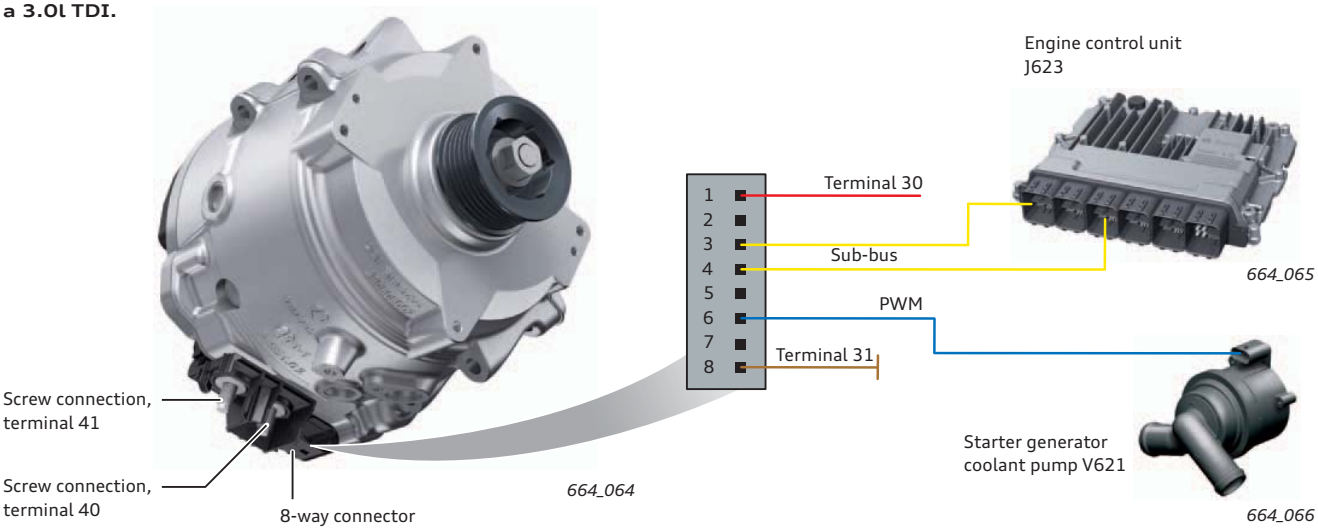
Starter generator C29

General description

The starter generator C29 is configured as a 48-volt belt starter generator. As a generator, it charges the 48-volt battery and supplies the voltage converter with 48 volts DC. As an electric motor, it can be used both as a starter and as a booster for the internal combustion engine.

It is water-cooled and has an electrical water pump. C29 communicates with the engine control unit via a sub-bus connection (also commonly known as the private CAN bus) and activates the starter generator coolant pump V621 by generating a pulse-width-modulated (PWM) signal.

The illustration shows the connection scenario for a 3.0l TDI.



Activation of V621

The starter generator coolant pump V621 is activated in an engine-specific fashion. It is connected to the starter generator in the 3.0l TDI (see figure) and directly to the engine control unit in the 3.0l TFSI. The integration of V621 into the engine cooling system varies from one engine type to another. In some engines coolant flow through the starter generator is assisted by the main water pump, while in others it is not. In some cases, V621 performs additional tasks within the engine cooling system. The conditions under which the starter generator coolant pump is operated are defined in the engine control unit software. In service centres it can be activated for purposes of function testing by means of the actuator diagnostics.

Specifications

Designation	Starter generator C29
Diagnostic code	00CC
Communication	Private CAN to engine control unit
48-volt positive / negative terminal designations	40/41
Nominal rpm	6000 rpm
Transmission ratio (starter generator / internal combustion engine)	2.72 – 3.40 (depending on engine type)
Rated voltage in motor mode	40 volts
Rated voltage in generator mode	51.5 volts
Rated output in motor mode (boost for the internal combustion engine, for max. 5 seconds)	approx. 6 kW
Rated output in generator mode (recuperation [2], for max. 5 seconds)	approx. 14 kW
Continuous rated output in generator mode	approx. 5 kW
Maximum torque in motor mode	60 Nm

[1] Recuperation: energy recovery, e.g. in overrun or under braking, the kinetic energy of the vehicle is transformed into electrical energy.

The 48-volt MHEV (Mild Hybrid Electric Vehicle)

General description

The abbreviation MHEV stands for Mild Hybrid Electric Vehicle. These vehicles generally have an additional battery as well as a small e-machine. This means, basically, that functions such as extended recuperation and internal combustion engine assistance by the e-machine (boost) are possible. The internal combustion engine is generally responsible for drive and for generating electrical energy. All-electric driving is not possible with the Audi A8 MHEV.

