

VARTA Handling Precautions and Prohibitions for VARTA CoinPower Cells and Batteries

PREFACE

Lithium batteries provide a high energy density which is often combined with a high-rate capability to the benefit of the customer. Due to these excellent performance properties, lithium batteries contain a certain safety risk. If short-circuited, heat and sometimes sparks may be generated. Mistreatment beyond the recommended limits can cause gas generation, leakage and fire.

This guideline "Handling Precautions and Prohibitions for VARTA CoinPower Cells and Batteries" shall be applied to all VARTA Lithium Ion CoinPower Cells and / or Batteries provided by VARTA Mircobattery GmbH or one of its affiliated companies (hereinafter called "VARTA") in its respective valid version. It shall be brought to the attention of all persons who handle those.

The respective valid version is available under <https://www.varta-ag.com/uk/industry/product-solutions/lithium-ion-button-cells>.

Notes

- The customer is requested **to contact VARTA in advance**, if and when the customer uses VARTA CoinPower Cells or Batteries in other Application Devices or applies **different operating conditions than those described in this document**. In this case additional tests and experiments may be necessary to verify performance and safety under such conditions. VARTA shall not be responsible for safety, performance, functionality, compatibility or fitness for a particular purpose unless such features have been expressly communicated, described and agreed in the specification.
- VARTA will take **no responsibility** for any accident when the Cell or Battery is used under **other conditions than those described in this document**.
- VARTA will inform the customer of improvement(s) regarding proper use and handling of the Cell or Battery, if deemed necessary.
- Cells or Batteries shall not be modified or opened without prior written approval by VARTA.
- Cells and Batteries are NOT intended for **resale to or use by consumers / end customers**.
- Definition of the terms used in this document:
 - "Cell" means the bare Lithium Ion CoinPower cell without any tags or wires.
 - "Battery" means an assembled Lithium Ion CoinPower cell with tags or wires or other assembly configurations. Battery may consist of one or several cells.
 - "Application Device" means the product that VARTA's customer designs and assembles using VARTA's Cell or Battery. The Application Device can be a sub-module or a complete end product sold to the consumer/end customer.

1. Charging

1.1. Charging current

Charging current should **not exceed maximum charge current** specified in the applicable data sheet.

Charging with higher current than recommended may cause damage to performance and safety features and can lead to **heat generation or leakage**.

1.2. Charging voltage

A3/A3X:

Charging at above 4.250 V, which is the absolute maximum voltage, is strictly prohibited. The charging has to be done according to the applicable data sheet. The charger shall be designed accordance with this condition. Use specified charger only.

A4/A4X/A5X:

Charging at above 4.350 V, which is the absolute maximum voltage, is strictly prohibited. The charging has to be done according to the applicable data sheet. The charger shall be designed accordance with this condition. Use specified charger only.

Charging with higher voltage than specified may cause damage to performance and safety features, and can lead to **fire, heat generation or leakage**.

1.3. Charging temperature

The Cell or Battery shall be charged within the range of specified temperatures in the applicable data sheet. If the Cell or Battery is charged at a temperature out of the specified range, **leakage, heat generation, or other damages** may occur.

Repeated charging and discharging at high and low temperature may cause degradation of performance even within the specified temperature range.

1.4. Prohibition of reverse charging

Reverse charging is prohibited. The Cell or Battery shall be connected correctly. The polarity has to be confirmed **before connecting** any wires.

Reverse charging will cause damage to the Cell or Battery and will lead to a loss of performance and safety (*including heat generation or leakage*).

1.5. Prohibition of trickle charging or continuous charging

Trickle charging or continuous charging is prohibited. Trickle charging conditions or continuous charging can lead to overcharging, generation of internal pressure and degeneration of the Cell or Battery.

The Cell or Battery shall be charged with constant current until 4.3 V ± 50 mV, then with constant voltage and tapering current. At approx. 0.02 C current the charging must be stopped. Charging should restart only if appreciable capacity has been discharged from the Cell or Battery, or the Cell or Battery voltage has dropped itself to below a voltage level of 4.0 V.

