

M3 Power Module

LTO, 34Ah

- All-new high power lithium-ion battery module
 - Ultra-high cycle life with scalable capacity
- Specifically designed for transport applications
 - Ideal for opportunity charging and hydrogen systems

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.

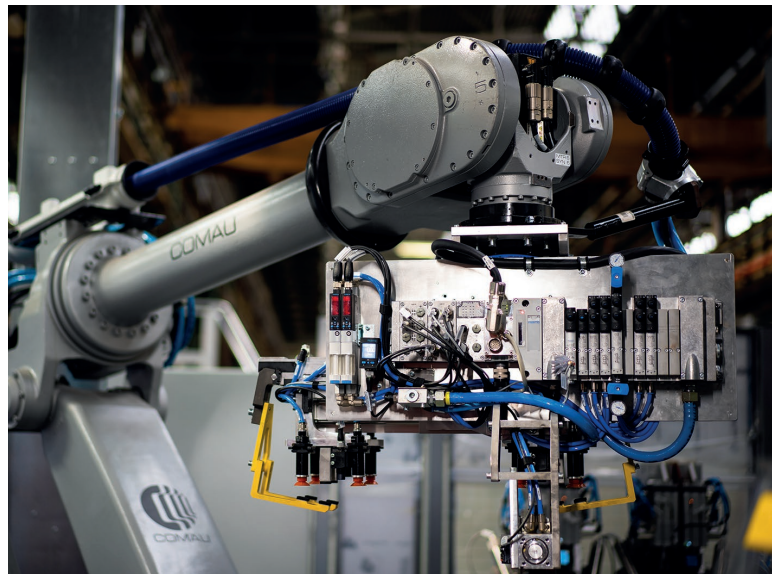
Lithium-Ion LTO Cells

The heart of any storage system is the cell. Its quality determines the performance of the entire storage system. Leclanché's li-ion LTO 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.

■ 20,000 Cycles

Rated to 20,000 full cycles at 80% depth of discharge (DoD) and with a 20-year calendar life, Leclanché's LTO cells set a benchmark for durability and performance. 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 LTO cells can be operated to 100% depth of discharge and can achieve up to 15,000 full cycles at this rate.

■ Class Leading Charge/Discharge Rates of 6C/6C

The maximum continuous discharge rate of 6C means that the LTO battery can be recharged in just 10 minutes.

Furthermore, charge and discharge rates of 10C can be achieved during 20 second pulses.

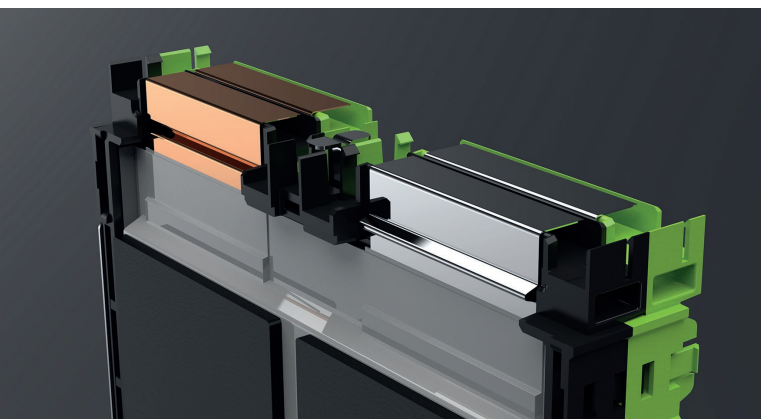
■ Wide Temperature Range (-20°C to 55°C)

Can be safely operated at lower and higher temperatures than other li-ion chemistries.

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 47 separate LTO module configurations each available in either 400A (medium) or 800A (high) power variants, based on 14 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

LTO Cell Data

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

Specifications

Cell chemistry	LTO/NCA
Cell voltage	2.2V nominal
Nominal cell capacity	34 Ah
Cycle life (80% DoD)	Up to 20,000 cycles
Cycle life (100% DoD)	Up to 15,000 cycles
Maximum calendar lifespan	20 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)
10s1p	10	34	0.7	22.0	28.0	15	204	340	204	174 x 322 x 202	16.6
16s1p	16	34	1.2	35.2	44.8	24	204	340	204	174 x 322 x 287	24.5
20s1p	20	34	1.5	44.0	56.0	30	204	340	204	174 x 322 x 344	30.1
10s2p	20	68	1.5	22.0	28.0	15	408	680	408	174 x 322 x 344	31.2
8s3p	24	102	1.8	17.6	22.4	12	612	800	612	174 x 322 x 401	36.1
24s1p	24	34	1.8	52.8	67.2	36	204	340	204	174 x 322 x 401	35.7
13s2p	26	68	1.9	28.6	36.4	19.5	408	680	408	174 x 322 x 430	38.9
14s2p	28	68	2.1	30.8	39.2	21	408	680	408	174 x 322 x 458	41.7
15s2p	30	68	2.2	33.0	42.0	23	408	680	408	174 x 322 x 487	44.5
16s2p	32	68	2.4	35.2	44.8	24	408	680	408	174 x 322 x 515	47.3
8s4p	32	136	2.4	17.6	22.4	12	720	800	720	174 x 322 x 515	47.3
18s2p	36	68	2.7	39.6	50.4	27	408	680	408	174 x 322 x 572	52.9

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

Additional configurations can be provided on request.

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