration is required.

SPN 516111

Service Code: J1939 Vehicle Speed Message Error

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------------|------------------------------------|------------------------|------------------|-----------------------------------|
| 19 | No message with valid vehicle speed | No message or valid data (2.5 sec) | System remain in place | Valid speed data | Message missing on J1939 data bus |

Description:

The system receives vehicle speed via the J1939 data link. If the ECU does not receive vehicle speed, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

No vehicle speed message received, or if an invalid message received for greater than 2.5 seconds.

Degraded Modes:

Suspension system to remain in place (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

The service code will be cleared when valid speed data is communicated to the ECU.

Possible Causes:

J1939 is not available or signal from the designated source address is not transmitting.

SPN 516112

Service Code: J1939 Engine RPM Message Error

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|----------------------------------|------------------------------------|--|----------------|-----------------------------------|
| 19 | No message with valid engine rpm | No message or valid data (4.5 sec) | No degraded mode, but no Low Air detection | Valid rpm data | Message missing on J1939 data bus |

Description:

The system receives engine RPM via the J1939 data link. If the ECU does not receive engine RPM, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

No engine RPM received, or if an invalid message received for greater than 4.5 seconds.

Degraded Modes:

No degraded mode (Unlatched). No main function degraded, however features which rely on engine rpm information will not function:

- No Low Air Service Code detection

Clearing the Service Code:

The service code will be cleared when valid engine RPM data is communicated to the ECU.

Possible Causes:

J1939 is not available or signal from the designated source address is not transmitting.

SPN 516113

Service Code: J1939 User Interface Message Error

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-----------------------------|--|------------------------|-----------------|-----------------------------------|
| 19 | Missing message(s) from HMI | No ASC2 message or valid data (3.5 sec.) | System remain in place | Valid ASC2 data | Message missing on J1939 data bus |

Description:

The system continuously receives commands via the J1939 data link. If the ECU does not receive any commands, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

No ASC2 message received, or if an invalid message received for 3.5 sec.

Degraded Modes:

Suspension system to remain in place (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

The service code will be cleared when valid ASC2 message is communicated to the ECU.

Possible Causes:

Customer command messages not addressed to ECUs.

SPN 516114

Service Code: J1939 Data Bus Offline

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------|--------------------|------------------------|-----------------|---|
| 19 | No valid J1939 communications | Offline (1.5 sec.) | System remain in place | Data Bus Online | Not connected to valid J1939 Data Bus (note: only seen as Historical) |

Description:

The system continuously receives commands via the J1939 data link. If the ECU does not see any activity on the J1939 data link, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

The ECU detects that it is not connected to a valid J1939 data link for greater than 1.5 seconds.

Degraded Modes:

Suspension system to remain in place (Unlatched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

The service code will be cleared when the J1939 link is restored.

Possible Causes:

No other ECUs connected to J1939 data link.

Faulty J1939 data link wiring.

Improper J1939 data link termination resistor connections.

SPN 516120

Service Code: Tow Mode Input High (optional - not on all systems)

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|-----------------------|------------------|-------|--|
| 3 | Signal shorted above reference voltage | > 15V (>250 msec.) | No degraded mode | < 15V | Wiring / connection between ECU and service truck connection |

Description:

The system continuously checks for 12V on a dedicated input to determine if tow truck is connected. If the ECU sees voltage greater than 15V, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

A shorted circuit is detected on the Tow mode pin with a voltage greater than 15V for greater than 250 milliseconds.

Degraded Modes:

None

Clearing the Service Code:

Repair and complete a power cycle. Check diagnostic tool for service code after power returns.

Possible Causes:

Tow mode pin shorted to supply at ECU connector C2, pin 9

SPN 516121

Service Code: Channel 1 (Left Side) Supply Solenoid

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------|--|--|---------------------------------|---|
| 2 | Shorted [High Side Driver] | ON: Short to ground; OFF: Short to battery voltage (> 80 msec.) | System remain in place (below ride height) Return and remain at ride height (above ride height) | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system controls both supply and vent valves in the PCU. If a shorted circuit is detected, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

A short is detected for greater than 80 milliseconds.

