

SPECIFICATION FOR APPROVAL

Customer Name :

Lenovo Group Limited

Product Name :

Rechargeable Lithium-ion Battery Pack

Model Name : L25C3P73

Customer ASM P/N : SB11M89975

Customer FRU P/N : 5B11M90174

Celxpert P/N :

921300778 (1st TCO AC85)

921300779 (2nd TCO ST85)

Cell Model Name : ATL GC-SDC-705780-R00H/GC-SDC-705780-R00L

[ACCEPTANCE]

Accepted by: _____

Date: _____

CELXPERT ENERGY CORPORATION

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1. Scope

This document describes a 3-cell pack specification. This specification is based on the Lenovo Common Smart Battery System Interface Specification V0.5.

2. Battery Pack Specification

Item	Function	Specification	Remarks
1	Cell Type 电池型号	Li-ion battery GC-SDC-705780- R00H/R00L Nominal 6411mAh/3.9V	
2	Pack Configuration 电池组配置	3S1P	
3	Ideal Nominal Capacity 理想标称容量	11.7V, 6411mAh (75Wh)	25 ± 2°C Charge: 0.2Cmin charge to 4.5V, then CV charge till charge current decline to 0.05Cmin Discharge: 0.2Cmin to 3.0V/cell
4	Ideal Minimum Capacity 理想最小容量	11.7V, 6283mAh(73.6Wh)	
5	Typical Capacity 标称容量	11.7V, 6411mAh (75Wh)	25 ± 2°C Charge: 0.2Cmin charge to 4.5V, then CV charge till charge current decline to 0.05Cmin Discharge: 0.2Cmin to 3.0V/cell
6	Rated Capacity 额定容量	11.7V, 6283mAh(73.6Wh)	
7	Charge Limited Voltage 充电限制电压	13.5V	
8	Upper Limited Charge Voltage 充电上限电压	13.59V	For GB 31241-2022
9	End of discharge Voltage 放电终止电压	9V	Stop discharge when one cell voltage reach 3.0V
10	Discharge Cut-off Voltage 放电截止电压	Temperature : ≤ 15°C Voltage : 8.1V	For GB 31241-2022 Stop discharge when one cell voltage reach 2.7V
		Temperature : > 15°C Voltage : 8.4V	For GB 31241-2022 Stop discharge when one cell voltage reach 2.8V
11	Max. Charge Current 最大充电电流	≥ 0°C	Initial low charge temp
		< 50°C	Initial high charge temp
		0°C~10°C: 1.282A / charge volt : 13.5V	
		10°C~15°C: 2.564A / charge volt : 13.5V	

		15~20°C: Step1: Charge Volt: 13.5V / Charge Current: 7.052A Step2: Charge Volt: 13.5V, step down Charge Current per 0.642A by six stage when max cell $\geq$ 4.1V until Charge Current = 3.205A Step3: Charge Volt: 13.5V / Charge Current: 3.205A to FC Note: Delay time of step down current is 3sec.	
		20°C~45°C: Step1: Charge Volt: 13.5V / Charge Current: 7.693A Step2: Charge Volt: 13.5V, step down Charge Current per 0.642A by five stage when max cell $\geq$ 4.2V until Charge Current = 4.487A Step3: Charge Volt: 13.5V / Charge Current: 4.487A to FC Note: Delay time of step down current is 3sec.	
		45°C~60°C: 4.487A / charge volt: 13.5V (Charge current report 0mA, if max cell voltage > 4.2V; Recovery charge: Temperature < 44°C or Cell Voltage1..3 < 3.9V)	
		Charging Current is modified by SOH. The SOH = (Ideal FCC / Design Capacity) * 100 [%] If SOH $\geq$ 100% : Charge Current = Initial Charging Current If SOH < 100% : Charge Current = Initial Charging Current * SOH	
12	Recommendation Charge Current 推荐充电电流	1.256A	For GB 31241-2022
13	Taper Current for Charge 充电截止电流	0.320A	

14	Max. Discharge Power 最大放电功率	80W	35°C(Ambient) ≤ 70°C(Cell Interface)
		100W / 30sec (RSOC >10%)	Peak power 35°C(Ambient)
15	Max. Discharge Current 最大放电电流	8.89A	For GB 31241-2022
16	Recommendation Discharge Current 推荐放电电流	1.256A	For GB 31241-2022
17	Initial AC Impedance 内部阻抗	≤120mΩ	
18	Operating Temperature (Charge) 上下限充电温度	0°C~60°C	Humidity: Max 95% RH
19	Operating Temperature (Discharge) 上下限放电温度	-20°C~60°C	Humidity: Max 95% RH (cell surface temp: <70°C max.)
20	Storage Temperature 存储温度	-20~50°C (1 week)	Humidity: Max 75% RH
		-20~45°C (1 month)	
		-20~40°C (6 months)	
		-20~35°C (1 year)	
21	Cycle Life 循环寿命	Charge: 1.2C to 12.6V, CV to 0.7C, 0.7C to 13.5V charge, cut off 0.05C Discharge: 0.5C to 3V (Cycles: 0-100 : 13.5V to 9.0V, 101-150: 13.47V to 9.0V, 151-300: 13.44V to 9.0V, 301-350: 13.41V to 9.0V, 351-400: 13.38V to 9.0V, 401-1000: 13.35V to 9.0V) 25± 2°C.	1000cycle > 80% of 0.2C Rated Capacity; 1000cycle Swelling<10%
22	Pack Weight 重量	Max 263g	

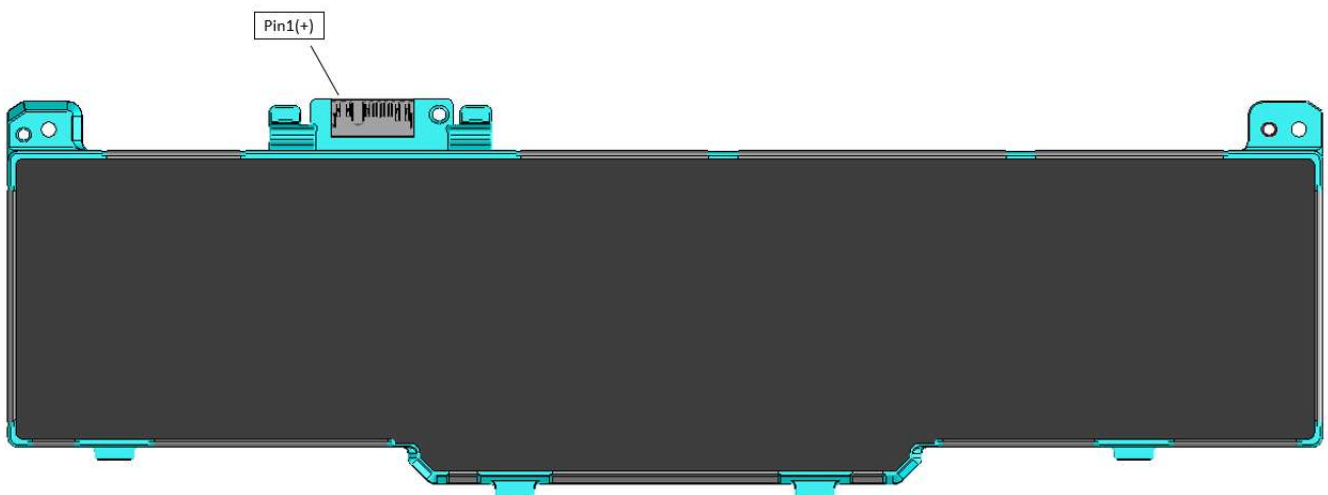
3. Pack Safety Certification

UL/CUL	UL 2054, UL 62368-1
CE EMC	EN 55032:2015 + A11:2020
	EN 55035:2017+ A11:2020
PSE	JIS C 62133-2 2020(J62133-2(2021))
CB	IEC/EN 62133-2:2017, IEC/EN 62368-1
KC	KC 62133-2:2020
UN	UN38.3
TISI	TIS 2217-2548
BSMI	CNS 15364:102
CCC	GB 31241-2022
BIS	IS 16046(Part2):2018
MIC	QCVN 101: 2020/BTTTT

4. Battery Terminals Definition

Pin No.	Define	Color	Comments
1	P+	--	Battery Positive Terminal.
2	P+	--	Battery Positive Terminal.
3	CLK	--	SMBus Clock interface I/O pin.
4	DAT	--	SMBus Data interface I/O pin.
5	Temp	--	10Kohm Resistor connected to GND
6	NA	--	-
7	P-	--	Battery Negative Terminal.
8	P-	--	Battery Negative Terminal.

Note :



5. Fuel Gauge Specification

Gauge IC solution: Renesas RAJ240057 & ECT FW

Item	Function	Specification	Comments
1	Firmware Upgrade Capability	Firmware must be flash programmable at the battery connector	
2	Voltage Accuracy	$\pm 10\text{mV}$ from 2.0V ~ 4.6V from -20°C ~ 80°C	Individual Cell Stack Voltages shall be communicated through SBS optional function registers.
3	Current Accuracy	$\pm 2.5\%$	
4	Temperature Accuracy	$\pm 3^\circ\text{C}$ from -20°C ~ 80°C	
5	Remaining Capacity (0x0f)	Shall be zero when the cell stack voltage reaches 9.0V or min cell voltage reaches 3.0V.	
6	Remaining Capacity Alarm (0x01)	10% of Design Capacity	
7	Remaining Time Alarm (0x02)	10 minutes	
8	Reserve Capacity	300 mWh	RSOC 0% to TDA
9	Charging Current (0x14)	0°C~10°C: 1.282A / charge volt : 13.5V	Normal charge
		10°C~15°C: 2.564A / charge volt : 13.5V	
		15~20°C: Step1: Charge Volt: 13.5V / Charge Current: 7.052A Step2: Charge Volt: 13.5V, step down Charge Current per 0.642A by six stage when max cell $\geq 4.1\text{V}$ until Charge Current = 3.205A Step3: Charge Volt: 13.5V / Charge Current: 3.205A to FC Note: Delay time of step down current is 3sec.	
		20°C~45°C: Step1: Charge Volt: 13.5V / Charge Current: 7.693A Step2: Charge Volt: 13.5V, step down Charge Current per 0.642A by five stage when max cell $\geq 4.2\text{V}$ until Charge Current = 4.487A Step3: Charge Volt: 13.5V / Charge Current: 4.487A to FC	

		Note: Delay time of step down current is 3sec.	
		45°C~60°C : 4.487A / charge volt: 13.5V (Charge current report 0mA, if max cell voltage > 4.2V; Recovery charge: Temperature < 44°C or Cell Voltage 1..3 < 3.9V)	
		Charge current: 0.314A Min Vcell < 3.0V/cell	Pre-charge
		0mA	Charge suspend
10	Charging Voltage (0x15)	13.5V	
11	Cycle Count (0x17)	When the amount of charge reaches 100% of the Full charge Capacity, Cycle Count increases by 1	
12	Fully Charged Bit (bit 5) in Battery Status Register (0x16)	All of the following conditions must occur for consecutive 60-s periods: Charging (that is, BatteryStatus [DSG] = 0) AND AverageCurrent() < 0.320A, AND Max Cell Voltage1..3 ≥ (ChargingVoltage() / number of cells in series) - 50mV Reset when RSOC (0x0D) < 95%	
13	Fully Discharged Bit (bit 4) in Battery Status register (0x16)	Set: Remaining Capacity() = 0%, Reset :Remaining Capacity() >20%	
14	Full Charge Capacity (0x10)	During a valid learning cycle, the new capacity should be learned when RSOC reach 6%.	
15	Cell Stack Voltages	Individual Cell Stack Voltages should be stored in the Optional Mfg Functions	
16	Device Name (0x21)	LNV-5B11M90174	
17	Manufacturer Name (0x20)	Celxpert 2025	
18	AlarmWarning Broadcast	Disabled	
19	Stage Version (0x37)	0006-0178-0031-0004	SIT Stage

Notes:

1. Charging Current: at normal condition, this register reports normal charge current, but reports “0” once the fuel gauge IC detects the battery has met at least one of the following conditions:
 - a. Charging condition not met (temperature out of range, etc.)
 - b. C-FET and D-FET are shorted and the fuse is blown.
 - c. Any other abnormal condition.

6. Fuel Gauge Board

6.1 Protection Function

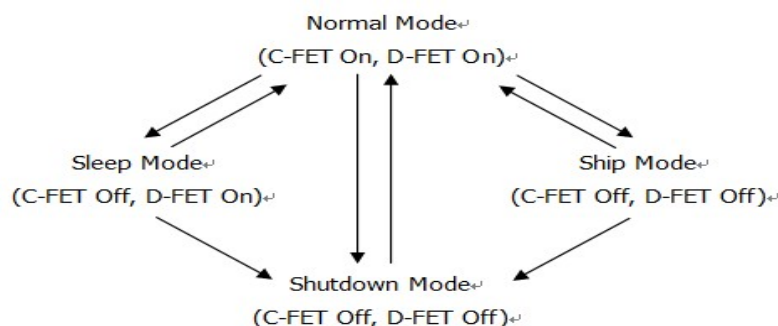
Item	Function	Activate Condition	Release Condition
1	Over Charge Voltage 过压充电保护电压	Voltage: $\geq 4.53V \pm 0.02V/\text{cell}$ and Delay Time: $\geq 3\text{sec}$ → C-FET off	Voltage: $\leq 4.4V \pm 0.02V/\text{cell}$, delay time $\geq 1\text{sec}$
2	HW Over Charge Voltage Protection 硬件过压充电保护电压	Voltage: $\geq 4.65V \pm 0.02V/\text{cell}$ and Delay Time: $4.8 \sim 7.2\text{sec}$ → Fuse blow	--
3	Over Discharge Voltage 欠压放电保护电压	Temperature: $\leq 15^\circ\text{C}$ Voltage: $\leq 2.7V \pm 0.02V/\text{cell}$ and Delay Time: $\geq 12\text{sec}$ → D-FET off Temperature: $> 15^\circ\text{C}$ Voltage: $\leq 2.8V \pm 0.02V/\text{cell}$ and Delay Time: $\geq 12\text{sec}$ → D-FET off	Voltage: $\geq 3.1V \pm 0.02V/\text{cell}$ keeps 1sec and Charge current $> 50\text{mA}$
4	Over Current protection 过流充电保护		
	Over Charge Current Protection 过流充电保护	Charge current: $\geq 8.1\text{A}$ and Delay time: $\geq 5\text{sec}$ → C-FET off	Current $\leq -50\text{mA}$, delay $\geq 1\text{sec}$ or Recovery time : $> 20\text{sec}$
	Over Discharge Current Protection 过流放电保护	Discharge current: $\leq -12.2\text{A}$ and Delay time: $\geq 3\text{sec}$ → D-FET off	Current $\geq 50\text{mA}$, delay $\geq 1\text{sec}$ or Recovery time : $> 20\text{sec}$
	HW Discharge Current Protection 硬件过流放电保护	Discharge current: $\leq -18.9\text{A} \sim -22.8\text{A}$ Typical: -20.83A and Delay time: $27.1 \sim 33.3\text{msec}$ → D-FET off	
	HW Discharge Short- circuit Protection 短路保护	Discharge current: $\leq -31.3\text{A} \sim -35.4\text{A}$ Typical: -33.33A and Delay time: $684 \sim 1146\mu\text{sec}$ → D-FET off	

5	Cell Voltage Imbalance 电压不平衡	1. Current = 0mA for 30min. and 2. $4400\text{mV} \leq \text{Max Cell Voltage} \leq 4500\text{mV}$, and 3. Max Cell Voltage 1..3 - Min Cell Voltage 1..3 $\geq 500\text{mA}$, delay Time > 1min → Battery Status (0x16) : Cell Imbalance (bit 10) = 1	permanent failure
6	Over Temperature Protection 过温度保护		
	Initial Charge Condition 初始充电温度范围	Temp > $50^{\circ}\text{C} \pm 3^{\circ}\text{C}$ → C-FET off	Temp $\leq 50^{\circ}\text{C} \pm 3^{\circ}\text{C}$
		Temp < $0^{\circ}\text{C} \pm 3^{\circ}\text{C}$, → C-FET off	Temp $\geq 0^{\circ}\text{C} \pm 3^{\circ}\text{C}$
	Over Temperature Protection-Charge 充电温度保护	Temp: $\geq 60^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 2\text{sec}$ → C-FET off	Temp: $\leq 50^{\circ}\text{C} \pm 3^{\circ}\text{C}$
		Temp: $\leq -2^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 2\text{sec}$ → C-FET off	Temp: $\geq 0^{\circ}\text{C} \pm 3^{\circ}\text{C}$
	Over Temperature Protection-Charge(2 nd) 二段充电温度保护	Temp: $> 90^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 10\text{sec}$ → Fuse blow	--
	Over Temperature Protection-Discharge 放电温度保护	Temp: $> 73^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 2\text{sec}$ → C & D-FET off	Temp: $\leq 65^{\circ}\text{C} \pm 3^{\circ}\text{C}$
		Temp: $< -25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 2\text{sec}$ → C & D-FET off	Temp: $\geq -15^{\circ}\text{C} \pm 3^{\circ}\text{C}$
	Over Temperature Protection-Discharge(2 nd) 二段放电温度保护	Temp: $> 90^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Discharge Current $\leq -100\text{mA}$ and Delay Time: $\geq 10\text{sec}$ → Fuse blow	--
7	Over Temperature Protection(FET) 充电场效应晶体温度保护	Temp: $> 98^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 2\text{sec}$ → C & D-FET OFF	Temp: $\leq 90^{\circ}\text{C} \pm 3^{\circ}\text{C}$
	Over Temperature Protection(FET)(2 nd) 二段充电场效应晶体温度保护	Temp: $> 120^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and Delay Time: $\geq 5\text{sec}$ → Fuse Blow	--
7	C-FET Error Function 充电场效应晶体管失效保护	C-FET OFF and Charge Current $\geq 500\text{mA}$ and Delay Time: $\geq 20\text{sec}$ → Fuse blow	--

8	D-FET Error Function 放电场效应晶体管失效保护	D-FET OFF and Discharge Current $\leq -500\text{mA}$ and Delay Time: $\geq 20\text{sec}$ → Fuse blow	--
9	Safety Cell Under Voltage Permanent Fail 安全电池低压永久故障	Min Cell Voltage $\leq 1300\text{mV}$, Delay $\geq 2\text{sec}$	--
10	Over current alarm protection 过流报警保护	Alarm current: -10.65A ($\leq 55^\circ\text{C}$) (decrease $250\text{mA}/10^\circ\text{C}$; $55^\circ\text{C}\sim 73^\circ\text{C}$) Delay time: 250 msec → ManufAccess (0x00) bit5 set 1	Alarm release: -10.15A ($\leq 55^\circ\text{C}$) (decrease $250\text{mA}/10^\circ\text{C}$; $55^\circ\text{C}\sim 73^\circ\text{C}$) → ManufAccess (0x00) bit5 set 0
11	CS2 function CS2 功能	Refer to BMU SPEC	--
12	Ship mode 省电模式	Condition 1: The gauge is in RELAX mode ($ \text{Current} < 10\text{mA}$ will entry) and $\text{RSOC} < 30\%$ and Timer $> 20160\text{ minutes}$ → enter SHIP mode and turn off both CHG and DSG FETs	Condition 1: • any SMBus communication → exit SHIP mode and turn on both CHG and D SG FETs
		Condition 2: • Host writes word 0x0000 to 0x34 • Host writes word 0x1000 to 0x34 – The two send words sequence must be done within 5 seconds; otherwise, the command sequence is cancelled. – Enter Ship mode if the Shuo mode entry command is sent. No need to check [FC] status. → enter SHIP mode and turn off both CHG and DSG FETs	Condition 2: • Host writes word 0x2000 to 0x34 • Host writes word 0x4000 to 0x34 – The two send words sequence must be done within 5 seconds; otherwise, the command sequence is cancelled. → exit SHIP mode and turn on both CHG and DSG FETs
13	Shutdown mode 关机模式	Host writes word 0x0010 to 0x00 within 5 seconds. or • Temperature: $\leq 15^\circ\text{C}$ Min cell voltage reaches 2.7V for 20sec and no charge and pack pin (Vin12) $< 1\text{V}$ • Temperature: $> 15^\circ\text{C}$ Min cell voltage reaches 2.8V for 20sec and no charge and pack pin (Vin12) $< 1\text{V}$	The gas gauge returns to normal mode when voltage at PACK pin (Vin12) $> 4\text{V}$ keep 3sec.

6.2 Fuel Gauge Board Current Consumption

Item	Function	Specification	Comments
1	Cell voltage sensing input leakage current on each block	$\leq 3\mu\text{A}$	@ 3.7V/cell
2	Circuit Current Consumption		
	I(normal) @ SMC / SMD=H	$\leq 600\mu\text{A}(\text{typ})$	Operating mode
	I(sleep) @ SMC / SMD=H	$\leq 100\mu\text{A}(\text{typ})$	Sleep mode
	I(ship) @ SMC / SMD=L	$\leq 80\mu\text{A}$	Ship mode
	I(shutdown $\geq 2.5\text{V}$) @ SMC / SMD=L	$\leq 5\mu\text{A}$	Shutdown Mode
	I(shutdown 2.5V~1.3V) @ SMC / SMD=L	$\leq 3\mu\text{A}$	Shutdown Mode



6.3 FC Condition by OCV

Except the primary taper current charge termination detection, a custom charge termination detection option by checking the OCV voltage is also support. The gauge will detect valid charge termination either if the primary taper current condition or the custom OCV charge termination condition is met.

The device enters OCV Charge Termination detection stage as following condition:

When max cell voltage > 4520mV for 1sec, gauge turn off charge FET and check voltage.

If max cell voltage > 4480mV for 60sec, gauge set the status to Fully Charge.

If max cell voltage $\leq 4480\text{mV}$, gauge turn on charge FET and go back to the beginning of the loop.

Dual Mode	Charge Voltage	Turn Off C-FET	Turn On C-FET	Fully Charge
Normal	4500mV	> 4520mV, 1sec	$\leq 4480\text{mV}$	> 4480mV, 60sec
LS1-1	4490mV	> 4510mV, 1sec	$\leq 4470\text{mV}$	> 4470mV, 60sec
LS1-2	4480mV	> 4500mV, 1sec	$\leq 4460\text{mV}$	> 4460mV, 60sec
LS1-3	4470mV	> 4490mV, 1sec	$\leq 4450\text{mV}$	> 4450mV, 60sec
LS1-4	4460mV	> 4480mV, 1sec	$\leq 4440\text{mV}$	> 4440mV, 60sec
LS1-5	4450mV	> 4470mV, 1sec	$\leq 4430\text{mV}$	> 4430mV, 60sec
LS2	4400mV	> 4420mV, 1sec	$\leq 4380\text{mV}$	> 4380mV, 60sec

6.4 Common Dual Mode

The Dual Mode reduce the ChargingVoltage() level based on cycle count or high voltage time at high temperature of the battery pack. There are three charging voltage modes: RUNTIME (RT) mode, LIFESPAN1 (LS1) mode, and LIFESPAN2 (LS2) mode. The DUAL Mode start from RT mode, move to LS1 mode, then move to LS2 mode. Battery will only go from RT →LS1 →LS2.

6.4.1 RUNTIME Mode (RT)

RUNTIME mode keep the same ChargingVoltage() value under different condition.

6.4.2 LIFESPAN1 Mode (LS1)

In LS1 mode, the ChargingVoltage() can be reduced in five steps. The table below summarizes the action in LIFESPAN1 mode.

Step	Entry Condition	ChargingVoltage()
LS1-1	HiTempVolt time $\geq$ 960hours, or Cycle Count > 100 cycles	Charge Voltage = 13470mV
LS1-2	HiTempVolt time $\geq$ 1200hours, or Cycle Count > 150 cycles	Charge Voltage = 13440mV
LS1-3	HiTempVolt time $\geq$ 1440hours, or Cycle Count > 300 cycles	Charge Voltage = 13410mV
LS1-4	HiTempVolt time $\geq$ 1680hours, or Cycle Count > 350 cycles	Charge Voltage = 13380mV
LS1-5	HiTempVolt time $\geq$ 1920hours, or Cycle Count > 400 cycles	Charge Voltage = 13350mV

6.4.3 LIFESPAN2 Mode (LS2)

Given the gauge is already in LS1 mode, the entry conditions to LS2 are either or as following:

LS2 transition point =

$\text{Init Min FCC} - ((\text{Init Min FCC} - \text{Floor min FCC}) / (\text{Floor age}[\text{days}] - \text{Init age}[\text{days}])) * \text{elapsed day}$

$\geq \text{Floor min FCC}$

Step	Entry Condition	ChargingVoltage()
LS2	As above description	Charge Voltage = 13200mV

6.5 DLS & PI Mode

6.5.1 Dynamic Life-Span Mode

The dynamic life span mode controls charging voltage shorter time than Dual mode as temporary. Permanent mode controls charging voltage as irreversibly. However, this mode can be returned to permanent mode when SOC will be lower than 20%. Basically, the transition condition is determined by minimum SOC for last 7days.

Each temporary life span mode controls charging voltage same as Dual mode. (The elapsed time will be accumulated based on a minute and the state will be changed based on a day.)

These modes can be moved to lower charging voltage mode from current mode.

Also, all modes can exit and move to permanent mode when SOC is lower than 20%, or power on reset, or shutdown or exit ship mode or exit PI mode or receive Force exit command or F/W update.

Min SOC last 7days	Permanent mode						
	RT	LS1-1	LS1-2	LS1-3	LS1-4	LS1-5	LS2
$X > 90$	PI	PI	PI	PI	PI	PI	PI
$65 \leq X < 90$	T-LS2	T-LS2	T-LS2	T-LS2	T-LS2	T-LS2	-
$55 \leq X < 65$	T-LS1-5	T-LS1-5	T-LS1-5	T-LS1-5	T-LS1-5	-	-
$50 \leq X < 55$	T-LS1-4	T-LS1-4	T-LS1-4	T-LS1-4	-	-	-
$45 \leq X < 50$	T-LS1-3	T-LS1-3	T-LS1-3	-	-	-	-
$40 \leq X < 45$	T-LS1-2	T-LS1-2	-	-	-	-	-
$35 \leq X < 40$	T-LS1-1	-	-	-	-	-	-
$X < 35$	-	-	-	-	-	-	-
$X < 50$ (PI mode) $X < 20$ (DLS mode)	Return to Permanent Mode (RT/LS-x) as Defined by Cycle Count / Hrs High Voltage						

6.5.2 Plugged-In Mode

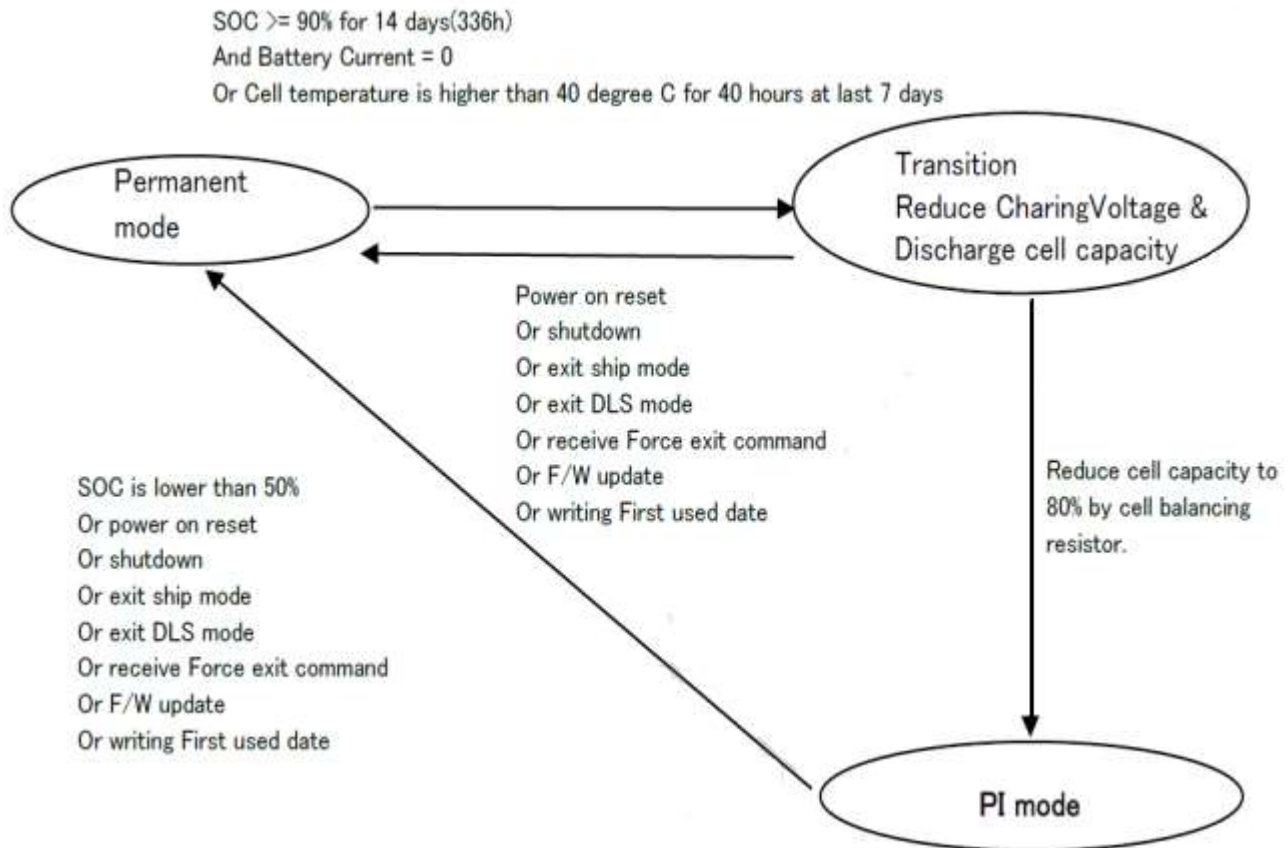
Plugged in mode controls Charging voltage for AC adapter connected condition.

If user is using PC with AC adapter always, PI reduce charging voltage and cell voltage. When SOC is over 90% and no current flowing, PI is monitoring AC connect condition and that condition continues for 14 days, PI reduce charging voltage as 80% of OCV. Also, PI reduce cell voltage to 80% of OCV by cell balancing resistor and execute cell balancing control. Each cell voltage difference will be 5mV. Once transition has started, that transition should be completed if any charging or discharging is happened.

When SOC will be lower than 50%, PI mode is finished.

Also, PI has another entering condition. In last 7 days, SOC or more 90% and over 40°C for 40 hours. The 40 hours is cumulative time, not duration time.

FCC: BMFW reports regular FCC to host. However, BMFW should have internal FCC for Charging control and that value will be reduced to 80% from regular FCC. Also, the internal FCC apply to Transition and PI mode.



6.6 96hr Function

The battery support Remaining Capacity holding feature and called it 96hrs function.

When battery meet FC condition and stay at relax mode, Remaining Capacity would be held for 96hrs. After this setting timer, gauge will do a smoothly Remaining Capacity updating as gauge calculation.

This function will exit as follow either one of below condition:

- Discharge current $> -5\text{mA}$ for 30sec.
- Discharge current $> -100\text{mA}$ for 1sec.

6.7 TDA (Terminate Discharge Alarm) shutdown condition

When TDA bit(bit11 of 0x16 BatteryStatus()) will be set to “1” then keep 10sec or more in discharging state, C/D FET will be turned off within 2 seconds and the BMU will enter shutdown.

7. Environmental and Reliability Specification

7.1 Electrical Performance

Item	Condition	Standard
ESD Susceptibility	Setup of electric discharge gun : 330 ohm, 150Pf Air : $\pm 15\text{kV}$, Contact : $\pm 15\text{kV}$, 25times each	No critical damage

7.2 Environment Characteristic

Item	Condition	Standard
Performance in high temperature	Communication and charge / discharge must be certified at 40°C .	No critical damage.
Performance in low temperature	Communication and charge / discharge must be certified at 0°C .	No critical damage.
Altitude Simulation	Method: Batteries shall be stored at a pressure of 11.6Kpa or less for at least six hours at ambient temperature $20\pm 5^{\circ}\text{C}$.	No critical damage.
Humidity	Operating and Non-Operating: The battery pack shall withstand without degradation 85% relative humidity, non-condensing.	No critical damage.

7.3 Safety Performance

Refer to the safety certification report.

7.4 Package Drop Test

Condition	Standard
*Drop directions: All 6 sides and 4 corners on to 3cm thickness wooden board. *Height: 76cm *Number of drops: 1 time for each direction. 2cycles(total 20 times)	No crack. No defective part. No part removal. No malfunction. No capacity variation.
Operating and Non-Operating: The battery pack shall withstand without degradation 95% relative humidity, non-condensing.	No critical damage.

8. Charge State of Battery Pack before at delivery

The battery pack voltage shall be shipped in 45% ~ 55% charged state

9. Handling Instructions

The following hazard alert signals and words must appear in user manuals and / or instructions for users.

HANDLING INSTRUCTIONS

FOR

LITHIUM ION RECHARGEABLE BATTERY

Please read and follow the handling instructions before using the battery.

Improper use of the battery may cause heat generation, fire, explosion, damage, or capacity deterioration of the battery.



WARNING

01. Keep the battery and equipment out of reach of infants/children or pets so that they are not able to swallow or mistreat the battery by mistake.

In case of ingestion, seek medical advice immediately.

02. Do not let leaked electrolyte come into contact with eyes or skin.

In such a case, immediately flush the contact area with plenty of water and seek help from a doctor.

If not treated soon, prolonged contact may cause serious injury.

03. Do not throw the battery into a fire. Do not use or leave it in a place near fire, heaters, or high temperature sources.

In such a case, the insulator in the battery may be melted, the safety vent and structure may be damaged, or the electrolyte may catch fire, all of which may cause heat generation, explosion, or fire.

04. Do not submerge the battery in water, or wet the battery.

If the protecting device assembled in the battery is damaged, the battery may be charged with an abnormal current and voltage and may cause an abnormal chemical reaction within the battery, which may result in the cause of heat generation, explosion, or fire of the battery.

05. Do not use any battery chargers not specified by the end product. Also, follow the charge conditions specified by the end product.

If the battery is charged under other conditions (a high temperature, a high voltage/current, or an altered charger) not specified by the end product, the battery may become over-charged with an excessive current and cause heat, explosion, or fire with abnormal chemical reactions.

06. Do not use, charge, or leave the battery in a car under the blazing sun. Such a high temperature may cause damage of the protecting device in the battery, which may result in an abnormal reaction, and then heat generation, explosion, or fire.

07. Do not connect the battery reversed to positive (+) and negative (-) terminals in the charger or

equipment.

In case the battery is connected and charged in reverse, it may cause heat generation, explosion, or fire due to an abnormal chemical reaction.

08. Do not let the terminals (+ and -) of the battery contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together.

In such a case, the battery would be shorted and cause an excessive current, which may result in heat generation, explosion, or fire.

09. Do not connect the battery directly to an electric outlet or cigarette heater socket in car.

With a high voltage applied, the battery may overheat, explode, or cause fire.

10. Do not throw or drop the battery.

Strong impacts or shocks may damage the protecting device, which may cause an abnormal chemical reaction during charging and result in heat generation, explosion, or fire of the battery.

11. Do not drive a nail in or piece the battery with sharp objects.

In such a case, the battery may be deformed and shorted, witch which may cause heat generation, explosion, or fire of the battery.

12. Do not solder the battery directly.

Heat applied during soldering may damage the insulator of the safety vent and mechanism, which may result in heat generation, explosion, or fire of the battery.

13. Do not disassemble or alter the battery.

The battery is designed with safety mechanism and protecting devices in order to avoid any danger. If these are damaged, heat, explosion or fire may be caused.



CAUTION

01. Do not put the battery in a microwave, oven, or high pressure container.

Sudden heat may damage the seal of the battery and may cause heat generation, explosion, or fire of the battery.

02. Do not leave the battery in a charger or equipment if it generates an odor and/or heat, color and/or shape changed, electrolyte leaked, or any other abnormalities.

In such a case, immediately take the battery out of the charge or equipment and keep it away from fire, otherwise, the battery might overheat, explode, or cause fire.

03. Discontinue charging after specified charging time even if the charge is not complete, otherwise, the battery might cause heat generation, explosion, or fire.

04. Do not use the battery in the place where the static electricity (more than the limit of the manufacturer's guarantee) occurs. Otherwise, the protecting device in the battery might be damaged and cause heat generation, explosion, or fire.

05. Do not use the battery in other than the following conditions; otherwise, the battery might cause heat generation, damage, or deterioration of its performance.

Operating environment:

When the battery is charged : 0°C ~ 60°C, Humidity: Max 95% RH

When the battery is discharged : -20°C ~ 60°C, Humidity: Max 95% RH

When stored 1 week : -20°C ~ 50°C, Humidity: Max 75% RH

When stored 1 month : -20°C ~ 45°C, Humidity: Max 75% RH

When stored 6 month : -20°C ~ 40°C, Humidity: Max 75% RH

When stored 12 month : -20°C ~ 35°C, Humidity: Max 75% RH

PRODUCT SPECIFICATION

Product: Rechargeable Li-ion Battery

CosMX Project Name:	CYC038
Model Name:	L25X3P73
Lenovo Part Number/ASM:	SB11M89968
FRU Part Number:	5B11M90167
CosMX Part Number:	CB030C0000242
Cell Model:	CA705680Q-Q1

Revise No: VER 04

CosMX Approval:

Prepared	R&D Reviewed	PM Reviewed	CQE Reviewed	Approved
Qin Zehua	Jay Ye&wallace.lin	Liu Cannan	Miya Tan	Jerry Yang
Date:2025-10-13	Date:2025-10-13	Date:2025-10-13	Date:2025-10-13	Date:2025-10-13

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Product Revision History			
REV.	Date	Revision Description	ORIGINATOR
01	2025-07-18	First edition	Qin Zehua
02	2025-08-19	1.Update 1000cycle >80% @0.2C discharge 2.Update Certification 3.Add Pack 2D、 Label	Qin Zehua
03	2025-09-05	1.Change Device Chemistry from LiP to LION 2.Add Design Capacity 3.Update 0x37 for FVT 4.Update Label	Qin Zehua
04	2025-10-13	Update Certification	Qin Zehua

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1. Scope

This specification is made to describe the product, product characteristics and performance, relevant measurement conditions and methods applied to the Rechargeable Li-ion Battery as specified in following details.

2. Product Name and Product Type

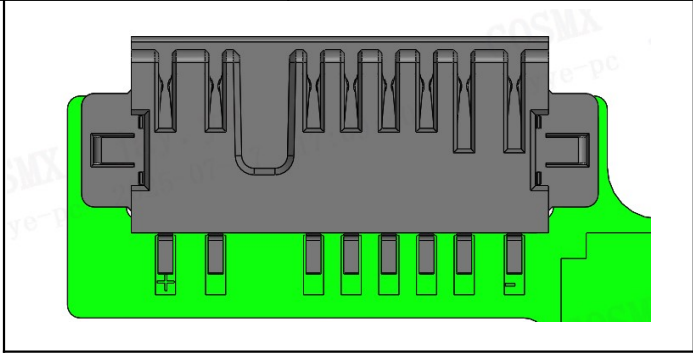
- 2.1 CosMX Project Name: CYC038
- 2.2 Model Name: L25X3P73
- 2.3 Lenovo Part Number/ASM: SB11M89968
- 2.4 FRU Part Number: 5B11M90167
- 2.5 CosMX Part Number: CB030C0000242
- 2.6 Cell Model: CA705680Q-Q1

3. Pack Configuration

Model	Li-ion Battery Pack Lenovo CYC038	
Structure	Battery Pack	3S1P of CA705680Q-Q1
	BMU Solution	TI BQ9004
	Model Name	L25X3P73
	Firmware Version	Tenpao 2002

4. Pin Assignment

Pin	Terminal Name	Definition
Pin1	P+	BATTERY PACK + TERMINAL
Pin2	P+	BATTERY PACK + TERMINAL
Pin3	I2C_CLK	SMBUS CLOCK
Pin4	I2C_DATA	SMBUS DATA
Pin5	TEMP	10k OHM/1% RESISTOR CONNECTED TO GND
Pin6	N/A	
Pin7	GND	BATTERY PACK GND TERMINAL
Pin8	GND	BATTERY PACK GND TERMINAL



5. Measurement Table of Accuracy

Model	Li-ion Battery Pack Lenovo CYC038		
Item	Accuracy	Unit	Resolution
Current	± 1%	mA	Charge & Discharge current = 2A 0.76uV/bit
Voltage	± 10	mV	3840 mV~3900 mV 0.24mV/bit
Temperature	± 3°C	degC	Environment Temp:25°C Thermistor is not linear,so there is no direct resolution.

