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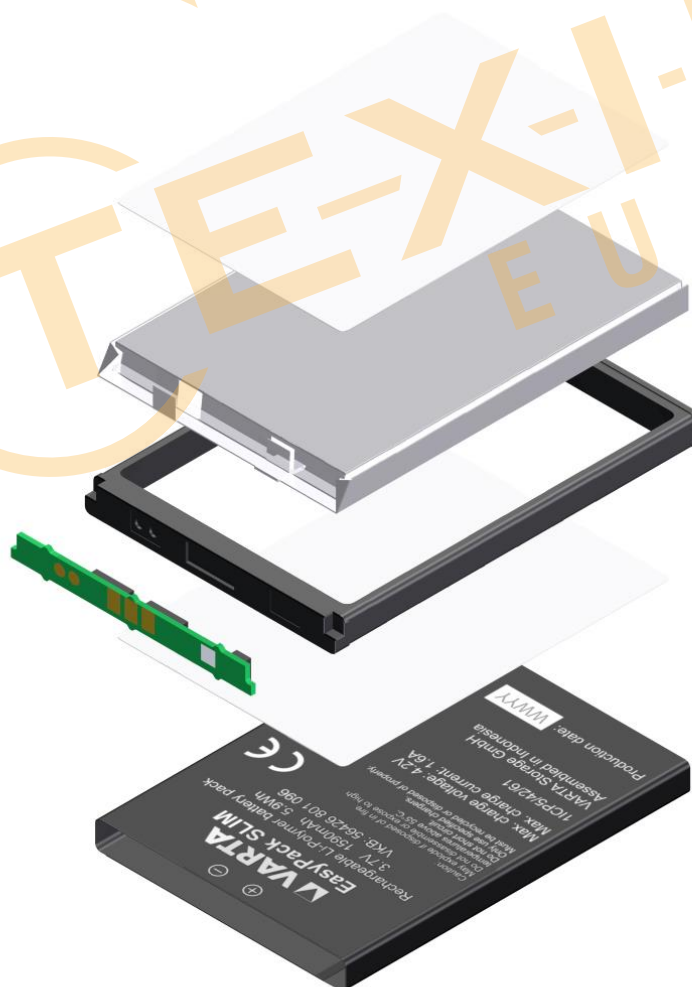


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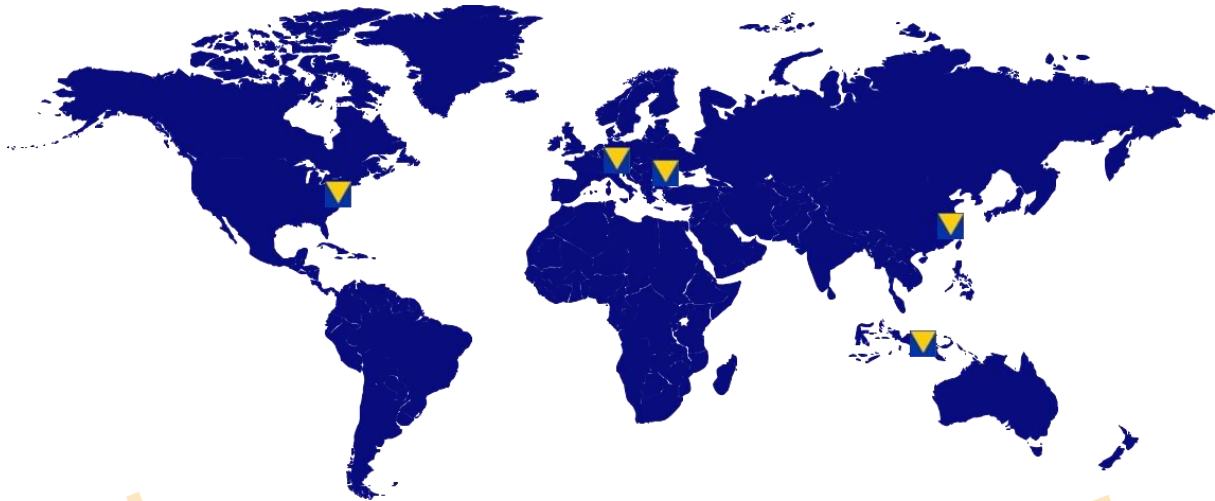
CELL PAC^{LITE}

Technical Handbook





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

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For more information visit our website <https://www.varta-ag.com/en/industry/service>



Overview

CELL PAC^{LITE}

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.

CELL PAC^{BLOX}

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.

CELL PAC^{PLUS}

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.

Find more information on the [website](#)



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For latest technical data please refer to our data sheets which you will find here on our website:

<https://www.varta-ag.com/en/industry/product-solutions/lithium-ion-battery-packs/cellpac-lite>

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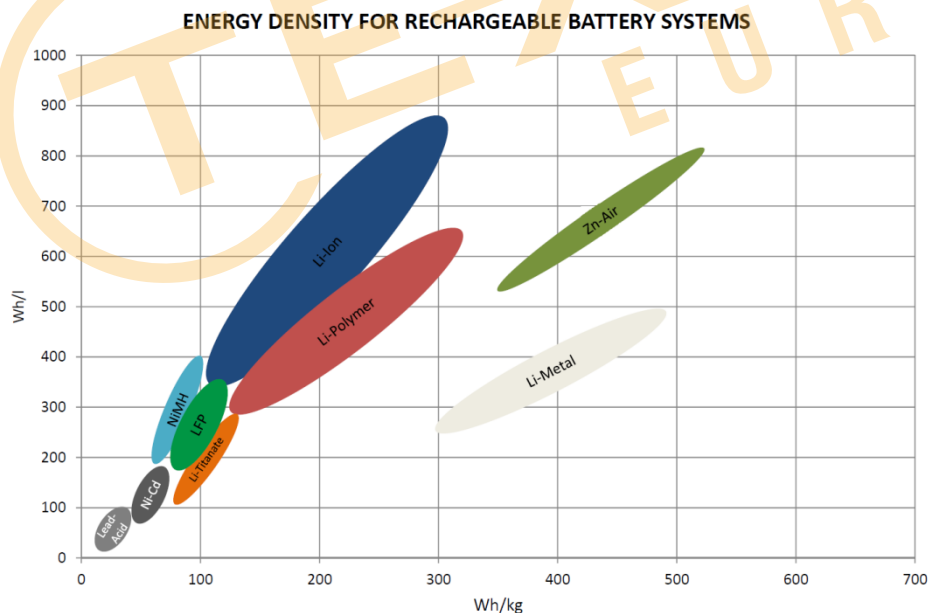
1. Introduction of CellPac LITE

