ENGINEERING MANUAL

Range **Monolite SLA**

Valve Regulated Recombination Batteries

FIAMM

INDICE

1. INTRODUCTION

It has always been extremely important to have a backup power source when possible because main power failure can cause severe problems.
After a careful study of new industrial and applicable needs FIAMM is proud to have developed the valve regulated recombination battery (VRLA) with starved electrolyte named “MONOLITE” to function as that alternative power source.
Wherever a stationary battery is required, Monolite can offer considerable advantages such as: ready for installation as delivered; no topping-up necessity during life; virtually sealed; it can be installed where people work and is office compatible.
Monolite utilises the most advanced technology and rigorous quality control which guarantees the utmost reliability and quality of the battery.

2. FEATURES

No topping-up
Monolite batteries require no topping-up throughout their life.

Compatibility
Monolite was specially designed to meet the requirements of modern electronic equipment and is compatible with normally available recharging systems without special modifications.

High energy density
The compact construction and excellent performance at high rates of discharge provide big savings in volume and weight as compared to conventional flooded, vented batteries.

Office compatibility
FIAMM Monolite batteries, which are valve regulated and virtually sealed, under normal operating conditions, do not give off perceptible amounts of gas; thus they can be installed with complete confidence in the same environment where people live and work.

Savings
Monolite offers substantial savings over the installation and maintenance costs of conventional vented batteries.
In fact, no special rooms and virtually no maintenance operations are required during the battery life.

Long life
Rigorous laboratory tests and extensive field experience have enabled FIAMM to manufacture a highly reliable product with a ten year minimum design life.

Installation
Monolite is very easy to position by hand because it’s designed with handles moulded into the case.
Smaller, more compact and lighter than normal batteries, Monolite is supplied filled and charged, i.e. it can be immediately installed directly into the equipment, in cabinets or on easily assembled racks of simple design.

Reliability
Monolite batteries have been tested in the field for a number of years and fully comply with established international standards.
Monolite has been fully tested with respect to charge and discharge characteristics, cyclic life, recombina-

tion efficiency, mechanical strength, vibration life and flame retardancy.

3. MAIN APPLICATIONS

Telecommunications
Monolite batteries were originally designed to meet the requirements of the new Telecom's digital exchanges and are the ideal product for reserve energy storage in telecommunications applications such as PABX systems, switching and transmission stations. Furthermore, FIAMM Monolite batteries are fully approved by TELECOM ITALIA (the Italian Telephone Operating Company) which has carried out all prescribed specification testing.

U.P.S.
Monolite batteries are indeed the best solution to room and installation problems thanks to their high energy and power density, adaptability to the most modern power systems and can be installed into a cabinet adjacent to the UPS or even directly into the UPS system itself.

Emergency lighting
Monolite guarantees the best solution in any situation where light failure may cause severe problems or inconvenience since Monolite can be installed anywhere.

Auxiliary equipment and control systems
Monolite is also suitable for various " remote " applications such as photovoltaic applications, engine starting, and switching substations, where the energy storage system must be completely reliable even without the possibility of any battery maintenance.

4. OPERATING PRINCIPLE OF THE RECOMBINATION TECHNOLOGY

Recombination

During cycling of conventional lead acid cells, water is lost from the cell due to electrolysis and results in the venting of hydrogen, oxygen and droplets of sulphuric acid entrained in the gas stream. This action results in the need for regular battery checks and periodic topping-up operations to maintain the electrolyte at the proper level. The sealed, valve regulated lead acid battery design, eliminates these problems through continuous recombination of the oxygen during overcharge. The oxygen recombination process occurs if the separators are not completely filled with electrolyte. This allows some pores to be free for the oxygen diffusion from the positive plates (where it is generated) directly to the negative plates where it reacts to reform water. During overcharge the following reactions occur:

1)Oxygen is evolved at the positive plate by the reaction;

$H_2O \rightarrow ½\ O_2 + 2H^+ + 2e^-$

and diffuses through the unfilled pores of the separator to the surface of the negative plate.

2)At the negative plate oxygen combines with Pb and sulphuric acid;

$Pb + H_2SO_4 + ½\ O_2 \rightarrow Pb\ SO_4 + H_2O$

3)The charging process electrochemically regenerates the lead in the negative plate, completing the cycle.

$Pb\ SO_4 + 2H^+ + 2e^- \rightarrow Pb + H_2SO_4$

As a result (see also fig. 1), the recombination process with an efficiency higher than 98% completes and reverses the water oxidation.

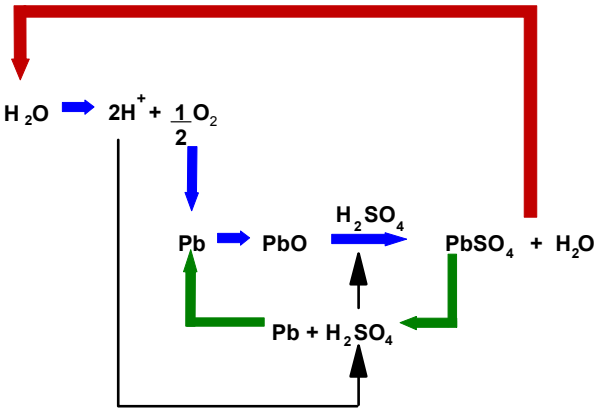


Fig. 1 - Recombination process

At the end of the process, the recombination has replaced the water, the electrolyte and the lead in the negative plates without having modified the state of charge of the plates.

Special separators with high porosity and very small pore diameter are required to facilitate the oxygen recombination cycle; in addition a carefully controlled quantity of electrolyte must be inserted into every single cell in order to maintain sufficient electrolyte to satisfy the discharge reactions while maintaining a sufficient quantity of pores free of electrolyte to maintain the gas diffusion. These unique requirements also result in the fact that all of the electrolyte is retained in the separator and plates and there is no free electrolyte. The gas pressure within the cells during operation is normally above atmospheric pressure and consists of oxygen, hydrogen, nitrogen and carbon dioxide.

It is thus necessary that each cell has an outlet for the release of non recombined gases to avoid excessive internal pressure. Safety valves are used for this purpose. The carbon dioxide is present because of the use of organic compounds used as “expanders” in the negative plate. These organic compounds are slowly oxidised to carbon dioxide.The hydrogen in the cell is the result of this oxidation as well as the very slow corrosion of the positive plate grids. It is also very important that the valves in the cell construction are in proper working conditions to prevent air from entering the cell since the internal pressure can be less than the external atmosphere, particularly during periods of open circuit; air leakage would allow the oxygen in the air to be in contact with the Pb lead of the negative plates and would chemically oxidise the lead. To meet these needs, each cell of the monobloc has a one way relief valve which permits the release of gases when necessary, while assuring that no air enters the cells. For this reason these accumulators cannot be described as fully sealed, but virtually sealed, valve regulated accumulators.

5. CONSTRUCTION FEATURES

FIAMM production of Monolite batteries

Table 1 lists the types of batteries now available with Monolite construction and the principal characteristics.

CELL TYPE	Nominal Voltage (V)	NOMINAL CAPACITY in Ah at 20°C				DIMENSIONS (mm)			WEIGHT (kg)	No. of pos.+neg. Poles	Terminal type (threaded male)
		10 hrs to 1.80 VPC	5 hrs to 1.80 VPC	3 hrs to 1.80 VPC	1 hr to 1.65 VPC	Length L	Width W	Height H			
12 SLA 12	12	12	10.5	9.5	7.6	200	77	138	5.6	1+1	M6
12 SLA 25	12	25	21.7	19.5	16.3	218	129	166	11.3	1+1	M8
12 SLA 30	12	30	26.1	23.4	19.6	201	138	190	14	1+1	M8
12 SLA 37	12	37	32.2	28.9	24.2	288	173	202	18	1+1	M8
12 SLA 50	12	50	43.5	39	32.7	288	173	202	22	1+1	M8
12 SLA 75	12	75	65.5	58.5	49	360	164	228	32.2	1+1	M8
6 SLA 100	6	100	87	78	65	271	173	202	21	1+1	M8
6 SLA 125	6	125	109	97.5	81	268	172	230	26	1+1	M8
4 SLA 150	4	150	130	119	98	271	173	202	20.2	1+1	M8
6 SLA 160	6	160	139	128	109	298	202	226	33.8	1+1	M8
6 SLA 180	6	180	156	140	117	387	173	251	37.4	1+1	M8
4 SLA 200	4	200	174	160	125	250	202	226	26	1+1	M8
2 SLA 200	2	200	174	156	131	271	173	202	15.3	1+1	M8
2 SLA 250	2	250	217	195	163	271	173	202	17.7	1+1	M8
2 SLA 300	2	300	261	234	196	271	173	202	20.5	1+1	M8
2 SLA 330	2	330	300	270	214	208	195	230	22	2+2	M8
2 SLA 405	2	400	347	320	250	250	202	226	26	2+2	M8
2 SLA 500	2	500	435	390	323	387	173	251	36.5	2+2	M8
2 SLA 580	2	580	505	453	374	387	173	251	41	2+2	M8
2 SLA 800	2	800	745	663	541	254	510.5	210	64	2+2	M12
2 SLA 1000	2	1000	930	831	677	254	510.5	210	74	2+2	M12
2 SLA 1500	2	1500	1270	1116	809	275	660	210	110	2+2	M12
2 SLA 2000	2	2000	1690	1488	1078	368	660	218	143	2+2	M12

Plates

Both positive and negative plates are of the flat pasted type. The active material is made of a paste of lead oxide, water, sulphuric acid and other materials needed to obtain the performances and stability required throughout the battery life. The grids are made of a high quality lead alloy with calcium and tin which assures good resistance against corrosion; the grids are sized to ensure a design life of 10 or more years at normal ambient temperature.

Containers

Battery cases and lids are made of a type of ABS which complies with American Standards UL 94, class V-0 and with IEC 707, method FV0. This material is shock resistant, self extinguishing and flame retardant. They are also designed to fully withstand the internal pressure variations during battery operation. This is further ensured by reinforced container walls and lids. Handles have been designed into the lids to facilitate handling.

Separators

The special separators, which ensure reliable operation of the oxygen recombination cycle, are one of the most important and basic components of the Monolite batteries. These separators are made of microfibre glass sheets by a special process which results in a high porosity with very small pore diameters to ensure maximum oxygen diffusion while maintaining high plate utilisation and low internal impedance. Thanks to the chemical nature of the separator material (silica), it is fully inert to the sulphuric acid and the lead dioxide, and remains unchanged during the life of the battery. The excellent electrical and mechanical characteristics remain constant over a very wide temperature range. The very low internal resis-

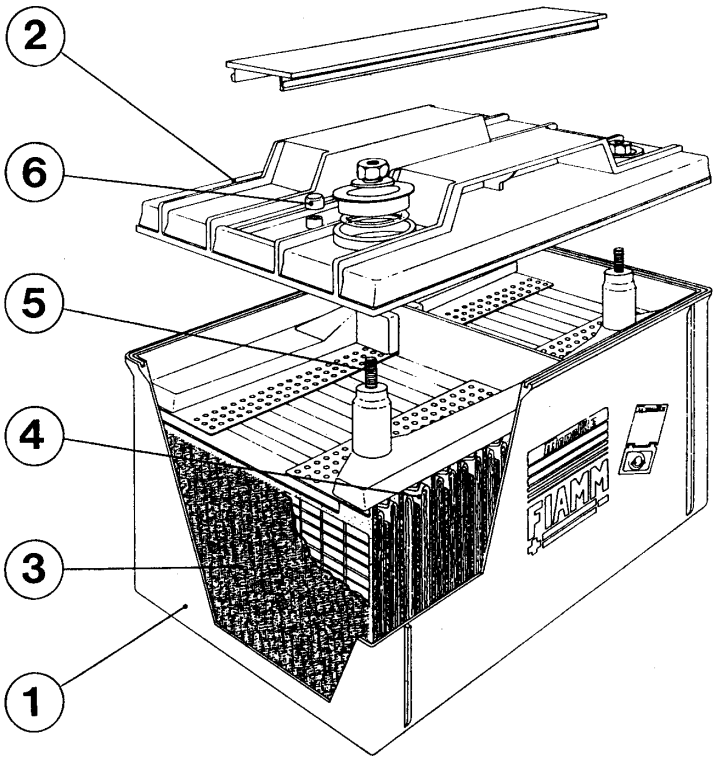
tance of the separator material combined with the special plates designed for the Monolite batteries results in excellent utilisation of the active materials in the plates over a wide range of high and low discharge rates. The plates are completely wrapped by the separator and the electrolyte is completely absorbed in the separator and plates. By this method, the shedding of active material which during the battery life causes shorting with flooded battery construction is avoided.

