[Revision: 2.3]

ZF	-	*4HP22EH*	-	*4.0l V8 vehicles*
		4HP24	-	*4.6l V8 vehicles*
BOSCH	-	*GS8.87.0*	-	*99MY Discovery Series II*
		GS8.87.1	-	*99MY Range Rover*

4 Speed Electronic Automatic Transmission System

APPLICABILITY:	99MY Discovery Series II - 4.0 Petrol and 2.5 Turbo Diesel 99MY Range Rover - 4.0l and 4.6l Petrol Vehicles **99MY Range Rover Diesel transmissions are not covered by this document**
DATE:	19th May 1998

INDEX

1 Introduction

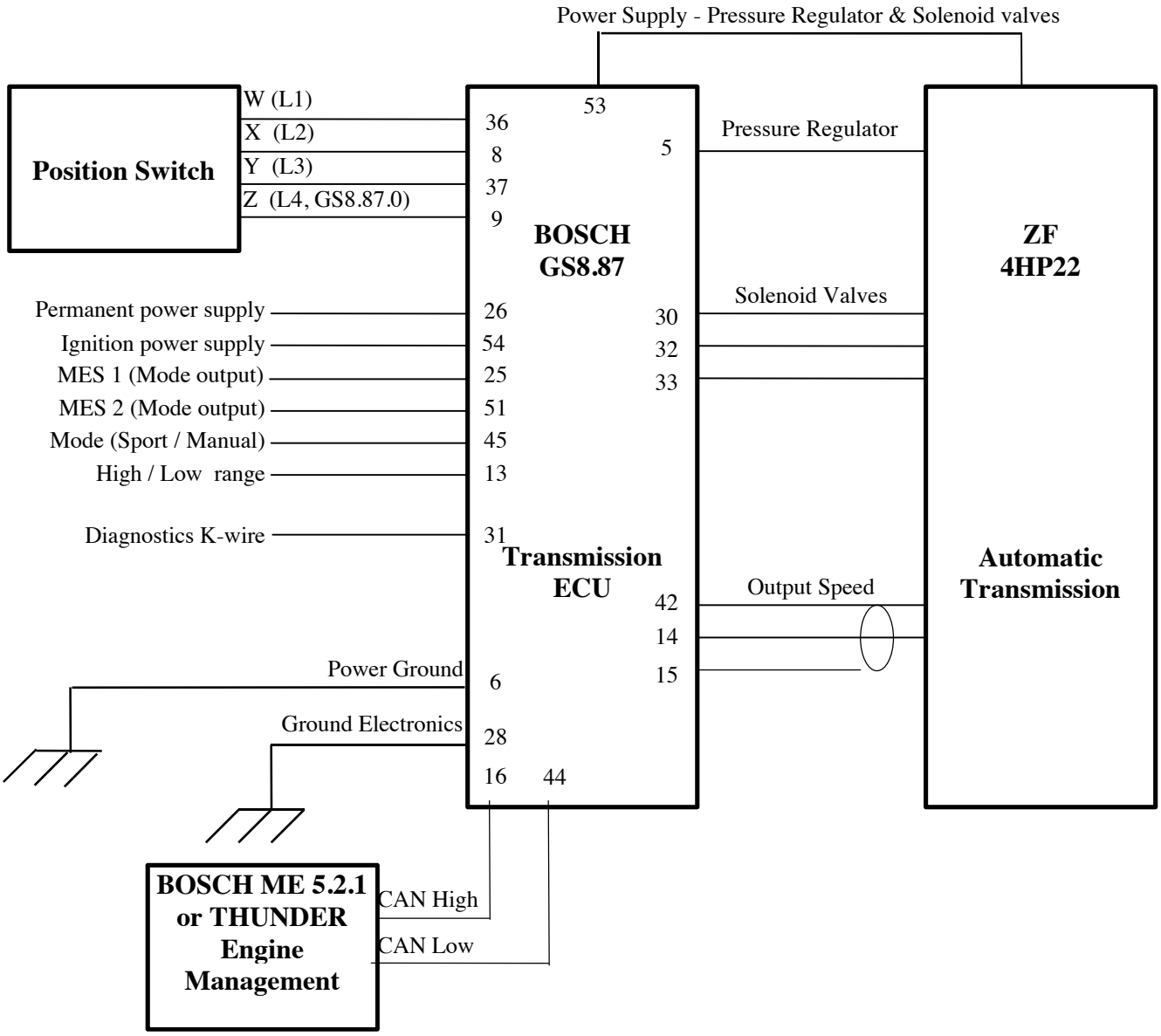
1.1 General

This document is intended to be a guide to the BOSCH Transmission controllers for the ZF 4 Speed Automatic Transmission unit incorporating the Torque Converter (4HP22). The information contained within gives the outline functionality, architecture and electrical specification. There should also be enough information to diagnose any system fault, which is complemented with a fault diagnosis tree.

2 Vehicle Interface requirements

2.1 Block Diagram

The Diagram below shows a summary of the vehicle architecture with reference to the Automatic Transmission Controller. For more detail, please refer to the following pages.



2.2 Interface specification

2.2.1 Gear Shift Solenoids

2.2.1.1 Pin 5 - Pressure regulator

The purpose of the Pressure regulator is to generate modulation pressure for the gearbox clutches. The pressure regulator is mounted between the common output supply (pin 53) and pin 6. It is driven by a pulse width modulated power signal that is generated and regulated in the CG202 ASIC.
+
The pulse width modulated signal frequency f_0 is generated permanently; the free running duty cycle corresponds to the minimal current and the maximal modulation pressure

- Component
  - Type: 2/2-way relief jet with falling characteristic line; the control edge is closed when the valve is without power supply.
  - Coil resistance R: 5.5Ω +/- 6% @20°C
  - I_max: 700mA mean value
  - I_min: 150mA mean value
  - Chopper frequency: 1000Hz +/- 50Hz @ +25°C
- Control Unit
  - Interface characteristic: current regulated, chopped output stage, pulse width modulated.
  - Current range: 145mA <= I_min <=175mA @ +25°C
  - Currrent range: 680mA <=I_max <=720mA @ +25°C
  - Reference point: Pin 6 (power ground
  - Recommended wire size: $1.0mm^2$

The ASIC status output is fed back to the processor for diagnostic purposes. See the diagnostic specification for details.

2.2.1.2 Pin 30 (MV1), 32 (MV3, lockup), 33 (MV2) - Solenoid valves 1,2 and 3

The purpose of solenoid valves 1 and 2 is to switch the hydraulic valves and thus control the hydraulic logic for gear selection. Solenoid valve 3 is to lock the torque converter.

The solenoid valves are mounted between the common output plus supply (pin 53) and their corresponding control pin. The solenoid valves are activated if the output control pins are drawn to ground.

- Component
  - Type: 3/2-way valves, inlet closed without power supply
  - Coil resistance: R20 = 32.5Ω +/- 2Ω
  - Operating voltage range: 9.5V <=U<=14V
  - Drop off current: I<30mA @ P-o = 4.5 bar +/- 0.1 bar
  - Temperature range: -30°C to +150°C under test conditions

- Control unit
  - Interface characteristic Power output
  - Output voltage low U_sat <=1V at I=1A
  - Reference point Pin 6 (power ground)
  - Recommended wire size: 1.0mm^2

The output voltages of Pin30, Pin32 and Pin33 are fed back over a resistor network to the processor for diagnostic purposes. During initialisation and operation the output signal is toggled periodically for a short time in order to enhance the diagnosis of the outputs.

2.2.1.3 Pin 53 - Power supply to Pressure regulator

When an ignition supply is available at the controller, pin 53 is a permanent power supply to the pressure regulator and the solenoid valves. This power supply can be switched off with hardware and software in the event of a failure in the transmission electrical system.

- Recommended wire size: 1.5mm^2

2.2.2 Controller power supply

2.2.2.1 Pin 6 - Power ground

Permanent connection from the ECU to 0V. This is used for driving the Solenoid valves and the Pressure regulator.

- Recommended wire size: 1.5mm^2

2.2.2.2 Pin 28 - Electronics ground

Permanent connection from the ECU to 0V. This is used for driving the electronics within the controller.

- Recommended wire size: 1.5mm^2

2.2.2.3 Pin 26 - Permanent ignition supply

Permanent connection to 12V required. This is essential in order to allow storage of data for adaptive pressure control.

- Recommended wire size: 0.5mm^2

2.2.2.4 Pin 54 - Ignition supply

Connection to +12V when the igntion is switch on. This is the main feed to the controller, allowing the transmission system to operate. It is essential that this supply is switch on at exactly the same time the engine management system receives an ignition supply. This is to ensure serial communications can be established between the two controllers.

If the battery supply is different from that expected, the following details the functionality of the transmission controller:

Voltage			System behaviour
16.0	-	26.0	Jump start; excess voltage without damage, limphome mode, output stanges for solenoid valves and pressure regulator switched off (max 1min at 40°C).
9.0	-	16.0	Voltage range for normal operation of the EAT with CAN-Bus corresponding to the specification.
6.5	-	9.0	Operation of the EAT with diagnostic functions and CAN-Bus enabled, limp home mode, output stages for solenoid valves and pressure regulator switched off.
3.0	-	6.5	Under voltage with data retention in SRAM, limp home mode, unreliable communication over the CAN bus.
0	-	3.0	Undervoltage without reliable function
-14	-	0	Reversed polarity without damage (-14V max 1 min at 25°C)

- Recommended wire size: $1.5mm^2$

2.2.3 Serial information - inputs

2.2.3.1 Pins 16 and 44 - CAN information from Engnine management system

Both Discovery Series II and 99MY Range Rover vehicles use a CAN specification owned by ZF called CAN 22H. This communication protocol operates at 500kBit/sec. Both the engine management system and the transmission controller should be fitted with 120Ω terminating resistors. For more information on the CAN bus, please refer to the CAN specification.

2.2.4 Serial information – outputs

2.2.4.1 Pins 16 and 44 - CAN information sent to Engine Management system

See section the relevant section - CAN information from the Engine management system.

2.2.5 Digital inputs

2.2.5.1 Pins 8, 9, 36, 37 - Position switch

The position switch is the electrical input to the Transmission ECU regarding the drivers requested gear. It is not however, exactly the same as the gear which the Transmission may have selected. The transmission assumes a new selector position has been selected after it has recognised a stable input / code from the position switch lines for a filter time TPO_FILT.

[ZF_4SPD\Project_Specs] [Revision: 2.3]

Discovery Series II (GS8.87.0):

A 12V supply is required to the position switch whenever there is an ignition feed to the Transmission controller. If this is not realised, the transmission will be unable to function correctly and so limphome mode will permanently be selected. The movement of the gear lever will make or break with 4 different sliding contacts. This creates a coded representation of the selected gear. These 4 wires go directly to the Transmission ECU (Terminals L1, L2, L3 and L4) where they are decoded. The software will then decide if the selected gear can be safely engaged without damage to the Transmission and Engine.

- Component
  - Type — Make contact to +12V
  - Location — Gearbox, assembled together with the switch block
  - Positions — Mechanical P R N D 3 2 1
    Hydraulic P R N D 1
    Electrical P R N D 3 2 1 Z
- Control Unit
  - Interface characteristic — Digital input, acitve high
  - Threshold U_low to U_high=<6.0V, label U_OS_AD
  - Threshold U_high to U_low=>2.0V, label U_US_AD
  - Hysteresis — U_low to U_high >= U_high to U_low + 0.5V
  - Input circuit — (1.15 +/- 0.2) kΩ (pull down to Ground)
  - Input current — 12.2 mA; input shorted to U_batt = 14V, R_in = 1.15 kΩ
  - Reference point — U_batt, pin 54

- Coded position inputs (a 1 represents a high potential, pulled high by the position switch)

Position Switch	**ECU Pin**	**P**	**Z1**	**R**	**Z1**	**N**	**Z2**	**D**	**Z3**	**3**	**Z4**	**2**	**Z4**	**1**
Line 1 (W)	36	1	1	0	1	1	1	1	1	0	0	0	0	0
Line 2 (X)	8	0	1	1	1	1	0	0	1	1	0	0	0	0
Line 3 (Y)	37	0	0	0	0	1	1	1	1	1	1	0	1	1
Line 4 (Z)	9	0	0	0	0	0	0	1	1	1	1	1	1	0

[ZF_4SPD\Project_Specs] [Revision: 2.3]

99MY Range Rover (GS8.87.1):

The position switch feed must be attached to ground at all times. If this is not realised, the transmission will be unable to function correctly and so limphome mode will permanently be selected. The movement of the gear lever will make or break with 3 different sliding contacts. This creates a coded representation of the selected gear. These 4 wires go directly to the Transmission ECU (Terminals L1, L2 and L3) where they are decoded. The software will then decide if the selected gear can be safely engaged without damage to the Transmission and Engine.

