

GENERAL DESCRIPTION AND SYSTEM OPERATION

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this knowledge, it will be difficult to use the diagnostic procedures contained in this section.

- **Basic Electrical Circuits** – You should understand the basic theory of electricity and know the meaning of voltage, current (amps), and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.
- **Use of Circuit Testing Tools** – You should know how to use a test light and how to bypass components to test circuits using fused jumper wires. You should be familiar with a digital multimeter. You should be able to measure voltage, resistance, and current, and be familiar with the controls and how to use them correctly.

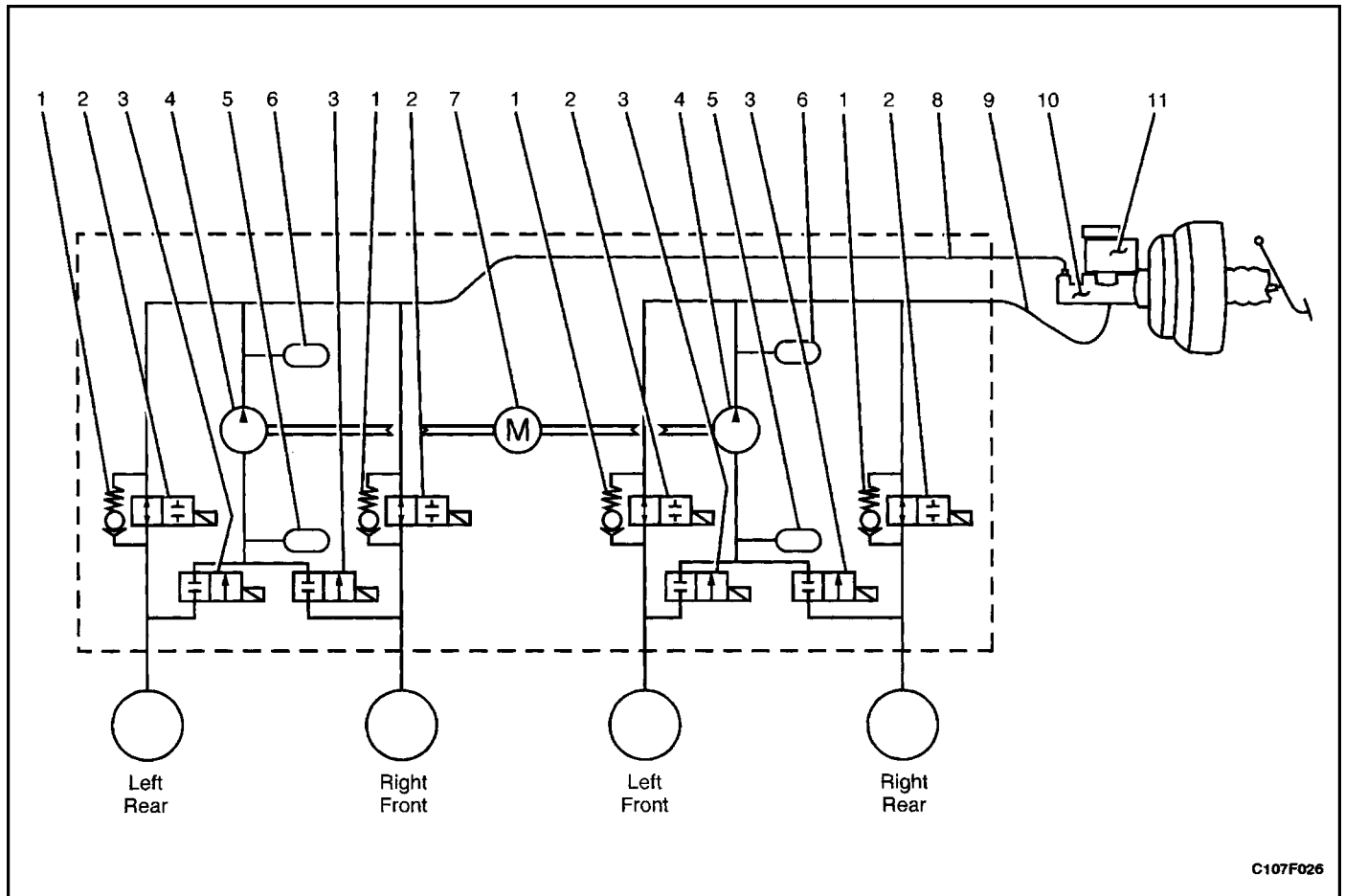
ABS SYSTEM COMPONENTS

The ABS 5.3 Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear leading/trailing drum brakes, interconnecting hydraulic brake pipes and hoses, brake fluid level sensor, and the BRAKE indicator.

