

Tadiran Lithium Batteries

Product Data
Catalogue



Customized battery packs

The design and assembly of battery packs require special skills, expertise and experience. Therefore it is not recommended that the end user attempt to self-assemble battery packs. It is preferable that any battery using lithium cells be fabricated by Tadiran to ensure proper battery design and construction (see [figure 1](#)). A full battery assembly service is available from Tadiran who can be contacted for further information. If for any reason, this is not possible, Tadiran can review the pack design in confidence to ensure that the design is safe (in assembly and use) and capable of meeting stated performance requirements.



Figure 1: Upon request, Tadiran designs, tests, and manufactures customized battery packs.

Page Contents

4	About Tadiran									
5	Lithium Thionyl Chloride (LTC) Batteries									
	Model	Terminations	Catalogue number ¹⁾	Size	Nominal voltage	Nominal capacity	Nominal current	Max. cont. discharge current	Temperature range	Dimensions (mm)
	SL-300 series: for standard use and stand-by									
6	SL-350	/S /T /P /PR /PT	11 1 0350x 00	1/2AA	3.6 V	1.2 Ah	0.6 mA	6 mA	-55 ... +85 °C	Ø 14.5 x 25
7	SL-361	/S /T /P /PR /PT	11 1 0361x 00	2/3AA	3.6 V	1.6 Ah	1 mA	10 mA	-55 ... +85 °C	Ø 14.5 x 33
8	SL-360	/S /T /P /PR /PT	11 1 0360x 00	AA	3.6 V	2.4 Ah	2 mA	20 mA	-55 ... +85 °C	Ø 14.5 x 50
	SL-500 series: for extended temperature range									
9	SL-550	/S /T /P /PR /PT	11 1 0550x 00	1/2AA	3.6 V	0.9 Ah	0.6 mA	50 mA	-55 ... +130 °C	Ø 14.5 x 25
10	SL-561	/S /T /P /PR /PT	11 1 0561x 00	2/3AA	3.6 V	1.1 Ah	1 mA	75 mA	-55 ... +130 °C	Ø 14.5 x 33
11	SL-560	/S /T /P /PR /PT	11 1 0560x 00	AA	3.6 V	1.8 Ah	2 mA	100 mA	-55 ... +130 °C	Ø 14.5 x 50
	SL-700 / SL-2700 series: for enhanced start									
12	SL-750	/S /T /P /PR /PT	11 1 0750x 00	1/2AA	3.6 V	1.1 Ah	1 mA	50 mA	-55 ... +85 °C	Ø 14.5 x 25
13	SL-761	/S /T /P /PR /PT	11 1 0761x 00	2/3AA	3.6 V	1.5 Ah	1.3 mA	75 mA	-55 ... +85 °C	Ø 14.5 x 33
14	SL-760	/S /T /P /PR /PT	11 1 0760x 00	AA	3.6 V	2.2 Ah	2 mA	100 mA	-55 ... +85 °C	Ø 14.5 x 50
15	SL-2770	/S /T /P	11 2 1770x 00	C	3.6 V	8.5 Ah	3 mA	230 mA	-55 ... +85 °C	Ø 26 x 50
16	SL-2780	/S /T /P	11 2 1780x 00	D	3.6 V	19 Ah	4 mA	340 mA	-55 ... +85 °C	Ø 33 x 60
17	SL-2790	/S /T	11 2 1790x 00	DD	3.6 V	35 Ah	10 mA	450 mA	-55 ... +85 °C	Ø 33 x 123
18	TL-2450	/P (with insulation)	11 1 13763 02	1/10C	3.6 V	0.55 Ah	0.5 mA	5 mA	-55 ... +85 °C	Ø 24 x 5.6
	TL-2450	/P (without insulation)	11 1 13763 22	1/10C	3.6 V	0.55 Ah	0.5 mA	5 mA	-55 ... +85 °C	Ø 24 x 5.6
	SL-800 / SL-2800 series: XOL for extended operating life									
19	SL-889	Solder pins	11 1 18894 00	1/10D	3.6 V	1 Ah	0.5 mA	10 mA	-55 ... +85 °C	Ø 33 x 6
20	SL-886	Solder pins	11 1 18864 00	1/6D	3.6 V	1.5 Ah	0.5 mA	10 mA	-55 ... +85 °C	Ø 33 x 10
21	SL-850	/S /T /P /PR /PT	11 1 0850x 00	1/2AA	3.6 V	1.2 Ah	0.5 mA	20 mA	-55 ... +85 °C	Ø 14.5 x 25
22	SL-861	/S /T /P /PR /PT	11 1 0861x 00	2/3AA	3.6 V	1.6 Ah	0.5 mA	30 mA	-55 ... +85 °C	Ø 14.5 x 33
23	SL-860	/S /T /P /PR /PT	11 1 0860x 00	AA	3.6 V	2.4 Ah	1 mA	60 mA	-55 ... +85 °C	Ø 14.5 x 50
24	SL-2870	/S /T /P	11 2 1870x 00	C	3.6 V	8.5 Ah	3 mA	75 mA	-55 ... +85 °C	Ø 26 x 50
25	SL-2880	/S /T /P	11 2 1880x 00	D	3.6 V	19 Ah	4 mA	100 mA	-55 ... +85 °C	Ø 33 x 60
26	PulsesPlus™ Batteries									
	Model	Termination	Catalogue number	Configuration		Nominal voltage	Nominal capacity	Max. pulse current ²⁾	Dimensions (mm)	
				Primary cell	HLC					
27	TLP-91111/A/SM	Flying leads	17 91111 101	AA	1550	3.6 V	2.40 Ah	3 A	55 x 32 x 16	
28	TLP-91311/A/SM	Pressure contacts	17 91311 101	AA	1520	3.6 V	2.40 Ah	1 A	Ø 16.5 x 75	
28	TLP-91311/A/ST	Solder tags	17 91311 102	AA	1520	3.6 V	2.40 Ah	1 A	Ø 16.5 x 75	
29	TLP-92111/A/SM	Flying leads	17 92111 101	C	1550	3.6 V	8.50 Ah	3 A	55 x 44 x 28	
30	TLP-92311/A/SM	Flying leads	17 92311 101	C	1520	3.6 V	8.50 Ah	1 A	Ø 29 x 67	
31	TLP-93111/A/SM	Flying leads	17 93111 101	D	1550	3.6 V	19.0 Ah	3 A	64 x 50 x 35	
32	TLP-93311/A/SM	Flying leads	17 93311 101	D	1520	3.6 V	19.0 Ah	1 A	Ø 34 x 78	
33	TLP-96111/A/SM	Flying leads	17 96111 101	1/2AA	1550	3.6 V	1.2 Ah	3 A	55 x 32 x 16	
34	TLP-96311/A/SM	Pressure contacts	17 96311 101	1/2AA	1520	3.6 V	1.2 Ah	1 A	Ø 16.5 x 50	
34	TLP-96311/A/ST	Solder tags	17 96311 102	1/2AA	1520	3.6 V	1.2 Ah	1 A	Ø 16.5 x 50	
35	TLP-97111/A/SM	Flying leads	17 97111 101	2/3AA	1550	3.6 V	1.6 Ah	3 A	55 x 32 x 16	
36	TLP-97311/A/SM	Pressure contacts	17 97311 101	2/3AA	1520	3.6 V	1.6 Ah	1 A	Ø 16.5 x 58	
36	TLP-97311/A/ST	Solder tags	17 97311 102	2/3AA	1520	3.6 V	1.6 Ah	1 A	Ø 16.5 x 58	
37	Hybrid Layer Capacitors (HLC) for use in PulsesPlus™ Batteries									
	Model	Maximum charge voltage	Maximum charging current	Max. cont. discharge current	Max. pulse discharge current	Maximum capacity (3.67 V)	Maximum capacity (3.9 V)	Discharge end voltage	Cell impedance	Dimensions (mm)
38	HLC-1020	3.95 V	8 mA	0.25 A	0.75 A	12.5 mAh	20 mAh	2.5 V	≤ 400 mΩ	Ø 10 x 20
38	HLC-1020L	3.95 V	6 mA	0.15 A	0.5 A	8 mAh	12.5 mAh	2.5 V	≤ 600 mΩ	Ø 10 x 20
39	HLC-1520A	3.95 V	25 mA	0.5 A	2 A	39 mAh	58 mAh	2.5 V	≤ 250 mΩ	Ø 15 x 20
40	HLC-1530A	3.95 V	50 mA	0.75 A	3 A	70 mAh	105 mAh	2.5 V	≤ 140 mΩ	Ø 15 x 27
41	HLC-1550A	3.95 V	100 mA	2 A	5 A	155 mAh	236 mAh	2.5 V	≤ 100 mΩ	Ø 15 x 50
42	Tadiran Lithium Metal Oxide (TLM) Batteries									
	Model	Nominal voltage	Max. cont. discharge current	Max. pulse discharge current	Maximum capacity	End voltage	Cell impedance	Capacity retention ³⁾	Dimensions (mm)	
43	TLM-1520HPM	4.0 V	1.75 A	3.75 A	125 mAh	2.8 V	≤ 100 mΩ	89 %	Ø 15 x 20	
44	TLM-1530HPM	4.0 V	3.2 A	6.8 A	225 mAh	2.8 V	≤ 100 mΩ	89 %	Ø 15 x 27	
45	TLM-1550HPM	4.0 V	7 A	15 A	500 mAh	2.8 V	≤ 100 mΩ	89 %	Ø 15 x 50	
46	Tadiran Lithium Ion (TLI) Batteries – RECHARGEABLE									
	Model	Max. charge voltage	Max. charging current	Max. cont. discharge current	Max. pulse discharge current	Maximum capacity	End voltage	Cell impedance	Dimensions (mm)	
47	TLI-1020A	4.1 V	8 mA	0.16 A	0.4 A	25 mAh	2.5 V	≤ 600 mΩ	Ø 10 x 20	
48	TLI-1520A	4.1 V	25 mA	0.5 A	1.25 A	90 mAh	2.5 V	≤ 250 mΩ	Ø 15 x 20	
49	TLI-1530A	4.1 V	50 mA	1 A	2.5 A	150 mAh	2.5 V	≤ 175 mΩ	Ø 15 x 27	
50	TLI-1550A	4.1 V	100 mA	2 A	5 A	330 mAh	2.5 V	≤ 100 mΩ	Ø 15 x 50	
51	Safety and Transport Regulations									

¹⁾ complete catalogue number depends on termination; see product page ²⁾ pulse duration 1 s to 3 V ³⁾ after 10 years of storage at RT

About Tadiran

Tadiran Batteries GmbH

Tadiran Batteries GmbH is the leading manufacturer of primary (non rechargeable) lithium batteries in Europe.

The company was founded as a Joint Venture between Tadiran and Sonnenschein in 1984 and has very successfully served the market – first under the name of Sonnenschein Lithium and since 2006 as Tadiran Batteries – for more than 35 years.

Together with its parent company Tadiran Batteries Ltd., the company is continuously improving its performance with regard to products, highest quality and customer service.

Tadiran Batteries Ltd. is fully owned by Saft Group.

The main focus of the company is to achieve a maximum customer satisfaction. Thus the guide line is to be the best in design-in, in full technical support and logistics.

The company is committed to the world class philosophy. The management system is certified to ISO 9001 (Quality) and – since 1999 – to ISO 14001 (Environment).

Tadiran Batteries GmbH employs approx. 120 people and has its production facilities in Büdingen, Germany.

The company is a leader in the development of lithium batteries for industrial use. Its Lithium Thionyl Chloride (LTC) technology is well established for more than 35 years. Tadiran LTC batteries are suitable where a 3.6 Volt high energy primary battery is required for up to 25 years and more stand alone operation.

The **PulsesPlus™** technology, providing high current pulses in combination with high energy, plays a significant role especially for long distance communication (e.g. GSM) modules.

The TLM technology has been developed for applications requiring high power discharge after a long storage time, e.g. as a back up battery for emergency call devices in automotive telematic systems.

The RECHARGEABLE TLI series is specifically designed for long-term use in harsh environments and represents an important breakthrough in lithium-ion battery technology.

Customer benefits

Tadiran has focused its ongoing efforts on promoting the understanding and further development of lithium batteries. This determination offers to the customer a number of decisive benefits such as:

- ▶ Access to over 50 years of experience in research and development, production and marketing
- ▶ Adaptability and reliability in meeting rapidly evolving customer needs
- ▶ Detailed technical support in terms of design and application – before, during and after the purchase
- ▶ Highly qualified experts available for support on short notice
- ▶ Customized production of single- and multi-cell batteries to meet specific requirements
- ▶ Reliable delivery, secured by contractual agreements and second sourcing.

For successful use of a battery, the co-operation between the supplier and the customer must commence at the earliest possible point: at times it is simply more economical to design a circuit for the characteristics of the best suitable energy supply, rather than having to forgo its advantages because it is too late for changes.

Environment

The European Battery Directive 2006/66/EC restricts the use of certain hazardous substances in batteries and establishes rules for the collection, treatment, recycling and disposal of waste batteries and accumulators. It is transposed individually in each EU member state.

The following information is important for end users of batteries:

Batteries are marked with the crossed-out wheeled bin symbol.



The symbol reminds end users that batteries must not be disposed as municipal waste, but collected separately. Used batteries can be returned at the point of sale at no charge.

A Technical Notice is available upon request with details on the disposal service offered by Tadiran.



Introduction

The Lithium Thionyl Chloride (LTC) battery

The Tadiran lithium thionyl chloride inorganic electrolyte battery is a power source that is suited to the requirements of the new generation in microelectronics. For example, CMOS memories as well as utility meters require a light-weight power source to provide a safe and reliable performance over a wide range of environmental conditions, for long periods of time.

The Tadiran lithium battery is a component that can be permanently connected to a circuit and, in many cases, will last the entire lifetime of the equipment.

Battery characteristics

The major advantages of the Tadiran lithium battery are:

High cell voltage

The battery has a nominal voltage of 3.6 Volts, which is considerably higher than any other commercially available primary cell.

Wide temperature range

The batteries are capable of operating in a wide temperature range normally from -55°C to $+85^{\circ}\text{C}$. One series, however, has an extended temperature range of up to $+130^{\circ}\text{C}$.

High energy density

The electrochemical system offers the highest energy density of any available primary battery: up to $\sim 650 \text{ Wh / kg}$ and $\sim 1280 \text{ Wh / dm}^3$ (see figure 2).

Superior shelf life and reliability

The Tadiran lithium battery has an outstandingly long shelf life. Tests have shown that storage for ten years at room temperature results in a capacity loss of less than 1 % per year.

Tadiran lithium batteries are also extremely reliable. Failure rates in memory back-up applications were found to be below 200 fit (fit: Failures in Time. 1 fit = 1 failure in 10^9 component hours).

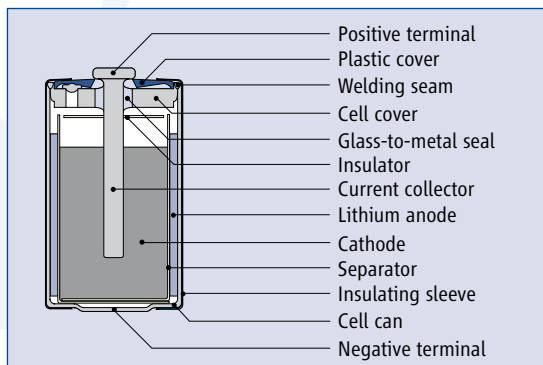


Figure 1: Cross sectional view of a 1/2AA size cell (bobbin-design)

Safe design

The battery's design has a major influence on its safety characteristics (see figure 1).

In the bobbin version, the cathode is cylindrical in shape. The anode is swaged against the inner wall of the battery case. This offers several advantages in terms of safety. In the event of an unintentional short-circuit, the discharge currents do not become very strong. The heat generated, primarily at the contact surface between the anode and cathode, can easily be channelled to the outside. This design leads to a safe battery that needs no additional rupture vent.

In the flat battery versions, the anode is pressed onto the bottom of the case, and the cathode is disk-shaped. Flat batteries are wider than they are high. They are just as safe as the bobbin type batteries.

Hermetically sealed case

The hermetically sealed case is essential for the long shelf life and inherent safety of the devices in which the batteries are used. The cover is welded to the can. A glass-to-metal seal is used to insulate the positive terminal.

The chemical reaction

The battery consists of a lithium (Li) anode, a carbon (C) cathode, and a non-aqueous electrolyte (a solution of lithium tetra-chloroaluminate in thionyl chloride). This solution performs a dual task: as the electrolyte for ion transport, and as an active depolarizer.

The Teflon™-bonded carbon cathode serves as a catalyst for cathodic reduction.

The generally accepted reaction mechanisms are as follows:

- ▶ Anodic reaction:
 $4 \text{ Li} \rightarrow 4 \text{ Li}^+ + 4 \text{ e}^-$
- ▶ Cathodic reaction:
 $2 \text{ SOCl}_2 + 4 \text{ e}^- \rightarrow \text{SO}_2 + \text{S} + 4 \text{ Cl}^-$
- ▶ Overall reaction:
 $4 \text{ Li} + 2 \text{ SOCl}_2 \rightarrow \text{S} + 4 \text{ LiCl} + \text{SO}_2$

Most of the sulphur dioxide generated during discharge dissolves in the electrolyte, preventing pressure build-up within the battery.

Long-term behaviour

The long shelf life of the Tadiran lithium batteries is a result of the fact that a thin protective layer of LiCl forms on the anode as soon as the lithium first comes into contact with the electrolyte. This layer prevents further reaction or loss of capacity on stand. The problem of anode corrosion, as occurs in aqueous systems, is thus eliminated.

On the other hand, the protective layer on the anode may cause a delay in the voltage build-up if relatively high loads are applied, or after extended storage at elevated temperatures. This voltage delay is not experienced at all in microampere applications, such as in typical CMOS circuits.

Features and attributes of the various series

SL-300 series
Keywords: standard use and stand-by

- ▶ Excellent shelf life (10 years)
- ▶ Extremely low self-discharge (1 % or less per year)
- ▶ Suited for long-term use with low current
- ▶ For operation at low current levels with long stands
- ▶ Intermittent discharge with medium current level provided the average is not below the active current level ($2 \mu\text{A} / \text{cm}^2$ anode surface area)
- ▶ Temperature range from -55°C to $+85^{\circ}\text{C}$

SL-500 series

Keywords: extended temperature range

- ▶ Extension of temperature range up to $+130^{\circ}\text{C}$
- ▶ Somewhat smaller capacity
- ▶ Otherwise like the SL-700 series

SL-700/

SL-2700 (iXtra) series

Keywords: for enhanced start/ for fast voltage recovery

- ▶ Major improvement of voltage delay (TMV) at

the start of discharge at medium current levels

- ▶ Intermittent discharge at medium current levels
- ▶ Higher voltage under pulse load even with low background currents
- ▶ Improved voltage delay behaviour at ambient and elevated temperatures
- ▶ Fast voltage recovery after long term storage
- ▶ Higher discharge rate

SL-800/2800 series (XOL)

Keywords: for extended operation life

- ▶ More capacity
- ▶ Extra low self discharge
- ▶ Extra low passivation during long term use

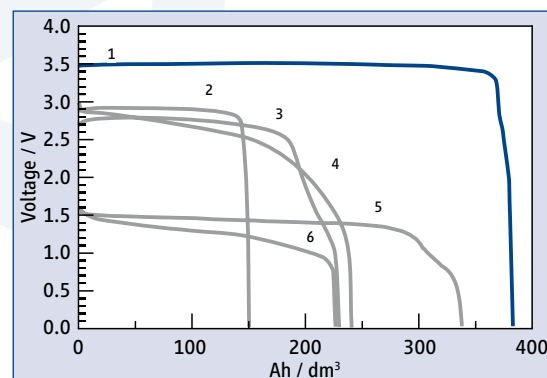


Figure 2:

Comparison of different battery systems. The curves represent typical best values of commercial cylindrical cells when discharged at $+25^{\circ}\text{C}$ at the 1000 hour rate. The area under the curves corresponds to the energy density listed below.

- 1 Li/SOCl₂ 1280 Wh / dm³
- 2 Li/SO₂ 430 Wh / dm³
- 3 Li/CF_x 550 Wh / dm³
- 4 Li/MnO₂ 580 Wh / dm³
- 5 Li/FeS₂ 450 Wh / dm³
- 6 Alkaline 280 Wh / dm³

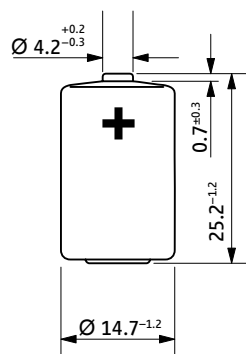
Performance Data

(Typical values for batteries stored at +25 °C for one year)

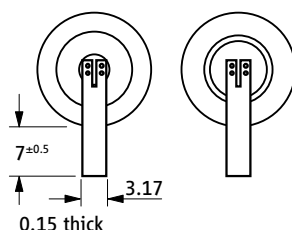
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.2 Ah
Nominal current	0.6 mA
Max. continuous discharge current	6 mA
Anode surface area	6 cm ²
Lithium content	0.35 g
Weight	9.6 g
Volume	4 cm ³
Temperature range	-55 °C ... +85 °C



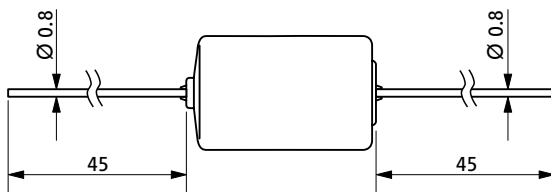
SL-350/S



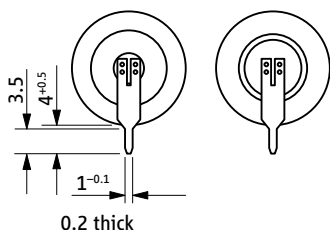
SL-350/T



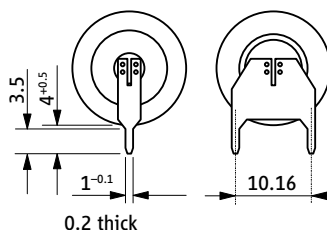
SL-350/P



SL-350/PR



SL-350/PT

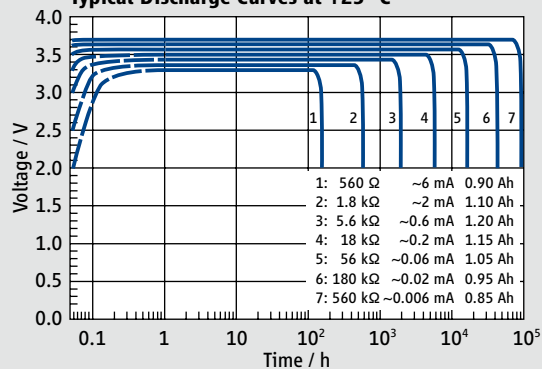


Available Terminations

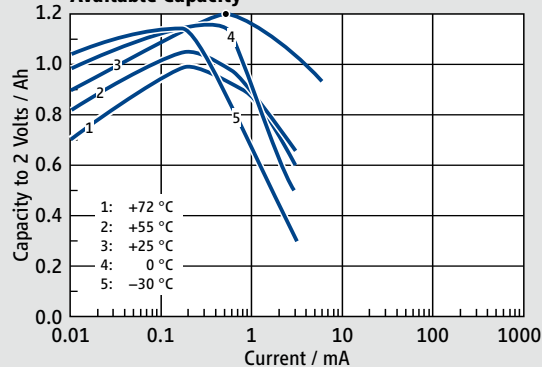
Termination	Catalogue No.
SL-350/S Standard	11 1 03501 00
SL-350/T Tags	11 1 03502 00
SL-350/P Pins	11 1 03503 00
SL-350/PR Pins radial	11 1 03506 00
SL-350/PT Polarized tags	11 1 03508 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

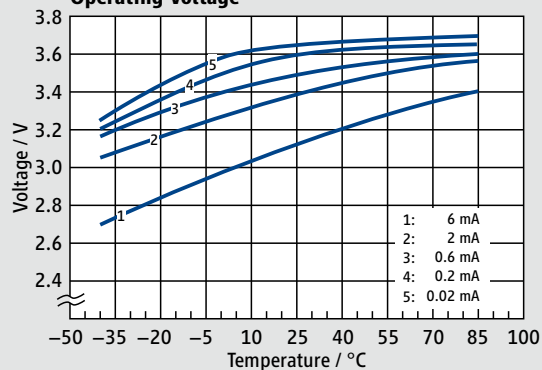
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



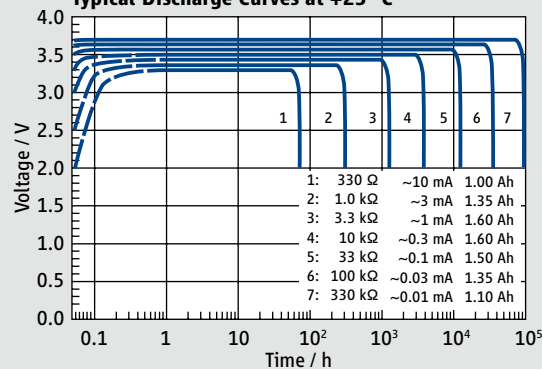
Performance Data

(Typical values for batteries stored at +25 °C for one year)

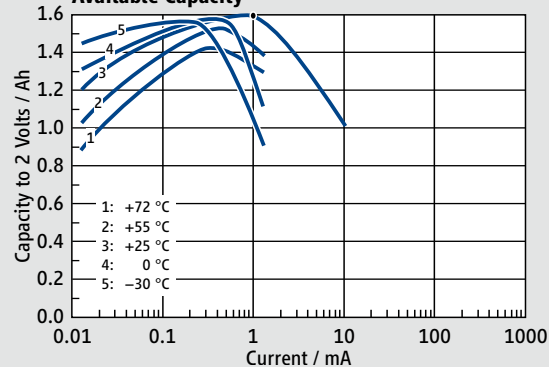
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.6 Ah
Nominal current	1 mA
Max. continuous discharge current	10 mA
Anode surface area	9 cm ²
Lithium content	0.5 g
Weight	12.5 g
Volume	5.2 cm ³
Temperature range	-55 °C ... +85 °C



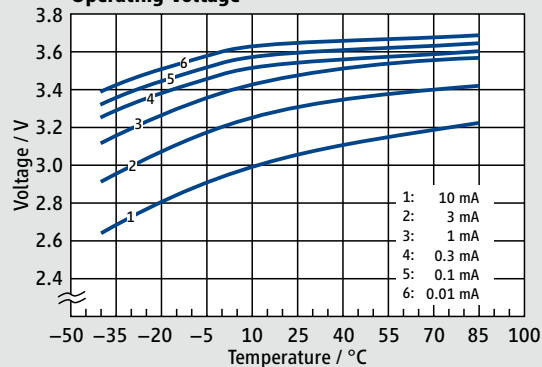
Typical Discharge Curves at +25 °C



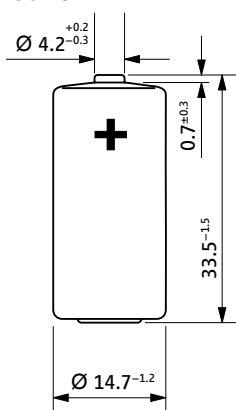
Available Capacity



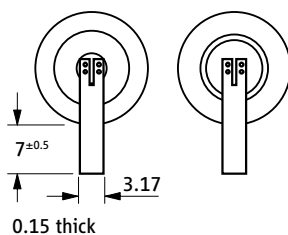
Operating Voltage



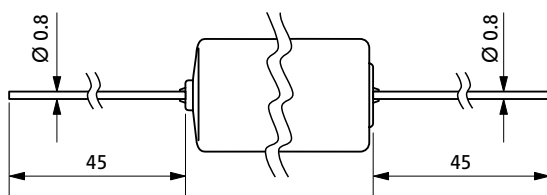
SL-361/S



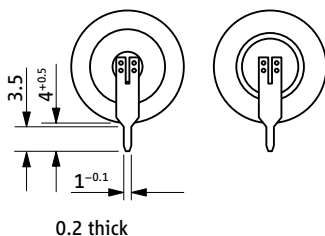
SL-361/T



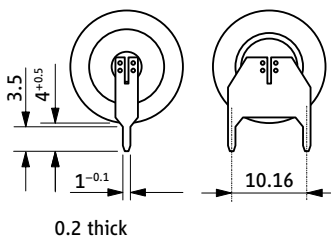
SL-361/P



SL-361/PR



SL-361/PT



Available Terminations

SL-361/S	Standard	11 1 03611 00
SL-361/T	Tags	11 1 03612 00
SL-361/P	Pins	11 1 03613 00
SL-361/PR	Pins radial	11 1 03616 00
SL-361/PT	Polarized tags	11 1 03618 00

Catalogue No.

