J1939 Datalink Diagnostics

54-15

> Recreational Vehicle
> School Bus
> Shuttle Bus
> Walk-In Van

Freightliner Custom Chassis Service Bulletin

General Information

This Service Bulletin contains information on how to diagnose problems and troubleshoot the J1939 datalinks.

Table of Contents

Freightliner Custom Chassis
Service Bulletin

> Recreational Vehicle
> School Bus
> Shuttle Bus
> Walk-In Van

1.0 J1939 Quick Reference Information

1.1 J1939 Troubleshooting Quick Reference

IMPORTANT: If working on a vehicle equipped with a Mercedes MBE900 engine, see subject 1.2 before proceeding.

IMPORTANT: The batteries **MUST** be disconnected and the ignition must be **OFF** prior to any J1939 resistance tests.

Quick Test #1: Check resistance of the J1939 datalink across pins C and D at the diagnostic connector.

See **Table 1** for test results and possible causes.

Quick Test #1: Check the J1939 datalink resistance across pins C and D at the diagnostic connector.	
Result	**Possible Cause**
60Ω ± 6Ω	The datalink backbone is intact and both terminating resistors are installed. Go to Quick Test #2.
NOT 60Ω ± 6Ω	Check the J1939 datalink terminating resistors. A resistance reading around 40Ω may indicate more than two terminating resistors. A resistance reading around 120Ω may indicate a missing terminating resistor or an open circuit somewhere in the backbone. Other readings may indicate an open circuit or a short circuit.

Table 1, Quick Test #1: Check Resistance Of The J1939 Datalink Across Pins C And D At The Diagnostic Connector

Quick Test #2: Check ECU communication on J1939 using the J1939 Datalink Monitor Template.

NOTE: The template contains instructions on its use.

See **Table 2** for test results and possible causes.

Quick Test #2: Check ECU communication on J1939 using the J1939 Datalink Monitor Template.	
Result	**Possible Cause**
All ECUs communicate.	The J1939 datalink is okay. No further testing is necessary.
One ECU does not respond.	There may be a problem in the J1939 wiring between the ECU and the J1939 backbone. Check J1939 circuit resistance at the ECU. If the result is 60Ω the ECU is probably at fault. If the result is NOT 60Ω check and repair J1939 datalink wiring.
All ECUs fail to respond.	The J1939 datalink polarity may be reversed at the diagnostic connector. There may be a problem with the PC to vehicle interface or the J1939 datalink may have a short to power or short to ground.

Table 2, Quick Test #2: Check ECU Communication On J1939 Using The J1939 Datalink Monitor Template

1.2 Special Instructions for Vehicles Equipped With Mercedes MBE900 Engines, Manufactured Through November 30, 2000

Some vehicles with MBE900 engines manufactured through November 30, 2000, may have been incorrectly built with three terminating resistors. In this case, one of the terminating resistors is located inside the Vehicle Control

Unit (VCU) and the other two are plugged into the backbone. On these vehicles, it does not appear that this affects driveability or functionality, however, the problem should be corrected when noted.

The VCU part number on these vehicles is MBT A0004461435. VCUs with this part number have an internal terminating resistor. If the VCU part number is NOT the one listed above, proceed with the diagnostics in Subject 1.1 or Section 2.

If the VCU part number is the one listed above, check the J1939 datalink resistance at terminals C and D of the diagnostic connector.

NOTE: The batteries must be disconnected before measuring resistance on the datalink.

If the resistance is 40Ω, disconnect the J1939 wiring inside the cab where it goes through the frontwall to the engine compartment. Leave the wiring and terminating resistor in the engine compartment intact. This wiring and terminating resistor will be necessary if the VCU is ever replaced with an updated unit that does not contain an internal terminating resistor. Proceed with the diagnostics in Subject 1.1 or Section 2, if necessary.

1.3 J1939 Terminology Quick Reference

See **Fig. 1** and **Fig. 2**.

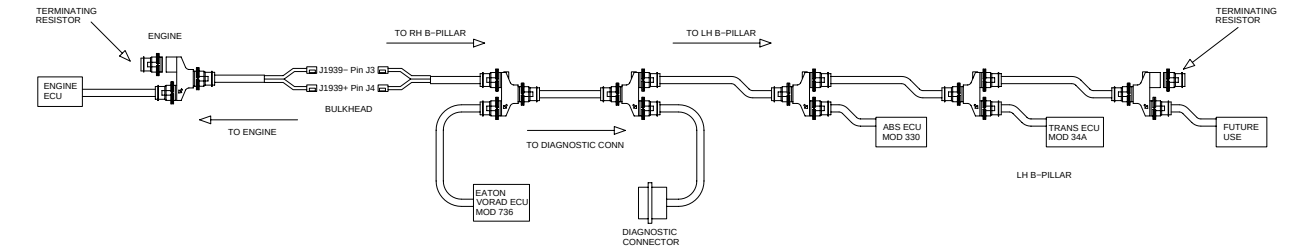
- Backbone—The main J1939 datalink wiring from one end of the datalink to the other. It does not include the branch circuits to each ECU or diagnostic connector.
- Branch Circuit—The section of J1939 datalink wiring between the backbone and each ECU that has J1939, and between the backbone and the diagnostic connector.
- J1939 Datalink Wiring—
    - Yellow (J1939+)
    - Green (J1939-)
    - Shield (optional; used only with J1939 "heavy" cable)
- Terminating Resistors—Located one at each end of the backbone, for a total of two. Each resistor is 120Ω. With two in parallel the total resistance is 60Ω.
  On vehicles equipped with a Mercedes MBE 900 engine, one of the terminating resistors may be located inside the VCU. This only applies to VCU part number MBT A0004461435. This resistor can be tested by checking the resistance across terminals 19 and 21 of the 21-pin connector on the VCU. If this resistor fails, the VCU must be replaced. New VCUs (p/n MBT A0004461735) do not contain an internal terminating resistor. If an older VCU is replaced with a newer one, a terminating resistor will have to be added to the J1939 backbone. See Subject 1.2 for more information.
- ECU—Electronic Control Unit. These connect to the J1939 datalink with a branch circuit.
- Diagnostic Connector—Most vehicles with J1939 use a 9-pin diagnostic connector (see Section 3, Frequently Asked Questions, for exceptions to this). Not all vehicles with 9-pin connectors have J1939. Vehicles with J1939 will have terminals in cavities C and D.

2.0 J1939 Datalink Detailed Troubleshooting: Steps For Pinpointing A J1939 Problem

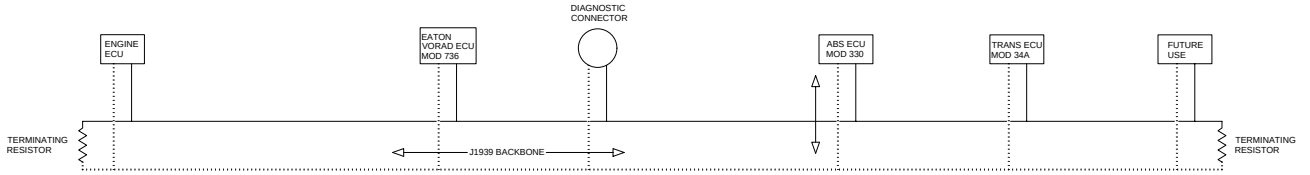
Use the following five basic steps in the order given to successfully locate J1939 datalink problems. Do not skip steps or tests unless directed to do so.

