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E90 Powertrain

Subject **Page**

Initial Print Date: 03/05 Revision Date: 04/05

E90 Powertrain

Model: E90

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Establish an overview of the advancements made with the N52 engine
- Identify the N52 engine designations
- Establish an overview of the MSV70 Engine Control Module
- Establish an overview of E90 transmissions
- Identify the components of the driveline
- Determine what ratio differential is installed with specific transmission

Engine

The introduction of the new BMW 3 series (E90) to the U.S. market will again set the standard by which all others will be judged, including its predecessors.

The previous M54/M56 engine is being replaced with a new engine variant referred to as the N52, which introduces a number of new technologies with regard to engine development.

The objectives in developing the N52 include:

- Increased power output and torque
- Reduction of fuel consumption
- Reduction of overall engine weight
- Top position in engine class through efficient dynamics
- Utilization of innovations for customer benefit

By implementing some of the latest technology into the N52 engine, BMW met the objectives by improving the power to weight ratio, reduced emissions and decreased fuel consumption.

N52B30 Engine

The simplest way of achieving these objectives was to reduce the weight of the engine. By utilizing new engine development technology the N52 variant is 10 Kg (22 lbs) lighter than its predecessor, as a result of:

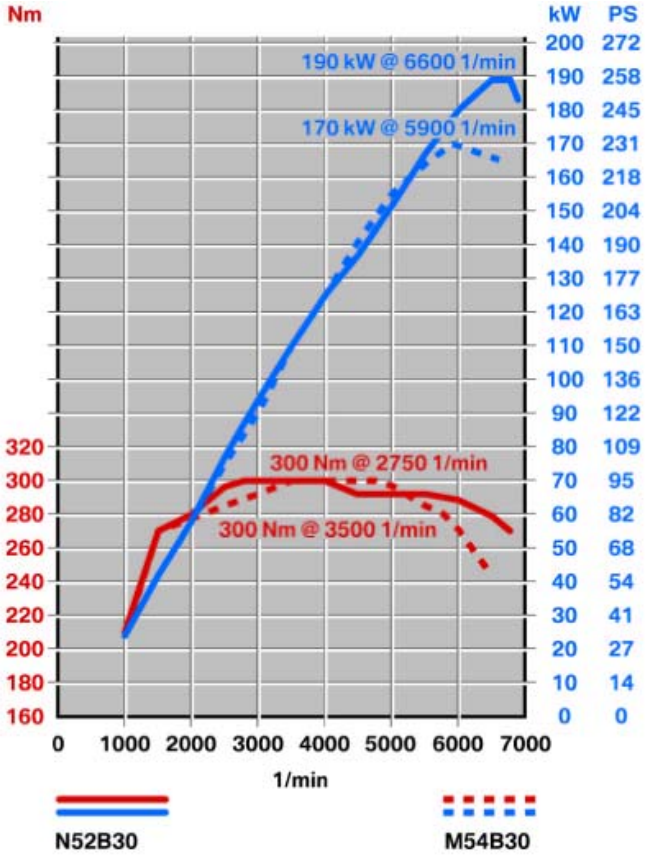
- New composite magnesium-aluminum crankcase
- Lightweight exhaust manifold
- Magnesium bedplate
- Magnesium cylinder head cover.

Improvements have also been made with regard to the Valvetronic system (Valvetronic II) along with a new 3 stage DISA intake manifold, electric coolant pump and a new Engine Management (MSV70).

The introduction of these improvements provides the N52 with a 12% reduction in fuel consumption and a 10% increase in dynamics, compared to the previous engine (M54/M56). The increases in efficiency allow the N52 to comply with ULEV II standards.

For the U.S. Market the N52 engine will be available in the 330i and 325i, both engine variants will be designated N52B30.

Engine Power Output (N52B30 - 3.0 Liter)

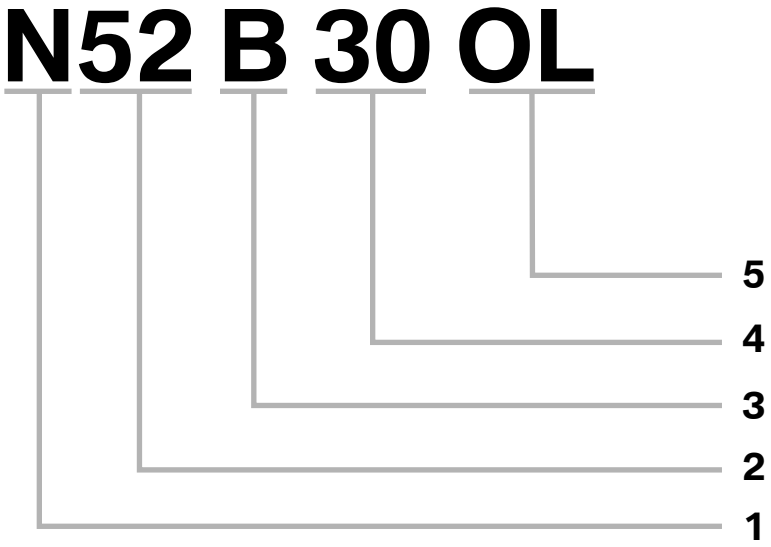


Technical Data (N52B30)

