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TEST REPORT
IEC 62619
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications

Report Number..... :	**AT24-0104732-01**
Date of issue ..... :	**2025-04-14**
Total number of pages ..... :	36
Name of Testing Laboratory preparing the Report ..... :	MIDAC S.p.A.
Applicant's name ..... :	MIDAC S.p.A.
Address ..... :	Via A. Volta, 2 - Z.I. - 37038 Soave VR - ITALIA
Test specification:	
Standard ..... :	IEC 62619:2022
Test procedure..... :	
Non-standard test method..... :	N/A
TRF template used ..... :	IECEE OD-2020-F1:2022, Ed.1.5
Test Report Form No. ..... :	IEC62619B
Test Report Form(s) Originator.... :	UL Solutions (Demko)
Master TRF ..... :	Dated 2023-02-24

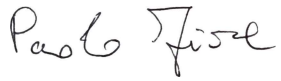
This report is not valid as a CB Test Report unless signed by an approved IECEE Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing NCB. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description ..... :	Li-Ion Batteries
Trademark(s) ..... :	MIDAC +- BATTERIES
Manufacturer ..... :	Same as applicant
Model/Type reference ..... :	3024049, 3024207, 3024265, 3024273, 3024381
Ratings ..... :	3024049 – LFP 51,2 V 540 Ah: Min / Nom / Max Voltages (V): 43,2 / 51,2 / 58,4 Nom / Max Discharge Current (A): 320 / 750 Nom / Max Charge Current (A): 225 / 648 3024207 – LFP 76,8 V 302 Ah: Min / Nom / Max Voltages (V): 64,8 / 76,8 / 87,6 Nom / Max Discharge Current (A): 250 / 453 Nom / Max Charge Current (A): 151 / 362 3024265 – LFP 89,6 V 604 Ah: Min / Nom / Max Voltages (V): 75,6 / 89,6 / 102,1 Nom / Max Discharge Current (A): 500 / 906 Nom / Max Charge Current (A): 320 / 725 3024273 – LFP 51,2 V 100 Ah: Min / Nom / Max Voltages (V): 43,2 / 51,2 / 58,4 Nom / Max Discharge Current (A): 50 / 100 Nom / Max Charge Current (A): 50 / 100 3024381 – LMN 51,8 V 126 Ah: Min / Nom / Max Voltages (V): 40,6 / 51,8 / 58,8 Nom / Max Discharge Current (A): 126 / 155 Nom / Max Charge Current (A): 63 / 76

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
☐ **CB Testing Laboratory:**		
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Approved by (name, function, signature)...:		
☐ **Testing procedure: CTF Stage 1:**		
Testing location/ address.....:		

Tested by (name, function, signature).....:		
Approved by (name, function, signature)...:		
☒ **Testing procedure: CTF Stage 2:**		
Testing location/ address.....:	Via A. Volta, 2 - Z.I. - 37038 Soave VR - ITALIA	
Tested by (name + signature).....:	Paolo Fiore	
Witnessed by (name, function, signature) .:	Fabio Pezzoli	
Approved by (name, function, signature)...:	Luca Stopelli	
☐ **Testing procedure: CTF Stage 3:**		
☐ **Testing procedure: CTF Stage 4:**		
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Witnessed by (name, function, signature) .:		
Approved by (name, function, signature)...:		
Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment):

Attachment 1: Photo documentation (1 page)

Attachment 2: Critical components documentation (4 pages)

Summary of testing:

Tests performed (name of test, test clause and date test performed):	**Testing location:**
cl. 7.2.1 External short-circuit test (ISP18/66/133-14HA single cell) cl. 7.2.3.3 Edge and corner drop test (battery system) cl. 7.3.3 Propagation test (battery system 3024381 only) cl. 8.2.2 Overcharge control of voltage (battery system) cl. 8.2.3 Overcharge control of current (battery system) cl. 8.2.4 Overheating control (battery system) The component cell IFP37/101/192(60)HA (3.2V, 60Ah, 192Wh) was evaluated according to IEC 62619:2017 by TÜV Rheinland, report No.: 60381259 001 The component cell 001CB240 (3.22 V, 302 Ah) was evaluated according to IEC 62619:2017 by TÜV Rheinland, report No.: CN21F0NC 001 The component cell CB0Y0 (3.2 V, 100 Ah) was evaluated according to IEC 62619:2017 by TÜV SÜD PSB Pte Ltd., report No.: 211-281930576-000 The component cell ISP18/66/133-14HA (3.65V 14Ah 51.1Wh) was evaluated according to IEC 62133-2:2017 by CQC Intime Testing Technology Co., Ltd, report No.: 20190506B08745. Since this cell was not tested according to internal short circuit, neither according to cl. 7.3.9 of IEC 62133-2:2017 nor according to cl. 7.3.2 of IEC 62619:2023, it was decided to perform Propagation test (cl. 7.3.3 of IEC 62619:2023) on battery system 3024381 and external short circuit (cl. 7.2.1 of IEC 62619:2023) on a single cell The battery systems codes 3024049, 3024207, 3024265, 3024273 and 3024381 were tested as representative of the battery systems listed in TABLE 10	**MIDAC S.p.A.** Via A. Volta, 2 - Z.I. - 37038 Soave VR - ITALIA

Summary of compliance with National Differences (List of countries addressed):
N/A

