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S-Power LR20 Datasheet	EBI	LE00225 / 1.1
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S-Power LR20 Datasheet

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1 S-Power

S-Power is a family of environmentally friendly, PFAS-free supercapacitors developed for applications requiring high power and excellent cycle life. This datasheet describes the S-Power LR20 product variant.

1.1 Features

- Extended low temperature operating range
- Low ESR
- Compact and slim
- Aluminum tabs as standard or with optional copper solderable tabs

1.2 Ratings

Capacitance	20	mF
Capacitance tolerance	-20 to 20	%
Rated voltage	2.7	VDC
Operating temperature	-40 to 60	°C

Table 1 Ratings table

2 Specifications

Product	S-Power LR20
Configuration ID	EBI
Configuration Revision	1.0
Article No	279

Table 2 Product specification

Note! Before working with the cell, it is strongly recommended to read and understand the S-Power handling instructions. These instructions are always provided when cells are ordered.

2.1 Physical

The data presented in this datasheet applies to the product variant illustrated in Figure 1. The overall dimensions, weight, and physical configuration of this product variant are provided in Figure 1 and Table 3.

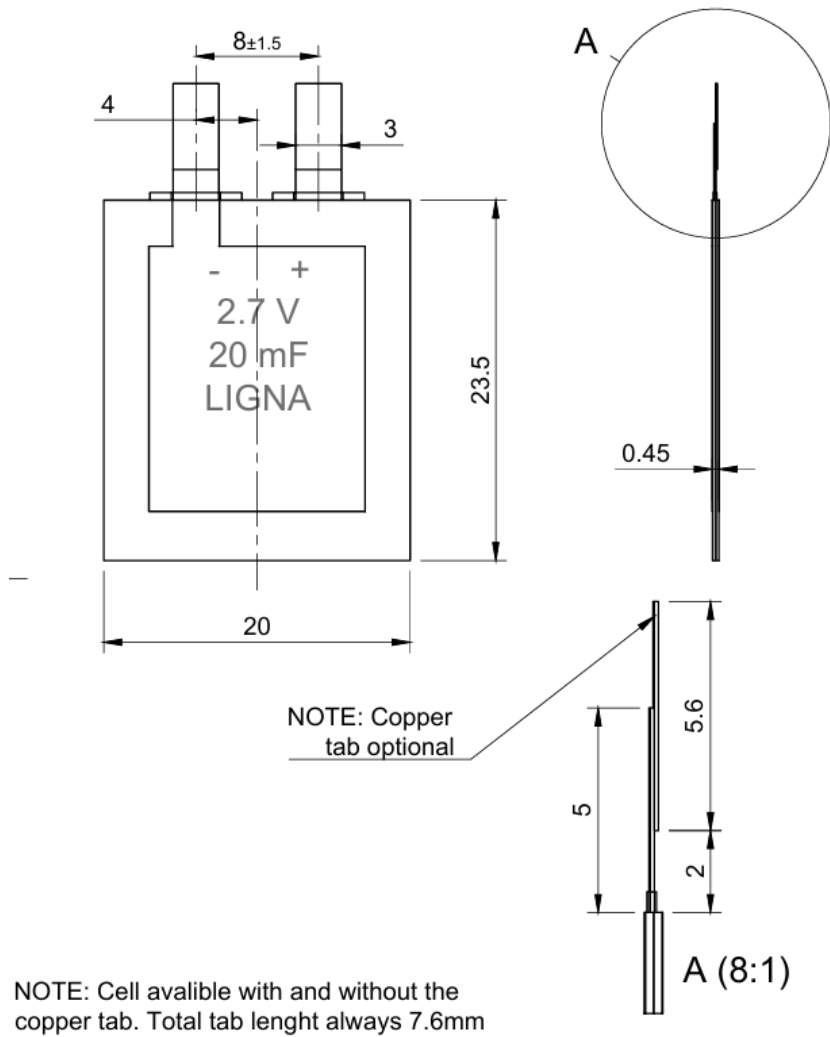


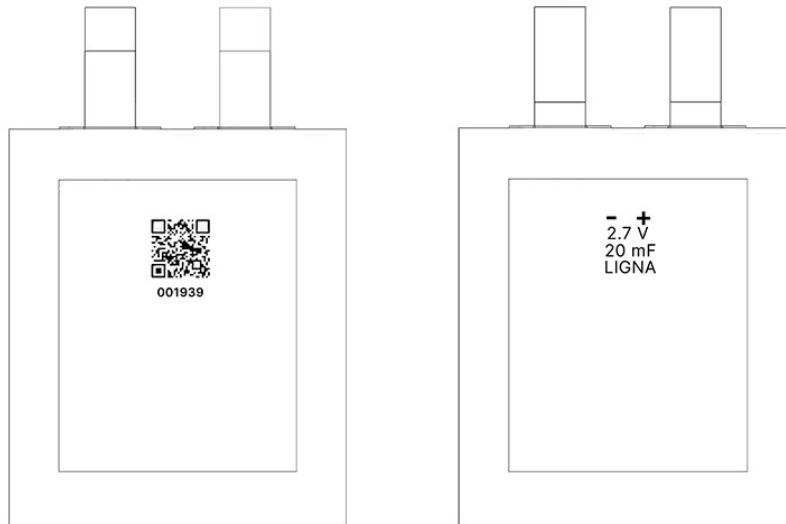
Figure 1 S-Power LR20 cell design

Parameter	Typical value	Unit
Width	20	mm
Height	23.5	mm
Thickness	≤ 0.45	mm
Terminal width	3	mm
Terminal thickness		
Al-tab	0.1	mm
Al/Cu-tab	0.2	mm
Mass	0.19	g

