

ENGINEERING MANUAL

SMG (OPzV)

Valve Regulated Recombination Cells



FIAMM
+ — -

TABLE OF CONTENTS

1. INTRODUCTION	3
2. FEATURES	3
No topping-up	3
Compatibility	3
Office compatibility	3
Savings	3
Long life	3
Installation	3
Reliability	3
3. MAIN APPLICATIONS	4
4. OPERATING PRINCIPLE OF THE RECOMBINATION TECHNOLOGY.....	4
Recombination	4
5. CONSTRUCTION FEATURES.....	5
FIAMM production of SMG (OPzV) cells.....	5
Plates	6
Containers	6
Separators	6
Electrolyte	6
Valves	6
Intercell connectors.....	6
Terminal protection	6
Marking	6
6. OPERATING FEATURES	7
Capacity.....	7
Cell Voltage	7
Capacity as a function of temperature	7
Internal impedance and short circuit.....	7
Open circuit.....	8
Gassing.....	8
Operation of batteries in parallel	8
7. CHARGING	9
Introduction.....	9
Recommended procedure for charging of SMG (OPzV) cells.....	9
a) Float charge	9
b) Recharge following discharge	10
8. APPLICABLE STANDARDS	10
9. STORAGE.....	10
10. INSTALLATION	10
11. CONSTANT CURRENT DESCHARGE DATA.....	11
12. CONSTANT POWER DESCHARGE DATA.....	13



1. INTRODUCTION

It has always been extremely important to have a backup power source when possible 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 gelled electrolyte.

Wherever a stationary battery is required, SMG (OPzV as per DIN Standard) cells can offer considerable advantages such as: ready for installation as delivered; no topping-up necessary during life; virtually sealed; can be installed where people work and are office compatible.

SMG (OPzV) cells utilise the most advanced technology and rigorous quality control which guarantees the utmost reliability and quality of the battery.

2. FEATURES

No topping-up

SMG (OPzV) cells require no topping-up throughout their life.

“Install and forget” properly describes the SMG (OPzV) concept.

Compatibility

SMG (OPzV) cells are specifically designed to meet the requirements of modern electronic equipment and are compatible with normally available recharging systems without special modifications.

Office compatibility

FIAMM SMG (OPzV) cells, 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

SMG (OPzV) cells offer 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 designed life of more than twelve years.

Installation

SMG (OPzV) cells are normally installed in the upright position, placed on steel stands. When necessary, they can be installed in the horizontal position, thus reducing the occupied floor space (horizontal installation is available only for cells with a capacity up to 1500 Ah).

SMG (OPzV) cells are supplied filled and charged, ready for installation and connection to the equipment.

Reliability

SMG (OPzV) cells have been tested in the field for a number of years and fully comply with established international standards.



3. MAIN APPLICATIONS

SMG (OPzV) cells, thanks to their construction and the use of tubular positive plates, are best suited for telecommunications systems, where the load normally needs to be backed-up for long periods of time.

In general, FIAMM SMG (OPzV) cells are best suited for following applications:

- telecommunications
- power generation back up systems
- solar energy systems
- wind energy systems
- computer stand-by
- alarm systems
- emergency lighting
- UPS systems (with long back-up time).

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.

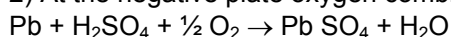
This action results in the need for regular battery checks and periodic topping-up operations to maintain the electrolyte at the proper level. The sealed, valve regulated lead acid battery design, eliminates these problems through continuous recombination of the oxygen during charging.

The oxygen recombination process in the SMG (OPzV) cells occurs because of the progressive formation of microfractures in the gellified mass. This creates a passage for the oxygen diffusion from the positive plates (where it is generated) directly to the negative plates where it reacts to form water again.

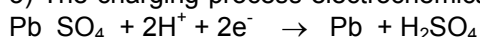
During charging the following reactions occur:

1) Oxygen is evolved at the positive plate by the reaction $\text{H}_2\text{O} \rightarrow \frac{1}{2} \text{O}_2 + 2\text{H}^+ + 2\text{e}^-$ and diffuses through the cracks in the gel to the surface of the negative plate.

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



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



As a result, the recombination process, which is virtually 100% efficient, completes and reverses the water oxidation. 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.

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. It is also very important that the valves in the cell construction be 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 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.