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

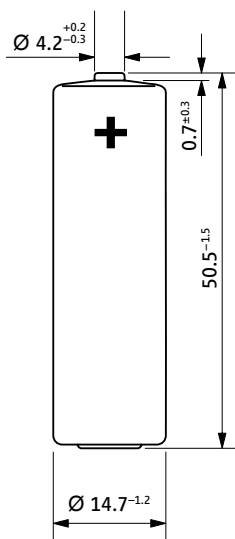
Performance Data

(Typical values for batteries stored at +25 °C for one year)

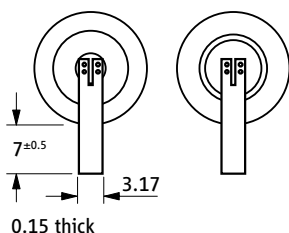
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	2.4 Ah
Nominal current	2 mA
Max. continuous discharge current	20 mA
Anode surface area	14 cm ²
Lithium content	0.65 g
Weight	18 g
Volume	8 cm ³
Temperature range	-55 °C ... +85 °C



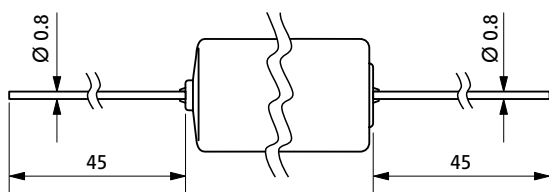
SL-360/S



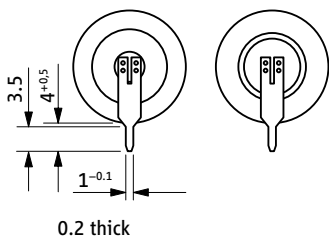
SL-360/T



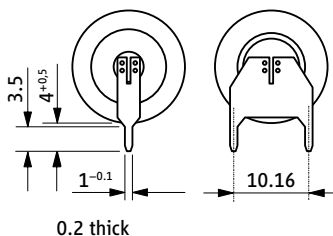
SL-360/P



SL-360/PR



SL-360/PT

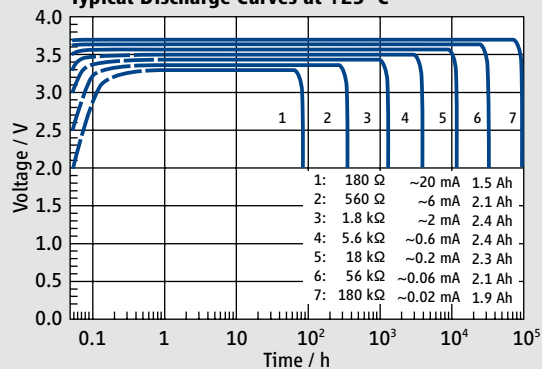


Available Terminations

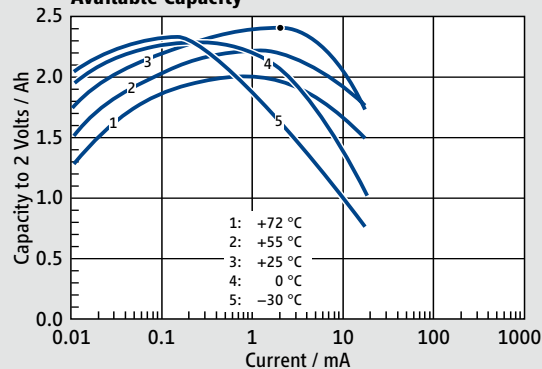
Termination	Catalogue No.
SL-360/S Standard	11 1 03601 00
SL-360/T Tags	11 1 03602 00
SL-360/P Pins	11 1 03603 00
SL-360/PR Pins radial	11 1 03606 00
SL-360/PT Polarized tags	11 1 03608 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

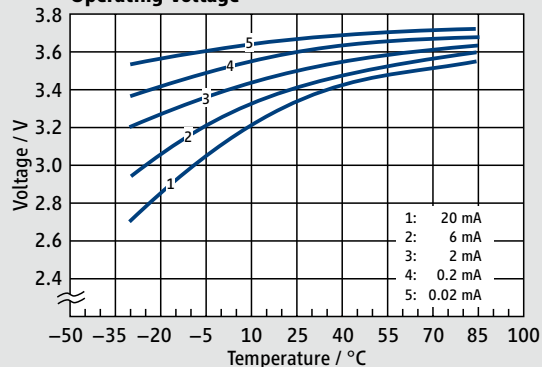
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



- Extended temperature range
- iXtra – long term high performance

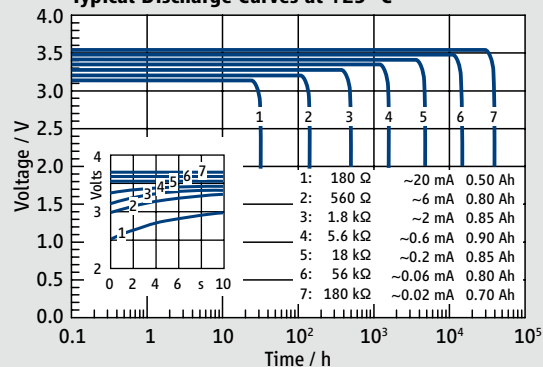
Performance Data

(Typical values for batteries stored at +25 °C for one year)

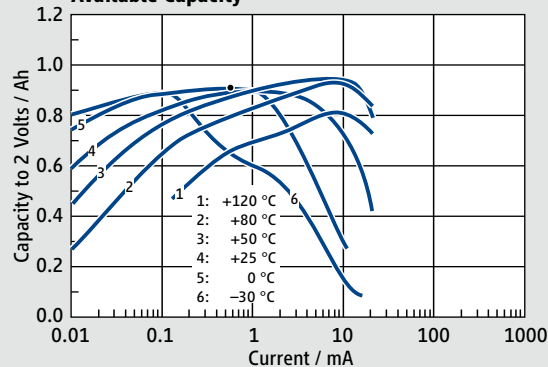
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	0.9 Ah
Nominal current	0.6 mA
Max. continuous discharge current	50 mA
Pulse current capability	100 mA
Anode surface area	6 cm ²
Lithium content	0.35 g
Weight	9.6 g
Volume	4 cm ³
Temperature range	-55 °C ... +130 °C



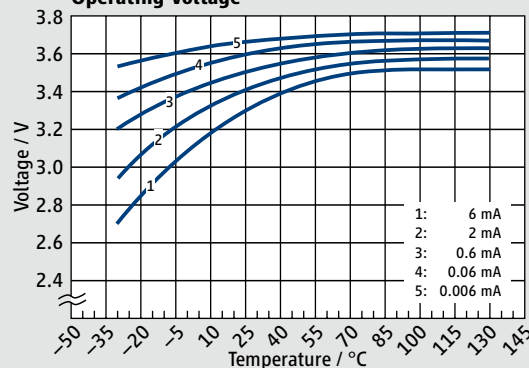
Typical Discharge Curves at +25 °C



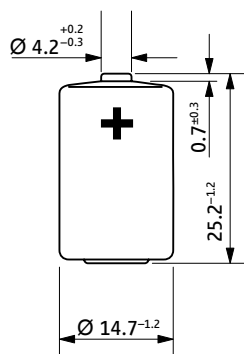
Available Capacity



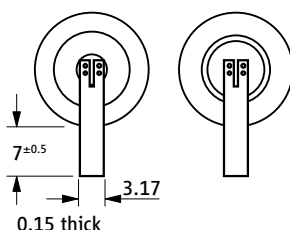
Operating Voltage



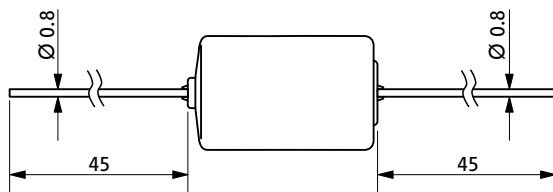
SL-550/S



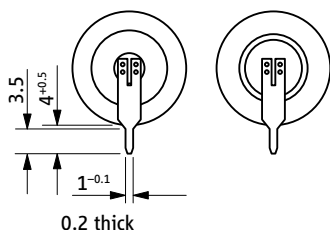
SL-550/T



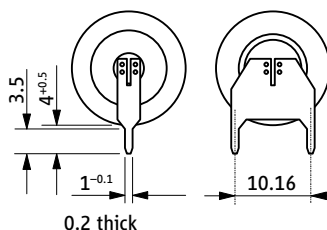
SL-550/P



SL-550/PR



SL-550/PT



Available Terminations

Catalogue No.

SL-550/S	Standard	11 1 05501 00
SL-550/T	Tags	11 1 05502 00
SL-550/P	Pins	11 1 05503 00
SL-550/PR	Pins radial	11 1 05506 00
SL-550/PT	Polarized tags	11 1 05508 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 150 °C, incinerate, or expose contents to water.

- Extended temperature range
- iXtra – long term high performance

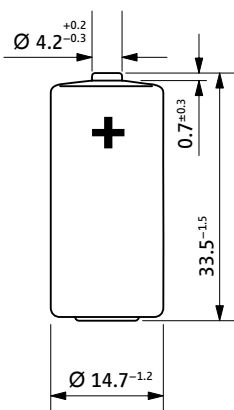
Performance Data

(Typical values for batteries stored at +25 °C for one year)

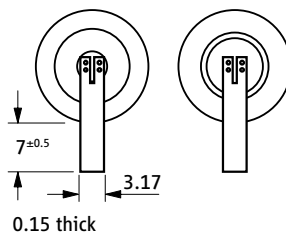
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.1 Ah
Nominal current	1 mA
Max. continuous discharge current	75 mA
Pulse current capability	150 mA
Anode surface area	9 cm ²
Lithium content	0.5 g
Weight	12.5 g
Volume	5.2 cm ³
Temperature range	-55 °C ... +130 °C



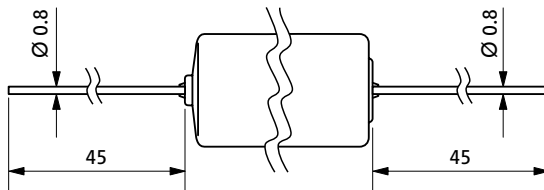
SL-561/S



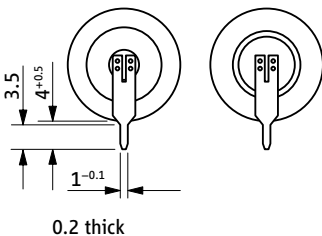
SL-561/T



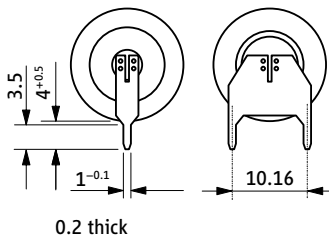
SL-561/P



SL-561/PR



SL-561/PT

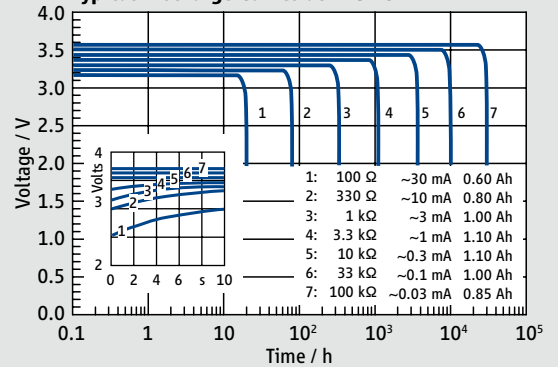


Available Terminations

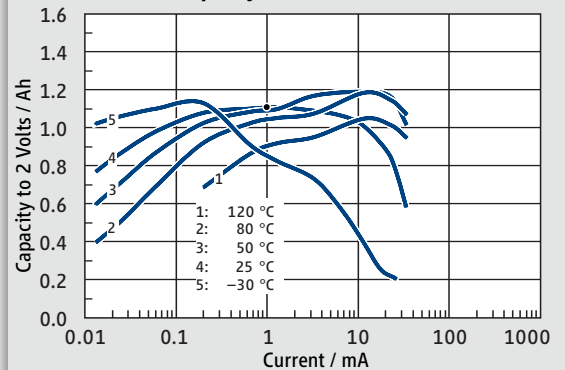
Termination	Catalogue No.
SL-561/S Standard	11 1 05611 00
SL-561/T Tags	11 1 05612 00
SL-561/P Pins	11 1 05613 00
SL-561/PR Pins radial	11 1 05616 00
SL-561/PT Polarized tags	11 1 05618 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 150 °C, incinerate, or expose contents to water.

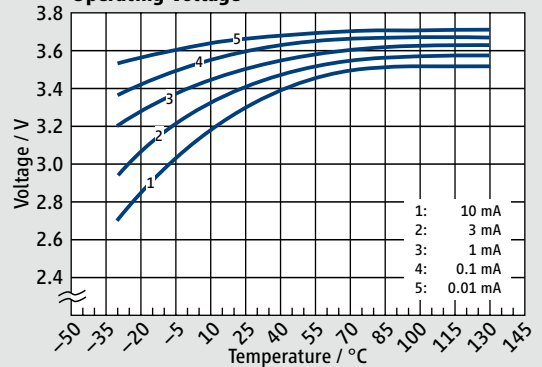
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



- Extended temperature range
- iXtra – long term high performance

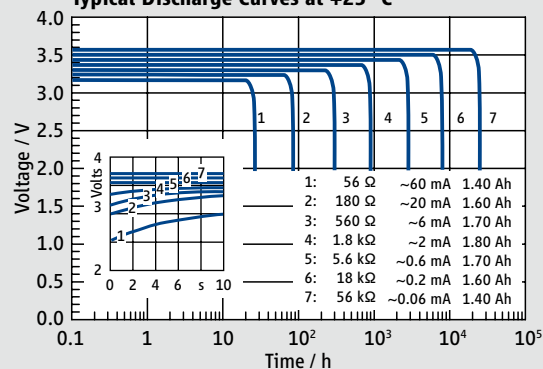
Performance Data

(Typical values for batteries stored at +25 °C for one year)

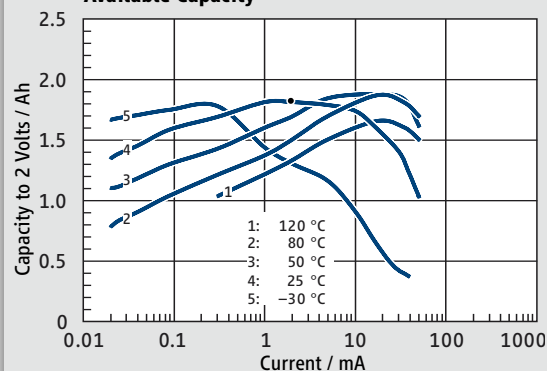
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.8 Ah
Nominal current	2 mA
Max. continuous discharge current	100 mA
Pulse current capability	200 mA
Anode surface area	14 cm ²
Lithium content	0.65 g
Weight	18 g
Volume	8 cm ³
Temperature range	-55 °C ... +130 °C



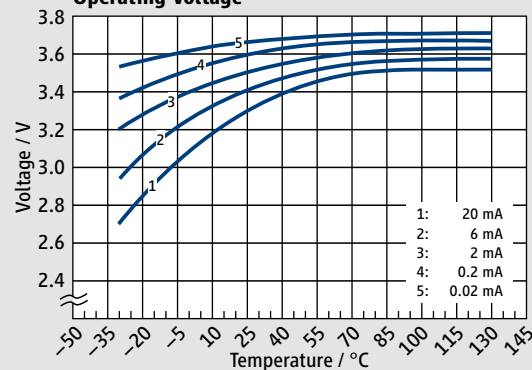
Typical Discharge Curves at +25 °C



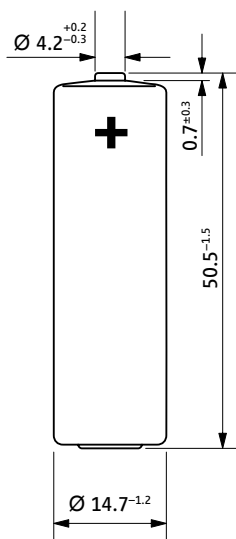
Available Capacity



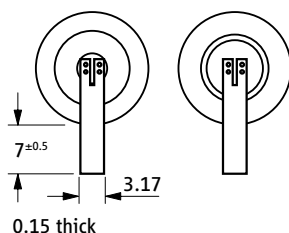
Operating Voltage



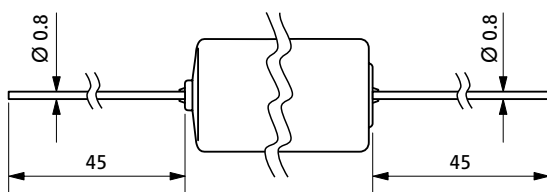
SL-560/S



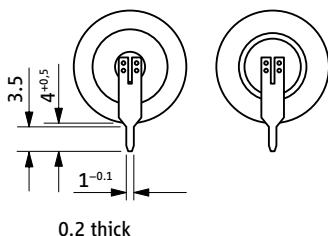
SL-560/T



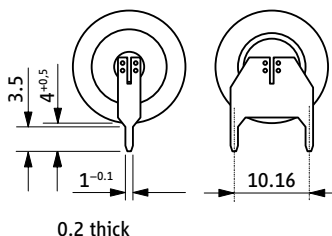
SL-560/P



SL-560/PR



SL-560/PT



Available Terminations

Catalogue No.

SL-560/S	Standard	11 1 05601 00
SL-560/T	Tags	11 1 05602 00
SL-560/P	Pins	11 1 05603 00
SL-560/PR	Pins radial	11 1 05606 00
SL-560/PT	Polarized tags	11 1 05608 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 150 °C, incinerate, or expose contents to water.

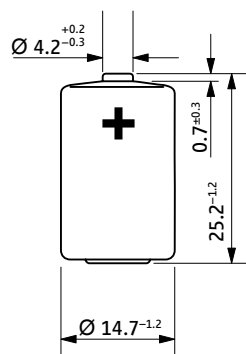
Performance Data

(Typical values for batteries stored at +25 °C for one year)

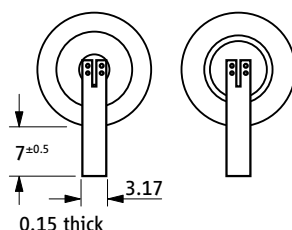
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.1 Ah
Nominal current	1 mA
Max. continuous discharge current	50 mA
Pulse current capability	100 mA
Anode surface area	6 cm ²
Lithium content	0.35 g
Weight	9.6 g
Volume	4 cm ³
Temperature range	-55 °C ... +85 °C



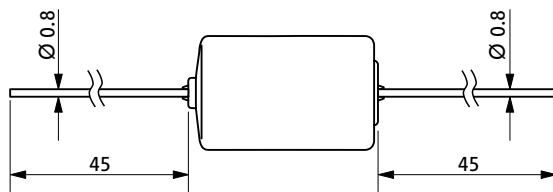
SL-750/S



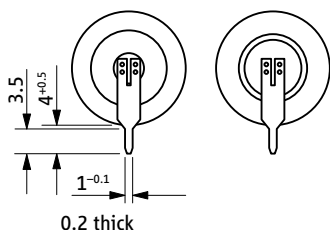
SL-750/T



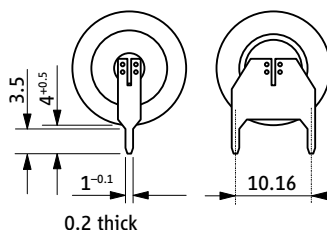
SL-750/P



SL-750/PR



SL-750/PT

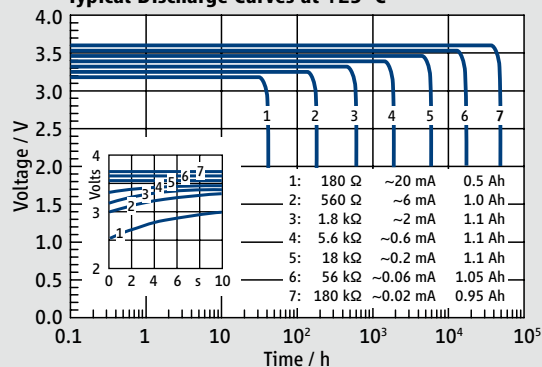


Available Terminations

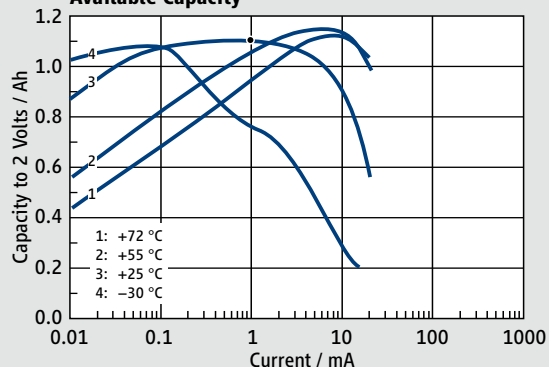
		Catalogue No.
SL-750/S	Standard	11 1 07501 00
SL-750/T	Tags	11 1 07502 00
SL-750/P	Pins	11 1 07503 00
SL-750/PR	Pins radial	11 1 07506 00
SL-750/PT	Polarized tags	11 1 07508 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

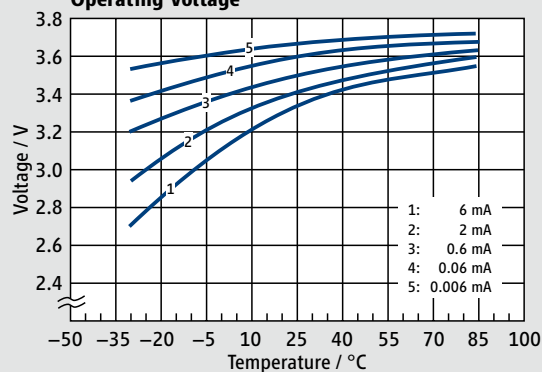
Typical Discharge Curves at +25 °C



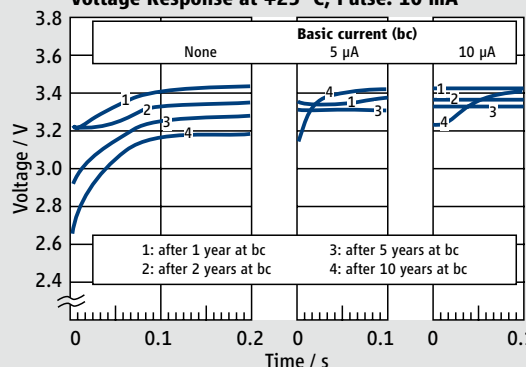
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 10 mA



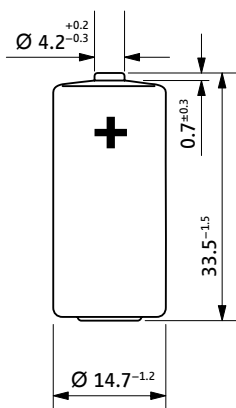
Performance Data

(Typical values for batteries stored at +25 °C for one year)

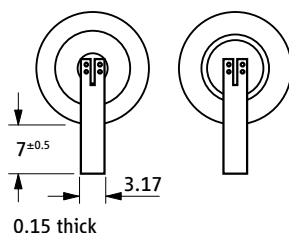
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.5 Ah
Nominal current	1.3 mA
Max. continuous discharge current	75 mA
Pulse current capability	150 mA
Anode surface area	9 cm ²
Lithium content	0.5 g
Weight	12.5 g
Volume	5.2 cm ³
Temperature range	-55 °C ... +85 °C



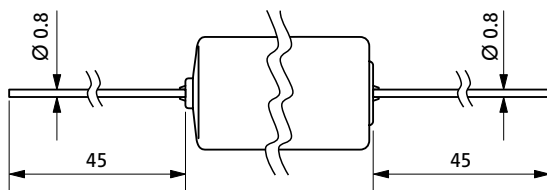
SL-761/S



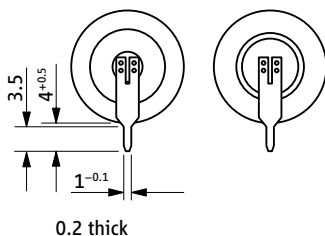
SL-761/T



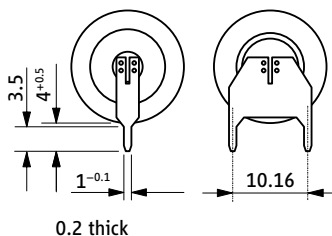
SL-761/P



SL-761/PR



SL-761/PT



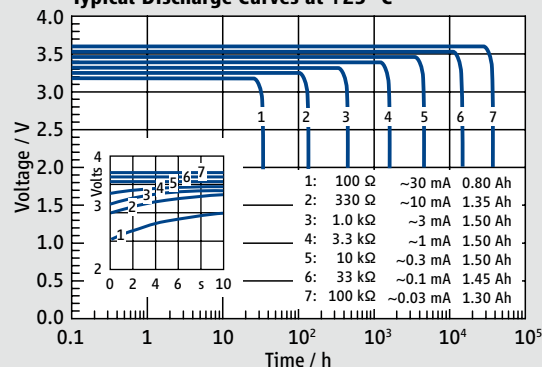
Available Terminations

Termination	Standard	Catalogue No.
SL-761/S	Standard	11 1 07611 00
SL-761/T	Tags	11 1 07612 00
SL-761/P	Pins	11 1 07613 00
SL-761/PR	Pins radial	11 1 07616 00
SL-761/PT	Polarized tags	11 1 07618 00

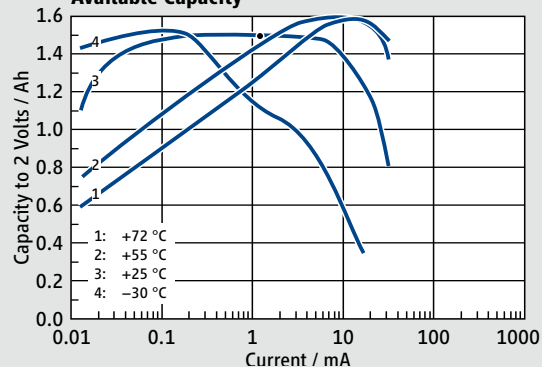


WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

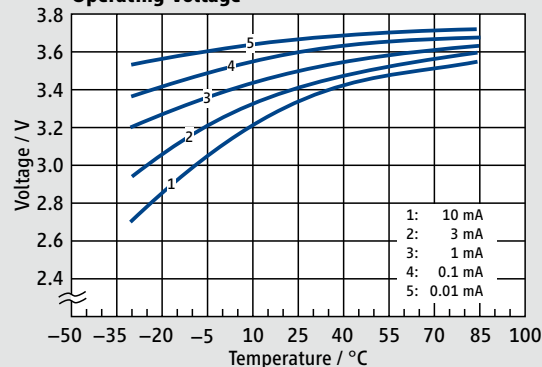
Typical Discharge Curves at +25 °C



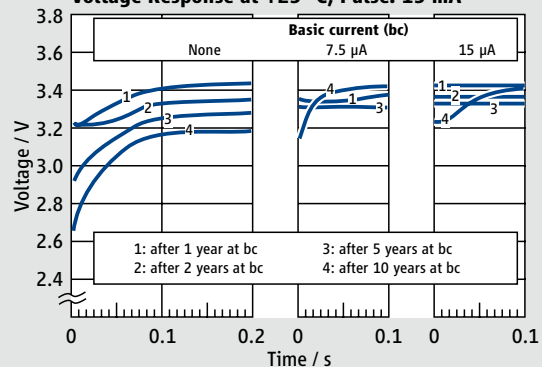
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 15 mA



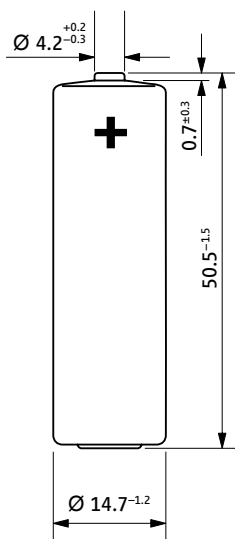
Performance Data

(Typical values for batteries stored at +25 °C for one year)

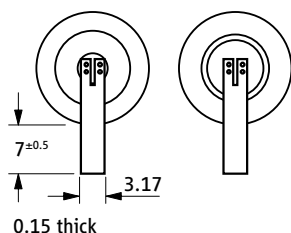
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	2.2 Ah
Nominal current	2 mA
Max. continuous discharge current	100 mA
Pulse current capability	200 mA
Anode surface area	14 cm ²
Lithium content	0.65 g
Weight	18 g
Volume	8 cm ³
Temperature range	-55 °C ... +85 °C



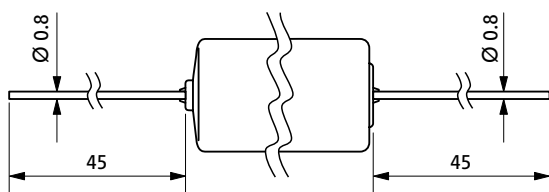
SL-760/S



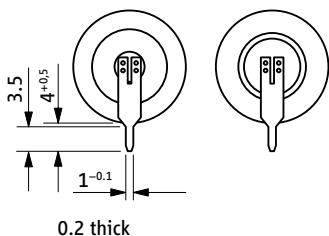
SL-760/T



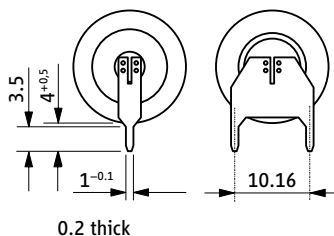
SL-760/P



SL-760/PR



SL-760/PT



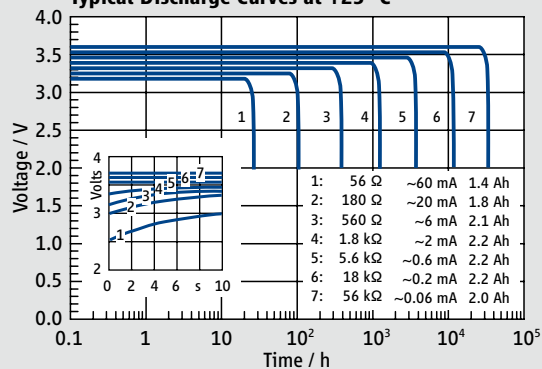
Available Terminations

Termination	Catalogue No.
SL-760/S Standard	11 1 07601 00
SL-760/T Tags	11 1 07602 00
SL-760/P Pins	11 1 07603 00
SL-760/PR Pins radial	11 1 07606 00
SL-760/PT Polarized tags	11 1 07608 00

