

**EnFilm™ - rechargeable solid state lithium thin film battery**

Datasheet - production data


**Applications**

Device is intended to be used in a wide range of applications including:

- Sensors
- Backup power
- Health care devices
- Wearable applications
- Smart card (see [Section 2.2: "Embedded assembly"](#))
- RF ID tags
- Energy storage for energy harvesting devices
- Internet of things

**Description**

The EFL1K0AF39 is a thin film rechargeable lithium battery. The battery has a LiCoO<sub>2</sub> cathode, LiPON ceramic electrolyte and a lithium anode.

**Features**

- All solid state
- Ultra-thin
- Fast recharge
- Low capacity loss
- Long cycle life
- RoHS compliant

**Table 1: Device summary**

Symbol	Value
Capacity	1 mAh
V <sub>nominal</sub>	3.9 V
V <sub>op</sub>	3.0 to 4.2 V
R <sub>int</sub>	80 Ohm
I <sub>p</sub>	15 mA
Dimension	25.8 mm x 28.8 mm
Thickness	160 μm

# 1 Characteristics

**Table 2: Absolute ratings**

Symbol	Parameter	Value	Unit
V <sub>op</sub>	Operating voltage	3.0 - 4.2	V
I <sub>c</sub>	Maximum continuous discharge current	5	mA
I <sub>p</sub>	Maximum pulsed discharge current <sup>(1)</sup>	15	mA
T <sub>stg</sub>	Storage temperature range	-20 to 60	°C
T <sub>op</sub>	Operating temperature range <sup>(2)</sup>	-20 to 60	°C

**Notes:**

<sup>(1)</sup>Pulsing conditions: 100 ms on, 0.9 s off, cut-off voltage during pulse = 2 V. For higher pulses current contact ST representative.

<sup>(2)</sup>1/30 C discharge rate at -20 °C: operating at 60 °C reduces the cycle life.