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) with 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	▶ Good cycle-life (500 full cycles typically)
▶ Variety of form-factors	▶ Low self-discharge
▶ High cell voltage (~3.7 V nom.)	▶ IEC62133-2:2017 certification for most of the packs
▶ UL2054 listing for EasyPack batteries	▶ Wide temperature range
▶ Charging technique compatible with Li-Ion (const. I / const. V)	▶ ISO9001 certified for design and manufacture



Comparison of different rechargeable battery systems regarding their energy densities



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: $C = I \cdot t$
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.
 $I = C/t = C/5 = 0.2 \text{ CA}$ when $t = 5 \text{ h}$



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



2. Quick Reference Table CellPac LITE

CELL PAC^{LITE}

2.4 Reference Table: EasyPack 1/1

	EasyPack 3	EasyPack 4	EasyPack 6	EasyPack 10.0
Order Number (VAG)	35450 101 000	35450 101 000	35450 101 000	35450 101 000
State of Charge	100%	100%	100%	100%
Nominal Capacity (mAh)	660	1000	2400	5200
Nominal Voltage (V)	3.7	3.7	3.7	3.85
Dimensions				
Height (mm)	9.8	6.4	11.4	21.2
Width (mm)	35.4	35.4	35.4	40.0
Length (mm)	43.0	54.0	54.0	75.1
Weight, approx. (g)	74g	29g	49g	160g
Operating Temperature				
Charging	0°C to +40°C	0°C to +40°C	0°C to +40°C	0°C to +40°C
Discharging	-20°C to +40°C	-20°C to +40°C	-20°C to +40°C	-20°C to +40°C
Storage	-20°C to +40°C	-20°C to +40°C	-20°C to +40°C	-20°C to +40°C
Life Expectancy (cycles)	>500 (100%)	>500 (100%)	>500 (100%)	>500 (100%)
Internal Impedance	150	80	60	60
Agency, RoHS, REACH	Yes	Yes	Yes	Yes
RoHS and REACH	Yes	Yes	Yes	Yes
Certification	UN38.3 IATA, ICAO, IATA ICAO-TI 100.1, ICAO-TI 100.2	UN38.3 IATA, ICAO, IATA ICAO-TI 100.1, ICAO-TI 100.2	UN38.3 IATA, ICAO, IATA ICAO-TI 100.1, ICAO-TI 100.2	UN38.3 IATA, ICAO, IATA ICAO-TI 100.1, ICAO-TI 100.2



2.1 Reference Table: Li-Ion Cylindrical CellPac LITE

	1/LIC 18650-26 SKE PCM S WC	2S/LIC 18650-26 SKE PCM S WC	2P/LIC 18650-26 SKE PCM S WC
Order Number (VKB)	56653 201 012	56653 502 012	56653 502 013
State of Charge	~ 25 %	~ 25 %	~ 25 %
Nominal Capacity (mAh)	2600	2600	5200
Nominal Voltage (V)	3.7	7.3	3.7
Dimensions (without wire)			
Height (mm)	71.2	70.4	70.0
Width (mm)	19.7	18.9	21.0
Length (mm)	-	37.7	38.0
Weight, approx. (g)	50	95	
Operating Temperature			
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 +20°C	-20°C to +20°C	-20°C to +20°C
Life Expectance (typical)			
No. of cycles (on Cmin)	300 (80%)	300 (80%)	300 (70%)
Internal Impedance			
Approx. (mOhm)@1kHz	120	220	100
Miscellaneous			
NTC	None	Yes	Yes
Connector	None	None	None
Certification	UN38.3 IEC62133 Ed.2 IEC62133-2:2017	UN38.3 IEC62133 Ed.2 IEC62133-2:2017	UN38.3 IEC62133 Ed.2 IEC62133-2:2017



2.2 Reference Table: Li-Ion Pouch CellPac LITE

	1/LPP 523450 S PCM W	1/LPP 503759 8HH PCM W	1/LPP 443441 S PCM W	2P/LPP 503562 S PCM WC
Order Number (VKB)	56457 201 020	56427 201 022	56455 201 017	56456 302 015
State of Charge	~ 30 %	~ 25 %	~ 30 %	~ 30 %
Nominal Capacity (mAh)	1000	1400	660	2400
Nominal Voltage (V)	3.7	3.7	3.7	3.7
Dimensions (without wire)				
Height (mm)	52.0	60.5	41.5	64.5
Width (mm)	5.4	5.4	4.6	10.6
Length (mm)	34.5	37.5	34.0	35.5
Weight, approx. (g)	20	25	13	45
Operating Temperature				
Charging	0°C to +45°C	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	-10°C to +60°C
Storage	-20°C to +45°C	at 23°C	-20°C to +45°C	-20°C to +60°C
Life Expectance (typical)				
No. of cycles (on Cmin)	500 (80%)	500 (80%)	500 (70%)	500 (70%)
Internal Impedance				
Approx. (mOhm)@1kHz	100	100	120	90
Miscellaneous				
NTC	Yes	Yes	None	Yes
Connector	None	None	None	Yes
Certification	UN38.3 IEC62133-2:2017	UN38.3 IEC62133-2:2017	UN38.3 IEC62133-2:2017	UN38.3 UL Recognition IEC62133-2:2017