Freightliner Custom Chassis
Service Bulletin

> **Recreational Vehicle** > **Shuttle Bus**
> **School Bus** > **Walk-In Van**



EXAMPLE J1939 WIRING DIAGRAM



EXAMPLE J1939 SCHEMATIC

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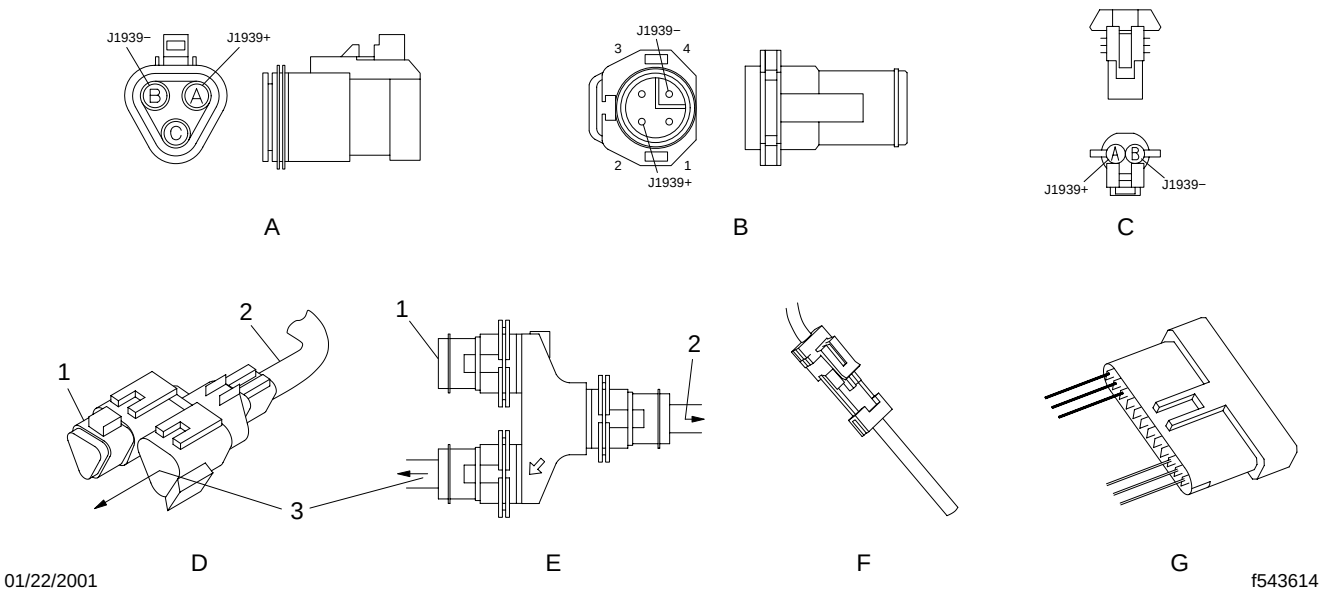
Fig. 1, J1939 Wiring Diagram And Schematic Examples



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A. Deutsch Connector
B. ITT Cannon Connector
C. Metripak Connector
D. Deutsch Tee
E. ITT Cannon Tee
F. Terminating Resistor (Metripak)
G. Splice Pack

1. Terminating Resistor
2. Backbone
3. To ECU

Fig. 2, J1939 Components

2.1 Step 1: J1939 Resistance Test

Test 1 - Checking resistance of the datalink.

This test checks whether or not both terminating resistors are installed, and ensures that there is a complete circuit from the diagnostic connector through the backbone loop. It does not ensure that branch circuits to each ECU are OK.

Tests in this subject are performed using a digital multimeter set to read ohms.

IMPORTANT: If working on a vehicle equipped with a Mercedes MBE900 engine, see Subject 1.2 before proceeding.

IMPORTANT: The batteries **MUST** be disconnected and the ignition must be **OFF** prior to any J1939 resistance tests. Failure to do so may result in inconclusive resistance measurements. The J1939 datalink is not completely inactive with only the ignition off. It may be active even if there appears to be no voltage on the the datalink.

1. Turn the ignition OFF and disconnect the batteries.
2. Connect the meter leads of a digital multimeter set to read ohms to pins C and D of the 9-pin diagnostic connector and measure the resistance.
3. Reconnect the batteries after the test is completed.

See **Table 3** for test results and possible causes.

Step 1, Test 1: J1939 Resistance Test	
Result	**Possible Cause**
60Ω ± 6Ω	The J1939 datalink backbone is intact and both terminating resistors are installed. Go to step 2.
120Ω ± 12Ω	Any of the following: • One of the terminating resistors is missing. • One of the terminating resistors is open. • The circuit may be open anywhere between the terminating resistors.
40Ω ± 4Ω	Three terminating resistors have been installed; one must be removed. There must be one terminating resistor at each end of the backbone for a total of two.
0Ω to 5Ω	J1939+ and J1939- have shorted together somewhere in the system.
Greater than 1000Ω	The most likely cause is an open circuit between the diagnostic connector and the J1939 backbone. It may also be that both terminating resistors are missing or open.
Any other readings	Any of the following: • Incorrect terminating resistor resistance. • Poor or corroded connections. • Short circuit to ground or an open circuit somewhere on the datalink. Go to step 2 to pinpoint the problem.

Table 3, Step 1, Test 1: J1939 Resistance Test

2.2 Step 2: ECU Communication Test Using Datalink Monitor

The following series of tests check for communication with each ECU connected to the J1939 datalink. If one fails to communicate, pinpoint whether the problem is wiring or an ECU. If all ECUs communicate as they should, J1939 is probably not the problem.

Test 1: Check whether each ECU connected to the J1939 datalink responds.

1. Connect the computer to the diagnostic connector.
2. Start the J1939 DataLink Monitor template.

NOTE: The template contains instructions on its use.

3. Check whether each ECU that is supposed to be connected to the datalink responds.

See **Table 4** for test results and possible causes.

Step 2, Test 1: Check whether each ECU connected to the J1939 datalink responds	
Result	**Possible Cause**
All ECUs respond	The J1939 datalink is probably not the problem.
One ECU fails to respond.	Go to Test 2.
No ECUs respond	Possible explanations are: • The J1939+ and J1939- pinouts may be reversed at the diagnostic connector. Check their polarity. • There may be a problem with the PC to vehicle interface. • The entire datalink may be down due to a short to power or short to ground. Go to Step 3 to pinpoint the problem.

Table 4, Step 2, Test 1: Check Whether Each ECU Connected To The J1939 Datalink Responds

Test 2: Check the J1939 datalink wiring to the ECU that does not respond.

IMPORTANT: The batteries **MUST** be disconnected and the ignition must be **OFF** prior to any J1939 resistance tests.

1. Turn the ignition OFF and disconnect the batteries.
2. Locate the connector at the ECU in Step 2, Test 1 that did not respond and disconnect it.
3. Locate the pins for J1939+ and J1939-. Refer to FCCC or component supplier literature or wiring diagrams for the specific component.
4. Check to make sure that J1939+ and J1939- polarity is correct at the component before proceeding. If not, this is the most likely problem.
5. Using a digital multimeter set to read ohms, measure the resistance across the two J1939 datalink pins at the connector to the suspect ECU.
6. Reconnect the batteries after the test is completed.

See **Table 5** for test results and possible causes.

Step 2, Test 2: Check the J1939 datalink wiring to the ECU that does not respond	
Result	**Possible Cause**
60Ω ± 6Ω	The datalink itself is probably not the problem. Make sure that any changeable J1939 parameters for this ECU are set correctly before proceeding. Also, make sure that there is power and ground to the suspect ECU. Go to Test 3 once the following have been confirmed: • J1939 parameters for the ECU (if they can be changed) are correct. • There is power and ground to the suspect ECU.
Not 60Ω ± 6Ω	There is a problem with the J1939 wiring between the ECU connector and its connection to the J1939 backbone. Repair as necessary.

Table 5, Step 2, Test 2: Check The J1939 Datalink Wiring To The ECU That Does Not Respond

Test 3: Install a test ECU to confirm the problem.

1. Install a test ECU and make sure that all J1939 parameters (if changeable) are set correctly.
2. Using the J1939 DataLink Monitor template, check to see if every ECU that is supposed to be connected to the datalink responds.

See **Table 6** for test results and possible causes.

Step 2, Test 3: Install a test ECU to confirm the problem	
Result	**Possible Cause**
All ECUs respond	The ECU was faulty and the test ECU confirmed this. Replace the ECU.
The ECU still does not respond.	The problem has not been confirmed. Carefully repeat all the diagnostics. If the ECU still does not respond, contact your District Service Manager or the ECU supplier directly for assistance.

Table 6, Step 2, Test 3: Install A Test ECU To Confirm The Problem

2.3 Step 3: Testing J1939 Voltage For Circuit Faults (Shorts To Power and Ground)

These tests check for shorts to power and shorts to ground on the J1939 datalink.

NOTE: All tests are performed using a digital multimeter set to read voltage.

NOTE: Before proceeding, verify that battery voltage (approximately +12 VDC) is available at pin B of the diagnostic connector. With the ignition ON, use a digital multimeter to test for voltage at pin B by placing the red (+) lead on pin B and the black (-) lead on a good chassis ground.

Test 1: Test J1939+ for shorts to power and ground.

1. Turn the ignition ON.
2. Touch the red (+) lead to pin B (+12 VDC) and the black (-) lead to pin C (J1939+) of the diagnostic connector.

See **Table 7** for test results and possible causes.

Step 3, Test 1: Test J1939+ for shorts to power and ground	
Result	**Possible Cause**
0 VDC	J1939+ is shorted to power. Go to Step 4.
12 VDC (battery voltage)	J1939+ is shorted to ground. Go to Step 4.
Any other reading	J1939+ is not shorted to power or ground. Go to Test 2.

Table 7, Step 3, Test 1: Test J1939+ For Shorts To Power And Ground

Test 2: Test J1939- for shorts to power and ground.

1. Turn the ignition ON.
2. Touch the red (+) lead to pin B (+12 VDC) and the black (-) lead to pin D (J1939-) of the diagnostic connector.

See **Table 8** for test results and possible causes.