2. Discharging

2.1. Discharge current

The Cell or Battery shall be discharged at **less or equal than the maximum discharge current** specified in the applicable data sheet.

High discharge current may reduce the discharging capacity significantly, or cause **overheating**.

2.2. Discharge temperature

The Cell or Battery shall be discharged within the temperature range that is specified in the applicable data sheet.

2.3. Overdischarging

Not using the Cell or Battery for a long time may lead to overdischarge. In order to prevent overdischarging, the Cell or Battery shall be charged periodically to maintain a voltage in the range of 3 V to 3.8 V.

Overdischarging may cause loss of performance, or damage battery function. The Application Device shall be equipped with a device to prevent further discharging below the **cutoff voltage** specified in the applicable data sheet.

PCM overdischarge detection threshold/voltage **must not** be used **as cut-off voltage** for Cell or Battery.

Also, the charger shall be equipped with a device to control the recharging procedures as following:

In case of overdischarging, recharging of the Cell or Battery shall start with a low current (0.01 – 0.07 C) for 15-30 minutes, i.e. precharging, before rapid charging starts. The charging according to the applicable data sheet shall be started after the individual Cell or Battery voltage has risen above about 3 V within 15-30 minutes, which can be determined and controlled by the use of an appropriate timer for precharging.

In case the individual Cell or Battery voltage does not rise to about 3 V within the precharging time, the charger shall have functions to stop the further continuous charging and display that the Cell or Battery is/are in an abnormal state.

3. Protection Circuit Module (PCM)

3.1. Requirements of PCM

The Cell or Battery shall be provided with a **PCM** which can protect Cell or Battery properly, e.g. in case of failing Charge Control Circuit.

PCM shall have functions of (i) overcharging prevention, (ii) over-discharging prevention, and (iii) over current prevention, to maintain safety and prevent significant deterioration of Cell or Battery performance. The overcurrent can occur by external short circuit.

3.2. Overdischarge Prohibition

Overdischarge prevention function shall work to minimize dissipation current to avoid further drop in Cell or Battery voltage to below 2.0 V.

It is recommended that the dissipation current of PCM shall be designed to be minimized to 0.5 microamperes or less after the overdischarge prevention function activates in order to minimize effects on shelf life of the battery.

In case the individual Cell or Battery voltage has dropped to below 2.0 V, PCM shall have functions to disconnect the Cell or Battery from electronic circuit and Cell or Battery shall not be recharged in any case.

4. Application Device

4.1. General requirements

Cells and Batteries approved by UL (File MH13654) shall be used at ordinary temperatures where anticipated high temperature excursions are not expected to exceed 60° C. Nevertheless, under reasonably foreseeable misuse conditions at temperatures up to 85°C over 4 hours no safety risk occurs.

4.2. Technician replaceable appliances

VARTA's Cells and Batteries do not fulfil the requirements of being replaceable by a consumer or an end customer, as the reverse polarity installation cannot be prevented. Therefore, the VARTA Cells or Batteries can be used only in Application Devices where servicing of the battery circuit and replacement of the Cell or Battery will only be done by a trained technician.

a) The instruction manual supplied with the Application Device shall contain the following warning notice:

- „Replacement of Cell or Battery has to be done by a trained technician. For replacement, only Cell or Battery with (battery manufacturer's name or manufacturer's name of Application Device), Part No. () may be used. Use of another Cell or Battery may present a risk of fire or explosion.“

or

„The Cell or Battery used in the (Application Device's name) must be replaced at (manufacturer of Application Device) service center only.“

- Caution: The Cell or Battery used in this Application Device may present fire or chemical burn hazard if mistreated. Do not disassemble, heat above 100 °C (212°F) or incinerate.

- „Dispose of used Cell or Battery by properly considering and following the local laws and rules. Keep away from children and disabled people – harmful if swallowed!“
- WARNING: Risk of Fire, Explosion, and Burns. Do Not Disassemble, Crush, Heat above 100°C (212°F), Short-Circuit or Incinerate.

