

## PRODUCT APPLICATIONS

A partial list of common applications includes:

- Communications Equipment.
- Emergency Alarms And Security Systems.
- Emergency Lighting Systems.
- Electric Wheelchairs.
- Electronic Equipment.
- Geophysical Equipment.
- Medical Equipment.
- Power Tools.
- Solar Powered Systems.
- Telecommunications Systems.
- Toys.
- Uninterruptible Power Supplies.

### Value Regulated (Sealed) Construction

The PowerUps valve regulated AGM rechargeable lead acid battery allows safe, trouble free operation in any position. There is never any requirement to refill electrolyte in normal operation. The PowerUps battery is leak-proof.

### Ease of Shipment

Sealed construction, the batteries can be shipped by sea, road or air without special handling and packaging precautions.

### Maintenance Free Operation

During the float service life, the PowerUps batteries not to be needed to check the specific gravity of the electrolyte or add water.

### Cycle or Float Service

Batteries are suitable for either cycling or floating service

### Heavy Duty Grids

PowerUps batteries utilize heavy duty calcium-tin alloy grids to extend service life.

### Compact Design

Utilizing the best possible raw materials to build a high power-to-weight ratio battery.

### Low Self Discharge

PowerUps lead calcium grids minimize capacity loss during storage periods. So the batteries can be stored for long periods of time without recharge at room temperature.

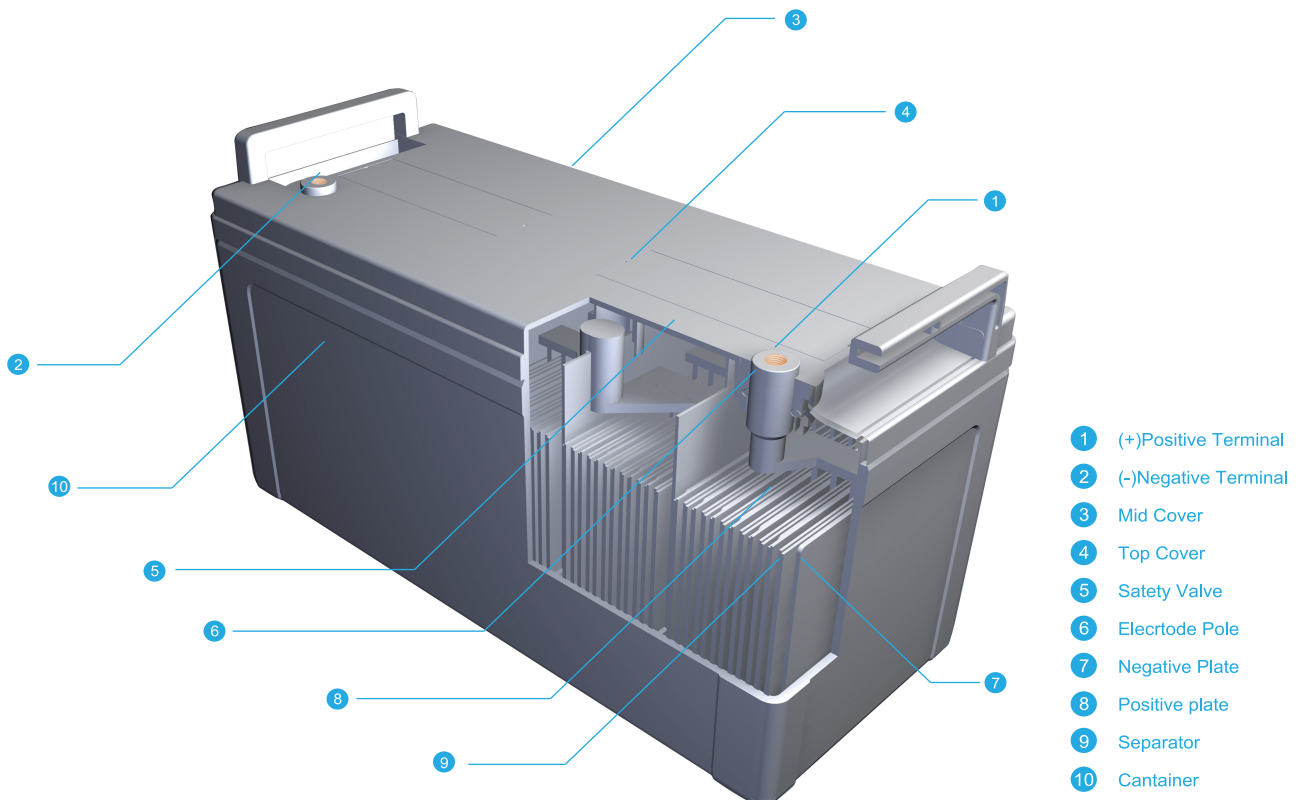
### Wide Operating Temperature

PowerUps batteries may be operated over a broad range of ambient temperatures.

