



DC SERIES

AGM Batteries for Deep Cycle service

Fullriver Battery

A brief history of Fullriver Battery Mfg. Co., Ltd.

Product development...

Fullriver Battery Manufacture Co., Ltd. was founded in **1995** and launched the **HGL series**. The HGL series batteries are mainly for general use purposes, i.e. low power UPS, Security & Alarm Systems, Emergency Lighting, Office machines, etc. The normal voltages for the HGL series are 6V and 12V; the capacity is ranged from 0.8Ah to 260Ah.

In 2001, the **HGXL series** was launched. This series is a 2V stationary maintenance-free battery, designed as high capacity, long life and high power batteries. These are mainly used for high capacity UPS systems, telecommunications and solar battery systems applications. The capacity of this series is ranged from 50 AH to 3000 AH.

In 2003, the **HGHL series** was launched. This series performs well in both high rate discharge and float service applications. This series was specially designed for UPS standby power supply. It is also available for other float service applications, such as emergency power supply, communication power supply, etc. the power of this series is ranged from 35W to 910W.

In 2004, the **FAT series** and the **DC series** were launched. The **FAT series** also has the characteristics of high rate discharge. They are widely used in UPS systems and telecommunications. The FAT series features front terminal connections for fast and easy installation and maintenance. The monobloc's compact design is suitable for 19", 23" and ETSI racking. The capacity of FAT series is ranged from 55Ah to 175Ah.

The **DC series** is specially designed and used for deep cycle applications, which may require many more cycles. This series also has excellent recovery from deep discharge. The DC series is mainly used in golf trolley, golf caddy, forklift, electric wheelchairs, floor cleaning machines, marine, photovoltaic systems, and more.

In 2008, we started research, development, and manufacturing of the **HC series**. This series is especially used for engine starting, which requires superior cranking performance at lower temperatures, for high current discharge. These batteries can also be fitted with the protective steel case and TP brass terminals.

In 2010, the **FSG series** was launched. Which use revolutionary Super GEL long life plate technology and are designed specifically for solar energy and wind energy applications. The designed life is 20 years in float service at 20°C. the battery can be used in a wide operating temperature range from -20°C to 50°C.

In 2011, the **DCG series** was launched. Fullriver Deep-Cycle Gel (DCG) batteries are maintenance free and require no watering, while providing you with the unmatched quality and power of Fullriver's advanced deep cycle technology. Fullriver offers a complete portfolio of Deep-Cycle Gel (DCG) products, featuring these benefits: Long-lasting runtime and battery life in the most demanding of applications; Proprietary Gel formulation prevents stratification; Superior engineering offers exceptional durability.

Fullriver batteries Qualifications, Approvals, and Certifications



- **Network Access License for Telecommunications Equipment**
(Ministry of information Industry.PRC)
- **DOT 49CFR173.159 (d) (i) and (ii)** (Non-hazardous shipping)
- **IEC 61056-1; 2004** (General purpose lead-acid batteries, valve regulated types)
- **IEC 60896-2: 2004** (Stationary lead-acid batteries, valve regulated types)
- **JIS C8704-2: 2006** (Stationary lead-acid batteries, valve regulated types)
- **JIS C8702-1: 2003** (Small-sized valve regulated lead-acid batteries)

Key Features

- ✧ New High-Density Active Paste Material
- ✧ Heavy Duty Thick Grids
- ✧ Special Lead-Calcium Alloy Grids
- ✧ Tank Formation Activation of Plates
- ✧ 10 Day Curing Chamber Process
- ✧ Unique Low Resistance Micro-porous Glass Fiber Separators
- ✧ Maintenance Free, Spill-Proof/Leak Proof
- ✧ Self Regulating Pressure Relief Valves
- ✧ Low Self Discharge Rate, Only 1% per month
- ✧ Faster Recharging Times
- ✧ Excellent Recovery from Deep Discharge

Benefits

- ✧ More Capacity and Longer Cycle Life
- ✧ Provides True Deep Cycle Performance
- ✧ Superior Corrosion Resistance
- ✧ Guarantees Fully Formed Voltage Matched Plates
- ✧ Ensures Bonding of Active Material Paste to Plates
Resulting in Longer Life
- ✧ Enhanced Electrolyte Retention
- ✧ DOT,IATA,ICAO,IMDG Approved as Safe for Air &
Sea Transportation
- ✧ Sure and Sage Operation of Batteries
- ✧ Longer Shelf Life , Easy to Inventory
- ✧ Hours Less than Flooded Batteries
- ✧ Recognized around the world for Quality

Application

- Renewable Energy Systems
- Golf/Utility Vehicles
- Floor Machines
- Aerial Work Platform
- Recreational Vehicles (RV)
- Medical Mobility
- Neighborhood Electric Vehicles
- Marine Vessels



Construction

- Positive and negative plates in lead-tin-calcium alloy
- Separators in low resistance micro-porous glass fiber. The electrolyte is absorbed within this material, preventing acid spill in case of accidental damage
- Case and lid in ABS material, highly resistant to shock and vibration
- Terminal with brass insert for maximum conductivity and with high compression grommet for long life
- Self-regulating pressure relief valve prevents ingress of atmospheric oxygen
- Can be choose to fitted with TP brass automotive terminal

Characteristics

Self Discharge

The result of testing the residual capacity of the battery which after fully charged, has been left standing in the open-circuit state for a specific period at a specific ambient temperature is shown in the **figure 1** below.

The self discharge rate is very much dependent on the ambient temperature of storage. The higher the ambient temperature, the less the residual capacity after storage for a specific period. The self discharge rate almost double by each 50°F (10°C) rise of storage temperature.

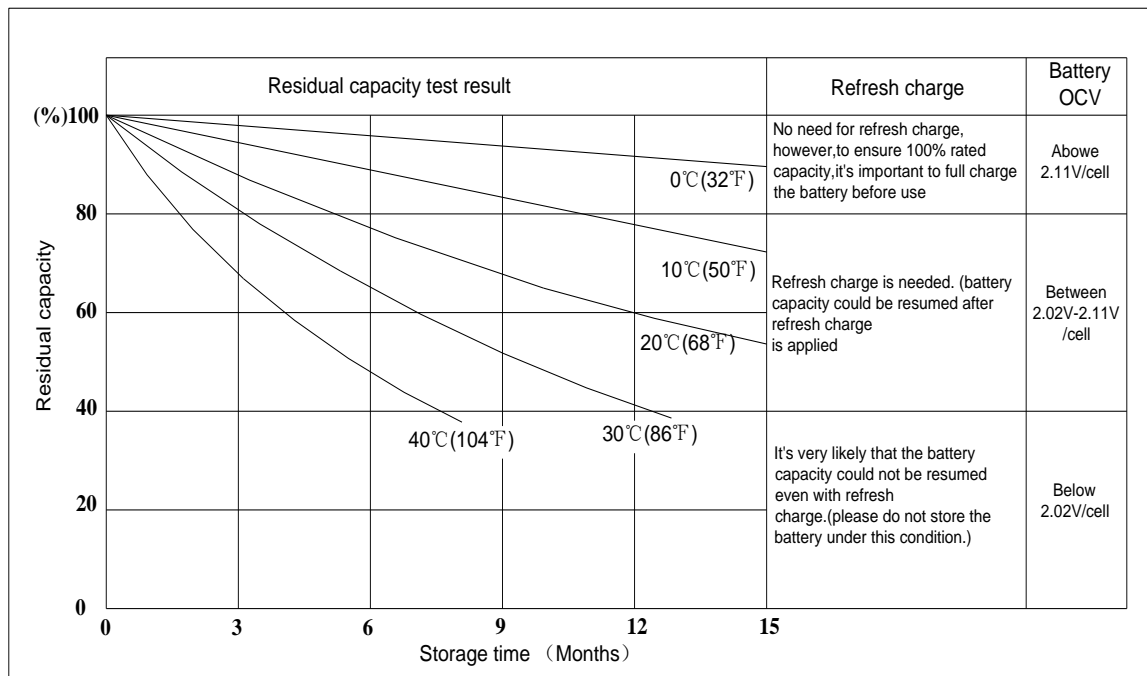


figure 1: Residual Capacity Vs. Storage time

Shelf Life

In general, when lead acid batteries of any type are stored in a discharged condition for extended periods of time, lead sulfate is formed on the negative plates of the batteries. This phenomenon is referred to as “sulfation”. Since the lead sulfate acts as an insulator, it has a direct detrimental effect on charge acceptance. The more advanced

