# ANTI-LOCK BRAKE SYSTEM

1995 Chevrolet Tahoe

1995 BRAKES General Motors Corp. - Anti-Lock - 4WAL

Chevrolet: Pickup, Tahoe GMC: Sierra, Suburban, Yukon

# MODEL IDENTIFICATION

Vehicle model can be identified by fifth character of Vehicle Identification Number (VIN), stamped on metal pad on top of left end of instrument panel, near windshield. See MODEL IDENTIFICATION table.

MODEL IDENTIFICATION TABLE

Ser	ie	S	(	1)																																	M	зd	le.	1
"C" "K"		•	•••	 	•	 	•	 	•••	•	•	•		•	•	•	•••	•••	•	 	•	•		•	 	•	 	•	•	 	•	 	•	•	•	  •		2 4	WE WE	)
(1)	_	7	/e	hi	.c	le		se	er	i	e	s	i	s		f	if	Ēt	h	C	ch	aı	ra	C	te	er	C	of	7	νı	N									

# DESCRIPTION

The Kelsey-Hayes 4-Wheel Anti-Lock (4WAL) brake system is used to prevent wheel lock-up during heavy braking. This allows driver to maintain steering control while stopping vehicle in shortest distance possible. The system consists of Electro-Hydraulic Control Unit (EHCU), Vehicle Speed Sensor (VSS), VSS buffer, wheel sensors, warning lights, electrical wiring and hydraulic lines. See Fig. 1.

The EHCU consists of the BPMV, Electronic Brake Control Module (EBCM), and combination valve. The BPMV consists of internal control cartridges, electric motor and pumps. Components of the EHCU are individually replaceable.



93C76119

Fig. 1: 4WAL Brake System Component Locations Courtesy of General Motors Corp.

# **OPERATION**

When ignition is turned on, BPMV performs a self-check of the 4WAL electrical system. The Yellow ANTI-LOCK and Red BRAKE warning lights will come on for 2 seconds. ANTI-LOCK light should turn off if no electrical 4WAL faults are detected by BPMV. The Red BRAKE light may come on or stay on if parking brake is applied or a mechanical brake problem is detected.

Once vehicle speed has exceeded 8 MPH and driver has fully released the brake pedal, BPMV performs a self-check on electrohydraulic portion of the system. This includes pump, control valves and reset switches. If BPMV detects a problem during this self-check or initial self-test, an indicator light will come on and 4WAL system will be disabled. A related trouble code will be stored.

When the brake pedal is depressed, voltage to the BPMV drops from 12 volts to one volt. At this point, BPMV monitors wheel speed through an AC signal generated by speed sensors located at each wheel. If the deceleration rate of wheel speed reaches a preprogrammed rate, BPMV will activate various control valves to prevent wheel lock-up by increasing or decreasing hydraulic pressure to each channel: left front, right front or rear wheels.

On 4WD models, a front-axle mounted switch is used to inform BPMV when vehicle is in 2WD or 4WD mode. Switch is open during 2WD operation, thus sending a one volt or less signal. During 4WD operation, switch closes, sending a 12-volt signal to BPMV. This signal causes BPMV to modify the anti-lock braking program for 4WD operation.

Speed sensor signal is sent through a Vehicle Speed Sensor (VSS) buffer located behind glove box. If axle ratio or tire size is changed, VSS buffer must be replaced to match axle ratio or tire size as necessary.

NOTE: On some vehicles, VSS buffer is actually a part of the Digital Ratio Adapter Controller (DRAC) although the 2 terms may be used interchangeably.

#### **BLEEDING BRAKE SYSTEM**

#### BRAKE PRESSURE MODULATOR VALVE (BPMV)

NOTE: It is not necessary to bleed BPMV during normal brake system bleeding. If BPMV is replaced or is suspected to have air in it, BPMV must be bled. Expect to use 2-3 quarts of fluid to thoroughly bleed system. Bleeding BPMV requires Tech 1 and appropriate cartridge.

Manual Bleeding

1) Raise and support vehicle. Remove bleeder valve cap from right rear wheel. Place proper size box end wrench over bleeder valve. Attach one end of clear tube over valve and submerge other end in container partially filled with clean brake fluid.

2) Loosen bleeder valve 1/2 - 1 turn. Have an assistant depress brake pedal slowly and hold. Tighten bleeder valve and slowly release brake pedal. Wait 15 seconds. Repeat sequence, including 15 second wait, until one pint of fluid has been bled from wheel.

3) Remove tube and wrench. Repeat step 2) at left rear, right front, and left front wheels in this order. Clean brake fluid should be present at each wheel bleed screw. Check master cylinder fluid level every 4-6 strokes of brake pedal to avoid ingesting air into system.

