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General information

- Electronic control unit (ECU) incorporates self-diagnosis function.
- ABS warning lamp will illuminate in the event of system failure.
- Trouble codes can be displayed with the ABS warning lamp.
- Trouble codes can also be accessed with suitable code reader connected to the data link connector (DLC) or diagnostic socket.
- 1994-95: Diagnostic socket [Fig. 1](#) .
- 1996-98: Data link connector (DLC) [Fig. 2](#) .
- For DLC or diagnostic socket location refer to System layout and components.

Accessing trouble codes

- Ensure ignition switched OFF.
- Remove ABS warning lamp relay.
- Switch ignition ON.
- Check warning lamp illuminates.
- Bridge diagnostic socket terminals 2 and 5. A: [Fig. 3](#)
- Bridge data link connector (DLC) terminals 4 and 15. B: [Fig. 3](#)
- Wait 5 seconds.
- Warning lamp extinguishes.
- Warning lamp starts flash sequence.
- Compare with trouble code table.

Erasing trouble codes

- Access trouble codes.
- Disconnect diagnostic socket or data link connector (DLC) bridge wire [Fig. 3](#) .
- Trouble code will be repeated until code erased.
- If more than one trouble code has been flashed, reconnect bridge wire [Fig. 3](#) .
- When last trouble code flashed, remove bridge wire.
- Refit ABS warning lamp relay.

Trouble code identification

Trouble code	Fault location
1-1	Start of sequence
2-6	Brake pedal position (BPP) switch
2-7	ECU supply continuous, ignition OFF - system relay
2-8	No solenoid valve supply - system relay

Manufacturer: Land Rover
Engine code:
Tuned for: R-Cat

Model: Discovery (90-98) 3,9
Output: 134 (182) 4750
Year: 1994-98

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2-12	Wheel speed sensor, RH front - air gap
2-13	Wheel speed sensor, LH rear - air gap
2-14	Wheel speed sensor, LH front - air gap
2-15	Wheel speed sensor, RH rear - air gap
3-0	Hydraulic modulator solenoid valve, RH front inlet - ECU connection/wiring
3-1	Hydraulic modulator solenoid valve, RH front outlet - ECU connection/wiring
3-2	Hydraulic modulator solenoid valve, LH front inlet - ECU connection/wiring
3-3	Hydraulic modulator solenoid valve, LH front outlet - ECU connection/wiring
3-4	Hydraulic modulator solenoid valve, RH rear inlet - ECU connection/wiring
3-5	Hydraulic modulator solenoid valve, RH rear outlet - ECU connection/wiring
3-6	Hydraulic modulator solenoid valve, LH rear inlet - ECU connection/wiring
3-7	Hydraulic modulator solenoid valve, LH rear outlet - ECU connection/wiring
3-8	Hydraulic modulator solenoid valve, inlet, isolating valve - ECU connection/wiring
3-9	Hydraulic modulator solenoid valve, outlet, isolating valve - ECU connection/wiring
4-0	Hydraulic modulator solenoid valve, RH front inlet - ECU connection/short circuit
4-1	Hydraulic modulator solenoid valve, RH front outlet - ECU connection/short circuit
4-2	Hydraulic modulator solenoid valve, LH front inlet - ECU connection/short circuit
4-3	Hydraulic modulator solenoid valve, LH front outlet - ECU connection/short circuit
4-4	Hydraulic modulator solenoid valve, RH rear inlet - ECU connection/short circuit
4-5	Hydraulic modulator solenoid valve, RH rear outlet - ECU connection/short circuit
4-6	Hydraulic modulator solenoid valve, LH rear inlet - ECU connection/short circuit
4-7	Hydraulic modulator solenoid valve, LH rear outlet - ECU connection/short circuit
4-8	Hydraulic modulator solenoid valve, inlet, isolating valve - ECU connection/short circuit
4-9	Hydraulic modulator solenoid valve, outlet, isolating valve - ECU connection/short circuit
4-12	Wheel speed sensor, RH front - high resistance/open circuit
4-13	Wheel speed sensor, LH rear - high resistance/open circuit
4-14	Wheel speed sensor, LH front - high resistance/ open circuit
4-15	Wheel speed sensor, RH rear - high resistance/open circuit
5-0	Hydraulic modulator solenoid valve, RH front inlet - ECU/solenoid valve supply short circuit
5-1	Hydraulic modulator solenoid valve, RH front outlet - ECU/solenoid valve supply short circuit
5-2	Hydraulic modulator solenoid valve, LH front inlet - ECU/solenoid valve supply short circuit
5-3	Hydraulic modulator solenoid valve, LH front outlet - ECU/solenoid valve supply short circuit
5-4	Hydraulic modulator solenoid valve, RH rear inlet - ECU/solenoid valve supply short circuit
5-5	Hydraulic modulator solenoid valve, RH rear outlet - ECU/solenoid valve supply short circuit
5-6	Hydraulic modulator solenoid valve, LH rear inlet - ECU/solenoid valve supply short circuit
5-7	Hydraulic modulator solenoid valve, LH rear outlet - ECU/solenoid valve supply short circuit
5-8	Hydraulic modulator solenoid valve, inlet, isolating valve - ECU/solenoid valve supply short circuit
5-9	Hydraulic modulator solenoid valve, outlet, isolating valve - ECU/solenoid valve supply short circuit
5-12	Wheel speed sensor, RH front - wiring
5-13	Wheel speed sensor, LH rear - wiring
5-14	Wheel speed sensor, LH front - wiring

