

SECTION 07: TRANSMISSION

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1. DESCRIPTION

X3 Series coaches may be provided with either an Allison automatic transmission or a Volvo I-Shift transmission while X3-45 VIP and XLII Bus Shells are provided with an Allison automatic transmission.

1.1 ALLISON AUTOMATIC TRANSMISSION

The B500 and B500R (with retarder) Allison Transmissions have 6 speeds with two top range (fifth and sixth) overdrives. Total coverage is determined by dividing the highest gear ratio by the lowest gear ratio. Total coverage expresses the transmission gear ratio versatility. Transmissions with larger total coverage number have a wider variety of available ratios.

An electronic control allows the transmission to shift at exactly the right point on the engine's fuel consumption curve for best economy. Early lockup maintains the highest possible mechanical efficiency through the closely-spaced gear steps, culminating in two overdrive ratios. This combination allows progressive shifting techniques, where engine speeds are reduced for higher efficiency and lower fuel consumption.

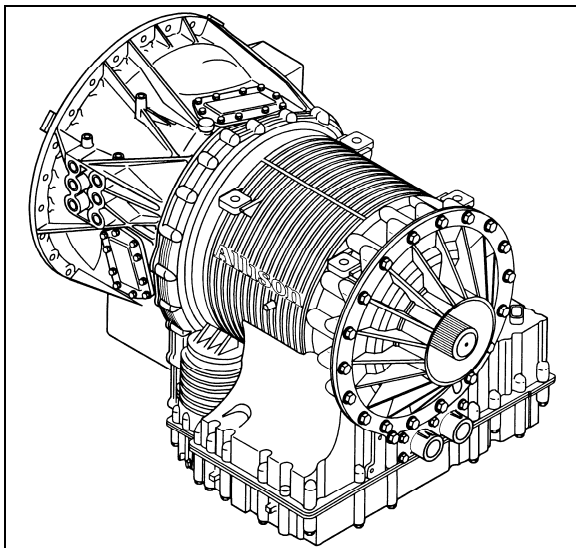


FIGURE 1: ALLISON TRANSMISSION

07136

Gear selection and torque converter modes are controlled by a microcomputer-based electronic transmission management system. It is fed information regarding throttle position, operator range selection, engine speed, turbine speed, transmission output speed and various system pressures from special electronic sensors. With this information, it computes shift points and clutch pressures to meet immediate needs. Using closed loop adaptive logic; the electronic

control looks at a number of parameters during the shift, and makes minute adjustments to match the shift to desired profile stored in its memory. It then looks at these adjustments and resets the parameters, which allow the transmission to quickly compensate for variations in load, terrain or environment and to adjust for clutch wear and engine power changes. A Diagnostic Data Reader can be connected to the electronic control unit to provide a self-check of all systems in the transmission. Five-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to paragraph "8. TROUBLESHOOTING" in this section).

1.1.1 Retarder (if applicable)

This optional auxiliary braking device for the automatic transmission is integrated into the basic envelope of the transmission and transmits its braking force directly to the propeller shaft. It requires no additional length and adds only 75 pounds (34 kg) of weight. Operation of the retarder is controlled electronically by the driver's use of the brake and/or by hand control lever.

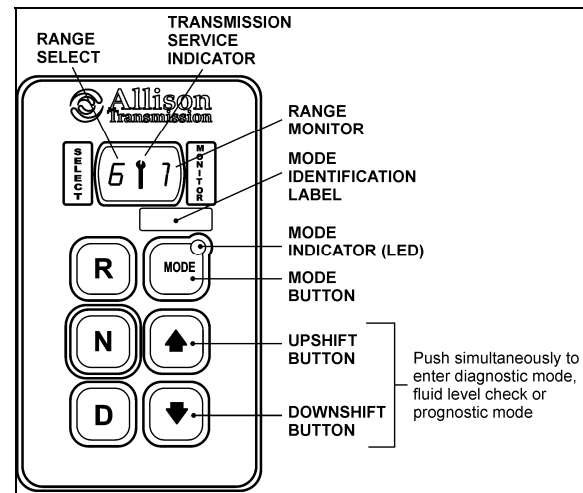


FIGURE 2: ALLISON TRANSMISSION CONTROL PAD 07142

When activated, fluid enters a cavity and provides resistance to the turning of rotor blades revolving with the output shaft. This effectively slows the vehicle to the point where the service brakes are needed only for final stopping. The retarder is fully modulated and is compatible with ABS.

1.2 VOLVO I-SHIFT TRANSMISSION

The Volvo I-Shift transmission is a single countershaft transmission with 12 forward gears and two reverse gears. The I-Shift is an automated mechanical transmission.

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If the I-Shift transmission system is to be used, the vehicle must have an electronic engine control unit as well as CAN communication. Since the clutch is automated (clutch pedal no longer fitted), the driver no longer has to activate the clutch.

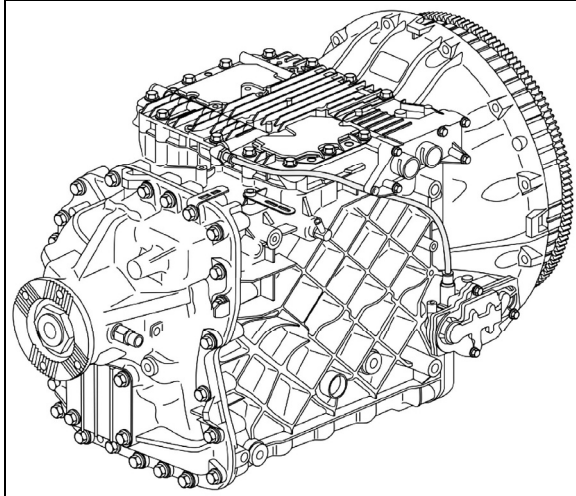


FIGURE 3: VOLVO I-SHIFT TRANSMISSION 07XXX

The transmitted torque (both engine and braking) will be interrupted during gear shifting, in both driving and coasting conditions. There is no clutch pedal and the gear shifting is controlled by the transmission or the driver through the pushbutton shift selector.

When in fully automatic mode, gears are selected and shifts made by the electronic control unit. The driver can still intervene if he wishes to. All system functions required are shown on the display, e.g. neutral, gear change, clutch overload and diagnosis information.

2. WELDING PROCEDURES

These procedures are intended only for vehicles equipped with transmission electronic controls. When frame or other welding is required on the vehicle, precautions are to be taken to protect the electronic control components. Refer to section 00: GENERAL INFORMATION, paragraph 3: "Precautions to be observed before welding" for complete procedure.

3. MAINTENANCE

3.1 ALLISON TRANSMISSION

To gain access to the dipstick, open the engine compartment rear doors; dipstick is located on the radiator side of the engine (Fig. 4).

3.1.1 Manual Fluid Level Check



DANGER

When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.

- Special care must be taken not to touch the engine coolant tubing and/or exhaust pipe, since this could cause severe burns.
- Do not wear loose clothing and, stay away from rotating parts during procedure; personal injury could occur.

Clean all dirt from around the end of the oil filler tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil system since it will cause valves to stick, undue wear of transmission parts, and clogged passages. Check the oil level using the procedures in Cold Check and Hot Check. Record any abnormal level on your "Maintenance Records".

Always check the oil level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

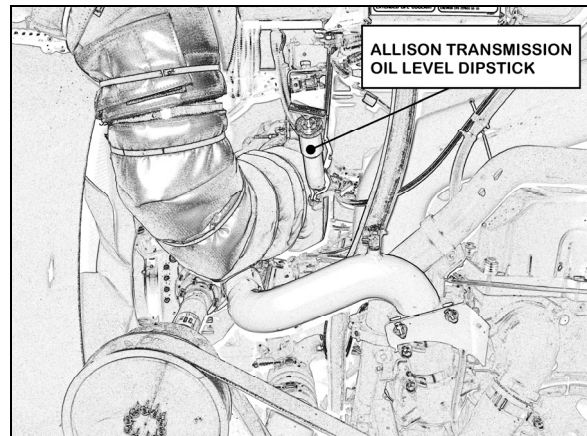


FIGURE 4: OIL LEVEL DIPSTICK (AUTO. TRANS.) 07113

3.1.2 Cold Check

The purpose of the **Cold Check** is to determine if the transmission has enough fluid to be operated safely until a **Hot Check** can be made.

1. If the engine has been shut down for an extended period of time, park the vehicle on a level surface and apply the parking brake.

CAUTION

The oil level rises as sump temperature increases. **DO NOT** fill above the "Cold Run" band if the transmission oil is below normal operating temperature. During operation, an overfull transmission can become overheated, leading to transmission damage.

2. Run the engine at idle in «N» (Neutral) for about one minute.
3. Shift to Drive (D) and operate the engine for 30 seconds at 1000-1500 rpm; then shift to Reverse (R) to clear the hydraulic system of air.
4. Move the vehicle to a level surface, put transmission in «N» (Neutral), and set the parking brake.
5. Finally shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).
6. While the engine is running, remove the dipstick from the tube and wipe it clean (Figs. 4 & 5). Insert the dipstick into the fill tube, pushing down until it stops.

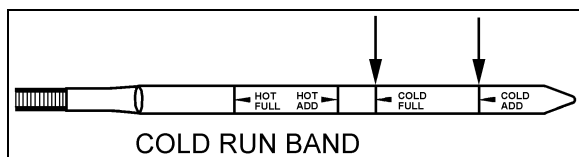


FIGURE 5: COLD CHECK

07050

7. Remove the dipstick and observe the fluid level. Repeat the check procedure to verify the reading. If the fluid on the dipstick is within the COLD CHECK band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a **Hot Check**. If the fluid level is **not** within this band, add or drain fluid as necessary to bring the level within the COLD CHECK band.
8. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160°F (71°C) to 200°F (93°C) is attained.

**CAUTION**

DO NOT operate the transmission for extended periods of time until a **Hot Check** has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.

**CAUTION**

Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500-800 rpm) in «N» (Neutral).
- Transmission fluid is at normal operating temperature.
- The vehicle is on a level surface.

3.1.3 Hot Check

**CAUTION**

The oil **must be hot** to ensure an accurate check for this procedure. The oil level rises as temperature increases.

To perform a **Hot Check**, do the following:

1. The **Hot Check** can be performed when the transmission oil reaches the normal operating temperature (160°F to 200°F / 71°C to 93°C). The transmission oil temperature can be checked with the dashboard message center display (MCD) when selecting the Gauge Mode (refer to the "Operator's Manual" for added information).
2. Park the vehicle on a level surface and shift to Neutral (N). Apply the parking brake and allow the engine to idle (500 - 800 rpm).
3. Remove the dipstick from the tube and wipe it clean. Insert the dipstick into the fill tube, pushing down until it stops.
4. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick. Repeat the check procedure to verify the reading.
5. If the level is **not** within this band, add or drain fluid as necessary to bring the level within the HOT RUN band. (Fig. 6).

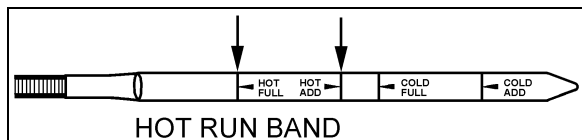


FIGURE 6: HOT CHECK 07049

- Be sure fluid level checks are consistent. Check level more than once and if readings are not consistent, check to be sure the transmission breather is clean and not clogged. If readings are still not consistent, contact your nearest Allison dealer or distributor.

NOTE

The Cold Check is more appropriate for verifying the oil level after the first fill-up. In case of conflict, the Hot Check has priority over the Cold Check; the fluid level check using the pushbutton shift selector has priority over the Hot Check.

3.1.4 Fluid Level Check Using the Pushbutton Shift Selector

Oil level codes are obtained as follows:

- Park vehicle on a level surface, select «N» (neutral) on the pushbutton shift selector and apply parking brake.
- Press simultaneously the ▲ (Up) and ▼ (Down) arrow buttons once.
- Oil level codes are displayed in 2 minutes (e.g. display will flash and 8, 7, 6, 5, ...; countdown will occur during the 2 minutes) once the following parameters are met:
 - Waiting time, vehicle must be stationary for at least 2 minutes to allow the oil to settle;
 - Engine at idle;
 - Oil at normal operating temperature, between 140°F (60°C) and 220°F (104°C);
 - Transmission in «N» (Neutral);
 - Transmission output shaft stopped;
 - Oil level sensor present and working.

After 2 minutes, the display will flash one of the codes shown below:

CODE	CAUSE OF CODE
O L...O K	Oil level is correct
O L...L O... 1	Oil Level is LOw 1 quart

CODE	CAUSE OF CODE
O L...L O... 2	Oil Level is LOw 2 quart
O L...L O... 3	Oil Level is LOw 3 quarts
O L...L O... 4	Oil Level is LOw 4 or more quarts
O L...H I... 1	Oil Level is Hlgh 1 quart
O L...H I... 2	Oil Level is Hlgh 2 quarts
O L...H I... 3	Oil Level is Hlgh 3 or more quarts
O L... - (fc)	Oil Level is invalid. Source of invalid reading is defined by a two-character fault code (fc)

NOTE

Note that the quantities LO 4 and HI 3 are the largest values displayed and that the actual variation in oil level may exceed these numbers.

NOTE

Failure to meet one of the above parameters will stop the two minute countdown. One of the codes shown hereafter will indicate the cause of the countdown interruption. Once all parameters are met, the countdown will continue from where it left off.

If the fluid level check cannot be completed, an Invalid for Display fault is reported. This condition is reflected by the display of "OL", followed by "-", followed by one or two additional characters. The displayed characters define the cause of the fault, which may be either a system malfunction or an improper condition for conducting the check.