Description	Value
Engine Type	6 cylinder in-line
Displacement (cm^3)	2.996
Stroke/bore (mm)	85.0/88.0
Cylinder spacing (mm)	91
Crankshaft main bearing diameter	6 @ 56mm / 1 @ 65mm
Crankshaft big-end (rod) bearing diameter	50mm
Firing Order	1-5-3-6-2-4
Power output (kW/hp)	190/255
@ engine speed	6,600
Torque	300
@ engine speed	2,500 to 4,000
Maximum rpm (governed cutoff)	7,000
Power to weight ratio	0.84
Power output per liter	63.4
Compression ratio	10.7
Valves per cylinder	4
Intake valve diameter (mm)	34.2
Exhaust valve diameter (mm)	29
Minimum intake valve lift (mm)	0.18
Maximum intake valve lift (mm)	9.9
Exhaust valve lift	9.7
Camshaft opening angle, intake (crankshaft degrees)	255
Camshaft opening angle, exhaust (crankshaft degrees)	263
Camshaft spread, intake (crankshaft degrees)	120-50
Camshaft spread, exhaust (crankshaft degrees)	115-60
Engine weight (kg.)	161
Fuel requirement	91 (98 RON)
Engine oil	SAE 5W-30
Knock control	Yes
Intake manifold	3 Stage Resonance Intake Manifold (DISA)
Engine Management	Siemens MSV70
Valvetrain System	Valvetronic II
Emissions Certification	ULEV 2

Engine Designations and Identification

The N52 engine designation is similar to past engines and is broken down as follows:

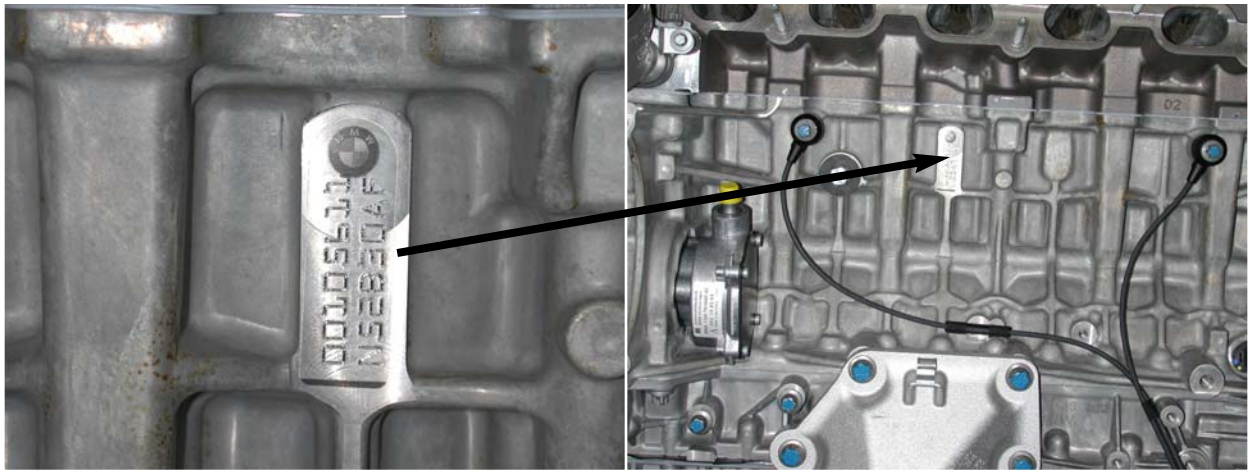


Index	Explanation	Index	Explanation
1	N = New Generation Engine	4	30 = 3.0 Liter Displacement
2	52 = Inline 6 Cylinder Engine	5	OL = Upper Output Stage (High Output) UL = Lower Output Stage (Low Output)
3	B = Gasoline		

The N52B30 engine in the U.S. will be available on the 330i as “OL” and on the 325i as “UL” versions. The “OL” designation refers to the upper output stage engine and the “UL” designation refers to the lower output stage engine.

The engine identification code is located on the side of the engine block, below the intake manifold directly between the knock sensors. The designation:

- “AF” in the engine code refers to the upper output stage or “OL”
- “AE” in the engine code refers to the lower output stage “UL”.



