



ANTI-LOCK BRAKE SYSTEM (ABS) AND AUTOMATIC TRACTION CONTROL, TORQTRAC 4™ (TT4™)

System Description

The ABS/TT4 is a hydraulic add-on system consisting of:

- Hydraulic modulator and pump assembly
- Electronic control unit
- Four wheel speed sensors
- ABS and TT4 warning lights

The add-on ABS/TT4 system is a four channel brake pressure modulation system fitted additional to the standard brake system. TT4 uses ABS and standard brake components to automatically control traction at the wheels when accelerating on low friction surfaces.

System Operation

ABS/TT4 system warning lights located in the status center of the instrument panel illuminate when there is a problem with the system. The lamps also illuminate during the initial key-on for a system self check and bulb test sequence. After key-on the ABS lamp will shine for approximately three seconds then go out and remain out unless there is a fault in the system or the ignition is cycled. The TT4 lamp will shine for three seconds then go out until there is a problem with the system (Figure 7-44). The TT4 lamp will flash during an overheat period due to extended continuous use. Whenever a lamp is lit due to a failure in the system, ABS and TT4 will be shut down partially or wholly, depending on the nature of the fault.

Anti-lock braking operates by continually sensing the speed of each wheel. Wheel speed information is transmitted to an Electronic Control Unit (ECU) which evaluates the information to determine when any wheel is about to lock. If locking commences, the ECU transmits a control signal to the appropriate solenoid valve in the modulator controlling hydraulic pressure to the brake, thus, brake pressure is adjusted to maintain wheel rotation.

The TorqTrac 4 system uses many of the same components as the ABS to control wheel spin when accelerating the vehicle on low friction surfaces. Information from the wheel speed sensors is evaluated by the ECU which determines if a wheel is losing traction and spinning. The ECU actuates the modulator pump to provide hydraulic pressure which is modulated by the solenoid valves and sent to the brake of the spinning wheel. This has the effect of transferring the torque to the non-spinning wheel on the higher friction surface. The system has an overheat protection feature which disables TT4 after 60 seconds of continuous use. This will be indicated by a blinking TT4 lamp. TT4 will automatically return to normal operation after a 60 second cool down period.

ABS/TT4 DIAGNOSTICS

Fault Diagnostic Procedure

Faults are stored in the ECU memory in code form. The information can be retrieved by initiating and reading a series of flash and pause sequences (blink codes) on the ABS warning light or with the Wabco Diagnostic Controller.

Use of the blink code procedure will determine the location of the fault prior to performing physical wiring and component tests, thus reducing diagnostic time.

NOTE: An attempt to initiate the blink code diagnostic may result in a solid “on” ABS warning lamp without progressing to the start phase of the diagnostic. If the above condition is present, remove the ABS Warning Lamp Relay from the exterior fuse box and perform the blink code diagnostic (See Figure 7-59). After repairs are completed, replace the warning lamp relay in the socket.

Blink Code Procedure

To initiate the blink code procedure, connect the blink code switch jumper J-44237 to the Diagnostic Link Connector (DLC) of the vehicle. The jumper allows you to short pin 4 to pin 15 of the DLC.

1. Switch on the ignition, the ABS warning light will illuminate and extinguish if there are no active faults.
2. Five seconds after connecting the switch jumper, the ABS warning light will extinguish, indicating the start of the blink code cycle.

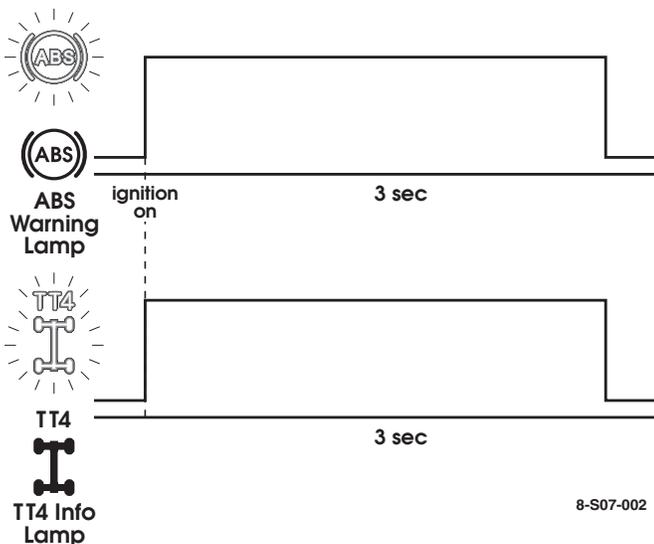


Figure 7-44: ABS/TT4 Warning Light Sequence.



3. The *start phase* consists of the ABS warning light flashing in the following sequence (Figure 7-45):
 - Pause = 2.5 seconds (long)
 - Flash = 2.5 seconds (long)
 - Pause = 2.5 seconds (long)
 - Flash = 0.5 seconds (short)

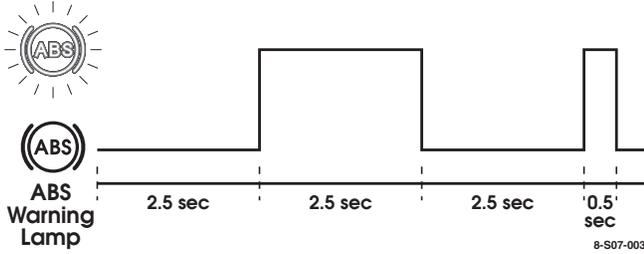


Figure 7-45: Blink Code Sequence For Start Phase.

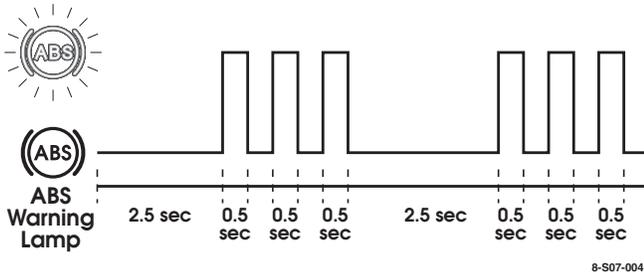


Figure 7-46: Blink Code Sequence For Code 3.3.