Table 3 Physical data

2.2 Product marking

Each cell is permanently marked with a QR code and a human-readable serial number to ensure product identification and traceability. The marking is centered and positioned 5 mm below the top edge of the cell.



Parameter	Content	Example
QR code content	YYWWXXXXXX (10 characters)	2628001939
Human-readable serial number	XXXXXX (6 digits)	001939

Table 4 Product identification

Where:

YY = Year

WW = Calendar week

XXXXXX = Sequential serial number

2.3 Electrical

Typical electrical specifications at 20 °C are presented in Table 5 unless otherwise stated. Note that specifications in this table are subject to change.

Parameter	Denotation	Typical value	Unit
Rated voltage ¹	V _R	2.7	V (DC)
Rated capacitance ^{2a}	C	20	mF
DC internal resistance (2 ms) ^{2a}	DCESR	600	mΩ
Equivalent series resistance ³	ACESR	360	mΩ
Leakage current after 8 h @ V _R ⁴	DCL	≤ 2	μA

Maximum RMS current ($\Delta T_{ss} \approx 5 \text{ }^{\circ}\text{C}$) ^{5,7}	$I_{RMS,max}$	300	mA RMS
Short-circuit current ⁶	I_{SC}	6.0	A
Thermal resistance ⁷	R_{th}	39	$^{\circ}\text{C/W}$
Charge retention 24 h ⁸		≥ 80	%
Max energy ⁹	E_{max}	20	μWh
Cycle life ¹⁰		$> 500\,000$	cycles

Table 5 Electrical specifications

Table 5 notes:

- ¹ At higher voltages lifetime and cycle life will be reduced while leakage increases.
- ² a) Rated capacitance is determined based on IEC 62391-1:2022 method A, see [1]:

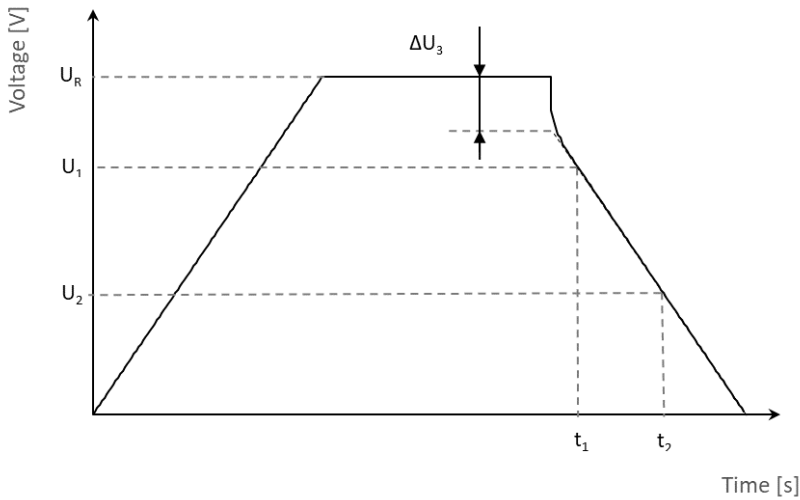


Figure 2 Charge/discharge characteristics between capacitor terminals in capacitance and internal resistance measurement