Components

The N52 engine consists of the following components/systems:

- 6-cylinder, 4-valve in-line, friction optimized engine
- Two-piece crankcase in composite magnesium-aluminum structure
- Trapezoidal connecting rods (weight optimized)
- Aluminum silicon (Alusil) cylinder head
- Timing case integrated in crankcase and cylinder head
- Cylinder head gasket with silicon sealing lip
- VALVETRONIC II
- Weight-optimized double VANOS
- Volumetric flow-controlled oil pump
- Electrically controlled coolant pump
- Crankcase ventilation with integrated heater
- 3-stage DISA

Engine Management (MSV70)

There are several new innovations introduced with the new MSV70 engine management system. The most obvious innovation is the addition of Valvetronic II to the six-cylinder engine line. This is the first use of Valvetronic on the BMW six-cylinder.

The MSV70 engine management system is responsible for the following tasks:

- Ignition control
- Injection control
- VALVETRONIC II control
- Control of “Weight Optimized” double VANOS
- Engine temperature control (characteristic map control of engine thermostat)
- Electric coolant pump control (Heat Management System)
- Knock control
- Lambda control
- Fuel tank ventilation control
- Load request to air conditioning control unit for A/C compressor
- Activation of 3-stage differentiated intake manifold (DISA)
- Electric fuel pump module control (EKP)
- Cruise control
- Alternator control
- Heated crankcase ventilation
- Electronic oil condition monitoring and oil level monitoring
- Energy management (IBS)
- Monitoring of input and output signals
- Calculation of substitute signals and failsafe functions
- Self-diagnosis

The engine management system on the N52 engine complies with OBD regulations and meets the ULEV II requirements for 2006.

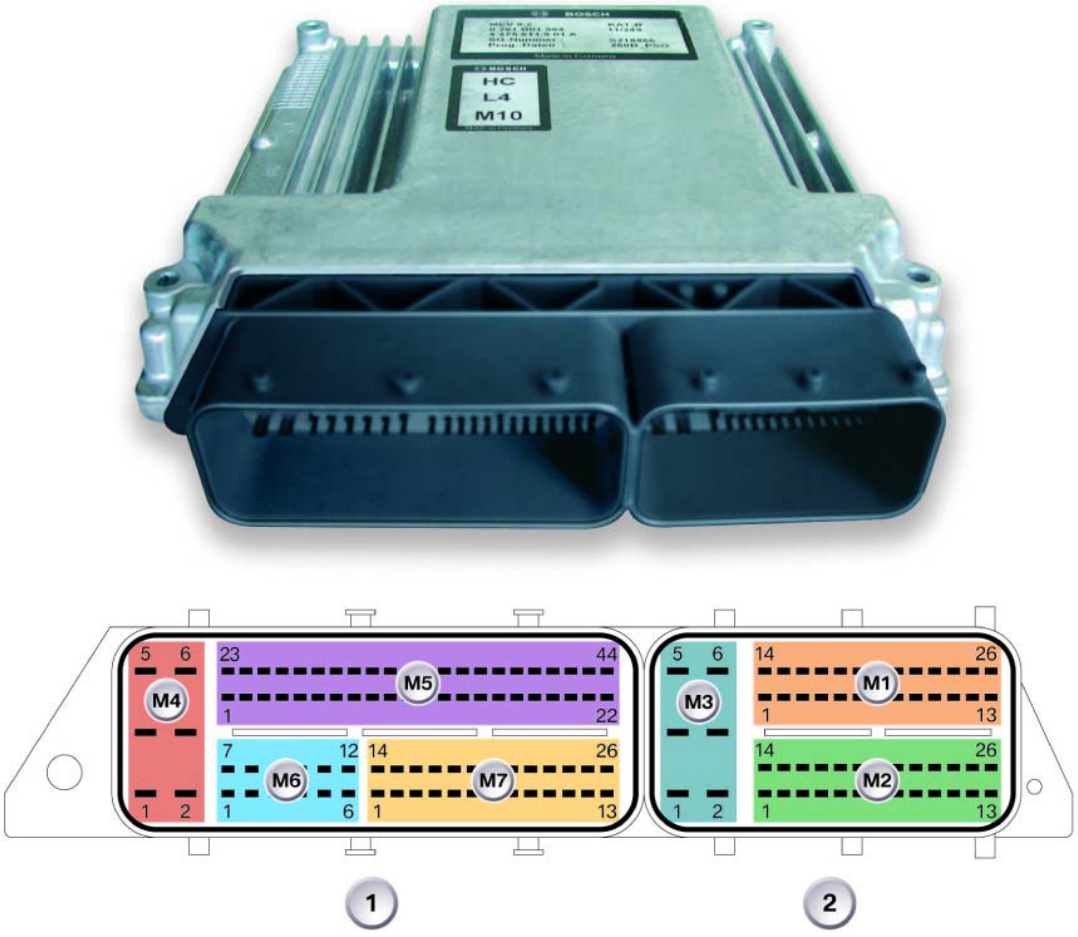
Control Module

The new MSV70 control module is manufactured by Siemens/VDO. The “MSV” designation indicates a Siemens control module (Motor Control with Valvetronic).

