**XC6230 Series**

Adjustable Voltage Output Multifunction 2A High Speed LDO Regulator

**FEATURES**
- Output current: 2.0A
- Current Limit setting range: 0.3A ~ 2.5A
- Dropout Voltage (USP-6C): 0.17V @ I_OUT = 1.0A / V_OUT_SET = 3.3V
- Dropout Voltage (SOP-8FD): 0.23V @ I_OUT = 1.0A / V_OUT_SET = 3.3V
- Input voltage range: 1.7 ~ 6.0V
- Adjustable Output Voltage Accuracy: 1.2V ±1.0%
- Output voltage setting range: 1.2V ~ 5.0V
- Supply current: 45μA
- Addition function: Reverse Current Protection (Option) / Inrush Current Protection
- Protection function: Thermal shutdown (Detection Temp: 150°C / Release Temp: 125°C)
- Current limit: Off
- Output capacitor: Ceramic capacitor (4.7μF)
- Operating Ambient Temperature: -40°C ~ +105°C
- Packages: USP-6C, SOP-8FD
- Environment friendly features: EU RoHS Directive compliant, Pb free

**APPLICATIONS**
- Industrial equipment
- Mobile modules
- Wireless modules

**GENERAL DESCRIPTION**

The XC6230 series are low on-resistance / low dropout voltage, highly precise, low noise, high PSRR, and large current High Speed LDO regulator IC. A built-in 0.17Ω low ON-resistance Pch driver transistor which can output up to a maximum output current 2.0A are also enclosed in a small surface-mount PKG, even in applications that input and output voltage difference is you use a very small state, it is possible to use in the space-saving.

Then, the output voltage is possible to set the output voltage value to 1.2V ~ 5.0V by connecting the external resistors to V_OFB terminal. The over current protection circuit will operate when the output current reaches its current limit. The thermal shutdown circuit will operate when the junction temperature reaches its limit temperature. The current limit is possible to arbitrarily set in a range of external resistor in 0.3 ~ 2.5A to I_LIM terminal. The inrush current prevention circuit perform the function of suppressing the variation of the V_IN line and it is possible to suppress the current (inrush current), which is charged in the output capacitor (C_L) during IC start rising (when the IC control in CE). In addition, the CE function enables the output to be turned off and the IC becomes a stand-by mode resulting in greatly reduced power consumption.

When in standby mode, the output capacitor (C_L) to be discharged at high speed it can be returned to the V_SSB level. The IC has further built-in reverse current prevention circuit, to prevent backflow current when the voltage state of more than input terminal (V_IN) to the output terminal (V_OUT).

**TYPICAL APPLICATION CIRCUIT**

![Typical Application Circuit](image)

**TYPICAL PERFORMANCE CHARACTERISTICS**

Output Voltage vs. Output Current (Output current externally adjusted.)

![Typical Performance Characteristics](image)
**XC6230 Series**

### BLOCK DIAGRAMS

**XC6230 series, Type H**

![Block Diagram Image]

*Diodes inside the circuit are an ESD protection diodes.*

**XC6230 series, Type S**

![Block Diagram Image]

*Diodes inside the circuit are an ESD protection diodes.*
PRODUCT CLASSIFICATION

Ordering Information
XC6230①②③④⑤⑥⑦⑧(*)

<table>
<thead>
<tr>
<th>DESIGNATOR</th>
<th>ITEM</th>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Type</td>
<td>H</td>
<td>Refer to Selection Guide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>②③</td>
<td>Output Voltage</td>
<td>00</td>
<td>Adjustable Output Voltage (V_{OFB}=1.20V)</td>
</tr>
<tr>
<td>④</td>
<td>Adjustable</td>
<td>1</td>
<td>±1%</td>
</tr>
<tr>
<td></td>
<td>Output Voltage</td>
<td></td>
<td>Accuracy</td>
</tr>
<tr>
<td>⑤⑥⑦(*)</td>
<td>Packages (Order</td>
<td>ER-G</td>
<td>USP-6C (3,000pcs/Reel)</td>
</tr>
<tr>
<td></td>
<td>Unit)</td>
<td></td>
<td>QR-G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SOP-8FD (1,000pcs/Reel)</td>
</tr>
</tbody>
</table>

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

Selection Guide

<table>
<thead>
<tr>
<th>TYPE</th>
<th>THERMAL SHUTDOWN</th>
<th>ADJUSTABLE CURRENT LIMITER</th>
<th>ADJUSTABLE OUTPUT VOLTAGE</th>
<th>REVERSE CURRENT PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<table>
<thead>
<tr>
<th>TYPE</th>
<th>INRUSH CURRENT PROTECTION</th>
<th>CE PULL-DOWN RESISTOR</th>
<th>C\text{\textsubscript{L}} AUTO-DISCHARGE</th>
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<tbody>
<tr>
<td>H</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
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</table>
XC6230 Series

PIN CONFIGURATION

PIN ASSIGNMENT

<table>
<thead>
<tr>
<th>PIN NUMBER</th>
<th>PIN NAME</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>USP-6C</td>
<td>SOP-8FD</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>VOUT</td>
</tr>
<tr>
<td>-</td>
<td>2, 7</td>
<td>NC</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>I\text{\textsubscript{LIM}}</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>V\text{\textsubscript{OFB}}</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>CE</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>V\text{\textsubscript{SS}}</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>V\text{\textsubscript{IN}}</td>
</tr>
</tbody>
</table>

PIN FUNCTION ASSIGNMENT

<table>
<thead>
<tr>
<th>PIN NAME</th>
<th>SIGNAL</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>H</td>
<td>Active</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>Stand-by</td>
</tr>
<tr>
<td></td>
<td>OPEN</td>
<td>Stand-by*</td>
</tr>
</tbody>
</table>

* For CE pin voltage is fixed as L level because of internal pull-down resister.

