

DATA SHEET

Green-Cap

- Green-Cap is the brand name of SAMWHA's electric double layer capacitor(EDLC).
- Electric double layer capacitor(EDLC) is a next generation energy storage device.

DM01500666W01006

Green-Cap Module

FEATURE

- 15V Operating Voltage
- High Power Density
- Low Internal Resistance
- Rapid charge and discharge
- Passive Balancing

APPLICATION

- Short Term UPS and Telecommunication
- Next Generation Vehicle (HEV, FCEV)
- Industrial and automation

PRODUCT SPECIFICATION

Rated Voltage	Capacitance (F)	ESR, 1kHz (mΩ)	ESR, DC (mΩ)	Total Energy (Wh)	Max. Continuous Current (A)	Max Peak Current (A)	Self-discharge (%of initial V)	Weight (kg)	Dimension L x W x H (mm)
15	66.6	21.0	24.0	2.43	21	208	50%; 15hours	1	220x37.5x67

- Dimension and Weight could be changed



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PRODUCT CHARACTERISTIC

CAPACITANCE		
Nominal Capacitance	66.6F	
Capacitance tolerance	0 ~ +20%	
VOLTAGE		
Rated voltage	15 V	
Surge voltage	16.2 V	
TEMPERATURE		
Operating temperature range	-40~+60℃	
Storage temperature range	-40~+60℃	
Temperature characteristics	Capacitance change	±5% (at 20℃)
	Internal resistance	±150% (at 20℃)
INTERNAL RESISTANCE		
DC ESR	< 24.0 mΩ	
AC ESR(1KHz)	< 21.0 mΩ	
CURRENT		
Maximum continuous current	21 A	
Maximum peak current (1 sec.)	208 A	
Self-discharge (15hours RT; 12hours charge and hold)	50%	

ENDURANCE	
Endurance	After 1,000hr application of rated voltage at 60℃
Capacitance change	Within ±30% of initial specified value
Internal resistance	Within 100% of initial specified value
Life test	After 10 years at rated voltage and 25℃
Capacitance change	< 30%
Internal resistance	< 200%
CYCLES	
Capacitors cycles between rated voltage under constant current at 25℃ (500,000Cycle)	
Capacitance change	< 30%
Internal resistance	< 200%



