VARTA

cell pac LITE

BATTERY DESIGN YOU CAN TRUST

STANDARD PACK TECHNICAL HANDBOOK

Revision 1.6 - 07/2017

To sample, buy or discuss any of the products in the CellPac LITE range:

USA	EUROPE	ASIA
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For more information visit our website www.varta-storage.com/en.html

Overview

CellPac LITE - Our Range of Standard Lithium-Ion Packs

We offer a range of pre-configured battery packs that are immediately available for standard applications: CellPac LITE. They are made exclusively of cylindrical or prismatic lithium batteries. CellPac LITE power packs are fitted with an electronic protective switch and additional overcurrent protection. They comply with the requirements of safety standard UL 1642. Find more information on the website: www.varta-storage.com.

CellPac BLOX – Semi-Custom Battery Design

CellPac BLOX suits those customers in need of semi-customization and where design-cycles, engineering costs and time to market must be minimized for success. Battery designs are limited in their complexity, but available for nearly no NRE cost and development effort.

CellPac PLUS – Custom Lithium Rechargeable Design Service

VARTA Storage's CellPac PLUS service focuses on designing and manufacturing customer-specific battery packs for mobile equipment. VARTA Storage combines its expert knowledge in cell chemistry and electronics with extensive market experience – for example in the fields of communications, medical technology, robotics and special-industrial. Because they are designed for specific applications, CellPac PLUS power packs offer maximum safety, reliability and efficiency.

CONTENTS

For latest technical data please refer to our data sheets which you will find here on our website:
www.varta-storage.com/en/power-packs/download.html

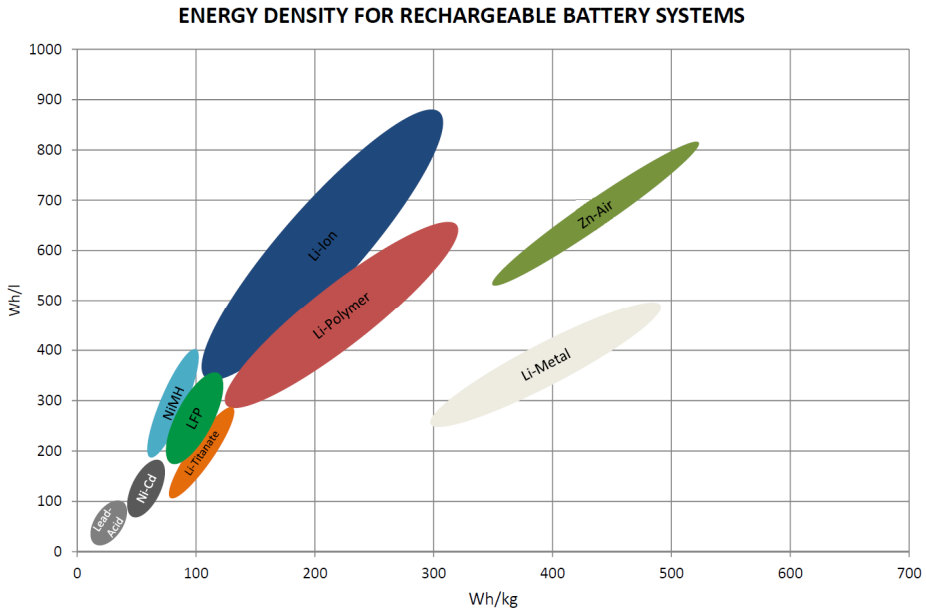
1. Introduction of CellPac LITE

CellPac LITE is the standard range of lithium-rechargeable battery products from VARTA Storage GmbH.

We offer a range of pre-configured battery packs that are immediately available for standard applications. They are made exclusively from cylindrical or prismatic form-factor cells. CellPac LITE power packs are fitted with an electronic protective circuit module (PCM) wth additional overcurrent protection. All cells used comply with the requirements of the safety standard UL1642 and many packs are certified to additional safety standards UL2054 or IEC62133. These are a complete battery solution, complete with the necessary cables and connectors that are ready for use.

SYSTEM HIGHLIGHTS OF VARTA Storage CellPac LITE BATTERIES:

- Excellent energy density
- Variety of form-factors
- High cell voltage (~3.7 V nom.)
- UL2054 listing for EasyPack batteries
- Charging technique compatible with Li-Ion (const. I / const. V)
- Good high-rate discharge capability up to 2.5A continuous (see specifications)
- Good cycle-life (500 full cycles typically)
- Low self-discharge
- IEC62133 certification for some packs
- Wide temperature range
- ISO9001 certified for design and manufacture
- Good recovery of capacity after storage, even at elevated temperature



Comparison of different rechargeable battery systems regarding their energy densities

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1.1 Definitions and Standards

BASICS

Unless otherwise stated the technical values and definitions are based on room temperature conditions (RT = 22°C ± 3°C).

SYSTEM – SPECIFIC DATA

The gravimetric energy density depends on battery size and ranges from approx. 170-200 Wh/kg and the volumetric energy density ranges from approx. 350-450 Wh/l incl. PCM.

VOLTAGE DEFINITIONS

Open Circuit Voltage (OCV): Equilibrium potential 3.0 V to 4.2 V on average, dependent on temperature, storage duration and state of charge.
Nominal Voltage is typically 3.7 V, see specifications for individual batteries.

End of Discharge Voltage (VE):
The voltage at the end of discharging is 2.75 V to 3.2 V per cell, depending on discharge rate and temperature.
End of Charge Voltage: Terminal voltage after charge is 4.2 V.

CAPACITY DEFINITIONS

The capacity C of a cell is defined by the discharge current I and the discharge time t: C = I * t
I = constant discharge current
t = duration from the beginning of discharge until the end of discharge voltage is reached

Rated Capacity: The rated capacity C denotes the energy amount in mAh (milli-Ampère hours) that the cell can deliver at the 5h discharge rate (0.2 CA). The reference temperature is +22°C ± 3°C, and the final discharge voltage 3.0 V.

Available Capacity:
Factors which affect the available capacity are:

- Rate of discharge
- End of discharge voltage
- Ambient temperature
- State of charge
- Age
- Cycle history

At higher than nominal discharge rates the available capacity is accordingly reduced.

CURRENT DEFINITIONS

Charge and discharge rates may be given as multiples of the Rated Capacity (C) in Ampères (A) with the term CA.
Example:
Rated Capacity C = 1000 mAh
0.1 CA = 100 mA, 1 CA = 1000 mA

Nominal Discharge Current:
The nominal discharge current of a CellPac LITE battery is the 5 hour discharge current (0.2 CA). It is the current at which the nominal capacity of a cell is discharged in 5 hours.
I = C/t = C/5 = 0.2 CA when t = 5 h

1.2 General Design and Application Criteria

Choose the best suitable battery from our wide range of CellPac LITE batteries according to your needs relating to the specific application and its corresponding planned operation conditions:

The most important criteria for the type-selection are these:

- Required minimum operating time
- Max. and average current drain
- Min. and max. voltage of operation
- Operating temperature range
- Mechanical properties
- Available space
- Environmental conditions

All CellPac LITE batteries are equipped with our specially selected and carefully designed safety electronic modules which prevent the risks of hazards due to any foreseeable abuse / misuse.

1.3 Features

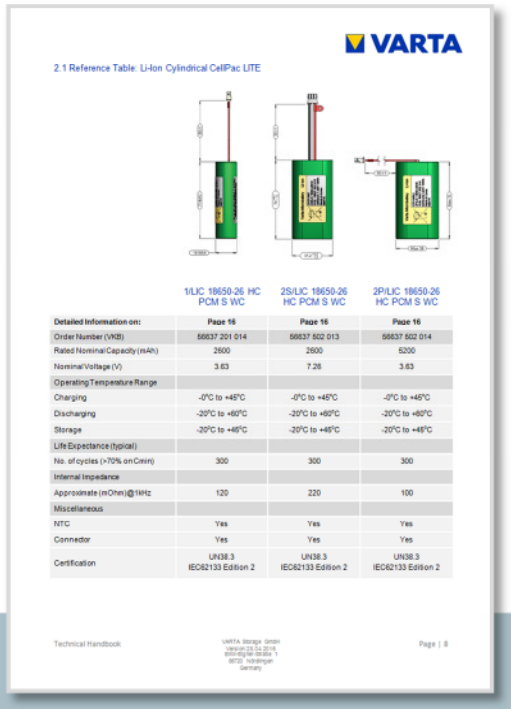
VARTA Storage CellPac LITE batteries are first choice for a number of modern high-tech products in the portable electronics field. They provide long lasting, reliable main power, occupying a minimum of space and weight in the corresponding devices.

VARTA Storage CellPac LITE batteries fulfill the most important design-in requirements: Reliable high-power output, design flexibility with a minimum of space requirement and a slim form-factor.

Feature	Advantage	Customer Benefit
UN38.3 Certified	Approved for Transport	Declaration of Conformity Available
IEC62133 Certified[1] UL Recognized/Listed[1]	Ready for design-in for certified applications	Reduced design-in cost
Multiple form-factors	Design flexibility	Product design convenience
Excellent overall performance	Supports many various applications	Highly satisfying product under extensive conditions of use
Complete pack solution	Supply of cells, electronics and assembly	Integrated performance and safety
Worldwide branch offices and distribution with technical support	Close customer relationship	Local contact, local knowledge - local language

[1] Only some packs are certified for IEC62133 or UL Recognition/Listing.

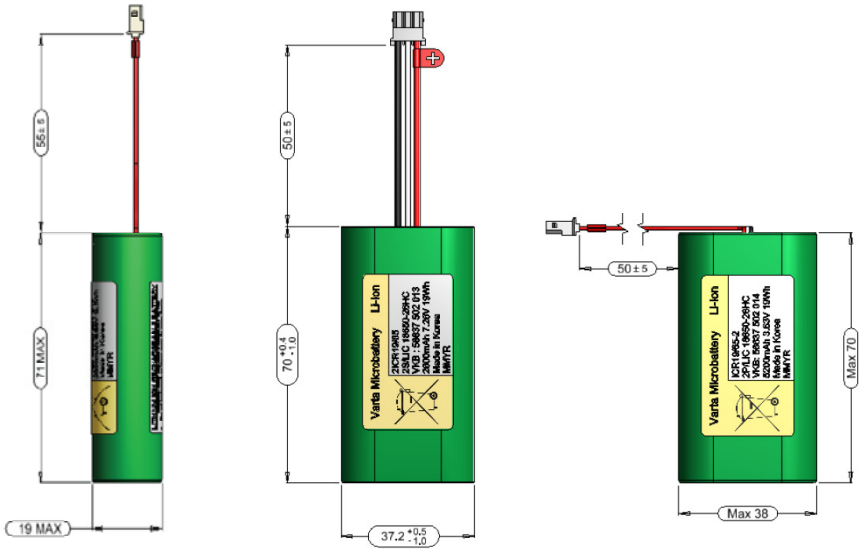
2. Quick Reference Table CellPac LITE



2.1 Reference Table: Li-Ion Cylindrical CellPac LITE

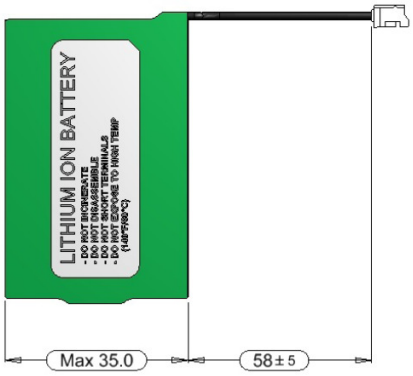
	1/LIC 18650-26 HC PCM S WC	2S/LIC 18650-26 HC PCM S WC	2P/LIC 18650-26 HC PCM S WC
Detailed Information on:	**Page 16**	**Page 16**	**Page 16**
Order Number (VKB)	56637 201 014	56637 502 013	56637 502 014
Rated Nominal Capacity (mAh)	2600	2600	5200
Nominal Voltage (V)	3.63	7.26	3.63
Operating Temperature Range			
Charging	-0°C to +45°C	-0°C to +45°C	-0°C to +45°C
Discharging	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
Storage	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)			
No. of cycles (>70% on Cnom)	300	300	300
Internal Impedance			
Approximate (mOhm) @ 1kHz	120	220	100
Miscellaneous			
NTC	Yes	Yes	Yes
Connector	Yes	Yes	Yes
Certification	UN38.3 IEC62133 Edition 2	UN38.3 IEC62133 Edition 2	UN38.3 IEC62133 Edition 2