The ABS components include a hydraulic unit, an electronic brake control module (EBCM), two system fuses, four wheel speed sensors (one at each wheel), interconnecting wiring, the ABS indicator, and the rear disk brakes. See "ABS Component Locator" in this section for the general layout of this system.

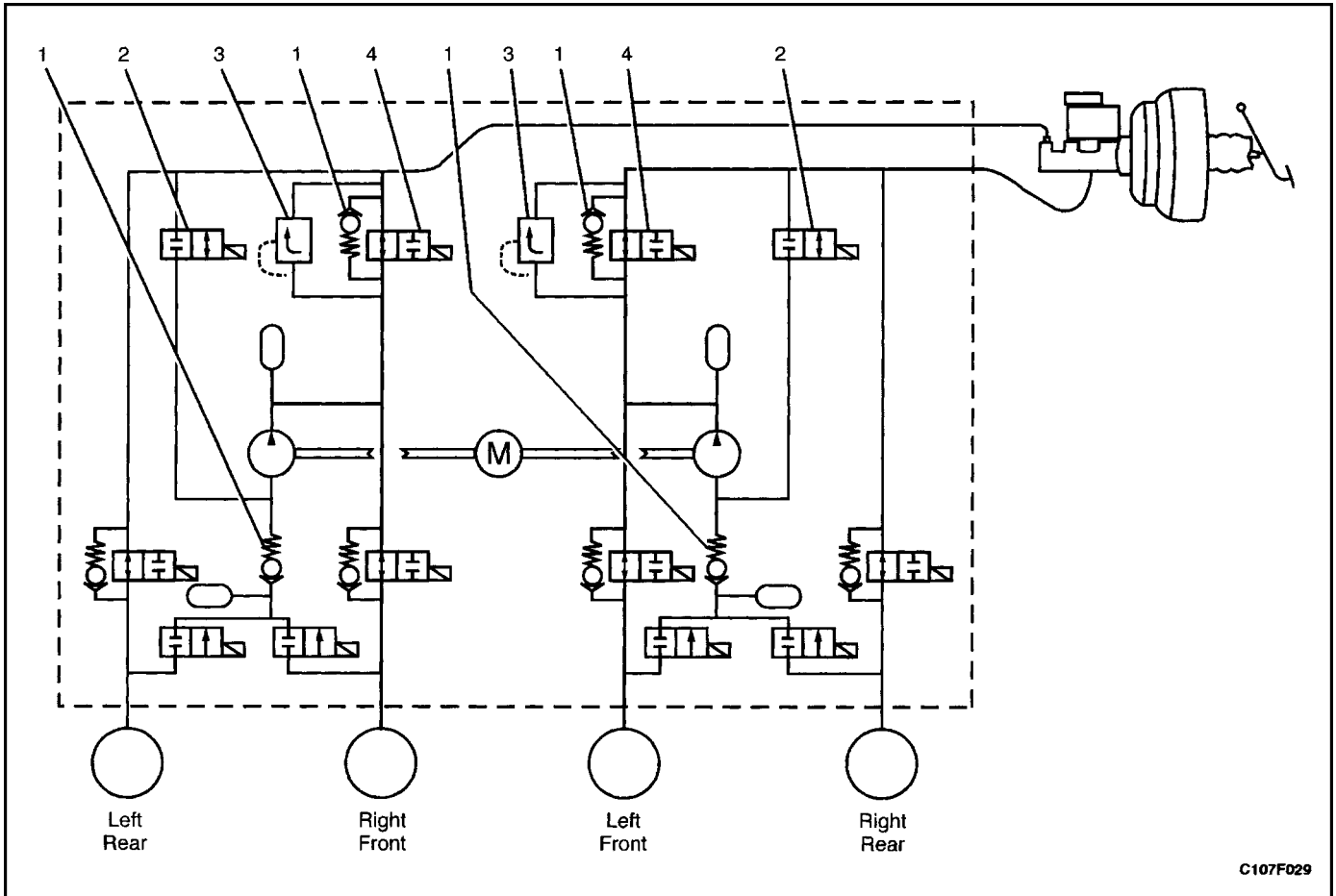
The hydraulic unit with the attached EBCM is located between the surge tank and the bulkhead on the left side of the vehicle.

