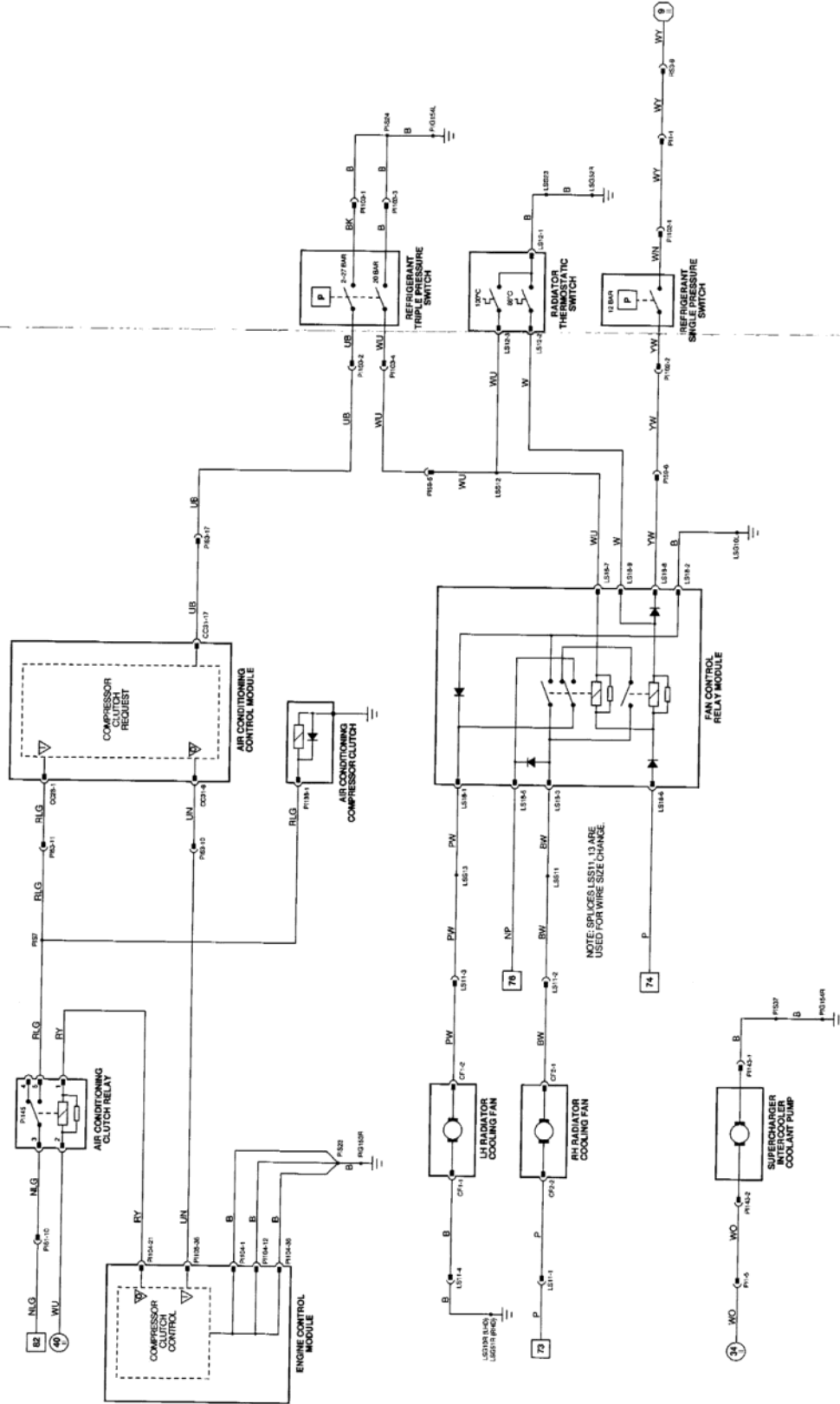


Radiator Cooling: Air Conditioning Compressor - AJ16

Fig. 07.1



Radiator Cooling: Air Conditioning Compressor - AJ16



VAMAR: AJ16 Vehicle  
VIN: 1N1AA11A180000000000  
DATE OF ISSUE: NOVEMBER 1996

Signal Ground (SG)  
Serial and Encoded Communications

## 1995 XJ RANGE - BRAKES - 212-12

### 12.2 SYSTEM DESCRIPTION

The anti-lock braking system (ABS) and traction control system (TC) comprise the following components:

- Hydraulic module: incorporating a pump, motor, low pressure accumulator, valve block, and either an ABS Control Module (ABS CM) or an ABS / TC Control Module (ABS / TC CM).

**NOTE:**

Within the hydraulic module are contained the electro-hydraulic inlet and outlet valves which regulate brake system pressure.

- Four wheel speed sensors; hub end mounted.
- Three warning indicators plus a Brake Warning Lamp and a Traction OFF / ON switch; fascia mounted.
- Throttle valve flap positioning mechanism; mounted adjacent to the hydraulic module.
- Various auxiliary inputs; providing information to ABS / TC CM.
- Diagnostic ISO communication BUS input / output link.

The solenoid operated hydraulic valves are activated by signals, from the ABS / TC CM, which are generated using information received from the wheel speed sensors.

For vehicles without traction control the valves operate on three circuits, two front and one rear, as necessary to prevent wheel locking during braking. Brake pressure is modulated individually at the front wheels and collectively at the rear. Rear wheel control operates a 'select low' principle such that locking in either wheel is sensed, and controlled brake pressure is applied to both wheels.

Vehicles with traction control fitted have all four wheels individually controlled allowing selective regulation of tractive and braking force to each wheel as necessary when traction control is in operation.

The ABS / TC system as a whole is monitored constantly by the ABS / TC CM and is disabled (switched off until fault is rectified) automatically when certain failures are identified. In the event of a failure being detected the ABS and TC MIL lamps, located on the instrument panel will illuminate. Full boosted brake operation and normal acceleration control is available when ABS / TC is disabled. The system will be disabled when the following conditions occur:

- Valve failure.
- Sensor failure.
- Main driver failure (internal ABS / TC CM fault).
- Redundancy error (internal ABS / TC CM fault).
- Over-voltage.
- Pump motor failure.
- Throttle valve actuator motor failure.

In the event of under-voltage both ABS and TC will be disabled and the ABS and TC MIL lamps on the instrument panel will illuminate.

**NOTE:**

The TC MIL lamp will only illuminate providing a voltage is still present at pin 15 'IGN FEED'.

Throttle potentiometer failure will disable the TC function only and illuminate the TC MIL lamp.

The module ABS / TC CM is activated when ignition is ON, after an initiation period of approximately 1.7 seconds. After this time delay the control module is ready to process signals provided from the various input sources and, using the software defined algorithm, control the electrical and hydraulic circuits.

The inductive sensors attached to each of the four wheels provide speed signals to the ABS / TC CM. These signals are processed by ABS / TC CM giving comparison between individual wheel speeds, controlling braking or traction as necessary and generating a pulse to drive the speedometer. Each sensor is monitored for open and short circuit failure, causing disabling of ABS / TC on detection of a fault condition.

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The input frequency of each sensor signal is translated, by the ABS / TC CM, into a comparable wheel speed. Should any sensed speed be in excess of 330 km / h the relevant sensor is designated 'faulty' and ABS / TC control disabled. Similarly ABS / TC control is inhibited (switched off until fault condition is cleared) at speeds up to 40 km / h when frequency fluctuations are detected that are inconsistent with wheel rotation. At speeds above 40 km / h both systems are disabled when inconsistencies are detected.