Fault Code List - Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
2-0	ECU internal failure.	-	-	Replace ECU.
2-1	ECU internal failure.	-	-	Replace ECU.
2-2	Recirculating Pump (RCP) operates continuously.	11 and 27 30 and 27	0 volts	Check the RCP wiring, the pump relay and the wiring connections. Repair or replace as required.
2-2	RCP does not operate.	9 and 11 27 and 30	Ignition "ON" approximate battery + voltage.	Check the RCP wiring, the pump relay and fuse and pump connections. Repair or replace as required.
2-4	RCP failure (motor locked).	9, 11 and 12	Ignition "ON" motor running.	Excessive current failure. If pump does not run with pins linked, replace modulator.

4. The *first part* of the code number (Figure 7-46): A pause of 2.5 seconds precedes a series of short flashes. Count the flashes until the next long pause occurs. The number of short flashes obtained is the first part of the code number.
5. The *second part* of the code number: A pause of 2.5 seconds occurs between the first and second parts, before a series of short flashes occurs. The number of short flashes forms the second part of the code number.
6. The sequence of the *start phase, first and second parts* will continue until the switch jumper is deactivated.

NOTE: If you are unsure of the code, do not deactivate the switch jumper from the DLC because the code for that fault will be cleared from the memory.

7. The memory is capable of storing more than one fault. To search the memory, reconnect the switch jumper and await the next start phase.
8. Repeat the procedure until no further faults are stored in the memory. The memory is cleared when a long pause of 7.5 seconds occurs after the start phase.

Clearing Fault Codes

At the end of a fault code cycle, deactivate the blink code jumper. The fault code will cycle one more time before the lamp remains on solid. Turn off the ignition and the fault code will be cleared from memory.

The fault codes, their causes and repair actions are listed in the following table.



Fault Code List - Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
2-6	Shuttle valve switch failure.	25 and 27	Brake pedal at rest 3k Ω . Brake pedal 1/2 down 2k Ω . Brake pedal full down 1k Ω .	If wiring and connections OK, replace modulator.
2-7	Continuous power to ECU with ignition "OFF".	9 and 27	0 volts. Less than 0.2 Ω to chassis ground.	Check for proper wiring connections, repair as necessary.
2-8	No voltage to ABS solenoid valves.	19 and 27 1 and 27 9 and 27 Link 8 and 9	Ignition "ON" approximate battery + voltage.	Check the valve relay, fuse and wiring. Repair as necessary.
2-9	Inlet valve supervision time exceeded.	-	-	Check voltage for normal function. Clear fault.
2-10	Reference ground interrupted.	31	Less than 0.2 Ω to chassis ground.	Repair wiring or connection as necessary.
2-11	Excessive recirculation pump cycle time.	Ignition "ON" link 9, 11 and 12	-	Check RCP function. Clear fault.
2-12 2-13 2-14 2-15	RF sensor weak LR sensor weak LF sensor weak RR sensor weak	17 and 34 18 and 35 15 and 32 16 and 33	Greater than 0.9 volts AC at one tire revolution per second.	Check sensor adjustment. Check geared hub bearing play at halfshaft. Adjust or repair as necessary.
3-0	Open circuit between ECU and right front inlet solenoid valve or wiring.	6 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-1	Open circuit between ECU and right front outlet solenoid valve or wiring.	7 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-2	Open circuit between ECU and left front inlet solenoid valve or wiring.	23 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
3-3	Open circuit between ECU and left front outlet solenoid valve or wiring.	24 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-4	Open circuit between ECU and right rear inlet solenoid valve or wiring.	4 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-5	Open circuit between ECU and right rear outlet solenoid valve or wiring.	5 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-6	Open circuit between ECU and left rear inlet solenoid valve or wiring.	21 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-7	Open circuit between ECU and left rear outlet solenoid valve or wiring.	22 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at the ECU connector and at the modulator connector. Repair wiring or replace modulator as necessary.
3-8	Open circuit between ECU and RCP relay 1.	11 and 27 30 and 27	Ignition "ON" approximate battery + voltage.	If pump does not run, check wiring from pin 11.
3-9	Open circuit between ECU and RCP relay 2.	12 and 27	Ignition "ON" approximate battery + voltage.	If pump does not run, check wiring from pin 12.
4-0	Short circuit to ground between ECU and right front inlet solenoid valve.	6 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-1	Short circuit to ground between ECU and right front outlet solenoid valve.	7 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
4-2	Short circuit to ground between ECU and left front inlet solenoid valve.	23 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-3	Short circuit to ground between ECU and left front outlet solenoid valve.	24 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-4	Short circuit to ground between ECU and right rear inlet solenoid valve.	4 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-5	Short circuit to ground between ECU and right rear outlet solenoid valve.	5 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-6	Short circuit to ground between ECU and left rear inlet solenoid valve.	21 and 27	5.0-7.5 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-7	Short circuit to ground between ECU and left rear outlet solenoid valve.	22 and 27	3.0-5.0 Ω	Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly as necessary.
4-8	Short circuit to ground between ECU and RCP relay 1.	11 or 30 and 27	Open circuit	Check wiring to pump relay and pump connector through pump. Repair wiring or replace modulator as necessary.
4-9	Short circuit to ground between ECU and RCP relay 2.	12 and 27	Open circuit	Check wiring to pump relay and pump connector through pump. Repair wiring or replace modulator as necessary.
4-12	Right front wheel speed sensor open circuit.	17 and 34	500-2000 Ω	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair wiring or replace sensor as necessary.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
4-13	Left rear wheel speed sensor open circuit.	18 and 35	500-2000 Ω	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair wiring or replace sensor as necessary.
4-14	Left front wheel speed sensor open circuit.	15 and 32	500-2000 Ω	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair wiring or replace sensor as necessary.
4-15	Right rear wheel speed sensor open circuit.	16 and 33	500-2000 Ω	Check electrical resistance of affected sensor and wiring at ECU connector and at harness plugs. Repair wiring or replace sensor as necessary.
5-0	Short circuit to battery between ECU and right front inlet valve solenoid or wiring.	6 and 27	0 volts 5.0-7.5 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-1	Short circuit to battery between ECU and right front outlet valve solenoid or wiring.	7 and 27	0 volts 3.0-5.0 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-2	Short circuit to battery between ECU and left front inlet valve solenoid or wiring.	23 and 27	0 volts 5.0-7.5 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-3	Short circuit to battery between ECU and left front outlet valve solenoid or wiring.	24 and 27	0 volts 3.0-5.0 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-4	Short circuit to battery between ECU and right rear inlet valve solenoid or wiring.	4 and 27	0 volts 5.0-7.5 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
5-5	Short circuit to battery between ECU and right rear outlet valve solenoid or wiring.	5 and 27	0 volts 3.0-5.0 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-6	Short circuit to battery between ECU and left rear inlet valve solenoid or wiring.	21 and 27	0 volts 5.0-7.5 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-7	Short circuit to battery between ECU and left rear outlet valve solenoid or wiring.	22 and 27	0 volts 3.0-5.0 Ω	Check voltages at wiring harness including connectors. Check electrical resistance of affected valve wiring to ground at ECU connector and at modulator assembly plug. Repair wiring or replace as necessary.
5-8	Short circuit to battery + between ECU and RCP relay 1.	11 and 27	0 volts	Check wiring harness between ECU and relay and pump ground connections. Repair wiring as necessary.
5-9	Short circuit to battery + between ECU and RCP relay 2.	12 and 27	0 volts	Check wiring harness between ECU and relay and pump ground connections. Repair wiring as necessary.
5-12	Right front wheel speed signal is erratic.	17 and 34	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
5-13	Left rear wheel speed signal is erratic.	18 and 35	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
5-14	Left front wheel speed signal is erratic.	15 and 32	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
5-15	Right rear wheel speed signal is erratic.	16 and 33	Greater than 0.9 volts AC at one tire revolution per second	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
6-0	Short circuit between two solenoid valve leads of right front inlet solenoid valve.	6 and 4, 5, 7, 21, 22, 23, 24	5.0-7.5 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-1	Short circuit between two solenoid valve leads of right front outlet solenoid valve.	7 and 4, 5, 6, 21, 22, 23, 24	3.0-5.0 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-2	Short circuit between two solenoid valve leads of left front inlet solenoid valve.	23 and 4, 5, 6, 7, 21, 22, 24	5.0-7.5 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-3	Short circuit between two solenoid valve leads of right front outlet solenoid valve.	24 and 4, 5, 6, 7, 21, 22, 23	3.0-5.0 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-4	Short circuit between two solenoid valve leads of right rear inlet solenoid valve.	4 and 5, 6, 7, 21, 22, 23, 24	5.0-7.5 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-5	Short circuit between two solenoid valve leads of right rear outlet solenoid valve.	5 and 4, 6, 7, 21, 22, 23, 24	3.0-5.0 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.



