Heavy-duty batteries for AGVs

- Very high discharge power > 3C
- Fast charging up to 30 minutes
- Very long service life > 6000 cycles
- Maintenance free
- Kokam cells
- Tyco vacuum contactors
- Hi-end components
- Dust and moisture tight case

Designed for AGVs with 24x7 opportunity charge; the ideal solution for uncompromising performance and reliability; compatible with existing chargers; can be retrofitted.

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Heavy-duty

126Ah 48V - AGV SYSTEM-SACMI

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- ✓ Cell type: SLPB-H 63 Ah
- ✓ Cell configuration: 2P14S
- ✓ Total rated capacity: 126 Ah
- ✓ Total rated voltage: 51.8 V
- ✓ Rated energy capacity: 6.5 kWh
- ✓ Total weight (including container and all components): 68 kg
- ✓ Maximum continuous cell charge current: 250 A (2C)
- ✓ Maximum battery discharge current: 250 A, limited by fuse
- ✓ Maximum voltage: 58.8 V
- ✓ Minimum voltage: 42 V
- ✓ Maximum discharge power: > 13 kW
- ✓ Operating temperature range during discharge: -10 °C to +55 °C
- ✓ Operating temperature range during charge: +10 °C to +40 °C
- ✓ Relative humidity range: 0% to 90%
- ✓ Life expectancy: greater than 6000 cycles @ 70% SOC (discharge < 0.5C, charge < 0.2C)

Heavy-duty

200Ah 48V - AGV SYSTEM-SACMI

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Heavy-duty

- ✓ Cell type: SLPB-H 200 Ah
- ✓ Cell configuration: 1P14S
- ✓ Total rated capacity: 200 Ah
- ✓ Total rated voltage: 51.8 V
- ✓ Rated energy capacity: 10.4 kWh
- ✓ Total weight (including container and all components): 96 kg
- ✓ Maximum continuous cell charge current: 200 A (1C)
- ✓ Maximum battery discharge current: 250 A, limited by fuse
- ✓ Maximum voltage: 58.8 V
- ✓ Minimum voltage: 42 V
- ✓ Maximum discharge power: > 12 kW
- ✓ Operating temperature range during discharge: -10 °C to +55 °C
- ✓ Operating temperature range during charge: +10 °C to +40 °C
- ✓ Relative humidity range: 0% to 90%
- ✓ Life expectancy: greater than 6000 cycles @ 70% SOC (discharge < 0.5C, charge < 0.2C)

300Ah 48V - AGV SACMI

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- ✓ Cell type: SLPB-H 100 Ah
- ✓ Cell configuration: 3P14S
- ✓ Total rated capacity: 300 Ah
- ✓ Total rated voltage: 51.8 V
- ✓ Rated energy capacity: 15.5 kWh
- ✓ Total weight (including container and all components): 135 kg
- ✓ Maximum continuous cell charge current: 350 A (> 1C)
- ✓ Maximum battery discharge current: 350 A, limited by fuse
- ✓ Maximum voltage: 58.8 V
- ✓ Minimum voltage: 42 V
- ✓ Maximum discharge power: > 18 kW
- ✓ Operating temperature range during discharge: -10 °C to +55 °C
- ✓ Operating temperature range during charge: +10 °C to +40 °C
- ✓ Relative humidity range: 0% to 90%
- ✓ Life expectancy: greater than 6000 cycles @ 70% SOC (discharge < 0.5C, charge < 0.2C)

Heavy-duty

63Ah 96V - AGV TECNOFERRARI

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Heavy-duty

- ✓ Cell type: SLPB-H 63 Ah
- ✓ Cell configuration: 1P27S
- ✓ Total rated capacity: 63 Ah
- ✓ Total rated voltage: 96.2 V
- ✓ Rated energy capacity: 6.1 kWh
- ✓ Total weight (including container and all components): 67 kg
- ✓ Maximum continuous cell charge current: 130 A (> 2C)
- ✓ Maximum battery discharge current: 160 A, limited by fuse
- ✓ Maximum voltage: 113.4 V
- ✓ Minimum voltage: 81 V
- ✓ Maximum discharge power: > 15 kW
- ✓ Operating temperature range during discharge: -10 °C to +55 °C
- ✓ Operating temperature range during charge: +10 °C to +40 °C
- ✓ Relative humidity range: 0% to 90%
- ✓ Life expectancy: greater than 6000 cycles @ 70% SOC (discharge < 0.5C, charge < 0.2C)

Retrofit for AGVs

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SCENARIO

The *Heavy-duty* batteries for *retrofitting* the AGVs are made with high performance cells to ensure high starting capacity, fast and efficient charging, very long service life and low weight.