- U_1 is the measuring start voltage (V).
- U_2 is the measuring end voltage (V).
- t_1 is the time at which the terminal voltage of the capacitor reaches the value U_1 from the start of the discharge.
- t_2 is the time at which the terminal voltage of the capacitor reaches the value U_2 from the start of the discharge.
- ΔU_3 is the voltage drop, see standard for details how it is derived.
- Capacitance, C , is measured by charging at constant current $I_{CCC} = 9.3 \text{ mA}$ to V_R ; followed by charging at constant voltage $V_C = V_R$ for 30 min; and finally discharging using constant current $I_{CCD} = 100 \text{ mA}$. $U_1 = 0.8 \cdot V_R$ and $U_2 = 0.4 \cdot V_R$.

$$C = I_{CCD} \frac{t_2 - t_1}{U_1 - U_2} [F]$$

- ² b) Internal resistance, DCESR, is measured by charging at constant current $I_{CCC} = 9.3 \text{ mA}$ to V_R ; followed by charging at constant voltage $V_C = V_R$ for 30 min; and finally discharging using constant current $I_{CCD} = 100 \text{ mA}$. The internal resistance is calculated as according to below, where ΔV_{2ms} corresponds to the voltage drop after 2 ms discharge at discharge current I_{CCD} .

$$DCESR = \frac{\Delta V_{2ms}}{I_{CCD}} [\Omega]$$

- ³ ESR measured at 1 kHz and $I_{RMS} = 0.5$ mA.
- ⁴ Leakage current, DCL, measured after biasing at V_R for the specified time. Observe that the initial current can be higher.
- ⁵ Maximum RMS current, $I_{RMS,max}$, is the maximum permissible RMS current under repetitive operation and specified reference thermal conditions. RMS current is calculated over the complete repetitive current waveform. Rated voltage and specified operating-temperature limits shall not be exceeded. Permissible RMS current may depend on waveform, duty cycle, ambient temperature and mounting conditions.
- ⁶ Short-circuit current, I_{SC} , is the estimated prospective initial short-circuit current at rated voltage, calculated as $I_{SC} = V_R / DCESR(10\mu s)$. Short-circuit current is provided for safety information only and shall not be used as an allowable operating or pulse current. Actual short-circuit current depends on cell resistance, state of charge, temperature, connections and external circuit impedance.
- ⁷ Thermal resistance, R_{th} , is the typical device-to-ambient thermal resistance under defined reference test conditions and is calculated as $R_{th} = \Delta T_{ss} / P_{loss}$, where Thermal resistance depends on mounting, terminal connections, airflow and surrounding thermal conditions. is the steady-state device temperature rise above ambient at the specified maximum RMS current under the reference test conditions: $\Delta T_{ss} = T_{device,ss} - T_{amb,ss}$. The reported value is a typical measured temperature rise and does not represent the maximum permissible device temperature. See [2] for details.
- ⁸ Remaining charge measured after:
 - a) 8-hour constant voltage charge followed by 24 h self-discharge.
 - b) 24-hour constant voltage charge followed by 7 days self-discharge.
- ⁹ Max energy: $E_{max} = (\frac{1}{2} C \cdot V_R^2) / 3.6 [mWh]$
- ¹⁰ Cycle life can vary significantly for various applications and thus each case should be studied individually. A cycle is defined by constant current charge to V_R followed by discharge to $1/3V_R$. Cycle life is determined based on capacitance and ESR. When capacitance has decreased by more than 20 % or ESR has increased by more than 100 % the cell is considered to have reached its end-of-life.

2.3.1 Capacitance vs temperature

Figure 3 illustrates how the capacitance varies with operating temperature. Data has been collected by exposing the cell to the following temperature profile; 20 -> -40 -> 60 -> 20 °C. The cell is allowed to soak for 30 min at each temperature before any electrical characterization is performed. Data in Figure 3 is gathered when increasing temperature from -40 to 60 °C.