4) Connect Tech 1 scan tester with RWAL/4WAL cartridge or Mass Storage Cartridge to Data Link Connector (DLC). Using Tech 1, perform 4 functional tests while firmly applying brake pedal. 5) Fill master cylinder reservoir, and install cover. Ensure there is no sponginess in brake pedal and that BRAKE warning light is off. Rebleed wheel cylinders/calipers to remove the remaining air in brake system. Evaluate brake pedal feel and braking performance. Repeat bleeding procedure if necessary.

#### Pressure Bleeding

1) Retain hold-off valve stem of metering portion of combination valve (if equipped) using Valve Retainer (J-39177). Remove both combination valve dust caps and install valve retainer on end of combination valve with brass center pin.

2) Clean master cylinder cap and surrounding area. Remove cap. With pressure tank at least 2/3 full, connect pressure bleeder to master cylinder with adapters. Attach bleeder hose to right rear bleeder valve.

3) Place other end of hose in glass jar partially filled with brake fluid so end of hose is submerged in fluid. Open release valve on pressure bleeder. Set pressure bleeder to 20-25 psi (1.4-1.8 kg/cm<sup>2</sup>) or pressure specified by equipment manufacturer.

kg/cm<sup>2</sup>) or pressure specified by equipment manufacturer. 4) Open bleeder screw 3/4 - 1 turn and note fluid flow. Close bleeder screw when one pint of fluid has been bled. Repeat procedure on left rear, right front, and left front wheels in this order. Remove combination valve retainer.

5) Connect Tech 1 scan tester with RWAL/4WAL cartridge or Mass Storage Cartridge to Data Link Connector (DLC). Using Tech 1, perform 4 functional tests while firmly applying brake pedal.

6) Repeat steps 1) - 4). Evaluate brake pedal feel and braking performance. Repeat bleeding procedure if necessary. Remove pressure bleeder. Refill master cylinder reservoir, if necessary.

#### ADJUSTMENTS

#### VEHICLE SPEED SENSOR (VSS) BUFFER

NOTE: Information for VSS buffer part number applicable to axle ratio and tire size combinations is not available from manufacturer. On some vehicles, VSS buffer is actually a part of the Digital Ratio Adapter Controller (DRAC), although the 2 terms may be used interchangeably.

If axle ratio or tire size is changed, it is necessary to replace VSS buffer to ensure proper operation or 4WAL brakes, cruise control, speedometer and engine Electronic Control Module (ECM) or Powertrain Control Module (PCM). Failure to replace VSS buffer as required may affect driveability of vehicle and 4WAL brake operation.

# **DIAGNOSIS & TESTING**

#### DESCRIPTION

NOTE: Use of Tech 1 scan tester is recommended but not required.

The Brake Pressure Modulator Valve (BPMV) contains a selfdiagnostic capability to detect system failures. When a fault code is set, the BPMV may disable 4WAL system and illuminate ANTI-LOCK light for duration of ignition cycle. Fault codes stored by BPMV can be displayed using Tech 1 with appropriate cartridge.

Before diagnosing 4WAL system, perform a comprehensive visual inspection of system by checking wiring harness connectors for looseness and harness routing (pay particular attention to wheel speed sensor wiring harness routing), applicable fuses in fuse block and ground connections. Ensure brake fluid level in master cylinder reservoir is full.

Start 4WAL system diagnosis with appropriate FUNCTIONAL TEST under TROUBLE SHOOTING CHARTS. If failures are found during FUNCTIONAL TEST, you will be directed to enter diagnostics to retrieve codes or perform symptom diagnosis. FUNCTIONAL TEST may indicate 4WAL system is functioning properly.

#### **RETRIEVING CODES**

NOTE: Perform procedures for appropriate FUNCTIONAL TEST under TROUBLE SHOOTING CHARTS.

1) If using Tech 1 for retrieving codes, go to step 3). If using ANTI-LOCK light for retrieving codes, turn ignition on. Using a jumper wire, connect terminal "H" to terminal "A" in Data Link Connector (DLC). See Fig. 2. System will repeat trouble code(s) as long as DLC terminals are connected.

NOTE: The DLC may also be referred to as the Assembly Line Data Link (ALDL) connector. These 2 terms may be used interchangeably.

2) Trouble codes will be displayed by a flashing ANTI-LOCK warning light. As an example, Code 25 would be displayed by ANTI-LOCK warning light flashing 2 times, followed by a pause, then flashing 5 more times. See 4WAL FAULT CODES table for diagnosis. If no fault codes are present, see 4WAL SYMPTOM DIAGNOSIS table.