2.1 Reference Table: Li-Ion Cylindrical CellPac LITE



	1/LIC 18650-26 HC PCM S WC	2S/LIC 18650-26 HC PCM S WC	2P/LIC 18650-26 HC PCM S WC
Detailed Information from:	**Page 14**	**Page 14**	**Page 14**
Order Number (VKB)	56637 201 016	56637 502 016	56637 502 017
State of Charge	< 30 %	< 30 %	< 30 %
Rated Nominal Capacity (mAh)	2600	2600	5200
Nominal Voltage (V)	3.63	7.26	3.63
Operating Temperature Range			
Charging	-0°C to +45°C	-0°C to +45°C	-0°C to +45°C
Discharging	-20°C to +60°C	-20°C to +60°C	-20°C to +60°C
Storage	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)			
No. of cycles (>70% on Cmin)	300	300	300
Internal Impedance			
Approximate (mOhm)@1kHz	120	220	100
Miscellaneous			
NTC	Yes	Yes	Yes
Connector	Yes	Yes	Yes
Certification	UN38.3 IEC62133 Edition 2	UN38.3 IEC62133 Edition 2	UN38.3 IEC62133 Edition 2

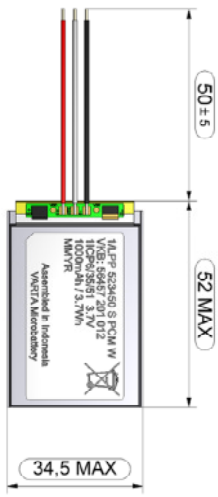
2.2 Reference Table: Li-Ion Prismatic CellPac LITE

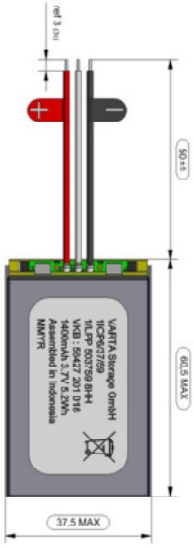


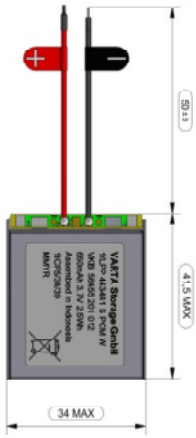
1/LIP 103450 SC PCM S WC

Detailed Information on:	**Page 16**
Order Number (VKB)	56429 201 016
State of Charge	< 30 %
Rated Nominal Capacity (mAh)	2030
Nominal Voltage (V)	3.7
Operating Temperature	
Charging	-0°C to +45°C
Discharging	-20°C to +60°C
Storage	-20°C to +45°C
Life Expectance (typical)	
No. of cycles (>70% on Cmin)	500
Internal Impedance	
Approximate (mOhm)@1kHz	140
Miscellaneous	
NTC	Yes
Connector	Yes
Certification	UN38.3 IEC62133 Edition 2

2.3 Reference Table: Li-Ion Pouch CellPac LITE 1/2

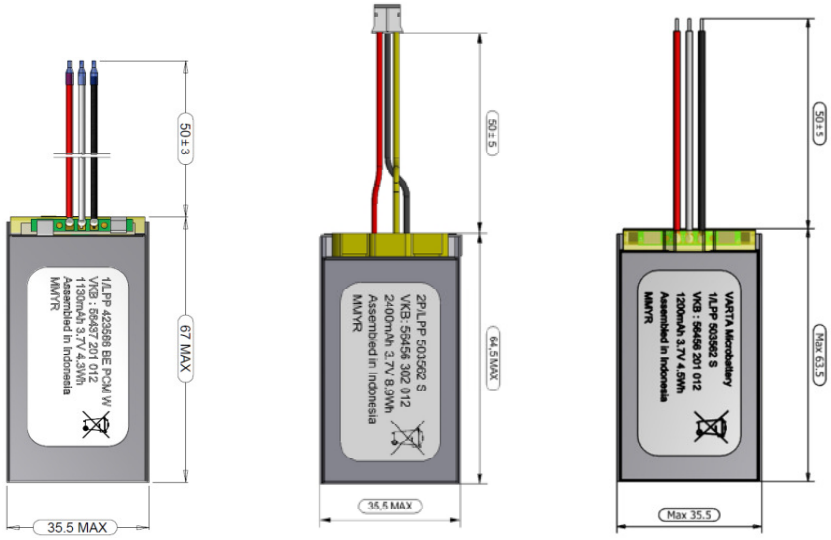






	1/LPP 523450 S PCM W	1/LPP 503759 8HH PCM W	1/LPP 443441 S PCM W
Detailed Information on:	**Page 18**	**Page 20**	**Page 22**
Order Number (VKB)	56457 201 012	56427 201 018	56455 201 012
State of Charge	~ 50 %	~ 50 %	~ 50 %
Rated Nominal Capacity (mAh)	1000	1400	660
Nominal Voltage (V)	3.7	3.7	3.7
Operating Temperature			
Charging	-0°C to +45°C	-0°C to +45°C	-0°C to +45°C
Discharging	-10°C to +60°C	-20°C to +60°C	-10°C to +60°C
Storage	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)			
No. of cycles (on Cmin)	500 (80%)	500 (80%)	500 (70%)[1]
Internal Impedance			
Approximate (mOhm)@1kHz	100	140	130
Miscellaneous			
NTC	Yes	Yes	None
Connector	None	None	None
Certification	UN38.3	UN38.3 IEC62133 Edition 2	UN38.3 IEC62133 Edition 2

2.3 Reference Table: Li-Ion Pouch CellPac LITE 2/2



	1/LPP 423566 BE NTC W	2P/LPP 503562 S PCM WC	1/LPP 503562 S PCM W
Detailed Information on:	**Page 24**	**Page 26**	**Page 26**
Order Number (VKB)	56437 201 012	56456 302 012	56456 201 012
State of Charge	~ 50 %	~ 50 %	~ 50 %
Rated Nominal Capacity (mAh)	1160	2400	1200
Nominal Voltage (V)	3.7	3.7	3.7
Operating Temperature			
Charging	-0°C to +45°C	-0°C to +45°C	-0°C to +45°C
Discharging	-20°C to +60°C	-10°C to +60°C	-10°C to +60°C
Storage	-20°C to +45°C	-20°C to +60°C	-20°C to +60°C
Life Expectance (typical)			
No. of cycles (on Cmin)	400 (75%)	500 (70%)	500 (70%)
Internal Impedance			
Approximate (mOhm)@1kHz	120	90	100
Miscellaneous			
NTC	Yes	Yes	Yes
Connector	None	Yes	None
Certification	UN38.3	UN38.3	UN38.3

2.4 Reference Table: EasyPack 1/2

	EasyPack S	EasyPack L	EasyPack XL
Detailed Information on:	**Page 22**	**Page 26**	**Page 26**
Order Number (VKB)	56455 701 099	56456 701 099	56456 702 099
State of Charge	~ 50 %	~ 50 %	~ 50 %
Rated Nominal Capacity (mAh)	660	1200	2400
Nominal Voltage (V)	3.7	3.7	3.7
Dimensions			
Height (mm)	5.8	6.4	11.4
Width (mm)	35.4	36.6	36.6
Length (mm)	43.5	64.5	64.5
Weight, approx. (g)	15g	26g	48g
Operating Temperature			
Charging	-0°C to +45°C	-0°C to +45°C	-0°C to +45°C
Discharging	-10°C to +60°C	-10°C to +60°C	-10°C to +60°C
Storage	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)			
No. of cycles (>70% on Cmin)	>500	>500	>500
Internal Impedance			
Approximate (mOhm)@1kHz	115	99	68
Miscellaneous			
NTC and ID Pin	Yes	Yes	Yes
Certification	UN38.3 UL Recognition IEC62133 Edition 2	UN38.3 UL Recognition IEC62133 Edition 2	UN38.3 UL Recognition IEC62133 Edition 2

2.4 Reference Table: EasyPack 2/2

	EasyPack Slim	EasyPack PLUS
Detailed Information on:	**Page 28**	**Page 14**
Order Number (VKB)	56426 801 096	56637 702 099
State of Charge	~ 50 %	~ 17 %
Rated Nominal Capacity (mAh)	1590	5200
Nominal Voltage (V)	3.7	3.63
Dimensions		
Height (mm)	5.05	21.2
Width (mm)	44.2	40.6
Length (mm)	64.2	75.1
Weight, approx. (g)	34g	105g
Operating Temperature		
Charging	-0°C to +45°C	-0°C to +45°C
Discharging	-20°C to +55°C	-20°C to +45°C
Storage	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)		
No. of cycles (>67% on Cmin)	>500	>300
Internal Impedance		
Approximate (mOhm)@1kHz	100	80
Miscellaneous		
NTC and ID Pin	Yes	Yes
Certification	UN38.3 UL Listing IEC62133 Edition 2	UN38.3 UL Listing IEC62133 Edition 2