Fault Code List
Ignition key "OFF" to test system (except where noted)

Fault Code	Problem Area	Test Pin Locations	Values	Check/Repair
6-6	Short circuit between two solenoid valve leads of left rear inlet solenoid valve.	21 and 4, 5, 6, 7, 22, 23, 24	5.0-7.5 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-7	Short circuit between two solenoid valve leads of left rear outlet solenoid valve.	22 and 4, 5, 6, 7, 21, 23, 24	3.0-5.0 Ω	Check electrical resistance of affected valves and wiring at ECU connector and at modulator assembly plug. Repair or replace wiring as necessary and replace modulator if short is internal. Note: Fault code for both affected valves will be stored in memory.
6-8	Short circuit between solenoid valve and RCP relay 1.	11 and 4, 5, 6, 7, 21, 22, 23, 24	Open circuit	Check wiring harness at ECU connector to pump relay. Repair or replace as necessary.
6-9	Short circuit between solenoid valve and RCP relay 2.	12 and 4, 5, 6, 7, 21, 22, 23, 24	Open circuit	Check wiring harness at ECU connector to pump relay. Repair or replace as necessary.
6-12	Right front wheel speed signal missing.	17 and 34	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
6-13	Left rear wheel speed signal missing.	18 and 35	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
6-14	Left front wheel speed signal missing.	15 and 32	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.
6-15	Right rear wheel speed signal missing.	16 and 33	Greater than 0.9 volts AC at one tire revolution per second.	Check for damaged tone wheel, incorrect sensor adjustment, excessive tone wheel runnout (> .041"), excessive geared hub input bearing play and tire size mismatch. Repair or replace as necessary.

