General Information

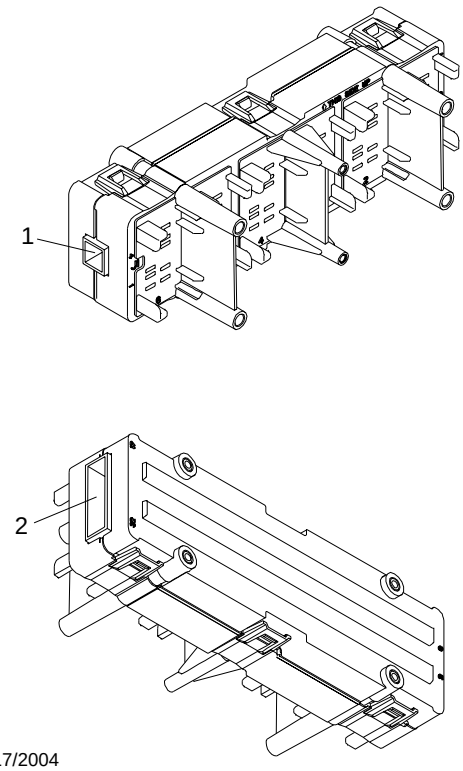
The Switch Expansion Module (SEM) is an optional module of the vehicle electrical system, and acts as a slave to the Bulkhead Module (BHM). An SEM is used on a vehicle to add smart switches when all smart switch locations on the vehicle are already in use, or when installing a smart switch in a location that existing smart switch harnesses or modules cannot access, such as overhead. The SEM does not control any outputs.

Since it is optional, there may be from zero to four SEMs on a vehicle. There can be up to six smart switches connected to each SEM. It has two harness connections, though both may not be used.

The SEM comes in two versions, dash-mounted (see **Fig. 1**) and remote-mounted (see **Fig. 2**). When dash-mounted, the smart switches may plug directly into the unit. When mounted remotely the smart switches must be plugged in through a harness connected to connector J2.

Both versions are supported by a single version of software.

The SEM communicates over only the SAE J1939 data bus; it has no J1708/J1587 communication.