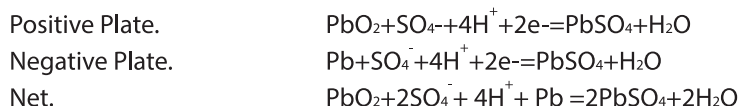
### High Impact Case

PowerUps batteries utilize high impact resistant and non-conductive plastic cast.

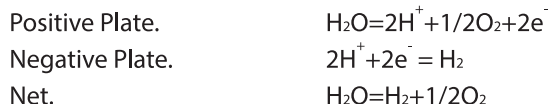
## CONSTRUCTION



# PRINCIPLE OPERATION OF VALVE REGULATED LEAD ACID BATTERY

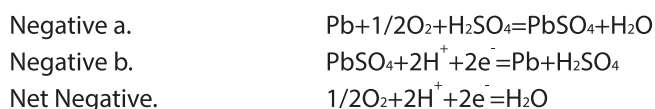


The gassing and water loss reactions are as follows:



It is noted that the gassing reaction only generally occurs to any extent when the battery is almost totally charged.

In the valve regulated battery it is obvious that water loss must be avoided. This is done by limiting the escape of hydrogen and oxygen from the battery. The design therefore accomplishes the recombination of the oxygen formed at the positive plate with the hydrogen formed at the negative plate. The reaction is as follows.



This virtually eliminates the production of free hydrogen at the negative plate to the action of recombination.

However it is necessary to ensure that correct charging voltages are used.

Because the construction provides a means of recombining the internally generated hydrogen and oxygen and the suppression of the evolution of hydrogen gas to limit the consumption of water from the electrolyte. Therefore the battery requires no addition of water during its normal life time.

Valve regulated batteries are sealed with the exception of a valve that opens when excess pressure builds up inside the battery. The valve automatically reseals itself. The recombination of charge gases is accomplished by allowing oxygen produced at the positive plate to pass through the separator material to the negative plates where the recombination reaction occurs. The valve controls the internal of the battery to optimize this efficiency of the recombination reaction and minimise the possible expense of electrolyte.

## NOMINAL CAPACITY

The capacity of an PowerUps battery is the available amount of electrical energy which can be obtained from a fully charged cell. The capacity of a cell is expressed in ampere hours (AH). Which is a current-time product.

The capacity value is dependent upon the discharge current, the temperature during discharge, the final cut-off voltage and the general history.

The nominal capacity of an PowerUps battery is measured at the 10 hour or 20 hour rate according to types at 25°C to a cut-off voltage of 1.75 volts per cell.

## STORAGE

During storage, batteries gradually lose their capacity due to their self-discharge, their self-discharge rate is low and is typically less than 3% per month at 25°C, Although the self-discharge rate is low, specific precautions must be taken against the battery over discharging itself by self-discharge when in storage or not operating.

### Precautions Against Over Self-discharge

- The batteries should be stored in a clean, cool and dry place.
- Storage place should not be affected by sources of radiant heat such as sunshine, heating units, radiators or steam pipes.
- The recommendable storage temperature: 10~20°C.
- The recommendable storage humidity: as low as possible.

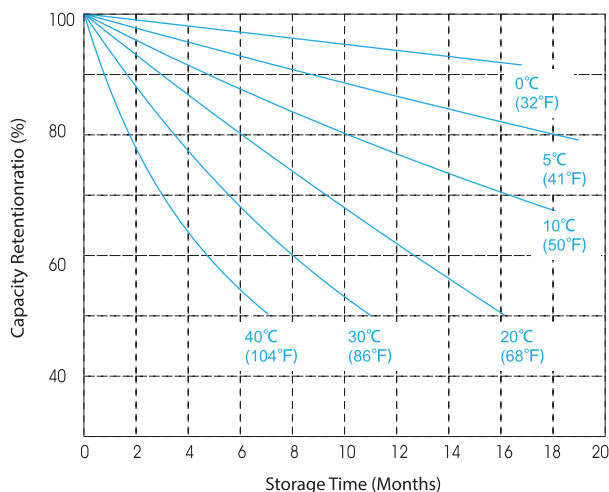
### Charge Advice

Storage Temperature	Charging Interval
20°C or less	9 months
20~30°C	6 months
30~40°C	3 months