3. Charging / Discharging

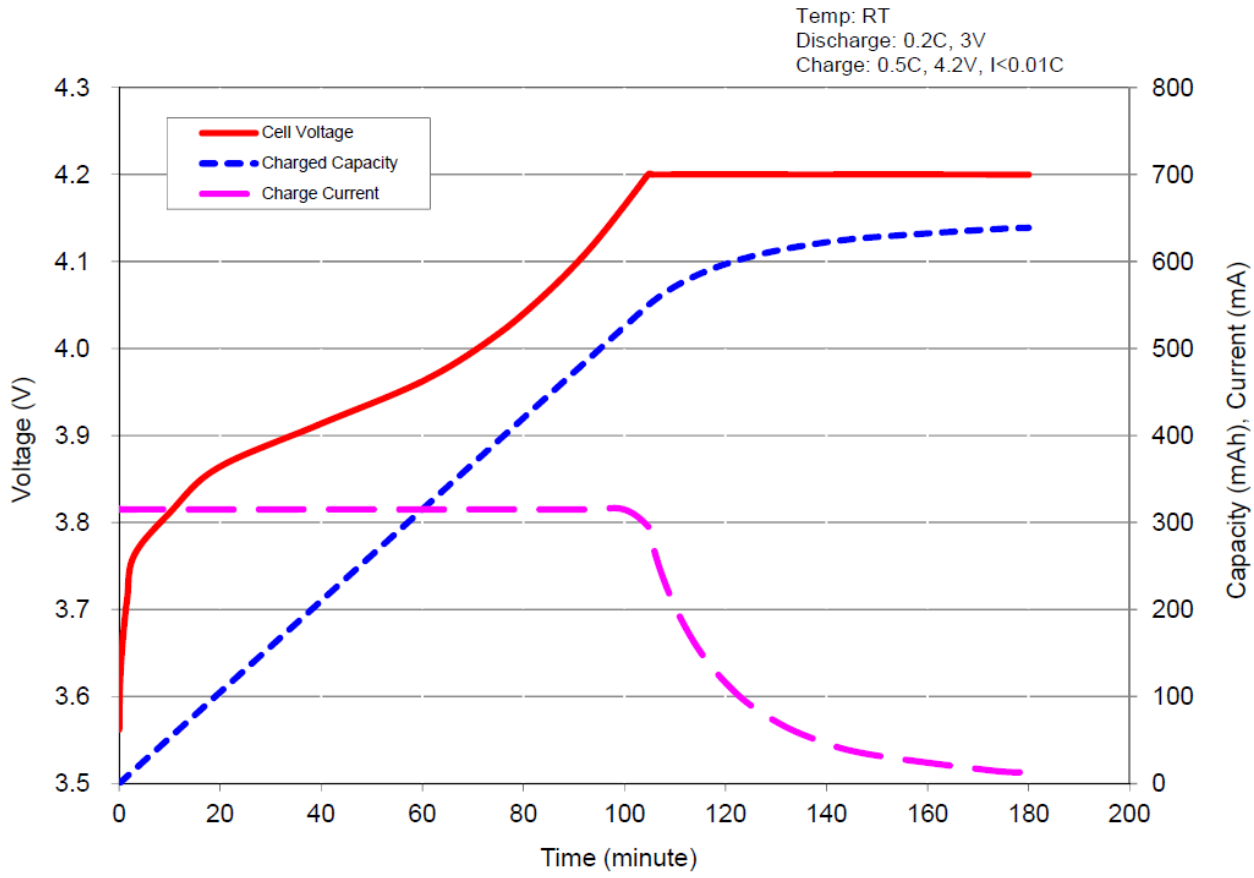
3.1 Charging

Fast charging can be achieved in a temperature range of 0 … +45°C.

The current of charging needs to be limited to individual specification of the battery selected. Limiting factors may be the PCM, wire connector assembly or the cell itself.

In order to avoid overcharging along with damaging the battery or even hazardous situations, the charging voltage has to be limited strictly to 4.2 V per cell, see the individual specification for your battery choice for the most in detail information. It is recommended to terminate the charging either after 3hrs and/or after the charging current falls below 0.02 C.

The charging process is illustrated below showing current and voltage of a LPP 443441 S battery using 1 C charging.

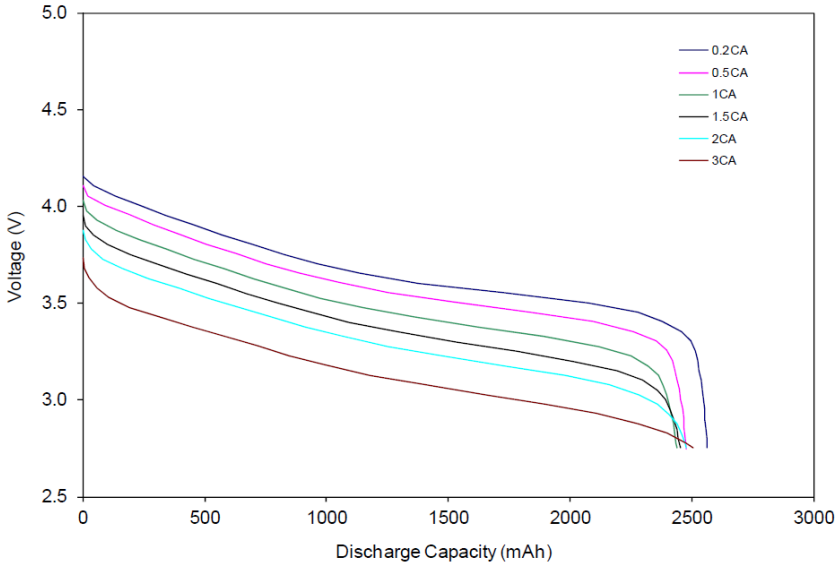


Example cell charging characteristics

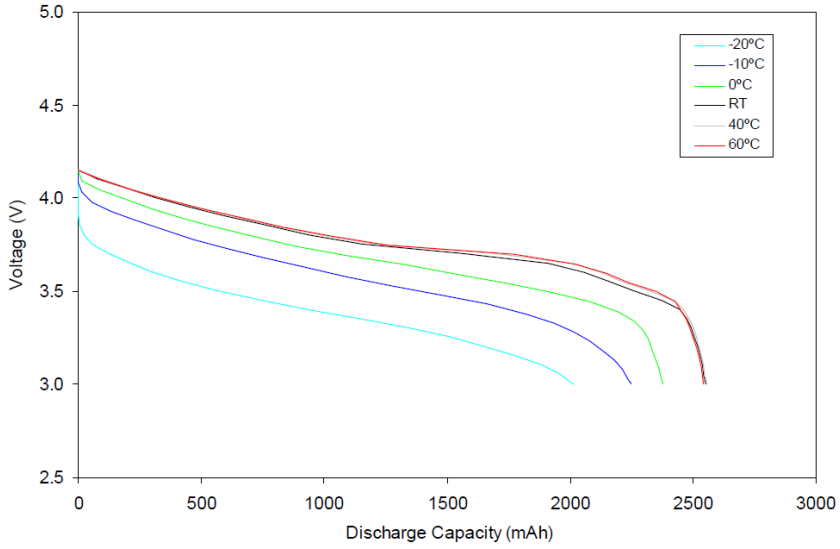
3.2 Discharging

Since all CellPac LITE batteries are delivered with a safety-circuit the maximum current rating established in the specification must be observed. There are two levels of overcurrent protection of which the first one will lead to a reversible interruption of current supply, while exceeding the second level will make the battery unusable permanently.

Please see the individual Product Information sheets for details of the safety parameters built into our modules which are set differently depending on the type designation.



Example discharge curves with the C rates as parameter



Example discharge at 1C with the temperature as parameter

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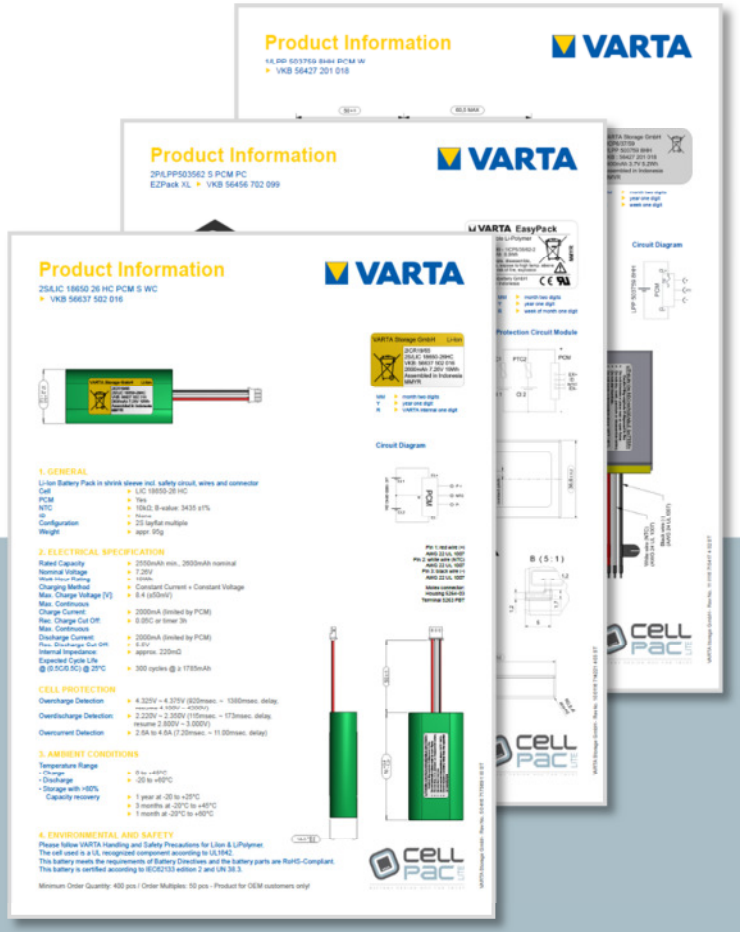
4. Individual Cell Specifications



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4.1 Technical Cell Data: LIC 18650 26HC

Relevant for the following model/s:

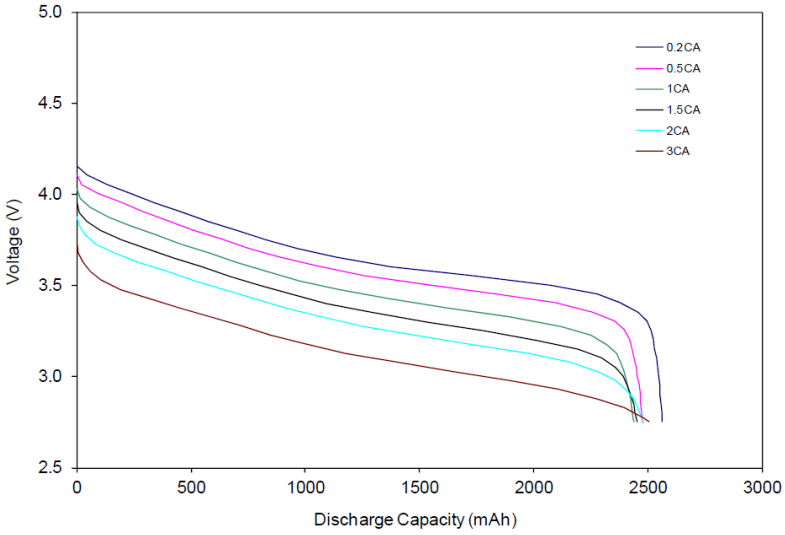
- 1/LIC 18650-26HC
  P/N: 56637 201 016
- 2S/LIC 18650-26HC
  P/N: 56637 502 016
- 2P/LIC 18650-26HC
  P/N: 56637 502 017
- EasyPack PLUS
  P/N: 56637 702 099

LIC 18650-26 HC Discharge Profile

Test Conditions:

1 – 3 cycles	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 1.0C UEOD = 3.0V
2 – 1 cycle	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 0.2C UEOD = 3.0V