Electrolyte
The electrolyte is sulphuric acid of 1.3 sp. gr. at 20°C with same purity characteristics as other types of high quality lead acid batteries.

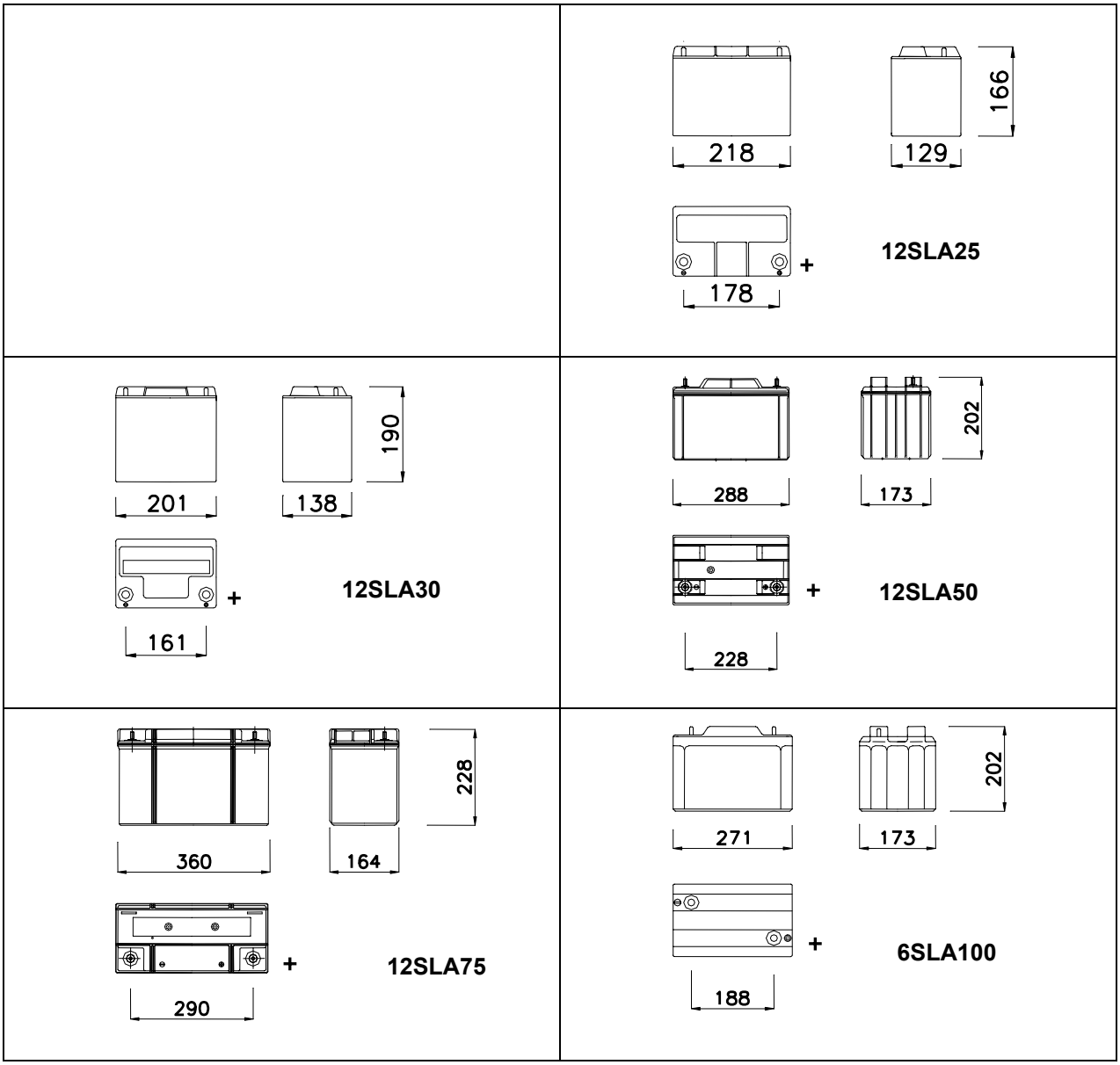
Valves
Each cell has a one way valve to permit the release of gases from the cell whenever the internal pressure exceeds the fixed safety value. The valve is rated at approximately 0.3 atmospheres (30 kPa).

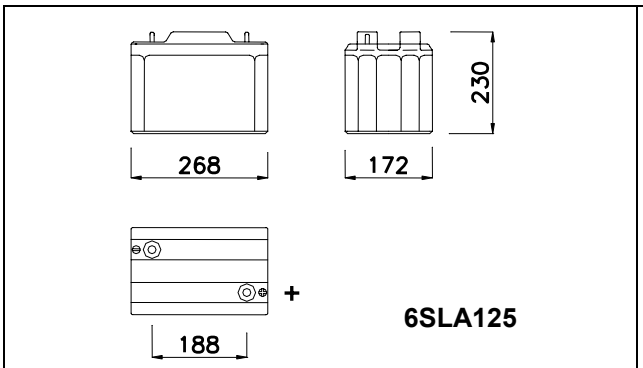
Terminal posts
Suitable threaded pillars with solid or flexible connectors are provided to ensure low ohmic losses. Post to lid seals are designed to prevent leakage (see fig. 2) over a wide range of internal pressures and conditions of thermal cycling. Intercell connections in the Monolite design are electrically welded through the cell walls to minimise the internal impedance while maintaining complete separation of the individual cells.

CUTAWAY DRAWING OF ONE 4 SLA 150 SEALED BLOC

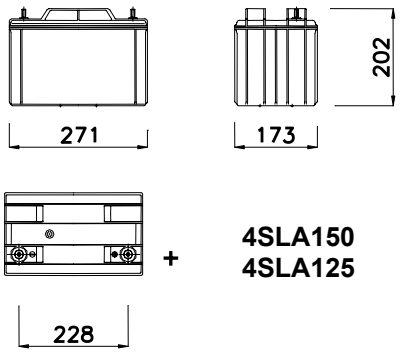


1 Container
2 Lid
3 Plate
4 Separator
5 Terminal
6 Valve

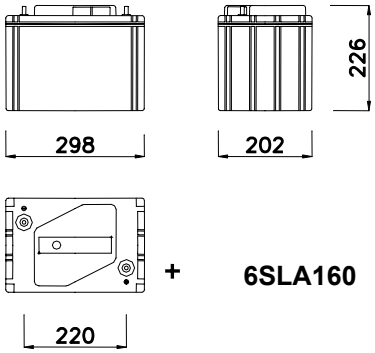




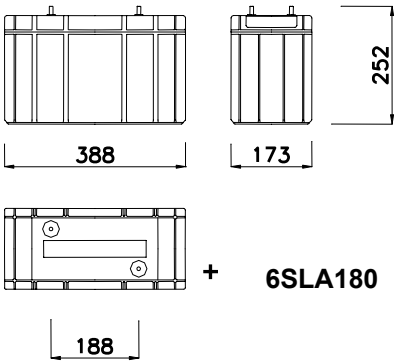
6SLA125



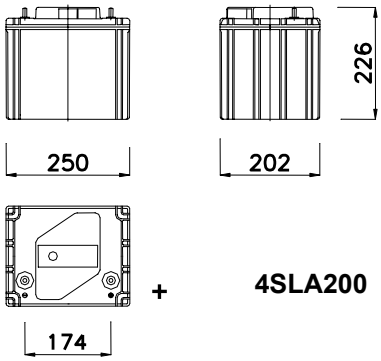
4SLA150
4SLA125



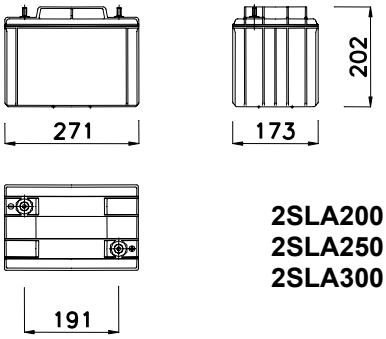
6SLA160



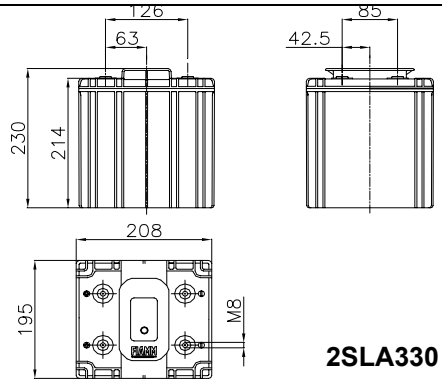
6SLA180



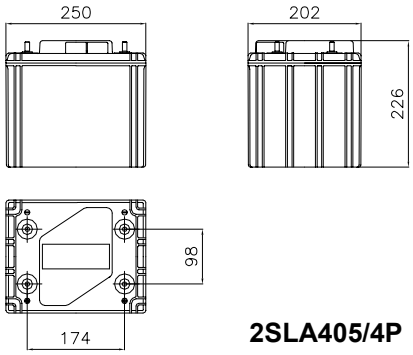
4SLA200



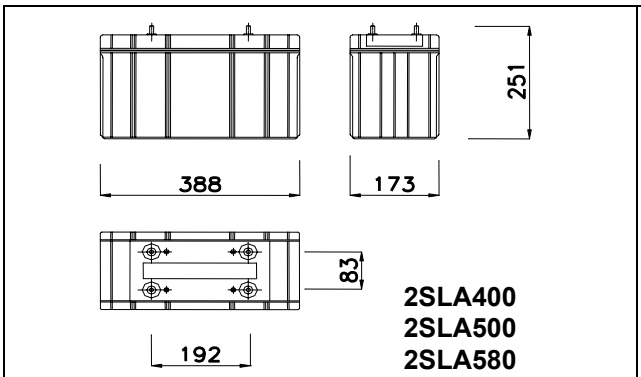
2SLA200
2SLA250
2SLA300



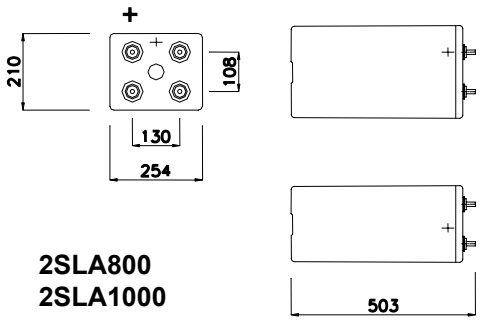
2SLA330



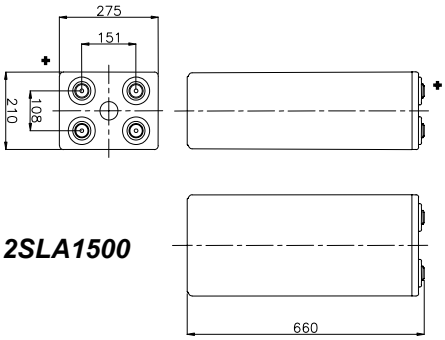
2SLA405/4P



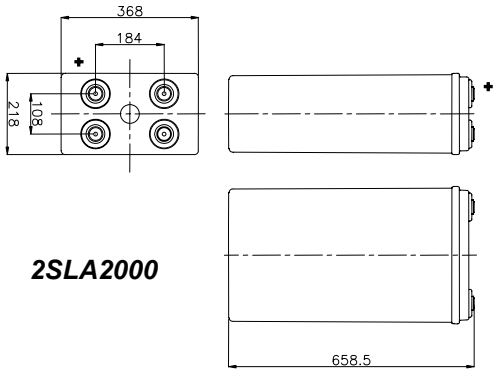
2SLA400
2SLA500
2SLA580



2SLA800
2SLA1000



2SLA1500



2SLA2000

Fig. 26. OPERATING FEATURES

Capacity
The battery capacity is rated in ampere hours (Ah) and is the quantity of electricity which it can supply during discharge. The capacity depends on the quantity of the active materials contained in the battery (thus on dimensions and weight) as well as the discharge rate and temperature. The nominal capacity (C_{10}) of Monolite batteries refers to the 10 hr discharge rate with constant current at 20° C.

