FULLRIVER®
SINCE 1995
Your CLEAN-GREEN Energy Solution

HC SERIES

AGM Batteries for High Cranking 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℃.the battery can be used in a wide operating temperature range from -20℃ to 50℃.

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

ISO9001 MH27867

- **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)

General Features

- Valve regulated lead acid battery.
- Dry cell technology with an absorbed glass mat.
- It has safety, low resistance so recharge is easy and energy output is more remarkable
- 5S.Pulse discharge capabilities
- Low self discharge, the self discharge rate below 4% per month
- High rate discharge construction
- Deep discharge recoverability
- Can be choose to install metal case(Except HC64,HC65,HC75) and fitted with TP brass automotive terminal
- Operation temperature range: -22℉ (-30℃) to 122℉ (50℃)

Benefits

- High capacity starting power-to start any size engines
- Highest reserve capacity in the industry-to power a wide range of accessories
- Superior conductivity – brass terminals provide greater electrical transmission
- Durability – rugged design to withstand shock and vibration
- Charge efficiency – faster recharge than conventional wet batteries
- Convenience – maintenance free sealed construction – no water needed
- Safety – DOT,IATA,IMDG and ICAO CERTIFIED as non-spillable

Applications

- Auto/LTV
- Marine
- Extreme racing
- Heavy duty/Commercial
- Car audio accessories
- Engine starting
- Power sports
- Vehicle fleet

Characteristics

Self Discharge

All lead acid batteries experience self-discharge in open circuit. The result is that open circuit voltage decreases, and the capacity also decreases. During storage please note:

a、 The self-discharge rate is related with ambient temperature. The self-discharge rate is smaller when the ambient temperature is lower, otherwise is larger. The required temperature of HC batteries' storage environment is from 0℃ to 35℃. The storage place must be clean, ventilated and dry.

b、 An important parameter in storage is open circuit voltage, which is related with density of the electrolyte. If the open circuit voltage is lower than 12.6V/block, or have been stored for three months, the batteries should be supplementally charged to avoid damage caused by self discharge.

c、 All batteries, which are ready to store, should be fully charged before storage. It's suggested to record the storage time in the periodic maintenance record and record the time when another necessary supplemental charge should be made.

d、 The quality certificates and packages of HC batteries record the latest charge time of the batteries, next charge time can be calculated according to this charge time.

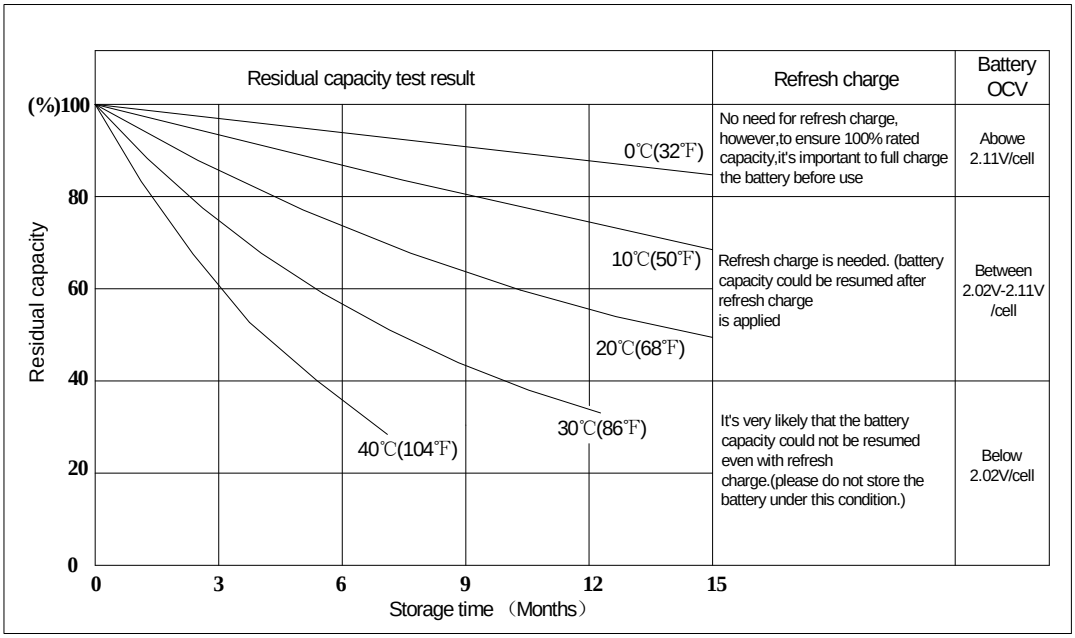

figure 1： Residual Capacity Vs. Storage time

Temperature Conditions

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

Table 1: Temperature conditions:

Charge	32℉(0℃)~104℉(40℃)
Discharge	5℉(-15℃)~122℉(50℃)
Storage	5℉(-15℃)~104℉(40℃)

Available Capacity, Measured By Open Circuit Voltage

Use **Figure 2** to determine the SOC of the Fullriver HC battery, as long as the battery has not been charged or discharged for six or more hours. The only tool needed is a good quality digital voltmeter to measure its open circuit voltage (OCV). The graph shows that a healthy, fully charged Fullriver battery will have an OCV of 12.84V or higher at 25ºC (77ºF)

The OCV of a battery is the voltage measured between its positive and negative terminals without the battery connected to an external circuit (load). It is very important to take OCV reading only when the battery has been off charge for at least 6-8 hours, preferably overnight.