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6. Product Specifications

No.	Item	Specification	Remark
1	Pack Normal Capacity (@0.2C)	Typical: 75.00 Wh (6411 mAh)	0.2Cnom charge by 4.5 V/cell and 0.2Cnom discharge rate by at 25°C
	Pack Minimum Capacity (@0.2C)	Typical: 73.60 Wh (6283 mAh)	0.2Cmin charge by 4.5 V/cell and 0.2Cmin discharge rate by at 25°C
2	PACK Config	3S1P	
3	Design Capacity	7500cWh	
4	Nominal Voltage	11.70 V	3.9 V / per cell
5	Charge Voltage	13.50 V	Max. allowable charging voltage RT Mode: 4.50 V / per cell
6	End of Discharging Voltage	9.00 V	3.00 V / per cell
7	Standard Charge Method**Note1	A. 1282 mA to 13.50 V (4.50 V / per cell) B. 4488 mA to 13.50 V (4.50 V / per cell) C. 7693 mA to 12.60 V (4.20 V / per cell) and 4488 mA to 13.50 V (4.50 V / per cell) D. 3206 mA to 12.60 V (4.20 V / per cell)	A. 0~15 °C B. 15~20 °C C. 20~45 °C(Quick charge) Charge time: 0~80% ≤60 mins 0~100% ≤120 mins D. 45~60 °C
8	Max charge Current	7923 mA	Only for safety certification
9	Pre-charge Current	641 mA	Min Vcell < 3.0V
10	Maximum Discharge Power	Continue Power: 80W from 100% SOC to 0% SOC. Peak Power: 100W / 30S from 100% SOC to 10%SOC.	@35°C
11	CB Power	100W	@35°C
12	Operating Temperature and Humidity Range	Charge: 0~60°C Humidity: 5%~95% RH Discharge: -20~60°C Humidity: 5%~95% RH	The tolerance of temperature is ± 3°C
13	Storage Temperature and Humidity Range	1 week: -20~50°C 1 month: -20~45°C 6 month: -20~40°C 1 year: -20~35°C Humidity: 5%~ 95% RH	The battery should cycle once in three month. Recommended storage temperature is 25°C of SOC 50%.
14	Internal Impedance (Initial)	ACIR ≤ 200mΩ	1KHz sine wave AC(25°C± 3°C)
15	Cycle Life	Residual Capacity: ≥ 70% of initial capacity Swelling after cycle: ≤ 10% @ 1000cycles	(Follow Battery Stand quick charge / 0.5C discharge) at 25± 5°C
		Residual Capacity: ≥ 80% of initial capacity Swelling after cycle: ≤ 10% @ 1000cycles	(Follow Battery Stand quick charge / 0.2C discharge) at 25± 5°C
16	Electro-Static Discharge (ESD)	Contact Discharge: +/-8KV Air Discharge: +/-15KV	Normal operation. No malfunction. Test equipment: Rd =330Ω, Cs=150pF, Discharge resistor = 2KΩ
17	Shipping Capacity	RSOC: 45%-55%	
18	Slave Address	0X16	
19	Authentication Method	SHA256	
20	Warranty Data	1 year / 750 cycles	
21	Weight	Max 263g	
22	Power consumption	Normal mode: < 600uA Sleep mode: < 150uA Ship mode: < 100uA Shutdown mode: < 10uA	3800mV/cell at 25± 5°C

Note : Charging current rate adjust by FCC

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7. Gas Gauge Specifications

7.1 SBS Data Information

No.	Item	Specification	Unit	Remark
1	Maker ID	00 09	HEX	
2	Hardware ID	00 38	HEX	
3	F/W Version	00 21	HEX	
4	DATA Version	00 02	HEX	
5	0X37 Information	09 00 38 00 21 00 02 00	HEX	
6	Manufacture name	COSMX 2025	---	
7	DeviceName	LNV-5B11M90167	---	
8	Device Chemistry	LION	---	

7.2 Protection Functin

7.2.1 Recoverable Failure

No.	Items	Detection	Delay Time	Action		Release condition	Delay Time
				C-FET	D-FET		
1	1st Over Cell Voltage Protection	Set: ≥ 4.53 V/cell $\pm 10\text{mV}$	3~5s	OFF	ON	≤ 4.4 V/cell $\pm 10\text{mV}$	$\leq 2\text{s}$
2	Dynamic Cutoff & Under Voltage Protection	Discharge mode & Temperature $0\sim 15$ DegC Set: ≤ 2.70 V/cell	12s	ON	OFF	≥ 3.10 V/cell $\pm 10\text{mV}$ & Charge mode	-
		Relax mode or Discharge mode & Temperature ≥ 15 DegC Set: ≤ 2.80 V/cell	12s	ON	OFF		
		All Temperature Set: ≤ 2.50 V/cell	5s	ON	OFF		
3	Shutdown Voltage of Cell	Relax mode Set: ≤ 2.8 V/cell	20s	OFF	OFF	≥ 3.00 V/cell & Charge mode	-
4	Over Pre-charge Current	Set: ≥ 841 mA	3~5s	OFF	ON	50 mA	3~5s
5	1st Over Charge Current	Set: ≥ 8470 mA	3~5s	OFF	ON	≤ 0 mA	$> 16\text{s}$
6	1st Over Discharge Current	Set: ≤ -11600 mA	3~5s	ON	OFF	≥ 0 mA	$> 16\text{s}$
7	1st Over Discharge Current for Cell	Set: $\leq 11.6\text{A}$ Protection threshold is compensated with cell temperature between $55^{\circ}\text{C}\sim 73^{\circ}\text{C}$, slope $0.288\text{A}/^{\circ}\text{C}$	3~5s	ON	OFF	-	$> 16\text{s}$
8	1st Over Discharge Current for FET	Set: $\leq 12.1\text{A}$ Protection threshold is compensated with cell temperature between $90^{\circ}\text{C}\sim 98^{\circ}\text{C}$, slope $0.65\text{A}/^{\circ}\text{C}$	3~5s	ON	OFF	-	$> 16\text{s}$
9	Overload in Discharge Protection (H/W)	Set : $\leq 13.887\text{A}$ (TYP) ; ($-11.656\text{A}\sim 16.117\text{A}$)	31 $\pm$ 4msec	ON	OFF	-	$> 16\text{s}$
10	Short Circuit in Charge (H/W)	Set : $\leq 29.6\text{A}$ (TYP) ; ($-25.813\text{A}\sim 33.42\text{A}$)	610 $\pm$ 400usec	OFF	ON	-	$> 16\text{s}$
11	Short Circuit in Discharge (H/W)	Set : $\leq 29.6\text{A}$ (TYP) ; ($-25.813\text{A}\sim 33.42\text{A}$)	610 $\pm$ 400usec	ON	OFF	-	$> 16\text{s}$
12	Charge Over Temperature of cell	Set: ≥ 60 $^{\circ}\text{C}$	1~3sec	OFF	ON	≤ 50 $^{\circ}\text{C}$	-
13	Charge Under Temperature of cell	Set: ≤ -2 $^{\circ}\text{C}$	1~3sec	OFF	ON	≥ 2 $^{\circ}\text{C}$	-
14	Discharge Over Temperature of cell	Set: ≥ 73 $^{\circ}\text{C}$	1~3sec	ON	OFF	≤ 65 $^{\circ}\text{C}$	-
15	Discharge Under Temperature of cell	Set: ≤ -25 $^{\circ}\text{C}$	1~3sec	ON	OFF	≥ -20 $^{\circ}\text{C}$	-
16	High Temperature Charge start	Set: ≥ 50 $^{\circ}\text{C}$	-	OFF	ON	≤ 50 $^{\circ}\text{C}$	-
17	Low Temperature Charge start	Set: ≤ 0 $^{\circ}\text{C}$	-	OFF	ON	≥ 0 $^{\circ}\text{C}$	-
18	Over Temperature of FET	Set: ≥ 98 $^{\circ}\text{C}$	3~5s	OFF	OFF	≤ 80 $^{\circ}\text{C}$	-
19	Fully Charge Protection by taper condition	Set: RT_Mode ≥ 4400 mV/cell , ≤ 321 mA(0.05C)	80s	OFF	ON	-	-
20	Fully Charged Protection by OCV condition	Set:RT_Mode CCV: ≥ 4520 mV/cell	1s	OFF	ON	-	-
		OCV: ≥ 4480 mV/cell	60s				
21	Pre-charge Timeout	Set: ≥ 1 Hours	-	OFF	ON	≥ -15 mA	$> 1\text{s}$

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7.2.2 Permanent Failure *Note 3

No.	Items	Detection	Delay Time	Enter PF Mode (FETs Off)	Fuse Blow
1	2nd Over Voltage (H/W, By 2nd IC)	Set: ≥ 4.65 V/cell	4~10s	YES	YES
2	2nd Under Voltage (Cu Deposition Detection)	Set: ≤ 1300 mV/cell	3~5s	YES	NO
3	Safety Over Charge current Temperature	Set: ≥ 90 °C & Charge Current ≥ 25 mA	10~12sec	YES	YES
	Safety Over Discharge current Temperature	Set: ≥ 90 °C & Discharge Current ≤ -100 mA			
4	Safety Overtemperature FET	Set: ≥ 120 °C	10~12sec	YES	YES
5	Charge FET Failure	Current ≥ 150 mA & Charge FET off	20~22sec	YES	YES
	Discharge FET Failure	Current ≤ -150 mA & Discharge FET off			
6	Open Thermistor	Thermistor is open ($\leq 50^{\circ}\text{C}$)	10~12sec	YES	YES
7	Short Thermistor	Thermistor is short ($\geq 150^{\circ}\text{C}$)	10~12sec	YES	YES

7.3 Lenovo/Other Feature

No.	Item	Condition	Action	Remark
1	Ship Mode	Two ways Entry : 1.By command condition Write word (0x0000) & (0x1000) by cmd(0x34) within 5s or 2.By storge time condition In sleep mode & Current ≤ 50 mA & Storage time > 2 weeks & RSOC $< 30\%$ & No communication	C/D-FET OFF	
		Two ways Exit : 1.By command condition Write word(0x2000) & (0x4000) by cmd(0x34) within 5s or 2.By communication condition SMBus communication by (0x16) address from sleep mode	C/D-FET ON	
2	Sleep Mode	Entry : Current ≤ 10 mA & No communication & Delay time ≥ 20 s		Detect voltage/temperature by every 5s and current by every 20s
		Four ways Exit : 1.SMBus communication or 2. Current ≥ 10 mA or 3.Charge current ≥ 100 mA~300mA ,delay time ≤ 1 s or 4.Safety Alert /Status		Detect voltage/temperature/ current by every 250ms
3	96 Hours Function	Entry condition: Fully charged & Enable 96 hours function		
		Exit condition: 1.96 hours timeout or 2. Current ≥ 5 mA for 30s or 3. Current ≥ 100 mA		
4	Charge Rate Control by FCC	The charging current adjusted by SBS FCC value , charge C-Rate remain unchanged .Minimum Charging Current = 0.1C		
5	cell imbalance alarm	Max cell voltage > 4150 mV & (Max cell voltage - min cell voltage) > 500 mV & charge current > 150 mA & delay time > 60 s		set bit10 at Battery Status 0x16
6	First Used Date	It's able to be written in any value when it's 0, and could rewrite to 0 from any value.	0x3F	The maximum writing count is 100.

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7.3 Lenovo/Other Feature

No.	Item	Condition	Action	Remark
7	Dual Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Enter condition : LS1_1:Storage time≥ 960 hours , or Cycle count ≥100 LS1_2:Storage time≥ 1200 hours , or Cycle count ≥150 LS1_3:Storage time≥ 1440 hours , or Cycle count ≥300 LS1_4:Storage time≥ 1680 hours , or Cycle count ≥350 LS1_5:Storage time≥ 1920 hours , or Cycle count ≥400 LS2 : SOH≤LS2 target SOH Adjusted time = Actual time * Temperature Modifier * Voltage Modifier where:Temperature Modifier= 2^((Max Cell Temp - 25) / 10) at 25℃~90℃Voltage Modifier = 1.0 if Vcell ≥4470 mV = 0.8 if 4420 mV ≤ Vcell < 4470 mV		
8	Dynamic Life Span AI Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Enter condition : T_LS1_1: 35% ≤RSOC< 40% & Rolling day ≥ 7days, Change charging voltage 4490 mV/Cell in temporary mode to start charging T_LS1_2: 40% ≤RSOC< 45% & Rolling day ≥ 7days, Change charging voltage 4480 mV/Cell in temporary mode to start charging T_LS1_3: 45% ≤RSOC< 50% & Rolling day ≥ 7days, Change charging voltage 4470 mV/Cell in temporary mode to start charging T_LS1_4: 50% ≤RSOC< 55% & Rolling day ≥ 7days, Change charging voltage 4460 mV/Cell in temporary mode to start charging T_LS1_5: 55% ≤RSOC< 65% & Rolling day ≥ 7days, Change charging voltage 4450 mV/Cell in temporary mode to start charging T_LS2: 65% ≤RSOC< 90% & Rolling day ≥ 7days, Change charging voltage 4400 mV/Cell in temporary mode to start charging Exit condition : RSOC<20%		13470 mV/Pack 13440 mV/Pack 13410 mV/Pack 13380 mV/Pack 13350 mV/Pack 13200 mV/Pack
9	PI Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Entry condition: 1.RSOC ≥ 90% for last 14 days 2.RSOC ≥ 90% & Cell temperature ≥40℃ & ≥40 hours for last 7 days Exit condition: 1.RSOC<50%		
10	Initialize status	Initialized bit (Bit 7 of 0x16 CMD set up) is already set when Smbus become enable .		
11	CCV Stepdown	CCV step down threshold: 4520 mV(RT mode) CCV step down threshold: 4510 mV(LS1-1/T-LS1-1 mode) CCV step down threshold: 4500 mV(LS1-2/T-LS1-2 mode) CCV step down threshold: 4490 mV(LS1-3/T-LS1-3 mode) CCV step down threshold: 4480 mV(LS1-4/T-LS1-4 mode) CCV step down threshold: 4470 mV(LS1-5/T-LS1-5 mode) CCV step down threshold: 4420 mV(LS2/T-LS2 mode) CCV step current threshold: 0.1C of FCC Minimum of CCV step current: 0.1C of FCC CCV step-down relax time: 1sec Release condition of CCV step down: Discharge current ≤-50mA or enter DSG mode		
12	End Of Life Prediction	Activation of EoL function can be set by parameter (EoLEnable = 1). 0x3C for Last value 0x3D for Calculated value The EoL remaining time/cycle count calculated based on the prediction results is returned by the 0x3D command. - EoL remaining time = (EoL target prediction time – current TotalStrageTimeHour) - EoL remaining cycle count = (EoL target prediction cycle count – current CycleCount)		
13	HSFCC Function	1. Ideal FCC value can be updated when fully charge battery pack from RSOC less than 65% by measure minimum pack IR 2. Pack IR is measured by turning off C-FET during charging within RSOC range 65%~75%. 3. During pack IR measurement, C-FET will be turned off for 5sec at each RSOC 1% step. 4. Maximum allowable percentage for ideal FCC change is 10%(comparing previous ideal FCC). HSFCC Cancellation Condition: 1. Within less than 72hrs after FCC updating by low side FCC learning. 2. Charging current deviation rate larger than 1% 3. Charging current lower than 1000mA. 4. When battery pack enter PI/DLS mode. 5. No detecting charging current for 72hrs or more during IR measurement. 6. Charging current more than 7693mA or less than 4488mA during IR measurement at SOC 55%. 7. Cell temperature more than 45degC or less than 20degC during IR measurement at SOC 55%. 8. Detect discharging current more than -5mA during IR measurement. 9. Discharge detection. SBS.AverageCurrent() is lower than 0mA. 10. Learned FCC deviation is larger than 10%. 11. SBS.MaxError() is larger than 10% when FC detected.		

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8. Mechanical Characteristics

8.1 External Dimension

Dimension	Thickness	Width	Length
Maximum	7.93 mm	59.70 mm	265.30 mm

External Form Figure （all unit in mm）

See next page for drawing details

8.2 Outside Appearance

The surface is smooth. No mechanical damage. The package membrane has no damage or leakage.

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8.3 Label



Background color : Pnatone black C
Text color :White



注：1、蓝色LOGO暂不印刷；
2、LOGO处“X”为预留认证编号，不可用于量产。

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Spec No.: PW-P3-00-2B0067

密级：绝密

8.4 Battery Barcode

编码规则：
8S P P P P P P P P P H H H H Y M D S S S S

- 第01-02位：8S，固定代码；
第03-12位：暂用P P P P P P P P P表示，固定代码，根据情况填写 Lenovo Production P/N 或 Lenovo FRU P/N ；
第13-16位：暂用H H H H表示，固定代码 (Lenovo Header Code) ；
第17位：Y，代表生产年份，用年份最后一位数表示，（如1表示2021年，2表示2022年...）；
第18位：M，代表生产月份，（1-9月用数字1-9表示，10-12月用字母A-C表示）；
第19位：D，代表生产日期，（1-9日用数字1-9表示，10-31日用字母A-Z表示,10=A；11=B；12=C；13=D；14=E；15=F；16=G；17=H
18=J；19=K；20=L；21=M；22=N；23=P；24=R；25=S；26=T；27=V；28=W；29=X；30=Y；31=Z；其中“l, O, Q, U”除外）；
第20-23位：S S S S，代表生产流水码(Serial Number)，32进制：
• 1st S : Serial Number4: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 2nd S : Serial Number3: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 3rd S : Serial Number2: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 4th S : Serial Number1: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• Maximun Volume Per Date Will Be 65,535 By Serial Numbering.

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9. Overall Protection Function

The electrolyte may be decomposed if a lithium ion secondary cell is subjected to a voltage higher than the allowable voltage or is charged with an excessive current, which may be resulted in safety problems.

Cell: TCO for polymer and prismatic.

Built-in control circuit: Have built-in control circuit for overcharge prevention function, over discharge prevention function, reverse polarity prevention function, high temperature prevention and prevent pack being used other than intended usage.

10. Packing

Packing form: Determined through discussion with the circuit.

Indication: Indication following items on the package box where can easily be seen.

- Name.
- Packed quantity.
- Shipping date.
- Manufacturer's name. (Or trade mark or abbreviation)

11. Time of Product Storage

The time of product storage will be 21 days before the product leave factory.

12. Guarantee Period of Quality

Guarantee period of quality is 24 months after sold.

13. Product Responsibility Agreement

The customers must abide by the Product Specification and remarks in using the cells manufactured by Zhuhai CosMX Battery Co., Ltd. The misuse may cause cell heat, fire or rupture. CosMX will NOT be responsible for any accident occurred by handling outside of the precautions in this specification.

Be attention to the package and structure of the polymer lithium ion cell:

a) The case of the polymer lithium ion cell shall be sustained the mechanical impact (collide, dropping, distortion and curve etc.) to protect the polymer lithium ion cell inside.

- Leakage and short-circuit etc. may be occurred if the cell is suffered strong impact.
- Take care in using the polymer lithium ion cell due to its soft package and is easier to be damaged than metal case cell in suffering from impact.

b) The polymer lithium ion cell shall be fastened inside the package to avoid the motion in suffering from mechanical impact such as dropping.

- The cell, PCB and connection wire may be damaged due to the motion of the cell inside the package is suffered from impact such as dropping etc., if the cell inside the package is not fastness.

- CosMX recommends fastening the wider face of the cell inside the package by adhesive tape.

• Do not make any damage to the bottom of the cell due to the bottom of polymer lithium ion cell is easy to be damaged in suffering from impact such as dropping.

c) Avoid connecting of polymer lithium ion cell with sharp or protruded articles.

- The membrane of polymer lithium ion cell is easy to be damaged by sharp articles, which may be resulted in the leakage of electrolyte.

• Put an isolated membrane between cell and PCB to avoid them connecting directly if the PCB of cell is put on the surface of the polymer lithium ion cell.

- Avoid to put sharp articles, protruded part of PCB (PTC, over-current sheet etc.) or connecting wire on the surface of polymer lithium ion cell directly.

• Avoid concentrating pressure on the cell to fasten the cell during the designing, because the performance of the cell may be decreased if the cell is extruded in a relative small area.

d) Be attention to the variation of the thickness of polymer lithium ion cell during charge-discharge:

- The thickness of polymer lithium ion cell may be increased a little during charge-discharge, if the design do not consider the variation of the thickness, the package may be damaged and the performance of the cell may be decreased due to the cell extrudes the case of cell, connecting wire or cell itself resulted from the thickness increase.

e) Keep the polymer lithium ion cell away from thermal source:

- Some performance of polymer lithium ion cell may be decreased if the cell is working or storage beyond the required temperature range.

f) If the connection of the package case and cap is welded by supersonic, there shall be no gap between case and cap during welding to avoid the energy created by supersonic welding passing to polymer lithium ion cell or PCM.

- Polymer lithium ion cell or PCM may be damaged by the energy created by supersonic welding.

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14. Handling precautions on Lithium ion secondary cell

To assure product safety, there shall be precautions below.

! Danger

- Use dedicated chargers and follow the specified conditions when charging the cell.
- Use the cell only in the specified equipment.
- Do not heat or put the cell into the fire. Also do not wet the cell.
- Do not use, leave cell close to fire or inside of a car where temperature may be above 60 °C . Also do not charge / discharge in such conditions.
- Do not put or store cell together with metal articles such as necklaces, hairpins, coins, or screws.
- Do not short circuit the (+) and (-) terminals with metal conductors.
- Do not place cell in a device with the (+) and (-) in a reverse way.
- Do not penetrate cell with a sharp articles such as a needle.
- Do not disassemble the cell.
- Do not weld the cell directly.
- Do not use a cell with serious scar or deformation.
- Thoroughly read the user's manual before use, inaccurate handling of polymer lithium ion cell may results in heat, fire, explosion, damage or the capacity loss of the cell.

! Warning

- Do not put cell into a heating vessel, washing machine or high-pressure container.
- Do not use cell with primary batteries, or batteries of a different package, type, or brand.
- Stop charging the cell if charging is not completed within the specified time.
- Stop using the cell if abnormal heat, odor, discoloration, deformation or abnormal condition is detected during use, charge, or storage.
- Keep away from cell immediately when leakage or foul odor is detected.
- Wash well with clean water immediately if liquid leaks onto your skin or clothes.
- If liquid leaking from the cell gets into your eyes, do not rub your eyes. Wash them well with clean water and call physician immediately.

! Caution

- Store batteries out of reach of children so that they are not accidentally swallowed.
- If younger children use the cell, their guardians should explain the proper handling.
- Be sure to read the user's manual and cautions on handling thoroughly before using the cell.
- Batteries have cycle life. Using one new cell the same to the old one to replace it if work time of the equipment using cell as power sources becomes much shorter than the usual.
- Remove it from the equipment and store in a place with low humidity and temperature if the cell is not used for an extended period.
- Keep it far away from articles or materials with static electric charges while the cell is charged, used or stored.
- Wipe with a dry clothe before using the cell if the terminals of the cell become dirty.

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15. Information of Company

ZHUHAI COSMX BATTERY CO., LTD
No.209, Zhufeng Way, Xinqing Science & Technology Park, Doumen
District, Zhuhai519180, P.R.China
Tel: 86—756—6199909 Fax: 86—756—6199910
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Appendix:
For Certification

安全工作参数 (Safety Operating Parameter)	电池组 (Battery Pack)
额定容量 RATED CAPACITY	6283mAh
标称电压 NOMINAL VOLTAGE	11.7V
充电限制电压 Limited charging voltage	13.5V
放电终止电压 END OF DISCHARGE VOLTAGE	9V
额定能量 JUST FOR GB31241 2022	73.6Wh
充电上限电压 JUST FOR GB31241 2022	13.59V
放电截止电压 JUST FOR GB31241 2022	8.37V
推荐充电电流 RECOMMENDED CHARGING CURRENT	1.2566A
最大充电电流 MAXIMUM CHARGING CURRENT	7.923A(0~45℃)
	3.142A(45~60℃)
充电截止电流 CHARGING TAPER CURRENT	0.321A
推荐放电电流 RECOMMENDED DISCHARGING CURRENT	-1.2566A
最大放电电流 MAXIMUM DISCHARGING CURRENT	-11.11A (-20~35℃)
	-3.142A(35~60℃)
推荐放电功率 RECOMMENDED DISCHARGING POWER	80W
最大放电功率 MAXIMUM DISCHARGING POWER	100W (-20~35℃)
	-3.142A(35~60℃)
充电工作温度范围 OPERATING CHARGING TEMPERATURE	0℃~60℃
放电工作温度范围 OPERATING DISCHARGING TEMPERATURE	-20℃~60℃
过压充电保护电压 OVER VOLTAGE PROTECTION	13.59V (4.53V±10mV/cell)
欠压放电保护电压 UNDER VOLTAGE PROTECTION	8.40V (2.8V±10mV/cell)
过流充电保护电流 OVER CHARGING CURRENT PROTECTION	8.470A±2.5%
过流放电保护电流 OVER DISCHARGING CURRENT PROTECTION	-11.600A±1.0%
上限充电温度保护 OVER CHARGING TEMPERATURE PROTECTION	60±3℃
下限充电温度保护 UNDER CHARGING TEMPERATURE PROTECTION	-2℃±3℃
上限放电温度保护 OVER DISCHARGING TEMPERATURE PROTECTION	73±3℃
下限放电温度保护 UNDER DISCHARGING TEMPERATURE PROTECTION	-25℃±3℃

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SPECIFICATION OF RECHARGEABLE LI-ion
BATTERY FOR APPROVAL

NO.	ITEMS	DESCRIPTION	
1	Customer	Lenovo	
2	Product	Rechargeable Li-ion Battery	
3	Product Name	Commercial T series 75Wh	
4	Model Name	L25B3P72	
5	ASM P/N	SB11M89972	
6	FRU P/N	5B11M90171	
7	Supplier P/N	19427336-00 （30%SOC） 19427337-00 （50%SOC）	
8	Cell P/N	19355255-00	
9	Supplier	SHANGHAI BYD COMPANY LIMITED	
		Address: No.999 Xiangjing Road,Songjiang Shanghai, P.R.China, 201611	
		Tel:+86-21-5777 8888	
		Fax:+86-21-5777 5000	
		Http://www.byd.com.cn	
Prepared		Checked	Approved
Shenfeng Shan Boyu Yang		Qingming Yang Jiafu Zhou	Qianwei Zhang



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1. Scope

The specification describes the requirements for the rechargeable Li-ion battery pack supplied by Shanghai BYD CO.,LTD. including product specification, function description, design details, test method, product liability, notice etc.

2. Definition

No.	Item	Definition
2.1	Standard environmental	Unless otherwise specified, all tests stated in this document shall be performed at Temperature of $25\pm 2^{\circ}\text{C}$ and relative ambient humidity of $65\pm 30\%$.
2.2	Measurement precision of equipment	Unless otherwise specified, all electrical tests stated in this document shall be performed to no less than the following levels of precision: Charge cut off and discharge cut off voltage: $\pm 0.5\%$ of scale Charge and discharge current: $\pm 0.2\%$ of scale Impedance: $\pm 0.5\%$ of scale Open circuit voltage (OCV): $\pm 1\text{mV}$
2.3	CC-CV	Constant current and constant voltage
2.4	C-Rate("C")	C-Rate (mA) is usually directed the charge or discharge current as a rate of the rated capacity,in this document ,"C"(mA) is defined as a numeral value of the design capacity of the battery.
2.5	Standard Charge	This"Standard charge"means charging the battery with specified charge method as the actual application (refer to"Limited charging voltage", "Common Dual Mode Function" .etc for details)
2.6	Standard discharge	The battery discharge to End of discharge voltage with 0.5C constant current.
2.7	Rest time	The time is needed for 10 minutes after every discharge or charge.
2.8	Explosion	When the battery contents are forcibly expelled and the battery casing is torn or split.
2.9	Fire	The emission of flames.
2.10	Leakage	Unplanned escape of electrolyte, gas or other material from battery, leakage has occurred when a battery loses more than 0.1% of its initial mass due to loss of internal components.
2.11	Residual Capacity	The residual capacity is measured by standard discharging to the cut-off voltage after storage.



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2.12

Recovery
capacity

The recovery capacity is the largest 0.2C capacity of three times standard charge and discharge after storage.



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3. Product specifications

No.	Item	Specification	
3.1	Cell Type & TCO type	705680&AC85ABD/CP85A-20	
3.2	Pack Configuration	3S1P	
3.3	Pack Model	L25B3P72	
3.4	Nominal Voltage	11.7V	
3.5	Pack Capacity	Design Capacity:6411mAh, 75 Wh Minimum Capacity: 6283mAh, 73.6 Wh Typical Capacity for Label: 6411mAh,75 Wh Rated Capacity for Label:6283mAh, 73.6 Wh (Test condition: Battery is charged by Item2.5, then discharge to 9V with 0.2C constant current) Reserve Capacity: 300mWh & ≥ 10 sec	
3.6	Limited charging voltage	13.50V 13.47V 13.44V 13.41V 13.38V 13.35V 13.20V 12.90V	For RT Mode For (T)LS1_1 Mode For(T) LS1_2 Mode For(T) LS1_3 Mode For(T) LS1_4 Mode For (T)LS1_5 Mode For (T)LS2 Mode For PI Mode
3.7	Upper limited charging voltage	13.5V	
3.8	Charging Current (In Different Temperature)	0~15° C	1283mA CC to 4.5V/cell, then CV to 321mA
		15~20° C	3205mA CC to 4.5V/cell, then CV to 321mA
		20~45° C	7694mA CC to 4.2V/cell, 4487mA CC to 4.5V/cell, then CV to 321mA
		45~60° C	3205mA CC to 4.2V/cell, then stop
		Note: 1. If temp and cell voltage doesn't in the charge mode range, the charging current will be 0mA 2. Hysteresis temperature is 1°C if temperature range changes from others to room 3. Hysteresis voltage is 300mV 15~20°C: When max voltage of the battery cell decreases by 300mV (4500-300=4200mV) delay 1s, charge current change to 3205mA; 20~45°C: When max voltage of the battery cell decreases by 300mV	



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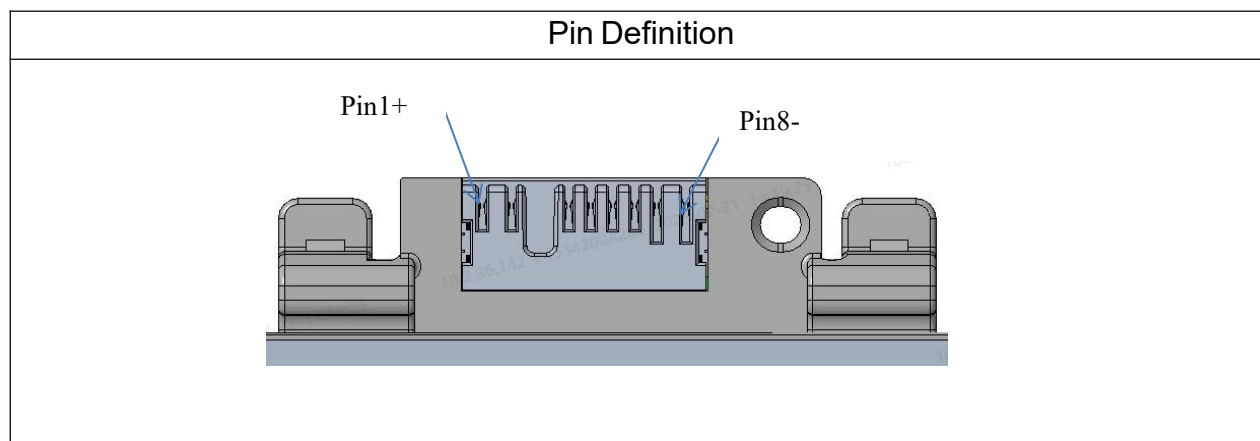
		(4200-300=3900mV) delay 1s, charge current change to 7694mA; 45 ~ 60℃ : When max voltage of the battery cell decreases by 300mV (4200-300=3900mV) delay 1s, charge current change to 3205mA;		
3.9	Charge Current for Pre-charge Mode	642mA	Min Cell Voltage<3.0V	
3.10	Max Discharge Power	Continue discharge power @35℃ 100%-0%	80W	
		30sec discharge power @35℃ 100%-10%	100W	
		CB power@35℃	100W	
3.11	End of discharge voltage	9V		
3.12	Max Continuous Discharge Current	8.889A@35℃		
3.13	Operation temperature	Charge: Initial: 0~50℃; Continuous: 0~60℃; Discharge: -20~70℃		Operation humidity range 10%~95%
3.14	Storage temperature	Storage temperature	Storage period	Recovery capacity
		-20 ~ +35℃	1 year	>80%
		-20 ~ +40℃	6 months	>80%
		-20 ~ +45℃	1 month	>80%
		-20 ~ +50℃	1 week	>80%
3.15	Battery Information(0x37)	Maker ID	0008	
		HW ID	0073	
		FW Version	0032	
		DF Version	0004	
3.16	Authentication Method	SHA256		
3.17	Internal impedance	≤200mΩ		
3.18	Pack weight	≤263g		
3.19	Shipment SOC of Pack	45%~55% for land & ocean shipment 20%~29% for air shipment		
3.20	Battery status when shipment	SHUTDOWN mode		

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4. Life cycle specification

Definition of cycle	1 cycle is defined when the battery after standard charged(Item 2.5) /rest 10 minutes, then Standard discharge (Item 2.6) to End of discharge voltage/rest 10minutes.
Definition of loading	Standard discharge (Item 2.6)
Definition of charging	standard charged(Item 2.5)
Ambient temperature	25±2℃
Life cycle specification	≥ 80% Energy at 3Years, 800 Cycles ≥ 80% Energy at 3Years, 1000 Cycles Note: 80% Energy=0.2C discharge capacity/minimal capacity(Rated capacity)

5. Pin assignment



Pin No.	Define	Comments
1	P+	P+ Battery Pack + Terminal
2	P+	P+ Battery Pack + Terminal
3	I2C_CLK	Smbus Clock
4	IC2C_DATA	Smbus Data
5	TEMP	10K OHM/1% RESISTOR CONNECTED TO GND
6	N/A	
7	GND	Battery Pack GND Terminal
8	GND	Battery Pack GND Terminal

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6. Battery Pack Function

6.1 Control IC

No.	IC Type	Manufacturer	Description
6.1.1	Gas Gauge	TI	bq9004 (FW Ver:ECT-T9004-2003-2C03) is used for battery management,communication with host through SMBus interfaces.
6.1.2	2nd protection IC	ABLIC	S-8264AAX-I8T1U is used for cell over voltage protection by hardware.
6.13	2nd protection IC	UPI	uP8306PDX8-H1 is used for cell over voltage protection by hardware.

6.2 Measurement accuracy

Item	Accuracy	Resolution
Voltage	$\pm 20\text{mV}$	Unless otherwise specified(eg. AFE settings), all electrical tests stated in this document shall be performed to no less than the levels of precision
Discharge current/Charge current	$\pm 1\%$	
Temperature	$\pm 3^{\circ}\text{C}$	
Delay time(SW)	$\pm 3\%$	

6.3 Protection Functions (Recovery)

No.	Item	Parameter	Value	Action	
				C-FET	D-FET
1	Cell over voltage(SwOv1)	Threshold	$\geq 4540\text{mV}$	OFF	ON
		Delay	3 s		
		Recovery	$\leq 4400\text{mV}$	ON	ON
2	Cell under voltage(UV) @RoomTemp($>15^{\circ}\text{C}$ and $\leq 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON

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3	Cell under voltage(UV) @Low Temp($\leq 15^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2700\text{mV}$	ON	OFF
		Delay	12s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
4	Cell under voltage(UV) @High Temp($> 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12 s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
5	Cell under voltage(UV) @All Temp & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2500\text{mV}$	ON	OFF
		Delay	5 s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
6	Cell under voltage(UV) @relax mode & Discharge Current $> -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12 s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
7	Shutdown voltage of cell @RoomTemp($>15^{\circ}\text{C}$ and $\leq 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s		
		Recovery	3000mV and Charging more than 5V within 1.6s, so as other temps	ON	ON
8	Shutdown voltage of cell @Low Temp($\leq 15^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2700\text{mV}$	OFF	OFF
		Delay	20s		
		Recovery	3000mV	ON	ON
9	Shutdown voltage of cell @High Temp($> 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s		
		Recovery	3000mV	ON	ON
10	Shutdown voltage of cell @relax mode & Discharge Current $> -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s		
		Recovery	3000mV	ON	ON
11	Over current in charge (Swocc)	Threshold	$\geq 8463\text{mA}$	OFF	ON
		Delay	5 s		



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		Recovery	$\leq -50\text{mA}$ delay 1s OR 16s passed	ON	ON
12	Over current in discharge (Swocd)	Threshold	$\leq -12111\text{ mA}$	ON	OFF
		Delay	5s		
		Recovery	$\geq 50\text{mA}$ delay 1s OR 16s passed	ON	ON
13	Over temperature in charge (TempAlarmBs)	Threshold	$\geq 60^{\circ}\text{C}$	OFF	ON
		Delay	2 s		
		Recovery	$\leq 50^{\circ}\text{C}$	ON	ON
14	Over temperature in discharge (CellTemp)	Threshold	$\geq 73^{\circ}\text{C}$	OFF	OFF
		Delay	2 s		
		Recovery	$\leq 65^{\circ}\text{C}$	ON	ON
15	Under temperature in charge (TempAlarmBs)	Threshold	$\leq -2^{\circ}\text{C}$	OFF	ON
		Delay	2 s		
		Recovery	$\geq 0^{\circ}\text{C}$	ON	ON
16	Over temperature of FET (FetTemp)	Threshold	$\geq 98^{\circ}\text{C}$	OFF	OFF
		Delay	2s		
		Recovery	$\leq 90^{\circ}\text{C}$	ON	ON
17	AFE OC Chg (HwScc)	Threshold	$\geq 22.2 \pm 2.36\text{ A}$	OFF	ON
		Delay	$366 \pm 10\% \text{ us}$		
		Recovery	$\leq -50\text{mA}$ delay 1s OR 30s passed	ON	ON
18	AFE OC Dsg(HwOcd)	Threshold	$\leq -16.64 \pm 2.08\text{A}$	ON	OFF
		Delay	$15 \pm 10\% \text{ ms}$		
		Recovery	$\geq 50\text{mA}$ delay 1s OR 30s passed	ON	ON
19	Short circuit(HwScd)	Threshold	$\leq -22.2 \pm 2.36\text{A}$	ON	OFF
		Delay	$366 \pm 10\% \text{ us}$		



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		Recovery	$\geq 50\text{mA}$ delay 1s OR 30s passed	ON	ON
20	Precharge Timeout (PrechargeTO)	Threshold	60min	OFF	ON
		Recovery	$\leq -5\text{mA}$ delay 1s	ON	ON
21	Precharge Over current (SwOcpc)	Threshold	$\geq 1284\text{mA}$	OFF	ON
		Delay	5s		
		Recovery	$\leq -15\text{mA}$ delay 1s OR 30s passed	ON	ON
22	Fast Over Current in Discharge_Cell Temp(CellFuse)	Threshold	$\leq -15300\text{ mA}$	ON	OFF
		Delay	5.25s		
		Recovery	16s passed	ON	ON
23	Fast Over Current in Discharge_FET Temp (FetFuse)	Threshold	$\leq -15300\text{ mA}$	ON	OFF
		Delay	5.25s		
		Recovery	16s passed	ON	ON
24	Charge Time Out(ChargeTO)	Threshold	65535min	OFF	ON
		Recovery	$\leq -15\text{mA}$ delay 1s	ON	ON



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6.4 Permanent Failure Functions (Fuse Blow)

No	Item	Condition	Action		
			Fuse	C-FET	D-FET
1	Cu Deposition Detection	Set: cell voltage $\leq 1.3V$ Delay Time: 2sec after wake up from shutdown mode	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
2	Second OVP Function (H/W)	Set: Max cell voltage: $4.65 \pm 0.025V$ & Delay time: 4.5 ~ 6.8sec (2ndP-IC:S-8264AAX-I8T1U) OR Max cell voltage: $4.65 \pm 0.025V$ & Delay time: 4.8 ~ 7.2sec(2nd P-IC: uP8306PDX8-H1) OR FET temp $\geq 130^{\circ}C$ Delay Time: 1sec	Blow	OFF	OFF
3	Second Over Temperature of Cell	Set: Cell Temperature $\geq 90^{\circ}C$ Delay Time: 10sec & Charge Current $\geq 25mA$ OR Set: Cell Temperature $\geq 90^{\circ}C$ Delay Time: 10sec & Discharge Current $\leq -100mA$	Blow	OFF	OFF
4	Second Over Temperature of FET	Set: FET Temperature $\geq 120^{\circ}C$ Delay Time: 5sec	Blow	OFF	OFF
5	C-FET Failure for Charge	Set: C-FET Turn Off & Charge current $\geq 250mA$ and Battery Voltage - Pack+ Voltage $< 350mV$ Delay Time: 20sec	Blow	OFF	OFF
6	D-FET Failure for Discharge	Set: D-FET Turn Off & Discharge current $\leq -250mA$ Delay Time: 20sec	Blow	OFF	OFF
7	Thermistor Open Detection	Set: TSx(Cell or FET) Temperature $\leq -46^{\circ}C$ Delay Time: 10sec	—	OFF	OFF



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8	Thermistor Short Detection	Set: TSx(Cell or FET) Temperature $\geq 150^{\circ}\text{C}$ Delay Time: 10sec	Blow	OFF	OFF
9	Disable Old Weak Batteries Function	Set: SOH at 25degC < 20% of DC & Total FW runtime > 52600hours & Charging start detected	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
10	Internal Short Detection	SBS Current = 0 CASE1 Maxcellvoltage: 3890mV ~ 4090mV CASE2 Maxcellvoltage: 4090mV ~ 4290mV DetectionWindow: 60min Detection: 2 times CASE1VoltageDeltaMax: 20mV CASE1Voltagegemin/minHisTimes: 5times CASE2VoltageDeltaMax: 25mV CASE2Voltagegemin/minHisTimes: 5times	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
11	Cell Imbalance Detection	Set: Max Cell Voltage 4400mV ~ 4500mV &No Current & Relax time >1800sec &Max $\Delta V_{\text{Cell}} \geq 500\text{mV}$ Delay Time=5min	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON



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6.5 Other Functions Introduction

NO.	Item	Condition	Action
1	SHIP Mode Function (D-FET OFF Function)	Enter: 1. Write "0x0000" by 0x34 & Write "0x1000" by 0x34 (Command interval smaller than 5s) OR 2. RSOC < 30% & No detectable charge or discharge current & Storage Time > 14 days & In Sleep Mode (Start counting from Sleep Mode)	1. D-FET OFF function 0x34 value changes to 0x0100 from 0x0000 2. Both D-FET and C-FET turn OFF
		Exit: 1. Write "0x2000" by 0x34 & Write "0x4000" by 0x34 (Command interval smaller than 5s) OR 2. BMU receives a SMBus communication after waking up from sleep mode.	1. D-FET OFF function 0x34 value changes to 0x0000 from 0x0100 2. Both D-FET and C-FET turn ON
		Note: 1. It's necessary to have an interval time that is more than 2sec between Entry Condition CMD and Exit Condition CMD for turning ON/OFF C/D-FET. 2. Any SMBus R/W commands are such as read 0x34. 3. The BMU will go back to normal operation mode after exit ship mode. 4. The D-FET OFF delay time is ≤400msec when battery meets the entry condition. 5. The ship mode couldn't exit by condition 2 before BMU enter sleep mode. 6. The current threshold of exit charge mode or discharge mode is 10mA 7. The D-FET ON delay time is ≤400msec when battery meets the exit condition.	



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2	Sleep Mode	Entry: 1. No Communication & 2. Current $ \leq 10\text{mA}$ & 3. Delay Time $\leq 20\text{sec}$ & 4. No specific safety&PF triggered	1. BMU goes to sleep mode 2. C-FET OFF.
		Exit: 1. Communication with battery OR 2. $ \text{Current} \geq 10\text{mA}$ OR 3. Power Wake-up Current $\geq 300\text{mA}$ (TYP) ; Delay Time $\leq 1\text{sec}$ OR 4. Any Safety Alert / Status	1. BMU goes back to Normal mode 2. C-FET ON. (Depends ON present status)
		Note: 1. BMU can't allow CLK pin High with Data pin Low or CLK pin Low with Data pin High. 2. The current condition of sleep mode is no matter current direction. 3. The C-FET is turned OFF in sleep mode. Normally, the current exit condition is in discharge. 4. BMU still can enter sleep mode even CLK and Data pins are high	
3	0x3F First Used Date	It's able to be written in any value when it's 0, and could rewrite to 0 from any value. There is no FUD writing counts limitation [4:0]:Day(1-31) [8:5]:Month(1-12) [15:9]: Year(0-127):(Year-1980) (Year-1980)x512 + Month x 32 + day	
4	0x16 Bit7 Initialized	Bit7= 1: Gauge initialization process has finished, BMU data is stable and can communicate normally with host through SMBus. Bit7= 0: Gauge IC is in initializing process; BMU has not finished initialization after reset.	