5. Storage

5.1. Storage of cells and batteries

The Cells or Batteries shall be stored within a **proper temperature range** as specified in the applicable data sheet. The state of charge shall be 30% of the nominal capacity; open circuit voltage OCV about 3.6 V. When stored for a long time, care has to be taken that the voltage has not dropped to below the cut-off voltage due to self-discharge (see 2.3).

5.2. Storage of assembled Cells and Batteries in Application Device

The assembled Cells and Batteries in Application Devices shall be stored within a **proper temperature range** as specified in the applicable data sheet. When stored for a long time, care has to be taken that the Cell or Battery voltage in Application Device has not dropped to below the cut-off voltage due to self-discharge (see 2.3).

For normal storage, the temperature should be between +10 °C and +25 °C and never exceed +35 °C. For short exposition (e.g. during transport) temperature may be in the range of –20 °C to +60 °C.

Extremes of humidity (over 90 % and below 40 % relative humidity) for sustained periods should be avoided since they are detrimental to the Cell or Battery and packaging.

6. Others

6.1. Cell connection

Soldering or welding of wires or other types of connectors directly to the Cell is strictly prohibited.

A proper Cell connection can only be done by the Cell manufacturer itself. If soldering or welding of wires or other types of connectors directly to the Cell will be done not by VARTA, all claims regarding warranty, performance and safety will be omitted.

6.2. Ultrasonic welding of Application Device housing

Ultrasonic welding of plastic lid to the plastic casing can be applied. However, the welding shall be done **avoiding the Application Device of ultrasonic wave power directly to the Cell or Battery**. Otherwise, it may cause serious damage to the Cell or Battery.

6.3. Prevention of short-circuit within Application Device

Enough **insulation layer(s)** between wiring and the Cell/Battery shall be used to maintain multiple safety protection.

The Cell or Battery housing shall be designed to prevent short-circuits while Cell or Battery is assembled and during usage of Application Device. This is because short circuits may cause **generation of smoke or fire**.

6.4. Assembly

- (1) **Important:** Always avoid any possible contact of Cell or Battery housing with sharp objects, corners, or points which could puncture or damage the Cell or Battery.
- (2) Avoid dropping the Cell or Battery, or applying mechanical stress (such as tension, pressure) to Cell or Battery itself during assembly. Do not remove or disassemble any component from the original VARTA supply configuration of the Cell or Battery.
- (3) Do not subject Cell or Battery to higher temperatures than specified in the applicable datasheet.
- (4) Do not subject Cell or Battery to ultrasonic weld process, vibration or energy.
- (5) Avoid accidental short-circuit of Cell or Battery during assembly and finishing processes.
- (6) Avoid accidental mechanical damage to Cell or Battery during assembly and finishing processes.
- (7) Packaging for Cell or Battery has to be made of insulating material, avoiding discharge or short-circuiting.
- (8) Wear personal protective equipment adapted to the situation (protection gloves, face protection, breathing protection).
- (9) Welding in the no-welding area of Cell or Battery is prohibited. Welding parameters study must be conducted, ensuring the Cell or Battery housing is not perforated. Please check with the VARTA Key Account Manager for the welding and no-welding area of the respective Cell or Battery.
- (10) Metallic tables and metallic tweezers are prohibited to use during assembly to avoid an external short circuit.
- (11) It is recommended to conduct an IQC inspection (i.e., visual check, impedance check, OCV check) to the Cell or Battery before assembly.

6.5. Prohibition of Disassembly

- (1) Never disassemble the Cell or Battery.
- (2) **Disassembling Cell or Battery** may cause an internal short-circuit in the Cell or Battery, which could further **cause gassing, fire, or other problems**.