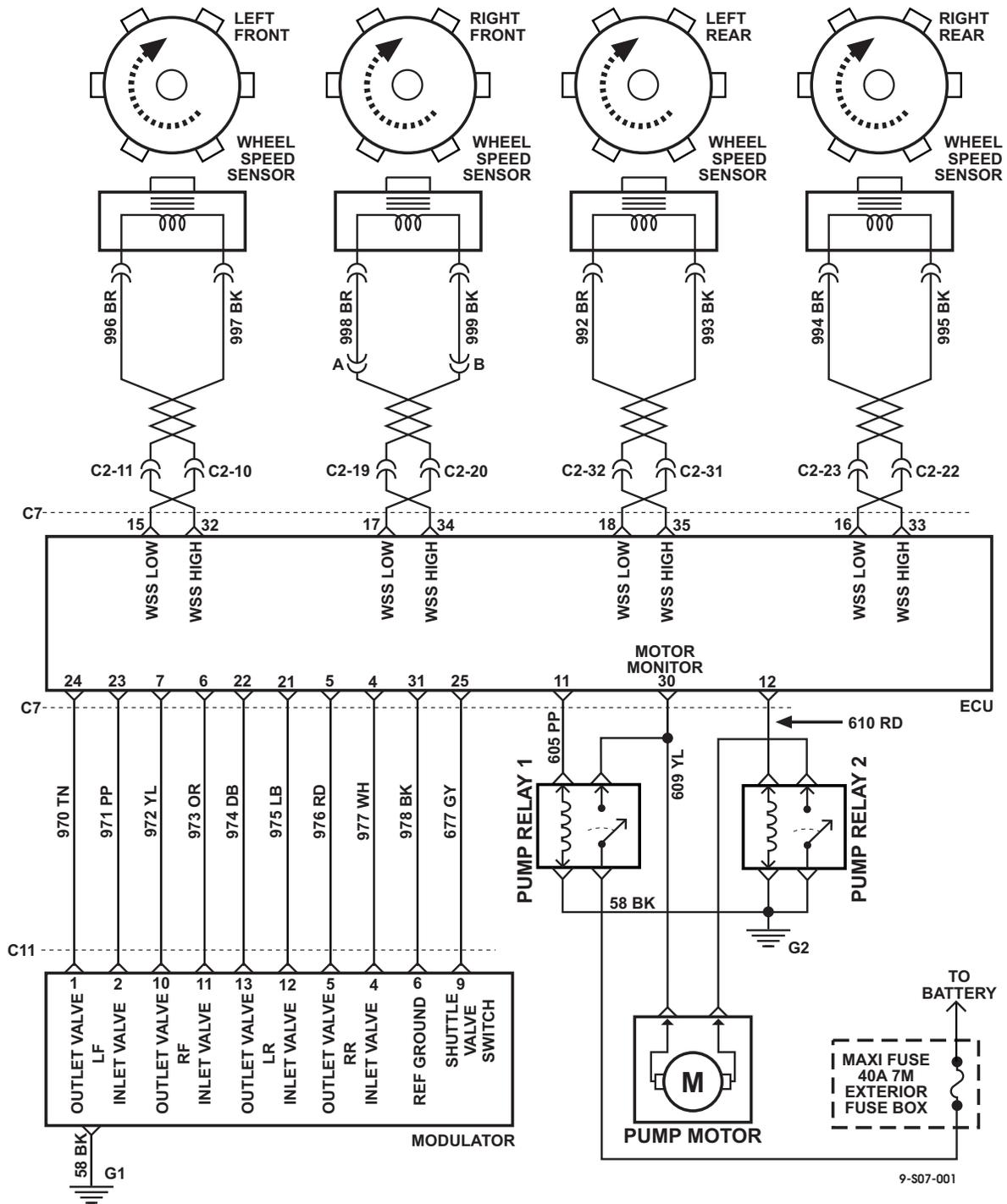


Figure 7-47: ABS/TT4 Main System Diagram.