- Component
  - Type — Make contact to Ground
  - Location — Gearbox, assembled together with the switch block
  - Positions — Mechanical P R N D 3 2 1
    Hydraulic P R N D 1
    Electrical P R N D 3 2 1 F
- Control Unit
  - Interface characteristic — Digital input, acitve low
  - Threshold U_low to U_high=<6.0V, label U_OS_AD
  - Threshold U_high to U_low=>2.0V, label U_US_AD
  - Hysteresis — U_low to U_high >= U_high to U_low + 0.5V
  - Input circuit — (1.21 +/- 0.2) kΩ (pull up to U_batt)
  - Input current — -11.2 mA; input shorted to Ground, R_in = 1.21 kΩ
  - Reference point — Digital ground, pin 28
  - Coded position inputs (a 0 represents a low potential, pulled low by the position switch)

Position Switch	ECU Pin	P	R	N	D	3	2	1
Line 1 (W)	36	0	0	1	1	0	0	0
Line 2 (X)	8	1	0	0	0	0	1	1
Line 3 (Y)	37	1	1	1	0	0	0	1

2.2.5.2 Pin 13 - High / Low range input

Discovery Series II (GS8.87.0):

The high / low range switch is electrically connected both to the transfer box and the EAT. It sets the transmission ratio of the transfer box and indicates the selected range to the EAT.

The closed switch indicates Low range, and open switch indicates high range. After a change of the signal (a rising or falling edge), the EAT ratains the signal vaue before the change for the applicable time THL_WAIT.

- Component
  - Type — Make contact to ground
  - Location — Centre console
  - Switch open — High range
  - Switch closed (to ground) — Low range
- Control Unit
  - Interface characteristic — Digital input, active low
  - Threshold U_low to U_high — =< 6.0V, U_OS_AD
  - Threshold U_high to U_low — => 2.0V, U_US_AD
  - Hysteresis — U_low to U_high => U_high to U_low +0.5V
  - Input circuit — (1.2 +/- 0.2) kΩ (pull up to Ubp)
  - Input current — -10mA, input grounded, U_batt = 14V, R_in = 1.2kΩ
  - Reference — Digital ground, pin 28

[ZF_4SPD\Project_Specs] [Revision: 2.3]

99MY Range Rover (GS8.87.1):

The high / low range switch on 99My Range Rover is a component of the H-gate. It is electrically connected to the transfer box; the input signal to the EAT is generated in the control unit of the transfer box.

A constant high signal indicates Low range, a constant low signal indicates high range. When the range is changing from Low range to High range, the transfer box ECU sends a periodic pulse whilst in the neutral position.

After a change of the signal (ie a rising or falling edge), the EAT retains the signal value before the change for the applicable time THL_WAIT.

- Component
  - Type: Active low
  - Location: Transfer box
  - Signal open circuit / high: Low range
  - Signal active / low: High range
- Control Unit
  - Interface characteristic: Digital input, active low
  - Threshold U_low to U_high: =< 6.0V, U_OS_AD
  - Threshold U_high to U_low: => 2.0V, U_US_AD
  - Hysteresis: U_low to U_high => U_high to U_low +0.5V
  - Input circuit: (1.2 +/- 0.2) kΩ (pull up to Ubp)
  - Input current: -10mA, input grounded, U_batt = 14V, R_in = 1.2kΩ
  - Reference: Digital ground, pin 28

2.2.5.3 Pin 45 - Driver mode request

Discovery Series II (GS8.87.0):

The program selector is used to select shift strategies depending on the setting of the High/Low range switch. The strategies can be selected independently for High range and Low range. After ignition on and after changing between High range and Low range, the EAT assumes a default shift strategy (normal mode).

The number of implemented shift strategies can be individually set for High range and Low range by the label KPG_MAX

The program selector is a push button that is debounced and latched by software in the EAT. The EAT changes the shift strategy after it has recognised the stable input voltage U_low for the time period TPG_FILT

- Component
  - Type: Make contact to ground
  - Max bounce time: <= 50ms
  - Location: facia or centre console
  - Positions: Toggle between shift strategies
  - Switching function: Normal - Sport (high range), Normal - Manual (low range)
- Control Unit
  - Interface characteristic: Digital input, active low
  - Threshold U_low to U_high: =< 6.0V, U_OS_AD
  - Threshold U_high to U_low: => 2.0V, U_US_AD
  - Hysteresis: U_low to U_high => U_high to U_low +0.5V
  - Input circuit: (1.2 +/- 0.2) kΩ (pull up to Ubp)
  - Input current: -10mA, input grounded, U_batt = 14V, R_in = 1.2kΩ
  - Reference: Digital ground, pin 28

99MY Range Rover (GS8.87.1):

The purpose of the program selector is to select shift strategies depending on the setting of the High / Low range input. The strategies can be selected independantly for High Range and Low Range. After ignition on and after changing between high range and low range, the EAT assumes a default shift strategy (normal mode).

The number of implemented shift strategies can be inndividually set for high range and Low range by the label KPG_MAX.

The program selector is a switch that is debounced and latch internally. The EAT changes shift strategy after it has recognised a stable input voltage for a time period TPG_FILT.

- Component
  - Type — Make contact to ground
  - Max bounce time — <= 50ms
  - Location — H gate
  - Positions — Toggle between shift strategies
  - Switching function — Switch open, signal high = Normal
    Switch closed, signal low = Sport (high range)
    Switch closed, signal low = Manual (low range)
- Control Unit
  - Interface characteristic — Digital input, active low
  - Threshold U_low to U_high — =< 6.0V, U_OS_AD
  - Threshold U_high to U_low — => 2.0V, U_US_AD
  - Hysteresis — U_low to U_high => U_high to U_low +0.5V
  - Input circuit — (1.2 +/- 0.2) kΩ (pull up to Ubp)
  - Input current — -10mA, input grounded, U_batt = 14V, R_in = 1.2kΩ
  - Reference — Digital ground, pin 28

2.2.6 Digital outputs

2.2.6.1 Pin 25 and 51 - MES lines 1 and 2

The MES signal lines drive lights in the instrument pack that display the selected shift strategy and the EAT's fault state. Pin 51 and Pin 25 are open drain outputs. The following table shows the switching function; a "0" represents a low output, a "1" represents a high output voltage.

	MES 1 - Pin 51	MES 2 - Pin 25
Normal	1	1
Sport	0	1
Manual	1	0
Fault	0	0

- Component
  - U_low — U < 1.2V
  - U_high — U > U_batt - 3.0V
  - R to U_batt — 1.0kΩ
- Control unit
  - Interface characterisics — Digital output / open drain, active low
  - U_low — <= 1.0V @ I = 30mA
  - U_high — >= U_batt - 2.0V at I <= 0.5mA
  - R to U_batt — 1.21 kΩ

N.B. After reset and igniton on, the MES lines display "Normal" as the default strategy.

2.2.7 Analogue inputs

2.2.7.1 Pins 14,15,42 - Output shaft speed sensor

The transmission output shaft speed is captured by an inductive sensor that is mounted at a magent wheel with 36 teeth. The signal is transmitted to the EAT over a shielded 2-wire connection.

- Component (inductive sensor)
  - location: Gearbox housing
  - output: 36 pulses per revolution
  - f_min: 102Hz (170 rpm)
  - f_max: 5.0kHz (8333 rpm)
  - sensor voltage Ui_min: 0.7 Vs at 102Hz (peak voltage)
  - sensor voltage Ui_max: 1.3 Vs at 102Hz (peak voltage)
  - sensor distance: 0.85mm
  - load resistance: R_1 = 20kΩ
- Control unit
  - Interface characteristic: Frequency input
  - R_in Pin 14 to Pin 42: 20kΩ
  - sensitivity U_min: 1.2Vss (peak to peak) @ 100 Hz
  - sensitivity U_max: 200 Vss @ 100 Hz
  - f_max: 6.0 kHz
- Rotational limit
  - n_min: 170 rpm
  - n_max: 8333 rpm
  - Switching voltage of input: (U @ Pin 42 - U @ Pin 14) /2
- Signal processing in the EAT
  - The EAT calculates the mean period time over one program loop.

2.2.8 Diagnostic interface

2.2.8.1 Pin 31 - Diagnostic line (K line)

The K line is the main interface between the on board electronic control units and external diagnostic devices as customer specific testers, Scantool, development tools or end of line programmers.

Customer specific testers are used to read diagnostic data from the fault memory, to manipulate diagnostic data and / or manipulate other data like country variants or calibration data. Scantools are used to access the OBDII relevant entries in the fault memory and to manipulate them.

Development tools are used to display and to manipulate random data of the EAT including the fault memory.

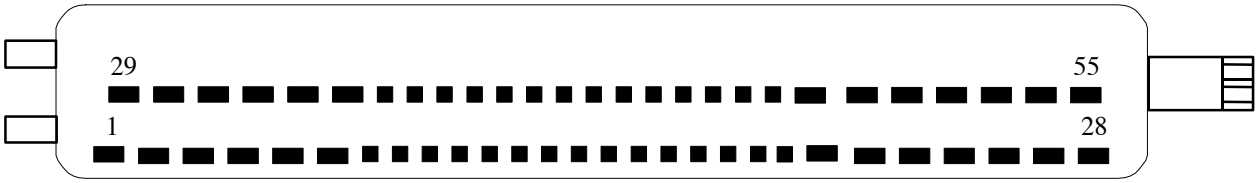
- Component

  The physical and transfer layer must be compatible to ISO9141 and ISO9141 CARB. The EAT supports the application and protocol layer of ISO9141 CARB. Other customer specific protocols can be implemented.

- Control unit

- interface characteristic	Digital input / output
- signal form	Square wave
- voltage levels	compliant to ISO 9141
- input resistance	compliant to ISO 9141
- data transfer rate	10.4 kBaud for CARB diagnostics Other supported protocols, see relevant specification.

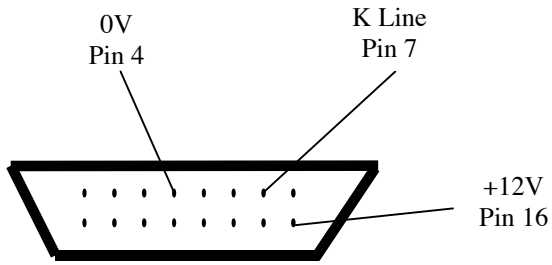
2.3 ECU Connector Pin-out



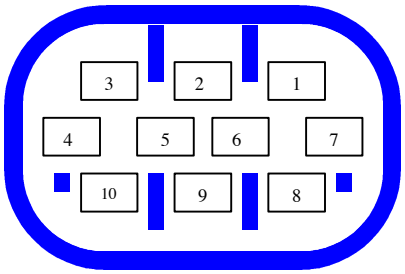
Pin	Function	Wire Colour	Pin	Function	Wire Colour
1	Not used		29	Not used	
2	Not used		30	Solenoid Valve 1; MV1	
3	Not used		31	K Line (Diagnostic line)	
4	Not used		32	Solenoid valve 3; MV3	
5	Pressure regulator		33	Solenoid valve 2; MV2	
6	Power Ground		34	Not used	
7	Not used		35	Not used	
8	Position Switch Line 2 (X)		36	Position Switch Line 1 (W)	
9	Position Switch Line 4 (Z) (GS8.87.0 only)		37	Position Switch Line 3 (Y)	
10	Not used		38	Not used	
11	Not used		39	Not used	
12	Not used		40	Not used	
13	High / Low Range Input		41	Not used	
14	Output speed sensor -		42	Output speed sensor +	
15	Output speed sensor screen		43	Not used	
16	CAN – High		44	CAN – Low	
17	Not used		45	Mode Switch	
18	Not used		46	Not used	
19	Not used		47	Not used	
20	Not used		48	Not used	
21	Not used		49	Not used	
22	Not used		50	Not used	
23	Not used		51	MES Line 1	
24	Not used		52	Not used	
25	MES Line 2		53	Supply, Solenoids & PR	
26	Permanent Battery Supply		54	Ignition Battery Supply	
27	Not used		55	Not used	
28	Electronic Ground				

2.4 Vehicle connector pin outs

2.4.1 Diagnostic Connector



2.4.2 Harness to Position switch (mounted on Transmission)



1	-	12V supply
2	-	Line 1
3	-	Line 2
4	-	Line 3
5	-	Line 4
6	-	
7	-	
8	-	
9	-	
10	-	

2.4.3 Harness to Solenoid Valves (mounted on Transmission)

3 Description of Functionality

In an Electronic Automatic Transmission, the hydraulic valve block is replaced with an Electronically controlled hydraulic valve block. This allows the shift points and valve pressures to be calibrated individually for every possible situation. The result is an improvement in shift quality, and increased torque capacity and more flexibility of shift patterns.

The Electronic Control Unit is programmed with software which monitors all the relevant electrical inputs required to decide what type of shift should be made. As well as this information, several special features exist within the software to improve the drivablility and functionality of the Vehicle.