Harmful Electrolytes: An electrolyte which leaks out from the Cell or Battery is harmful to the human body. If the electrolyte comes into contact with the skin, eyes or other parts of body, the electrolyte shall **be flushed immediately with water. Seek medical advice from a physician.**

6.6. Prohibition of short-circuit

Never short-circuit the Cell or Battery. It causes generation of very high currents resulting in heating of the Cell or Battery, which may cause electrolyte **leakage, gassing or fire.**

6.7. Prohibition of dumping of Cell or Battery into fire

Never incinerate nor dispose of Cell or Battery into fire.

6.8. Prohibition of Cell or Battery immersion into liquids such as water

The Cell or Battery shall never be soaked with liquids such as water, sea water, drinks such as soft drinks, juices, coffee or others.

6.9. Cell or Battery replacement

The Cell or Battery replacement shall be done **only by a manufacturer or supplier** of the Application Device and never be done by an end customer / consumer.

6.10. Prohibition of use of damaged Cell or Battery

Cell or Battery may be damaged during shipping by shocks, or other causes.

If any abnormal features of the Cell or Battery are found such as: damage to the stainless steel housing of the Cell or Battery, deformation of the Cell or Battery container, smell of electrolyte, an electrolyte leakage, or other abnormalities, the Cell or Battery **shall not be used any more.**

Cell or Battery with a smell of electrolyte or leakage shall be kept away from fire to avoid **ignition.**

6.11. General supply notices and responsibilities

The customer agrees to manufacture, assemble, sell, transport and/or dispose of the Application Devices in a way that the health and safety of people, including workers and general public, and environmental protection can always be assured. Customer agrees and guarantees to comply with any and all relevant safety and environmental requirements, laws and regulations in the countries where the Application Devices are sold, manufactured, transported, stored or disposed.

The customer shall instruct in their user manual how end customers / consumers can dispose or recycle the Application Devices which contain the Cell or Battery in a way that complies with local law and regulations for disposal and recycling, and all relevant safety and environmental requirements.

The customer shall be solely responsible for health, safety and environmental matters arising from its manufacture, assembly, sales, use, transportation and/or disposal of the

Application Devices, and shall defend, indemnify, and hold VARTA, its affiliated companies, customers, and suppliers and its and their respective representatives and employees harmless from and against all costs, liabilities, claims, lawsuit, including but not limited to attorney's fees, with respect to any pollution, threat to the environment, or death, disease or injury to any person or damage to any property resulting, directly or indirectly, from the manufacture, assembly, purchase, sales, use, operation, transportation or disposal of the Application Devices.

6.12. Battery compartment design

- (1) Protection circuit shall be isolated from the Cell or Battery to diminish damage from any electrolyte leakage which may occur by mishap. The battery compartment shall be designed not to allow leaked electrolyte access to protection circuit.
- (2) Battery case material resistance for electrolyte shall be considered when battery case material is selected.
- (3) Under abusive conditions, the Cell or Battery may vent. To ensure venting, Cell or Battery has venting holes in cup on the circumference of Cell or Battery. Care has to be taken that overpressure can be released in any abusive condition. Assembly must not interfere with venting mechanism.
- (4) Venting Requirements according to IEC 62133: *'Battery cases and cells shall incorporate a pressure relief mechanism or shall be so constructed that they will relieve excessive internal pressure at a value and rate that will preclude rupture, explosion and self-ignition. If encapsulation is used to support cells within an outer case, the type of encapsulant and the method of encapsulation shall neither cause the battery to overheat during normal operation nor inhibit pressure relief.'*

6.13. Specific VARTA safety mechanism activation point

A3

| Cell Type | Venting Holes open | CID Breakage | Pressure Release Vent |
|-----------|--------------------|--------------|-----------------------|
| CP7840 A3 | n.a. | n.a. | 0.5 mm |
| CP0854 A3 | n.a. | n.a. | 0.5 mm |
| CP9440 A3 | n.a. | n.a. | 0.5 mm |
| CP1240 A3 | 0.5 mm | 1.0 mm | n.a. |
| CP1254 A3 | 0.7 mm | 1.5 mm | n.a. |
| CP1454 A3 | 0.7 mm | 1.5 mm | n.a. |
| CP1654 A3 | 0.7 mm | 1.5 mm | n.a. |