the sulfation, the lower the charge acceptance. “Brief storage”, i.e., a few days, at temperatures higher than the ranges recommended, will have no adverse effect on storage time or service life. However, if such use continues for more than one month, the storage time must be determined according to the new ambient temperature.

Table 1: shelf life at various ambient temperatures.

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

Over Discharge (Deep Discharge)

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. DC batteries have been designed to withstand some levels of over-discharge. However, whilst this is not the recommended way of operation, FULLRIVER DC batteries can recover their capacity when recharged correctly. Final discharge voltage is shown in **Table 2**.

Table 2: Final discharge voltage

Discharge Current	Final Discharge Voltage (V/Cell)
0.1C or below, or intermittent discharge	1.75
0.17C or current close to it	1.70
0.26C or current close to it	1.67
0.6C or current close to it	1.60
Current in excess of 3C	1.30

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

Temperature Conditions

Recommended temperature ranges for charging, discharging and storing the battery are tabulated below.

Table 3: Temperature conditions:

Charge	32°F (0°C)~104°F (40°C)
Discharge	5°F (-15°C)~122°F (50°C)
Storage	5°F (-15°C)~104°F (40°C)

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.

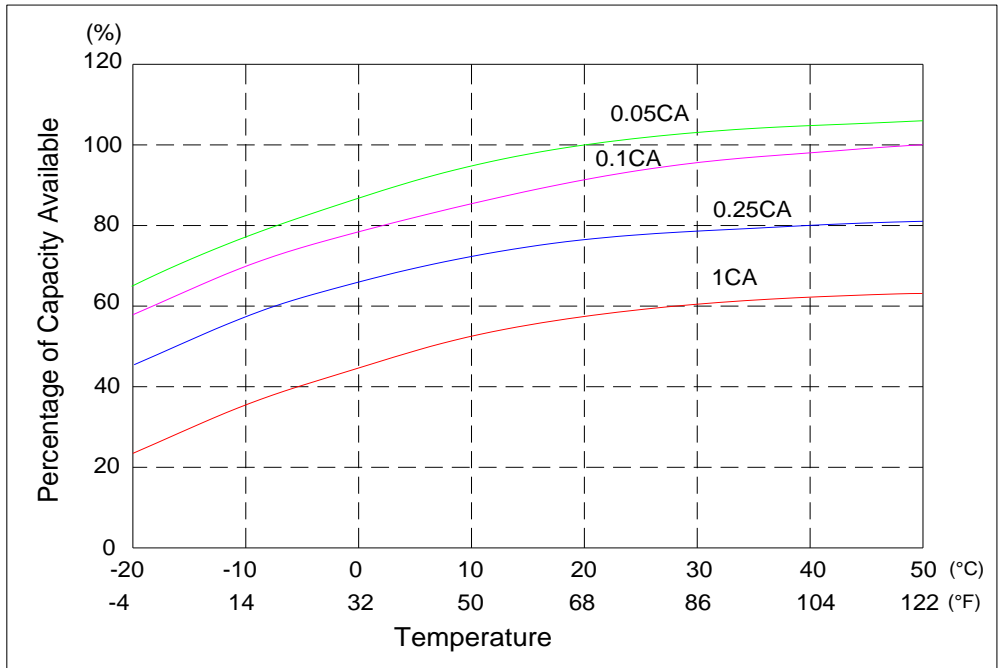


figure 2:Temperature Effects in relation to Battery Capacity

Available Capacity, Measured By Open Circuit Voltage

The approximate depth of discharge, or remaining capacity, in a FULLRIVER DC battery can be empirically determined by referring to **Figure 3**.

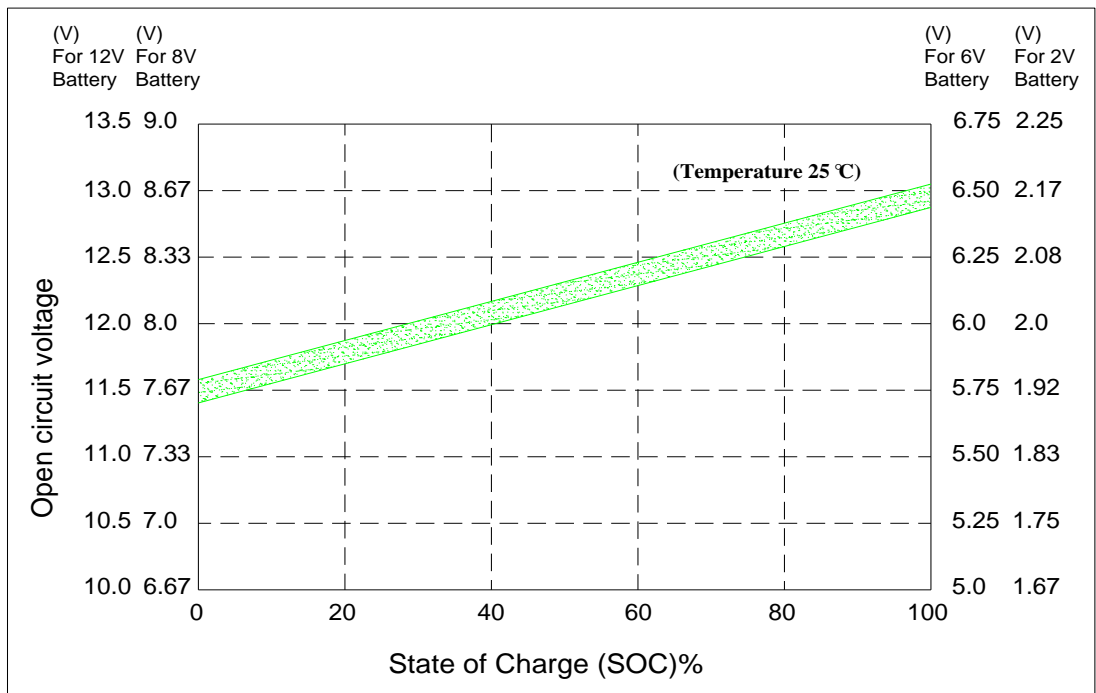


figure 3:Open Circuit Voltage Vs. State of Charge(SOC)

Battery Charging

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 Current Charging
- ✧ Two Step Constant-Voltage Charging

Constant-Current Charging

This charging method is not often utilized for sealed lead- acid batteries, but is an effective method for charging a multiple number of batteries at one time, and/or as an equalizing charge to correct variances in capacity between batteries in a group. Caution should be exercised when charging by constant current. If the charge is continued at the same rate for an extended period of time after the battery has reached a fully charged state, severe overcharge may occur, resulting in damage to the battery. Figure 4 shows the characteristics of a FULLRIVER DC battery under continuous overcharge conditions.