3.1 Special features

3.1.1 Sport Mode.

In order to activate the sport mode, the "mode" button must be pressed whilst the vehicle is in high range. This will make the vehicle more responsive to accelerator pedal movement, changing down gears sooner than would be the case in the default normal mode.

3.1.2 Manual Mode.

In order to activate the manual mode, the "mode" button must be pressed whilst the vehicle is in low range. This mode is designed to give improved off road performance. If the vehicle is in manual mode, the position of the selector will refelect the gear engaged, rather than the maximum gear required. For example, if the selector position is in "3" whilst driving in normal modes, gears 1,2 and 3 will be available However, in manual mode, if position "3" is selected, the transmission will select 3rd gear very shortly after pulling away from rest. Kickdown is disabled in this mode.

3.1.3 Towing / Driving up steep gradients

When the vehicle is in its normal default mode (ie, High range with sport not selected) the transmission will select a shift pattern approriate the the current conditions. If either a heavy trailer is being pulled, or a steep gradient is being climbed, the transmission will hold onto gears longer than would normally be the case to aid performance and drivability.

3.1.4 Compensation for reduced engine torque

In a similar way to the Towing mode, if the vehicle is producing less torque than would normally be the case (high altitude or very hot air into the engine) then the transmission will hold onto gears longer than would normally be the case. This is a very similar situation to towing, but the performance of the vehicle is reduced due to a lack of engine power, rather than the weight of the vehicle.

3.1.5 Calibration Selection (99MY V8 Range Rover Only)

ECU part numbers differentiate between North America, UK/Euro and Rest of world. Each ECU contains two calibrations, 4.0l and 4.6l. When an ECU is fitted to a vehicle, the correct calibration must be selected, or a gearbox fault will be stored, and "Gearbox fault" will be displayed in the message centre. The vehicle can be driven in this state, and is not in limp home mode. However, vehicles must not be driven for long in this state.

When the correct calibration is selected (4.0l or 4.6l), the fault code memory is deleted automatically. If the ECU is removed from the vehicle, the correct calibration is remembered. For this reason, it is important that if ECU's are swapped between vehicles, the correct calibration must be selected.

4 Fault finding

If there is a fault with the transmission, a substitute function will be activated which will allow the vehicle to be driven in some manner whilst attempting to protect the transmission. Depending on the fault, the substitute function activated may or may not be noticeable to the driver.

Abnormal gear shifting

If a fault exists that will not damage the transmission, cause inconvienience to the driver or increase the emmisions output of the vehicle by 15%, there will be no warning lights illuminated but a fault code will be stored. If a driver does notice the vehicle is behaiving differently, this could be due to a fault of this type.

Sport and Manual lights flashing together

If something has happend which will effect the performance of the transmission, the Sport and Manual lights will flash at the same time. This indicates a fault code has been stored. If this happens to a customer, the first thing the customer should attempt is to turn off the ignition, and re-start the vehicle. If the lights continue to flash, the car should be taken to the nearest Land Rover dealer as soon as possible.

If both lights are flashing, the transmission will have selected a limp-home mode. Although the vehicle will drive, damage to the transmission may occur if the fault is not corrected. When the vehicle is in this state, special care should be taken when selecting position D. In absolutly no circumstances should the vehicle be moving backwards when position D is selected.

4.1 Fixing faults

If either of the above conditions are true, the transmission controller should have stored a fault code. The following is recommended as the order in which abnormal transmission beaviour should be investigated.

4.1.1 The transmission ECU is disconnected

The automatic transmission ECU is located under the left hand from seat of 98MY and later Discovery vehicles. On vehicles prior to this model year, the transmission is hydraulic and therefore has no controlling electronics.

If the ECU has been disconnected, the transmission will have selected a hydraulic limp-home. The ECU should be connected whilst the ignition is off.

4.1.2 The transmission has diagnosed a fault.

If the software within the transmission ECU has diagnosed there is something wrong with the system, a fault code will be stored. If the diagnosed fault is currently active (ie, the transmission can currently not fucntion correctly), the Sport and Manual lights will flash together. After a fault code has been stored and the car has completed 40 journeys and the fault has not happend again, the fault code will be deleted from memory.

If a fault is stored, the vehicle must be interogatted using a TestBook. The following page lists each fault code and its effect on the transmission system.

4.1.3 Power to the ECU has been lost or K line not connected.

If the transmission ECU is connected, but the TestBook cannot communicate with the ECU, then the power supply to the ECU may have been lost or the K line is not connected. In this instance, the following sequence of events should be followed.

A) Turn the ignition to the off position.
B) Disconnect the transmission ECU.
C) Test the voltage at Pin 26 with a volt meter. This should read greater than 10V.
D) Measure the resistance to ground with a digital volt meter or equivalent, of pins: 6 and 28. The resistance should be less than 100 ohms.
E) Turn the ignition to position II (normal running position).
F) Test the voltage at Pin 54 with a volt meter. This should read greater than 10V.

If the above is completed with no strange reading, the ECU's power supply is OK. The only possibility is the Diagnostic connector is not attached to the ECU. To check for this:

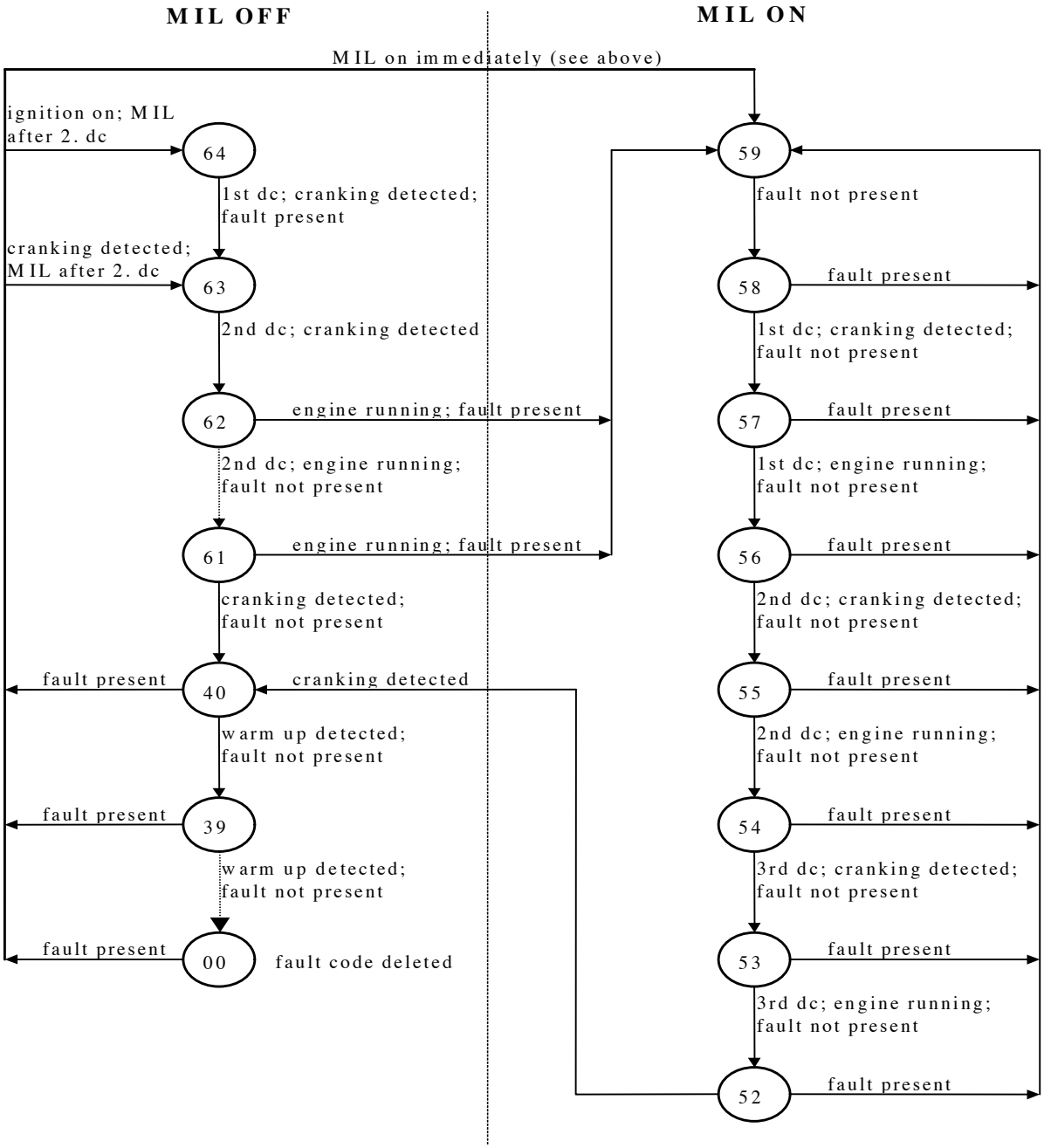
G) Measure the resistance between pin 31 of the ECU connector, and pin 7 of the vehicle diagnostic connector (see drawing later). This should be less than 10 ohms.

[ZF_4SPD\Project_Specs] [Revision: 2.3]

4.2 MIL light illumination (N.A.S. vehicles only)

The illumination of the MIL (Check engine light) is controlled by the following counter. This counter is only applicable for MIL (emissions) related faults. Any faults which prevent the gearbox from requesting the MIL light will automatically illuminate the MIL light immediately.

Definition of a Warmup: Engine Coolant temperature rises by 16ºC and exceeds 72ºC.



5 Fault codes

5.1 Ambient conditions stored

The following lists all fault codes, together with the associated CARB P code, a description and the ambient conditions saved with each fault code. The ambient conditions must be multiplied by the following conversion factors in order to calculate the ambient conditions present when the fault was diagnosed.

Please note. The ambient conditions stored with each fault are those at the time of the first occurrence of the fault and are not updated if the fault re-occurs. The ambient conditions stored with each fault may change prior to volume. This will not effect TestBook, as the ambient conditions of each fault are referenced in the diagnostic protocol.

Variable	Scaling factor	Description
AN6	1 Volt = 4.65_{10}	Solenoid valve 1 voltage
AN7	1 Volt = 4.65_{10}	Solenoid valve 2 voltage
AN8	1 Volt = 4.65_{10}	Solenoid valve 3 voltage
AN9	1 Volt = 4.65_{10}	MES1 voltage
AN11	1 Volt = 4.65_{10}	MES2 voltage
MMM	2 Nm = 1_{10}	Engine torque
N_MOT	32 rpm = 1_{10}	Engine speed
UBATT	1 Volt = 9.8_{10}	Battery voltage
VGT_$X	1 km/h = 1_{10}	Output shaft speed
YPO_Old	L1=Bit 0, L2 = Bit 1 etc	Position switch L1 - L4 inputs

5.2 Fault codes descriptions

For the recommended method to diagnose each of the fault codes, please refer to the last section in this document, Fault tree analysis.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
1	Transmission relay control (Relay sticks, short circuit)	P1613	AN6	AN7	UBATT

The transmission controllers supply to the power outputs is faulty. This could be due to a problem in the harness (short circuit to 12V of a power output stage), or an internal ECU fault.

Diagnostic operates:	Initialisation; approximately 60ms after ignition is switched on. Normal operation;
Conditions to be met to run Diagnostic:	None
Time between fault present & fault stored:	10ms max
Variables used by the diagnostic:	Status of Watchdog circuit, Status of Highside switch
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switch on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
2	Transmission relay control (Relay sticks, open circuit)	P1612	AN6	AN7	UBATT

The transmission controllers supply to the power outputs is faultly. This could be due to a problem in the harness (short circuit to 0V), or and internal ECU fault.

Diagnostic operates:	Initialisation; approximately 200ms after ignition is switched on
Conditions to be met to run Diagnostic:	Battery voltage > 10.5V
Time between fault present & fault stored:	60ms max.
Variables used by the diagnostic:	Status of Watchdog circuit, Status of Highside switch
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
3	EEPROM communication fault	P1606	N_MOT	VGT_$X	MMM

The ECU cannot communicate with part of its internal memory, ie ECU fault

Diagnostic operates:	Continuously
Conditions to be met to run Diagnostic:	None
Time between fault present & fault stored:	1 second
Variables used by the diagnostic:	Internal communication between the Processor and the memory
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
4	EEPROM checksum fault	P1601	N_MOT	VGT_$X	MMM

The software within the transmission control unit is not recognised. Part of the software is programmed to recognised if any changes to the software or calibration have been made. If this is the case, the transmission will select limphome.

Diagnostic operates:	Normal operation
Conditions to be met to run Diagnostic:	Initialisation complete
Time between fault present & fault stored:	Max. 1 minute.
Variables used by the diagnostic:	Function of all data stored on EPROM
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition switched on whilst fault not present, engine cranked

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
5	Torque converter lock-up clutch monitoring	P0741	N_MOT	VGT_$X	MMM

The software has detected a potential problem with the torque converter system.