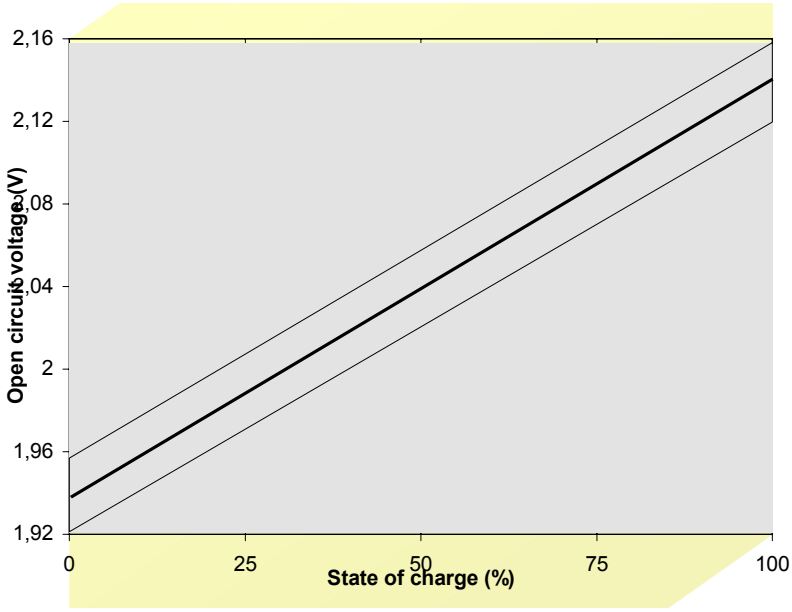


Fig. 3 Open circuit voltage in relation to the state of charge of the cell

Cell Voltage
The voltage of lead acid cells is due to the electrochemical potential differences between the active electrode materials (PbO_2 and Pb) in the presence of electrolyte (sulphuric acid). Its value depends on the electrolyte concentration in contact with these electrodes, but is approximately 2 Volts under most open circuit conditions. More precisely, it is a function of the state of charge of the battery; the open circuit voltage of a Monolite cell at ambient temperature can be represented by the following figure 3:

Short circuit
Monolite batteries are designed to withstand a short circuit current for 1 minute without damaging. For Monolite batteries at 20°C please refer to table 2:

Internal impedance
The internal impedance of a lead acid battery is a direct result of the type of internal construction, plate thickness, number of plates, separator material, electrolyte sp. gr., temperature and state of charge. The internal resistance of Monolite batteries at 100% state of charge at 20° C is given in the following table 2:**The values of the internal resistance have been determined by the method described in IEC 60896 or BS6290**

CELL TYPE	Capacity (Ah)	Internal Resistance (mΩ)	Short circuit current (Amps.)
12 SLA 12	12	24	500
12 SLA 25	25	11	1150
12 SLA 30	30	9	1300
12 SLA 37	37	8	1520
12 SLA 50	50	6	2030
12 SLA 75	75	4	3000
6 SLA 100	100	1.7	3800
6 SLA 125	125	1.4	4300
4 SLA 150	150	0.7	5000
6 SLA 160	160	1.96	3050
6 SLA 180	180	1.75	3400
4 SLA 200	200	1	3800
2 SLA 200	200	0.4	5100
2 SLA 250	250	0.35	5900
2 SLA 300	300	0.32	6300
2 SLA 330	330	0.310	6600
2 SLA 405	400	0.26	7600
2 SLA 500	500	0.21	9700
2 SLA 580	580	0.19	10800
2 SLA 800	800	0.206	9700
2 SLA 1000	1000	0.165	12000
2 SLA 1500	1500	0.125	16000
2 SLA 2000	2000	0.102	20000

Table 2: Short circuit and Internal resistance

Capacity in relation to the discharge rate

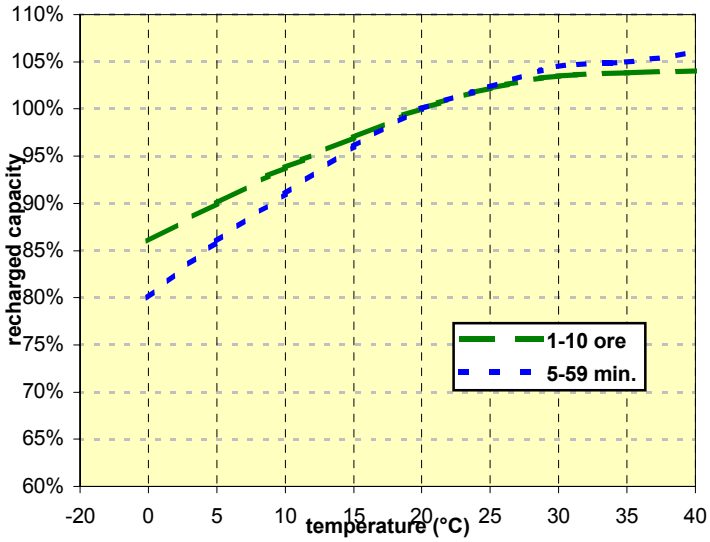
The capacity available from a battery, depends on the rate of discharge. For Monolite batteries at 20°C please refer to table 3.

DISCHARGE RATE (hours)	End Voltage	CAPACITY (% of C_{10} Ah)
10	1.8	100
5	1.8	87
3	1.8	78
1	1.7	65

Table 3: Capacity in relation to the discharge rate

Capacity in relation to the temperature

The capacity available from a battery, at any particular discharge rate, varies with temperature. The following graph (see fig.4) shows the available capacity at different temperatures and discharge rates.



Cycling

Monolite batteries have passed successfully the cycle life test as described in the standards BS 6290.

Gassing

As previously stated, Monolite batteries have a high recombination efficiency (>98%) and for cells operated at 20°C under normal operating conditions venting is virtually negligible. Laboratory test measurements show the following gassing rates:

- 2 ml/Ah/cell/month at a float voltage of 2.27 V/cell
- 10 ml/Ah/cell/month at a recharge voltage of 2.40 V/cell.

The quantity of gas given off in the air (it basically consists of 80-90% hydrogen) is very low and thus it is clear that Monolite recombination batteries can be installed in rooms containing electric equipment with no explosion danger or corrosion problems under normal conditions. The only requirements is that these rooms or cabinets must have a natural ventilation and not be fully sealed.

Operation of batteries in parallel

When the required capacity is greater than the maximum available from our range, it is possible to connect batteries in parallel to obtain the desired capacity. Certain guidelines should be followed, summarised as follows:

- use only batteries of the same type, i.e. same capacity and same number of cells per battery;
- make all electrical connection of parallels as equal as possible and symmetrical between the batteries (e.g., length and type of connector) to minimise possible impedance variations;
- limit the number of string in parallel (usually up to 4 battery strings are connected in parallel).

7. CHARGING

Introduction

After installation, batteries are an energy source ready to be used whenever necessary. It is very important that batteries are:

- Float charged in order to be maintained in a fully charged condition during the standby period.
- Completely recharged after a discharge. Recharged as soon as possible to ensure maximum protection against subsequent power outages. Early recharge also ensures the maximum battery life.

Recharge can be done in many ways, depending on the needs of recharge time or life of the batteries. In general, charging is performed as follows:

- at recharge voltages equal to the float voltage and low currents (long recharge time);
- at recharge voltage not higher than 2.4 V/cell and high currents (faster recharge).

The IU recharge method, also known as modified constant potential, has been used for many years and in a variety of applications, as it combines the need of having the battery quickly recharged while ensuring maximum battery life. With this method, recharge starts at a constant current rate. The voltage increases up to a pre-set value. The pre-set voltage is maintained and the current then decreases to a minimum defined value. Finally, the recharge is completed at a final constant voltage value equal to or less than that defined for float charge with the current decreasing to the value used in float.

Recommended procedure for charging and floating of Monolite batteries

It is important to recharge valve regulated recombination batteries using methods which do not cause excessive gassing. Such methods would cause excessive water consumption and a loss of battery life in addition to the venting of gases. The only charging methods which should be used are those which operate automatically with a preset constant voltage value supplying a charging current whose maximum value cannot be exceeded; i.e., constant voltage charging with current limit and automatic crossover.

Float charge

The voltage recommended for float charge, which will ensure the maximum life of the Monolite batteries is 2.27 V at 20°C. These batteries can operate over a temperature range of –20 to +60°C, as performance and life are greatly reduced outside of this temperature range. The recommended float voltages to maximise the battery life over the range of temperatures between -20 and +60°C are shown in the following figure 5:

The normal float current observed in fully charged Monolite batteries at 2.27 VPC and a temperature of 20°C is approximately 0.3 mA/Ah. Because of the nature of recombination phenomena, the float current observed in the case of the Monolite batteries is normally higher than that of vented batteries and is not an indication of the state of charge of batteries.

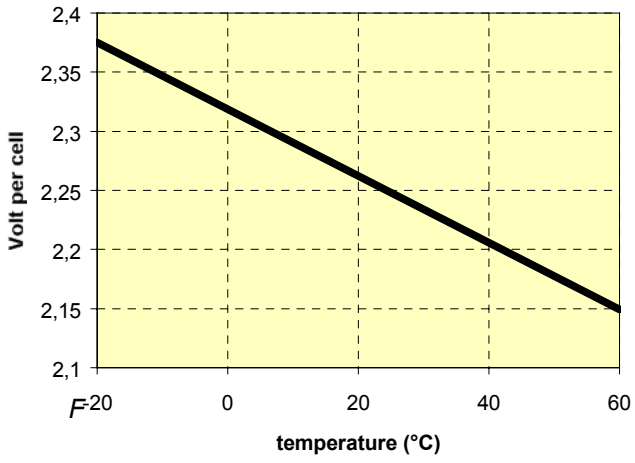


Fig. 5 Float Voltage vs. temperature

Recharge following discharge

The recommended recharge method of Monolite batteries to maximise the battery life is to use a constant voltage equal to the float charge voltage (2.27 VPC at 20°C) with a maximum charge current of 0.25 C_{10} amperes. Using this procedure, the recharge times at different values of maximum current, for a fully discharged cell (100%) are shown on the following figure 6:

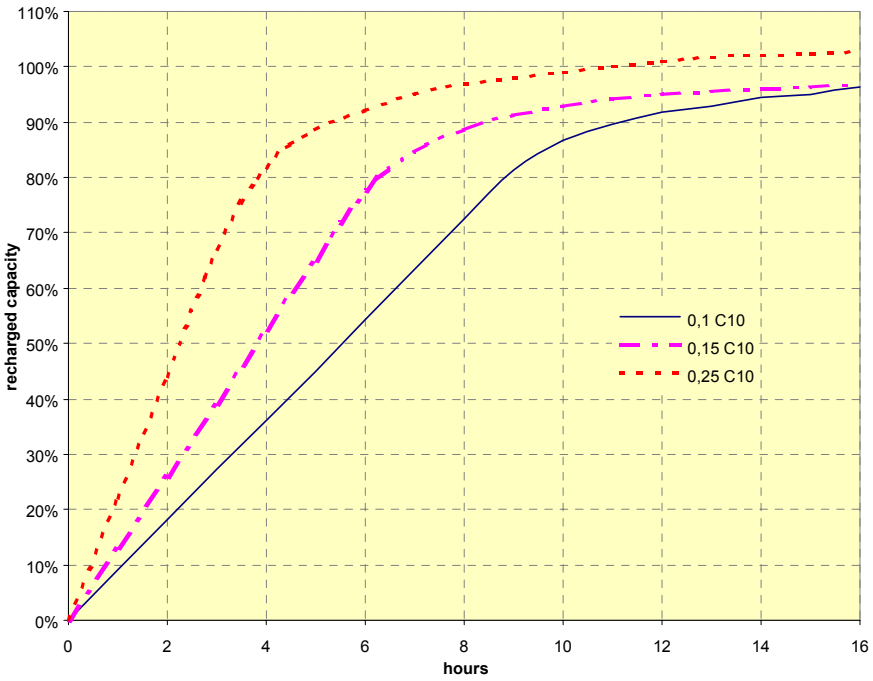


Fig. 6 Recharged capacity

If it is necessary to reduce the recharge time, the IU recharge method previously explained can be used with a maximum voltage of 2.4 V/cell at 20°C with a maximum current of 0.25 C_{10}. However this recharge should be limited to no more than once per month to ensure the maximum service life of the battery.

