VARTA

SALES PROGRAM AND
TECHNICAL HANDBOOK


# Primary Lithium Cylindrical Cells
# Lithium-Thionyl-Chloride

# CONTENT

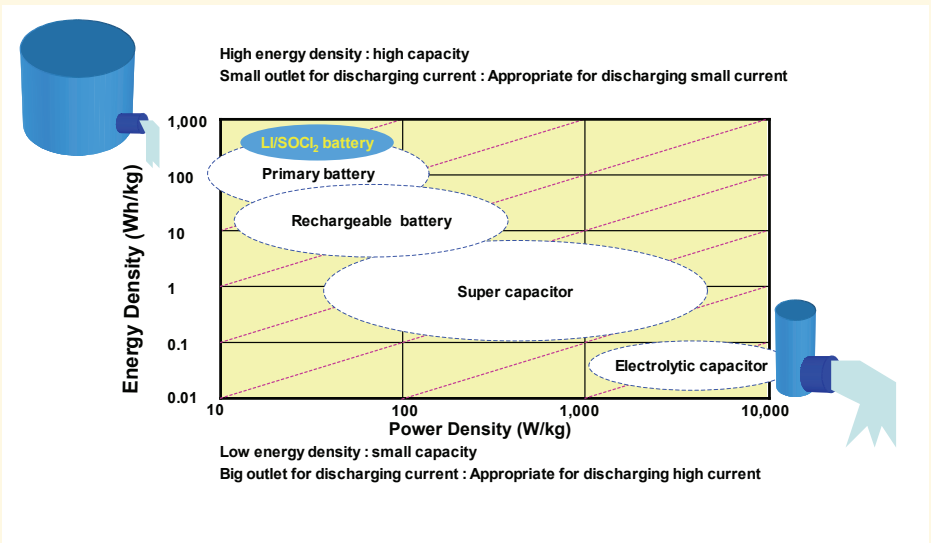
# 1. GENERAL INFORMATION

The VARTA Microbattery lithium thionyl chloride cell chemistry offers an excellent shelf life, good low-current capability, a wide operating temperature range and availability in cylindrical cell designs. Potential design-in applications for these products are electronic, telecommunication, metering, safety, security, instrumentation, industrial and other portable equipment use. Based on the outstanding cell performance and reliability of these products, they have been able to meet and exceed the requirements of our customer base worldwide.

## Advantages for VARTA Microbattery Li/$SOCl_2$ Cells

- High open circuit and load voltage (above 3.6 volts per cell)
- High energy density (760 Wh/kg and 1250 Wh/l)
- High capacity cell construction
- Operation over a wide temperature range
- Flat discharge profile under low to medium current applications
- Low self discharge (less than 1% per year at RT)
- Superior shelf life and operational life (Up to 15 years and more)
- UL Recognition
- Ability to provide a variety of laser welded termination tabs for all cell types

## Li/$SOCl_2$ has the biggest energy density among primary Batteries

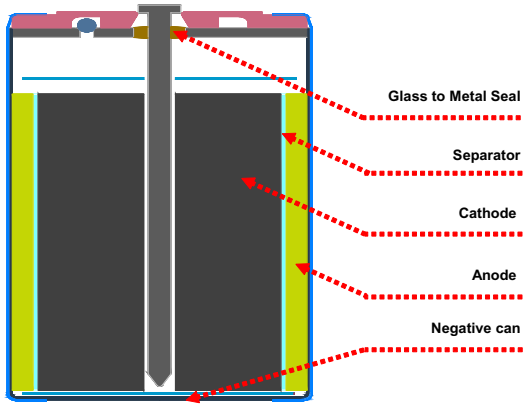


# 1.1 CONSTRUCTIONS OF LITHIUM THIONYL CHLORIDE CELLS

VARTA Microbattery offers a complete range of primary lithium cylindrical and button cells for metering memory back-up and portable applications worldwide.
The cylindrical lithium thionyl chloride cell configurations offer the high-capacity bobbin construction. The bobbin construction is targeted at low to moderate power requirements, dedicated for applications requiring up to a 15 years operational life at 20°C.

## Bobbin Type

Bobbin type battery is consisted of anode rolled against innersurface of case, separator and cathode of cylinder shape. Cathode current collector is connected with cathode of porous carbon mixture from the center of battery. As bobbin type battery has structure of containing maximum active material (lithium and $SOCl_2$) weight, it has huge energy density. Also, due to its structure of small reaction area and excellent in heat emission characteristics, short circuit current is limited and accordingly, it has excellent characteristics in safety.



Bobbin Type

## Mechanism of VARTA Lithium Battery

Anode surface structure of VARTA lithium ($Li/SOCl_2$) battery can be different in case of storage (Open Circuit) and discharge (Closed Circuit) based on Figure. Passivation film was formed by itself on the surface of lithium (anode) in open circuit and this is LiCl film which is created by chemical reaction between lithium that reactivity is very big and $SOCl_2$. LiCl film which has insulating characteristic provide excellent storage ability to battery because it block auto reaction of Li and $SOCl_2$. In case of discharge, reaction products of LiCl, $SO_2$ and S is created caused by chemical reaction, LiCl and S in a solid phase deposited to porous carbon cathode. Therefore, cathode should provide enough pore space till completion of discharge and efficient structural design is required because speed of reaction products 'deposition is different according to discharge current. $Li/SOCl_2$ battery has nature that inner pressure is not increased until end of discharge since $SO_2$ that is in a gas phase is dissolved to electrolyte.

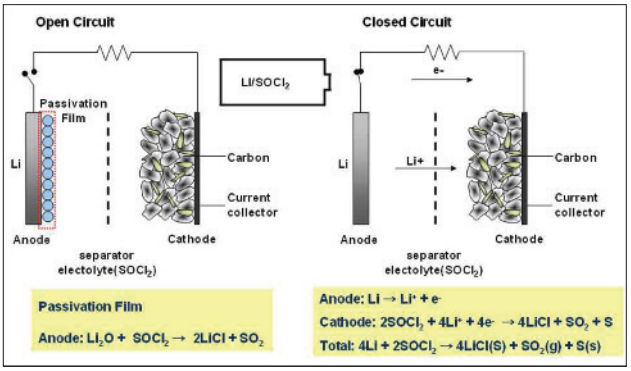


Figure: Mechanism for reaction of $Li/SOCl_2$

# 1.2 CHARACTERISTICS

## Main Applications

Both mechanical and electrical properties, together with reliability, ensure that VARTA Microbattery lithium thionyl chloride batteries meet the requirements of modern electronics.

They are therefore ideally suited as power sources for the long term supply of microelectronic security. Due to their extended energy density and high voltage level they are ideally suited as power sources for metering medical home and office securtity systems.

