



**Description**

SE9020C/D is a complete Limit-current & constant voltage charger for single cell Lithium-ion and Lithium-Polymer batteries. Its SOT-23-6L package and low external component count make SE9020C/D ideally suited for portable applications. Furthermore, the SE9020C/D is specifically designed to work within Universal Travel Charger.

SE9020C/D has a built-in detector that will automatically detect the polarity of the inserted battery and charge the battery at the correct the polarity. The charge voltage is fixed at 4.2V. The SE9020C/D automatically terminates the charge cycle when the charge current drops to 14mA after the final float voltage is reached.

When the input supply is removed, the SE9020C/D automatically enters a low current stage, dropping the battery drain current to less than 7mA. The SE9020C/D can be put into shutdown mode, reducing the supply current to 30uA.

SE9020C/D supports two LED drivers that give the customers the option to select which method fit best in their respective applications. One LED driver is internally set to indicate the power on/off of the IC. Another LED driver can either drive a standard LED named SE9020D or 7-color LED named SE9020C, which will be explained in detail in the application notes.

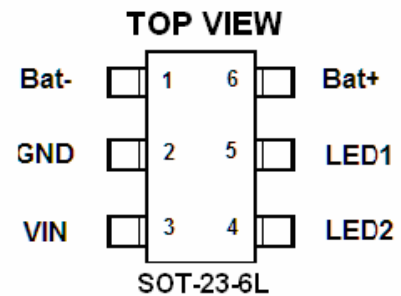
**Application**

- Universal Travel Charger

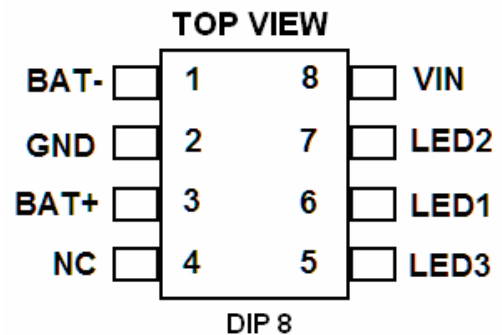
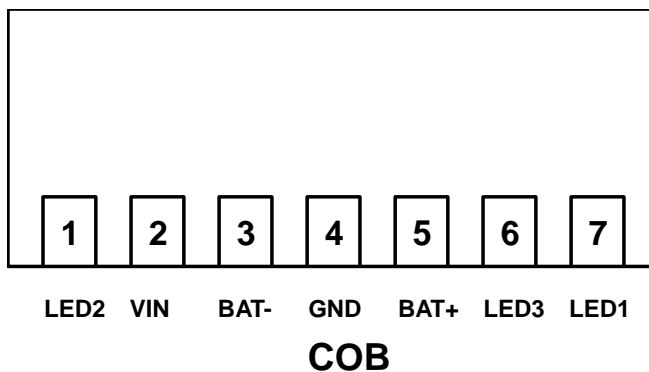
**Features**

- Automatically Identifies the polarity of the battery
- Typical-Current to 250mA
- Short-Circuit Protection
- Low external component
- Build in high precision reference voltage
- Preset 4.2V Charge Voltage with ±1% Accuracy.
- 20uA Supply Current in Shutdown.
- Support Standalone Battery Charger.
- Support both 2-LED and Flashing LED schemes.
- Available in 6-Lead SOT-23-6L DIP-8 and COB Packages.
- RoHS Compliant and 100% Lead (Pb)-Free