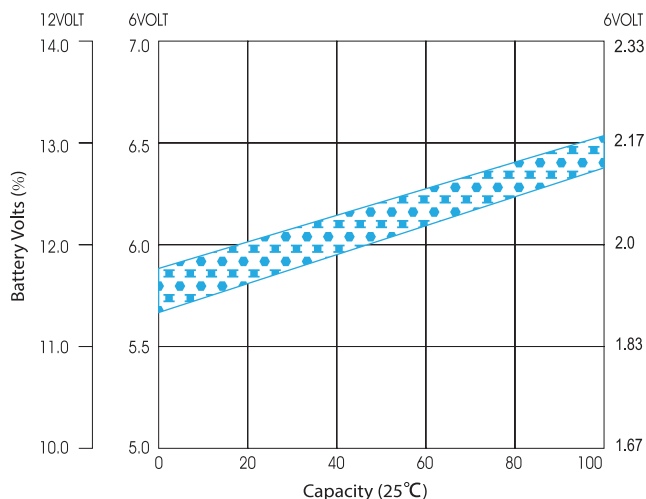
Temperature above 40°C should be avoided. After long term storage, all batteries deliver less than the rated capacity. Full capacity will be obtained through several charge/discharge cycles.

For longest life, PowerUps battery should be fully charged before going into storage.

### Self-Discharge Characteristics



### Open Circuit Voltage and Remaining Capacity



## BATTERY DISCHARGING

The capacity of an PowerUps battery is the available amount of electrical energy which can be obtained from a fully charged cell.

The capacity of a battery is expressed in ampere-hours(AH),which is a current-time product. The capacity value is dependent upon the discharge current, the temperature during discharge, the final cut-off voltage and the general history. The nominal capacity of an PowerUps battery is measured at the 10 hour or 20 hour rate according to types at 25°C to a cut-off voltage of 1.80 volts or 1.75 volts per cell.

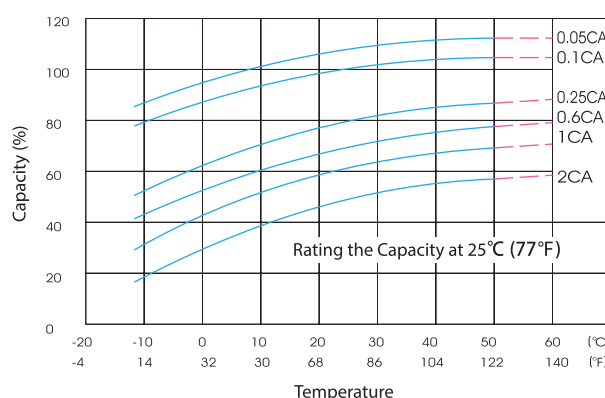
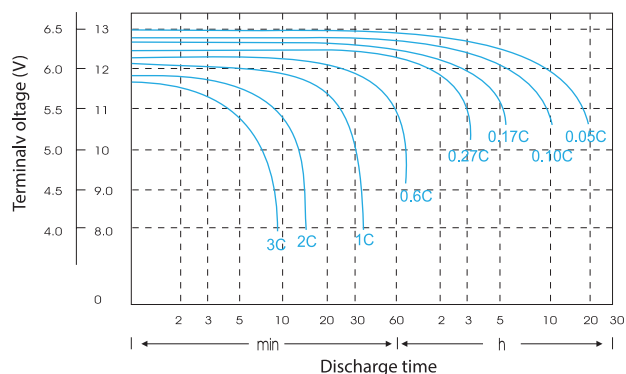
### Battery Selection

The battery discharge curve may be utilised in battery selection. However it is suggested that a review is made of the data sheet for each battery size or the chart showing the actual ampere hour capacity of each battery size at various discharge times.

### Temperature Effect on discharge Capacity

The discharge capacity varies according to the temperature during discharge. At low temperature the discharge capacity decreases and at high temperature it increases. the temperature effects on the discharge capacity at various discharge current rates are shown in the graph.