## Main Characteristics

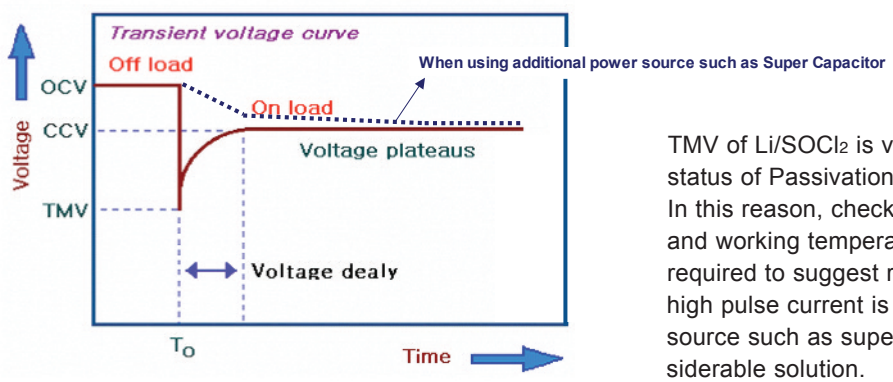
- Long life expectancy and long operational life
- Low self discharge rate
- High energy density (up to 1280Wh/l)
- High cell voltage (3.6V)
- Wide temperature range (-55 to +85°C)
- High operating safety
- High reliability
- Resistance to corrosion with stainless steel case
- No leakage problems
- Non flammable electrolyte
- Inorganic electrolyte
- Non pressurized
- Corrosive electrolyte

## Transient Minimum Voltage (TMV)

Lithium thionyl chloride battery has very low self discharge rate than other conventional batteries. That is due to the passivation layer formed on the lithium surface as explained above. This layer effectively prevents the self-discharge of the lithium as it is non-conductive. Therefore, this layer should be broken at the initial stage of discharge to allow lithium ion to flow.

In the process, the layer adds to internal resistance, causing a momentary voltage drop, which is called TMV (Transient Minimum Voltage). The voltage of cells kept under proper conditions immediately recovers to normal operational voltage after TMV. TMV varies depending on the thickness and density of the passivation layer. The higher the discharge current gets, the lower TMV becomes. The passivation layer makes the shelf life longer by effectively preventing self-discharge but it brings about TMV. Thus, this must be fully considered, when the device is designed.

## Pulse Curve of $Li/SOCl_2$ Battery



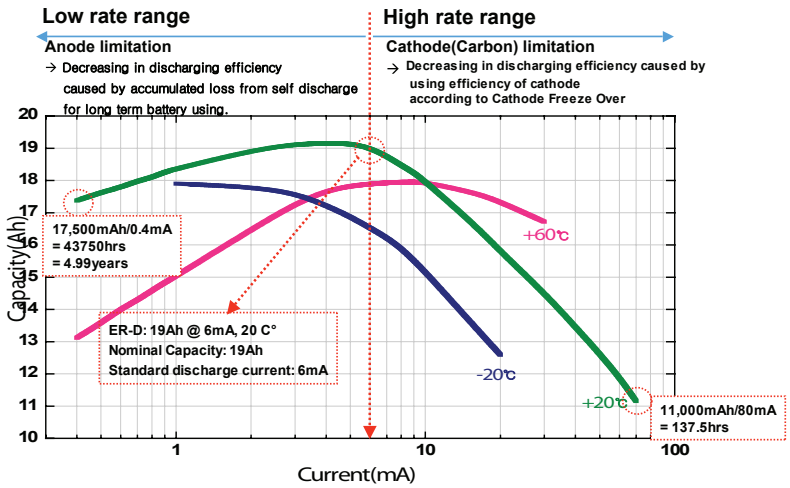

**OCV: Open Circuit Voltage**

**TMV: Transient Minimum Voltage**

**CCV: Closed Circuit Voltage**

TMV of $Li/SOCl_2$ is very changeable depending on status of Passivation Film (thickness, structure).
In this reason, checking power profile, cut-off voltage and working temperature range of application are required to suggest right battery solution. In case that high pulse current is required, using additional power source such as super capacitor could be one of considerable solution.

## Discharge Capacity of $Li/SOCl_2$ Battery




The figure shows the capacity as the discharge current about ER-D. The capacity efficiency of $Li/SOCl_2$ battery is decreased based on the standard discharge currentas the figure shows, in high rate discharge or low rate discharge.
In case of the use in low rate range, available capacity of lithium battery is decreased by accumulated self-discharge loss due to long discharge period and the main reason of ending discharge is because of depletion of lithium or $SOCl_2$. In addition, available capacity of lithium battery can be dramatically decreased at high-temperature condition because temperature affects self-discharge rate in proportion.

# 1.3 APPLICATIONS

## Utility Meters

Electricity Meters, Gas Meters, Water Meters, Calorimeters, Automatic Meter Reading (AMR).

Utility Meters

## Safety/Security Systems

Door Lockers, Security and Alarm Systems, Smoke and other Sensors and Detectors, Burglar Alarm Systems.

Security Systems

## Automotive Electronics

Mileage or Kilometer Counters, Onboard Computers, Electronic Monitoring, Navigational Equipment, Airbag Sensor and Gas Generators, Car radios, Container temperature loggers, Community Traffic Control Systems, Traffic Volume Control, Traffic Chart Recorders, Taximeters.

Toll Pass

## Asset Tracking

Personal Identification, RF-ID Transponder, Bar Code Reader, Scanner, Goods Tracking, Trailer Identification, Goods Locationing.

Asset Tracking

## Automation

Memory back-up, Intelligent Interfaces, Personal Computers, Intelligent Typewriters, Address Printers, Envelopment Franking Machines, Cash Points, Scales, Copy Machines, Cash Register.

Automation

## Vending Machines

Ticket Vending Machines, Newspaper Vending Machines, Cigarette Vending Machines, Sweet Vending Machines, Drink Vending Machines, Parking Meter.

Vending Machines

## High End Consumer

Audio and Video Memory back-up and RTC, Video Games, Gambling Machines, SCUBA Diving Meters, Altimeters, Marine Electronics, Ski Bindings, Portable Timing Units for sports events, Pigeon Flight Time Recorders.

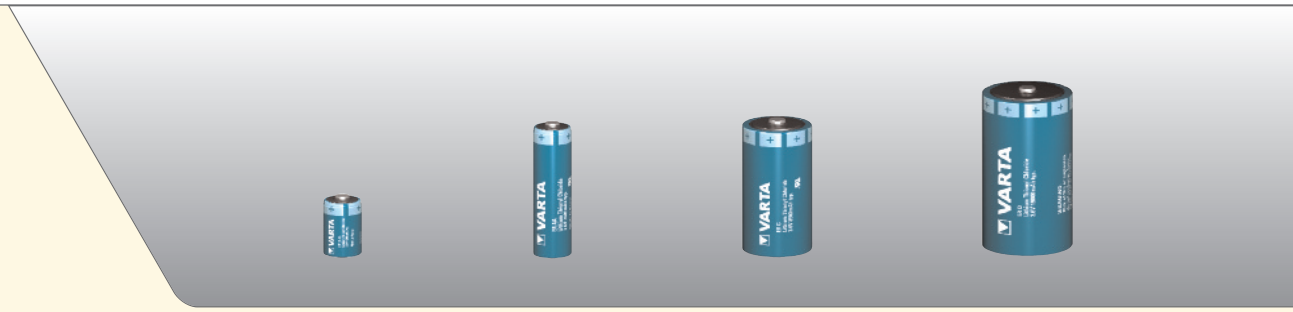
High End Consumer

## Industrial/Medical Instrumentation

Industrial Clocks, Pulse-/Event-Counters, High Voltage Power Line Fault Detectors, Remote Data Logging and Data Acquisition Systems, Seismic Measurement Equipment, Biotelemetry, Telemetry Equipment, Weather Balloon Transmitters, Automatic Weather Monitoring Stations, Compass Illumination, Caliper Pig for pipeline maintenance, Oscilloscopes, Medical Instruments, Gauges.

