



AfterSales Training

General Servicing & Repair – Panamera

P003

Porsche AfterSales Training

Student Name: _____

Training Center Location: _____

Instructor Name: _____

Date: _____

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Description	Section
General Information	0
Engine	1
Fuel, Exhaust and Engine Electrics	2
Transmission	3
Running Gear	4
Body	5
Body Equipment, Exterior	6
Body Equipment, Interior	7
Heating and Air Conditioning	8
Electrical System	9
Conversion Charts	10

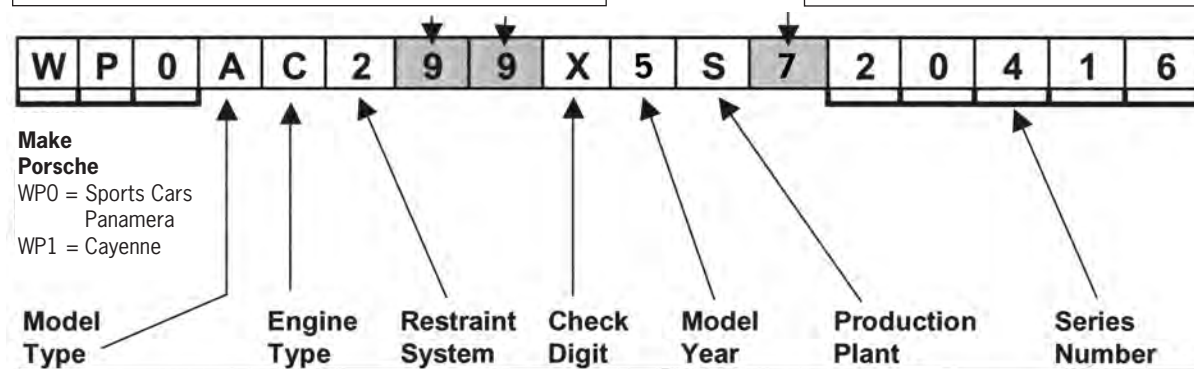
Porsche Vehicle Identification Number (VIN) Structure

Model Years 1981–2009: Used VIN positions 7, 8 & 12 as Porsche model type designation digits.

477 = 924/S	980 = Carrera GT
911 = 911	986 = Boxster
928 = 928	987 = Boxster/Cayman
930 = 911 Turbo	993 = 911 (993)
944 = 944	996 = 911 (996)
951 = 944 Turbo	997 = 911 (997)
964 = 911 (964)	9PA = Cayenne

As of Model Year 2010: VIN position 7 was changed to a "A", leaving positions 8 & 12 as Porsche model type designation digits.

A87 = Boxster/Cayman
A97 = 911 (997)
A70 = Panamera
APA = Cayenne



A 2-Door Coupes 4-Door SUV (Cayenne) 4-Door Sedan (Panamera)	A B C D	0 Active	Per NHTSA Code	L = 1990 M = 1991 N = 1992 P = 1993 R = 1994 S = 1995 T = 1996 V = 1997 W = 1998 X = 1999 Y = 2000 1 = 2001 2 = 2002 3 = 2003 4 = 2004 5 = 2005 6 = 2006 7 = 2007 8 = 2008 9 = 2009 A = 2010 B = 2011 C = 2012 D = 2013 E = 2014 F = 2015 G = 2016 H = 2017 J = 2018 K = 2019 L = 2020	N S U L
B 2-Door Targa		2 Passive			
C 2-Door Convertible Including Boxster	A = Normally Aspirated B = Normally Aspirated S - Models C = Turbo D = Specific 911's and Cayenne GTS				N = Neckarsulm S = Stuttgart - Zuffenhausen U = Uusikaupunki, Finland - 987 Models L = Leipzig
D 2-Door Targa Has been used on earlier Targa models	Note: Letters E, F, etc. have also been used in various years and they are not necessarily model specific.				
E 2-Door Targa & Convert- ibles Has been used on earlier 911 Turbo, Targa and Convertible models	If there is a Z in positions 4, 5 & 6 (on VIN label), vehicle is not for USA.				
F 2-Coupes Has been use on earlier 928 S4 and 911 Turbo Coupes					

General Information

Model Year 1981-on USA Model Designations Used In The 17 Digit VIN

911	911 (Various models 1981-89)
924	924 (Various models 1981-88)
928	(Various models 1981-95)
930	911 Turbo (1981-1989)
931	924 Turbo (1981-82)
944	(Various models 1985-91)
951	944 Turbo (1986-89)
964	911 Carrera (Various models 1989-94)
968	968 (1992-1995)
970	Panamera (2010-on)
980	Carrera GT (2004-06)
986	Boxster (Various models 1997-04)
987	Boxster (1st Generation) (2005-08)
987	Boxster (2nd Generation) (2009-on)
987	Cayman (1st Generation) (2006-08)
987	Cayman (2nd Generation) (2009-on)
993	911 (1995-98)
996	911 (1999-05)
997	911 (1st Generation) (2005-08)
997	911 (2nd Generation) (2009-on)
9PA	Cayenne (E1 - 1st Generation) (2003-06)
9PA	Cayenne (E1 - 2nd Generation) (2008-10)
92A	Cayenne (E2) (2011)

Engine Number Identification

Panamera/S/T

Digit:

1 2 3 4 5 6 7 8

Example:

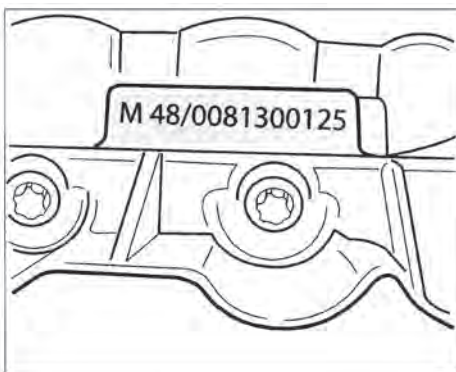
8 1 3 0 0 5 0 1

Engine Type: (8 = 8 Cyl. Engine)

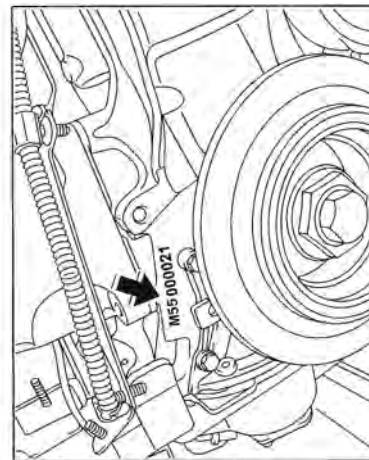
Engine Version:

Model Year:

Serial Number:



V8 – The engine number is located on the bottom of the crankcase, left side (5-8 cylinder bank), by the oil pan sealing surface. **Note:** Underside paneling needs to be removed.

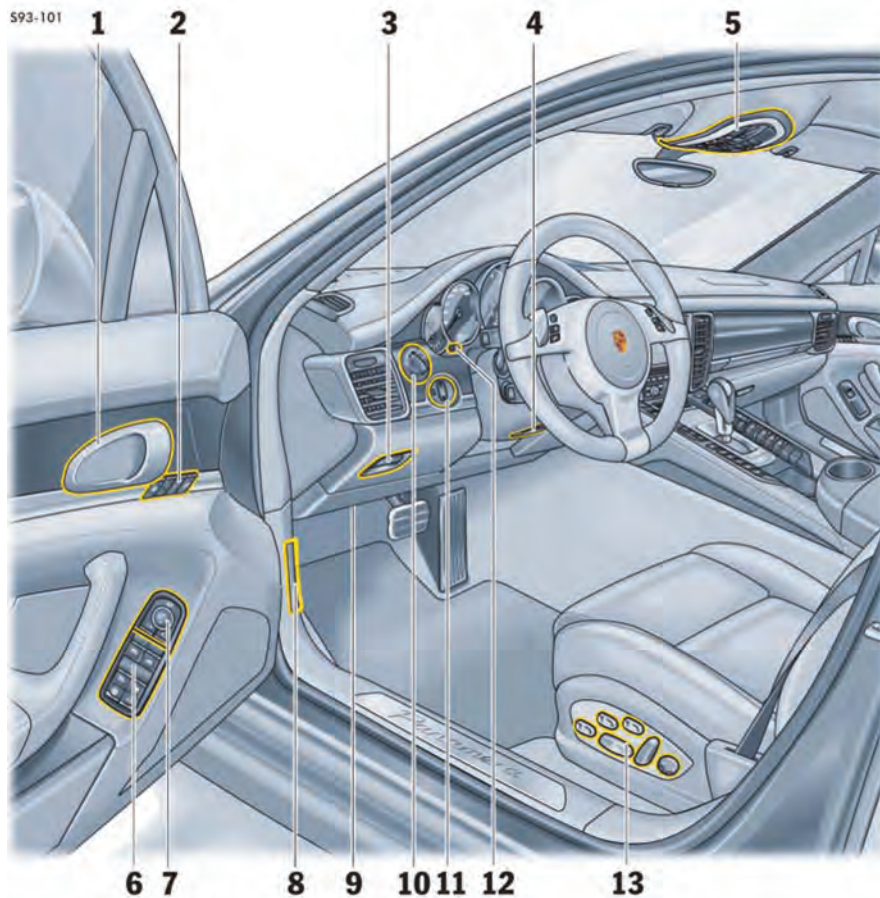


V6 – The engine number is located on the front right of the crankcase next to the crankshaft pulley.

Panamera Engine Type Designations Since Model Year 2010

Model Year	Engine Type	Displ. Liters	Engine Power kW / HP	Installed In
2010	M48.20	4.8 V8	294/400	Panamera S
	M48.40	4.8 V8	294/400	Panamera 4S
	M48.70	4.8 V8	386/500	Panamera Turbo
2011	M46.20	3.6 V6	220/300	Panamera
	M46.40	3.6 V6	220/300	Panamera 4
	M48.20	4.8 V8	294/400	Panamera S
	M48.40	4.8 V8	294/400	Panamera 4S
	M48.70	4.8 V8	386/500	Panamera Turbo

Panamera/S/T – Interior Controls (May Vary Depending on Model and Equipment)



Driver's Cockpit

1. Door opener
See page 32.
2. Vehicle setting memory buttons
See page 40.
3. Electric parking brake
See page 171.
4. Steering wheel adjustment
See page 62.
5. Overhead operating console
See page 15.
6. Power windows
See page 86.
7. Exterior-mirror setting
See page 58.
8. Engine compartment lid release
See page 33.
9. Diagnostic socket (OBD)
10. Light switch
See page 92.
11. Ignition lock, steering lock
See page 164.
12. Dimming of instrument lighting
See page 95.
13. Seat adjustment
See page 39.

Maintenance Checklist

These checklists cover, yearly maintenance & lubrication, minor maintenance, and major maintenance schedules.

PNA 000 162 KA	Panamera/S/Turbo - Intermediate Maintenance (MY 2010)	Online Only
PNA 000 162 KB	Panamera/S/Turbo - Maintenance (MY 2010)	Online Only
PNA 000 162 KD	Panamera/S/Turbo - Intermediate Maintenance (MY 2011)	Online Only
PNA 000 162 KE	Panamera/S/Turbo - Maintenance (MY 2011)	Online Only
PNA 000 162 KC	Panamera/S/Turbo - Oil Change Service Checklist (MY 2011)	Online Only



Note!

Pre-MY 2008 Maintenance Sheets were available in printed form. However, due to short application cycles, MY 2008-on Maintenance Sheets will only be available online for download.



Intermediate Maintenance Checklist – Panamera S/Turbo (970) (2010)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only)

* **Oil Change** Every 10,000 miles (15,000 km) or 1 year. **See Below Check Box.**

☐ **Intermediate Maintenance** (Labor Operation 03 14 00 ..) See Technical Manual
After 20,000, 60,000, 100,000, 140,000 miles (30,000, 90,000, 150,000, 210,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, intermediate maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

- ☐ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ☐ Change engine oil and oil filter (Every 10,000 miles/15,000 km, see separate Oil Change Sheet, PNA 000 162 KC)
- ☐ PDCC: Check fluid level
- ☐ Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze protection level
- ☐ Brake system: Visual inspection of the brake pads and brake discs for wear (without removing wheels)
- ☐ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ☐ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ☐ Tires: Check condition and tire pressure
- ☐ Check firewall body drains and sunroof drains for debris
- ☐ Vehicle lighting: Check function
All headlights: Check setting
- ☐ Horn: Check function
- ☐ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ☐ Check wiper blades
- ☐ Clean reversing camera lense
- ☐ Battery vent hoses: Check condition

Additional maintenance for spark plugs (Labor operation 03 81 00 ..)

- ☐ Replace spark plugs: Panamera S every 40,000 miles (60,000 km) or every 4 years
- ☐ Replace spark plugs: Panamera Turbo every 30,000 miles (45,000 km) or every 4 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years (Labor operation 03 83 00 ..)

- ☐ Replace PDCC reservoir
- ☐ PDK transmission: Change oil

Additional maintenance 80,000 miles (120,000 km) or every 4 years (Labor operation 03 85 00 ..)

- ☐ Air filter: Replace element

Additional maintenance every 120,000 miles (180,000 km) or 12 years (Labor operation 03 88 00 ..)

- ☐ Change manual transmission oil
- ☐ Change all-wheel front differential drive oil
- ☐ Change rear differential oil

Every 2 years (Labor operation 03 51 00 ..)

- ☐ Change brake fluid (use only genuine Porsche brake fluid)

Every 4 years (Labor operation 03 52 00 ..)

- ☐ Replace tire sealant

Inspection Performed - Technician Signature: _____

Road Test Check

- ☐ Remote control, front seats, foot brake and electric parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, PSM switch, heater, air-conditioning system and instruments: Check operation
- ☐ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ Date: ____/____/____

VIN: WPO _____

Mileage (check one) ☐ Miles ☐ Kilometers: _____

Dealer Name: _____ Dealer Code: _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____



Intermediate Maintenance Checklist – Panamera (V6)/S/Turbo (2011)

Required Maintenance and Lubrication Service

* **Oil Change** Every 10,000 miles (15,000 km) or 1 year. **See Below Check Box.**

☐ **Intermediate Maintenance** (Labor Operation 03 14 00 ..) See Technical Manual

After 20,000, 60,000, 100,000, 140,000 miles etc. / 30,000, 90,000, 150,000, 210,000 km etc.

Note: If the mileage for scheduled maintenance is not reached, intermediate maintenance must be performed no later than after 2, 6, 10..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

Electrics

☐ Diagnosis system: Read out fault memory; reset maintenance interval

☐ Windshield wiper/washer system, headlight washer: Check function and nozzle adjustment

☐ Horn: Check operation

☐ Tires: Check tire pressure

☐ Batteries and ventilation hoses: Check condition

☐ Electrical equipment as well as indicator and warning lights: Check operation

Inside of Vehicle

☐ Pollen filter: Replace filter element

Outside of Vehicle

☐ Check wiper blades

☐ Clean reversing camera lense

☐ Vehicle lighting: Check operation

☐ All headlights: Check adjustment

☐ Check firewall body drains and sunroof drains for debris

☐ Radiators and air intakes: Visual inspection for exterior debris and blockage

Under the Vehicle

☐ Drain engine oil and change oil filter (Every 10,000 miles/15,000 km, see separate Oil Change Sheets, PNA 000 162 KC)

☐ Tires: Check condition and tire pressure

☐ Brake system: Visual inspection of the brake pads and brake discs for signs of wear (without removing wheels)

☐ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion Check brake fluid level

☐ Drive shafts: Visual inspection of the sleeves for leaks & signs of damage

Engine Compartment

☐ Fill engine oil (See separate Oil Change Sheets, PNA 000 162 KC)

☐ Coolant and hoses: Check level and antifreeze, check condition of hoses

☐ Windshield wiper/washer system, headlight washer: Check fluid level and antifreeze protection level

☐ PDCC: Check fluid level

☐ Power steering: Check fluid level

Additional maintenance for spark plugs (Labor operation 03 81 00 ..)

☐ Replace spark plugs: Panamera every 40,000 miles (60,000 km) or every 4 years

☐ Replace spark plugs: Panamera S every 40,000 miles (60,000 km) or every 4 years

☐ Replace spark plugs: Panamera Turbo every 30,000 miles (45,000 km) or every 4 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years (Labor operation 03 83 00 ..)

☐ Replace PDCC reservoir

☐ PDK transmission: Change oil

Additional maintenance 80,000 miles (120,000 km) or every 4 years (Labor operation 03 85 00 ..)

☐ Air filter: Replace element

Additional maintenance every 120,000 miles (180,000 km) or 12 years (Labor operation 03 88 00 ..)

☐ Change all-wheel front differential drive oil

☐ Change rear differential oil

Every 2 years (Labor operation 03 51 00 ..)

☐ Change brake fluid (use only genuine Porsche brake fluid)

Every 4 years (Labor operation 03 52 00 ..)

☐ Replace tire sealant

Inspection Performed - Technician Signature: _____

Road Test Check

- ☐ Remote control, front seats, foot brake and electric parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, PSM switches, sports exhaust system, heater, air-conditioning system and instruments: Check operation
- ☐ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ Date: ____/____/____

VIN: WPO _____

Mileage (check one) ☐ Miles ☐ Kilometers: _____

Dealer Name: _____ Dealer Code: _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____



Maintenance Checklist – Panamera S/Turbo (970) (2010)

Required Maintenance and Lubrication Service (USA & Canadian Vehicles Only)

* **Oil Change** Every 10,000 miles (15,000 km) or 1 year. **See Below Check Box.**

☐ **Intermediate Maintenance** (Labor Operation 03 16 00 ..) See Technical Manual

After 40,000, 80,000, 120,000, 160,000 miles (60,000, 120,000, 180,000, 240,000 km) etc.

Note: If the mileage for scheduled maintenance is not reached, intermediate maintenance must be performed no later than after 4, 8, 12..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

- ☐ Diagnosis system: Read fault memory; reset maintenance interval/Read and record range information on R.O.
- ☐ Change engine oil and oil filter (Every 10,000 miles/15,000 km, see separate Oil Change Sheet, PNA 000 162 KC)
- ☐ Vehicle underside and engine compartment: Visual inspection for leaks (oils and fluids) and abrasion (lines and hoses); Underbody panels: visual inspection for completeness, secure installation and damage
- ☐ PDCC: Check fluid level
- ☐ Pollen filter: Replace filter element
- ☐ Steering gear: Visual inspection of the dust boots for damage
Tie rod ends: Check play and dust boots
- ☐ Power steering: Check fluid level
- ☐ Fuel lines and connections: Visual inspection for damage and leaks
- ☐ Radiators and air intakes: Visual inspection for external debris and blockage
Coolant: Check level and antifreeze protection level
- ☐ Brake system: Visual inspection of the brake pads and brake discs for wear
- ☐ Brake hoses and lines: Visual inspection for damage, routing and corrosion
- ☐ Drive shafts: Visual inspection of the dust boots for leaks and damage
- ☐ Axle joints: Check play; visual inspection of the dust boots for damage.
- ☐ Exhaust system: Visual inspection for leaks and damage; check mounting and heat shields
- ☐ Tires: Check condition and tire pressure
- ☐ Check firewall body drains and sunroof drains for debris
- ☐ Seat belts: Check function and condition
- ☐ Vehicle lighting: Check function
All headlights: Check setting
- ☐ Horn: Check function
- ☐ Windshield wiper/washer system, headlight washer: Check fluid level and nozzle settings (use winter antifreeze protection during winter months)
- ☐ Check wiper blades
- ☐ Clean reversing camera lense
- ☐ Battery vent hoses: Check condition
- ☐ Trailer hitch: Check operation

Additional maintenance for spark plugs (Labor operation 03 81 00 ..)

- ☐ Replace spark plugs: Panamera S every 40,000 miles (60,000 km) or every 4 years
- ☐ Replace spark plugs: Panamera Turbo every 30,000 miles (45,000 km) or every 4 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years (Labor operation 03 83 00 ..)

- ☐ Replace PDCC reservoir
- ☐ PDK transmission: Change oil

Additional maintenance 80,000 miles (120,000 km) or every 4 years (Labor operation 03 85 00 ..)

- ☐ Air filter: Replace element

Additional maintenance every 120,000 miles (180,000 km) or 12 years (Labor operation 03 88 00 ..)

- ☐ Change manual transmission oil
- ☐ Change all-wheel front differential drive oil
- ☐ Change rear differential oil

Every 2 years (Labor operation 03 51 00 ..)

- ☐ Change brake fluid (use only genuine Porsche brake fluid)

Every 4 years (Labor operation 03 52 00 ..)

- ☐ Replace tire sealant

Inspection Performed - Technician Signature: _____

Road Test Check

- ☐ Remote control, front seats, foot brake and electric parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, PSM switch, heater, air-conditioning system and instruments: Check operation
- ☐ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ Date: ____/____/____

VIN: WPO _____

Mileage (check one) ☐ Miles ☐ Kilometers: _____

Dealer Name: _____ Dealer Code: _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____



Maintenance Checklist – Panamera (V6)/S/Turbo (2011)

Required Maintenance and Lubrication Service

* **Oil Change** Every 10,000 miles (15,000 km) or 1 year. **See Below Check Box.**

- ☐ **Maintenance** (Labor Operation 03 16 00 ..) See Technical Manual
After 40,000, 80,000, 120,000, 160,000 miles etc. / 60,000, 120,000, 180,000, 240,000 km etc.
Note: If the mileage for scheduled maintenance is not reached, maintenance must be performed no later than after 4, 8, 12..... years.

The terms 'check' and 'inspection' include all necessary subsequent work such as adjusting, readjusting, correcting and topping off, but do not include repairing, replacing and reconditioning parts or assemblies.

Electrics

- ☐ Diagnosis system: Read out fault memory; reset maintenance interval
☐ Windshield wiper/washer system, headlight washer: Check function and nozzle adjustment
☐ Horn: Check operation
☐ Tires: Check tire pressure
☐ Batteries and ventilation hoses: Check condition
☐ Electrical equipment as well as indicator and warning lights: Check operation
☐ Panorama roof: Adapt control module

Inside of Vehicle

- ☐ Seat belts: Check operation and condition
☐ Pollen filter: Replace filter element

Outside of Vehicle

- ☐ Check wiper blades
☐ Clean reversing camera lense
☐ Vehicle lighting: Check operation
☐ All headlights: Check adjustment
☐ Trailer hitch: Check operation
☐ Check firewall body drains and sunroof drains for debris
☐ Radiators and air intakes: Visual inspection for exterior debris and blockage

Under the Vehicle

- ☐ Drain engine oil and change oil filter (Every 10,000 miles/15,000 km, see separate Oil Change Sheets, PNA 000 162 KC)
☐ Tires: Check condition and tire pressure
☐ Underside of vehicle: Visual inspection for leaks (oil and fluids)
Underbody covers: Visual inspection, check that all are securely fastened – replace any damaged or missing panels
☐ Brake system: Visual inspection of the brake pads and brake discs for signs of wear (without removing wheels)
☐ Brake hoses and lines: Visual inspection for damage, correct routing and corrosion Check brake fluid level
☐ Axle shafts: Visual inspection of the dust boots for leaks & signs of damage
☐ Axle joints: Check play; visual inspection of the dust boots for signs of damage
☐ Drive shafts: Visual inspection of the sleeves for leaks & signs of damage
☐ Steering gear: Visual inspection of the dust boots for signs of damage
Tie rod ends: Check play and dust boots
☐ Exhaust system: Visual inspection for leaks and signs of damage; check mounts

Engine Compartment

- ☐ Fill engine oil (See separate Oil Change Sheets, PNA 000 162 KC)
☐ Visual inspection for leaks (oil and fluids)
☐ Fuel system lines and connections: Visual inspection
☐ Coolant and hoses: Check level and antifreeze, check condition of hoses
☐ Windshield wiper/washer system, headlight washer: Check fluid level and antifreeze protection level
☐ PDCC: Check fluid level
☐ Power steering: Check fluid level

Additional maintenance for spark plugs (Labor operation 03 81 00 ..)

- ☐ Replace spark plugs: Panamera every 40,000 miles (60,000 km) or every 4 years
- ☐ Replace spark plugs: Panamera S every 40,000 miles (60,000 km) or every 4 years
- ☐ Replace spark plugs: Panamera Turbo every 30,000 miles (45,000 km) or every 4 years

Additional maintenance 60,000 miles (90,000 km) or every 6 years (Labor operation 03 83 00 ..)

- ☐ Replace PDCC reservoir
- ☐ PDK transmission: Change oil

Additional maintenance 80,000 miles (120,000 km) or every 4 years (Labor operation 03 85 00 ..)

- ☐ Air filter: Replace element

Additional maintenance every 120,000 miles (180,000 km) or 12 years (Labor operation 03 88 00 ..)

- ☐ Change all-wheel front differential drive oil
- ☐ Change rear differential oil

Every 2 years (Labor operation 03 51 00 ..)

- ☐ Change brake fluid (use only genuine Porsche brake fluid)

Every 4 years (Labor operation 03 52 00 ..)

- ☐ Replace tire sealant

Inspection Performed - Technician Signature: _____

Road Test Check

- ☐ Remote control, front seats, foot brake and electric parking brake (also operating travel), engine, clutch, steering, transmission, ParkAssist, automatic speed control, PSM switches, sports exhaust system, heater, air-conditioning system and instruments: Check operation
- ☐ Oils, fluids: Visual inspection for leaks

Road Test Performed - Technician Signature: _____

Customer Name: _____ Date: ____/____/____

VIN: WPO _____

Mileage (check one) ☐ Miles ☐ Kilometers: _____

Dealer Name: _____ Dealer Code: _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____



Oil Change Service Checklist – Panamera (V6)/S/Turbo (970)
USA and Canadian Models Only (2010-on)

☐ **Oil Change Service** (Labor Operation 03 04 00 ..) See Technical Manual
Every 10,000 miles (15,000 km) or 1 year

Note: See appropriate Maintenance Checklists for complete maintenance requirements.

Oil Change Service Performed - Technician Signature: _____

Customer Name: _____ **Date:** ____/____/____

VIN: WPO _____

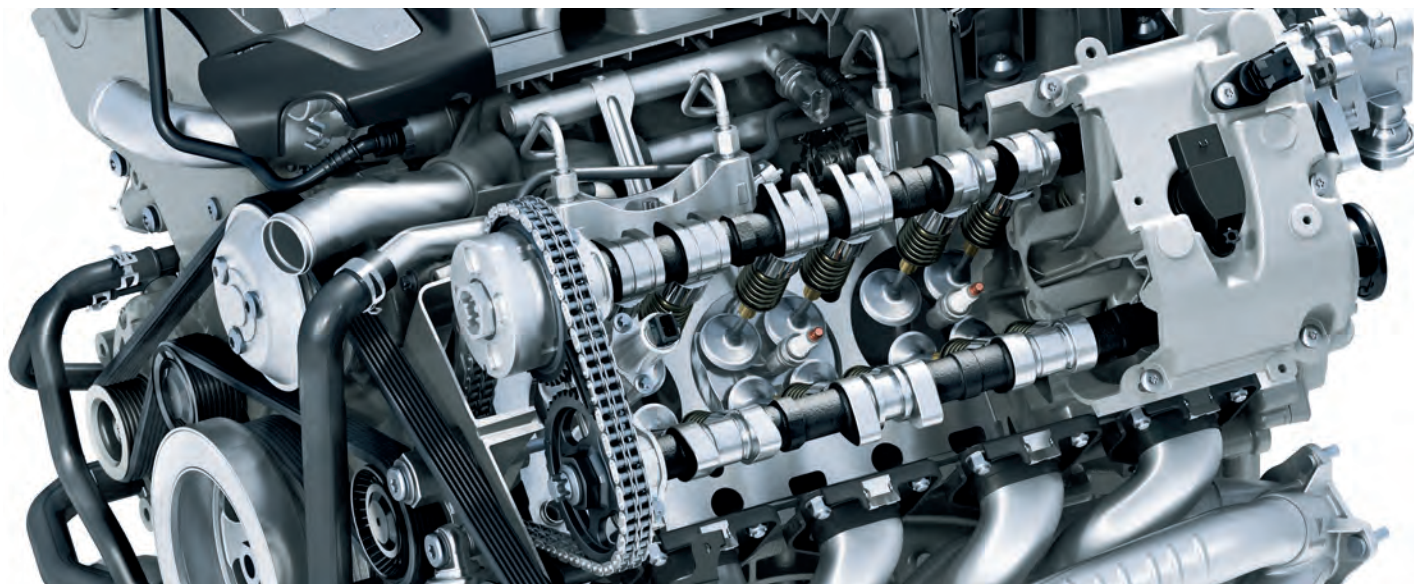
Mileage (check one) ☐ **Miles** ☐ **Kilometers:** _____

Dealer Name: _____ **Dealer Code:** _____

Repair Order #: _____

Technician Name: _____

Technician Signature: _____



Subject	Page
Panamera V8 Models	
General Information – Engine Types M48.20/M48.40	2
General Information – Engine Type M48.70	3
Engine Data	3
Power/Torque Graphs	4
Torque Support	5
Crankcase/Crankshaft	6
Connecting Rods/Pistons	7
Cylinder Head	7
VarioCam Plus	8
Positive Crankcase Ventilation	8
Oil Level Check and Display	10
Oil Level Sensor	11
Oil Guide Housing	12
Variable Oil Pump	12
Oil Collection Tank	14
Panamera V6 Models	
General Information – Engine Types M46.20/M46.40	15
Engine Data	16
Crankcase	17
Balance Shaft	17
Variable Oil Pump	17
Oil Circuit	18

Engine – Panamera S/Turbo (V8)

General Information

An enhanced generation of V8 engines is used for the new Panamera models: A 4.8-liter V8 naturally aspirated engine for the Panamera S and a 4.8-liter V8 twin turbo engine for the Panamera Turbo. The enhanced and optimized engines used in the Panamera are based on the Cayenne engines. This made it possible to achieve the ambitious targets for fuel consumption and CO₂ emissions despite the enhanced performance.

Development Objectives

Reduction in weight using lightweight design measures, such as:

- Timing case and valve covers made of magnesium (5.5 lbs./2.5 kg lighter)
- Fully aluminum, lightweight camshaft controllers (3.7 lbs./1.7 kg lighter)
- Aluminum bolts for magnesium parts and for connecting engine and transmission (2.2 lbs./1.0 kg lighter)
- Lighter crankshaft and connecting rods designed specifically for naturally aspirated engines (5 lbs./2.3 kg lighter)
- Magnesium oil guide housing specifically for the Panamera S

Lower fuel consumption and lower emissions by installing various systems, such as:

- Start/stop systems
- Heat management using a map-controlled thermostat (with integrated flow suppression)
- Direct fuel injection (DFI)
- VarioCam Plus
- Demand-controlled oil pump

High performance due to:

- Larger throttle valve, 82 mm (Panamera S)
- Pressure sensor for measuring mass air flow
- Sport button as standard
- Intake system with variable intake manifold

Compact design with:

- Front-axle differential flanged to the engine
- Engine installed at a lower position
- Very flat oil guide housing made of magnesium (Panamera S) or aluminum (Panamera Turbo, 4S)
- Manifold and turbocharger produced as a single unit without an intermediate flange (Turbo only)
- Integrated dry-sump lubrication

V8 Naturally Aspirated Engine



Engine type M48.20 for 2WD

Engine type M48.40 for 4WD

The 4.8-liter V8 naturally aspirated engine in the Panamera S and 4S has the following main features:

- Newly designed, lighter crankshaft and lighter connecting rods
- Oil guide housing made of magnesium (Panamera S) or aluminum (Panamera 4S)
- Intake camshafts optimized for power output and torque curves
- Intake system with variable intake manifold
- Larger throttle valve for greater power

V8 Turbo Engine



Engine type M48.70

The 4.8-liter V8 twin turbo engine in the Panamera is noted for its high power output and torque with low fuel consumption and has the following main features:

- Adapted intake system
- Positive crankcase ventilation
- Charge-air cooling
- Manifold and turbocharger produced as a single unit without an intermediate flange
- Weight-optimized crankshaft
- Optimized oil guide with aluminum oil guide housing

Notes:

Engine Data

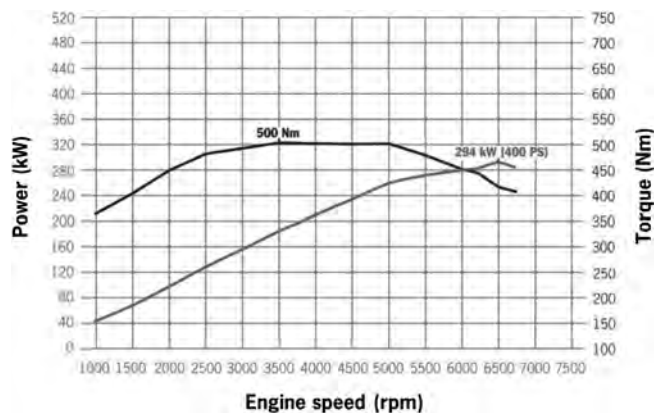
	Panamera S	Panamera 4S	Panamera T
Engine type	M48/20	M48/40	M48/70
Cylinders	8	8	8
Bore	96 mm	96 mm	96 mm
Stroke	83 mm	83 mm	83 mm
Displacement	4806 cm3	4806 cm3	4806 cm3
Compression ratio	12.5	12.5	10.5
Max. power	400 hp/294 kW	400 hp/294 kW	500 hp/368 kW
at engine speed	6500 rpm	6500 rpm	6000 rpm
Max. torque	500 Nm	500 Nm	700 Nm
at engine speed	3500-5000 rpm	3500-5000 rpm	2250-4500 rpm
Governed speed	6700 rpm	6700 rpm	6700 rpm
Engine weight w/PDK	468 lbs	474 lbs.	520 lbs.
Firing order	1-3-7-2-6-5-4-8	1-3-7-2-6-5-4-8	1-3-7-2-6-5-4-8

Sport Chrono Turbo Package (Optional)

The torque is increased to 770 Nm in conjunction with the Sport Chrono Turbo Package. The Overboost function is activated when the Sport or Sport Plus button is active and when fast pedal movements are detected and/or when kickdown is activated. When this occurs, the boost pressure is increased by up to 10% for max. 10 seconds between 3000 and 4000 rpm, i.e. 770 Nm instead of 700 Nm.

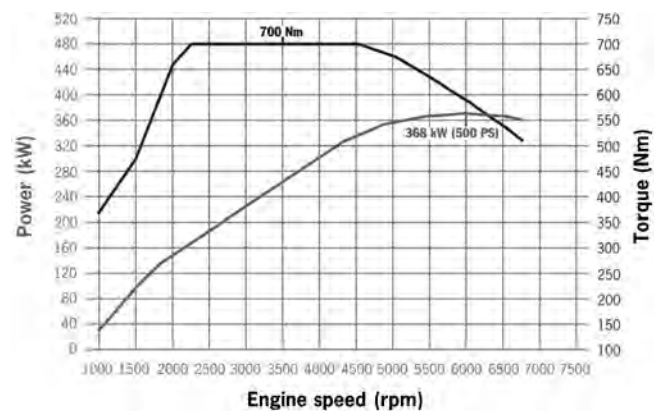
Engine – Panamera S/Turbo (V8)

Engine Power/Torque Graph – Panamera S/4S



Similar to the Cayenne engines, it has also been possible here to achieve a very flat torque curve for the Panamera engines. To highlight the flat curve, the graph shows that the engine provides a torque of approx. 215 Nm at only 1000 rpm. A maximum torque of 500 Nm is achieved at 3500 rpm.

Engine Power/Torque Graph – Panamera Turbo



The maximum torque is the same as for the naturally aspirated engine at 1000 rpm because the turbocharger has not yet kicked in. Shortly afterwards, the torque increases considerably due to turbocharging. The maximum possible torque is 700 Nm at 2250 rpm and stays at this high level up to 4500 rpm. A torque of more than 500 Nm is achieved even at a governed speed of 6700 rpm.

Engine Compartment – Panamera S/4S



When you look into the engine compartment, you see the engine compartment design. On the left side (yellow arrows), you can see the secondary air pump (Not for USA) and the torque support. On the right side (red arrows), you see the power-steering reservoir and the oil separator for positive crankcase ventilation.

Engine Compartment – Panamera Turbo



Here is the same view of the Panamera Turbo. The yellow arrows on the left here also point to the secondary air pump (Not for USA) and the torque support. The reservoir and the oil separator can be seen on the right (red arrows).

Torque Support



A plastic version of the torque support used in the Cayenne V8 models is used in the Panamera to reduce weight and it is secured with aluminum bolts. The torque support reduces engine movements, which occur on engines with high torque.

Engine Position



The engine was positioned especially low in the Porsche Panamera in order to give the vehicle a particularly low center of gravity. This ensures excellent driving dynamics and outstanding roadholding. To also achieve this low installation position on models that feature Porsche Traction Management (PTM), the front-axle differential has been bolted directly to the engine. Instead of installing the engine at a higher level and positioning the drive shaft beneath the engine, the front drive shaft runs in a channel directly through the crankcase.

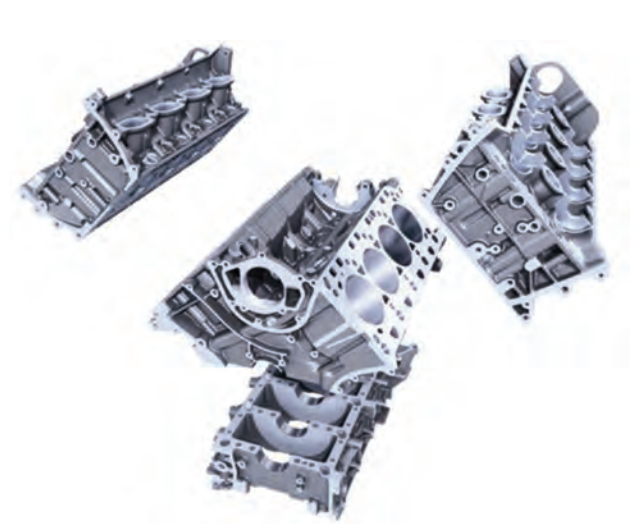
Notes:

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Engine – Panamera S/Turbo (V8)

Crankcase

The proven closed-deck design of the aluminum-alloy crankcase is used. In this design, the housing and coolant ducts around the cylinders form a closed system. This creates a very rigid engine assembly, minimises cylinder delays, and results in low oil consumption as well as a reduction in the amount of combustion gases that make it past the piston rings into the crankcase (blow-by gases). The lightweight, rigid engines therefore ensure lower fuel consumption and a long service life.



The alloy used for the crankcase is the familiar and proven hypereutectic light metal alloy AlSi17Cu4Mg , in which silicon crystals form. In order to create a wear-resistant surface on the cylinder lining, these silicon crystals are exposed through multiple special honing processes. A fully aluminum bedplate is used in order to reduce weight. The forged crankshaft has five bearings and a very rigid design to reduce vibrations in the engine block.

The cylinder head and camshaft housing have been integrated into a one-piece aluminum cylinder head on the V8 engines. At the same time, the arrangement of the intake port and injector has been optimally designed for direct fuel injection. The water jacket ensures that the cooling system has sufficient reserves even in the cylinder head, which is subject to substantial thermal loads. The one-piece design also reduces the weight slightly.

Crankshaft



A lighter crankshaft is used in the Panamera S as a light-weight design measure aimed at reducing weight. This is adapted to suit load demands specific to naturally aspirated engines. The diameter of the connecting rods is reduced compared with the previous V8 crank drive used in the Cayenne and the crankshaft has a larger counter-weight radius. As a result, the crank drive is 5 lbs. (2.3 kg) lighter than the previous V8 crank drive. The crankshaft in the Panamera Turbo is also weight-optimized. The crankshaft has a larger counter-weight radius than the previous V8 crank drive.

Crankshaft Bearings

In order to reduce the weight of the naturally aspirated engine in the Panamera S, the diameter of the connecting-rod bearing pins was reduced from 54 mm to 52 mm. Since the connecting rods in the naturally aspirated engine were also weight-optimized, it was also possible to reduce the weight of the balancing weights on the crankshaft. A larger counter-weight radius means that the further out the weight is attached, the lighter this can be.

Connecting Rods



Lighter connecting rods are used in the Panamera S as a lightweight design measure aimed at reducing weight. These are adapted to suit load demands specific to naturally aspirated engines. Connecting-rod diameters are reduced compared with the previous V8 crank drive used in the Cayenne.

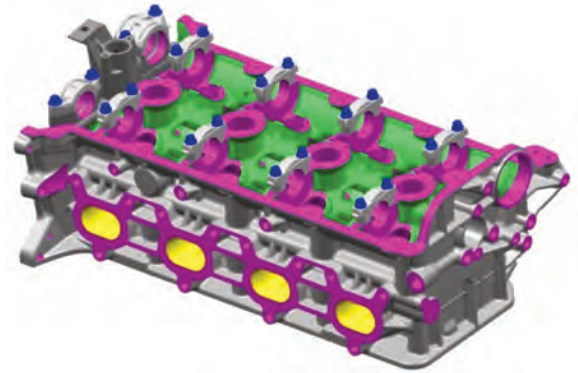
Since the crank pin for the crankshaft on naturally aspirated engines was reduced from 54 mm to 52 mm, the connecting rod and connecting-rod diameter was also adapted. The overall weight of the connecting rod was reduced. Similar to the Cayenne V8, 3-component connecting-rod bearings are used on the Panamera Turbo, while 2-component bearings are used on the Panamera naturally aspirated engine.

Pistons



The pistons used in the Panamera naturally aspirated engine (1) and turbo engine (2) have been adopted from the Cayenne models.

Cylinder Head



The cylinder head and camshaft housing have been integrated into a one-piece aluminum cylinder head on the V8 engines. At the same time, the arrangement of the intake port and injector has been optimally designed for direct fuel injection. The water jacket ensures that the cooling system has sufficient reserves even in the cylinder head, which is subject to substantial thermal loads. The one-piece design has also reduced the weight slightly.

The exhaust valves on the naturally aspirated engine are bi-metallic and single valve springs are installed for each valve. The exhaust valves on the turbo engine are also bi-metallic and are filled with sodium. Double valve springs are also installed on the outlet side.

Notes:

Engine – Panamera S/Turbo (V8)

VarioCam Plus



VarioCam Plus, the system used to control the intake camshafts, is also used in the Panamera engines. Apart from the continuous adjustment of the valve timing, the system also enables adjustment of the valve lift for the intake valves. When combined with direct fuel injection, this allows high power output and torque values, while reducing fuel consumption. A new feature of the new generation of V8 engines is a fully aluminum, lightweight camshaft controller. This lightweight design measure reduces the weight by approx. 3.75 lbs (1.7 kg) and also reduces rotating masses, thereby achieving a more agile response from the engine.

Intake valve lift on naturally aspirated engine: 10.00 mm
Intake valve lift on turbo engine: 9.85 mm

Positive Crankcase Ventilation



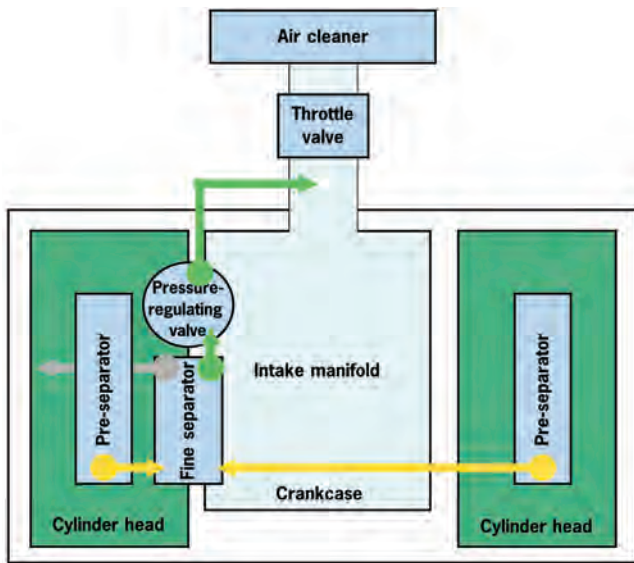
General Information

During combustion, every engine blows some of the combustion gases past the piston towards the crankcase - these gases are called blow-by gases. If these gases were not drawn off, the pressure in the crankcase would increase considerably. A vent connection is installed in the crankcase for this reason. For environmental protection reasons, these gases are not released into the atmosphere but are sent back to the engine for combustion via the intake system.

Of course, these positive crankcase ventilation gases contain a high proportion of engine oil and other combustion residues as well as a lot of fuel residues in some cases. If these gases get into the intake duct, they will contaminate the intake air and can then impair running smoothness, exhaust emissions and reduce knock resistance. It is obvious for these reasons why effective oil separation is important for the engine.

Notes:

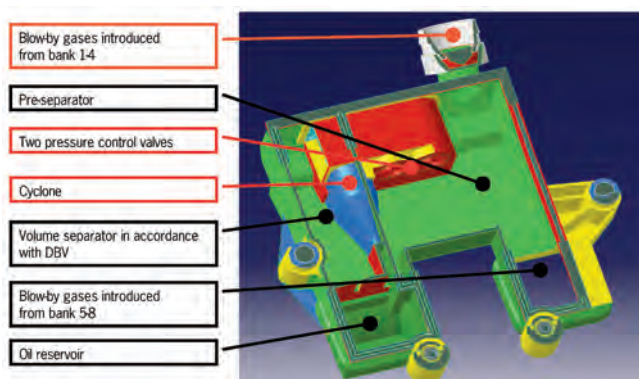
Positive Crankcase Ventilation System – Naturally Aspirated Engine



The two pre-separators, which are integrated in the cylinder head cover, are used to draw off most of the transported oil into the crankcase. The remaining blow-by gases are fed to the fine separator via hoses.

The hoses have a larger diameter compared with the hoses used in the Cayenne and as a result, air speed is reduced and less oil is transported in the gases.

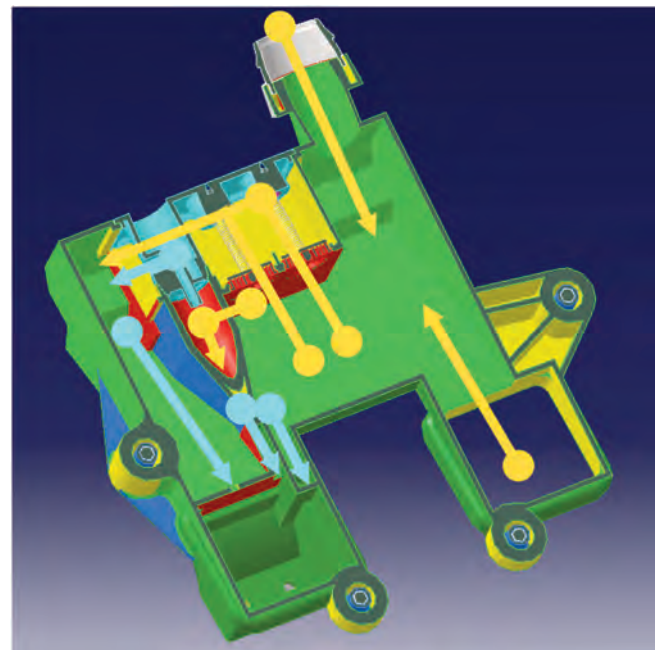
PCV Oil Separator



The various parts of the oil separator are pointed out in the above illustration.

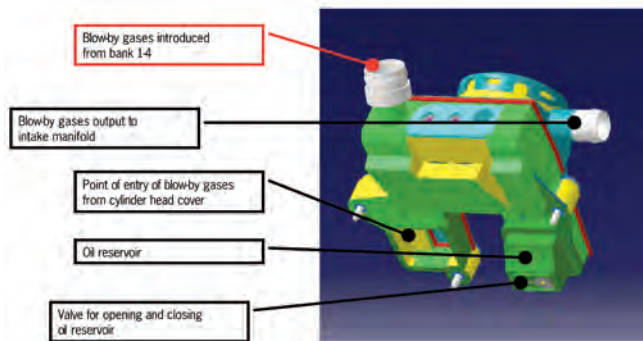


If there is only a small amount of blow-by gases, these go into the cyclone, where air is separated from oil. The oil goes into the reservoir, while the air is channelled out of the tank and fed back to the engine by the intake system.



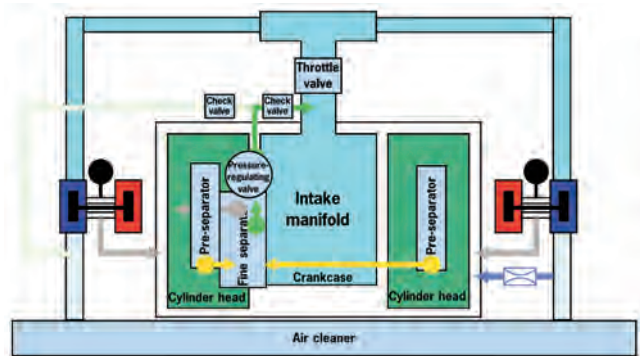
For example, if the blow-by gases increase as a result of higher engine speeds, the two pressure control valves open and an additional bypass is activated in order to separate the oil. The air is again fed to the engine and the oil goes into the reservoir. The oil reservoir is always drained whenever there is a vacuum in the system, but never at full throttle.

Engine – Panamera S/Turbo (V8)



The valve, which opens or closes the reservoir depending on whether or not there is a vacuum in the system, is installed beneath the oil reservoir. The size of the reservoir is designed so that even if the vehicle is only driven at full throttle (whereby the reservoir is never drained), a correspondingly large amount can be taken in until the vehicle needs to be refuelled.

Positive Crankcase Ventilation System – Turbo Engine



The diagram shows that the positive crankcase ventilation system in the turbo engine essentially works in the same way as in the naturally aspirated engine. However, there is not always a vacuum in the intake system of the turbo engine, but overpressure in the charger area. Additional check valves are therefore installed here. As a result, separation can be performed in the intake area, just like on a naturally aspirated engine, and between the air cleaner and turbocharger in the charger area.

Additionally, the aeration and ventilation system PCV is also used in the Panamera Turbo. This system ventilates the crankcase with a steady stream of fresh air, which evaporates fuel that is carried in. For this purpose, fresh air is removed between the charge air cooler and throttle valve and is delivered to the crank chamber via a line. The pressure that exists at any time between the removal point and the crankcase causes a steady flow of fresh air through the crankcase.

Oil Level Check and Display

The oil level can be measured when the ignition is on, or when the vehicle is stationary with the engine running, or even while driving. If the hood was opened, the oil level can only be measured after driving the vehicle for at least 6 miles (10 km).



Oil level OK.



Minimum oil level



Oil level below MIN marking



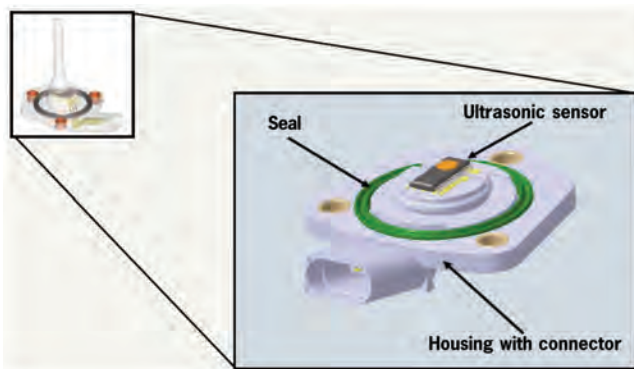
Oil level too high

The difference between the MIN and MAX markings is approx. 1 liter. One segment on the display corresponds to a top-up quantity of 0.25 liters. If the oil-level indicator fails, the message "Failure Oil level measurement" appears on the multi-function display.

Oil Level Sensor

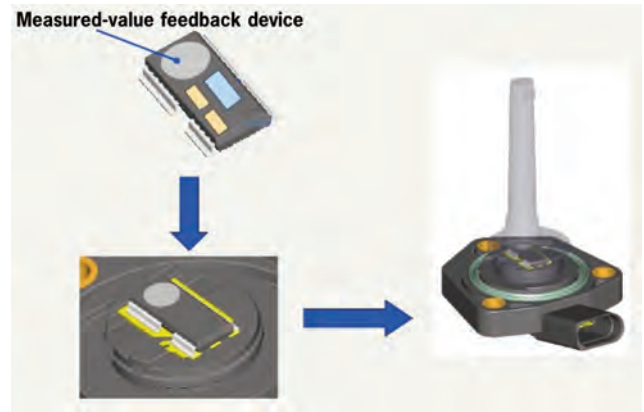
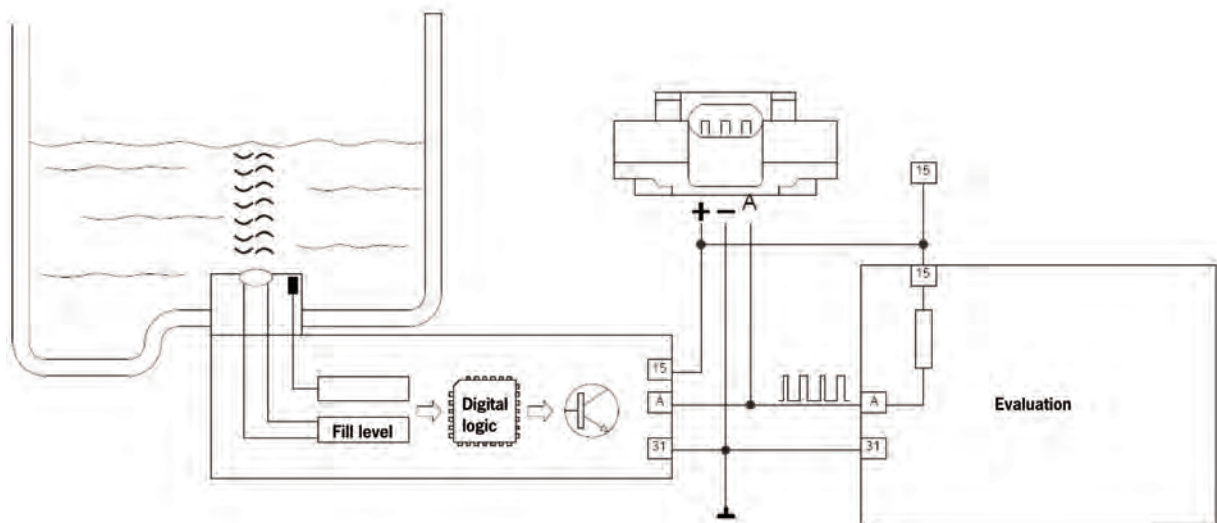


The oil level sensor is a PULS (**P**ackaged **U**ltrasonic **L**evel **S**ensor) sensor. The advantage of this sensor is that it can detect both a minimum and maximum oil level as well as overfills. It works according to the principle of ultrasonic measurement.



The ultrasonic sensor is a continually operating sensor system for recording the engine oil level. The determined fill-level data is supplied via a pulse-width modulated signal. The displayed oil level is calculated from a long-term mean value. The mean value is calculated on 100 km and 3600 measured values. When the mean value has been calculated, the last mean value is stored and mean value calculation starts all over again.

Oil Level Sensor System Diagram



Only measured values that were formed within certain temperature, engine speed, vehicle speed and lateral acceleration thresholds (enabling signal from DME) are used for calculating mean values. The last mean value is always displayed in the Oil menu. An oil level is always displayed. Exception: No oil level is displayed for approx. 6 miles (10 km) after the hood has been opened, but the message "Display after short drive only" is displayed.

Mean value calculation is restarted after the hood has been opened. The oil level can be displayed if at least 360 measured values are used to calculate the mean value over a distance of at least 6 miles (10 km).

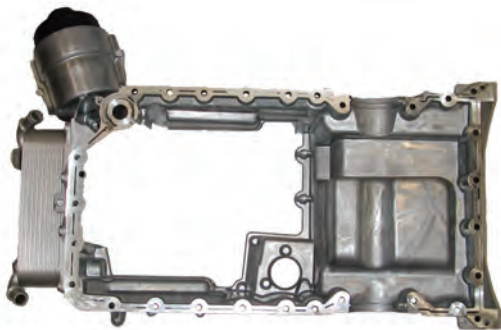
The warning message for max/min oil level is formed based on the long-term mean value. There are two minimum thresholds: Minimum oil level reached (yellow warning, appears only when terminal 15 is off), Oil level below minimum (yellow warning, also appears while driving). No oil level warnings are displayed after the hood has been opened and until such a time as the long-term mean value has been calculated again.

Engine – Panamera S/Turbo (V8)

Oil Guide Housing

To guarantee a reliable oil supply in all driving situations, the V8 engines in the Panamera S and 4S as well as the Panamera Turbo have an integrated dry-sump lubrication system. The oil pan is designed in two parts and has an upper and lower part. The oil reservoir is in the engine rather than in an external oil tank. This saves space and reduces the weight.

A very flat oil guide housing (upper part of the oil pan) made of magnesium (Panamera S) or aluminum (Panamera 4S, Turbo) was also installed. The oil guide housing for the rear-wheel-drive model allows a further reduction in weight of approx. 4.4 lbs (2 kg).

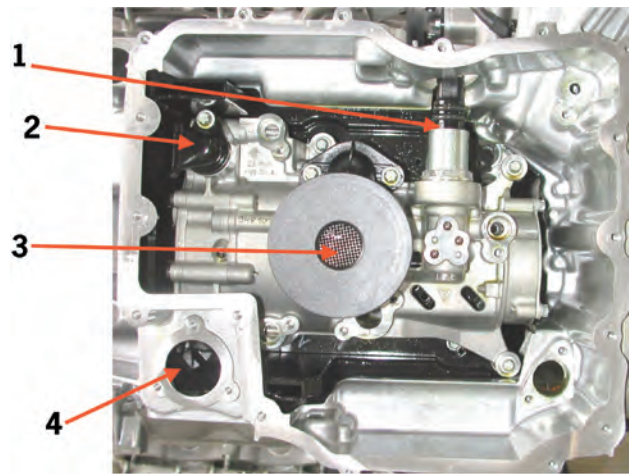


Note!

Since the continuous shaft used in the all-wheel version would weaken the housing, this is made of aluminum. As a result, the oil guide housing on the rear-wheel-drive model can be made of magnesium. Both types are bolted with aluminum bolts.

Variable Oil Pump

To ensure high efficiency is to use an oil pump that is variably controlled as required. The pump is designed as an external gear pump with an integrated turbocharger extraction stage for the V8 bi-turbo engine. The required control is provided by the engine management system, while adjustment is hydraulic. The engine management system uses the input values for engine speed, oil temperature and torque. Based on this information, the engaged gear wheel width and therefore the geometric displacement volume of the gear wheel set is changed through the axial movement of a gear wheel and this in turn changes the oil pressure.



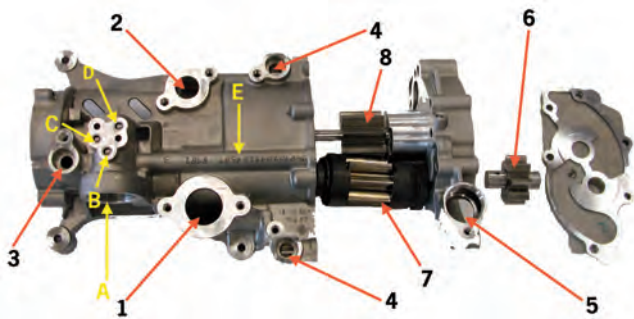
- 1 - Control valve
- 2 - Additional oil extraction in the rear area
- 3 - Oil intake snorkel
- 4 - Opening for oil level sensor

Notes:

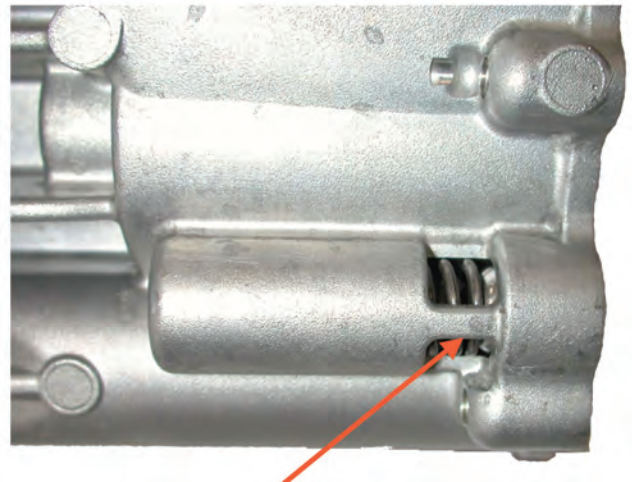
The pump ensures that only the pumping work required for the relevant load range of the engine is demanded. This reduces the energy consumption of the oil pump to a minimum and also ensures demand-controlled lubrication.

Additionally, the demand-controlled oil pump for the Panamera now has a new, very flat design. By using the flat oil pan and lowering the position of the engine in the vehicle, it was possible to move the center of gravity of the vehicle down further, thereby achieving impressive roadholding and driving performance.

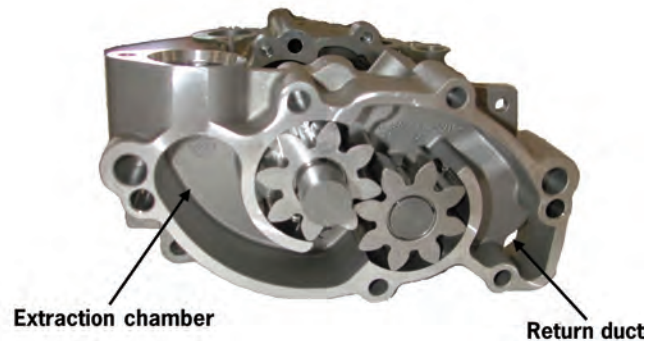
The variable oil pump works in the same way as the pump used in the Cayenne. The main difference is that the Cayenne oil pump has a 3/2-way control valve, while the oil pump in the Panamera has a 4/3-way control valve. The reason for this is that a hydraulic support is now also used on the side on which the spring force acts. This results in faster control.



- 1 - Intake duct
- 2 - Pressure duct to oil/water heat exchanger
- 3 - Pressure duct from the system for supplying the control valve and lubricating the pump shaft
- 4 - Extraction ducts for turbocharger
- 5 - Extraction duct for rear engine area
- 6 - Oil extraction pump
- 7 - Adjustable pump gear
- 8 - Fixed pump gear
- A - Opening for control valve
- B - Supply bore for control valve with system pressure
- C - Regulated pressure to spring support (increasing pressure)
- D - Regulated pressure to piston in adjustable pump gear (reducing pressure)
- E - Duct to piston in adjustable pump gear



The valve shown here on the oil pump (red arrow) is a safety valve (cold-start valve). The opening pressure, which is lower on the Panamera than it was on the Cayenne, is now 9 ± 1 bar. This reduction was possible due to improved oil pressure control (4/3-way valve instead of the 3/2-way valve used on the Cayenne). This opening pressure is generally set as low as possible. The opening pressure on the Cayenne was $11 \pm 2/-1$.

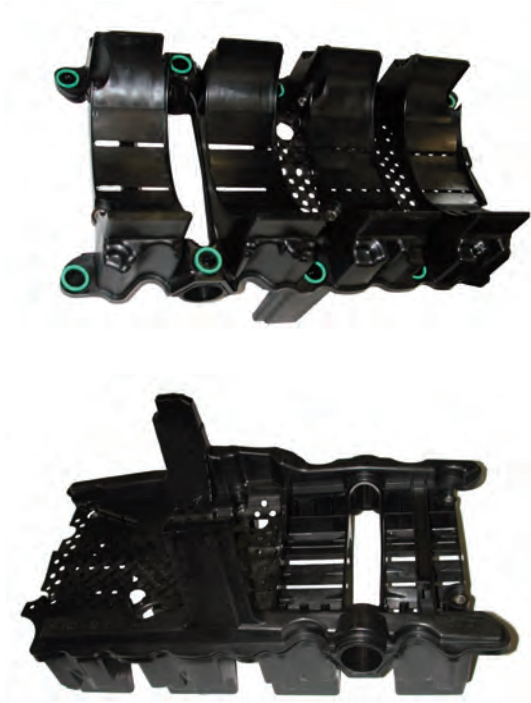


One pressure stage and two suction stages are used in the main sump and auxiliary sump on V8 naturally aspirated engines, while one pressure stage and three suction stages are used in the main sump and auxiliary sump as well as in the turbocharger on V8 turbo engines.

Engine – Panamera S/Turbo (V8)

Oil Collection Tank

To ensure a lightweight design, the oil plane, oil return collection tank and oil return ducts are all together in a plastic housing installed in the oil pan.



Notes:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

General

Newly developed, highly efficient 3.6 l engines are used in the new Panamera and Panamera 4. These engines were based on the units installed in the V8 models. Similar to the V8, they have an aluminum design and feature direct fuel injection (DFI) and VarioCam Plus. As a result, the Panamera and Panamera 4 develop a power output of 300 hp (220 kW) at 6,500 rpm and a maximum torque of 400 Nm at 3,750 rpm.



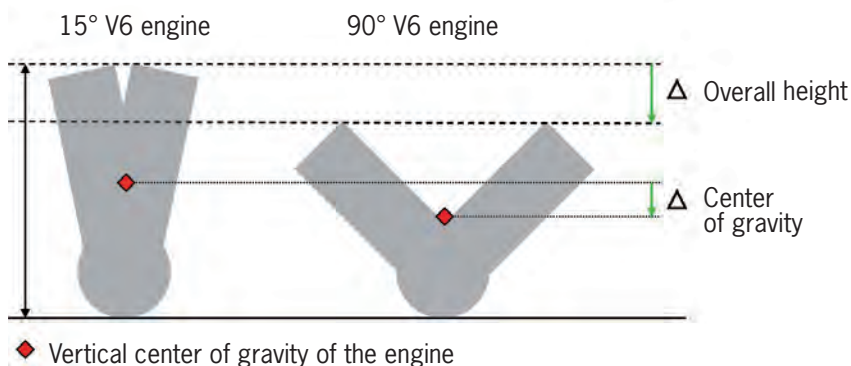
Engine type M46.20 for 2WD
Engine type M46.40 for 4WD

This means that the rear-wheel drive Panamera with the Porsche Doppelkupplung (PDK), is able to accelerate from 0 to 62 mph (0 to 100 km/h) in just 6.3 seconds and has a top speed of 161 mph (259 km/h). The values for the Panamera 4 are 0 to 62 mph (0 to 100 km/h) in 6.1 seconds and a top speed of 160 mph (257 km/h).

The current V8 engine of the Panamera S, 4S and Turbo models already features a host of innovative technologies and concepts. These have been adopted in the V6 engine as well. For example, the low installation position in the engine compartment was also realized for the V6 models through the especially flat design of the oil pan and the 90° cylinder arrangement. It was also again possible to realize the drive-through axle through the engine block (oil pan), familiar from the Panamera 4S and Panamera Turbo, for the V6 engine. Overall, the concept-based advantages of the V8 units were therefore transferred to the V6 engines and guarantee outstanding weight distribution for exceptionally dynamic handling.

Since the design principle of a 90° V-engine makes this engine much flatter than typical 60° V6 engines or VR6 engines with a 15° cylinder bank angle. The flat design also means that it was possible to preserve the engine hood contours for the V6 models as well.

V6 Design



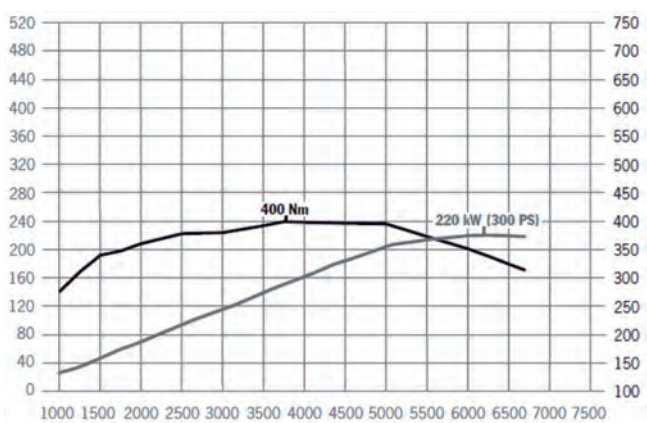
Like with the V8 models, a specially adapted intake system and a new engine control generation for the V6 engines permits power development of 300 hp (220 kW) at 6,200 rpm and a maximum torque of 400 Nm at 3,750 rpm. A balance shaft in the oil pan reduces vibrations and guarantees extremely smooth running.

Engine – Panamera (V6)

Engine Data – M46.20/M46.40

Number of cylinders	6
Valves/cylinder	4
Displacement	3.6 liter
Bore	96 mm
Stroke	83 mm
Max. engine power	300 hp (220 kW)
at engine speed	6,200 rpm
Max. torque	400 Nm
at engine speed	4,250 rpm
Engine speed limitation at	6,700 rpm
Engine weight	approx. 408 lbs (185 kg)
Compression ratio	12.5

Engine Power/Torque Graph – Panamera V6



Engine Design

Type	V6-cylinder engine 90°
Crankcase	Aluminum, two-part
Crankshaft	Forged, supported by 4 bearings
Crankshaft bearings	Binary bearings, dia. 64 mm
Connecting rods	Steel cracked rods, 157.4 mm long
Connecting-rod bearings	Binary bearings, dia. 52 mm
Pistons	Cast aluminum
Cylinders	Alusil linings, silicon particles exposed
Cylinder head	Aluminum, single-part, cross-flow cooling
Intake valve diameter	38.3 mm
Exhaust valve diameter	33 mm
Large intake valve lift	10.27 mm
Exhaust valve lift	9.85 mm
Intake camshaft adjustment	25° camshaft angle, stepless
Timing, intake opens, large lift	28.5° before TDC*
Timing, intake opens, small lift	21.5° after TDC*
Timing, intake closes, large lift	10.5° after BDC*
Timing, intake closes, small lift	60.5° after BDC*
Timing, exhaust opens	26.5° before BDC*
Timing, exhaust closes	0.5° before TDC

* Timing in late position with 10 mm valve lift and zero clearance

Technical Data for Engine Lubrication

Type	Integrated dry sump
Oil cooling	Via oil/water heat exchanger
Oil filter	On pressure side after oil pump
Oil pressure at n=5,000 rpm at 194° F. (90° C.)	65 PSI (4.5 bar)

Notes:

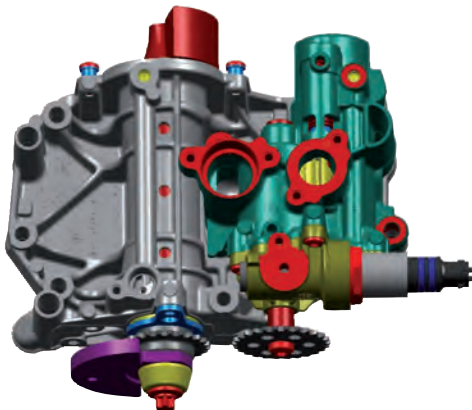
Crankcase

The proven closed-deck design of the aluminum crankcase is used for the V6 models like on the V8 models. In this construction, the housing and coolant ducts form a closed system around the cylinders. This creates a very rigid engine assembly, minimizes cylinder distortion and results in low oil consumption as well as a reduction in the amount of combustion gases that pass by the piston rings into the crankcase (blow-by gases). The lightweight, rigid engines therefore ensure lower fuel consumption and a long service life. The water jacket ensures that the cooling system has sufficient reserves even in the cylinder head, which is subject to substantial thermal loads.

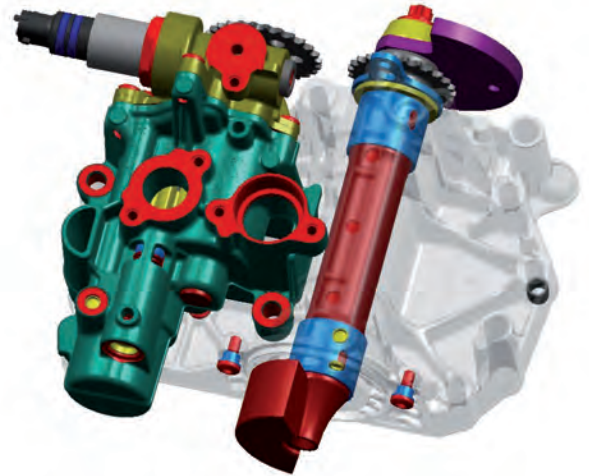
Lightweight Construction

The use of aluminum screws for all magnesium parts, e.g. timing-case cover, for screwing together the top and bottom parts of the crankcase and for connecting the engine and transmission, also contributes to a further weight reduction. The new generation of V6 engines also features a fully aluminum, lightweight camshaft adjuster. The timing-case and valve covers, which cover the timing drive mechanism and camshafts respectively, as well as the oil guide housing of the Panamera are manufactured entirely from magnesium.

Balance Shaft

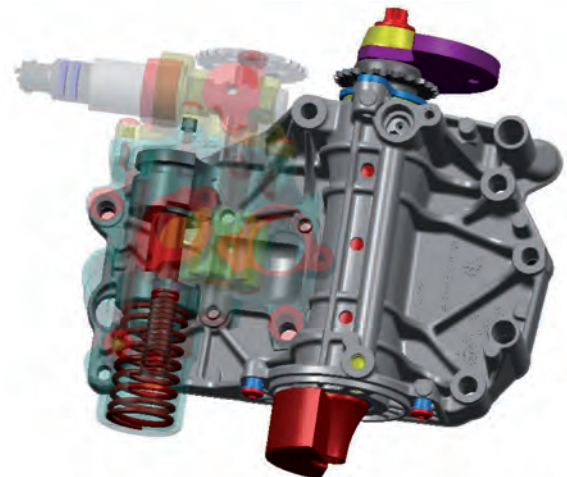


A discontinuous free first-order moment of inertia is produced in the V6 engine which is compensated by counterweights on the crankshaft and masses on the balance shaft. Since the balance shaft should be located as centrally as possible under the middle of the engine, it is installed directly next to the oil pump housing.



The module housing with oil pump and balance shaft must transfer the applied forces and moments under all engine operating conditions so that functional reliability is maintained. The balance shaft is supported by plain bearings. The shaft rotates at the same speed as the engine, counter to the engine's direction of rotation.

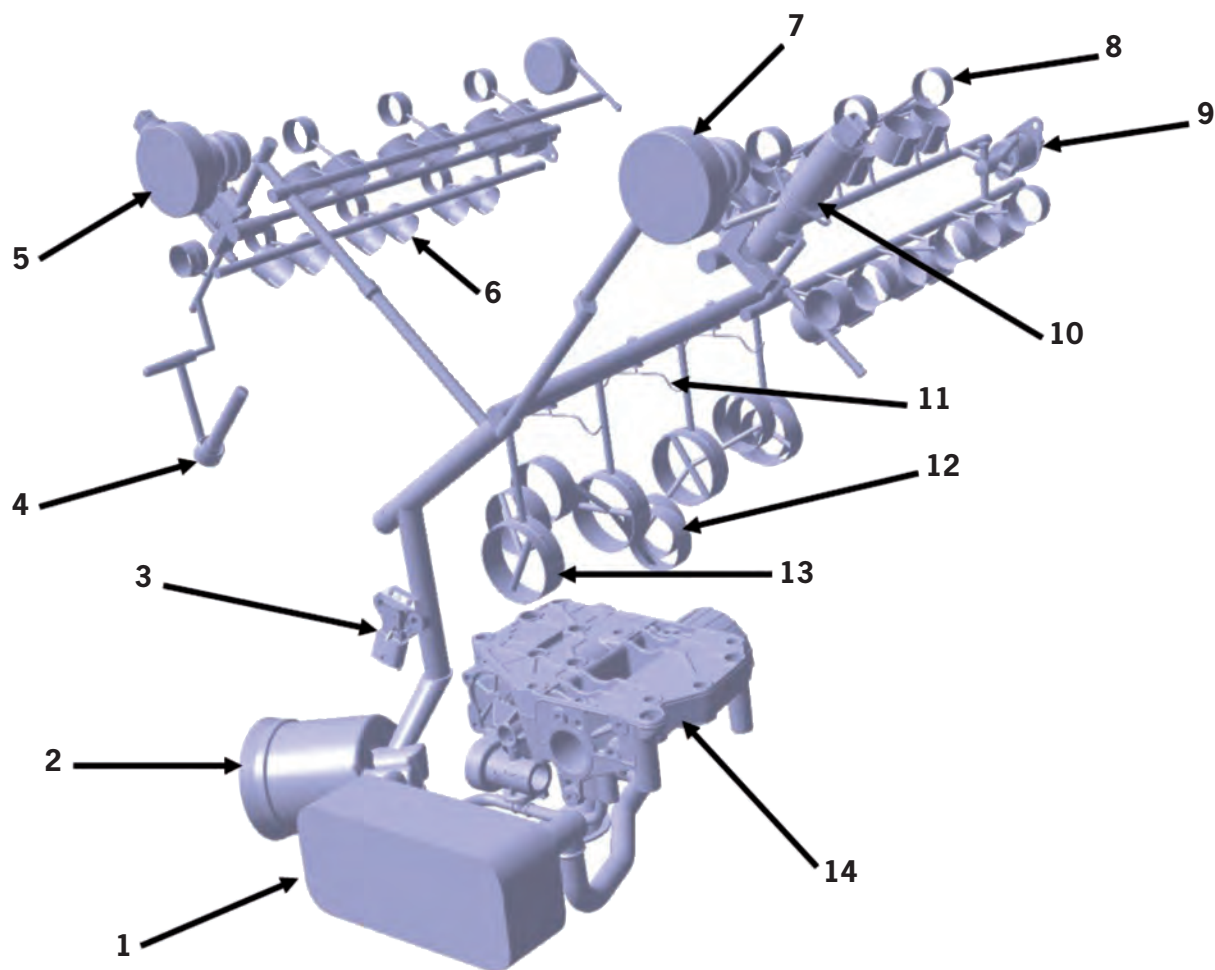
Variable Oil Pump



In order to reduce drive losses and therefore improve the efficiency of the engine while at the same time reducing fuel consumption, the V6 Panamera engines equipped with an electronic demand controlled oil pump. The oil pump and its delivery rate are pressure and volume regulated over the entire engine map. In other words, a demand based oil pressure is set with a defined oil volume for each engine operating state, e.g. different engine speeds and loads. The oil pump is integrated compactly in the oil pan area and is driven by the crankshaft via a chain.

Engine – Panamera (V6)

Oil Circuit



- 1 - Oil-water heat exchanger
- 2 - Oil filter housing
- 3 - Oil pressure sensor
- 4 - Chain tensioner
- 5 - Camshaft controller

- 6 - Bucket tappet guide housing
- 7 - Camshaft controller
- 8 - Camshaft bearing
- 9 - Valve for valve lift switchover
- 10 - Camshaft controller valve

- 11 - Piston spray cooling
- 12 - Connecting-rod bearing
- 13 - Main bearing
- 14 - Oil pump housing

Notes:



Subject	Page
Panamera V8 Models	
DME Control Unit DFI EMS SDI 6.1	2
Injection Strategies	3
Other Functions of the DME Control Unit	5
Diagnostic Options With The PIWIS II Tester	6
DME Inputs and Outputs	7
DME Power Supply	8
DME Sensors	8
Fuel Level Sensor (MAPPS)	10
Fuel Pump Control Unit	12
Auto Start Stop System	13
Coolant System	16
Fuel Supply, Low-Pressure Side – Fuel Tank	18
Fuel Tank Ventilation	19
Leakage Diagnostic Pump (LDP)	21
Fuel Supply, High-Pressure Side – DFI	23
High-Pressure Pump	23
Ignition System	24
Intake System	25
Boost Control – Turbo	27
Exhaust Systems	28
Panamera V6 Models	
General Information	32
DME Control Unit DFI, EMS SDI 7.1	32
DME Injection Strategies V6 DFI	35
Fuel Supply, Low-Pressure Side	38
Fuel Supply, High-Pressure Side V6 DFI	40
Ignition System	41
Intake System	42
Exhaust System	43

Fuel, Exhaust & Engine Electrical – V8

DME Engine Electronics

Development Objectives

- Best in Class driving performance
- High engine power
- High maximum torque
- Low fuel consumption
- Low emissions
- Thermal management
- Start Stop system
- Reduced component weight

An enhanced generation of Porsche V8 engines is used for the new Panamera models:

4.8 l V8 naturally aspirated engine for the Panamera S/S4
4.8 l V8 twin turbo engine for the Panamera Turbo.