8. BATTERY SIZING

A method for calculating the number and type of cells required for a particular load is described here below. The tables at the end of this manual show:

- Constant current discharge data (Amp) at different end voltages and discharge rates.
- Constant power discharge data (Watts/cell) at different end voltages and discharge rates.

Values are referred to 20°C for fully charged cells.

Calculation

If the battery is permanently connected to the equipment, at a float voltage of 2.27 V/cell and the equipment can operate between the voltage limits of Max V and Min V, the total number of cells is given by:

$$n1 = \frac{V\,max}{2.27}$$

In case charge voltage is equal to 2.4 V/cell, the total number of cells is given by:

$$n2 = \frac{V\,max}{2.4}$$

The final cell voltage is then given by:

$$Vfn1 = \frac{V\,min}{n1} \quad \text{or} \quad Vfn2 = \frac{V\,min}{n2}$$

If the battery is connected to the equipment only on discharge, then the number of cells is calculated considering the nominal voltage (Vn) and the minimum (Vm) required by the equipment.

Thus:

$$n = \frac{Vn}{2}$$

and the final cell voltage is given by:

$$Vf = \frac{V\,min}{n}$$

Type of cell to use

Once the minimum cell voltage has been calculated and the desired back up time has been defined it is possible to determine the most suitable cell type using the discharge tables listed at the end of this manual.

Examples

1) Constant current discharge

A 30 minute back up time, current of 100 Amps with a minimum system voltage of 101 V. Nominal system voltage is 120 V.

No. of cells $\frac{120}{2}$ = 60 cells

Final voltage/cell $\frac{101}{60}$ = 1.68 V

Consulting the discharge tables for constant current with a final voltage/cell of 1.7 and 30 min back up, look for the required current figure or that one immediately higher.

In this case it gives 110 Amps which corresponds to the type 6 SLA 100.

Then $\frac{60}{3^{(*)}}$ = 20 monoblocs (type 6 SLA 100)

(*) 3 because each monobloc 6 SLA 100 comprises 3 cells.

N.B.:

Take into account that the battery is to be on float and would then require a charger able to provide minimum voltage of 2.27 x 60 cells = 136.2 Volts and a current between 0.1 C_{10} and 0.25 C_{10} depending on

the required recharge time.

2) Constant power discharge

Supposing to have a UPS of 25 KVA which requires a D.C. constant power of 22 kW for 1 hour with a voltage range of 410 V max and 324 V min.

Max No. of cells = $\frac{410}{2.27}$ = 180 cell Final voltage/cell = $\frac{324}{180}$ = 1.8 Vpc

The required D.C. power is 22 kW thus using 180 cells, the power per cell will be:

$\frac{22000}{180}$ = 122 W/cell

Thus the required performance is 122 W/cell to a minimum of 1.8 V/cell at 20°C. Consulting the relevant tables for constant power discharge down to 1.8 V/cell, the power equal or just higher than that required, is 145 Watt/cell for a monobloc type 6 SLA 125.

Thus the battery will consist of:

$\frac{\text{N° of cells required}}{\text{N° of cells per bloc}} = \frac{180}{3}$ = 60 blocs type 6 SLA 125

9. APPLICABLE STANDARDS

Monolite batteries fully comply with:

- British Standards N° 6290 Part 4 "Specification for lead acid batteries"
- IEC 896-2 - Part 2 Stationary lead-acid battery - General requirements and test methods - Part 2: Valve regulated types
- Norme CEI 21.6 fascicolo 1434 Batterie di accumulatori stazionari al piombo
- Eurobat Guide to the specification of valve regulated Lead acid stationary cells and batteries: Group I: 10 + year-high integrity
- Bellcore Technical Reference TR-NWT - 000 766: Generic Requirements for Valve Regulated Lead Acid Cells
- Australian Standard AS 4029.2 - 1992 Stationary batteries - Lead-acid - Part 2: Valve - regulated sealed type.

Furthermore, the FIAMM valve regulated recombination batteries have been approved by the major Telecoms Operating Companies, such as the Italian P.T.T. and the Italian Telephone Operating Company.

10. STORAGE

Batteries are delivered filled, charged and ready for installation.
•No operation such as filling, commissioning or other type is required. They need only to be connected in series and/or in parallel as required by the particular application.
•If they cannot be installed immediately, batteries are to be kept in fresh, clean dry rooms. Furthermore, considering that on open circuit batteries lose part of their capacity due to self discharge (2% per month at 20°C), a float recharge is recommended at least every 6 months.
Float recharge consists in applying a voltage of 2.27 V/cell for approx. 48 hours.

11. INSTALLATION

Monolite valve regulated recombination batteries can be fitted on stands or into cabinets. FIAMM offers a wide selection of stands, from one tier/one row to six tiers/three rows, to suit most applications. Cabinets are available with or without circuit breaker and its relevant compartment.

1)Upon installation of Monolite blocs into a cabinet or on a stand, first place the single units at their correct position according to the electrical layout. Start with the lowest shelf to ensure stability. Carefully preserve the sequence: positive, negative, positive, negative throughout the whole battery. Flexible cable connectors for connecting from one shelf to the one below, will be applied once that all the blocs have been connected (we would suggest to connect such inter-shelf or inter-row cable connectors at the final User's premises only).

2)To ensure a good electrical contact between the bottom of each terminal and the connecting strap and, at the same time, to ensure that the threaded terminals are not damaged by excessive torque, use a torque spanner set on the value of:

- 7-8 Nm for batteries with nominal capacity up to 580 Ah
- 20-25 Nm for batteries with nominal capacity from 800Ah to 2000Ah

3) For safety reasons, we would recommend not to pre-assemble the blocs into the cabinets before shipment to the final Customer. However, if this is normal practice for some system makers, we would strongly recommend to pay special attention to protect the battery system from mechanical stress and vibrations occurring during transport. For this purpose, we would require to properly fasten all the blocs to the relevant cabinet shelves by means of plastic band and/or other adequate methods. Furthermore, the cabinet should be protected, in the outside, with shock-absorbing packaging material, in order to prevent any transmission of vibrations to the internal components such as the battery blocs. Special precautions must be taken to avoid accidental short circuits.

12. BATTERY RACK DETERMINATION

Instruction for the determination of the correct battery rack
To identify the proper type of rack proceed as follows:

1) choose the battery configuration according to the customer's needs and/or the available space (i.e.: 1 tier, 2 tiers, 2 steps, etc.) in the table 5. The rack type is identified by a group of letters and numbers. 2T 2R means a rack with 2 tiers and 2 rows for tier.
2) According to the configuration and to the cell type, determine the "intercell length L" (this is the length of the cell plus the space between the cells).
3) The total length of the rack (RL= rack length in mm) required is obtained as follows:

$$Ls = \frac{N \times L}{nf \times np}$$

where:
L = intercell (interbloc) length
N = total number of cells/monoblocs for the battery
nr = number of rows per tier
nt = number of tiers

3) Once the RL has been determined, the proper rack length must be choose considering as follow:
   - **the racks design specifically for SLA batteries have lengths from 600 to 3000 mm in multiple of 300 mm**
   - **the racks for other battery types have lengths from 600 to 4000 mm in multiple of 100 mm**
   - **it is possible to divide the rack into smaller racks provided that the minimum length is 600 mm , as they can be erected side to side**

Example: 156 blocs type 2 SLA 300
a. We choose the 6 tiers - 3 rows configuration from table 5. Again from table 5
L = 300
H = Overall height = 2120 (with blocs)
W = Rack width = 650

$$Ls = \frac{156 \times 300}{6 \times 3} = 2600\text{mm}$$

Note:

- The racks designed specifically for SLA batteries have lengths from 600 to 3000 mm in multiples of 300 mm (in the above example the suitable length is **2700 mm**).
- It is possible to divide the rack into smaller racks provided that the minimum length is 600 mm, as they can be erected side to side.
- In case of parallel strings it is possible to use a single rack for each battery string.
- Anyhow, if the battery dimension allows a single rack, it is better to choose the rack type to allow the best electrical lay-out.

Example: 3 x 36 2 SLA 200
1 rack per each string of 36 blocs i.e.: 4 tiers 3 rows

$$Ls = \frac{36 \times 300}{4 \times 3} = 900\text{mm}$$

Thus use 3 racks each 900 (length) x 650 (width) x 1420 (height).

b. Single rack (most compact solution) Considering that there are 3 parallel strings it is possible to use a 6 tier 3 row rack connecting the parallel strings every 2 tiers.

$$Ls = \frac{300 \times 36 \times 3}{6 \times 3} = 1800\text{mm}$$

Thus rack dimension are: 1800 (length) x 650 (width) x 2120 (height).

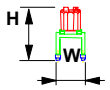
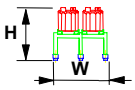
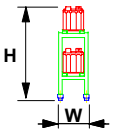
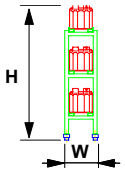
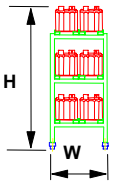
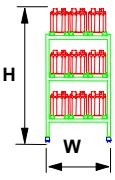
STEEL STANDS (side view)	Rack Type	Dimen-sion (mm)	BLOC TYPE							
			12 SLA 25	**12SLA 30**	**12SLA 75**	**12SLA 37** 12 SLA 50 6 SLA 75 6 SLA 100 4 SLA 125 4 SLA 150 2 SLA 200 2 SLA 250 2 SLA 300	6 SLA 125	**6SLA 180** 2 SLA 400 2 SLA 500 2 SLA 580	6SLA160	4 SLA 200 2 SLA 405
	1 Tier 1 Row	Length	220	210	370	300	300	180	305	260
		Width	250	250	250	250	250	500	350	350
		Height	415	440	480	455	480	500	480	480
	1 Tier 2Rows	Length							305	260
		Width							550	550
		Height							480	480
	2 Tiers 1 Row	Length								
		Width								
		Height								
	3 Tiers 1 Row	Length	220	210	370	300	300	180	305	260
		Width	250	250	250	250	250	500	350	350
		Height	1085	1110	1150	1125	1150	1280	1240	1240
	3 Tiers 2 Rows	Length	220	210	370	300	300		305	260
		Width	450	450	450	450	450		550	550
		Height	1085	1110	1150	1125	1150		1240	1240
	3 Tiers 3 Rows	Length	220	210	370	300	300		305	260
		Width	650	650	650	650	650		750	750
		Height	1085	1110	1150	1125	1150		1240	1240

Table 5

This table includes some basic information for preliminary analysis of battery rack dimension.
Other battery racks are available.
FIAMM remains at your disposal to design and engineer suitable battery lay-outs to meet particular requests.

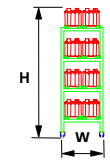
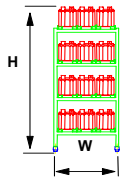
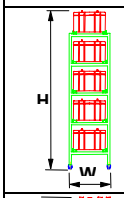
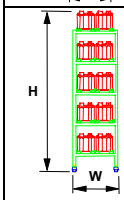
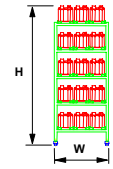
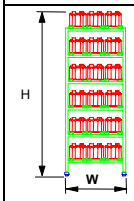
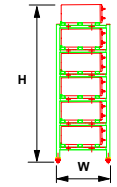
STEEL STANDS	Rack Type	Dimen-sion (mm)	BLOC TYPE										
			12 SLA 25	**12SLA 30**	12SLA 75	**12SLA 37** 12 SLA 50 6 SLA 75 6 SLA 100 4 SLA 125 4 SLA 150 2 SLA 200 2 SLA 250 2 SLA 300	6 SLA 125	**6SLA 180** 2 SLA 400 2 SLA 500 2 SLA 580	**6SLA 160**	4 SLA 200 2 SLA 405	2 SLA 800 2SLA1000	2SLA1500	2SLA2000
	4 Tiers 2 Rows	Length	220	210	370	300	300		305	260			
		Width	450	450	450	450	450		550	550			
		Height	1385	1410	1450	1425	1450		1700	1700			
	4 Tiers 3 Rows	Length	220	210	370	300	300		305	260			
		Width	650	650	650	650	650		750	750			
		Height	1385	1410	1450	1425	1450		1700	1700			
	5 Tiers 1 Rows	Length						180	305	260			
		Width						500	350	350			
		Height						2140	2000	2000			
	5 Tiers 2 Rows	Length	220	210	370	300			305	26055 0			
		Width	450	450	450	450			550	2000			
		Height	1735	1760	1800	1775			2000	260			
	5 Tiers 3 Rows	Length	220	210	370	300	300		305	750			
		Width	650	650	650	650	650		750	2000			
		Height	1735	1760	1800	1775	1800		2000				
	6 Tiers 3 Rows	Length	220	210	370	300	300						
		Width	650	650	650	650	650						
		Height	2085	2110	2150	2125	2150						
	6 Tiers 1 Row	Length									260	1200	1540
		Width									620	765	765
		Height									1812	1875	1875

Table 5

This table includes some basic information for preliminary analysis of battery rack dimension.Other battery racks are available. FIAMM remains at your disposal to design and engineer suitable battery lay-outs to meet particular requests.