Industrial/Medical Instrumentation

# 2. LITHIUM THIONYL CHLORIDE CELLS




## Key Characteristics

- High and stable operating voltage
- Low self-discharge rate (less than 1% after 1 year of storage at + 20°C)
- Bobbin type
- Non-flammable inorganic electrolyte
- Hermetic glass-to-metal sealing
- UL recognized (file number MH13654(N))
- ISO9001:2000, ISO14001:2004 approved
- Size 1/2 AA, AA non-restricted for transport
- Size C, D class 9 restricted for transport

# 2.1 TYPES TECHNICAL DATA

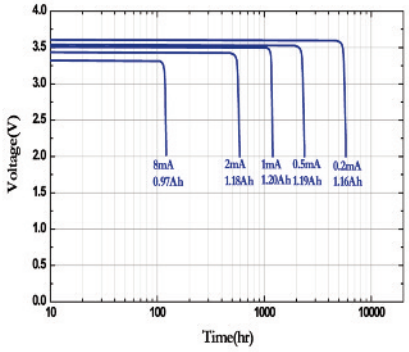
## ER 1/2 AA

### Specifications

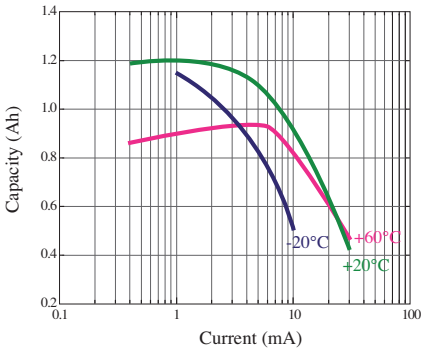
| | |
|---|---|
| Nominal voltage | 3.6 V |
| Nominal capacity (at 1 mA, 20 °C, 2.0 V cut off) | 1.2 Ah |
| Discharge current to achieve half capacity | 20 mA |
| Max. pulse discharge current | 80 mA |
| Weight | 9.0 g |
| Operating temperature range | -55 ~ 85 °C |


Max. pulse current / 0.1 second pulses, drained every 2 min at + 20 °C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions.

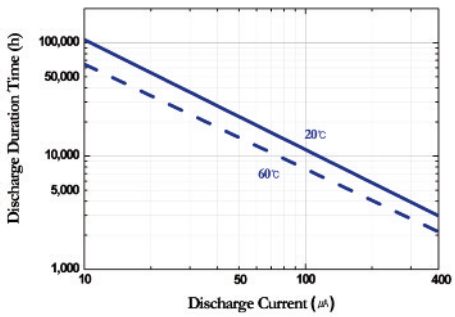
### Continuous Discharge at 20°C




### Capacity vs. Current




### Discharge Current vs. Duration Time




This data was made on basis of nominal capacity for the purpose of enabling users to forecast approximate life time.
In order to calculate precise life time under various environments, we recommend you to consult VARTA Microbattery.

**Warning**: Fire, explosion and severe burn hazard. Do not recharge, crush, disassemble, heat, above 212 °F (100 °C), incinerate, short circuit or expose contents to water. Keep battery out of reach of children and in original package until ready to use. Dispose of used batteries promptly.

**Note**: Any information given here is for reference only. Information is also dependent on actual conditions of use and does not guarantee future performance. And subject to change.

In case where the products are improved, the specifications described herein are subject to change.

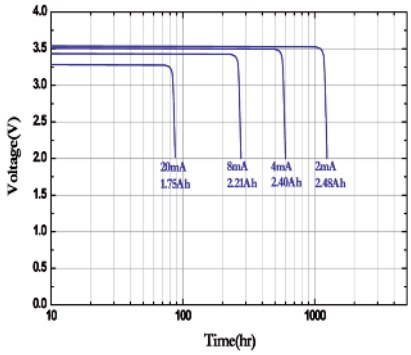
# ER AA

## Specifications

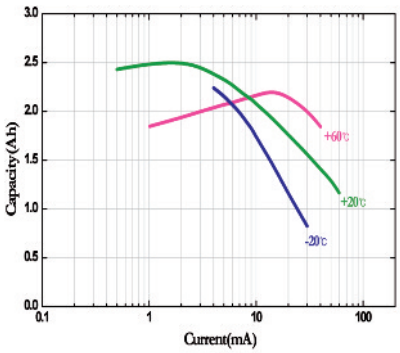
| | |
|---|---|
| Nominal voltage | 3.6 V |
| Nominal capacity (at 2 mA, 20 °C, 2.0 V cut off) | 2.5 Ah |
| Discharge current to achieve half capacity | 60 mA |
| Max. pulse discharge current | 150 mA |
| Weight | 16.0 g |
| Operating temperature range | -55 ~ 85 °C |


Max. pulse current / 0.1 second pulses, drained every 2 min at + 20 °C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions.

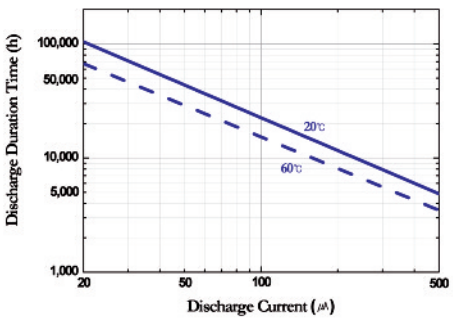
## Continuous Discharge at 20°C




## Capacity vs. Current




## Discharge Current vs. Duration Time

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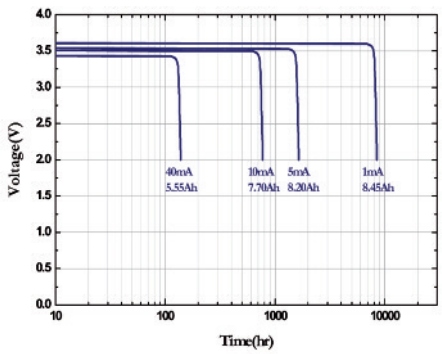
# ER C

## Specifications

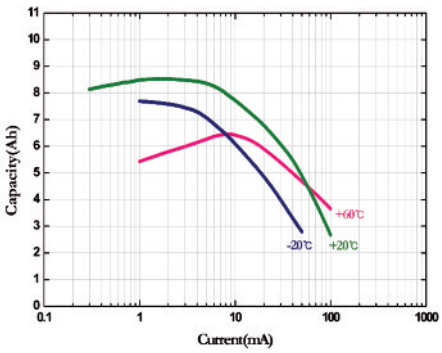
| | |
|---|---|
| Nominal voltage | 3.6 V |
| Nominal capacity (at 4 mA, 20 °C, 2.0 V cut off) | 8.5 Ah |
| Discharge current to achieve half capacity | 80 mA |
| Max. pulse discharge current | 180 mA |
| Weight | 51.0 g |
| Operating temperature range | -55 ~ 85 °C |


Max. pulse current / 0.1 second pulses, drained every 2 min at + 20 °C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions.

