



THE POWER OF CARBON FOAM

# REVOLUTIONIZING ENERGY STORAGE

## RELIABLE. SUSTAINABLE. POWERFUL.

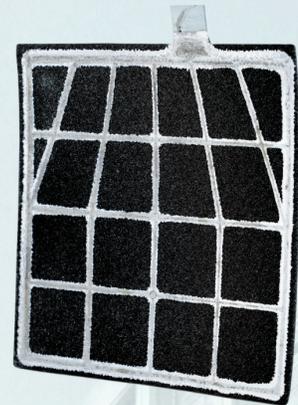




**Carbon Foam Block**



**Carbon Foam Slice**



**Carbon Negative Electrode**

- Firefly Energy delivers a new class of advanced lead-acid batteries powered by patented carbon-foam electrode technology—an aerospace-age material engineered into a rugged, scalable energy platform. The carbon foam, originally developed in Caterpillar’s R&D labs, is a 3-D micro-cell structure with exceptionally high surface area, high electrical conductivity and inert to chemicals or solvents. In a battery, that architecture changes how lead-acid behaves: it improves charge acceptance, resists sulfation under partial state-of-charge operation and helps sustain high-power output with more predictable performance over life. The result is a safer, fully recyclable alternative that brings many “lithium-like” benefits without thermal-runaway concerns or complex BMS requirements. Firefly’s technology is well suited for mission-critical backup and high-demand environments such as data centres and AI infrastructure, telecom, marine, RV and Trucking applications. With manufacturing in India and active supply into North America, Japan, Firefly combines innovation with real-world deployability and service support.



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## Why Firefly Carbon-Foam Battery Makes the Difference in Data Centres

### PSOC-Optimised by Design

- Carbon-foam's 3-D porous structure prevents sulfation and acid stratification, allowing stable operation under partial-charge and micro-cycling UPS conditions.

### 3× Longer Effective Life

- Carbon-foam replaces fragile lead grids, dramatically reducing corrosion and active-material shedding—the main failure modes of conventional VRLA.

### Predictable Runtime, Even at End-of-Life

- Uniform current distribution across the carbon-foam matrix maintains consistent voltage and usable capacity as the battery ages.

### High-Power UPS Performance

- Ultra-low internal resistance of carbon-foam enables fast electron transport, supporting high-rate discharge required for 5–15 minute UPS runtimes.

### Safer Than Lithium

- Carbon-foam batteries use non-flammable lead-acid chemistry, eliminating thermal runaway risk and the need for complex BMS-based safety controls.



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#### **Drop-In VRLA Replacement**

- Carbon-foam batteries integrates into standard VRLA form factors (12V /2V/ 4V), operating on existing UPS charging profiles without system redesign.

#### **Resilient at Higher Temperatures**

- Carbon-foam electrodes resist grid corrosion and thermal degradation, maintaining performance at elevated battery-room temperatures.

#### **Lower Total Cost of Ownership**

- Longer service life, fewer replacements, and no lithium-specific fire-safety or compliance costs reduce lifetime \$/kWh delivered.

#### **100% Recyclable & ESG-Aligned**

- Carbon-foam batteries use the established lead-acid recycling ecosystem, achieving >95% material recovery without introducing new waste streams.

#### **The Smart Middle Path for Data Centres**

- Carbon-foam batteries delivers lithium-like power and cycle performance while retaining the safety, cost control, and familiarity of VRLA systems.
- Carbon-foam technology fundamentally changes how VRLA batteries perform—making Firefly the most reliable and lowest-risk energy storage choice for data-centre UPS systems.