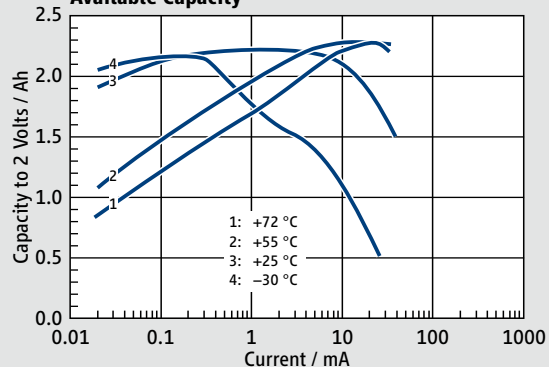


WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

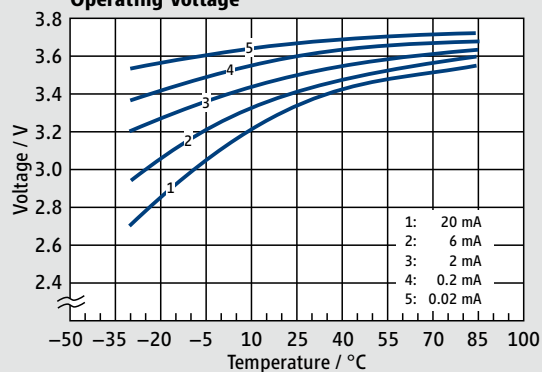
Typical Discharge Curves at +25 °C



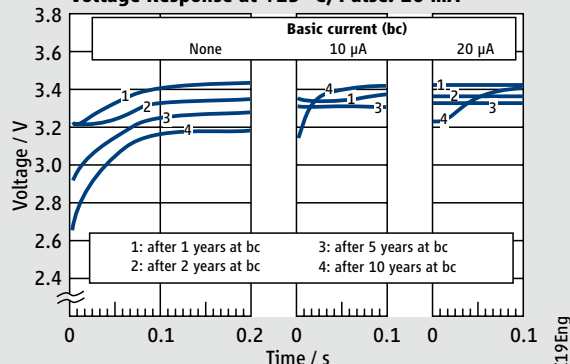
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 20 mA



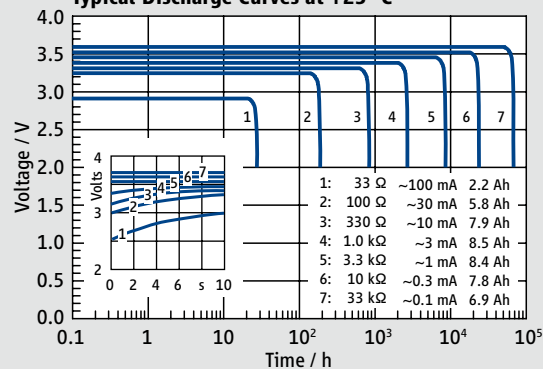
Performance Data

(Typical values for batteries stored at +25 °C for one year)

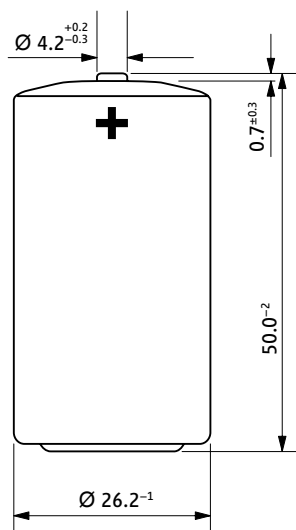
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	8.5 Ah
Nominal current	3 mA
Max. continuous discharge current	230 mA
Pulse current capability	400 mA
Anode surface area	30 cm ²
Lithium content	2.5 g
Weight	49.5 g
Volume	26 cm ³
Temperature range	-55 °C ... +85 °C



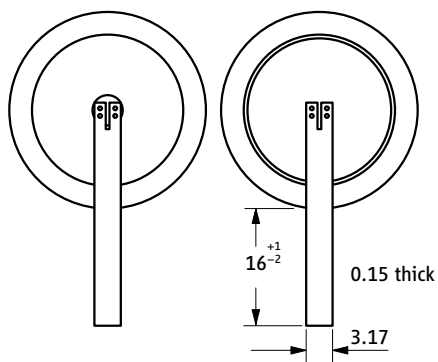
Typical Discharge Curves at +25 °C



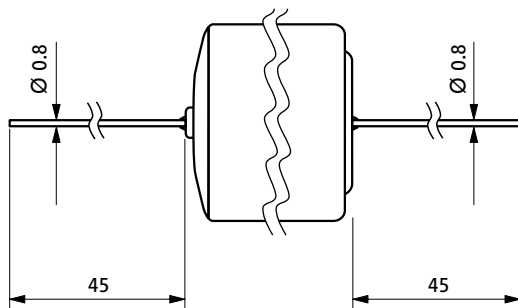
SL-2770/S



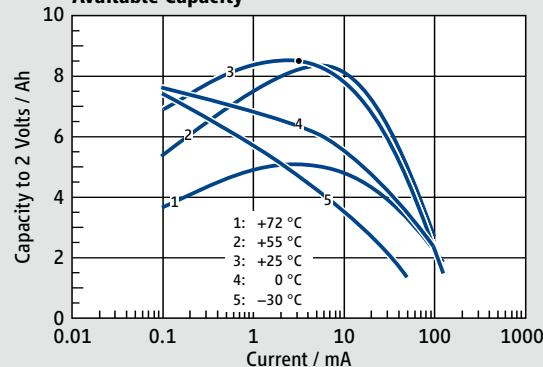
SL-2770/T



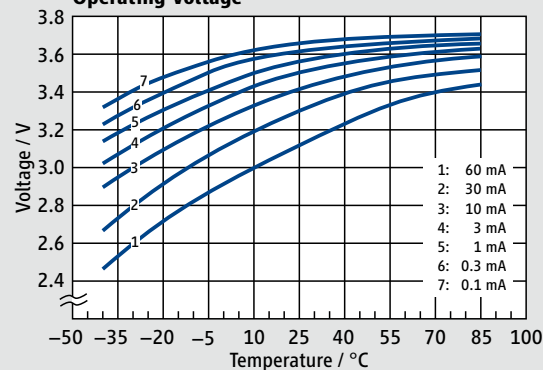
SL-2770/P



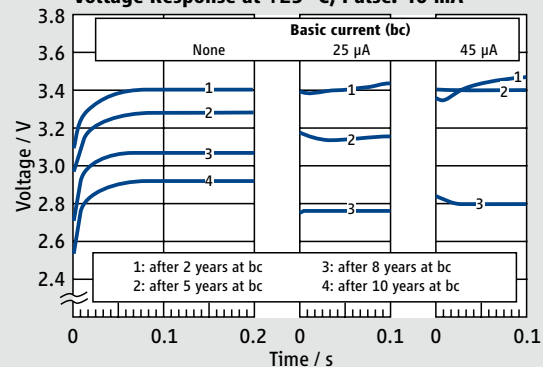
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 40 mA



Available Terminations

Termination	Catalogue No.
SL-2770/S Standard	11 2 17701 00
SL-2770/T Tags	11 2 17702 00
SL-2770/P Pins	11 2 17703 00



WARNING: Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

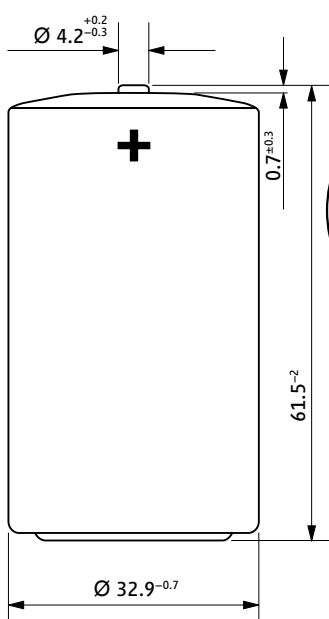
Performance Data

(Typical values for batteries stored at +25 °C for one year)

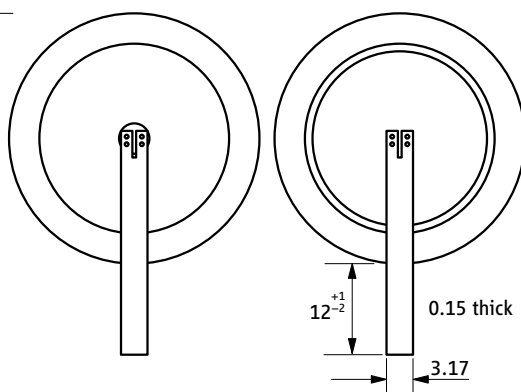
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	19 Ah
Nominal current	4 mA
Max. continuous discharge current	340 mA
Pulse current capability	600 mA
Anode surface area	45 cm ²
Lithium content	5 g
Weight	93 g
Volume	51 cm ³
Temperature range	-55 °C ... +85 °C



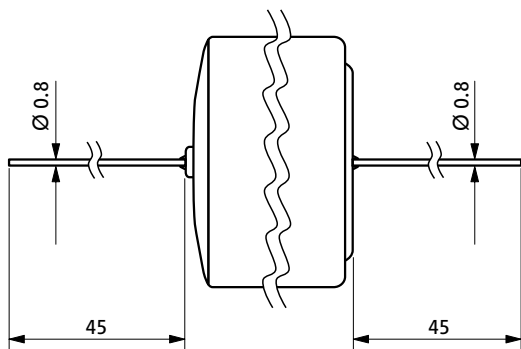
SL-2780/S



SL-2780/T



SL-2780/P

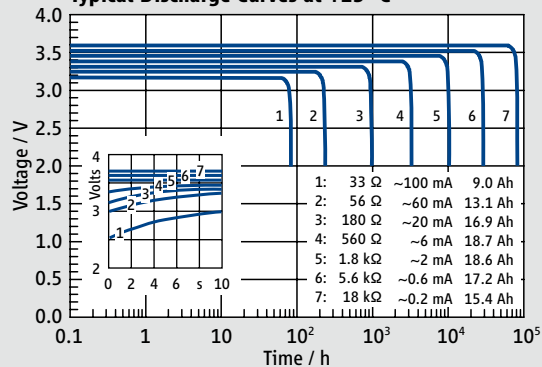


Available Terminations

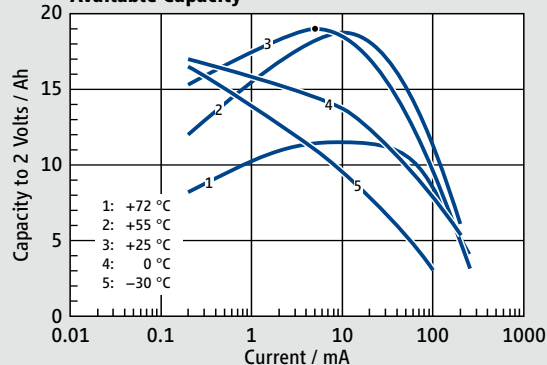
		Catalogue No.
SL-2780/S	Standard	11 2 17801 00
SL-2780/T	Tags	11 2 17802 00
SL-2780/P	Pins	11 2 17803 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

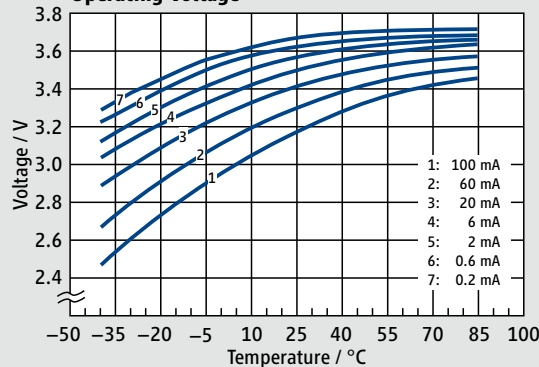
Typical Discharge Curves at +25 °C



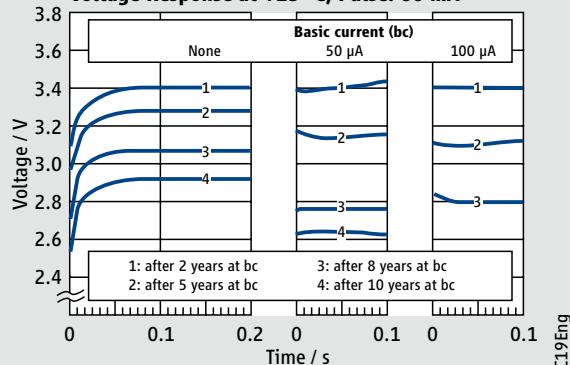
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 60 mA



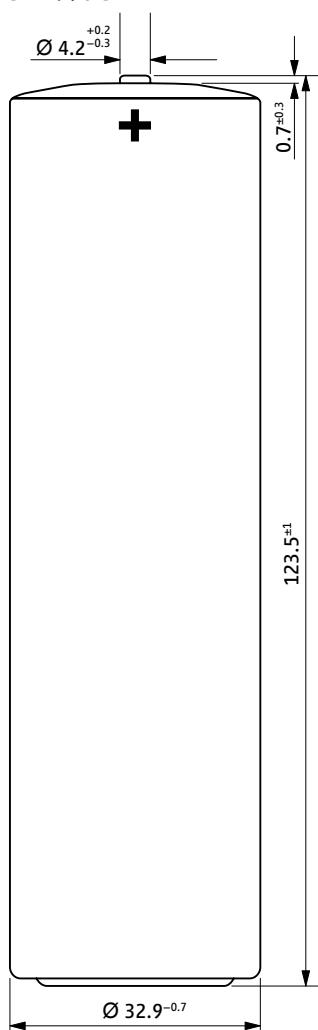
Performance Data

(Typical values for batteries stored at +25 °C for one year)

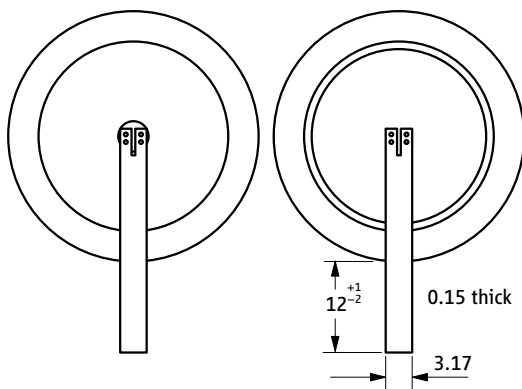
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	35 Ah
Nominal current	10 mA
Max. continuous discharge current	450 mA
Pulse current capability	1000 mA
Anode surface area	90 cm ²
Lithium content	10 g
Weight	190 g
Volume	105 cm ³
Temperature range	-55 °C ... +85 °C



SL-2790/S



SL-2790/T



Available Terminations

SL-2790/S	Standard
SL-2790/T	Tags

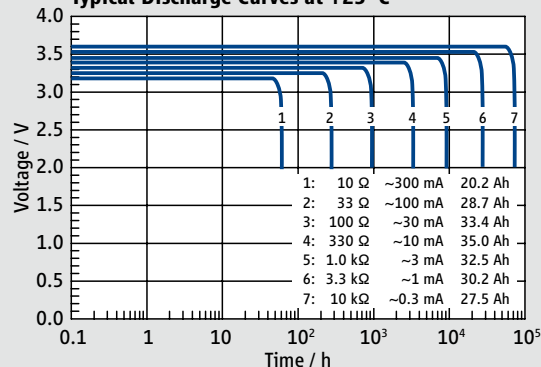
Catalogue No.

11 2 17901 00
11 2 17902 00

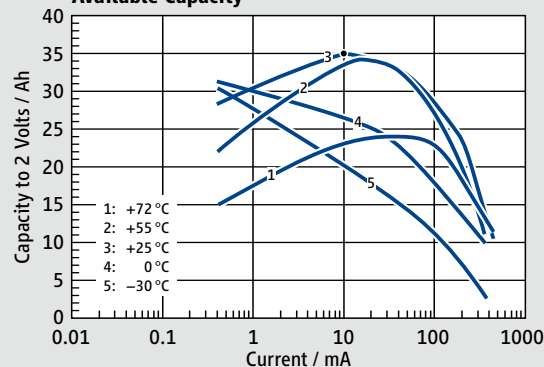


WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

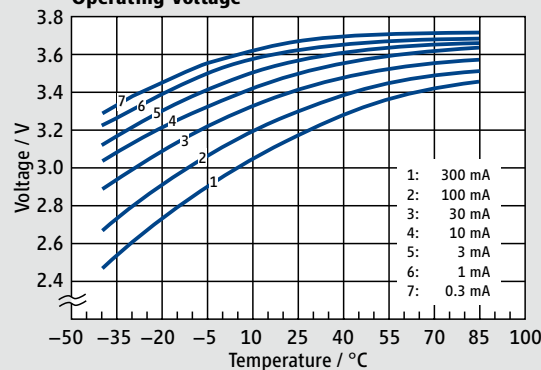
Typical Discharge Curves at +25 °C



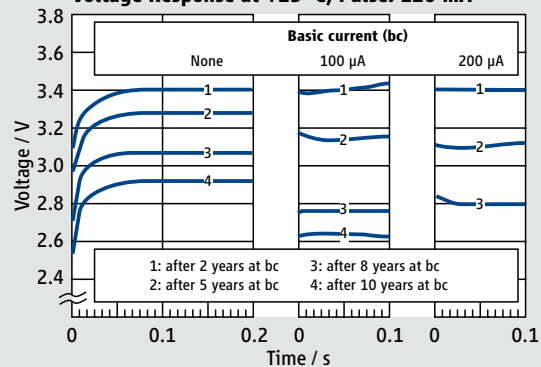
Available Capacity



Operating Voltage



Voltage Response at +25 °C, Pulse: 120 mA



TL-2450

Size: 1/10C

› iXtra – long term high performance

Performance Data

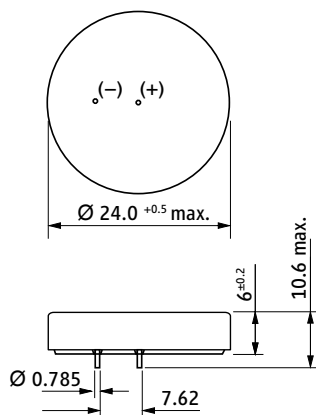
(Typical values for batteries stored at +25 °C for one year)

System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	0.55 Ah
Nominal current	0.5 mA
Max. continuous discharge current	5 mA
Pulse current capability	10 mA
Anode surface area	4.3 cm ²
Lithium content	0.2 g
Weight	8.8 g
Volume	2.6 cm ³
Temperature range	-55 °C ... +85 °C

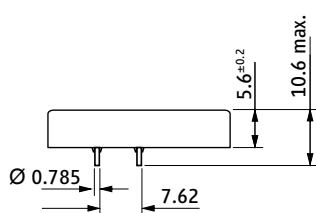


A high temperature version TLH-2450 is also available.
For more information please refer to Tadiran's website.

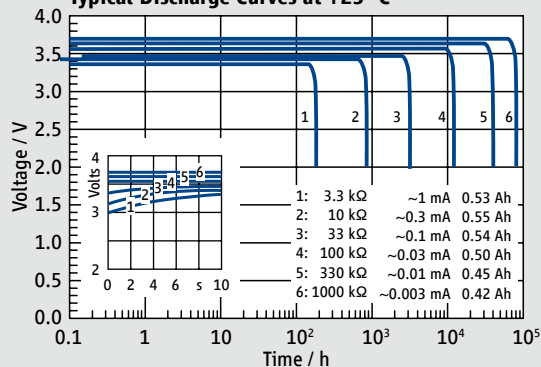
TL-2450 (with insulation disc)



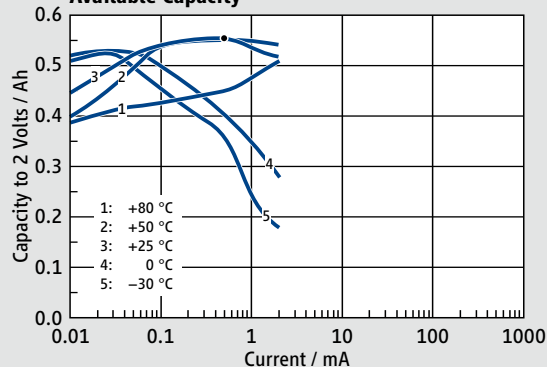
TL-2450 (without insulation disc)



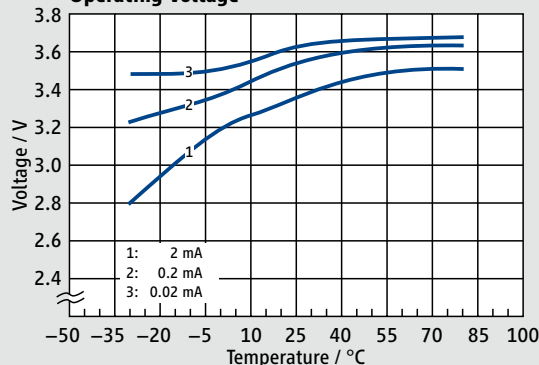
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



Available Terminations

Termination	Catalogue No.
TL-2450/P Pins (with insulation disc)	11 1 13763 02
TL-2450/P Pins (without insulation disc)	11 1 13763 22

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

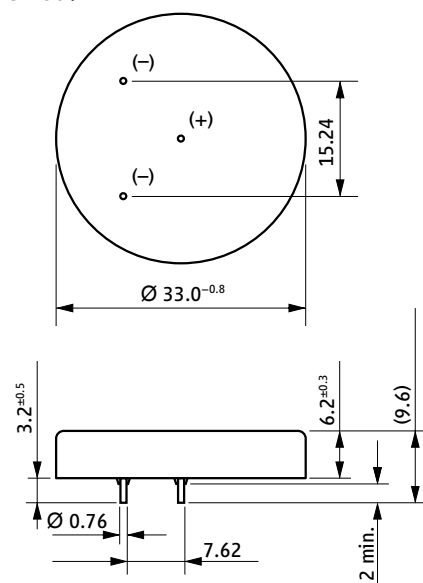
Performance Data

(Typical values for batteries stored at +25 °C for one year)

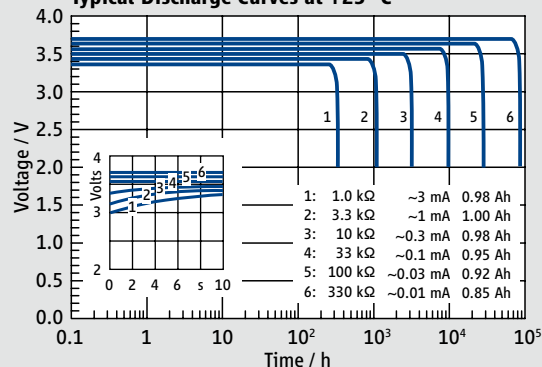
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1 Ah
Nominal current	0.5 mA
Max. continuous discharge current	10 mA
Pulse current capability	20 mA
Anode surface area	7.5 cm ²
Lithium content	0.3 g
Weight	16 g
Volume	5 cm ³
Temperature range	-55 °C ... +85 °C



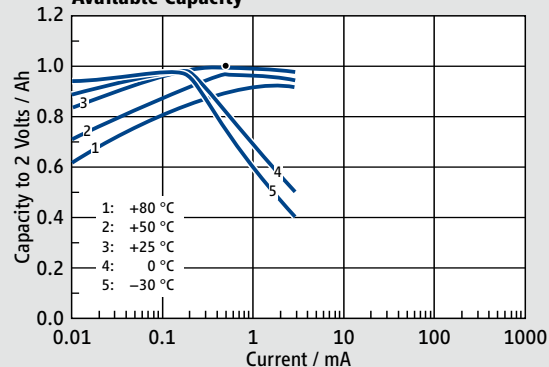
SL-889



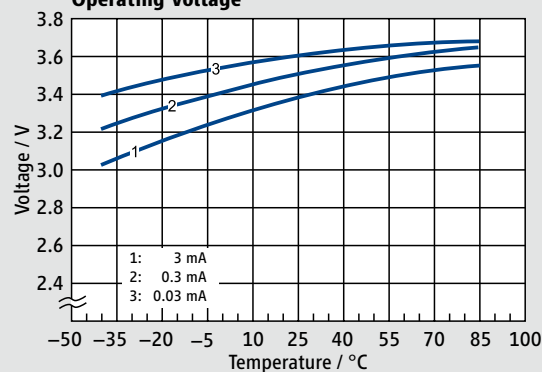
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

Available Terminations

SL-889/P Pins

Catalogue No.

11 1 18894 00

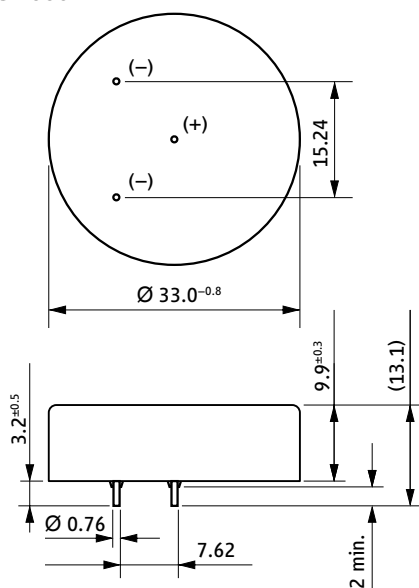
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.7 Ah
Nominal current	0.5 mA
Max. continuous discharge current	10 mA
Pulse current capability	20 mA
Anode surface area	7.5 cm ²
Lithium content	0.5 g
Weight	21 g
Volume	8.2 cm ³
Temperature range	-55 °C ... +85 °C



SL-886



Available Terminations

SL-886/P Pins

Catalogue No.

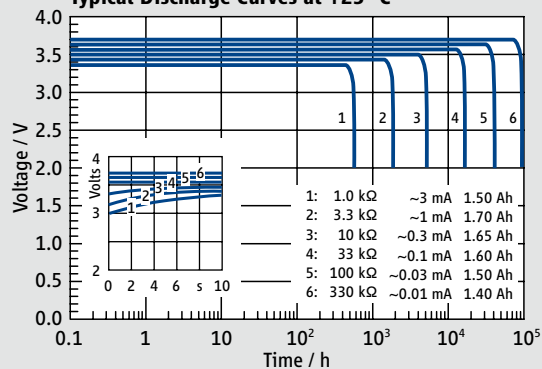
11 1 18864 00

WARNING:
 Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

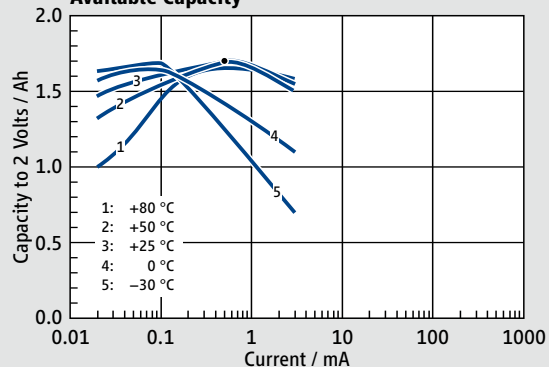
Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.

20

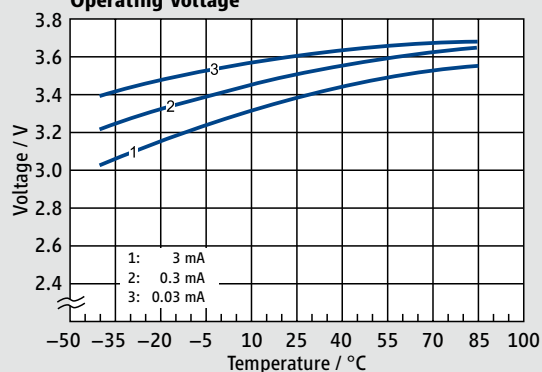
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



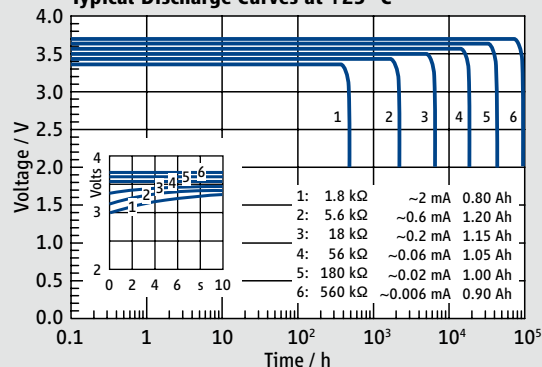
Performance Data

(Typical values for batteries stored at +25 °C for one year)

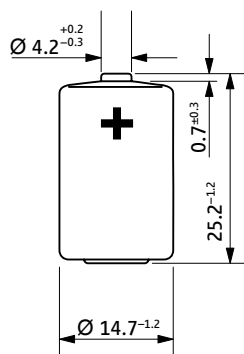
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.2 Ah
Nominal current	0.5 mA
Max. continuous discharge current	20 mA
Pulse current capability	50 mA
Anode surface area	6 cm ²
Lithium content	0.35 g
Weight	9.6 g
Volume	4 cm ³
Temperature range	-55 °C ... +85 °C



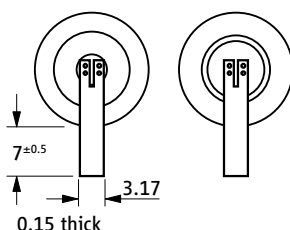
Typical Discharge Curves at +25 °C



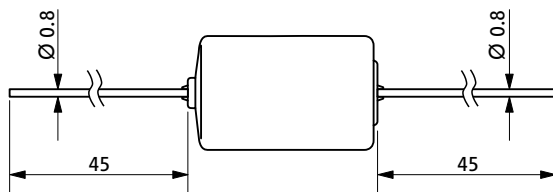
SL-850/S



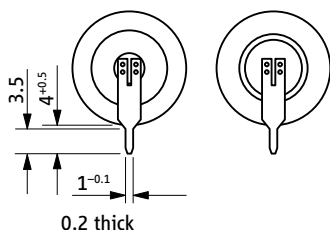
SL-850/T



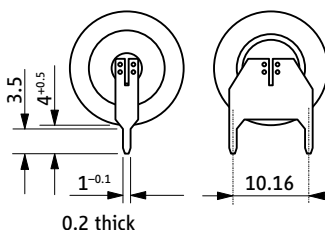
SL-850/P



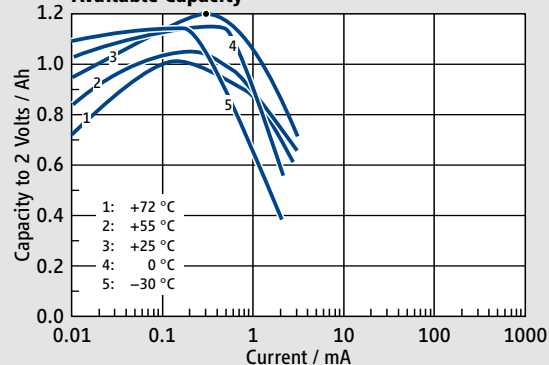
SL-850/PR



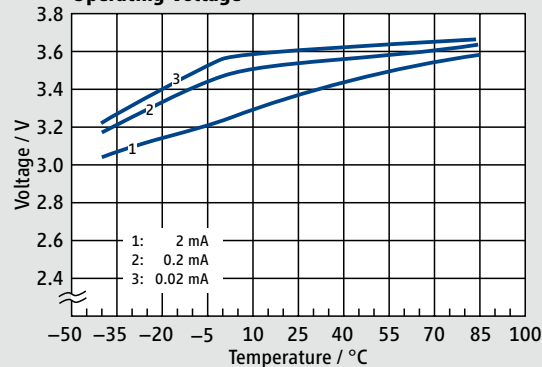
SL-850/PT



Available Capacity



Operating Voltage



Available Terminations

Termination	Catalogue No.
SL-850/S Standard	11 1 08501 00
SL-850/T Tags	11 1 08502 00
SL-850/P Pins	11 1 08503 00
SL-850/PR Pins radial	11 1 08506 00
SL-850/PT Polarized tags	11 1 08508 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

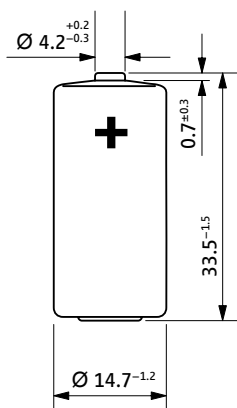
Performance Data

(Typical values for batteries stored at +25 °C for one year)

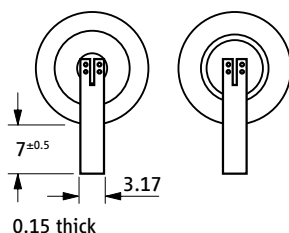
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	1.6 Ah
Nominal current	0.5 mA
Max. continuous discharge current	30 mA
Pulse current capability	75 mA
Anode surface area	9 cm ²
Lithium content	0.5 g
Weight	12.5 g
Volume	5.2 cm ³
Temperature range	-55 °C ... +85 °C



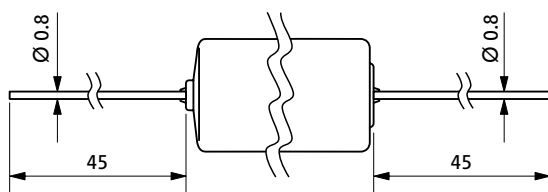
SL-861/S



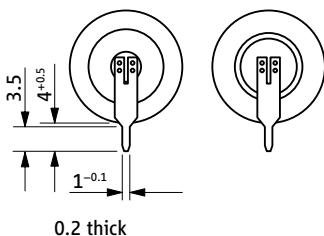
SL-861/T



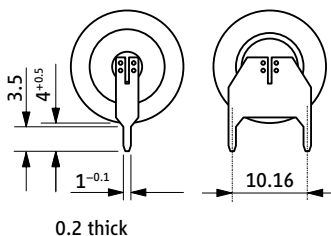
SL-861/P



SL-861/PR



SL-861/PT

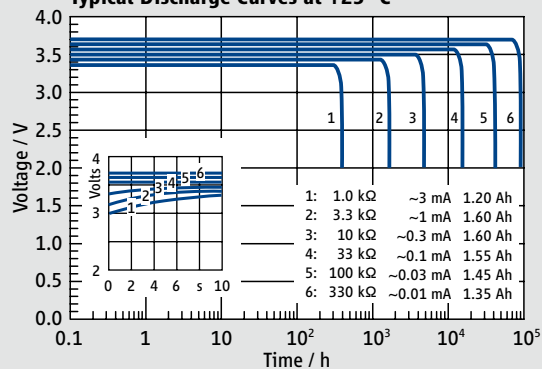


Available Terminations

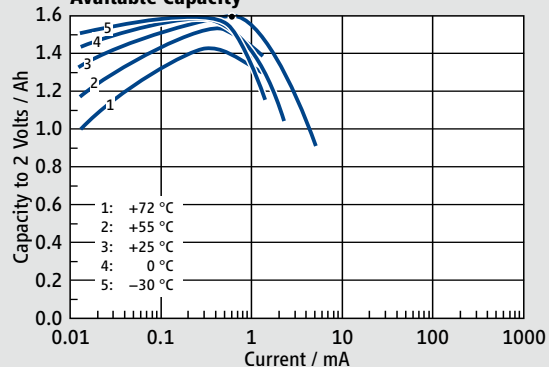
Termination	Catalogue No.
SL-861/S Standard	11 1 08611 00
SL-861/T Tags	11 1 08612 00
SL-861/P Pins	11 1 08613 00
SL-861/PR Pins radial	11 1 08616 00
SL-861/PT Polarized tags	11 1 08618 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

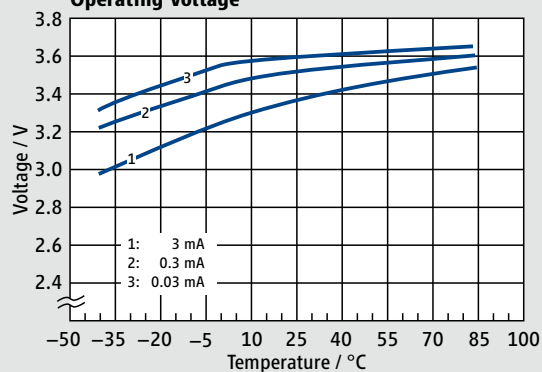
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



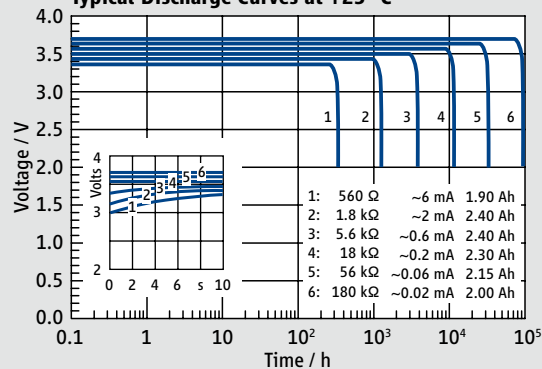
Performance Data

(Typical values for batteries stored at +25 °C for one year)

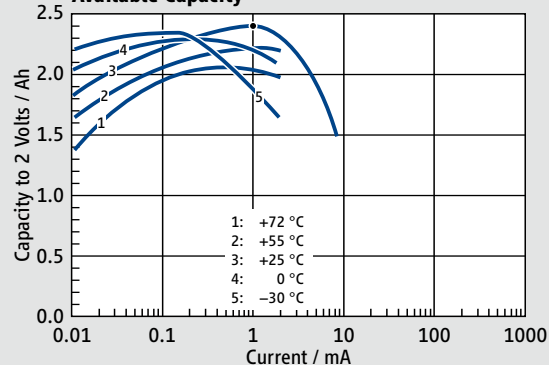
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	2.4 Ah
Nominal current	1 mA
Max. continuous discharge current	60 mA
Pulse current capability	120 mA
Anode surface area	14 cm ²
Lithium content	0.65 g
Weight	18 g
Volume	8 cm ³
Temperature range	-55 °C ... +85 °C



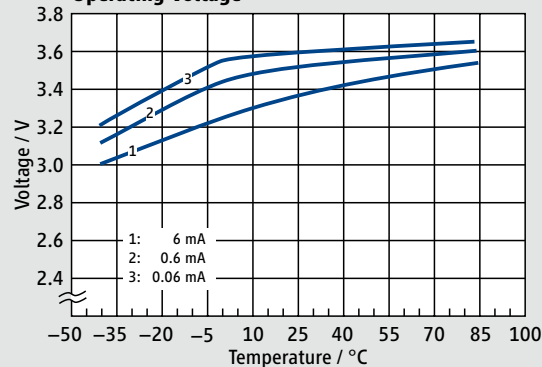
Typical Discharge Curves at +25 °C



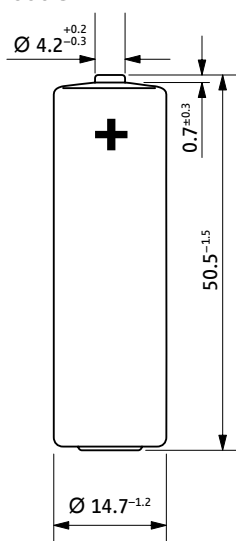
Available Capacity



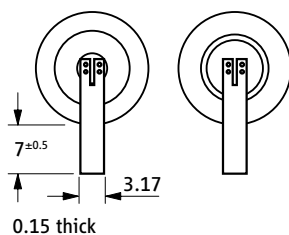
Operating Voltage



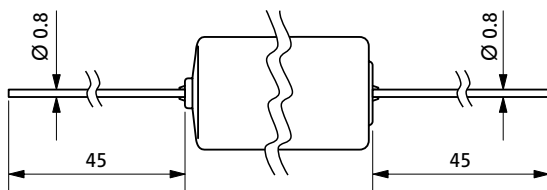
SL-860/S



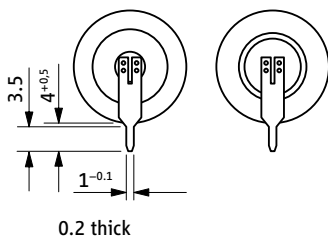
SL-860/T



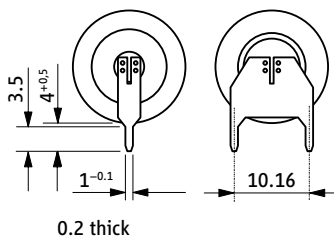
SL-860/P



SL-860/PR



SL-860/PT



Available Terminations

Termination	Catalogue No.
SL-860/S Standard	11 1 08601 00
SL-860/T Tags	11 1 08602 00
SL-860/P Pins	11 1 08603 00
SL-860/PR Pins radial	11 1 08606 00
SL-860/PT Polarized tags	11 1 08608 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

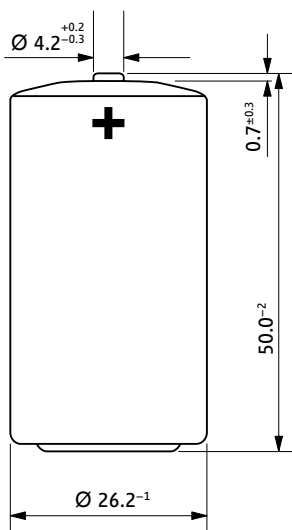
Performance Data

(Typical values for batteries stored at +25 °C for one year)

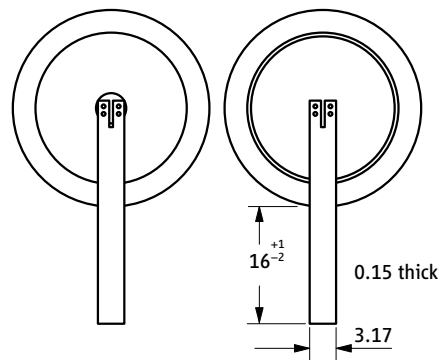
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	8.5 Ah
Nominal current	3 mA
Max. continuous discharge current	75 mA
Pulse current capability	200 mA
Anode surface area	30 cm ²
Lithium content	2.5 g
Weight	49.5 g
Volume	26 cm ³
Temperature range	-55 °C ... +85 °C



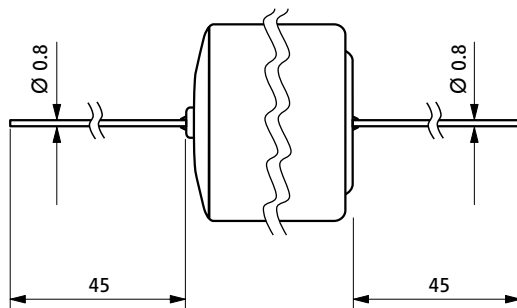
SL-2870/S



SL-2870/T



SL-2870/P

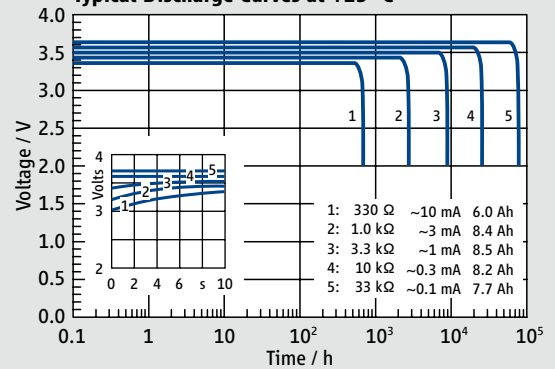


Available Terminations

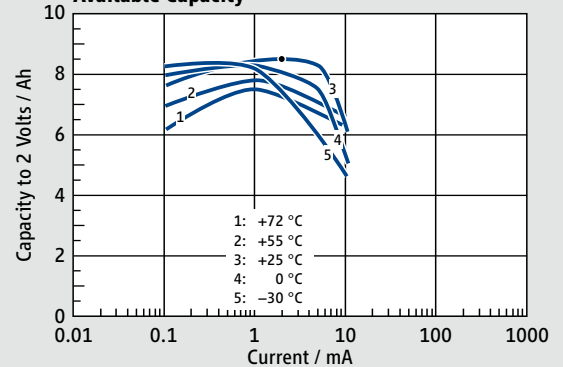
Termination	Standard	Catalogue No.
SL-2870/S	Standard	11 2 18701 00
SL-2870/T	Tags	11 2 18702 00
SL-2870/P	Pins	11 2 18703 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

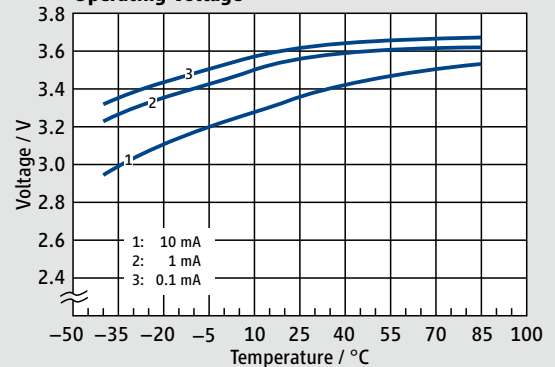
Typical Discharge Curves at +25 °C



Available Capacity



Operating Voltage



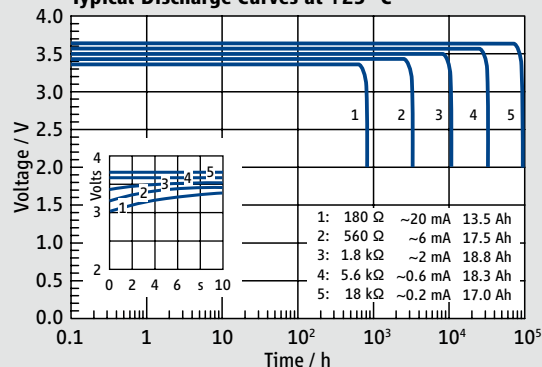
Performance Data

(Typical values for batteries stored at +25 °C for one year)

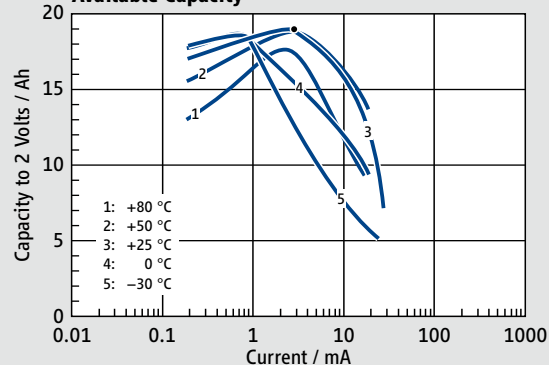
System	Lithium Thionyl Chloride
Nominal voltage	3.6 V
Nominal capacity	19 Ah
Nominal current	4 mA
Max. continuous discharge current	100 mA
Pulse current capability	250 mA
Anode surface area	45 cm ²
Lithium content	5 g
Weight	93 g
Volume	51 cm ³
Temperature range	-55 °C ... +85 °C



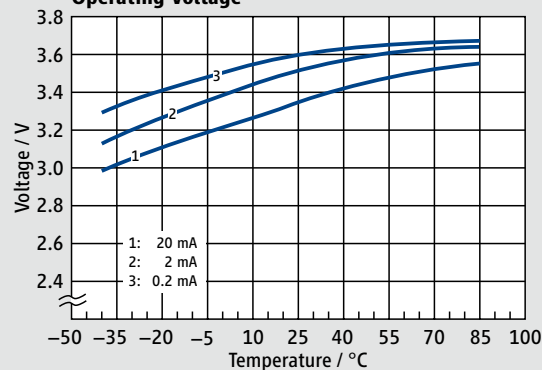
Typical Discharge Curves at +25 °C



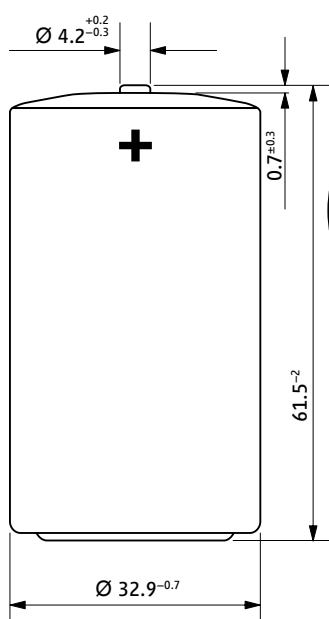
Available Capacity



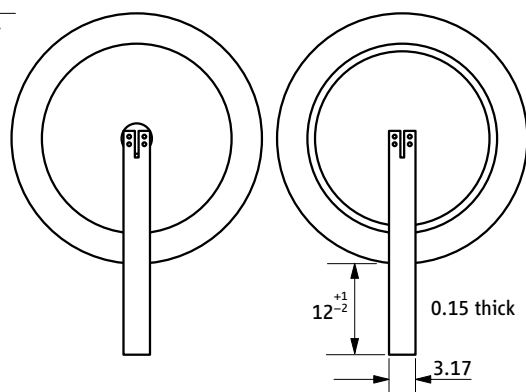
Operating Voltage



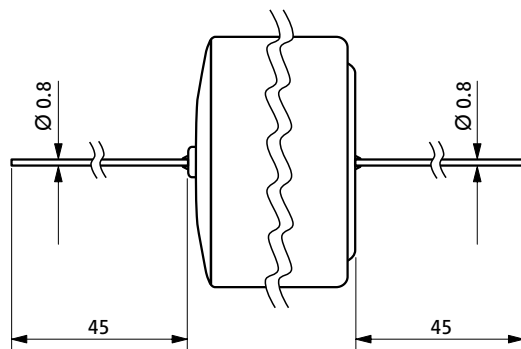
SL-2880/S



SL-2880/T



SL-2880/P



Available Terminations

Termination	Catalogue No.
SL-2880/S Standard	11 2 18801 00
SL-2880/T Tags	11 2 18802 00
SL-2880/P Pins	11 2 18803 00

WARNING:
Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

PulsesPlus™ Batteries Introduction



The PulsesPlus™ battery

The **PulsesPlus™** battery series was introduced by Tadiran Batteries in order to extend the range of applications for the Lithium Thionyl Chloride (LTC) battery by eliminating the voltage delay, increasing the pulse current capability and minimizing the impedance loss of the battery. A proprietary Hybrid Layer Capacitor (HLC) was developed for this purpose. A **PulsesPlus™** battery is formed by connecting one or more primary lithium thionyl chloride batteries in parallel with one or more HLCs.

The Hybrid Layer Capacitor

This HLC is a secondary element. Its electrodes comprise Lithium Intercalated Compounds and are spirally wound. The HLC has been optimized with respect to self discharge, temperature range and durability by carefully selecting the material properties of the electrodes and the hermetic glass to metal seal.

Performance

As a result, the **PulsesPlus™** battery outperforms conventional high rate lithium bat-

Advantages

The performance advantages of the **PulsesPlus™** battery include:

- ▶ Higher voltage – 3.6 V versus 3.0 V
- ▶ Higher capacity – e.g. 19 Ah for D size cell (versus 7 Ah for other Lithium batteries)
- ▶ Lower self discharge – less than 1 % per year (versus 5 % per year with spiral wound)
- ▶ Lower impedance (internal resistance)
- ▶ High pulse current capability
- ▶ No passivation effect
- ▶ High reliability (hermetic laser sealing, glass-to-metal seal)
- ▶ Widest operating temperature – -40°C to $+85^{\circ}\text{C}$ (versus 0°C to $+60^{\circ}\text{C}$)
- ▶ Greater safety, UL registration of the component cells

No impedance loss

The **PulsesPlus™** battery overcomes the impedance loss which occurs when an LTC battery is used to deliver high pulse currents over a long time. This effect is demonstrated in **figure 1** where a D-size

than 10 or 20 years. However, after 2 years, the voltage level under pulse load starts to decline reaching as low as 1.5 Volts after 5 years. At this voltage level, most applications would stop to work and the battery would be considered as discharged. However, it is not, as can be seen from the red curve showing the battery voltage under background load. It stays at 3.6 Volts, even after 5 and 10 years. Connecting Tadiran's Hybrid Layer Capacitor (HLC) in parallel solves the problem. The HLC maintains its low internal resistance throughout the remaining battery life. During that time period the pulse voltage stays always above 3.4 Volts. The duration for that test is more than 14 years.

Application in GSM modules

One major application for **PulsesPlus™** batteries is in GSM communication modules for data exchange. GSM is the global system for mobile communication also used for mobile phones. The GSM network uses a multiplexing technology called time division multiple access (TDMA) in order to provide multiple communication channels with the same signal, dividing it into 8 time slots. A typical TDMA transmission requires a basic current of 150 mA and a pulse current of 2 A for 577 μs every 4.615 ms. **Figure 2** shows the voltage behaviour of a **PulsesPlus™** battery with one HLC-1550A under these conditions at

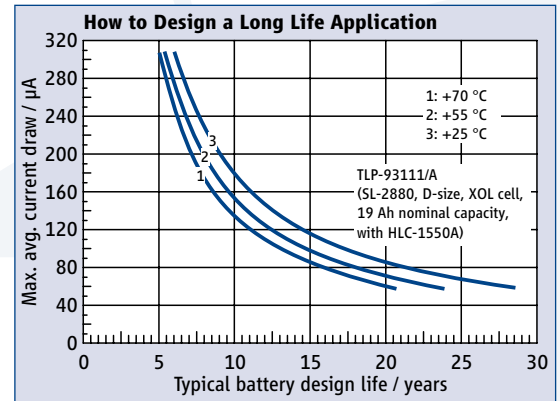


Figure 3: How to Design a Long Life Application

various temperature levels between -40°C and $+25^{\circ}\text{C}$. The chart shows two curves for each temperature level. The upper curve corresponds to the voltage level under the background current of 150 mA while the lower curve corresponds to the voltage level under the peak current of 2 A. Curves at higher temperatures are not shown but can be considered to lie slightly above the curves for $+25^{\circ}\text{C}$.

Extremely low self discharge

The **PulsesPlus™** battery can be used where 20 years of continuous power are required for applications including GSM and radio modules. This is due to the stability of both Tadiran's primary LTC battery and the HLC with respect to the sealing system, the internal resistance, and the self-discharge.

Fit for 20 years of life

Figure 3 shows the maximum average current draw of a TLP-93111/A **PulsesPlus™** battery as a function of the design life of the battery. This battery will typically deliver 20 years operation life when the average current is not more than 87.5 μA at $+25^{\circ}\text{C}$. Under these conditions, the accumulated self discharge loss of the battery is less than 15 % during its operating life. As a result it is fair to say that Tadiran's **PulsesPlus™** battery is the smallest and most cost effective battery for a 20 year stand alone power supply.

Variable design

PulsesPlus™ batteries can be assembled in a great variety of combinations. The primary cell can be selected from Tadiran's large range of 3.6 Volt LTC batteries. A special range of LSC (Lithium Sulphury Chloride) cells with a nominal voltage of 3.9 Volts is also available, often allowing a more economic approach where equipment needs to operate at very low temperatures. Each of these primary cells can be combined with one or more HLCs from a range of four sizes. Series and parallel combinations of more primary cells extend the voltage range and capacity range where necessary. Only a few standard combinations can be shown in this catalogue. Contact Tadiran for a customized application proposal.

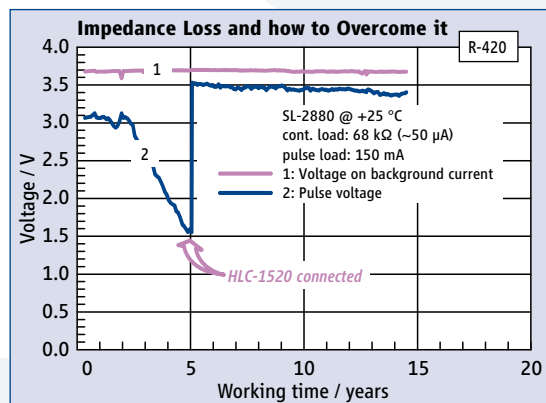


Figure 1: Impedance Loss and how to Overcome it

teries such as lithium sulphur dioxide (Li/SO_2) batteries, lithium manganese dioxide (Li/MnO_2) batteries as well as spirally wound lithium thionyl chloride (Li/SOCl_2) batteries. Compared to these battery systems, **PulsesPlus™** batteries deliver higher voltage and higher capacity. These batteries also offer unmatched service life due to their extremely low self-discharge.

cell was discharged under a continuous load of $\sim 50 \mu\text{A}$ and short pulses of 150 mA.

The battery is able to deliver this current at a voltage level of 3 Volts, at least for a period of 2 years. From the low average current draw of 50 μA , one would be misled to assume that the battery could continue to deliver these pulse currents for more

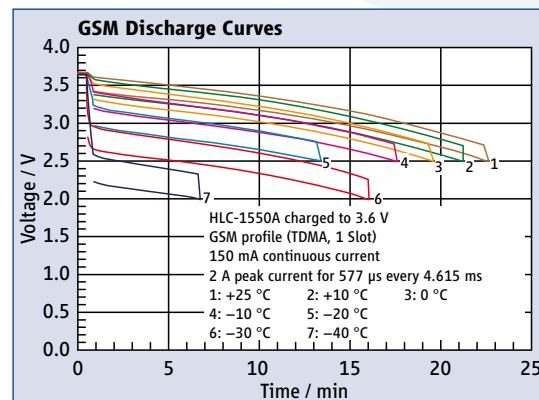


Figure 2: GSM Discharge Curves

TLP-91111/A

- › High energy
- › Up to 3 A pulse capability
- › Instant voltage response
- › No passivation effect

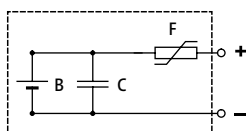
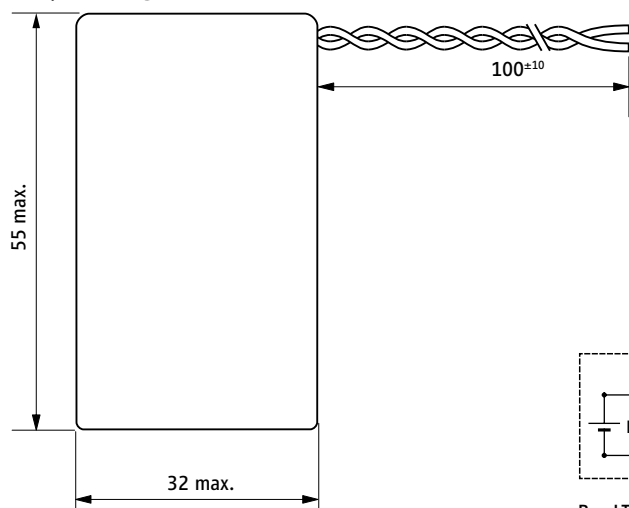
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	2.4 Ah
Nominal current	2 mA
Max. 1 s pulse to 3 V	3 A
Max. pulse length @ 0.5 A to 2.8 V	1000 s
Delay time to 3 V @ 0.5 A	none
Weight	55 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	87 %

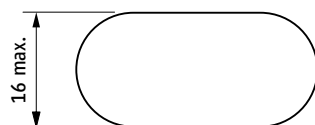


TLP-91111/A/SM



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.



WARNING:
Risk of fire or explosion.
Do not charge, incinerate,
disassemble, heat above
100 °C, or expose
contents to water.

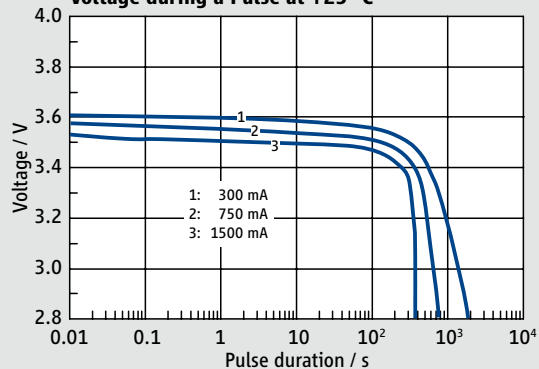
Available Terminations

TLP-91111/A/SM Flying leads

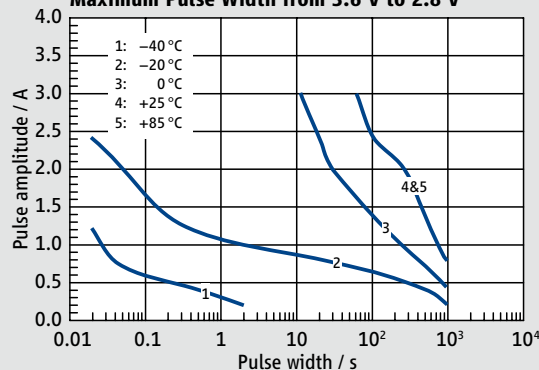
Catalogue No.

