OUTLINE

The R1201x Series are PWM control type step-up DC/DC converter ICs with low supply current. The R1201x is fully dedicated to drive White LEDs with constant current. Each of these ICs consists of an NMOS FET, a forward diode, an oscillator, a PWM comparator, a voltage reference unit, an error amplifier, a current limit circuit, an under voltage lockout circuit (UVLO), and an over-voltage protection circuit (OVP).

The R1201x can drive white LEDs in constant current with high efficiency by using an inductor, a resistor and capacitors as external components. A diode is built-in; therefore it is possible to drive up to 5 serial white LEDs without an external diode.

The LEDs current can be set by an external resistance value and can adjust the dimming of LEDs by CE pin according to the signal of PWM. Feedback voltage is 0.2V, therefore power loss by current setting resistance is small and efficiency is good. Maximum duty cycle is internally fixed, Typ. 91%. LEDs can be driven from low voltage. Protection circuits are the current limit of Lx peak current, the over voltage limit of output, and the under voltage lockout function. The oscillator frequency can be selected from 1MHz or 1.2MHz.

It is controllable the dimming of LEDs quickly when the PWM signal (between 200Hz to 300kHz) input to CE pin. If the CE pin input is "L" in the fixed time (Typ. 0.5ms), the IC becomes the standby mode and turns OFF LEDs.

FEATURES

- Supply Current ...........................................................Typ. 450μA (R1201xxx3A/4A)
  Typ. 500μA (R1201xxx1A/2A)
- Standby Current .........................................................Max. 5μA
- Input Voltage Range .................................................. 1.8V to 5.5V
- Feedback Voltage ..................................................... 0.2V
- Feedback Voltage Accuracy ..................................... ±10mV
- Temperature-Drift Coefficient of Feedback Voltage ...±150ppm/°C
- Oscillator Frequency ............................................... Typ. 1MHz, Typ. 1.2MHz
- Maximum Duty Cycle ............................................... Typ. 91%
- Switch ON Resistance ............................................. Typ. 1.35Ω
- UVLO Detector Threshold ....................................... Typ. 1.6V
- Lx Current Limit Protection ....................................... Typ. 700mA
- OVP Detector Threshold ......................................... Select from 9.5V, 14.0V, 18.5V, 20.6V, 21.6V
- Switching Control .................................................... PWM
- LED dimming control .............................................. by external PWM signal (Frequency 200Hz to 300kHz)
- Packages ............................................................... DFN1616-6, SOT-23-6
- Ceramic capacitors are recommended ..................... 0.22μF (R1201x02xA/ 03xA/ 04xA)
  1μF (R1201x05xA)

APPLICATION

- White LED Backlight for portable equipment
R1201x

**BLOCK DIAGRAMS**

```
| V_FB | | | V_IN | L_X | V_OUT |
|------| | | ---- | ----|------|
| Error Amp | PWM Comp. | UVLO | Switch Control | OVP |
| V_ref | | | | |
| PWM Control | | | | |
| Shutdown delay | | | | |
| Chip Enable | | | | |
| CE | | | | |
| GND |
```

**SELECTION GUIDE**

The OVP threshold voltage, and the package for the ICs can be selected at the user’s request.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Package</th>
<th>Quantity per Reel</th>
<th>Pb Free</th>
<th>Halogen Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1201LxxxA-TR</td>
<td>DFN1616-6</td>
<td>5,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R1201NxxxA-TR-FE</td>
<td>SOT-23-6</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xxx : Designation of OVP detector threshold

- (021) 9.5V threshold of OVP, Frequency 1.2MHz
- (031) 14.0V threshold of OVP, Frequency 1.2MHz
- (041) 18.5V threshold of OVP, Frequency 1.2MHz
- (051) 20.6V threshold of OVP, Frequency 1.2MHz
- (052) 21.6V threshold of OVP, Frequency 1.2MHz
- (023) 9.5V threshold of OVP, Frequency 1MHz
- (033) 14.0V threshold of OVP, Frequency 1MHz
- (043) 18.5V threshold of OVP, Frequency 1MHz
- (053) 20.6V threshold of OVP, Frequency 1MHz
- (054) 21.6V threshold of OVP, Frequency 1MHz

*As for R1201x052A/054A version, input voltage range is 1.8V to 4.5V.