The control module features an all aluminum housing with a new modular connector configuration. The control module has two main connections, one with 4 modular connections and the other with 3 for a total of 7 “sub” connectors. This arrangement provides a total of 146 possible pin connections.

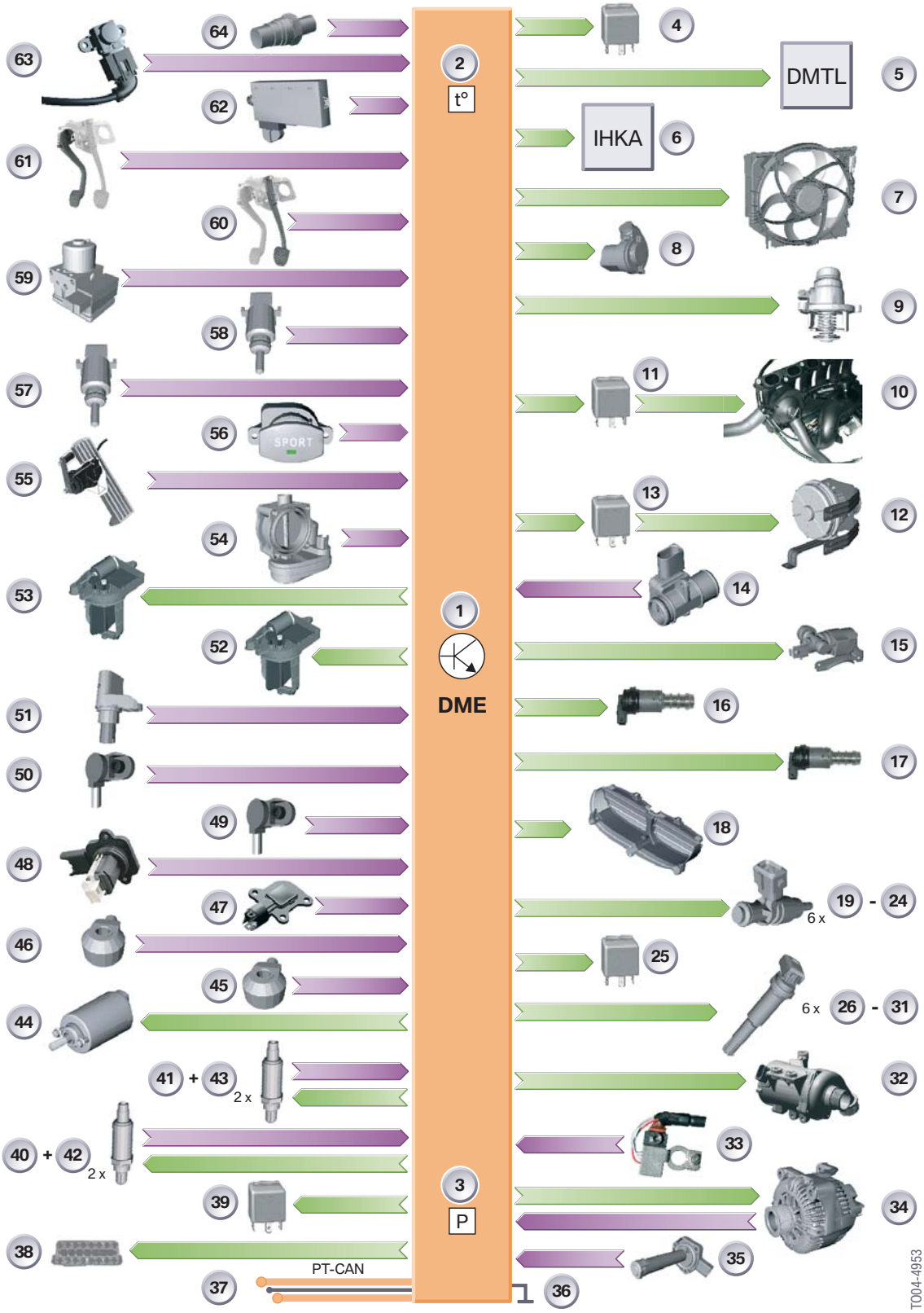
Processor Power

The computing power has been increased to a clock frequency of 60 MHz to accommodate the extended functions.



Index	Explanation	Index	Explanation
1	Connector X60004 to X60007	M4	Connector module 4 (6 pins)
2	Connector X60001 to X60003	M5	Connector module 5 (44 pins)
M1	Connector module 1 (26 pins)	M6	Connector module 6 (12 pins)
M2	Connector module 2 (26 pins)	M7	Connector module 7 (26 Pins)
M3	Connector module 3 (6 pins)		

MSV70 System Overview



Legend for MSV70 System Overview

Index	Explanation	Index	Explanation
1	DME (ECM)	38	Diagnosis connection
2	Integral ambient temperature sensor	39	Valvetronic relay
3	Integral ambient pressure sensor	40	Oxygen Sensor
4	DME (ECM) main relay	41	Oxygen Sensor
5	DM-TL	42	Oxygen Sensor
6	IHKA	43	Oxygen Sensor
7	Electric engine cooling fan	44	Valvetronic motor
8	E-Box fan	45	Knock sensor (cyl 1-3)
9	Characteristic map thermostat	46	Knock sensor (cyl 4-6)
10	Crankcase ventilation heater	47	Eccentric shaft sensor
11	Crankcase ventilation heater relay	48	Hot-film air mass meter (HFM)
12	Secondary air pump	49	Exhaust camshaft sensor
13	Secondary air pump relay	50	Intake camshaft sensor
14	HFM for Secondary air	51	Crankshaft sensor
15	Fuel tank vent valve (TEV)	52	DISA actuator
16	VANOS solenoid valve (Intake cam)	53	DISA Actuator
17	VANOS solenoid valve (Exhaust cam)	54	Electric Throttle Valve (EDK)
18	Electro-magnet for airflap control (not for US)	55	Accelerator Pedal Module (FPM)
19-24	Fuel injectors	56	SPORT button
25	Fuel injector relay	57	Coolant temperature sensor (engine temp)
26-31	Ignition coils	58	Coolant temperature sensor (radiator outlet)
32	Electric coolant pump	59	DSC module
33	Intelligent Battery Sensor (IBS)	60	Brake Light Switch (BLS)
34	Alternator	61	Clutch switch
35	Oil Condition Sensor (OZS)	62	Car Access System (CAS)
36	Ground connection	63	Differential pressure sensor
37	PT-CAN	64	Oil pressure switch

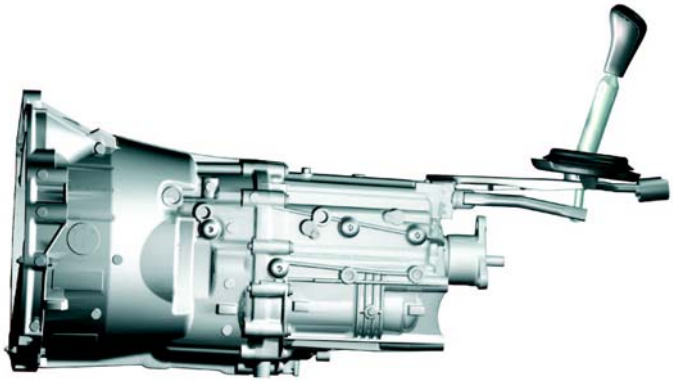
Additional information on the N52 engine & MSV70 is provided in ST501 New Engine Technology

Transmissions

On the E90 a six speed manual transmission (GS6-37BZ) will be standard and a six speed automatic transmission with STEPTRONIC (GA6HP19Z) will be optional.

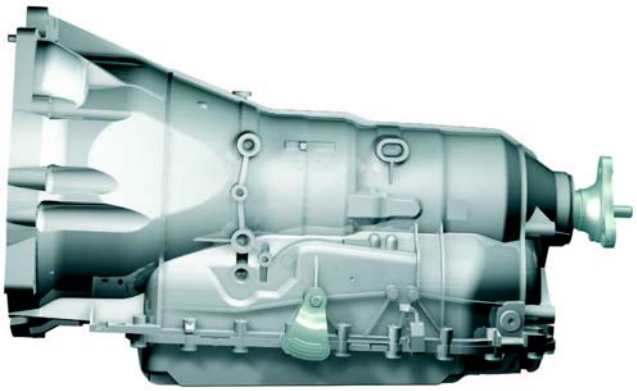
Manual Transmission

The Manual Transmission (GS6-37BZ) available on the E90 is the same as that used previously on the E46 and currently on the E60 & E85. The transmission has a lifetime oil fill.



Automatic Transmission

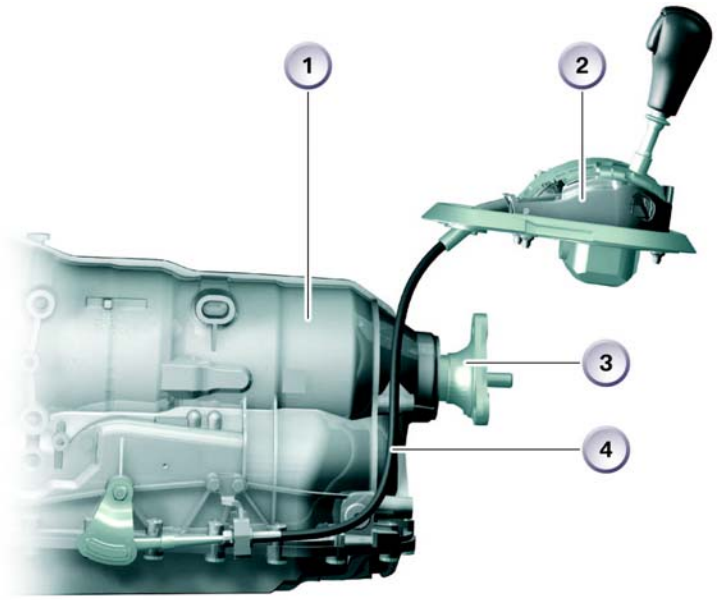
For the first time the 3 series will see a six speed Automatic Transmission (GA6HP19Z) with STEPTRONIC.