17 91111 101

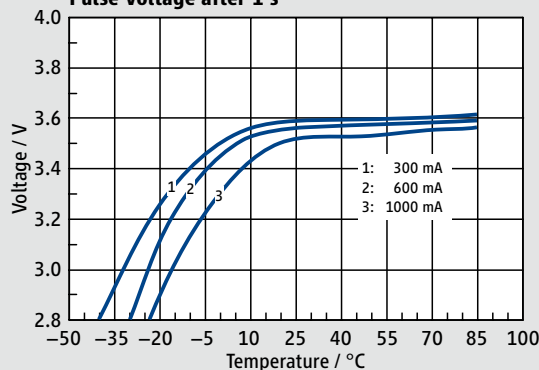
Voltage during a Pulse at +25 °C



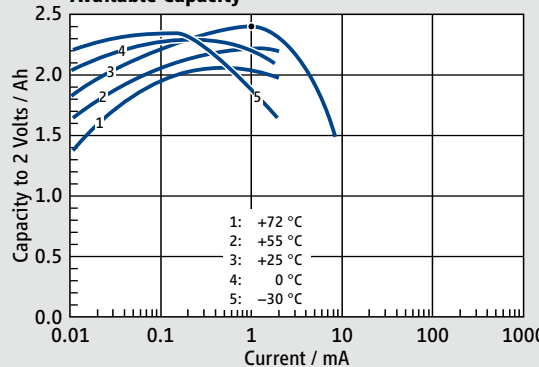
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



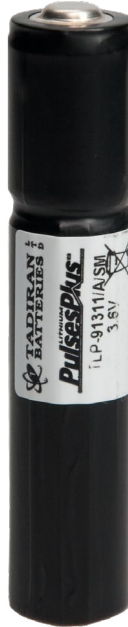
TLP-91311/A

- › High energy
- › Up to 1 A pulse capability
- › Instant voltage response
- › No passivation effect

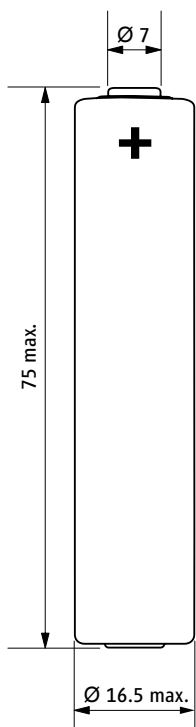
Performance Data

(Typical values for batteries stored at +25 °C for one year)

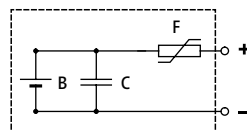
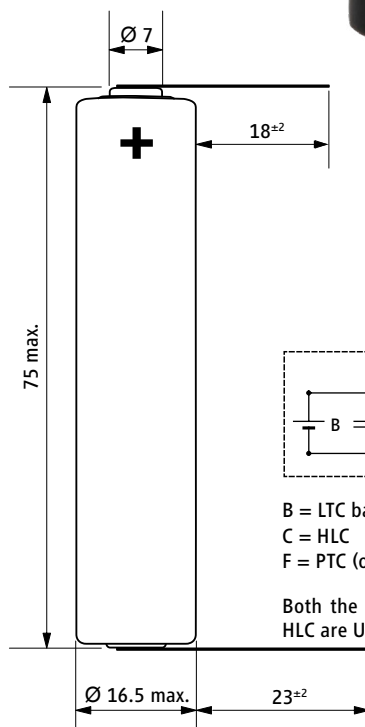
System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	2.4 Ah
Nominal current	2 mA
Max. 1 s pulse to 3 V	1 A
Max. pulse length @ 0.125 A to 2.8 V	1000 s
Delay time to 3 V @ 0.125 A	none
Weight	40 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	90 %



TLP-91311/A/SM



TLP-91311/A/ST



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

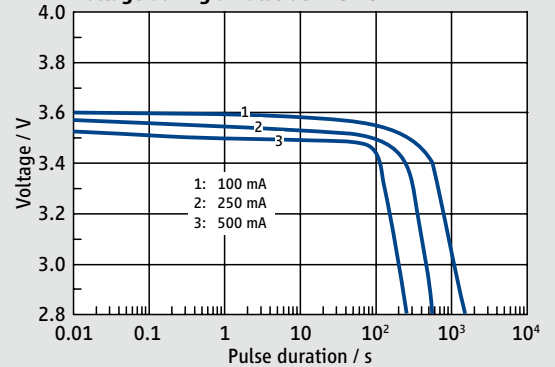
Available Terminations

		Catalogue No.
TLP-91311/A/SM	Pressure contacts	17 91311 101
TLP-91311/A/ST	Solder tags	17 91311 102

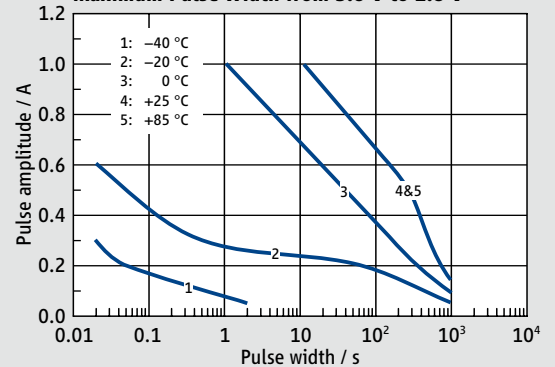
WARNING:

Do not charge. Battery can explode if disassembled, heated above 100 °C, incinerated, or contents exposed to water.

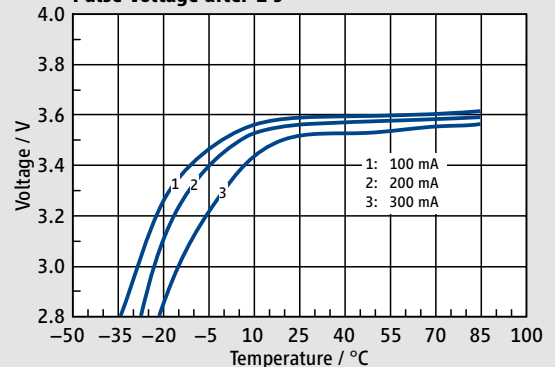
Voltage during a Pulse at +25 °C



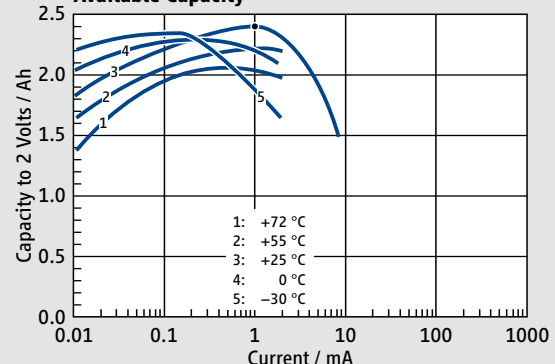
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



TLP-92111/A

- › High energy
- › Up to 3 A pulse capability
- › Instant voltage response
- › No passivation effect

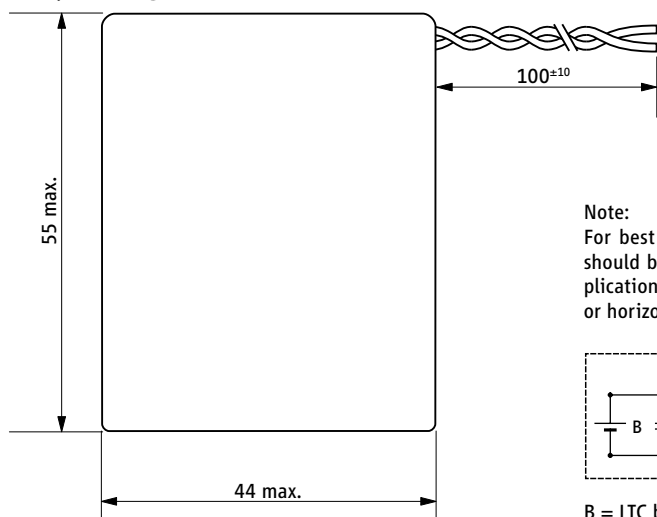
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	8.5 Ah
Nominal current	3 mA
Max. 1 s pulse to 3 V	3 A
Max. pulse length @ 0.5 A to 2.8 V	1000 s
Delay time to 3 V @ 0.5 A	none
Weight	100 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	93 %

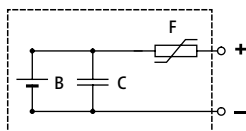


TLP-92111/A/SM



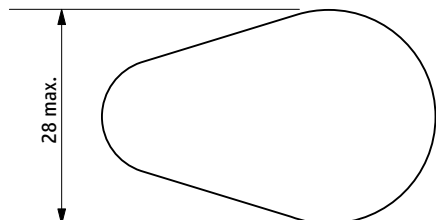
Note:

For best performance battery should be mounted in the application in upright or horizontal orientation.



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.



WARNING:

Risk of fire or explosion.
Do not charge, incinerate, disassemble, heat above 100 °C, or expose contents to water.

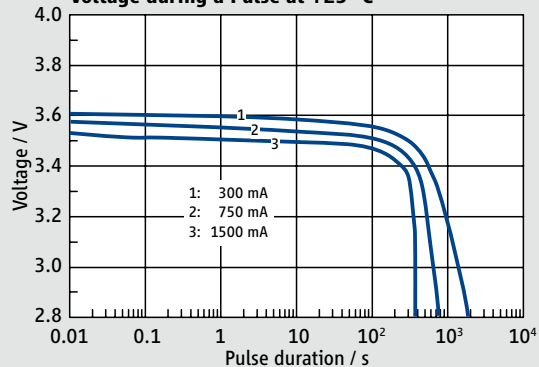
Available Terminations

TLP-92111/A/SM Flying leads

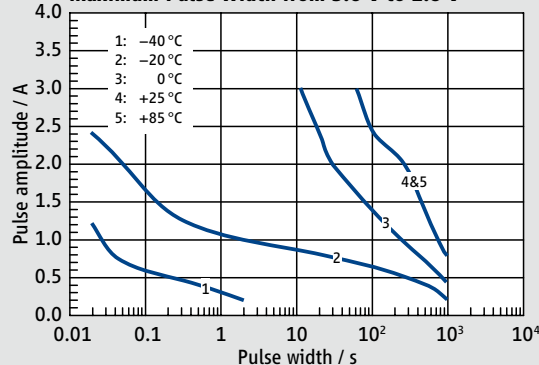
Catalogue No.

17 92111 101

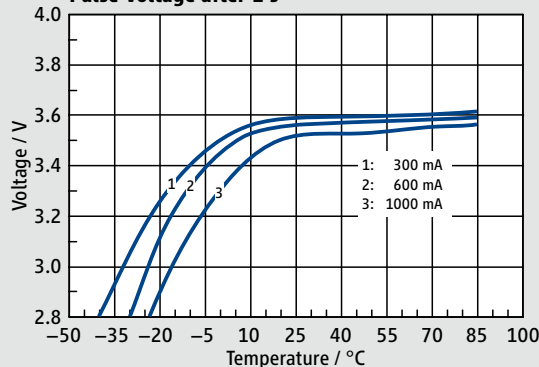
Voltage during a Pulse at +25 °C



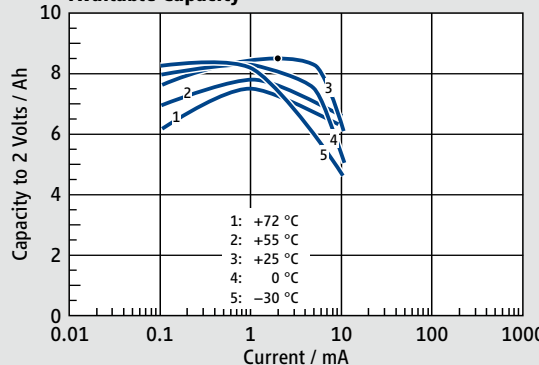
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



TLP-92311/A

- › High energy
- › Up to 1 A pulse capability
- › Instant voltage response
- › No passivation effect

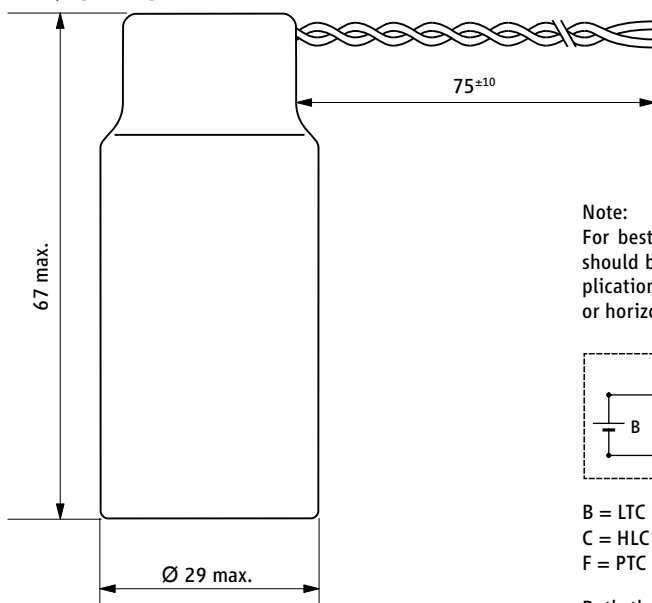
Performance Data

(Typical values for batteries stored at +25 °C for one year)

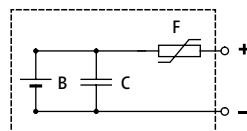
System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	8.5 Ah
Nominal current	3 mA
Max. 1 s pulse to 3 V	1 A
Max. pulse length @ 0.125 A to 2.8 V	1000 s
Delay time to 3 V @ 0.125 A	none
Weight	80 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	93 %



TLP-92311/A/SM



Note:
For best performance battery should be mounted in the application in upright or horizontal orientation.



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

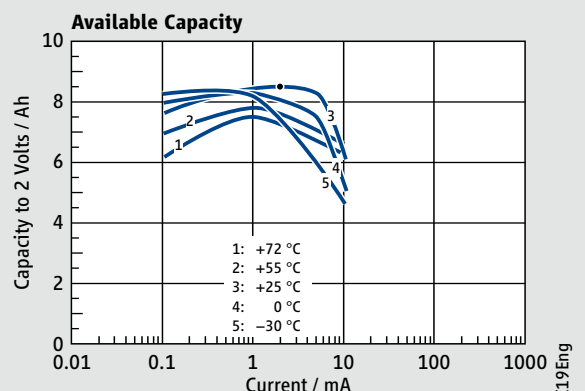
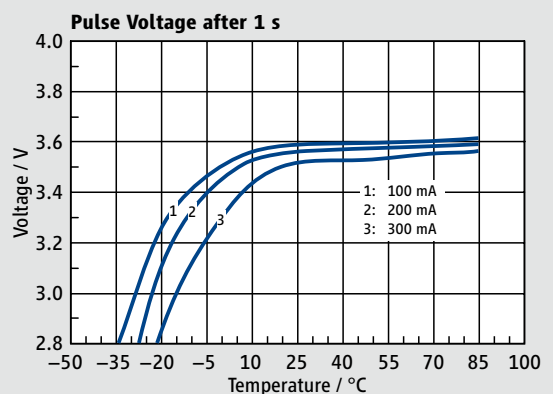
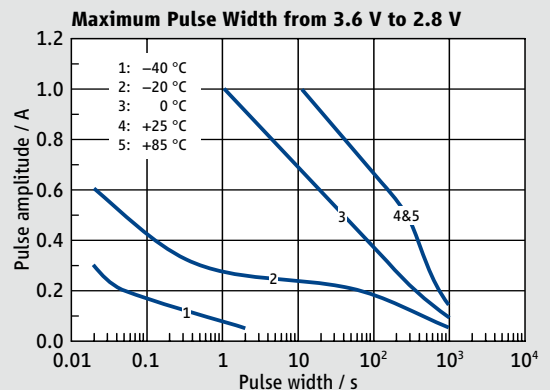
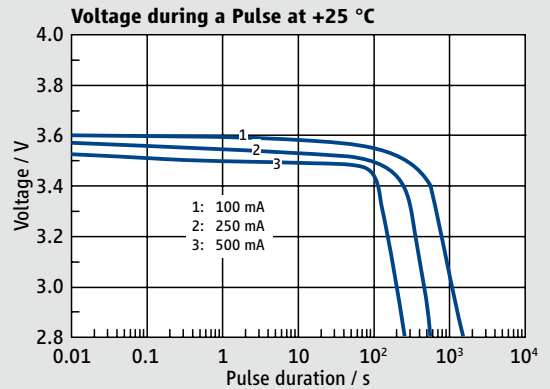
Available Terminations

TLP-92311/A/SM Flying leads

Catalogue No.

17 92311 101

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



TLP-93111/A

- › High energy
- › Up to 3 A pulse capability
- › Instant voltage response
- › No passivation effect

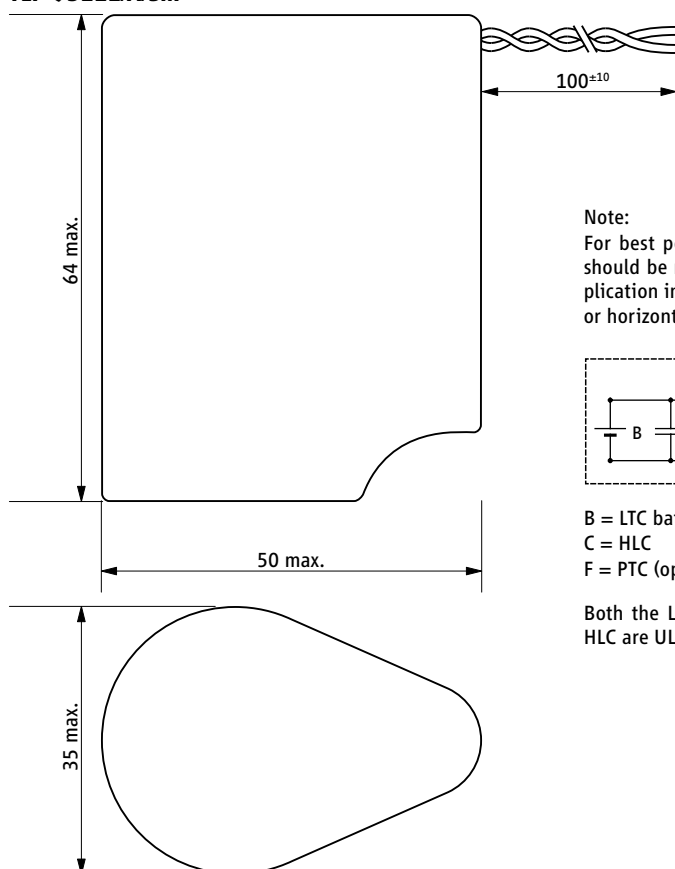
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	19 Ah
Nominal current	4 mA
Max. 1 s pulse to 3 V	3 A
Max. pulse length @ 0.5 A to 2.8 V	1000 s
Delay time to 3 V @ 0.5 A	none
Weight	140 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	96 %

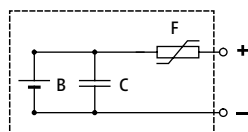


TLP-93111/A/SM



Note:

For best performance battery should be mounted in the application in upright or horizontal orientation.



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

WARNING:

Risk of fire or explosion.
Do not charge, incinerate, disassemble, heat above 100 °C, or expose contents to water.

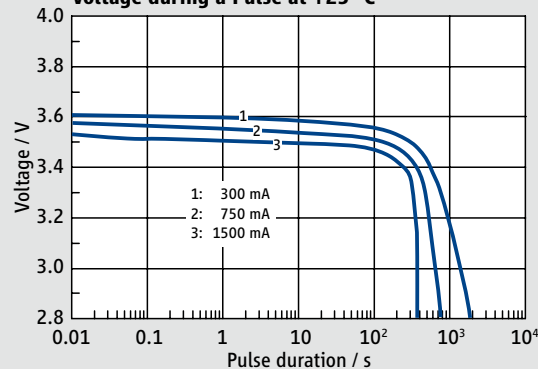
Available Terminations

TLP-93111/A/SM Flying leads

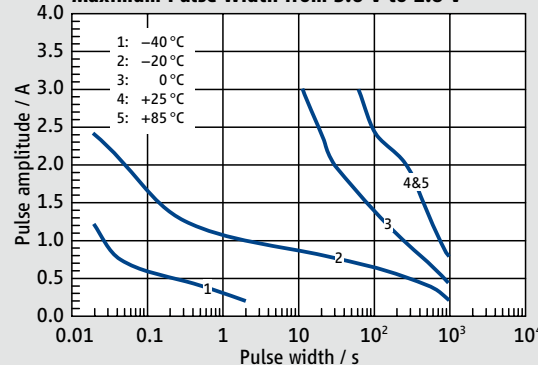
Catalogue No.

17 93111 101

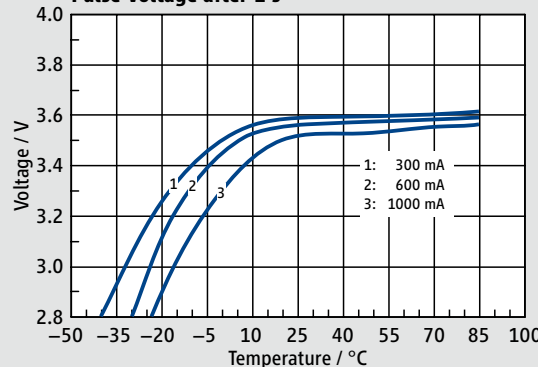
Voltage during a Pulse at +25 °C



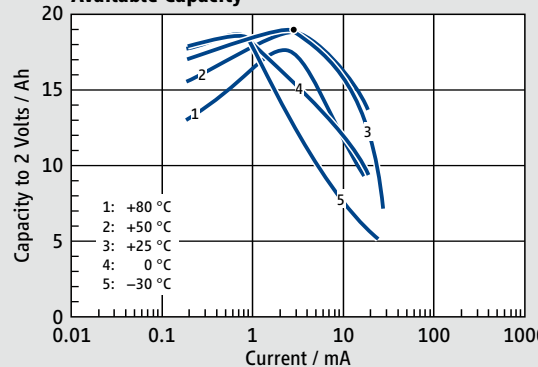
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



TLP-93311/A

- › High energy
- › Up to 1 A pulse capability
- › Instant voltage response
- › No passivation effect

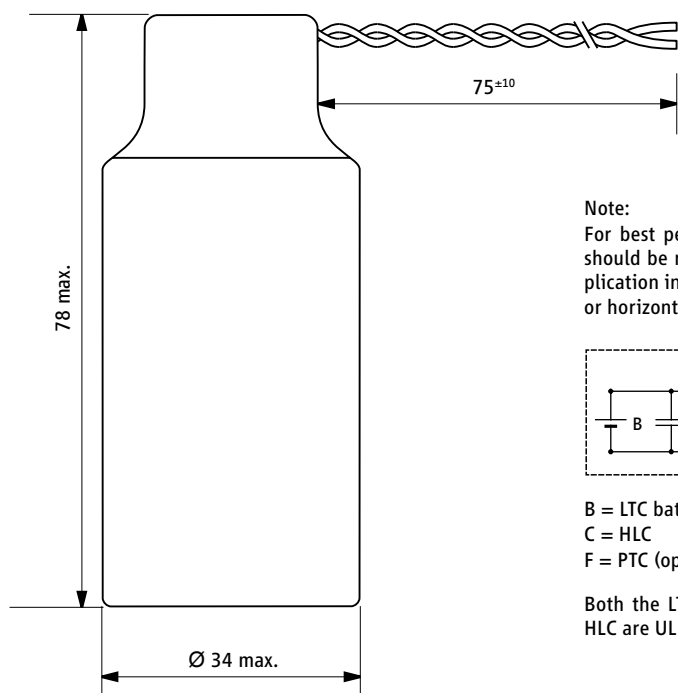
Performance Data

(Typical values for batteries stored at +25 °C for one year)

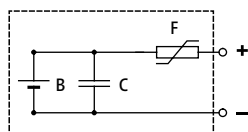
System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	19 Ah
Nominal current	4 mA
Max. 1 s pulse to 3 V	1 A
Max. pulse length @ 0.125 A to 2.8 V	1000 s
Delay time to 3 V @ 0.125 A	none
Weight	120 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	96 %



TLP-93311/A/SM



Note:
For best performance battery should be mounted in the application in upright or horizontal orientation.



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

WARNING:
Risk of fire or explosion.
Do not charge, incinerate, disassemble, heat above 100 °C, or expose contents to water.

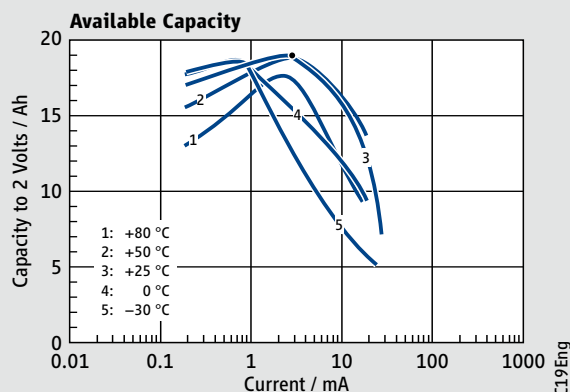
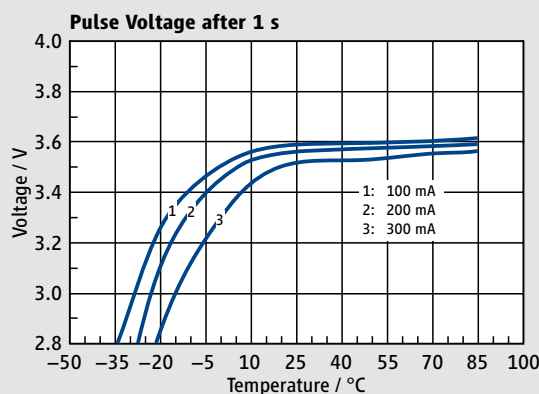
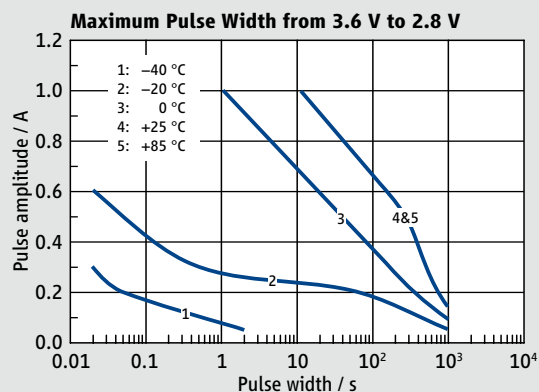
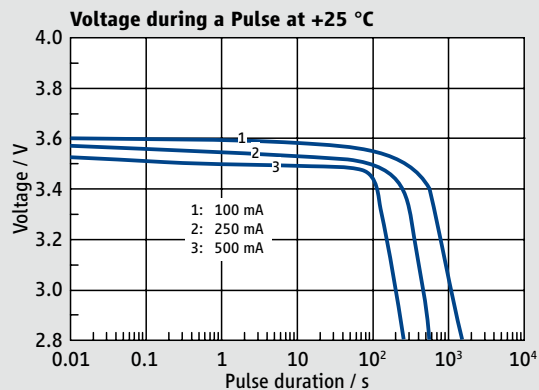
Available Terminations

TLP-93311/A/SM Flying leads

Catalogue No.

17 93311 101

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



TLP-96111/A

- › High energy
- › Up to 3 A pulse capability
- › Instant voltage response
- › No passivation effect

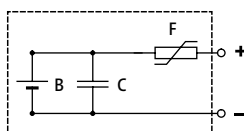
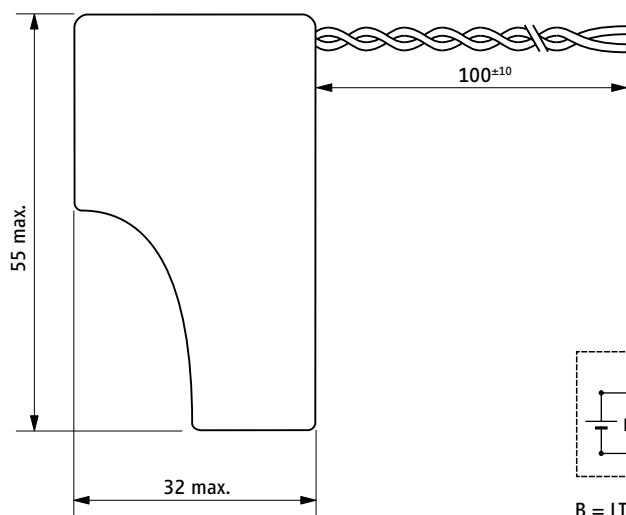
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	1.2 Ah
Nominal current	0.6 mA
Max. 1 s pulse to 3 V	3 A
Max. pulse length @ 0.5 A to 2.8 V	1000 s
Delay time to 3 V @ 0.5 A	none
Weight	45 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	78 %

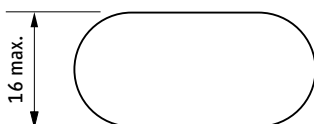


TLP-96111/A/SM



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.



WARNING:
Risk of fire or explosion.
Do not charge, incinerate,
disassemble, heat above
100 °C, or expose
contents to water.

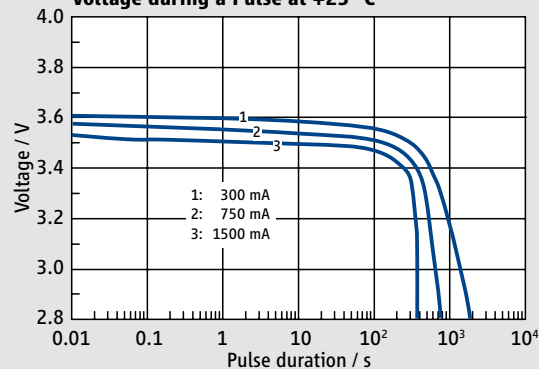
Available Terminations

TLP-96111/A/SM Flying leads

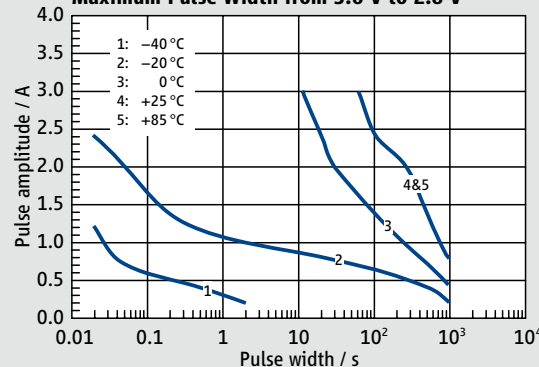
Catalogue No.

