Test Report issued under the responsibility of:

UL Solutions

TEST REPORT
IEC 62133-2
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems

Report Number.....:	TSZ23050539-P01-R01
Date of issue.....:	2023-07-10
Total number of pages.....:	25
Name of Testing Laboratory preparing the Report.....:	Shenzhen Tiansu Calibration and Testing Co., Ltd.
Applicant's name.....:	Merits Healthcare Industries (Suzhou) Co., Ltd.
Address.....:	No.29 Fuzhou Road, Chengxiang Town, Taicang City, Jiangsu Province, 215411, China
Test specification:	
Standard.....:	IEC 62133-2:2017, IEC 62133-2:2017/AMD1:2021
Test procedure.....:	CB Scheme
Non-standard test method.....:	N/A
TRF template used.....:	IECEE OD-2020-F1:2021, Ed.1.4
Test Report Form No.....:	IEC62133_2C
Test Report Form(s) Originator.....:	DEKRA Certification B.V.
Master TRF.....:	Dated 2022-07-01

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General disclaimer:

The test results presented in this report relate only to the object tested.

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Test item description.....:	Rechargeable Li-ion Battery
Trade Mark(s).....:	N/A
Manufacturer.....:	Maima Energy Technology (Jiangsu) Co., Ltd. Building 3, 1668 Huacheng Road, Jintan District, Changzhou City, Jiangsu Province, China
Model/Type reference.....:	ML24114
Ratings.....:	24V, 11.4Ah, 273.6Wh

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	**CB Testing Laboratory:**	Shenzhen Tiansu Calibration and Testing Co., Ltd.	
Testing location/ address.....:		Building 4, No.2, Jinlong Road, Longgang District, Shenzhen, Guangdong, China.	
Tested by (name, function, signature).....:		Evan Luo/Project Handler	Evan Luo
Approved by (name, function, signature)...:		Chovy Qiu/Reviewer	Chovy Qiu
☐	**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.....:			
Tested by (name + signature).....:			
Witnessed by (name, function, signature)..:			
Approved by (name, function, signature)...:			
☐	**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):

National Differences (3 pages)

Enclosures (14 pages)

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
Testing for Battery: ML24114 7.2.2 Case stress at high ambient temperature (battery) 7.3.2 External short-circuit (battery) 7.3.3 Free fall 7.3.6 Over-charging of battery 7.3.8 Mechanical tests (batteries) 7.3.8.1 Vibration 7.3.8.2 Mechanical shock	Shenzhen Tiansu Calibration and Testing Co., Ltd. Building 4, No.2, Jinlong Road, Longgang District, Shenzhen, Guangdong, China.

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

EU group *, United Kingdom (Per customer's request shown separately)

*=No National or Group Differences declared

☒ The product fulfils the requirements of EN 62133-2:2017/A1:2021

☒ The product fulfils the requirements of BS EN 62133-2:2017/A1:2021

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.

Rechargeable Li-ion Battery

ML24114 7INR19/66-4

24V 11.4Ah 273.6Wh

Maima Energy Technology (Jiangsu) Co., Ltd.

YYYYMMDD Made in China

WARNING: Risk of Fire and Burns. Do Not Open, Crush, Heat Above 60°C/140°F or Incinerate, Do not short circuit. If bulges severely discontinue use. Follow Manufacturer's Instructions

Remark:

The date code "YYYYMMDD" indicates the production date. Where "YYYY" represents the year, "MM" represents the month and "DD" represents the day.

Test item particulars.....:	--
Classification of installation and use.....:	--
Supply Connection.....:	DC terminal
Recommend charging method declared by the manufacturer.....:	CC/CV
Discharge current (0,2 It A).....:	2.28A
Specified final voltage.....:	19.25V
Upper limit charging voltage per cell.....:	4.25V
Maximum charging current.....:	5A
Charging temperature upper limit.....:	50°C
Charging temperature lower limit.....:	0°C
Polymer cell electrolyte type.....:	☐ gel polymer ☐ solid polymer ☒ N/A
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.....:	2023-05-30
Date (s) of performance of tests.....:	2023-06-07 to 2023-06-10

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 manufacturer

General product information and other remarks:

- **Supplementary Information on National/Group Differences not to be listed on CBTC:** ND for Korea for information only since the ND/GD TRF latest revision does not match the latest revision of IEC Standard TRF used for evaluation.

- Electronic components and 28 cells in 7S4P are mounted on PWB and connected to the DC connector through wire for Rechargeable Li-ion Battery model ML24114.

- Inner cell has been evaluated by SGS to meet the requirements according to IEC 62133-2:2017, IEC 62133-2:2017/AMD1:2021. CB test report No.: SHES220901784801 issued on 2022-10-28, issued by SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. CB test certificate: BE-42972 issued on 2022-10-28.

- Battery Pack (Model: ML24114) has been evaluated to comply with ST/SG/AC.10/11/Rev.7 /Section 38.3. Test report No.: TSZ23060298-P01-R01 issued on 2023-06-26, issued by Shenzhen Tiansu Calibration and Testing Co., Ltd.

- Type reference 7INR19/66-4 is IEC designation which is identical Model ML24114 except for model designation.

- Detailed information of the battery, as following:

Product Name: Rechargeable Li-ion Battery	
Model	ML24114
Nominal Capacity	11.4Ah
Nominal Voltage	24V
Maximum Charge Voltage	29.4V
Normal Charge Current	5A
Maximum Charge Current	5A
Normal Discharge Current	11.4A
Maximum Discharge Current	20A
Discharge Cut-Off Voltage	19.25V
End of charging current	0.57A
Charging Temperature Range	0°C~50°C
Discharging Temperature Range	-20°C~60°C

IEC 62133-2			
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 so designed and constructed that they are safe under conditions of both intended use and reasonably foreseeable misuse		P
5.2	**Insulation and wiring**		P
	The insulation resistance between the positive terminal and externally exposed metal surfaces of the battery (excluding electrical contact surfaces) is not less than 5 MΩ	No metal case exists.	N/A
	Insulation resistance (MΩ)..... :		—
	Internal wiring and insulation are sufficient to withstand maximum anticipated current, voltage and temperature requirements		P
	Orientation of wiring maintains adequate clearances and creepage distances between conductors		P
	Mechanical integrity of internal connections accommodates reasonably foreseeable misuse		P
5.3	**Venting**		P
	Battery cases and cells incorporate a pressure relief mechanism or are constructed so that they relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition	Venting mechanism exists on top of the cylindrical cell.	P
	Encapsulation used to support cells within an outer casing does not cause the battery to overheat during normal operation nor inhibit pressure relief		P
5.4	**Temperature, voltage and current management**		P
	Batteries are designed such that abnormal temperature rise conditions are prevented		P
	Batteries are designed to be within temperature, voltage and current limits specified by the cell manufacturer	Cell specification and battery specification have been provided. The design of the battery refers to the parameters of the cell.	P
	Batteries are provided with specifications and charging instructions for equipment manufacturers so that specified chargers are designed to maintain charging within the temperature, voltage and current limits specified	Battery specifications have been provided.	P
5.5	**Terminal contacts**		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The size and shape of the terminal contacts ensure that they can carry the maximum anticipated current		P
	External terminal contact surfaces are formed from conductive materials with good mechanical strength and corrosion resistance		P
	Terminal contacts are arranged to minimize the risk of short circuits		P
5.6	**Assembly of cells into batteries**		P
5.6.1	General		P
	Each battery has an independent control and protection for current, voltage, temperature and any other parameter required for safety and to maintain the cells within their operating region	Protective circuit equipped on battery.	P
	This protection may be provided external to the battery such as within the charger or the end devices		N/A
	If protection is external to the battery, the manufacturer of the battery provide this safety relevant information to the external device manufacturer for implementation		N/A
	If there is more than one battery housed in a single battery case, each battery has protective circuitry that can maintain the cells within their operating regions		N/A
	Manufacturers of cells specify current, voltage and temperature limits so that the battery manufacturer/designer may ensure proper design and assembly	Current, voltage and temperature limits specified by cell manufacturer.	P
	Batteries that are designed for the selective discharge of a portion of their series connected cells incorporate circuitry to prevent operation of cells outside the limits specified by the cell manufacturer	Battery without selective discharge function.	N/A
	Protective circuit components are added as appropriate and consideration given to the end-device application		P
	The manufacturer of the battery provide a safety analysis of the battery safety circuitry with a test report including a fault analysis of the protection circuit under both charging and discharging conditions confirming the compliance		N/A
5.6.2	Design recommendation	7S4P	P
	For the battery consisting of a single cell or a single cellblock, it is recommended that the charging voltage of the cell does not exceed the upper limit of the charging voltage specified in Table 2		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	For the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that the voltages of any one of the single cells or single cellblocks does not exceed the upper limit of the charging voltage, specified in Table 2, by monitoring the voltage of every single cell or the single cellblocks	Cell upper limit of the charging voltage: 4.25V	P
	For the battery consisting of series-connected plural single cells or series-connected plural cellblocks, it is recommended that charging is stopped when the upper limit of the charging voltage is exceeded for any one of the single cells or single cellblocks by measuring the voltage of every single cell or the single cellblocks		N/A
	For batteries consisting of series-connected cells or cell blocks, nominal charge voltage are not counted as an overcharge protection		P
	For batteries consisting of series-connected cells or cell blocks, cells have closely matched capacities, be of the same design, be of the same chemistry and be from the same manufacturer		P
	It is recommended that the cells and cell blocks are not discharged beyond the cell manufacturer's specified final voltage		P
	For batteries consisting of series-connected cells or cell blocks, cell balancing circuitry are incorporated into the battery management system		N/A
5.6.3	Mechanical protection for cells and components of batteries		P
	Mechanical protection for cells, cell connections and control circuits within the battery are provided to prevent damage as a result of intended use and reasonably foreseeable misuse	Mechanical protection for cells, cell connections and control circuits within the battery are provided.	P
	The mechanical protection can be provided by the battery case or it can be provided by the end product enclosure for those batteries intended for building into an end product	The mechanical protection provided by the battery case.	P
	The battery case and compartments housing cells are designed to accommodate cell dimensional tolerances during charging and discharging as recommended by the cell manufacturer		P
	For batteries intended for building into a portable end product, testing with the battery installed within the end product is considered when conducting mechanical tests		N/A
5.7	**Quality plan**		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The manufacturer prepares and implements a quality plan that defines procedures for the inspection of materials, components, cells and batteries and which covers the whole process of producing each type of cell or battery	Complied. Quality Declaration provided.	P
5.8	**Battery safety components**		N/A
6	**TYPE TEST AND SAMPLE SIZE**		P
	Tests are made with the number of cells or batteries specified in Table 1 using cells or batteries that are not more than six months old		P
	The internal resistance of coin cells are measured in accordance with Annex D. Coin cells with internal resistance less than or equal to 3 Ω are tested in accordance with Table 1	Not coin cells.	N/A
	Unless otherwise specified, tests are carried out in an ambient temperature of 20 °C ± 5 °C		P
	The safety analysis of 5.6.1 identify those components of the protection circuit that are critical for short-circuit, overcharge and over discharge protection		N/A
	When conducting the short-circuit test, consideration is given to the simulation of any single fault condition that is likely to occur in the protecting circuit that would affect the short-circuit test		P
7	**SPECIFIC REQUIREMENTS AND TESTS**		P
7.1	**Charging procedure for test purposes**		P
7.1.1	First procedure		P
	This charging procedure applies to subclauses other than those specified in 7.1.2		P
	Unless otherwise stated in this document, the charging procedure for test purposes is carried out in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer		P
	Prior to charging, the battery has been discharged at 20 °C ± 5 °C at a constant current of 0,2 It A down to a specified final voltage		P
7.1.2	Second procedure		N/A
	This charging procedure applies only to 7.3.1, 7.3.4, 7.3.5, and 7.3.9		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	After stabilization for 1 h to 4 h, at an ambient temperature of the highest test temperature and the lowest test temperature, respectively, as specified in Table 2, cells are charged by using the upper limit charging voltage and maximum charging current, until the charging current is reduced to 0,05 It A, using a constant current to constant voltage charging method		N/A
7.2	**Intended use**		P
7.2.1	Continuous charging at constant voltage (cells)		N/A
	Fully charged cells are subjected for 7 days to a charge using the charging method for current and standard voltage specified by the cell manufacturer		N/A
	Results: no fire, no explosion, no leakage.....:		N/A
7.2.2	Case stress at high ambient temperature (battery)		P
	Oven temperature (°C).....:	70	—
	Results: no physical distortion of the battery case resulting in exposure of internal protective components and cells		P
7.3	**Reasonably foreseeable misuse**		P
7.3.1	External short-circuit (cell)		N/A
	The cells were tested until one of the following occurred:		N/A
	- 24 hours elapsed; or		N/A
	- The case temperature declined by 20 % of the maximum temperature rise		N/A
	Results: no fire, no explosion.....:		N/A
7.3.2	External short-circuit (battery)		P
	The batteries were tested until one of the following occurred:		P
	- 24 hours elapsed; or		N/A
	- The case temperature declined by 20 % of the maximum temperature rise		N/A
	In case of rapid decline in short circuit current, the battery pack remained on test for an additional one hour after the current reached a low end steady state condition		P
	A single fault in the discharge protection circuit is conducted on one to four (depending upon the protection circuit) of the five samples before conducting the short-circuit test	Single fault conducted on four samples.	P