Degraded Modes:

(Below ride height): Suspension system to remain in place (Latched).

(Above ride height): Suspension system to remain in place until vehicle is stopped. Once stopped and ride height requested, system with service code will allow exhausting to ride height, then remain at ride height (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground or shorted to battery between PCU connector, pin 8 and ECU connector C2, pin 6.

SPN 516122

Service Code: Channel 2 (Right Side) Supply Solenoid

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------|--|--|---------------------------------|---|
| 2 | Shorted [High Side Driver] | ON: Short to ground; OFF: Short to battery voltage (> 80 msec.) | System remain in place (below ride height) Return and remain at ride height (above ride height) | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system commands both supply and vent valves in the PCU. If a shorted circuit is detected, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

Shorted line is detected for greater than 80 milliseconds.

Degraded Modes:

(Below ride height): Suspension system to remain in place (Latched).

(Above ride height): Suspension system to remain in place until vehicle is stopped. Once stopped and ride height requested, system with service code will allow exhausting to ride height, then remain at ride height (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Repair and cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground or shorted to battery between PCU connector, pin 9 and ECU connector C2, pin 17.

SPN 516131

Service Code: Channel 1 (Left Side) Vent Solenoid

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------|--|--|---------------------------------|---|
| 2 | Shorted [High Side Driver] | ON: Short to ground; OFF: Short to battery voltage (> 80 msec.) | System remain in place (below ride height) Return and remain at ride height (above ride height) | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system commands both supply and vent valves in the PCU. If a shorted circuit is detected, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

Shorted line is detected for greater than 80 milliseconds.

Degraded Modes:

(Above ride height): Suspension system to remain in place (Latched).

(Below ride height): Suspension system to remain in place until vehicle is stopped. Once stopped and ride height requested, system with service code will allow exhausting to ride height, then remain at ride height (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground or shorted to battery between PCU connector, pin 7 and ECU connector C2, pin 5.

SPN 516132

Service Code: Channel 2 (Right Side) Vent Solenoid

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|-------------------------------|--|--|---------------------------------|---|
| 2 | Shorted [High Side Driver] | ON: Short to ground; OFF: Short to battery voltage (> 80 msec.) | System remain in place (below ride height) Return and remain at ride height (above ride height) | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system commands both supply and vent valves in the PCU. If a shorted circuit is detected, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

Shorted line is detected for greater than 80 milliseconds.

Degraded Modes:

(Above ride height): Suspension system to remain in place (Latched).

(Below ride height): Suspension system to remain in place until vehicle is stopped. Once stopped and ride height requested, system with service code will allow exhausting to ride height, then remain at ride height (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground or shorted to battery between PCU connector, pin 6 and ECU connector C2, pin 18.

SPN 516141

Service Code: Channel 1 (Left Side) Solenoids - Common Ground

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--------------------------------------|--|-------------------------|---------------------------------|---|
| 2 | Shorted or open [Low Side Driver] | OFF: Open; ON: Short to battery voltage (> 80 msec.) | System remains in place | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system commands both fill and exhaust valves in the PCU. If an open or shorted circuit is detected or the valve is non-responsive, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

At power up and valve monitoring service code state is true for greater than 80 milliseconds.

Degraded Modes:

Suspension system to remain in place (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground, shorted to battery, or open between PCU connector, pin 11 and ECU connector C2, pin 1.

Circuit open between PCU connector, pin 7 and ECU connector C2, pin 5.

Circuit open between PCU connector, pin 8 and ECU connector C2, pin 6

SPN 516142

Service Code: Channel 2 (Right Side) Solenoids - Common Ground

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--------------------------------------|--|-------------------------|---------------------------------|---|
| 2 | Shorted or open [Low Side Driver] | OFF: Open; ON: Short to battery voltage (> 80 msec.) | System remains in place | Repair; Cycle switched ignition | Wiring / connection between ECU and PCU |

Description:

The system commands both fill and exhaust valves in the PCU. If an open or shorted circuit is detected or the valve is non-responsive, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

At power up and valve monitoring service code state is true for greater than 80 milliseconds.

Degraded Modes:

Suspension system to remain in place (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

Cycle switched ignition OFF then ON to clear the service code.