The enhanced and optimized engines used in the Panamera are based on the Cayenne engines. This made it possible to achieve the ambitious targets for fuel consumption and CO₂ emissions despite the enhanced performance. A common design engineering process with clearly defined goals permitted use of many identical parts in the naturally aspirated and turbo engines.

DME Control Unit DFI EMS SDI 6.1



Characteristics of direct fuel injection:

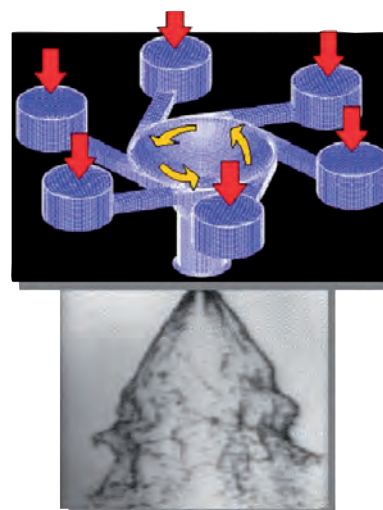
- High cylinder charging
- Low knock sensitivity
- High compression ratio
- High-pressure stratified-charge ignition
- Dual injection possible
- Homogeneous operation with engine at operating temperature

General Information

In the case of direct fuel injection, the fuel is injected directly into the combustion chamber, so that the mixture formation takes place almost entirely within the combustion chamber. The direct fuel injection system used in the Panamera engines is based on homogeneous operation when the engine is at operating temperature. The mixture of fuel and air is distributed as evenly as possible in the combustion chamber, thereby enabling optimal combustion. In this process, the fuel is injected directly in the combustion chamber at a pressure of up to 1740 psi (120 bar).

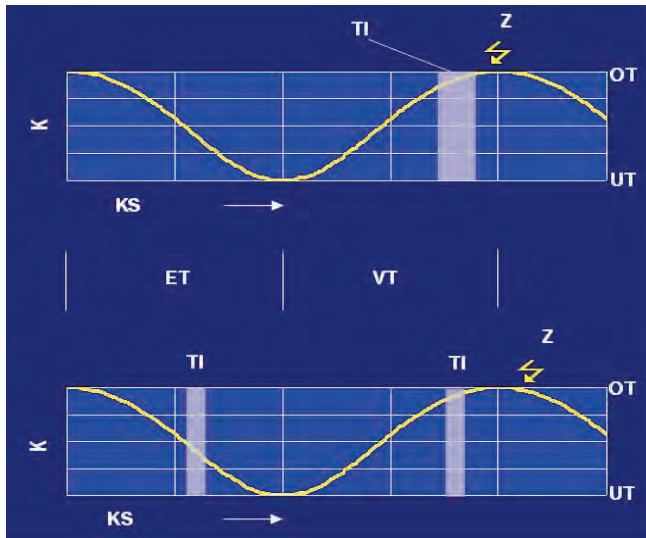
The jet and cone angles of the injectors have been optimized to achieve optimum homogenization across the entire operating range. Within the injector, the fuel jet is swirled (rotated about the longitudinal axis). This rotation forms a cone-shaped cloud of fuel. This results in fine atomization which in turn enables quicker evaporation of the fuel. The heat energy required for this is removed from the air by the fuel evaporation and this cools the air as a result. This reduces the cylinder charge volume and additional air is drawn in through the open intake valve, which in turn improves cylinder filling.

The reduced temperature level also helps to create the prerequisites for the high compression ratio in all Panamera engines, since knock sensitivity and engine efficiency have been improved. The high compression ratio of 12.5:1 for the V8 naturally aspirated engine and 10.5:1 for the V8 twin 2turbo engine realized through DFI serves to optimize both engine power and fuel consumption.



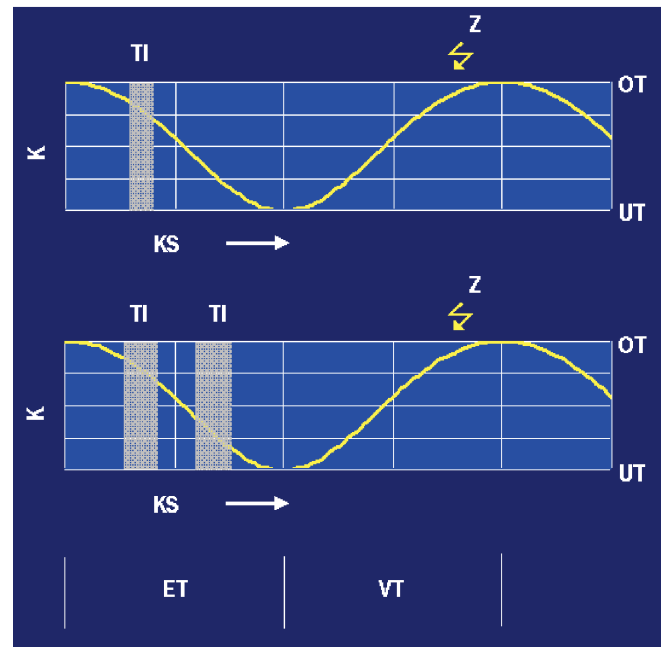
Injection Strategies

The piston recesses are important for high-pressure stratified-charge ignition and for dual injection during the catalytic converter heating phase. This allows late injection of fuel in order to create an ignitable air/fuel mixture around the spark plug for late ignition.



With high-pressure stratified-charge ignition (top graph), DFI injects the fuel very late during the engine start, just before the end of the compression stroke. In the high-pressure stratified-charge ignition process, a quantity of fuel is injected into the specifically shaped piston recesses to create a stratified ignitable mixture around the spark plugs. The piston recess ensures that the injected fuel is channelled directly to the spark plug. This reduces both the amount of fuel required and the emissions compared with intake manifold injection.

After engine starting by high-pressure stratified-charge ignition, the engine management system switches to the catalytic converter heating phase (bottom graph). In this operating state, dual injection helps to bring the catalytic converter to the temperature required for optimal conversion as quickly as possible by increasing the exhaust gas temperature. For this purpose, the second injection is made into the piston recess with closed intake valves shortly before the end of the compression stroke. The fuel-air mixture is ignited very late, thereby increasing the exhaust gas temperature. This reduces the emissions during the starting phase.



Engine at operating temperature: (homogeneous operation)

Single injection - idle speed
Partial load up to 3500 rpm

When the engine is at operating temperature (top graph), injection into the cylinder takes place only during the intake stroke. In this so-called homogeneous operation there is uniform mixture formation for the entire cylinder charging process.

Dual Injection:

Full throttle up to 3500 rpm

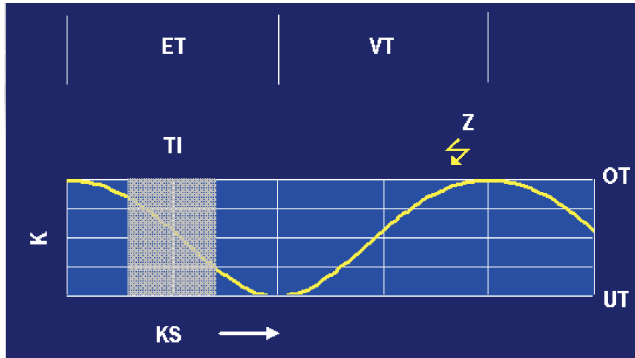
Under conditions with high load (e.g. large valve lift), a dual injection takes (bottom graph) place up to an engine speed of 3500 rpm. The quantity of fuel required for combustion is shared between two successive injections. In the upper load range, both injections take place during the intake stroke (synchronous intake injection) with open intake valves, thereby ensuring better homogenization (spatial distribution in the combustion chamber) in order to save fuel and increase power output.

Legend

OT - Top dead center (TDC)
UT - Bottom dead center (BDC)
KS - Crankshaft position
K - Piston position
TI - Injection
Z - Ignition
ET - Intake stroke
VT - Compression stroke

Fuel, Exhaust & Engine Electrical – V8

Injection Strategies (Cont'd)



Legend

OT - Top dead center (TDC)

UT - Bottom dead center (BDC)

KS - Crankshaft position

K - Piston position

TI - Injection

Z - Ignition

ET - Intake stroke

VT - Compression stroke

Single injection:

Full throttle above 3500 rpm

At high load and with an engine speed of over 3500 rpm, injection takes place only once in the intake stroke, since there is not enough time to divide up the injection time at high engine speeds.

Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Other Functions of the DME Control Unit

Sport Button (Standard Equipment)



Standard setting:

- Optimized comfort and fuel consumption
- Dynamically comfortable accelerator characteristic

Sport mode:

- Auto Start Stop function deactivated
- Sporty engine setup
- Accelerator reacts more quickly, more spontaneous throttle response
- Throttle open further for same pedal travel
- Coolant temperature is reduced

Sport Plus Button (Optional Equipment)

- Auto Start Stop function deactivated
- For even sportier setup
- Performance-orientated
- Turbo with overboost (for max. 10 sec. + 10% torque 770 Nm)
- Coolant temperature is lowered
- Activation of the shift indicator

Activation of VarioCam Plus

The DME control unit also controls the VarioCam Plus system (stepless control of the intake camshafts from 0 to 50° crank angle) as well as valve lift adjustment of the intake valves (large/small lift)

Apart from continuous adjustment of the timing, the system also enables switching of the valve lift of the intake valves. In conjunction with direct fuel injection, this allows high power output and torque values together with low fuel consumption. A new feature of the new generation of V8 engines is a fully aluminium, lightweight camshaft adjuster. This lightweight design measure reduces the weight by approx. 3.7 lbs (1.7 kg) and also reduces rotating masses, thereby achieving a more agile engine response.

Activation of the Demand-Controlled Variable Oil Pump

Another measure designed to achieve high efficiency is use of a variable oil pump with demand-based control. The pump is designed as an external gear pump with an integrated turbocharger suction stage for the V8 bi-turbo engine. Demand-based control takes place via the engine management system and adjustment is performed hydraulically. The engine management system uses the engine speed, oil temperature and torque as input values. Based on this information, the engaged gear wheel width and thus the geometric displacement volume of the gear wheel set is changed through the axial movement of a gear wheel (moved hydraulically) and this in turn changes the oil pressure.

Activation of the Infinite Controlled Radiator Fan

1 electric radiator fan:
Panamera S - 0 to 600 W
Panamera Turbo - 0 to 850 W

Diagnostic information is described in Guided Fault Finding.

Note: When removing the electric radiator fan, the fan must never be held by the fan blades as this can lead to extreme imbalance.

Fuel, Exhaust & Engine Electrical – V8

Adaptive Cruise Control (ACC)

Acceleration or deceleration via electronic accelerator and brake as appropriate, also braking to standstill.

Electronic Accelerator Pedal Unit



An electronic accelerator pedal unit (A) is installed in the Panamera as a sensor, like in the 9X7 vehicles.

Increase in Idle Speed

In the Panamera, the idle speed can be increased if a corresponding request is received from the gateway in order to increase the charging current of the generator. The field current is regulated in the gateway.

The following actual values are available in the DME control unit, for example:

- Setpoint generator voltage
- Actual generator voltage
- Generator capacity utilization
- Generator temperature



Note!

For other vehicles as from model year 2007:
All of these functions are contained in the DME control unit for 987 and 997 models (except for GT3) as from model year 2007. For this purpose, the DME control unit regulates the field current depending on the power requirement of the vehicle electrical system, the instantaneous generator utilisation as well as the generator temperature. The voltage in the vehicle electrical system can be increased to significantly above 15 V and the engine idle speed can be increased in order to improve the charge balance.

Diagnostic Options With The PIWIS Tester II

The DME functions and diagnostic options largely correspond to those of the DFI control unit EMS SDI 4.1 for the V8 Cayenne engines:

- adaptation to current components/functions (e.g. new sensors/systems)
- extension (e.g. Start Stop system, thermal management).

Fault Memory

- Adaptation to current legal regulations (e.g. USA: Permanent fault memory = Mode A, via Scan Tool)

Fault Deletion Counter

- 40 warm-up phases have to be completed to delete a sporadic fault in order to decrement the deletion counter from 40 to 0

Actual Values

- Mixture adaptations are preserved in the event of an interruption in the power supply
- Extension of actual values (e.g. Start Stop system, thermal management)

Drive Links

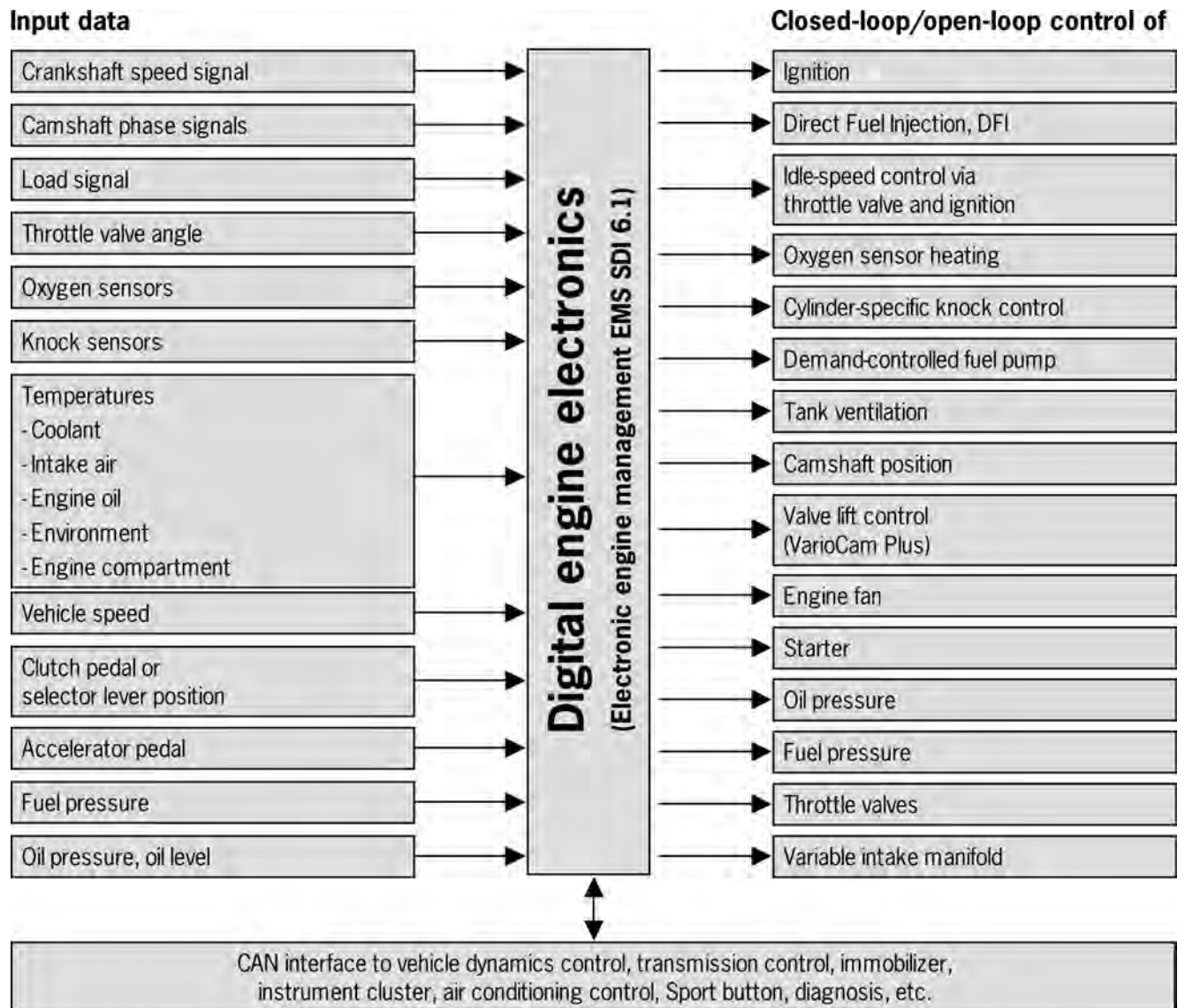
- New drive links (e.g. for Start Stop system)



Note!

For the DFI control unit EMS SDI 6.1 also, a corresponding code comprising letters and numbers is specified in front of every actual value for each actual value filter. This simplifies assignment in the case of different languages. The explanation of individual selected actual values is also new; this function is displayed using the softkey F1 (? / Help) (as with 9X7 DFI vehicles).

Inputs and Outputs



The high-performance electronic engine control unit EMS SDI 6.1 is used for the Panamera engines. This control unit has been specially designed to meet the requirements relating to direct fuel injection and VarioCam Plus. Of particular significance here is control of the injectors, since these are the central elements of the direct fuel injection system. The engine control also controls the throttle valve position (electronic accelerator) - this is a prerequisite for the Porsche Stability Management (PSM) system installed as standard equipment.

The modern engine management system EMS SDI 6.1 allows sequential injection of fuel into the combustion chamber for each cylinder at precisely defined time intervals. This contributes to minimizing fuel consumption and reducing emissions even in dynamic driving operation. Each cylinder receives precisely the amount of fuel that corresponds to the engine load condition in order to realize the optimum air/fuel ratio.

Fuel, Exhaust & Engine Electrical – V8

DME Power Supply

The DME control unit EMS SDI 6.1 is located in the right plenum panel.



The following relays and fuses are installed on the relay carrier in the plenum panel next to the DME control unit:

- main relay for DME; relay for terminal 50
- relay for secondary-air pump
- relay for circulating air pump.



Most fuses related to DME are located on the fuse carrier on the left switch panel.

The battery is installed in the luggage compartment at the rear left. The luggage compartment also accommodates the power distributor (behind the battery) as well as the fuse/relay carrier (on the right next to the battery).

New or Modified DME Sensors and Functions

Differential Hall Sensor

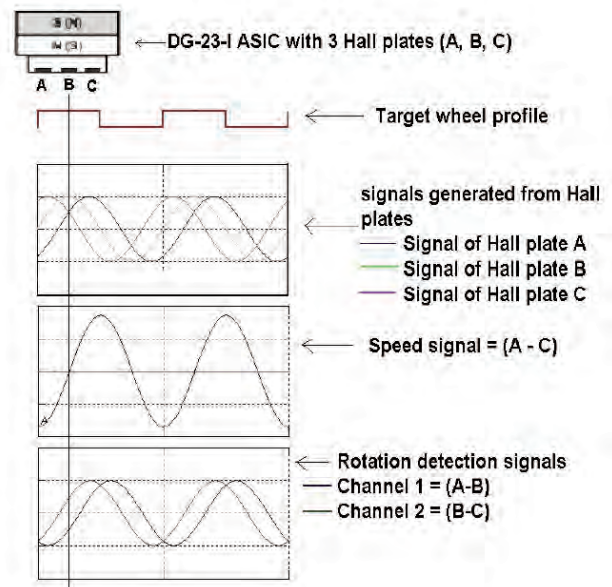


The speed sensor is installed on the left behind the engine at the bottom of the transmission bell housing viewed in driving direction.

A new Hall sensor is used in the Panamera for determination of the engine speed instead of the previous inductive pick-up. In addition to detecting the engine speed and reference mark, the new multiple Hall sensor also detects the direction of rotation of the engine. This function means that the engine starting operation is very fast. The speed sensor has 3 integrated Hall sensors (A - B - C). Only 1 rotor with 60 - 2 teeth is needed on the crankshaft to generate the corresponding PWM signal.



Function – The sensor calculates two signal channels from three Hall signals.



2 signal channels:

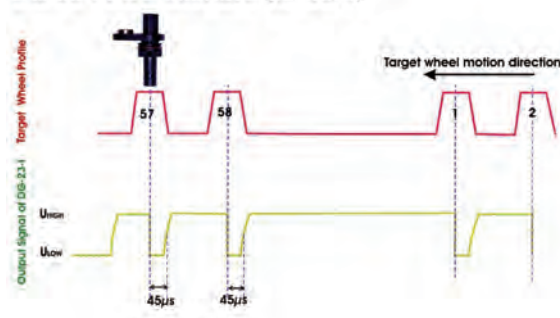
Channel 1 = Speed channel (A - B)

Channel 2 = Direction of rotation channel (B - C)

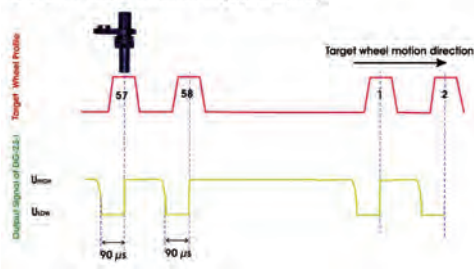
Signal

The sensor switches “low” when the speed channel passes through the zero line. The offset between the tooth center adapted in the DME software. Detection of the direction of rotation takes place on the basis of the phase displacement between the speed channel and direction of rotation channel.

DG-23-i ECU Interface (forward)



DG-23-i ECU Interface (backward)



Channels 1 and 2 are needed to detect the direction of rotation:

Channel 1 = Speed channel (A - B)

Channel 2 = Direction of rotation channel (B - C)

Direction of rotation forward (upper graph)

Channel 2 leads channel 1

Direction of rotation backward (lower graph)

Channel 1 leads channel 2



Note!

In the event of speed sensor failure, the engine starts with a delay, a fault is stored and the vehicle is operated with reduced engine power.

Temperature range -40° F. (-40° C.) to 302° F. (150° C.)

Engine speed range 0 to 10,000 rpm forward

0 to 3,000 rpm backward

New Pressure/Intake Temperature Sensor on the Intake Manifold (naturally aspirated and turbo engines)



The pressure sensor detects the intake manifold pressure. The DME control unit determines the respective air mass from different maps and the intake air temperature installed at the rear of the intake manifold (1).



Advantages of the pressure sensor:

- Increased performance thanks to dethrottling of the intake section
- Lightweight design (the pressure sensor replaces 2 MAF sensors)

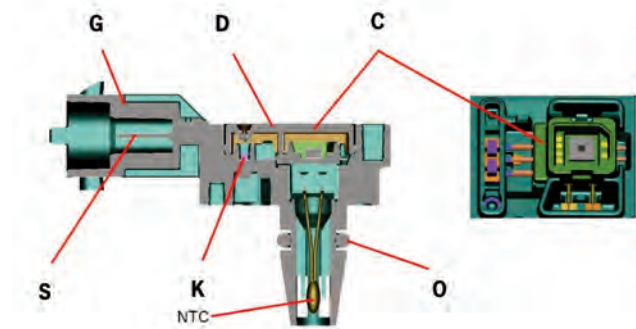
The new pressure sensor on the intake manifold replaces the previous hot-film mass air flow (MAF) sensor. In order to ensure that the correct mixture composition is always present in the combustion chambers, the actual intake air mass is continuously measured using a pressure sensor for measuring the mass air flow. As a result, the correct mixture is always available in the combustion chambers, and any changes in the atmospheric pressure (due to changes in altitude) and outside temperature are compensated. This new pressure sensor replaces the hot-film mass air flow measurement system used in the past and also contributes to increased performance by dethrottling the intake section.

The integrated temperature sensor measures the intake air temperature on both naturally aspirated and turbo engines. The load signal of the pressure sensor and the intake air temperature can be found under the DME actual values.

Fuel, Exhaust & Engine Electrical – V8

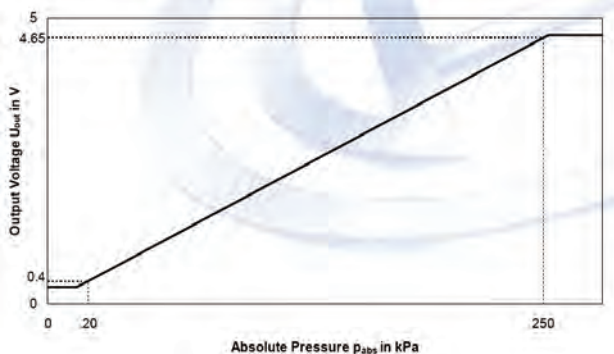
Design and Signal

The cross section and design of the pressure sensor.



- G - Sensor housing
- D - Cover
- C - Premould with sensor chip
- O - O-ring
- K - EMC capacitors
- S - Lead frame
- NTC - Intake air temperature sensor

The voltage characteristic as a function of the intake manifold pressure are shown in the following graph.

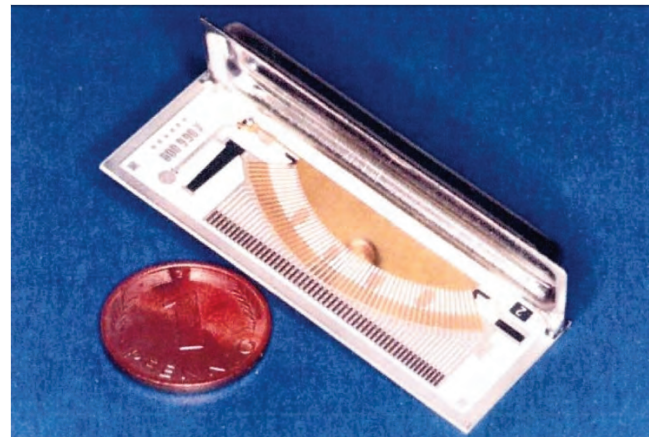


- Supply voltage = 5 V
- U_{out} - Output voltage (V)
- U_S - p_{abs} - Absolute pressure (kPa)

The plausibility check for the pressure sensor signal is performed in the DME control unit. For this purpose, the current filtered values of the ambient pressure sensor (in the DME control unit) and intake manifold pressure sensor (and boost pressure sensor: Turbo only) are compared with each other in the event of ignition On > 10 seconds or control unit run-on > 10 seconds, for example. Further diagnostic information is described in Guided Fault Finding.

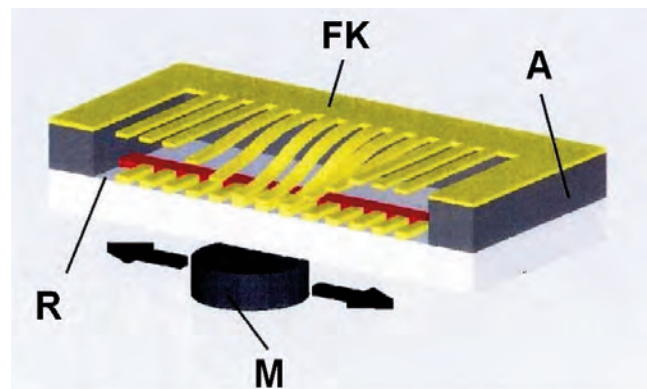
Fuel Level Magnetic Passive Position Sensor (MAPPS)

There are 3 new MAPPS fuel level sensors installed in the fuel tank for measurement of the fuel level.



Advantages of the new fuel-level sensors:

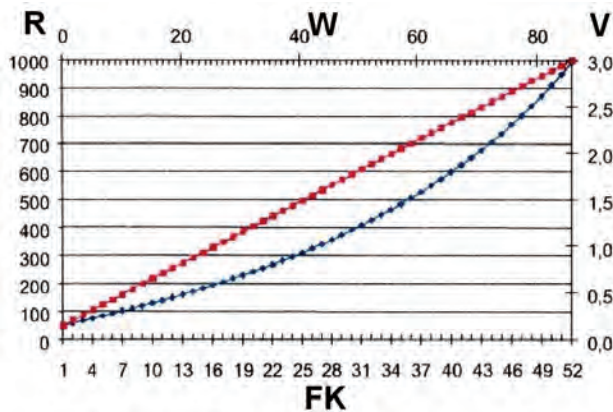
- Longer service life (low-wear)
- Perfect protection against soiling
- Resistant to all gasoline and diesel fuels
- Low contact current (<20 mA)
- Redundant contacts
- Resistant to magnetic interference fields



- M - Magnet
- A - Spacer
- R - Resistance layer
- FK - Spring contacts

Signal

The electrical output signal is varied proportionally depending on the magnet position. Thanks to the magnetic coupling principle, it was possible to hermetically seal the measuring system. As a result, there is no risk of soiling of the micro-contacts even under extreme ambient conditions.



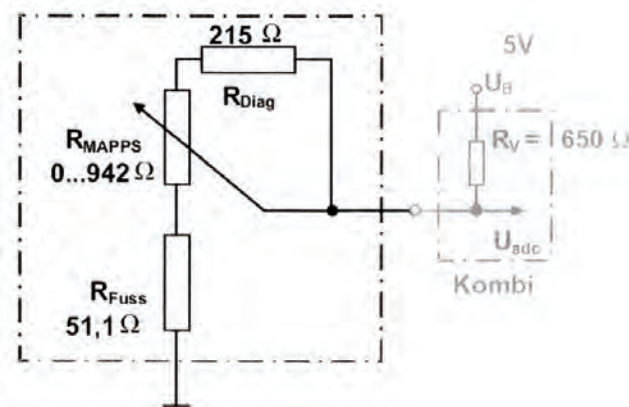
W - Angle (up to 86 degrees)

FK - Spring contact

R - Resistance in ohms

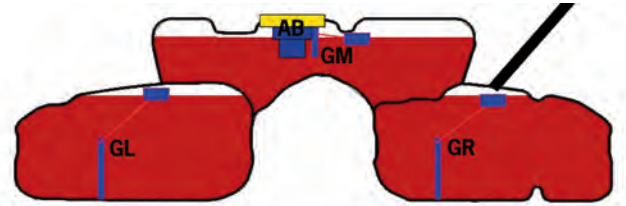
V - Voltage in volts

Electrical Circuit



- 52 film resistors
- Series connection with single taps
- 52 spring contact tabs
- Measuring system hermetically sealed

Fuel Level Sensors (MAPPS)



GL – MAPPS fuel level sender left side

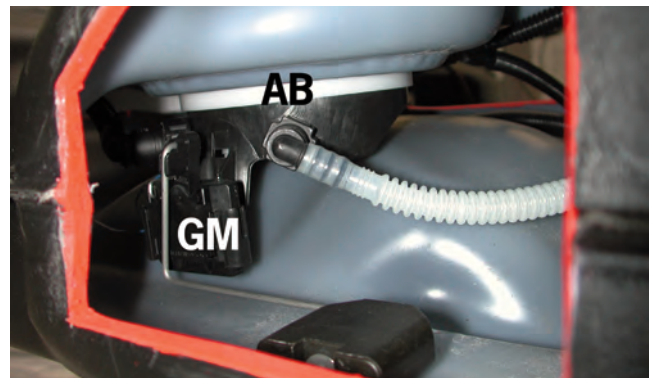
GM – MAPPS fuel level sender middle (in the upper tank area)

AB – Vapor separator

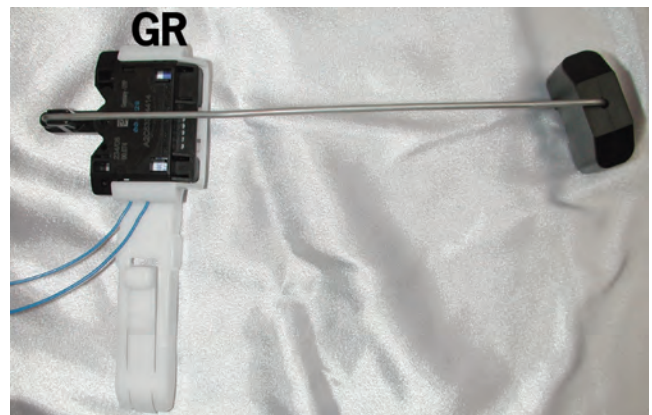
GR – MAPPS fuel level sender right side



GL – MAPPS fuel level sender left side



GM – MAPPS fuel level sender middle



GR – MAPPS fuel level sender right side

Auto Start Stop System



All versions of the Panamera with the Porsche Doppelkupplung (PDK; optional for Panamera S, standard for Panamera 4S and Panamera Turbo) are equipped with the Auto Start Stop function.

This function switches off the combustion engine under defined conditions when the vehicle is stopped and therefore contributes to reducing fuel consumption when the vehicle is stationary. The Auto Start Stop function can be deactivated and activated by button in the center console. In addition, both the engine and transmission as well as the battery must have reached operating temperature and the speed threshold of 1 mph (2 km/h) must have been exceeded once.

For the driver, use of the Auto Start Stop function does not mean that he/she has to change his/her driving behavior. The driver does not have to perform any additional activities for an engine stop and restart.

Depending on country, the Auto Start Stop function is either switched on automatically when the ignition is switched on (e.g. Japan and some European countries) or must be activated each time the ignition is switched on (e.g. USA and RoW). Fuel consumption is reduced by up to 5% in the NEDC (up to 10% in the urban cycle)



Note!

Normal operation is:

- > When vehicle is started, the Start Stop System is off.
- > It must be turned on after each key cycle.



The goal was to exploit the fuel-saving potential of the Auto Start Stop function for the driver. In order to permit realization of the Auto Start Stop function, the starter was reinforced and designed for the increased number of engine starting operations. In addition, the battery charge and aging condition as well as temperature are monitored in order to ensure the restart capability.

The vehicle assists the driver when the engine is switched off by maintaining the brake pressure on uphill slopes. This was integrated as an additional function in Porsche Stability Management (PSM). This prevents the vehicle from rolling away opposite to the driving direction when the engine is switched off.

The most important comfort and safety functions continue to operate even when the engine is switched off. For example, the audio and communication systems still operate and the lighting, airbag systems and PSM remain available. These functions are supplied with power from the battery for this purpose. Voltage changes when the engine stops and restarts are partially compensated and their effects therefore reduced.

The air conditioning ensures temperature comfort. For this purpose, it uses the residual heat of the engine for heating or the residual cooling energy in the cooling system to cool the passenger compartment. If there is a risk of the passenger compartment temperature deviating significantly from the preselected value, the engine is automatically restarted in order to guarantee continued climate comfort for the passengers.

Fuel, Exhaust & Engine Electrical – V8

System Operation

Automatic engine stop:

If the prerequisites are met, the engine is stopped as soon as the vehicle comes to a stop.

1. Brake vehicle to a stop with the footbrake.
2. Keep footbrake depressed or select PDK selector lever position P.

If the vehicle is stopped by brake operation and the brake pedal is held, the Auto Start Stop function switches off the engine after approx. 1 - 2 seconds. The driver is informed about this by the **“green”** Auto Start Stop symbol in the instrument cluster. The tachometer reading falls to zero. The selector lever can remain in position D or M. The engine remains stopped even if the lever is shifted to P and N. If the engine cannot be switched off automatically, the driver is informed about this by a **“yellow”** Auto Start Stop symbol in the instrument cluster.

The Auto Start Stop system starts the engine:

- In PDK selector lever position D, N or manually selected transmission range 1 or 2.
- Footbrake is released,
- or accelerator pedal pressed
- or select PDK selector lever position R

The engine is restarted when the driver releases the brake. The starting operation is supported by the direct fuel injection and ignition systems so that it can take place quickly and in a way that saves energy and protects the battery. To achieve this, the engine was supplemented by a sensor that detects the position of the crankshaft and therefore makes the information available as to which cylinder can be charged and ignited early. As a result, the engine power required for driving away is already available again after a short time.



Note!

The DC converter compensates for voltage dips during the starting operation.

No engine stop or restart readiness (function indication):

If the engine cannot be switched off automatically, the driver is informed about this by a **“yellow”** Auto Start Stop symbol in the instrument cluster.

The Auto Start Stop system has detected that:

- at least one prerequisite is not met
- or at least one exception condition is present
- or e.g. the following faults are present:
 - generator fault
 - battery fault
 - DC converter fault, etc.



Note!

Depending on the load of the vehicle electrical system, the DME control unit can increase the idle speed in order to improve the charge balance of the generator

The engine is not switched off or restarted again:

- if the engine has not yet reached its operating temperature
- if “Sport” mode or “Sport Plus” mode is activated
- if PSM was switched off
- if manoeuvring or a parking operation has been detected (large steering angle), i.e. reverse gear has been engaged or the steering wheel has been turned by a large angle
- if the height adjustment function of the adaptive air suspension has been selected or is active
- if the vehicle stops on steep uphill or downhill gradients
- if the automatic air conditioning/heating with residual heat function cannot guarantee that the set temperature can be maintained without running engine, e.g. at very low and very high outside temperatures
- if the total energy requirement of the vehicle systems from the battery cannot be met (charge condition)
- if the rear fog light is activated
- if internal vehicle operations are taking place that must not be interrupted, e.g. flushing operations in the fuel system after refuelling
- if trailer operation has been detected

Restarting is also prevented:

- if the presence of the driver is not confirmed, i.e. driver's door is open or driver's seat belt is not fastened
- if the hood is open.

Diagnostic options of the Auto Start Stop system in the DME control unit:

Actual values:

ST010_Status Start Stop Manager
ST020_to ST026_Request (by ... system)
ST030_Start Stop system active
ST041_Stop prohibition by vehicle systems
ST042_Stop prohibition by DME control unit
ST051_to ST061_Restart request by (... system)
ST071_Stop request by vehicle systems
ST072_Stop request by DME control unit
ST081_Deactivation by vehicle systems
ST082_Deactivation by DME control unit
ST083_Deactivation by drive link activation
ST101_to ST120_Stop prohibition 1 to 20 (1 was the last
stop prohibition)
ST201_to ST220_Restart request 1 to 20 (1 = last
request)
ST301_to ST320_Deactivation 1 to 20 (1 = last deactivation)

Drive links:

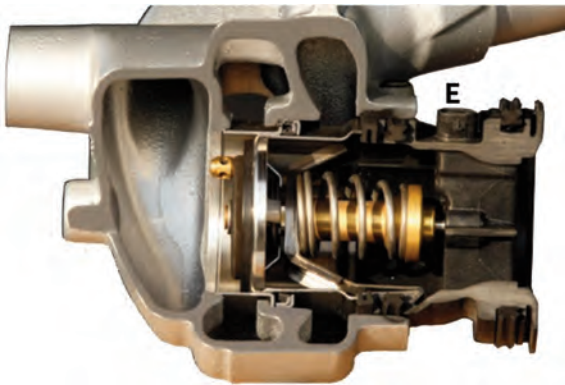
- Request stop
- Request restart
- Deactivate system for 1 ignition cycle

Notes:

[illegible]

Fuel, Exhaust & Engine Electrical – V8

Coolant System Thermal Management

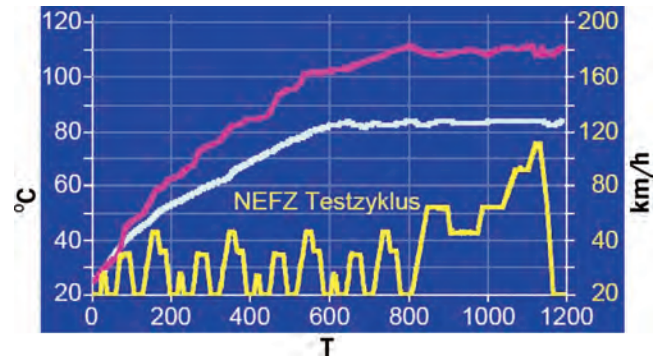


Electrical connection on the coolant thermostat (E).

The cooling system is part of the thermal management system and has two circuits which can be regulated depending on the coolant temperature. In the Panamera, this is done by an electric, map-controlled and deactivatable thermostat.

The thermostat permits automatic, demand-based suppression of the coolant flow when the engine is cold (cold start). As a result, the engine heats up more quickly (Start Stop operating condition is reached more quickly) and friction, fuel consumption and pollutant emissions are reduced in the warm-up phase.

Depending on the increase in engine temperature, the coolant flow through the engine (small circuit) is then activated during warming up. After this, the coolant radiator is activated (large circuit) depending on the engine operating point and based on a map stored in the engine control. The map control of the thermostat then regulates the coolant temperature between 201° F. (94° C.) and 221° F. (105° C.), depending on load, and therefore ensures optimum friction conditions in the engine that are adapted to the respective load point. This thermal management made it possible to reduce fuel consumption by up to 1.5%.



NEDC	- New European Driving Cycle (yellow)
Pink	- with thermal management
Light blue	- without thermal management
° C	- Coolant temperature
T	- Time in seconds
km/h	- Vehicle speed

Electrical activation of the coolant thermostat by the DME control unit benefits:

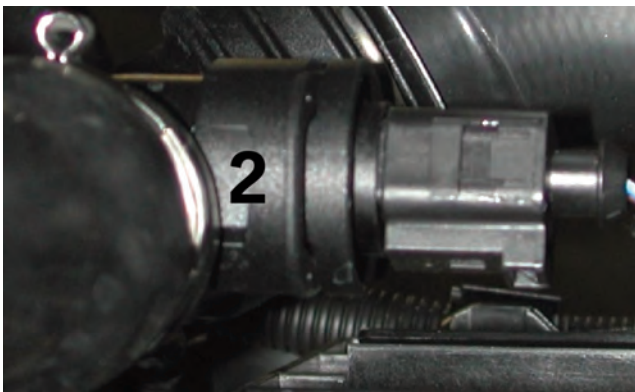
- Map-controlled coolant temperature regulation by suppressing coolant flow in the warm-up phase
- Engine heats up more quickly
- Reduced engine friction
- Lower fuel consumption
- -1.5% in the NEDC
- Reduced emissions

Temperature Sensors

Two temperature sensors are used for thermal management control.



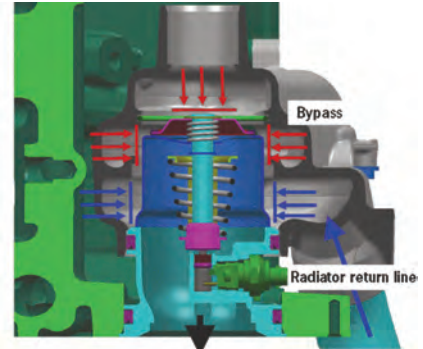
The coolant temperature sensor (1) is installed on the cylinder head at the rear right.



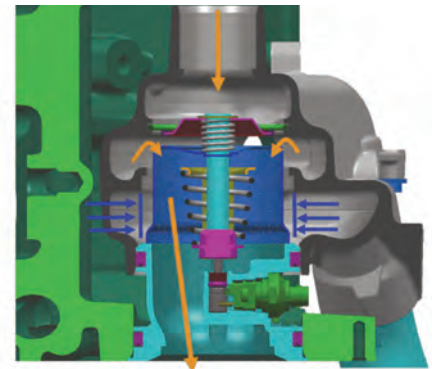
Temperature sensor (2) is located on the left coolant hose of the radiator outlet.

Thermostat Opening

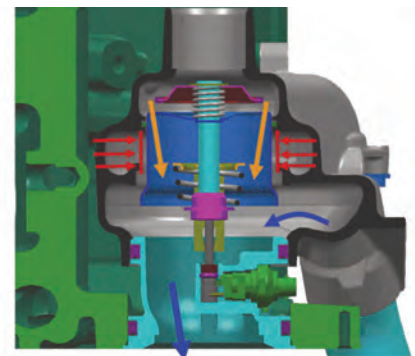
The main advantage of the map-controlled thermostat, which is electrically heated by the DME control unit, is that it is possible to regulate a specific temperature.



The thermostat is **fully closed** when the engine is cold.



Bypass Open – Electrical preheating makes it possible to quickly open the bypass for the small engine circuit in a controlled manner during the warm-up phase. This is achieved by providing more or less electrical heating close to the wax elements. The controlled bypass circulation in the small engine circuit allows the engine to reach operating temperature more quickly and in a uniform way.

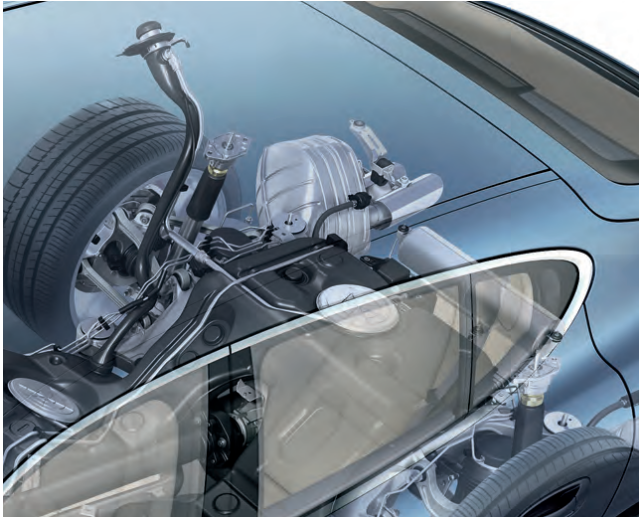


Fully Open – The 2nd temperature sensor on the coolant hose permits early detection of when the thermostat starts to open and allows the necessary corrective action if necessary in order to achieve the setpoint temperature. The DME control unit adapts the opening behavior of the thermostat in order to compensate for tolerances and aging. The setpoint temperature in normal operation is 221° F. (105° C.); the setpoint temperature is reduced to 201° F. (94° C.) in Sport mode and in the event of certain faults.

Fuel, Exhaust & Engine Electrical – V8

Fuel Supply, Low-Pressure Side

Fuel Tank



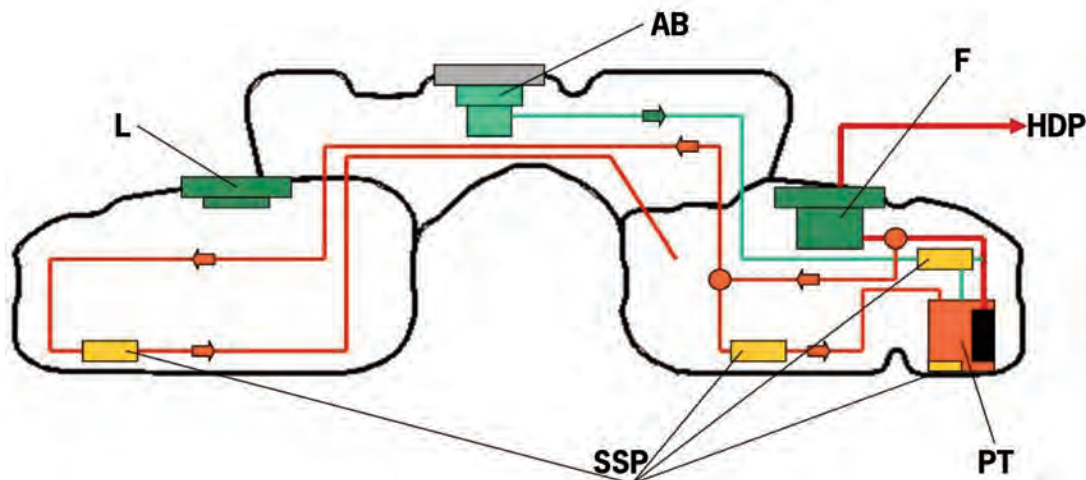
The engine is designed to provide optimum performance and fuel consumption with unleaded fuel 93 octane ($\frac{R+M}{2}$). When fuel with 90 octane ($\frac{R+M}{2}$) is used, the engine's knock controller automatically adapts the ignition timing.

In order to make optimum use of the available space, the Panamera is equipped with a saddle step fuel tank with a capacity of approx. 21 Gals. (80 l) on the Panamera S, and 26 Gals. (100 l) on the Panamera 4S and Turbo. This includes approx. 4 Gal. (15 l) reserve capacity.

The low-pressure side of the fuel supply system consists of a returnless fuel system (RLFS - ReturnLess Fuel System). The regulated electric fuel pump delivers the fuel via the fuel filter and fuel-pressure regulator (in the fuel tank) to the quantity control valve on the high-pressure pump with a pressure of approx. 80 psi (5.5 bar). The suction jet pumps in the fuel tank are also operated with the low-pressure side. The 3 fuel-level sensors are installed in the fuel tank for measurement of the fuel level.

On USA vehicles, a leakage diagnostic pump (LDP) is used for the tank leakage test, as in the Cayenne vehicles. This pump is installed directly at the fresh-air connection of the activated carbon filter. The carbon canister is located behind the fuel tank.

Function of the Four Sucking Jet Pumps



PT – Pump containment with demand controlled fuel pump and suction jet pump run by the first (low pressure) stage of the fuel pump

F – Lifetime fuel filter in right tank flange

HDP – Feed line for high pressure pump

SSP – Suction jet pumps:

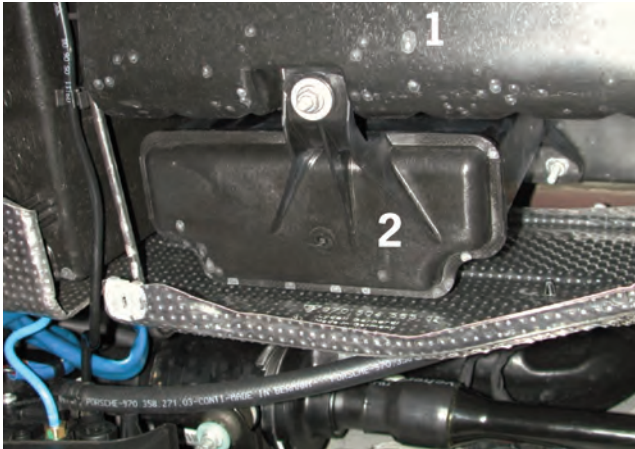
- 1 from tank to pump containment
- 1 from Left tank chamber to right
- 1 from right tank chamber to pump containment
- 1 from vapor separator to pump containment

AB – Vapor separator in middle tank flange

L – Left tank flange

Fuel Tank Ventilation

The fuel tank is aerated and vented exclusively via the activated carbon filter, which acts as an intermediate storage device for any HC emissions. Regeneration of the activated carbon filter takes place via the tank vent valve when the engine is running. The activated carbon filter is installed behind the fuel tank.



1 - Fuel Tank
2 - Carbon Filter

The tank vent valve is located on the right next to the electronic accelerator. When the engine is running, the system is vented by the tank vent valve to the intake system of the engine.

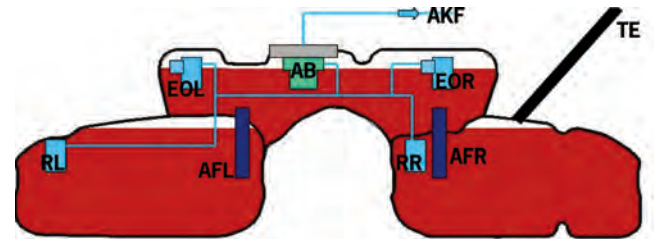
- On the naturally aspirated engine (and on the turbo engine if no boost pressure is present), this takes place below the electronic accelerator directly into the intake manifold.
- On the turbo engine with boost pressure, this takes place to the intake side of the left turbocharger.



3 - Tank Vent Valve
4 - Positive Crankcase Ventilation

Positive Crankcase Ventilation

Positive crankcase ventilation also takes place into the intake system. On the naturally aspirated engine, this takes place on the left of the electronic accelerator directly into the intake manifold and on the turbo engine if no boost pressure is present (4). On the turbo engine with boost pressure, this takes place to the intake side of the left turbocharger.



View from rear of vehicle



View from passenger side

- TE – Filler neck
- AFR – Vapor separator right
- AFL – Vapor separator left
- RR – Roll-over valve right
- RL – Roll-over valve left
- EOR – Vent line upper right (with roll-over valve)
- EOL – Vent line upper left (with roll-over valve)
- AB – Main vapor separator
- AKF – Line to Charcoal canister

Fuel, Exhaust & Engine Electrical – V8

Fuel Tank Ventilation (Cont'd)



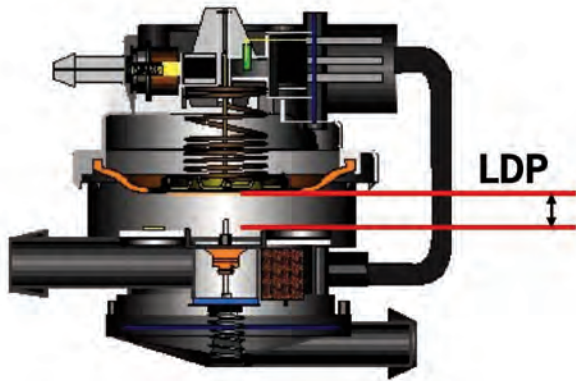
- TE – Filler neck
- AS – Anti- Spitbackvalve
- BE – Filler neck vent line
- AFR – Vapor separator right
- AFL – Vapor separator left
- EOR – Ventilation line upper right (with roll-over valve)
- EOL – Ventilation line upper left (with roll-over valve)
- RR – Roll-over valve right
- RL – Roll-over valve left
- AB – Main vapor seperator
- AKF – Vapor line to Carbon Canister
- KF – Fuel filter in tank flange

Fuel Filler Neck



AS - Anti-Spit-back valve

Leakage Diagnostic Pump (LDP) (USA vehicles)



The functional principle of the leakage diagnostic pump (LDP) is identical to that of the Cayenne vehicles. The complete fuel tank system is checked for possible leaks using the positive pressure method. This takes place only when the engine is running. The LDP is an electro-pneumatic diaphragm pump which is supplied via the vacuum pump on the engine. Evaluation by means of a reed contact switch located on the diaphragm takes place after the pumping phase.



Carbon Canister and LDP

LDP – Leak Diagnosis Pump
F – Air filter for flushing air line



Carbon Canister and LDP (other side)



Inside view of Carbon Canister



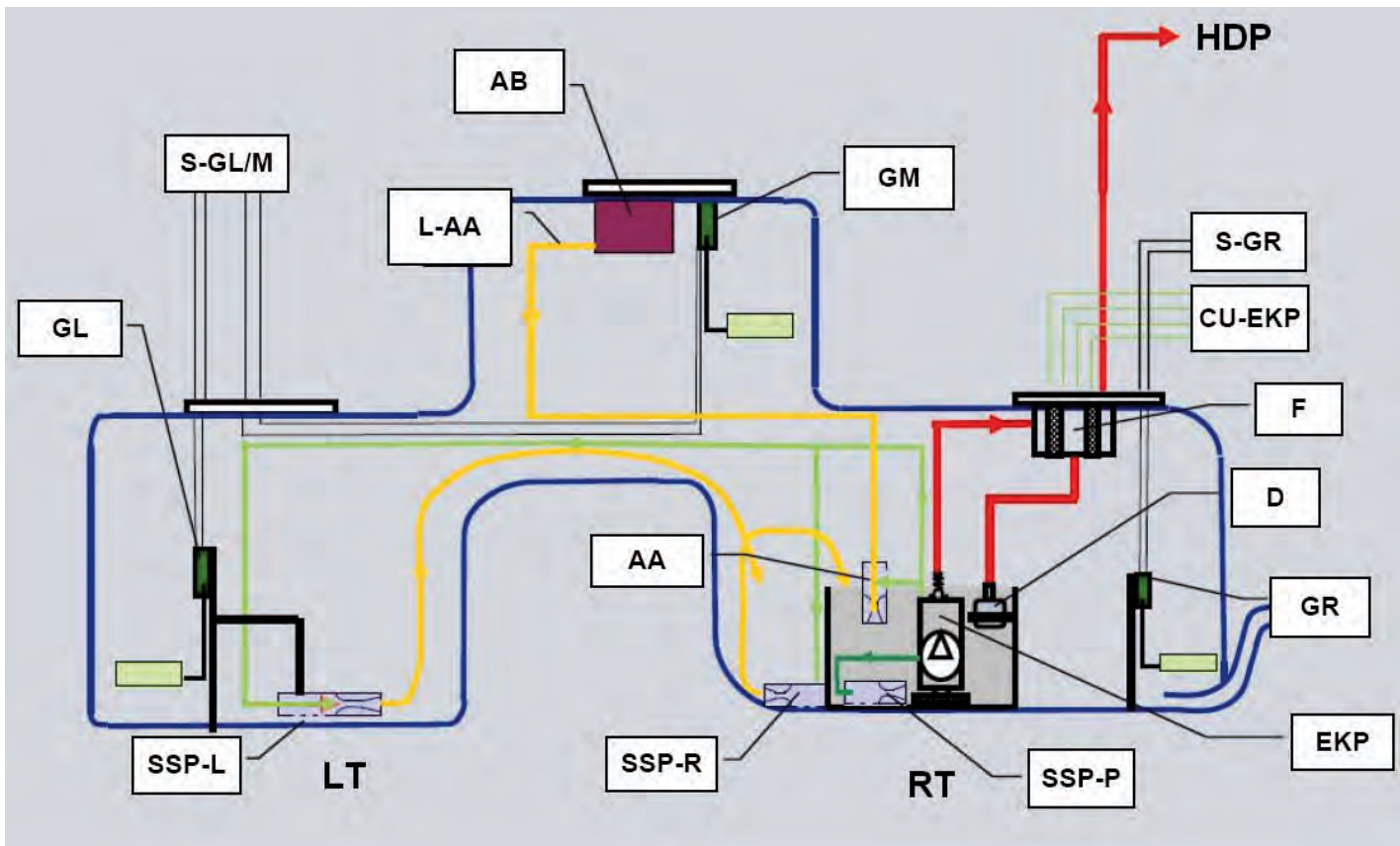
Note!

The procedures for checking the fuel pressure, holding pressure and delivery rate of the electric fuel pump are described in the Technical Manual.

Notes:

Fuel, Exhaust & Engine Electrical – V8

Diagram of the fuel tank low-pressure side RLFS



- LT - Left tank chamber
- RT - Right tank chamber
- CU-EKP - Control unit for electric fuel pump
- EKP - Electric fuel pump (demand-controlled)
- F - Fuel filter (lifetime filter)
- D - Fuel-pressure regulator (approx. 80 psi/5.5 bar rel.)
- HDP - To the quantity control valve on the fuel high-pressure pump
- SSP-L - Suction jet pump, left (0.5 mm 80 psi/5.5 bar),
delivers to right tank chamber
- SSP-R - Suction jet pump, right (0.5 mm 80 psi/5.5 bar), fills the pump chamber
- SSP-P - Suction jet pump for filling the electric fuel pump (up to approx. 29 psi/2 bar)
- AB - Degassing tank
- L-AA - Line from degassing tank to active extraction system
- AA - Active extraction (0.3 mm) from the degassing tank
- GL - Fuel-level sensor, left (MAPPS - Magnetic Passive Position Sensor)
- GM - Fuel-level sensor, centre (MAPPS)
- GR - Fuel-level sensor, right (MAPPS)
- S-GLM - Signal from left and center fuel-level sensors
- S-GR - Signal from right fuel-level sensor

Fuel Supply, High-Pressure Side

Direct Fuel Injection (DFI)

The high-pressure fuel system (from the high-pressure pump to the injectors) is comparable with that of the Cayenne 8-cylinder DFI engines.



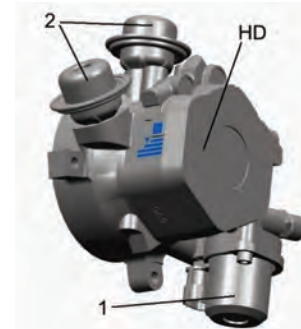
The picture shows the 3-piston high-pressure pump of the Panamera S

The direct fuel injection is optimally matched to the characteristics of the V8 naturally aspirated engine and V8 bi-turbo engine. An axial piston pump is used in both engines. This is driven by the left intake camshaft. In the V8 naturally aspirated engine, the fuel high pressure is built by up 3 pistons. In the V8 bi-turbo engine, this is done by 6 pistons. Fuel is distributed in both engines via a central high-pressure fuel rail in the inner-V of the engine with separate lines leading to the fuel injectors. When the engine is running, the high pressure is measured by the pressure sensor and is regulated to a pressure of between approx. 580 and 1740 psi (40 and 120 bar) by the quantity control valve (at the input of the high-pressure pump).

Notes:

High-Pressure Pump

This provides the high pressure of between approx. 580 and 1740 psi (40 and 120 bar) needed for injection. The pump is driven via the intake camshaft of the left cylinder bank.



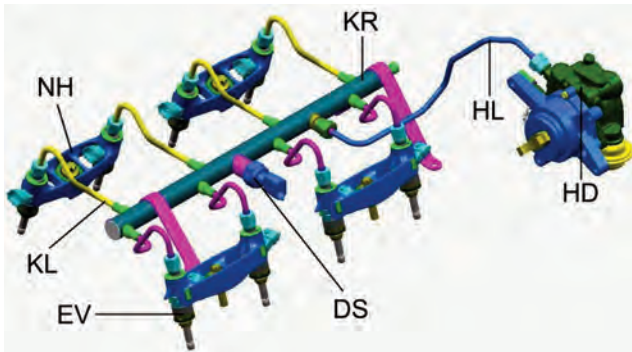
- Naturally aspirated engine – 3-piston high-pressure pump (HD) with quantity control valve and 1 damper.
- Turbo engine – 6-piston high-pressure pump (HD) with quantity control valve (1) and 2 dampers (2).

Quantity Control Valve

The quantity control valve installed at the inlet port of the high-pressure pump regulates the fuel high pressure.

Fuel, Exhaust & Engine Electrical – V8

High-Pressure Rail



The central high-pressure rail (KR) is located in the inner-V of the engine, from where the fuel is supplied to the injectors via individual lines. The volume of the high-pressure rail differs for the naturally aspirated and turbo engines. The high-pressure rail provides the same pressure for all injectors.

Pressure Sensor

The pressure sensor (DS) on the high-pressure rail measures the fuel high pressure at approx. 580 and 1740 psi (40 and 120 bar) .

Fuel Injectors

The injectors (EV) are solenoid-operated and are positioned beneath the intake ducts of each cylinder. They inject the fuel under high pressure directly into the combustion chamber. To open an injector, the activation voltage is briefly raised to up to 75 V by means of a voltage booster in the DME control unit.

The V8 naturally aspirated engine injection quantity is 210 g/min and V8 Turbo engine injection quantity is 349 g/min.

Ignition System

Ignition Coils

The Panamera features static high-voltage ignition distribution with individual ignition coils for each spark plug. The individual ignition coils with integral drivers have the following advantages:

- High level of ignition reliability
- Minimum electromagnetic interference with other electronic components
- No requirement for ignition cables and distributor

The function of the ignition distributor is performed by the engine control unit. All of the described advantages of the ignition system ensure safe ignition processes and contribute to optimized power output together with reduced emissions and fuel consumption.



- Individual ignition coils (1) with integral driver
- Aluminum screws (2) for securing on the magnesium cover
- Engine compartment temperature sensor (3)



Note!

After removal of the ignition coils, the screws must be replaced with new screws. The following must be observed, for example, when securing the ignition coils:

- > The screw threads must be absolutely clean.
- > Aluminum screws must always be tightened in two steps (torque and torque angle) or using a special yield-point wrench.
- > Aluminum screws must not be installed using the tightening parameters for steel screws. Subsequent clicking with the wrench is not necessary and can damage the screws.

Intake System

Air Filter



On the new Panamera the air filter housing is located under the front apron (1). To access you must remove the front apron to change the air filter element.

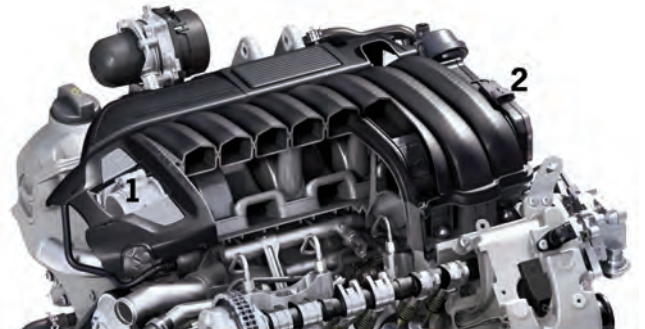


The recommended replacement interval will be 80,000 miles or every 4 years.

In the naturally aspirated engines, the 2 air ducts from the air filter housing are joined before the electronic accelerator.

Intake System for Naturally Aspirated Engine

Like the Cayenne GTS, the Panamera S is equipped with a throttle valve (electronic accelerator) with a diameter of 82 mm (Cayenne S 76 mm). The new intake manifold is provided with a mounting at the rear for the new pressure sensor for load detection.



- 1 - Electronic accelerator for Panamera S throttle valve diameter 82 mm.
- 2 - Modified intake system with mounting for pressure sensor (at rear of intake manifold).



- 2 - Pressure sensor (at rear of intake manifold).

The intake system with variable intake manifold combines the advantage of a long intake manifold – higher torque at low rpm – with that of a short one: high specific output in the upper rpm range. For this purpose, the resonance intake system uses the air mass oscillations in the intake tract, dependent on the engine speed, to achieve better volumetric efficiency of the engine. Depending on the position of the intake manifold flap, this permits realization of a high torque curve in conjunction with the optimized intake duct geometry.

The DME control unit controls the electro-pneumatic switching valve, which switches a vacuum to the diaphragm cell in order to switch to the long intake manifold length at low engine speeds. Switching to the short intake manifold takes place as from mid-range engine speeds. The proven production process from the Cayenne has made it possible to manufacture the multi-part intake system from plastic to achieve the lowest possible weight.

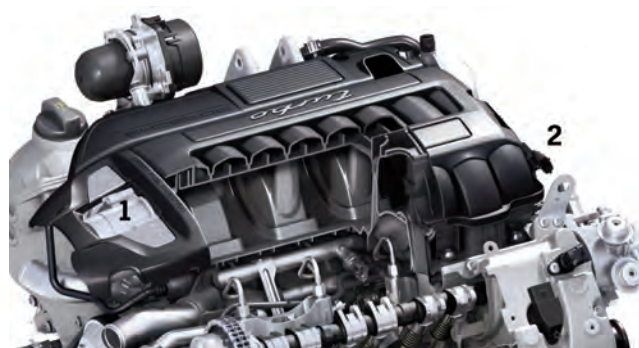
Fuel, Exhaust & Engine Electrical – V8

Intake System for Turbo Engine

In the turbo engine, the intake air is routed from the air-cleaner housing via the separate air ducts on the left and right directly to the intake side of the respective turbocharger.



After the compressor, the compressed and heated air is cooled in the charge-air coolers on the left and right and then routed together again ahead of the electronic accelerator. Cooling of the charge air ensures high cylinder charging and reduced component temperatures.



- 1 - Air routing via the air cleaner, turbochargers and charge-air coolers to the electronic accelerator.
- 2 - Modified turbo intake system with mounting for pressure sensor for load detection (at rear of intake manifold).



2 - Pressure sensor (at rear of intake manifold).

The intake system of the Panamera Turbo does not require any flaps since the charge effect is produced by the two turbochargers. This means that the short intake manifold lengths are effective for the entire map.

Deceleration air control is activated in deceleration mode. For this purpose, a connection is produced between the pressure side and suction side of the intake air on each turbocharger. Activation takes place when the DME control unit switches the electric switching valve (installed below the intake manifold). The vacuum then opens the diaphragm cells for deceleration air control on the left and right.

Notes:

Boost Pressure Control Turbo



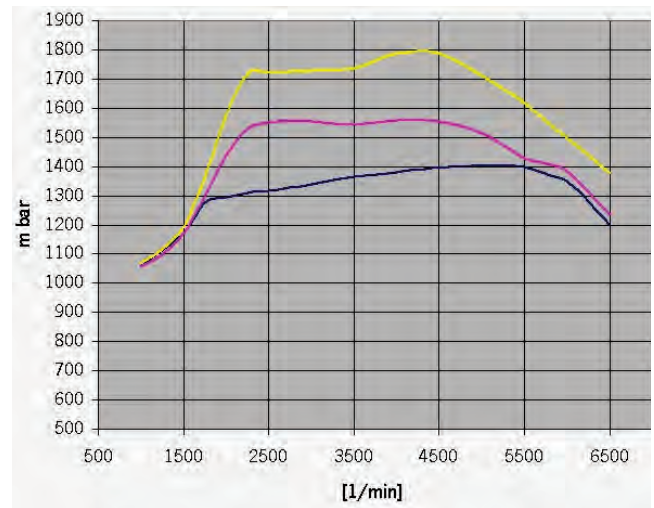
The boost pressure is detected by the boost-pressure sensor ahead of the electronic accelerator. Similar to the Panamera S, the intake air temperature is detected by the pressure sensor for the engine load at the rear of the intake manifold.



- 3 - Pressure sensor for boost pressure control ahead of the throttle valve (without temperature measurement).
4 - Electric valve for boost pressure control.

Boost pressure control takes place ahead of the throttle valve. The DME control unit regulates the boost pressure by activating the electric boost pressure control valve (installed on the left next to the electronic accelerator). This modulates a corresponding control pressure for activating the wastegate valves on the turbochargers. The boost pressure is therefore regulated to the boost pressure setpoint calculated in the DME control unit ahead of the electronic accelerator.

With the optional Sport Chrono Turbo Package the overboost function briefly increases the boost pressure (max. torque 770 Nm).



The graph shows the boost pressure curve for the Cayenne Turbo DFI engine at full throttle.

rpm - Engine speed in rpm

mbar - Boost pressure (in millibar absolute pressure)

blue - Basic boost pressure in emergency mode

purple - Boost pressure in normal mode

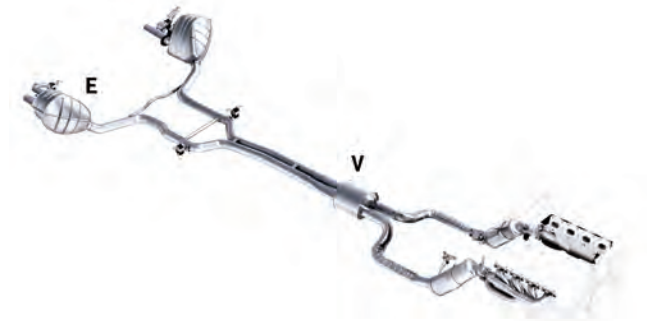
yellow - Boost pressure with Sport button activated

Fuel, Exhaust & Engine Electrical – V8

Exhaust Systems, Emission Control

Exhaust System – Panamera S/4S

A special exhaust system made of long-life stainless steel is used for the new Panamera S and 4S. The front muffler contains an integrated branch coupling connection between the left and right exhaust branches; the rear mufflers on the right and left have twin-tailpipe covers (standard equipment).



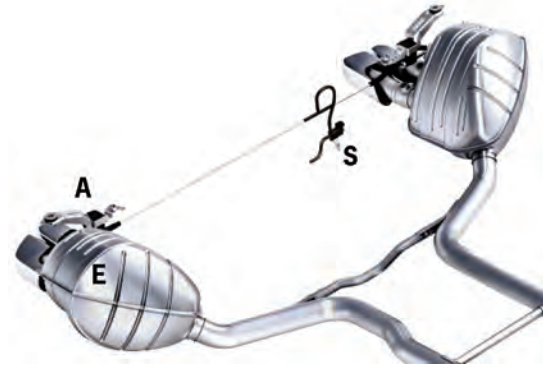
V - Front muffler with integrated branch coupling connection.
E - Rear mufflers right/left.



Twin-tailpipe covers (standard equipment).

Optional Sports Exhaust System

A sports exhaust system is offered additionally for all Panamera models. Like the standard exhaust system, the sports exhaust system up to the rear muffler consists of 2 primary catalytic converters and 2 main catalytic converters as well as a center muffler. The main muffler provides a rich and full sound typical of the V8 engines.



Both rear mufflers (E) with vacuum-controlled exhaust flaps (A) for an especially sporty sound. Electric switching valve (S) for vacuum control.



Sports Exhaust Twin-tailpipe covers (optional).

Similar to the exhaust system of the Panamera Turbo, there are two exhaust flaps in each case between the rear mufflers and the tailpipe covers which can be opened in order to achieve improved throughput. The tailpipe design is characterised by two striking twin tailpipes with titanium-colored trim elements that are additionally installed with distinctive twin-tailpipe covers made of stainless steel. An additional button for activating the sports exhaust system is integrated in the center console. The sound of the sports exhaust system is controlled taking into account the parameters of load, speed, engine speed and gear. This provides a richer sports car sound at the push of a button.

Exhaust Manifold and Catalytic Converters

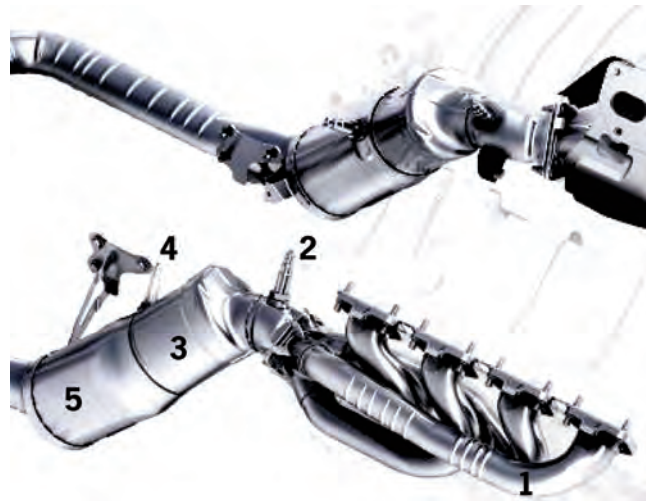
To keep emissions low in the cold start phase in particular, it is important that the catalytic converter reaches its optimal operating temperature quickly. For this reason, the exhaust manifolds of all Panamera models are very short so that the high exhaust gas temperature can be used to heat the catalytic converters. This allows the highly-efficient pre- and main catalytic converters to heat up quickly and guarantee effective emission control.



1 - Thin-wall tubular manifold with long single pipe routing for an optimum gas cycle.



The cylinder bank-specific LSU oxygen sensors ahead of the catalytic converter and LSF oxygen sensors behind the catalytic converter signal the exhaust gas composition to the DME control unit. The DME control unit can then use this information for targeted intervention in bank-specific mixture control. This ensures that the strictest emission standards are met - for the Panamera S and 4S: EU 5 in Europe and ULEV in the USA.



- 2 - Wideband oxygen sensor LSU 4.9 ahead of catalytic converter
- 3 - Pre-catalytic converter
- 4 - Step oxygen sensor LSF 4.2 behind catalytic converter
- 5 - Main catalytic converter



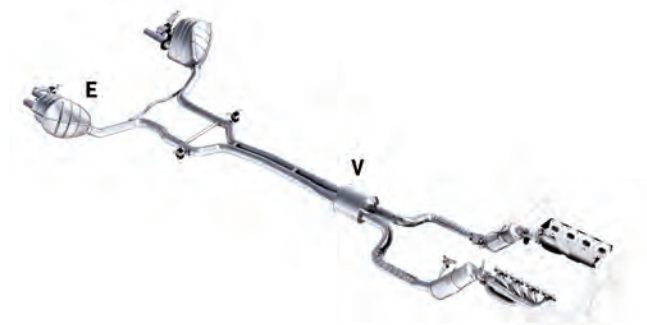
The 3-way cascade catalytic converters on the left and right each contain a pre- and main catalytic converter.

Notes:

Fuel, Exhaust & Engine Electrical – V8

Exhaust System – Panamera Turbo

There are a number of differences in the exhaust system of the V8 turbo engine compared with the exhaust system of the V8 naturally aspirated engine. For example, the pipes of the exhaust system on the Panamera Turbo have wider cross-sections than those in the exhaust system of the V8 naturally aspirated engine. This results in comparable exhaust gas speeds in both exhaust systems. The branch coupling connection installed in the V8 naturally aspirated engine is omitted for the V8 bi-turbo engine. For the latter, perforated pipes are routed through a common chamber of the center muffler. These have the same effect as a branch coupling connection. As with the V8 naturally aspirated engine, the rear muffler of the V8 turbo engine is installed visibly as a design element.



V - Front muffler with perforated pipes
E - Rear mufflers with switchable exhaust flaps (standard)



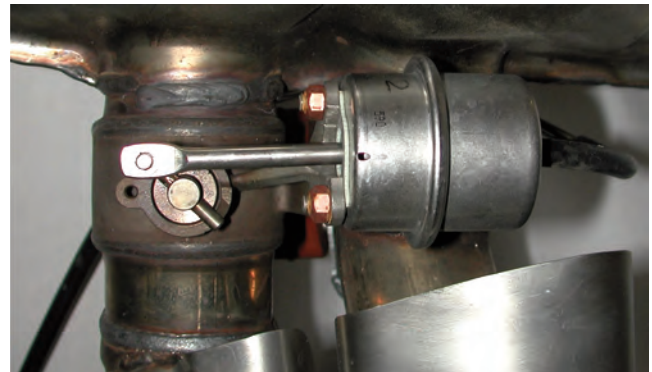
Twin-tailpipe covers (standard equipment).



Sports Exhaust Twin-tailpipe covers (optional).

The exhaust emissions leave the Panamera Turbo through two twin tailpipes in matt silver which differ in design from the tailpipes of the V8 naturally aspirated engine. Unlike the tailpipes of the Panamera S/4S, these tailpipes are rectangular. Optimum sound is achieved in all engine speed ranges through specific insulation and pipe routing in the rear muffler as well as by means of specially designed tailpipes.

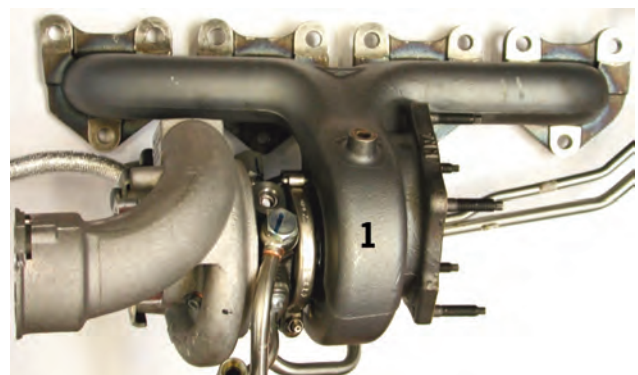
The exhaust system of the V8 turbo engine automatically switches between two operating states: as a result, there is a low noise level in the lower rpm range, and this increases in the high rpm range and at full throttle due to improved throughput. The improved throughput is achieved by opening the exhaust flaps located on one of the two exhaust pipes between the rear muffler and tailpipe cover in each case. This opens the second exhaust pipe in each muffler.



Switchable exhaust flap.

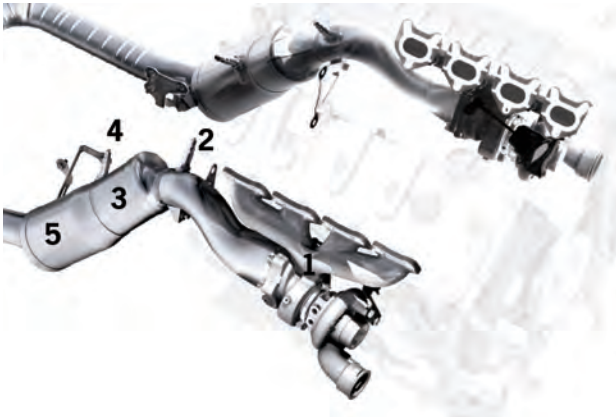
Exhaust Manifold and Catalytic Converters

A single-piece exhaust manifold turbocharger module made of high-temperature-resistant cast steel without intermediate flange has been realized for the first time for the Porsche V8 engine.



1 - Single-piece exhaust manifold turbocharger module made of cast steel (flow-optimized with integral turbocharger housing).

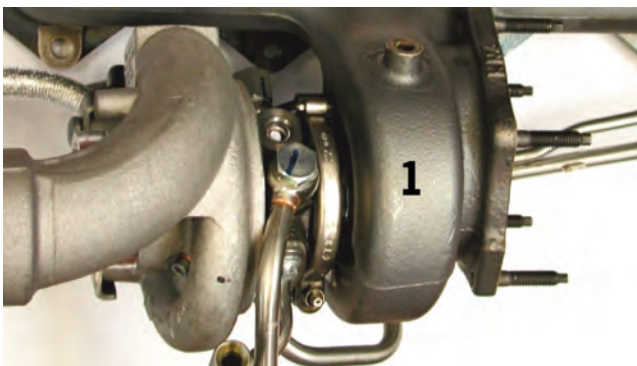
The cylinder bank-specific LSU oxygen sensors ahead of the catalytic converter and LSF oxygen sensors behind the catalytic converter signal the exhaust gas composition to the DME control unit. The DME control unit can then use this information for targeted intervention in bank-specific mixture control. This ensures that the strictest emission standards are met or even bettered - for the Panamera Turbo: EU 5 in Europe and LEV in the USA.



- 2 - Wideband oxygen sensor LSU 4.9 ahead of catalytic converter
- 3 - Pre-catalytic converter
- 4 - Step oxygen sensor LSF 4.2 behind catalytic converter
- 5 - Main catalytic converter

Turbochargers

The two turbochargers are arranged in parallel. The compact exhaust manifold turbocharger modules for each cylinder bank are adapted to the engine and ensure good responsiveness in combination with the compact intake manifold volume. A small intake manifold volume, short exhaust manifolds and newly designed turbochargers adapted to the air requirements of the engine ensure good responsiveness. At the same time, the degree of form freedom allowed by this design makes it possible to realise flow-optimized cross-sections and ensure minimum pressure loss in front of the turbine.