Step 3, Test 2: Test J1939- for shorts to power and ground	
Result	**Possible Cause**
0 VDC	J1939- is shorted to power. Go to Step 4.
12 VDC (battery voltage)	J1939- is shorted to ground. Go to Step 4.
Any other reading	J1939- is not shorted to power or ground. There may be a problem with the vehicle to computer interface. The datalink itself appears to be OK.

Table 8, Step 3, Test 2: Test J1939- For Shorts To Power And Ground

2.4 Step 4: Pinpointing Short Circuits On The J1939 Datalink

These tests pinpoint shorts to power and shorts to ground on the J1939 datalink. The tests will indicate on which side of the cab/engine interface the problem exists. They will indicate whether the problem is in the cab to engine wiring or inside the cab.

NOTE: All tests are performed using a digital multimeter set to read voltage.

Before proceeding, verify that battery voltage (approximately +12 VDC) is available at pin B of the diagnostic connector. With the ignition ON, use a digital multimeter to test for voltage at pin B by placing the red (+) lead on pin B and the black (-) lead on a good chassis ground.

Test 1: Test J1939+ for shorts to power and ground.

1. Locate the cab to engine compartment bulkhead connector that contains the J1939 datalink and disconnect it.
2. Turn the ignition ON.
3. Touch the red (+) lead to pin B (+12 VDC) and the black (-) lead to pin C (J1939+) of the diagnostic connector.

See **Table 9** for test results and possible causes.

Step 4, Test 1: Test J1939+ for shorts to power and ground	
Result	**Possible Cause**
0 VDC	J1939+ is shorted to power inside the cab. NOTE: On vehicles with frame mounted ABS with J1939, the problem may be either inside the cab or between the cab and the ABS.
12 VDC (battery voltage)	J1939+ is shorted to ground inside the cab. NOTE: On vehicles with frame mounted ABS with J1939, the problem may be either inside the cab or between the cab and the ABS.
Any other reading	J1939+ is shorted to power or ground between the cab and the engine. Repair as necessary.

Table 9, Step 4, Test 1: Test J1939+ For Shorts To Power And Ground

Test 2: Test J1939- for shorts to power and ground.

1. Locate the cab to engine compartment bulkhead connector that contains the J1939 datalink and disconnect it, if it hasn't already been disconnected.
2. Turn the ignition ON.
3. Touch the red (+) lead to pin B (+12 VDC) and the black (-) lead to pin D (J1939-) of the diagnostic connector.

See **Table 10** for test results and possible causes.

Step 4, Test 2: Test J1939- for shorts to power and ground	
Result	**Possible Cause**
0 VDC	J1939- is shorted to power inside the cab. NOTE: On vehicles with frame mounted ABS with J1939, the problem may be either inside the cab or between the cab and the ABS.
12 VDC (battery voltage)	J1939- is shorted to ground inside the cab. NOTE: On vehicles with frame mounted ABS with J1939, the problem may be either inside the cab or between the cab and the ABS.
Any other reading	J1939- is shorted to power or ground between the cab and the engine. Repair as necessary.

Table 10, Step 4, Test 2: Test J1939- For Shorts To Power And Ground

2.5 Step 5: Locating Faults By Circuit Isolation (Example)

To further pinpoint exactly what part of the circuit the problem identified in Step 4 is, use a procedure similar to the following example.

If the results of Step 4 indicate there is a J1939- short to ground someplace other than between the cab and the engine, use the typical wiring diagram shown here to pinpoint the problem. See **Fig. 3**. When a short to ground is present on J1939- battery voltage will read 12VDC with the positive (red) lead on pin B (+12 VDC) and the negative (black) lead on pin D (J1939-) at the diagnostic connector. When the short to ground is not present, the reading will be much less than +12VDC.

NOTE: Never cut wires to isolate circuits.

One way to pinpoint the short is to isolate it by systematically disconnecting connections on the datalink until battery voltage reads zero when measuring across the diagnostic connector pins, as outlined in the previous paragraph.

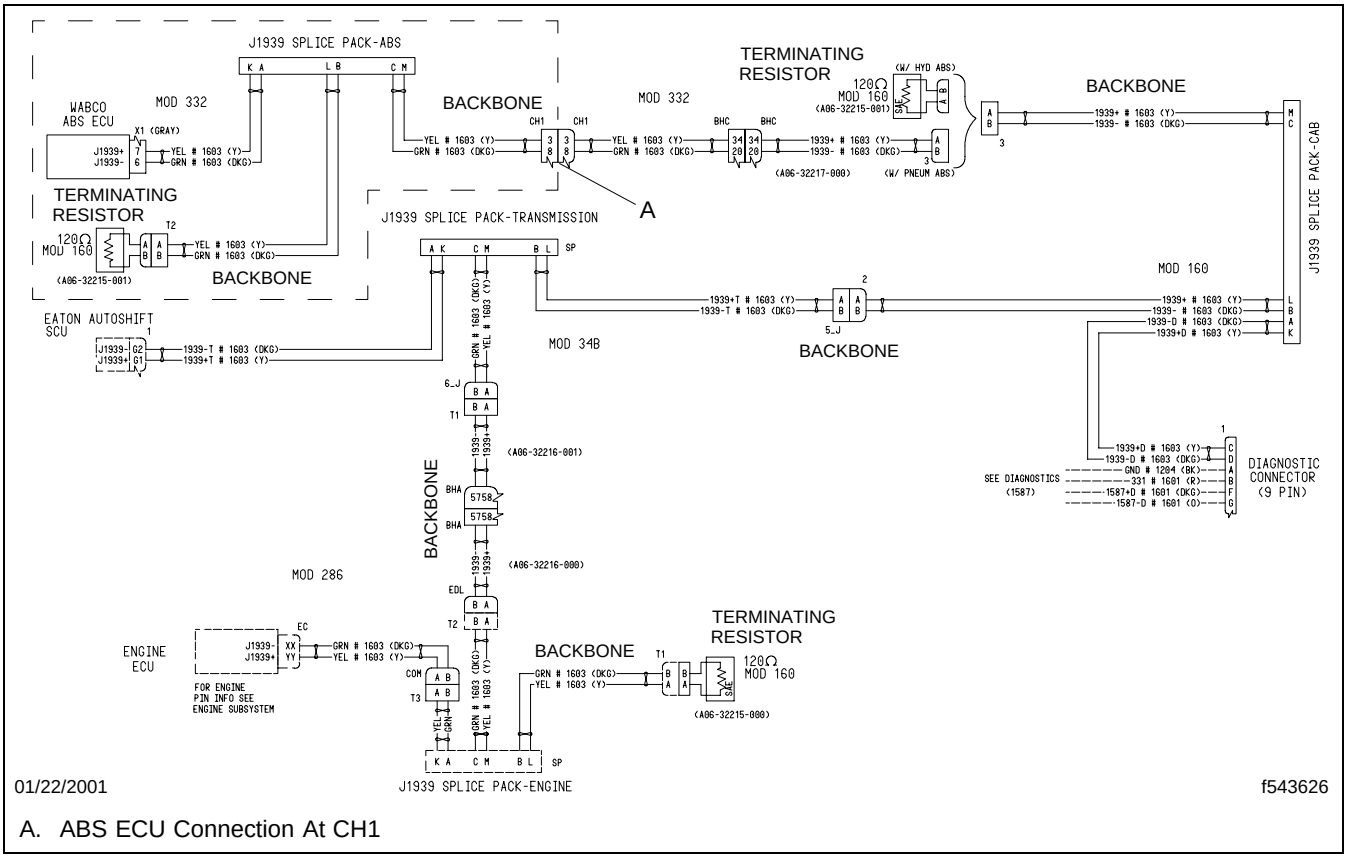
Start by checking whether the problem is in the wiring to the ABS ECU. Isolate part of that system by disconnecting the chassis harness connector CH1 (see **Fig. 3**) since this connector is relatively easy to access, then touch the positive (red) lead to pin B (+12 VDC) and the negative (black) lead to pin D (J1939-) at the diagnostic connector. This isolates the portion of the figure in the upper left-hand corner indicated by the dashed line. This measurement will indicate one of two things:

- A battery voltage reading significantly less than +12VDC confirms the problem has been isolated. It indicates that when the circuit was disconnected at the CH1 connector the ground fault was no longer present on J1939- between that point and the diagnostic connector. Therefore, the problem is between the CH1 connector and the ABS ECU portion of the circuit.
- If battery voltage reads +12VDC the problem has not yet been isolated. This means that when the circuit was disconnected at the CH1 connector, the ground fault was still present on J1939- between that point and the diagnostic connector or some other portion of the datalink. It also means that the problem is not between the CH1 connector and the ABS ECU portion of the circuit. Continue to look for places to isolate and test the circuit.

