

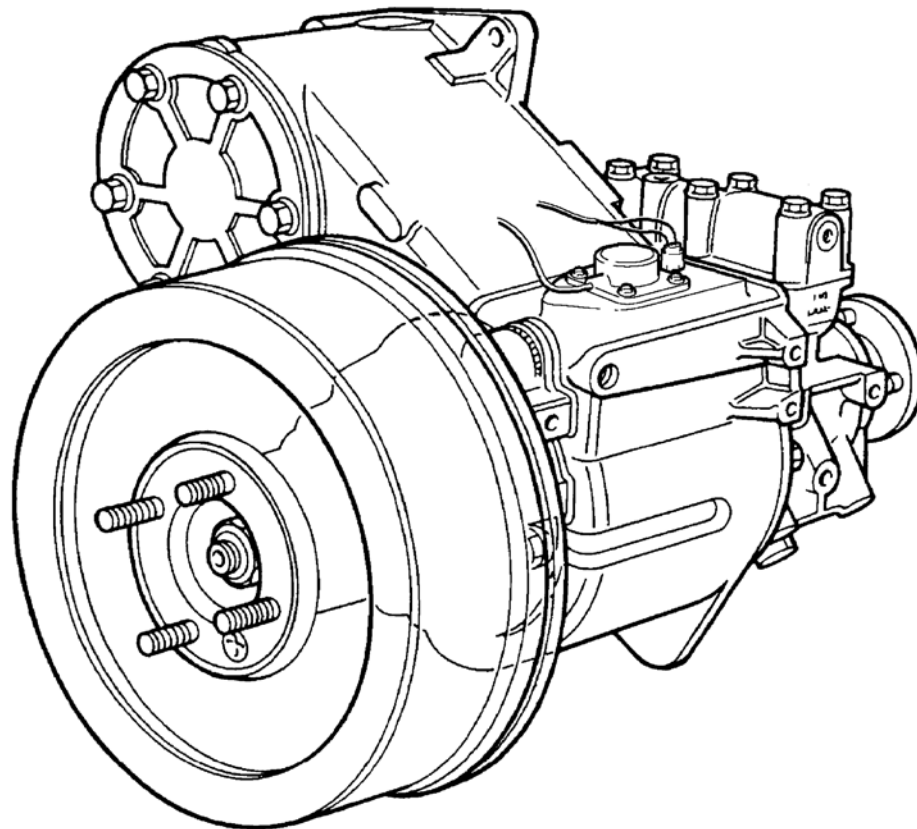
LT230T/Q TRANSFER GEARBOX

The LT230T has been used for many years and is manufactured by Land Rover at the factory in Solihull, England. It utilizes a constant mesh gear train with a front to rear differential, and a differential locking mechanism.

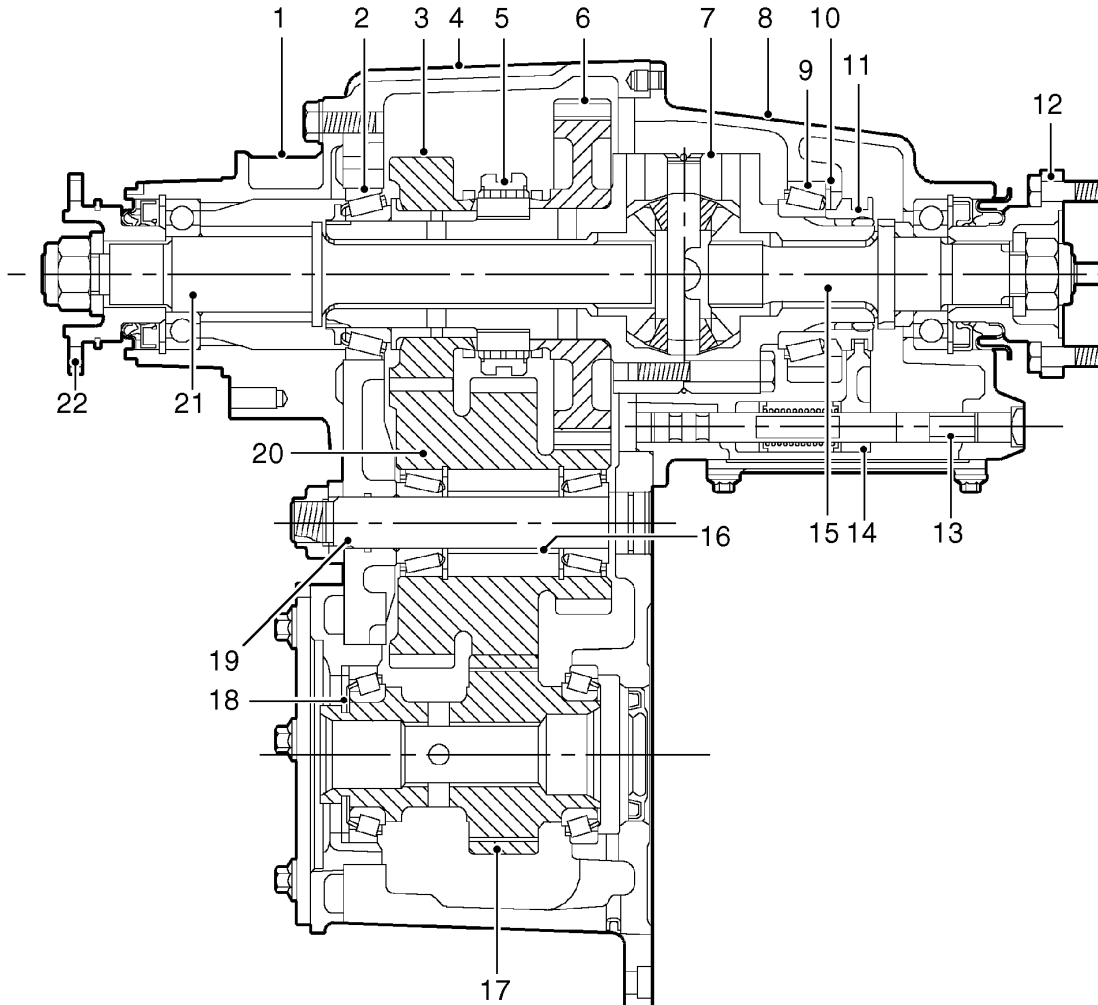
Its use on North American Specification (N.A.S.) vehicles began with the 1987 and 1988 Range Rovers. It was used on all N.A.S. Defenders, and 1994 to 1999 Discoverys. As a running change in 1997, the LT230T was replaced with the LT230Q which features numerous detail improvements including fine cut teeth on the high range gears. This was done to reduce noise. The low range gear teeth remain coarse for strength.