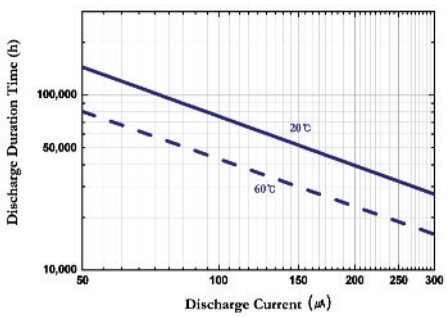
## Continuous Discharge at 20°C




## Capacity vs. Current




## Discharge Current vs. Duration Time

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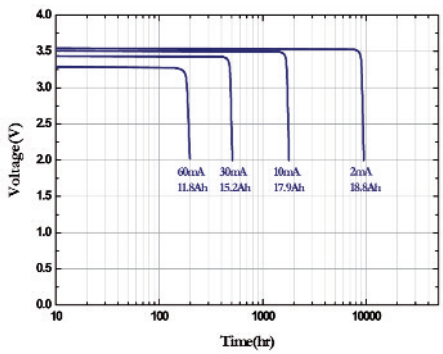
# ER D

## Specifications

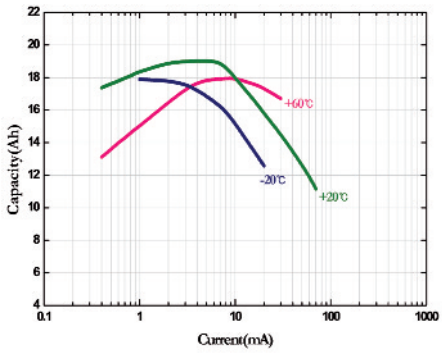
| | |
|---|---|
| Nominal voltage | 3.6 V |
| Nominal capacity (at 6 mA, 20 °C, 2.0 V cut off) | 19.0 Ah |
| Discharge current to achieve half capacity | 100 mA |
| Max. pulse discharge current | 250 mA |
| Weight | 100.0 g |
| Operating temperature range | -55 ~ 85 °C |


Max. pulse current / 0.1 second pulses, drained every 2 min at + 20 °C from undischarged cells with 10 µA base current, yield voltage readings above 3.0 V. The readings may vary according to the pulse characteristics, the temperature, and the cell's previous history. Fitting the cell with a capacitor may be recommended in severe conditions.

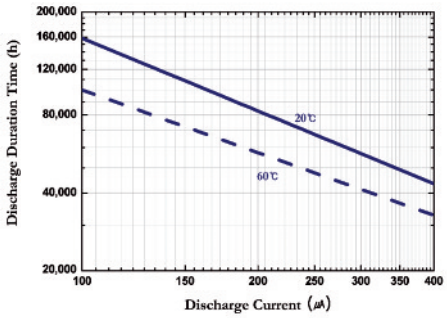
## Continuous Discharge at 20°C




## Capacity vs. Current




## Discharge Current vs. Duration Time

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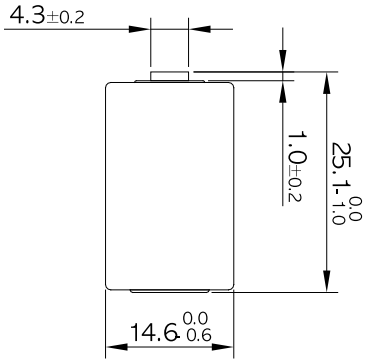
# 2.2 ASSEMBLIES

## ER 1/2 AA

### Standard Battery Assembly Version Overview

| Article Designation | Order No. |
|---|---|
| ER 1/2 AA S | 7126 101 511 |
| ER 1/2 AA ST | 7126 301 301 |
| ER 1/2 AA PCBS | 7126 701 301 |
| ER 1/2 AA PCBD-7.5N | 7126 201 382 |
| ER 1/2 AA PCBD-7.5 | 7126 201 302 |
| ER 1/2 AA PCBD-10.0N | 7126 201 381 |
| ER 1/2 AA CD | 7126 501 301 |

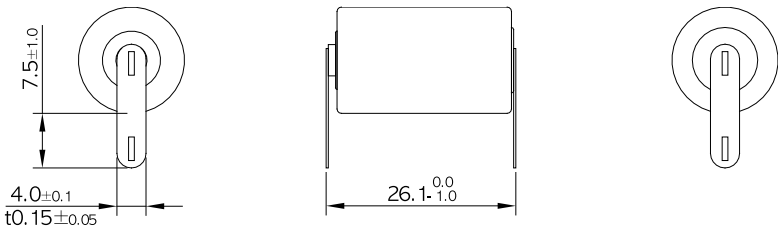

### Scheme



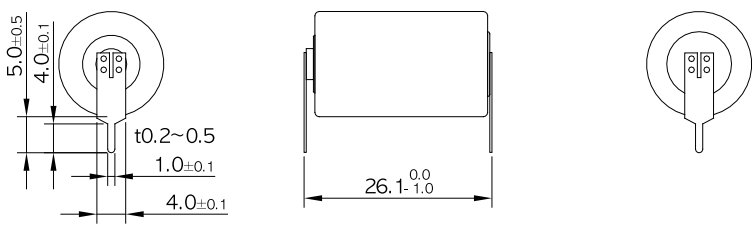

ER 1/2 AA S
Shrink Sleeve
Version

### Battery Dimension

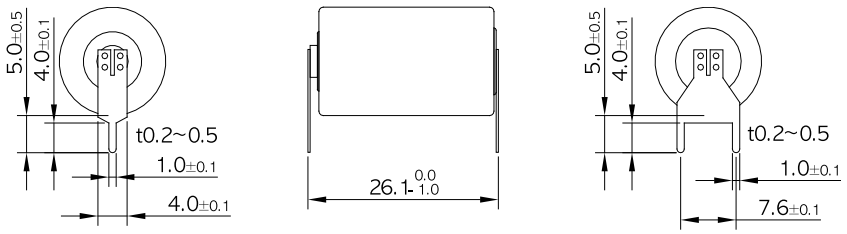
ER 1/2 AA ST
Solder Tag Version



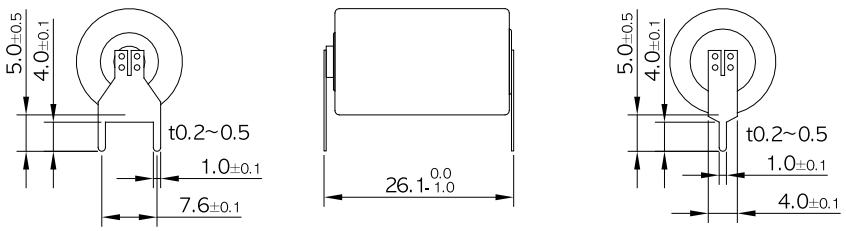

ER 1/2 AA PCBS
Single Tag Version



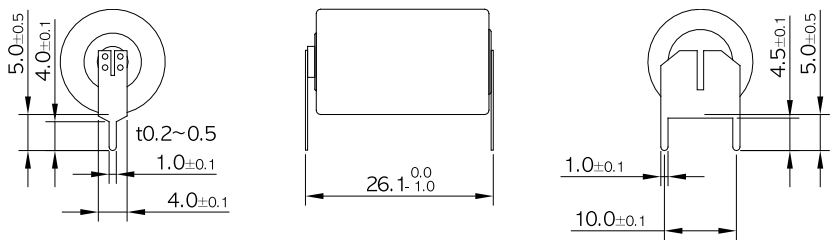
ER 1/2 AA PCBD-7.5N
Single Double (7.5)
Tag Version
Non Std Polarity



