PowerSafe® SBS

EON TECHNOLOGY®

Operation Guide for Hybrid Applications

EnerSys®

Power/Full Solutions

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1. Applications

Whilst PowerSafe® SBS EON Technology® battery solutions are well proven in standby and cyclic applications, recent developments have focused on improving robustness in harsh environments and challenging operating conditions. Today EON Technology has higher cyclic performance, improved endurance at high temperature and the ability to operate in partial state of charge, providing that the operating conditions are well understood.

Where mains grid power is not available, the power requirement is typically alternatively supplied by diesel generator or battery bank but can also incorporate renewable energy sources such as wind turbine or PV array. In these off-grid hybrid applications the battery can be subjected to warm ambient temperature with regular cyclic duty – typically one cycle per day.

Off-grid hybrid applications can be split into two sub categories as shown in table 1.

Controlled full state of charge:
An operating mode with regular cyclic duty where the battery is returned to full state of charge between discharge cycles. The duty cycle is designed to optimised balanced battery life and operating expenditure savings. Can be subjected to high ambient temperatures.

Controlled partial state of charge:
An operating mode with regular cyclic duty where the battery is deliberately operated in partial state of charge to maximise operating expenditure savings. The battery is periodically returned to full state of charge when predefined trigger points are reached. Can be subjected to high ambient temperatures.

Table 1

Table 2 provides a summary of the operating parameters (charging) that will deliver optimum service life and performance relative to the type of application.

Application	PowerSafe® SBS EON Technology® Charge Parameter for Optimised Life and Performance
Hybrid Operation to Full State of Charge	✔ Boost voltage equivalent to 2.35 to 2.40Vpc @ 20°C ✔ Charge current - minimum 0.1C_{10}A, maximum unlimited ✔ Return to full state of charge between discharge cycles. Optimum charge factor 103% of discharged Ah
Hybrid Operation in Partial State of Charge (controlled PSoC) - Example	✔ Boost voltage equivalent to 2.35 to 2.40Vpc @ 20°C to return to 95% state of charge ✔ Charge current - minimum 0.1C_{10}A, maximum unlimited ✔ Full recharge every 10 days ✔ EnerSys® will consider variations in controlled PSoC operation as necessary - please contact your local representative to discuss details

2. General Operating Instructions

2.1 Operating Temperature Range

The recommended operating temperature range for PowerSafe SBS EON Technology monoblocs and cells in hybrid applications is -40°C to +50°C. Optimum life and performance are attained at +20°C, however, with the correct controls in place, cyclic performance in hybrid applications is not impacted by elevated temperatures (providing that the maximum battery temperature is not allowed to exceed +50°C).

2.2 Storage

PowerSafe SBS EON Technology monoblocs and cells have a shelf life of 2 years when stored at 20°C. Higher temperatures increase the rate of self discharge and reduce storage life.

Figure 1 gives the relationship between storage time, open circuit voltage (OCV) and state of charge as a function of temperature.

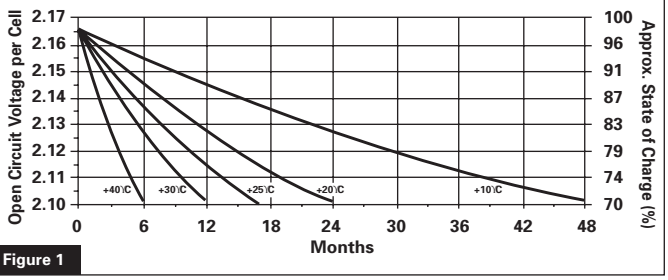

Figure 1

2.3 Freshening Charge

PowerSafe SBS EON Technology monoblocs and cells must be given a freshing charge when the OCV approaches 2.10 Volts/cell or when maximum storage time is reached (whichever occurs first).

The freshening charge should be conducted using constant voltage in the range of 2.29 to 2.40 volts per cell for a period of 24 hours. The minimum charge current should be equivalent to 0.1 C_{10} Amps, the maximum value is unlimited.

The maximum storage times between refresh charge and recommended OCV audit frequency is given in the table below.

Temperature (°C / °F)	Storage Time Months	OCV Audit Interval (Months)
+10 / +50	48	6
+15 / +59	34	6
+20 / +68	24	4
+25 / +77	17	4
+30 / +86	12	3
+35 / +95	8.5	2
+40 / +104	6	2

2.4 Commissioning

Prior to commencement of cyclic duty, the battery must be given a commissioning charge. This shall consist of 24 hours charge at a voltage equivalent to 2.40Vpc with no load connected.