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5-15	Wheel speed sensor, RH rear - wiring
6-0	Hydraulic modulator solenoid valve, RH front inlet - short circuit, two ECU/solenoid valve connections
6-1	Hydraulic modulator solenoid valve, RH front outlet - short circuit, two ECU/solenoid valve connections
6-2	Hydraulic modulator solenoid valve, LH front inlet - short circuit, two ECU/solenoid valve connections
6-3	Hydraulic modulator solenoid valve, LH front outlet - short circuit, two ECU/solenoid valve connections
6-4	Hydraulic modulator solenoid valve, RH rear inlet - short circuit, two ECU/solenoid valve connections
6-5	Hydraulic modulator solenoid valve, RH rear outlet - short circuit, two ECU/solenoid valve connections
6-6	Hydraulic modulator solenoid valve, LH rear inlet - short circuit, two ECU/solenoid valve connections
6-7	Hydraulic modulator solenoid valve, LH rear outlet - short circuit, two ECU/solenoid valve connections
6-8	Hydraulic modulator solenoid valve, inlet, isolating valve - short circuit, two ECU/solenoid valve connections
6-9	Hydraulic modulator solenoid valve, outlet, isolating valve - short circuit, two ECU/solenoid valve connections
6-12	Wheel speed sensor, RH front - no output signal/air gap
6-13	Wheel speed sensor, LH rear - no output signal/air gap
6-14	Wheel speed sensor, LH front - no output signal/air gap
	<p>Wheel speed sensor, RH rear - no output signal/air gap</p> <p>ABS warning lamp</p> <p>Correct operating sequence - Fig. 4</p> <ul style="list-style-type: none"> • Switch ignition ON. • Lamp illuminates Fig. 4 . • Wait 1-2 seconds. • Lamp extinguishes briefly. • Lamp illuminates. • Drive vehicle forward at 5 mph (7 km/h) minimum. • Lamp extinguishes. <p>General test procedures</p> <p>NOTE: Due to small size of ECU harness multi-plug pins it is advisable to use a breakout box.</p> <p>Warning lamp circuit</p> <p>Checking - Fig. 5</p> <ul style="list-style-type: none"> • Switch ignition ON. • Check warning lamp illuminates. • If not: Check fuse 14 (10A). • Switch ignition OFF. • Remove ABS warning lamp relay. • Bridge relay base terminals 30 and 87a. • Switch ignition ON. • Check warning lamp illuminates. • If not: Check wiring and bulb. <p>Wheel speed sensors</p> <p>Preparatory conditions</p>

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- Check wheel bearings for excessive play. Adjust or replace as necessary.
- Check wheel speed sensors for mechanical security.
- Inspect wheel speed sensor rings visually for damage and cleanliness.

Checking air gap

Technical Data	
Air gap	Not specified
Number of ring teeth	60

- No manual adjustment of wheel speed sensor air gaps is possible.
- If removed or replaced: Renew wheel speed sensor bush and seal.
- Replacing wheel speed sensor:
- Lightly oil wheel speed sensor.
- Insert wheel speed sensor until tip contacts sensor ring.

NOTE: Wheel speed sensor will be pushed back into correct position when vehicle is driven.

Checking resistance - front - [Fig. 6](#) & [Fig. 7](#)

Technical Data		
Terminals	Wheel speed sensor	Resistance
15 & 32	Left hand	950 Ω approx.
17 & 34	Right hand	950 Ω approx.