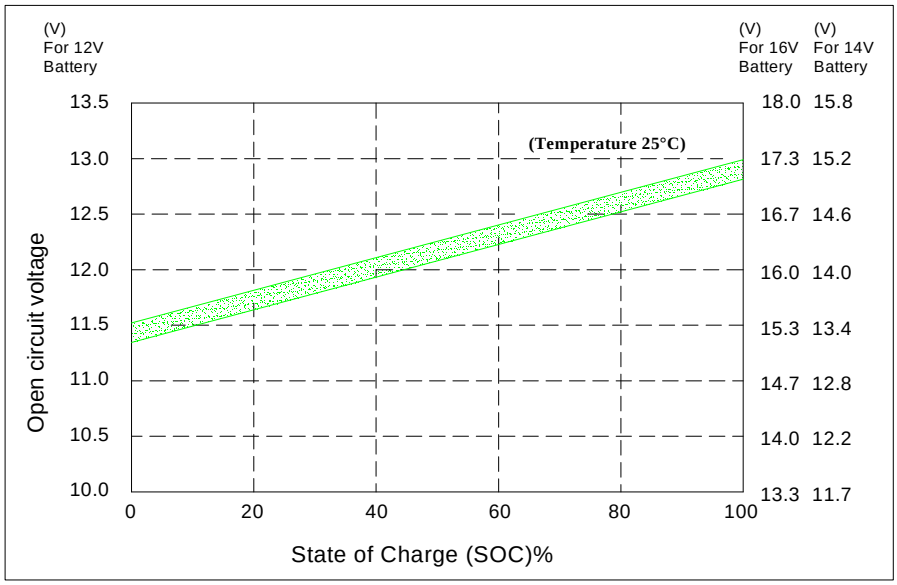

figure 2:Open Circuit Voltage Vs. State of Charge(SOC)

Low Temperature Performance

Excellent low temperature performance is another feature that sets the Fullriver battery apart from the others. **Figure 3** below shows that at -30ºC (-22ºF) the battery will deliver as much as 40% of its 15-minute rating. But too low temperature will cause battery long term insufficient charged, also will no discharge and negative plates sulfate.

The capacity will increase when temperature raises. For example the capacity will increase to 102% of rated capacity if temperatures increase from 25℃ to 50℃. It will quicken plate's corrosion and water loss if temperature raises, and shorten battery's life.