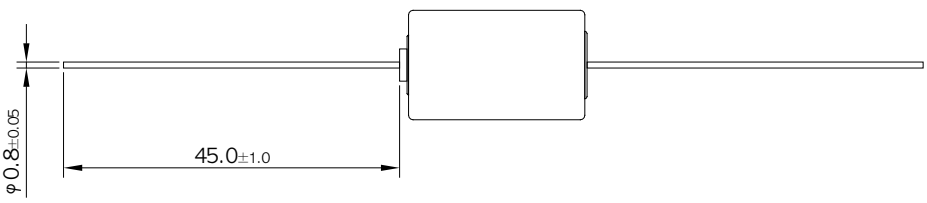

ER 1/2 AA PCBD-7.5
Single Double (7.5)
Tag Version




ER 1/2 AA PCBD-10.0N
Single Double (10.0)
Tag Version
Non Std Polarity




ER 1/2 AA CD
Contact Disc + wire

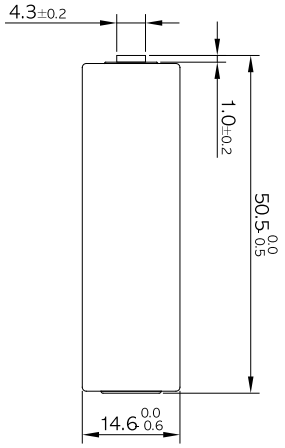


# ER AA

## Standard Battery Assembly Version Overview

| Article Designation | Order No. |
|---|---|
| ER AA S | 7106 101 511 |
| ER AA ST | 7106 301 301 |
| ER AA PCBS | 7106 701 301 |
| ER AA PCBD-7.5N | 7106 201 382 |
| ER AA PCBD-7.5 | 7106 201 302 |
| ER AA PCBD-10.0N | 7106 201 381 |
| ER AA CD | 7106 501 301 |

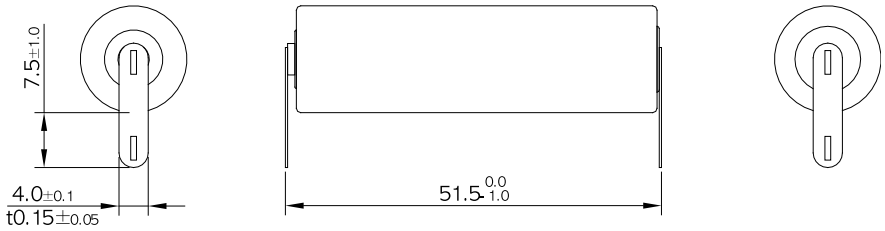

## Scheme



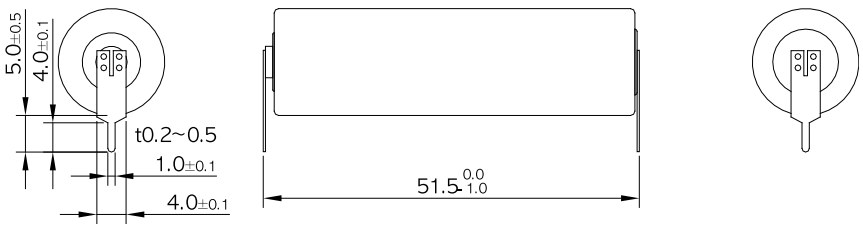

ER AA S
Shrink Sleeve
Version

## Battery Dimension

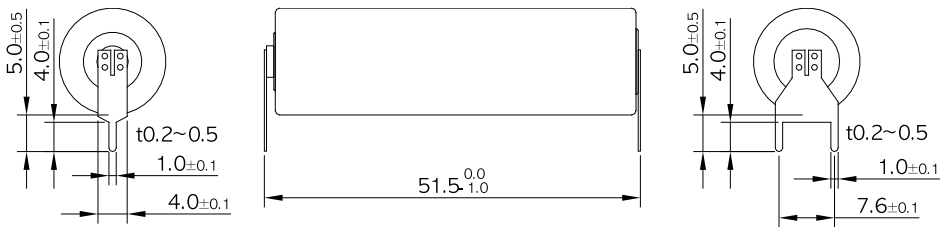
ER AA ST
Solder Tag Version




ER AA PCBS
Single Tag Version

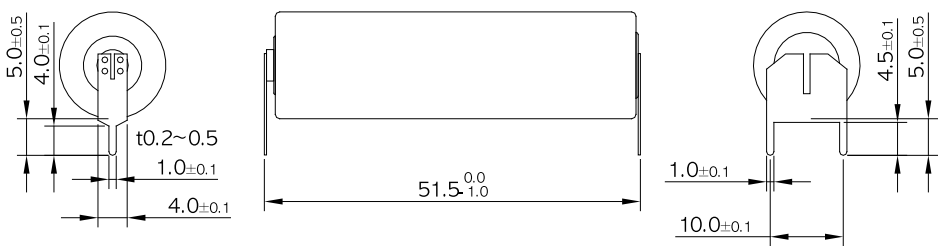


ER AA PCBD-7.5N
Single Double (7.5)
Tag Version
Non Std Polarity

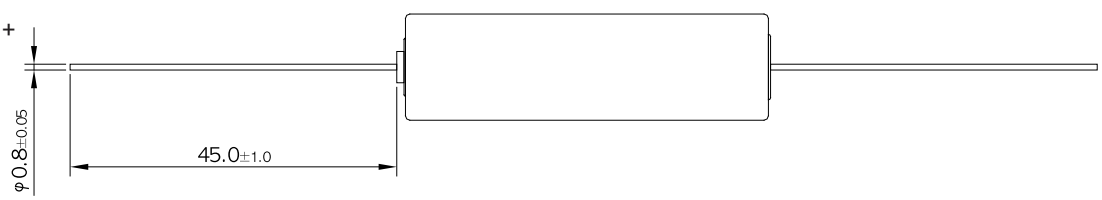



ER AA PCBD-7.5
Single Double (7.5)
Tag Version


ER AA PCBD-10.0N
Single Double (10.0)
Tag Version
Non Std Polarity




ER AA CD
Contact Disc +
wire

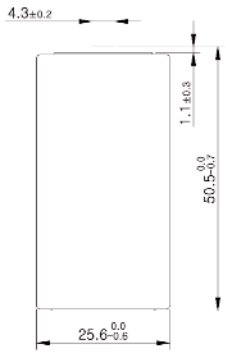


# ER C

## Standard Battery Assembly Version Overview

| Article Designation | Order No. |
|---|---|
| ER C S | 7114 101 511 |
| ER C ST | 7114 301 301 |
| ER C CD | 7114 501 301 |