CODE	CAUSE OF CODE
OL...-...0X	Waiting period is not complete
OL...-...EL	Engine speed (rpm) too low
OL...-...EH	Engine speed (rpm) too high
OL...-...SN	N (neutral) must be selected
OL...-...TL	Sump oil temperature too low
OL...-...TH	Sump oil temperature too high
OL...-...SH	Output shaft rotation
OL...-...FL	Sensor failure


To exit the Oil Level Display Mode, press any range button: «R», «N» or «D» at any time.

3.1.5 Importance of Proper Fluid Level

It is important that the proper fluid level be maintained at all times because the transmission fluid cools, lubricates, and transmits hydraulic power. If the fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate, causing the transmission to shift erratically or overheat.

3.1.6 Keeping Oil Clean

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick on a clean surface area while filling the transmission.

	<h3>CAUTION</h3>
<p>Containers or fillers that have been used to handle antifreeze or engine coolant must NEVER be used for handling transmission fluid. Antifreeze and coolant solutions contain ethylene glycol that, if introduced into the transmission, can cause the clutch plates to fail.</p>	

3.1.7 Recommended Automatic Transmission Fluid

Hydraulic fluids used in the transmission are important influences on transmission performance, reliability and durability. **Castrol TranSynd™ Synthetic Fluid** and **DEXRON-III®** fluids are recommended for on-highway applications.

- **TranSynd™** is a full synthetic transmission fluid developed by Allison Transmission and Castrol Ltd. This fluid meets Allison specifications for Severe Duty and Extended Drain Intervals. TranSynd™ is fully qualified to the Allison TES295 specifications and is available through Prevost Parts.

<p>NOTE</p> <p><i>The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode must be disabled. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.</i></p>
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- To be sure a fluid is qualified for use in Allison transmission, check for the **DEXRON-III®** license number on the container or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types.

Customers may use TranSynd™/TES 295 equivalent and extend drain intervals. Equivalent TranSynd™ fluid must meet or exceed TES 295 requirements. Customers may choose from a wide variety of approved Dexron-III® fluids.

Customers may choose from a wide variety of approved non-TES 295 like Dexron-III® or approved Schedule 1 TES-389 fluids.

The Transmission Fluid Operating Temperature Requirements table lists the minimum fluid temperatures at which the transmission may be safely operated without preheating. Preheat with auxiliary heating equipment or by running the equipment or vehicle with the transmission in «N» (Neutral) for a minimum of 20 minutes before attempting range operation.

Fluid type	Minimum operating temperature	
	Celsius	Fahrenheit
TranSynd™	-30	-22
DEXRON-III®	-25	-13

	<h3>CAUTION</h3>
<p>Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.</p>	


<p>NOTE</p> <p><i>The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the TCM will restrict full operation until the sump temperature is increased.</i></p>
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3.1.8 Oil Contamination

At each oil change, examine the drained oil for evidence of dirt or water. A nominal amount of condensation will emulsify during operation of the transmission. However, if there is evidence of water; check the cooler (heat exchanger) for other signs of leakage. This, however, may also indicate leakage from the engine oil system.

3.1.9 Metal Particles

Metal particles in the oil (except for minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, coolers, and all other areas where the particles could lodge.

 CAUTION
If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.

3.1.10 Coolant Leakage


If engine coolant leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant contamination must be removed. Friction clutch plates contaminated with ethylene glycol must be replaced.



3.1.11 Control System Prognostics

The transmission control system includes the provision for the user to monitor various transmission operating parameters. Transmission operating parameters monitored by the prognostics feature are:

- Oil Life Monitor
- Filter Life Monitor
- Transmission Health Monitor

NOTE
<i>The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode must be disabled. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.</i>
<i>Refer to TES 295 Approved Fluids list, found under the Service/Fluids heading on the home page of the Allison Transmission web site.</i>
www.allisontransmission.com


When a specified threshold is detected for any of the serviceable conditions, the TRANSMISSION SERVICE indicator  is illuminated to alert the operator. Failure to attend to the service condition and reset the TRANSMISSION SERVICE indicator within a defined operating period will result in illumination of the CHECK TRANS light on the dashboard telltale panel, indicating the increased probability that the service condition will develop into a more serious condition.

To access the Prognostic Mode functions, simultaneously press the  (Up) and  (Down) arrow buttons repeatedly. See the reference table at the end of this section.

- Oil Life Monitor

The display message denotes the calculated remaining life of the transmission fluid. This value is based on the established life for the required baseline fluid, and then is continuously adjusted for cumulative effects of such operating parameters as operating time, retarder operation, output shaft revolutions and shift frequency.

Display: The display is a two-digit number, denoting percentage of the fluid life which remains. New fluid is displayed as 99%.

The TRANSMISSION SERVICE indicator  will be illuminated, denoting a required change of transmission fluid, when the remaining fluid life reaches approximately 1–2 %. The indicator will be lit steadily upon each initialization of the TCM, and will remain on steady for approximately 1–2 minutes after the first selection of “D” (drive) range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the TRANSMISSION SERVICE indicator within a defined period will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P0897 Transmission Fluid at Limit will be set.

Reset: The TRANSMISSION SERVICE indicator can be reset by a message over the SAE J1939 communication interface, with the Allison DOC™ for PC diagnostic program, or by depressing and holding the MODE button for ten (10) seconds while the Oil Life Monitor function is displayed. It may also be reset by selecting N-D-N-D-N-R-N on the shift selector, pausing briefly (less than 3 seconds) between each

selector movement, with the ignition on and the engine not running.




CAUTION


Required calendar-based oil & filter change intervals (based on month) still apply because Oil Life Monitor function cannot measure time while ignition power is OFF.

If the Oil Life Monitor function has not indicated the need for a fluid change before 60 month (five years) have passed, it will be necessary to change the fluid and filters per calendar requirements and reset the system.

○ Filter Life Monitor

The display message denotes operating status of the transmission main fluid filter, based on the measured pressure drop across the filter. The feature is not functional at transmission sump temperatures below 40 °C (105 °F). Both the main and lube filters **must be** changed when the TRANSMISSION SERVICE indicator  shows the main filter should be changed.

Display: An acceptable filter life status is displayed as "OK". An unacceptable filter life status is displayed as "LO".

Once the programmed threshold for maximum filter pressure drop has been observed and verified, the diagnostic code P088A Transmission Filter At/Over Limit will be recorded to indicate that the filter has reached the end of its designed life. At the next initialization of the TCM, the TRANSMISSION SERVICE indicator  will flash for approximately 1–2 minutes after the first selection of "D" (drive) range. Thereafter, the indicator will illuminate and flash upon each TCM initialization, continuing to flash for 1–2 minutes after the first selection of a drive range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a calibration-defined number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P088B will be recorded to indicate a highly deteriorated filter.

Reset: The feature will reset automatically when the main fluid filter has been changed and the pressure drop across the filter no longer exceeds the threshold value. A manual reset can be performed by depressing and holding the MODE button for ten (10) seconds while the Filter Life Monitor function is displayed. It may also be reset by selecting N-R-N-R-N-D-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running.

○ Transmission Health Monitor

The display message denotes clutch life status, as determined by monitored changes and the calculated running clearance of the transmission clutches C1, C2, C3, C4 & C5.

Display: An acceptable clutch life status is displayed as "OK". An unacceptable clutch life status is displayed as "LO". The specific clutch(es) for which the function indicates "LO" cannot be identified with the shift selector. Allison DOC™ for PC-Service Tool displays clutch condition as OK or NOT OK for each clutch, C1 through C5.

The TRANSMISSION SERVICE indicator will be illuminated, indicating the need for clutch maintenance, when the remaining clutch life reaches approximately 10%, or if the running clearance exceeds a maximum value which may indicate a non-wear-related issue. Thereafter, the indicator will be lit upon each initialization of the TCM, and will remain on steady during all vehicle operation until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P2789 Clutch Adaptive learning at Limit will be set.

Reset: The feature will reset automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be manually reset using the Allison DOC™ for PC diagnostics program if necessary.

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The following table illustrates how to access Oil Level Check, Prognostics & Diagnostic Troubleshooting Codes functions on the Allison pushbutton shift selector.

▲ (up) & ▼ (down) arrow buttons pressed simultaneously	Description	SELECT	MONITOR
1 st press	Allison transmission oil level check	" _ "	" _ "
	Other codes will be displayed		
2 nd press	Oil Life Monitor	" O "	" M "
	Oil life remaining will range from 99% down to 00%	Some number from 9 to 0	Some number from 9 to 0
3 rd press	Filter Life Monitor	" F "	" M "
	Present life of filter is OK	" O "	" K "
	Present life of filter is low	" L "	" O "
4 th press	Transmission Health Monitor	" O "	" K "
	Shows "OK" until remaining life of one or more of the clutch(es) wear enough so that the programming changes	" O "	" K "
	One or more of the clutches C1 through C5 have worn enough to change the program	" L "	" O "
5 th press	Display of diagnostic codes	" d "	" 1 "
	Other codes will be displayed		

TABLE 1

Recommended Fluid and Filter Change Intervals Using Dexron-III / Non-TranSynd™/Non-TES 295/Mixture							
Severe ³ All vehicles equipped with retarder				General ⁴ All vehicles without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
12,000 Miles (20 000 km) 6 Months/ 500 Hrs	12,000 Miles (20 000 km) 6 Months/ 500 Hrs	Overhaul	12,000 Miles (20 000 km) 6 Months/ 500 Hrs	25,000 Miles 40 000 km 12 Months/ 1000 Hrs	25,000 Miles 40 000 km 12 Months/ 1000 Hrs	Overhaul	25,000 Miles (40 000 km) 12 Months/ 1000 Hrs

2 inch Control Module (1.75 approximately) – Requires High-Capacity Filter kit Allison P/N 571709

TABLE 2

Recommended Fluid and Filter Change Intervals ¹ Using 100% TranSynd™/TES 295 Approved Fluid ²							
Severe ³ All vehicles equipped with retarder				General ⁴ All vehicles without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
150,000 Miles (240 000 km) 48 Months/ 6000 Hrs	75,000 Miles (120 000 km) 36 Months/ 3000 Hrs	Overhaul	75,000 Miles (120 000 km) 36 Months/ 3000 Hrs	300,000 Miles 480 000 km 48 Months/ 6000 Hrs	75,000 Miles (120 000 km) 36 Months/ 3000 Hrs	Overhaul	75,000 Miles (120 000 km) 36 Months/ 3000 Hrs

¹ Extended TranSynd™/TES 295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

² Less than 100% concentration of TranSynd™/TES 295 approved fluid is considered a mixture and should utilize non-TES 295 change intervals. If the customer replaces non-TranSynd™/non-TES 295 fluid with TranSynd™/TES 295 equivalent, the change interval recommendations of non-TranSynd™/non-TES 295/mixture must be followed. Upon the next oil change, if the customer reinstall TranSynd™/TES 295 equivalent, the fluid & filter change recommendation outlined in 100% TES 295 approved fluids must be followed.

³ Severe vocation= All retarder, On/Off highway, transit and intercity coach with duty cycle greater than one (1) stop per mile.

⁴ General vocation= intercity coach with duty cycle less than or equal to one (1) stop per mile and all other vocations not listed in severe vocation.

TABLE 3

Recommended Fluid and Filter Change Intervals Using 100% TranSynd™/TES 295 Approved Fluid And Gold Series Filters							
Coaches equipped with retarder				Coaches without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
	Initial Break-in 5,000 miles (8,000 km)/ 200 Hrs				Initial Break-in 5,000 miles (8,000 km)/ 200 Hrs		
50,000 Miles (80 000 km) 24 Months/ 2000 Hrs	50,000 Miles (80 000 km) 24 Months/ 2000 Hrs	Overhaul	50,000 Miles (80 000 km) 24 Months/ 2000 Hrs	150,000 Miles 240 000 km 48 Months/ 4000 Hrs	50,000 Miles 80 000 km 24 Months/ 2000 Hrs	Overhaul	50,000 Miles (80 000 km) 24 Months/ 2000 Hrs

3.1.12 Oil And Filter Change Interval

- Oil and Filter Change interval With Prognostics Mode Disabled

Allison transmissions are factory fill with **Castrol TranSynd™** fluid. Oil change must be performed with the vehicle on a flat and level surface and with parking brake applied. Oil and oil filter change frequency is determined by the severity of

service and operating conditions of the transmission and by the filter equipment installed. See "TABLE 1, TABLE 2 or TABLE 3" for oil and filter change intervals. More frequent changes may be required when operations are subject to high levels of contamination or overheating. Filters must be changed at or before recommended intervals.

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IMPORTANT NOTE

Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. Many customers have a systematical annual transmission fluid change while, in many cases, fluid analysis could demonstrate that the transmission fluid is still in good condition and a fluid change is not required. In the absence of a fluid analysis program, the fluid change interval listed in TABLE 1, TABLE 2 & TABLE 3 should be used.

IMPORTANT NOTE

Your transmission is equipped with **High Capacity filters**. High Capacity filters allow for increased fluid and filter change intervals in transmissions utilizing TES 295 approved fluid/TranSynd™. High Capacity filters eliminate the requirement of the initial 5000 miles (8000km) main filter change.

Former Gold Series filter kits are completely cancelled and serviced with current High Capacity filter kits. However, if you are using stocked Gold Series filter kits with TES 295 approved fluid/TranSynd™, use TABLE 3 for oil and filter change intervals.