The transmission is similar to that used in the E60 with the M54 engine. In order to utilize this transmission on the E90 changes were made to:

- Outer gearshift mechanism with electrical interlock
- New transmission control module
- Adapted hole circle diameter at the output flange

External Gearshift Mechanism



Index	Explanation	Index	Explanation
1	Gearbox Casing	3	Output Flange
2	Selector Lever Unit	4	Cable Assembly

The external gearshift mechanism consists of the selector lever with the following components:

- Cable assembly to gearbox
- Solenoid valve for shiftlock function
- Solenoid valve for interlock function
- Microswitch for detecting locked shift lever
- Emergency release of interlock function
- Switch unit for Steptronic function
- Selector lever position switch indicator

Cable Assembly

The cable assembly is the mechanical connection between the selector lever and the inner gearshift mechanism (mechatronics module). The drive stages are preselected and the parking lock engaged with the aid of the cable assembly.

Shiftlock

The shiftlock function prevents the vehicle from inadvertently being placed in gear with the ignition on, unless the brake pedal is depressed. A solenoid is used to lock the shift lever in position P or N once the ignition is swithed off and the lever has been placed into position P or N. The solenoid is activated by a switched ground signal from the Transmission Control Module

Interlock

The interlock function prevents removal of the remote control “key” when the selector lever is not in position P . The selector lever remains locked in position P if the remote control “key” is not inserted in its slot. For this purpose, the selector lever is locked in position P by two electric magnets once the ignition is switched off.

Index	Explanation
1	Emergency Release Pawl for Interlock

Interlock Without Comfort Access:

The selector lever is locked in position P after ignition OFF and the radio remote control “key” can be removed.

The microswitch on the selector lever unit monitors the lock state of the selector lever and sends the signal to the CAS to release the radio remote control once the selector lever is in position P.

Interlock with Comfort Access:

When the vehicle is stationary, the engine or terminal 15 can only be turned off when the selector lever is in position P.

Emergency Release

In case of an emergency (e.g. failure of the power supply system), the selector lever can be released by operating the emergency release. The emergency release is accessible by removing the selector lever cover. The selector lever is released by pressing on the pawl (1).

Transmission Control Module

The newly developed Transmission Control Module (GS 19.11) is used for the automatic transmission GA6HP19Z (in all models). Compared to its predecessor (GS 19.04) it offers the following advantages:

- Flash memory expanded from 512 Kbit to 1 MB
- Designed to withstand higher temperatures
- Electromagnetic compatibility considerably improved
- Reserve for further functions

The Transmission Control Module is located on the mechatronics module in the gearbox with the same housing and pin assignments from the previous version.

Torque Converter

A torque converter (LUK) with a two-layer torque converter lockup clutch is used.