Possible Causes:

Circuit shorted to ground, shorted to battery, or open between PCU connector, pin 10 and ECU connector C2, pin 2.

Circuit open between PCU connector, pin 6 and ECU connector C2, pin 18.

Circuit open between PCU connector, pin 9 and ECU connector C2, pin 17.

SPN 516147

Service Code: Low Air Supply / Supply Line Open

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|---|---|------------------------|---------------------------------|--|
| 1 | Waited too long for adequate air pressure | Engine > 300rpm while supply pressure remains < 20 psi (5 min.) | System remain in place | Air pressure > 20 psi | Air supply unable to build required pressure, non-functional |
| 10 | Air Supply Line Opened | Supply pressure drops < 5 psi (>5 sec) | System remain in place | Supply pressure recover > 5 psi | Air spring failure; Supply line break |

Description:

The system uses the supply pressure measurement to determine if adequate air is available to achieve some system functions. If adequate supply pressure is not achieved for a prescribed amount of time, or if the supply line becomes open, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 1: Either of the J1939 Engine speed or AirCompressorStatus messages are greater than 300 rpm and supply pressure is less than 20 psi for greater than 5 minutes.

FMI 10: PCU supply pressure is greater than 20 psi then drops below 5 psi for greater than 5 seconds.

Degraded Modes:

Suspension system to remain in place (Not Latched).

Unlatched Degraded Mode:

When the vehicle is stationary and service code has cleared, the operator must select the recovery switch before the Degraded Mode is cleared.

When the vehicle moving, and the service code has cleared, the Degraded Mode will automatically clear if the vehicle is at ride height. Otherwise, the operator must select the recovery switch to clear the Degraded Mode.

Clearing the Service Code:

FMI 1,10: The service code will clear when the PCU supply pressure exceeds 20 psi.

Possible Causes:

FMI 1: Check the PCU supply line for leaks, breaks or blockage and/or non-functional compressor.

FMI 10: Check the PCU supply line for a severe leak, break or air spring failure.

SPN 516151

Service Code: Channel 1 (Left Side) Major Line/Seal Leak

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|--|------------------------|--|-----------------------------------|
| 7 | Significant leak detected (DAV actuation) | Channel 1 pressure unable to achieve >15 psi while actuating DAV. (4 sec.) | System remain in place | Fix air lines/seals; Cycle switched ignition | Air spring leak; Ch1 PCU plumbing |
| 10 | Significant leak detected (no DAV actuation) | Channel 1 pressure drops < 5 psi while not actuating DAV. (2 sec.) | System remain in place | Fix air lines/seals; Cycle switched ignition | Air spring leak; Ch1 PCU plumbing |

Description:

The system manages air pressure in each channel. In the event a channel line cannot retain pressure, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 7: At power up, while commanding a fill operation, channel pressure does not achieve greater than 15 psi for greater than 4 seconds.

FMI 10: At power up, with no exhaust commanded, channel pressure drops from above 15 psi to below 5 psi for greater than 2 seconds.

Degraded Modes:

Suspension system to remain in place (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

After air line repair and ignition cycling, channel must retain constant pressure for more than 5 seconds.

Possible Causes:

FMI 7: Check the channel air line for leaks, breaks or blockage. This can include connections to the air spring or the PCU.

FMI 10: Check the channel air line or air spring for a severe leak, break or air spring failure.

SPN 516152

Service Code: Channel 2 (Right Side) Major Line/Seal Leak

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|--|------------------------|--|-----------------------------------|
| 7 | Significant leak detected (DAV actuation) | Channel 2 pressure unable to achieve >15 psi while actuating DAV. (4 sec.) | System remain in place | Fix air lines/seals; Cycle switched ignition | Air spring leak; Ch2 PCU plumbing |
| 10 | Significant leak detected (no DAV actuation) | Channel 2 pressure drops < 5 psi while not actuating DAV. (2 sec.) | System remain in place | Fix air lines/seals; Cycle switched ignition | Air spring leak; Ch2 PCU plumbing |

Description:

The system manages air pressure in each channel. In the event a channel line cannot retain pressure, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 7: At power up, while commanding a fill operation, channel pressure does not achieve greater than 15 psi for greater than 4 seconds.