The basic hydraulic unit configuration consists of hydraulic check valves, two solenoid valves for each wheel, a hydraulic pump, and two accumulators. The hydraulic unit controls hydraulic pressure to the front calipers and rear wheel cylinders by modulating hydraulic pressure to prevent wheel lockup.



1. Check Valve
2. Inlet Valve
3. Outlet Valve
4. Pump
5. Accumulator
6. Damper
7. Pump Motor
8. Hydraulic Circuit 2
9. Hydraulic Circuit 1
10. Master Cylinder
11. Master Cylinder Reservoir

Units equipped with TCS add two more valves for each drive wheel for the purpose of applying the brake to a wheel that is slipping. This is done with pressure from the hydraulic pump in the unit. There is also a TCS indicator lamp on the instrument panel to alert the driver to the fact that the TCS system is active. The components identified in the drawing are those added to the basic ABS 5.3 system to provide traction control.

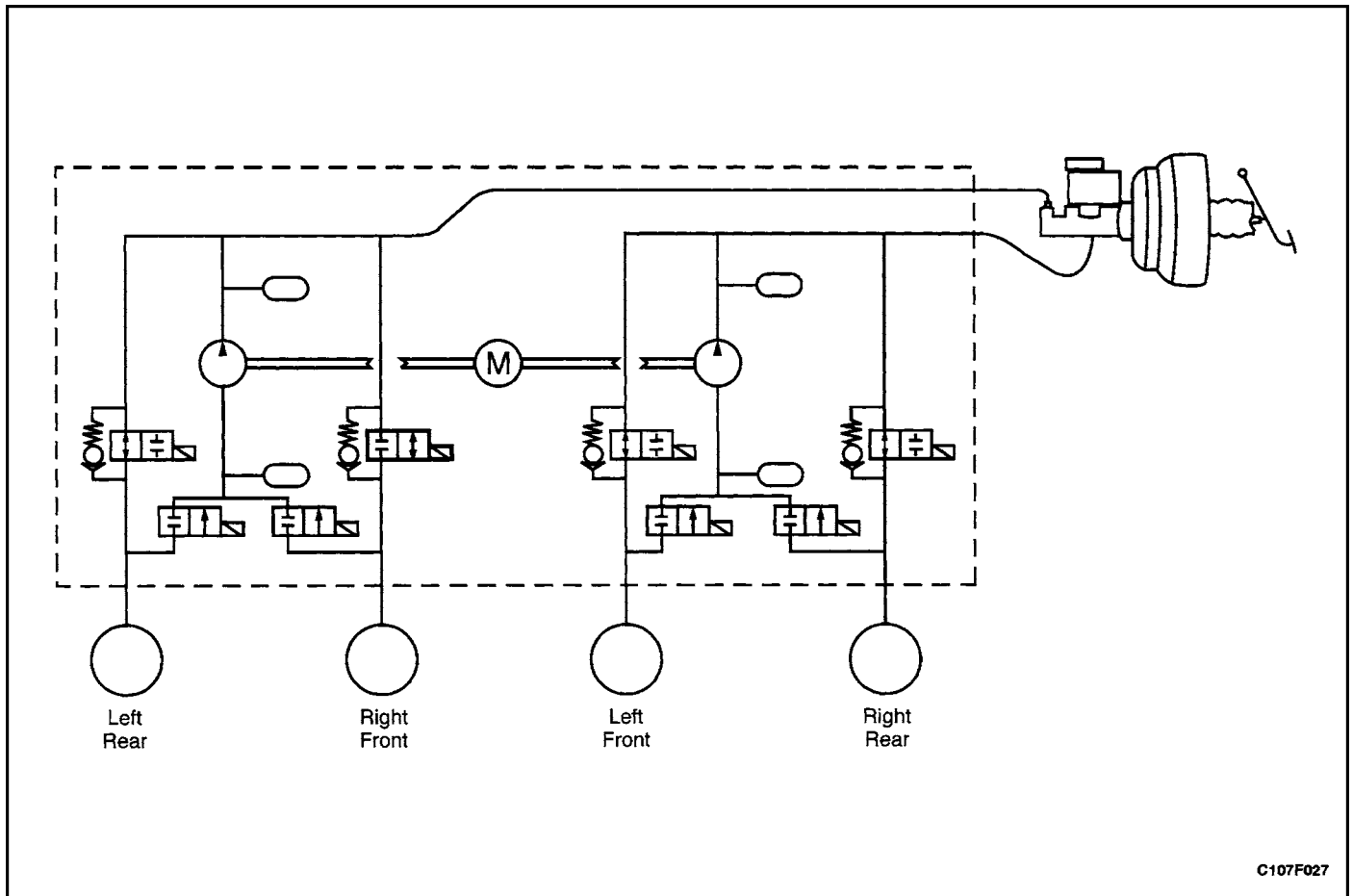


1. Non-return Valve
2. Prime Valve
3. Pressure Relief Valve
4. Pilot Valve

Nothing in the hydraulic unit or the EBCM is serviceable. In the event of any failure, the entire ABS unit with attached EBCM must be replaced. For more information, refer to "Base Braking Mode" and "Antilock Braking Mode" in this section.

