

## Product Datasheet

### Small cell ultracapacitors – 6V Module type

- Rated voltage 6VDC
- 1.5 up to 5F capacitance
- High capacitance and low ESR
- High cycle life of 500'000 cycles
- Excellent DC life performance
- Wetting proof design



#### ELECTRICAL SPECIFICATIONS

Type	M00S-006-01C5 M00S-006-01S5 M00S-006-01H5	M00S-006-02C5 M00S-006-02S5 M00S-006-02H5	M00S-006-05C0 M00S-006-05S0 M00S-006-05H0
Rated Voltage $V_R$ @ -40 - +65°C	6.00 V	6.00 V	6.00 V
Rated Voltage $V_R$ @ -40 - +85°C	5.00 V	5.00 V	5.00 V
Rated Capacitance $C^2$	1.5 F	2.5 F	5 F
Capacitance Tolerance <sup>3</sup>	-10% / +20%	-10% / +20%	-10% / +20%
ESR, 1kHz <sup>2</sup> (Typical Values)	90 mΩ (82 mΩ)	80 mΩ (54 mΩ)	50 mΩ (32 mΩ)
ESR, DC <sup>2</sup> (Typical Values)	140 mΩ (126 mΩ)	90 mΩ (78 mΩ)	80 mΩ (60 mΩ)
Leakage Current $I_L$ <sup>4</sup>	0.015 mA	0.020 mA	0.060 mA
Max Peak Current $I_{Max}$ <sup>5</sup>	3.72 A	6.12 A	10.71 A
Usable Continuous Current $I_S$ <sup>6</sup>	1.2 A	2.0 A	3.0 A
Stored Energy $E^7$	7.5 mWh	12.5 mWh	25 mWh
Energy Density $E_d$ <sup>8</sup>	1.79 Wh/kg	2.23 Wh/kg	3.13 Wh/kg
Matched Impedance Power, Density $P_{dMax}$ <sup>9</sup>	15.3 kW/kg	17.9 kW/kg	21.0 kW/kg

#### THERMAL CHARACTERISTICS

Type	M00S-006-01C5 M00S-006-01S5 M00S-006-01H5	M00S-006-02C5 M00S-006-02S5 M00S-006-02H5	M00S-006-05C0 M00S-006-05S0 M00S-006-05H0
Working Temperature	-40 ~ 65°C	-40 ~ 65°C	-40 ~ 65°C
Temperature Characteristics	Capacitance change within ±5% of value at RT, ESR change within ±150% of value at RT		
Thermal Resistance $R_{Th}$ <sup>10</sup>	74 K/W	42K/W	21K/W

#### LIFETIME CHARACTERISTICS

Type	M00S-006-01C5 M00S-006-01S5 M00S-006-01H5	M00S-006-02C5 M00S-006-02S5 M00S-006-02H5	M00S-006-05C0 M00S-006-05S0 M00S-006-05H0
DC Life at HT @ 65°C <sup>11</sup>	1000 hours		
DC Life at HT @ 85°C <sup>11</sup>	1000 hours @ max. 5.0V		
DC Life at RT <sup>12</sup>	10 years		
Cycle Life <sup>13</sup>	500'000 cycles		
Shelf Life <sup>14</sup>	3 years		

#### SAFETY & ENVIRONMENTAL SPECIFICATIONS

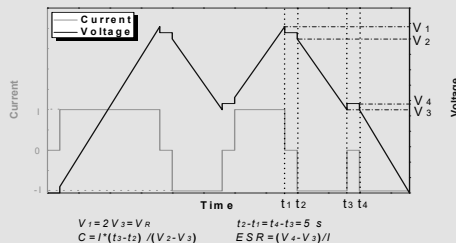
Type	M00S-006-01C5 M00S-006-01S5 M00S-006-01H5	M00S-006-02C5 M00S-006-02S5 M00S-006-02H5	M00S-006-05C0 M00S-006-05S0 M00S-006-05H0
Safety	RoHS, REACH and UL810		
Shock and vibration	MIL-STD-202, Method 213, Fig. 1, condition C; Method 204 (acc. AEC-Q200)		

## PHYSICAL PARAMETERS

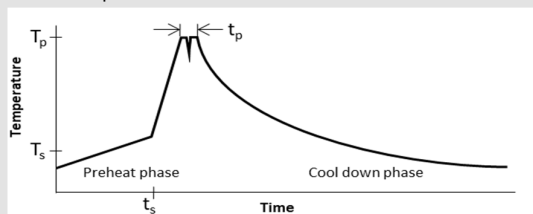
Type	M00S-006-01C5 M00S-006-01S5 M00S-006-01H5	M00S-006-02C5 M00S-006-02S5 M00S-006-02H5	M00S-006-05C0 M00S-006-05S0 M00S-006-05H0
Mass M	4.2 g	5.6 g	8.0 g
Terminals (wire leads)	Solderable, tinned copper-ply wire <sup>16</sup>		
Dimensions <sup>17</sup> L x W x D	22.0 x 17.0 x 8.5 mm	22.0 x 21.0 x 10.5 mm	32.0 x 21.0 x 10.5
Lead distance P	Type <b>C</b> Type <b>S</b> Type <b>H</b>	5.5 mm 15.5 mm 10.5 mm	5.5 mm 15.5 mm 10.5 mm
Lead diameter d	0.6 mm	0.6 mm	0.6 mm

## NOTES:

- Surge voltage  $V_S$ : Absolute maximum voltage, non-repetitive. The duration must not exceed 1 second.
- Capacitance C: The test current is 0.075 A/F, if the calculated current is >100A, then apply 100A.