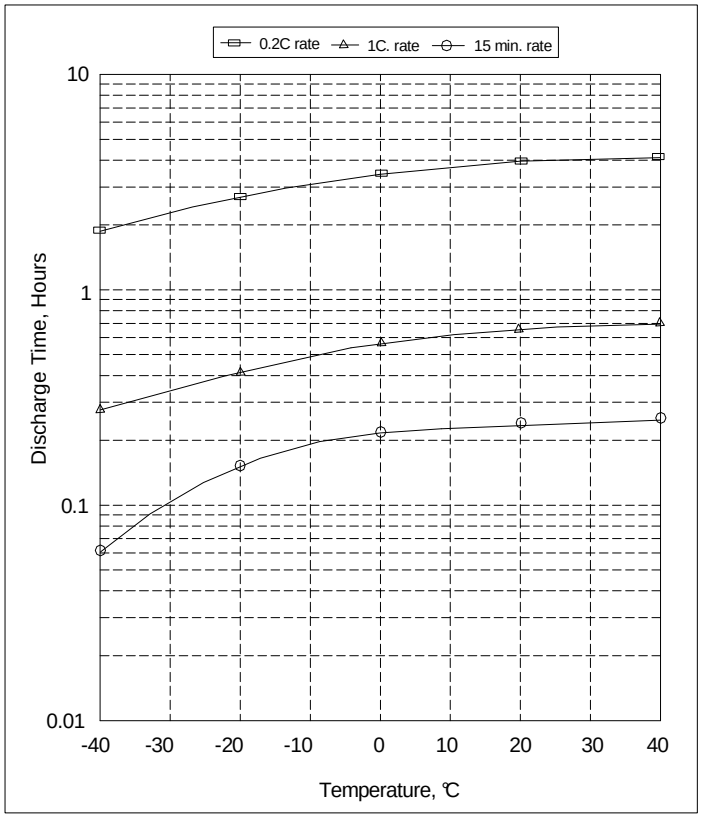

Figure 3: capacity Vs. Ambient Temperature

HC Series General Specifications

Fullriver Type	Industry Ref.	Capacity C20 1.75 V/C 25℃ Ah	5 sec. pulse hot cranking amps （PHCA）	Cranking Performance			Reserve capacity, Minutes 25A	Length	Width	Height	Total Height	Weight (Approx.)	Terminal Type	Pallet QTY
				CCA @ 0ºF	CA @ 32ºF	HCA @ 80ºF		mm (in)	mm (in)	mm (in)	mm (in)	kg (pound)		
12V High Cranking Battery														
HC8	N/A	8	310	100	155	200	8	138 (5.43)	86 (3.39)	101.6 (4.00)	101.6 (4.00)	3.00 (6.61)	M6	220
HC14A	N/A	14	535	200	265	300	20	170.2 (6.70)	99.1 (3.90)	155 (6.10)	155 (6.10)	6.00 (13.23)	M6	160
HC14B	N/A	14	545	185	240	300	15	177 (6.97)	86 (3.39)	130.7 (5.15)	130.7 (5.15)	5.00 (11.02)	M6	192
HC15	N/A	15	370	156	190	220	25	200 (7.87)	77 (3.03)	134 (5.28)	138 (5.43)	5.55 (12.24)	M6	192
HC18	N/A	18	625	265	350	440	26	170.2 (6.70)	99.1 (3.90)	175 (6.89)	175 (6.89)	7.00 (15.43)	M6	144
HC20	N/A	20	680	230	310	410	28	181 (7.13)	77 (3.03)	167 (6.57)	167 (6.57)	7.00 (15.43)	M6	144
HC28	N/A	28	925	410	530	625	48	165 (6.50)	176 (6.93)	125 (4.92)	125 (4.92)	10.70 (23.59)	M8	120
HC30	N/A	30	950	450	550	635	60	250 (9.84)	97 (3.82)	142 (5.59)	156 (6.14)	10.60 (23.37)	M6 M	104
HC35	U1	35	975	438	525	605	50	196 (7.72)	131 (5.16)	167 (6.57)	167 (6.57)	12.1 (26.68)	M6	66
HC40	N/A	40	1100	500	600	700	70	250 (9.84)	97 (3.82)	192 (7.56)	206 (8.11)	14.90 (32.85)	M6 M	78
HC44	N/A	44	1200	560	725	860	80	198 (7.80)	166 (6.54)	170 (6.69)	170 (6.69)	15.10 (33.29)	M8	66
HC50	(DIN/L2)	50	1280	610	745	890	105	241 (9.49)	175 (6.89)	190 (7.48)	190 (7.48)	19.10 (42.11)	AP	64
HC55	22NF	55	1300	620	745	890	100	229 (9.02)	138 (5.43)	208 (8.19)	212 (8.35)	18.00 (39.68)	M6	63
HC60	N/A	60	1340	700	840	1010	105	220 (8.66)	121 (4.76)	247 (9.72)	261 (10.28)	20.50 (45.19)	M6 M	48
HC60B	(DIN/L3)	60	1320	680	810	975	120	278 (10.94)	175 (6.89)	190 (7.48)	190 (7.48)	21.80 (48.06)	AP	48
HC64	25	64	1400	750	900	1080	120	240.3 (9.46)	173.7 (6.84)	202 (7.95)	220 (8.64)	22.30 (49.16)	AP	48
HC64X	25	64	1400	750	900	1080	120	240.3 (9.46)	168.7 (6.64)	202 (7.95)	220 (8.64)	22.30 (49.16)	AP	48
HC65X	34	65	1500	825	1000	1200	135	261 (10.28)	164.5 (6.48)	182.5 (7.19)	186.5 (7.34)	20.80 (45.86)	M8	48
HC65	34	65	1500	825	1000	1200	135	261 (10.28)	171.5 (6.75)	182.5 (7.19)	186.5 (7.34)	20.80 (45.86)	M8	48
HC65/T	34	65	1500	825	1000	1200	135	261 (10.28)	171.5 (6.75)	182.5 (7.19)	204 (8.03)	20.90 (46.08)	M8+TP28	48
HC65/S	34	65	1500	825	1000	1200	135	261 (10.28)	180 (7.09)	182.5 (7.19)	192 (7.56)	21.00 (46.30)	M8+FR45	48
HC65/ST	34	65	1500	825	1000	1200	135	261 (10.28)	180 (7.09)	182.5 (7.19)	207 (8.15)	21.10 (46.52)	M8+TP28 +FR45	48
HC70	93	70	1650	900	1080	1250	160	351 (13.82)	167 (6.58)	179 (7.05)	179 (7.05)	24.8 (54.68)	M8	30
HC75	65	75	1750	930	1070	1350	142	300 (11.81)	182 (7.17)	169.5 (6.67)	187.5 (7.38)	25.40 (56.00)	AP	36
HC75X	65	75	1750	930	1070	1350	142	300 (11.81)	178 (7.01)	169.5 (6.67)	187.5 (7.38)	25.40 (56.00)	AP	36
HC80	(DIN/L5)	80	1800	890	1070	1300	168	353 (13.90)	175 (6.89)	190 (7.48)	190 (7.48)	27.70 (61.07)	AP	36
HC100	27	100	1950	965	1170	1380	205	307 (12.09)	169 (6.65)	214 (8.31)	237 (9.33)	32.20 (70.99)	DT	36
HC105	30H	105	2150	1050	1300	1505	242	330 (12.99)	172 (6.77)	214 (8.43)	220 (8.66)	34 (74.96)	M8	36
HC110	31	110	2200	1100	1360	1560	230	330 (12.99)	173 (6.81)	214 (8.43)	237 (9.33)	34.6 (76.28)	M10M	33
HC120	6T	120	2250	1150	1450	1700	273	284 (11.18)	268 (10.55)	205.5 (8.09)	209.5 (8.25)	38.7 (85.32)	M8	27