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Check resistance between breakout box terminals [Fig. 6](#) .
- If resistance not as specified:
- Disconnect relevant wheel speed sensor multi-plug.
- Check resistance between wheel speed sensor terminals [Fig. 7](#) .
- If resistance as specified: Check wiring.
- If resistance not as specified: Suspect faulty wheel speed sensor.
- Repeat test for other wheel speed sensor.

Checking resistance - rear - [Fig. 7](#) & [Fig. 8](#)

Technical Data		
Terminals	Wheel speed sensor	Resistance
18 & 35	Left hand	950 Ω approx.
16 & 33	Right hand	950 Ω approx.

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Check resistance between breakout box terminals **Fig. 8** .
- If resistance not as specified:
- Disconnect relevant wheel speed sensor multi-plug.
- Check resistance between wheel speed sensor terminals **Fig. 7** .
- If resistance as specified: Check wiring.
- If resistance not as specified: Suspect faulty wheel speed sensor.
- Repeat test for other wheel speed sensor.

Checking voltage - front - **Fig. 9** & **Fig. 10**

Technical Data		
Terminals	Wheel speed sensor	Voltage
15 & 32	Left hand	0,4 V ac approx.
17 & 34	Right hand	0,4 V ac approx.

- Ensure ignition switched OFF.
- Raise vehicle.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Adjust voltmeter to measure alternating current.
- Turn road wheel at approximately 60 rpm.
- Check voltage between breakout box terminals **Fig. 9** .
- If voltage not as specified:
- Disconnect relevant wheel speed sensor multi-plug.
- Turn road wheel at approximately 60 rpm.
- Check voltage between wheel speed sensor terminals **Fig. 10** .
- If voltage as specified: Check wiring.
- If voltage not as specified: Suspect faulty wheel speed sensor.
- Repeat test for other wheel speed sensor.

Checking voltage - rear - **Fig. 10** & **Fig. 11**

Technical Data		
Terminals	Wheel speed sensor	Voltage
18 & 35	Left hand	1,5 V ac approx.
16 & 33	Right hand	1,5 V ac approx.

- Ensure ignition switched OFF.
- Raise vehicle.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Adjust voltmeter to measure alternating current.
- Turn road wheel at approximately 60 rpm.
- Check voltage between breakout box terminals **Fig. 11** .
- If voltage not as specified:

- Disconnect relevant wheel speed sensor multi-plug.
- Turn road wheel at approximately 60 rpm.
- Check voltage between wheel speed sensor terminals **Fig. 10**.
- If voltage as specified: Check wiring.
- If voltage not as specified: Suspect faulty wheel speed sensor.
- Repeat test for other wheel speed sensor.

Checking wave form - front - **Fig. 12**

Technical Data		
Terminals	Wheel speed sensor	Voltage
15 & 32	Left hand	0,4 V ac approx.
17 & 34	Right hand	0,4 V ac approx.

- Ensure ignition switched OFF.
- Raise vehicle.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Connect oscilloscope between breakout box terminals.
- Turn road wheel at approximately 60 rpm.
- Check wave form and voltage of wheel speed sensor.
- If wave form or voltage not as specified:
- Disconnect relevant wheel speed sensor multi-plug.
- Turn road wheel at approximately 60 rpm.
- Check wave form and voltage between wheel speed sensor terminals.
- If wave form and voltage as specified: Check wiring.
- If wave form or voltage not as specified: Suspect faulty wheel speed sensor.
- Repeat test for other wheel speed sensor.

Checking wave form - rear - **Fig. 13**

Technical Data		
Terminals	Wheel speed sensor	Voltage
18 & 35	Left hand	1,5 V ac approx.
16 & 33	Right hand	1,5 V ac approx.

- Ensure ignition switched OFF.
- Raise vehicle.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Connect oscilloscope between breakout box terminals.
- Turn road wheel at approximately 60 rpm.
- Check wave form and voltage of wheel speed sensor.
- If wave form or voltage not as specified:
- Disconnect relevant wheel speed sensor multi-plug.
- Turn road wheel at approximately 60 rpm.
- Check wave form and voltage between wheel speed sensor terminals.
- If wave form and voltage as specified: Check wiring.
- If wave form or voltage not as specified: Suspect faulty wheel speed sensor.

- Repeat test for other wheel speed sensor.

Relays

Checking operation - system relay - [Fig. 14](#)

Technical Data		
Terminals	Condition	Resistance
30 & 87	Battery voltage disconnected	∞
30 & 87	Battery voltage connected	Zero
Battery + to terminal 86		
Battery - to terminal 85		

NOTE: Ensure battery voltage supply is connected correctly. Otherwise relay could be damaged.

- Ensure ignition switched OFF.
- Remove system relay.
- Check resistance between relay terminals.
- Connect battery voltage supply to specified relay terminals.
- Check resistance between relay terminals.

Checking supply voltage - system relay - [Fig. 15](#)

Technical Data		
Terminals	Condition	Voltage
30 & earth	Ignition OFF	Battery voltage
86 & earth	Ignition ON	Battery voltage

NOTE: Electronic control unit (ECU) must be fitted and working correctly in order to carry out supply voltage checks.

- Ensure ignition switched OFF.
- Remove system relay.
- Check voltage between relay base terminal and earth.
- Switch ignition ON.
- Check voltage between relay base terminal and earth.
- If voltage not as specified: Check wiring, fuses and electronic control unit (ECU).

Checking earth connection - system relay - [Fig. 15](#)

Technical Data	
Terminals	Resistance
85 & earth	Zero

- Ensure ignition switched OFF.
- Remove system relay.
- Check resistance between relay base terminal and earth.
- If resistance not as specified: Check wiring.

Checking operation - pump motor relay - [Fig. 14](#)

Technical Data		
Terminals	Condition	Resistance
30 & 87	Battery voltage disconnected	∞
30 & 87	Battery voltage connected	Zero
Battery + to terminal 86		
Battery - to terminal 85		

NOTE: Ensure battery voltage supply is connected correctly. Otherwise relay could be damaged.

- Ensure ignition switched OFF.
- Remove pump motor relay.
- Check resistance between relay terminals.
- Connect battery voltage supply to specified relay terminals.
- Check resistance between relay terminals.

Checking supply voltage - pump motor relay - [Fig. 15](#)

Technical Data		
Terminals	Condition	Voltage
30 & earth	Ignition OFF	Battery voltage
86 & earth	Ignition ON	Battery voltage

NOTE: Electronic control unit (ECU) must be fitted and working correctly in order to carry out supply voltage checks.

- Ensure ignition switched OFF.
- Remove pump motor relay.
- Check voltage between relay base terminal and earth.
- Switch ignition ON.
- Check voltage between relay base terminal and earth.
- If voltage not as specified: Check wiring, fuses and electronic control unit (ECU).

Checking earth connection - pump motor relay - [Fig. 15](#)

Technical Data	
Terminals	Resistance
85 & earth	Zero

- Ensure ignition switched OFF.
- Remove pump motor relay.
- Check resistance between relay base terminal and earth.
- If resistance not as specified: Check wiring.

Checking operation - ABS warning lamp relay - [Fig. 16](#)

Technical Data		
Terminals	Condition	Resistance
30 & 87a	Battery voltage disconnected	∞
30 & 87a	Battery voltage connected	Zero
Battery + to terminal 86		
Battery - to terminal 85		

NOTE: Ensure battery voltage supply is connected correctly. Otherwise relay could be damaged.

- Ensure ignition switched OFF.
- Remove ABS warning lamp relay.
- Check resistance between relay terminals.
- Connect battery voltage supply to specified relay terminals.
- Check resistance between relay terminals.

Checking supply voltage - ABS warning lamp relay - [Fig. 17](#)

Technical Data	
Terminals	Voltage
86 & earth	Battery voltage

NOTE: Electronic control unit (ECU) and system relay must be fitted and working correctly in order to carry out supply voltage checks.

- Ensure ignition switched OFF.
- Remove ABS warning lamp relay.
- Switch ignition ON.
- Check voltage between relay base terminal and earth.
- If voltage not as specified: Check wiring.

Checking earth connection - ABS warning lamp relay - [Fig. 17](#)

Technical Data	
Terminals	Resistance
85 & earth	Zero
87a & earth	Zero

- Ensure ignition switched OFF.
- Remove ABS warning lamp relay.
- Check resistance between relay base terminals and earth.
- If resistance not as specified: Check wiring.

Electronic control unit (ECU)

Checking supply voltage - [Fig. 18](#)

Technical Data	
Terminals	Voltage
9 & earth	Battery voltage

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Switch ignition ON.
- Check voltage between breakout box terminal and earth.
- If voltage not as specified: Check wiring and fuses.

Checking earth connection - [Fig. 18](#)

Technical Data	
Terminals	Resistance
27 & earth	Zero
31 & earth	Zero

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Check resistance between breakout box terminals and earth.
- If resistance not as specified: Check wiring.

Hydraulic modulator solenoid valves

Checking - [Fig. 19](#)

Technical Data		
Terminals	Hydraulic modulator solenoid valve	Resistance
23 & 27	LH front inlet	7 Ω approx.
24 & 27	LH front outlet	5 Ω approx.
6 & 27	RH front inlet	7 Ω approx.
7 & 27	RH front outlet	5 Ω approx.
21 & 27	LH rear inlet	7 Ω approx.
22 & 27	LH rear outlet	5 Ω approx.
4 & 27	RH rear inlet	7 Ω approx.
5 & 27	RH rear outlet	5 Ω approx.

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Check resistance between breakout box terminals.

Pump motor

Checking operation - [Fig. 20](#)

NOTE: DO NOT allow pump motor to run for more than 2 seconds.

- Ensure ignition switched OFF.
- Remove pump motor relay.
- Bridge relay base terminals 30 and 87 with a switched lead.
- Operate switch.
- Pump motor should run.
- If not: Check wiring and fuses.

Brake pedal position (BPP) switch

Checking operation - [Fig. 21](#)

Technical Data		
Terminals	Condition	Voltage
25 & earth	Pedal released	Zero
10 & earth	Pedal released	Zero
25 & earth	Pedal depressed	Battery voltage
10 & earth	Pedal depressed	Battery voltage

- Ensure ignition switched OFF.
- Disconnect ECU multi-plug.
- Connect breakout box to harness multi-plug.
- Switch ignition ON.
- Check voltage between breakout box terminals and earth.
- Depress brake pedal while checking voltage.

NOTE: When pedal depressed, voltage must be supplied to terminal 25 before terminal 10.

Checking resistance - Fig. 22

Technical Data		
Terminals	Condition	Resistance
1 & 2	Pedal released	∞
3 & 4	Pedal released	∞
1 & 2	Pedal depressed	Zero
3 & 4	Pedal depressed	Zero

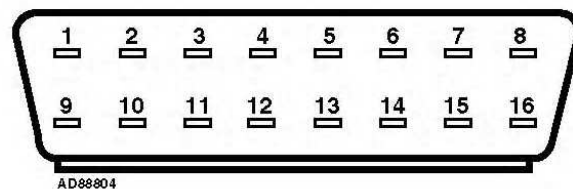
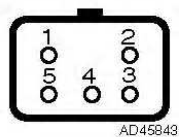
- Ensure ignition switched OFF.
- Disconnect BPP switch multi-plug.
- Check resistance between BPP switch terminals.
- Depress brake pedal while checking resistance.

NOTE: When pedal depressed, resistance must change at terminals 1 and 2 before terminals 3 and 4.

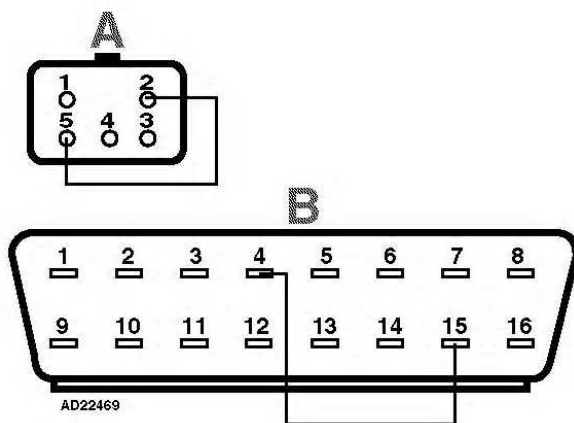
Hydraulic system

Bleeding

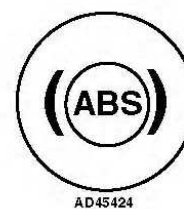
- Ensure ignition switched OFF.
- Ensure reservoir topped up to MAX.
- Bleed in sequence: RH front, LH front, RH rear, LH rear.
- Connect tube to bleed screw and immerse end in jar of clean fluid.
- Depress brake pedal firmly 5 times until pedal goes hard.
- Open bleed screw.
- Depress brake pedal fully.
- Close bleed screw. Tightening torque: 15 Nm.
- Allow brake pedal to return.
- Repeat process until fluid is air free.
- Maintain fluid level in reservoir during bleeding procedure.
- Top up reservoir to MAX.