2.5 Fast Charging

Fast charge is recommended for frequent discharge cyclic applications. In such applications the rectifier output voltage should be set at 2.35 to 2.40Vpc (20°C).

2.6 Charging Current Limit

Due to the very low internal resistance PowerSafe SBS EON monoblocs and cells will accept unlimited current during recharge, with minimum acceptable current equivalent to the load + 0.1C_{10} Amps.

2.7 Disposal

PowerSafe SBS EON Technology monoblocs and cells are recyclable. End of life batteries must be packaged and transported according to prevailing transportation rules and regulations. End of life batteries must be disposed of in compliance with local and national laws by a licensed battery recycler.

3. Cyclic Operation Guidelines

3.1 Cyclic Performance

EON Technology has been developed to retain the long float life characteristics associated with standard PowerSafe SBS technology and has the added capability to deliver high performance in harsh applications where cyclic duty predominates.

The optimal cyclic performance shown in figure 2 is based on the battery being returned to full state of charge between discharge cycles. It is possible to operate SBS EON Technology monoblocs and cells in controlled partial state of charge condition, however, in such situations it is very important to ensure that the battery is periodically returned to full state charge to maintain battery state of health. It is recommended to contact your EnerSys representative to obtain additional information and guidance for such PSoC applications.

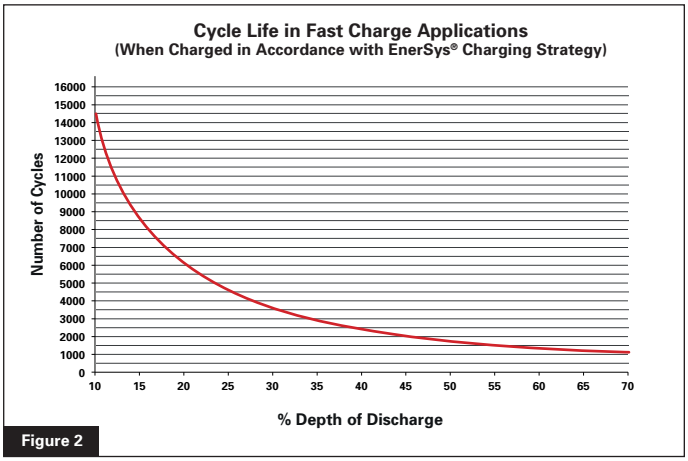

Figure 2

3.2 Discharge

Discharge may be stopped and recharge commenced when the on load battery voltage falls to the level equivalent to the configured depth of discharge in the duty cycle, using the curve for PowerSafe SBS EON as shown in figure 3. As an example, a 48V system could be set up for 60% DoD in normal operation, with an end of discharge voltage trigger of 47.8V (1.99 Vpc). In abnormal situations (e.g. where a generator fails to start), a partial load disconnect at 47V (1.96 Vpc - 70% DoD) and low voltage disconnect at 46.3V (1.93 Vpc - 80% DoD) should be applied to protect the battery from abusive over discharge.

The discharge may also be measured by means of an Ah counting device with accuracy ± 1% of the expected current range. In abnormal situations e.g. where a generator fails to start, a partial load disconnect at 47V (1.96 Vpc - 70% DoD) and low voltage disconnect at 46.3V (1.93 Vpc - 80% DoD) should be applied to protect the battery from abusive over discharge.

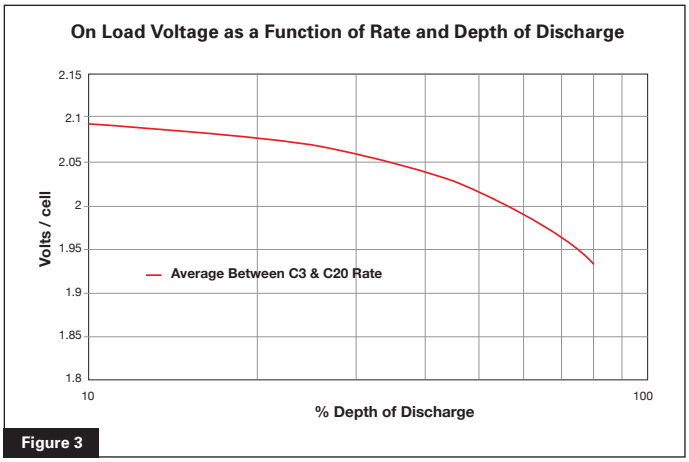

Figure 3

3.3 Recharge

There is a number of methods that can be utilised to control the recharge time:

1. Current Absorption Rate: Recharge can be stopped when current being absorbed by the battery reaches 0.01C. At this point a timer is activated to deliver an additional 1 hour of charge.
2. Time Base: It is possible to estimate time to full state of charge by using the calculation:

   Recharge time (hrs) = 2* ((0.8 x discharged Ah) / current limit) +1

Indication of time to full state of charge using the above formula for various depths of discharge and current limits is shown in figure 4

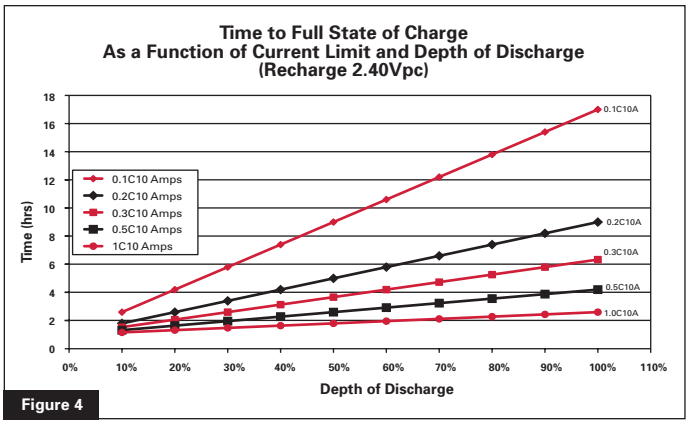

Figure 4

Where time based recharge is used, temperature compensation for charge voltage (2.40Vpc at 20°C) should be applied at the rates shown in figure 5.

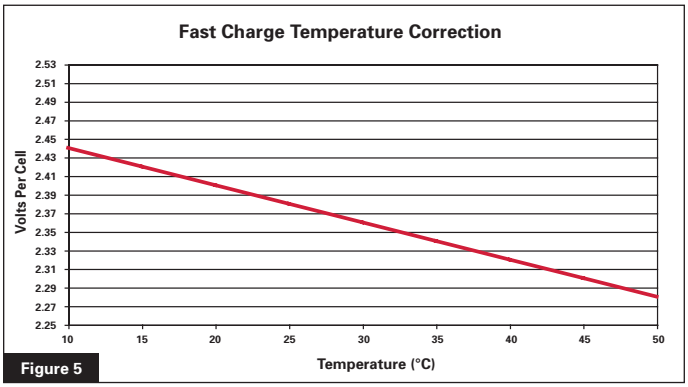

Figure 5

3. Ah Counting: Controlled recharge can be achieved by Ah counting using a device with accuracy ± 1% of the expected current range. However, inaccuracies associated with equipment calibration and/ or controller algorithm accuracy can lead to drift in determining the true SoC, meaning that periodic equalisation charge and recalibration of SoC is required.

Where Ah counting is used to control the recharge (i.e.103% of discharged Ah is returned/ 115% in terms of Wh returned), the battery voltage can be maintained at a constant 2.40 Volts/cell provided that the battery temperature is controlled at or below +50°C discharged Ah returned.

Where rectifier voltage cannot be adjusted to values >2.40 Volts/cell to compensate for temperatures below 20°C, the time to full state of charge will be increased. For additional information and guidance on this, please contact your EnerSys® representative.

3.4 Data Recording

It is recommended that as a minimum, the following information be recorded by means of regular data logging – which the user must make available to EnerSys to validate any warranty decision.

1) Records of the commission charge.
2) The number of cycles performed and the depth of discharge (“DoD”) of each cycle.
3) The duration of each discharge and charge cycle, and the Ah in and out (Wh in and out).
4) Full details of the recharge voltage/current profile for the last 50 cycles.
5) A full history of the ambient and battery surface temperatures, recorded at regular intervals throughout battery operation and life.
6) The time and date of each “event” (an “event” is defined as the start /stop of the battery discharge, the start/stop of the battery recharge, the start stop of any generator input power or other input power source, etc).

Warning
In hybrid applications it is important that the maximum temperature of the battery in operation does not exceed +50°C. Continuous charge at 2.35Vpc to 2.40Vpc will significantly reduce the battery life.

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EnerSys World Headquarters
2366 Bernville Road, Reading,
PA 19605, USA
Tel: +1-610-208-1991 /
+1-800-538-3627

EnerSys EMEA
EH Europe GmbH,
Baarerstrasse 18,
6300 Zug
Switzerland

EnerSys Asia
152 Beach Road,
Gateway East Building #11-03,
Singapore 189721
Tel: +65 6508 1780

Contact: