Bi Modal Minibus

50 Tons Version - 20 seats

Data Sheet

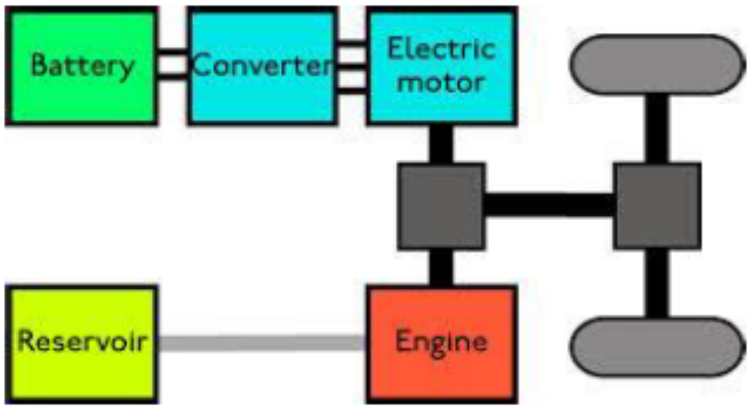
Technical Details	
Drivetrain Features	AC operation - 40 kW power - ECE 85 - 288 V (rated voltage)
Electric Motor	AC type - 30 kW (rated power) 60 kW (max power) - 130 Nm (rated torque) - 260 Nm (max torque) - 4 poles - 3000 rpm (rated speed) - IP 56
Motor controller	350 A (max current) - modulation PWM - 320 Hz (max frequency) - controlled with microprocessor - IP 56
Cooling System	liquid cooling with dedicate circuit
Battery Type	LiPo o LiFePO4 72S battery pack with conditioned steel housing
Capacity and performance	20 kWh
Battery life cycles	2000 (80% DOD) - 3000 (70% DOD)
Time of recharge	around 2,5 hours for total recharge
Batterycharger	380 V - 9 kW - 3P +t + N PWM modulation
Auxiliary Battery	12 V - 120 Ah
Interface display	LCD for operating mode selection
Max Speed	80/90 Km/h
Gradi ability	18%
Autonomy	50 Km

Design of the traction system

DRIVETRAIN DESCRIPTION

The basic design includes a drivetrain architecture called "parallel hybrid" and generally called "bi-modal".

The thermal engine is normally connected to the traction axis through the gearbox-clutch unit without any change while the electric drivetrain is connected in parallel on the transmission shaft through a two-speed mechanical gearbox.



Parallel powertrain diagram

Gear motor group picture

This system provides for the simultaneous traction of the two propulsion units that operate in a totally independent way thanks to the mechanical reducer that is equipped with the disconnection and allows to exclude the non-operational line.

The component is installed downstream of the clutch-change unit by adapting the length of the transmission shaft to its overall dimensions.

The electric traction part employs a three-phase electric motor AC driven by a dedicated motor controller and powered in direct current by an accumulator group (LiPo o LiFePO4) in 72S configuration with rated voltage of about 250V.

DESCRIPTION OF THE ACCUMULATORS AND BMS

The accumulator group is dimensioned with a power that meets two main needs required by the drivetrain:

1- Rated power and peak power
2- 50 Km autonomy

The first item leads to the design of a storage system that has the capacity to continuously deliver power equal to that of the driver's plate and at most, a value slightly higher than the peak power of the electric motor (maximum time of 20-30").

Lithium iron phosphate cells (Lifepo4) are preferred for their ability to operate in a wide range of temperature, chemical stability, low flammability and, above all, useful life in terms of discharge-charge cycles (over 1500 with DOD level less than 80%).

In cases where particular operational performance is required at the powertrain we opt for the technology Lithium Polymers (Lipo) that guarantees higher discharge currents, higher energy density but low chemical stability, safety and above all a reduced useful life in terms of discharge-charge cycles (about 800 with DOD level less than 80%).

LiPo cell picture

$LiFePO_4$ picture

The second item also depends on the nominal power of the driver, but also on the type of vehicle and above all on the use it has to perform.

The data provided by the Lifepo4 cells manufacturer ensures continuous discharge values at 3 times the rated power and a peak value (for 30") of 10 times greater.

Having not modified the drivetrain, it was enough to verify that the accumulation group in halved size still has the minimum operating performance, in order to meet the demands of the system that has to supply.

