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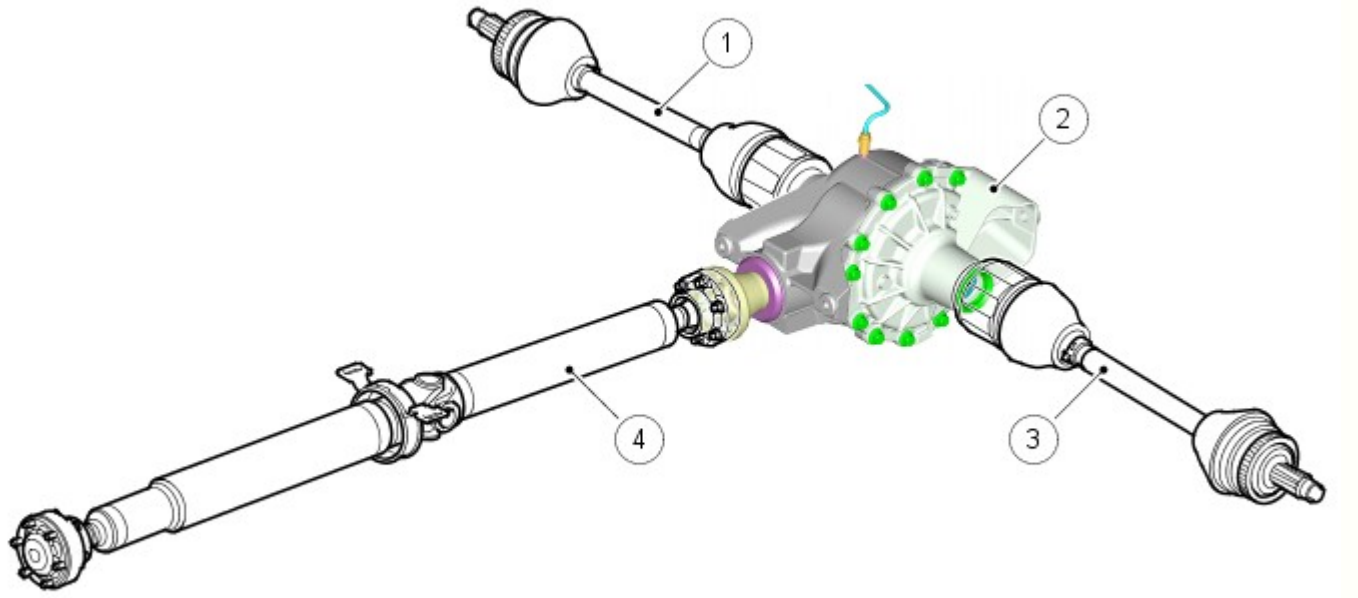
Rear Drive Axle/Differential - Rear Drive Axle and Differential

Description and Operation

OPEN REAR DIFFERENTIAL

Component Location



E59428

Item	Description
1	RH rear drive halfshaft
2	Rear differential
3	LH rear drive halfshaft
4	Rear driveshaft assembly

OVERVIEW

The rear differential converts the 'angle of drive' through 90 degrees and distributes drive, via the rear drive halfshafts, to the rear wheels.

The output ratio of the rear differential varies depending on the engine variant.
For additional information, refer to: Specifications (205-02 Rear Drive Axle/Differential, Specifications).

The unit is located centrally in the rear of the chassis and is mounted to the chassis via rubber bushes and bolts; two mounting points at the front of the unit and one at the rear.

The cast iron casing comprises two parts; a cover and a carrier. The carrier provides locations for all the internal components. The carrier is sealed to the cover with sealant and secured with 12 bolts. The cover and carrier have cast ribs, which assist mobility. A breather tube is fitted to the top of the carrier. This allows a plastic tube to be fitted and routed to a high point under the vehicle body, preventing the ingress of water when the vehicle is wading.

The differential is a conventional design using a hypoid gear layout, similar to the front differential. The ratio is changed by changing the amount of teeth between the crown wheel drive gear and pinion gear. For example, with a ratio of 3.54:1, the crown wheel drive gear will have 3.54 times more teeth than the pinion gear.

The carrier contains an oil drain plug.

OPEN REAR DIFFERENTIAL INTERNAL COMPONENTS

The differential comprises a pinion shaft and hypoid pinion gear and a crown wheel drive gear with an integral cage, which houses 2 planet gears. Two sun wheels are also located in the cage and pass the rotational drive to the drive shafts.

The pinion shaft is mounted on two opposed taper roller bearings, with a collapsible spacer located between them. The spacer is used to hold the bearings in alignment and also collapses under the pressure applied to the pinion-flanged nut. This allows the flanged nut to be tightened by measuring the torque-to-turn, which collapses the spacer, setting the correct bearing preload.

The pinion shaft has an externally splined outer end, which accepts and locates the input flange, which is retained by the pinion nut. The input flange has four threaded holes and mates with the rear drive shaft. Four bolts secure the rear drive shaft to the input flange. An oil seal is pressed into the pinion housing and seals the input flange to the pinion housing. The pinion shaft has a hypoid gear at its inner end, which mates with the crown wheel drive gear.

The crown wheel drive gear is located on the differential case and secured with 10 bolts. The differential case is mounted on taper roller bearings located in machined bores on each side of the pinion housing. Belleville washers are used to apply the correct bearing preload and hypoid backlash.

The differential carrier has a through hole, which provides location for the shaft. The shaft is supported by a sun gear and a needle roller bearing. The shaft is fitted with a snap ring at one end, which locates in a machined groove in the sun gear, locking the shaft in position.

The sun gears are located in pockets in the carrier cage and mesh with the planet gears. Spacers are fitted between the sun wheels and the carrier and set the correct mesh contact between the planet gears and the sun wheels. Each sun wheel has a machined bore with internal splines and machined groove near the splined end. The groove provides positive location for a snap ring fitted to the end of each output flange.

Each output shaft has a spline, which locates in each sun wheel. A snap ring fitted to the splined shaft locates in the groove of the sun wheel bore and positively locates the output shaft. Oil seals are pressed into each side of the pinion housing and seals the output shaft.

The operating principles of the front and rear differentials are the same. Rotational input from the drive shaft is passed via the input flange to the pinion shaft and pinion gear. The angles of the pinion gear to the crown wheel drive gear moves the rotational direction through 90 degrees.