☒ **The product fulfils the requirements of EN 62619:2022**

Use of uncertainty of measurement for decisions on conformity (decision rule):

☒ No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other: … (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

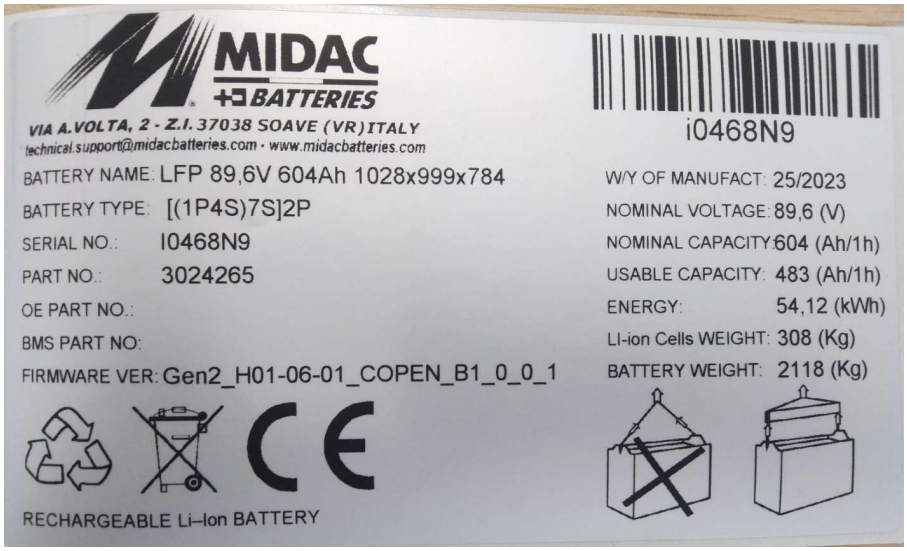
Information on uncertainty of measurement:
The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.
IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.
Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

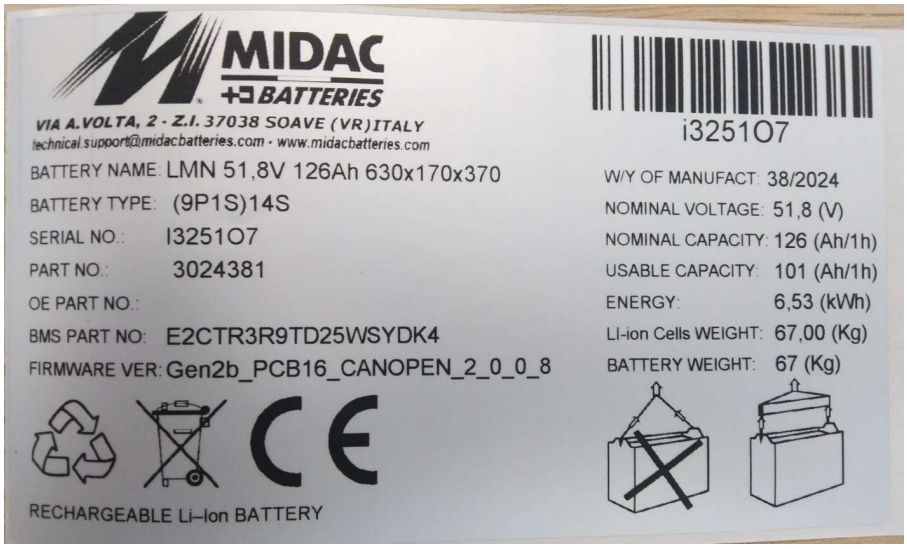
Marking plate of P/N 3024049 – LFP 51,2 V 540 Ah (*)

Marking plate of P/N 3024207 – LFP 76,8 V 302 Ah



Marking plate of P/N 3024265 – LFP 89,6 V 604 Ah (*)

Marking plate of P/N 3024273 – LFP 51,2 V 100 Ah (*)



Marking plate of P/N 3024381 – LMN 51,8 V 126 Ah (*)

Test item particulars.....:	
Classification of installation and use.....:	To be defined in final product
Supply Connection.....:	Not directly connected to mains
.....:	
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item .....:	Item(s) sampled by applicant
Date (s) of performance of tests.....:	2024-10-29 ÷ 2025-03-26

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) ..... : Same as applicant

General product information and other remarks:

The battery systems object of this test report are used in electrical energy storage system (ESS) and traction fields.

Tested battery systems (3024049, 3024207, 3024265, 3024273 and 3024381) were selected as representative of all model's codes listed in TABLE 10, with reference to different cell types used for battery system construction. The main differences between tested battery systems and all the other models listed in TABLE 10 is the number of cells and the enclosure of the battery system.

All battery systems include overcharge, over-discharge, over current and short-circuits proof circuit.