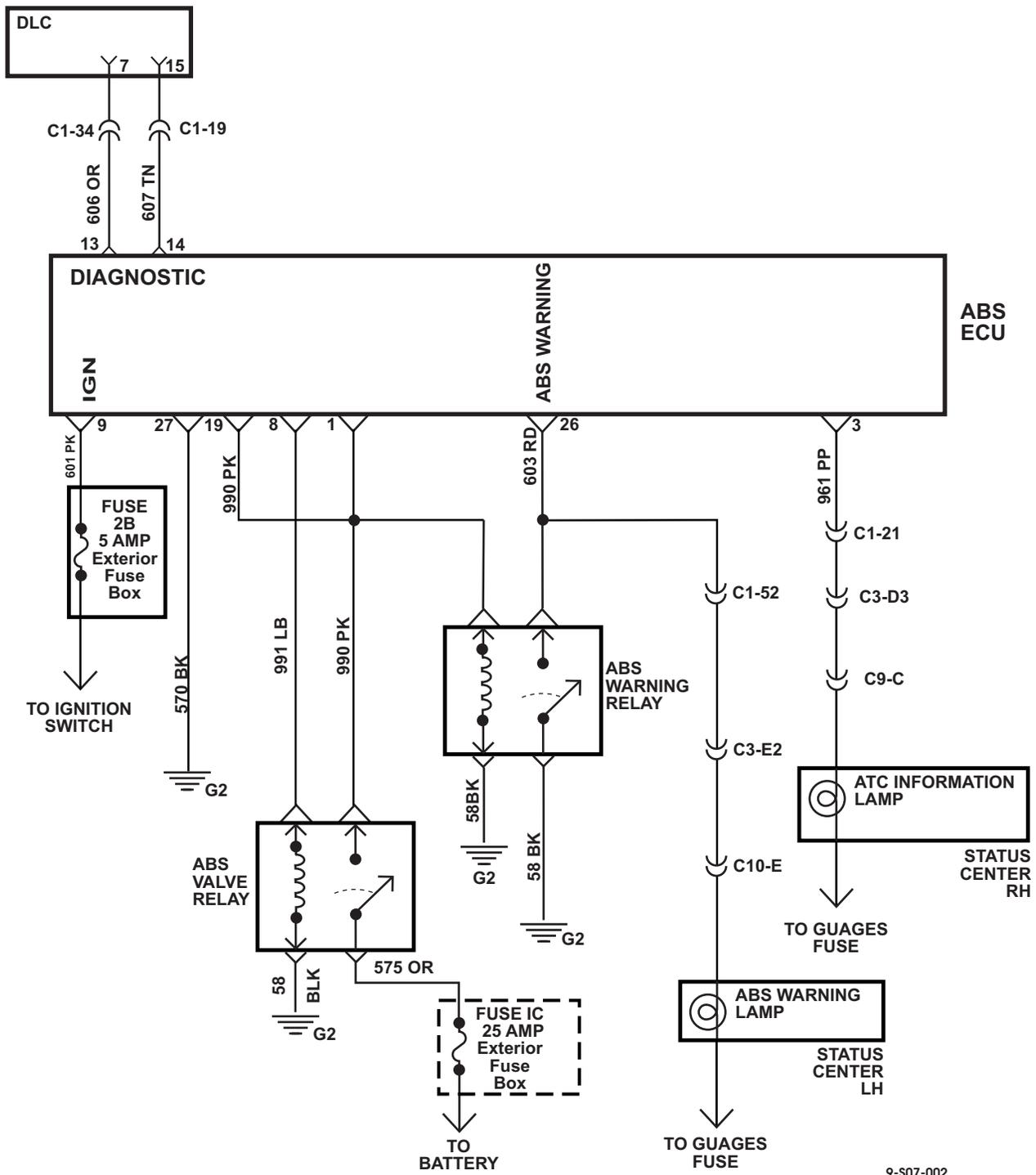


Figure 7-48: ABS/TT4 Power, Ground and Warning Lamp Circuit.



C7 FEMALE ONLY

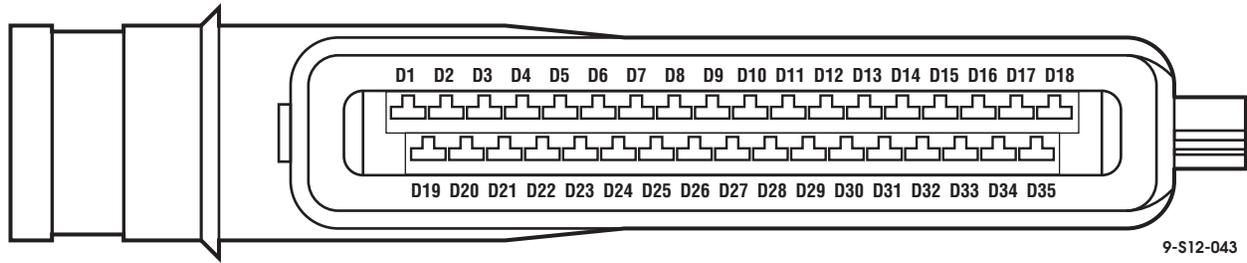


Figure 7-49: 35 Pin ECU Connector Female Half

PIN	CKT	COLOR	DESCRIPTION
1	990	PK	ABS valve relay input
3	961	PP	TT4 lamp activation
4	977	WH	Right rear inlet valve activation
5	976	RD	Right rear outlet valve activation
6	973	OR	Right front inlet valve activation
7	972	YL	Right front outlet valve activation
8	991	LB	ABS valve relay activation
9	601	PK	Ignition feed
11	605	PP	Positive pump relay activation
12	610	RD	Negative pump relay activation
13	606	OR	Diagnostic line
14	607	TN	Diagnostic line
15	997	BK	Left front wheel speed sensor low
16	995	BK	Right rear wheel speed sensor low
17	999	BK	Right front wheel speed sensor low
18	993	BK	Left rear wheel speed sensor low
19	990	PK	ABS valve relay redundant input
21	975	LB	Left rear inlet valve activation
22	974	DB	Left rear outlet valve activation
23	971	PP	Left front inlet valve activation
24	970	TN	Left front outlet valve activation



PIN	CKT	COLOR	DESCRIPTION
25	677	GY	Shuttle valve switch signal
26	603	DG	ABS warning lamp activation
27	570	BK	Ground
30	609	YL	Pump motor monitor
31	978	BK	Reference ground
32	996	BR	Left front wheel speed sensor high
33	994	BR	Right rear wheel speed sensor high
34	998	BR	Right front wheel speed sensor high
35	992	BR	Left rear wheel speed sensor high

C11 FEMALE ONLY

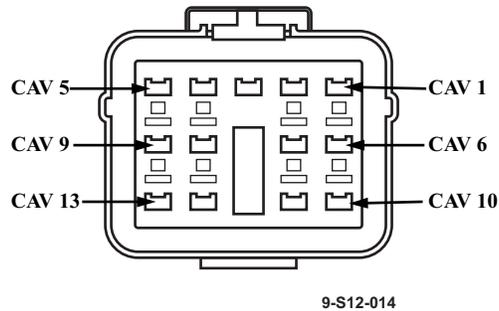


Figure 7-50: 13 Pin Modulator Connector Female Half

PIN	CKT	COLOR	DESCRIPTION
1	970	TN	Left front outlet valve activation
2	971	PP	Left front inlet valve activation
4	977	WH	Right rear inlet valve activation
5	976	RD	Right rear outlet valve activation
6	978	BK	Reference ground
9	677	GY	Shuttle valve switch signal
10	972	YL	Right front outlet valve activation
11	973	OR	Right front inlet valve activation
12	975	LB	Left rear inlet valve activation
13	974	DB	Left rear outlet valve activation