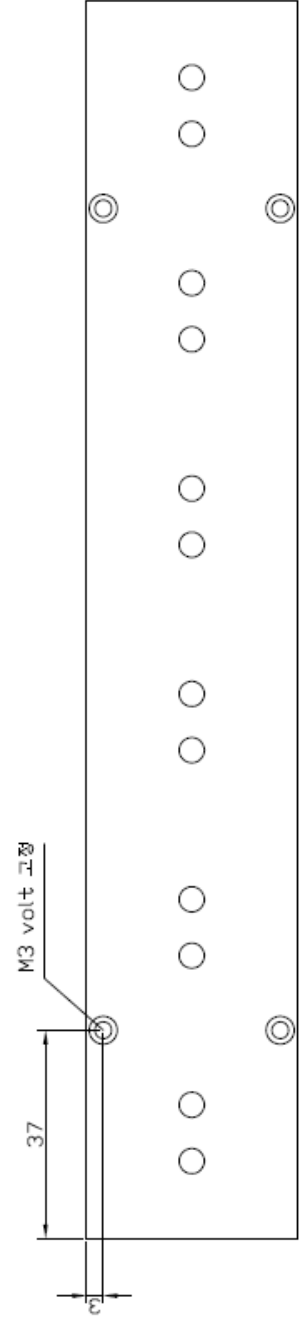
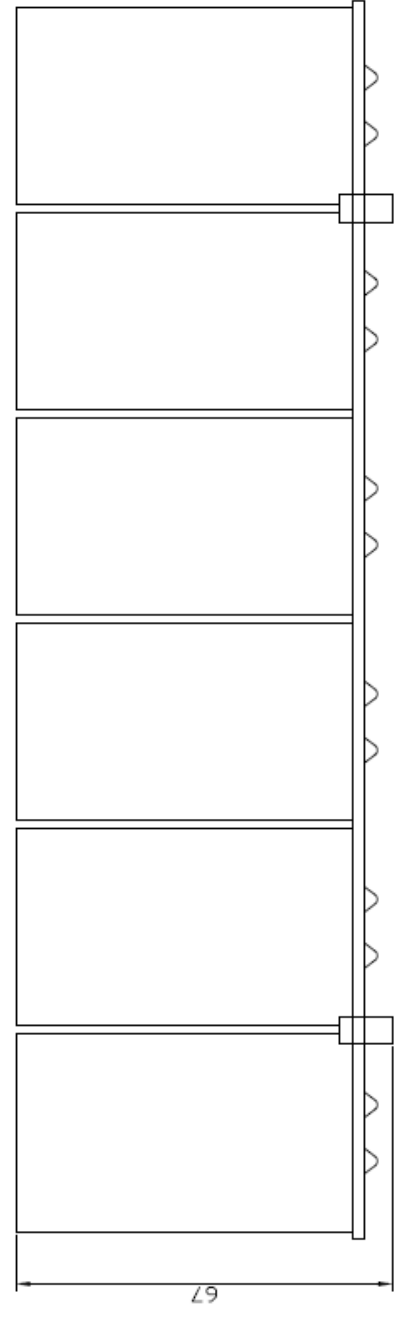
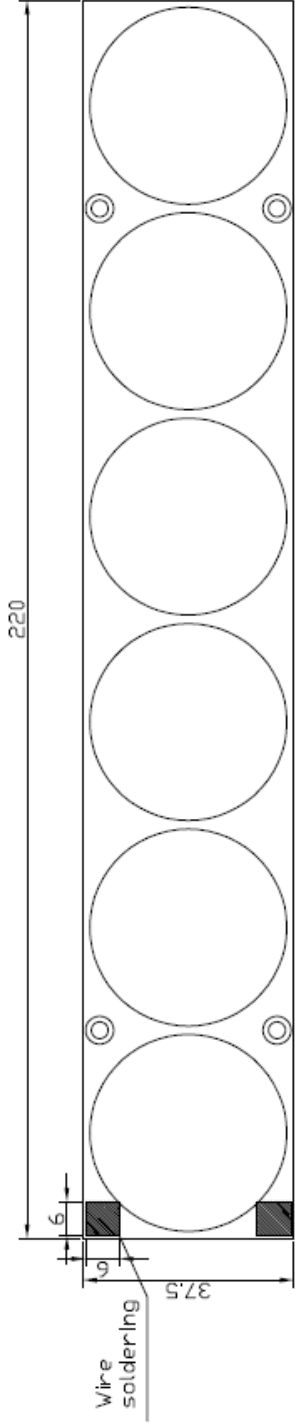
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SINGLE CELL PRODUCT CHARACTERISTIC

CAPACITANCE		
Nominal Capacitance	400F	
Capacitance tolerance	0 ~ +20%	
VOLTAGE		
Rated voltage	2.7 V	
Surge voltage	2.85 V	
TEMPERATURE		
Operating temperature range	-40~+60 ℃	
Storage temperature range	-40~+60 ℃	
Temperature characteristics	Capacitance change	±5% (at 20 ℃)
	Internal resistance	±150% (at 20 ℃)
INTERNAL RESISTANCE		
DC ESR	< 4 mΩ	
AC ESR(1KHz)	< 3.5 mΩ	
CURRENT		
Maximum continuous current	21 A	
Maximum peak current (1 sec.)	208 A	
SIZE		
Weight (g)	65	
Dimension (ΦxH) (mm)	35 x 60	

ENDURANCE	
Endurance	After 1,000hr application of rated voltage at 60 ℃
Capacitance change	Within ±30% of initial specified value
Internal resistance	Within 100% of initial specified value
Life test	After 10 years at rated voltage and 25 ℃
Capacitance change	< 30%
Internal resistance	< 200%
CYCLES	
Capacitors cycles between rated voltage under constant current at 25 ℃ (500,000Cycle)	
Capacitance change	< 30%
Internal resistance	< 200%