13. CONSTANT CURRENT DISCHARGE DATA

Amperes to 1,60 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	135	91,4	63,7	48,1	39,4	29,2	21,4	16,8	11,9	9,34	6,67	5,30	4,43	3,42	3,08	2,55	1,38
12 SLA 30	161	109	75,8	57,3	46,9	34,8	25,6	20,2	14,3	11,2	8,01	6,36	5,31	4,10	3,69	3,07	1,65
12 SLA 50	268	181	126	95,5	78,2	58,0	42,6	33,7	23,8	18,7	13,3	10,6	8,85	6,84	6,15	5,11	2,75
12 SLA 75	402	272	189	143	117	87,0	63,9	50,5	35,7	28,0	20,0	15,9	13,3	10,3	9,23	7,67	4,13
6 SLA 100	536	363	253	191	156	116	85,3	67,3	47,7	37,4	26,7	21,2	17,7	13,7	12,3	10,2	5,50
6 SLA 125	390	326	270	215	180	138	103	83,3	59,6	46,7	33,4	26,5	22,1	17,1	15,4	12,8	6,88
4 SLA 150	760	524	369	287	235	174	128	101	71,5	56,0	40,0	31,8	26,6	20,5	18,5	15,3	8,25
6 SLA 160	573	491	376	280	232	178	136	109	81,0	64,1	45,7	36,0	30,0	23,0	20,6	17,2	9,08
6 SLA 180	562	469	389	309	260	198	149	120	85,8	67,2	48,0	38,1	31,9	24,6	22,2	18,4	9,90
4 SLA 200	605	529	446	372	310	230	170	138	101	80,2	57,1	45,0	37,5	28,7	25,7	21,4	11,3
2 SLA 250	1004	750	567	451	375	286	213	168	119	93,3	67,6	54,4	45,6	34,6	31,0	25,6	14,0
2 SLA 300	1044	825	652	526	440	336	254	201	143	112	81,2	65,3	54,8	41,6	37,2	30,7	16,8
2 SLA 330	1302	1057	805	629	515	378	275	221	162	129	93,3	73,9	61,3	46,0	41,0	33,4	17,3
2 SLA 405/4	1621	1198	886	712	597	449	333	268	197	157	113	89,6	74,3	55,8	49,7	40,4	21,0
2 SLA 500	1652	1354	1076	863	719	543	406	325	237	187	133	106	88,5	68,4	61,5	51,1	27,5
2 SLA 580	1781	1493	1220	996	837	636	478	382	275	217	155	123	103	79,3	71,4	59,3	31,9
2 SLA 800	1698	1607	1432	1303	1127	882	664	534	398	321	235	187	156	117	105	86,2	46,5
2 SLA 1000	2123	2009	1790	1629	1409	1102	830	668	497	402	294	234	195	147	131	108	58,1
2 SLA 1500	2318	2065	1836	1635	1463	1231	977	818	633	524	394	315	266	208	187	155	86,7
2 SLA 2000	3091	2753	2449	2181	1950	1641	1303	1091	843	698	525	420	354	277	249	206	116

Amperes to 1,65 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	118	87,4	61,0	46,7	38,4	28,6	21,0	16,5	11,7	9,28	6,65	5,28	4,42	3,41	3,07	2,55	1,37
12 SLA 30	140	104	72,6	55,7	45,7	34,2	25,1	19,8	14,1	11,1	7,98	6,34	5,30	4,09	3,69	3,06	1,65
12 SLA 50	234	173	121	92,8	76,2	57,0	41,9	33,0	23,5	18,5	13,3	10,6	8,83	6,82	6,14	5,10	2,74
12 SLA 75	351	260	182	139	114	85,5	62,8	49,5	35,2	27,8	20,0	15,9	13,2	10,2	9,21	7,65	4,11
6 SLA 100	468	347	242	186	152	114	83,7	65,9	46,9	37,1	26,6	21,1	17,7	13,6	12,3	10,2	5,48
6 SLA 125	350	307	255	206	176	134	101	81,7	58,7	46,3	33,3	26,4	22,1	17,1	15,4	12,8	6,86
4 SLA 150	638	498	357	278	228	171	126	99,4	70,9	56,2	40,5	32,1	26,9	20,8	18,7	15,5	8,34
6 SLA 160	560	481	368	271	226	174	133	107	79,9	63,0	45,2	35,6	29,6	22,6	20,3	17,0	8,99
6 SLA 180	505	442	368	297	253	193	145	118	84,5	66,7	47,9	38,0	31,8	24,6	22,1	18,4	9,87
4 SLA 200	574	508	430	361	304	225	166	135	99,8	78,8	56,5	44,5	37,0	28,3	25,4	21,2	11,2
2 SLA 250	872	692	533	429	364	279	209	165	117	92,4	67,0	54,0	45,4	34,5	30,9	25,5	14,0
2 SLA 300	905	754	610	498	423	328	249	198	141	111	80,4	64,8	54,4	41,4	37,0	30,6	16,8
2 SLA 330	1265	1029	784	587	501	369	271	217	161	128	92,6	73,3	60,9	45,6	40,6	33,3	17,3
2 SLA 405/4	1490	1140	858	712	584	442	329	263	195	155	112	88,9	73,8	55,3	49,3	40,3	20,9
2 SLA 500	1513	1271	1022	831	695	529	398	321	235	185	133	106	88,3	68,2	61,4	51,0	27,4
2 SLA 580	1681	1425	1166	962	811	618	468	378	272	215	154	123	102	79,1	71,2	59,2	31,8
2 SLA 800	1496	1423	1334	1215	1054	852	651	528	393	318	233	186	155	117	104	85,6	46,3
2 SLA 1000	1870	1779	1667	1519	1318	1065	814	660	492	397	291	233	194	146	130	107	57,9
2 SLA 1500	2117	1934	1748	1573	1406	1193	961	809	625	518	391	314	264	206	185	154	86,4
2 SLA 2000	2822	2579	2330	2097	1874	1590	1282	1078	834	690	521	418	352	275	247	205	115

Amperes to 1,67 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	113	84,8	59,2	45,6	37,6	28,1	20,7	16,3	11,6	9,23	6,63	5,27	4,41	3,41	3,07	2,55	1,37
12 SLA 30	135	101	70,5	54,3	44,8	33,6	24,8	19,6	14,0	11,1	7,96	6,33	5,29	4,09	3,68	3,06	1,64
12 SLA 50	225	168	118	90,5	74,6	55,9	41,3	32,7	23,3	18,4	13,3	10,5	8,82	6,81	6,13	5,09	2,74
12 SLA 75	337	252	176	136	112	83,9	61,9	49,0	34,9	27,6	19,9	15,8	13,2	10,2	9,20	7,64	4,10
6 SLA 100	449	336	235	181	149	112	82,6	65,4	46,5	36,9	26,5	21,1	17,6	13,6	12,3	10,2	5,47
6 SLA 125	338	297	244	199	171	131	99,6	80,7	58,2	46,1	33,2	26,4	22,0	17,0	15,3	12,7	6,84
4 SLA 150	611	480	347	271	224	168	124	98,6	70,3	55,8	40,3	32,1	26,8	20,7	18,6	15,5	8,32
6 SLA 160	549	472	358	265	222	171	131	106	79,2	62,5	44,9	35,3	29,3	22,4	20,1	16,8	8,94
6 SLA 180	487	427	352	287	247	188	143	116	83,8	66,3	47,8	38,0	31,7	24,5	22,1	18,3	9,85
4 SLA 200	556	495	418	352	296	221	164	134	99,0	78,2	56,1	44,1	36,6	28,0	25,1	21,0	11,2
2 SLA 250	826	659	513	417	357	275	206	163	116	91,7	66,7	53,8	45,1	34,4	30,8	25,4	13,9
2 SLA 300	859	716	585	483	415	323	246	196	140	111	80,0	64,5	54,2	41,3	36,9	30,5	16,7
2 SLA 330	1207	988	754	583	491	364	268	215	159	127	92,0	72,9	60,6	45,4	40,5	33,2	17,3
2 SLA 405/4	1438	1105	841	691	576	437	325	261	193	154	112	88,4	73,5	55,0	49,1	40,3	20,9
2 SLA 500	1462	1227	980	808	681	520	392	317	233	184	133	105	88,2	68,1	61,3	50,9	27,4
2 SLA 580	1601	1364	1119	928	787	605	462	373	270	214	154	122	102	79,0	71,1	59,1	31,7
2 SLA 800	1387	1329	1255	1164	1018	830	639	520	390	315	231	185	155	116	103	85,3	46,1
2 SLA 1000	1734	1662	1569	1455	1273	1038	798	650	488	393	289	232	193	145	129	107	57,6
2 SLA 1500	1976	1830	1661	1508	1367	1167	947	800	620	514	388	312	263	205	185	153	85,9
2 SLA 2000	2634	2440	2215	2010	1822	1556	1262	1067	827	686	517	416	351	274	246	204	115

Amperes to 1,70 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	109	82,6	57,8	44,6	36,9	27,7	20,5	16,2	11,6	9,19	6,62	5,26	4,40	3,40	3,06	2,54	1,36
12 SLA 30	130	98,2	68,7	53,2	44,0	33,0	24,5	19,5	13,9	11,0	7,94	6,32	5,28	4,08	3,67	3,05	1,64
12 SLA 50	217	164	115	88,6	73,3	55,0	40,8	32,5	23,1	18,3	13,2	10,5	8,81	6,80	6,12	5,09	2,73
12 SLA 75	325	245	172	133	110	82,5	61,2	48,7	34,7	27,5	19,9	15,8	13,2	10,2	9,18	7,63	4,10
6 SLA 100	433	327	229	177	147	110	81,6	64,9	46,2	36,7	26,5	21,1	17,6	13,6	12,2	10,2	5,46
6 SLA 125	327	288	235	194	168	128	98,3	80,0	57,8	45,8	33,1	26,3	22,0	17,0	15,3	12,7	6,83
4 SLA 150	589	464	337	266	220	165	123	97,9	69,8	55,6	40,3	32,0	26,8	20,7	18,6	15,5	8,30
6 SLA 160	540	464	350	260	219	169	129	105	78,6	62,2	44,6	35,0	29,1	22,2	19,9	16,7	8,90
6 SLA 180	471	414	338	279	241	184	142	115	83,2	66,0	47,7	37,9	31,7	24,5	22,0	18,3	9,83
4 SLA 200	542	483	408	344	289	218	162	132	98,3	77,7	55,7	43,8	36,4	27,8	24,9	20,9	11,1
2 SLA 250	787	631	497	407	352	272	203	162	116	91,2	66,4	53,6	45,0	34,3	30,7	25,4	13,9
2 SLA 300	819	684	565	471	408	318	243	194	139	110	79,7	64,3	54,0	41,2	36,9	30,5	16,7
2 SLA 330	1158	953	729	580	482	360	266	214	158	126	91,5	72,6	60,4	45,2	40,3	33,2	17,2
2 SLA 405/4	1394	1075	825	673	570	433	322	259	191	153	111	88,0	73,2	54,8	48,9	40,2	20,9
2 SLA 500	1420	1189	944	788	669	513	388	315	231	183	132	105	88,1	68,0	61,2	50,9	27,3
2 SLA 580	1533	1313	1078	900	767	595	457	369	268	213	154	122	102	78,9	71,0	59,0	31,7
2 SLA 800	1294	1249	1189	1120	987	812	628	513	388	312	229	184	154	116	103	85,0	45,9
2 SLA 1000	1618	1561	1486	1400	1234	1015	785	642	484	390	287	231	193	145	129	106	57,4
2 SLA 1500	1856	1742	1587	1452	1334	1145	934	793	616	512	386	311	263	204	184	153	85,5
2 SLA 2000	2474	2322	2117	1936	1778	1526	1246	1058	822	682	514	414	351	273	246	203	114

