VALVE-REGULATED
SEALED LEAD
ACID BATTERY

Powerline
SC Series

Standard Commercial

Product Guide

Contents

Introduction

ABT Powerline SC is a Standard Commercial battery according to Eurobat Classification design life for standby application with 3-5 years . As with all ABT batteries, all are rechargeable , highly efficient, leakage proof and maintenance free.

Technical Features

Sealed Construction

The construction and sealing techniques of Powerline SC guarantee leakage proof operation in any position with no adverse effect to capacity or service life.

Electrolyte Suspension System

Powerline SC utilize an electrolyte suspension system consisting of microporous glass fibre separator material. This suspension system helps to achieve maximum service life, by fully retaining the electrolyte and preventing its escape from the separator material.

Gas Generation

Powerline SC incorporates a unique design that effectively recombines over 99% of the gas generated during floating usage.

Maintenance Free Operation

During the life of Powerline SC, there is no need to check the specific gravity or add water etc. In fact, there are no provisions for such maintenance functions to be carried out.

Operation In Any Orientation

The combination of sealed construction and it's electrolyte suspension system permits operation of Powerline SC in any orientation (excluding continuous inverted use) without loss of capacity, service life, or leakage of electrolyte. The Powerline SC also conforms to IEC 60896-21/22(2004).

Low Pressure Venting System

Powerline SC are equipped with a safe, low pressure venting system, which is designed to release excess gas and close automatically as the internal gas pressure rising to an unacceptable level. This low pressure venting system, coupled with the significantly high recombination efficiency, make Powerline SC one of the safest valve regulated lead acid batteries available.

high quality alloy

The positive grid alloy contained high Tin and low calcium quantity in Powerline SC should provide an extra margin of performance and service life in floating applications.

Floating Service Life

The expected service life of the standard model Powerline SC when used in floating application is typically 3- 5 years; however, experience has shown that their service life often exceeds 5 years, if the Powerline SC are operated strictly within specification.

Self Discharge -- Shelf Life

At temperatures of between 20 & 25℃, the self discharge rate of Powerline SC per month is approximately 3% of the rated capacity. This low self discharge rate permits storage for up to one year without any appreciable deterioration of battery performance.

Operating Temperature

Powerline SC can be used over a wide range of ambient temperatures:-20℃~60℃, allowing considerable flexibility in system design and location.

Deep Discharge Recovery

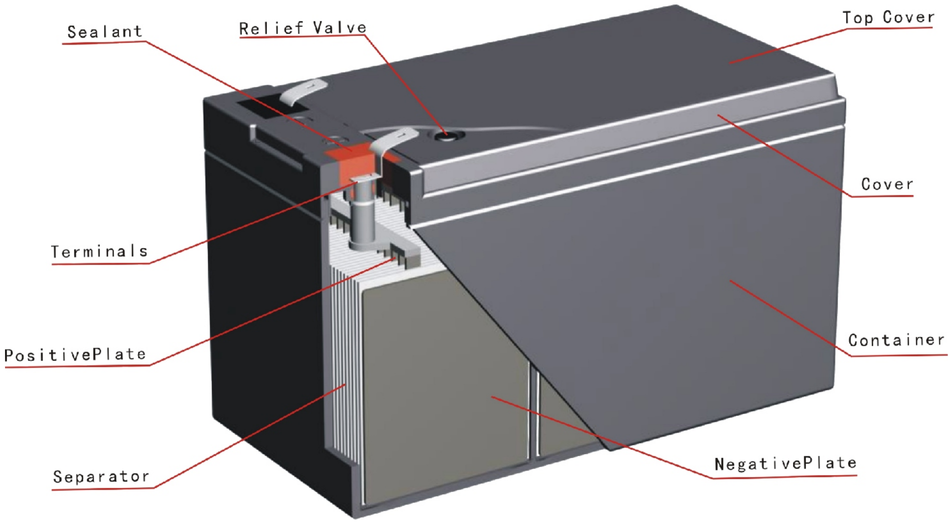
Powerline SC recover their capacities even after deep discharges.

Applications

A list of some of the more common applications for standby or principal power is given below:

Alarm Systems
Cable Television
Communications Equipment
Computers
Control Equipment
Electronic Cash Registers
Electronic Test Equipment
Emergency Lighting Systems
Fire & Security Systems
Geophysical Equipment
Medical Equipment
Microprocessor Based Office machines
Solar Powered Systems
Telecommunication Systems
Television & Video Recorders
UPS/EPS
Vending Machines

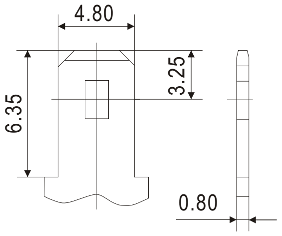
Construction



General Specifications

Model	20hr to 1.75Vpc	10hr to 1.75Vpc	Voltage	Volumic Energy Density (Wh/L.20hr)	Mass Energy Density (Wh/kg.20hr)	Int. Resistance (m.Ohms)	Maximum Charge Current (A)	Short Circuit current (A)	Dimensions (mm)			Weight (Kg)	Terminal	Layout
									Length	Width	Height overall			
SC6-1	1	0.93	6	49.1	24.0	35	0.3	30	51	42	57	0.25	F1	E
SC6-1.2	1.2	1.12	6	52.1	22.5	24	0.36	36	97	25	57	0.32	F1	A
SC6-3.2	3.2	2.98	6	63.9	29.5	28	0.96	96	134	34	66	0.65	F1	A
SC6-4	4	3.72	6	68.2	31.6	24	1.2	120	70	47	107	0.76	F1	E
SC6-4.5	4.5	4.15	6	76.7	31.8	17	1.35	135	70	47	107	0.85	F1	E
SC6-7	7	6.48	6	81.8	35.0	11	2.1	210	151	34	100	1.2	F1	A
SC6-7.5	7.5	6.98	6	87.7	34.6	8	2.25	225	151	34	100	1.3	F1	A
SC6-12	12	11.10	6	95.4	40.0	9.5	3.6	360	151	50	100	1.8	F1 or F2	A
SC12-0.8	0.8	0.74	12	64.5	27.4	270	0.24	24	96	25	62	0.35	T1	F
SC12-1.2	1.2	1.12	12	59.5	23.2	44	0.36	36	97	43	58	0.62	F1	C
SC12-2A	2	1.85	12	90.1	35.3	50	0.6	60	182	24	61	0.68	F4	D
SC12-2B	2	1.85	12	89.9	34.3	53	0.6	60	150	20	89	0.7	F5	D
SC12-2.3	2.3	2.12	12	66.1	28.2	34	0.69	69	178	35	67	0.98	F1	A
SC12-2.9	2.9	2.70	12	75.6	29.5	40	0.87	87	79	55.5	105	1.18	F1	B
SC12-3	3	2.77	12	79.5	30.5	45	0.9	90	132	33	104	1.18	F1	A
SC12-3.2	3.2	2.98	12	63.8	28.9	35	0.96	96	134	67	67	1.33	F1	C
SC12-4A	4	3.70	12	70.5	32.9	45	1.2	120	90	70	108	1.46	F1	A
SC12-4B	4	3.70	12	68.9	30.0	50	1.2	120	195	47	76	1.6	F1	A
SC12-4.5	4.5	4.16	12	79.4	32.7	32	1.35	135	90	70	108	1.65	F1	A
SC12-5	5	4.62	12	88.2	32.4	19	1.5	150	90	70	108	1.85	F1	A
SC12-6	6	5.59	12	97.3	36.9	20	1.8	180	151	50	98	1.95	F1 & F2	D
SC12-7	7	6.30	12	87.3	35.9	22	2.1	210	151	65	98	2.34	F1or F2	D
SC12-7.5	7.5	6.98	12	93.6	35.3	18	2.25	225	151	65	98	2.55	F1or F2	D
SC12-8	8	7.45	12	99.8	37.2	17	2.4	240	151	65	98	2.58	F1or F2	D
SC12-9	9	8.32	12	93.3	37.6	36	2.7	270	151	65	118	2.87	F2	D
SC12-12	12	11.10	12	97.3	40.3	17	3.6	360	151	98	100	3.57	F1or F2	D
SC12-18	18	16.20	12	94.6	36.9	15	5.4	540	181	76	166	5.85	M5XΦ12	B

Terminals



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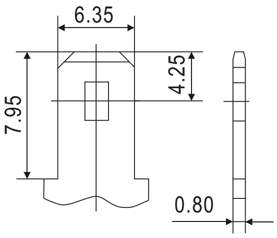

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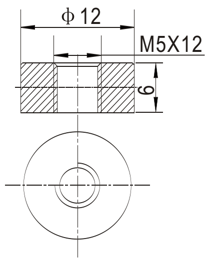

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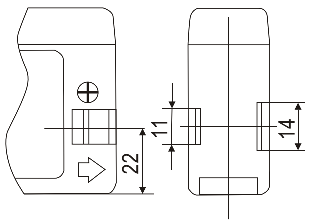

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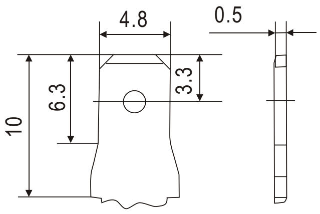

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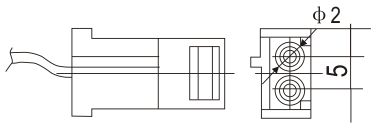
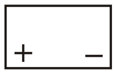


T1

Layout



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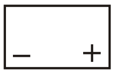

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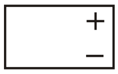

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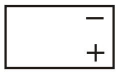

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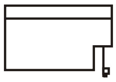

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Discharge

Discharge Characteristics

The curves shown in Figure 1 and the discharge current rates shown in Table 3 illustrate the typical discharge characteristics of Powerline SC at an ambient temperature of 20℃. The symbol "C"expresses the nominal capacity of the battery measured at a 20-Hour discharge rate. Please refer to General Specifications to determine the nominal capacity rating of specific Powerline SC models. The standard industry practice to determine the nominal capacity of a valve regulated lead acid battery is to discharge the battery under test at C_{20} and 1.75Vpc.

Table 3 shows the different currents that can be drawn at various discharge capacity rates.

Table 4 shows that the rated nominal capacity of a battery is reduced when it is discharged at a value of current that exceeds its 20-Hour discharge rate. This should be taken into consideration when a battery is being selected for a particular application.

Figure1. Discharge Characteristics

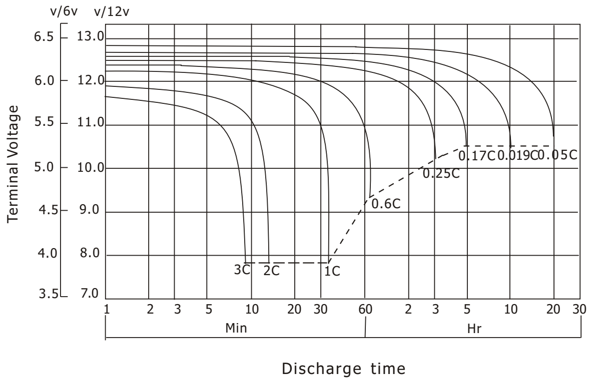


Table 3. Discharge current at stipulated discharge rates

20 Hr. Capacity	Discharge Current(A,20℃)									
	0.05C	0.10C	0.15C	0.20C	0.25C	0.40C	0.60C	1.0C	2.0C	3.0C
0.80	0.04	0.08	0.12	0.16	0.20	0.32	0.48	0.8	1.6	2.4
1	0.05	0.10	0.15	0.20	0.25	0.40	0.60	1.0	2.0	3.0
1.2	0.06	0.12	0.18	0.24	0.30	0.48	0.72	1.2	2.4	3.6
2	0.10	0.20	0.30	0.40	0.50	0.80	1.20	2.0	4.0	6.0
2.3	0.115	0.23	0.345	0.46	0.575	0.92	1.38	2.3	4.6	6.9
2.9	0.145	0.29	0.435	0.58	0.725	1.16	1.74	2.9	5.8	8.7
3	0.15	0.30	0.45	0.60	0.75	1.20	1.80	3.0	6.0	9.0
3.2	0.16	0.32	0.48	0.64	0.80	1.28	1.92	3.2	6.4	9.6
4	0.20	0.40	0.60	0.80	1.0	1.60	2.4	4.0	8.0	12.0
4.5	0.225	0.45	0.675	0.90	1.125	1.80	2.7	4.5	9.0	13.5
5	0.25	0.50	0.75	1.0	1.25	2.0	3.0	5.0	10.0	15.0
6	0.30	0.60	0.90	1.2	1.50	2.4	3.6	6.0	12.0	18.0
7	0.35	0.70	1.05	1.4	1.75	2.8	4.2	7.0	14.0	21.0
7.5	0.375	0.75	1.125	1.5	1.875	3.0	4.5	7.5	15.0	22.5
8	0.40	0.80	1.20	1.6	2.0	3.2	4.8	8	16	24
9	0.45	0.90	1.35	1.8	2.25	3.6	5.4	9	18	27
12	0.60	1.20	1.80	2.4	3.0	4.8	7.2	12	24	36
18	0.90	1.80	2.70	3.6	4.5	7.2	10.8	18	36	54

Table 4. Discharge capacity at various discharge rates

20 Hr. Capacity	Discharge Current(A,20℃)				
	20Hr	10Hr	5Hr	3Hr	1Hr
	TO 1.75V/C	TO 1.75V/C	TO 1.75V/C	TO 1.70V/C	TO 1.60V/C
0.8	0.040	0.074	0.137	0.212	0.505
1	0.050	0.093	0.172	0.265	0.632
1.2	0.060	0.112	0.206	0.318	0.758
2	0.100	0.185	0.344	0.531	1.263
2.3	0.115	0.212	0.395	0.610	1.453
2.9	0.145	0.270	0.498	0.769	1.831
3	0.150	0.277	0.515	0.796	1.895
3.2	0.160	0.298	0.550	0.849	2.021
4	0.200	0.370	0.687	1.061	2.526
4.5	0.225	0.416	0.773	1.194	2.842
5	0.250	0.462	0.859	1.327	3.158
6	0.300	0.559	1.031	1.592	3.789
7	0.350	0.630	1.202	1.857	4.421
7.5	0.375	0.698	1.288	1.990	4.737
8	0.400	0.745	1.374	2.123	5.052
9	0.450	0.832	1.546	2.388	5.684
12	0.600	1.110	2.061	3.184	7.578
18	0.900	1.620	2.989	4.616	10.988

Over Discharge (Deep Discharge)

The dotted line in Figure 3 indicates the lowest recommended voltage under load, or cut off voltage, for Powerline SC at various discharge rates. In general, lead acid batteries are damaged in terms of capacity and service life if discharged below the recommended cut off voltages. It is generally recognized that all lead calcium alloy grid batteries are subject to over discharge damage. For example, if a lead acid battery were discharged to zero volts, and left standing in either "on" or "off" load conditions for a long period of time, severe sulphation would occur, raising the internal resistance of the battery abnormally high. In such an extreme case, the battery may not accept charge. Powerline SC have been designed to withstand some levels of over-discharge. However, whilst this is not the recommended way of operation, Powerline SC can recover their capacity when recharged correctly. Final discharge voltage is shown in Table 5.

Table 5. Final discharge voltage

Discharge current (Ampere)	Final discharge Voltage (Vpc)
$I \leqslant 0.20C_{20}$	1.75
$0.20C_{20} \leqslant I < 0.50\ C_{20}$	1.70
$0.50C_{20} \leqslant I < 1.0\ C_{20}$	1.65
$1.0C_{20} \leqslant I$	1.60

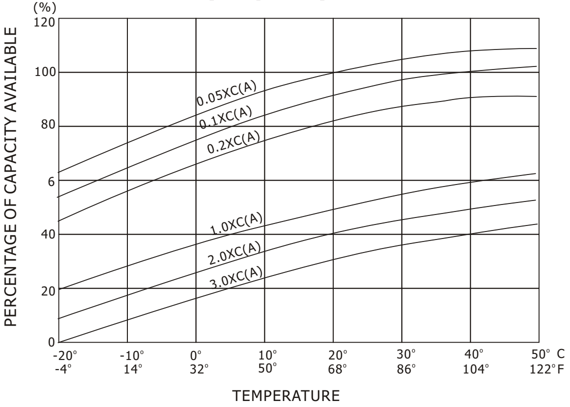
If a battery is to be discharged at a rate in excess of 3C Amps, please contact us prior to use.

Temperature characteristics

At higher temperatures, the electrical (Ah) capacity of a battery increases and conversely at lower temperatures, the electrical (Ah) capacity of a battery decreases.

Figure 2 shows the effects of different temperatures in relation to battery capacity.

Figure 2. Temperature effects in relation to battery capacity

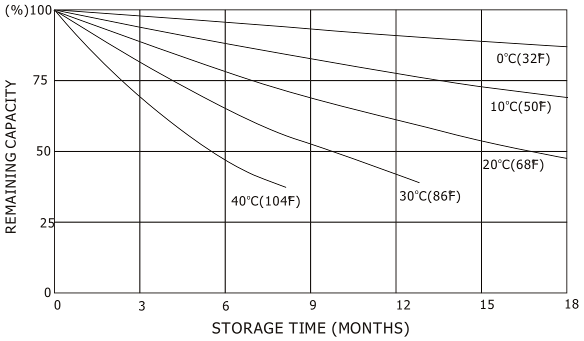


Storage, self discharge and shelf life

Self discharge

The self discharge rate of Powerline SC is approximately 3% per month when stored at an ambient temperature of 20℃. The self discharge rate will vary as a function of ambient storage temperature. Figure 3 shows the relationship between storage times at various temperatures and the remaining capacity.

Figure 3. Self discharge characteristics



Shelf Life

In general, when lead acid batteries of any type are stored for extended periods of time, lead sulphate is formed on the negative plates of the batteries. This phenomenon is referred to as "sulphation". Since the lead sulphate acts as an insulator, it has a direct detrimental effect on charge acceptance. The more advanced the sulphation, the lower the charge acceptance.

Table 6 below shows the normal storage time or shelf life at various ambient temperatures.

Table 6. Shelf life at various temperatures

Temperature	Shelf Life
-20℃(-4°F) to -1℃(-30.2°F)	15 months
0℃(32°F) to 20℃(68°F)	12 months
21℃(70°F) to 30℃(86°F)	9 months
31℃(88°F) to 40℃(104°F)	5 months
41℃(106°F) to 50℃(122°F)	2.5 months

Recharging stored batteries

In general, to optimize performance and service life, it is recommended that powerline sc which are to be stored for extended periods of time be given a supplementary charge, commonly referred to as a "top charge", periodically. Please refer to the recommendations listed on page 24 under top charging.

figure 4. Temperature/Life characteristics of powerline SC

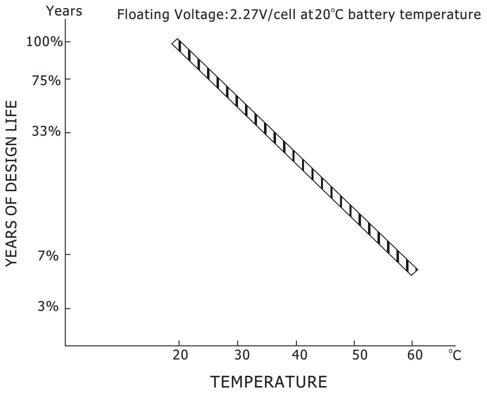
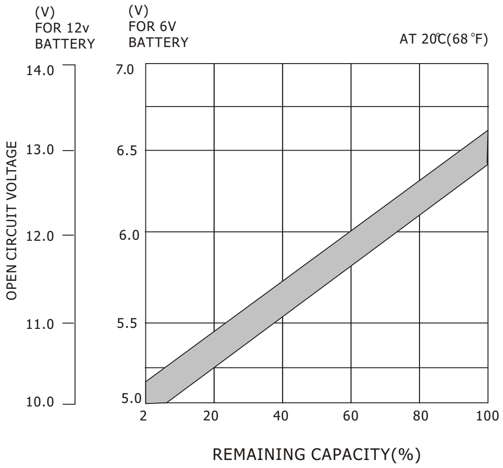


Figure 4 shows extrapolated service life condition for powerline sc at different ambient temperatures. As can be seen from figure 4 higher ambient temperatures will reduce service life.

Available capacity, measured by open circuit voltage

The approximate depth of discharge, or remaining capacity, in a powerline sc battery can be empirically determined by referring to figure 5.

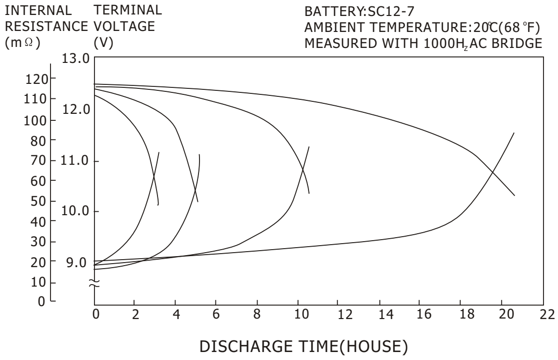
Figure 5. Open circuit voltage vs remaining capacity



Impedance

The internal resistance (impedance) of a battery is lowest when the battery is in a fully charged state. The internal resistance increases gradually during discharge, Figure 6 shows the internal resistance of an Powerline SC12-6 model measured through a 1,000 Hz AC bridge.

Figure 6. Internal resistance of SC battery



Charge

Correct charging is one of the most important factors to consider when using valve regulated lead acid batteries. Battery performance and service life will be directly affected by the efficiency of the charger selected. The basic charging methods are:

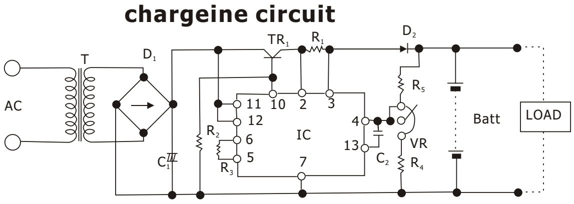
- Constant Voltage Charging
- Constant Current Charging
- Two Stage Constant Voltage Charging

Constant Voltage Charging

Charging at constant voltage is the most suitable and commonly used method for charging valve regulated lead acid batteries. Figures 8 - 13 show the charging characteristics of Powerline SC when charged by constant voltage chargers at 2.275 volts/cell, 2.40 volts/cell and 2.50 volts/cell when the initial charging current is controlled at 0.1C Amps and 0.25C Amps.

Figure 7 shows one example of a constant voltage charging circuit. In this circuit, the initial charging current is limited by the series resistance R1.

Figure 7. One example of constant voltage chargeine circuit



Note

The recommended float charge voltage for Powerline SC at 20℃ is 2.275vpc ± 0.005v. this should be the measured average for the total battery, however when measured within a battery network or string the allowable tolerances can be expected between 2.25vpc to 2.30vpc.

Figure 8. Charging characteristics

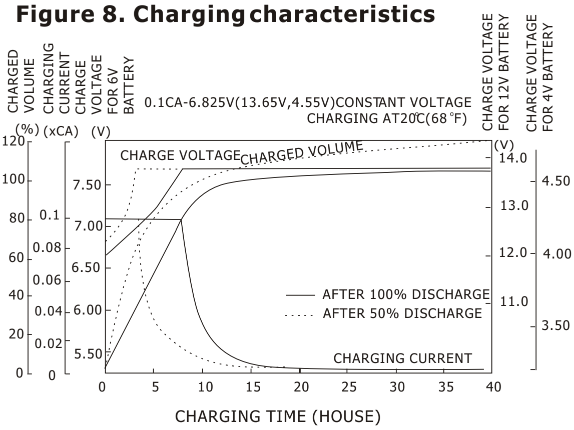


Figure9. Charging characteristics

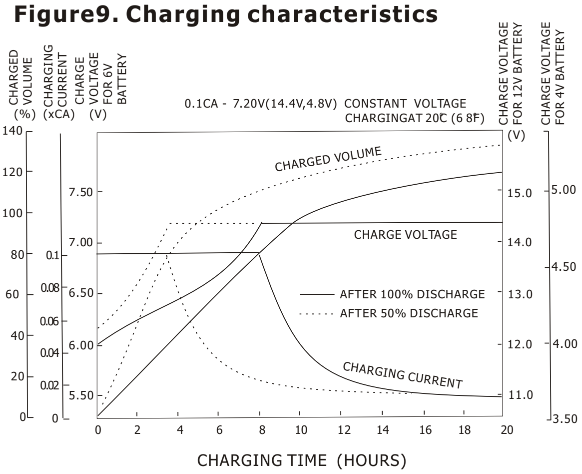


Figure10. Charging characteristics

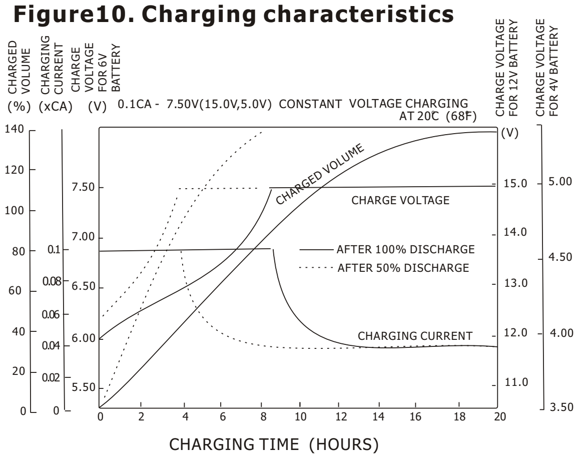


Figure 11. Charging characteristics

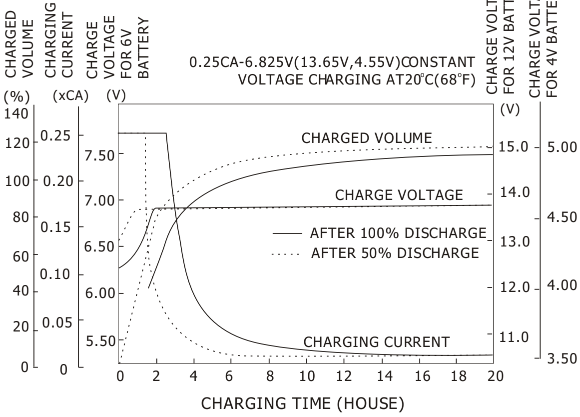


Figure 12. Charging characteristics

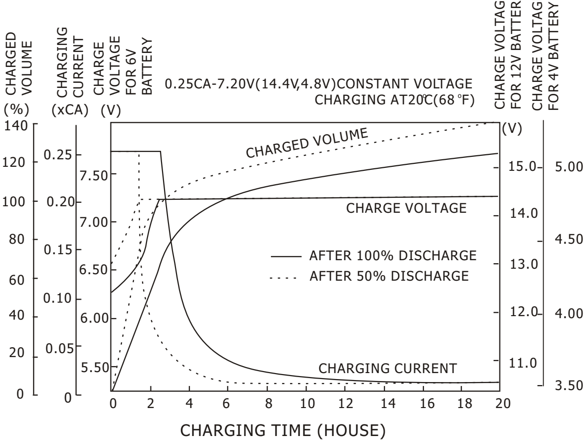
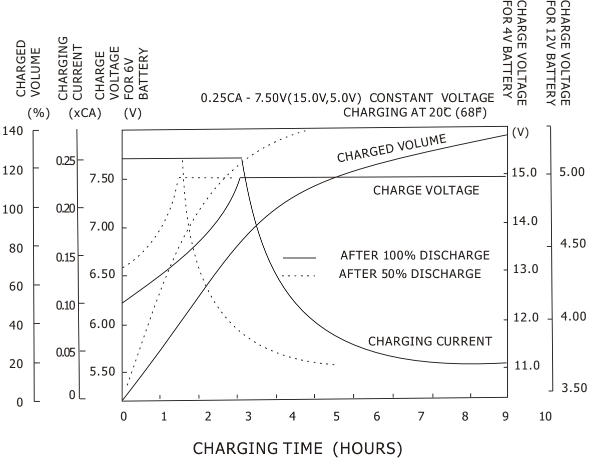


Figure13.charging characteristics



Constant Current Charging

This charging method is not often utilised for valve regulated lead acid batteries, but is an effective method for charging a number of series connected batteries at the same time, and/or as an equalising charge to correct variances in capacity between batteries in a series group.

Extreme care is required when charging Powerline SC with a constant current. If, after the battery has reached a fully charged state, the charge is continued at the same rate, for an extended period of time, severe overcharge may occur, resulting in damage to the battery. Figure 14 shows a typical constant current charging circuit; Figure 15 shows the characteristics of two Powerline SC12-6 under continuous overcharge conditions.

Figure 14. Constant current charging circuit

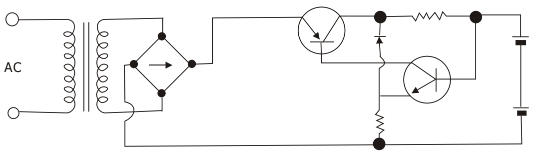
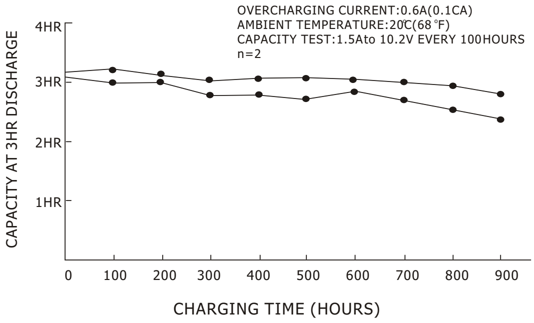


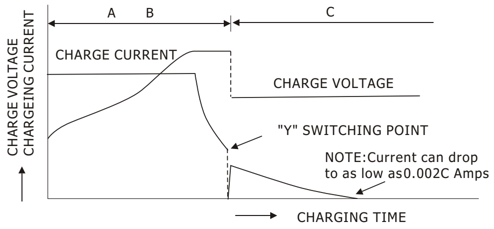
Figure 15. Characteristics of two SC12-6 under conditions of continuous overcharge



Two Stage Constant Voltage Charging

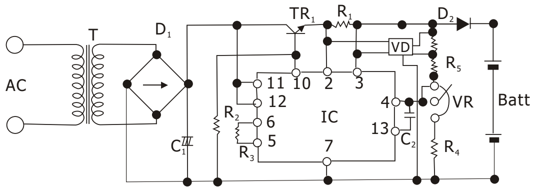
Two stage constant voltage charging is a recommended method for charging valve regulated lead acid batteries in a short period of time and then maintaining them in a fully charged float or standby condition. Figure 16 illustrates the characteristics of a two stage constant voltage charger.

Figure 16. Charging characteristics of a two stage constant voltage charger



The characteristics shown in Fig.16 are those of a constant voltage, current limited charger. In the initial charging stage, the current flowing into the battery is limited to a value of 0.30C Amps. The charging voltage across the battery terminals rises, during the charging process, to a value equal to the constant voltage output of the charger, which is set to 2.45 volts per cell. Whilst continuing to charge, in stage 1 (A-B), at 2.45 volts per cell, the current will eventually decrease to point "Y", where the value of this decreasing current is"sensed" causing the circuit to switch into the second stage (B-C), reducing the charging voltage from 2.45 volts per cell to a constant voltage, float/standby, level of 2.3 volts per cell. The switch to stage two, where the constant voltage level of 2.3 volts per cell is applied, occurs after the battery has recovered about 80% of its rated capacity. This is one of the most efficient charging methods available as the recharge time is minimized during the initial stage whilst the battery is protected from overcharge by the system switching to stage 2 (float/standby) charge at the switching point"Y".

Figure17. Example of a two stage constant voltage,Current limited charging circuit



When this charging method is used, the output values will be as follows:

Initial Charge Current . . . . . 0.30C Amps (max.)

Charge Voltage:

1st Stage . . . . .2.45V/cell (2.40 to 2.50 v/cell, max.)

2nd Stage . . . . 2.275V/cell(2.25 to 2.30 v/cell, max.)Switching Current From

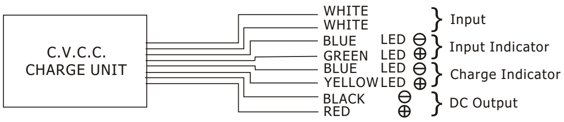
1st Stage to 2nd Stage . . . . 0.05C Amps (0.04C to 0.08C Amps)

-Note: This charging method cannot be used in applications where the load and the battery are connected in parallel.

C.V.C.C. CONSTANT VOLTAGE, CONSTANT CURRENT CHARGE MODULE

The C.V.C.C. is a fully regulated automatic charging module designed for batteries. There are two 6 volt versions available; one for standby applications and the other for cyclic applications. Also there are two 12 volt versions available, again one for standby applications and the other for cyclic applications. When interfaced with the appropriate AC or DC power supply, the C.V.C.C. guarantees safe charging and maximum battery life. Figure 18 is a block diagram of the C.V.C.C.

Figure 18. Block diagram of C.V.C.C.

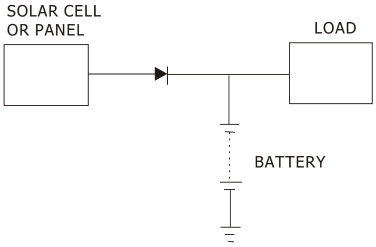


The C.V.C.C. modules are protected from both the short circuiting of their D.C. output voltage and from being reverse polarity connected to the battery. Detailed specifications are available on request.

Solar Powered Chargers

A battery is an indispensable component of any solar powered system designed for demand energy use. Since solar cells have inherent constant voltage characteristics, Powerline SC can be charged directly from the solar array using a simple diode regulated circuit as shown in Figure 19.

Figure 19. BLOCK DIAGRAM OF A SOLAR POWERED CHARGING SYSTEM



In designing a solar powered system, consideration should be given to the fact that in addition to normal periods of darkness, weather conditions may be such that solar energy is limited, or virtually unavailable for long periods of time. In extreme cases, a system may have to operate for 10 to 20 days with little or no power available for charging. Therefore, when selecting the correct battery for a solar application, the capacity should be determined based upon maximum load conditions for the maximum period of time the system may be expected to be without adequate solar input.

In many instances the battery capacity will be 10 to 50 times greater than the maximum output of the solar panels. Under these circumstances, the maximum output of the solar array should be dedicated to charging the battery with no load sharing or intervening control devices of any kind.

Naturally, in cases where the output of the solar array exceeds the capacity of the battery, and weather conditions are such that the potential for overcharging the battery exists, appropriate regulated charging circuitry between the solar panels and the battery is recommended.

Remote sites and other outdoor applications is where most solar powered systems are to be normally found. When designing a solar powered system for this class of application, a great deal of consideration must be given to environmental conditions. For example, enclosures which may be used to house batteries and other equipment may be subject to extremely high internal temperatures when exposed to direct sunlight. Under such conditions, insulating the enclosure and/or treating the surface of the enclosure with a highly reflective, heat resistive material is highly recommended.

In general, when designing a solar powered system, consultation with the manufacturers of both the solar panel and the battery is strongly advised.

Charging Voltage

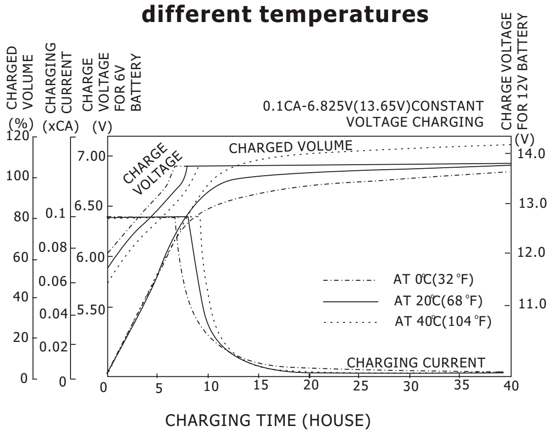
The charging voltage should be chosen according to the type of service in which the battery will be used. Generally, the following voltages are used:

For float (standby) use. . . . . .. 2.25 to 2.30 volts per cell

For cyclic use . . . . 2.40 to 2.50 volts per cell

In a constant voltage charging system, a large amount of current will flow during the initial stage of charging but will decrease as the charging progresses. When charging at 2.275 volts per cell, the current at the final stage of charging will drop typically to a value of between 0.0005C Amps and 0.004C Amps. When a battery has been charged up to a level of 100% of the discharged ampere hours, the electrical energy stored and available for discharge will be 90% or more, of the energy applied during charging. Charging voltage should be regulated in relation to the ambient temperature. When the temperature is higher, the charging voltage should be lower and conversely when the temperature is lower, the charging voltage should be higher. For specific recommendations, please refer to the section on Temperature Compensation. Similarly, charged volume (measured in ampere hours) realized over a given time will vary in direct relation to the ambient temperature; the higher the ambient temperature, the higher the charged volume in a given period of time and the lower the ambient temperature, the lower the charged volume in the same given period of time. Figure 20 shows the relationship between charged volume and temperature.

Figure 20. Charging characteristics at different temperatures

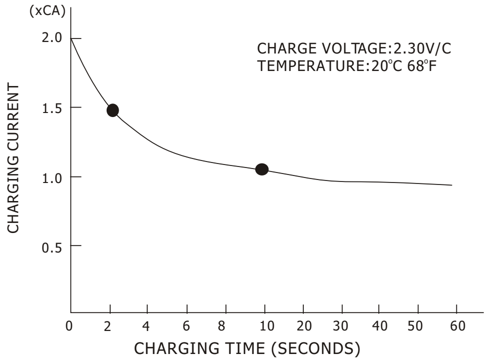


Initial Charge Current Limit

A discharged battery will accept a high charging current at the initial stage of charging. High charging current can cause abnormal internal heating which may damage the battery. Therefore, when applying a suitable voltage to recharge a battery that is being used in a recycling application it is necessary to limit the charging current to a value of 0.30C Amps(max.). However, in float/standby use, Powerline SC are designed so that even if the available charging current is higher than the recommended limit, they will not accept more than 2C Amps and the charging current will fall to a relatively small value in a very brief period of time. Normally, therefore, in the majority of float/standby applications no current limit is required. Figure 21 shows current acceptance in Powerline SC charged at a constant voltage of 2.30 Vpc without current limit.

When designing a charger, it is recommended that suitable circuitry is employed to prevent damage to the charger caused by short circuiting the charger output or connecting it in reverse polarity to the battery. The use of current limiting and heat sensing circuits fitted within the charger are normally sufficient for the purpose.

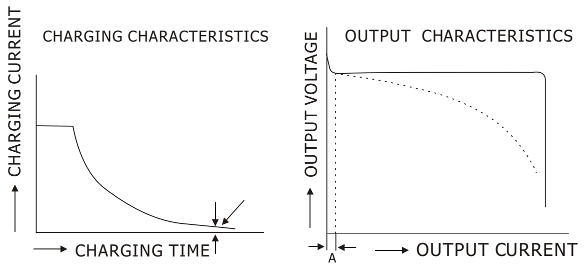
Figure21. Constant voltage charge characteristics with no current limit



Charge Output Regulation and Accuracy

To ensure the correct voltage is set accurately, when adjusting the output voltage of a constant voltage charger, all adjustments must be made with the charger "ON LOAD" Adjusting the output voltage with the charger in an"OFF LOAD" condition may result in undercharging. The constant voltage range required by a battery is always defined as the voltage range applied to a battery which is fully charged. Therefore, a charger having the output characteristics illustrated in Figure 22, should be adjusted with the output voltage based on point A. The most important factor in adjusting charger output voltage is the accuracy at point A, which should be in the range of 2.275vpc± 0.005 volts per cell; however this accuracy is not normally required over the entire range of the load. A charger adjusted in accordance with Figure 22 will never damage a battery, even if the charger has the characteristics shown by the broken line in Figure 22.

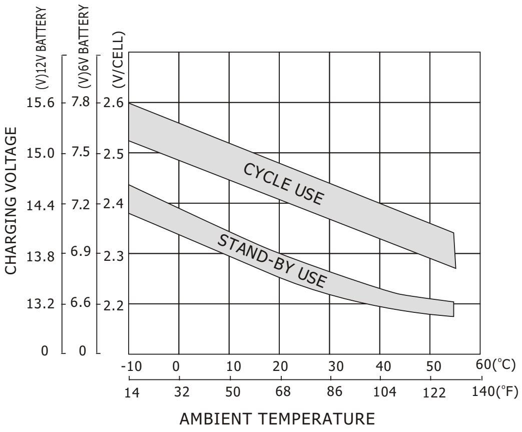
Figure 22. Output voltage adjustment



Temperature Compensation

As the temperature rises, electrochemical activity in a battery increases and conversely decreases as temperature falls. Therefore, as the temperature rises, the charging voltage should be reduced to prevent overcharge and increased, as the temperature falls, to avoid undercharge. In general, in order to attain optimum service life, the use of a temperature compensated charger is recommended. The recommended compensation factor for Powerline SC is -3mV/°C/Cell (for float/standby) and -4mV /°C /Cell (cyclic use). The standard centre point for temperature compensation is 20°C. Figure 23 shows the relationship between temperatures and charging voltages in both cyclic and float/standby applications.

Figure 23. Relationship between charging voltage and temperature



In practice where there are short term temperature fluctuations between 5°C and 40°C, temperature compensation is not absolutely essential. However, it is desirable to set the voltage at a value shown in Figure 23 which, as closely as possible, corresponds to the average ambient temperature of the battery during its service life. When designing a charger equipped with temperature compensation, the temperature sensor must sense only the temperature of the battery. Therefore, consideration should be given to thermally isolating the battery and temperature sensor from other heat generating components in the system.

Charging Efficiency

The charging efficiency η of a battery is expressed by the following formula:

$$\eta = \frac{\text{(Ah)Ampere hours Discharged}}{\text{(Ah)Ampere hours Charged}}$$

The charging efficiency varies depending upon the state of charge of the battery, temperatures and charging rates. Figure 24 illustrates the concept of the state of charge and charging efficiency. As shown in Figure 25, Powerline SC exhibit very high charging efficiency, even at low charging rates, unlike some nickel cadmium batteries.

Figure25. Charging efficiency

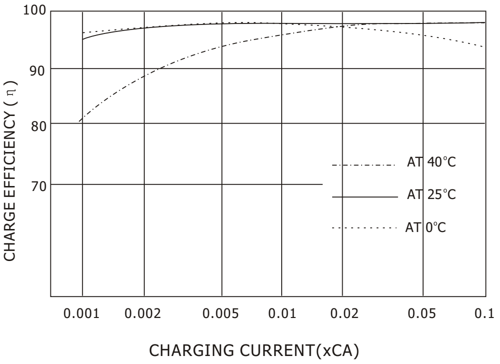
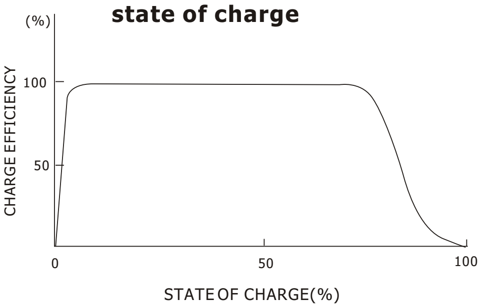


Figure 24. Charging efficiency vs state of charge



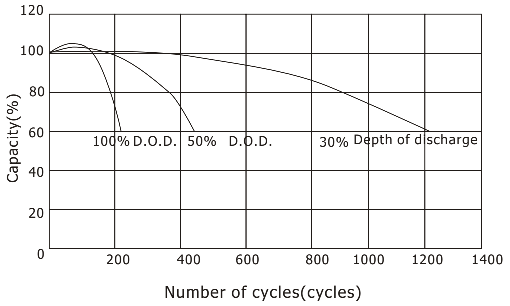
Expected Service Life of Powerline SC

cyclic service life

There are a number of factors that will affect the length of cyclic service of a battery. The most significant are ambient operating temperature, discharge rate, depth of discharge, and the manner in which the battery is recharged.

Generally speaking, the most important factor is depth of discharge. Figure 26 illustrates the effects of depth of discharge on cyclic life.

Figure 26. Cycle service life in relation to depth of discharge

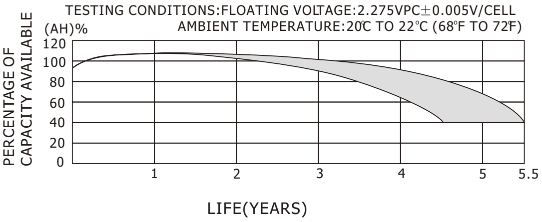


The relationship between the number of cycles which can be expected and the depth of discharge is readily apparent. If an extended cycle life is required then it is common practice to select a battery with a larger capacity than the one that is required to carry the load. Thus, at the specified discharge rate over the specified time, the depth of discharge will be shallower and cyclic service life will be longer.

Float Service Life

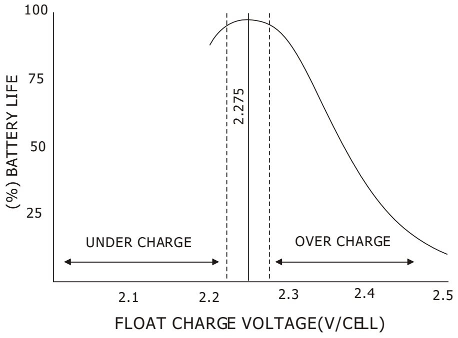
Powerline SC are designed to operate in float/standby service for approximately 5 yrs based upon a normal service condition in which float charge voltage is maintained between 2.275vpc±0.005 volts per cell in an ambient temperature of approximately 20°C. Figure 27 shows the float service life characteristics of Powerline SC when discharged once every three months to 100% depth of discharge.

Figure 27. Float service life



In a normal float service, where the charging voltage is maintained at 2.275vpc±0.005 volts per cell (see Fig. 28), the gases generated inside an Powerline SC battery are continually recombined into the negative plates and return to the water content of the electrolyte. Therefore, electrical capacity is effectively not lost due to the "drying up" of the electrolyte; the loss of capacity and eventual end of service life is brought about by the gradual corrosion of the electrodes. It should be noted that this corrosive process will be accelerated by high ambient operating temperatures and/or high charging voltage. When designing a float service system, always consider the following: LENGTH OF SERVICE LIFE WILL BE DIRECTLY AFFECTED BY THE NUMBER OF DISCHARGE CYCLES, DEPTH OF DISCHARGE, AMBIENT TEMPERATURE AND CHARGING VOLTAGE.

Figure 28.
Relationship between float charge



Design/Application Suggestions to Ensure Maximum Service

Powerline SC are highly efficient maintenance free electrochemical systems designed to provide years of trouble free electrical energy. The performance and service life of these batteries can be maximized by observing the following guidelines:

1. Heat kills batteries. Avoid placing batteries in close proximity to heat sources of any kind. The longest service life will be attained where the battery temperature does not exceed 20°C. (also see notes 3 & 8 hereunder). When calculating the correct float voltage setting, whether or not temperature compensation is required, full consideration must be given to the temperature of the battery and room ambient. For the purpose of the calculation, consider the temperature of a battery on float to be 1°C. above local ambient. Also, if the battery is used in an enclosure, the temperature gradient of the enclosure itself must be included in the calculation. i.e. The operating temperature of the battery is given by: Room temperature + enclosure temperature +1°C.
2. Since a battery may generate ignitable gases, do not install close to any equipment that can produce electrical discharges in the form of sparks.
3. When the battery is operated in a confined space, adequate ventilation should be provided.
4. The battery case is manufactured from high impact ABS plastic resin. It should not be placed in an atmosphere of, or in contact with organic solvents or adhesive materials.
5. Correct terminals should be used on battery connecting wires. Soldering is not recommended but if unavoidable please refer to us for further guidance.
6. Avoid operating at temperatures outside the requested range.
7. When there is a possibility of the battery being subjected to heavy vibration or mechanical shock, it should be fastened securely and the use of shock absorbent material is advisable.
8. When connecting the batteries, free air space must be provided between each battery. The recommended minimum space between batteries is 0.2 inches (5mm) to 0.4 inches (10mm). In all installations due consideration must be given to adequate ventilation for the purposes of cooling.
9. When the batteries are to be assembled in series to provide more than 100V, proper handling and safety procedures must be observed to prevent accidental electric shock).
10. If 2 or more battery groups are to be used, connected in parallel, they must be connected to the load through lengths of wires, cables or busbars that have the same loop line resistance as each other. This makes sure that each parallel

bank of batteries presents the same impedance to the load as any other of the parallel banks thereby ensuring correct equalization of the source to allow for maximum energy transfer to the load.

11. Ripple current (the AC component on the DC charge current). Ideally this should be zero, as it will reduce the service life of a cell/battery, the larger the component the greater the reduction it will cause. For example 0.1C Amps R.M.S will reduce the optimum service life by a minimum 3%.) Ripple current can be source or load generated.) Ripple current can vary with load change and is often its greatest at part load.
12. When cleaning the battery case, ALWAYS use a water dampened cloth but NEVER use oils, organic solvents such as petrol, paint thinners etc. DO NOT even use a cloth that is impregnated or has been in contact with any of these or similar substances.
13. Do not attempt to dismantle the battery. If accidental skin/eye contact is made with the electrolyte, wash or bathe the affected area/part straight away with liberal amounts of clean fresh water and seek IMMEDIATE medical attention.
14. DO NOT INCINERATE batteries as they are liable to rupture if placed into a fire. Batteries, that have reached the end of their service life, can be returned to us for safe disposal.
15. Touching electrically conductive parts might result in an electric shock. Be sure to wear rubber gloves before inspection or maintenance work.
16. The use of mixed batteries with different capacities, that may have been subjected to different uses, be of different ages and are of different manufacturers is liable to cause damage to the battery itself and/or the associated equipment. If this is unavoidable please consult us beforehand.
17. To obtain maximum life, batteries should never be stored in a discharged state.
18. In order to obtain maximum working life, when the batteries are used in an UPS system the following is advised:

(a) Where the D.C. input exceeds 60 volts, each battery should be insulated from the battery stand by using suitable polypropylene or polyethylene material.

(b) In high voltage systems the resistance between battery and stand should always be greater than 1 MΩ. An appropriate alarm circuit could be incorporated to monitor any current flow.

ABT VRLA Battery:

PowerLine/Thunder/Enduro/Sunwind/e-Trek

ABT World Wide

Our sales growth is due to a complete Global Network with Master distributors and Country managers who apply ABT commercial strategy and trough Global Key Account, in Telecom,Power Supply and UPS

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