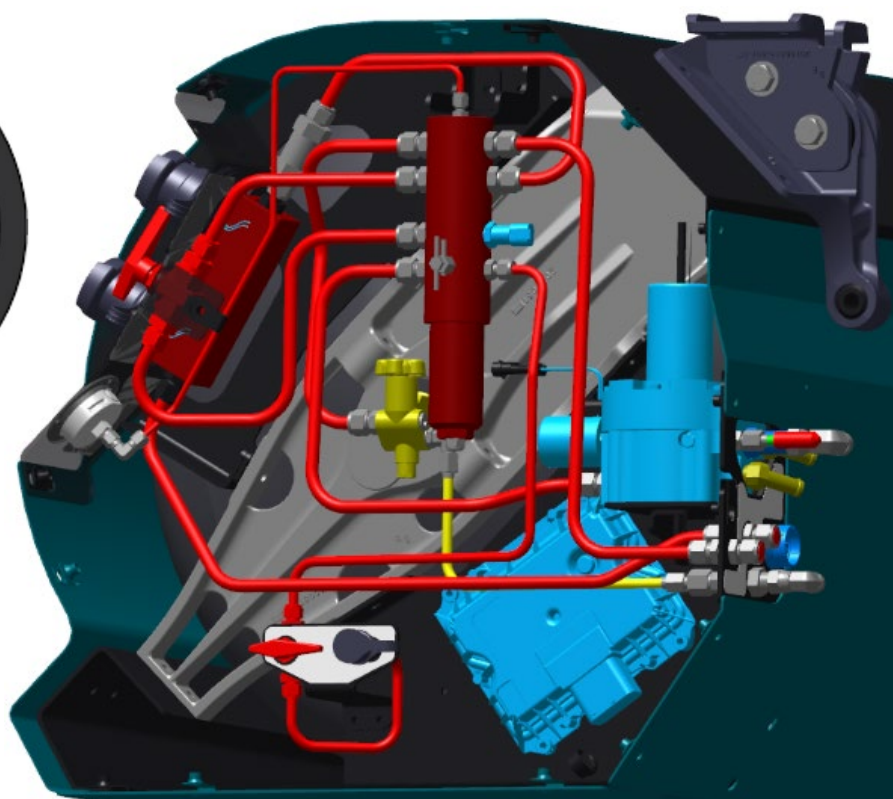




Blue iQ[®] Diagnostic Service Manual



DSM.0001 Ver. 2.0
December 29, 2021

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Appendix A. Blue iQ Fuel System Control Module (FSCM) Circuit Diagram oversize

NOTICE

Please refer to USM.0001 Blue iQ User Manual for detailed operating instructions.



Please contact Hexagon Agility® Customer Care and Technical Services (CCTS) for assistance.

Warning Messages and Symbols Used in this Document



WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



NOTICE is used to address practices not related to physical injury, such as best practices or tips to help an operation or procedure go smoothly and prevent equipment damage.



Critical Characteristic

Product feature directly affects:

- Safety of vehicle users, people nearby and maintenance personnel, or
- Regulatory compliance.

1. Description and Operation Overview

Hexagon Agility® compressed natural gas (CNG) fuel systems equipped with Blue iQ® access original equipment manufacturer (OEM) Cummins® engine data to maximize vehicle uptime and optimize performance. Blue iQ sensors monitor system pressure and temperature to deliver accurate temp-compensated fuel readings via a multifunction dashboard gauge.

Blue iQ provides crucial system monitoring and operating data including real-time fuel economy, and places multiple functions at the operator's fingertips. Features include the following:

- **Engine-Linked Startup Logic** protects fuel system and engine and guards against downtime in cold conditions
- **Vehicle Range Monitor** calculates distance with fuel on board, provides constant and accurate fuel readings, and instant fuel economy feedback
- **Eco Mode** enhances fuel economy and extends vehicle range
- **Low Fuel Derate** permits safe exit from traffic at extremely low fuel levels
- **Over Temperature Warning** alerts driver of potentially unsafe operating conditions

Although Blue iQ systems will vary with differing vehicle configurations and applications, all systems can be summarized with the following simplified diagram, **FIGURE 1–1**:

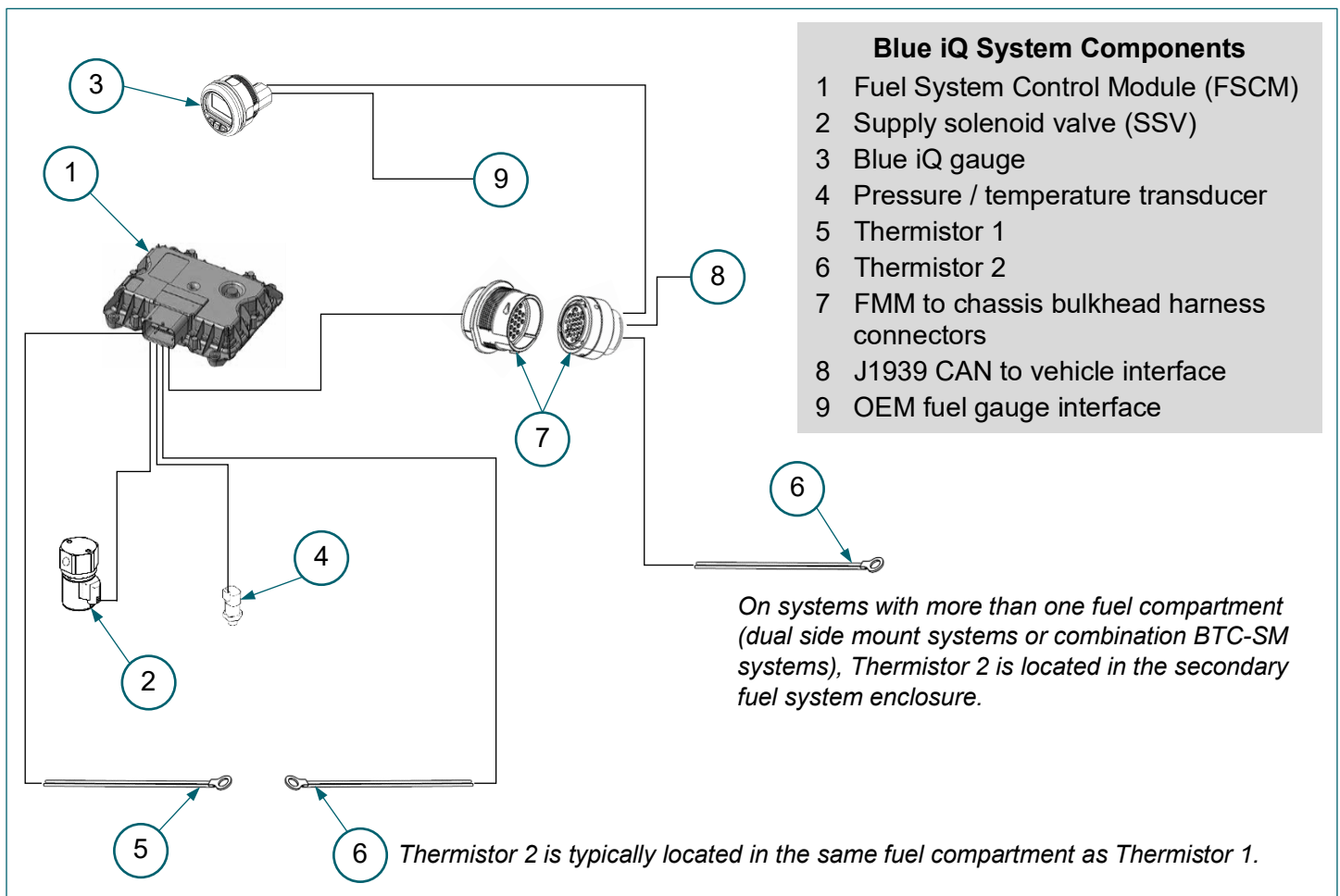
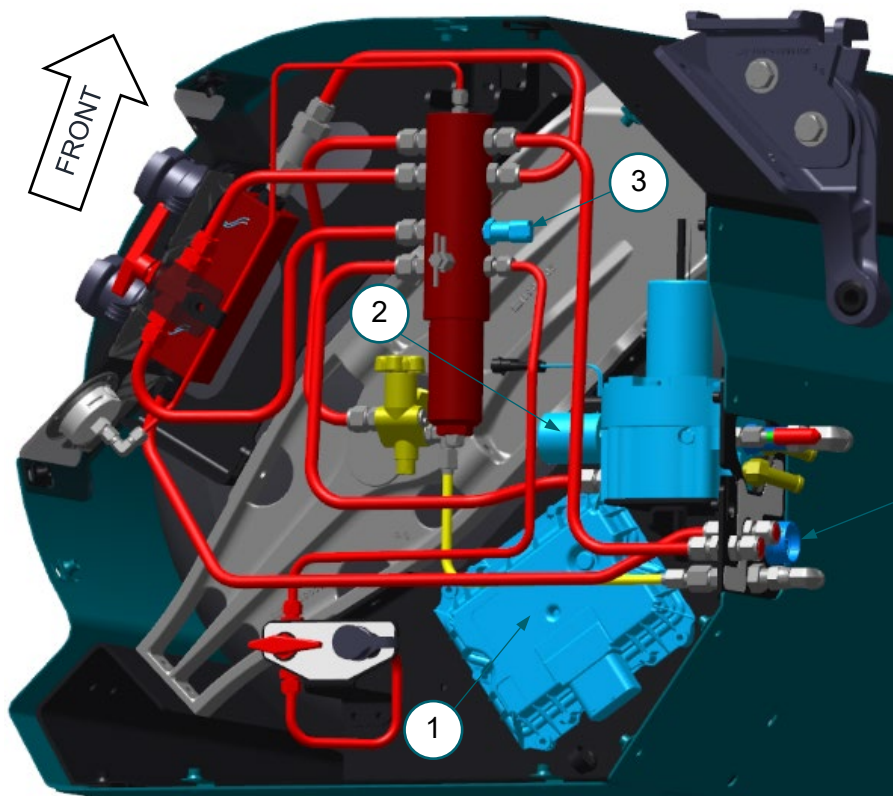


FIGURE 1–1. Simplified Blue iQ fuel system diagram

With the exception of fuel systems equipped with “box” (standalone) fuel management modules (FMMs), all Blue iQ components are housed in fuel storage compartments with integrated FMMs. **FIGURE 1–2** and **FIGURE 1–3**

Blue iQ Fuel Storage Compartment Components

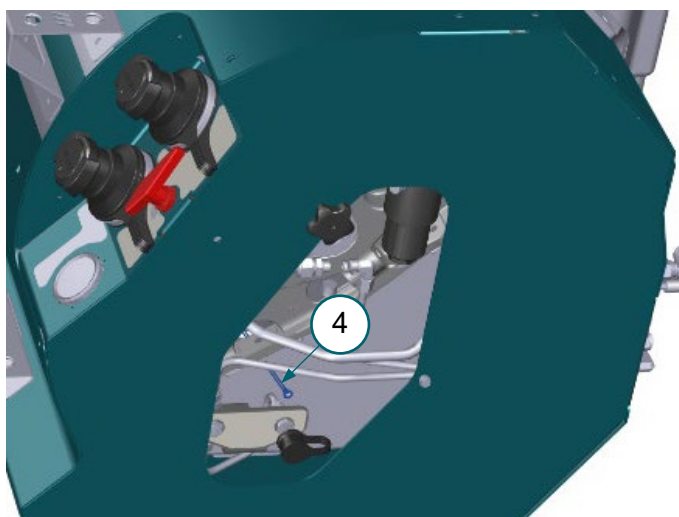
- | | |
|--|---------------------------------------|
| 1 Fuel System Control Module (FSCM) | 4 thermistor 1 |
| 2 supply solenoid valve (SSV) <i>NOTE: integral with regulator</i> | 5 FMM bulkhead connector |
| 3 pressure / temperature transducer | 6 thermistor 2 (<i>not visible</i>) |



Driver side (DS) FMM with rear cover panel removed

On a **single** side mount fuel system, Thermistor 2 is located at the front of the fuel storage compartment regardless of whether the FMM is located on driver side or passenger side.

On a **dual** side mount fuel system, Thermistor 2 is located at the front of the non-FMM fuel storage compartment. (See **FIGURE 1–3** below.)



Driver side (DS) FMM with access door removed

FIGURE 1–2. Gen 5 side mount (SM) Blue iQ fuel compartment component overview

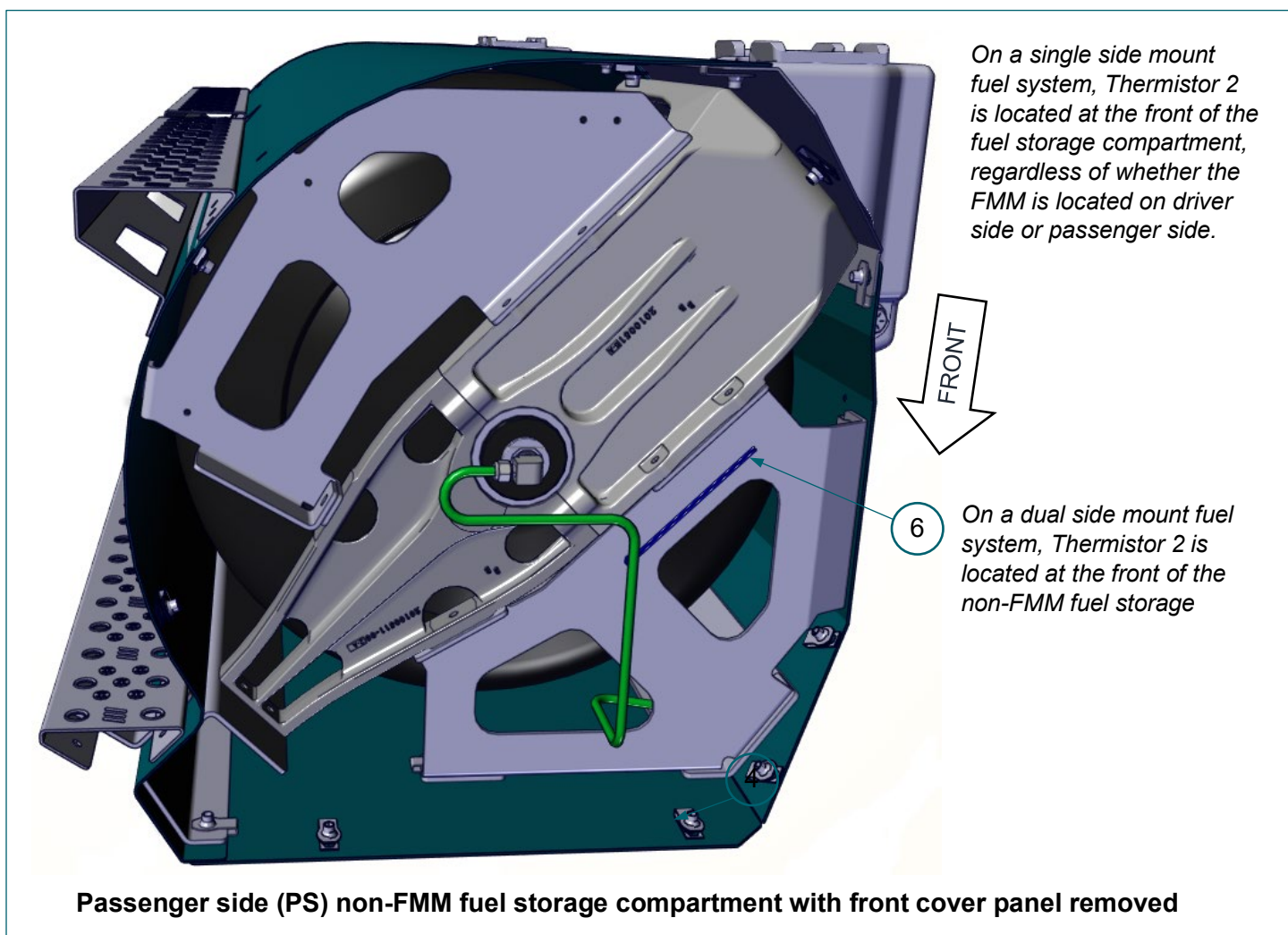


FIGURE 1–3. Gen 5 SM Blue iQ fuel storage compartment

BTC FMM Blue iQ Fuel Compartment Components

- | | |
|-------------------------------------|--------------------------|
| 1 Fuel System Control Module (FSCM) | 4 thermistor 1 |
| 2 supply solenoid valve (SSV) | 5 FMM bulkhead connector |
| 3 pressure / temperature transducer | 6 thermistor 2 |

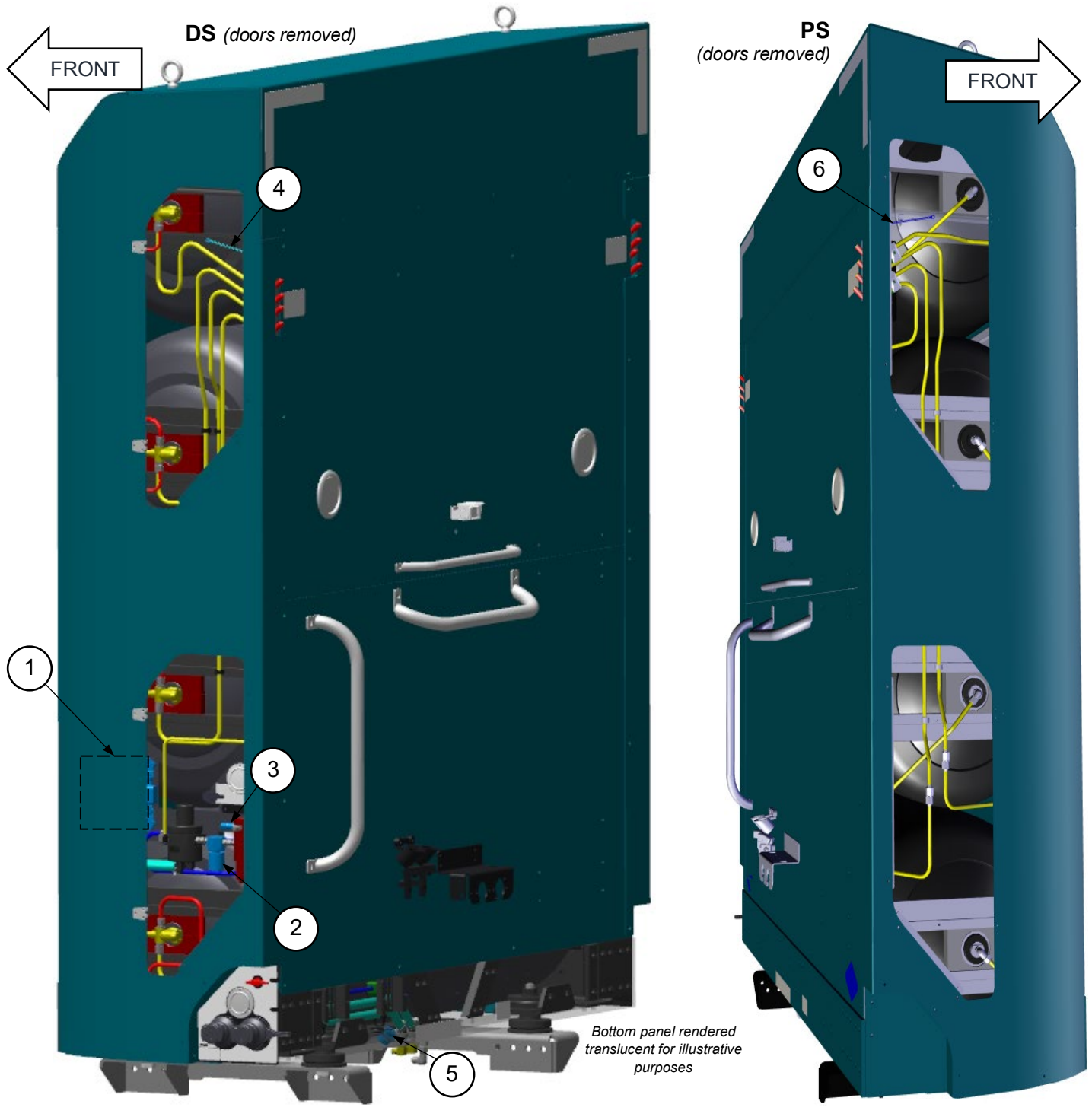


FIGURE 1–3. BTC with integrated FMM Blue iQ fuel compartment component overview

Box FMM Blue iQ Components

- | | |
|-------------------------------------|-------------------------------------|
| 1 Fuel System Control Module (FSCM) | 3 pressure / temperature transducer |
| 2 supply solenoid valve (SSV) | 4 FMM bulkhead connector |

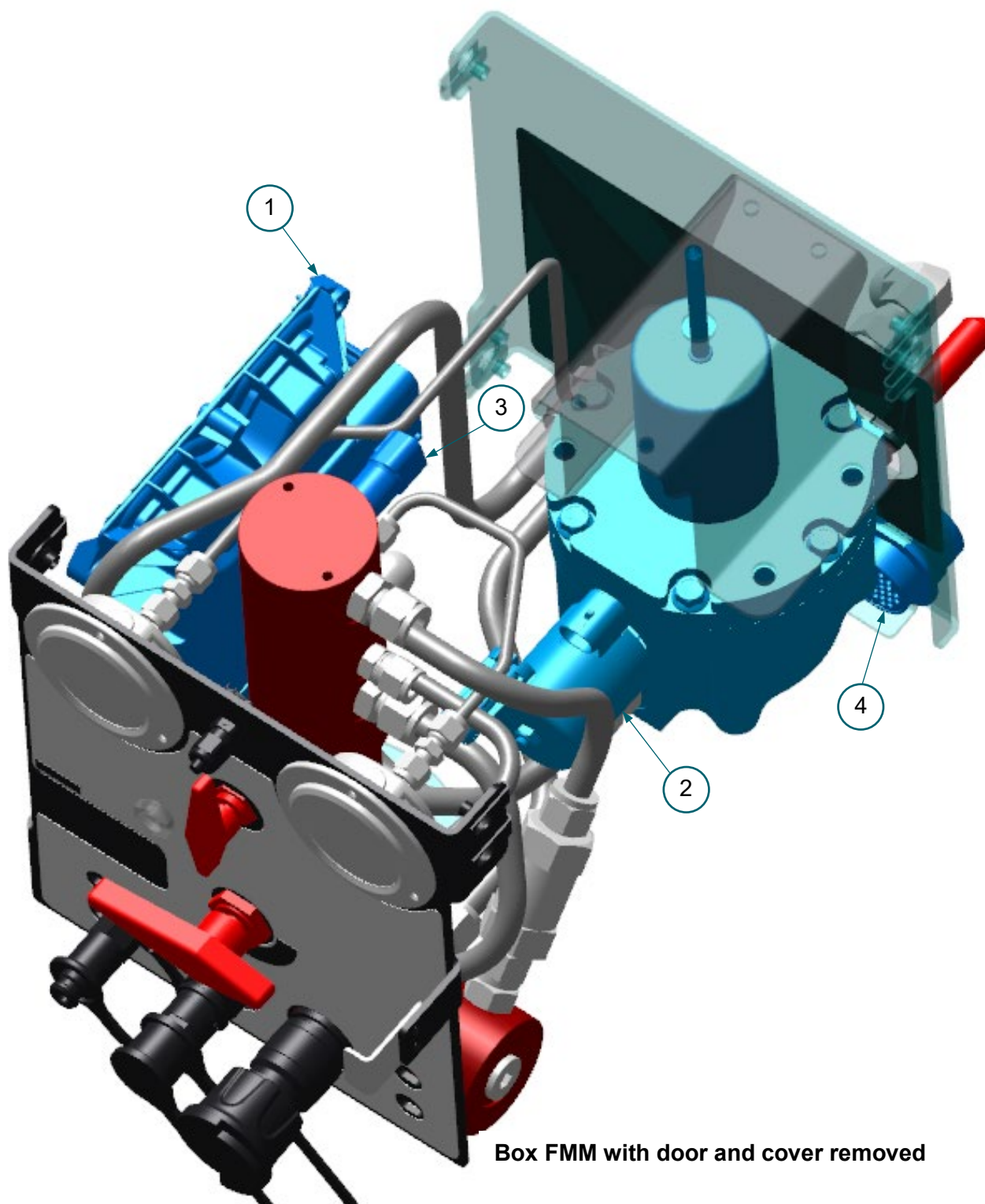


FIGURE 1–4. Typical standalone “box” FMM Blue iQ fuel compartment component overview

2. Components, Circuit Schematics, Connector End Views, and Pinouts

2.1. Blue iQ® gauge

A dash mounted Blue iQ gauge provides a user-configurable interface for vital fuel system operating data and warning messages. **FIGURE 2–1**



FIGURE 2–2. Blue iQ gauge and sample Blue iQ gauge screens

The Blue iQ gauge also alerts operators to fuel system faults requiring service. **FIGURE 2–3**



FIGURE 2–3. Blue iQ gauge screen indicating multiple system faults

Please refer to USM.0001 Blue iQ User Manual for detailed Blue iQ gauge operating instructions. **FIGURE 2–4**



FIGURE 2–4. USM.0001 Blue iQ User Manual

The Blue iQ gauge connects to the Blue iQ FSCM using the fuel system bulkhead harness (refer to Section 2.7.) and communicates with OEM vehicle via the SAE J1939 CAN network (refer to Section 2.10.). **FIGURE 2–5** and **FIGURE 2–6**

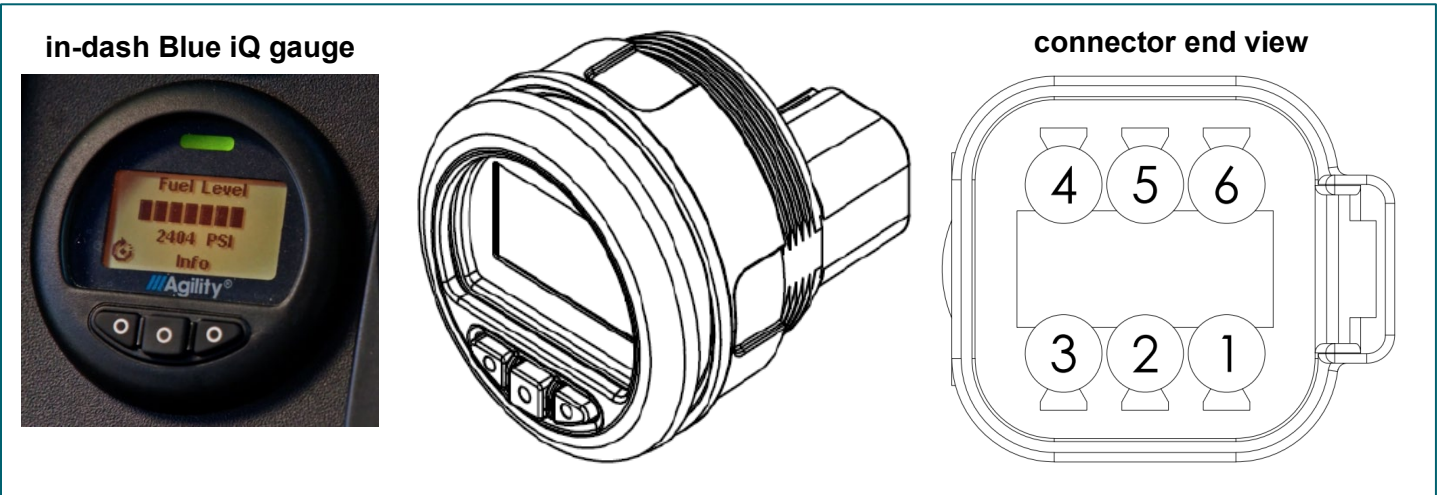
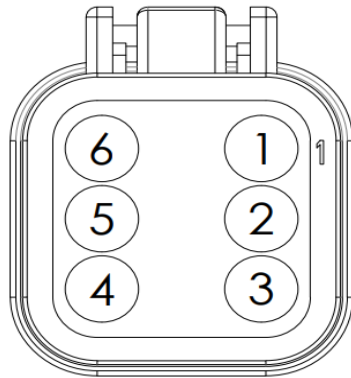


FIGURE 2–5. In-dash mount Blue iQ gauge and Blue iQ gauge connector end view

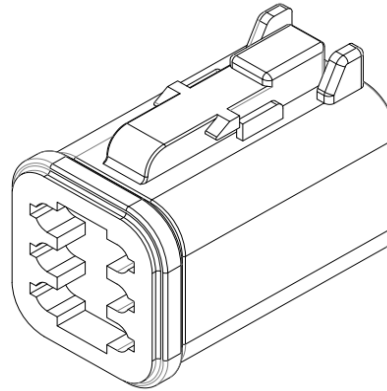
Blue iQ gauge circuit pin out

Pin	Color	Circuit	Pin	Color	Circuit
1	Red	+12V Ignition	4	Yellow	J1939 +
2	Black	Ground	5	Green	J1939 –
3	–	–	6	–	–

connector end view



connector image

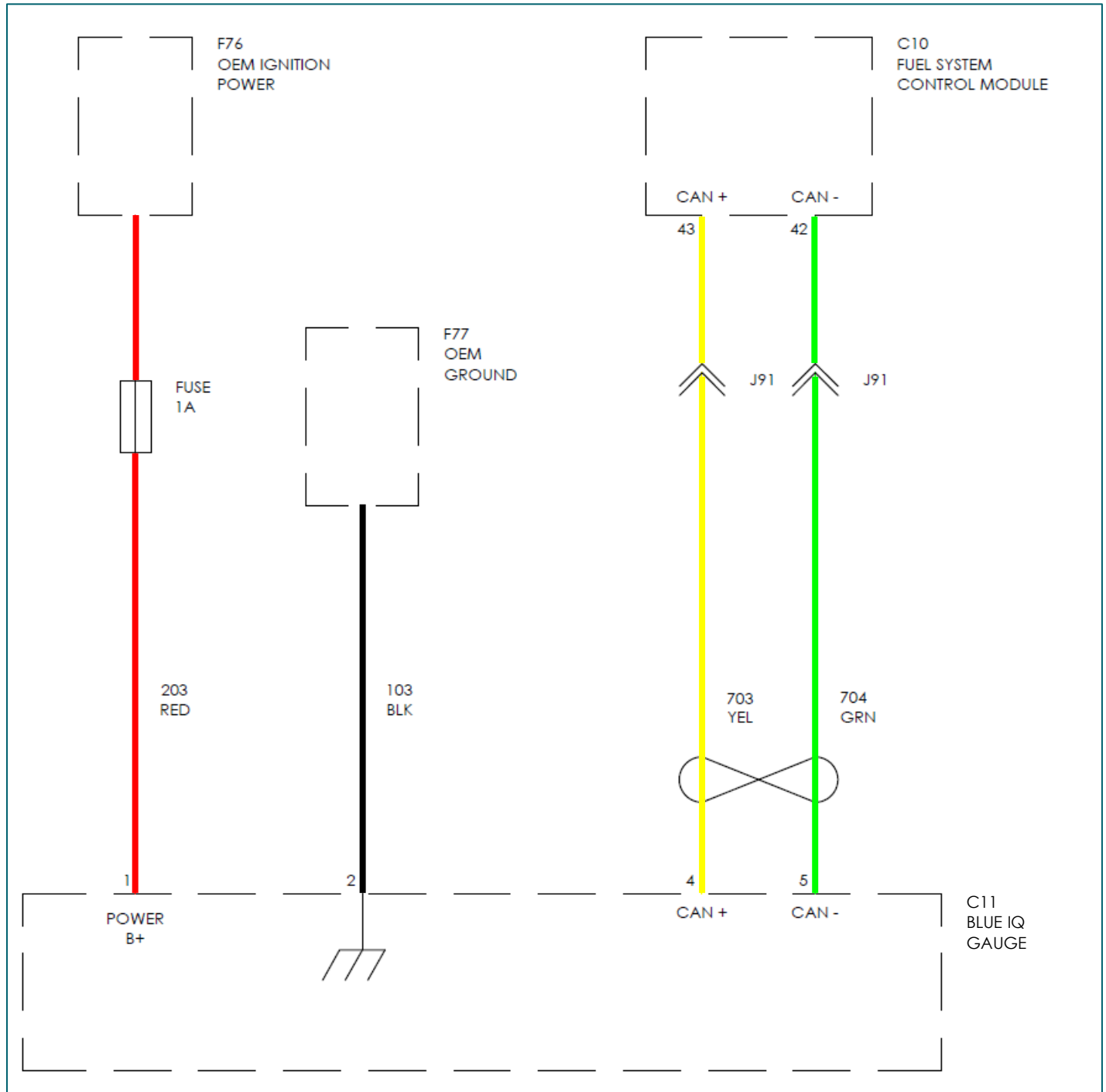


connector harness
wire view



FIGURE 2-6. Blue iQ gauge harness and wire connector end view (*inset*). **NOTE:** Partial harness circuit shown; Blue iQ gauge harness connects to SAE J1939 circuit harness; refer to Section 2.10.

Blue iQ gauge circuit diagram



2.2. Fuel System Control Module (FSCM)

The Blue iQ Fuel System Control Module (FSCM) located inside the fuel management module (FMM) monitors and manages fuel system function. The FSCM receives multiple inputs and utilizes internal monitors to continuously examine and direct fuel system safety and performance. **FIGURE 2–7**

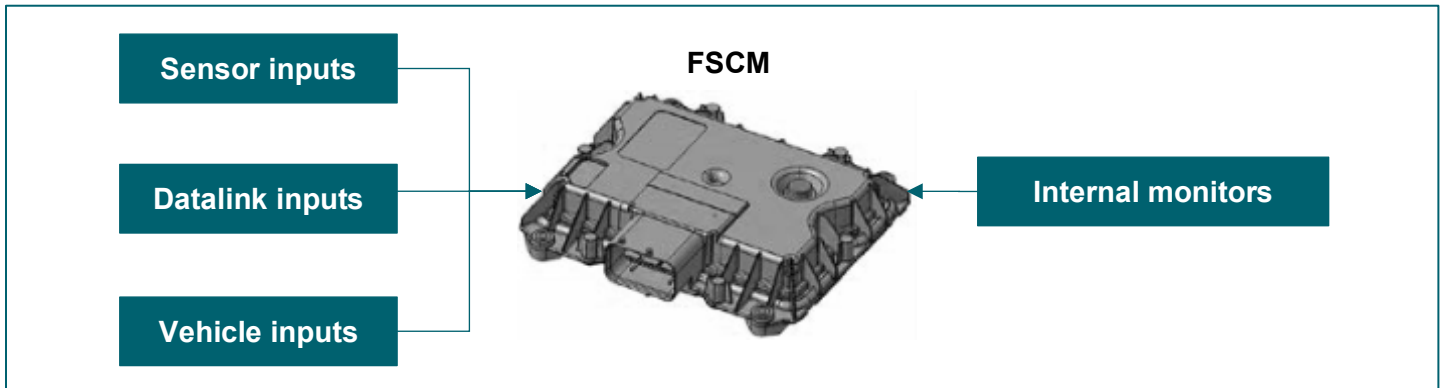


FIGURE 2–7. Blue iQ Fuel System Control Monitor (FSCM) inputs

Fuel system components delivering data to the Blue iQ FSCM include the following items:

1. Pressure / temperature transducer
2. Supply solenoid valve (SSV)
3. Two fuel compartment temperature sensors called “thermistors”
4. Drive Away Protection (DAP) switches

Additionally, the OEM vehicle communicates datalink inputs including engine operating status and data to the Blue iQ FSCM via a J1939 CAN bus connection.

Vehicle inputs to the Blue iQ FSCM are as follows:

1. Ignition ON (Battery + switch)
2. Battery power (B+)
3. Battery ground (B–)
4. Crank request
5. Fuel gauge circuit closed loop feedback

The FSCM outputs data directing fuel system components to ensure safety and performance. **FIGURE 2–8**

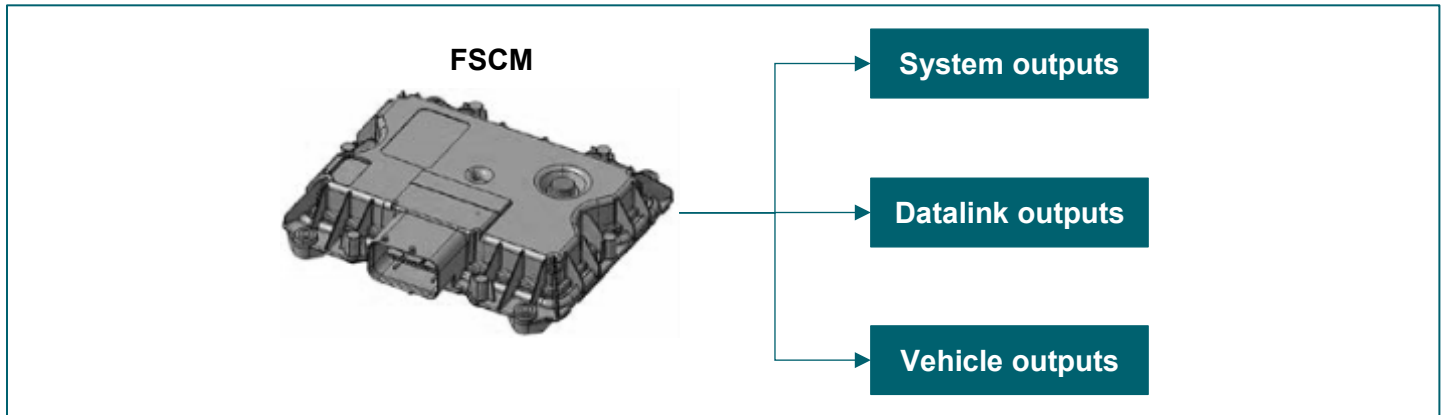


FIGURE 2–8. Blue iQ Fuel System Control Monitor (FSCM) outputs

FSCM system outputs include the following:

1. Supply solenoid valve (SSV) command (ON/OFF)
2. Sensor supply voltage (Supply 5V)
3. Sensor return (Low Reference—also called “system ground”)

FSCM datalink outputs include the following:

1. Engine Common Data Interface Messages
2. System Messages to Blue iQ gauge
3. Fault Code Status and Warning Lamps

FSCM vehicle outputs include the following:

1. Fuel Level
2. Crank Confirm
3. Low Fuel Warning
4. Drive Away Protection (DAP) Lamp. *NOTE: optional on some systems.*

The FSCM is located within the fuel system FMM. **FIGURE 2–9; FIGURE 2–10; FIGURE 2–11; FIGURE 2–12**

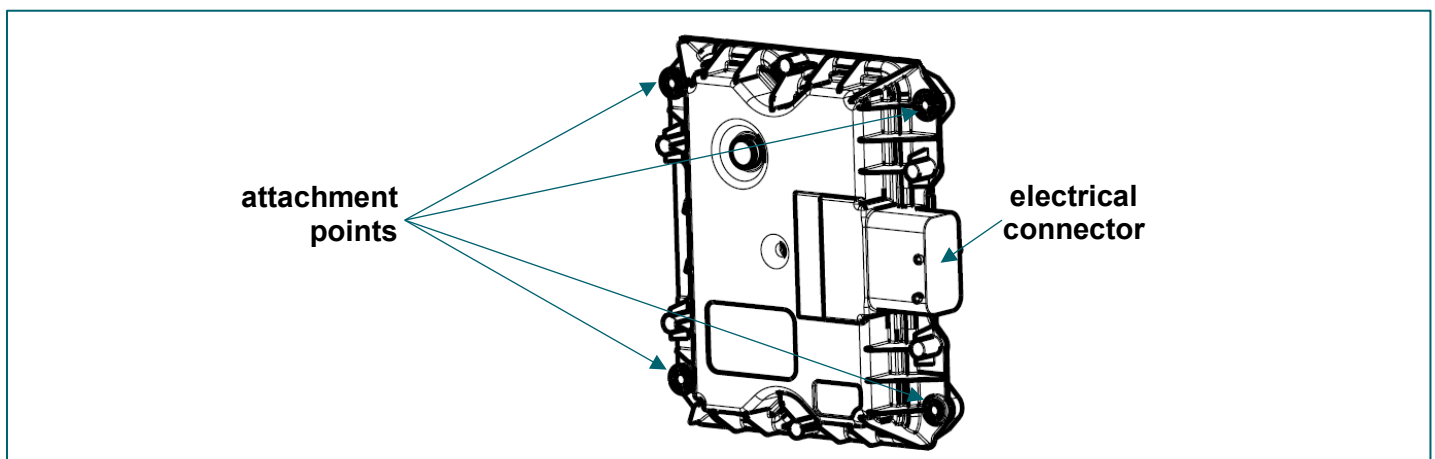


FIGURE 2–9. Blue iQ Fuel System Control Module (FSCM)

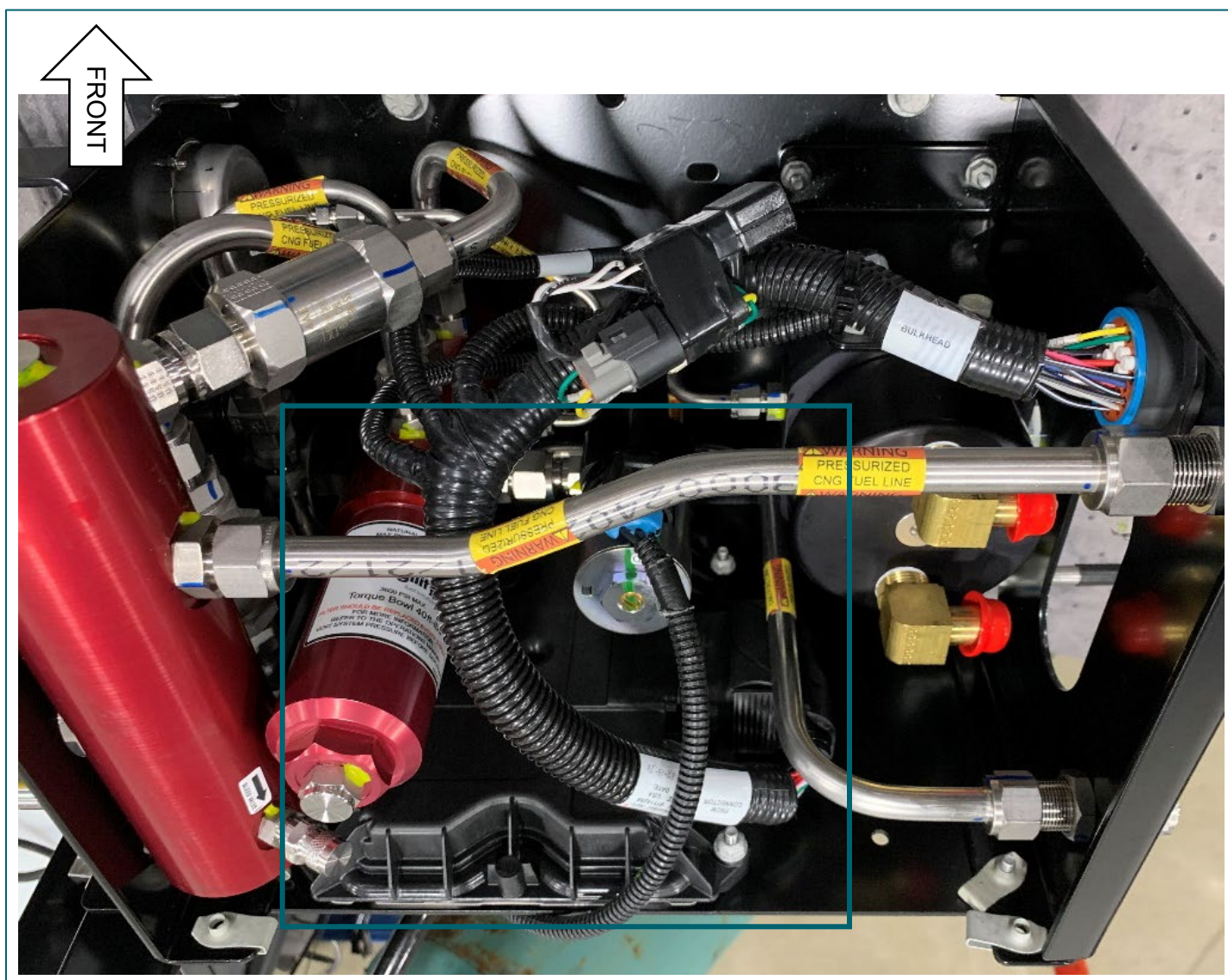


FIGURE 2-10. Box FMM FSCM location (square).

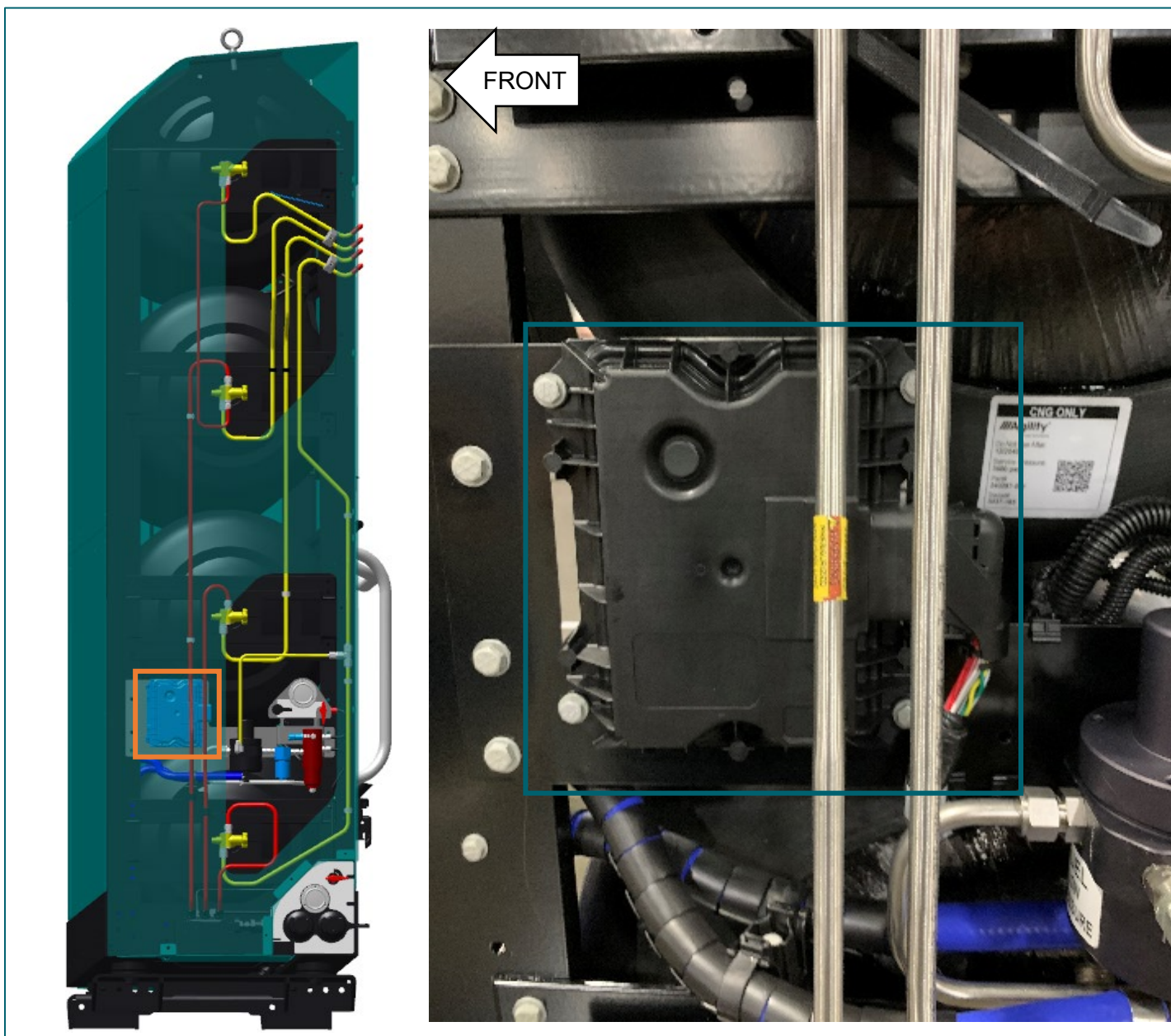


FIGURE 2-11. ProCab® BTC FSCM location (square).

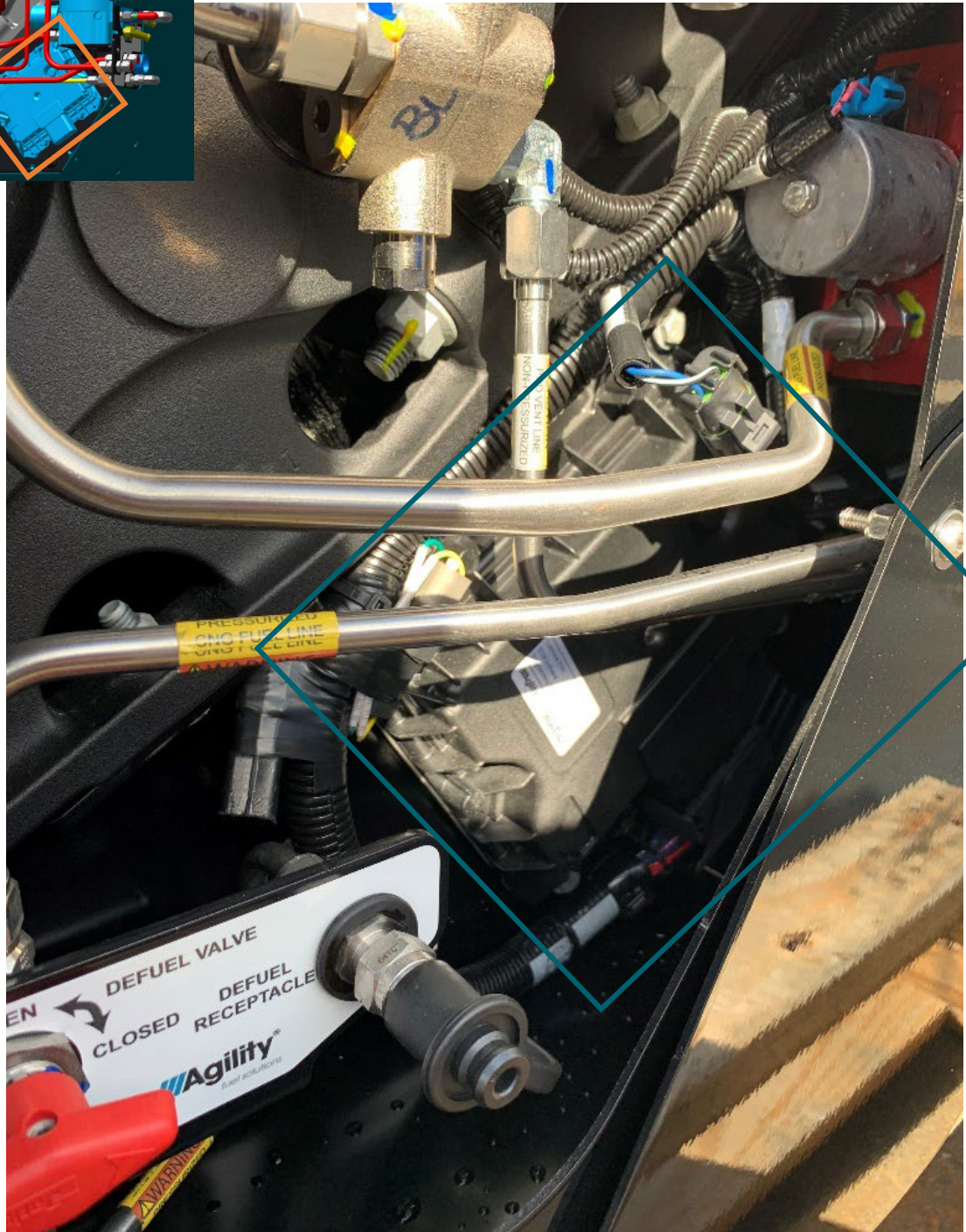
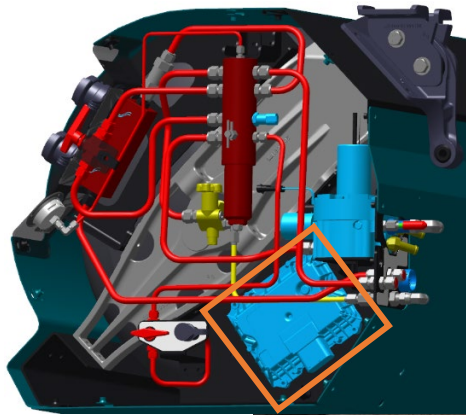
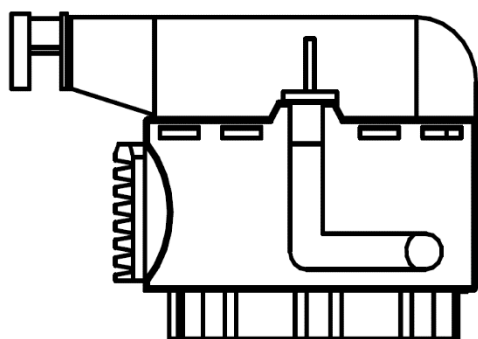
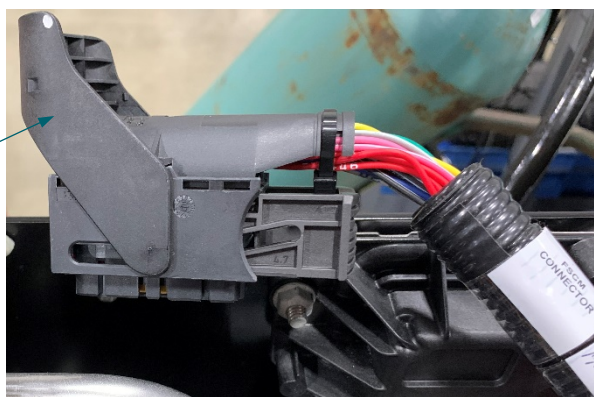


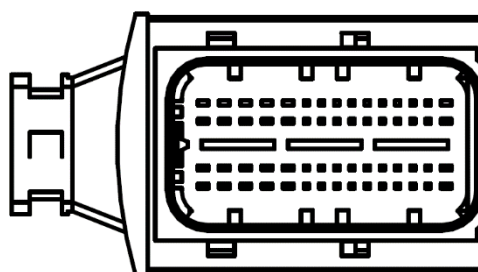
FIGURE 2-12. ProRail® Gen 5 SM FSCM location (square).

