

Battery Charger Application Note

80000NT10006a Rev. 1 - 04/09/07



This document is related to the following products:

APPLICABILITY TABLE

PRODUCT	PART NUMBER	APPLICABILITY
EZ10-QUAD-PY	3990150467	
GT863-PY	3990150466	
GT864-QUAD	4990150069	
GT864-PY	4990150070	
GM862-GPRS	3990250631	√
GM862-QUAD	3990250655	√
GM862-QUAD-PY	3990250656	√
GM862-GPS	3990250657	√
GM862-GPS	3990250689	√
GM862-QUAD-PY	3990250658	√
GM862-QUAD	3990250659	√
GC864-QUAD	3990250675	√
GC864-PY	3990250676	√
GC864-QUAD-C2	3990250681	
GC864-PY-C2	3990250686	
GE863-QUAD	3990250664	√
GE863-PY	3990250665	√
GE863-QUAD	3990250653	√
GE863-PY	3990250654	√
GE863-GPS	3990250660	√
GE863-GPS	3990250690	√
GE863-PY	3990250661	√
GE863-QUAD	3990250662	√
GE864-PY	3990250650	√
GE864-QUAD	3990250648	√



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2 Battery Charger

2.1 Pre-charging Current

All Telit modules with battery pack voltage under 3.3 V are shut down since the voltage is too low. When the module gets connected to a battery charger, pre-charging current is used to bring it to the voltage necessary for hardware power on (which is 3.1 V_{typ} , 3.0 V_{min} , 3.2 V_{max}) and after that almost instantly starts normal recharging process.

2.1.1 Pre-charging Current 1¹

For the battery voltage lower than 3.1 V_{typ} , the charging current is between 15 and 30 mA. The value of this current is deliberately maintained low by in order to fulfill the requirements of the manufacturers of the Lilon elements that recommend low level of charging when the element is completely discharged. Battery charging system is not able to performing the charging process in case the external circuit of the Telit module absorbs a couple of dozens of mA.

2.1.2 Pre-charging Current 2²

For this type of Power Management Telit has decided to use the higher value in order to avoid problems described in the previous paragraph. The Pre-charging Current has value t_{yp} of 120 mA (96 mA $_{min}$, 144 mA $_{max}$). If the absorbed current of the circuits external to the module is higher than approximately 120 mA and for the voltage lower than 3.1 V_{typ} , battery charger will not be able to start the recharging of the element.

¹ For the products with the following Order-Num.: 3990250655, 3990250656, 3990250664, 3990250665, 3990250653 and 3990250654

² For the products with the following Order-Num.: 3990250658, 3990250659, 3990250657, 3990250675, 3990250676, 3990250660, 3990250661, 3990250662, 3990250650 and 3990250648



2.2 Normal charging

All products have the same charging procedure as described below:

- 1) The charging process starts when the module detects the presence of the battery charger
- 2) For the battery voltage³ lower than 4.0 V, the charging is performed with the constant current and the current limitation is provided by external charge.
- 3) When the voltage of the battery reaches 4.2 V, the module shifts from constant current to constant voltage. If this occurs the battery is considered fully charged and the message of battery charged appears in case *AT#CBC* command has been issued, but the charging continues for another 40 min at the constant voltage of 4.2V.⁴
- 4) Battery voltage is monitored every second. When the voltage goes under 4.0V the procedure is repeated from number 1)

2.2.1 Charging current

Current limitation, as described above, needs to be implemented from the external power supply/charger. In *Hardware User Guide* for **Telit module** the current recommended for the charging process is 400mA. Charging current passes through the Mosfet and diode Schottky. The maximum current of the Schottky diode is 1A; and that is also the maximum current allowed in the charging process. Value of 400mA has been recommended for the current limit in order to maintain low overtemperature that is generated for the dissipation on the Schottky diode and Mosfet (increases linearly).

In applications where the voltage of external power supply/charger is 5.2V +/- 200 mV, the maximum changing current of 1A can be accepted.

³ NOTE: if any other component is connected to the battery, apart from module, it can disturb the measurement of the battery voltage and can give wrong data

⁴ -for the products GE863(P/N:3990250653 e 3990250654): when the battery reaches 4.2V the module performs the measurements with charger disconnected for a couple of seconds and after that repeats the measurements with the charger connected. The charging process is terminated when the difference between these two conditions is 20mV.

