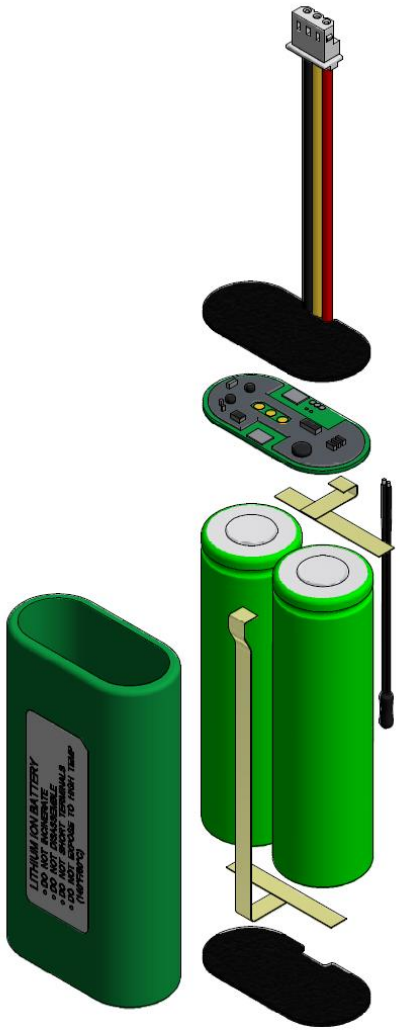
VARTA

cell pac BLOX

Technical Handbook



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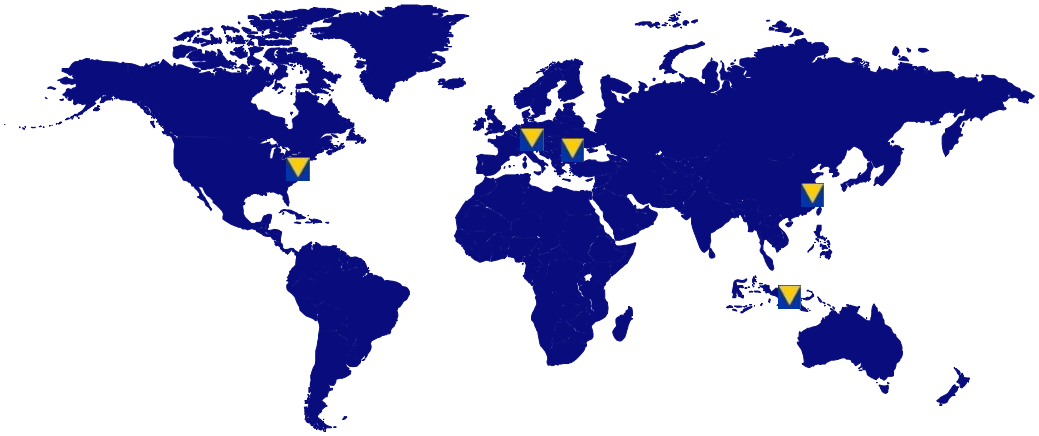

To buy or discuss any of the products in the CellPac BLOX range:

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

Overview

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 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.

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

Contents

Note:

This handbook is subject to change without prior notice and should be used in an advisory capacity and does not form part of any offer. Data and product availability is updated and the latest version of this handbook can be downloaded from our website at the following link: https://www.varta-ag.com/en/industry/product-solutions/lithium-ion-battery-packs/cellpac-blox

1. Introduction to CellPac BLOX

How does CellPac BLOX work?

This handbook is a portfolio of all combinations of cells and PCM which can be ordered under the CellPac BLOX program. We have already reviewed and tested these combinations in detail to ensure a good fit between the cell and safety electronics.

On the following pages, there is detailed information about each cell and the cell performance as well as the configurations which can be ordered of that type. On each datasheet page, there is a **CellPac BLOX Order Reference Number** (CPB XXXX) and MOQ for that individual battery.

The VARTA CellPac BLOX distributor will quote the customer for samples, mass production and any NREs if necessary. All that needs to be provided to quote you is:

- CPB Reference Number
- Wire & connector requirements (wire length & connector type)
- Mass production quantities for pricing determination

Once orders are received for samples, VARTA will work on a battery drawing and build samples of the battery, which will be shipped normally within 3 weeks from order. After internal customer testing of the samples you can send the approved drawing back to your distributor and order the agreed mass production quantity with any necessary NREs, which were already determined. The provided drawing of the battery is the master document and defines the battery (check it carefully!). Lead time for mass production is typically 12-16 weeks. Please note that this will be longer if certification such as IEC62133 edition 2 is required for the battery pack.

2. FAQ - Frequently Asked Questions

How many samples can be ordered?

Up to 25 samples can be ordered to test and validate the design.

How long does it take?

Once POs are placed and your project is started, a technical drawing of the final battery and the samples will be provided for you for drawing approval and samples testing. We aim to ship the drawing and sample bundle within 3 weeks.

For the mass production order after your approval the typical lead time can vary between 12 and 16 weeks for the mass production quantity. Actual lead-times can be checked via your distributor when you discuss your individual requirements.

I need a high volume, is special pricing available?

CellPac BLOX can be ordered at any volume above the MOQ but fits best to OEMs requiring volumes of 5000-50k pcs. Pricing can be negotiated with your distributor to reflect commitment levels.

Why is there an NRE (Non-Recurring Engineering) charge?

Your battery will be a new design, with its own part number. As well as the new drawing, there will be manufacturing and quality documentation established. Fixtures will be produced to ensure repeatable quality and UN38.3 testing and certification is mandatory. NRE is kept as low as possible and avoided completely in many cases.

Can the CellPac BLOX battery be certified for special requirements, such as IEC62133 edition 2?

Yes, additional certification is possible for medium-to-high volume projects but more time and effort is involved. Please discuss your individual requirements with your VARTA representative.

3. The CellPac BLOX Range of Cells

Cylindrical	Cell	Nominal Capacity
	LIC 18650-26 SKE	2600mAh
	LIC 18650-29 EC	2850mAh

Polymer	Cell	Nominal Capacity
	LPP 443441 S	660mAh
	LPP 463149 S	700mAh
	LPP 523450 S	1000mAh
	LPP 423566 BE	1160mAh
	LPP 503562 S	1200mAh
	LPP 683566 BE	1880mAh

4. Connectors

If the choice of the connector is not critical, VARTA will supply you with a standard 2-Pin or 3-Pin Connector for your battery. If you want to have special connector from our existing range, please inform your BLOX distributor. This will be specified in your battery drawing. We handle a large number of connector types from the majority of market-leading manufacturers. In the rare case that your connector requirement cannot be met, you will be informed.