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5	Charge Rate Control by FCC	SBS Charging Current value will base on the SBS FCC value and reduce accordingly with the FCC degradation Minimum SBS Charging Current is limited to Pre-Charging Current.
6	Common Dual Mode Function	Switch charge mode from RT to LS1 mode: By Cycle Count: LS1 Step1: Cycle Count ≥ 100 LS1 Step2: Cycle Count ≥ 150 LS1 Step3: Cycle Count ≥ 300 LS1 Step4: Cycle Count ≥ 350 LS1 Step5: Cycle Count ≥ 400 OR By Hrs at Full Charge: LS1 Step1: Hrs at Full Charge Value ≥ 960 hrs LS1 Step2: Hrs at Full Charge Value ≥ 1200 hrs LS1 Step3: Hrs at Full Charge Value ≥ 1440 hrs LS1 Step4: Hrs at Full Charge Value ≥ 1680 hrs LS1 Step5: Hrs at Full Charge Value ≥ 1920 hrs Switch charge mode from LS1 to LS2 mode: Threshold Condition: SBS FCC $\leq$ LS2 target value (Minimum of LS2 target threshold: 50% of DC) (Age of LS2 target threshold: 0.75%/month) (Mode transition at the start of charging) (LS2 target threshold calculation condition: FUD$\neq$0 or Cycle Count ≥ 5 or HiV time ≥ 120hrs) Temperature Modifier and Voltage Modifier: Temperature modifier: $= 2^{((\text{Cell temperature} - 25)/10)}$ The calculation range of this modifier is 25 deg C to 90 deg C Voltage modifier: =0.8: If Max Charge Voltage - 100mV $\leq$ Cell Voltage < Max Charge Voltage - 50mV =1.0: If Max Charge Voltage - 50mV $\leq$ Cell Voltage The adjusted time is calculated by following formula. Adjust time = Actual time at high voltage* Temperature modifier * Voltage modifier



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Actual Voltage Higher than Charging Voltage Prevention:

To Check the OCV value when charge mode change.

1. Enter Permanent Life Span mode
2. Both SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA
3. Delay time: 5sec

If OCV voltage value $\geq$ Charging Voltage Value of current Life Span mode.

1. SBS RSOC value report 100%
2. FC bit set 1
3. SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA

If OCV voltage value $<$ Charging Voltage Value of current Life Span mode.

1. SBS Charging Voltage()0x15 & Charging Current()0x14 report current Life Span mode value
2. C-FET turn ON
3. BMU will enter full charge detection at charge mode status

* OCV detection time counter(5sec) will be cleared if detecting the discharging current during OCV detection period



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7 Temporary Mode Function

Dynamic Lifespan mode:

Min RSOC in Rolling Time Window DLS (7days)

T-LS1 Step1: $35\% \leq \text{RSOC} < 40\%$

T-LS1 Step2: $40\% \leq \text{RSOC} < 45\%$

T-LS1 Step3: $45\% \leq \text{RSOC} < 50\%$

T-LS1 Step4: $50\% \leq \text{RSOC} < 55\%$

T-LS1 Step5: $55\% \leq \text{RSOC} < 65\%$

T-LS2 : $65\% \leq \text{RSOC} < 90\%$

Recovery condition:

RSOC < Exit DLS RSOC Threshold (RSOC 20%)

Plugged-in mode:

1. RSOC $\geq$ PI RSOC Threshold (90%) in Rolling Time Window PI
(20160min: 14days)

OR

2. Cell temperature is ≥ 40 degc for 40 hours at last 7 days

Recovery condition:

RSOC < Exit PI RSOC Threshold (RSOC 50%)

***Time window are initialized when:FUD $\neq$ 0 or Cycle Count $\geq$ 5 or HiV time $\geq$ 120hrs**

Actual Voltage Higher than Charging Voltage Prevention:

To Check the OCV value when charge mode change.

1. Enter Temporary mode
2. Both SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA
3. Delay time: 5sec

If OCV voltage value $\geq$ Charging Voltage Value of current Temporary mode.

1. SBS RSOC value report 100%
2. FC bit set 1
3. SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA



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		If OCV voltage value < Charging Voltage Value of current Temporary mode. 1. SBS Charging Voltage()0x15 & Charging Current()0x14 report current Life Span mode value 2. C-FET turn ON 3. BMU will enter full charge detection at charge mode status * OCV detection time counter(5sec) will be cleared if detecting the discharging current during OCV detection period
8	96 Hour Function	96hrs function enable: When battery is fully charged 96hrs function disable: 96hours time out. OR Discharge current>5mA for duration time (as 30 seconds) OR Discharge current> 100mA without delay time
9	Transition to Shutdown State Condition	~~By Command Condition while RSOC≤5%:~~ ~~1. Receive 0x34 command in RSOC ≤ 5%~~ ~~2. C/D FET will be turned off within 2 sec~~ ~~3. BMU detect output voltage for shutdown within 2 sec~~ ~~4. BMU will enter Shutdown mode~~ ~~By Ship Mode Condition:~~ ~~1. RSOC ≤ 5% while in Ship Mode~~ ~~2. C/D FET will be turned off within 2 sec~~ ~~3. BMU detect output voltage for shutdown within 2 sec~~ ~~4. BMU will enter Shutdown mode~~ ~~By Sleep Mode Condition:~~ ~~1. RSOC ≤ 5% while in Ship Mode~~ ~~2. C/D FET will be turned off within 2 sec~~ ~~3. BMU detect output voltage for shutdown within 2 sec~~ ~~4. BMU will enter Shutdown mode~~ By TDA Condition: 1. When TDA bit(bit11 of 0x16 BatteryStatus()) set to “1”, and keep 10sec or more in discharging state. 2. C/D FET will be turned off within 2 sec 3. BMU detect output voltage for shutdown within 2 sec 4. BMU will enter Shutdown mode



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10 Cell Balancing Function

Cell Balance ON Condition:

Fully charged

&

Max CellV - Min CellV delta >20mV

Delay time: 60sec

Cell Balance OFF Condition:

1. Max CellV - Min CellV delta < 10mV

2. Discharge current detected

3. Minimum cell Voltage $\leq$ 3800mV

4. SBS AVG current not equal 0

Cell Balance Disable Condition:

1. Fully charged & Max CellV - Min CellV delta $\geq$ 40mV

2. RSOC $\leq$ 10% & Max CellV - Min CellV delta $\geq$ 100mV

3. Condition1 Max CellV and Condition2 Min CellV is same cell block

Continues detect 5 times

Cell Balance Re-enable Condition:

1. Fully charged & Max CellV - Min CellV delta $\geq$ 40mV

2. RSOC $\leq$ 10% & Max CellV - Min CellV delta $\geq$ 100mV

3. Condition1 Max CellV and Condition2 Min CellV is different cell block

Continues detect 5 times



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11 HSFCC Function

1. HSFCC Learning is based on cell IR measurement and the amount of charging capacitance to full charge.

BMFW measures cell IR every 1 percent from 60% to 80% of SOC when pack is charged from lower than 60% of SOC.

Cell IR:

V0: Voltage just before turning off C-FET

V1: Voltage just before turning on C-FET

I : Current just before turning off C-FET

$IR = (V0 - V1) / I$

Operating condition:

1. Cell Temp: $\geq 20^{\circ}\text{C}$ and $\leq 45^{\circ}\text{C}$.
2. Changing rate: $\geq 0.45^{\circ}\text{C}$ and $\leq 1.05^{\circ}\text{C}$
3. Charging current $\geq 0.05\text{C}$
4. More than 72h after FCC updating by low side FCC learning
5. Max error $\leq 10\%$
6. When IR Measurement discharge current need less than 5mA
7. Charging Current need higher than 1000mA
8. One cycle after exiting PI/DLS mode
9. Not enter PI/DLS mode
10. Charging Current need be detected within 72hrs during IR Measurement
11. FCC learning deviation $\leq 10\%$
12. No discharge detection. (SBS AVG current need higher than 0mA)



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12 EOL Function

The End-of-Life (EoL) Prediction function is to predict the life time of the battery pack and inform users of the optimal time to replace CRU batteries.

The degraded level should be determined from the change of cell internal resistance

BMFW measures cell IR every 5 percent from 55% to 75% of SOC when pack is charged from lower than 55% of SOC.

Cell IR:

V0: Voltage just before turning off C-FET

V1: Voltage just before turning on C-FET

I : Current just before turning off C-FET

$$IR = (V0 - V1) / I$$

Operating condition:

1. Cell Temp: $\geq 7.5^{\circ}\text{C}$ and $\leq 52.5^{\circ}\text{C}$.
2. IR: $\geq 0\text{m}\Omega$ and $\leq 100\text{m}\Omega$
3. No discharge current during IR measurement
4. Charge start from RSOC < 55%
5. SBS AVG Current need > 0.05C during IR measurement
6. SBS Current need > 1000mA

Formula:

Impedance-based FCC

= DesignCapacity * Impedance-based FCC coefficient

(Impedance-based FCC coefficient)

$$= 1.0 + a * (\text{Cycle count}) + b * (\text{High-temp. \& voltage time}) + c *$$

(Temp-modified Impedance Growth)

$$*(a = -1.802 \times 10^{-5}, b = 7.498 \times 10^{-5}, c = -0.2569)$$

Prediction:

When Impedance-based FCC < Fcc Threshold, calculate the Cycle Count and Storage Time until EolTargetFcc (degradation to the point where battery replacement is recommended) is reached by linear regression (calculated by the least-squares method for both the CycleCount and Storage Time cases) on 20 buffers of history data for EoL prediction.



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Full Charge Detection

By Taper Condition:

Max Cell Voltage $\geq$ Taper Voltage
&
Average Current $<$ Taper Current
Delay Time: 60sec~90sec

Mode	Taper Voltage(mV)	Taper Current
RT	4450	0.05C of Nominal Capacity
LS1/T-LS1 Step1	4440	
LS1/T-LS1 Step2	4430	
LS1/T-LS1 Step3	4420	
LS1/T-LS1 Step4	4410	
LS1/T-LS1 Step5	4400	
LS2/T-LS2	4350	
PI	4250	

Recovery condition:

RSOC $<$ Exit RSOC Threshold (RSOC 95%)

By Pulse Charge OCV Detection:

Step1: (Turn Off C-FET)

Cell Voltage $\geq$ CV + 20mV continues for 1sec, C-FTE is turned OFF.

Step2: (Turn On C-FET, Not Fully Charge)

If Max Cell Voltage $<$ CV - 20mV continues for 1sec, C-FET is turned ON.

(Fully Charge)

If Max Cell Voltage $\geq$ CV - 20mV continues for 60sec, detect Full charge.

Mode	Turn Off C-FET (mV) ($\geq$ CV + 20mV)	Turn On C-FET (mV) ($<$ CV - 20mV)	Fully Charge (mV) ($\geq$ CV - 20mV)
RT	4520	4480	
LS1/T-LS1 Step1	4510	4470	
LS1/T-LS1 Step2	4500	4460	
LS1/T-LS1 Step3	4490	4450	
LS1/T-LS1 Step4	4480	4440	
LS1/T-LS1 Step5	4470	4430	
LS2/T-LS2	4420	4380	
PI	4320	4280	

Recovery condition:

RSOC $<$ Exit RSOC Threshold (RSOC 95%)



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By CCV step down function:

Max Cell Voltage $\geq$ CV + 10mV continues for 1sec, CC Step down with 0.1C of SBS FCC

In Normal

Mode	CCV Step down Voltage(mV)
RT	4510
LS1/T-LS1 Step1	4500
LS1/T-LS1 Step2	4490
LS1/T-LS1 Step3	4480
LS1/T-LS1 Step4	4470
LS1/T-LS1 Step5	4460
LS2/T-LS2	4410
PI	4310

Minimum of CC step down value: 0.1C

Released to initial current condition: Discharge current detection or BMU enter DSG mode(sleep mode)

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Shutdown cancel Function

Pre-condition:

BMU enter shutdown process

Set:

1.Shutdown delay time passed

2.C/D FET turn off

3.Pack P+ Voltage > SBS charging voltage -200mV

Delay time: 3 sec

Action:

BMU shutdown cancel, BMU return to normal status

Mode	SBS Charging Voltage(mV)
RT	13500
LS1/T-LS1 Step1	13470
LS1/T-LS1 Step2	13440
LS1/T-LS1 Step3	13410
LS1/T-LS1 Step4	13380
LS1/T-LS1 Step5	13350
LS2/T-LS2	13200
PI	12900

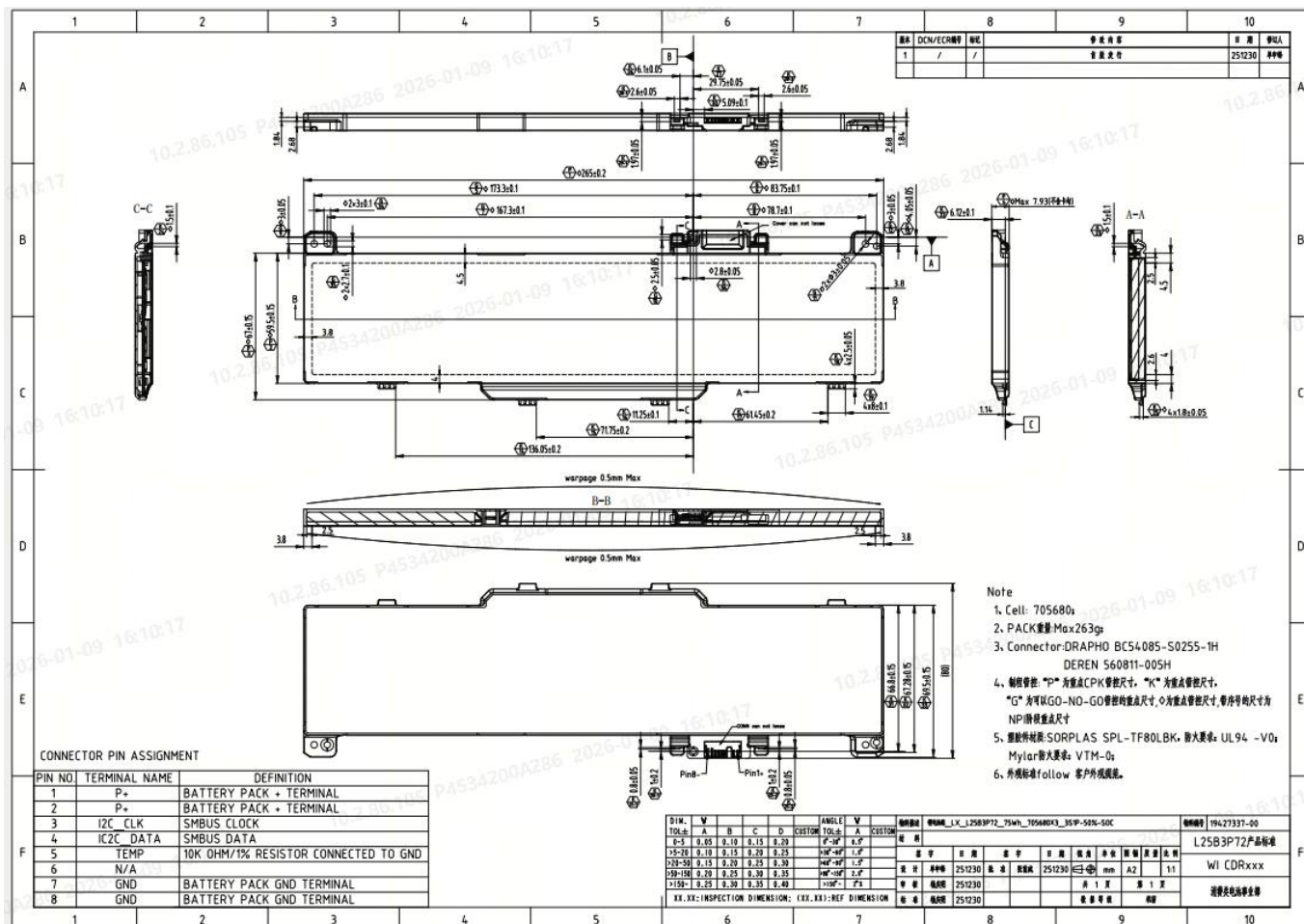
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7.Safety Operating Parameters for GB 31241-2022

安全工作参数 Safety Operating Parameter	符号 Symbol	电池组 L25B3P72 Battery Pack
充电限制电压 (Limited charging voltage)	Ucl	13.5V
充电上限电压 (Upper limited charging voltage)	Uup	13.5V
放电截止电压 (Discharge cut-off voltage)	Udo	7.5V
放电终止电压 (End of discharge voltage)	Ude	9.0V
推荐充电电流 (Recommendation charging current)	Icr	7694mA CC to 12.6V, 4487mA CC to 13.5V, then CV to 321mA
最大充电电流 (Maximum charging current)	Icm	7924mA
推荐放电电流 (Recommendation discharging current)	ldr	1283mA
最大放电电流 (Maximum discharging current)	Idm	8.889A
过压充电保护电压 (Over voltage for charge protection)	Ucp	4520mV/Cell
过流充电保护电流 (Over current for charge protection)	Icp	8463mA
欠压放电保护电压 (Low voltage for discharge protection)	Udp	2800mV/Cell
过流放电保护电流 (Over current for discharge protection)	Idp	12111mA
上限充电温度 (Upper limited charging temperature)	Tcm	60℃
下限充电温度 (Lower limited charging temperature)	Tcl	0℃
上限放电温度 (Upper limited discharging temperature)	Tdm	70℃
下限放电温度 (Lower limited discharging temperature)	Tdl	-20℃
充电截至电流 (Taper current for charging)	-	321mA

8.Pack Design

8.1 2D Drawings



8.2 Label printing





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Lenovo

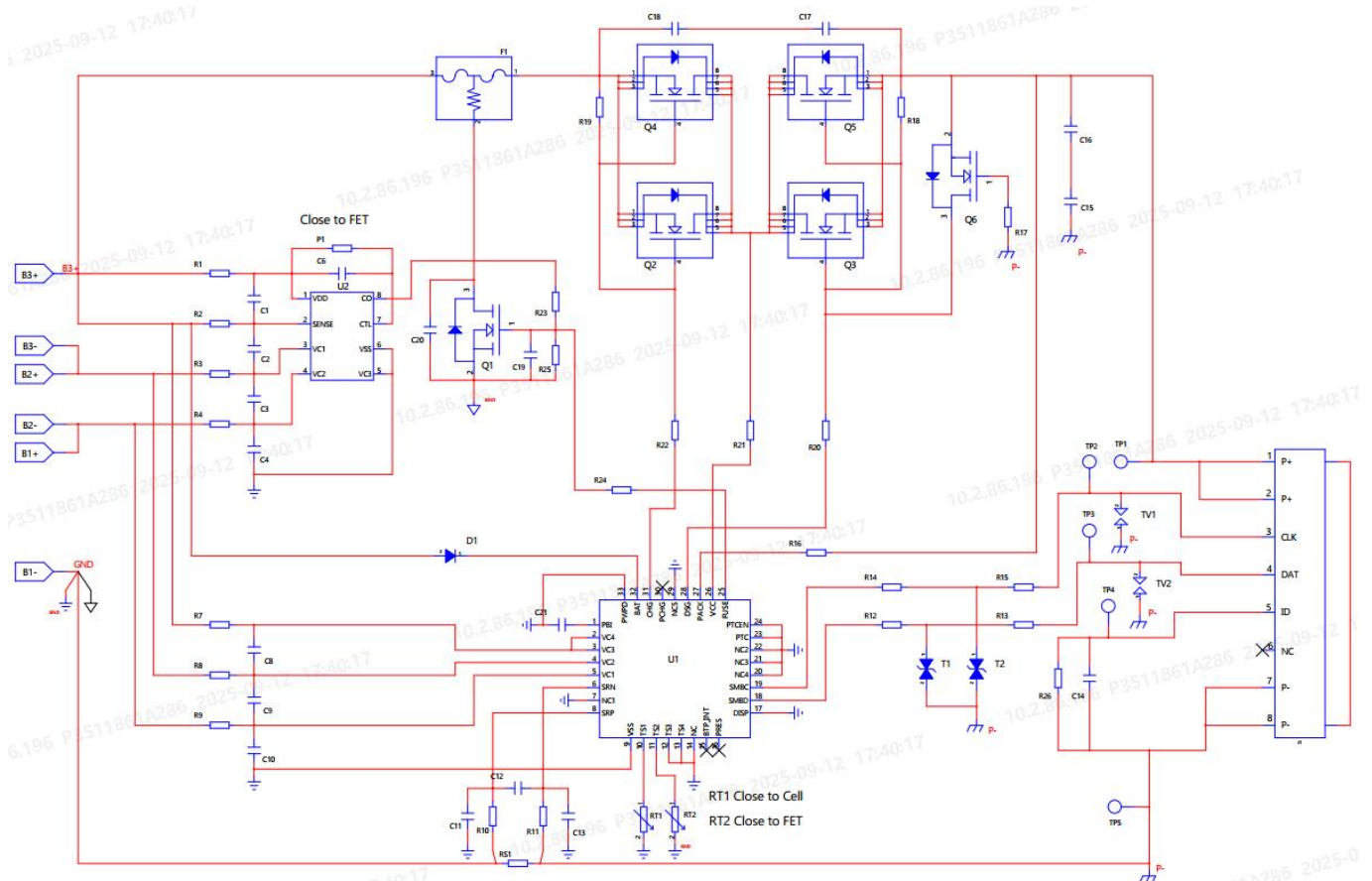
Lenovo is the trademark of Lenovo, used under license.
Lenovo 联想集团所有企业的商标, 未经许可不得使用。
Model Name 型号/名称: L25B3P72
ASM P/N: SB11M65872
FRU P/N: 5B11M90171
3ICP1/57/80
11.7V 75Wh Typical Capacity 641mAh,
Rated Capacity 6283mAh
For use with Lenovo personal computer
制造商: 上海比亚迪有限公司
Manufactured by Shanghai BYD Co., Ltd.
Rechargeable Li-ion Battery
Made in China

CAUTION: Replace with same type only.
Use of another battery may present a fire or explosion.
ATTENTION: remplacer la batterie par le même type uniquement.
L'utilisation d'un autre type de batterie peut provoquer un incendie ou une explosion.
PLEASE REFER TO USER MANUAL OR FOLLOW LOCAL ORDINANCES AND/OR REGULATIONS FOR DISPOSAL.
注意: 用错误型号电池更换会有爆炸危险, 务必按照说明处置用完的电池。
注意: 用错误型号电池更换会有爆炸危险, 务必按照说明处置用完的电池。
EU contact: Lenovo, 3rd Floor, 25, Temple Avenue, Farnborough, GU14 6FE, UK.
UK contact: Lenovo, 3rd Floor, 25, Temple Avenue, Farnborough, GU14 6FE, UK.

锂离子电池组
额定能量: 73.6Wh
标称容量: 75Wh
额定容量: 6283mAh
标称电压: 11.7V
充电限制电压: 13.5V
中国制造
生产厂: 上海比亚迪有限公司



8.3.PCB Design Schematic



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9.Others

9.1 Warranty period:

Warranty period of this product is 12 months from manufacture code, which the battery should be used accordance with this specification.

9.2 Product liability:

You are kindly requested to use the battery which is delivered from Shanghai BYD CO.,LTD in strict accordance with the specification and remarks include at the end of the document.

Due to improper usage of the battery, an accident or a fire may occur. Shanghai BYD CO.,LTD will not guarantee against any accidents occurring due to use beyond the content of this specification.

9.3 Prior notice of change:

In case specification, materials, production process, and control system for the products are changed, the notice of change in writing together with quality and reliability data is to be informed in advance to the buyer.

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10. Attentions

Please read and follow the handling instructions for the battery before use. Improper use of the battery may cause heat, fire, rupture, damage or capacity deterioration.

WARNING

1. Do not put the battery into a fire, or heat the battery; do not store the battery under high temperature environment.
2. Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment.
3. Do not let the battery terminals (+ and -) contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together, may cause short-circuit.
4. Do not drive a nail in, hit with a hammer, or stamp on the battery, do not strike the battery in other ways.
5. Do not disassemble or alter the battery's' outside structure.
6. Do not submerge the battery in water, do not wet the battery when store the battery.

NOTICE

Battery should be charged and discharged with proper charger, in compliance with correct operation contents.

1. Do not use the battery with other maker's batteries, different types and /or models of batteries such as dry batteries, nickel-metal hydride batteries, or nickel-cadmium batteries, or new and old lithium batteries together.
2. Do not leave the battery in a charger or equipment if it generates an older and/or heat, changes color and/or shape, leaks electrolyte, or cause any other abnormality.

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3. Do not discharge the battery continuously when it is not charged



1. In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times.
2. The battery was inspected carefully by QA before shipment to confirm with the specifications. However, in the case any abnormality of bad smell or heat, etc, arises after purchase, bring it and communicate with us.
3. For long-term storage, please charge at 50%SOC about in advance.
4. Do not use the battery in other than the following conditions; otherwise, the battery might cause heat generation, damage, or deterioration of its performance.

Operating environment:

- Charge: 0°C ~ +60°C
- Standard Discharge: -20°C ~ +70°C
- Store less than 30 days: -20°C ~ +45°C
- Store less than 180 days: -20°C ~ +40°C
- Store less than 360 days: -20°C ~ +35°C



SPECIFICATION FOR BATTERY

CONFIDENTIAL

Customer: Lenovo

Model Name: L25D3P78

Sunwoda P/N: 1002008808381/1002008808401/1002008808432/1002008808442

Lenovo P/N: SB11M89970

FRU P/N: 5B11M90169

Description: Rechargeable Li-ion Battery PACK 3S1P Min 6283mAh

SUNWODA Electronic Co., Ltd.

地址：广东省深圳市宝安区石岩街道石龙社区颐和路2号

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Guangdong Province, China

TEL: +86-755-27623775

FAX: +86-755-29517078

E.E	Check	Approval
彭昊锋 Harvey Peng	张添翔 Jed Zhang	高涛 Shawn Gao

1.Revision History

[illegible]

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2.Scope

This specification describes the requirements for a Rechargeable Li-ion Battery pack supplied by SUNWODA Electronic Co., Ltd.

3.Battery Pack Overview

3.1.Cell Main Characteristics

Cell Manufacturer	Cell Model	Nominal Voltage	TypicalCapacity	Minimum Capacity
LWN	705680H5R	3.9V	6411mAh	6283mAh

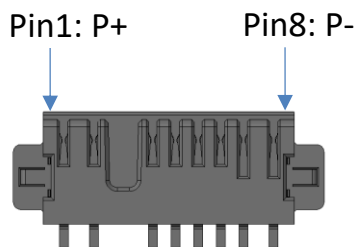
3.2.Compliant Communications

Battery is fully SMBus 1.1 agreement compliant.

3.3.Connector Terminals Definition

Terminal	Name	Description
1	P+	Battery Positive Terminal
2	P+	Battery Positive Terminal
3	CLK	SMBus clock interface I/O pin
4	DATA	SMBus data interface I/O pin
5	ID	Connect 10Kohm $\pm 1.5\%$ resistor to P-
6	NC	NC
7	P-	Battery Negative Terminal
8	P-	Battery Negative Terminal

Battery pack output port diagram



Pin Number	Description	DEFINITION
Pin 1	P+	P+ BATTERY PACK + TERMINAL
Pin 2	P+	P+ BATTERY PACK + TERMINAL
Pin 3	I2C_CLK	SMBUS CLOCK
Pin 4	IC2C_DATA	SMBUS DATA
Pin 5	TEMP	10k OHM/1% RESISTOR CONNECTED TO GND
Pin 6	NC	/
Pin 7	GND	BATTERY PACK GND TERMINAL
Pin8	GND	BATTERY PACK GND TERMINAL
Connector	Drapho BC54085-S0255-1H DEREN 560811-005H	

4. Production Specification

No.	Items		Rated Performance	Remark	
1	Nominal Voltage		11.7V	3.9V/cell	
2	Typical Capacity		6411mAh	0.2C discharge with 3V/cell cut off voltage at 25 °C ± 3°C (cell's spec)	
			75Wh		
3	Minimum Capacity		6283mAh	0.2C discharge with 3V/cell cut off voltage at 25 °C ± 3°C (cell's spec)	
			73.6Wh		
4	Reserve Capacity		500mWh	From RSOC=0% to TDA	
5	Initial AC Impedance		≤210mΩ	1KHz AC Method	
6	Limited Charging Voltage		13.5V	Upper limited charge voltage 13.5V	
7	End of Discharge Voltage		9V	9V→RSOC 0%	
8	Max Continue Charge Current		1282mA	1282mA CCCV to 4.5V/cell	0°C~15°C
			6411mA	6411mA CC to 4.1V;3205mA CCCV to 4.5V/cell	15°C~20°C
			7693mA	7693mA CC to 4.2V;4487mA CCCV to 4.5V/cell	20°C~45°C
			3205mA	3205mA CC to 4.2V/cell, then stop; Reset: max cell voltage≤3900mV	45°C~60°C
9	Max Discharge Current		8888mA	35 °C (Ambient); Cell surface temperature ≤ 70 °C	
10	Max Continue Discharge Power		80W	from SOC 100% to 0% @ 35 °C (Ambient); Cell surface temperature ≤ 70 °C	
11	Max Peak Discharge Power		100W for 30S	from SOC 100% to 0% @ 35 °C (Ambient); Cell surface temperature ≤ 70 °C	
12	CB Maximum Discharge Power		100W	CB Max Discharge Current: 11111mA @ 35 °C (Ambient) ; Cell surface temperature ≤ 70 °C	
13	Standard Charge Current		1282mA	Cell surface temperature ≤ 70 °C	
14	Standard Discharge Current		1282mA		
15	Storage Temperature	Storage 1 week	-20°C~50°C	If the battery pack (shipping status) store at over the 3 months period, it should be recharged. Humidity ≤ 95% RH	
		Storage 1 months	-20°C~45°C		
		Storage 6 months	-20°C~40°C		
		Storage 1 year	-20°C~35°C		
16	Operating Temperature Range (Charge)		0°C~60°C ± 3°C	Humidity ≤ 95% RH	
			≥ 0°C ± 3°C	Initial low charge temp	
			< 50°C ± 3°C	Initial high charge temp	

PRODUCTION SPECIFICATION

17	Operating Temperature Range (Discharge)	-20℃~60℃ ± 3℃	Humidity ≤ 95% RH
18	Over Temperature Protection (Charge)	60 ± 3℃	
19	Under Temperature Protection (Charge)	-2 ± 3℃	
20	Cycle Life	≥ 70% Cmin at 1000 Cycle	See 10.6 Electrical Characteristics For Detail
21	Battery Pack Weight	Max 263g	
22	Shipping Capacity	25%~30%	By Air
		45%-55%	By Sea & Land
23	BMU Solution	Tenpao_RAJ240047_E108_EC16	

5.Standard SBS Commands

No.	Function	CMD	Specification		Comments							
1	Remaining Capacity Alarm	0x01	10% of design capacity=750cWh									
2	Remaining Time Alarm	0x02	10 minutes									
3	Relative State Of Charge	0x0D	Remaining Capacity/Full Charge Capacity x 100									
4	Remaining capacity	0x0F	Shall be 0 when the cell stack voltage reaches 3V/cell									
5	Full charge capacity	0x10	Update the value when detect the full charge									
6	Charging current	0x14	0℃~15℃	1282mA	End of Charge Current:320mA							
			15℃~20℃	6411mA								
			20℃~45℃	7693mA								
			45℃~60℃	3205mA								
			Precharge current	320mA								
7	Charging voltage	0x15	0℃~15℃	13500mV								
			15℃~20℃	13500mV								
			20℃~45℃	13500mV								
			45℃~60℃	13500mV								
8	Cycle count	0x17	When the charging capacity exceeds 100% of FullChargeCapacity, CycleCount is added to 1									
9	Design Capacity	0x18	7500cWh									
10	Design Voltage	0x19	11700mV									
11	Manufacture Name	0x20	Sunwoda 2025									
12	Device Name	0x21	LNV-5B11M90169									
13	Device Chemistry	0x22	LION									
14	DFET OFF Function	0x34	Ship Mode Function. See 9.3 Ship Mode For Detail.									
15	Read Battery Info.	0x37	Maker ID	HW ID	FW Version	Data Version						
			byte1 byte0	byte3 byte2	byte5 byte4	byte7 byte6						
			07 00	B8 0C	30 00	03 00						
			Lenovo Spec.									
			Target Schedule		0x37							
			Phase	Lenovo Phase	A0 : Maker ID		A1 : HW ID		FW Version		Data Version	
					byte 1	byte 0	byte 3	byte 2	byte 5	byte 4	byte 7	byte 6
			EP	EVT/SDV	xx	00	xx	xx	1x	00	xx	xx
SP	FVT/SIV	xx	00	xx	xx	2x	00	xx	xx			
PP	SIT	xx	00	xx	xx	3x	00	xx	xx			
MV	SIT-R/SVT	xx	00	xx	xx	0x	01	xx	xx			
MP	SOVP	xx	00	xx	xx	XX	01	xx	xx			

6. Fuel Gauge Board Current Consumption

No.	Function	Specification	Comments
1	Cell voltage sensing input leakage current on each block	$\leq 10\mu\text{A}$	@3.8V/cell
2	Circuit Current Consumption		
	I(normal) @ SMC / SMD=H	$\leq 600\mu\text{A}(\text{typ})$	Operating mode
	I(sleep) @ SMC / SMD=L	$\leq 200\mu\text{A}(\text{typ})$	Sleep mode
	I(shutdown) @ SMC / SMD=L	$\leq 15\mu\text{A}(\text{typ})$	Shutdown Mode

7.Fuel Gauge Accuracy

No.	Function	Specification	Comments
1	Voltage Accuracy	$\pm 20\text{mV}$	@25°C
2	Current Accuracy	$\geq 600\text{mA}$ $\pm 0.5\%$ $< 600\text{mA}$ $\pm 3\text{mA}$	
3	Temperature Accuracy	$\pm 3^\circ\text{C}$	

8.PCBA Protection function (25℃^{第 10 页}±3℃)

8.1.Protection Function (Recovery)

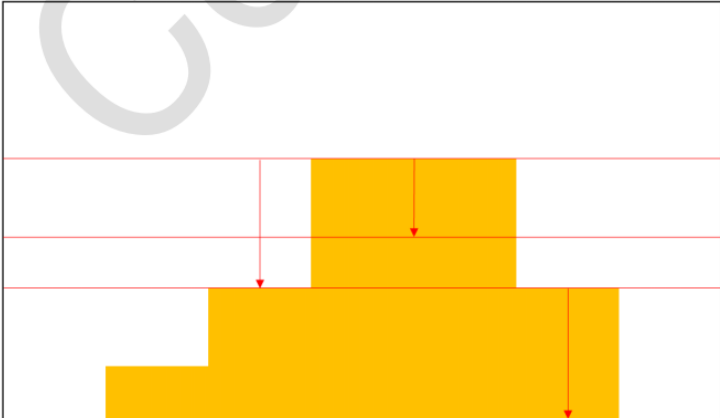
No.	Item	Threshold	Action	
			CFET	DFET
1	Over Cell Voltage Protection (1st)	4.54V ±0.02V / cell Delay time: 2Sec~6Sec	Off	On
		Reset: ≤4.4V±0.02V /cell	On	On
2	Under Cell Voltage Protection	Set: ≤2.70V ±0.02V / cell(<15℃) Delay time: 11Sec~15Sec OR Set: ≤2.80V ±0.02V / cell(>15℃) Delay time: 11Sec~15Sec OR Set: ≤2.50V ±0.02V / cell(for all temp) Delay time: 4Sec~8Sec	On	Off
		Reset: ≥3.10V ±0.02V / cell & Charging Delay time: 0Sec~3Sec	On	On
3	Shutdown Voltage of Cell	Set: ≤2.70V ±0.02V / cell(<15℃) Delay time: 19Sec~23Sec OR Set: ≤2.80V ±0.02V / cell(>15℃) Delay time: 19Sec~23Sec	Off	Off
		Reset: Charge Voltage Input	On	On
4	Pre-Charge Over Current Protection	Set: ≥600mA Delay time: 2Sec~6Sec	Off	On
		Reset1: Current≤-15mA Delay time: 1Sec Reset2: Current>-15mA Delay time≤30Sec	On	On
5	Pre-Charge Timeout Protection	Delay time: 60mins	Off	On
		Reset: Current≤-10mA	On	On
6	SW Over Charge Current Protection	Set: ≥8.2A±0.2A Delay time: 2Sec~6Sec	Off	On
		Reset: Current≤-50mA	On	On

7	SW Over Discharge Current protection	Set: $\geq 12.5A \pm 0.2A$ Delay time: 4Sec~8Sec	On	Off
		Reset: Current $\geq 50mA$	On	On
8	HW Over Discharge Current Protection	Set: $\geq 16.67A(TYP)$ (14.2-20.5) Delay time: 27ms $\pm 10\%$	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
9	HW Discharge Short-Circuit Protection (1st)	Set: $\geq 33.3A$ (TYP) (27-35) Delay time: 600us~1500us	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
10	HW Discharge Short-Circuit Protection (2nd)	Set: $\geq 22.2A$ (TYP) (20.5-27) Delay time: 300us~900us	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
11	Charge Over Temperature Protection of Cell	Set: $\geq 60^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\leq 50^{\circ}C \pm 3^{\circ}C$	On	On
12	High Temperature Charge Start Protection (Charge inhibit function)	Set: $> 50^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\leq 50^{\circ}C \pm 3^{\circ}C$	On	On
13	Discharge Over Temperature Protection of Cell	Set: $\geq 73^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\leq 65^{\circ}C \pm 3^{\circ}C$	On	On
14	Over temperature protection of FET	Set: $\geq 98^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\leq 70^{\circ}C \pm 3^{\circ}C$	On	On
15	Low Temperature Charge Protection	Set: $\leq -2^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\geq 0^{\circ}C \pm 3^{\circ}C$	On	On
16	Low Temperature Discharge Protection	Set: $\leq -20^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\geq -15^{\circ}C \pm 3^{\circ}C$	On	On
17	Fully Charge Protection	1) Taper Current FC Condition: Max Cell Voltage $\geq 4.45V$ & Average Current $< 320mA$ & Delay Time: 80Sec 2) OCV FC Condition: Max Cell Voltage $\geq 4.48V$ & Delay Time : 60Sec	Off	On
		Reset: RSOC $< 95\%$	On	On

8.2. Protection function (Permanent Failure)

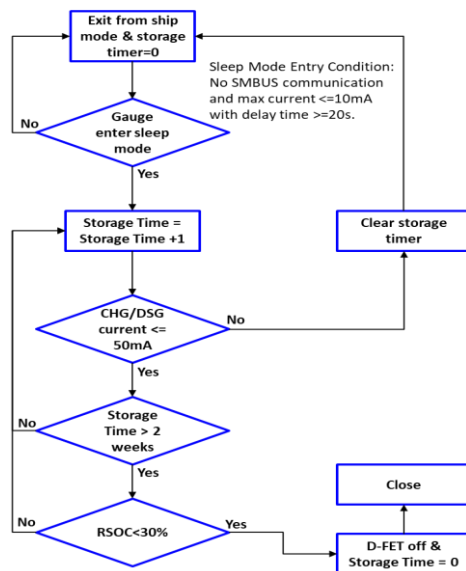
No.	Item	Threshold	Action		
			FUSE	CFET	DFET
1	SW Over Voltage Protection (2nd)	Set: $\geq 4.6V \pm 0.02V$ / cell Delay Time: 4Sec~8Sec	Blow	Off	Off
2	HW Over Voltage Protection (2nd)	Set: $\geq 4.65V \pm 0.025V$ / cell Delay Time: 4.2Sec~7.8Sec	Blow	Off	Off
3	Over Temperature Protection of Cell (2nd)	Set: $\geq 90^{\circ}C \pm 3^{\circ}C$ & Charge Current $\geq 25mA$ OR Discharge Current $\geq 100mA$	Blow	Off	Off
4	Over Temperature Protection of FET (2nd)	Set: $\geq 120^{\circ}C \pm 3^{\circ}C$	Blow	Off	Off
5	D-FET Failure Detection	Set: D-FET Turn Off & Discharge Current $\geq 500mA$ Delay Time: 10Sec~13Sec	Blow	Off	Off
6	C-FET Failure Detection	Set: C-FET Turn Off & Charge Current $\geq 500mA$ Delay Time: 10Sec~13Sec	Blow	Off	Off
7	Thermistor Short Detection	Short Condition: $\geq 150^{\circ}C$ Delay Time: 10Sec~13Sec	Blow	Off	Off
8	Thermistor Open Detection	Open Condition: $\leq -46^{\circ}C$ Delay Time: 10Sec~13Sec	-	Off	Off
9	Cu Deposition Detection	Set: Cell Voltage $\leq 1.3V$ Delay Time: 1Sec~4Sec	-	Off	Off

9. Other Function Description

No.	Item	Condition		Action
1	Charge Mode	Pre-Charge Mode	Min Cell Voltage <3000mV	Charging Current: 320mA
		Smart Charge Mode	Temp: 0°C~15°C	1282mA CCCV to 4.5V/cell
			Temp: 15°C~20°C	6411mA CC to 4.1V/cell; 3205mA CCCV to 4.5V/cell
			Temp: 20°C~45°C	7693mA CC to 4.2V/cell; 4487mA CCCV to 4.5V/cell
			Temp: 45°C~60°C	3205mA CC to 4.2V/cell, then stop; Reset: max cell voltage≤ 3900mV
		Advanced Charge Profile:		
		T1(0°C)≤T2(10°C)≤T5 (15°C) ≤T6 (20°C) ≤T3 (45°C) ≤T4 (60°C)		
Charging Current  Cell Temperature				

2	Sleep Mode	Entry: 1. No Communication 2. $Current() \leq 10\text{mA}$ 3. No PF and No Safety Alert / Status	BMU goes to sleep mode C-FET turn off
		Exit: 1. Communication with battery OR 2. $Current \geq 10\text{mA}$ OR 3. Abnormal situation: 1) Sbs.Temp $> 73\text{degC}$ 2) Sbs.Temp $< -20\text{degC}$ 3) Sbs.FET Temp $> 98\text{degC}$ 4) Sbs.FET Temp $< -20\text{degC}$ 5) Max cellV $> 4.54\text{V}$ 6) Min cellV $< 2800\text{mV}$	1. BMU goes back to normal mode 2. C-FET turn on. (Depends on present status)
		Note: 1. BMU can't allow CLK pin High with Data pin Low or CLK pin Low with Data pin High. 2. The current condition of sleep mode is no matter current direction. 3. The C-FET is turned off in sleep mode. Normally, the current exit condition is discharge.	
3	Shipping Mode Function	Entry: 1. Write "0x0000" by 0x34 & Write "0x1000" by 0x34 (Command interval less than 5 sec) OR 2. RSOC $< 30\%$ & No detectable charge or discharge current & Storage Time > 2 weeks	1. D-FET off function 0x34 value changes to "0x0100" 2. Both D-FET and C-FET turn off
		Exit: 1. Write "0x2000" by 0x34 & Write "0x4000" by 0x34 (Command interval less than 5 sec) OR 2. BMU receives a SMBus Command after waking up from sleep mode.	1. D-FET off function 0x34 value changes to "0x0000" 2. Both D-FET and C-FET turn on Return to normal mode
		Note: It's necessary to have an interval time that is more than 5sec between entry condition command and exit condition command for turning on/off C/D-FET.	