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				CCA @ 0ºF	CA @ 32ºF	HCA @ 80ºF		mm (in)	mm (in)	mm (in)	mm (in)	kg (pound)		
14V High Cranking Battery														
HC14V25	34	25	820	375	450	550	32	260.4 (10.25)	164.2 (6.46)	178.9 (7.04)	182.9 (7.20)	12.4 (27.34)	M6	48
HC14V50	34	50	1250	570	675	820	75	260.4 (10.25)	164.2 (6.46)	178.9 (7.04)	182.9 (7.20)	19.1 (42.11)	M6	48
16V High Cranking Battery														
HC16V25	34	25	820	375	450	550	32	260.4 (10.25)	164.2 (6.46)	178.9 (7.04)	182.9 (7.20)	13.8 (30.42)	M6	48
HC16V50	34	50	1250	570	675	820	75	260.4 (10.25)	164.2 (6.46)	178.9 (7.04)	182.9 (7.20)	21.2 (46.74)	M6	48

Note: A) Note that successive discharges must be spaced apart to allow the terminals to cool down,

B) CCA(Cold Cranking Amps) – the discharge load in amperes which a new, fully charged battery can maintained for 30 seconds at 0℉(-17.8℃) at a voltage above 1.2V/cell.

C) CA (Cranking Amps) – the discharge load in amperes which a new, fully charged battery can maintained for 30 seconds at 32℉ (0℃) at a voltage above 1.2V/cell. This is sometimes referred to as marine cranking amps@32℉ or M.C.A.@32℉.

D) HCA (Hot Cranking Amps) - the discharge load in amperes which a new, fully charged battery can maintained for 30 seconds at 80℉ (27℃) at a voltage above 1.2V/cell.

Battery Supplier Cross Reference

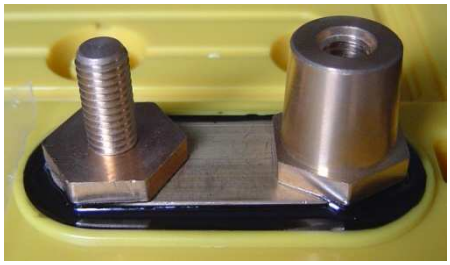
Fullriver	Yuasa	EXIDE	Deka	Delco	Interstate
HC8	YTX9-BS	9-BS	ETX9	GTX9-BS	CYTX9-BS
HC14A	YTX20-BS	16-BS	ETX16	TBA	CYTX20-BS
HC14B	YTX14-BS	14-BS	ETX14	GTX14-BS	CYTX14-BS
HC18	YTX20HL-BS-PW	16L-BS	ETX16L	TBA	CYTX20L-BS
HC20	YTX24HL-BS	18L-BS	ETX18L	TBA	CYTX24HL-BS
HC28	YIX30L-BS	-	-	-	FAYIX30L

Terminal and Accessories

M5, M6, M8
(Button Terminal)

M6M or M10M
(Male Stud Terminal)

AP
(Automotive Post)



DT
(AP and Stud Terminal)

TP28 (TP29)
M8 (M6)-A0 Terminal

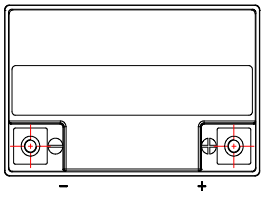
FR45 (FR46)
Side Receptacles for HC65 (HC75)