5. CellPac BLOX possible configurations

Description	BLOX No.	Estimated SOC	MOQ/ MDQ	Capacity mAh	Voltage Volts	Energy Wh
1S1P / LIC 18650 – 26 SKE	CPB 1007	25%	5000	2600 mAh	3,60 V	9,50 Wh
1S2P / LIC 18650 – 26 SKE sbs	CPB 1008	25%	5000	5200 mAh	3,60 V	19,00 Wh
2S1P / LIC 18650 – 26 SKE sbs	CPB 1009	25%	5000	2600 mAh	7,30 V	19,00 Wh
1S1P / LIC 18650 – 29EC	CPB 1011	18%	5000	2850 mAh	3,65 V	10,40 Wh
1S2P / LIC 18650 – 29EC sbs	CPB 1012	18%	5000	5700 mAh	3,65 V	20,81 Wh
1S1P / LPP 423566 BE	CPB 3005	~ 50%	5000	1160 mAh	3,70 V	4,29 Wh
1S1P / LPP 443441 S	CPB 3007	~ 50%	5000	660 mAh	3,70 V	2,44 Wh
1S2P / LPP 443441 S sbs	CPB 3008	~ 50%	10000	1320 mAh	3,70 V	4,88 Wh
1S1P / LPP 463149 S	CPB 3015	~ 50%	5000	700 mAh	3,70 V	2,59 Wh
1S2P / LPP 463149 S sbs	CPB 3016	~ 50%	10000	1400 mAh	3,70 V	5,18 Wh
1S1P / LPP 503562 S	CPB 3019	~ 50%	5000	1200 mAh	3,70 V	4,44 Wh
1S2P / LPP 503562 S sbs	CPB 3020	~ 50%	10000	2400 mAh	3,70 V	8,88 Wh
1S1P / LPP 523450 S	CPB 3027	~ 50%	5000	1000 mAh	3,70 V	3,70 Wh
1S2P / LPP 523450 S sbs	CPB 3028	~ 50%	10000	2000 mAh	3,70 V	7,40 Wh
1S1P / LPP 683566 BE	CPB 3031	~ 50%	5000	1880 mAh	3,70 V	6,96 Wh

The standard terms and conditions of VARTA apply.
In addition the relevant version of our Handling Precautions and Prohibitons apply for Li-Ion batteries.

Subject to change without prior notice

For Volumes >10k pieces shipment can be scheduled

Final box quantity will only be defined during the project

6. Individual BLOX Datasheets

cell pac BLOX

LIC 18650-26SKE

System	▪ Li-Ion
Recognition	▪ UL 1642
	▪ IEC62133 ed. 2
Nominal Voltage	▪ 3.6V
Nominal Capacity	▪ 2600 mAh
Minimum Capacity, C	▪ 2500 mAh (at 0.2C and 25±2°C)
Impedance Initial	▪ ≤120 mΩ @ 1kHz at 4.2 V
Life Expectancy	▪ 300 cycles for ≥80 %
Battery	
Diameter (d)	▪ 19.5 mm (max.)
Height (h)	▪ 71.0 mm (max.)
Weight, approx.	▪ 50 g
Function	▪
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V
Initial Charge Current	▪ Standard Charge: 1300mA (15~45°C)
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3h
	▪ Rapid Charge: 2.5h
b) by min. current	▪ 52mA
Discharge Cut-Off voltage	▪ 2.75V
Max. Continuous Discharge Current	▪ 3900mA (+45°C to +60°C)
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -20°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +60°C >90%
Capacity Rate	▪ 3 Month at -20°C to +40°C >90%
	▪ 1 Year at -20°C to +20°C >90%

CONFIGURATIONS	1S1P	1S2P sbs *	2S1P sbs *
Rated Capacity	2600mAh	5200mAh	2600mAh
Nominal Voltage	3.65 V	3.65 V	7.30 V
Watt-Hour Rating	9.5Wh	19Wh	19Wh
Charge Temperature	0 to +45°C	0 to +45°C	0 to +45°C
Discharge Temperature	-20 to +60°C	-20 to +60°C	-20 to +60°C
Overcharge Detection	4.3V ± 25mV	4.275V ± 25mV	4.35 V ± 25mV
Overdischarge Detection	2.4V ± 35mV	2.3V ± 80mV	2.3V ± 50mV
Overcurrent Detection	6A - 8A	4A - 6.3A	4A - 6.3A
NTC	10k B=3435k	10k B=3435k	10k B=3435k
MOQ/ MDQ	**5.000**	**5.000**	**5.000**
Order Reference Number	**CPB 1001**	**CPB 1002**	**CPB 1003**

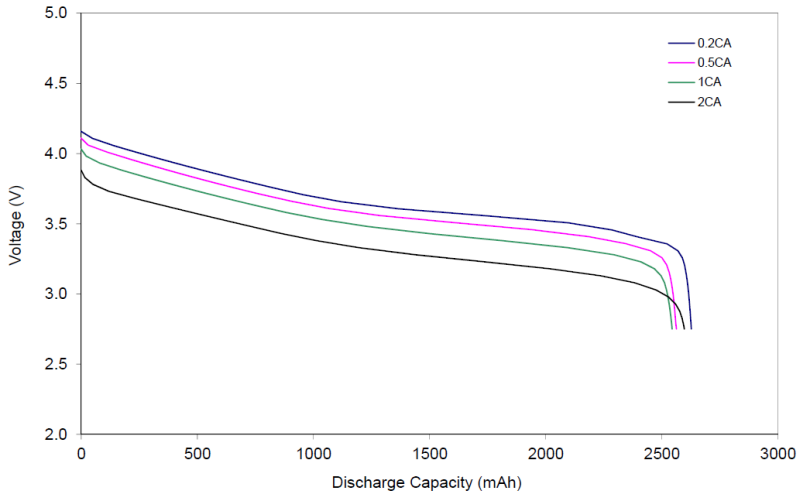
* sbs – denotes cells will be side by side