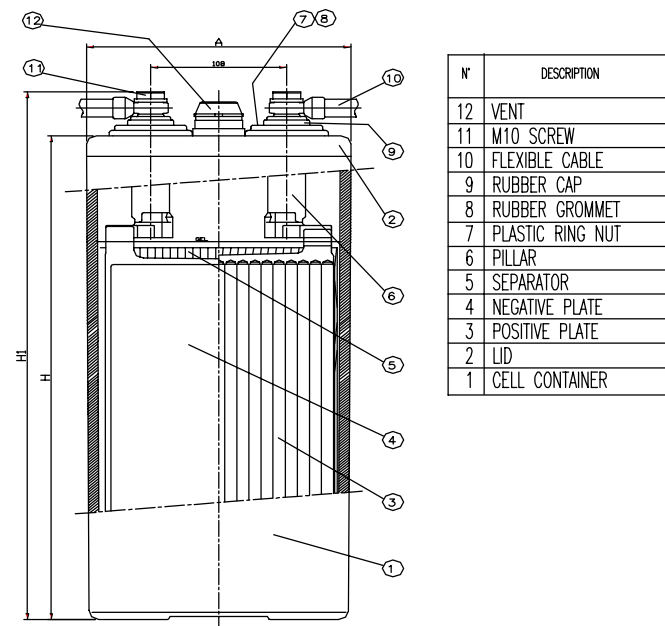
CUTAWAY DRAWING OF ONE SMG 200 (4 OPzV 200) CELL

Fig. 2

Plates

Positive plates are of tubular construction, incorporating a special grid pressure cast from antimony free alloy, with highly porous gauntlets that retain the active material.

Negative plates are of flat, pasted construction with a service life compatible with the positive plates.

The active material paste is made of lead oxide, water, sulphuric acid and other ingredients needed to guarantee full capacity throughout the battery life.

Containers

Battery cases and lids are made of plastic ABS material. Upon request, we can also supply SMG (OPzV) cells housed in ABS flame retardant cases to IEC707, method FV, category FVO and UL 94 class VO.

Separators

Separators are of extremely high porosity and low internal resistance.

Electrolyte

The electrolyte is immobilised in a gel structure with the same purity characteristics as other types of high quality lead acid batteries.

Valves

Each cell has a one way valve to allow the release of gases from the cell whenever the internal pressure gets too high.

Intercell connectors

Flexible connectors are provided together with insulated bolts.

Terminal protection

Each terminal is protected by plastic cover to avoid damage during shipment and handling.

Marking

Each cell is permanently marked with the following information:

- name of manufacture
- cell type designation
- nominal capacity
- date of assembling and first charge.



6. OPERATING FEATURES

Capacity

The battery capacity is rated in ampere hours (Ah) and is the quantity of electricity which the battery can supply during discharge.

The capacity depends on the quantity of the active materials contained in the battery plates as well as the discharge rate and temperature.

The nominal capacity (C_{10}) of SMG (OPzV) cells in accordance with international standards refers to the 10 hr discharge rate with constant current at 20° C down to 1.80 VPC.

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.

Capacity as a function of temperature

The capacity available from a battery, at any particular discharge rate, varies with temperature.

For SMG (OPzV) cells at 20°C please refer to table 2:

Temperature	Capacity at 20°C at 10 hours discharge rate in %	End voltage (Volt per cell)
-20 °C	50	1.80
-10 °C	70	1.80
0 °C	80	1.80
+20 °C	100	1.80
+30 °C	105	1.80
+40 °C	106	1.80

Table 2

Internal impedance and short circuit

The internal impedance of a lead acid battery is a function of the type of internal construction, plate thickness, number of plates, separator material, electrolyte sp. gr., temperature, state of charge and short circuit current.