17 96111 101

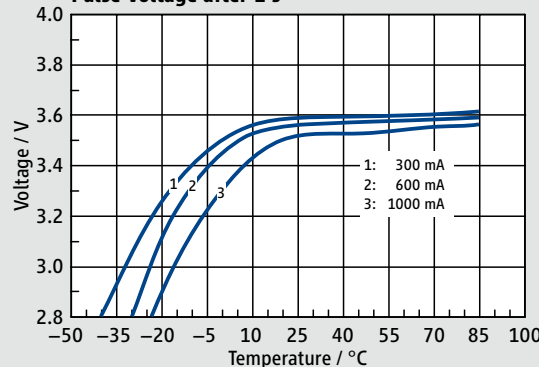
Voltage during a Pulse at +25 °C



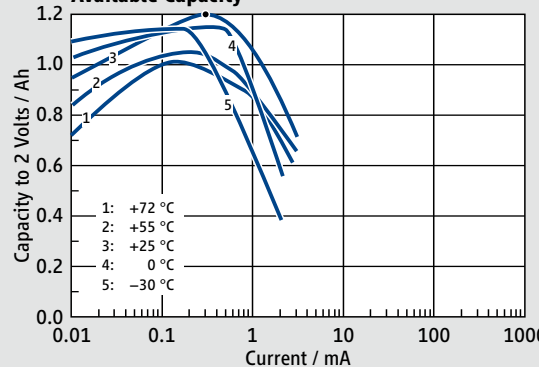
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



TLP-96311/A

- › High energy
- › Up to 1 A pulse capability
- › Instant voltage response
- › No passivation effect

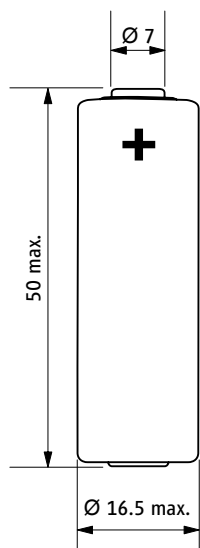
Performance Data

(Typical values for batteries stored at +25 °C for one year)

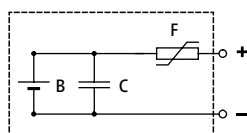
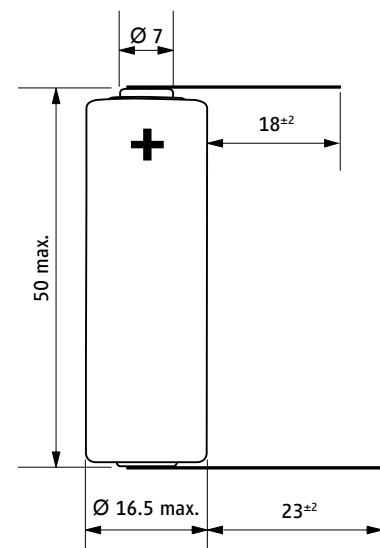
System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	1.2 Ah
Nominal current	0.6 mA
Max. 1 s pulse to 3 V	1 A
Max. pulse length @ 0.125 A to 2.8 V	1000 s
Delay time to 3 V @ 0.125 A	none
Weight	30 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	83 %



TLP-96311/A/SM



TLP-96311/A/ST



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

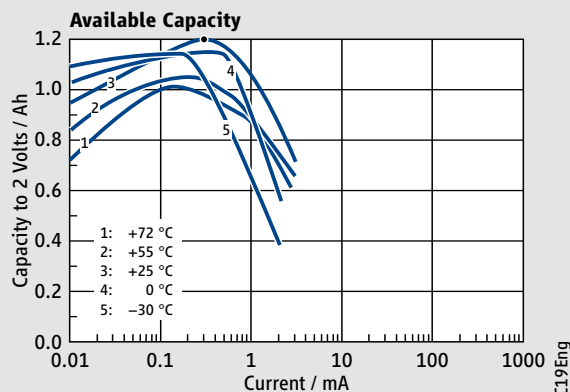
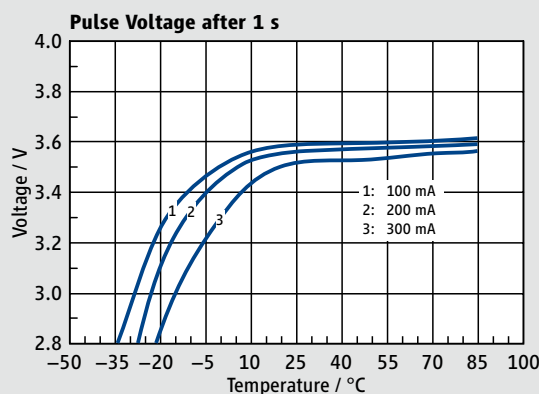
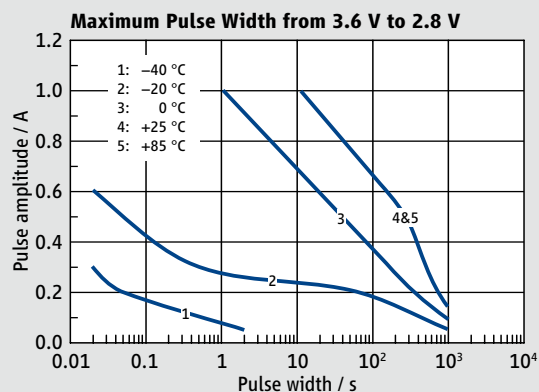
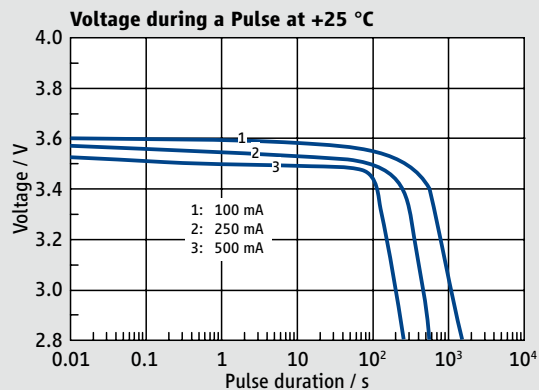
WARNING:

Do not charge. Battery can explode if disassembled, heated above 100 °C, incinerated, or contents exposed to water.

Available Terminations

Termination	Catalogue No.
TLP-96311/A/SM Pressure contacts	17 96311 101
TLP-96311/A/ST Solder tags	17 96311 102

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



TLP-97111/A

- › High energy
- › Up to 3 A pulse capability
- › Instant voltage response
- › No passivation effect

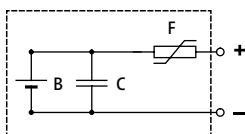
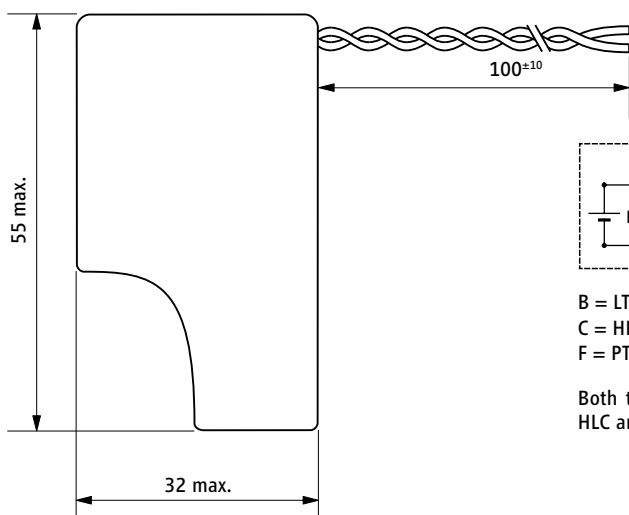
Performance Data

(Typical values for batteries stored at +25 °C for one year)

System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	1.6 Ah
Nominal current	1 mA
Max. 1 s pulse to 3 V	3 A
Max. pulse length @ 0.5 A to 2.8 V	1000 s
Delay time to 3 V @ 0.5 A	none
Weight	45 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	80 %



TLP-97111/A/SM



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

Available Terminations

TLP-97111/A/SM Flying leads

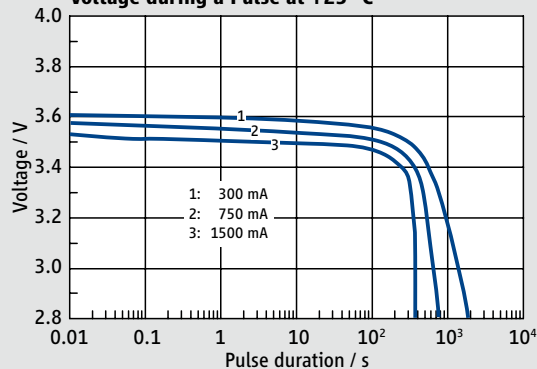
Catalogue No.

17 97111 101

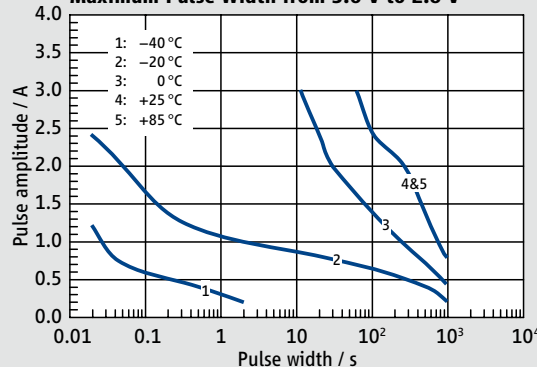
WARNING:

Risk of fire or explosion.
Do not charge, incinerate,
disassemble, heat above
100 °C, or expose
contents to water.

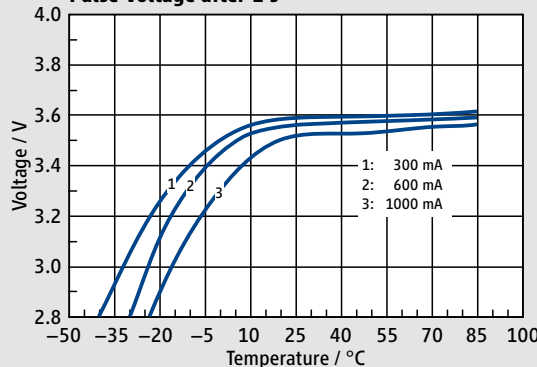
Voltage during a Pulse at +25 °C



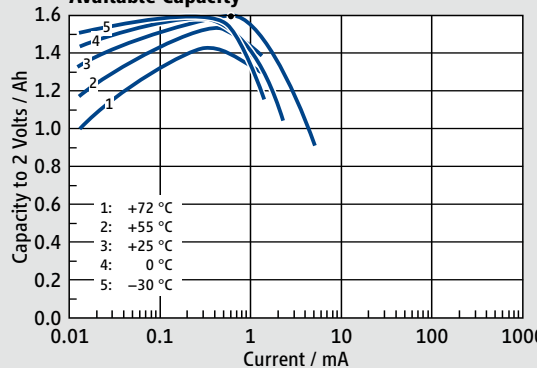
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Available Capacity



TLP-97311/A

- › High energy
- › Up to 1 A pulse capability
- › Instant voltage response
- › No passivation effect

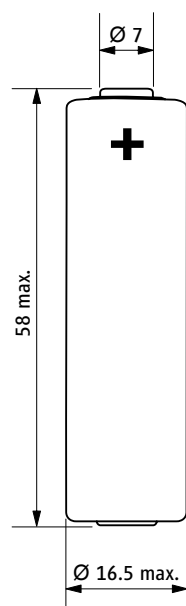
Performance Data

(Typical values for batteries stored at +25 °C for one year)

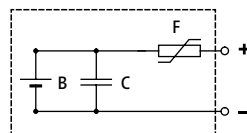
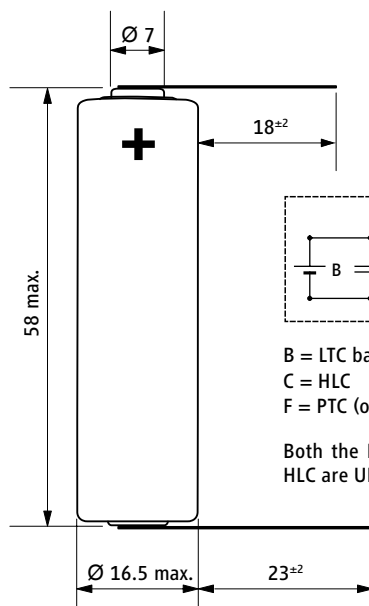
System	LTC and HLC
Nominal voltage	3.6 V
Nominal capacity	1.6 Ah
Nominal current	1 mA
Max. 1 s pulse to 3 V	1 A
Max. pulse length @ 0.125 A to 2.8 V	1000 s
Delay time to 3 V @ 0.125 A	none
Weight	35 g
Temperature range	-40 °C ... +85 °C
Capacity retention after 10 year storage	85 %



TLP-97311/A/SM



TLP-97311/A/ST



B = LTC battery
C = HLC
F = PTC (optional)

Both the LTC battery and the HLC are UL recognized.

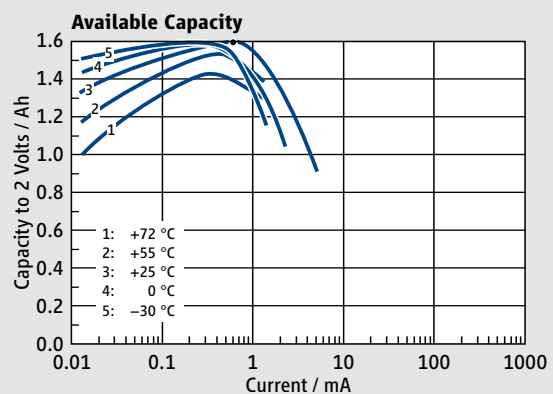
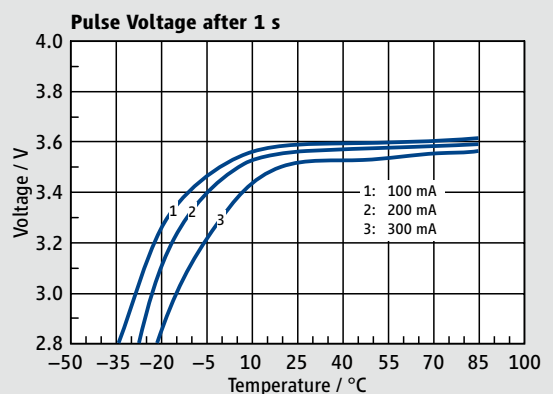
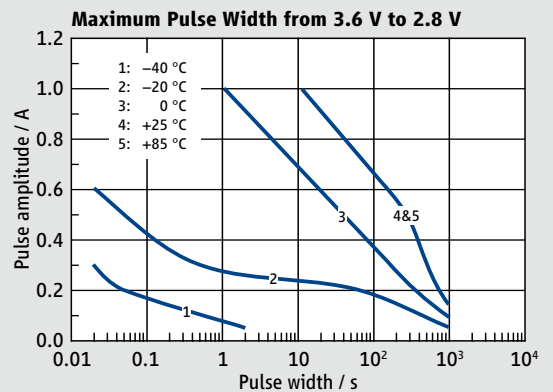
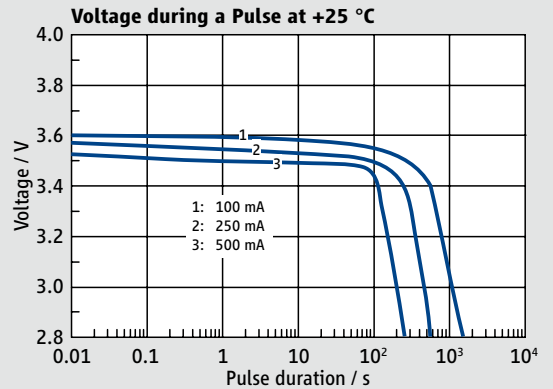
Available Terminations

Termination	Catalogue No.
TLP-97311/A/SM Pressure contacts	17 97311 101
TLP-97311/A/ST Solder tags	17 97311 102

WARNING:

Do not charge. Battery can explode if disassembled, heated above 100 °C, incinerated, or contents exposed to water.

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



Hybrid Layer Capacitors (HLCs)

Introduction



Properties

Hybrid Layer Capacitors are a kind of rechargeable battery. They are used as a capacitor in **PulsesPlus™** batteries, where they are connected in parallel to Tadiran Lithium Batteries. The electrodes of HLCs comprise Lithium intercalation compounds. They have low impedance and can deliver high current pulses. The performance and reliability properties of HLCs have been carefully optimized to match those of Tadiran Lithium Batteries. The result is a battery with a maximum of both energy and power density for stand alone use of up to 25 years.

Safety

WARNING:

HLCs are designed for use in **PulsesPlus™** batteries. When used independently, they must not be fast charged.

Overcharge above 3.95 V may lead to capacity loss and/or an increase of internal resistance.

Overcharge above 4.4 V may lead to excessive internal pressure. This may result in explosion or rupture.

HLCs must not be charged after a deep discharge below 2.5 Volts.

Transport

HLCs have passed the UN transport tests. They contain less than 1 Wh nominal energy and are not restricted under international dangerous goods regulations. Connected to a Tadiran Lithium Thionyl Chloride battery, the resulting hybrid battery can be transported according to UN 3090. For more information on classification and transport regulations, please refer to Tadiran's technical notice: www.tadiranbatteries.de/regulations/

Temperature range	–40 °C ... +85 °C	for operation in PulsesPlus™ batteries
	–30 °C ... +60 °C	for storage and independent use

Electrical characteristics

Discharge end voltage	2.5 V	Discharge below 2.5 V at +25 °C and discharge below 2 V at –40 °C may lead to an increase of the internal resistance.
Max. charge voltage	3.95 V	

Shelf life	in PulsesPlus™ batteries	used independently
@ +25 °C	10 years	3 years
@ +60 °C	7 years	4 weeks
@ +85 °C	≥ 1 year	1 week

Cycle life	at 3.6 V	at 3.9 V
to 1 % DOD ¹⁾	400000 cycles	100000 cycles
to 10 % DOD	40000 cycles	10000 cycles
to 100 % DOD	4000 cycles	1000 cycles

¹⁾ DOD = depth of discharge

HLC-1020

- › Delivering high current pulses
- › Up to 25 years lifetime and more
- › Wide operating temperature range
- › Low self discharge

Performance Data

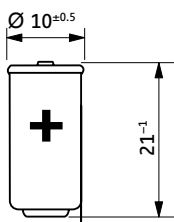
(Typical values in *PulsesPlus™* batteries stored at +25 °C)

System	Lithium Intercalated Compounds	
Version	HLC-1020	(HLC-1020L)
Nominal voltage	3.7 V	
Nominal capacity	45 As @ 3.7 V	(30 As @ 3.7 V)
Nominal current	15 mA	
Max. continuous discharge current	250 mA	(150 mA)
Pulse current capability	750 mA	(500 mA)
Max. charge voltage	3.95 V	
Max. charge current	8 mA	(6 mA)
Discharge end voltage	2.5 V	
Cell impedance	max. 400 mΩ	(max. 600 mΩ)
Nominal energy	0.07 Wh	
Weight	4.2 g	

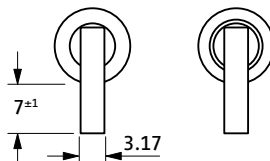
For more data please refer to page 37.



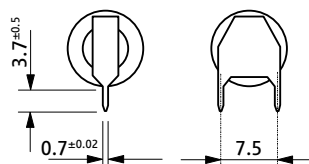
HLC-1020(L)/S



HLC-1020(L)/T



HLC-1020(L)/TP

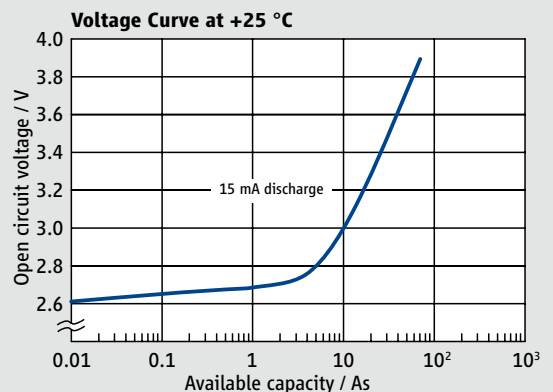
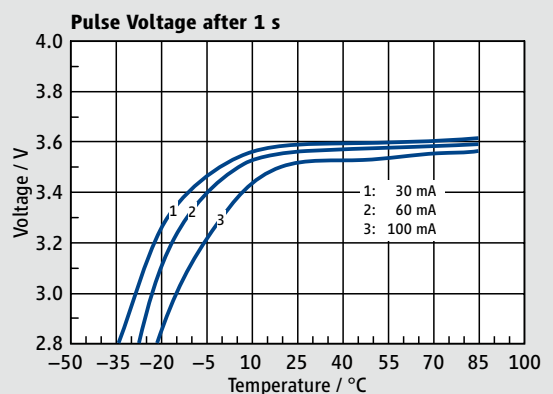
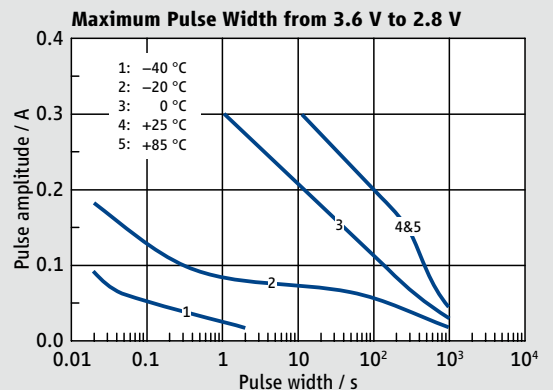
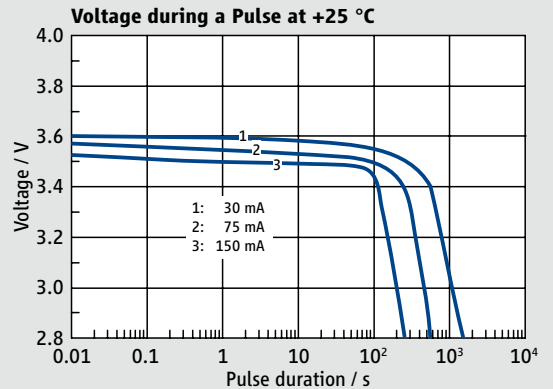


Available Terminations

Termination	Catalogue No.
HLC-1020/S	Standard 13 0 11021 02
HLC-1020/T	Tags 13 0 11022 02
HLC-1020/TP	Polarized tags 13 0 11027 02
HLC-1020L/S	Standard 13 0 13021 02
HLC-1020L/T	Tags 13 0 13022 02
HLC-1020L/TP	Polarized tags 13 0 13027 02

CAUTION:
Fire, explosion,
and severe burn hazard.
Do not disassemble, heat
above 100 °C, or incinerate.
Use as part of *PulsesPlus™*
battery only. Do not
charge above 3.95 V.

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



HLC-1520A

- › Delivering high current pulses
- › Up to 25 years lifetime and more
- › Wide operating temperature range
- › Low self discharge

Performance Data

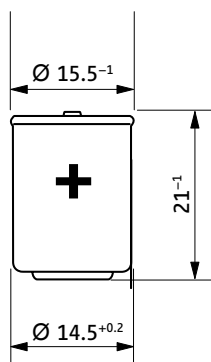
(Typical values in **PulsesPlus™** batteries stored at +25 °C)

System	Lithium Intercalated Compounds
Nominal voltage	3.7 V
Nominal capacity	140 As (39 mAh) @ 3.7 V
Nominal current	25 mA
Max. continuous discharge current	500 mA
Pulse current capability	2000 mA
Max. charge voltage	3.95 V
Max. charge current	25 mA
Discharge end voltage	2.5 V
Cell impedance	max. 250 mΩ (@ 1 kHz, RT)
Nominal energy	0.22 Wh
Weight	7.7 g

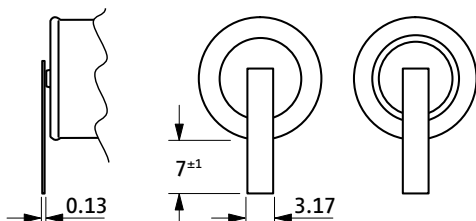
For more data please refer to page 37.



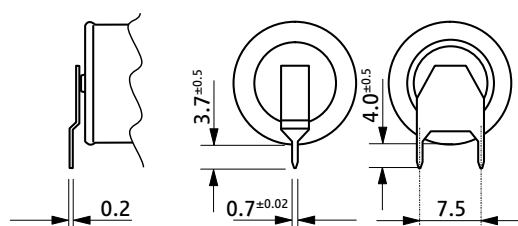
HLC-1520/S



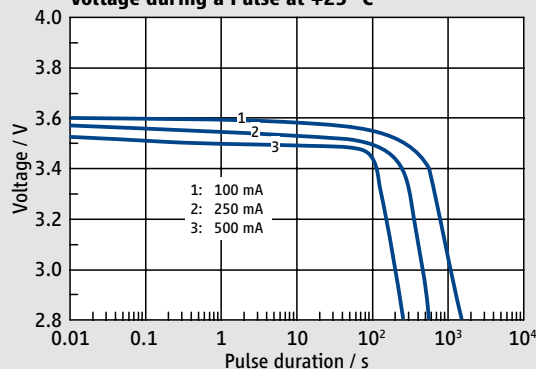
HLC-1520/T



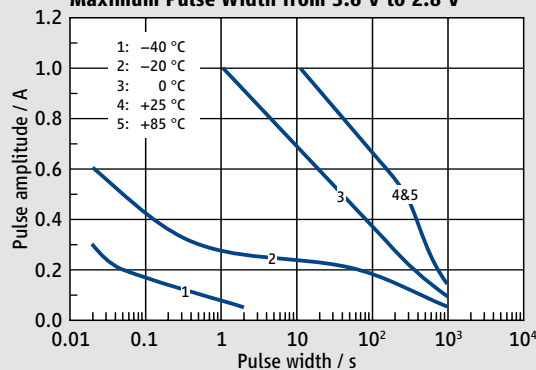
HLC-1520/TP



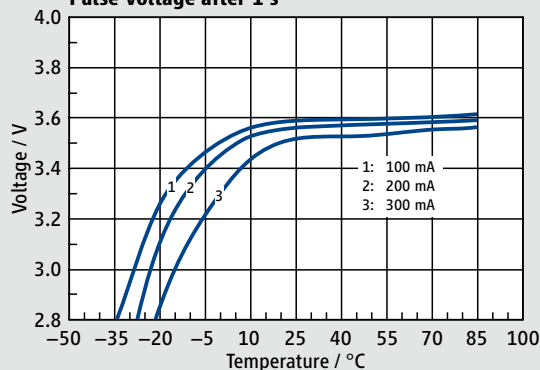
Voltage during a Pulse at +25 °C



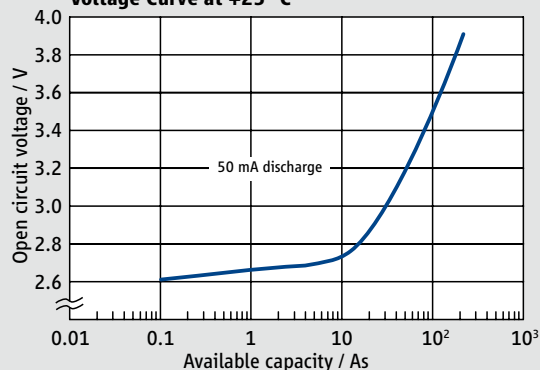
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Voltage Curve at +25 °C



Available Terminations

Termination	Standard	Catalogue No.
HLC-1520A/S	Standard	13 0 11521 02
HLC-1520A/T	Tags	13 0 11522 02
HLC-1520A/TP	Polarized tags	13 0 11527 02



CAUTION:
Fire, explosion,
and severe burn hazard.
Do not disassemble, heat
above 100 °C, or incinerate.

Use as part of **PulsesPlus™**
battery only. Do not
charge above 3.95 V.

HLC-1530A

- › Delivering high current pulses
- › Up to 25 years lifetime and more
- › Wide operating temperature range
- › Low self discharge

Performance Data

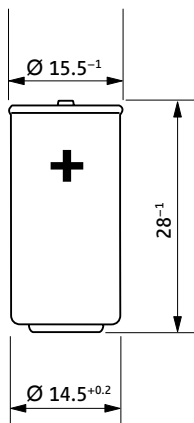
(Typical values in *PulsesPlus™* batteries stored at +25 °C)

System	Lithium Intercalated Compounds
Nominal voltage	3.7 V
Nominal capacity	250 As (70 mAh) @ 3.7 V
Nominal current	50 mA
Max. continuous discharge current	750 mA
Pulse current capability	3000 mA
Max. charge voltage	3.95 V
Max. charge current	50 mA
Discharge end voltage	2.5 V
Cell impedance	max. 140 mΩ (@ 1 kHz, RT)
Nominal energy	0.4 Wh
Weight	10.3 g

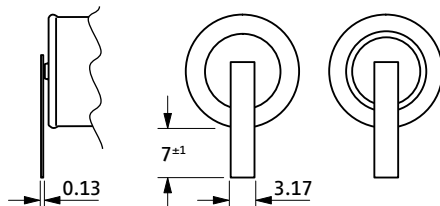
For more data please refer to page 37.