Diagnostic operates:	When the Torque converter is locked
Conditions to be met to run Diagnostic:	No Engine speed, Output shaft speed or gear ratio faults active.
Time between fault present & fault stored:	5 seconds max.
Variables used by the diagnostic:	Engine Speed, Output shaft speed, Throttle angle, selected gear.
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition switched on whilst fault not present, engine cranked

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
6	Watchdog check	P1606	N_MOT	VGT_$X	MMM

Internal ECU fault.

Diagnostic operates:	Initialisation; approximately 70ms after ignition on. Normal operation;
Conditions to be met to run Diagnostic:	None
Time between fault present & fault stored:	60ms max.
Variables used by the diagnostic:	Status of Highside switch, Status of Watchdog circuit.
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition switched on whilst fault not present, engine cranked

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
7	Solenoid valve lockup clutch check (short circuit to +)	P0743	N_MOT	AN8	UBATT

The transmission ECU has diagnosed a short circuit to 12V of pin 32.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: Torque converter unlocked
Time between fault present & fault stored: 10ms
Variables used by the diagnostic: Voltage at Pin 32
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Initialisation complete, engine cranked, diagnostic runs & fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
8	Solenoid valve 1check (short circuit to +)	P0753	N_MOT	AN6	UBATT

The transmission ECU has diagnosed a short circuit to 12V of pin 30.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: Solenoid valve 1 = off
Time between fault present & fault stored: 10ms
Variables used by the diagnostic: Voltage at Pin30
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Initialisation complete, engine cranked, diagnostic runs & fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
9	Solenoid valve 2check (short circuit to +)	P0758	N_MOT	AN7	UBATT

The transmission ECU has diagnosed a short circuit to 12V of pin 33.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: Solenoid valve 2 = off
Time between fault present & fault stored: 10ms
Variables used by the diagnostic: Voltage at Pin 33
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Initialisation complete, engine cranked, diagnostic runs & fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
10	Pressure regulator check (short circuit to +)	P0748	N_MOT	VGT_$X	UBATT

The transmission ECU has diagnosed a short circuit to 12V of pin 5.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 150ms
Variables used by the diagnostic: Voltage at Pin 5
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Initialisation complete, engine cranked, diagnostic runs & fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
11	CAN message MD_REIB invalid (FFh)	P1884	N_MOT	VGT_$X	MMM

The CAN message from the engine management controller which informs the transmission of the engine friction is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: No CAN timeout or CAN level fault stored
Time between fault present & fault stored: Filter time 2.5s
Variables used by the diagnostic: CAN message MD_REIB from engine management controller
Will limp home mode be selected: No
Conditions to be met to clear the fault: Engine started with fault no present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
12	MES line 1 fault	P1810	N_MOT	AN9	UBATT

One of the wires which drives the sport and manual lights in the instrument pack has an electrical fault.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 1 s
Variables used by the diagnostic: Voltage at 51
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition on with fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
13	MES line 2 fault	P1810	N_MOT	AN11	UBATT

One of the wires which drives the sport and manual lights in the instrument pack has an electrical fault.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 1 s
Variables used by the diagnostic: Voltage at pin 25
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition on with fault not present

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
14	Position switch monitoring (permanent)	P0705	N_MOT	YPO_OLd	UBATT

The position switch is the electrical input to the transmission controller of the driver selected PRiNDle position. The fault means the ECU has recognised an electrical code from this switch which does not represent a valid position.

The fault can be due to 3 reasons. Firstly, one or more of the wires to the position switch has become open circuit or short circuit to 0V or 12V. Secondly, the 12V supply from the body control unit to the position switch has been removed whilst the ignition is in position II (in extreme circumstances, this may be possible whilst the vehicle is cranking). Thirdly, the position switch is worn, or has water / dirt ingress. In the last case, the position switch must be changed. The following table indiates the voltages which should be seen by the ECU in each selector position, whilst the ignition is on.

98MY Discovery selector codes. (A Z* code in this table represents an intermediate selector position.)

Position Switch	ECU Pin	Selector Position												
		P	Z1	R	Z1	N	Z2	D	Z3	3	Z4	2	Z4	1
Line 1 (W)	36	12V	12V	-	12V	12V	12V	12V	12V	-	-	-	-	-
Line 2 (X)	8	-	12V	12V	12V	12V	-	-	12V	12V	-	-	-	-
Line 3 (Y)	37	-	-	-	-	12V	12V	12V	12V	12V	12V	-	12V	12
Line 4 (Z)	9	-	-	-	-	-	-	12V	12V	12V	12V	12V	12V	-

99MY Range Rover selector codes.

Position Switch	ECU Pin	Selector Position						
		P	R	N	D	3	2	1
Line 1 (W)	36	0V	0V	>	>	0V	0V	>
Line 2 (X)	8	>	0V	0V	0V	0V	>	>
Line 3 (Y)	37	>	>	>	0V	0V	0V	0V

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 100 ms
Variables used by the diagnostic: W,X,Y, (Z) digital inputs
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
15	CAN level monitoring	P1842	N_MOT	VGT_$X	MMM

The CAN protocol is not compatible between the engine and transmission controller.

Diagnostic operates: On arrival of first CAN message from the Engine Management Controller
Conditions to be met to run Diagnostic: Ignition on
Time between fault present & fault stored: 1.5 s
Variables used by the diagnostic: CAN_STAND = 22H (CAN message)
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
16	CAN bus monitoring	P1841	N_MOT	VGT_$X	MMM

Messages being transmitted on the CAN bus are being corruprted.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 300 ms
Variables used by the diagnostic: None
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
17	CAN timeout monitoring	P1843	N_MOT	VGT_$X	UBATT

There has been no communication from the engine management controller over the CAN serial link for a specified time.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 1 s
Variables used by the diagnostic: Time since last CAN message received
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
18	CAN message WFPDK (Throttle angle) is invalid (FFh)	P1884	N_MOT	VGT_$X	MMM

The CAN message WFPDK indicates to the transmission controller the driver demand (ie accelerator pedal position).

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10ms
Variables used by the diagnostic: Throttle angle signal on CAN
Will limp home mode be selected: No, substitute throttle angle, Gearbox lights to indicate Kick down not available
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
19	CAN message T_MOT invalid (FFh)	P1884	N_MOT	VGT_$X	MMM

The CAN message T_MOT (engine temperature) from the engine management controller is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: Engine temperature signal via CAN
Will limp home mode be selected: No, substitute engine temperature used.
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
20	CAN message V3 (road speed) invalid (FFh)	P1884	N_MOT	VGT_$X	MMM

The CAN message V3 (Velocity) from the engine management controller is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10ms
Variables used by the diagnostic: CAN message V3
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
21	Downshift safety monitoring	P0721	N_MOT	VGT_$X	MMM

The transmission control unit has prevented a gear shift which would have caused an engine overspeed.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: Transmission not in Limp Home
Time between fault present & fault stored: 10ms max.
Variables used by the diagnostic: Engine Speed, Target gear
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
22	Stall speed monitoring	P0722	N_MOT	VGT_$X	MMM

The torque converter has appeared to slip more than the specificed amount.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 40 ms
Variables used by the diagnostic: Engine Speed, gear selected, Output shaft speed.
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
23	Position Switch during cranking (99MY Range Rover only)	P0705	N_MOT	YPO_Old	UBATT

The engine speed has exceeded its maximum speed.

Diagnostic operates: During cranking only
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: Engine speed, selector position, road speed ?
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
24	Battery supply check	P1562	N_MOT	MMM	UBATT

Whilst the engine is running, the battery supply has fallen to below 9V.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: Engine speed > 996 rpm
Time between fault present & fault stored: 300 ms
Variables used by the diagnostic: Engine speed, battery supply voltage
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
25	Solenoid valve for TC (short circuit to - or open circuit)	P0743	N_MOT	AN8	UBATT

Pin 32 (Solenoid valve for torque convertor lockup) is either short circuit to 0V or open circuit.

Diagnostic operates:	Continuously
Conditions to be met to run Diagnostic:	Torque converter = locked
Time between fault present & fault stored:	20 ms
Variables used by the diagnostic:	Status of torque converter drive, Battery voltage
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
26	Solenoid valve 1 (line short circuit to - or open circuit)	P0753	N_MOT	AN6	UBATT

Pin 30 (Solenoid valve 1) is either short circuit to 0V or open circuit.

Diagnostic operates:	Continuously
Conditions to be met to run Diagnostic:	Solenoid valve 1 = on
Time between fault present & fault stored:	20ms
Variables used by the diagnostic:	Status of Solenoid valve 1, Battery voltage
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
27	Solenoid valve 2 (line short circuit to - or open circuit)	P0758	N_MOT	AN7	UBATT

Pin 33 (Solenoid valve 2) is either short circuit to 0V or open circuit.

Diagnostic operates:	Continuously
Conditions to be met to run Diagnostic:	Solenoid valve 2 = on
Time between fault present & fault stored:	20 ms
Variables used by the diagnostic:	Status of Solenoid valve 1, Battery voltage
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
28	Pressure regulator (line short circuit to - or open circuit)	P0748	N_MOT	VGT_$X	UBATT

Pin 5 (pressure regulator) is either short circuit to 0V or open circuit.

Diagnostic operates:	Continuously
Conditions to be met to run Diagnostic:	None
Time between fault present & fault stored:	20 ms
Variables used by the diagnostic:	Status of low side pressure regulator driver
Will limp home mode be selected:	Yes
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
29	Gear ratio monitoring, 1st gear	P0731	N_MOT	VGT_$X	MMM

Ratio of engine speed to output shaft speed whilst 1st gear is engaged is out of range.

Diagnostic operates:	NAS vehicles only, Continuously
Conditions to be met to run Diagnostic:	1st gear selected, gear shift not in progress
Time between fault present & fault stored:	800 ms
Variables used by the diagnostic:	Engine Speed, Engine Torque, Output shaft speed, Selected gear
Will limp home mode be selected:	No
Conditions to be met to clear the fault:	Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
30	Gear ratio monitoring, 2nd gear	P0732	N_MOT	VGT_$X	MMM

Ratio of engine speed to output shaft speed whilst 2nd gear is engaged is out of range.

Diagnostic operates: NAS vehicles only, Continuously
Conditions to be met to run Diagnostic: 2nd gear selected, gear shift not in progress
Time between fault present & fault stored: 800 ms
Variables used by the diagnostic: Engine Speed, Engine Torque, Output shaft speed, Selected gear
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
31	Gear ratio monitoring, 3rd gear	P0733	N_MOT	VGT_$X	MMM

Ratio of engine speed to output shaft speed whilst 3rd gear is engaged is out of range.

Diagnostic operates: NAS vehicles only, Continuously
Conditions to be met to run Diagnostic: 3rd gear selected, gear shift not in progress
Time between fault present & fault stored: 800 ms
Variables used by the diagnostic: Engine Speed, Engine Torque, Output shaft speed, Selected gear
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
32	Gear ratio monitoring, 4th gear	P0734	N_MOT	VGT_$X	MMM

Ratio of engine speed to output shaft speed whilst 4th gear is engaged is out of range.

Diagnostic operates: NAS vehicles only, Continuously
Conditions to be met to run Diagnostic: 4th gear selected, gear shift not in progress
Time between fault present & fault stored: 800 ms
Variables used by the diagnostic: Engine Speed, Engine Torque, Output shaft speed, Selected gear
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
33	CAN message MD_IND invalid, indicated by F_TL_MES	P1884	N_MOT	VGT_$X	MMM

The CAN message from the engine management controller which informs the transmission of the engine torque is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: CAN message F_TL_MES
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
34	CAN message MD_IND invalid (FFh)	P1884	N_MOT	VGT_$X	MMM

The CAN message from the engine management controller which informs the transmission of the engine torque is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: CAN message MD_IND
Will limp home mode be selected: No, substitute engine torque used.
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
35	CAN message N_MOT invalid, indicated by F_N_MOT	P1884	N_MOT	VGT_$X	MMM

The CAN message from the engine management controller which informs the transmission of the engine speed is invalid.

Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: CAN message F_N_MOT
Will limp home mode be selected: Yes
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

99MY Range Rover only, Discovery Series II dummy code.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
36	Transmission calibration selection incorrect / invalid	P1602	N_MOT	VGT_$X	MMM

An ECU has been fitted to a vehicle an not had the correct calibration selected, or no calibration has been selected.

Diagnostic operates: During initialisation
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: Tune select status
Will limp home mode be selected: No, default shift maps used (normally 4.0l calibration)
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
37	CAN message T_ANS invalid (FFh).	P1884	N_MOT	VGT_$X	MMM

The CAN message which informs the transmission of the air intake temperature is invalid.
Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: CAN message T_ANS
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
38	CAN message FHOEHE invalid (FFh).	P1884	N_MOT	VGT_$X	MMM

The CAN message used to control the special altitude shift patterns is not correct.
Diagnostic operates: Continuously
Conditions to be met to run Diagnostic: None
Time between fault present & fault stored: 10 ms
Variables used by the diagnostic: CAN message FHOEHE
Will limp home mode be selected: No
Conditions to be met to clear the fault: Ignition to be switched on whilst fault not present, engine cranked.