* The dissipation pad for the USP-6C package and the SOP-8FD package should be solder-plate to enhance mounting strength and heat release. Please see the reference mount pattern and metal masking. If the pad needs to be connected to other pins, it should be connected to the V\text{\textsubscript{SS}} (USP-6C: No. 5, SOP-8FD: No. 6) pin.
### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>VIN</td>
<td>-0.3 ~ +7.0 V</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>VOUT</td>
<td>-0.3 ~ +7.0 V</td>
<td>V</td>
</tr>
<tr>
<td>CE Input Voltage</td>
<td>VCE</td>
<td>-0.3 ~ +7.0 V</td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;OFB&lt;/sub&gt; Pin Voltage</td>
<td>V&lt;sub&gt;OFB&lt;/sub&gt;</td>
<td>-0.3 ~ +6.0 V</td>
<td>V</td>
</tr>
<tr>
<td>I&lt;sub&gt;LIM&lt;/sub&gt; Pin Voltage</td>
<td>V&lt;sub&gt;LIM&lt;/sub&gt;</td>
<td>-0.3 ~ +6.0 V</td>
<td>V</td>
</tr>
<tr>
<td>I&lt;sub&gt;LIM&lt;/sub&gt; Pin Current</td>
<td>I&lt;sub&gt;LIM&lt;/sub&gt;</td>
<td>±1.0 mA</td>
<td>mA</td>
</tr>
</tbody>
</table>

| Power Dissipation (Ta=25°C) | USP-6C Pd | 1000 (40mm x 40mm Standard board) (*)<sup>1</sup> | mM |
|                           | SOP-8FD  | 1250 (JESD51-7 board) (*)<sup>1</sup> | mM |
|                           |          | 1500 (40mm x 40mm Standard board) (*)<sup>1</sup> | mM |
|                           |          | 2500 (JESD51-7 board) (*)<sup>1</sup> | mM |

| Operating Ambient Temperature | Topr | -40 ~ +105 °C |
| Storage Temperature         | Tstg | -55 ~ +125 °C |

All voltage ratings are relative to V<sub>SS</sub>.

(*)<sup>1</sup> This power dissipation figure shown is PCB mounted and is for reference only.
The mounting condition is please refer to PACKAGING INFORMATION.
## ELECTRICAL CHARACTERISTICS

### XC6230 series

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNITS</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable Output Voltage</td>
<td>( V_{OFB} )</td>
<td>-</td>
<td>1.188</td>
<td>1.200</td>
<td>1.212</td>
<td>V</td>
<td>①</td>
</tr>
<tr>
<td>Output Voltage Setting Range</td>
<td>( V_{OUT_SET} )(^{(1)})</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
<td>5.0</td>
<td>V</td>
<td>①</td>
</tr>
<tr>
<td>Output Current</td>
<td>( I_{OUT_MAX} )</td>
<td>-</td>
<td>2000</td>
<td>-</td>
<td>-</td>
<td>mA</td>
<td>①</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>( V_{IN} )</td>
<td>-</td>
<td>1.7</td>
<td>-</td>
<td>6.0</td>
<td>V</td>
<td>①</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>( \Delta V_{OUT} )</td>
<td>( 0.1 \text{mA} \leq I_{OUT} \leq 500 \text{mA} )</td>
<td>-</td>
<td>1</td>
<td>8</td>
<td>mV</td>
<td>①</td>
</tr>
<tr>
<td>Dropout Voltage1 (Offset of Reverse Current Protection)</td>
<td>( V_{diff}(2) )</td>
<td>( R_{21}=33k\Omega, R_{22}=11k\Omega )</td>
<td>-</td>
<td>60</td>
<td>110</td>
<td>mV</td>
<td>①</td>
</tr>
<tr>
<td>Dropout Voltage2</td>
<td>( V_{diff}(2) )</td>
<td>[\text{USP-6C}] ( R_{21}=33k\Omega, R_{22}=11k\Omega )</td>
<td>-</td>
<td>170</td>
<td>200</td>
<td>mV</td>
<td>①</td>
</tr>
<tr>
<td>Dropout Voltage3</td>
<td>( V_{diff}(2) )</td>
<td>[\text{SOP-8FD}] ( R_{21}=33k\Omega, R_{22}=11k\Omega )</td>
<td>-</td>
<td>350</td>
<td>410</td>
<td>mV</td>
<td>①</td>
</tr>
<tr>
<td>Supply Current</td>
<td>( I_{SS} )</td>
<td>( V_{IN}=6.0V, I_{OUT}=0\text{mA} )</td>
<td>-</td>
<td>45</td>
<td>83</td>
<td>( \mu A )</td>
<td>②</td>
</tr>
<tr>
<td>Stand-by Current</td>
<td>( I_{STBY} )</td>
<td>( V_{IN}=6.0V, V_{CE}=V_{SS} )</td>
<td>-</td>
<td>0.01</td>
<td>0.10</td>
<td>( \mu A )</td>
<td>②</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>( \Delta V_{OUT}/(\Delta V_{IN} \cdot V_{OUT}) )</td>
<td>( 1.7V \leq V_{IN} \leq 6.0V, I_{OUT}=100\text{mA} )</td>
<td>-</td>
<td>0.05</td>
<td>0.10</td>
<td>%/V</td>
<td>①</td>
</tr>
<tr>
<td>Output Voltage Temperature Characteristics</td>
<td>( \Delta V_{OUT}/(\Delta T_{Topr} \cdot V_{OUT}) )</td>
<td>(-40^\circ C \leq T_{Topr} \leq 105^\circ C )</td>
<td>-</td>
<td>±100</td>
<td>-</td>
<td>ppm/°C</td>
<td>①</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio</td>
<td>PSRR</td>
<td>( V_{IN}=V_{CE}=2.2V+0.5Vp-p\text{ac}, I_{OUT}=30\text{mA}, f=1kHz )</td>
<td>-</td>
<td>70</td>
<td>-</td>
<td>dB</td>
<td>(3)</td>
</tr>
</tbody>
</table>