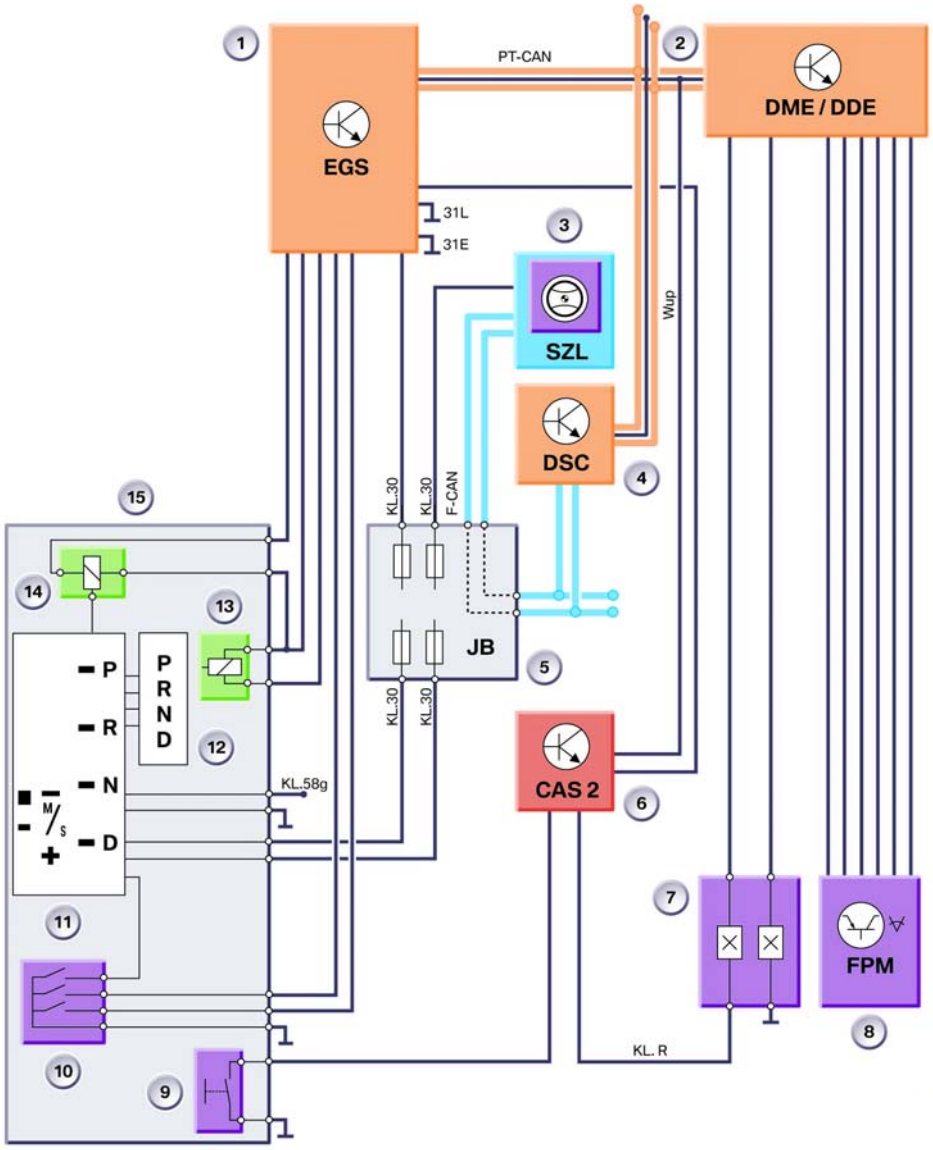
Stationary Disconnection

The gearbox features a stationary disconnection (uncoupling) function for the torque converter. The torque converter is disconnected from the drivetrain instead of running the engine against the torque converter when the vehicle is stationary. By disconnecting the torque converter with the vehicle stationary, the engine is subject to minimum load and fuel consumption is reduced.

Disconnection (uncoupling) of the torque converter is achieved as a function of the following signals:

- Brake operated
- Selector lever position D
- Gear oil temperature > 20°C and < 120°C
- No trailer signal applied