Tested battery system 3024049 is constructed with IFP37/101/192(60)HA (3.2V, 60Ah, 192Wh) lithium-ion cells, with battery module configuration [(3P4S)4S]3P, and main features are shown below:

Product name	Li-Ion Batteries
Model	3024049
Nominal voltage	51,2 V
Maximum voltage	58,4 V
Minimum voltage	43,2 V
Nominal capacity	540 Ah
Usable capacity	540 Ah
Nominal discharge current	320 A
Maximum discharge current	750 A
Nominal charge current	225 A
Maximum charge current	648 A
Absolute cell temperature limits	-25 °C ÷ +55 °C
Discharging temperature	-10 °C ÷ +45 °C
Charging temperature	0 °C ÷ +45 °C
Storage temperature	-10 °C ÷ +35 °C
Nominal mass	839 kg (± 2%)
Dimensions (mm)	830 x 630 x 627

Tested battery system 3024273 is constructed with CB0Y0 (3.2 V, 100 Ah) lithium-ion cells, with battery module configuration (1P8S)2S, and main features are shown below:

Product name	Li-Ion Batteries
Model	3024273
Nominal voltage	51,2 V
Maximum voltage	58,4 V
Minimum voltage	43,2 V
Nominal capacity	100 Ah
Usable capacity	80 Ah
Nominal discharge current	50 A
Maximum discharge current	100 A
Nominal charge current	50 A
Maximum charge current	100 A
Absolute cell temperature limits	-25 °C ÷ +55 °C
Discharging temperature	-10 °C ÷ +45 °C
Charging temperature	0 °C ÷ +45 °C
Storage temperature	-10 °C ÷ +35 °C
Nominal mass	50 kg (± 2%)
Dimensions (mm)	565 x 406 x 143

Tested battery system 3024207 is constructed with 001CB240 (3.22 V, 302 Ah) lithium-ion cells, with battery module configuration (1P4S)6S, and main features are shown below:

Product name	Li-Ion Batteries
Model	3024207
Nominal voltage	76,8 V
Maximum voltage	87,6 V
Minimum voltage	64,8 V
Nominal capacity	302 Ah
Usable capacity	242 Ah
Nominal discharge current	250 A
Maximum discharge current	453 A
Nominal charge current	151 A
Maximum charge current	362 A
Absolute cell temperature limits	-25 °C ÷ +60 °C
Discharging temperature	-25 °C ÷ +45 °C
Charging temperature	-25 °C ÷ +45 °C
Storage temperature	-10 °C ÷ +35 °C
Nominal mass	234 kg (± 2%)
Dimensions (mm)	814 x 534 x 592

Tested battery system 3024265 is constructed with 001CB240 (3.22 V, 302 Ah) lithium-ion cells, with battery module configuration [(1P4S)7S]2P, and main features are shown below:

Product name	Li-Ion Batteries
Model	3024265
Nominal voltage	89,6 V
Maximum voltage	102,1 V
Minimum voltage	75,6 V
Nominal capacity	604 Ah
Usable capacity	483 Ah
Nominal discharge current	320 A
Maximum discharge current	906 A
Nominal charge current	320 A
Maximum charge current	725 A
Absolute cell temperature limits	-25 °C ÷ +55 °C
Discharging temperature	-25 °C ÷ +45 °C
Charging temperature	-25 °C ÷ +45 °C
Storage temperature	-10 °C ÷ +35 °C
Nominal mass	2118 kg (± 2%)
Dimensions (mm)	1028 x 999 x 784

Tested battery system 3024381 is constructed with ISP18/66/133-14HA lithium-ion cells, with battery module configuration (9P1S)14S, and main features are shown below:

Product name	Li-Ion Batteries
Model	3024381
Nominal voltage	51,8 V
Maximum voltage	58,8 V
Minimum voltage	40,6 V
Nominal capacity	126 Ah
Usable capacity	101 Ah
Nominal discharge current	126 A
Maximum discharge current	155 A
Nominal charge current	63 A
Maximum charge current	76 A
Absolute cell temperature limits	-25 °C ÷ +55 °C
Discharging temperature	-10 °C ÷ +45 °C
Charging temperature	0 °C ÷ +45 °C
Storage temperature	-10 °C ÷ +35 °C
Nominal mass	67 kg (± 2%)
Dimensions (mm)	630 x 170 x 370

BMS functional safety was evaluated according to IEC 60730-1 Annex H, see test reports, AT24-0110799-01 and AT24-0110799-02

The original Test Report ref. AT24-0104732-01, dated 2025-04-14, was modified on 2025-09-26 for following corrections:

- replaced wrong products' marking plates on pages 6 to 8 – highlighted with an asterisk (*)
- misprint on TABLE 10 at page 29: battery systems code 3024175, 3024195, 3024374, 3024464, 3024547 and 3024604 were wrongly listed and were removed from list
- missing information on list of test equipment used at page 30 – highlighted with an asterisk (*)