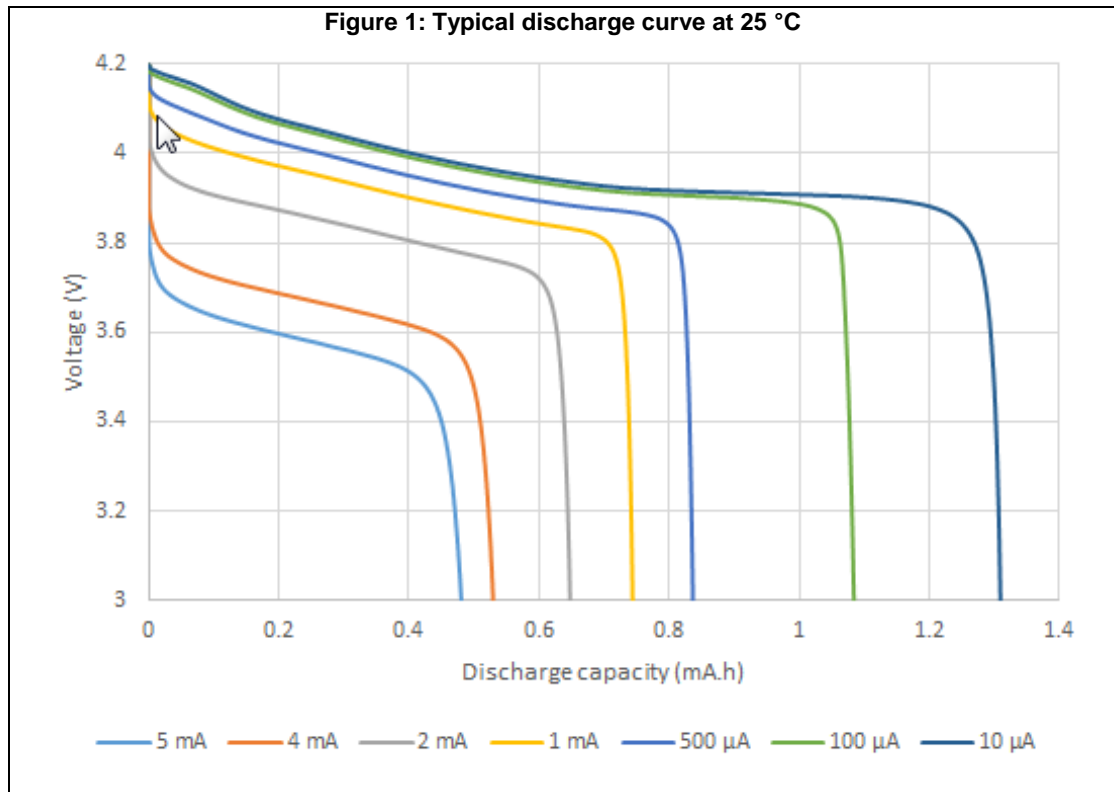
**Table 3: Electrical characteristics**

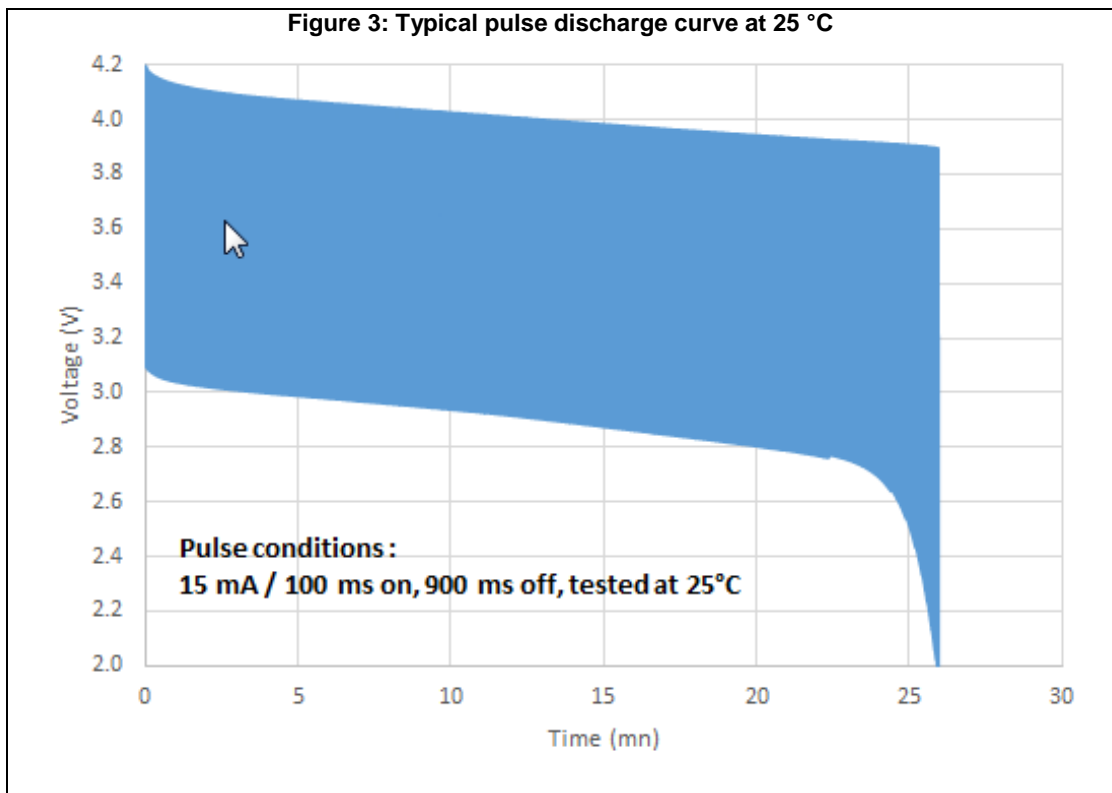
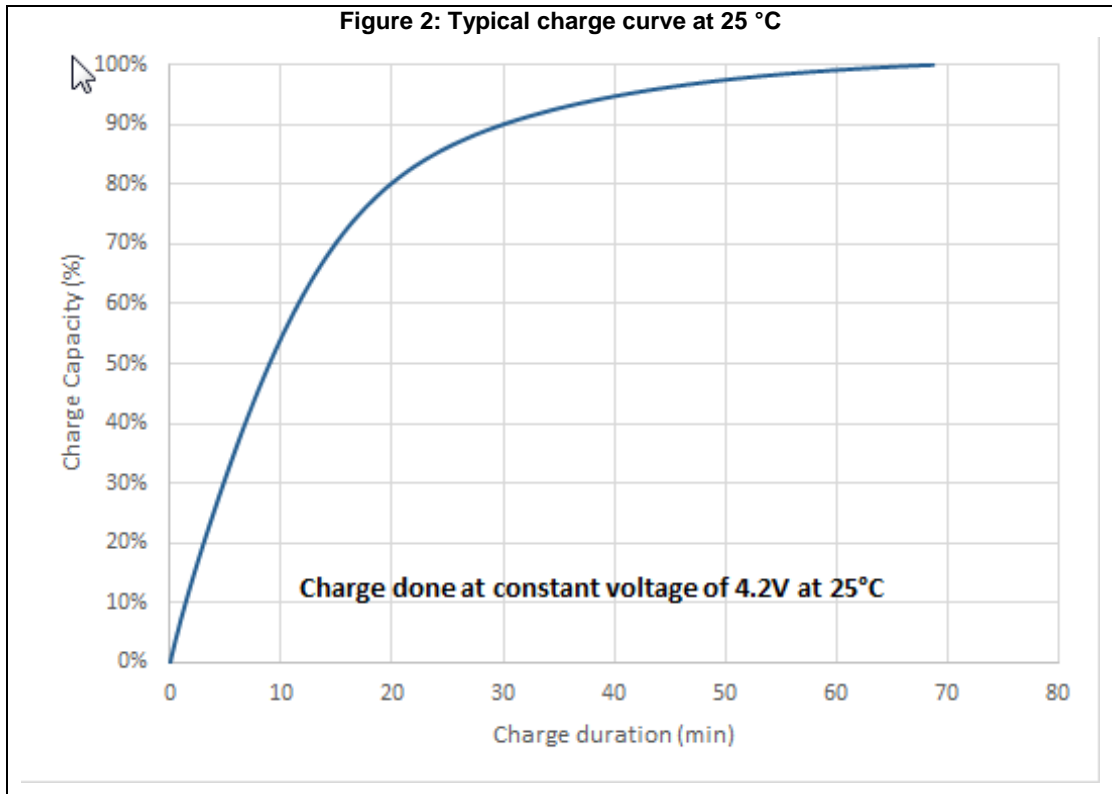
Symbol	Parameter		Test conditions	Min.	Typ.	Max.	Unit
C	Nominal capacity (minimum)		Current discharge = 100 µA, from 4.2 to 3 V at T = 25 °C	1		-	mAh
			Current discharge = 1 mA, from 4.2 to 3 V at T = 25 °C	0.7		-	
R <sub>int</sub>	Internal resistance		T = 25 °C		80	-	Ohm
C <sub>t</sub>	Charge time to 80% of full capacity		Constant voltage = 4.2 V T >= 25 °C		20	-	min
C <sub>life</sub>	Cycle life (to minimum of 80% of initial capacity) at 25 °C <sup>(1)</sup>			4000		-	Cycle
S <sub>Dish</sub>	Self-discharge	Charge loss (recoverable)	T = 25 °C, SoC = 50%		3	-	% year
		Capacity loss (Non-recoverable)			20	-	% over 10 years