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# 2V 900 Ah / 4V 450 Ah (VRLA AGM GEL)

Partial state of charge cycling Efficiency	2 V 900 Ah	4V 450 Ah
	Ampere-hour >97% & Watt-hour > 90 %	
Nominal Voltage	2V	4V
Maximum charge voltage	2.35V	4.70V
Maximum charge current	0.5C Amps for continuous charge	
	1C Amps can be tolerated for Sporadic sessions."	
Internal Resistance	< 0.6mΩ	< 1.2mΩ
Shelf life@25°C(77°F)	2 years	
Self- Discharge	< 2% per month	

Temperature	Low	High
Operation	-20°C/-4°F	50°C/122°F
storage	-30°C/-22°F	60°C/140°F

Weights & Dimensions	
Length	10.15 in/258mm
Width	6.85 in /174 mm
Height	17.2 in/438 mm
Weight	94 lbs / 42.6 kgs
Volume	1200 Cu.in/19.7 liters
Construction	
Terminal configuration	3/8 "-16 UNC
Case/Cover	PPCP
Racks	Available upon request

International Compliance	
IEC 60896 -21/22 :2004	
IEC 61427	
IS 15549:2005	
ISO 9001:2008	

Discharge Rates to 1.75 VPC *					
2v 900 Ah			4V 450 Ah		
Hours	Amps	Ah	Amps	Ah	Kwh
8	93.7	750	46.9	375	1.5
10	80	800	40	400	1.6
20	45	900	22.5	450	1.8
24	38.3	920	19.2	460	1.84
100	9.6	960	4.8	480	1.92

Battery Life *	
DOD(%)	Cycles
30	13500-16500
50	4650-5200
65	2400-3000
80	1300-1650
100	800-1000

\* All above are at 25°C/77°F

Charge Temperature Compensation							
Operating Temperature	°C	-20	-5	10	25	40	50
	°F	-4	23	50	77	104	131
Absorption Charge Voltage(V)	2V 900 Ah	2.55	2.45	2.40	2.35	2.30	2.25
	4V 450 Ah	5.10	4.90	4.80	4.70	4.60	4.50

# 12V G31M (VRLA AGM GEL)

Partial state of charge cycling Efficiency	Ampere-hour >97% & watt hour >90%
Nominal Voltage	12V
Maximum charge voltage	14.10V
Maximum charge current	0.5C Amps for continuous charge 1C Amps can be tolerated for Sporadic sessions.
Internal resistance	5.0 mΩ
Shelf life@25°C(77°F)	2 years
Self- Discharge	<2% per Month
CCA	630 Amps

Temperature	Low	High
Operation	-20°C/-4°F	50°C/122°F
Storage	-30°C/-22°F	60°C/140°F

Weights & Dimensions	
Length	13.0in/320mm & 13.8in/350mm
Width	6.8in/171mm
Height	8.6in/218 mm
Weight	69.5lbs/31.5kgs
Volume	807Cu.in/12.3liters
Construction	
Terminal configuration	3/8 "-16 UNC
Case/Cover	ABS
Racks	Available upon request

Discharge Rates to 1.75V Per Cell*			
Hours	Amps	Ah	Kwh
0.25	155	38.8	0.47
1	63	63	0.76
3	26.7	80	0.96
5	17.4	87	1.04
10	10	100	1.2
20	5.25	105	1.26

International Compliance	
IEC 60896 -21/22 :2004	
IEC 61427	
IS 15549:2005	
ISO 9001:2008	
IEC 60095	

Battery Life *	
DOD(%)	Cycles
30	9000-13500
50	3600-4200
65	1800-2400
80	1000-1300
100	600-800

\*All above are at 25°C/77°F

Charge Temperature Compensation Charge Temperature Compensation					
Operating Temperature	°C	-20	25	40	55
	°F	-4	77	104	131
Absorption Charge Voltage	v	15.3	14.1	13.8	13.9

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## PERFORMANCE :-

- **Self Discharge** : Less than 2% per month @ 25°C
- **Shelf Life Without Re-charge** : 2 years
- **Operating Conditions** : -40°C to 60°C
- **Design Float Life** : more than 20 Years
- **Recombination Efficiency** : 98%