C2 MALE

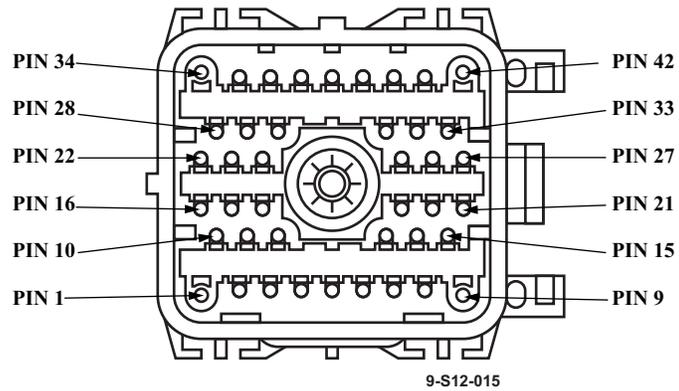


Figure 7-51: 42 Pin Underbody Connector Male Half

C2 FEMALE

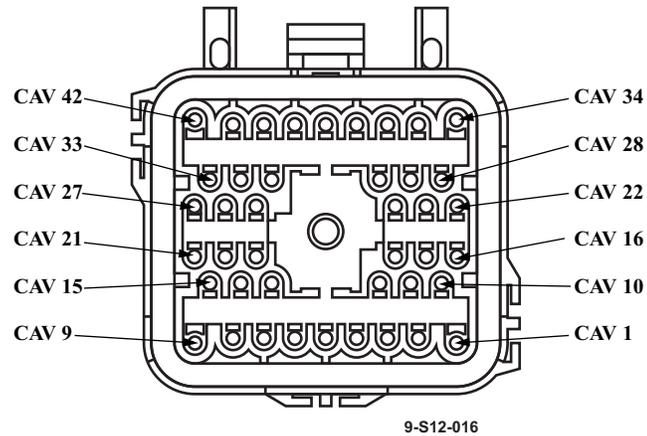


Figure 7-52: 42 Pin Underbody Connector Female Half

PIN	CKT	COLOR	DESCRIPTION
10	996	BR	Left front wheel speed sensor low signal
11	997	BK	Left front wheel speed sensor high signal
19	999	BK	Right front wheel speed sensor high signal
20	998	BR	Right front wheel speed sensor low signal
22	994	BR	Right rear wheel speed sensor low signal
23	995	BK	Right rear wheel speed sensor high signal
31	992	BR	Left rear wheel speed sensor low signal
32	993	BK	Left rear wheel speed sensor high signal



ABS MODULATOR REPLACEMENT

Removal

WARNING: Batteries must be disconnected when the brake hydraulic system is being serviced and bled. If the ABS motor pump runs when air is in the hydraulic system, air can get trapped behind the valves in the modulator causing a spongy brake pedal.

1. Disconnect the batteries.
2. Remove the left front splash shield.
3. Remove the horn bracket and horns (Figure 7-53).

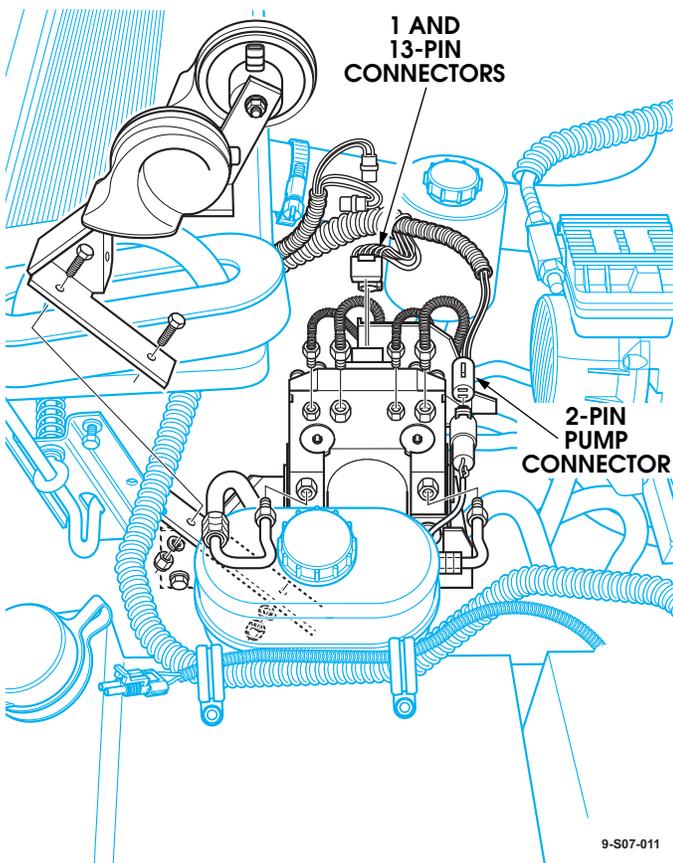
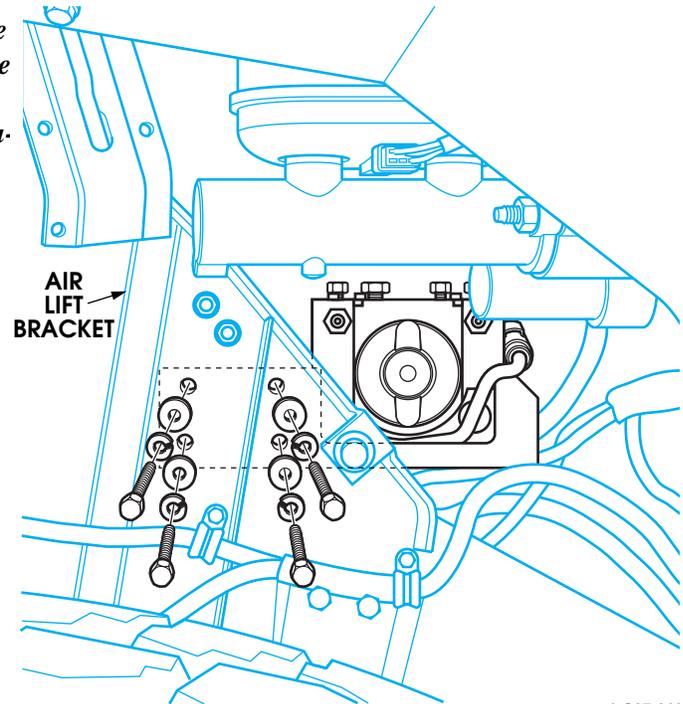


Figure 7-53: Brake Line And Wire Connections

4. Remove the thirteen-pin, the two-pin and the one-pin wire connectors from the modulator assembly.
5. Remove the master cylinder brake hoses at the modulator and cap off (note the position of the lines in the modulator for installation).
6. Remove the four wheel brake lines from the modulator and cap off (note the position of the lines in the modulator for installation).
7. Remove the “P” clamp securing the oil cooler lines to the modulator mounting bracket.