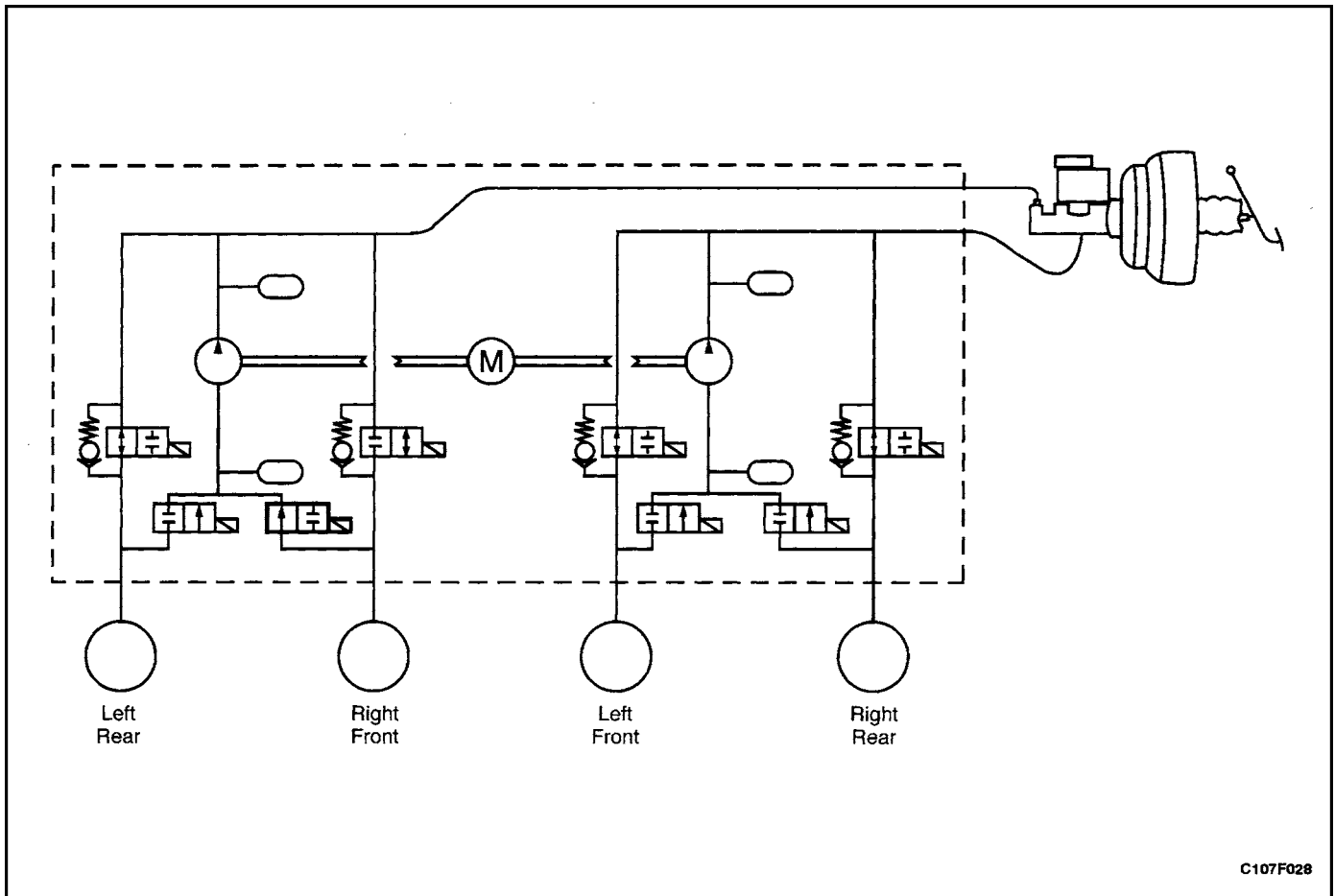
BASE BRAKING MODE

The baseline braking mode of the ABS 5.3 system used in this vehicle is a diagonal split system. In this system, one master cylinder circuit supplies pressure to the right front and the left rear brakes; the other circuit supplies pressure to the left front and the right rear brakes. All valves in the hydraulic modulator are in their normal, non-energized positions as shown in the drawings found in "ABS System Components" in this section.