LIC 18650-26SKE 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

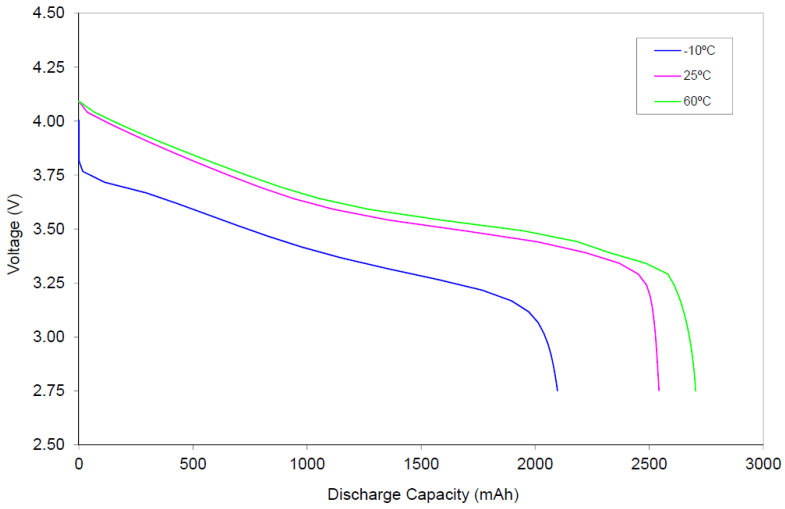


LIC 18650-26SKE Temperature Profile @ 0.5C/ 0.2C

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



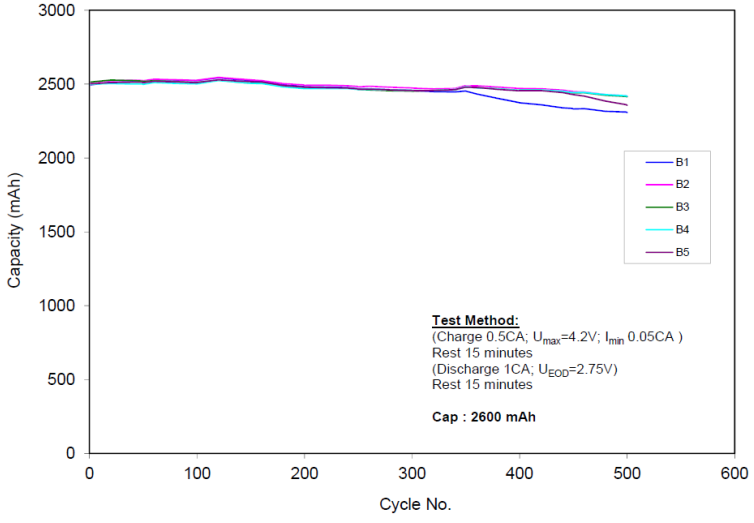
LIC 18650-26SKE Cycling at 20°C

Test Conditions:

a) Capacity
charge (0.5C; t = 3h; Imin 0.02C; Umax = 4.2V)
discharge (1.0C; UEOD = 2.75)
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



LIC 18650-29EC

System	
Recognition	▪ Li-Ion
	▪ UL 1642
Nominal Voltage	▪ IEC62133 ed. 2
Nominal Capacity	▪ 3.65V
Minimum Capacity, C	▪ 2850 mAh (at 0.2C and 20°C)
Impedance Initial	▪ 2750 mAh
Life Expectancy	▪ ≤45 mΩ @ 1kHz at 4.2 V
	▪ 500 cycles for ≥1868 mAh
Battery	
Diameter (d)	▪ 18.4 mm (max.)
Height (h)	▪ 65.0 mm (max.)
Weight, approx.	▪ 48.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 1375 mA
	▪ Rapid Charge: 2700 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3h
	▪ Rapid Charge: 2.5h
b) by min. current	▪ 0.02C
Discharge Cut-Off voltage	▪ 2.5V
Max. Continuous Discharge Current	▪ 5500 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -20°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +60°C >80%
Capacity Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +25°C >80%

CONFIGURATIONS	1S1P	1S2P sbs *
Rated Capacity	2850 mAh	5700 mAh
Nominal Voltage	3.65 V	3.65 V
Watt-Hour Rating	10.40 Wh	20.81 Wh
Charge Temperature	0 to +45°C	0 to +45°C
Discharge Temperature	-20 to +60°C	-20 to +60°C
Overcharge Detection	4.3 V ± 25 mV	4.275 V ± 25 mV
Overdischarge Detection	2.4 V ± 35 mV	2.3 V ± 80 mV
Overcurrent Detection	6A - 8A	4A - 6.3A
NTC	10k B=3435k	10k B=3435k
MOQ/ MDQ	**5.000**	**5.000**
Order Reference Number	**CPB 1001**	**CPB 1002**

* sbs – denotes cells will be side by side

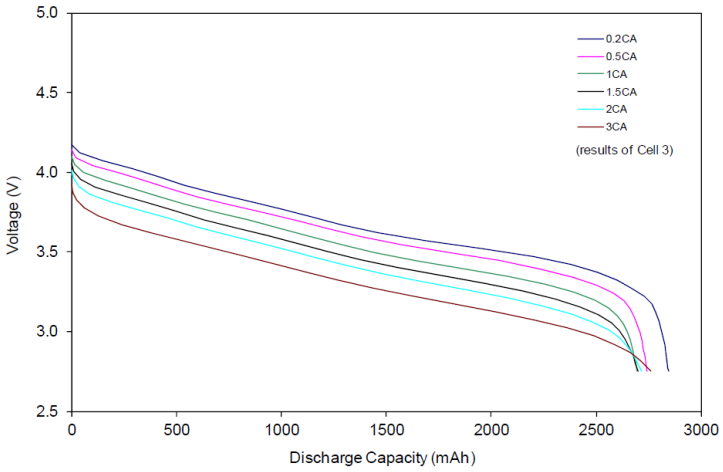
LIC 18650-29 EC Discharge Profile

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

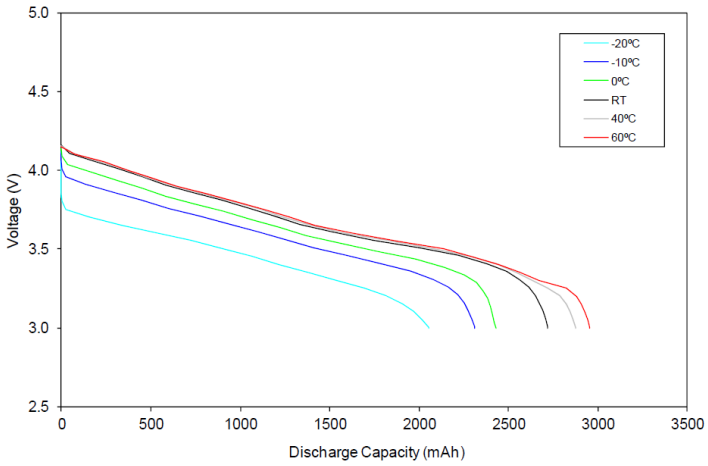


LIC 18650-29 EC Temperature Profile @ 1C

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



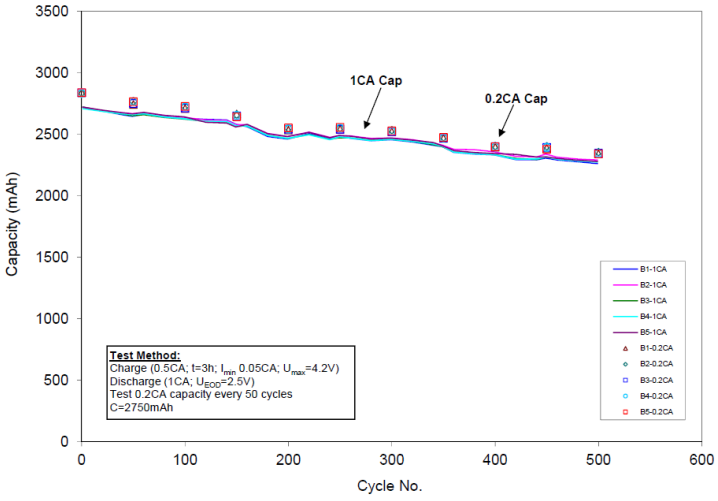
LIC 18650-29 EC Cycling at 20°C

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



LPP 423566 BE

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.70 V
Nominal Capacity, C	▪ 1160 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 1130 mAh
Impedance Initial	▪ ≤80 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 400 cycles for ≥848 mAh
Battery	
Length (l)	▪ 65.4 mm (max.)
Width (w)	▪ 35.0 mm (max.)
Height (h)	▪ 4.5 mm (max.)
Weight, approx.	▪ 25.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 565 mA
	▪ Rapid Charge: 1130 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 5 h
	▪ Rapid Charge: 2.5 h
b) by min. current	▪ 0.02 C
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 2260 mA
data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -20°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +45°C >85%
Capacity Recovery Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +35°C >80%