This transfer gearbox was replaced in 1999 by the LT230SE, with the introduction of Discovery Series II (LT). The LT 230SE is essentially the same construction but with an uprated torque capacity and new sensors and switches.

Beginning with the launch of Discovery Series II (LT), the differential lock function was no longer driver selectable although the internal components were retained. For the 2004 North American model, driver selectable differential lock again became available using cable linkage activation.



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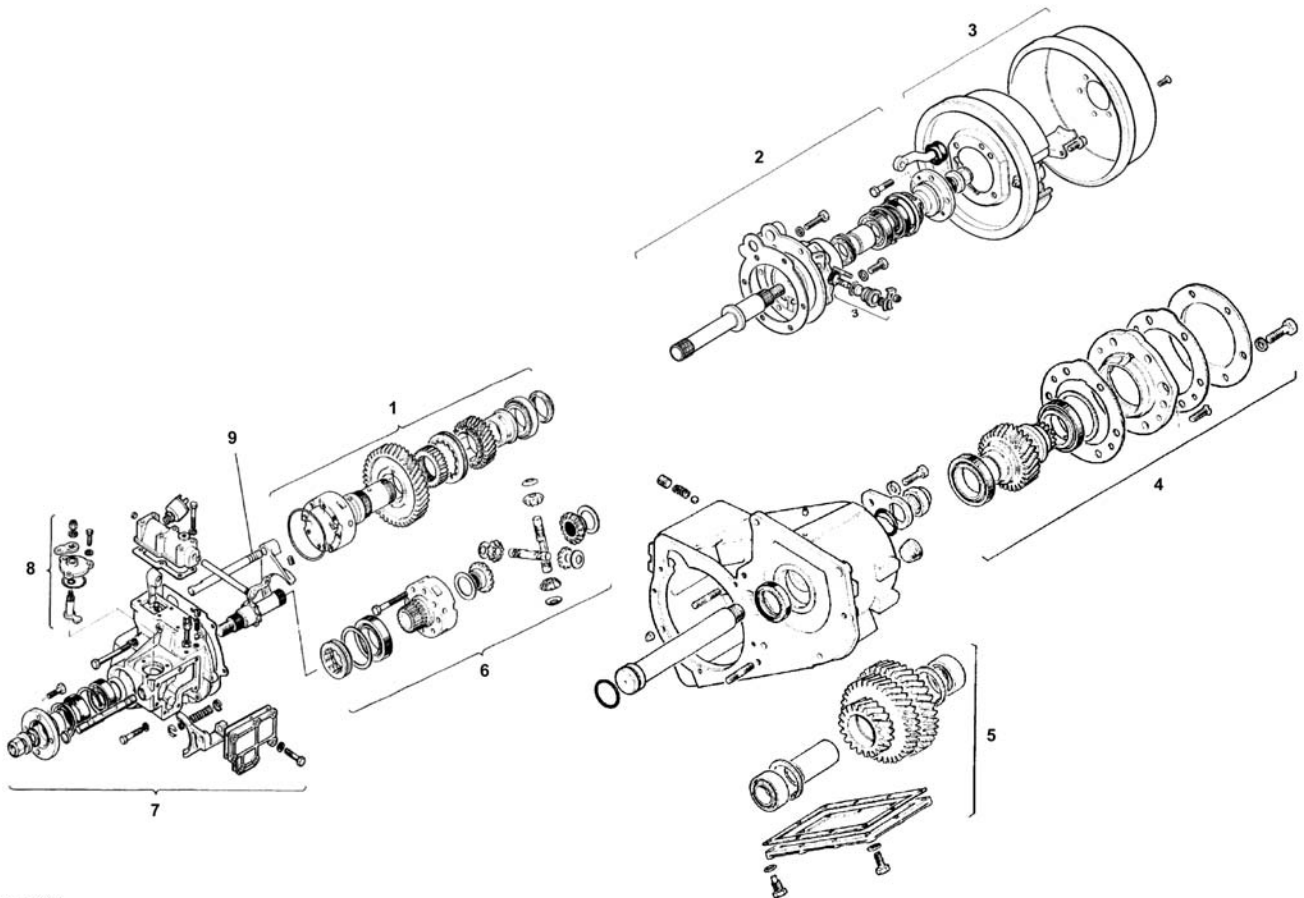
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|--|--|
| 1 Rear output housing | 12 Front output flange |
| 2 Differential rear bearing | 13 Differential lock selector shaft |
| 3 High range gear and bush | 14 Selector fork |
| 4 Main casing | 15 Front output shaft |
| 5 High/low selector sleeve and hub | 16 Collapsible or Selective spacer |
| 6 Low range gear | 17 Mainshaft input gear |
| 7 Differential assembly | 18 Selective shim - input gear bearing pre-load |
| 8 Front output housing | 19 Intermediate shaft |
| 9 Differential front bearing | 20 Intermediate gear cluster |
| 10 Selective shim - differential bearing pre-load | 21 Rear output shaft |
| 11 Dog clutch | 22 Rear output flange |