**Notes:**

<sup>(1)</sup>1 C discharge rate: cycling between SoC = 75% to SoC = 0% (SoC = state of charge)

### 1.1 Characteristics curves





## 2 Application information

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### 2.1 Handling precautions

Do not short circuit the 2 connection pads. A short circuit incident may not always result to an immediate failure, but it can degrade the battery life. Handle the batteries in a non-conductive work space to prevent accidental short circuiting.

Handle the thin film batteries with care to prevent breaking/cracking the substrate. Do not force or abruptly bend the batteries.

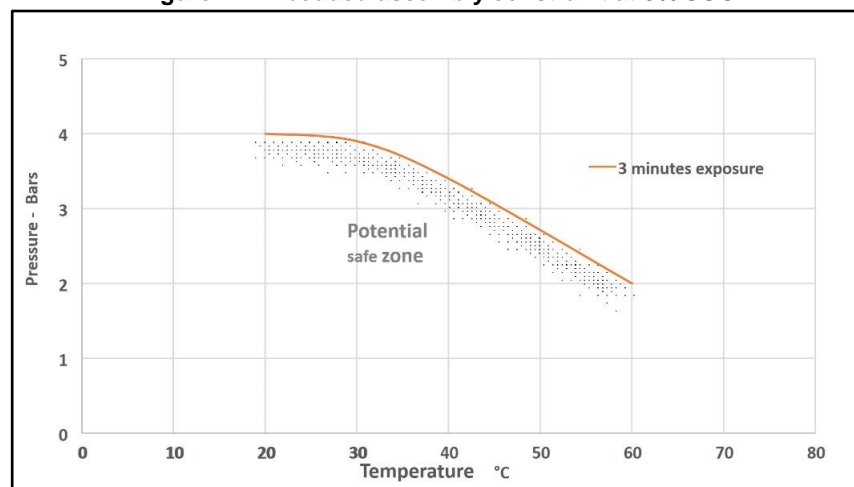
### 2.2 Embedded assembly

EnFilm™ batteries are fabricated by stacking very thin solid films for the active cell, and protected using a metallized cover with barrier adhesives. This structure consequently results to the battery being vulnerable to pressure and/or temperature during assembly, and can result to its degradation.