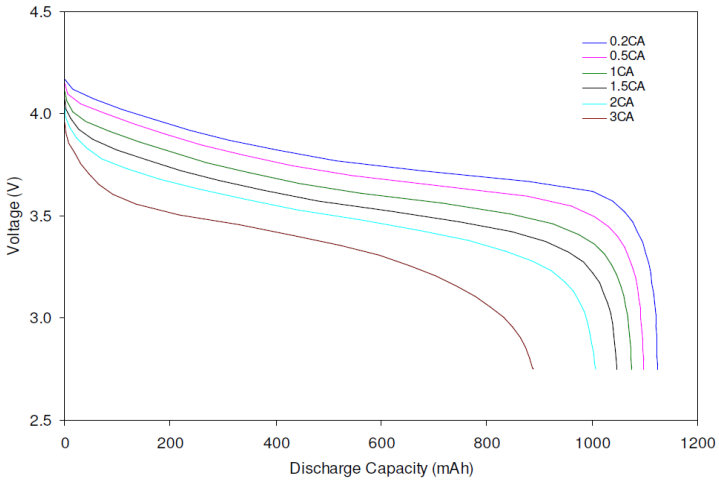
CONFIGURATIONS	**1S1P**
Rated Capacity	1160 mAh
Nominal Voltage	3.70 V
Watt-Hour Rating	4.29 Wh
Charge Temperature	0 to +45°C
Discharge Temperature	-20 to +60°C
Overcharge Detection	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A
NTC	10k B=3380k
MOQ/ MDQ	**5.000**
Order Reference Number	**CPB 3005**

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

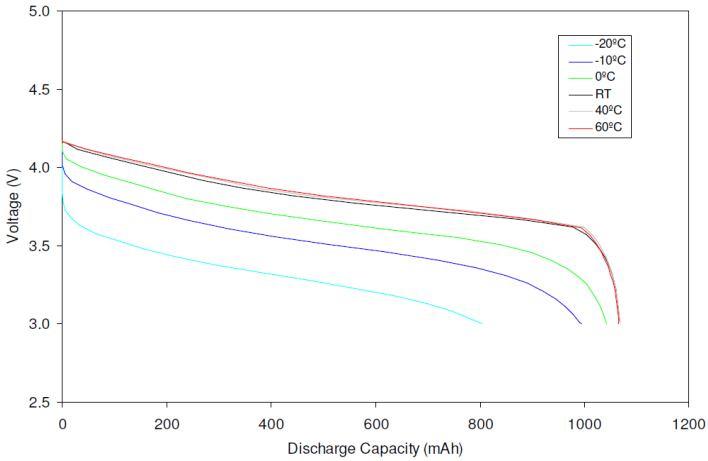


LPP 423566 BE Temperature Profile @ 1C/ 0.2C

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



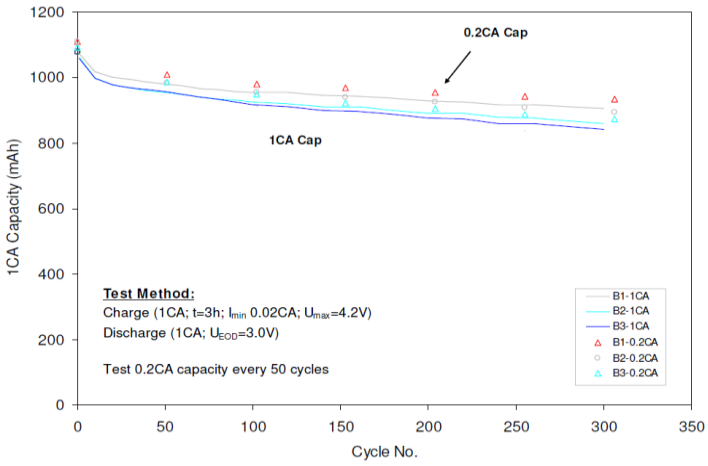
LPP 423566 BE Cycling at 20°C

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



LPP 443441 S

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.7 V
Nominal Capacity, C	▪ 660 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 630 mAh
Impedance Initial	▪ ≤70 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 500 cycles for ≥ 70 %
Battery	
Length (l)	▪ 39.0 mm (max.)
Width (w)	▪ 34.0 mm (max.)
Height (h)	▪ 4.5 mm (max)
Weight, approx.	▪ 12.8 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 315 mA
	▪ Rapid Charge: 630 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3.5 h
	▪ Rapid Charge: 2.5 h
b) by min. current	▪ 6.3 mA
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 1260 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -10°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +45°C >90%
Capacity Recovery Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +30°C >80%

CONFIGURATIONS	**1S1P**	**1S2P sbs ***
Rated Capacity	660 mAh	1320 mAh
Nominal Voltage	3.70 V	3.70 V
Watt-Hour Rating	2.44 Wh	4.88 Wh
Charge Temperature	0 to +45°C	0 to +45°C
Discharge Temperature	-10 to +60°C	-10 to +60°C
Overcharge Detection	4.275 V ± 25 mV	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A	2A - 4A
NTC	10k B=3380k	10k B=3380k
MOQ/ MDQ	**5.000**	**10.000**
Order Reference Number	**CPB 3007**	**CPB 3008**

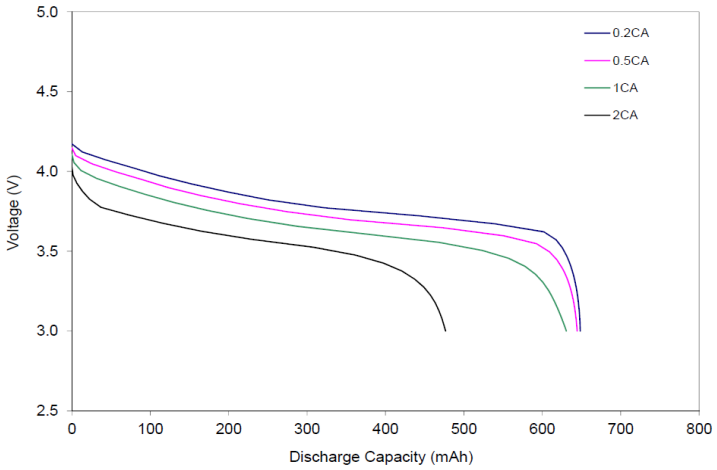
* sbs – denotes cells will be side by side