LT230 TRANSFER BOX



CONSTRUCTION AND OPERATION

The LT230 consists of a helical-cut, constant mesh gear train with high and low speed ranges. A center differential (contained in the transfer gearbox) driven by the output gear provides full time 4WD by allowing the front and rear output shafts/flanges to automatically adjust their relative speeds to compensate for road wheel speed differences. A mechanical lock allows the operator to effectively eliminate the center differential under adverse conditions. Doing this provides a 50/50 power distribution front to rear.



LRULT230

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|---|------------------------------------|
| 1 High/Low Gears and Center Differential Carrier (Rear Half). | 6 Center Differential Assy. |
| 2 Rear Output Drive Assy. | 7 Front Output Drive Assy. |
| 3 Parking Brake Assy. | 8 Differential Lock Selector Assy. |
| 4 Power Take-Off Assy. | 9 High/Low Selector Fork |
| 5 Intermediate Gear and Bottom Cover | |

The differential lock consists of a sliding operating sleeve and linkage. As the operator slides the lever forward the "lock" position, a spring loaded shift fork, pushes the operating sleeve over a set of dog teeth on the center diffs front output end. This then joins the front and rear outputs together and splits power equally front to rear.



LT230 TRANSFER BOX

Shifting into diff-lock can be done at any speed as long as the front and rear axles are moving at the same relative speed. NEVER shift into diff-lock if one or more wheels are spinning - this will damage the transfer gearbox.

Due to the fact that the diff- lock sleeve is moved by spring pressure there is usually some delay for engagement or disengagement. Any engagement delay is due to the sleeve and hub being “tooth to tooth” and will quickly resolve itself. Disengagement delay is caused by “axle windup” and may require that the vehicle be backed up short distance. Driving for extended periods on a non slippery surface in diff-lock will cause disengagement problems.

The diff-lock indicator lamp in the instrument cluster or console is only activated when the sleeve is in or out of diff-lock and is not triggered directly by the high/low lever itself.

The high/low ratios are selected by a lever which moves a shift fork. Just like in a manual transmission, the shift fork moves an operating sleeve which locks either the high or low output gear onto its shaft.

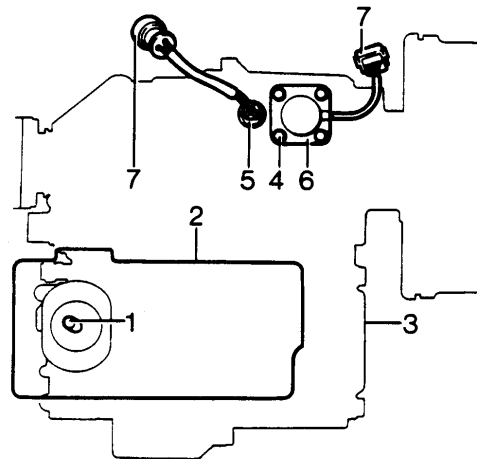
All LT230 units, regardless of transmission, are equipped with a neutral warning switch which sounds a buzzer if the shift lever has not been moved completely into either high or low range.

DISCOVERY GEARBOX INTERLOCK ASSEMBLY

Discovery vehicles with automatic transmissions are equipped with a transfer gearbox interlock solenoid which prevents the driver from moving the transfer gearbox lever from high to low or from low to high unless the automatic transmission is in neutral. In any event, gear changes should always be made at less than 5 mph (7 kph).

Shown below is the transfer gearbox interlock and related components used on Discoverys with automatic transmissions through 2003 model year.

Beginning with the 2004 model year, the range select interlock solenoid is moved to the shift lever housing.