TP07 (TP08)
M6 (M8)-A01 Terminal with knurling

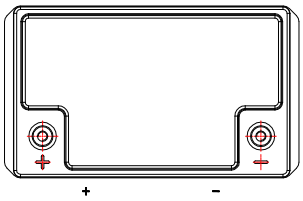
Metal Jacket

Terminal Layouts

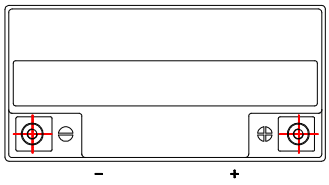
HC8



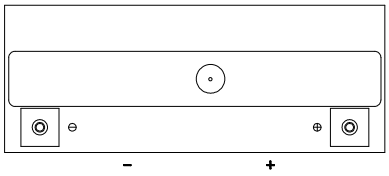
HC14A



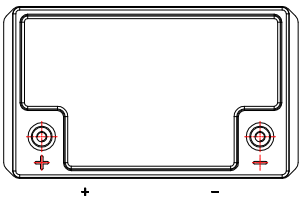
HC14B



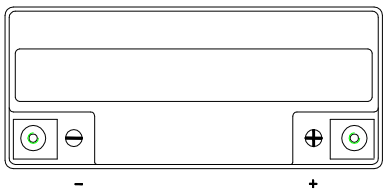
HC15



HC18



HC20



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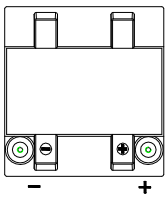
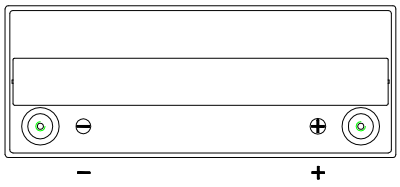


HC30



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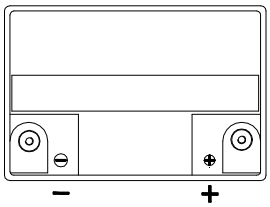

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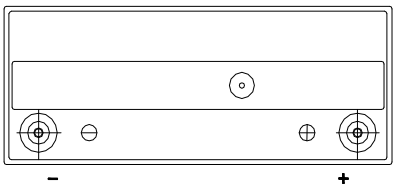

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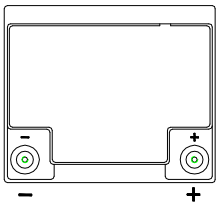
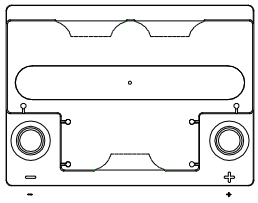


HC50



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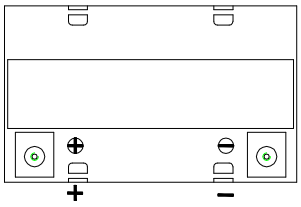

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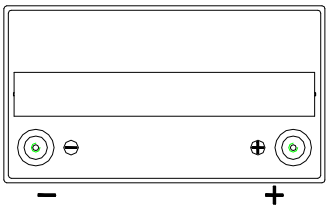
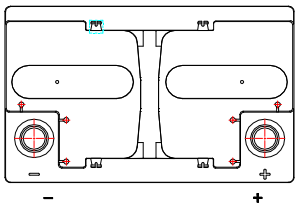


HC60B



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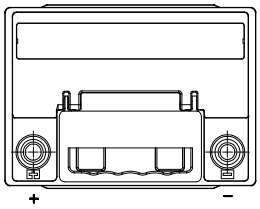


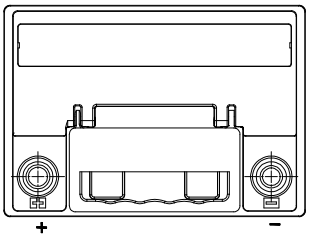
HC64X

HC65

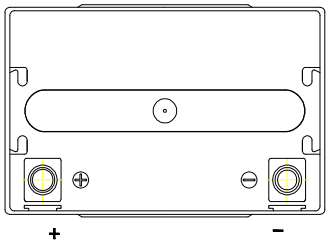
HC65X

HC70

HC75



HC75X



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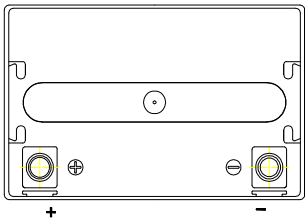

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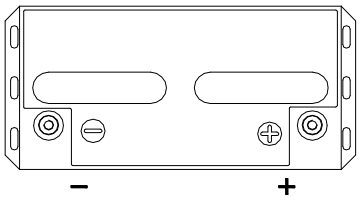
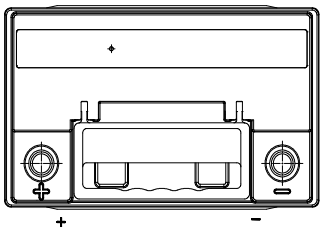


HC105



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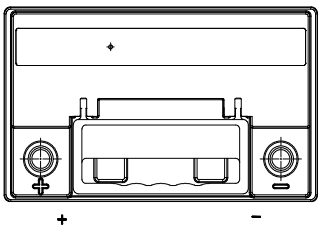