2.4 Reference Table: EasyPack

	EasyPack S	EasyPack L	EasyPack XL	EasyPack PLUS
Order Number (VKB)	56455 701 014	56456 701 012	56456 702 012	56637 702 099
State of Charge	~ 30 %	~ 30 %	~ 30 %	~ 25 %
Nominal Capacity (mAh)	660	1200	2400	5200
Nominal Voltage (V)	3.7	3.7	3.7	3.63
Dimensions				
Height (mm)	5.8	6.4	11.4	21.2
Width (mm)	35.4	36.6	36.6	40.6
Length (mm)	43.5	64.5	64.5	75.1
Weight, approx. (g)	14g	26g	48g	105g
Operating Temperature				
Charging	0°C to +45°C	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	-20°C to +45°C
Storage	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C	-20°C to +45°C
Life Expectance (typical)				
No. of cycles (on Cmin)	>500 (>70%)	>500 (>70%)	>500 (>70%)	>300 (>70%)
Internal Impedance				
Approx. (mOhm)@1kHz	150	99	68	80
Miscellaneous				
NTC and ID Pin	Yes	Yes	Yes	Yes
Certification	UN38.3 UL Listing IEC62133-2:2017	UN38.3 UL Listing IEC62133-2:2017	UN38.3 UL Listing IEC62133-2:2017	UN38.3 UL Listing IEC62133-2:2017



