**XC6801 Series**

**500mA 1 Cell Li-ion and Li-Po Battery Linear Charger IC with Constant-Current/Constant-Voltage**

### GENERAL DESCRIPTION

The XC6801 series is a constant-current/constant-voltage linear charger IC for single cell Lithium-ion and Lithium polymer batteries. The XC6801 includes a reference voltage source, battery voltage monitor, driver transistor, constant-current/constant-voltage charge circuit, overheat protection circuit and phase compensation circuit. The battery charge termination voltage is internally set to 4.2V ±0.7% and the trickle charge voltage and accuracy is 2.9V ±3%. In trickle charge mode, a safe Lithium-ion and Lithium polymer battery charge is possible because approximately only 1/10 of the full charge current is supplied to the battery. As it is possible to select a highly accurate charge current of either 100mA (MAX.) for L level input to the LIM pin or 500mA (MAX.) for H level, the series is ideal for applications where the charge is from USB. The series’ charge status output pin, /CHG pin, is capable of checking the IC’s charging state via connection to an external LED.

### APPLICATIONS

- USB charge applications
- Charging docks, charging cradles
- MP3 players, portable audio players
- Cellular phones, PDAs
- Bluetooth headsets

### FEATURES

- **Operating Voltage Range**: 4.25V ~ 6.0V
- **Charge Current (externally set)**: 100mA (MAX.) @ LIM pin=L (externally set) 500mA (MAX.) @ LIM pin=H
- **Charge Termination Voltage**: 4.2V ±0.7%
- **Trickle Charge Voltage**: 2.9V ±3%
- **Supply Current (Stand-by)**: 12μA (TYP.)
- **Operating Ambient Temperature**: -40℃ ~ +85℃
- **Packages**: SOT-89-5, SOT-25, USP-6C
- **Constant-current/constant-voltage operation with thermal shutdown**
- **Automatic recharge**
- **Charge status output pin**
- **Soft-start function (Inrush limit current)**
- **Environmentally Friendly**: EU RoHS Compliant, Pb Free

### TYPICAL APPLICATION CIRCUIT

![Typical Application Circuit](image)

### TYPICAL PERFORMANCE CHARACTERISTICS

- **Battery Charge Cycle**

![Typical Performance Characteristics](image)
**XC6801 Series**

### PIN CONFIGURATION

![PIN CONFIGURATION Diagram]

- SOT-25 (TOP VIEW)
- SOT-89-5 (TOP VIEW)
- USP-6C (BOTTOM VIEW)

* The dissipation pad for the USP-6C package should be solder-plated in recommended mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to the VSS (No. 2) pin.

### PIN ASSIGNMENT

<table>
<thead>
<tr>
<th>PIN NUMBER</th>
<th>PIN NAME</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOT-25</td>
<td>5 /CHG</td>
<td>Charge Status Output Pin</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>/CHG</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>VSS</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>BAT</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>V_IN</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>LIM</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>NC</td>
</tr>
</tbody>
</table>

### FUNCTIONS

**XC6801A421**

<table>
<thead>
<tr>
<th>PIN NAME</th>
<th>CONDITIONS</th>
<th>IC OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIM</td>
<td>L, 0V ≤ V_LIM ≤ 0.4V</td>
<td>Charging Battery Current 1 (CC Mode)</td>
</tr>
<tr>
<td></td>
<td>H, 1V ≤ V_LIM ≤ 6V</td>
<td>Charging Battery Current 2 (CC Mode)</td>
</tr>
</tbody>
</table>

*If LIM pin is left open, battery current is unstable. LIM pin level should be fixed "High" or "Low".*

### PRODUCT CLASSIFICATION

**Ordering Information**

**XC6801A421①②③④**

<table>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>ITEM</th>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Setting Charge Current</td>
<td>1</td>
<td>L_L&quot;=95mA, L_H&quot;=475mA</td>
</tr>
<tr>
<td>②③④*(1)</td>
<td>Packages (Order Unit)</td>
<td>PR-G</td>
<td>SOT-89-5 (1,000pcs/Reel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MR-G</td>
<td>SOT-25 (3,000pcs/Reel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ER-G</td>
<td>USP-6C (3,000pcs/Reel)</td>
</tr>
</tbody>
</table>

*(1) The "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.*
■ BLOCK DIAGRAM

![Block Diagram]

* Diodes inside the circuits are ESD protection diodes and parasitic diodes.

■ ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN Pin Voltage</td>
<td>VIN</td>
<td>-0.3 ~ +6.5 V</td>
<td>V</td>
</tr>
<tr>
<td>LIM Pin Voltage</td>
<td>V_LIM</td>
<td>-0.3 ~ +6.5 V</td>
<td>V</td>
</tr>
<tr>
<td>BAT Pin Voltage</td>
<td>V_BAT</td>
<td>-0.3 ~ +6.5 V</td>
<td>V</td>
</tr>
<tr>
<td>/CHG Pin Voltage</td>
<td>V_/CHG</td>
<td>-0.3 ~ +6.5 V</td>
<td>V</td>
</tr>
<tr>
<td>BAT Pin Current</td>
<td>I_BAT</td>
<td>900(*) mA</td>
<td>mA</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>Pd</td>
<td>250 mW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOT-25</td>
<td>600 (PCB mounted)(*)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOT-89-5</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>USP-6C</td>
<td>1300 (PCB mounted)(*)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>120 mW</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 (PCB mounted)(*)</td>
<td></td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>Topr</td>
<td>-40 ~ +85 °C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Tstg</td>
<td>-55 ~ +125 °C</td>
<td></td>
</tr>
</tbody>
</table>

All voltages are described based on the VSS pin.

(*) Please use within the range of \( I_{BAT} \leq \frac{Pd}{(V_{IN} - V_{BAT})} \).

(”) The power dissipation figure shown is PCB mounted.

Please see the power dissipation page for the mounting condition.
## ELECTRICAL CHARACTERISTICS

