According to an aspect of the present invention, there is provided a method for powering up a medical device powered by a battery includes executing an initial battery test. The initial battery test including the steps of:

a) determining a no-test-load voltage $U_{NoTestLoad}$ of the battery without a test load being connected to the battery;

b) providing an alarm if the no-test-load voltage $U_{NoTestLoad}$ is below a predetermined no-test-load voltage threshold $U_{Threshold,NoTestLoad}$ and terminating the method;

c) if the no-test-load voltage $U_{NoTestLoad}$ is above the no-test-load voltage threshold $U_{Threshold,NoTestLoad}$, executing the steps of:

c1) determining a test-load voltage $U_{TestLoad}$ of the battery with the test load being connected to the battery;

c2) comparing a difference voltage $\Delta U$ between the no-test-load voltage $U_{NoTestLoad}$ and the test-load voltage $U_{TestLoad}$ with a difference voltage threshold $\Delta U_{Treshold}$, the difference voltage threshold $\Delta U_{Treshold}$ being predefined in dependence of the no-test-load voltage $U_{NoTestLoad}$; and

c3) if the difference voltage $\Delta U$ is above the difference voltage threshold $\Delta U_{Treshold}$, providing an alarm;

wherein the difference voltage threshold $\Delta U_{Treshold}$ predefined in dependence of the no-test-load voltage $U_{NoTestLoad}$ is determined by a method including the steps of:

(1) experimentally determining a functional relation between values of an effective internal resistance $R_i$ and values of an open-circuit voltage $U_0$ for which the battery is capable of powering-up the medical device;

(2) determining a minimum no-test-load voltage $U_{NoTestLoad,min}$ of the battery for powering up the medical device without the test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step (1);

(3) determining a minimum test-load voltage $U_{TestLoad,min}$ of the battery for powering up the medical device with the test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step (1); and

(4) computing the difference voltage threshold $\Delta U_{Treshold}$ from the difference between the minimum no-test-load voltage $U_{NoTestLoad,min}$ and the minimum test-load voltage $U_{TestLoad,min}$ in dependence of the minimum no-test-load voltage $U_{NoTestLoad,min}$ with the open circuit voltage $U_0$ as parameter.

~~wherein the method further includes executing subsequent steps of the method if the difference voltage $\Delta U$ is below the difference voltage threshold $\Delta U_{Treshold}$.~~

A battery-powered medical device may include:

- a battery compartment, the battery compartment being designed to removably hold a battery and contact elements for electrically contacting the battery;
- a test load, the test load being selectively coupleable to the battery;

## CLAIMS

1. A ~~M~~method for powering up a medical device powered by a battery, wherein the method includes executing an initial battery test, the initial battery test including the steps of:

a) determining a no-test-load voltage $U_{NoTestLoad}$ of the battery without a test load $R_{Test}$ being connected to the battery;

b) providing an alarm if the no-test-load voltage $U_{NoTestLoad}$ is below a predetermined no-test-load voltage threshold $U_{Threshold,NoTestLoad}$ and terminating the method;

c) if the no-test-load voltage $U_{NoTestLoad}$ is above the no-test-load voltage threshold $U_{Threshold,NoTestLoad}$~~.~~ executing the steps of:

c1) determining a test-load voltage $U_{TestLoad}$ of the battery with the~~a~~ test load $R_{Test}$ being connected to the battery;

c2) comparing a difference voltage $\Delta U$ between the no-test-load voltage $U_{NoTestLoad}$ and the test-load voltage $U_{TestLoad}$ with a difference voltage threshold $\Delta U_{Treshold}$, the difference voltage threshold $\Delta U_{Treshold}$ being predefined in dependence of the no-test-load voltage $U_{NoTestLoad}$; and

c3) if the difference voltage $\Delta U$ is above the difference voltage threshold $\Delta U_{Threshold}$, providing an alarm~~.~~;

~~wherein the method further includes executing subsequent steps of the method if the difference voltage $\Delta U$ is below the difference voltage threshold $\Delta U_{Treshold}$~~

wherein the difference voltage threshold $\Delta U_{Treshold}$ predefined in dependence of the no-test-load voltage $U_{NoTestLoad}$ is determined by a method including the steps of:

(1) experimentally determining a functional relation between values of an effective internal resistance $R_i$ and values of an open-circuit voltage $U_0$ for which the battery is capable of powering-up the medical device;

(2) determining a minimum no-test-load voltage $U_{NoTestLoad,min}$ of the battery for powering up the medical device without the test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step (1);

(3) determining a minimum test-load voltage $U_{TestLoad,min}$ of the battery for powering up the medical device with the test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step (1); and

(4) computing the difference voltage threshold $\Delta U_{Treshold}$ from the difference between the minimum no-test-load voltage $U_{NoTestLoad,min}$ and the minimum test-load voltage $U_{TestLoad,min}$ in dependence of the minimum no-test-load voltage $U_{NoTestLoad,min}$ with the open circuit voltage $U_0$ as parameter.