The below figure shows the potential allowable assembly conditions - pressure applicable on the EFL1K0AF39 versus the temperature for a maximum time of 3 minutes. The batteries should be first put in a 0% state of charge (SOC) before their assembly in order to minimize capacity/internal resistance drifts or degradation.

Please contact your local ST office for your embedded assembly process requirements.

**Figure 4: Embedded assembly constraint at 0% SOC**



## 3 Recommended charge and discharge processes

### 3.1 Charge

Battery can be charged from a  $4.2\text{ V} \pm 0.05\text{ V}$  constant voltage source with or without current limit. More than 90% of the total capacity is recharged when the charge current falls below 0.1 mA.

### 3.2 Discharge

When discharging under constant current or constant load, the cut-off voltage should be no less than 3.0 V. Cut-off voltage can be lowered to 2 V for pulsed discharge.

### 3.3 Design recommendations

Refer to STMicroelectronics application note:

- AN4085: EnFilm™ series user guide.

## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 EnFilm package information

Figure 5: EnFilm package outline

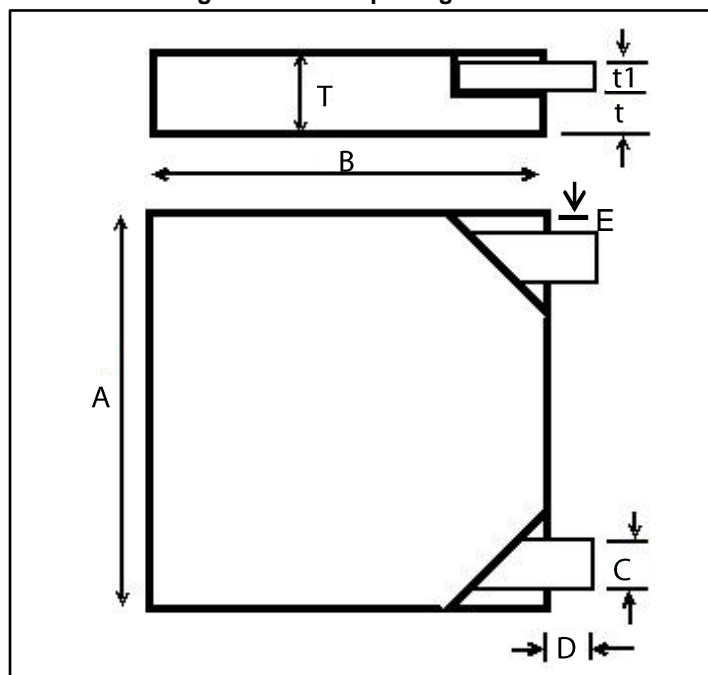
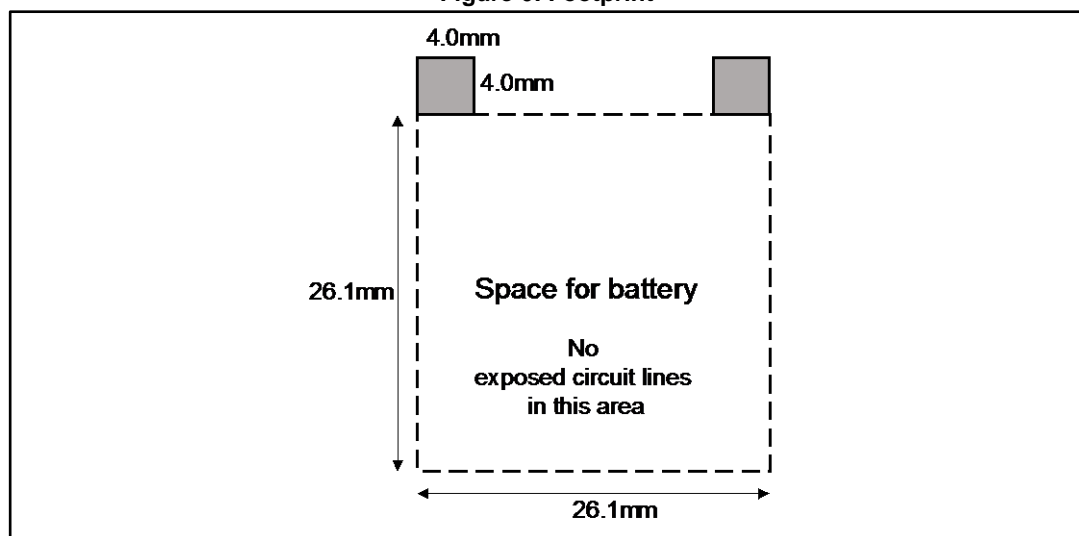