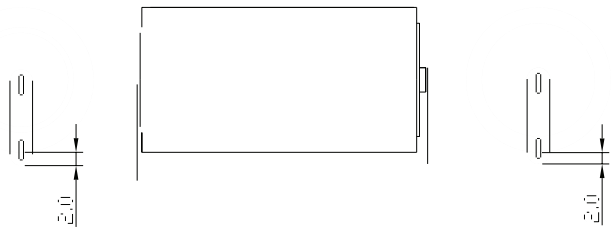

## Scheme



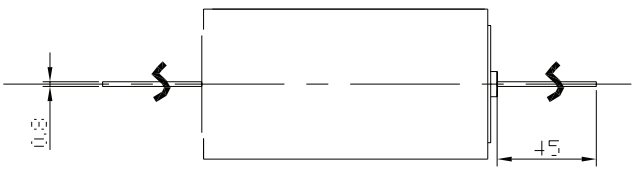

ER C S
Shrink Sleeve
Version

## Battery Dimension

ER C ST
Solder Tag Version




ER C CD
Contact Disc + wire

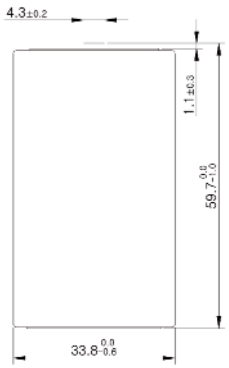


# ER D

## Standard Battery Assembly Version Overview

| Article Designation | Order No. |
|---|---|
| ER D S | 7120 101 511 |
| ER D ST | 7120 301 301 |
| ER D CD | 7120 501 301 |

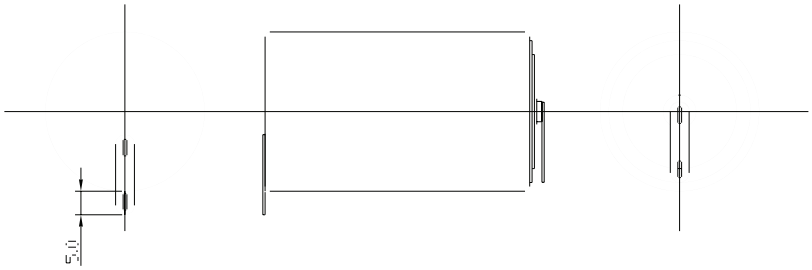

## Scheme



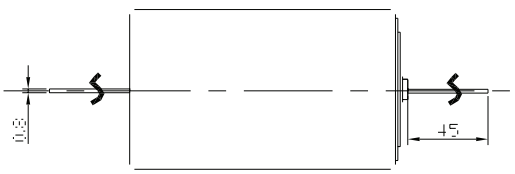

ER D S
Shrink Sleeve
Version

## Battery Dimension

ER D ST
Solder Tag Version




ER D CD
Contact Disc + wire



# 3. GENERAL DESIGN CHARACTERISTICS

## 3.1 CELL ORIENTATION

According to the cell orientation, the capacity during discharge can be affected because of the different position of electrolyte and amount against lithium and cathode. There are three possible cell orientations when the cell is installed to the applied device as figure among.

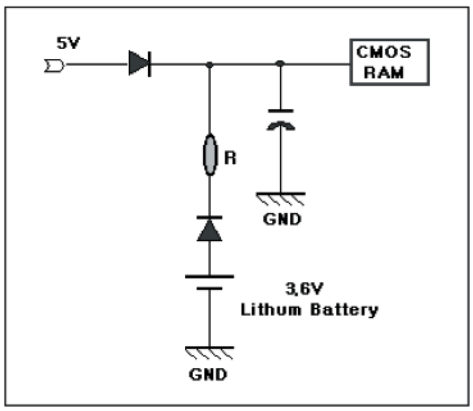
Upright Horizontal Upside down


- Under upright installation, the capacity is not affected whether discharge current is high, nominal or low.
- Under horizontal installation, the capacity of smaller size (1/2 AA, AA) is not affected whether discharge current is high, nominal or low. The capacity of bigger size (C, D) cannot be affected when discharge current is low or normal but it can be affected when discharge current is high. (About 15~30% of capacity reduction at higher discharge current will be expected.)
- Under upside down installation, the capacity of smaller size (1/2 AA, AA) is less affected whether discharge current is high, nominal or low. However, the capacity of bigger size (C, D) especially at higher discharge current is affected. Under upside down installation, the lithium and cathode is located in a fixed area whereas the electrolyte falls to the bottom in this case. At the top of the cell there is a space leaving an area of the anode and cathode, not covered by the electrolyte. Bigger size cells have a bigger empty space, so the capacity decrease in upside down installation is higher than in cells of smaller size. (About 20~40% of its capacity at same higher discharge current.)

## 3.2 CIRCUIT DESIGN FOR MEMORY BACK-UP

VARTA lithium batteries are recognized and accepted by UL with file No. MH28122. Underwriter's Laboratories (UL) recommends the following circuit design requirements to use VARTA lithium batteries.

VARTA lithium cells should not be connected in series with an electrical power source that would increase the forward current through the cells. Figure among is a generally recommended circuit design for memory back-up using VARTA lithium batteries.




General Circuit Design of Memory Back-up

The circuit for these cells shall include one of followings:

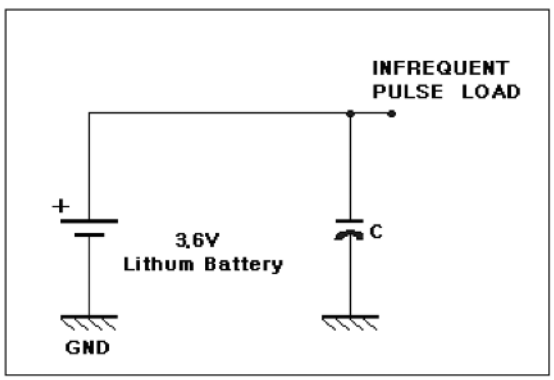
- Two suitable diodes or the equivalent are connected in series with the cells to prevent any reverse (charging) current. The second diode is used to provide protection in the event that one should fail. Quality control, or equivalent procedures, shall be established by device manufacturer to insure the diode polarity is correct for each unit, or
- A blocking diode or the equivalent to prevent any reverse (charging) current and a resistor to limit the current in case of a diode failure. The resistor should be sized to limit the reverse (charging) current to the maximums shown below.

| Model | Maximum |
|---|---|
| ER 1/2 AA | 15 mA |
| ER AA | 15 mA |
| ER C | 15 mA |
| ER D | 150 mA |

The storage, handling, and disposal of these cells should be in accordance with the "Warning Notice" which is printed on VARTA cells as follows:
"WARNING: Fire, explosion, and severe burn hazard. Do not recharge, crush, disassemble, heat above 100°C (212°F), incinerate, or expose contents to water."

## 3.3 CAPACITOR SUPPORT

It is normal that the internal resistance of a lithium battery can be increased after long storage without an appropriate discharge rate or very irregular but higher pulse discharge. The internal resistance can also be dramatically increased when the discharge with smaller continuous load is performed for several years (around 80% of capacity discharge). The full capacity of the lithium battery cannot be supplied by the end of lifetime because the operating voltage can drop caused by increased internal resistance under long discharge.
In addition, under higher current levels Voltage Delay Curves or under lower operating temperatures, TMV drop can be severe and operating voltage can be reduced.
In that case, VARTA recommends using batteries with capacitor support to maximize performance by the end of service life.