### Discharge Characteristic Curve



### Final Acceptable Discharge Voltages

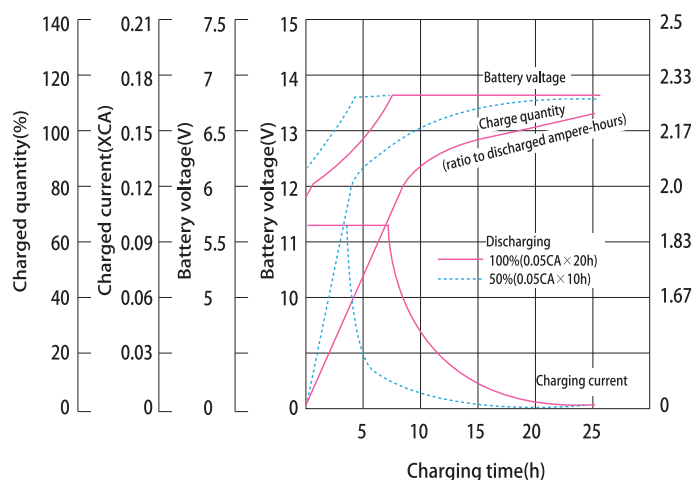
battery cut-off voltage is the volts per cell to which a battery may be discharged safely to maximise battery life, this value is specified according to the actual discharge load and run time.As a rule of thumb high amp loads and short run times will tolerate a lower cut off voltage,whereas a low amps long run time discharge will require a higher cut off voltage.

Discharge current	Cut off Volts/Cell
3CA	1.30
1CA	1.30
0.5-1.0 CA	1.55
0.2-0.5 CA	1.70
0.05-0.2CA CA	1.75

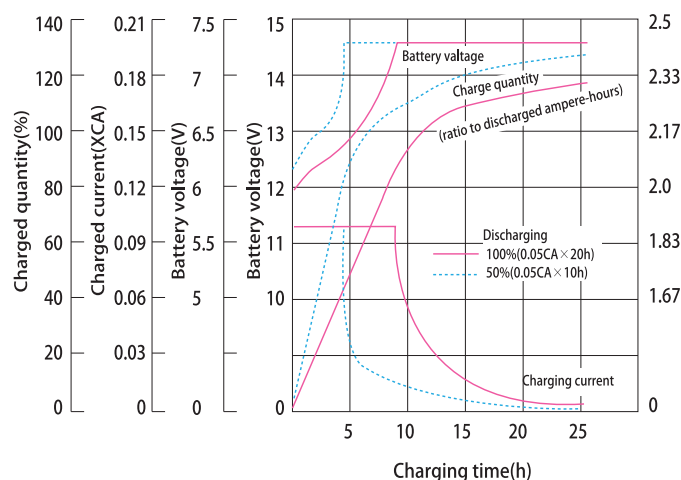
# CHARGING CHARACTERISTICS

Charging characteristics by constant voltage which is the most recommendable for PowerUps battery are shown in the graph.

## Standby Use



## Cycle Use



Application Charging method	Cyclic Operation	Float Operation	Refresh Charge During storage
Constant Voltage	2.40~2.45vpc Initial current 0.3CA or less	2.25~2.30vpc Initial current 0.3CA or less	2.40~2.45vpc Initial current 0.3CA or less
Constat Current	Charging current approx.0.1CA Charging time control is recommended because an overcharge is more likely to occur.	Not applicable	Charging current: approx. 0.1CA

## Charging Method

Ambient Temperature:25°C

Note: it is necessary to ensure that the voltage is correctly set. A voltage set too high will increase the corrosion of the positive plates and shorten battery life. A voltage set too low will lead to sulphation of the plates causing loss of capacity and ultimately shortening the life of the battery.

## Effect of Temperature on Charging Voltage

Within the normal operating parameters of 20°C~30°C voltage compensation for operating temperature may not be necessary.

However, to maximise the life of the battery, temperature compensation for operating temperatures outside this temperature range should be considered.