Unless otherwise stated, \( V_{IN}=V_{CE}=V_{OUT}+1.0V, V_{OUT}=V_{OFB}, I_{OUT}=10\text{mA}, C_{IN}=2.2\text{pF}, C_{L}=4.7\text{pF}, R_{LIM}=0\Omega \)

Parameter of electrical characteristics is applied when \( T_j \approx 25^\circ C \) become load conditions (pulse applied).

Unless \( \Delta V_{OUT}/(\Delta T_{Topr} \cdot V_{OUT}) \), \( T_{SD} \) and \( T_{SR} \) conditions.

**NOTE:**

\(^{(1)}\) \( V_{OUT\_SET} \) : Nominal output voltage. \( V_{OUT\_SET} \) is adjustable with external resistors (\( R_{21}, R_{22} \)). \( V_{OUT\_SET} \) is 1.2V, if \( V_{OUT} = V_{OFB} \).

\(^{(2)}\) \( V_{diff} = |V_{IN}-V_{OUT}| \)

\( V_{IN} \): Gradually lower the input voltage, the input voltage when 3.3V is output.

\( V_{OUT\_SET} \) is set to more than 3.3V, it is confirmed that the 3.3V is output to \( V_{OUT} \).

\(^{(3)}\) Design reference value. This parameter is provided only for reference.
### ELECTRICAL CHARACTERISTICS (Continued)

#### XC6230 Series

<table>
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<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>CONDITIONS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNITS</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit Current</td>
<td>$I_{\text{ILM}}$</td>
<td>-</td>
<td>2250</td>
<td>2500</td>
<td>2750</td>
<td>mA</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$R_{\text{ILM}}=200k\Omega$</td>
<td>-</td>
<td>240</td>
<td>300</td>
<td>- mA</td>
<td>(1)</td>
</tr>
<tr>
<td>Short-Circuit Current</td>
<td>$I_{\text{ISHORT}}$</td>
<td>-</td>
<td>-</td>
<td>320</td>
<td>-</td>
<td>- mA</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{\text{OUT}}=V_{\text{SS}}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>- mA</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{\text{OUT}}=V_{\text{SS}} R_{\text{ILM}}=200k\Omega$</td>
<td>-</td>
<td>180</td>
<td>-</td>
<td>- mA</td>
<td>(1)</td>
</tr>
<tr>
<td>Input Impedance $V_{\text{OFB}}$</td>
<td>$R_{\text{OFB}}$</td>
<td>$V_{\text{IN}}=V_{\text{CE}}=6.0V, V_{\text{OFB}}=5.5V$</td>
<td>0.7</td>
<td>1.7</td>
<td>2.7</td>
<td>MΩ</td>
<td>(1)</td>
</tr>
<tr>
<td>CE &quot;H&quot; Level Voltage</td>
<td>$V_{\text{CEH}}$</td>
<td>-</td>
<td>0.9</td>
<td>-</td>
<td>6.0</td>
<td>V</td>
<td>(1)</td>
</tr>
<tr>
<td>CE &quot;L&quot; Level Voltage</td>
<td>$V_{\text{CEL}}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>V</td>
<td>(1)</td>
</tr>
<tr>
<td>CE &quot;H&quot; Level Current</td>
<td>$I_{\text{CEH}}$</td>
<td>$V_{\text{IN}}=6.0V, V_{\text{CE}}=6.0V$</td>
<td>-</td>
<td>6.0</td>
<td>10.4</td>
<td>μA</td>
<td>(1)</td>
</tr>
<tr>
<td>CE &quot;L&quot; Level Current</td>
<td>$I_{\text{CEL}}$</td>
<td>$V_{\text{IN}}=6.0V, V_{\text{CE}}=V_{\text{SS}}$</td>
<td>-0.1</td>
<td>-</td>
<td>-</td>
<td>μA</td>
<td>(1)</td>
</tr>
<tr>
<td>Reverse Current</td>
<td>$I_{\text{REV}}$</td>
<td>$V_{\text{IN}}=0V, V_{\text{CE}}=2.0V, V_{\text{OUT}}=6.0V$</td>
<td>-</td>
<td>0.05</td>
<td>0.10</td>
<td>μA</td>
<td>(1)</td>
</tr>
<tr>
<td>V$_{\text{OUT}}$ Sink Current at Reverse condition</td>
<td>$I_{\text{REV}}$</td>
<td>$V_{\text{IN}}=5.0V, V_{\text{CE}}=6.0V$</td>
<td>-</td>
<td>0.9</td>
<td>1.6</td>
<td>μA</td>
<td>(1)</td>
</tr>
<tr>
<td>Inrush Current</td>
<td>$I_{\text{IRUSH}}$</td>
<td>$V_{\text{IN}}=6.0V, V_{\text{CE}}=0\rightarrow6.0V$</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>mA</td>
<td>(1)</td>
</tr>
<tr>
<td>Thermal Shutdown Detect Temperature</td>
<td>$T_{\text{TSD}}$</td>
<td>Junction Temperature</td>
<td>-</td>
<td>150</td>
<td>-</td>
<td>℃</td>
<td>(1)</td>
</tr>
<tr>
<td>Thermal Shutdown Release Temperature</td>
<td>$T_{\text{TTSR}}$</td>
<td>Junction Temperature</td>
<td>-</td>
<td>125</td>
<td>-</td>
<td>℃</td>
<td>(1)</td>
</tr>
<tr>
<td>$C_{\text{L}}$ Discharge Resistance (H Type)</td>
<td>$R_{\text{DCCHG}}$</td>
<td>$V_{\text{IN}}=6.0V, V_{\text{CE}}=V_{\text{SS}}, V_{\text{OUT}}=1.2V$</td>
<td>-</td>
<td>35</td>
<td>-</td>
<td>Ω</td>
<td>(1)</td>
</tr>
</tbody>
</table>