**2.** The ~~M~~method according to claim 1, wherein the difference voltage threshold $\Delta U_{Treshold}$ is a linear function of the no-test-load voltage $U_{NoTestLoad}$.

**3.** The ~~M~~method according to either of the preceding claims, wherein the test load is a constant resistance test load.

**4.** The ~~M~~method according to either of the preceding claims, wherein the initial battery test includes storing a result of the initial battery test in a history memory of the medical device.

**5.** The ~~M~~method according to either of the preceding claims, wherein the method further includes, if it is determined in step (c2) that the difference voltage $\Delta U$ is below the difference voltage threshold $\Delta U_{Treshold}$, executing a further battery test, wherein the further battery test includes drawing a further test load current, thereby stressing the battery to a limit that is expected to occur during regular operation of the medical device and providing an alarm if it is determined that the battery is not capable of powering the medical device.

**6.** The ~~M~~method according to either of the preceding claims, wherein the method includes before step a):

0) turning on the power of the medical device.

**7.** The ~~M~~method according to either of the preceding claims, wherein the method further includes executing subsequent steps of the method if the difference voltage $\Delta U$ is below the difference voltage threshold $\Delta U_{Treshold}$, and wherein the subsequent steps include at least one of the following: memory checks, communication controller checks, medical device circuitry checks, sensor checks, electrode checks, checking of a communication controller, tests of acoustic indication devices, checks of tactile indication devices, and initializing steps of the medical device.

**8.** A ~~B~~battery-powered medical device, the medical device including:

- a battery compartment, the battery compartment being designed to removably hold a battery and contact elements for electrically contacting the battery;
- a test load $R_{Test}$, the test load $R_{Test}$ being selectively coupleable to the battery;
- a control circuit, the control circuit being configured to execute the~~a~~ method according to any of the preceding claims.

**9.** The ~~B~~battery-powered medical device according to claim 8, wherein the battery-powered medical device includes one or more DC/DC step-up converters, the DC/DC step-up converter(s) powering at least some functional units of the medical device, wherein the test load $R_{Test}$ is electrically arranged between the contact elements and an input side of the DC/DC step-up converter(s).

**10.** The ~~B~~battery-powered medical device according to either of claims 8 – 9, wherein a relation between the difference voltage threshold $\Delta U_{Treshold}$ and the no-test-load voltage $U_{NoTestLoad}$ is stored in a memory of the control circuit.

**11.** The ~~B~~battery-powered medical device according to either of claims 8 to 10, wherein the control circuit comprises a processor or computer and a computer readable storage medium, in particular memory, the computer-readable storage medium comprising instructions which, when executed by the processor or computer causes the processor or computer to control execution the method for powering up the medical device.

**12.** The ~~B~~battery-powered medical device according to either of claims 8 to 11, wherein the medical device is an extracorporeal insulin pump, the extracorporeal insulin pump being configured to be carried by a user for an extended time period under clothing and/or attached to the body.

~~**13.** Method for determining the difference voltage threshold $\Delta U_{Treshold}$ in dependence of the no-test-load voltage $U_{NoTestLoad}$ for use in a method according to either of claims 1 to 7, the method including the steps of:~~

~~(1) experimentally determining a functional relation between values of an effective internal resistance $R_i$ and values of an open circuit voltage $U_0$ for which the battery is capable of powering up the medical device;~~

~~(2) determining a minimum no-test-load voltage $U_{NoTestLoad,min}$ of the battery for powering up the medical device without a test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step;~~

~~(3) determining a minimum test-load voltage $U_{TestLoad,min}$ of the battery for powering up the medical device with a test load $R_{Test}$ being connected to the battery as a function of the open-circuit voltage $U_0$ based on the functional relation as determined in step;~~

~~(4) computing the difference voltage threshold $\Delta U_{Treshold}$ from the difference between the minimum no-test-load voltage $U_{NoTestLoad,min}$ and the minimum test-load voltage $U_{TestLoad,min}$ in dependence of the minimum no-test-load voltage $U_{NoTestLoad,min}$ with the open-circuit voltage $U_0$ as parameter.~~

~~14.~~13. The ~~M~~method according to claim 1~~3~~, wherein the method for determining the difference voltage threshold $\Delta U_{Treshold}$ in dependence of the no-test-load voltage $U_{NoTestLoad}$ further includes~~ing~~ determining the functional relation between values of the effective internal resistance $R_i$ and values of the open-circuit voltage $U_0$ as approximated linear functional relation.

~~15.~~14. The ~~M~~method according to either of claim 1~~3~~ or claim 1~~3~~4, wherein the method for determining the difference voltage threshold $\Delta U_{Treshold}$ in dependence of the no-test-load voltage $U_{NoTestLoad}$ further includes~~ing~~ computing the difference voltage threshold $\Delta U_{Treshold}$ as linear approximation.