Charging voltage compensation for battery temperature:

1.Float operation: $V_t = V - 0.003(t - 25)$

2.Cyclic operation: $V_t = V - 0.005(t - 25)$

( $V$ =Charging voltage at 25°C,

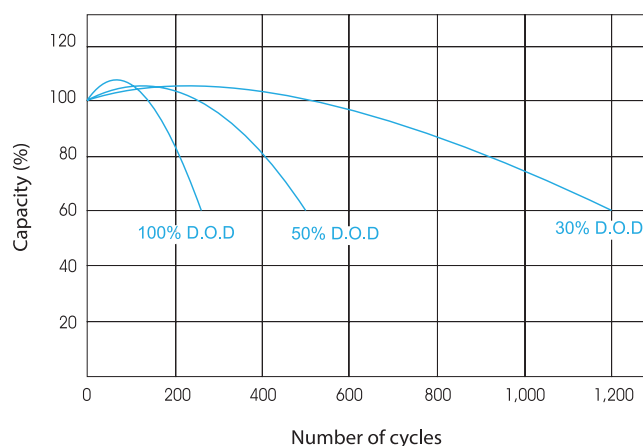
$t$ =Temperature, $V_t$ =Charging voltage at  $t$ °C)

# BATTERY LIFE

## Cyclic Use

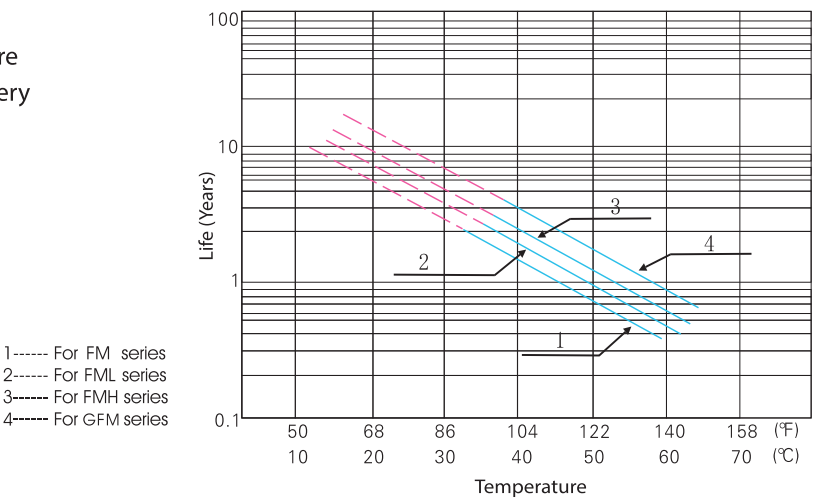
The cycle life is very dependent on the depth of discharge which the battery experiences during each cycle.

The various number of cycles relating to the depth of discharge is shown in the graph.

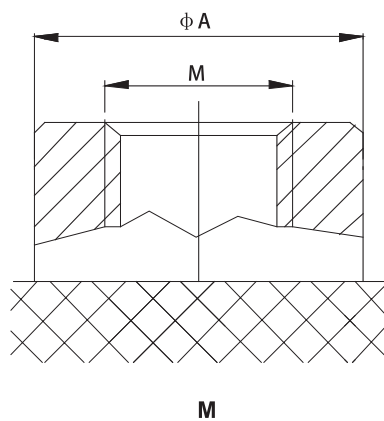
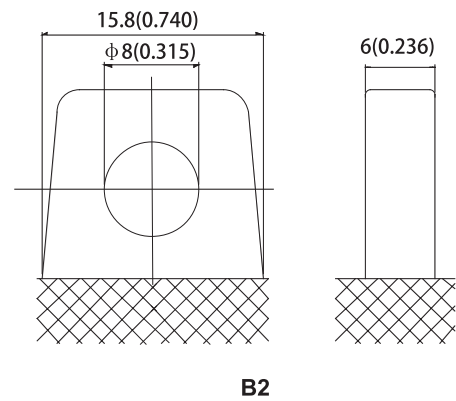
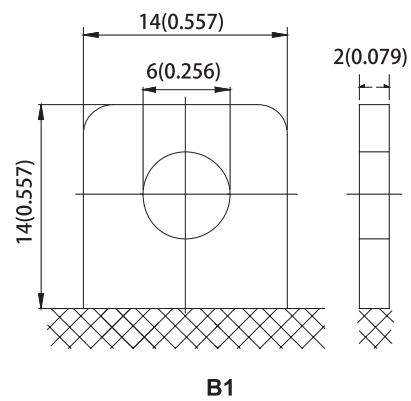
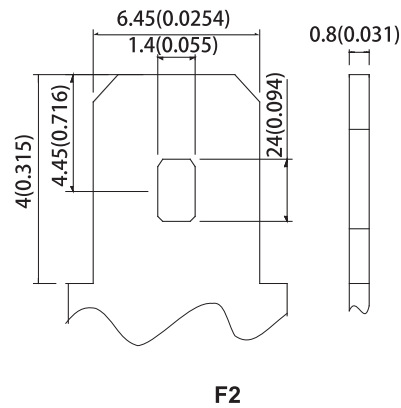
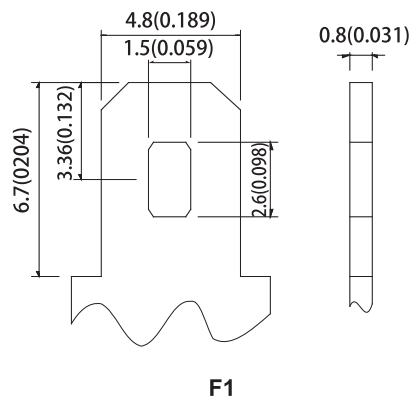