- Oil And Filter Change Interval With Prognostics Mode Enabled

Oil Life Monitor and Filter Life Monitor of the Prognostics mode provide indicators of required maintenance actions. They are designed to maximize fluid and filter utilization. **Prognostics enabled requires the use of 100% TranSynd™ or an Allison approved TES-295 transmission fluid and Allison High Capacity filters.** If any other fluids or filters are used, Prognostic mode **must be disabled**. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.

IMPORTANT NOTE

The following schedule is to be used with Prognostics enabled.

100% concentration of TES-295 Allison approved fluids and Allison High Capacity Filters is **required**. Less than 100% concentration of TES-295 Allison approved fluids are considered a mixture and shall not be used with Prognostics mode or this change schedule. Utilization of previous Non-TES 295 fluid/filter change intervals (Table 1) is required.

	General or Severe Vocation
FLUIDS Prognostics enabled	Change fluid when indicated by TRANSMISSION SERVICE indicator or 60 month (five years) whichever occurs first. In addition, change filters with fluid.
FILTERS Prognostics enabled	Change filters (Main & Lube) when indicated by TRANSMISSION SERVICE indicator between fluid change or 60 month (five years) whichever occurs first.

- Changing The Transmission Oil And Oil Filters

The procedure for changing the transmission oil and oil filters is as follows:


Drain

1. The transmission should be at an operating temperature of 160°F (71°C) to 200°F (93°C) when the oil is drained. This will ensure quicker and more complete fluid drainage.

NOTE

Remove transmission protective panel located underneath transmission for easier access.

2. Remove the drain plug from under the transmission (Fig. 7) and allow the oil to drain into a suitable container. Check the condition of the oil as described previously.
3. To replace the integral filters, remove twelve bolts (6 on each cover), two filter covers, two O-rings, two square cut seals and the two filters from the bottom of the control module (Fig. 7).
4. To install filters, pre-lube and install the two O-rings, the two square cut seals followed by the filters (lube the O-ring in filter cartridge only) into the filter compartment. Index each filter/cover assembly to holes in channel plate/sump. Push the cover assembly in by hand to seat the seals.

 **CAUTION**

Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.

5. Install twelve bolts and both covers, and then tighten to 38-45 lbf-ft (51-61 Nm).

6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 lbf-ft (25-32 Nm).
7. Reinstall transmission protective panel

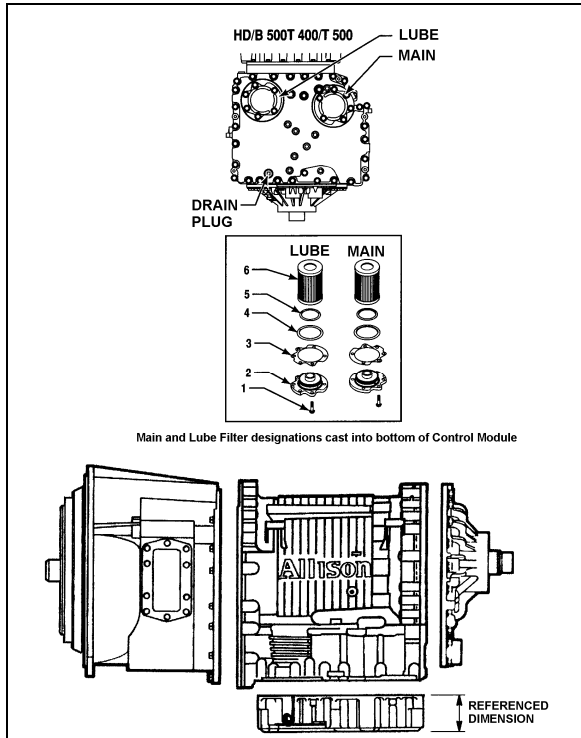


FIGURE 7: DRAIN PLUG AND FILTERS 07074

Fluid loss with filter change only

When changing main and lube filters at recommended intervals, approximate fluid loss for each filter as follows:

- Main filter = 2 quarts (1.9 liters)
- Lube filter = 8 quarts (7.6 liters)

Refilling Transmission

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

NOTE
 Quantities listed above are approximations and do not include external oil cooler lines.

Using the oil level dipstick filler tube, refill with 24 US qts (23 liters) [28 US qts (26.5 liters) if equipped with retarder] and check the oil level using the **Fluid Level Check Using Pushbutton Shift Selector** procedure in this section.

3.2 VOLVO I-SHIFT TRANSMISSION

All information needed for the removal /installation or maintenance of the Volvo I-Shift transmission is included in the documents annexed at the end of this section.

3.2.1 Transmission Oil

CAUTION
 Only use Castrol Syntrans SAE 75W85 (Prevost #684516) gearbox oil in the I-Shift transmission. Using non-approved oil can result in damage to transmission components.

CAUTION
 Never reuse drained I-Shift oil. The oil must be replaced along with the oil filter. Reusing drained oil can result in damage to transmission components.

Keep the transmission oil at the proper level and change it at the Volvo recommended intervals. Always replace the oil filter when the oil is changed (#20779040). Always use the Volvo approved synthetic oil whenever adding or changing the transmission oil.

3.2.2 Checking Oil Level

Check the transmission oil level at each service interval. Park the vehicle on a level surface. Check the oil level through the sight glass on the side of the transmission. Add oil as necessary. Always use the correct Volvo approved synthetic oil (Castrol Syntrans SAE 75W85).

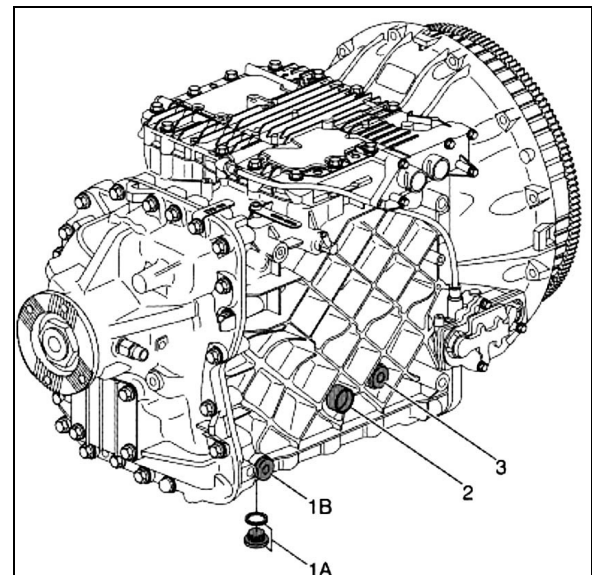


FIGURE 8: I-SHIFT TRANSMISSION OIL CHANGE

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- Vehicle should be on horizontal ground when oil is changed;
- Do not check oil level straight after a journey (incorrect measurement). Undertake the check once the transmission oil has cooled down (lower than 104°F or 40 °C);
- Check oil level using transmission sight glass (2, Fig. 8) ;

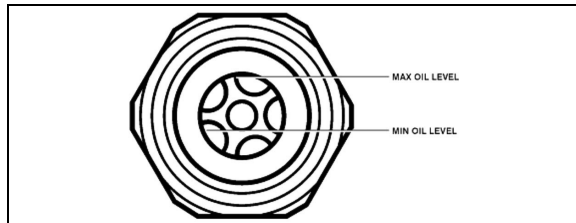


FIGURE 9: SIGHT GLASS FOR CHECKING OIL LEVEL

- Add oil through the oil filling point if necessary (3, Fig. 8) ;
- Torque tighten fill plug to 26±4 Lb-Ft (35±5 Nm).


3.2.3 Oil Change Interval

The length of time a transmission can operate before an oil change is required depends on the quality of the oil used and the vehicle application.

For on-highway applications, change the transmission oil every 800 000 km (500,000 miles) or every 5 years. This extended oil change interval only applies when using Castrol Syntrans SAE 75W85. Always replace the oil filter when the oil is changed. For all other vehicle applications or if not using Castrol Syntrans SAE 75W85, change the transmission oil every 400 000 km (250,000 miles) or every 3 years.

3.2.4 Oil Change

Approximately 15 liters (16 quarts) is needed for a complete oil change.

	WARNING
Hot oil can cause burns. DO NOT allow hot oil to contact the skin. When changing oil, wear protective gloves.	

Remove the drain plug from under the transmission (1A or 1B, Fig. 8) and allow the oil to drain into a suitable container.

Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 26±4 Lb-Ft (35±5 Nm).



CAUTION

Always dispose of all lubricants (engine oil, coolant, transmission oil, etc) and filters according to Federal or local regulations.

Change the oil filter (#20779040) at every oil change. Drain the oil filter housing before you remove the filter.

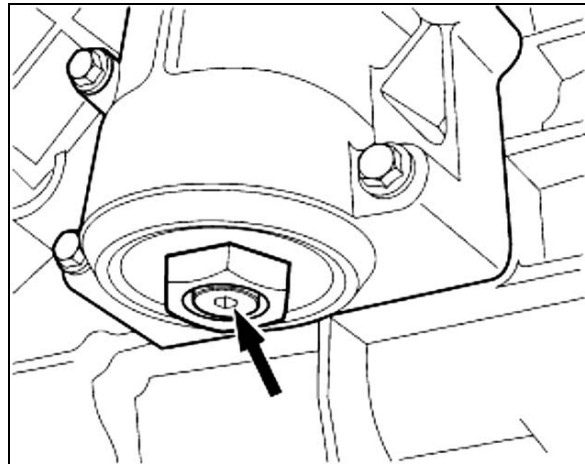


FIGURE 10: OIL FILTER HOUSING DRAIN PLUG

NOTE

Torque tighten oil filter housing drain plug to 12±1 Lb-Ft (16±2 Nm).

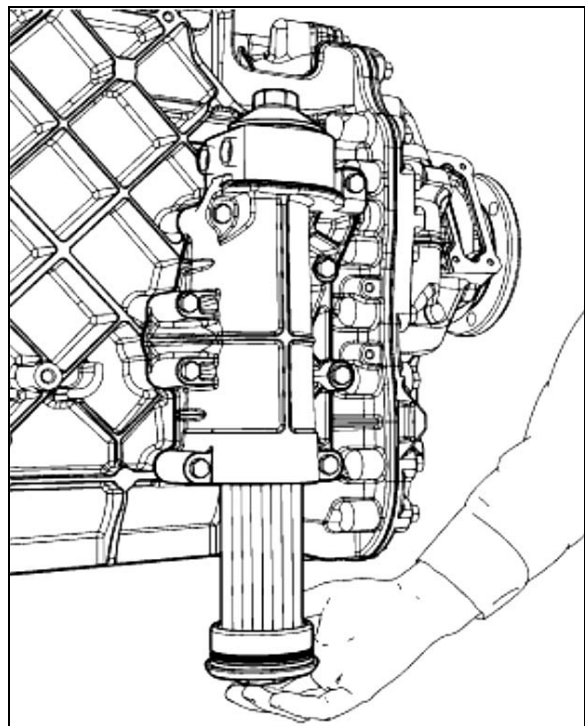


FIGURE 11: OIL FILTER

4. ALLISON TRANSMISSION REMOVAL

The following procedure deals with the removal of the Allison transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission's "NEUTRAL" position, apply parking brake, then set battery master switch to the "OFF" position.
2. Jack up vehicle, then place safety supports underneath body.



CAUTION

Only the recommended jacking points must be used as outlined in Section 18, "BODY".

NOTE

For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).

3. Remove engine splash guards and protective panels surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug and tighten to 33-41 lbf-ft (45-56 Nm) (see "3.1.12 Oil and Filter Change" in this section.



WARNING

It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.

6. Remove transmission dipstick and filler tube.
7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, "PROPELLER SHAFT".
8. Disconnect the two oil cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.



WARNING

A significant amount of oil may drain from oil lines when they are disconnected.

9. Disconnect all sensors on L.H. side of the transmission.
10. Disconnect main wiring harness.
11. Disconnect the air supply line (steel-braided hose) from retarder control valve (if applicable).
12. Remove any locking tie, clamp and bracket that may interfere with the removal of transmission.
13. Support transmission using a suitable transmission jack.

NOTE

Remove starter motor located on engine L.H. side. Removing the starter motor will allow access to unfasten the 12 converter-to-flexible plate attaching screws. Remove the plug located below starter motor and install cranking tool (88800014). Cranking the engine to gain access to the attaching screws may be done by turning the cranking tool using a suitable adapter (fig. 12).

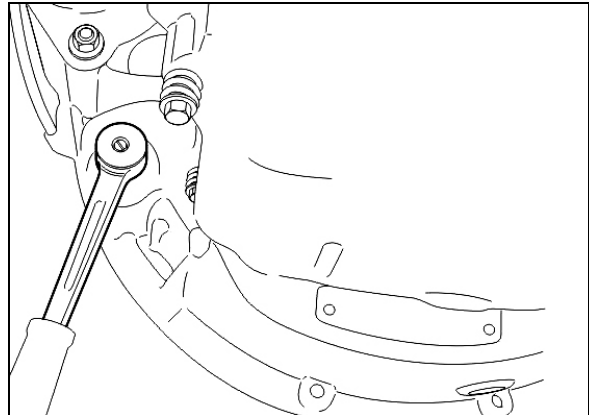


FIGURE 12: VOLVO ENGINE CRANKING POSITION



CAUTION

Do not rotate alternator shaft clockwise to avoid removing tension on belt.

14. Remove the 12 screws retaining the torque converter housing to the flywheel housing.



CAUTION

Make sure transmission-to-engine alignment is maintained when removing screws to avoid damaging torque converter housing.