### XC6801 Series

**XC6801A421**

**Ta=25°C**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>V\text{IN}</td>
<td></td>
<td>4.25</td>
<td>-</td>
<td>6.00</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Supply Current</td>
<td>I\text{SS}</td>
<td>Charge mode (V\text{LIM}=H or V\text{LIM}=L)</td>
<td>-</td>
<td>12</td>
<td>30</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Stand-by Current</td>
<td>I\text{STBY}</td>
<td>Stand-by mode</td>
<td>-</td>
<td>12</td>
<td>30</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Shut-down Current</td>
<td>I\text{SHUT}</td>
<td>Shut-down mode</td>
<td>-</td>
<td>8</td>
<td>18</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Float Voltage 1</td>
<td>V\text{FLOAT1}</td>
<td>Ta=25°C, I\text{BAT}=40mA</td>
<td>×0.993</td>
<td>4.2</td>
<td>1.007</td>
<td>V</td>
<td>(2)</td>
</tr>
<tr>
<td>Float Voltage 2 (^{(1)})</td>
<td>V\text{FLOAT2}</td>
<td>0°C ≤ Ta ≤ 50°C, I\text{BAT}=40mA</td>
<td>×0.99</td>
<td>4.2</td>
<td>1.01</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Battery Current 1</td>
<td>I\text{BAT1}</td>
<td>V\text{BAT}=3.8V, V\text{LIM}=L, CC mode</td>
<td>88</td>
<td>95</td>
<td>100</td>
<td>mA</td>
<td>(3)</td>
</tr>
<tr>
<td>Battery Current 2</td>
<td>I\text{BAT2}</td>
<td>V\text{BAT}=3.8V, V\text{LIM}=H, CC mode</td>
<td>440</td>
<td>475</td>
<td>500</td>
<td>mA</td>
<td>(3)</td>
</tr>
<tr>
<td>Battery Current 3</td>
<td>I\text{BAT3}</td>
<td>Stand-by mode, V\text{BAT}=4.2V</td>
<td>-</td>
<td>-</td>
<td>2.5</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Battery Current 4</td>
<td>I\text{BAT4}</td>
<td>Shut-down mode</td>
<td>-</td>
<td>-</td>
<td>2.0</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Battery Current 5</td>
<td>I\text{BAT5}</td>
<td>Stop mode, V\text{IN}=0V</td>
<td>-</td>
<td>-</td>
<td>2.0</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>Trickle Charge Current 1</td>
<td>I\text{TRIK1}</td>
<td>V\text{BAT}&lt;V\text{TRIKL} (V\text{LIM}=L)</td>
<td>7.5</td>
<td>9.5</td>
<td>12.0</td>
<td>mA</td>
<td>(3)</td>
</tr>
<tr>
<td>Trickle Charge Current 2</td>
<td>I\text{TRIK2}</td>
<td>V\text{BAT}&lt;V\text{TRIKL} (V\text{LIM}=H)</td>
<td>37.5</td>
<td>47.5</td>
<td>60.0</td>
<td>mA</td>
<td>(3)</td>
</tr>
<tr>
<td>Trickle Voltage</td>
<td>V\text{TRIKL}</td>
<td>V\text{LIM}=L, V\text{BAT Rising}</td>
<td>2.813</td>
<td>2.9</td>
<td>2.987</td>
<td>V</td>
<td>(3)</td>
</tr>
<tr>
<td>Trickle Voltage Hysteresis Width</td>
<td>V\text{TRIKL_HYS}</td>
<td>V\text{LIM}=L</td>
<td>58</td>
<td>90</td>
<td>116</td>
<td>mV</td>
<td>-</td>
</tr>
<tr>
<td>UVLO Voltage</td>
<td>V\text{UVLO}</td>
<td>V\text{IN} : L → H</td>
<td>3.686</td>
<td>3.8</td>
<td>3.914</td>
<td>V</td>
<td>(6)</td>
</tr>
<tr>
<td>UVLO Hysteresis Width</td>
<td>V\text{UVLO_HYS}</td>
<td>-</td>
<td>150</td>
<td>190</td>
<td>280</td>
<td>mV</td>
<td>-</td>
</tr>
<tr>
<td>V\text{IN}–V\text{BAT} Shutoff Voltage</td>
<td>V\text{ASD}</td>
<td>V\text{IN} : L → H</td>
<td>70</td>
<td>100</td>
<td>140</td>
<td>mV</td>
<td>-</td>
</tr>
<tr>
<td>V\text{IN}–V\text{BAT} Shutoff Voltage Hysteresis Width</td>
<td>V\text{ASD_HYS}</td>
<td>-</td>
<td>50</td>
<td>70</td>
<td>90</td>
<td>mV</td>
<td>-</td>
</tr>
<tr>
<td>C/10 Charge Termination Current Threshold</td>
<td>I\text{TERM}</td>
<td>V\text{LIM}=L</td>
<td>0.07</td>
<td>0.1</td>
<td>0.13</td>
<td>mA/mA</td>
<td>(2)</td>
</tr>
<tr>
<td>/CHG Pin Weak Pull-Down Current</td>
<td>I\text{CHG1}</td>
<td>V\text{BAT}=4.3V, V\text{CHG}=5V</td>
<td>8</td>
<td>20</td>
<td>35</td>
<td>μA</td>
<td>(3)</td>
</tr>
<tr>
<td>/CHG Pin Strong Pull-Down Current</td>
<td>I\text{CHG2}</td>
<td>V\text{BAT}=4.0V, V\text{CHG}=1V</td>
<td>4</td>
<td>10</td>
<td>18</td>
<td>mA</td>
<td>(3)</td>
</tr>
<tr>
<td>/CHG Pin Output Low Voltage</td>
<td>V\text{CHG}</td>
<td>I\text{CHG}=5mA</td>
<td>-</td>
<td>0.35</td>
<td>0.60</td>
<td>V</td>
<td>(4)</td>
</tr>
<tr>
<td>Recharge Battery Threshold Voltage</td>
<td>(\Delta V\text{RECHRG})</td>
<td>V\text{FLOAT1}–V\text{RECHRG}((^{(2)}))</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>mV</td>
<td>(3)</td>
</tr>
<tr>
<td>ON Resistance</td>
<td>R\text{ON}</td>
<td></td>
<td>-</td>
<td>300</td>
<td>450</td>
<td>800</td>
<td>mΩ</td>
</tr>
<tr>
<td>Soft-Start Time</td>
<td>I\text{SS}</td>
<td>I\text{BAT}= 0 → I\text{BAT2} (V\text{LIM}=H)</td>
<td>120</td>
<td>150</td>
<td>180</td>
<td>μs</td>
<td>(5)</td>
</tr>
<tr>
<td>Recharge Battery Time</td>
<td>t\text{RECHRG}</td>
<td>V\text{BAT} : H → L</td>
<td>0.4</td>
<td>1.7</td>
<td>3.2</td>
<td>ms</td>
<td>(6)</td>
</tr>
<tr>
<td>Battery Termination Detect Time</td>
<td>t\text{TERM}</td>
<td>I\text{BAT falling (Less than I\text{TERM})}</td>
<td>0.3</td>
<td>1.2</td>
<td>2.4</td>
<td>ms</td>
<td>(6)</td>
</tr>
<tr>
<td>L\text{IM} Pin &quot;H&quot; Level Voltage</td>
<td>V\text{LIM_H}</td>
<td></td>
<td>1</td>
<td>V</td>
<td>-</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>L\text{IM} Pin &quot;L&quot; Level Voltage</td>
<td>V\text{LIM_L}</td>
<td></td>
<td>0.4</td>
<td>V</td>
<td>-</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>L\text{IM} Pin &quot;H&quot; Level Current</td>
<td>I\text{LIM_H}</td>
<td></td>
<td>-0.1</td>
<td>0.1</td>
<td>μA</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>L\text{IM} Pin &quot;L&quot; Level Current</td>
<td>I\text{LIM_L}</td>
<td></td>
<td>-0.1</td>
<td>0.1</td>
<td>μA</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>Thermal Shut-Down Detect Temperature</td>
<td>T\text{TSD}</td>
<td>Junction temperature</td>
<td>120</td>
<td>V</td>
<td>-</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Thermal Shut-Down Release Temperature</td>
<td>T\text{TSR}</td>
<td>Junction temperature</td>
<td>100</td>
<td>V</td>
<td>-</td>
<td>(3)</td>
<td></td>
</tr>
</tbody>
</table>