FMI 10: At power up, with no exhaust commanded, channel pressure drops from above 15 psi to below 5 psi for greater than 2 seconds.

Degraded Modes:

Suspension system to remain in place (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

After air line repair and ignition cycling, channel must retain constant pressure for more than 5 seconds.

Possible Causes:

FMI 7: Check the channel air line for leaks, breaks or blockage. This can include connections to the air spring or the PCU.

FMI 10: Check the channel air line or air spring for a severe leak or break.

SPN 516211

Service Code: Channel 1 (Left Side) Minor Leak

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|---------------------------|---|------------------|---------------------|--|
| 17 | Channel 1 minor leak down | Pressure and height decrease across power cycle (750 msec.) | No degraded mode | Fix air lines/seals | Air spring leak; PCU vent valve leak |
| 20 | Channel 1 minor leak up | Pressure and height increase across power cycle (750 msec.) | No degraded mode | Fix air lines/seals | Manually filling (shop air) while vehicle powered down; PCU fill valve leak |

Description:

The system can detect minor channel leaks during non-operational activity. In the event a channel line leak has been detected, a service code is set momentarily at startup for the affected axle(s).

Conditions:

FMI 17: After the ignition is turned off, channel pressure decreases by more than a predetermined height and pressure differential for greater than 750 milliseconds.

FMI 20: After the ignition is turned off, channel pressure increases by more than a predetermined height and pressure differential for greater than 750 milliseconds.

Degraded Modes:

No degraded mode.

Clearing the Service Code:

The service code indicator will be cleared 3 seconds after the vehicle is powered up. The Parker diagnostic tool must be used to view these historical service codes.

Possible Causes:

FMI 17: Check the channel air line for minor leaks. This can include connections to the air spring or the PCU.

FMI 20: Check for channel line pressure increases over long-duration power cycles (i.e. 30 minutes) using the Parker diagnostic tool to verify leaking channel fill valve.

SPN 516212

Service Code: Channel 2 (Right Side) Minor Leak

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|---------------------------|---|------------------|---------------------|--|
| 17 | Channel 2 minor leak down | Pressure and height decrease across power cycle (750 msec.) | No degraded mode | Fix air lines/seals | Air spring leak; PCU vent valve leak |
| 20 | Channel 2 minor leak up | Pressure and height increase across power cycle (750 msec.) | No degraded mode | Fix air lines/seals | Manually filling (shop air) while vehicle powered down; PCU fill valve leak |

Description:

The system can detect minor channel leaks during non-operational activity. In the event a channel line leak has been detected, a service code is set momentarily at startup for the affected axle(s).

Conditions:

FMI 17: After the ignition is turned off, channel pressure decreases by more than a predetermined height and pressure differential for greater than 750 milliseconds.

FMI 20: After the ignition is turned off, channel pressure increases by more than a predetermined height and pressure differential for greater than 750 milliseconds.

Degraded Modes:

No degraded mode.

Clearing the Service Code:

The service code indicator will be cleared 3 seconds after the vehicle is powered up. The Parker diagnostic tool must be used to view these historical service codes.

Possible Causes:

FMI 17: Check the channel air line for minor leaks. This can include connections to the air spring or the PCU.

FMI 20: Check for channel line pressure increases over long-duration power cycles (i.e. 30 minutes) using the Parker diagnostic tool to verify leaking channel fill valve.

SPN 516235

Service Code: PCU Manifold Pressurized

| FMI | Description | Set | Degraded Mode | Clear | Possible Cause |
|-----|--|--|------------------------|--------------------------|------------------------|
| 7 | Negative sensor reading, cover not venting | All sensors < -0.3psi; (250 msec.) [no Sensor Reference codes] | System remain in place | Remove PCU vent blockage | PCU cover vent blocked |

Description:

The pressure sensors within the PCU manifold reference atmosphere for pressure measurements. If the manifold cavity builds pressure and does not properly vent, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

Either of the channel pressure sensors is reading negative for greater than 250 milliseconds.

Degraded Modes:

Suspension system to remain in place (Latched).