3) Turn ignition off. Connect Tech 1 to DLC. Access 4WAL brake trouble codes using Tech 1. Repair trouble codes in order they appear. See 4WAL FAULT CODES table for diagnosis. If no fault codes are present, see 4WAL SYMPTOM DIAGNOSIS table.

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Fig. 2: Identifying DLC Terminals Courtesy of General Motors Corp.

#### 4WAL SYMPTOM DIAGNOSIS TABLE

Symptom	See	:
Functional Test		_
2WD	Fig. 3	3
4WD	Fig. 4	ł
ANTI-LOCK Light On	Fig. 5	j
ANTI-LOCK Light Off (1)	Fig. 6	5
Brake Pedal Pulses (1)	Fig. 7	1
Wheel Pull During Hard Braking (1)	Fig. 8	3
(1) - These conditions must exist with no fault codes	stored	ł

#### 4WAL FAULT CODES TABLE

DTC																																	S	ee
21 22 23 25 26 27		•	• • • • • •		•	• •	· •	•			•	· · · · · ·	•	•		•	• •	· ·		•	• •	· ·	•			•	•	• ·	• •	• • • •	Fi Fi Fi Fi Fi	'ic g. g. g. g.	[ <b>-</b>	9 10 11 12 13 14

29	)	 Fig. 16
35		 Fig. 17
36	· · · · · · · · · · · · · · · · · · ·	 Fig. 18
37	· · · · · · · · · · · · · · · · · · ·	 Fig. 19
38	· · · · · · · · · · · · · · · · · · ·	 Fig. 20
41-	-54	 Fig. 21
65	o Or 66	 Fig. 22
67	' Or 68	 Fig. 23
71-	74	 Fig. 24
81		 Fig. 25
86	· · · · · · · · · · · · · · · · · · ·	 Fig. 26
88	3	 Fig. 27

### **CLEARING FAULT CODES**

1) Turn ignition on. Using jumper wire, connect DLC terminal "H" to terminal "A" for 2 seconds. See Fig. 2. Remove jumper wire for one second. Again, connect DLC terminal "H" to "A" for 2 seconds. Remove jumper wire.

2) Fault codes are cleared when ANTI-LOCK and BRAKE lights illuminate, then turn off. Turn ignition off. Verify codes are cleared. See RETRIEVING CODES. If ANTI-LOCK light is on continuously, Tech 1 can be used to clear codes.

# **REMOVAL & INSTALLATION**

# \* PLEASE READ THIS FIRST \*

CAUTION: When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See the COMPUTER RELEARN PROCEDURES article in the GENERAL INFORMATION section before disconnecting battery.

#### COMBINATION VALVE

Removal & Installation

1) Before replacing combination valve, note "pin punched" identification code on valve. It is necessary to have the code when ordering replacement valve.

2) Disconnect electrical connector from combination valve. Disconnect hydraulic lines from combination valve. Remove combination valve bolts. Remove combination valve and transfer tubes from BPMV.

3) To install, reverse removal procedure. DO NOT reuse combination valve transfer tubes. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Bleed brake system, including BPMV. See BLEEDING BRAKE SYSTEM.

#### BRAKE PRESSURE MODULATOR VALVE (BPMV)

NOTE: Brake Pressure Modulator Valve (BPMV) and Electronic Brake Control Module (EBCM) are combined into one unit, referred to as the Electro-Hydraulic Control Unit (EHCU).

Removal & Installation

1) Disconnect negative battery cable. Disconnect electrical connectors from BPMV. Disconnect electrical connector from combination valve. Disconnect hydraulic lines from combination valve. Disconnect hydraulic lines from BPMV. Remove BPMV-to-bracket bolts.

2) Remove EHCU from vehicle as an assembly. Remove bolts from BRAKE SYSTEM Arti EBCM. Separate EBCM from BPMV. DO NOT pry on EBCM or BPMV. EADJULOCK BRAKE SYSTEM Arti

force will damage EBCM. Remove combination valve bolts. Remove combination valve and transfer tubes from BPMV.

3) To install, reverse removal procedure. DO NOT reuse EBCM gasket and mounting bolts, or combination valve transfer tubes. Bleed brake system, including BPMV. See BLEEDING BRAKE SYSTEM. Tighten bolts to specification. See TORQUE SPECIFICATIONS.

# ELECTRONIC BRAKE CONTROL MODULE (EBCM)

#### Removal & Installation

1) Disconnect negative battery cable. Disconnect 4 electrical connectors from EBCM. Remove 4 EBCM-to-BPMV Torx bolts. Separate EBCM from BPMV. DO NOT pry on EBCM or BPMV. Excessive force will damage EBCM.