Floating Use

The float use life is very dependent on the temperature at which the battery is float charged. The float life is very long at low temperature (10~20°C) but at higher temperature the float life is shortened.



TERMINAL DATA



Items Type	$\phi A$		M	
M1	14	0.551"	6	0.236"
M2	16	0.630"	6	0.236"
M3	20	0.787"	8	0.315"
M4	12	0.47"	5	0.20"
M5	18	0.71"	8	0.31"
M6	18	0.71"	6	0.236"

# BATTERY INDEX

## FM Series Battery For General Use

Type	Nominal Voltage (V)	Rated Capacity(Ah)				Dimensions(mm)				Weight Appox (kg)	Terminal type
		20HR	10HR	5HR	1HR	Length	Width	Height	Total Height		
		1.75V/C	1.80V/C	1.75V/C	1.75V/C						
3-FM-1.2	6	1.2	1.1	1.00	0.7	97.5	24.0	52.0	58.0	0.31	F1
3-FM-3	6	3.0	2.7	2.6	1.8	135.0	35.0	60.0	66.0	0.71	F1
3-FM-4	6	4.0	3.7	3.4	2.4	70.0	47.0	100.0	106.0	0.73	F1
3-FM-7	6	7.0	6.5	5.6	4.20	151.0	34.0	95.0	101.0	1.19	F1/F2
6-FM-1.9	12	1.9	1.7	1.60	1.1	178.5	35.0	60.5	66.5	0.90	F1
6-FM-3	12	3.0	2.7	2.6	1.8	135.0	67.5	61.0	67.0	1.28	F1
6-FM-4	12	4.0	3.7	3.4	2.4	90.0	70.0	101.0	107.0	1.44	F1/F2
6-FM-4.5	12	4.5	4.2	3.6	2.7	90.0	70.0	101.0	107.0	1.50	F1/F2
6-FM-5A	12	5.0	4.7	4.0	3.0	90.0	70.0	101.0	107.0	1.65	F1/F2
6-FM-5B	12	5.0	4.7	4.0	3.0	151.5	51.5	93.0	99.0	1.87	F1/F2
6-FM-6	12	6.0	5.6	4.8	3.6	151.0	65.0	94.0	100.0	2.00	F1/F2
6-FM-6.5	12	6.5	6.0	5.2	3.9	151.0	65.0	94.0	100.0	2.12	F1/F2
6-FM-7	12	7.0	6.5	5.6	4.2	151.0	65.0	94.0	100.0	2.20	F1/F2
6-FM-7.2	12	7.2	6.7	5.7	4.3	139.5	48.0	118.0	118.0	2.20	F1/F2
6-FM-7.5	12	7.5	6.9	6.0	4.5	151.0	65.0	94.0	100.0	2.40	F1/F2
6-FM-8	12	8.0	7.4	6.4	4.8	151.0	65.0	94.0	100.0	2.51	F1/F2
6-FM-9	12	9.0	8.3	7.2	5.4	151.0	65.0	94.0	100.0	2.51	F1/F2
6-FM-9S	12	9.0	8.3	7.2	5.4	151.0	65.0	94.0	100.0	2.69	F1/F2
6-FM-12	12	12.0	11.2	9.6	7.2	151.0	98.0	94.0	100.0	3.60	F2
6-FM-14	12	14.0	13.0	11.2	8.4	151.0	98.0	94.0	100.0	4.20	F2
6-FM-15	12	15.0	13.9	12.0	9.0	181.0	77.0	167.0	167.0	4.90	B1/M4
6-FM-17	12	17.0	15.8	13.6	10.2	181.0	77.0	167.0	167.0	5.10	B1/M4
6-FM-18	12	18.0	16.7	14.4	10.8	181.0	77.0	167.0	167.0	5.10	B1/M4
6-FM-20	12	20.0	18.6	16.0	12.0	181.5	77.0	167.0	167.0	6.00	M4
6-FM-22	12	22.0	20.5	17.6	13.2	181.5	77.0	167.0	167.0	6.30	M4
6-FM-24A	12	24.0	22.3	19.2	14.4	166.0	126.0	174.0	174/179	8.00	M1
6-FM-24B	12	24.0	22.3	19.2	14.4	177.0	167.0	126.0	126.0	8.40	B1/M4
6-FM-24C	12	24.0	22.3	19.2	14.4	166.0	126.0	174.0	174.0	8.00	M1
6-FM-26	12	26.0	24.1	20.8	15.6	177.0	167.0	126.0	126.0	8.40	B1/M4
6-FM-28	12	28.0	26.0	22.4	16.8	166.0	126.0	174.0	174.0	9.50	M1