ANTILOCK BRAKING MODE

If a wheel speed sensor detects a wheel locking up, the electronic brake control module (EBCM) closes the normally open inlet valve for the brake on that wheel to prevent adding more hydraulic pressure to that brake. The illustration shows this for the right front brake.



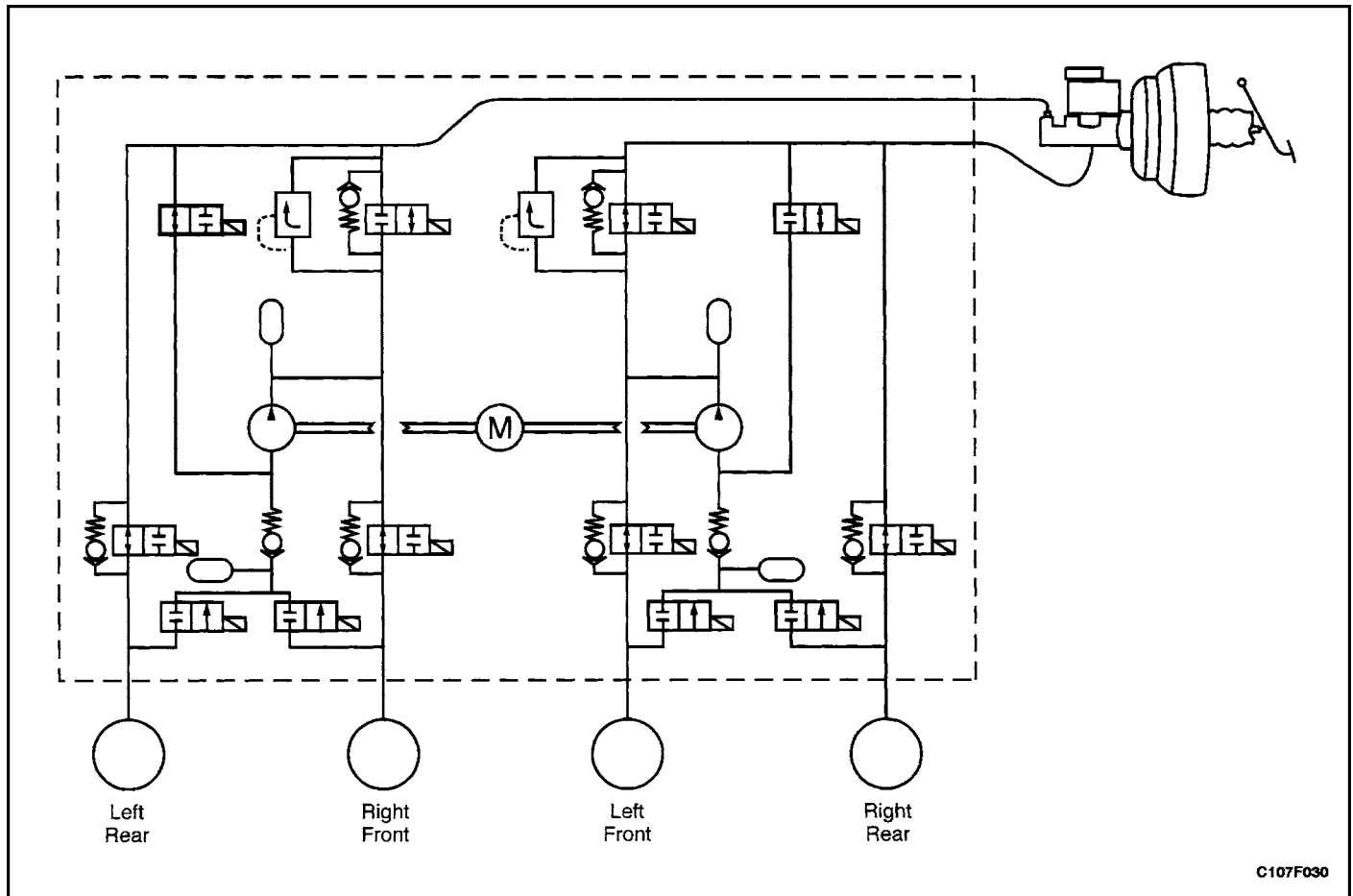
If the wheel locking tendency continues, the EBCM releases the hydraulic pressure at that brake by opening the outlet valve for that wheel.

These inlet and outlet valves at the wheels operate same way in a TCS system. The additional TCS do not operate for the ABS function.

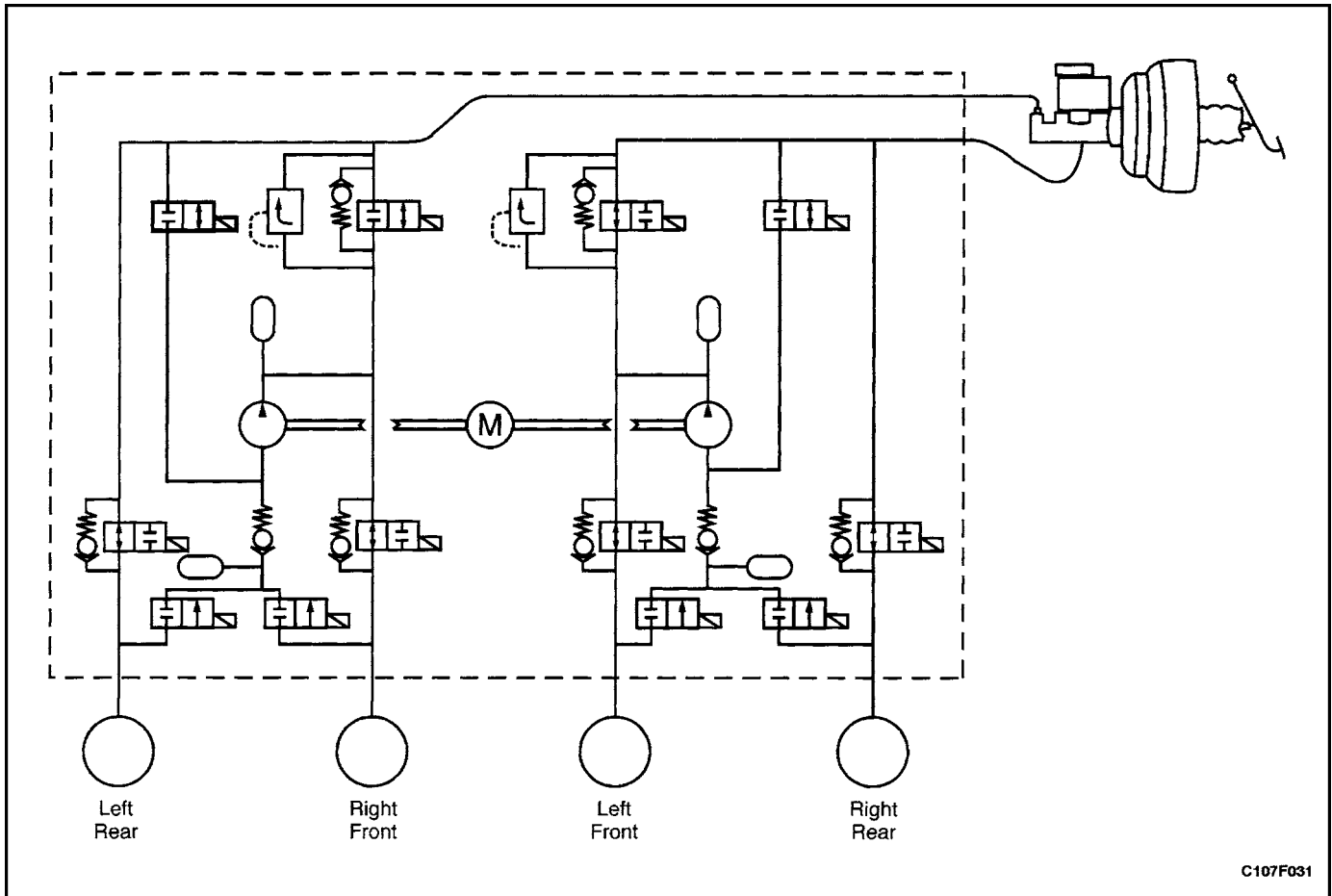
TRACTION CONTROL MODE

The Automatic Brake Differential form of traction control (TCS) used in this system operates by brake application to the drive wheel which is losing traction. This transfers torque to the wheel that has traction. It is available only at low speed (<40 km/h [25 mph]). When the TCS is active the TCS indicator lamp in the instrument cluster will be blinking.