Maximum Discharge Current taken from the product specification

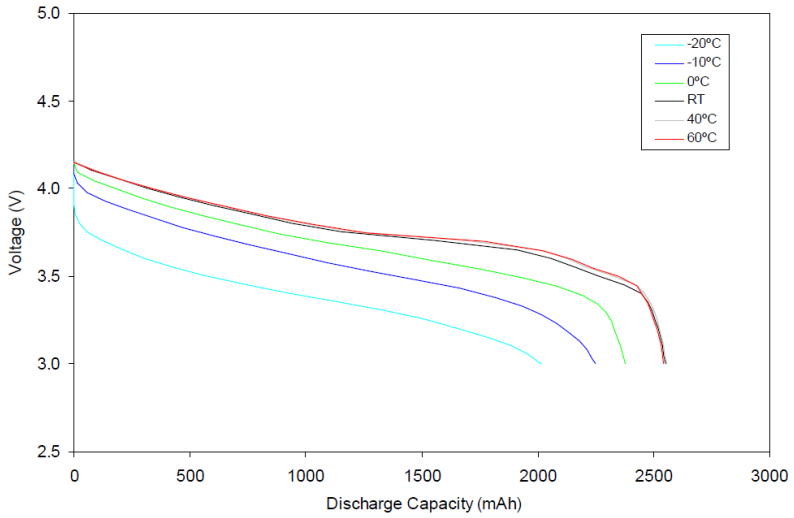


LIC 18650-26 HC Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature) 4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



LIC 18650-26 HC Cycling at 20°C

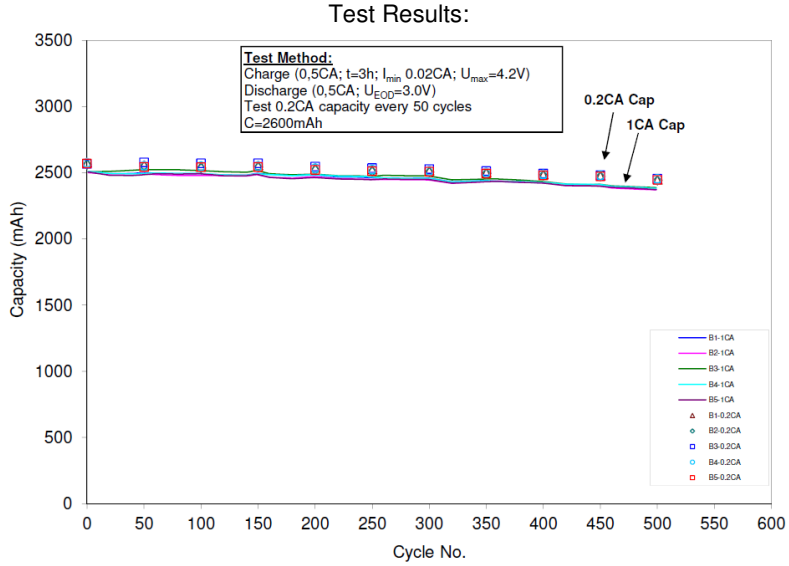
Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-

Test Results:



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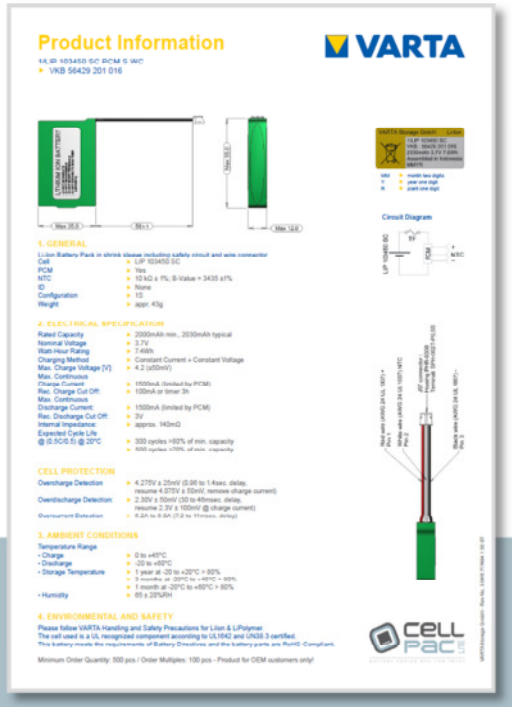
4.2 Technical Cell Data: LIP 103450 SC


Product Information

VARTA

VKB 56429 201 016

Circuit Diagram

1. GENERAL

2. ELECTRICAL SPECIFICATION

CELL PROTECTION

3. AMBIENT CONDITIONS

4. ENVIRONMENTAL AND SAFETY

Relevant for the following model/s:

- 1/LIP 103450 SC PCM S WC
  P/N: 56429 201 016

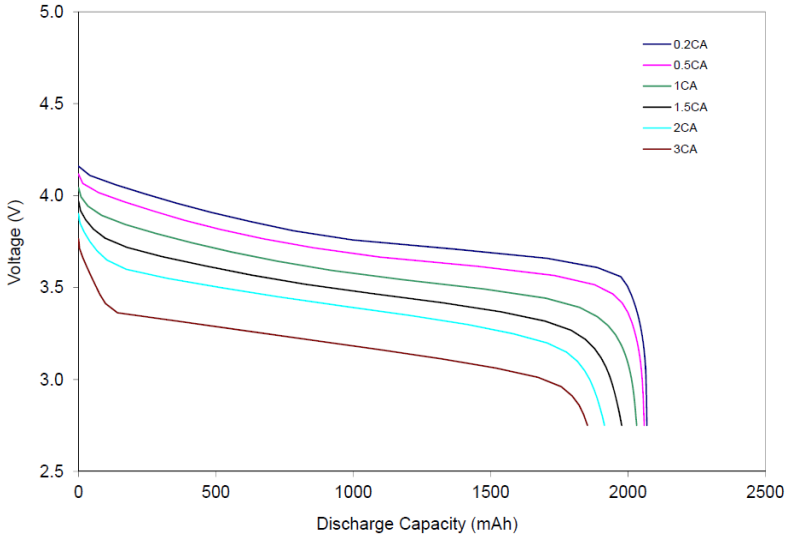
LIP 103450 SC Discharge Profile

Test Conditions:

1 – 3 cycles Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 1.0C
UEOD = 3.0V

2 – 1 cycle Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 0.2C
UEOD = 3.0V

Maximum Discharge Current taken from the product specification

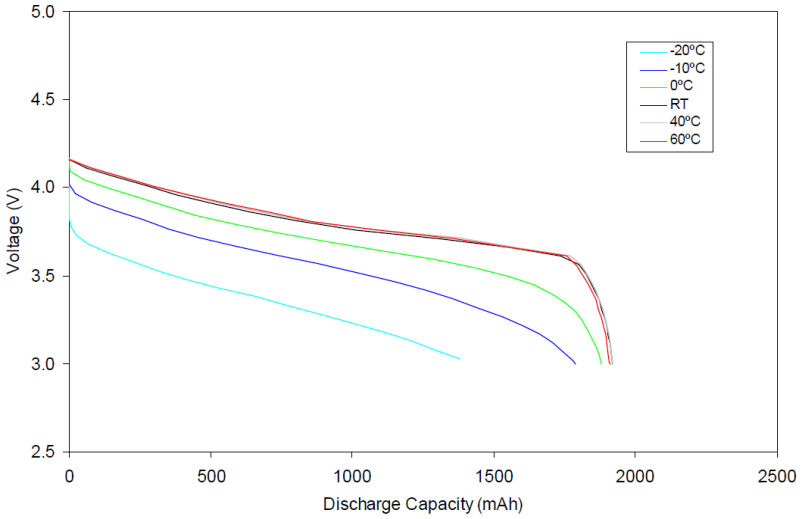


LIP 103450 SC Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature) 4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



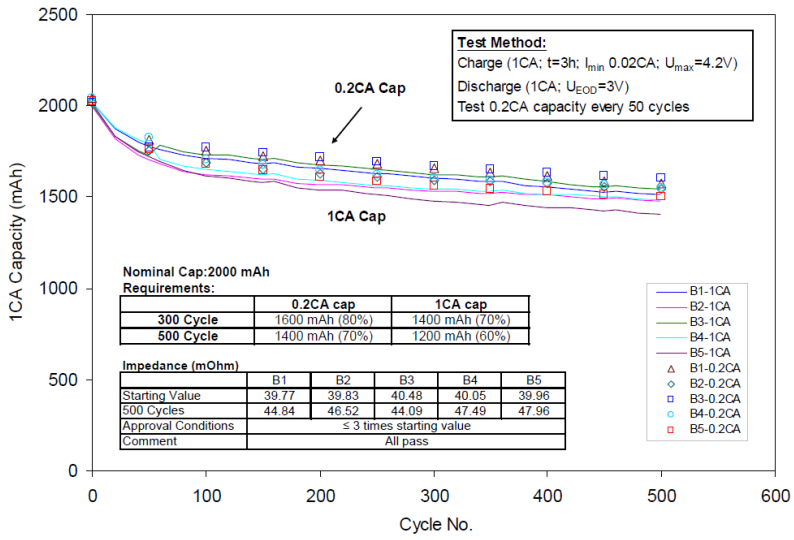
LIP 103450 SC Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-



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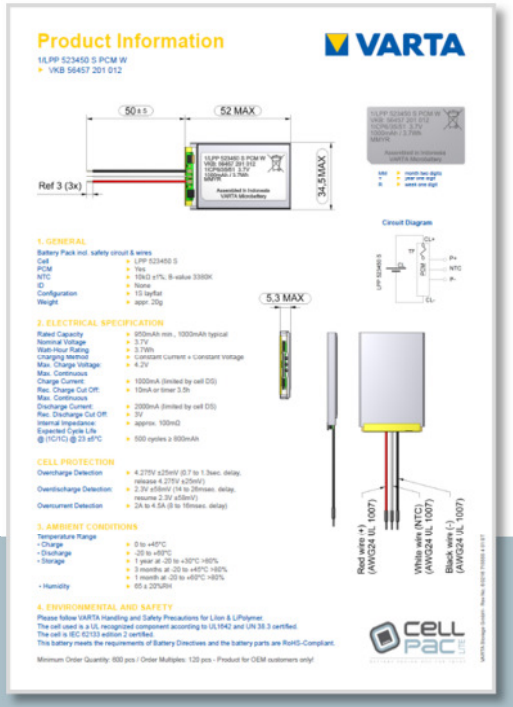
4.3 Technical Cell Data: LPP 523450 S


Product Information

1/LPP 523450 S PCM W

VKB 56457 201 012

Relevant for the following model/s:

- 1/LPP 523450 S PCM W
  P/N: 56457 201 012

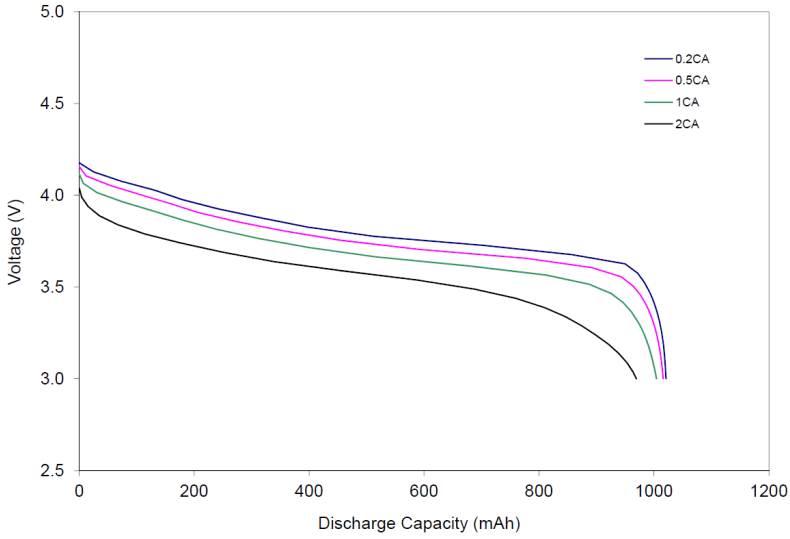
LPP 523450 S Discharge Profile

Test Conditions:

1 – 3 cycles Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 1.0C
UEOD = 3.0V

2 – 1 cycle Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 0.2C
UEOD = 3.0V

Maximum Discharge Current taken from the product specification

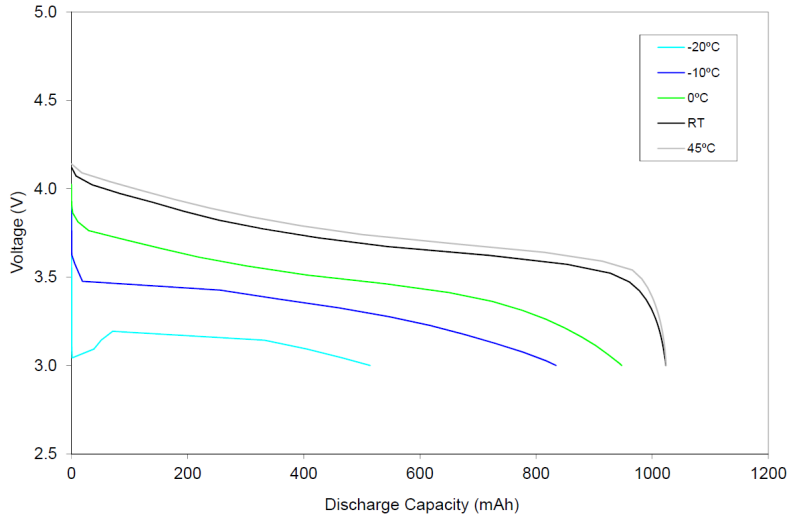


LPP 523450 S Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



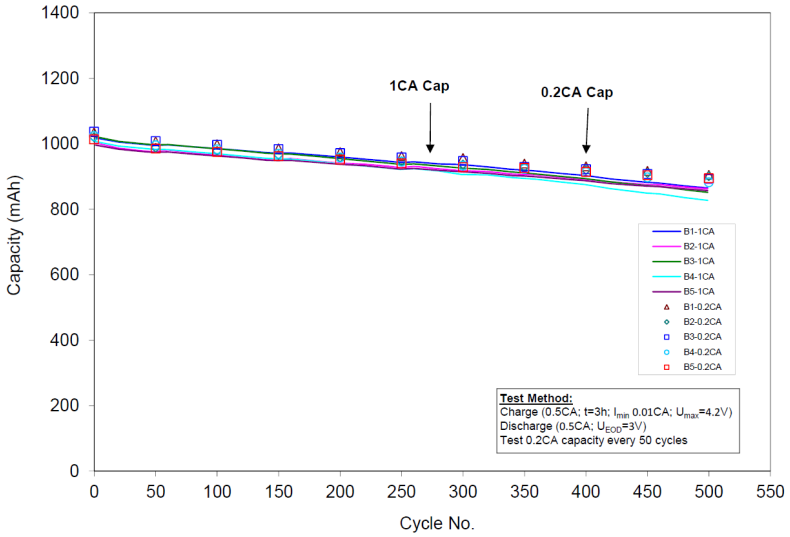
LPP 523450 S Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-



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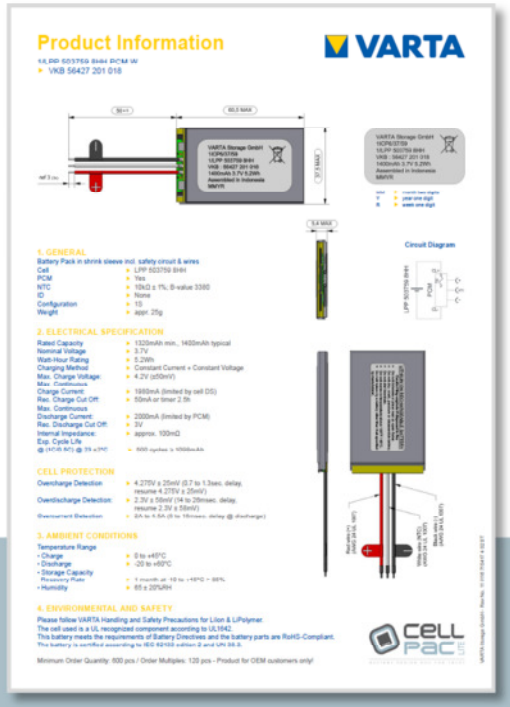
4.4 Technical Cell Data: LPP 503759 8HH



Relevant for the following model/s:

- 1/LPP 503759 8HH PCM W
  P/N: 56427 201 018

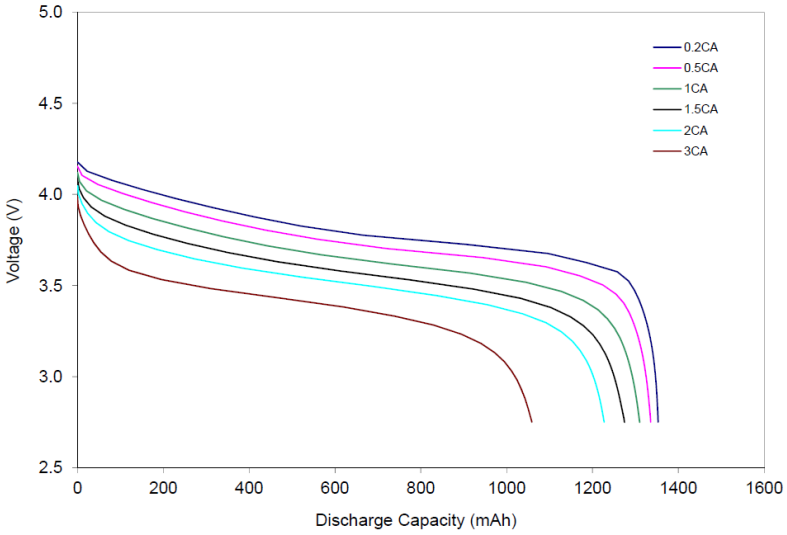
LPP 503759 8HH Discharge Profile

Test Conditions:

1 – 3 cycles Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 1.0C
UEOD = 3.0V

2 – 1 cycle Charge 1.0C; tmax = 3h;
Imin = 0.02C; 4.2V
Discharge 0.2C
UEOD = 3.0V

Maximum Discharge Current taken from the product specification

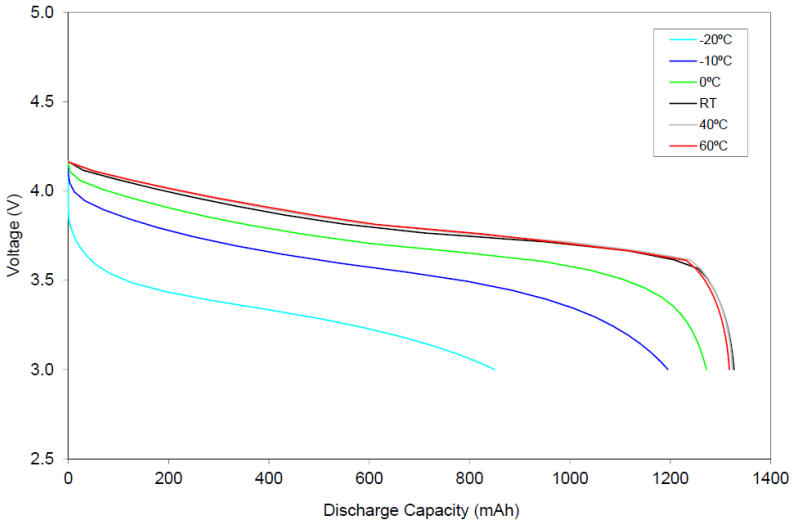


LPP 503759 8HH Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



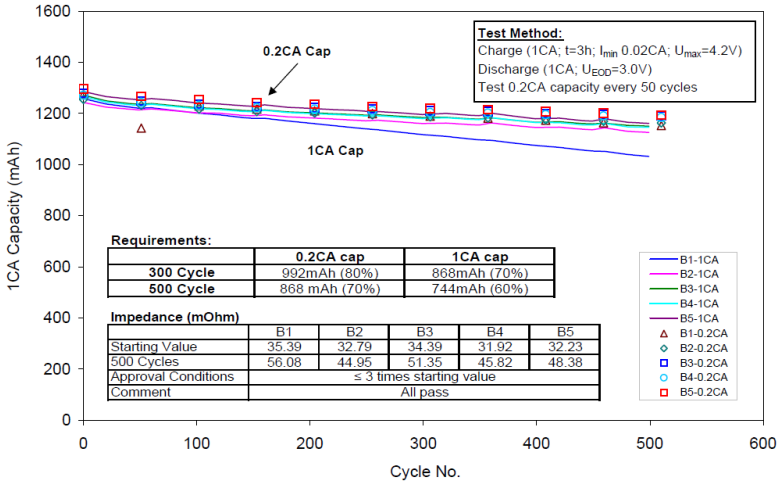
LPP 503759 8HH Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) c.) Thickness measurement before and after cycling reference thickness according to specification of cell-



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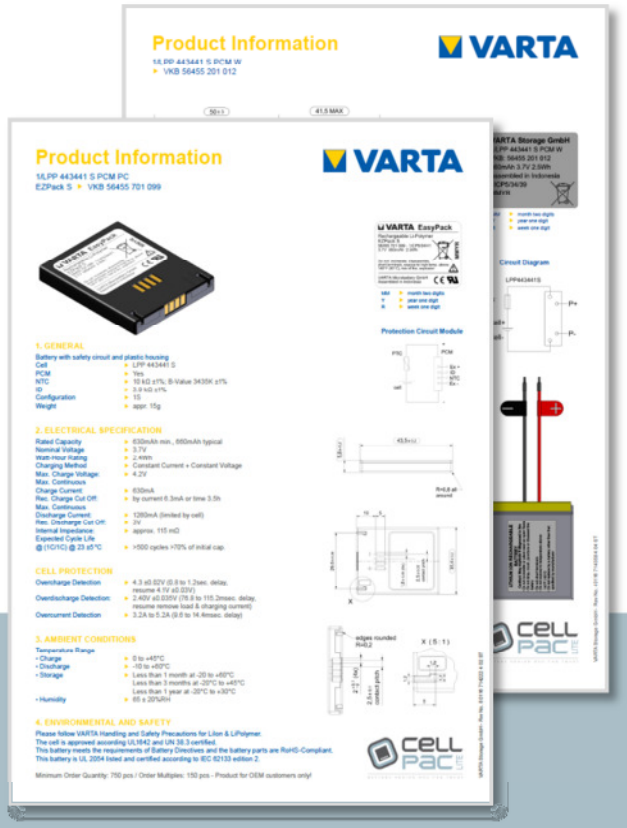
4.5 Technical Cell Data: LPP 443441 S