## METHOD: -

Constant Potential Current Limited

Charge Provision	Charging Voltage	Maximum Charging Current(Amps)
Float charge	2.23 – 2.25 VPC	0.2 C
Boost charge	2.30 – 2.32 VPC	0.2 C



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**Discharge current in Amps to End volt of 1.75 V Per cell**

Battery Type	C20-Ah	No of Cells/ Bty	5 min	10 min	15 min	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	10 hrs	20 hrs
G31M (12V105Ah)	105	6	276.3	210	175	105	75	43.8	30	23.3	19.1	16.4	14.2	12.5	11.3	10.4	5.4
L16 (4V450Ah)	450	2	1184.2	900	750	450	321.4	187.5	128.6	100	81.8	70.3	60.8	53.6	48.4	44.6	23.1
L16 (2V900Ah)	900	1	2368.4	1800	1500	900	642.9	375	257.1	200	163.6	140.6	121.6	107.1	96.8	89.1	46.2

**Constant Watts Discharge/Battery to End volt of 1.75V per cell**

Battery Type	C20-Ah	No of Cells/ Bty	10 min	15 min	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	10 hrs	20 hrs	
G31M (12V105Ah)	105	6	3067	2331	1943	1166	833	486	333	259	223	192	166	146	132	122	63
L16 (4V450Ah)	450	2	4382	3330	2775	1665	1189	694	476	370	319	274	237	209	189	174	90
L16 (2V900Ah)	900	1	4382	3330	2775	1665	1189	694	476	370	319	274	237	209	189	174	90

**Constant Watts Discharge/Cell (WPC) to End volt of 1.75V [er cell**

Battery Type	C20-Ah	No of Cells/ Bty	10 min	15 min	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs	7 hrs	8 hrs	9 hrs	10 hrs	20 hrs	
G31M (12V105Ah)	105	6	511	389	324	194	139	81	56	43	37	32	28	24	22	20	11
L16 (4V450Ah)	450	2	2191	1665	1388	833	595	347	238	185	160	137	119	104	94	87	45
L16 (2V900Ah)	900	1	4382	3330	2775	1665	1189	694	476	370	319	274	237	209	189	174	90

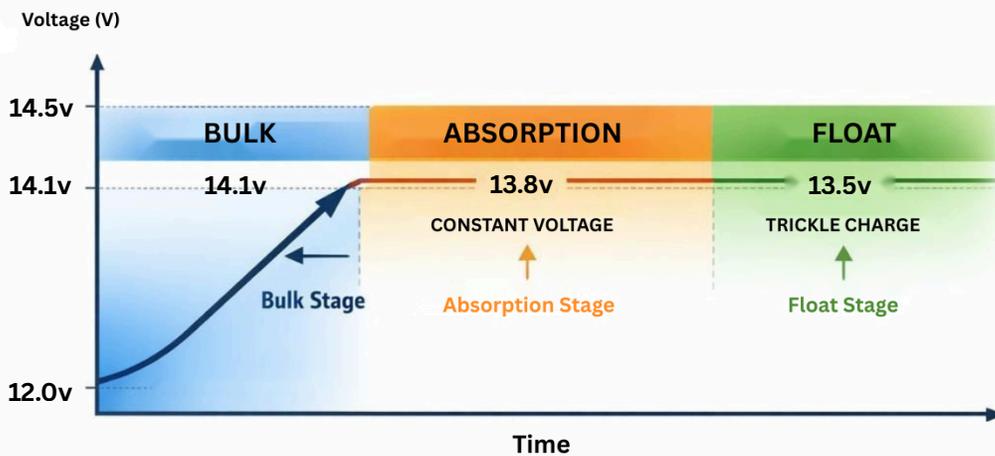
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**Charging Instructions for Programmable Chargers. Battery Type : G31M (12V105Ah)**