The TCS will operate when a wheel speed sensor detects a wheel spin situation with one of the drive wheels. The electronic brake control module (EBCM) closes the normally open pilot valve to isolate the affected drive wheel brake from the master cylinder and from the rear wheel brake channel. The EBCM also turns on the pump and opens the prime valve to apply pressure to the brake at the wheel that is spinning. The following figures show action at the right front wheel only.

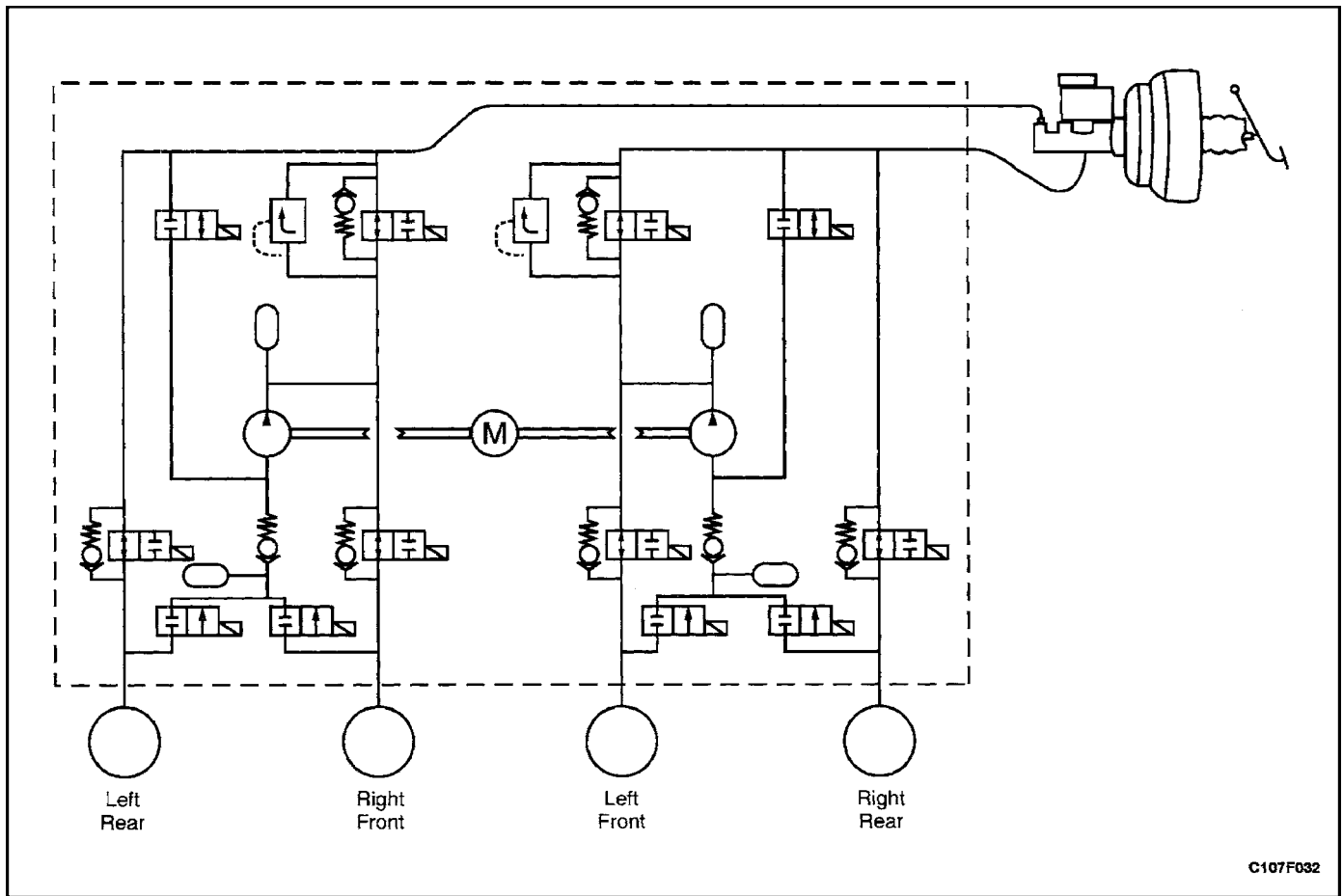


When the wheel spin condition is under control, the EBCM closes the prime valve for the wheel that was spinning to avoid additional braking at that wheel. The pressure relief valves will allow the excess hydraulic fluid being pumped to return to the master cylinder.



