Maxwell TECHNOLOGIES
Enabling Energy's Future™

DATASHEET

# 2.7V 325F ULTRACAPACITOR CELL

BCAP0325 P270 S19


## High Power Energy Solution in Compact Form Factor

Maxwell Technologies' 2.7V 325F ultracapacitor cell is part of Maxwell's full featured lineup of energy storage solutions designed to support the latest trends in automotive applications, small UPS systems, consumer and industrial electronics, and medical equipment. The 2.7V 325F ultracapacitor cell has by far the lowest ESR and highest power density among Maxwell's medium cell family is designed for performance and system optimization in a long life, small form factor. Whether used alone, integrated into a module assembly, or in a hybrid configuration, Maxwell's ultracapacitor products will help reduce the overall cost and size of the system while improving return on investments for the customer.

Ultracapacitors are the technology of choice for high energy and high power applications because of their longer operating lifetime, low maintenance requirements, and superior cold weather performance when compared to batteries.

### FEATURES AND BENEFITS

- High power cell with ultra-low ESR, suitable for automotive application (AEC-Q200 qualified)
- 3,000 hour DC life at rated voltage and maximum operating temperature*
- Designed for up to 1 million duty cycles*
- Small 33mm diameter enabling compact system designs
- Integrated 4-pin terminals for easy PCB mounting
- Compliant with UL, RoHS, and REACH requirements

### TYPICAL APPLICATIONS

- Automotive – Peak Power Assist Subsystems, Back-Up Power Applications
- Backup and UPS System
- Consumer and Industrial Electronics
- Medical Equipment
- Emergency Lighting

### ORDERING INFORMATION

| Model Number | Part Number | Package Quantity (MOQ) |
|---|---|---|
| BCAP0325 P270 S19 | **135968** | **110** |

*Results may vary. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.

## PRODUCT SPECIFICATIONS & CHARACTERISTICS

Values are referenced at $T_A$ = room temperature and $V_R$ = 2.7V rated voltage (unless otherwise noted). Min and Max values indicate product specifications. Typical results will vary and are provided for reference only. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details for applicable operating and use requirements.

| Symbol | Parameter | Conditions | Min | Typical | Max | Unit |
|---|---|---|---|---|---|---|
| **ELECTRICAL** | | | | | | |
| $V_R$ | Rated Voltage | | – | – | 2.7 | V |
| $V_{SURGE}$ | Surge Voltage | Note 1 | – | – | 2.85 | V |
| $C_R$ | Rated Capacitance | BOL, Note 2,8 | 325 | 345 | 390 | F |
| $R_S$ | Equivalent Series Resistance ($ESR_{DC}$) | BOL, Note 2,8 | – | 1.6 | 1.9 | mΩ |
| $I_{LEAK}$ | Leakage Current | Note 3,8 | – | 0.45 | 0.70 | mA |
| $I_{PEAK}$ | Peak Current | BOL, Note 4,8 | – | – | 270 | A |
| $I_{MAX}$ | Continuous Current | BOL, Note 7,8<br>- $\Delta T$ = 15°C<br>- $\Delta T$ = 40°C | <br>–<br>– | <br>–<br>– | <br>30<br>49 | $A_{RMS}$ |
| **LIFE** | | | | | | |
| $t_{65C}$ | High Temperature Life | $V_R$ = 2.7V and $T_A$ = 65°C, EOL, Note 8<br>- Capacitance change ΔC from min $C_R$<br>- Resistance change ΔR from max $R_S$ | –<br>–<br>– | 3,000<br>-20<br>+100 | –<br>–<br>– | hours<br>%<br>% |
| $t_{85C}$ | De-rated Voltage & Higher Temperature Life | $V_R$ = 2.3V and $T_A$ = 85°C, EOL, Note 8<br>- Capacitance change ΔC from min $C_R$<br>- Resistance change ΔR from max $R_S$ | –<br>–<br>– | 1,500<br>-20<br>+100 | –<br>–<br>– | hours<br>%<br>% |
| $t_{25C}$ | Projected Life Time | $V_R$ = 2.7V and $T_A$ = 25°C, EOL, Note 8<br>- Capacitance change ΔC from min $C_R$<br>- Resistance change ΔR from max $R_S$ | –<br>–<br>– | 10<br>-20<br>+100 | –<br>–<br>– | years<br>%<br>% |
| $n_{CYCLE}$ | Projected Cycle Life | $T_A$ = 25°C, EOL, Note 6,8<br>- Capacitance change ΔC from min $C_R$<br>- Resistance change ΔR from max $R_S$ | –<br>–<br>– | 1,000,000<br>-20<br>+100 | –<br>–<br>– | cycles<br>%<br>% |
| $t_{SHELF}$ | Shelf Life | Stored uncharged, $T_A$ = 25°C and RH ≤ 50% | – | 4 | – | years |