NOTE: Driver side FMM shown with rear cover panel removed; passenger side similar.

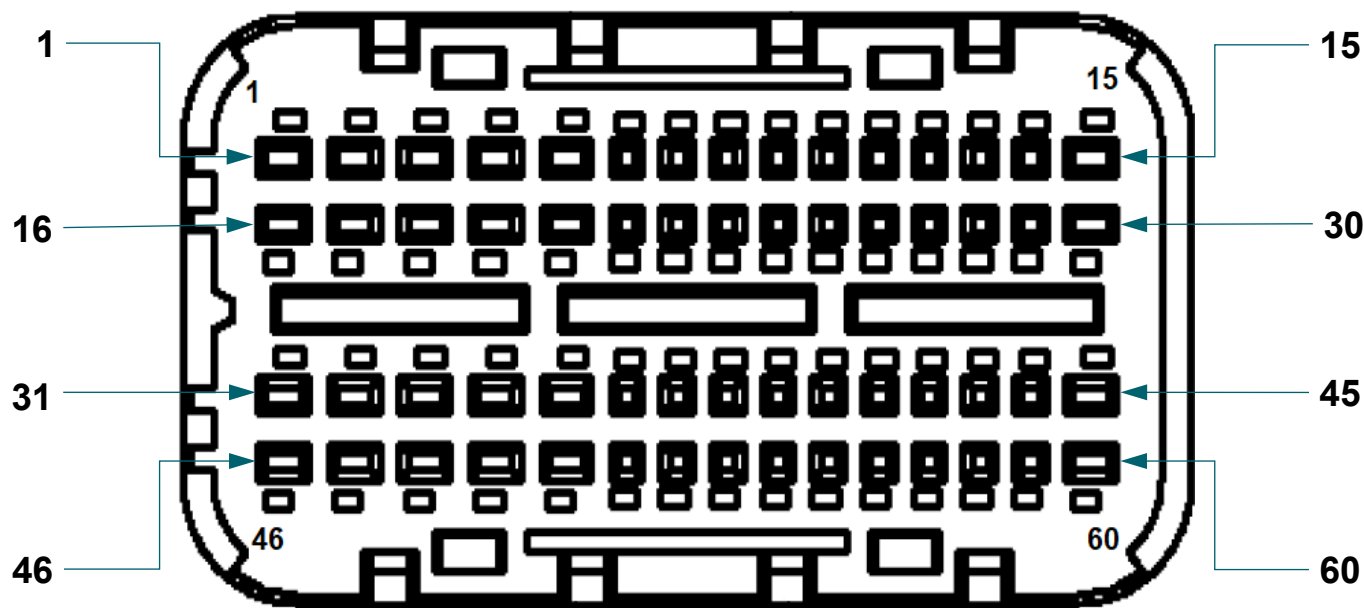
FSCM connector
locking lever



Connector side view



Connector end view



Connector end view (closeup)

FIGURE 2-13. Fuel System Control Module (FSCM) connector views

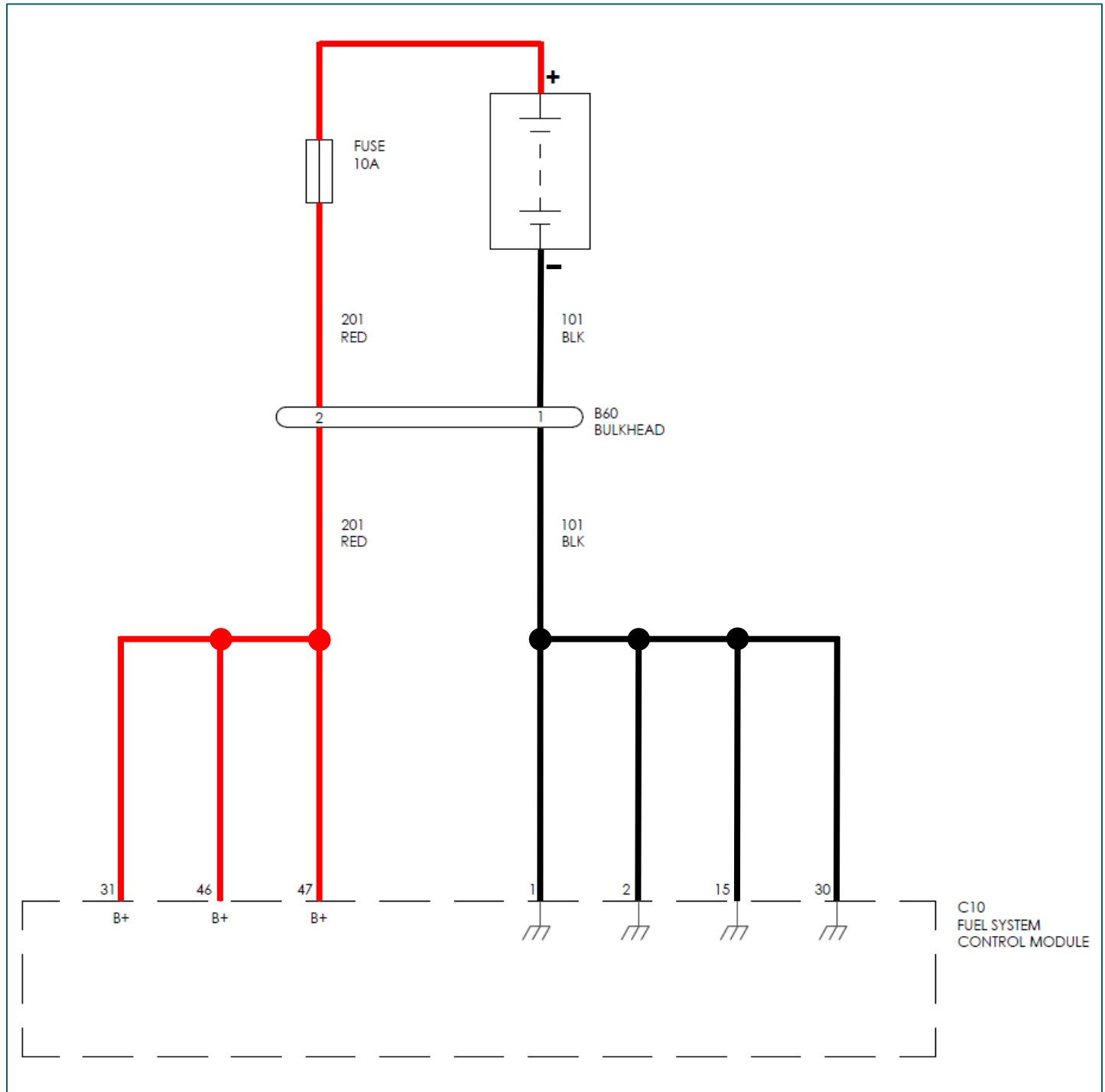
Fuel System Control Module (FSCM) circuit pin out

Pin	Color	Circuit
1	Black	Battery Ground
2	Black	Battery Ground
3	—	—
4	—	—
5	Black/White	Drive Away Protection (DAP) 1 / DAP 2 Return
6	Gray	DAP 1 Signal
7	Blue/White	Transducer Pressure Signal
8	Gray	DAP 2 Signal
9	Blue	Transducer Temperature Signal
10	Gray	DAP 5 Signal
11	—	—
12	—	—
13	Blue	Fuel Compartment 1 Temp Sensor Signal (Thermistor 1 Signal)
14	Violet	5V Signal
15	Black	Battery Ground
16	—	—
17	Pink/Black	Low-pressure (LP) Lamp Signal <i>(if equipped)</i>
18	—	—
19	—	—
20	White/Black	Supply Solenoid Valve Return Current Monitor
1	Blue/White	OEM Fuel Gauge Feedback
22	White/Red	Crank Request
23	Blue	Fuel Compartment 2 Temp Sensor Signal (Thermistor 2 Signal)
24	Gray	DAP 4 Signal
25	Gray	DAP 3 Signal
26	—	—
27	Black/White	DAP 3 / DAP 4 / DAP 5 Return
28	Black/White	Fuel Compartment 1 & 2 Temp Sensor Return (Thermistor 1 & 2 Return)
29	Black/White	Ground
30	Black	Battery Ground

Fuel System Control Module (FSCM) circuit pin out (continued)

Pin	Color	Circuit
31	Red	Battery +
32	—	—
33	—	—
34	—	—
35	—	—
36	—	—
37	Red/White	Ignition Switch Input
38	—	—
39	Black/White	OEM Fuel Gauge Return
40	—	—
41	—	—
42	Green	CAN Public Low FSCM
43	Yellow	CAN Public High FSCM
44	—	—
45	Black/Pink	LP Lamp Return (<i>if equipped</i>)
46	Red	Battery +
47	Red	Battery +
48	—	—
49	—	—
50	—	—
51	—	—
52	—	—
53	Pink	Solenoid Supply Valve Signal
54	—	—
55	Pink/White	Start Confirm
56	—	—
57	—	—
58	Gray/White	DAP Lamp (<i>if equipped</i>)
59	White	OEM Fuel Gauge PWM Signal
60	Pink/Black	LP Lamp Signal (<i>if equipped</i>)

Fuel System Control Module (FSCM) power and ground circuit diagram



2.3. Supply solenoid valve (SSV)

The supply solenoid valve (SSV)—called the “fuel shutoff solenoid” in Cummins® INSITE™—opens or closes to enable or stop fuel system flow by means of an inductive coil.

Supply solenoid valves on some systems are mounted between the high-pressure (HP) filter and the pressure regulator. **FIGURE 2–14**

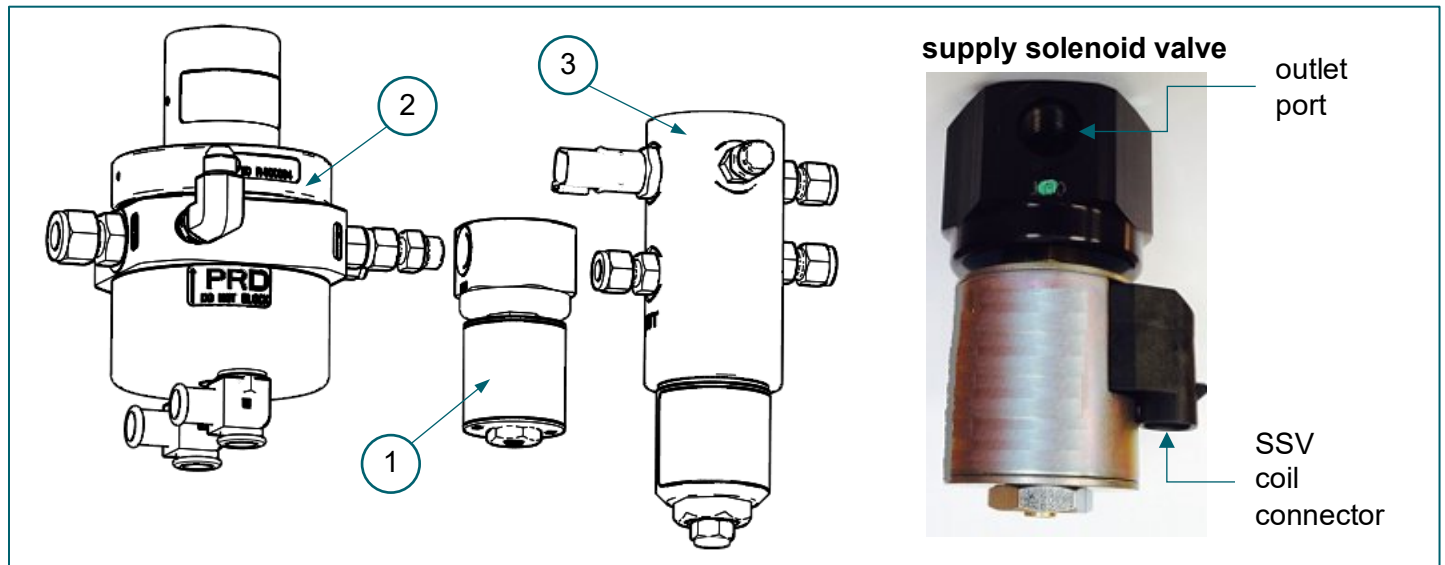


FIGURE 2–14. Standalone supply solenoid valve (SSV) typical location and features (BTC system shown)

1 supply solenoid valve

2 pressure regulator

3 HP filter

On other systems supply solenoid valves are mounted integrally on the extended range Marathon pressure regulator. **FIGURE 2–15**

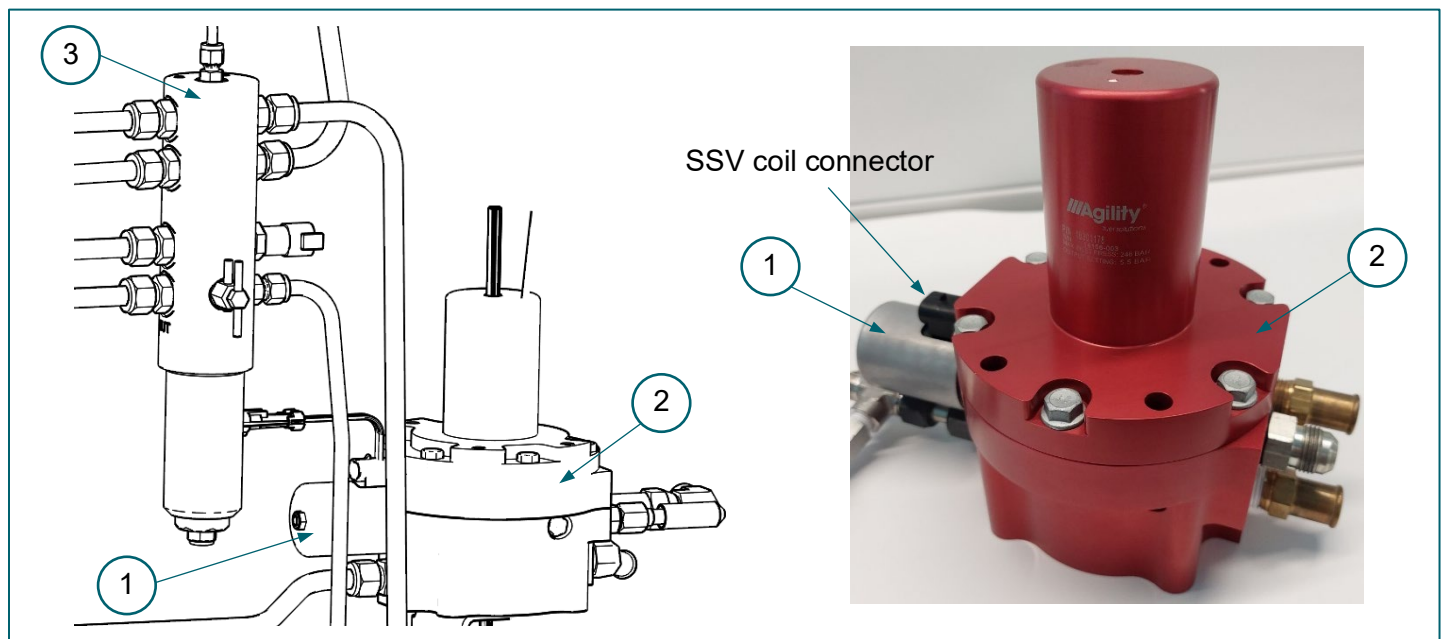


FIGURE 2–15. Marathon extended range pressure regulator with integral supply solenoid valve (SSV) typical location and features (Gen 5 SM system shown at left)

1 supply solenoid valve

2 Marathon pressure regulator

3 Manifilter

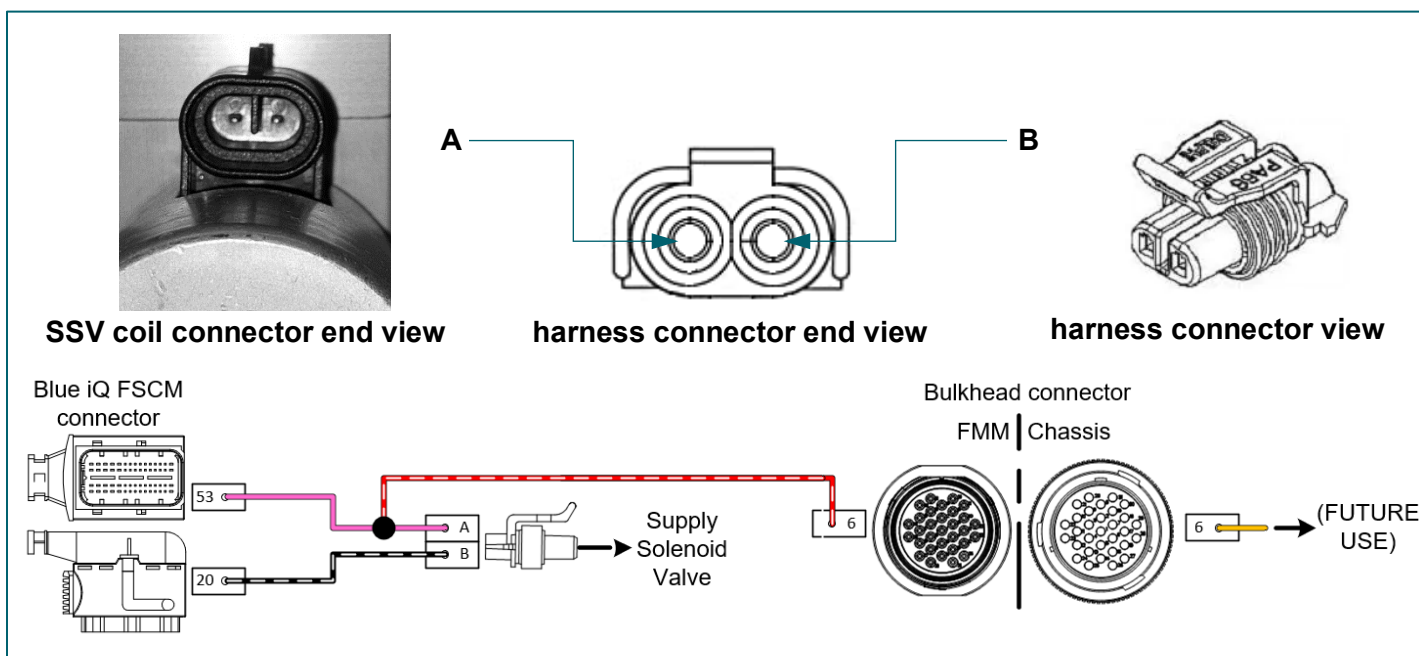


FIGURE 2-16. Supply solenoid valve (SSV) circuit and connector end views

Supply solenoid valve (SSV) circuit pin out

Pin	Color	Circuit
A	Pink	+12V or +24V Supply*
B	White/Black	Return

NOTICE

*Verify whether fuel system is equipped with a 12V or 24V supply solenoid valve; if uncertain, please contact Hexagon Agility® CCTS.

NOTICE

TABLE 2-1 and TABLE 2-2 resistance at temperature values are for standalone SSV coil measurements only. Please contact Hexagon Agility® Customer Care and Technical Services for Marathon extended range regulator integrated SSV coil resistance at temperature values.

NOTICE

The supply solenoid valve (SSV) is powered by a pulse width modulation (PWM) signal. The duty cycle is initially set to 100% (Full On) for two minutes and it then ramped down to 80%. Therefore, the initial voltage measured will be equal to Battery + and will be 80% of Battery + after ramp down.

Blue iQ is used with both 12V and 24V supply solenoid valves (SSVs); use the correct table to determine proper SSV coil operation. **TABLE 2-1** and **TABLE 2-2**

TABLE 2-1. 12V Standalone Supply Solenoid Valve (SSV) Coil Resistance at Temperature Chart

Temp.		Resistance (Ω)		
$^{\circ}\text{C}$	$^{\circ}\text{F}$	Min	Nominal	Max
-40	-40	5.1	5.3	5.6
-35	-31	5.3	5.5	5.7
-30	-22	5.4	5.6	5.8
-25	-13	5.6	5.8	6.0
-20	-4	5.7	5.9	6.1
-15	5	5.8	6.0	6.2
-10	14	6.0	6.2	6.4
-5	23	6.1	6.3	6.5
0	32	6.2	6.4	6.7
5	41	6.4	6.6	6.8
10	50	6.5	6.7	6.9
15	59	6.7	6.9	7.1
20	68	6.8	7.0	7.2
25	77	6.9	7.1	7.3
30	86	7.1	7.3	7.5

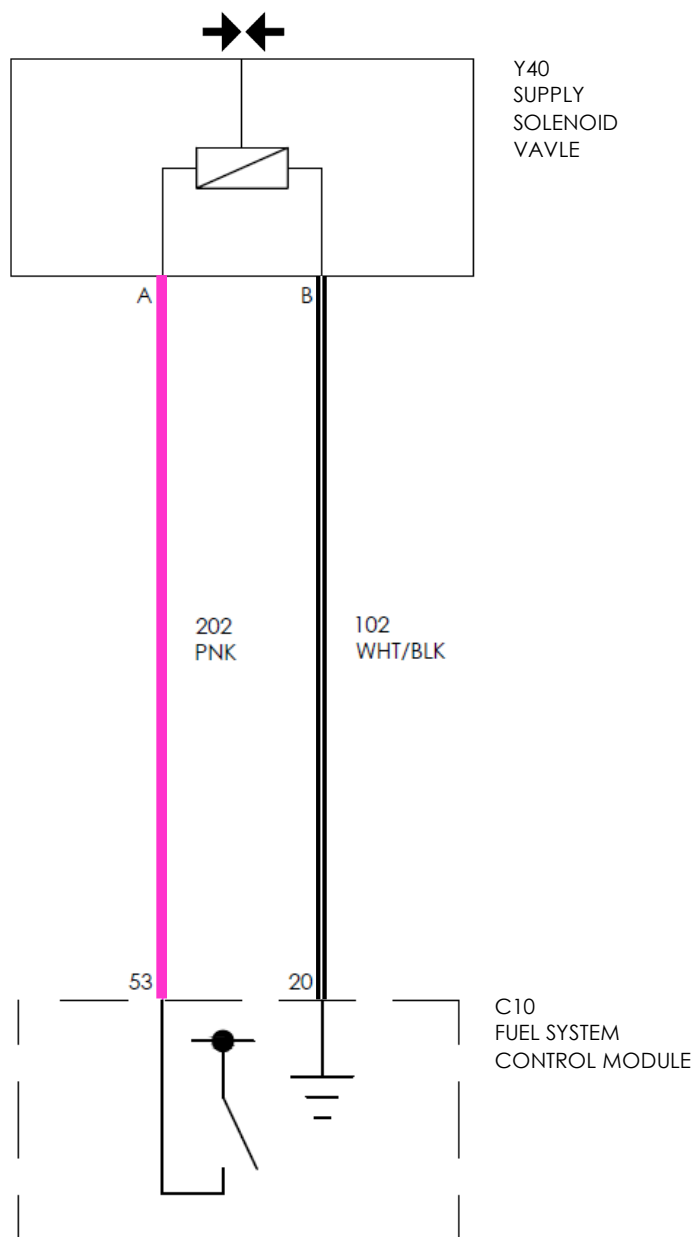
Temp.		Resistance (Ω)		
$^{\circ}\text{C}$	$^{\circ}\text{F}$	Min	Nominal	Max
35	95	7.2	7.4	7.6
40	104	7.3	7.6	7.8
45	113	7.5	7.7	7.9
50	122	7.6	7.8	8.0
55	131	7.8	8.0	8.2
60	140	7.9	8.1	8.3
65	149	8.0	8.2	8.4
70	158	8.2	8.4	8.6
75	167	8.3	8.5	8.7
80	176	8.4	8.7	8.9
85	185	8.6	8.8	9.0
90	194	8.7	8.9	9.1
95	203	8.9	9.1	9.3
100	212	9.0	9.2	9.4
105	221	9.1	9.3	9.5

TABLE 2-2. 24V Standalone Supply Solenoid Valve (SSV) Coil Resistance at Temperature Chart

Temp.		Resistance (Ω)		
$^{\circ}\text{C}$	$^{\circ}\text{F}$	Min	Nominal	Max
-40	-40	20.3	21.8	23.2
-35	-31	20.9	22.3	23.8
-30	-22	21.5	22.9	24.3
-25	-13	22.0	23.5	24.9
-20	-4	22.6	24.0	25.4
-15	5	23.1	24.6	26.0
-10	14	23.7	25.1	26.6
-5	23	24.3	25.7	27.1
0	32	24.8	26.3	27.7
5	41	25.4	26.8	28.2
10	50	25.9	27.4	28.8
15	59	26.5	27.9	29.4
20	68	27.1	28.5	29.9
25	77	27.6	29.1	30.5
30	86	28.2	29.6	31.1

Temp.		Resistance (Ω)		
$^{\circ}\text{C}$	$^{\circ}\text{F}$	Min	Nominal	Max
35	95	28.8	30.2	31.6
40	104	29.3	30.7	32.2
45	113	29.9	31.3	32.7
50	122	30.4	31.9	33.3
55	131	31.0	32.4	33.9
60	140	31.6	33.0	34.4
65	149	32.1	33.5	35.0
70	158	32.7	34.1	35.5
75	167	33.2	34.7	36.1
80	176	33.8	35.2	36.7
85	185	34.4	35.8	37.2
90	194	34.9	36.3	37.8
95	203	35.5	36.9	38.3
100	212	36.0	37.5	38.9