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Clause	Requirement + Test	Result - Remark	Verdict
	A single fault applies to protective component parts such as MOSFET (metal oxide semiconductor field-effect transistor), fuse, thermostat or positive temperature coefficient (PTC) thermistor	(See appended table 7.3.2)	P
	Results: no fire, no explosion.....:	(See appended table 7.3.2)	P
7.3.3	Free fall		P
	Results: no fire, no explosion		P
7.3.4	Thermal abuse (cells)		N/A
	Oven temperature (°C).....:		—
	Results: no fire, no explosion		N/A
7.3.5	Crush (cells)		N/A
	The crushing force was released upon:		N/A
	- The maximum force of 13 kN ± 0,78 kN has been applied; or		N/A
	- An abrupt voltage drop of one-third of the original voltage has been obtained		N/A
	Results: no fire, no explosion.....:		N/A
7.3.6	Over-charging of battery		P
	The supply voltage which is:		P
	- 1,4 times the upper limit charging voltage presented in Table A.1 (but not to exceed 6,0 V) for single cell/cell block batteries or		N/A
	- 1,2 times the upper limit charging voltage resented in Table A.1 per cell for series connected multi-cell batteries, and	35.7V	P
	- Sufficient to maintain a current of 2,0 It A throughout the duration of the test or until the supply voltage is reached		P
	Test was continued until the temperature of the outer casing:		P
	- Reached steady state conditions (less than 10 °C change in 30-minute period); or		P
	- Returned to ambient		N/A
	Results: no fire, no explosion.....:	(See appended table 7.3.6)	P
7.3.7	Forced discharge (cells)		N/A
	Discharge a single cell to the lower limit discharge voltage specified by the cell manufacturer		N/A
	The discharged cell is then subjected to a forced discharge at 1 It A to the negative value of the upper limit charging voltage		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	- The discharge voltage reaches the negative value of upper limit charging voltage within the testing duration. The voltage is maintained at the negative value of the upper limit charging voltage by reducing the current for the remainder of the testing duration		N/A
	- The discharge voltage does not reach the negative value of upper limit charging voltage within the testing duration. The test is terminated at the end of the testing duration		N/A
	Results: no fire, no explosion.....:		N/A
7.3.8	Mechanical tests (batteries)		P
7.3.8.1	Vibration		P
	Results: no fire, no explosion, no rupture, no leakage or venting.....:	(See appended table 7.3.8.1)	P
7.3.8.2	Mechanical shock		P
	Results: no leakage, no venting, no rupture, no explosion and no fire.....:	(See appended table 7.3.8.2)	P
7.3.9	Design evaluation – Forced internal short-circuit (cells)		N/A
	The cells complied with national requirement for.....:		—
	The pressing was stopped upon:		N/A
	- A voltage drop of 50 mV has been detected; or		N/A
	- The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) has been reached		N/A
	Results: no fire.....:		N/A

8	**INFORMATION FOR SAFETY**		P
8.1	**General**		P
	Manufacturers of secondary cells provides information about current, voltage and temperature limits of their products		N/A
	Manufacturers of batteries provides information regarding how to minimize and mitigate hazards to equipment manufacturers or end-users	Information for safety mentioned in manufacturer's specifications.	P
	Systems analyses are performed by device manufacturers to ensure that a particular battery design prevents hazards from occurring during use of a product	Considered in end product.	N/A
	As appropriate, any information relating to hazard avoidance resulting from a system analysis is provided to the end user	Considered in end product.	N/A
	Do not allow children to replace batteries without adult supervision		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
8.2	**Small cell and battery safety information**	Not small battery.	N/A
	The following warning language is to be provided with the information packaged with the small cells and batteries or equipment using them:		N/A
	- Keep small cells and batteries which are considered swallowable out of the reach of children		N/A
	- Swallowing may lead to burns, perforation of soft tissue, and death. Severe burns can occur within 2 h of ingestion		N/A
	- In case of ingestion of a cell or battery, seek medical assistance promptly		N/A
9	**MARKING**		P
9.1	**Cell marking**		N/A
	Cells are marked as specified in IEC 61960, except coin cells		N/A
	Coin cells whose external surface area is too small to accommodate the markings on the cells show the designation and polarity	Not coin cells.	N/A
	By agreement between the cell manufacturer and the battery and/or end product manufacturer, component cells used in the manufacture of a battery need not be marked		N/A
9.2	**Battery marking**		P
	Batteries are marked as specified in IEC 61960, except for coin batteries	IEC Designation: 7INR19/66-4	P
	Coin batteries whose external surface area is too small to accommodate the markings on the batteries show the designation and polarity	Not coin battery.	N/A
	Batteries are marked with an appropriate caution statement		P
	- Terminals have clear polarity marking on the external surface of the battery, or		N/A
	- Not be marked with polarity markings if the design of the external connector prevents reverse polarity connections		P
9.3	**Caution for ingestion of small cells and batteries**	Not small batteries.	N/A
	Coin cells and batteries identified as small batteries include a caution statement regarding the hazards of ingestion in accordance with 8.2	Not coin battery.	N/A
	Small cells and batteries are intended for direct sale in consumer-replaceable applications, caution for ingestion is given on the immediate package		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.4	**Other information**		P
	The following information are marked on or supplied with the battery:	Information for storage and disposal instructions in manufacturer's specifications.	P
	- Storage and disposal instructions	Information for storage and disposal instructions in manufacturer's specifications.	P
	- Recommended charging instructions	Information for recommended charging instructions in manufacturer's specifications.	P

10	**PACKAGING AND TRANSPORT**		P
	Packaging for coin cells are not be small enough to fit within the limits of the ingestion gauge of Figure 3	Not coin cells.	N/A