Amperes to 1,75 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	98,1	75,7	54,3	42,7	35,4	26,7	20,0	15,8	11,4	9,05	6,57	5,23	4,38	3,38	3,05	2,53	1,35
12 SLA 30	117	90,0	64,7	50,8	42,2	31,8	23,9	19,0	13,6	10,9	7,88	6,28	5,26	4,06	3,66	3,03	1,63
12 SLA 50	196	150	108	84,7	70,3	53,1	39,8	31,7	22,7	18,0	13,1	10,5	8,76	6,77	6,09	5,05	2,71
12 SLA 75	294	225	162	127	106	79,6	59,7	47,5	34,1	27,0	19,7	15,7	13,1	10,1	9,14	7,58	4,07
6 SLA 100	392	300	216	169	141	106	79,6	63,3	45,5	36,0	26,3	20,9	17,5	13,5	12,2	10,1	5,42
6 SLA 125	292	252	210	180	157	123	95,0	78,0	56,9	45,2	32,8	26,2	21,9	16,9	15,2	12,6	6,78
4 SLA 150	530	426	317	254	211	159	120	95,4	68,7	54,8	39,9	31,8	26,6	20,6	18,5	15,3	8,24
6 SLA 160	509	432	320	247	209	164	126	103	76,6	61,0	43,7	34,4	28,6	21,8	19,6	16,4	8,78
6 SLA 180	421	362	302	260	226	176	137	112	81,9	65,1	47,3	37,7	31,5	24,4	21,9	18,2	9,76
4 SLA 200	498	452	382	321	270	208	157	127	96,2	76,3	54,7	43,0	35,7	27,2	24,5	20,5	11,0
2 SLA 250	684	569	460	381	332	258	195	156	114	90,2	65,8	53,1	44,7	34,1	30,5	25,2	13,8
2 SLA 300	737	623	513	441	387	306	233	187	136	109	79,0	63,8	53,6	40,9	36,6	30,3	16,6
2 SLA 330	1068	868	679	550	458	348	260	209	154	123	89,7	71,0	59,1	44,4	39,7	33,0	17,1
2 SLA 405/4	1260	998	782	645	548	420	315	253	186	149	109	86,0	71,6	53,8	48,1	40,0	20,8
2 SLA 500	1293	1058	856	731	631	491	376	308	227	181	131	105	87,6	67,7	60,9	50,5	27,1
2 SLA 580	1355	1173	970	837	723	568	443	362	264	210	152	121	102	78,5	70,7	58,6	31,5
2 SLA 800	1108	1089	1058	1006	910	770	603	499	377	307	227	182	152	114	102	84,2	45,5
2 SLA 1000	1385	1362	1323	1258	1137	963	754	623	472	383	283	228	191	143	128	105	56,9
2 SLA 1500	1589	1519	1430	1334	1236	1080	901	767	600	500	378	306	260	202	183	151	84,8
2 SLA 2000	2118	2025	1907	1778	1649	1440	1202	1023	800	666	504	408	346	270	244	202	113

Amperes to 1,80 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	87,8	68,4	50,4	40,2	33,4	25,6	19,4	15,4	11,2	8,87	6,50	5,19	4,35	3,36	3,03	2,50	1,34
12 SLA 30	104	81,3	60,0	47,9	39,9	30,8	23,2	18,5	13,4	10,6	7,80	6,23	5,22	4,03	3,63	3,00	1,61
12 SLA 50	174	136	100,0	79,8	66,4	51,3	38,7	30,9	22,3	17,5	13,0	10,4	8,70	6,72	6,05	5,00	2,69
12 SLA 75	261	203	150	120	99,6	77,0	58,0	46,3	33,4	26,3	19,5	15,6	13,1	10,1	9,08	7,50	4,03
6 SLA 100	348	271	200	160	133	103	77,4	61,7	44,6	35,1	26,0	20,8	17,4	13,4	12,1	10,0	5,37
6 SLA 125	260	219	186	163	142	115	90,7	75,6	55,8	44,3	32,5	25,9	21,8	16,8	15,1	12,5	6,72
4 SLA 150	475	386	294	240	200	154	116	93,1	67,4	53,7	39,5	31,5	26,4	20,4	18,4	15,0	8,15
6 SLA 160	455	380	288	233	199	158	122	99,0	73,9	59,5	42,6	33,5	27,8	21,2	19,0	16,0	8,62
6 SLA 180	374	316	268	234	204	165	131	109	80,3	63,8	46,8	37,4	31,3	24,2	21,8	18,0	9,67
4 SLA 200	441	408	358	300	253	198	152	124	93,0	74,4	53,3	41,9	34,8	26,5	23,8	20,0	10,8
2 SLA 250	550	472	396	340	300	241	181	148	110	88,2	65,0	52,5	44,2	33,8	30,2	25,0	13,7
2 SLA 300	643	556	463	401	356	284	218	177	132	106	78,0	63,0	53,0	40,5	36,3	30,0	16,4
2 SLA 330	851	713	587	487	417	327	248	203	150	120	85,5	68,4	56,8	43,0	38,3	31,3	16,4
2 SLA 405/4	992	824	687	581	506	396	301	245	182	145	104	82,9	68,9	52,1	46,4	38,0	19,8
2 SLA 500	1088	903	769	664	582	462	361	298	221	177	130	104	87,0	67,2	60,5	50,0	26,9
2 SLA 580	1194	1007	864	753	662	540	421	347	257	206	151	120	101	78,0	70,2	58,0	31,2
2 SLA 800	979	968	937	900	829	707	565	471	362	296	221	178	149	112	100	82,0	44,5
2 SLA 1000	1223	1210	1172	1125	1037	884	707	588	452	370	277	222	186	140	125	103	55,6
2 SLA 1500	1383	1321	1245	1171	1094	980	833	722	575	485	368	300	254	199	180	150	82,8
2 SLA 2000	1845	1761	1660	1561	1458	1306	1111	962	767	646	490	400	338	266	240	200	110

Amperes to 1,85 VPC (at 20°C)

	Discharge Time (minutes)																	
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	77,0	59,5	45,5	37,2	31,7	21,1	16,2	13,8	10,4	8,38	6,15	4,95	4,17	3,23	2,90	2,43	1,30
12 SLA 30	77,0	62,4	48,5	39,4	33,8	26,2	20,0	16,5	12,5	10,1	7,38	5,94	5,00	3,87	3,48	2,91	1,56
12 SLA 50	121	102	82,2	68,7	57,8	45,0	34,0	27,5	20,8	16,8	12,3	9,90	8,34	6,45	5,81	4,85	2,60
12 SLA 75	181	154	123	103	86,6	67,5	50,9	41,3	31,2	25,1	18,5	14,9	12,5	9,68	8,71	7,28	3,90
6 SLA 100	242	205	164	137	116	90,0	67,9	55,0	41,6	33,5	24,6	19,8	16,7	12,9	11,6	9,70	5,20
6 SLA 125	218	188	159	139	125	104	84,1	70,4	52,0	41,9	30,8	24,8	20,9	16,1	14,5	12,1	6,51
4 SLA 150	333	281	228	195	169	132	99,6	82,5	62,5	50,3	36,9	29,7	25,0	19,4	17,4	14,6	7,81
6 SLA 160	325	279	235	199	175	139	110	90,4	70,1	57,1	41,4	32,6	27,0	20,4	18,2	15,3	8,21
6 SLA 180	314	270	230	201	180	150	121	101	74,9	60,3	44,3	35,6	30,0	23,2	20,9	17,5	9,37
4 SLA 200	371	346	302	252	209	169	130	110	83,3	67,0	49,2	39,6	33,4	25,8	23,2	19,4	10,4
2 SLA 250	459	398	340	295	262	211	162	138	104	83,8	61,5	49,5	41,7	32,3	29,0	24,3	13,0
2 SLA 300	551	478	407	353	314	254	195	165	125	101	75,8	61,3	51,5	39,2	35,2	29,1	15,8
2 SLA 330	625	542	456	395	346	279	221	183	138	111	78,8	63,0	52,5	39,9	35,7	29,6	15,6
2 SLA 405/4	757	656	553	478	419	338	273	226	167	134	95,5	76,4	63,7	48,3	43,3	35,8	18,9
2 SLA 500	881	767	662	572	511	424	335	276	208	168	123	99,0	83,4	64,5	58,1	48,5	26,0
2 SLA 580	975	866	740	654	587	489	392	327	241	194	143	115	96,7	74,8	67,3	56,3	30,2
2 SLA 800	829	823	809	763	704	604	489	409	325	272	206	169	141	106	94,9	78,3	41,3
2 SLA 1000	1036	1029	1011	953	880	754	612	512	407	340	257	211	176	133	119	97,9	51,7
2 SLA 1500	1137	1095	1043	984	932	855	741	653	531	445	346	285	240	188	169	142	77,2
2 SLA 2000	1517	1460	1390	1313	1243	1140	988	870	708	594	462	380	320	250	226	190	103

Amperes to 1,90 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	30,9	28,9	26,0	23,4	21,5	18,0	14,4	11,9	9,30	7,50	5,46	4,37	3,66	2,78	2,51	2,11	1,13
12 SLA 30	44,9	40,3	34,9	29,6	25,9	21,6	17,3	14,3	11,2	9,00	6,55	5,24	4,39	3,34	3,01	2,53	1,36
12 SLA 50	61,9	57,7	52,0	46,8	43,1	36,0	28,9	23,8	18,6	15,0	10,9	8,74	7,31	5,57	5,02	4,21	2,27
12 SLA 75	92,8	86,6	77,9	70,1	64,6	54,0	43,3	35,7	27,9	22,5	16,4	13,1	11,0	8,35	7,53	6,32	3,40
6 SLA 100	124	115	104	93,5	86,2	72,0	57,8	47,6	37,2	30,0	21,8	17,5	14,6	11,1	10,0	8,42	4,53
6 SLA 125	155	144	130	117	108	90,1	72,2	59,5	46,5	37,5	27,3	21,9	18,3	13,9	12,6	10,5	5,67
4 SLA 150	186	173	156	140	129	108	86,6	71,4	55,8	45,0	32,8	26,2	21,9	16,7	15,1	12,6	6,80
6 SLA 160	198	185	166	150	137	112	90,7	76,6	59,5	48,0	34,9	28,0	23,4	17,8	16,1	13,5	7,25
6 SLA 180	223	208	187	168	155	130	104	85,7	67,0	54,0	39,3	31,5	26,3	20,0	18,1	15,2	8,16
4 SLA 200	252	242	217	199	172	144	116	95,2	74,4	60,0	43,7	35,0	29,2	22,3	20,1	16,8	9,07
2 SLA 250	309	289	260	234	215	180	144	119	93,0	75,0	54,6	43,7	36,6	27,8	25,1	21,1	11,3
2 SLA 300	371	346	312	281	259	216	173	143	112	90,0	65,5	52,4	43,9	33,4	30,1	25,3	13,6
2 SLA 330	463	413	361	320	284	238	191	157	123	99,0	72,1	57,7	48,3	36,7	33,1	27,8	14,8
2 SLA 405/4	561	501	437	388	348	297	241	202	151	120	87,4	69,9	58,5	44,5	40,2	33,7	18,0
2 SLA 500	586	541	494	448	415	349	286	238	186	150	109	87,4	73,1	55,7	50,2	42,1	22,7
2 SLA 580	717	670	603	542	500	418	335	276	216	174	127	101	84,8	64,6	58,2	48,8	26,3
2 SLA 800	696	686	672	640	586	509	430	368	295	248	183	149	125	92,7	84,5	71,0	37,3
2 SLA 1000	869	857	840	800	733	636	537	460	369	310	229	186	156	116	106	88,7	46,7
2 SLA 1500	935	899	859	816	762	692	605	542	454	391	307	257	219	170	154	129	69,8
2 SLA 2000	1246	1198	1146	1087	1016	922	807	722	605	521	410	342	292	227	205	172	93,0