Relevant for the following model/s:

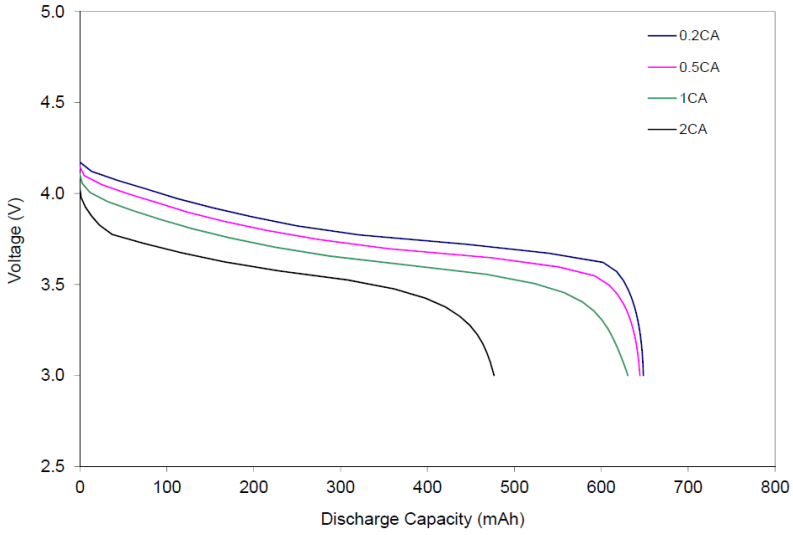
- 1/LPP 443441 S PCM W
  P/N: 56455 201 012
- EasyPack S
  P/N: 56455 701 099

LPP 443441 S Discharge Profile

Test Conditions:

1 – 3 cycles	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 1.0C UEOD = 3.0V
2 – 1 cycle	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 0.2C UEOD = 3.0V

Maximum Discharge Current taken from the product specification

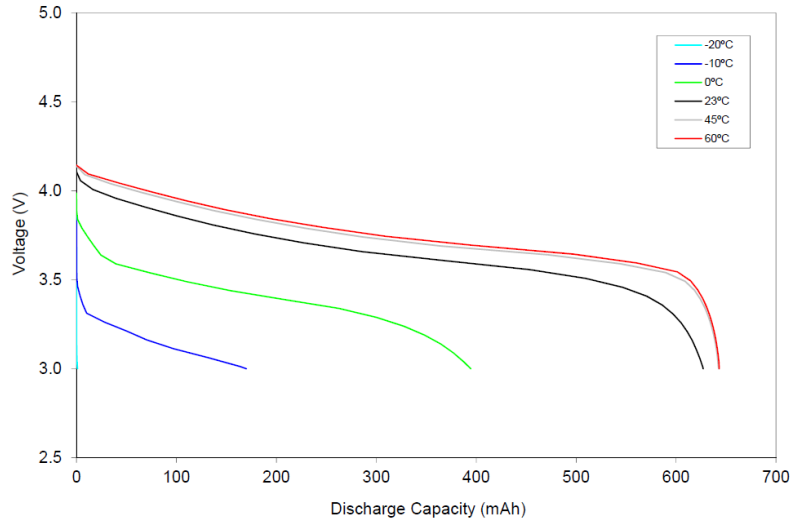


LPP 443441 S Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



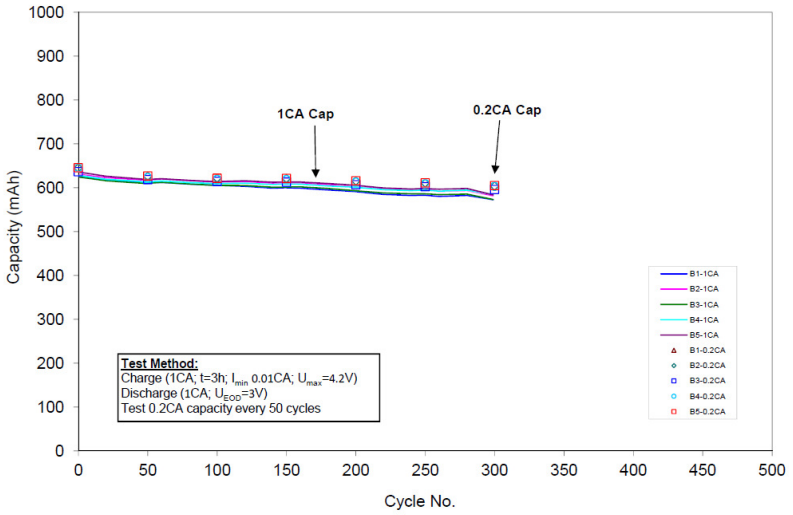
LPP 443441 S Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-



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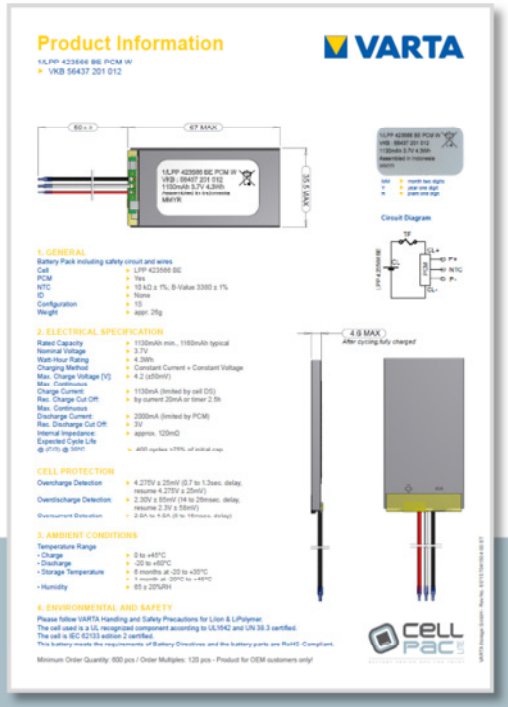
4.6 Technical Cell Data: LPP 423566 BE



Relevant for the following model/s:

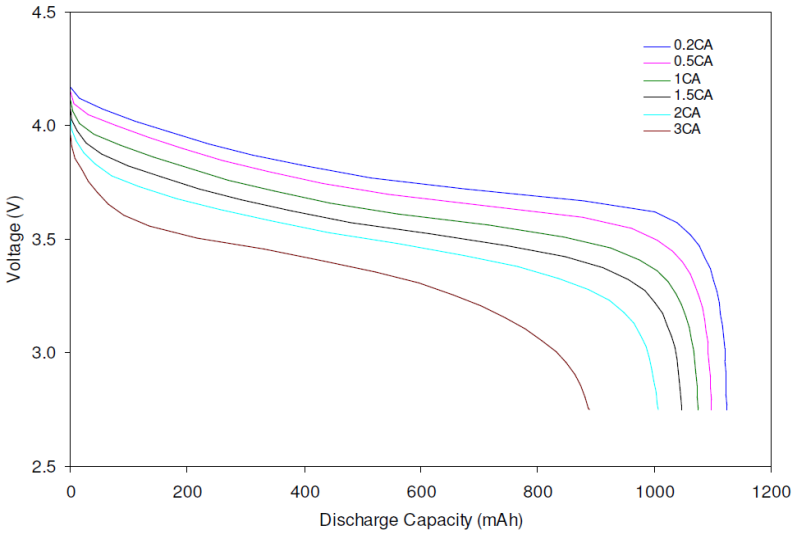
- 1/LPP 423566 BE NTC W
  P/N: 56437 201 012

LPP 423566 BE Discharge Profile

Test Conditions:

1 – 3 cycles	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 1.0C UEOD = 3.0V
2 – 1 cycle	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 0.2C UEOD = 3.0V

Maximum Discharge Current taken from the product specification

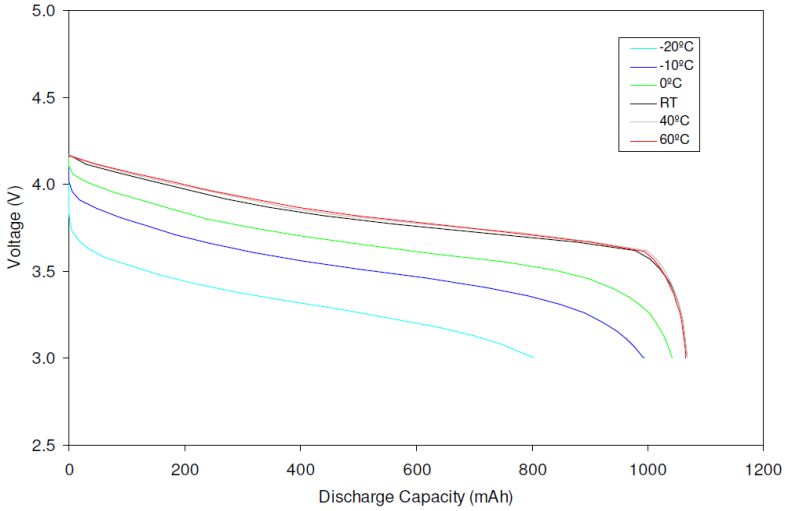


LPP 423566 BE Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



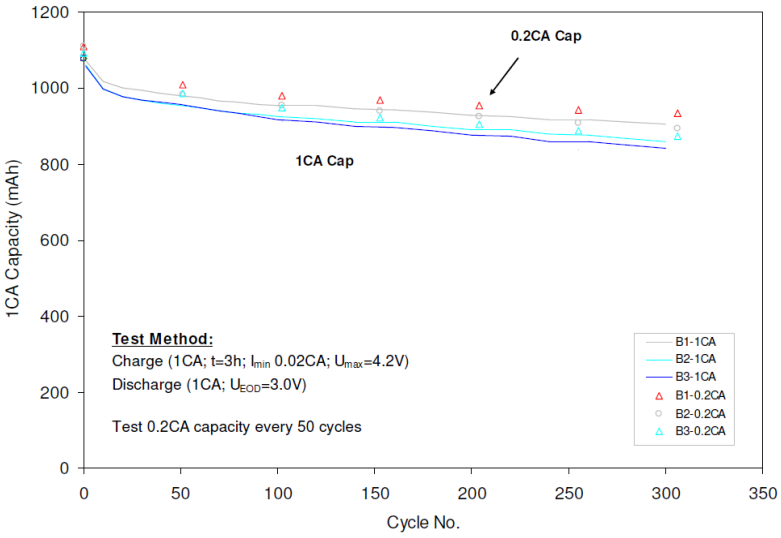
LPP 423566 BE Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-