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

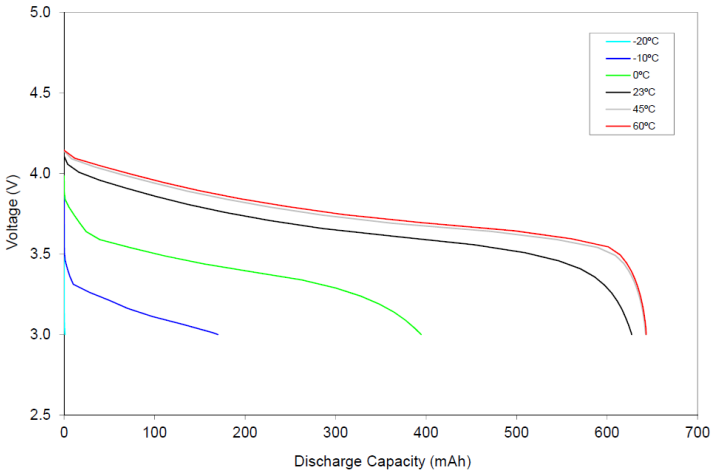


LPP 443441 S Temperature Profile @ 1C/ 0.2C

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



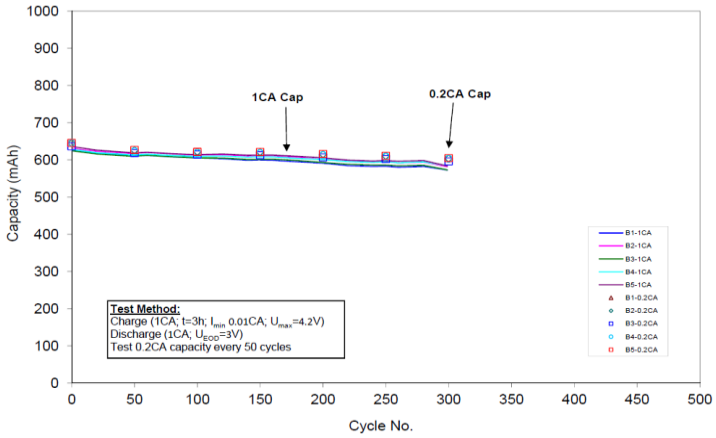
LPP 443441 S Cycling at 20°C

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



LPP 463149 S

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.7 V
Nominal Capacity, C	▪ 700 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 670 mAh
Impedance Initial	▪ ≤70 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 500 cycles for ≥ 80 %
Battery	
Length (l)	▪ 49.0 mm (max.)
Width (w)	▪ 31.5 mm (max.)
Height (h)	▪ 4.5 mm (max.)
Weight, approx.	▪ 14.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 335 mA
	▪ Rapid Charge: 670 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3.5 h
	▪ Rapid Charge: 2.5 h
b) by min. current	▪ 6.7 mA
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 670 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -20°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +45°C >80%
Capacity Recovery Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +30°C >80%

CONFIGURATIONS	**1S1P**	**1S2P sbs ***
Rated Capacity	1590 mAh	3180 mAh
Nominal Voltage	3.70 V	3.70 V
Watt-Hour Rating	5.88 Wh	11.77 Wh
Charge Temperature	0 to +45°C	0 to +45°C
Discharge Temperature	-20 to +60°C	-20 to +60°C
Overcharge Detection	4.275 V ± 25 mV	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A	2A - 4A
NTC	10k B=3380k	10k B=3380k
MOQ/ MDQ	**5.000**	**10.000**
Order Reference Number	**CPB 3011**	**CPB 3012**

* sbs – denotes cells will be side by side

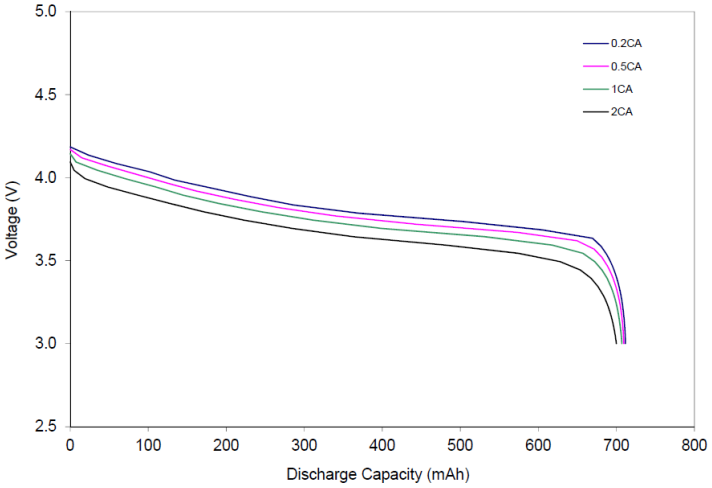
LPP 463149 S Discharge Profile

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

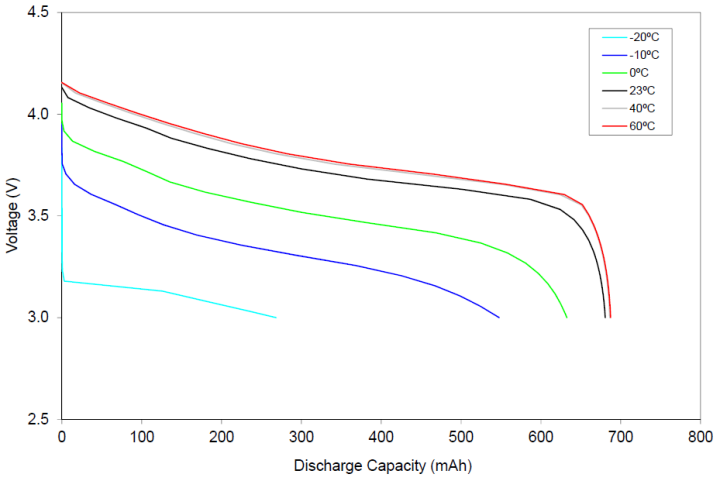


LPP 463149 S Temperature Profile @ 1C/ 0.2C

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



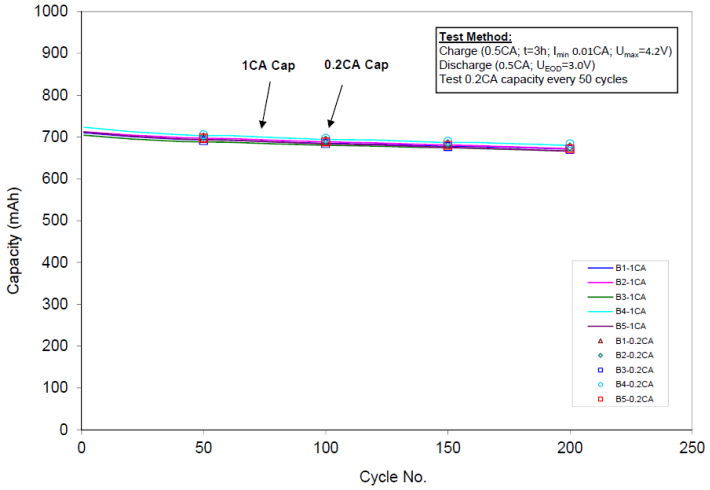
LPP 463149 S Cycling at 20°C

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



LPP 523450 S

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.7 V
Nominal Capacity, C	▪ 1000 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 950 mAh
Impedance Initial	▪ ≤60 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 500 cycles for ≥80 %
Battery	
Length (l)	▪ 50.5 mm (max.)
Width (w)	▪ 35.5 mm (max.)
Height (h)	▪ 5.2 mm (max.)
Weight, approx.	▪ 19.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 500 mA
	▪ Rapid Charge: 1000 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3.5 h
	▪ Rapid Charge: 2.0 h
b) by min. current	▪ 10 mA
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 2000 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -10°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +60°C >80%
Capacity Recovery Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +30°C >80%