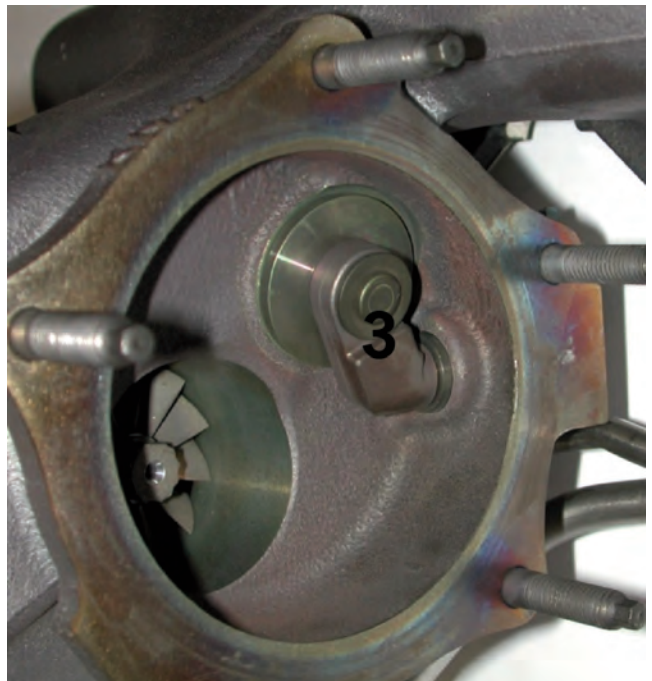


- 1 - Water-cooled turbocharger directly integrated in the cast steel exhaust manifold.

The DME control unit regulates the boost pressure by activating the electric boost pressure control valve (installed on the left next to the electronic accelerator). This modulates a corresponding control pressure onto the diaphragm cell (2) for activating the wastegate valves (3) on the turbochargers.



- 2 - Diaphragm valve for controlling wastegate.



- 3 - Wastegate valve.

Fuel, Exhaust & Engine Electrical – V6

DME Engine Electronics



V6 Engine Specifications

DME control unit	EMS SDI 7.1
Displacement	3.6 liter
Power	300 hp (220kW)
Torque	400 Nm
Compression ratio	12.5
Idle speed	635 rpm
Max. engine speed	6,700 rpm
VarioCam Plus	0 - 50° crank angle

Development objectives for the V6 DFI engine:

- High engine power
- High maximum torque
- Low fuel consumption
- Low emissions

The objectives were realized by the following measures:

- Thermal management
- Auto Start Stop function
- Variable deceleration fuel cutoff
- Vehicle electrical system recuperation
- Reduced component weight

The current V8 engine of the Panamera S, 4S and Turbo models already features a host of innovative technologies and concepts. These have been adopted in the V6 engine and further enhanced.

General Information

Newly developed, highly efficient 3.6 l V6 engines are used in the new Panamera and Panamera 4. These engines were based on the units installed in the V8 models. Like the latter, they have a fully aluminum design and feature direct fuel injection (DFI) and VarioCam Plus. As a result, the Panamera and Panamera 4 develop a power output of 300 hp (220 kW) at 6,500 rpm and a maximum torque of 400 Nm at 3,750 rpm.

DME Control Unit DFI, EMS SDI 7.1



Components and functions adopted or modified from the Panamera S:

- Differential Hall sensor on the crankshaft for detection of the engine speed
- Reference mark and direction of rotation of the engine
- Pressure sensor on the intake manifold to detect the mass air flow and the intake air temperature
- Control unit for electric fuel pump
- Thermal management
- Auto Start Stop function
- Variable deceleration fuel cutoff
- Vehicle electrical system recuperation

The DME control unit EMS SDI 7.1 controls the following functions and communicates with the corresponding components:

- Direct fuel injection (DFI)
- Returnless fuel system
- Fuel high-pressure control
- Electronic accelerator pedal
- Electronic throttle with idle speed control
- VarioCam Plus
- Demand-controlled oil pump
- Intake system with variable intake manifold
- Stereo lambda control circuits
- Static high-voltage ignition distribution with individual ignition coils

- Cylinder-selective knock control (with 2 knock sensors)
- Differential Hall sensor (detects engine speed, reference mark and engine direction of rotation)
- Pressure sensor on the intake manifold (detects intake manifold pressure and intake air temperature)
- Thermal management
- Auto Start Stop function
- Variable deceleration fuel cutoff
- Vehicle electrical system recuperation
- On-board diagnosis for monitoring the emission control system

The new DME control unit EMS SDI 7.1 of the V6 engines has fewer drivers for the injectors and ignition coils than the V8 control unit. In addition, the intake system, exhaust system and fuel rail have been adapted specifically for the V6 engine.

Thermal Management

The cooling system is part of the thermal management system and has two circuits which can be regulated depending on the coolant temperature. In the Panamera, this is done by an electric, map-controlled and deactivatable thermostat. The thermostat permits automatic, demand-based suppression of the coolant flow when the engine is cold (cold start). As a result, the engine heats up more quickly (Start Stop operating condition is reached more quickly) and friction, fuel consumption and pollutant emissions are reduced in the warm-up phase.

Depending on the increase in engine temperature, the coolant flow through the engine (small circuit) is then activated during warming up. After this, the coolant radiator is activated (large circuit) depending on the engine operating point and based on a map stored in the engine control. The map control of the thermostat then regulates the coolant temperature between 201° F. (94° C.) and 221° F. (105° C), depending on engine speed, and therefore ensures optimum friction conditions in the engine that are adapted to the respective load point. This thermal management made it possible to reduce fuel consumption by up to 1.5 %.



Note!

The function of the thermal management system and the diagnostic options were already described in the V8 section.

Auto Start Stop function

The Auto Start Stop function was adopted from the V8 models. All Panamera models feature the Auto Start Stop function in combination with PDK. This function automatically switches off the engine when the vehicle is stationary, e.g. at a traffic light or in a traffic jam. The system starts the engine again when the brake is released. This saves fuel and reduces CO₂ emissions without the driver having to adapt his/her driving style. The audio and communication systems remain switched on in spite of the fact that the engine has been switched off and the air conditioning system also maintains the selected temperature.

The engine is started again if more energy or cooling power is needed. The Auto Start Stop function can be activated and deactivated by way of a button in the center console. This function is inactive in certain situations, e.g. at very high outside temperatures, on steep uphill gradients or if the battery charge is low. The starter was adapted to meet the increased demands. The charge state and aging condition of the battery are continuously monitored.

Variable Deceleration Fuel Cutoff

Variable deceleration fuel cutoff is a further development of conventional deceleration fuel cutoff for controlled interruption of the fuel supply in overrun condition, e.g. when driving downhill. After a phase with deceleration fuel cutoff, fuel injection is resumed variably depending on the driving situation, which may correspond to an even lower engine speed.

Vehicle Electrical System Recuperation

All Panamera models now feature vehicle electrical system recuperation for improved fuel economy. With this function, the battery is charged during the braking phases. In contrast, the charging current of the alternator is restricted during acceleration, which means that the combustion engine has to supply less power to charge the battery.



Note!

The function of the Auto Start Stop system and the diagnostic options were already described in the V8 section.

Increase in Idle Speed to Increase the Charging Current

In the Panamera, the idle speed can be increased if a corresponding request is received from the Gateway in order to increase the charging current of the generator. The field current is regulated in the gateway. There is no increase in stage 1 for the V6 engine (base idle speed of the V6 corresponds approximately to stage 1 of the V8). The speed is increased to 700 rpm in stage 2 and 880 rpm in stage 3.

DME Diagnosis

The diagnostic options in the DME area largely correspond to those of the DFI control unit EMS SDI 6.1 of the Panamera engines with:

- adaptation to current components/functions, e.g. new sensors/systems
- extension for new functions, e.g. Start Stop system, thermal management

Fault Memory

Adaptation to current legal requirements (e.g. USA: Permanent fault memory = Mode A, via Scan Tool)

Fault Deletion Counter

40 warm-up phases have to be completed to delete a sporadic fault in order to decrement the deletion counter from 40 to 0.

Actual Values

- Mixture adaptations are preserved in the event of an interruption in the power supply
- Extension of actual values, e.g. Start Stop system, thermal management

Drive Links

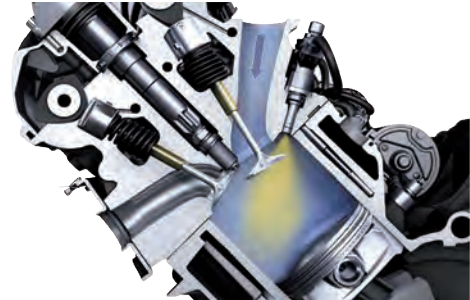
- New drive links, (e.g. for Start Stop system)



Note!

For the DFI control unit EMS SDI 7.1 also, a corresponding code comprising letters and numbers is specified in front of every actual value for each actual value filter. This simplifies assignment in the case of different languages. The explanation for individually selected values is also displayed by means of the Help key (?).

DME Injection Strategies V6 DFI



Characteristics of direct fuel injection:

- High cylinder charging
- Low knock sensitivity
- High compression ratio
- High-pressure stratified charge injection
- Multiple injection possible
- Homogeneous operation (=1) with engine at operating temperature

In the case of direct fuel injection, the fuel is injected directly into the combustion chamber, so that mixture formation takes place almost entirely within the combustion chamber.

The direct fuel injection system used in the Panamera engines is based on homogeneous operation when the engine is at operating temperature. The mixture of fuel and air is distributed as evenly as possible in the combustion chamber, thereby enabling optimal combustion. In this process, the fuel is injected directly in the combustion chamber at a pressure of up to 1740 psi (120 bar). The jet and cone angles of the injectors have been optimized to achieve optimum homogenization across the entire operating range.

Within the injector, the fuel jet is swirled (rotated about the longitudinal axis). This rotation forms a cone-shaped cloud of fuel. This results in fine atomization which in turn enables quicker evaporation of the fuel. The heat energy required for this is removed from the air by the fuel evaporation and this cools the air as a result. This reduces the cylinder charge volume and additional air is drawn in through the open intake valve, which in turn improves cylinder filling.

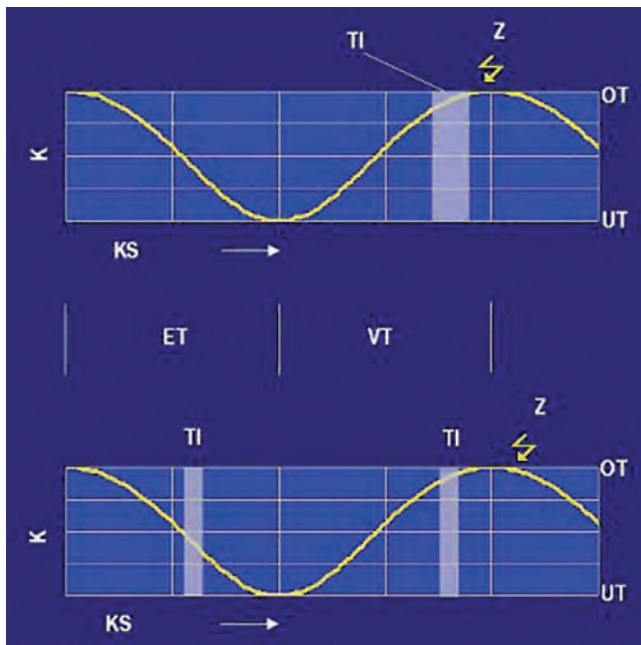
The reduced temperature level also helps to create the prerequisites for the high compression ratio in all Panamera engines, since knock sensitivity and engine efficiency have been improved.

Fuel, Exhaust & Engine Electrical – V6

Injection Strategies

The recesses in the piston are important for high-pressure stratified-charge injection and for dual injection during the catalytic converter heating phase. They allow late injection of fuel in order to create an ignitable air/fuel mixture around the spark plug for late ignition.

With high-pressure stratified-charge ignition, DFI injects the fuel very late during the engine start, just before the end of the compression stroke. In this so-called high-pressure stratified-charge injection process, a quantity of fuel is injected into the specifically molded piston recesses to create a coating around the spark plugs which produces an ignitable mixture. The piston recess ensures that the injected fuel is channelled directly around the spark plug. This reduces both the amount of fuel required and the emissions compared with intake manifold injection system.



Engine start with single injection (top graph)

Catalytic converter heating with dual injection
(bottom graph)

Legend

- OT Top dead center (TDC)
- UT Bottom dead center (BDC)
- KS Crankshaft position
- K Piston position
- TI Injection
- Z Ignition
- ET Intake stroke
- VT Compression stroke

Catalytic Converter Warm-up

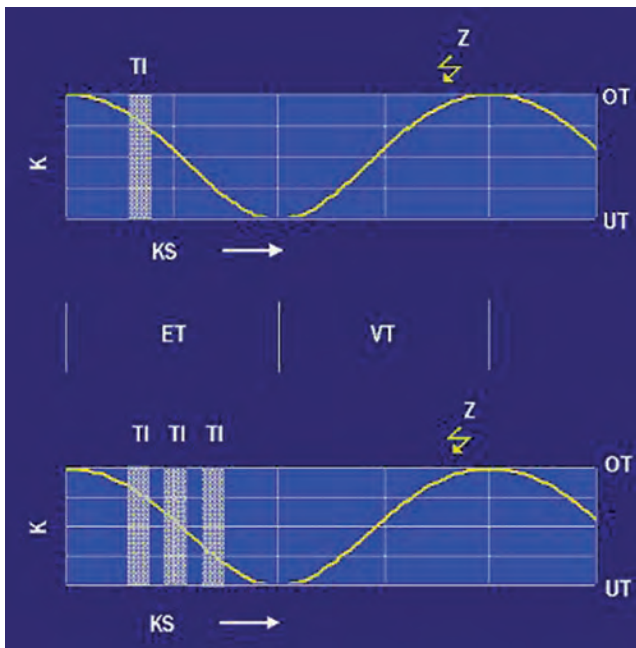
After engine starting by high-pressure stratified-charge ignition, the engine management system switches to the catalytic converter heating phase. In this operating state, a dual injection system helps to bring the catalytic converter to the temperature required for optimal conversion as quickly as possible by increasing the exhaust gas temperature. For this purpose, the second injection is made into the piston recess with closed intake valves shortly before the end of the compression stroke. The fuel-air mixture is ignited very late, thereby increasing the exhaust-gas temperature. This reduces the emissions during the starting phase.

Engine at Operating Temperature (homogeneous operation)

When the engine is at operating temperature, injection into the cylinder takes place only during the intake stroke. In this so-called homogeneous operation there is uniform mixture formation for the entire cylinder charging process.

Single injection at idle speed and partial load up to 3,500 rpm

At speeds close to idle speed and in the lower partial-load range, the engine is operated with a single injection in the intake stroke since this relatively short injection time cannot be divided up.



Single injection at idle speed and partial load up to 3,500 rpm (top graph)

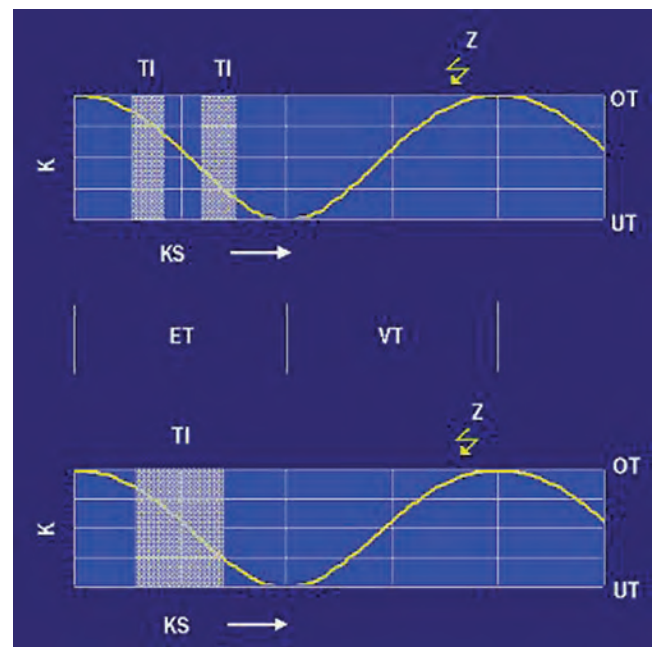
Triple injection at full load 1,000 rpm to 1,900 rpm (bottom graph)

Multiple Injection

In the upper load range, the quantity of fuel needed for combustion is shared between two or three successive injection operations per cycle. This multiple injection takes place during the intake stroke (synchronous intake injection) with open intake valves, thereby ensuring better homogenization (spatial distribution in the combustion chamber) in order to save fuel and increase power output.

Triple Injection

Under conditions with high load (e.g. large valve lift), a triple injection takes place at an engine speed from 1,000 to 1,900 rpm. The quantity of fuel required for combustion is shared between 3 successive injections.



Dual injection at full load 1,900 - 3,500 rpm (top graph)

Under conditions with high load (e.g. large valve lift), a dual injection takes place at an engine speed from 1,900 to 3,500 rpm. The quantity of fuel required for combustion is shared between two successive injection processes.

Single injection at full load above 3,500 rpm (bottom graph)

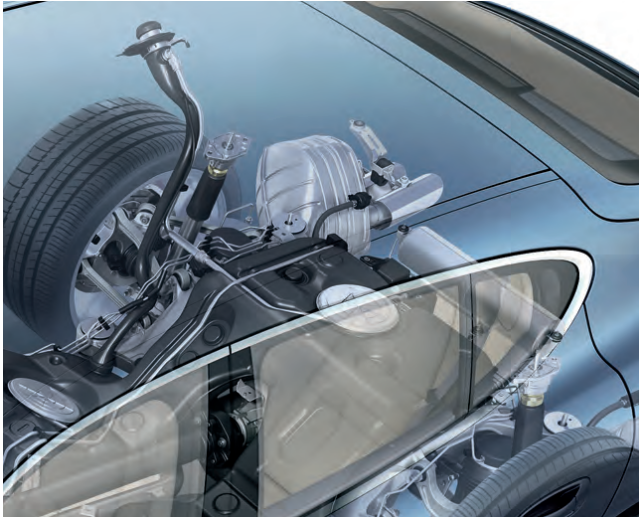
At high load and with an engine speed of over 3,500 rpm, injection takes place only once in the intake stroke, since there is not enough time to divide up the injection time at high engine speeds.

Notes:

Fuel, Exhaust & Engine Electrical – V6

Fuel Supply, Low-Pressure Side

Fuel Tank



The engine is designed to provide optimum performance and fuel consumption with unleaded fuel 93 octane ($\frac{R+M}{2}$). When fuel with 90 octane ($\frac{R+M}{2}$) is used, the engine's knock controller automatically adapts the ignition timing.

In order to make optimum use of the available space, the Panamera is equipped with a saddle step fuel tank with a capacity of approx. 21 Gals. (80 l) on the Panamera V6. This includes approx. 4 Gal. (15 l) reserve capacity.

The following systems and functions are identical with the Panamera S models:

- Internal design of the fuel tank (low-pressure side of the RLFS)
- A demand-controlled electric fuel pump
- Fuel filter (lifetime filter in the tank)
- Fuel-pressure regulator (rel. fuel pressure approx. 80 psi (5.5 bar))
- Tank ventilation via active carbon filter
- Tank leakage diagnosis (LDP)
- Tank vent valve (1)
- Positive crankcase ventilation (2) to intake manifold

The entry point for positive crankcase ventilation directly on the intake manifold has an electric heater to prevent freezing at corresponding temperatures and to therefore avoid the risk of excess pressure in the crankcase.

Tank Ventilation



The fuel tank is aerated and vented exclusively via the active carbon filter, which acts as an intermediate storage device for any HC emissions. Regeneration of the active carbon filter takes place via the tank vent valve when the engine is running.

The active carbon filter is installed behind the fuel tank. The tank vent valve is located on the right next to the electronic throttle. When the engine is running, the system is vented by the tank vent valve to the intake system of the engine (below the electronic throttle directly into the intake manifold).

Leak Detection Pump (LDP)

The functional principle for tank leakage diagnosis (LDP) is identical to that of the Cayenne vehicles. The complete fuel tank system is checked for possible leaks using the positive pressure method. This takes place only when the engine is running. The LDP is an electro-pneumatic diaphragm pump which is supplied via the intake manifold vacuum. Evaluation by means of a reed contact switch located on the diaphragm takes place after the pumping phase.

Positive Crankcase Ventilation

On the V6 engine, positive crankcase ventilation is routed directly into the intake manifold on the left of the electronic throttle.

Control Unit for Electric Fuel Pump



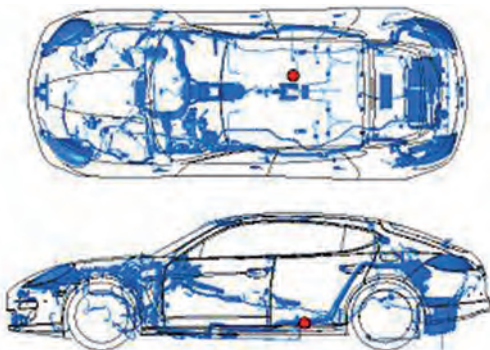
The control unit (S) for the electric fuel pump is used for demand-based control of the fuel delivery rate (like for the V8 models).

Electric Fuel Pump

The speed of the electric fuel pump is regulated by the specified frequency (with limitation of the phase current).

Operating Principle

The fuel pump control unit is installed on the right in front of the fuel tank and has the task of stepless control of the electric fuel pump. This control unit receives the setpoint speed of the fuel pump from the DME control unit via a bidirectional PWM interface and sends back diagnostic information.



Note!

The electric fuel pump must be operated only with the electric control unit.

Power Supply

The control unit is connected to the vehicle electrical system voltage via terminal 30. Terminal 31 represents the connection to vehicle ground.

Control Input

The output of the fuel pump is controlled by the DME control unit by a PWM control signal. This bidirectional PWM interface is also used for diagnosis of the control unit for the electric fuel pump. Diagnostic information is described in Guided Fault Finding.

Control of the Electric Fuel Pump (EKP)

The speed of the electric fuel pump is regulated by way of the specified frequency within the power limits of the fuel pump (with limitation of the phase current) and independently of the vehicle electrical system voltage (voltage compensation). The pump motor is a 3-phase synchronous motor without position feedback and without sensor. Further diagnostic information on the PWM signal and diagnosis is described in Guided Fault Finding.

Activation of the Electric Fuel Pump Via the Door Contact

As soon as the DME control unit switches to Sleep mode, it is awakened again via a CAN wakeup signal when the driver's door is opened on the current Panamera models. The electric fuel pump is then operated at maximum speed for a period of 2 seconds. The electric fuel pump cannot be activated as long as the DME is now active (without ignition on). After the DME has switched back to Sleep mode again, this process can take place a maximum of three times without the ignition being switched on. This limit is designed to protect the vehicle electrical system management. Door contact activation can be activated again for a further three times with ignition On/Off.

Activation When Ignition is Switched On

On the current Panamera models, the electric fuel pump is activated at maximum speed for 1 second when the ignition is switched on. This ensures rapid pressure build-up for a quick "get away".

Ignition System

Ignition Coils

The Panamera V6 features static high-voltage ignition distribution with individual ignition coils for each spark plug.

The individual ignition coils with integral drivers have the following advantages:

- High level of ignition reliability
- Minimum electromagnetic interference with other electronic components
- No requirement for ignition cables and distributor

The function of the ignition distributor is performed by the engine control unit. All of the described advantages of the ignition system ensure safe ignition processes and contribute to optimized power output together with reduced emissions and fuel consumption.



- 1 - Ignition coil
2 - Aluminum screw
3 - Engine compartment temperature sensor

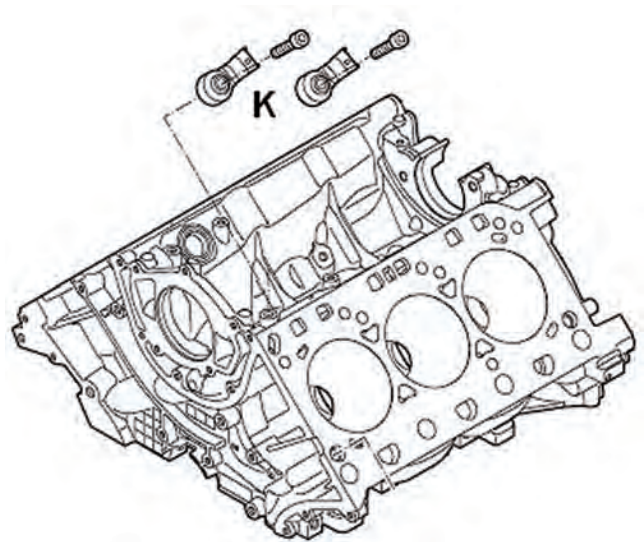


Note!

The aluminum mounting screws of the ignition coils are secured in the magnesium valve cover. In order to prevent consequential damage, it is essential to observe the new tightening method in accordance with the Technical Manual.

Knock Sensors

The V6 engine has 2 knock sensors (K) in the V of the engine block for knock detection (the V8 has 4).



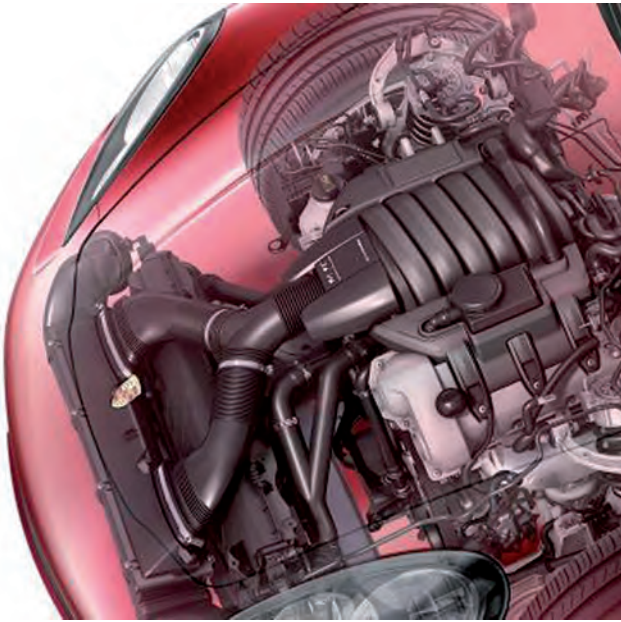
Spark Plugs

The service interval of the V6 engine spark plugs is 40,000 miles or every 4 years.

Fuel, Exhaust & Engine Electrical – V6

Intake System

Air Filter



Changes in the V6 engine (compared with V8) are:

- The air filter housing is located behind the front apron
- The Panamera V6 has only one fresh air intake in front of the air filter housing
- The front apron must be removed to change the air-cleaner element

On the new Panamera the air filter housing is located under the front apron (1). To access you must remove the front apron to change the air filter element.

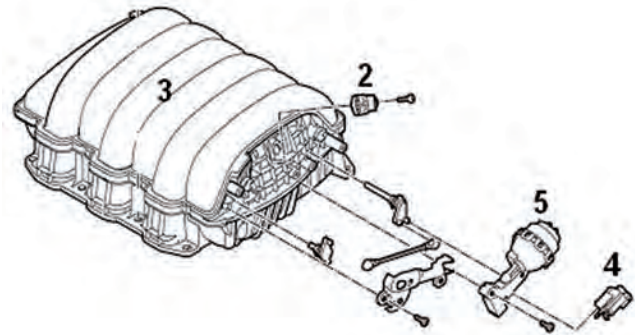


The recommended replacement interval will be 80,000 miles or every 4 years.

Compared with the V8 engines, the left fresh air intake on the air filter housing is omitted. The air filter housing is closed with a cap and a water drain hose is installed instead. In the V6 engine, the 2 air ducts from the air filter housing are joined before the electronic throttle.

Intake Manifold

The intake system developed for the V6 engine is provided with a mounting at the rear for the new pressure sensor for load detection. The intake system with variable intake manifold combines the advantage of a long intake manifold – higher torque at low revs – with that of a short manifold, namely high specific output in the upper rpm range. For this purpose, the resonance intake system uses the air mass oscillations in the intake tract, dependent on the engine speed, to achieve better volumetric efficiency of the engine. Depending on the position of the intake manifold flap, this permits realisation of a high torque curve in conjunction with the optimized intake duct geometry.



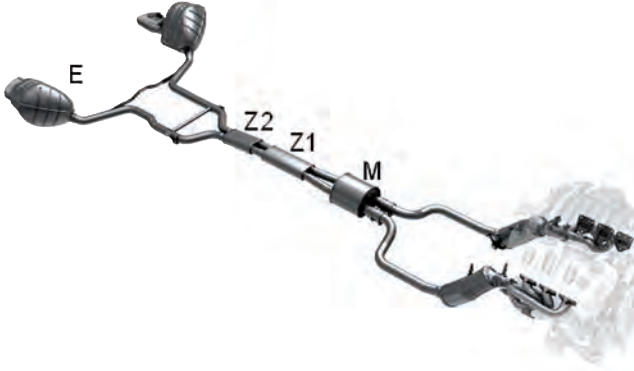
- 1 - Electronic throttle for Panamera Throttle valve diameter 74 mm
- 2 - Pressure sensor at rear of intake manifold
- 3 - Variable intake manifold
- 4 - Electropneumatic change-over valve
- 5 - Diaphragm cell for change-over

The DME control unit controls the electro-pneumatic change-over valve, which switches a vacuum to the diaphragm cell in order to switch to the long intake manifold length at low engine speeds (torque position 578 mm). Switching to the short intake manifold takes place as from an engine speed of 3,680 rpm (power position 304 mm).

Exhaust System

A special exhaust system made of long-life stainless steel is used for the new Panamera V6. The twin-branch exhaust system with 3-way catalytic converters has a common center muffler, two common intermediate mufflers and rear left and right mufflers.

The exhaust systems of the Panamera V6 models feature additional center mufflers, which contribute to optimizing the sound in the passenger compartment while at the same time still allowing the typical Porsche sound. The branch coupling connection on the V6 is located in intermediate muffler 2. This is advantageous for the torque in the low rpm range < 2,000 rpm (it is located in the center muffler on the V8).



- M - Center muffler
- Z1 - Intermediate muffler 1
- Z2 - Intermediate muffler 2 with integrated branch coupling connection
- E - Rear muffler right/left

In contrast to the twin-tailpipe look of the S models, the Panamera and Panamera 4 have one oval tailpipe each on the left and right in a unique design.



Oval tailpipe covers (standard equipment).

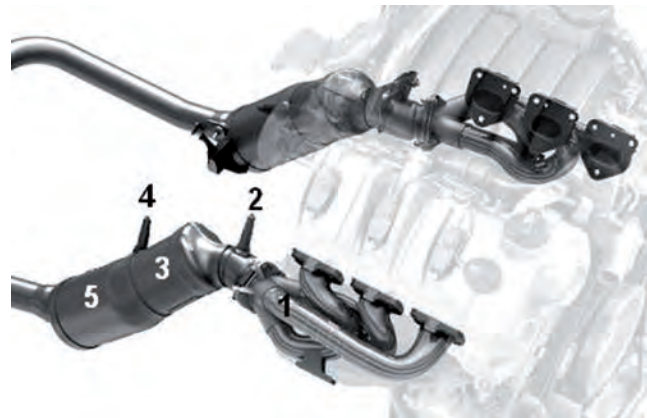
Notes:

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Fuel, Exhaust & Engine Electrical – V6

Exhaust Manifold/Catalytic Converter

To keep emissions low in the cold start phase in particular, it is important that the catalytic converter reaches its optimal operating temperature quickly. For this reason, the exhaust manifolds of all Panamera models are very short so that the high exhaust gas temperature can be used to heat the catalytic converters. This allows the highly-efficient primary and main catalytic converters to heat up quickly and guarantee effective emission control.

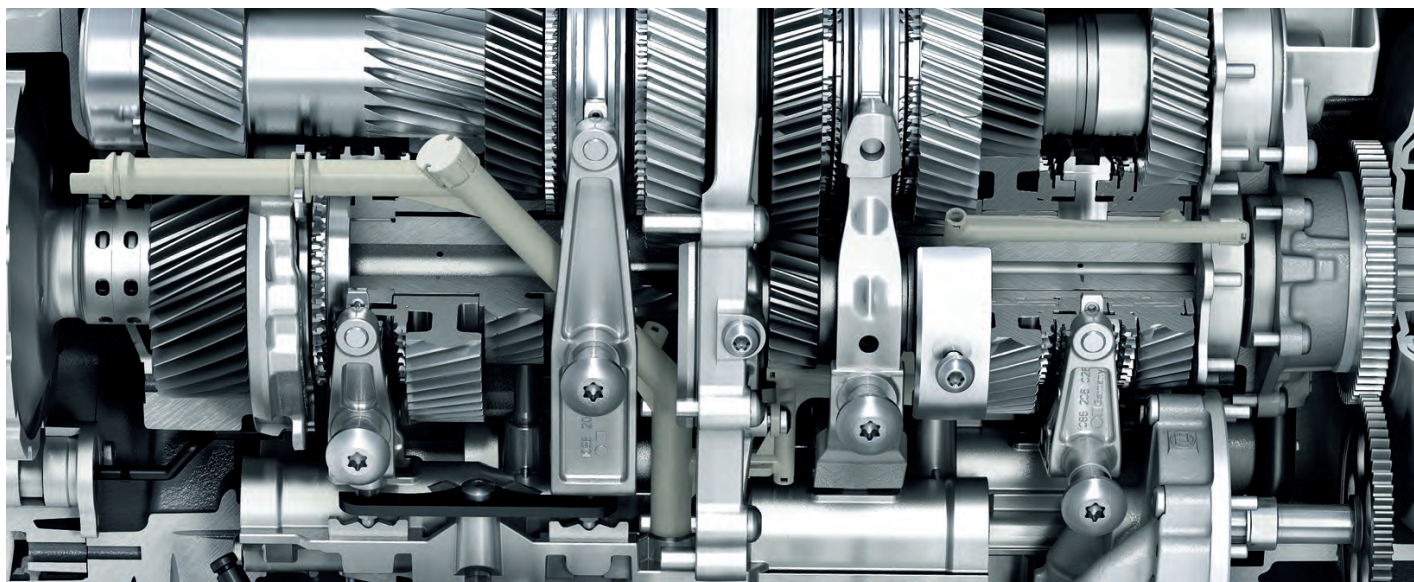


- 1 - Thin-wall tubular manifold with long single-pipe routing for an optimum gas cycle
- 1A - Bottom shield for exhaust manifold (illustrated without the top half)
- 2 - Wideband oxygen sensor LSU 4.9 ahead of catalytic converter
- 3 - Primary catalytic converter 1 (ceramic)
- 4 - Step oxygen sensor LSF 4.2 behind catalytic converter
- 5 - Main catalytic converter (metal)

The 3-way cascade catalytic converters on the left and right each contain one primary and one main catalytic converter. The cylinder bank-specific LSU oxygen sensors ahead of the catalytic converter and LSF oxygen sensors behind the catalytic converter signal the exhaust gas composition to the DME control unit. The DME control unit can then use this information for targeted intervention in bank-specific mixture control. This ensures that the strictest emission standards are met or even bettered.

Emission Standard

All Panamera V6 models comply with the LEV emission standard in the USA and Canada.



Subject	Page
General Information	.2
Porsche Doppelkupplung (PDK) Transmission	.2
PDK Oil Type/Quantity/Change Intervals	.4
Transmission Layout	.5
Operation - Description	.7
3-Spoke Steering Wheel	.8
Display in Instrument Cluster	.8
Gearshift Strategy	.9
Special Functions	.10
Transmission Design	.14
Power Flow	.15
Porsche Traction Management (PTM)	.16
Double Clutch	.18
Shafts and Gears	.19
Parking Lock	.21
Sensors	.21
Shifting	.23
Hydraulic Unit	.24
Transmission Cooling	.25
Limited Slip Differential	.25

Transmission

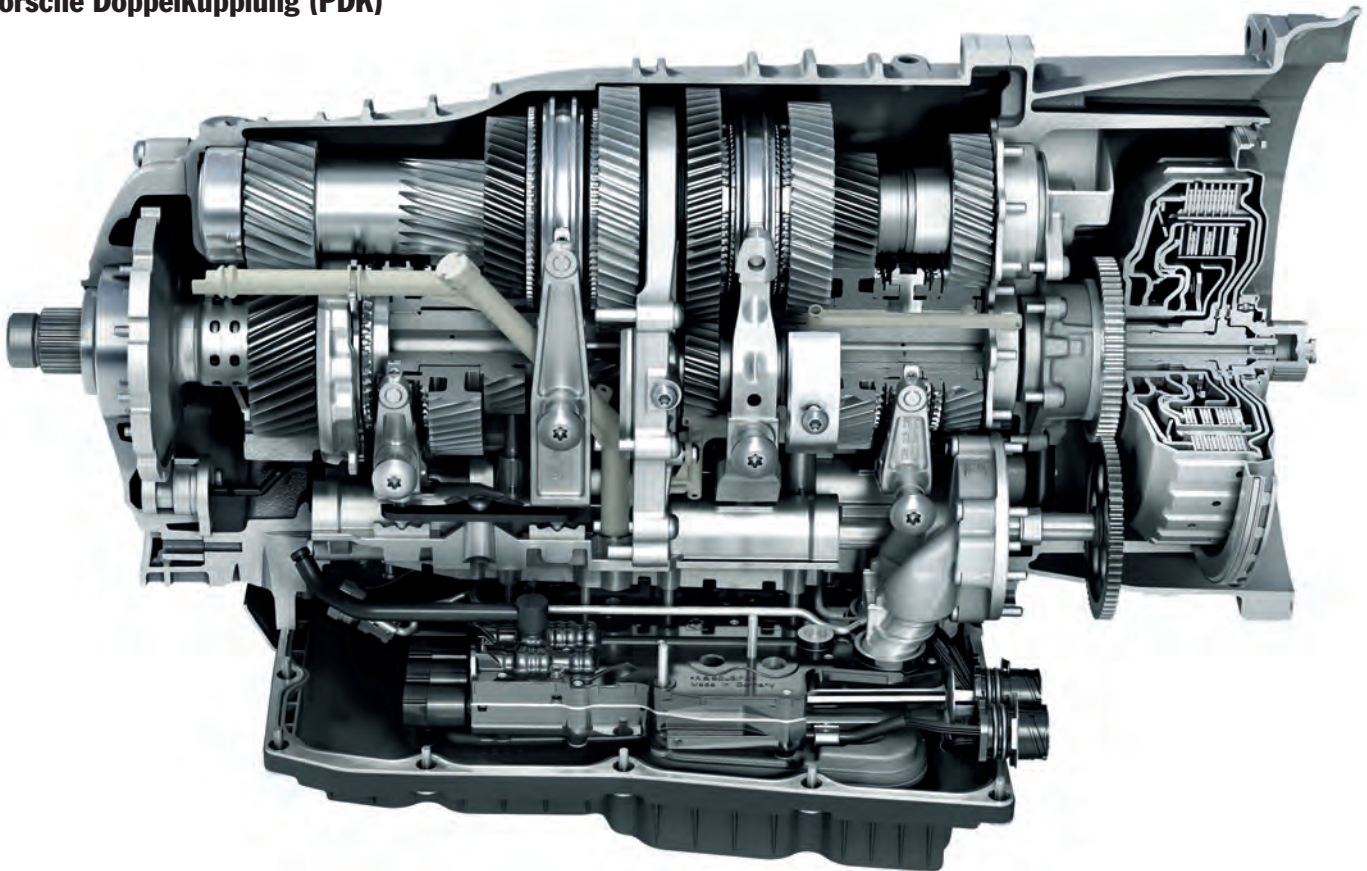
General Information

The Panamera/S model are available with a 6-speed manual transmission in Rest of World (RoW) markets. For the North American market, all Panamera models will get the Porsche Doppelkupplung (PDK) transmission and an active all-wheel-drive Porsche Traction Management system (PTM), consisting of an electronically controlled, map-controlled multiple-disc clutch as standard equipment.

The Porsche Doppelkupplung (PDK) combines the driving dynamics and the superb mechanical efficiency of a manual transmission with the excellent shifting and driving comfort of a conventional automatic transmission without any noticeable interruption in traction. Both a manual mode, which indicates the recommended gear, and an automatic mode are available. As a result, the Porsche Doppelkupplung (PDK) meets the requirements of Panamera customers in terms of both sportiness and comfort.

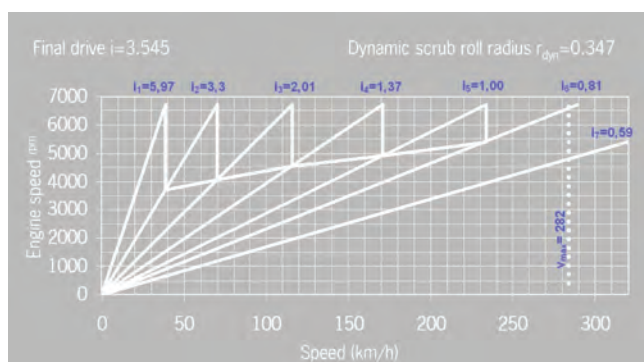
The principle familiar from the Porsche 911 was completely revised for this purpose and further optimized with regard to driving comfort. Among the numerous transmission concepts available, the Porsche Doppelkupplung (PDK) represents an innovative development in the top-end segment.

Porsche Doppelkupplung (PDK)

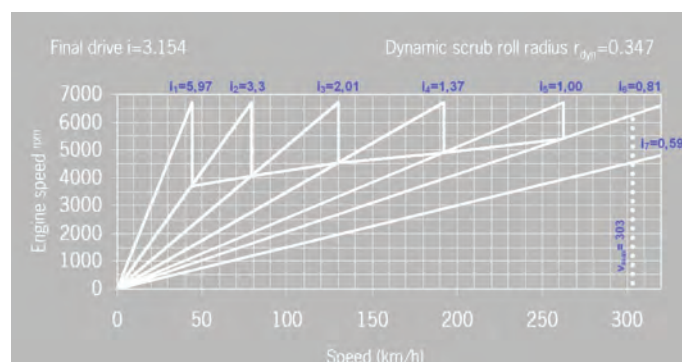


PDK Gear Ratios

The transmission (gear) ratios are identical in the naturally aspirated engine and the turbo engine; differences in gear ratios are caused by final-drive ratios. Panamera/4 chart not available.



Panamera S/4S

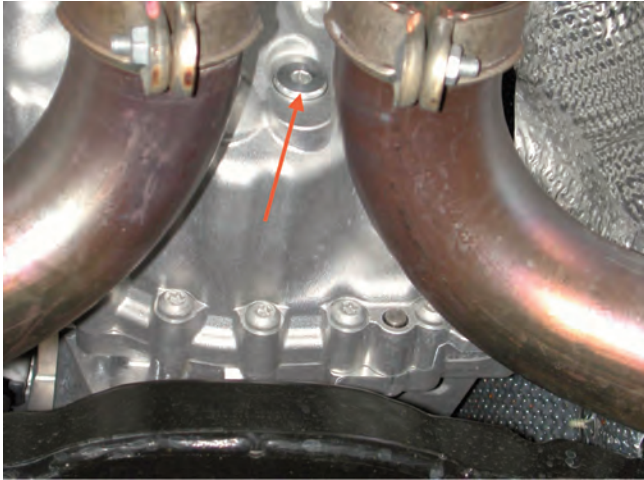


Panamera Turbo

Transmission Type	Panamera C70.00	Panamera 4 C70.30	Panamera S C70.05	Panamera 4S C70.35	Panamera Turbo C70.50
1st gear	12/47	12/47	12/47	12/47	12/47
i_{gear}	3.917	3.917	3.917	3.917	3.917
$i_{transmission}$	5.97	5.97	5.97	5.97	5.97
i_{total}	21.164	21.164	21.164	21.164	18.829
2nd gear	23/50	23/50	23/50	23/50	23/50
i_{gear}	2.174	2.174	2.174	2.174	2.174
$i_{transmission}$	3.308	3.308	3.308	3.308	3.308
i_{total}	11.727	11.727	11.727	11.727	10.433
3rd gear	31/41	31/41	31/41	31/41	31/41
i_{gear}	1.323	1.323	1.323	1.323	1.323
$i_{transmission}$	2.013	2.013	2.013	2.013	2.013
i_{total}	7.136	7.136	7.136	7.136	6.345
4th gear	39/35	39/35	39/35	39/35	39/35
i_{gear}	0.897	0.897	0.897	0.897	0.897
$i_{transmission}$	1.366	1.366	1.366	1.366	1.366
i_{total}	4.842	4.842	4.842	4.842	4.308
5th gear	35/23	35/23	35/23	35/23	35/23
i_{gear}	0.657	0.657	0.657	0.657	0.657
$i_{transmission}$	1.000	1.000	1.000	1.000	1.000
i_{total}	3.90	3.90	3.545	3.545	3.154
6th gear	49/26	49/26	49/26	49/26	49/26
i_{gear}	0.531	0.531	0.531	0.531	0.531
$i_{transmission}$	0.807	0.807	0.807	0.807	0.807
i_{total}	2.861	2.861	2.861	2.861	2.545
7th gear	57/22	57/22	57/22	57/22	57/22
i_{gear}	0.386	0.386	0.386	0.386	0.386
$i_{transmission}$	0.587	0.587	0.587	0.587	0.587
i_{total}	2.081	2.081	2.081	2.081	1.851
Reverse gear	4.57	4.57	4.57	4.57	4.57
i_{gear}					
Final-drive ratio	3.90	3.90	3.545	3.545	3.154

Transmission

Oil Type/Oil Quantity/Change Intervals



Since the final drive is located in a separate housing, the Porsche Doppelkupplung (PDK) transmission in the Panamera models manages with one oil chamber.

Pentosin Gear Oil FFL3 is used in this chamber. The oil chamber has a filling capacity of 8.5 liters, the oil must be changed every 60,000 miles (90,000 km) or every 6 years.

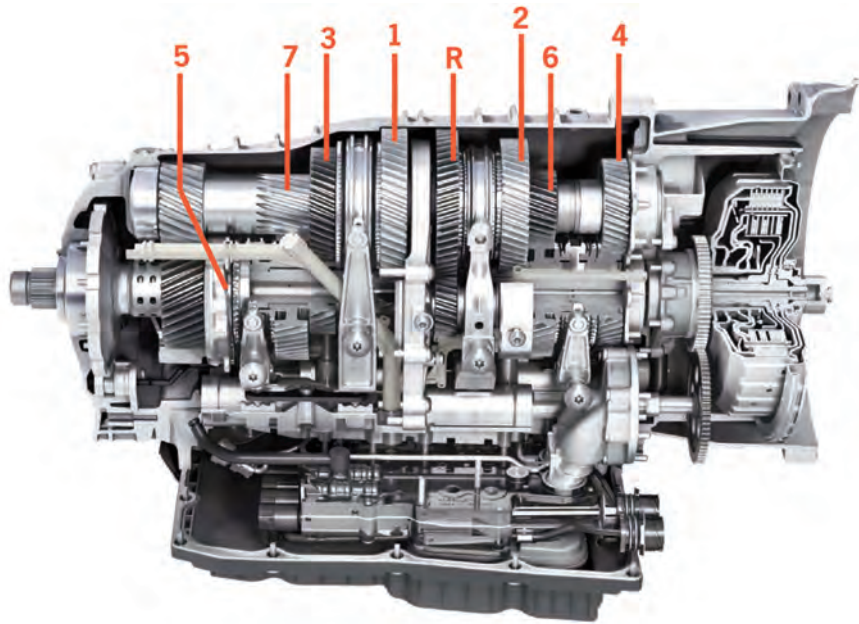
Viewed in the direction of travel, the oil inspection plug is located at the rear, in the middle, at the end of the transmission between the exhaust pipes (arrow). You can add oil/check the oil level in the same way that you do for the PDK in sports cars. The correct oil level is important for proper operation and long life of the transmission.

The following prerequisites must be met in order to check or correct the oil level:

- Engine must be idling
- Vehicle must be horizontal in both longitudinal and transverse axis
- Oil temperature between 86° F. and 104° F. (30° C. and 40° C.)
- Selector-lever position “P”
- Clutch cooling volume flow must be switched off (using PIWIS Tester in Oil fill mode)
- Retain the described states for approx. 1 minute to allow the oil to settle
- Open the screw plug on the oil overflow bore (see red arrow) and collect the emerging oil until only drops of oil are emerging
- Once there is no more oil emerging, top up the clutch fluid until oil escapes from the oil overflow bore
- To avoid damaging the clutches, the procedure must be completed within 5 minutes (PIWIS Tester exits Oil fill mode automatically after 5 minutes)

Notes:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



Porsche Doppelkupplung (PDK) Layout

The new Porsche Doppelkupplung (PDK) basically comprises a conventional manual transmission that has been split into two partial transmissions and a hydraulic control unit. At its core, the transmission has two multiple-disc clutches. One clutch is for the first transmission with the odd gear stages (1, 3, 5, 7) and the other clutch is responsible for the second transmission with the even gear stages and reverse gear (2, R, 4, 6). The hydraulic control unit uses a number of pressure valves to control both the multiple-disc clutches and the shift cylinders for engaging the desired gear ratio.

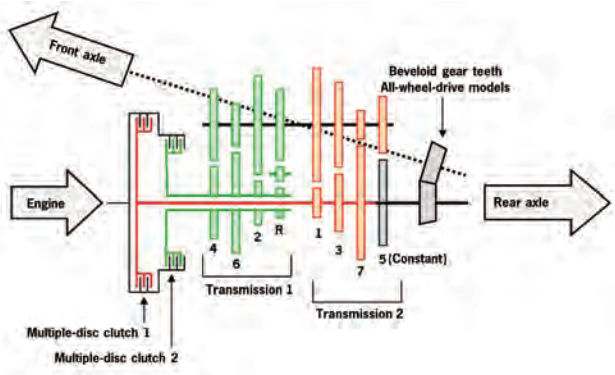
The particular feature of this transmission concept is that it provides a continuous flow of power between the engine and the final drive, even during a gear change. One of the two clutches is always closed in normal driving mode. The second clutch is open while the power is being relayed from the engine to the wheels via the first clutch and the first transmission; the next gear up or down will already be engaged in the second transmission depending on the driving situation and the shift strategy.

When changing gear, the first clutch opens as the second clutch simultaneously closes. Through this continuous and alternating gear change operation, the propulsion force, monitored by the engine, is changed over from one transmission to the other without any interruption in traction. In the PDK, the entire gear change itself involves complex fine tuning of the function processes between the two clutches and the gear stages of the individual transmissions.

The use of two clutches or transmissions makes it possible to execute gear changes smoothly without interrupting the traction. Rapid gear changes and short response times within just a few milliseconds are a further characterising feature of the Porsche Doppelkupplung (PDK). This is possible thanks to the principle of parallel gear preselection. The transmission control system assists here in preselecting and keeping ready the appropriate gear ratio for the particular driving state and driving situation in the inactive transmission.

Transmission

Transmission Concept



The new Porsche Doppelkupplung (PDK) is noted for the following customer benefits:

- Much faster gear shifts with no noticeable interruption in traction due to rapid change-over of disengagement and engagement operations, rapid gear changes and short response times; this ensures greater agility and more driving pleasure
- Outstanding driving comfort because of gentle, automated clutch and shift operations
- Direct connection to the engine (without rubber-band effect of a torque converter)
- Outstanding drive dynamics due to a short 1st gear that changes rapidly to the preselected 2nd gear
- Direct and fast multiple downshifts with spontaneous power requirements
- Much greater range of functions such as the Launch Control function (with optional Sport Chrono Package Plus) and performance oriented shift operations with increased torque
- Lower fuel consumption and emissions thanks to the additional 7th gear and a total ratio spread of 10.1 with a significantly reduced rev range
- Reduction in fuel consumption and CO₂ emissions through high overall efficiency and a simplified Start Stop function
- Reduction in system weight of approx. 33 lbs. (15 kg) compared to a conventional all-wheel automatic system
- Dual-mass flywheel for reducing vibration and noise

The Porsche Doppelkupplung (PDK) comprises 7 gears and 1 reverse gear. Gears 1 to 6 have a sporty tuning and top speed is reached in 6th gear. The total ratio spread between the 1st and 7th gear of the transmission is 10.1.

This efficient arrangement of gear increments is unique in the passenger car segment. Together with short 1st gear, it ensures outstanding drive-off dynamics. In contrast, the 7th gear has a very high ratio and this makes it possible to increase comfort when driving long distances and also to improve fuel economy through reduced engine speeds.

Porsche developed the Porsche Doppelkupplung (PDK) in the 1980s for motor sports. The fact that there was no interruption in traction when changing gears gave it the edge over competitor vehicles. Shorter shifting times were possible and this considerably increased the race car's acceleration. In addition to these benefits, the PDK in the Panamera also helps to improve driving comfort, efficiency and fuel consumption.



Note!

Ratio spread is the gear ratio range of the transmission, i.e. the relationship between the largest gear ratio value and the smallest gear ratio value. This means that the transmission should use a crawling gear with a high gear ratio for very low speeds and a gear with a low gear ratio for overdrive mode.

Operation – Description



The Porsche Doppelkupplung (PDK) is operated primarily by the selector lever in the center console and the two ergonomic sliding switches on the steering wheel. In manual shift mode, the gear recommendation function in the instrument cluster helps to ensure optimized fuel consumption when driving. The Porsche Doppelkupplung (PDK) shift strategy is operated and thus influenced on a secondary level via the driving characteristics selected by the driver, in particular via the accelerator and brake pedals as well as steering wheel movements. In addition, the shift strategy of the Porsche Doppelkupplung (PDK) can be actively influenced by means of the SPORT and SPORT PLUS control buttons of the Sport Chrono Package Plus in the centre console, available as an optional extra. The selected driving mode and the gear indicator (1 to 7) are displayed in the digital display of the tachometer.

The ergonomic selector lever, familiar from Porsche sports cars, is used in the PDK. It is used to activate the basic functions: P (parking), R (reverse gear), N (neutral), D (drive) and M (manual). Manual mode is activated by tilting the selector lever to the left. The manual gate can be found here. The driver can shift up or down by tilting the selector lever forward (+) or back (-). This additional shift function provides the driver with the option, depending on the preferred way of operating, of performing a manual shift intervention on the selector lever or using the sliding switches on the steering wheel.

With the Porsche Doppelkupplung (PDK) in the Panamera, the selector lever positions at the support are relayed to the transmission control unit using electrical signals, except for the parking lock position (P). By separating the mechanical actuation from the electrical information processing in this way, it was possible to adapt the selector lever's mechanical system directly with extreme precision.

The PDK logo is displayed on the selector lever to enhance it visually and to indicate the new Porsche Doppelkupplung (PDK) technology. Both the selector lever panel and the cover of the selector and shift gate, designed as a spherical cap that also moves, feature a galvanised surface and have been matched to the interior design.

Notes:

[illegible]

Transmission

3-Spoke Sports Steering Wheel



In combination with the Porsche Doppelkupplung (PDK), the new Panamera models with PDK feature two handy sliding switches integrated into the steering wheel spokes, which facilitate precise and straightforward shifting. Pressing the sliding switches forward shifts the PDK up, pressing them towards the driver from the back of the steering wheel shifts the PDK down. It makes no difference whether the right or the left sliding switch is used for changing gears. Holding the sliding switches allows the driver to shift up or down sequentially to the maximum or minimum permitted gear.

Display in Instrument Cluster



Gearshifts for the Porsche Doppelkupplung (PDK) are displayed in the instrument cluster. The display is based on the PDK concept that has been used in sports cars. The familiar displays of the selector lever position (drive mode) and the numerical gear indicator are located in the tachometer.

Other displays in the instrument cluster:

- A flashing selector lever position in the instrument cluster means that the selector lever is between two positions.
- “Transmission temperature too high” prompts the driver to change his driving style. “Warning jerks” can be felt when driving off and the engine power may be restricted. Do not hold the vehicle on a hill, for example, using the accelerator pedal - use the brake pedal instead. Reduce engine load. Stop the vehicle in a suitable place if possible, and allow the engine to run in selector lever position “N” or “P” until the warning disappears.
- “Transmission emergency run” in white letters means that the vehicle can still be driven, but you should call in at a workshop.
- “Transmission emergency run” in red letters means that the vehicle can only be brought to a stop, after which it can no longer be driven.
- If the selector lever is accidentally changed from P or N into a gear (due to a fault or improper use) without pressing the brake, this gear will also “flash” on the display and no power transmission will occur. To drive off, the brake must be pressed and the selector lever shifted from “P” or “N” into the required gear again.
- A flashing selector lever position “R” or “D” means that the selector lever was engaged without pressing the footbrake or only the reduced driving program is available when the message “Transmission emergency run” appears.

Shift Indicator



The consumption-oriented shift indicator (A) to the right of the digital speed display on the tachometer helps the driver to develop a more fuel-efficient driving style. The shift indicator lights up as a recommendation to shift up to the next gear, depending on the selected gear, engine speed and accelerator pedal position. The shift indicator is only active when “SPORT PLUS” is deactivated. When the shift indicator lights up, you should shift up into the next highest gear.

Gearshift Strategy



The center console includes a SPORT (1) and a SPORT PLUS (2) button. The basic shifting characteristic curves change, depending on which button is pressed.

Driving in selector lever position “M”, Sport and Sport Plus button not active

Upshifts and downshifts can be performed both on the steering wheel and using the selector lever. Shifting comfort is adaptive over the entire operating range and adapts to suit the driver's individual driving style. For improved shifting comfort, the engine torque is reduced during gear changes. Downshifts in deceleration state are accomplished with very little intermediate throttle application and are therefore hardly perceptible. To avoid under-revving and the associated loss of driving comfort, the current gear is switched down to the next-lowest gear at engine speeds of less than approx. 1100 rpm. An upshift at the engine speed limit is only accomplished if there is a kickdown in the speed limiting range (panic shifting). The vehicle always moves off in 2nd gear. The Launch Control function (racing start) is not available.

Driving in selector lever position “M”, Sport button active

Upshifts and downshifts can be performed both on the steering wheel and using the selector lever. Gearshift comfort is therefore adaptive over the entire operating range and adapts to suit the driver's individual driving style, but basic sportiness is increased. The engine torque is reduced only slightly while changing gears. Downshifts in deceleration state are accomplished with

intermediate throttle application. To avoid under-revving and the associated loss of driving comfort, the current gear is switched down to the next-lowest gear at engine speeds of less than approx. 1100 rpm. An upshift at the engine speed limit takes place if there is a kickdown in the engine speed limit range (panic shifting). The vehicle always moves off in 2nd gear. The Launch Control function (racing start) is not available.

Driving in selector lever position “M”, Sport Plus button active

Upshifts and downshifts can be performed both on the steering wheel and using the selector lever. Gearshifts are not adaptive and are purely power-oriented, with a corresponding loss of comfort. In addition, the engine torque is not reduced while changing gears. Downshifts in deceleration state involve quick and audible intermediate throttle application with a sporty sound. To avoid under-revving and the associated loss of driving comfort, the current gear is switched down to the next-lowest gear at engine speeds of less than approx. 1100 rpm. An upshift at the engine speed limit takes place if there is a kickdown in the engine speed limit range (panic shifting). The vehicle always moves off in 1st gear. 7th gear is not used in this program. The Launch Control function (racing start) is also available.

Driving in selector lever position “D”, Sport and Sport Plus button not active

When the selector lever is moved to position “D”, an extremely intelligent driving program is activated. Shifting adapts continuously and almost seamlessly to the driving style and route profile over the entire operating range. Gearshifts and gear-changing speeds here are changed from economic/comfortable to sporty. Gearshifts are basically performed with more emphasis on comfort. Also for improved comfort, the engine torque is reduced during upshifts and downshifts. Downshifts in deceleration state and deceleration downshifts are accomplished with very little intermediate throttle application and are thus hardly perceptible. The vehicle moves off in 2nd gear.

Driving in selector lever position “D”, Sport active

An extremely intelligent driving program is also activated in this position and shifting adapts continuously and almost seamlessly to the driving style and route profile over the entire operating range. Basic sportiness is increased with faster pick-up and slower deceleration. Gearshifts are more power-oriented and the engine torque is only reduced slightly during upshifts and downshifts.

Transmission

Downshifts in deceleration state and deceleration downshifts are accomplished with intermediate throttle application and are therefore audible. The vehicle moves off in 2nd gear. 7th gear is avoided for the most part and is engaged only at higher speeds.

Driving in selector lever position “D”, Sport Plus active

Shift map adaptations are not active in this program. The most sporty map is activated permanently. Gearshifts are performance-oriented with reduced shifting comfort. Downshifts in deceleration state and deceleration downshifts are accomplished with intermediate throttle application and are therefore very audible. Gear changes are performance-oriented and the engine torque is not reduced during upshifts and downshifts. The vehicle moves off in 1st gear. 7th gear is not available. The racing start function is also available.

Adaptation of shifting characteristic curves to driving style and route profile

Various measured values such as accelerator pedal position, change in speed of accelerator pedal depression, longitudinal and lateral acceleration, vehicle speed and engine speed and the steering angle are used to adapt the shifting characteristic curves almost continuously to the driving style and route profile. This adaptation is performed in “Normal” mode (no sport buttons pressed) and sometimes in “Sport” mode. No adaptation is performed in “Sport Plus” mode. When this adaptation is selected, the shift program not only takes the driving style into consideration, but also road resistance. Changes in road resistance are particularly noticeable when driving uphill and downhill. In addition, the PDK control unit calculates an altitude correction factor, i.e. since the volumetric efficiency of the engine decreases as the altitude increases, the driver automatically accelerates more and the transmission would switch to a more shift-conducive map. This is detected by the altitude sensor and the optimal map is made available to the driver.

Special Functions

Launch Control (racing start function)

This function is available both in selector lever positions “D” and “M” in Sport Plus mode. Preconditions are as follows: Vehicle stationary, brake applied, kickdown active. The function is triggered by releasing the brake. The double clutch in the transmission now allows optimum wheel slip for maximum acceleration. Stress on components increases significantly when driving off at maximum acceleration compared with driving off “normally”. In addition, the components in the clutches are exposed to high levels of thermal stress. Therefore, the clutches are cooled with the maximum cooling volume flow to protect the components.

Prevention of downshifts in deceleration state, e.g. when approaching a corner (Fast Off)

If the driver decelerates, i.e. releases the accelerator pedal quickly, when approaching a corner, the currently engaged gear is retained. If the driver also applies the brakes now, downshifts adapted to the vehicle speed are performed so that engine braking torque is available when approaching a bend and the vehicle can be accelerated out of the bend in the optimum gear. If the accelerator pedal is now moved towards throttle valve “open” again, gear changes are performed once again according to the driver's requests. This function responds differently, depending on which mode was selected. If “Normal” mode is selected, the function is only activated for a high negative accelerator pedal gradient. In “Sport” mode, the function is activated for a medium negative accelerator pedal gradient, while it is activated for a low negative accelerator pedal gradient in “Sport Plus” mode.

Downshifts while braking (Fast Back)

A downshift is initiated immediately if the driver switches quickly (within approx. 1 second) from accelerating to braking. However, the sportiness characteristic and the selected mode dictate how early a downshift is initiated.

Gear retention while cornering

Lateral acceleration is detected via the lateral-acceleration sensor (single component with yaw rate sensor), which is located under the center console and works for the PSM system, and the engaged gear is retained, depending on the shift map, engaged gear and lateral acceleration.

Special Functions (cont'd)

Active switching to a sporty map

For increased spontaneity, the system switches to a sporty and dynamic map when the driver uses fast, positive accelerator pedal movements. The previous map is then activated again afterwards. This function is intended, for example, for situations in which a driver is driving at an extremely comfortable speed on a country road, but now decides to overtake and wants the vehicle to drive dynamically for a short time.

Manual momentary intervention in selector lever position "D"

To enable manual downshifts even in the automatic gear-selection gate, for example:

- when approaching a corner
- when entering speed zones/small towns
- when driving downhill

the upshift and downshift buttons (both on the steering wheel and on the selector lever) are active in the automatic gear-selection gate. In other words: PDK transmission switches to the manual program when the corresponding button is pressed. "M" appears in the instrument cluster and the requested gearshift is performed. At the same time, an 8-second timer is started in the control unit. If the upshift or downshift button is pressed again within this 8 seconds, the timer is restarted.

The PDK transmission automatically switches back to Automatic mode ("D" appears in the instrument cluster) if:

- the timer runs out, no cornering is performed and the vehicle is not in deceleration state
- the selector lever is moved from "D" to "M" and back to "D"

Automatic upshifts and downshifts at the engine speed limits remain active. The deceleration downshift function is also active.

Warm-up Program

The warm-up map is a shift program with raised gear-changing points, which has the effect of heating the catalytic converters to their operating temperature as quickly as possible. The engine and transmission also reach their operating temperature more quickly with this map. The coolant temperature of the engine is checked when the engine is started. If the temperature is less than approx. 68° F. (20° C.), the warm-up programme is activated and is deactivated again when the coolant temperature reaches 86° F. (30° C.).

Overheating Protection

Various measures are implemented on the transmission in order to protect the transmission and double clutch from overheating. The temperature sensor, which is installed above the hydraulic control unit and measures the oil sump temperature, is used for this purpose. A calculation model which calculates the clutch temperature from the engine torque and the slip at the clutch, is also used. Overheating protection is activated in several stages and actively prompts the driver to adapt his driving style in advance.

If the temperature continues to rise (oil sump temperature > 293° F./145° C.), stage two is activated. This means that jerking continues. The engine torque and kickdown revs are reduced more drastically in this case. The white warning "Transmission temperature too high" appears in the instrument cluster. Another fault is stored in the fault memory.

If the temperature rises even further (oil sump temperature > 302° F./150° C.), the red warning "Transmission emergency run" appears in the instrument cluster. Shortly afterwards, the double clutch is opened completely and power transmission is no longer available. Another fault is stored in the fault memory. If the driver now presses the accelerator, the vehicle will drive off, but not with the usual level of comfort. After implementing these measures, the transmission activates a special shift program in which gear changes are performed very slowly and uncomfortably. Once the temperature falls below a certain temperature threshold, the transmission reverts to its normal program.

Transmission

Clearly perceptible jerking occurs in the first stage (at an oil sump temperature > 275° F./135° C.) due to continuous opening and closing at drive-off or crawling speed, thereby prompting the driver to change the driving situation. Engine torque and kickdown revs are also reduced and a fault is stored in the control unit.

Upshift suppression for 7th gear

7th gear is designed as an overdrive on the Porsche Doppelkupplung (PDK). This means that in various driving situations (high road resistance, for example), the vehicle would decelerate when 7th gear was engaged. As a result, 7th gear is not engaged in such situations.

Upshift interruption

In automatic transmissions, the time that elapses between triggering a change in speed and starting to change speed is called the response time. Naturally, this response time depends on the shift program and the shifting characteristic curve. During this time, the driver does not yet notice that the gear change has already started. If the driver's intention changes (the driver quickly removes his foot from the accelerator, for example), the upshift that has started is interrupted provided the engine speed remains unchanged.

One-touch hold function

The one-touch button on the steering wheel or the selector lever must be held in a downshift ("–") or upshift ("+") direction in order to engage the lowest or highest possible gear in the manual gate. Tipping the button back initially triggers the first gear change in accordance with the touch command. The next-lowest or next-highest gear is then always engaged by holding the button. This saves the driver from having to touch the button repeatedly. This function is switched off after 25 seconds to prevent malfunctions.

Stationary decoupling

When the vehicle comes to a stop, the clutch is generally opened as long as the brakes are applied. However, the clutch remains slightly engaged in order to take full advantage of crawling. The reason for this measure is reduced fuel consumption.

Drive-Off Assistant

If the vehicle is stopped on an incline, the driver will apply the brake and set a certain brake pressure. When the driver now switches from the brake pedal to the accelerator pedal in order to drive off, the set brake pressure is maintained for as long as it takes for the vehicle to drive off. This prevents the vehicle from rolling back while the driver is switching pedals.

Tow-starting/towing

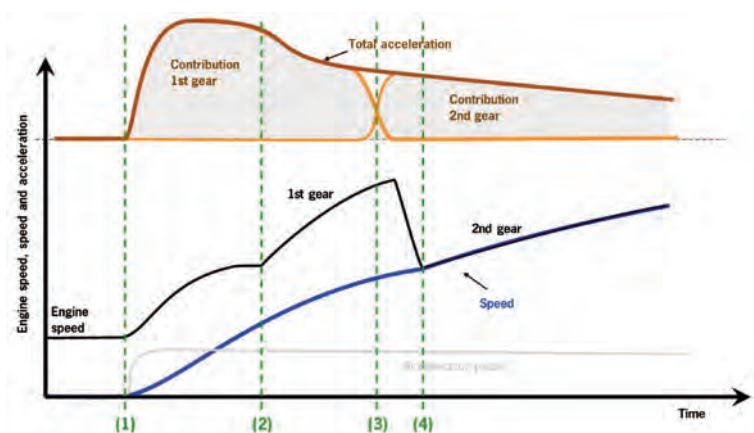
Never lift the vehicle at just one axle when towing all-wheel-drive vehicles. The vehicle cannot be tow-started, nor should this be attempted due to the risk of serious damage to the transmission.

When the engine is not running, adequate lubrication of the transmission is not guaranteed. Therefore the following points must be observed:

1. Engage selector-lever position "N"
2. Top speed = 30 mph (50 km/h)
3. Maximum towing distance = 30 miles (50 km)
4. In the case of long towing distances, the all-wheel-drive vehicle must be transported on a trailer.

Notes:

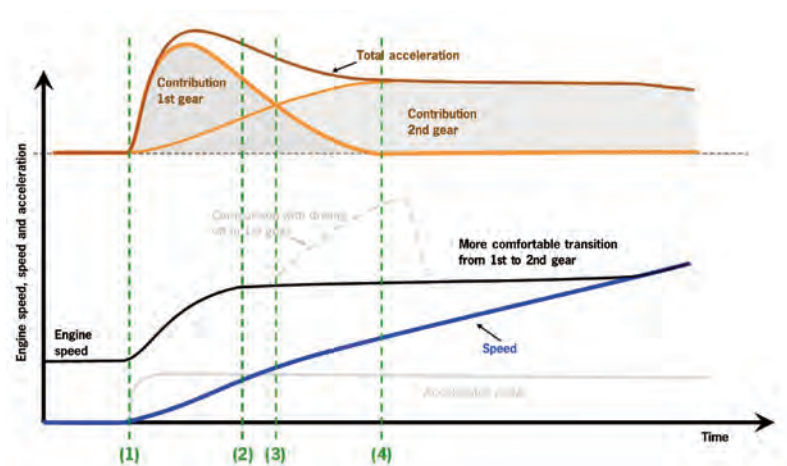
Driving off in manual or with accelerator pedal position > 60%



Procedure when driving off:

- (1) Driver presses the accelerator pedal, acceleration begins, clutch 1 enters the slip phase, vehicle moves off
- (2) Slip phase ends for clutch 1, further acceleration is accomplished with closed clutch
- (3) Clutch 1 opens while clutch 2 closes, short transition phase
- (4) Gear change has been completed, further acceleration is accomplished in 2nd gear

Driving off with accelerator pedal position approx. 10% to 60%



The implementation of comfort mode when driving off represents an innovative development. With this feature, the large drive-off torque of 1st gear is used to build up acceleration at low to average partial loads, depending on the driver request and driving program. The subsequent upshift into 2nd gear is performed seamlessly by means of an intelligent clutch slip management system in the two clutches. The result is an impressive drive-off performance that is both extremely comfortable and smooth.

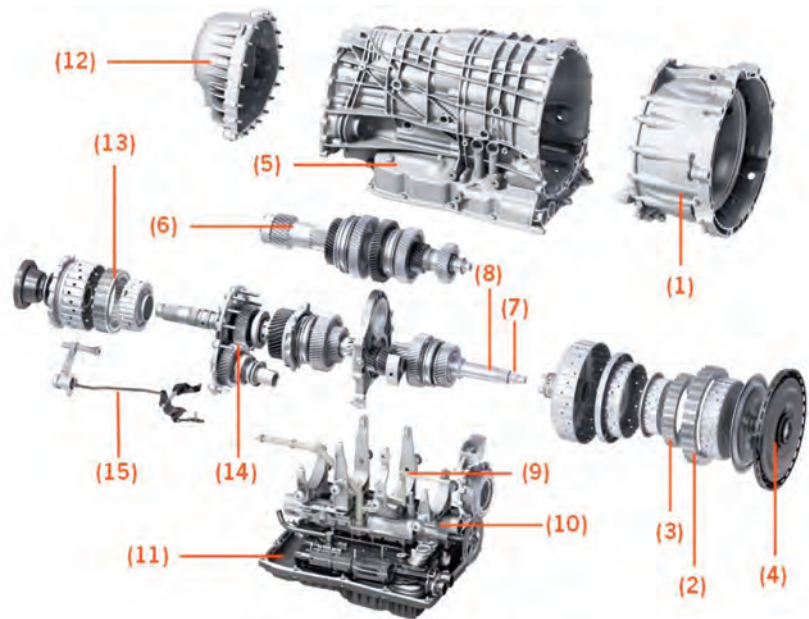
Procedure when driving off:

- (1) Driver presses the accelerator pedal, both 1st and 2nd gear are engaged, both clutches enter the slip phase
- (2) Engine speed is constant, clutch 2 begins to close
- (3) Clutch 2 closes, engine speed remains constant
- (4) Clutch 2 is closed, further acceleration in 2nd gear without any increase in engine speed

Transmission

Porsche Doppelkupplung (PDK) Design

- 1 - Clutch housing
- 2 - Disc pack, first clutch
- 3 - Disc pack, second clutch
- 4 - Dual-mass flywheel
- 5 - Transmission housing
- 6 - Output shaft
- 7 - Drive shaft 1
- 8 - Drive shaft 2
- 9 - Gearshift swinging fork
- 10 - Cylinder assembly (gearshift swinging forks)
- 11 - Oil pan with oil filter
- 12 - All-wheel Housing (4WD)
- 13 - Electronically controlled multiple-disc clutch
- 14 - Beveloid gear teeth (4WD)
- 15 - Parking lock actuator



The Porsche Doppelkupplung (PDK) features two multiple-disc clutches operating in oil. Compared to a system with dry clutches, the design of the wet-running multiple-disc clutches increases thermal stability.

Advantages of wet-running multiple-disc clutches compared to dry clutches:

- Good mechanical load capacity for high torques in a compact design
- Good thermal load capacity even under extreme loads
- Better clutch engagement response
- Long service life due to less friction plate wear
- Greater comfort and driving dynamics

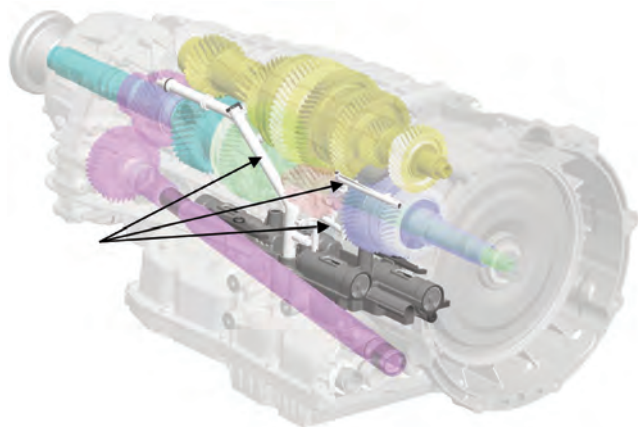
The two transmissions in the Porsche Doppelkupplung (PDK) each comprise a multiple-disc clutch and a drive shaft. Each transmission thus has the functional design of a manual transmission and an extremely compact construction. The drive shafts of the transmission act on a common countershaft and from there on the output shaft via a constant. The output shaft is connected via the drive flange to the cardan shaft, which drives the wheels via the rear axle differential. In the all-wheel version, the downforce is provided by the hang-on all-wheel clutch, the beveloid gear wheel set and the connecting shaft directly onto the front-axle final drive and therefore onto the drive shafts of the wheels. The clutches and the shift functions of the individual transmissions are controlled by way of a hydraulic control unit in the bottom part of the transmission.

The oil injection lubrication feature in the Porsche Doppelkupplung (PDK) is another factor in the increased efficiency. This is a type of circulation lubrication in which the oil is injected into the friction point. The gear wheels therefore no longer have to turn in the oil bath, as they do with splash lubrication. Churning losses can therefore be avoided.

The Porsche Doppelkupplung (PDK) has one oil chamber that serves the gear wheels and clutch via a shared oil circuit. Compared to a solution that has two separate oil chambers between the clutch and the gear housing, the advantage of this design is that an extra oil chamber division is not required. This not only reduces the weight of the transmission but also ensures a more compact construction. The weight aspect is also a consideration in the plastic design of the oil pan with integrated oil filter.

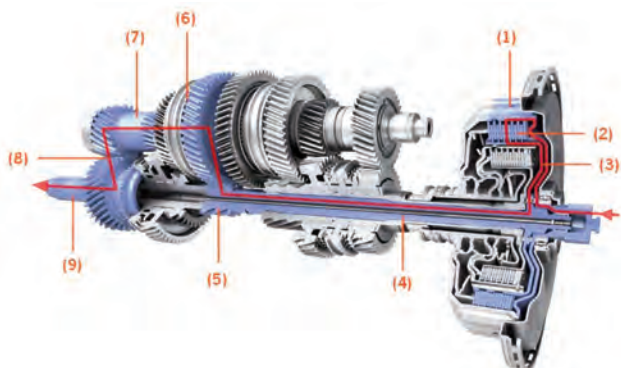
The function of the vibration-balancing damping mass is performed by a new dual-mass flywheel in the Porsche Doppelkupplung (PDK). This new dual-mass flywheel is integrated between the engine and the transmission and absorbs engine vibrations. By filtering noise and vibrations, the dual-mass flywheel also ensures comfortable driving in the lower rpm range. This helps to further reduce fuel consumption.

Gear Wheel Lubrication



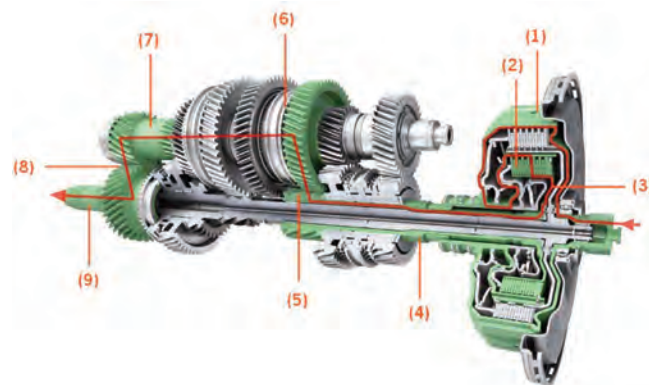
Since the countershaft (yellow) is positioned on the top of the transmission due to its design, it does not churn the oil. While churning losses are reduced, adequate lubrication of the transmission is still not guaranteed. To ensure that optimum lubrication of the gear wheels is achieved, additional oil splash tubes (arrow) are installed in the transmission.

Power Flow on Transmission 1, 1st Gear



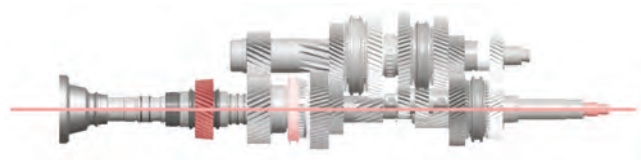
By tracing the flow of power in 1st gear, for example, it can be seen that the engine power is transmitted to the disc pack of the first clutch (1) by means of the pot-shaped outer disc carrier (2). From there, the power passes via the associated, likewise pot-shaped inner disc carrier (3) to the drive shaft of the 1st transmission (4). The splines for the 1st gear are located on this shaft (5). Passing via the corresponding gear wheels and the synchronisation (6), the power then reaches the countershaft (7), and from there via the constant (8) to the output shaft. The output shaft (9) is connected via the drive flange to the cardan shaft, which drives the wheels via the rear axle differential. In the all-wheel version, the downforce is provided by the hang-on all-wheel clutch, the beveloid gear wheel set and the connecting shaft directly onto the front-axle final drive.