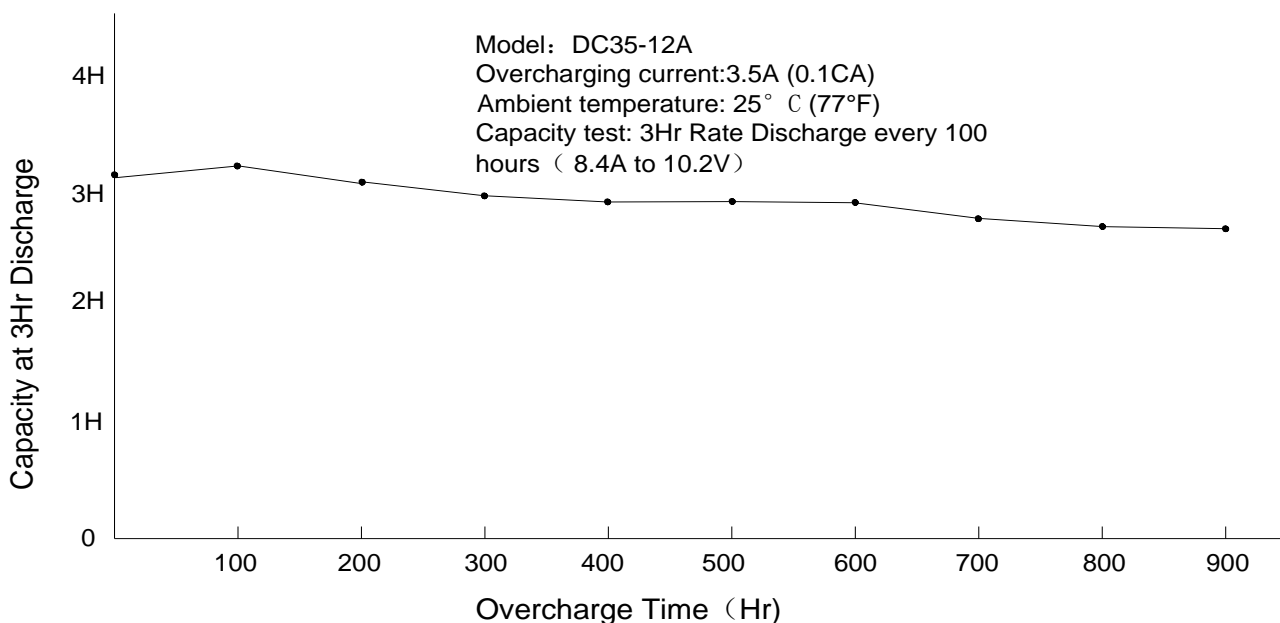


figure4:Continuous Overcharge Characteristics

Two Step Constant-Voltages Charging

To maximize the life of your FULLRIVER battery, it is important that it is properly charged. As with all lead-acid batteries, both over and under-charging a FULLRIVER battery will result in shortened service life. **The best protection from improper charging is the use of a quality charger and routinely checking that the charger current and voltage settings are maintained.**

Please read the following instructions before using your battery.

Charger inspection

The charger cabling should be insulated and free of breaks or cuts. The cable connectors should be clean and properly mate with the battery terminals to ensure a snug connection. The charger's AC cord should be free of breaks or cuts and the wall plug should be clean.

Charging guidelines

- Fully charge batteries after each use.
- Charge in a ventilated area as gasses may be released through the pressure relief valve if the batteries are excessively over-charged.
- Never charge a frozen battery.
- Ideal charging temperatures: 32°F ~ 104°F (0°C ~ 40°C)

Charging characteristics

If the charger has a setting for AGM, use this setting to charge your FULLRIVER battery. To maximize your battery life a voltage regulated charger with temperature compensation is strongly recommended.

See figure 5 for the recommended voltage regulated charge profile.

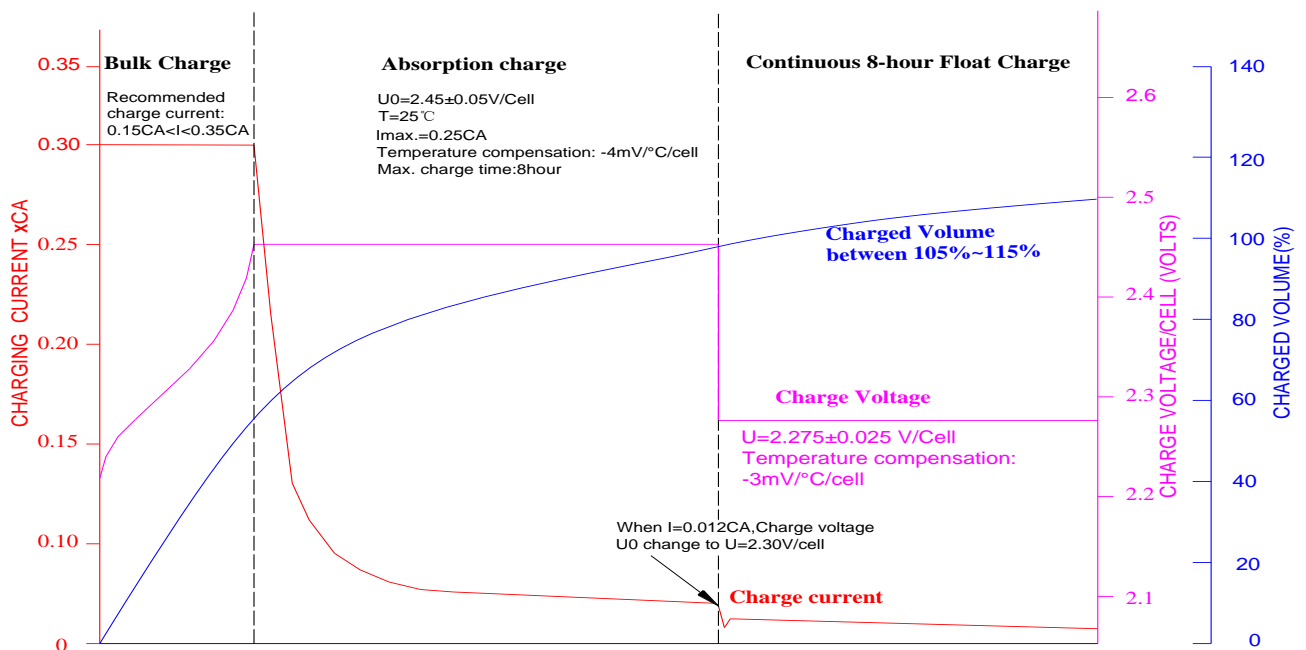


figure 5: Charging characteristics of a two constant voltage charger

The characteristics shown in **Figure 5** are those of a constant voltage, constant current charger. In the initial charging stage, the battery is charged by constant current. The initial charge current is recommended to be set at $I = 0.25XC$ ($I_{max} = 0.35XC$) in order to fully charge the batteries within a reasonable amount of time. The charging voltage rises, as the charge continues, until it reaches 2.45 volts per cell, at which point the charging mode automatically changes to constant voltage charging. During the constant current charging stage (Bulk Charge-Absorption Charge) the charging current which has decreased to point I is sensed, and the charging voltage is switched to the float level of 2.3 volts per cell from the recovery level of 2.45 volts per cell. The switch to constant voltage trickle charging occurs after the battery has recovered approximately 80% of the rated capacity over a given period of time. This charging method is one of the most efficient. The recharge time is minimized during the initial charging stage while the battery is protected from overcharge by the system switching over to float charge at the switching point I.