Unless otherwise stated,

$V_{\text{IN}}=V_{\text{CE}}=V_{\text{OUT}}+1.0V, V_{\text{OUT}}=V_{\text{OIFB}}, I_{\text{OUT}}=10mA, C_{\text{IN}}=2.2\mu F, C_{\text{L}}=4.7\mu F, R_{\text{ILM}}=50\Omega$

Parameter of electrical characteristics is applied when $T_{\text{J}}=25^\circ\text{C}$ become load conditions (pulse applied).

Unless $\Delta V_{\text{OUT}} / (\Delta T_{\text{OPR}} \times V_{\text{OUT}})$, $T_{\text{TSD}}$ and $T_{\text{TTSR}}$ conditions.

**NOTE:**

*($^4$) reverse current ($I_{\text{REV}}$) shows the current flowing from the $V_{\text{OUT}}$ terminal to $V_{\text{IN}}$ terminal.

*($^5$) reverse flow during the $V_{\text{OUT}}$ pin sink current ($I_{\text{REV}}$) shows the current flowing from the $V_{\text{OUT}}$ pin to the $V_{\text{SS}}$ terminal.*
XC6230 Series

TEST CIRCUITS

• Circuit 1

• Circuit 2

• Circuit 3
OPERATIONAL EXPLANATION

The XC6230 series controls the output voltage, divided by resistors R11 & R12 which are connected to the VOFB pin is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET connected to the VOUT pin, is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled & stabilized by negative feedback.

This IC the current limit circuit and short protect circuit operate in relation to the level of output current. The thermal protection operates in relation to the level of heat generation. The reverse current protection operates when VOUT voltage is higher than VIN voltage. Further, the IC's internal circuitry can be turned off via the CE pin's signal.

<Output voltage outside the adjustable function>

XC6230 series are possible to adjust the output voltage in the range of up to 1.2V ~ 5.0V by the value of the external resistor divider R21 and R22. The output voltage can be set externally by the following equation:

\[ I_{21} = I_{FB} + I_{22} \]  \hspace{1cm} (1)

\[ I_{22} = \frac{VOFB [V]}{R_{22}} \]  \hspace{1cm} (2)

Following (1), (2)

\[ I_{21} = \frac{VOFB [V]}{R_{11} + R_{12}} \]  \hspace{1cm} (3)

Setting output voltage "VOUT_SET" is the sum of the voltage which is determined by the current flowing through the VOFB voltage and resistance R21.

\[ V_{OUT\_SET} = \frac{VOFB [V]}{R_{21} + R_{22}} \]  \hspace{1cm} (4)

Substituting (3) in (4),

\[ V_{OUT\_SET} = \frac{VOFB [V]}{R_{21} + R_{22}} \times (R_{21} + R_{22}) \]  \hspace{1cm} (5)

Following (5), can decide arbitrary setting voltage.

In this case, it becomes \( V_{OFB} [V] = 1.200 [V] \) (TYP.) from the electrical characteristics.

The second term of the equation (5), \( R_{21} \times I_{FB} \), is the cause of the output voltage precision error.

The \( I_{FB} \) can be calculated by the following equation;

\[ I_{FB} = \frac{VOFB [V]}{R_{11} + R_{12}} \]  \hspace{1cm} (6)

\( R_{21} \times I_{FB} \) can be calculated by the equation below;

\[ R_{21} \times I_{FB} = \frac{VOFB [V]}{R_{OFB}} \times \frac{R_{OFB}}{R_{21} \times I_{FB}} \]  \hspace{1cm} (7)

Accordingly, if \( R_{21} \ll R_{OFB} \), Precision error of the output voltage setting, it can be made very small.

However, customers please would be selected on that was evaluated by your conditions of use. If the external resistance value is small, there is a trade-off between current consumption increases. The value of R22 is recommended TYP=47kΩ.