3.0 Frequently Asked Questions

3.1 What is a J1939 datalink?

J1939 is a high-speed vehicle datalink that can communicate information between ECUs on the vehicle. The J1939 datalink communicates at 250,000 bits per second. Unlike the J1587 datalink, which has been used on



A. ABS ECU Connection At CH1

Fig. 3, J1939 Wiring Diagram Example

vehicles for many years, the J1939 datalink allows an ECU to broadcast requests as well as information. A few examples of what might be communicated on the J1939 datalink are:

- Engine rotational speed information
- Road speed information
- Transmission tailshaft speed information
- Engine retarder de-activation request
- Engine torque reduction request

3.2 How do you know if a vehicle has a J1939 datalink?

The best way to determine if a vehicle is equipped with a J1939 datalink is to review the electronic units installed on the vehicle against FCCC's design guidelines. See **Table 11**.

How To Tell If a Vehicle Has a J1939 Datalink	
If the vehicle has:	**J1939 is installed:**
Automated Mechanical Transmission (Eaton AutoShift, Meritor SureShift) OR Meritor stand-alone Engine Synchro Shift (ESS) OR newer Eaton Top2 (Lightning)	Always
ABS with Automatic Traction Control	Cummins ISB, ISC, ISM, ISX, Signature 600 engines; Caterpillar CFE/3126 engines; Mercedes Engines (except Sprinter)
Cummins RoadRelay 4.0	Cummins ISB, ISC, ISM, ISX, Signature 600 engines
Eaton VORAD with SmartCruise option	Always
Allison 1000/2000/2400 Transmission	Always
Allison MD-series transmission	MBE900 Engines

Table 11, How To Tell If A Vehicle Has A J1939 Datalink

Most vehicles with a J1939 datalink have a 9-pin J1939 diagnostic connector. If there is a 9-pin J1939 diagnostic connector, verify that terminals are installed in positions C and D. (The diagnostic connector pinouts are defined later in this document.) The presence of terminals in pins C and D does not guarantee the presence of a J1939 datalink, however, since some vehicles built with pins in these locations may NOT have a J1939 datalink, but this quick check should be accurate for nearly all vehicles.

Some vehicles have a J1939 datalink but do NOT have a 9-pin diagnostic connector. If either of the following is true, the vehicle has a J1939 datalink:

- Vehicles equipped with Cummins ISB, ISC, ISL, ISM, ISX, and Signature 600 engines, or vehicles equipped with CAT ADEM III engine controllers (which includes most CAT engines from 1999 or later) have a J1939 Deutsch connector programming stub. When a J1939 datalink is present, this stub will be connected to the vehicle J1939 datalink and become part of the branch circuit between the engine ECU and the backbone. Otherwise, the stub can be found near the engine.
- Vehicles equipped with Autoshift Generation 1 transmissions (September through December 1998 chassis build dates) have a J1939 datalink without a 9-pin diagnostic connector. The datalink is connected between the engine and the transmission.

Special situations are:

- Allison MD-series transmissions need throttle position sensor (TPS) information to select transmission shift points. When paired with an MBE900 engine, the transmission requires a J1939 datalink to get TPS data from the engine.
- Allison 1000/2000/2400 transmissions do not require J1939 because they can select shift points that are nearly optimal. However, without J1939, shifting may not be as smooth under all operating conditions. Therefore, FCCC has chosen to use J1939 with these transmissions.
- Vehicles equipped with a Detroit Diesel engine or a Caterpillar C10, C12, C15, C16 or 3406E engine will use J1922 for ABS with ATC unless J1939 is required for another option on the vehicle.

If J1939 is required for any optional item, as noted in **Table 11**, the J1939 datalink will be connected to all J1939-capable ECUs on the vehicle.

3.3 What does the J1939 system look like?

To gain a basic understanding of how the J1939 datalink is wired, see the simplified typical J1939 wiring diagram and schematic in **Fig. 4**.

Notice that the backbone is the section between the two terminating resistors. Many vehicles do not use a shield wire (FCCC vehicles are the exception; they use the J1939 "heavy" cable). All the ECUs connected to the J1939 backbone are wired in parallel. Splice packs or tee connectors are located where the ECU branch wiring and terminating resistors connect to the J1939 backbone. These are discussed in more detail in Subject 1.4.

See **Fig. 5** for an example of a typical wiring diagram to use when troubleshooting a J1939 datalink problem. This drawing is only intended to illustrate how to trace the backbone and branch circuits, and to show where the terminating resistors are, depending on options. For actual troubleshooting, use the appropriate wiring diagram specific to the subject vehicle.

In the upper portion of the wiring diagram, the J1939 backbone ends at the terminating resistor near the ABS ECU. In the upper right hand corner of the diagram is an alternate terminating resistor location. This is where

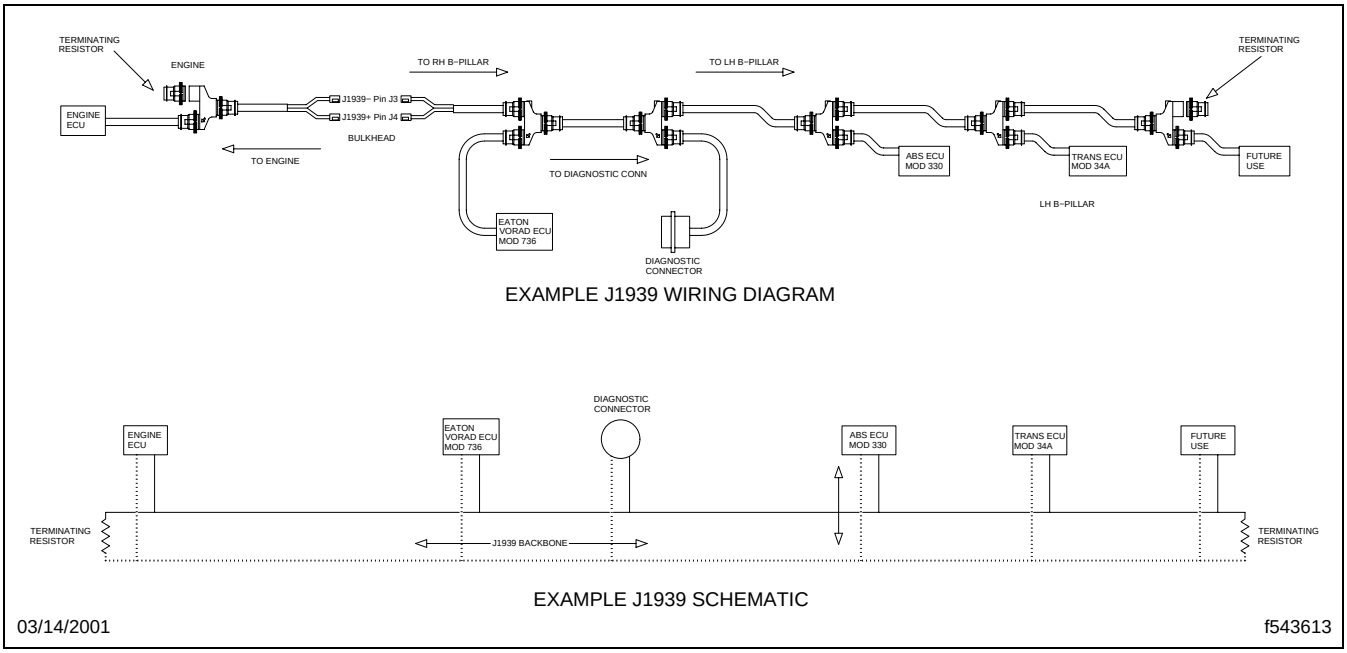


Fig. 4, J1939 Wiring Diagram And Schematic Examples

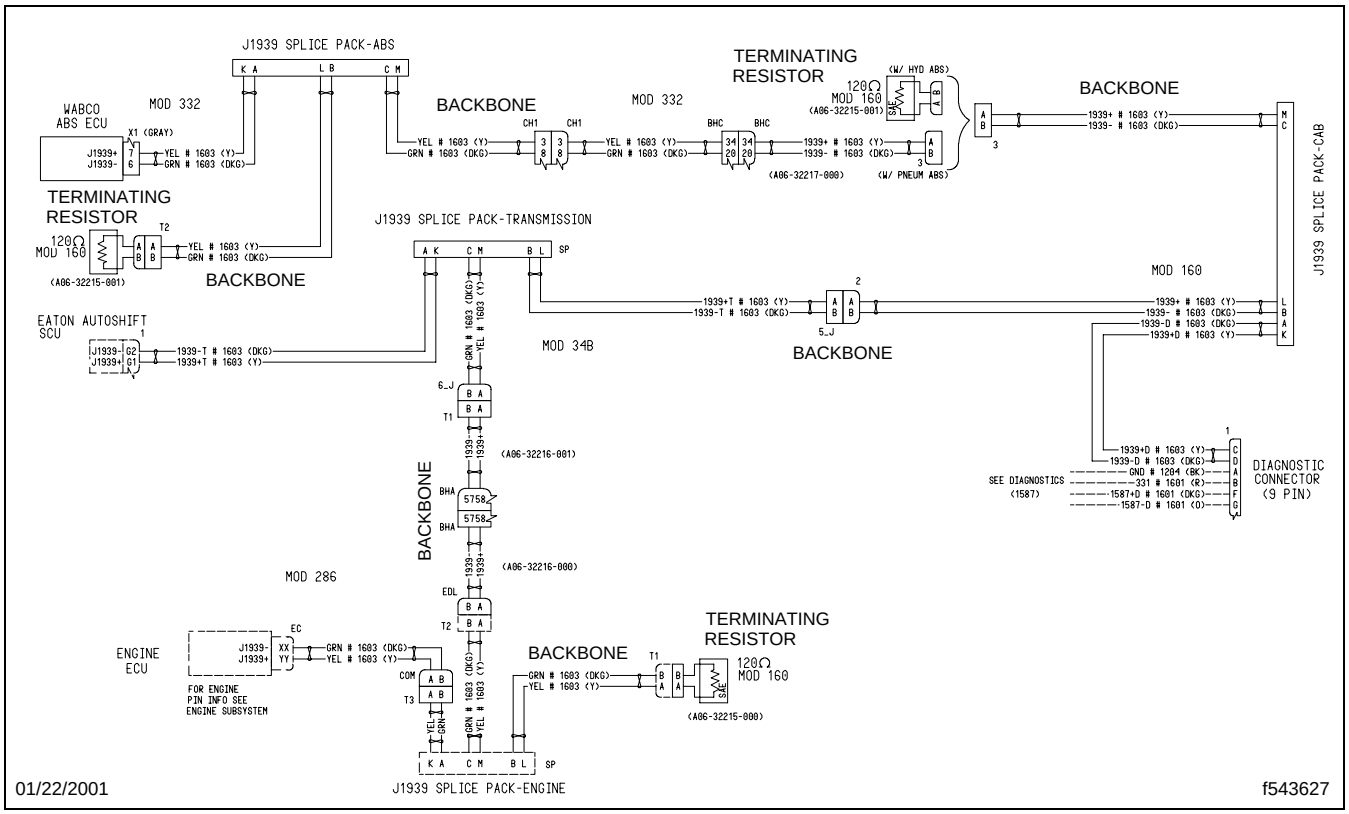


Fig. 5, J1939 Wiring Diagram Example

the J1939 backbone would end if J1939 were not required for the ABS. Notice that splice packs or tee connectors are used where ECUs and terminating resistors are connected to the J1939 backbone. Splice packs or tee connectors also are circuit locations where branch circuits to the ECUs or diagnostic connectors end.

3.4 What are some of the symptoms of a malfunctioning J1939?

Symptoms of a malfunctioning J1939 include:

- J1587 fault codes or blink codes indicating a J1939 problem.
- Autoshift doesn't function correctly; it reverts to AutoSelect mode with a code 35 active.
- CHECK ENGINE or ENGINE WARNING lamp is illuminated.
- TRACTION or WHEEL SPIN or ATC lamp is illuminated.
- SmartCruise does not work.
- Cummins Road Relay does not work.
- Harsh shifting with Allison 1000/2000/2400 transmissions, with Allison code U2105 (this code can only be viewed with Allison software). Since Allison 1000/2000/2400 transmissions use J1939 and not J1587, this fault will not show up in ServiceLink. Allison 1000/2000/2400 transmissions generally do well at estimating shift points without J1939, therefore, this problem often goes unnoticed.

3.5 What are "terminating resistors"?

All vehicles with a J1939 datalink have two terminating resistors; one at each end of the backbone.

The purpose of the terminating resistors is to minimize the reflection of data on the datalink. Collision of reflected data can cause J1939 messages to become partially or completely lost. Data collision can also cause the data to be erratic. Terminating resistors prevent this from occurring. Although the J1939 datalink may function with a missing or failed terminating resistor, data collision can occur and cause problems.

Each individual terminating resistor is 120Ω, but the equivalent resistance of two 120Ω resistors in parallel is 60Ω.

Since the resistors are in parallel with one another, their total resistance equals 60Ω. If a terminating resistor is removed, the circuit resistance should be 120Ω. However, with both resistors installed in the circuit there should be 60Ω measured at any two points between J1939+ and J1939- in the circuit, such as between pins C and D of the diagnostic connector.

There are four basic types of terminating resistors. The first type is shown in **Fig. 6**.

The second type is found on vehicles that use Deutsch connectors in the J1939 datalink. See **Fig. 7**.

The third type plugs into the ITT Cannon style connector. See **Fig. 8**.

The fourth type is located inside the VCU on some Mercedes MBE900-equipped vehicles manufactured through November 30, 2000. Only VCUs with part number MBT A0004461435 have an internal terminating resistor.

Regardless of the style encountered, the nominal resistance of each will be 120Ω.

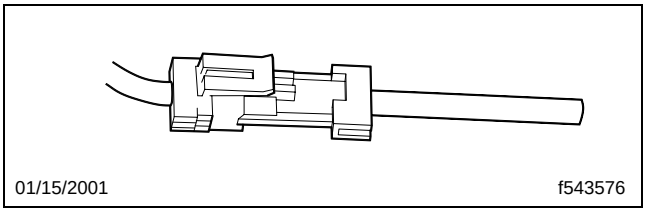
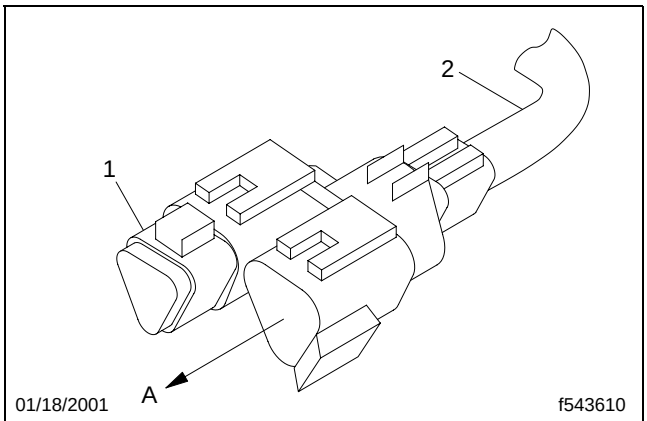


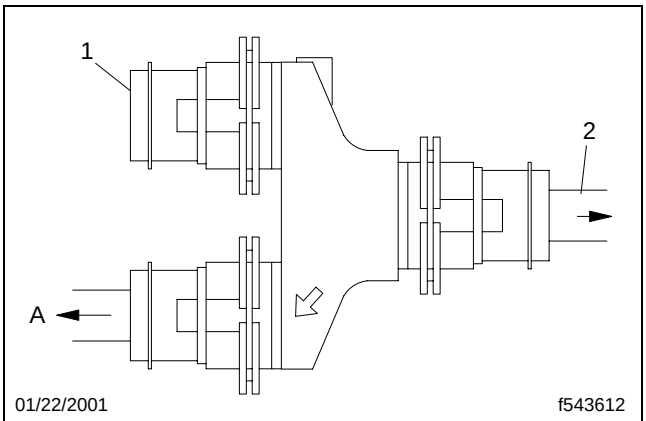
Fig. 6, Metripak Terminating Resistor



A. To ECU

1. Terminating Resistor
2. Backbone

Fig. 7, Deutsch Tee



A. To ECU

1. Terminating Resistor
2. Backbone

Fig. 8, ITT Cannon Tee

IMPORTANT: It is imperative that two terminating resistors are installed in the J1939 system. Numerous J1939 problems have been attributed to missing terminating resistors.

3.6 How are ECUs and terminating resistors connected to the datalink?

Methods used to connect ECUs and terminating resistors to the J1939 backbone include:

- Splice Packs—See **Fig. 9** for a typical splice pack.
- Deutsch Connectors—These are the standard connectors used on FCCC vehicles to connect ECUs and terminating resistors to the J1939 backbone. See **Fig. 10** and **Fig. 7**.
- Cannon Connectors—See **Fig. 11** and **Fig. 8** for Cannon connectors.

3.7 How do you tell the difference between J1939+ and 1939-?

Two types of J1939 datalink wiring are:

- J1939 "Heavy"—Found on FCCC vehicles, including XC, XCS, XCL, VCL and XB models, and in some OEM-supplied J1939 stubs. Heavy cable includes the yellow and green wires plus the shield.
- J1939 "Lite"—J1939 Lite includes the yellow and green wires but does not have a shield; the twisted pair is wrapped in a protective jacket.

Wire colors for the J1939 datalink are:

- Yellow—J1939+

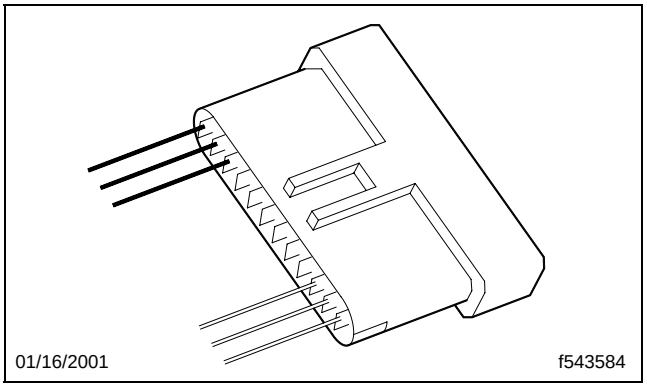


Fig. 9, Splice Pack

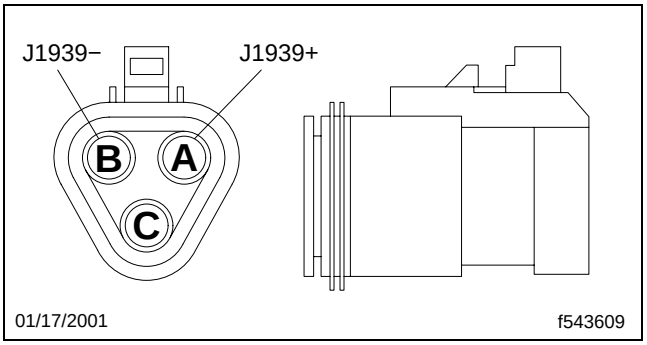


Fig. 10, Deutsch Connector

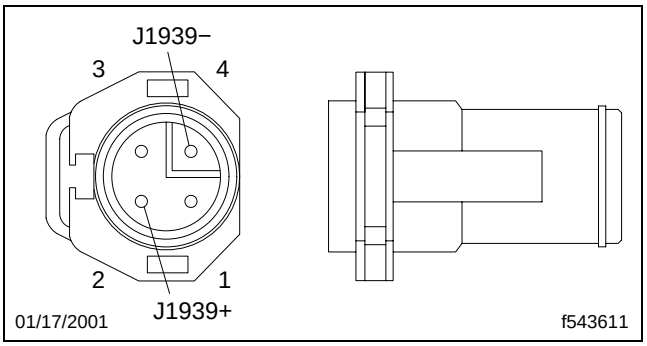


Fig. 11, ITT Cannon Connector

- Green—J1939-
- Shield—Used only with J1939 "Heavy" wiring

3.8 Which connector pins are J1939+ and J1939-?

Connectors:

- For any 2-pin connector
  - Pin A = J1939+
  - Pin B = J1939-
- For a 3-pin Deutsch connector
  - Pin A = J1939+
  - Pin B = J1939-
  - Pin C = Shield (If used, otherwise open)
- For a 4-pin Cannon connector
  - Pin 2 = J1939+
  - Pin 4 = J1939-

3.9 What is each pin in the diagnostic connector for?

See **Fig. 12** and **Table 12** for J1939 diagnostic connector pinouts.

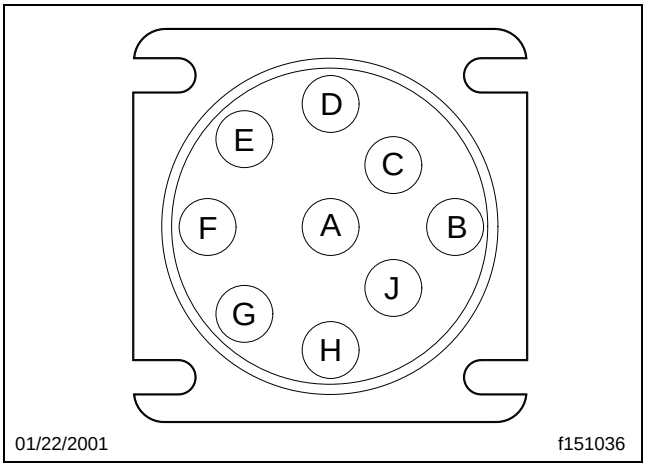


Fig. 12, J1939 Diagnostic Connector Pinouts (viewed looking toward the connector)

J1939 Diagnostic Connector Pinouts	
Pin	**Description**
A	Ground
B	Battery +12V

J1939 Diagnostic Connector Pinouts	
Pin	**Description**
C	J1939+
D	J1939-
E	J1939 Shield (only if heavy cable is used)
F	J1587+
G	J1587-
H	Not used
J	Not used

Table 12, J1939 Diagnostic Connector Pinouts

3.10 The pins are difficult to see; what can I do to make pinout measurements easier?

On some vehicles, it is difficult to see the pins in the diagnostic connector when testing. If so, use a "Y" cable as an extension to the diagnostic connector to make test measurements easier. See **Fig. 13** for a diagram of the connector at the end of the "Y" cable and its corresponding 9-pin diagnostic connector pins.

3.11 Can a vehicle have J1939 but not have a 9-pin diagnostic connector?

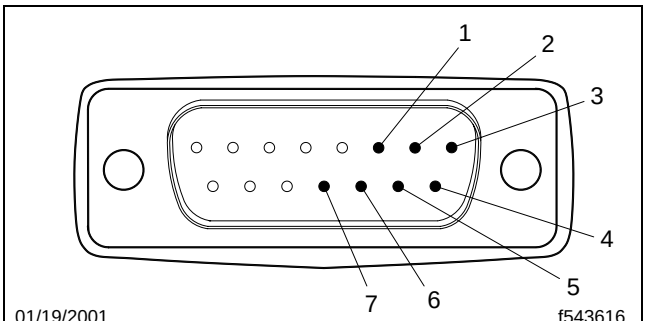
Most vehicles equipped with J1939 have a 9-pin diagnostic connector. There are two exceptions:

- Vehicles with early Autoshift transmissions, built during the last few months of 1998.
- Vehicle without components requiring J1939 but equipped with an engine programming stub as provided on all Cummins and some CAT engines.

3.12 Where can I find wiring diagrams for J1939?

Refer to installation drawings, harness assembly drawings, and wiring diagrams specific to the vehicle being worked on. Drawings for the J1939 datalink can usually be found in engineering Module 160, however, other modules specific to the particular components may also contain datalink wiring information. See **Table 13**.

NOTE: Use PartsPro to get a list of drawing numbers to assist in troubleshooting a specific vehicle.



1. Pin A
2. Pin E
3. Pin B
4. Pin F
5. Pin G
6. Pin C (J1939+)
7. Pin D (J1939-)

Fig. 13, "Y" Cable Pinouts

Component Module Locations	
Component	**Specification Location**
General J1939 harness drawings, schematics and installation drawings	Module 160
Engine harness and installation drawings	Modules 283 and 286
Transmission harness and installation drawings	Modules 34A and 343
ABS harness and installation drawings	Modules 330, 332 and 333
Eaton VORAD system	Module 736

Table 13, Component Module Locations

4.0 General Repair Procedures

This section contains general repair procedures for the J1939 backbone and branches.

4.1 Repair, Replace, Or Overlay?

While the J1939 backbone and its branches can be repaired, it is often preferable to simply replace the faulty section. It is up to the technician to decide depending upon the specific situation. If a repair to the backbone or a branch will take more than 20 minutes to complete, FCCC recommends that the faulty section be replaced.

In most vehicles, the J1939 backbone enters the cab through the front wall, runs through the dash, and over to the driver's side B-pillar. This makes it extremely difficult and time consuming to remove and replace the backbone. It is acceptable to overlay a new backbone without removing the original backbone from the vehicle.

The length of the individual branches can vary from as little as several inches to as much as 3 meters. Again, it will be up to the technician to decide whether to repair, replace, or overlay the faulty section.