14. CONSTANT POWER DISCHARGE DATA

Watt per cell to 1,60 VPC (at 20°C)

	Discharge Time (minutes)																	
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	225	158	112	85,9	70,8	52,8	39,0	30,8	21,9	17,4	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	268	188	134	102	84,4	63,1	46,6	36,9	26,2	20,8	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	440	309	220	168	139	104	76,8	61,0	43,4	34,6	25,4	20,3	17,0	13,1	11,8	9,78	5,26
12 SLA 75	660	463	330	252	208	156	115	91,4	65,1	51,9	38,0	30,4	25,5	19,7	17,8	14,7	7,89
6 SLA 100	880	617	440	337	278	208	154	122	86,8	69,2	50,7	40,5	34,0	26,3	23,7	19,6	10,5
6 SLA 125	650	552	463	373	316	244	185	150	108	86,4	63,3	50,6	42,4	32,8	29,6	24,4	13,1
4 SLA 150	1229	881	637	501	414	310	230	182	130	104	76,0	60,7	51,0	39,4	35,5	29,3	15,8
6 SLA 160	1032	796	606	491	414	321	245	200	148	117	84,5	66,6	55,3	42,4	38,1	31,8	17,0
6 SLA 180	936	794	667	537	455	351	266	216	156	124	91,1	72,8	61,1	47,3	42,6	35,2	18,9
4 SLA 200	1024	907	774	653	549	413	307	251	185	147	105	83,0	69,1	53,0	47,5	39,7	21,1
2 SLA 250	1647	1271	983	793	665	513	385	305	217	172	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1722	1396	1125	921	777	601	457	365	261	207	151	122	103	78,8	70,6	58,4	32,0
2 SLA 330	2123	1817	1414	1119	924	684	503	406	301	241	175	140	116	87,6	78,1	63,7	33,2
2 SLA 405/4	2642	2060	1557	1267	1070	814	609	493	365	292	212	169	141	106	94,6	77,2	40,3
2 SLA 500	2831	2354	1895	1537	1289	982	738	593	436	346	252	202	169	131	118	97,4	52,4
2 SLA 580	3049	2590	2143	1766	1495	1147	868	698	505	401	293	234	196	152	137	113	60,8
2 SLA 800	2767	2638	2383	2191	1921	1531	1172	955	718	583	430	346	291	219	196	161	87,5
2 SLA 1000	3459	3297	2979	2739	2401	1914	1465	1194	897	729	537	433	364	274	245	202	109
2 SLA 1500	3918	3526	3165	2842	2559	2173	1743	1472	1146	955	723	584	496	387	350	291	163
2 SLA 2000	5224	4702	4220	3789	3412	2898	2324	1963	1529	1273	964	779	661	516	467	388	217

Watt per cell to 1,65 VPC (at 20°C)

	Discharge Time (minutes)																	
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	202	153	109	84,7	70,0	52,6	38,8	30,6	21,8	17,4	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	241	183	130	101	83,4	62,8	46,4	36,7	26,2	20,8	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	396	300	214	166	137	103	76,5	60,6	43,4	34,6	25,3	20,2	17,0	13,1	11,8	9,77	5,25
12 SLA 75	594	451	321	249	206	155	115	90,9	65,1	51,8	38,0	30,4	25,5	19,7	17,7	14,7	7,88
6 SLA 100	792	601	428	332	275	207	153	121	86,8	69,1	50,7	40,5	34,0	26,3	23,6	19,5	10,5
6 SLA 125	598	530	446	364	313	241	183	149	108	86,3	63,2	50,5	42,4	32,8	29,5	24,4	13,1
4 SLA 150	1070	854	627	493	407	309	229	181	130	104	75,9	60,7	50,9	39,4	35,5	29,3	15,8
6 SLA 160	953	775	589	481	408	318	244	199	148	117	84,4	66,5	55,3	42,4	38,0	31,8	16,9
6 SLA 180	862	763	643	525	451	347	264	215	156	124	91,0	72,7	61,0	47,2	42,5	35,2	18,9
4 SLA 200	991	887	758	643	546	409	305	248	185	146	105	83,0	69,0	52,9	47,5	39,7	21,1
2 SLA 250	1478	1199	940	767	655	507	384	304	217	172	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1539	1305	1072	886	760	595	455	364	261	207	151	122	103	78,8	70,6	58,4	32,0
2 SLA 330	2112	1800	1399	1105	911	677	501	404	301	241	175	139	116	87,1	77,6	63,7	33,2
2 SLA 405/4	2489	1994	1532	1253	1061	810	607	489	365	292	212	169	140	106	94,1	77,2	40,2
2 SLA 500	2647	2251	1831	1502	1264	969	734	593	436	346	252	202	169	131	118	97,4	52,4
2 SLA 580	2933	2515	2082	1733	1471	1130	861	698	505	401	293	234	196	152	137	113	60,8
2 SLA 800	2515	2406	2270	2087	1833	1504	1166	955	718	583	430	346	291	219	196	161	87,5
2 SLA 1000	3143	3008	2837	2609	2292	1880	1458	1194	897	729	537	433	364	274	245	202	109
2 SLA 1500	3659	3369	3067	2779	2500	2139	1740	1472	1146	955	723	584	496	387	350	291	163
2 SLA 2000	4879	4491	4089	3706	3334	2852	2320	1963	1529	1273	964	779	661	516	467	388	217

Watt per cell to 1,67 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	196	150	107	83,3	69,1	52,0	38,6	30,5	21,8	17,4	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	233	179	128	99,3	82,3	62,1	46,1	36,6	26,2	20,8	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	384	294	210	163	136	102	76,0	60,6	43,4	34,5	25,3	20,2	17,0	13,1	11,8	9,77	5,25
12 SLA 75	577	441	315	245	203	154	114	90,8	65,0	51,8	38,0	30,3	25,5	19,7	17,7	14,7	7,88
6 SLA 100	769	589	420	327	271	205	152	121	86,7	69,1	50,7	40,5	34,0	26,2	23,6	19,5	10,5
6 SLA 125	583	517	431	356	308	237	182	149	108	86,2	63,2	50,5	42,4	32,8	29,5	24,4	13,1
4 SLA 150	1038	832	614	486	403	306	227	181	130	104	75,9	60,6	50,9	39,3	35,4	29,3	15,8
6 SLA 160	904	749	577	475	404	316	243	198	148	117	84,3	66,4	55,2	42,2	37,9	31,7	16,9
6 SLA 180	840	745	621	513	443	341	262	214	155	124	91,0	72,7	61,0	47,2	42,5	35,1	18,9
4 SLA 200	970	871	744	632	536	405	303	248	185	146	105	82,9	68,9	52,8	47,4	39,6	21,1
2 SLA 250	1418	1154	915	752	649	504	381	303	217	172	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1479	1254	1040	868	751	590	453	362	260	207	151	122	103	78,8	70,6	58,4	32,0
2 SLA 330	2044	1746	1358	1082	899	673	499	403	299	240	175	139	116	86,9	77,5	63,7	33,2
2 SLA 405/4	2436	1953	1514	1242	1055	807	605	488	363	291	212	168	140	105	94,0	77,3	40,2
2 SLA 500	2585	2193	1771	1472	1248	961	729	591	435	346	252	202	169	131	118	97,4	52,4
2 SLA 580	2824	2432	2016	1687	1439	1116	857	695	505	401	293	234	196	152	137	113	60,8
2 SLA 800	2367	2279	2165	2021	1788	1479	1154	948	718	582	430	346	291	219	196	161	87,5
2 SLA 1000	2959	2849	2706	2527	2236	1849	1443	1185	897	727	538	433	364	274	245	202	109
2 SLA 1500	3459	3224	2946	2690	2453	2110	1727	1468	1146	955	723	584	496	387	350	291	163
2 SLA 2000	4612	4299	3928	3587	3270	2814	2303	1958	1528	1273	964	779	661	516	467	388	217

Watt per cell to 1,70 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	191	147	105	82,1	68,3	51,5	38,3	30,5	21,8	17,4	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	227	176	125	97,9	81,4	61,5	45,8	36,6	26,1	20,8	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	375	289	206	161	134	101	75,6	60,5	43,3	34,5	25,3	20,2	17,0	13,1	11,8	9,76	5,25
12 SLA 75	562	434	309	242	201	152	113	90,8	65,0	51,8	38,0	30,3	25,5	19,7	17,7	14,6	7,87
6 SLA 100	749	578	413	322	268	203	151	121	86,6	69,1	50,6	40,4	33,9	26,2	23,6	19,5	10,5
6 SLA 125	571	506	418	349	303	233	181	148	108	86,2	63,1	50,5	42,4	32,7	29,5	24,4	13,1
4 SLA 150	1011	812	602	480	400	303	226	181	130	104	75,9	60,6	50,9	39,3	35,4	29,3	15,7
6 SLA 160	863	727	567	471	400	315	241	197	148	117	84,3	66,3	55,1	42,1	37,8	31,7	16,9
6 SLA 180	822	729	602	502	437	336	261	213	155	124	90,9	72,7	61,0	47,2	42,5	35,1	18,9
4 SLA 200	953	858	732	623	527	402	300	247	184	146	105	82,8	68,8	52,6	47,3	39,6	21,1
2 SLA 250	1367	1116	894	740	643	502	378	303	217	172	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1428	1210	1012	853	743	586	451	361	260	207	151	122	103	78,8	70,6	58,4	32,0
2 SLA 330	1986	1700	1324	1063	889	669	498	402	298	239	174	139	116	86,8	77,5	63,8	33,2
2 SLA 405/4	2391	1918	1499	1234	1050	805	603	487	361	290	211	168	140	105	93,9	77,3	40,3
2 SLA 500	2531	2143	1720	1447	1234	954	725	590	435	346	252	202	169	131	118	97,4	52,4
2 SLA 580	2732	2362	1959	1648	1412	1104	853	692	504	401	293	234	196	152	137	113	60,8
2 SLA 800	2242	2171	2076	1966	1750	1458	1143	942	717	581	430	346	291	219	196	161	87,5
2 SLA 1000	2802	2714	2594	2457	2188	1823	1429	1178	897	726	538	433	364	274	245	202	109
2 SLA 1500	3289	3101	2843	2614	2412	2086	1716	1465	1146	955	723	584	496	387	350	291	163
2 SLA 2000	4385	4134	3791	3486	3216	2781	2288	1954	1528	1273	964	779	661	516	467	388	217

Watt per cell to 1,75 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	176	138	101	79,7	66,5	50,4	37,9	30,2	21,7	17,3	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	209	164	120	94,9	79,3	60,2	45,3	36,2	26,1	20,8	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	347	270	197	156	131	99,2	74,8	59,9	43,2	34,4	25,3	20,2	17,0	13,1	11,8	9,75	5,24
12 SLA 75	521	405	296	235	196	149	112	89,8	64,9	51,6	37,9	30,3	25,4	19,7	17,7	14,6	7,87
6 SLA 100	694	541	395	313	261	198	150	120	86,5	68,8	50,6	40,4	33,9	26,2	23,6	19,5	10,5
6 SLA 125	521	453	381	330	289	227	178	147	108	86,1	63,1	50,4	42,3	32,7	29,5	24,4	13,1
4 SLA 150	932	762	575	466	390	297	224	179	130	104	75,8	60,6	50,8	39,3	35,4	29,3	15,7
6 SLA 160	772	677	541	455	393	305	239	196	147	117	83,8	65,9	54,9	41,8	37,7	31,6	16,9
6 SLA 180	750	652	549	476	416	327	256	211	155	124	90,8	72,6	60,9	47,1	42,4	35,1	18,9
4 SLA 200	895	817	697	591	501	390	296	241	183	146	105	82,3	68,5	52,2	47,1	39,5	21,1
2 SLA 250	1220	1028	841	704	616	482	368	296	216	172	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1315	1126	937	812	717	572	439	353	259	207	151	122	103	78,8	70,6	58,4	32,0
2 SLA 330	1885	1580	1254	1023	856	655	492	396	293	235	172	137	114	85,6	76,6	63,8	33,2
2 SLA 405/4	2224	1816	1444	1200	1025	790	596	480	355	285	209	165	138	104	92,9	77,3	40,2
2 SLA 500	2352	1945	1589	1363	1183	926	712	586	434	346	252	202	169	131	118	97,4	52,4
2 SLA 580	2467	2152	1795	1559	1353	1069	838	687	503	401	293	234	196	152	137	113	60,8
2 SLA 800	1974	1944	1892	1807	1645	1407	1115	928	709	579	430	346	291	219	196	161	87,5
2 SLA 1000	2468	2430	2366	2258	2056	1758	1394	1161	886	723	538	433	364	274	245	202	109
2 SLA 1500	2885	2766	2613	2446	2276	2000	1681	1438	1131	945	719	583	496	387	350	291	163
2 SLA 2000	3847	3688	3484	3261	3035	2666	2241	1917	1508	1260	958	778	661	516	467	388	217