Charging Voltage

The charging voltage should be regulated according to the type of service in which the battery will be used. Generally, the following voltages are used at 25°C (77°F).

For standby (float) 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, and decreases as the charging progresses. When charging at 2.30 volts per cell, charging current at the final stage of charging will drop to as little as 0.002CA. Charging voltage should be regulated in relation to the ambient temperature. When the temperature is higher, the charging voltage should be lower. When the temperature is lower, the charging voltage should be higher. For specific recommendations, please refer to the section on Temperature Compensation. Similarly, capacity (measured in ampere hours) attainable over time will vary in direct relation to the ambient temperature. The capacity in a given period of time will be larger at higher temperatures, and smaller at lower 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 0.25C Amps. However, in float/standby use, FULLRIVER batteries 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 6 shows current acceptance in FULLRIVER batteries charged at a constant voltage of 2.30 Vpc without current limit.

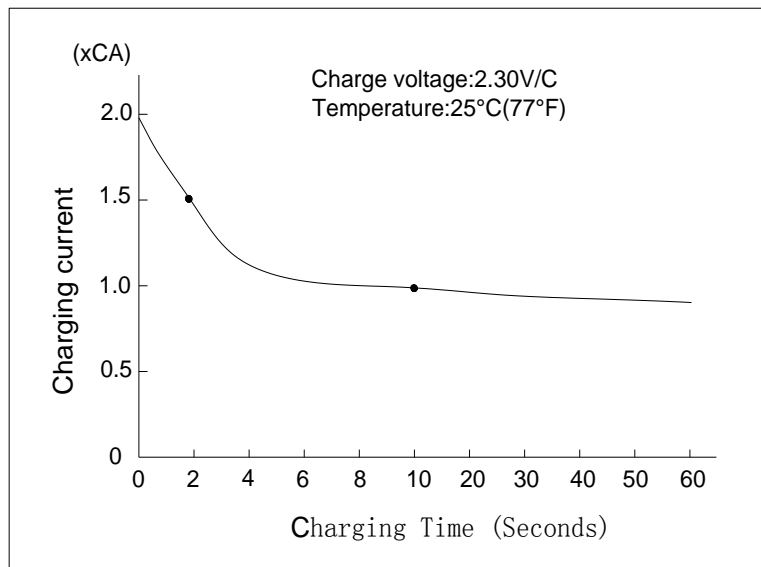


figure 6: Constant-Voltage Charge Characteristics with no Current Limit

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.

Temperature Compensation

As temperature rises, electrochemical activity in a battery increases. Similarly, as temperature falls, electrochemical activity decreases. Therefore, conversely, as temperature rises, charging voltage should be reduced to prevent overcharge, and increased as temperature falls to avoid undercharge. In general, to assure optimum service life, use of a temperature compensated charger is recommended. The recommended compensation factor for FULLRIVER batteries is $-3\text{mV}/^\circ\text{C}/\text{Cell}$ (stand by) and $-4\text{mV}/^\circ\text{C}/\text{Cell}$ (cyclic use). The standard center point for temperature compensation is 25°C (77°F).

Table 4 has the temperature compensated voltage values for a 12V battery. For a 6V battery divide the voltage by 2. For a 24V, 36V, 48V system, multiply the values in the table by 2, 3 or 4 respectively.

Table4: Charge Voltage Quick Reference

12V Battery	32°F (0°C)	50°F (10°C)	68°F (20°C)	77°F (25°C)	86°F (30°C)	104°F (40°C)
Bulk & Absorption	15.30V	15.06V	14.82V	14.70V	14.58V	14.34V
Float	14.25V	14.01V	13.77V	13.65V	13.53V	13.29V

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 7 illustrates the effects of depth of discharge on cyclic life.

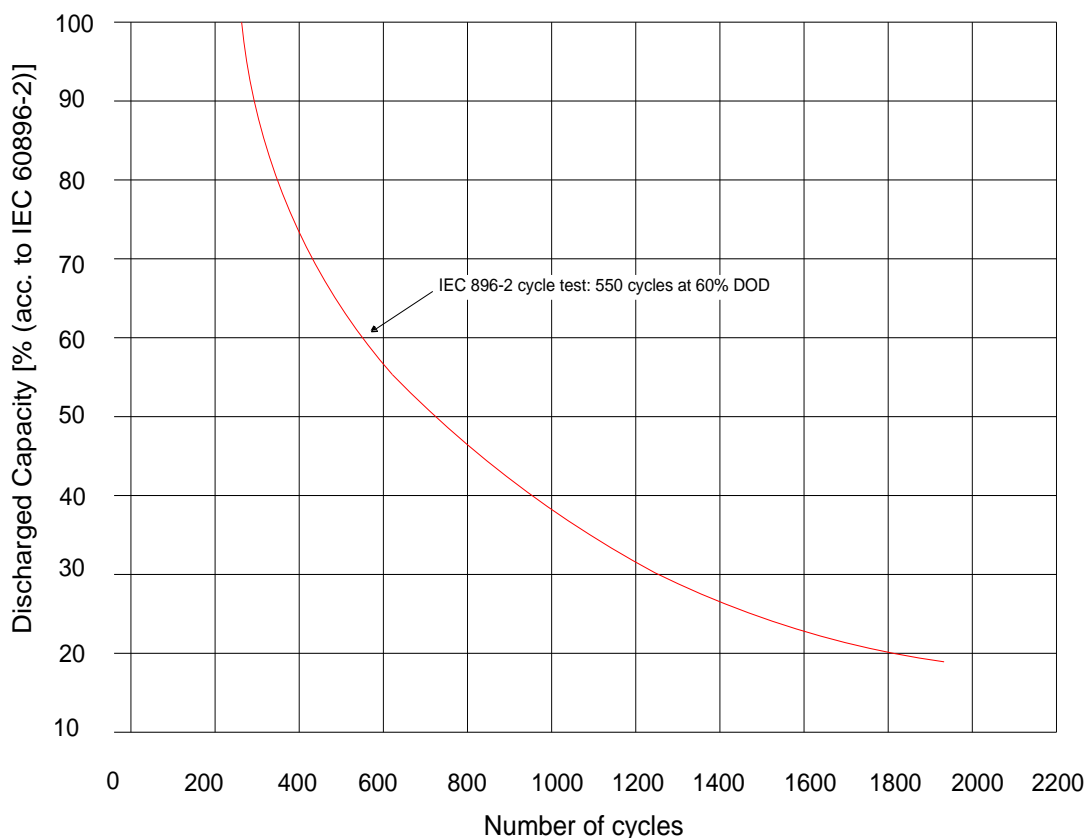


figure 7: Number of Cycles vs. Depth of Discharge (DOD)