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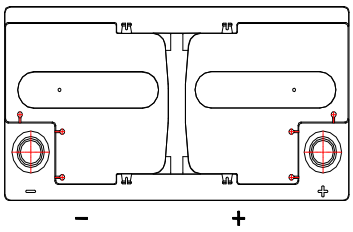
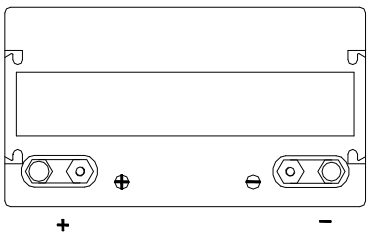
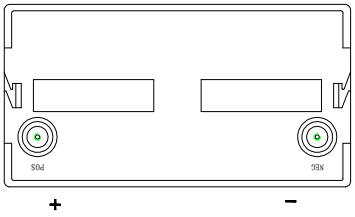
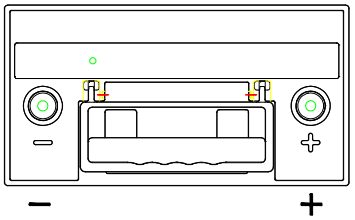
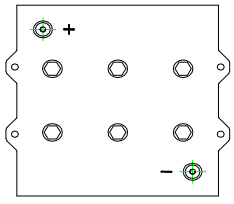


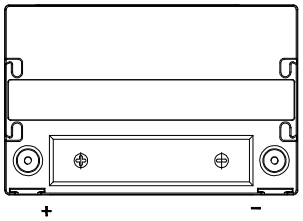
HC14 (16) V25 (50)











Drawing sizes are for terminal position reference only;
Diagrams are not proportionate to each other.
Optional Reversed Polarity (L).

Battery 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℉~104℉(0℃~40℃)

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.

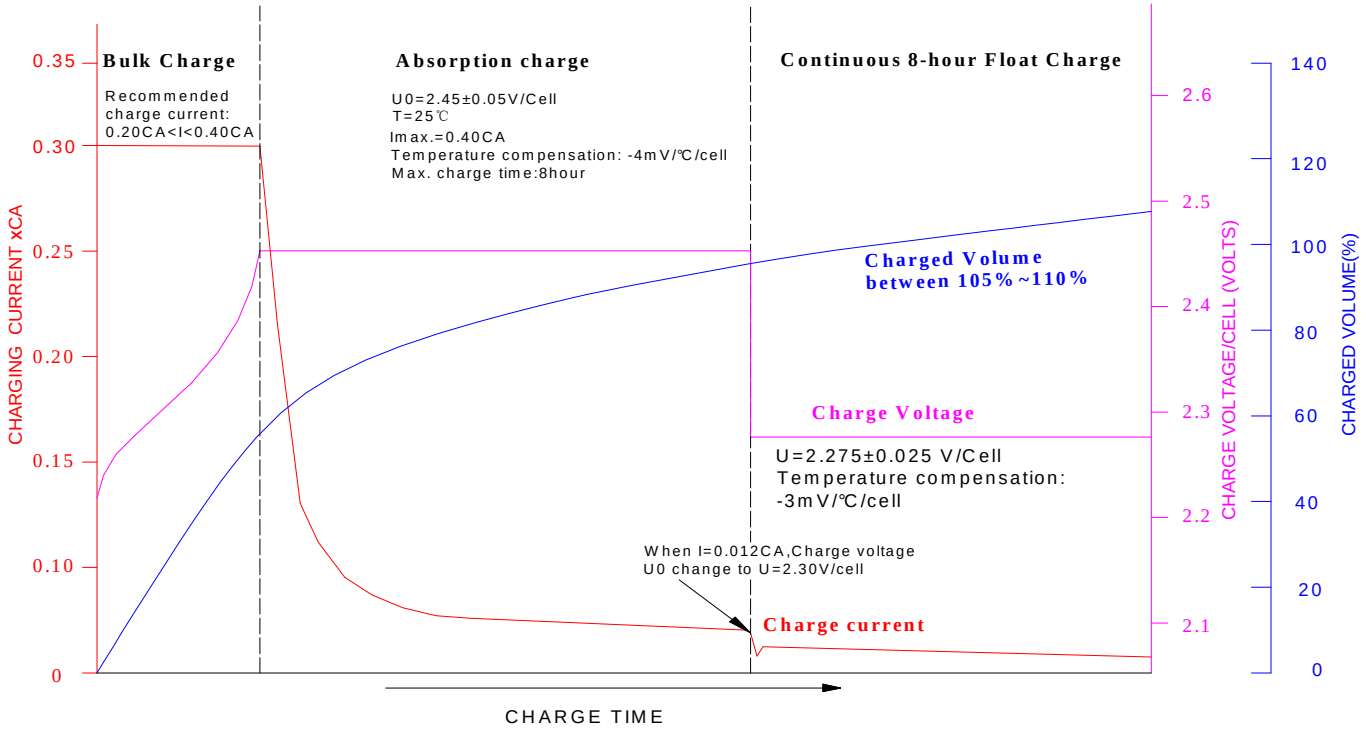


figure 5： Charging characteristics of a two constant voltage charger

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=0.30XC (I_{max}=0.40XC) 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.