FM Series Battery For General Use

Type	Nominal Voltage (V)	Rated Capacity(Ah)				Dimensions(mm)				Weight Appox (kg)	Terminal type
		20HR	10HR	5HR	1HR	Length	Width	Height	Total Height		
		1.75V/C	1.80V/C	1.75V/C	1.75V/C						
3-FM-180	6	180.0	165.0	144.0	108.0	323.0	178.0	226.0	231.0	27.7	M5
3-FM-200	6	200.0	184.0	160.0	120.0	323.0	178.0	226.0	231.0	28.8	M5
6-FM-33	12	33.0	30.5	26.4	19.8	196.0	131.0	155.0	169.0	10.1	M1
6-FM-38A	12	38.0	34.2	30.4	22.8	198.0	166.0	170.0	170.0	12.0	M1
6-FM-38B	12	38.0	34.2	30.4	22.8	198.0	166.0	175.0	175.0	12.0	M1
6-FM-40	12	40.0	36.0	32.0	24.0	198.0	166.0	170.0	170.0	13.7	M1
6-FM-45	12	45.0	40.5	36.0	27.0	198.0	166.0	170.0	170.0	13.8	M1
6-FM-50	12	50.0	46.0	40.0	30.0	229.0	138.0	208.0	213.0	16.2	M1
6-FM-55	12	55.0	50.6	44.0	33.0	229.0	138.0	212.0	217.0	18.9	M1
6-FM-65A	12	65.0	61.0	52.0	39.0	350.0	167.0	177.0	177.0	20.0	M2
6-FM-65B	12	65.0	61.0	52.0	39.0	330.0	173.0	171.0	176.0	20.0	M3
6-FM-70	12	70.0	64.4	56.0	42.0	260.0	169.0	211.0	216.0	21.4	M1
6-FM-75	12	75.0	68.0	60.0	45.0	260.0	169.0	211.0	216.0	22.0	M1
6-FM-80	12	80.0	72.0	64.0	48.0	260.0	169.0	211.0	216.0	22.5	M1
6-FM-90	12	90.0	82.8	72.0	54.0	307.0	169.0	211.0	216.0	26.6	M2
6-FM-100	12	100.0	92.0	80.0	60.0	329.0	172.0	215.0	220.0	27.7	M2
6-FM-100A	12	100.0	92.0	80.0	60.0	407.0	174.0	208.0	236.0	32.4	M3
6-FM-100B	12	100.0	92.0	80.0	60.0	409.0	177.0	225.0	225.0	32.3	M2
6-FM-120A	12	120.0	110.0	96.0	72.0	407.0	174.0	208.0	236.0	34.5	M3
6-FM-120B	12	120.0	110.0	96.0	72.0	409.0	177.0	225.0	225.0	35.0	M2
6-FM-150A	12	150.0	138.0	120.0	90.0	532.0	207.0	216.0	221.0	47.8	M3
6-FM-150B	12	150.0	138.0	120.0	90.0	483.0	170.0	241.0	241.0	45.0	M2
6-FM-160(S)	12	160.0	144.0	130.0	100.0	341.0	173.0	281.0	288.0	46.1	M5
6-FM-200	12	200.0	184.0	160.0	120.0	523.0	240.0	225.0	230.0	60.3	M3
6-FM-250	12	250	230	200	150	520	269	220	225	69.0	M5