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15. Slowly pull transmission straight out to clear the engine.
16. Remove the transmission.

5. TRANSMISSION OIL COOLER REMOVAL

5.1 TRANSMISSION WITHOUT RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.

1. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
2. Disconnect the two transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination (Refer to fig.13).



WARNING

A significant amount of oil may drain from oil lines when they are disconnected.

3. Unfasten the constant-torque hose clamps and remove the two hoses.
4. Unscrew the four holding nuts and remove the U-bolts, remove the oil cooler from engine compartment.
5. Reinstall transmission oil cooler by using reverse procedure.

5.2 TRANSMISSION WITH RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

1. To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.
2. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

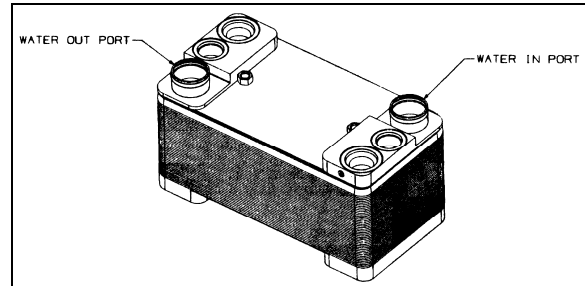


FIGURE 13: ALLISON OIL COOLER



WARNING

A significant amount of oil may drain from oil lines when they are disconnected.

4. Unfasten the constant-torque hose clamps and remove the two hoses.
5. Unscrew the holding bolts and nuts and remove the oil cooler from engine compartment.

6. CLEANING AND INSPECTION OF ALLISON AUTOMATIC TRANSMISSION

The exterior of the transmission should be cleaned and inspected at regular intervals. The length of service and severity of operating conditions will determine the frequency of such inspections. Inspect the transmission for:

1. Loose bolts (transmission and mounting components);
2. Oil leaks (correct immediately);
3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose oil lines;
5. Worn or frayed electrical harnesses, improper routing;
6. Worn or out of phase drive line U-joint and slip fittings.



CAUTION

DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.

6.1 BREATHER


The breather is located on the engine, flywheel side near the valve cover. It serves to prevent pressure build-up within the transmission and

must be cleaned to keep the passage opened. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the engine. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use care when removing the hose connector from transmission to prevent the entry of foreign matter.


7. ALLISON TRANSMISSION INSTALLATION

NOTE
For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).

1. With the starter motor removed, align one of the 12 attaching screw holes in the flexible plate with the access opening.
2. Place the transmission on a transmission jack.
3. Install a headless guide bolt into one of the 12 threaded holes for flexible plate attaching screws in the flywheel.
4. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
5. Raise transmission and position the flywheel pilot boss into the flexible plate adapter. Align the guide bolt previously installed in the flywheel with the flexible plate hole facing the access opening in the flywheel housing.

 **DANGER**
 Severe damages and/or personal injury can occur if transmission is not adequately supported.

5. Seat the transmission against the engine flywheel housing. **NO FORCE IS REQUIRED.** If interference is encountered, move the transmission away from engine, then investigate the cause.

 **CAUTION**
 The torque converter housing must be seated against the flywheel housing prior to tightening any screws. **DO NOT USE SCREWS TO SEAT THE HOUSING.**

6. Start all torque converter housing screws, and then tighten four of them gradually and in a criss-cross sequence around the housing. Tighten the 12 remaining screws. Recommended torque is between 42-50 lbf-ft (57-68 Nm).
7. Remove the guide bolt through the access opening in the flywheel housing. Replace it with a self-locking screw, finger-tighten then start the remaining screws; tighten to 17-21 lbf-ft (23-28 Nm).

NOTE
Remove the plug located below starter motor and install cranking tool (88800014). Crank the engine to gain access to the threaded holes by turning the cranking tool using a suitable adapter (Refer to fig. 12).
Reinstall starter motor and connect cables.
Reinstall access plug below starter motor.

8. Remove jack from under transmission.
9. Connect all sensors.
10. Connect the main wiring harness.
11. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
12. Connect the two transmission oil cooler hoses as they were previously.
13. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
14. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".
15. Install transmission dipstick and filler tube.
16. Install cross member under transmission.
17. Install engine splash guards.
18. Adjust the retarder pressure to 85 ± 3 psi with the air pressure regulator. For more information refer to Section 12, "BRAKE AND AIR SYSTEM", under heading "AIR PRESSURE REGULATOR". The air pressure regulator is located in the engine compartment, on engine cradle R.H. side (Fig. 14).
19. Make sure that the drain plug is in place, and then remove the transmission dipstick and pour approximately 24 US quarts (23 L) of

automatic transmission fluid through the filler tube. Check and adjust oil level.

CAUTION

Do not overfill the transmission. Overfilling can cause oil aeration (milky appearance) and overheating. If overfilling occurs, drain oil as required to bring it to the proper level.

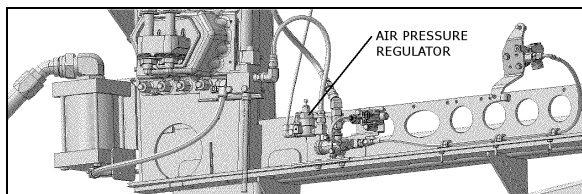


FIGURE 14: AIR PRESSURE REGULATOR (TYPICAL) 07130

8. ALLISON AUTOMATIC TRANSMISSION TROUBLESHOOTING

For complete information about Allison transmission troubleshooting, refer to "Allison 4th Generation Controls – Troubleshooting Manual: 3000 and 4000 Product families (TS3989)".

8.1 4TH GENERATION TRANSMISSION CONTROL MODULE

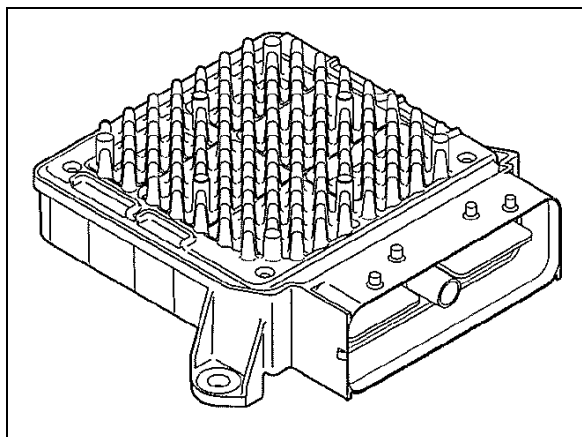


FIGURE 15: TRANSMISSION CONTROL MODULE 07140

The Allison transmission has a new Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located in the coach rear electrical compartment.

TCM Replacement

The TCM is a non-serviceable electronic device. When it fails, it must be replaced using the following procedure:

- Open the coach rear baggage compartment then remove the rear electrical compartment door in order to get access to the TCM;
- Remove the electrical cable connectors;
- Unscrew the TCM unit;
- Replace by reversing the procedure.

CAUTION

Place the battery master switch to the "OFF" position.

8.2 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) — ALLISON 4TH GENERATION CONTROLS

Diagnostic codes (DTC) are numerical indications relating to a malfunction in transmission operation. These codes are logged in a list in the TCM memory with the most severe or most recent code listed first. A maximum of five codes (numbered d1 to d5) may be listed in memory at one time. As codes are added, the oldest inactive code is dropped from the list. If all codes are active, the code with the lowest priority that is not included on the severity list is dropped from the list.

Diagnostic codes (DTC) and code information may be accessed through the pushbutton shift selector or using an Allison DOC™ diagnostic tool.

The TCM separately stores the active and inactive codes. An active code is any code that is current in the TCM decision-making process. Inactive codes are codes that are retained in the TCM memory and will not necessary affect the TCM decision-making process. Inactive codes are useful in determining if a problem is:

- Isolated ;
- Intermittent ;
- Result from a previous malfunction.



The TCM may automatically delete a code from memory if it has not recurred. If the MODE INDICATOR (LED) is not illuminated, the displayed code is not active. An illuminated MODE INDICATOR (LED) during normal operation signifies secondary shift mode operation.

8.3 DIAGNOSTIC CODES – ALLISON 4TH GENERATION CONTROLS

When the diagnostic mode is entered, the first code (position d1) is displayed as follows:

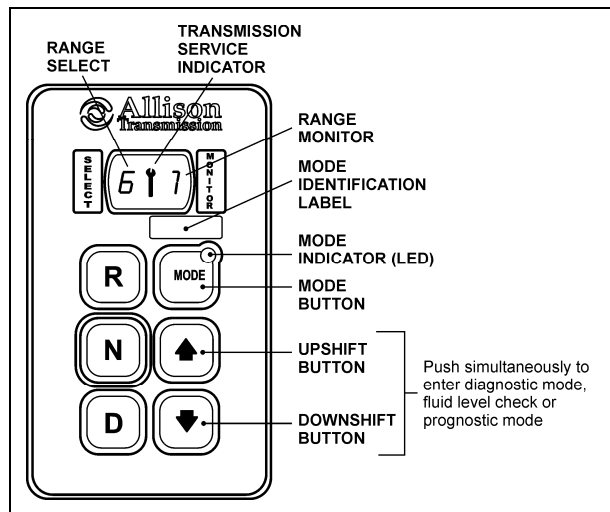
Example: Code P0722

Displayed as: **d1...P...07...22**

The code list position is the first item displayed, followed by the DTC. Each item is displayed for about one second. The display cycles continuously until the next code list position is accessed by pressing the **MODE** button. The following example shows how DTC P0722 is displayed on the pushbutton shift selector.

SELECT	d	1	MONITOR
		P	
	0	7	
	2	2	

- d1 (code list position) – The position which a code occupies in the list. Positions are displayed as « d1 » through « d5 » (code list position 1 through code list position 5).
- P0722 (DTC) – The diagnostic troubleshooting code number referring to the general condition or area of fault detected by the TCM.



8.4 DIAGNOSTIC CODE DISPLAY AND CLEARING PROCEDURE – ALLISON 4TH GENERATION CONTROLS

Diagnostic codes can be read and cleared by two methods:

- Using an Allison DOC™ diagnostic tool. For specific instructions on how to use an Allison DOC™ diagnostic tool, refer to the User Guide.
- Using the pushbutton shift selector.

To begin the diagnostic process:

1. Bring the vehicle to a stop at a safe location.
2. Apply the parking brake.

To display stored codes:

1. Simultaneously press the ▲ (Up) and ▼ (Down) arrow buttons twice to access the Diagnostic Display Mode.

NOTE

To access the Oil Level Display Mode, simultaneously press the ▲ (Up) and ▼ (Down) arrow buttons once. Consult paragraph: « ALLISON TRANSMISSION OIL LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR » at the end of this section.

2. Observe the digital display for code (d1).
3. Press the MODE button to see the next code (d2) – repeat for subsequent codes (d3, d4 & d5).

NOTE

Be sure to record all codes displayed before they are cleared. This is essential for troubleshooting.

NOTE

The Diagnostic Display Mode can be entered for viewing codes at any speed. Codes can only be cleared when the output speed = 0 and no output speed sensor failure is active

Active indicators (MODE INDICATOR LED) and inactive codes can be cleared manually, while in the diagnostic display mode, after the condition causing the code is identified.

To clear active indicators and inactive codes:

1. While in Diagnostic Display Mode, press and hold the MODE button for 10 seconds to clear both active indicators and inactive codes.
2. Begin operating as normal. Have the transmission checked at the earliest opportunity by an Allison Transmission distributor or dealer.

NOTE

All active indicators are cleared at TCM power down.

Some codes will clear their active indicator when the condition causing the code is no longer detected by the TCM.

The Diagnostic Display Mode can be exited by any of the following methods:

- Press simultaneously the ▲ (Up) and ▼ (Down) arrow buttons at the same time on the pushbutton shift selector.
- Press any range button «D», «N» or «R» on the pushbutton shift selector (the shift will be commanded if it is not inhibited by an active code).
- Wait until the calibrated time (approximately 10 minutes) has passed. The system will automatically return to the normal operating mode.
- Turn off power to the TCM (shut off the engine using the ignition key).

NOTE

If clearing a code while locked in a «D» (Drive) or «R» (Reverse) position (fail-to-range), the transmission will still be in «D» (Drive) or «R» (Reverse) when the clearing procedure is completed. «N» (Neutral) must be manually selected.

8.5 DIAGNOSTIC CODE RESPONSE

The following responses are used in the "Diagnostic Troubleshooting Code List and Inhibited Operation Description" table to command safe operation when diagnostic codes are sent.

DNS - Do Not Shift Response

Release lock up clutch and inhibit lock up operation.

Inhibit all shifts.

Turn ON the CHECK TRANS light.

Display the range attained.

Ignore any range selection inputs from the shift selector.

DNA - Do Not Adapt Response

The TCM stops adaptive shift control while the code is active.

SOL OFF - SOLenoid OFF Response

All solenoids are commanded OFF (turning solenoids "A" and "B" off electrically cause them to be on hydraulically).

RPR - Return to Previous Range Response

When the speed sensor ratio or C3 pressure switch test associated with a shift not successful, the TCM commands the same range as commanded before the shift.

NNC - Neutral No Clutches Response

When certain speed sensor ratio or C3 pressure switch tests are not successful, the TCM commands a neutral condition with no clutches applied.