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PERFORMANCE

Test environmental conditions

- Ambient temperature : 25 ± 2 °C, Relative humidity : 60~70%, Air pressure : 86~106kPa

No	ITEM	TEST CONDITION	SPECIFICATION															
1	Rated voltage		See the table "PRODUCT CHARACTERISTIC"															
2	Capacitance (tolerance)	To see measure method (See No. 9)	See the table "PRODUCT CHARACTERISTIC"															
3	Internal resistance	To see measure method (See No. 10)	See the table "PRODUCT CHARACTERISTIC"															
4	Temperature characteristics	<table border="1"><thead><tr><th>STEP</th><th>TEMPERATURE(°C)</th><th>TIME</th></tr></thead><tbody><tr><td>1</td><td>20 \pm2</td><td></td></tr><tr><td>2</td><td>-40 \pm2</td><td>2hr</td></tr><tr><td>3</td><td>20 \pm2</td><td>15 min</td></tr><tr><td>4</td><td>60 \pm2</td><td>2 hr</td></tr></tbody></table> <p>Step-1 Capacitance, ESR and leakage current shall be measured. Step-2, 4 After the capacitor being stored for 2hours, capacitance and ESR and leakage current shall be measured. Step-3 After the capacitor being stored for 15min, capacitance and ESR and leakage current shall be measured.</p>	STEP	TEMPERATURE(°C)	TIME	1	20 \pm 2		2	-40 \pm 2	2hr	3	20 \pm 2	15 min	4	60 \pm 2	2 hr	<ul style="list-style-type: none">• Capacitance change within $\pm 5\%$ of initial specified value• Internal resistance $\leq 150\%$ of initial value• Leakage current \leq Initial specified value
STEP	TEMPERATURE(°C)	TIME																
1	20 \pm 2																	
2	-40 \pm 2	2hr																
3	20 \pm 2	15 min																
4	60 \pm 2	2 hr																

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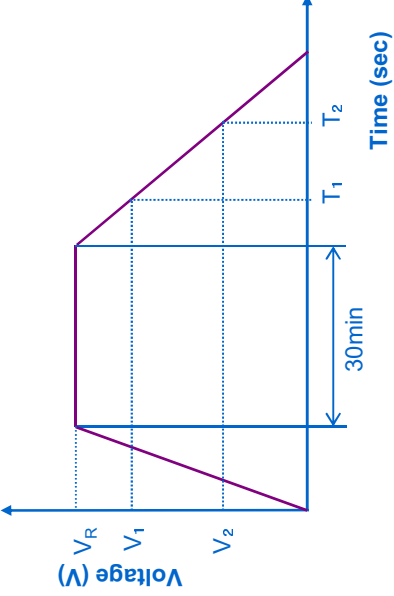
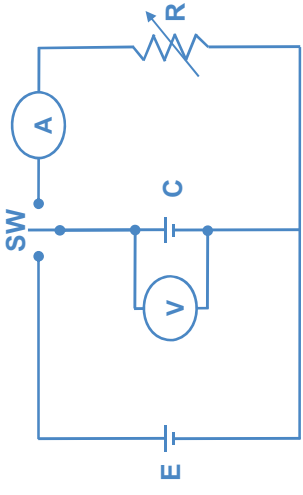
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PERFORMANCE

Test environmental conditions

- Ambient temperature : 25 ± 2 °C, Relative humidity : 60~70%, Air pressure : 86~106kPa