1. Connector J1
2. Connector J2

Fig. 1, Dash-Mounted SEM

General Information

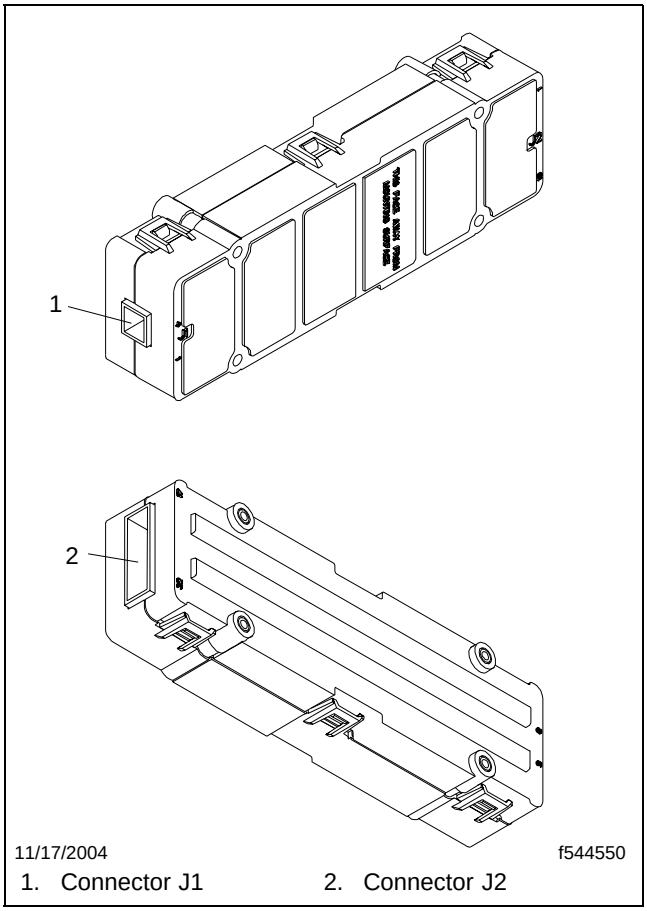


Fig. 2, Remote-Mounted SEM

SEM J1939 Source Address Claiming Scheme

Switch Expansion Modules (SEMs) on the J1939 data bus claim a J1939 "source address." The source address identifies the module and can be viewed using ServiceLink. See **Table 1** for a list of the possible SEM source addresses.

SEM J1939 Source Address Claiming Scheme	
Source Address	**SEM Number**
128	SEM #1
129	SEM #2
130	SEM #3
131	SEM #4

Table 1, SEM J1939 Source Address Claiming Scheme

Switch Expansion Modules on a vehicle are numbered SEM #1 through SEM #4 depending on the serial number of the SEM. The SEM with the lowest serial number (printed on a decal on the SEM casing) attempts to claim the lowest SEM source address, 128. Each additional SEM then claims a source address in similar fashion from low to high: the SEM with the next-highest serial number claims the next-highest source address (129), and so on until all SEMs have claimed a source address.

Once an SEM is installed and claims an address, it will store that as a preferred source address. Every time the vehicle is turned on after that, the SEM will attempt to re-use that preferred source address. This way, each SEM should appear in ServiceLink as the same SEM number (SEM #1 through SEM #4) each time ServiceLink is connected, regardless of whether an SEM is removed, or whether the physical locations of the SEMs on the vehicle have changed. The only exception is when an SEM with a lower serial number is added.

If a new SEM is installed that has a serial number lower than those already on the vehicle, the new SEM will claim the lowest source address (128) and bump up the source addresses of the other SEMs. The SEM that used to claim the source address of 128 must now claim 129, the SEM that used to claim 129 must now claim 130, and so on.

Invalid SEM (Unresponsive)

An SEM that has problems during flashing may no longer be able to claim an address in the proper way. Instead it will report on the J1939 data bus with a Source Address of 133, and appear in ServiceLink as an icon labeled "Invalid SEM (Unresponsive)." It will not report any make, model, or software ID. In this case, the technician can still access the Flashing tab and attempt to flash the SEM to recover it.

Locating the Correct SEM to Troubleshoot

To assist the technician in determining the specific SEM a given Smart Switch is connected to, ServiceLink has a "Smart Switches" tab, located under the SEM icon. There, the technician will find an "Identify SEM" button that can be used to briefly flash the indicator lights of a bank of Smart Switches connected to a specific SEM. This allows the technician to locate the correct SEM for troubleshooting Smart Switches.

Adding an SEM

After installing an SEM, turn the vehicle ignition to the ON position and connect to the vehicle using ServiceLink. Notice that the newly installed SEM appears in ServiceLink as a new SEM icon in the left side bar.

The following may be encountered in ServiceLink:

- If the new SEM's serial number is lower than those already on the vehicle, it claims Source Address 128 and appears as SEM #1.
- If the new SEM's serial number is higher than those already on the vehicle, it appears as the next SEM in numerical order. For example, if there are two SEMs already on the vehicle, appearing in ServiceLink as SEM #1 and SEM #2, the new SEM appears in ServiceLink as SEM #3.
- If the new SEM's serial number is between the serial numbers of SEMs already on the vehicle, the new SEM bumps up the 2nd SEM. The new SEM appears as SEM #2, and the SEM that used to be SEM #2 appears as SEM #3. Since SEM #1 still has the lowest serial number, it still appears as SEM #1.

ServiceLink Interaction

- If there are already four SEMs installed on the vehicle, the installation of a fifth SEM causes an icon to appear in ServiceLink labeled "Invalid ECU (duplicate) – Unable to claim address," since four is the maximum number of SEMs allowed on a vehicle. The fifth SEM should show a source address of 254.