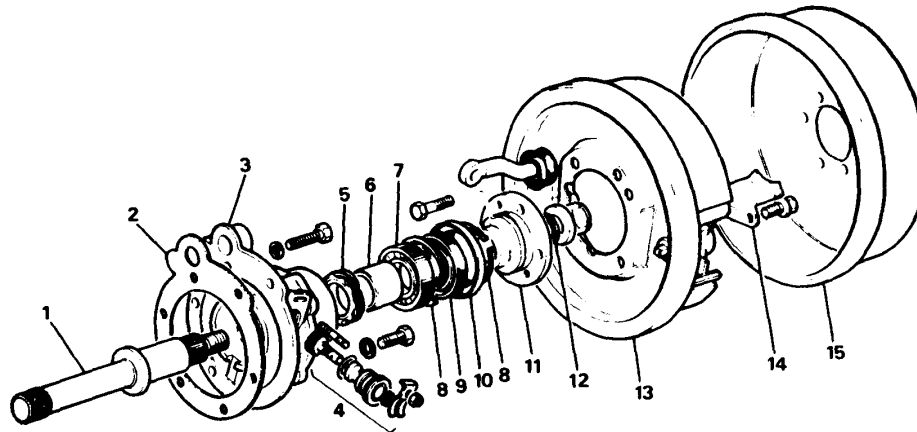
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Interlock & Audible Warning - 1994 - 2003 M.Y.

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|-------------------------|--------------------------|
| 1 High/low lever | 5 Audible warning/switch |
| 2 Trans. Tunnel opening | 6 Interlock solenoid |
| 3 Transfer gearbox | 7 Harness connectors |
| 4 Bolt | |

REAR OUTPUT DRIVE AND TRANSMISSION BRAKE ASSEMBLY

As shown in the illustration, the rear output flange drives the parking brake drum. A backing plate with brake shoes is attached to the transfer gearbox case. When the brake shoes are applied, the drum locks the rear output and propeller shaft and in doing so acts on the front output and propeller shaft - a very effective 4 wheel parking brake.



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|----------------------------------|-----------------------------|
| 1 Rear output Shaft | 9 Oil Seal |
| 2 Joint Washer | 10 Oil Shield |
| 3 Speedometer Drive Housing | 11 Rear Output Flange |
| 4 Speedometer Drive Pinion Assy. | 12 Sealing Washer |
| 5 Speedometer Worm Drive | 13 Transmission Brake Assy. |
| 6 Spacer | 14 Oil Catcher |
| 7 Ball Bearing | 15 Brake Drum |
| 8 Circlip | |



LT230 TRANSFER BOX

SERVICE INFORMATION

Service Intervals

Drain and refill the transfer gearbox every 30,000 miles (48,000km) under normal on-road driving conditions. If the vehicle is used extensively off-road, this service should be performed every 15,000 miles (24,000km).

Oil Type	Quantity
80/90W EP GL 4 or 5	2.4Q (2.3L)

RATIOS

Range Rover Classic, Defender 90

High Range 1.22:1

Low Range 3.32:1

Discovery (LJ)

High Range 1.21:1

Low Range 3.27:1

Discovery (LT)

High Range 1.21:1

Low Range 3.32:1

SERIAL NUMBER PREFIXES

LT230T

Range Rover Classic	28D
Discovery (LJ)	28D, 34D
Defender	25D, 29D, 32D

LT230Q

Discovery (LJ)	36D, 37D
Defender	38D, 40D

LT230SE

Discovery (LT)	42D
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GENERAL DESCRIPTION

The LT230SE transfer box was introduced with 1999 Discovery Series II, and is currently the only North American Land Rover product with this gearbox. Mechanically it is essentially the same unit as others in the LT230 family, but with the addition of new sensors and switches. In Discovery Series II, the mechanical differential locking mechanisms are not used but remain present, their functionality replaced by the Electronic Traction Control (ETC) system.

The LT230SE transfer box is a constant mesh gear type unit, and transmits drive via high or low reduction ratios to the front and rear axles via the propeller shafts. The high/low ratios are 1.211:1 and 3.32:1 respectively.

North American specification transfer boxes have the prefix 42D to the unit serial number, indicating that the unit is equipped with a neutral interlock.

While similar to LT230Q transfer boxes fitted to other models, the LT230SE transfer box has certain engineering modifications incorporated which are as follows:

- Up-rated torque capacity
- Modified front and rear output and cross shaft housings
- Intermediate gear bearing pre-load now controlled by a selective, non-collapsible spacer
- Speedometer drive and driven gears not fitted for this application
- Modified high/low hub
- Modified front output flange and mud shield
- Differential lock fitted but no longer driver operated
- Modified, cable operated, high/low selector lever and brackets
- Fixed setting of differential lock warning lamp switch

The speedometer drive has been deleted from the transfer box, with the vehicle speed signal now being supplied by the self levelling anti lock brake system (SLABS) Electronic Control Unit (ECU). The speedometer drive casing is therefore blanked off. High-Low shift is now cable operated. The ABS simulates the center differential lock, so no driver operation is available or required.

LUBRICATION

Lubrication is by splash, oil filler/level and drain plugs being located in the main casing.