Latched Degraded Mode:

Once the service code has cleared, the vehicle must be stationary, and the operator must select the recovery switch before the Degraded Mode is cleared.

Clearing the Service Code:

To remove the service code, blockage at the back of the PCU must be removed and a power cycle completed.

Possible Causes:

Check for vent blockage on the back side of the PCU.

SPN 516300

Service Code: Height Calibration Error

| | Description | Set | Degraded Mode | Clear | Possible Cause |
|----|---|---|------------------|--|---|
| 7 | Height Calibration failed | Faulted height or pressure sensors; PCU pressures not dropping below thresholds; Calibration failed. | No degraded mode | Fix height assembly install; Fix any height/pressure sensor faults. Recalibration required | Bus cal'd on unlevel ground; PCU sensor issue; Sensor faults active |
| 13 | Height calibration bump stops out of acceptable range | Height sensors vary by more than predetermined thresholds (axle dependent) after calibration completes. | No degraded mode | Fix height assembly install; Fix damaged bump pad; Recalibration required | Bus cal'd on unlevel ground; Missing bump stop pad; Dust cover damaged or incorrectly installed |

Description:

The system features a height calibration procedure. If the calibration procedure does not complete or detects unexpected heights, a service code and associated degraded mode is set for the affected axle(s).

Conditions:

FMI 7: Height calibration timeout occurs or sensor service code becomes active.

FMI 13: Axle bump stop height values vary by more than a configured threshold (axle dependent) during calibration.

Degraded Modes:

No degraded mode.

Clearing the Service Code:

To clear the service code, a re-calibration is required after other codes are corrected or hardware issued identified below are corrected.

Possible Causes:

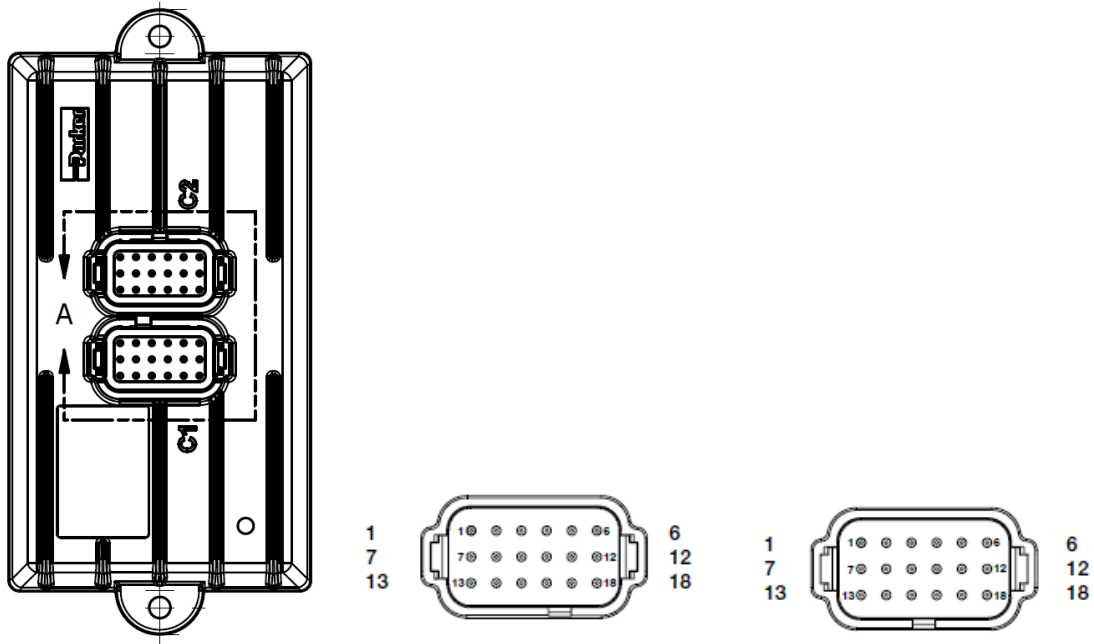
FMI 7: Calibration occurred on un-level ground OR pressure sensed by the PCU is in range but invalid. To verify pressures, manually deflate air springs completely and confirm pressure values are reading less than 3 PSI [20 kPa]. Consult your OEM if pressure measurements are not reading correctly.