They are mechanically compatible with lead-acid batteries, since they can be installed using the same fixing points.

The batteries can also use the existing electrical signals and voltages, thus avoiding the need for significant modifications to the original system.

Three-phase battery charger

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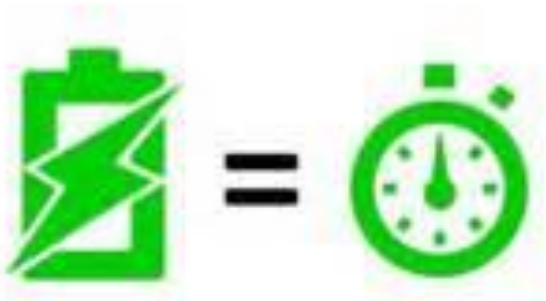
SCENARIO

Although the existing battery chargers can be used to reduce the initial *retrofit* costs by gradually replacing lead-acid batteries with lithium ones, we recommend the use of dedicated battery chargers for fast charging.



The use of a controlled three-phase battery charger allows you to optimize the charging process and also maximize the speed of opportunity charges.

Diagnostics

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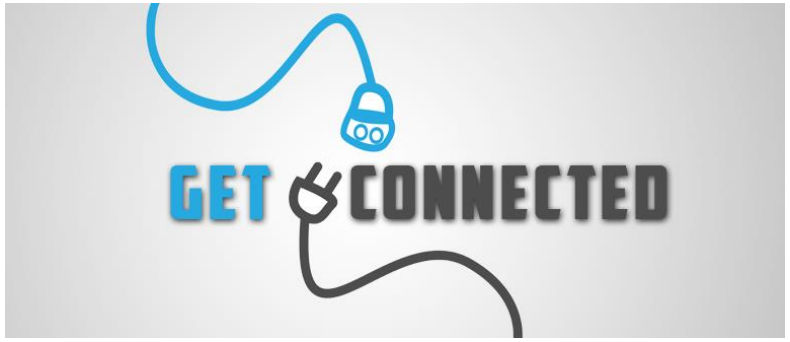
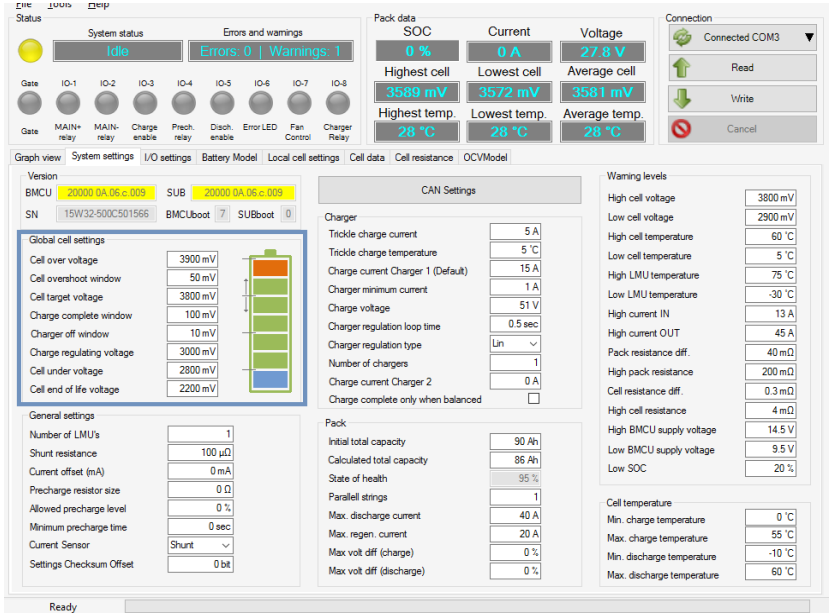
SCENARIO

The innovative management system (BMS) of all Voltmec batteries allows advanced monitoring of the battery's state of charge and continued safe operation.

- ✓ All diagnostic details are available on the CAN network. They enable performance of preventive maintenance, improvement of process efficiency during operation and notification when charging is necessary.
- ✓ The accurate calculation of the state of charge takes both voltage/temperature and energy into account (Coulomb counting).





Diagnostic accuracy makes the vehicle safer and more reliable.

Safety

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SCENARIO

Voltmec batteries are equipped with multiple levels of security, both hardware and software, passive and active, in particular:

- ✓ Continuous voltage monitoring of each cell and comparison with string voltages.
- ✓ Continuous monitoring of the temperatures of each module and of the electronics.
- ✓ Current monitoring and quick release of contactors.
- ✓ 2 x TYCO vacuum protection contactors with very high breaking capacity.
- ✓ Continuous monitoring of galvanic isolation.
- ✓ 160-500 A fuse.

All cells come with an individual acceptance test certificate and are supplied by leading international manufacturers.

Disadvantages of lead-acid batteries

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SCENARIO

- Short service life
  - ✓ In cyclic use for traction, there is a loss of autonomy immediately starting from the first few months.
- Rapid performance decay
  - ✓ After only 18-24 months the batteries may be unusable.
- Excessive weight
  - ✓ It limits the payload and accelerates the wear of tires, brake bearings and mechanical parts.
- Slow and inefficient charging
  - ✓ Although it lasts 8-12 hours, it is quite inefficient, since only 50-60% of the energy used is stored.

Advantages of lithium batteries

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- Long service life
  - ✓ The battery life is usually comparable to that of the system it powers.
- Unwavering performance
  - ✓ There are no appreciable drops in performance during use.
- Extremely low weight
- Fast and highly efficient charging.

Comparison and TCO

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SCENARIO

A lithium battery has a **service life** 5-7 times greater than a lead-acid one

+

90% charge efficiency means **less energy** wasted

+

improved vehicle **carrying capacity** and **no routine** maintenance

+

shorter charging time, i.e. **longer** run time

=

fewer **batteries** (only one) in the vehicle life cycle

and

fewer **vehicles** to achieve the same productivity

Retrofit – Economic analysis

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EXAMPLE OF TCO

In order to better assess the advisability of replacing the lead-acid battery of an AGV with a lithium battery, some evaluations are given on the break-even point of operating costs by comparing exclusively:

- ✓ battery's initial cost and service life
- ✓ charging efficiency and energy consumption during service
- ✓ AGV's weight and capacity
- ✓ maintenance times and costs

In order to simplify the calculations, the indirect advantages of the reduced wear of all AGV's mechanical parts due to lower weight have therefore been omitted.

Charging efficiency and consumption

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EXAMPLE OF TCO

A great advantage of lithium batteries is the efficiency of the charge-discharge process, which reaches 90%, while in lead-acid batteries this efficiency does not exceed 50%, especially when they are charged for short times.

- ✓ Assuming that an AGV performs 20 cycles of 20Ah per day, its consumption equals to = 20*20 Ah * 96V = 38.5 kWh

To charge this energy from the electricity grid, it requires:

38.5 kWh / 0.9 = 42.8 kWh WITH LITHIUM BATTERIES

38.5 kWh / 0.5 = 77.0 kWh WITH LEAD-ACID BATTERIES

The energy savings during recharging is 34.2 kWh/day, equal to € 6.15/day (with € 0.18/kWh) for each AGV

Voltmec guarantees high charging efficiency by producing only lithium batteries with very low internal impedance and high charge capacity.

AGV's weight and capacity

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EXAMPLE OF TCO

Another considerable advantage is the weight reduction, since an AGV with lithium batteries weighs around 500 kg less (assuming the replacement of a 250Ah lead-acid battery with a 63Ah lithium).

- ✓ By estimating a covered distance of 50 km/day and a consumption of 0.22 kWh/ton * km, there is an energy saving of 0.6 ton * 50 km * 0.22 kWh/ton * km = 6.6 kWh, equal to a saving of 1.2 €/day (with 0.18 €/kWh) for each AGV

In addition, the payload of the AGV increases by 500 kg, extending the capacity and therefore the profitability of the transportation system.

Actual break-even point

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EXAMPLE OF TCO

If we consider that an AGV equipped with a lithium battery works on average 30% more time each day, *the actual break-even point of a lithium battery is reached in **a few weeks**, at least in high-usage plants*.