Supply solenoid valve (SSV) circuit diagram



2.4. Pressure / temperature transducer

The pressure / temperature transducer allows Blue iQ to monitor high-pressure fuel entering the pressure regulator at approximately 3600 psi (24.8 MPa) before the regulator reduces fuel pressure to from 85 psi* (0.59 MPa) to 125 psi (0.86 MPa) for use by the engine, depending upon application. **TABLE 2-3**

TABLE 2-3. Low Pressure Fuel Requirements by Engine Size and Pressure Regulator Type

Engine size	LP fuel pressure	Pressure regulator type
9L	125 psi (0.86 MPa)	standard
12L	87 psi (0.60 MPa)	standard
12L	85 psi (0.59 MPa)	Marathon – extended range

As its name implies, the pressure/temperature transducer also monitors fuel temperature. **FIGURE 2-17a**

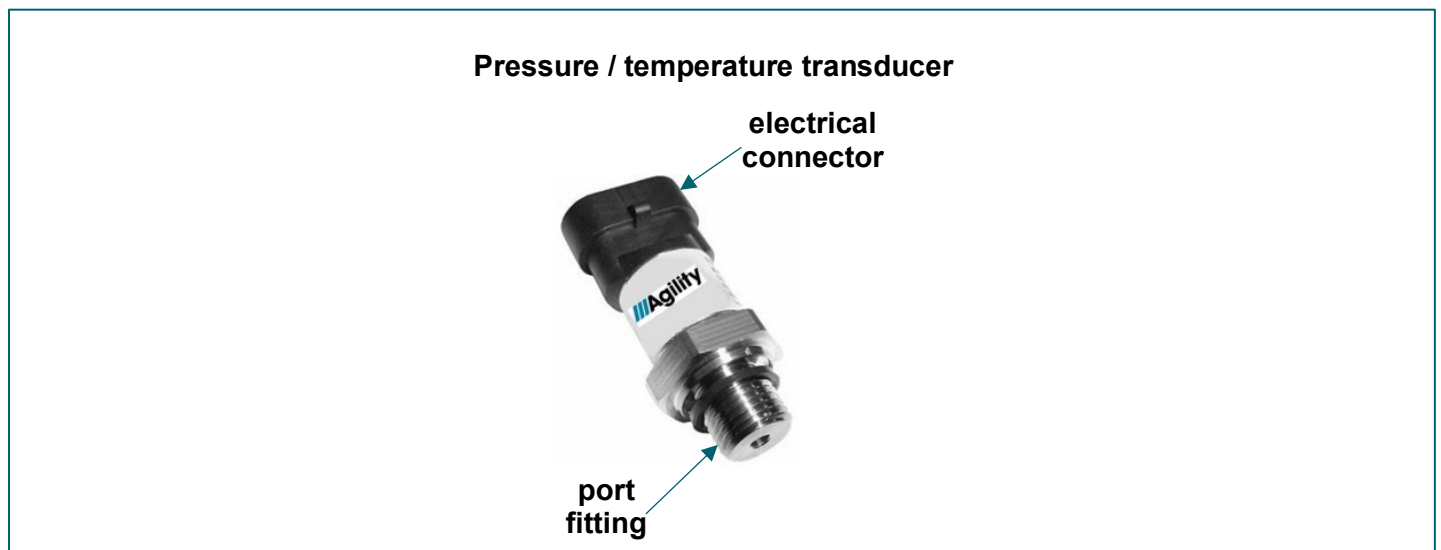


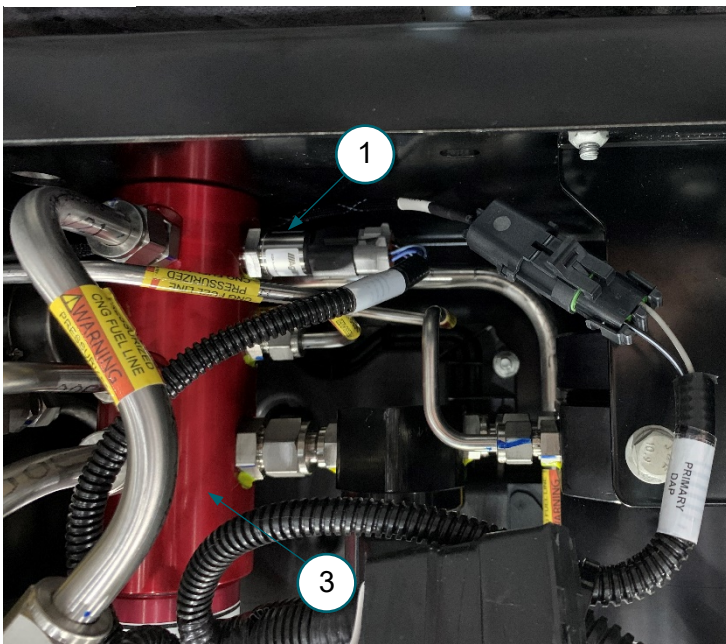
FIGURE 2-17a. Pressure / temperature transducer

Depending upon system design, the pressure / temperature transducer may be located on a manifold or the Manifilter [high-pressure (HP) filter]. **FIGURE 2-17b**

ProCab® BTC



Box FMM



ProRail® Gen 5 SM

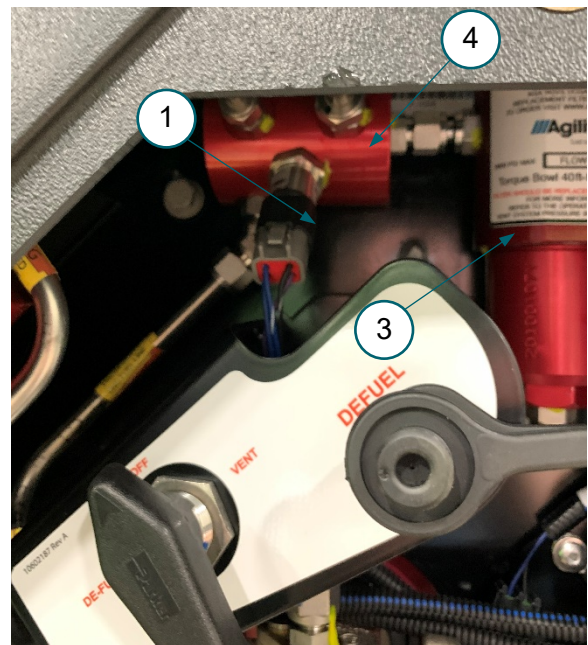


FIGURE 2-17b. Pressure transducer locations in box FMM, ProCab® BTC, ProRail® Gen 5 SM fuel systems.

- | | |
|-----------------------|------------|
| 1 pressure transducer | 3 Manifold |
| 2 pressure regulator | 4 manifold |

The pressure/temperature transducer has an integral temperature sensor that is monitored by the Blue-iQ FSCM. The output voltage of the transducer or both temperature and pressure are *ratio-metric* outputs in which the output voltage scales with the voltage supplied to the transducer. If the transducer measures a pressure or temperature that is half of the full scale, then the output would be equal to half of the supply voltage. In the case of a 5V sensor this would be 2.5V and in the case of a 12V sensor it would be 6V. The voltage supplied to the pressure transducer is regulated to 5V by the Blue iQ FSCM.

The transducer has a pressure range of zero psi (zero MPa) to 6000 psi (41.4 MPa) which corresponds to 0.5V and 4.5V, respectively. **TABLE 2-4**

TABLE 2-4. Pressure / temperature Transducer Voltage at Pressure Chart

Voltage (V)	Pressure	
	psi	MPa
3.4	4350	30.0
3.1	3900	26.9
2.9	3600	24.8
2.5	3000	20.7
2.1	2400	16.6
1.7	1800	12.4
1.3	1200	8.3
0.9	600	4.1
0.7	300	2.1

The pressure/temperature transducer has a temperature range from -40°F to 221°F (-40°C to 105°C) with an output voltage of 0.5V to 4.5V, respectively. **TABLE 2-5**

TABLE 2–5. Pressure/temperature Transducer Voltage at Temperature Chart

Voltage (V)	Temperature	
	°C	°F
4.5	105	221
4.4	101	214
4.3	98	208
4.2	94	201
4.1	91	195
4	87	188
3.9	83	182
3.8	80	175
3.7	76	169
3.6	72	162
3.5	69	156
3.4	65	149
3.3	62	143
3.2	58	136
3.1	54	130
3	51	123
2.9	47	117
2.8	43	110
2.7	40	104
2.6	36	97
2.5	33	91
2.4	29	84
2.3	25	77
2.2	22	71
2.1	18	64
2	14	58
1.9	11	51
1.8	7	45
1.7	4	38
1.6	0	32
1.5	-4	25
1.4	-7	19
1.3	-11	12
1.2	-15	6
1.1	-18	-1
1	-22	-7
0.9	-25	-14
0.8	-29	-20
0.7	-33	-27
0.6	-36	-33
0.5	-40	-40

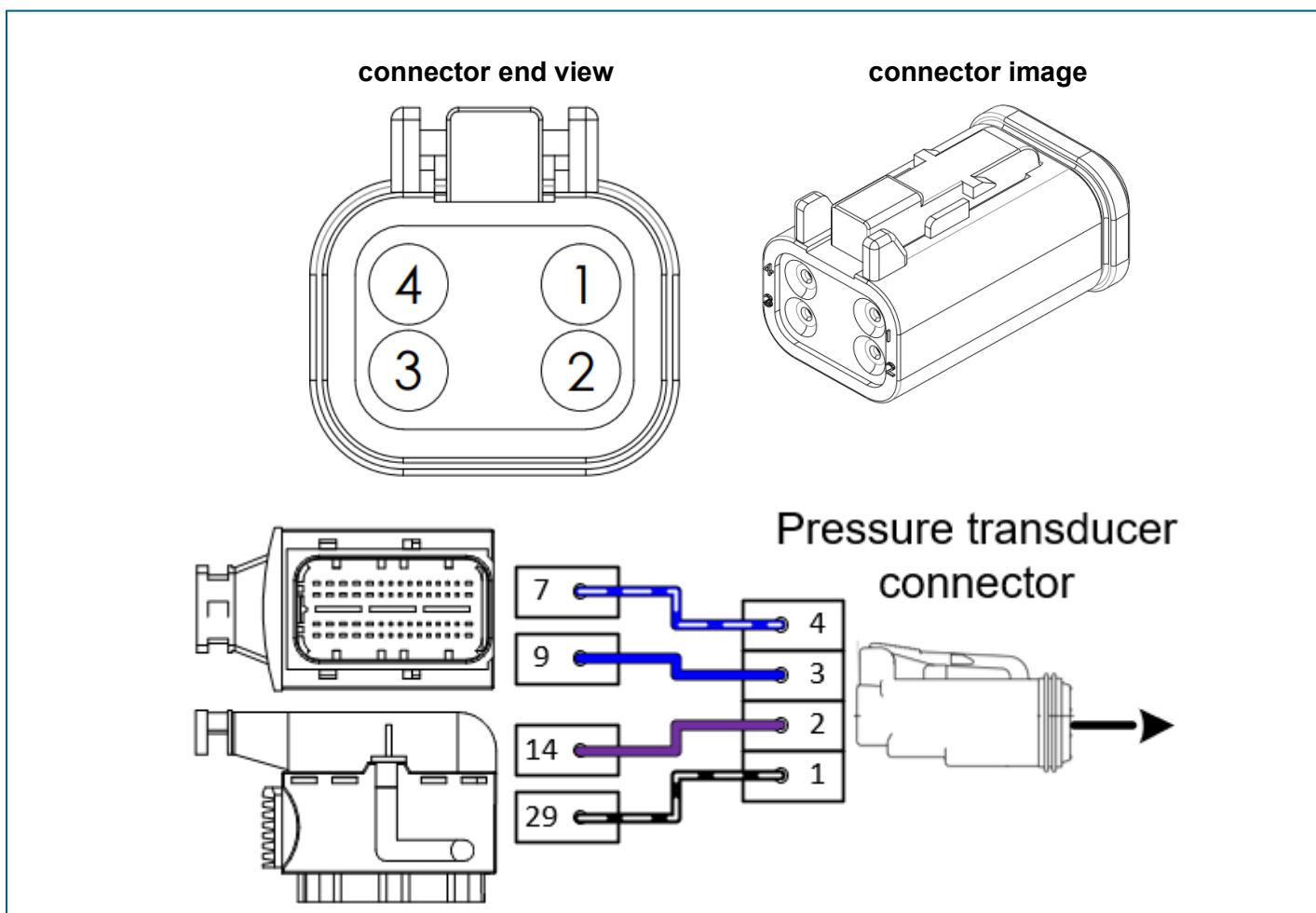
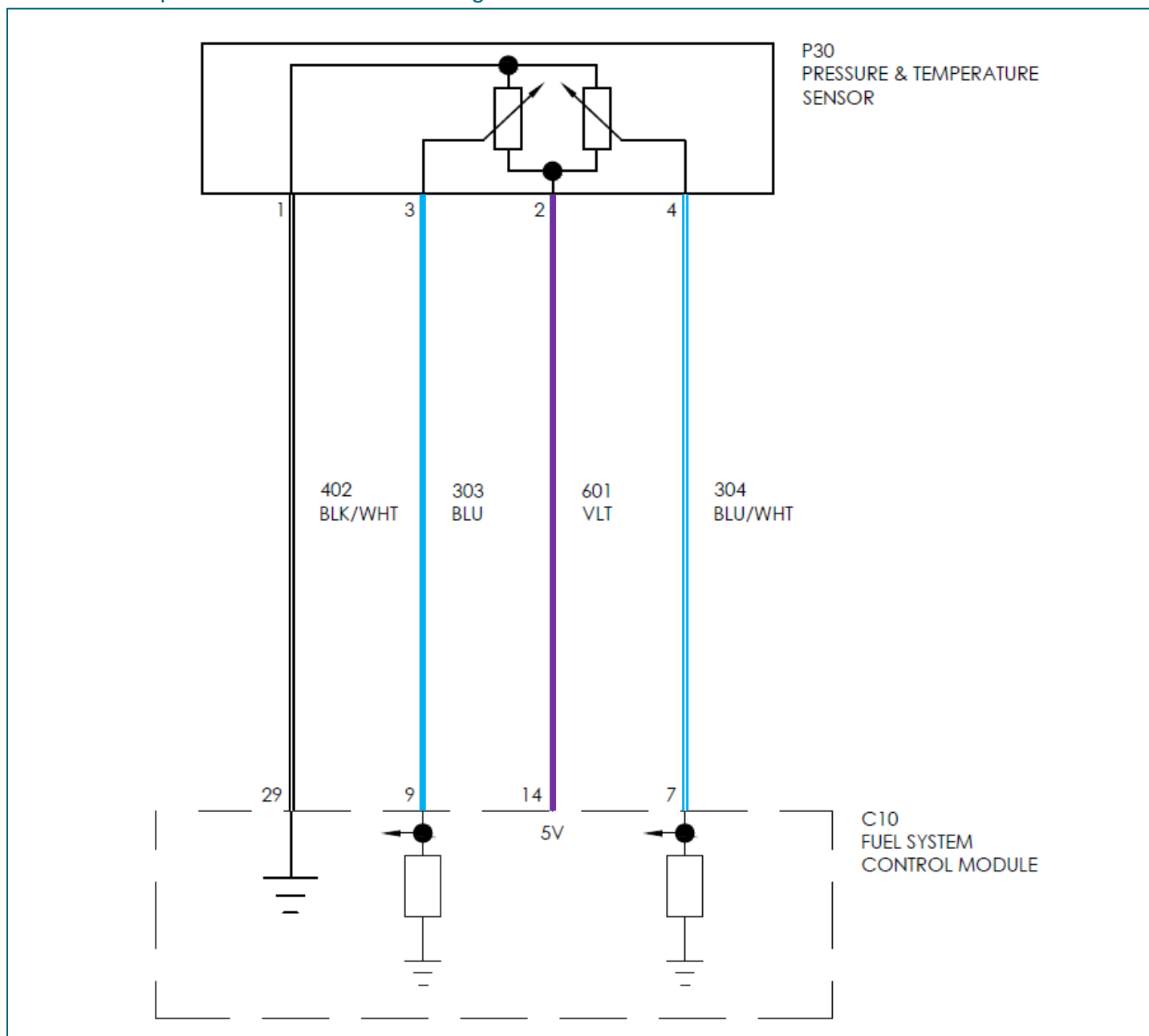


FIGURE 2-18. Pressure / temperature transducer circuit and connector views

Pressure / temperature transducer circuit pin out

Pin	Color	Circuit
1	Black/White	Low Reference
2	Violet	5V Supply
3	Blue	Temperature Signal
4	Blue/White	Pressure Signal

Pressure / temperature transducer circuit diagram



2.5. Thermistors

Two temperature sensors called “thermistors”¹ located at opposite extremes within the fuel system compartment(s) allow the Blue iQ FSCM to calculate temperature-compensated pressure readings to deliver accurate fuel readings and ensure fuel system safety. **FIGURE 2–19a** and **FIGURE 2-19b**

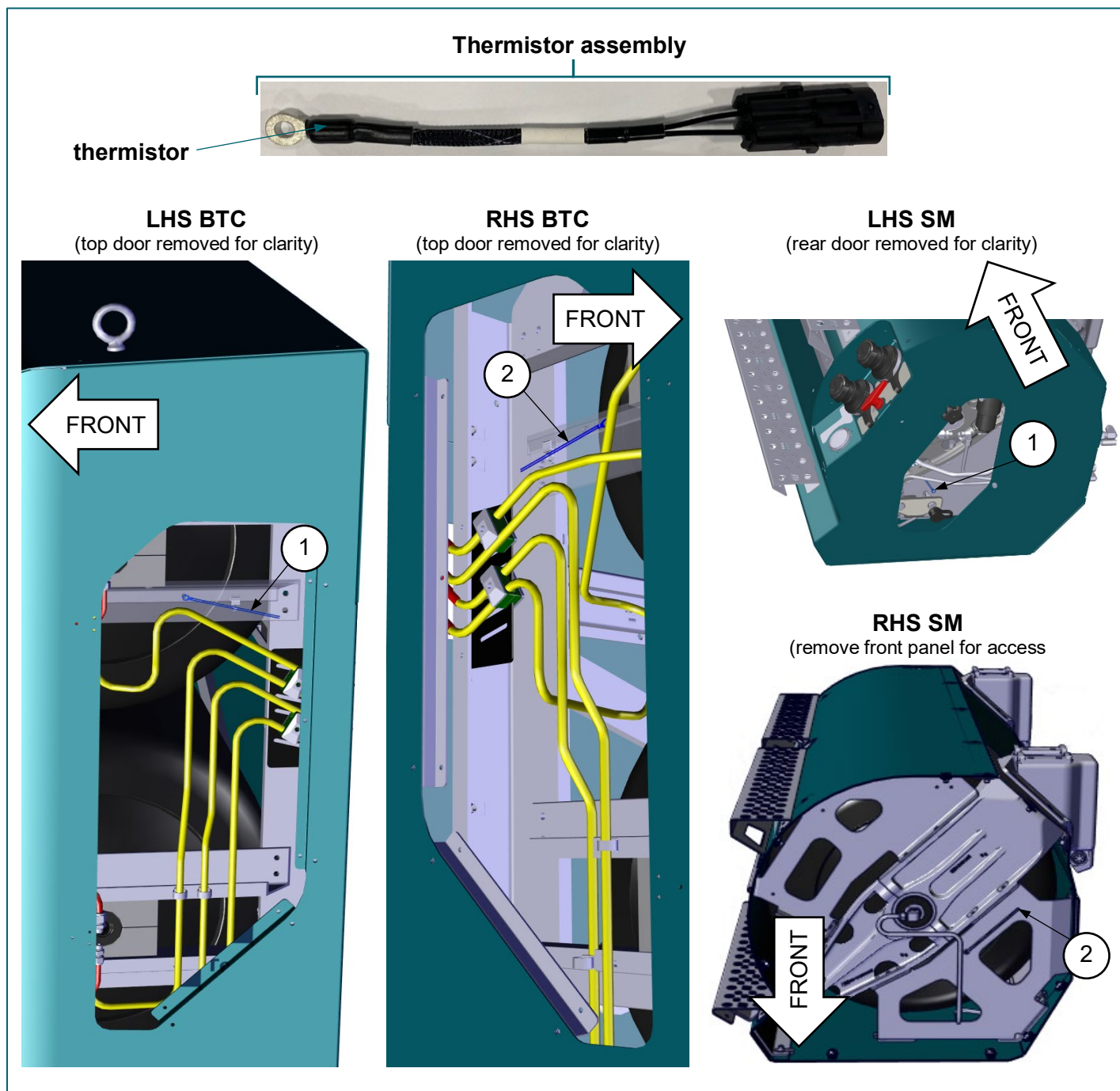


FIGURE 2–19a. Typical BTC and Gen 5 SM thermistor locations: (1) thermistor 1, (2) thermistor 2

As a rule, thermistor 1 is in the FMM or on the side of the system nearest the FMM. The location of thermistor 2 varies with fuel system configuration.

¹ Cummins® INSITE™ software refers to thermistors as “Fuel Compartment Temperature Sensors.”



FIGURE 19b. Gen 3 Refuse Roof Mount (RM) Thermistor Locations

1 Thermistor 1

2 Thermistor 2

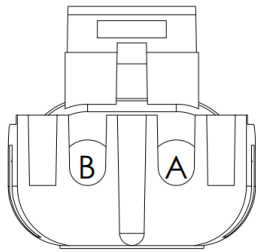
Functionally, the thermistors measure electrical resistance and translate it into temperature readings. **TABLE 2-6**

TABLE 2-6. Thermistor Resistance at Temperature Chart

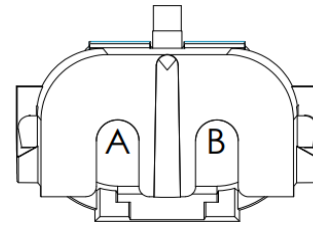
Temp		Resistance (Ω)		
$^{\circ}\text{F}$	$^{\circ}\text{C}$			
-40	-40	32277	to	35177
-22	-30	17083	to	18359
-4	-20	9413	to	10015
14	-10	5397	to	5673
32	0	3197	to	3335
50	10	1954	to	2026
77	25	989	to	1011
86	30	796	to	816
104	40	524	to	542
122	50	352	to	368
140	60	243	to	255
158	70	170	to	180
176	80	122	to	130
194	90	89	to	95
212	100	66	to	70

Each thermistor has a 5V Signal circuit and a Low Reference circuit which are provided from the FSCM. The signal circuit in the FSCM monitors the 5V Signal using a resistor; if there is an open circuit, the analog pin will default to the peak 5V reading. Thermistor 1 and Thermistor 2 share the Low Reference circuit. **FIGURE 2-20**

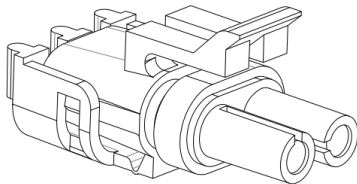
thermistor harness connector end view



thermistor connector end view



thermistor harness connector image



thermistor connector image

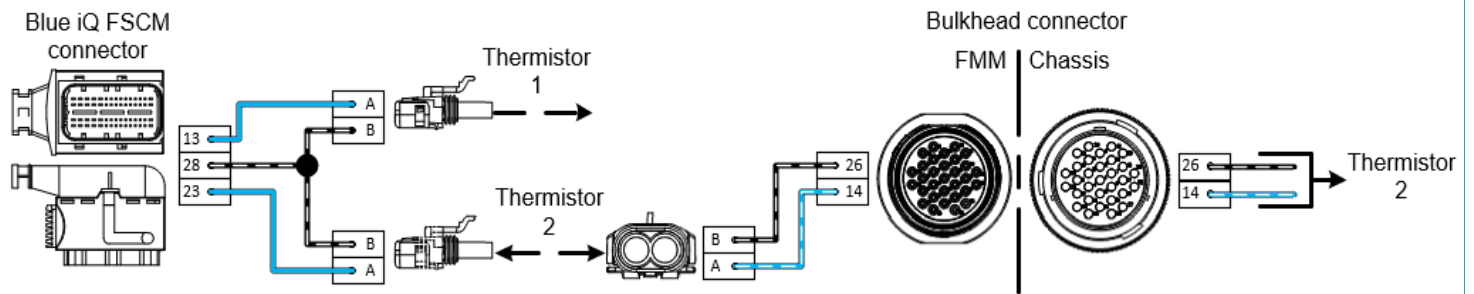
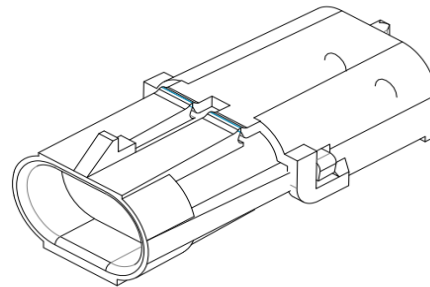
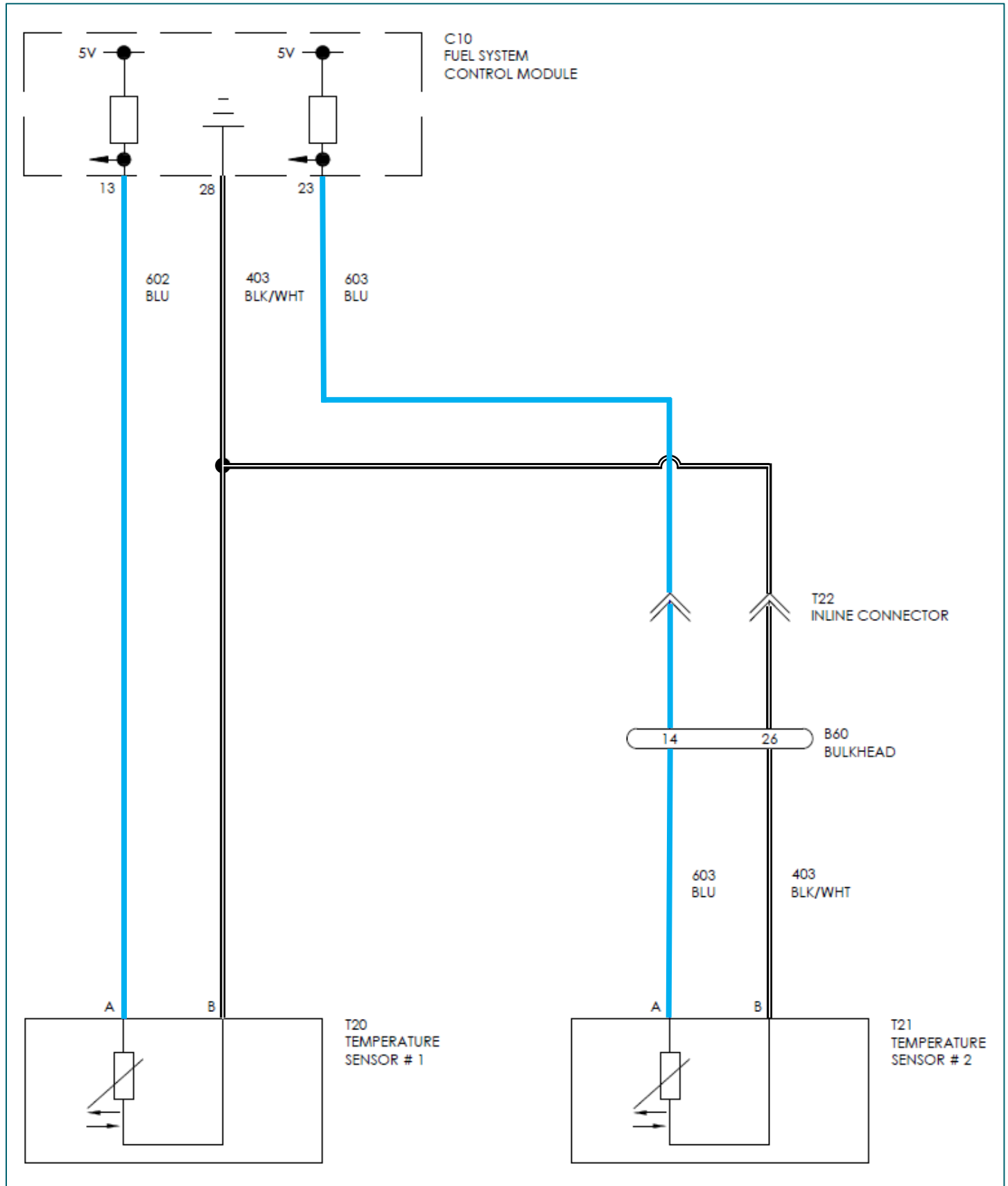


FIGURE 2–20. Thermistor wiring schematic and connector views

Thermistor 1 & Thermistor 2 circuit pin out

Pin	Color	Circuit
A	Blue	5V Supply
B	Black/White	Low Reference

Thermistor 1 & Thermistor 2 (Fuel Storage Compartment Temperature Sensor #1 & #2) Circuit Diagram



2.5.1. Thermistor Replacement Procedure

If replacing a thermistor assembly, care must be exercised to remove it without damaging adjacent cylinders or wiring and mounted according to system thermistor mounting requirements.