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
4	**PARAMETER MEASUREMENT TOLERANCES**		**P**
	Parameter measurement tolerances		P
5	**GENERAL SAFETY CONSIDERATIONS**		**P**
5.1	**General**		**P**
	Cells and batteries are safe under conditions of both intended use and reasonably foreseeable misuse... :	Clause 6, Clause 7, 8.1, and 8.2. See also table 5.1 for Critical components information	P
	Reduce the risk of injuries from moving parts		P
5.2	**Insulation and wiring**		**P**
	Voltage, current, altitude, and humidity requirements		P
	Adequate clearances and creepage distances between connectors and live parts at different voltages or between live parts and non-current-carrying accessible parts		P
	Protect from hazardous live parts, including during installation		P
	The mechanical integrity of internal connections		P
5.3	**Venting**		**P**
	Pressure relief function		P
	Encapsulation used to support cells within an outer casing		P
5.4	**Temperature/voltage/current management**		**P**
	The design prevents abnormal temperature-rise		P
	Voltage, current, and temperature limits of the cells	Overcharge, over current and overheating proof circuit used in batteries' BMS. With reference to clause 8 tests	P
	Specifications and charging instructions for equipment manufacturers	With reference to customer's battery systems datasheets	P
5.5	**Terminal contacts of the battery pack and/or battery system**		**P**
	Polarity marking(s)		P
	Polarity marking not provided for keyed external connector		P
	Capability to carry the maximum anticipated current		P
	External terminal contact surfaces		P
	Terminal contacts are arranged to minimize the risk of short circuits		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
5.6	**Assembly of cells, modules, or battery packs into battery systems**		**P**
5.6.1	General		P
	Independent control and protection method(s)	Battery system has independent control and protective functions managed by integrated BMS	P
	Recommendations of cell operating limits, mounting advice, storage conditions and other design recommendations by the cell manufacturer	Requirements considered by manufacturer's battery system design	P
	Batteries designed for the selective discharge of a portion of their series connected cells		N/A
	Protective circuit component(s) and consideration to the end-device application		P
5.6.2	Battery system design		P
	The voltage control function		P
	Maximum charging/discharging current of the cell are not exceeded		P
5.7	**Operating region of lithium cells and battery systems for safe use**		**P**
	The cell operating region..... :		P
	Designation of battery system to comply with the cell operating region	Any battery system has dedicated specification	P
5.8	**System lock (or system lock function)**		**P**
	Non-resettable function to stop battery operation	All battery systems safety functions fully managed by BMS	P
	Manual with procedure for resetting of battery operation	With reference to customer's battery system instruction, installation and maintenance manuals	P
	Emergency battery final discharge		P
5.9	**Quality plan**		**P**
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented..... :	ISO 9001:2015 certificate, Reference: IMQ 0714-2021	P
	The process capabilities and the process controls		P

6	**TYPE TEST CONDITIONS**		**P**
6.1	**General**		**P**
6.2	**Test items**		**P**
	Cells or batteries that are not more than six months old (See Table 1 of IEC 62619)		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Capacity confirmation of the cells or batteries		P
	Default ambient temperature of test, 25 °C ± 5 °C	Tests were carried out in an ambient temperature of 25±5 °C	P

7	**SPECIFIC REQUIREMENTS AND TESTS**		**P**
7.1	**Charging procedure for test purposes**		**P**
	The battery discharged to a specified final voltage prior to charging		P
	The cells or batteries charged using the method specified by the manufacturer..... :	Method specified by the manufacturer's documents	P
7.2	**Reasonably foreseeable misuse**		**P**
7.2.1	External short-circuit test (cell or cell block)	Approved cells used apart cell type ISP18/66/133-14HA, that was tested – see Table 7.2.1	P
	Short circuit with total resistance of 30 mΩ ± 10 mΩ at 25 °C ± 5 °C	25,17 mΩ	P
	Results: no fire, no explosion		P
7.2.2	Impact test (cell or cell block)	Approved cells used	N/A
	Cylindrical cell, longitudinal axis impact		N/A
	Prismatic cell, longitudinal axis and lateral axis impact		N/A
	Results: no fire, no explosion.		N/A
7.2.3	Drop test (cell or cell block, and battery system)	Battery systems 3024049, 3024207, 3024265, 3024273 and 3024381 tested	P
7.2.3.1	General	Battery systems 3024273 and 3024381 with mass ≥ 50 kg and < 100 kg (height 50 mm), and all other units' mass > 100 kg (height 25 mm)	P
7.2.3.2	Whole drop test (cell or cell block, and battery system)	Approved cells used and no battery systems with mass < 20 kg	N/A
	Description of the Test Unit..... :		—
	Mass of the test unit (kg)..... :		—
	Height of drop (m)..... :		—
	Results: no fire, no explosion		N/A
7.2.3.3	Edge and corner drop test (cell or cell block, and battery system)	With reference to 7.2.3.1 above	P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Description of the Test Unit..... :	Battery systems 3024049, 3024207, 3024265, 3024273 and 3024381	—
	Mass of the test unit (kg)..... :	50 kg (3024273), 67 kg (3024381), 234 kg (3024207), 839 kg (3024049), 2118 kg (3024265)	—
	Height of drop (m)..... :	50 mm (3024273, 3024381) 25 mm (3024049, 3024207, 3024265)	—
	Results: no fire, no explosion		P
7.2.4	Thermal abuse test (cell or cell block)	Approved cells used	N/A
	Results: no fire, no explosion		N/A
7.2.5	Overcharge test (cell or cell block)	Approved cells used	N/A
	For those battery systems that are provided with only a single protection for the charging voltage control		—
	Results: no fire, no explosion..... :	See Table 7.2.5	N/A
7.2.6	Forced discharge test (cell or cell block)	Approved cells used	N/A
	Cells connected in series in the battery system ..... :		N/A
	Redundant or single protection for discharge voltage control provided in battery system ..... :		N/A
	Target Voltage ..... :		N/A
	Maximum discharge current of the cell, Im..... :		N/A
	Discharge current for forced discharge, 1.0 It ..... :		N/A
	Discharging time, t = (1 It / Im) x 90 (min.) ..... :		N/A
	Results: no fire, no explosion..... :	See Table 7.2.6	N/A
7.3	**Considerations for internal short-circuit – Design evaluation**		**N/A**
7.3.1	General		N/A
7.3.2	Internal short-circuit test (cell)		N/A
	Samples preparation procedure: In accordance with Clause A.5 and A.6 of IEC 62133-2:2017		N/A
	Tested per 7.3.2 b) in an ambient temperature of 25 °C ± 5 °C.		N/A
	The appearance of the short-circuit location recorded by photograph or other means .....:	See Attachment # __	—
	The pressing was stopped - When a voltage drop of 50 mV was detected, or		N/A
	- The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) was reached		N/A