**Pin Configuration**



**Pin Configuration**





Application Diagram

Figure 1 7 color LED circuit

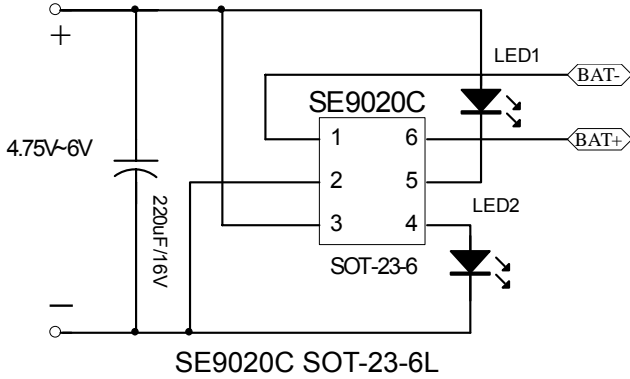


Figure 2 2 LED circuit

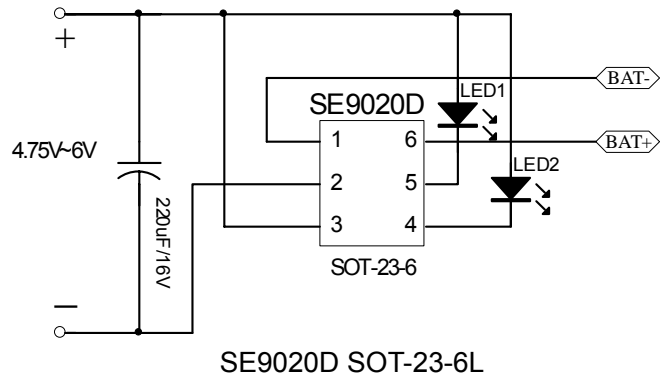


Figure 3 7 color LED circuit

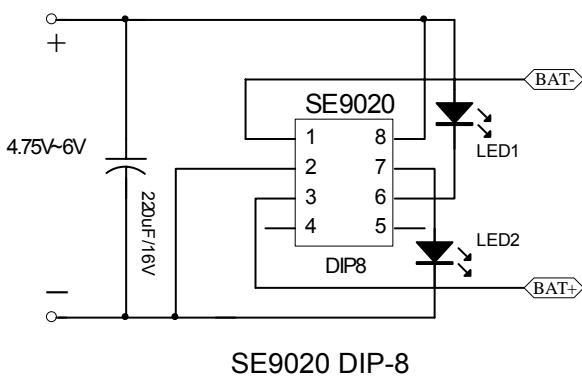


Figure 4 2 LED circuit

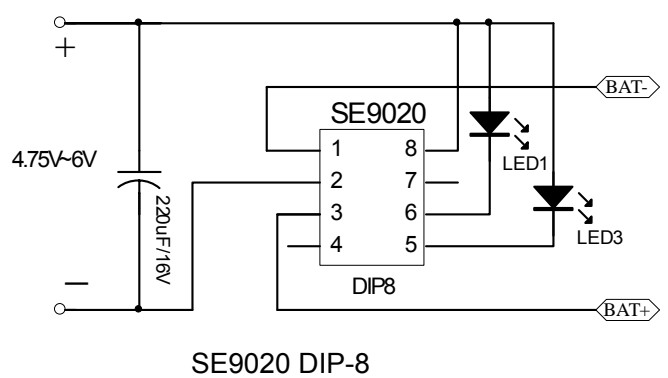


Figure 5 7 color LED circuit

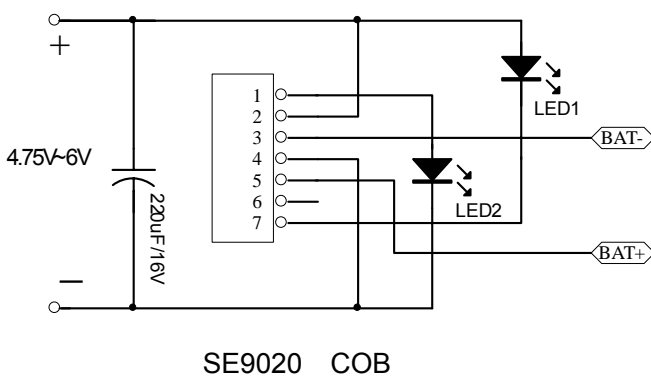
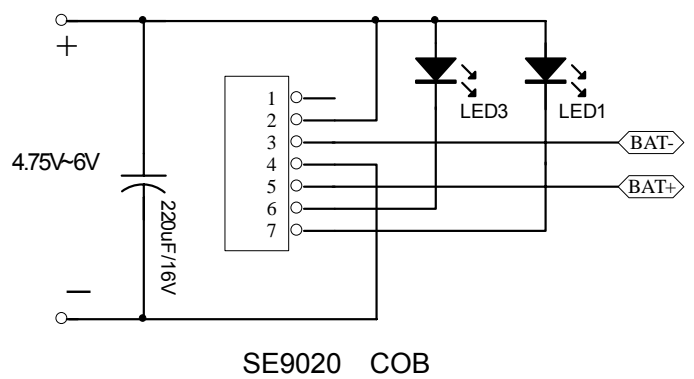