Fault	Description	CARB	Ambient 1	Ambient 2	Ambient 3
39	Range switch plausibility error	P1705	N_MOT	VGT_$X	MMM

The input received from the range switch input cannot be correct. This may be due to not moving the lever fully, not necessarily a faulty switch

Diagnostic operates:
Conditions to be met to run Diagnostic: Road speed > 5km/h
Time between fault present & fault stored: 50 ms
Variables used by the diagnostic: O/P shaft speed, Road speed (V3), Range Switch status
Will limp home mode be selected:
Conditions to be met to clear the fault:

5.3 Impact on the system of each fault

Settings are those for Range Rover, 99MY (Software release L944e1414, 4.0l & 4.6l V8, NAS only)

					Priority		Control								Byte 2 – Protection & Default								Byte 1 – Protection & Default							
Fault Number	Priority Byte	Control Byte	Byte 1 - Protection & default	Byte 2 - Protection & default	Priority level (0 – 7, Bits 5 – 7	MIL on with activation of substitute function	Diagnostic function enable	Delete error after 40 warm-up cycles	Fault is CARB relevant	Filtering depends on time	Filter counter not changed if test not fulfilled	After cranking, return to normal function if fault still present	Not used	Return to normal function in operation if error not present	Limphome	Max pressure	Flash Sport and Manual lights (Gearbox fault message in RR)	No Kickdown	Substitute throttle angle	Use calculate range, not Range switch input	Substitute engine temperature	Only E program allowed	Substitute engine torque	No adaptive pressure control	No adaptive shift point control	Maintain current gear in low range / Limphome in High	No CAN communication	No gear and lockup diagnostics	Don't change status of MES line driver outputs	No Hot / High shift point & pressure adaption
1	224	244	32	7	7		1	1	1	1		1			1	1	1											1		
2	224	244	32	7	7		1	1	1	1		1			1	1	1											1		
3	225	244	0	0	7	1	1	1	1	1		1																		
4	224	240	32	7	7		1	1	1	1					1	1	1											1		
5	96	244	32	0	3		1	1	1	1		1																1		
6	224	244	32	7	7		1	1	1	1		1			1	1	1											1		
7	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
8	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
9	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
10	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
11	96	244	164	0	3		1	1	1	1		1													1			1		1
12	0	212	64	0	0		1	1		1		1																	1	
13	0	212	64	0	0		1	1		1		1																	1	
14	224	252	40	6	7		1	1	1	1	1	1				1	1									1		1		
15	224	244	56	6	7		1	1	1	1		1				1	1									1	1	1		
16	224	228	40	6	7		1	1	1			1				1	1									1		1		
17	224	236	40	6	7		1	1	1		1	1				1	1									1		1		
18	96	244	166	156	3		1	1	1	1		1					1	1	1			1		1	1			1		1
19	96	212	0	64	3		1	1		1		1									1									
20	96	212	0	0	3		1	1		1		1																		
21	96	244	40	6	3		1	1	1	1		1				1	1									1		1		
22	96	244	40	6	3		1	1	1	1		1				1	1									1		1		
23	96	244	40	6	3		1	1	1	1		1				1	1									1		1		
24	96	244	40	6	3		1	1	1	1		1				1	1									1		1		
25	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
26	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
27	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
28	96	252	32	7	3		1	1	1	1	1	1			1	1	1											1		
29	96	244	32	0	3		1	1	1	1		1																1		
30	96	244	32	0	3		1	1	1	1		1																1		
31	96	244	32	0	3		1	1	1	1		1																1		
32	96	244	32	0	3		1	1	1	1		1																1		
33	96	244	164	0	3		1	1	1	1		1													1			1		1
34	96	244	165	0	3		1	1	1	1		1											1		1			1		1
35	96	244	40	6	3		1	1	1	1		1				1	1									1		1		
36	96	244	0	4	3		1	1	1	1		1					1													
37	96	212	128	0	3		1	1		1		1																		1
38	96	212	128	0	3		1	1		1		1																		1
39	0	0	0	0	0																									

6 General information

6.1 Dimensions and fixing details

The transmission controller ECU is located under the front left had seat, under a black metal bracket. To remove the ECU, a medium sized philips screwdriver is required, together with 8mm and 10mm sockets, a short (40mm) extension and a 1/4 inch drive socket.

The trim surrounding the base of the seat must first be removed. This sometimes requires the panel on the left of the seat to be removed. After this has been done, remove 3 x 10mm screws which hold down the bracket. When these have been removed, disconnect the ECU from the harness (ensure the ignition is off). The bracket can now be removed from the vehicle. Remove the ECU from the bracket using an 8mm socket.

Approximate ECU dimensions:

6.2 Voltage requirements

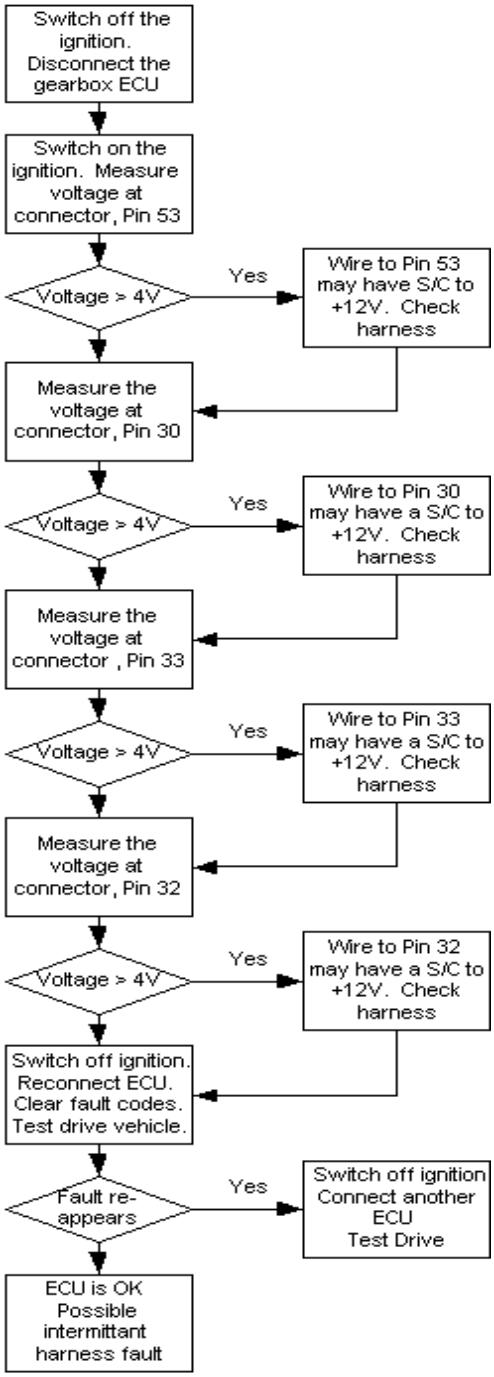
Voltage			System behaivor
16.0	-	26.0	Jump start; excess voltage without damage, limphome mode, output stanges for solenoid valves and pressure regulator switched off (max 1min at 40°C).
9.0	-	16.0	Voltage range for normal operation of the EAT with CAN-Bus corresponding to the specification.
6.5	-	9.0	Operation of the EAT with diagnostic functions and CAN-Bus enabled, limp home mode, output stages for solenoid valves and pressure regulator switched off.
3.0	-	6.5	Under voltage with data retention in SRAM, limp home mode, unreliable communication over the CAN bus.
0	-	3.0	Undervoltage without reliable function
-14	-	0	Reversed polarity without damage (-14V max 1 min at 25°C)

7 Fault tree analysis

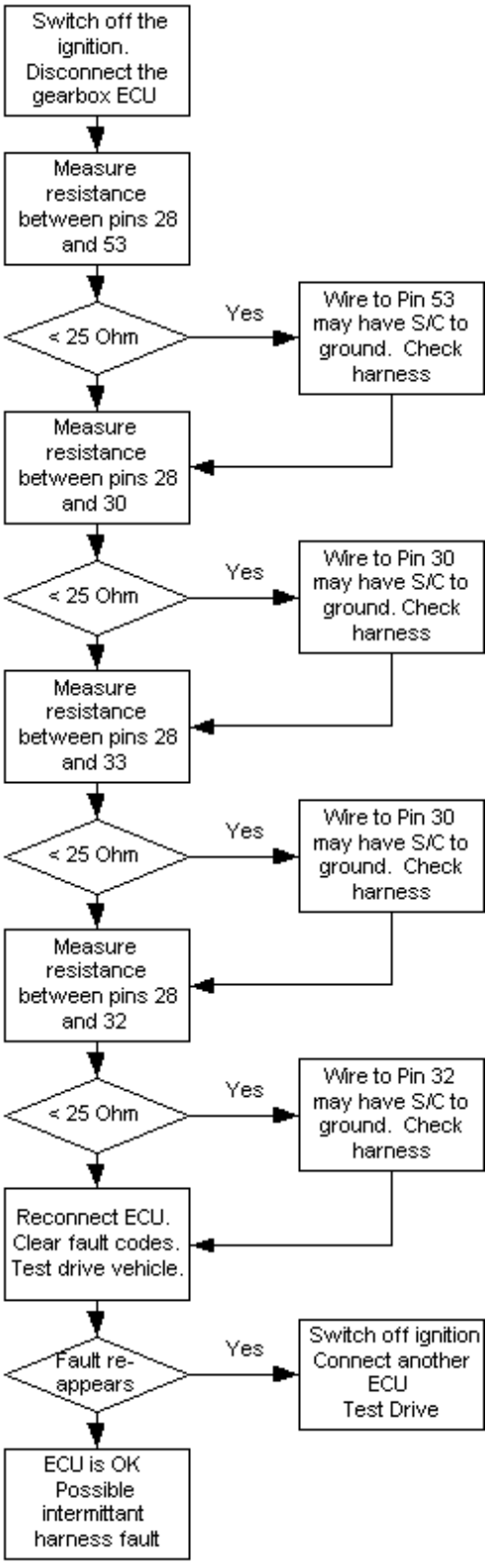
The following pages are a guide to fixing faults with the electronic automatic transmission. In order to solve fault, the fault trees indicate the most logical way a problem should be approached. If the fault tree indicates the transmission or controller is faultly, the transmission electronics department should first be consulted.

In the instance, somebody will look at the car, and if nothing is deemed to be faulty with the electronics, the Transmissions department will check the condition of the gearbox. If both the transmission and the controller are deemed to be OK, the diagnosis will have to be further investigated by Transmission Electronics.

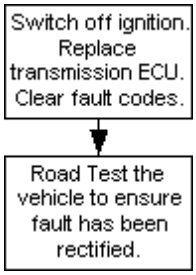
7.1.1.1 Fault code 1 – Transmission relay control (Sticks S/C)



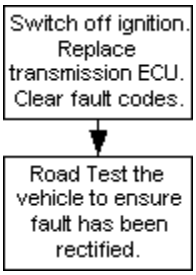
7.1.1.2 Fault code 2 – Transmission relay control (Permanent O/C)



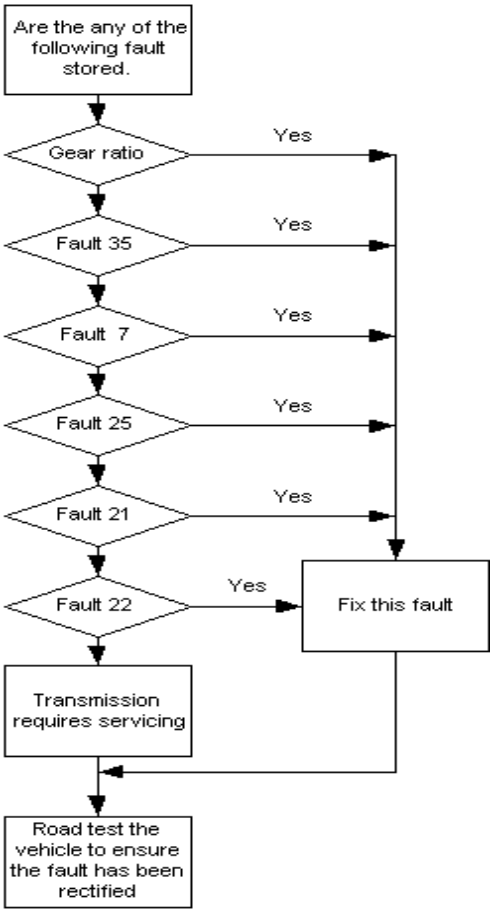
7.1.1.3 Fault code 3 – EEPROM communication fault



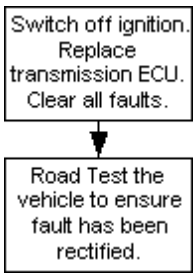
7.1.1.4 Fault code 4 – EPROM checksum fault



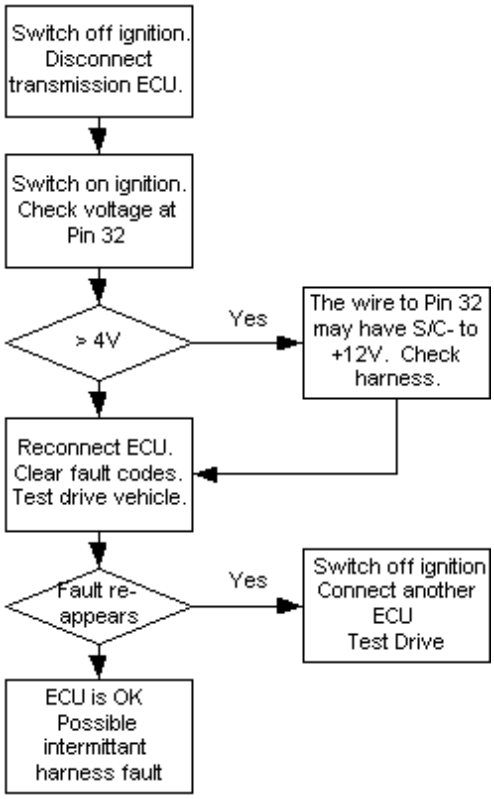
7.1.1.5 Fault code 5 – Lockup clutch monitoring



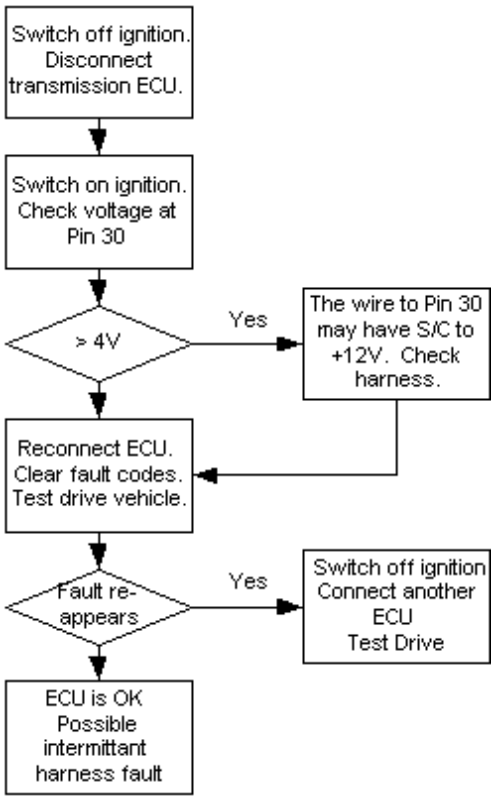
7.1.1.6 Fault code 6 – Watchdog Check



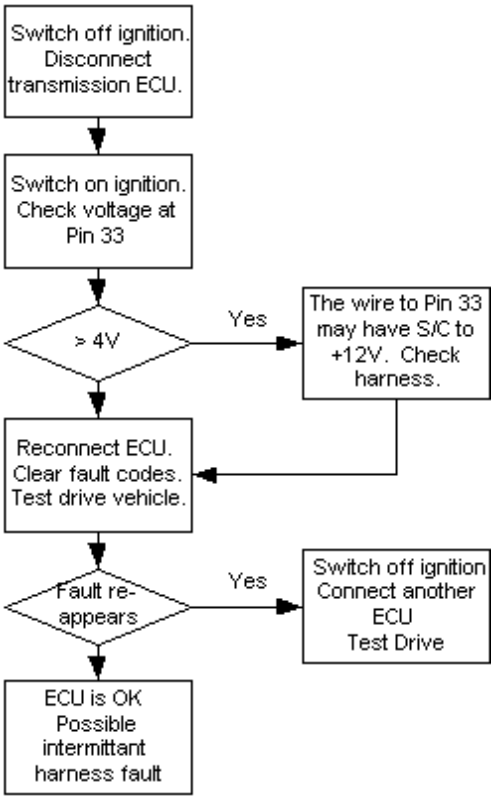
7.1.1.7 Fault code 7 – Solenoid valve lockup clutch S/C +12V



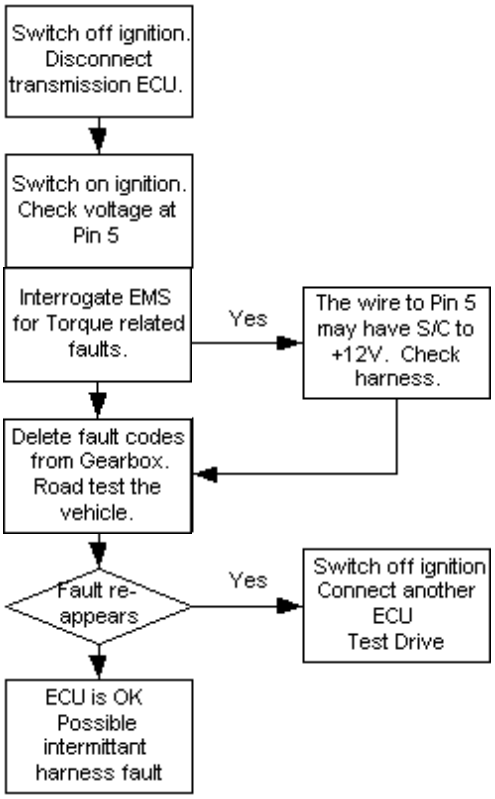
7.1.1.8 Fault code 8 – Solenoid valve 1 S/C +12V



7.1.1.9 Fault code 9 – Solenoid valve 2 S/C +12V



7.1.1.10 Fault code 10 – Pressure regulator S/C +12V

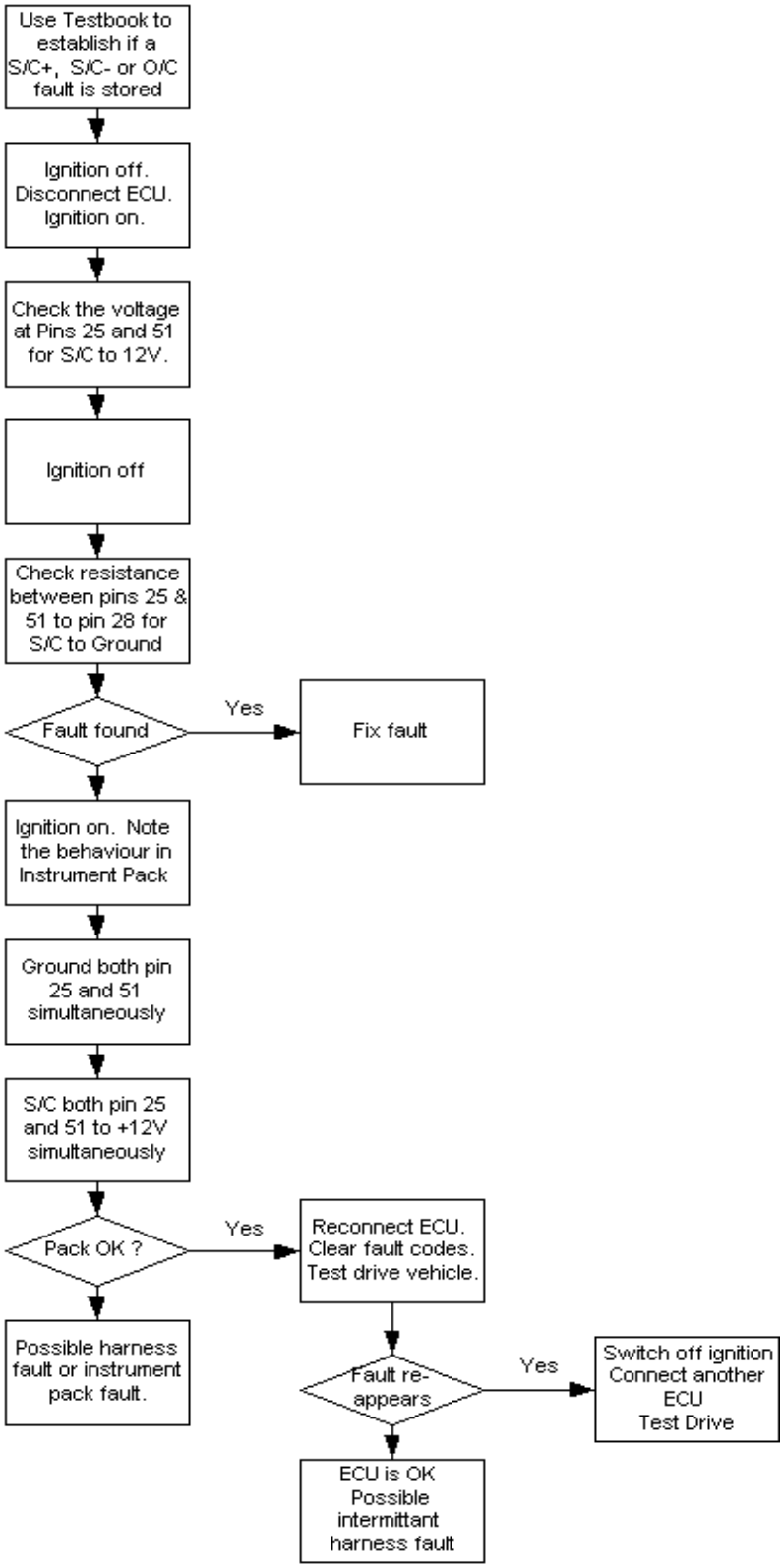


7.1.1.11 Fault code 11 – CAN message MD_REIB invalid (FFh)

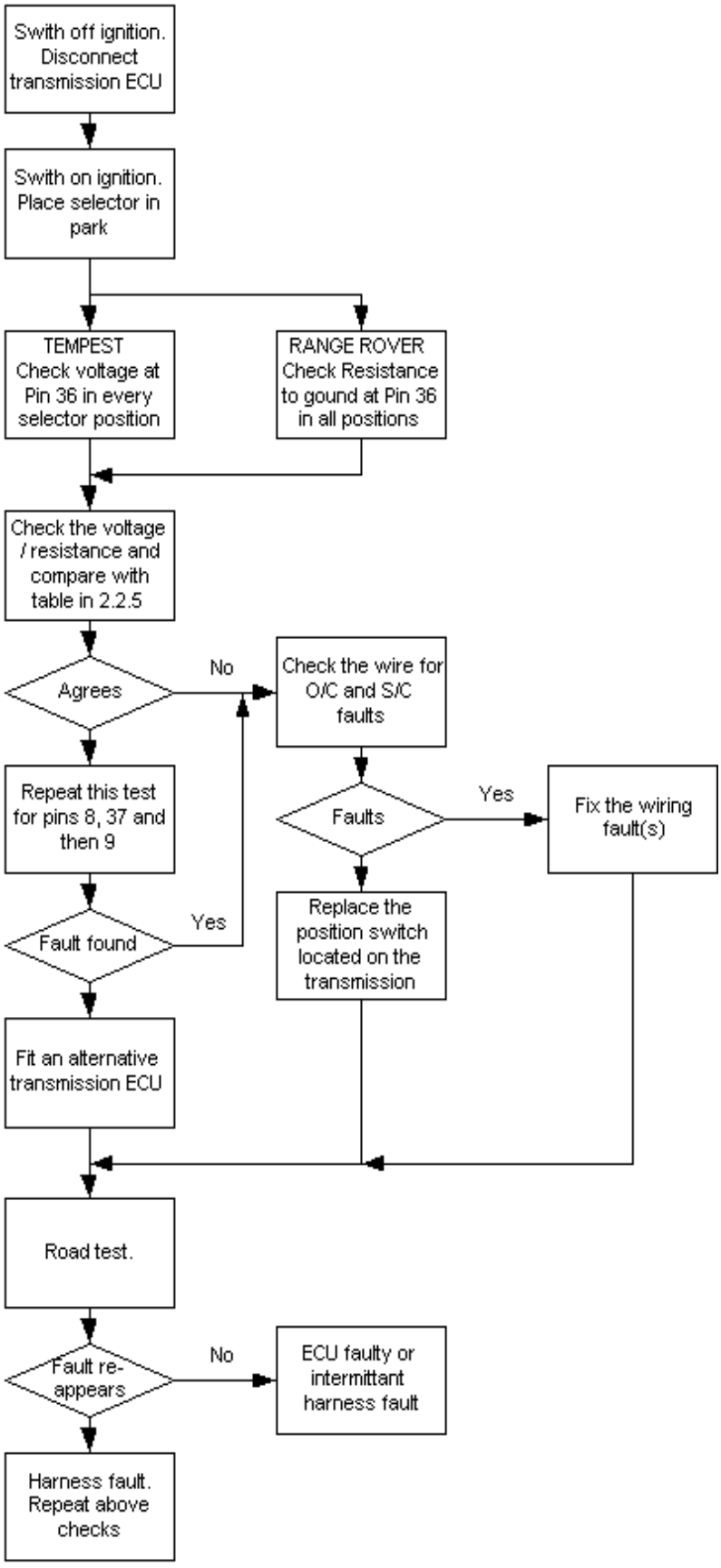
7.1.1.12 Fault code 12 – MES line 1, Electrical fault

See below, Fault code 13 MES line 2, Electrical fault for details.

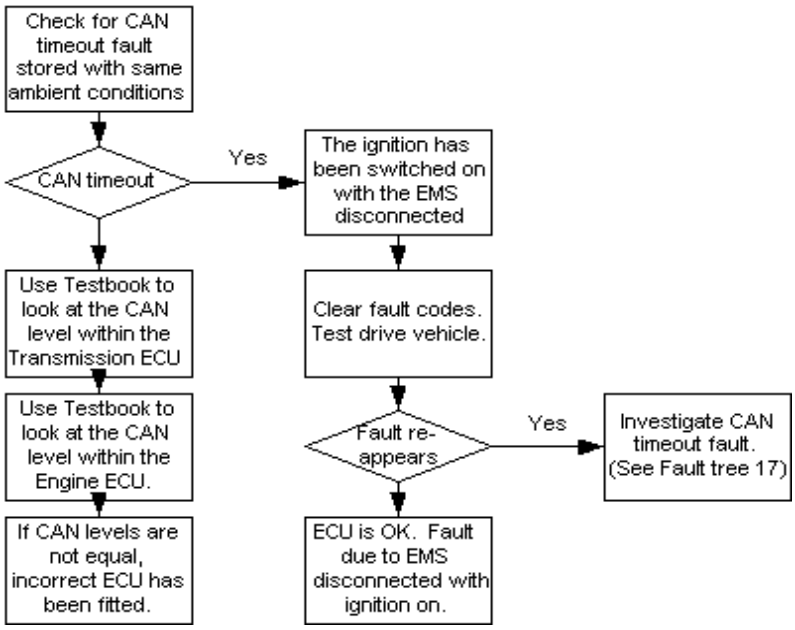
7.1.1.13 Fault code 13 – MES line 2, Electrical fault



7.1.1.14 Fault code 14 – Position switch monitoring (Permanent)

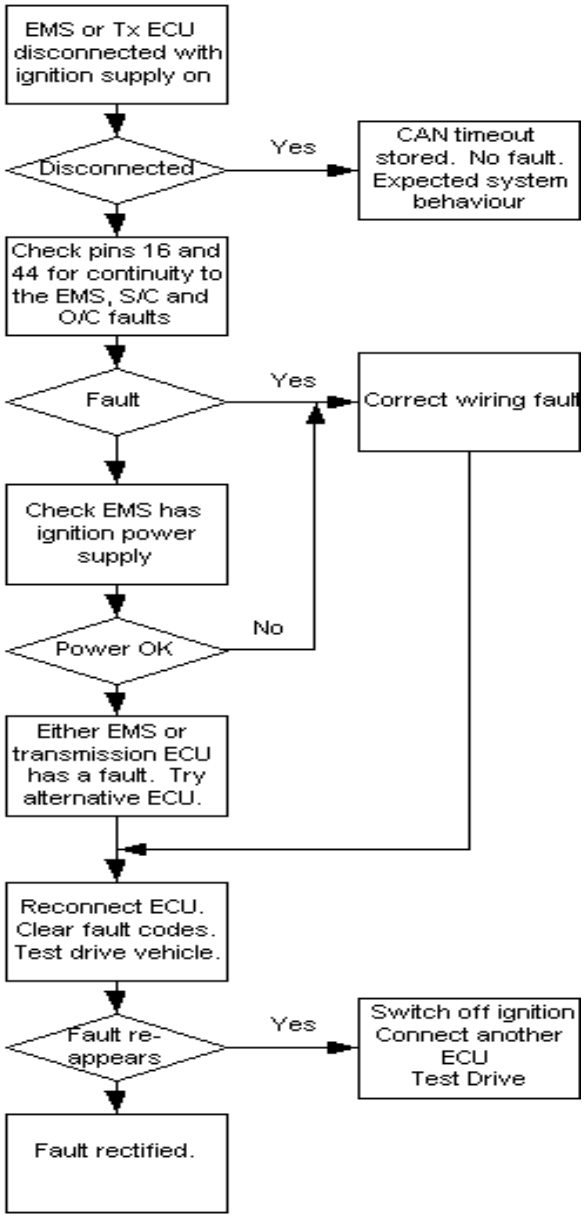


7.1.1.15 Fault code 15 – CAN level invalid

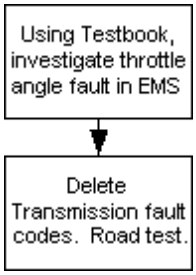


7.1.1.16 Fault code 16 – CAN bus fault – See following, CAN timeout

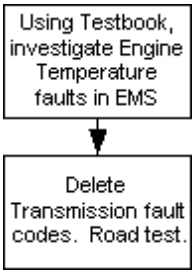
7.1.1.17 Fault code 17 – CAN timeout fault



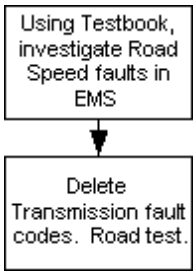
7.1.1.18 Fault code 18 – CAN message DKI fault (Throttle angle)



7.1.1.19 Fault code 19 – CAN message T_MOT (Engine temperature)



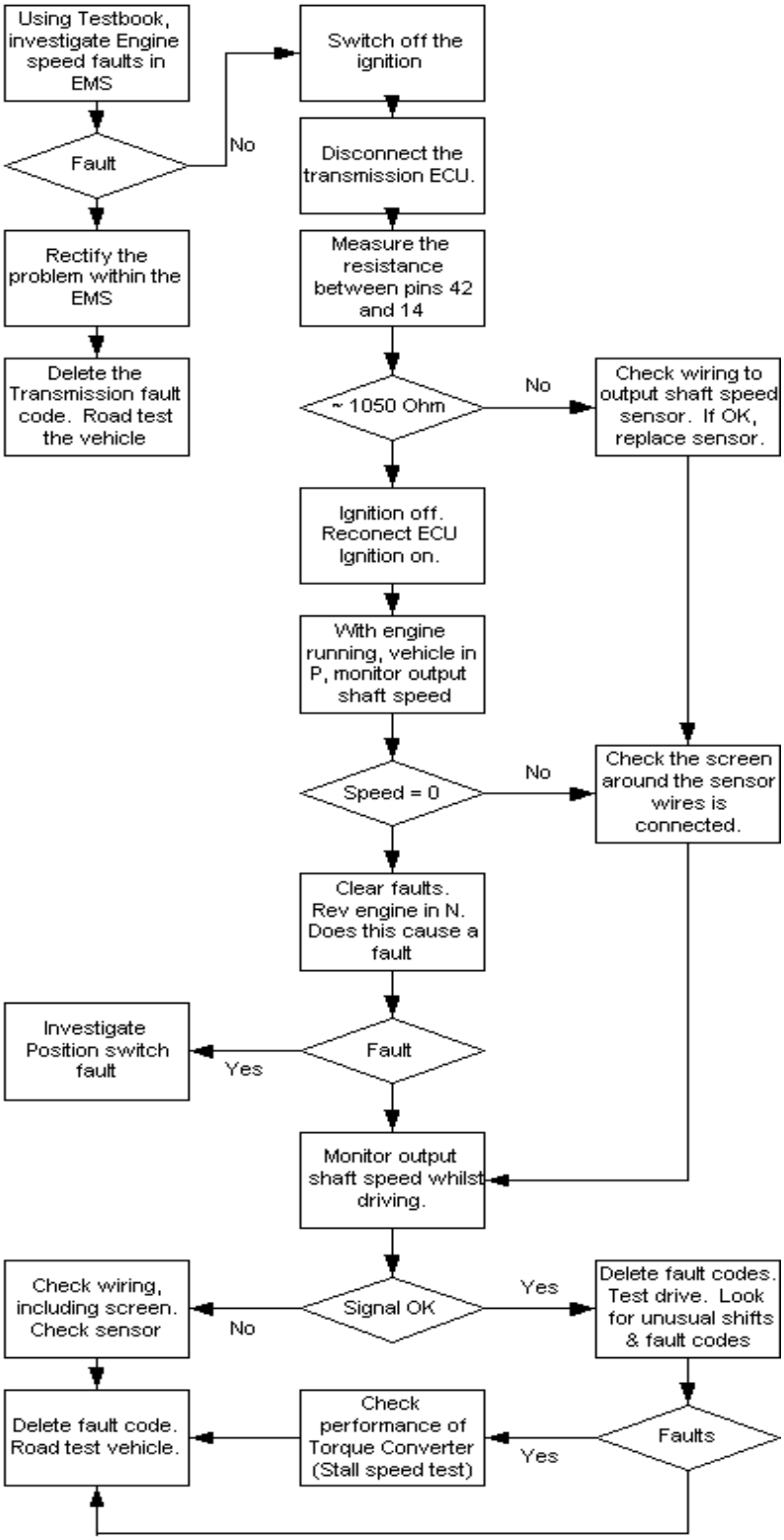
7.1.1.20 Fault code 20 – CAN message V3 (Road speed)



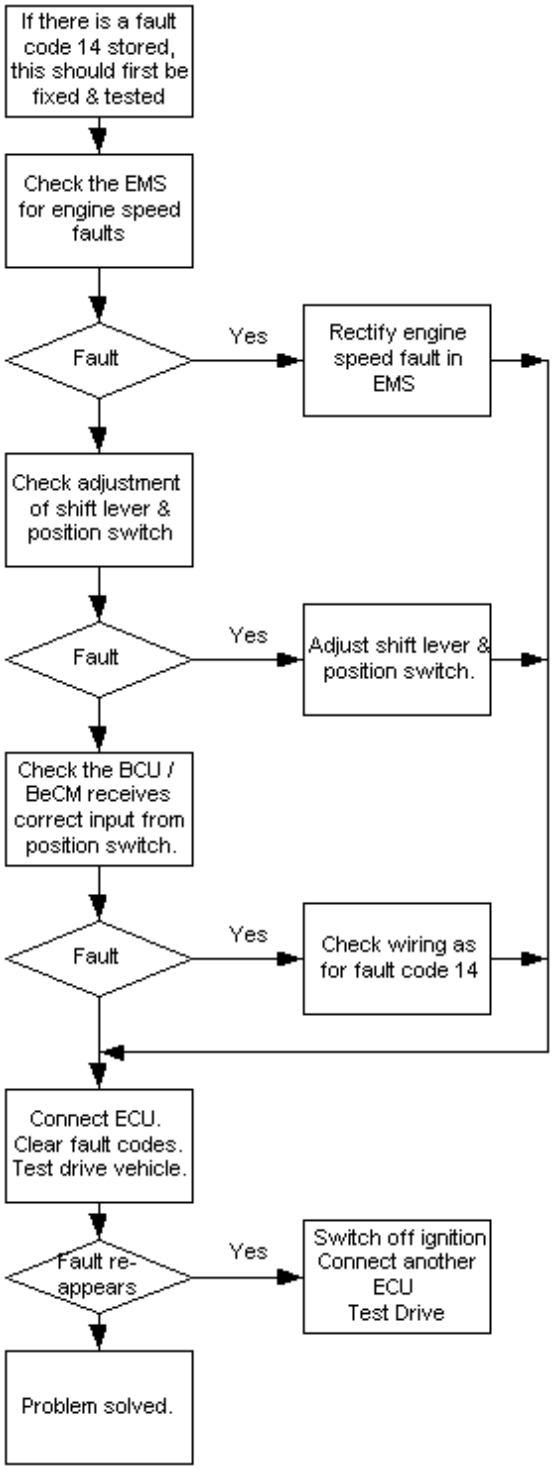
7.1.1.21 Fault code 21 – Downshift safety monitoring

Work through the Stall speed monitoring flowchart. Depending on Ambient conditions, these fault codes may refer to the same failure.