The battery pack is housed inside a metal containment box that includes the installation of temperature sensors and any conditioning of the cells.

In relation to the type of cells chosen, BMS (battery management system) is developed. It has the function to manage the cells of the accumulator group during the charging and discharging phase.

The term BMS indicates not only the battery monitoring part, but also the current sensor, the cell equalization system and the datalogger, that has the purpose to store the trend of the overall voltage of the battery pack so as to be able to verify the correct use by the end customer.

These three components are to be considered integral parts of the BMS and work in combination with it.

The hardware architecture is designed according to the number of cells used and any additional features required in order to subsequently program the component with a dedicated configurable via USB interface software .

DESIGNING AND CONSTRUCTING OF THE GEARMOTOR

The electric motor used is sized according to the characteristics of the vehicle and the operating conditions in which it is called to operate.

In relation to the maximum speed required and the specifications of the vehicle, the power size of the engine to be installed through dedicated calculation systems is obtained .

The reduction ratio and the maximum weight of the vehicle at full load, together with other parameters, determine the maximum torque required and therefore the choice of the ratios of the mechanical gearbox.

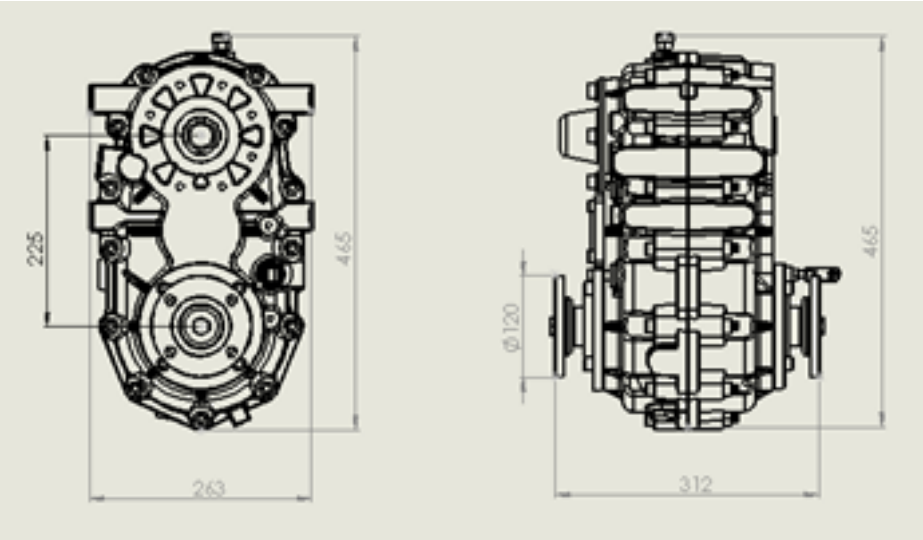
The latter component, in fact, has two different reduction ratios to allow the overcoming of gradients up to 15% (with the largest reduction) and the achievement of the required speed (with the smallest reduction) at the maximum engine speed offered by the electric motor.

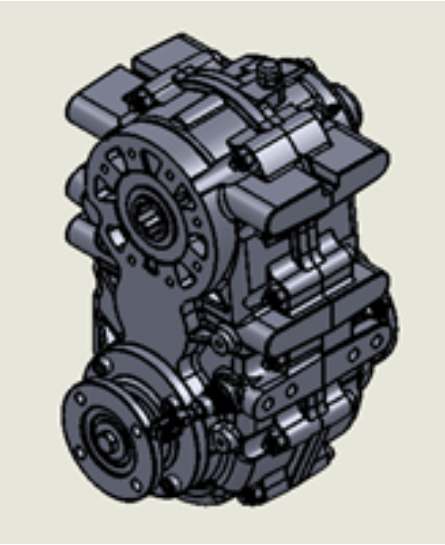
The same gearbox is equipped with a system that allows disconnection from the original transmission, in order to make the entire original system completely insensitive to the presence of the electric drivetrain while driving in thermal mode.

Conversely, when the traction is implemented by the electric motor, the line connected to the thermal engine is put into neutral and the vehicle is only driven by the electric motor without this being affected by the presence of the rest.

There is an additional and independent closed-circuit liquid cooling system to dissipate the heat generated while driving by the electric drivetrain.

The system also provides recovery in braking where, the electric motor acts as a generator for direct charging of the battery pack.





GREEN VEHICLES

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