Socket Mobile Customer Support Notice CSN-1004
SoMo Power failures related to the Battery
12/01/2009

ISSUE

Customers have reported several failure conditions related to the Extended Li-Ion Battery (PN 1610-00010) used in the SoMo product.

SYMPTOM

There are a number of different conditions, most commonly seen in applications with Extended Batteries (PN 1610-00010):

1) SoMo fails out of Charging Cradle: After SoMo is pulled out of a charging cradle (often after the battery in it was charging for an extended period) it will go blank and be inoperable.

2) Unknown Battery: In Setting>System>Battery the battery type is indicated as “Unknown”. In addition often there is no battery level indicated.

3) Short Charge Life: A battery seems to have been charged (either within the SoMo or in the Battery Charge slot on the cradle) but will give a very short life until it requires another charge.

4) Battery Charging time: Battery Charging time is very long.

5) Bulging Battery: Battery is bulging and is not its normal size. This is a special case and could be dangerous – see Root Cause Summary below.

Although in some rare cases the battery has a problem, in almost all cases we have found the problems to be due to a poor battery to battery slot connection.

ROOT CAUSE SUMMARY

See Detailed Background section below for further technical information.

1) SoMo fails out of Charging Cradle: After SoMo is pulled out of a charging cradle (often after the battery in it was charging for an extended period) it will go blank and be inoperable. Possible causes:

    a. The battery connector path that connected to the Battery may be open and the battery was never charged. Or the battery power-out path is open and can not supply power to the SoMo device. The connector pin in the battery compartment may be over-compressed and not making proper contact with the battery connectors or battery may need “battery spacer” to compress the battery connector better. See section below on “APPLICATION OF BATTERY SPACER” on how to apply the spacer.

    b. Battery Door Switch may be broken (see CSN-1001- Socket Customer Notice - SoMo Battery Door closure.pdf)

    c. Battery has failed or is beyond its recommended life. Battery has a recommended life of 500 full charge discharge cycles. After that point the battery capacity is guaranteed to be 60% or better. Battery life degrades quickly after this point.

2) Unknown Battery: From the start menu go to Setting>System>Battery where the battery type is indicated as "Unknown". In addition often there is no battery level indicated. Possible Causes:

    a. Typically indicates that the Smart Battery communication path is open and the SoMo can not query the Battery Status. Connector pin may be over-compressed and not making proper contact with the battery connectors or battery may need "battery spacer" to compress the Battery connector better. See section below on "APPLICATION OF BATTERY SPACER" on how to apply the spacer.

3) Short Charge Life: A battery seems to have been charged (either within the SoMo or in the Battery Charge slot on the cradle) but will give a very short life and quickly requires another charge. If Battery life is 5 minutes or less then this is the same problem as #1. If it is on the order of a few hours then the issue might be:

    a. The battery connector path that charges the Battery may be open. This means that the Battery can provide power to the SoMo, however the Battery can not be charged. Connector pin may be over-compressed and not making proper contact with the battery connectors or battery may need "battery spacer" to compress the Battery connector better. See section below on "APPLICATION OF BATTERY SPACER" on how to apply the spacer.

    b. Midnight Power-On issue: Microsoft has a function built into all Windows Mobile Operating systems. This function will wake-up the SoMo (but not turn on the LCD display) at Midnight every day. It can sometimes be seen by the flashing green LED indicating WLAN activity – if WLAN was on at shutdown time. The unit will turn on for a time equal to the backlight disable setting in. Depending on applications on the SoMo device, the unit may be put in an "on" state and drain the battery.

    c. Battery has failed or is beyond its recommended life. Battery has a recommended life of 500 full charge discharge cycles. A full charge discharge cycle is equivalent to 70% of the capacity of the battery. After those 500 cycles the battery capacity is guaranteed to be 60% or better. Battery life degrades quickly after this point. It is strongly recommended that the battery is replaced at this point. See note in appendix labeled "Extending Battery Life".

4) Battery Charging time: Batteries charging time is very long. For an extended battery this would be more than 9 hours. Possible causes:

    a. The Battery has built in protection circuitry that prevents the battery from charging when its temperature is above 45C/113F. If a SoMo is charged with LCD turned and room temperature is high 24-27C/75-80F the internal temperature of the battery can get above the 45C "shut-off" point. The protection circuitry will then prevent charging of the battery. This problem is most exaggerated when the battery is in a 4 bay charger with multiple batteries and SoMo's charging – this will cause the highest local temperature and the greatest chance of the charging to shut-down. Work around is to 1) Turn off the LCD when the unit is being charged (will also increase the life of the SoMo), 2) to charge in an environment with lower room temperatures, or 3) to charge using the AC Adapter cable outside the cradle.

b. Battery has failed or is beyond its recommended life. Battery has a recommended life of 500 full charge discharge cycles. A full charge discharge cycle is equivalent to 70% of the capacity of the battery. After those 500 cycles the battery capacity is guaranteed to be 60% or better. Battery life degrades quickly after this point. It is strongly recommended that the battery is replaced at this point.

5) Bulging Battery: Battery is bulging and is not its normal size. This is a special case and could be dangerous.

a. A bulging battery SHOULD NEVER be used. A bulging battery can indicate the battery has been over-charged or that it has a malfunction. There are multiple protection systems in place: The battery has built-in mechanical and electrical protection and the battery charging circuit has built-in electrical protection to minimize any possible damage. However a bulging battery implies there is a problem.
b. The battery should be disposed of or returned to Socket if it under the 90 day warranty period for consumables. There is a possibility that the problem was due to a charging circuit problem, so the SoMo or the cradle that was used to charge the battery should be returned for testing to confirm it was not the cause.

APPLICATION OF BATTERY SPACER

NOTE: The Battery spacer is to only be used on an extended battery (PN 1610-00010).