Power Flow on Transmission 2, 2nd Gear



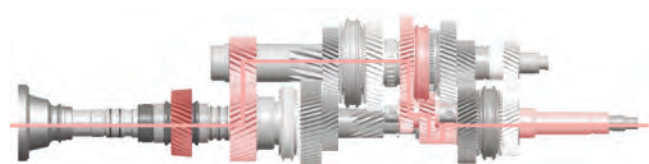
By tracing the flow of power in 2nd gear, it can be seen that the engine power is transmitted to the disc pack of the second clutch (1) by means of the pot-shaped outer disc carrier (2). From there, the power passes via the associated, likewise pot-shaped inner disc carrier (3) to the hollow drive shaft of the 2nd transmission (4). The splines for 2nd gear are located on this shaft (5). The power then reaches the countershaft (7) via the corresponding gear wheels and the synchronisation (6). The additional distribution of power takes place as for the 1st transmission via the constant (8) to the output shaft. The output shaft (9) is connected via the drive flange to the cardan shaft, which drives the wheels via the rear axle differential. In the all-wheel version, the downforce is provided by the hang-on all-wheel clutch, the beveloid gear wheel set and the connecting shaft directly onto the front-axle final drive.

Power Flow on Transmission 1, 5th Gear



In 5th gear, drive shaft 1 is connected to the constant with the result that the power flows directly through the transmission at a ratio of 1:1.

Power Flow on Transmission 2, Reverse Gear



The flow of power in reverse gear.

Transmission

Porsche Traction Management (PTM)



The active all-wheel-drive system, Porsche Traction Management (PTM), which is standard in the new Panamera 4S and Panamera Turbo, is designed to influence longitudinal and lateral dynamics. The system provides increased driving stability, traction and more agile handling, depending on the driving situation.

PTM comprises the following systems:

- Active all-wheel drive with an electronically controlled, map-controlled, hydraulically activated multiple-disc clutch
- Automatic Brake Differential (ABD)
- Anti-slip regulation (ASR)

Benefits of Porsche Traction Management (PTM)

General benefits:

- Extremely agile and dynamic
- Very good traction and vehicle stability
- Good control of the vehicle and driving safety in extreme driving situations

Compared to conventional all-wheel drives:

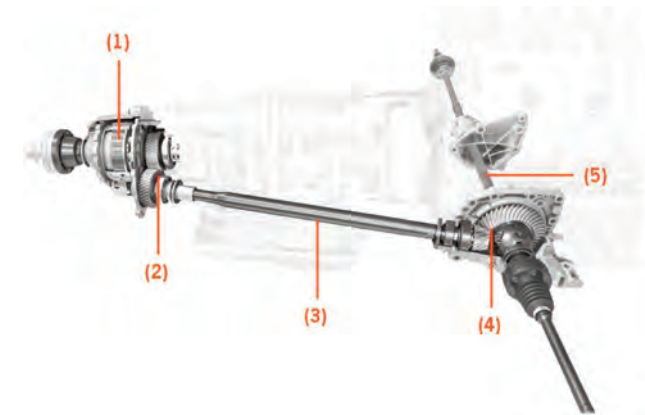
- Reduced weight and consumption due to its compact construction
- Improved driving performance thanks to the low centre of gravity of the engine

Other features:

- Further improved traction with Automatic Brake Differential (ABD)
- Further improved vehicle stability during acceleration with anti-slip regulation (ASR)

Porsche Traction Management (PTM) actively improves vehicle handling and increases traction in the new all-wheel-drive Panamera models. Strictly speaking, driving dynamics and traction are one and the same thing since the transitions within the systems are performed smoothly. Here is an example: Only when a vehicle has good traction, i.e. the tires do not build up any excess slip, can lateral forces also be transferred. This means steering control for the front axle, and lateral support for the rear axle. Drive wheel spin can be reduced - or ideally, eliminated completely - using PTM.

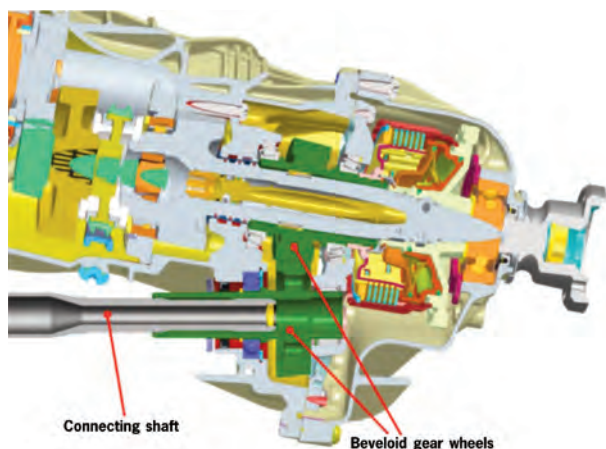
With PTM, the active all-wheel drive in the Panamera is designed as a controlled hang-on all-wheel which has been integrated into the main housing of the Porsche Doppelkupplung (PDK). The electronically controlled multiple-disc clutch installed in the PDK regulates the distribution of drive power between the full-time drive rear axle and the front axle in a way that is fully variable without a fixed basic distribution. Permanent monitoring of driving conditions enables the system to respond to different driving situations. Sensors continuously monitor various parameters, including the speeds of all 4 wheels, axial and lateral acceleration of the vehicle and the steering angle.



- 1 - Electronically controlled multiple-disc clutch
- 2 - Beveloid gear teeth
- 3 - Connecting shaft
- 4 - Front-axle differential
- 5 - Front drive-through axle through the engine

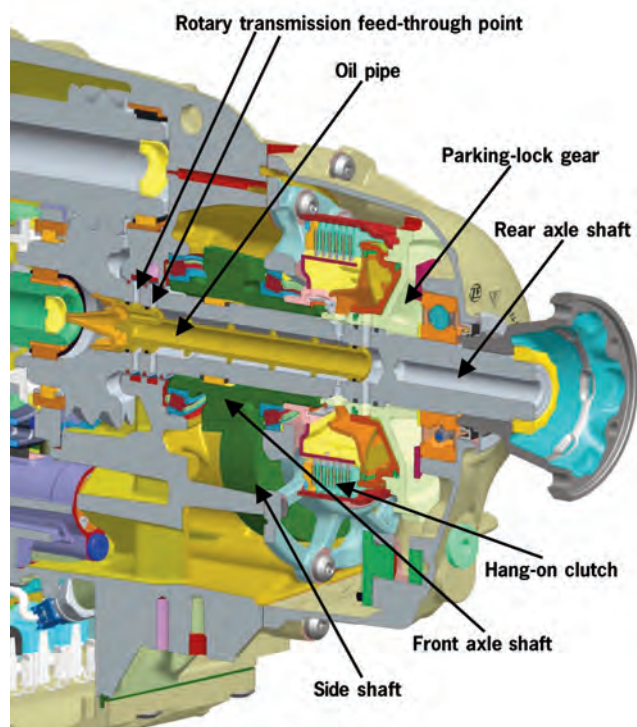
If the rear wheels are turning during acceleration, for example, additional drive power (if necessary up to 100% more) is distributed forward through greater intervention of the multiple-disc clutch. The all-wheel drive is therefore fully variable. ASR also reduces wheelspin. In bends, only the right amount of drive power reaches the front wheels to ensure optimum lateral support.

Drive power is transmitted to the front-axle differential via a beveloid gear in the hang-on all-wheel. The helical gear wheels mesh in two planes, permitting the connecting shaft to the front-axle differential to be installed at an inclination of 11 degrees. Compared to a conventional transfer gear, this solution is more compact and is approx. 6.6 lbs. (3 kg) lighter. The weight reduction continues with the hollow connecting shaft fitted to the front-axle final drive.

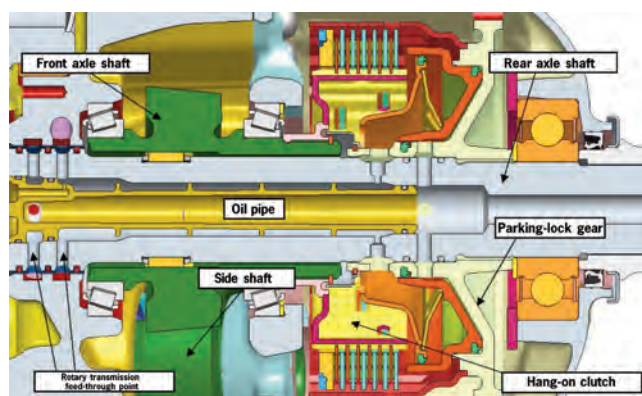


Another innovation in this segment is the front-axle differential, which is bolted directly on to the engine. The front drive-through axle through the engine keeps the engine in the Panamera sitting particularly low. This lowers the center of gravity and improves driving properties. A particularly compact and low-weight design is characteristic of this area also.

PTM works with the enhanced Porsche Stability Management system to ensure that power is distributed appropriately for excellent propulsion in every driving situation: on long straights and in tight corners as well as on surfaces with varying levels of grip. The Automatic Brake Differential (ABD) feature also improves traction. When the brake control systems are actuated, PTM disengages the front axle completely to facilitate PSM interventions on individual wheels.



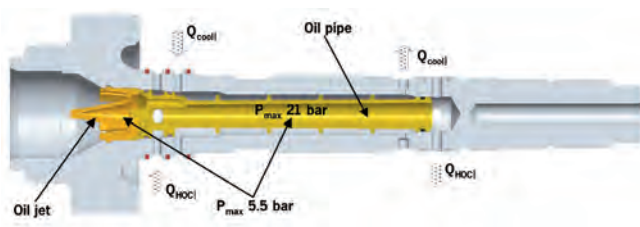
Depending on driving conditions, the torque is distributed from the hang-on clutch (HOC) to the axles according to load to guarantee permanent traction for all wheels. The inner disc carrier on the HOC is pressed onto the front axle shaft, which is connected to the side shaft via beveloid gear teeth. The outer disc carrier of the HOC is firmly welded to the parking-lock gear and is mounted on the rear axle shaft. Like the double clutch, the HOC is a wet clutch and is supplied with oil through the oil pipe.



Notes:

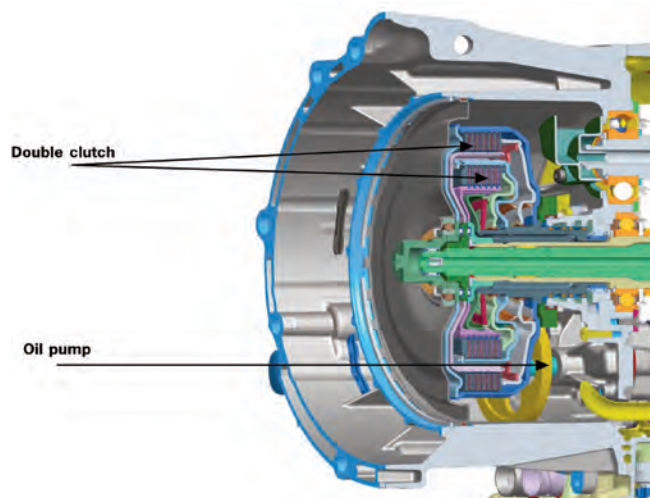
Transmission

Rear Axle Shaft With Oil Pipe and Oil Jet



The oil for actuating the HOC flows at a maximum pressure of 304 psi (21 bar) directly through the oil pipe. The cooling oil travels between the oil pipe and the inner wall of the rear axle shaft to the HOC at a maximum pressure of 80 psi (5.5 bar). Some of the cooling oil is routed to the oil jet and from there injected into the drive shaft to cool/lubricate the bearings.

Double Clutch



The wet-running double clutch is a central module of the Porsche Doppelkupplung (PDK). With its wide range of technical features, it meets the functional requirements of the transmission control system, thereby shaping the special character of this transmission concept. Very fast response times, low inertia and good, comfortable friction values combined with good economic viability allow both very sporty driving with highly dynamic gear changing as well as comfortable cruising.

For safety reasons, the clutches are opened when they are depressurized and inactive. The radial arrangement of the disc packs provides the best combination from the points of view of performance and space.

The wet-running double clutches installed in the Panamera transmissions come in two size:

- One for the aspirated models for engine torques up to 520 Nm
- One for the turbo model for engine torques up to 750 Nm

The double clutch for the aspirated models is identical to the double clutch in the sportscars. The oil pump is designed to output a maximum of 67 liters.

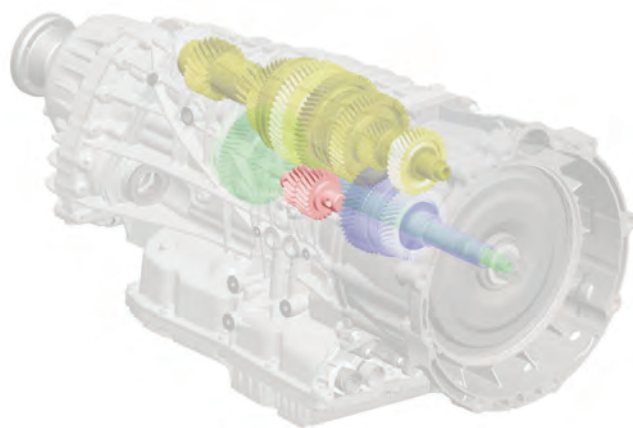
Careful selection of pad type, pad dimensions and usage as well as uniform distribution of thermal load and oil flow in the disc pack, along with the corresponding oil types, are prerequisites for comfort and performance over the service life. Low drag torques even at low temperatures and good resistance at high speeds guarantee comfort and excellent sportiness, but are also important safety requirements.

The friction discs comprise a steel carrier and a friction material made from paper. Paper is perhaps a misnomer, since it is a high-performance fiber more due to the production method than to the product. This fiber matrix is produced on a paper-making machine, in which an aqueous paper slurry (fibers and fillers) is dried on a strainer and bonded to a steel carrier.

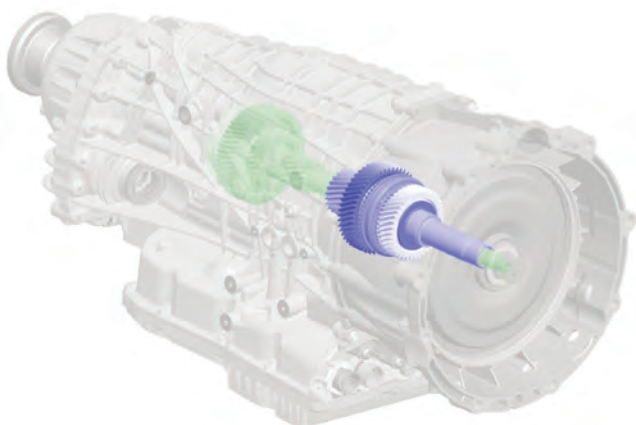
Shafts and Gears



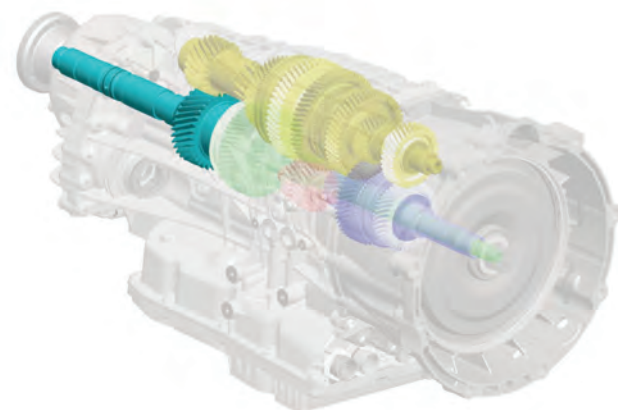
Driveshaft 1



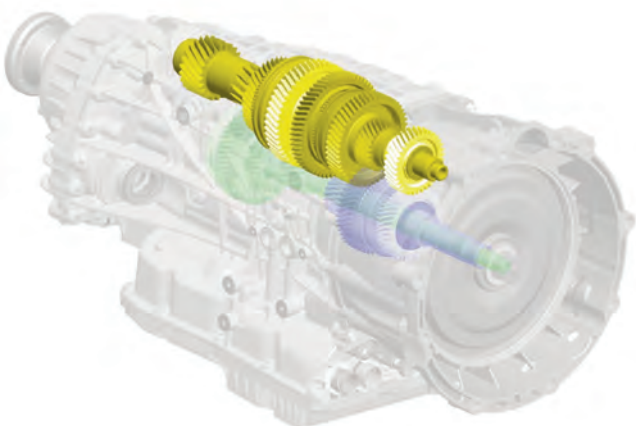
Intermediate Gear Wheel for Reverse Gear (red)



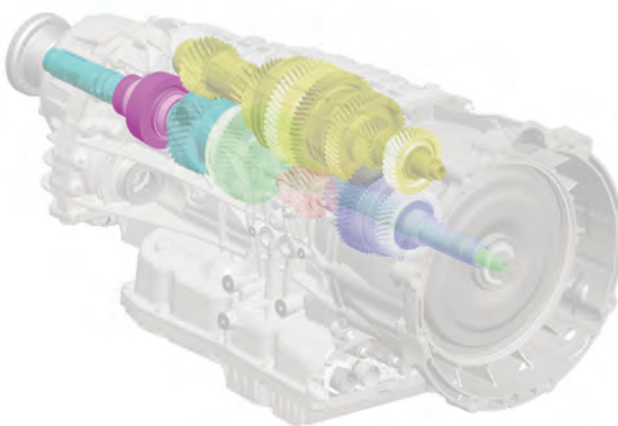
Driveshaft 2



Rear Axle Shaft



Counter Shaft



Front Axle Shaft

Transmission

Shafts and Gears (cont'd)

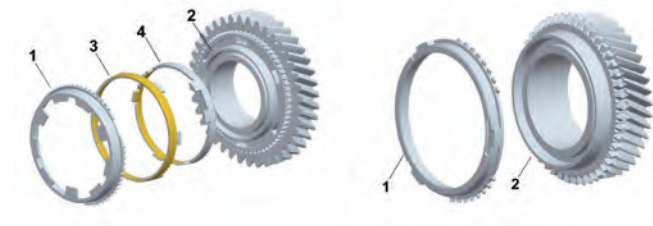


Rear Axle Shaft



Complete Gear Wheel Set

Sincronization



Triple cone synchronization is used for reverse, 1st, 2nd and 3rd gear. The use of three friction cones has resulted in a considerable reduction in synchronizing forces. This reduces shifting forces when engaging gears. The first friction cone comprises the friction cone of the clutch hub of the loose gear wheel (2) and the inner cone of the inner ring (4). The second friction cone comprises the outer cone of the inner ring (4) and the inner cone of the intermediate ring (3). The third friction cone comprises the outer cone of the intermediate ring (3) and the inner cone of the synchronizer ring (1). Single cone synchronization is used for 4th, 5th, 6th and 7th gear. The cones from the clutch hub (2) and the cones of the synchronizer rings (1) form the friction cone.

Notes:

[illegible]

Parking Lock



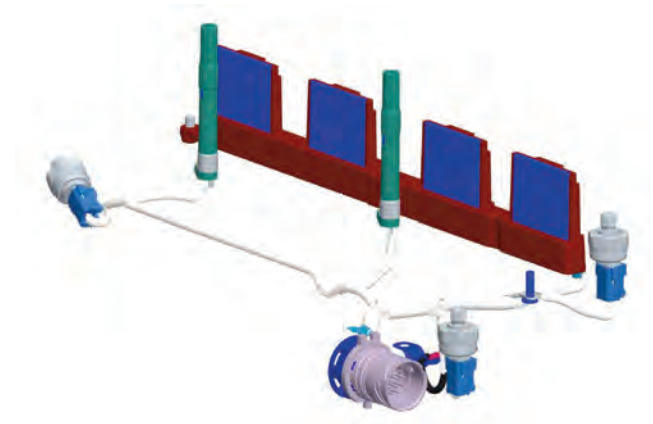
Even if the vehicle is in gear, it cannot be prevented from rolling back in the same way as with a manual transmission because the clutches are opened in a depressurized state and thus do not stop the vehicle from moving. The parking lock prevents the vehicle from rolling away, as with an automatic transmission. When the vehicle is stationary, the parking lock is engaged (purely mechanically) using a selector lever and blocks the rear axle shaft via a stop which engages in the splines of the parking-lock gear. In this way, the connecting shaft that is driven via the rear axle shaft is blocked.

The pawl is positioned by the connecting shaft in the guide bush. If the parking lock is engaged using the selector lever, the pawl pushes the stop out of its neutral position against the parking-lock gear. The stop engages in the splines of the parking-lock gear and blocks the rear axle shaft. When the parking lock is disengaged, the pawl is pulled back out of the guide bush and the stop can occupy the unlocked position again through the spring force of the spring.

Sensor Technology

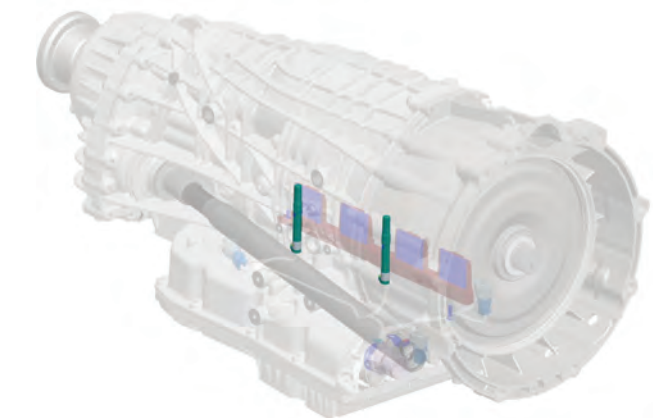
Various sensors are used for recording engine speed, temperature, pressure and distance signals:

- 4 distance sensors (combined in one housing)
- 2 speed sensors
- 2 (2WD) or 3 (4WD) pressure sensors
- 1 temperature sensor



The distance, speed and pressure sensors and the temperature sensor are connected by a wiring harness and their lines are routed outwards via the 16-pin connector. The distance and speed sensors and the temperature sensor are connected permanently to the wiring harness. The two solenoid valves and the six (2WD) or seven (4WD) pressure adjusters are connected by a second wiring harness. The wiring of this sensor is routed outwards via a 20-pin connector. The sensors are all located in the transmission. Sensors can be replaced from the outside after the oil pan and the hydraulic control unit are removed.

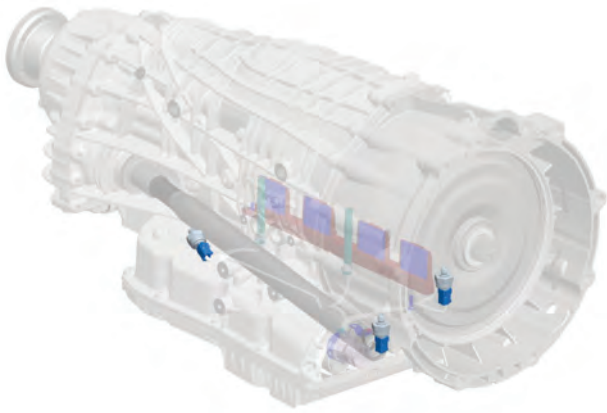
Speed Sensors



There are two Hall-effect sensors in each speed sensor.

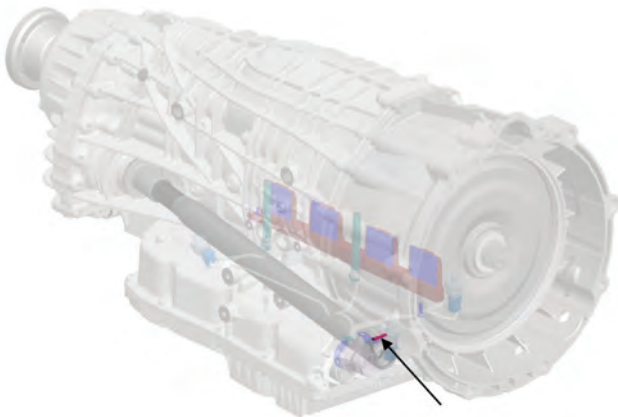
Transmission

Pressure Sensors



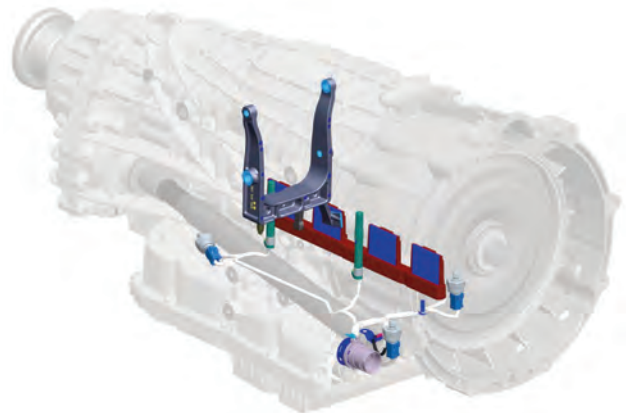
The pressure sensors for measuring the clutch pressure values are read directly at the rotary transmission feed-through point. They are installed inside the housing and are connected to the wiring harness by connectors. As the 4WD transmission has an additional clutch, the hang-on clutch, it also has an additional pressure sensor.

Temperature Sensor



The temperature sensor is used to record the sump temperature of the hydraulic oil. It is a temperature dependent resistor.

Distance Sensors



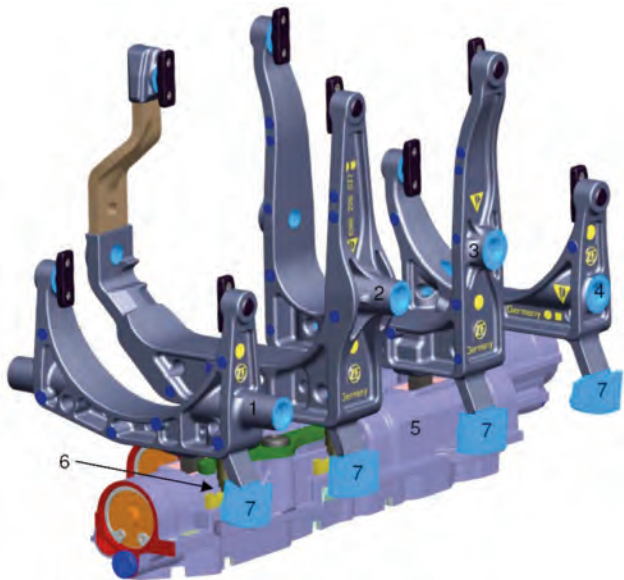
All four gearshift swinging forks have an aluminum damping element in the bottom section which dampens the signals being sent from the distance sensor. Each gearshift swinging fork is assigned a distance sensor, which converts the movement of the shift rod into a distance-proportional PWM signal.

Operating principle of the distance sensors:

The distance sensor works according to the eddy-current principle, i.e. a conductive material (a rectangular-shaped aluminium damping element on the gearshift swinging fork) drains energy from the oscillatory circuit, which leads to damping and a change in frequency in the oscillatory circuit of the sensor element. The principle is not magnetic, i.e. the gearshift swinging fork, shaped as a damping element, works as a sensor to deliver a frequency-dependent output signal depending on the overlap of the displacement sensing coil.

For every swivel arm or sensor island there is a sensing coil for measuring distance and a sensing coil for calculating the gap between the swivel arm and the printed circuit board. These sensing coils consist of a printed circuit board coil that is adapted to the geometry of the gearshift swinging fork. The position of the damping element's edge is calculated from a geometric perspective and output via the interfaces to an appropriate PWM signal. The sensor can detect two degrees of freedom (the gap between the damping element and the printed circuit board) and distance (angle of the gearshift swinging fork). The height coil is always completely covered by the damping element as it provides a frequency-proportional signal regarding the gap between the damping element and the printed circuit board.

Shifting



The Porsche Doppelkupplung (PDK) transmission for the Panamera is shifted using gearshift swinging forks consisting of the following individual parts:

- 1 - Gearshift swinging fork for 4th/6th gear
- 2 - Gearshift swinging fork for 2nd/reverse gear
- 3 - Gearshift swinging fork for 1st/3rd gear
- 4 - Gearshift swinging fork for 7th/5th gear
- 5 - Shifting unit with shifting pistons
- 6 - Shifting unit with detents
- 7 - Sender for shifting unit

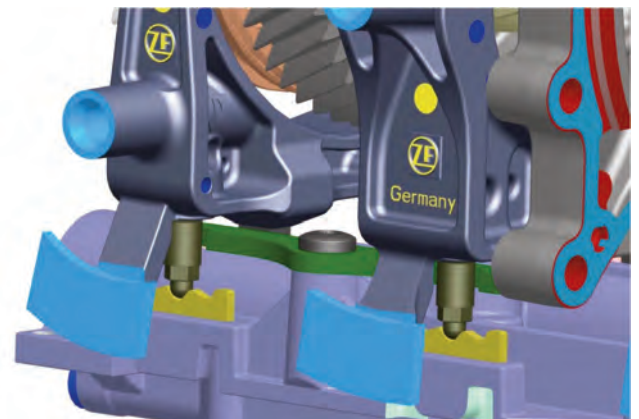
The gearshift swinging forks are actuated hydraulically via the shifting unit using the shifting pistons and are used to shift the synchronizers and thus to change gears. They transfer the shifting forces generated in the actuator hydraulics to the synchronizers' operating elements. Each gearshift swinging fork actuates two synchronizers and therefore two gears. Once the gear is engaged, the gearshift swinging fork is depressurized. The gear is held securely and without strain by detent in traction/deceleration mode by positive engagement of the toothing. Each gearshift swinging fork has an aluminum sender (7) for recording signals via the transmission distance sensors.

There are two different stipulations when numbering the gearshift swinging forks. The numbers must be counted once according to the specification for the transmission software and once according to the geometric arrangement of the gearshift swinging forks in the transmission, beginning with the clutch bell-housing. The distance sensors and therefore the gearshift swinging fork travel are also arranged according to this specification.

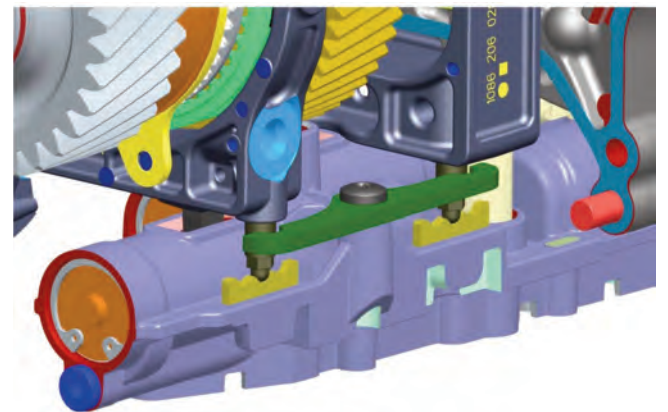
Shifting Interlock

The gearshift swinging forks in a transmission are locked against each other. In transmission 2, gearshift swinging fork 3 (1st/3rd gear) is locked against gearshift swinging fork 4 (5th/7th gear). In transmission 1, gearshift swinging fork 1 (4th/6th gear) is locked against gearshift swinging fork 2 (2nd/reverse gear).

The gearshift swinging forks are locked in the neutral and end positions. The shift throw from neutral into the locked engaged positions of the gears is nominally the same for all gearshift swinging forks. The mechanical neutral position is nominally 0 mm shift throw, in accordance with the characteristic of the transmission sensors.



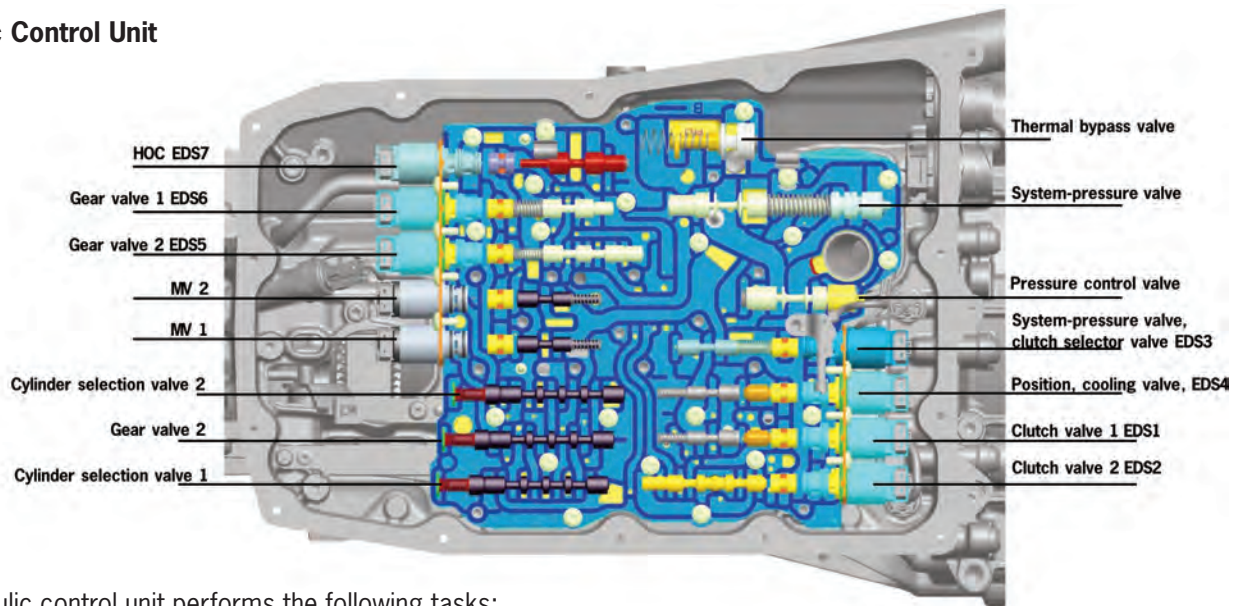
Locking mechanism for 4/6, 2/reverse in neutral, no gear engaged.



Locking mechanism for 1/3, 7/5 in neutral, no gear engaged.

Transmission

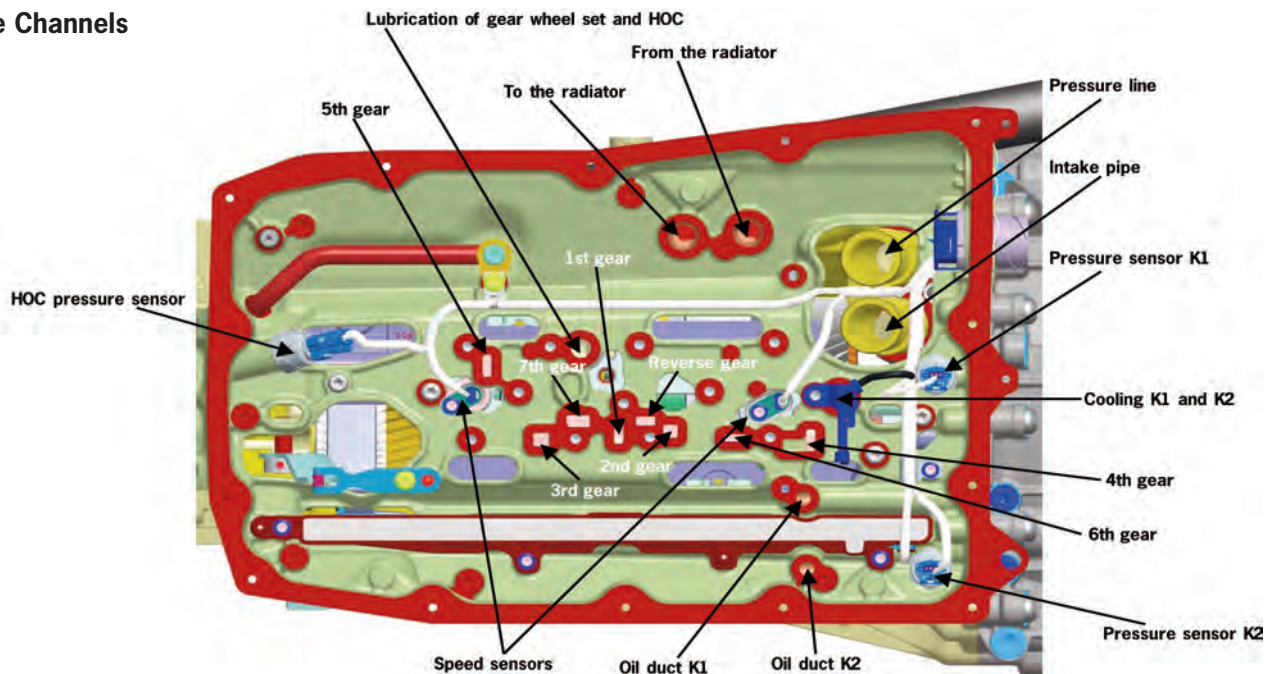
Hydraulic Control Unit



The hydraulic control unit performs the following tasks:

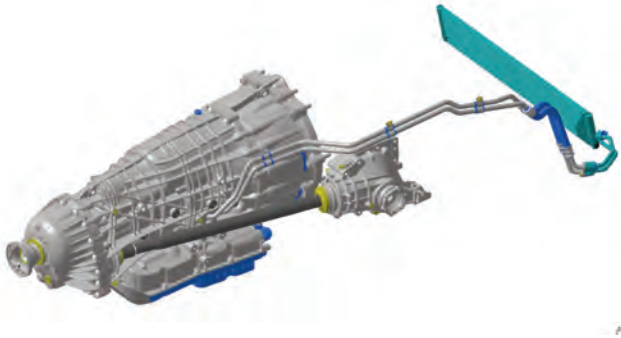
- Controls the system and reduces pressure
- Supplies oil to the actuators, clutches, actuating cylinders, cooling system and lubrication system
- Activates the clutches and actuating cylinders
- Provides emergency hold functions in mechanical transmission limp-home mode

Pressure Channels



The pressure channels of the gears run directly into the shifting unit behind. The oil ducts for actuating the two clutches and the cooling-flow oil duct for the double clutch pass through the transmission housing, across into the clutch bell-housing, reaching the rotary transmission feed-through point via the centering plate. The oil duct for lubricating the gear wheel set extends to the oil line, which branches off to the gear wheels and oils these.

Transmission Cooling



A separate radiator is located at the front of the vehicle to cool the transmission oil. The cooling flow to the radiator is not controlled by a thermostat (the transmission oil temperature would be too high due to the thermal management). Instead, it is controlled by a control valve located in the hydraulic control unit.

Limited Slip Differential

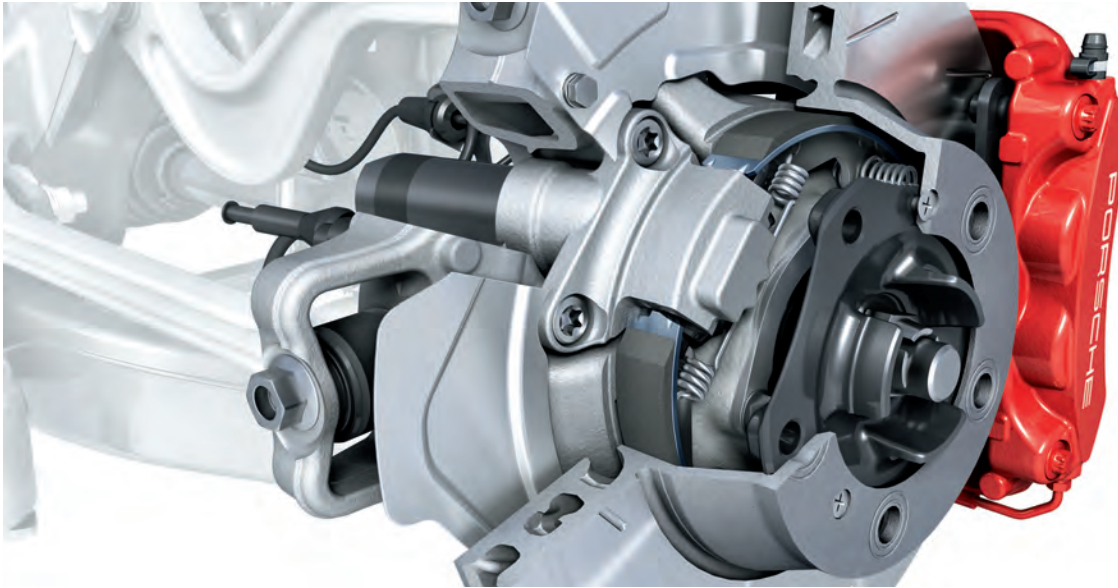


The advantages in terms of driving dynamics are boosted once again by the electronically controlled rear-axle differential lock with variable locking effect. The rear-axle differential lock improves traction if required during extreme lateral acceleration, when accelerating on surfaces with varying levels of grip and when accelerating out of tight bends. Electronic braking intervention (ABD) for traction control is used less frequently.

During load changes in a bend, the vehicle turns in less and remains more in line as a result of the yawing moment produced by the rear-axle differential lock. Any turn-in response triggered by abrupt deceleration is significantly reduced. Extreme acceleration can make the vehicle oversteer, e.g. on race circuits, which experienced drivers find easier to control. On the all-wheel-drive models, the rear-axle differential lock supports the driving dynamics of the controlled all-wheel system, Porsche Traction Management (PTM).

Notes:

[illegible]



Subject	Page
General Information	.2
Front Axle	.3
Steering	.4
Rear Axle	.6
Porsche Active Suspension Management (PASM)	.7
Porsche Active Suspension Management Inputs and Outputs	.8
Adaptive Air Suspension With PASM	.9
Adaptive Air Suspension With PASM Inputs and Outputs	.14
Porsche Dynamic Chassis Control	.15
Porsche Dynamic Chassis Control Inputs and Outputs	.17
Wheels and Tires	.18
Tire Pressure Monitoring System	.18
Brake System	.20
Electric Parking Brake (EPB)	.21
Electric Parking Brake Inputs and Outputs	.23
Porsche Stability Management (PSM)	.25
Porsche Stability Management Inputs and Outputs	.27

Chassis

General Information

To achieve the development objectives listed below, the chassis and suspension systems have been developed and adapted to suit the high performance and specific requirements of the Panamera models. For superb performance and driving comfort, the Porsche Dynamic Chassis Control (PDCC) system used in the Cayenne and Porsche Active Suspension Management (PASM) are also used for the Panamera in addition to adaptive air suspension.

Development objectives:

- Good driving dynamics
- Outstanding traction and vehicle control
- High level of driving pleasure and agility
- Very good driving comfort and day-to-day usability
- High level of driving safety

Technical features:

- Double-wishbone front axle
- Variable rack-and-pinion steering gear with power assistance
- Multi-link rear axle with chassis subframe
- Porsche Active Suspension Management (PASM)
- Adaptive air suspension with levelling system and height adjustment
- Porsche Dynamic Chassis Control (PDCC)

Chassis Overview

Chassis options	Panamera Panamera 4	Panamera S Panamera 4S	Panamera Turbo
Standard = ●			
Option = ○			
Not available = -			
Steel spring suspension	●	-	-
Steel spring suspension with Porsche Active Suspension Management (PASM)	○	●	-
Adaptive air suspension with levelling system, ride-height adjustment and PASM	○	○	●
Porsche Dynamic Chassis Control (PDCC) in combination with air suspension	○	○	○
Servotronic	○	○	○

Steel spring suspension with PASM.

- The new Panamera S and Panamera 4S models have a steel suspension with PASM as standard.

Adaptive air suspension with levelling system and height adjustment, including PASM.

- The new Panamera Turbo features adaptive air suspension including PASM as standard. This combined system enhances both driving dynamics and comfort and is optional for the Panamera/4 and Panamera S/4S.

Porsche Dynamic Chassis Control (PDCC) with electronically controlled rear differential lock.

- The active chassis control system PDCC with electronically controlled rear differential lock is available as an option for all Panamera models in combination with adaptive air suspension.

Notes:

Front Axle



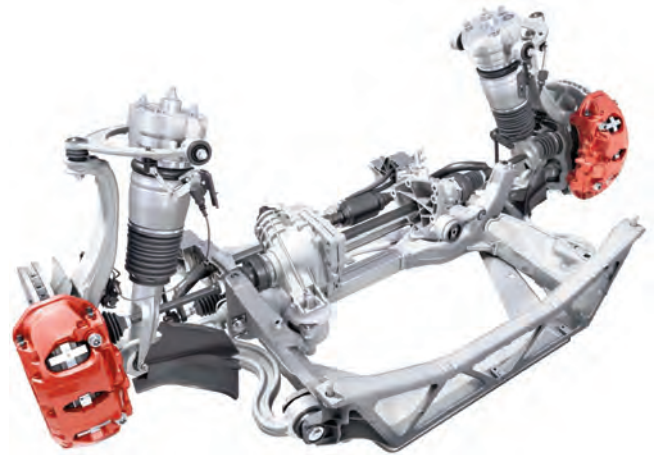
Front Axle With Steel Springs

- Aluminum double-wishbone front axle with aluminum subframe.
Advantage: Reduced weight
The subframe is bolted directly to the body.
- Integrated front spring/shock absorber unit with PASM.
Advantage: Takes up less space.
Color coding for suspension/chassis variant.
- Hydraulic bearings on front control arms.
Improved damping of vibrations in longitudinal direction and as a result, fewer disruptive vibrations are transmitted to the steering.
- Supporting mount with optimized damping characteristics on the front axle with Cellasto inserts.
- Steering gear with variable steering ratio and controlled power-steering pump (Servotronic option).
- Tube-type anti-roll bar with a diameter of 25.5 x 5.5 mm.



Color coding for suspension/chassis variant is shown in the above picture.

Cellasto inserts in spring-strut mount for optimized vibrational and rolling comfort. Cellasto is based on a highly abrasion-resistant polyurethane elastomer, which is ideally suited for dynamically highly stressed components in cars. These include springs in the chassis, shock absorber mounts, steel spring supports, rubber stops and torque supports.



Front Axle With Air Suspension

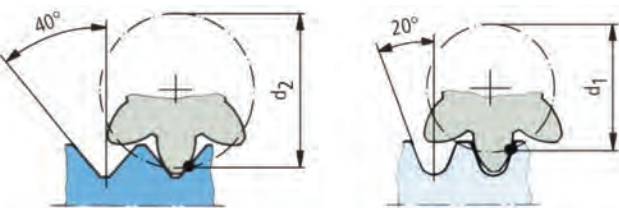
- Aluminum double-wishbone front axle with aluminum subframe.
Advantage: Reduced weight.
- Integrated front spring/shock absorber unit with PASM
Advantage: Takes up less space.
- Hydraulic bearings on control arms.
Improved damping of vibrations in longitudinal direction and as a result, fewer disruptive vibrations are transmitted to the steering.
- Supporting mount with optimized damping characteristics on the front axle with Cellasto inserts.
- Steering gear with variable steering ratio and controlled power-steering pump (Servotronic option).
- Tube-type anti-roll bar with a diameter of 25.5 x 5.5 mm for the Panamera/S and Panamera 4/4S and 28.0 x 4.0 mm for the Turbo.

Chassis

Steering



The steering rack is designed for a high level of variability. The angle at the center of the steering is smaller. As a result, the contact point is deeper in the pinion. The pinion pitch diameter is smaller, which means that the transmission ratio is higher. If the angle is increased, the pinion pitch diameter increases and the transmission ratio is lowered accordingly.



- Rack-and-pinion steering gear with variable steering ratio.

Advantage: Driving stability at high speeds thanks to a higher steering ratio around the central position ($i = 17.11:1$). The steering ratio becomes more direct when the steering wheel is turned more sharply ($i = 13.76:1$). This makes driving around tight corners or parking easier. The turning circle is approx. 11.9 m.

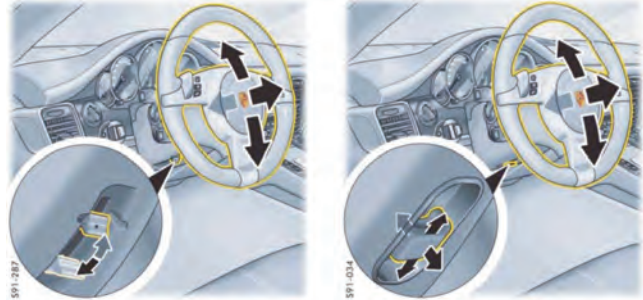


Note!

Repair instructions: Markings on the housing identify the central steering position.

Steering Wheel Adjustment

Steering wheel can be adjusted mechanically or electrically by approx. 60 mm (reach) and approx. 45 mm (height)



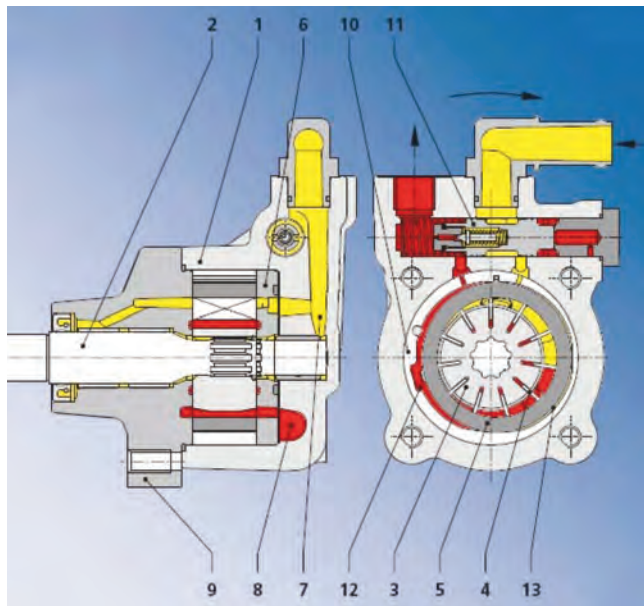
Mechanical steering-wheel adjustment is standard equipment on the Panamera/4 and Panamera S/4S, while electric steering-wheel adjustment is standard equipment on the Panamera Turbo, and is optional on the Panamera/4 and Panamera S/4S models.

Steering Controlled ZF Power Steering Pump



Power steering with controlled power-steering pump with a variable geometric flow rate. The demand-controlled flow rate reduces energy consumption and thus lowers fuel consumption.

Servotronic (speed-dependent steering assistance) is available as an option for all Panamera models. The steering is firm and precise with excellent steering comfort at high speeds. At low speeds, on the Servotronic makes manoeuvring and parking easier.



- | | |
|--------------------|----------------------|
| 1 - Housing | 2 - Shaft |
| 3 - Rotor | 4 - Vane |
| 5 - Curve ring | 6 - End plate |
| 7 - Intake chamber | 8 - Pressure chamber |
| 9 - Cover | 10 - Outer ring |
| 11 - Control valve | 12 - Left chamber |
| 13 - Right chamber | |

The pump delivers a constant volume flow to the hydraulic power steering when the engine is idling. An increasing change in engine speed causes the pump pressure, which is rising internally, to open the control valve (11), apply pressure on the curve ring (5) and reduce eccentricity to the rotor (3). As a result, the pump chambers become smaller and only produce a reduced flow rate.

The development objective of this type of pump was to support the automotive industry in its endeavour to achieve the CO₂ and fuel consumption limit values,

particularly in top-of-the-range mid-size and luxury class vehicles. There is also room for improvement by reducing the steering oil temperature and protecting the pump from possible overload.

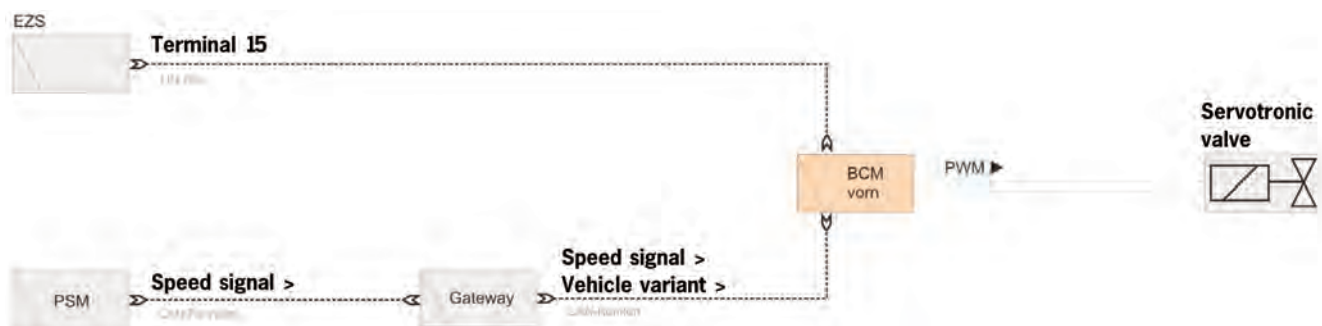
Design

Unlike normal ZF vane-type pumps, the curve ring (5) in the rotor set in the VARIOSERV pump can be adjusted and can generate a variable geometric flow rate thanks to the varying eccentricity. The curve ring is adjusted according to engine speed based on the pre-existing differential pressure between the left (12) and right chambers (13). A control valve (11) with integrated pressure control fitted at a right angle to the shaft (2) essentially controls how it works.

Function

Once the pump speed is reached, the pump delivers a constant volume flow to the hydraulic power steering when the engine is idling. An increasing change in engine speed causes the pump pressure, which is rising internally, to open the control valve (11), apply pressure on the curve ring (5) and reduce eccentricity to the rotor (3). As a result, the pump chambers become smaller and only produce a reduced geometric flow rate. This restricted pump function prevents an overproduction of pressure oil and as a result, significantly less energy is used at higher pump speeds due to reduced power consumption. This makes it possible to simplify cooling measures in the steering system. When the change in engine speed in the vehicle is falling, the pressure that exists between the left and right chambers increases the eccentricity between the rotors (3) and the curve ring (5). As a result, the geometric flow rate increases continuously again.

Steering Servotronic Control Unit Structure



The on-board computer control unit (BCM) receives information about speed and vehicle variant via the gateway. The Servotronic valve is controlled via a corresponding PWM signal. The steering remains fully functional in the event of an electrical malfunction. If the power supply fails, the converter valve opens to maximum, i.e. maximum hydraulic feedback or "high-speed characteristic".

Chassis

Rear Axle



Rear Axle With Steel Springs

- Aluminum multi-link rear axle LSA.
Makes a vital contribution to exemplary driving stability, particularly when accelerating and braking as well as changing lanes sharply and for load changes in corners.
- Separate spring/shock absorber arrangement.
Springs and shock absorbers mounted separately, thereby increasing the luggage compartment volume and maximising the load width.
- Hydraulically damped chassis subframe mount.
Greater comfort.
- Porsche Active Suspension Management (PASM)
Shock absorber system for active and continuous damper control on front and rear axle. It regulates the damping force for each individual wheel, depending on driving style and driving conditions.
- Supporting mount with optimized damping characteristics.
This allows exact control of chassis elements as well as increased driving comfort.
- Tube-type anti-roll bar with a diameter of 17.2 x 2.5 mm for the Panamera/S and 17.8 x 2.6 mm for the Panamera 4/4S.



Rear Axle With Air Suspension

- Aluminum multi-link rear axle LSA.
Makes a vital contribution to exemplary driving stability, particularly when accelerating and braking as well as changing lanes sharply and for load changes in corners.
- Separate spring/shock absorber arrangement.
Air springs and shock absorbers mounted separately, thereby increasing the luggage compartment volume and maximizing the load width.
- Hydraulically dampened chassis subframe mount.
Increases comfort.
- Porsche Active Suspension Management (PASM)
Shock absorber system for active and continuous damper control on front and rear axle with level control.
- Spring-strut mount with optimized damping characteristics. This allows exact control of chassis elements as well as increased driving comfort.
- Tube-type anti-roll bar with a diameter of 17.2 x 2.5 mm for the Panamera/S, 17.2 x 2.5 mm for the Panamera 4/4S and 18.5 x 2.5 mm for the Panamera Turbo.

Notes:

Porsche Active Suspension Management (PASM)

Porsche Active Suspension Management (PASM) is a shock absorber system for active and continuous damper control on front and rear axle. It regulates the damping force for each individual wheel, depending on driving style and driving conditions. PASM is standard equipment for steel and air suspension.

The three chassis programs Comfort, Sport and Sport Plus can be used to adjust the chassis on the Panamera to suit individual requirements. The driver enjoys the comfort of a touring in the Comfort program and the performance and agility of a Porsche sports car in the Sport Plus program. The required damping force is always calculated and applied for each wheel in all three programs, as described above. Only the emphasis is different, depending on the ultimate objective, be it comfort or performance.

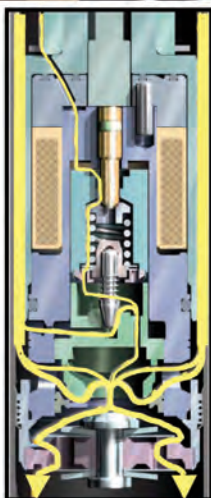
PASM is controlled by regulating the oil flow in the shock absorbers. In Comfort mode, for example, the oil can flow freely and the shock absorber is regulated easily. Depending on the selected program, the flow paths close or contract and the oil is prevented from flowing through. Based on this principle, damping force and vehicle handling can be controlled at the push of a button.



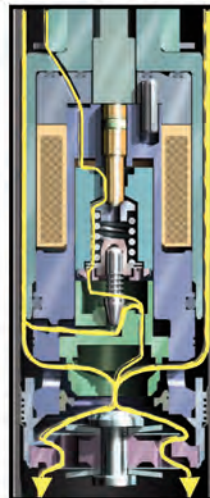
PASM With Steel Springs



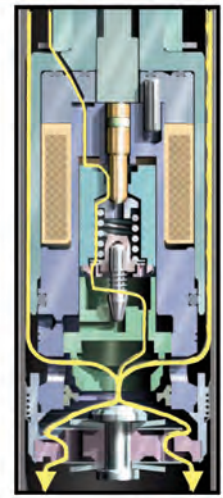
PASM With Air Suspension



Comfort Mode



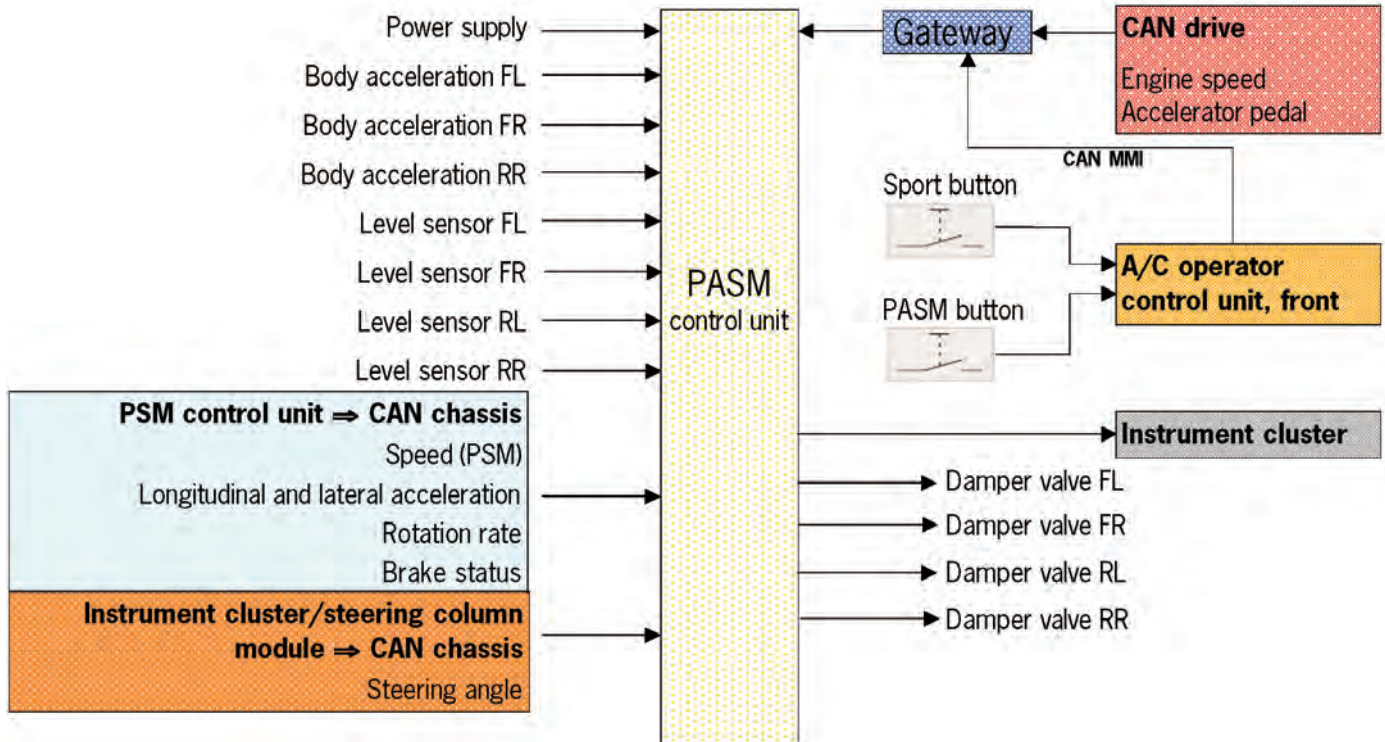
Sport Mode



Sport Plus Mode

Chassis

PASM Inputs and Outputs



PASM Control Unit

- Power supply for terminal 15, 30 and 31
- Body acceleration sensors and level sensors provide information about body position as well as vertical movements, vertical acceleration, pitching, rolling and yawing
- Signals such as lateral acceleration, steering angle, brake pressure, engine torque and driving speed are sent to the control unit via CAN and the vehicle setup is adjusted accordingly
- The Sport and PASM buttons send an analog signal into the A/C control unit and via CAN and the gateway control unit into the PASM control unit

Body Acceleration Sensors



Body acceleration sensor on the right front.



Body acceleration sensor on the left front.

Adaptive Air Suspension With PASM

Compared with a steel spring suspension with PASM, adaptive air suspension offers the following advantages:

- Wide setup range between comfort and sportiness by enabling/disabling the air volume
- Total load balancing: constant vehicle height and full compression travel regardless of load (levelling system)
- Additional lift function at low speeds up to 20 mph (30 km/h) (height adjustment)
- Better day-to-day usability
- Sporty look and reduced drag at low level

The height adjustment feature allows the air suspension to vary the ground clearance of the Panamera by setting it to three different levels: from Normal level (basic air suspension level) to High Level or Low Level. It takes approx. 4 seconds to switch to the next lower or next higher level. The running-gear setup is shown on the multi-function display for approx. 4 seconds. The levelling system automatically ensures a constant vehicle position regardless of how the load is distributed.



Note!

Automatic level control must be switched off when driving onto a lifting platform or when raising one wheel. Level control can only be switched off when the vehicle is stationary. Level control is switched on automatically at a speed of more than approx. 4 mph (7 km/h).

Switching off level control

1. Switch on ignition.
2. Press and hold the button for approx. 10 seconds. The message "Control off" appears on the multi-function display in the instrument panel.

Switching on level control

1. Lower the vehicle.
2. Switch on ignition.
3. Press and hold the button for approx. 10 seconds. The message "Control on" appears on the multi-function display in the instrument panel.



PASM Button Comfort - Not Pressed



Vehicle Level

Normal Level (basic level of the system)

Max. ground clearance: 144 mm.

Spring rate: Soft

Damping: Comfort



PASM Button Comfort - Pressed Once



Vehicle Level

Normal Level

Spring rate: Soft

Damping: Sport

Porsche Active Suspension Management (PASM) optimally regulates the damping force. Modified software tuning enables a particularly fast build-up of damping forces and as a result, a harder damper rate is selected in "Sport" mode.

Chassis



PASM Button Comfort - Pressed Twice



Vehicle Level

Low Level
Spring rate: Hard
Damping: Sport

In addition to selecting a harder damper rate, a harder spring rate is also set in “Sport Plus” mode. The driver therefore has a sports chassis at the press of a button.



High Level Button



Vehicle Level

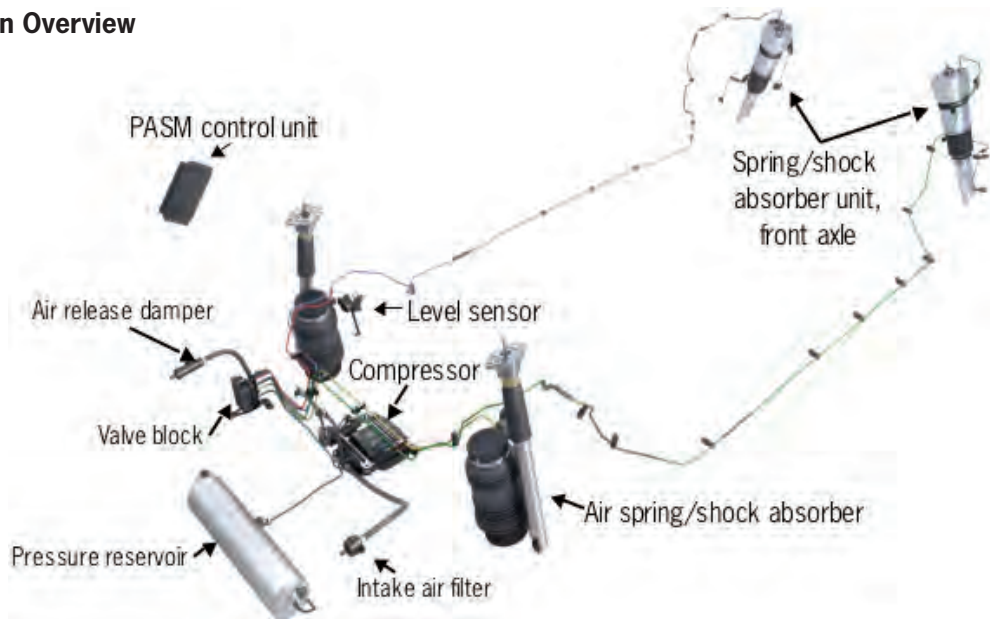
High Level (20 mm higher than normal)

The manually selectable high level can be used to raise the vehicle by approx. 20 mm in order to drive safely over high speed bumps or steep ramps into parking garages. To ensure that the Panamera is not driven in High Level on public roads, the chassis automatically goes back to Normal Level once a speed of 20 mph (30 km/h) is reached.

Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Air Suspension Overview



The Panamera features a closed air-spring system with a compressor, solenoid block with integrated pressure sensor, and a pressure accumulator. To raise the vehicle, air is pumped into the spring units by the electric compressor. When lowering the vehicle, the excess air is not released outwards, but is fed back into the 5.2 liter pressure accumulator. This system makes the Panamera particularly energy-efficient and easy to control with a control speed of at least 10 mm per second, depending on load.

The adaptive air suspension system includes the following components:

- Closed air supply system for better energy usage and faster level switching
- Electrically driven compressor, uncoupled from the interior, with temperature sensor
- Solenoid valves for controlling the air-spring volume
- Light-alloy pressure accumulator
- Two fully load-bearing air springs with an outer guide and integrated dampers on the front axle
- Two free-standing air springs and separate dampers on the rear axle
- Air springs with switchable additional volume
- Four level sensors (spring travel sensors) for recording body movements
- PASM control unit



Note!

The air suspension is filled with nitrogen.

Control Unit

Location: Luggage compartment, left.

Function: System control, diagnosis, monitoring.

Level Sensor (4 x)

Location: Front and rear control arms.

Function: Determining vehicle level.

Compressor

Location: Behind the rear axle.

Function: Pumps the air between the pressure reservoir and air springs in order to raise or lower the vehicle. If the air pressure falls below the required pressure, air is drawn in via the air cleaner.

Pressure Reservoir (5.2 liter)

Location: Under the rear apron.

Function: Stores the required air volume.

Valve Block

Location: To the left of the compressor.

Function: Supplies air to the relevant components. If the air pressure exceeds a certain nominal value, air is released via a release valve.

Intake Filter

Location: To the right of the compressor.

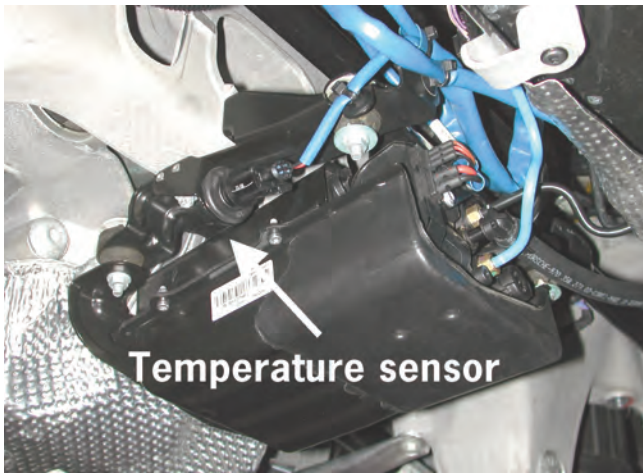
Function: Cleans the aspirated air.

Release Damper

Location: At the left, above the valve block.

Function: Prevents noise when releasing air.

Chassis



Compressor - on rear auxiliary support.



Air release damper left of the tank.



Valve unit - rear left, next to the compressor.



Pressure reservoir at the rear under the rear apron.



Installation position of intake air filter - right of the tank.

Filling The Air System Following Repairs



Air connection for front right air spring (green line)

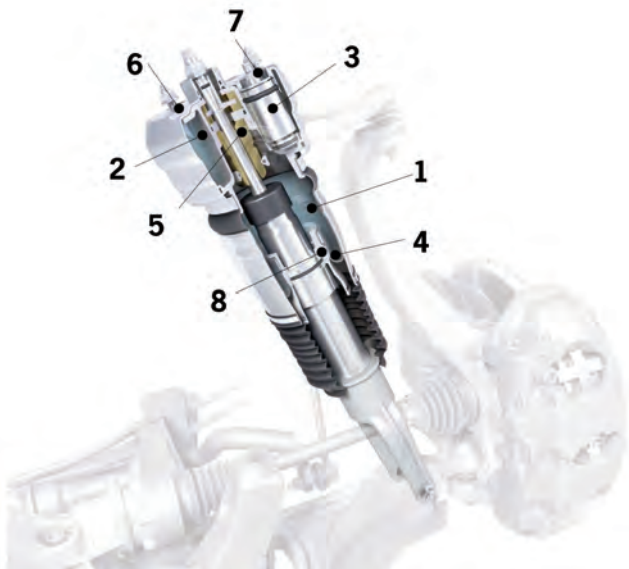
Required tools:

- Intermediate piece (special tool)
- Connection to nitrogen bottle
- Nitrogen bottle with pressure regulator and pressure gauge

For instructions on draining and filling, see Workshop Manual.

Front Axle Additional Air Volume

In the air suspension system, the air bellows generally acts as the spring. The newly developed, lightweight adaptive air suspension system has a selectable additional air volume for changing the spring rate. This additional air volume is integrated into the spring strut together with the shock absorber on the front axle and can be enabled and disabled by an electric valve. The total air volume in the Comfort setting is approx. 2.2 liters. Closing the valve reduces the volume to approx. 1.1 liters. This increases the spring rate significantly, thereby enabling extremely varied vehicle handling ranging from comfortable to particularly sporty. The spring rate also becomes more progressive during the course of compression travel.



- 1 - Basic air tank
- 2 - Air tank for additional volume
- 3 - Electric control valve
- 4 - Air bellows (spring)
- 5 - Additional spring
- 6 - Supporting mount
- 7 - Air connection
- 8 - Rolling contour

Rear Axle Additional Air Volume

The air spring on the rear axle (RA) is designed as a free-standing spring and works according to the same principle as the springs on the front axle (FA).



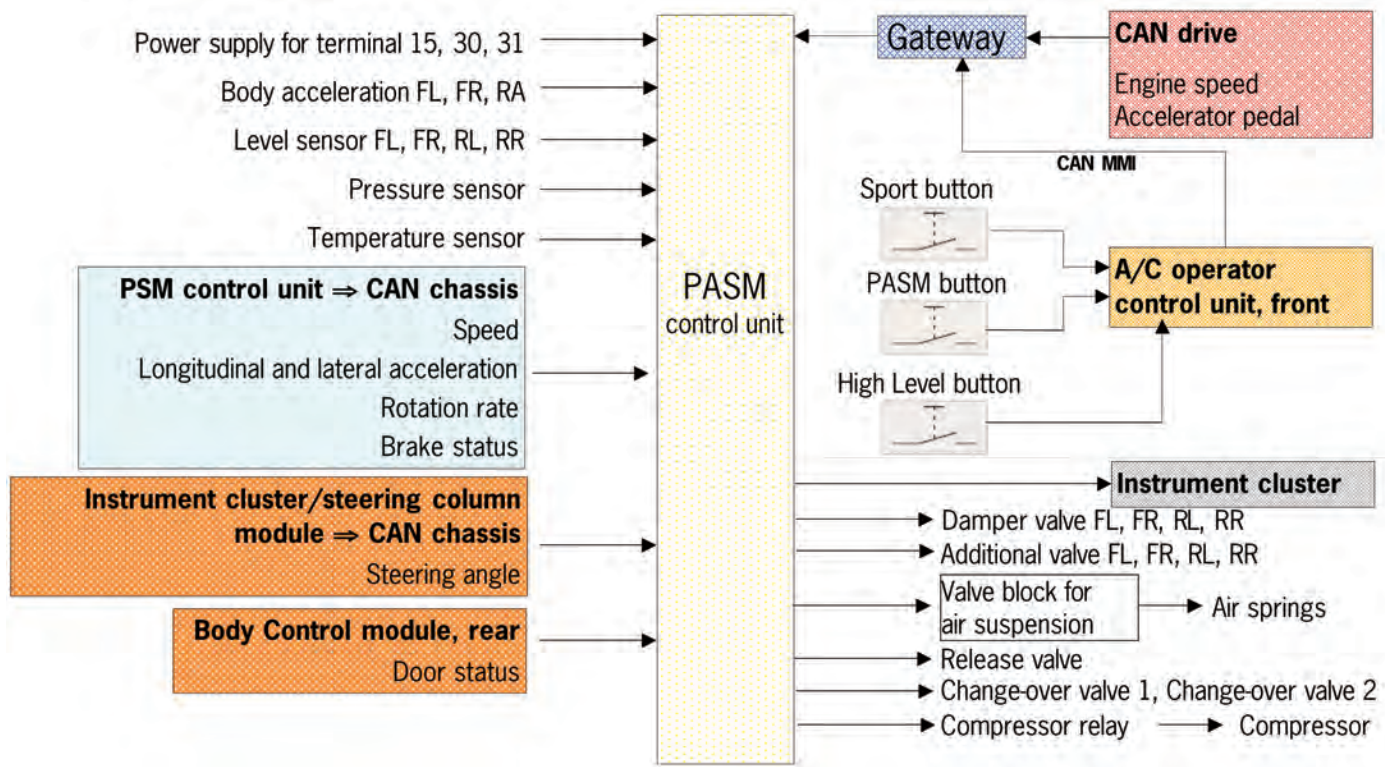
Small air volume.



Larger air volume.

Chassis

Air Suspension With PASM Inputs and Outputs



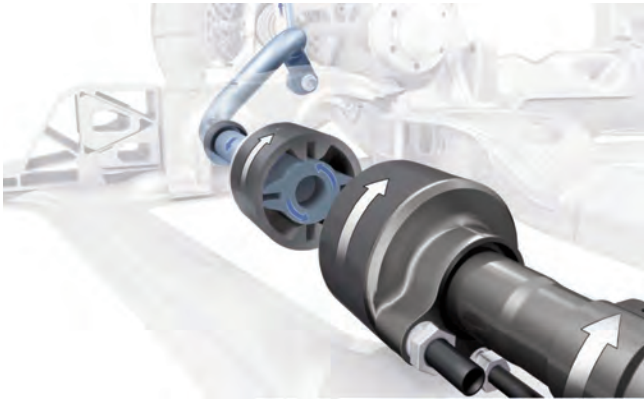
Input signals:

- Power supply for terminal 15, 30 and 31
- Body acceleration sensors and level sensors provide information about body movements, vertical movements and vertical acceleration as well as pitching, rolling and/or yawing
- Level sensors determine the vehicle level - level control/ride height adjustment
- The pressure sensor records the current air pressure in the individual components (pressure accumulator, air-spring elements)
- The temperature sensor records the ambient temperature of the compressor (compressor protection)
- Signals such as lateral acceleration, steering angle, brake pressure, engine torque and driving speed are sent to the control unit via CAN so that the vehicle setup can be adjusted accordingly
- Door status - no adjustments can be made while the doors are open and any adjustments that are in progress are interrupted when a door is opened
- The Sport, PASM and High Level buttons send an analogue signal into the A/C control unit and via CAN and the gateway control unit into the PASM control unit

Output signals:

- Damper valves - PASM control
- Additional valve - increases/reduces the air volume - spring rate adjustment
- Valve block - activates solenoid valves for controlling the air volume (vehicle height)
- Release valve in the valve block - releases air in the event of overpressure
- Change-over valves in the compressor - raise or lower the vehicle
- Compressor relay - switches compressor on/off

Porsche Dynamic Chassis Control (PDCC)



The active chassis control system PDCC with electronically controlled rear differential lock is available as an option for all Panamera models in combination with adaptive air suspension. It is an active system that is used in conjunction with adaptive air suspension and PASM to optimally stabilize the vehicle. PDCC prevents rolling movements of the body around the vehicle's longitudinal axis by applying a counter-moment using the active anti-roll bars on the front and rear axle. The system also improves the vehicle's balance through dynamic rolling moment distribution. It thus enables superb agility at all speeds, optimal steering behavior and balanced load alteration behaviour.

The benefits of the system for the driver are in the following areas:

Improved vehicle performance due to:

- Increased steering precision
- Reduced lateral inclination (vehicle tilt) during cornering
- More agile steering behavior
- Higher maximum lateral acceleration during cornering
- Noticeably more solid vehicle handling

Greater comfort due to:

- Almost total compensation of the roll angle
- Suppression of body movements
- Decoupling of the anti-roll bars when driving straight ahead, resulting in fewer copy effects (counter-movement of the body when one side moves)

Porsche Dynamic Chassis Control can also be controlled using the PASM chassis buttons. PASM and PDCC are always configured together by selecting one of the three PASM chassis control programs. In Comfort mode, PDCC ensures a very comfortable ride on uneven road surfaces thanks to the anti-roll characteristics. In Sport mode, the active intervention of the systems affects steering

behaviour, maximum rolling support, self-steering properties and traction in such a way that maximum performance and agility is guaranteed.



PASM Button Comfort - Not Pressed

Vehicle Level

Normal Level
Spring rate: Soft
Damping: Comfort
PDCC: Comfort



PASM Button Comfort - Pressed Once

Vehicle Level

Normal Level
Spring rate: Soft
Damping: Sport
PDCC: Sport



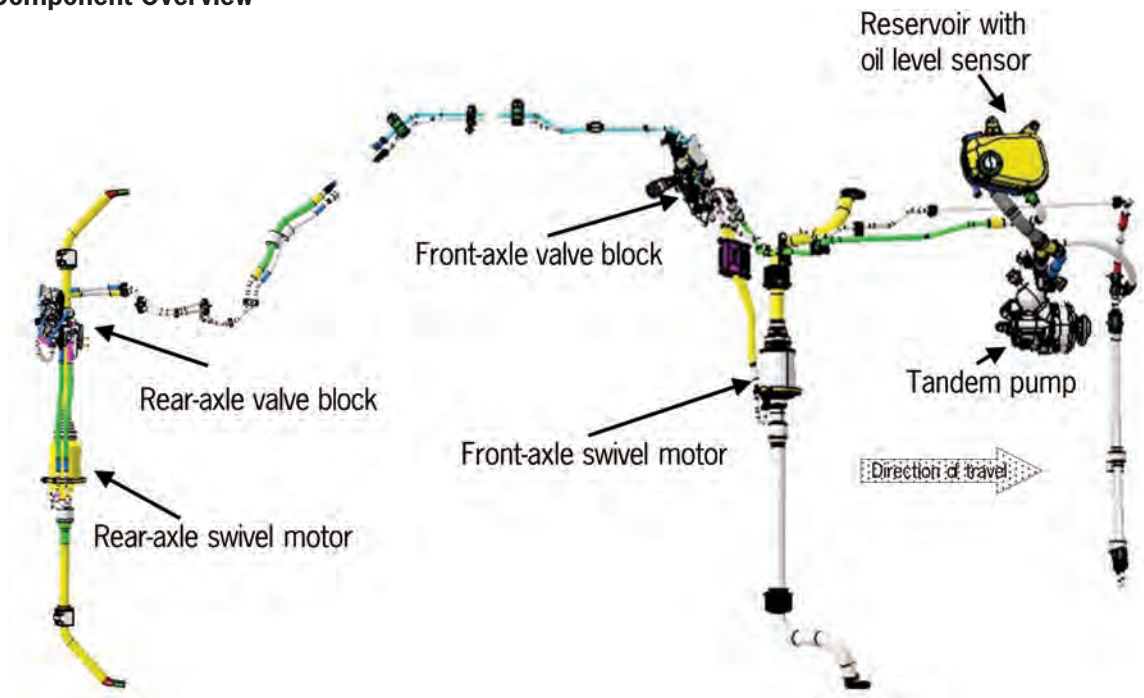
PASM Button Comfort - Pressed Twice

Vehicle Level

Low Level
Spring rate: Hard
Damping: Sport
PDCC: Sport Plus

Chassis

PDCC Component Overview



Reservoir

Installation position at front left in the engine compartment, supplies oil for power steering and PDCC, with oil level sensor (float with reed contact), change interval: 60,000 miles (90,000 km) or every 6 years.