ANNEX A	**CHARGING AND DISCHARGING RANGE OF SECONDARY LITHIUM ION CELLS FOR SAFE USE**		N/A
A.1	**General**		N/A
A.2	**Safety of lithium ion secondary battery**		N/A
A.3	**Consideration on charging voltage**		N/A
A.3.1	General		N/A
A.3.2	Upper limit charging voltage		N/A
A.3.2.1	General		N/A
A.3.2.2	Explanation of safety viewpoint		N/A
A.3.2.3	Safety requirements, when different upper limit charging voltage is applied		N/A
A.4	**Consideration of temperature and charging current**		N/A
A.4.1	General		N/A
A.4.2	Recommended temperature range		N/A
A.4.2.1	General		N/A
A.4.2.2	Safety consideration when a different recommended temperature range is applied		N/A
A.4.3	High temperature range		N/A
A.4.3.1	General		N/A
A.4.3.2	Explanation of safety viewpoint		N/A
A.4.3.3	Safety considerations when specifying charging conditions in the high temperature range		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
A.4.3.4	Safety considerations when specifying a new upper limit in the high temperature range		N/A
A.4.4	Low temperature range		N/A
A.4.4.1	General		N/A
A.4.4.2	Explanation of safety viewpoint		N/A
A.4.4.3	Safety considerations, when specifying charging conditions in the low temperature range		N/A
A.4.4.4	Safety considerations when specifying a new lower limit in the low temperature range		N/A
A.4.5	Scope of the application of charging current		N/A
A.4.6	Consideration of discharge		N/A
A.4.6.1	General		N/A
A.4.6.2	Final discharge voltage and explanation of safety viewpoint		N/A
A.4.6.3	Discharge current and temperature range		N/A
A.4.6.4	Scope of application of the discharging current		N/A
A.5	**Sample preparation**		N/A
A.5.1	General		N/A
A.5.2	Insertion procedure for nickel particle to generate internal short		N/A
A.5.3	Disassembly of charged cell		N/A
A.5.4	Shape of nickel particle		N/A
A.5.5	Insertion of nickel particle in cylindrical cell		N/A
A.5.5.1	Insertion of nickel particle in winding core		N/A
A.5.5.2	Marking the position of the nickel particle on both ends of the winding core of the separator		N/A
A.5.6	Insertion of nickel particle in prismatic cell		N/A
A.6	**Experimental procedure of the forced internal short-circuit test**		N/A
A.6.1	Material and tools for preparation of nickel particle		N/A
A.6.2	Example of a nickel particle preparation procedure		N/A
A.6.3	Positioning (or placement) of a nickel particle		N/A
A.6.4	Damaged separator precaution		N/A
A.6.5	Caution for rewinding separator and electrode		N/A
A.6.6	Insulation film for preventing short-circuit		N/A
A.6.7	Caution when disassembling a cell		N/A
A.6.8	Protective equipment for safety		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
A.6.9	Caution in the case of fire during disassembling		N/A
A.6.10	Caution for the disassembling process and pressing the electrode core		N/A
A.6.11	Recommended specifications for the pressing device		N/A
ANNEX B	**RECOMMENDATIONS TO EQUIPMENT MANUFACTURERS AND BATTERY ASSEMBLERS**		P
ANNEX C	**RECOMMENDATIONS TO THE END-USERS**		N/A
ANNEX D	**MEASUREMENT OF THE INTERNAL AC RESISTANCE FOR COIN CELLS**		N/A
D.1	**General**	Not coin cells.	N/A
D.2	**Method**		N/A
	A sample size of three coin cells is required for this measurement		N/A
	Coin cells with an internal resistance greater than 3 Ω require no further testing.....:	(See appended table D.2)	N/A
	Coin cells with an internal resistance less than or equal to 3 Ω are subjected to the testing according to Clause 6 and Table 1		N/A
ANNEX E	**PACKAGING AND TRANSPORT**		P
ANNEX F	**COMPONENT STANDARDS REFERENCES**		N/A

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict
	TABLE: Critical components information		**P**

Object / part No.	**Manufacturer/ trademark**	**Type / model**	**Technical data**	**Standard**	**Mark(s) of conformity[1)]**
1. Cell	Hengdian Group DMEGC Magnetics Co., Ltd	INR18650-29E	3.7V, 2900mAh	IEC 62133-2:2017/AMD1:2021	SGS-CSTC Certificate No.: BE-42972
2. PCB 1 (Internal battery pack)	Interchangeable	Interchangeable	V-0, 130°C	UL 796 UL 94	UL Approved
3. PCB 2 (Electric quantity display)	Interchangeable	Interchangeable	V-0, 130°C	UL 796 UL 94	UL Approved
4. Electric quantity display	Jinhua GuYu electronic technology co., LTD	GY-6GD	24V	--	--
5. IC (U1) (for PCB 1)	O_2Micro International Limited.	CRSS052N08N	VDD output voltage: 4.92V~5.08V, T_{opr}: -40°C to 85°C	--	Tested with appliance
6. MOSFET (M1, M2, M3, M4, M5, M6) (for PCB 1)	China Resources Microelectronics(Chongqing) Limited.	CRSS052N08N	V_{DS}=85V, V_{GS}=±20V, I_D= 120A [TC = 25° C (Package limit)], T_j, T_{stg}: -55°C to +150°C	--	Tested with appliance
7. IC (U1) (for PCB 2)	Shenzhen Yunpu Electronic Technology Co., Ltd	YM7130	V_{OUT}=1.455V~1.545V(Ta=25°C), T_{opr}= -40°C ~ 85°C, T_{stg}: -40°C ~ +125°C	--	Tested with appliance
8. IC (U2) (for PCB 2)	STMicroelectronics	STM8S103F3	Operating voltage range: 2.95V~5.5V, T_J max.=150°C, T_J, T_{STG}= -65°C to +150°C	--	Tested with appliance
9. IC (U3) (for PCB 2)	Shenzhen Vinka Electronic Technology Co., Ltd	VK1S56D	V_{DD}: 2.4V~5.2V, T_{STG}: -50°C ~ +125°C, T_{OTG}: -25°C ~ +75°C	--	Tested with appliance

IEC 62133-2					
Clause	Requirement + Test		Result - Remark		Verdict
10. MOSFET (T1) (for PCB 2)	Kersemi Electronic Co., Ltd.	FQD2N60C	V_{DSS}: 600V, I_D: 1.9A (T_C=25°C), V_{GSS}= ±30V, TJ, T_{STG}= -55°C to +150°C	--	Tested with appliance
11. MOSFET (T2) (for PCB 2)	Dongguan Canyu Electronics Co., Ltd.	2N7002	V_{DS}=60V, I_D=115mA, T_J=150°C, T_{stg}= -55°C to +150°C	--	Tested with appliance
12. Internal battery pack connector	SHENZHEN GRID POWER CONNECTORS CO LTD	GPS40AFP-G3011G	2pins, 600Vdc, 70A	UL 1977	UL E357218
13. Internal battery pack lead wire	DONGGUAN ZHONGZHEN ENERGY TECHNOLOGY CO.,LTD	3135	12AWG, 200°C, 600Vac	UL 758	UL E355578
14. Charge connector	Interchangeable	Interchangeable	3pins, 600Vdc, 70A	UL 1977	UL Approved
15. Discharge connector	Interchangeable	Interchangeable	2pins, 600Vdc, 70A	UL 1977	UL Approved
16. Plastic housing	Interchangeable	Interchangeable	85°C, V-0	UL 746 UL 94	UL Approved
Supplementary information: 1) Provided evidence ensures the agreed level of compliance. See OD-CB2039.					

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict

7.2.1	TABLE: Continuous charging at constant voltage (cells)			N/A
Sample No.	**Recommended charging voltage Vc (Vdc)**	**Recommended charging current I_{rec} (A)**	**OCV before test (Vdc)**	**Results**
Supplementary information:				

7.3.1	TABLE: External short circuit (cell)				N/A
Sample No.	**Ambient (°C)**	**OCV at start of test (Vdc)**	**Resistance of circuit (mΩ)**	**Maximum case temperature rise ΔT (K)**	**Results**
Samples charged at charging temperature upper limit (°C)					
Samples charged at charging temperature lower limit (°C)					
Supplementary information:					

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.2	TABLE: External short circuit (battery)					P
Sample No.	**Ambient T (°C)**	**OCV before test (Vdc)**	**Resistance of circuit (mΩ)**	**Maximum case temperature rise ΔT (K)**	**Component single fault condition**	**Results**
B04#	22.0	29.104	83	1.1	Normal	A, D
B05#	22.0	29.112	86	2.8	Short Circuit MOSFET M1 Pin (S to D)	A, D
B06#	22.0	29.109	85	1.2	Short Circuit MOSFET M1 Pin (S to D)	A, D
B07#	22.0	29.088	80	1.0	Short Circuit MOSFET M1 Pin (S to D)	A, D
B08#	22.0	29.036	88	30	Short Circuit MOSFET M1 Pin (S to D)	A, D

Supplementary information:

A - No fire or explosion

B - The test ends after 24 hours

C - The case temperature declined by 20% of the maximum temperature rise

D - Rapid decline in short circuit current, the battery pack should remain on test for an additional one hour after the current reaches a low end steady state condition.

7.3.5	TABLE: Crush (cells)				N/A
Sample No.	**OCV before test (Vdc)**	**OCV at removal of crushing force (Vdc)**	**Maximum force applied to the cell during crush (kN)**	**Results**	
Samples charged at charging temperature upper limit (°C)					
Samples charged at charging temperature lower limit (°C)					

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information:

7.3.6	TABLE: Over-charging of battery			P
Constant charging current (A).....:		**22.8**		—
Supply voltage (Vdc).....:		**35.7**		—
Sample No.	**OCV before charging (Vdc)**	**Total charging time (minute)**	**Maximum outer case temperature (°C)**	**Results**
B12#	21.813	96	30.1	A, B
B13#	21.821	96	29.9	A, B
B14#	21.801	96	30.3	A, B
B15#	21.788	96	30.2	A, B
B16#	21.799	96	29.0	A, B

Supplementary information:

A - No fire or explosion

B - The test was continued until the temperature of the outer casing reached steady state conditions.