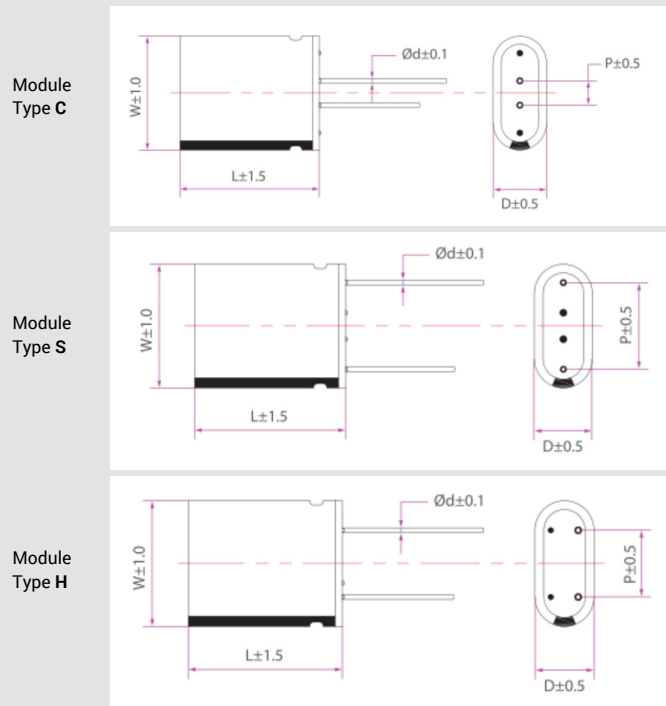


- Capacitance tolerance: Typical tolerance is +5%~+10%.
- Leakage current measurement procedure: 1) Charge the capacitor to the  $V_R$  with a constant current (0.075 A/F, if the calculated current is >100A, then apply 100A). 2) Hold the voltage at  $V_R$  for 72h. 3) The current to maintain  $V_R$  after 72 h is the leakage current.
- Max current:  $I_{Max} = 0.5C \cdot V_R / (\Delta t + ESR \cdot C)$ , discharge from  $V_R$  to  $V_R/2$  in 1 second.
- Max constant working current:  $I_{MCC} = \sqrt{\Delta T / (ESR \cdot R_{Th})}$
- Stored energy:  $E = 0.5C \cdot V^2 / 3600$
- Energy density:  $E_d = E / M$
- Matched impedance power density:  $P_{dMax} = (0.25V_R^2 / ESR) / M$
- Thermal resistance ( $\Delta T = 15^\circ\text{C}$ ):  $R_{Th} = \Delta T / P$ , where  $P = ESR \cdot I^2$
- DC life at high temperature HT: At  $65^\circ\text{C}$  hold the capacitor charged at rated voltage for 1000h or at  $85^\circ\text{C}$  at max. 2.5V for 1000h. The capacitance shall be >70% of the rated value, the ESR shall be <200% of the rated value.
- DC life at RT: Hold the capacitor charged at rated voltage at room temperature RT, the capacitance shall be >80% of the rated value, the ESR shall be <200% of the rated value.
- Cycle life: Charge and discharged the capacitor in the range between  $V_R$  and  $V_R/2$ . 5 seconds waiting period between charge and discharge. The constant test current is 0.075 A/F (if the calculated current >100A, then apply 100A).
- Storage temperature: Storage in discharge state, < $35^\circ\text{C}$
- Shelf life: Stored uncharged at RT, <50% RH
- Wave solder profile



Profile feature	Standard SnPb	Pb free
Preheat/soak temperature $T_s$	100°C	100°C
Preheat/soak time $t_s$	60 s	60 s
Peak temperature $T_p$	220 – 260°C	250 – 260°C
Time to peak temperature $t_p$	10s max, 5s max/wave	10s max, 5s max/wave
Ramp-down rate	2-5 K/s	2-5 K/s
Time solder process (RT to RT)	4 min	4 min

## 17. Dimensions:



## Notes:

### Standard markings:

- + Name of manufacturer, part number, serial number
- + Rated voltage and capacitance, negative and positive terminals, warning marking
- + Stored energy in watt-hours

### Mounting recommendations:

- + Mounting without applying undue mechanical stress on the terminals
- + Provide adequate spacing in between cells to secure required insulation strength
- + Provide clearance around the safety vent and do not position anything above the safety vent that may be damaged in an event of vent rupture

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