Watt per cell to 1,80 VPC (at 20°C)

Discharge Time (minutes)

TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	161	127	94,8	76,3	63,7	49,1	37,4	29,8	21,6	17,2	12,6	10,1	8,47	6,54	5,89	4,87	2,62
12 SLA 30	191	151	113	90,8	76,0	59,0	44,7	35,8	25,9	20,6	15,2	12,1	10,2	7,85	7,07	5,85	3,14
12 SLA 50	315	249	186	150	125	97,4	73,8	59,2	43,0	34,0	25,3	20,2	16,9	13,1	11,8	9,74	5,24
12 SLA 75	472	373	279	225	188	146	111	88,8	64,5	50,9	37,9	30,3	25,4	19,6	17,7	14,6	7,86
6 SLA 100	630	498	372	300	251	195	148	118	86,0	67,9	50,5	40,4	33,9	26,2	23,6	19,5	10,5
6 SLA 125	474	404	345	303	266	216	172	144	107	85,6	63,0	50,4	42,3	32,7	29,4	24,3	13,1
4 SLA 150	854	703	544	447	374	290	221	177	129	103	75,7	60,5	50,8	39,2	35,3	29,2	15,7
6 SLA 160	685	607	507	433	377	302	236	191	145	115	82,7	65,2	54,1	41,2	37,0	31,2	16,8
6 SLA 180	682	581	497	437	383	312	248	208	154	123	90,7	72,5	60,9	47,1	42,4	35,1	18,9
4 SLA 200	810	753	665	562	478	376	290	237	179	144	103	81,3	67,5	51,5	46,2	38,9	21,0
2 SLA 250	1010	874	739	640	567	458	346	285	212	171	126	102	85,8	65,7	58,8	48,7	26,6
2 SLA 300	1175	1026	862	752	671	540	417	340	254	206	151	122	103	78,8	70,6	58,4	31,9
2 SLA 330	1544	1326	1104	922	793	625	477	390	289	232	166	133	111	83,9	74,7	61,2	32,0
2 SLA 405/4	1801	1532	1292	1099	961	757	578	472	351	281	201	161	134	102	90,5	74,2	38,7
2 SLA 500	2024	1694	1453	1259	1109	884	694	574	428	344	252	202	169	131	118	97,4	52,4
2 SLA 580	2219	1887	1629	1425	1258	1030	808	668	496	398	293	234	196	152	137	113	60,8
2 SLA 800	1785	1767	1715	1651	1529	1315	1062	890	689	566	426	343	288	217	194	159	86,6
2 SLA 1000	2231	2209	2143	2064	1911	1644	1328	1112	861	707	532	429	360	271	243	199	108
2 SLA 1500	2567	2457	2322	2190	2051	1845	1578	1372	1100	930	708	579	491	386	349	291	161
2 SLA 2000	3423	3275	3096	2920	2735	2460	2104	1830	1467	1239	944	773	654	515	466	388	215

Watt per cell to 1,85 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	144	113	87,0	71,7	61,3	41,1	31,7	26,9	20,4	16,5	12,1	9,75	8,22	6,36	5,73	4,79	2,57
12 SLA 30	145	119	93,2	76,1	65,5	51,0	39,2	32,3	24,5	19,8	14,5	11,7	9,87	7,64	6,87	5,74	3,08
12 SLA 50	229	195	158	133	112	87,6	66,3	53,9	40,9	32,9	24,2	19,5	16,4	12,7	11,5	9,57	5,14
12 SLA 75	343	293	237	199	168	131	99,5	80,8	61,3	49,4	36,3	29,3	24,7	19,1	17,2	14,4	7,71
6 SLA 100	457	390	315	265	224	175	133	108	81,7	65,9	48,4	39,0	32,9	25,5	22,9	19,1	10,3
6 SLA 125	411	356	305	267	240	201	163	137	102	82,1	60,4	48,7	41,0	31,8	28,6	23,9	12,8
4 SLA 150	628	534	437	374	326	256	194	161	122	98,7	72,6	58,5	49,3	38,2	34,4	28,7	15,4
6 SLA 160	614	532	450	382	339	270	214	177	137	112	81,5	64,2	53,3	40,2	35,9	30,1	16,2
6 SLA 180	592	513	439	385	346	289	235	198	147	118	87,0	70,1	59,1	45,8	41,2	34,4	18,5
4 SLA 200	698	653	574	481	402	327	252	214	163	131	96,7	77,9	65,7	50,8	45,8	38,3	20,6
2 SLA 250	864	754	647	564	503	408	315	268	204	164	121	97,4	82,1	63,6	57,2	47,8	25,7
2 SLA 300	1031	901	773	675	601	489	378	321	244	197	149	120	101	77,2	69,3	57,3	31,2
2 SLA 330	1161	1026	873	759	668	541	430	358	269	217	155	124	103	78,6	70,4	58,3	30,8
2 SLA 405/4	1407	1243	1058	920	809	656	532	440	327	263	188	150	125	95,2	85,3	70,7	37,3
2 SLA 500	1677	1468	1272	1104	988	823	652	538	408	329	242	195	164	127	115	95,7	51,4
2 SLA 580	1853	1653	1420	1260	1133	948	763	638	473	381	281	226	191	148	133	111	59,6
2 SLA 800	1549	1539	1513	1432	1326	1146	936	787	630	528	401	330	276	209	186	154	81,5
2 SLA 1000	1936	1923	1892	1790	1658	1432	1170	984	787	660	502	412	345	261	233	193	102
2 SLA 1500	2158	2081	1986	1879	1782	1639	1427	1261	1030	866	676	558	470	369	333	280	152
2 SLA 2000	2878	2775	2648	2505	2376	2186	1902	1681	1374	1155	902	744	627	492	444	373	203

Watt per cell to 1,90 VPC (at 20°C)

	Discharge Time (minutes)																
TYPE	1	5	10	15	20	30	45	60	90	120	180	240	300	420	480	600	1200
12 SLA 25	60,6	56,6	51,1	46,0	42,5	35,6	28,6	23,6	18,5	14,9	10,9	8,72	7,30	5,56	5,02	4,21	2,27
12 SLA 30	87,6	78,8	68,4	58,3	51,0	42,7	34,4	28,4	22,2	17,9	13,1	10,5	8,76	6,67	6,02	5,05	2,72
12 SLA 50	121	113	102	92,1	85,0	71,2	57,3	47,3	37,0	29,9	21,8	17,4	14,6	11,1	10,0	8,42	4,53
12 SLA 75	182	170	153	138	127	107	85,9	70,9	55,5	44,8	32,7	26,2	21,9	16,7	15,1	12,6	6,80
6 SLA 100	242	227	204	184	170	142	115	94,6	74,0	59,8	43,6	34,9	29,2	22,2	20,1	16,8	9,07
6 SLA 125	300	280	253	228	211	177	142	118	92,2	74,5	54,4	43,6	36,5	27,8	25,1	21,0	11,3
4 SLA 150	362	338	305	275	254	213	171	142	111	89,6	65,3	52,3	43,8	33,4	30,1	25,2	13,6
6 SLA 160	386	361	326	294	269	220	180	152	118	95,6	69,7	55,8	46,7	35,6	32,1	26,9	14,5
6 SLA 180	431	404	364	329	304	255	205	170	133	107	78,3	62,7	52,5	40,0	36,1	30,3	16,3
4 SLA 200	488	468	422	387	337	283	228	188	148	119	87,0	69,7	58,3	44,5	40,1	33,6	18,1
2 SLA 250	599	561	506	457	422	354	285	235	184	149	109	87,1	72,9	55,6	50,1	42,1	22,7
2 SLA 300	716	670	605	546	505	424	341	282	221	179	130	104	87,5	66,7	60,1	50,5	27,2
2 SLA 330	884	800	704	627	558	468	376	311	244	197	143	115	96,2	73,3	66,2	55,5	29,7
2 SLA 405/4	1072	970	853	760	684	585	476	400	299	238	174	139	117	88,9	80,2	67,3	36,0
2 SLA 500	1144	1059	969	879	817	689	565	472	370	299	218	174	146	111	100	84,2	45,3
2 SLA 580	1396	1306	1178	1063	981	823	662	547	429	346	252	202	169	129	116	97,6	52,6
2 SLA 800	1329	1312	1286	1228	1129	985	836	719	579	488	363	296	248	185	168	141	74,6
2 SLA 1000	1661	1640	1607	1535	1411	1231	1045	899	724	610	453	370	310	231	210	177	93,2
2 SLA 1500	1810	1743	1669	1586	1485	1352	1186	1064	895	772	609	509	435	338	306	257	139
2 SLA 2000	2413	2324	2225	2115	1979	1802	1582	1419	1193	1029	812	679	580	451	408	342	186

ENGINEERING MANUAL

range **Monolite SLA**

Austria:
BÄREN BATTERIE Gmbh
Dr. Leopold Jungfer Str.
9181 Feistriz
Tel : +43 4228 2036 99
Fax : +43 4228 2036 68
info.standby.austria@fiamm.com

China:
FIAMM Enertech Co., Ltd.
Building A, Zhuankou Industrial Park,
Wuhan Econ. & Tech. Development Zone
Wuhan City, Hubei Province, PR China 430057
Tel: +86 27 84297900
Fax : +86 27 84231256
www.fiammenertech.com

Czech Republic:
AKUMA - prumyslove baterie s.r.o.
Parizske komuny 96, Debr nad Jizerou
293 07 Mlada Boleslav
Tel : +420/326/748344
Fax : +420/326/748370
info.standby.czech@fiamm.com

France:
FIAMM FRANCE
1, rue du Clos Reine Z.I.
78410 Aubergenville
Tel : +33 139297701
Fax : +33 130903369
info.standby.france@fiamm.com

Germany:
FIAMM GmbH
Hansestrasse 101
51149 Köln
Tel : +49 (0)2203-92578-0
Fax : +49 (0)2203-92578-49
info.standby.germany@fiamm.com

Italy:
FIAMM S.P.A.
Viale Europa, 63
36075 Montecchio Maggiore (VI)
Tel : +39 0444 709311
Fax : +39 0444 694178
info.standby.italy@fiamm.com

Singapore :
FIAMM ASIA PACIFIC Pte Ltd
36 Tuas Crescent
638724 Singapore
Tel : +65 68653276-8
Fax : +65 68626550
info.standby.asiapacific@fiamm.com

Spain:
FIAMM IBERICA S.A.
Calle Nubes, 7 - P.I. San José de Valderas
28918 Leganes - Madrid
Tel : +34 91 4880247
Fax : +34 91 6105618
info.standby.spain@fiamm.com

UK:
FIAMM UK Limited - Standby Battery
1st floor, Unit 10 Brookfield
Duncan Close - Moulton Park
NN3 6WL Northampton
Tel : +44 1604 647 004
Fax : +44 1604 643 329
info.standby.uk@fiamm.com

USA:
FIAMM Technologies, Inc.
One FIAMM Way
Waynesboro, GA 30830
Tel : +1 (678) 746-5640
Fax : +1 (770) 360-1240
www.fiammamerica.com

www.fiamm.com