Internal pressures caused by thermal expansion and contraction are avoided by the use of a plastic breather pipe venting the interior of the box to atmosphere. The pipe is attached to the top of the high/low selector housing by a banjo bolt and is then routed in a continuously rising path into the engine compartment where the open end is secured by a clip attached to the engine cylinder block.



LT230 TRANSFER BOX

CONSTRUCTION

The transfer box comprises three main assemblies; the main casing, the front output housing and the rear output housing. Both output housings and all cover plates are sealed to the main casing by sealant; mud and water ingress being prevented by mud shields located on the output flanges.

Main Casing

The main casing carries the mainshaft input gear, the intermediate gears and the differential, together with the high/low range gears, selector shaft and fork. The front and rear output housings are bolted to either side of the main casing.

Mainshaft input gear

The gearbox output shaft is splined into the mainshaft input gear which is supported by taper roller bearings. Input gear bearing pre-load is achieved by the use of a selective shim located in the bearing housing.

Front output housing

The front output housing carries the front output shaft and flange, high/low cross shaft, housing and selector and the differential lock selector shaft and fork.

The front output shaft is supported in the housing by a single bearing and is splined into the differential front sun gear.

Intermediate gears

The intermediate gear cluster is supported by the taper roller bearings located at each end of the cluster and runs on the intermediate shaft which, in turn, is supported at the front and rear by the main casing.

A selective spacer, positioned between the gears, pre-loads the intermediate gear bearings when the intermediate shaft nut is tightened sufficiently to achieve the correct 'torque to turn' of the intermediate gears.

Rear output housing

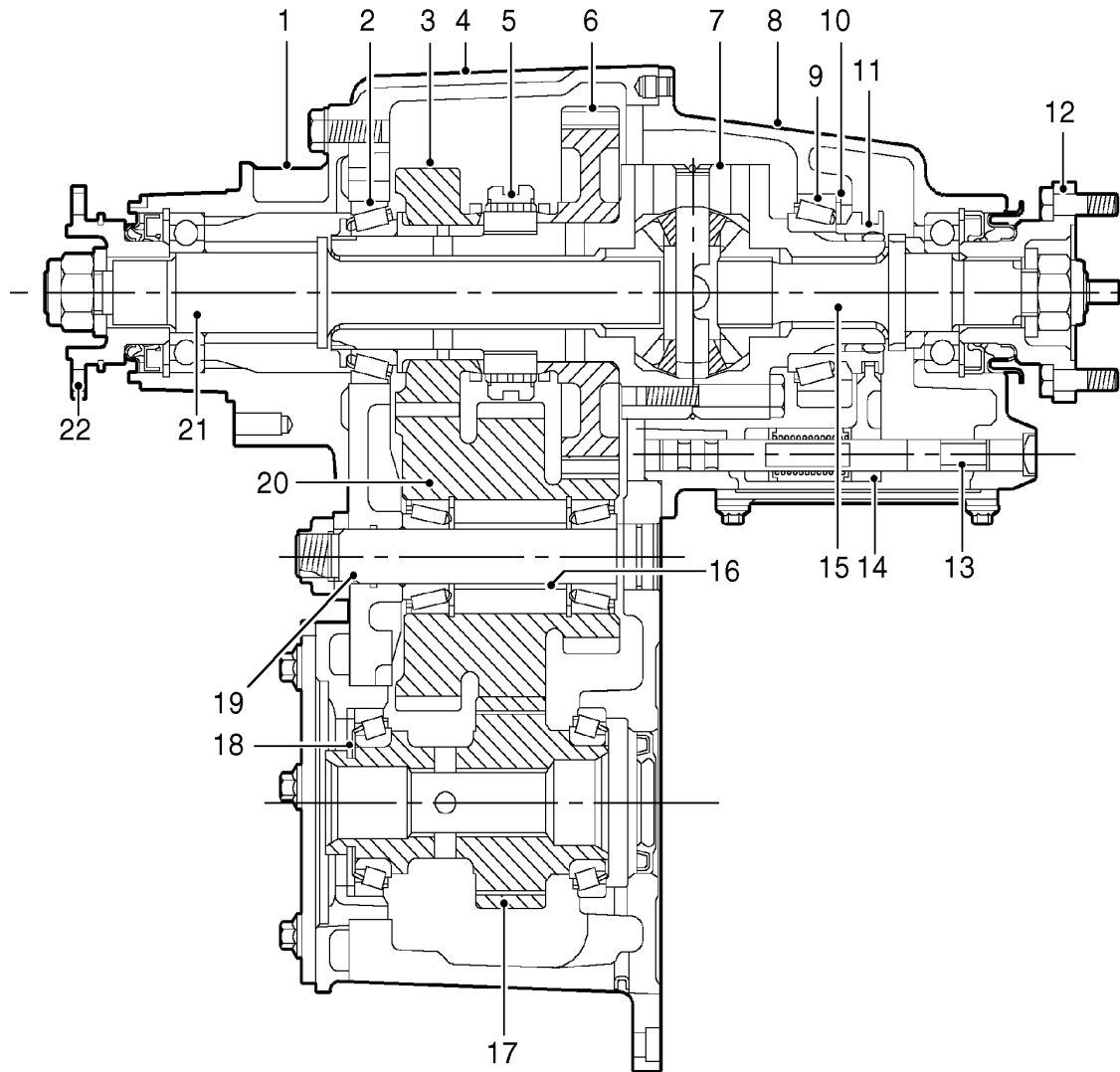
The rear output housing carries the output shaft and flange. A cable operated transmission brake is attached to the housing, the brake drum being attached to the output flange.