## PRODUCT SPECIFICATIONS & CHARACTERISTICS

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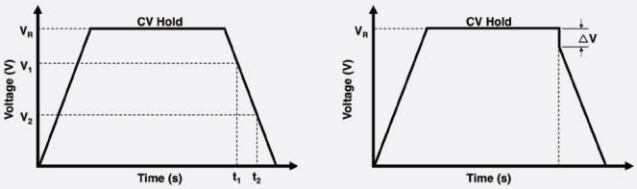
| Symbol | Parameter | Conditions | Min | Typical | Max | Unit |
|---|---|---|---|---|---|---|
| **POWER & ENERGY** | | | | | | |
| $P_d$ | Usable Specific Power | BOL, Note 5,8 | 7.1 | 8.4 | – | kW/kg |
| $P_{MAX}$ | Impedance Match Specific Power | BOL, Note 5,8 | 14.8 | 17.5 | – | kW/kg |
| $E_d$ | Gravimetric Specific Energy | BOL, Note 5,8 | 5.1 | 5.4 | – | Wh/kg |
| $E_{MAX}$ | Stored Energy | BOL, Note 5,8,9 | 0.33 | 0.35 | – | Wh |
| **TEMPERATURE** | | | | | | |
| $T_A$ | Operating Temperature | Cell case temperature | -40 | 25 | 65 | °C |
| $R_{th}$ | Thermal Resistance | Case to ambient, Note 7 | – | 8.8 | – | °C/W |
| $C_{th}$ | Thermal Capacitance | | – | 76 | – | J/°C |
| **PHYSICAL** | | | | | | |
| m | Mass | | – | 65 | – | g |
| – | Vibration – Sine Wave | | IEC 60068-2-6 | | | – |
| – | Shock | | IEC 60068-2-27 | | | – |
| **SAFETY** | | | | | | |
| – | Certifications | | UL810A, RoHS, REACH | | | |

# NOTES

1. Surge Voltage
   Absolute maximum voltage, non-repetitive. The duration must not exceed 1 second.

2. Rated Capacitance & $ESR_{DC}$ (Measurement Method)
   - Capacitance: Constant current charge (10mA/F) to $V_R$, 5 min hold at $V_R$, constant current discharge (10mA/F) to 0.1V.
   - $ESR_{DC}$: Constant current charge (10mA/F) to $V_R$, 5 min hold at $V_R$, constant current discharge (40 * $C_R$ * $V_R$ [mA]) to 0.1V.




$$C_R = \frac{I \times (t_2 - t_1)}{V_1 - V_2} \qquad R_S = \frac{\Delta V}{I}$$

where $C_R$ is the capacitance (F);
$I$ is the absolute value of the discharge current (A);
$V_R$ is the rated voltage (V);
$V_1$ is the measurement starting voltage, 0.8 X $V_R$ (V);
$V_2$ is the measurement end voltage, 0.4 X $V_R$ (V);
$t_1$ is the time from discharge start to reach $V_1$ (s);
$t_2$ is the time from discharge start to reach $V_2$ (s);
$R_S$ is the DC equivalent series resistance (Ω);
$\Delta V$ is the voltage drop during first 10ms of discharge (V).

3. Leakage Current (Measurement Method)
   - Current measured after 72 hours of constant voltage hold at $V_R$ and 25°C. Initial leakage current can be higher.
   - If applicable, module leakage current is the sum of cell leakage current and bypass current created by balancing circuit.

4. Peak Current
   - Current needed to discharge cell or module from $V_R$ to 1/2$V_R$ in 1 second.

$$I_{PEAK} = \frac{½V_R}{\Delta t / C_R + R_S}$$

where $I_{PEAK}$ is the maximum peak current (A);
$V_R$ is the rated voltage (V);
$\Delta t$ is the discharge time (sec); $\Delta t$ = 1 sec in this case;
$C_R$ is the rated BOL capacitance (F);
$R_S$ is the maximum BOL $ESR_{DC}$ (Ω).

   - The stated peak current should not be used in normal operation and is provided as a reference value only.

5. Energy & Power (Based on IEC 62576)
   - Usable Specific Power, $P_d$ (W/kg) = $\frac{0.12V_R^2}{R_S \times m}$
   - Impedance Match Specific Power, $P_{MAX}$ (W/kg) = $\frac{0.25V_R^2}{R_S \times m}$
   - Gravimetric Specific Energy, $E_d$ (Wh/kg) = $\frac{E_{MAX}}{m}$
   - Stored Energy, $E_{MAX}$ (Wh) = $\frac{½C_R \times V_R^2}{3{,}600}$

where $V_R$ is the rated voltage (V);
$R_S$ is the maximum BOL $ESR_{DC}$ (Ω);
m is the typical mass (kg);
$C_R$ is the rated BOL capacitance (F).

6. Projected Cycle Life
   - Constant current charge-discharge cycle from $V_R$ to 1/2$V_R$ at 25°C.
   - Cycle life is dependent upon application-specific characteristics. Actual results will vary.

7. Continuous Current & Thermal Resistance
   - Maximum current which can be used continuously within the allowed temperature range.

$$I_{MAX} = \sqrt{\frac{\Delta T}{R_{th} \times R_S}}$$

where $I_{MAX}$ is the maximum continuous current (A);
$\Delta T$ is the change in temperature (°C);
$R_{th}$ is the typical thermal resistance (°C/W);
$R_S$ is the maximum BOL $ESR_{DC}$ (Ω).