	Bulk Phase @14.10V/battery in series					Absorption Phase @13.80V/battery in series					Float chg. Phase @13.50V/Battery
Charge rate Current Limit --->	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	No limit
↓ DOD%	Charging hours to be set					Charging hours to be set					Charging hours to be set
10%	0	0	0	0	0	1	0.5	0.25	0.25	0.25	6
20%	0.5	0.5	0.5	0.25	0.25	1	0.5	0.5	0.25	0.25	6
30%	1	0.5	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	6
40%	2	1	0.5	0.25	0.25	2	0.5	0.5	0.5	0.5	6
50%	3	1.5	1	0.5	0.5	3	0.5	0.5	0.5	0.5	6
60%	4	2	1.5	1	0.5	4	1	0.5	0.5	0.5	6
70%	5	2.5	2	1.5	1	5	2	1	0.5	0.5	6
80%	6	3	2.5	2	1.5	6	3	2	0.5	0.5	6

### 3 - Stage Charging for G31M (12V105Ah) Battery



**NOTE:**  
 For Initial Charging before commissioning / cycling / Recovery Charging after every 15/ 30 cycles )  
 CCCY ( Constant Current\_ Constant Voltage ) Chargers with in built Temperature Compensation  
 Temperature Sensor shall be fixed to Battery Terminals only.  
 All the chargers to be used shall be with Automatic Temperature compensation type with sensors  
 Chargers without Temperature compensation shall not be used. If used , warranty will be void.

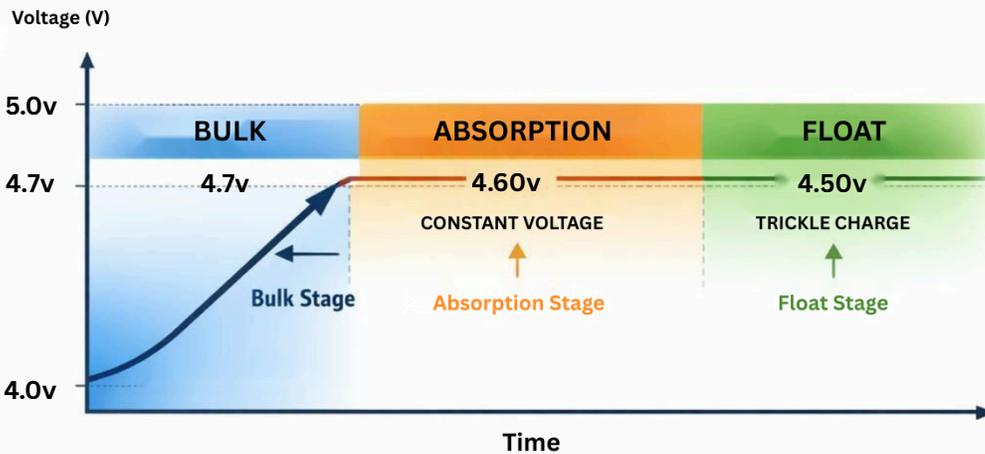
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**Charging Instructions for Programmable Chargers. Battery Type : L-16 (4V450Ah)**

	Bulk Phase @4.70V/battery in series					Absorption Phase @4.60V/battery in series					Float chg. Phase @4.50V/Battery
Charge rate Current Limit ----->	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	No limit
↓ DOD%	Charging hours to be set					Charging hours to be set					Charging hours to be set
10%	0	0	0	0	0	1	0.5	0.25	0.25	0.25	6
20%	0.5	0.5	0.5	0.25	0.25	1	0.5	0.5	0.25	0.25	6
30%	1	0.5	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	6
40%	2	1	0.5	0.25	0.25	2	0.5	0.5	0.5	0.5	6
50%	3	1.5	1	0.5	0.5	3	0.5	0.5	0.5	0.5	6
60%	4	2	1.5	1	0.5	4	1	0.5	0.5	0.5	6
70%	5	2.5	2	1.5	1	5	2	1	0.5	0.5	6
80%	6	3	2.5	2	1.5	6	3	2	0.5	0.5	6

### 3 - Stage Charging for L16 (4V450Ah) Battery



**NOTE:**

For Initial Charging before commissioning / cycling / Recovery Charging after every 15/ 30 cycles )

CCCY ( Constant Current\_ Constant Voltage ) Chargers with in built Temperature Compensation

Temperature Sensor shall be fixed to Battery Terminals only.