CONFIGURATIONS	**1S1P**	**1S2P sbs ***
Rated Capacity	1000 mAh	2000 mAh
Nominal Voltage	3.70 V	3.70 V
Watt-Hour Rating	3.70 Wh	7.40 Wh
Charge Temperature	0 to +45°C	0 to +45°C
Discharge Temperature	-10 to +60°C	-10 to +60°C
Overcharge Detection	4.275 V ± 25 mV	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A	2A - 4A
NTC	10k B=3380k	10k B=3380k
MOQ/ MDQ	**5.000**	**10.000**
Order Reference Number	**CPB 3027**	**CPB 3028**

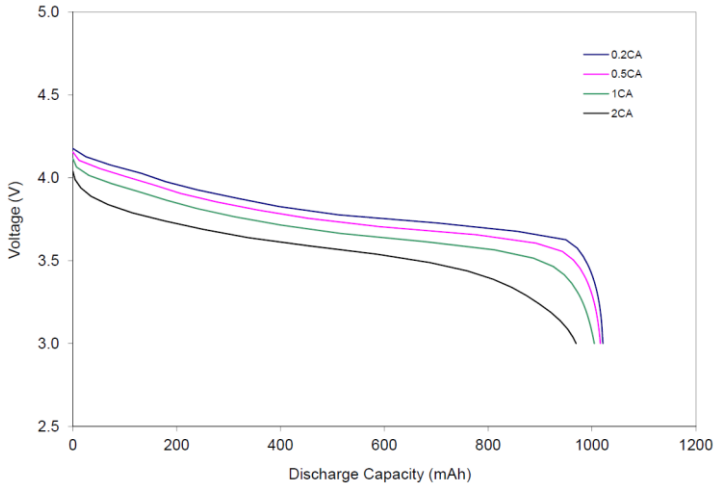
* sbs – denotes cells will be side by side

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

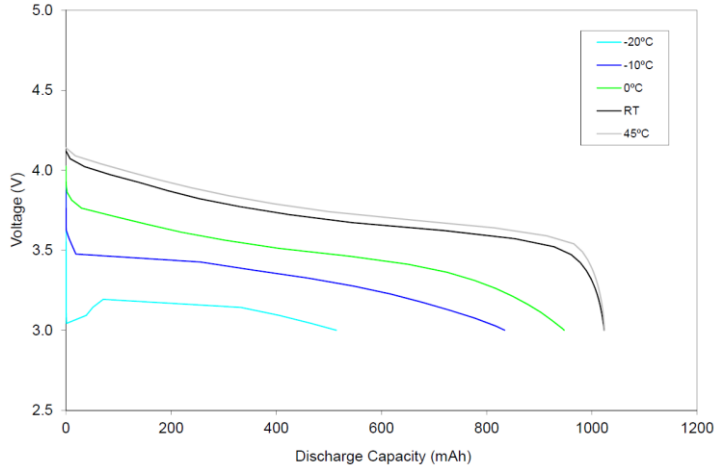


LPP 523450 S Temperature Profile @ 1C/ 0.2C

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



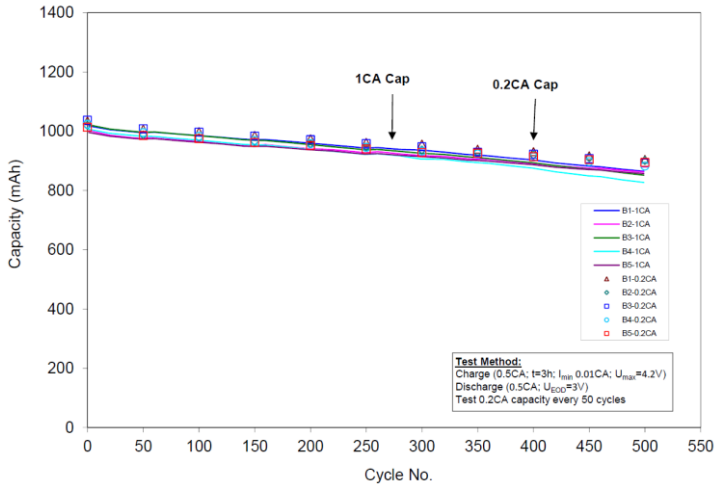
LPP 523450 S Cycling at 20°C

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



LPP 503562 S

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.7 V
Nominal Capacity, C	▪ 1200 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 1150 mAh
Impedance Initial	▪ ≤55 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 500 cycles for ≥70 %
Battery	
Length (l)	▪ 60.0 mm (max.)
Width (w)	▪ 35.0 mm (max.)
Height (h)	▪ 4.65 mm (max.)
Weight, approx.	▪ 22.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20 V (± 50mV)
Initial Charge Current	▪ Standard Charge: 575 mA
	▪ Rapid Charge: 1150 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 3.5 h
	▪ Rapid Charge: 2.5 h
b) by min. current	▪ 11.5 mA
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 2300 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -10°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +45°C >90%
Capacity Recovery Rate	▪ 3 Month at -20°C to +45°C >80%
	▪ 1 Year at -20°C to +30°C >80%

CONFIGURATIONS	**1S1P**	**1S2P sbs ***
Rated Capacity	1200 mAh	2400 mAh
Nominal Voltage	3.70 V	3.70 V
Watt-Hour Rating	4.44 Wh	8.88 Wh
Charge Temperature	0 to +45°C	0 to +45°C
Discharge Temperature	-10 to +60°C	-10 to +60°C
Overcharge Detection	4.275 V ± 25 mV	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A	2A - 4A
NTC	10k B=3380k	10k B=3380k
MOQ/ MDQ	**5.000**	**10.000**
Order Reference Number	**CPB 3019**	**CPB 3020**