Unless otherwise stated, V\text{IN}=5.0V.

\(^{(1)}\) The figures under the condition of 0°C ≤ Ta ≤ 50°C are guaranteed by design calculation.

\(^{(2)}\) V\text{RECHRG} is a voltage to start recharging while reducing V\text{BAT} in stand-by mode from the full charge.
■ OPERATIONAL DESCRIPTION

<Charge Cycle>
If the BAT pin trickle voltage is less than 2.9V (TYP.), the charger enters trickle charge mode. In this mode, a safe battery charge is possible because approximately only 1/10 of the charge current is supplied to the battery. When the BAT pin voltage rises above trickle voltage, the charger enters constant-current mode (CC mode) and the battery is charged by the programmed charge current. When the BAT pin voltage reaches 4.2V, the charger enters constant-voltage mode (CV mode) automatically. After this, the charge current starts to drop and when it reaches a level which is 1/10 of the programmed charge current, the charge terminates.

<Setting Charge Current>
The charge current can be set from 475mA (TYP.) or 95mA (TYP.) by the LIM pin.

- LIM “H” level input: 475mA (TYP.)
- LIM “L” level input: 95mA (TYP.)

<Charge Termination>
The battery charge is terminated when the charge current decreases to 1/10 of the full charging level after the battery pin voltage reaches a float voltage. An internal comparator monitors the ISEN pin voltage to detect the charge termination. When the comparator sees that the ISEN pin voltage is less than 1.2ms (charge termination detect time), the IC enters stand-by mode. A driver transistor turns off during the stand-by mode.

<Automatic Recharge>
In stand-by mode battery voltage falls. When the voltage level at the battery pin drops to recharge battery threshold voltage 4.05V (TYP.) or less, the charge cycle automatically re-start after a delay of 1.7ms. As such, no external activation control is needed.
OPERATIONAL EXPLANATION (Continued)

<Charge Condition Status>
The /CHG pin constantly monitors the charge states classified as below:
- Strong pull-down: $I_{\text{CHG}}=10\text{mA (TYP.)}$ in a charge cycle,
- Weak pull-down: $I_{\text{CHG}}=20\text{μA (TYP.)}$ in a stand-by mode,
- High impedance: in shutdown mode.

<Connection of Shorted BAT Pin>
Even if the BAT pin is shorted to $V_{\text{SS}}$, a trickle charge mode operates in order to protect the IC from destruction caused by over current.

<Under-voltage Lockout (UVLO)>
The UVLO circuit keeps the charger in shut-down mode until the input voltage, $V_{\text{IN}}$, rises above the UVLO voltage. Moreover, in order to protect the battery charger, the UVLO circuit keeps the charger in shut-down mode when the voltage between the input pin voltage and BAT pin voltage falls to less than 30mV. The charge will not restart until the voltage between the input pin voltage and BAT pin voltage rises more than 100mV. During shut-down mode, the driver transistor turns off but a failure detection circuit operates, and supply current is reduced to $8\text{μA}$.