Please use by connecting the VOUT pin and VOFB terminal, when used as 1.2V set up.
OPERATIONAL EXPLANATION (Continued)

XC6230 series setting resistor dependence of output voltage

Large external feedback resistor (R21, R22) cannot be ignored in the IC, they will affect the set output voltage and the output voltage temperature characteristics. Therefore, the feedback resistor should be chosen to be R22 ≤ 220kΩ.

XC6230 series Temperature characteristics of the output voltage

Low ESR Capacitors

The XC6230 series needs an output capacitor (C_L) for phase compensation. In order to ensure the stable phase compensation, please place an output capacitor (C_L) of 4.7μF or bigger at the VOUT pin and VSS pin as close as possible. For a stable power input, please connect an input capacitor (C_IN) of 2.2μF between the input pin (VIN) and the ground pin (VSS).

Since input capacitor (C_IN), the output capacitor (C_L) are bias dependence of the capacitor the influence of the missing capacity due to temperature characteristics, also there is a risk that cannot be stable phase compensation under the influence of the ESR. Please pay attention to the selection of the capacitor to be used.
OPERATIONAL EXPLANATION (Continued)

<Current Limiter, Short-Circuit Protection>

The protection circuit operates as a combination of an output current limiter and fold-back short circuit protection. When load current reaches the current limit level, the output voltage drops. As a result, the load current starts to reduce with showing fold-back curve. The output current finally falls at the level of 320mA (TYP.) when the output pin (VOUT) is short-circuited (RILIM=0Ω).

<Current limit external adjustment function>

By connecting a resistor to the current limit external adjustment pin (ILIM), the current limit can be set to any value. By the following each equations, the current limit value can be set to any value within a range of 300mA to 2500mA (TYP.).

Initial value of the current limit is set to 2500mA (TYP.) on IC inside. Please be sure to use the current limit external control terminal (ILIM) are connected by either 0Ω short to VSS terminal on the substrate.

When the ILIM pin is open, the switch transistor is forcibly turned off.

In case of $300mA \leq \text{ILIM(T)} \leq 500mA$ range, $R_{\text{ILIM}}[k[\Omega]] = \frac{74300} {\text{ILIM(T)}[mA]} - 48.2[k[\Omega]]$ .............(8)

In case of $500mA < \text{ILIM(T)} \leq 1500mA$ range, $R_{\text{ILIM}}[k[\Omega]] = \frac{65200} {\text{ILIM(T)}[mA]} - 30.0[k[\Omega]]$ .............(9)

In case of $1500mA < \text{ILIM(T)} < 2500mA$ range, $R_{\text{ILIM}}[k[\Omega]] = \frac{49800} {\text{ILIM(T)}[mA]} - 19.9[k[\Omega]]$ .............(10)

$R_{\text{ILIM}}$: The external resistance value, $\text{ILIM(T)}$: The current limit value

<table>
<thead>
<tr>
<th>$\text{ILIM(T)}$ [mA]</th>
<th>$R_{\text{ILIM}}$ [kΩ]</th>
<th>(E96) Resistor [kΩ]</th>
<th>Current Limit [mA] (TYP.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>199.5</td>
<td>200</td>
<td>299</td>
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<tr>
<td>400</td>
<td>137.6</td>
<td>137</td>
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<td>600</td>
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<td>42.2</td>
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<td>1100</td>
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<td>16.6</td>
<td>16.5</td>
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<tr>
<th>$\text{ILIM(T)}$ [mA]</th>
<th>$R_{\text{ILIM}}$ [kΩ]</th>
<th>(E96) Resistor [kΩ]</th>
<th>Current Limit [mA] (TYP.)</th>
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<td>11.2</td>
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<tr>
<td>2500</td>
<td>R_{\text{ILIM}} shorted to VSS</td>
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</tbody>
</table>

![XC6230 Current Limit(I_{\text{ILIM}}) vs External Resistor(R_{\text{ILIM}})](image-url)
OPERATIONAL EXPLANATION (Continued)

<Thermal Shutdown>
When the junction temperature of the built-in driver transistor reaches the temperature limit, the thermal shutdown circuit operates and the driver transistor will be set to OFF. The IC resumes its operation when the thermal shutdown function is released and the IC's operation is automatically restored because the junction temperature drops to the level of the thermal shutdown release voltage.

<CE Pin>
The IC's internal circuitry can be shutdown via the signal from the CE pin. H type has a pull-down resistor at the CE pin inside IC, so that the CE pin input current flows.

<Inrush Current Protection>
The inrush current protection circuit is built in the IC. When the IC starts to operate, the protection circuit limits the inrush current within 500mA (MAX.) from input pin (V IN) to output pin (V OUT) to charge C L capacitor. However the control of the internal IC cannot be supply more than 500mA (MAX.) for about 300μs.

<Reverse Current Protection>
The XC6230 series includes reverse current protection to prevent the damage battery or the like which is connected to the V IN pin to prevent the destruction as a result of backflow from V OUT pin to the V IN pin and V SS pin when the power supply is connected to the V OUT pin. When V IN is smaller than V OUT, the reverse current protection works and suppress the reverse current to 0.1μA (MAX.). When V IN is smaller than V OUT, the V OUT pin sink current IREVS flowing from the V OUT pin to the V SS pin is 0.9μA (TYP.) as the IC operation current.