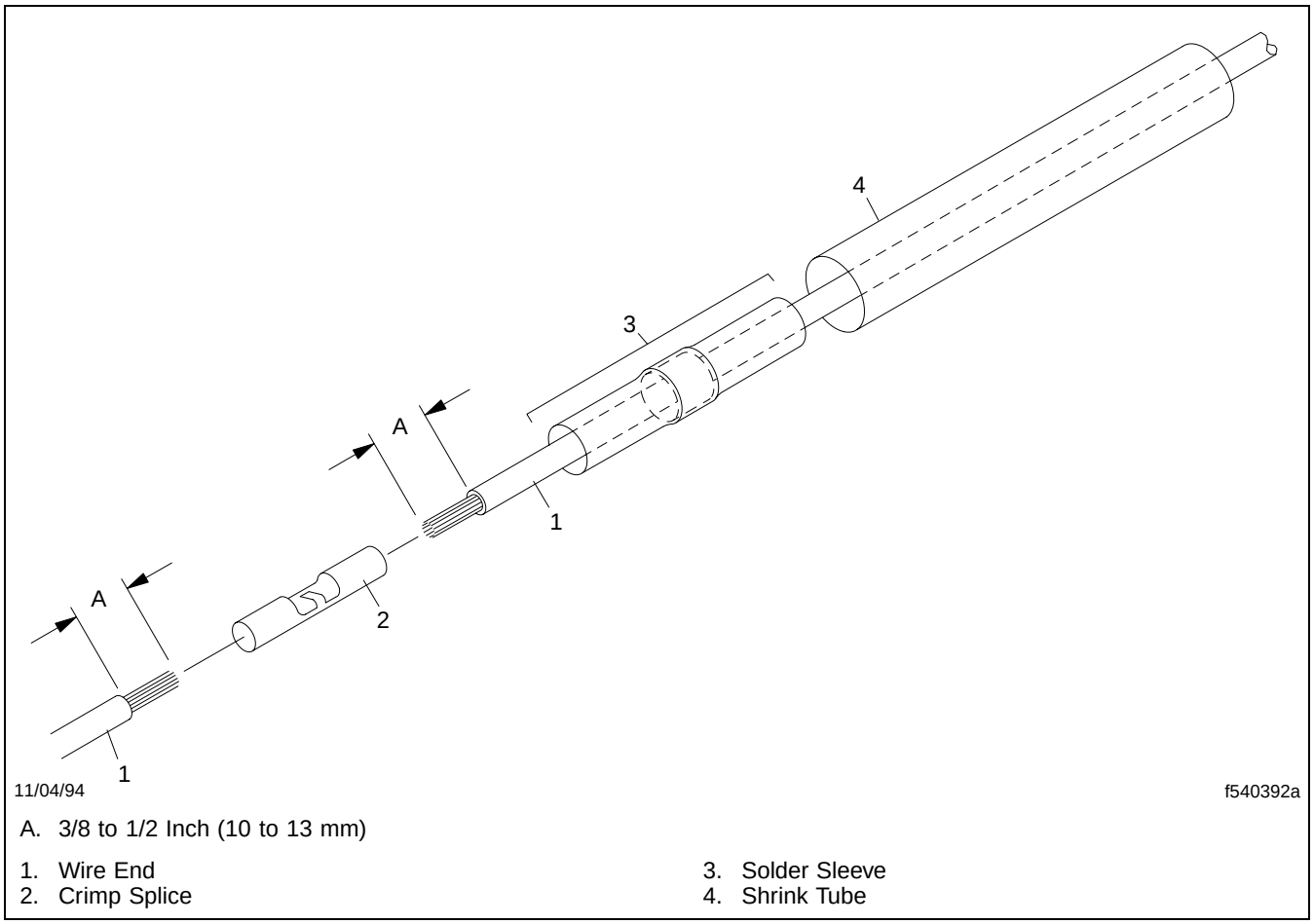
4.2 Repair Procedures

⚠ CAUTION

Use care when soldering connections inside the dash. Do not allow a hot soldering iron to contact other wires or components, as damage could occur. If you are unable to safely solder the connection, overlay the damaged harness with a new harness.

IMPORTANT: The following procedure is the only approved method of repairing broken wires on FCCC vehicles. This procedure (solder splicing) is done using solder repair kit ESYES66 404, and is for 14-or 16-gauge wire. Don't repair wire that is 12 gauge or larger; replace it.

1. Strip the ends of the wire to be repaired. Make sure the stripped ends are 3/8- to 1/2-inch (10- to 13-mm) long.
2. If repairing an exterior wire, slip a 3-inch (75-mm) long piece of shrink tube over one end of the wire. See **Fig. 14**.
3. Slip a solder sleeve from kit ESYES66 404 over one end of the wire. See **Fig. 14**.
4. Using a suitable crimp tool and a crimp splice from the kit, crimp the ends of the wire as follows (see **Fig. 15**):
   - 4.1 Insert a stripped wire end into the crimp splice until it touches the wire stop in the middle of the crimp splice.



A. 3/8 to 1/2 Inch (10 to 13 mm)

1. Wire End
2. Crimp Splice
3. Solder Sleeve
4. Shrink Tube

Fig. 14, Exterior Wire Repair

4.2 Center the crimping tool between the wire stop and the end of the crimp splice, then crimp the wire.

4.3 Repeat the two substeps above for the other wire end.

5. Check the crimp, making sure the crimping tool impression is on both ends of the crimp splice.
6. Slide the solder sleeve over the crimp splice so the solder ring is over the center of the crimp splice (see **Fig. 16**). Then apply 250°F (121°C) heat until the solder flows into the splice crimp, and the plastic sleeve has shrunk completely against the wire.
7. Slide the shrink tubing over the splice; then apply 250°F (121°C) heat to it until completely shrunk against the wire insulation. Some of the sealant material should be bubbling out from the ends of the shrink tube.

5.0 Warranty

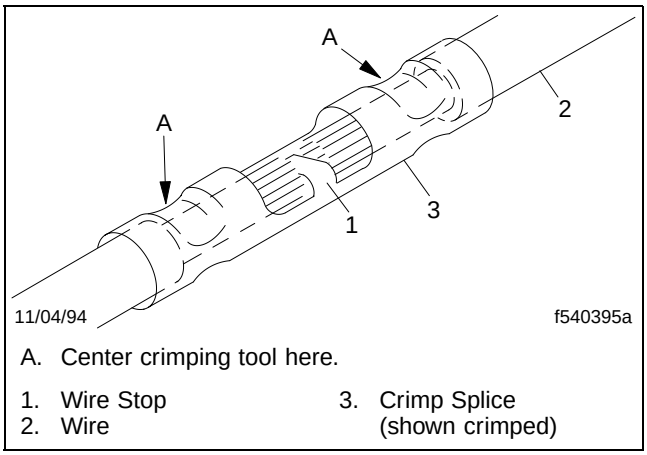
This is an informational bulletin only; warranty does not apply.

Attachment (Quick Reference Card, STI-434)

See attached Quick Reference Card, form STI-434, **1939 Diagnostics/Terms** and **J1939 Wiring/Connectors**.

Freightliner Custom Chassis
Service Bulletin

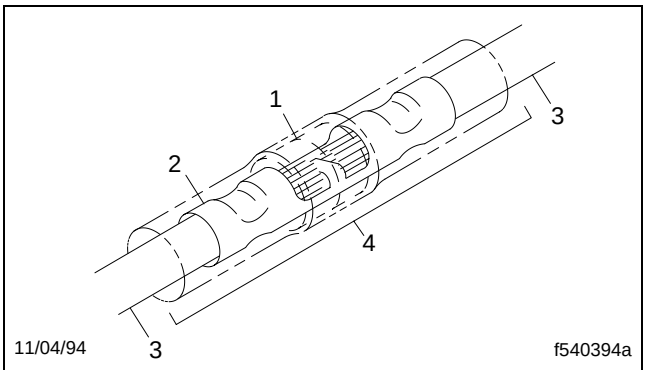
> Recreational Vehicle
> School Bus
> Shuttle Bus
> Walk-In Van



A. Center crimping tool here.

1. Wire Stop
2. Wire
3. Crimp Splice (shown crimped)

Fig. 15, Centering the Crimping Tool



1. Solder
2. Crimp Splice (shown crimped)
3. Wire
4. Solder Sleeve

Fig. 16, Wire Ready for Soldering

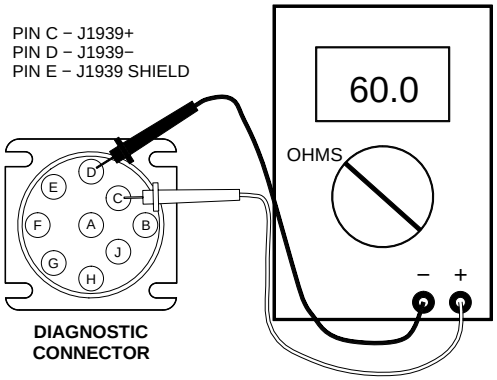
J1939 Diagnostics/Terms

J1939 Troubleshooting:

Note: If working on a vehicle equipped with an MBE900 engine, refer to Freightliner Service Bulletin 54−133 or Sterling Service Bulletin 54−16.