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 -3mV/℃/Cell (stand by) and -4mV/℃/Cell (cyclic use). The standard center point for temperature compensation is 25℃ (77℉).

Selecting the right charger for your battery

Qualifying portable automotive and power sport chargers for your Fullriver HC battery is a simple two-step process.

Step 1 Charger output voltage

Determining the charger output voltage is the most important step in the charger qualification process. If the voltage output from the charger is less than 14.2V or more than 15V for a 12V battery, then do not use the charger. For 24V battery systems, the charger output voltage should be between 28.4V and 30V. If the charger output voltage falls within these voltage limits when the battery approaches a fully charged state, proceed to Step 2, otherwise pick another charger.

Step 2 Charger type - automatic or manual

The two broad types of small, portable chargers available today are classified as either automatic or manual. Automatic chargers can be further classified as those that charge the battery up to a certain voltage and then shut off and those that charge the battery up to a certain voltage and then switch to a lower float (trickle) voltage.

An example of the first type of automatic charger is one that charges a battery up to 14.7V, then immediately shuts off. An example of the second type of automatic charger would bring the battery up to 14.7V, then switches to a float (trickle) voltage of 13.6V; it will stay at that level indefinitely. The second type of automatic charger is preferred, because the first type of charger will undercharge the battery.

A manual charger typically puts out either a single voltage or single current level continuously and must be switched off manually to prevent battery overcharge. Should you choose to use a manual charger you're your Fullriver HC battery, do not exceed charge times suggested in **Table 4** below. It is extremely important to ensure the charge voltage does not exceed 15V.

Other charger

Another class of chargers is designed specifically to maintain a battery in a high SOC. These chargers, normally in the 3/4 amp to 1 1/2 amp range, are not big enough to charge a deeply discharged **HC** battery. They must only be used either to continuously compensate for parasitic losses or to maintain a trickle charge on a stored battery, as long as the correct voltages are applied. It is very important, therefore, to ensure that the Fullriver HC battery is fully charged before this type of charger is connected to it.

Selecting battery type on your charger

Although it is not possible to cover every type of battery charger available today, this section gives the Fullriver HC battery user some general charger usage guidelines to follow, after the charger has been qualified for use with this battery.

In general, do not use either the gel cell or maintenance free setting, if provided on your charger. Choose the deep cycle or AGM option, should there be one on your charger. **Table 4** below gives suggested charge times based on charger currents. To achieve maximum life from your Fullriver HC battery after completing the charge time in **Table 4**, we recommend that you switch your charger to the 2A trickle charge position and leave the battery connected to the charger for an additional 6-8 hours. The trickle charge voltage should be 13.5V to 13.8V.

The charge times recommended in **Table 4** assume that the Fullriver HC battery is fully discharged and these charge times will only achieve a 90% state of charge. For partially discharged batteries, the charge times should be appropriately reduced.

The graph in **Figure 2**, showing OCV and SOC, must be used to determine the battery's SOC. The battery should be trickle charged (2A setting) after high rate charging, regardless of its initial SOC.

Table 4: Suggested charge times

	Charge time for 100% discharged battery				
Model	**10A charger**	**20A charger**	**Model**	**10A charger**	**20A charger**
HC8	1 hr.	30 min.	**HC60B**	4 3/4 hr.	2 1/2hr.
HC14A(B)	1 1/2 hr.	45 min.	**HC64**	5 hr.	2 3/4 hr.
HC15	1 3/4 hr.	55 min.	**HC65**	5 hr.	2 3/4 hr.
HC18	2 hr.	1 hr.	**HC70**	6 hr.	3 hr.
HC20	2 hr.	1 hr.	**HC75**	7 hr.	3 1/2 hr.
HC28	2 1/2 hr.	1 1/4 hr.	**HC80**	8 hr.	4 hr.
HC30	3 hr.	1 1/2 hr.	**HC100**	9 1/2 hr.	4 3/4 hr.
HC35	3 1/2 hr.	1 3/4 hr.	**HC105**	10 hr.	5 hr.
HC40	3 3/4 hr.	2 hr.	**HC110**	10 3/4 hr.	5 1/2 hr.
HC44	4 hr.	2 hr.	**HC120**	11 1/2 hr.	5 3/4 hr.
HC50	4 1/2 hr.	2 1/4 hr.	**HC14(16) V 25**	2 1/4 hr.	1 1/3 hr.
HC55	4 1/2 hr.	2 1/4 hr.	**HC14(16) V 50**	4 1/2 hr.	2 1/4 hr.
HC60	4 3/4 hr.	2 1/2 hr.			