Tandem Pump

Vane cell pump for power steering, radial piston pump for PDCC.

Front Axle Valve Block

The valve block comprises two pressure sensors, a failsafe valve, the direction valve and a pressure-regulating valve. The valve block also has an integrated volume flow component, which distributes the volume flow at a fixed division ratio of 60/40 on front and rear axle. The valve block is fitted in the front left wheel housing.

Rear Axle Valve Block

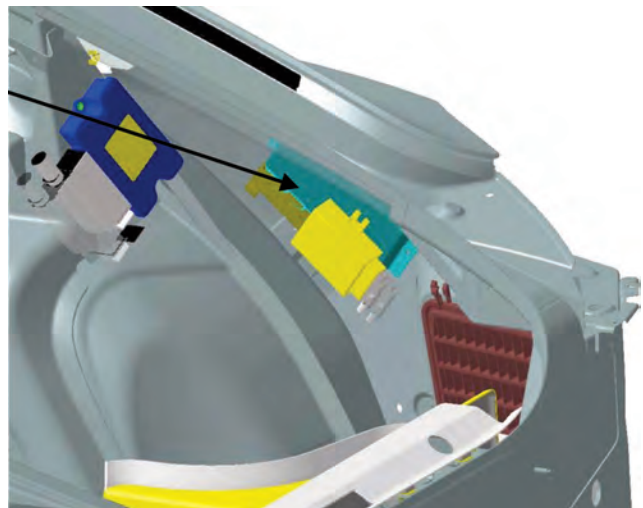
The valve block comprises two pressure sensors, a pressure-regulating valve and the direction valve. The valve block is fitted on the left rear-axle auxiliary support.

Swivel Motor

The core elements of the system are the active anti-roll bars with hydraulic swivel motors, which are integrated on front and rear axle instead of the conventional mechanical anti-roll bars. A vane controller divides the swivel motor into several chambers, which are filled with oil. A torque, which affects the body as well as the wheels via the anti-roll bar halves fitted on both sides of the swivel motor, is built up by specifically activating individual chambers and changing the oil pressure. The system has variable control

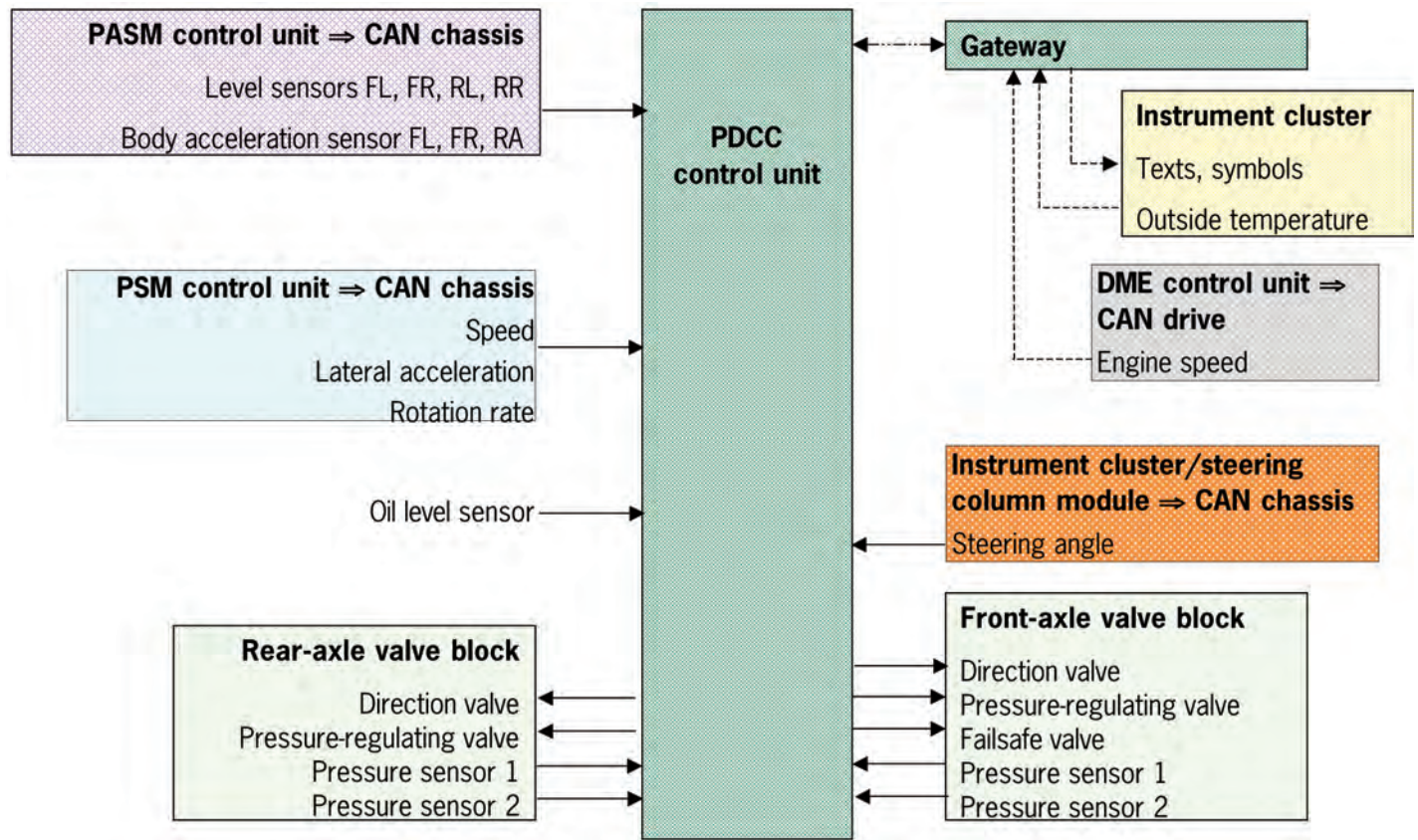
over the oil pressure and oil flow in both rolling directions and can thus counteract lateral inclination forces, which can occur while cornering due to lateral acceleration affecting the vehicle. As a result, lateral inclination can be almost entirely compensated even in high lateral acceleration ranges, thereby keeping the vehicle horizontal.

PDCC Control Unit



The control unit is installed at the right-hand side of the luggage compartment. The input data is evaluated continuously and appropriate control operations are initiated in the valve blocks over the vehicle's entire speed range.

PDCC Inputs and Outputs



Input Signals	Function
Level and body acceleration sensors from PASM control unit	Detect body movements so that the vehicle setup can be adjusted accordingly.
Speed, lateral acceleration, rotation rate from PSM control unit	Speed-dependent adjustment, vehicle setup is adjusted according to lateral acceleration and rotation rate
Oil level sensor	Warns if the fluid level is too low, legal requirement as two systems are supplied by one tank.
Pressure sensors in the valve blocks	Record the current pressure in the chambers of the swivel motors.
Steering-angle sensor	Records the direction of travel and steering speed
Engine speed and outside temperature	The current pressure in the system (high pressure and low pressure) is monitored, depending on engine speed
Output Signals	Function
Front-axe and rear-axe pressure control valves	Supply between 0 and 14 amps 0 A = de-pressurized, 14 A = approx. 160 bar
Direction valve	Controls the current pressure in the chambers of the swivel motors.
Failsafe valve in front-axe valve block	When a fault occurs, the failsafe valve is de-energized and returns to its normal position by spring force. This short-circuits the pump hydraulic system and switches the system to a failsafe mode.

Chassis

Wheels and Tires

General Information

The Panamera models come with newly developed 18 and 19-inch wheels or optional 20-inch wheels in a unique design. During the development of each of these wheels, huge emphasis was placed on performance through light-weight construction combined with an attractive unique design. Axle-specific wheel sizes for each of the Panamera models were optimized with regard to rim width and rim offset (RO). In addition, all Panamera models feature mixed tires, i.e. different tire width on front and rear axle. By introducing these measures, it was possible to adapt the tyres to suit the requirements of each axle on the vehicle, thereby achieving optimal traction, driving stability and steering control while ensuring the greatest possible comfort. Since all tires have been specially adapted to the Panamera, they all have the usual Porsche N specifications.

Wheels	Description = Standard = Optional	Panamera		
		S	4S	Turbo
	18-inch Panamera S wheel Alloy wheel with 10-spoke design Front axle: 8.0 x 18 with 245/50 ZR 18 tires, Rear axle: 9.0 x 18 with 275/45 ZR 18 tires	●	●	
	19-inch Panamera Turbo wheel Alloy wheel with 5 double-spoke light-weight design Front axle: 9.0 J x 19 with 255/45 ZR 19 tires, Rear axle: 10.0 J x 19 with 285/40 ZR 19 tires	○	○	●

Panamera/4 same as Panamera S/4S

Tire Pressure

The Panamera can be driven with various tire pressures. A distinction is made between:

1. Standard tire pressure for summer/winter and all-season tires, with partial or full vehicle load, up to the maximum speed.
2. Comfort tire pressure for summer tires up to 170 mph (270 km/h), with full or partial vehicle load.
3. Comfort tire pressure for summer/winter and all-season tires up to 100 mph (160 km/h), with partial or full vehicle load.

For details of tire pressure, refer to the Owner's Manual, door pillar decal or Workshop Manual.

Run-flat Systems

All the Panamera models come as standard with a space-saving tire repair system comprising tire sealing compound and an electric pneumatic compressor.

Tire Pressure Monitoring (TPM) Generation 2.4

The main function of the system is to monitor the tire pressure while driving. The tire pressure is monitored according to axle, tires, vehicle load and speed. The most important additional function offered by the system is the ability to automatically and quickly determine which wheels are mounted and their installation position. The radio telegrams from the wheel electronics units are requested by the control unit as required via the trigger senders. The system recognizes the wheels mounted on the vehicle and their installation positions by evaluating the trigger location and carrying out a statistical analysis of the information received from the wheel electronics units. The tire inflation information is displayed for the driver in the instrument cluster. The individual system components are diagnosed by the control unit.

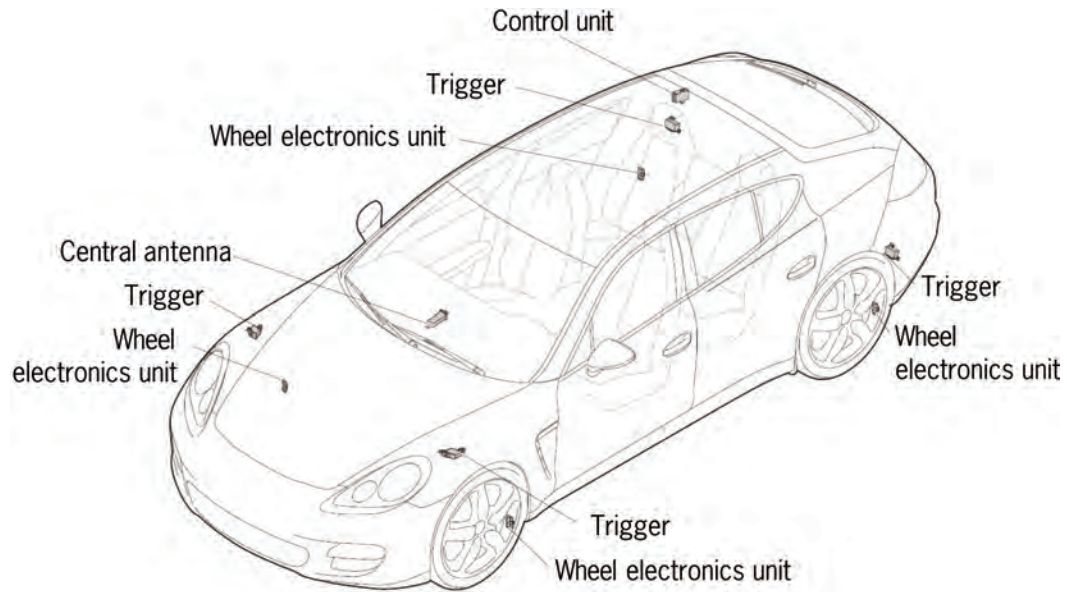
The most important additional function offered by the TPM system in the Panamera model range is the ability to differentiate between required pressure for comfort and standard required pressure (Vmax required pressure). Another important change relates to the activation of the hard warning.

A "hard" warning in red text is only displayed:

- if the tire pressure is more than 7 psi (0.5 bar) too low for the speed range from 0 - 100 mph (0 to 160 km/h) and
- if the tire pressure is more than 6 psi (0.4 bar) too low at speeds of more than 100 mph (160 km/h).

The dynamic warning is no longer used, i.e. no warning is issued when the tire pressure starts to drop quickly within a certain time period. There is a slight time delay before the warning appears if one of the parameters mentioned above comes into effect.

Tire Pressure Monitoring (TPM) Components



Control Unit

The control unit is located at the right-hand side of the luggage compartment. The control unit analyses the incoming data from the antenna and forwards the relevant information to the instrument cluster. Since the data is transmitted via cable from the central antenna, the control unit is designed to pick up both frequencies (433/315 MHz). If a new control unit is installed, it must be coded accordingly.

Triggers (trigger senders)

The four triggers, which are located under the wheel housing liners in each of the four wheel housings, send a 125 kHz signal directly to the wheel electronics units in order to transmit the desired information to a central antenna immediately. The request to do this comes from the PSM control unit via a PWM signal.

Central Antenna

The digital central antenna (reception frequency 315 or 433 MHz) is mounted to the right side of the vehicle floor. The signals received from the wheel electronics units are digitalized in the antenna and forwarded to the control unit via two lines (LIN bus - Local Interconnect Network).

Wheel Electronics Unit

The wheel electronics unit comprises the following components: Pressure sensor, temperature sensor, roll switch, measuring and control electronics, receiver and transmitter as well as a battery.



Note!

A complete description of the TPM system can be found in the Service Information Technik for the Boxster and Cayman, model year 2009.

Notes:

Chassis

Brake System

Panamera/4 Brakes

The brake systems of the V6 models are designed to cope with the power of the vehicles and therefore offer the high braking performance typical for Porsche and share similar specifications with the Panamera S/4S. 6-piston aluminum monobloc fixed-caliper brakes and brake discs with a diameter of 360 mm are installed at the front. At the rear, the vehicle is braked by 4-piston aluminum monobloc fixed-caliper brakes and brake discs with a diameter of 330 mm. The brake callipers are black for the Panamera V6 models. The ceramic brake system Porsche Ceramic Composite Brake (PCCB) is optionally available.

Panamera S/4S Brakes



6-piston aluminum monobloc fixed caliper brakes and integral-type brake discs with a diameter of 360 mm are used on the front of the Panamera S and Panamera 4S. 4-piston aluminum monobloc fixed caliper brakes and integral-type brake discs with a diameter of 330 mm are installed at the rear. The brake discs are involute-shaped and internally vented for better dissipation of heat and have grooves for greater friction. A specific cooling air duct on the front axle ensures effective cooling of the brake system. A brake pad wear indicator on each wheel indicates when the pads need to be replaced.

Panamera Turbo Brakes



6-piston aluminum monobloc fixed caliper brakes and compound brake discs with a diameter of 390 mm are used on the front of the Panamera Turbo. 4-piston aluminum monobloc fixed caliper brakes and integral-type brake discs with a diameter of 350 mm are used at the rear. The brake discs are involute-shaped and internally vented for better dissipation of heat and have grooves for greater friction and optimal braking comfort. The standard compound brake discs with an aluminum hub and grey cast-iron friction ring on the front axle of the Panamera Turbo help to reduce the weight and unsprung masses.

Panamera Turbo Brakes Cooling



A specific cooling air duct on the front axle ensures effective cooling of the brake system. A brake pad wear indicator on each wheel indicates when the pads need to be replaced.

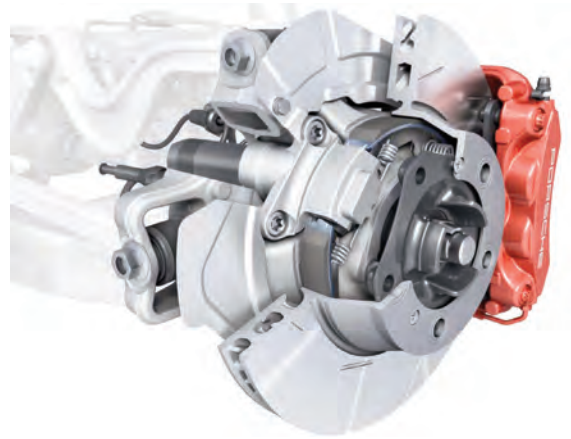
Porsche Ceramic Composite Brake (PCCB)



Similar to other Porsche models, the high-performance ceramic brake system Porsche Ceramic Composite Brake (PCCB), is also available as a option.

For the Panamera/4 and Panamera S/4S models, this brake system is designed with a brake disc diameter of 390 mm at the front and 350 mm at the rear, while the system used on the Panamera Turbo has a brake disc diameter of 410 mm at the front and 350 mm at the rear. 6-piston aluminum monobloc fixed caliper brakes are also used here on the front axle and 4-piston aluminum monobloc fixed caliper brakes on the rear axle of all Panamera models.

Electric Parking Brake (EPB)

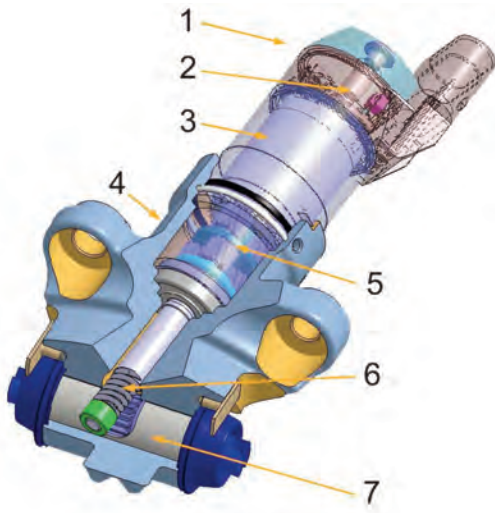


The Porsche Panamera is the first Porsche model ever to feature an electrically operated parking brake, which can be controlled conveniently using a switch at the left of the steering wheel. The electric parking brake can be activated manually using this switch and deactivated by pressing the footbrake (and clutch pedal). It is also released automatically following manual activation when the driver's intention to drive off is detected via the accelerator pedal.

	Panamera S	Panamera 4S	Panamera Turbo
Service brake	Foot-operated, hydraulic-mechanical gear ratio, dual-circuit brake system, axle distribution, vented brake discs at front and rear axles, PSM 8.0 (Porsche Stability Management) as standard	Foot-operated, hydraulic-mechanical gear ratio, dual-circuit brake system, axle distribution, vented brake discs at front and rear axles, PSM 8.0 (Porsche Stability Management) as standard	Foot-operated, hydraulic-mechanical gear ratio, dual-circuit brake system, axle distribution, vented brake discs at front and rear axles with multi-part brake discs, PSM 8.0 (Porsche Stability Management) as standard
Brake booster	Tandem vacuum brake booster i = 7 Mechanically driven vacuum pump	Tandem vacuum brake booster i = 7 Mechanically driven vacuum pump	Tandem vacuum brake booster i = 7 Mechanically driven vacuum pump
Brake master cylinder Ø	26.99/26.99 mm	26.99/26.99 mm	26.99/26.99 mm
Brake discs Ø FA/RA	360/330 mm	360/330 mm	390/350 mm
Brake disc thickness, FA/RA	36/28 mm	36/28 mm	38/28 mm
Brake calliper pistons Ø FA/RA	6 x 36/4 x 32 mm	6 x 36/4 x 32 mm	6 x 36/4 x 32 mm
Parking brake	Duo-servo, electrically operated, works on the rear axle	Duo-servo, electrically operated, works on the rear axle	Duo-servo, electrically operated, works on the rear axle
Brake drum Ø	180 mm	180 mm	180 mm
Brake shoe width	24 mm	24 mm	24 mm

Chassis

Electric Parking Brake (EPB) (cont'd)



- 1 - Housing with connector
- 2 - Rotary encode
- 3 - Motor
- 4 - Housing for mechanical components
- 5 - Planetary gear
- 6 - Pinion
- 7 - Expander mechanism

Functions

Activating when the vehicle is stationary

Conditions:

- Vehicle speed less than 1.5 mph (2.2 km/h)
- At least one valid wheel signal per axle
- Press switch

Display

- Function light comes on in the instrument cluster and on the switch

Emergency Stop

If at least one valid wheel signal is not available on each axle, the electric parking brake can be clamped under the following conditions and the vehicle is stopped safely:

- Ignition off
- Switch pressed for longer than 10 seconds

Releasing when the vehicle is stationary

Conditions:

- Ignition on
- Brake pedal (also clutch pedal in vehicles with manual transmission) pressed
- Pull switch

Display:

- Function light goes out (on instrument cluster and switch)

Automatic electric parking brake release when driver's intention to drive off is detected

(Drive Off Assistant)

Conditions:

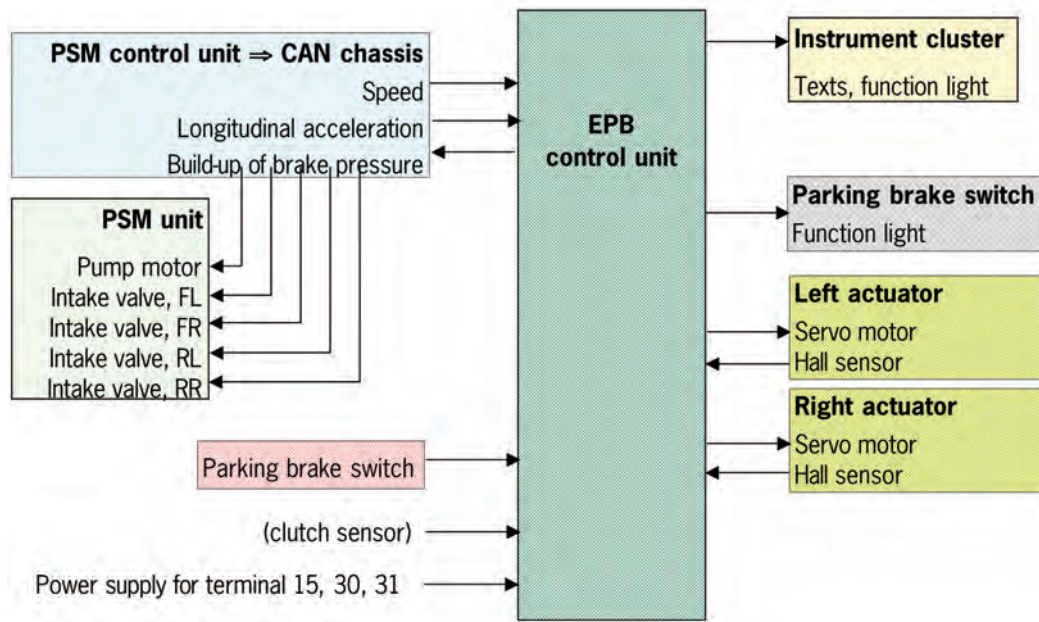
- Driver's intention to drive off detected (Porsche Doppelkupplung (PDK) = selector lever in position D or R, manual transmission = clutch pressed)
- Gradient angle $> 5^\circ$
- Driver's seat belt fastened
- Driver's door closed

Display:

- Function light goes out (on instrument cluster and switch)

Notes:

Electric Parking Brake Inputs and Outputs



Note!

If the driver's door is not closed or the driver's seat belt is not fastened, the electric parking brake will not be released automatically when the driver attempts to drive off. The message "Release electric parking brake" appears on the multi-function display in the instrument panel. The Brake warning light on the instrument panel and the indicator light on the switch start to flash. The parking brake must be released manually.

Emergency braking - vehicle deceleration of 0.8 g

Conditions:

- Vehicle speed greater than 2 mph (3.5 km/h)
- One valid wheel signal per axle
- Press switch continuously

Display:

- Function light flashes (instrument cluster and switch)
- Warning sounds
- "Emergency braking" message in instrument cluster

Special Functions

- TÜV mode, automatic activation when vehicle rolling is detected
- Bedding in the pads, activated using the PIWIS Tester
- Calibration of the system, activated using the PIWIS Tester
- Driving to assembly position, activated using the PIWIS Tester

Electric Parking Brake Control Unit (located right C-pillar)

- Speed signal - wheel speeds are detected in order to run the various functions, depending on vehicle speed.
- Longitudinal acceleration - the gradient is detected in order to activate/deactivate the Drive-Off Assistant.
- Output signals to the PSM hydraulic unit - targeted build-up of brake pressure during emergency braking

Parking Brake Switch



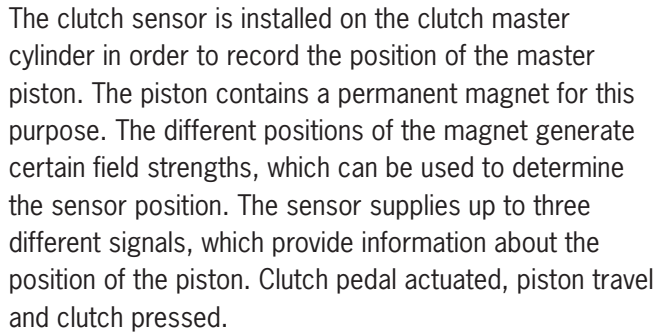
Press = apply, pull = release, press continuously = initiate emergency braking function

Brake Light Sensor



Instead of a conventional brake light switch, a Hall sensor transmits the position of the brake pedal. The sensor can be adjusted by moving it in the holder.

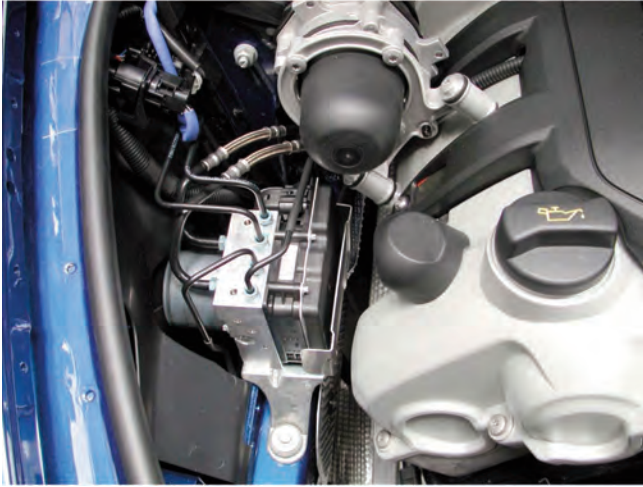
Clutch Sensor



- [illegible]

- 1 - Loosen the oval-head screw on the back of the actuator using an Allen key (a/f 3).
- 2 - Access the emergency release screw using an Allen key (a/f/ 3).
- 3 - Complete approx. 300 turns anti-clockwise with a torque of less than 100 Nm (74 ft lb.). Keep turning until the torque increases perceptibly. The fully released position of the brake shoes is then reached.

Porsche Stability Management (PSM)



All Panamera models come as standard with enhanced Porsche Stability Management (PSM) for superior active driving safety in manoeuvres involving extreme longitudinal and lateral acceleration without affecting the typical Porsche agility.

PSM improves active safety by making use of the following:

- ABS (anti-lock brake system)
- MSR (engine drag torque control)
- ASR (anti-slip control)
- ABD (automatic brake differential)
- EBD (electronic brake-force distribution)
- VDC (driving dynamics control)
- Brake assist
- Enhanced braking readiness by pre-filling the brake system
- PSM can be switched off using the “PSM OFF” button, e.g. for driving on race circuits

What's new?

- Earlier pre-filling of the brake system and brake assist sensitivity combined with adaptive cruise control (ACC)
- Trailer Stability Management
- Standstill management: HOLD function in conjunction with electric parking brake
- Longitudinal deceleration control in conjunction with adaptive cruise control
- Electric parking brake (EPB) - emergency brake booster

PSM - ACC Function

With adaptive cruise control, PSM initiates selective braking action to maintain the preselected distance from the vehicle in front. If the environment sensors in the adaptive cruise control system report that the driver is getting closer to a vehicle in front, the brake system is automatically switched to enhanced braking readiness mode. In addition, the brake hydraulic system also supports the driver here with an impending full-braking operation so that optimum brake pressure is provided.

PSM - Trailer Stability Management

PSM now includes a Trailer Stability Management function for all Panamera models. The driving properties of the towing vehicle change considerably when a trailer is attached. The system can detect swaying movements of the trailer if these movements impair the driving stability of the towing vehicle. The tendency to sway is counteracted by targeted braking intervention on the front axle. Trailer Stability Management is also switched off by activating the “PSM OFF” function. When the driver presses the brake pedal, Trailer Stability Management is activated again even if PSM is switched off. Trailer Stability Management is only provided in markets for which the optional electric trailer hitch is available.

PSM - Standstill Management Function (Drive-Off Assistant)

The various functions of the Drive-Off Assistant, which will be familiar from the Cayenne and Carrera models, have been optimized for the Panamera with manual transmission in order to make life easier for the driver. The vehicle is automatically prevented from rolling back away from the desired direction of travel until such a time as the driver drives off. When the function is activated, the “HOLD” function light in the instrument panel lights up.

The entire Drive-Off Assistant function depends on the position of the vehicle on the hill and the desired direction of travel as well as the selected gear. The Drive-Off Assistant is active if the vehicle is facing uphill with a forward gear engaged. The function is deactivated when you put the vehicle into reverse gear in order to park the vehicle for example. The Drive-Off Assistant is only active in reverse gear if the vehicle is facing downhill.

Chassis

Drive-Off Assistant on Vehicles with Manual Transmission

As soon as the vehicle comes to a stop on a hill by specifically using the brakes, the hydraulic brake pressure applied by the driver prevents it from rolling forward or back. If a gear is engaged and the clutch is pressed, this brake pressure is maintained even when the brake pedal is released. Only when the driver starts to drive off - and depending on the calculated downgrade force and the position of the clutch pedal - is the brake pressure reduced to such an extent that the vehicle can start to move without rolling forward or back.

If the system detects that the driver is about to get out of the vehicle (the driver's seat belt and the driver's door are opened), the Drive-Off Assistant passes the HOLD function on to the electric parking brake in order to secure the vehicle. If the vehicle is held on the slope by the electric parking brake, the driver can drive off in the usual way. The electric parking brake detects the driver's intention to drive off and is released automatically.

Drive-Off Assistant on Vehicles with Porsche Doppelkupplung (PDK)

Vehicles with Porsche Doppelkupplung (PDK) are also prevented from rolling away. Just like on Panamera vehicles with manual transmission, the brake pressure applied by the driver prevents the vehicle from rolling forward or back. However, if the driver allows the vehicle to come to a standstill without pressing the brake, the PSM hydraulic unit builds up the required brake pressure.

When the driver starts to drive off - and depending on the calculated downgrade force and the closing clutch - the braking torque is reduced to such an extent that the vehicle can start to move without rolling forward or back. If the driver's seat belt and the driver's door are opened while the HOLD function is active, the electric parking brake is activated automatically.

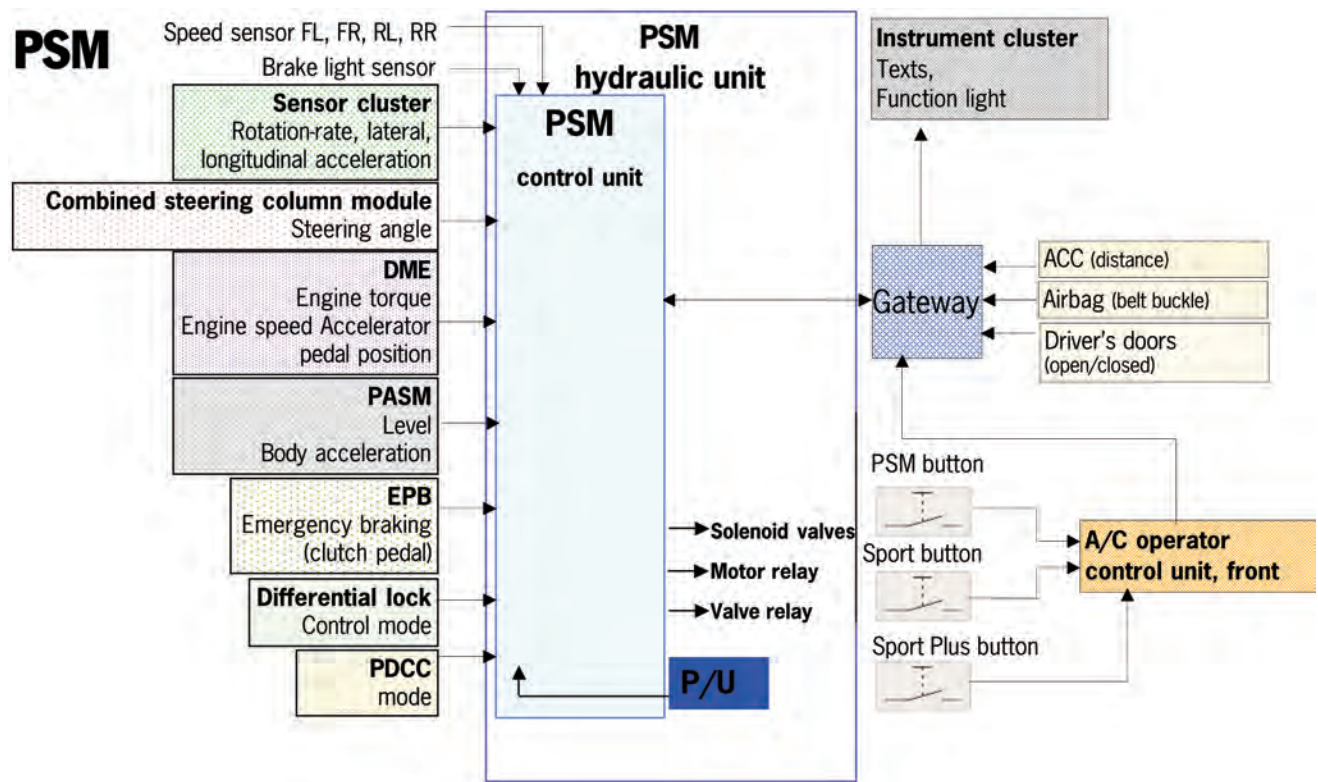
Electric Parking Brake (EPB) - Emergency Brake Booster

In dangerous situations, it is possible to decelerate sharply and stop the vehicle using the electric parking brake in addition to the footbrake. To do this, press the switch and keep it pressed. Vehicle deceleration of 0.8 g is requested while the switch is pressed. The PSM control unit implements this request in a controlled braking operation.

Interaction With Other Chassis Control Systems

Depending on which other chassis control systems are available, e.g. EPB, PDCC, PASM and air suspension, PSM uses the sensor information provided by these chassis systems to optimally match PSM control in all sub-functions with the behavior of the other control systems. For example, the "Clutch pedal position" signal sent by the EPB control unit is used for the Drive-Off Assistant. Or the self-steering properties of the Panamera are determined based on PDCC activity and the PSM intervention thresholds are optimally adapted to suit these properties. PASM supplies information about road contact forces and any uneven road surfaces. This information is read in by PSM and is used there for optimal, situation-based fine-tuning of the ABS system in order to optimize braking distance in emergency braking situations, even on different road conditions.

Porsche Stability Management Inputs and Outputs



Notes:



Subject	Page
General Information	2
Body Front Section	2
Aerodynamics	2
Body Side Section	2
Body Rear Section	3
Underbody Panels	3
Bodyshell	4
Body Aluminum Parts	6
Aluminum Repairs	7
Aluminum Repair Work Bay	9
Steel Repairs	10
Variable Door Stop	11
Powerlift Rear Hatch	11

Body

General Information

The Panamera body represents the synthesis of a typical lightweight sports car construction, a high level of comfort, generous space and efficient aerodynamics. Modern manufacturing processes and a variety of materials are selectively used. Several grades of steel are used, as are aluminum and magnesium light alloys and plastics.

Development objectives:

- Sports-car-like lightweight construction
- Attractive Porsche design
- Efficient aerodynamics
- High level of comfort
- Great functionality

The sporty influence is apparent in the front view:

- Contoured engine hood and fenders
- Characteristically shaped headlights
- Front apron with large air intakes
- Horizontal front light modules

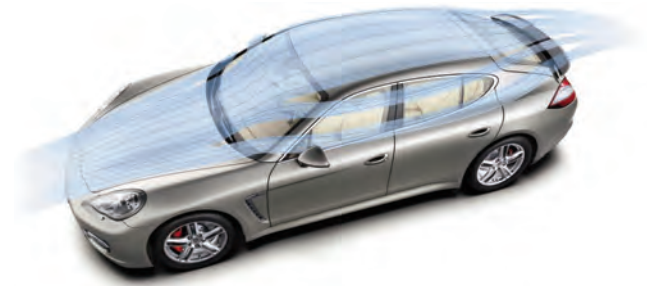
Body Front Section



The front end of the Panamera presents a striking appearance with its three large air intake openings. The side air intakes are closed in the Panamera/4 and Panamera S/4S to enhance the aerodynamics and reduce the cd value.

Another impressive detail is the adaptive cruise control sensor, while located in the center air intake, has been designed in such a way that it does not adversely affect the supply of cooling air.

Aerodynamics and Air Guidance



Aerodynamic development objectives:

- Very low cd value
- Low fuel consumption
- Optimum driving performance

To live up to its reputation as a sporty model and to ensure that the entire vehicle is very efficient, considerable emphasis has been placed on the aerodynamic characteristics of the Porsche Panamera body. The Panamera underwent extensive testing in the wind tunnel in Weissach and was continuously optimized. This resulted in a very low cd value which not only enhances the vehicle's performance, but also helps it to achieve low fuel consumption.

Cd Value (Drag coefficient)

Panamera	0.29
Panamera S	0.29
Panamera Turbo	0.30

Body Side Section



The Porsche design philosophy is clearly seen in the character lines of the Panamera's side section. The air vents behind the front wheels, the exterior mirrors and the active rear spoiler are particularly striking. The side windows are flush with the A, B and C pillars which help to keep the windows clean, reduce noise and cut down on drag while the wheel spoilers ensure an optimum flow of air around the wheels.



Exterior dimensions:

- Length: 4970 mm
- Width: 1931 mm (without exterior mirrors)
- Width: 2114 mm (with exterior mirrors)
- Height: 1418 mm
- Wheelbase: 2920 mm

Body Rear Section



Key features of the aerodynamically optimized rear area:

- Speed sensitive rear spoiler
- Chrome molding and Porsche logo
- Typical Porsche tail lights with LED technology
- Rear apron with integrated diffuser
- Brushed stainless steel twin tailpipes

Aerodynamic optimization in the rear area is enhanced for all models by an active rear spoiler. Because of its location, it visually enlarges the rear window due to the black paint finish and lends the Panamera an even more elongated and dynamic silhouette.

The rear spoiler extends upwards in the same way as the rear spoiler of the 911 Carrera and like the rear spoiler for the Porsche Boxster its upper surface features a Gurney flap. The Panamera/4 and Panamera S/4S are equipped with a two-way rear spoiler while the Panamera Turbo comes with a four-way rear spoiler. As in the 911 Carrera models, it is retracted while the vehicle is stationary and extends at higher speeds or can be manually extended by actuating a switch on the center console.

Underbody Panels and Diffusor



All Panamera models have a fully panelled underbody to optimize the air flow under the vehicle and to reduce turbulence. This improves the cd value and reduces fuel consumption. A fully panelled underbody also enables the air that is flowing past to be directed to specific areas where cooling air is required. Gills located in the area around the rear-axle differential capture the cooling air to cool the rear-axle differential in a targeted manner.

Body

Bodyshell

The Panamera body shell is a hybrid structure, which is made up of several grades of advanced high-strength steels, stainless steel, aluminum and magnesium.

Advantages:

- Low vehicle weight
 - Vehicle mass: approx. 3858 lbs (1750 kg)
 - Bodyshell mass: approx. 772 lbs (350 kg)
- Low fuel consumption
- Optimum weight distribution
- Excellent occupant protection

This fully galvanized body makes for an extremely robust passenger cell and provides excellent impact protection for the occupants. A longitudinal and cross member structure at the front, patented by Porsche, absorbs deformation energy through two load paths that lie directly above one another. This structure then distributes the forces, minimizing deformation of the passenger compartment. As a second load path beside the longitudinal member structure, the aluminum subframe of the front axle increases passive safety by means of a defined deformation.

In the event of minor collisions, impact elements mounted to the front structure protect the bodyshell. These are easy to replace which helps keep repair costs reasonable. In the case of a more severe collision, a rigid bulkhead cross member prevents deformation of the footwell area and improves protection for occupants' lower extremities.

The reinforced doors also help to stiffen the overall structure. In the event of a frontal crash, the collision energy is transferred via an upper load path around the passenger cell, through the doors and to the rear of the vehicle. Manufacturing the front hood, fenders, doors and rear lid in aluminum also helped to reduce weight and consequently fuel consumption.

Notes:

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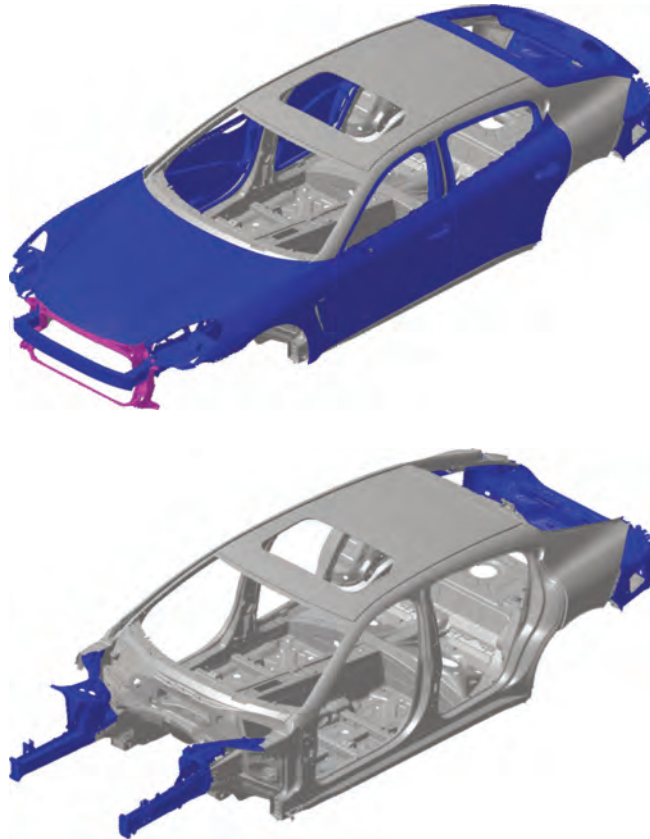
- Magnesium
- Aluminum
- Mild steel
- High-strength low-alloy steel
- Multiphase steel
- Boron steel

Body

Body Aluminum Parts

Aluminum parts:

- Longitudinal member, front
- Spring strut mount, front
- Rear
- Engine hood
- Fender
- Doors
- Rear lid



Doors and Lids

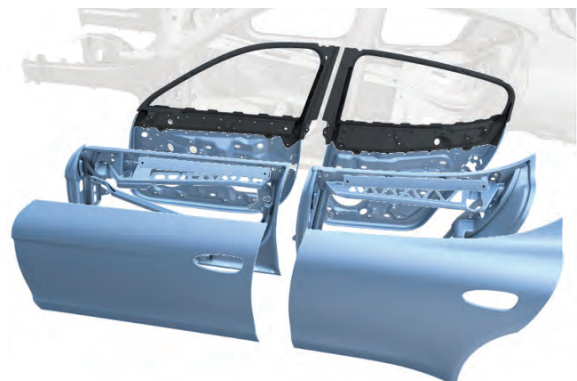


Reduced weight thanks to intelligent mix of materials:

- Laser-cut door frames in die-cast aluminum
- Reinforcements from aluminium extruded sections
- Aluminum door inner panel
- Magnesium window frame

The four doors and rear lid are made from aluminum and the window frames are made from magnesium, ensuring a low gross weight. As a result, the body of the Panamera has a very low center of gravity, which benefits roadholding and driving performance.

The lightweight doors are characterized by a bearing structure made from laser-treated die-cast aluminum, an aluminum outer skin and a door window frame made from thin-walled die-cast magnesium.

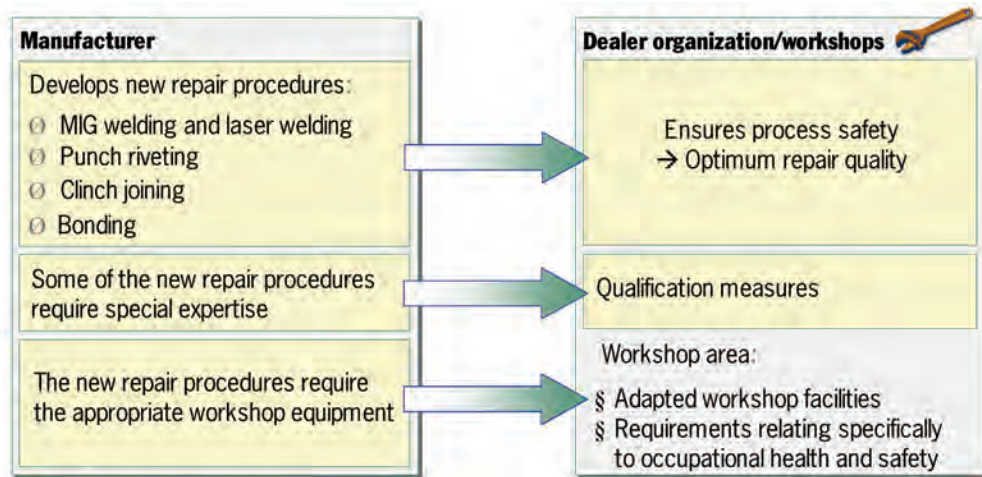


Notes!

- > Damaged magnesium components must always be replaced completely as they cannot be repaired.
- > There are several screws that hold the window frame to the door, two are aluminum, and these screws are one time use only.

Aluminum Repairs

Aluminum technology is fundamentally different from lightweight steel construction with regard to design, manufacture and repairs. The following criteria must be considered when carrying out repairs:



The essential requirement placed on the development of the Porsche Panamera body structure was a reduction in body weight that took passive safety, cost-efficiency and quality into account, in order to improve driving performance while also lowering fuel consumption.

The lightweight materials used to fulfill this requirement, in combination with new joining techniques, demand a new set of conditions for performing body repairs, with the result that the previously tried-and-tested repair methods and tools can no longer be used to the same extent in order to carry out the required work.

To safeguard repair quality, repair work on the new Porsche Panamera body structure requires the application of new tools and methods (e.g. bonding, riveting).

Standard Equipment

Standard workshop equipment can be used to carry out the following repairs:

- Simple metal working tasks (removal of dents and bulges)
- Simple replacement of outer skin parts (rear closing panel)
- Assembly work
- Repairs to safety-relevant parts in accordance with the workshop manual "No welded joints or replacement procedures for structural parts"

Specialized/Equipment

Full workshop equipment can be used to carry out the following additional repairs:

- Approved factory repair procedures: Punch riveting and welding.



Note!

Bodyshell repairs can only be carried out by properly equipped workshops with specially trained personnel.

Body

Aluminum Repairs (cont'd)

The Porsche Panamera has a front end section made from various aluminum materials, which are joined using mainly punch rivets and adhesive. For repair of these parts, punch rivets are replaced by high-strength blind rivets and repair adhesive specified by the workshop manual. To enable sectional repairs to be made to the front longitudinal member, a special repair part is available with an additional connecting piece, since this repair must be conducted without any welding work.

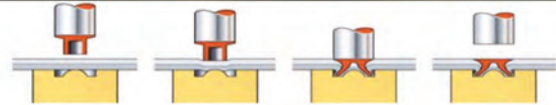
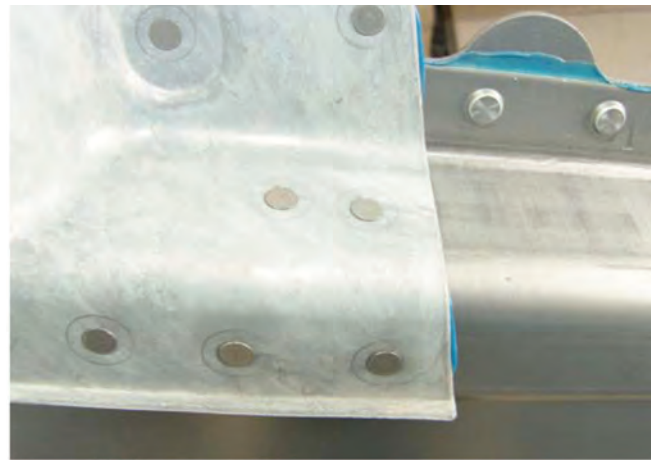
New joining techniques and new repair methods:

- High-strength blind rivets with repair adhesives as a replacement for punch rivet connections
- Complete replacement of damaged aluminum structural components – they cannot be straightened
- Aluminum work bay and aluminum tool set required

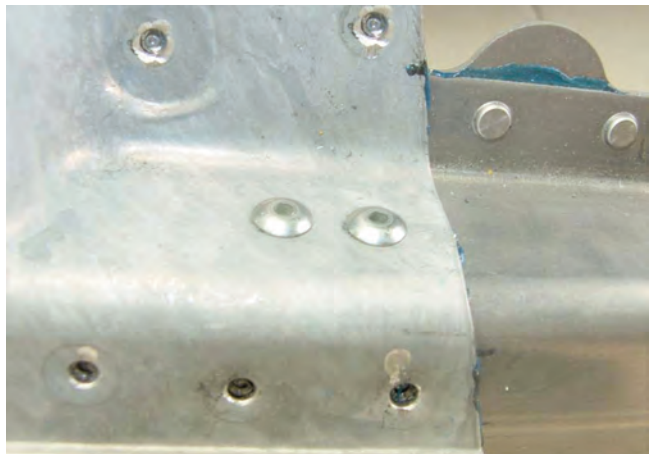


When performing aluminum repairs please note that aluminum can only be straightened to a certain extent, with the result that damaged structural components generally have to be completely replaced.

> The tools and equipment used for repair of steel vehicles must never be used for aluminum repairs. A totally separate, dedicated repair area and tool set must be reserved for aluminum use only. When steel particles come into contact with aluminum, corrosion can occur.



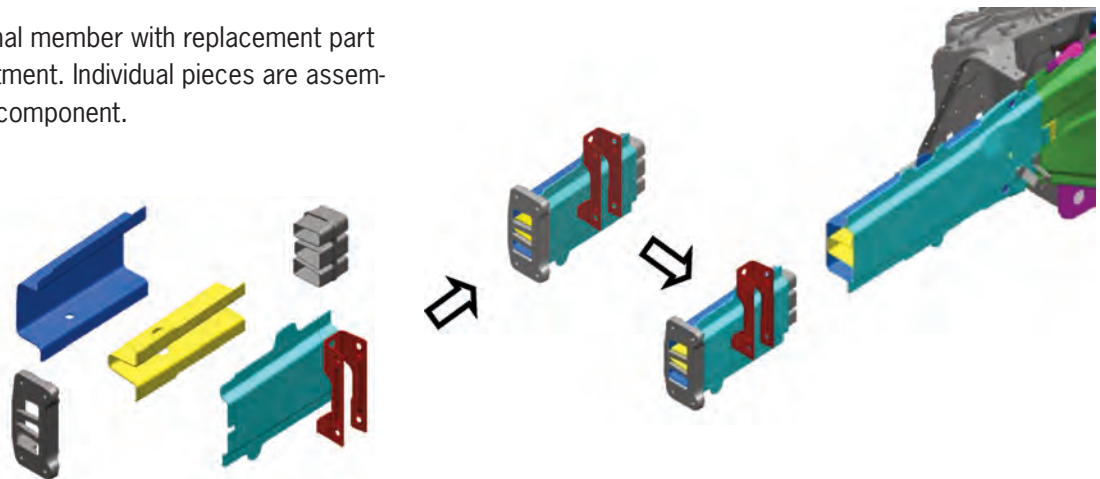
Factory punch rivets and adhesive.



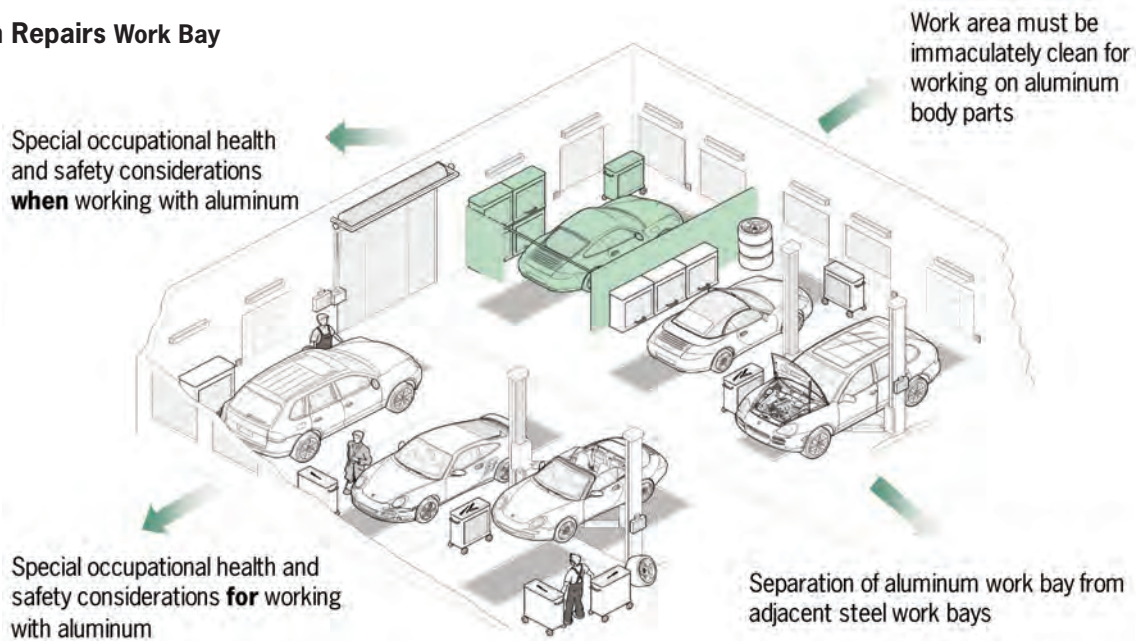
Factory published repairs with blind rivets and adhesive.

Longitudinal Member Replacement Part

Sectional repair of longitudinal member with replacement part supplied by the parts department. Individual pieces are assembled and sold as a complete component.



Aluminum Repairs Work Bay



Work area must be immaculately clean for working on aluminum body parts:

- Few horizontal surfaces, pipes and lines
- Less dust deposits
- Vacuum cleaning or sweeping (no vacuum cleaning using compressed air – risk of explosion)
- Optimal would be a area with washable walls and floors for wet-cleaning

Special occupational health and safety considerations for working with aluminum:

- Existing tools for working with steel must not be used for working on both steel and aluminum
- Tools and connecting elements (e.g. screws, washers) made of steel must never come into direct contact with the aluminum body
- Tools and connecting elements for aluminum must always be marked in a different color to avoid confusion

Separation of aluminum work bays from adjacent steel work bays:

- The aluminum work bay must be protected from steel/grinding dust and steel chips from adjacent workshop areas due to the risk of corrosion

Special occupational health and safety considerations for working with aluminum:

- Electrical installations and equipment must have extra protection in accordance with the guidelines in the area in which aluminum dust concentrations occur (lights, plug sockets, lifting platforms, vacuum cleaners and all electrical equipment or compressed air tools used in the area).

Other requirements:

- The vehicle to be repaired must be completely covered with only the actual repair area exposed in order to prevent consequential damage.
- If steel components, e.g. steel rivets, need to be ground, the aluminium parts must be protected from flying sparks.

Body

Steel Repairs

Increasingly stringent safety requirements demand that the Porsche Panamera uses even higher-strength materials than in the past. These ultra-high-strength steels are used for safety components such as upper tunnel sections, A and B pillars, roof frames and door sills.

These materials present new challenges in terms of body repairs because their extremely high strength significantly impairs their malleability, weldability and machinability.

New materials and repair options for these materials:

- Ultra-high-strength steels
- Ultra-high-strength components may only be replaced as complete parts – partial replacement is not an option
- No straightening of ultra-high-strength components
- Resistance spot welding is permitted only with the approved inverter welding equipment



One of the approved resistance welders.

The ultra-high-strength components may only be replaced as complete parts, partial replacement is not allowed for safety reasons. Here too, any straightening of these components is only possible to a limited extent, as these components are too rigid and adjacent components may be damaged.

Resistance spot welding for these components can only be performed reliably using Porsche AG's currently approved inverter welding equipment, as otherwise the strength of the body may be compromised and consequential damage may result. Resistance spot welds cannot be evaluated by visual means, so prior to work on the vehicle, test welds must be performed and destructively tested. The list of approved resistance welding equipment can be found in PIWIS.

Straightening Bench

Body repairs to the Porsche Panamera are to be made using a completely new straightening set, designed especially for the Panamera. Initial use and application is conducted in a similar manner to that used for the existing straightening sets for the current vehicle models. The manufacturers here are familiar companies, such as Car Bench and Celette.

Notes:

Variable Door Stop



A variable door stop is used for the first time in the Panamera models. This means that all four doors can be stopped conveniently in any position and passengers can get in and out easily at any time without running the risk of opening the door too far and encountering an obstacle.



The variable door stop consists of a damper, which is attached to the middle of the door by a ball hitch and is bolted to the body.

Powerlift Rear Hatch (Option)



The shape of the hinged rear hatch, which features a large glass window, makes for an exceptionally high volume luggage compartment. The wide opening facilitates convenient loading and unloading and makes it easy to rearrange items. And electric closing aid is particularly convenient. A power lift hatch, which can be opened at the push of a button on the key or in the passenger compartment and closed using a button on the hatch, is available on request. The opening height can be adjusted as required.

Detection of obstacles when opening:

- The tailgate stops moving if the opening procedure is blocked by an obstacle. A warning signal sounds.

Detection of obstacles when closing:

- Closing of the tailgate is interrupted if the procedure is blocked by an obstacle. A warning signal sounds and the tailgate opens again.



Note!

- > The individual setting for the opening height of the hatch is described in the Panamera Owner's Manual in the section entitled "Opening and Closing".

Body

Powerlift Rear Hatch (Cont'd)

Operation

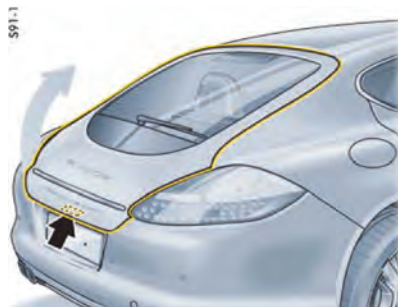
This option facilitates the automatic opening and closing of the hatch and the individual setting of the opening height. Open using a switch (A) in the passenger compartment, key remote control (B) or a button on the hatch (C). Close using a button on the inside of the hatch (D).



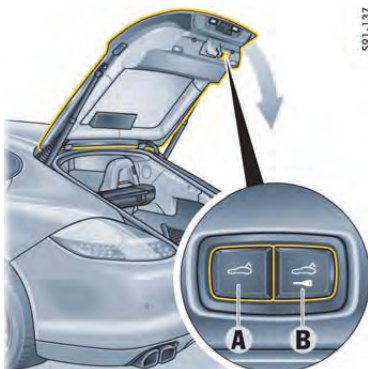
Switch (A)



Key Remote (B)



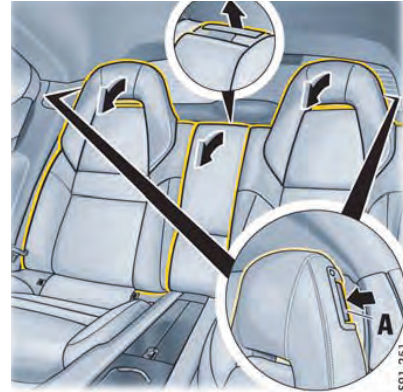
Hatch (C)



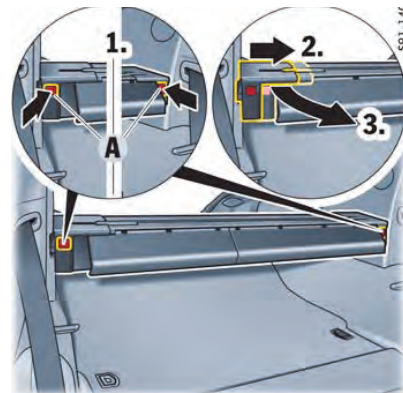
Button on Hatch (D)

Emergency Operation

Check that the fuse is intact before initiating emergency operation. If the electrical release mechanism is faulty, the hatch can be opened as follows:



1. Move driver's seat all the way forward.
2. Release rear-seat backrest and fold it forwards.
3. Remove retractable luggage compartment cover.
4. Unclip luggage compartment light using a plastic wedge.



5. Insert needle-nose pliers into the cut-out on the hatch trim panel and pull out the emergency release cable from the lower part of the hatch lock.
6. Open the hatch by hand.





Subject	Page
Front View	.2
Exterior Mirrors	.2
Rear View	.3
Window Glass	.3
Sunroof	.4
Two-Way Rear Spoiler, Panamera/4 and Panamera S/4S	.6
Four-Way Rear Spoiler, Panamera Turbo	.6
Fuel Filler Door Emergency Unlocking	.7
Roof Transport System (RTS)	.7
Passive Safety	.8

Body Equipment, Exterior

Front View

The front end of the Panamera/4 and Panamera S/4S, together with the integrated cooling-air intakes, are painted in the exterior color. While the Panamera/S are characterized by black double vents in the side air intakes in the front end of the vehicle, the all-wheel-drive Panamera 4/4S model can be identified by their titanium-colored double vents. The Panamera Turbo has a completely distinctive front section. The air intakes of the turbo-specific vehicle front, designed in a grille structure, convey an even more powerful and dynamic appearance.



Panamera/S



Panamera 4/4S



Panamera Turbo

- In the Panamera Turbo, the charge air cooler is located behind the side air intakes. The charge air cooler receives additional cooling air from the center air intake, which features bypass ducts. Another optimized detail is the adaptive cruise control feature whose sensor in the center air intake has been designed in such a way that it does not affect the supply of cooling air.
- The naturally aspirated engine obtains the required intake air through the underbody.



Connection point for the tow hook on the front apron.

Exterior Mirrors



The exterior mirrors of the Porsche Panamera help to minimize drag. They are mounted on the doors to enhance aerodynamics and acoustics and to prevent soiling of the side windows. The convex mirror on the passenger's side and the aspherical mirror on the driver's side provide a larger field of vision.

- When reverse gear is engaged, the mirror on the passenger's side swivels down slightly to show the curb area.

- The exterior mirrors change to the anti-dazzle position automatically in synchronization with the interior mirror.
- The exterior mirror heating is activated automatically when the heated rear window is switched on while the engine is running.

Rear View

A visual highlight is the diffuser which is integrated harmoniously into the rear design, adding to the aerodynamic optimization of the vehicle. The diffuser in the Panamera/S have a smooth black finish, the Panamera 4/4S versions are also black but includes additional fins and the Panamera Turbo diffuser has fins and is titanium colored.



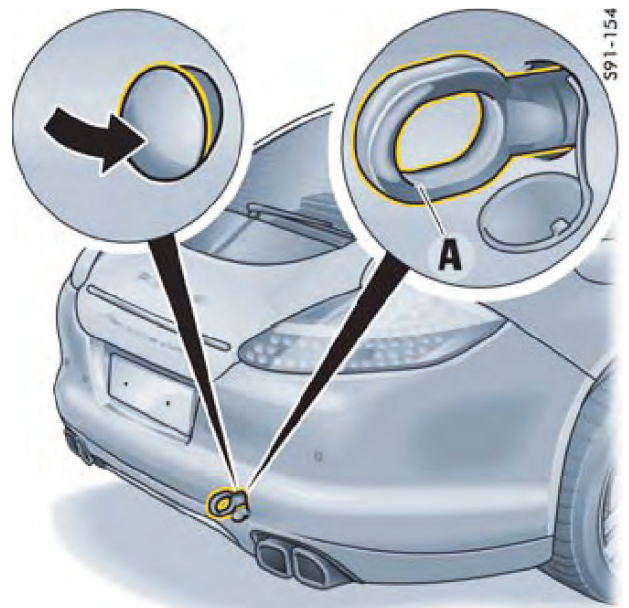
Panamera/S



Panamera 4/4S



Panamera Turbo



Connection point for the tow hook on the rear apron.

Window Glass



The Panamera comes with tinted heat-insulating glass all round as standard equipment. This glass reduces the temperature in the passenger compartment and offers occupant privacy with a dark tint.

Additional features:

- Windshield with grey top-tint
- Reduced sunlight glare

Body Equipment, Exterior



Hydrophobic front side windows (coating is based on nano technology), helps to keep the windows clean.

Noise and Heat Insulated Glass (Optional)

Available as an option is noise-insulated and heat-insulating laminated glass. With enhanced reflectivity all round and heavily tinted glazing of the rear side and the rear window.

- Reduces noise and heat levels
- Enhances reflectivity of infrared rays
- Additional break-in protection

Notes:

[illegible]

Sunroof



The electric slide/tilt roof is made of tinted single-sheet safety glass. It has a sliding roof cover that can be continuously adjusted manually to protect against the occupants from direct sunlight.



The slide/tilt roof can be slid open or lifted at the rear.

The slide/tilt roof is ready for operation:

- > When the ignition is switched on
- > After the ignition is switched off and before the driver's or passenger's door is first opened, but for a maximum of 10 minutes

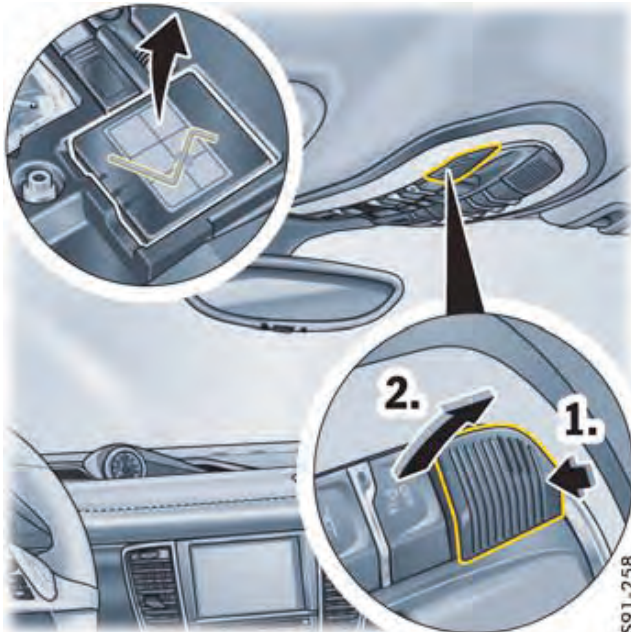


Note!

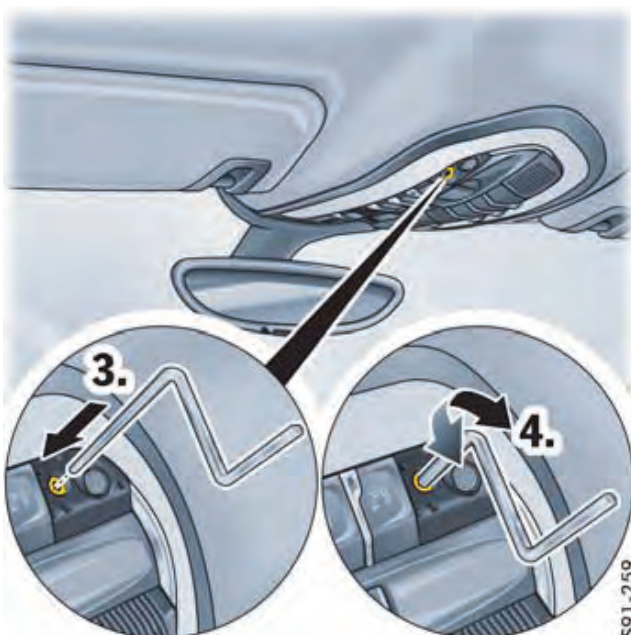
The slide/tilt roof features a force limiter. If obstructed during the closing process, the slide/tilt roof opens again immediately.

Emergency Operation

If the slide/tilt roof becomes inoperable, it can be closed or opened manually using the hexagon key from the tool kit. First, check that the fuse is intact before initiating emergency operation.



1. Press lightly on the front tip of the cover over the left passenger compartment monitoring sensor. The opposite end of the cover lifts up.
2. Unclip cover.



3. Insert the hexagon key all the way into the opening.
4. Hold the key in this position and turn it.
5. Remove the key. Stow the key in the tool kit.
6. Clip in cover.

i Important!

There is a risk of injury or damage during emergency operation. There is a risk of crushing or pinching from all moving slide/tilt roof parts. Always use the emergency operation feature with extreme care.

> Do not press the slide/tilt roof button during emergency operation.

Emergency closing after repeated intervention from the force limiter.

Remove the obstruction. Press or press-and-hold the sliding roof button repeatedly in the closing direction until the roof closes and stops in the closed position.

Storing the end position of the slide/tilt roof.

The end position of the slide/tilt roof are lost if the vehicle battery is disconnected/reconnected or dead, the vehicle is started using jumper cables, the electrical fuse for the slide/tilt roof is replaced or after emergency operation.

The vehicle must be stationary to store the end position of the slide/tilt roof.

1. Switch on ignition.
2. Press the button forwards in closing direction and hold in position. The process for storing the end position begins after approximately 10 seconds. Press and hold the button until the roof has stopped moving completely. The process takes a maximum of 20 seconds. Start the storing process again if the button is released prematurely.

i Warning!

Risk of injury when closing the slide/tilt roof. When the end position is stored, the force limiter is not available and the slide/tilt roof will close with full force.

Body Equipment, Exterior

Two-Way Rear Spoiler – Panamera/4/S/4S

The Panamera/4/S/4S series feature an innovative rear spoiler with special aerodynamic measures to ensure efficiency:

- Enhances driving stability at high speeds
- Reduces fuel consumption at low speeds
- Reduces lift at high speeds



The Panamera/4/S/4S series has a two-way rear spoiler, which extends horizontally depending on the speed:

- From 56 mph (90 km/h): -3° horizontal (normal position)
- Between 56 and 99 mph (90 and 160 km/h): $+5^{\circ}$ horizontal
- From 127 mph (205 km/h): $+14^{\circ}$ horizontal (performance position)

This means that the increased lift at higher speeds can be reduced by even greater contact pressure. As a result, very good roadholding and excellent directional stability are guaranteed even at very high speeds. In Sport/Sport Plus mode, spoiler control is based on a performance-oriented program.

Four-Way Rear Spoiler – Panamera Turbo

The Panamera Turbo feature an active rear spoiler system that adapts to specific driving situations:

- Adaptive, extending four-way rear spoiler
- Two-piece upper section of spoiler
- Enlarged spoiler surface area
- Additional rear spoiler



The Panamera Turbo has a four-way rear spoiler. The upper section of the spoiler consists of two parts. Similar to the two-way spoiler on the Panamera/4/S/4S series, this extends:

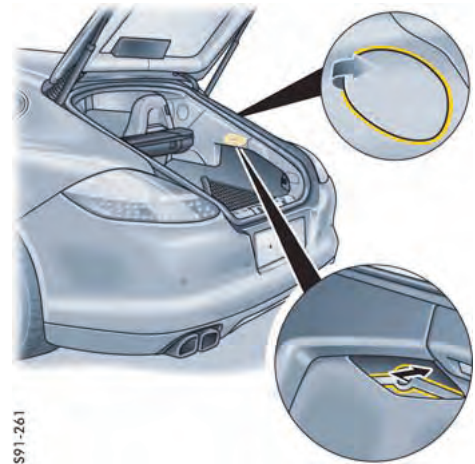
- To the normal position (-3°) at 56 mph (90 km/h)
- To the performance position ($+10^{\circ}$) at 127 mph (205 km/h)

The two-piece top section of the spoiler extends left and right simultaneously, enlarging the surface area of the spoiler. As a result, the four-way spoiler not only reduces lift: in the performance position, it even generates downforce at the rear axle at high speeds, just like the rear wing of the 911 Turbo. Given the high top speeds of the Panamera Turbo, this feature ensures excellent directional stability and optimum driving performance at all times. The four-way rear spoiler also features an additional edge on the side wings. The overpressure that is generated minimizes the flow of air under the spoiler, effectively enlarging its surface area. This also enhances the aerodynamics.

Fuel Filler Door – Emergency Unlocking

If the electrical unlocking mechanism is faulty, the filler flap can be opened as follows:

1. Open tailgate.
2. Pull the emergency release mechanism behind the right luggage compartment trim panel in the direction of the arrow. The filler flap pops open.



Rear Spoiler Retracted.



Normal Position of Rear Spoiler.



Performance Position of Rear Spoiler.

Roof Transport System (Optional)



The Roof Transport System (RTS) consists of two lockable aluminum bars that are anchored in the lateral roof channels. The anchoring points (threaded bolts) are integrated as standard in the roof channel. All Porsche load-carrying devices (e.g. roof box, ski rack and snowboard holder) can be mounted onto the roof. This further enhances the Panamera's touring qualities and flexibility.



Note!

The opening angle of the rear hatch may be restricted by long roof carriers, such as; ski boxes/surfboard carriers.

Body Equipment, Exterior

Passive Safety



The Porsche Panamera features a comprehensive safety concept that provides reliable and secure protection for occupants in the event of accidents. It includes the following equipment:

- Two-stage, full-size airbags for driver and passenger
- Porsche Side Impact Protection System (POSIP)
- Side impact protection in each door
- Side airbags in the rear
- Knee airbags for restraining the lower body in the event of a frontal impact
- Curtain airbags across the entire roof frame and side windows from the A to the C pillar
- Twin-chamber thorax/pelvic side airbags for driver and passenger

Driver and passenger are protected by full-size airbags which are deployed in two stages depending on the severity and type of accident (e.g. head-on or diagonally from the front). Two sensors at the front of the vehicle, together with the sensor technology in the airbag control unit, detect a crash and evaluate it significantly more accurately and at a much earlier stage. In less severe accidents, the occupants are restrained by the first stage. The airbag is softer in this stage, reducing the load on the occupants.

The knee airbags are standard equipment and are located in the lower section of the dashboard. The addition of these, ensure that the driver's and passenger's lower body are restrained in the event of a frontal impact in accordance with the severity of the accident.

The Porsche Side Impact Protection System (POSIP), available as standard equipment, includes seat-mounted twin-chamber thorax/pelvic side airbags at the front, adapted to the pelvic and rib area for the driver and passenger, curtain airbags across the entire roof frame and side windows from the A to the C pillar, side impact protection in each door and side airbags in the rear.



Knee Airbag – Driver's Side



Knee Airbag – Passenger's Side

Passive Safety Components



- Safety steering column
- Seat-belt height adjustment
- 3-point automatic seat belt
- Seat-belt pretensioners (front and rear) and force limiters (front)
- Roll-over sensor
- ISOFIX mountings on rear seats and (optionally) on the front passenger seat
- Integrated fire extinguisher underneath passenger seat (optional)

Notes:



Subject	Page
General Information	.2
Materials For Passenger Compartment	.2
Steering Wheel	.3
Seat System	.4
Front Seat Switches	.5
Front Seat Adjustments	.6
Front Passenger Adjustment From Rear	.7
Rear Seat Assembly	.7
Rear Seat Adjustments	.8
Storing Seat Settings	.9
Luggage Compartment and Storage	.10
Cool Box (Optional)	.11
Sun Blinds (Optional)	.11

Body Equipment, Interior

General Information



Main objectives of the development team were:

- Seating for four in full-size sporty, comfortable seats with integrated headrests
- Unlimited day-to-day usability with a flexible and highly functional luggage compartment that is perfect for touring
- High standards with regard to quality and appearance
- A wide range of Porsche personalization options
- Familiar Porsche shapes in the passenger compartment
- A unique and clear operating concept

The continuous center console running from front to rear and rising towards the dashboard with a raised shift mechanism is reminiscent of the Carrera GT and draws attention to the idea of the four individual seats. The streamlined individual seats with integrated headrests give a light appearance to the passenger compartment and allow rear passengers an unobstructed view of the road ahead.

As a result, the passenger compartment has an integrated appearance and rear passengers also have the feeling that they are participating directly in the driving experience. Even familiar Porsche elements such as the five dial-type instruments with the centrally positioned tachometer and the ignition lock to the left of the steering wheel, typical of the 911, are reproduced here.

The numerous functions available in the Panamera can be easily accessed by way of the 7-inch touchscreen, the center console and the roof console, all of which are standard in all Panamera models. The most important functions for vehicle operation are arranged according to function group in the center and roof console and can be accessed quickly and easily by the driver using buttons on the left and right of the shift mechanism.

Materials For Passenger Compartment



Porsche is pursuing new avenues with the selection of materials that it uses in the passenger compartment of the Panamera and is setting new standards in terms of material quality and appearance.

- Consistent, high-quality material concept in the passenger compartment (e.g. aluminum, leather and real wood)
- High-quality look and feel of surfaces, high-spec grain
- High-quality decorative stitching
- Use of silver-colored elements, metallic look & feel
- Chrome-colored highlights

Standard and Optional Features

- Standard partial leather seats with many items in embossed leather
- Smooth-finish leather interior available as an option (standard in the Panamera Turbo)
- Two-tone leather interior available as an option
- Natural leather interior available as an option (also available in a two-tone version)
- All leather interiors are also available with draped leather
- Optional Alcantara headliner (standard in the Turbo)
- Eight different interior designs



The Alcantara headliner, available as standard in the Panamera Turbo and as an option in the Panamera/4 and Panamera S/4S series and improves the look and feel of the interior even further. In addition to the roofliner, the A-pillar trim, the B-pillar cover and the sun visors are also available in Alcantara.



Steering Wheel



3-spoke sports steering wheel.

All models are equipped with a 3-spoke sports steering wheel with a steering wheel rim in smooth-finish leather as standard. The airbag module and steering wheel spokes are in the interior color. In the case of the optional leather interior (standard in the Panamera Turbo), a leather airbag module is included in the vehicle equipment. Models equipped with the Porsche Doppelkupplung (PDK) can be shifted manually using shift buttons on the steering wheel. It makes no difference which of the two shift buttons is used for changing gears. The shift buttons themselves have a high-quality metallic surface.



3-spoke multi-function steering wheel.

With the 3-spoke multi-function steering wheel in leather, the driver can quickly and easily operate a variety of functions such as audio/communication, on-board computer, plus voice control and telephone if applicable, by means of multi-function buttons and rollers, even while driving.



3-spoke multi-function steering wheel in wood or carbon.

The 3-spoke multi-function steering wheel in wood or carbon is available to match the interior packages. In such cases, the steering wheel rim includes wood or carbon inlays. The functions are the same as those of the leather multi-function steering wheel. The sports steering wheel (optional) and the multi-function steering wheel in leather (optional), which is available on request, can come with steering wheel heating as an optional extra for greater comfort during the cold season. The optional multi-function steering wheels in wood and carbon are always equipped with steering wheel heating.