-for the products GM862-QUAD/PY(P/N: 3990250655 e 3990250656): when the battery reaches 4.2V the module performs the measurements of the current absorbed by the charger and stops the charging process when this current goes under 30mA



2.3 Capacity of the battery pack

2.3.1 Maximum charging current

Usually the maximum charging current of the battery pack is $1C$ (where "C" stands for capacity of the battery pack without "h"; for example: pack with capacity of $C = 750 \text{ mAh}$, when you remove "h" becomes 750 mA). The current value of 750 mA is usually the maximum charging current permitted for that battery pack.

2.3.2 Minimum charging current

The minimum charging current can be set to $0.1C$. For example, with charging current of 750 mA it is possible to recharge a battery pack of 7.5 Ah . Note that the charging time in this case becomes very long: more than 10 h .



2.4 Battery Charge System: block diagram and calculation of loss

In the figure below you can find the complete block diagram⁵ of the battery charge system. Also the parasitical resistances are highlighted.

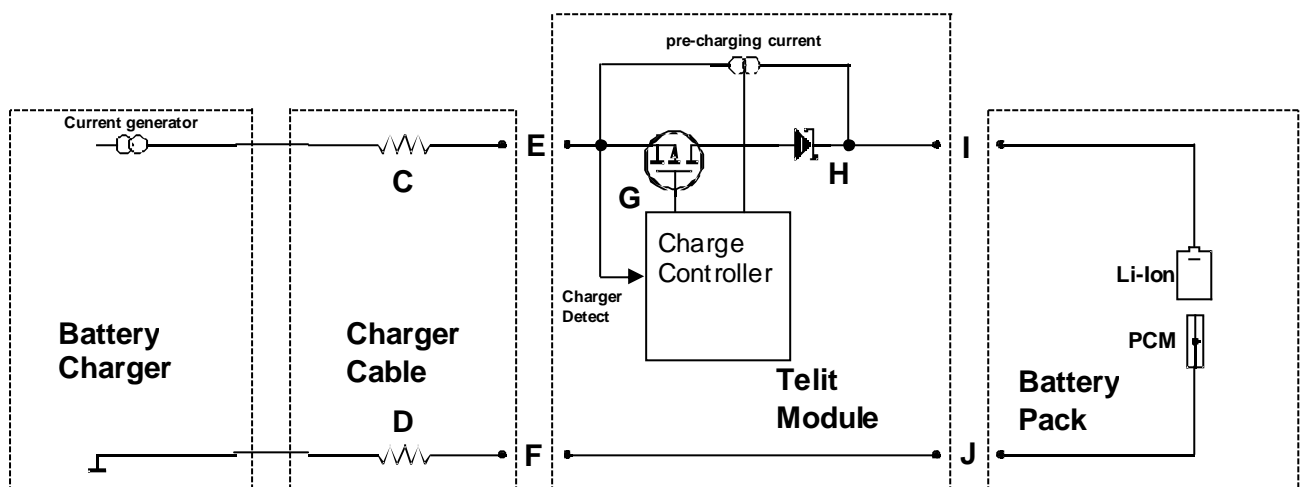


Fig.1 Complete block diagram of the Battery Charging System (PCM = Protection Circuit Module)

Wire C 24 A.W.G.	120 mΩ	84	mV@700 mA
Wire D 24 A.W.G.	120 mΩ	84	mV@700 mA
Contact E	10.0 mΩ	7	mV@700 mA
Contact F	10.0 mΩ	7	mV@700 mA
Mosfet Drain-Source resistance	65.0 mΩ	45.5	mV@700 mA
Schottky diode voltage drop		480	mV
Contact I	10.0 mΩ	7	mV@700 mA
Contact J	10.0 mΩ	7	mV@700 mA

Total voltage drop @ 700 mA 721.5 mV

The above data justify the 5.2 V (± 0.2 V) output voltage for the Battery Charger: 4.20V (Max battery voltage) + 721 mV = 4.92 V.

⁵ NOTE: consider this block diagram exclusively as a sustain in your project, not as a final solution



3 Document Change Log

Revision	Date	Changes
ISSUE#0	16/03/07	Initial Release
ISSUE#1	04/09/07	new disclaimer, updated applicability table