Traction control (where fitted) is achieved by using a small motor and pulley arrangement to adjust the position of the throttle flap. Under normal operating conditions the system is enabled by default. Operation of the Traction OFF / ON switch, located on the RH side of the fascia switch pack, disables the system and illuminates the TRACTION OFF lamp located in the instrument pack.

Control is effected to prevent wheel spin by regulating (reducing) the throttle flap position, irrespective of the accelerator pedal position, using sensor signal comparisons and applying braking force to the wheel affected. Precise positioning of the flap is achieved by monitoring the position of a throttle position sensor. When traction control is requested a downshift inhibit signal is transmitted to the traction control module and cruise control (if selected) is disabled.

### Control Module Connections

Control module connections numbering 1 - 28, inclusive, provide the necessary input / output signals to enable the module to control and monitor ABS / TC operation.

Connections are as follows:

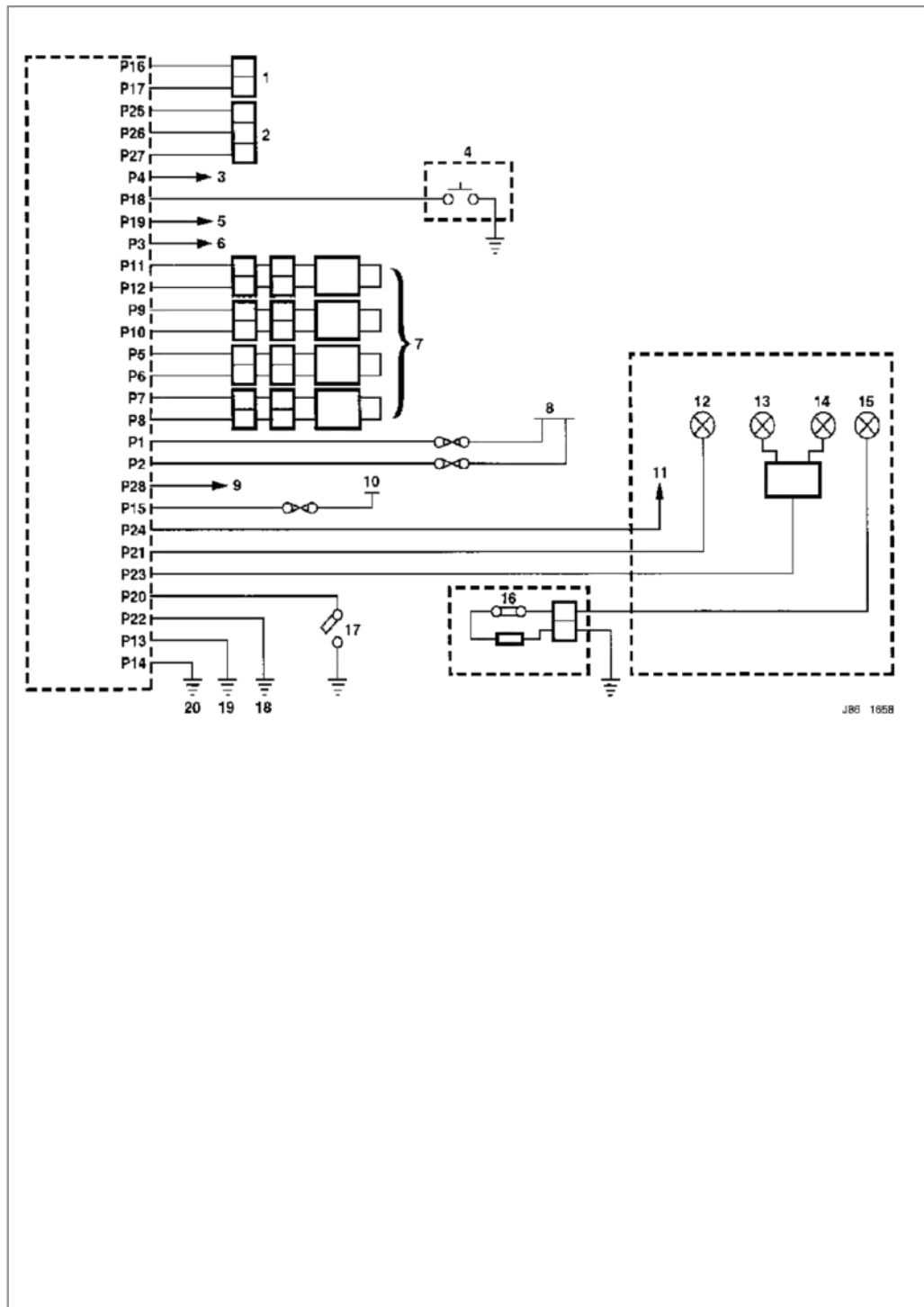
#### RS 027/00

1	Battery positive feed (via fuse F7,located in the left-hand heelboard).
2	Battery positive feed (via fuse F7,located in the right-hand heelboard).
3	Downshift inhibit - during traction control.
4	Cruise control inhibit - during traction control.
5/6	Wheel sensor - LHF.
7/8	Wheel sensor - RHF.
9/10	Wheel sensor - LHR.
11/12	Wheel sensor - RHR.
13	Ground.
14	Ground.
15	Ignition feed - monitoring battery voltage to ignition switch.
16	Throttle valve actuator motor - battery voltage reference.
17	Throttle valve actuator motor switching - during traction control.
18	Traction inhibit - via traction OFF / ON switch.
19	Not used.
20	Brake pedal switch.
21	ABS MIL - malfunction indicator lamp.
22	ABS ground - illuminates ABS MIL lamp if ABS / TC CM connector loose or not fitted.
23	TC MIL - malfunction indicator lamp.
24	RL out - LHR wheel sensor signal drive pulse to speedometer.
25	Throttle position sensor 5V supply.
26	Throttle position sensor wiper.
27	Throttle position sensor ground.
28	Diagnostic ISO communication bus.

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**Fig. 1 Anti-lock braking system and traction control - schematic diagram**

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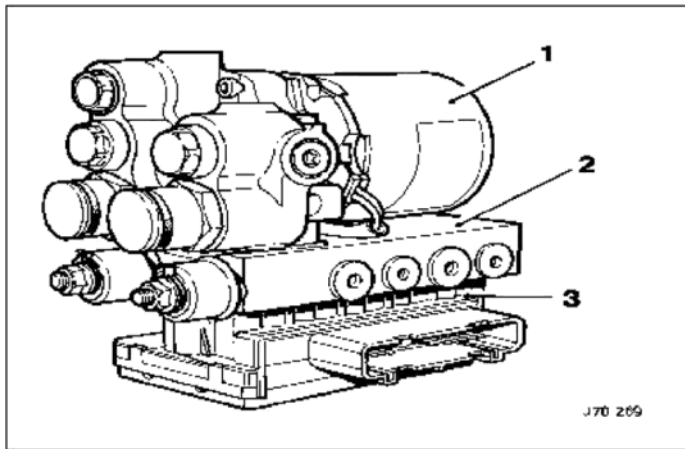
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### 12.3 COMPONENT DESCRIPTIONS

#### ABS / TC CM (3 Fig. 1)

The ABS / TC CM, located just below the hydraulic valve block on the bulkhead, is the system controller and processes all the various information supplied from the external sensors and probes. The unit monitors ABS / TC operation giving fault indication and disabling the systems when defects are detected. The unit is self testing and cannot be fault diagnosed beyond 'black box' level i.e. faulty module. System fault codes are stored in a non-volatile memory for interrogation by external diagnostic equipment.

Fig. 1



#### Solenoid Valves (2 Fig. 1)

**NOTE:**

For ABS only, the driving (rear) wheels are controlled by a common braking circuit.

The traction control system isolating valve has the same characteristics as a normally open valve.