7.3.7	TABLE: Forced discharge (cells)			N/A
Sample No.	**OCV before application of reverse charge (Vdc)**	**Measured reverse charge I_t (A)**	**Lower limit discharge voltage (Vdc)**	**Results**

Supplementary information:

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.8.1	TABLE: Vibration				P
Sample No.	**OCV before test (Vdc)**	**OCV after test (Vdc)**	**Mass before test (g)**	**Mass after test (g)**	**Results**
B17#	29.108	29.085	2201.95	2201.92	A, B, C, D
B18#	29.083	29.074	2204.33	2204.30	A, B, C, D
B19#	29.112	29.102	2206.18	2206.08	A, B, C, D

Supplementary information:

A - No fire or explosion
B - No rupture
C - No leakage
D - No venting
E - Others (please explain)

7.3.8.2	TABLE: Mechanical shock				P
Sample No.	**OCV before test (Vdc)**	**OCV after test (Vdc)**	**Mass before test (g)**	**Mass after test (g)**	**Results**
B20#	29.114	29.106	2203.45	2203.39	A, B, C, D
B21#	29.105	29.093	2208.21	2208.14	A, B, C, D
B22#	29.094	29.085	2206.59	2206.56	A, B, C, D

Supplementary information:

A - No fire or explosion
B - No rupture
C - No leakage
D - No venting
E - Others (please explain)

IEC 62133-2			
Clause	Requirement + Test	Result - Remark	Verdict

7.3.9	TABLE: Forced internal short circuit (cells)				N/A
Sample No.	**Chamber ambient T (°C)**	**OCV before test (Vdc)**	**Particle location 1)**	**Maximum applied pressure (N)**	**Results**
Samples charged at charging temperature upper limit (°C)					
Samples charged at charging temperature lower limit (°C)					
Supplementary information:					

D.2	TABLE: Internal AC resistance for coin cells			N/A
Sample no.	**Ambient T (°C)**	**Store time (h)**	**Resistance Rac (Ω)**	**Results 1)**
Supplementary information:				

IEC62133_2B ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
ATTACHMENT TO TEST REPORT **IEC 62133-2** **(REPUBLIC OF KOREA) NATIONAL DIFFERENCES** (SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES - SAFETY REQUIREMENTS FOR PORTABLE SEALED SECONDARY LITHIUM CELLS, AND FOR BATTERIES MADE FROM THEM, FOR USE IN PORTABLE APPLICATIONS - PART 2: LITHIUM SYSTEMS)			
Differences according to.....:	National standard KC62133-2(2020-07)		
TRF template used:.....:	IECEE OD-2020-F3, Ed. 1.1		
Attachment Form No..... :	KR_ND_IEC62133_2B		
Attachment Originator.....:	KTR		
Master Attachment.....:	Dated 2022-05-27		
Copyright © 2020 IEC System for Conformity Testing and Certification of Electrical Equipment (IECEE), Geneva, Switzerland. All rights reserved.			
	National Differences		P
7.3.6	**Over-charging of battery**		N/A
(Revision)	***[Add the bolded text]*** b) Test The test shall be carried out in an ambient temperature of 20 °C ± 5 °C. Each test battery shall be discharged at a constant current of 0,2 It A, to a final discharge voltage specified by the manufacturer. Sample batteries shall then be charged at a constant current of 2,0 It A, using a supply voltage which is: • 1,4 times the upper limit charging voltage presented in Table A.1 (but not to exceed 6,0 V) for single cell/cell block batteries or • 1,2 times the upper limit charging voltage presented in Table A.1 per cell for series connected multi-cell batteries, and • sufficient to maintain a current of 2,0 It A throughout the duration of the test or until the supply voltage is reached. **• <u>In case the charging voltage specified by the manufacturer is higher than the overcharge test voltage, the maximum charging voltage specified by manufacturer should be applied with 2.0 ItA,</u>** **<u>(e.g., quick charging power bank, etc.)</u>**	See Table 7.3.6 for test result.	N/A

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IEC62133_2B ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	[Replace to the following statement] c) Acceptance criteria Filling beyond the manufacturer's specified limits should not result in ignition or explosion		N/A
Annex G	**Definition for shape and materials of outer case for cell**		—
(Addition)	G.1 General Annex G provides definitions for shape and materials of outer case for cell G.2 Shape of outer case for cell G 2.1 Cylindrical cell Cell with a cylindrical shape in which the overall height is equal to or greater than diameter. G 2.2 Prismatic cell Cell having the shape of a parallelepiped whose faces are rectangular G.3 Materials of outer case for cell G.3.1 Soft case Non-metallic outer case or container for cell G.3.2 Hard case Metallic outer case or container for cell.	(Shape of outer cases) ☒ Cylindrical ☐ Prismatic (Materials of outer cases) ☒ Hard ☐ Soft	—
Annex H	**Calculation method of the volumetric energy density for cell**		—
(Addition)	Annex H provide a calculation method of the volumetric energy density for cell in use of smart phone, tablet, notebook. H.1 General Unless otherwise stated in the Annex E, the dimensions for calculation are based on these for cell before shipment and the volumetric energy density shall be calculated with a maximum values specified by manufacturer. If the specification for cell can't be provided a dimension for calculation, the manufacturer's other documentation shall be provided to demonstrate compliance for its calculation.	616.0Wh / L	—

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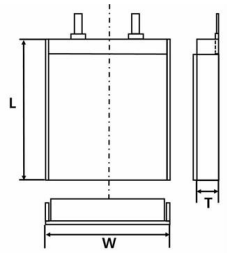
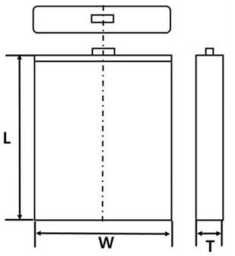
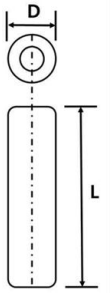
IEC62133_2B ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	H.2 Calculation Method  L : Length (max.) of cell (including terrace) W : Width (max.) of cell T : Thickness (max.) when shipping charge (For reference, Please Exclude the dimension of any tape that Is attached to cell) $Volumetric\ energy\ density\ (Wh/L) = \frac{Nominal\ voltage\ (V) \times Rated\ capacity\ (Ah)}{Length\ (L) \times Width\ (W)\ \times Thickness\ (T)}$ [H.1 – Prismatic cell using soft case]  L : Length (max.) of cell W : Width (max.) of cell T : Thickness when shipping charge (For reference, Please Exclude the dimension of any tape that Is attached to cell) $Volumetric\ energy\ density\ (Wh/L) = \frac{Nominal\ voltage\ (V) \times Rated\ capacity\ (Ah)}{Length\ (L) \times Width\ (W)\ \times Thickness\ (T)}$ [H.2 – Prismatic cell using hard case]  D : Diameter (max.) of cell L : Length (max.) of cell (According to shape of cell at shipping, The dimension of tube for cell may be included In overall dimension of cell) $Volumetric\ energy\ density\ (Wh/L) = \frac{Nominal\ voltage\ (V) \times Rated\ capacity\ (Ah)}{3.14159\ \times \frac{Diameter\ (D)^2}{4} \times Length(L)}$ [H.3 – Cylindrical cell using hard case]	—	

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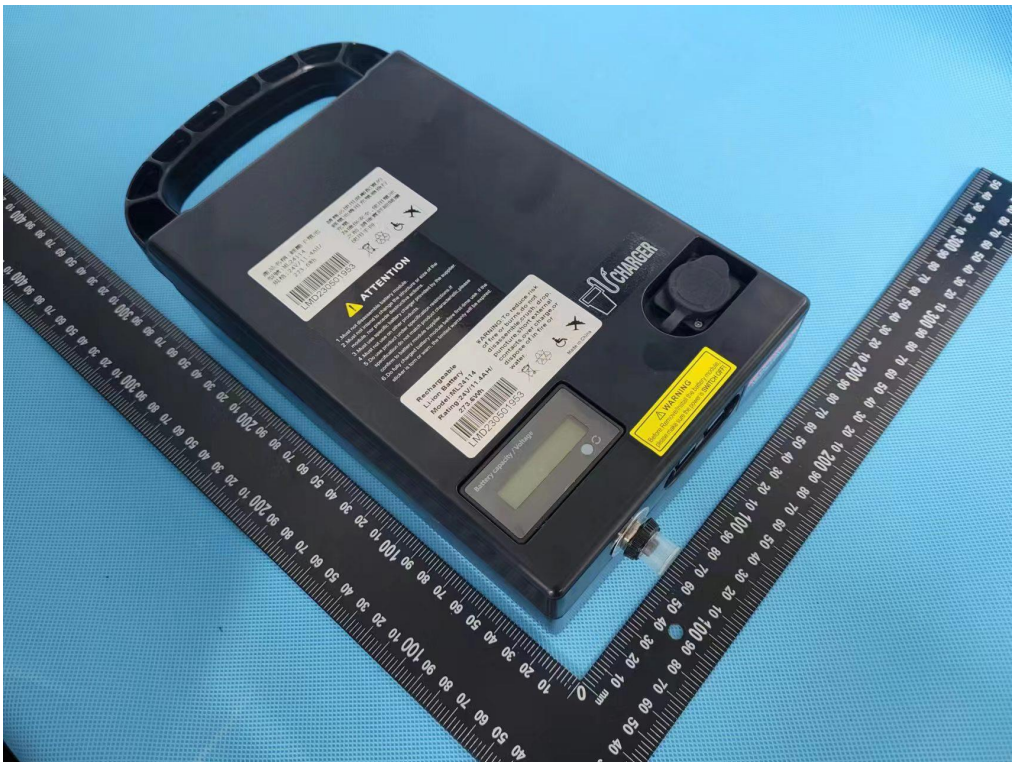
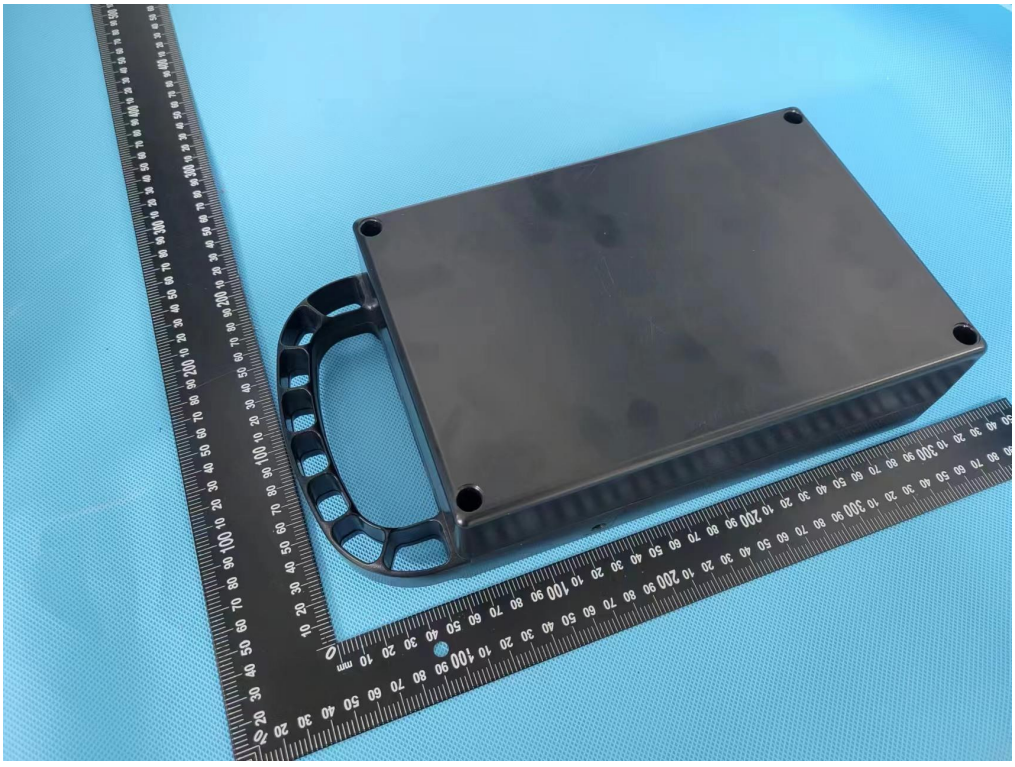
ENCLOSURES