<CL Auto-Discharge Function>
The XC6230 H type contains a C L auto-discharge resistor and an N-channel transistor between the V OUT pin and the V SS pin. The device quickly discharge the electric charge in the output capacitor (C L) when a low signal to the CE pin is input to turn off a whole IC circuit. The C L auto-discharge resistance is set at 35Ω (V OUT=1.2V TYP. @ V IN=6.0). Discharge time of the output capacitor (C L) is determined by a C L auto-discharge resistor value (R DCHG) and an output capacitor value. Time constant τ is defined as ( τ=C L x R DCHG). Output voltage after starting discharge can be calculated by the following formula.

\[ V=V_{OUT(E)}\times e^{-t/\tau} \]\n
\[ V: \text{Output voltage after starting discharge} \]
\[ V_{OUT(E)}: \text{Output voltage} \]
\[ t: \text{Discharge time} \]
\[ \tau :R_{DCHG}\times C_{L} \]
\[ C_{L}: \text{Capacitance connected VOUT pin} \]
\[ R_{DCHG}: \text{Output discharge resistor (CL Discharge Resistance)} \]

It can be expanded on "t", it is possible to obtain the discharge time from the above equation.

\[ t=\tau \ln(V_{OUT(E)} / V) \]
**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 the noise and/or phase lag depending on output current. Please strengthen $V_{IN}$ and $V_{SS}$ wiring in particular.

3. The input capacitor ($C_{IN}$) and the output capacitor ($C_{L}$) should be placed to the as close as possible with a shorter wiring.

4. This IC has output stabilized by negative feedback control so as to follow the output fluctuation. The negative feedback control because the response delay exists, for a change of steep load current, to compensate for the supply of the load current by the discharge of charge from the output capacitor ($C_{L}$). However, since the electric charge discharge voltage temporarily drops, please use as large as possible a stabilization capacitance value of output capacitor ($C_{L}$) you have our check the electrical characteristics if that can occur sudden input change and load change on the application.

5. Torex recommend that the resistance tolerance and temperature coefficient of resistance (T.C.R) is selected the small parts in use, since the characteristics of the external resistor will affect the output voltage and current limit.

6. If you are setting the current limit with an external resistor, Please set the maximum output current, which is to use it as equal to or less than about 80% of the current limit setting value ($I_{LIMIT}$).

7. In the case that high resistors value of the $R_{21}, R_{22}$ are used for the XC6230S001 version and a voltage close to the input voltage level is applied to the output voltage Pin in the condition of $CE=L$, the output voltage may be maintained near the input voltage level. If it is necessary to reduce the output voltage to 0 V under these conditions, please adjust the resistance of $R_{21}$ and $R_{22}$ and connect a load resistance so that a load current of 30uA or more can flow to the output side.

8. Please use in the $V_{IN}-V_{OUT}$ difference and load current, in the range of heat loss does not exceed the allowable loss. For a change in the heat dissipation properties also by the substrate conditions, please design or select a good substrate of the heat dissipation efficiency.

9. Torex places an importance on improving our products and its reliability. However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.
TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

XC6230 (V\text{OUT,\,SET}=1.2\,V)

Output Voltage vs. Output Current

XC6230 (V\text{OUT,\,SET}=3.3\,V)

Output Voltage vs. Output Current

XC6230 (V\text{OUT,\,SET}=5.0\,V)

Output Voltage vs. Output Current

(2) Output Voltage vs. Output Current

(Out current externally adjusted.)
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Output Voltage vs. Input Voltage

**XC6230 (V\textsubscript{OUT\_SET}=1.2V)**

- \( V_{IN} \) vs. \( V_{OUT} \) for \( V_{OUT\_SET}=1.2V \), \( I_{OUT}=1mA \), \( I_{OUT}=10mA \), \( I_{OUT}=100mA \)
- Ta=25°C

- \( C_{IN}=2.2 \mu F\) (ceramic), \( C_{L}=4.7 \mu F\) (ceramic)

**XC6230 (V\textsubscript{OUT\_SET}=3.3V)**

- \( V_{IN} \) vs. \( V_{OUT} \) for \( V_{OUT\_SET}=3.3V \), \( I_{OUT}=1mA \), \( I_{OUT}=10mA \), \( I_{OUT}=100mA \)
- Ta=25°C

- \( C_{IN}=2.2 \mu F\) (ceramic), \( C_{L}=4.7 \mu F\) (ceramic)

**XC6230 (V\textsubscript{OUT\_SET}=5.0V)**

- \( V_{IN} \) vs. \( V_{OUT} \) for \( V_{OUT\_SET}=5.0V \), \( I_{OUT}=1mA \), \( I_{OUT}=10mA \), \( I_{OUT}=100mA \)
- Ta=25°C

- \( C_{IN}=2.2 \mu F\) (ceramic), \( C_{L}=4.7 \mu F\) (ceramic)
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(4) Dropout Voltage vs. Output Current

**XC6230HxxxER-G**

- **VOUT_SET=1.2V**
- **VOUT_SET=3.3V**
- **VOUT_SET=5.0V**

![Dropout Voltage vs. Output Current](image)

- **XC6230HxxxER-G**
- **XC6230HxxxQR-G**

**CIN=2.2 μF (ceramic), CL=4.7 μF (ceramic)**

- Below the minimum operating Voltage

**Ta=105℃**
**Ta=25℃**
**Ta=-40℃**
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) Supply Current vs. Input Voltage