The rear output shaft is supported in the housing by a single bearing and is splined into the differential rear sun gear.

High/low selector

The high/low cross shaft is located in a housing bolted to the top of the output housing and is connected to the high/low selector finger which locates in a slot in the selector shaft.

LT230 TRANSFER BOX



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|----|--|----|--|
| 1 | Rear output housing | 13 | Differential lock selector shaft |
| 2 | Differential rear bearing | 14 | Selector fork |
| 3 | High range gear and bush | 15 | Front output shaft |
| 4 | Main casing | 16 | Selective spacer -intermediate gear bearing pre-load |
| 5 | High/low selector sleeve and hub | 17 | Mainshaft input gear |
| 6 | Low range gear | 18 | Selective shim - input gear bearing pre-load |
| 7 | Differential assembly | 19 | Intermediate shaft |
| 8 | Front output housing | 20 | Intermediate gear cluster |
| 9 | Differential front bearing | 21 | Rear output shaft |
| 10 | Selective shim - differential bearing pre-load | 22 | Rear output flange |
| 11 | Dog clutch | | |
| 12 | Front output flange | | |

Differential assembly

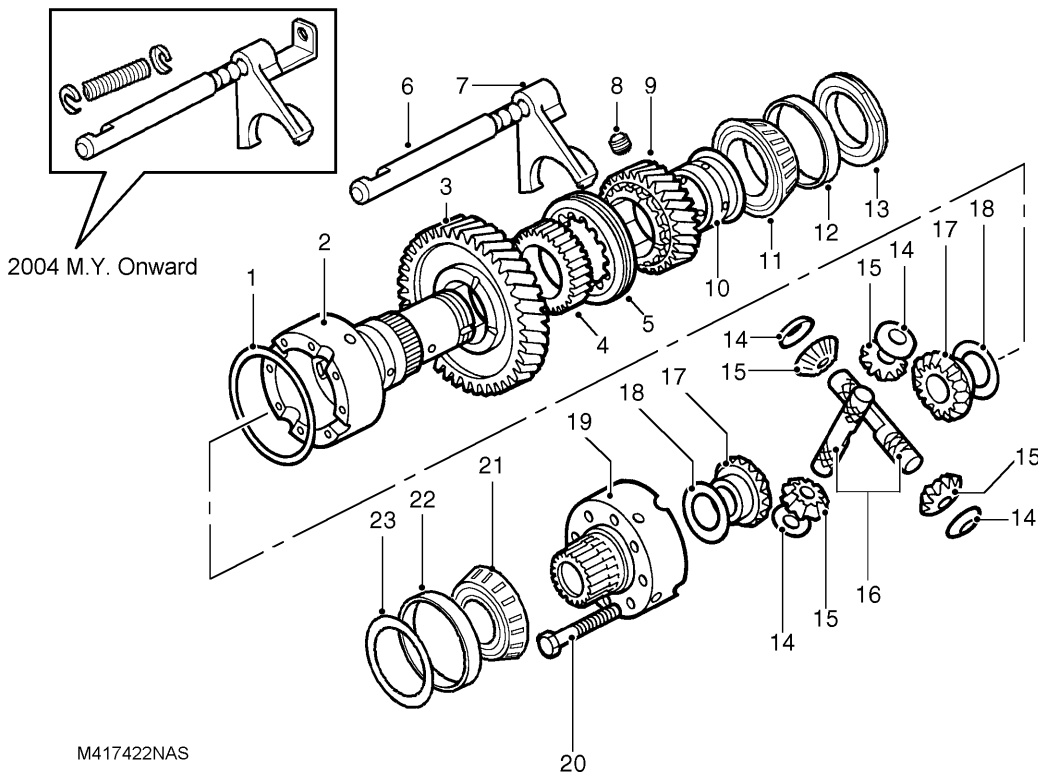
The differential assembly is supported at the front and rear by taper roller bearings (11,12 & 21,22), the front bearing outer track is located in the front output housing and the rear bearing outer track is located in the main casing by the rear output housing. Bearing pre-load is achieved by means of a selective shim (13) located in the front output housing.

The differential rear shaft carries the low range gear (9), high/low selector sleeve and hub (4,5), high range gear (3) and bush and the differential rear bearing; these components being secured to the shaft by a special staked nut.

The differential assembly comprises front (19) and rear (2) half carriers with integral shafts and with sun (17) and planet (15) gears mounted on cross shafts (16) within the half carriers. Dished, non-selective thrust washers (14) control the engagement of the planet gears with the sun gears, while selective thrust washers (18) are used to control engagement of the sun gears and 'torque to turn' of the differential. The differential carrier halves are bolted together, a retaining ring providing positive location of the cross shafts.

NOTE: Excessive operation of the sun and planet gears, such as that which occurs during driving under slippery conditions without differential lock engagement, will result in premature wear of the thrust washers (14,18). This thrust washer wear can contribute to a complaint of 'clunk' on acceleration/deceleration.