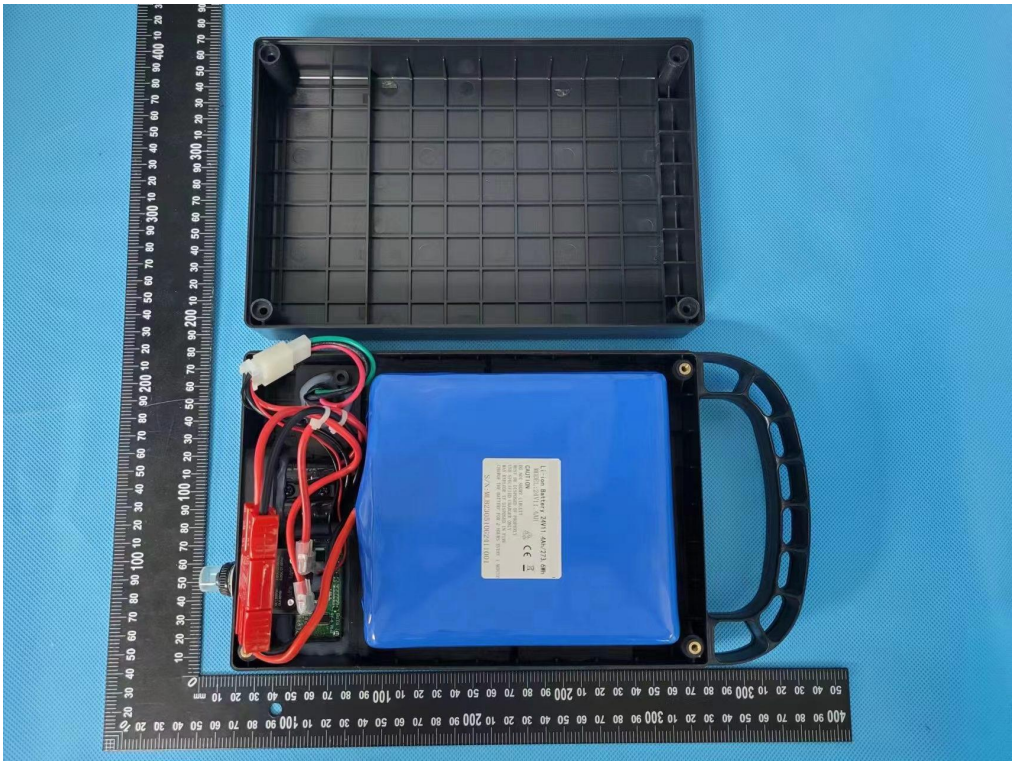
Supplement ID	Description
01	Overall view of Rechargeable Li-ion Battery, Model ML24114
02-1, 02-1, 02-3	Internal view of Rechargeable Li-ion Polymer Battery, Model ML24114
03-1, 03-2	PWB for Li-ion Polymer Battery, Model ML24114
04	Overall view of Rechargeable Li-ion Cell, Model INR18650-29E
05	PWB layout of Rechargeable Li-ion Battery, Model ML24114
06-1, 06-2	PWB schematic diagram of Rechargeable Li-ion Battery, Model ML24114
07	Assembly Drawing for Rechargeable Li-ion Cell, Model INR18650-29E
08	Assembly Drawing for Rechargeable Li-ion Battery, Model ML24114
09	Safety information and instruction for Rechargeable Li-ion Battery, Model ML24114