No	ITEM	TEST CONDITION	SPECIFICATION															
5	Endurance	<ul style="list-style-type: none"> • Temperature : 60 °C ± 2 °C • Applied voltage : rated voltage • Duration : 1000 +72/-0 hours 	<ul style="list-style-type: none"> • No visible damage • Capacitance change within $\pm 30\%$ of initial specified value • Internal resistance $\leq 100\%$ of Initial specified value • Leakage current \leq of initial specified value 															
6	Shelf life	<ul style="list-style-type: none"> • Temperature : 60 °C ± 2 °C • Duration : 1000 +72/-0 hours 	<ul style="list-style-type: none"> • No visible damage • Capacitance change within $\pm 30\%$ of initial specified value • Internal resistance $\leq 100\%$ of Initial specified value • Leakage current \leq of initial specified value 															
7	Cycle life	<table border="1"> <thead> <tr> <th>STEP</th> <th>VOLTAGE (V)</th> <th>TIME (sec.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Charge to Rated Voltage</td> <td>20 \pm 1</td> </tr> <tr> <td>2</td> <td>Rest to Rated Voltage</td> <td>10 \pm 0.5</td> </tr> <tr> <td>3</td> <td>Discharge to Rated Voltage $\times 1/2$</td> <td>about(20 \pm 1)</td> </tr> <tr> <td>4</td> <td>Rest to Rated Voltage $\times 1/2$</td> <td>10 \pm 0.5</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Cycle : 500,000 cycles 	STEP	VOLTAGE (V)	TIME (sec.)	1	Charge to Rated Voltage	20 \pm 1	2	Rest to Rated Voltage	10 \pm 0.5	3	Discharge to Rated Voltage $\times 1/2$	about(20 \pm 1)	4	Rest to Rated Voltage $\times 1/2$	10 \pm 0.5	<ul style="list-style-type: none"> • No visible damage • Capacitance change within $\pm 30\%$ of initial specified value • Internal resistance $\leq 200\%$ of Initial specified value • Leakage current \leq of initial specified value
STEP	VOLTAGE (V)	TIME (sec.)																
1	Charge to Rated Voltage	20 \pm 1																
2	Rest to Rated Voltage	10 \pm 0.5																
3	Discharge to Rated Voltage $\times 1/2$	about(20 \pm 1)																
4	Rest to Rated Voltage $\times 1/2$	10 \pm 0.5																
8	Damp heat (steady state)	<ul style="list-style-type: none"> • Temperature : 40 ± 2 °C • Relative humidity : 90%~95% • Duration : 240 ± 8 hours 	<ul style="list-style-type: none"> • No visible damage • Capacitance change within $\pm 30\%$ of initial specified value • Internal resistance $\leq 200\%$ of Initial specified value • Leakage current \leq of initial specified value 															

Measuring Method Of Characteristics	
9	<p style="text-align: center;">Capacitance</p> <p>1) Charging is performed by constant current followed by constant voltage charging 2) Charging is performed for duration of 30 minutes at rated voltage. 3) Discharge use a constant current load device and measure the time for the terminal voltage to drop from V_1 to V_2 upon discharge at 1mA/F. ($V_1 = 0.8 \times V_R$, $V_2 = 0.4 \times V_R$) 4) The capacitance can be obtained by the following equation.</p> $C = \frac{I \times (T_2 - T_1)}{V_1 - V_2} \text{ (F)}$  
10	<p style="text-align: center;">ESR</p> <p>The AC Resistance is used. 1) The Frequency of the measuring voltage shall be 1kHz. 2) The AC current shall be from 1 to 10mA.</p>

• Please contact SAMWHA Green-Cap directly for any technical specifications critical to application.



Installation	
11	<p>Power Cable Connection</p> <ol style="list-style-type: none"> 1) Confirm cleanness of compression terminal. 2) Connecting a power cable, use standard size nut and spring washer. 3) A screw should be tightened with standard torque according to 'bolt' and 'nut' size. 4) Confirm the polarity of cable for correct connection.
12	<p>Caution</p> <ol style="list-style-type: none"> 1) In case more than two Green-Cap modules are connected in series, use capacitor module of the same specification supplied by the same company This is to prevent unbalances resulting from difference of capacitance and leakage current of Module. 2) In case more than two Green-Cap modules are connected in Series, each module should be connected together with equivalent voltage(0V) after those modules are discharged completely. 3) If the outside of a Module is wet, Do not touch it. 4) Never touch both capacitor terminals at the same time. 5) Do not open the case of Green-Cap Module. 6) Operate the Green-Cap module under the guaranteed range. 7) Before the module is stored, discharge the module completely, then Short the terminal.

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