FMI 13: Check for missing bump stop pad.

FMI 7,13: Height sensor or magnet assembly is not mounted correctly or has been damaged.

Appendix

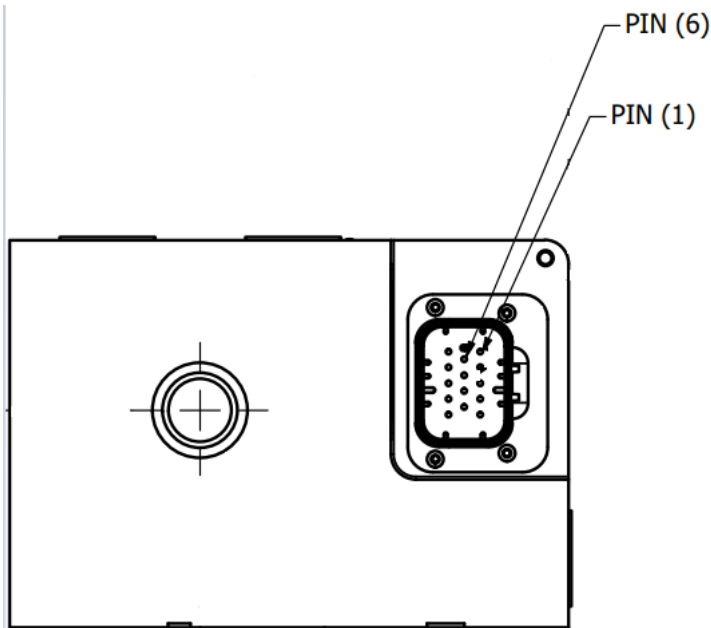
Electronic Control Unit (ECU) Pinout



| Connector | Pin | Description |
|-----------|-----|---|
| C1 | 1 | Ignition Input - System Enable |
| | 2 | N/C |
| | 3 | N/C |
| | 4 | CAN1 Low - Bus Interface / Programming |
| | 5 | CAN Shield |
| | 6 | 5V sensor supply |
| | 7 | Bootmode |
| | 8 | N/C |
| | 9 | N/C |
| | 10 | CAN1 High - Bus Interface / Programming |
| | 11 | Sensor Ground |
| | 12 | +Vbatt (24V Nominal) |
| | 13 | Address High |
| | 14 | Address Low |
| | 15 | -Vbatt (GND) |
| | 16 | -Vbatt (GND) |
| | 17 | +Vbatt (24V Nominal) |
| | 18 | +Vbatt (24V Nominal) |