General Specifications DC Series

Fullriver Type	Industry Ref.	Capacity Amp-Hours (AH)				Capacity ^A Minutes		Cranking Performance		Length mm (inch)	Width mm (inch)	Height mm (inch)	Total Height mm (inch)	Weight (Approx.) Kg (lbs)	Terminal Type	Pallet QTY
		5-Hr rate	20-Hr rate	72-Hr rate	100-Hr rate	@25 Amps	@75 Amps	CCA ^B @0°F	CA ^C @32 °F							
2V DEEP CYCLE BATTERY																
DC1150-2	903 /L16	945	1150	1220	1275	2235	658	/	/	295 (11.61)	179 (7.05)	404 (15.91)	411 (16.18)	57.60 (126.99)	M10	22
6V DEEP CYCLE BATTERY																
DC200-6	27	165	200	212	220	400	100	/	/	306 (12.05)	169 (6.65)	220 (8.66)	226 (8.90)	30.00 (66.14)	M8	36
DC200-6B	(DIN)	165	200	212	220	400	100	/	/	244 (9.61)	190 (7.48)	275 (10.83)	275 (10.83)	31.00 (68.34)	AP	30
DC220-6	27	180	220	232	242	425	112	/	/	306 (12.05)	174 (6.85)	220 (8.66)	226 (8.90)	32.70 (72.09)	M8	36
DC224-6A	GC2	179	224	237	246	441	113	/	/	260 (10.24)	180 (7.09)	245 (9.65)	251 (9.88)	29.8 (65.70)	M8	42
DC224-6B	GC2	179	224	237	246	441	113	/	/	260 (10.24)	180 (7.09)	245 (9.65)	267 (10.51)	30.4 (67.02)	M8	42
DC245-6	(DIN)	198	245	260	270	457	120	/	/	244 (9.61)	190 (7.48)	275 (10.83)	275 (10.83)	32.30 (71.21)	AP	30
DC250-6	GC2	204	250	265	275	531	135	/	/	262 (10.31)	181 (7.13)	266 (10.47)	272 (10.71)	34.50 (76.06)	M8	28
DC335-6	902 /J305	274	335	350	370	751	184	/	/	295 (11.61)	178 (7.01)	346 (13.62)	366 (14.41)	47.80 (105.38)	DT	22
DC400-6	L16	340	415	435	460	885	229	/	/	295 (11.61)	179 (7.05)	404 (15.91)	424 (16.69)	56.00 (123.46)	DT	22
8V DEEP CYCLE BATTERY																
DC160-8A	GC8	131	160	170	178	315	112 @56 Amps	/	/	260 (10.24)	182 (7.17)	268 (10.55)	272 (10.71)	31.70 (69.89)	M8	28
DC160-8B	GC8	131	160	170	178	315	112 @56 Amps	/	/	260 (10.24)	182 (7.17)	288 (11.34)	288 (11.34)	31.80 (70.11)	M8	28
DC180-8A	GC8	147.5	180	191	198	335	125 @56 Amps	/	/	260 (10.24)	182 (7.17)	268 (10.55)	272 (10.71)	36.60 (80.69)	M8	28
DC180-8B	GC8	147.5	180	191	198	335	125 @56 Amps	/	/	260 (10.24)	182 (7.17)	288 (11.34)	288 (11.34)	36.70 (80.91)	M8	28
DC200-8	GC8H	164	200	212	220	390	140 @56 Amps	/	/	260 (10.24)	182 (7.17)	295 (11.61)	299 (11.77)	40.00 (88.18)	M8	28
12V DEEP CYCLE BATTERY																
DC7-12	N/A	/	7	/	/	/	/	/	/	151 (5.94)	65 (2.56)	95 (3.74)	101 (3.98)	2.73 (6.02)	F1	420
DC10-12	N/A	/	10	/	/	/	/	/	/	151 (5.94)	65 (2.56)	111 (4.37)	117 (4.61)	3.30 (7.28)	F1	336
DC12-12	N/A	/	12	/	/	/	/	/	/	151 (5.94)	99 (3.90)	95 (3.74)	101 (3.98)	4.20 (9.26)	F1	264
DC17-12	N/A	/	17	/	/	20	/	120	148	181 (7.13)	77 (3.03)	167 (6.57)	167 (6.57)	6.22 (13.71)	M5	192
DC20-12	N/A	16.5	20	/	/	23	/	135	165	181 (7.13)	77 (3.03)	167 (6.57)	167 (6.57)	6.44 (14.20)	M5	192
DC24-12	N/A	19.8	24	25.5	27	27	/	160	195	167 (6.57)	175 (6.89)	125 (4.92)	125 (4.92)	9.2 (20.28)	M5	120
DC26-12	N/A	21.3	26	27.6	30	30	/	165	200	165 (6.50)	176 (6.93)	125 (4.92)	125 (4.92)	9.8 (21.61)	M6	120
DC35-12A	U1	29	35	37	39	52	/	190	230	196 (7.72)	131 (5.16)	155 (6.10)	167 (6.57)	11.5 (25.35)	M6	108
DC35-12B	U1	29	35	37	39	52	/	190	230	196 (7.72)	131 (5.16)	167 (6.57)	180 (7.09)	11.5 (25.35)	F25	108
DC38-12	U1L	31	38	40	42	52	/	265	315	198 (7.80)	166 (6.54)	174 (6.85)	174 (6.85)	13.3 (29.32)	M6	96