XC6230 (V\text{OUT, SET}=1.2\text{V})

(6) Supply Current vs. Ambient Temperature

XC6230

(7) Output Voltage vs. Ambient Temperature

XC6230 (V\text{OUT, SET}=1.2\text{V})
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Output Voltage vs. Ambient Temperature

![Output Voltage vs. Ambient Temperature Graph](image)

(8) CE Threshold Voltage vs. Ambient Temperature

![CE Threshold Voltage vs. Ambient Temperature Graph](image)

(9) Reverse Current vs. Output Voltage

![Reverse Current vs. Output Voltage Graph](image)

(10) V_{OUT}Sink Current vs. Input Voltage

![V_{OUT}Sink Current vs. Input Voltage Graph](image)

(11) Rising Response Time

![Rising Response Time Graph](image)
(11) Rising Response Time

**XC6230 (V_{OUT_SET}=3.3V)**

- \(V_{IN}/V_{OUT}=4:3, t_r=5\,\mu s, T_a=25^\circ C\)
- \(C_s=3.2\,\mu F\) (ceramic), \(C_l=4.7\,\mu F\) (ceramic)

**XC6230 (V_{OUT_SET}=5.0V)**

- \(V_{IN}/V_{OUT}=6:9, t_r=5\,\mu s, T_a=25^\circ C\)
- \(C_s=3.2\,\mu F\) (ceramic), \(C_l=4.7\,\mu F\) (ceramic)

(12) Input Transient Response

**XC6230 (V_{OUT_SET}=1.2V)**

- \(V_{IN}/V_{OUT}=2.2:3.2, t_r=t_f=5\,\mu s, T_a=25^\circ C\)
- \(C_s=3.2\,\mu F\) (ceramic), \(C_l=4.7\,\mu F\) (ceramic)

**XC6230 (V_{OUT_SET}=3.3V)**

- \(V_{IN}/V_{OUT}=4:3, t_r=t_f=5\,\mu s, T_a=25^\circ C\)
- \(C_s=3.2\,\mu F\) (ceramic), \(C_l=4.7\,\mu F\) (ceramic)

**XC6230 (V_{OUT_SET}=5.0V)**

- \(V_{IN}/V_{OUT}=5:8, t_r=t_f=5\,\mu s, T_a=25^\circ C\)
- \(C_s=3.2\,\mu F\) (ceramic), \(C_l=4.7\,\mu F\) (ceramic)
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Load Transient Response

**XC6230 (V_{OUT_SET} = 1.2V)**

- Output Voltage vs. Output Current
- Time (200 μs/div)
- For V_{OUT} = 2.2V, C_{IN} = 2.2 μF (ceramic), C_{L} = 4.7 μF (ceramic)
- I_{OUT} = 10mA ⇔ 300mA, tr=tf = 5μs, Ta=25℃
- VIN = 2.2V, C_{IN} = 2.2 μF (ceramic), CL = 4.7 μF (ceramic)

**XC6230 (V_{OUT_SET} = 3.3V)**

- Output Voltage vs. Output Current
- Time (200 μs/div)
- For V_{OUT} = 3.3V, C_{IN} = 2.2 μF (ceramic), C_{L} = 4.7 μF (ceramic)
- I_{OUT} = 10mA ⇔ 1000mA, tr=tf = 5μs, Ta=25℃
- VIN = 4.3V, C_{IN} = 2.2 μF (ceramic), CL = 4.7 μF (ceramic)

**XC6230 (V_{OUT_SET} = 5.0V)**

- Output Voltage vs. Output Current
- Time (200 μs/div)
- For V_{OUT} = 5.0V, C_{IN} = 2.2 μF (ceramic), C_{L} = 4.7 μF (ceramic)
- I_{OUT} = 10mA ⇔ 1000mA, tr=tf = 5μs, Ta=25℃
- VIN = 6.0V, C_{IN} = 2.2 μF (ceramic), CL = 4.7 μF (ceramic)
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(14) CE Rising Response Time

**XC6230 (V_{OUT, SET}=1.2V)**

- T_{r}=0.5μs, Ta=25°C
- V_{IN}=2.2V, C_{IN}=2.2μF (ceramic), C_{L}=4.7μF (ceramic)

**XC6230 (V_{OUT, SET}=3.3V)**

- T_{r}=0.5μs, Ta=25°C
- V_{IN}=4.3V, C_{IN}=2.2μF (ceramic), C_{L}=4.7μF (ceramic)

**XC6230 (V_{OUT, SET}=5.0V)**

- T_{r}=0.5μs, Ta=25°C
- V_{IN}=6.0V, C_{IN}=2.2μF (ceramic), C_{L}=4.7μF (ceramic)