8.6 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) LIST - ALLISON 4TH GENERATION CONTROLS

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1312	Retarder Request Sensor Failed Low	No	May inhibit retarder operation if not using J1939 datalink
C1313	Retarder Request Sensor Failed High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Low Voltage	No	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor High Voltage	No	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature	No	Use hot mode shift schedule. Holds fourth range. TCC is inhibited. Freezes shift adapts.
P0561	System Voltage Performance		
P0562	System Voltage Low		
P0563	System Voltage High		
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0610	TCM Vehicle Options (Trans ID) Error	Yes	Use TID A calibration
P0613	TCM Processor	No	All solenoids off
P0614	Torque Control Data Mismatch - ECM/TCM	Yes	Allows operation only in reverse and second range.
P0634	TCM Internal Temperature Too High	Yes	SOL OFF (hydraulic default)
P063E	Auto Configuration Throttle Input Not Present	Yes	Use default throttle values
P063F	Auto Configuration Engine Coolant Temp Input Not Present	No	None
P0658	Actuator Supply Voltage 1 (HSD1) Low	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Voltage 1 (HSD1) High	Yes	DNS, SOL OFF (hydraulic default)
P0667	TCM Internal Temperature Sensor Circuit Range / Perform		
P0668	TCM Internal Temperature Sensor Circuit Low		
P0669	TCM Internal Temperature Sensor Circuit High		
P0701	Transmission Control System Performance		
P0702	Transmission Control System Electrical (TransID)	Yes	Use TID A calibration
P0703	Brake Switch Circuit Malfunction	No	No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active.
P0708	Transmission Range Sensor Circuit High Input	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit – Low Input	No	None
P070D	Transmission Fluid Level Sensor Circuit – High Input	No	None
P0711	Transmission Fluid Temperature Sensor Circuit Performance	Yes	Use default sump temp
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High Input	Yes	Use default sump temp
P0716	Turbine Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0719	Brake Switch ABS Input Low	No	TCM assumes ABS is OFF

Section 07: TRANSMISSION

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None
P0720	Output Speed Sensor Circuit		
P0721	Output Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6 th Gear Ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0730	Incorrect Neutral Gear ratio		
P0731	Incorrect 1 st Gear ratio	Yes	DNS, Attempt 2 nd , then 5 th
P0732	Incorrect 2 nd Gear ratio	Yes	DNS, Attempt 3 rd , then 5 th
P0733	Incorrect 3 rd Gear ratio	Yes	DNS, Attempt 4 th , then 6 th
P0734	Incorrect 4 th Gear ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0735	Incorrect 5 th Gear ratio	Yes	DNS, Attempt 6 th , then 3 rd , then 2 nd
P0736	Incorrect Reverse Gear ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch System Stuck Off	Yes	None
P0776	Pressure Control Solenoid 2 Stuck Off	Yes	DNS, RPR
P0777	Pressure Control Solenoid 2 Stuck On	Yes	DNS, RPR
P0796	Pressure Control Solenoid 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0847	Transmission Pressure Switch 2 Circuit Low		
P0848	Transmission Pressure Switch 2 Circuit High		
P088A	Transmission Fluid Filter Deteriorated		
P088B	Transmission Fluid Filter Very Deteriorated		
P0880	TCM Power Input Signal	No	None
P0881	TCM Power Input Signal Performance	No	None
P0882	TCM Power Input Signal Low	Yes	DNS, SOL OFF (hydraulic default)
P0883	TCM Power Input Signal High	No	None
P0894	Transmission Component Slipping	Yes	DNS, Lock in first
P0960	Pressure Control Solenoid Main Mod Control Circuit Open	Yes	None
P0961	Pressure Control Solenoid (PCS) MM System Performance		
P0962	Pressure Control Solenoid Main Mod Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Pressure Control Solenoid Main Mod Control Circuit High	Yes	None
P0964	Pressure Control Solenoid 2 (PCS2) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0965	Pressure Control Solenoid (PCS) 2 System Performance		
P0966	Pressure Control Solenoid 2 (PCS2) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid 2 (PCS2) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid 3 (PCS3) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0969	Pressure Control Solenoid (PCS) 3 System Performance		
P0970	Pressure Control Solenoid 3 (PCS3) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0971	Pressure Control Solenoid 3 (PCS3) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0973	Shift Solenoid 1 (SS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 (SS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0975	Shift Solenoid 2 (SS2) Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0976	Shift Solenoid 2 (SS2) Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R Inhibit TCC operation
P0977	Shift Solenoid 2 (SS2) Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Failed Low	No	None
P0990	Retarder Pressure Sensor Failed High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2 nd and allow shifts 2 through 6, N, R
P1891	Throttle Position Sensor PWM Signal Low Input	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High Input	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor Circuit Low Input	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor Circuit High Input	No	Use default engine coolant values
P2637	Torque Management Feedback Signal (SEM)	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal (LRTP)	Yes	Inhibit LRTP
P2670	Actuator Supply Voltage 2 (HSD2) Low	Yes	DNS, SOL OFF (hydraulic default)
P2671	Actuator Supply Voltage 2 (HSD2) High	Yes	DNS, SOL OFF (hydraulic default)
P2685	Actuator Supply Voltage 3 (HSD3) Low	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Voltage 3 (HSD3) High	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid 4 (PCS4) Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid 4 (PCS4) Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid 4 (PCS4) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2719	Pressure Control Solenoid (PCS) 4 System Performance		
P2720	Pressure Control Solenoid 4 (PCS4) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid 4 (PCS4) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid 1 (PCS1) Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid 1 (PCS1) Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid 1 (PCS1) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2728	Pressure Control Solenoid (PCS) 1 System Performance		
P2729	Pressure Control Solenoid 1 (PCS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2730	Pressure Control Solenoid 1 (PCS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid 5 (PCS5) Control Circuit Open	Yes	Inhibit retarder operation
P2737	Pressure Control Solenoid (PCS) 5 System Performance		
P2738	Pressure Control Solenoid 5 (PCS5) Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid 5 (PCS5) Control Circuit High	Yes	Inhibit retarder operation
P2740	Retarder Oil Temperature Hot	No	None
P2742	Retarder Oil Temperature Sensor Circuit – Low Input	No	Use default retarder temp values
P2743	Retarder Oil Temperature Sensor Circuit – High Input	No	Use default retarder temp values
P2761	TCC PCS Control Circuit Open	Yes	Inhibit TCC operation

9. VOLVO I-SHIFT TRANSMISSION TECU FAULT CODES

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Brake switch	PID65	FMI14	Brake interlock active	<p>Activate: The gearlever is moved from neutral without prior application of the service brake</p> <p>Deactivate: The gearlever is returned to neutral or the vehicle speed is above 5km/h</p>	White lamp is sent together with a pop-up message The transmission will not engage the selected gear (stays in neutral)	<p>Conditions for activation: (and) The brake interlock function is activated (VTNA vehicles only) The vehicle speed is below 5km/h</p> <p>The gear lever is moved from neutral or in folded position without prior activation of the service brake or parking brake</p> <p>Conditions for deactivation: (either) The vehicle speed is above 5km/h The gearlever is returned to neutral or folded position</p>
Calibration memory	SID253	FMI13	Out of range	<p>Active: Flash CS dataset error or program code missing</p> <p>Deactivate: Flash CS OK</p>	Yellow lamp is sent Cranking is inhibited Engine can not start	
Clutch cylinder slip point position	PPID51	FMI13	Calibration value out of range	<p>Activate: 1. The CS in NVRAM is not correct, or 2. The slip point has not been calibrated</p> <p>Deactivate: Slip point has been successfully calibrated</p>	Yellow lamp is sent The vehicle can not drive	
Clutch load on plates	PID50	FMI0	Data valid but above normal operational range	<p>Activate: The calculated stored energy is above 200kJ. The energy calculation is time-based for VTNA and physical for others.</p> <p>Deactivate: 7.0s after activation and, energy below 180 kJ or neutral, or driving without clutch slip</p>	Yellow lamp is sent Start gear changed to gear 1 in A/D, for RTC also in M The clutch is overheated The clutch is slowly engaged	Clutch load on plates are set without any filtering
Clutch load on plates		FMI11	Clutch protection active (unidentifiable error)	<p>Activate: Only activated for VTNA. Clutch slip more than 8.0s with vehicle movement less than 0.8m (e.g. hill holding event)</p> <p>Deactivate: 7.0s after activation and, acc pedal released more than 6.0s or neutral, or driving without clutch slip</p>	Yellow lamp is sent Start gear changed to gear 1 in A/D, for RTC also in M There has been unnecessary clutch slip The clutch is slowly engaged	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Clutch load on plates		FMI14	Special instructions	Activate: If there is an attempt to start on a high range gear or above gear 4 in VTNA in manual mode Deactivate: The start gear is changed to an allowed gear	White lamp is sent Not possible to start	This fault code is not saved
Clutch plate wear condition	PID36	FMI0	Data valid but above normal operational range	Activate: The clutch wear is more than or equal to "Service due position" Deactivate: The clutch disc is replaced and calibrated	Yellow lamp is sent If active during a long time the clutch may wear out and become damaged	
Clutch position sensor supply (SEPoC5V)	PPID54	FMI0	Data valid but above normal operational range	Activate: Voltage is above normal range Deactivate: Voltage is within normal range	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling Gear changes are slow	
Clutch position sensor supply (SEPoC5V)		FMI1	Data valid but below operational range	Activate: Voltage is below normal range Deactivate: Voltage is within normal range	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling Gear changes are slow	
Clutch system	PSID27	FMI0	Unintentional disengagement of the clutch	Activate: 1. The clutch disengages when not commanded and, 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the clutch cylinder valves and, 5. The PCB temperature is above a specific limit Deactivate: The	Yellow lamp is sent Slow gear changes Low clutch performance	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: - The clutch has been engaged for less than 10s with inactive engagement valves - The clutch cylinder position has been at least 1mm below the engaged limit at some point during this time - The clutch leaves the engaged state - The clutch disengagement valves are inactive - There is no active fault code on any of the clutch

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				clutch response is OK		cylinder position sensor (SEPoC) the clutch valves - There is no active fault code for low air pressure - The PCB temperature is above 10 dgC <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The clutch has been engaged for more than 20s with inactive engagement valves - There is an active fault code for the clutch cylinder position sensor (SEPoC)
Clutch system		FMI1	Unintentional engagement of the clutch	Activate: 1. The clutch engages when not commanded and, 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the clutch cylinder valves and, 5. The PCB temperature is above a specific limit Deactivate: The clutch response is OK	Yellow lamp is sent Slow gear changes Low clutch performance	Algorithm for activation/deactivation The following sequence must be passed three times (only once if the fault code-filter is switched OFF) in order to activate: - The clutch is near the disengaged position - All clutch valves are deactivated - The initial average clutch position is calculated during 0.1s - Wait for 3s - The final average clutch position is calculated during 0.1s - If the position has moved more than 1mm in the engagement direction, the FMI is set, else if the clutch has moved less than 0.2mm in the engagement direction the FMI is reset. <i>Additional conditions for activation:</i> - There is no active fault code on any of the clutch cylinder position sensor (SEPoC) the clutch valves low air pressure - The PCB temperature is above 10dgC
Clutch system		FMI7	Mechanical system not responding properly	Activate: 1. The clutch does not disengage/engage properly when commanded 2. There is no active fault code on the SEPoC and, 3. There is no active fault code for low air pressure and, 4. There is no active fault code on any of the	Yellow lamp is sent Slow gear changes Low clutch performance	Detailed conditions to activate/deactivate One of the following conditions must be fulfilled three times in a row in order to activate the fault: - The clutch position is more than 2mm from the disengaged position, after control of the clutch to the disengaged position during 1.0 s - The clutch position is not in the interval [set point +3mm; set point -1mm] after control of the clutch to near the slip

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				clutch cylinder valves and, 5. The PCB temperature is above 10 dgC Deactivate: The clutch response is OK		point position during 1.0s - The clutch position is more than 2.5mm from the engaged position, after control of the clutch to the engaged position during 1.0s <i>The fault is deactivated after three successful occurrences, of control of the clutch to the requested position in 0.5s</i> The fault is also deactivated if - There is an active fault on the clutch position sensor - There is an active fault on any of the clutch valves - There is an active fault code for low air pressure - The PCB temperature is below 10 dgC
Clutch system		FMI12	Unintentional clutch slip	Activate: The clutch can not transfer a specific torque without slipping Deactivate: The clutch can transfer a specific torque without slipping	Yellow lamp is sent The engine torque is reduced so that the clutch does not continue to slip	Detailed conditions Activation: - Clutch slip is detected when the engine torque is already reduced below the "Clutch slip warning torque level" in an attempt to prevent clutch slip. The clutch slip warning level is 2500Nm for MD16 (TMF) variants and 2000Nm for other variants (SMF) - There is no active fault on any of: the sensor for the countershaft speed (SECS) the sensor for the clutch position (SEPoC) and the engine torque & engine speed is received from the engine ECU Deactivation: The clutch can transfer the maximum engine torque without slipping the fault is also deactivated at startup of the system
Clutch system		FMI11	Clutch drag	Activate: The clutch transfers too much torque in disengaged position Deactivate: The clutch transfers no torque in disengaged position	Yellow lamp is sent The clutch wear is high	Algorithm for activation/deactivation - Start the check when the counter shaft has been stopped with the brake during slip point calibration when the gearlever is in neutral during normal operation. - Release the brake and check the input shaft speed after 0.5s if input shaft speed > 300rpm, activate this fault code if input shaft speed < 300rpm, deactivate this fault code - Continue with the slip point calibration