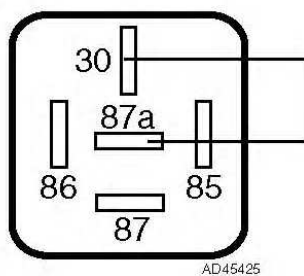
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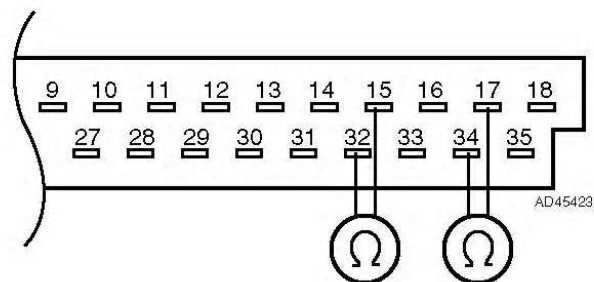
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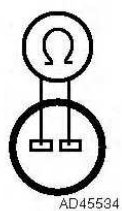
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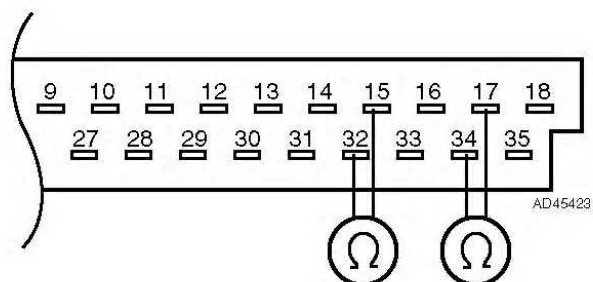
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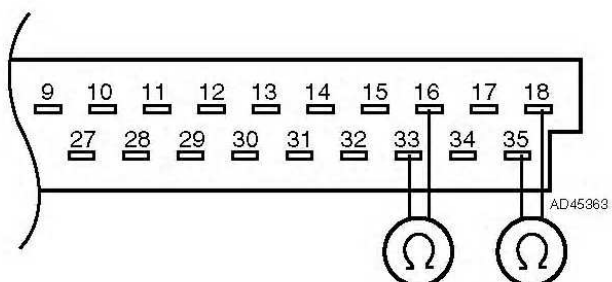
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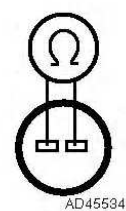
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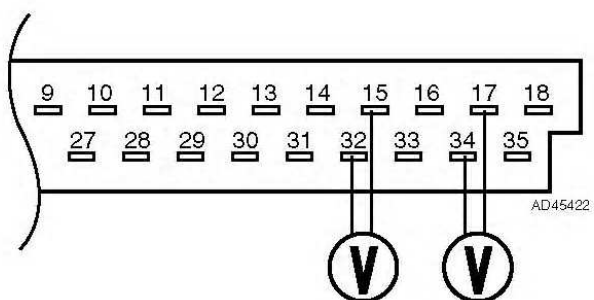
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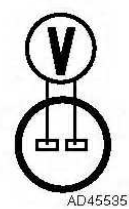
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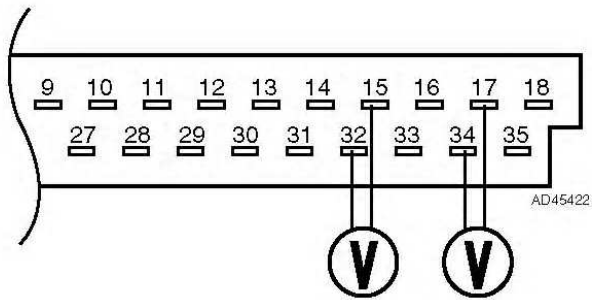