RSOC<30% storage condition flow chart:



4	Shutdown Mode Function	Common Entry: 1.Min cell voltage continuous <2800mV for 20Sec & Voltage at PACK pin < 1000mV OR 2. 1.Write 0x0010 to 0x00 2.Write 0x0010 to 0x00 This sequence will be canceled if interval time of between Step(a) and Step(b) is over than 5sec RTC Entry: 1. Battery in shipmode and RSOC <= 5% for 2s with RTC function enable. 2. Battery in sleep mode over 1hour and RSOC <= 2% with RTC function enable. 3. TDA=1 for 11sec with RTC function enable (TDA release condition: charge current>50mA and Vcell>3200mV/cell)	Turn D-FET and C-FET turn off
		Exit: Voltage at PACK pin>4V if the charging voltage continues to be applied to Pack+ while the shutdown condition is satisfied, the shutdown will be canceled if Pack+ is equal or larger than (ChargingVoltage – CancelChgVoltOffset) forCancelDela	Both D-FET and C-FET turn on; Return to normal mode
5	96 Hours Function	96hrs function enable: When battery is fully charged 96hrs function disable: 96hours time out. OR Discharge current>5mA for 30Sec OR Discharge current>100mA for 1Sec	
6	Cell Imbalance Function	Max cell voltage>4.20V & (Max cell voltage – Min cell voltage)>500mV & Current=0mA & Delay time>5mins	Set Bit10 (Cell Imbalance Alarm) at Battery Status 0x16

7	Permanent Dual Mode			
Permanent DM	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
	Cycle Count	Adjusted Hrs at High Voltage		
RT	0	0	13.5V	100%
LS1-1	100	960	13.47V	99%
LS1-2	150	1200	13.44V	98%
LS1-3	300	1440	13.41V	97%
LS1-4	350	1680	13.38V	96%
LS1-5	400	1920	13.35V	95%
LS2	SoH FCC < 50% of DesignCapacity() OR SoH FCC < LS1 to LS2 FCC transition threshold(Min FCC: 54%)		13.2V	90%
8	Dynamic Dual Mode			
Dynamic DM	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
	RSOC for last 7days			
RT	RSOC<35%		13.5V	100%
T-LS1-1	35%≤RSOC<40%		13.47V	99%
T-LS1-2	40%≤RSOC<45%		13.44V	98%
T-LS1-3	45%≤RSOC<50%		13.41V	97%
T-LS1-4	50%≤RSOC<55%		13.38V	96%
T-LS1-5	55%≤RSOC<65%		13.35V	95%
T-LS2	65%≤RSOC<90%		13.2V	90%
Exit Condition: RSOC≤20%				
9	PI Mode			
Entry	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
1	RSOC>90% for 14days		12.9V	80%
2	RSOC>90% for 7days & High Temp(>40℃) for 40hours			
Exit condition: RSOC≤50%				

PRODUCTION SPECIFICATION

10. Electrical Characteristics

Standard environmental test condition

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

Temperature : 25 °C ± 3 °C , Humidity: 5%~ 95% RH

No.	Item	Test Method and Condition	Criteria
1	Standard Charge	Charging shall consist of charging at a constant current rate of 1282mA until the battery voltage reaches 4.5V/cell. The battery shall then be charged at constant voltage of 4.5V/cell while tapering the charge current. Charging shall be terminated when the charging current has tapered to 320mA	\
2	Open circuit voltage	After standard charge, measure it within 24 hours	Above 11.1V
3	Initial capacity	After the standard charge, the battery should be discharged at 0.2C constant current to the cut-off voltage of 3V/cell.	≥6283mAh
4	Initial Impedance	The battery is fully charged, with 1KHz sine wave AC 4 terminal measurement method to test the initial.	≤210mΩ
5	Charge retention	When the battery has completed standard charged, it shall be disconnected and put aside for 28 Days at 20°C±5°C, Then measured the capacity with 0.2 C till 3V/cell.	Residual capacity > 85%
6	Cycle Life	Charge battery with specified charge method and discharge battery with 0.5C current until min cell voltage reaches 3V/cell. Repeat to 1000cycles, record remained capacity of 1000th cycle.	Capacity ≥70% of Cmin Thickness Swelling ≤ 10% of initial thickness

11.Safety compliance

No.	Item	Test Method and Condition	Criteria
1	Heat test	The battery is fully charged in accordance with the standard charging method, placed in a gravity convection or circulating air oven. The temperature of the oven is to be raised at a rate of $(5 \pm 2) ^\circ \text{C}/\text{min}$ to a temperature of $(130 \pm 2) ^\circ \text{C}$ and remain for 30 mins at that temperature before the test is discontinued.	No Explosion, No Fire
2	Short between terminal	Short the positive (+) and negative (-) of the pack with copper wire having a maximum resistance load of 0.1Ω at $20^\circ \text{C} \pm 5^\circ \text{C}$ and $55^\circ \text{C} \pm 2^\circ \text{C}$ for 2hours after standard charge at $25^\circ \text{C} \pm 3^\circ \text{C}$.	No rupture, fire, smoke or leakage
3	Reverse charge	Apply a power supply at a reverse polarity, constant voltage and constant current adjusted to 13.5V/ 7693mA condition at $25^\circ \text{C} \pm 3^\circ \text{C}$ and leave it for 24 hours.	No rupture, fire, smoke or leakage
4	Overcharge performance	Constant current and constant voltage 0.5C/13.62V charge for 48hours at $25^\circ \text{C} \pm 3^\circ \text{C}$. Then check outside appearance right after rated charge.	No leakage or prominent breakage
5	Thermal cycling	Procedure: Place the fully charged battery at thermal chamber $72 \pm 2^\circ \text{C}$ for 6Hr $\leftrightarrow$ $-40 \pm 2^\circ \text{C}$ for 6Hrs (Transfer time : 30min), 10cycle take out the battery at $(20 \pm 5)^\circ \text{C}$ for 24hours	No mass loss (not exceed 0.1%) No leakage, No venting No disassembly, No rupture No fire OCV(open circuit voltage) > 90% of the initial voltage

12.Safety Operating Parameters for GB 31241-2022

安全工作参数 Safety Operating Parameter	符号 Symbol	电池组 Battery Pack
充电限制电压 (Limited charging voltage)	Ucl	13.5V
充电上限电压 (Upper limited charging voltage)	Uup	13.5V
放电截止电压 (Discharge cut-off voltage)	Udo	8.34V
放电终止电压 (Discharge terminate voltage)	Ude	9V
推荐充电电流 (Recommendation charging current)	Icr	1282mA
最大充电电流 (Maximum charging current)	Icm	Max cell voltage > 4.20V &
推荐放电电流 (Recommendation discharging current)	Idr	1282mA
最大放电电流 (Maximum discharging current)	Idm	8888mA
过压充电保护电压 (Over voltage for charge protection)	Ucp	4.54V $\pm$ 0.02V/cell
过流充电保护电流 (Over current for charge protection)	Icp	8.2A $\pm$ 0.2A
欠压放电保护电压 (Low voltage for discharge protection)	Udp	2.80V $\pm$ 0.02V/cell
过流放电保护电流 (Over current for discharge protection)	Idp	12.5A $\pm$ 0.2A
上限充电温度 (Upper limited charging temperature)	Tcm	60°C $\pm$ 3°C
上限放电温度 (Upper limited discharging temperature)	Tdm	60°C $\pm$ 3°C
下限充电温度 (Lower limited charging temperature)	Tcl	0°C $\pm$ 3°C
下限放电温度 (Lower limited discharging temperature)	Tdl	-20°C $\pm$ 3°C
可允许的最高表面温度 (Maximum allowable surface temperature)	Tmax	70°C $\pm$ 3°C
充电截止电流 (Taper current for charging)	-	320mA

13.Safety License

Type	Standard
CQC	GB31241-2022
CB	IEC60950,IEC62368,IEC62133
CE	EN60950,EN62368,EN62133,EN 55032 and EN55024
UL	UL60950-1,UL62368,UL2054
BSMI	CNS 15364/14857-2
PSE	JIS C8712, JIS C8714
KC	K62133
BIS	IS16046, IEC62133
No mercury report	EU Directive 2006/66/EC
MSDS report	
MIC	

16.Safety Instruction

Warnings
.Use the dedicated charger. .Keep away from children to avoid any accidents. .Don't use the independent charger. .Don't leave the battery near the fire or heating source. .Don't throw the battery into the fire or in direct sunlight or immerse into the water. .Don't penetrate the battery with a sharp object such a needle or driver. .Don't impact with heavy objects such as a hammer, weight. .Don't throw or drop the battery on the hard floor. .Don't disassemble the battery or modify the battery including design or electrical circuit. .Don't use seriously cared or deformed battery. . Leakage of the battery is strictly prohibited to use again. .If liquid leaks onto your skin or clothes, wash well with fresh water immediately. .If the battery is needed to be stored for a long period, battery should be removed from the application and stored in a place where humidity and temperature are low.

SPECIFICATION FOR APPROVAL

Customer Name :

Lenovo Group Limited

Product Name :

Rechargeable Lithium-ion Battery Pack

Model Name : L25C3P72

Customer ASM P/N : SB11M89974

Customer FRU P/N : 5B11M90173

Celxpert P/N :

921300776 (HC85)

921300777 (OT85)

Cell Model Name : ATL GC-SDC-615780-R00L/ GC-SDC-615780-R00H

[ACCEPTANCE]

Accepted by: _____

Date: _____

CELXPERT ENERGY CORPORATION

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技術文件制/修訂履歷表

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頁次	版次	修訂日期	制/修訂摘要說明	是否變更 電測規範
1-21	X01	2025/08/21	Frist Release	☐ 是 ☒ 否
1-21	X02	2025/10/21	Modify current of Over current alarm protection - Alarm current: -9.45A to -8.45A - Alarm release: -8.45A to -7.95A	☐ 是 ☒ 否
1-21	X03	2025/11/18	Modify Stage Version (0x37) - 0006-0179-0021-0002 to 0006-0179-0031-0004	☐ 是 ☒ 否

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1. Scope

This document describes a 3-cell pack specification. This specification is based on the Lenovo Common Smart Battery System Interface Specification V0.5.

2. Battery Pack Specification

Item	Function	Specification	Remarks
1	Cell Type 电池型号	Li-ion battery GC-SDC-615780-R00L/ GC-SDC-615780-R00H Nominal 5170mAh/3.87V	
2	Pack Configuration 电池组配置	3S1P	
3	Ideal Nominal Capacity 理想标称容量	11.61V, 5170mAh (60.0Wh)	Charge: 0.2Cmin CC to 4.45V, 4.45V CV to 0.05Cmin Discharge: 0.2Cmin CC to 3.0V/cell @25±3°C
4	Ideal Minimum Capacity 理想最小容量	11.61V, 5070mAh(58.86Wh)	
5	Typical Capacity 标称容量	11.61V, 5168mAH (60.0Wh)	Charge: 0.2Cmin CC to 4.45V, 4.45V CV to 0.05Cmin Discharge: 0.2Cmin CC to 3.0V/cell @25±3°C
6	Rated Capacity 额定容量	11.61V, 5065mAH(58.9Wh)	
7	Charge Limited Voltage 充电限制电压	13.35V	
8	Upper Limited Charge Voltage 充电上限电压	13.44V	For GB 31241-2022
9	End of discharge Voltage 放电终止电压	9V	Stop discharge when one cell voltage reach 3.0V
10	Discharge Cut-off Voltage 放电截止电压	Temperature : ≤ 15°C Voltage : 8.1V	For GB 31241-2022 Stop discharge when one cell voltage reach 2.7V
		Temperature : > 15°C Voltage : 8.4V	For GB 31241-2022 Stop discharge when one cell voltage reach 2.8V
11	Max. Charge Current 最大充电电流	≥ 0°C	Initial low charge temp
		< 50°C	Initial high charge temp
		0°C~10°C: 1.034A / charge volt : 13.35V	
		10°C~15°C: 2.067A / charge volt : 13.35V	

		15°C~20°C: Step1: charge volt: 13.35V / charge current: 5.168A Step2: charge volt: 13.35V, step down charge current per 0.517A by five stage when max cell $\geq 4.1V$ until charge current = 2.584A Step3: charge volt: 13.35V / charge current: 2.584A to FC Note: Delay time of step down current is 3sec.	
		20°C~45°C: Step1: charge volt: 13.35V / charge current: 6.202A Step2: charge volt: 13.35V, step down charge current per 0.517A by five stage when max cell $\geq 4.2V$ until charge current = 3.618A Step3: charge volt: 13.35V / charge current: 3.618A to FC Note: Delay time of step down current is 3sec.	
		45°C~60°C: 2.584A / charge volt: 13.35V (Charge current report 0mA, if max cell voltage $> 4.1V$; Recovery charge: Temperature $< 44^{\circ}C$ or Cell Voltage1..3 $< 3.9V$)	
		Charging Current is modified by SOH. The SOH = (Ideal FCC / Design Capacity) * 100 [%] If SOH $\geq 100\%$: Charge Current = Initial Charging Current If SOH $< 100\%$: Charge Current = Initial Charging Current * SOH	
12	Recommendation Charge Current 推荐充电电流	1.013A	For GB 31241-2022

13	Taper Current for Charge 充电截止电流	0.258A	
14	Max. Discharge Power 最大放电功率	65W	35°C(Ambient) ≤ 70°C(Cell Interface)
		80W / 30sec (RSOC >10%)	Peak power 35°C(Ambient)
15	Max. Discharge Current 最大放电电流	7.222A	For GB 31241-2022
16	Recommendation Discharge Current 推荐放电电流	1.013A	For GB 31241-2022
17	Initial AC Impedance 内部阻抗	≤ 210mΩ	
18	Operating Temperature (Charge) 上下限充电温度	0°C~60°C	Humidity: Max 95% RH
19	Operating Temperature (Discharge) 上下限放电温度	-20°C~60°C	Humidity: Max 95% RH (cell surface temp: 70°C max.)
20	Storage Temperature 存储温度	-20~50°C (1 week)	Humidity: Max 95% RH
		-20~45°C (1 month)	
		-20~40°C (6 months)	
		-20~35°C (1 year)	
21	Cycle Life 循环寿命	Charge: 1.2C CC to 4.2V, CV to 0.7C, then 0.7C CC to 4.45V, CV to 0.05C (Voltage adjustment values with cycle count: Cycles 0-100: 4.45V to 3.0V, Cycles 101-150: 4.44V to 3.0V, Cycles 151-300: 4.43V to 3.0V, Cycles 301-350: 4.42V to 3.0V, Cycles 351-400: 4.41V to 3.0V, Cycles 401-1000: 4.40V to 3.0V.) Discharge: 0.5C to 3V 25± 2°C.	Capacity > 80% of Rated capacity @1000 cycles Swelling < 10% @1000 cycles
22	Pack Weight 重量	Max 225 g	

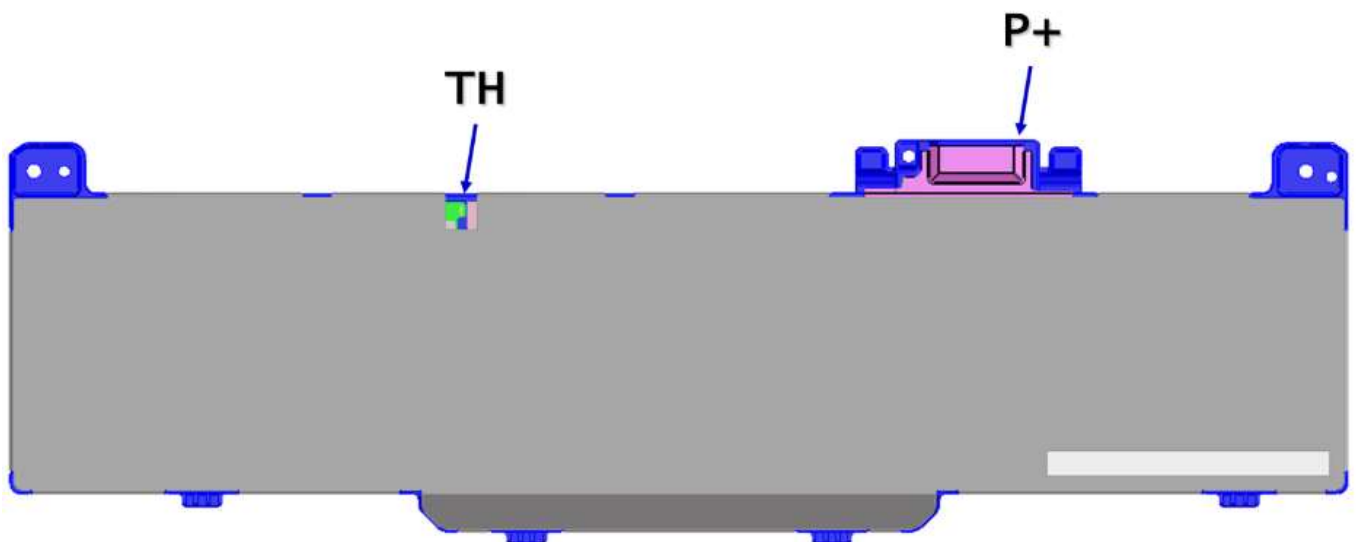
3. Pack Safety Certification

UL/CUL	UL 2054, UL 62368-1
CE EMC	EN 55032:2015 + A11:2020
	EN 55035:2017+ A11:2020
PSE	JIS C 62133-2 2020(J62133-2(2021))
CB	IEC/EN 62133-2:2017, IEC/EN 62368-1
KC	KC 62133-2:2020
UN	UN38.3
TISI	TIS 2217-2548
BSMI	CNS 15364:102
CCC	GB 31241-2022
BIS	IS 16046(Part2):2018
MIC	QCVN 101: 2020/BTTTT

4. Battery Terminals Definition

Pin No.	Define	Comments
1	P+	Battery Positive Terminal.
2	P+	Battery Positive Terminal.
3	CLK	SMBus Clock interface I/O pin.
4	DAT	SMBus Data interface I/O pin.
5	Temp	10Kohm Resistor connected to GND
6	N/A	-
7	P-	Battery Negative Terminal.
8	P-	Battery Negative Terminal.

Note :



5. Fuel Gauge Specification

Gauge IC solution: TI BQ9004 & ECT FW

Item	Function	Specification	Comments
1	Firmware Upgrade Capability	Firmware must be flash programmable at the battery connector	
2	Voltage Accuracy	$\pm 10\text{mV}$ from $2.0\text{V} \sim 4.6\text{V}$ from $-20^{\circ}\text{C} \sim 80^{\circ}\text{C}$	Individual Cell Stack Voltages shall be communicated through SBS optional function registers.
3	Current Accuracy	$\pm 2.5\%$	
4	Temperature Accuracy	$\pm 3^{\circ}\text{C}$ from $-20^{\circ}\text{C} \sim 80^{\circ}\text{C}$	
5	Remaining Capacity (0x0f)	Shall be zero when the cell stack voltage reaches 9.0V or min cell voltage reaches 3.0V .	
6	Remaining Capacity Alarm (0x01)	10% of Design Capacity	
7	Remaining Time Alarm (0x02)	10 minutes	
8	Reserve Capacity	300 mWh	RSOC 0% to TDA
9	Charging Current (0x14)	$0^{\circ}\text{C} \sim 10^{\circ}\text{C}$: 1.034A / charge volt : 13.35V	Normal Charge
		$10^{\circ}\text{C} \sim 15^{\circ}\text{C}$: 2.067A / charge volt : 13.35V	
		$15^{\circ}\text{C} \sim 20^{\circ}\text{C}$: Step1: charge volt: 13.35V / charge current: 5.168A Step2: charge volt: 13.35V, step down charge current per 0.517A by five stage when max cell $\geq 4.1\text{V}$ until charge current = 2.584A Step3: charge volt: 13.35V / charge current: 2.584A to FC Note: Delay time of step down current is 3sec	
		$20^{\circ}\text{C} \sim 45^{\circ}\text{C}$: Step1: charge volt: 13.35V / charge current: 6.202A Step2: charge volt: 13.35V, step down charge current per 0.517A by five stage when max cell $\geq 4.2\text{V}$ until charge current = 3.618A Step3: charge volt: 13.35V / charge	

		current: 3.618A to FC	
		Note: Delay time of step down current is 3sec	
		45°C~60°C: 2.584A / charge volt: 13.35V	
		(Charge current report 0mA, if max cell voltage > 4.1V ; Recovery charge: Temperature < 44°C or Cell Voltage1..3 < 3.9V)	
		Charge current: 0.253A Min Vcell < 3.0V/cell	Pre-charge
		0mA	Charge suspend
10	Charging Voltage (0x15)	13.35V	
11	Cycle Count (0x17)	When the amount of charge reaches 100% of the Full charge Capacity, Cycle Count increases by 1	
12	Fully Charged Bit (bit 5) in Battery Status Register (0x16)	All of the following conditions must occur for consecutive 60-s periods: Charging (that is, BatteryStatus [DSG] = 0) AND AverageCurrent() < 0.258A, AND Max Cell Voltage1..3 ≥ (ChargingVoltage() / number of cells in series) - 50mV	
13	Fully Discharged Bit (bit 4) in Battery Status register (0x16)	Set: Remaining Capacity() = 0%, Reset :Remaining Capacity() >20%	
14	Full Charge Capacity (0x10)	During a valid learning cycle, the new capacity should be learned when RSOC reach 6%.	
15	Cell Stack Voltages	Individual Cell Stack Voltages should be stored in the Optional Mfg Functions	
16	Device Name (0x21)	LNV-5B11M90173	
17	Manufacturer Name (0x20)	Celxpert 2025	
18	AlarmWarning Broadcast	Disabled	

19	Stage Version (0x37)	0006-0179-0031-0004	
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Notes:

1. Charging Current: at normal condition, this register reports normal charge current, but reports “0” once the fuel gauge IC detects the battery has met at least one of the following conditions:
 - a. Charging condition not met (temperature out of range, etc.)
 - b. C-FET and D-FET are shorted and the fuse is blown.
 - c. Any other abnormal condition.

6. Fuel Gauge Board

6.1 Protection Function

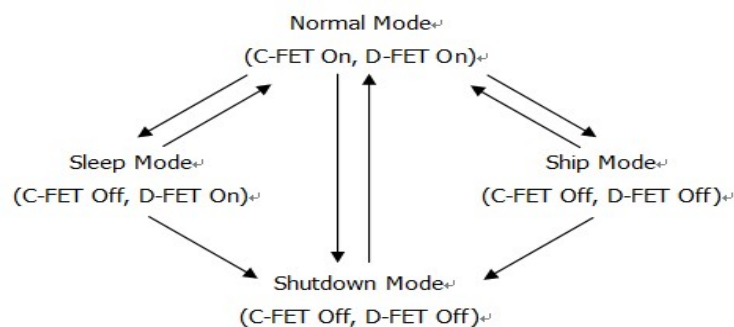
Item	Function	Activate Condition	Release Condition
1	Over Charge Voltage 过压充电保护电压	Voltage: $\geq 4.48\text{V}\pm 0.02\text{V}/\text{cell}$ and Delay Time: $\geq 3\text{sec}$ → C-FET off	Voltage: $\leq 4.35\text{V}\pm 0.02\text{V}/\text{cell}$, delay time $\geq 1\text{sec}$
2	HW Over Charge Voltage Protection 硬件过压充电保护电压	Voltage: $\geq 4.65\text{V}\pm 0.02\text{V}/\text{cell}$ and Delay Time: 4.8~7.2sec → Fuse blow	--
3	Over Discharge Voltage 欠压放电保护电压	Temperature: $\leq 15^{\circ}\text{C}$ Voltage: $\leq 2.7\text{V}\pm 0.02\text{V}/\text{cell}$ and Delay Time: $\geq 12\text{sec}$ → D-FET off	Voltage: $\geq 3.1\text{V}\pm 0.02\text{V}/\text{cell}$ keeps 1sec and Charge current $> 50\text{mA}$
		Temperature: $> 15^{\circ}\text{C}$ Voltage: $\leq 2.8\text{V}\pm 0.02\text{V}/\text{cell}$ and Delay Time: $\geq 12\text{sec}$ → D-FET off	
4	Over Current protection 过流充电保护		
	Over Charge Current Protection 过流充电保护	Charge current: $\geq 6.7\text{A}$ and Delay time: $\geq 5\text{sec}$ → C-FET off	Current $\leq -50\text{mA}$, delay $\geq 1\text{sec}$ or Recovery time : $> 20\text{sec}$
	Over Discharge Current Protection 过流放电保护	Discharge current: $\leq -9.7\text{A}$ and Delay time: $\geq 3\text{sec}$ → D-FET off	Current $\geq 50\text{mA}$, delay $\geq 1\text{sec}$ or Recovery time : $> 20\text{sec}$
	HW Discharge Current Protection 硬件过流放电保护	Discharge current: $\leq -16.4\text{A} \sim -20.6\text{A}$ Typical: -18.5A and Delay time: 27.7~34.3msec → D-FET off	
	HW Discharge Short-circuit Protection 短路保护	Discharge current: $\leq -26.3\text{A} \sim -32.9\text{A}$ Typical: -29.6A and Delay time: 823~1007μsec → D-FET off	
5	Cell Voltage Imbalance 电压不平衡	1.Current = 0mA for 30min. and 2. $4350\text{mV} \leq \text{Max Cell Voltage} \leq 4450\text{mV}$, and 3. Max Cell Voltage 1..3 - Min Cell Voltage 1..3 $\geq 500\text{mV}$, delay Time $> 1\text{min}$ → Battery Status Register (0x16) : Cell imbalance (bit 10) set 1 → C & D-FET Permanent off	--

6	Over Temperature Protection 过温度保护		
	Initial Charge Condition 初始充电温度范围	Temp > 50°C±3°C → C-FET off	Temp ≤ 50°C±3°C
		Temp < 0°C±3°C, → C-FET off	Temp ≥ 0°C±3°C
	Over Temperature Protection-Charge 充电温度保护	Temp: > 60°C±3°C and Delay Time: ≥ 2sec → C-FET off	Temp: ≤ 50°C±3°C
		Temp: < -2°C±3°C and Delay Time: ≥ 2sec → C-FET off	Temp: ≥ 0°C±3°C
	Over Temperature Protection-Charge(2 nd) 二段充电温度保护	Temp: > 90°C±3°C and Charge Current ≥ 25mA and Delay Time: ≥ 10sec → Fuse blow	--
	Over Temperature Protection-Discharge 放电温度保护	Temp: > 73°C±3°C and Delay Time: ≥ 2sec → C & D-FET off	Temp: ≤ 65°C±3°C
		Temp: < -25°C±3°C and Delay Time: ≥ 2sec → C & D-FET off	Temp: ≥ -15°C±3°C
	Over Temperature Protection-Discharge(2 nd) 二段放电温度保护	Temp: > 90°C±3°C and Discharge Current ≤ -100mA and Delay Time: ≥ 10sec → Fuse blow	--
7	Over Temperature Protection(FET) 充电场效应晶体温度保护	Temp: > 98°C±3°C and Delay Time: ≥ 2sec → C & D-FET OFF	Temp: ≤ 90°C±3°C
	Over Temperature Protection(FET)(2 nd) 二段充电场效应晶体温度保护	Temp: >120°C±3°C and Delay Time: ≥ 5sec → Fuse Blow	--
	C-FET Error Function 充电场效应晶体管失效保护	C-FET OFF and Charge Current ≥ 500mA and Delay Time: ≥ 20sec → Fuse blow	--
8	D-FET Error Function 放电场效应晶体管失效保护	D-FET OFF and Discharge Current ≤ -500mA and Delay Time: ≥ 20sec → Fuse blow	--
9	Safety Cell Under Voltage Permanent Fail 安全电池低压永久故障	Min Cell Voltage ≤ 1300mV, Delay ≥ 2sec	--

10	Over current alarm protection 过流报警保护	Alarm current: -8.45A ($\leq 55^{\circ}\text{C}$) (decrease 250mA/10°C; 55°C~73°C) Delay time: 250 msec → ManufAccess (0x00) bit5 set 1	Alarm release: -7.95A ($\leq 55^{\circ}\text{C}$) (decrease 250mA/10°C; 55°C~73°C) → ManufAccess (0x00) bit5 set 0
11	CS2 function CS2 功能	Refer to BMU SPEC	--
12	Ship mode 省电模式	Condition 1: The gauge is in RELAX mode ($ \text{Current} < 10\text{mA}$ will entry) and RSOC < 30% and Timer > 20160 minutes → enter SHIP mode and turn off both CHG and DSG FETs	Condition 1: • any SMBus communication → exit SHIP mode and turn on both CHG and DSG FETs
		Condition 2: • Host writes word 0x0000 to 0x34 • Host writes word 0x1000 to 0x34 – The two send words sequence must be done within 5 seconds; otherwise, the command sequence is cancelled. – Enter Ship mode if the Shuo mode entry command is sent. No need to check [FC] status. → enter SHIP mode and turn off both CHG and DSG FETs	Condition 2: • Host writes word 0x2000 to 0x34 • Host writes word 0x4000 to 0x34 – The two send words sequence must be done within 5 seconds; otherwise, the command sequence is cancelled. → exit SHIP mode and turn on both CHG and DSG FETs
13	Shutdown mode 关机模式	Host writes word 0x0010 to 0x00 within 5 seconds. or • Temperature: $\leq 15^{\circ}\text{C}$ Min cell voltage reaches 2.7V for 20sec and no charge and pack pin (Vin12) < 1V • Temperature: $> 15^{\circ}\text{C}$ Min cell voltage reaches 2.8V for 20sec and no charge and pack pin (Vin12) < 1V	The gas gauge returns to normal mode when voltage at PACK pin (Vin12) > 2.05V keep 3sec.

6.2 Fuel Gauge Board Current Consumption

Item	Function	Specification	Comments
1	Cell voltage sensing input leakage current on each block	$\leq 3\mu\text{A}$	@ 3.7V/cell
2	Circuit Current Consumption		
	I(normal) @ SMC / SMD=H	$\leq 450\mu\text{A}$	Operating mode
	I(sleep) @ SMC / SMD=L	$\leq 125\mu\text{A}$	Sleep mode
	I(ship) @ SMC / SMD=L	$\leq 110\mu\text{A}$	Ship mode
	I(shutdown : $\geq 2.5\text{V}$) @ SMC / SMD=L	$\leq 5\mu\text{A}$	Shutdown mode
	I(shutdown : $2.5\text{V}\sim 1.3\text{V}$) @ SMC / SMD=L	$\leq 3\mu\text{A}$	Shutdown mode



6.3 FC Condition by OCV

Except the primary taper current charge termination detection, a custom charge termination detection option by checking the OCV voltage is also support. The gauge will detect valid charge termination either if the primary taper current condition or the custom OCV charge termination condition is met.

The device enters OCV Charge Termination detection stage as following condition:

When max cell voltage > 4470mV for 1sec, gauge turn off charge FET and check voltage.

If max cell voltage > 4430mV for 60sec, gauge set the status to Fully Charge.

If max cell voltage $\leq 4430\text{mV}$, gauge turn on charge FET and go back to the beginning of the loop.

Dual Mode	Charge Voltage	Turn Off C-FET	Turn On C-FET	Fully Charge
Normal	4450mV	> 4470mV, 1sec	$\leq 4430\text{mV}$	> 4430mV, 60sec
LS1-1	4440mV	> 4460mV, 1sec	$\leq 4420\text{mV}$	> 4420mV, 60sec
LS1-2	4430mV	> 4450mV, 1sec	$\leq 4410\text{mV}$	> 4410mV, 60sec
LS1-3	4420mV	> 4440mV, 1sec	$\leq 4400\text{mV}$	> 4400mV, 60sec
LS1-4	4410mV	> 4430mV, 1sec	$\leq 4390\text{mV}$	> 4390mV, 60sec
LS1-5	4400mV	> 4420mV, 1sec	$\leq 4380\text{mV}$	> 4380mV, 60sec
LS2	4350mV	> 4370mV, 1sec	$\leq 4330\text{mV}$	> 4330mV, 60sec

6.4 Common Dual Mode

The Dual Mode reduce the ChargingVoltage() level based on cycle count or high voltage time at high temperature of the battery pack. There are three charging voltage modes: RUNTIME (RT) mode, LIFESPAN1 (LS1) mode, and LIFESPAN2 (LS2) mode. The DUAL Mode start from RT mode, move to LS1 mode, then move to LS2 mode. Battery will only go from RT →LS1 →LS2.

6.4.1 RUNTIME Mode (RT)

RUNTIME mode keep the same ChargingVoltage() value under different condition.

6.4.2 LIFESPAN1 Mode (LS1)

In LS1 mode, the ChargingVoltage() can be reduced in five steps. The table below summarizes the action in LIFESPAN1 mode.

Step	Entry Condition	ChargingVoltage()
LS1-1	HiTempVolt time $\geq$ 960hours, or Cycle Count > 100 cycles	Charge Voltage = 13320mV
LS1-2	HiTempVolt time $\geq$ 1200hours, or Cycle Count > 150 cycles	Charge Voltage = 13290mV
LS1-3	HiTempVolt time $\geq$ 1440hours, or Cycle Count > 300 cycles	Charge Voltage = 13260mV
LS1-4	HiTempVolt time $\geq$ 1680hours, or Cycle Count > 350 cycles	Charge Voltage = 13230mV
LS1-5	HiTempVolt time $\geq$ 1920hours, or Cycle Count > 400 cycles	Charge Voltage = 13200mV

6.4.3 LIFESPAN2 Mode (LS2)

Given the gauge is already in LS1 mode, the entry conditions to LS2 are either or as following:

LS2 transition point =

$$\text{Init Min FCC} - ((\text{Init Min FCC} - \text{Floor min FCC}) / (\text{Floor age}[\text{days}] - \text{Init age}[\text{days}])) * \text{elapsed day}$$

$\geq$ Floor min FCC

Step	Entry Condition	ChargingVoltage()
LS2	As above description	Charge Voltage = 13050mV

6.5 DLS & PI Mode

6.5.1 Dynamic Life-Span Mode

The dynamic life span mode controls charging voltage shorter time than Dual mode as temporary. Permanent mode controls charging voltage as irreversibly. However, this mode can be returned to permanent mode when SOC will be lower than 20%. Basically, the transition condition is determined

by minimum SOC for last 7days.

Each temporary life span mode controls charging voltage same as Dual mode. (The elapsed time will be accumulated based on a minute and the state will be changed based on a day.)

These modes can be moved to lower charging voltage mode from current mode.

Also, all modes can exit and move to permanent mode when SOC is lower than 20%, or power on reset, or shutdown or exit ship mode or exit PI mode or receive Force exit command or F/W update.

Min SOC Last 7days	Permanent mode						
	RT	LS1-1	LS1-2	LS1-3	LS1-4	LS1-5	LS2
X > 90	PI	PI	PI	PI	PI	PI	PI
65 =< X < 90	T-LS2	T-LS2	T-LS2	T-LS2	T-LS2	T-LS2	-
55 =< X < 65	T-LS1-5	T-LS1-5	T-LS1-5	T-LS1-5	T-LS1-5	-	-
50 =< X < 55	T-LS1-4	T-LS1-4	T-LS1-4	T-LS1-4	-	-	-
45 =< X < 50	T-LS1-3	T-LS1-3	T-LS1-3	-	-	-	-
40 =< X < 45	T-LS1-2	T-LS1-2	-	-	-	-	-
35 =< X < 40	T-LS1-1	-	-	-	-	-	-
X < 35	-	-	-	-	-	-	-
X < 50 (PI mode) X < 20 (DLS mode)	Return to Permanent Mode (RT/LS-x) as Defined by Cycle Count / Hrs High Voltage						

6.5.2 Plugged-In Mode

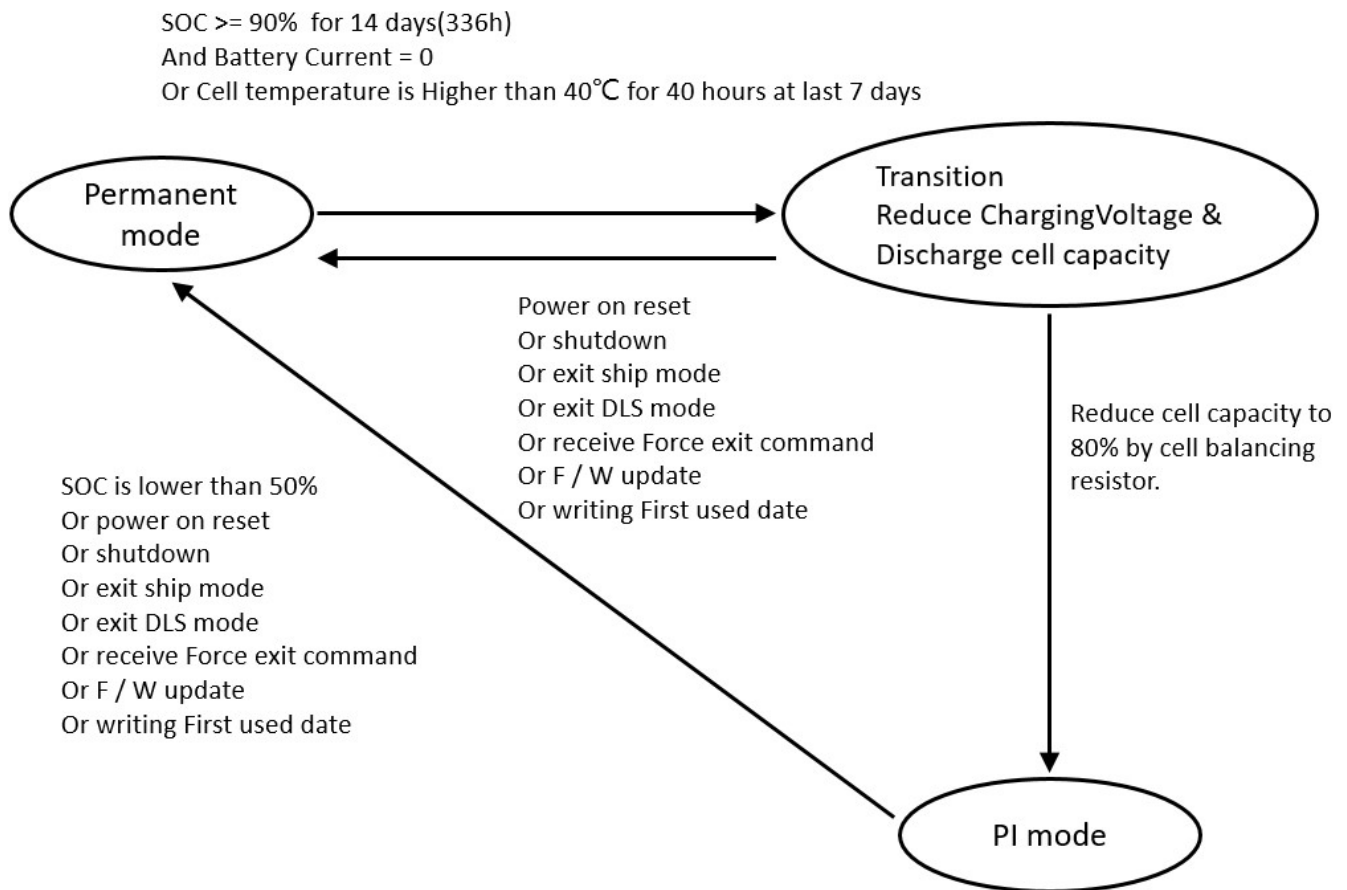
Plugged in mode controls Charging voltage for AC adapter connected condition.

If user is using PC with AC adapter always, PI reduce charging voltage and cell voltage. When SOC is over 90% and no current flowing, PI is monitoring AC connect condition and that condition continues for 14 days, PI reduce charging voltage as 80% of OCV. Also, PI reduce cell voltage to 80% of OCV by cell balancing resistor and execute cell balancing control. Each cell voltage difference will be 5mV. Once transition has started, that transition should be completed if any charging or discharging is happened.

When SOC will be lower than 50%, PI mode is finished.

Also, PI has another entering condition. In last 7 days, SOC or more 90% and over 40°C for 40 hours. The 40 hours is cumulative time, not duration time.

FCC: BMFW reports regular FCC to host. However, BMFW should have internal FCC for Charging control and that value will be reduced to 80% from regular FCC. Also, the internal FCC apply to Transition and PI mode.



6.6 96hr Function

The battery support Remaining Capacity holding feature and called it 96hrs function.

When battery meet FC condition and stay at relax mode, Remaining Capacity would be held for 96hrs. After this setting timer, gauge will do a smoothly Remaining Capacity updating as gauge calculation.

This function will exit as follow either one of below condition:

- Discharge current < -5mA for 30sec.
- Discharge current < -100mA for 1sec.

6.7 TDA (Terminate Discharge Alarm) Shutdown Condition

When TDA bit (bit11 of 0x16 BatteryStatus) will be set to “1” then keep 10 seconds or more in discharge state, C/D FET will be turned off within 2 seconds. Then BMU will enter shutdown within 2 seconds.

7. Environmental and Reliability Specification

7.1 Electrical Performance

Item	Condition	Standard
ESD Susceptibility	Setup of electric discharge gun : 330 ohm, 150Pf Air : $\pm 15\text{kV}$, Contact : $\pm 15\text{kV}$, 25times each	No critical damage

7.2 Environment Characteristic

Item	Condition	Standard
Performance in high temperature	Communication and charge / discharge must be certified at 40°C .	No critical damage.
Performance in low temperature	Communication and charge / discharge must be certified at 0°C .	No critical damage.
Altitude Simulation	Method: Batteries shall be stored at a pressure of 11.6Kpa or less for at least six hours at ambient temperature $20\pm 5^{\circ}\text{C}$.	No critical damage.
Humidity	Operating and Non-Operating: The battery pack shall withstand without degradation 85% relative humidity, non-condensing.	No critical damage.

7.3 Safety Performance

Refer to the safety certification report.