To identify an SEM, go into the SEM's icon in ServiceLink. Click on the "Smart Switches" tab, and use the "Identify SEM" button to flash the indicator lights of the Smart Switches connected to that particular SEM. This makes it possible to locate the SEM, and to see which Smart Switches are connected to which SEM.

Removing an SEM

1. Connect to the vehicle in ServiceLink and take note of the icons that appear for the SEMs connected to the vehicle.
2. Remove the SEM.
3. Reconnect to the vehicle in ServiceLink and take note of the icons that appear for the SEMs connected to the vehicle.
4. The icon for the removed SEM should be gone, and none of the other SEMs still on the vehicle should change their order. For example, if there are three SEMs on a vehicle, appearing in ServiceLink as SEM #1, SEM #2, and SEM #3, and the 2nd SEM is removed, on reconnecting to the vehicle in ServiceLink the icons for SEM #1 and SEM #3 still appear, and the icon for SEM #2 is gone.

Replacing an SEM

1. After removing the old SEM, the expected behavior should be as described under the previous heading "Removing an SEM." However, if the SEM being removed was not appearing in ServiceLink, then no change should occur.
2. After installing the new SEM, the expected behavior should be as outlined in the previous section "Adding an SEM."
3. When in doubt, use ServiceLink to identify a particular SEM. See the heading titled "Adding an SEM."

Fault Codes

This subject contains information on all proprietary Switch Expansion Module (SEM) fault codes for J1939 data bus protocols. See **Table 1**.

Also included is a reference table of Failure Mode Identifiers (FMIs) for J1939 data bus protocols. See **Table 2**.

J1939 SPNs for Switch Expansion Module (SEM) SAs 128 through 131		
SPN	**SAE J1939 Description**	**Possible FMI**
2033	No CAN communication from BHM	19
6914	Smart Switch VBatt Short to Ground	04

Table 1, J1939 SPNs for Switch Expansion Module (SEM) SAs 128 through 131

Failure Mode Identifiers	
FMI	**SAE J1939 Description**
19	Received network data in error
04	Voltage below normal or shorted low

Table 2, Failure Mode Identifiers

Specifications

For an isometric view of the dash-mounted Switch Expansion Module (SEM), see **Fig. 1**. For an end view of the dash-mounted module connectors, see **Fig. 2**.

For an isometric view of the remote-mounted SEM, see **Fig. 3**. For an end view of the remote-mounted module connectors, see **Fig. 4**.

For SEM pinout definitions at connector J1, see **Table 1**.

For SEM pinout definitions at connector J2, see **Table 2**.