The high/low selector shaft and fork (6,7) are located at the side of the differential, movement of the shaft, fork and selector sleeve being controlled by the high/low selector finger. A spring loaded detent ball fitted in the main casing, locates in grooves in the shaft..



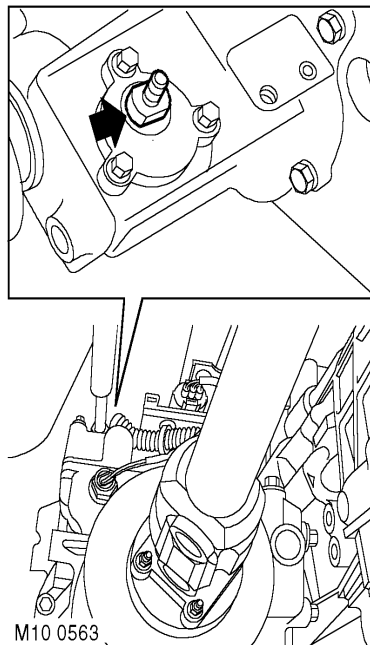
Differential lock

The differential lock selector housing is bolted to the top of the output housing, the selector finger passes through the housing, locating in a slot in the differential lock selector shaft. The differential lock selector shaft passes through the selector fork which is located beneath a plate bolted to the side of the output housing. The selector fork engages the dog clutch sleeve with the differential rear shaft when the splines of the sleeve and differential rear shaft are aligned. A spring loaded detent ball fitted in the output housing locates in grooves in the shaft.

1999 - 2003 Model Year

The function of the differential lock on these vehicles is performed by the Electronic Traction Control System. However, for the purposes of 2 wheel rolling road testing, the differential lock components are retained. For all driving conditions however, the differential lock must be set in the unlocked position. Engagement of the lock disables the traction control feature and inhibits correct operation of the electronic brake distribution and hill descent features.

It will also be necessary to disconnect the propeller shaft from the transfer box output shaft driving the axle whose wheels are NOT on the rolling road. The lock may be engaged/disengaged by using a 10 mm open ended spanner on the flats machined on the differential lock selector shaft.



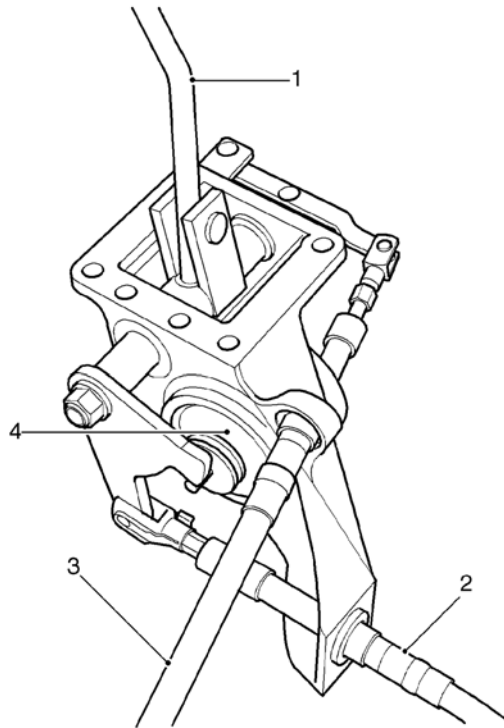


LT230 TRANSFER BOX

2004 Model Year Onward

The differential lock must be engaged for 2 wheel rolling road testing. It will also be necessary to disconnect the propeller shaft from the transfer box output shaft driving the axle whose wheels are NOT on the rolling road. In addition, the ETC system must be deactivated by either, removing a fuse (10A fuse 28 in the passenger compartment fusebox, labelled ABS) or disconnecting the ABS modulator pump. This must be done with the ignition switched off.

Note that the SLABS ECU may record a system fault. The lock can be engaged or disengaged using the selector lever.



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High/Low Range and Differential Lock Selector Lever

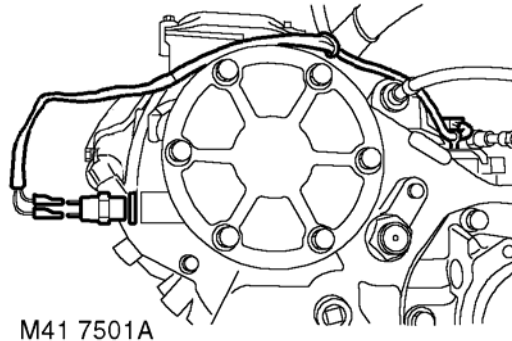
- 1 Selector lever
- 2 High/Low range cable

- 3 Differential lock cable
- 4 Interlock solenoid

SWITCHES AND SENSORS

Oil temperature warning lamp switch

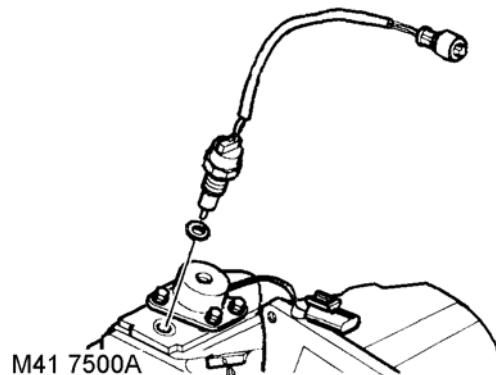
An oil temperature switch is fitted to V8 engine models. In the event of the transfer box oil approaching maximum recommended working temperature of 145° C (293° F), the switch will close and a warning lamp in the instrument pack will be illuminated.