ID 01



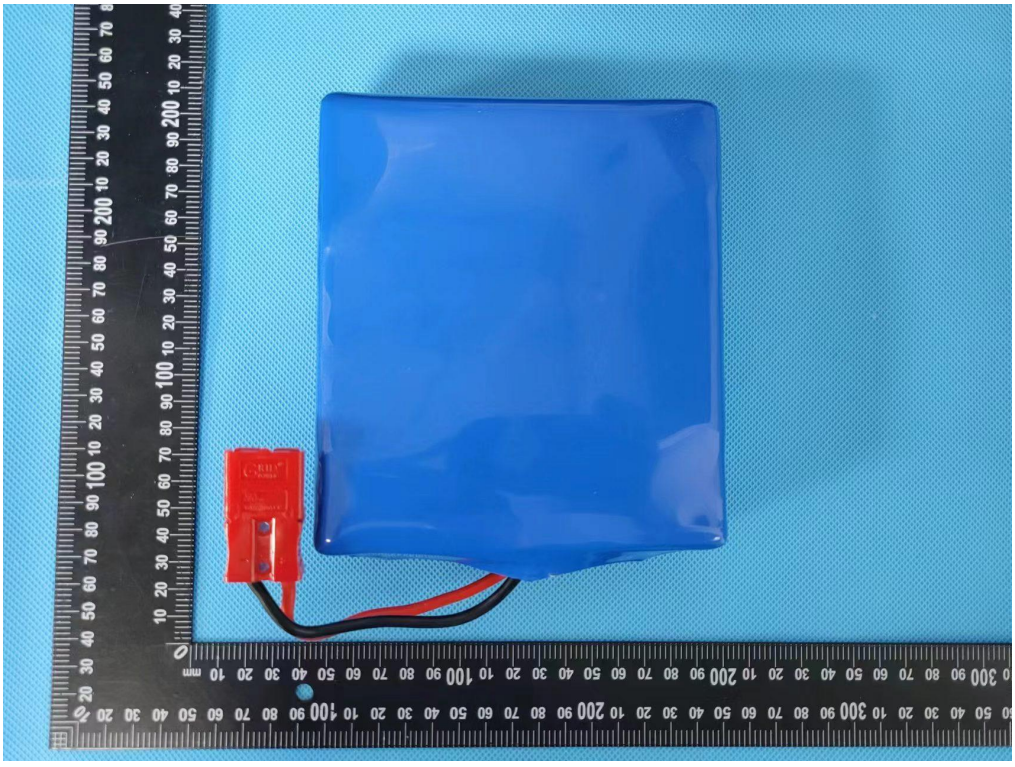


ID 02-1

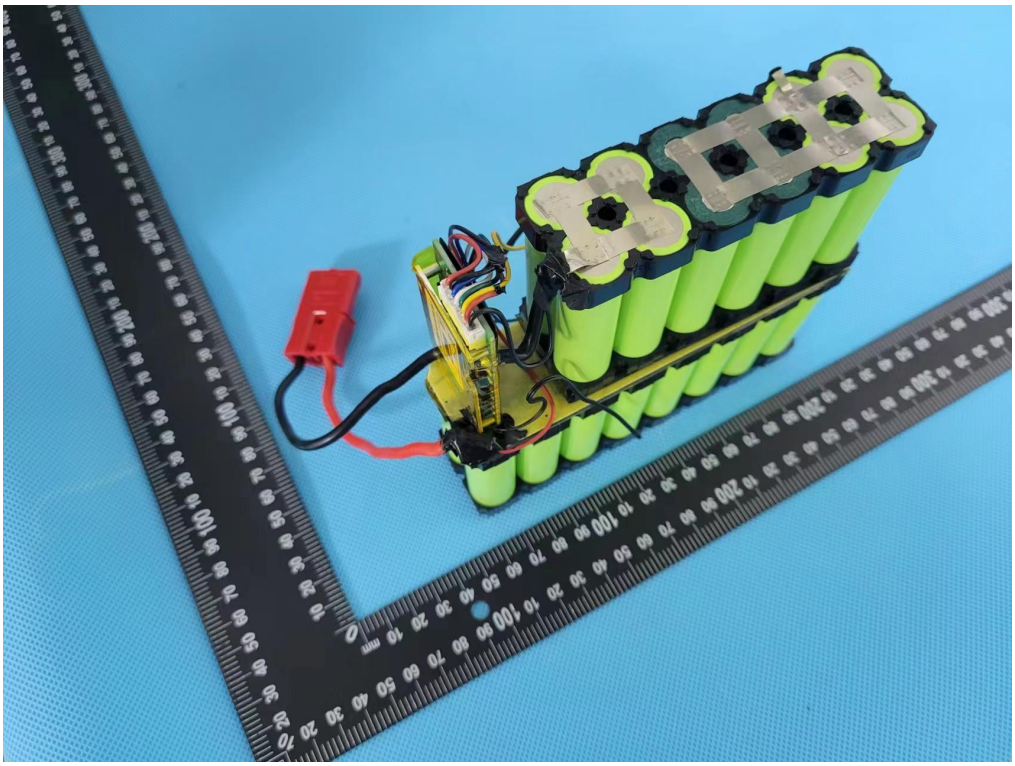


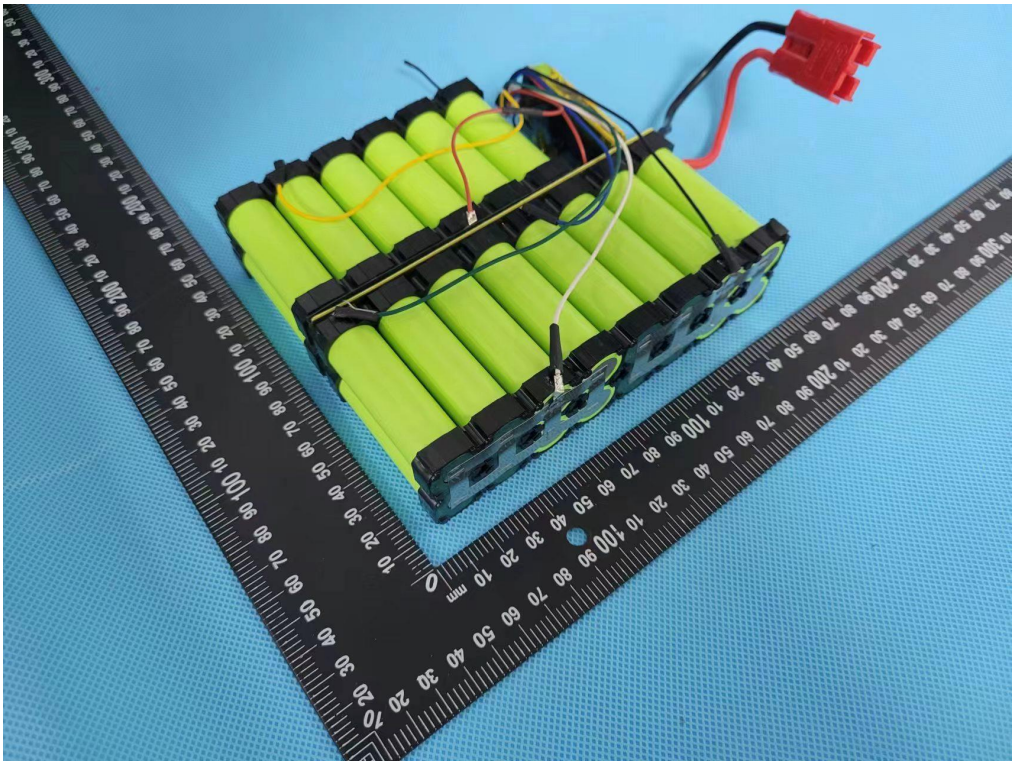
ID 02-2

Li-ion Battery 24V11.4Ah/273.6Wh
MODEL:24V11.4AH
CAUTION
S/N:MLB23051062411001

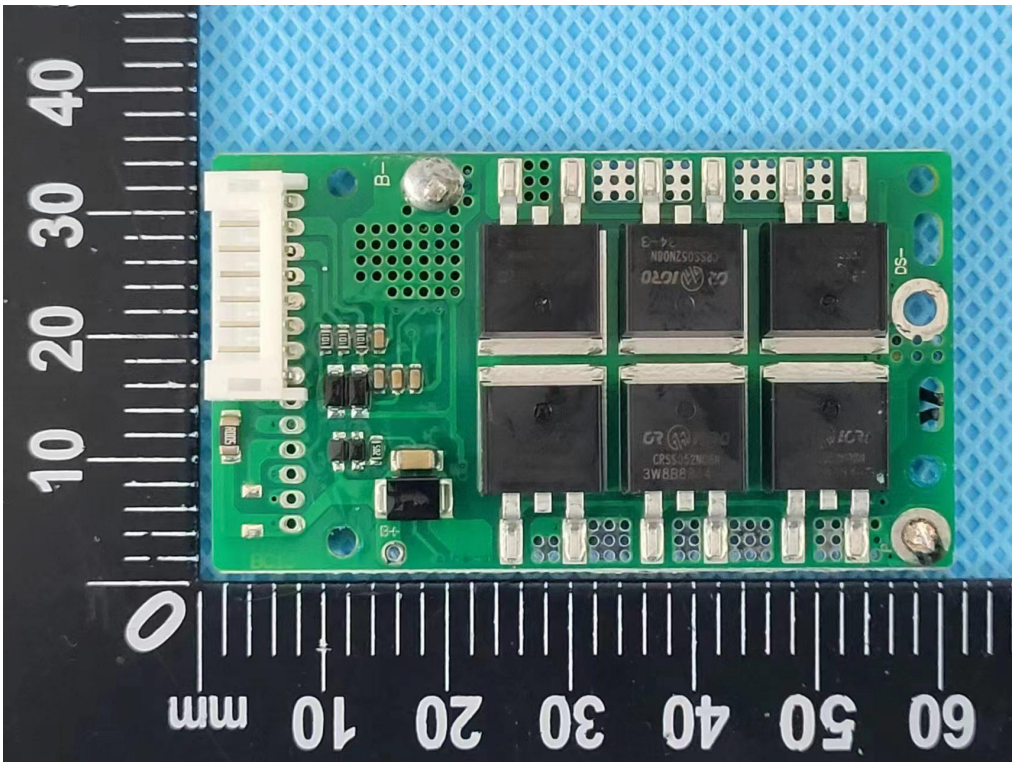


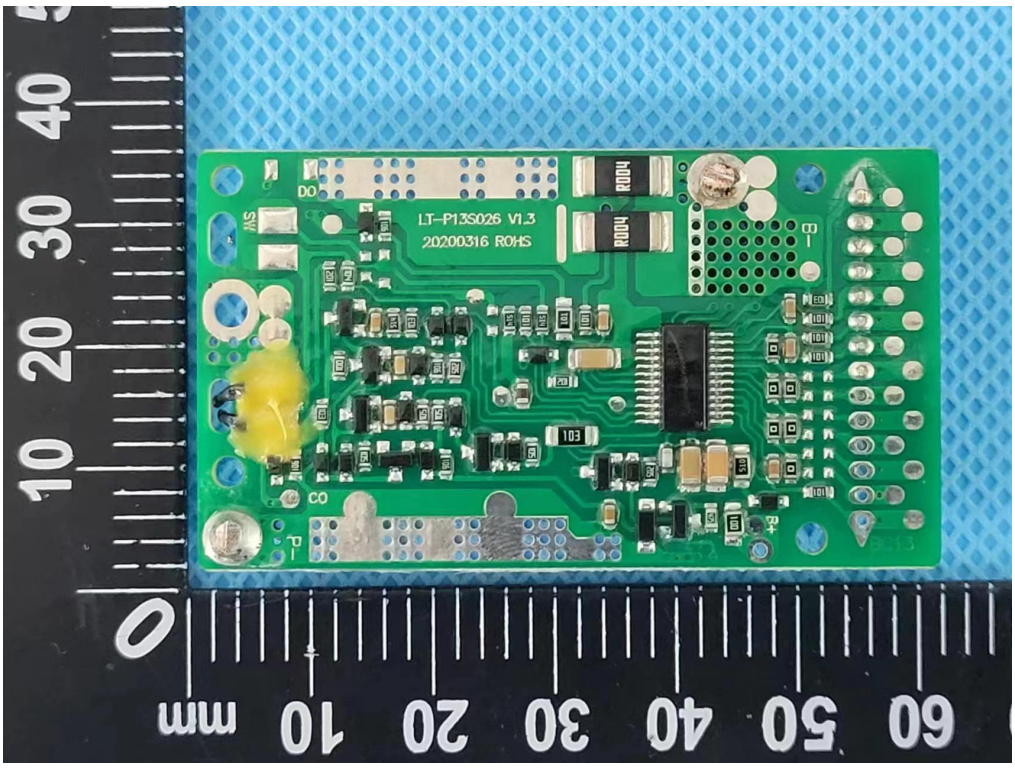
ID 02-3





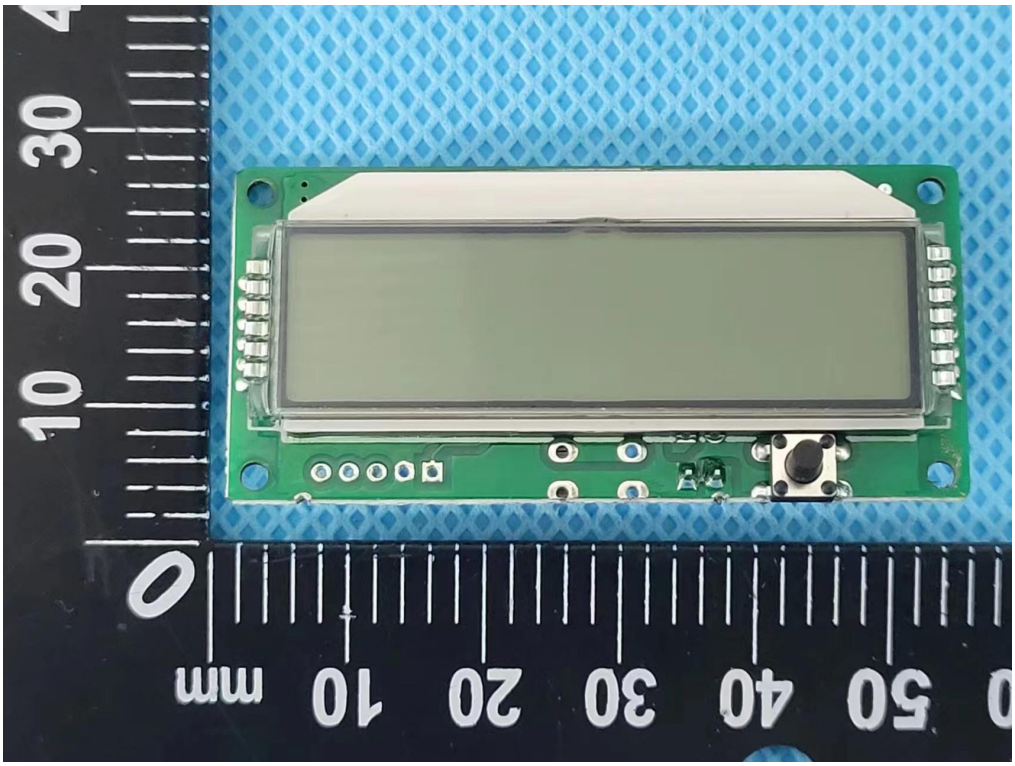
ID 03-1

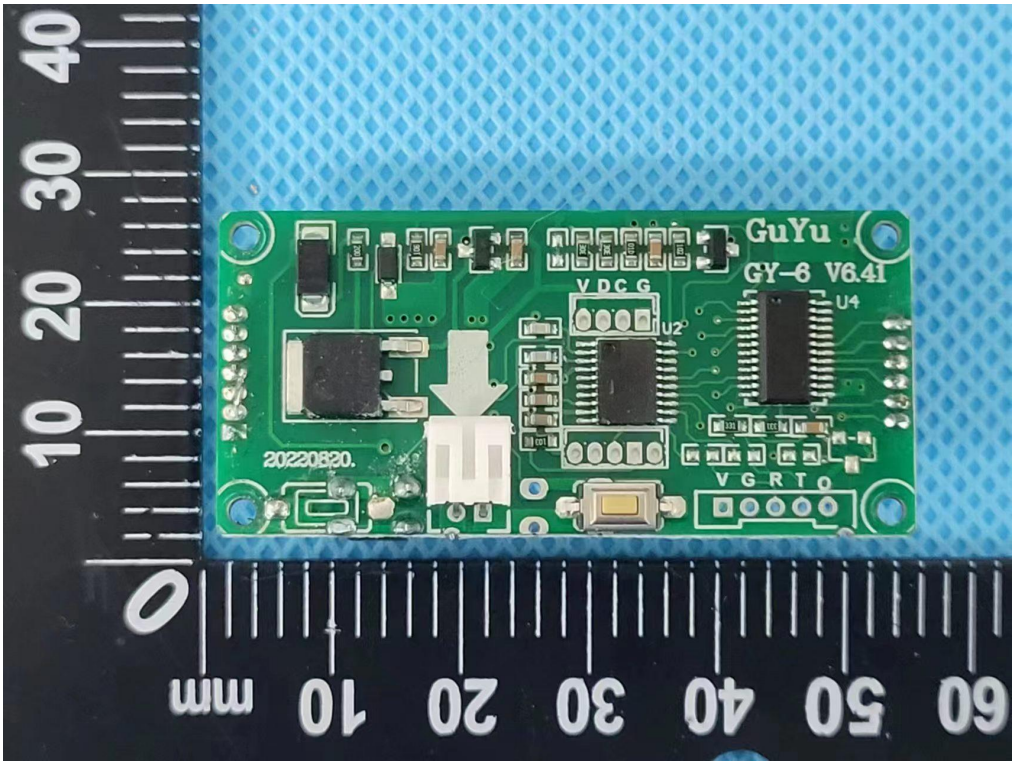




PCB 1

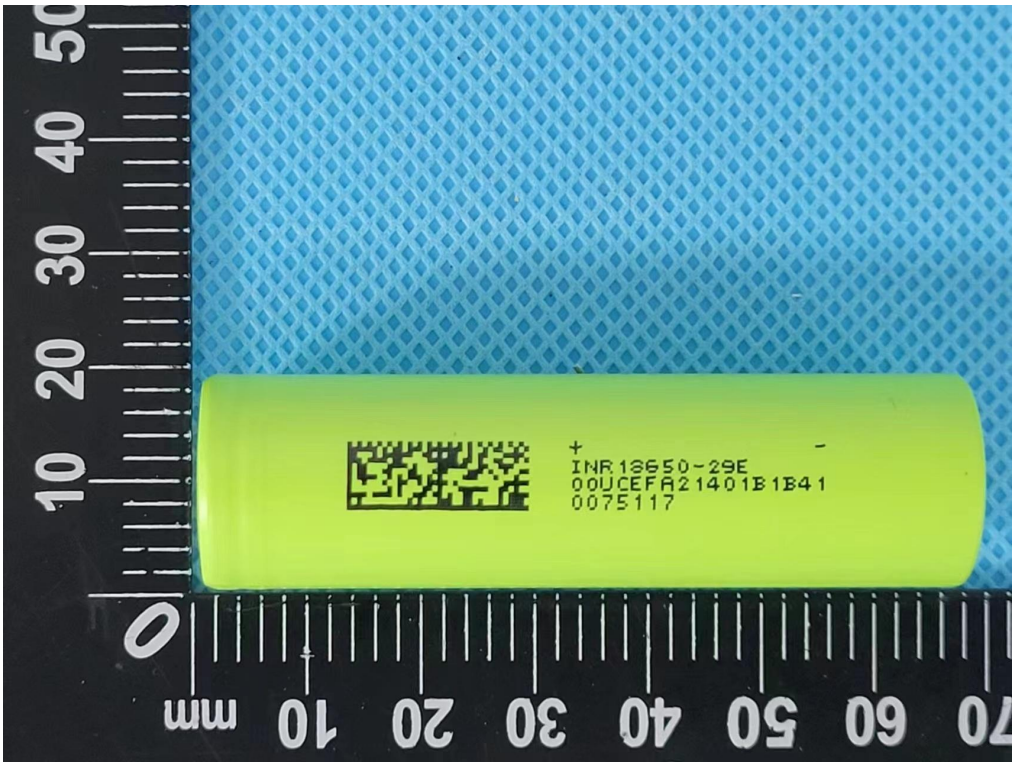
ID 03-2

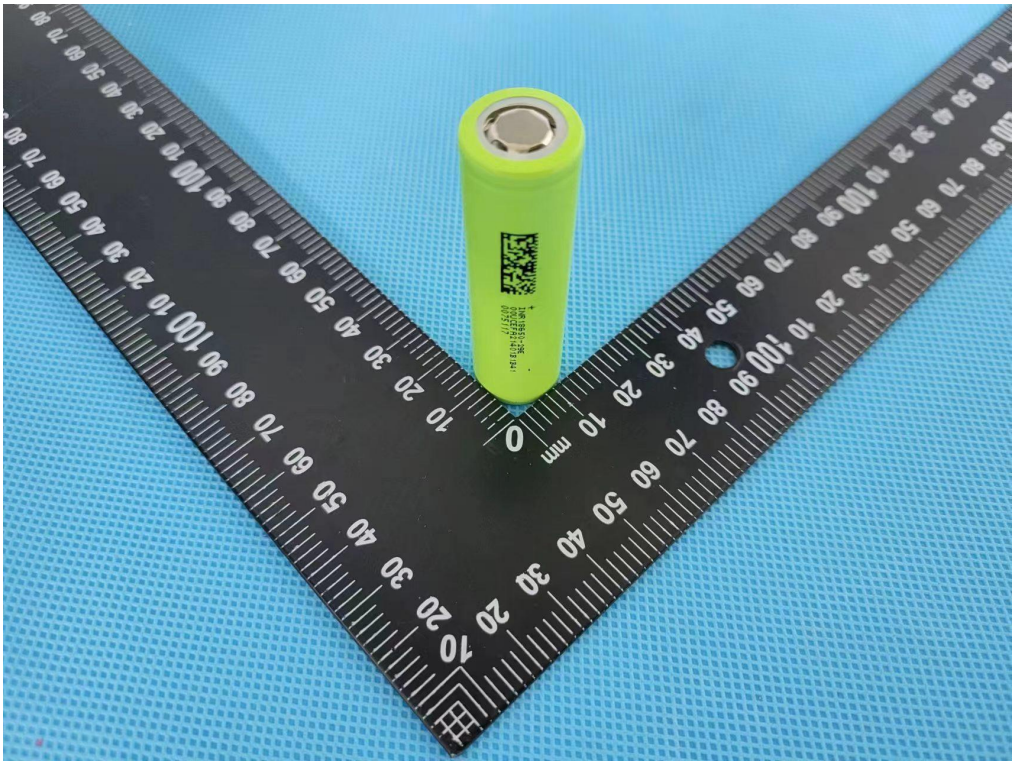




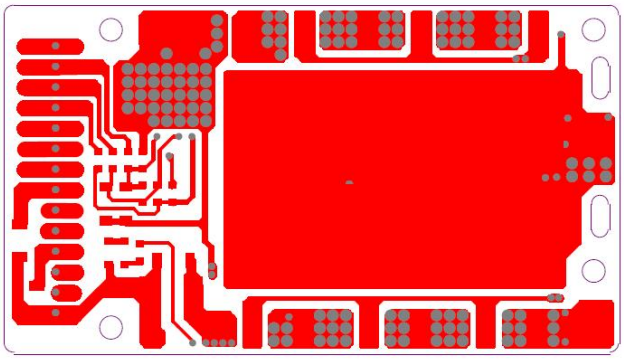
PCB 2

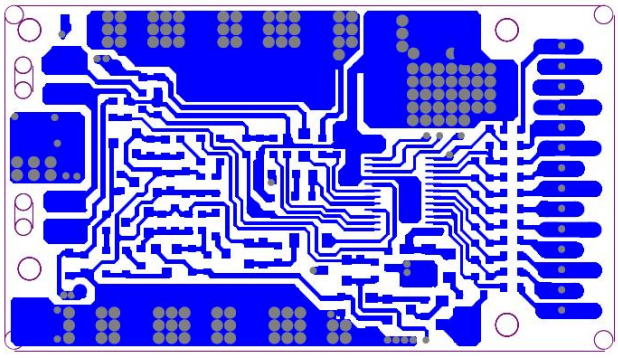
ID 04



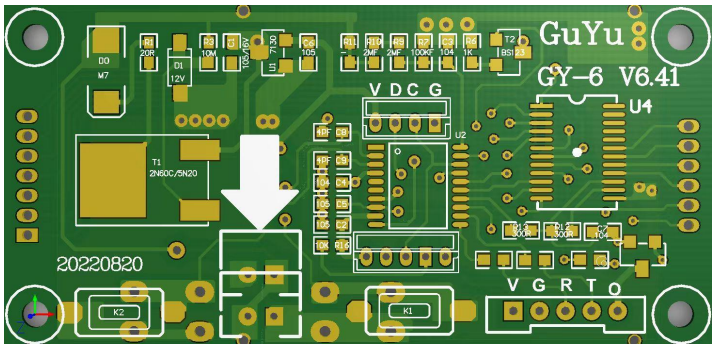


ID 05



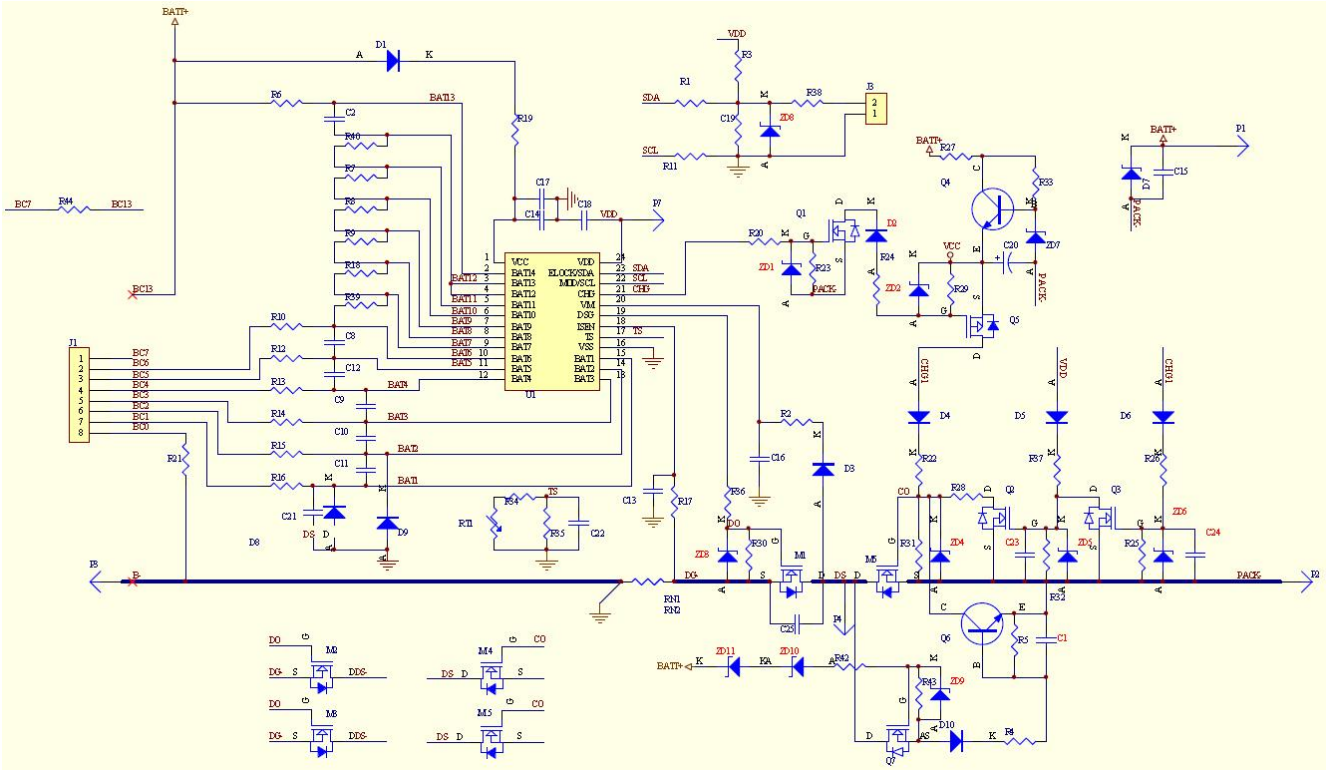


PWB layout of Internal battery pack (for PCB 1)



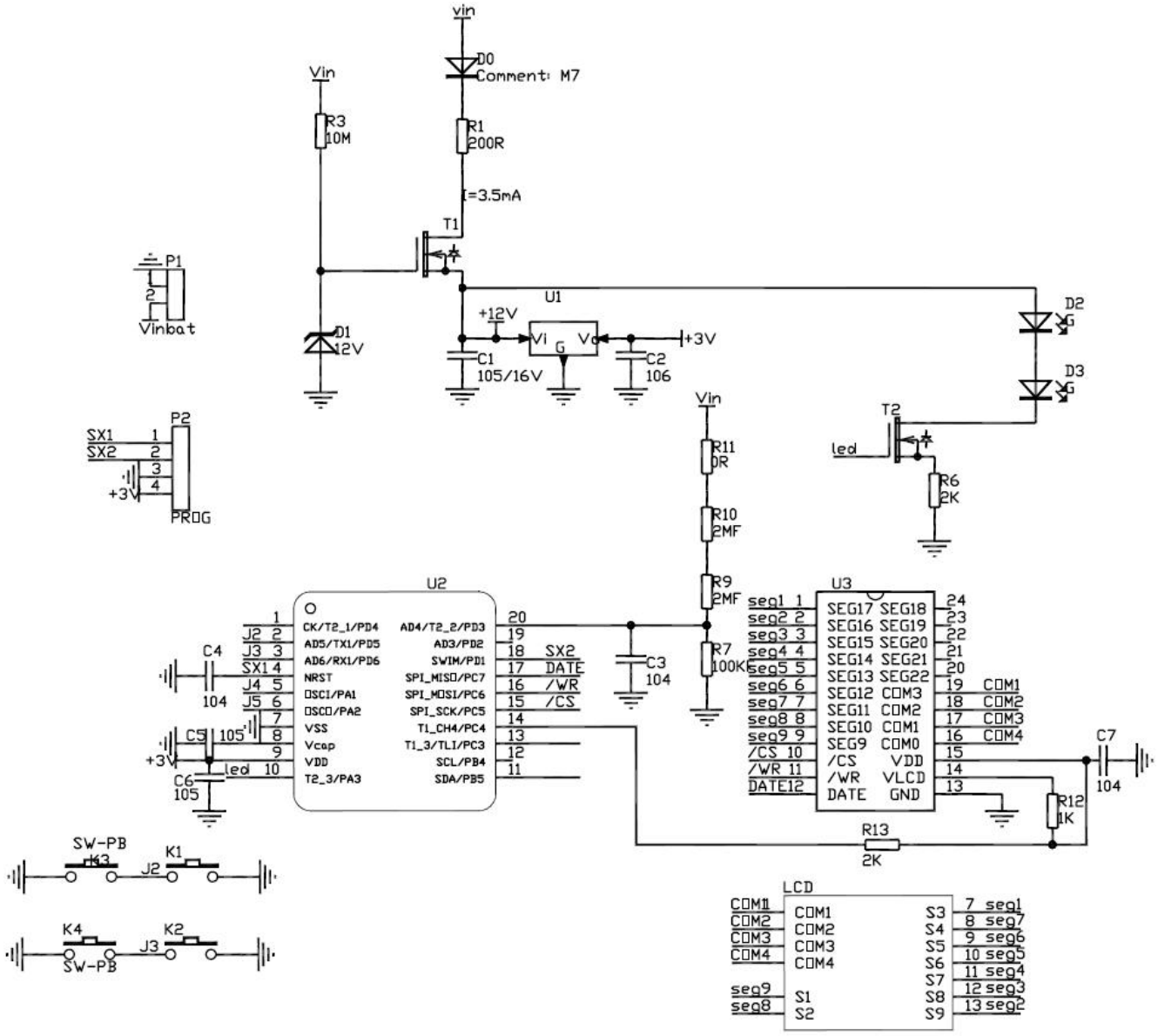
PWB layout of Electric quantity display (for PCB 2)

ID 06-1



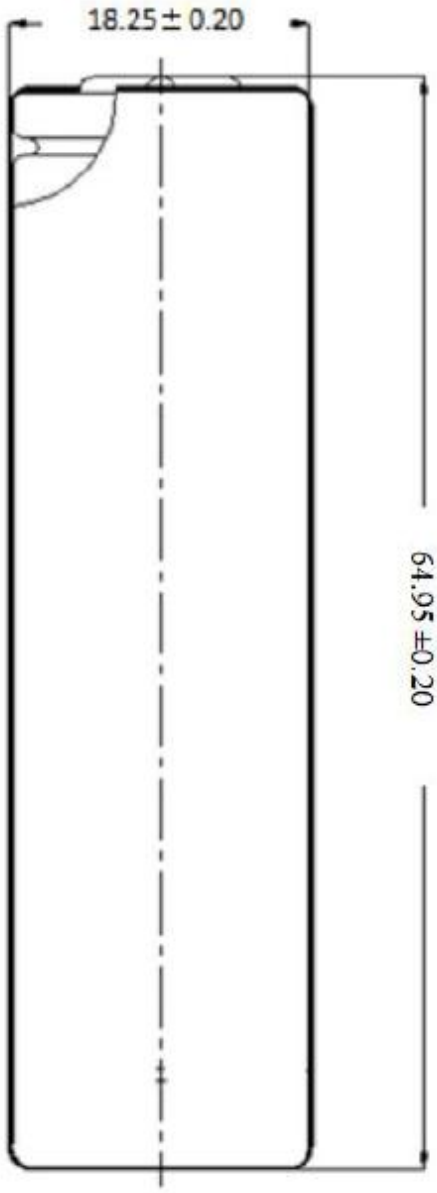
