firefly energy

THE POWER OF CARBON FOAM

REVOLUTIONIZING ENERGY STORAGE

RELIABLE. SUSTAINABLE. POWERFUL.



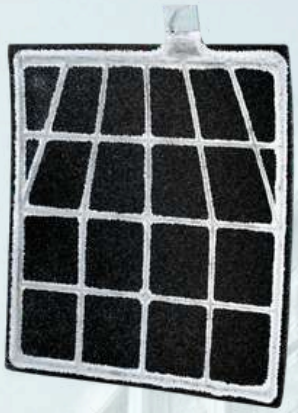




Carbon Foam Block



Carbon Foam Slice



Carbon Negative Electrode

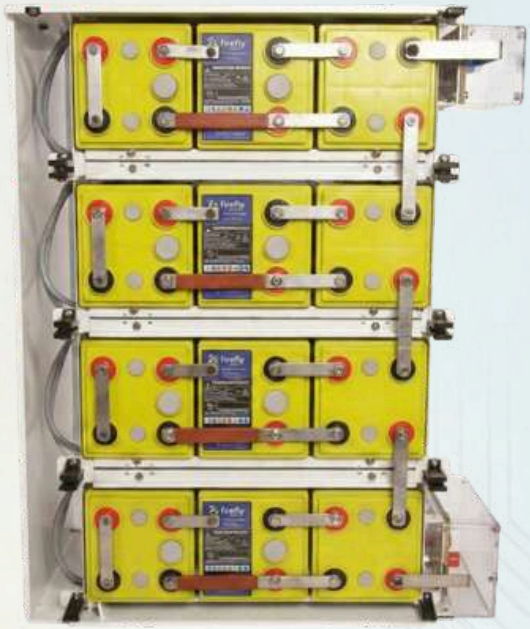
- Firefly Energy delivers a new class of advanced lead-acid batteries powered by patented carbon-foam electrode technology—an aerospace-age material engineered into a rugged, scalable energy platform. The carbon foam, originally developed in Caterpillar's R&D labs, is a 3-D micro-cell structure with 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 @ 25°C	

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/427 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 9001:2015

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	7500-11250
50	3000-3500
65	1500-2000
80	850-1100
100	500-700
* 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

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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 @ 25°C
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	14.00in/356mm
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

International Compliance
IEC 60896 -21/22 :2004
IEC 61427
IS 15549:2005
ISO 9001:2015
IEC 60095

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

Battery Life *	
DOD(%)	Cycles
30	7500-11250
50	3000-3500
65	1500-2000
80	850-1100
100	500-700
*All above are at 25°C/77°F	

Charge Temperature CompensationCharge 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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RANGE SPECIFICATIONS :-

Firefly offers high-performance battery solutions for data centre applications, designed with a modular rack-based architecture to ensure reliability, scalability, and efficient space utilization.

The product range includes three key battery types for integrated rack systems :-:

- **2V 900Ah** high-capacity cells for large-scale UPS and backup power installations
- **4V 450Ah** batteries for compact and flexible modular rack configurations
- **G31M 12V 105Ah** batteries for auxiliary and distributed power support

All three battery types are engineered for seamless integration into modular rack systems, enabling easy installation, simplified maintenance, improved airflow management, and future capacity expansion. This modular design supports uninterrupted operations and ensures dependable power backup for critical data centre infrastructure.

PERFORMANCE :-

- **Self Discharge :** Less than 2% per month @ 25°C
- **Shelf Life Without Re-charge** : 2 years
- **Operating Conditions :** -20°C to 50°C
- **Design Float Life** : >12 years at 27°C (80.6°F)
- **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	2.33 – 2.35 VPC	0.2 C

- **C is rated capacity @20 hour**

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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	-	210.0	169.9	115.4	75.0	43.8	30.0	23.3	19.1	16.4	14.2	12.5	11.3	10.4	5.4
L16 (4V450Ah)	450	2	493.5	449.4	409.5	367.5	273.0	168.0	132.3	105.0	87.2	76.7	67.2	60.9	54.6	50.4	24.3
L16 (2V900Ah)	900	1	987.0	898.8	819.0	735.0	546.0	336.0	264.6	210.0	174.3	153.3	134.4	121.8	109.2	100.8	48.5