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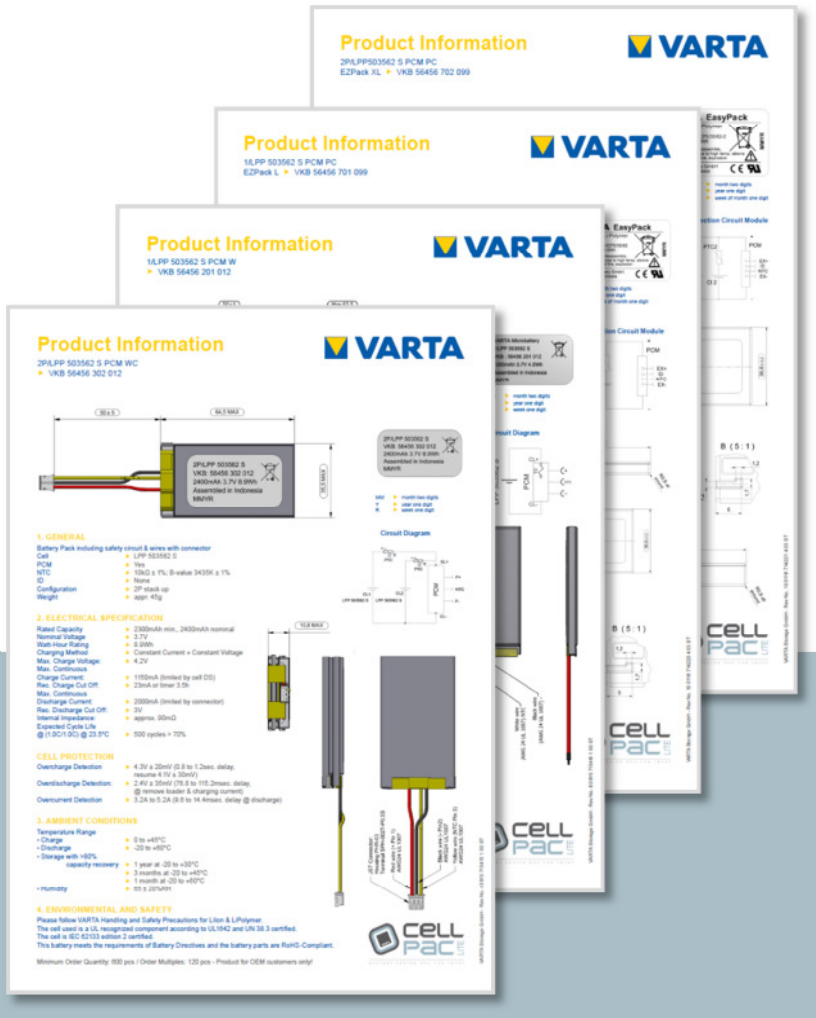
4.7 Technical Cell Data: LPP 503562 S



Relevant for the following model/s:

- 2P/LPP 503562 S PCM WC
  P/N: 56456 302 012
- 1/LPP 503562 S PCM W
  P/N: 56456 201 012
- EasyPack L
  P/N: 56456 701 099
- EasyPack XL
  P/N: 56456 702 099

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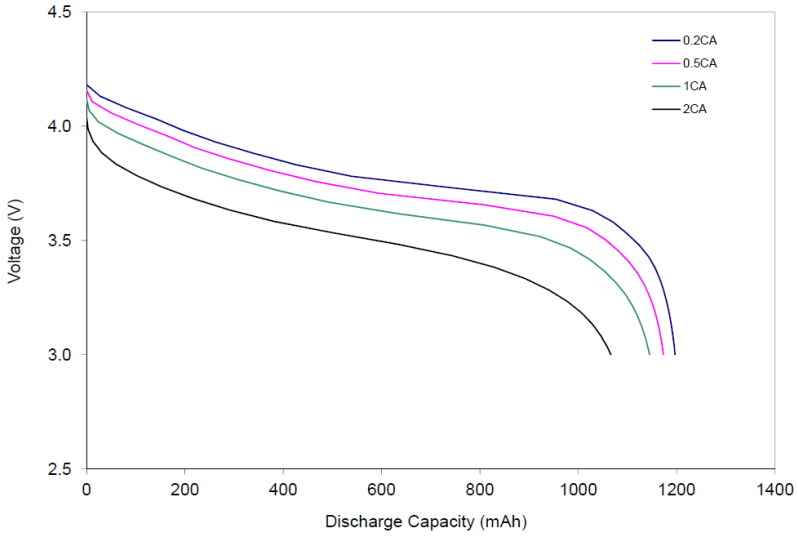
LPP 503562 S Discharge Profile

Test Conditions:

1 – 3 cycles	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 1.0C UEOD = 3.0V
2 – 1 cycle	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 0.2C UEOD = 3.0V

Maximum Discharge Current taken from the product specification

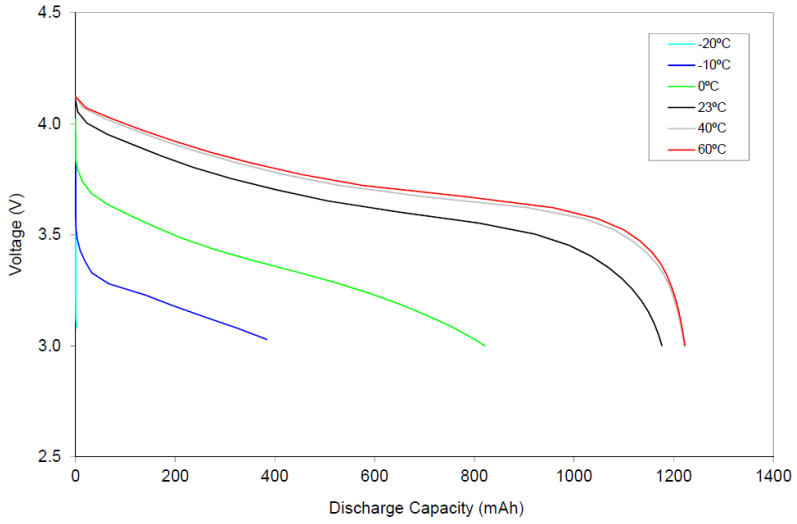


LPP 503562 S Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



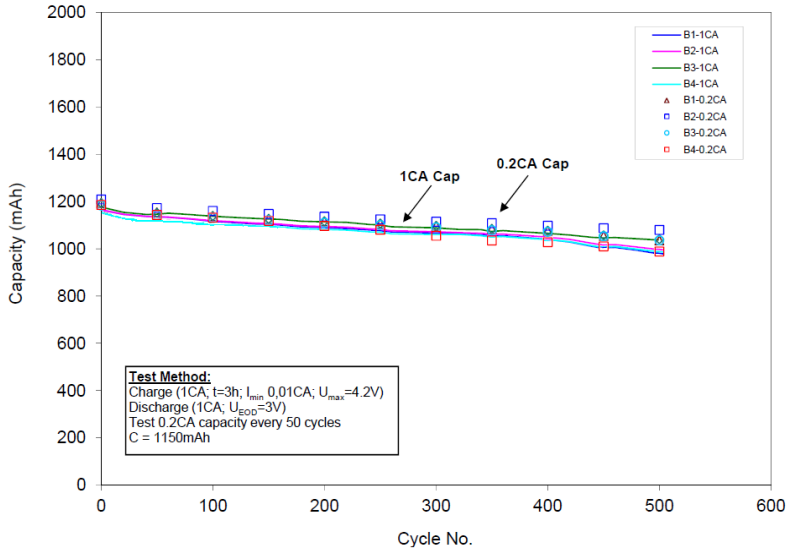
LPP 503562 S Cycling at 20°C

Test Conditions:

a) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

b) Impedance measurements before and after cycling reference impedance according to specification of cell.

c) Thickness measurement before and after cycling reference thickness according to specification of cell-



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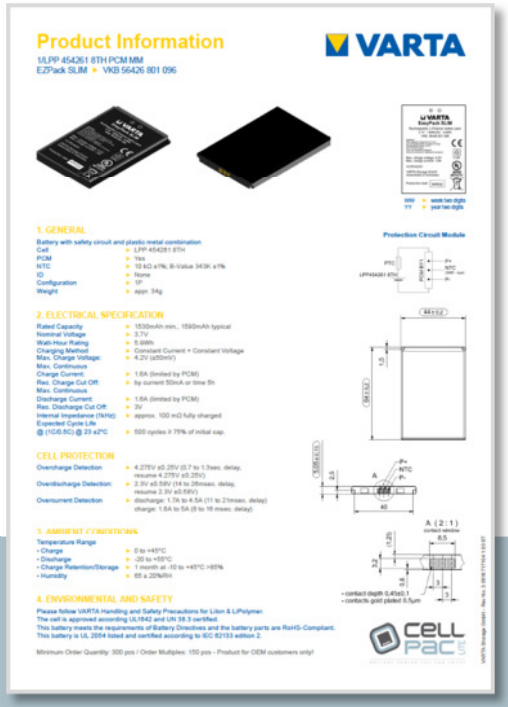
4.8 Technical Cell Data: LPP 454261 8TH



Relevant for the following model/s:

- EasyPack Slim
  P/N: 56426 801 096

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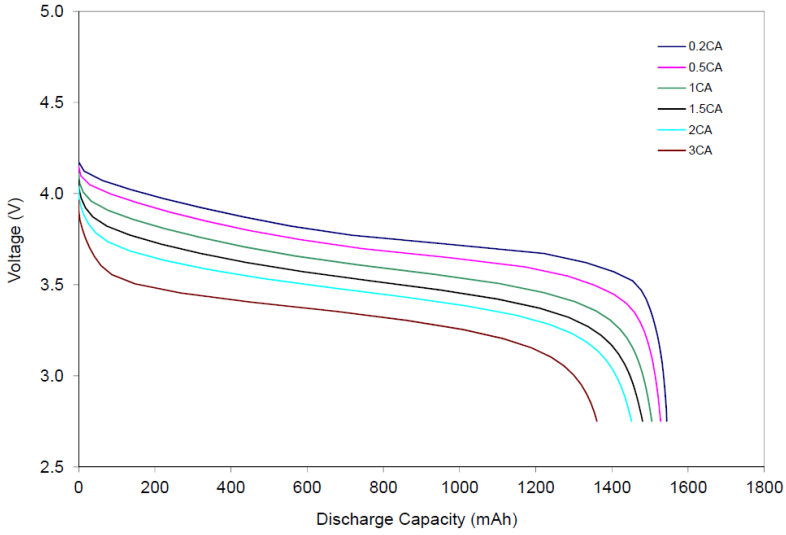
LPP 454261 8TH Discharge Profile

Test Conditions:

1 – 3 cycles	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 1.0C UEOD = 3.0V
2 – 1 cycle	Charge 1.0C; tmax = 3h; Imin = 0.02C; 4.2V Discharge 0.2C UEOD = 3.0V