7.4 Package Drop Test

Condition	Standard
*Drop directions: All 6 sides and 4 corners on to 3cm thickness wooden board. *Height: 76cm *Number of drops: 1 time for each direction. 2cycles(total 20 times)	No crack. No defective part. No part removal. No malfunction. No capacity variation.
Operating and Non-Operating: The battery pack shall withstand without degradation 95% relative humidity, non-condensing.	No critical damage.

8. Charge State of Battery Pack before at delivery

The battery pack voltage shall be shipped in 45% ~ 55% charged state

9. Handling Instructions

The following hazard alert signals and words must appear in user manuals and / or instructions for users.

HANDLING INSTRUCTIONS

FOR

LITHIUM ION RECHARGEABLE BATTERY

Please read and follow the handling instructions before using the battery.

Improper use of the battery may cause heat generation, fire, explosion, damage, or capacity deterioration of the battery.



WARNING

01. Keep the battery and equipment out of reach of infants/children or pets so that they are not able to swallow or mistreat the battery by mistake.

In case of ingestion, seek medical advice immediately.

02. Do not let leaked electrolyte come into contact with eyes or skin.

In such a case, immediately flush the contact area with plenty of water and seek help from a doctor.

If not treated soon, prolonged contact may cause serious injury.

03. Do not throw the battery into a fire. Do not use or leave it in a place near fire, heaters, or high temperature sources.

In such a case, the insulator in the battery may be melted, the safety vent and structure may be damaged, or the electrolyte may catch fire, all of which may cause heat generation, explosion, or fire.

04. Do not submerge the battery in water, or wet the battery.

If the protecting device assembled in the battery is damaged, the battery may be charged with an abnormal current and voltage and may cause an abnormal chemical reaction within the battery, which may result in the cause of heat generation, explosion, or fire of the battery.

05. Do not use any battery chargers not specified by the end product. Also, follow the charge conditions specified by the end product.

If the battery is charged under other conditions (a high temperature, a high voltage/current, or an altered charger) not specified by the end product, the battery may become over-charged with an excessive current and cause heat, explosion, or fire with abnormal chemical reactions.

06. Do not use, charge, or leave the battery in a car under the blazing sun. Such a high temperature may cause damage of the protecting device in the battery, which may result in an abnormal reaction, and then heat generation, explosion, or fire.

07. Do not connect the battery reversed to positive (+) and negative (-) terminals in the charger or

equipment.

In case the battery is connected and charged in reverse, it may cause heat generation, explosion, or fire due to an abnormal chemical reaction.

08. Do not let the terminals (+ and -) of the battery contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together.

In such a case, the battery would be shorted and cause an excessive current, which may result in heat generation, explosion, or fire.

09. Do not connect the battery directly to an electric outlet or cigarette heater socket in car.

With a high voltage applied, the battery may overheat, explode, or cause fire.

10. Do not throw or drop the battery.

Strong impacts or shocks may damage the protecting device, which may cause an abnormal chemical reaction during charging and result in heat generation, explosion, or fire of the battery.

11. Do not drive a nail in or piece the battery with sharp objects.

In such a case, the battery may be deformed and shorted, witch which may cause heat generation, explosion, or fire of the battery.

12. Do not solder the battery directly.

Heat applied during soldering may damage the insulator of the safety vent and mechanism, which may result in heat generation, explosion, or fire of the battery.

13. Do not disassemble or alter the battery.

The battery is designed with safety mechanism and protecting devices in order to avoid any danger. If these are damaged, heat, explosion or fire may be caused.



CAUTION

01. Do not put the battery in a microwave, oven, or high pressure container.

Sudden heat may damage the seal of the battery and may cause heat generation, explosion, or fire of the battery.

02. Do not leave the battery in a charger or equipment if it generates an odor and/or heat, color and/or shape changed, electrolyte leaked, or any other abnormalities.

In such a case, immediately take the battery out of the charge or equipment and keep it away from fire, otherwise, the battery might overheat, explode, or cause fire.

03. Discontinue charging after specified charging time even if the charge is not complete, otherwise, the battery might cause heat generation, explosion, or fire.

04. Do not use the battery in the place where the static electricity (more than the limit of the manufacturer's guarantee) occurs. Otherwise, the protecting device in the battery might be damaged and cause heat generation, explosion, or fire.

05. Do not use the battery in other than the following conditions; otherwise, the battery might cause heat generation, damage, or deterioration of its performance.

Operating environment:

When the battery is charged : 0°C ~ 60°C, Humidity: Max 95% RH

When the battery is discharged : -20°C ~ 60°C, Humidity: Max 95% RH

When stored 1 week : -20°C ~ 50°C, Humidity: Max 95% RH

When stored 1 month : -20°C ~ 45°C, Humidity: Max 95% RH

When stored 6 months : -20°C ~ 40°C, Humidity: Max 95% RH

When stored 12 months : -20°C ~ 35°C, Humidity: Max 95% RH.

PRODUCT SPECIFICATION

Product: Rechargeable Li-ion Battery

CosMX Project Name:	CYC037
Model Name:	L25X3P72
Lenovo Part Number/ASM:	SB11M89967
FRU Part Number:	5B11M90166
CosMX Part Number:	CB030C0000241
Cell Model:	CA615680F-Q1

Revise No: VER 05

CosMX Approval:

Prepared	R&D Reviewed	PM Reviewed	CQE Reviewed	Approved
Qin Zehua	Jay Ye& Monica Wei	Liu Cannan	Miya Tan	Jerry Yang
Date:2025-09-19	Date:2025-09-19	Date:2025-09-19	Date:2025-09-19	Date:2025-09-19

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Product Revision History			
REV.	Date	Revision Description	ORIGINATOR
01	2025-07-18	First edition	Qin Zehua
02	2025-08-08	Add Pack 2D、Label	Qin Zehua
03	2025-08-19	Update Label	Qin Zehua
04	2025-09-05	1.Add Design Capacity 2.Update 0x37 3.Add Cycle Life in 0.2C diacharge condition 4.Adjust Device Chemistry 5.Update Label	Qin Zehua
05	2025-09-19	Update Recommended discharge current	Qin Zehua

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1. Scope

This specification is made to describe the product, product characteristics and performance, relevant measurement conditions and methods applied to the Rechargeable Li-ion Battery as specified in following details.

2. Product Name and Product Type

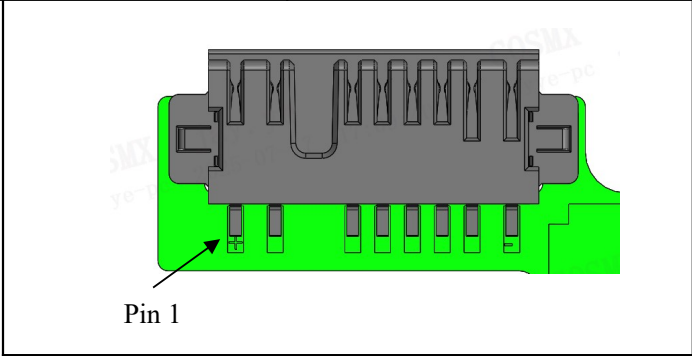
- 2.1 CosMX Project Name: CYC037
- 2.2 Model Name: L25X3P72
- 2.3 Lenovo Part Number/ASM: SB11M89967
- 2.4 FRU Part Number: 5B11M90166
- 2.5 CosMX Part Number: CB030C0000241
- 2.6 Cell Model: CA615680F-Q1

3. Pack Configuration

Model	Li-ion Battery Pack Lenovo CYC037	
Structure	Battery Pack	3S1P of CA615680F-Q1
	BMU Solution	TI BQ9004
	Model Name	L25X3P72
	Firmware Version	Tenpao 2002

4. Pin Assignment

Pin	Terminal Name	Definition
Pin1	P+	BATTERY PACK + TERMINAL
Pin2	P+	BATTERY PACK + TERMINAL
Pin3	I2C_CLK	SMBUS CLOCK
Pin4	I2C_DATA	SMBUS DATA
Pin5	TEMP	10k OHM/1% RESISTOR CONNECTED TO GND
Pin6	N/A	
Pin7	GND	BATTERY PACK GND TERMINAL
Pin8	GND	BATTERY PACK GND TERMINAL



5. Measurement Table of Accuracy

Model	Li-ion Battery Pack Lenovo CYC037		
Item	Accuracy	Unit	Resolution
Current	± 1%	mA	Charge & Discharge current = 2A 0.76uV/bit
Voltage	± 10	mV	3840 mV~3900 mV 0.24mV/bit
Temperature	± 3°C	degC	Environment Temp:25°C Thermistor is not linear,so there is no direct resolution.

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6. Product Specifications

No.	Item	Specification	Remark
1	Pack Normal Capacity (@0.2C)	Typical: 60.00 Wh (5168 mAh)	0.2Cnom charge by 4.45 V/cell and 0.2Cnom discharge rate by at 25°C
	Pack Minimum Capacity (@0.2C)	Typical: 58.90 Wh (5065 mAh)	0.2Cmin charge by 4.45 V/cell and 0.2Cmin discharge rate by at 25°C
2	PACK Config	3S1P	
3	Design Capacity	6000 cWh	
4	Nominal Voltage	11.61 V	3.87 V / per cell
5	Charge Voltage	13.35 V	Max. allowable charging voltage RT Mode: 4.45 V / per cell
6	End of Discharging Voltage	9.00 V	3.00 V / per cell
7	Standard Charge Method**Note1	A. 1034 mA to 13.35 V (4.45 V / per cell) B. 3619 mA to 13.35 V (4.45 V / per cell) C. 6204 mA to 12.60 V (4.20 V / per cell) and 3619 mA to 13.35 V (4.45 V / per cell) D. 2585 mA to 12.60 V (4.20 V / per cell)	A. 0~15 °C B. 15~20 °C C. 20~45 °C(Quick charge) Charge time: 0~100%≤120 mins D. 45~60 °C
8	Max charge Current	6390 mA	Only for safety certification
9	Pre-charge Current	517 mA	Min Vcell < 3.0V
10	Maximum Discharge Power	Continue Power: 65W from 100% SOC to 0% SOC.	@35°C
		Peak Power: 80W / 30S from 100% SOC to 10%SOC.	
11	CB Power	80W	@35°C
12	Operating Temperature and Humidity Range	Charge: 0~60°C Humidity: 5%~95% RH	The tolerance of temperature is ± 3°C
		Discharge: -20~60°C Humidity: 5%~95% RH	
13	Storage Temperature and Humidity Range	1 week: -20~50°C 1 month: -20~45°C 6 month: -20~40°C 1 year: -20~35°C Humidity: 5%~ 95% RH	The battery should cycle once in three month. Recommended storage temperature is 25°C of SOC 50%.
14	Internal Impedance (Initial)	ACIR ≤ 200mΩ	1KHz sine wave AC(25°C± 3°C)
15	Cycle Life	Residual Capacity: ≥ 70% of initial capacity Swelling after cycle: ≤ 10% @ 1000cycles	(Follow Battery Stand quick charge / 0.5C discharge) at 25± 5°C
		Residual Capacity: ≥ 80% of initial capacity Swelling after cycle: ≤ 10% @ 1000cycles	(Follow Battery Stand quick charge / 0.2C discharge) at 25± 5°C
16	Electro-Static Discharge (ESD)	Contact Discharge: +/-8KV	Normal operation. No malfunction. Test equipment: Rd =330Ω, Cs=150pF, Discharge resistor = 2KΩ
		Air Discharge: +/-15KV	
17	Shipping Capacity	RSOC: 45%-55%	
18	Slave Address	0X16	
19	Authentication Method	SHA256	
20	Warranty Data	1 year / 750 cycles	
21	Weight	Max225 g	
22	Power consumption	Normal mode: < 600uA	3800mV/cell at 25± 5°C
		Sleep mode: < 150uA	
		Ship mode: < 100uA	
		Shutdown mode: < 10uA	

Note : Charging current rate adjust by FCC

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7. Gas Gauge Specifications

7.1 SBS Data Information

No.	Item	Specification	Unit	Remark
1	Maker ID	00 09	HEX	
2	Hardware ID	00 37	HEX	
3	F/W Version	00 21	HEX	
4	DATA Version	00 02	HEX	
5	0X37 Information	09 00 37 00 21 00 02 00	HEX	
6	Manufacture name	COSMX 2025	---	
7	DeviceName	LNV-5B11M90166	---	
8	Device Chemistry	LION	---	

7.2 Protection Functin

7.2.1 Recoverable Failure

No.	Items	Detection	Delay Time	Action		Release condition	Delay Time
				C-FET	D-FET		
1	1st Over Cell Voltage Protection	Set: ≥ 4.48 V/cell $\pm 10\text{mV}$	3~5s	OFF	ON	≤ 4.35 V/cell $\pm 10\text{mV}$	$\leq 2\text{s}$
2	Dynamic Cutoff & Under Voltage Protection	Discharge mode & Temperature 0~15 DegC Set: ≤ 2.70 V/cell	12s	ON	OFF	≥ 3.10 V/cell $\pm 10\text{mV}$ & Charge mode	-
		Relax mode or Discharge mode & Temperature ≥ 15 DegC Set: ≤ 2.80 V/cell	12s	ON	OFF		
		All Temperature Set: ≤ 2.50 V/cell	5s	ON	OFF		
3	Shutdown Voltage of Cell	Relax mode Set: ≤ 2.8 V/cell	20s	OFF	OFF	≥ 3.00 V/cell & Charge mode	-
4	Over Pre-charge Current	Set: ≥ 717 mA	3~5s	OFF	ON	50 mA	3~5s
5	1st Over Charge Current	Set: ≥ 6830 mA	3~5s	OFF	ON	≤ 0 mA	$> 16\text{s}$
6	1st Over Discharge Current	Set: ≤ -9400 mA	3~5s	ON	OFF	≥ 0 mA	$> 16\text{s}$
7	1st Over Discharge Current for Cell	Set: $\leq -9.4\text{A}$ Protection threshold is compensated with cell temperature between 55℃~73℃, slope 0.044A/℃	3~5s	ON	OFF	-	$> 16\text{s}$
8	1st Over Discharge Current for FET	Set: $\leq -9.9\text{A}$ Protection threshold is compensated with cell temperature between 90℃~98℃, slope 0.075A/℃	3~5s	ON	OFF	-	$> 16\text{s}$
9	Overload in Discharge Protection (H/W)	Set : $\leq -12.03\text{A}$ (TYP) ; (-9.988A~-14.078A)	31±4msec	ON	OFF	-	$> 16\text{s}$
10	Short Circuit in Charge (H/W)	Set : $\leq -29.6\text{A}$ (TYP) ; (-25.813A~-33.42A)	610±400usec	OFF	ON	-	$> 16\text{s}$
11	Short Circuit in Discharge (H/W)	Set : $\leq -29.6\text{A}$ (TYP) ; (-25.813A~-33.42A)	610±400usec	ON	OFF	-	$> 16\text{s}$
12	Charge Over Temperature of cell	Set: ≥ 60 ℃	1~3sec	OFF	ON	≤ 50 ℃	-
13	Charge Under Temperature of cell	Set: ≤ -2 ℃	1~3sec	OFF	ON	≥ 2 ℃	-
14	Discharge Over Temperature of cell	Set: ≥ 73 ℃	1~3sec	ON	OFF	≤ 65 ℃	-
15	Discharge Under Temperature of cell	Set: ≤ -25 ℃	1~3sec	ON	OFF	≥ -20 ℃	-
16	High Temperature Charge start	Set: ≥ 50 ℃	-	OFF	ON	≤ 50 ℃	-
17	Low Temperature Charge start	Set: ≤ 0 ℃	-	OFF	ON	≥ 0 ℃	-
18	Over Temperature of FET	Set: ≥ 98 ℃	3~5s	OFF	OFF	≤ 80 ℃	-
19	Fully Charge Protection by taper condition	Set: RT_Mode ≥ 4350 mV/cell , ≤ 259 mA(0.05C)	80s	OFF	ON	-	-
20	Fully Charged Protection by OCV condition	Set:RT_Mode CCV: ≥ 4470 mV/cell	1s	OFF	ON	-	-
		OCV: ≥ 4430 mV/cell	60s				
21	Pre-charge Timeout	Set: ≥ 1 Hours	-	OFF	ON	≥ -15 mA	$> 1\text{s}$

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7.2.2 Permanent Failure *Note 3

No.	Items	Detection	Delay Time	Enter PF Mode (FETs Off)	Fuse Blow
1	2nd Over Voltage (H/W, By 2nd IC)	Set: ≥ 4.60 V/cell	4~10s	YES	YES
2	2nd Under Voltage (Cu Deposition Detection)	Set: ≤ 1300 mV/cell	3~5s	YES	NO
3	Safety Over Charge current Temperature	Set: ≥ 90 °C & Charge Current ≥ 25 mA	10~12sec	YES	YES
	Safety Over Discharge current Temperature	Set: ≥ 90 °C & Discharge Current ≤ -100 mA			
4	Safety Overtemperature FET	Set: ≥ 120 °C	10~12sec	YES	YES
5	Charge FET Failure	Current ≥ 150 mA & Charge FET off	20~22sec	YES	YES
	Discharge FET Failure	Current ≤ -150 mA & Discharge FET off			
6	Open Thermistor	Thermistor is open ($\leq 50^{\circ}\text{C}$)	10~12sec	YES	YES
7	Short Thermistor	Thermistor is short ($\geq 150^{\circ}\text{C}$)	10~12sec	YES	YES

7.3 Lenovo/Other Feature

No.	Item	Condition	Action	Remark
1	Ship Mode	Two ways Entry : 1.By command condition Write word (0x0000) & (0x1000) by cmd(0x34) within 5s or 2.By storge time condition In sleep mode & Current ≤ 50 mA & Storage time > 2 weeks & RSOC $< 30\%$ & No communication	C/D-FET OFF	
		Two ways Exit : 1.By command condition Write word (0x2000) & (0x4000) by cmd(0x34) within 5s or 2.By communication condition SMBus communication by (0x16) address from sleep mode	C/D-FET ON	
2	Sleep Mode	Entry : Current ≤ 10 mA & No communication & Delay time ≥ 20 s		Detect voltage/temperature by every 5s and current by every 20s
		Four ways Exit : 1.SMBus communication or 2. Current ≥ 10 mA or 3.Charge current ≥ 100 mA~300mA ,delay time ≤ 1 s or 4.Safety Alert /Status		Detect voltage/temperature/current by every 250ms
3	96 Hours Function	Entry condition: Fully charged & Enable 96 hours function		
		Exit condition: 1.96 hours timeout or 2. Current ≥ 5 mA for 30s or 3. Current ≥ 100 mA		
4	Charge Rate Control by FCC	The charging current adjusted by SBS FCC value , charge C-Rate remain unchanged .Minimum Charging Current = 0.1C		
5	cell imbalance alarm	Max cell voltage > 4100 mV & (Max cell voltage - min cell voltage) > 500 mV & charge current > 150 mA & delay time > 1 min		set bit10 at Battery Status 0x16
6	First Used Date	It's able to be written in any value when it's 0, and could rewrite to 0 from any value.	0x3F	The maximum writing count is 100.

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7.3 Lenovo/Other Feature

No.	Item	Condition	Action	Remark
7	Dual Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Enter condition : LS1_1:Storage time≥ 960 hours , or Cycle count ≥100 LS1_2:Storage time≥ 1200 hours , or Cycle count ≥150 LS1_3:Storage time≥ 1440 hours , or Cycle count ≥300 LS1_4:Storage time≥ 1680 hours , or Cycle count ≥350 LS1_5:Storage time≥ 1920 hours , or Cycle count ≥400 LS2 : SOH≤LS2 target SOH Adjusted time = Actual time * Temperature Modifier * Voltage Modifier where:Temperature Modifier= 2^((Max Cell Temp - 25) / 10) at 25℃~90℃ Voltage Modifier = 1.0 if Vcell ≥4400 mV = 0.8 if 4350 mV ≤ Vcell < 4400 mV		
8	Dynamic Life Span AI Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Enter condition : T_LS1_1: 35% ≤RSOC< 40% & Rolling day ≥ 7days, Change charging voltage 4440 mV/Cell in temporary mode to start charging T_LS1_2: 40% ≤RSOC< 45% & Rolling day ≥ 7days, Change charging voltage 4430 mV/Cell in temporary mode to start charging T_LS1_3: 45% ≤RSOC< 50% & Rolling day ≥ 7days, Change charging voltage 4420 mV/Cell in temporary mode to start charging T_LS1_4: 50% ≤RSOC< 55% & Rolling day ≥ 7days, Change charging voltage 4410 mV/Cell in temporary mode to start charging T_LS1_5: 55% ≤RSOC< 65% & Rolling day ≥ 7days, Change charging voltage 4400 mV/Cell in temporary mode to start charging T_LS2: 65% ≤RSOC< 90% & Rolling day ≥ 7days, Change charging voltage 4350 mV/Cell in temporary mode to start charging Exit condition : RSOC<20%		13320 mV/Pack 13290 mV/Pack 13260 mV/Pack 13230 mV/Pack 13200 mV/Pack 13050 mV/Pack
9	PI Mode	Pre-condition : FUD≠0 , or Cycle count≥5 or High voltage time≥120 hours Entry condition: 1.RSOC ≥ 90% for last 14 days 2.RSOC ≥ 90% & Cell temperature ≥40℃ & ≥40 hours for last 7 days Exit condition: 1.RSOC<50%		
10	Initialize status	Initialized bit (Bit 7 of 0x16 CMD set up) is already set when Smbus become enable .		
11	CCV Stepdown	CCV step down threshold: 4450 mV(RT mode) CCV step down threshold: 4440 mV(LS1-1/T-LS1-1 mode) CCV step down threshold: 4430 mV(LS1-2/T-LS1-2 mode) CCV step down threshold: 4420 mV(LS1-3/T-LS1-3 mode) CCV step down threshold: 4410 mV(LS1-4/T-LS1-4 mode) CCV step down threshold: 4400 mV(LS1-5/T-LS1-5 mode) CCV step down threshold: 4350 mV(LS2/T-LS2 mode) CCV step current threshold: 0.1C of FCC Minimum of CCV step current: 0.1C of FCC CCV step-down relax time: 1sec Release condition of CCV step down: Discharge current ≤-50mA or enter DSG mode		
12	End Of Life Prediction	Activation of EoL function can be set by parameter (EoLEnable = 1). 0x3C for Last value 0x3D for Calculated value The EoL remaining time/cycle count calculated based on the prediction results is returned by the 0x3D command. - EoL remaining time = (EoL target prediction time – current TotalStrageTimeHour) - EoL remaining cycle count = (EoL target prediction cycle count – current CycleCount)		
13	HSFCC Function	1. Ideal FCC value can be updated when fully charge battery pack from RSOC less than 65% by measure minimum pack IR 2. Pack IR is measured by turning off C-FET during charging within RSOC range 65%~75%. 3. During pack IR measurement, C-FET will be turned off for 5sec at each RSOC 1% step. 4. Maximum allowable percentage for ideal FCC change is 10%(comparing previous ideal FCC). HSFCC Cancellation Condition: 1. Within less than 72hrs after FCC updating by low side FCC learning. 2. Charging current deviation rate larger than 1% 3. Charging current lower than 1000mA. 4. When battery pack enter PI/DLS mode. 5. No detecting charging current for 72hrs or more during IR measurement. 6. Charging current more than 6204mA or less than 3619mA during IR measurement at SOC 55%. 7. Cell temperature more than 45degC or less than 20degC during IR measurement at SOC 55%. 8. Detect discharging current more than -5mA during IR measurement. 9. Discharge detection. SBS.AverageCurrent() is lower than 0mA. 10. Learned FCC deviation is larger than 10%. 11. SBS.MaxError() is larger than 10% when FC detected.		

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8. Mechanical Characteristics

8.1 External Dimension

Dimension	Thickness	Width	Length
Maximum	6.98 mm	59.70 mm	265.30 mm

External Form Figure （all unit in mm）

See next page for drawing details

8.2 Outside Appearance

The surface is smooth. No mechanical damage. The package membrane has no damage or leakage.

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8.3 Label



Background color : Pantone black C
Text color :White



注：1、蓝色LOGO暂不印刷；
2、LOGO处“X”为预留认证编号，不可用于量产。

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Spec No.: PW-P3-00-2B0066

密级：绝密

8.4 Battery Barcode

编码规则：
8S P P P P P P P P P H H H H Y M D S S S S

- 第01-02位：8S，固定代码；
第03-12位：暂用P P P P P P P P P表示，固定代码，根据情况填写 Lenovo Production P/N 或 Lenovo FRU P/N ；
第13-16位：暂用H H H H表示，固定代码 (Lenovo Header Code) ；
第17位：Y，代表生产年份，用年份最后一位数表示，（如1表示2021年，2表示2022年...）；
第18位：M，代表生产月份，（1-9月用数字1-9表示，10-12月用字母A-C表示）；
第19位：D，代表生产日期，（1-9日用数字1-9表示，10-31日用字母A-Z表示,10=A；11=B；12=C；13=D；14=E；15=F；16=G；17=H
18=J；19=K；20=L；21=M；22=N；23=P；24=R；25=S；26=T；27=V；28=W；29=X；30=Y；31=Z；其中“l, O, Q, U”除外）；
第20-23位：S S S S，代表生产流水码(Serial Number)，32进制：
• 1st S : Serial Number4: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 2nd S : Serial Number3: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 3rd S : Serial Number2: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• 4th S : Serial Number1: (0123456789ABCDEFGHIJKLMNPRSTVWXYZ, 其中“l, O, Q, U”除外) ；
• Maximun Volume Per Date Will Be 65,535 By Serial Numbering.

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9. Overall Protection Function

The electrolyte may be decomposed if a lithium ion secondary cell is subjected to a voltage higher than the allowable voltage or is charged with an excessive current, which may be resulted in safety problems.

Cell: TCO for polymer and prismatic.

Built-in control circuit: Have built-in control circuit for overcharge prevention function, over discharge prevention function, reverse polarity prevention function, high temperature prevention and prevent pack being used other than intended usage.

10. Packing

Packing form: Determined through discussion with the circuit.

Indication: Indication following items on the package box where can easily be seen.

- Name.
- Packed quantity.
- Shipping date.
- Manufacturer's name. (Or trade mark or abbreviation)

11. Time of Product Storage

The time of product storage will be 21 days before the product leave factory.

12. Guarantee Period of Quality

Guarantee period of quality is 24 months after sold.

13. Product Responsibility Agreement

The customers must abide by the Product Specification and remarks in using the cells manufactured by Zhuhai CosMX Battery Co., Ltd. The misuse may cause cell heat, fire or rupture. CosMX will NOT be responsible for any accident occurred by handling outside of the precautions in this specification.

Be attention to the package and structure of the polymer lithium ion cell:

a) The case of the polymer lithium ion cell shall be sustained the mechanical impact (collide, dropping, distortion and curve etc.) to protect the polymer lithium ion cell inside.

- Leakage and short-circuit etc. may be occurred if the cell is suffered strong impact.
- Take care in using the polymer lithium ion cell due to its soft package and is easier to be damaged than metal case cell in suffering from impact.

b) The polymer lithium ion cell shall be fastened inside the package to avoid the motion in suffering from mechanical impact such as dropping.

- The cell, PCB and connection wire may be damaged due to the motion of the cell inside the package is suffered from impact such as dropping etc., if the cell inside the package is not fastness.
- CosMX recommends fastening the wider face of the cell inside the package by adhesive tape.
- Do not make any damage to the bottom of the cell due to the bottom of polymer lithium ion cell is easy to be damaged in suffering from impact such as dropping.

c) Avoid connecting of polymer lithium ion cell with sharp or protruded articles.

- The membrane of polymer lithium ion cell is easy to be damaged by sharp articles, which may be resulted in the leakage of electrolyte.

• Put an isolated membrane between cell and PCB to avoid them connecting directly if the PCB of cell is put on the surface of the polymer lithium ion cell.

- Avoid to put sharp articles, protruded part of PCB (PTC, over-current sheet etc.) or connecting wire on the surface of polymer lithium ion cell directly.

• Avoid concentrating pressure on the cell to fasten the cell during the designing, because the performance of the cell may be decreased if the cell is extruded in a relative small area.

d) Be attention to the variation of the thickness of polymer lithium ion cell during charge-discharge:

- The thickness of polymer lithium ion cell may be increased a little during charge-discharge, if the design do not consider the variation of the thickness, the package may be damaged and the performance of the cell may be decreased due to the cell extrudes the case of cell, connecting wire or cell itself resulted •from the thickness increase.

e) Keep the polymer lithium ion cell away from thermal source:

- Some performance of polymer lithium ion cell may be decreased if the cell is working or storage beyond the required temperature range.

f) If the connection of the package case and cap is welded by supersonic, there shall be no gap between case and cap during welding to avoid the energy created by supersonic welding passing to polymer lithium ion cell or PCM.

- Polymer lithium ion cell or PCM may be damaged by the energy created by supersonic welding.

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14. Handling precautions on Lithium ion secondary cell

To assure product safety, there shall be precautions below.

! Danger

- Use dedicated chargers and follow the specified conditions when charging the cell.
- Use the cell only in the specified equipment.
- Do not heat or put the cell into the fire. Also do not wet the cell.
- Do not use, leave cell close to fire or inside of a car where temperature may be above 60 °C . Also do not charge / discharge in such conditions.
- Do not put or store cell together with metal articles such as necklaces, hairpins, coins, or screws.
- Do not short circuit the (+) and (-) terminals with metal conductors.
- Do not place cell in a device with the (+) and (-) in a reverse way.
- Do not penetrate cell with a sharp articles such as a needle.
- Do not disassemble the cell.
- Do not weld the cell directly.
- Do not use a cell with serious scar or deformation.
- Thoroughly read the user's manual before use, inaccurate handling of polymer lithium ion cell may results in heat, fire, explosion, damage or the capacity loss of the cell.

! Warning

- Do not put cell into a heating vessel, washing machine or high-pressure container.
- Do not use cell with primary batteries, or batteries of a different package, type, or brand.
- Stop charging the cell if charging is not completed within the specified time.
- Stop using the cell if abnormal heat, odor, discoloration, deformation or abnormal condition is detected during use, charge, or storage.
- Keep away from cell immediately when leakage or foul odor is detected.
- Wash well with clean water immediately if liquid leaks onto your skin or clothes.
- If liquid leaking from the cell gets into your eyes, do not rub your eyes. Wash them well with clean water and call physician immediately.

! Caution

- Store batteries out of reach of children so that they are not accidentally swallowed.
- If younger children use the cell, their guardians should explain the proper handling.
- Be sure to read the user's manual and cautions on handling thoroughly before using the cell.
- Batteries have cycle life. Using one new cell the same to the old one to replace it if work time of the equipment using cell as power sources becomes much shorter than the usual.
- Remove it from the equipment and store in a place with low humidity and temperature if the cell is not used for an extended period.
- Keep it far away from articles or materials with static electric charges while the cell is charged, used or stored.
- Wipe with a dry clothe before using the cell if the terminals of the cell become dirty.

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15. Information of Company

ZHUHAI COSMX BATTERY CO., LTD
No.209, Zhufeng Way, Xinqing Science & Technology Park, Doumen
District, Zhuhai519180, P.R.China
Tel: 86—756—6199909 Fax: 86—756—6199910
Website : www.cosmx.com

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Appendix:
For Certification

安全工作参数 (Safety Operating Parameter)	电池组 (Battery Pack)
额定容量 RATED CAPACITY	5065mAh
标称电压 NOMINAL VOLTAGE	11.61V
充电限制电压 Limited charging voltage	13.35V
放电终止电压 END OF DISCHARGE VOLTAGE	9V
额定能量 JUST FOR GB31241 2022	58.9Wh
充电上限电压 JUST FOR GB31241 2022	13.44V
放电截止电压 JUST FOR GB31241 2022	8.37V
推荐充电电流 RECOMMENDED CHARGING CURRENT	1.013A
最大充电电流 MAXIMUM CHARGING CURRENT	6.390A(0~45℃)
	2.533A(45~60℃)
充电截止电流 CHARGING TAPER CURRENT	0.259A
推荐放电电流 RECOMMENDED DISCHARGING CURRENT	-1.013A
最大放电电流 MAXIMUM DISCHARGING CURRENT	-8.889A (-20~35℃)
	-2.533A(35~60℃)
推荐放电功率 RECOMMENDED DISCHARGING POWER	65W
最大放电功率 MAXIMUM DISCHARGING POWER	80W (-20~35℃)
	-2.533A(35~60℃)
充电工作温度范围 OPERATING CHARGING TEMPERATURE	0℃~60℃
放电工作温度范围 OPERATING DISCHARGING TEMPERATURE	-20℃~60℃
过压充电保护电压 OVER VOLTAGE PROTECTION	13.44V (4.48V±10mV/cell)
欠压放电保护电压 UNDER VOLTAGE PROTECTION	8.40V (2.8V±10mV/cell)
过流充电保护电流 OVER CHARGING CURRENT PROTECTION	6.830A±2.5%
过流放电保护电流 OVER DISCHARGING CURRENT PROTECTION	-9.400A±1.0%
上限充电温度保护 OVER CHARGING TEMPERATURE PROTECTION	60±3℃
下限充电温度保护 UNDER CHARGING TEMPERATURE PROTECTION	-2℃±3℃
上限放电温度保护 OVER DISCHARGING TEMPERATURE PROTECTION	73±3℃
下限放电温度保护 UNDER DISCHARGING TEMPERATURE PROTECTION	-25℃±3℃

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Battery Specification Confirmation Sheet

Of

Amperex Technology Limited

NingdeAmperex Technology Limited

Dongguan Amperex Technology Limited

(each and collectively, “ATL”)

ATL 电池产品规格书

ATL Product Part Number/ATL产品代码:

ATL Pack PN	GB-S30-615780-010H	GB-S30-615780-010L
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Pack Configuration/电池结构: 3Series 1 parallel (3S1P)

Prepared by TPM	Approved by TPM	Approved by CPD	Approved by QA
Cheney Zhang			

Customer Confirmation	Authorized Signatory		Date
	Signature	Print Name	
	Company Name Of Customer: LEN		
	Company Stamp Of Customer:		

Confidential : () Level 3 Private confidential () Level 2 High confidential (V) Level 1 Low confidential

AMENDMENT RECORDS/变更记录

Revision/版本	Description/描述	Originator/制作者	Date/日期
Draft 1	New Release/新发行	Sam/Nico	2025/07/24
Draft 2	Update SIT 0x37	Sam/Nico	2025/11/24

SECTION/部分	Content/目录	Page/页码
1	Scope/适用范围:.....	4
2	Model Name/型号: 615780R (NVT Model Name: LENNSQ7).....	4
3	Standard Environmental Test Conditions/标准环境测试条件:	4
4	Detailed Specifications/详细规格:	4
5	Warranty period/保质期:	7
6	Assembly Drawing (all unit is mm, not in scale) /电池图纸 (单位: mm):	7
7	Terminal Specification/引脚定义	10
8	PCM Specifications/保护板规格	11
9	Battery Packing requirement/电池包装要求:.....	22
10	Appendix Handling Precautions and Guidelines for Rechargeable Li-ion Batteries:	23
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1 Scope/适用范围:

The purpose of this Document (“Document”) is to specify the specifications of the Li-ion (“LION”) rechargeable battery with ATL Part Number GB-S30-615780-010H, GB-S30-615780-010L (“Product” or “Pack”) to be supplied by ATL to Customer under Customer’s purchase order and ATL’s confirmation relevant to the Product. For the avoidance of doubt, the specifications specified herein do not apply to any Host Device, apparatus, instrument, equipment or hardware device containing Product or Cell (“Host Device”).

本产品规格书描述了 ATL 依据客户采购订单生产的可充电锂离子(“LION”)电池的产品性能指标, ATL 产品代码号 GB-S30-615780-010H, GB-S30-615780-010L (“产品” 或 “电池”)。为避免疑问, 本产品规格书不适用于任何包含该产品或电芯的主机设备、仪器、仪表、器件、硬件设备等 (“主机”)。

2 Model Name/型号:

Customer mode name: L25N3P71

Lenovo PN/ASM : SB11M89973

Lenovo P/N FRU : 5B11M90172

NVT Model Name: LENNSQ7

3 Standard Environmental Test Conditions/标准环境测试条件:

3.1 Unless otherwise specified, all tests stated in this Product Specification are conducted at below conditions:

除非特别指定, 本产品规格书所有的测试遵循如下条件:

Temperature/温度: $25 \pm 3^{\circ}\text{C}$ (“Temperature Condition” /温度条件)

Humidity/湿度: $65 \pm 20\% \text{ RH}$ (“Humidity Condition” /湿度条件)

3.2 Throughout this Document, numeric criteria annotated by “*” means such criteria are only applicable to fresh unused Product within 30 days from manufacture by ATL. Products either have been used or stored for a period longer than 30 days by Customer and/or its customer may exhibit an inferior numeric parameter than such criteria. Customer agrees that such occurrence does not constitute nonconformance of specification.

本产品规格书中, 所有标有“*”的项目是指仅适用于“未使用的且从ATL制造日起30天内的产品”。如果产品已被客户使用或存储时间超过30天, 可能表现出低于标准规格, 客户同意并接受产品不构成不符合规格。

4 Detailed Specifications/详细规格:

The specifications listed in this Section 4 shall be the detailed specifications for the Product (“Detailed Specifications”). 列在第 4 部分的规格作为产品的详细规格。

No.	Items	Specifications	Remark
4.1	F/W Rev FW 版本	RAJ240057_Tenpao FW	Tenpao FW Version : F00B
4.2	Typical Capacity 典型容量	5168mAh/60Wh	Standard capacity measure method: 0.2Cmin CC (constant current) charge to 4.45 V, then CV (constant voltage 4.45V) charge till charge current decline to 0.05Cmin, then with 0.2Cmin discharge to 3.0V cut-off
4.3	Minimal Capacity 最小容量	5065mAh/58.9Wh	
4.4	Reserve Capacity 保留容量	300mWh	RC 200mWh to TDA: $\geq 300\text{mWh}$ RSOC 0% to TDA: $\geq 300\text{mWh}$ TDA to ODP: $\geq 10\text{sec}$
4.5	*Typical Voltage 典型电压	11.61V	
4.6	Charge Cutoff Voltage 充电截止电压	13.35V	



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4.7	Voltage at end discharge 放电截止电压	9.0V for capacity measure	
4.8	Charge Current 充电电流	Initial low charge temp	$\geq 0^{\circ}\text{C}$
		Initial high charge temp	$< 50^{\circ}\text{C}$
		1034mA to 13.35V	$0^{\circ}\text{C} \equiv \text{Cell temp} < 15^{\circ}\text{C}$
		2584mA to 13.35V	$15^{\circ}\text{C} \equiv \text{Cell temp} < 20^{\circ}\text{C}$
		6202mA to 12.6V, then 3618mA to 13.35V.	$20^{\circ}\text{C} \equiv \text{Cell temp} < 45^{\circ}\text{C}$
		3472mA to 12.3V	$45^{\circ}\text{C} \equiv \text{Cell temp} < 60^{\circ}\text{C}$
	Smart Quick Charge Current 快充电流	6202mA to 12.6V, then 3618mA to 13.35V.	$20^{\circ}\text{C} \equiv \text{Cell temp} < 45^{\circ}\text{C}$ 0x26 bit0=1 0x26 bit1=1
4.9	Max Continue Discharge Power 最大持续放电功率	65W	@35°C
4.10	Peak Power 峰值功率	80W	Max. 30sec (at 35°C)
4.11	Charge Voltage 充电电压	13.35V 13.32V 13.29V 13.26V 13.23V 13.20V 13.05V 12.75V	For RT Mode For LS1-1/T-LS1-1 Mode For LS1-2/T-LS1-2 Mode For LS1-3/T-LS1-3 Mode For LS1-4/T-LS1-4 Mode For LS1-5/T-LS1-5 Mode For LS2/T-LS2 Mode For PI Mode
4.12	Storage Condition 存储条件	-20°C ~ + 35°C; over 1 year. -20°C ~ + 40°C; over 6 months. -20°C ~ + 45°C; over 1 months. -20°C ~ + 50°C; over 1 week.	-20°C to + 35°C within 1 year with shipping status; -20°C to + 40°C within 6 months with shipping status; -20°C to + 45°C within 1 month with shipping status; -20°C to + 50°C within 1 week with shipping status.
4.13	Battery Information 电池信息	Maker ID: 000A Hardware ID: 0041 FW Version: 0031 Data Version: 0003	For SIT Sample Build by CMD 0X37(hex): 0A 00 41 00 31 00 03 00
4.14	Slave Address/ 从属地址	0X16	
4.15	Authentication Method/ 身份认证方式	SHA-2	



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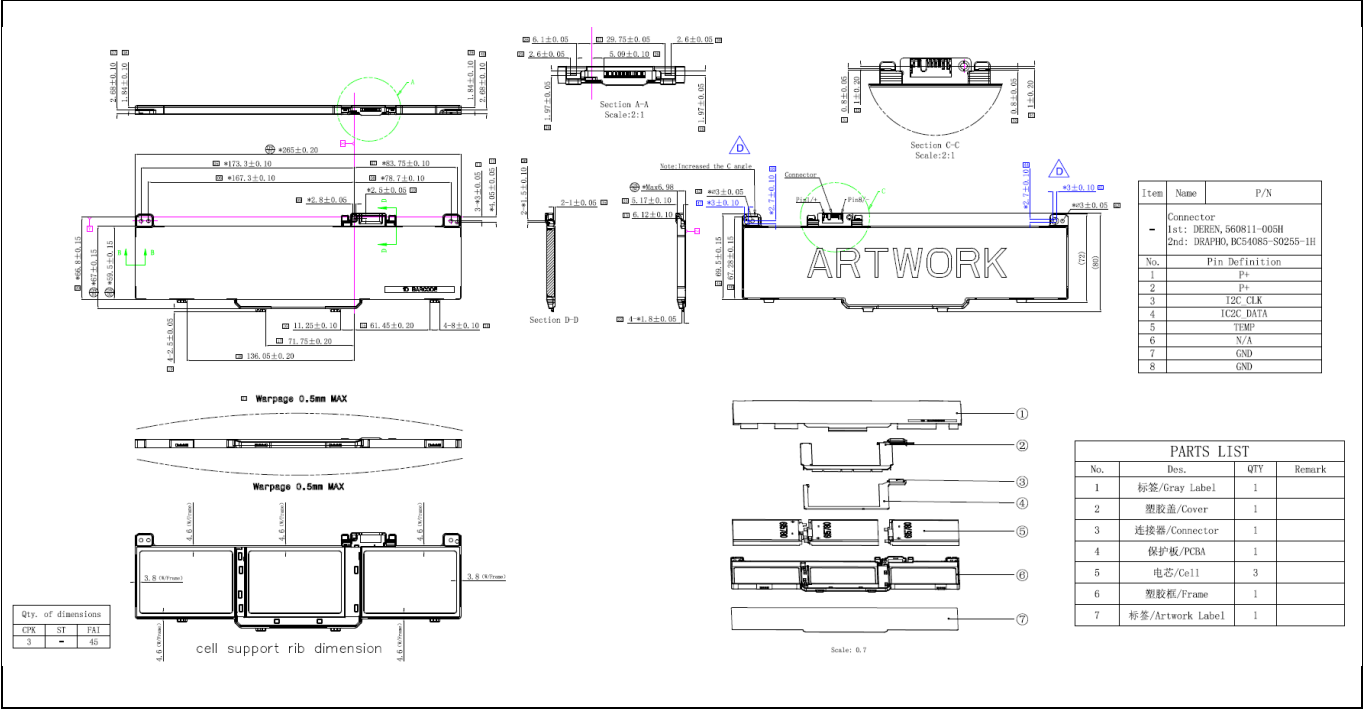
4.16	*Initial resistance 初始内阻	$\leq 200\text{m}\Omega$	Internal resistance measured at AC 1KHz after charge to shipment voltage.
4.17	*Pack Voltage(as of shipment) 电池电压 (出货状态)	11.55~11.88V	Non air transport
4.18	*Pack Voltage(as of shipment) Shipping RSOC	20%~30%	Air transport (IATA require shipping SOC $\leq$ 30%)
	电池RSOC (出货状态)	45%~55%	Non air transport
4.19	*RT Cycle life/常温循环寿命 (23°C $\pm$ 2°C) (only for cell)	Charge Cell with charge method specified in the Detailed Specifications charging current (The 151~1000 cycle full charge voltage decrease 0.05V) and discharge cell with 1C DC to 3.5V, 0.5C to 3.0V discharging current until battery voltage reaches 3.0V. Repeat to 1000 cycles, record remained capacity of 800th cycle and 1000cycle swelling. Test temperature: 25°C $\pm$ 3°C	1000cycle $\geq$ 70% of Cnom; 1000cycle Swelling $\leq$ 10%
4.20	Allowable Humidity Range 允许的湿度范围	35%~95%	
	DeviceChemistry ()	LION	
4.21	Pack Weight/电池重量	Max.225 g	for reference only
4.22	ManufacturerName ()	ATL 2025	
4.23	DeviceName ()	LNV- 5B11M90172	
4.24	Accuracy of current 电流精度	The accuracy below 1200mA is $\pm 6\text{mA}$; above 1200mA, the accuracy was $\pm 1\%$	
4.25	voltage accuracy 电压精度	The Pack voltage accuracy is $\pm 10\text{mV}$	
4.26	Accuracy of temperature 温度精度	The temperature accuracy is $\pm 3^\circ\text{C}$.	