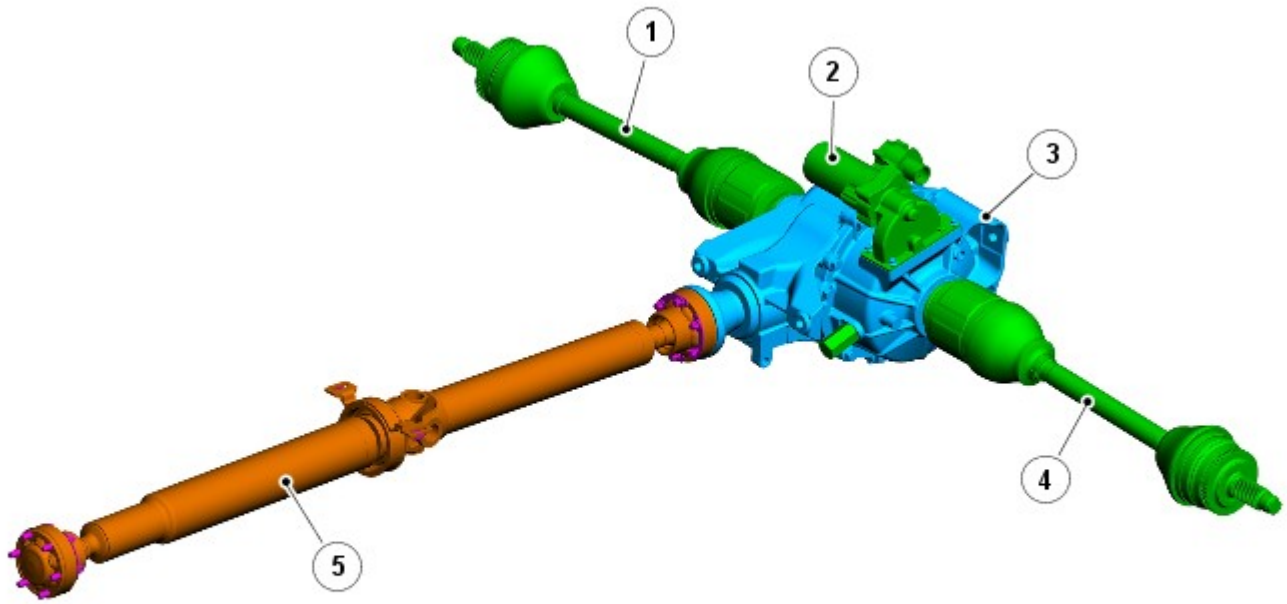
The transferred rotational motion is now passed to the crown wheel drive gear, which in turn rotates the differential casing. The shaft, which is secured to the casing, also rotates at the same speed as the casing. The planet gears, which are mounted on the shaft, also rotate with the casing. In turn, the planet gears transfer their rotational motion to the left and right hand sun wheels, rotating the drive halfshafts.

When the vehicle is moving in a forward direction, the torque applied through the differential to each sun wheel is equal. In this condition both drive halfshafts rotate at the same speed. The planet gears do not rotate and effectively lock the sun wheels to the differential casing.

If the vehicle is turning, the outer wheel will be forced to rotate faster than the inner wheel by having a greater distance to travel. The differential senses the torque difference between the sun wheels. The planet gears rotate on their axes to allow the outer wheel to rotate faster than the inner one.

ELECTRONIC TORQUE MANAGED (ETM) REAR DIFFERENTIAL

Component Location



E84160

Item	Description
1	RH rear drive halfshaft
2	Actuator motor
3	Rear differential
4	LH rear drive halfshaft
5	Rear driveshaft assembly

OVERVIEW

The Electronic Torque Managed (ETM) rear differential is available as an option on both petrol and diesel derivatives. The output ratio for the ETM rear differential remains the same as the open differentials for both petrol and diesel derivatives.

The ETM differential has the same functionality as the open rear differential but incorporates a locking feature.

ELECTRONIC TORQUE MANAGED (ETM) REAR DIFFERENTIAL INTERNAL COMPONENTS

An electronically controlled multi-plate clutch provides a rear differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy, to electronically control the rear differential multi-plate clutch assembly, has been developed to provide:

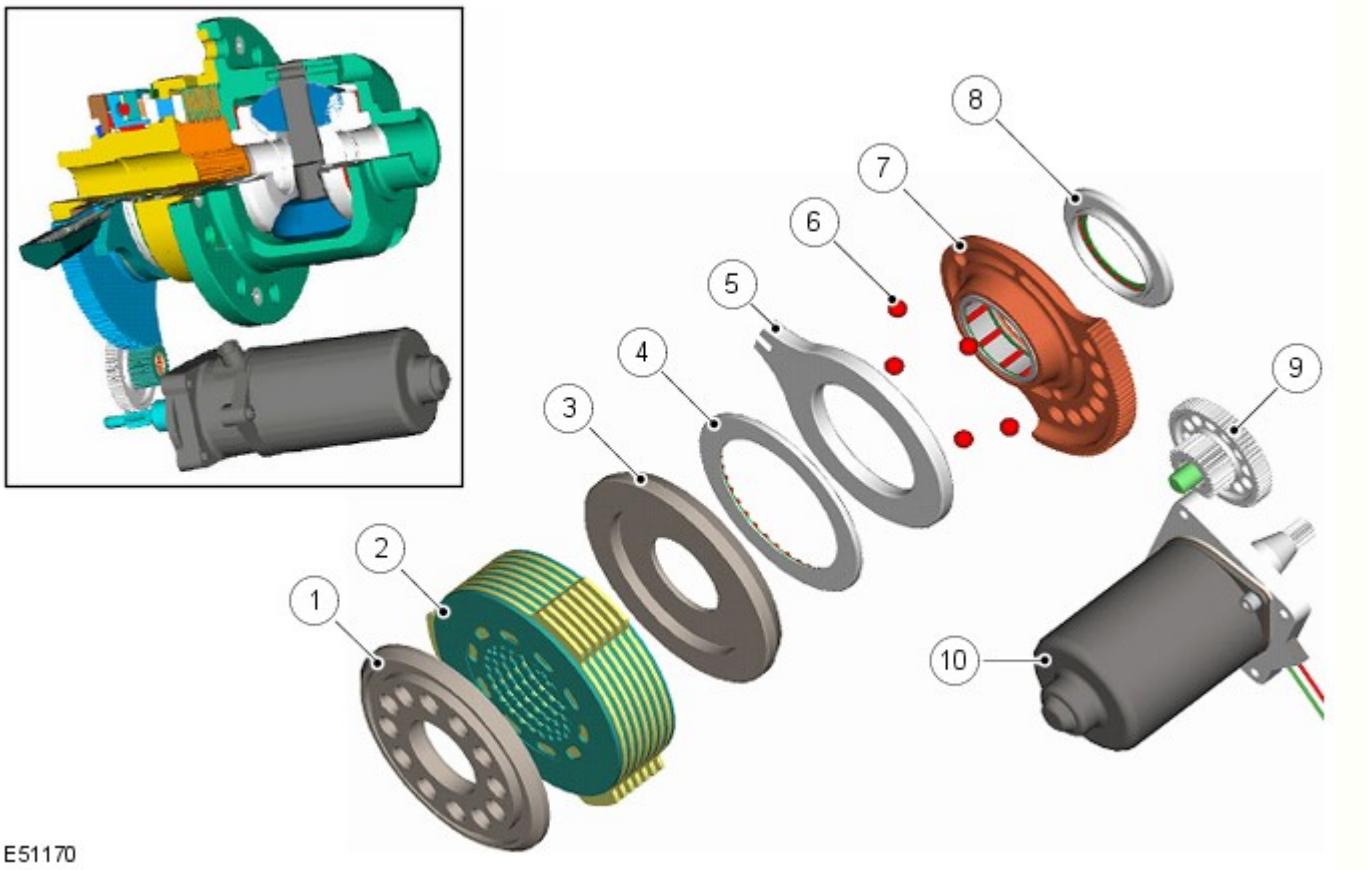
- a pre-loading function, increasing locking torque with increased driving torque
- a slip controller to increase locking torque under off-road conditions and decrease locking torque for optimum comfort, e.g. parking.