Body Equipment, Interior

Seat System



The four-door Panamera offers a new sense of space and driving experience in all four seats:

- Sporty
- Good lateral support
- A wide range of adjustment options
- Seat air-conditioning function
- Excellent fit and finish
- Outstanding travelling comfort
- Generous leg and head room

With a continuous center console that extends from the dashboard to the rear seats, the four-door Gran Turismo makes for a new driving experience and sense of space. The passenger compartment provides the driver with optimum ergonomic conditions and emphasizes the personal space of each individual passenger with the tailor-made individual seats. The low seat position and the sporty flat steering wheel convey direct contact with the road, as is customary with Porsche.

All Panamera seats feature a cut-out in the neck area. This allows the air to circulate and adds to the generous feeling of space for rear passengers when looking to the road ahead. As a result, the passenger compartment has an integrated appearance and rear passengers also have the feeling that they are participating directly in the driving experience.



8-way power seat.



14-way power seats with memory package (standard in Panamera Turbo).



Adaptive sports seats (optional).

Child Seat Feature:

- ISOFIX mounting for child seat on the passenger seat

Memorizing of driver and passenger seat positions:

- Steering column and door mirror position
- Light, windshield wiper, air conditioning, door locking, instrument cluster and PCM settings

Non-memorizable electric adjustment of:

- Bolsters for seat surfaces and backrests (front)
- LED exterior mirror lights

Notes:

[illegible]

Front Seat Switches



1. Seat-surface length adjustment
2. Seat cushion side bolster adjustment (with adaptive sports seats)
3. Backrest side bolster adjustment (with adaptive sports seats)
4. Seat height, fore and aft position, seat angle
5. Backrest angle
6. Four-way lumbar support (pelvic and spinal column support)

Body Equipment, Interior

Standard 8-way Power Seats

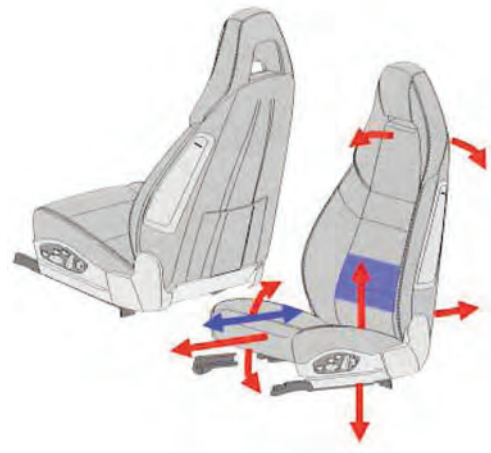
The Panamera/4 and Panamera S/4S feature electrically adjustable 8-way power seats (front) as standard equipment. The seats are sporty in design and in addition to offering excellent lateral support, their broad range of adjustment options ensure perfect adaptation to the user and outstanding travelling comfort at all times.



- Seat height
- Seat angle
- Backrest angle
- Fore and aft adjustment

14-way Power Seats

14-way power seats with memory package are standard equipment on the Panamera Turbo and optional on the Panamera/4/S/4S series.

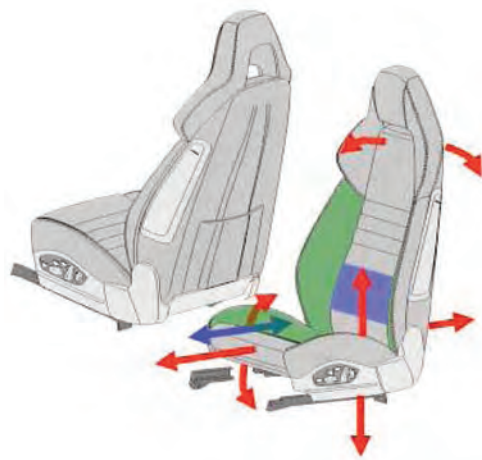


Additional adjustment options:

- Seat-surface length adjustment
- 4-way lumbar support for driver and front passenger
- Steering column adjustment

18-way Adaptive Sport Seats

The optional adaptive sports seat with higher seat cushion side bolsters and more defined shaping in the shoulder area adapts perfectly to the contour of the driver (air cushions in the side bolsters). The seat therefore guarantees optimal lateral support even during particularly sporty driving.

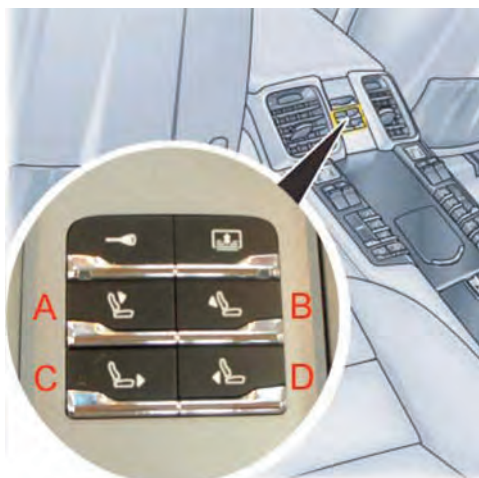


Additional adjustment options:

- Seat surface side bolsters (front)
- Backrest side bolsters (front)

Front Passenger Seat Adjustment From The Rear

The front passenger seat can be adjusted electrically from the rear to make more leg room (master function). The passenger seat cannot be adjusted from the rear when the child locks are on. If the child locks are activated while the front passenger seat is being adjusted from the rear, front passenger seat adjustment will be interrupted. Priority is given to adjusting the front passenger seat using the seat controls!



Adjusting front passenger seat from the rear:

- A. Adjust backrest angle forwards
- B. Adjust backrest angle backwards
- C. Move seat forward and up
- D. Move seat to the rear and down

Rear Seat Assembly



The rear seat assembly in the Panamera sets new standards in terms of combining comfort and flexibility in the premium class:

- Individual seats with electric adjustment and seat air-conditioning functions for maximum individual comfort in the rear



Lightweight backrest structure in aluminum.

Notes:

Body Equipment, Interior

Rear Seat 8-way Adjustments

The optional 8-way power seats in the rear offer additional adjustment options for both the comfort and sports seats. The backrests can be folded over separately (40%/20%/40%) using a handle. In conjunction with the optional front and rear seat ventilation system, the rear headrests are designed to provide extra support with wider seat bolsters than comfort seats (with comfort headrests).



The optional power seats offer individual:

- Backrest adjustment
- Seat-surface length adjustment
- 4-way lumbar support for each seat



- A. Seat cushion depth
- B. Backrest angle
- C. Lumbar support

Adjustable rear seat assembly with two individual seats and folding backrests.

The Panamera features a highly functional passenger compartment and luggage compartment with top-quality, split (folding) seat backrests and attractive individual seats.

- Intuitive single-hand operation
- Continuous loading floor
- Additional load-through provision
- Seat backrests fold separately



The backrests of the rear seat system fold separately (60% to 40%). When they are folded forward they provide a level loading floor in the luggage compartment. A folding center armrest with storage compartment is located between the rear seats.



The split (folding) seat backrests (40% to 40%) are available in combination with the large center console.

Storing Seat Settings



The current seat, door mirror and steering wheel settings are stored automatically on the vehicle key when the vehicle is locked. Individual position settings for the driver's seat, door mirrors and steering wheel can be stored on person buttons 1 and 2 in the driver's door and can be retrieved at any time using these buttons.

To store settings:

Press the Set button, then press button 1 or 2 an acknowledgement signal confirms that the setting is now stored).

14-way power seats with memory package:

In addition to the settings for the driver memory package, numerous vehicle settings, e.g. air conditioning or the multi-function display, are stored on the vehicle key and on person buttons 1 and 2 in the driver's door on vehicles with 14-way power seats with memory package. Individual front passenger seat settings can be stored on person buttons 1 and 2 in the passenger's door. The passenger seat settings are not stored on the vehicle key.

To deactivate automatic storage of settings on the vehicle key:

Press the OFF button before leaving the vehicle. The indicator light in the button comes on. The current settings are stored on the vehicle key. Any changes to settings that were made with the active function OFF are not stored on the vehicle key.

To re-activate automatic storage of settings:

Press the OFF button briefly or press and hold the OFF button until the last settings that were stored on the vehicle key are restored. The indicator light in the button goes off. Automatic storage is activated.

Switching Comfort Entry/Easy Entry function on and off:

The driver's seat and steering wheel can be set to move back automatically in order to make it easier for you to get in and out of the vehicle.

1. Select Main menu
 - > "Vehicle"
 - > "Settings"
 - > "Locking"
2. "Comfort Entry"



- Exiting the vehicle:
The steering wheel moves upwards and the driver's seat moves rearwards after the ignition is switched off and the driver's door is opened.
- Entering the vehicle:
Once the driver's door is closed and the ignition key is inserted or, in the case of vehicles with Porsche Entry & Drive, the ignition is switched on, the seat and steering wheel move to the stored position.

Body Equipment, Interior

Luggage Compartment and Storage

Special attention has been devoted to the luggage compartment in the Panamera. Four cases easily fit behind the rear seats via the rear hatch. The high luggage compartment means that the cases can be stowed in an upright position. A retractable luggage compartment cover to keep stowed items out of sight comes as standard. A fixed luggage compartment cover, which provides increased protection for luggage compartment contents and insulates the passenger compartment further from driving noises, is available as an option. A ski bag is available as an option (not in combination with the large center console).



Luggage compartment capacity:

Panamera/S: 15.7 cu.ft. (445 liters)

Panamera 4/4S: 15.7 cu.ft. (445 liters)

Panamera Turbo: 15.2 cu.ft. (432 liters)



Luggage compartment capacity with rear seats folded down:

Panamera/S: 45 cu.ft. (1263 liters)

Panamera 4/4S: 45 cu.ft. (1263 liters)

Panamera Turbo: 44 cu.ft. (1250 liters)



Note!

When installed, the fixed luggage compartment cover reduces the usable height of the luggage compartment.

- > The maximum permissible load on the loadspace floor in the luggage compartment is 440 lbs. (200 kg.) The weight must be distributed evenly over the entire luggage compartment floor.
- > The load can be secured in the luggage compartment to prevent it from slipping by fastening lashing belts to the lashing points.
- > Make sure that all the lashing points are equally loaded when securing a load.

Storage Options

The spacious passenger compartment is based on a well thought-out concept that includes several useful and practical storage options:

- Glove box: lockable and cooled by the air-conditioning system
- Two integrated cupholders with adjustable diameters (optional)
- Storage net in passenger's footwell
- An integrated cupholder in the front section of the center arm rest
- Storage compartment underneath the center console armrest (charging tray is optional)
- Door pockets, front (folding) and rear
- Ashtray, front and rear
- Integrated cupholder in the rear center console
- Rear storage compartment in center console including cup holder
- Storage compartment for rear armrest
- Pockets in the backrest shell of the front seats
- Additional storage compartment in the power windows console
- Passenger's side: storage nets in luggage compartment side trim panels

Cool Box (Optional)



A coolbox with a capacity of .37 cu.ft. (10.5 liters) is available with the integrated preparation as an option in combination with the large center console. This can be ordered as a factory installed option or a retrofit set through the parts department. It makes working or traveling in the rear area even more comfortable.

πSun Blinds (Optional)



Electric roll-up sunblind on rear side windows. Electrically extendable protection from direct sunlight on the rear doors.



Electric roll-up sunblind on back window. Electrically extendable roll-up sunblind behind the rear seats to protect occupants from direct sunlight, lowered automatically when backing up vehicle.



In combination with the standard retractable luggage compartment cover more effort is required to remove the roll-up module.

Operation

Roll-up sunblind, rear side windows:

- The roll-up sunblinds on the rear side windows can be raised or lowered only when the rear side windows are closed.
- If child protection is activated, the roll-up sunblinds on the rear side windows can only be operated using the roll-up sunblind button in the front center console or the power window buttons in the driver's door.

Roll-up sunblind, rear window:

- If child protection is activated, the rear window roll-up sunblind can only be operated using the roll-up blind button in the front center console.
- If the roll-up sunblind is extended when reverse gear is engaged, the roll-up blind is lowered automatically. The roll-up sunblind is raised when the vehicle drives forward again.

Prerequisites:

- The ignition must be switched on.
- The function must be activated on the multi-function display.



Subject	Page
General Information	2
Cayenne vs. Panamera System Differences	3
Heating Unit	4
Temperature Mixing Chamber	6
Air Ducts	6
Air Distribution	7
Modular Operator Control Panel	7
Operating and Air-Conditioning Unit, Front	8
Extended Air-Conditioning Functions	11
Operating and Air-Conditioning Unit - 4-Zone, Rear	12
Operating and Air-Conditioning Unit - 2-Zone, Rear	13
Refrigerant Circuit	14
Air-Conditioning Network Topology	15
Actuators and Sensors	16
Seats - Heating and Ventilation	18
Heated Steering Wheel	18

Heating/Air Conditioning



General Information

The Panamera is equipped with 2-zone automatic climate control as standard. 4-zone automatic climate control is available as an option for all Panamera models.

The following functions can be set on an individual basis for all climate controlled areas:

- Temperature
- Air distribution
- Air flow

The required temperature is adjusted automatically. To prevent the windows from misting, the humidity is first of all measured and taken into consideration. The climate control also features automatic air-recirculation control, utilization of residual engine heat, AC MAX mode, MONO mode and individually adjustable “extended air-conditioning functions”. A cooled glove box also comes as standard.

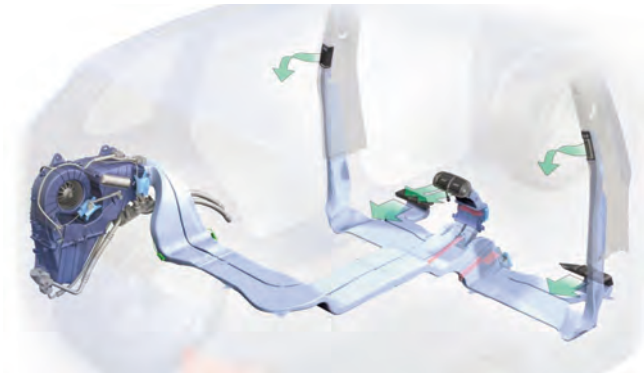
Overview of the Climate-Related Equipment

Equipment	Panamera/S	Panamera 4/4S	Panamera Turbo
2-zone climate control (automatic)	Standard	Standard	Standard
4-zone climate control (automatic)	Optional	Optional	Optional
Air quality sensor for automatic air-recirculation function	Standard	Standard	Standard
Extended air-conditioning functions (14-way power seats with memory package)	Optional	Optional	Standard
Heated rear window with automatic OFF function	Standard	Standard	Standard
Heated seats at front/front and rear	Standard/Optional	Standard/Optional	-/Standard
Seat ventilation* at front/front and rear	Optional/Optional	Optional/Optional	Optional/Optional
Cooled glove box	Standard	Standard	Standard
Heated steering wheel** (sports and multi-function steering wheel/leather	Optional	Optional	Optional
Tinted heat-insulating glazing all round (incl. grey top-tint)	Standard	Standard	Standard
Heated windscreen washer jets	Standard	Standard	Standard
Auxiliary heater (available from SOP V6)	-	-	-

* Not available for adaptive sports seats

**Standard for multi-function steering wheel in wood or carbon

Cayenne vs. Panamera A/C System



Cayenne air-conditioning system (2+2 air-conditioning system):

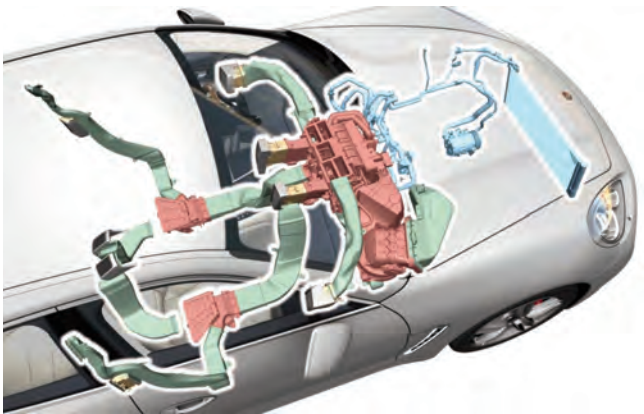
- Rear air vents (footwell, center console and B-pillar) are served by a separate heating unit (shown here)

Advantage:

- Passenger adjustments in the rear do not impact on the front air-conditioned areas

Note:

- High additional weight (e.g. heating unit)
- Large amount of space required
- Additional lines (e.g. air-conditioning line)
- High cost



Panamera air-conditioning system (4-zone system):

- All air vents in the vehicle (incl. the rear) are served by just one air-conditioning unit (heating unit at front)

Advantages:

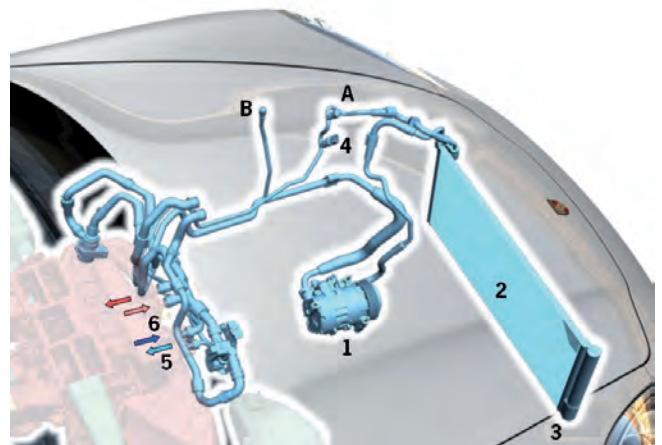
- More cost-effective
- Weight advantages
- Less space required

Note:

Rear passenger adjustments (especially changing the strength of the fan) can lead to feedback in the front air-conditioned areas

Refrigerant Circuit

The function and design of the refrigerant circuit.



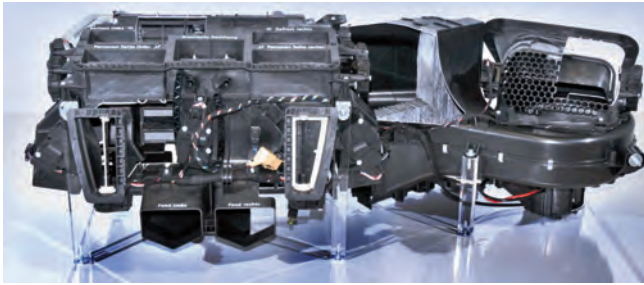
1. Compressor (electronically controlled)
 2. Condenser
 3. Holder (pipe) for dryer cartridge
 4. Pressure sensor
 5. Expansion valve input (high pressure)
 6. Expansion valve output (low pressure)
- A - Service connection (high pressure)
B - Service connection (low pressure)
Red Arrow - Heat exchanger connection
Blue Arrow - Evaporator connection

Notes:

[illegible]

Heating/Air Conditioning

Heating Unit (2-zone and 4-zone)



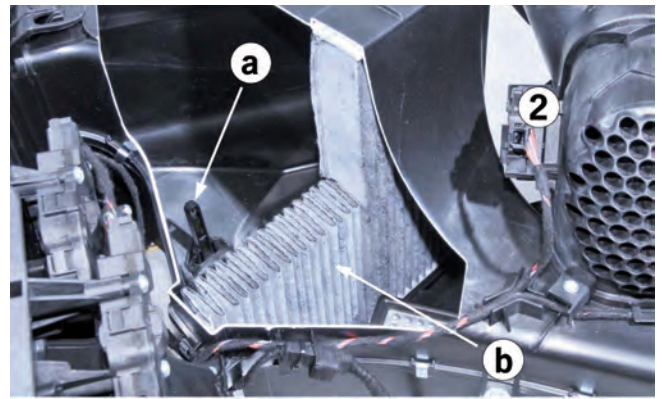
The heating unit is similar in some respects to the heating unit in the Cayenne. However, as this system provides all areas with air conditioning using one heating unit, the heating unit design is more complex and not comparable.

Heating Unit Air Intake



1. Servo motor for fresh air/recirculated air
2. Servo motor for ram air

The fresh-air/recirculation flap and the ram-air flap each have a servo motor located directly beside the air intake opening of the heating unit. The particle filter is positioned at the point where the heating unit's air intake opening connects with the air-mixing/distribution chamber (view in direction of air movement). To change the particle filter (for maintenance) a service opening is located in the housing of the heating unit (similar to the Cayenne). The opening can be reached by removing the knee guard on the passenger's side.

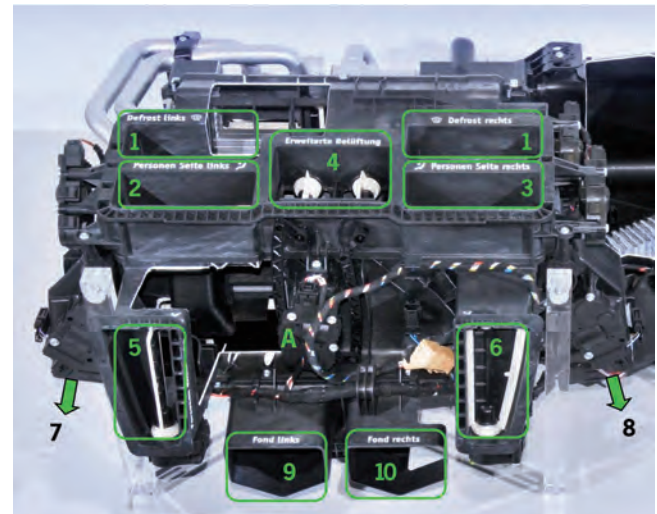


- a - Intake air temperature sensor
b - Particle filter with active carbon coating

Distinguishing between the 2- and 4-zone heating unit by the number of servo motors:

- A total of 15 servo motors are integrated in the 2-zone system.
- A total of 19 servo motors are integrated in the 4-zone system.

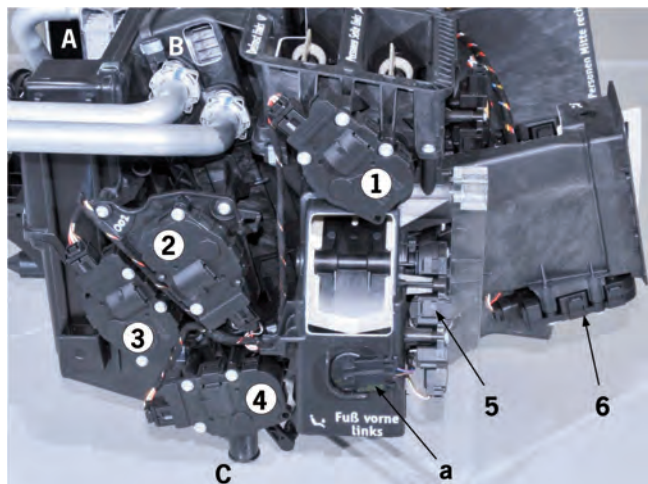
Heating Unit Air Outlet



- A. Servo motor for extended ventilation
1. Defroster, left/right
 2. Side passenger air vent, left
 3. Side passenger air vent, right
 4. Extended ventilation, left/right
 5. Center passenger vent, left
 6. Center passenger vent, right
 7. Left footwell
 8. Right footwell
 9. Rear left
 10. Rear right

Only one servo motor is available for extended ventilation. Both air flow flaps are activated using this drive link.

Heating Unit, Left Side



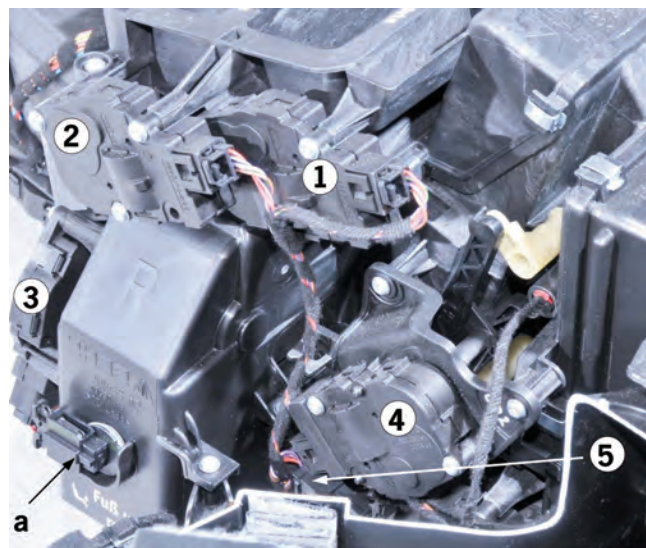
1. Servo motor for front side air vent
2. Servo motor for front temperature mixing flaps (cold and hot flap)
3. Servo motor for rear temperature mixing flaps (cold and hot flap)
4. Servo motor for front center vent left/right (cold air metering for bypass duct)
5. Servo motor for front footwell
6. Servo motor for front center vent

A. Evaporator
B. Heat exchanger
C. Condensation outlet

a. Temperature sensor, front footwell

Additional cold air can be fed to the center vent through a bypass duct). The temperature sensor for the side air vent (one each on the right/left side) is not positioned directly on the heating unit. The sensors are located in an intermediate piece just behind the air vents of the heating unit. This intermediate piece (connector) is an integrated component of the underside of the switch panel and routes the air flow to the air ducts, which serve the side air vents (right/left switch panel).

Heating Unit, Right Side



1. Servo motor for defroster, left/right
2. Servo motor for front side air vent
3. Servo motor for front footwell
4. Servo motor for front temperature mixing flaps (cold and hot flap)
5. Servo motor for rear temperature mixing flaps (cold and hot flap) - this drive link is located below item 4

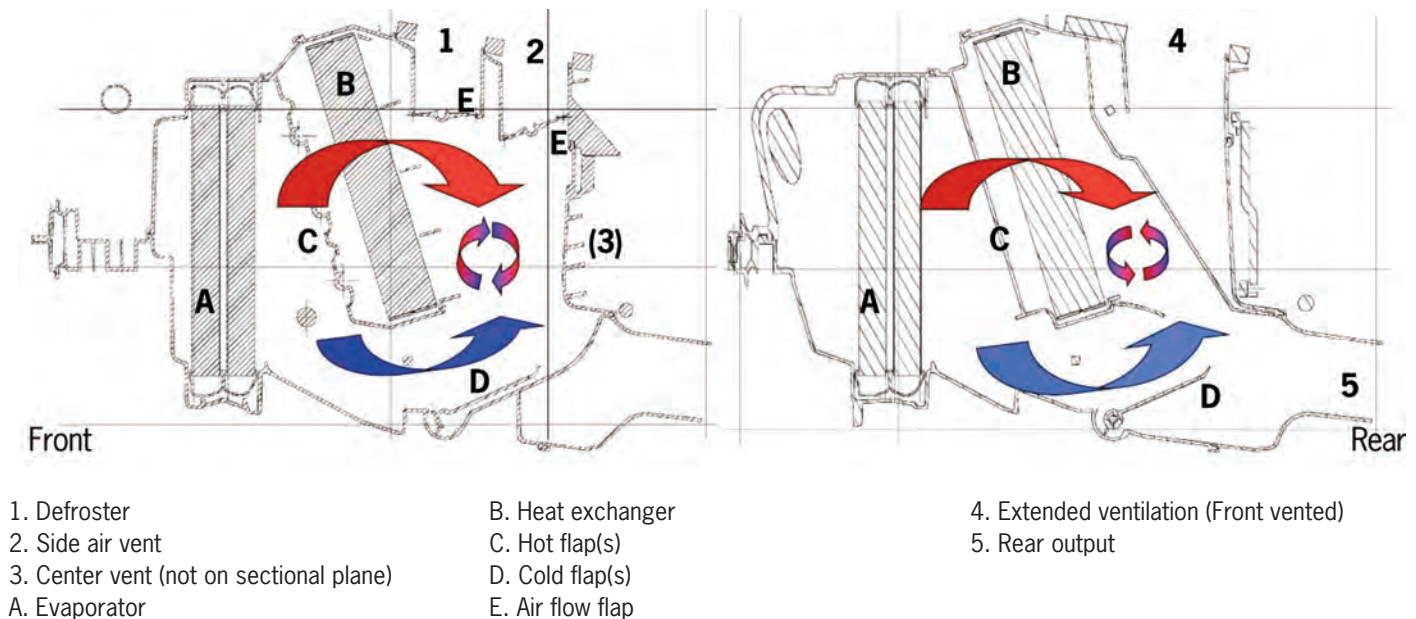
a. Temperature sensor, front footwell

The servo motor for the temperature mixing flap at the rear is located below position 4. The arrow points only to the connector for this drive link.

Notes:

Heating/Air Conditioning

Temperature Mixing Chamber (front and rear)



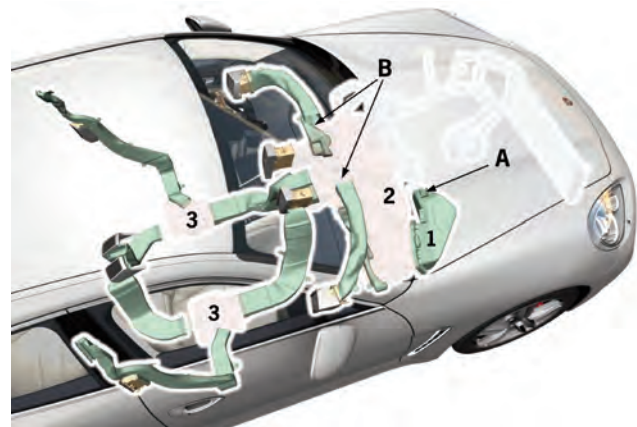
The temperature-mixing chamber is a symmetrical structure. This means that there are temperature mixing flaps for the left and right side at the front and rear (see section on the left side).

Behind the evaporator, the entire air flow is routed separately for the front and rear by the respective temperature mixing flap system (cold and hot flaps) into the temperature-mixing chamber behind. The cold and hot flaps are connected and actuated by a servo motor (temperature mixing flap). All flap positions are adjustable depending on the temperature required.

Example: Cold flap OPEN max $\Leftrightarrow$ Hot flap CLOSED max

Depending on the setting (automatic or manual mode) the air flows from the various temperature-mixing chambers (four in total) are routed separately through the air flow flaps in the heating unit to the individual vent ducts. An air flow flap for the rear is located in the air distributor.

Air Ducts



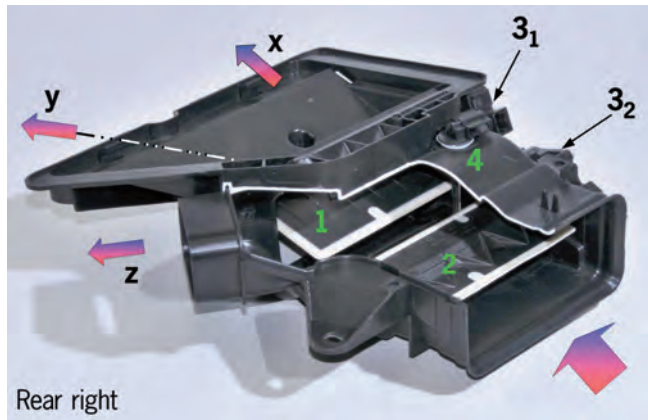
- 1. Fresh air intake tubes
- 2. Heating unit (indicated)
- 3. Air distributor (left/right)
- A. Air quality sensor
- B. POS Temperature sensors, side air vents (left/right)

- All air ducts are served by one heating unit.
- An air distributor (only indicated here) also distributes the air flows towards the rear vents.

Position of the temperature sensor on the side air vent:

The temperature sensor for the side air vent (one each on the right/left side) is not positioned directly on the heating unit. The sensors are located in an intermediate piece just behind the air vents of the heating unit. This intermediate piece (connector) is an integrated component of the underside of the switch panel and routes the air flow to the air ducts, which the side air vents (right/left switch panel) serve

Air Distributor



The air flow for the rear is distributed via a distributor to the vents. There are two flaps and the associated servo motors (3x) on the air distributor housing:

- Air distribution flap in footwell/center (1)
- Air flow flap (2)

Directions of air flow (distributor outlets):

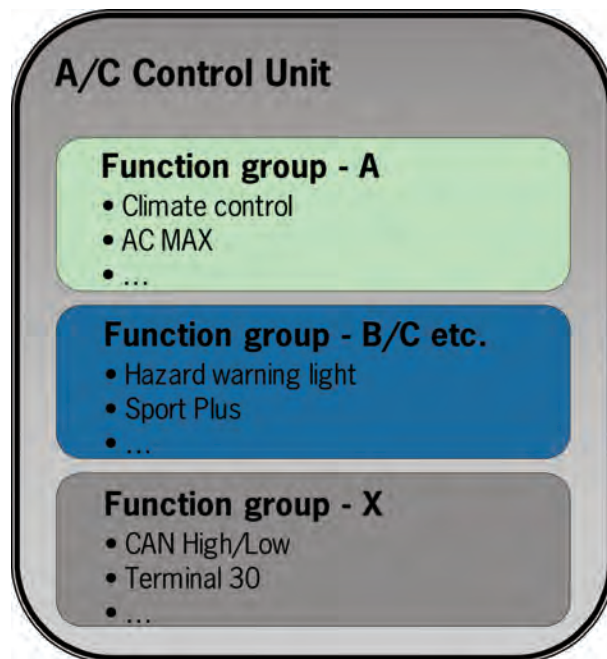
x - Air flow to footwell vent

y - Air flow to center vent

z - Air flow to B-pillar (always open)

In addition, the rear temperature sensor (4) is located on the right and left in the distributor housing.

Modular Operator Control Unit



A modular operator control unit in the center console allows you to adjust the air-conditioning functions, operate the chassis settings and perform other control functions (function groups).

Several comfort functions are integrated in the Panamera thanks to the new operating concept in the operator control units. The inputs and outputs for these are subdivided into various function groups. Concept of the front operator control unit. (Operator control unit = OCU or OCE*)

Function group - A:

Settings for air-conditioned areas (e.g. heated/ ventilated seats, automatic mode etc.)

Function group - B/C etc.:

Safety or chassis functions, their inputs and outputs (e.g. Sport Plus etc.)

Function group - X:

General inputs and outputs (e.g. CAN High/Low, terminal 30 etc.)

Heating/Air Conditioning

Operating and Air-Conditioning Unit (OAU, front) 4-Zone System



Air-conditioning functions - A

Safety functions - B

Chassis functions - C

Body functions - D

The influence of the Carrera GT can be seen in the center console. The idea to transfer almost all of the switches from the switch panel to the center console simplifies operation for the driver. The most important functions are sorted into function groups for fast, uncomplicated and intuitive operation.

- The driver's inputs are evaluated by these controls (buttons and sliders) in the operating and air-conditioning unit and forwarded to the relevant control units in the various function groups.
- The operating and air-conditioning unit also regulates and controls all the heating and air-conditioning system components required for cabin air conditioning. Feedback is provided through the control panel (e.g. LED button lights up/display at the front).
- A distinction can be made between the following versions:
 - a) OAU with automatic 2-zone adjustment
Automatic adjustment (left/right) with different temperature, air flows and air distribution for driver and passengers
 - b) OAU with automatic 4-zone adjustment
This automatic adjustment also enables "single seat" air conditioning with independent temperature, air flow and air distribution control for all four seats. A second OAU is used to operate these functions in the rear. Both OAUs are connected via the LIN bus.

Notes:

Operating and Air-Conditioning Unit (OAU, front) 4-Zone System



Button assignment for air-conditioning functions (individually for left/right):

- Switch on climate control (AUTO button)
- Set temperature
- Set air quantity (air volume)
- Set air distribution
- Set heated seats/seat ventilation

Anti-Mist Control ("Auto Defrost")

An anti-mist control function is also available for the first time in the Panamera in automatic mode. As part of this function, a sensor records the humidity in the vehicle. The sensor for anti-mist control is located at the base of the rearview mirror.

With manual windshield defrosting (defroster), the air supply to the rear is cut off automatically in "defrost mode" to achieve maximum defrosting efficiency in the 4-zone system. OFF appears on the rear OAU display. In the 2-zone system, the windshield is defrosted with maximum efficiency when the air vents in the rear are closed.

- When outside temperatures $< 27^{\circ}\text{F}$. (-3°C .) or the intake air temperature $< 36^{\circ}\text{F}$. (2°C .), the compressor is switched off automatically.
- The heated rear window/door mirror heating function is available when the engine is running (indicator light in the button is illuminated). Depending on the outside temperature, the heating switches off automatically after approx. 5 to 20 minutes. The heating can be switched back on by pressing the button again.

The heated rear window/door mirror heating function is available up to an outside temperature of 86°F . (30°C .).

Air-Recirculation Control

The outside air/fresh air supply is interrupted. If the air-conditioning compressor is switched off manually or automatically, air-recirculation mode ends after approx. 3 minutes).

Automatic Air-Recirculation Control

The air-recirculation mode is adjusted automatically depending on the air quality (air quality sensor). Automatic air-recirculation mode can be switched on and off. Anti-mist control terminates air-recirculation control if necessary.

Terminating the air-recirculation control when the compressor is switched off and the anti-mist control (measuring the humidity) prevent the windows from misting. The recommended operating mode is automatic air-recirculation mode (default setting).

Heating/Air Conditioning

Automatic Air-Recirculation Control (cont'd)

When the outside temperature < 50° F. (10° C.), air-recirculation mode is deactivated automatically to prevent the windows from misting. The maximum recirculation period request by the air quality sensor is 14 minutes.

The air moisture sensor is an integrated component of the rain-light-moisture sensor. This is located at the base of the rearview mirror and detects:

- Precipitation events for wiping cycle requirements
- The light sensor (light/dark) for driving light requirements
- Humidity for clearing misted windows

MONO Mode ("MONO" button)

All air-conditioned areas depend on the setting of the driver's air-conditioned area. The three displays change their values.

AC MAX Mode ("AC MAX" button)

In AC MAX mode, the passenger compartment is cooled at maximum power (no automatic mode). In MONO mode, the indicator light is illuminated until the MONO button is pressed again. The values that are set are maintained for all areas (no memory for the original settings). MONO mode is also exited if a setting in an air-conditioned area (not the driver's area) is changed.

In AC MAX mode in a 4-zone system (when the indicator light is illuminated on the button), maximum cooling power is focused on the two areas in the front. The air conditioned areas in the rear are deactivated automatically to achieve this increase in cooling power. OFF appears on the rear OAU display.

The following conditions are automatically set for rapid cooling:

- Most of the air (air flow) is routed to the passenger air vents in the switch panel
- Maximum fan speed
- Coldest possible temperature ("LO" appears on the front display)
- Air-recirculation mode

Residual Engine Heat Utilization ("AUTO REST" button)

The residual heat of the engine can be used to heat the interior for up to 20 minutes after the ignition has been switched off. The indicator light on the button lights up in REST mode. The settings for the air-conditioning system (e.g. fan speed) cannot be changed manually.



Note!

If the battery voltage is too low, REST mode is restricted initially and then switched off.

Setting and Adjusting Climate Control For Rear Areas With The Front Operator Control Unit

Changing the air-conditioned areas at the rear with the front operating and air-conditioning unit:

1) "AUTO REAR" button

Press the button for approx. 2 seconds. In REAR mode, the word REAR appears on the display.

2) "MONO" button

For more information, see MONO mode.

The REAR mode function switches off automatically approx. 4 seconds after the last settings are configured. REAR mode can also be switched off manually. To do this, press the "AUTO REAR" button in the front OAU for approx. 2 seconds.



Note!

- > The rear OAU can also be switched on/off using the child protection button "AA" (driver's door). A lock symbol appears on the display.
- > The power window buttons on the rear doors and the control panel (all function groups) on the center console can be deactivated by pressing the safety button (child protection) in the keypad on the driver's door.

Extended Air-Conditioning Functions

The “Extended air-conditioning functions” setting on the on-board computer can be configured using the small thumb wheel (on the right) on the steering wheel. Once the vehicle/settings/air conditioning has been selected, the options listed below can be set.



In the Panamera, the extended air-conditioning functions listed below are available in conjunction with the “14-way power seats with memory package” and can be set individually. The settings can be configured using the combination control stalk on the on-board computer of the instrument cluster (multi-function display).

Adjusting Air Flow

Three settings ("low", "medium" and "high") are available in automatic mode to regulate the intensity of the air flow.

Extended Ventilation Panel (middle of the switch panel)

This ventilation panel can switch on and off.

Switching Automatic Air-Recirculation Mode on/off

You can configure the fresh air supply to adjust automatically to the air quality (air quality sensor).

Setting Center Vent to Blow Colder Air

A bypass duct is located in the heating unit for this purpose. The preset interior temperature remains the same.

Notes:

[illegible]

Heating/Air Conditioning

Operating and Air-Conditioning Unit (OAU, rear) 4-Zone System



The control buttons can also be assigned to individual function groups on the rear operator control unit.

Air-conditioning functions - A (only in 4-zone systems)

Safety functions - B

Comfort functions - F (passenger seat adjustment)

Button assignment for air-conditioning functions (individually for left/right):

- Switch on climate control (AUTO button)
- Set temperature
- Set air quantity
- Set air distribution
- Set heated seats/seat ventilation

- The operating and air-conditioning unit (OAU) in the center console at the rear of the vehicle allows you to set the air-conditioning, safety and comfort functions. The OAU is only available in vehicles with 4-zone systems and is connected to the front OAU via the LIN bus. Feedback is provided through the control panel (e.g. LED button lights up/display at the rear).
- The buttons for the heated seats and seat ventilation are designed as three-stage buttons and can be adjusted individually for each seat (for more information, see "Seat air conditioning").
- Depending on the equipment in the vehicle, additional buttons for adjusting the backrests and seat cushions (passenger) are available in the top middle section of the OAU. Also available are options for adjusting the roll-up sunblind for the rear window and actuating the central locking system. Depending on the equipment, various trims are available for the control unit (operator control unit).



Note!

- > The picture of the rear OAU is not correct. In the 4-zone system, there is no button for heated seats or seat ventilation in function group F.
- > The buttons for the individual function groups may differ, depending on the various options that can be ordered (e.g. with and without heated seats).

Operating and Air-Conditioning Unit (OAU, rear) 2-Zone System



- The operator control unit (OCU) in the center console at the rear of the vehicle allows you to operate various function groups, depending on the equipment. Buttons may be available for adjusting the roll-up sunblind for the rear window, actuating the central locking system or adjusting the heated seats and seat ventilation, available as optional extras. Depending on the equipment, various trims are available here for the control unit (OCU).
- The operator control unit is connected to the front operator and air-conditioning unit via the LIN bus. Feedback is provided through the control panel (e.g. LED button lights up/display at the rear).

The control buttons can also be assigned to individual function groups on the rear operator control unit.

Safety functions - B

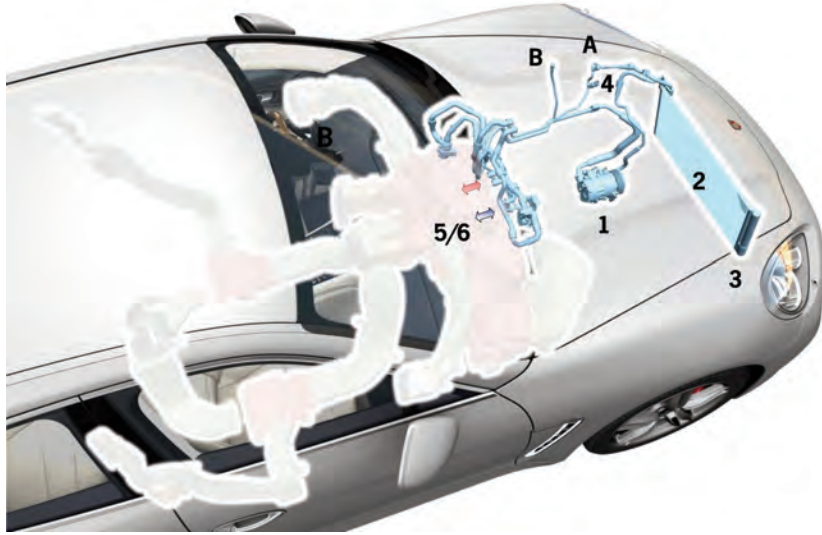
Comfort functions - F (passenger seat adjustment)

The buttons for the individual function groups may differ, depending on the various options that can be ordered (e.g. with and without heated seats).

Notes:

Heating/Air Conditioning

Refrigerant Circuit (2-Zone and 4-Zone System)



1. Compressor (electronically controlled)
2. Condenser
3. Mounting (pipe) Dryer cartridge
4. Pressure sensor
5. Expansion valve input (high pressure)
6. Expansion valve output (low pressure)
- A. Service connection (high pressure)
- B. Service connection (low pressure)

↔ Heat exchanger connection

With the electronically controlled compressor and condenser with integrated mounting for the dryer equipment (dryer cartridge), the refrigerant circuit is similar to that in the Cayenne. The electronic control valve in the compressor is actuated by the OAU. The OAU uses the evaporator temperature sensor value as the main input variable for the actuation. When outside temperatures < 27° F. (-3° C.) or the intake air temperature < 36° F. (2° C.), the compressor is always switched off automatically.

Compressor Switch-off Conditions Codes

The compressor's OFF code uses the PIWIS Tester to assign the reason for switching off. If the charging condition of the battery is critical, the following air-conditioning functions are restricted initially and then switched off:

- Heated seats
- Heated rear window/door mirror heating
- Fresh air fan
- Air-conditioning compressor

Codes

- 0 - OK (no switch-off condition)
- 1 - High-pressure cut-off
- 2 - Low fan speed
- 3 - Low-pressure cut-off
- 4 - ECON
- 5 - Engine start
- 6 - ECON mode
- 7 - AC off (fan OFF)

- 8 - Outside temperature
- 9 - Not used
- 10 - Low battery voltage
- 11 - High engine temperature
- 12 - Engine control module (engine temperature is too high)
- 13 - High battery voltage
- 14 - Evaporator temperature sensor (risk of freezing)
- 15 - Three overpressure events
- 16 - Servo motor fault (e.g. servo motor)
- 17 - Pressure sensor fault
- 18 - Overheating protection (if engine speed is too high)
- 19 - Vehicle electrical system control unit requirement
- 20 - Low refrigerant level
- 21 - Compressor run-in period (end of assembly line)
- 22 - Run-in period is not yet completed



Note!

Since the compressor system is similar to that in the Cayenne, the OFF code can also be used for diagnosis purposes.

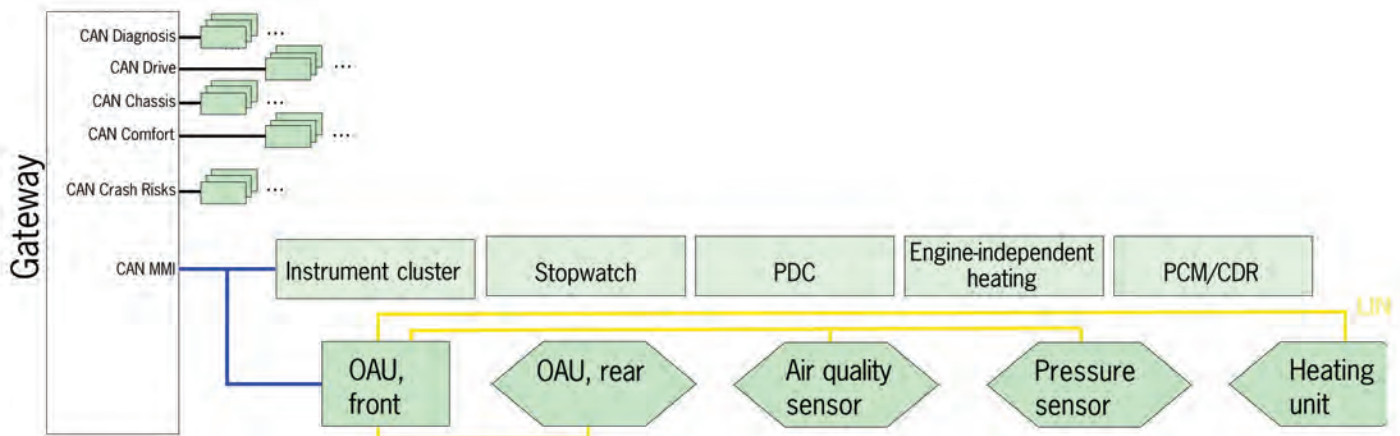
Code 8: When outside temperatures < 27° F. (-3° C.) or the intake air temperature < 36° F. (2° C.), the compressor is always switched off automatically

Code 12: Switch-off request from the DME control unit (e.g. when T_Mot > 244° F. (118° C.)

Code 19: Switch-off request from battery control unit or vehicle electrical system control unit

Code 21: During the run-in period, the compressor is switched off if the engine speed of > 1200 rpm is exceeded

Air-Conditioning Network Topology



When it comes to exchanging data, the air-conditioning system is fully integrated into the various networks and bus technologies (CAN/LIN). The front control panel is connected directly to the CAN MMI and is used as the master for air conditioning. The master obtains its information (e.g. from the rear OAU) via the LIN bus. Information required from other CAN bus areas is provided via the gateway's bus interfaces (e.g. engine temperature).

Bus speeds in the Panamera:

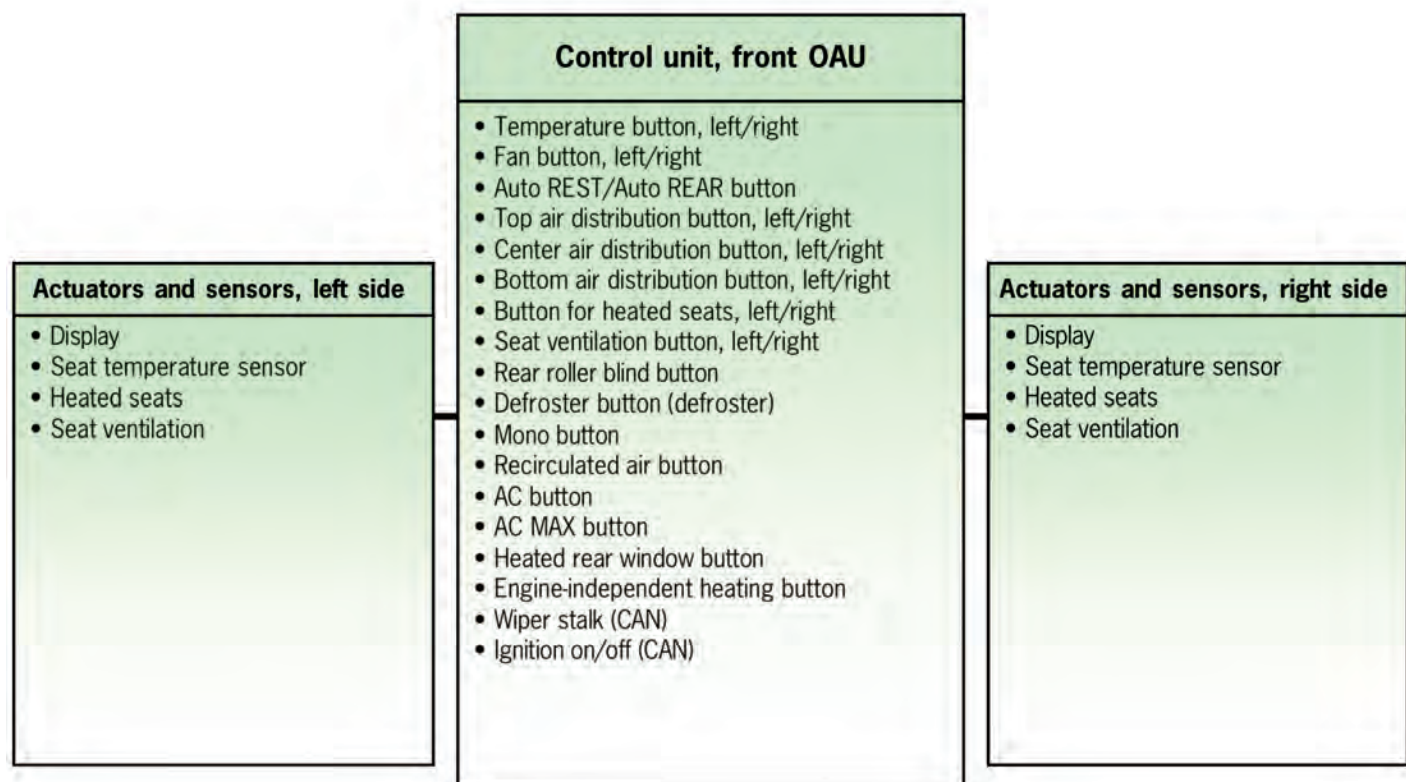
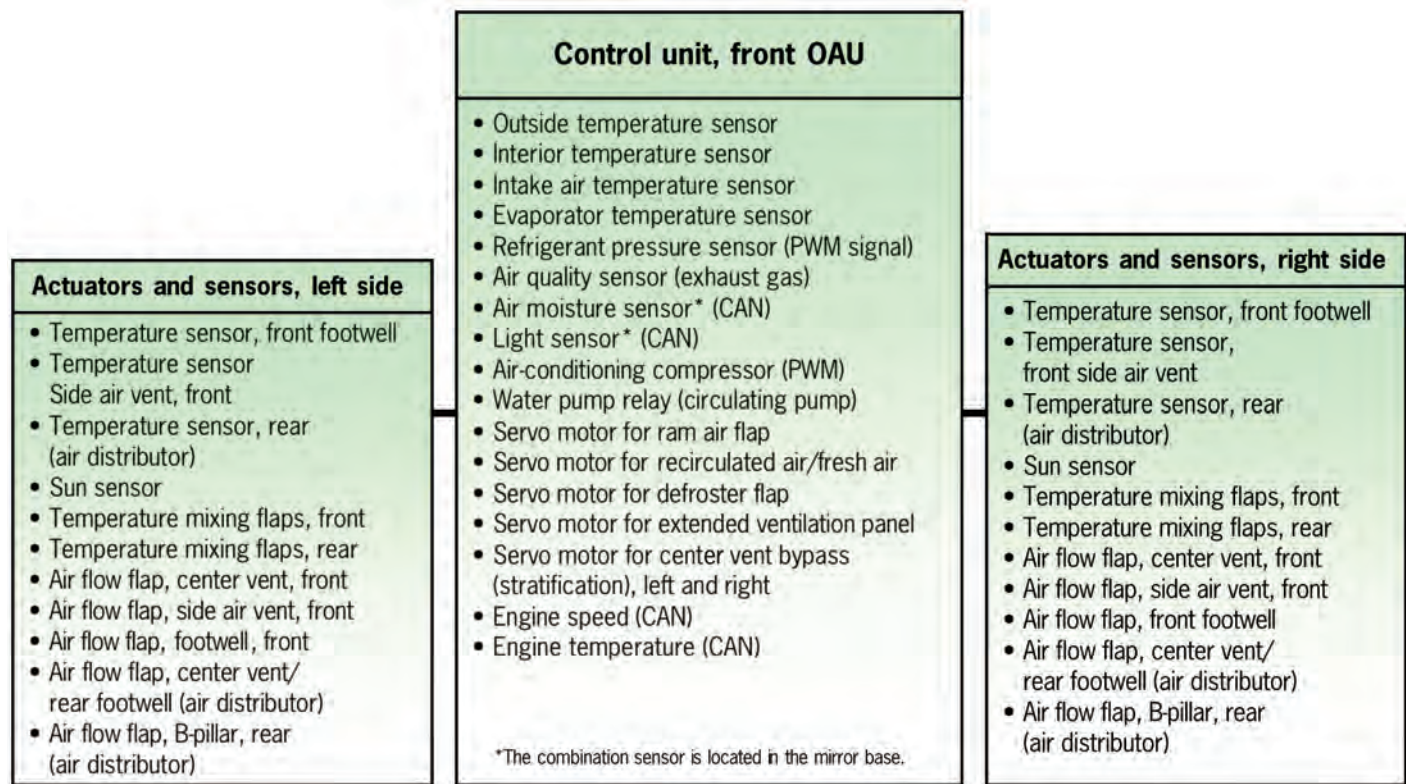
CAN drive	500 Kbaud
CAN crash risks	500 Kbaud
CAN diagnosis	500 Kbaud
CAN chassis	500 Kbaud
CAN comfort	500 Kbaud
CAN MMI	500 Kbaud (MMI = Man Machine Interface)
LIN	20 Kbaud

Notes:

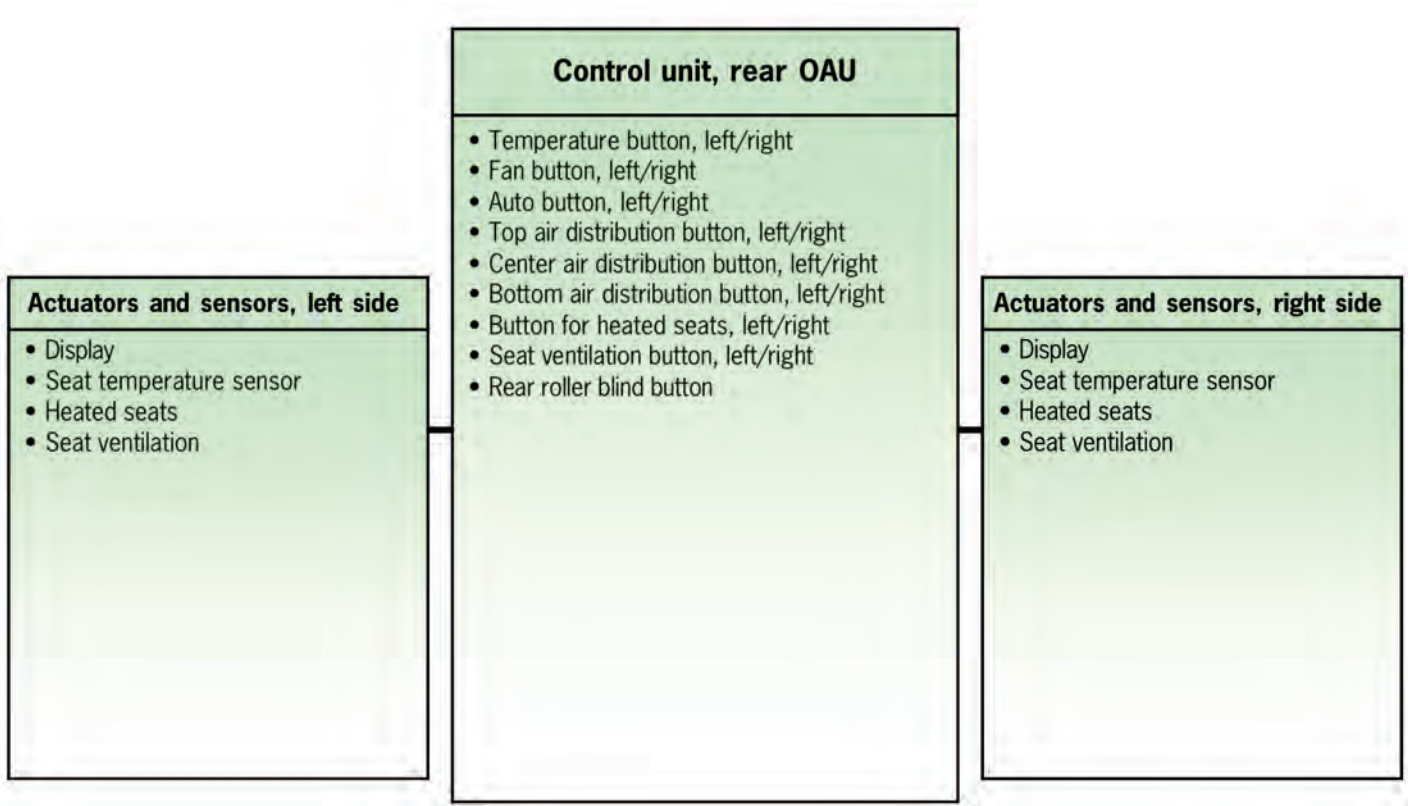
This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

Heating/Air Conditioning

Actuators and Sensors (front OAU in the 4-zone system)



Actuators and Sensors (rear OAU in the 4-zone system)



Additional Information

- Pressing the “Auto REST” and “Auto REAR” buttons briefly starts automatic mode on the left and right.
- The sensor for measuring humidity in the cabin is located at the base of the rearview mirror. Additional sensors are also located here (e.g. light sensor).
- The servo motors for the temperature mixing flaps each actuate a cold and hot flap for the front and rear (linked).
Example: Cold flap OPENmax $\Leftrightarrow$ Hot flap CLOSED max
- Air moisture sensor/front BCM/CAN comfort/gateway/CAN MMI/front OAU
- Engine speed/DFI control unit/CAN drive/gateway/CAN MMI/front OAU
- The humidity is measured by a sensor integrated in the rain-light-moisture sensor (located at the base of the rearview mirror). In addition to humidity, this sensor also records dew point temperature, the temperature of the windshield, sun intensity on the left and right and the angle of incidence.
- Wiper stalk activated/combined steering column module (CSCM)/CAN comfort/gateway/CAN MMI/front OAU
- Ignition on (terminal 15)/front BCM/CAN comfort/gateway/CAN MMI/front OAU

Heating/Air Conditioning

Seats - Heating and Ventilation



The seat heater heats the centers of the seat surfaces and the backrests. The heating operates in three stages and can be controlled separately via switches in the front and rear center console (depending on the design).



Seat ventilation is also available as an optional extra. The three-stage controllable ventilation system (fan module position 1 and 2) under the perforated seat and backrest center generates an air swirl. The perspiration is thus sucked in and dissipated away through air ducts in the seat. To prevent the occupants from getting too cold, seat ventilation cannot be switched on if the seat temperature is below 59° F. (15° C.).

Heated Steering Wheel (Option)

The sports and multi-function steering wheel can be equipped with steering wheel heating as an optional extra. The optional multi-function steering wheels in wood and carbon are always equipped with steering wheel heating. The heating for the steering wheel rim can be switched on and off separately using a button on the 6 o'clock spoke (subject to release from energy management system).

Activation and deactivation of the system is indicated on the on-board computer of the instrument cluster.

- “Steering wheel heating ON” or
- “Steering wheel heating OFF”

When the heated steering wheel is activated, the temperature of the steering wheel rim is controlled by a temperature sensor located on the steering wheel rim. When the heated steering wheel is activated, the temperature of the steering wheel rim is kept constant at 95° F. (35° C.) by the combined steering column module (CSCM) through a temperature sensor.



3-spoke sports steering wheel with steering wheel rim in smooth finish leather.



3-spoke multi-function steering wheel in leather.



3-spoke multi-function steering wheel in wood or carbon.

Function:

Once activated by the button on the 6 o'clock spoke, the “Heated steering wheel active” request is received by the combined steering column module (CSCM) (conventional signal). The NTC signal from the temperature sensor in the steering wheel rim is now sent to the CSCM and is evaluated by it. The CSCM energizes the heating foil/heating fabric on the steering wheel rim in accordance with this value.



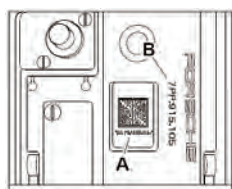
Subject	Page
Vehicle Electrical System	2
Relay/Fuse Panels	4
Electronic Ignition Lock	5
Local Interconnect Network (LIN)	11
Front-End Electrics	15
Gateway	16
Entry & Drive Function	21
Front Door Control Unit	26
Rear Door Control Unit	28
Rear-End Electrics	29
Rear Spoilers	30
Instrument Cluster	35
Adaptive Cruise Control (ACC)	41
ParkAssist (PDC - Park Distance Control)	48
CDR-31	51
PCM3.1	52
Sound Systems (CDR-31, PCM3.1, BOSE & Burmester)	54
Rear Seat Entertainment System	56
Antenna Systems	56
Headlights	59
Bi-Xenon Headlights	61
Tail Lights	64
Rotary Light Switch Set To Auto	64

Vehicle Electrical System – Power Management

Battery



The battery is located in the luggage compartment under the loadspace floor.



The AGM battery is a maintenance-free, sealed battery. This battery must not be opened, if the battery is opened it must be replaced.

When replacing a battery in the gateway control unit, enter both numbers using the following path:

- Gateway/Maintenance, Repair/Battery replacement.
- The battery size and manufacturer must also be entered when replacing the battery.

Replacement Information

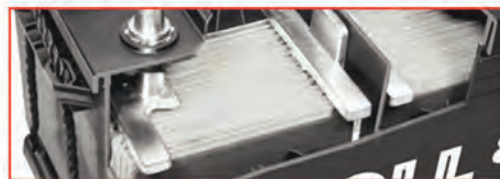
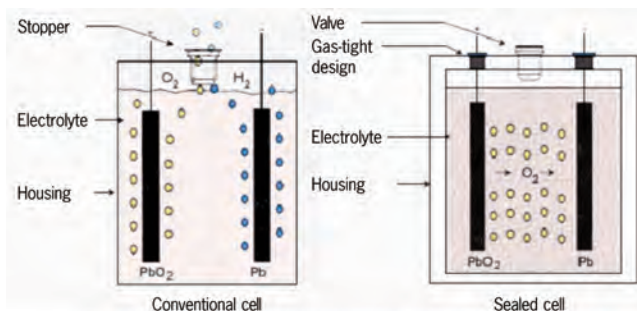
- Battery terminals do not need to be greased.
- The battery terminal clamps must only be attached by hand without using excessive force (such as a hammer) to prevent damage to the battery.
- The tightening torque for the battery clamps is: 6 Nm $\pm$ 0.5 Nm (4.5 ftlb. $\pm$ 0.5 ftlb.).
- The battery open-circuit voltage should not fall below 12.5 V.



Notes!

- > Connect the battery charger and jump leads directly in the engine compartment.
- > If the charger or jumper leads are connected at the battery, the battery sensor may become damaged. In addition, incorrect information (battery charging directly at the battery sensor) is forwarded to the gateway.

Battery Technology – Absorbed Glass Mat (AGM)



The AGM batteries are completely maintenance-free throughout its entire service life thanks to a special separator. A valve seals the cell. Gases that are generated are removed electrochemically at the counter electrode. This means that very little fluid is lost and refilling with water is no longer necessary or possible. If the battery is opened, it must be replaced. (Refer to the workshop manual when replacing batteries.)

Battery Sensor

The battery sensor is located on the negative terminal of the battery, it is part of the energy management system (battery management). The battery sensor is connected between the negative terminal of the battery and the ground cable.

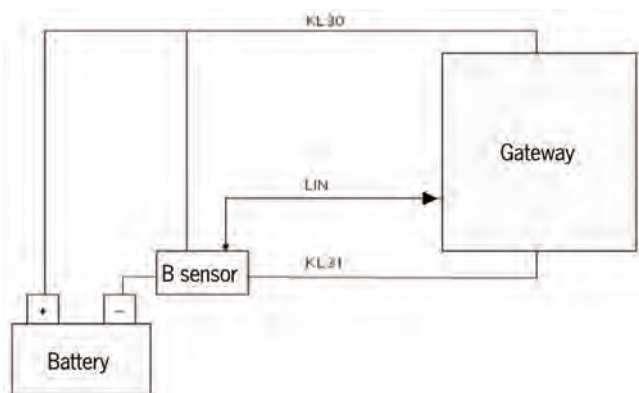


Important: Always connect the charging cable/jump leads directly in the engine compartment as otherwise the battery sensor could be damaged.

Tasks:

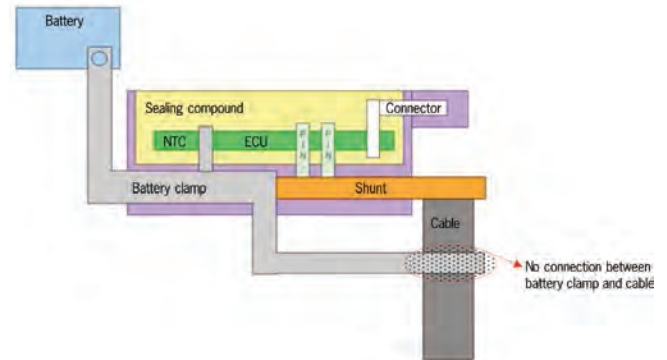
- Measures battery voltage
- Measures battery power
- Measures the temperature at the negative terminal

Using algorithms, the battery sensor (slave) calculates the current battery condition from these values in the ECU and communicates this value to the gateway (master).



The battery sensor has an electrical connection to the battery terminal and the ground strap of the vehicle. There is a further connection to the battery's positive terminal to register voltage and to the gateway via a LIN connection. The entire electric current of all components (including the battery sensor) flows through the shunt to the negative

terminal. The direction of charge of the energy delivered by the generator is routed to the positive terminal. This means that a charging current or discharging current (closed-circuit current) can be determined by the evaluation electronics.



The battery sensor is a module that monitors and diagnoses battery activity, it is a LIN slave module in a LIN network that communicates with the gateway.

It is connected directly to the negative terminal:

- Operating temperature of -40° F. to 221° F. (-40° C. to 105° C.)
- Service life of at least 15 years
- Battery voltage measurement range of 6 to 16.5V
- Resistance between battery terminal and ground strap max. 300 µOhm
- ECU contains the NTC for temperature sensing

Electrics/Electronics

Power Distributor

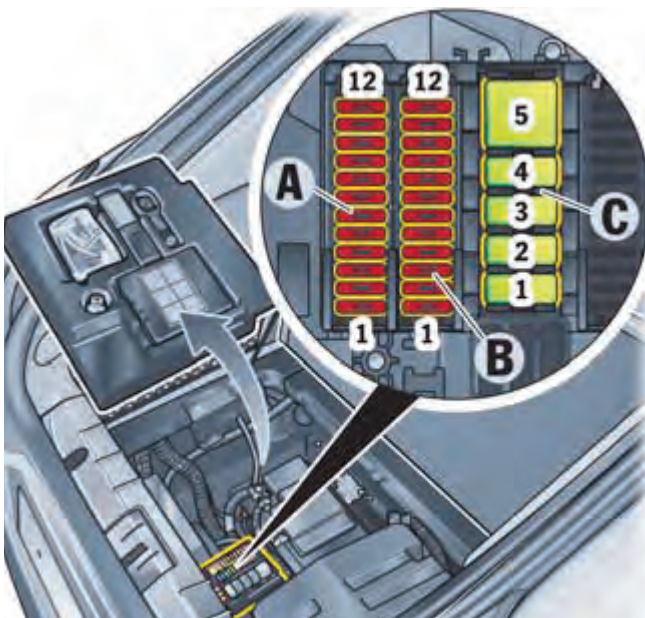


Located in the luggage compartment. The pyrofuses in the power distributor must be replaced once they have been triggered.

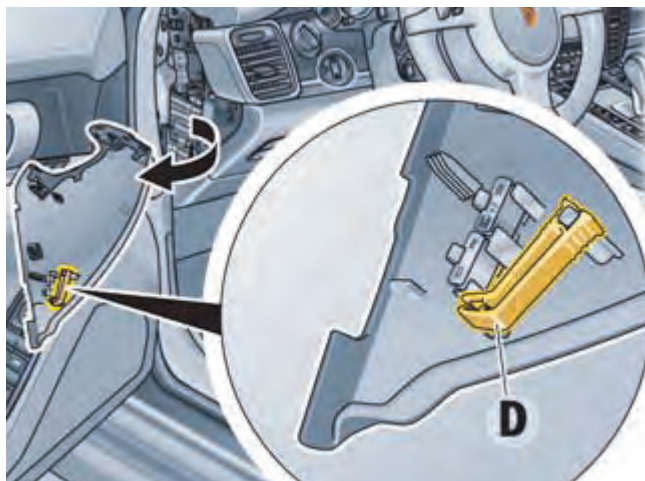
Relay/Fuse Carriers



Located in the luggage compartment.



A. Fuses B. Fuses C. Relays



Located on the left and right sides of the dashboard.



Dashboard, Left



Dashboard, Right

Additional Fuse/Relay Carriers



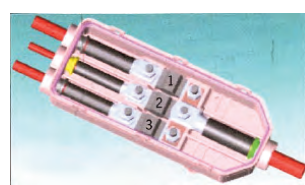
Plenum Panel



Under Passenger's Seat



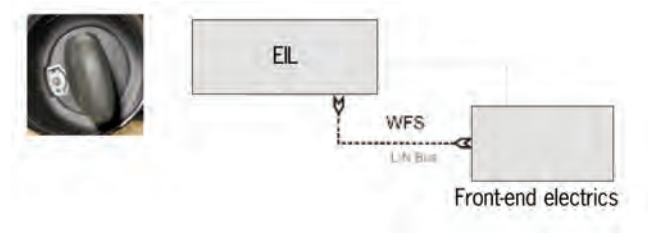
Fuse carrier located in left front wheel housing.



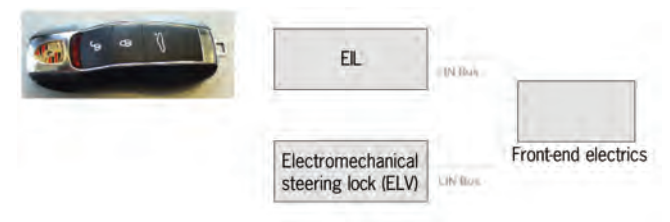
The Owner's Manual does not show the wheel housing fuse carrier (front left wheel housing) or the fuse carrier under the passenger seat. For more information, please see the wiring diagram.

Electronic Ignition Lock (EIL)

The basic system includes an immobilizer function in the key; the engine immobilizer release is sent from the electronic ignition lock (LIN slave) via the LIN bus to the front-end electrics (LIN master).



In the second generation (Porsche Entry & Drive/KESSY), the control panel is inserted in the EIL instead of the vehicle key; the electrically adjustable steering column function has also been added.



Key Anti-Removal Lock

After turning the key to the right from the “OFF” position to “Ignition (terminal 15)” or “Start engine (terminal 50)”, the key is mechanically secured against removal from the electronic ignition lock. The key anti-removal lock is released by a solenoid when the key is turned back from the “Ignition (terminal 15)” position to the “OFF” position. If the vehicle battery is discharged, the key anti-removal lock can be deactivated in the “OFF” position via the mechanical emergency unlocking function.

Notes:

[illegible]

Generator

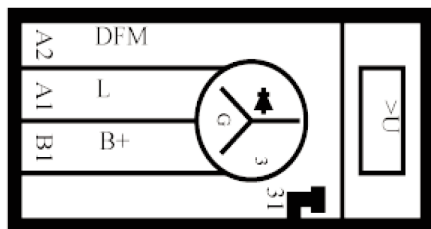
Liquid-cooled generator, 190A of nominal power, depending on temperature and adjustment, 350A of power can be generated.

- Voltage regulation = BSS voltage regulator (Bit Synchronous Single-Wire technology)
- Vehicle electrical system voltage potentially > 15V, depending on vehicle electrical system requirements

The generator delivers the electrical energy required to supply the electric/electronic components and systems in the vehicle. The voltage is largely independent of load and is set by an integrated BSS regulator in accordance with a predefined characteristic.

Generator Control

The battery sensor transmits information (battery voltage, charging current, battery temperature) = battery condition to the gateway, the gateway calculates the energy requirements and sends this requirement request signal via DFI to the BSS generator regulator. The BSS generator regulator controls the exciting voltage according to requirements (charging current) and communicates the generator's utilization status to the gateway.



The chip temperature of the BSS regulator is used for overload protection: if the temperature is too high (coolant temperature high, excessive charging current), the field current is limited to reduce the temperature.

The interface regulator is designed as a LIN slave for the DFI control unit (LIN master). A second-generation bit-synchronous serial interface (BSS2) enables communication between the regulator and the control unit.



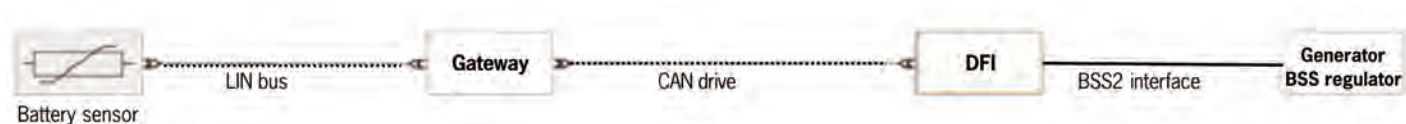
Note!

BSS regulators have been installed since model year 2007 except (GT3).

Load-Response Start (LRS)

This function prevents the generator from generating charging current during and immediately after starting. This means that the starting process is not impeded or prolonged by the braking torque of the generator. Exciting voltage/utilization signal (DFM) Dynamo Field Monitor Signal (PWM) reflects the pulse/duty factor and is a measure of the utilization rate of the generator. The pulse width depends on the operating point of the generator (load, engine speed and temperature).

Generator Control Communication



Energy Management

Battery management takes place in the gateway.

Task:

Battery management must ensure that the vehicle can start in all operating conditions.

Objective:

In order to be sure that the vehicle will start every time, electrical energy consumption must be reduced, depending on the battery charging condition.

A distinction between interventions in battery management in the following situations:

- When the engine is running
- When the engine is off (Start Stop operation)
- Closed-circuit current management (engine is running, generator is not activated)
- If there are problems with the vehicle electrical system or generator an emergency load switch-off is activated. This also happens if a pyrofuse is triggered in the power distributor.

Closed-Circuit Current Management

In the case of long transport times and idle periods, the vehicle battery discharges due to closed-circuit current loads to the extent that the battery becomes damaged or unusable. Discharged batteries sulphate and are subsequently permanently damaged.

To increase startability of the vehicle, electrical energy consumption must be reduced, depending on the battery charging condition. Electrical energy consumption should be reduced during prolonged idle periods and during transport by switching off subsystem software (existing control units).

Measures for Reducing Parasitic Drain

- Reduce closed-circuit current
- Reduce loads with controlled run-on time after terminal 15 is switched off
- Reduce operating current when vehicle is stationary
- Switch off lighting after a defined run-on time through terminals G1 (Switching off comfort lighting in the passenger compartment) and G2 (Switching off security lighting in the passenger compartment)
- Switch off terminal 30 F in the event of a vehicle electrical system fault after a defined run-on time after terminal 15 is switched off

Switch-off Levels

In the event of a critical vehicle electrical system status, the escalation stages proceed step by step; when the vehicle electrical system recovers, the escalation stages are scaled back accordingly.

Stage	Meaning	Effect
0	Engine is running, generator is not yet activated	Behaves in accordance with the closed-circuit current management system
1	Control intervention, stage 1	No restrictions in terms of customer requirements, windscreen heating control and PTC
2	Control intervention, stage 2	Increase in idle speed and heating system restriction
3	Control intervention, stage 3	Further increase in idle speed
4	Control intervention, stage 4	Reduction of interior blower
5	Control intervention, stage 5	Further reduction of interior blower
6	Control intervention, stage 6	Maximum reduction of interior blower and cut-out of air-conditioning compressor
	Emergency load switch-off	
	In the event of a fault	

Electrics/Electronics

Measures for Reducing Parasitic Drain (cont'd)

Operating current loads are loads that can be activated and deactivated manually by the driver when terminal 15 is off/on and the engine is not running, e.g. radio, television, residual heat, interior lighting etc. Loads with controlled run-on time are loads that switch themselves on independently or remain on after terminal 15 is switched off and then switch off independently after a specified run-on time. The run-on times can vary. Examples include engine cooling, engine control unit, steering-angle sensor etc.

Closed-circuit current loads are electrical loads that must be powered indefinitely after terminal 15 is switched off while the vehicle is stationary. Examples include interior surveillance, interfaces, sensors, receivers etc.
Comfort loads with "engine off"

Comfort loads with high static current consumption are prohibited when the engine is off, e.g. the heated rear window, mirror heating, windshield heating, heated seats, heated steering wheel.