DC40-12	U1L	32.8	40	42	44	53	/	275	320	198 (7.80)	166 (6.54)	174 (6.85)	174 (6.85)	13.4 (29.54)	M6	96
DC50-12	DIN(L2)	41	50	53	56	85	17	440	575	241 (9.49)	175 (6.89)	190 (7.48)	190 (7.48)	18.5 (40.79)	AP	64
DC55-12	22NF	45	55	58	61	96	21	400	480	229 (9.02)	138 (5.43)	208 (8.19)	212 (8.35)	17.6 (38.80)	M6	63
DC60-12	48	49.2	60	64	66	95	24	410	485	265 (10.43)	166 (6.54)	188 (7.40)	188 (7.40)	20.7 (45.64)	AP	45
DC60-12B	DIN(L3)	49.2	60	64	66	105	24	510	670	278 (10.94)	175 (6.89)	190 (7.48)	190 (7.48)	22 (48.50)	AP	48
DC65-12	93	53.3	65	69	72	100	28	430	510	351 (13.82)	167 (6.57)	176 (6.93)	176 (6.93)	23.6 (52.03)	M6	48
DC70-12	24	57.5	70	74	77	115	31	450	540	260 (10.24)	169 (6.65)	211 (8.31)	215 (8.46)	23.8 (52.47)	M6	48
DC79-12	27	64	79	84	87	125	31	600	710	307 (12.09)	169 (6.65)	211 (8.31)	215 (8.46)	26.5 (58.42)	AP	36
DC80-12	DIN(L5)	65.5	80	85	89	142	32	630	756	353 (13.90)	175 (6.89)	190 (7.48)	190 (7.48)	26.80 (59.08)	AP	36
DC85-12	24	70	85	90	94	148	34	510	600	260 (10.24)	169 (6.65)	211 (8.31)	215 (8.46)	25.10 (55.34)	M6	48
DC90-12	27	74	90	95.5	99	140	38	530	630	307 (12.09)	169 (6.65)	211 (8.31)	215 (8.46)	28.7 (63.27)	M6	36
DC105-12	27	86	105	111	116	170	40	550	660	307 (12.09)	169 (6.65)	211 (8.31)	215 (8.46)	30.20 (66.58)	M6	36
DC115-12A	31	91	115	122	128	175	43	600	710	328 (12.91)	172 (6.77)	214 (8.43)	220 (8.66)	32.7 (72.09)	M8	36
DC115-12B	31	91	115	122	128	175	43	605	720	331 (13.03)	175 (6.89)	214 (8.43)	218 (8.58)	32.9 (72.53)	M8	36
DC120-12A	N/A	98	120	127	132	223	52	750	900	407 (16.02)	174 (6.85)	210 (8.27)	240 (9.45)	38.2 (84.22)	M8	27
DC120-12B	31	98	120	127	132	230	54	760	910	331 (13.03)	175 (6.89)	214 (8.43)	218 (8.58)	36.5 (80.47)	M8	36
DC120-12C	(DIN)	98	120	127	132	232	56	750	900	341 (13.43)	172 (6.77)	267 (10.51)	283 (11.14)	38.7 (85.32)	AP	24
DC140-12	(DIN)	115	140	148	154	260	62	795	950	341 (13.43)	172 (6.77)	267 (10.51)	283 (11.14)	43.1 (95.02)	AP	24
DC145-12	N/A	122	145	154	160	279	86	820	975	341 (13.43)	173 (6.81)	281 (11.06)	287 (11.30)	44.3 (97.66)	M8	24
DC150-12	GC12	123	150	158	165	295	80	900	1050	327 (12.87)	182 (7.17)	269 (10.59)	273 (10.75)	42.6 (93.92)	M8	22
DC160-12	N/A	130	160	165	176	300	82	910	1070	484 (19.06)	171 (6.73)	241 (9.49)	241 (9.49)	45.5 (100.31)	M8	24
DC180-12	4D	147.5	180	191	198	350	85	/	/	530 (20.87)	209 (8.23)	214 (8.43)	218 (8.58)	56.8 (125.22)	M8	21
DC210-12	4D	172	210	223	231	400	105	/	/	530 (20.87)	209 (8.23)	214 (8.43)	218 (8.58)	60.5 (133.38)	M8	21
DC215-12	921 /J185	172	215	225	234	420	110	/	/	381 (15.00)	178 (7.01)	351 (13.82)	371 (14.61)	60 (132.28)	DT	20
DC220-12	4D	175	220	233	240	415	110	/	/	522 (20.55)	242 (9.53)	218 (8.58)	222 (8.74)	66.5 (146.61)	M8	18
DC240-12	8D	197	240	255	262	520	135	/	/	520 (20.47)	269 (10.59)	204 (8.03)	208 (8.19)	75.2 (165.79)	M8	12
DC260-12	8D	213	260	276	285	578	145	/	/	521 (20.51)	269 (10.59)	220 (8.66)	224 (8.82)	78.2 (172.40)	M8	12

A. The amount of amp-hours (AH) a battery can deliver when discharged at a constant rate at 80°F (27°C) for the 20 Hr 72Hr and 100 Hr rates and 86°F (30°C) for the 5-Hr rate and maintain a voltage above 1.75 V/cell. Capacities are based on peak performance.

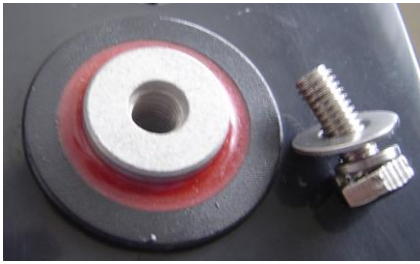
B. RC (Reserve Capacity) - the number of minutes a battery can be discharged at 25 or 75 amps at 27°C (80°F) and maintain a voltage above 1.75v/cell.

C. CCA(Cold Cranking Amps) - the discharge load in amperes which a new, fully charged battery can maintained for 30 seconds at 0°F (-17.8°C) at a voltage above 1.2v/cell.

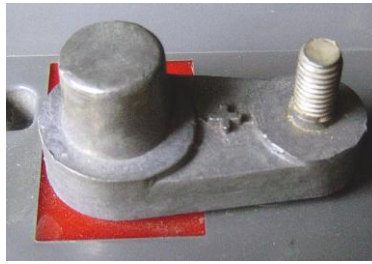
D. CA(Cranking Amps) - the discharge load in amperes which a new, fully charged battery can maintained for 30 seconds at 32°F 0°C) at a voltage above 1.2v/cell.

E. Terminal type –Please see our terminal configurations

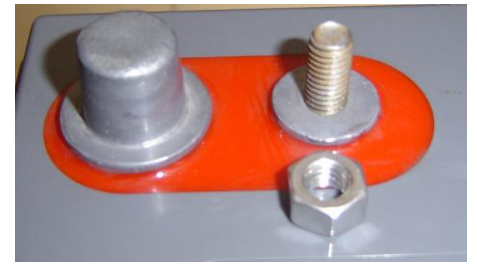
Terminal configurations



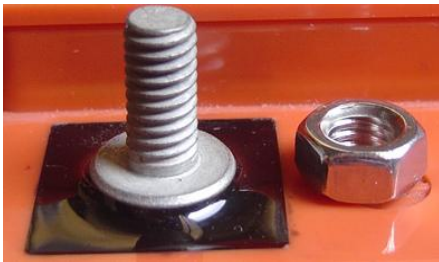
M5、 M6 、 M8 or M10
(Button Terminal)



APW
(Marine Dual Terminal)



DT
(AP and Stud Terminal)



M6M or M8M
(Male Stud Terminal)



F7 or F25
(" L " Terminal)



F2 or F1
(Fasten Tab 250&187)



AP
(Automotive Post)

Battery accessories



TP01 (TP02)
M8(M6)-AP Terminal



TP08 (TP07)
M8(M6)-A01 Terminal,
With knurling



TP28 (TP29)
M8(M6)-A0 Terminal



AP400
Terminal Cover



LP100
Terminal Cover



VP100
Terminal Cover



Battery Bag
for DC35, DC17, DC20, DC26



Cross Belt
for DC35, DC17, DC20



Adaptor
for DC26-12B



JSTE Cables
for DC20-12&DC17-12



Adaptor
for DC35-12B



Adaptor
for DC24-12

Battery Connections

Battery cables provide the link between the batteries, equipment and charging system. Faulty connections can lead to poor performance and terminal damage, meltdown or fire. To ensure proper connections, please use the following guidelines for cable size, torque values and terminal protection.

Cable size

Battery cables should be sized to handle the expected load. Refer to **Table 5** for the maximum current carrying capacity (amps) based on the cable/wire gauge size.

Table 5: cable size

Wire Gauge Size(AWG)	Ampacity (Amps)
14	25
12	30
10	40
8	55
6	75
4	95
2	130
1	150
1/0	170
2/0	265
4/0	360

Table values are for cable lengths less than 6 feet (1829 mm). In series/parallel battery banks, it is preferable for all series cables to be the same length and all parallel cables to be the same length.