The unit receives a torque input from the transfer box output shaft, which is passed through the unit to two outputs for the rear drive halfshafts.

The unit detects wheel slip via various vehicle system inputs to the ETM rear differential control module and locks the differential accordingly.

The ETM differential locking and biasing feature is actuated via a Direct Current (DC) motor, which is controlled by the ETM rear differential control module, via a Pulse Width Modulation (PWM) signal.

Multi-plate Clutch Assembly



Item	Description
1	Pressure disc
2	Clutch plate assembly
3	Pressure disc
4	Thrust race
5	Output actuator
6	Actuator balls
7	Input actuator
8	Bearing pre-load spacer
9	Reduction gearset
10	Actuator motor

The multi-plate clutch assembly for both center (transfer box) and ETM rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximize the traction performance of the vehicle. This is fundamentally different from the 'braked' traction control, which can only counteract differential slip when it occurs.

A certain amount of differential slip is required to allow the vehicle to turn corners and to remain stable under control of the Anti-lock Braking System (ABS). The transfer box control module monitors the driver's demands through primary vehicle controls and automatically sets the slip torque at the rear differential, via the ETM rear differential control module. The system is completely automatic and does not require any special driver input.

The multi-plate clutch assembly actively controls the torque flow through the rear differential and optimizes the torque distribution in the driveline. The clutch assembly biases the torque from the differential to the wheels with the higher grip and prevents the wheels with the lower grip from spinning.

By turning the input actuator disc, via the motor shaft, the output actuator is rotated. This movement acts on five balls in a ramp mechanism between the input and output actuators and gives a defined axial movement. The movement forces the pressure disc to induce friction between the sun gear and differential case via the clutch plates supported by the sun gear and the plates supported by the clutch basket on the differential case. This frictional force inhibits the differential rotation; the differential case and left hand differential side gear are locked together.

Electronic Torque Managed (ETM) Rear Differential Control Module

The ETM rear differential control module controls the multi-plate clutch actuation. The control module is mounted on a bracket located on the LH C-pillar, behind the trim.

The control module is connected on the Controller Area Network (CAN) bus and controls the differential operation using CAN messages from other control modules on the network.

The control module uses three connectors for all inputs and outputs. It receives a permanent power supply via a 40A fusible link located in the Battery Junction Box (BJB), and an ignition supply via fuse 24 located in the Central Junction Box (CJB).

The control module memorizes the position of the ETM rear differential motor when the ignition is switched off.

The control module controls the closed loop position sensing system within the motor and regulates the power supply to the motor.

If the control module is replaced, a Land Rover approved diagnostic tool must be connected to the vehicle and the ETM rear differential control module self-calibration procedure must be performed. This procedure must also be performed if the motor or differential assembly is replaced.

If a fault occurs with the ETM rear differential, the control module or one of the required input signals, i.e. road speed signal, the control module records an error code and a warning lamp, in the instrument cluster, illuminates permanently.

CAN Bus Messages

The CAN bus is a high speed broadcast network connected between various vehicle control modules. It allows the fast exchange of data between control modules every few microseconds. The bus comprises 2 wires, which are twisted together to minimize electromagnetic interference (noise) produced by the CAN messages.

The ETM rear differential control module is connected on the CAN bus, via the transfer box control module, and controls differential operation using CAN messages from other control units on the network. Wheel speed, steering angle, automatic transmission speed, temperature information, car configuration, axle ratios and mode inputs, are some of the main signals received by the control module.

The control module also sends messages via the CAN bus to tell other control modules on the network, the status of the ETM rear differential. The clutch torque and default mode status are some of the main signals sent out by the control module.

The following table shows the messages that can be displayed in the message center of a high-line instrument cluster relating to the ETM rear differential:

Message	Description	Chime
'TRANSMISSION OVERHEAT' 'SLOW DOWN'	Rear differential temperature has reached or is approaching the overheat threshold	None
'TRANSMISSION FAULT' 'TRACTION REDUCED'	Transfer box control module has stopped transmitting CAN bus messages. Defaults to open center differential. Message also displayed when fault occurs with ETM rear differential	None
'TRANSMISSION FAULT' 'STOP SAFELY'	Fault has occurred with ETM rear differential. Stop vehicle at earliest opportunity	Single

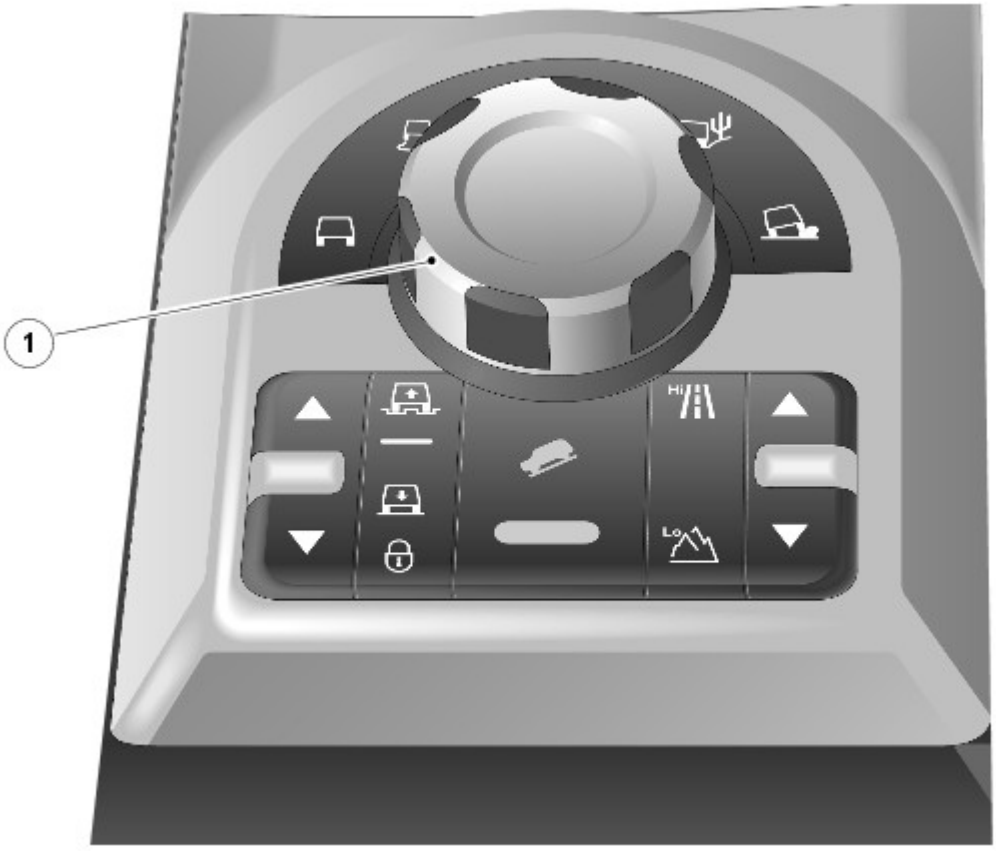
On vehicles fitted with the low line instrument cluster, in place of the message center there will be a status lamp, which has the following logic:

- Amber - Over temperature
- Red - Failure, stop vehicle

TERRAIN RESPONSE

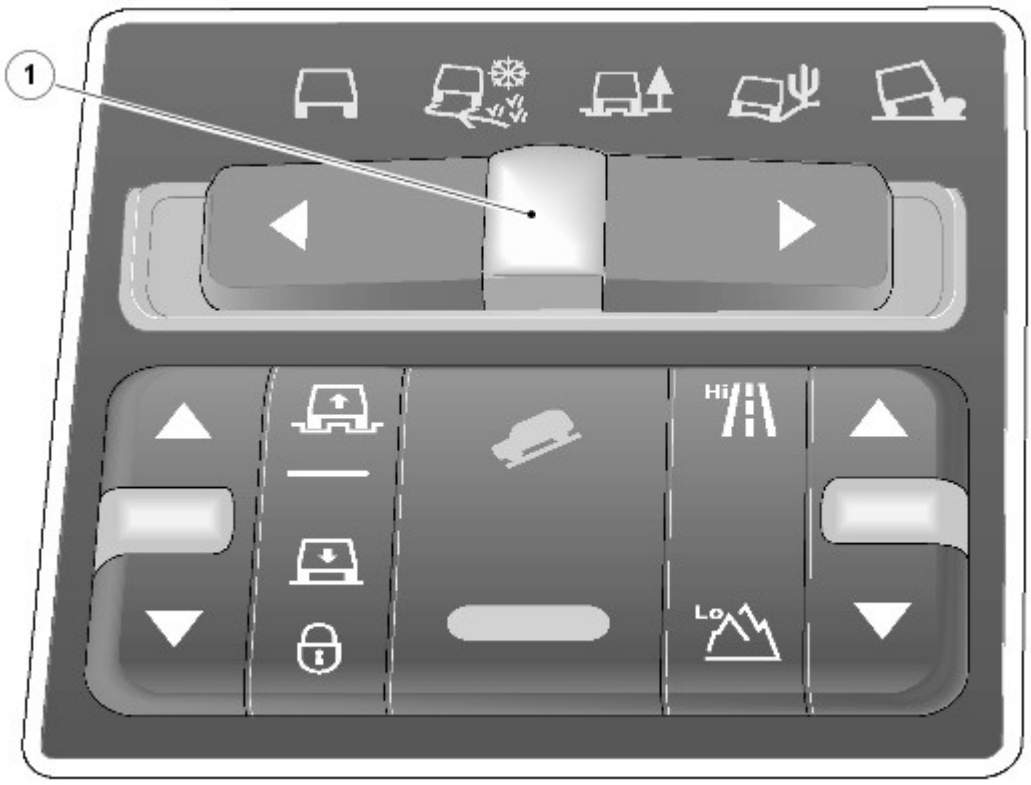
The Terrain Response system allows the driver to select a program, which will provide the optimum settings for traction and performance for the prevailing terrain conditions.

Depending on vehicle specification the system is controlled by either a rotary control or rocker switch located on the floor console:



E80045

Item	Description
1	Terrain Response rotary control knob



E130458

Item	Description
1	Terrain Response rocker-switch

The system uses a combination of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems form the Terrain Response system:

- Engine management system (EMS)
- Automatic transmission
- Transfer box
- Brake system
- Air suspension

Each subsystem control module provides a feedback for the selected program so that the Terrain Response control module can check that all systems are controlling the system correctly. The exception to this is the ETM rear differential control module, which does not provide feedback to the Terrain Response system as it is a slave to the transfer box control module. For additional information, refer to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).

SERVICE

The oil used in the ETM rear differential contains unique additives and friction modifiers, which enhance the differentials operation. No other oil must be used in the ETM rear differential.
For additional information, refer to: Specifications (205-02 Rear Drive Axle/Differential, Specifications).

Electronic Torque Managed (ETM) Rear Differential Serviceable Components

- Halfshaft seals
- Needle roller bearing assembly
- Chassis bush/fixings
- Actuator motor
- Temperature sensor
- Control module and bracket
- Lubricant

DIAGNOSTICS

The ETM rear differential control module can store fault codes, which can be retrieved by connecting the Land Rover approved diagnostic tool using ISO-14229 protocol.

The information is communicated via a diagnostic socket.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and the Land Rover approved diagnostic tool. The information is communicated to the socket, via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using the Land Rover approved diagnostic tool.

The ETM rear differential control module uses Diagnostic Trouble Codes (DTC), which relate to ETM rear differential electrical faults.