5 Warranty period/保质期:

The warranty period of Battery is 12Months/750cycle after the manufacture date.
电池保质期为从生产日期算起12个月/750Cycle

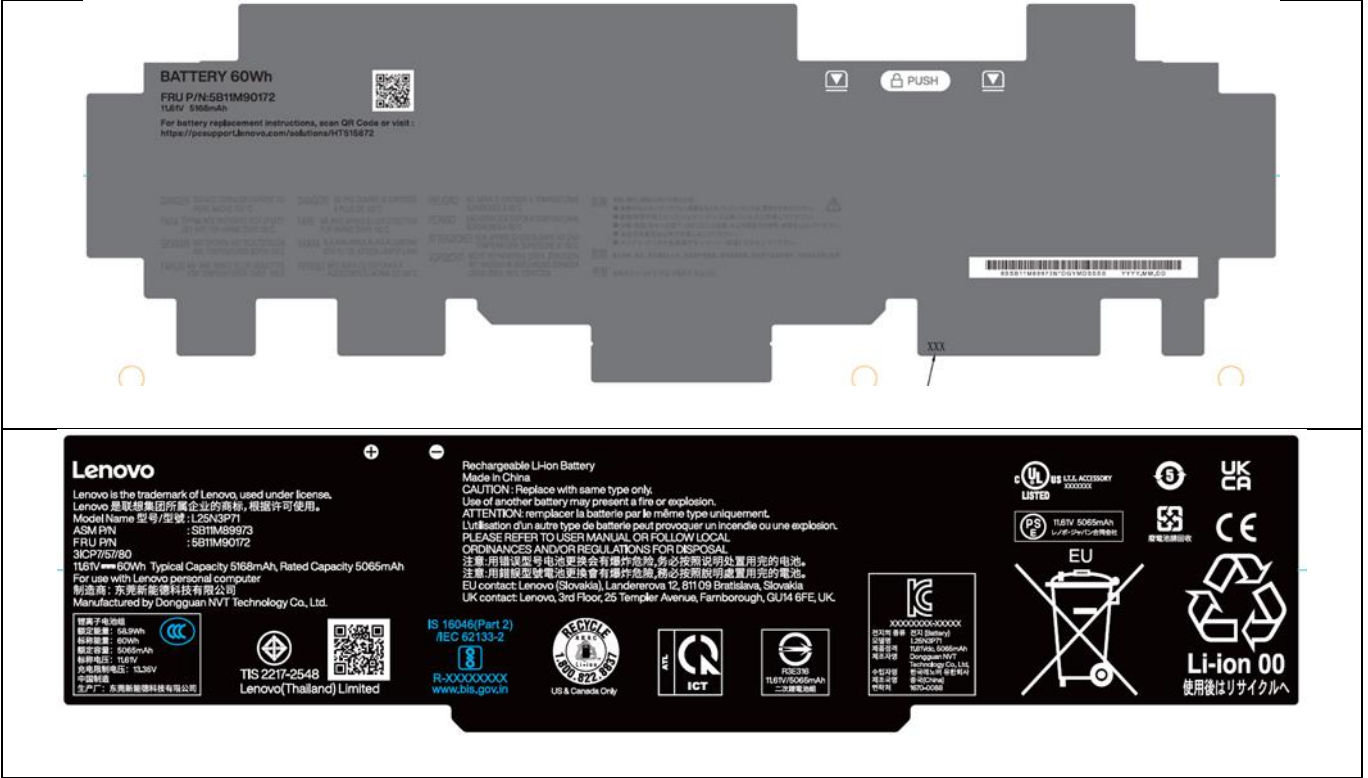
6 Assembly Drawing (all unit is mm, not in scale) /电池图纸 (单位: mm):

6.1 Battery Drawing/电池图纸



6.2 Battery Barcode Drawing/电池喷码图纸

(ATL PN/ATL料号: GB-S30- 615780-010H/L)





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6.3 Battery barcode and Rule/电池条码规则

喷码规则说明如下(Code 128码), 扫描等级≥C;



明码规则:

8SSB11M89926N*DG YMDSSSS YYYY.MM.DD

第1~2位:

– 8S : Fixed code

– 8S : 固定代码

第3~12位:

– SB11M89926: Lenovo Production P/N

– SB11M89926: 联想产品编号

第13~16位:

– Sample stage: N*DG, ("*" = A, B, C, D... Refer to the sample request list, defined by PM); Mass production stage: N1DG, fixed code

– 样品阶段: N*DG, ("*" = A, B, C, D..., 参考样品需求单, 由PM定义); 量产阶段: N1DG, 固定代码

第17~23位:

– Special meaning and rules for YMDSSSS, see "Lenovo Common Part Number - Release 1.2"

– YMDSSSS的编码规则, 详见文件"Lenovo Common Part Number - Release 1.2"

– Y : Year: last digit of the year, 2=2022

– Y : 年: 年份的最后一位, 如2=2022

– M : Month: 1=Jan, 2=Feb, ... A=Oct, B=Nov, C=Dec

– M : 月: 1=1月, 2=2月, ... A=10月, B=11月, C=12月

– D : D=D, 1=1 2=2 3=3 4=4 5=5 6=6 7=7 8=8 9=9 10=A 11=B 12=C 13=D 14=E 15=F

16=G 17=H 18=J 19=K 20=L 21=M 22=N 23=P 24=R 25=S 26=T 27=V 28=W 29=X

30=Y 31=Z, "I", "O", "Q" and "U" are not used.

– D : D=日, 1=1 2=2 3=3 4=4 5=5 6=6 7=7 8=8 9=9 10=A 11=B 12=C 13=D 14=E 15=F

16=G 17=H 18=J 19=K 20=L 21=M 22=N 23=P 24=R 25=S 26=T 27=V 28=W 29=X

30=Y 31=Z, "I", "O", "Q" and "U" 禁用

• 1st S : Serial number4: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" can't be used.

• 第一位流水码 S : Serial number4: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" 不能使用.

• 2nd S : Serial number3: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" can't be used

• 第二位流水码 S : Serial number4: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" 不能使用.

• 3rd S : Serial number2: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" can't be used

• 第三位流水码 S : Serial number4: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" 不能使用.

• 4th S : Serial number1: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" can't be used

• 第四位流水码 S : Serial number4: 0123456789ABCDEFGHIJKLMNPRSTVWXYZ, "I", "O", "Q", "U" 不能使用.

• Maximun volume per date will be 1,048,576 (=32 x 32 x 32 x 32) by Serial numbering.

• 流水码每天最大数量为1048576(=32 x 32 x 32 x 32)

第24~27位:

– Blank space bit

– 空格

第28~37位:

– Year of manufacture. Month. day

– YYYY.MM.DD: 制造年份.月份.日

一维码暗码规则:

– 维码扫描显示为: 8SSB11M89926N*DG YMDSSSS (内容与明码第1~23位内容保持一致)



喷码示意图/Scale 3:1

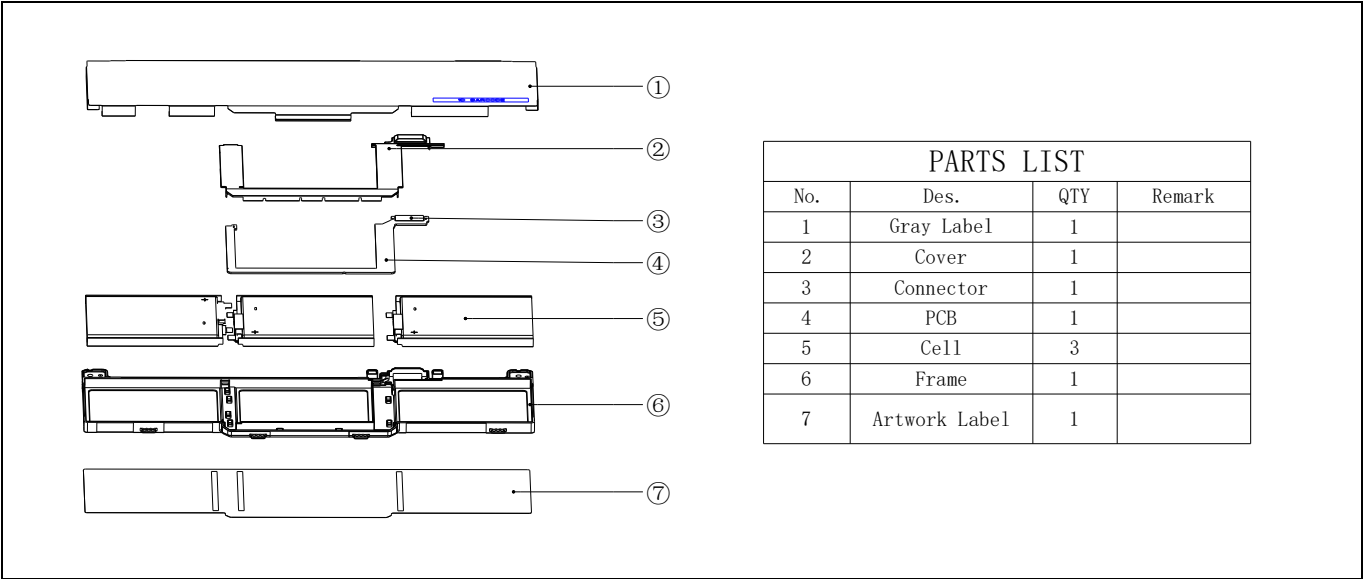
	PRODUCT SPECIFICATION	DOC NO.: <u>PS-GB-615780-01</u> REV. : <u>Draft 1</u> Page : <u>9</u> of <u>27</u>
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6.4 Battery Photos/电池图片

ATL PN	Front Photo
	
GB-S30-615780-010H/L	Back Photo
	

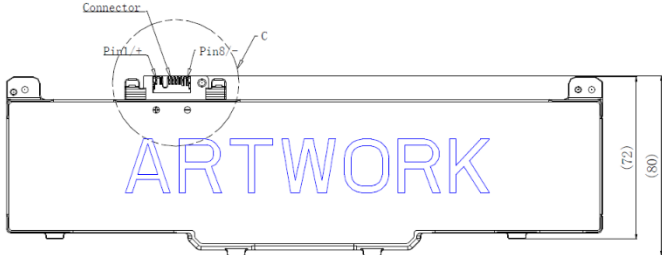
*The picture is for reference only. /图片仅供参考，移印内容以移印图纸为准。

6.4.1 Disassembly Drawing for Pack/电池拆分图



7.Terminal Specification/引脚定义

Pin Define



Item	Name	P/N
-	Connector	
	1st: DEREN, 560811-005H	
	2nd: DRAPHO, BC54085-S0255-1H	

No.	Pin Definition
1	P+
2	P+
3	I2C_CLK
4	IC2C_DATA
5	TEMP
6	N/A
7	GND
8	GND

PIN	TERMINAL NAME	DEFINITION
Pin 1	P+	P+ BATTERY PACK + TERMINAL
Pin 2	P+	P+ BATTERY PACK + TERMINAL
Pin 3	I2C_CLK	SMBUS CLOCK
Pin 4	IC2C_DATA	SMBUS DATA
Pin 5	TEMP	10K OHM/1%RESISTOR CONNECTED TO GND
Pin 6	N/A	
Pin 7	GND	BATTERY PACK GND TERMINAL
Pin 8	GND	BATTERY PACK GND TERMINAL



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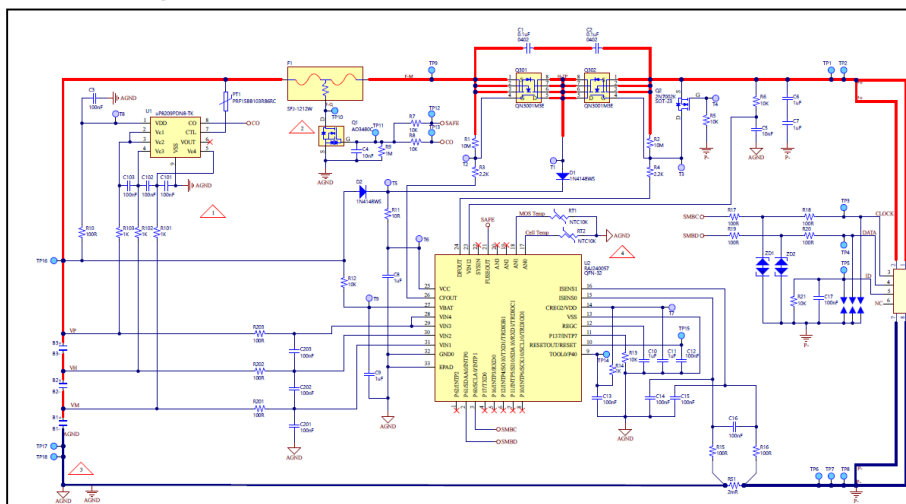
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Pack Safety Certification

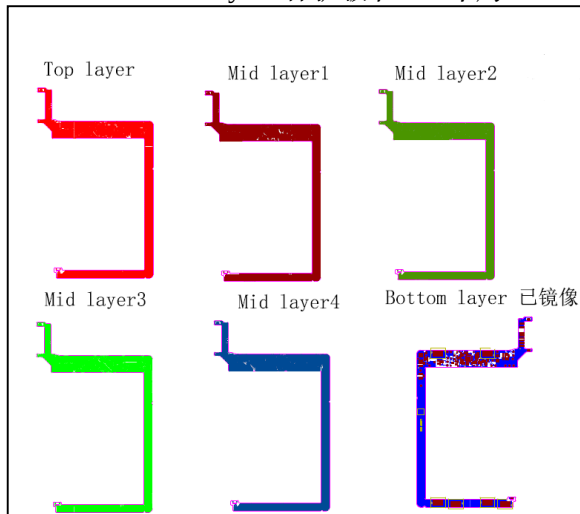
UL/CUL	UL 60950-1, UL 2054, UL 62368-1
CE EMC	EN 55032:2012 + AC:2013 EN 55024:2010 + A1:2015
PSE	JIS C 8712, JIS C 8714.
CB	IEC/EN 62133, IEC/EN 60950-1, IEC/EN 62368-1
KC	KC 62133
UN	UN38.3
TISI	TIS 2217-2548
BSMI	CNS 15364
CQC	CQC---B31241-2022
BIS	IS 16046(Part2):2018
CTIA	IEEE 1625
MIC	QCVN 101: 2016/BTTTT

8 PCM Specifications/保护板规格

8.1 Circuit diagram/电路图



8.2 PCM and FPC Layout/保护板和FPC布局



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8.3 Key Component Part/关键元器件

Item	Specification		Qty	Unit	Remark (Vendor)
PCBA	U1	Main Source : uP8209PDN8-TK	1	pcs	
		Second Source : SH367203E/008EY-AAD00		pcs	
	U2	RAJ240057	1	pcs	
	PT1	PRF18BA103QB5RB	1	pcs	
	B1-, B1+ B2-, B2+ B3-, B3+	Ni;Flat;L1×L2×T=6×3×0.3mm;1/4Y;GP+HF;NVT-0000-B87;B	6	pcs	
	RT1	Main Source : NCP15XH103F03RC	1	pcs	
		Second Source : TH05-3I103FR		pcs	
	RS1	Main Source : RLT12FTCR002M	1	pcs	
		Second Source : RLT12FTCR002M		pcs	
	D1,D2	Main Source : PANJIT;1N4148WS	2	pcs	
		Second Source : JSCJ;1N4148WS		pcs	
	F1	Main Source : SFJ-1212W	1	pcs	
		Second Source : WPF12A3J		pcs	
	Q301, Q302	Main Source : QN3001M3E	2	pcs	
		Second Source : ME7824CS-G		pcs	
	Q1	Main Source : AO3480C	1	pcs	
		Second Source : CJK3400AH		pcs	
	Q2	Main Source : Panjit;2N7002K	1	pcs	
		Second Source : JSCJ;2N7002K		pcs	
PACK	TCO	HC85AY-BL/OT85C-20	3	pcs	

8.4 PCM Parameter(Recovery)

Item	Threshold	Action	
		C-FET	D-FET
Over Voltage Protection(1st)	Set: 4.48±0.025V/Cell; Delay time:3~6s	OFF	ON
Over charge recovery	Reset: 4.35±0.025V/Cell; Delay time:≤2s	ON	ON
Under Voltage Protection	Discharge mode temperature < 15degC & Discharge Current ≤ -50mA : Set: Cell voltage<2.7V and delay time 12s OR Set: Cell voltage<2.5V and delay time 5s	ON	OFF



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	Discharge mode temperature $\geq 15\text{degC}$ & Discharge Current $\leq -50\text{mA}$: Set: Cell voltage $< 2.8\text{V}$ and delay time 12s OR Set: Cell voltage $< 2.5\text{V}$ and delay time 5s Relax mode all temperature & Discharge Current $> -50\text{mA}$: Set: Cell voltage $< 2.8\text{V}$ and delay time 15s Discharge current $\geq -50\text{mA}$ BMU enter discharge mode Release to Relax mode condition: Discharge Current $< -10\text{mA}$		
	Reset: $\geq 3.0\text{V} \pm 0.025\text{V} / \text{cell}$ and Charge current $\geq 50\text{mA}$	ON	ON
Shutdown voltage protection	Discharge mode temperature $< 15\text{degC}$ & Discharge Current $\leq -50\text{mA}$: Set: Cell voltage $< 2.7\text{V}$ and delay time 20s Discharge mode temperature $\geq 15\text{degC}$ & Discharge Current $\leq -50\text{mA}$: Set: Cell voltage $< 2.8\text{V}$ and delay time 20s Relax mode all temperature & Discharge Current $> -50\text{mA}$: Set: Cell voltage $< 2.8\text{V}$ and delay time 20s Discharge current $\geq -50\text{mA}$ BMU enter discharge mode Release to Relax mode condition: Discharge Current $> -10\text{mA}$	OFF	OFF
	Reset: $\geq 2.80\text{V}/\text{cell}$ and wake-up the BMU by charge($\geq 5\text{V}/1\text{ms}$)	ON	OFF
Fully Charge Protection (by taper fully charge condition)	No trigger FC status when charge current $= 0\text{mA}$ 1. RT mode: Cell voltage $\geq 4.40\text{V}$ and average current $< 250\text{mA}$ and delay time 80s(80~120s) 2. LS1-1/T-LS1-1 mode: Cell voltage $\geq 4.39\text{V}$ and average current $< 250\text{mA}$ and delay time $\leq 80\text{s}$ (80~120s) 3. LS1-2/T-LS1-2 mode: Cell voltage $\geq 4.38\text{V}$ and average current $< 250\text{mA}$ and delay time $\leq 80\text{s}$ (80~120s)	OFF	ON



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	4. LS1-3/T-LS1-3 mode: Cell voltage $\geq 4.37V$ and average current $< 250mA$ and delay time $\leq 80s(80\sim 120s)$ 5. LS1-4/T-LS1-4 mode: Cell voltage $\geq 4.36V$ and average current $< 250mA$ and delay time $\leq 80s(80\sim 120s)$ 6. LS1-5/T-LS1-5 mode: Cell voltage $\geq 4.35V$ and average current $< 250mA$ and delay time $\leq 80s(80\sim 120s)$ 7. LS2/T-LS2 mode: Cell voltage $\geq 4.30V$ and average current $< 250mA$ and delay time $\leq 80s(80\sim 120s)$ 8. PI mode: Cell voltage $\geq 4.20V$ and average current $< 250mA$ and delay time $\leq 80s(80\sim 120s)$		
	Reset: RSOC $< 95\%$	ON	ON
Fully Charge Protection (by OCV fully charge condition)	RT mode: In charge mode CCV: Cell Voltage $\geq 4.47V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.43V$ and keep time $\geq 60s$, LS1-1/T-LS1-1 mode: In charge mode CCV: Cell Voltage $\geq 4.46V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.42V$ and keep time $\geq 60s$, LS1-2/T-LS1-2 mode: In charge mode CCV: Cell Voltage $\geq 4.45V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.41V$ and keep time $\geq 60s$ LS1-3/T-LS1-3 mode: In charge mode CCV: Cell Voltage $\geq 4.44V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.40V$ and keep time $\geq 60s$ LS1-4/T-LS1-4 mode: In charge mode CCV: Cell Voltage $\geq 4.43V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.39V$ and keep time $\geq 60s$ LS1-5/T-LS1-5 mode: In charge mode CCV: Cell Voltage $\geq 4.42V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.38V$ and keep time $\geq 60s$ LS2/T-LS2 mode: In charge mode CCV: Cell Voltage $\geq 4.37V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.33V$ and keep time $\geq 60s$	OFF	ON



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	PI mode: In charge mode CCV: Cell Voltage $\geq 4.27V$ and keep time $\geq 1s$ OCV: Cell Voltage $\geq 4.23V$ and keep time $\geq 60s$		
	Reset: RSOC $< 95\%$	ON	ON
Pre--charge Timeout	Set: In pre-charge mode and charge mode $\geq 50mA$, 3600s	OFF	ON
	Reset: BMU detect discharge current $\leq -50mA$ or SMBus pull low	ON	ON
Shutdown the BMU by Command Function	Set: To send the CMD 0x00, data 0x0010 2times within 4s, delay time 10s. OR Set: To send the CMD 0X00, data 0X00F0 2times within 4s AND RSOC $< 30\%$ (for IATA), delay time 10s.	OFF	OFF
	Reset: To wake-up the BMU by more than charge($\geq 5V/1mS$) condition in pack pin(connector P+). C-FET and D-FET turn ON, delay time 2~6s.。	ON	ON
Cell Fuse Protection	Alarm (0x00 Bit 5=1): discharge current is less than -9400mA ($\leq 55^{\circ}C$) for 250msec (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 73^{\circ}C$)	ON	ON
	Alarm Clear (0x00 bit 5=0) : discharge current rise above -8900mA ($\leq 55^{\circ}C$) for 1 sec (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 73^{\circ}C$)	ON	ON
	Set: discharge current is less than -10400mA ($\leq 55^{\circ}C$) for 250msec and the alarm has been active for 5sec (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 73^{\circ}C$)	ON	OFF
	Recovery: current is above -10400mA ($\leq 55^{\circ}C$) for 16sec or charge current is above 50mA. (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 73^{\circ}C$)	ON	ON
	Cell break temperature (55 $^{\circ}C$) Discharge over temperature (H) (73 $^{\circ}C$)	-	-
FET Fuse Protection	Alarm (0x00 bit2=1): discharge current is less than -9400 mA ($\leq 55^{\circ}C$) for 250msec (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 98^{\circ}C$)	On	On
	Alarm clear (0x00 bit2=0): discharge current rises above -8900 mA ($\leq 55^{\circ}C$) for 1sec. (decrease 348.8mA/10 $^{\circ}C$; 55 $^{\circ}C \sim 98^{\circ}C$)	On	On



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	Trip: discharge current is less than -10400mA ($\leq 55^{\circ}\text{C}$) for 250msec and the alarm has been active for 22sec (decrease 348.8mA/10 $^{\circ}\text{C}$; 55 $^{\circ}\text{C}$ ~98 $^{\circ}\text{C}$)	On	Off
	Recovery: average current is above -10400mA ($\leq 55^{\circ}\text{C}$) for 16sec or charge current is above 50mA (decrease 348.8mA/10 $^{\circ}\text{C}$; 55 $^{\circ}\text{C}$ ~98 $^{\circ}\text{C}$)	On	On
	FET break temperature (55 $^{\circ}\text{C}$) FET temp FET-off temperature (98 $^{\circ}\text{C}$)	-	-
Pre-charged overcurrent protection	$\geq 600\text{mA}$; delay time:3~6s	OFF	ON
	Release: $\leq 100\text{mA}$;delay time:10~13s	ON	ON
Over charge current protection 1st	$\geq 6.71 \pm 0.5\text{A}$;Delay time:5~8s	OFF	ON
	Release: $\leq 50\text{mA}$; Delay time:16~19s	ON	ON
Over discharge current protection	$\geq 9.39 \pm 0.5\text{A}$; Delay time:5~8s	ON	OFF
	Release: $\geq -50\text{mA}$; Delay time:16~19s	ON	ON
Overload in Discharge Protection(H/W)	Set: $\leq -18.75\text{A}$ (TYP) ; 13.75A~23.75A Delay time:21~41ms	ON	OFF
	Release: Delay time: $\geq 30\text{s}$	ON	ON
Short Circuit in Charge Protection(H/W)	Set: $\geq 31.25\text{A}$ (TYP) ; 26.25A~36.25A Delay time:915-1600us	OFF	ON
	Release: Delay time: $\geq 30\text{s}$	ON	ON
Short Circuit in Discharge Protection(H/W)	$\leq -43.75\text{A}$ (TYP) ; 38.75A~48.75A delay time:1830-2600us	ON	OFF
	Release: Delay time: $\geq 30\text{s}$	ON	ON
Initial Charge Condition (High temp , no charge)	Temp $\geq 50 \pm 3^{\circ}\text{C}$	OFF	ON
	Release: $< 50^{\circ}\text{C} \pm 3^{\circ}\text{C}$	ON	ON
Initial Charge Condition (Low temp , no charge)	Temp $\leq 0 \pm 3^{\circ}\text{C}$	OFF	ON
	Release: $\geq 0 \pm 3^{\circ}\text{C}$	ON	ON
Charge under temperature protection (Low temp , charge)	$\leq -2^{\circ}\text{C} \pm 3^{\circ}\text{C}$;Delay time:3~6s	OFF	ON
	Release: $\geq 0^{\circ}\text{C} \pm 3^{\circ}\text{C}$	ON	ON
Charge over temperature protection (High temp , charge)	$\geq 60^{\circ}\text{C} \pm 3^{\circ}\text{C}$; Delay time:3~6s	OFF	ON
	Release: $\leq 50^{\circ}\text{C}$	ON	ON

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Discharge under temperature protection	$\leq -40^{\circ}\text{C} \pm 3^{\circ}\text{C}$; Delay time: 3~6s	OFF	OFF
	Release: $\geq -37^{\circ}\text{C} \pm 3^{\circ}\text{C}$;	ON	ON
Discharge over temperature protection	$\geq 73^{\circ}\text{C} \pm 3^{\circ}\text{C}$; Delay time: 1~4s	OFF	OFF
	Release: $\leq 65^{\circ}\text{C}$	ON	ON
FET over temperature protection	$\geq 98^{\circ}\text{C} \pm 3^{\circ}\text{C}$; Delay time: 3~7s	OFF	OFF
	Release: $\leq 90^{\circ}\text{C} \pm 3^{\circ}\text{C}$	ON	ON

8.5 Fuse Blow Function (Permanent Failure)

Item	Threshold	Action		
		FUSE	C-FET	D-FET
2 nd protection chip over voltage protection	$4.60 \pm 0.025\text{V}/\text{Cell}$; Delay time: 5-7s	Blow	OFF	OFF
Safety Over Temperature Cell	$\geq 90^{\circ}\text{C}$; Delay time: 10-14s	Blow	OFF	OFF
Safety Over Temperature FET	$\geq 120^{\circ}\text{C}$; Delay time: 5-8s	Blow	OFF	OFF
Safety Cell Over Voltage protection	Set: $\geq 4.48\text{V}/\text{cell}$ & Delay time: >255sec	Blow	OFF	OFF
D-FET Failure Detection	D-FET off & discharge current < -300mA; Delay time: 20s	Blow	OFF	OFF
C-FET Failure Detection	C-FET off & charge current > 300mA; Delay time: 20s	Blow	OFF	OFF
Cell Interrupt Detection/Tab Disconnection Detection	For charging Monitoring SOC range: 20% to 60% Min cell voltage > 3400mV & Current > 1000mA & Max cell voltage > Min cell voltage * 105% & Re-tries=1	/	OFF	OFF
	For discharging Monitoring SOC range: 0% to 60% Min cell voltage > 0mV & Current > 1000mA & Max cell voltage > Min cell voltage * 105% & Re-tries=1			
	Reset: By Error Reset function detection	/	ON	ON
Internal Short Detection	Pre-condition: OCV status(no current), Relax time > 1800s Interval time: 3600s & Max cell voltage $\geq 3.7\text{V}$ & cell temperature < 45 °C &	/	OFF	OFF

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	Max delta voltage $\geq 50\text{mV}$ & Max Delta V $\geq$ Multiplier (100) * Min Delta V, Re-try: 3 times			
	Reset: By Error Reset function detection	/	ON	ON
Safety Cell Under Voltage	Min cell voltage $\leq 1.3\text{V}$, After wake-up from shutdown mode ;delay time:2s	/	OFF	OFF
	Reset: By Error Reset function detection	/	ON	ON
Disable Old /Weak Batteries function	Set: SBS FCC < 20% of DC & Total FW runtime > 52560hours & Charging start detected	/	OFF	OFF
	Reset: By Error Reset function detection	/	ON	ON

8.6 Other Function Description

Cell Imbalance Function	Max cell voltage > 4.35V & (Max cell voltage – Min cell voltage) > 500mV & Charge current $\geq 150\text{mA}$, Delay time > 20min	Set Bit10 (Cell Imbalance Flag) at Battery Status 0x16)
Shipping Mode Function (D-FET OFF Function)	Enter: By command 0x34 condition: Write “0x0000” by 0x34 & Write “0x1000” by 0x34 (Command interval smaller than 5s) By storage time condition : FG enter sleep mode & No detect charge/discharge current & Storage Time > 2 weeks (storage time counter will be clear when detect any charge/discharge current) & RSOC < 30%	D-FET OFF function 0x34 value changes to “0x0100” from “0x0000” 2. Both D-FET and C-FET turn OFF
	Exit: 1. Write “0x2000” by 0x34 & Write “0x4000” by 0x34 (Command interval smaller than 5 s) OR 2. BMU receives a SMBus communication after waking up from sleep mode.	1. D-FET OFF function 0x34 value changes to “0x0000” from “0x0100” 2. Both D-FET and C-FET turn ON
	Note: 1. It's necessary to have an interval time that is more than 2s between Entry Condition CMD and Exit Condition CMD for turning ON/OFF C/D-FET. 2. Any SMBus R/W commands are such as read 0x34 Ship Mode Status or write 0x27 Challenge Code...etc. 3. The ship mode couldn't be exited by condition2 before BMU enter sleep mode. 4. The BMU will go back to normal operation mode after exit ship mode. 5. If BMU has entered shutdown mode, it will go back to normal mode directly. 6. The current threshold of exit charge mode or discharge mode is 10mA. 7. The D-FET OFF delay time is $\leq 400\text{ms}$ when battery meets the entry condition.	



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Pre-charge Mode	Min Cell V < 3.0V	Charging Current: 248mA
Sleep Mode	Entry: 1. No Communication & 2. Current $\leq 10\text{mA}$ & 3. Delay Time $\leq 20\text{s}$	1. BMU goes to sleep mode 2. C-FET turn OFF.
	Exit: 1. Communication with battery 2. Current $\geq 10\text{mA}$ for 20s 3. HW Wake-up Current $\geq 125\text{mA(TYP)}$;Delay Time $\leq 1\text{s}$ 4. Any Safety Alert / Status	1. BMU goes back to normal mode 2. C-FET turn ON. (Depends ON present status)
	Note: 1. BMU can't allow CLK pin High with Data pin Low or CLK pin Low with Data pin High. 2. The current condition of sleep mode is no matter current direction. 3. The C-FET is turned OFF in sleep mode. Normally, the current exit condition is in discharge. 4. BMU still can enter sleep mode if CLK and Data pins are High 5. BMU will check the battery status every 120s during sleep mode and check time is 250ms, during 250ms check time, "SlpChk"bit will be set and lock C-FET in OFF status.	
0x3F First Used Date	It's able to be written in any value when it's 0, and could rewrite to 0 from any value. The maximum writing count is 100.	
0x16 Bit7 Initialized	Set 1: BMU initialization process has finished, BMU data is stable and can communicate normally with host through SMBUS. Set 0: BMU IC is in initializing process; BMU has not finished initialization after reset.	
Common Dual Mode Function	Switch charge mode from RT to LS1 mode: By cycle count: LS1-1: Cycle Count ≥ 100 LS1-2: Cycle Count ≥ 150 LS1-3: Cycle Count ≥ 300 LS1-4: Cycle Count ≥ 350 LS1-5: Cycle Count ≥ 400 By Hours at Full Charge value: LS1-1: Hours at Full Charge Value ≥ 960 LS1-2: Hours at Full Charge Value ≥ 1200 LS1-3: Hours at Full Charge Value ≥ 1440 LS1-4: Hours at Full Charge Value ≥ 1680 LS1-5: Hours at Full Charge Value ≥ 1920 Switch charge mode from LS1 to LS2: SBS FCC value $\leq$ LS2 target threshold (Minimum of LS2 target threshold: 50% of DC)	



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(Age of LS2 target threshold: 0.75%/month)
(Mode transition at the start of charging)
(LS2 target threshold calculation condition: FUD≠0 or cycle count≥5 or HiV time ≥120h)

Temperature Modifier:

$$= 2^{((\text{Max Cell Temp}-25)/10)};$$

Cell Temperature range Maximum:80degC, Minimum: 25degC

Voltage Modifier

$$=0.8 \text{ if } 4350\text{mV} \leq \text{Cell Voltage} < 4400\text{mV}$$

$$=1.0 \text{ if } 4400\text{mV} \leq \text{Cell Voltage}$$

Hours at Full Charge value

$$=\text{Actual time at high voltage} * \text{Voltage Modifier} * \text{Temperature Modifier}$$

96 Hour Function

96h function enable: When battery is fully charged

96h function disable: 96hours time out. OR Discharge current >5mA for duration time (as 30s) OR Discharge current >100mA without delay time

Dynamic Cut-off Function

Protect Item	Cell Temp ≤ 15°C		Cell Temp >15°C	
	Discharge Mode	Relax Mode	Discharge Mode	Relax Mode
0% Compensation by voltage	2700mV @ 10sec	3000mV @ 10sec	3000mV @ 10sec	3000mV @ 10sec
UVP (D-FET off)	2700mV @ 12sec	2800mV @ 12sec	2800mV @ 12sec	2800mV @ 12sec
Gauge Shutdown	2700mV @ 20sec	2800mV @ 20sec	2800mV @ 20sec	2800mV @ 20sec

Discharge mode temperature <15degC & Discharge Current 50mA

1. 0% Compensation Voltage:

Set: cell voltage ≤2.7V and delay time 10s

OR Set: cell voltage ≤2.5 V and delay time 1s

2. Over Discharge Protection

Set: Cell voltage ≤2.7 V and delay time 12 s

OR Set: Cell voltage ≤2.5V and delay time 5s

3. Shutdown Voltage

Set: Cell voltage ≤2.7V and delay time 20sec

Discharge mode temperature >15degC & Discharge Current 50mA

1. 0% Compensation Voltage:

Set: cell voltage ≤3.0 V and delay time 10s

OR Set: cell voltage ≤2.5V and delay time 1s



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	2. Over Discharge Protection Set: Cell voltage ≤ 2.8 V and delay time 12s OR Set: Cell voltage ≤ 2.5 V and delay time 5s 3. Shutdown Voltage Set: Cell voltage ≤ 2.8 V and delay time 20s Relax mode all temperature & Discharge Current ≥ 50 mA 1. Over Discharge Protection Set: Cell voltage ≤ 3.0 V and delay time 12s 2. Shutdown Voltage Set: Cell voltage ≤ 2.8 V and delay time 20sec Discharge current ≥ -50 mA BMU enter discharge mode Release to Relax mode condition: Discharge Current ≤ -10 mA
DLS Mode Function	Start Time Window Counter Condition By ● FUD $\neq 0$ or ● Cycle Count ≥ 5 or ● HiV Time ≥ 120 h Switch charge mode to TLS1 to TLS2 mode, By Minimum RSOC in Rolling Time Window 7days T_LS1 _1 : 35% $\leq$ RSOC < 40% T_LS1 _2 : 40% $\leq$ RSOC < 45% T_LS1 _3 : 45% $\leq$ RSOC < 50% T_LS1 _4 : 50% $\leq$ RSOC < 55% T_LS1 _5 : 55% $\leq$ RSOC < 65% T_LS 2 : 65% $\leq$ RSOC < 80% Requested Charge Voltage, enter Temporary Mode in charging start T LS1 1 mode: 4.44V/Cell T LS1 2 mode: 4.43V/Cell T LS1 3 mode: 4.42V/Cell T LS1 4 mode: 4.41V/Cell T LS1 5 mode: 4.40V/Cell T LS 2 mode: 4.35V/Cell Fully charged detection at charge mode status: Max cell voltage $\geq$ (SBS Charging Voltage/cell-100mV/cell) and average current < 258mA and continue 10s Mode only changes to higher voltage mode upon RSOC 20%(in DLS Mode) and start charging
PI mode Function	Start Time Window Counter Condition By

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	● FUD≠0 or ● Cycle Count≥5 or ● HiV Time≥120h Switch charge mode to PI: 1. By Minimum RSOC ≥80% in Rolling Time Window 14days 2. By Minimum RSOC ≥80% ,7days if ≥ 40degC for ≥ 40hrs Requested Charge Voltage, enter Temporary Mode in current=0 PI: 4.20V/Cell Fully charged detection at charge mode status: Max cell voltage ≧(SBS Charging Voltage/cell-100mV/cell) and average current 258mA and continue 10sec Mode only changes to higher voltage mode up on RSOC 50% (in PI Mode)
BMU Initialization time after wake up from shutdown mode	Initialized bit set Time (T1) ≧530ms C-FET open time (T2) ≧ Max 2730ms D-FET open time (T3) ≧ Max 2730ms Note. Initialized bit (Bit 7 of 0x16 CMD) is already set when SMBus become enable.

9 Battery Packing requirement/电池包装要求:

9.1 Cell Packing method/电芯包装方式

The Cells are delivered in trays with 6 pcs in a tray, 126 pcs Cells are packed in a bulk package then put into the carton box. Tray dimensions are 282mm (L) *224mm (W) , Carton box dimensions are 294mm(L)*243mm(W)*240mm(T)./ 每盘吸塑盒可装 6 pcs 电芯，每箱装 126 pcs 电芯，吸塑盒尺寸为 282mm (L) *224mm (W) ，纸箱尺寸为 294mm(L)*243mm(W)*240mm(T),一体化打包.

9.2 Pack Packing method/电池包装方式

The battery are delivered in trays with 2pcs in a tray, 42 pcs battery are packed in a bulk package then put into the carton box. Tray dimensions are 310mm (L) *260mm (W) , Carton box dimensions are 324mm(L)*274mm(W)*240mm(T)./ 每盘吸塑盒可装 2 pcs 电池，每箱装 42pcs 电池，吸塑盒尺寸为 310mm(L)*260mm(W), 纸箱尺寸为 324mm(L)*274mm(W)*240mm(T),一体化打包.

9.3 ROHS FREE/HF/LEAD FREE EHM marking/ROHS FREE/HF/LEAD FREE 环保标识:

All these labels will be marked on the carton by ATL. /这些标签将由 ATL 进行标示在外箱

图案	区分	Size 比例	颜色
	背景	横 3.75 : 竖 1 (8cm) : (3cm)	黑(青)
	字体	Large 3 : Small 1	白

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9.4 Customer label printing, ATL QA stick to the carton when printed. (Reference only) /客户 label 打印实例, ATL 打印后贴于外箱 (下图仅供参考)



9.5 Swelling 测试: HTHH, THERMAL SHOCK. 至少每 2 周测试 1 次。

9.6 XRF daily report/ XRF 日报:

Before shipment of every lot, OQA must check below 8 XRF Data and save as documents. (NVT offer) /每 Lot 出货前, OQA 须检测如下 8 项的 XRF Data, 并存档. (NVT 提供)

9.7 XRF monthly report/ XRF 月报: OQA must check the XRF data of below parts ,and submit the report .this will be suitable for two conditions. (NVT offer) /OQA 须检测如下各部件的 XRF Data, 并提交报告, 适用于两种情况 (NVT 提供) :

9.7.1 New products for first shipment. /新产品量产首次交货;

9.7.2 Should be inspected at least one time each month for mass products / 量产中, 每月至少一次抽检。

9.8 TVOC test/TVOC 测试: NVT provide testing data every shipping lot/每个 shipping Lot 由 NVT 提供 TVOC 测试 data。

10 Appendix Handling Precautions and Guidelines for Rechargeable Li-ION Batteries

附录 可充电锂离子电池操作指示及注意事项

Foreword/前言

These *Handling Precautions and Guidelines for LIP Rechargeable Batteries* shall apply to the Product.