All the chargers to be used shall be with Automatic Temperature compensation type with sensors

Chargers without Temperature compensation shall not be used. If used , warranty will be void.

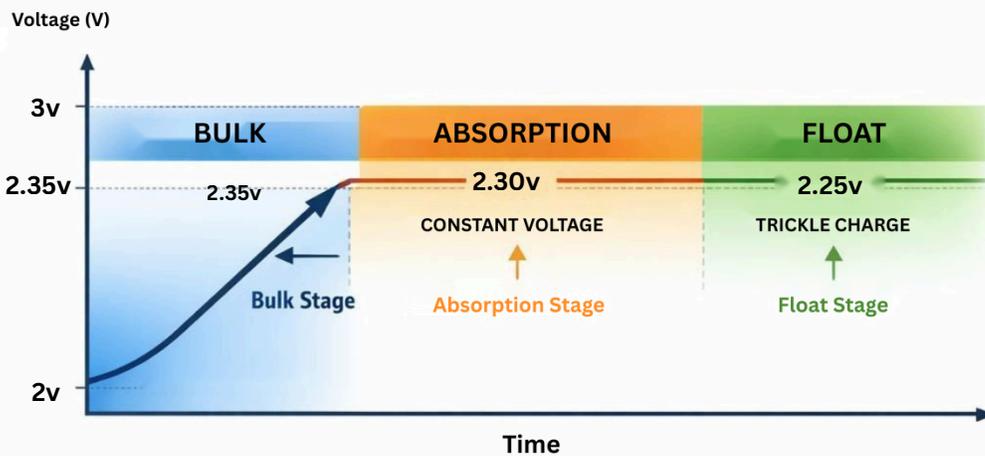
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**Charging Instructions for Programmable Chargers. Battery Type : L-16 (2V900Ah)**

	Bulk Phase @2.35V/battery in series					Absorption Phase @2.30V/battery in series					Float chg. Phase @2.25V/Battery
Charge rate Current Limit - ----->	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	0.1C A	0.2C A	0.3C A	0.4C A	0.5C A	No limit
↓ DOD%	Charging hours to be set					Charging hours to be set					Charging hours to be set
10%	0	0	0	0	0	1	0.5	0.25	0.25	0.25	6
20%	0.5	0.5	0.5	0.25	0.25	1	0.5	0.5	0.25	0.25	6
30%	1	0.5	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	6
40%	2	1	0.5	0.25	0.25	2	0.5	0.5	0.5	0.5	6
50%	3	1.5	1	0.5	0.5	3	0.5	0.5	0.5	0.5	6
60%	4	2	1.5	1	0.5	4	1	0.5	0.5	0.5	6
70%	5	2.5	2	1.5	1	5	2	1	0.5	0.5	6
80%	6	3	2.5	2	1.5	6	3	2	0.5	0.5	6

### 3 - Stage Charging for L16 (2V900Ah) Battery



**NOTE:**  
 For Initial Charging before commissioning / cycling / Recovery Charging after every 15/ 30 cycles )  
 CCCY ( Constant Current\_ Constant Voltage ) Chargers with in built Temperature Compensation  
 Temperature Sensor shall be fixed to Battery Terminals only.  
 All the chargers to be used shall be with Automatic Temperature compensation type with sensors  
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RELIABLE. SUSTAINABLE. POWERFUL.



Contains Lead Please handover at approved waste handling point



Completely Recyclable



Protect eyes from Electrolyte



Electrical Hazard



Read Instructions



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