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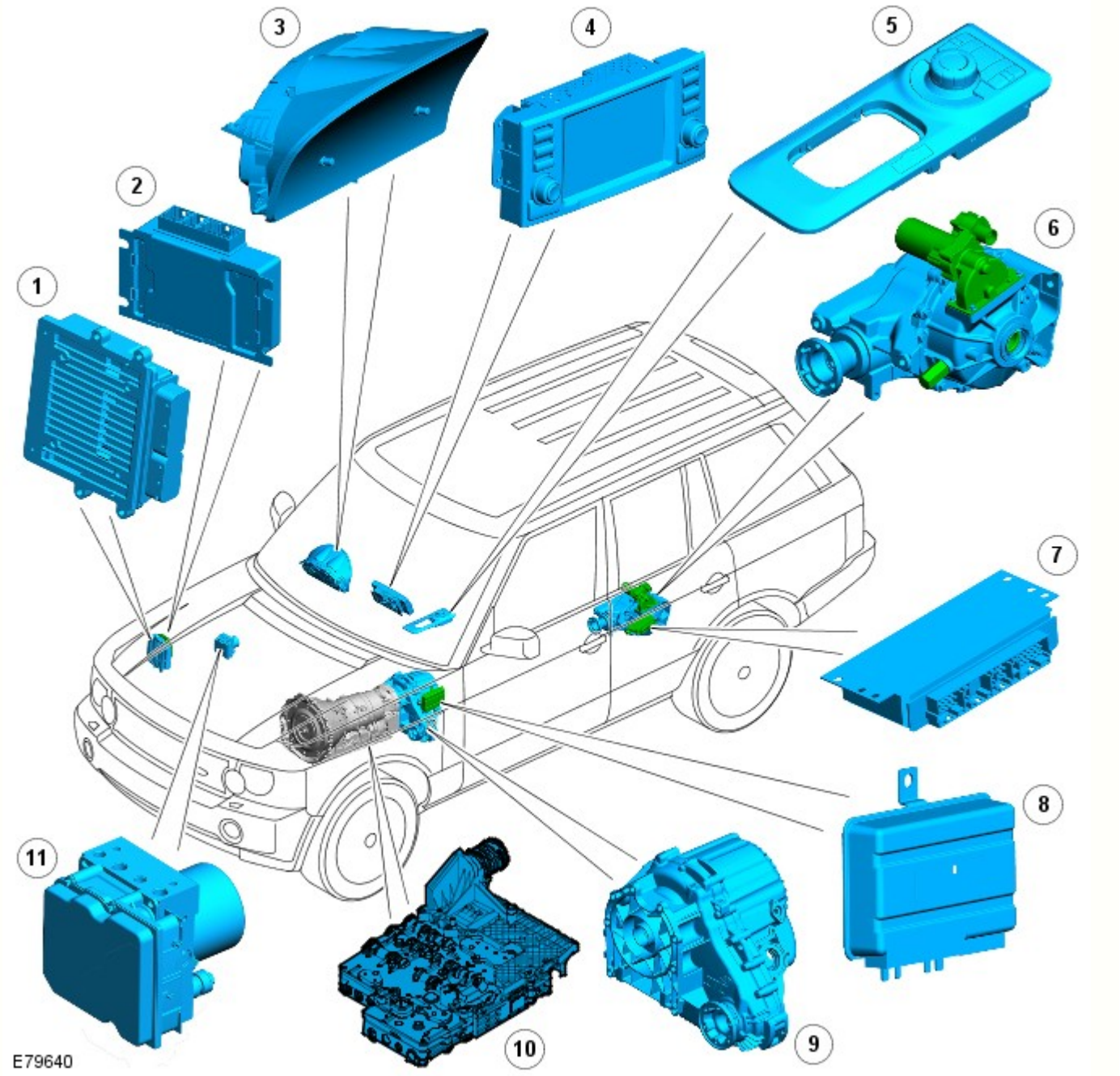
Ride and Handling Optimization - Ride and Handling Optimization

Description and Operation

Terrain Response - Component Location



Item	Description
1	engine control module (ECM)
2	Transfer box control module
3	Instrument cluster
4	Touch Screen Display (TAD)
5	Terrain Response rotary control (shown), or rocker switch
6	Rear differential
7	Rear differential control module
8	Air suspension control module
9	Transfer box (center differential and high/low range)
10	transmission control module (TCM)
11	anti-lock brake system (ABS) module

INTRODUCTION

The Terrain Response™ system allows the driver to select a program which aims to provide the optimum settings for traction and performance for the prevailing terrain conditions. The system cannot be switched off. The 'special programs off' is the default program and covers all general driving conditions. Four specific terrain programs are selectable to cover all terrain surfaces.

Depending on vehicle specification the system is controlled by either a rotary control or rocker switch located on the floor console, rearward of the transmission selector lever. Both of these controls allow the selection of one of the following five programs:

- Special programs off
- Grass/Gravel/Snow
- Mud/Ruts
- Sand
- Rock crawl.

The rotary-control type selector can be rotated through 360 degrees or more in either direction to select each program in turn. Whereas the rocker-switch type selector moves forward or back through the five program selections. The instrument cluster will display the selected program in the message center.

The Terrain Response system uses a combination of a number of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems make up the Terrain Response system:

- Engine management system
- Automatic transmission
- Transfer box (center differential)
- Rear differential (electronically controlled)
- Brake system (DSC/ETC/HDC functions)
- Air suspension.

A Terrain Response control module is located, depending on specification, below the rotary control or rocker switch. The control module detects the program selection made and transmits a signal on the high speed controller area network (CAN) bus which is received by each of the subsystem control modules.

Each of the affected sub-system control modules contain software which applies the correct operating parameters to their controlled system for the Terrain Response program selection made.

They also provide feedback for the selected program so that the Terrain Response control module can check that all systems have changed to the correct operating parameters.

Information is displayed in the instrument cluster message center which informs the driver of improvements which can be made to the vehicle operating parameters to optimize the vehicle for the prevailing conditions. Inexperienced off-road drivers may benefit from the automatic assistance of the Terrain Response system and the driver information. Experienced off-road drivers can select the specific programs for extreme conditions to access control over the vehicle systems for example, transmission shift maps, accelerator pedal maps or traction settings.

TERRAIN RESPONSE

Terrain Response Controls

The type of Terrain Response control fitted will depend on the specification of the vehicle.

When the vehicle is fitted with a gear selector lever, Terrain Response selection is via a rotary control. There are five Terrain Response programs marked around the control.

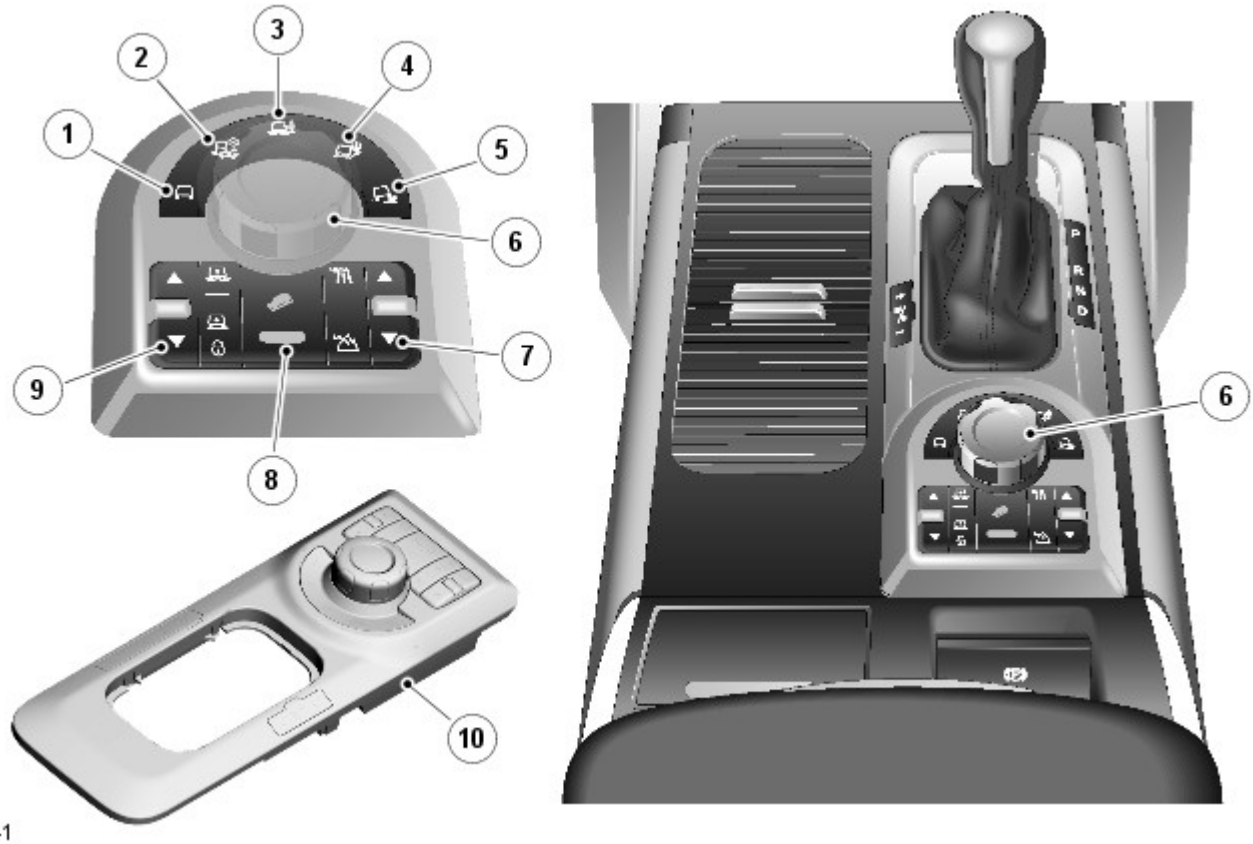
When the vehicle is fitted with a rotary drive selector, Terrain Response selection is via a rocker switch. The switch is used to move forward or back through the five program selections.

Each program is denoted by a symbol which represents the terrain encountered.

Information relating to the suitability of each selected program on different types of surface, is given on the touch screen, via the '4 x 4 Info' soft key. The displayed text is relevant to the currently selected program.

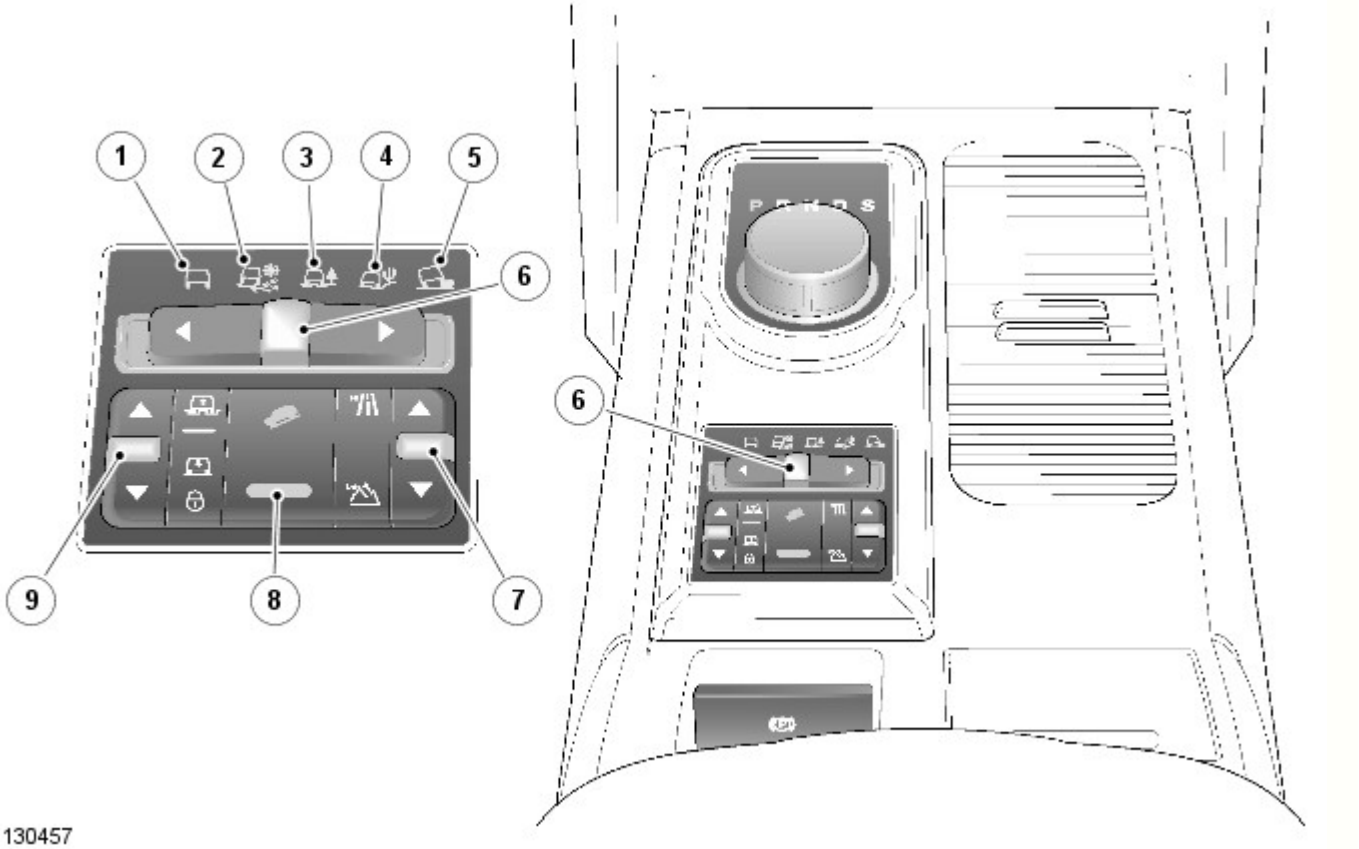
The Terrain Response control module is located below either the Terrain Response control. The module is connected via a harness connector which also contains the wiring for the: Hill Descent Control (HDC) switch, transfer box high/low range switch, air suspension control switch and the switch illumination circuits.