Typical Design of Capacitor Support

Formula to choose capacitor value can be suggested by capacitor manufacturers as follows;

Type of Capacitor: Electrolytic capacitor, Super Capacitor, Gold Capacitor
Formula for Capacitor Size: $C = U / R \times t / \Delta V$
C: Capacitor
U: Basic voltage (working voltage under basic current)
$R = R_L + R_C$
RL: Resistance of load circuit (voltage / pulse current)
RC: Internal resistance of capacitor C (mΩ value with small effect)
t: Back-up time
ΔV: Allowed voltage drop

In actual case, customers shall choose a capacitor size with about 2 times of the above calculation to cover various environmental conditions sufficiently.
There is some leakage current in the capacitor and it could be related to the consumption of battery capacity. It is normally small but must be taken into account against battery capacity.

## 3.4 BATTERY ASSEMBLY

The work of battery assembly requires experience. Customers who are not qualified in battery assembly should not attempt to assemble batteries. Especially, Li-$SOCl_2$ batteries which have a glass-to-metal sealing around the head terminal and a bottom insulator inside the bottom case, so careful assembly is necessary to avoid any mechanical damage or problem. VARTA cannot take any responsibility for quality problems caused by incorrect battery assembly. Therefore, please let VARTA or a qualified assembler assemble batteries for you.

## 3.5 SOLDERING

VARTA provides batteries with various terminal types to mount cells to printed circuit boards by soldering. VARTA's terminals are made of nickel and some are pre-soldered with SnPb around the tips of the terminal for easier soldering.

Following are the available soldering methods. More information can be available upon request.

### Hand Soldering

Using manual soldering iron by skilled persons.

Precautions

- Do not allow soldering iron to contact the body of the battery because of higher generation of battery heat.
- Finish the soldering work on a termination within a short period of time (max. 5 sec.)
- Do not overheat battery during soldering.

### Wave Soldering

Using automatic soldering baths on a mass-production line.

**Precautions**

- Do not drop cells in the solder bath.
- Keep the temperature of solder bath within 260~280°C.
- Dipping time shall be within 5 sec.
- Do not overheat battery during soldering.

# 4. SAFETY TESTS

## 4.1 GENERAL

Basically, VARTA lithium batteries are safely designed to endure various environmental conditions. The design of the hermetically seal rim and the glass-to-metal welding can give the battery high endurance in various environmental conditions such as variant temperatures, humidity and vibration. Also, the position of lithium against the inner wall of the cell case makes heat dissipated to the outside easier when inside heat is generated. Therefore, there is no concern over safety when the suggested cautions are followed during usage, handling or storage.

However, there might be some possibilities of mishandling or misuse by the customer. Thus, following simulation tests have been performed. The test conditions are based on the procedures of the UL standard tests and Military Standards for environmental and safety testing. The abnormal test is only carried out to check the behavior of the batteries under misuse conditions and make certain the batteries react in a safe manor.

## UL-Recognition

All **VARTA** Microbattery Lithium Cells and Batteries listed below are recognized by Underwriters Laboratories Inc. under UL-file number MH13654(N).

The cells are marked with the Recognized Component Mark.

Underwriters Laboratories requires for lithium cells/ batteries a circuit, which must contain a protective component to prevent charging. In case of diode failure a current limiting resistor must be chosen according to the values listed in Tab. below.

Please also pay attention to the Safety Guidelines on the Material Safety Datasheet at www.varta-microbattery.com.

For safety tests of the cells, “UL” requires either an additional diode, or a resistor, limiting the current to a safe level as “portable“.

It should be noted that the value of the resistor has to be calculated using the higher power supply voltage – not the battery voltage.

The supply voltage to the load can be calculated by the battery voltage drop across the diode and the resistor.

## Printed Circuit Board Mounting

Never solder on the body of the battery directly, use a battery equipped with PC-mount terminals. When using automatic soldering apply 260–280 °C within 5 seconds. Make sure that the battery is not suspended or dropped into the soldering bath.

Do not heat above 80 °C to avoid leakage caused by deterioration in the battery’s performance.

Trademark of Underwriters Laboratories

| Model | Primary Type (a) | Max. Abnormal Charging Current, mA | Max. Charge Voltage | Replacement (b), (c) |
|---|---|---|---|---|
| ER 1/2 AA | Lithium/thionyl chloride | 15 | 12 | Technician |
| ER AA | Lithium/thionyl chloride | 15 | 12 | Technician |
| ER C | Lithium/thionyl chloride | 15 | 4.2 | Technician |
| ER D | Lithium/thionyl chloride | 150 | 4.2 | Technician |

(a) These cells and batteries are not rechargeable. The circuit containing these cells or batteries is to contain a protective component which prevents charging. The circuitry is to include a current-limiting component intended to protect the cell or battery, in the event the protective component malfunctions, from a charging current in excess of the maximum abnormal charging current indicated.

(b) Technician – These cells and batteries are intended for use in applications subject to replacement only by a trained service.

(c) The Max. Charge Voltage noted in the column is the maximum voltage employed during the abnormal charging test of the secondary lithium cell. However, the maximum recommended charging voltage for lithium cells is 4.2 V, unless indicated otherwise in the individual Recognitions.

Marking: Company name, model designation, date of manufacture and the Recognized Component Mark on the individual cell/battery or the smallest shipping container.

## 4.2 TRANSPORTATION OF VARTA MICROBATTERY LITHIUM CELLS AND BATTERIES

Please see http://www.varta-microbattery.com/top/trans-safe for lastest information about Transportation, Safety and Recycling Note for Batteries

### 4.2.1 ADR/RID AND IMDG-CODE SPECIAL PROVISION 188

"Cells and batteries offered for transport are not subject to other provisions of these Regulations if they meet the following:

- For a lithium metal alloy cell, the lithium content is not more than 1 g;
- For a lithium metal battery the aggregate lithium content is not more than 2 g;
- Each cell or battery is of the type proved to meet the requirements of each test in the Manual of Tests and Criteria, Part III, sub-section 38.3;
- Cells and batteries, except when installed in equipment, shall be packed in inner packagings that completely enclose the cell or battery. Cells and batteries shall be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit. The inner packagings shall be packed in strong outer packagings which conform to the provisions of 4.1.1.1, 4.1.1.2, and 4.1.1.5 (IATA DGR packaging instruction 968 part 1).
- Cells and batteries when installed in equipment shall be protected from damage and short circuit, and the equipment shall be equipped with an effective means of preventing accidental activation. When lithium batteries are installed in equipment, the equipment shall be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained;
- Except for packages containing no more than four cells installed in equipment or no more than two batteries installed in equipment, each package shall be marked with the following:
  – an indication that the package contains "lithium metal" cells or batteries;
  – an indication that the package shall be handled with care and that a flammability hazard exists if the package is damaged;
  – an indication that special procedures shall be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  – a telephone number for additional information;
- Each consignment of one or more packages marked in accordance with paragraph shall be accompanied with a document including the following:
  – an indication that the package contains "lithium metal";
  – an indication that the package shall be handled with care and that a flammability hazard exists if the package is damaged;
  – an indication that special procedures shall be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  – a telephone number for additional information;

- Except when lithium batteries are installed in equipment, each package shall be capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell to cell) contact and without release of contents; and
- Except when lithium batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass."

As used above and elsewhere in these Regulations, "lithium content" means the mass of lithium in the anode of a lithium metal cell. Separate entries exist for lithium metal batteries to facilitate the transport of these batteries for specific modes of transport and to enable the application of different emergency response actions.