The internal resistance and short circuit current of SMG (OPzV) cells at 100% state of charge and 20° C is given in the following table 2. **The values of the internal resistance and short circuit current, have been determined by the method described in IEC 60896 – part 2, or BS6290**

For the SMG (OPzV) cells short current at 20°C please refer to table 3:

CELL TYPE	Equivalent DIN Standard designation	Capacity (Ah)	Short circuit current (Amps.)	Internal Resistance (mΩ)
SMG 200	4 OPzV 200	200	1600	1.25
SMG 250	5 OPzV 250	250	2000	1.00
SMG 300	6 OPzV 300	300	2400	0.94
SMG 350	5 OPzV 350	350	2600	0.833
SMG 420	6 OPzV 420	420	3200	0.625
SMG 490	7 OPzV 490	490	3700	0.540
SMG 600	6 OPzV 600	600	3800	0.539
SMG 800	8 OPzV 800	800	5000	0.404
SMG 1000	10 OPzV 1000	1000	6300	0.324
SMG 1200	12 OPzV 1200	1200	7600	0.270
SMG 1500	12 OPzV 1500	1500	9500	0.216
SMG 2000	16 OPzV 2000	2000	12000	0.162
SMG 2500	20 OPzV 2500	2500	15000	0.129
SMG 3000	24 OPzV 3000	3000	18000	0.108

Table 3



Open circuit

The state of charge of lead acid batteries slowly decreases when left in open circuit condition.

In SMG (OPzV) cells self discharge rate is approximately 2% a month at 20°C. During prolonged storage it is necessary to charge the battery at least once every 6 months from date of shipment according to the instructions in paragraph 7.

Failure to do so will result in permanent damage to the battery capacity.

Gassing

As previously stated, SMG (OPzV) cells have a high recombination efficiency and for cells operated at 20°C under normal operating conditions venting is virtually negligible.

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 SMG (OPzV) recombination batteries can be installed in rooms containing electric equipment with no explosion danger or corrosion problems under normal conditions.

The only requirement is that these rooms or cabinets must have a natural ventilation.

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 connections of parallels as equal as possible and symmetrical between the batteries (e.g., length and type of connector) to minimise possible impedance variations.
- do not connect more than 4 batteries 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 maintain 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 a number of 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 (long recharge time);
- at recharge voltage not higher than 2.4 VPC (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 of SMG (OPzV) cells

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.

Recommended values for charging, voltage and current:

a) Float charge

The voltage recommended for float charge, which will ensure the maximum life of the SMG (OPzV) cells is 2.23 VPC at 20°C.

These batteries can operate over a temperature range of -15 to +40°C.

However operation at temperature higher and lower of 20°C will affect respectively life and performance.

The recommended float voltages to maximise the battery life over the range of temperatures between -15 and +40°C are shown in the following figure 4:

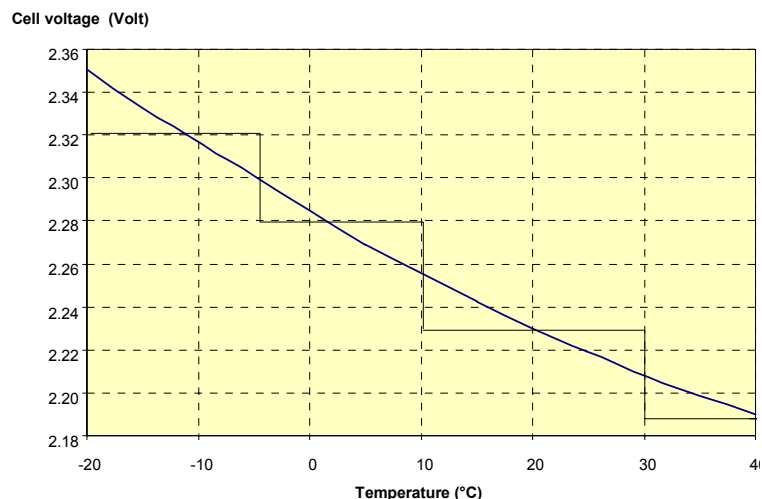


Fig. 4 Float Voltage vs. temperature

The normal float current observed in fully charged SMG (OPzV) cells at 2.23 VPC and a temperature of 20°C is approximately 0.3 mA/Ah.