Constant Watts Discharge/Battery to End volt of 1.75V 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	-	2268	1855	1260	824	483	333	260	222	191	166	149	135	128	68
L16 (4V450Ah)	450	2	1777	1618	1474	1338	999	618	490	391	338	297	262	241	218	207	99
L16 (2V900Ah)	900	1	1777	1618	1474	1338	999	618	490	391	338	297	262	241	218	207	99

Constant Watts Discharge/Cell (WPC) to End volt of 1.75V 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	-	378	309	210	137	81	56	43	37	32	28	25	23	21	11
L16 (4V450Ah)	450	2	888.3	808.9	737.1	668.9	499.6	309.1	244.8	195.3	169.1	148.7	131.0	120.6	109.2	103.3	49.7
L16 (2V900Ah)	900	1	1776.6	1617.8	1474.2	1337.7	999.2	618.2	489.5	390.6	338.1	297.4	262.1	241.2	218.4	206.6	99.4

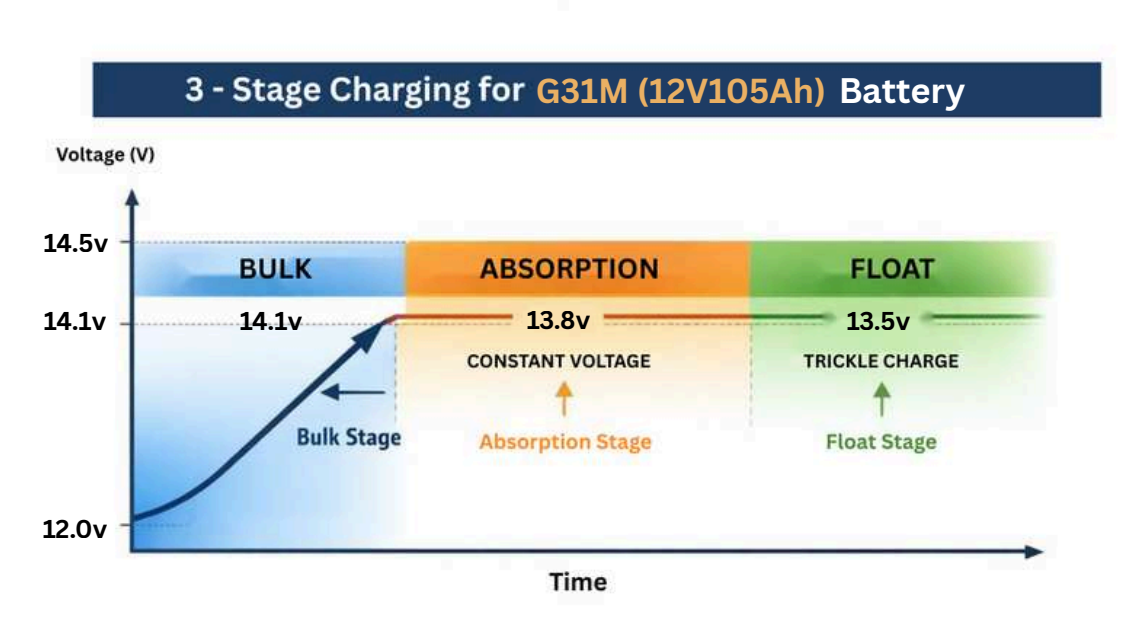
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Charging Instructions for Programmable Chargers. Battery Type : G31M (12V105Ah)											
	Bulk Phase @14.10V/battery in series					Absorption Phase @13.80V/battery in series					Float chg. Phase @13.50V/Battery
Charge rate Current Limit --->	0.1C 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