Torque Values

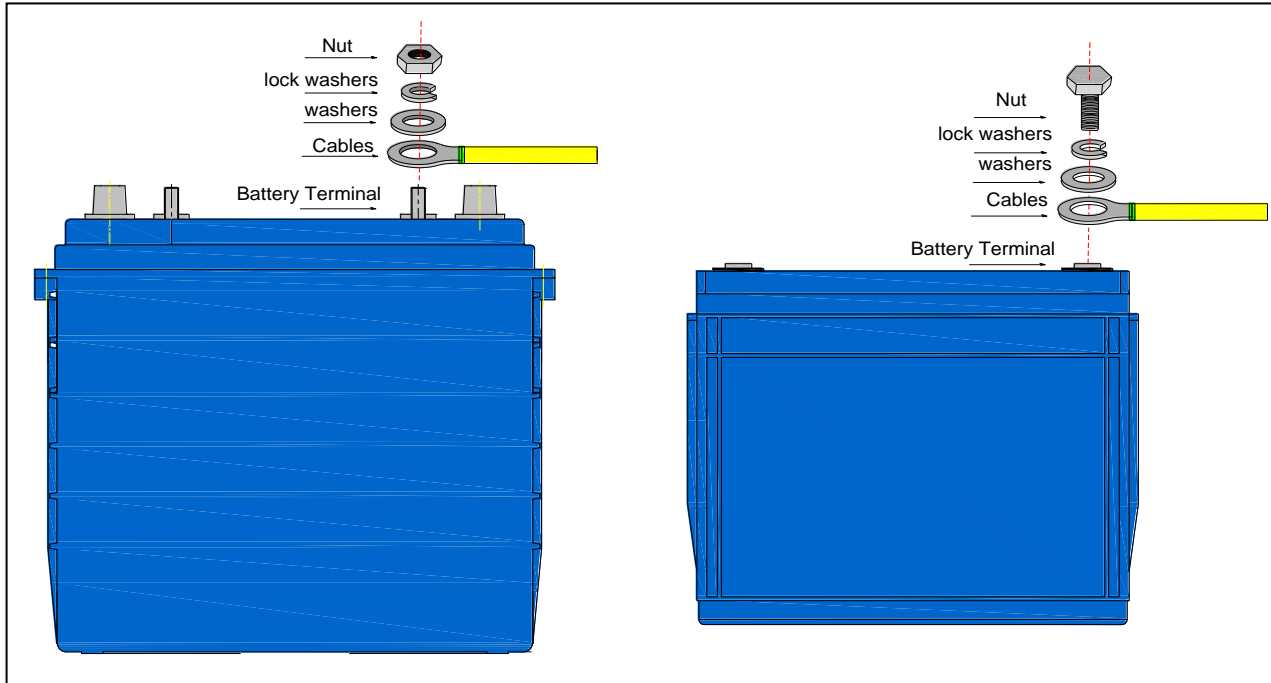
Terminal connections must be tightened using the correct torque values as defined in **Table 6**. Over or under-tightened connections can result in terminal breakage, over-heating and/or meltdown. Using the proper torque value will provide optimum conductivity. Use a wrench with an insulated or rubber coated handle when making terminal connections to avoid a short circuit. See **diagram 1** for proper washer placement.

Table 6: Battery Terminal Torque Values

Terminal Type	lbs-in	Nm
M5	20~30	2.0~2.9
M6	50~70	5.6~7.9
M8	85~95	9.6~10.7
M6M-Stud	50~70	5.6~7.9
M10M-Stud	110~125	12.2~14
FR45	70~90	7.9~10.1
TP07-AP / TP08-AP / AP	50~70	5.6~7.9
DT		
AP	50~70	5.6~7.9
Stud	110~125	12.2~14

Note: Never place a washer between the mating surfaces of the terminals and cables, this will compromise electrical transmission and increase resistance, resulting in extreme heat generation and probable terminal melting. Corrosion can build up on terminals if they are not kept clean and dry. To prevent corrosion apply a thin coat of petroleum jelly or terminal protector that can be purchased through your local battery dealer.

Diagram 1: Terminal Connections



Ventilation

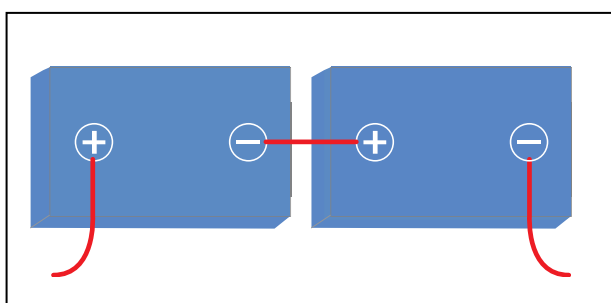
Gel and AGM batteries generally do not release gas but can if too much pressure builds up during charging. It is critical to charge batteries in a properly ventilated area. For more assistance in calculating ventilation needs, please contact your local FULLRIVER distributor or email info@fullriver.com.

Connecting Batteries to Increase System Power

Series Connections

To increase voltage, connect batteries in series. This will not increase the system capacity. Refer to Diagram 2 for series connections.

Diagram 2:



Example:

Two DC224-6,6V Batteries
Rated at 224AH Connected in Series

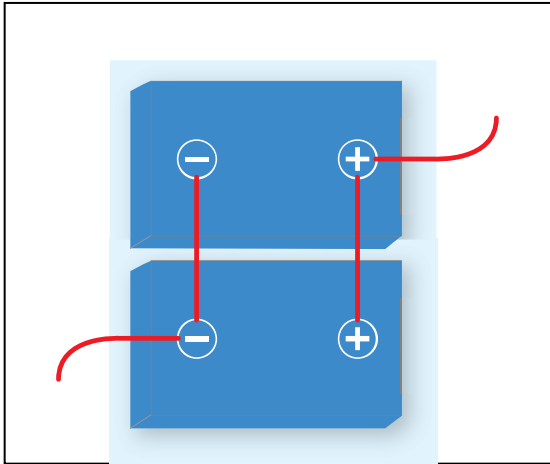
System Voltage: $6V+6V=12V$

System Capacity=224AH

Parallel Connections

To increase capacity, connect batteries in parallel. This will not increase the system voltage. Refer to Diagram 3 for parallel connections.

Diagram3:



Example:

Two DC224-6,6V Batteries
Rated at 224AH Connected in parallel

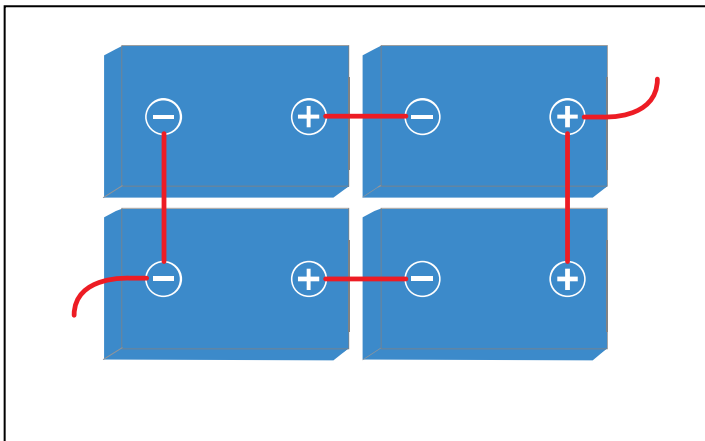
System Voltage: 6V

System Capacity: $224\text{AH}+224\text{AH}=448\text{AH}$

Series/Parallel Connections

To increase both voltage and capacity, connect additional batteries in series and parallel. Refer to Diagram 4 for series/parallel connections.

Diagram4:



Example:

Two DC224-6,6V Batteries
Rated at 224AH Connected in parallel

System Voltage: $6\text{V}+6\text{V}=12\text{V}$

System Capacity: $224\text{AH}+224\text{AH}=448\text{AH}$

Note: when connecting the batteries, free air space must be provided between each battery. The recommended minimum space between batteries is 0.3 inches (8mm) to 0.6 inches (15mm). In all installations due consideration must be given to adequate ventilation for the purposes of cooling.

Battery orientation

The ideal placement of batteries is upright. AGM batteries can be placed on their side if necessary. It is preferred that all the batteries within a pack be placed in the same orientation.