The solenoid operated hydraulic valves, located within the hydraulic module valve block, regulate the supply of pressure to the braking circuits allowing individual control of all wheels with a full ABS / TC system.

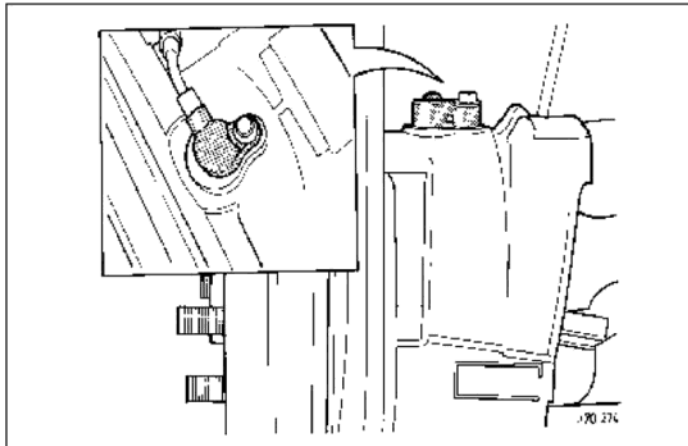
#### Hydraulic Pump / Motor Unit (1 Fig. 1)

This unit, located above the hydraulic valve block, ensures that brake fluid is transmitted around the system at the correct operating pressure. The 250W d.c. motor draws 32A current at peak operation and has an internal resistance of 0.8Ω.

#### Wheel Speed Sensors (Fig. 2)

The four wheel speed sensors are identical in function and construction. Wheel rotation creates the signal within the sensor. This signal is supplied to the ABS / TC CM where it provides wheel speed information. The sensor coil has a resistance value of 1.1 kΩ and will have a voltage of 2.5V present on each connecting pin when the vehicle is stationary.

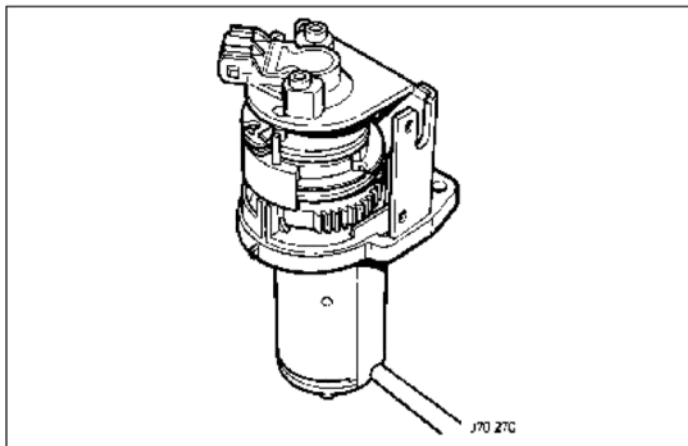
Fig. 2



**Throttle Flap Actuator Motor / Position Sensor (Fig. 3)**

The throttle flap actuator motor, mounted adjacent to the hydraulic control unit, adjusts throttle position, irrespective of accelerator pedal position, by regulating throttle opening when traction control is demanded. The actuator motor nominal 12V terminal voltage is supplied by ABS / TC CM during normal operation. The motor has an internal resistance of approximately  $1.6\Omega$ . The throttle position sensor supplies information relative to the position of its centre tap to the ABS / TC CM which regulates actuator movement. The sensor has a resistance of  $6.4\text{ K}\Omega$ . A terminal voltage of 5V is supplied by ABS / TC CM to connection 3 during normal operation, voltage between connections 1 and 2 will vary between 0 and 5V dependant on wiper position.

Fig. 3





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### 12.4 SYSTEM FAULT INDICATION

#### Fault Indication:

ABS MIL lamp is still illuminated after ignition switch on and instrument pack self test.

#### NOTE:

It is likely that the TC MIL lamp and Traction OFF lamp will also illuminate on vehicles with traction control fitted.

#### Possible causes

Fuses blown.