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Results: no fire ..... :	See Table 7.3.2	N/A
7.3.3	Propagation test (battery system)	Approved cells used, tested according to 7.3.2, propagation test required only for LMN battery systems using cells type ISP18/66/133-14HA	P
	Method to create a thermal runaway in one cell ... :	See Annex B and C	P
	Results: No external fire from the battery system, no battery case rupture ..... :	See results in Table 7.3.3	P

8	**BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)**		**P**
8.1	**General requirements**		**P**
	Functional safety analysis for critical controls	Evaluated according to IEC 60730-1 Annex H	P
	Conduct of a process hazard analysis for both the cell manufacturing process and the battery system manufacturing process	Evaluated according to IEC 60730-1 Annex H	P
	Conduct of risk assessment and mitigation of the battery system	Evaluated according to IEC 60730-1 Annex H	P
8.2	**Battery management system (or battery management unit)**		**P**
8.2.1	Requirements for the BMS		P
	The safety integrity level (SIL) target of the BMS		P
	The charge control evaluated by tests in clauses 8.2.2 to 8.2.4		P
8.2.2	Overcharge control of voltage (battery system)		P
	The exceeded charging voltage applied to the whole battery system		P
	The exceeded charging voltage applied to only a part of the battery system, such as the cell(s) ..... :		N/A
	Results: no fire, no explosion ..... :	See Table 8.2.2	P
	The BMS terminated the charging before exceeding the upper limit charging voltage		P
8.2.3	Overcharge control of current (battery system)		P
	Results: no fire, no explosion ..... :	See Table 8.2.3	P
	The BMS detected the overcharging current and controlled the charging to a level below the maximum charging current		P
8.2.4	Overheating control (battery system)		P
	The cooling system, if provided, was disconnected		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :		P
	Results: no fire, no explosion..... :	See Table 8.2.4	
	The BMS detected the overheat temperature and terminated charging		P
	The battery system operated as designed during test		P
9	**EMC**		**P**
	Battery system fulfil EMC requirements of the end-device application..... :	See Table 9 P/N tested and relevant EMC reports in Table 9, otherwise intended to be tested in the end use application	P
10	**INFORMATION FOR SAFETY**		**P**
	The cell manufacturer provides information about current, voltage and temperature limits of their products	Considered (cell manufacturer's datasheets)	P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.	With reference to customer's battery system instruction, installation and maintenance manuals	P
11	**MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)**		**P**
	The marking items shown in Table 1 in IEC 62620 indicated on the cell, battery system or instruction manual.	See pages 6 to 8	P
	Cell or battery system has clear and durable markings		P
	Cell designation		N/A
	Battery designation	See "**General product information**" on page 9	P
	Battery structure formulation	See "**General product information**" on page 9	P
12	**PACKAGING AND TRANSPORT**		**P**
	Refer to Annex D		P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
ANNEX A	**OPERATING REGION OF CELLS FOR SAFE USE**		**P**
A.1	General		P
A.2	Charging conditions for safe use		P
A.3	Consideration on charging voltage		P
A.4	Consideration on temperature		P
A.5	High temperature range		P
A.6	Low temperature range		P
A.7	Discharging conditions for safe use		P
A.8	Example of operating region		P

ANNEX B	**PROCEDURE OF 7.3.3 PROPAGATION TEST BY LASER IRRADIATION**		**N/A**
B.1	**General**		N/A
B.2	**Test conditions**		N/A
B.2.1	Cell test (preliminary test)		N/A
	The cell fully charged according to the manufacturer recommended conditions ..... :		—
	Laser irradiation point on the cell ..... :		—
	Output power of laser irradiation ..... :		—
	Tested in an ambient temperature of 25 °C ± 5 °C		N/A
	Repeat of cell test for 3 times		N/A
B.2.2	Battery system test (main test)	Approved cells used, tested according to 7.3.2, propagation test not required for battery system	N/A
	The battery system fully charged according to the manufacturer recommended conditions ..... :		—
	Target cell to be laser irradiated ..... :		—
	The irradiation point on the target cell same or similar as that on the cell test		
	Output power of laser irradiation ..... :		—
	Tested in an ambient temperature of 25 °C ± 5 °C		N/A

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
ANNEX C	**PROCEDURE OF 7.3.3 PROPAGATION TEST BY METHODS OTHER THAN LASER**		**P**
C.1	General	Approved cells used, tested according to 7.3.2, propagation test required only for LMN battery systems using cells type ISP18/66/133-14HA	P
C.2	Test conditions:		P
	– The battery fully charged according to the manufacturer recommended conditions ..... :	Battery fully charged according to the manufacturer recommended conditions	—
	– Target cell forced into thermal runaway ..... :	Rear top-left corner cell	—
	– A specially prepared sample (e.g. a heater or a hole for nail penetration provided) used for ease of testing..... :	Target cell prepared with heater	—
C.3	Method used for initiating the thermal runaway. 1) Heater (Heater, Burner, Laser, Inductive heating 2) Overcharge 3) Nail penetration of the cell 4) Combination of above methods 5) Other methods..... :	Thermal runaway initiated with heater	—