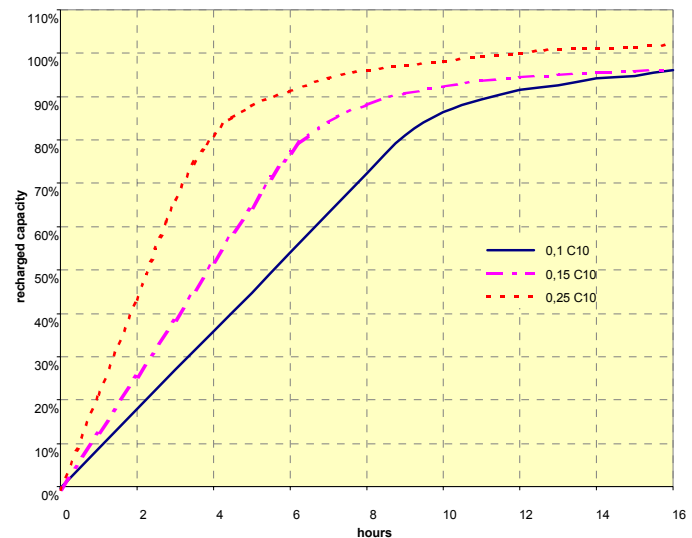
Because of the nature of recombination phenomena, the float current observed in the case of the SMG (OPzV) cells is normally higher than that of vented batteries and is not an indication of the state of charge of batteries.

b) Recharge following discharge

The recommended recharge method of SMG (OPzV) cells to maximise the battery life is to use a constant voltage equal to the float charge voltage (2.23 VPC at 20°C) with a maximum charge current of 0.25 C₁₀ amperes.

Using this procedure, the recharge times at different values of maximum current to recharge the discharged capacity are shown on the following figure 5:

Fig. 5



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 VPC at 20°C with a maximum current of 0.25 C₁₀.

However this recharge should be limited to no more than once a month to ensure the maximum service life of the battery.

8. APPLICABLE STANDARDS

SMG (OPzV) cells fully comply with:

- DIN 40742
- IEC 896-2 - Part 2
- Eurobat Guide to the specification of valve regulated Lead acid stationary cells and batteries: 12 years and longer-long life.

9. STORAGE

- Batteries are delivered filled, charged and ready for installation.
- No operations such as filling, commissioning or any 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 2.23 VPC for approx. 48 hours.

10. INSTALLATION

Please refer to the Installation and Operating Instruction Manual supplied with the battery. If additional copies are needed, please contact FIAMM or local distributor.



11. CONSTANT CURRENT DISCHARGE DATA

AMPERES TO 1.65 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	282	186	114	71.8	52.6	35.2	24.6	20.6
SMG 250	5 OPzV 250	312	223	143	90	65.8	44	30.8	25.8
SMG 300	6 OPzV 300	366	260	172	108	79	53.1	36.9	31
SMG 350	5 OPzV 350	400	290	197	126	93	62.8	43.6	36.3
SMG 420	6 OPzV 420	456	348	235	151	112	75	52.3	43.6
SMG 490	7 OPzV 490	496	391	274	176	131	88	61.1	50.9
SMG 600	6 OPzV 600	572	466	333	215	160	108	74.8	62.3
SMG 800	8 OPzV 800	896	658	460	287	213	144	100	83
SMG 1000	10 OPzV 1000	1055	822	565	361	269	180	124	104
SMG 1200	12 OPzV 1200	1176	956	682	431	318	215	149	125
SMG 1500	12 OPzV 1500	1306	1104	810	533	401	274	188	157
SMG 2000	16 OPzV 2000	1741	1472	1080	710	535	365	251	209
SMG 2500	20 OPzV 2500	2177	1840	1350	888	669	457	313	261
SMG 3000	24 OPzV 3000	2612	2208	1620	1066	803	548	376	313

AMPERES TO 1.70 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	259	179	112	70.4	52	34.9	24.5	20.6
SMG 250	5 OPzV 250	294	214	140	88	65	43.7	30.6	25.7
SMG 300	6 OPzV 300	342	247	168	106	78	52.6	36.7	30.9
SMG 350	5 OPzV 350	368	277	192	123	92	62.3	43.4	36.2
SMG 420	6 OPzV 420	410	323	227	148	110	74.8	52.1	43.4
SMG 490	7 OPzV 490	444	360	265	172	129	87	60.7	50.7
SMG 600	6 OPzV 600	516	429	324	211	158	107	74.4	62.1
SMG 800	8 OPzV 800	802	616	440	281	210	142	99	83
SMG 1000	10 OPzV 1000	950	770	550	353	265	178	124	103
SMG 1200	12 OPzV 1200	1048	872	649	422	313	214	148	124
SMG 1500	12 OPzV 1500	1159	994	765	520	396	272	187	156
SMG 2000	16 OPzV 2000	1545	1325	1020	694	528	362	249	208
SMG 2500	20 OPzV 2500	1932	1657	1275	867	660	453	312	260
SMG 3000	24 OPzV 3000	2318	1988	1530	1041	792	543	374	312