Figure 6 2 LED circuit





**Absolute Maximum Rating <sup>(1)</sup>**

| Parameter                               | Symbol        | Value          | Units |
|---|---------------|----------------|-------|
| Input Supply Voltage                    | $V_{in}$      | 8              | V     |
| BAT Voltage                             | $V_{BAT+}$    | 7              | V     |
| BAT Voltage                             | $V_{BAT-}$    | 7              | V     |
| LED1                                    | $V_{LED1}$    | 7              | V     |
| LED2                                    | $V_{LED2}$    | 7              | V     |
| BAT Short-Circuit Duration              |               | Continuous     |       |
| Thermal Resistance, Junction-to-Ambient | $\Theta_{JA}$ | 250 (SOT-23-6) | °C/W  |
| BAT Pin Current                         | $I_{BAT}$     | 250            | mA    |
| LED1/2 Current                          | $I_{LED}$     | 20             | mA    |
| Maximum Junction Temperature            | $T_J$         | 125            | °C    |
| Storage Temperature                     | $T_S$         | -65 to +125    | °C    |
| Lead Temperature (Soldering, 10 sec)    |               | 300            | °C    |

**Operating Rating <sup>(2)</sup>**

| Parameter            | Symbol   | Value       | Units |
|----------------------|----------|-------------|-------|
| Supply Input Voltage | $V_{IN}$ | +4.75 to +6 | V     |
| Junction Temperature | $T_J$    | -40 to +85  | °C    |

**Electrical Characteristics**

$V_{IN} = 5V$ ;  $T_J = 25^\circ C$ ; unless otherwise specified.

| Symbol      | Parameter                           | Conditions   | Min   | Typ      | Max   | Unit |
|-------------|-------------------------------------|--|-------|----------|-------|------|
| $V_{in}$    | Input Supply Voltage                |  | 4.75  |          | 6     | V    |
| $V_{Term}$  | Regulated Output (Terminal) Voltage | $V_{in}=6V$ , $I_{BAT} = 14mA$ .                     | 4.158 | 4.2      | 4.242 | V    |
| $V_{Float}$ | Floating Voltage                    | $V_{in}=6V$ , $I_{BAT} = 0$ . Note #1.               |       | $V_{in}$ |       | V    |
| $I_{BAT}$   | BAT Pin Current                     | $V_{in}=6V$ , $ V_{btp}-V_{btn} <3.5V$               |       | 250      |       | mA   |
| $V_{Short}$ | Short Circuit Protection Voltage    | $V_{in}=6V$ , $ V_{btp}-V_{btn}  :3V \text{ to } 0V$ |       | 2.5      |       | V    |
| $F_{OSC}$   | Flashing Frequency                  | $V_{in}=6V$ , $ V_{btp}-V_{btn} =3.5V$               |       | 5        |       | Hz   |

**Notes:**

#1. When the battery disconnected to the charger, SE9020 disables the internal charging transistor. This will cause the  $V_{bat}$  to float to  $V_{in}$ .

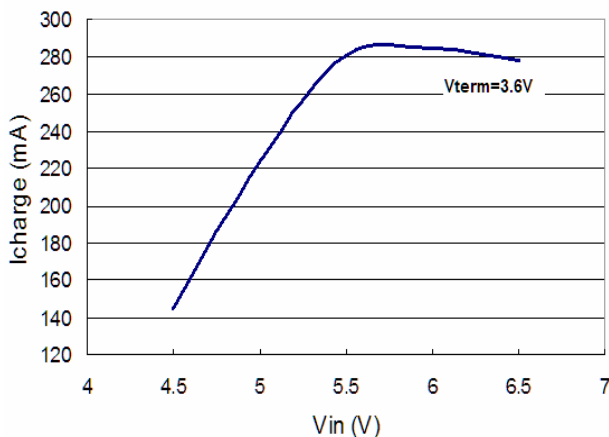


**Pin Functions**

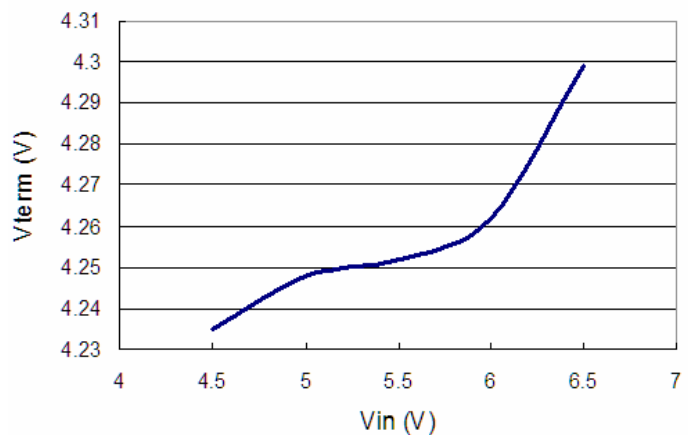
| Pin         | Pin Function Description   | Pin         | Pin Function Description   |
|-------------|--|-------------|--|
| <b>Vin</b>  | Positive Input Supply Voltage. Provides power to the charger. Vin can range from 4.75V to 6V and should be bypassed with at least a 1μF capacitor.   | <b>BAT-</b> | Charge Current Output. Provides charge current to the battery and regulates the final float voltage to 4.2V. SE9020C/D will automatically identify the polarity so this pin can be connected to BAT+ also.   |
| <b>GND</b>  | Ground.  | <b>LED1</b> | LED1 is lit on when the Vin is connected to any voltage between 4.75V and 6V.  |
| <b>BAT+</b> | Charge Current Output. Provides charge current to the battery and regulates the final float voltage to 4.2V. SE9020C/D will automatically identify the polarity so this pin can be connected to BAT- also. | <b>LED2</b> | With SOT-23-6L package. LED2 supports 2 options to indicate the Charging and Full of the battery. With SE9020D, the LED2 will flash at 5Hz frequency during charging. When the battery is full, LED2 will output a constant voltage and the flashing will stop. With SE9020C, LED2 can drive a standard 7-color IC-LED.<br><br>With DIP-8 package LED2 can only drive a standard 7-color IC-LED. |
| <b>LED3</b> | With DIP-8 package the LED3 will flash at 5Hz frequency during charging. When the battery is full, LED3 will output a constant voltage and the flashing will stop  | <b>NC</b>   | With DIP-8 package NC is the unused PIN  |

**Typical Operating Characteristics**

**Icharge Versus Vin**

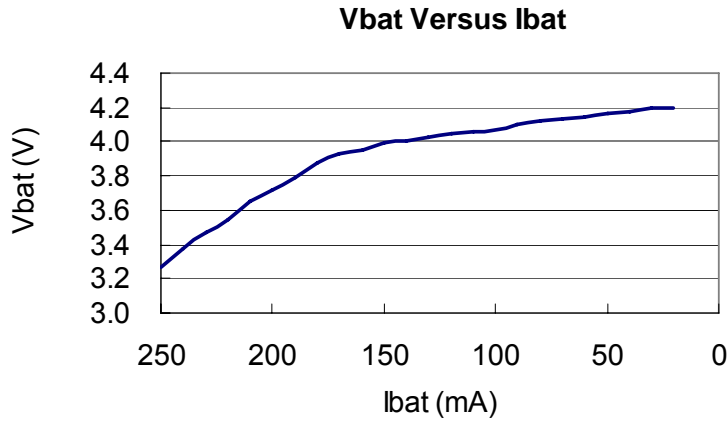


**Vterm Versus Vin**

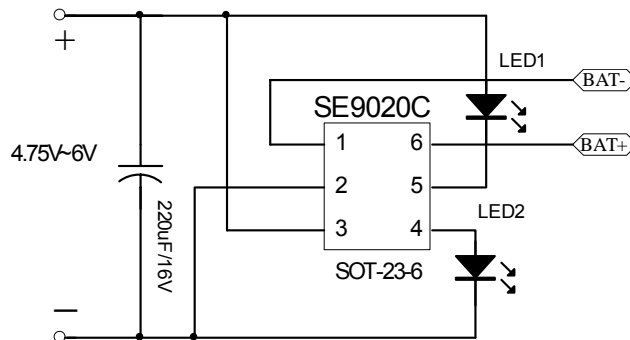




Typical Operating Characteristics



Application Notes:

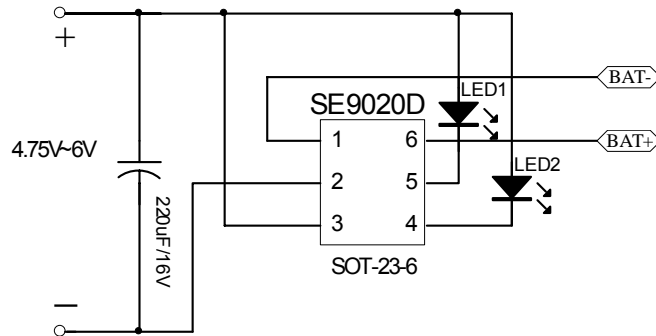


**Figure #5. Flashing 7-Color LED Application.** SE9020C also supports 7-color LED applications. The connections are shown in this schematic and the Logic of LED's is shown in the table below.

| Detection Description | Power Supply Condition | Battery Condition | LED1   | LED2 (7-color) |
|-----------------------|------------------------|-------------------|--------|----------------|
| Battery Detection     | Disconnected           | Connected         | Bright | Dark           |
|                       | Connected              | Disconnected      | Bright | Dark           |
| Battery Unload        | Connected              | Disconnected      | Bright | Dark           |
| Battery Charge        |                        | Connected         | Bright | Flash          |
| Battery Full          |                        | Connected         | Bright | Dark           |
| Battery Shorted       |                        | Shorted           | Dark   | Dark           |



**Application Notes:**

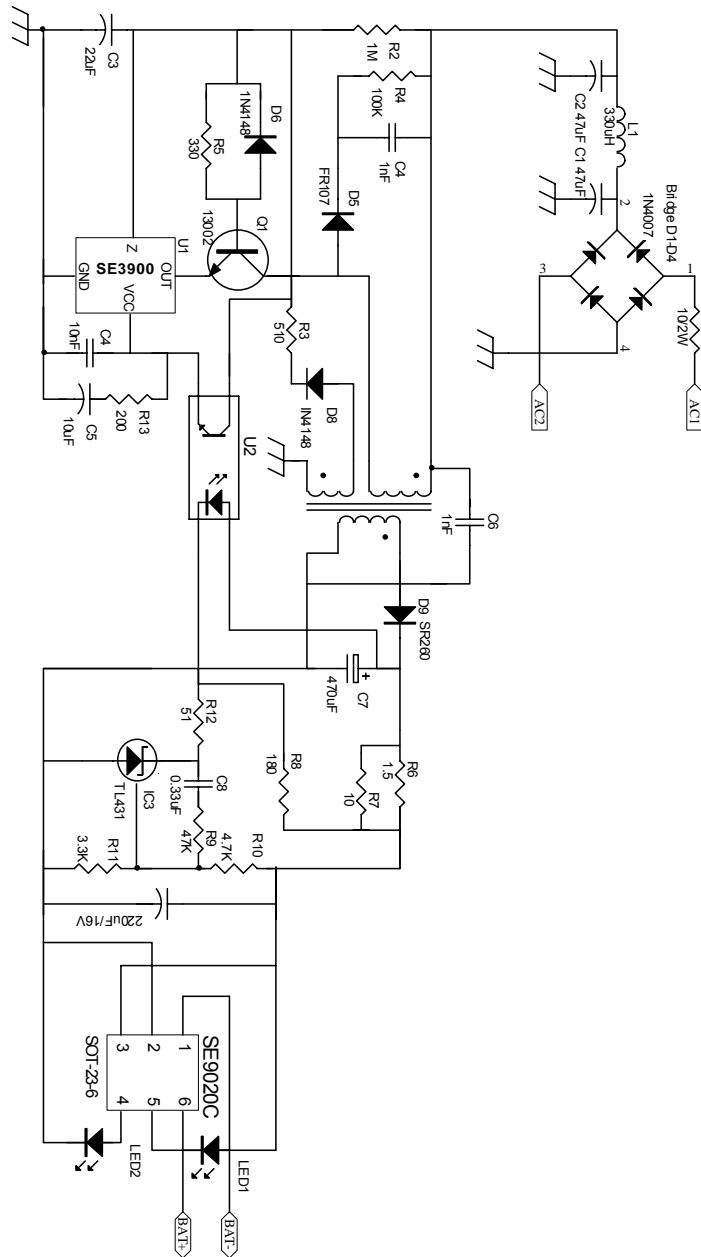


**Figure #6. Flashing 2-LED Application.** The LED's are connected between Pin1 and Pin6 to Power Supply. The logic of LED's operations is shown in the table below.