3. Charging / Discharging

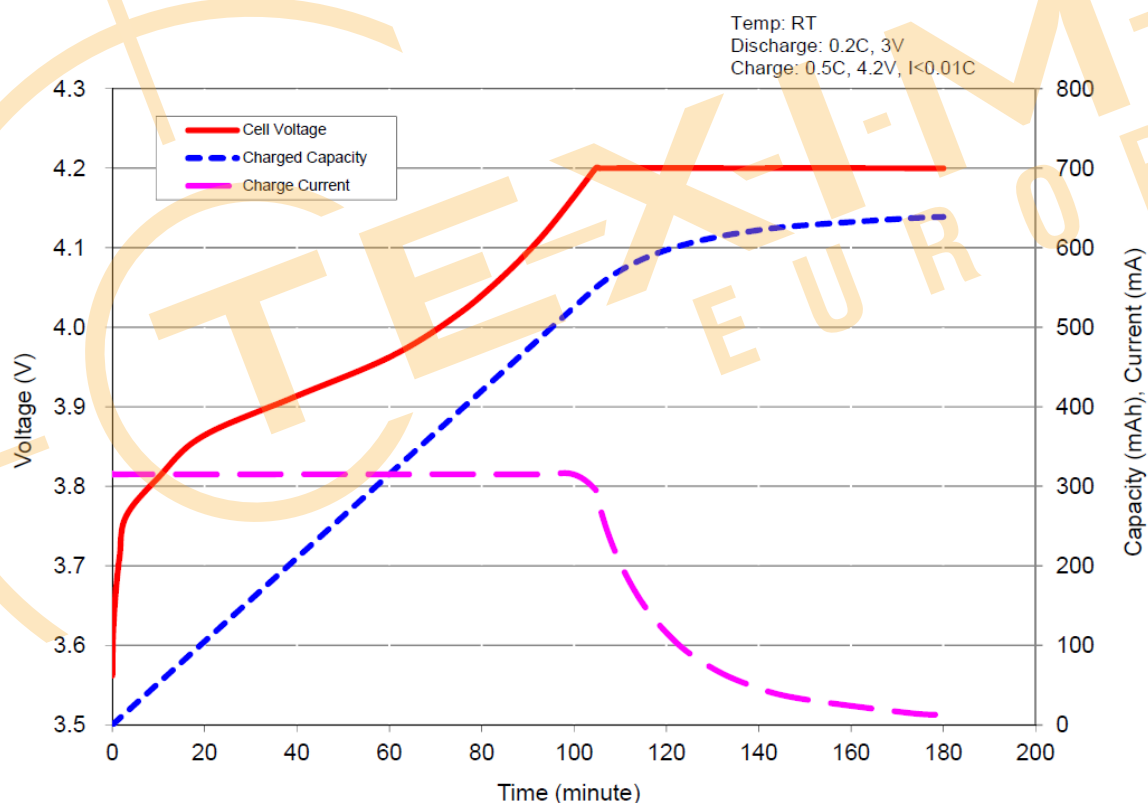
3.1 Charging

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



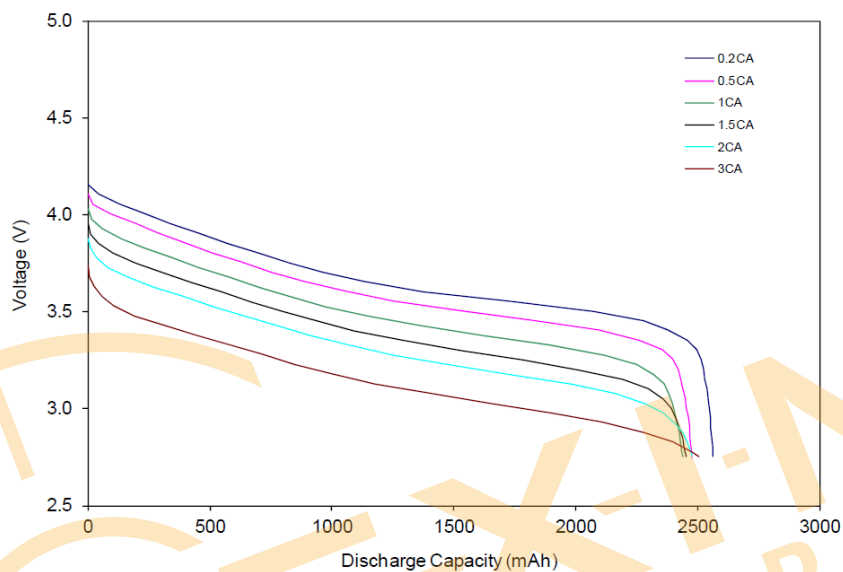
Example cell charging characteristics



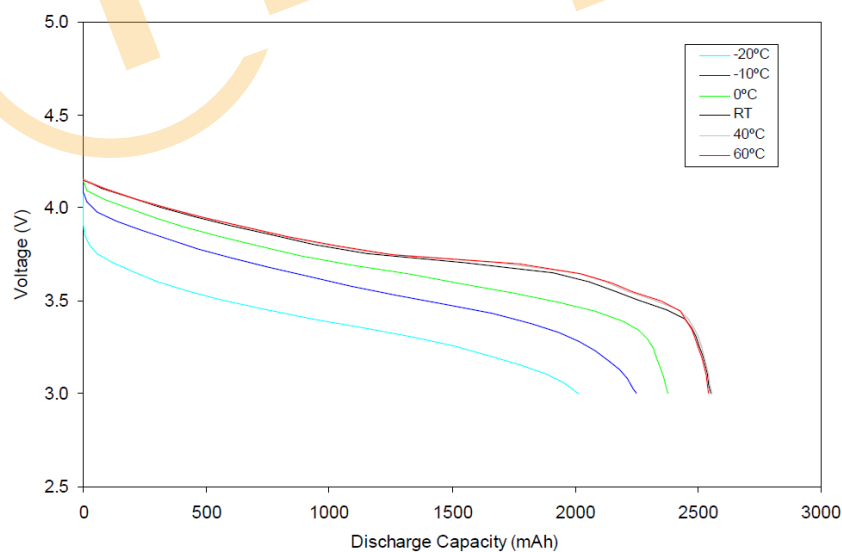
3.2 Discharging

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



4. Individual Cell Specifications

4.1 Technical Cell Data: LIC 18650-26SKE

Relevant for the following model:

- ▶ 1/LIC 18650-26 SKE PCM S WC
P/N: 56653 201 012
- ▶ 2S/LIC 18650-26 SKE PCM S WC
P/N: 56653 502 012
- ▶ 2P/LIC 18650-26 SKE PCM S WC
P/N: 56653 502 013

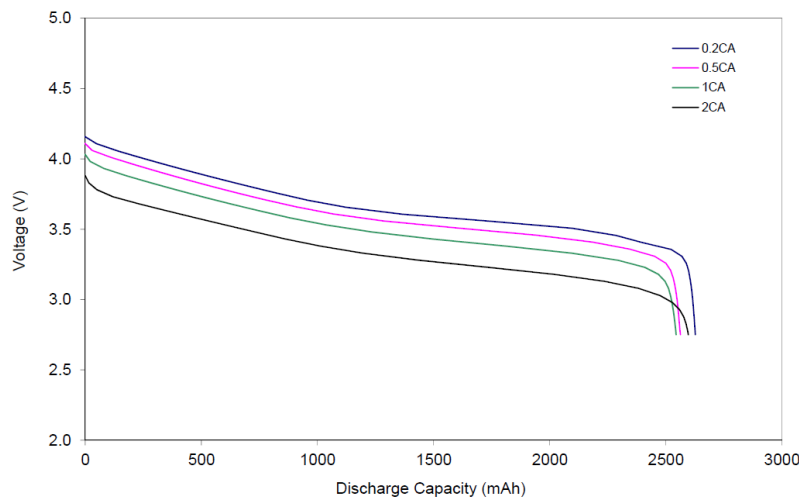


LIC 18650-26 SKE Discharge Profile

Test Conditions:

- 1 – 3 cycles Charge 0.5; 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

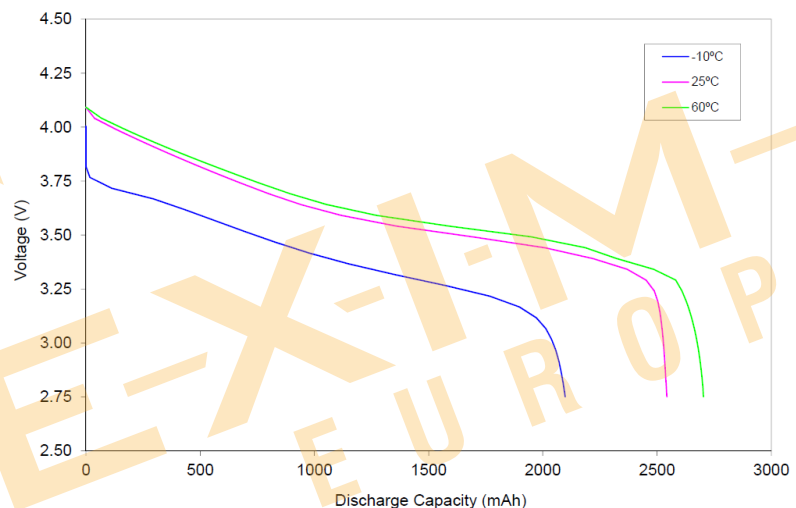


LIC 18650-26 SKE Temperature Profile @ 0.5C

Test Conditions:

Charge (0.5C; t = 3h; Imin 0.02C; Umax = 4.2V at room temperature)
4h rest at the below mentioned temperatures.

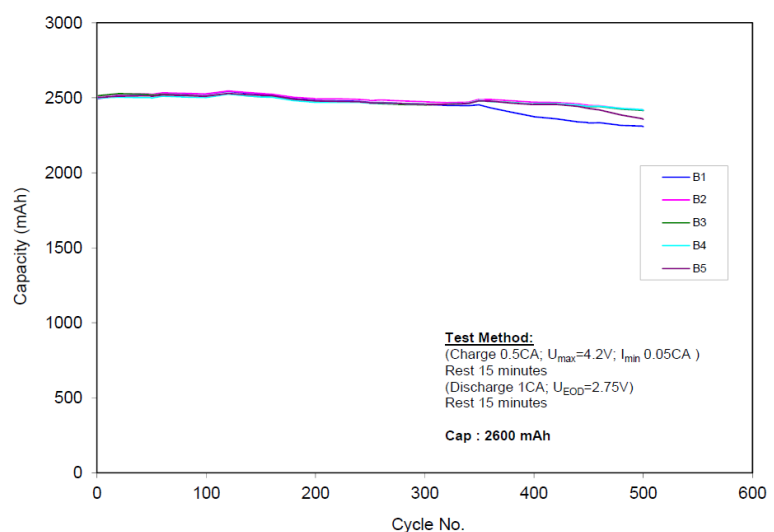
Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 25°C, -10°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



LIC 18650-26 SKE Cycling at 20°C

Test Conditions:

- Capacity charge (0.5C; 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
- Impedance measurements before and after cycling reference impedance according to specification of cell.
- Thickness measurement before and after cycling reference thickness according to specification of cell-





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4.2 Technical Cell Data: LPP 523450 S

Relevant for the following model:

- ▶ 1/LPP 523450 S PCM W
P/N: 56457 201 020

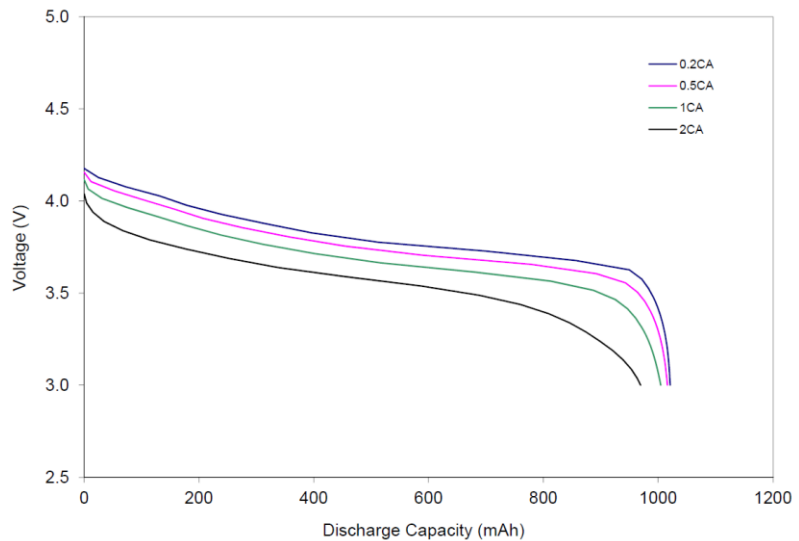


LPP 523450 S Discharge Profile

Test Conditions:

- 1 – 3 cycles Charge 1.0C; $t_{max} = 3h$;
 $I_{min} = 0.02C$; 4.2V
Discharge 1.0C
UEOD = 3.0V
- 2 – 1 cycle Charge 1.0C; $t_{max} = 3h$;
 $I_{min} = 0.02C$; 4.2V
Discharge 0.2C
UEOD = 3.0V

Maximum Discharge Current taken from the product specification

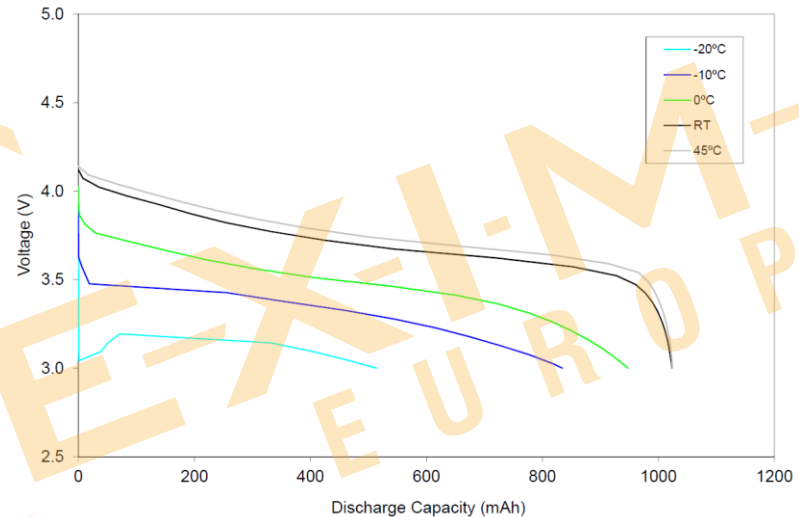


LPP 523450 S Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; $t = 3h$; $I_{min} 0.02C$; $U_{max} = 4.2V$ at room temperature)
4h rest at the below mentioned temperatures.

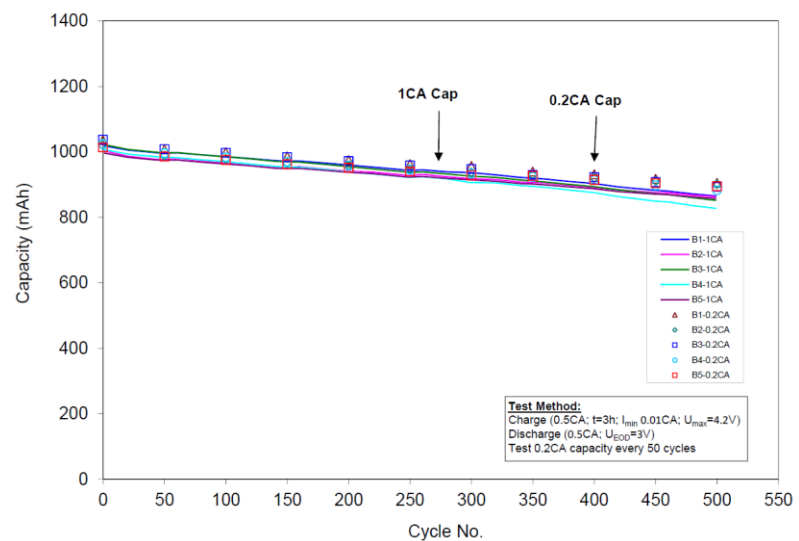
Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



LPP 523450 S Cycling at 20°C

Test Conditions:

- Capacity charge (1.0C; $t = 3h$; $I_{min} 0.02C$; $U_{max} = 4.2V$)
discharge (1.0C; UEOD = 3.0V)
Determination of the 0.2C capacity
(Discharge 0.2C; UEOD = 3.0V)
after charging each 50 cycles
- Impedance measurements before and after cycling reference impedance according to specification of cell.
- Thickness measurement before and after cycling reference thickness according to specification of cell-





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4.3 Technical Cell Data: LPP 503759 8HH

Relevant for the following model:

- ▶ 1/LPP 503759 8HH PCM W
P/N: 56427 201 022

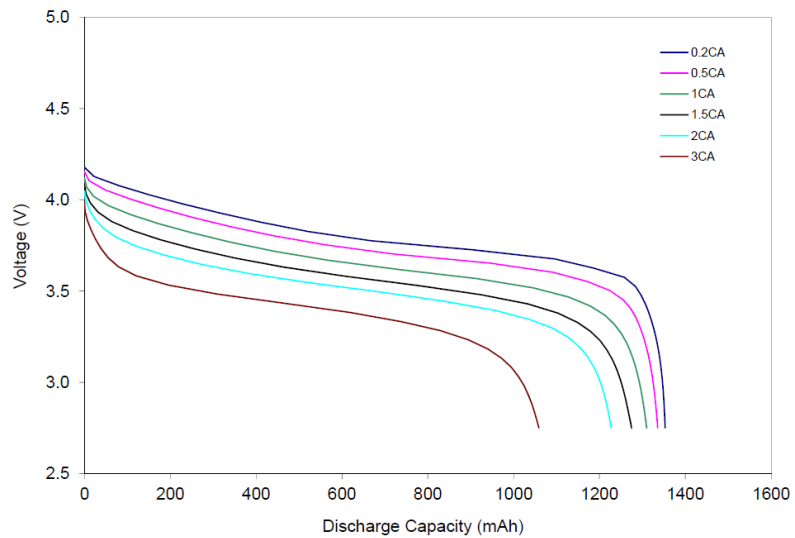


LPP 503759 8HH Discharge Profile

Test Conditions:

- 1 – 3 cycles Charge 1.0C; t_{max} = 3h;
I_{min} = 0.02C; 4.2V
Discharge 1.0C
UEOD = 3.0V
- 2 – 1 cycle Charge 1.0C; t_{max} = 3h;
I_{min} = 0.02C; 4.2V
Discharge 0.2C
UEOD = 3.0V

Maximum Discharge Current taken from the product specification

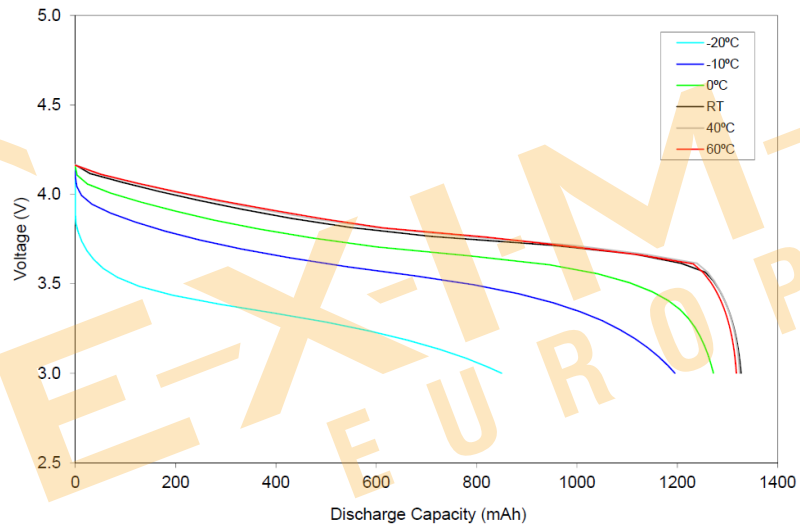


LPP 503759 8HH Temperature Profile @ 1C

Test Conditions:

Charge (1.0C; t = 3h; I_{min} 0.02C;
U_{max} = 4.2V at room temperature)
4h rest at the below mentioned temperatures.

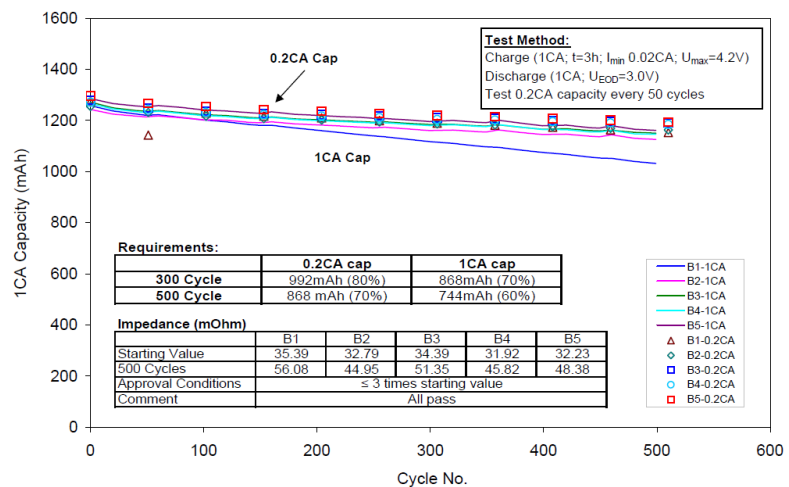
Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



LPP 503759 8HH Cycling at 20°C

Test Conditions:

- a) Capacity
charge (1.0C; t = 3h; I_{min} 0.02C;
U_{max} = 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 443441 S

Relevant for the following model:

- ▶ 1/LPP 443441 S PCM W
P/N: 56455 201 017
- ▶ EasyPack S
P/N: 56455 701 014

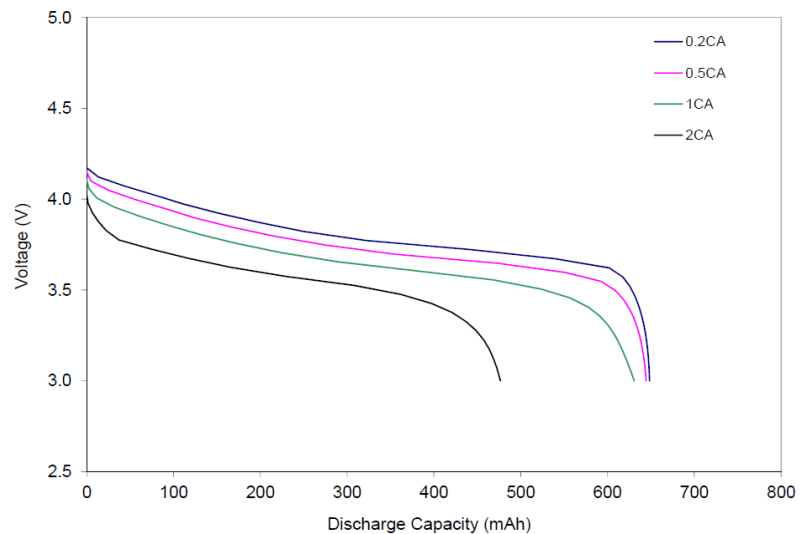


LPP 443441 S Discharge Profile

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

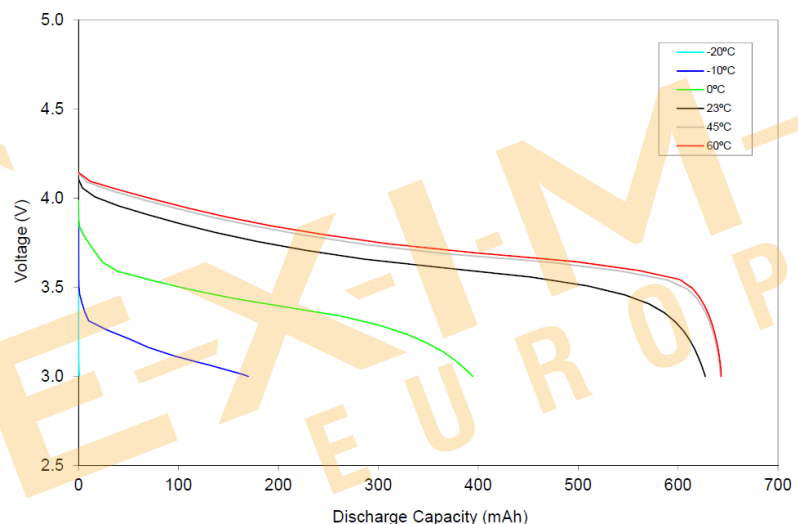


LPP 443441 S Temperature Profile @ 1C

Test Conditions:

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

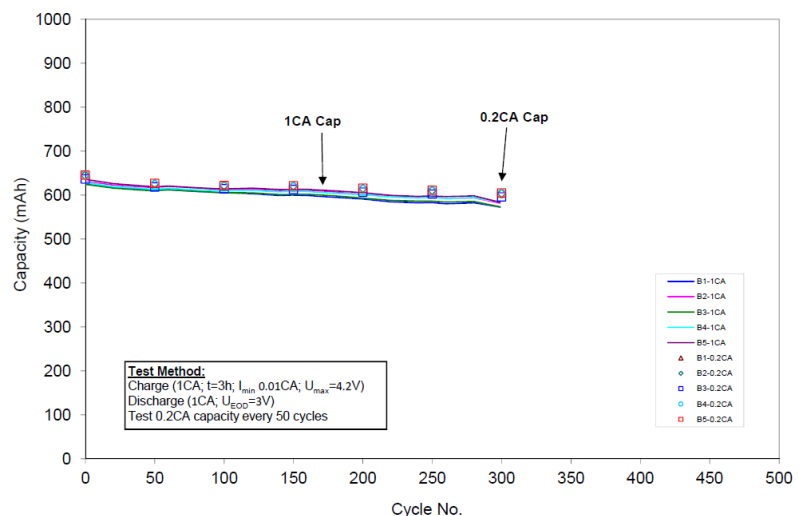
Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



LPP 443441 S Cycling at 20°C

Test Conditions:

- 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
- Impedance measurements before and after cycling reference impedance according to specification of cell.
- Thickness measurement before and after cycling reference thickness according to specification of cell-





VARTA

4.6 Technical Cell Data: LPP 503562 S

Relevant for the following model:

- ▶ 2P/LPP 503562 S PCM WC
P/N: 56456 302 015
- ▶ EasyPack L
P/N: 56456 701 012
- ▶ EasyPack XL
P/N: 56456 702 012

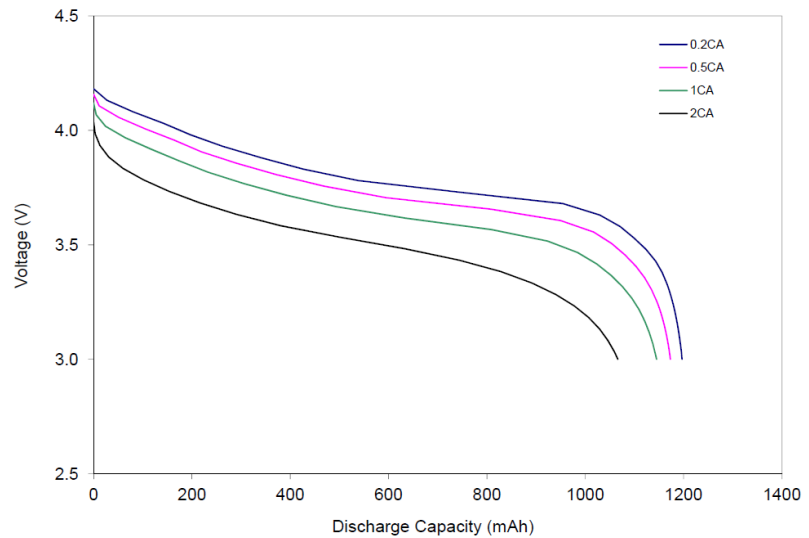


LPP 503562 S Discharge Profile

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

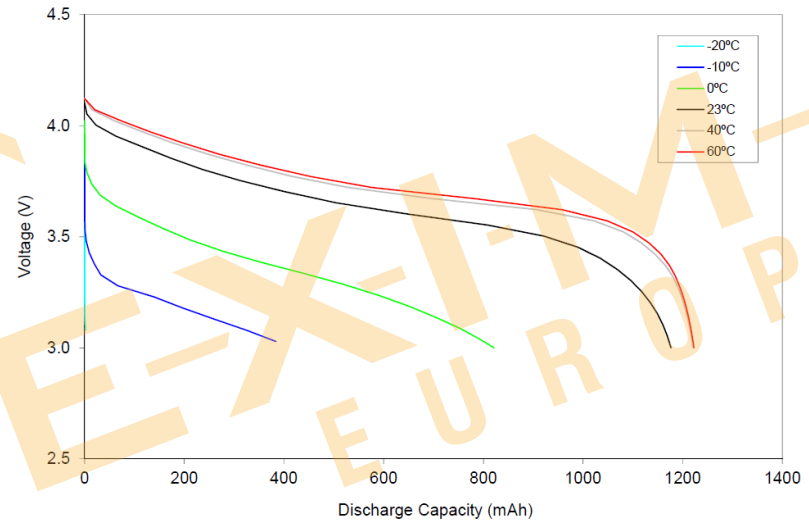


LPP 503562 S Temperature Profile @ 1C

Test Conditions:

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

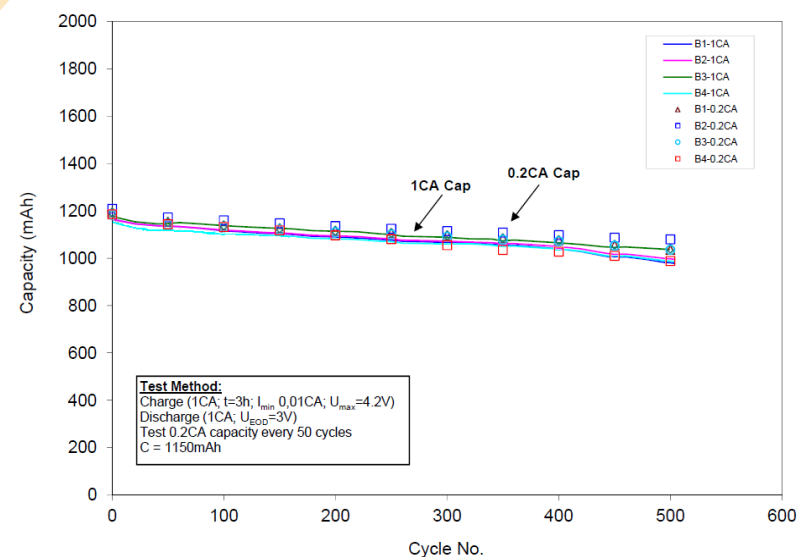
Discharge (0.2C; UEOD = 3.0V) at the following temperatures:
60°C, 40°C, RT, 0°C, -10°C, -20°C
Starting with 0.2C at -20°C; always charging at RT after 4h rest time



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-





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.

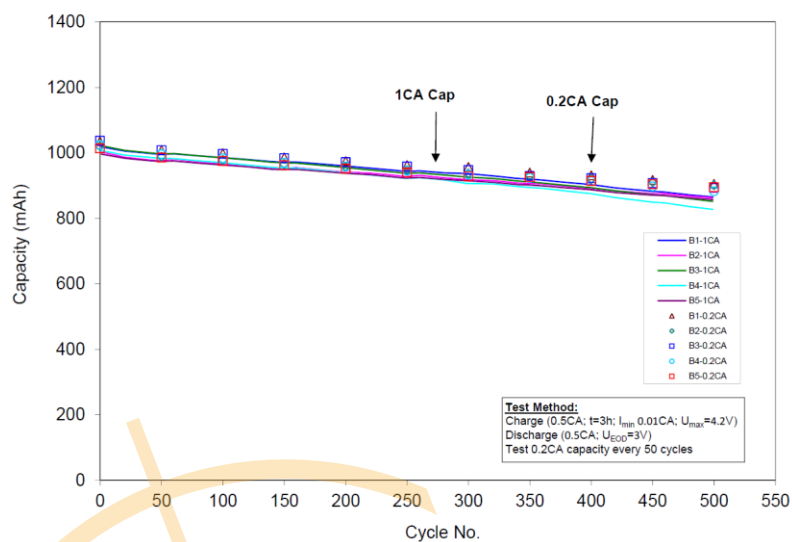


Fig. Typical cycle-life at room temperature (20°C) LPP 523450 S

Disclaimer

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

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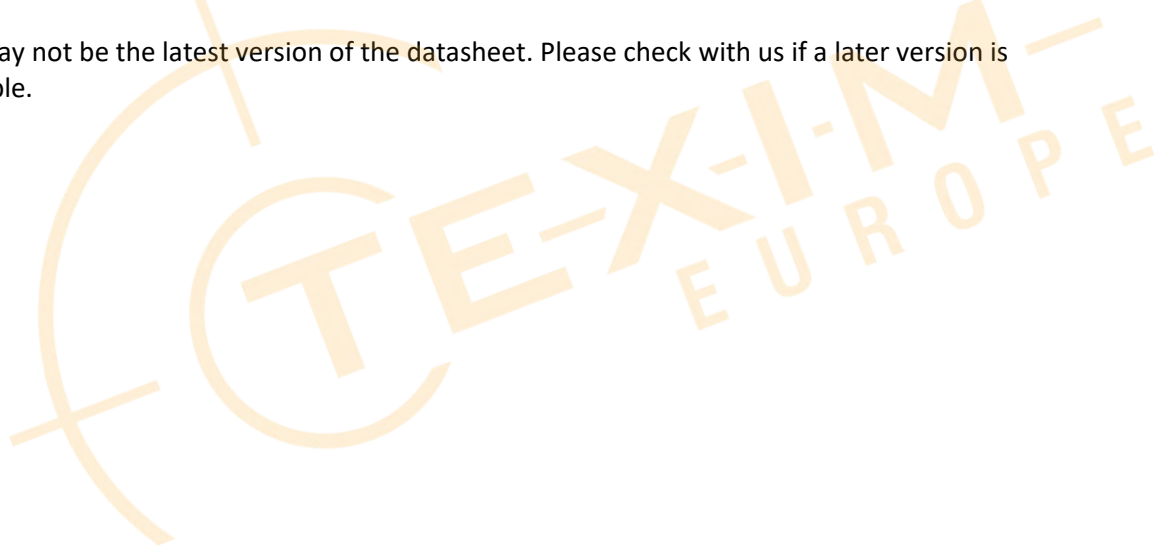
It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application.

Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time.

All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts.

Please contact us if you have any questions about the contents of the datasheet.

This may not be the latest version of the datasheet. Please check with us if a later version is available.





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