Side mount (SM) Systems

1. Drill out (6) rivet securing (1) thermistor assembly (2) loop to (3) structure. **FIGURE 2-21**

⚠ WARNING Use caution not to contact adjacent plumbing, or harness when drilling out rivet.

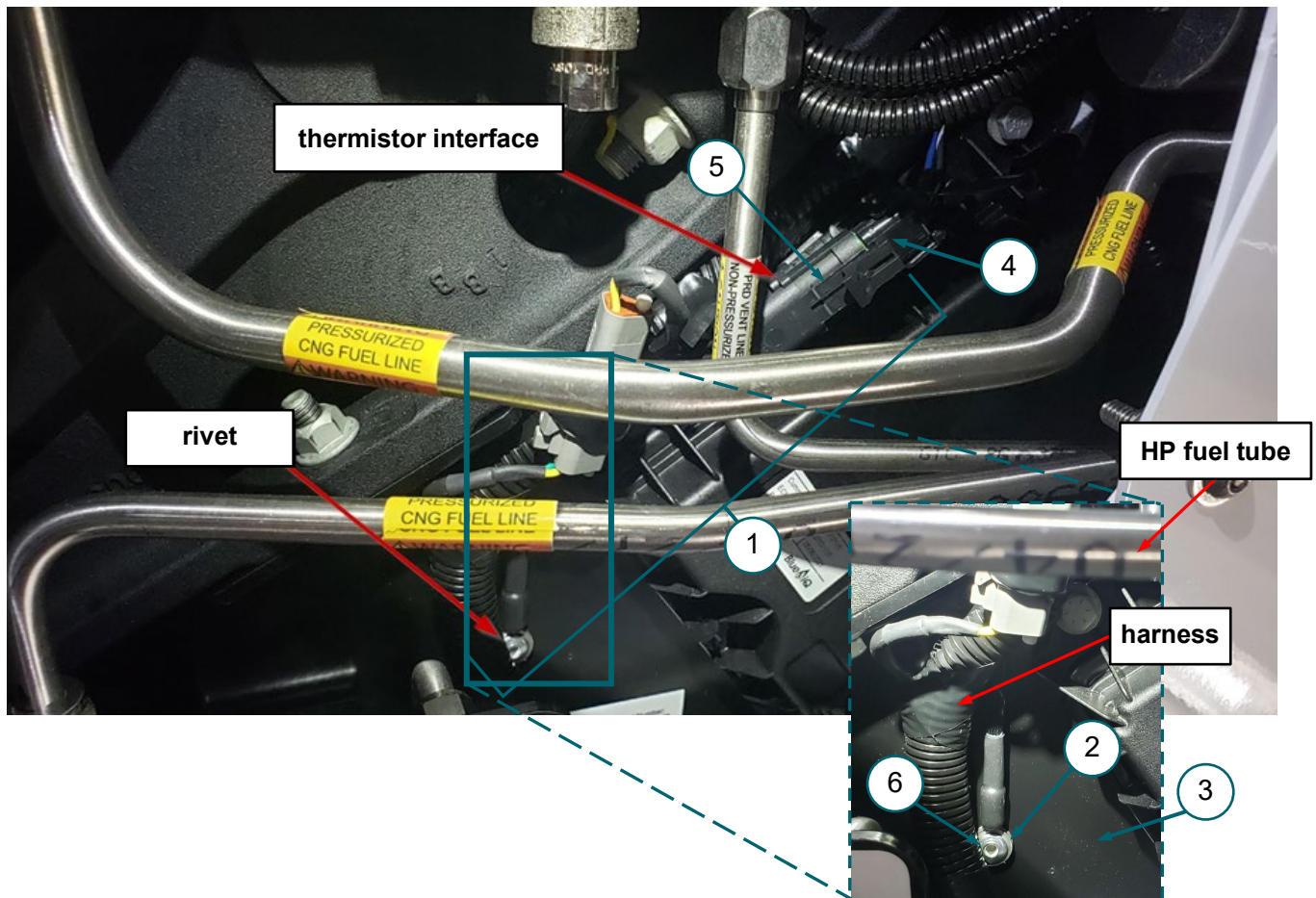


FIGURE 2-21. Thermistor mounting detail, Gen 5 SM systems. **NOTE:** Thermistor 1 shown; thermistor 2 similar.

- | | | |
|-----------------------|-----------------------------|------------------------|
| 1 thermistor assembly | 3 structure | 5 thermistor connector |
| 2 thermistor loop | 4 Blue iQ harness connector | 6 rivet |

2. Unplug (1) thermistor assembly (5) connector from Blue iQ harness at thermistor interface. **FIGURE 2-21**
3. Use a (6) rivet* to mount (1) thermistor assembly to (3) structure using (2) loop. **FIGURE 2-21**
4. Connect (1) thermistor assembly (5) connector to (4) Blue iQ chassis harness connector at thermistor interface.



*Please contact Hexagon Agility® CCTS to order.

Behind the Cab (BTC), Roof Mount (RM), and Front of Body (FOB) Systems

1. Disconnect (1) thermistor assembly (5) connector from (2) Blue iQ harness connector. **FIGURE 2–22**



FIGURE 2–22. Use side cutters to remove edge clip zip ties from thermistor assembly

- | | | |
|---|----------------------|------------------------|
| 1 thermistor sensor (<i>not visible; red box</i>) | 3 edge mount zip tie | 5 thermistor connector |
| 2 Blue iQ harness connector | 4 side cutters | |

2. Use (4) side cutters to remove zip ties. **FIGURE 2–22**
3. Use (3) QTY: 2 edge clip zip tie, p/n 10712380, to mount each (1) thermistor assembly, placing one edge clip on each end of thermistor assembly. **FIGURE 2–23**

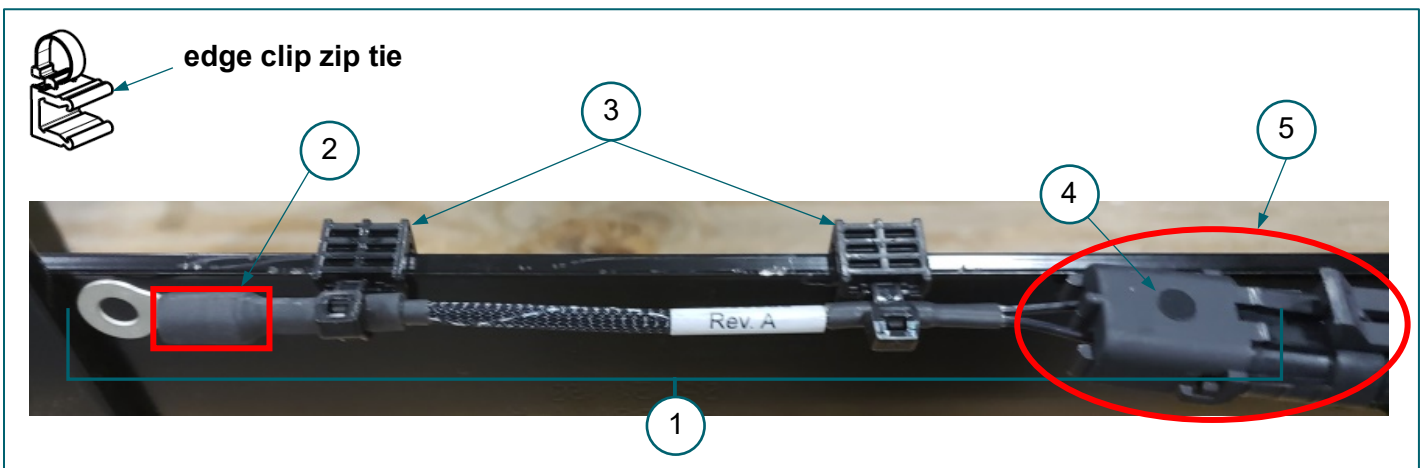


FIGURE 2–23. Thermistor mounting details, BTC. **NOTE:** Other non-SM systems similar.

- | | | |
|---|------------------------|------------------------|
| 1 thermistor assembly | 3 edge clip zip tie | 5 thermistor interface |
| 2 thermistor sensor (<i>not visible; red box</i>) | 4 thermistor connector | |



2.6. Drive Away Protection (DAP) components

The Blue iQ Drive Away Protection (DAP) feature prevents engine starting unless all fuel doors and fuel caps (including auxiliary fill caps) are securely in place. The Blue iQ gauge displays a “Starter Lockout—Fill Receptacle” message indicating a fuel door is open or a fuel receptacle cap is not installed properly. **FIGURE 2–24**



FIGURE 2–24. “Starter Lockout—Fill Receptacle” Blue iQ gauge warning message

Three types of DAP are used with Blue iQ on various fuel systems (**FIGURE 2–25**):

1. Fuel door switch
2. Fuel receptacle cap
3. Fuel receptacle kill cap

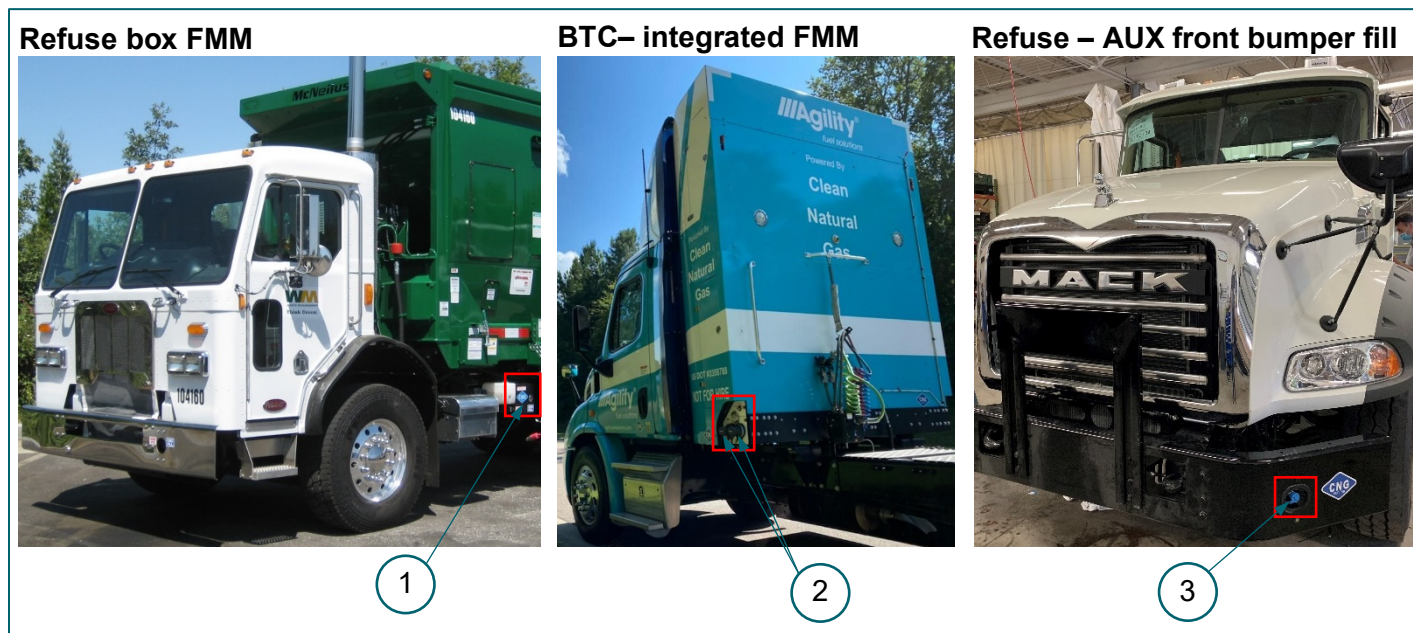


FIGURE 2–25. Drive Away Protection (DAP) types

- 1 fuel door switch 2 fuel receptacle cap 3 fuel receptacle kill cap

Please refer to the appropriate DAP type below for identification, location, operation, and circuit schematics.

NOTICE

More than one type of DAP may be installed on the same vehicle. FIGURE 2–26

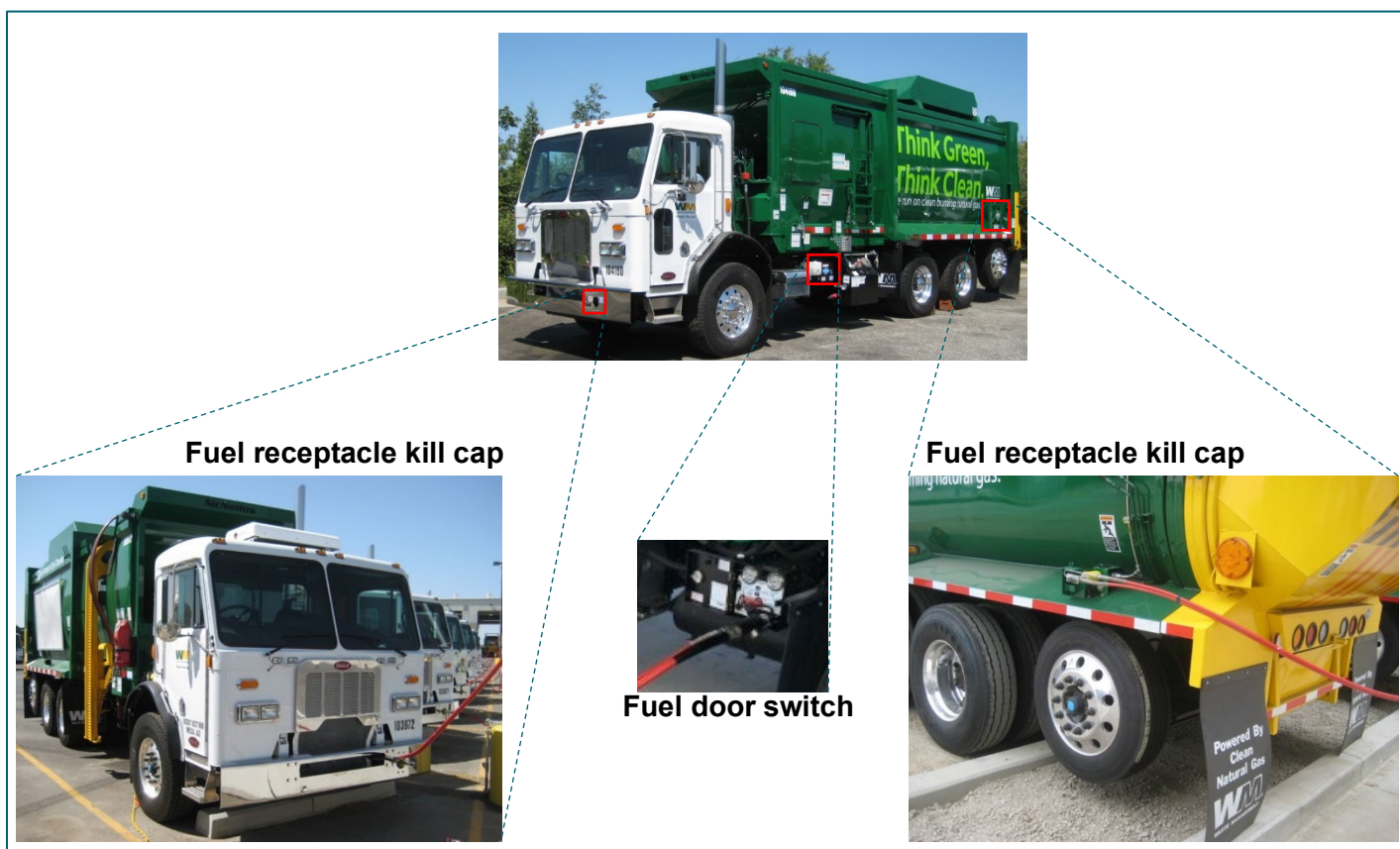


FIGURE 2–26. Multiple Drive Away Protection (DAP) systems on a single refuse truck

Regardless of fuel receptacle or switch type, all DAP circuit sensors are numbered, located, and diagrammed as follows:

DAP Circuit #	Location	Circuit schematic	Notes
1	driver side	Refer to DAP 1 & 2 circuit diagram below	—
2	driver side		—
3	passenger side	Refer to DAP 3, 4 & DAP 5 circuit diagram below	—
4	passenger side		—
5	varies, but always uses a kill cap		▪ front bumper fill ▪ remote fill ▪ body side fill

Please contact Hexagon Agility® CCTS for specific DAP application details.

2.6.1 Fuel door switch

Box type FMMs typically incorporate DAP function into the FMM door. When the FMM door is properly closed, a magnet contacts the reed switch to complete the circuit enabling the engine to start. **FIGURE 2–27**

NOTICE

The vehicle will not start if the fuel fill door is not completely latched.

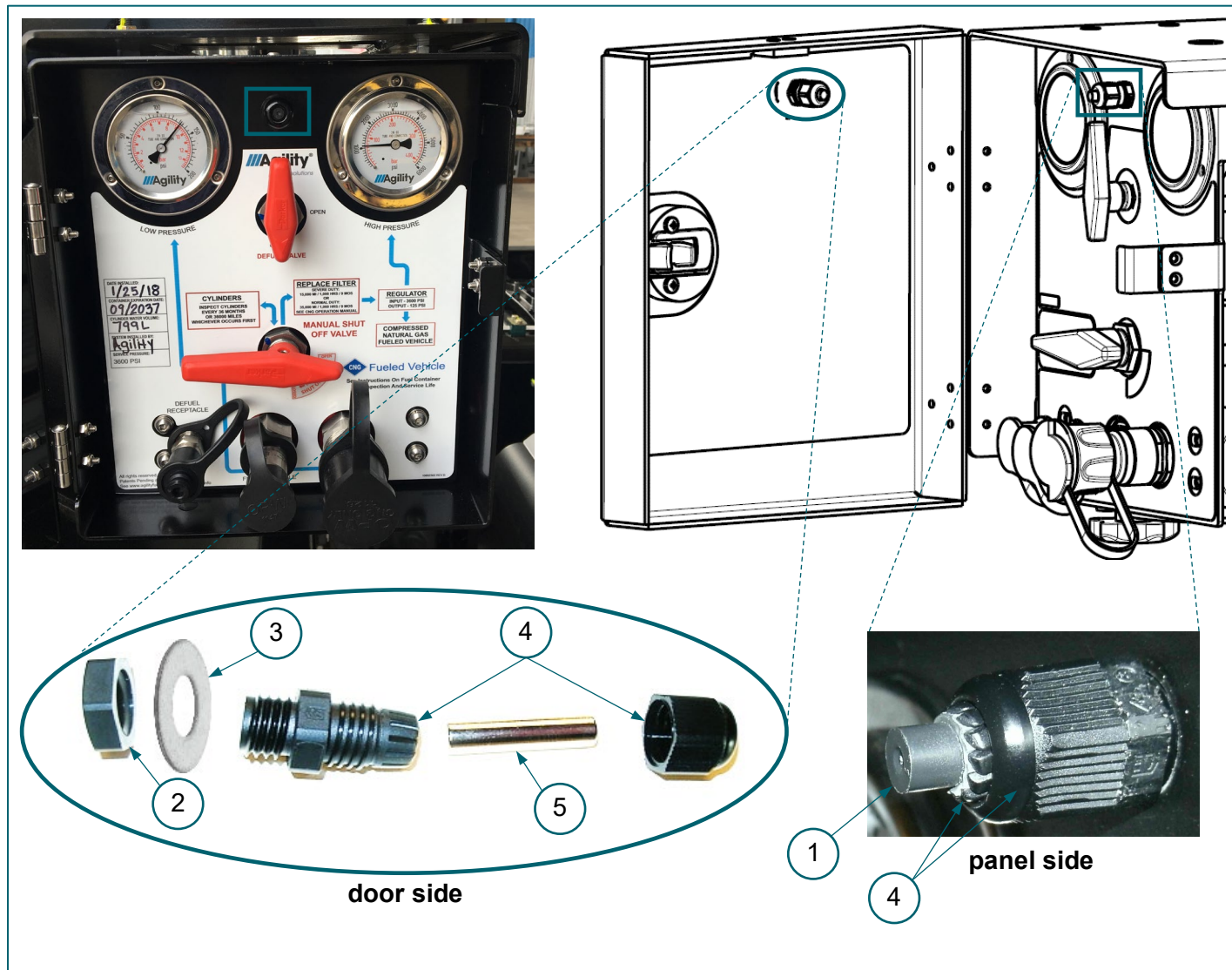


FIGURE 2–27. Box FMM fuel fill door DAP components

- | | |
|------------------|---------------|
| 1 contact switch | 4 cable gland |
| 2 lock nut | 5 magnet |
| 3 washer | |

panel side switch (rectangles)
door side switch (circles)

2.6.2. Fuel receptacle cap(s)

Fuel systems not equipped with an FMM door typically use fuel receptacle caps to prevent FOD intrusion and for DAP. A magnet in the cap aligns with a magnet on the tether to close a reed switch in the FMM panel, completing the circuit to the FSCM. **FIGURE 2–28, FIGURE 2–29, FIGURE 2–30, FIGURE 2–31**

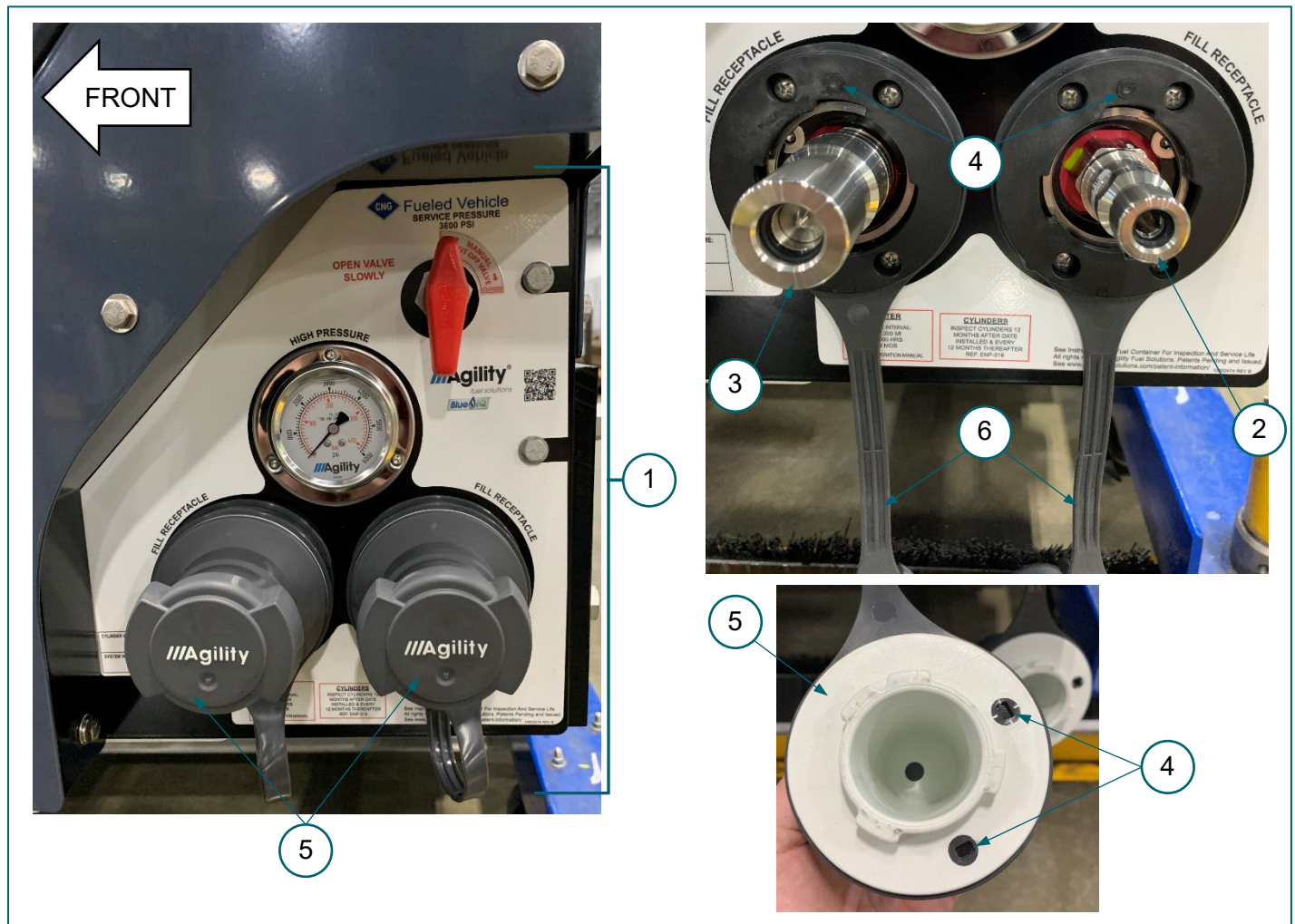


FIGURE 2–28. Driver side ProCab® BTC FMM fuel receptacle caps and DAP components

- | | | |
|--|-----------------------------|----------|
| 1 FMM fuel fill panel with HP fuel gauge | 3 fast fill fuel receptacle | 5 caps |
| 2 NGV1 fuel fill receptacle | 4 magnets | 6 tether |