Battery Testing

Testing batteries can be complex and there are many application specific variables that cannot be considered in one simple test. This section is a guide to help you determine the overall condition of your batteries. Contact your local FULLRIVER distributor for assistance.

Test Preparation

1. Check that battery cables are in good condition. Replace any damaged or broken cables.
2. Check that all terminal connections are tightened to the proper torque specification.
3. Fully charge the batteries.
4. Let batteries rest for at least 8 hours once the charge is complete.

Open Circuit Voltage Test

1. Check and record open circuit voltage (OCV) of each battery.
2. If all the batteries are below 2.04V (2V battery), 6.1V (6V battery), 8.1V (8V battery) or 12.2V (12V battery) the set is failed. Replace the entire set of batteries. In this situation the battery set had either provided all its available energy or was severely abused.
3. Otherwise any battery that is 0.08V lower than the highest battery voltage (2V battery), 0.25V lower than the highest battery voltage (6V battery), 0.35V lower than the highest battery voltage (8V battery) or 0.5V lower than the highest battery voltage (12V battery) might have failed. Make note of these batteries.

Note: all battery in a good set should be above 2.14V (2V battery), 6.4V (6V battery), 8.5V (8V battery), 12.7V (12V battery) when fully charged after at least 8 hours of rest.

Discharge Test(if you do not have a discharger proceed to **Optinal Test**)

1. Connect and start discharger.
2. Record minutes(runtime) when discharge is complete.
Correct runtime minutes for battery temperature using the following formula:
(valid between 24 °C to 32 °C(75 °F to 90 °F):
 $M_c = M_r(1 - 0.009(T - 27))$
where M_c is the corrected minutes, M_r is the minutes recorded and T is the temperature at the end of discharge in °C.
3. If the set runs more than 50% of its rated capacity, the batteries are good test is complete.
4. If the set runs less than 50% of its rated capacity, reconnct the discharger and while under the discharge load; record the end of discharge voltage of each battey.
5. The batteries that are 0.5V lower than the highest end of discharge voltage should be noted.

6. If the set delivered less than 50% of its rated capacity, and the same batteries that were noted in **Open Voltage Test** section., Step 3 were also the ones noted in section **Discharge Test.**,Step 5, those batteries are most likely failed and should be replaced.

Otherwise, please contact your local FULLRIVER distributor or email info@fullriver.com to review your data in detail. Additional testing may be required depending on your specific application.

Optimal Test

After completing sections **Test Preparation** and **Open Circuit Voltage Test** follow these steps:

1. Operate the vehicle/equipment until battery performance decreases.
2. Record voltages during and after operation.
3. Record time and distance of operation.
4. Provide the voltage , time and distance data to a FULLRIVER distributor or technical support at info@fullriver.com
5. This data will be analyzed in comparison to what is expected of the vehicle/equipment.

Battery Replacement Instructions

Charge the set of batteries before replacing the failed ones, as long as is safe to do so, to make sure the good batteries are fully charged.

If possible, replace failed batteries with good batteries around the same age from another piece of equipment. Try to avoid mixing new batteries in equipment with old batteries. Put all new batteries in the same piece of equipment.

For battery replacement, follow the installation instructions in section **Open Circuit Voltage Test**.



Fullriver Battery is Your Clean-Green Energy Solution

At Fullriver Battery we are committed to providing you energy while protecting the environment.

Our products

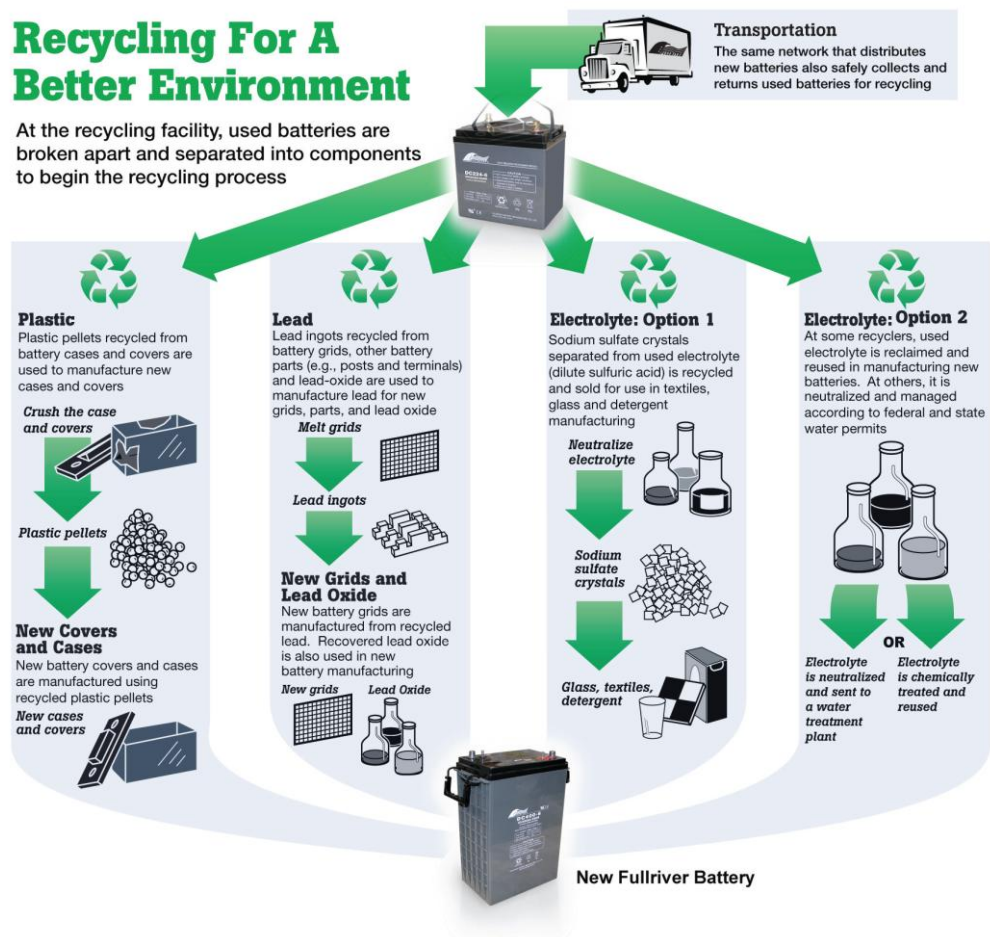
Fullriver Battery produces sealed, maintenance-free batteries that are non-hazardous and non-spillable and are made from ~80% recycled materials. During normal operation our batteries will not release any harmful gasses and will not leak any acidic electrolyte into the environment.

Fullriver Batteries are classified as safe for air, sea and ground transportation as they meet the requirements of: the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO), the International Maritime Dangerous Goods (IMDG) and the Department of Transportation (DOT).

More than 98% of the lead in batteries is recycled, placing lead-acid batteries at the top of the list of the most highly recycled consumer product. The recycling loop of a lead-acid battery goes on indefinitely. See Recycling Diagram below.

Our Manufacturing

Fullriver Battery manufactures batteries in accordance with international environmental regulations. We continually improve our processes in order to minimize waste, recycle all waste that is recyclable and discard waste that is not recyclable in accordance with local disposal regulations. We strictly enforce the use of proper ventilation and protective gear to minimize exposure of lead to our employees well below the suggested levels.





[HTTP://WWW.FULLRIVER.COM](http://www.fullriver.com)



FULLRIVER BATTERY MANUFACTURE CO.,LTD.