Rotary-Control Type Selector



Item	Description
1	Special programs off
2	Grass/gravel/snow program
3	Mud/ruts program
4	Sand program
5	Rock crawl program
6	Terrain Response rotary control
7	Transfer box high/low range switch
8	Hill Descent Control (HDC) switch
9	Air suspension control switch
10	Terrain Response control module

Rocker-Switch Type Selector



E130457

Item	Description
1	Special programs off
2	Grass/gravel/snow program
3	Mud/ruts program
4	Sand program
5	Rock crawl program
6	Terrain Response rocker switch
7	Transfer box high/low range switch
8	Hill Descent Control (HDC) switch
9	Air suspension control switch

PRINCIPLES OF OPERATION

The following vehicle subsystem control modules are used for the Terrain Response system:

- Engine management (ECM)
- Transmission control (TCM)
- Transfer box control (transfer box and center differential control module)
- Rear differential control (rear differential control module - if fitted)
- Air suspension control (air suspension control module)
- Brake system (DSC/ETC/HDC functions) (ABS module)

Each subsystem operates in different ways in relation to the selected Terrain Response program to achieve the optimum traction, stability and ease of control for the terrain encountered. The system has a safety factor built in which ensures that any program can be safely used on any surface, even when an inappropriate program selection has been made.

Engine Management System (EMS)

The EMS varies the accelerator pedal response to control the engine torque output. The EMS can change the accelerator pedal maps to change the amount of torque per percentage of pedal travel. The EMS can also change the accelerator response to control the allowed torque change relative to the percentage pedal travel.

Each terrain program uses a combination of operating parameters for each subsystem. Changing between terrain programs initiates a different set of operating characteristics which will be noticeable to the driver. The driver will notice differences in engine and accelerator response when, for example, the accelerator pedal is held in a constant position and the terrain program is changed from grass/gravel/snow to sand, the driver will notice the torque and engine speed increase. If the terrain program is changed from sand to grass/gravel/snow the driver will notice a reduction in torque and engine speed.

NOTE: The change in torque and engine speed can take approximately 30 seconds and care must be taken not to confuse the Terrain Response system operation with an EMS fault.

Transmission Control

The TCM changes the shift maps for the Terrain Response program selected. This changes the shift points providing early or late upshifts and downshifts.

On slippery surfaces the transmission will select 2nd gear in high range or 3rd gear in low range for starting from a standstill to minimize wheel slip. In muddy conditions the transmission will provide maximum torque output from the transmission. In sand the transmission will provide an output which passes maximum engine power from the transmission.

In rock crawl special program (low range only) the transmission will select 1st gear for driving off.

Sport mode is only available when the general program is selected and the transfer box is in high range. Sport mode is disabled in low range and when any Terrain Response special program is selected. CommandShift™ is available in any program and also in high or low range.

If the transmission is in 'Sport' mode and a special program is subsequently selected, the transmission will automatically change to manual 'CommandShift™' mode. If a special program is already selected and the transmission selector lever is moved from drive 'D' to the 'Sport' mode position, the transmission will automatically change to 'CommandShift™' mode.

Transfer Box and Rear Differential Control

The transfer box electronically controlled differential and the rear electronically controlled differential are treated as one system. The electronic rear differential is an optional fitment on vehicles fitted with the Terrain Response system. The differential control has two operating strategies; pre-emptive and reactive.

The pre-emptive strategy anticipates and predicts the locking torque value required for each differential to minimize slip and maximize stability. Each Terrain Response program has a different threshold and input criteria for the pre-emptive strategy. The pre-emptive strategy improves vehicle traction and composure by avoiding wheel spin. This is achieved by anticipating the amount of differential lock required for the program selected. For example, a high locking torque would be applied for rock crawl or slippery surfaces.

The reactive strategy varies the amount of locking torque in response to the actual slip level and the dynamic behavior of the vehicle. Each Terrain Response program has a different threshold and input for the reactive strategy. The reactive strategy improves vehicle traction and composure by eliminating any wheel spin which has occurred after the pre-emptive strategy was applied. The locking torque applied is applicable to the terrain program selected, for example, very sensitive on slippery surfaces to provide maximum traction and minimize surface damage.

The Dynamic Stability Control (DSC) function of the ABS can override the Terrain Response differential control and reduce any applied locking torque during DSC action.

Air Suspension Control

The air suspension control module contains a strategy which provides automatic switching between normal and off-road heights. Changes in vehicle height settings will be relayed to the driver via the instrument cluster message center and light emitting diode (LED) illuminated icons on the switch. The automatic selection of off-road ride height provides an increase in ground clearance and aims to provide maximum benefit to the selected terrain program.

On a vehicle fitted with a correctly installed, Land Rover approved trailer socket, if an electrical load is sensed on the trailer socket, height changes are prohibited and the message center displays a message advising that a trailer is connected and off-road height is not automatically selected. The driver can raise the suspension manually using the air suspension switch.

NOTE: The prohibiting of the automatic ride height selection is only operational if a Land Rover approved trailer socket is fitted and an electrical load is sensed on the socket.

Brake System Control

The ABS module controls several vehicle functions and adjusts the operating parameters of these functions to optimize the selected Terrain Response program.

Traction control uses different slip/acceleration thresholds to improve traction and vehicle composure. For example, the system sensitivity is increased on slippery surfaces to reduce wheel spin.

If DSC is switched off (with the DSC switch on the instrument panel) when using a Terrain Response special program, if the special program is subsequently changed for a different program, DSC is automatically switched back on.

The stability control uses different threshold values for the selected program to automatically reduce DSC intervention, removing the requirement for the driver to disable the DSC system in order to reduce engine intervention which is sometimes induced in extreme off-road conditions. In extreme sand conditions, there may be an additional benefit of disabling the DSC function using the DSC switch on the instrument panel in addition to selecting the sand program.

HDC is automatically switched on or off and target speeds are adjusted in response to the Terrain Response program selected. The responsiveness of the HDC function is also increased where required.

Incorrect Program Usage

Selection of an inappropriate program is discouraged in the following ways:

- The active program icon is continually displayed in the instrument cluster message center
- The Terrain Response control module 'locks' out certain functions in some programs, for example:
  - adaptive speed control or speed control are only available with the 'special programs off' or 'grass/gravel/snow program' selected,
  - transmission 'Sport' mode is deactivated in all special programs.
- In any special program, except the grass/gravel/snow program, when the ignition has been in the off position, continually for more than six hours, the Terrain Response system defaults to the Special Programs off. When in the grass/gravel/snow program, the Terrain Response system will never default to the Special Programs off. This is to allow for drivers in cold climates where continuous use of the grass/gravel/snow program would be beneficial.
- The rock crawl program is only available with the transfer box in low range.

Selection of an inappropriate program for the terrain conditions will not endanger the driver or cause immediate damage to the vehicle. Although, continued use of an inappropriate program may reduce the life of some components. The driver may notice reduced vehicle response, with the engine and transmission being less responsive than in the special programs off. Also, in some programs, HDC will remain on, signified by illumination of the HDC indicator in the instrument cluster. The driver may also notice torque 'wind-up' in the center and rear differentials causing a 'braking' effect when the vehicle is manoeuvred in some special programs.

The use of the special programs in the Terrain Response system is monitored by the Terrain Response control module which records the mileage and time the vehicle has operated in a specific program in high and low range. This information can be retrieved using an approved Land Rover diagnostic system and used by the dealer technician to check customer concerns, e.g. high fuel consumption which may be due to continued use of a certain program.