| Detection Description | Power Supply Condition | Battery Condition | LED1   | LED2   |
|-----------------------|------------------------|-------------------|--------|--------|
| Battery Detection     | Disconnected           | Connected         | Bright | Dark   |
|                       | Connected              | Disconnected      | Bright | Dark   |
| Battery Unload        | Connected              | Disconnected      | Bright | Dark   |
| Battery Charge        |                        | Connected         | Bright | Flash  |
| Battery Full          |                        |                   | Bright | Bright |
| Battery Shorted       |                        | Shorted           | Dark   | Dark   |



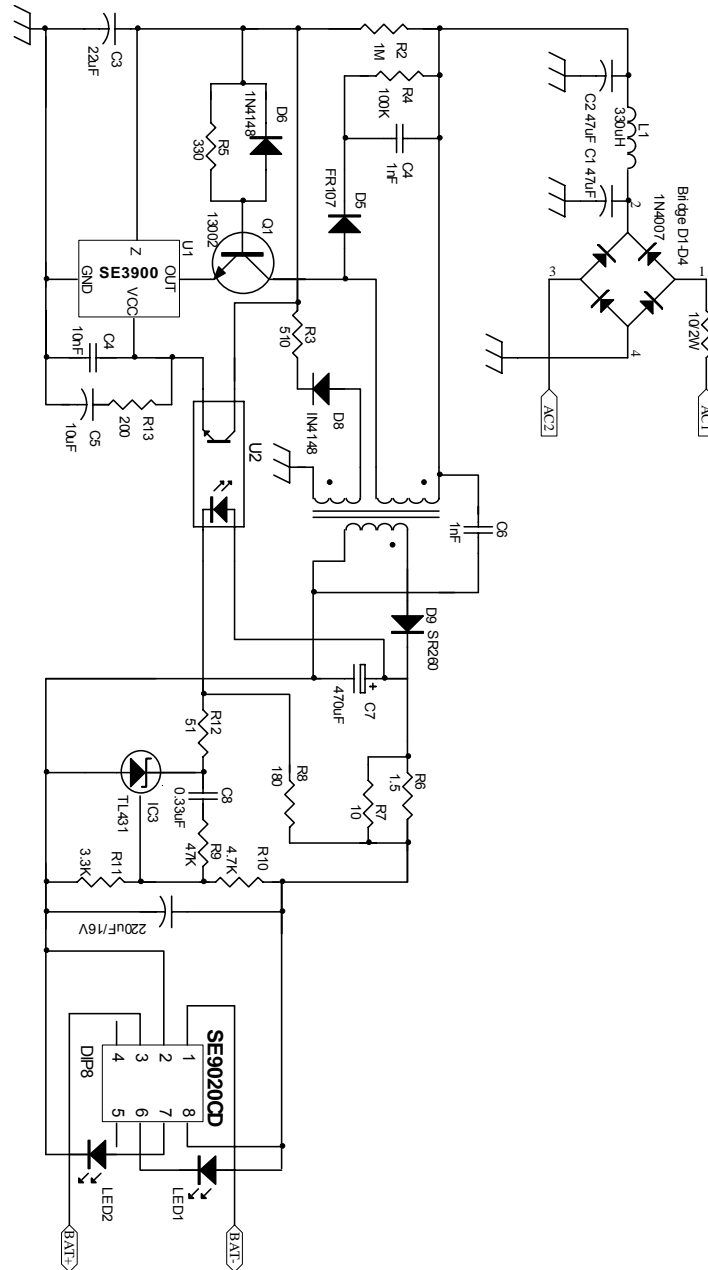
**Application Notes: (continued)**



**Figure #7. SE9020C & SE3900 Application.** The SE3900, SE9020C(SOT-23-6L) and SE431 can make a complete AC/DC solution for a standalone Universal Lithium Battery charger.