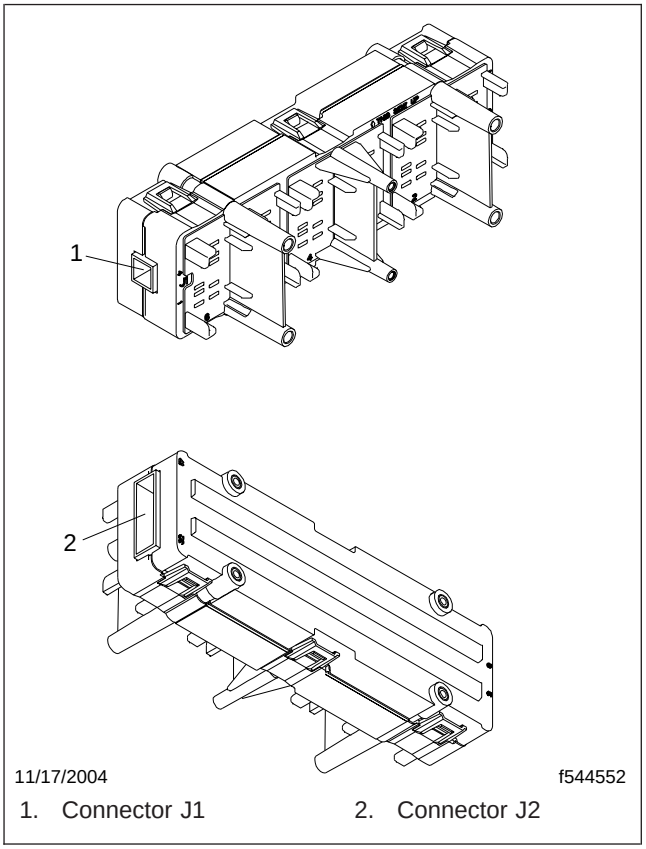


Fig. 1, Dash-Mounted SEM

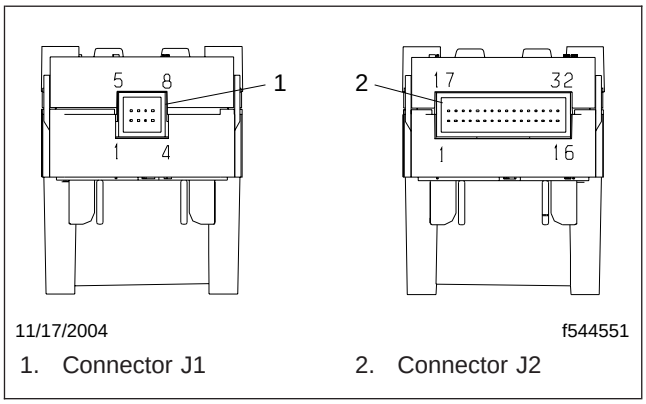


Fig. 2, Dash-Mounted SEM (end views, both ends)