AMPERES TO 1.75 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	232	167	109	69	51.4	34.6	24.3	20.4
SMG 250	5 OPzV 250	265	198	136	86	64.3	43.2	30.3	25.6
SMG 300	6 OPzV 300	313	236	164	104	77	51.8	36.4	30.7
SMG 350	5 OPzV 350	324	255	180	119	90	61.4	43	36
SMG 420	6 OPzV 420	359	291	213	142	108	73.7	51.6	43.2
SMG 490	7 OPzV 490	388	321	243	166	126	86	60.2	50.4
SMG 600	6 OPzV 600	443	384	297	203	154	105	73.7	61.7
SMG 800	8 OPzV 800	700	549	413	271	205	140	98	82
SMG 1000	10 OPzV 1000	830	686	516	341	259	175	122	103
SMG 1200	12 OPzV 1200	912	771	596	407	308	211	147	123
SMG 1500	12 OPzV 1500	1005	873	699	500	387	268	185	155
SMG 2000	16 OPzV 2000	1340	1164	932	667	516	357	247	207
SMG 2500	20 OPzV 2500	1675	1455	1165	833	645	446	309	259
SMG 3000	24 OPzV 3000	2010	1746	1398	1000	774	536	371	310



AMPERES TO 1.80 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	202	154	103	67	50	33.9	24	20.3
SMG 250	5 OPzV 250	235	185	133	85	62.5	42.3	30	25.4
SMG 300	6 OPzV 300	270	215	155	101	75	50.8	36	30.4
SMG 350	5 OPzV 350	278	224	166	113	87	60.2	42.5	35.7
SMG 420	6 OPzV 420	307	256	197	135	105	72.2	51	42.8
SMG 490	7 OPzV 490	329	282	221	158	122	84	59.5	50
SMG 600	6 OPzV 600	382	336	267	193	149	103	72.8	61.2
SMG 800	8 OPzV 800	596	491	374	258	199	138	97	82
SMG 1000	10 OPzV 1000	707	600	468	324	251	172	121	102
SMG 1200	12 OPzV 1200	773	670	534	387	301	206	145	122
SMG 1500	12 OPzV 1500	810	747	630	473	375	263	183	154
SMG 2000	16 OPzV 2000	1080	996	840	630	500	350	244	205
SMG 2500	20 OPzV 2500	1350	1245	1050	788	625	438	305	257
SMG 3000	24 OPzV 3000	1620	1494	1260	945	750	525	366	308

AMPERES TO 1.85 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	167	131	93	61.3	45.8	31.6	22	18.5
SMG 250	5 OPzV 250	195	157	116	76	57.3	39.5	27.5	23.1
SMG 300	6 OPzV 300	221	180	135	91	68.7	47.4	33	27.8
SMG 350	5 OPzV 350	230	189	141	98	76	54.5	38.8	32.6
SMG 420	6 OPzV 420	245	209	164	118	92	65.4	46.6	39.1
SMG 490	7 OPzV 490	259	228	186	137	107	76	54.3	45.7
SMG 600	6 OPzV 600	299	272	221	168	131	93	66.5	55.9
SMG 800	8 OPzV 800	467	391	310	224	174	124	89	74.6
SMG 1000	10 OPzV 1000	554	489	387	280	218	156	111	93
SMG 1200	12 OPzV 1200	606	546	442	330	262	187	133	112
SMG 1500	12 OPzV 1500	593	573	489	378	305	225	162	135
SMG 2000	16 OPzV 2000	790	764	652	504	406	300	216	181
SMG 2500	20 OPzV 2500	988	955	815	630	508	375	270	226
SMG 3000	24 OPzV 3000	1185	1146	978	756	609	450	323	271