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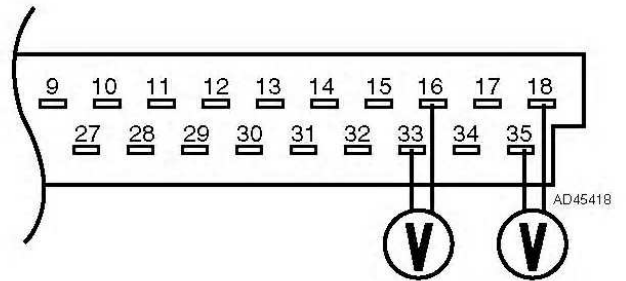
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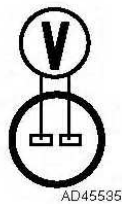
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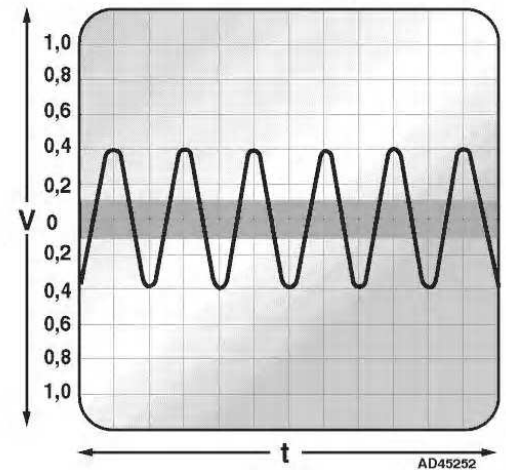
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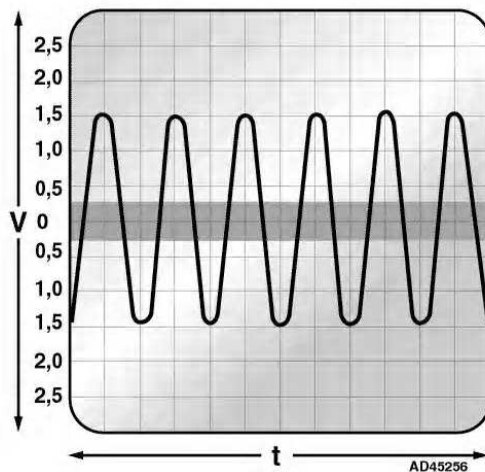
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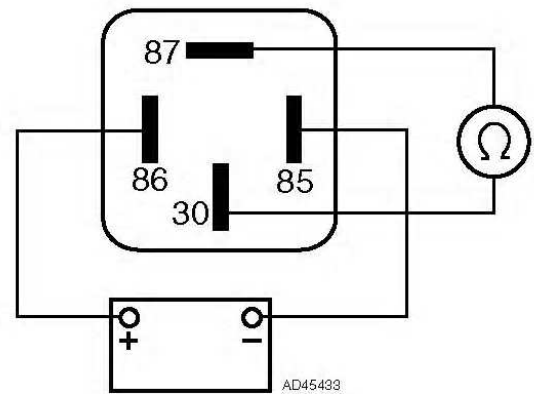
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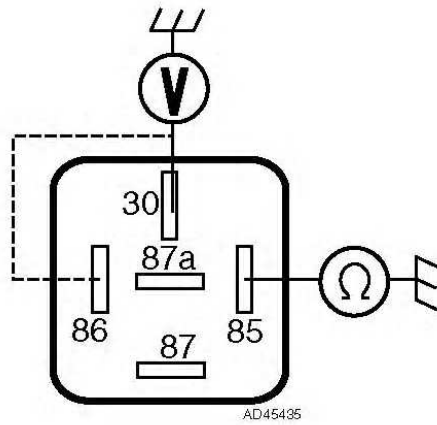
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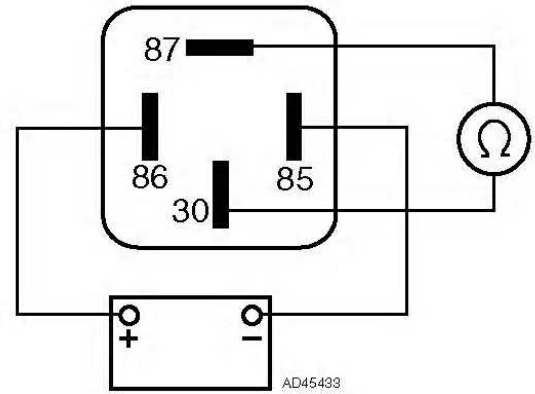
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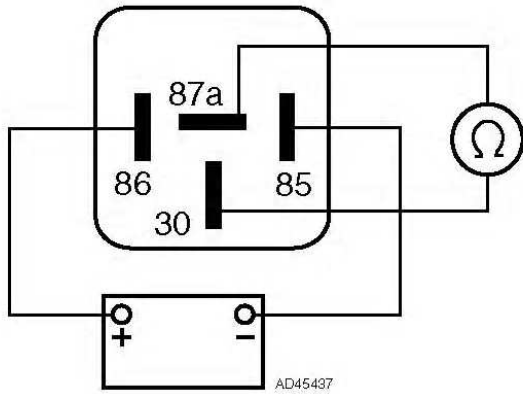
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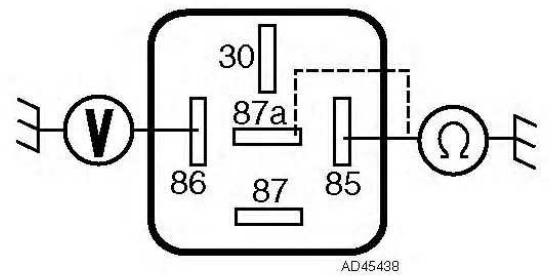
