



M3 Energy Module

G/NMC, 65Ah

- 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.

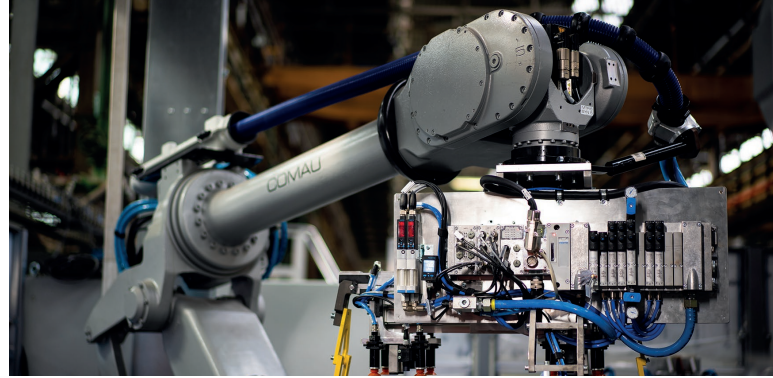
Lithium-Ion G/NMC Cells

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.

■ 7,000 Cycles

With 7,000 charge/discharge cycles at 70% 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 4,000 full cycles at this rate.

■ 2C Charge and 3C Discharge

The cells are capable of over 4C for a 20 second pulsed discharge.

■ Wide Temperature Range

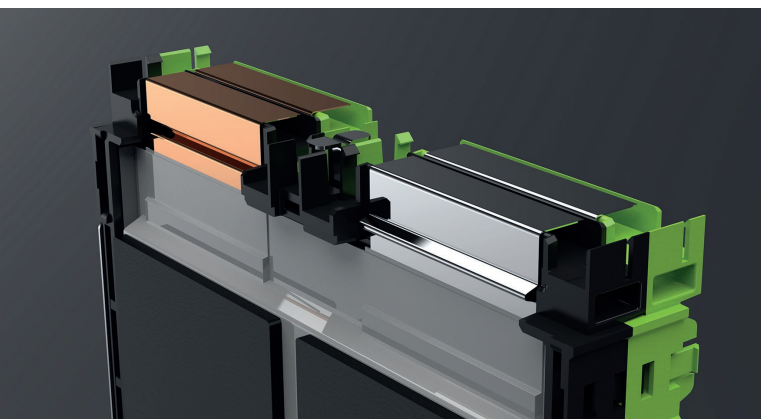
The G/NMC cells can be safely charged and discharged in a wide range of temperatures:

- 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	3.72V nominal
Nominal cell capacity	65Ah
Cycle life (80% DoD)	Up to 7,000 cycles
Cycle life (100% DoD)	Up to 4,000 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	65	4.8	74.4	87.0	60.0	180	300	120	174 x 322 x 344	31.5
10s2p	20	130	4.8	37.2	43.5	30.0	360	600	240	174 x 322 x 344	31.8
12s2p	24	130	5.8	44.6	52.2	36.0	360	600	240	174 x 322 x 401	37.7
16s2p	32	130	7.7	59.5	69.6	48.0	360	600	240	174 x 322 x 515	49.5
8s4p	32	260	7.7	29.8	34.8	24.0	720	800	480	174 x 322 x 515	49.5
18s2p	36	130	8.7	67.0	78.3	54.0	360	600	240	174 x 322 x 572	55.3
12s3p	36	195	8.7	44.6	52.2	36.0	540	800	360	174 x 322 x 572	55.4
9s4p	36	260	8.7	33.5	39.2	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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