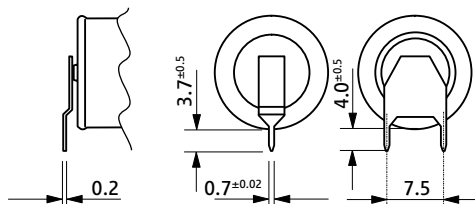
HLC-1530/S



HLC-1530/T



HLC-1530/TP

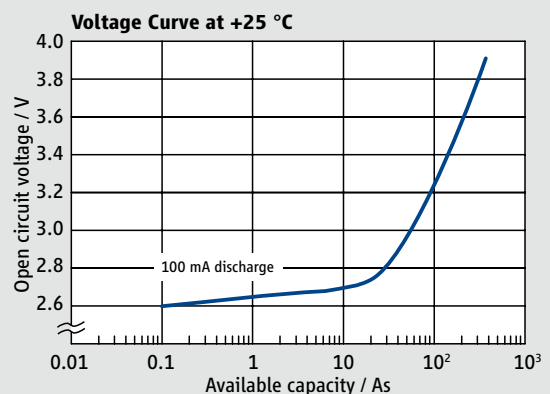
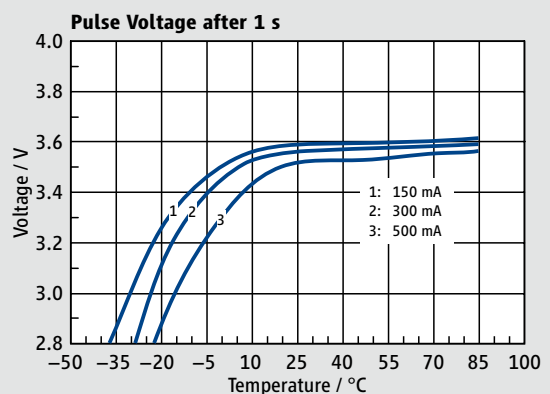
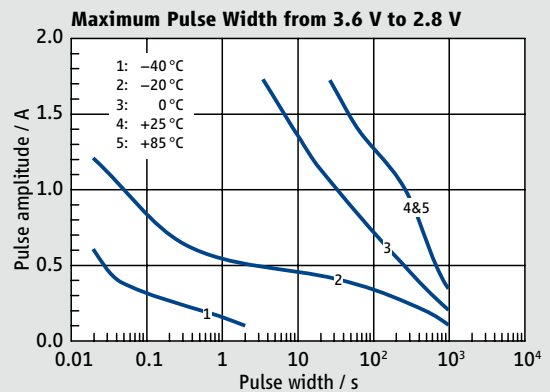
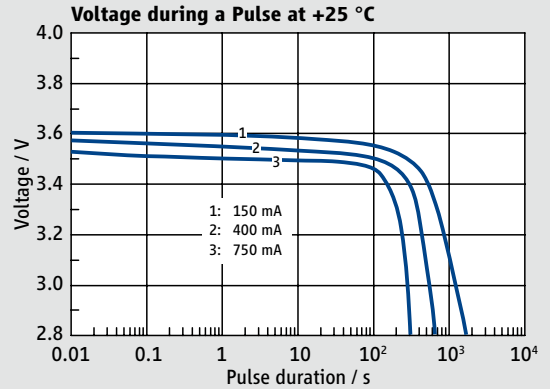


Available Terminations

Termination	Catalogue No.
HLC-1530A/S Standard	13 0 11531 02
HLC-1530A/T Tags	13 0 11532 02
HLC-1530A/TP Polarized tags	13 0 11537 02

CAUTION:
Fire, explosion,
and severe burn hazard.
Do not disassemble, heat
above 100 °C, or incinerate.
Use as part of *PulsesPlus™*
battery only. Do not
charge above 3.95 V.

Any values given here are for informational purposes only. They also depend on actual conditions of use and are not warranties of future performance. Subject to change.



HLC-1550A

- › Delivering high current pulses
- › Up to 25 years lifetime and more
- › Wide operating temperature range
- › Low self discharge

Performance Data

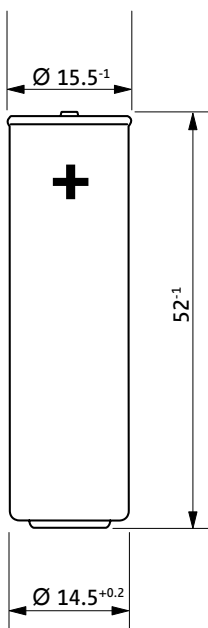
(Typical values in **PulsesPlus™** batteries stored at +25 °C)

System	Lithium Intercalated Compounds
Nominal voltage	3.7 V
Nominal capacity	560 As (155 mAh) @ 3.7 V
Nominal current	50 mA
Max. continuous discharge current	2000 mA
Pulse current capability	5000 mA
Max. charge voltage	3.95 V
Max. charge current	100 mA
Discharge end voltage	2.5 V
Cell impedance	max. 100 mΩ (@ 1 kHz, RT)
Nominal energy	0.86 Wh
Weight	20 g

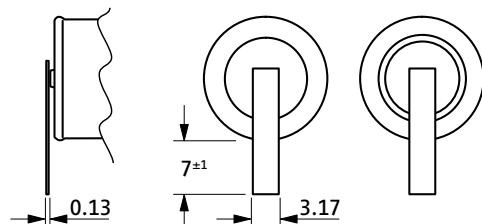
For more data please refer to page 37.



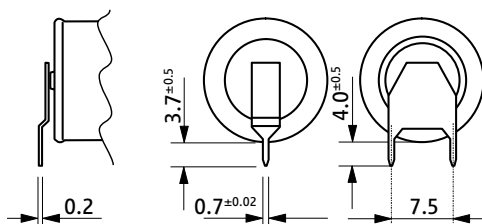
HLC-1550/S



HLC-1550/T



HLC-1550/TP



Available Terminations

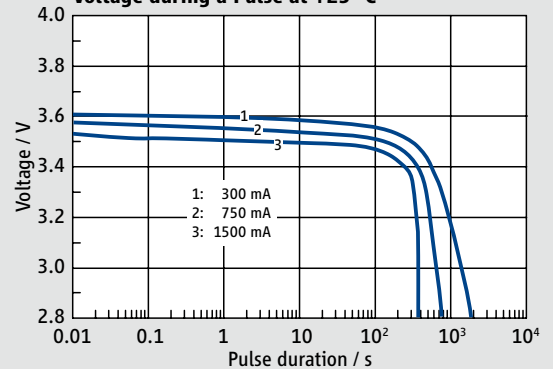
Termination	Standard	Catalogue No.
HLC-1550A/S	Standard	13 0 11551 02
HLC-1550A/T	Tags	13 0 11552 02
HLC-1550A/TP	Polarized tags	13 0 11557 02



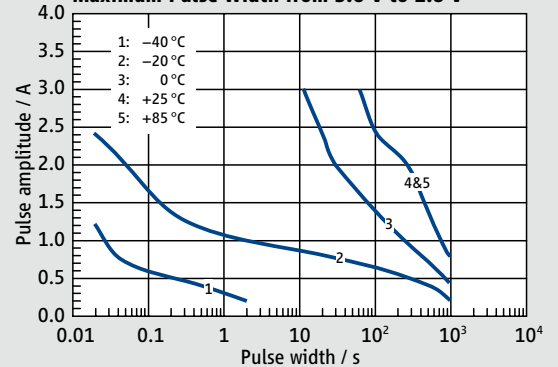
CAUTION:
Fire, explosion,
and severe burn hazard.
Do not disassemble, heat
above 100 °C, or incinerate.

Use as part of **PulsesPlus™**
battery only. Do not
charge above 3.95 V.

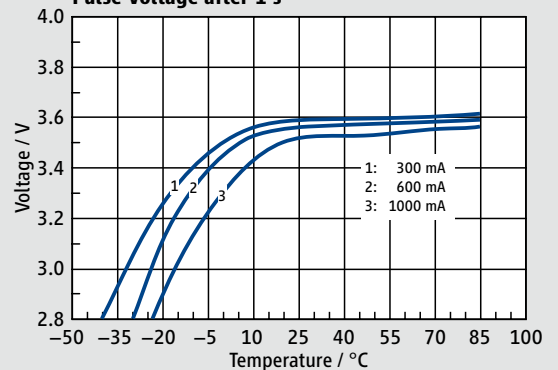
Voltage during a Pulse at +25 °C



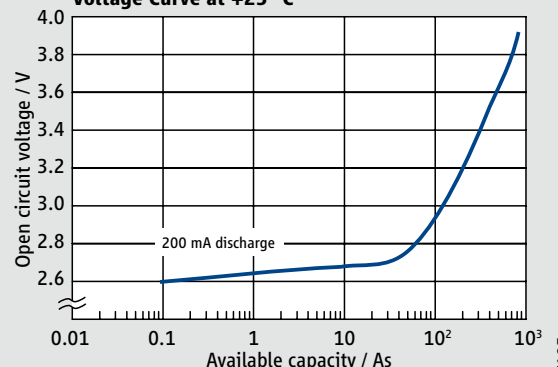
Maximum Pulse Width from 3.6 V to 2.8 V



Pulse Voltage after 1 s



Voltage Curve at +25 °C



Introduction



The TLM battery

The Tadiran TLM series, the newest product innovation from Tadiran Batteries, is distinguished by its extremely high power in the decisive moment – when it really mat-

Outperforms competition

Compared to other commercial high rate lithium batteries, TLM batteries are superior with respect to their voltage, energy content, and temperature behaviour.

Smallest high power battery

Figure 2 shows the behaviour of TLM-1550HPM under these conditions. The battery was subjected to accelerated ageing by storing it at +72 °C for 3 weeks prior to the test.

Enduring low impedance

For demanding applications like the back-up battery in eCall systems, the durability of the battery in a wide temperature range is a decisive factor. Especially two para-

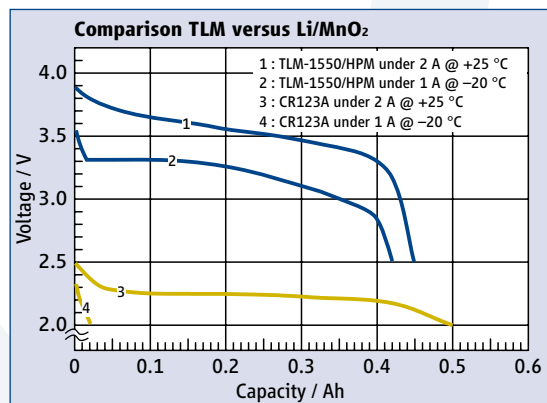


Figure 1: Comparison TLM versus Li/MnO₂

ters! It stands for guaranteed power even after long storage or stand-by up to more than 10 years. Its outstanding properties make it the ideal back-up battery for the eCall system, surgical instruments, and other special applications.

Military version

TLM batteries are also available in a more robust version for military applications.

Advantages

- ▶ High voltage 4.0 V
- ▶ Very high pulse current capability
- ▶ Immediate response, no passivation effect
- ▶ Wide operating temperature range (–40 °C to +85 °C)
- ▶ High reliability (hermetic laser sealing, glass-to-metal seal)
- ▶ Outstanding storage capability (up to 10 years)
- ▶ Recognized safety (UL)
- ▶ Very low self discharge
- ▶ Easy health monitoring during storage

Figure 1 shows a comparison with CR123A batteries. These batteries have almost the same volume as TLM-1550HPM and belong to the Lithium Manganese Dioxide 3 Volt system. Under a 2 Ampere discharge at room temperature, they deliver almost the same capacity as TLM-1550HPM but at much lower voltage. Under 1 Ampere discharge at –20 °C, CR123A delivers almost no capacity above 2 Volts, while TLM-1550HPM still delivers more than 70 % of its nominal capacity.

Application in eCall modules

One major application for TLM batteries is the so-called Autonomous Telematics Box or Advanced Telematics Module where the TLM battery serves as the back-up battery for eCall, the automatic emergency call system for cars in Europe. The requirements for this system include operation under high pulse currents at low temperature at any time up to 10 years after installation. Even under these severe conditions, an air time of more than 10 minutes is required. During this air time, the system exchanges both car condition and position data and voice signals between the car and an emergency call centre.

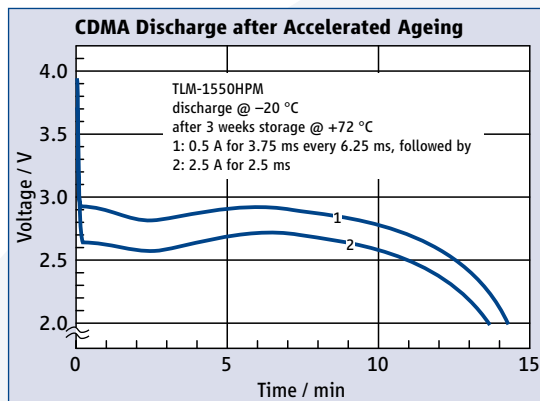


Figure 2: CDMA Discharge after Accelerated Ageing

It was then cooled down to –20 °C and discharged under a simulated application load profile comprising 2.5 A of 2.5 ms duration every 6.25 ms on a basic load of 0.5 A. The upper curve (1) shows the voltage on the basic load while the lower curve (2)

meters need to be sufficiently low and stable: self discharge and internal resistance. The development of self discharge, expressed as capacity loss over storage time, is shown in the data sheets of TLM batteries on the following pages while Figure 3 shows the develop-

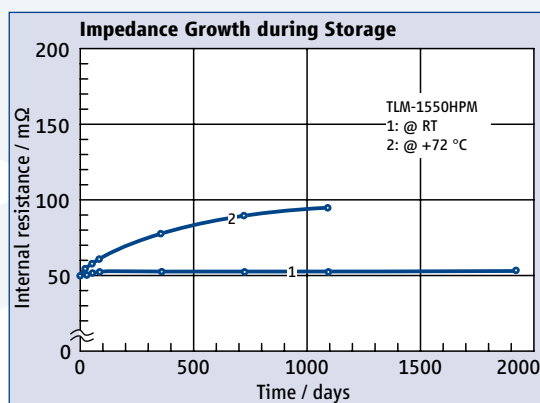


Figure 3: Impedance Growth during Storage

shows the voltage during the 2.5 A pulses. The discharge duration is clearly in excess of 10 minutes. TLM-1550HPM is the smallest battery commercially available on the market that can fulfil these requirements.

ment of the internal resistance of TLM-1550HPM over time at two different storage temperatures. It remains within the specified limits, even after storage at +72 °C for 3 years.

TLM-1520HPM

- High power 4 Volt cell
- No voltage delay
- Long shelf life
- End of life indication capability

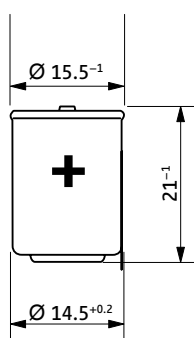
Performance Data

(Typical values for batteries stored at +25 °C for one year)

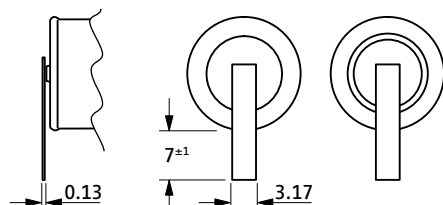
System	Lithium Metal Oxide
Nominal voltage	4.0 V
Nominal capacity	125 mAh
Nominal current	5 mA
Max. continuous discharge current	1.75 A
Pulse current capability	3.75 A
Cell impedance	max. 100 mΩ
Anode surface area	90 cm ²
Lithium content	0.04 g
Weight	9 g
Volume	3.2 cm ³
Temperature range	-40 °C ... +85 °C



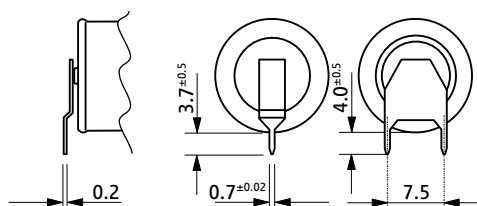
TLM-1520HPM/S



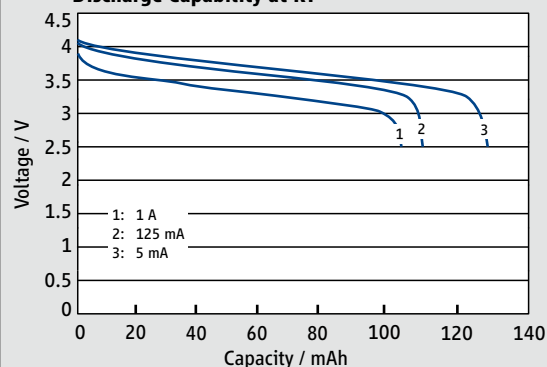
TLM-1520HPM/T



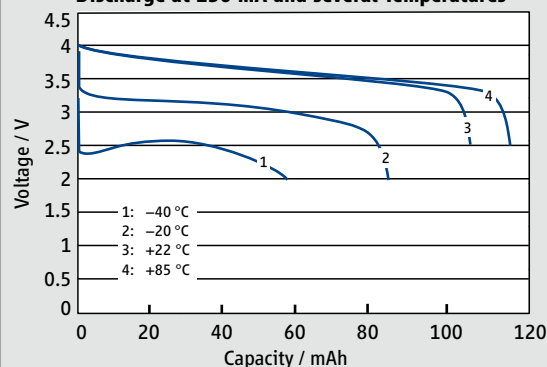
TLM-1520HPM/TP



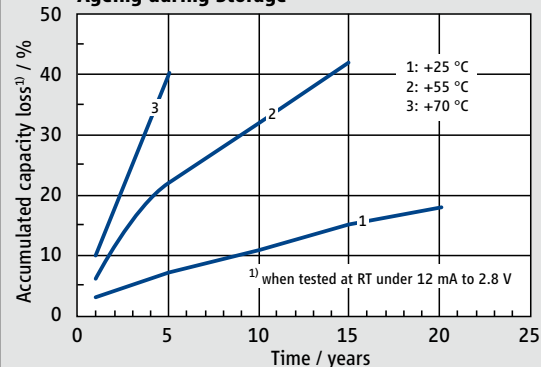
Discharge Capability at RT



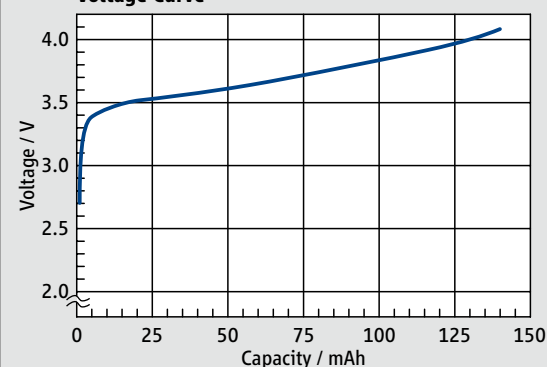
Discharge at 250 mA and several Temperatures



Ageing during Storage



Voltage Curve



Available Terminations

Termination	Catalogue No.
TLM-1520HPM/S Standard	12 0 22521 02
TLM-1520HPM/T Tags	12 0 22522 02
TLM-1520HPM/TP Polarized tags	12 0 22527 02

WARNING:
Fire, explosion,
and severe burn hazard. Do
not charge, disassemble,
heat above 100 °C,
incinerate, or short circuit.

TLM-1530HPM

- › High power 4 Volt cell
- › No voltage delay
- › Long shelf life
- › End of life indication capability

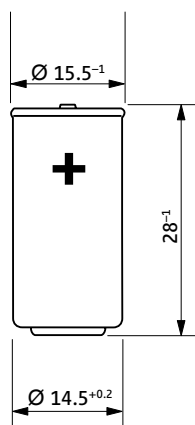
Performance Data

(Typical values for batteries stored at +25 °C for one year)

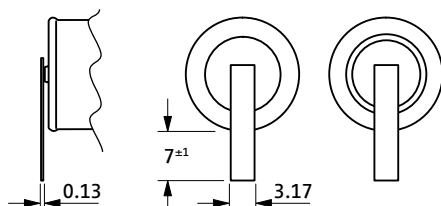
System	Lithium Metal Oxide
Nominal voltage	4.0 V
Nominal capacity	225 mAh
Nominal current	9 mA
Max. continuous discharge current	3.2 A
Pulse current capability	6.8 A
Cell impedance	max. 100 mΩ
Anode surface area	160 cm ²
Lithium content	0.1 g
Weight	11 g
Volume	4.4 cm ³
Temperature range	-40 °C ... +85 °C



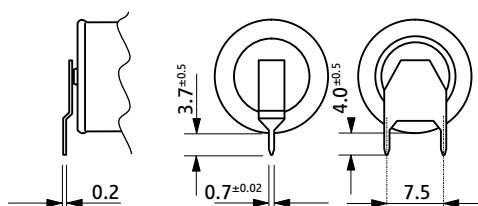
TLM-1530HPM/S



TLM-1530HPM/T



TLM-1530HPM/TP

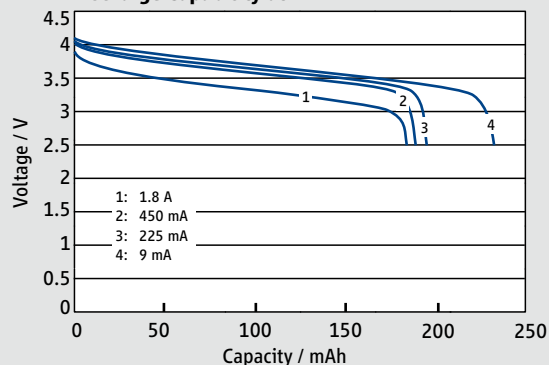


Available Terminations

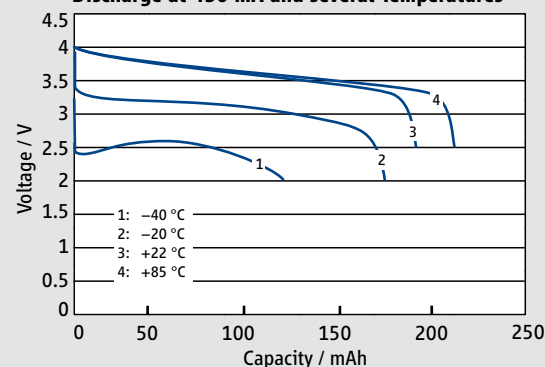
Termination	Catalogue No.
TLM-1530HPM/S Standard	12 0 22531 02
TLM-1530HPM/T Tags	12 0 22532 02
TLM-1530HPM/TP Polarized tags	12 0 22537 02

WARNING:
Fire, explosion,
and severe burn hazard. Do
not charge, disassemble,
heat above 100 °C,
incinerate, or short circuit.

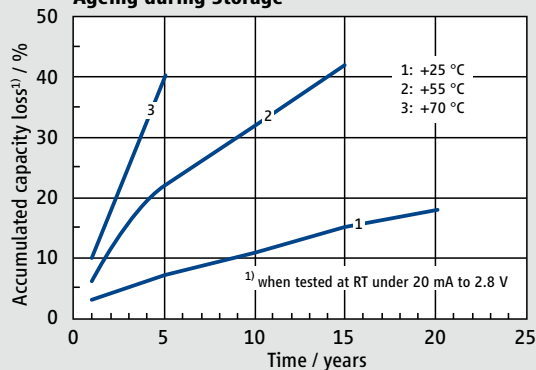
Discharge Capability at RT



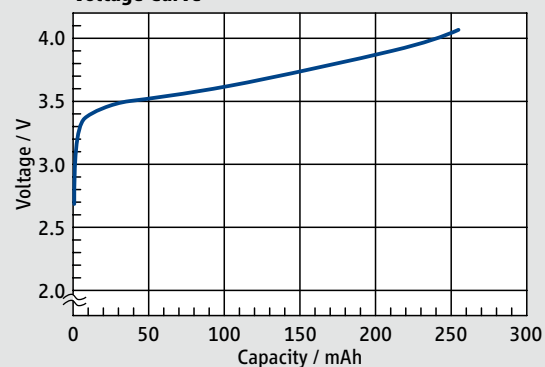
Discharge at 450 mA and several Temperatures



Ageing during Storage



Voltage Curve



TLM-1550HPM

- High power 4 Volt cell
- No voltage delay
- Long shelf life
- End of life indication capability

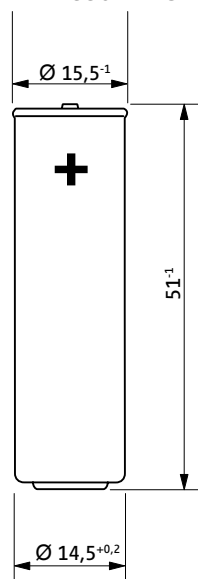
Performance Data

(Typical values for batteries stored at +25 °C for one year)

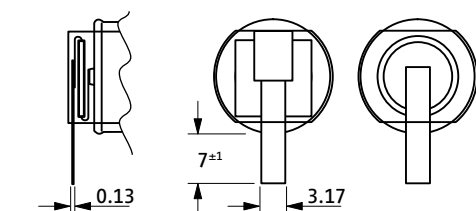
System	Lithium Metal Oxide
Nominal voltage	4.0 V
Nominal capacity	500 mAh
Nominal current	100 mA
Max. continuous discharge current	7 A
Pulse current capability	15 A
Cell impedance	max. 100 mΩ
Anode surface area	360 cm ²
Lithium content	0.4 g
Weight	20 g
Volume	8 cm ³
Temperature range	-40 °C ... +85 °C



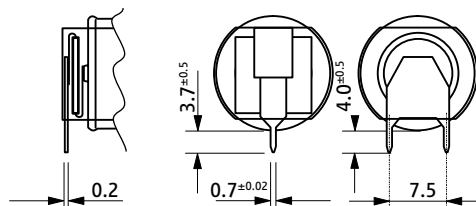
TLM-1550HPM/S



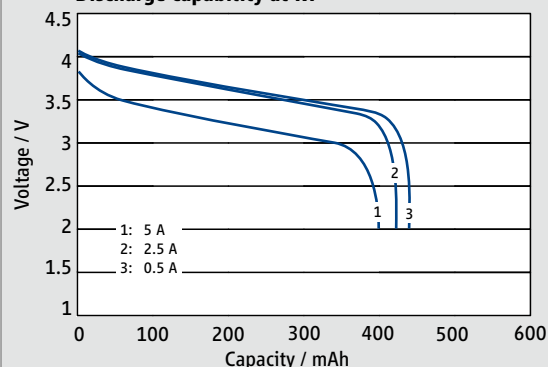
TLM-1550HPM/Z2/T



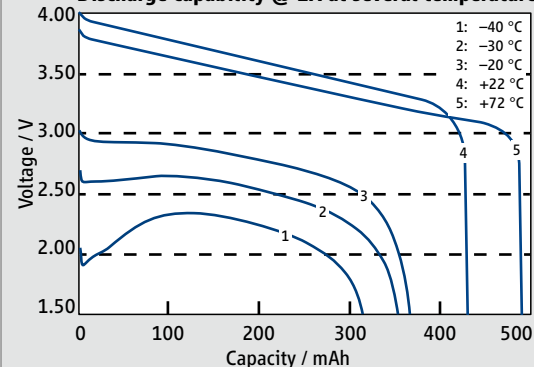
TLM-1550HPM/Z2/TP



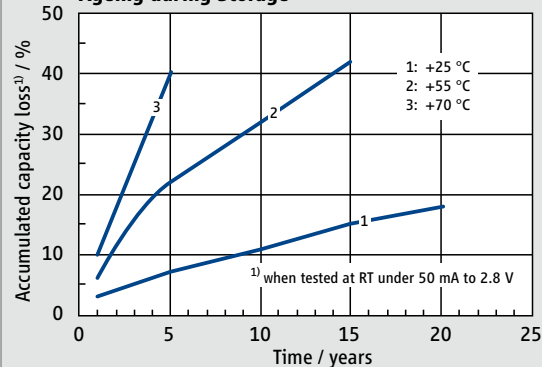
Discharge capability at RT



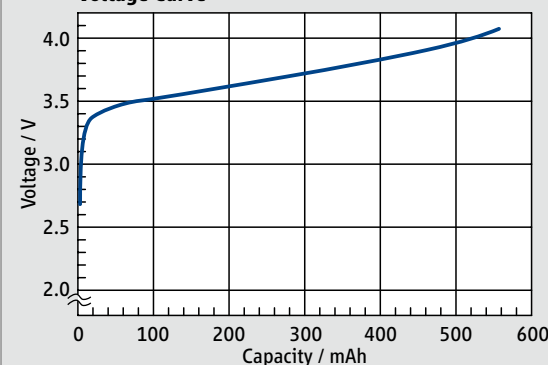
Discharge capability @ 2A at several temperatures



Ageing during Storage



Voltage Curve



Available Terminations

TLM-1550HPM/S	Standard	Catalogue No. 12 0 22551 02
TLM-1550HPM/Z2/T	Tags*	12 1 22552 02
TLM-1550HPM/Z2/TP	Polarized tags*	12 1 22557 02

* with PTC SRP 200



WARNING:
Fire, explosion,
and severe burn hazard. Do
not charge, disassemble,
heat above 100 °C,
incinerate, or short circuit.

Introduction

TLI-Battery

The TLI series is specifically designed for long-term use in harsh environments. It represents an important breakthrough in rechargeable lithium-ion battery technology.

Standard rechargeable lithium ion cells have inherent drawbacks which have an impact on long term applications. These include short operating life (maximum 5 years), low maximum cycle life (1000 cycles), high self-discharge (up to 60 % per year), and limited temperature range (0 °C to 60 °C) with no possibility of charging at low and high temperatures.

By contrast, TLI series batteries utilize technology found in Tadiran's patented hybrid layer capacitor (HLC). Tadiran's technology has been field-proven in millions of cells to deliver 25 years and more service life. TLI series batteries modify this technology to deliver reliable, long-term performance under extreme environmental conditions.

Characteristics

- ▶ Wide operating temperature (–40 °C to +85 °C)
- ▶ Short time storage up to +90 °C possible
- ▶ Ability to deliver high current pulses (up to 5 A)
- ▶ Low self-discharge (less than 5 % per year)
- ▶ Up to 5 times extended cycle life (5000 full charge/discharge cycles)
- ▶ Long operating time (10 years)
- ▶ Charging possible at extreme temperatures (10h-rate)
- ▶ Hermetically sealed cell (glass-to-metal seal)
- ▶ Certified safety (UL)
- ▶ Easy monitoring of cell fitness during storage

Table 1 shows a comparison of a standard lithium ion cell 18650 with the TLI-1550. It can be seen that the characteristics of the TLI series are superior in terms of power, self-discharge and operating temperature range.