Table 4: EnFilm package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	25.4	25.8	26.1	1.000	1.016	1.028
B	25.4	25.8	26.1	1.000	1.016	1.028
C	2.4	2.5	2.6	0.094	0.098	1.102
D	2.20	3	3.5	0.087	0.118	0.138
E		0.5	0.7		0.020	0.028
T		0.16	0.2		0.006	0.008
t		0.05			0.002	
t1		0.025			0.0010	

Figure 6: Footprint







## 6 Recommendation for the PCB assembly

Refer to STMicroelectronics technical note:

- TN1249: EnFilm™ micro-battery EFL1K0AF39 mounting on printed circuit board.

## 7 Ordering information

Figure 9: Ordering information scheme

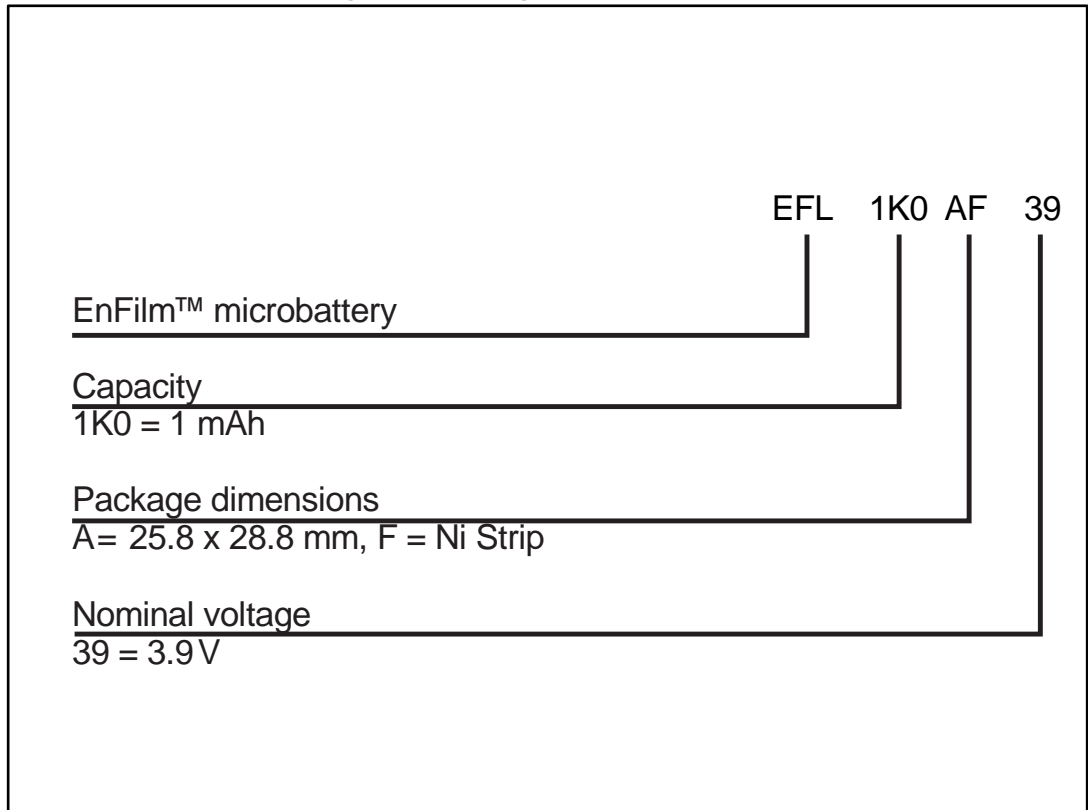


Table 5: Ordering information

Order code	Marking	Weight	Base qty.	Delivery mode
EFL1K0AF39	EFL1K0AF39	0.3 g	25	Tray
EFL1K0AF39RL	EFL1K0AF39	0.3 g	100	Tape and reel

## 8 Revision history

Table 6: Document revision history

Date	Revision	Changes
03-Jul-2017	1	First issue
07-Sept-2017	2	Updated <a href="#">Section "Applications"</a> , <a href="#">Table 1: "Device summary"</a> and <a href="#">Section 1: "Characteristics"</a> . Added <a href="#">Section 2.1: "Handling precautions"</a> and <a href="#">Section 2.2: "Embedded assembly"</a> .

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