Driver Information

The instrument cluster contains a message center which displays vehicle information to the driver. The message center contains the Terrain Response program icons which display the currently selected program. If no symbol is displayed, no special program is selected and the system is in special programs off.

Any required changes to the subsystems are also passed to the driver in the form of indicator illumination in the instrument cluster or appropriate messages in the message center, HDC off or air suspension height change for example.

In certain operating conditions, the Terrain Response system also displays advice or warning messages to ensure the driver is using the vehicle to its full potential, e.g.,

- Steering angle is displayed in the message center to avoid driving in deep ruts with steering lock applied
- gear information is displayed to recommend a gear for slippery conditions
- if the system automatically provided off road ride height, but the driver subsequently lowers the vehicle to normal height, then the system may advise that this will cause a risk of grounding.

The messages which can be displayed in the instrument cluster message center are detailed in the Information and Message Center section.
For additional information, refer to: Information and Message Center (413-08, Description and Operation).

DIAGNOSTICS

The Terrain Response control module stores information on detected Terrain Response faults and CAN errors which can be interrogated using an approved Land Rover diagnostic system. The Terrain Response sub-systems and the instrument cluster also store fault information relating to CAN errors from the Terrain Response control module.

The control module also stores the miles traveled and time elapsed in high range for the individual programs and in low range for use of all programs which can also be retrieved using an Land Rover approved diagnostic system. This information aids diagnosis of the Terrain Response system and also provides an indication of Terrain Response system abuse by the driver which can lead to premature component failure.

Terrain Response System Fault Diagnosis

Terrain Response relies on the correct functionality of the five sub-systems. If one of the sub-systems develops a fault, the Terrain Response system will not function, even though the fault is NOT in the Terrain Response system. The Terrain Response control module and control selector should only be investigated if there are no apparent faults in any of the sub-systems. If a fault in a sub-system is subsequently corrected, the Terrain Response system will function normally after an ignition on and off cycle.

Terrain Response Sub-System Faults

If a fault occurs in a sub-system, the driver is alerted by the illumination of a warning indicator and/or an appropriate message for that sub-system in the instrument cluster message center. There will be no warning of a Terrain Response system fault.

When a sub-system fault is present and the driver attempts to select a different Terrain Response program using the control selector or at the next ignition on cycle, a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will appear in the message center. **This implies that the Terrain Response system has a fault, but only because a sub-system fault is preventing its operation.** This message will be displayed for 5 seconds per ignition cycle, but is repeated if a further selection is made by the driver using the Terrain Response control selector or at the next ignition on cycle.

NOTE: The message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' can also be generated by a fault in the Terrain Response control selector or control module. See following section for details of rotary control or control module faults.

It is not possible for the Terrain Response control module to cause any fault behavior (warning indicator illumination or message generation) in any of the five sub-systems. Illumination of a sub-system warning indicator and/or a sub-system related message will never be associated with a Terrain Response control module or Terrain Response system fault.

The sub-system control modules can detect a fault with the CAN bus signal from the Terrain Response control module. If a fault in the Terrain Response system is detected, the sub-system control modules will operate in the 'special programs off' setting. The sub-system control modules will record a fault code for a failure of the Terrain Response CAN bus signal. These faults can be retrieved using an approved Land Rover diagnostic system and will provide useful information to indicate investigation of the Terrain Response control module or the CAN bus network.

Terrain Response Control Selector or Control Module Fault

If a fault occurs in the Terrain Response control selector, all control icon amber LED's will be turned off (background illumination will remain on) and selection of the control is ignored. The instrument cluster message center will display a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' when the fault occurs, if the fault is present and the driver attempts to select a special program (if the control module is able to do this) or at the next ignition on cycle.

If a failure of a control icon amber LED occurs, the Terrain Response system will still function. Any selected special program will default to 'special programs off' at every ignition on cycle, with the exception of the grass/gravel/snow program.

The Terrain Response control selector and the control module are an integral unit. If a fault occurs in either component, the whole unit will require replacement. **BEFORE REPLACING THE TERRAIN RESPONSE CONTROL MODULE, ENSURE THAT THE FAULT IS NOT IN ANY OF THE SUB-SYSTEM MODULES.**

CAN Bus Faults

If a CAN bus fault exists and prevents Terrain Response system operation, all of the Terrain Response control icon LED's will be illuminated and the control selection ignored.

If the instrument cluster does not receive a Terrain Response system CAN bus message from the Terrain Response Control module, the message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will be displayed when the fault occurs and will be repeated at every ignition on cycle.

User Error

The following incorrect usage of the system may be misinterpreted as a system fault:

- Engine not running - Program changes and driver advisory messages are only available with the engine running
- Rock crawl program selected but transfer box in high range
- Special program change attempted with DSC or ABS active (this includes ABS cycling which is operational when HDC is being used on slippery or loose surfaces).
- Special program change attempted with overheat condition present on center or rear differential.

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Rear Drive Axle/Differential -

Sealers

Item	Land Rover Part No.
Input shaft splines	STC 50554
Differential electronic torque managed (ETM) unit locking motor	STC 50550

Lubricants

Item	Specification
*** Recommended lubricant:**	
Open unit	Castrol SAF-XO - 75W/90
ETM unit	Castrol SAF Carbon Mod Plus

*** Do not use any lubricant other than that specified**

Capacities

Unit	Service Fill Capacity
Open differential	1.14 liters (2.41 US pints) (1.20 US quarts)
ETM differential	1.55 liters (3.28 US pints) (1.64 US quarts)

Rear 'Open' Differential

Item	Specification
Reduction ratio:	
TDV8 Diesel engine	3.54:1
V8 Supercharged Petrol engine	3.54:1
V8 Naturally Aspirated Petrol engine	3.54:1

Rear Electronic Torque Managed (ETM) Differential

Item	Specification
ETM range	Up to 2500 Nm (98.5 lbf/ft)
ETM motor	Operates the ball/ramp mechanism and wet clutch. Motor incorporates a temperature sensor and is controlled by an ECU
Differential type	4 pin
Reduction ratio:	
TDV8 Diesel engine	3.54:1
V8 Supercharged Petrol engine	3.54:1
V8 Naturally Aspirated Petrol engine	3.54:1

Torque Specifications

Description	Nm	lb-ft
Oil drain plug	28	21
Oil filler plug	34	25
Oil temperature sensor	22	16
++ Differential locking motor	10	7
Differential front mounting bolts	100	74
** Differential rear mounting bolt		
Stage 1	120	89
Stage 2	Tighten a further 180 degrees	
* Driveshaft to rear axle drive flange bolts		
Stage 1	44	33
Stage 2	Tighten a further 45 degrees	

*** New "Patchlok' Torx bolts must be installed**

**** New nut must be installed**

++ Apply sealant, Part No. STC 50550 to flange of locking motor