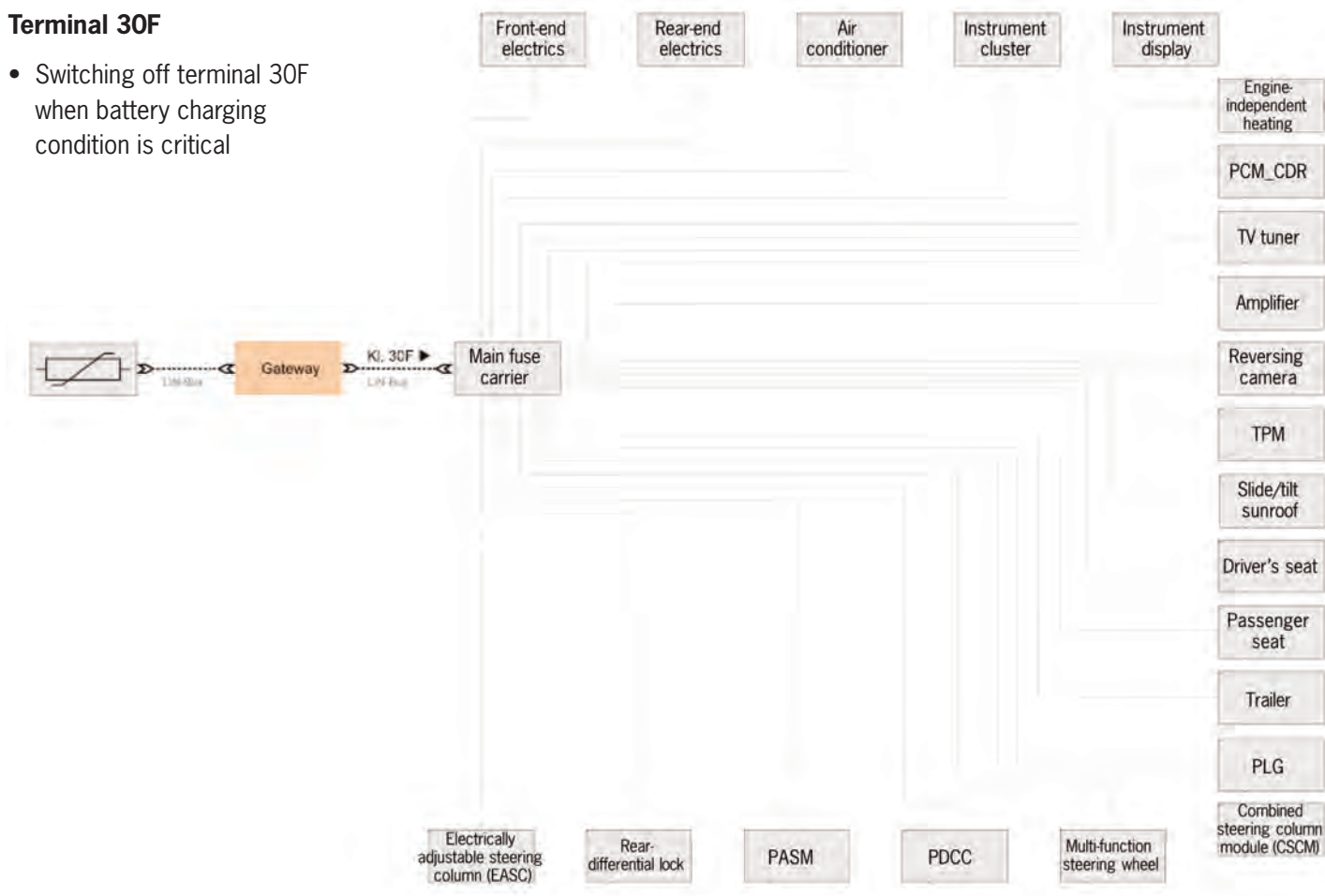
Terminal 30F

Switching off terminal 30F helps to reduce energy consumption in the vehicle in the event of a faulty battery and vehicle electrical system before the startability limit is reached. The terminal is only switched off once all of the following conditions have been met:

- The minimum run-on time of 32 minutes has expired
- The ignition has been switched off
- The S contact is "off" (the key is not inserted)
- The alarm system is not active
- The diagnosis session is not active
- There is a fault in the vehicle electrical system

Terminal 30F

- Switching off terminal 30F when battery charging condition is critical



Transport Mode (hardware connector)

Two independent transport modes have been implemented to reduce energy consumption to a minimum during production and transport. With the first mode, a hardware connector is activated in the power distributor. The power distributor is supplied with the hardware connector inserted. It remains inserted during production and transport and is only disconnected when it reaches the dealer and the vehicle is driven.

During transport, all terminal 30TP control units are connected to terminal 30F via the transport connector. Use of the transport connector is displayed in the instrument cluster.

Transport Mode (PIWIS Tester)

The second transport mode is activated using the PIWIS diagnostic tester (PIDT).



Note!

If terminal 30F is switched off in transport mode, terminals G1/G2 and the plug sockets are deactivated simultaneously.

Switching Off Interior Lighting

Switching off the interior lighting helps to avoid the unnecessary energy consumption caused mainly by this when the vehicle is stationary (terminal 15 is switched off) and to switch it off centrally. When terminal 15 is "off" the gateway sends a switch-off signal to the individual control units via the vehicle network.

Switching off comfort lighting in the passenger compartment: Terminal G1

Switching off security lighting in the passenger compartment: Terminal G2

The run-on times of both signals depend on the vehicle status.

- When the vehicle is locked, the gateway sends signals to the load switch-off immediately locking.
- When the vehicle is unlocked, the gateway sends the switch-off signal for terminal G1 after 16 minutes.
- When the vehicle is unlocked, the gateway sends the switch-off signal for terminal G2 after 32 minutes.

Switching Off Plug Sockets – Idle State

Switching off the plug sockets helps to improve a critical system status by reducing load current. In the idle state, the plug sockets are always switched off after a minimum run-on time of 10 minutes plus a run-on time of 60 minutes after terminal 15 is switched off. Switching off of the plug sockets may be necessary before the end of the run-on time if the system status is critical.

If the plug sockets are switched on, the gateway issues a network message requesting that they be switched off if the following conditions have been met:

- The diagnosis session is not active
- No external charging is taking place
- Terminal 15 is off

Measures for Reducing Energy Consumption

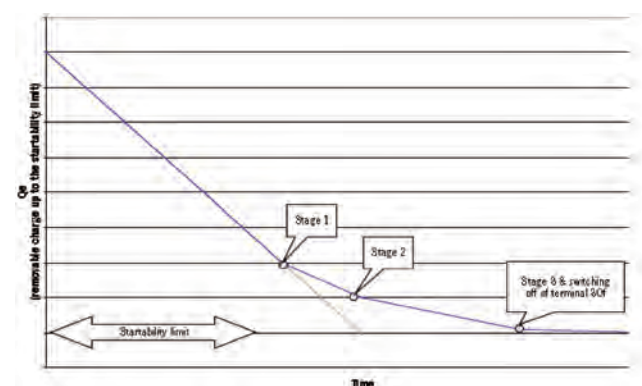
When the battery's voltage limit is reached (vehicle startability still just ensured) stage 3 is sent by the gateway.

Exceptions:

- Terminal 15 on = wake-up
- Front-end/rear-end electrics
- Remote control
- Triggering of alarm system
- Hazard warning lights
- Rotary light switch

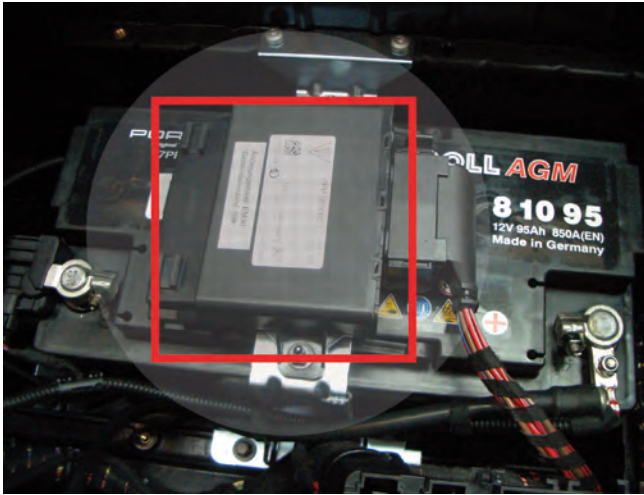
Once stage 3 has been sent by the gateway, wake-up by means of bus nodes is no longer possible. In addition to the wakeup lock, terminal 30F is also deactivated if all switch-off conditions have been met (minimum waiting time, terminal 15 is switched off etc).

Switch Off Stages

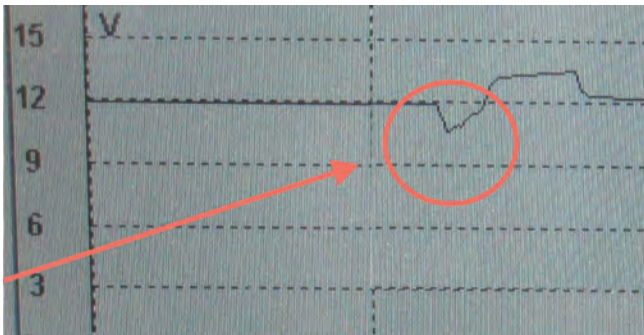


Electrics/Electronics

DC/DC Converter (Start Stop)



The DC/DC converter is only installed in vehicles with Start Stop systems. The DC/DC converter is installed in the luggage compartment, underneath the luggage compartment cover and above the battery.



Situation:

- When the engine is started, the vehicle voltage drops and various components are no longer supplied with the usual 12V voltage. This can result in a system failure.

Solution:

- The DC/DC converter is activated when the engine starts and delivers this missing voltage to the vehicle electrical system.

During Start Stop operation, the Start Stop coordinator (DME) decides to switch off the engine. When the engine is off, the electrical loads are supplied with energy by the vehicle battery reserves. The battery voltage falls many times below the cell open-circuit voltage (2.1V/cell).

When the engine is started, voltage drops occur (when the starter engages and a second voltage drop when the main contacts of the starter are closed and the engine breaks away). Afterwards, the voltage recovers as a function of the starter speed when the starter is switched off and disengages, generator charging then commences and the charging voltage is reached. The size of the voltage drop depends on the temperature of all the relevant components in the current path, internal resistance and the age of the battery as well as the engine resisting torque when it is turned.

Notes:

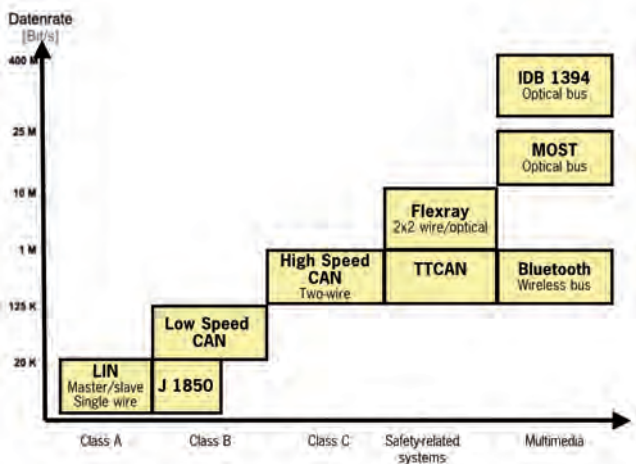
Local Interconnect Network (LIN)

History

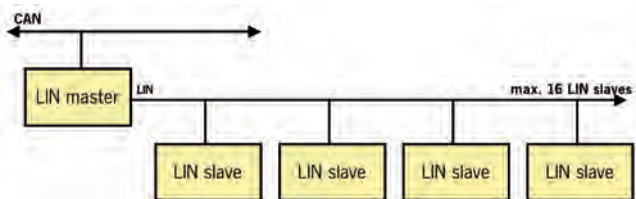
The first version of the LIN standard was adopted by Audi, BMW, Daimler-Benz, Motorola, Volvo and Volkswagen in 1999. Just two years later, the LIN consortium celebrated the first series launch of a LIN bus subsystem (SLK).

Its main characteristics are as follows:

- Simple concept
- LIN applications are always easy to develop and maintain
- LIN is also designated as a subbus (supplement to CAN)
- LIN is based on cost-effective standard components

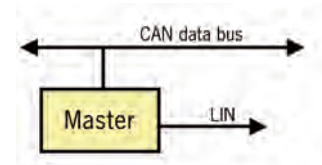


The system facilitates the exchange of data between a LIN master control unit and up to 16 LIN slave control units.



- Single-wire bus
- No shielding required
- Data transfer rate: 19.2 kbit/sec

Tasks



- Monitors the transfer of data and the data transfer speed
- Sends out the message header
- Specifies the cycle, when and how often which message is placed on the LIN data bus
- Performs the translation function/acts as gateway
- The only control unit connected to the CAN data bus in the LIN bus system
- Diagnosis of the LIN slave control units is performed via the LIN master control unit

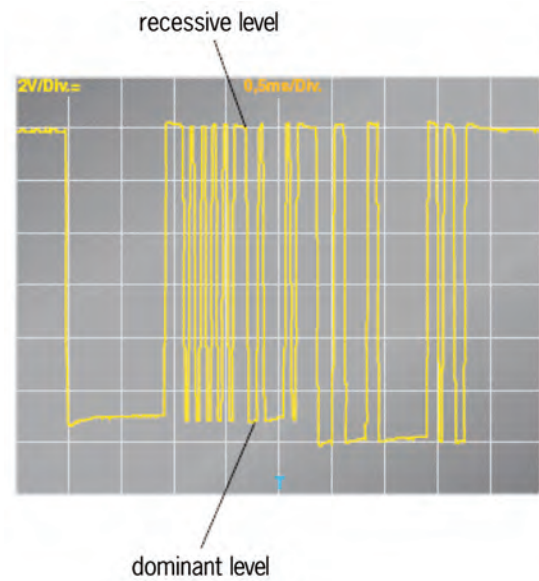
LIN Slave Control Unit

Tasks

- Individual control units, or even sensors and actuators, can be deployed as LIN slave control units within a LIN data bus system. Electronics that evaluate the measured values are integrated into the sensors. The values are then transferred as a digital signal via the LIN bus. Only one pin is required on the LIN master's socket for multiple sensors and actuators.
- The LIN actuators are intelligent electronic or electro-mechanical assemblies, which receive their tasks from the LIN master control unit via the LIN data signal. The LIN master uses the integrated sensors to query the actual status of the actuators and thus perform a required/actual comparison.

Electrics/Electronics

Data Signal



Data transfer:

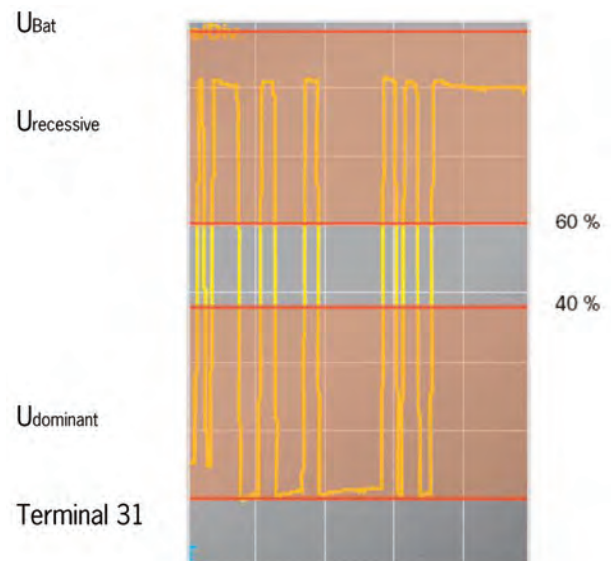
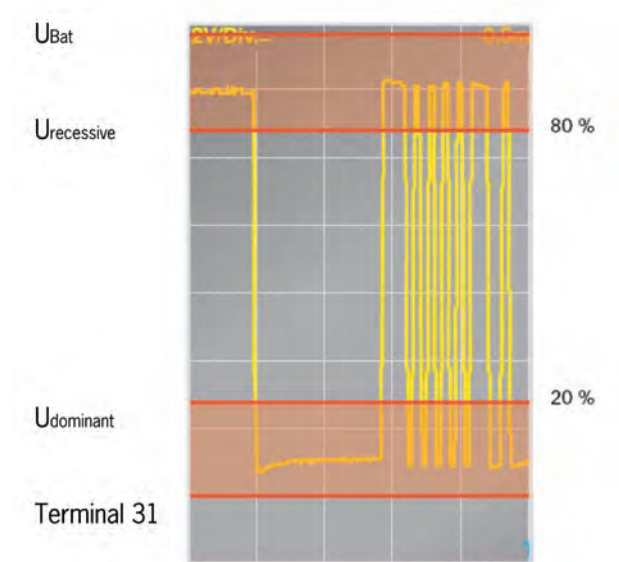
- The sensors and actuators only respond if a header has been sent out by the LIN master control unit. The data transfer rate ranges from 1 to 20 kbit/sec.

Signal:

- Recessive level – If no message or a recessive bit is sent via the LIN data bus, close to battery voltage is present on the data bus line.
Dominant level – To transmit a dominant bit via the LIN data bus, the data bus line is switched to ground by a transceiver in the sender control unit.

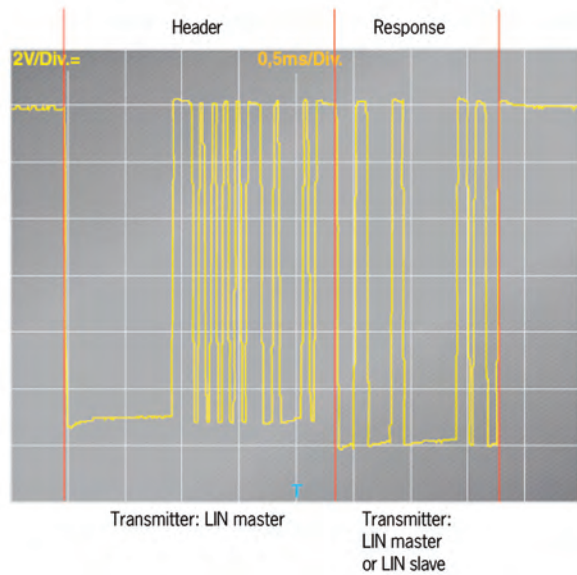
Transmission Reliability

Data transfer stability is ensured by the specification of tolerances during transmission and reception in the recessive and dominant level range.

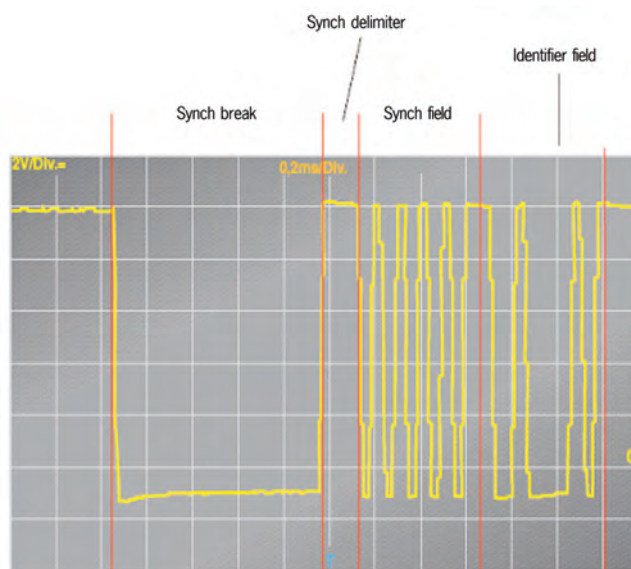


Notes:

LIN Messages



- Message header: Header
- Message content: Response



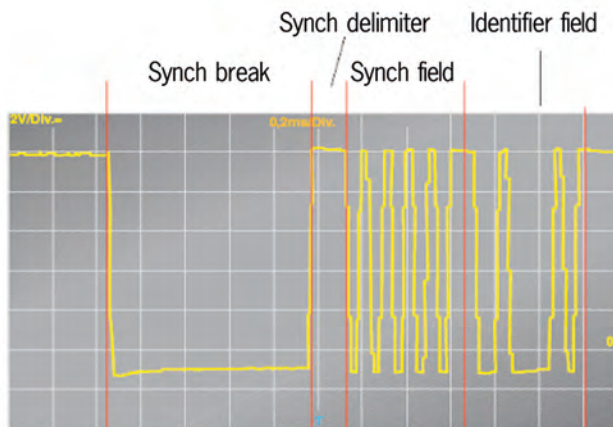
- Message header: Header

The header is sent by the LIN master control unit on a cyclical basis. It can be divided into four sections:

- Synch break
- Synch delimiter
- Synch field
- Identifier field

The synch break is at least 13 bit times in length. It is sent at a dominant level. A length of 13 bits is required in order to communicate the start of a message to all LIN slave control units. A maximum of 9 dominant bits are transferred consecutively in the subsequent message parts. The synch delimiter is at least 1 bit long and recessive ($\approx$ UBat).

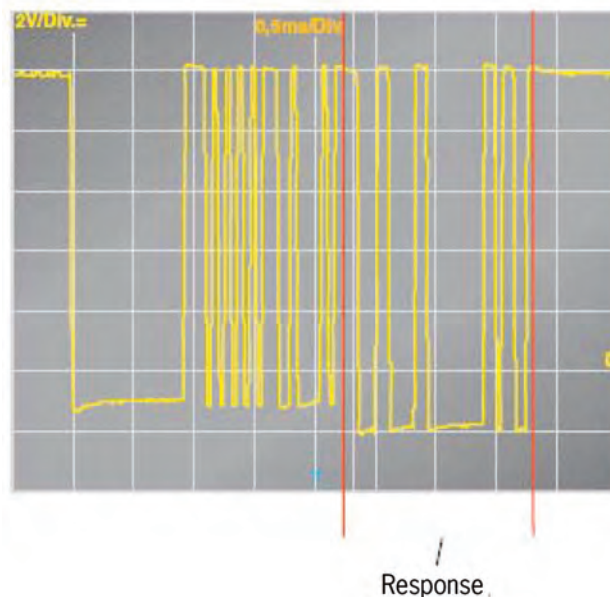
LIN Messages (cont'd)



The sync field consists of the bit sequence 0101010101.

All LIN slave control units can adjust to (synchronize with) the system clock rate of the LIN master control unit via this bit sequence. All control units must be synchronized to ensure a seamless exchange of data. If the synchronization is lost, the bit values would be positioned incorrectly in the message upon reception. This would lead to errors in the data transfer.

The identifier field is 8 bit times in length. The first 6 bits contain the message ID and the number of data fields in the response. The number of data fields in the response can range from 0 to 8. The last 2 bits contain the checksum of the first 6 bits. The checksum is used to detect transfer errors and is necessary to avoid allocation to the wrong message in the event of transfer errors in the identifier.



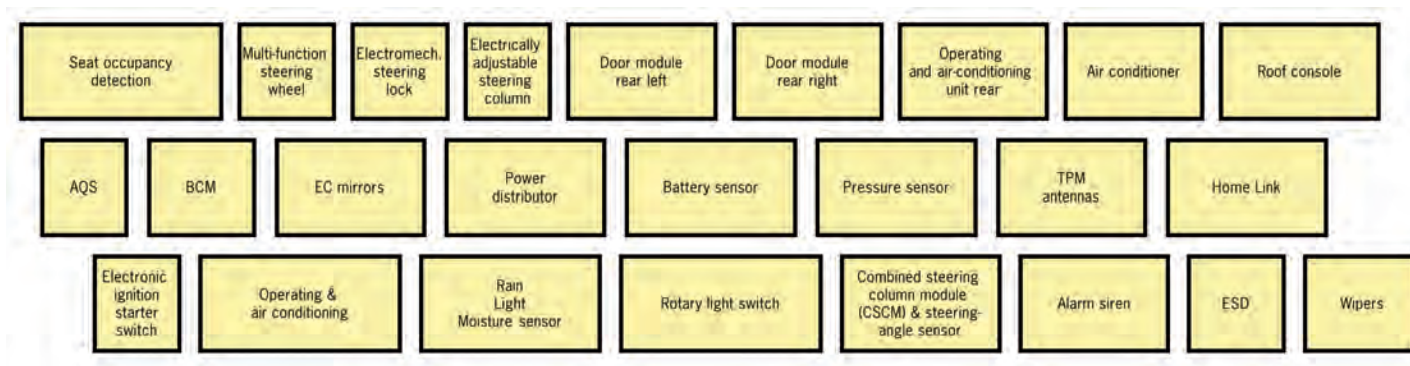
Response message header:

The response consists of 1 to 8 data fields. One data field consists of 10 bits. Each data field comprises a dominant start bit, a data byte (which contains the information) and a recessive stop bit. The start and stop bits are used for synchronization and to avoid transfer errors.

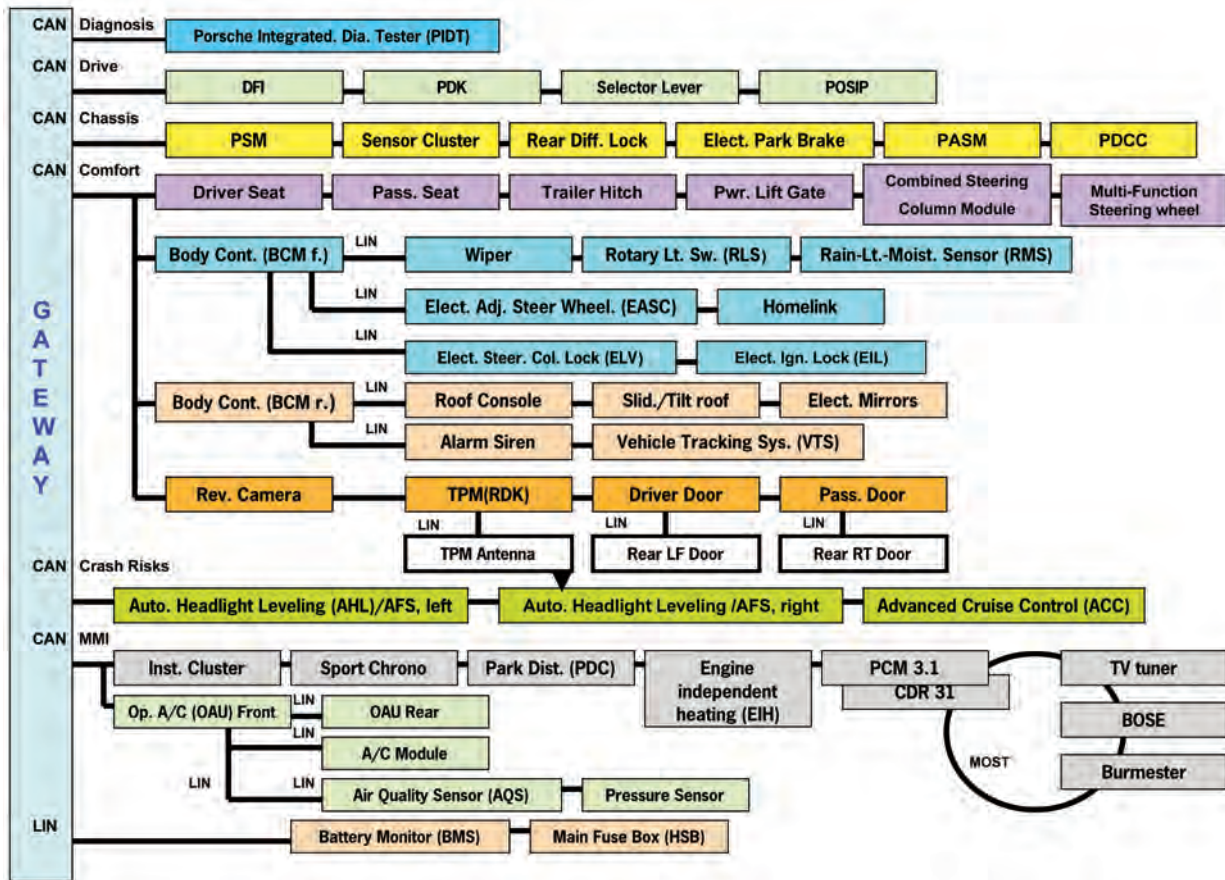
LIN Usage at Porsche

Previous LIN applications: Rain sensor, TPM & Weight sensors

Panamera: Shown in the chart below.



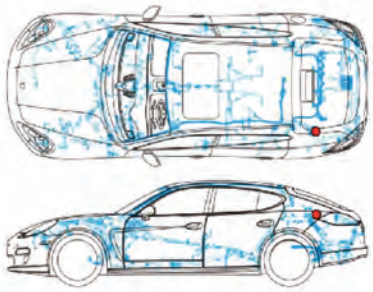
Front-End Electronics



Abbreviation	English	German
ACC	Adaptive Cruise Control	N/A
AFS	Adaptive forward lighting	Automatische Fahrlicht Steuerung
AHK	Trailer Hitch	Anhängerkupplung
ALWR	Self -levelling Headlamp system	Automatische Leuchtweitenregulierung
AQS	Air Quality Sensor	Luftgutesensor
BKE	AC control unit	Bedien Klima Einheit
BMS	Batterie Monitoring Sensor	Batteriesensor
CDR	CD Headunit	CD Radio
DFI	Direct Fuel Injection	Direkt Einspritzer
ELV	Electronic steering locking device	Elektronische Lenksäulen Verriegelung
EPB	Electronic Park Brake	Elektrische Park Bremse
EVLS	Electronic adjustable Steering	Elektronisch Verstellbare Lenksäule
EZS	Electronic Ignition Switch	Elektronisches Zundschoß
HSB	Main Fusebox	Hauptsicherungsbox
KLSM	Steering Column Switch Modul	Kombi Lenkstockmodul
LDS	Rotary Light Switch	Lichtdreheschalter
LIN	Local Interconnect Network	Master/Slave 20 KBit/s
MFL	Multi functional steering wheel	Multi Funktions Lenkrad
MMI	Man Machine Interface	High Speed CAN 500 KBit/s)
MOST	Media Oriented System Transport	Optischer Bus, 20 MBit/s
PDK	Porsche double clutch	Porsche Doppel Kupplung
POSIP	Porsche Supplement Impact Protection	Porsche Erweiterter Insassenschutz
PSM	Porsche Stability Management	Porsche Stabilitätskontrolle
PASM	Porsche Active Suspension Management	Porsche Aktives Fahrwerk
PCM	Porsche Communication Management	Infotainment
PDC	Park Distance Control	Parkassistent
PDCC	Porsche Dynamic Chassis Control	Porsche Dynamische Fahrwerksregelung
RLF	Rain Light Humidity Sensor	Regen Licht Feuchtesensor
RDK	Tire pressure monitoring system (also known as TPM)	Reifen Druck Kontrolle
RFK	Backview camera	Rückfahr Kamera
SAD	Sliding lift Roof	Schiebe Ausstell Dach
STH	Park heating	Stand Heizung
VTS	Vehicle Tracking System	Fahrzeug verfolgungs System
VWE	Front End Electronic (BCM front)	Vorderwagenelektronik

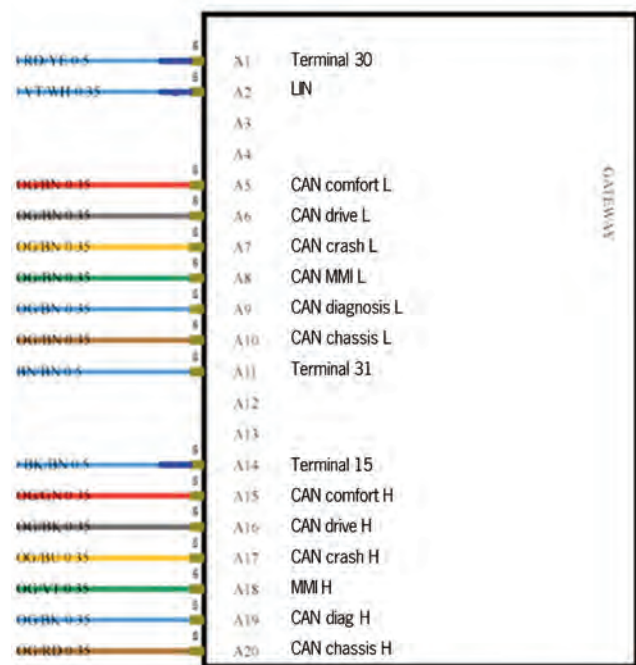
Electrics/Electronics

Gateway – Bus Interfaces



Red dot is location of control unit.

The LIN interfaces are designed as LIN master interfaces. These LIN interfaces are intended for a battery sensor connection and for connecting an intelligent main fuse carrier. Energy management on the gateway can use the battery sensor to call up various battery characteristics, e.g. voltage, battery charging condition, etc and if required switch off the control units in the vehicle electrical system. For this purpose, the gateway sends the relevant switch-off messages, e.g. via the same LIN bus, to the intelligent main power distributor.



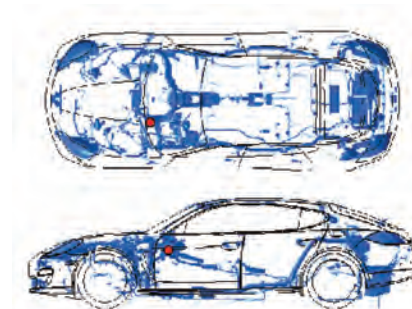
The gateway has the following bus interfaces:

• CAN drive		500 Kbaud
• CAN crash risks		500 Kbaud
• CAN diagnosis	wakeable	500 Kbaud
• CAN chassis	wakeable	500 Kbaud
• CAN comfort	wakeable	500 Kbaud
• CAN MMI	wakeable	500 Kbaud
• 4 x LIN	wakeable	20 Kbaud

Tasks:

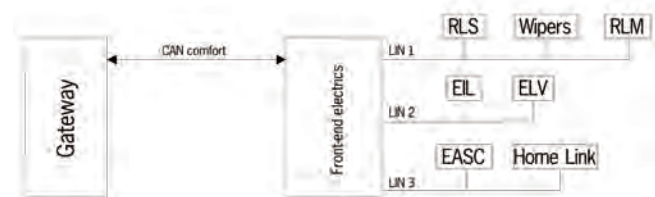
- The gateway control unit facilitates the exchange/translation of data between the various networks and bus technologies (CAN/LIN)
- Vehicle energy management
 - Optimization of battery charging during driving
 - Terminal management, before/after driving the vehicle, (WfS5, ELV)
- System and diagnostic functions (PIDT – PIWIS diagnostic tester)
- Wake-up/power-down function (Vehicle Network State Manager)

Front-End Electronics Control Unit



Red dot is location of control unit.

The front-end electronics control unit is located by instrument panel/steering wheel and is connected directly to CAN comfort. The control unit delivers the supply voltage for the ignition lock and the axle height sensor via output terminals 30.

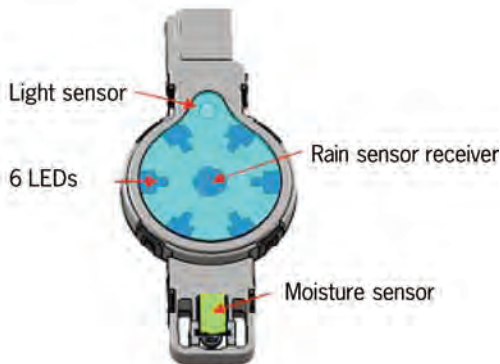


- LIN 1 = Light and vision functions
LIN control units: Rotary light switch (RLS), rain-light-moisture sensor (RLM sensor) and wipers
- LIN 2 = Access systems
LIN control units: Electronic ignition lock (EIL), electronic steering column lock (ELV)
- LIN 3 = Comfort
LIN control units: Electronically adjustable steering column (EASC), garage door opener or Home Link

Exterior Lights

A rotary light switch (RLS), which is connected via a LIN bus system, controls the marker light, dipped beam, high beam and fog lights. In addition, the switch setting “0” is transferred directly to the control unit. (LIN failure)

The driving light assistant (RLS position “1”) can be used to automatically control light functions using the front-end electrics control unit. Light and weather conditions are a factor in this activity. A rain-light-moisture sensor is connected in order to register these.



The rain/light functions have been retained and expanded to include a moisture function, which helps to detect misting on the windshield. The data is made available to air-conditioning control via the data line in order to prevent the window from misting.

Rain sensor function:

This sensor detects quantities of rainfall and issues a wipe request for the windscreen wiper. The sensor is attached to the windscreen near the rearview mirror.

Light sensor function:

The light sensor, which is integrated into the rain sensor, detects the rapid or slow onset of darkness, e.g. a tunnel or dusk, and outputs a signal accordingly to switch on the driving light. If it is bright enough, the relevant signal for switching off the driving light is output.

Functional concept behind the moisture sensor:

The condensation sensor is used to identify how likely the windshield (inside the vehicle) is to become misted. The data is made available to air-conditioning control via the data line. Air-conditioning control can then respond and prevent condensation.

Exterior light function:

- Headlight flasher, flashing via CAN signal (CSCM)
- Hazard warning light operated manually by hazard warning light button, automatic crash signal (flashing)

Ambient Lighting

Active:

When the vehicle is unlocked, when a door is opened, when the ignition key is removed, when the RLM sensor detects darkness or the door contact function is active. Dimmable.

Not active:

When brightness is detected, when the vehicle is locked (dimmed) or when all doors, including the rear lid, are closed and the ignition is off (delayed dimming).

Orientation Lighting

Active:

When it is dark and the ignition is “off”, when the vehicle is unlocked, a door is open or the ignition key is removed.

Not active:

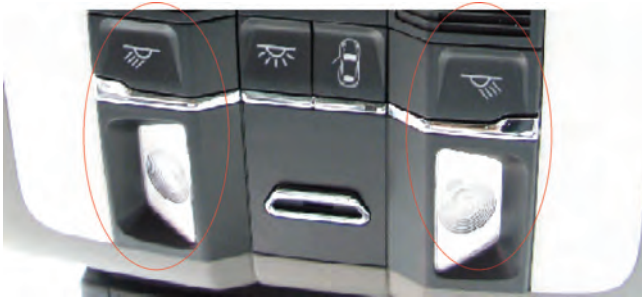
When locking the vehicle (dimmed), when the ignition is “off”.

LIN Exterior Light Signals (inputs)

- Marker light
- Dipped beam, high beam
- Fog light, switch position “0” (RLS)
- Headlight flasher, flashing (CSCM)
- UGDO, Home Link
- ELV, EIL
- RLM sensor
- RLS
- Wipers

The ambient lighting in the rear is integrated into the center rear interior light and performs the same function as the ambient lighting in the roof console (slave function). As the rear interior light is connected to the roof console, the function is also performed by the roof console.

Reading Lights



Activation:

These lights are activated by controls, dimmed when a door is opened, when the vehicle is unlocked by remote control or when the ignition key is removed, light is not switched off manually and door contact function is active. Manually dimmed when the reading light button is pressed.

Deactivation:

These lights are deactivated using controls, dimmed when locking the vehicle or when the ignition is switched on, provided that the doors are closed and the lights have not been switched on manually in an unlocked vehicle. Automatic, undimmed, when load switch-off is active. Delay dimmed once all doors have been closed and provided the engine is "off". Reading lights are switched off at the same time as the interior light. Manually dimmed when switching the reading lights are "off".

Load Switch-Off

Comfort Lighting:

All lights that do not perform a safety-related function. The sole purpose of this type of lighting is to guarantee the comfort of occupants and ensure that they can get their bearings. Comfort lighting includes: reading lights, interior light or make-up lights, footwell lighting, ambient lighting, interior light, engine compartment light, luggage compartment light.

Safety lighting:

Safety lighting includes all lighting components that are responsible for the safety of the vehicle or the occupants, e.g. brake lights or hazard warning lights, door-guard lights and exit lights.

Switch-off is performed in three stages via battery management (gateway):

a) Vehicle is not locked:

Comfort lighting - Gateway terminal G1 after 16 minutes

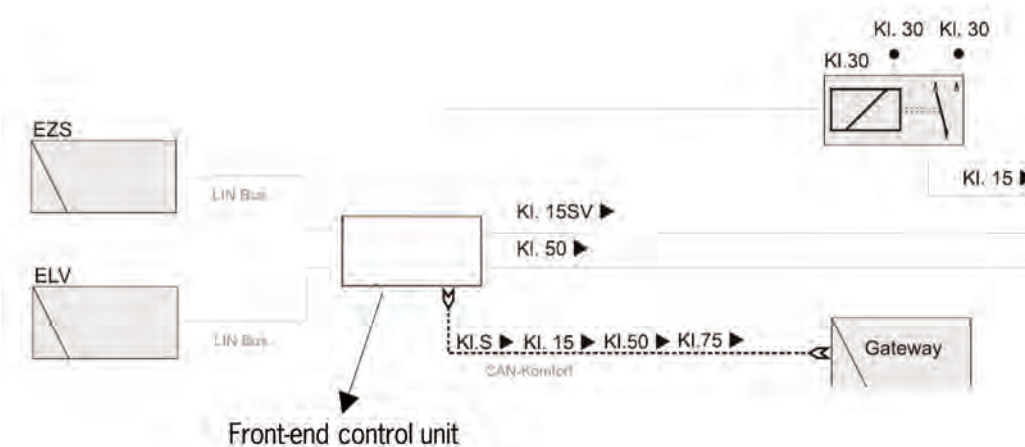
Safety lighting - Gateway terminal G2 after 32 minutes

b) Vehicle is locked: Immediately after locking

c) Transport mode

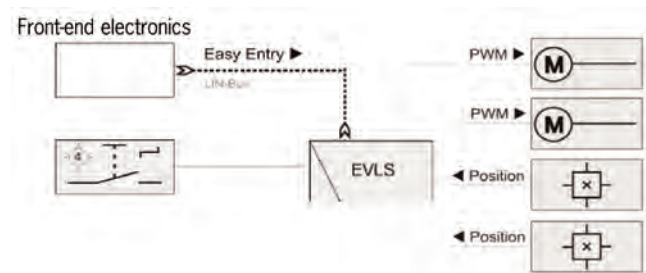
Terminal Management

The front-end electronics are responsible for terminal management. The relays for terminals 15, 30 and 50 are therefore connected to the control unit. When the ignition is on, one relay switches voltage to terminal 15. When a start command is issued, one relay switches terminal 50 and the engine starts.



Electrics/Electronics

Control Systems



- Activation of the cooling-air flaps/DFI (speed/temperature, CAN signal)
- Activation of flaps for brake cooling
- Activation of Servotronic (power steering)
- Steering column adjustment (EASC) is activated via a LIN bus system and facilitates the adjustment by means of buttons. A variety of steering column position settings can be saved, called up using a memory function and automatically adjusted.
- The central locking system controls locking and unlocking of the filler flap. An actuating element is connected to the front-end electrics control unit for this purpose.

Wiper and Washer Functions



The wiper and washer functions are controlled via a steering column switch. This is connected to the control unit via the CAN bus. If no signals are received from the CSCM on the CAN bus, a limp-home mode is activated via the rain sensor. The washer fluid level is monitored by a sensor and the driver is notified if the level is too low.

The headlight washer system (HWS) can be started in two different ways:

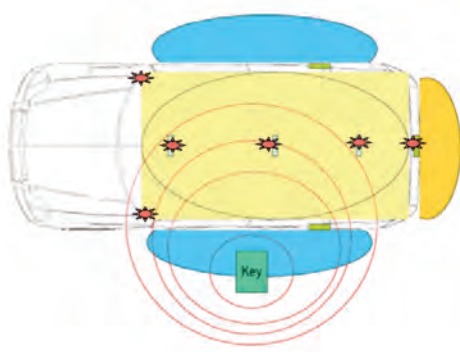
by tapping the HWS button or, automatically, after every tenth activation of the headlight washing function.

Access and Driving Authorization

Access to the vehicle is gained via the mechanical closing function, remote control and Keyless Entry. For keyless operation, a valid key must be detected within one meter of the vehicle. Six antennas are provided for this purpose. They are distributed at various positions on the vehicle and connected to the control unit. The vehicle is unlocked as soon as the proximity sensors detect that someone with a valid key is approaching a door handle. The signals from the remote control are received by a UHF antenna and relayed to the front-end control unit.



Entry & Drive Access Function



- Access to the vehicle is gained via Keyless Entry, remote control and the mechanical closing function.
- For keyless operation, a valid key must be detected within one meter of the vehicle (six antennas). The vehicle is unlocked as soon as the proximity sensors detect that someone with a valid key is approaching a door handle.
- The signals from the remote control are received by a UHF antenna.
- Unauthorized use of the vehicle is prevented by the electromechanical steering lock (ELV) and a key transponder (Online Engine Immobilizer – Generation 5). Detection of a valid key initiates communication between the engine immobilizer and the engine control unit and the engine can be started.

As part of the brand's increasingly advanced user-friendliness, the Porsche Entry & Drive functions have been implemented in the Panamera, as previously in the Cayenne (E1). Porsche Entry & Drive allows the vehicle to be used without having to actively handle the key. The user only needs to have the key with them to open/close the vehicle or to start the engine. To illustrate this functionality, the ID transmitter function has been added to the remote control electronics (vehicle key). The set of functions now available with this feature enables the secure exchange of data between the vehicle and the key when the user wishes to gain keyless access to the vehicle or wishes to start the vehicle.

The familiar key functions – remote control, central locking and operation via the ignition lock as back-up – are also retained. On the vehicle side, the intelligence necessary to perform the various functions is integrated into the front-end electrics control unit at the front. Proximity sensors have been integrated into the four outer door handles and in the area around the external antennas on the door sills to facilitate keyless access (Porsche Entry).

The system detects the user's intention to access the vehicle by means of these proximity sensors and initiates a coded request via the external antennas. Located on the side on which the intention to access has been detected, an authorised key receives the request and returns an appropriate, encoded response to the control unit in the vehicle. Following positive authentication of the key, the central locking system is released in accordance with the selected setting. The communication interface between the vehicle and the key is limited to approx. 1.5 m. The key can receive the signal from the external antennas within this range.

When leaving the vehicle, the procedure is identical to that for accessing it. After closing the doors, the user only needs to press one of the locking buttons in the outer door handles to initiate the request to the externally located key. If this request is correctly answered by the key, the vehicle is locked. It is also possible to open the rear of the vehicle without actively using the key. The key must simply be located externally, within a range of approx. 1.5 m from the rear of the vehicle.

To start the opening process, the user must press the rear button. As when approaching a door, pressing this button sends a request to the key via the antenna integrated in the rear. Following authentication of the key, the relevant part of the tailgate is released and can be opened. To start the vehicle, the key just needs to be inside it. If the operating element in the ignition lock is actuated, the system initiates a request to the key. If the key is inside the vehicle, it detects the request and returns an appropriate, encoded response. Based on this response, the steering column lock is released electromechanically, the ignition is activated and once the engine immobilizer has been authenticated, the engine is started via the engine control. The engine is switched off by moving the operating element into the off position.

Electrics/Electronics

Access and Drivng Authorization

Since the ELV is a safety-related component, electric activation is ensured by two independent control units. The first channel controls the supply voltage for the logic and the internal sensors of the ELV. The front-end electronics and ELV communicate by means of the LIN bus. In addition to activation, the LIN interface is also responsible for the complete diagnosis of the ELV.

The supply voltage for the drive link is switched via the second channel. The front-end electrics control unit also receives the unlocking status via a microswitch/sensor for activating the drive link. The ELV is an embedded logic component control unit and, in addition to its electrical aspects, also has a mechanical interface with the steering column.

Unintentional, faulty locking of the ELV and consequently blocking of the steering is ruled out in all cases. On request, a status for blocking or releasing the steering is adopted by the ELV, i.e. after a particular action, the ELV must always have either an “unlocked” or “locked” status. An electric drive link actuates the locking mechanism, which engages in the steering column.

Unauthorized use of the vehicle is prevented by the electromechanical steering lock (ELV) and a key transponder that detects an invalid key in the ignition lock (in the case of Keyless Entry in the passenger compartment). Detection of a valid key initiates communication between the engine immobiliser and the engine control unit and the engine can be started.

Locked:

Key operation: Removing the key from the ignition lock

Keyless operation: Locking the vehicle or deliberate locking, i.e. after switching off terminal 15 by actuating the control panel again in the “Lock ELV” position for $t > 2$ seconds

Unlocked:

Key operation – By unlocking the central locking system and then opening the driver's door or by inserting a valid key in the electronic ignition lock.

Keyless operation – Unlock the central locking system and open the driver's door or initiate a trigger event for the passenger compartment query (activate ignition or start), valid ID transmitter is detected in the vehicle passenger compartment.

Anti-Theft Protection



A passenger compartment sensor and an inclination sensor help to safeguard against theft. The interior surveillance system, including the associated sensors (transmitter and receiver), are located in the rear section of the roof console. Their status is queried via the LIN.

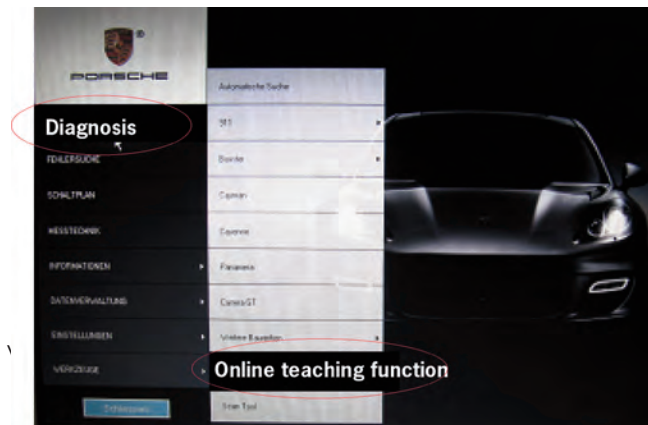
As a sub-function of the alarm system, the vehicle's passenger compartment is monitored for movement when the alarm system is active. Ultrasonic technology in the roof module is used for monitoring the passenger compartment. The ultrasonic sensors sense via two suitable openings (fleece) into the interior of the vehicle.

The interior surveillance and inclination sensor, if required, are activated and deactivated by the alarm system control unit (BC control unit) via a LIN bus, which is also used to transmit the status and diagnostic functions.

Online Engine Immobilizer – Generation 5 (WFS5)



With the launch of the Panamera, Porsche AG is introducing the Online Engine Immobilizer – Generation 5. The engine immobilizer may need to be serviced because of newly installed control units or in order to teach new vehicle keys. Preconditions for this are: PIDT, VCI module, online access and PPN registration (ATP = Anti-Theft Protection).



The learning process can be broken down into four steps:

- 1) Start the Immobilizer – Generation 5 teaching application (PIDT/Main menu/Diagnose/Online Teaching Function)
- 2) Switch on ignition
- 3) Teach control units
- 4) Teach key

1) Starting the Immobilizer – Generation 5 teaching application

The system first checks whether all the required control units are installed. If a control unit is not present, teaching for that control unit is not possible. The learning process must be repeated after the control unit has been installed. The learning process is terminated if the front-end electronics or ELV are not present. Otherwise, the chassis number of the vehicle is read from the control units and the user can then accept or change it. In order to continue with the learning process, the user must authenticate himself in the PPN.

2) Switching on ignition

A further condition for successful learning is that the vehicle ignition is switched on. This can be done

a) manually or b) via the diagnostics:

- a) If an intact control unit network is present and a key has already been taught, the ignition can be switched on using this key during the learning process.
- b) If all control units are present, but are not connected to form an intact control unit network or if no taught key exists for an intact network, the components (control units and keys) are checked for authenticity and, if they pass, the ignition is then switched on via the diagnostics.
- c) If the control units or keys do not match the vehicle or if their ID is unknown or reported as stolen, the learning process is aborted. (Cancellation of the learning process due to an invalid identification is still possible in step 3.)

3) Teaching control units

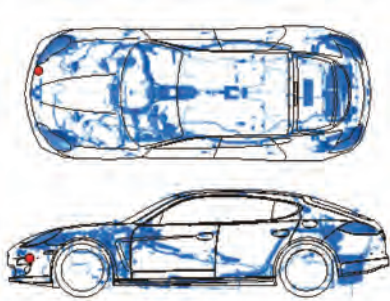
During the learning process, the tester reads out the required control unit data and forwards it via the PPN. Once this data has been checked in the engine immobilizer database, the activation data is supplied to the tester. This writes the data to be taught to the control units.

4) Teaching the keys

In the last section of the learning process, the user enters the number of keys to be taught for the particular vehicle (entry range permitted: 1 to 8). You are then requested to insert all the keys into the ignition lock, one after the other, so that the system can read the key IDs. A key with an ID not assigned to the vehicle is not taught. After the key insertion process, the user can see in an evaluation report whether all keys have been successfully taught.

Electrics/Electronics

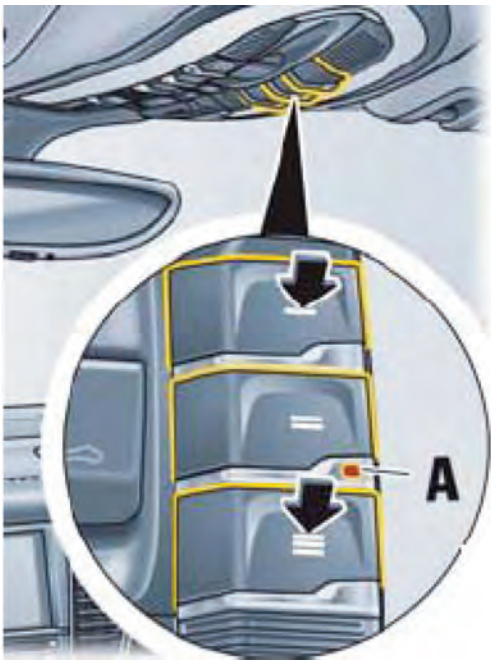
Home Link



Red dot is location of control unit.

The Panamera features a Home Link system that actuates the garage door drive, gate to property, alarm system or door locking. The programmed function is activated by pressing the relevant button in the keypad of the roof console. The garage door opener used in North America assigned frequency range 288 MHz - 418 MHz.

Deleting Programmed Signals From The Buttons



This process deletes the standard factory-set codes. Do not repeat this process if you want to assign additional signals to the buttons. Keep the two outer buttons (arrows in above illustration) on the overhead operating console pressed down for approx. 20 seconds until indicator light A on the button begins to flash quickly.

To delete the programmed signals and save garage door opener signals, the ignition must be switched on and the direction indicators switched off. When using the garage door opener, the vehicle must be in range of the receiver.

Assigning Home Link to Button With Fixed Code System

- 1) The standard factory-set codes must be deleted before programming for the first time.
- 2) Keep the required button pressed down in the keypad on the overhead operating console until indicator light A on the button begins to flash slowly. The button is now ready to learn for five minutes.



- 3) Hold the original hand-held transmitter approx. 30 cm from the marked position and keep the send button pressed down until the vehicle's direction indicator lights light up three time or indicator light A flashes quickly. Three flashes of the direction indicator lights and the rapidly flashing indicator light A confirm that the new signal has been programmed successfully. A number of attempts may be necessary at different distances between the vehicle and the original hand-held transmitter.
- 4) Once the five-minute learning period has expired, the direction indicator lights flash once. Repeat steps 2 and 3.
- 5) Repeat steps 2 to 4 to assign signals to the other buttons.

Assigning Home Link to Button With Variable Code System

- 1) The standard factory-set codes must be deleted before programming for the first time.
- 2) Keep the required button pressed down in the keypad on the overhead operating console until indicator light A on the button begins to flash slowly. The button is now ready to learn for five minutes.



- 3) Hold the original hand-held transmitter approx. 30 cm in front of the bumper and keep the send button pressed down until the vehicle's direction indicator lights light up three time or indicator light A flashes quickly. Three flashes of the direction indicator lights and the rapidly flashing indicator light A confirm that the new signal has been programmed successfully. A number of attempts may be necessary at different distances between the vehicle and the original hand-held transmitter.
- 4) To synchronize the system:
Press the programming button on the receiver for the garage door opener. Afterwards, you usually have approx. 30 seconds to initiate step 5.
- 5) Press the button in the keypad of the overhead operating console selected in step 2 (with some devices, you need to press the button in the keypad several times in order to complete the setting process).
- 6) Repeat steps 2 to 5 to assign signals to the other buttons.

To Reprogram a Single Button

- 1) Keep the button to be programmed in the keypad of the overhead operating console pressed down (approx. 20 seconds) until indicator light A on the button flashes slowly. The button is now ready to learn for five minutes.



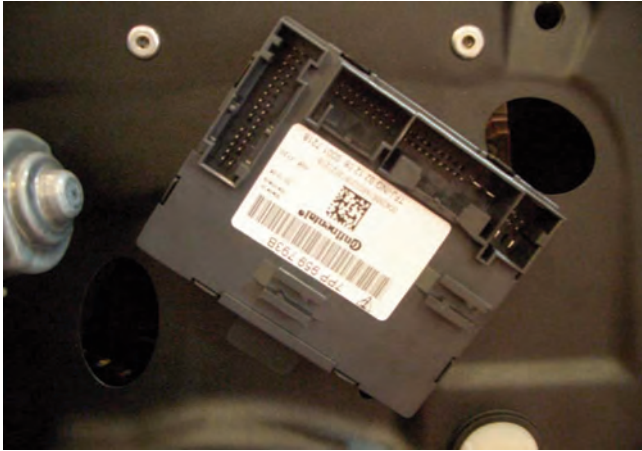
- 2) Hold the original hand-held transmitter approx. 30 cm from the marked position and keep the send button pressed down until the vehicle's direction indicator lights light up three time or indicator light A flashes quickly. Three flashes of the direction indicator lights and the rapidly flashing indicator light A confirm that the new signal has been programmed successfully. A number of attempts may be necessary at different distances between the vehicle and the original hand-held transmitter.

Notes:

Electrics/Electronics

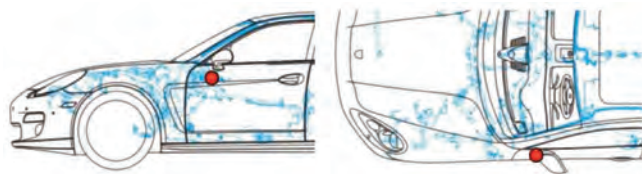
Door Control Units

Front Door Control Unit



The door control units are responsible for activating and evaluating the actuators and sensors in the following components:

- Power windows
- Electric mirrors
- Central locking system
- Door lights
- Control switch



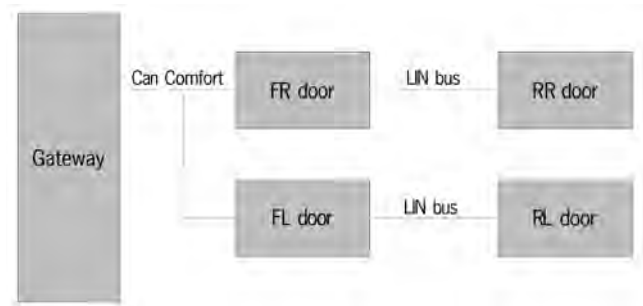
Red dot is location of control unit.



Note!

If the door is not opened for more than 7 days, the door control unit shuts down and is activated again when the microswitch in the door is actuated for the first time via a wake-up signal. In this case, the door can only be opened when the microswitch is actuated a second time.

Door Control Units Bus System



The door control units are connected to the vehicle electrical system voltage via terminal 30. Terminal 31 represents the connection to vehicle ground. The front door control units communicate with the other control units via CAN Comfort and with the rear door control units via the LIN bus.

Power Windows



Driver's Side

Passenger's Side

The power window switches are designed as voltage-coded dual press and pull switches. The driver's door module reads in one switch for each individual window and transmits the information for the front passenger's door and the rear doors via CAN to the relevant door control units. The other door control units read in the switch for their respective windows locally.

When the power window buttons are actuated in order to open and close the electric side roller blinds, the signal is evaluated by the door control units and the roller blinds are opened and closed accordingly.

Electric Mirrors



The mirrors on the driver's and passenger's side are set using a rocker switch. This allows continuous adjustment of the mirrors in a positive and negative direction around both axes. The adjustment function remains active for as long as the rocker switch is pressed in the relevant direction. The mirror to be adjusted, the folding function or mirror heating can be selected by actuating the rocker switch.

When "Passenger's side" is selected, the function for lowering the passenger's side mirror is activated when reverse gear is engaged (only with memory).

Electrochromic Mirrors (EC)

The interior mirror determines the dimming value. The EC mirror connecting lines are looped through the door control unit. The door control unit activates the EC mirrors. Information about EC mirrors is supplied to the door control unit via CAN. The door courtesy lights are activated by the front-end control unit via CAN. The lights come on when the LDS "Auto" function is active. In this case, the headlights come on when the driving light is switched off after or when the vehicle is unlocked. The lights are switched off after a preset off-delay time.

Central Locking System

The vehicle is locked or unlocked using the switch shown here in the center console and rear console.



Center Console Switch



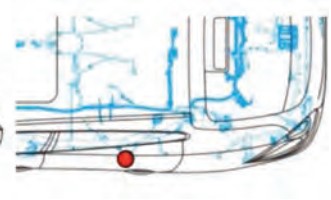
Rear Switch

If the radio link is disrupted or if the battery is flat, the vehicle can be locked or unlocked using a mechanical emergency lock cylinder in the driver's door.

Rear Door Control Unit



A close-up photograph of a control panel with several buttons. A red circle highlights a button in the top right corner that features a white icon of a person sitting in a chair, representing a 'person' or 'user' function.



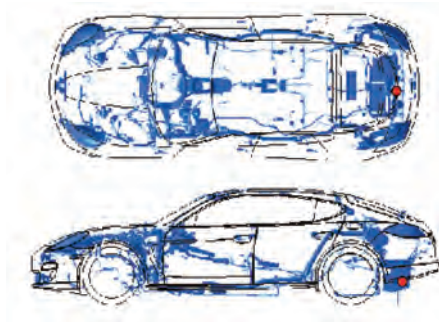
Red dot is location of control unit.

Notes:

[illegible]

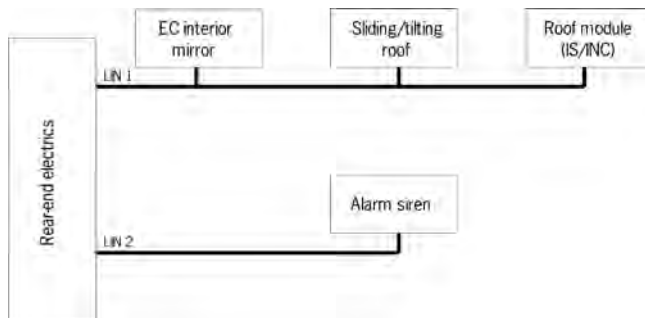
Rear-End Electronics

Rear-End Electronics Control Unit



Red dot is location of control unit.

The rear-end electronics are connected directly to CAN comfort.



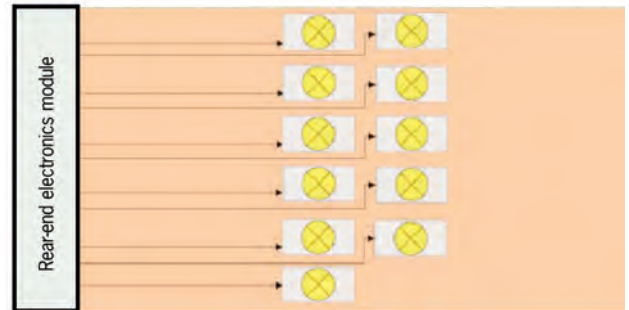
Two LIN connections are available to activate a variety of peripheral devices; these connections are divided according to area:

LIN 1 covers = EC interior mirror, sliding roof and roof module with interior surveillance (IS) and inclination sensor (INC).

LIN 2 connects the alarm siren to the control unit.

Rear Exterior Lights

The rear left and right brake lights and the third brake light are controlled by a hard-wired signal from the PSM control unit. The back-up lights are activated by a selector lever CAN signal in PDK transmission.



The tail lights, rear fog lights and license lighting are also connected to the rear-end electronics control unit.

i Notes!

The brake lights are activated in the following cases:

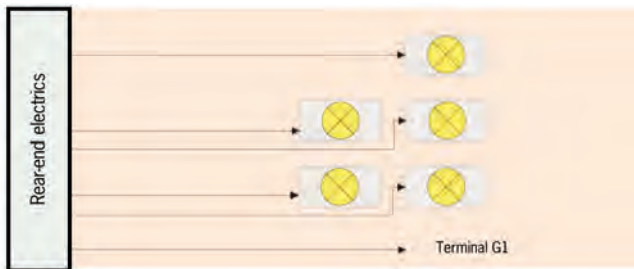
1. Driver brakes manually using the brake pedal
2. ACC brakes automatically
3. Emergency braking is triggered via the electric parking brake.

The emergency brake signal may be triggered at speeds above 43 mph (70 km/h) in the event of sharp deceleration or an ABS intervention.

Electrics/Electronics

Interior Lighting

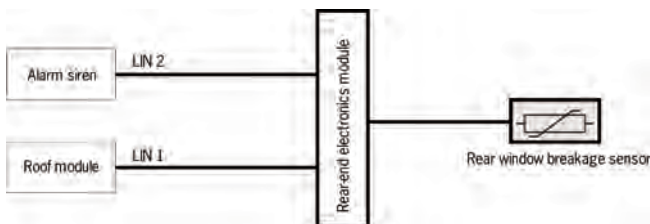
An orientation light is available in the passenger compartment for the center storage compartment. This light is dimmable so that it can be adjusted to the relevant lighting conditions. Safety and exit lighting at the tailgate illuminate the ground around the tailgate and provide better visibility at the rear of the vehicle when the rear hatch is open and it is dark. The luggage compartment lighting illuminates the interior of the luggage compartment when the rear lid is open.



Terminal G1 (comfort lighting, switches off after 16 minutes).

Access and Driving Authorization/Alarm System

The alarm siren is connected via LIN 2 and triggers an alarm if the rear-end electronics detect an attempted theft. The alarm siren is equipment-specific and must be coded in the rear-end electronics.



The roof module is connected via LIN 1. Inclination sensors (INC) and an interior surveillance feature (IS) are integrated in the roof module. If required, these can be deactivated by pressing a button. If the vehicle is locked and an alarm event is detected by the interior surveillance system or the inclination sensors, the roof console sends a signal to the alarm system. A breakage sensor in the rear window detects a broken window and alerts the alarm system.

Rear Spoiler (2-way/4-way)



The rear spoiler improves driving stability at high speeds and reduces fuel consumption at low speeds.



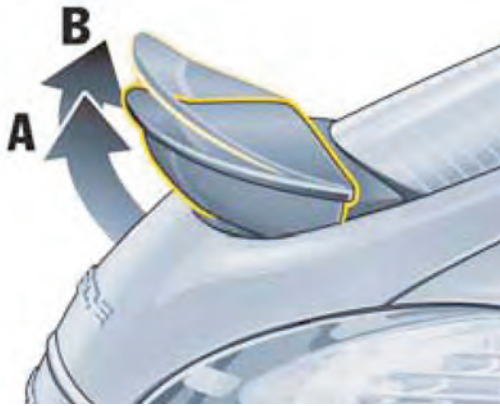
Panamera/4/S/4S Extended



Panamera Turbo Extended

Vehicles with a turbo engine have an extended rear spoiler whose aerodynamically effective surface is increased by means of additional wings (flaps).

Spoiler Settings – Automatic Mode



The spoiler setting depends on a number of conditions. The rear spoiler extends automatically:

- to position A at 56 mph (90 km/h)
- to position B at 127 mph (205 km/h)

The rear spoiler retracts automatically:

- from position B to position A at 112 mph (180 km/h)
- from position A to the end position at 37 mph (60 km/h)

In vehicles without turbo engine, the rear spoiler also moves to an intermediate position when extending between 99 mph and 127 mph (160 km/h and 205 km/h) or when retracting between 112 mph and 90 mph (180 km/h and 145 km/h). This intermediate position is located between A and B.

Spoiler Settings – “Sports Plus” Mode

The rear spoiler extends directly to position B at approx. 56 mph (90 km/h). The rear spoiler retracts from position B directly to the end position at 37 mph (60 km/h).

In the event of malfunctions  lights up in the instrument cluster.

Additional Information

Control units involved:

Master: Rear-end electronics

Slave: Front-end electronics, gateway

Level 2: PSM

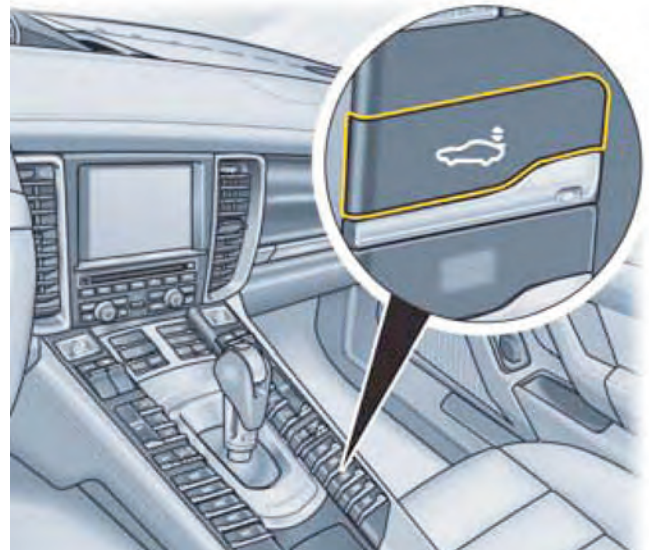
Bus systems involved:

CAN comfort: Rear-end electronics, front OAU (operating and air-conditioning unit), gateway

CAN chassis: Gateway, PSM

Spoiler Settings – Manual Mode

When the ignition is switched on, the rear spoiler can be extended and retracted manually using the button in the center console. If the rear spoiler is in manual mode, the indicator on the button lights up.



Extending spoiler manually:

Press button briefly, the rear spoiler extends to position A. The indicator light in the button comes on, the rear spoiler is in manual mode.

Retracting the spoiler manually:

When the vehicle is stationary, keep the button pressed down until the rear spoiler has reached its end position. The indicator light in the button goes off, the rear spoiler is in automatic mode. At speeds up to approx. 56 mph (90 km/h), press the button, the rear spoiler retracts. The indicator light in the button goes off, the rear spoiler is in automatic mode. At speeds above approx. 56 mph (90 km/h), press the button, the rear spoiler remains extended, the indicator light in the button goes off. The rear spoiler is in automatic mode.

Deactivated “Sport Plus” mode:

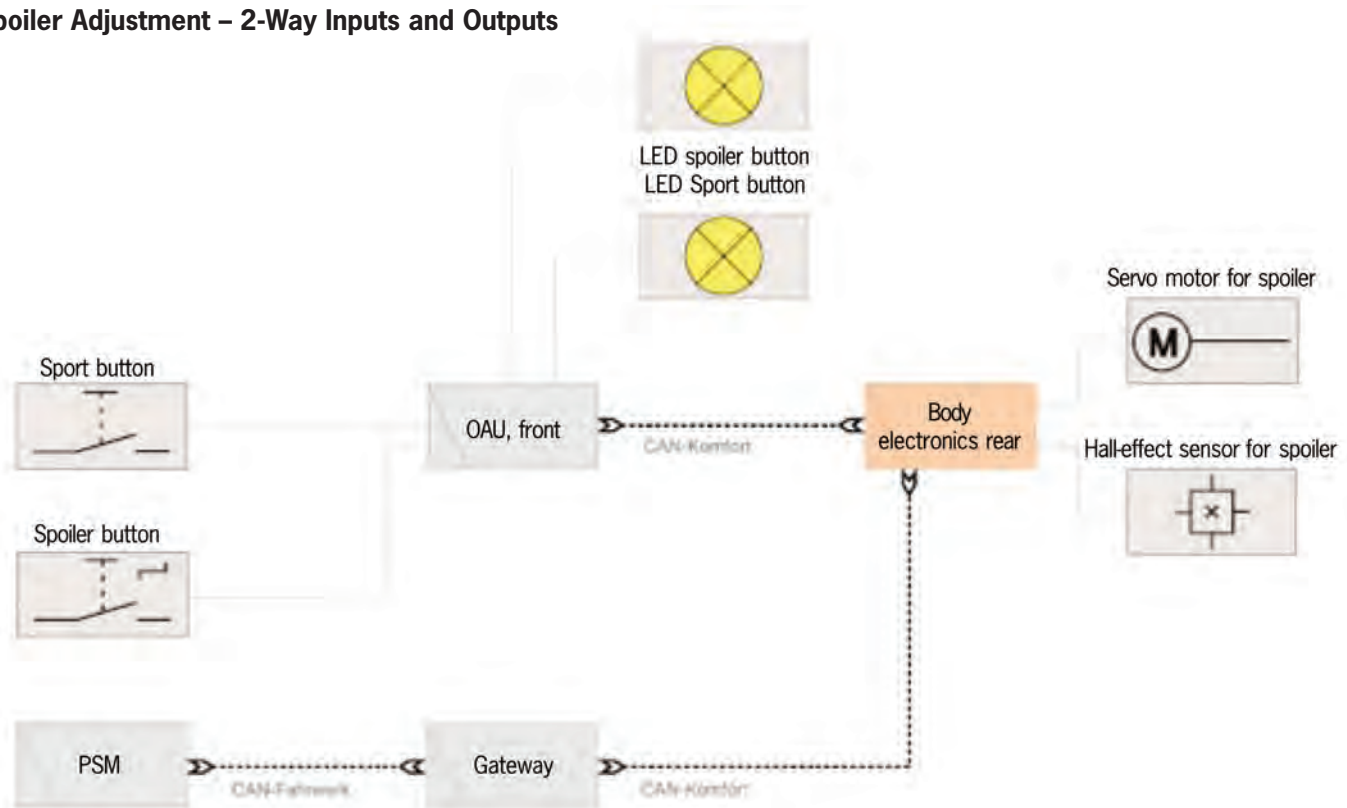
- The rear spoiler extends automatically from position A to position B at approx. 127 mph (205 km/h)
- The rear spoiler retracts automatically from position B to position A at approx. 112 mph (180 km/h).

Activated “Sport Plus” mode:

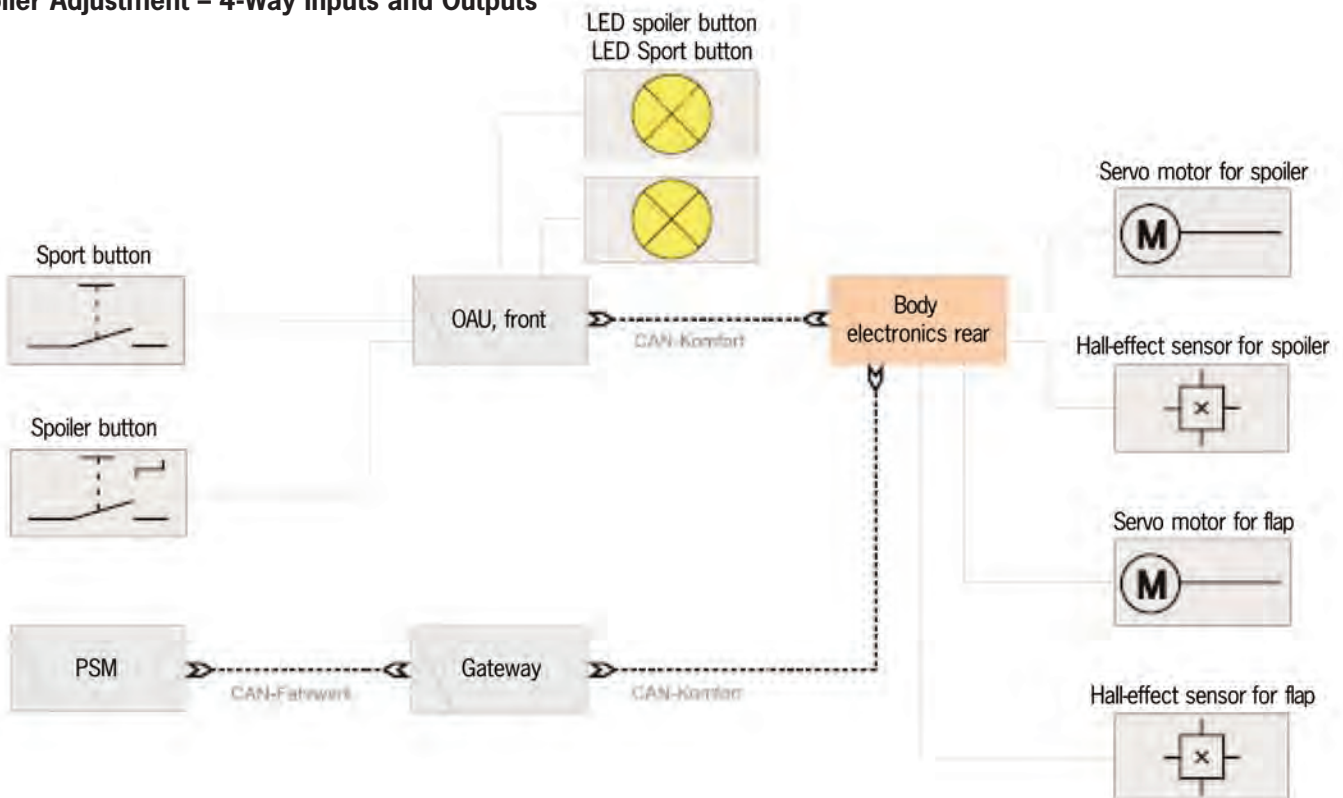
The rear spoiler extends automatically from position A to position B at approx. 56 mph (90 km/h). The rear spoiler retracts automatically from position B to position A at approx. 37 mph (60 km/h).

Electrics/Electronics

Spoiler Adjustment – 2-Way Inputs and Outputs



Spoiler Adjustment – 4-Way Inputs and Outputs



Control Systems – Roll-up Sunblind on Side Window

The roll-up sunblinds on the rear side windows can be raised or lowered only when the rear side windows are closed. If child protection is activated, the roll-up sunblinds on the rear side windows can only be operated using the roll-up sunblind button in the front center console or the power window buttons in the driver's door.

Control Systems – Roll-up Sunblind on Rear Window

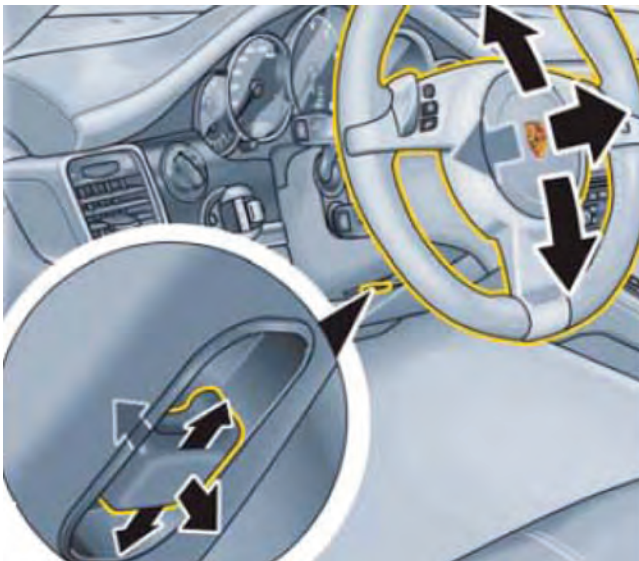
When the ignition is switched on, the roll-up sunblind can be raised or lowered in the luggage compartment cover. Push roll-up sunblind button forward or back. The indicator light in the button comes on. The roll-up sunblind is raised or lowered. The roll-up blind on the rear window is lowered automatically when reverse gear is engaged. If the roll-up sunblind is extended and reverse gear is engaged, the blind is lowered automatically. The roll-up sunblind is raised when the vehicle drives forward again.

Prerequisites:

- The ignition must be switched on.
- The function must be activated on the multi-function display.

Control Systems – Exhaust flap control (DFI)

Control Systems – Electronic Adjustable Steering



A signal (to lock or unlock) is sent to the ELV via a hard-wired line.

Control Systems – EC Mirrors

The LIN control unit for EC mirrors uses sensors to measure the glare caused by vehicles coming behind and darkens the interior mirror accordingly. This darkening value is also transmitted to the exterior mirrors via the bus system. The function can be manually controlled using a button.

Control Systems – Sliding Roof



Sliding roof (LIN 1) is ready for operation when:

- The ignition is switched on.
- After the ignition is switched off and before the driver's or passenger's door is first opened, but for a maximum of 10 minutes.

Control Systems – DFI Engine wake-up

The DFI engine wake-up terminal is connected directly to the engine control unit and is used to wake up the engine control unit when the engine-independent heating is operational.

Notes:

[illegible]

Electrics/Electronics

Heated Rear Window

The rear-end electronics receive a CAN message via the gateway, stating that the heated rear window should be switched on or off. The rear-end electronics also control the relay for the heated rear window.



Coolant Level

The coolant level sensor specifies the current value to the rear-end electronics. From there, the information is forwarded as a CAN message via the gateway to the instrument cluster and the lamp in the instrument cluster.