ANNEX D	**PACKAGING AND TRANSPORT**		**P**
	The materials and pack design chosen in a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants		P
	Regulations concerning international transport of secondary lithium batteries	Battery tested according to UN 38.3	P

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.2.1	TABLE: External short-circuit test (cell or cell block)				P
Sample No.	**Ambient (at 25°C ± 5°C)**	**OCV at start of test (V dc)**	**Resistance of Circuit (mΩ)**	**Maximum Case Temperature Rise ΔT (°C)**	**Results**
1	21,5	4,13	25,17	70,1	A

Supplementary information:

A – No fire or Explosion
B – Fire
C – Explosion
D – The test was completed after 6 h
E – The test was completed after the cell casing cooled to 20% of the maximum temperature rise
F – Other (Please explain):___

7.2.5	TABLE: Overcharge test (cell or cell block)					N/A
Sample No.	**OCV at start of test (V dc)**	**OCV at end of test (V dc)**	**Measured Maximum Charging Current (A)**	**Measured Maximum Charging Voltage (V dc)**	**Max. Cell Case Temperature, (°C)**	**Results**

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Test concluded when temperature reached a steady state condition
E – Test concluded when temperature returned to ambient
F – Other (Please explain): _____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.2.6	TABLE: Forced discharge test (cell or cell block)				N/A
Sample No.	**OCV before applying reverse charge, (V dc)**	**Target Voltage (V dc)**	**Measured Reverse Charge Current It, (A)**	**Total Time for Reversed Charge Application (min)**	**Results**

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Other (Please explain): ___

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.2	TABLE: Internal short-circuit test (cell)			N/A
Sample No.	**OCV at start of test, (V dc)**	**Particle location [1)]**	**Maximum applied pressure, (N)**	**Results**

Supplementary information:

[1)] Identify one of the following**:**
1: Nickel particle inserted between positive and negative (active material) coated area.
2: Nickel particle inserted between positive aluminium foil and negative active material coated area.

Results:

A – No fire or explosion
B – Fire
C – Explosion
D – Test concluded when 50 mV voltage drop occurred prior to reaching force limit
E – Test concluded when 800/400 N pressure was reached and 50 mV voltage drop was not achieved
F – Test was concluded when fire or explosion occurred
G – Other (Please explain): __

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.3	TABLE: Propagation test (battery system)				P
Sample No.	**OCV of Battery System Before Test, (V dc)**	**OCV of Target Cell Before Test, (V dc)**	**Maximum Cell Case Temperature, (°C)**	**Maximum DUT Enclosure Temperature, (°C)**	**Results**
3024381	57,2	4,09	316,8	316,8	A

Method of cell failure 1)	**Location of target cell**	**Area for fire protection (m^2)**
Applied heat	Rear top-left corner	Battery system with outer covering

Supplementary information:

1) Cell can be failed through laser exposure, applied heat, overcharge, nail penetration or combinations of these failures or other acceptable methods. See supporting documentation for details on cell failure method

2) If the battery system has no outer covering, the manufacturer is required to specify the area for fire protection.

Results:
A – No fire external to DUT enclosure or area for fire protection or no battery case rupture
B – Fire external to DUT enclosure or area for fire protection
C – Explosion
D – Battery case rupture
E – Other (Please explain): __

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

8.2.2	TABLE: Overcharge control of voltage (battery system)				P
Sample No.	**OCV at start of test for Cell/Cell Blocks, (V dc)**	**Maximum Charging Current, (A)**	**Max. Charging Voltage, (V dc)**	**Max. Voltage of Cell/Cell Blocks, (V dc)**	**Results**
3024049	3,363	19,8	59,7	3,751	A, D, F
3024273	3,330	20,2	59,8	3,798	A, D, F
3024207	3,608	20,2	90,9	3,801	A, D, F
3024265	3,432	40,0	104,9	3,790	A, D, F
3024381	4,090	30,5	59,5	4,252	A, D, F

	Charge Voltage Applied Battery System: 1)	
	Whole	**Part**
	Applied	N/A

Supplementary information:

1) The exceeded voltage can be applied to only a part of the system such as the cell(s) in the battery system per Figure 6 of IEC 62619, if it is difficult to do it in using the whole battery system.

Results:
A – No Fire or Explosion
B – Fire
C – Explosion
D – The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage
E – The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ___

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

8.2.3	TABLE: Overcharge control of current (battery system)			P
Sample No.	**OCV at start of test, (V dc)**	**Max. Charging Current, (A)**	**Max. Charging Voltage, (V dc)**	**Results**
3024049	52,78	784,2	55,09	A, D, F
3024273	51,71	130,0	54,52	A, D, F
3024207	78,61	444,8	84,97	A, D, F
3024265	92,42	872,0	99,97	A, D, F
3024381	53,81	92,00	55,74	A, D, F

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Overcurrent sensing function of BMU did operate and then charging stopped
E – Overcurrent sensing function of BMU did not operate and then charging stopped
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

