GS Yuasa E-Learning Support Documentation

Auxiliary Batteries

Overview:

This support documentation has been designed to work in conjunction with the GS Yuasa e-learning course “Auxiliary Batteries” and covers of the following subjects:

- **Auxiliary battery overview**
- **IC engine auxiliary battery function**
- **IC engine auxiliary battery operation**
- **Hybrid & electric vehicle auxiliary battery**
- **Autonomous vehicle battery**

Auxiliary battery overview

Applications & usage

Modern vehicles with emission reduction technologies, high specification levels or electronic driver aids may feature an auxiliary battery. This operates alongside the starter battery on internal combustion engine vehicles or the high voltage battery on hybrid and electric vehicles.

Auxiliary batteries vary in size and specification depending on the demands of the vehicle electrical system. They can be used as a safety back-up to support the main battery when required or to provide voltage for specific vehicle systems continuously.

Internal combustion engine auxiliary battery function

Battery function

The auxiliary battery on internal combustion engine vehicles is connected to the vehicles electrical system but isolated from the starter circuit. It prevents the voltage drop caused by engine starting from affecting the operation of the electrical system and ensures reliable cold starting. This means it must be able to store and provide large amounts of electrical energy and withstand regular discharge and recharge.

Its size and capacity are dictated by the level of power required to support electrical consumers such as central locking and anti-theft systems that are active when the engine is switched off. This prevents the starter battery from becoming discharged by these systems ensuring reliable cold starting.

The system is controlled by a vehicle power management module which adapts to provide optimum charging of both batteries. It is configured based on the charge level of either the starter or auxiliary battery to ensure that the vehicle electrical system remains operational.

Internal combustion engine auxiliary battery operation

Engine starting

Typically the architecture of the system consists of a starter motor, stater battery, auxiliary battery, alternator, control switches, voltage sensitve and non-voltage sensitive loads.

During engine starting the voltage sensitive loads are isolated from the starter circuit and powered solely by the auxiliary battery. The starter battey therfore supplies the starter motor and non-voltage sensitive loads such as the engine ECU.

Engine running

Once the engine is running the voltage sensitive loads are reconnected to the electrical system and supported by the starter battery and alternator. The starter battery is therefore being charged by the alternator and the auxiliary battery is isolated from the circuit if it is fully charged.

If the system detects a low auxiliary battery voltage it is not isolated from the charging circuit and is therefore being charged. Once the auxiliary battery is fully charged it is then isolated from the charging circuit to prevent battery damage and reduce alternator and consequently engine loads saving fuel and reducing emissions.

Hybrid & electric vehicle auxiliary battery

Hybrid vehicle auxiliary battery

Most hybrid vehicles such as the Toyota Prius feature a conventional 12 Volt auxiliary battery in addition to the high voltage hybrid system battery.

The auxiliary battery is not used for engine starting or to power the traction motors. It is used to supply power to vehicle accessory systems, headlights, audio system and computer controls.

Electric vehicle auxiliary battery

As with hybrid vehicles, electric vehicles such as the Mitsubishi MiEV feature an auxiliary battery in addition to the high voltage traction battery. The auxiliary battery is not used by the traction motor but is charged by the traction battery. It is used to support all electrical systems except air conditioning and heating.

Autonomous vehicle battery

Autonomous vehicle overview

Levels of driving automation or autonomy are a set of guidelines determined by the Society of Automotive Engineers (SAE) to describe the differing levels of autonomy in driverless cars. There are currently 5 levels in total, with one being the most basic and five being the most advanced. As the sophistication of vehicle autonomy increases and we move on to level 3 there is a need for auxiliary batteries to support the main electrical system in the event of a fault.

Level 1 autonomy

Level one autonomy is the most basic type where one element of the driving process is taken over in isolation using sensors, control modules and cameras but the driver is still in control of the vehicle. These systems include radar guided cruise control or automatic lane departure assistance.

Level 2 autonomy

In level 2 autonomy vehicle computers take over two or more functions from the driver and are intelligent enough to integrate speed and steering systems together using multiple data sources. The most common examples of this are self-parking and radar guided cruise control, where the vehicle uses satellite navigation data to automatically brake for corners and maintain a set distance from the car in front. Again, the driver must still be in control of the vehicle whilst these systems are operational.

Level 3 autonomy

In level 3 autonomy vehicles computers can take control of safety critical systems and the vehicle can drive itself. This is known as conditional automation which allows all aspects of the driving to be done for the driver, however the driver must be on-hand to intervene when requested. This type of autonomy will require an auxiliary battery to support the electrical system if a fault renders the main electrical system inoperative giving the driver time to assume full control of the vehicle.

Level 4 & 5 autonomy

Autonomy level 4, where the vehicle is fully autonomous in controlled areas with the driver present and level 5 where the vehicle is fully autonomous anywhere with an optional driver are still in development. It is anticipated that these vehicle types will also require the addition of an auxiliary battery support system.