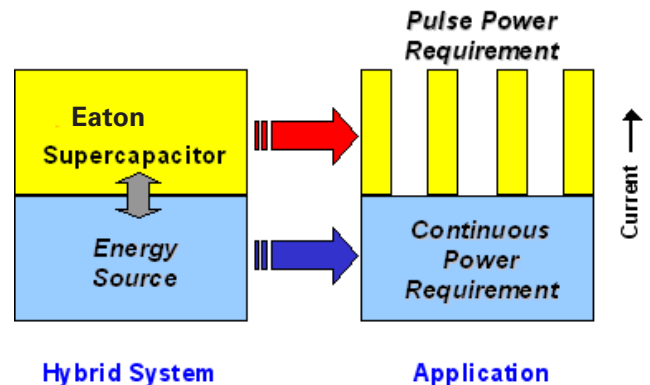


# Supercapacitors for remote RF transmission

RF transmission is commonly used to communicate data, status and position information from remote and mobile facilities. Typically, a primary Lithium battery powers these applications, but it alone does not allow for operation at very low temperatures and commonly falls short of operating life requirements.

In order to overcome these shortcomings, a supercapacitor can be fitted in parallel with the primary battery to create a hybrid battery-capacitor as shown in Figure 1. The battery provides the total energy requirement while the capacitor, with its lower series resistance, supplies the peak current demand.



**Figure 1.** Hybrid Battery-Capacitor Configuration

The advantage of the hybrid battery-capacitor being that, because the overall impedance of the power source is lower than the battery alone, a much smaller voltage drop is seen at the battery terminals when peak current is supplied. This in turn means that the hybrid system can maintain the voltage level above the required minimum even when the battery impedance increases during operation at very low temperatures. Battery life is also improved as exposure to high current discharge is reduced and more of the available energy can be retrieved from the battery.

It is clear that supercapacitors can be used to support battery operation in RF transmission applications; however for them to be a viable solution for remote applications, such as automated meter reading and asset tracking, supercapacitors also need to meet stringent requirements.

Table 1 shows the general requirements for automated meter reading applications. These include greater than 10 year operating life, wide temperature operation and low capacitor leakage current. In fact, all these parameters relate to the operating life. Capacitor leakage current presents an additional load on the battery, if this additional load is too high then the battery will be prematurely drained and the required operating life will not be achieved.

Also, supercapacitor characteristics change with temperature; at low temperatures the equivalent series resistance (ESR) increases and the capacitance will be reduced. Therefore -40 °C presents the worst case operating condition, making solutions with small changes in ESR and capacitance at subzero temperatures desirable. At high temperatures supercapacitors will irreversibly degrade, so it is essential that there is sufficient design margin to allow for the specified change in capacitance and ESR over time.

**Table 1.** Requirements for remote RF communication applications vs. Eaton PM family capabilities

Parameter	Requirement	Eaton PM Family
<u>Long Operational Life</u>	10 years operation (including >100k discharge pulses) + 0.5 years storage prior to installation	> 10 years operational life > 375K discharge pulses
<u>Low Temperature Capability</u>	Typically -40°C	Excellent low temperature performance, capability not affected by aging
<u>High Temperature Capability</u>	Typically up to 85°C	Reliable 85°C operation @ 3.9V
<u>Low Self-Discharge</u>	Minimum (averaged over time) self-discharge	Leakage current in the micro Ampere range

The Eaton PM family of ultra lower ESR supercapacitors meets all these requirements. With an extended operating temperature range of -40 to +85 °C and leakage current in the micro amps range the PM family provides a reliable solution for all remote RF transmission applications. For more information on Eaton supercapacitors, visit [www.eaton.com/electronics](http://www.eaton.com/electronics).

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