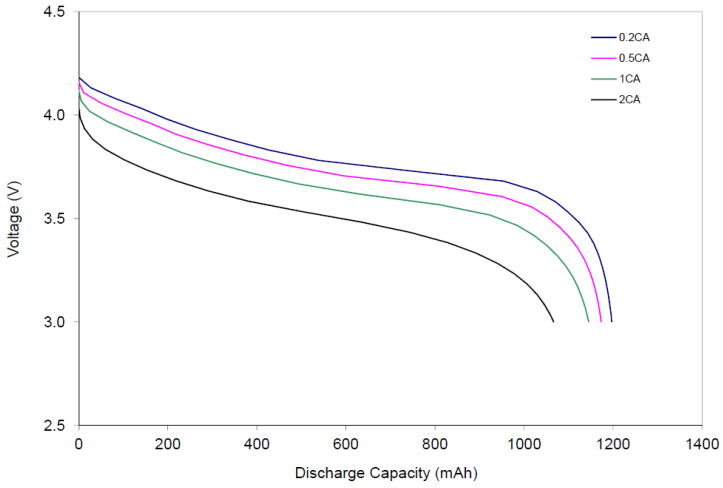
* sbs – denotes cells will be side by side

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

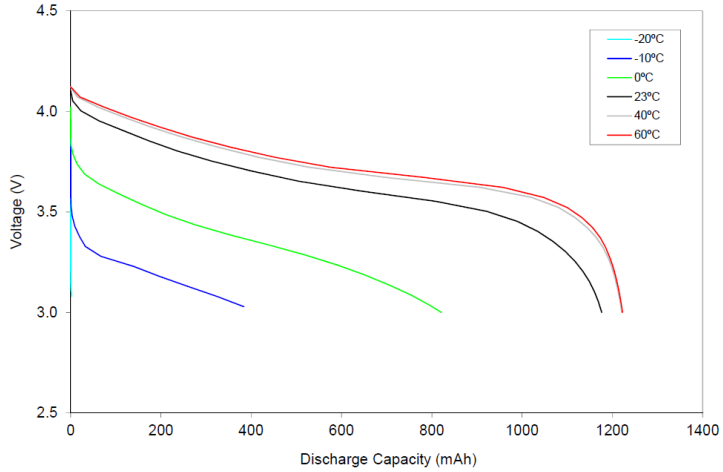


LPP 503562 S Temperature Profile @ 1C/ 0.2C

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



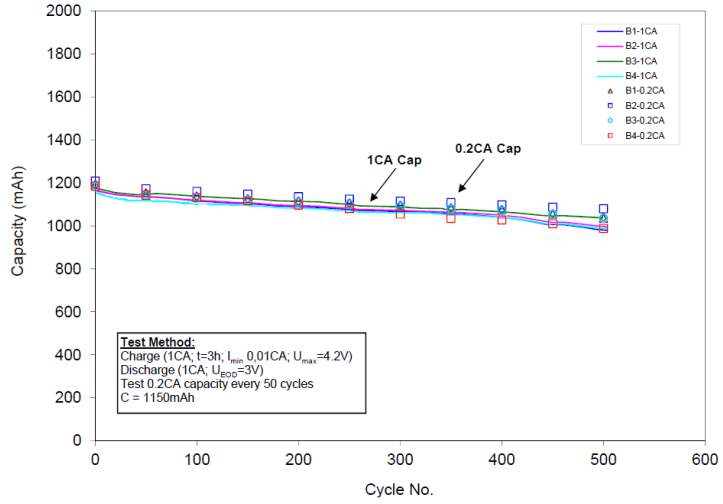
LPP 503562 S Cycling at 20°C

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



LPP 683566 BE

System	
Recognition	▪ UL 1642
Nominal Voltage	▪ 3.7 V
Nominal Capacity, C	▪ 1880 mAh (at 0.2C and 20°C)
Minimum Capacity	▪ 1820 mAh
Impedance Initial	▪ ≤80 mΩ @ 1kHz at 4.2V
Life Expectancy	▪ 400 cycles for ≥75 %
Battery	
Length (l)	▪ 65.85 mm (max.)
Width (w)	▪ 35.0 mm (max.)
Height (h)	▪ 6.8 mm (max.)
Weight, approx.	▪ 40.0 g
Function	
Charging Method	▪ Constant Current + Constant Voltage
Charge Voltage	▪ 4.20V (± 50mV)
Initial Charge Current	▪ Standard Charge: 910 mA
	▪ Rapid Charge: 1820 mA
Charging Cut-Off (a) or (b)	
a) by time	▪ Standard Charge: 5 h
	▪ Rapid Charge: 2.5 h
b) by min. current	▪ 20 mA
Discharge Cut-Off voltage	▪ 3.0 V
Max. Continuous Discharge Current	▪ 3640 mA
Data connection	
Operating Temperature	▪ Charge: 0°C to+ 45°C
	▪ Discharge: -20°C to +60°C
Storage Temperature	▪ 1 Month at -20°C to +60°C >85%
Capacity Recovery Rate	

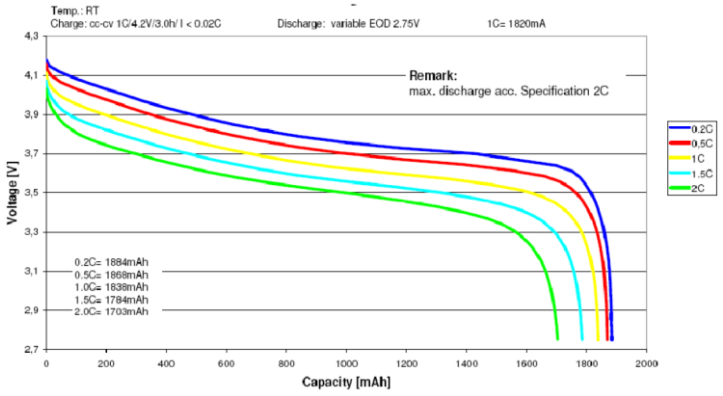
CONFIGURATIONS	**1S1P**
Rated Capacity	1880 mAh
Nominal Voltage	3.70 V
Watt-Hour Rating	6.96 Wh
Charge Temperature	0 to +45°C
Discharge Temperature	-20 to +60°C
Overcharge Detection	4.275 V ± 25 mV
Overdischarge Detection	2.3 V ± 58 mV
Overcurrent Detection	2A - 4A
NTC	10k B=3380k
MOQ/ MDQ	**5.000**
Order Reference Number	**CPB 3031**