PWB schematic diagram of Internal battery pack (for PCB 1)

ID 06-2



PWB schematic diagram of Electric quantity display (for PCB 2)

ID07



ID 08

ID 09

电池使用时警告事项及注意事项 Warnings and Cautions in Using the Battery

为防止电池可能发生泄漏,发热、爆炸,请注意以下预防措施:

To prevent a possibility of the battery from leaking, heating or explosion please observe the following precautions:

- 严禁将电池浸入海水或水中,保存不用时,应放置于阴凉干燥的环境中.
  Do not immerse the battery in water or seawater, and keep the battery in a cool dry surrounding if it stands by.
- 禁止将电池在热高温源旁,如火、加热器等使用和留置
  Not use or leave the battery near a heat source as fire or heater.
- 充电时请选用锂离子电池专用充电器.
  Use the battery charger specifically for that purpose when recharging.
- 严禁颠倒正负极使用电池
  Do not reverse the position and negative terminals.
- 严禁将电池直接插入电源插座.
  Do not connect the battery to an electrical outlet.
- 禁止将电池丢于火或加热器中
  Do not discard the battery in fire or a heater.
- 禁止用金属直接连接电池正负极短路.
  Do not short-circuit the battery by directly connecting the positive and negative terminals with metal objects.
- 禁止将电池与金属,如发夹、项链等一起运输或贮存
  Do not transport or store the battery together with metal objects such as hairpins, necklaces, etc
- 禁止敲击或抛掷、踩踏电池等
  Do not strike, trample or throw the battery..
- 禁止直接焊接电池和用钉子或其它利器刺穿电池.
  Do not directly solder the battery and pierce the battery with a nail or other sharp objects.
- 禁止在高温下（炙热的阳光下或很热的汽车中）使用或放置电池,否则可能会引起电池过热、起火或功能失效、寿命减短.
  Do not use or leave the battery at high temperature (for example, at strong direct sunlight or in a vehicle in extremely hot weather). Otherwise, it can overheat or fire or its performance will be degenerate and its service life will be decreased.
- 禁止在强静电和强磁场的地方使用,否则易破坏电池安全保护装置,带来不安全的隐患.
  Do not use the battery in a location where static electricity and magnetic field is great, otherwise, the safety devices may be damaged, causing hidden trouble of safety.
- 如果电池发生泄露,电解液进入眼睛,请不要揉擦,应用清水冲洗眼睛,并立即送医治疗,否则会伤害眼睛