Maximum Discharge Current taken from the product specification

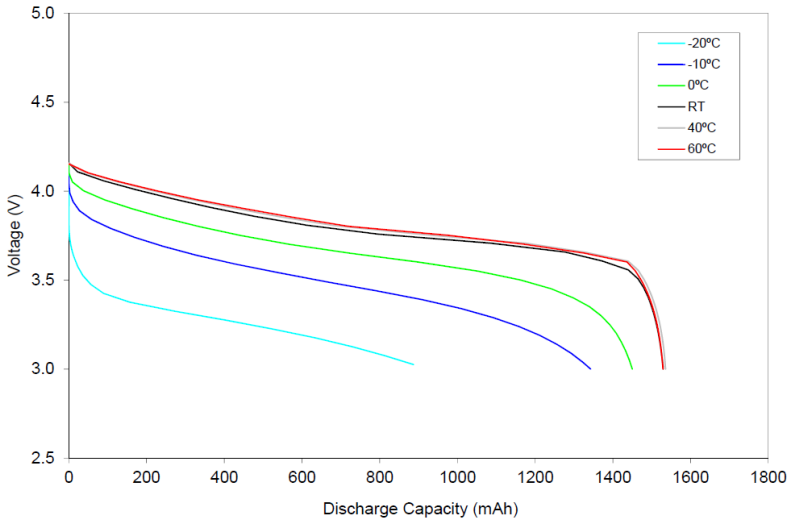


LPP 454261 8TH Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures

Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



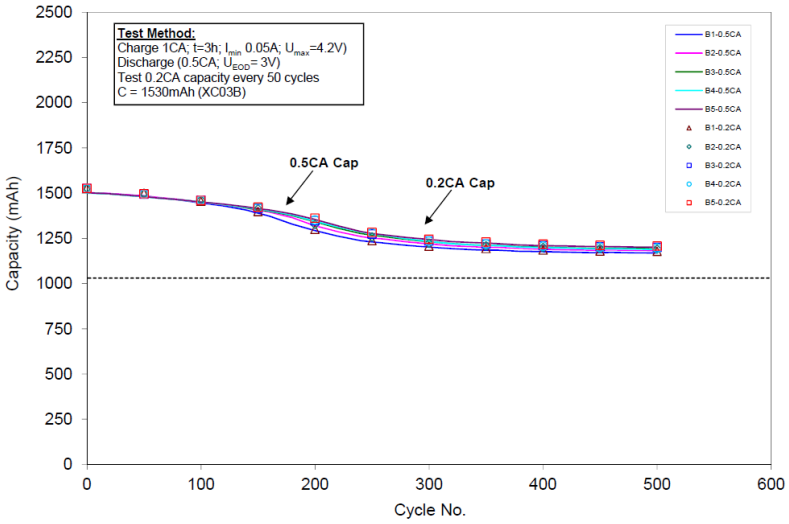
LPP 454261 8TH Cycling at 20°C

Test Conditions:

d) Capacity
charge (1.0C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity (discharge 0.2C; UEOD = 3.0V) after charging each 50 cycles

e) Impedance measurements before and after cycling reference impedance according to specification of cell.

f) Thickness measurement before and after cycling reference thickness according to specification of cell-



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5. Reliability and Life Expectancy

VARTA CellPac LITE batteries combine maximum safety with top-performance and reliability.

Cycle life is expected to be 300-500 cycles with a remaining capacity of approximately 70% - 80%, depending on exact model.

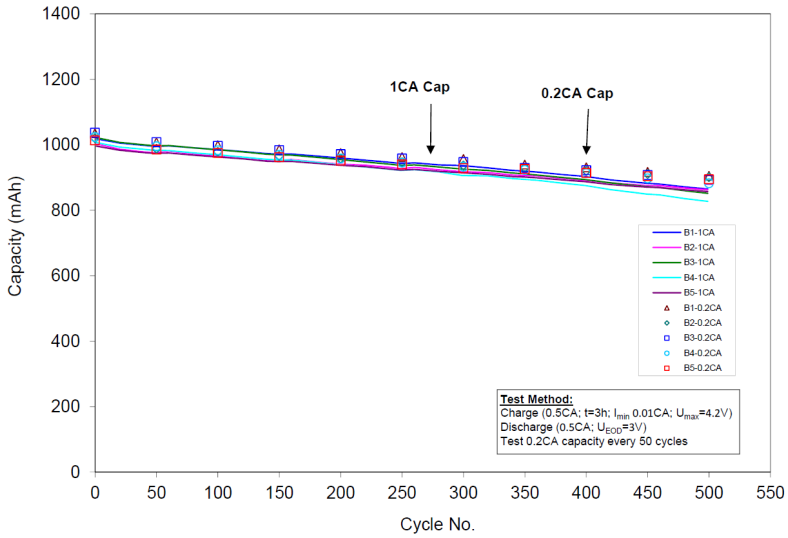

Fig. Typical cycle-life at room temperature (20°C) LPP 523450 S

6. Safety

All CellPac LITE batteries are equipped with an electronic module for protection against malfunction of charging and discharging, misuse and abuse. Moreover, cells are selected which provide the best of performance data combined with excellent inherent safety features for usage within reasonable boundaries of specifications. To cope with any foreseeable abuse of our batteries, we have implemented a number of safety criteria which are usually multi-redundant when implemented together with a carefully designed application device and related charging circuitry in particular.

It is VARTA Storage policy to have all new cells tested and listed/recognized by UL (a worldwide acting, non-profit organisation in the field of consumer safety protection), according to the standard UL 1642. Relevant testing requirements, which represent to us the minimum level of safety testing, are given in the following table:

Test	Description	Required results
Abnormal Charging Test	► Charging Current I: 3 times max. allowed charging current ► Charging Voltage U: CellPac LITE cells: 4.8 V ► Charging Time t: t = 2.5 C / I, (Current in CA) – at open voltage ► t = 12 h – at limited charging voltage (manufacturer specification) ► If necessary additional safety elements according to UL file <u>Testing Conditions:</u> ► Test at RT ► Cell in discharged state (3.0 V after 1.0 C discharge) ► An integrated overcurrent or over temperature safety element is ► not allowed to be activated (the maximum load has to be chosen) ► The cell will be connected in series with a direct current source and a charging current is applied	no bursting, no fire
Short Circuit Test	<u>Testing Conditions:</u> ► Test at RT ► Cell used in charged state (3 h with 1.0 CA to 4.2 V, Imin 0.02 C) ► Cell is shortened in the test with a maximum resistance ► of 100 mOhm (to be documented)	no bursting, no fire Max. temperature 150°C
Voltage Reversal Charge Test (according to UN Manual 38.3)	<u>Testing Conditions:</u> ► Test at RT ► Cell in discharged state (3.0 V after 1.0 C discharge) ► - 1 C; 12 V until cell temperature is back at RT (tmax = 1h)	no bursting, no fire Max. temperature 75°C
Heating Test	<u>Testing Conditions:</u> ► Charge conditions: cell fully charged (according to UL 1642) ► 3h / 4.25 V (1 C) ► Heating of the cell in the temperature box to 130°C (D 5°C/min +/- 2°C) ► - 10 minutes holding time at 130°C	no fire, no rupture

Table Required safety tests for VARTA CellPac LITE cells

7. Storage

CellPac LITE batteries are shipped in a state of charge of approx. 30-50 % of their full capacity. This enables the best conditions for storage.

Where possible, storage under fully charged state (CC/CV 4.2V, 3h) should be avoided to maximize longevity. Trickle charge, common in aqueous battery systems (Ni-Cd, Ni-MH), is strictly forbidden to avoid performance issues and safety concerns.

8. Transportation of VARTA CellPac LITE Batteries

Rechargeable lithium ion batteries manufactured by VARTA Storage are considered to be UN 3480 Lithium Ion Batteries, and are tested according to 38.3 of the “UN Manual of Tests and Criteria” for compliance with the requirements of special provisions ADR 188, IMDG 188, DOT / 49 CFR § 173.102, and the requirements of IATA DGR packing instruction 965. Positive test results as well as other relevant information required for transportation are stated in dedicated “Declarations of Conformity”.

Onward transportation of CellPac LITE batteries in original VARTA packaging is permitted provided the shipment is made in accordance with the transport rules in force at the time of shipping. Repackaging and onward shipment should only be done by trained personnel in accordance with the latest transportation regulations in force and is the sole responsibility of the shipping party.

9. Proper Use and Handling

For proper use and handling please refer to the latest VARTA Handling Precautions supplied with your batteries or under following links:

Handling Precautions Cylindrical & Prismatic
Handling Precautions Polymer Pouch

10. Design Tips for VARTA CellPac LITE Battery Packs

In general, we strongly recommend for any design-in to consult the sales engineer of the distributing company. For applications with special requirements or environments which go beyond the specified conditions, CellPac LITE batteries will not be suitable. A custom design may be recommended under VARTA's CellPac PLUS program, for high-value projects.

To support your own design-in process, we offer the following tips, to help avoid the most common issues which can occur:

1. A lithium rechargeable battery is a "living" product combining mechanical, electrical and chemical engineering disciplines. It's performance is highly dependent on how it is treated, as shown in the technical data within this handbook. The limitation of our own data is that it is generic and therefore in most cases only indicative of reality. **Whenever possible, do get samples of your chosen CellPac LITE battery and test its performance specifically for your application before finalizing your design and moving to mass production.**

2. For pouch-cell battery designs, it is important to take care good care of the case during handling or installation. The cavity should not contain any protrusions which may dent or pressure the pouch surface and should be big enough to contain the cell with room for a little swelling over lifetime (0.1-0.2mm per cell, unless stated on the Product Information Sheet).

3. To secure pouch cells comfortably, especially in cases of too much space, a suitably-sized adhesive pad secured inside the battery cavity will normally ensure a good fit.

4. It's important to be aware of any standby-mode or continuous-drain which your application may put on the battery (e.g. clock, memory or data functions), especially with respect to avoiding over-discharge. Some batteries may have relatively low charge on arrival or at the time of installation to your devices. Long-term storage without re-charging, especially after full discharge of your application, may risk bringing the battery into "deep-discharge" at a very low voltage below 3.0V. This can cause long-term performance problems, swelling and in very extreme cases, lithium plating within the cell. A half-charge is an ideal condition for storage in general, but if your application does drain the battery in standby or "off" modes, the storage lifetime should be calculated and managed.

5. Avoid extreme or tight bending of wires, especially at the connector point or where the wires are soldered to the battery electronics.

6. Never rely on the VARTA safety electronic functions to act as the primary electronics within your application. The application functions must be designed to use the battery only within normal specification and the battery safety functions should only be called upon in case of a failure in the normal operation of your application electronics.

7. For installation of pouch cells, especially designs with no connector, take special care to consider the installation process. Dropping cells directly onto hard surfaces may damage them and cause swelling over time. If cells are dropped before installation, it is generally recommended that they are removed from your production and not installed. Soldering processes should not be done too close to the PCM or pouch to avoid any risk of heat damage. For example, to trim wires down to a very short length would bring the solder point very close to critical components. The safety function of the PCM could be compromised or the cell itself could become damaged.

8. Sharp ribs or corners within the cavity should be avoided where possible. In a scenario where your application may be dropped (a high risk for handheld devices especially), these can cut into the cell during impact