

### Handling Precautions and Guideline for Lithium Polymer (LP) batteries

#### General

1. The customer is strongly advised to contact DYNAMIS in advance in case the application or operating conditions of the battery will differ from those specified in the specification sheet. Additional testing may be necessary to verify the suitability of the particular cell type for the intended use.
2. DYNAMIS will take no responsibility whatsoever for any accident due to use of the battery other than specified by DYNAMIS.
3. Improvements or changes for the proper use and handling of the cell will be forwarded to the customer in cases necessary.

#### Handling

##### 1. Charge

###### 1.1 Charge current

The maximum charging current specified is not to be exceeded during use. Application of a higher current than that may cause damage to the cell with respect to electrical, mechanical or safety-related performance. Unusual heat generation, bloating or leakages may be a result of over charge.

###### 1.2 Charge voltage

A maximum charge voltage of 4.2 V per cell shall not be exceeded. At voltages higher than 4.25 Vpc the same kind of damages may occur than described in 1.1

###### 1.3 Charge temperature

The recommended temperature range of the specification shall not be exceeded.

###### 1.4 Reverse charge

Reverse charging is strongly prohibited. DYNAMIS recommends a polarity check of the cell before assembly or connection to a charging device. Reverse charge may cause serious damage of any kind to the cell.

##### 2. Discharge

###### 2.1 Discharge current

The discharge current specified by DYNAMIS is not to be exceeded due to possible damage to the cell. The damage will result in reduced capacity and/or unusual heat generation.

###### 2.2 Discharge temperature

The recommended temperature range of the specification shall not be exceeded.

###### 2.3 Over discharge

The cell shall not be discharged to lower voltages than specified (cut-off voltage). Deeper discharge than that will result in reduced cell performance and may cause damage to the cell.

Over discharge also occurs if the self-discharge is not compensated during long periods of storage time. For cases like this, the OCV of the cell is to be

checked. For voltages lower than 3.7 V re-charge is recommended.

For very low voltages, e.g. < 2.75 V, the following procedure is recommended:

Step 1 – Re-charge w/ 0.01C current for 15-30 min

Step 2 – After the cell OCV is > 3.0V, standard charge may be applied (after a pause of 15-30 min)

In case Step 1 does not lead to an OCV of more than 3.0V, the cell may be auto-detected by a voltage measurement / timer combination and considered damaged. No further charge is recommended in this case.

### 3. Protection Circuit Module (PCM)

- 3.1 The use of a PCM is recommended for all types of LP batteries in order to protect the cell and enable best performance with respect to the application.
- 3.2 The over-charge protection function shall stop charging if the voltage exceeds the recommended value.
- 3.3 The over-discharge prevention shall work to minimize dissipation current to avoid a drop of the cell voltage below 2.5 Vpc or less. The protection function shall monitor each bank of a LiPo battery pack and control the current.

### 4. Storage

The storage conditions specified shall not be exceeded in order to assure proper cell function and prevent the battery from damages.

### 5. Handling Advice

- 5.1 The outer skin of Lithium Polymer (LP) cells is a laminated Aluminum film consisting of different layers and materials. This film can be easily damaged by sharp tools of any kinds, sharp edges, pins, needles or similar. Therefore the LP cells must be prevented from being treated like that. Damages to the hull of the cell may result in different hazards as described in the MSDS.
- 5.2 Due to the same reason, the film hull of LP batteries can be damaged by application of heat of any kind. This is also prohibited.
- 5.3 The LP batteries are to be protected against any possibility of short-circuit. The very high currents generated by short-circuit will cause severe damages, heat generation and emission of gas, smoke and/or fire.

The danger of short circuit applies particularly to the cell without PCM, since the open lead-outs can be shorted easily by any conductive part, if they are not insulated properly. Cells with PCM shall be designed to minimize the risk of accidental short circuit.

- 5.4 The soft pack LP batteries are very sensitive to mechanical stress of any kind. Any bending, falling, deformation by hitting etc. must be prevented. Mechanical deformation may lead to inner damage of the plate pack and result in short circuits or similar.
- 5.5 The lead-out tabs of a cell are to be treated cautiously. The flexible structure of the metal, especially Aluminum, is not to be stressed by force of any kind

beyond proper use.

### 6. Advice for battery pack design

- 6.1 The overall toughness of a battery pack consisting of LP cells shall be achieved by an additional mechanical protection in order to prevent damages like described in section 5.
- 6.2 Fixation inside a battery pack is to be achieved by the cell's large surface area. No cell movement shall be allowed inside the pack.
- 6.3 No sharp edges shall be allowed inside a battery pack which can damage a cell. This applies as well to the positioning of the PCM.
- 6.4 For tab connection US (ultrasonic) welding is recommended. Shear force is not to be applied to tabs.
- 6.5 The design of the pack shall be appropriate not to emit heat in case of leakages due to mishaps.
- 6.6 The PCM is to be protected as good as possible from eventual contact with leak electrolyte.
- 6.7 The common state of good practice is necessary in all kinds of design of a battery pack, e.g. proper insulation of wiring and layers, sufficient spacing between different voltage patterns and so on.
- 6.8 The PCM design shall be made with respect to the case of leaked electrolyte touching the circuit patterns. Short circuits must be prevented by cover material.

### 7. Battery pack assembly

- 7.1 Shocks, high temperature or contact with sharp edge tooling shall not be applied during battery pack assembly.
- 7.2 Soldering of wires etc directly on LP tabs is not recommended. Temperatures above 80 °C will cause damages to the LP cells. Spot welding using appropriate parameters may be preferred.
- 7.3 The welding power of US welding is to be controlled in order to prevent the cell and PCM from serious damage.

### 8. Further

- 8.1 Disassembly of cells is strongly prohibited.
- 8.2 Dumping of LP cells and batteries into fire, water or other conductive liquids is strongly prohibited.
- 8.3 Damaged cells shall be prevented from any further use.
- 8.4 Mechanical damages can occur during transport. If damages like holes, deformations, leakages, smelling of electrolyte or other abnormal features are found the particular cell shall not be used anymore.

8.5 After the use of LP cells the appropriate way of disposal has to be followed.