2) To install, reverse removal procedure. DO NOT reuse EBCM gasket or mounting bolts. Ensure gasket is properly aligned. DO NOT use any type of sealant on EBCM gasket or mating surfaces. Bleed brake system, including BPMV. See BLEEDING BRAKE SYSTEM. Tighten EBCM bolts to specification. See TORQUE SPECIFICATIONS. Perform anti-lock bulb check. Using Tech 1, revise tire size calibration.

#### FRONT WHEEL SPEED SENSOR

NOTE: For installation purposes, note speed sensor wire routing before removing. Misrouted wiring may cause electromagnetic interference failures.

#### Removal & Installation (2WD)

1) Remove wheel. Remove brake caliper and wire aside. Remove hub and rotor assembly. Disconnect speed sensor electrical connector. Using 3/16" drill, remove speed sensor harness clip rivets. Remove splash shield and speed sensor assembly. To install, reverse removal procedure. Tighten wheel bearing nut to 12 ft. lbs. (16 N.m), then back off until just loose.

2) Back off wheel bearing nut again, no more than 1/4 of a turn, until hole in spindle aligns with slot in wheel bearing nut. If wheel bearing nut is adjusted properly, hub end play should be .001-. 008" (.03-.20 mm). If hub end play is not within specification, repeat procedure. Speed sensor air gap is non-adjustable.

#### Removal & Installation (4WD)

1) Remove wheel. Remove brake caliper and wire aside. Remove rotor. Disconnect speed sensor electrical connector. Remove speed sensor wire from clip on upper control arm. Remove bolt attaching speed sensor wiring harness to vehicle frame.

2) Thoroughly clean sensor mounting area. Remove bolt attaching speed sensor to back of hub and bearing assembly. Carefully remove speed sensor by pulling it straight out of bore. DO NOT pry sensor out of bore.

3) To install, reverse removal procedure. Lightly lubricate NEW speed sensor "O" ring with bearing grease. DO NOT lubricate bore. Speed sensor air gap is non-adjustable.

#### Removal & Installation (3500 HD)

1) Remove wheel. Remove brake caliper and wire aside. Remove hub and rotor assembly. Disconnect speed sensor electrical connector. Remove bolts attaching speed sensor bracket to knuckle. Remove bolts attaching speed sensor to bracket. Remove speed sensor.

2) To install, reverse removal procedure. Tighten wheel bearing nut to 12 ft. lbs. (16 N.m), then back off nut one flat. If hole in spindle aligns with slot in wheel bearing nut, install cotter pin. If hole in spindle is not aligned with slot in wheel bearing nut, back off nut no more than one additional flat. 3) If wheel bearing nut is adjusted properly, hub end play should be .005-.008" (.013-.20 mm). If hub end play is not within specification, repeat procedure. Speed sensor air gap is non-adjustable.

# VEHICLE SPEED SENSOR (VSS)

Removal & Installation (Except 4L80-E Transmission) 1) Vehicle Speed Sensor (VSS) is located in left rear of transmission (2WD) or transfer case (4WD). Ensure ignition is off. Raise and support vehicle. Disconnect VSS electrical connector. Place a container under VSS mounting area to catch transmission fluid when VSS is removed.

2) Remove VSS mounting bolt. Using J-38417, remove VSS and"O" ring. To install, coat NEW "O" ring with transmission fluid. Install "O" ring onto VSS. Install VSS and "O" ring into transmission using J-38417. Install mounting bolt through VSS bracket.

Removal & Installation (4L80-E Transmission)

1) Vehicle Speed Sensor (VSS) is located on left side in the middle of transmission. Ensure ignition is off. Raise and support vehicle. Disconnect VSS electrical connector. Remove 2 VSS mounting bolts. Remove input and output speed sensor and bracket assemblies. To install reverse removal procedure.

### VEHICLE SPEED SENSOR (VSS) BUFFER

CAUTION: VSS buffer is sensitive to Electrostatic Discharge (ESD). DO NOT touch VSS buffer terminals with hands or tools, or VSS buffer may damage due to static electricity.

Removal & Installation

Ensure ignition is off. Disconnect negative battery cable. VSS buffer is located behind glove box. Remove 4 screws mounting VSS buffer to dashboard. Disconnect 2 small electrical connectors from VSS buffer. Remove VSS buffer. To install, reverse removal procedure.

# **TROUBLE SHOOTING CHARTS**

NOTE: See WIRING DIAGRAM for circuit and terminal identification. See Fig. 28 for Brake Pressure Modulator Valve (BPMV) connector terminal identification.



