

F-POD: Rechargeable Lithium Battery Pack

Safety:

Lithium ion batteries are well known to carry a fire risk. The configuration and management of the F-POD lithium batteries avoids these risks and this guide sets out the principles for managing the F-POD rechargeable Lithium Battery Pack – the Lithium Pack. More technical details below.

Management:

A single person = the Battery Manager - should be given specific responsibility for managing the packs, the batteries and the battery recharging and monitoring.

Packs should, in general, not be exchanged at sea, as having lithium batteries outside the POD housing may violate ship safety constraints – insurance etc. and cells could be dropped etc. So F-PODs should be swapped at sea so that data downloading and battery recharging undertaken ashore. A careful decision might be made about carrying a spare pack in the custom battery pack carrier and exchanging complete packs in a safe cabin.

The Batteries

Samsung 50E Lithium-ion Rechargeable Cell (SDI Model : INR21700-50E) are the only cells we have found with enough power to run a POD for 7months +. They deliver 5Ah - they are rated fractionally lower than that, but deliver more when discharged slowly as in an F-POD. The Lithium Pack only takes 21700 cells (21mm diameter 70mm long). Do not use 18650 cells, do not mix cells of different brands or with different histories of use).

Chelonia cannot ship these batteries, so they must be procured by users. Each Lithium Pack takes 25 cells.

These cells are flat top cells so it is essential to mark the positive end of each cell with red adhesive tape, or other colours to identify the sets of 25 cells used together – sets should be kept together.

This marking reduces the chance of putting in a cell the wrong way round and allows you to check the orientation of each cell in the pack – the lower two layers can be checked through the back of the pack. A wrongly inserted cell would significantly reduce the running time.



Charger



Storage box



F-POD Lithium Pack and container



There are many chargers available. All cells in a pack must be fully charged before they are put back into the pack. The LiitoKala S8 charger shows the voltage and current delivered during charging of each cell - at the end of charging you use the NEXT button and view the mAh value for each cell – you may need to wait for some seconds for the mAh value to be shown. This is the charge that has been put in during this charging session, and may be much less than the battery's capacity.

The lowest value for the 8 cells should be more than 75% of the highest. This shows that there is no significantly deteriorated cell and they are being used evenly. These charge values are held indefinitely while the charger is ON, so if you left it running overnight you can check it next day.

The POWxS charger is another good charger – it has 4 slots and one can be used to run a capacity test on any 21700 cell. The capacity of new lithium ion cells (especially the smaller 18650 cells) can be far below the advertised capacity.

The storage box shown is useful for safely storing cells ashore. It is robust, padded and water resistant.

The Lithium Pack :

- Has built in diode protection to prevent reverse current flow through a stack in which a cell is the wrong way round.
- Has built in fuses on each stack to avoid the risk of cells overheating if the stacks were shorted.
- Recessed contact points at the outer end so that the voltage can be measured.
- Two black thumbscrews at the outer end that are unscrewed to allow cells to be taken out or put in. The thumbscrews are then screwed up fully.
- All cells face the same way, which is marked on the ends of the pack.
- The power cable is fitted when the pack is nearly fully inserted into the F-POD housing, and the connector can then be fully inserted into the socket in the battery pack.

Loading the pack:

The thumbscrews should be out like this:



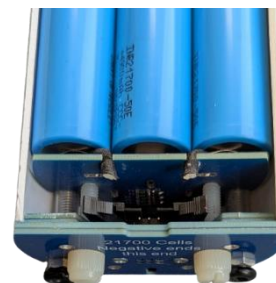
Put the 5 batteries in each end – slide them out towards the end.

Add this set last, putting the negative end in first

Check the back to ensure all cells are the right way round!!



Screw the thumbscrews in fully – a flat blade screwdriver is useful.



Unloading the pack:

Unscrew the thumbscrews.

Push from behind the middle set of cells to get them out and the rest will fall out.

Keep the cells from one POD together.

Running time:

The Lithium Pack will give 14 months when logging alternate minutes (adequate for most projects) and half that when running continuously, so servicing trips can be fewer. This depends on having 5Ah cells, as below.

Lithium Pack Carrier

This is a robust tube with a waterproof lid and is like a short F-POD housing. It allows safe transport of packs and you may evaluate whether exchanging whole packs at sea, using this carrier, is legal and safe.

F-POD settings

F-POD housings that take the Lithium Pack cannot take any other battery pack.

These F-PODs are given the appropriate settings for these cells. These force the POD to stop logging when the battery voltage falls to some way above their acceptable minimum.

The Battery Manager does these things:

- Procures Samsung 50E cells.
- Note their initial voltage when placed in the charger and the mAh recorded when fully charged – these should all be above 75% of the highest, confirming that these are original cells in good condition.
- Mark all cells in a 25-cell set with coloured tape at the positive end to reduce the chance of putting one in the wrong way round and make it easy to check on this.
- Load the battery pack
- Check all cells in both layers are the right way round
- Check the voltage on the contact points
- Put the pack in the F-POD

Recharging:

- Note the mAh taken by each cell to confirm uniformity across the set. The lowest value should be >75% of the highest value. This confirms all cells are good.
- Store any cells in a suitable storage box or spare Lithium Pack

Technical information

The larger pack with 5x5 Samsung 50E cells nominally delivers 375Wh, and the 2x5 delivers 150Wh. The discharge rate is very low, below the level used for those power ratings, and the internal resistance of these cells rises with the current delivered, so the actual power delivered to these instruments will be higher than these nominal figures. Actual running times achieved will be added to this document when available.

The risks arise when batteries are being charged in series or at excessive currents or voltages, or discharged too fast, or are punctured or crushed.

These risks are avoided in the F-POD by in the very robust waterproof housing of the F-POD (or the structurally similar battery pack carrier) and by these features:

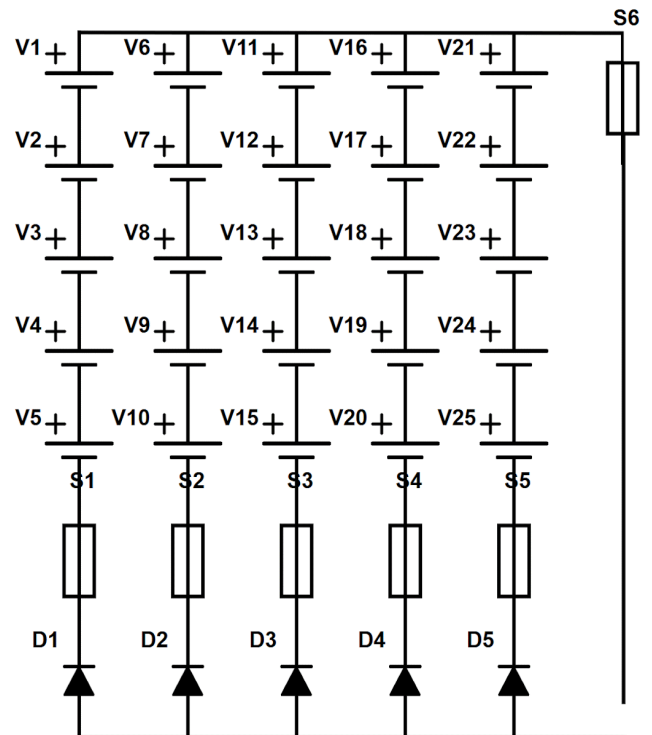
Samsung 50E cells are not protected by an internal circuit. So in this pack each stack is protected against insertion of cells the wrong way round by diodes.

Resettable fuses protect each stack and a non-resettable fuse protects the whole pack.

Individual cell charging means that any damaged or deteriorating cell can be identified as soon as it deviates from the rest.

Over-discharge is prevented by the F-POD which monitors the voltage every minute and shuts down the F-POD when the voltage is still within the manufacturer's specified range.

The voltage record stored in each POD file allows the performance of the pack to be seen for each deployment.



Batteries V1..V25 Lithium 21700
Fuses S1..S5 200mA resettable
Fuse S6 5A

Battery storage

Batteries can be stored in the F-POD provided that no SD card is present in the slot. Ideally they should be above 1/3 charged. If stored outside the F-POD or Lithium pack container a waterproof box is recommended as shown above.