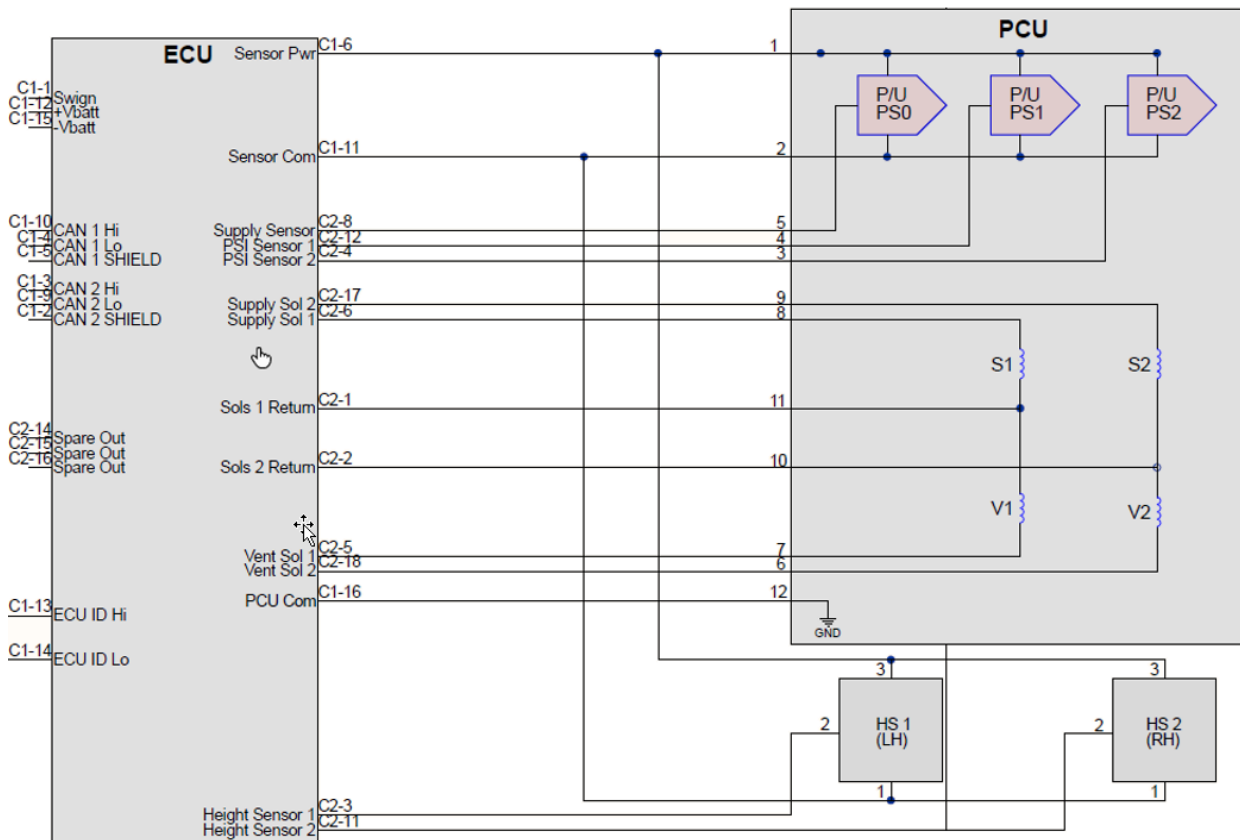
| Connector | Pin | Description |
|-----------|-----|----------------------------------|
| C2 | 1 | CH 1 (LEFT) Current Feedback |
| | 2 | CH 2 (RIGHT) Current Feedback |
| | 3 | CH 1 (LEFT) Height Sensor |
| | 4 | CH 2 (RIGHT) Bag Pressure Sensor |
| | 5 | CH 1 (LEFT) Valve Vent |
| | 6 | CH 1 (LEFT) Fill Valve |
| | 7 | N/C |
| | 8 | PCU Air Supply Pressure Sensor |
| | 9 | N/C |
| | 10 | N/C |
| | 11 | CH 2 (RIGHT) Height Sensor |
| | 12 | CH 1 (LEFT) Bag Pressure Sensor |
| | 13 | N/C |
| | 14 | N/C |
| | 15 | N/C |
| | 16 | N/C |
| | 17 | CH 2 (RIGHT) Fill Valve |
| | 18 | CH 2 (RIGHT) Valve Vent |

Pneumatic Control Unit (PCU) Pinout



| PINOUT TABLE | |
|--------------|----------------------------------|
| PIN | DESCRIPTION |
| 1 | 5V SENSOR SUPPLY |
| 2 | SENSOR GROUND |
| 3 | CH 2 (RIGHT) BAG PRESSURE SENSOR |
| 4 | CH 1 (LEFT) BAG PRESSURE SENSOR |
| 5 | LOCAL AIR SUPPLY PRESSURE SENSOR |
| 6 | CH 2 (RIGHT) EXHAUST VALVE |
| 7 | CH 1 (LEFT) EXHAUST VALVE |
| 8 | CH 1 (LEFT) FILL VALVE |
| 9 | CH 2 (RIGHT) FILL VALVE |
| 10 | CH 2 (RIGHT) CURRENT FEEDBACK |
| 11 | CH 1 (LEFT) CURRENT FEEDBACK |
| 12 | GROUND |
| 13 | N/C |
| 14 | N/C |

Wiring Interconnect



ECU ID Tag Resistors

| RESISTOR TAGS | | |
|---------------|----------|-------------|
| Tag | P/N | ECU ID |
| 0 | 20085050 | Front Axle |
| 1 | 20085051 | Rear Axle |
| 2 | 20085052 | Center Axle |