本文件《可充电锂离子电池操作指示及注意事项》仅适用于新能源科技有限公司生产的电池。

Statement (1):

Customer is requested to contact ATL in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.

声明 (1): 客户若需要将电池用于超出文件规定以外的设备, 或在文件规定以外的使用条件下使用电池应事先联系 ATL, 因为需要进行特定的实验测试以核实电芯在该使用条件下的性能及安全性。

Statement (2):

ATL will take no responsibility for any accident when the Product is used under other conditions than those described in this Document.

声明 (2): 对于在超出文件规定以外的条件下使用电池而造成的任何意外事故, ATL 概不负责。

- Use specified charge/discharge conditions/使用指定的充放电条件。
- Specified product use only/仅用于指定产品。
- Do not immerse in water pour/禁止投入水中。
- Do not heat or throw in fire/禁止加热或投入火中。
- Do not attempt to crush or drop/禁止尝试挤压或跌落。
- Do not attempt to modify/禁止任何修改。
- Leave in cool places/存放在阴凉处。



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- Do not put it in microwave oven, oven or pressure container/禁止放在微波炉，炉子或压力容器里。
- Do not use battery if not recover during conditions above/假如在上述条件下电池不能恢复请不要继续使用。□
- During assembly, charging, normal use and storage of battery pack, such as change of color, mechanical are detected do not use/在组装，充电，正常使用和存储中，如有变色或机械损伤，请不要继续使用。
- In case of leakage or smells remove from thermal conditions, Also wash off with clean water/万一有漏液或气味，要从热源移除，并且用清水清洗干净。
- Do not place or leave the battery and equipment in the reach of infants so that they are not able to swallow or mistreat the battery by mistake. In case of ingestion, consult with a doctor immediately/请将电池放在幼儿不宜触碰的地方，以免吞食和误处理。万一发生请立即就医。
- Do not let leaked electrolyte come into contact with eyes or skin. In such a case, immediately wash the area of contact with clean water and seek help from a doctor. If not treated soon, prolonged contact may cause serious injury/漏出的电解液远离眼睛和皮肤，万一发生立即清洗干净或就医，假如不能立即处理，可能引起严重伤害。
- Do not put the battery into a fire. Do not use it or leave it in a place near fire, heaters, or high temperature sources. In such a case, the insulator in the battery may be melted, the safety vent and structure may be damaged, or the electrolyte may catch fire, all of which may cause heat generation, explosion, or fire/不要将电池丢入火中。不要在离火源，热源或高温源近的地方使用或放置。在这种情况下，电池中的绝缘保护可能融化，安全阀等结构可能会被毁坏，这样可能会过热，爆炸或起火。
- Do not submerge the battery in water, or wet the battery. If the protecting device assembled in the battery is damaged, the battery may be charged with an abnormal current and voltage and may cause a chemical reaction within the battery, which may result in the cause of heat generation, explosion, or fire of the battery/禁止浸泡或弄湿电池，如果电池保护装置被损坏，电池可能会被异常电流和电压充电从而引起电池内化学变化，导致过热，爆炸或起火。
- Do not use any battery charger not specified. Incorrect charging method and charging equipment, the battery will be damaged, which may cause firing, or other problems/禁止使用非指定充电器，错误的充电方法和充电设备，可能损坏电池，导致起火或其它安全问题。
- Do not use, charge, or leave the battery near fire or in a car under the blazing sun. Such a high temperature may cause damage of the protecting device in the battery, which may result in an abnormal reaction, and then heat generation, explosion, or fire/禁止离火源很近的位置或烈日下的车中放置，使用或给电池充电，这种高温环境下可能毁坏电池中的保护机构，从而引起异常反应，发热，爆炸和起火。
- Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment. In the case the battery is connected in reverse, it is charged reversibly and may cause heat generation, explosion, or fire due to an abnormal chemical reaction/禁止反接电池正负极，在这种情况下，电池被异常充电可能会导致过热，爆炸或起火。
- Do not short terminals. Do not let the battery terminals (+ and -) contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together. In such a case, the battery is shorted and causes an excessive current, which may result in heat generation, explosion, or fire/禁止短接，禁止直接用导线或任何金属（比如金属项链或发卡）连接电池正负极。这种情况下，电池外短路引起过电流，有可能导致过热，爆炸或起火。
- Do not connect the battery directly to an electric outlet or cigarette heater socket in car. With a high voltage applied, the battery may overheat, explode, or cause fire/车上禁止直接连接到电源插座和点烟器上，因为高压下，电池可能会过热，爆炸，或起火。
- Do not throw or drop the battery. Strong impact may damage the protecting device, which may cause an abnormal chemical reaction during its charge and result in heat generation, explosion, or fire of the battery/禁止抛扔或跌落电池，强的重力冲击可能破坏保护机构，可能引起异常化学反应导致发热，爆炸或起火。
- Do not drive a nail in, hit with a hammer, or stamp on the battery. In such a case, the battery may be deformed and shorted, which may cause heat generation, explosion, or fire of the battery/禁止针刺，砸锤或邮戳电池，这种情况

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下，电池可能变形和短路，从而导致过热，爆炸，起火。

- Do not solder the battery directly. Heat applied during soldering may damage the insulator of the safety vent and mechanism, which may result in heat generation, explosion, or fire of the battery/禁止锡焊电池，可能破坏安全阀，以及机构的绝缘保护措施，导致过热，爆炸，起火。
- Do not disassemble or alter the battery. The battery employs a safety mechanism and a protecting device in order to avoid any danger. If these are damaged, heat, explosion or fire may be caused/禁止拆解或更换电池，电池安置了安全机构和保护机构避免安全隐患，假如损坏，可能导致过热，爆炸或起火。
- Do not put the battery in a microwave oven or a pressure cooker. Sudden heat may damage the seal of the battery and may cause heat generation, explosion, or fire of the battery/禁止将电池放在微波炉或压力锅内，极速的热可能导致过热，爆炸或起火。
- Do not leave the battery in a charger or equipment if it generates an odor and/or heat, changes color and / or shape, leaks electrolyte, or causes any other abnormality. In such a case, immediately take the battery out of the charge or equipment and keep it away from fire, otherwise, the battery might overheat, explode, or cause fire/如果电池已经发出气味或发热，颜色和/或外形有变化，电解液露出或任何不正常的现象，请不要再将电池放到充电器或设备里。这种情况下，应立刻将电池从充电器或设备中取出并远离火源，否则电池可能过热，爆炸或起火。
- Discontinue charging after specified charging time even if the charge is not complete, otherwise, the battery might cause heat generation, explosion, or fire/规定时间内不能完成充电不要继续充电，否则可能导致过热，爆炸或起火。
- Do not use the battery in the place where the static electricity (more than the limit of the manufacturer's guarantee) occurs. Otherwise, the protecting device in the battery might be damaged and cause heat generation, explosion, or fire/禁止将电池搁置在超出制造商定义的静电区，否则保护机构可能损坏导致过热，爆炸或起火。
- Do not use the battery in other than the conditions specified; otherwise, the battery might cause heat generation, damage, or deterioration of its performance/禁止在超出规定条件下使用电池，否则可能导致过热，损坏，恶化电池电性能。
- Read the instructions of your equipment regarding the battery installation and removal from the equipment so as not to mishandle and waste the battery/阅读设备和电池关于安装和拆卸指导书，避免误操作导致浪费。
- In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times/如果小孩使用电池，务必指导他们正确操作，确保电池正确使用。
- The battery was manufactured and inspected carefully before shipment to conform with the specification. However, in the case any abnormality of bad smell or heat, etc. arises after purchase, bring the battery back to the retail shop where you bought it/电池制造和出厂前检查是满足本规格的，万一购买后发现像气味，热等任何异常，去购买处退回处理。
- The battery was charged a little before shipment for temporary use by an end user. In case your equipment does not operate with the battery or in the case of a long use, charge the battery with a specified charger once/出厂前电池充了一点电，购买后使用不能工作或使用一段时间后，需要规定的充电器充电。
- Do not charge the battery over the specified time described in the instructions, otherwise, the battery performance might deteriorate/禁止用超出规格书规定的充电时间，否则可能恶化电池电性能。
- Turn off your equipment power switch after use, otherwise, the performance of the battery might deteriorate/设备使用后请关掉电源，否则可能恶化电池电性能。
- The battery after long storage might not be sufficiently charged for use/电池长期存储不用可能导致电量不足。
- Prolonged standing or storage, PACK must be stored after removal from the host (disconnect the electrical properties of contacts); PACK need to conduct a test at least once in half of year. If necessary, the PACK needs to supplement electricity. PACK shall be kept for at least 40% capacity after a path to storage.

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- 长时间搁置或储存，电池必须从主机上拆卸下储存（断开电子器件的接触）；电池至少在半年需要进行测试一次，如有必要，电池需要补充电力，保持至少 40%的容量。
- If the PACK cannot removed from the host , the PACK need to be set to the lowest power consumption mode before the storage, and arrangements the PACK supplementary charge regularly and performance testing according the Consumption rate (recommendation: supplementary charge to 60 - 70% every two months, adjustment depending on the system actual storage conditions and power consumption. With Smart-Gauge products, it is strongly recommended to set Shipping Mode of the PACK after storage.
- 如果电池无法从主机上拆卸，电池需要被设置为最低功耗模式存储，并安排定期充电和性能测试，根据自耗电率（建议：每 2 个月充电至 60-70%，根据系统的实际存储条件和耗电调整。带有智能电量计的产品，强烈建议储存设置为电池出货模式。
- In the case the battery terminals are dirty, clean the terminals with a dry cloth before use, otherwise, the contact with equipment might cause insufficiency, and power failure or charge failure/万一电池金手指脏污，请清洁干净后使用，否则连接设备后可能引起一些异常，甚至可能导致电源或充电失效。
- Despite being rechargeable, the battery has a limited life span, Replace when usage time between charges becomes short/尽管可充电，电池有极限使用寿命，当满充后使用时间明显变短需要更换电池。
- Keep the handling instructions and your equipment instructions in a suitable place for future reference/确保操作指导书和设备指导书在合适的位置为进一步参考。

11. Disclaimer/免责声明

11.1 The Customer hereby agrees that it has carefully read and understand any and all terms and conditions, safety precautions and measures set forth in this Document, furthermore, the Customer agrees to bear full responsibilities of these risks and responsible for any accidents, injury to persons, or property damage that may occur, Customer further agrees to waive claiming any liability against ATL.

客户在此确认并同意，其已认真阅读并理解本产品规格书中所阐明的条款、所有安全规范及措施，并且将完全地对可能因此产生的任何意外事故、人身伤害及财产损失等风险承担责任而不会向 ATL 主张任何责任。

11.2 The Product is produced and supplied to Customer with B2B nature, and is not for direct consumer use. Customer should verify the fitness for a particular purpose of such Product described hereof under certain application. Except as provided in the Specifications, ATL makes no representation or warranty of any kind, whether express or implied, including with respect to any warranty as to merchantability, compatibility, fitness for use or for any particular purpose. The parameters provided in this Document may vary in different applications and performance may vary from time to time. All operating parameters, including typical parameters, must be validated for each customer application by the Customer's technical experts.

本产品是基于企业对企业(B2B)的交易模式所向客户制造及供应，非供终端消费者之直接使用。客户应当验证本规格书定义的产品在客户特定终端（或应用）满足特定用途的适用性。除规格书中有明确规定的情况外，ATL 不作任何明示或暗示的陈述或保证，包括关于适销性、兼容性、适用性或任何特定目的的任何保证。本产品规格书中提供的参数在不同的应用中可能会有所不同，并且性能可能随时间而变化。客户的技术专家必须就每次应用对所有操作参数（包括典型参数）进行验证。

11.3 The parties agree that ATL shall have no liability or obligation with respect to any infringement, claim or action which is based upon:

双方同意对于下列的侵权、索赔或诉讼，ATL 无须承担任何责任：

11.3.1 ATL's incorporation or use of materials, designs, technology or intellectual property designed, designated or instructed by Customer, its affiliates, contract manufacturers, customer, or end user into the products;

ATL 在其产品上结合或使用客户、客户之关联方、分包方、客户或终端用户的设计、指定或指示的材料、设计、技术或知识产权；

11.3.2 the combination, assembly, operation, or use of the products with materials, devices, parts, or software not supplied by ATL;

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客户将 ATL 的产品与非 ATL 提供的材料、设备、组件或软件进行结合、组装使用/运行；

11.3.3 modifications, disassembly, repair, and rework to the products made by Customer or any third party without the prior written consent of ATL;

未经 ATL 授权(包括甲方或其他第三人)而对 ATL 的产品进行的修改、拆解、维修或重工；

11.3.4 ATL's modification of the products in compliance with the design, specification, requirements, or instructions of Customer;

ATL 依照客户的设计、规格、要求或指示而对其产品进行的修改；

11.3.5 the claim or action arising from non-compliance with the requirements for use, storage, delivery, assembly, and disposal of the products designated by ATL;

客户或任何第三方未依据 ATL 指定的产品使用方式对 ATL 的产品进行使用或未按照 ATL 指定的标准对产品进行安置、贮存、运输、组装或处理而导致的任何侵权或索赔事项；

11.3.6 use of the products outside the scope of intended use under this Document; or

客户或任何第三方未依据本产品规格书中约定的使用范围对 ATL 的产品进行使用；或

11.3.7 any defect that may exist before ATL's product enters the market or any defect that is unable to be detected by the existing technology at the time ATL's product enters market.

ATL 未投入流通的产品或 ATL 产品在投入流通时引起损害发生的缺陷尚不存在或投入流通时的技术水平尚不能发现缺陷的存在的。

11.4 ATL shall have no liability or obligation with respect to any Products which have been subjected to abuse, misuse, improper use, negligence, accident, alternation, repair or rework performed by any unauthorized persons or entities other than ATL.

对于任何未经授权的个人或非 ATL 实体滥用，不当使用，疏忽，意外，改动，修理或返工的产品，ATL 概不承担任何责任或义务。

11.5 Neither party shall be liable for any indirect, special, incidental, punitive or consequential damages of any kind (including lost profits), regardless of the form of action, whether in contract, tort (including negligence), strict liability or otherwise, even if informed of the possibility of such damages in advance.

即便对方已提前通知一方下述损失发生的可能性，双方同意并确认，任何一方均不对任何间接的、特别的、附带的、惩罚性的或结果性的损失（包括可得利益损失）承担赔偿责任，无论是基于任何诉讼方式、无论是基于合同或侵权之债（包含过失侵权行为）、无论是否基于严格责任。

11.6 The maximum overall liability of each party, alone or in the aggregate with respect to all claims of any kind, if any, whether in contract, tort (including negligence), strict or product liability, damages, reimburse, indemnification or otherwise, shall not exceed two times of the goods price allocable to the specific Product upon which the claim is directly based.

任一方所应承担的全部责任，无论是基于合同、侵权（包括过失）、严格责任或产品责任、损害、补偿、赔偿或其他任何原因，单次及累计金额应不超过引发该索赔的特定产品的货款的两倍。

12. Miscellaneous/其他

In the event of any conflict, ambiguity or discrepancy between the Chinese version and English version of this Document, both parties agree that the Chinese version of this Document shall prevail.

本产品规格书之中文文本与英文文本如有任何矛盾，歧义或者不一致之处，双方同意应以中文文本优先适用。

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SPECIFICATION OF RECHARGEABLE Li-ion
BATTERY FOR APPROVAL

NO.	ITEMS	DESCRIPTION	
1	Customer	Lenovo	
2	Product	Rechargeable Li-ion Battery	
3	Product Name	Commercial T series 60Wh	
4	Model Name	L25B3P71	
5	ASM P/N	SB11M89971	
6	FRU P/N	5B11M90170	
7	Supplier P/N	19411871-00（30%） 19411872-00（50%）	
8	Cell P/N	19427919-00	
9	Supplier	SHANGHAI BYD COMPANY LIMITED	
		Address: No.999 Xiangjing Road,Songjiang Shanghai, P.R.China, 201611	
		Tel:+86-21-5777 8888	
		Fax:+86-21-5777 5000	
		Http://www.byd.com.cn	
Prepared		Checked	Approved
Ye Yang Shijiang Tan		Qingming Yang Jiafu Zhou	Qianwei Zhang



BATTERY PRODUCT SPECIFICATION

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Revision History

Version	Prepared	Content updated	Date
1.0	Ye Yang Shijiang Tan	First release	2025-07-21
2.0	Ye Yang Shijiang Tan	1、For FVT 2、Pack specification	2025-09-15
3.0	Ye Yang Shijiang Tan	1、Update 3.15 0x37 information and 6.1 FW Version 2、Update 2D Drawings	2025-11-19

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1. Scope

The specification describes the requirements for the rechargeable Li-ion battery pack supplied by Shanghai BYD CO.,LTD. including product specification, function description, design details, test method, product liability, notice etc.

2. Definition

No.	Item	Definition
2.1	Standard environmental	Unless otherwise specified, all tests stated in this document shall be performed at Temperature of $25\pm 2^{\circ}\text{C}$ and relative ambient humidity of $65\pm 30\%$.
2.2	Measurement precision of equipment	Unless otherwise specified, all electrical tests stated in this document shall be performed to no less than the following levels of precision: Charge cut off and discharge cut off voltage: $\pm 0.5\%$ of scale Charge and discharge current: $\pm 0.2\%$ of scale Impedance: $\pm 0.5\%$ of scale Open circuit voltage (OCV): $\pm 1\text{mV}$
2.3	CC-CV	Constant current and constant voltage
2.4	C-Rate("C")	C-Rate (mA) is usually directed the charge or discharge current as a rate of the rated capacity,in this document , "C"(mA) is defined as a numeral value of the design capacity of the battery.
2.5	Standard Charge	This "Standard charge" means charging the battery with specified charge method as the actual application (refer to "Limited charging voltage", "Common Dual Mode Function" .etc for details)
2.6	Standard discharge	The battery discharge to End of discharge voltage with 0.5C constant current.
2.7	Rest time	The time is needed for 10 minutes after every discharge or charge.
2.8	Explosion	When the battery contents are forcibly expelled and the battery casing is torn or split.
2.9	Fire	The emission of flames.
2.10	Leakage	Unplanned escape of electrolyte, gas or other material from battery, leakage has occurred when a battery loses more than 0.1% of its initial mass due to loss of internal components.
2.11	Residual Capacity	The residual capacity is measured by standard discharging to the cut-off voltage after storage.
2.12	Recovery capacity	The recovery capacity is the largest 0.2C capacity of three times standard charge and discharge after storage.

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3. Product specifications

No.	Item	Specification	
3.1	Cell Type & TCO Type	615680 & OT85C-20/HC85AY-BL	
3.2	Pack Configuration	3S1P	
3.3	Pack Model	L25B3P71	
3.4	Nominal Voltage	11.61V	
3.5	Pack Capacity	Design Capacity: 5168mAh, 60Wh Minimum Capacity: 5065mAh, 58.9Wh Typical Capacity for Label: 5168mAh, 60Wh Rated Capacity for Label: 5065mAh, 58.9Wh (Test condition: Battery is charged by Item 2.5, then discharge to 9V with 0.2C constant current) Reserve Capacity: 300mWh & ≥ 10 sec	
3.6	Limited charging voltage	13.35V For RT Mode 13.32V For (T) LS1_1 Mode 13.29V For (T) LS1_2 Mode 13.26V For (T) LS1_3 Mode 13.23V For (T) LS1_4 Mode 13.2V For (T) LS1_5 Mode 13.05V For (T) LS2 Mode 12.75V For PI Mode	
3.7	Upper limited charging voltage	13.35V	
3.8	Standard Charging Current	0~15℃	1034mA CC to 4.45V/cell, then CV to 259mA
		15~20℃	2584mA CC to 4.45V/cell, then CV to 259mA
		20~45℃	6202mA CC to 4.2V/cell, 3618mA CC to 4.45V/cell, then CV to 259mA
		45~60℃	2584mA CC to 4.2V/cell, then stop
		Note: 1. If temp and cell voltage doesn't in the charge mode range, the charging current will be 0mA 2. Hysteresis temperature is 1℃ if temperature range changes from others to room 3. Hysteresis voltage is 300mV 20~45℃: When max voltage of the battery cell decreases by 300mV (4200-300=3900mV) delay 1s, charge current change to 6202mA; 45~60℃: When max voltage of the battery cell decreases by 300mV (4200-300=3900mV) delay 1s, charge current change to 2584mA;	

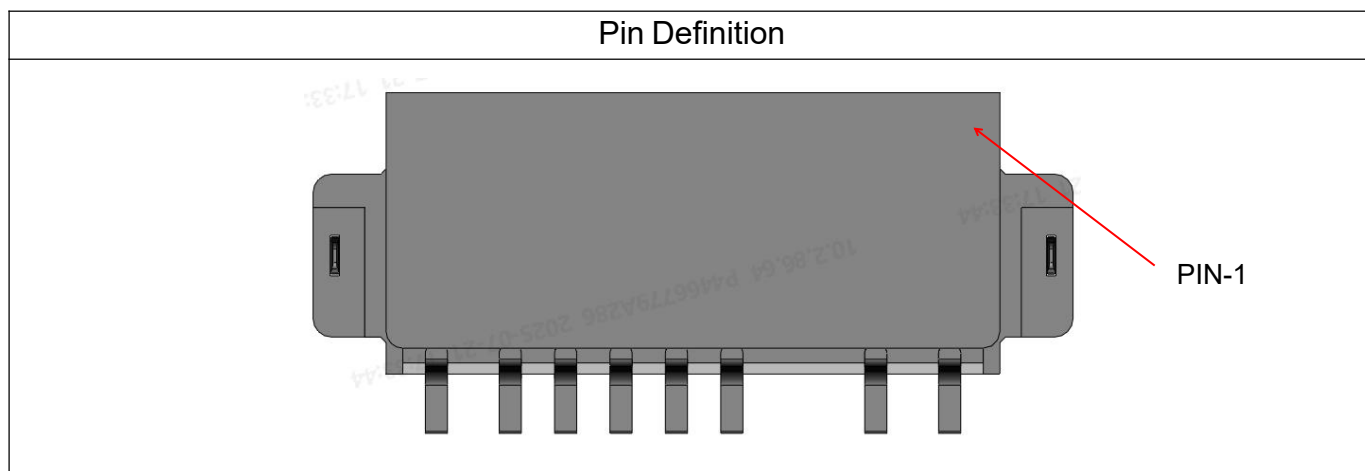
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3.9	Charge Current for Pre-charge Mode	516mA	Min Cell Voltage<3.0V	
3.10	Max Discharge Power	Continue discharge power @35℃ 100%-0%		65W
		30sec discharge power @35℃ 100%-10%		80W
		CB power @35℃		80W
3.11	End of discharge voltage	9V		
3.12	Max Continuous Discharge Current	7.222A@35℃		
3.13	Operation temperature	Charge: Initial: 0-50℃; Continuous: 0-60℃; Discharge: -20-70℃		Operation humidity range 10%~95%
3.14	Storage temperature	Storage temperature	Storage period	Recovery capacity
		-20 ~ +35℃	1 year	>80%
		-20 ~ +40℃	6 months	>80%
		-20 ~ +45℃	1 month	>80%
		-20 ~ +50℃	1 week	>80%
3.15	Battery Information(0x37)	Maker ID:0x0008 HW ID: 0x0072 FW Version:0x0032 DF Version:0x0003		
3.16	Authentication Method	SHA256		
3.17	Internal impedance	≤200mΩ		
3.18	Pack weight	≤225g		
3.19	Shipment SOC of Pack	45%~55% for land & ocean shipment 20%~29% for air shipment		
3.20	Battery status when shipment	ShutDown Mode		

4. Life cycle specification

Definition of cycle	1 cycle is defined when the battery after standard charged(Item 2.5) /rest 10 minutes, then Standard discharge (Item 2.6) to End of discharge voltage/rest 10minutes.
Definition of loading	Standard discharge (Item 2.6)
Definition of charging	standard charged(Item 2.5)

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Ambient temperature	25±2℃	
Life cycle specification	≥ 80% Energy at 3Years, 800 Cycles ≥ 80% Energy at 3Years, 1000 Cycles Note: 80% Energy=0.2C discharge capacity/minimal capacity(Rated capacity)	

5. Pin assignment



PIN	TERMINAL NAME	DEFINITION
1	P+	Battery Pack Positive Terminal.
2	P+	Battery Pack Positive Terminal.
3	CLOCK	SMBus Clock interface I/O pin.
4	DATA	SMBus Data interface I/O pin.
5	ID	10Kohm Resistor connected to GND.
6	NC	NC
7	GND	Battery Pack Negative Terminal.
8	GND	Battery Pack Negative Terminal.

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6. Battery Pack Function

6.1 Control IC

No.	IC Type	Manufacturer	Description
6.1.1	Gas Gauge	TI	bq9004(FW Ver:ECT-T9004-2003-2C03) is used for battery management,communication with host through SMBus interfaces.
6.1.2	2nd protection IC	ABLIC	S-8264AAV-I8T1U is used for cell over voltage protection by hardware.
6.1.3	2nd protection IC	UPI	uP8306PDX8-G1 is used for cell over voltage protection by hardware.

6.2 Measurement accuracy

Item	Accuracy	Resolution
Voltage	$\pm 20\text{mV}$	Unless otherwise specified(eg. AFE settings), all electrical tests stated in this document shall be performed to no less than the levels of precision
Discharge current/Charge current	$\pm 1\%$	
Temperature	$\pm 3^{\circ}\text{C}$	
Delay time(SW)	$\pm 3\%$	

6.3 Protection Functions (Recovery)

No.	Item	Parameter	Value	Action	
				C-FET	D-FET
1	Cell over voltage(SwOv1)	Threshold	$\geq 4490\text{mV}$	OFF	ON
		Delay	3 s	—	—
		Recovery	$\leq 4350\text{mV}$	ON	ON
2	Cell under voltage(UV)@Room Temp($>15^{\circ}\text{C}$ and $\leq 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12 s	—	—
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
3	Cell under voltage(UV)@Low Temp($\leq 15^{\circ}\text{C}$)	Threshold	$\leq 2700\text{mV}$	ON	OFF
		Delay	12 s	—	—



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		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
4	Cell under voltage(UV)@High Temp($> 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12 s	—	—
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
5	Cell under voltage(UV)@all Temp & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2500\text{mV}$	ON	OFF
		Delay	5s	—	—
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
6	Cell under voltage(UV) @relax mode & Discharge Current $> -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	ON	OFF
		Delay	12 s		
		Recovery	$\geq 3000\text{mV}$ AND Charge Current $\geq 50\text{mA}$	ON	ON
7	Shutdown voltage of cell @Room Temp($>15^{\circ}\text{C}$ and $\leq 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s	—	—
		Recovery	3000mV and Charging more than 5V within 1.6s, so as other temps.	ON	ON
8	Shutdown voltage of cell @Low Temp($\leq 15^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2700\text{mV}$	OFF	OFF
		Delay	20s	—	—
		Recovery	3000mV	ON	ON
9	Shutdown voltage of cell @High Temp($> 40^{\circ}\text{C}$) & Discharge Current $\leq -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s	—	—
		Recovery	3000mV	ON	ON
10	Shutdown voltage of cell @relax mode & Discharge Current $> -50\text{mA}$	Threshold	$\leq 2800\text{mV}$	OFF	OFF
		Delay	20s	—	—
		Recovery	3000mV	ON	ON
11	Over current in charge (SW OCC)	Threshold	$\geq 6822\text{mA}$	OFF	ON
		Delay	5 s		
		Recovery	$\leq -50\text{mA}$ delay 1s OR 16s passed	ON	ON



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12	Over current in discharge (SWOCD)	Threshold	$\leq -9889 \text{ mA}$	ON	OFF
		Delay	5s		
		Recovery	$\geq 50 \text{ mA}$ delay 1s OR 16s passed	ON	ON
13	Over temperature in charge (TempAlarmBs)	Threshold	$\geq 60^\circ\text{C}$	OFF	ON
		Delay	2 s		
		Recovery	$\leq 50^\circ\text{C}$	ON	ON
14	Over temperature in discharge (Cell Temp)	Threshold	$\geq 73^\circ\text{C}$	OFF	OFF
		Delay	2 s		
		Recovery	$\leq 65^\circ\text{C}$	ON	ON
15	Under temperature in charge (TempAlarmBs)	Threshold	$\leq -2^\circ\text{C}$	OFF	ON
		Delay	2 s		
		Recovery	$\geq 0^\circ\text{C}$	ON	ON
16	Over temperature of FET (FetTemp)	Threshold	$\geq 98^\circ\text{C}$	OFF	OFF
		Delay	2s		
		Recovery	$\leq 90^\circ\text{C}$	ON	ON
17	AFE OC Chg (HwScc)	Threshold	$\geq 22.2 \pm 2.36 \text{ A}$	OFF	ON
		Delay	$366 \pm 10\% \text{ us}$		
		Recovery	$\leq -50 \text{ mA}$ delay 1s OR 30s passed	ON	ON
18	AFE OC Dsg(HwOcd)	Threshold	$\leq -16.64 \pm 2.08 \text{ A}$	ON	OFF
		Delay	$15 \pm 10\% \text{ ms}$		
		Recovery	$\geq 50 \text{ mA}$ delay 1s OR 30s passed	ON	ON
19	Short circuit(HwScd)	Threshold	$\leq -22.2 \pm 2.36 \text{ A}$	ON	OFF
		Delay	$366 \pm 10\% \text{ us}$		
		Recovery	$\geq 50 \text{ mA}$ delay 1s OR 30s passed	ON	ON
20	Precharge Timeout (PrechargeTO)	Threshold	60min	OFF	ON
		Recovery	$\leq -5 \text{ mA}$ delay 1s	ON	ON
21	Precharge Over current (SwOcpc)	Threshold	$\geq 1034 \text{ mA}$	OFF	ON
		Delay	5s		
		Recovery	$\leq -15 \text{ mA}$ delay 1s OR 30s passed	ON	ON
22	Fast Over Current in Discharge_Cell	Threshold	$\leq -11400 \text{ mA}$	ON	OFF



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		Delay	5.25s		
		Recovery	16s passed	ON	ON
23	Fast Over Current in Discharge_FET Temp (FetFuse)	Threshold	$\leq -12000\text{mA}$	ON	OFF
		Delay	5.25s		
		Recovery	16s passed	ON	ON
24	Charge Time Out(ChargeTO)	Threshold	65535min	OFF	ON
		Recovery	$\leq -15\text{mA}$ delay 1s	ON	ON

6.4 Permanent Failure Functions (Fuse Blow)

No.	Item	Condition	Action		
			Fuse	C-FET	D-FET
1	Cu Deposition Detection (PfCuDeposition)	Set: cell voltage $\leq 1.3\text{V}$ Delay Time: 2sec after wakeup from shutdown mode	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
2	Second OVP Function (2nd P-IC) (Pf2ndOv)	Set: Max cell voltage: $4.6 \pm 0.025\text{V}$ & Delay time: 4.5 ~ 6.8sec (2ndP-IC:S-8264AAV-I8T1U) OR Max cell voltage: $4.6 \pm 0.025\text{V}$ & Delay time: 4.8 ~ 7.2sec(2nd P-IC: uP8306PDX8-G1) OR FET temp $\geq 130^\circ\text{C}$ Delay Time: 1sec	Blow	OFF	OFF
3	Second Over Temperature of Cell (PfCellTemp)	Set: Cell Temperature $\geq 90^\circ\text{C}$ Delay Time: 10sec & Charge Current $\geq 25\text{mA}$ OR Set: Cell Temperature $\geq 90^\circ\text{C}$ Delay Time: 10sec & Discharge Current $\leq -100\text{mA}$	Blow	OFF	OFF
4	Second Over Temperature of FET (PfFetTemp)	Set: FET Temperature $\geq 120^\circ\text{C}$ Delay Time: 5sec	Blow	OFF	OFF
5	C-FET Failure for Charge (PfFetFailure)	Set: C-FET Turn Off & Charge current $\geq 250\text{mA}$ and Battery Voltage - Pack+ Voltage $< 350\text{mV}$ Delay Time: 20sec	Blow	OFF	OFF



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6	D-FET Failure for Discharge (PfFetFailure)	Set: D-FET Turn Off & Discharge current $\leq -250\text{mA}$	Blow	OFF	OFF
7	Thermistor Open detection (PfThermOpen)	Set: TSx(Cell or FET) Temperature $\leq -46^{\circ}\text{C}$ Delay Time: 10sec	—	OFF	OFF
8	Thermistor Short detection (PfThermShort)	Set: TSx(Cell or FET) Temperature $\geq 150^{\circ}\text{C}$ Delay Time: 10sec	Blow	OFF	OFF
9	Disable Old Weak Batteries Function (PfOldBattery)	Set: SOH at $25^{\circ}\text{C} < 20\%$ of DC & Total FW runtime $> 52600\text{hours}$ & Charging start detected	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
10	Internal Short Detection (PfCellShort)	SBS Current = 0 CASE1 Maxcellvoltage: $3850\text{mV} \sim 4050\text{mV}$ CASE2 Maxcellvoltage: $4050\text{mV} \sim 4250\text{mV}$ DetectionWindow: 60min DetectionWindowDelay: 2 count CASE1VoltageDeltaMax: 25mV CASE1Vtagemin/minHisTimes: 5times CASE2VoltageDeltaMax: 35mV CASE2Vtagemin/minHisTimes: 5times	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON
11	Cell Imbalance Detection(PfCellImbalance)	Set: Max Cell Voltage $4350\text{mV} \sim 4450\text{mV}$ Relax for 30min Max $\Delta V_{\text{Cell}} \geq 500\text{mV}$ Delay Time=5min	—	OFF	OFF
		Recovery: By Error Reset Function Detection	—	ON	ON



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6.5 Other Functions Introduction

NO.	Item	Condition	Action
1	SHIP Mode Function (D-FET OFF Function)	Enter: 1. Write "0x0000" by 0x34 & Write "0x1000" by 0x34 (Command interval smaller than 5s) OR 2. RSOC < 30% & No detectable charge or discharge current & Storage Time > 14 days & In Sleep Mode (Start counting from Sleep Mode)	1. D-FET OFF function 0x34 value from "0x0000" changed to "0x0100" 2. Both D-FET and C-FET turned OFF
		Exit: 1. Write "0x2000" by 0x34 & Write "0x4000" by 0x34 (Command interval smaller than 5s) OR 2. BMU receives a SMBus communication after waking up from sleep mode.	1. D-FET OFF function 0x34 value from "0x0100" changed to "0x0000" 2. Both D-FET and C-FET turned ON
		Note: 1. It's necessary to have an interval time that is more than 2sec between Entry Condition CMD and Exit Condition CMD for turning ON/OFF C/D-FET. 2. Any SMBus R/W commands are such as read 0x34. 3. The BMU will go back to normal operation mode after exit ship mode. 4. The D-FET OFF delay time is ≤400msec when battery meets the entry condition. 5. The ship mode couldn't exit by condition 2 before BMU enter sleep mode. 6. The current threshold of exit charge mode or discharge mode is 10mA 7. The D-FET ON delay time is ≤400msec when battery meets the exit condition.	



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2	Sleep Mode	Entry: 1.No Communication for 20sec & 2. Current ≤10mA & 3.No specific safety&PF triggered	1.BMU goes to sleep mode. 2.C-FET OFF.
		Exit: 1. Communication with battery OR 2. Current ≥10mA OR 3. Power Wake-up Current ≥300mA (TYP) ; Delay Time ≤1sec OR 4. Any Safety Alert / Status	1.BMU goes back to Normal mode. 2.C-FET ON. (Depends ON present status)
		Note: 1. BMU can't allow CLK pin High with Data pin Low or CLK pin Low with Data pin High. 2. The current condition of sleep mode is no matter current direction. 3. The C-FET is turned OFF in sleep mode. Normally, the current exit condition is in discharge. 4. BMU still can enter sleep mode even CLK and Data pins are high	
3	0x3F First Used Date	It's able to be written in any value when it's 0, and could rewrite to 0 from any value. There is no FUD writing counts limitation [4:0]:Day(1-31) [8:5]:Month(1-12) [15:9]: Year(0-127):(Year-1980) (Year-1980)x512 + Month x 32 + day	
4	0x16 Bit7 Initialized	Bit7= 1: Gauge initialization process has finished, BMU data is stable and can communicate normally with host through SMBus. Bit7= 0: Gauge IC is in initializing process; BMU has not finished initialization after reset.	
5	Charge Rate Control by FCC	SBS Charging Current value will base on the SBS FCC value and reduce accordingly with the FCC degradation Minimum SBS Charging Current is limited to Pre-Charging Current.	



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6

Common Dual
Mode Function

Switch charge mode from RT to LS1 mode:

By Cycle Count:

LS1 Step1: Cycle Count ≥ 100

LS1 Step2: Cycle Count ≥ 150

LS1 Step3: Cycle Count ≥ 300

LS1 Step4: Cycle Count ≥ 350

LS1 Step5: Cycle Count ≥ 400

OR

By Hrs at Full Charge:

LS1 Step1: Hrs at Full Charge Value ≥ 960 hrs

LS1 Step2: Hrs at Full Charge Value ≥ 1200 hrs

LS1 Step3: Hrs at Full Charge Value ≥ 1440 hrs

LS1 Step4: Hrs at Full Charge Value ≥ 1680 hrs

LS1 Step5: Hrs at Full Charge Value ≥ 1920 hrs

Switch charge mode from LS1 to LS2 mode:

Threshold Condition: SBS FCC $\leq$ LS2 target value

(Minimum of LS2 target threshold: 50% of DC)

(Age of LS2 target threshold: 0.75%/month)

(Mode transition at the start of charging)

(LS2 target threshold calculation condition: FUD $\neq$ 0 or Cycle Count ≥ 5 or HiV time ≥ 120 hrs)

Temperature Modifier and Voltage Modifier:

Temperature modifier:

$$= 2^{((\text{Cell temperature} - 25)/10)}$$

The calculation range of this modifier is 25 deg C to 90 deg C

Voltage modifier:

$$= 0.8: \text{If Max Charge Voltage} - 100\text{mV} \leq \text{Cell Voltage} < \text{Max Charge Voltage} - 50\text{mV}$$

$$= 1.0: \text{If Max Charge Voltage} - 50\text{mV} \leq \text{Cell Voltage}$$

The adjusted time is calculated by following formula.

Adjust time = Actual time at high voltage * Temperature modifier * Voltage modifier

Actual Voltage Higher than Charging Voltage Prevention:

To Check the OCV value when charge mode change.

1. Enter Permanent Life Span mode
2. Both SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA



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		3. Delay time: 5sec If OCV voltage value $\geq$ Charging Voltage Value of current Life Span mode. 1. SBS RSOC value report 100% 2. FC bit set 1 3. SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA If OCV voltage value $<$ Charging Voltage Value of current Life Span mode. 1. SBS Charging Voltage()0x15 & Charging Current()0x14 report current Life Span mode value 2. C-FET turn ON 3. BMU will enter full charge detection at charge mode status * OCV detection time counter(5sec) will be cleared if detecting the discharging current during OCV detection period
7	Temporary Dual Mode Function	Dynamic Lifespan mode: Min RSOC in Rolling Time Window DLS (7days) T-LS1 Step1: $35\% \leq \text{RSOC} < 40\%$ T-LS1 Step2: $40\% \leq \text{RSOC} < 45\%$ T-LS1 Step3: $45\% \leq \text{RSOC} < 50\%$ T-LS1 Step4: $50\% \leq \text{RSOC} < 55\%$ T-LS1 Step5: $55\% \leq \text{RSOC} < 65\%$ T-LS2 : $65\% \leq \text{RSOC} < 90\%$ Recovery condition: RSOC $<$ Exit DLS RSOC Threshold (RSOC 20%) Plugged-in mode: 1. RSOC $\geq$ PI RSOC Threshold (90%) in Rolling Time Window PI (20160min: 14days) OR 2. Cell temperature is ≥ 40 degc for 40 hours at last 7 days Recovery condition: RSOC $<$ Exit PI RSOC Threshold (RSOC 50%) *Time window are initialized when:FUD$\neq$0 or Cycle Count $\geq$5 or HiV time $\geq$120hrs Actual Voltage Higher than Charging Voltage Prevention: To Check the OCV value when charge mode change.