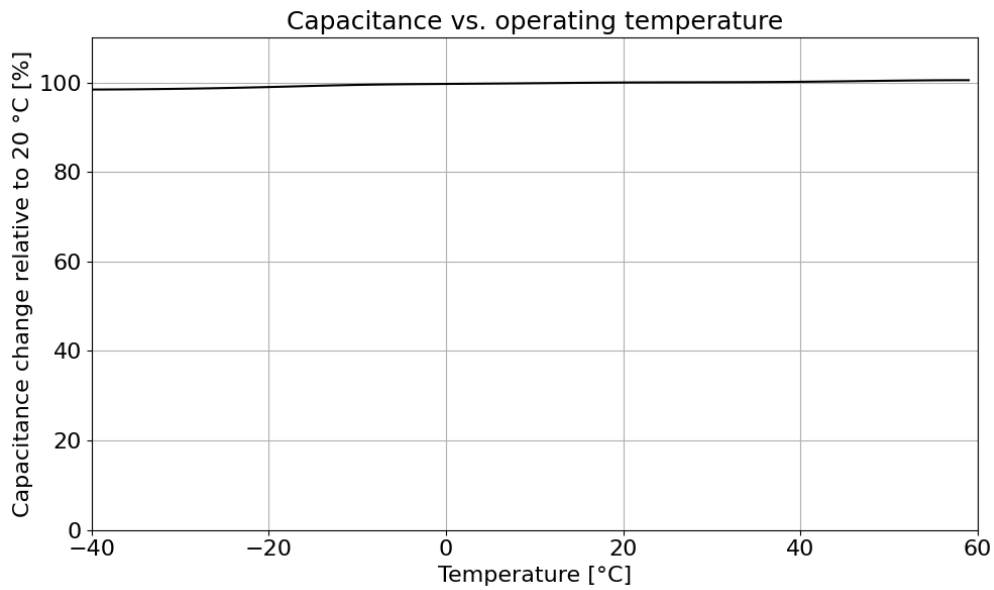


Figure 3 Capacitance vs. operating temperature

2.3.2 ESR vs temperature

The equivalent series resistance and its dependency on operating temperature is shown in Figure 4. The data is gathered using the same test and temperature protocol as for capacitance vs. temperature, presented in the previous section.

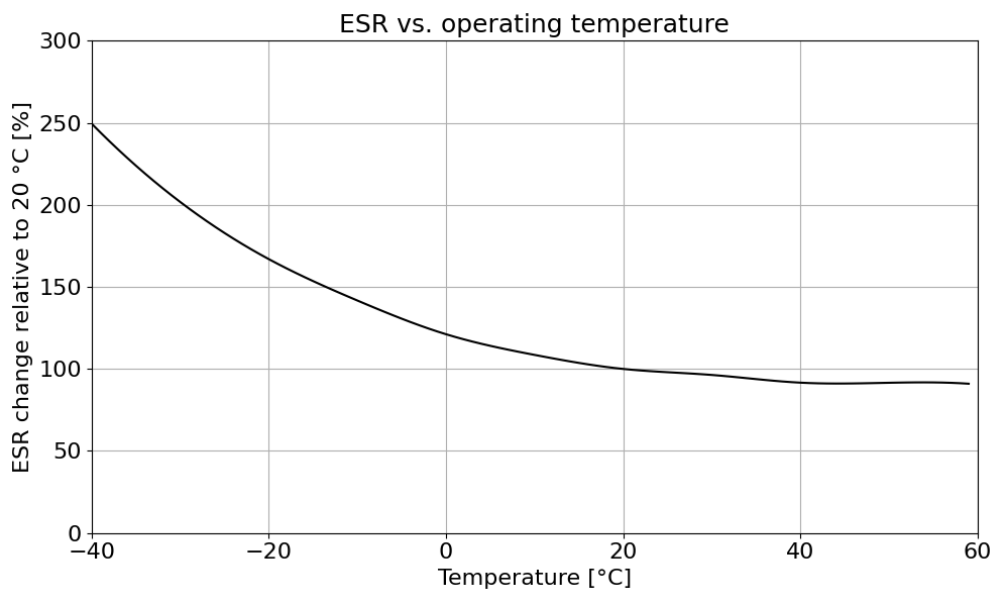


Figure 4 ESR vs. operating temperature

2.4 Environmental specifications

The operating environmental specifications are presented in Table 6 below.

It is recommended to store the cell at controlled indoor conditions below 30 °C. Longer exposure times to elevated temperatures may have a negative impact on lifetime. Rapid changes in temperature can cause condensation and shall consequently be avoided.

Parameter	Denotation	Conditions	Min	Typical	Max	Unit
Operating temperature	T _{op}		-40	RT	60	°C
Operating rel. humidity	RH _{op}	None condensing	0	45	85 *	%

(*) None condensing

Table 6 Environmental specifications

3 References

- [1] IEC 62391-1:2022 - Fixed electric double-layer capacitors for use in electric and electronic equipment - Part 1: Generic specification
- [2] LE00222_Determination of Thermal Resistance