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Digital input flash NVRAM programming enable (DIEE)	PSID254	FMI3	Voltage above normal or shorted high	Activate: The voltage level for DIEE-pin is high Deactivate: The voltage for the DIEE-pin is low	Yellow lamp is sent Cranking is inhibited Engine can not start All communication with the control unit is disabled except from programming of MSW	The boot-program does not save any fault codes
Digital input flash NVRAM programming enable (DIEE)		FMI3	Voltage above normal or shorted high	Active: The voltage level for DIEE-pin is high Deactivate: The voltage for the DIEE-pin is low	Yellow lamp is sent	If the DIEE-pin is high during normal operation the fault code is saved.
Fast clutch valves low side (VAF-)	PSID5	FMI3	Voltage above normal or shorted high	Activate: The low-side drive is short circuit to Ubatt Deactivate: The low-side drive is OK	Yellow lamp is sent Fast engagement/disengagement disabled Reduced clutch performance Gear changes are slow	
Fast clutch valves low side (VAF-)		FMI6	Current above normal or grounded circuit	Activate: 1. The low-side drive is short circuit to Gnd and 2. There is no active fault code for short circuit to Gnd on VAFE or VAFD Deactivate: The low-side drive is OK	Yellow lamp is sent Fast engagement/disengagement disabled Reduced clutch performance Gear changes are slow	
Gearbox brake	PSID28	FMI7	Mechanical system not responding properly	Activate: The gearbox brake does not brake when the valve is activated	Yellow lamp is sent Slow gear changes at standstill	Detailed conditions The following conditions must be fulfilled for five activations (only one with the fault code-filter switched OFF) of the gearbox brake in order to activate the fault code: - The activation must last for at least 0.2s - There is no active fault code on the sensor for the split cylinder position (SEPoS) - The minimum valve of the derivative of the input shaft speed during activation is greater than -500 rpm/s - There is no active fault on any of the gearbox brake valve (VAGB) the sensor for the counter

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>shaft speed (SECS) the sensor for the split cylinder position (SEPoS) low air pressure. The following conditions must be fulfilled for one activation of the gearbox brake in order to deactivate:</p> <ul style="list-style-type: none"> - The minimum value of the derivative of the countershaft speed during the activation is greater than -100rpm/s <p>The fault is also deactivated if there is an active fault on the countershaft speed sensor (SESC), on the gearbox brake valve (VAGB), or the split position sensor (SEPoS)</p>
Gears 1/R engagement system	PSID25	FMI0	Unintentional disengagement of 1:st gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 1/R cylinder leaves the 1:st position -The 1:st cylinder valves are inactive 	<p>Yellow lamp is sent Loss of torque</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 1/R cylinder position indicates that the 1/R gear leaves the 1:st position - The 1:st cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <p><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.</p>
Gears 1/R engagement system		FMI1	Unintentional disengagement of reverse gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 1/R gear leaves the reverse position -The 1/R cylinder valves are inactive 	<p>Yellow lamp is sent Loss of torque</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 1/R cylinder position indicates that the 1/R gear leaves the reverse position - The 1/R cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						(SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.
Gears 1/R engagement system		FMI2	Unintentional disengagement of neutral gear (1:st and reverse gear cylinder)	Conditions to set the fault code: -The 1/R gear leaves the neutral position -The 1/R cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 1/R cylinder position indicates that the 1/R gear leaves the neutral position - The 1/R cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure <i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.
Gears 1/R engagement system		FMI11	Blocked engagement of 1:st gear	Conditions to set the fault code: -The 1:st gear can not engage -There is no active fault code on the SEPo1R -There is no active fault code for low air pressure -There is no active fault code on any of the 1:st and reverse gear cylinder valves	Yellow lamp is sent Loss of torque The 1:st gears will not be selected by the system for a short while. After five successful gear changes a new attempt to use 1:st gear may be made	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:(engagement of another gear will reset the count) - The valve for reaching 1:st gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that 1:st position is not engaged - There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure The fault is deactivated if any of the following conditions are fulfilled:

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<ul style="list-style-type: none"> - The 1/R position sensor indicates that 1:st position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 1/R engagement system		FMI12	Blocked engagement of reverse gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The reverse gear can not engage 	<p>Yellow lamp is sent</p> <p>The R gear can not engage, but the system will try to engage it as long as the gearlever is in the reverse position</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching the reverse gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that R position is not engaged - There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear - There is no active fault code for low air pressure. The fault is deactivated if any of the following conditions are fulfilled: - The 1/R position sensor indicates that R position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 1/R engagement system		FMI7	Blocked engagement of neutral gear (1:st and reverse gear cylinder)	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The neutral gear (1:st and reverse gear cylinder) can not engage 	<p>Yellow lamp is sent</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The valve for reaching the reverse gear is activated for at least 0.8s - The 1/R cylinder position sensor indicates that neutral position is not engaged - There is no active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>reverse gear</p> <ul style="list-style-type: none"> - There is no active fault code for low air pressure <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The 1/R position sensor indicates that neutral position is engaged - There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear
Gears 2/3 engagement system	PSID26	FMI0	Unintentional disengagement of 2:nd gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position - The 2:nd cylinder valves are inactive 	<p>Yellow lamp is sent</p> <p>Loss of torque</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position - The 2:nd cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <p><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.</p>
Gears 2/3 engagement system		FMI1	Unintentional disengagement of 3:rd gear	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The 2/3 cylinder leaves the 3:rd position - The 3:rd cylinder valves are inactive 	<p>Yellow lamp is sent</p> <p>Loss of torque</p>	<p>Detailed conditions to activate/deactivate</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> - The 2/3 cylinder position indicates that the 2/3 gear leaves the 3:rd position - The 3:rd cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.
Gears 2/3 engagement system		FMI2	Unintentional disengagement of neutral gear (2:nd and 3:rd gear cylinder)	Conditions to set the fault code: -The 2/3 cylinder leaves the neutral position - The 2/3 cylinder valves are inactive	Yellow lamp is sent	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The 2/3 cylinder position indicates that the 2/3 gear leaves the neutral position - The 2/3 cylinder valves are inactive - There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.
Gears 2/3 engagement system		FMI11	Blocked engagement of 2:nd gear	Conditions to set the fault code: -The 2:nd gear can not engage	Yellow lamp is sent Loss of torque The 2:nd gear will not be selected by the system for a short while. After five successful gearshifts a new attempt to use 2:nd gear may be made	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The valve for reaching 2:nd gear is activated for at least 0.8s - The 2/3 cylinder position sensor indicates that 2:nd position is not engaged - There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The 2/3 position sensor indicates that 2:nd 2:nd position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						gear the valve for shift to 3:rd gear
Gears 2/3 engagement system		FMI12	Blocked engagement of 3:rd gear	Conditions to set the fault code: -The 3:rd gear can not engage	Yellow lamp is sent Loss of torque The 3:rd gear will not be selected by the system for a short while. After five successful gearshifts a new attempt to use 3:rd gear may be made	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The valve for reaching 3:rd gear is activated for at least 0.8s - The 2/3 cylinder position sensor indicates that 3:rd position is not engaged - There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The 2/3 position sensor indicates that 3:rd position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear
Gears 2/3 engagement system		FMI7	Blocked engagement of neutral gear (2:nd and 3:rd gear cylinder)	Conditions to set the fault code: -The neutral gear (2:nd 3:rd gear cylinder) can not engage	Yellow lamp is sent	Detailed conditions to activate/deactivate The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code: (engagement of another gear will reset the count) - The valve for reaching gear (2:nd and 3:rd gear cylinder) is activated for at least 0.8s - The 2/3 cylinder position sensor indicates that neutral position is not engaged - There is no active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear - There is no active fault code for low air pressure <i>The fault is deactivated if any of the following conditions are fulfilled:</i> - The 2/3 position sensor

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						indicates that neutral position is engaged - There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear
J1708/J1587	SID250	FMI9	Abnormal update rate	Activate: The FMI shall be set if any of the messages* have not been received on the bus for 30s Deactivate: The FMI shall be cleared if all messages* are sent on the bus *PID190, PID85 and PPID212	Yellow lamp is sent Fault codes can not be read On-vehicle tests can not be performed	
J1939	SID231	FMI2	Data erratic, intermittent or incorrect	Active: This FMI shall be set if the CAN transceiver signals "bus-off" Deactivate: FMI cleared if CAN-transceiver does not signal "bus-off"	Yellow lamp is sent Much reduced gear selection and gear change performance	
Missing data on J1939 form BECU	PSID204	FMI8	Abnormal frequency, pulse width or period	Activate: The FMI shall be set if the wheel speeds from the BECU (MID136) are incorrect Deactivate: The FMI shall be cleared if the wheel speeds from the BECU (MID136) are correct	Yellow lamp Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 form BECU		FMI9	Abnormal update rate	Activate: The FMI shall be set if message WSI from BECU (MID136) is not received within 1s Deactivate: The FMI shall be cleared if message WSI is received at normal rate	Yellow lamp Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 form GECU	PSID207	FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP6 from GECU (MID223) is not received within 1s Deactivate: The FMI shall be cleared if message VP6 is received at normal rate	Yellow lamp Slow response on manual gear changes and slow response when buttons are pressed on the gear lever.	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Missing data on J1939 from the adaptive cruise control	PSID211	FMI9	Abnormal update rate	<p>Activate: The FMI shall be set if message ACC1 from ACC (MID219) is not received within 1s, and ACC is installed</p> <p>Deactivate: The FMI shall be cleared if message ACC1 is received at normal rate</p>	Yellow lamp The retarder ACC function does not work	
Missing data on J1939 from the EMS	PSID200	FMI9	Abnormal update rate	<p>Activate: The FMI shall be set if message EEC1 from EECU is not received within 200ms</p> <p>Deactivate: The FMI shall be cleared if message EEC1 is received at normal rate</p>	Yellow lamp is sent If there is no POWERTRAIN_CAN, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds If there is no Powertrain_CAN and the engine does not receive any messages from the TECU, the gear changes will be slow	
Missing data on J1939 from the light control module (LCM)	PSID210	FMI9	Abnormal update rate	<p>Activate: The FMI shall be set if message VP37 from LCM (MID216) is not received within 10s</p> <p>Deactivate: The FMI shall be cleared if message VP37 is received at normal rate</p>	Yellow lamp The start gear might be wrong Automatic gear selection performance might be reduced a certain time after start Automatic gear selection performance might be reduced a certain time after a trailer has been connected/disconnected	
Missing data on J1939 from the suspension ECU (ECS)	PSID208	FMI9	Abnormal update rate	<p>Activate: The FMI shall be set if message VW from ECS (MID150) is not received within 10s, and ECS is installed</p>	Yellow lamp The start gear might be wrong after loading and unloading	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				Deactivate: The FMI shall be cleared if message VW is received at normal rate		
Missing data on J1939 from VECU	PSID201	FMI8	Abnormal frequency, pulse width or period	Activate: The FMI shall be set if the acc pedal pos or service brake-switch from the VECU (MID144) is incorrect Deactivate: The FMI shall be cleared if the acc pedal pos and service brake-switch from the VECU (MID144) are correct	Yellow lamp If pedal pos is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds If pedal pos is undefined, gearbox comfort at start and marshalling might be reduced If service brake is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds	
Missing data on J1939 from VECU		FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP2 from VECU (MID144) is not received within 100ms Deactivate: The FMI shall be cleared if message VP2 is received at normal rate	Yellow lamp Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds Gearbox comfort at start and marshalling might be reduced	
Powertrain CAN	PSID232	FMI2	Data erratic, intermittent or incorrect	Activate: The FMI shall be set if the CAN transceiver signals "busOFF" Deactivate: The FMI shall be cleared if the CAN-transceiver does not signal "busOFF"	Yellow lamp is sent Reduced automatic gear selection and gear change performance	This fault code is only valid for vehicles where a Pwertrain_CAN link exist between the TECU and the engine.
Powertrain CAN		FMI9	Abnormal update rate	Activate: The FMI shall be set if message VP24/MID128 is not received	Yellow lamp is sent Reduced automatic gear selection	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				within 100ms Deactivate: The FMI shall be cleared if message VP24/MID128 is received at normal rate	and gear change performance	
Program memory	SID240	FMI2	Data erratic, intermittent or incorrect	Activate: Flash CS error or program code missing Deactivate: Flash CS OK	Yellow lamp is sent Cranking is inhibited Engine can not start	
Range engagement system	PSID24	FMI0	Unintentional disengagement of low range	Conditions to set the fault code: -The range cylinder leaves the low range position -The range cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The range cylinder position indicates that range gear leaves the low range position - The range cylinder valves are inactive - There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the valve for shift to low range - There is no active fault code for low air pressure note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Range engagement system		FMI1	Unintentional disengagement of high range	Conditions to set the fault code: -The range cylinder leaves the high range position -The range cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The range cylinder position indicates that the range gear leaves the high range position - The range cylinder valves are inactive - There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						valve for shift to low range - There is no active fault code for low air pressure <i>note:</i> The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Range engagement system		FMI11	Blocked engagement of low range	Conditions to set the fault code: -The low range gear can not engage	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The low range can not engage within 3.8s - The gearbox oil temperature is above 10dgC - There is no active fault code on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves The fault is deactivated if any of the following conditions are fulfilled: - The range cylinder position sensor indicates that low range is engaged - The gearbox oil temperature is below 10dgC - There is an active fault on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves
Range engagement system		FMI12	Blocked engagement of high range	Conditions to set the fault code: -The high range gear can not engage	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The high range gear can not engage within 3.8s - The gearbox oil temperature is above 10dgC - There is no active fault on any of the range position sensor (SEPoR) low air pressure the range cylinder valves - There is no active fault code for low air pressure The fault is deactivated if