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When the wheel speed tendency is no longer detected, the EBCM turns off the pump and opens the pilot valve to release the braking pressure, returning the system its normal configuration.



TIRES AND ABS/TCS

Replacement Tires

Tire size is important for proper performance of the ABS/TCS system. Replacement tires should be the same size, load range, and construction as the original tires. Replace tires in axle sets and only with tires of the same tire performance criteria (TPC) specification number. The use of any other size or type of tire may seriously affect the ABS/TCS operation.

ELECTRONIC BRAKE CONTROL MODULE (EBCM)

Notice : There is no serviceable or removable PROM. The EBCM must be replaced as an assembly.

The EBCM is attached to the hydraulic unit in the engine compartment. The controlling element of ABS 5.3 is a microprocessor-based EBCM. Inputs to the system include

the four wheel speed sensors, the stoplamp switch, the ignition switch, and the unswitched battery voltage. There is an output to a bi-directional serial datalink, located in pin 12 of the data link connector (DLC), for service diagnostic tools and assembly plant testing.

The EBCM monitors the speed of each wheel. If any wheel begins to approach lockup and the brake switch is closed (brake pedal pressed), the EBCM controls the solenoids to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lockup. This cycle repeats until either the vehicle comes to a stop, the brake pedal is released, or no wheels approach lockup.

Additionally, the EBCM monitors itself, each input (except the serial data link), and each output for proper operation. If it detects any system malfunction, the EBCM will store a DTC in nonvolatile memory (DTCs will not disappear if the battery is disconnected). Refer to "Self Diagnostics" in this section for more detailed information.

FRONT WHEEL SPEED SENSORS

The front wheel speed sensors are of a variable reluctance type. Use sensor is attached to the steering knuckle, close to a toothed ring. The result, as teeth pass by the sensor, is an ac voltage with a frequency proportional to the speed of the wheel. The magnitude of the voltage and frequency increase with increasing speed. The sensor is not repairable, nor is the air gap adjustable.

FRONT WHEEL SPEED SENSOR RINGS

The toothed ring mentioned above is pressed onto the wheel-side (outer) constant velocity joint. Each ring contains 48 equally spaced teeth. Use care during service procedures to avoid prying or contacting this ring. Excessive contact may cause damage to one or more teeth. If the ring is damaged, the wheel-side constant velocity joint must be replaced.

REAR WHEEL SPEED SENSORS AND RINGS

The rear wheel speed sensors operate in the same manner as the front wheel speed sensors. They incorporate a length of flexible harness with the connector attached to the end of the harness. The rear wheel speed rings are incorporated into the hub assemblies and cannot be replaced separately, but require replacement of the rear hub/bearing assembly.

VALVE RELAY AND PUMP MOTOR RELAY

The valve relay and the motor pump relay are located in-

side the electronic brake control module (EBCM) and are not replaceable. If one should fail, replace the EBCM.

WIRING HARNESS

The wiring harness is the mechanism by which the electronic brake control module (EBCM) is electrically connected to power and to ground, to the wheel speed sensors, the fuses, the switches, the indicators, and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection, and connectors (terminals, pins, contacts, or lugs) that provide an electrical/mechanical interface from the wire to a system component.

INDICATORS

The electronic brake control module (EBCM) continuously monitors itself and the other ABS components. If the EBCM detects a problem with the system, the amber ABS indicator will light continuously to alert the driver to the problem. An illuminated ABS indicator indicates that the ABS system has detected a problem that affects the operation of ABS. No antilock braking will be available. Normal, non-antilock brake performance will remain. To regain ABS braking ability, the ABS must be serviced.

The red BRAKE indicator will be illuminated when the system detects a low brake fluid level in the master cylinder or when the parking brake switch is closed (the parking brake is engaged).

When the vehicle is equipped with traction control (TCS), there is also a TCS indicator which the EBCM will illuminate when the traction control system is active.