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Notes on the use of CR2450 lithium batteries in Human Detector *Flex* systems

The Human Detector *Flex* sensor modules (**HDF modules** for short) use **CR2450** batteries for mains-independent operation. The batteries are lithium button cells with a diameter of 24.5 mm and a height of 5 mm. The average capacity of **CR2450** batteries is between 560 - 620 mAh.

Lithium button cells are often used for sensor applications. They offer a high energy density (capacity) and a largely constant output voltage over a long period of time in a small design.

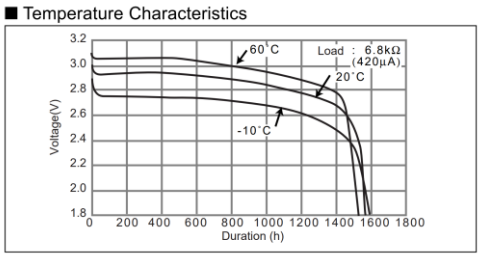

Figure 1:
Temperature characteristics of a **CR2450** lithium coin cell
Source: Panasonic

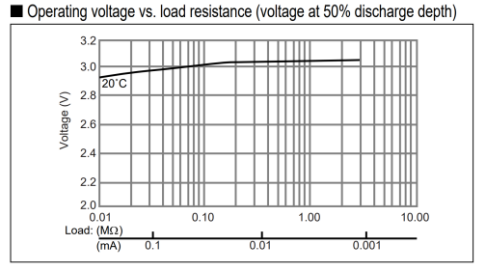

Figure 2:
Operating voltage vs. load for **CR2450** lithium button cell.
Source: Panasonic

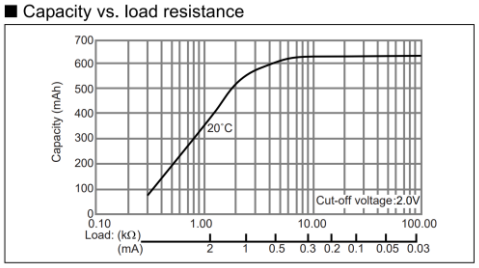

Figure 3:
Capacity vs. load for a **CR2450** lithium button cell
Source: Panasonic

However, this is exactly where a problem lies. The transition from stable operation, at a voltage of Ub > 2.9 volts, to unstable operation is slight. There are some circumstances that can postpone this point in time. In particular, a high load (high current consumption) immediately leads to changes in the capacitance and the output voltage.

The essential circumstances are:

- The ambient temperature of the **HDF module**. Low temperatures reduce the capacity.
- The age of the lithium button cell. There is a constant self-discharge.
- The quality of the button cell. Inexpensive non-brand batteries often do not meet the stated capacity values.
- With high current draw or largely discharged batteries, the output voltage drops more sharply under load.
- Frequent and rapid successive strong power withdrawals lead to a premature drop in the operating voltage.
- Longer pauses between strong power withdrawals lead to a recovery of the lithium button cell (refresh effect).

In daily operation, it is important that the **HDF modules** function and are not put out of operation unnoticed by drained batteries. For this purpose, the units have a "Battery low" detection. This signals at an early stage that the battery needs to be changed. In view of the low cost of lithium button cells and the safety requirements, this point in time is brought forward. This means that a "Battery low" message does not necessarily indicate the end of battery use. Depending on the circumstances described above, it is possible that the lithium button cell can still be used for a longer time.

Sensors with lithium batteries that have sent a "Battery low" message must be observed with the utmost care. The function of the **HDF modules** should be checked regularly as far as possible. This can easily be done with various sensors. For all other **HDF modules**, it is recommended to replace the batteries as a precaution. Especially if the above-mentioned conditions change, e.g. low temperatures in winter, appropriate precautions should be taken.

In addition to the typical sensor monitoring functions, the **HDF modules** are busy in the background monitoring their basic availability and reporting this to the alarm system. For this purpose, messages are sent to the alarm centres or alarm management systems at short and regular intervals. These availability signals, so-called "heartbeats", require a lot of energy and reduce the total life of the lithium button cells. To prevent this, it is possible to suppress the sending of the availability signals. This extends the battery life. To ensure that the modified **HDF module** does not simply stop working when the battery is empty, an automatic battery check is carried out approx. every 24 hours. If this check is negative, a "Battery low" message is issued once. This may be repeated every day thereafter.

If you want to suppress the sending of the availability identifiers, please proceed as follows:

- Make sure that the **HDF module** is switched off.
- Press and hold the **TEST button** on the **HDF module**.
- Switch on the **HDF module**.
- Stop pressing the **TEST button**.
- The green **PROG LED** lights up to indicate the following:

  Short light -> Sending availability identifiers switched off.
  Long light -> Sending of availability identifiers switched on.

If you have switched off the sending of availability signals, you should monitor the HDF module with great care. Regular monitoring is important to ensure safe operation.

If you suppress the sending of availability signals, you must also switch off the monitoring in the alarm centres. You should also switch off the **heartbeat monitoring** in the **HDF-SUPERVISOR app**. Otherwise you will receive regular error messages (heartbeat errors). You will find the necessary information in the manuals of the alarm centres (**HDF-BUZZER** and **HDF-SPEECH**).

Important note:

In principle, all **HDF modules** can also be operated with external batteries or mains adapters. This will considerably extend the service life. More detailed information can be found in the manuals of the **HDF modules**.