Oil Temperature Warning lamp Switch

Neutral sensor

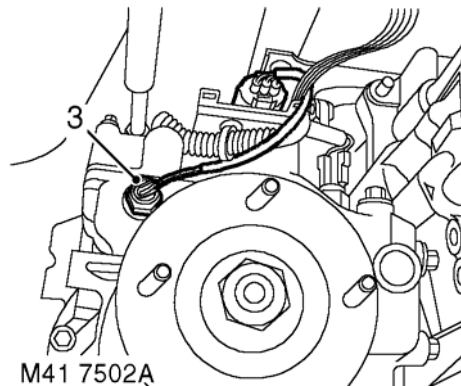
A neutral sensor is fitted for North America and Japan. The sensor is connected to the BCU and is normally in the open position. The sensor provides an earth path for the BCU which then interprets the signal and activates an audible warning generated by the IDM if neutral is selected on the transfer box when the ignition is on.



Neutral Sensor

High/low detect switch

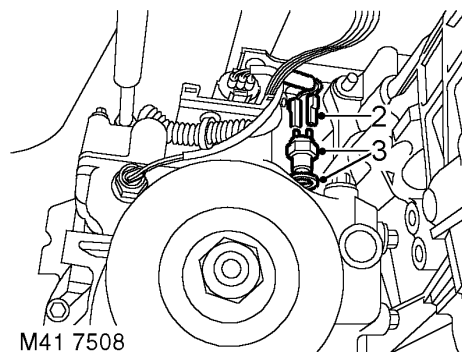
A high/low detect switch is fitted in the front output housing and connects to earth when low is selected. The switch is connected to the engine ECM, the SLABS ECU and the BCU. The purpose of the switch is to enable selection of the hill descent feature and to modify the engine fuelling and automatic gearbox gearshift maps stored within the respective ECM's and ECU's.



High/Low Detect Switch

Differential lock warning lamp switch

A differential lock warning lamp switch connected to the SLABS ECU and operated by movement of the selector fork and shaft is screwed into the top of the output housing. The switch connects to earth when the differential lock is engaged.



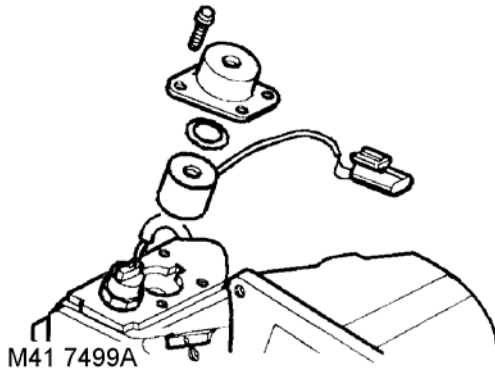
Differential Lock Switch

Differential lock warning lamp

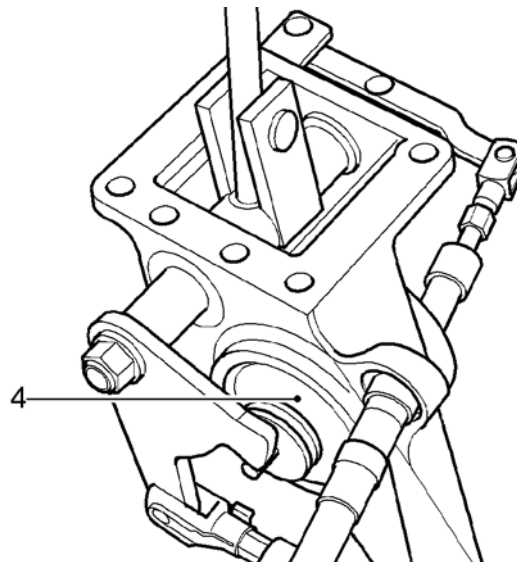
The differential lock warning lamp is located in the instrument pack and provides a warning to the driver when the ignition is switched on that the differential lock is engaged. With the lock engaged, the traction control and electronic brake distribution warning lamps will also be illuminated. Disengagement of the differential lock should be carried out with the ignition switched off. The warning lamps must be extinguished when the ignition is switched on again.

Transfer box interlock solenoid

An interlock solenoid is fitted for North America and Japan. The solenoid is located on the top of the transfer box main casing on vehicles up to 04 model year or on the selector lever assembly on vehicles from 04 model year. The solenoid is connected to the transfer box relay which, in turn, is controlled by the IDM. The purpose of the solenoid is to prevent neutral being selected on the transfer box when the ignition key is removed, thereby locking the box in either high or low ratio.



Interlock Solenoid 1994 - 2003 M.Y.



Interlock Solenoid 2004 - Onward



LT230 TRANSFER BOX

NOTES