AMPERES TO 1.90 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	129	104	76	51.4	39.4	27.4	19.2	16.1
SMG 250	5 OPzV 250	146	125	94	63.5	49.3	34.3	24	20.1
SMG 300	6 OPzV 300	163	143	109	76	59.1	41.1	28.8	24.2
SMG 350	5 OPzV 350	165	146	111	79	63.5	46.2	33.4	28.4
SMG 420	6 OPzV 420	173	158	127	95	76	55.4	40	34.1
SMG 490	7 OPzV 490	181	168	142	110	89	64.7	46.7	39.8
SMG 600	6 OPzV 600	203	197	172	135	109	79	57.2	48.7
SMG 800	8 OPzV 800	317	289	244	180	145	106	76	65
SMG 1000	10 OPzV 1000	376	361	305	225	181	132	95	81
SMG 1200	12 OPzV 1200	411	388	332	263	216	158	114	97
SMG 1500	12 OPzV 1500	405	405	380	296	245	184	139	117
SMG 2000	16 OPzV 2000	540	540	506	394	326	246	185	156
SMG 2500	20 OPzV 2500	675	675	633	493	408	307	231	195
SMG 3000	24 OPzV 3000	810	810	759	591	489	369	278	234



12. CONSTANT POWER DISCHARGE DATA

WATT PER CELL TO 1.65 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	465	318	201	129	96	64.9	45.8	38.8
SMG 250	5 OPzV 250	520	383	253	161	120	81	57.3	48.5
SMG 300	6 OPzV 300	612	448	303	193	144	97	68.8	58.3
SMG 350	5 OPzV 350	666	497	346	225	169	115	81	68.3
SMG 420	6 OPzV 420	762	596	413	270	202	138	97	82
SMG 490	7 OPzV 490	835	672	482	315	236	161	114	96
SMG 600	6 OPzV 600	964	800	585	385	289	197	139	117
SMG 800	8 OPzV 800	1485	1123	805	513	385	263	185	156
SMG 1000	10 OPzV 1000	1760	1404	990	645	485	328	231	195
SMG 1200	12 OPzV 1200	1970	1633	1192	770	573	394	277	234
SMG 1500	12 OPzV 1500	2181	1874	1408	946	721	499	349	294
SMG 2000	16 OPzV 2000	2909	2499	1877	1262	962	666	465	392
SMG 2500	20 OPzV 2500	3636	3124	2346	1577	1202	832	581	489
SMG 3000	24 OPzV 3000	4363	3749	2815	1892	1442	999	698	587

WATT PER CELL TO 1.70 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	440	311	200	128	96	64.8	45.8	38.8
SMG 250	5 OPzV 250	500	374	251	160	120	81	57.2	48.5
SMG 300	6 OPzV 300	583	433	301	192	144	97	68.7	58.2
SMG 350	5 OPzV 350	627	483	343	223	168	115	81	68.2
SMG 420	6 OPzV 420	703	565	405	268	202	138	97	82
SMG 490	7 OPzV 490	766	631	473	313	236	161	113	95
SMG 600	6 OPzV 600	891	751	577	382	288	197	139	117
SMG 800	8 OPzV 800	1365	1073	783	510	385	262	185	156
SMG 1000	10 OPzV 1000	1626	1341	979	641	485	328	231	195
SMG 1200	12 OPzV 1200	1802	1522	1154	765	572	394	277	234
SMG 1500	12 OPzV 1500	1988	1727	1353	938	721	499	348	293
SMG 2000	16 OPzV 2000	2651	2303	1804	1251	961	665	465	391
SMG 2500	20 OPzV 2500	3313	2879	2256	1564	1201	832	581	489
SMG 3000	24 OPzV 3000	3976	3455	2707	1876	1441	998	697	587

WATT PER CELL TO 1.75 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	406	297	198	128	96	64.7	45.8	38.8
SMG 250	5 OPzV 250	464	353	247	159	120	81	57.2	48.4
SMG 300	6 OPzV 300	547	421	297	191	143	97	68.6	58.1
SMG 350	5 OPzV 350	567	454	326	219	167	115	81	68.1
SMG 420	6 OPzV 420	632	520	387	262	200	138	97	82
SMG 490	7 OPzV 490	687	575	441	306	234	161	113	95
SMG 600	6 OPzV 600	785	687	539	374	286	197	139	117
SMG 800	8 OPzV 800	1225	978	747	499	381	262	185	156
SMG 1000	10 OPzV 1000	1458	1222	934	627	480	328	230	195
SMG 1200	12 OPzV 1200	1609	1376	1079	749	572	393	276	233
SMG 1500	12 OPzV 1500	1770	1553	1260	915	714	499	348	293
SMG 2000	16 OPzV 2000	2360	2071	1680	1220	952	665	464	391
SMG 2500	20 OPzV 2500	2950	2589	2101	1525	1190	831	580	488
SMG 3000	24 OPzV 3000	3540	3107	2521	1830	1429	997	696	586



