



PCS™ Battery Pack: Operation Manual

The PCS Battery Pack is a high-performance rechargeable power source for use with Palm OS handhelds and the deepTec Power Cradle.

The battery pack is precision-engineered and constructed of the highest-quality components: a molded ABS "spine", hardened nickel charging contacts, short-circuit protection, and two high-capacity **NiMH** (nickel metal hydride) cells.



Installation

Remove the existing battery door and batteries from the Palm handheld and insert the PCS battery pack (note the red arrow marked "INSERT INTO SPRINGS FIRST").

Clip the PCS battery door onto the Palm handheld -- note that the charging contacts are visible through the holes in the replacement battery door.

Insert into the Power Cradle, and allow the battery pack to fully charge before use.

Typical Performance and Usage Tips

A fully-charged battery pack provides about 2/3 the energy capacity of a pair of disposable alkaline cells. This translates to weeks of use under "normal" conditions, and several days even under heavy use. Of course, unlike alkalines, every time the PCS-equipped Palm is inserted into the charge cradle, it is quickly replenished. Regularly topping-up the battery pack is a good practice.

Battery type should be set for NiMH cells (using an application such as our free *Power Panel*) to ensure the proper Low Battery Warnings are given. Once the battery voltage reaches 2.32V; a warning message will pop up on the Palm screen warning of a low battery condition; and a second, more urgent warning message appears at 2.00V. If the battery voltage is allowed to reach 1.6V, the Palm will not turn on (to retain the data in its memory).

The PCS NiMH battery pack will provide full performance for a minimum of 500 charge / discharge cycles, and if treated properly can easily reach 1000 cycles. (Under heavy use (recharging 3 times a week), even 500 cycles will provide a useful lifespan of more than 3 years.)

Maintenance

The PCS Battery Pack requires no special maintenance under regular use.

It will deliver continuous peak performance and a long lifetime by following a few common-sense guidelines:

- Don't charge or discharge the battery pack using unsupported chargers.
- Don't expose the pack to temperature extremes of heat or cold.
- Don't let the charging contact plates become contaminated.
- Don't let the battery pack become deep discharged (detailed explanation below).

If the Palm is not going to be used for an extended period of time (e.g. several weeks), the battery pack should not be left in the Palm. Even when "off", the handheld continues to use some power to keep memory refreshed. Eventually this will empty the battery, resulting in data loss and increasing the danger of deep-discharge. The recommended procedure in this situation is to fully charge the battery pack, HotSync to backup data, and remove the battery pack. Doing this will preserve the battery pack's charge for months. (If the battery pack is unused for a very long period of time and becomes totally empty from self-discharge, there will be no permanent damage to the cell. Even after 1 or 2 years of storage, a few charge/discharge cycles and the pack is back to peak performance!)

Deep Discharge: Cause and Effect

A NiMH **cell** is considered "empty" when the cell voltage measures 0.9V or less under a "normal load" (e.g. a Palm device). The NiMH battery **pack** has 2 cells connected in series, so "empty" is 1.8V or less.

Deep-discharging occurs when the voltage is allowed to drop far below empty.

For Palm devices, this could only happen under extraordinary circumstances:

- the handheld is left unused (and out of the charger) for an extended period of time;
- a poorly-designed serial accessory and software cause excessive power draw;
- the battery pack's built-in short-circuit protection is somehow bypassed;
- the Palm handheld itself has faulty internal components.

So deep-discharge is very unlikely to happen. But what if it does?

Battery manufacturers state that an individual NiMH cell that is deep discharged below "empty" (0.9V to 0V) can be revitalized with a few charge / discharge cycles, a so-called "refresh cycle". However, this only works for individual cells -- for a battery pack, the situation is more complicated.

No two cells are identical, and even when matched cells are used in a pack, one cell will almost always be able to hold a little more power than the other.

If the battery pack is allowed to fully discharge, the "weaker" cell will reach 0V while the "stronger" cell is still supplying a current. But since the weaker cell can no longer supply current, the current from the stronger cell flows through the weak cell in the wrong direction. This can literally change the polarity of the weaker cell, causing irreparable damage. Specifically, the capacity of that cell (or amount of power it can hold) will be permanently reduced.

When the deep-discharged battery pack is recharged, the charge current begins filling the stronger cell, while correcting the polarity of the weaker cell. As charging continues, the strong cell becomes full first, and indicates an end-of-charge voltage peak to the charger before the weak cell is completely refilled. The unfortunate result is that the capacity of the two cells drifts further apart, increasing the possibility of another polarity-reversal of the weaker cell in the future.

Recharging a Deep Discharged Battery Pack

This is a tricky problem because of the somewhat odd system of power management used by Palm devices.

Assume the pack voltage has been allowed to drain to 0V. The Palm is 'dead' too - all data and configuration settings in RAM memory are lost.

As specified by battery manufacturers, a battery must not be charged with a fast charge current rate until the battery voltage is at least 0.9V per cell, or 1.8V for the battery pack. Following these rules, if a deep-discharged battery pack is placed in the charger, the charger will apply a small 'conditioning' current to gently bring it up to 1.8V. Once 1.8V is reached, the charger detects this and switches to fast charge mode.

Unfortunately, the Palm tries to automatically start up once it detects a battery voltage of about 1.6V and during this activity it uses a lot of power. (*note: This is an unusual and basically wrong behaviour for electronic devices. Do mobile phones switch on when the battery is attached? Of course not!*). The battery's voltage then promptly drops below the Palm 1.6V threshold, and the whole process enters an endless loop...


The only way to circumvent this situation is to charge the battery without the Palm connected - which is not mechanically possible when using a charging cradle. However, there **is** a workaround: Insert a small piece of paper between the battery pack and the Palm's battery springs. The battery pack is now electrically insulated from the Palm, yet is positioned properly to charge in the cradle. Allow the battery to charge for at least a few hours (remember that conditioning current is small, and a deeply-discharged battery pack will take a longer period of time to fully recharge).

Once the battery is fully charged, remove the paper and **perform a reset** on the Palm. This is necessary to cleanly initialize the handheld.

*Please note: this is **not** an issue using the deepTec **VIC** charger, which monitors and intelligently adapts charging to compensate for Palm power management "issues".*

To restore the battery pack to its highest possible capacity, discharge and recharge the battery two or three times. A good way to discharge the Palm fairly quickly is to deactivate the "Auto-power off" setting, turn on the backlight, and leave it running over night. Once it is drained, recharge it fully.

To deactivate "Auto off", open a text-entry field (e.g. MemoPad or Find) and Graffiti **shortcut . 3** If done correctly, the following text will appear: *[No Auto-Off]*. Re-enable your standard Auto-power off setting with a soft-reset.

(The shortcut symbol looks like: , then tap twice to get a period, then the number 3.)