8.2.4	TABLE: Overheating control (battery system)		P
Model No.	**OCV at start (SOC 50%) of test, V dc**	**Maximum Charging Current, A**	**Measured Maximum Charging Voltage, V dc**
3024049	52,86	9,8	52,93
3024273	52,88	5,1	53,18
3024207	80,31	5,2	80,40
3024265	92,72	5,2	92,78
3024381	54,26	5,0	54,64
Maximum Specified Temperature of Battery System, °C		**Maximum Measured Cell Case Temperature, °C**	**Results**
55		55,6	A, D, F
55		56,6	A, D, F
60		63,2	A, D, F
55		54,6	A, D, F
55		59,3	A, D, F

Supplementary information:

Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Temperature sensing function of BMU did operate and then charging stopped
E – Temperature sensing function of BMU did not operate and then charging stopped
F – All function of battery system did operate as intended during the test.
G – All function of battery system did not operate as intended during the test.
H – Other (Please explain): ____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

9	TABLE: EMC				P
Standard used for EMC test: IEC 61000-6-2/3					
Sample No.	**EMC Test Item**	**Battery Condition**	**EMC Test Level/ Parameters**	**Compliance Criteria**	**Results**
1	3024049	See TR 2024/00378 (DTL-000586)		A, E	P
2	3024207	See TR R24037901 (DTL-000565)		A, E	P
3	3024265	See TR 2024/00380 (DTL-000587)		A, E	P
4	3024065	See TR 2024/00377 (DTL-000585)		A, E	P
5	3024025	See TR R24229401 (DTL-000679)		A, E	P
6	3024382	See TR R23200301 (DTL-000495)		A, E	P

Supplementary information:

Battery Condition During EMC test

1 – In Operation Mode, [ ] Supplied at ____, [ ] Load at____

2 – In non-operation Mode, Battery state of charge (SOC) before test at around____

Compliance Criteria and Test Results:
A – No fire or Explosion
B – Fire
C – Explosion
D – Battery system did operate as intended during the test.
E - All function of battery system did operate as intended after the test.
F - All function of battery system did not operate as intended during the test, (Please explain): ____
G - Other (Please explain): ____

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict

10	LIST OF BATTERY SYSTEMS COVERED BY TESTS PERFORMED	

Customer's Battery Systems codes with relevant cells used:

Cell type ISP18/66/133-14HA (3.65V 14Ah 51.1Wh)

3024381, 3022470, 3022525, 3023475, 3023813, 3024382

Cell type IFP37/101/192(60)HA (3.2V, 60Ah, 192Wh)

3024049, 3023579, 3023596, 3023598, 3023642, 3023643, 3023644, 3023650, 3023662, 3023663, 3023664, 3023665, 3023668, 3023678, 3023705, 3023749, 3023773, 3023781, 3023784, 3023785, 3023786, 3023787, 3023800, 3023801, 3023802, 3023803, 3023804, 3023805, 3023806, 3023807, 3023809, 3023810, 3023812, 3023814, 3023815, 3023816, 3023821, 3023832, 3023840, 3023843, 3023844, 3023852, 3023854, 3023856, 3023861, 3023872, 3023873, 3023874, 3023882, 3023883, 3023901, 3023906, 3023912, 3023917, 3023924, 3023947, 3023957, 3023958, 3023960, 3023969, 3023973, 3023976, 3023977, 3023979, 3023982, 3023983, 3023990, 3023992, 3023993, 3023995, 3023996, 3023998, 3023999, 3024001, 3024004, 3024005, 3024009, 3024010, 3024011, 3024012, 3024013, 3024014, 3024015, 3024016, 3024017, 3024018, 3024019, 3024020, 3024021, 3024022, 3024023, 3024024, 3024025, 3024026, 3024027, 3024028, 3024029, 3024030, 3024031, 3024032, 3024033, 3024034, 3024035, 3024036, 3024037, 3024038, 3024039, 3024040, 3024041, 3024042, 3024043, 3024044, 3024045, 3024046, 3024047, 3024048, 3024050, 3024051, 3024052, 3024053, 3024054, 3024055, 3024056, 3024057, 3024058, 3024059, 3024060, 3024061, 3024062, 3024063, 3024064, 3024065, 3024066, 3024067, 3024068, 3024069, 3024070, 3024073, 3024074, 3024075, 3024076, 3024079, 3024080, 3024081, 3024082, 3024086, 3024087, 3024088, 3024093, 3024095, 3024097, 3024102, 3024104, 3024105, 3024106, 3024107, 3024112, 3024113, 3024115, 3024116, 3024120, 3024121, 3024123, 3024124, 3024127, 3024145, 3024149, 3024155, 3024157, 3024158, 3024162, 3024163, 3024164, 3024165, 3024166, 3024167, 3024168, 3024172, 3024173, 3024177, 3024179, 3024196, 3024199, 3024200, 3024202, 3024203, 3024204, 3024205, 3024208, 3024226, 3024229, 3024231, 3024232, 3024233, 3024237, 3024238, 3024248, 3024249, 3024250, 3024253, 3024260, 3024261, 3024281, 3024295, 3024296, 3024306, 3024309, 3024349, 3024350, 3024353, 3024354, 3024355, 3024359, 3024363, 3024364, 3024370, 3024373, 3024394, 3024397, 3024422, 3024451, 3024462, 3024463, 3024468, 3024469, 3024470, 3024476, 3024477, 3024478, 3024479, 3024480, 3024501, 3024511, 3024518, 3024521, 3024522, 3024524, 3024525, 3024532, 3024549, 3024580, 3024581, 3024584, 3024593, 3024595, 3024606