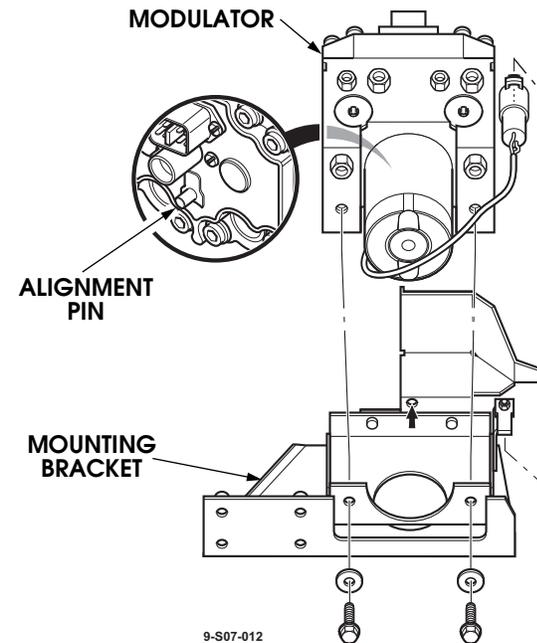
8. Remove the four bolts, washers and lock washers securing the modulator bracket to the air lift bracket (Figure 7-54).



9-S07-01C

Figure 7-54: Modulator and Bracket Assembly-Mounting

9. Remove the modulator, mounting bracket and shield from the vehicle.
10. Remove the motor pump wire connector from the modulator bracket and the two bolts securing the modulator to the bracket.



9-S07-012

Figure 7-55: Modulator Mounting



11. Disengage the modulator alignment pin from the mounting bracket and remove the modulator from the mounting bracket.
12. Remove the brake line adapters, noting the position for reinstallation

Installation

1. Install the brake line adapters in the same position as in the original modulator. Torque the 12 mm threaded adapter to 11 lb-ft (15 N•m) and the 10 mm adapter to 9 lb-ft (12 N•m).
2. Place the modulator alignment pin in the hole in the mounting bracket, install the two mount bolts and torque to 5 lb-ft (7 N•m).
3. Connect the motor pump wire connector to the mounting bracket and install the assembly on the left air lift bracket with four bolts, washers and lock washers. Torque the bolts to 28 lb-ft (38N•m).
4. Connect the four wheel brake lines in their respective positions on the modulator and torque to 11 lb-ft (15 N•m).
5. Connect the master cylinder hoses in their respective positions on the modulator and torque to 11 lb-ft (15 N•m).
6. Connect the thirteen-pin, the two-pin and the one-pin wire connectors to the modulator assembly.
7. Install the horn bracket and horns.
8. Install the left front splash shield.
9. Bleed the complete brake system.
10. Connect the batteries.

SPEED SENSOR REPLACEMENT

NOTE: The procedure for speed sensor replacement is basically the same for all four wheel ends.

WARNING: Connect speed sensors to the proper harness connectors. Connecting speed sensors to incorrect harness connectors can cause the ABS/TT4 to malfunction.

Removal

1. Rotate and pull the speed sensor head from the speed sensor mounting bracket and retaining sleeve (Figure 7-56).
2. Remove and discard the speed sensor retaining sleeve.

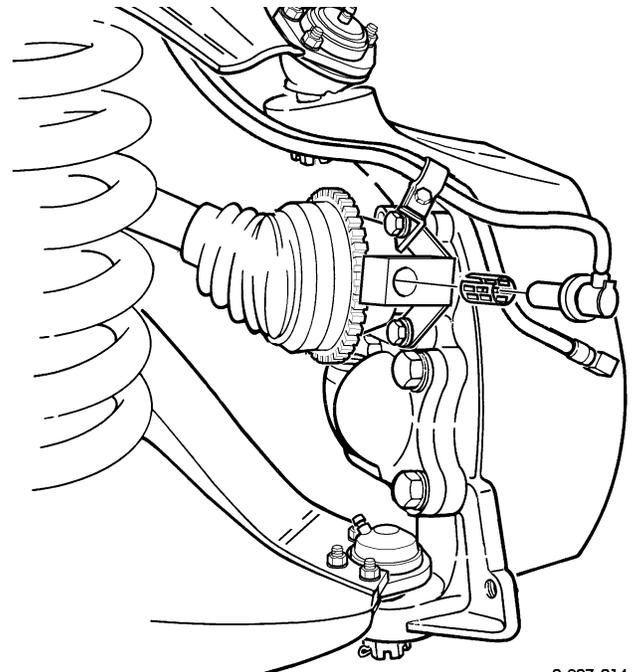


Figure 7-56: Speed Sensor Removal

3. Remove the speed sensor connector from the retaining clip near the top of the upper A-arm and disconnect the speed sensor lead from the speed sensor harness (Figure 7-57).
4. Remove the capscrews and clips securing the speed sensor lead to the A-arm and geared hub, and remove the sensor from the vehicle.