Battery spares are shipped in sheets. Figure 1 shows how spacers will be delivered.

Figure 1

Figure 2 is a top side view of the extended battery. The spacer will be applied to the end of the battery on the left side of the picture. This is the side opposite the connector side of the battery.

Figure 2

Figure 3 below shows application of the spacer.

Figure 3

After spacer is pressed down onto the battery, then the protective clear plastic cover need to be removed, if it is still on the battery. See Figure 4 shows this being done. After the cover is removed the final spacer look and placement is shown in Figure 5.

Figure 4

Figure 5

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BROKEN BATTERY DOOR SWITCH

A Customer Notice has been sent out on how to prevent this problem. The problem results from the door being snapped vertically in place. The door can NOT be snapped in, it must be slid on. Snapping the door on could cause the breakage, particularly with new units. See

"CSN-1001- Socket Customer Notice - SoMo Battery Door closure.pdf"

for a detailed description of the issue. Figure 6 below shows the location of the switch. There is normally a small black protruding piece. When it is broken that piece will not be present or will not be protruding.

Figure 6

APPENDIX: DETAILED BACKGROUND

Extended Battery Pinouts:

The Extended Lithium Ion batteries have 4 contacts as shown in Figure 7.

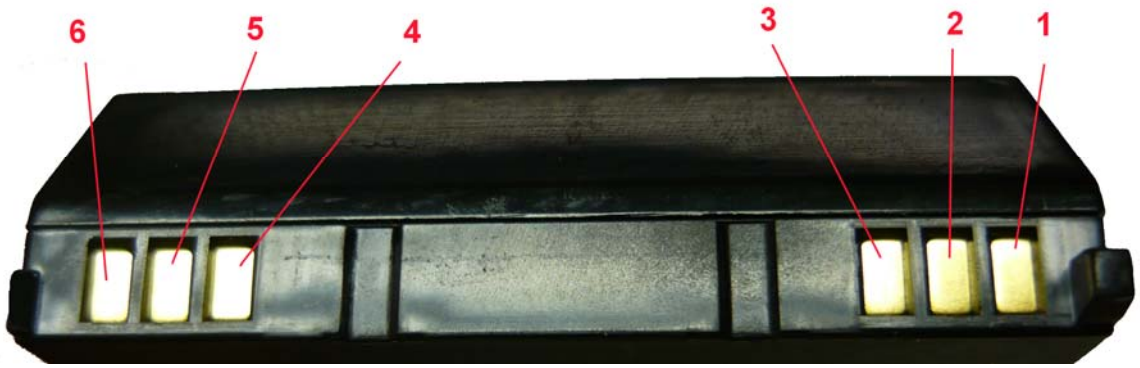

Figure 7

The connections are:

1: Temperature sense from Battery to SoMo
2: Charge Path from SoMo to Battery
3: Power out of Battery into SoMo

4: Gnd
5: Gnd
6: Battery Charge status to SoMo

Connection 1 allows the battery charging circuit in the SoMo to sense if the battery is over heating from charging. In the case the battery is overheating or ambient temperature is too high, the charging circuit will shut off charging of the battery to protect it. This happens when the internal battery temperature rises above 45 degrees C.

Connection 2 is the charging path to the battery. If this connection is open, the SoMo could still operate off battery power as long as there was enough charge left in the battery.

Connection 3 is the power output from the battery to the SoMo. If this path is open then the SoMo will not operate on battery power.

Connection 6 is the path by which battery status is sent back to the SoMo. If this path is open then the SoMo will not be able to get any information on charge status or battery type.

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Battery Charge shutdown due to High Temperature:

In high ambient temperature situations when the SoMo is in the cradle, charging an Extended Battery with full LCD brightness, and WLAN active, the unit & battery can get warm enough that the battery temperature "shutdown" turns on. In this high temperature condition the battery charging process will be affected. Depending on the temperature conditions (higher temperature is worse) it has been observed during the charging cycle that the battery will charge for about 30 min, get too hot, shutoff for about 2 minutes, cool off then turn on and start charging again for about 5 minutes, get too hot, then go thru the shutdown cycle again and again until the battery is fully charged. The end result is that the charging process may take much longer than normal (approximately 7 hours for a complete charge).

The "Battery charge shut off" is an internal circuit in the charging circuit that monitors the battery temperature. If it finds that the battery temperature exceeds approximately 45C/113F it will shut off charging of the battery. The time that the battery charging is "shut off" depends on how long it takes to cool the battery to below 45C/113F. This is a typical mode you will see in all Lithium Ion batteries to prevent charging and usage during high temperature situations that could damage the battery or the equipment.

The second biggest contributor is the LCD display being on, because it dissipates a lot of heat. If experiencing battery charge shutdown due to high temperature, it is recommended to turn the display off during charging if possible.

Extending Battery Life:

All rechargeable batteries wear out, and Li-ion cells are no exception. As described the SoMo battery has a recommended life of about 500 charge-discharge cycles.

The number of charge/discharge cycles is the most common figure of merit for the life of the battery but there are other factors that strongly affect the battery life as well (often called Service Life). The way a battery is handled when not in use can have an equal impact on battery life.

For maximum storage life, batteries should be stored with a 30-40% charge (about 3.6 V) at 40°F. An example of the worst storage condition would be one where the battery is left fully charged (100%) and at a high temperature. This condition will cause permanent capacity loss.

SoMo users might run into this condition if they leave their SoMo in a charger with the display permanently on in a high temperature environment. The high temperature along with the unit being consistently at 100% charge both cause conditions that will shorten the battery life and reduce the life down to 6-12 months, independent of the charge-discharge cycles. A properly cared for SoMo battery should have a life of up to two to four years, depending on its usage level.