Cell type CB0Y0 (3.2 V, 100 Ah)

3024273, 3023905, 3024220, 3024221, 3024222, 3024267

Cell type 001CB240 (3.22 V, 302 Ah)

3024207, **3024265**, 3024255, 3024264, 3024512, 3024539, 3024594

List of test equipment used:

A completed list of used test equipment shall be provided in the Test Reports when a Customer's Testing Facility according to CTF stage 1 or CTF stage 2 procedure has been used.
Note: This page may be removed when CTF stage 1 or CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

Clause	Measurement / testing	Testing / measuring equipme12nt / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
6 (*)	Ambient temperature	Environmental Thermohygrometer Testo – 174H S/N 37378455	(-20 ÷ 70) °C	2024-04-19	2025-04-19
7.2.1	External short-circuit test	Battery HiTester Hioki – BT3562-01 Midac ref. WLI03	R: (3 ÷ 300) mΩ	2024-03-25	2028-03-25
7.2.3.3 (*)	Edge and corner drop test	Digital scale (0-150 kg) Kern – ITB 150K5IP S/N 2677039	(0 ÷ 150) kg	2024-04-22	2025-04-22
		Caliper (0-150 mm) Mitutoyo – CD15CPX S/N 12514572	(0 ÷ 150) mm	2024-06-19	2025-06-19
7.2.1	External short-circuit test	Multi-channel data logger Hioki – LR8540 S/N 240420398	I: (0 ÷ 450) A	2024-07-26	2025-07-26
7.3.3	Propagation test	Wireless Logger Module for Current Sensors Hioki – LR8536 S/N 240603268			
8.2.2	Overcharge control of voltage	AC/DC current clamp Hioki – CT7736 S/N 240423907			
8.2.4	Overheating control				
8.2.3	Overcharge control of current	Multi-channel data logger Hioki – LR8540 S/N 240420398	I: (0 ÷ 2000) A	2024-07-26	2025-07-26
		Wireless Logger Module for Current Sensors Hioki – LR8536 S/N 240603268			
		AC/DC current clamp Hioki – CT7742 S/N 240432917			
7.2.1	External short-circuit test	Multi-channel data logger Hioki – LR8540 S/N 240420398	V: (0 ÷ 100) V	2024-08-05	2025-08-05

7.3.3 8.2.2 8.2.4	Propagation test Overcharge control of voltage Overheating control	Wireless logger module for voltage Hioki – LR8533 S/N 240321966			
7.2.1	External short-circuit test	Multi-channel data logger Hioki – LR8540 S/N 240420398	T: (0 ÷ 150) °C	2024-08-05	2025-08-05
7.3.3 8.2.2 8.2.4	Propagation test Overcharge control of voltage Overheating control	Wireless logger module for V, T, R Hioki – LR8531 S/N 240225274			

– End of test report –

Attachment 1: Photo documentation

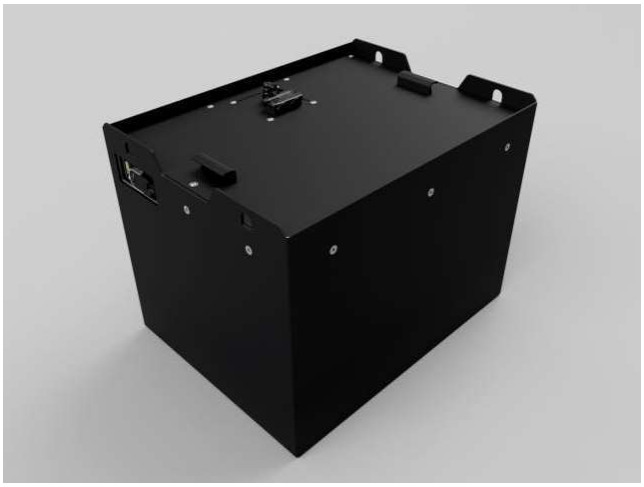


Figure 1 – P/N 3024049 – LFP 51,2 V 540 Ah

Figure 2 – P/N 3024207 – LFP 76,8 V 302 Ah

Figure 3 – P/N 3024265 – LFP 89,6 V 604 Ah

Figure 4 – P/N 3024273 – LFP 51,2 V 100 Ah

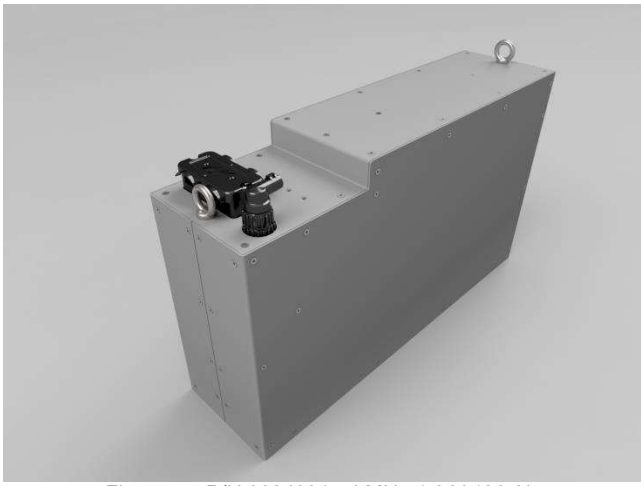


Figure 5 – P/N 3024381 – LMN 51,8 V 126 Ah