(15) Inrush Current Response
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(16) Power Supply Rejection Ratio

\[ \text{Power Supply Rejection Ratio (PSRR)} \; \text{(dB)} \]

\[ \text{Frequency : f (kHz)} \]

\[ \text{XC6230 (V_{OUT, SET}=1.2V)} \]

\[ \begin{aligned}
& V_{IN}=2.2V+0.5V_p-p, \; Ta=25^\circ C \\
& C_{IN}=2.2\mu F \text{ (ceramic)}, \; C_L=4.7\mu F \text{ (F ceramic)}
\end{aligned} \]

\[ \begin{aligned}
& I_{OUT}=1mA \\
& I_{OUT}=30mA \\
& I_{OUT}=100mA
\end{aligned} \]

\[ \text{XC6230 (V_{OUT, SET}=3.3V)} \]

\[ \begin{aligned}
& V_{IN}=4.3V+0.5V_p-p, \; Ta=25^\circ C \\
& C_{IN}=2.2\mu F \text{ (ceramic)}, \; C_L=4.7\mu F \text{ (F ceramic)}
\end{aligned} \]

\[ \begin{aligned}
& I_{OUT}=1mA \\
& I_{OUT}=30mA \\
& I_{OUT}=100mA
\end{aligned} \]

(17) Output Noise Density

\[ \text{Output Noise Density : (\mu V\sqrt{Hz})} \]

\[ \text{Frequency : f (kHz)} \]

\[ \text{XC6230 (V_{OUT, SET}=1.2V)} \]

\[ \begin{aligned}
& V_{IN}=2.2V, \; Ta=25^\circ C \\
& C_{IN}=2.2\mu F \text{ (ceramic)}, \; C_L=4.7\mu F \text{ (F ceramic)}
\end{aligned} \]

\[ \begin{aligned}
& I_{OUT}=100mA
\end{aligned} \]

\[ \text{Frequency-Range} : 0.1 \sim 100kHz \\
\text{Output Noise} : 226.6 \mu Vrms \]

\[ \text{XC6230 (V_{OUT, SET}=3.3V)} \]

\[ \begin{aligned}
& V_{IN}=4.3V, \; Ta=25^\circ C \\
& C_{IN}=2.2\mu F \text{ (ceramic)}, \; C_L=4.7\mu F \text{ (F ceramic)}
\end{aligned} \]

\[ \begin{aligned}
& I_{OUT}=100mA
\end{aligned} \]

\[ \text{Frequency-Range} : 0.1 \sim 100kHz \\
\text{Output Noise} : 325.1 \mu Vrms \]

\[ \text{XC6230 (V_{OUT, SET}=5.0V)} \]

\[ \begin{aligned}
& V_{IN}=6.0V, \; Ta=25^\circ C \\
& C_{IN}=2.2\mu F \text{ (ceramic)}, \; C_L=4.7\mu F \text{ (F ceramic)}
\end{aligned} \]

\[ \begin{aligned}
& I_{OUT}=100mA
\end{aligned} \]

\[ \text{Frequency-Range} : 0.1 \sim 100kHz \\
\text{Output Noise} : 325.1 \mu Vrms \]
### PACKAGING INFORMATION

For the latest package information go to, [www.torexsemi.com/technical-support/packages](http://www.torexsemi.com/technical-support/packages)

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>OUTLINE / LAND PATTERN</th>
<th>THERMAL CHARACTERISTICS</th>
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<tbody>
<tr>
<td>SOP-8FD</td>
<td>SOP-8FD PKG</td>
<td>Standard Board</td>
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<td>JESD51-7 Board</td>
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<td>SOP-8FD Power Dissipation</td>
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<td>USP-6C Power Dissipation</td>
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### MARKING RULE

#### USP-6C

①,②,③ represents product series

<table>
<thead>
<tr>
<th>MARK</th>
<th>PRODUCT SERIES</th>
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<tbody>
<tr>
<td>0A1</td>
<td>XC6230H001**-G</td>
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<tr>
<td>0B1</td>
<td>XC6230S001**-G</td>
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</table>

#### SOP-8FD

④,⑤ represents production lot number
01 to 09, 0A to 0Z, 11 to 9Z, A1 to A9, AA to AZ, B1 to ZZ repeated (G, I, J, O, Q, W excluded)

*No character inversion used.*
1. The product and product specifications contained herein are subject to change without notice to improve performance characteristics. Consult us, or our representatives before use, to confirm that the information in this datasheet is up to date.

2. The information in this datasheet is intended to illustrate the operation and characteristics of our products. We neither make warranties or representations with respect to the accuracy or completeness of the information contained in this datasheet nor grant any license to any intellectual property rights of ours or any third party concerning with the information in this datasheet.

3. Applicable export control laws and regulations should be complied and the procedures required by such laws and regulations should also be followed, when the product or any information contained in this datasheet is exported.

4. The product is neither intended nor warranted for use in equipment of systems which require extremely high levels of quality and/or reliability and/or a malfunction or failure which may cause loss of human life, bodily injury, serious property damage including but not limited to devices or equipment used in 1) nuclear facilities, 2) aerospace industry, 3) medical facilities, 4) automobile industry and other transportation industry and 5) safety devices and safety equipment to control combustions and explosions. Do not use the product for the above use unless agreed by us in writing in advance.

5. Although we make continuous efforts to improve the quality and reliability of our products; nevertheless Semiconductors are likely to fail with a certain probability. So in order to prevent personal injury and/or property damage resulting from such failure, customers are required to incorporate adequate safety measures in their designs, such as system fail safes, redundancy and fire prevention features.

6. Our products are not designed to be Radiation-resistant.

7. Please use the product listed in this datasheet within the specified ranges.

8. We assume no responsibility for damage or loss due to abnormal use.

9. All rights reserved. No part of this datasheet may be copied or reproduced unless agreed by Torex Semiconductor Ltd in writing in advance.

TOREX SEMICONDUCTOR LTD.