WATT PER CELL TO 1.80 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	363	279	190	126	94	64.3	45.7	38.7
SMG 250	5 OPzV 250	423	336	245	159	118	80	57.1	48.4
SMG 300	6 OPzV 300	487	391	286	190	142	96	68.6	58.1
SMG 350	5 OPzV 350	500	408	306	211	164	114	81	68.1
SMG 420	6 OPzV 420	554	467	363	253	197	137	97	82
SMG 490	7 OPzV 490	597	516	408	295	230	160	113	95
SMG 600	6 OPzV 600	693	614	493	361	281	195	139	117
SMG 800	8 OPzV 800	1073	893	690	481	375	261	185	156
SMG 1000	10 OPzV 1000	1275	1093	863	605	472	326	230	194
SMG 1200	12 OPzV 1200	1399	1222	985	722	566	391	276	233
SMG 1500	12 OPzV 1500	1468	1361	1158	878	702	496	348	293
SMG 2000	16 OPzV 2000	1958	1814	1544	1171	936	661	464	390
SMG 2500	20 OPzV 2500	2447	2268	1929	1464	1170	826	580	488
SMG 3000	24 OPzV 3000	2937	2721	2315	1757	1404	991	695	586

WATT PER CELL TO 1.85 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	309	243	175	117	88	60.8	42.5	35.8
SMG 250	5 OPzV 250	360	292	218	144	110	76	53.1	44.7
SMG 300	6 OPzV 300	408	336	254	173	132	91	63.8	53.7
SMG 350	5 OPzV 350	426	351	266	186	146	105	74.9	63.1
SMG 420	6 OPzV 420	454	390	309	224	175	126	90	76
SMG 490	7 OPzV 490	482	427	350	261	204	147	105	88
SMG 600	6 OPzV 600	558	509	416	319	250	179	128	108
SMG 800	8 OPzV 800	864	730	583	426	333	239	171	144
SMG 1000	10 OPzV 1000	1027	912	729	532	417	299	214	180
SMG 1200	12 OPzV 1200	1126	1020	832	627	500	359	257	216
SMG 1500	12 OPzV 1500	1107	1072	920	717	581	432	312	261
SMG 2000	16 OPzV 2000	1475	1429	1227	956	774	575	415	349
SMG 2500	20 OPzV 2500	1844	1786	1534	1195	968	719	519	436
SMG 3000	24 OPzV 3000	2213	2143	1840	1434	1161	863	623	523

WATT PER CELL TO 1.90 VPC (AT 20°C)

CELL TYPE	DIN CELL TYPE	DISCHARGE TIME (MINUTES)							
		15	30	60	120	180	300	480	600
SMG 200	4 OPzV 200	245	198	146	100	77	53.5	37.6	31.6
SMG 250	5 OPzV 250	277	237	180	123	96	66.9	47	39.5
SMG 300	6 OPzV 300	309	273	210	147	115	80	56.4	47.4
SMG 350	5 OPzV 350	313	279	214	153	123	90	65.3	55.7
SMG 420	6 OPzV 420	331	301	245	183	148	108	78	66.9
SMG 490	7 OPzV 490	347	322	274	214	173	126	91	78
SMG 600	6 OPzV 600	389	378	330	261	211	155	112	95
SMG 800	8 OPzV 800	604	552	469	348	282	206	149	127
SMG 1000	10 OPzV 1000	718	690	586	435	352	258	187	159
SMG 1200	12 OPzV 1200	786	743	640	508	419	309	224	191
SMG 1500	12 OPzV 1500	777	777	729	571	474	359	271	229
SMG 2000	16 OPzV 2000	1036	1036	972	762	632	479	362	305
SMG 2500	20 OPzV 2500	1295	1295	1215	952	791	599	452	381
SMG 3000	24 OPzV 3000	1554	1554	1459	1143	949	718	542	457



ENGINEERING MANUAL

SMG (OPzV)



www.fiamm.com