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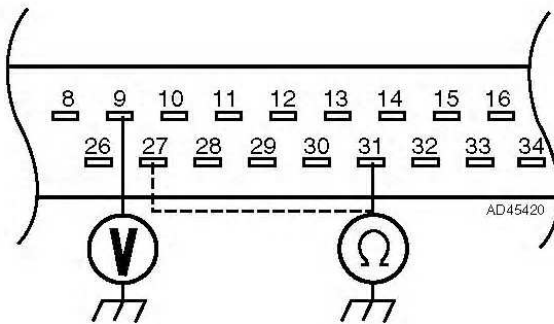
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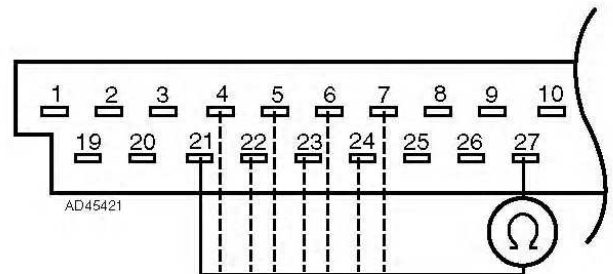
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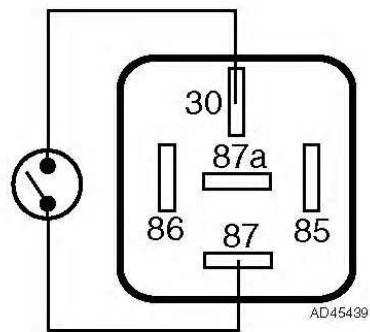
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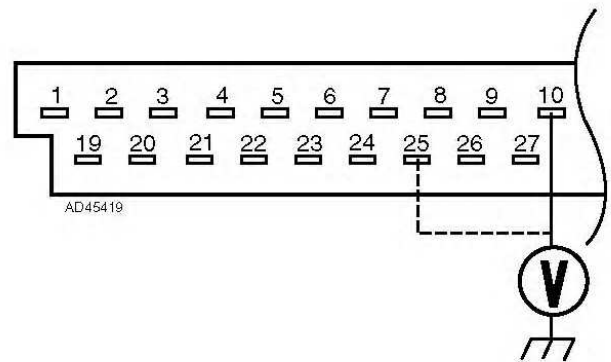
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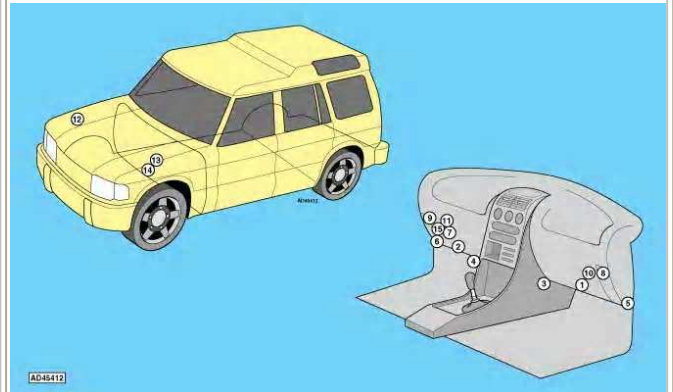
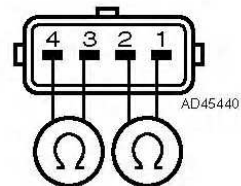
20



21



22



Manufacturer: Land Rover
Engine code:
Tuned for: R-Cat

Model: Discovery (90-98) 3,9
Output: 134 (182) 4750
Year: 1994-98

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9/20/2010

V7.412-ENG0195770

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