Characteristics	18650 Li-Ion	TLI-1550A
Dimensions	Ø 18 mm x 64 mm	Ø 15 mm x 50 mm
Capacity	3.2 Ah	0.4 Ah
Power:		
@ +25 °C	18W	18 W
@ –20 °C	< 3 W	> 6 W
Temperature range:		
Storage	–20 °C to +60 °C	–40 °C to +85 °C
Discharge	–20 °C to +60 °C	–40 °C to +85 °C
Charge	±0 °C to +45 °C	–40 °C to +85 °C
Self discharge	20 % per year	< 5 % per year
Operating life	5 years	10+ years

Table 1: Comparison of TLI-1550 versus a standard lithium ion cell 18650

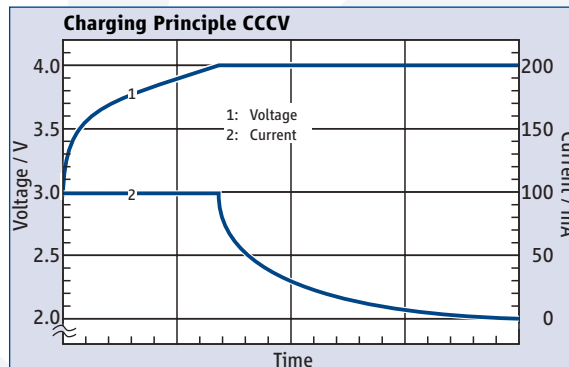


Figure 1: Charging principle CCCV. Example for TLI-1550

Figure 1 shows the constant current/constant voltage (CCCV) charging principle which is recommended for the TLI series. The battery is charged with a constant current until the maximum voltage is reached. Afterwards, the charging current is decreased to maintain constant voltage. Charging may be discontinued when a predefined end-of-charge current is reached. With the maximum current, charging takes approximately 6.5 hours in the temperature range between –20 °C and +50 °C. In the extended temperature range between –40 °C and +85 °C the maximum charging current is five times lower, resulting in a five times longer charging time.

TLI in eCall applications

The TLI battery ensures constant power supply even under high current pulses. This is required for applications like bidirectional wireless communication modules. One major application for TLI batteries is

the so-called Autonomous Telematics Box or Advanced Telematics Module where the TLI battery serves as the back-up battery for eCall, the automatic emergency call system for cars in Europe. The requirements for this system include operation under high pulse currents at low temperature at any time up to 10 years after installation. Even under these severe conditions, an air time of more than 10

minutes is required. During this air time, the system exchanges both car condition and position data and voice signals between the car and an emergency call centre.

Figure 2 shows the behaviour of TLI-1550 in a typical eCall application after an ageing period of one month at 72 °C. The GSM transmission profile of the application requires a 2 A pulse for the duration of 577 µs followed by a 150 mA pulse for 4.6 ms. This load alternation is continuously repeated. Even at a temperature of –40 °C a TLI-1550 cell ensures an air time of more than 15 minutes.

Protection

In order to ensure a high level of safety, TLI cells 1530 and 1550 should be protected by a PTC either on the battery or on the PC-board. Recommended PTC types include SRP120 and SRP200, respectively, as follows: SRP120 limits the discharge current to 1.2 A and SRP200 to 2 A. In special cases cells can be used without PTC.

TLI batteries have no integrated overcharge protection. The protection circuit should be designed by the customer and be approved by Tadiran. Please refer to the TLI guidelines posted on Tadiran's website under products >> TLI-batteries.

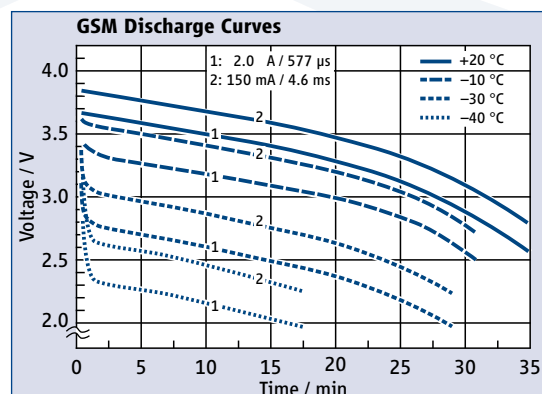


Figure 2: Discharge behaviour of TLI-1550 under the GSM profile after storage at 72 °C for one month



Approval by Tadiran

The design of the following items should be approved by Tadiran:

- ▶ Implementation of the protection circuit against overcharge, e.g. by limitation of the charging voltage and charging current to the values given in the individual data sheets
- ▶ Implementation of low voltage protection against deep discharge



TLI-1020A

- RECHARGEABLE
- Up to 5000 cycles
- Extremely low self discharge rate
- Charging possible at extreme temperatures

Performance Data

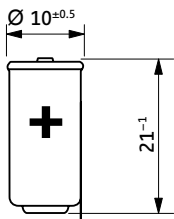
(Typical values for batteries stored at +25 °C for one year)

System	Lithium Intercalated Compounds	
Nominal voltage	4 V	
Max. capacity	25 mAh	
Max. continuous discharge current	160 mA	
Pulse current capability	400 mA	
Discharge end voltage	2.5 V	
Max. charge voltage	4.1 V	
Max. charge current	8 mA	1.6 mA
Temperature range	-20 °C ... +50 °C	-40 °C ... +85 °C
Cell impedance @ 1 kHz, RT	max. 600 mΩ	
Nominal energy	0.09 Wh	
Weight	4.2 g	

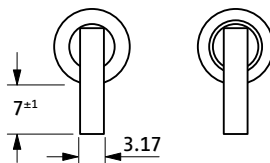
For more information please refer to page 46.



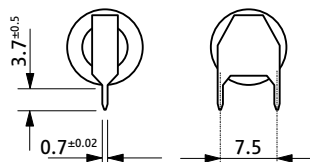
TLI-1020A/S



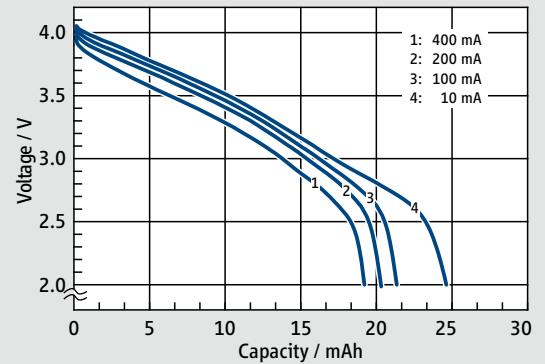
TLI-1020A/T



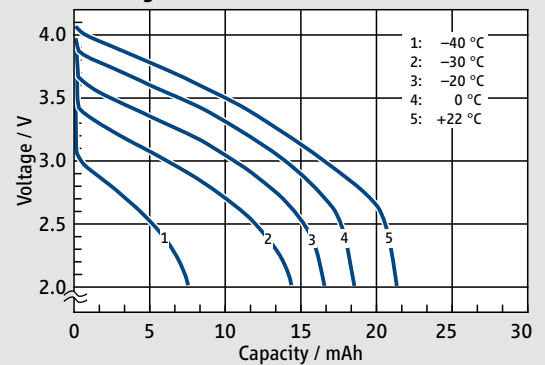
TLI-1020A/TP



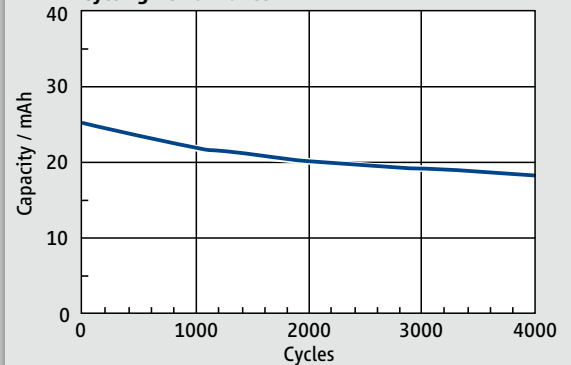
Discharge Curve at 25 °C



Discharge Curve at 100 mA



Cycling Performance



Available Terminations

Termination	Catalogue No.
TLI-1020A/S Standard	13 2 11021 02
TLI-1020A/T Tags	13 2 11022 02
TLI-1020A/TP Polarized tags	13 2 11027 02



Warning:
Fire, explosion,
and severe burn hazards.
Do not disassemble, heat
above 100 °C, short circuit,
incinerate or expose
contents to water.

Do not charge above 4.1 V.
Please refer to TLI-guidelines.

TLI-1520A

- › RECHARGEABLE
- › Up to 5000 cycles
- › Extremely low self discharge rate
- › Charging possible at extreme temperatures

Performance Data

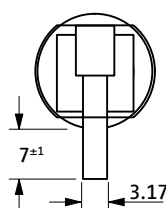
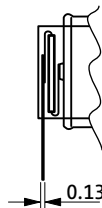
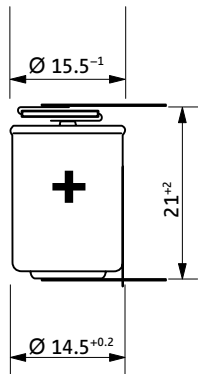
(Typical values for batteries stored at +25 °C for one year)

System	Lithium Intercalated Compounds	
Nominal voltage	4 V	
Max. capacity	90 mAh	
Max. continuous discharge current	500 mA	
Pulse current capability	1.25 A	
Discharge end voltage	2.5 V	
Max. charge voltage	4.1 V	
Max. charge current	25 mA	5 mA
Temperature range	-20 °C ... +50 °C	-40 °C ... +85 °C
Cell impedance @ 1 kHz, RT	max. 250 mΩ	
Nominal energy	0.3 Wh	
Weight	9 g	

For more information please refer to page 46.



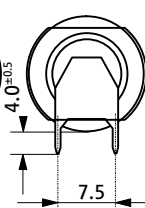
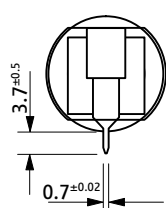
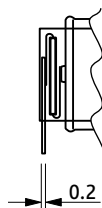
TLI-1520A/Z2



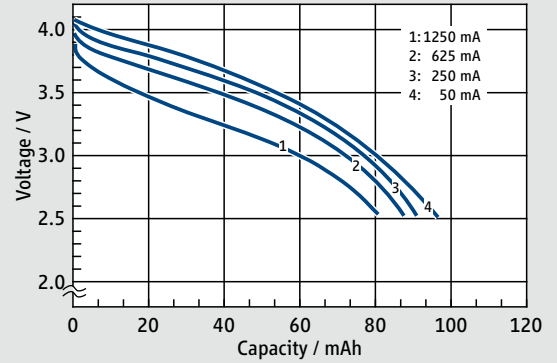
TLI-1520A/Z2/T



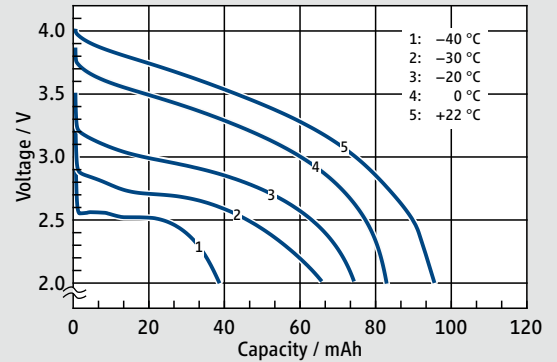
TLI-1520A/Z2/TP



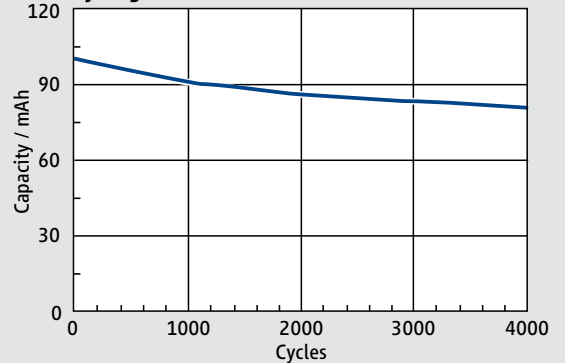
Discharge Curve at 25 °C



Discharge Curve at 500 mA



Cycling Performance



Available Terminations

TLI-1520A/Z2/T	Tags*	Catalogue No.
TLI-1520A/Z2/TP	Polarized tags*	13 3 11522 02
	* with PTC SRP 200	13 3 11527 02

Warning:
Fire, explosion,
and severe burn hazards.
Do not disassemble, heat
above 100 °C, short circuit,
incinerate or expose
contents to water.

Do not charge above 4.1 V.
Please refer to TLI-guidelines.



TLI-1530A

- RECHARGEABLE
- Up to 5000 cycles
- Extremely low self discharge rate
- Charging possible at extreme temperatures

Performance Data

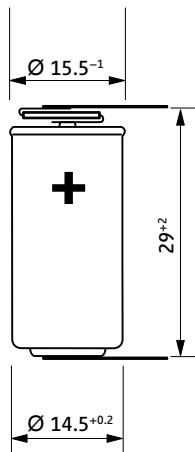
(Typical values for batteries stored at +25 °C for one year)

System	Lithium Intercalated Compounds	
Nominal voltage	4 V	
Max. capacity	150 mAh	
Max. continuous discharge current	1 A	
Pulse current capability	2.5 A	
Discharge end voltage	2.5 V	
Max. charge voltage	4.1 V	
Max. charge current	50 mA	10 mA
Temperature range	-20 °C ... +50 °C	-40 °C ... +85 °C
Cell impedance @ 1 kHz, RT	max. 175 mΩ	
Nominal energy	0.5 Wh	
Weight	10 g	

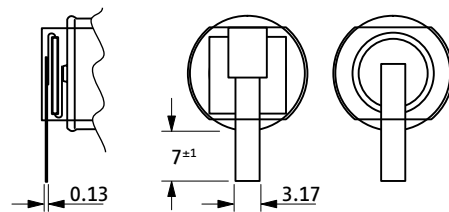
For more information please refer to page 46.



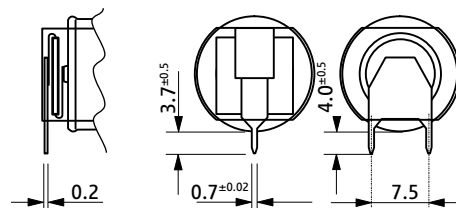
TLI-1530A/Z2



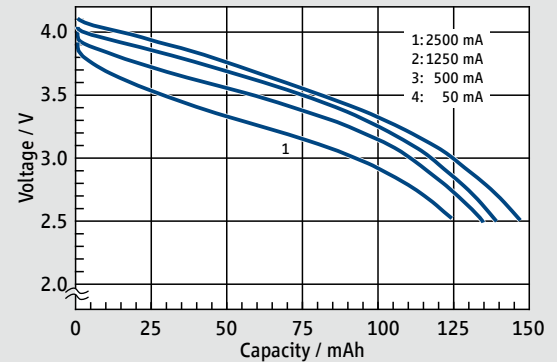
TLI-1530A/Z2/T



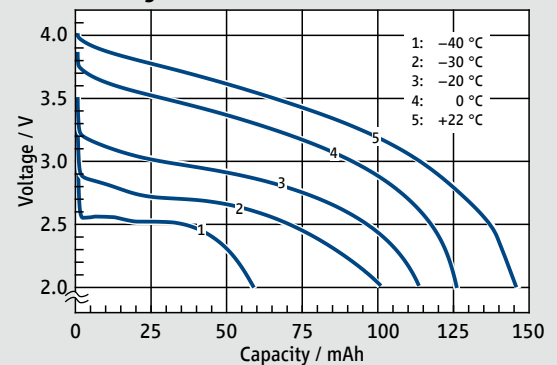
TLI-1530A/Z2/TP



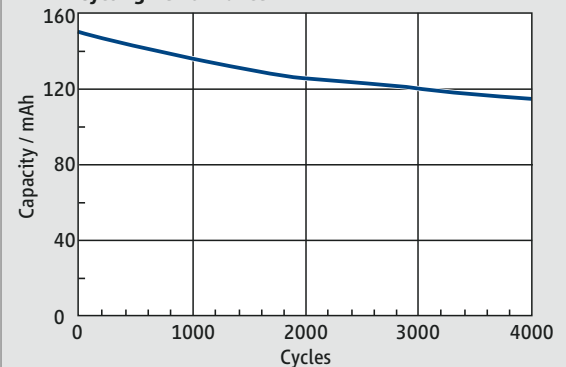
Discharge Curve at 25 °C



Discharge Curve at 1 A



Cycling Performance



Available Terminations

TLI-1530A/Z2/T	Tags*	13 3 11532 02
TLI-1530A/Z2/TP	Polarized tags*	13 3 11537 02
* with PTC SRP 200		

Catalogue No.

Warning:
Fire, explosion,
and severe burn hazards.
Do not disassemble, heat
above 100 °C, short circuit,
incinerate or expose
contents to water.
Do not charge above 4.1 V.
Please refer to TLI-guidelines.

TLI-1550A

- RECHARGEABLE
- Up to 5000 cycles
- Extremely low self discharge rate
- Charging possible at extreme temperatures

Performance Data

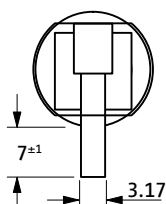
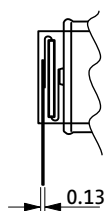
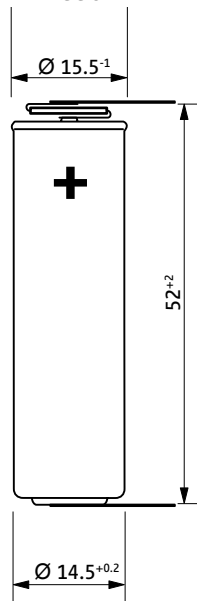
(Typical values for batteries stored at +25 °C for one year)

System	Lithium Intercalated Compounds	
Nominal voltage	4 V	
Max. capacity	330 mAh	
Max. continuous discharge current	2 A	
Pulse current capability	5 A	
Discharge end voltage	2.5 V	
Max. charge voltage	4.1 V	
Max. charge current	100 mA	20 mA
Temperature range	-20 °C ... +50 °C	-40 °C ... +85 °C
Cell impedance @ 1 kHz, RT	max. 100 mΩ	
Nominal energy	1.32 Wh	
Weight	20 g	

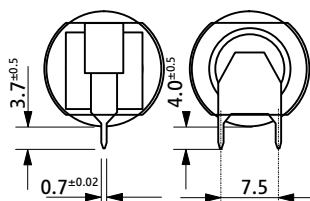
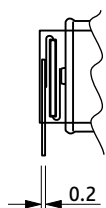
For more information please refer to page 46.



TLI-1550A/Z2



TLI-1550A/Z2/T



TLI-1550A/Z2/TP

Available Terminations

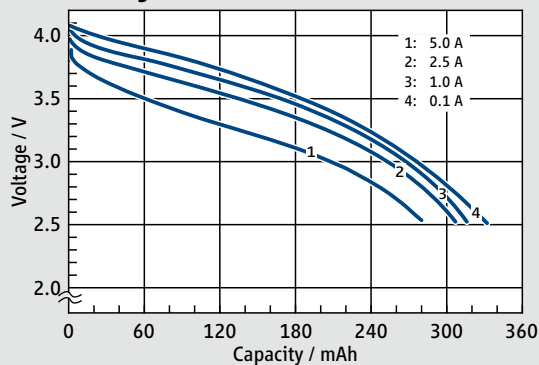
Available Terminations	Catalogue No.
TLI-1550A/Z2/T Tags*	13 3 11552 02
TLI-1550A/Z2/TP Polarized tags*	13 3 11557 02
* with PTC SRP 200	



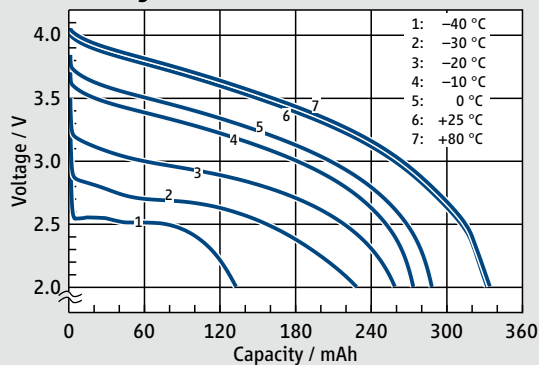
Warning:
Fire, explosion,
and severe burn hazards.
Do not disassemble, heat
above 100 °C, short circuit,
incinerate or expose
contents to water.

Do not charge above 4.1 V.
Please refer to TLI-guidelines.

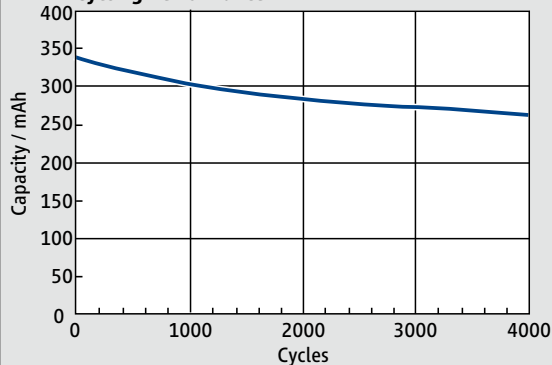
Discharge Curve at 25 °C



Discharge Curve at 2 A



Cycling Performance



Safety & Transport Regulations

Standards

General safety recommendations for lithium batteries have been published in the standards *UL 1642* and *IEC 60086-4*.

UL-recognition

Tadiran Lithium Batteries are recognized by UL under file *MH 12827*, please refer to *UL ONLINE CERTIFICATIONS DIRECTORY* for further information. The following text or a modified version thereof appears on each battery:

WARNING:

Fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose contents to water.

Classification of lithium batteries, lithium hybrid batteries (PulsesPlus) and lithium ion batteries

Lithium metal batteries and lithium hybrid batteries are dangerous goods, UN No. 3090. Lithium ion batteries are dangerous goods, UN No. 3480. *Table 2* indicates which Tadiran lithium cells are exempted from the dangerous goods regulations and which are not.

In air transport, exemptions are limited.

For more information on classification and transport regulations, please refer to Tadiran's technical notice: tadiranbatteries.de/regulations.

UN tests

Table 2 also shows the status of UN-tests for Tadiran Lithium Batteries according to the UN Handbook of Tests and Criteria, part III, sub-section 38.3. Regarding Tadiran Lithium Batteries not listed in *table 2*, you may find a confirmation at tadiranbatteries.de/reports.

Protection against charging

Whenever lithium batteries are not the single power source in a circuit the following measures are recommended by the Underwriters Laboratories:

The battery should not be connected in series with an electrical power source that would increase the forward current through the battery.

The circuit shall include one of the following:

A. Two suitable diodes in series with the battery to prevent any reverse (charging) current. The second diode provides protection if the other one fails; or

B. A blocking diode or the equivalent to prevent any reverse (charging) current and a resistor to limit current in case of a diode failure. The resistor should be sized to limit the reverse (charging) current to the maximums $I_{R \max}$ shown in *table 1*.

In addition to this UL requirement, which gives the safety limits, Tadiran Batteries recommend to limit the reverse (charging) current to values below 10 μ A. This will ensure that service life is not affected.

Type	$I_{R \max}$
SL-350	15 mA
SL-360	50 mA
SL-361	20 mA
SL-550	15 mA
SL-560	50 mA
SL-561	15 mA
SL-750	15 mA
SL-760	50 mA
SL-761	20 mA
SL-850	15 mA
SL-860	50 mA
SL-861	20 mA
SL-886	25 mA
SL-889	20 mA
SL-2770	15 mA
SL-2780	50 mA
SL-2790	100 mA
SL-2870	15 mA
SL-2880	50 mA
TLM-1520HPM	25 mA
TLM-1530HPM	50 mA
TLM-1550HPM	100 mA

Table 1: Maximum reverse current

Protection against forced discharge

Forced discharge of a cell can occur when it is connected in series with other cells. A by-pass diode should be provided in parallel with each cell in a series connection. The effect of a by-pass diode is that current passes through the diode if a cell has been discharged, preventing forced discharge.

REACH and RoHS

All Tadiran cell are compliant with REACH regulation and RoHS directive.

System	Size	Type		Exempted ¹⁾		Lithium content [g] or nominal energy [Wh]	UN Test passed	UN Number	
Lithium Thionyl Chloride (LTC)	BEL			SL-840	Yes	0.13 g	Yes	3090/91	
	¹ / ₁₀ C		TLH-2450	TL-2450	Yes	0.18 g	Yes	3090/91	
	¹ / ₁₀ D			SL-889	Yes	0.3 g	Yes	3090/91	
	¹ / ₆ D			SL-886	Yes ²⁾	0.5 g	Yes	3090/91	
	¹ / ₂ AA	SL-350	SL-550	SL-750	SL-850	Yes ²⁾	0.35 g	Yes	3090/91
	² / ₃ AA	SL-361	SL-561	SL-761	SL-861	Yes ²⁾	0.5 g	Yes	3090/91
	AA	SL-360	SL-560	SL-760	SL-860	Yes ²⁾	0.65 g	Yes	3090/91
	C			SL-2770	SL-2870	No	2.5 g	Yes	3090/91
	D			SL-2780	SL2880	No	5 g	Yes	3090/91
	DD			SL-2790	No	10 g	Yes	3090/91	
Hybrid Layer Capacitors (HLC)	¹ / ₂ AAA	HLC-1020				Yes	0.07 Wh	Yes	3090/91 ³⁾
	¹ / ₂ AA	HLC-1520				Yes	0.22 Wh	Yes	3090/91 ³⁾
	² / ₃ AA	HLC-1530				Yes	0.4 Wh	Yes	3090/91 ³⁾
	AA	HLC-1550				Yes	0.86 Wh	Yes	3090/91 ³⁾
TLM batteries	¹ / ₂ AA	TLM-1520HPM				Yes	0.04 g	Yes	3090/91
	² / ₃ AA	TLM-1530HPM				Yes	0.1 g	Yes	3090/91
	AA	TLM-1550HPM				Yes	0.4 g	Yes	3090/91
TLI batteries	¹ / ₂ AAA	TLI-1020A				Yes	0.09 Wh	Yes	3480/81
	¹ / ₂ AA	TLI-1520A				Yes	0.3 Wh	Yes	3480/81
	² / ₃ AA	TLI-1530A				Yes	0.5 Wh	Yes	3480/81
	AA	TLI-1550A				Yes	1.32 Wh	Yes	3480/81

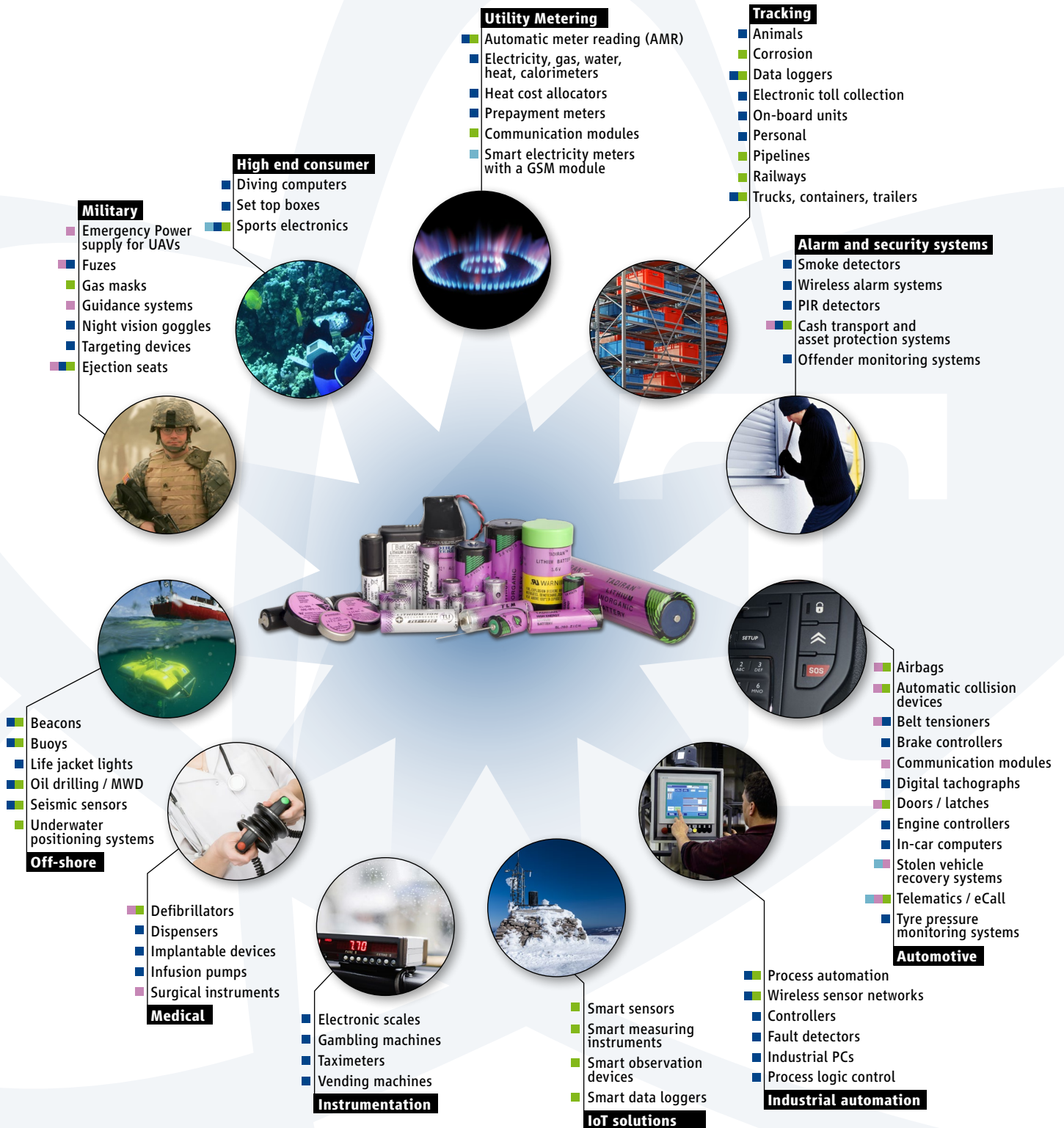
Table 2: Classification of Tadiran Lithium Batteries

¹⁾ if conditions mentioned in Tadiran's technical notice are fulfilled

²⁾ see also IATA DGR under UN 3090 / PI 968 / Table 968-II

³⁾ within a PulsesPlus combination

Tadiran Lithium Batteries – Applications



Your Distributor

- Lithium Thionyl Chloride (LTC) Batteries
- PulsesPlus™ Batteries
- Tadiran Lithium Metal Oxide (TLM) Batteries
- Tadiran Lithium Ion (TLI) Batteries