Faulty wheel speed sensor or harness.

Faulty wiring.

Faulty ABS / TC CM.

#### Fault Diagnosis

#### NOTE:

On the first ignition cycle after a fault has been successfully diagnosed and corrected the vehicle must be driven to a speed above 20kph (12.5 mile / h) before warning lamps will extinguish. If lamps remain on after this exercise repeat fault diagnosis.

- Check fuses (F7) in battery feed lines and (F16) in ignition line. Battery fuses are located in the left and right hand heelboard fuse boxes. The ignition supply fuse is located in the left hand heelboard fuse box.
- Unbolt 28 way multi-plug connector from ABS / TC CM.
- Measure resistance across each wheel speed sensor.

Is value measured  $1100\Omega$ , + 50%?

No - Unplug sensor flying lead and re-measure sensor resistance.

#### NOTE:

Rear sensor connectors are located beneath the rear seat. Seat must be removed to gain access to connector. Forward sensor connectors are located adjacent to the hood catch bracket.

Is value now within range?

Yes - Examine harness between ABS / TC CM and sensor.

No - Renew sensor.

- Check continuity to ground from ABS / TC CM harness connections 13 and 14. If value is much greater than  $0.1\Omega$  renew harness.
- With the ignition switch ON, measure voltage between ABS / TC CM harness connection 14 and connections 1 and 2 respectively. If value is not approximately equivalent to battery voltage renew harness.
- With the ignition switch ON, measure voltage between ABS / TC CM harness connections 14 and 15. If value is not approximately equivalent to battery voltage renew harness.
- Renew ABS / TC CM if fault is not located during the above procedures.

#### Fault Indication:

ABS MIL lamp illuminates at 20 kph.

#### NOTE:

It is likely that the TC MIL lamp and Traction OFF lamp will also illuminate on vehicles with traction control fitted.

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### Possible Causes

Fuses blown.

Faulty hydraulic module pump / motor unit or circuitry.

Faulty ABS / TC CM.

### Fault Diagnosis

- Check fuses.
- Disconnect pump / motor unit and measure resistance across two pin connector. Measured value should be in the region of  $0.8\Omega$ . Renew unit if excessive resistance or short circuit is recorded.
- Unbolt 28-way connector from ABS / TC CM and measure voltage between harness connections 1 and 14. If value is not approximately equal to battery volts renew harness.
- Renew ABS / TC CM if fault is not located during the above procedures.

### Fault Indication:

ABS MIL lamp illuminates on 'pull-away' or during driving

#### NOTE:

It is likely that the TC MIL lamp and Traction OFF lamp will also illuminate on vehicles with traction control fitted.

### Possible Causes

Faulty sensor or wiring.

Faulty rotor or wheel bearing installation giving inconsistent signals to ABS / TC CM.

### Fault Diagnosis

- Check sensor installation for:  
Security of sensor lead fixing bolt.  
Damage to sensor lead.  
Possible damage to rotor.  
Excessive play in wheel bearing.  
Intermittent faults caused by poor harness connection or damage.

### Fault Indication:

TC MIL lamp only is still illuminated after ignition switch on and instrument pack self test.

### Possible Causes

Faulty throttle position actuator.

Faulty actuator potentiometer.

Faulty wiring.

### Fault Diagnosis

- Disconnect flying lead to actuator motor bi-pin connector and measure motor resistance, reading should be approximately  $1.6\Omega$ . Renew actuator if value is excessive or short circuit.
- Disconnect actuator potentiometer and measure resistance across pins 1 and 3, reading should be

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approximately  $6.4k\Omega$ . Renew actuator if value indicates open or short circuit. If value is correct, operate accelerator pedal while measuring resistance between pins 1 and 2, readings should vary in accordance with pedal travel.