Courtesy of General Motors Corp.



Fig. 4: Functional Test (4WD) Courtesy of General Motors Corp.



Fig. 5: ANTI-LOCK Light On Courtesy of General Motors Corp.

![](_page_10_Figure_0.jpeg)

Fig. 6: ANTI-LOCK Light Off - No DTC's Courtesy of General Motors Corp.

![](_page_11_Figure_0.jpeg)

Courtesy of General Motors Corp.

![](_page_12_Figure_0.jpeg)

**93B76126** Fig. 8: Wheel Pull During Hard Braking - No DTC's Courtesy of General Motors Corp.

# DIAGNOSTIC CHARTS

For Integral Speed Sensor Resistance Values (4WD) chart, NOTE: see Fig. 15.

![](_page_13_Figure_0.jpeg)

![](_page_14_Figure_0.jpeg)

![](_page_15_Figure_0.jpeg)

![](_page_16_Figure_0.jpeg)

![](_page_17_Figure_0.jpeg)

![](_page_18_Figure_0.jpeg)

![](_page_19_Figure_0.jpeg)

95G27157 Fig. 15: Integral Speed Sensor Resistance Values (4WD) Courtesy of General Motors Corp.

![](_page_20_Figure_0.jpeg)

Courtesy of General Motors Corp.

![](_page_21_Figure_0.jpeg)

Courtesy of General Motors Corp.

![](_page_22_Figure_0.jpeg)

![](_page_23_Figure_0.jpeg)

<sup>95</sup>B27160

Fig. 19: DTC 37 - Erratic Rear Speed Signal Courtesy of General Motors Corp.

![](_page_24_Figure_0.jpeg)

95C27161 Fig. 20: DTC 38 - Wheel Speed Error Courtesy of General Motors Corp.

![](_page_25_Figure_0.jpeg)

95D27162 Fig. 21: DTC's 41-54 - Control Valves Courtesy of General Motors Corp.

![](_page_26_Figure_0.jpeg)

95E27163 Fig. 22: DTC 65 Or 66 - Open Or Shorted Pump Motor Relay Courtesy of General Motors Corp.

![](_page_27_Figure_0.jpeg)

Fig. 23: DTC 67 - Open Motor Circuit Or Shorted BPMV Output; DTC 68 Locked Motor Or Shorted Motor Circuit Courtesy of General Motors Corp.

![](_page_28_Figure_0.jpeg)

93C76150

Fig. 24: DTC's 71-74 - Memory Errors Courtesy of General Motors Corp.

![](_page_29_Figure_0.jpeg)

![](_page_30_Figure_0.jpeg)

93F76153 Fig. 27: DTC 88 - Shorted Brake Warning Light Courtesy of General Motors Corp.

![](_page_31_Figure_0.jpeg)

![](_page_31_Figure_1.jpeg)

![](_page_31_Picture_2.jpeg)

Fig. 28: BPMV Connector Terminals (Face Side Of Connector Shown) Courtesy of General Motors Corp.

**TORQUE SPECIFICATIONS** 

#### TORQUE SPECIFICATIONS TABLE

Application Ft. Lbs. (N.m)
Axle Shaft Nut (4WD)173 (235)Brake Caliper Mounting Bolts37 (50)Brake Caliper Lock Mounting Bolt15 (20)Brakeline Hydraulic Fittings18 (25)Combination Value To-BPMV Bolt
Step 1 6 (8) Step 2 12 (16) Hub & Bearing Assembly Mounting Bolts (4WD) 133 (180) Intermediate Steering Shaft
"U" Joint Pinch Bolt30 (41)Speed Sensor Mounting Bolts (1)11 (15)Splash Shield Bolts12 (16)Steering Gear-To-Frame Bolts55 (75)Wheel Bearing Nut (2WD) (2)12 (16)
With Single Rear Wheels 120 (163)
Light Duty
INCH Lbs. (N.m)
BPMV Internal Bleeder Screw 60 (7)   BPMV-To-Mounting Bracket Bolt 84 (10)   EBCM-To-BPMV (3) 39 (5)   EHCU-To-Mounting Bracket Bolt 80 (9)   Vehicle Speed Sensor Mounting Bolt 97 (11)
(1) - Not all models have speed sensor mounting bolts. Some models have a speed sensor which is mounted onto
a splash shield. (2) - See FRONT WHEEL SPEED SENSOR under REMOVAL & INSTALLATION for proper adjustment. (3) - Use NEW Torx bolts. Tighten bolts in a cross pattern.

WIRING DIAGRAM

![](_page_33_Figure_0.jpeg)

![](_page_33_Figure_1.jpeg)