LPP 683566 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

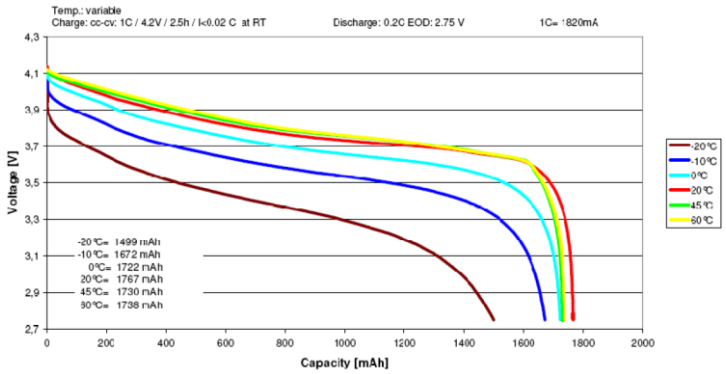


LPP 683566 BE Temperature Profile @ 1C/ 0.2C

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



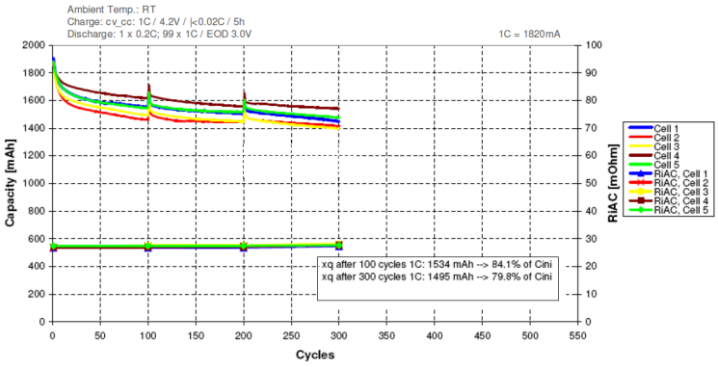
LPP 683566 BE Cycling at 20°C

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



6. Design Tips for VARTA CellPac BLOX 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 BLOX batteries will not be suitable.

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. Its 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. **For CellPac BLOX batteries you will get samples to 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 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 is recommended to 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. The safety electronics of the PCM included in the battery are intended as a final safety function. They should not be relied upon within the application design to control the application behaviour. The electronics within the application design and charger design should normally control all functions of the application without any trigger to the battery safety functions. The battery safety functions are intended to intervene in the event of a failure of the normal electronics function of the application and/or charger.

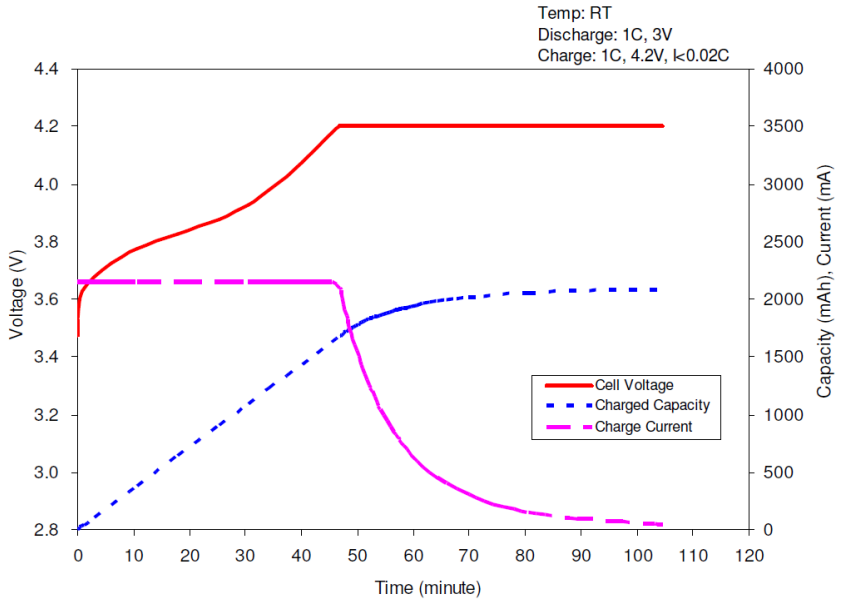
7. For installation of pouch cells, especially designs with no connector, take special care to consider the installation process. Dropping cells directly onto hard surfaces may damage them and cause swelling over time. If cells are dropped before installation, it is generally recommended that they are 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.

Charging

Fast charging (CC/CV 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 I/V – charging.

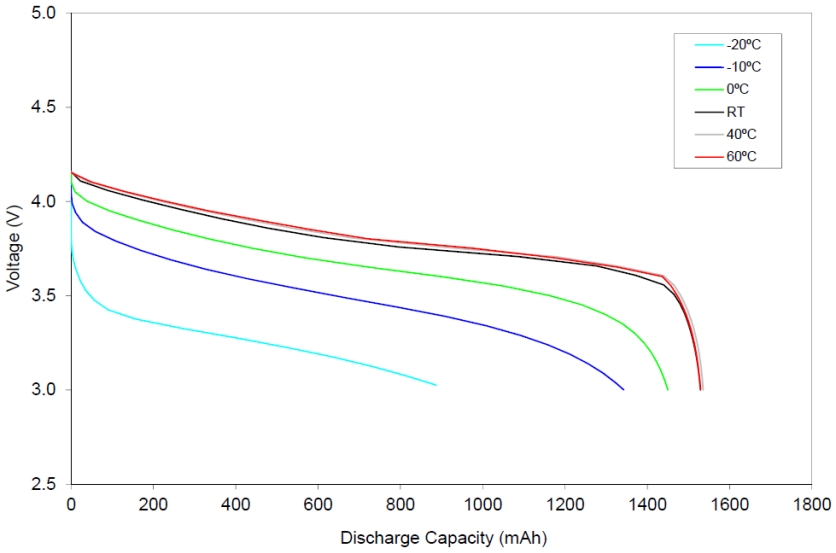


Cell charging characteristics

Discharging

Since all CellPac BLOX batteries are delivered with a safety-circuit, the max. 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.

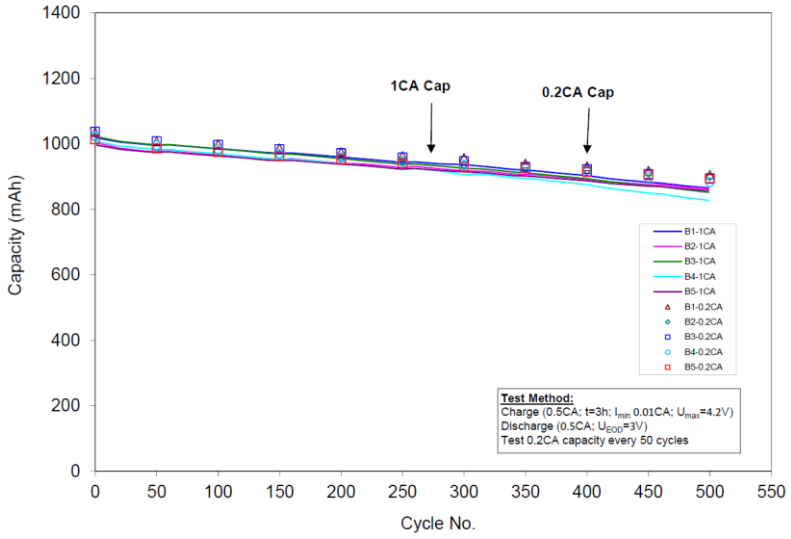


Typical discharge curves with different temperatures as parameter

7. Reliability and Life Expectancy

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

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



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

8. Safety

All CellPac BLOX 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 BLOX 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.	<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 164 ▶ 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

9. 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.

10. Transportation of VARTA CellPac BLOX 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 BLOX 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.

11. Proper Use and Handling

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

https://www.varta-ag.com/en/industry/service/downloads