Automatic Transmission Selector Lever - Circuit Diagram

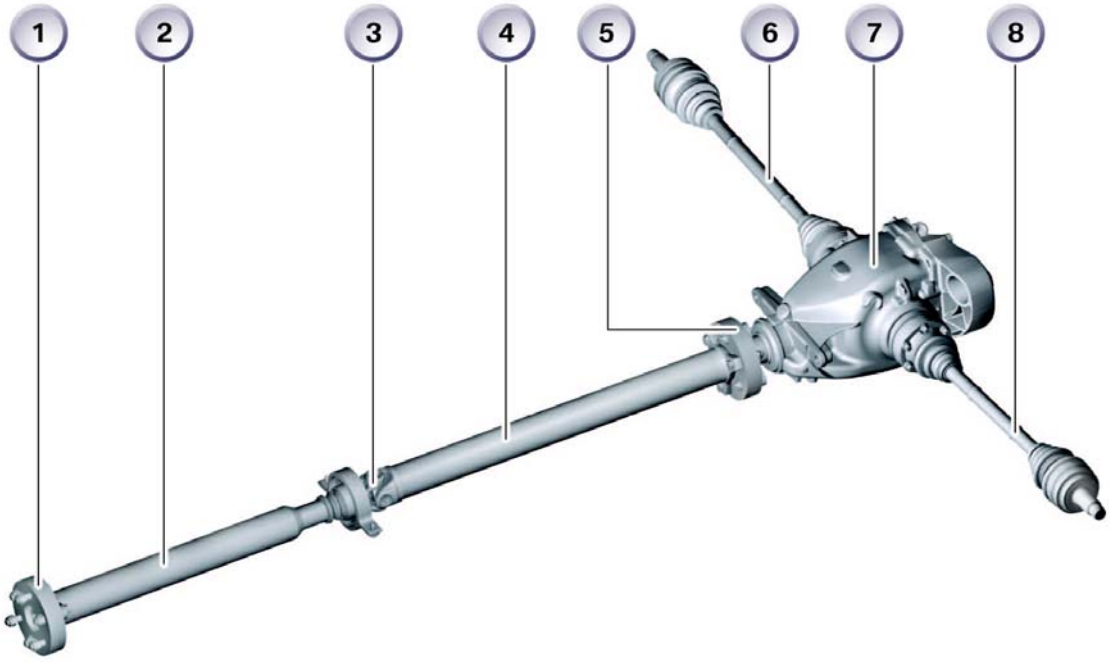


Index	Explanation	Index	Explanation
1	Electronic Transmission Control Module (TCM)	9	Microswitch for Detecting Locked Shift Lever
2	Engine Control Module (DME/ECM)	10	Switch for S-program and Steptronic
3	Steering Column Switch Cluster (SZL)	11	Position indicator on selector lever
4	Dynamic Stability Control (DSC)	12	Sliding Contact for Background Lighting of Position Indicator on Selector Lever
5	Junction Box (JB)	13	Shiftlock Magnet
6	Car Access System (CAS2)	14	Interlock Magnet
7	Brake- Light Switch	15	Selector Lever Unit
8	Accelerator Pedal Module		

Driveline

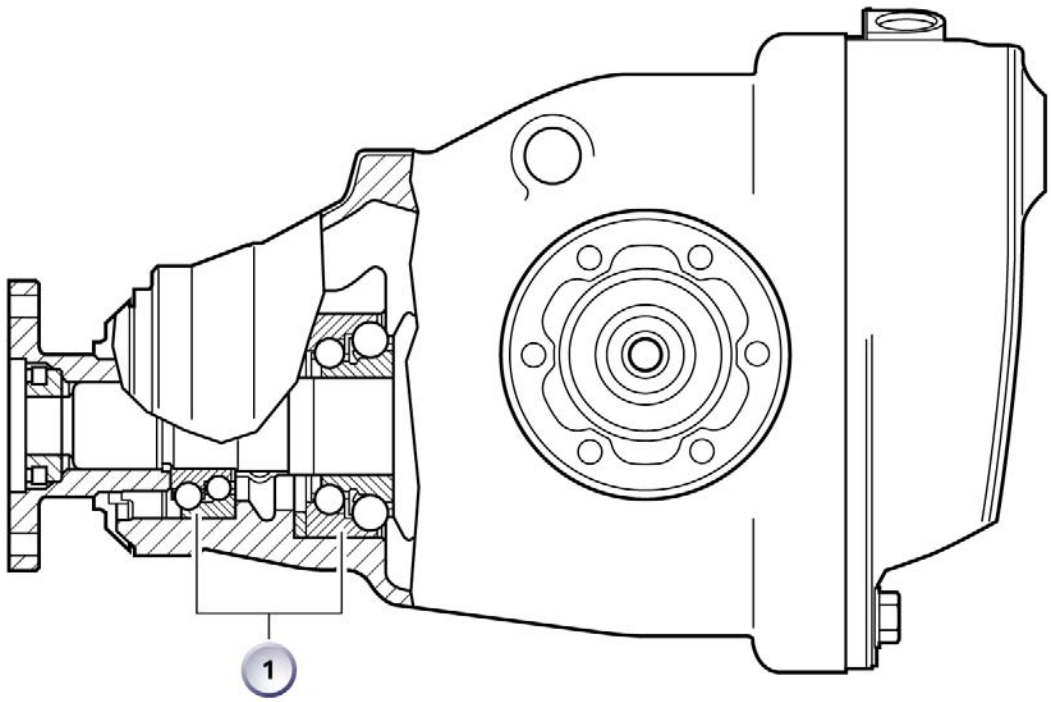
Drive Shaft

The E90 utilizes a two piece steel drive shaft with a deformation element (collapsing tube similar to E60).



Index	Explanation	Index	Explanation
1	Flexible Coupling	5	Flexible Coupling
2	Front Drive Shaft Section	6	Right-Hand Output Shaft
3	Universal Joint	7	Final Drive Unit 188L
4	Rear Drive Shaft Section	8	Left Hand Output Shaft

Final Drive/Differential



1. Angular-contact ball bearing

Series/Model	Engine	Gearbox	Final Drive
E90/325i	N52B30 UL	GS6-37BZ	188 L (i = 3. 23)
E90/325iA	N52B30 UL	GA6HP19Z	188 L (i = 3.73)
E90/330i	N53B30 OL	GS6-37BZ	188 L (i = 3.15)
E90/330iA	N52B30 OL	GA6HP19Z	188 L (i = 3.64)

The differential unit 188 L (L = low friction) is used for the first time on the 3 series.

The 188 L differential uses angular-contact ball bearings (1), compared to the linear contact of tapered roller bearings, the point contact of the angular-contact ball bearings produces less friction. By reducing friction the temperature of the gearbox is reduced which in turn increases efficiency.

The differential utilizes a lifetime fill oil.

Output Shafts

Solid shafts, torsionally-rigid hollow shafts or torsionally-flexible hollow shafts are used depending on the engine-gearbox combination.

The joint size also varies corresponding to the engine-gearbox combination.