<Soft-Start Function>
To protect against inrush current from the input to the battery, soft-start time is optimized and internally set (150μs, TYP.).

<Backflow Prevention Between the BAT Pin and the $V_{\text{IN}}$ Pin>
A backflow prevention circuit protects against current flowing from the BAT pin to the $V_{\text{IN}}$ pin even if the BAT pin voltage is higher than the $V_{\text{IN}}$ pin voltage.
NOTES ON USE

1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.

2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please wire the $C_{in}$ as close to the IC as possible.

3. Torex places an importance on improving our products and their reliability. We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.
## TEST CIRCUITS

**CIRCUIT①**
ON Resistance, LIM Pin “H” level current, LIM Pin “L” level current,

![CIRCUIT① Diagram](image)

**CIRCUIT②**
C/10 Charge Termination Current Threshold, Battery Termination Voltage1

![CIRCUIT② Diagram](image)

**CIRCUIT③**
Trickle Charge Current1~2, Battery Current1~5, LIM Pin “H” level Voltage, LIM Pin “L” level Voltage, Trickle Charge Voltage, Recharge Battery Threshold Voltage, V_{IN}-V_{BAT} Shut-down Voltage, /CHG Pin Weak_Pull_down Current, /CHG Pin Strong_Pull_down Current, Supply Current, Stand-by Current, Shut-down Current

![CIRCUIT③ Diagram](image)

**CIRCUIT④**
/CHG Pin Output Low Voltage

![CIRCUIT④ Diagram](image)

**CIRCUIT⑤**
Soft-Start Time

![CIRCUIT⑤ Diagram](image)

**CIRCUIT⑥**
Recharge Time at Charge Termination Detect, UVLO Voltage

![CIRCUIT⑥ Diagram](image)
**TYPICAL PERFORMANCE CHARACTERISTICS**

(1) Charge Cycle

![Charge Cycle Graph](image1)

(2) Battery Current vs. Battery Voltage

![Battery Current vs. Battery Voltage Graph](image2)
(3) Battery Voltage vs. Battery Current

![Battery Voltage vs. Battery Current](image1)

![Battery Voltage vs. Battery Current](image2)

(4) Charge Termination Voltage vs. Ambient Temperature

![Charge Termination Voltage vs. Ambient Temperature](image3)

![Charge Termination Voltage vs. Ambient Temperature](image4)
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) バッテリー電流 - 周囲温度特性例

XC6801A421

![Battery Current1 vs. Ambient Temperature](image1)

![Battery Current2 vs. Ambient Temperature](image2)

(6) トリクル充電電流 - 周囲温度特性例

XC6801A421

![Trickle Charge Current1 vs. Ambient Temperature](image3)

![Trickle Charge Current2 vs. Ambient Temperature](image4)

(7) トリクル電圧 - 周囲温度特性例

XC6801A421

![Trickle Voltage vs. Ambient Temperature](image5)

(8) UVLO電圧 - 周囲温度特性例

XC6801A421

![UVLO Voltage vs. Ambient Temperature](image6)
XC6801 Series

- **TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

  9) $V_{IN} - V_{BAT}$ Shutdown Voltage vs. Ambient Temperature

  ![Graph 9](image)

  10) Charge Termination Detect Time vs. Ambient Temperature

  ![Graph 10](image)

  11) Recharge Time vs. Ambient Temperature

  ![Graph 11](image)

  12) Recharge Threshold Voltage vs. Ambient Temperature

  ![Graph 12](image)

  13) Soft Start Time vs. Ambient Temperature

  ![Graph 13](image)

  14) ON Resistance vs. Ambient Temperature

  ![Graph 14](image)
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(15) Shutdown Current vs. Ambient Temperature

\[ V_{IN}=5V \]

(16) Stand-by Current vs. Ambient Temperature

\[ V_{IN}=5V, V_{BAT}=4.3V \]

(17) /CHG Weak Pull Down Current vs. /CHG Pin Voltage

\[ V_{IN}=5V, V_{BAT}=4.3V \]

(18) /CHG Strong Pull Down Current vs. /CHG Pin Voltage

\[ V_{IN}=5V, V_{BAT}=4.0V \]

(19) /CHG Pin Output Low Voltage vs. Ambient Temperature

\[ I_{CHG}=5mA, V_{IN}=5V, V_{BAT}=2.5V \]
PACKAGING INFORMATION

**SOT-25**

- SOT-25 Reference Pattern Layout

**SOT-89-5**

- SOT-89-5 Reference Pattern Layout

(unit: mm)
PACKAGING INFORMATION (Continued)

- **USP-6C**

(Unit: mm)

- **USP-6C Reference Pattern Layout**

- **USP-6C Reference Metal Mask Design**
SOT-89-5 Power Dissipation

Power dissipation data for the SOT-89-5 is shown in this page. The value of power dissipation varies with the mount board conditions. Please use this data as the reference data taken in the following condition.