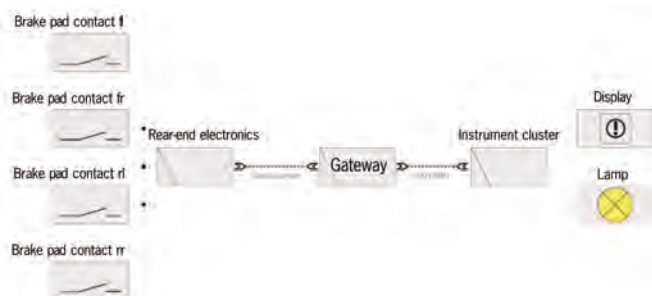
Wiper and Washer Functions

The rear wiper electronics are hard-wired and connected via a connector. The rear wiper can be activated using the wiper stalk in the instrument cluster. The rear-end electrics control unit then receives a CAN message. The rear wiper only wipes if terminal 15 and terminal X are on.



Brake Pad Wear

Sensors for monitoring brake pad wear are attached to all four brakes. This signal is communicated to the rear-end electronics and sent as a CAN message to the instrument cluster.



Wheel Speed Signals

The wheel speed signals (PWM) are acquired directly from the PSM control unit.



Instrument Cluster

General Information

The instrument cluster is the central driver information unit and is used to display data relating to the vehicle, e.g. engine speed, vehicle speed, temperatures and fill levels, warnings and messages. General applicable vehicle settings can be implemented in the instrument cluster and made available to the control unit network via CAN using a menu. The instrument cluster also manages all on-board computer values (e.g. average fuel consumption) and warnings and informative audio signals for the entire vehicle.



PCM sends the GPS time to the instrument cluster in systems with a navigation module. The instrument cluster allows the user to implement settings for time, date, display format (time and date), time zone as well as summer and winter time. If there is no navigation module installed, or if a GPS signal was not yet received in the current terminal 15 cycle ("GPS once received" = 0), the user cannot adjust the time zone or summer/winter time setting in the instrument cluster.

Oil Gauge



The oil gauge displays:

- Engine oil temperature (analog)
- Engine oil pressure (analog)

A warning message will appear on the multi-function display in the instrument panel if the engine oil temperature is too high.

Speedometer



The speedometer displays:

- Current speed (analog)
- Current mileage and trip counter (digital)
- Other indicator lights

Warning and indicator lights on the speedometer:

- Rear fog light indicator light
- HOLD function indicator light
- Headlight indicator light
- Adaptive light system warning light
- Tire pressure warning light

Tachometer



The tachometer displays:

- Engine speed
- PDK shift pattern (P-R-N-D-M) via LEDs and display of engaged gear (digital)
- Gear indicator/upshift indicator
- Current speed (digital)
- Upshift prompt
- Most important warning lights

Warning and indicator lights on the tachometer:

- Emission control warning light (Check Engine)
- Airbag warning light
- Seat belt warning light
- PSM warning light
- PSM OFF warning light
- ABS warning light
- Direction indicator, left
- Direction indicator, right
- Brake warning light
- High beam indicator
- Electric parking brake warning light

Multi-Function Display (4.8 inch TFT)

The new Panamera features a 4.8-inch high-resolution TFT colour display in the instrument cluster. It is easy to operate either using the right on-board computer lever or using the right steering-wheel rotary knob on the optional multi-function steering wheel. Numerous different settings (e.g. Info, Oil level, Limits, Light/Visibility, etc.) are available for selection in the vehicle settings menu.

The TFT display in the vehicle settings menu can be configured as required in order to pre-set the most frequently used displays (e.g. compass display, driving time, telephone information, radio station/track, etc.). This ensures even greater comfort and convenience. In addition, the top line in all display areas (with the exception of the map display) can be programmed.

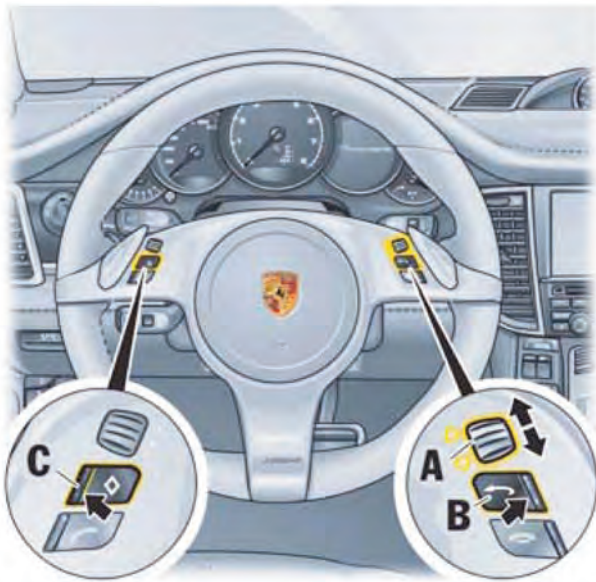


The multi-function screen displays:

- Current vehicle status
- Communication and Infotainment
- Navigation map display (with PCM)

Operation – Multi-Function Steering Wheel

On the multi-function display, you can view information relating to the relevant vehicle equipment, operate the audio source (radio, CD, iPod, etc.), check the oil level, check the tire pressure, use the stopwatch or operate the navigation system. You can also modify numerous vehicle settings in the Vehicle menu. The multi-function steering wheel (MFS) button C can be assigned either Porsche Communication Management (PCM) functions or multi-function display functions in the multi-function display on the instrument panel. Audio source selection is the default setting.



The multi-function display is operated using the rotary knob A, the Back button B and the MFS button C, which can be assigned as required.

Selecting menu, function, setting option:

- Turn rotary knob A upwards or downwards.

Confirming selection (Enter):

- Press rotary knob A.

Moving back one or several selection levels:

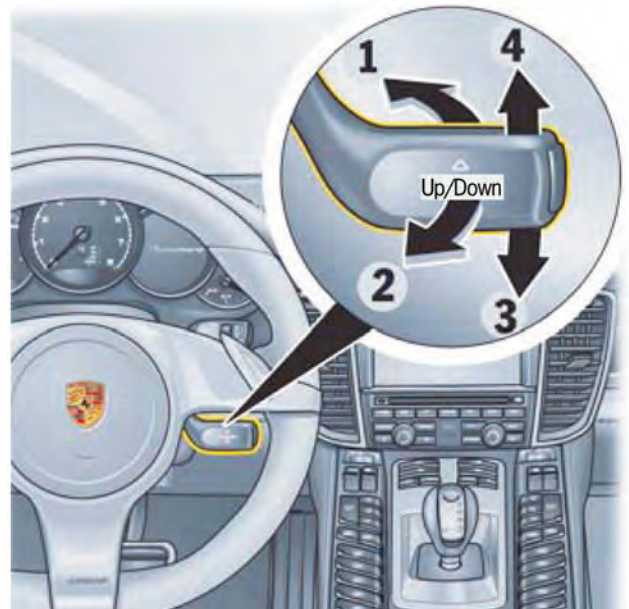
- Press button B (Back button).



Notes!

The multi-function display is only active when the ignition is on. Certain menus are only available when the vehicle is stationary, e.g. the adjustment menu for tire pressure monitoring.

Operation – Steering Column Lever (Without Multi-Function Steering Wheel)



The multi-function display is operated with the lower lever on the right of the steering column.

Selecting menu, function, setting option:

- Push the lever downwards (position 3) or Upwards (position 4).

Confirming selection (Enter)

- Push the lever forward (position 1).

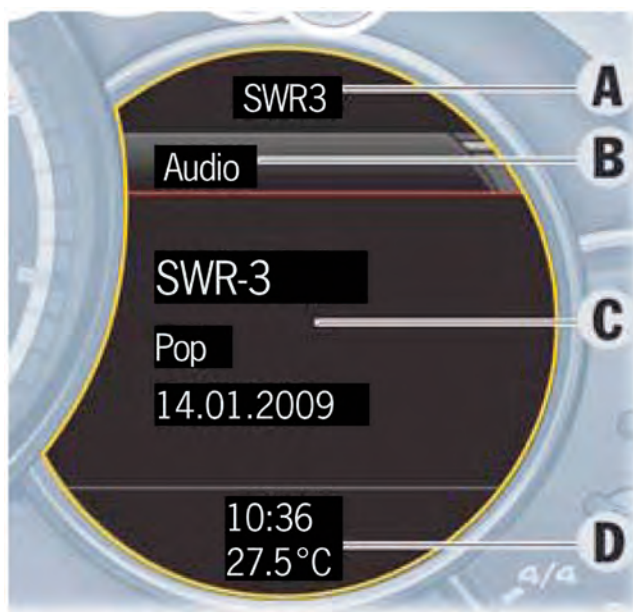
Moving back one or several selection levels

- Pull the lever towards the steering wheel once or several times (position 2).

Electrics/Electronics

Display – Upper Status Area/Lower Status Area

The upper A and lower status area D permanently display basic information, such as the current radio station, time and temperature or the remaining range. Area B is the selection menu, area C displays either the menu items that are currently available for selection or other selection options.



Overview of Display Menus



Selection Menu

Vehicle:

Various types of vehicle information can be displayed on the multi-function display.

Example: To change the current language:



1. Select Main menu > **"Vehicle"**



2. Select Main menu
 > "Vehicle"
 > **"Settings"** & confirm your selection.



3. Select Main menu
 > "Vehicle"
 > "Settings"
 > **"Language"** & confirm your selection.



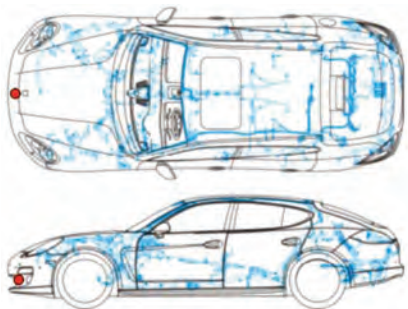
4. Select Main menu
 > "Vehicle"
 > "Settings"
 > "Language"
 > **"Deutsch"** or a different language & confirm

Adaptive Cruise Control (ACC)

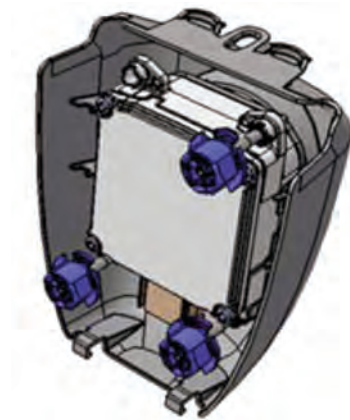


General Information

- ACC optional, only available with Porsche Doppelkupplung (PDK)
- ACC is based on the standard cruise control functionality (cruise control = maintaining a constant speed)
- ACC controls speed and distance by activating brakes & engine
- The ACC control unit is connected to the gateway via CAN crash risks and communicates via: CAN drive, CAN chassis, CAN comfort and CAN MMI



Red dot is location of control unit.

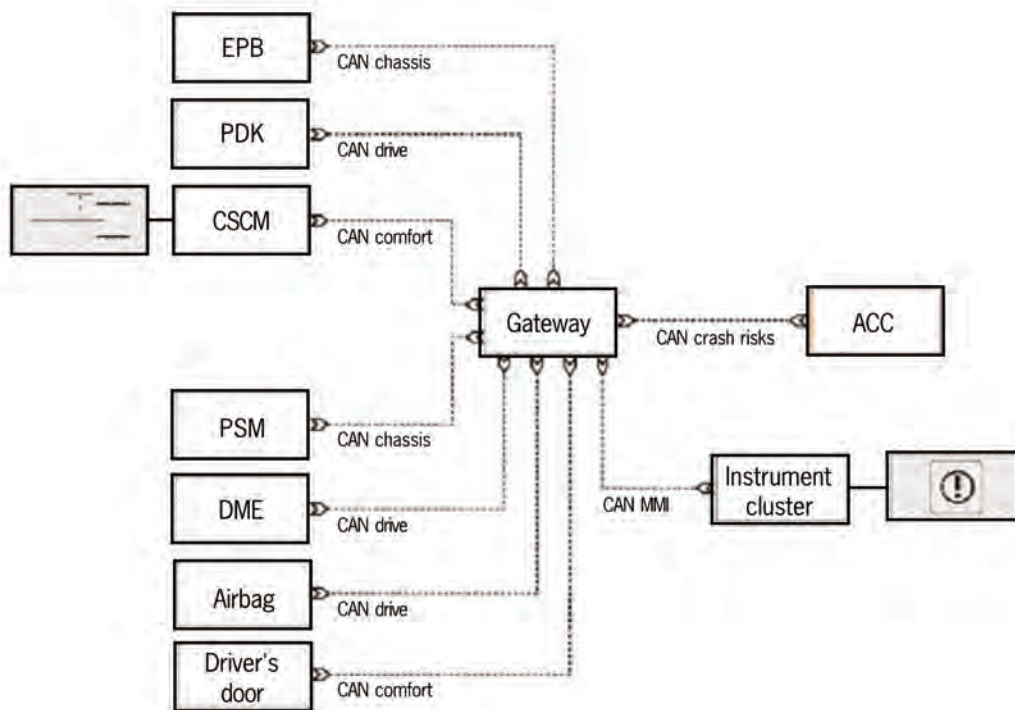


Adaptive cruise control (ACC) control unit.

The ACC control unit is connected to the vehicle electrical system voltage via terminal 15 and is therefore only active when the ignition is switched on.

The radar sensor includes four antennas, which scan the area in front of the vehicle. The antennas are integrated into the housing of the ACC control unit and have a transmitter and receiver frequency of 76.5 GHz. Objects that are moving in the direction of travel reflect the emitted radar waves back to the sensor's antennas. Stationary objects are ignored. Vehicles that change lane are also detected.

ACC Topology



ACC Distance Regulation Function

The distance between the vehicle with ACC and the vehicle in front can be set in four intervals using the operating lever. These intervals are 1.0, 1.25, 1.75 and 2.25 seconds. If you multiply this time value by the current speed, the result is the distance between the ACC vehicle and the one in front.

If there is no vehicle in front, the ACC vehicle is in automatic acceleration (cruise control) mode. The regulator is located in the ACC control unit and not in the engine control unit as in vehicles with conventional cruise control.

If a vehicle in front enters the detection area of the ACC vehicle (changes lane), the ACC vehicle enters into tracking mode. The tracking regulator (in the ACC control unit) manages engine control unit requests via a coupling interface and PSM requests via an acceleration interface.

Operating Principle

In terms of functionality, adaptive cruise control (ACC) is based on the conventional cruise control principle. A distance regulator is superimposed on the cruise control, i.e. if the system does not detect a vehicle in front, the desired speed is set. If a vehicle is detected in front, the ACC attempts to keep the time gap with this vehicle as constant as possible. The distance is measured via a radar sensor. The brakes and engine are used as drive links. The driver can use an operating lever to change the desired speed and time gap with respect to the vehicle in front and also to accelerate and decelerate.

Designed as a comfort system, the ACC function supports the driver, particularly on multi-lane highways, in congested traffic and in the event of road construction or speed restrictions. Automatically adapting the vehicle speed to the speed of the vehicle in front increases versatility and comfort compared with a conventional cruise control system. The driver is incorporated into the ACC system's control loop by means of the appropriate controls and displays and if necessary is clearly requested to assume control of the vehicle speed.

Activating ACC



- 1** - Set/increase desired speed
- 2** - Reduce desired speed
- 3** - Interrupt (OFF)
- 4** - Operational readiness on/return to set speed (RESUME)

In automatic acceleration mode, the adaptive cruise control maintains any selected speed between approx. 19 and 130 mph (30 and 210 km/h) without the driver having to use the accelerator. If a vehicle travelling slower than the selected speed is detected in the same lane, the adaptive cruise control automatically maintains a specific distance. The adaptive cruise control applies the brakes if the distance between it and the vehicle in front is too small and accelerates if the distance increases.

The ACC function includes full cruise control functionality and is activated by pressing on the “ACC on/off” button on the bottom left operating lever of the combined steering column module (CSCM). The ACC system behaves like a cruise control system if no vehicle is detected in front. Once a vehicle has been detected in front, the ACC system enters into distance regulation mode.

The speed that can be set by the driver ranges from 19 to 130 mph (30 to 210 km/h). ACC is active in the speed range from 0 to 130 mph (210 km/h). If necessary, ACC applies the brakes until the vehicle comes to a stop.

Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

Electrics/Electronics

Deactivating ACC

- On/Off switch
- PSM switched off
- Brake pedal pressed
- Accelerator pedal pressed (no control), accelerator pedal released, automatic ACC control
- No forward gear engaged
- Electric parking brake (EPB) pressed
- Door open
- Driver's seat belt not fastened

ACC is deactivated under the following individual conditions:

The off switch on the operating lever is set to "OFF", the brake pedal is pressed. A CAN signal from the PSM control unit is communicated to the ACC. The accelerator pedal is pressed, e.g. when passing. The automatic control system is disabled, automatic braking is discontinued. Once the accelerator pedal is released, ACC automatically takes control again. No forward gear is engaged, EPB is pressed, specific deactivation if a door is open or the driver's seat belt is not fastened. ACC applies the brakes until the vehicle comes to a stop. However, the vehicle is not held stationary and ACC is deactivated two seconds after the vehicle comes to a stop.

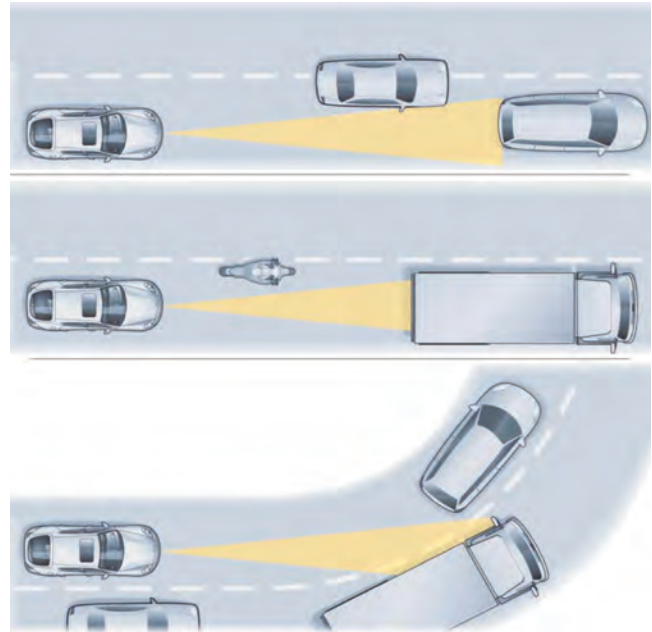
Adaptive cruise control is **not** available:

- When the ignition is switched off
- When PSM is switched off
- When the driver's door is opened and the seat belt on the driver's side has not been fastened
- When large steering wheel movements are made, e.g. when parking or manoeuvring
- When the Porsche Doppelkupplung (PDK) selector lever position is N
- When uphill or downhill gradients are greater than 20%

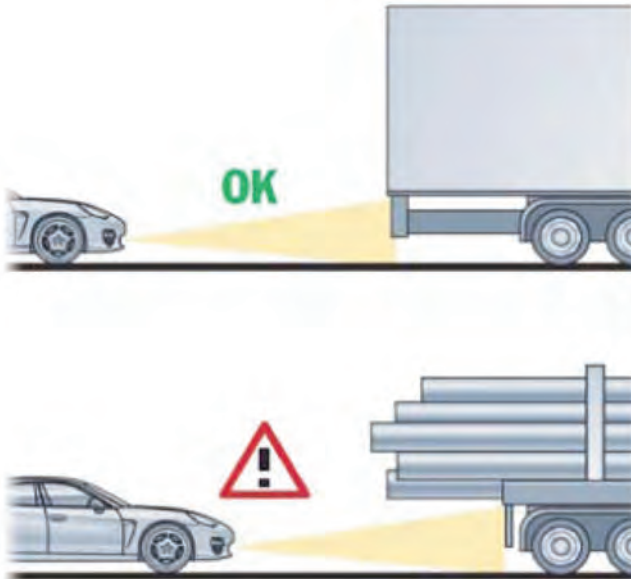
If one of these situations arise while adaptive cruise control is switched on, it is switched off. A corresponding message will then appear on the multi-function display.

ACC Detects the Following Obstacles

- Only moving objects (no stationary obstacles)
- Almost all standard road vehicles that can drive faster than the ACC minimum speed, e.g.:
 - Passenger vehicles
 - Light/heavy utility vehicles/semi truck/trailers
 - Vehicles with trailers
 - Buses/RVs
 - Motorcycles



The radar sensor of the adaptive cruise control detects objects within a narrow, cone-shaped area in front of the vehicle. As a result, the detection of obstacles can be restricted. The system may brake too late or unexpectedly.



Staggered vehicles/vehicles cutting in.

If other vehicles are moving in and out of the ACC vehicle's lane, these vehicles will only be detected when they are fully in the relevant lane.

Vehicles with a small cross section/narrow vehicles.

Narrow or small vehicles are not detected or detected too late.

Entering or exiting a corner.

When entering or exiting a corner, vehicles are not detected or detected too early or the vehicle responds to vehicles in neighboring lanes.

Vehicles with large projections.

In the case of vehicles with oversized loads with large overhangs (e.g. lumber trucks), the end of the vehicle may not be detected correctly.

Setting the Distance



This is speed-sensitive and can be preselected in four stages. Adjustments are made using the rocker switch (**Z**) on the ACC operating lever. (Press downwards to decrease the distance/upwards to increase it.)

The distance (four bars in display) represent time intervals:

- Stage 1 = 1 second,
- Stage 2 = 1.25 seconds,
- Stage 3 = 1.75 seconds ~ half the speed reading,
- Stage 4 = 2.25 seconds.

In Stage 1 the vehicle tends to accelerate and brake more dynamically and more gently in the highest stage. When terminal 15 is off/on, the time gap corresponding to the statutory minimum distance (1.75 seconds) is preset by default or the driver preselects a personalized setting using the key.

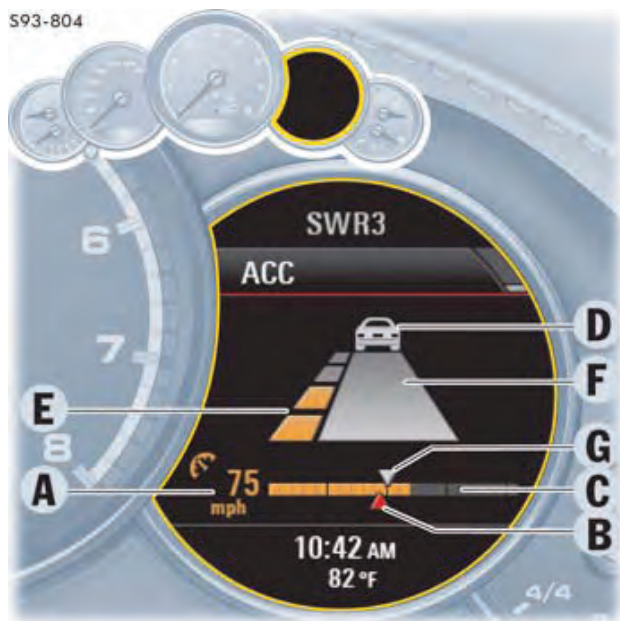
i Notes!

- > When adjusting the distance, the "ACC" main menu in the adaptive cruise control is displayed temporarily in the multi-function display.
- > Increasing the distance – Move the rocker switch upwards. The distance is increased. The number of orange segments in the distance display increases.
- > Decreasing the distance – Move the rocker switch downwards. The distance is decreased. The number of orange segments in the distance display decreases.

Electrics/Electronics

Feedback and Display

- Any braking intervention by the ACC is indicated to the vehicles behind by the brake lights.
- Vehicle passing (over take) requests are indicated visually to the driver (flashing) and acoustically via the instrument cluster (please brake, brake immediately).
- The passive or off status is indicated by the acronym displayed in ACC menu in the instrument cluster. The desired speed that is set (A) and a vehicle in front is displayed permanently to the driver in the instrument cluster (D).
- If a vehicle in front is detected and the distance with respect to this vehicle is adjusted, a vehicle symbol is displayed in the multi-function display. As described earlier, the distance is displayed in four stages.



- A** - Status display and desired speed
- B** - Current speed
- C** - Progress bar showing speed control range (0–100 mph, 0–160 km/h)
- D** - Vehicle detected in front
- E** - Desired distance from vehicle in front
- F** - Current distance from vehicle in front
- G** - Current speed of vehicle travelling in front

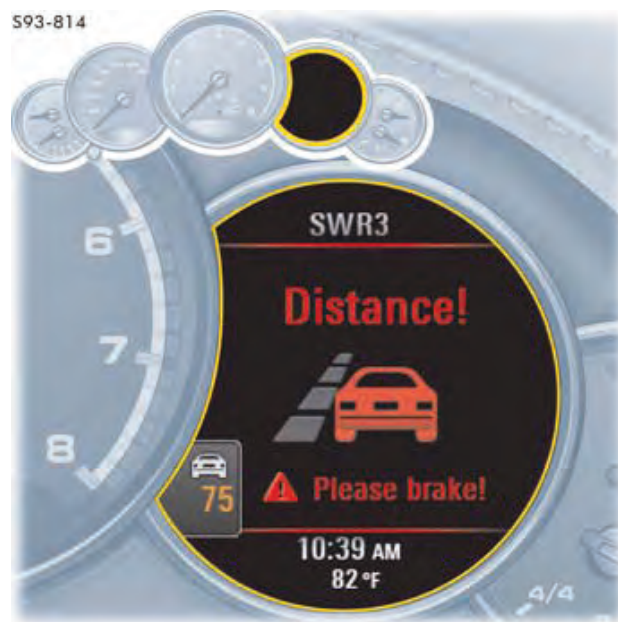
ACC passive = Distance warning when control intervention is not active.

ACC active = Vehicle passing (over take) request when control intervention is active.

The ACC system does not perform any safety functions and is therefore not a tool for preventing collisions, providing distance warnings, detecting the end of a tailback (no adjustment for stationary objects) for Stop & Go operation (no Full Speed Range (FSRA) ACC) and is not to be used where there is poor visibility (fog) or any kind of icy roads.

Important!

The driver maintains full responsibility for steering the vehicle at all times. Consequently, the driver can switch off the ACC distance regulator at any time (using the operating lever or by actuating the brake). If the situation is unclear, the driver must assume longitudinal control switch off ACC.



In cases where the system has detected that braking assistance is required from the driver, a red warning appears on the ACC screen with the instructions “over take” “Distance”. An acoustic warning also sounds.

The corresponding warnings or instructions are displayed in the instrument cluster if the conditions for operating the ACC are not met, e.g. if there is an ABS or PSM intervention, or if the parking brake is pulled while driving. The system intervenes only to apply the brakes and completes the initiated braking manoeuvre before switching off. If required, the system can then be used again, provided the prerequisites for operating the ACC are met.

System and Multi-function Display Error Messages

ACC not available – Adaptive cruise control is not available, e.g. when manoeuvring.

ABS/PSM intervention – Adaptive cruise control was deactivated because of an ABS or PSM intervention.

Electric parking brake – Adaptive cruise control was deactivated because the electric parking brake was activated.

Selector lever position – Adaptive cruise control was deactivated because the Porsche Doppelkupplung (PDK) selector lever is not in position D or manual position M.

Not possible while stationary – Vehicle is stationary, e.g. while setting the desired speed.

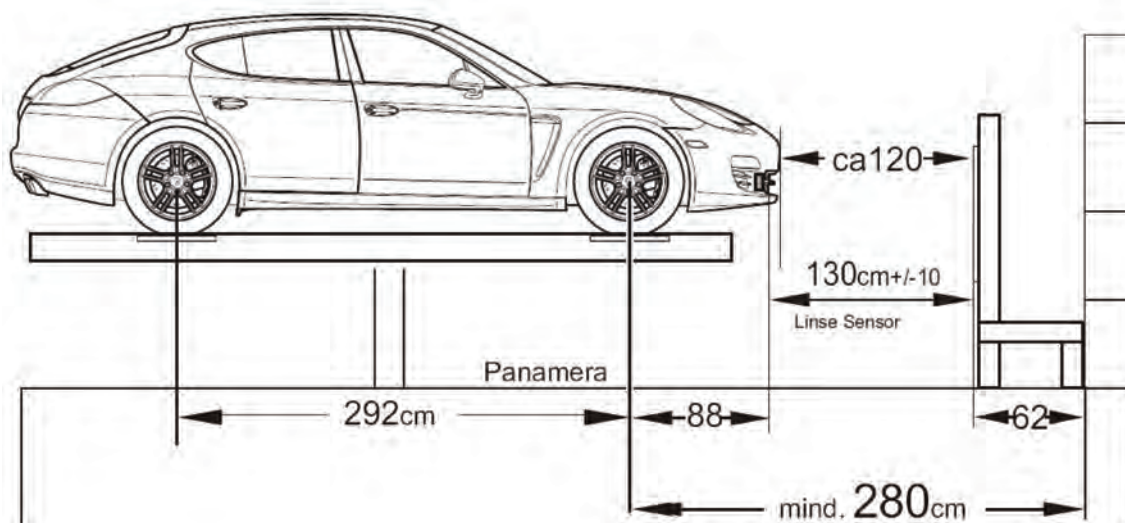
Engine speed – Adaptive cruise control was deactivated because the engine speed limit was reached in manual position M of the Porsche Doppelkupplung (PDK) selector lever.

Gradient too steep – Uphill or downhill gradients > 20%: ACC cannot be enabled because the gradient of the road is too steep.

Stationary object – Operation is not possible because a stationary object was detected ahead.

PSM switched off – Adaptive cruise control is not available because PSM was switched off.

Diagnosis Setting



Notes:

Electrics/Electronics

ParkAssist (PDC – Park Distance Control)

General Information

- Active after switching on ignition
- Operating range 0 - 9 mph (15 km/h)
- Acoustic warning:
 - front – 120 cm or less &
 - behind – 150 cm or less
- Visual warning:
 - front – 120 cm or less,
 - side – 120 cm or less &
 - rear – 180 cm or less

All Panamera models are equipped with a rear 4-channel ParkAssist system with an acoustic warning as standard equipment. A tone generator in the instrument cluster provides the driver with an acoustic warning (intermittent tones getting continuously faster) when approaching an obstacle.

An enhanced ParkAssist system with six additional sensors in the front area – making it a 10-channel ParkAssist system – comes as standard equipment in the Panamera Turbo and is available as an option in the other models. The rear-area warning is output by a loudspeaker in the C-pillar. The sound is therefore different in the front and rear (lower in the rear). In addition, the distances are displayed in the form of a schematic representation of the top view of the vehicle in the PCM (and CDR). Dynamic guide lines are displayed in conjunction with the reversing camera.

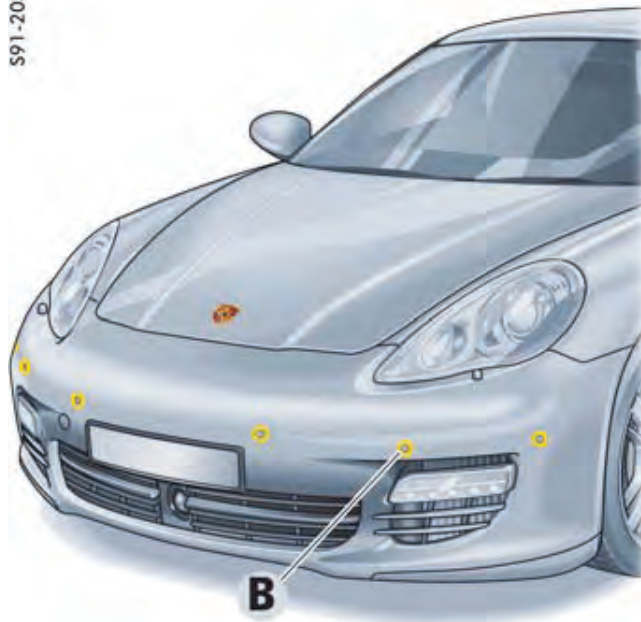
When the ignition is switched on, ParkAssist is activated automatically as soon as reverse gear is engaged. This is confirmed by a short acoustic signal in the 4-channel ParkAssist variant, while the visual display on the PCM or CDR system is activated in the 10-channel ParkAssist variant. The operating range is from 0 to 9 mph (15 km/h). It can be switched on and off using a switch on the head unit. (The 10-channel variant can also be switched off using a switch on the roof console. The LED in the switch then lights up). ParkAssist is switched on again the next time the ignition is switched on. ParkAssist is activated automatically when there is a distance of 80 cm or less from an obstacle to the front and 60 cm or less to the side of the vehicle.

S91-144



Rear Sensors (A)

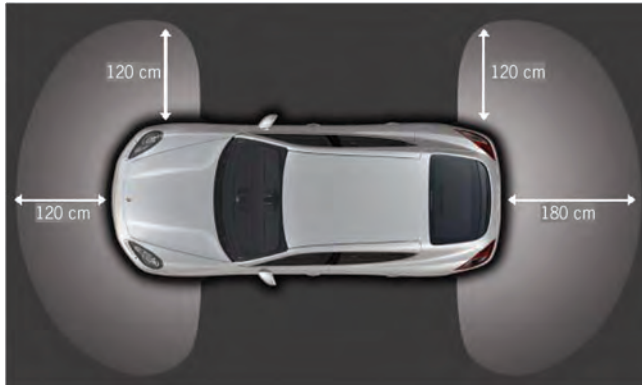
S91-203



Front Sensors (B)

Obstacle Detection

An intermittent tone sounds when obstacles are detected. The intervals decrease in five stages as the vehicle comes closer to the obstacle. A continuous tone sounds when the distance is less than approx. 35 cm.



The obstacle detection function of the ultrasonic measurement is impaired by:

- Sound-absorbing obstacles (e.g. winter driving, powder snow)
- Sound-reflecting obstacles (e.g. glass surfaces, flat painted surfaces)
- Very thin obstacles (e.g. thin posts)
- Other ultrasonic sources (e.g. pneumatic brakes on other vehicles)



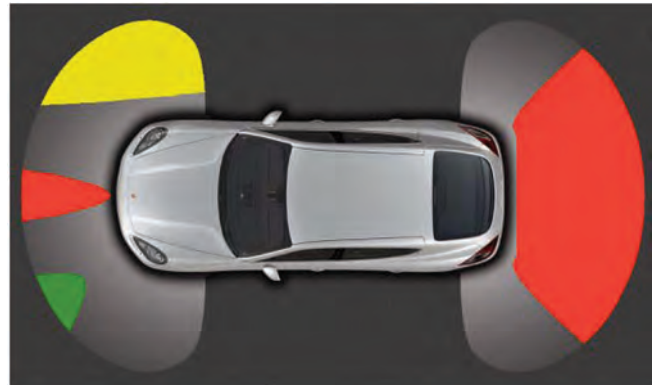
Notes!

- > Obstacles cannot be detected in the sensor's "blind spot" (above and below the sensors, e.g. objects hanging down or close to the ground).
- > Correct operation may be impaired if there is a temporary fault (e.g. caused by ice formation or heavy soiling on the sensors).

Notes:

Display Area

The proximity to obstacles is displayed in the form of a schematic representation (diagram) of the top view of the vehicle in the central PCM display or in the CDR. ParkAssist activation is indicated both by the visual display and sound output.



Color	Distance in front of vehicle	Distance behind vehicle
Green	80-120 cm	80-180 cm
Yellow	40-79 cm	40-79 cm
Red	< 40 cm	< 45 cm
Red with continuous tone	< 30 cm	< 35 cm

Maintenance notes:

- The sensors must always be kept free of dust, ice and snow in order to ensure that they are fully functional
- Do not damage sensors by abrasion or scratching
- Maintain a sufficient distance when cleaning with power washers
- The sensors will be damaged if the pressure is too high

Electrics/Electronics

Deactivating ParkAssist

Press the switch on the roof operating console. If the indicator light on the switch comes on, ParkAssist is off!



Function for each PDK position:

- P** - No warning
- R** - Acoustic and visual warning active
- N** - Diagram appears only at a distance < 80 cm at the front + warning tone at 120 cm or less, acoustic and visual warning active if vehicle rolls back
- D** - Diagram appears only at a distance < 80 cm, system remains active for another 30 seconds when driver switches from "R" to "D"

On vehicles with Porsche Doppelkupplung (PDK), no visual or acoustic warning is issued when selector-lever position "P" is selected. The acoustic and visual warning for the front and rear is active in position "R" and the diagram appears in the display on the head unit. When PDK is switched to position "N", a diagram only appears when there is an obstacle at a distance of < 80 cm in front of the vehicle. Irrespective of this, the front warning tone sounds at a distance of 120 cm or less.

If an obstacle is approaching from behind, there is no warning tone but the distance at the rear is displayed in the diagram. If the vehicle rolls backwards while selector-lever position "N" is selected, the vehicle behaves in the same way as for position "R". When position "D" is selected, the diagram is only displayed at a certain

distance (< 80 cm). When the driver switches from "R" to "D", full system functionality is retained for a further 30 seconds. In vehicles with manual transmission, the acoustic warning at the front and rear is active when reverse gear is engaged. In all other gears, the system behaves in the same way as for position "D" on vehicles with PDK.

Additional Information

When ParkAssist is switched on, the visual parking aid is displayed on the PCM screen in the following situations:

- When reverse gear is engaged
- When ParkAssist detects that the vehicle is rolling backwards
- When the distance from a detected object at the front is less than 80 cm
- In PCM – manual activation using the CAR button at a speed of < 9 mph (15 km/h), at a distance of > 80 cm and intermittent tone sounds (CAR – OPTION > PARKASSIST)
- In PCM – manual activation via CAR – OPTION – PARKASSIST
- In CDR – manual activation via CAR – PARKASSIST

The display disappears again as soon as:

- One of the main menu buttons is pressed on the PCM/CDR (In this case, the display can be restored by pressing the CAR button)
- The Back button is pressed on the PCM/CDR (In this case, the display can be restored by pressing the CAR button)
- The driver shifts out of reverse (after 30 seconds or speed > 9 mph (15 km/h))
- The electric parking brake is applied
- The PDK selector lever is moved to position P

Audio and Communication

CDR-31



The new CDR-31 audio system, which comes as standard, has an extremely high-quality operator interface. The look, feel and central functions correspond to the latest PCM generation. The main feature of the new generation of audio systems is a new 7-inch TFT display with touch-screen. All functions (except for the volume) of the new CDR-31 system can be selected by touching the color screen. This allows fast and simple navigation through the various menus. Touchscreen operation significantly reduces operating time and is also less distracting for the driver. The touchscreen has a long-lasting, easy-to-clean coating. Unlike earlier touchscreen systems, the surface is particularly resistant to soiling from fingerprints.

The basic radio functions can also be controlled using the optional multi-function steering wheel. An additional feature of the new generation of audio systems is its enhanced display options in the instrument cluster, e.g. telephone and radio station lists.

Changes compared to CDR-30:

- 7-inch TFT colour display in 16:9
- Touchscreen
- High-quality operator interface (PCM 3.1 screen design)
- ParkAssist with Top View display
- New attachment concept (4 screw points & centering)

CDR Options

The operator interface is adapted to suit the new color screen – both the operating structure and the screen design are the same as for the PCM. The screen display is very clear thanks to the fact that a whole series of rarely-used functions have been moved to the second menu level ("OPTION"). Up to five easy to-read list entries are displayed on each page.

For radio listeners, there are up to 36 memory locations if necessary. 30 locations can be set as required, while 6 presets are for Best FM. The integrated CD drive plays music in MP3 format. The following formats are supported: MP3, AAC and WMA.

	Mobile phone preparation
	6-disc CD auto changer
	Universal audio interface
	Satellite radio SDARS (PCNA only)
	BOSE Surround Sound System
	Burmester High-End Surround Sound System
	Rear Seat Entertainment

An FM double tuner with integrated RDS is installed as well as the latest generation of the Antenna Phase Diversity function. This multi-antenna system allows optimized reception, whereby the two available antenna signals are either combined or evaluated separately, depending on the situation. The CDR-31 system calculates the optimal phase combination of the two signals for each reception situation in order to ensure maximum reception performance of the system. The antenna system for CDR-31 includes two FM antennas and one AM antenna. All the antennas are located in the rear window of the Panamera.

Electrics/Electronics

PCM 3.1 – Porsche Communication Management



New features of PCM 3.1:

- High-resolution 7-inch WVGA
- (Wide Video Graphics Array)
- 3D navigation map
- Speed limit display in PCM
- Map display in instrument cluster

The latest, enhanced generation of PCM with navigation module is available on request. While making operation even easier, it was possible at the same time to make the central control unit for all audio and communication equipment even more efficient. The exemplary ease of operation of the last PCM generation has been optimized further, while the basic logic of the menu structure has been retained to make it as easy as possible for existing Porsche customers to get used to the new system.

One main feature of PCM is the new high-resolution 7-inch (800 x 480 pixel) screen. Thanks to a display resolution that is four times higher than the previous generation, the display is now even easier to read and considerably clearer. Like the CDR-31 audio system, the screen is set in a high position on the sloping, continuous center console.

Bus systems:

The control unit communicates with other control units via CAN MMI. In order to communicate with external multimedia components, PCM 3.1 is connected via an optical MOST.

PCM 3.1 Options

	Telephone module with cordless handset
	Charging cradle for cordless handset in the rear
	Mobile phone preparation
	6-disc CD/DVD autochanger
	Universal audio interface
	SDARS satellite radio (PCNA only)
	BOSE® Surround Sound System
	Burmester® High-End Surround Sound System
	Electronic logbook
	Voice control
	TV tuner
	Porsche Rear Seat Entertainment

For radio listeners, the audio system includes up to 48 memory locations if required (42 locations can be freely assigned, 6 presets for Best FM; together with the optional TV tuner, this gives a total of up to 66 memory locations – 48 for audio and 18 for TV), an FM double tuner with RDS (Radio Data Service) and the latest generation of the Antenna Scan and Phase Diversity function.

The integrated CD/DVD drive not only plays music in MP3 format, but also supports audio playback of audio and video DVDs – both in conjunction with the BOSE® Surround Sound System and the Burmester® High-End Surround Sound-System, even in 5.1 Discrete Surround format (see chapter 9.6), otherwise in stereo. The following formats are supported: MP3, AAC, WMA, Dolby Digital, MLP and DTS.

3D Navigation Map

The 3D City model currently features approx. 40 cities in North America.



Terrain Model



City Model

The map view gives users the option of viewing the map as the new 3D display of the terrain and city models, in the familiar perspective or as a normal two-dimensional display. The scale of the map is adjusted continuously when the entire route is displayed in order to show the remaining distance from the vehicle position to the destination flag at maximum enlargement. The Autozoom function allows the scale of the map to be adjusted automatically depending on the distance to the next turn-off. Additional graphic turn-off instructions with lane recommendations are displayed for better guidance at motorway exits and junctions.

A speed limit display is available for the first time in the new Panamera. This shows any speed limits that apply on the roads recorded in the navigation system on the PCM (Car display) or in the TFT display on the instrument cluster.

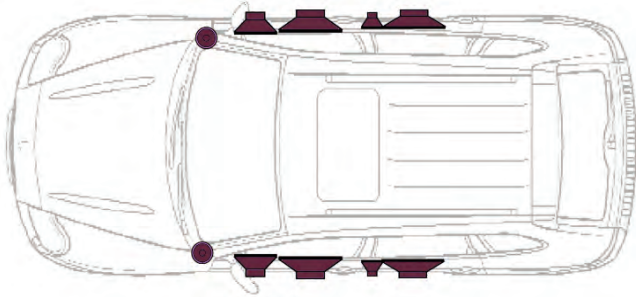
The navigation module has an integrated 40 GB hard drive, on which navigation data for most countries in any region (e.g. Europe, North America, Middle East, etc.) is stored.

Notes:

Electrics/Electronics

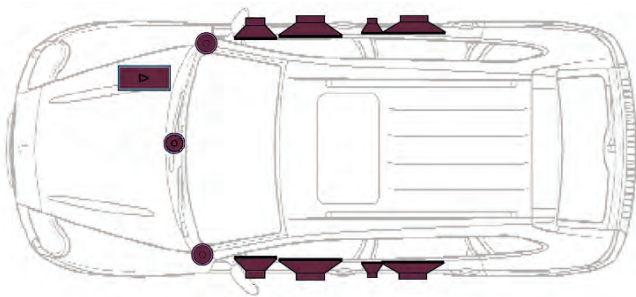
CDR-31 Sound System

The CDR-31 has a sound system with 10 loudspeakers divided into 4 channels with a total power output of 100 watts and can be used to play audio CDs and music in MP3 format (formats: mp3, aac, wma).



PCM 3.1 Sound System

The optional PCM system (standard in the Panamera Turbo) includes 11 loudspeakers divided into 7 channels, an external amplifier and a total power output of 235 watts. The integrated CD/DVD drive supports audio playback of audio and video DVDs and plays music in MP3 format (formats: mp3, aac, wma, wav).



BOSE Sound System

The optional BOSE® Surround Sound System (standard in the Panamera Turbo) with 14 loudspeakers, including a 200-watt active subwoofer, and 9 amplifier channels provides an impressive total power output of 585 watts. The BOSE® technologies Centerpoint® 2 and Surround-Stage® allow the system to play stereo sources in Surround mode and – together with PCM – makes available the audio spectrum of digital 5.1 recordings. AudioPilot® Noise Compensation Technology achieves a balanced sound in all driving situations.



BOSE Amplifier

The amplifier has the following functions:

- Playback of discrete 5.1 audio formats (AC3, DTS, MLP), stereo and “Announcement” sources
- Processing of DTCP-encrypted data
- Implementation of symmetric, analog inputs for connecting an external head unit
- Microphone-based driving noise compensation with taking into account other state variables, which are communicated to the amplifier via the CAN/MOST gateway
- Implementation of intelligent temperature management

Notes:

Burmester Sound System

The optional High-End Surround Sound System from the Berlin-based manufacturer of high-end sound systems Burmester® can be ordered for an absolutely top-class music experience. The technical data: 16 individually selectable loudspeakers with a 300-watt active subwoofer and a total output of more than 1,000 watts.

Thanks to the 16-channel amplifier technology, the use of special Air Motion Transformers (ribbon tweeters), an unprecedented, acoustically effective diaphragm area of more than 2,400 cm², and a microphone for noise compensation, an extraordinarily natural, rich and consistent surround sound is achieved in all driving situations.

In addition, various predefined sound settings, including digital 5.1 playback (in conjunction with PCM), can be selected exclusively for the Burmester® High-End Surround Sound System in CDR and PCM.



Air motion transformers are known for their excellent pulse behavior and high level of efficiency due to the very small masses moved. Air motion transformers are used, in particular, in HiFi loudspeakers as tweeters in the frequency range from around 1 kHz to up to around 25 kHz.

Sound System Comparison



BOSE

Burmester
ART FOR THE EAR

	Audio system CDR-31	PCM 3.1	Bose® Surround Sound System	Burmester® High-End Surround Sound System
Total output (watts)	100	235	585	1003
Number of loudspeakers	10	11	14	16
Amplifiers	4 x 25 W	5 x 25 W 2 x 55 W	1 x 25 W 5 x 40 W 2 x 80 W 1 x 200 W	3 x 41 W 4 x 25 W 6 x 50 W 2 x 90 W 1 x 300 W
Audio playback formats	Audio CD MP3	Audio CD Audio & video DVD MP3	Audio CD Audio & video DVD MP3 Digital 5.1 recordings (with PCM 3.1)	Audio CD Audio & video DVD MP3 Digital 5.1 recordings (with PCM 3.1)

Electrics/Electronics

Rear Seat Entertainment System (RSE)

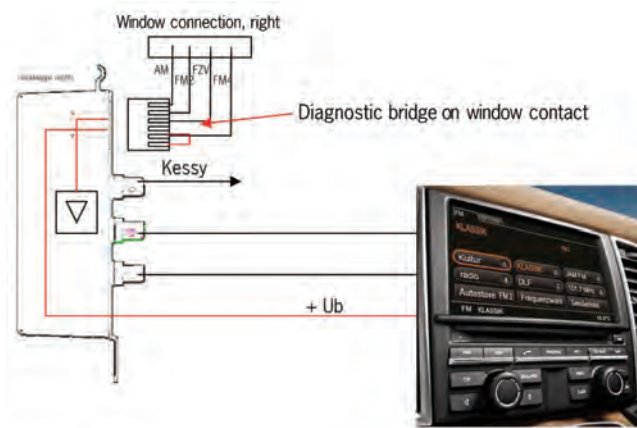


The optional Porsche Rear Entertainment system is a new development compared with the existing system used in the Cayenne models. It consists of two display consoles, which are integrated into the backrests of the front seats and include integrated players, as well as two sets of wireless infrared headphones. They are equipped with swivelling, high-resolution 7-inch WVGA TFT displays.

The main advantage of the new system, besides the elegant integration of the two players in the display consoles, is the brand new touchscreen control feature. The vibration-proof system plays films on DVD as well as all current formats (e.g. CD, MP3, etc.). Each display console has a USB interface. The system also allows the connection of two separate, individually selectable AV sources, such as a game console, an iPod® or a digital camera. Using the crosslink function, it is possible to insert a disc into or connect a data carrier to one player and have the same film or data displayed on both players.

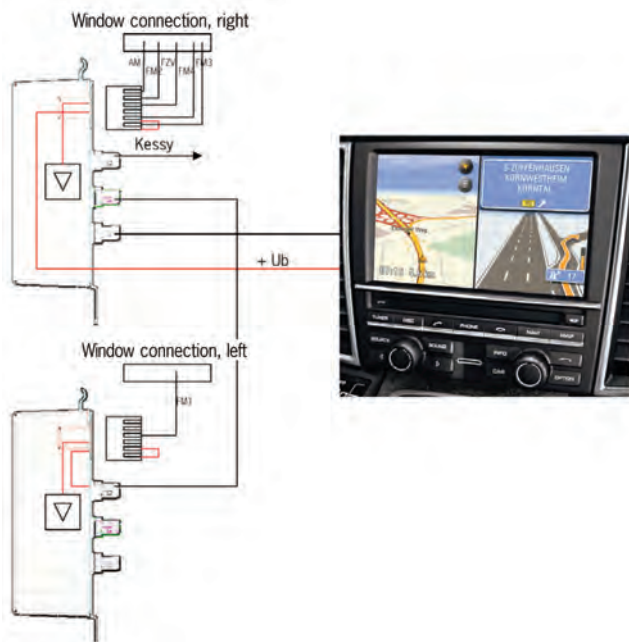
In addition, the optional TV tuner allows passengers in the rear to receive unencrypted analogue (PAL, Secam and NTSC) and digital (DVB-T) TV signals on the screens. Signals can also be received while driving, but the reception quality of the sound and picture signal depends on speed and local network coverage. It is also possible to play a DVD on one screen and watch TV on the other screen at the same time. The TV channel is always selected via the PCM.

CDR-31 Antenna System



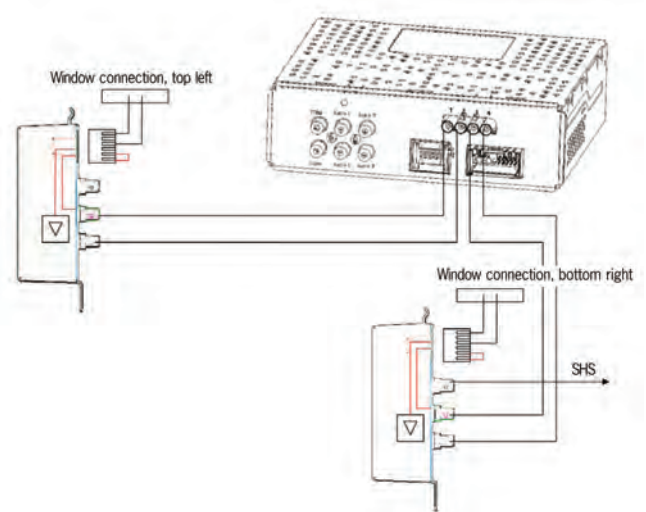
The basic AM/FM system includes a Phase Diversity system with two FM antennas and one AM antenna. Two antennas are always available for the CDR. Internal evaluation electronics ensure that the strongest signals are used in the tuner. The antennas are located in the rear window.

PCM 3.1 Antenna System



The antenna system is essentially located in the tailgate of the Panamera. When the optional PCM system is installed, a Scan Diversity system, consisting of 3 antennas, is used for FM. These are passed on to PCM via two antenna amplifiers (diversity logic is integrated in the right antenna amplifier). What is innovative about this system is that sensible antenna combinations can be combined with three different phase drive links in order to improve reception so that 10 FM antennas are available in reality for PCM. This combines the advantages of Scan Diversity with the advantages of Phase Diversity. PCM always gets the signal for a defined antenna or a switched combination from the Diversity system. The tuner in the PCM system returns the intermediate frequency to the Diversity system via the high-frequency line. Reception interference that occurs is detected there in the μs range and causes the system to switch to a different antenna. An offset AM structure was developed to further enhance performance.

PCM 3.1 /TV Antenna System



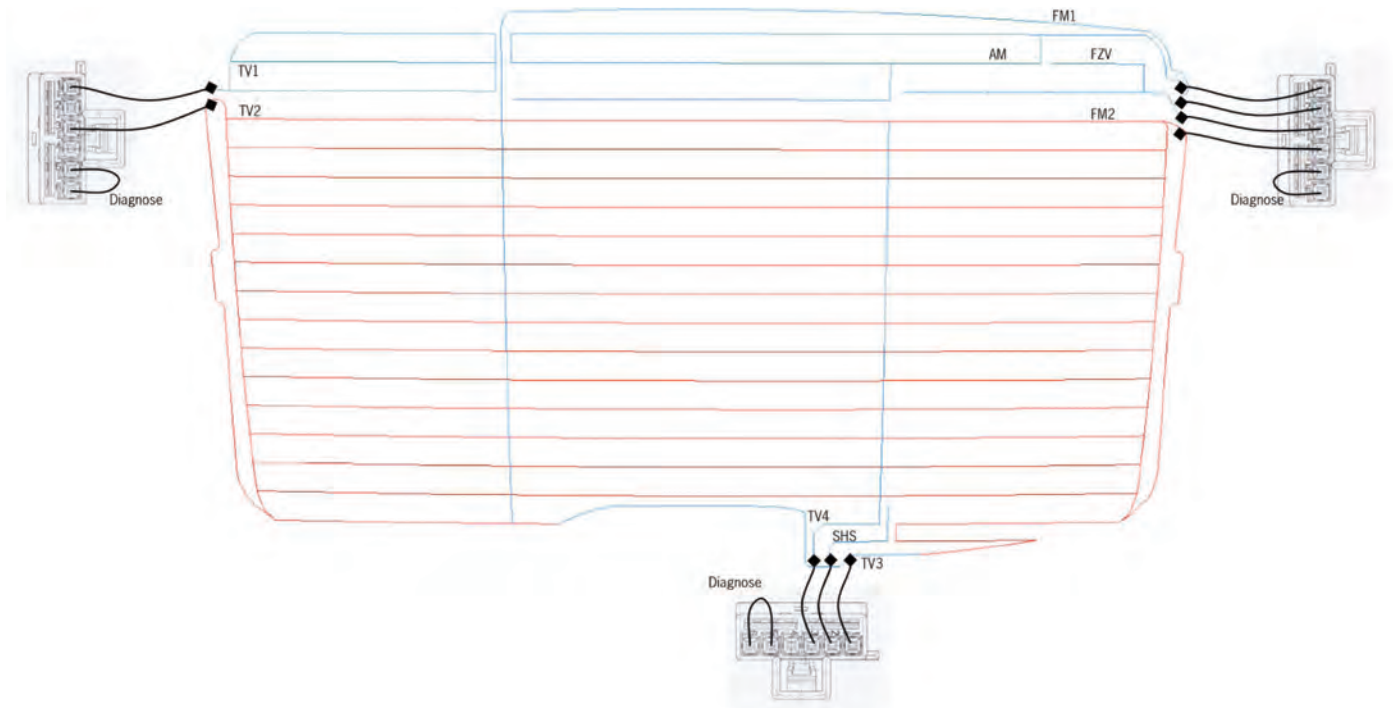
The antenna system comprises 4 TV antennas, which are coupled out from the rear window. The 4 antennas are all made available to the TV hybrid tuner, which always selects the best signal.

Notes:

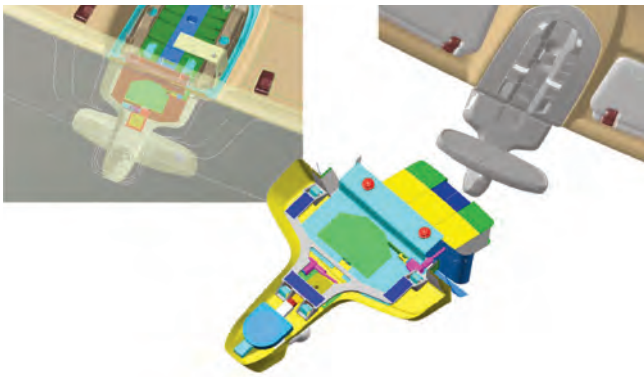
Electrics/Electronics

Overview of Rear Window Antennas

The FZV antenna is coupled out in wide-band from the right antenna amplifier. As a result, this antenna is suitable for the USA (315 MHz) and RoW (433 MHz) frequency range. The SHS antenna (866 MHz) is coupled out from a TV amplifier housing (lower edge of window).

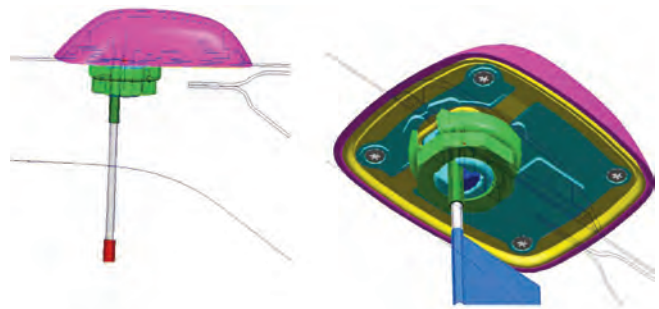


GSM/GPS Antenna System



The GSM and GPS antennas are located under the rear-view mirror trim. It is important that the cables for the adjacent sensors are not routed between the window and antenna so as not to impair the GPS functionality.

Satellite Digital Audio Radio Services (SDARS) Antenna System



The SDARS antenna is mounted in the rear third of the roof.

Light Systems

Main Headlights

Model	Panamera/4/S/4S		Panamera Turbo		Characteristics and product advantages
	Components	Design	Components	Design	
Main headlights	• Bi-Xenon headlights (dipped/high beam) • Halogen auxiliary high beam (H7)	Day design 	• Bi-Xenon headlight (dipped/high beam) with adaptive light system • Halogen auxiliary high beam (H7) • LED daytime driving lights	Day design 	• Bi-Xenon headlight – around twice as bright as halogen lamps, including headlight cleaning system • Dynamic, automatic headlight levelling system automatically adapts the range of the beam according to the vehicle load and driving situation. It also balances the pitching movement during braking and acceleration. • Halogen auxiliary main beam in the headlight • The daytime driving lights on the Panamera Turbo with 4 LED spotlights are integrated in the main headlights. • Adaptive light system is a standard feature on the Turbo and is optional on the Panamera/4/S/4S
		Night design 		Night design 	
				LED daytime driving lights 	

Low beam/driving light

Depending on the light switch position, the low beams are switched on automatically in the following situations: dusk, darkness, driving through tunnels, rain, highway driving

Highway function in bright conditions

The driving light is switched on automatically at speeds of more than approx. 90 mph (140 km/h) in bright conditions and when the daytime running lights are deactivated. When driving at a speed of less than approx. 40 mph (65 km/h), the driving light is switched off after a delay of approx. 4 minutes if the external lighting conditions permit.

Rain function

The driving light is switched on automatically after five seconds of continuous wiper operation. If the wipers have not been used for approx. 4 minutes, the driving light is switched off.

Fog lights

When the fog lights are switched on, the driving light distribution changes at speeds of less than approx. 38 mph (60 km/h). The light beam is widened and glare is reduced.

Front Lights

Model	Panamera/4/S/4S		Panamera Turbo		Characteristics and product advantages
	Components	Design	Components	Design	
Front lights	- Direction indicator light - Position light - LED daytime driving lights	Day design 	- Direction indicator light - Position light	Day design 	- Bar-shaped LED daytime driving lights on the Panamera/4/S/S4 are positioned horizontally in the lower part of the front lights for better visibility during the day - Turbo-specific front lights: LED light guides designed to surround the direction indicator lights serve as the position lights
		Night design (position light) 		Night design (position light) 	
		LED daytime driving lights 			

All Panamera models also come with front lights with direction indicator lights and LED position light (bar shaped LED light guides) as standard. On the Panamera/4 and Panamera S/4S, the front lights also house the horizontal, LED-technology daytime driving lights. On the Panamera Turbo, the daytime driving lights – with four LED spotlights each – are located as mentioned earlier in the main headlights. The position light (LED light guides) is designed to surround the direction indicator lights. Daytime running lights increase driving safety during the day by making the vehicle more visible for other road users.

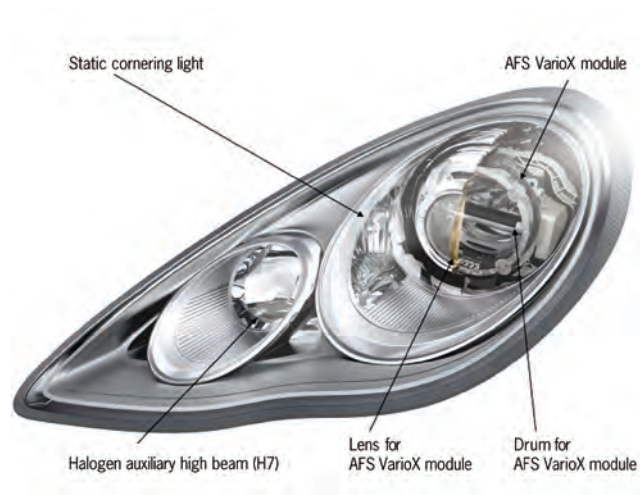
Notes:

Bi-Xenon Headlights With AFS

The adaptive light system comes as standard on the Panamera Turbo and is optional for the Panamera/4/S/4S (Adaptive Front Lighting System (AFS))

AFS offers the following functions:

- Dynamic and static cornering light
- Speed-dependent headlight range control (country road light and highway light)
- Fog light function

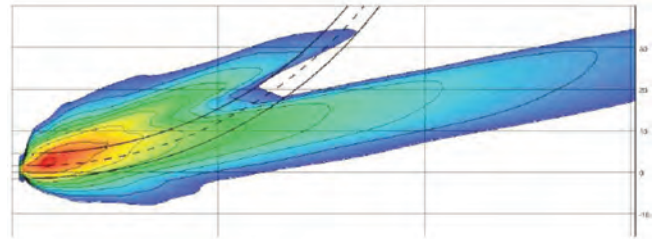


The AFS consists of a swivelling AFS VarioX module for the dynamic cornering light and headlight levelling and works in accordance with the projection system. The projection system includes, among other components, a rotating drum with various contours for modifying the light/dark border of the light as, well as a lens.

The Bi-Xenon headlight can be set to different light modes, e.g. country road light and highway light, by way of the drum and changes in the light intensity. The AFS is enhanced by the light from the static cornering light, which is also used as a turning light. Together with the normal Xenon high beam light, which already illuminates the area in front of the vehicle particularly effectively due to the drum position with the cover open fully and higher light intensity, a halogen auxiliary high beam light is also installed in the AFS.

Cornering Light

- Dynamic cornering light swivels the main headlights by up to 15° around the vertical axis, depending on the steering angle and vehicle speed in the bend.
- Static cornering light activates the additional halogen headlights, depending on the steering angle or direction indicator lights



The dynamic cornering light is activated at speeds of over 5 mph (8 km/h). The headlight adjustment angles depend on the vehicle speed and how sharply the driver turns the steering wheel. Viewed from the center axis of the vehicle, the maximum adjustment angle of the headlight at the inside of the bend is 15°, while the headlight angle at the outside of the bend is 7.5°. This ensures the widest possible illumination of the bend because the two light beams do not focus their light on a single point. The low beam in the Bi-Xenon headlights follows the driver's steering movements and continuously adjusts to the current driving speed. Sensors continuously record the driving speed, lateral acceleration and steering angle, and use this information to "measure" the corner. A control unit uses the data it receives to work out the best angle for controlling the dynamic cornering light.

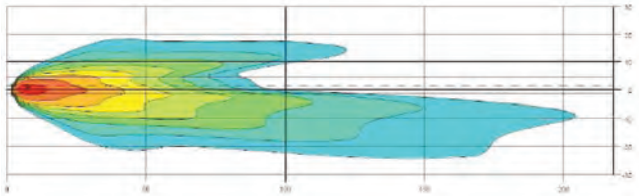
The cornering light also remains active when the high beam is switched on, improving the driver's visibility. When the vehicle stops in a bend, the headlight swivel angle is adjusted slowly back to the zero position to give a quiet overall impression. The dynamic cornering light is not activated when reverse gear is engaged.

The static cornering light activates an additional halogen light source with a beam angle of approx. 30° with respect to the direction of travel. The static cornering light is activated by the direction indicators or by turning the steering wheel when the vehicle is stationary and while driving at low speeds of up to 25 mph (40 km/h). Only the movement of the steering wheel activates the static cornering light at higher speeds.

Electrics/Electronics

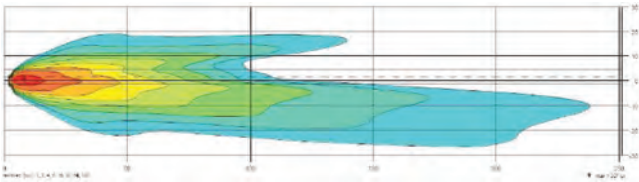
Country Road Light

The country road light has a greater range on the left side of the road and scatters the light wider than the basic dipped beam headlight setting. Headlight range control changes the range of the dipped beam at higher speeds by adapting the light beam. The light spreads further forward and thus improves visibility without blinding oncoming traffic.



Highway Light

The light intensity is increased in conjunction with more effective adaptation at the light/dark border.

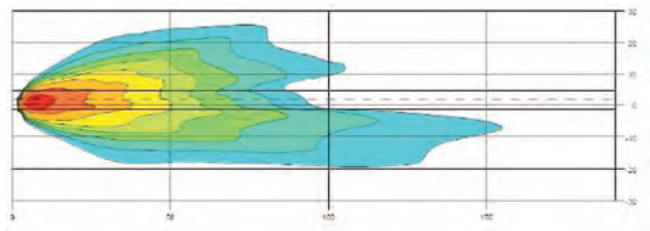


The highway light is activated at speeds of over 80 mph (130 km/h) in the absence of other factors (the light beam becomes longer). The highway light also comes on when the vehicle is travelling at a speed of more than 70 mph (110 km/h) for a long stretch (70 seconds) with a small steering angle (i.e. radius of bend greater than 500 m).

The highway light is characterized by higher light intensity and a more effective adaptation of the light/dark border for these speeds. The highway light is deactivated at speeds of less than 56 mph (90 km/h), depending on the time delay and the steering angle (radius of bend). The highway light is switched off immediately without any other conditions at speeds of less than 45 mph (70 km/h). It is important to bear in mind here that the highway light will not be activated in markets with speed limits of less than 110 km/h or 70 mph (e.g. parts of USA)!

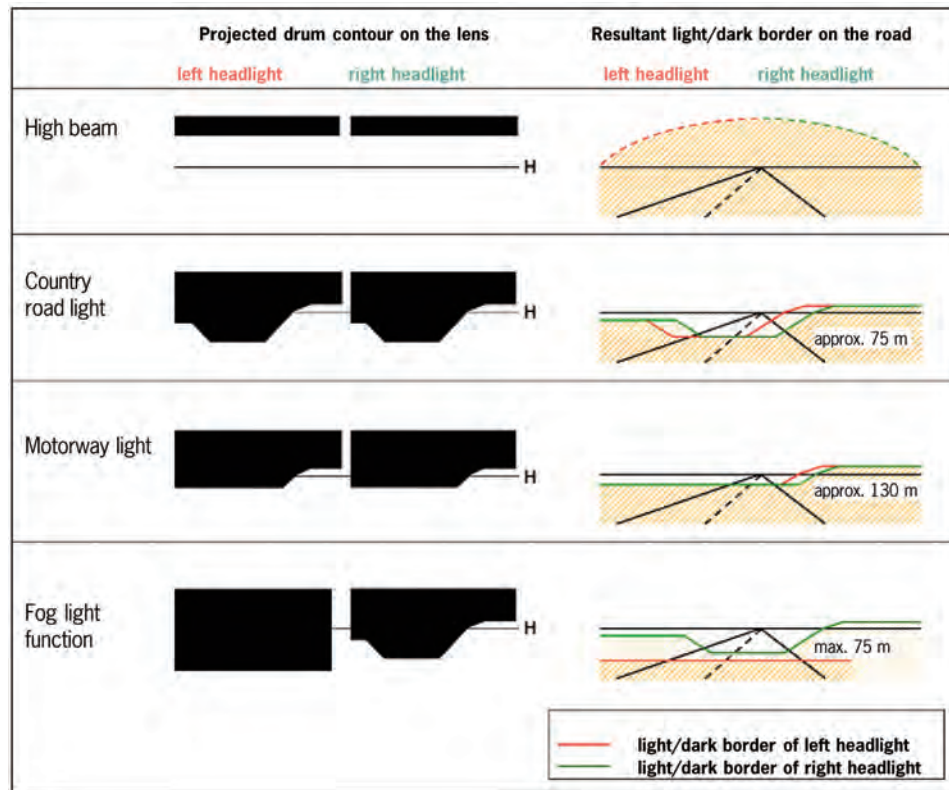
Fog Light

The fog light function of the adaptive light system, which is activated when the rear fog lights are switched on, reduces reflections in low-visibility conditions, e.g. in fog or when driving on snow. The dipped beam spreads out wider and the left headlight adapts the light/dark border horizontally, thereby reducing the range of the light beam. The left headlight also swivels to the left, causing the focal point of the light to move outwards accordingly. This reduces dazzle for the driver. The fog light function is available at speeds of up to 45 mph (70 km/h). The light system switches back to country road light at higher speeds. light



Light Functions

This illustration gives a summary of how the light functions high beam, country road light, highway light and fog light function can be produced using the various contours of the drum in headlights with the adaptive light system. The Xenon headlight shines onto the drum and projects the contour of the drum onto the lens (projection system). This produces the blended contours and light/dark borders on the road surface.



Notes:

[illegible]

Electrics/Electronics

LED Tail Lights

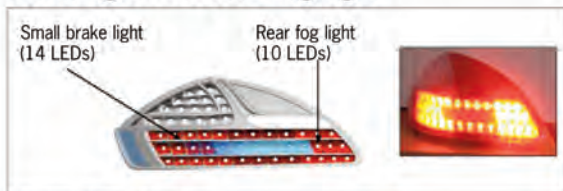
The advantages:

- Extremely fast response
- Excellent illumination
- Greater visibility
- Energy efficiency
- Long service life and environmentally friendly

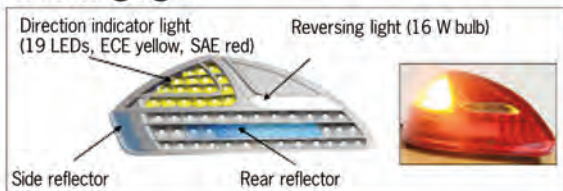
Brake light



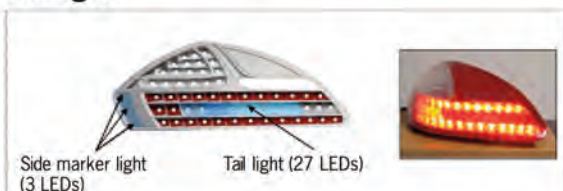
Brake light with rear fog light



Reversing light



Tail light



State-of-the-art LED technology is also used for the tail lights, the third brake light in the tailgate and for the rear direction indicator lights and rear fog lights. In addition to the visual impact and the long service life, the main advantage of LED technology is its short response time.

The side marker light with a yellow reflector is integrated into the front apron and the rear direction indicator lights are red in North America and yellow in Europe. The rear fog light only lights up on one side – on the left side for in order to distinguish it more clearly from the brake light. When the rear fog light is on, only the inner 14 LEDs of the 30 LEDs in the brake light are used in order to further differentiate the fog light.

Rotary Light Switch Set To Auto

- Daytime running lights
- Vehicle courtesy lights
- License plate lights
- Marker light

Leaving the vehicle:

RLF (rain-light-moisture) sensor detects darkness, terminal S is off, a door is open. The marker light (side light) and daytime running lights are then activated. The activation time (10-120 seconds) can be set in the instrument cluster.

Approaching the vehicle:

Unlock using the remote control, RLF sensor detects darkness. The marker light (side light) and daytime running lights are then activated. The activation time (10-120 seconds) can be set in the instrument cluster.

Vehicles with the driver memory package or 14-way power seats with memory package (standard feature in the Panamera Turbo) have an additional LED courtesy light in the automatically dimming exterior mirrors. This function is also activated when the vehicle is unlocked by remote control or using Porsche Entry & Drive.



Daytime Running Light



Vehicle Courtesy Lights

Rear Interior Light Package

A rear interior lighting package with ambient lighting is available on request. In addition to providing adjustable, covered continuous lighting in the front and rear overhead console, it also offers additional, bright LED reading lights, orientation lights and footwell lighting for the rear.



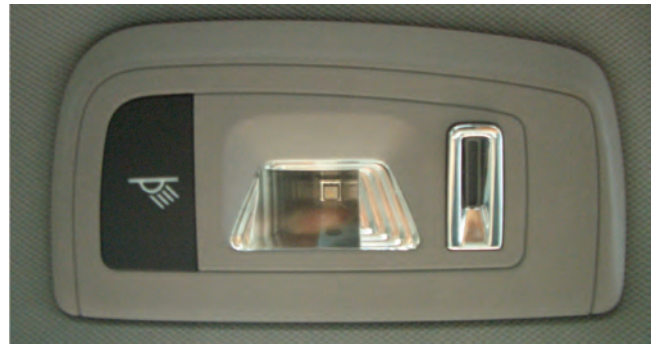
License Plate Lights



Marker Light



Reading Light



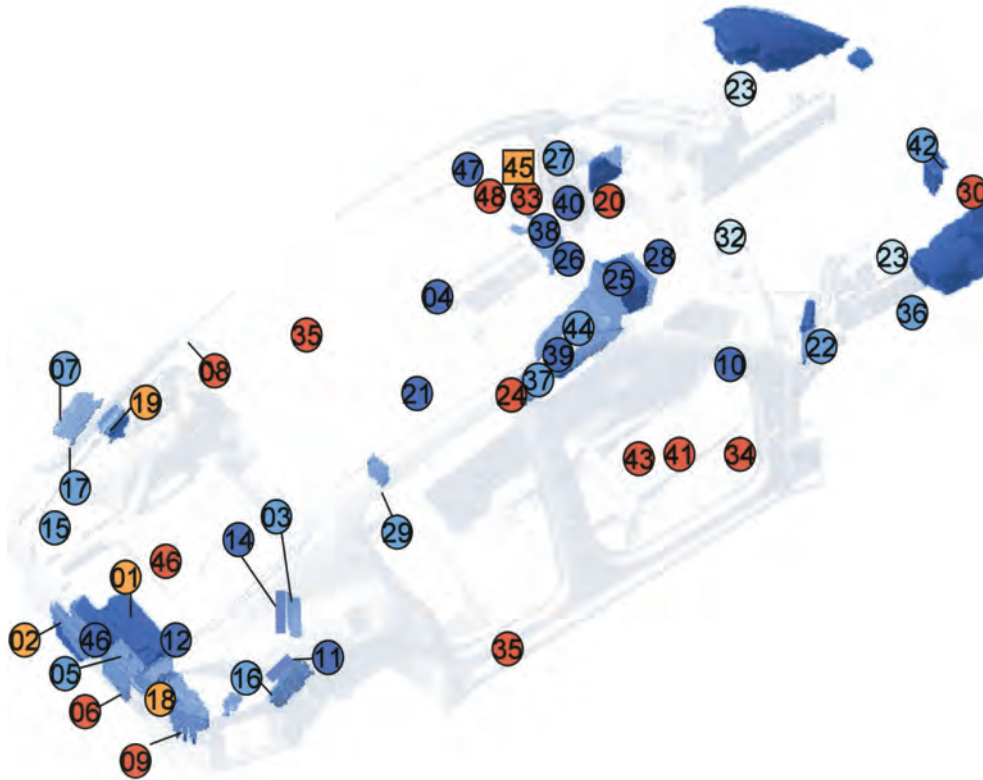
Overhead Console Light



Footwell/Orientation Lighting

Electrics/Electronics

Component Overview



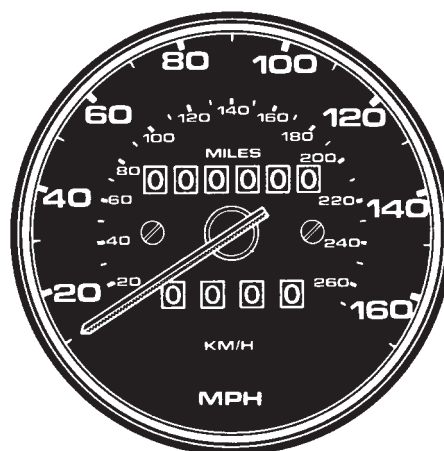
- | | |
|--------------------------------|----------------------------|
| 01. Battery | 25. ECU PCM3.1 |
| 02. HSB/power distributor rear | 26. Roof console |
| 03. ECU EPB | 27. ECU PDK |
| 04. ECU PDC | 28. Sport Chrono |
| 05. Compressor | 29. Fuel pump |
| 06. HWE/BCM-rear | 30. ECU Homelink |
| 07. ECU Transverse lock | 32. Front wipers |
| 08. Sounder Parkassist | 33. ECU driver door |
| 09. ECU Trailer | 34. ECU passenger door |
| 10. Amplifier | 35. ECU door rear (2x) |
| 11. ECU rear Camera | 36. ECU PSM |
| 12. Subwoofer | 37. ECU Shift lever |
| 14. TV Tuner | 38. ECU KLSM |
| 15. ECU PDCC (AAK) | 39. Air control unit front |
| 16. ECU TPM | 40. Instrument cluster |
| 17. ECU PASM | 41. ECU Seat |
| 18. ECU VTS | 42. ECU ACC |
| 19. ECU Gateway | 43. ECU Weight sensor |
| 20. VWE/BCM-front | 44. Sensor cluster |
| 21. Air control unit rear | 45. Diagnosis connector |
| 22. ECU Engine | 46. Auxiliary heater |
| 23. ECU ALWR | 47. Lightswitch |
| 24. ECU Airbag | 48. Ignition lock |

Temperature Conversion



Metric Conversion Formulas

INCH	X	25.4	=	MM
MM	X	.0394	=	INCH
MILE	X	1.609	=	KILOMETER (KM)
KM (KILOMETER)	X	.621	=	MILE
OUNCE	X	28.35	=	GRAM
GRAM	X	.0352	=	OUNCE
POUND (lb)	X	.454	=	KILOGRAM (kg)
kg (KILOGRAM)	X	2.2046	=	lb (POUND)
CUBIC INCH	X	16.387	=	CUBIC CENTIMETER (cc)
CC (CUBIC CENTIMETER)	X	.061	=	CUBIC INCH
LITERS	X	.0353	=	CUBIC FEET (cu.ft.)
CUBIC FEET (cu.ft.)	X	28.317	=	LITERS
CUBIC METERS	X	35.315	=	CUBIC FEET (cu.ft.)
FOOTPOUND(ft lb)	X	1.3558	=	NEWTON METER (Nm)
Nm (NEWTON METER)	X	.7376	=	ft lb (FOOT POUND)
HORSEPOWER (SAE)	X	.746	=	KILOWATT (Kw)
HORSEPOWER (DIN)	X	.9861	=	HORSEPOWER (SAE)
Kw (KILOWATT)	X	1.34	=	HORSEPOWER (SAE)
HORSEPOWER (SAE)	X	1.014	=	HORSEPOWER (DIN)
MPG (MILES PER GALLON)	X	.4251	=	Km/l (KILOMETER PER LITER)
BAR	X	14.5	=	POUND/SQ. INCH (PSI)
PSI (POUND SQUARE INCH)	X	.0689	=	BAR
GALLON	X	3.7854	=	LITER
LITER	X	.2642	=	GALLON
FAHRENHEIT	-	32÷1.8	=	CELSIUS
CELSIUS	X	1.8+32	=	FAHRENHEIT



Conversion Charts

Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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