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						any of the following conditions are fulfilled: - The range cylinder position sensor indicates that high range is engaged - The gearbox oil temperature is below 10dgC - There is an active fault code on any of the range position sensor (SEPoR) low air pressure the range cylinder valves
Sensor for the 1:st and reverse gear cylinder (SEPo1R)	PPID10	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the 1:st and reverse gear cylinder (SEPo1R)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the inclination of the gearbox (SEIG)	PPID140	FMI2	Data erratic, intermittent or incorrect	Activate: 1. The sensor signal is above or below normal range and 2. The vehicle has been standing still for a specific time Deactivate: The sensor signal is in the normal range	Yellow lamp is sent The start gear might be wrong Gear selection performance might be reduced Downhill and uphill gear change performance may be reduced	
Sensor for the PCB temperature	PPID55	FMI0	Data valid but above normal operational range	Activate: temp above 125dgC Deactivate: temp below 125dgC	Yellow lamp is sent	
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)	PPID11	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20°C from the average-temp, if the temperature is out of boundary -60°C to +160°C or if the temperature changes at a rate higher than 10°C during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the position of the range (SEPoR)	PID31	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20°C from the average-temp, if the temperature is out of boundary -60°C to +160°C or if the temperature changes at a rate higher than 10°C during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the range (SEPoR)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range (SEPoR)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range (SEPoR)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the range (SEPoR)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the position of the Split (SEPoS)	PID32	FMI2	Data erratic, intermittent or incorrect	Activate: The position sensor is distributing a temperature-signal from the	Yellow lamp is sent Slow gear changes	Detailed conditions to activate / deactivate: Activate: The position sensor is distributing a temperature-signal from the

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				sensor ASIC, if the value from this sensor deviates too much this fault code is triggered. Deactivate:		sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20°C from the average-temp, if the temperature is out of boundary -60°C to +160°C or if the temperature changes at a rate higher than 10°C during 15s, then this fault code is set. Deactivate: Fault code stays until a clear DTC command is received
Sensor for the position of the Split (SEPoS)		FMI3	Voltage above normal or shorted high	Activate: Status from the ASIC is short circuit to Ubatt Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI5	Current below normal or open circuit	Activate: Status from the ASIC is open circuit Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI6	Current above normal or grounded circuit	Activate: Status from the ASIC is short circuit to Gnd. Deactivate: Status is OK	Yellow lamp is sent Slow gear changes	
Sensor for the position of the Split (SEPoS)		FMI13	Calibration value out of range	Activate: The Checksum of the NVRAM is not correct, or the sensor has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	
Sensor for the pressure of the supply air (SEPrSA)	PID37	FMI0	Data valid but above normal operational range	Activate: 1. Sensor signal is in normal range 2. Pressure is above 10.0 [bar] Deactivate: 1. Sensor signal is in normal range 2. Pressure is below 10.0 [bar]	Yellow lamp is sent reduced clutch performance	
Sensor for the pressure of the supply air (SEPrSA)		FMI1	Data valid but below operational range	Activate: 1. Sensor signal is in normal range 2. Pressure is below 5.0 [bar] Deactivate: 1. Sensor signal is in normal range 2. Pressure is above 5.0 [bar]	Yellow lamp is sent. The symbol for compressed air, gearbox is sent. Gear changes may be absent. Reduced clutch performance	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the pressure of the supply air (SEPrSA)		FMI3	Voltage above normal or shorted high	Activate: The sensor signal is above normal range Deactivate: The sensor signal is in normal range	Yellow lamp is sent	
Sensor for the pressure of the supply air (SEPrSA)		FMI5	Current below normal or open circuit	Activate: The sensor signal is below normal range Deactivate: The sensor signal is in normal range	Yellow lamp is sent	
Sensor for the speed on the counter shaft (SESC)	PID161	FMI1	Data valid but below operational range	Activate: 1. The sensor signal is within normal range and, 2. The counter shaft speed differs from both the main shaft speed (SESM) and the vehicle speed received from the vehicle ECU when the counter shaft is rotating Deactivate: 1. The sensor signal is within normal range 2. The counter shaft speed and the main shaft speed are equal when the counter shaft is rotating	Yellow lamp is sent Reduced gear change performance Gearbox brake up shifts can not be used Slip point can not be updated which will give reduced performance at starts Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine	Detailed condition to activate: The following conditions must be fulfilled for a time of 2.0s in order to activate: A gear (not neutral) is engaged in the gearbox The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm -The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ more than 50rpm -The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ more than 30rpm -The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ less than 30rpm -There is no active fault on any of -The sensor for the main shaft speed (SESM) -The sensor for the position of the split cylinder (SEPoS) -The sensor for the position of the shift cylinder1R (SEPo1R) -The sensor for the position of the shift cylinder 23 (SEPo23) -The sensor for the position of teh range cylinder (SEPoR)

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>The fault is deactivated if the following conditions are fulfilled for a time of 2.0s:</p> <ul style="list-style-type: none"> -A gear (not neutral) is engaged in the gearbox -The value of the input shaft speed calculated from the countershaft speed sensor (SESC) is more than 300rpm, or -the value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm -The values of the input shaft speed calculated from the countershaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ less than 50rpm <p>The fault is also deactivated if the following conditions are fulfilled for a time of 2.0s:</p> <ul style="list-style-type: none"> -A neutral gear is engaged in the gearbox -The engine speed is above 400rpm -The clutch is engaged -Direct or indirect split is engaged -The values of the input shaft speed is calculated from the counter shaft speed sensor (SESC) and the engine speed received from the engine ECU differ less than 50 rpm <p>The fault is also deactivated if the signal from the countershaft speed sensor (SESC) is not within normal range or if there is an active fault code on any of:</p> <ul style="list-style-type: none"> -The clutch position sensor (SEPoC) -The sensor for the position of the split cylinder (SEPoS) -The sensor for the position of the shift cylinder1R (SEPo1R) -The sensor for the position of the shift cylinder 23 (SEPo23) -The sensor for the position of teh range cylinder (SEPoR)
Sensor for the speed on the counter shaft (SESC)		FMI4	Voltage below normal or shorted low	<p>Activate: The sensor signal is below normal range.</p> <p>Deactivate: The sensor signal is within normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Gearbox brake up shifts can not be used</p>	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					Slip point cannot be updated which will give reduced performance at starts Start gear engagement only possible at standstill and when the vehicle speeds is high enough to synchronize the main box with the engine	
Sensor for the speed on the counter shaft (SESC)		FMI5	Current below normal or open circuit	Activate: The sensor signal is above normal range Deactivate: The sensor signal is within normal range	Yellow lamp is sent Reduced gear change performance Gearbox brake up shifts can not be used Slip point cannot be updated which will give reduced performance at starts Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine	
Sensor for the speed on the main shaft (SESM)	PID160	FMI1	Data valid but below operational range	Activate: 1. Sensor signal is within normal range and 2. The main shaft speed differs from both the value of the countershaft speed and the vehicle speed received from the vehicle ECU Deactivate: 1. Sensor signal is within normal range and, 2. The main shaft speed and the counter shaft speed are equal	Yellow lamp is sent Reduced gear change performance Reduced gear change comfort	Detailed condition to activate: The following conditions must be fulfilled for a time of 2.0s in order to activate: A gear (not neutral) is engaged in the gearbox The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm. The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the counter shaft speed sensor

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				<i>when the main shaft is rotating</i>		<p>(SESC) differ more than 50rpm The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ more than 30rpm. The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ less than 30rpm.</p> <p>There is no active fault on any of the sensor for the countershaft speed (SECS) The sensor for the position of the split cylinder (SEPoS) The sensor for the position of the shift cylinder1R (SEPo1R) The sensor for the position of the shift cylinder 23 (SEPo23) The sensor for the position of teh range cylinder (SEPoR)</p> <p>The following conditions must be fulfilled for a time of 2.0s in order to deactivate: A gear (not neutral) is engaged in the gearbox The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm. The value of the input shaft speed calculated from the main shaft speed sensor (SESM) and the counter shaft speed sensor (SESC) differ less than 50rpm. The fault is also deactivated if The sensor signal (SESM) is not within normal range. There is an active fault on any of The sensor for the countershaft speed (SECS) The sensor for the position of the split cylinder (SEPoS) The sensor for the position of the shift cylinder1R (SEPo1R) The sensor for the position of the shift cylinder 23 (SEPo23) The sensor for the position of teh range cylinder (SEPoR)</p>

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Sensor for the speed on the mainshaft (SESM)		FMI2	Data erratic, intermittent or incorrect	<p>Activate: The sensor indicates wrong traveling direction</p> <p>Deactivate: The sensor indicates correct traveling direction</p>	Yellow lamp is sent Reduced gear change performance	<p>Detailed conditions to activate The following conditions must be fulfilled for a time of 2.0s in order to activate: The input shaft speed calculated from the countershaft speed sensor (SESC) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the countershaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and above 600rpm. A forward gear is engaged in the gearbox and the main shaft speed sensor (SESM) indicates reverse movement or a reverse gear is engaged and the main shaft speed sensor (SESM) indicates forward movement There is no other active fault on the sensor for the main shaft speed (SESM) There is no active fault on any of: -The sensor for the countershaft speed (SECS) -The sensor for the clutch position (SePoC) -The sensor for the position of the split cylinder (SePoS) -The sensor for the position of the shift cylinder (1R SEPo1R) -The sensor for the position of the shift cylinder (23 SEPo23) -The sensor for the range cylinder (SEPoR)</p> <p>The fault is deactivated if the following conditions are fulfilled for a time of 2,0s: The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and above 600rpm A forward gear is engaged in the gearbox and the main shaft speed sensor (SESM) indicates forward movement</p>

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>or A reverse gear is engaged and the main shaft speed sensor (SESM) indicates reverse movement.</p> <p>The fault is also deactivated if the main shaft speed sensor (SESM) signal is not within normal range, or if there is an active fault on any of the sensors:</p> <ul style="list-style-type: none"> -The sensor for the countershaft speed (SECS) -The sensor for the clutch position (SePoC) -The sensor for the position of the split cylinder (SePoS) -The sensor for the position of the shift cylinder (1R SEPo1R) -The sensor for the position of the shift cylinder (23 SEPo23) -The sensor for the range cylinder (SEPoR)
Sensor for the speed on the main shaft (SESM)		FMI3	Voltage above normal or shorted high	<p>Activate: Signal or supply voltage is above normal range</p> <p>Deactivate: Signal and supply voltage is in normal range.</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Reduced gear change comfort</p>	
Sensor for the speed on the main shaft (SESM)		FMI4	Voltage below normal or shorted low	<p>Activate: Signal and supply voltage is below normal range.</p> <p>Deactivate: Signal and supply voltage is within normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Reduced gear change comfort</p>	
Sensor for the speed on the main shaft (SESM)		FMI5	Current below normal or open circuit	<p>Activate: 1.Signal voltage is below normal range and, 2. Supply voltage is in the normal range</p> <p>Deactivate: Signal and supply voltage is in the normal range</p>	<p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> <p>Reduced gear change comfort</p>	
Sensor for the temperature of the gearbox oil (SETeGO)	PID177	FMI0	Data valid but above normal operational range	<p>Activate low:</p> <ol style="list-style-type: none"> 1.The sensor signal is in normal range 2. Temperature is above 100dgC during 18000s <p>Deactivate low:</p> <ol style="list-style-type: none"> 1. The sensor signal is in normal range 2. Temperature is below 100dgC <p>Activate medium:</p> <ol style="list-style-type: none"> 1. The 	<p>Low:</p> <p>Yellow lamp is sent</p> <p>Symbol for high gearbox oil temperature is lit</p> <p>Medium:</p> <p>Yellow lamp is sent</p> <p>Symbol for high gearbox oil temperature is</p>	<p>Gearbox oil temperature fault codes are only set if the vehicle has oil temperature sensor functionality installed</p>