8. BOL & EOL Conditions
   - BOL (Beginning of Life): Rated/Initial product performance
   - EOL (End of Life):
     – Capacitance: 80% of min. BOL rating (0.8 x min. $C_R$)
     – $ESR_{DC}$: 200% of max. BOL rating (2 x max. $R_S$)

9. Transportation Regulation
   - Per United Nations material classification UN3499, all Maxwell ultracapacitor cells have less than 10Wh stored energy to meet the requirements of Special Provisions 361. Both individual ultracapacitors and modules composed of ultracapacitors shipped by Maxwell can be transported without being treated as dangerous goods (hazardous materials) under transportation regulations.

# DETAILED PRODUCT DESCRIPTION

## Introduction

The BCAP0325 P270 S19 energy storage cell is a robust ultracapacitor solution in a cylindrical style can with integrated 4-pin terminals.

## Technology Overview

Ultracapacitor, also known as supercapacitor or electric double layer capacitor (EDLC), delivers energy at relatively high rates (beyond those accessible with batteries). Ultracapacitors store charge electrostatically (non-Faradaic) by reversible adsorption of the electrolyte onto electrochemically stable high surface area carbon electrodes. Charge separation occurs on polarization at the electrode/electrolyte interface, producing a double layer. This mechanism is highly reversible, allowing the ultracapacitor to be charged and discharged hundreds of thousands of times.*

## Ultracapacitor Construction

An ultracapacitor is constructed with symmetric carbon positive and negative electrodes separated by an insulating ion-permeable separator and packaged into a container filled with organic electrolyte (salt/solvent) designed to maximize ionic conductivity and electrode wetting. It is the combination of high surface area activated carbon electrodes (typically >1500$m^2$ /g) with extremely small charge separation (Angstroms) that results in high capacitance.

**Ultracapacitor Energy = ½ $CV^2$**

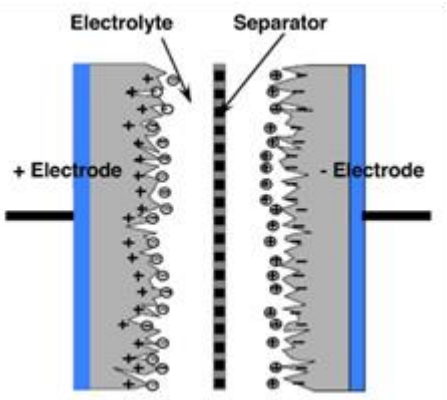



Figure 1: Ultracapacitor Structure Diagram

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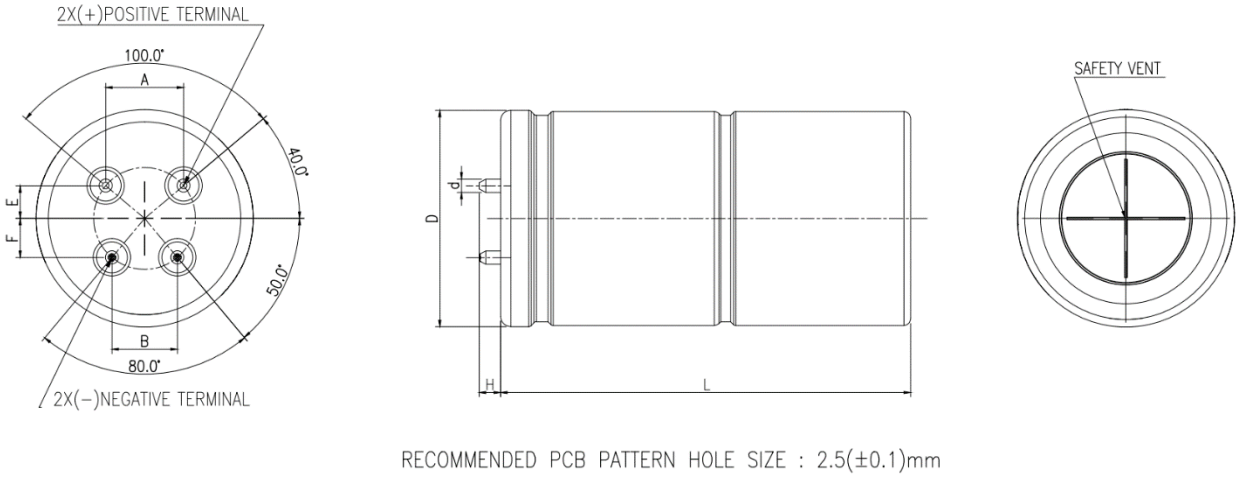
# MECHANICAL DRAWINGS

## BCAP0325 P270 S19




RECOMMENDED PCB PATTERN HOLE SIZE : 2.5(±0.1)mm

| Dimension (Tolerance) | L (±1.0) | D (+1.0) | d (±0.1) | H (±0.3) | A (±0.1) | B (±0.1) | E (±0.1) | F (±0.1) | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| BCAP0325 P270 S19 | 62.5 | 33.0 | 2.0 | 4.0 | 11.9 | 10.0 | 5.0 | 5.9 | mm |



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