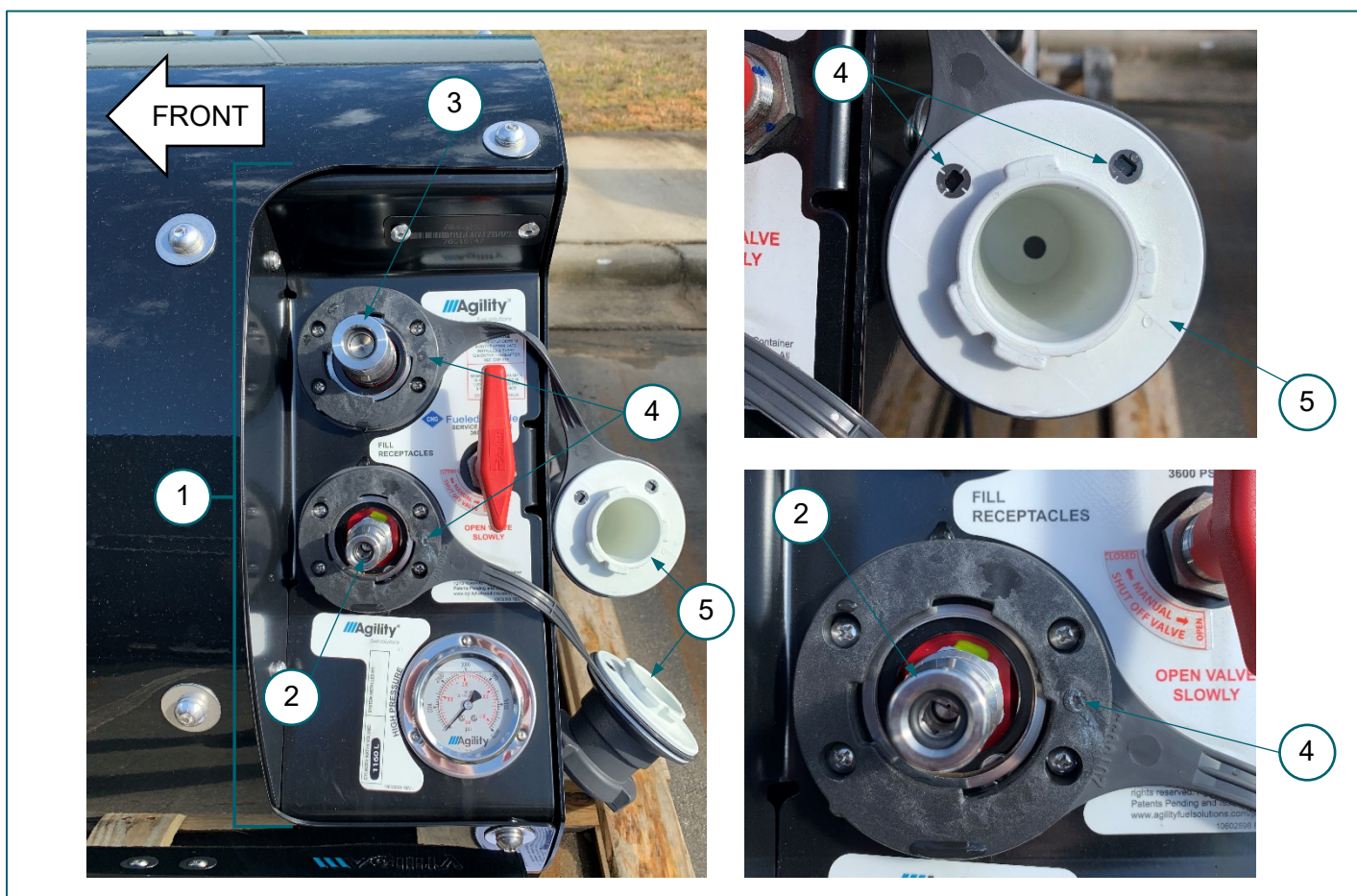


FIGURE 2-29. Gen 5 ProRail® side mount FMM fuel receptacle fuel cap DAP components

- | | | |
|--|-----------------------------|------------|
| 1 FMM fuel fill panel with HP fuel gauge | 3 fast fill fuel receptacle | 5 fuel cap |
| 2 NGV1 fuel fill receptacle | 4 magnets | |

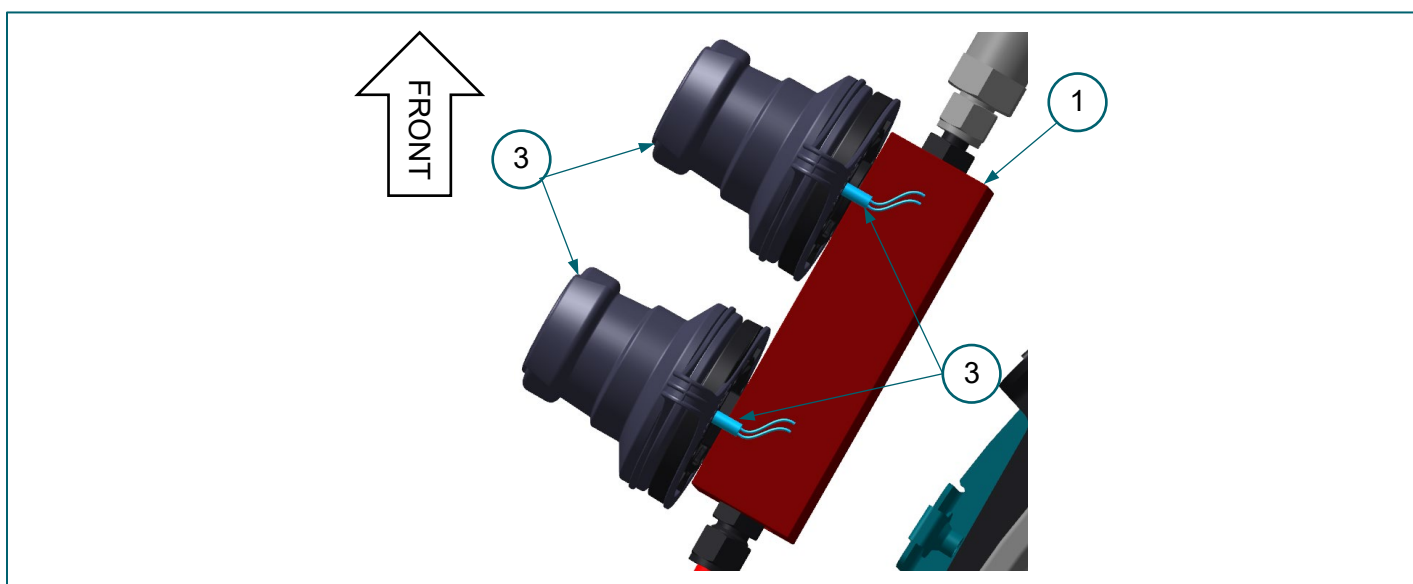


FIGURE 2-30. Gen 5 ProRail® side mount FMM cutaway showing fuel receptacle DAP reed switch locations

- | | | |
|----------------------|-----------------|-------------|
| 1 fuel fill manifold | 2 reed switches | 3 fuel caps |
|----------------------|-----------------|-------------|

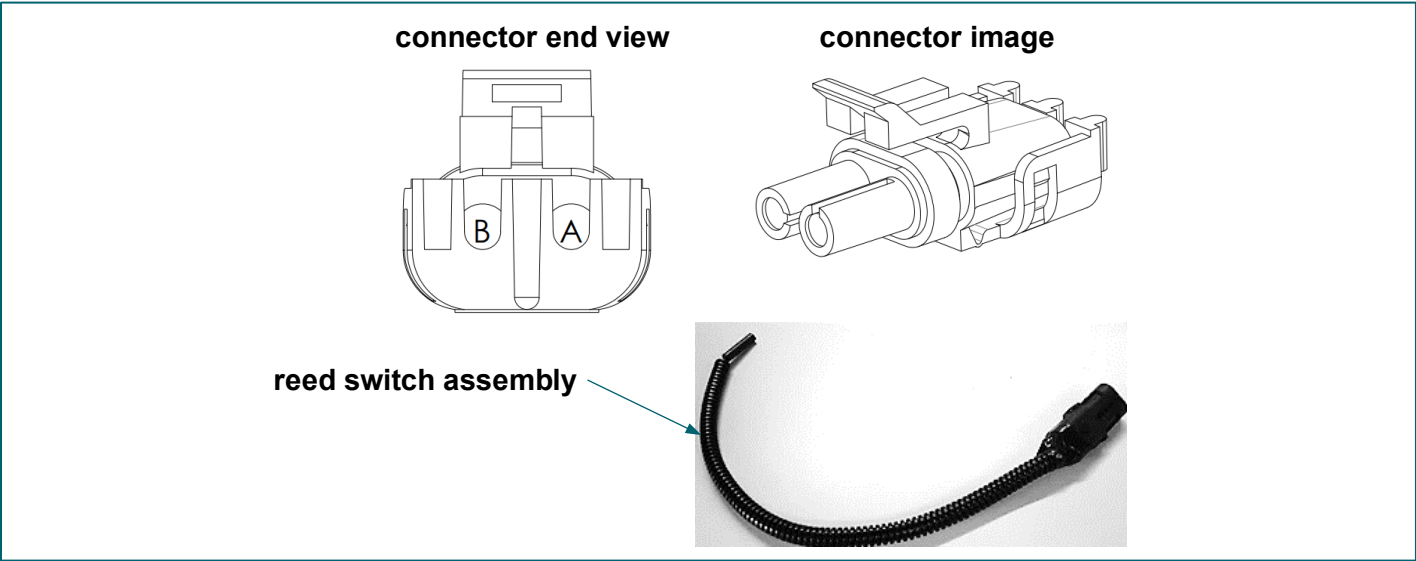


FIGURE 2-31. Reed switch assembly with fuel door and fuel receptacle fuel cap connector views

Fuel door reed switch circuit pin out

Pin	Color	Circuit
A	Gray	DAP Signal
B	Black/White	DAP Return

2.6.3. Fuel receptacle kill cap(s)

“Kill” caps used on some fuel systems prevent engine starts when not installed on the fuel fill receptacle. FIGURE 2-32

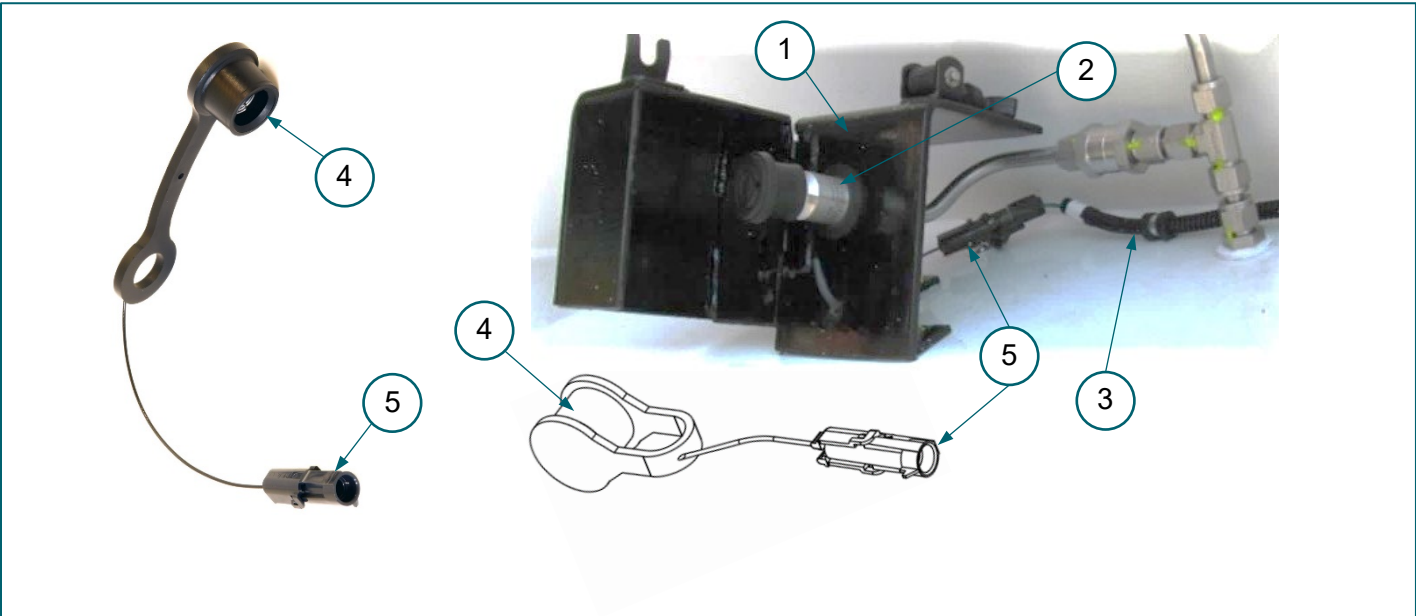


FIGURE 2-32. Auxiliary (AUX) body side fuel fill receptacle assembly with kill cap; kill cap assemblies

- 1 AUX fuel fill panel
- 2 fuel receptacle
- 3 fuel receptacle
- 4 kill cap
- 3 Blue iQ chassis harness
- 5 kill cap connector

Kill caps are often used on systems with auxiliary (AUX) fuel fill receptacles separate from the FMM. These remote fill panels are often installed on or near the front bumper but may be configured for other locations per OEM or customer preferences on the body side or body rear.

Unlike two wire reed switch DAP circuits, the kill cap DAP circuit relies on one wire to carry the FSCM DAP 5 Signal, while the fuel fill receptacle provides ground. **FIGURE 2–33**

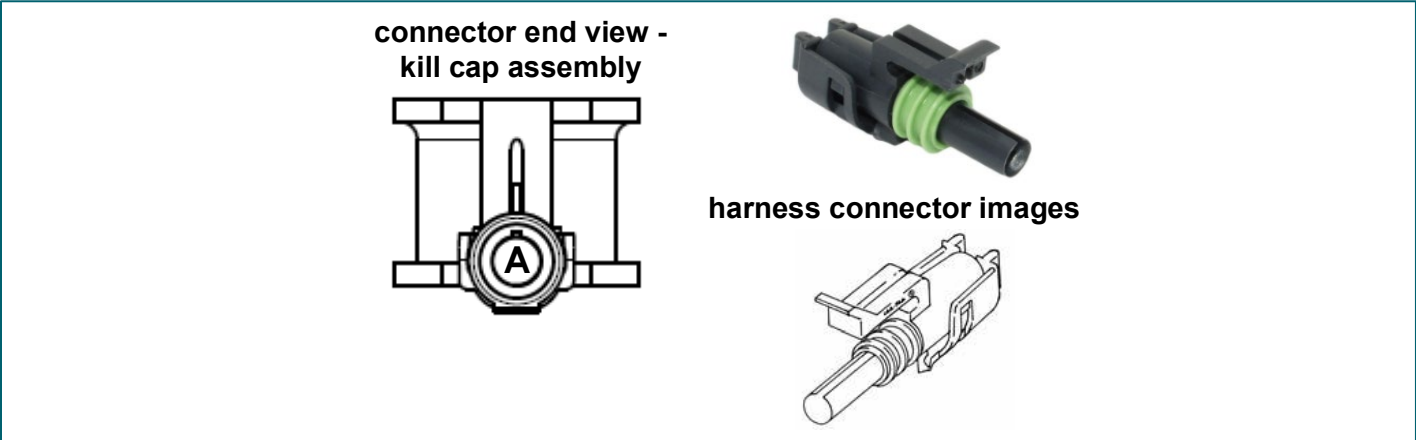


FIGURE 2–33. Fuel receptacle kill cap connector views

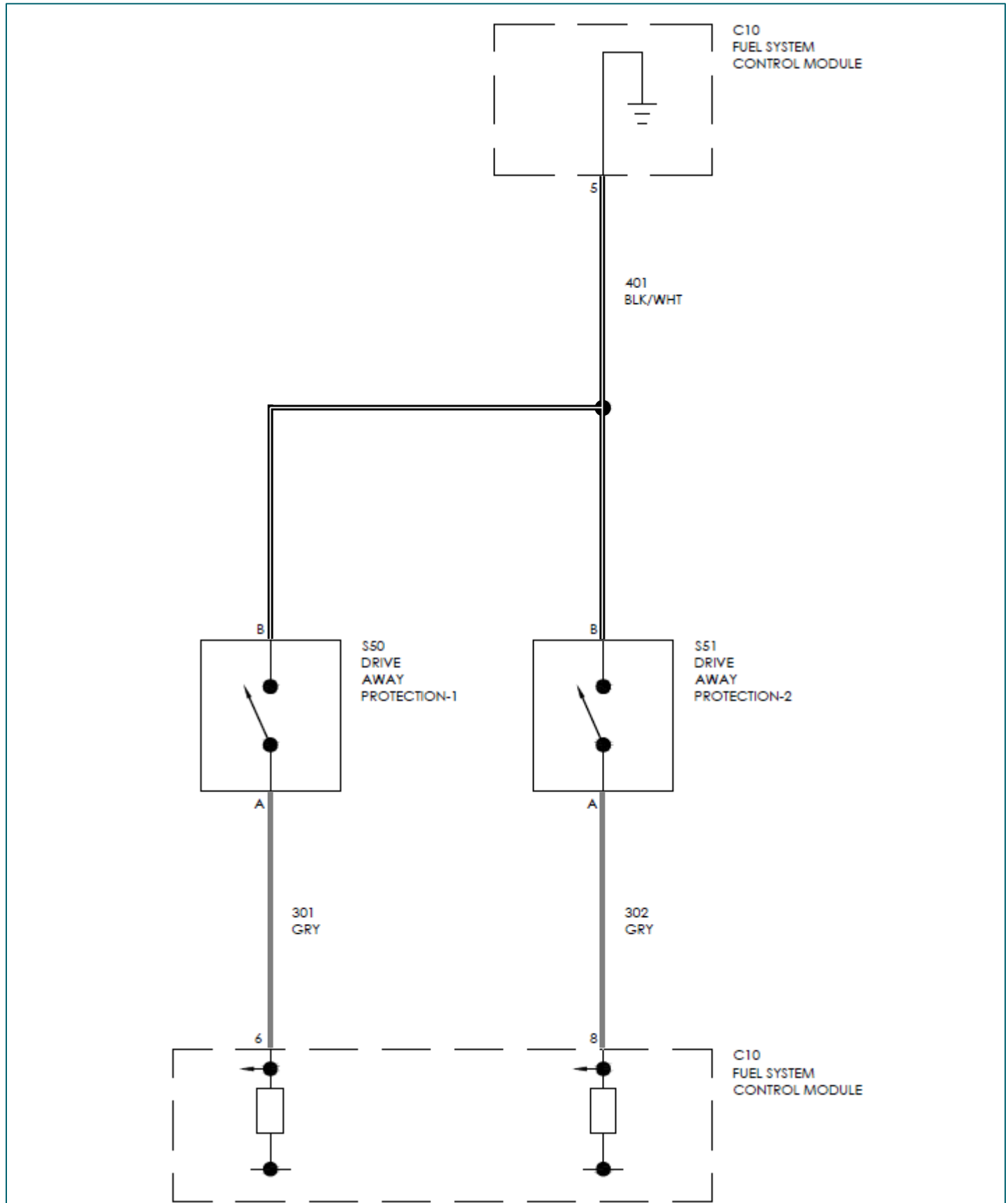
Fuel receptacle kill cap circuit pin out

Pin	Color	Circuit
A	Gray	DAP 5 Signal

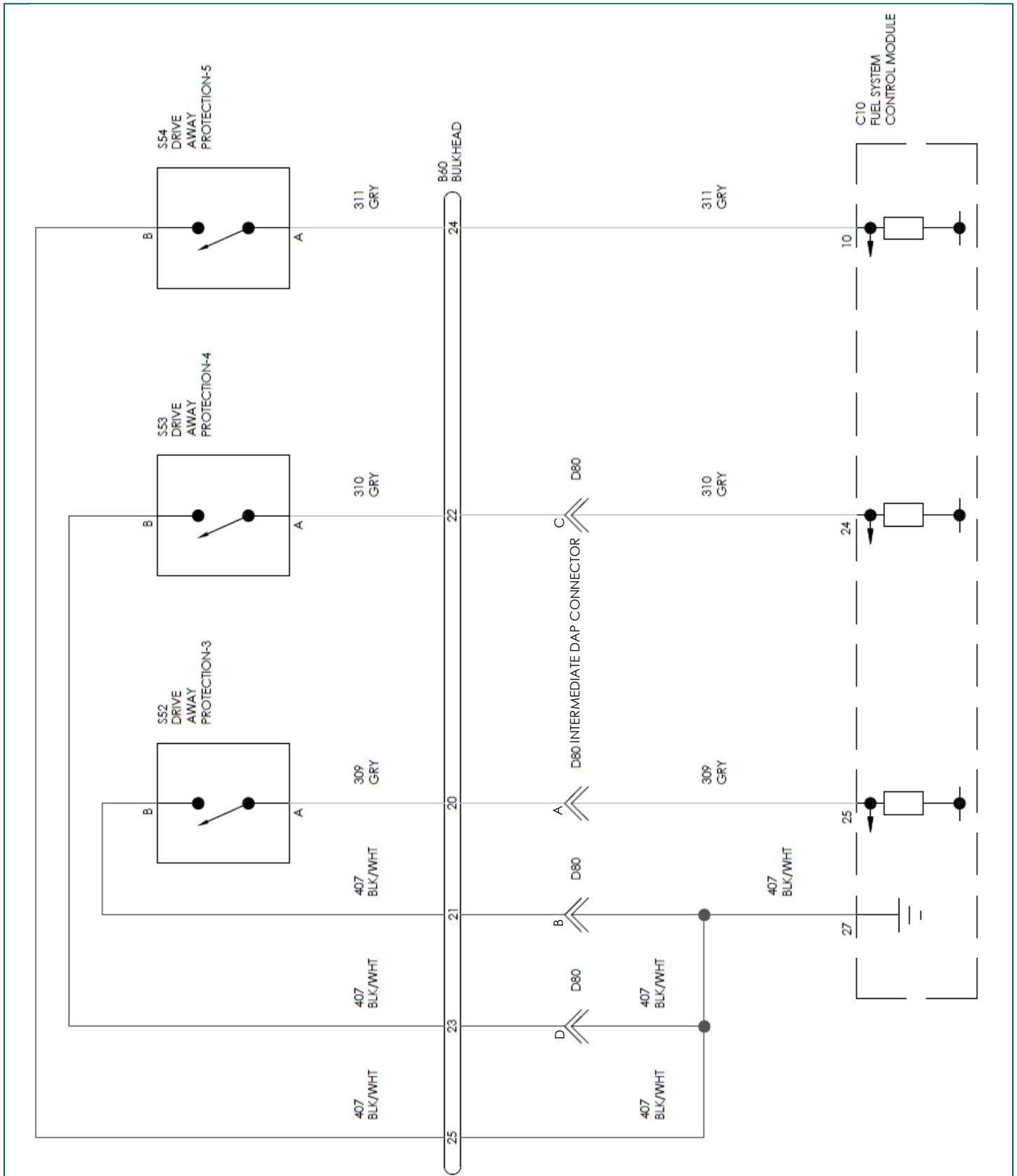
NOTICE

The DAP 5 circuit is always used on auxiliary (AUX) fuel fill receptacles such as front bumper fill or body side fill receptacles.

DAP 1 and DAP 2 circuit diagram



Typical* DAP 3, DAP 4, and DAP 5 circuit diagram



*Basic circuit runs illustrated; harness extensions may be used on various fuel system configurations.

2.7. Blue iQ FMM Harness to Blue iQ Chassis Harness bulkhead connectors

Every Blue iQ system relies on a 31-pin bulkhead connector for the controller network. Bulkheads link the FSCM to fuel system components, sensors, and OEM vehicle interfaces. **FIGURE 2–34**

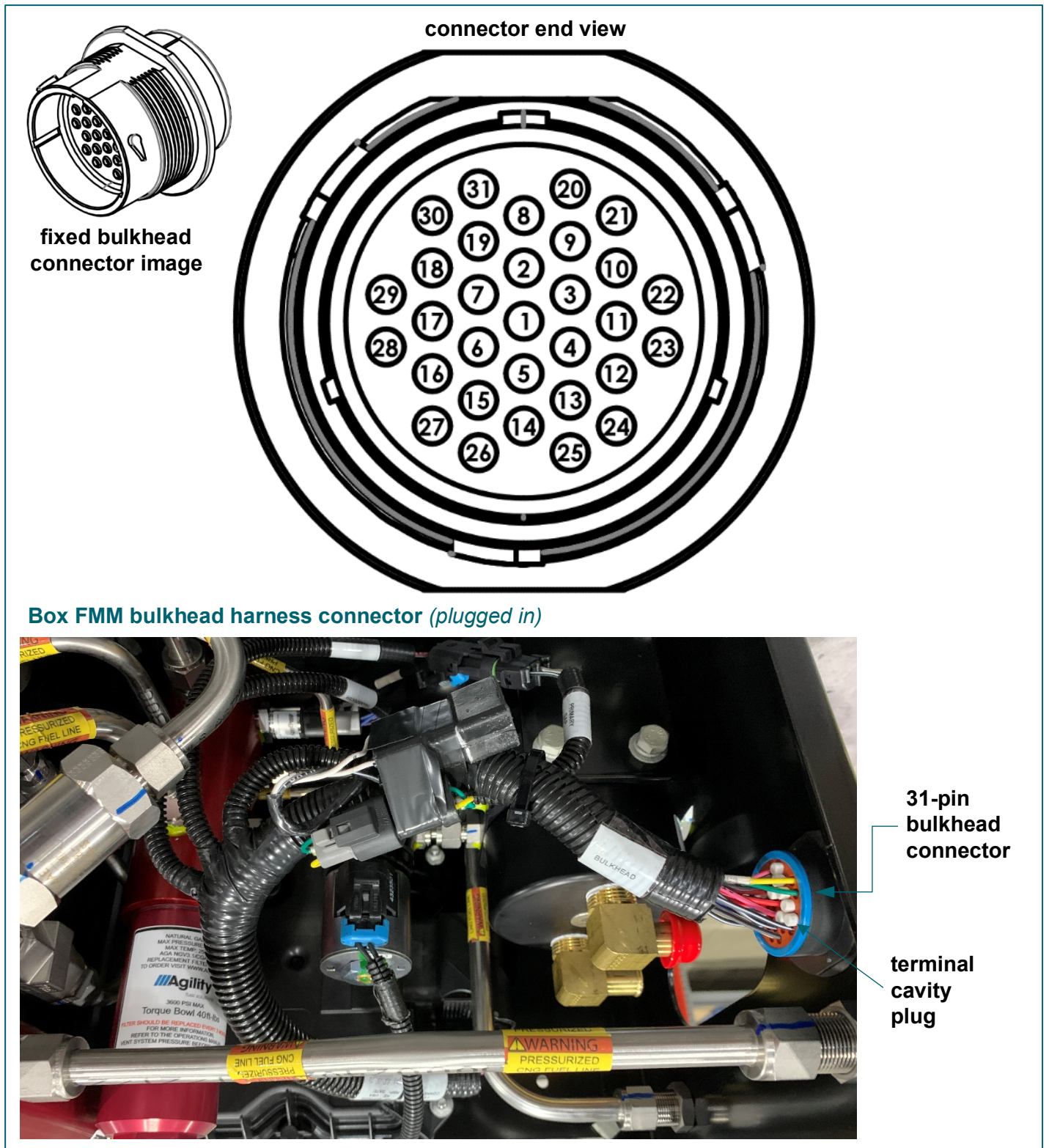


FIGURE 2–34. Bulkhead harness connector end view and image

FMM harness bulkhead connector circuit pin out

Pin #	Color	Description
1	Black	Battery Ground
2	Red	Battery Power
3	Red / White	Ignition Switch Power
4	Red / White	Crank Request
5	Pink / White	Start Confirm
6	Red / White	External Solenoid Control
7	-	
8	-	
9	-	
10	White	OEM Fuel Gauge Signal
11	Gray / White	DAP Lamp <i>(if equipped)</i>
12	-	
13	-	
14	Blue	Fuel Compartment Temperature Sensor 2 (Thermistor 2) Signal
15	-	
16	-	
17	-	
18	-	
19	Black / Pink	LP Lamp Return <i>(if equipped)</i>
20	Gray	DAP 3
21	Black / White	DAP 3,4,5 Return*
22	Gray	DAP 4
23	Black / White	DAP 3,4,5 Return*
24	Gray	DAP 5
25	Black / White	DAP 3,4,5 Return*
26	Black / White	Fuel Compartment Temperature Sensor 2 (Thermistor 2) Return
27	-	
28	Green	J1939 CAN (+)
29	Yellow	J1939 CAN (-)
30	-	
31	Pink / Black	LP Lamp Signal <i>(if equipped)</i>

**Installer choice ; consult vehicle-specific wiring manual*

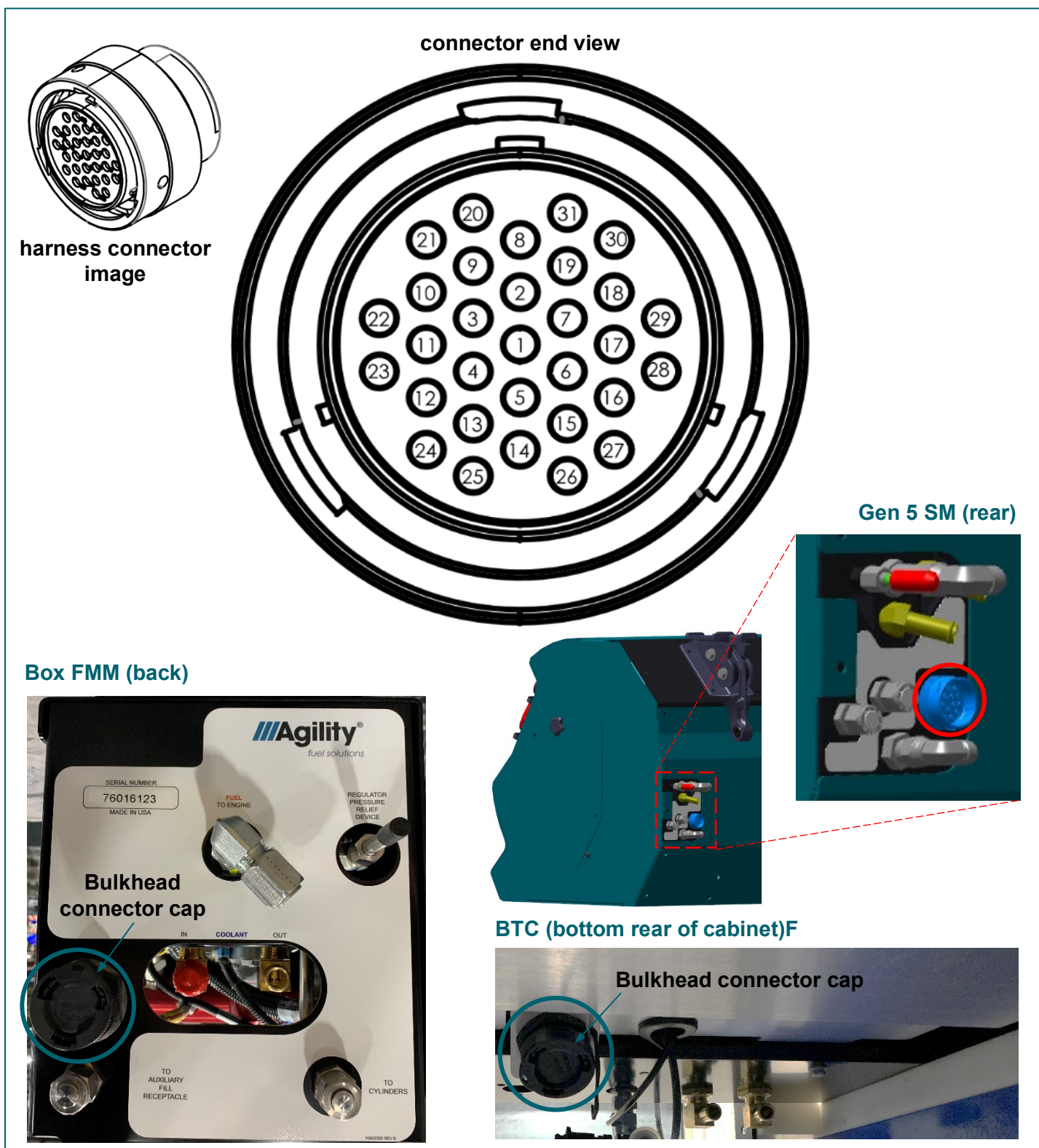


FIGURE 2–35. Bulkhead fixed connector end view and typical system bulkhead locations (circled). **NOTE:** Bulkhead connector caps shown in place to protect bulkhead terminals; will be removed.

Chassis harness bulkhead connector circuit pin out

Pin #	Color	Description
1	Black	Battery Ground
2	Red	Battery Power
3	Red / White	Ignition Switch Power
4	Red / White	Crank Request
5	Pink / White	Start Confirm
6	Red / White	External Solenoid Control
7	-	
8	-	
9	-	
10	White	OEM Fuel Gauge Signal
11	Gray / White	DAP Lamp <i>(if equipped)</i>
12	-	
13	-	
14	Blue	Fuel Compartment Temperature Sensor 2 (Thermistor 2) Signal
15	-	
16	-	
17	-	
18	-	
19	Black / Pink	LP Lamp Return <i>(if equipped)</i>
20	Gray	DAP 3
21	Black / White	DAP 3,4,5 Return*
22	Gray	DAP 4
23	Black / White	DAP 3,4,5 Return*
24	Gray	DAP 5
25	Black / White	DAP 3,4,5 Return*
26	Black / White	Fuel Compartment Temperature Sensor 2 (Thermistor 2) Return
27	-	
28	Green	J1939 CAN (+)
29	Yellow	J1939 CAN (-)
30	-	
31	Pink / Black	LP Lamp Signal <i>(if equipped)</i>

**Installer choice; consult vehicle-specific wiring manual.*

2.9. SAE J1939 CAN connectors

Blue iQ interfaces with OEM vehicle data through several SAE J1939 CAN chassis harness connectors. **FIGURE 2-36a** and **FIGURE 2-36b**

NOTICE

J1939 CAN connection configurations vary according to vehicle OEM and model.

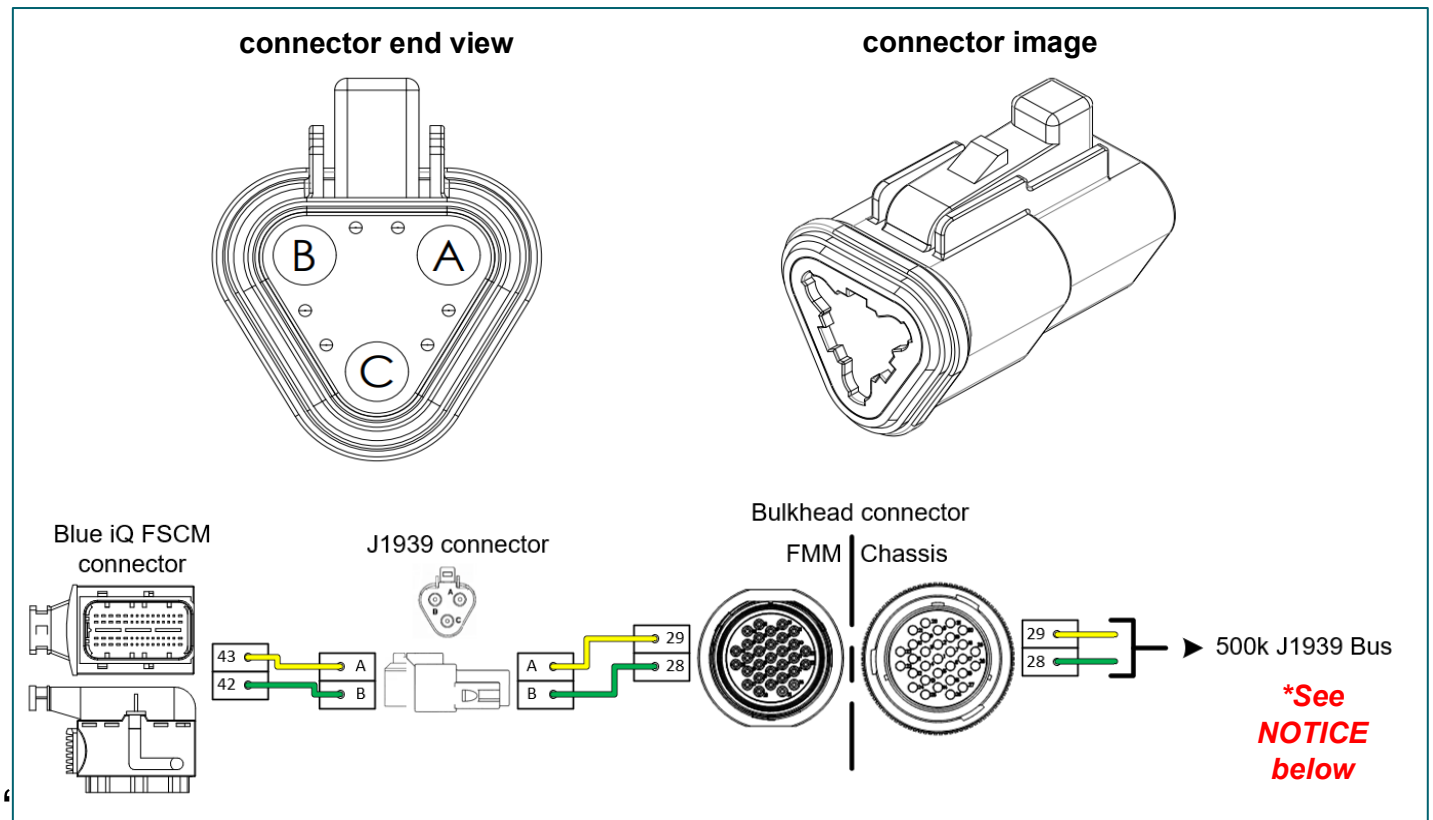


FIGURE 2-36a. SAE J1939 circuit schematic and connector views – FSCM harness

SAE J1939 circuit connector pin out

Pin	Color	Circuit
A	Yellow	J1939 CAN (+)
B	Green	J1939 CAN (–)
C	PLUG	–

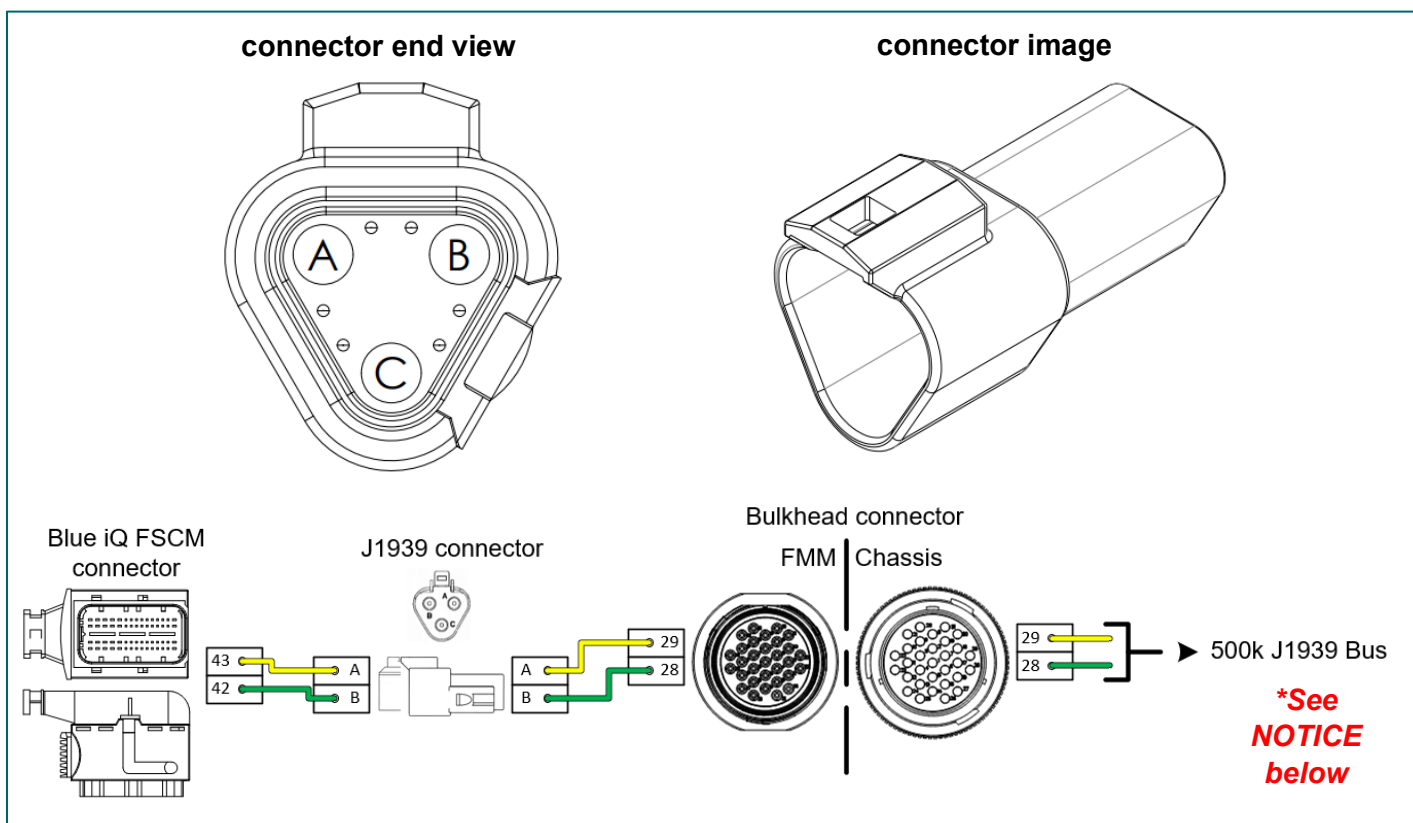


FIGURE 2-36b. SAE J1939 circuit schematic and connector views – bulkhead harness

SAE J1939 circuit connector pin out

Pin	Color	Circuit
A	Yellow	J1939 CAN (+)
B	Green	J1939 CAN (–)
C	PLUG	–

NOTICE

J1939 bus should connect to OEM vehicle 500K network unless otherwise specified.

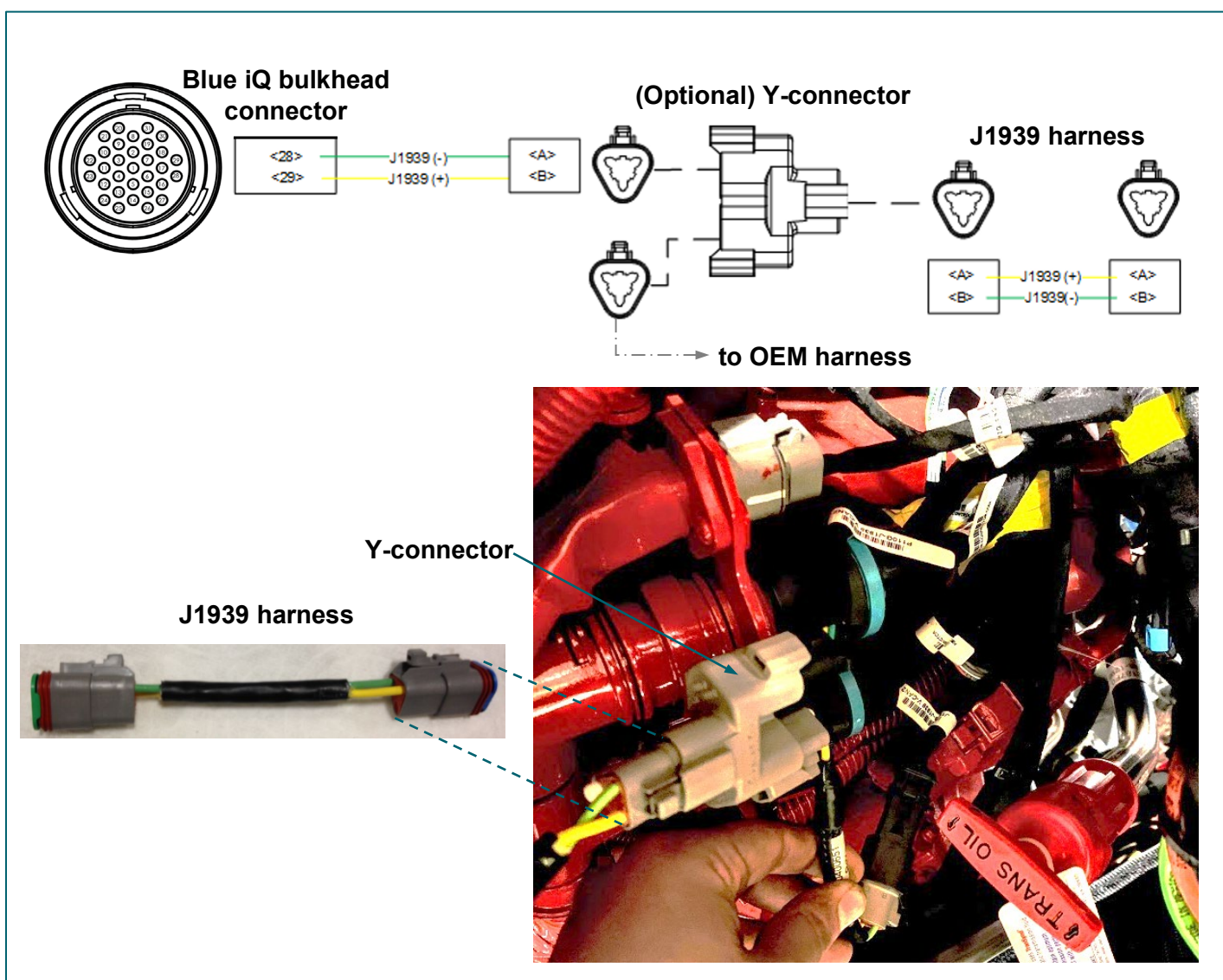


FIGURE 2–37. SAE J1939 circuit connector end view and typical system locations. **NOTE:** Y-connector not used on all vehicle configurations.

Please contact Hexagon Agility® CCTS for vehicle specific details.

2.10. SAE J1939 CAN Blue iQ Gauge Harness

An additional Blue iQ harness consisting of a 9-pin bulkhead connector, a 3-pin J1939 CAN bus connector, and a 2-pin connector links the Blue iQ gauge to the vehicle via the OEM J1939 OBD CAN port. **FIGURES 2-38 and 2-39**

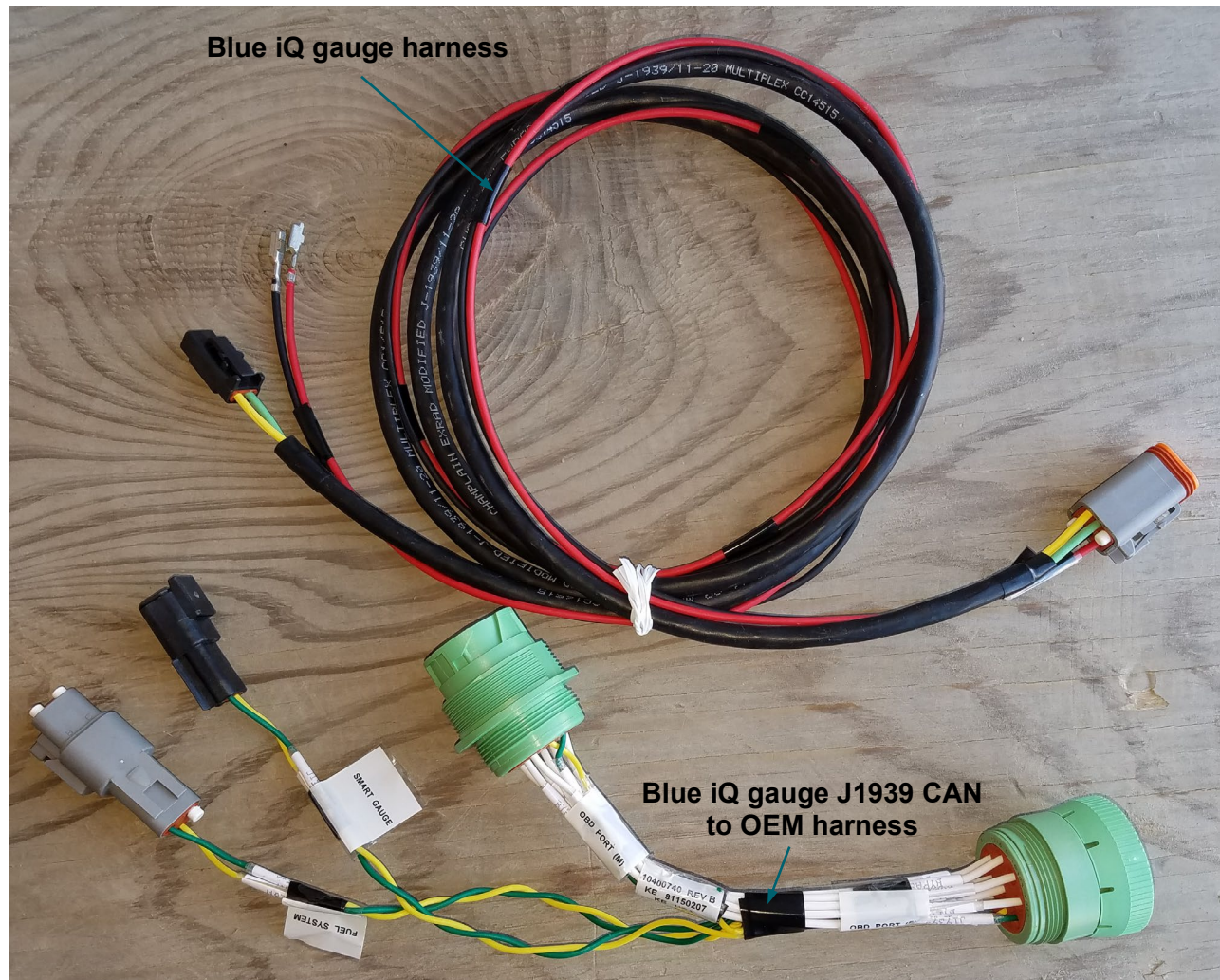


FIGURE 2-38. Typical SAE J1939 circuit harness and Blue iQ gauge harness (*refer to Section 2.1*)

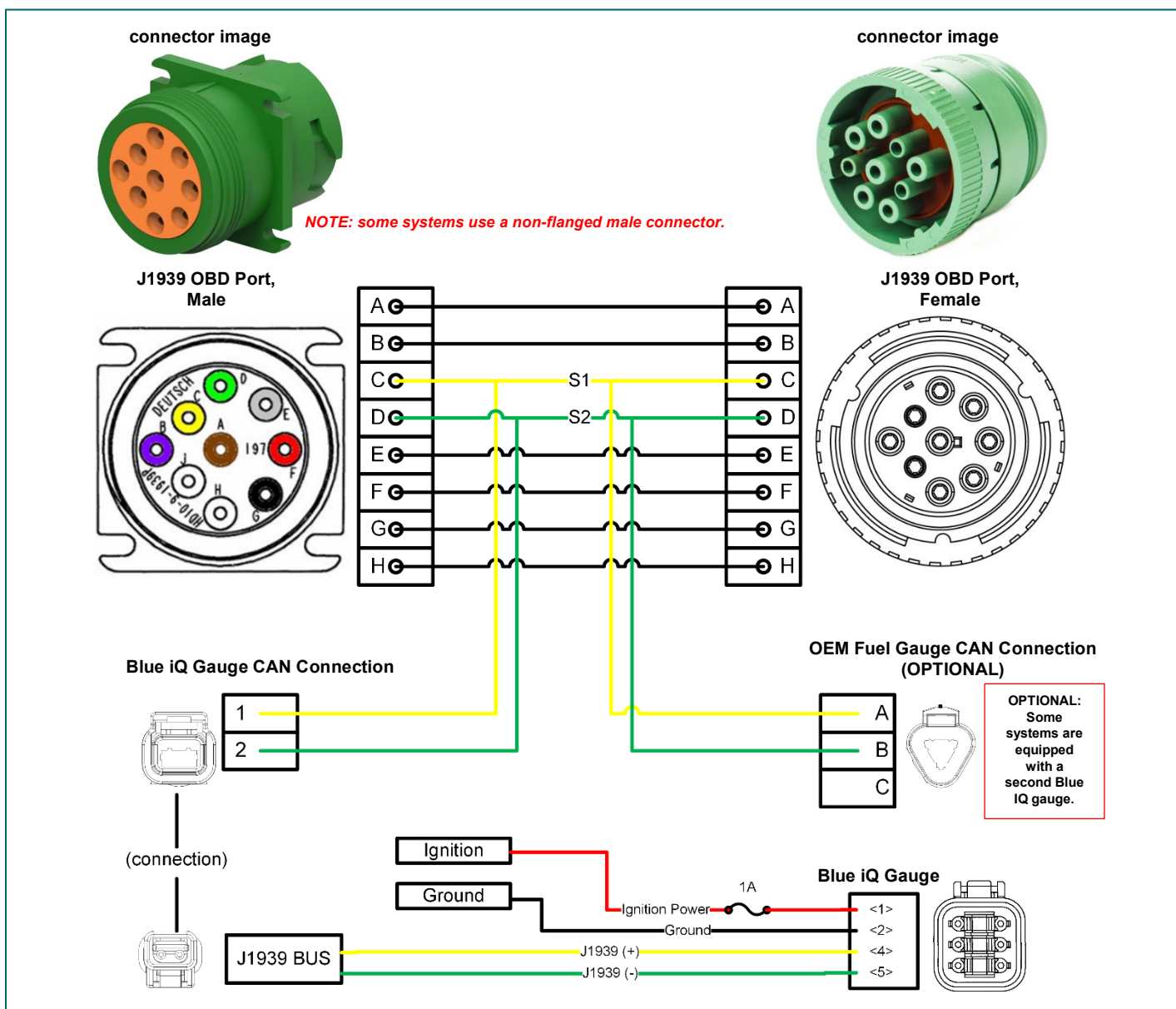


FIGURE 2–39. Secondary SAE J1939 circuit and connector views

Secondary SAE J1939 connector circuit pin out –
3-pin connector to fuel system

Pin	Color	Circuit
A	Yellow	J1939 CAN (+)
B	Green	J1939 CAN (–)
C	PLUG	–

Secondary SAE J1939 connector circuit pin out –
2-pin connector to Blue iQ gauge

Pin	Color	Circuit
1	Yellow	J1939 CAN (+)
2	Green	J1939 CAN (–)

2.11. OEM Fuel Gauge Conditioning Circuit

Blue iQ interfaces with the OEM vehicle fuel gauge via a conditioning circuit. **FIGURE 2–40**

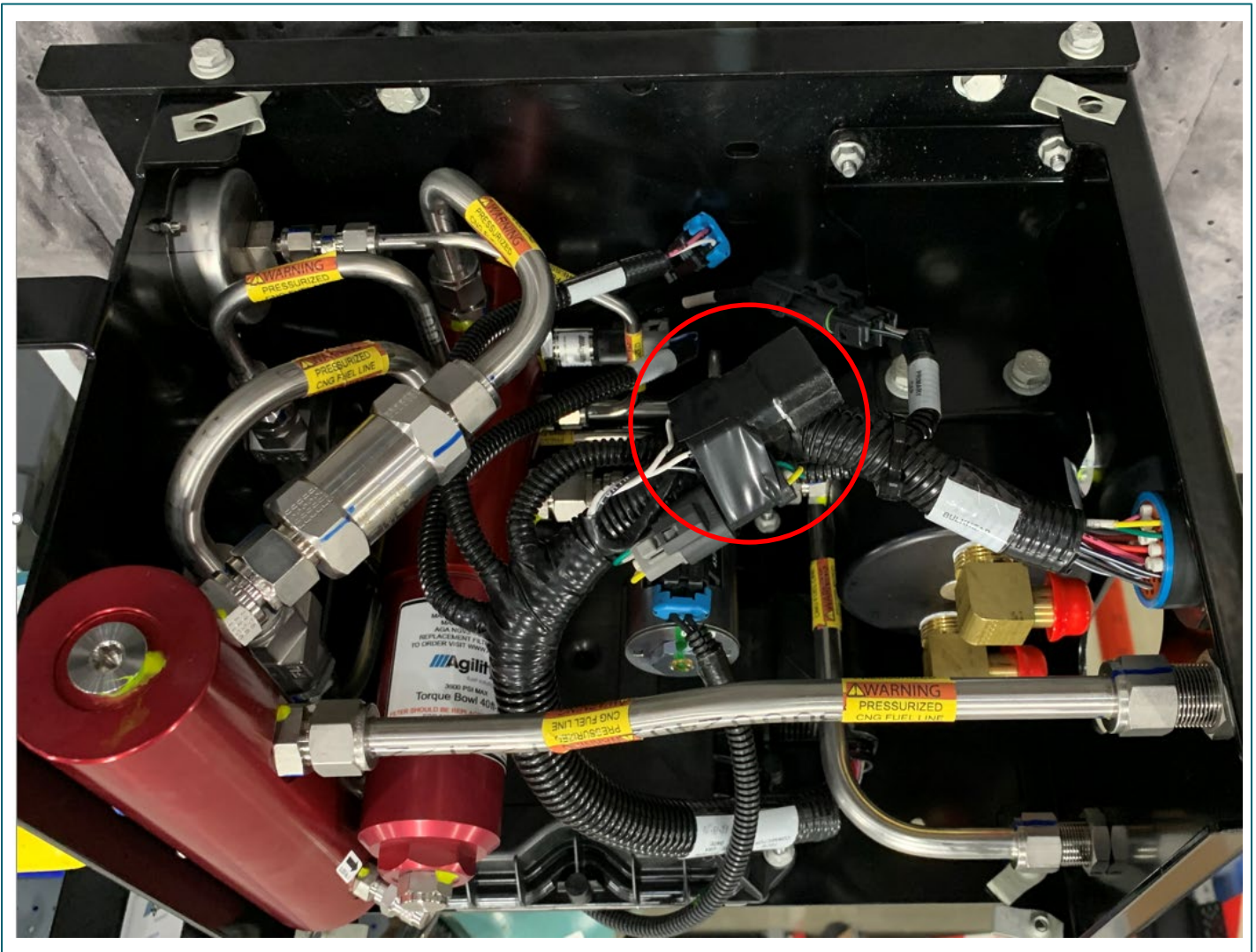


FIGURE 2–40. OEM fuel gauge conditioning circuit (*circle*) location taped to Blue iQ FMM harness in a box FMM.

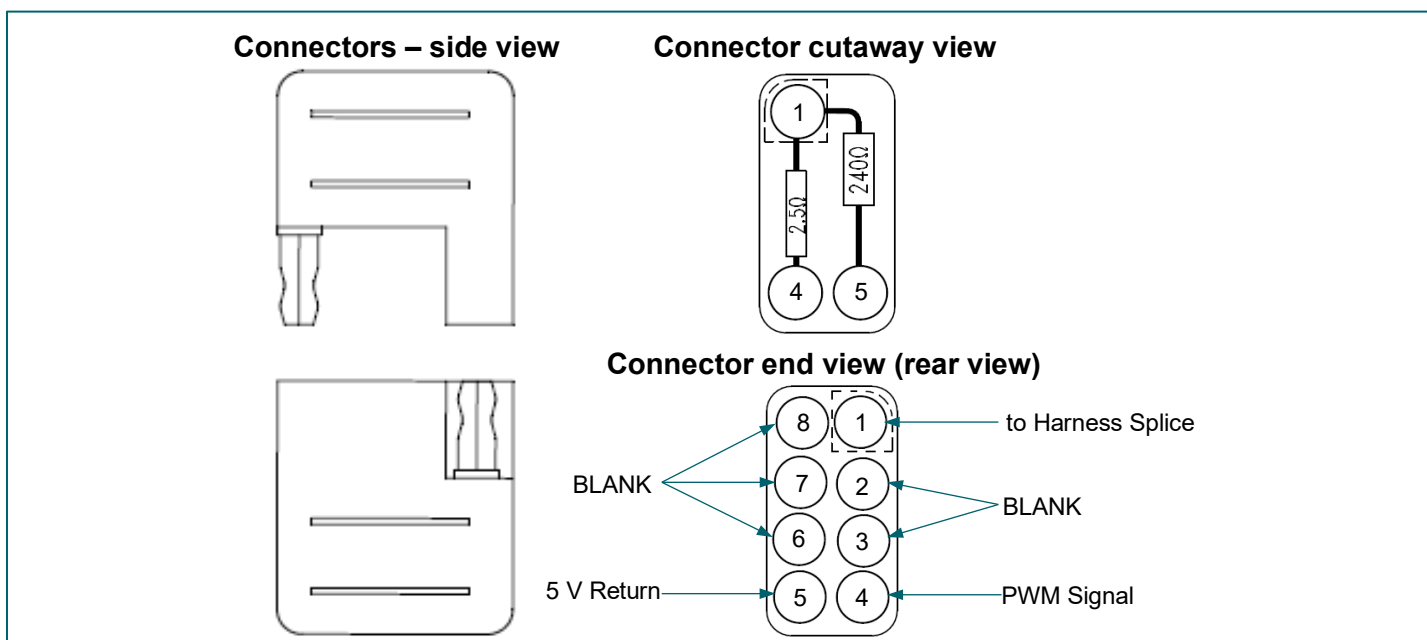
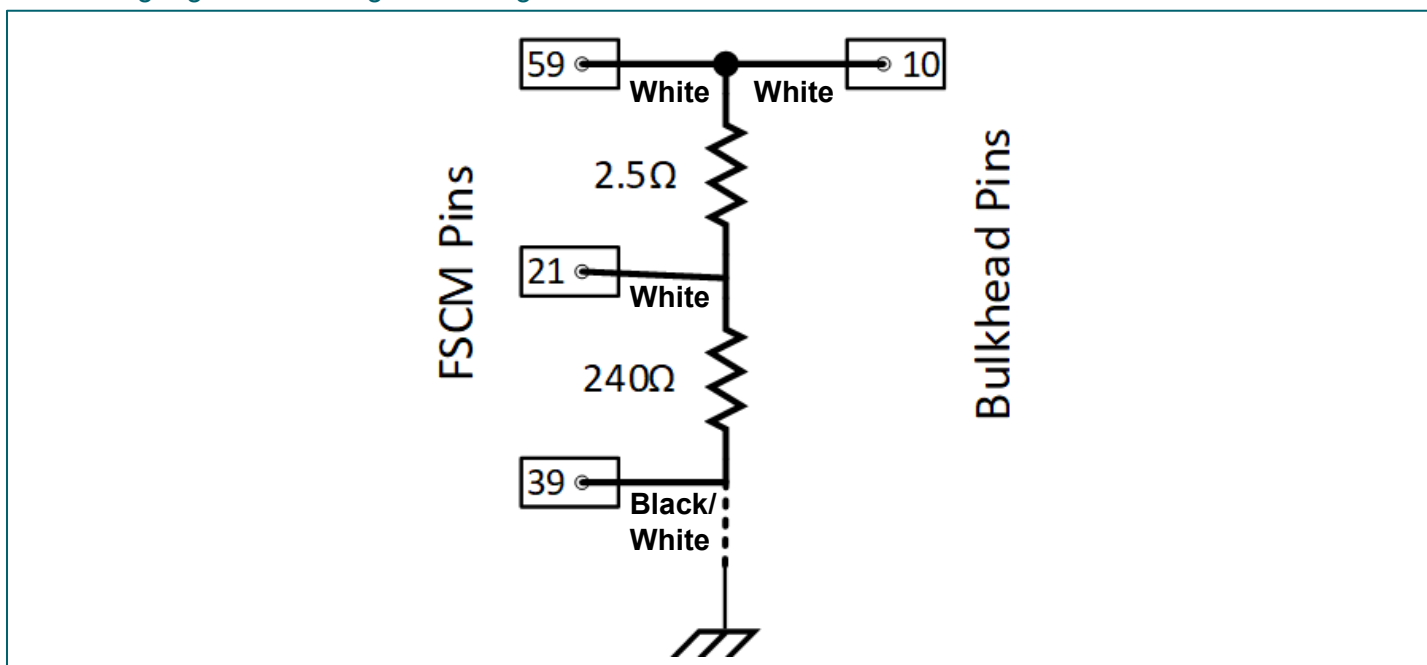


FIGURE 2-41. OEM fuel gauge conditioning circuit connector end views.

NOTICE

Some Blue iQ systems do not use connectors shown in FIGURE 2-41. Instead, terminating resistors are soldered, sealed, and packaged inside the FMM Blue iQ harness.

OEM fuel gauge conditioning circuit diagram



NOTICE

FSCM Pin 21 is a pulse width modulation (PWM) signal. Therefore, resistance cannot be measured with the system energized. The Blue iQ chassis harness must be disconnected from both the FSCM and the bulkhead connector to properly measure resistance in the OEM fuel gauge circuit.

OEM fuel gauge conditioning circuit pin out

Pin	Color	Circuit
1	White	to Splice 8
2	—	—
3	—	—
4	White	PWM Signal
5	Black/White	5V Return
6	—	—
7	—	—
8	—	—

2.12. (Optional) OEM Vehicle Interface

On certain fuel system configurations, Blue iQ interfaces with key OEM vehicle functions via an 8-pin connector and a bulkhead connector. **FIGURE 2-42**

Functions communicated through the OEM vehicle interface include the following items.

- | | | | |
|----------------------|----------------------|------------------|----------------|
| 1. Key (Ignition) On | 3. Low Fuel | 5. J1939 CAN (+) | 7. Battery (+) |
| 2. DAP Lamp | 4. Fuel Gauge Signal | 6. J1939 CAN (-) | |

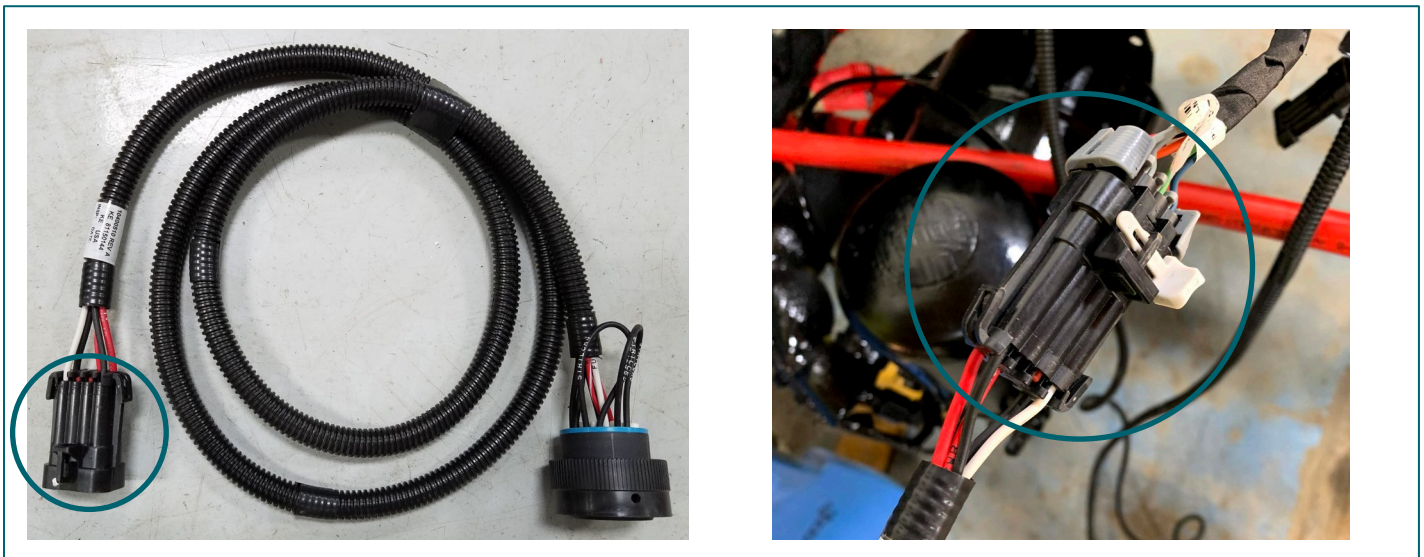


FIGURE 2-42. Optional OEM vehicle interface harness (8-pin connector circled).

Please contact Hexagon Agility® CCTS for vehicle specific details

2.13. Blue iQ System Schematic

Please refer to Appendix A (below).

3. Fault Code Diagnostics

3.1. Fault Code (FC) Lists

FC	Title	Description
5572	Engine Gaseous Fuel Pressure Regulator Intake Pressure - Data Valid But Above Normal Operating Range – Moderately Severe Level	pressure / temperature transducer pressure above 4500 psi (31 MPa) for more than 2.5 seconds
6845	Engine Gaseous Fuel Temperature Regulator Intake Temperature Sensor Circuit – Voltage Below Normal or Shorted to Low Source	pressure / temperature transducer temperature circuit shorted to ground or open circuit for more than 0.5 seconds
6849	Gaseous Fuel High Pressure Shutoff Valve – Current Below Normal or Open Circuit	solenoid power is open circuit (less than 0.3 A current flow)
6857	Fuel System Control Module – Data Erratic, Intermittent, or Incorrect	common interface fault – information only to engine. Indicates that data from engine is not received at normal update rate.
6858	Fuel System Control Module – Abnormal Update Rate	common interface fault – information only to engine. Indicates that data from engine is not received at normal update rate.
6947	Fuel Tank Receptacle Cover – Mechanical System Not Responding or Out of Adjustment	receptacle cover open at time of crank request, crank prevented
6955	Fuel Tank Receptacle Cover Detached During Operation – Condition Exists	receptacle cover open during vehicle operation
6958	Gaseous Fuel High Pressure Shutoff Valve Circuit – Current Above Normal or Grounded Circuit	solenoid power shorted to ground (more than 4 A current flow)
6963	Fuel Storage Compartment 1 Temperature - Data Valid But Above Normal Operating Range – Most Severe Level	single thermistor above 82.2°C (180°F)
7194	Fuel System Control Module - Data Valid But Below Normal Operating Range – Least Severe Level	Engine Inlet Pressure drops below 30 psi (0.21 MPa) after engine crank start, crank aborted
7195	Fuel System Control Module - Data Valid But Below Normal Operating Range – Moderately Severe Level	Engine Inlet Pressure below 60 psi (0.41 MPa) at time of crank request, crank prevented
7264	Gaseous Fuel High Pressure Shutoff Valve - Data Valid But Above Normal Operating Range – Moderately Severe Level	supply solenoid valve (SSV) coil resistance greater than normal

FC	Title	Description
7281	Fuel System Control Module – Condition Exists	common interface fault – information only to engine. Indicates there is a fault in the Hexagon Agility® system that may cause an engine performance issue. NOTE: FC 7281 is secondary to other fault codes; troubleshoot any other faults first.
7265	Gaseous Fuel High Pressure Shutoff Valve - Data Valid But Below Normal Operating Range – Moderately Severe Level	12V supply solenoid valve (SSV): resistance is below 5 ohms for more than 0.4 seconds
		24V supply solenoid valve (SSV): resistance is below 15 ohms for more than 0.4 seconds
7289	Engine Gaseous Fuel Pressure Regulator Intake Pressure Circuit – Voltage Below Normal or Shorted to Low Source	pressure/temperature transducer pressure circuit shorted to ground or open for more than 0.5 seconds
7291	Fuel Storage Compartment 1 Temperature - Data Valid But Below Normal Operating Range – Most Severe Level	average thermistor temperature below -45°C (-49°F)
7292	Fuel Storage Compartment 1 Temperature 1 Sensor Circuit – Voltage Above Normal or Shorted to High Source	thermistor 1 circuit shorted to high source or open circuit
7293	Fuel Storage Compartment 1 Temperature 1 Sensor Circuit – Voltage Below Normal or Shorted to Low Source	thermistor 1 circuit shorted to ground
7294	Fuel Storage Compartment 1 Temperature 2 Sensor Circuit – Voltage Above Normal or Shorted to High Source	thermistor 2 circuit shorted to high source or open circuit
7295	Fuel Storage Compartment 1 Temperature 2 Sensor Circuit – Voltage Below Normal or Shorted to Low Source	thermistor 2 circuit shorted to ground
7296	Engine Gaseous Fuel Pressure Regulator Intake Pressure – Data Valid But Below Normal Operating Range – Most Severe Level	pressure/temperature transducer pressure below 250 psi (1.72 MPa) for more than 2.5 seconds
7298	Engine Gaseous Fuel Pressure Regulator Intake Pressure Circuit – Voltage Below Normal or Shorted to High Source	pressure/temperature transducer pressure circuit shorted to high source for more than 0.5 seconds
7299	Engine Gaseous Fuel Temperature Regulator Intake Temperature – Data Valid But Above Normal Operating Range – Moderately Severe Level	pressure/temperature transducer temperature above 95°C (203°F) for more than 2.5 seconds
7311	Engine Gaseous Fuel Temperature Regulator Intake Temperature Sensor Circuit – Voltage Above Normal or Shorted to High Source	pressure/temperature transducer temperature circuit shorted to high source for more than 0.5 seconds

3.2. Fault Code Diagnostic Procedures

TABLE 3–1 lists all Blue iQ fault code procedures by Fault Code number(s) and the associated Hexagon Agility® document control numbers.

TABLE 3–1. List of Blue iQ Fault Code Procedures by Document Control Number

Fault Code(s) Diagnostic	Document Control Number
5572	DSM.0013
6845	DSM.0014
6849	DSM.0015
6857	DSM.0016
6858	DSM.0017
6947	DSM.0018
6955	DSM.0019
6958	DSM.0020
6963	DSM.0021
7194	DSM.0022
7195	DSM.0023
7264	DSM.0024
7265	DSM.0025
7281	DSM.0026
7289	DSM.0027
7291	DSM.0028
7292 and 7293	DSM.0029
7294 and 7295	DSM.0030
7296	DSM.0031
7298	DSM.0032
7299	DSM.0033
7311	DSM.0034

Glossary of Terms

Term/Abbreviation	Definition
AUX	Hexagon Agility® term applied to any auxiliary fuel receptacle configuration not located on the driver side (left side) of the vehicle. Examples include the following: passenger side (right side) fuel receptacles; remote fuel fill receptacles mounted on the front bumper, body side, or rear of body.
Blue iQ gauge	driver configurable in-cab Blue iQ fuel system display
CAN	acronym for Controller Area Network (<i>see</i>)
controller area network	serial bus communication system for connecting vehicle components and sensors for on-board diagnostics
CNG	compressed natural gas
DAP	Drive Away Protection – safety feature preventing engine start if fuel receptacle dust caps are not in place or fuel filler door is not closed
datalink connector	cable connecting a PC to the vehicle OBD-II port
Derate	reduction in engine power in response to a low fuel condition
DGE	diesel gallon equivalent – measure of natural gas capacity as compared to diesel volume
Diagnostic Trouble Code	standard codes used to identify abnormal operating conditions in an electronic circuit or by an electronic component as detected by the Fuel System Control Module (FSCM)
DTC	Diagnostic Trouble Code (<i>see</i>); refer also to fault code
DTE	distance to empty
Eco Mode	fleet configurable Blue iQ operating parameter to maximize fuel system efficiency; Eco Mode is enabled by default, but a driver may disable
Engine Gaseous Fuel Pressure Regulator Intake Pressure Sensor	Cummins® INSITE™ term for pressure/temperature transducer pressure sensor
Engine Gaseous Fuel Temperature Regulator Intake Temperature Sensor	Cummins® INSITE™ term for pressure/temperature transducer temperature sensor
English units	Blue iQ gauge display option for units of measure utilizing miles for distance, psi for pressure, volume in gallons, and temperature in Fahrenheit. Also referred to as U.S. customary units. <i>Compare:</i> “metric units”

Term/Abbreviation	Definition
Failure Mode Identifier	A Failure Mode Identifier may indicate that an abnormal operating condition has been detected. The failure mode of the Diagnostic Trouble Code is determined by evaluating the electronic signal from the suspect circuit. FMIs are divided into two types: 1) codes indicating a problem with an electronic circuit or an electronic component has been detected, 2) codes indicating a system event has been detected.
fault code	codes relating to improper fuel system operation stored by the fuel system control module (FSCM)
FC	abbreviation for fault code (<i>see</i>); refer also to Diagnostic Trouble Code (DTC)
FMI	acronym for Failure Mode Identifier (<i>see</i>)
FMM	fuel management module – comprises fuel fill, flow, filtration, pressure regulation, and control components and defueling components
FOD	foreign object debris
FSCM	fuel system control module – electronic FMM component which monitors and manages fuel system function
Fuel Storage Compartment Temperature Sensor	Cummins® INSITE™ term for thermistor (<i>see</i>)
fuel system control module electronic	FMM component which monitors and manages Blue iQ fuel system function
Fuel Tank Receptacle Cover	Cummins® INSITE™ term for fuel receptacle cap, fuel receptacle cover, or, or FMM fuel door. Refer to Drive Away Protection (DAP).
Gaseous Fuel High Pressure Shutoff Valve	Cummins® INSITE™ term for supply solenoid valve (SSV)
HP	high-pressure
INSITE™	Cummins® proprietary diagnostic tool
kPa	kilopascal – metric unit of pressure
J1939	SAE standard for CAN communication and diagnostics among heavy-duty vehicle components
LP	low-pressure
Low Fuel	fleet-adjustable Blue iQ bottom fuel threshold to trigger a “Low Fuel” message
Manifilter	machined Hexagon Agility® FMM component which removes moisture and impurities from fuel and—on some systems—contains the fuel system pressure/temperature transducer

Term/Abbreviation	Definition
metric units	Blue iQ gauge display option for International System units of measure utilizing kilometers for distance, kPa for pressure, volume in liters, and temperature in Celsius. <i>Compare:</i> “English units”
MPa	megapascal – metric unit of pressure
Over Temp Warning	Blue iQ gauge message indicating fuel storage temperature has risen above normal operating levels
pressure/temperature transducer	component consisting of fuel pressure and temperature sensors mounted in the pressure regulator (<i>see</i>) or Manifilter (<i>see</i>)
pressure regulator	FMM flow component which reduces fuel system pressure from cylinder storage pressure (approx. 3600 psi / 24.8 MPa) to a lower pressure usable for the engine
psi	pounds per square inch – English unit of pressure
SPN	acronym for Suspect Parameter Number (<i>see</i>)
SSV	acronym for supply solenoid valve (<i>see</i>)
supply solenoid valve	electrical coil controlled valve in the FMM which opens at ignition on to permit fuel flow to the engine or closes to stop fuel flow when ignition is off
Suspect Parameter Number	unique value assigned to a particular vehicle or fuel system fault code
thermistor	Blue iQ fuel system temperature sensor which relies upon electrical resistance to measure temperature in the fuel system enclosure(s)

Contact information

Hexagon Agility® Customer Care and Technical Services

Fuel system warranty or non-warranty product support may be obtained by calling or emailing Hexagon Agility® Customer Care and Technical Services (CCTS).

Please provide **your name, phone number, email address, and complete vehicle information: VIN, year, make, model, mileage, unit number vehicle owner, and current vehicle location**. A service advisor will contact you to arrange vehicle repair or ship a part.

833-4-HEX-CARE

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