The Audi A8 (type 4N) is designed as a 48-volt MHEV. The 48-volt battery serves as an auxiliary battery and the starter generator as the e-machine. This applies to both the 3.0l TFSI and 3.0l TDI versions of the A8. Only A8 models still equipped with the 2nd generation 3.0l TDI due to national restrictions are not designed as MHEV's and, therefore, do not have a 48-volt electrical system.

Mild hybrid functions

The 48-volt MHEV concept offers drivers a number of new functions which enhance both efficiency and ride comfort. These additional functions also require additional controls and displays.

The following functions have been implemented in the Audi A8 (type 4N):

- Start-stop at speeds of less than 22 kph
- Internal combustion engine assistance by the starter generator
- Extended recuperation
- Intelligent coasting with internal combustion engine shut-off
- More comfortable internal combustion engine start-up by the starter generator
- More comfortable internal combustion engine shut-off by the starter generator
- Immediate restarting of the internal combustion engine by the starter generator (change of mind)

Start-stop

The engine in the new Audi A8 (type 4N) can be shut off by the start-stop system at speeds of less than 22 kph, e. g. when coasting to a standstill at a red traffic light.
The driver sees the dial of the rev counter at "READY" and the green start-stop symbol in the instrument cluster.

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If all of these conditions are not met, the engine is not shut off automatically by the start-stop system. The engine may still be in the warm-up phase, the engine oil temperature may be too high due to motorway driving, the air conditioning system may be preventing the engine from shutting off automatically, etc.
In this case, the engine runs at idling speed when the vehicle is stationary and the white start-stop symbol is visible.

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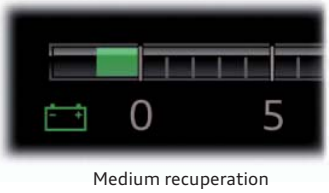
Extended recuperation

In recuperation mode the vehicle's kinetic energy is used to charge the battery during overrun phases. Thanks to their auxiliary battery, mild-hybrid vehicles have a higher recuperation capacity than previous vehicles. The Audi A8 (type 4N) with its lithium-ion battery and the 48-volt starter generator has a recuperation capacity of up to 12 kW.

The so-called "overrun recuperation" cycle is indicated by a 50% display in the instrument cluster.



Medium recuperation

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The "extended recuperation" cycle is initiated by efficient assist and indicated by the 100% display in the instrument cluster.

Maximum recuperation

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Intelligent coasting / engine off

General description

The coasting strategy works in much the same way as an anticipatory driving style. Coasting is initiated in selected, anticipatory and worthwhile situations. Only the ancticipatory function (efficiency assist) actively initiates coasting mode (engine on or engine off). The basic principle is: When the driver takes his foot off the accelerator, the vehicle always enters overrun mode, unless the ancticipatory functions (efficiency assist, ACC or cruise control) initiate coasting mode. The intelligent coasting function can be selected by the driver in the MMI under the menu item "Driver assistance systems/Efficiency assist".

Limits

- Speed range 55 – 160 kph
- Selector position D or efficiency mode
- Accelerator and brake pedals not pressed
- Downhill gradient <4 %
- Uphill gradient <3 %
- Lateral acceleration <1.5 m/s^2

Displays

Displays in the instrument cluster indicate to the driver when intelligent coasting mode is active and when the engine is shut off. The dial on the speedometer indicates a speed of between 55 and 160 kph, the rev counter dial is at "READY" and the green start-stop symbol is lit.

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If coasting mode is active but the engine continues to run, this is indicated as follows in the instrument cluster.
A vehicle speed of greater than 0 kph is displayed and the rev counter indicates idling speed.

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Improvements by starter generator

The use of the starter generator makes restarting the internal combustion engine while driving much more comfortable than is the case with conventional pinion-type starters. The fact that the starter generator is permanently coupled to the internal combustion engine via the poly V belt allows the internal combustion engine to be restarted even if it has not yet come to a complete standstill. This situation can occur if, for example, the engine is shut off by the start-stop system, but has not come to a complete standstill and the driver presses the accelerator because he wants to continue driving (change of mind situation).

A further improvement stems from the fact that the internal combustion engine can be braked precisely by the starter generator during shut-off, allowing "shut-off judder" to be reduced significantly. The starter generator can be used as an e-machine while the engine is running and can assist the internal combustion engine in certain load ranges, thus improving fuel economy. The starter generator in the Audi A8 (type 4N) is not designed to boost the torque and/or power output of the internal combustion engine.

Reference
For further, detailed information on coasting mode, refer to Self Study Programme 662 "Audi A8 (type 4N)".