### Labeling and marking

Labeling of the goods to be dispatched e.g.:


Upon every transport of lithium batteries the delivery note must show the following:
CAUTION!
Lithium Batteries! Handle with care!
### not restricted – no dangerous goods transport ###
According SP 188 ADR/RID/IMDG-Code;
IATA Packing instruction 965 Part 1 for Lithium Ion Batteries and Packing instruction 968 Part 1 for Lithium Metal Batteries
If package is damaged, batteries must be quarantined. Inspected and repacked.
For Emergency information call:
+49 (7961) 921110 (USA: 011 49 7961 921110)

## 4.2.2 IATA (AIR TRANSPORT)

Transportation of batteries has to follow Packing Instruction 968 Part 1:

„Lithium metal cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the following requirements:

- A lithium metal cell, the lithium content is not more than 1g;
- A lithium metal battery, the aggregate lithium content is not more than 2 g;
- Each cell or battery is of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3.
- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery. Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Cells and batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein; shifting of the contents so as to allow battery to battery (or cell to cell) contact; release of contents.

- The gross quantity per package is max 2.5 kg. Each package must be labelled with a lithium battery handling label (Figure as below)."


CAUTION!
Lithium Metal Batteries! Handle with care! ### not restricted – no dangerous goods transport ### according IATA Packing instruction 968 Part 1 for Lithium Ion Batteries."
Transportations of Cells or Batteries packed with equipment or contained in equipment have to follow Packing Instructions 969 Part 1 or 970 Part 1.

## 4.2.3 DANGEROUS GOODS TRANSPORT OF BATTERIES

This chapter is valid for products with cells of types ER C and ER D.

### 4.2.3.1 ADR/RID AND IMDG-CODE FOR BATTERIES EXCEEDING THE LIMITS OF SP188

- Batteries have to be transported as Dangerous Goods, class 9.
- Lithium metal batteries UN 3090, lithium metal batteries packed with equipment or contained in equipment UN 3091.
- Each cell or battery is of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3.
- Each packaging must comply with the UN specification packagings, and must be labelled and packed according the requirements of Packing Instruction 903.

### 4.2.3.2 IATA FOR BATTERIES EXCEEDING THE LIMITS FROM PACKING INSTRUCTION 968 PART 1

- Lithium metal batteries have to be transported as Dangerous Goods according to Packing Instruction 968 Part 2, class 9 UN 3090
- Each cell or battery is of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3.
- Each packaging must comply with the UN specification packagings, and must be labelled and packed according the requirements of Packing Instruction 968 Part 2.
- Transportations of cells or batteries packed with equipment or contained in equipment have to follow Packing Instructions 969 Part 2 or 970 Part 2, class 9 UN 3091

## 4.2.4 TRANSPORTATION OF PRIMARY LITHIUM BATTERIES IN THE U.S.A.

Effective December 29, 2004, the DOT requires that the outside of each package that contains primary lithium batteries, regardless of size or number of batteries, be labeled with the following statement: "PRIMARY LITHIUM BATTERIES – FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT". The labeling requirement covers shipments via highway, rail, vessel or cargo-only aircraft and covers all shipments inside, into or out of the US. The label must be in contrasting color and the letters must be 12 mm (0.5 in) in height for packages weighing more than 30 kg and 6 mm (0.25 in) in height for packages weighting less than 30 kg.

## 4.2.5 GENERAL REMARK

The exemptions from dangerous goods regulations are only applicable with respect to the delivery form in which the products are dispatched by VARTA Microbattery. Any re-packaging or assembly of cells is in the responsibility of the customer. Especially in the case of lithium systems new safety tests may be necessary; note that the maximum amount of lithium according to special provisions 188 (ADR/RID/IMDG-Code) or Packaging Instruction 965 Part 1 (IATA) may be exceeded as a consequence of assembly.

The given emergency number is only valid for transports initiated by VARTA Microbattery.

# 4.3 OEM – APPLICATION CHECK LIST

## 1. PROJECT INFORMATION

| | |
|---|---|
| From (Writer) | Sales Agreement |
| Customer | Application |
| Name of the project | Country |

## 2. MARKETING DATA

| | |
|---|---|
| Yearly expectation of sales | Per batch of |
| Estimated selling price | Expected data of first order |
| Lifetime of the project | Start of volume production |
| Competitors | |
| Yes ☐ No ☐ | |
| Substitution of existing product | Which |
| Comments | |

## 3. WHAT IS REQUIRED?

| | | | Reply wishes for | Reply provided for |
|---|---|---|---|---|
| Feasibility study, preliminary proposal | Yes ☐ | No ☐ | | |
| Technical proposal | Yes ☐ | No ☐ | | |
| Preliminary drawing | Yes ☐ | No ☐ | | |
| Samples to run electric tests | Yes ☐ | No ☐ | | |
| Samples (with dummy cells) | Yes ☐ | No ☐ | | |
| Prototypes (for qualification by the customer) | Yes ☐ | No ☐ | | |
| Preliminary cost estimation (+/- 20%) | Yes ☐ | No ☐ | | |
| Development and industrial cost estimation | Yes ☐ | No ☐ | | |
| Product cost estimation (+/- 5%) | Yes ☐ | No ☐ | | |

## 4. TECHNICAL REQUIREMENTS

### 4.1. Storage before use

Duration | Temperature min. | Average | max.

Humidity

### 4.2. Storage into the device before operating

Duration | Temperature min. | Average | max.

Humidity

### 4.3. Specific tests prior incorporation

### 4.4. Electric data

Required minimum life time in use

Maximum voltage | Nominal capacity

Cut off voltage | Required minimum capacity

Current profile (average current, current pulse strength, pulse duration, pulse rate…)

Others

### 4.5. climatic data

Operating temperature min. | Average | max.

Humidity

Others

## 4.6. Mechanical data (vibration, drop, bump, shock, …)

Mention the applicable specification and enclose the document if necessary

## 4.7. Available dimensions: (weight, volume, if possible enclose the user drawing of the prospect)

## 4.8. Assembly (describe or enclose a drawing)

## 4.9. Applicable specifications / standards

UL ☐ BS UN ☐ IEC86-4 ☐ Other ☐

Reference and issue

## 4.10. Reliability level – Guarantees

## 4.11. Labeling and Packaging

VARTA standard labeling and packaging ☐

Customised labeling ☐ (enclose the customer specification)

Customised packaging ☐ (enclose the customer specification)

## 4.12. Attached documents

Samples ☐ Competitor samples ☐ Drawing ☐ Specification of the customer ☐

Copy of specific standards ☐ Samples of connector ☐ Samples of specific components ☐ Other ☐

## 4.13. Additional information

## Product Portfolio

| Primary Batteries | | | | | |
|---|---|---|---|---|---|
|  | Silver Oxide Button Cells |  | Lithium-Manganese Cells<br>Lithium-Thionyl-Chloride Cells |  | Zinc Air Cells |
|  | Alkaline Batteries |  | Lithium Button Cells | | |
| **Rechargeable Batteries** | | | | | |
|  | Li-Polymer |  | NiMH Button Cells<br>(V...H / HR / HT / HRT) |  | Cylindrical & Prismatic<br>Li-Ion & NiMH Cells |

## Contacts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For e-mail contact please visit: http://contact.varta-microbattery.com.

**www.varta-microbattery.com**

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