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		1. Enter Temporary mode 2. Both SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA 3. Delay time: 5sec If OCV voltage value $\geq$ Charging Voltage Value of current Temporary mode. 1. SBS RSOC value report 100% 2. FC bit set 1 3. SBS Charging Voltage()0x15 & Charging Current()0x14 report 0mV and 0mA If OCV voltage value $<$ Charging Voltage Value of current Temporary mode. 1. SBS Charging Voltage()0x15 & Charging Current()0x14 report current Life Span mode value 2. C-FET turn ON 3. BMU will enter full charge detection at charge mode status * OCV detection time counter(5sec) will be cleared if detecting the discharging current during OCV detection period
8	96 Hour Function	96hrs function enable: When battery is fully charged 96hrs function disable: 96hours time out. OR Discharge current $>$ 5mA for duration time (as 30 seconds) OR Discharge current $>$ 100mA without delay time
9	TDA Shutdown Function	1. When TDA bit(bit11 of 0x16 BatteryStatus()) set to "1", and keep 10sec or more in discharging state. 2. C/D FET will be turned off within 2 sec 3. BMU detect output voltage for shutdown within 2 sec 4. BMU will enter Shutdown mode



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10	Cell Balancing Function	Cell Balance ON Condition: Fully charged (FC=1) & Max CellV - Min CellV delta >20mV Delay time: 60sec Cell Balance OFF Condition: 1. Max CellV - Min CellV delta < 10mV 2. Average current not equal 0 3. Minimum cell Voltage $\leq$ 3800mV Cell Balance Disable Condition: 1. Fully charged & Max CellV - Min CellV delta $\geq$ 40mV 2. RSOC $\leq$ 10% & Max CellV - Min CellV delta $\geq$ 100mV 3. Condition1 Max CellV and Condition2 Min CellV is same cell block Continues detect 5 times Cell Balance Re-enable Condition: 1. Fully charged & Max CellV - Min CellV delta $\geq$ 40mV 2. RSOC $\leq$ 10% & Max CellV - Min CellV delta $\geq$ 100mV 3. Condition1 Max CellV and Condition2 Min CellV is different cell block Continues detect 5 times
11	HSFCC Function	HSFCC Learning is based on cell IR measurement and the amount of charging capacitance to full charge. BMFW measures cell IR every 1 percent from 65% to 75% of SOC when pack is charged from lower than 65% of SOC. Cell IR: V0: Voltage just before turning off C-FET V1: Voltage just before turning on C-FET I : Current just before turning off C-FET $IR = (V0 - V1) / I$ Operating condition: 1. Cell Temp: $\geq 20^{\circ}\text{C}$ and $\leq 45^{\circ}\text{C}$. 2. Changing rate: $\geq 0.45^{\circ}\text{C}$ and $\leq 1.24^{\circ}\text{C}$ 3. Charging current $\geq 0.05\text{C}$ 4. More than 72h after FCC updating by low side FCC learning 5. Max error $\leq 10\%$ 6. When IR Measurement discharge current need less than 5mA 7. Charging Current need higher than 1000mA 8. One cycle after exiting PI/DLS mode 9. Not enter PI/DLS mode 10. Charging Current need be detected within 72hrs during IR Measurement 11. FCC learning deviation $\leq 10\%$ 12. No discharge detection. (SBS AVG current need higher than 0mA)



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12	EOL Function	The End-of-Life (EoL) Prediction function is to predict the life time of the battery pack and inform users of the optimal time to replace CRU batteries. The degraded level should be determined from the change of cell internal resistance BMFW measures cell IR every 5 percent from 55% to 75% of SOC when pack is charged from lower than 55% of SOC. Cell IR: V0: Voltage just before turning off C-FET V1: Voltage just before turning on C-FET I : Current just before turning off C-FET $IR = (V0 - V1) / I$ Operating condition: 1. Cell Temp: $\geq 7.5^{\circ}\text{C}$ and $\leq 52.5^{\circ}\text{C}$. 2. IR: $\geq 0\text{m}\Omega$ and $\leq 100\text{m}\Omega$ 3. No discharge current during IR measurement 4. Charge start from RSOC < 55% 5. SBS AVG Current need > 0.05C during IR measurement 6. SBS Current need > 1000mA Formula: Impedance-based FCC = DesignCapacity * Impedance-based FCC coefficient (Impedance-based FCC coefficient) = $1.0 + a * (\text{Cycle count}) + b * (\text{High-temp.\&voltage time}) + c * (\text{Temp-modified Impedance Growth})$ *($a = -1.802 \times 10^{-5}$, $b = 7.498 \times 10^{-5}$, $c = -0.2569$) Prediction: When Impedance-based FCC < Fcc Threshold, calculate the Cycle Count and Storage Time until EoLTargetFcc (degradation to the point where battery replacement is recommended) is reached by linear regression (calculated by the least-squares method for both the CycleCount and Storage Time cases) on 20 buffers of history data for EoL prediction.								
13	Full charge detection	By Taper Condition: Max Cell Voltage $\geq$ Taper Voltage & Average Current < Taper Current Delay Time: 60sec~90sec <table><tr><th>Mode</th><th>Taper Voltage(mV)</th><th>Taper Current</th></tr><tr><td>RT</td><td>4400</td><td rowspan="2">0.05C of Nominal Capacity</td></tr><tr><td>LS1/T-LS1 Step1</td><td>4390</td></tr></table>	Mode	Taper Voltage(mV)	Taper Current	RT	4400	0.05C of Nominal Capacity	LS1/T-LS1 Step1	4390
Mode	Taper Voltage(mV)	Taper Current								
RT	4400	0.05C of Nominal Capacity								
LS1/T-LS1 Step1	4390									



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LS1/T-LS1 Step2	4380
-----------------	------

LS1/T-LS1 Step3	4370
-----------------	------

LS1/T-LS1 Step4	4360
-----------------	------

LS1/T-LS1 Step5	4350
-----------------	------

LS2/T-LS2	4300
-----------	------

PI	4200
----	------

Recovery condition:

RSOC < Exit RSOC Threshold (RSOC 95%)

By Pulse Charge OCV Detection:

Step1:

(Turn Off C-FET)

Cell Voltage $\geq$ CV + 20mV continues for 1sec, C-FTE is turned OFF.

Step2:

(Turn On C-FET, Not Fully Charge)

If Max Cell Voltage < CV - 20mV continues for 1sec, C-FET is turned ON.

(Fully Charge)

If Max Cell Voltage $\geq$ CV - 20mV continues for 60sec, detect Full charge.

Mode	Turn Off C-FET (mV) ($\geq$ CV + 20mV)	Turn On C-FET (mV) ($<$ CV - 20mV)	Fully Charge (mV) ($\geq$ CV - 20mV)
RT	4470	4430	
LS1/T-LS1 Step1	4460	4420	
LS1/T-LS1 Step2	4450	4410	
LS1/T-LS1 Step3	4440	4400	
LS1/T-LS1 Step4	4430	4390	
LS1/T-LS1 Step5	4420	4380	
LS2/T-LS2	4370	4330	
PI	4270	4230	

Recovery condition:

RSOC < Exit RSOC Threshold (RSOC 95%)

By CCV step down function:

Max Cell Voltage $\geq$ CV + 10mV continues for 1sec, CC Step down with 0.1C of SBS FCC

Mode	CCV Step down Voltage(mV)
RT	4460
LS1/T-LS1 Step1	4450
LS1/T-LS1 Step2	4440
LS1/T-LS1 Step3	4430
LS1/T-LS1 Step4	4420
LS1/T-LS1 Step5	4410
LS2/T-LS2	4360



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		PI	4260
		Minimum of CC step down value: 0.1C Released to initial current condition: Discharge current detection or BMU enter DSG mode(sleep mode)	
14	Shutdown cancel Function	Pre-condition: BMU enter shutdown process Set: 1.Shutdown delay time passed 2.C/D FET turn off 3.Pack P+ Voltage > SBS charging voltage -200mV Delay time: 3 sec Action: BMU shutdown cancel, BMU return to normal status	
		Mode	SBS Charging Voltage(mV)
		RT	13350
		LS1/T-LS1 Step1	13320
		LS1/T-LS1 Step2	13290
		LS1/T-LS1 Step3	13260
		LS1/T-LS1 Step4	13230
		LS1/T-LS1 Step5	13200
		LS2/T-LS2	13050
		PI	12750

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7.Safety Operating Parameters for GB 31241-2022

安全工作参数 Safety Operating Parameter	符号 Symbol	电池组 L25B3P71 Battery Pack
充电限制电压 (Limited charging voltage)	Ucl	13.35V
充电上限电压 (Upper limited charging voltage)	Uup	13.35V
放电截止电压 (Discharge cut-off voltage)	Udo	7.5V
放电终止电压 (End of discharge voltage)	Ude	9V
推荐充电电流 (Recommendation charging current)	Icr	6202mA CC to 12.6V,3618mA CC to 13.35V, then CV to 259mA
最大充电电流 (Maximum charging current)	Icm	6202mA
推荐放电电流 (Recommendation discharging current)	Idr	1034mA
最大放电电流 (Maximum discharging current)	Idm	7222mA
过压充电保护电压 (Over voltage for charge protection)	Ucp	4470mV/Cell
过流充电保护电流 (Over current for charge protection)	Icp	6822mA
欠压放电保护电压 (Low voltage for discharge protection)	Udp	2800mV/Cell
过流放电保护电流 (Over current for discharge protection)	Idp	9889mA
上限充电温度 (Upper limited charging temperature)	Tcm	60℃
下限充电温度 (Lower limited charging temperature)	Tcl	0℃
上限放电温度 (Upper limited discharging temperature)	Tdm	70℃
下限放电温度 (Lower limited discharging temperature)	Tdl	-20℃
充电截至电流 (Taper current for charging)	-	259mA



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DOC NO. :

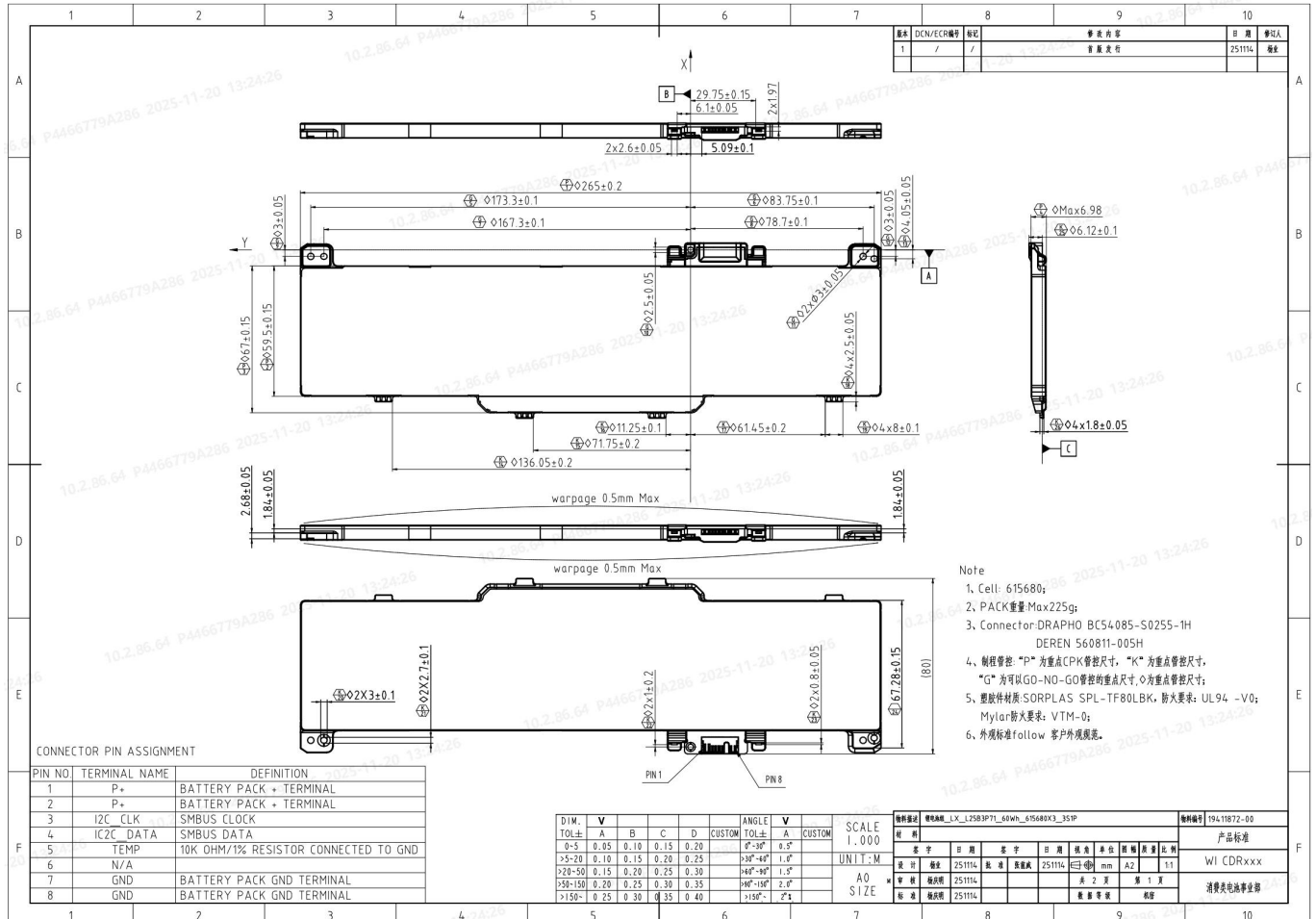
ISSUED DATE: 20251119

VERSION: v3.0

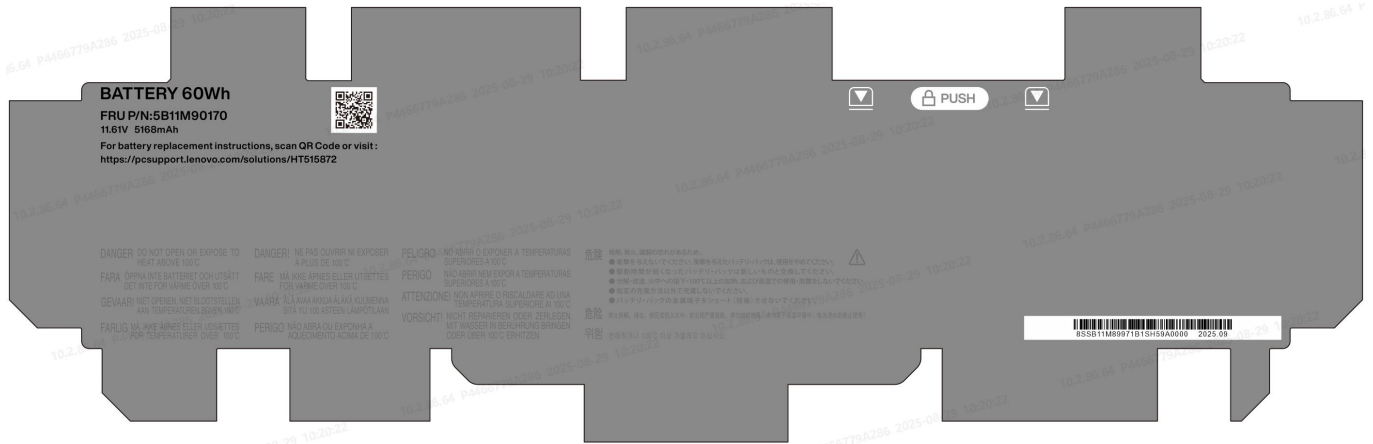
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8.Pack specification

8.1 2D Drawings



8.2 Label printing



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9. Others

9.1 Warranty period:

Warranty period of this product is 12 months from manufacture code, which the battery should be used accordance with this specification.

9.2 Product liability:

You are kindly requested to use the battery which is delivered from Shanghai BYD CO.,LTD in strict accordance with the specification and remarks include at the end of the document.

Due to improper usage of the battery, an accident or a fire may occur. Shanghai BYD CO.,LTD will not guarantee against any accidents occurring due to use beyond the content of this specification.

9.3 Prior notice of change:

In case specification, materials, production process, and control system for the products are changed, the notice of change in writing together with quality and reliability data is to be informed in advance to the buyer.

10. Attentions

Please read and follow the handling instructions for the battery before use. Improper use of the battery may cause heat, fire, rupture, damage or capacity deterioration.



1. Do not put the battery into a fire, or heat the battery; do not store the battery under high temperature environment.
2. Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment.
3. Do not let the battery terminals (+ and -) contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together, may cause short-circuit.
4. Do not drive a nail in, hit with a hammer, or stamp on the battery, do not strike the battery in other ways.
5. Do not disassemble or alter the battery's' outside structure.

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6. Do not submerge the battery in water, do not wet the battery when store the battery.

NOTICE

Battery should be charged and discharged with proper charger, in compliance with correct operation contents.

1. Do not use the battery with other maker's batteries, different types and /or models of batteries such as dry batteries, nickel-metal hydride batteries, or nickel-cadmium batteries, or new and old lithium batteries together.
2. Do not leave the battery in a charger or equipment if it generates an older and/or heat, changes color and/or shape, leaks electrolyte, or cause any other abnormality.
3. Do not discharge the battery continuously when it is not charged

Caution

1. In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times.
2. The battery was inspected carefully by QA before shipment to confirm with the specifications. However, in the case any abnormality of bad smell or heat, etc, arises after purchase, bring it and communicate with us.
3. For long-term storage, please charge at 50%SOC about in advance.
4. Do not use the battery in other than the following conditions; otherwise, the battery might cause heat generation, damage, or deterioration of its performance.

Operating environment:

Charge: 0°C ~ +60°C

Standard Discharge: -20°C ~ +70°C

Store less than 30 days: -20°C ~ +45°C



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Store less than 180 days: -20℃ ~ +40℃

Store less than 360 days: -20℃ ~ +35℃



SPECIFICATION FOR BATTERY

CONFIDENTIAL

Customer: Lenovo

Model Name: L25D3P77

Sunwoda P/N: 1002008808371/1002008808391/1002008808412/1002008808422

Lenovo P/N: SB11M89969

FRU P/N: 5B11M90168

Description: Rechargeable Li-ion Battery PACK 3S1P Min 5065mAh

SUNWODA Electronic Co., Ltd.

地址：广东省深圳市宝安区石岩街道石龙社区颐和路2号

Address: No.2 Yihe Rd. Shilong Community, Shiyan Street, Baoan District, Shenzhen City,
Guangdong Province, China

TEL: +86-755-27623775

FAX: +86-755-29517078

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彭昊锋 Harvey Peng	张添翔 Jed Zhang	高涛 Shawn Gao

1.Revision History

[illegible]

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2.Scope

This specification describes the requirements for a Rechargeable Li-ion Battery pack supplied by SUNWODA Electronic Co., Ltd.

3.Battery Pack Overview

3.1.Cell Main Characteristics

Cell Manufacturer	Cell Model	Nominal Voltage	TypicalCapacity	Minimum Capacity
LWN	615680H3R	3.87V	5168mAh	5065mAh

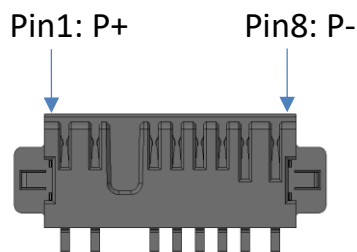
3.2.Compliant Communications

Battery is fully SMBus 1.1 agreement compliant.

3.3.Connector Terminals Definition

Terminal	Name	Description
1	P+	Battery Positive Terminal
2	P+	Battery Positive Terminal
3	CLK	SMBus clock interface I/O pin
4	DATA	SMBus data interface I/O pin
5	ID	Connect 10Kohm $\pm 1\%$ resistor to P-
6	NC	NC
7	P-	Battery Negative Terminal
8	P-	Battery Negative Terminal

Battery pack output port diagram



Pin Number	Description	DEFINITION
Pin 1	P+	P+ BATTERY PACK + TERMINAL
Pin 2	P+	P+ BATTERY PACK + TERMINAL
Pin 3	I2C_CLK	SMBUS CLOCK
Pin 4	IC2C_DATA	SMBUS DATA
Pin 5	TEMP	10k OHM/1% RESISTOR CONNECTED TO GND
Pin 6	NC	/
Pin 7	GND	BATTERY PACK GND TERMINAL
Pin8	GND	BATTERY PACK GND TERMINAL
Connector	Drapho BC54085-S0255-1H DEREN 560811-005H	

4. Production Specification

No.	Items		Rated Performance	Remark	
1	Nominal Voltage		11.61V	3.87V/cell	
2	Typical Capacity		5168mAh	0.2C discharge with 3V/cell cut off voltage at 25 °C ± 3°C (cell's spec)	
			60Wh		
3	Minimum Capacity		5065mAh	0.2C discharge with 3V/cell cut off voltage at 25 °C ± 3°C (cell's spec)	
			58.9Wh		
4	Reserve Capacity		400mWh	From RSOC=0% to TDA	
5	Initial AC Impedance		≤210mΩ	1KHz AC Method	
6	Limited Charging Voltage		13.35V	Upper limited charge voltage 13.35V	
7	End of Discharge Voltage		9V	9V→RSOC 0%	
8	Max Continue Charge Current		1033mA	1033mA CCCV to 4.45V/cell	0°C~15°C
			5168mA	5168mA CC to 4.1V/cell; 2584mA CCCV to 4.45V/cell	15°C~20°C
			6201mA	6201mA CC to 4.2V/cell; 3617mA CCCV to 4.45V/cell	20°C~45°C
			2584mA	2584mA CC to 4.2V/cell, then stop; Reset: max cell voltage ≤ 3900mV	45°C~60°C
9	Max Discharge Current		7222mA	35°C (Ambient); Cell surface temperature ≤ 70°C	
10	Max Continue Discharge Power		65W	from SOC 100% to 0% @ 35°C (Ambient); Cell surface temperature ≤ 70°C	
11	Max Peak Discharge Power		80W for 30S	from SOC 100% to 0% @ 35°C (Ambient); Cell surface temperature ≤ 70°C	
12	CB Maximum Discharge Power		80W	CB Max Discharge Current: 8888mA @ 35°C (Ambient); Cell surface temperature ≤ 70°C	
13	Standard Charge Current		1033mA	Cell surface temperature ≤ 70°C	
14	Standard Discharge Current		1033mA		
15	Storage Temperature	Storage 1 week	-20°C~50°C	If the battery pack (shipping status) store at over the 3 months period, it should be recharged. Humidity ≤ 95% RH	
		Storage 1 months	-20°C~45°C		
		Storage 6 months	-20°C~40°C		
		Storage 1 year	-20°C~35°C		
16	Operating Temperature Range (Charge)		0°C~60°C ± 3°C	Humidity ≤ 95% RH	
			≥ 0°C ± 3°C	Initial low charge temp	
			< 50°C ± 3°C	Initial high charge temp	

PRODUCTION SPECIFICATION

17	Operating Temperature Range (Discharge)	-20℃~60℃ ± 3℃	Humidity ≤ 95% RH
18	Over Temperature Protection (Charge)	60 ± 3℃	
19	Under Temperature Protection (Charge)	-2 ± 3℃	
20	Cycle Life	≥ 70% Cmin at 1000 Cycle	See 10.6 Electrical Characteristics For Detail
21	Battery Pack Weight	Max 225g	
22	Shipping Capacity	25%~30%	By Air
		45%-55%	By Sea & Land
23	BMU Solution	Tenpao_RAJ240047_E108_EC16	

5.Standard SBS Commands

No.	Function	CMD	Specification		Comments					
1	Remaining Capacity Alarm	0x01	10% of design capacity=600cWh							
2	Remaining Time Alarm	0x02	10 minutes							
3	Relative State Of Charge	0x0D	Remaining Capacity/Full Charge Capacity x 100							
4	Remaining capacity	0x0F	Shall be 0 when the cell stack voltage reaches 3V/cell							
5	Full charge capacity	0x10	Update the value when detect the full charge							
6	Charging current	0x14	0℃~15℃	1033mA	End of Charge Current:258mA					
			15℃~20℃	5168mA						
			20℃~45℃	6201mA						
			45℃~60℃	2584mA						
			Precharge current	517mA						
7	Charging voltage	0x15	0℃~15℃	13350mV						
			15℃~20℃	13350mV						
			20℃~45℃	13350mV						
			45℃~60℃	13350mV						
8	Cycle count	0x17	When the charging capacity exceeds 100% of FullChargeCapacity, CycleCount is added to 1							
9	Design Capacity	0x18	6000cWh							
10	Design Voltage	0x19	11610mV							
11	Manufacture Name	0x20	Sunwoda 2025							
12	Device Name	0x21	LNV-5B11M90168							
13	Device Chemistry	0x22	LION							
14	DFET OFF Function	0x34	Ship Mode Function. See 9.3 Ship Mode For Detail.							
15	Read Battery Info.	0x37	Maker ID		HW ID	FW Version	Data Version			
			byte1 byte0		byte3 byte2	byte5 byte4	byte7 byte6			
			07 00		A8 0C	00 01	04 00			
			Lenovo Spec.							
			Target Schedule		0x37					
			Phase	Lenovo Phase	A0 : Maker ID		A1 : HW ID		FW Version	
		byte 1	byte 0	byte 3	byte 2	byte 5	byte 4	byte 7	byte 6	
EP	EVT/SDV	xx	00	xx	xx	1x	00	xx	xx	
SP	FVT/SIV	xx	00	xx	xx	2x	00	xx	xx	
PP	SIT	xx	00	xx	xx	3x	00	xx	xx	
MV	SIT-R/SVT	xx	00	xx	xx	00	01	xx	xx	
MP	SOVP	xx	00	xx	xx	XX	01	xx	xx	

6.Fuel Gauge Board Current Consumption

No.	Function	Specification	Comments
1	Cell voltage sensing input leakage current on each block	$\leq 10\mu\text{A}$	@3.8V/cell
2	Circuit Current Consumption		
	I(normal) @ SMC / SMD=H	$\leq 600\mu\text{A}(\text{typ})$	Operating mode
	I(sleep) @ SMC / SMD=L	$\leq 200\mu\text{A}(\text{typ})$	Sleep mode
	I(shutdown) @ SMC / SMD=L	$\leq 15\mu\text{A}(\text{typ})$	Shutdown Mode

7.Fuel Gauge Accuracy

No.	Function	Specification	Comments
1	Voltage Accuracy	$\pm 20\text{mV}$	@25°C
2	Current Accuracy	$\geq 600\text{mA}$ $\pm 0.5\%$ $< 600\text{mA}$ $\pm 3\text{mA}$	
3	Temperature Accuracy	$\pm 3^\circ\text{C}$	

8.PCBA Protection function (25℃^{第 10 页}±3℃)

8.1.Protection Function (Recovery)

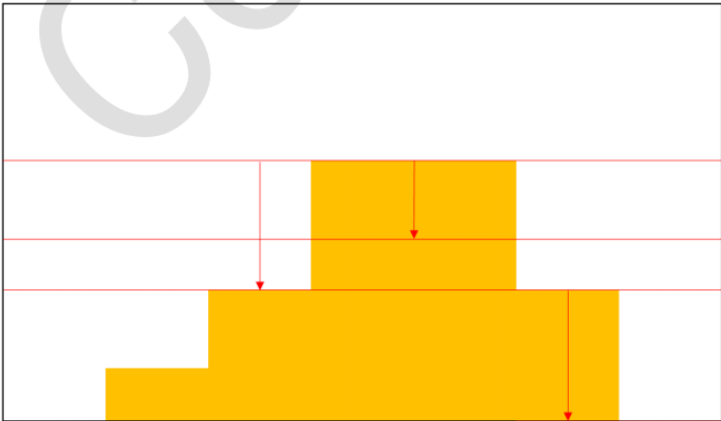
No.	Item	Threshold	Action	
			CFET	DFET
1	Over Cell Voltage Protection (1st)	4.49V ±0.02V / cell Delay time: 2Sec~6Sec	Off	On
		Reset: ≤4.35V±0.02V /cell	On	On
2	Under Cell Voltage Protection	Set: ≤2.70V ±0.02V / cell(<15℃) Delay time: 11Sec~15Sec OR Set: ≤2.80V ±0.02V / cell(>15℃) Delay time: 11Sec~15Sec OR Set: ≤2.50V ±0.02V / cell(for all temp) Delay time: 4Sec~8Sec	On	Off
		Reset: ≥3.10V ±0.02V / cell & Charging Delay time: 0Sec~3Sec	On	On
3	Shutdown Voltage of Cell	Set: ≤2.70V ±0.02V / cell(<15℃) Delay time: 19Sec~23Sec OR Set: ≤2.80V ±0.02V / cell(>15℃) Delay time: 19Sec~23Sec	Off	Off
		Reset: Charge Voltage Input	On	On
4	Pre-Charge Over Current Protection	Set: ≥600mA Delay time: 2Sec~6Sec	Off	On
		Reset1: Current≤-15mA Delay time: 1Sec Reset2: Current>-15mA Delay time≤30Sec	On	On
5	Pre-Charge Timeout Protection	Delay time: 60mins	Off	On
		Reset: Current≤-10mA	On	On
6	SW Over Charge Current Protection	Set: ≥6.8A±0.2A Delay time: 2Sec~6Sec	Off	On
		Reset: Current≤-50mA	On	On

7	SW Over Discharge Current protection	Set: $\geq 10.1A \pm 0.2A$ Delay time: 4Sec~8Sec	On	Off
		Reset: Current $\geq 50mA$	On	On
8	HW Over Discharge Current Protection	Set: $\geq 16.67A(TYP)$ (14.2-20.5) Delay time: 27ms $\pm 10\%$	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
9	HW Discharge Short-Circuit Protection (1st)	Set: $\geq 33.3A(TYP)$ (27-35) Delay time: 600us~1500us	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
10	HW Discharge Short-Circuit Protection (2nd)	Set: $\geq 22.2A(TYP)$ (20.5-27) Delay time: 300us~900us	On	Off
		Reset: Delay time $\leq 30Sec$	On	On
11	Charge Over Temperature Protection of Cell	Set: $> 60^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\leq 50^{\circ}C \pm 3^{\circ}C$	On	On
12	High Temperature Charge Start Protection (Charge inhibit function)	Set: $> 50^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\leq 50^{\circ}C \pm 3^{\circ}C$	On	On
13	Discharge Over Temperature Protection of Cell	Set: $\geq 73^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\leq 65^{\circ}C \pm 3^{\circ}C$	On	On
14	Over temperature protection of FET	Set: $\geq 98^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\leq 70^{\circ}C \pm 3^{\circ}C$	On	On
15	Low Temperature Charge Protection	Set: $\leq -2^{\circ}C \pm 3^{\circ}C$	Off	On
		Reset: $\geq 0^{\circ}C \pm 3^{\circ}C$	On	On
16	Low Temperature Discharge Protection	Set: $\leq -20^{\circ}C \pm 3^{\circ}C$	Off	Off
		Reset: $\geq -15^{\circ}C \pm 3^{\circ}C$	On	On
17	Fully Charge Protection	1) Taper Current FC Condition: Max Cell Voltage $\geq 4.4V$ & Average Current $< 258mA$ & Delay Time: 80Sec 2) OCV FC Condition: Max Cell Voltage $\geq 4.43V$ & Delay Time : 60Sec	Off	On
		Reset: RSOC $< 95\%$	On	On

8.2. Protection function (Permanent Failure)

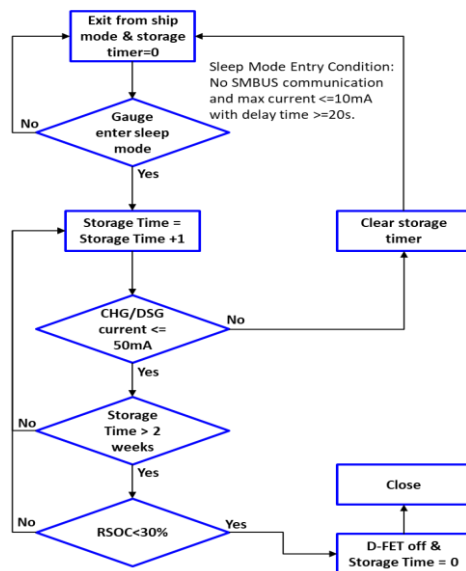
No.	Item	Threshold	Action		
			FUSE	CFET	DFET
1	SW Over Voltage Protection (2nd)	Set: $\geq 4.55V \pm 0.02V$ / cell Delay Time: 4Sec~8Sec	Blow	Off	Off
2	HW Over Voltage Protection (2nd)	Set: $\geq 4.6V \pm 0.025V$ / cell Delay Time: 4.2Sec~7.8Sec	Blow	Off	Off
3	Over Temperature Protection of Cell (2nd)	Set: $\geq 90^{\circ}C \pm 3^{\circ}C$ & Charge Current $\geq 25mA$ OR Discharge Current $\geq 100mA$	Blow	Off	Off
4	Over Temperature Protection of FET (2nd)	Set: $\geq 120^{\circ}C \pm 3^{\circ}C$	Blow	Off	Off
5	D-FET Failure Detection	Set: D-FET Turn Off & Discharge Current $\geq 500mA$ Delay Time: 10Sec~13Sec	Blow	Off	Off
6	C-FET Failure Detection	Set: C-FET Turn Off & Charge Current $\geq 500mA$ Delay Time: 10Sec~13Sec	Blow	Off	Off
7	Thermistor Short Detection	Short Condition: $\geq 150^{\circ}C$ Delay Time: 10Sec~13Sec	Blow	Off	Off
8	Thermistor Open Detection	Open Condition: $\leq -46^{\circ}C$ Delay Time: 10Sec~13Sec	-	Off	Off
9	Cu Deposition Detection	Set: Cell Voltage $\leq 1.3V$ Delay Time: 1Sec~4Sec	-	Off	Off

9.Other Function Description

No.	Item	Condition		Action
1	Charge Mode	Pre-Charge Mode	Min Cell Voltage <3000mV	Charging Current: 517mA
		Smart Charge Mode	Temp: 0°C~15°C	1033mA CCCV to 4.45V/cell
			Temp: 15°C~20°C	5168mA CC to 4.1V/cell; 2584mA CCCV to 4.45V/cell
			Temp: 20°C~45°C	6201mA CC to 4.2V/cell; 3617mA CCCV to 4.45V/cell
			Temp: 45°C~60°C	2584mA CC to 4.2V/cell, then stop; Reset: max cell voltage≤ 3900mV
		Advanced Charge Profile:		
		T1(0°C)≤T2(10°C)≤T5 (15°C) ≤T6 (20°C) ≤T3 (45°C) ≤T4 (60°C)		
Charging Current  Cell Temperature				

2	Sleep Mode	Entry: 1. No Communication 2. $Current() \leq 10\text{mA}$ 3. No PF and No Safety Alert / Status	BMU goes to sleep mode C-FET turn off
		Exit: 1. Communication with battery OR 2. $Current \geq 10\text{mA}$ OR 3. Abnormal situation: 1) Sbs.Temp $> 73\text{degC}$ 2) Sbs.Temp $< -20\text{degC}$ 3) Sbs.FET Temp $> 98\text{degC}$ 4) Sbs.FET Temp $< -20\text{degC}$ 5) Max cellV $> 4.49\text{V}$ 6) Min cellV $< 2800\text{mV}$	1. BMU goes back to normal mode 2. C-FET turn on. (Depends on present status)
		Note: 1. BMU can't allow CLK pin High with Data pin Low or CLK pin Low with Data pin High. 2. The current condition of sleep mode is no matter current direction. 3. The C-FET is turned off in sleep mode. Normally, the current exit condition is discharge.	
3	Shipping Mode Function	Entry: 1. Write "0x0000" by 0x34 & Write "0x1000" by 0x34 (Command interval less than 5 sec) OR 2. RSOC $< 30\%$ & No detectable charge or discharge current & Storage Time > 2 weeks	1. D-FET off function 0x34 value changes to "0x0100" 2. Both D-FET and C-FET turn off
		Exit: 1. Write "0x2000" by 0x34 & Write "0x4000" by 0x34 (Command interval less than 5 sec) OR 2. BMU receives a SMBus Command after waking up from sleep mode.	1. D-FET off function 0x34 value changes to "0x0000" 2. Both D-FET and C-FET turn on Return to normal mode
		Note: It's necessary to have an interval time that is more than 5sec between entry condition command and exit condition command for turning on/off C/D-FET.	

RSOC<30% storage condition flow chart:



4	Shutdown Mode Function	Common Entry: 1.Min cell voltage continuous <2800mV for 20Sec & Voltage at PACK pin < 1000mV OR 2. 1.Write 0x0010 to 0x00 2.Write 0x0010 to 0x00 This sequence will be canceled if interval time of between Step(a) and Step(b) is over than 5sec RTC Entry: 1. Battery in shipmode and RSOC <= 5% for 2s with RTC function enable. 2. Battery in sleep mode over 1hour and RSOC <= 2% with RTC function enable. 3. TDA=1 for 11sec with RTC function enable (TDA release condition: charge current>50mA and Vcell>3200mV/cell)	Turn D-FET and C-FET turn off
		Exit: Voltage at PACK pin>4V if the charging voltage continues to be applied to Pack+ while the shutdown condition is satisfied, the shutdown will be canceled if Pack+ is equal or larger than (ChargingVoltage – CancelChgVoltOffset) forCancelDela	Both D-FET and C-FET turn on; Return to normal mode
5	96 Hours Function	96hrs function enable: When battery is fully charged 96hrs function disable: 96hours time out. OR Discharge current>5mA for 30Sec OR Discharge current>100mA for 1Sec	
6	Cell Imbalance Function	Max cell voltage>4.20V & (Max cell voltage – Min cell voltage)>500mV & Current=0mA & Delay time>5mins	Set Bit10 (Cell Imbalance Alarm) at Battery Status 0x16

7	Permanent Dual Mode			
Permanent DM	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
	Cycle Count	Adjusted Hrs at High Voltage		
RT	0	0	13.35V	100%
LS1-1	100	960	13.32V	99%
LS1-2	150	1200	13.29V	98%
LS1-3	300	1440	13.26V	97%
LS1-4	350	1680	13.23V	96%
LS1-5	400	1920	13.2V	95%
LS2	SoH FCC < 50% of DesignCapacity() OR SoH FCC < LS1 to LS2 FCC transition threshold(Min FCC: 54%)		13.05V	90%
8	Dynamic Dual Mode			
Dynamic DM	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
	RSOC for last 7days			
RT	RSOC<35%		13.35V	100%
T-LS1-1	35%≤RSOC<40%		13.32V	99%
T-LS1-2	40%≤RSOC<45%		13.29V	98%
T-LS1-3	45%≤RSOC<50%		13.26V	97%
T-LS1-4	50%≤RSOC<55%		13.23V	96%
T-LS1-5	55%≤RSOC<65%		13.2V	95%
T-LS2	65%≤RSOC<90%		13.05V	90%
Exit Condition: RSOC≤20%				
9	PI Mode			
Entry	Criterion to Enter		Requested Charge Voltage	Capacity (Approx % of RT Capacity)
1	RSOC>90% for 14days		12.75V	80%
2	RSOC>90% for 7days & High Temp(>40℃) for 40hours			
Exit condition: RSOC≤50%				

PRODUCTION SPECIFICATION

10. Electrical Characteristics

Standard environmental test condition

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

Temperature : 25 °C ± 3 °C , Humidity: 5%~ 95% RH

No.	Item	Test Method and Condition	Criteria
1	Standard Charge	Charging shall consist of charging at a constant current rate of 1033mA until the battery voltage reaches 4.45V/cell. The battery shall then be charged at constant voltage of 4.45V/cell while tapering the charge current. Charging shall be terminated when the charging current has tapered to 258mA	\
2	Open circuit voltage	After standard charge, measure it within 24 hours	Above 11.1V
3	Initial capacity	After the standard charge, the battery should be discharged at 0.2C constant current to the cut-off voltage of 3V/cell.	≥5065mAh
4	Initial Impedance	The battery is fully charged, with 1KHz sine wave AC 4 terminal measurement method to test the initial.	≤210mΩ
5	Charge retention	When the battery has completed standard charged, it shall be disconnected and put aside for 28 Days at 20°C±5°C, Then measured the capacity with 0.2 C till 3V/cell.	Residual capacity > 85%
6	Cycle Life	Charge battery with specified charge method and discharge battery with 0.5C current until min cell voltage reaches 3V/cell. Repeat to 1000cycles, record remained capacity of 1000th cycle.	Capacity ≥70% of Cmin Thickness Swelling ≤ 10% of initial thickness

11.Safety compliance

No.	Item	Test Method and Condition	Criteria
1	Heat test	The battery is fully charged in accordance with the standard charging method, placed in a gravity convection or circulating air oven. The temperature of the oven is to be raised at a rate of $(5 \pm 2) ^\circ \text{C/min}$ to a temperature of $(130 \pm 2) ^\circ \text{C}$ and remain for 30 mins at that temperature before the test is discontinued.	No Explosion, No Fire
2	Short between terminal	Short the positive (+) and negative (-) of the pack with copper wire having a maximum resistance load of 0.1Ω at $20 ^\circ \text{C} \pm 5 ^\circ \text{C}$ and $55 ^\circ \text{C} \pm 2 ^\circ \text{C}$ for 2hours after standard charge at $25 ^\circ \text{C} \pm 3 ^\circ \text{C}$.	No rupture, fire, smoke or leakage
3	Reverse charge	Apply a power supply at a reverse polarity, constant voltage and constant current adjusted to 13.35V/ 6201mA condition at $25 ^\circ \text{C} \pm 3 ^\circ \text{C}$ and leave it for 24 hours.	No rupture, fire, smoke or leakage
4	Overcharge performance	Constant current and constant voltage 0.5C/13.47V charge for 48hours at $25 ^\circ \text{C} \pm 3 ^\circ \text{C}$. Then check outside appearance right after rated charge.	No leakage or prominent breakage
5	Thermal cycling	Procedure: Place the fully charged battery at thermal chamber $72 \pm 2 ^\circ \text{C}$ for 6Hr $\leftrightarrow$ $-40 \pm 2 ^\circ \text{C}$ for 6Hrs (Transfer time : 30min), 10cycle take out the battery at $(20 \pm 5) ^\circ \text{C}$ for 24hours	No mass loss (not exceed 0.1%) No leakage, No venting No disassembly, No rupture No fire OCV(open circuit voltage)> 90% of the initial voltage

12.Safety Operating Parameters for GB 31241-2022

安全工作参数 Safety Operating Parameter	符号 Symbol	电池组 Battery Pack
充电限制电压 (Limited charging voltage)	Ucl	13.35V
充电上限电压 (Upper limited charging voltage)	Uup	13.35V
放电截止电压 (Discharge cut-off voltage)	Udo	8.34V
放电终止电压 (Discharge terminate voltage)	Ude	9V
推荐充电电流 (Recommendation charging current)	Icr	1033mA
最大充电电流 (Maximum charging current)	Icm	Max cell voltage > 4.20V &
推荐放电电流 (Recommendation discharging current)	Idr	1033mA
最大放电电流 (Maximum discharging current)	Idm	7222mA
过压充电保护电压 (Over voltage for charge protection)	Ucp	4.49V $\pm$ 0.02V/cell
过流充电保护电流 (Over current for charge protection)	Icp	6.8A $\pm$ 0.2A
欠压放电保护电压 (Low voltage for discharge protection)	Udp	2.80V $\pm$ 0.02V/cell
过流放电保护电流 (Over current for discharge protection)	Idp	10.1A $\pm$ 0.2A
上限充电温度 (Upper limited charging temperature)	Tcm	60°C $\pm$ 3°C
上限放电温度 (Upper limited discharging temperature)	Tdm	60°C $\pm$ 3°C
下限充电温度 (Lower limited charging temperature)	Tcl	0°C $\pm$ 3°C
下限放电温度 (Lower limited discharging temperature)	Tdl	-20°C $\pm$ 3°C
可允许的最高表面温度 (Maximum allowable surface temperature)	Tmax	70°C $\pm$ 3°C
充电截止电流 (Taper current for charging)	-	258mA

13.Safety License

Type	Standard
CQC	GB31241-2022
CB	IEC60950,IEC62368,IEC62133
CE	EN60950,EN62368,EN62133,EN 55032 and EN55024
UL	UL60950-1,UL62368,UL2054
BSMI	CNS 15364/14857-2
PSE	JIS C8712, JIS C8714
KC	K62133
BIS	IS16046, IEC62133
No mercury report	EU Directive 2006/66/EC
MSDS report	
MIC	

16.Safety Instruction

Warnings
.Use the dedicated charger. .Keep away from children to avoid any accidents. .Don't use the independent charger. .Don't leave the battery near the fire or heating source. .Don't throw the battery into the fire or in direct sunlight or immerse into the water. .Don't penetrate the battery with a sharp object such a needle or driver. .Don't impact with heavy objects such as a hammer, weight. .Don't throw or drop the battery on the hard floor. .Don't disassemble the battery or modify the battery including design or electrical circuit. .Don't use seriously cared or deformed battery. . Leakage of the battery is strictly prohibited to use again. .If liquid leaks onto your skin or clothes, wash well with fresh water immediately. .If the battery is needed to be stored for a long period, battery should be removed from the application and stored in a place where humidity and temperature are low.