- With the ignition switch ON, measure voltage across harness connections to potentiometer pins 1 and 3, reading should be  $5V + 0.5V$ . If a voltage below  $4.5V$  is recorded ensure that supply fuses are intact and all connections secure before renewing harness.
- Check continuity between harness connection to potentiometer pin 2 and pin 26 of 28-way multi-pug connector to ABS / TC CM.

### NOTE:

Examine ABS MIL lamp at ignition switch-on. If lamp illuminates briefly, then goes out the supply fuses will be intact. If lamp does not illuminate at all supply fuses may be blown, or MIL lamp may be faulty.

### Fault Indication:

TC MIL lamp only is still illuminated 8 seconds after ignition switch on.

### Possible Causes

Faulty harness or TCS switch.

### Fault Diagnosis

- Check pin 18 of 28 way multi-plug connector is not shorted to ground.

### Pin Point Tests

#### Wheel Sensor

The wheel sensors are connected across ABS / TC CM pins 5 - 12 inclusive, one sensor per pair of pins (see 'Control Module Connections', page 3).

- Testing between pins of the 28 way multi-plug connector, check that the resistance of each sensor coil is  $1.1k\Omega$  (tolerance of + 50%).

#### Hydraulic Pump Motor

- Disconnect the pump motor bi-pin connector.
- Check the resistance value of the motor winding is approximately  $0.8\Omega$ .

#### Throttle position sensor

- With the vehicle ignition ON, test the throttle position sensor harness between ABS / TC CM pins 25 and 27. A voltage of  $5V (+ 0.5V)$  should be recorded.
- Repeat the test between ABS / TC CM pins 26 and 27 with the accelerator pedal pressed down approximately half of full travel. A voltage of approximately half the first value should be recorded. Variation in accelerator pedal position should cause a varying voltage value to be recorded.

#### Throttle Flap Actuator Motor

- Test the throttle flap actuator motor between ABS / TC CM multi-plug connector pins 16 and 17. A resistance value of  $1.6\Omega$  should be recorded.

#### Brake Switch

- Measure the voltage at the brake switch between ABS / TC CM pin 20 and ground. With pedal UP, ie not operated, a reading equivalent to battery voltage should be achieved. Operate brake pedal fully ensuring coinciding ground, ie 0 volts, through switch.

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### Traction Switch

- Check continuity of traction OFF / ON switch between ABS / TC CM pin 18 and ground. Operate switch ensuring coinciding short circuit.

### Stored Fault codes

The following information details fault codes which may be stored, automatically within the ABS / TC CM and accessed as an aid to fault diagnosis using Jaguar Diagnostic Equipment.

Code	Fault	Comment
Brakes		
5246h	Outlet valve, rear right	
5254h	Inlet valve, rear right	
5242h	Outlet valve, rear left	
5250h	Inlet valve, rear left	
5120h	Outlet valve, front right	
5214h	Inlet valve, front right	
5194h	Outlet valve, front left	
5198h	Inlet valve, front left	
5404h	Isolating valve	
5168h	Sensor, rear right	
5178h	Sensor, rear left	
5148h	Sensor front right	
5158h	Sensor, front left	
5165h	Sensor, rear right	
5175h	Sensor, rear left	Sensor failure recognised by 'monitoring of wheel speed continuity'
5145h	Sensor, front right	
5155h	Sensor, front left	
5260h	Sensor, rear right	
5261h	Sensor, rear left	Sensor failure recognised by 'wheel speed comparison'
5259h	Sensor, front right	
5258h	Sensor, front left	
5235h	Sensor, rear right	
5236h	Sensor, rear left	Sensor failure recognised by 'long term detection of missing sensor signal'
5234h	Sensor, front right	
5233h	Sensor, front left	
9317h	Overvoltage	
9342h	CPU failure	
5095h	Pump Motor	
5267h	Disturbance detection	

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Traction Control		
5450h	Throttle flap motor (elec or mech)	
5495h	Throttle flap potentiometer (elec or mech)	
5449h	Throttle flap potentiometer / positioning	