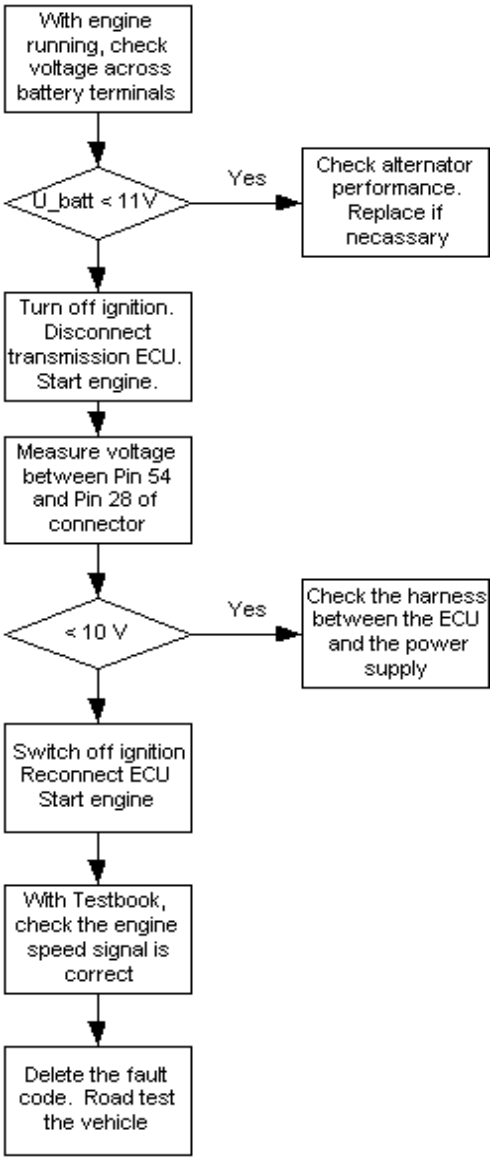
7.1.1.22 Fault code 22 – Stall speed monitoring



7.1.1.23 Fault code 23 – Position switch during cranking (99MY Range Rover only)



7.1.1.24 Fault code 24 – Battery supply check



7.1.1.25 Fault code 25 – Solenoid valve lockup clutch S/C- or O/C

Carry out tests as for fault code 28 but substitute Pin 32 in place of pin 5

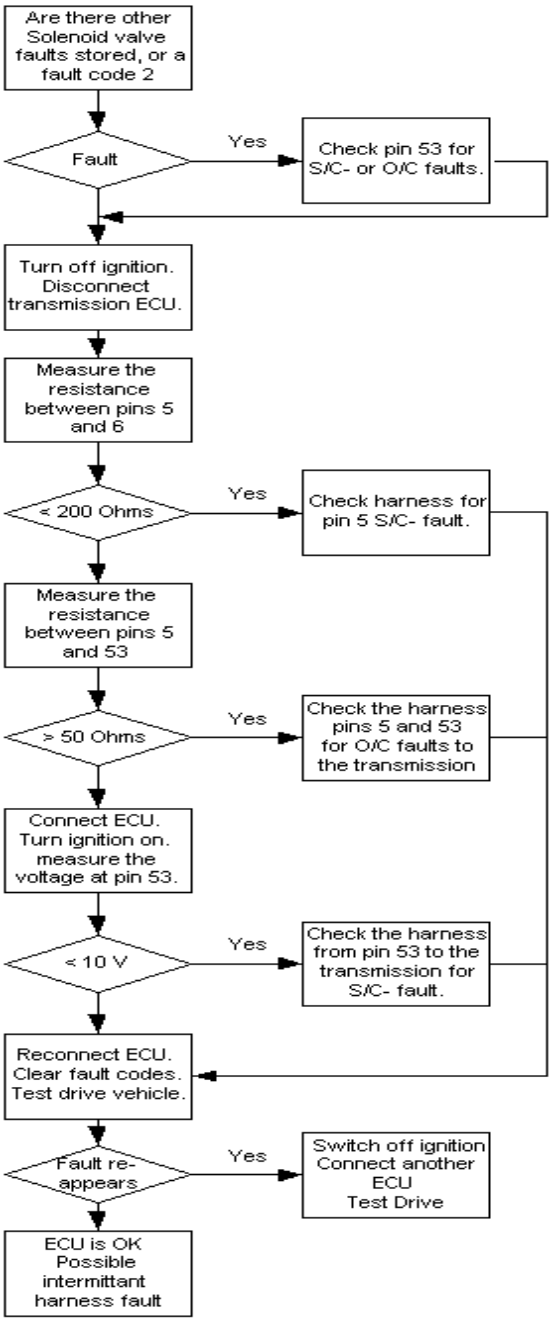
7.1.1.26 Fault code 26 – Solenoid valve 1, S/C- or O/C

Carry out tests as for fault code 28 but substitute Pin 30 in place of pin 5

7.1.1.27 Fault code 27 – Solenoid valve 2, S/C- or O/C

Carry out tests as for fault code 28 but substitute Pin 33 in place of pin 5

7.1.1.28 Fault code 28 – Pressure regulator S/C- or O/C



7.1.1.29 Fault code 29 – Gear ratio 1st

See gear ratio 4th (fault code 32)

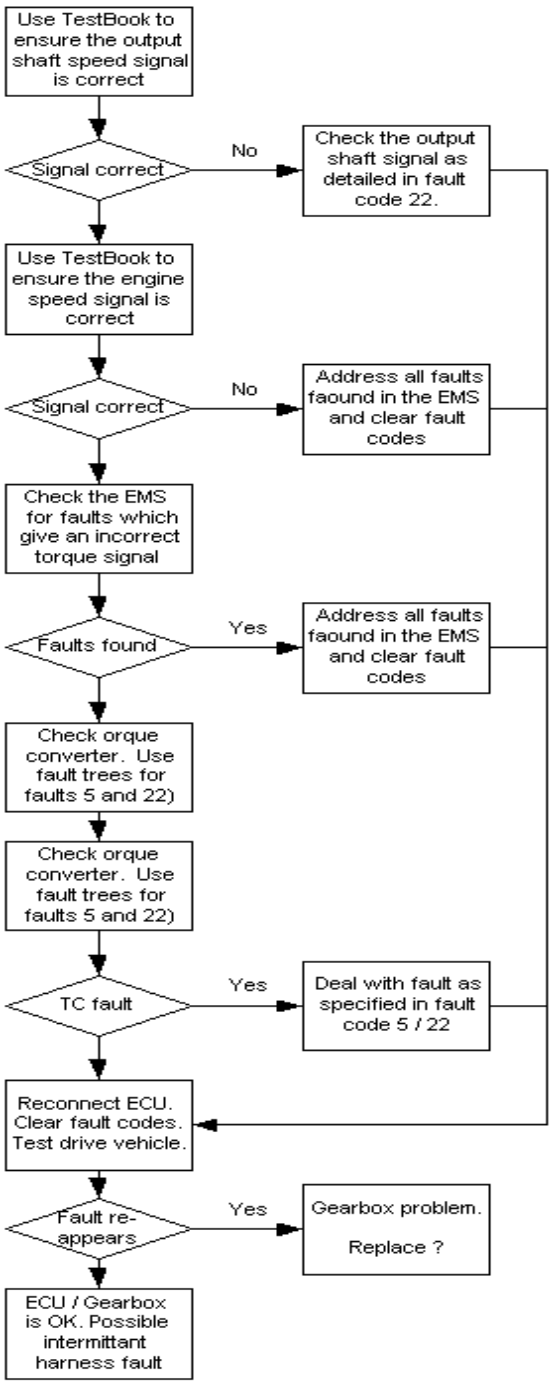
7.1.1.30 Fault code 30 – Gear ratio 2nd

See gear ratio 4th (fault code 32)

7.1.1.31 Fault code 31 – Gear ratio 3rd

See gear ratio 4th (fault code 32)

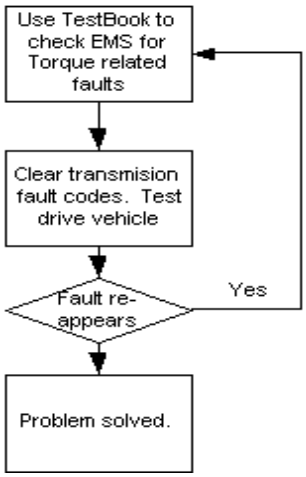
7.1.1.32 Fault code 32 – Gear ratio 4th



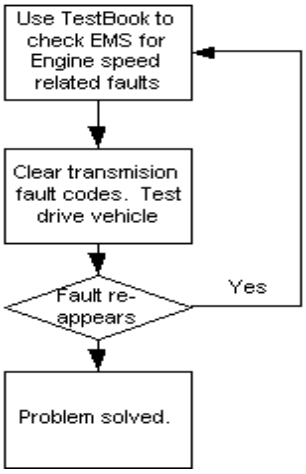
7.1.1.33 Fault code 33 – CAN message MD_IND invalid (indicated by F_TL_MES)

See fault code 34

7.1.1.34 Fault code 34 – CAN message MD_IND invalid (FFh)



7.1.1.35 Fault code 35 – CAN message N_MOT invalid (indicated by F_N_MOT)



7.1.1.36 Fault code 36 – Transmission calibration selection incorrect / invalid

Use Testbook to select the correct calibration from the transmission ECU (4.0l or 4.6l)

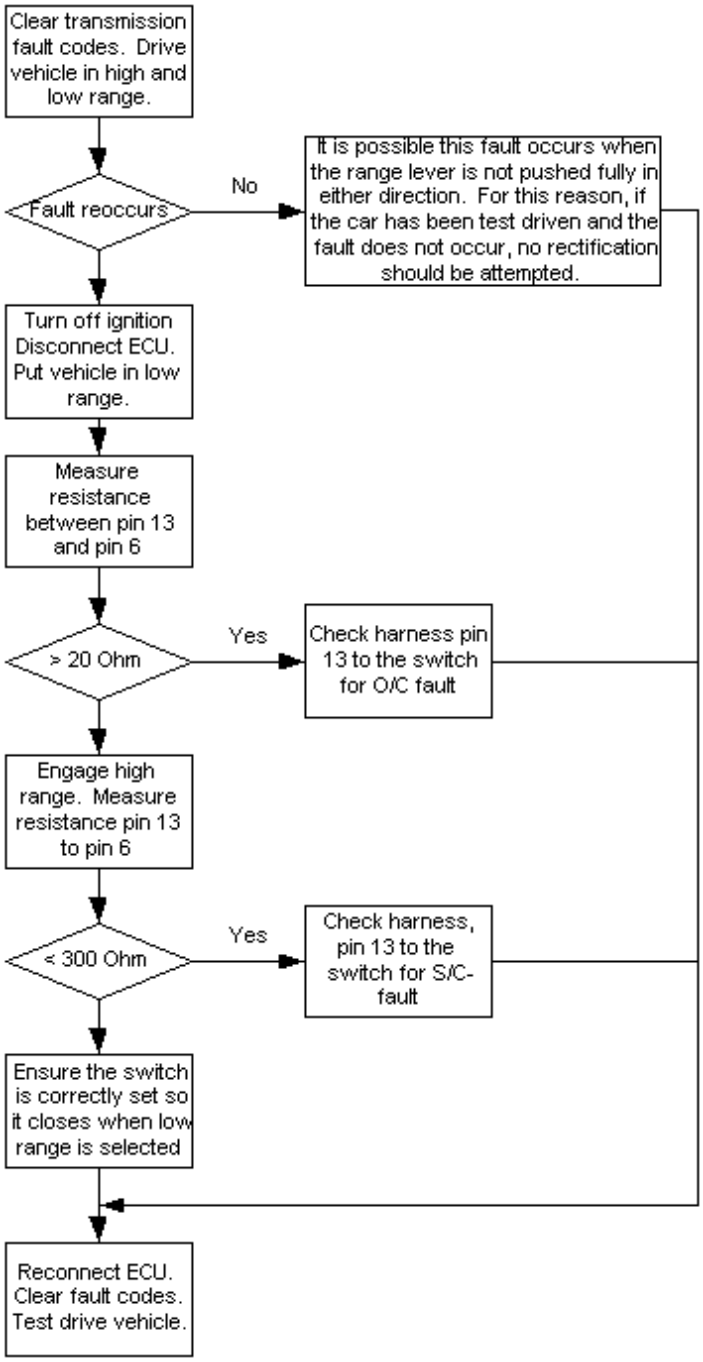
7.1.1.37 Fault code 37 – CAN message T_ANS invalid (FFh)

Check the EMS for faults which prevent it from transmitting the air inlet temperature.

7.1.1.38 Fault code 38 – CAN message FHOEHE invalid (FFh)

Check the EMS for faults which prevent it from transmitting the calculate altitude (air density).

7.1.1.39 Fault code 39 – Range switch plausibility



oooooooOOOOOOOOooooooo

SEALANTS, ADHESIVES AND LUBRICANTS

No sealants or adhesives are used for automatic transmission assembly.

Gaskets are installed dry.

Lip seals should be dipped in ATF before installation. Clutch linings should be soaked in ATF for at least one-half hour before assembly.

Use petroleum jelly to retain torrington bearings in place during assembly. Do not use ordinary grease.

Never use rags or wiping cloths during transmission assembly. Lint from the rags can block tiny passages in the valve body. Use compressed air or lint free synthetic wipes.

Most Land Rover service literature specifies Dexron IID as the correct ATF type. Since IID is no longer commonly available, use Dexron III/Mercon.

Synthetic ATF is not recommended for Land Rover automatic transmissions.