Application Notes: (continued)

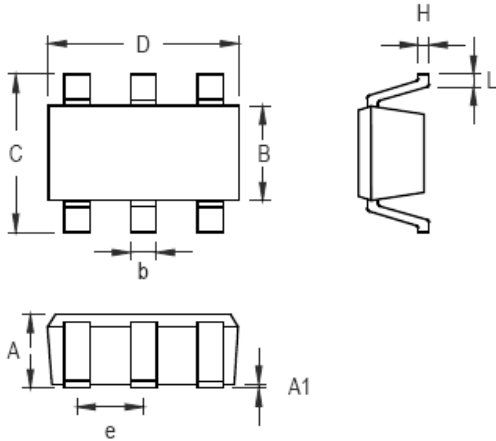


**Figure #8. SE9020CD & SE3900 Application.** The SE3900, SE9020CD(DIP-8) and SE431 can make a complete AC/DC solution for a standalone Universal Lithium Battery charger.



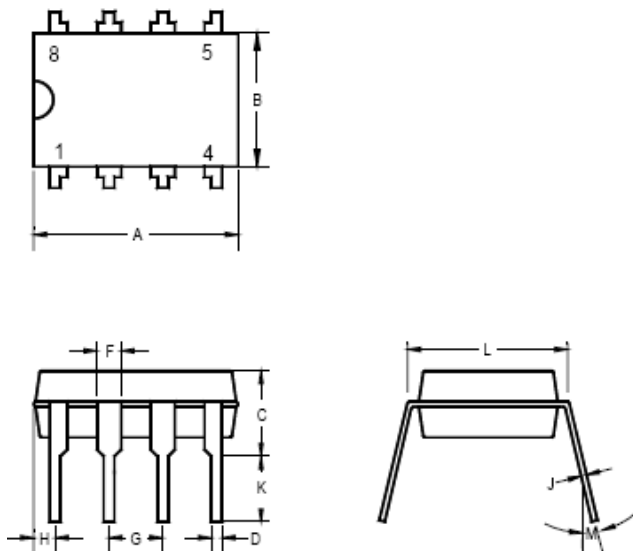


**OUTLINE DRAWING SOT-23-6L**



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.889                     | 1.295 | 0.031                | 0.051 |
| A1     | 0.000                     | 0.152 | 0.000                | 0.006 |
| B      | 1.397                     | 1.803 | 0.055                | 0.071 |
| b      | 0.250                     | 0.560 | 0.010                | 0.022 |
| C      | 2.591                     | 2.997 | 0.102                | 0.118 |
| D      | 2.692                     | 3.099 | 0.106                | 0.122 |
| e      | 0.838                     | 1.041 | 0.033                | 0.041 |
| H      | 0.080                     | 0.254 | 0.003                | 0.010 |
| L      | 0.300                     | 0.610 | 0.012                | 0.024 |

**OUTLINE DRAWING DIP-8**



|   | INCHES     |       |       | MILLIMETERS |      |       |
|---|------------|-------|-------|-------------|------|-------|
|   | MIN        | TYP   | MAX   | MIN         | TYP  | MAX   |
| A | 0.355      | 0.365 | 0.400 | 9.02        | 9.27 | 10.16 |
| B | 0.240      | 0.250 | 0.280 | 6.10        | 6.35 | 7.11  |
| C | -          | -     | 0.210 | -           | -    | 5.33  |
| D | -          | 0.018 | -     | -           | 0.46 | -     |
| F | -          | 0.060 | -     | -           | 1.52 | -     |
| G | -          | 0.100 | -     | -           | 2.54 | -     |
| H | 0.050      | -     | 0.090 | 1.27        | -    | 2.29  |
| J | 0.008      | -     | 0.015 | 0.20        | -    | 0.38  |
| K | 0.115      | 0.130 | 0.150 | 2.92        | 3.30 | 3.81  |
| L | 0.300 BSC. |       |       | 7.62 BSC.   |      |       |
| M | -          | 7°    | 15°   | -           | 7°   | 15°   |



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Last Updated - 9/27/2008