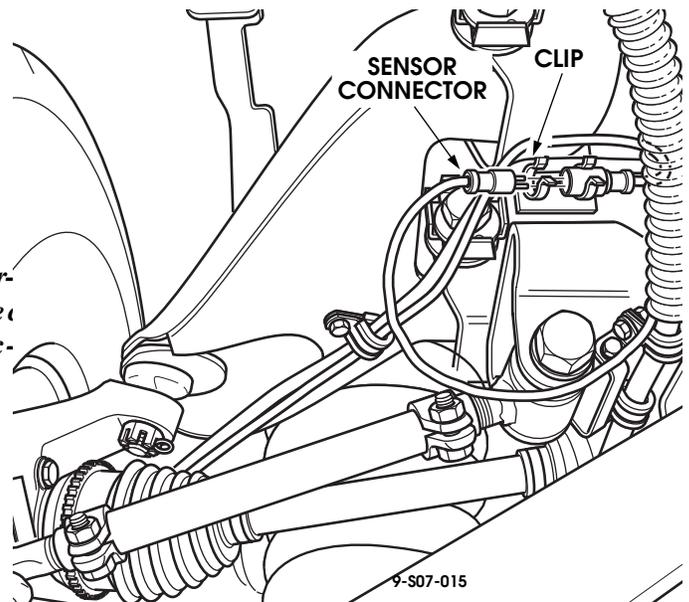


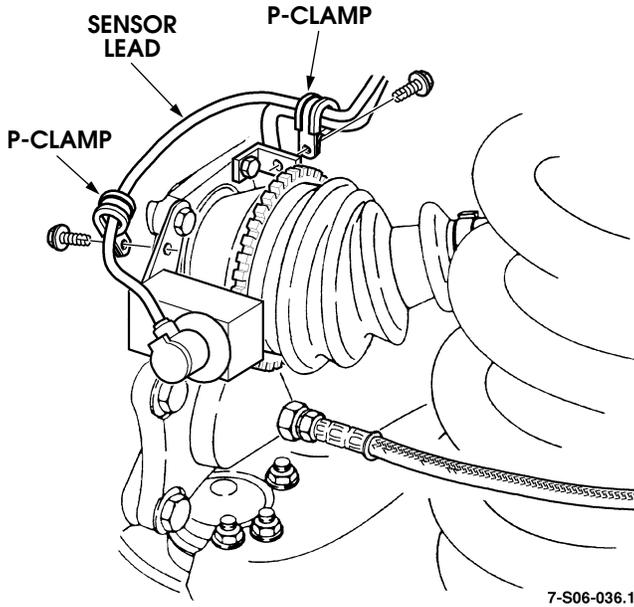
Figure 7-57: Speed Sensor Connection



Installation

NOTE: Left side speed sensor leads route across above the halfshaft cv-joint. Care must be taken to ensure the lead does not come in contact with the cv-joint.

1. Clean all grease, rust and debris from the speed sensor cavity in the speed sensor mounting bracket.



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Figure 7-58: Left Side Sensor Lead Routing

2. Install a new speed sensor retainer sleeve in the speed sensor mounting bracket.
3. Lubricate the head of the speed sensor with chassis lube and install in the speed sensor mounting bracket. Push the speed sensor all the way in until it touches the tone wheel on the CV joint.
4. Route the speed sensor lead away from the halfshaft and secure with the clips and capscrews (do not kink the speed sensor lead).
5. Connect the speed sensor connector to the speed sensor harness connector and install into the connector retaining clip.

STONE WHEEL REPLACEMENT

NOTE: The tone wheel is pressed onto the outer CV joint of the halfshaft and requires halfshaft replacement when servicing the tone wheel. See section 9.

ABS ECU REPLACEMENT

1. Turn ignition switch "OFF".
2. Remove the ECU enclosure hold-down bracket and lift the top half of the ECU enclosure up and out of the pocket in the windshield washer fluid reservoir.
3. Pull the ECU and ECU harness out of the lower half of the ECU enclosure, depress the lock tabs on the 35 pin harness connector and swing the connector around until the hook on the end opposite of the lock tab disconnects from the ECU.
4. Reverse the procedure for installation.

FUSE AND RELAY REPLACEMENT

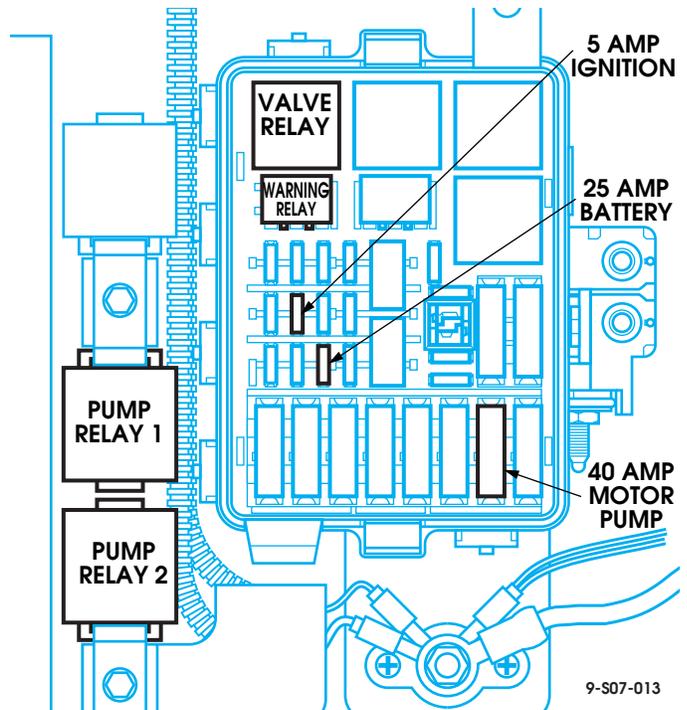
The ABS TT4 system has three fuses located in the under-hood fuse/relay center (Figure 7-59):

1. A 5 ampere ignition power fuse.
2. A 25 ampere battery power fuse.
3. A 40 ampere motor pump fuse.

The ABS TT4 system has four relays:

1. Valve relay.
2. Warning relay.
3. Pump relay 1.
4. Pump relay 2.

The valve relay and the warning relay are located in the under-hood fuse/relay center (Figure 7-59). The valve and warning relays are accessible after removal of the under-hood fuse/relay center cover. The two pump relays are located forward of the fuse-relay center and can be accessed after removing the ABS ECU enclosure hold-down bracket.



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Figure 7-59: ABS/TT4 Relay Locations.