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				<p>sensor signal is in normal range</p> <p>2. Temperature above 120dgC during 600s</p> <p>Deactivate medium: 1. The sensor signal is in normal range</p> <p>2. Temperature is below 120dgC</p> <p>Activate high: 1. The sensor signal is in normal range</p> <p>2. Temperature is above 140dgC during 30s</p> <p>Deactivate high: 1. The sensor signal is in normal range</p> <p>Temperature is below 140dgC</p>	<p>lit</p> <p>High: Red lamp is sent</p> <p>Symbol for high gearbox oil temperature is lit</p>	
Sensor for the temperature of the gearbox oil (SETeGO)		FMI4	Voltage below normal or shorted low	<p>Activate: The sensor signal is below normal range</p> <p>Deactivate: The sensor signal is in normal range</p>	Yellow lamp is sent	
Sensor for the temperature of the gearbox oil (SETeGO)		FMI5	Current below normal or open circuit	<p>Activate: The sensor signal is above normal range</p> <p>Deactivate: The sensor signal is in normal range</p>	Yellow lamp is sent	
Sensor position of the clutch (SEPoC and SEPoCINV)	PID33	FMI2	Data erratic, intermittent or incorrect	<p>Activate: The difference between clutch positions indicated by the sensor signal (SEPoC) and the inverted sensor signal (SEPoC INV) is to large and both signals is within normal range</p> <p>Deactivate: The difference between clutch positions indicated by the sensor signal (SEPoC) and the inverted sensor signal (SEPoC INV) is normal</p>	<p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>Gear changes are slow</p>	<p>The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)</p> <p>The clutch position sensor has four connectors: one supply, one ground and two connectors for the sensor signal. With correct input the input voltage of the sensor signal, the inverted sensor signal and the sensor supply, they will follow the nominal relation (Usepoc + Usepoc_inv) / Usepoc5V = 100%</p>
Sensor position of the clutch		FMI3	Voltage above normal or shorted high	Activate: Sensor signal is short circuit to Ubatt or sensor supply,	Yellow lamp is sent Reduced clutch	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
(SEPoC and SEPoCINV)				when at least one of the sensor signals is above normal range. Deactivate: No sensor signal is above normal range	performance Reduced gearbox comfort at start and marshalling Gear changes are slow	supply (PPID 54)
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI5	Current below normal or open circuit	Activate: 1. Open circuit on any of the sensor signals is detected when: one of the sensor signals is within normal range and the other sensor signal is below normal range 2. Open circuit on ground, detected when both the sensor signals are within the normal range and the sum of the sensor signals is above a specific value Deactivate: No activation condition is no longer fulfilled	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling gear changes are slow	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI12	Faulty device or component	Activate: Both sensor signals are below normal when: 1. Status of the sensor ASIC reports internal fault on the sensor, or 2. Short circuit to Gnd on any of the sensor signals, or 3. Open circuit on supply, or 4. Short circuit between the two sensor signals Deactivate: Both sensor signals are not below normal level	Yellow lamp is sent Reduced clutch performance Reduced gearbox comfort at start and marshalling gear changes are slow	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Sensor position of the clutch (SEPoC and SEPoCINV)		FMI13	Calibration value out of range	Activate: 1. The CS in NVRAM is not correct 2. The cylinder has not been calibrated Deactivate: Sensor signal has been successfully calibrated	Yellow lamp is sent Cranking is inhibited Engine can not start	The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)
Slow clutch valves low side (VAS-)	PSID6	FMI3	Voltage above normal or shorted high	Activate: The low-side drive is short circuit to Ubatt	Yellow lamp is sent Slow engagement/d	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
				Deactivate: The low-side drive is OK	isengagement disabled Reduced clutch performance, especially at start and marshalling	
Slow clutch valves low side (VAS-)		FMI6	Current above normal or grounded circuit	Activate: 1. The low-side drive is short circuit to Gnd and 2. There is no active fault code for short circuit to Gnd on VASE or VASD Deactivate: The low-side drive is OK	Yellow lamp is sent Slow engagement /disengagement disabled Reduced clutch performance, especially at start and marshalling	
Split engagement system	PSID23	FMI0	Unintentional disengagement of indirect split	Conditions to set the fault code: -The split cylinder position leaves the indirect position -The split cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the indirect position - The split cylinder valves are inactive - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure <i>note:</i> The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI1	Unintentional disengagement of direct split	Conditions to set the fault code: -The split cylinder position leaves the direct position -The split cylinder valves are inactive	Yellow lamp is sent Loss of torque	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the direct position - The split cylinder valves are inactive - There is no active fault on

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure Note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI2	Unintentional disengagement of neutral split	Conditions to set the fault code: -The split cylinder position leaves the neutral position -The split cylinder valves are inactive	Yellow lamp is sent	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: (engagement of another gear will reset the count) - The split cylinder position indicates that split gear leaves the neutral position - The split cylinder valves are inactive - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure Note: The fault will always have the state inactive. Check fault-count and last occurrence to get more information
Split engagement system		FMI11	Blocked engagement of indirect split	Conditions to set the fault code: -The indirect split gear can not engage	Yellow lamp is sent Loss of torque Only direct split gears will be selected by the system for a short while. After five successful gearshifts a new attempt to use indirect split may be made	Detailed conditions to activate/deactivate: The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code: - The split valve for reaching indirect split is activated for at least 0.8s - The split cylinder position sensor indicates that indirect position is not engaged - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure The fault is deactivated if any of the following

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<p>conditions are fulfilled:</p> <ul style="list-style-type: none"> - The split cylinder position sensor indicates that indirect position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
Split engagement system		FMI12	Blocked engagement of direct split	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The direct split gear can not engage 	<p>Yellow lamp is sent Loss of torque Only indirect split gears will be selected by the system for a short while. After five successful gearshifts a new attempt to use direct split may be made</p>	<p>Detailed conditions to activate/deactivate:</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:</p> <ul style="list-style-type: none"> - The split valve for reaching direct split is activated for at least 0.8s - The split cylinder position sensor indicates that direct position is not engaged - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split - There is no active fault code for low air pressure <p>The fault is deactivated if any of the following conditions are fulfilled:</p> <ul style="list-style-type: none"> - The split cylinder position sensor indicates that direct position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
Split engagement system		FMI7	Blocked engagement of neutral split	<p>Conditions to set the fault code:</p> <ul style="list-style-type: none"> -The neutral split gear can not engage 	<p>Yellow lamp is sent Eco roll is not available</p>	<p>Detailed conditions to activate/deactivate:</p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:</p> <ul style="list-style-type: none"> - The split valve for reaching neutral split is activated for at least 0.8s - The split cylinder position sensor indicates that neutral position is not engaged - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
						<ul style="list-style-type: none"> - There is no active fault code for low air pressure The fault is deactivated if any of the following conditions are fulfilled: - The split cylinder position sensor indicates that neutral position is engaged - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split
TECU Power supply	PID158	FMI0	Data valid but above normal operational range	Activate: 24V system: above 36V 12V system: above 19V Deactivate: 24V system: below 36V. 12V system: below 19V	Yellow lamp is sent	
TECU Power supply		FMI1	Data valid but below normal operational range	Activate: 24V system: below 17V. 12V system: below 9V Deactivate: 24V system: above 17V 12V system: above 9V	Yellow lamp is sent Reduced gearbox performance	
Valve for activating the PTO number 1 (VAP1)	PSID20	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated The PTO can not be deactivated Reduced gear change comfort	PTO fault codes are only set if the PTO exists
Valve for activating the PTO number 1 (VAP1)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 1 (VAP1)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 2 (VAP2)	PSID21	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated The PTO can not be deactivated Reduced gear change comfort	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Valve for activating the PTO number 2 (VAP2)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for activating the PTO number 2 (VAP2)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated The PTO does not work	
Valve for fast disengagement of the clutch (VAFD)	PSID3	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuited to Ubatt and 2. there is no active fault code for short circuit to Ubatt on VAF- Deactivate: The high-side drive is OK	Yellow lamp is sent Fast engagement/d isengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast disengagement of the clutch (VAFD)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent Fast disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast disengagement of the clutch (VAFD)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Fast disengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast engagement of the clutch (VAFE)	PSID1	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuited to Ubatt and, 2. there is no active fault code for short circuit to Ubatt on VAF- Deactivate: The high-side drive is OK	Yellow lamp is sent Fast engagement/d isengagement disabled Reduced clutch performance Gear changes are slow	
Valve for fast engagement of the clutch (VAFE)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent Fast engagement disabled Reduced clutch performance Gear changes are slow	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Valve for fast engagement of the clutch (VAFE)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Fast engagement disabled Reduced clutch performance Gear changes are slow	
Valve for shifting to direct split (VADS)	SID37	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Indirect and neutral split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to direct split (VADS)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to direct split (VADS)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)	PSID12	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Gears are missing Automatic	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 1 (VAG1)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)	PSID14	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 2 (VAG2)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)	PSID15	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear 3 (VAG3)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent. The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)	PSID13	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to gear reverse (VAGR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to high range (VAHR)	SID35	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Low range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Valve for shifting to high range (VAHR)		FMI5	Current below normal or open circuit	Activate: The high side drive is Open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to high range (VAHR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to indirect split (VAIDS)	SID38	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated Direct and neutral split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to indirect split (VAIDS)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
Valve for shifting to indirect split (VAIDS)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Split gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)	SID36	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Yellow lamp is sent The valve is activated High range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for shifting to low range (VALR)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Range gears are missing Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds	
Valve for slow	PSID4	FMI3	Voltage above normal or	Activate: 1. The high-side drive is	Yellow lamp is sent Slow	

FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
disengagement of the clutch (VASD)			shorted high	short circuit to Ubatt and 2. There is no active fault code for short circuit to Ubatt on VAS- Deactivate: The high-side drive is OK	engagement/d is- engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for slow disengagement of the clutch (VASD)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high-side drive is OK	Yellow lamp is sent Slow disengagement disabled Reduced clutch performance	
Valve for slow disengagement of the clutch (VASD)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Slow disengagement disabled Reduced clutch performance	
Valve for slow engagement of the clutch (VASE)	PSID2	FMI3	Voltage above normal or shorted high	Activate: 1. The high-side drive is short circuit to Ubatt and 2. There is no active fault code for short circuit to Ubatt on VAS- Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement/d is- engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for slow engagement of the clutch (VASE)		FMI5	Current below normal or open circuit	Activate: The high-side drive is open circuit Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for slow engagement of the clutch (VASE)		FMI6	Current above normal or grounded circuit	Activate: The high-side drive is short circuit to Gnd Deactivate: The high-side drive is OK	Yellow lamp is sent Slow engagement disabled Reduced clutch performance, especially at start and marshalling	
Valve for the gearbox brake (VAGB)	PSID22	FMI3	Voltage above normal or shorted high	Activate: The high side drive is short circuit to Ubatt Deactivate: The high side drive is OK	Red lamp is sent. The valve and the brake are activated The gearbox will be damaged if the vehicle	

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FUNCTION	PID/SID	FMI J1587	ERROR	CONDITION	SYMPTOM	COMMENT
					drives. The prop shaft has to be removed to move the vehicle	
Valve for the gearbox brake (VAGB)		FMI5	Current below normal or open circuit	Activate: The high side drive is open circuit Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Shifting to the start gear takes long time	
Valve for the gearbox brake (VAGB)		FMI6	Current above normal or grounded circuit	Activate: The high side drive is short circuit to Gnd Deactivate: The high side drive is OK	Yellow lamp is sent The valve can not be activated Shifting to the start gear takes long time	

10. VOLVO I-SHIFT TRANSMISSION GSECU FAULT CODES

PID/PPID SID/PSID	FMI	LAMP	CONTENT	TEXT	COMMENT	CONSEQUENCES
SID231	2	None	SAE J1939 Data Link	-	-	Redundancy on J1587
SID237	3		Start enable device	Check Gear Selector System at next stop	Only for EMS1.xx vehicles	Start relay not working
SID240	2		Program memory	Gear Selector System failure	Boot	Not possible to engage gear
SID250	9	None	SAE J1708 /J1587 data link	-	-	-
SID253	2		Program memory	Gear Selector System failure	-	Not possible to engage gear
SID254	12		Controller #1	Gear Selector System failure	-	Not possible to engage gear
PSID9	12		Gear level position sensors	Check Gear Selector System at next stop	-	Not possible to engage/change gear
PSID36	7		Output actuator (REPS)	Check Gear Selector System at next stop	-	Fault displayed after ignition OFF. Risk of battery discharge if main circuit breaker is not opened when vehicle is not used
PSID36	12		Output actuator (REPS)	Check Gear Selector System at next stop	-	Gearbox not supplied

PID/PPID SID/PSID	FMI	LAMP	CONTENT	TEXT	COMMENT	CONSEQUENCES
PSID42	2	None	Ignition signals	-	-	Power supply always on
PSID200	9	None	Data Link, MID128	Check Gear Selector System at next stop	Only for AMT-C, Boot	Affects RT only (can be sent for VT)
PSID201	9	None	Data Link, MID144	Check Gear Selector System at next stop	Only for AMT-C, Boot	Affects RT only (can be sent for VT)
PSID205	9	None	Data Link, MID130	Check Gear Selector System at next stop	Boot	Affects RT only (can be sent for VT)
PSID214	9	None	Data Link, MID249	-	Only when second gear selector is installed, Boot	Not possible to switch to/from secondary gear lever

11. SPECIFICATIONS

ALLISON AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

X3-45 Coaches

Gross input power (maximum).....500 HP (373 kW)
 Gross input torque (maximum)1525 Lbf-ft- (2068 Nm)
 Rated input speed (minimum-maximum) 1600-2300 rpm

X3-45 VIP & XLII BUS SHELLS

Gross input power (maximum).....525 HP (392 kW)
 Gross input torque (maximum) 1650 Lbf-ft (2237 Nm)
 Rated input speed (minimum-maximum) 1600-2300 rpm

Mounting:

Engine.....SAE #1 flywheel housing, flex disk drive

Torque converter:

Type One stage, three element, polyphase
 Stall torque ratio TC 551-1.8
 Lockup clutch with torsional damper Integral/standard

Gearing:

Type Patented, constant mesh, helical, planetary

Ratio:

First3.51:1
 Second.....1.91:1
 Third.....1.43:1
 Fourth.....1.00:1
 Fifth0.74:1
 Sixth0.64:1
 Reverse4.80:1

Section 07: TRANSMISSION

Ratio coverage:

6 speed5.48:1

*** Gear ratios do not include torque converter multiplication.**

Oil System:

Oil type..... TRANSYND, DEXRON-III

Capacity (excluding external circuits)Initial fill 47 US qts (45 liters)

Oil change..... 24 US qts (23 liters)

Oil change (with retarder)..... 27.6 US qts (26 liters)

Oil Filters:

Make Allison Transmission

Type Disposable cartridge

Prevost Part Number (2-filter replacement kit)571709

VOLVO I-SHIFT TRANSMISSION

Oil System:

Oil type..... CASTROL SYNTRANS 75W85

Oil change..... 16 US qts (15 liters)

Oil Filter:

Make Volvo

Type Disposable cartridge

Prevost Part Number20779040