FMH Series For Front Terminal

Type	Nominal Voltage (V)	Rated Capacity(Ah)				Dimensions(mm)				Weight Appox (kg)	Terminal type
		20HR	10HR	5HR	1HR	Length	Width	Height	Total Height		
		1.75V/C	1.80V/C	1.75V/C	1.75V/C						
6-FMH-55	12	55.0	50.0	44.0	33.0	277.0	106.0	222.0	222.0	16.0	M1
6-FMH-75	12	75.0	67.5	60.0	45.0	562.0	114.0	188.0	188.0	29.0	M6
6-FMH-100	12	100.0	93.0	80.0	60.0	395.0	110.0	286.0	286.0	32.3	M6
6-FMH-105	12	105.0	95.0	84.0	63.0	507.0	110.0	227.0	227.0	42.7	M6
6-FMH-150	12	150.0	138.0	120.0	90.0	551.0	110.0	288.0	288.0	45.9	M6



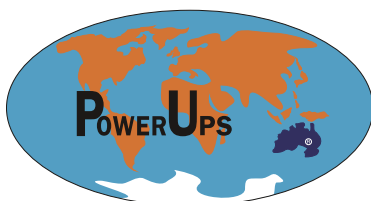
# BATTERY INDEX

## FML Series For High Cycle Use

Type	Nominal Voltage (V)	Rated Capacity(Ah)				Dimensions(mm)				Weight Appox (kg)	Terminal type
		20HR	10HR	5HR	1HR	Length	Width	Height	Total Height		
		1.75V/C	1.80V/C	1.75V/C	1.75V/C						
3-FML-100	6	100	92	80	60	195	170	206	210	16	M2
3-FML-150	6	150	138	120	90	260	180	247	250	25	M3
3-FML-200	6	200	184	160	120	323	178	226	231	31	M5
6-FML-36	12	36	33.1	28.8	21.6	195	131	155	169	11.4	M1
6-FML-38	12	38.0	34.2	30.4	22.8	198.0	166.0	170.0	170.0	13.2	M1
6-FML-56	12	56.0	51.4	44.8	33.6	229.0	138.0	212.0	217.0	19.0	M1
6-FML-65	12	65.0	61.0	52.0	39.0	350.0	167.0	177.0	177.0	21.5	M2
6-FML-85	12	85	78.2	68	51	260	169	211	216	25.0	M1
6-FML-100	12	100.0	92.0	80.0	60.0	407.0	174.0	208.0	236.0	32.6	M3
6-FML-110	12	110	101	88	66	329	172	215	222	33.5	M5
6-FML-120	12	120.0	110.0	96.0	72.0	407.0	174.0	208.0	236.0	36.5	M3
6-FML-150	12	150	138	120	90	532	207	216	221	50	M5
6-FML-200	12	200.0	184.0	160.0	120.0	523.0	240.0	225.0	230.0	62.5	M3

## GFM For LongLife Standby Use

Type	Nominal Voltage (V)	Rated Capacity(Ah)			Dimensions(mm)				Weight Appox (kg)	Terminal type
		10HR	5HR	1HR	Length	Width	Height	Total Height		
		1.80V/C	1.75V/C	1.75V/C						
GFM100	2	100	90	60	171	72	205	210	5.9	M3
GFM200	2	200	180	120	172	111	329	365	13.1	M3
GFM300	2	300	270	180	171	151	330	366	18.0	M3
GFM400	2	400	360	240	210	171	329	363	25.0	M3
GFM500	2	500	450	300	241	172	331	366	29.0	M3
GFM600	2	600	540	360	301	175	331	366	35.0	M3
GFM800	2	800	720	480	410	175	330	365	49.5	M3
GFM1000	2	1000	900	600	475	175	328	365	56.3	M3
GFM1500	2	1500	1350	900	401	351	342	378	92.6	M3
GFM2000	2	2000	1800	1200	491	351	343	383	122.5	M3
GFM3000	2	3000	2700	1800	712	353	341	382	174.0	M3



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