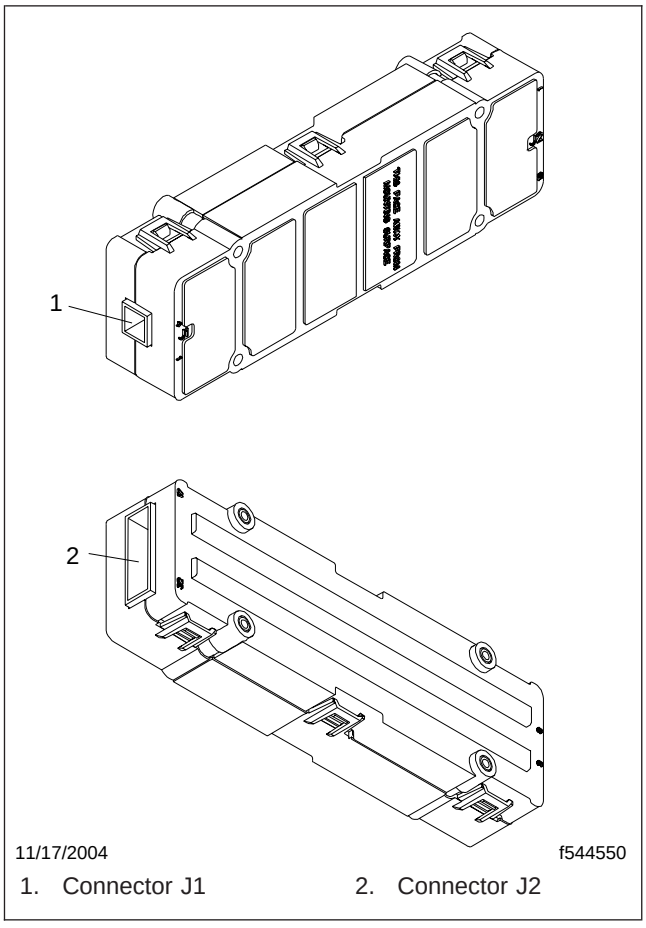


Fig. 3, Remote-Mounted SEM

Specifications

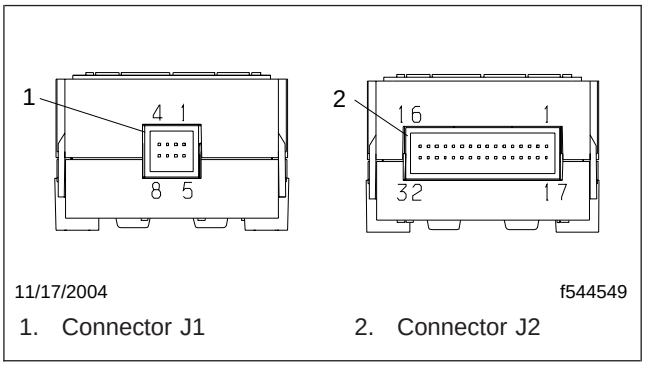


Fig. 4, Remote-Mounted SEM (end views, both ends)

SEM Pinout Definitions at Connector J1			
Connector Pin	**Signal Name**	**Type**	**Current: Amps**
J1-1	VBAT1 (unswitched power)	Power	1
J1-2	System Wakeup	Bi-Directional	—
J1-3	System Ignition	Input	—
J1-4	J1939– Data Bus	Comm	—
J1-5	GND	Ground	—
J1-6	GND	Ground	—
J1-7	GND	Ground	—
J1-8	J1939+ Data Bus	Comm	—

Table 1, SEM Pinout Definitions at Connector J1

SEM Pinout Definitions at Connector J2			
Connector Pin	**Signal Name**	**Type**	**Current: Amps**
J2-1	Smart Switch Ground	Signal Ground	—
J2-2	SS5 Indicator	Smart Switch LED Drive	—
J2-3	SS3 Indicator	Smart Switch LED Drive	—
J2-4	SS1 Indicator	Smart Switch LED Drive	—
J2-5	SS6 ID1	Smart Switch Analog Input	—
J2-6	SS5 ID2	Smart Switch Analog Input	—
J2-7	SS5 Switch Position	Smart Switch Analog Input	—
J2-8	Smart Switch Backlight	Smart Switch Backlight	0.2
J2-9	Smart Switch Vbat	Smart Switch Vbat	0.2
J2-10	SS4 ID2	Smart Switch Analog Input	—
J2-11	SS4 Switch Position	Smart Switch Analog Input	—
J2-12	SS3 ID1	Smart Switch Analog Input	—

SEM Pinout Definitions at Connector J2			
Connector Pin	**Signal Name**	**Type**	**Current: Amps**
J2-13	SS2 ID2	Smart Switch Analog Input	—
J2-14	SS2 Switch Position	Smart Switch Analog Input	—
J2-15	SS1 ID1	Smart Switch Analog Input	—
J2-16	Smart Switch Ground	Signal Ground	—
J2-17	Smart Switch Ground	Signal Ground	—
J2-18	SS6 Indicator	Smart Switch LED Drive	—
J2-19	SS4 Indicator	Smart Switch LED Drive	—
J2-20	SS2 Indicator	Smart Switch LED Drive	—
J2-21	SS6 ID2	Smart Switch Analog Input	—
J2-22	SS6 Switch Position	Smart Switch Analog Input	—
J2-23	SS5 ID1	Smart Switch Analog Input	—
J2-24	Smart Switch Ground	Signal Ground	—
J2-25	Smart Switch Ground	Signal Ground	—
J2-26	SS4 ID 1	Smart Switch Analog Input	—
J2-27	SS3 ID2	Smart Switch Analog Input	—
J2-28	SS3 Switch Position	Smart Switch Analog Input	—
J2-29	SS2 ID1	Smart Switch Analog Input	—
J2-30	SS1 ID2	Smart Switch Analog Input	—
J2-31	SS1 Switch Position	Smart Switch Analog Input	—
J2-32	Smart Switch Ground	Signal Ground	—

Table 2, SEM Pinout Definitions at Connector J2