



M3 Energy Module

G/NMC, 60Ah

- All-new high energy lithium-ion battery module
 - Very-high cycle life with scalable capacity
- Specifically designed for transport applications



The Leclanché Advantage

Engineered to rigorous standards, our lithium-ion cells are manufactured in a state-of-the-art automated production facility in Germany. Our modules, packs and racks are assembled in Switzerland. Leclanché battery systems offer unrivalled safety, quality and durability.

The M3 module is assembled on an all new automated production and testing facility in Switzerland, which is designed to automotive industry standards. This production line can produce 11 times more modules than previously possible, with a capacity of more than 250 MWh per year.

M3 modules include a battery management system (BMS) with functionally safe slave units which can take up to 24 cell measurements. The slave units runs the diagnostics and communicates to the master BMS to ensure optimum safety and comprehensive monitoring.

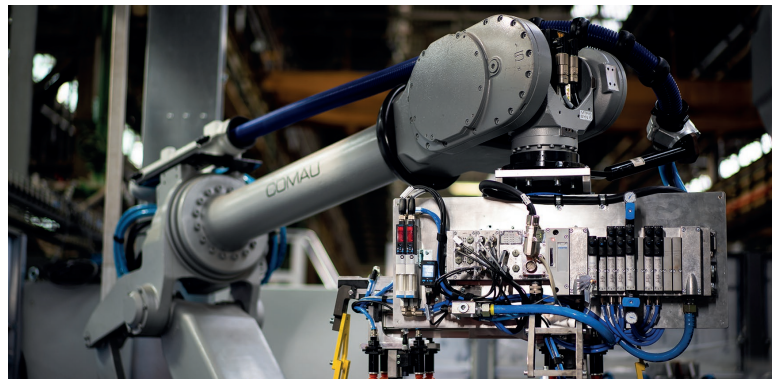
Lithium-Ion G/NMC Cells

The heart of any storage system is the cell. Its quality determines the performance of the entire storage system. Leclanché's Li-ion G/NMC pouch cells are made of the highest quality materials, using unique, state-of-the-art processes to maximise safety and cycle life.



Cell production facility

Through a combination of Swiss precision and German engineering, **Leclanché** provides battery systems and energy storage solutions with the highest quality and reliability levels.



Module production facility

■ Industry Leading Safety and Reliability

Bi-cell laminate design, integrated with a ceramic separator, make cells capable of withstanding abuse without catastrophic, thermal runaway occurring.

■ High Energy Density

The G/NMC technology used by Leclanché provides a 50% energy density advantage and higher life expectancy over LFP chemistries allowing a greater payload or a longer range.

■ 8,000 Cycles

With 8,000 charge/discharge cycles at 80% depth of discharge (DoD), Leclanché's G/NMC cells typically quadruple the cycle life of most competitors and are ideal for long term investments and low-maintenance energy storage systems. This enables significant improvements in total cost of ownership (TCO) to be achieved making them perfect for commercial applications.

■ Up to 100% depth of discharge

Leclanché G/NMC cells can be operated to 100% depth of discharge and can achieve up to 4,500 full cycles at this rate.

■ 2C Charge and 3C Discharge

The cells are capable of 5C for a 20 second pulsed discharge.

■ Wide Temperature Range

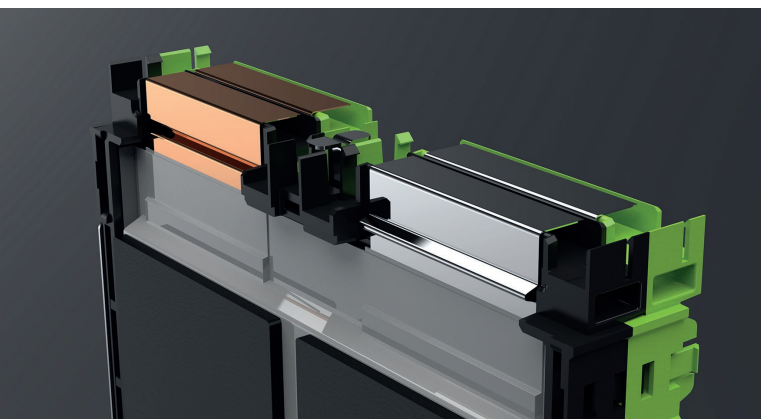
The G/NMC cells can be safely charged and discharged in a wide range of temperatures:

- Charge: 0°C to +45°C
- Discharge: -20°C to +55°C

M3 Modules

Leclanché pouch cells represent the highest in quality, safety and cycle life. The M3 modules provide a rugged and technically advanced housing to fully utilise the cell's high performance. Key benefits include:

- Rugged and resilient (50g acc. and 4kV isolation tested) housing for the cells.
- Large choice of module capacity, voltage and size.
- Improved thermal monitoring using sensors on alternate cells.
- Each module is designed using careful thermal analysis to ensure even temperature distribution and heat sinking across all cells in the module.
- All modules have built-in battery management electronics to simplify installation.
- There are 8 separate G/NMC module configurations each available in either 400A (medium) or 800A (high) power variants, based on 4 module sizes (see table on next page).
- Parallel string connections are also supported for higher pack capacities. Modules can be liquid cooled with conductive cooling plates or force air-cooled.