1. Turn the ignition off and disconnect the batteries.

2. Measure the J1939 resistance at the diagnostic connector pins C and D.



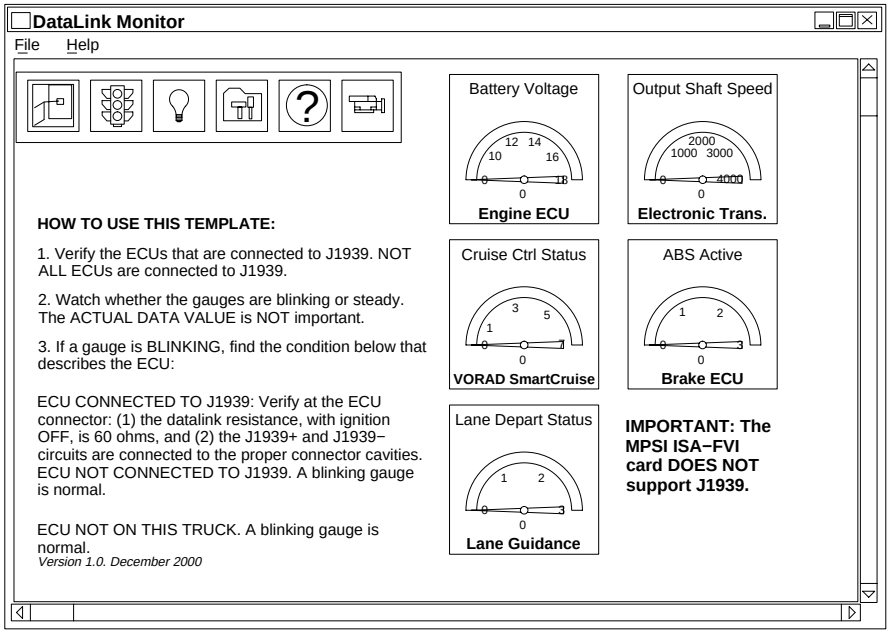
   If the resistance is 60±6Ω, reconnect the batteries and go to step 3.

   If the resistance is not 60Ω, check for:

   - 0Ω− J1939+ and J1939− shorted together
   - 40Ω− Too many terminating resistors (three)
   - 120Ω− Missing terminating resistor or open circuit in backbone
   - High Ohms − Both terminating resistors missing, or open between diagnostic connector and backbone

   Make repairs, reconnect the batteries and go to step 3 to verify function.

3. Check ECU communication on J1939 using the J1939 DataLink Monitor template. NOTE: The template is launched from ServiceLink. Follow the instructions on the template.



J1939 Terms:

J1939 DataLink− Differs from J1587 in that the data rate for J1939 is faster and the wiring network uses terminating resistors.

Terminating Resistors− All J1939 datalinks have two 120Ω terminating resistors, one at each end of the backbone. Total datalink parallel resistance is 60Ω.

Backbone− The portion of the J1939 datalink that runs continuously between the two terminating resistors.

Branch− The portion of the datalink that runs between the backbone and an ECU or the diagnostic connector.

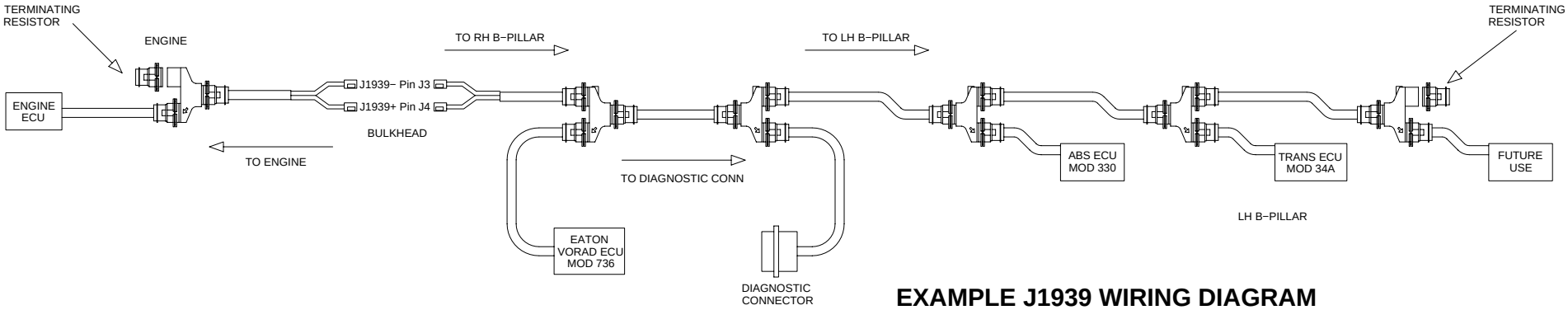
Connectors− Three types used: ITT Cannon, Deutsch, and Metripak.

Tee Connector/Splice Packs− Junctions where branch circuits and terminating resistors connect to the backbone of the datalink.

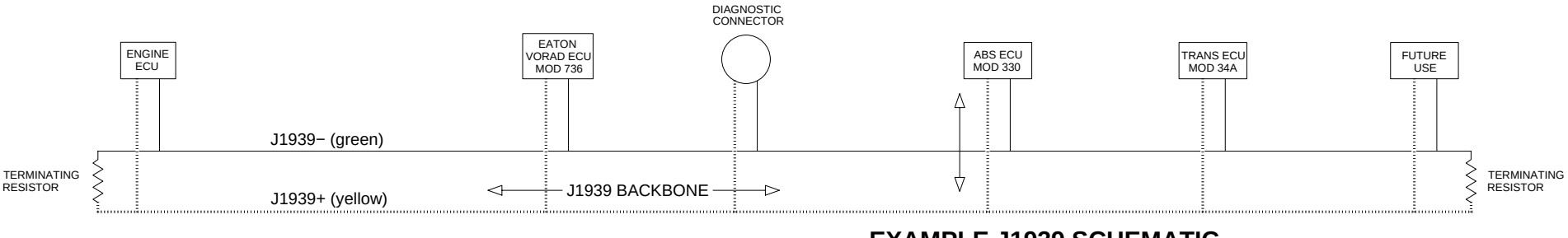
Diagnostic Connector− 9−pins for J1939.

J1939 DataLink Wiring−Yellow−J1939+, Green−J1939−, Shield (heavy cable only).

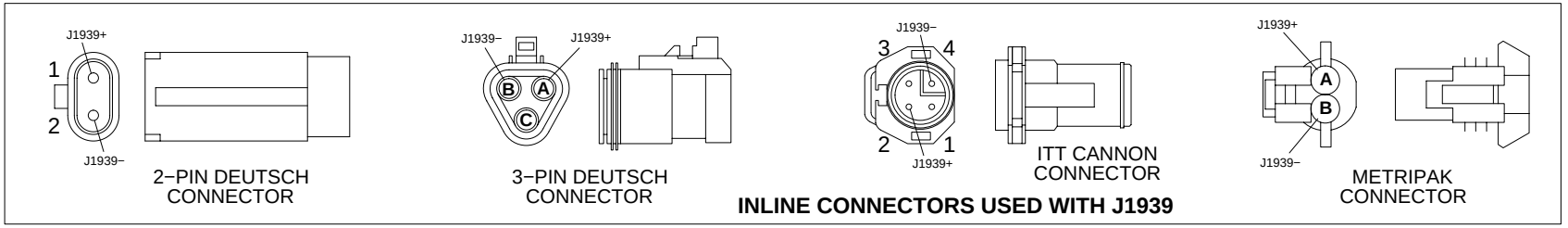
J1939 Wiring/Connectors



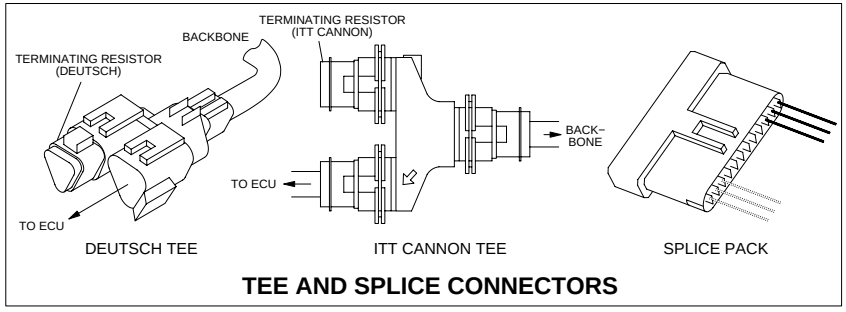
EXAMPLE J1939 WIRING DIAGRAM



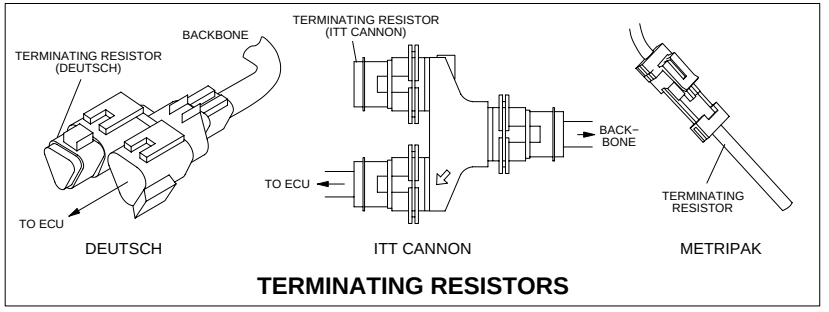
EXAMPLE J1939 SCHEMATIC



INLINE CONNECTORS USED WITH J1939



TEE AND SPLICE CONNECTORS



TERMINATING RESISTORS