1. Measurement Condition

Condition: Mount on a board
Ambient: Natural convection
Soldering: Lead (Pb) free
Board: Dimensions 40 x 40 mm
(1600 mm² in one side)
Copper (Cu) traces occupy 50% of the board area in top and back faces
Package heat-sink is tied to the copper traces
Material: Glass Epoxy (FR-4)
Thickness: 1.6mm
Through-hole: 5 x 0.8 Diameter

2. Power Dissipation vs. Ambient Temperature

<table>
<thead>
<tr>
<th>Ambient Temperature (°C)</th>
<th>Power Dissipation Pd (mW)</th>
<th>Thermal Resistance (°C/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1300</td>
<td>76.92</td>
</tr>
<tr>
<td>85</td>
<td>520</td>
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</tbody>
</table>

Pd vs Ta

Ambient Temperature Ta (°C)
PACKAGING INFORMATION (Continued)

- **SOT-25 Power Dissipation**

Power dissipation data for the SOT-25 is shown in this page. The value of power dissipation varies with the mount board conditions. Please use this data as the reference data taken in the following condition.

1. **Measurement Condition**

- **Condition**: Mount on a board
- **Ambient**: Natural convection
- **Soldering**: Lead (Pb) free
- **Board**:
  - Dimensions 40 x 40 mm
  - (1600 mm² in one side)
  - Copper (Cu) traces occupy 50% of the board area in top and back faces
  - Package heat-sink is tied to the copper traces
  - (Board of SOT-26 is used.)
- **Material**: Glass Epoxy (FR-4)
- **Thickness**: 1.6mm
- **Through-hole**: 4 x 0.8 Diameter

2. **Power Dissipation vs. Ambient Temperature**

<table>
<thead>
<tr>
<th>Ambient Temperature (°C)</th>
<th>Power Dissipation Pd (mW)</th>
<th>Thermal Resistance (°C/W)</th>
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<tbody>
<tr>
<td>25</td>
<td>600</td>
<td>166.67</td>
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![Evaluation Board (Unit: mm)](image)

Pd vs. Ta

![Graph showing Power Dissipation vs. Ambient Temperature](image)
PACKAGING INFORMATION (Continued)

- **USP-6C Power Dissipation**

Power dissipation data for the USP-6C is shown in this page. The value of power dissipation varies with the mount board conditions. Please use this data as the reference data taken in the following condition.

1. **Measurement Condition**

   - **Condition**: Mount on a board
   - **Ambient**: Natural convection
   - **Soldering**: Lead (Pb) free
   - **Board**: Dimensions 40 x 40 mm (1600 mm² in one side)
   - **Material**: Glass Epoxy (FR-4)
   - **Thickness**: 1.6 mm
   - **Through-hole**: 4 x 0.8 Diameter

2. **Power Dissipation vs. Ambient Temperature**

<table>
<thead>
<tr>
<th>Ambient Temperature (°C)</th>
<th>Power Dissipation Pd (mW)</th>
<th>Thermal Resistance (°C/W)</th>
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<tbody>
<tr>
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<td>1000</td>
<td>100.00</td>
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<tr>
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<td>400</td>
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![Evaluation Board (Unit: mm)](image)
**MARKING RULE**

**SOT-25**

① represents product series

<table>
<thead>
<tr>
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<th>PRODUCT SERIES</th>
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<tr>
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② represents the 7th digits

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③ represents the 8th digits

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</tr>
</tbody>
</table>

④⑤ represents production lot number

01~09, 0A~0Z, 11・・・9Z, A1・・・A9, AA・・・Z9, ZA・・・ZZ in order.

(G, I, O, Q, W excepted)

*No character inversion used.*

**SOT-89-5**

**USP-6C**
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