Cell frame detail

With industry leading lithium-ion technology, we **provide advanced battery solutions** for power and energy intensive applications.

Functionally Safe BMS

The M3 module is fitted with a functionally safe slave unit which communicates with a functionally safe BMS master. This functionally safe battery management system offers the following advanced features:

- The system is designed to meet both ASIL C and SIL 2 requirements.
- The slave measures cell voltages, cell temperatures and runs diagnostics such as open wire detection, reverse polarity protection and self-checks.
- Dual core processor offers redundancy and the functionally safe operating system provides reliability by memory protection and task management.
- Power management integrated circuits (IC) offers stable power.
- Low power consumption during operation and even lower during sleep mode.
- Temperature sensors fitted on alternate cells provide fast response regarding cell temperature while ensuring maximum safety and optimum module lifespan.
- BMS master enclosure is rated to IP67.



Functionally Safe
BMS Master

Battery Management

| | |
|---|---|
| Integrated battery management system (BMS) and master/ slave architecture | ISO26262 / IEC61508 / railway applications / CE Marking |
| Max. voltage | 1,200 V |
| Number of channels per module | Up to 24 in Series |
| External communications (from master) | 2 x CAN (CANOpen), ethernet (Modbus/TCP) |
| Isolation monitoring | ASIL B level |
| Development process | As per ISO 26262 and IEC61508 |
| Diagnostics and performance indicators (SOX algorithm) | Run at each module level |

The Leclanché philosophy :
provide customers with the
highest possible quality,
reliability and service.

G/NMC Cell Data

Specifications

| | |
|---------------------------|--------------------|
| Cell chemistry | G/NMC |
| Cell voltage | 3.65V nominal |
| Nominal cell capacity | 60Ah |
| Cycle life (80% DoD) | Up to 8,000 cycles |
| Cycle life (100% DoD) | Up to 4,500 cycles |
| Maximum calendar lifespan | 10 years |

M3 Module Range

| Module Type | Number of Cells | Nominal Capacity (Ah) | Nominal Energy (kWh) | Nominal Voltage (V) | Max. Voltage (V) | Min. Voltage (V) | Continuous Discharge (A) | Pulse Discharge (A) | Continuous Charge (A) | WxHxL (mm) | Weight (kg) |
|-------------|-----------------|-----------------------|----------------------|---------------------|------------------|------------------|--------------------------|---------------------|-----------------------|-----------------|-------------|
| 20s1p | 20 | 60 | 4.4 | 73.0 | 84.0 | 60.0 | 180 | 300 | 120 | 174 x 322 x 344 | 31.5 |
| 10s2p | 20 | 120 | 4.4 | 36.5 | 42.0 | 30.0 | 360 | 600 | 240 | 174 x 322 x 344 | 31.8 |
| 12s2p | 24 | 120 | 5.3 | 43.8 | 50.4 | 36.0 | 360 | 600 | 240 | 174 x 322 x 401 | 37.7 |
| 16s2p | 32 | 120 | 7.0 | 58.4 | 67.2 | 48.0 | 360 | 600 | 240 | 174 x 322 x 515 | 49.5 |
| 8s4p | 32 | 240 | 7.0 | 29.2 | 33.6 | 24.0 | 720 | 800 | 480 | 174 x 322 x 515 | 49.5 |
| 18s2p | 36 | 120 | 7.9 | 65.7 | 75.6 | 54.0 | 360 | 600 | 240 | 174 x 322 x 572 | 55.3 |
| 12s3p | 36 | 180 | 7.9 | 43.8 | 50.4 | 36.0 | 540 | 800 | 360 | 174 x 322 x 572 | 55.4 |
| 9s4p | 36 | 240 | 7.9 | 32.9 | 37.8 | 27.0 | 720 | 800 | 480 | 175 x 322 x 572 | 55.4 |

Lower power versions (up to 360A continuous discharge) are available on selected configurations.

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THE ENERGY TRANSITION**



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