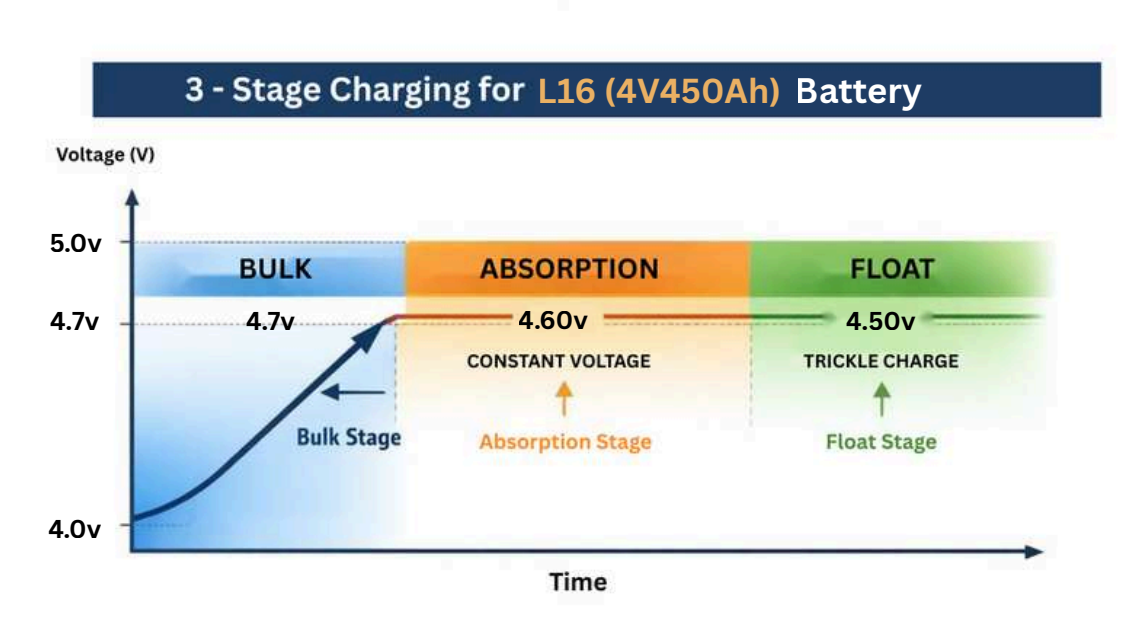
NOTE:
For Initial Charging before commissioing / cycling / Recovery Charging after every 15/ 30 cycles)
CCCY (Constant Current_ Constant Voltage) Chargers with in built Temperature Compensation
Temperature Sensor shall be fixed to Battery Terminals only.
All the chargers to be used shall be with Automatic 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



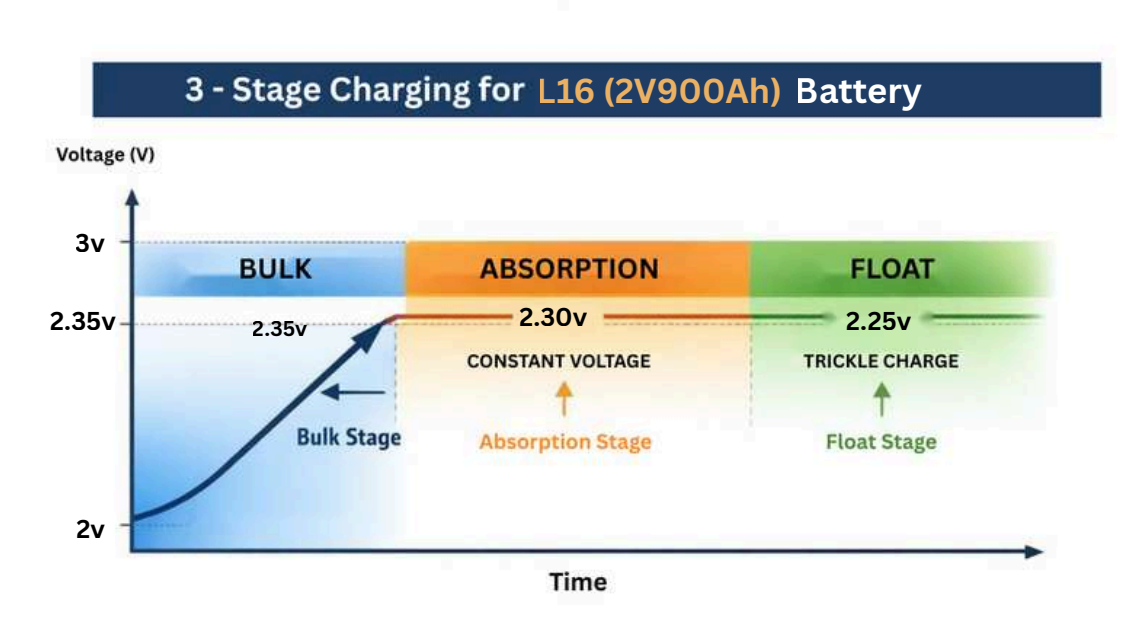
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Charging Instructions for Programmable Chargers. Battery Type : L-16 (2V900Ah)											
	Bulk Phase @2.35V/battery in series					Absorption Phase @2.30V/battery in series					Float chg. Phase @2.25V/Battery
Charge rate Current Limit ----->	0.1C A	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



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