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(FR46)	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.

Ventilation

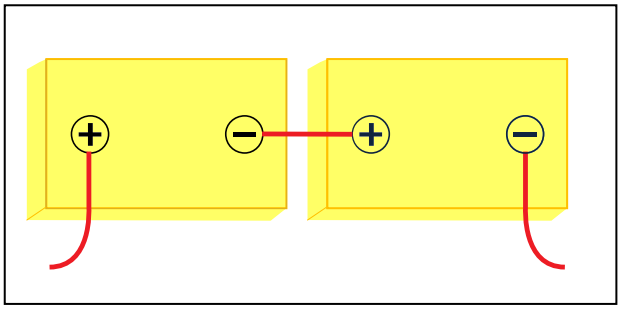
Gel and AGM batteries generally do not release gas but can if too much pressure builds up during charging. It is critical to charge batteries in a properly ventilated area. For more assistance in calculating ventilation needs, please contact your local FULLRIVER distributor or email into@fullriver.com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

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 1 for series connections.

Diagram 1:



Example:

Two HC110, 12V Batteries

Rated at 110 AH Connected in Series

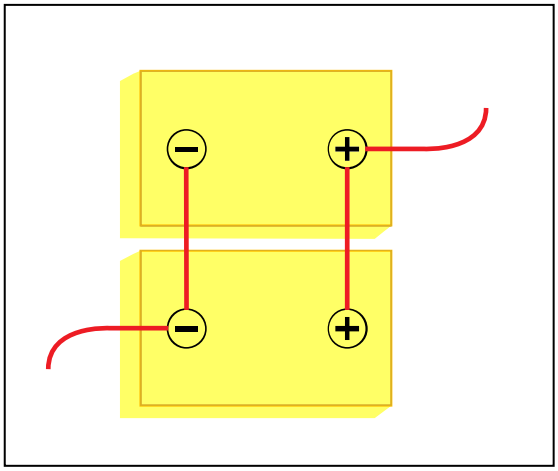
System Voltage: 12V+12V=24V

System Capacity=110AH

Parallel Connections

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

Diagram 2:



Example:

Two HC110, 12V Batteries

Rated at 110AH Connected in parallel

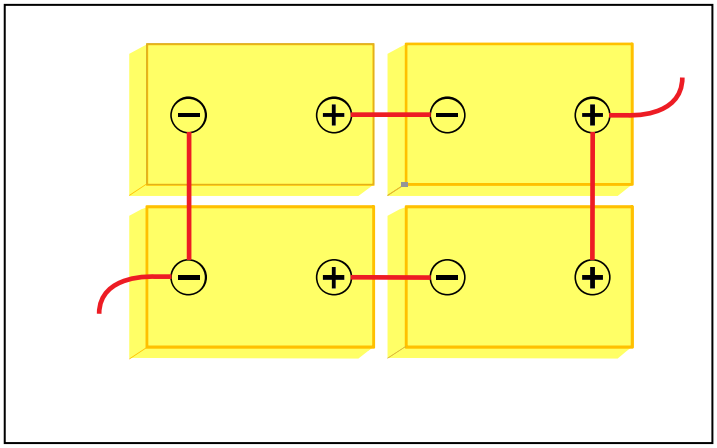
System Voltage: 12V

System Capacity: 110AH+110AH=220AH

Series/Parallel Connections

To increase both voltage and capacity, connect additional batteries in series and parallel. Refer to Diagram 3 for series/parallel connections.

Diagram 3:



Example:

Two HC110, 12V Batteries

Rated at 110AH Connected in parallel

System Voltage: 12V+12V=24V

System Capacity: 110AH+110AH=220AH

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.

Now that you have defined your battery needs refer to your Fullriver Brochure to select the model that meets those specifications. **Call your local Fullriver Battery Distributor and they would be happy to assist you in the final selection of your new Fullriver Batteries.**

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 12.2V (12V battery), 14.3V (14V battery) or 16.3V (16V 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 0.5V lower than the highest battery voltage (12V battery), 0.60V lower than the highest battery voltage (14V battery) or 0.65V lower than the highest battery voltage (16V battery) might have failed. Make note of these batteries.

Note: all battery in a good set should be above 12.7V (12V battery), 14.8V (14V battery), 16.9V (16V 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 ℃ to 32 ℃(75 ℉ to 90 ℉):

Mc=Mr(1-0.009(T-27)

where Mc is the corrected minutes, Mr is the minutes recorded and T is the temperature at the end of discharge in ℃.

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(12V battery) lower than the higest 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.

Optinal Test

After completing sections **Test Prepartion** 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/eqipment.

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 aroud the same age frome another piece of equipment. Try to aviod 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**.

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FULLRIVER BATTERY MANUFACTURE CO.,LTD.

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