A4/A4X

| Cell Type | Venting Holes open | CID Breakage | Pressure Release Vent |
|------------|--------------------|--------------|-----------------------|
| CP9440 A4X | n.a. | n.a. | 0.5 mm |
| CP9454 A4X | n.a. | n.a. | 0.5 mm |

| | | | |
|------------|--------|--------|------|
| CP1240 A4 | 0.5 mm | 1.0 mm | n.a. |
| CP1240 A4X | 0.5 mm | n.a. | n.a. |
| CP1250 A4 | 0.7 mm | 1.5 mm | n.a. |
| CP1250 A4X | 0.7 mm | n.a. | n.a. |
| CP1254 A4 | 0.7 mm | 1.5 mm | n.a. |
| CP1254 A4X | 0.7 mm | n.a. | n.a. |
| CP1454 A4 | 0.7 mm | 1.5 mm | n.a. |
| CP1454 A4X | 0.7 mm | n.a. | n.a. |
| CP1654 A4 | 0.7 mm | 1.5 mm | n.a. |
| CP1654 A4X | 0.7 mm | n.a. | n.a. |

A5X

| Cell Type | Venting Holes open | CID Breakage | Pressure Release Vent |
|------------|--------------------|--------------|-----------------------|
| CP1054 A5X | 0.7 mm | n.a. | n.a. |

x-Version: Cells without CID. Different UL recognition, with different overcharge approval (see technical datasheet – datasheet is available with your respective sales person / key account manager).

If breaking of CID is not possible due to CID is not applicable or due to limited venting space, it must be secured that charging is stopped in case of venting mechanism activation.

6.14. Protection circuit module design

- (1) Electrolyte has corrosive characteristics. Protection circuit module may not work correctly if exposed to electrolyte.
- (2) This should be considered in protection circuit module design. Main wiring patterns shall be separated from each other as much as possible.
- (3) Conductive patterns and connection terminals which may be short-circuited by electrolyte leakage should be separated from each other as much as possible. Another method is coating the whole surface of the module by conformal coating material.

6.15. Warning

- Keep small Cells and Batteries which are considered swallowable out of the reach of children and disabled people.
- Swallowing may lead to burns, perforation of soft tissue and death. Severe burns can occur within 2h of ingestion.
- In case of ingestion of a Cell or Battery, seek medical assistance promptly.

This warning is also to be provided with the information packaged with these Cells and Batteries or Application Devices or equipment using them.

7. Marking

The customer shall prepare comprehensive instructions and appropriate markings for end customers / consumers.

The Application Device shall be provided with **packing, handling and safety instructions** regarding Cell or Battery usage, storage, charging, replacement and disposal, and shall be marked with information in accordance with applicable regulations. The prohibitions mentioned in this document and in the UL 1642 documentations shall be clearly explained to the end customers / consumers.

The markings shall also be done in accordance with requirements based on guidelines for rechargeable Lithium-Ion batteries for maintaining.

Example for marking according to the UL 1642 regulation:

- (1) Mark the manufacturer's name, business name or trademark, and specified model name.
- (2) Use the word "Warning" and indicate the statement "Risk of Fire, Explosion, and Burns. Do not disassemble, crush, heat above 100 °C (212°F), short-circuit or incinerate" or equivalent.
- (3) Application Device shall be marked with following statement or equivalent: "Replacement may only be made with Cell or Battery specified by the manufacturer of Application Device, with correct part number. Fire or burning may occur if the customer uses Cell or Battery other than specified by the manufacturer of Application Device. The customer shall refer to the handling instruction issued by the manufacturer of Application Device."

If it is not possible to mark the warnings mentioned above on the Application Devices, the manufacturer of Application Device shall mark and print the warnings in the handling or maintenance instructions or manuals of the Application Device.

Especially the marking shall contain the advice in Chapter 4 according to the type of usage.