* R1201L (DFN1616-6) is the limited product. As of March in 2014.
PIN CONFIGURATIONS

• DFN1616-6

Top View

Bottom View

• SOT-23-6

Top View

Bottom View

PIN DESCRIPTIONS

• DFN1616-6

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CE</td>
<td>Chip Enable Pin (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>2</td>
<td>$V_{FB}$</td>
<td>Feedback Pin</td>
</tr>
<tr>
<td>3</td>
<td>$Lx$</td>
<td>Switching Pin (Open Drain Output)</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>5</td>
<td>$V_{IN}$</td>
<td>Input Pin</td>
</tr>
<tr>
<td>6</td>
<td>$V_{OUT}$</td>
<td>Output Pin</td>
</tr>
</tbody>
</table>

*) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

• SOT-23-6

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CE</td>
<td>Chip Enable Pin (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>2</td>
<td>$V_{OUT}$</td>
<td>Output Pin</td>
</tr>
<tr>
<td>3</td>
<td>$V_{IN}$</td>
<td>Input Pin</td>
</tr>
<tr>
<td>4</td>
<td>$Lx$</td>
<td>Switching Pin (Open Drain Output)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>6</td>
<td>$V_{FB}$</td>
<td>Feedback Pin</td>
</tr>
<tr>
<td>Symbol</td>
<td>Item</td>
<td>Rating</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>( V_{IN} )</td>
<td>( V_{IN} ) Pin Voltage</td>
<td>(-0.3 ) to ( 6.5 ) V</td>
</tr>
<tr>
<td>( V_{CE} )</td>
<td>CE Pin Voltage</td>
<td>(-0.3 ) to ( V_{IN}+0.3 ) V</td>
</tr>
<tr>
<td>( V_{FB} )</td>
<td>( V_{FB} ) Pin Voltage</td>
<td>(-0.3 ) to ( V_{IN}+0.3 ) V</td>
</tr>
<tr>
<td>( V_{OUT} )</td>
<td>( V_{OUT} ) Pin Voltage</td>
<td>(-0.3 ) to ( 25.0 ) V</td>
</tr>
<tr>
<td>( V_{LX} )</td>
<td>( V_{LX} ) Pin Voltage</td>
<td>(-0.3 ) to ( 25.0 ) V</td>
</tr>
<tr>
<td>( I_{LX} )</td>
<td>( V_{LX} ) Pin Current</td>
<td>1000 mA</td>
</tr>
<tr>
<td>( P_{D} )</td>
<td>Power Dissipation (DFN1616-6) ( \ast )</td>
<td>640 mW</td>
</tr>
<tr>
<td></td>
<td>Power Dissipation (SOT-23-6) ( \ast )</td>
<td>420 mW</td>
</tr>
<tr>
<td>( T_{opt} )</td>
<td>Operating Temperature Range</td>
<td>(-40 ) to ( 85 ) °C</td>
</tr>
<tr>
<td>( T_{stg} )</td>
<td>Storage Temperature Range</td>
<td>(-55 ) to ( 125 ) °C</td>
</tr>
</tbody>
</table>

\( \ast \) For Power Dissipation, please refer to PACKAGE INFORMATION.

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.
## ELECTRICAL CHARACTERISTICS

### Symbol (R1201x)

Topt=25°C

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IN}$</td>
<td>Operating Input Voltage</td>
<td>$R1201\times xx1A$, $R1201\times xx3A$</td>
<td>1.8</td>
<td>5.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$R1201\times 052A$, $R1201\times 054A$</td>
<td>1.8</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{DD}$</td>
<td>Supply Current</td>
<td>$V_{IN}$=Input voltage Max, $V_{FB}=0V$, Lx at no load</td>
<td>$R1201\times xx1A/2A$</td>
<td>0.5</td>
<td>1.0</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$R1201\times xx3A/4A$</td>
<td>0.45</td>
<td>0.9</td>
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<tr>
<td>$I_{standby}$</td>
<td>Standby Current</td>
<td>$V_{IN}$=Input voltage Max, $V_{CE}=0V$</td>
<td>1.0</td>
<td>5.0</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>$V_{UVLO1}$</td>
<td>UVLO Detector Threshold</td>
<td>$V_{IN}$ falling</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>V</td>
</tr>
<tr>
<td>$V_{UVLO2}$</td>
<td>UVLO Released Voltage</td>
<td>$V_{IN}$ rising</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$V_{CEH}$</td>
<td>CE Input Voltage &quot;H&quot;</td>
<td>$V_{IN}$=Input voltage Max</td>
<td>1.5</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{CEL}$</td>
<td>CE Input Voltage &quot;L&quot;</td>
<td>$V_{IN}=1.8V$</td>
<td></td>
<td></td>
<td>0.5</td>
<td>V</td>
</tr>
<tr>
<td>$R_{CE}$</td>
<td>CE Pull Down Resistance</td>
<td>$V_{IN}=3.6V$</td>
<td></td>
<td></td>
<td>600</td>
<td>1200</td>
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<tr>
<td>$V_{FB}$</td>
<td>$V_{FB}$ Voltage Accuracy</td>
<td>$V_{IN}=V_{CE}=3.6V$</td>
<td></td>
<td></td>
<td>0.19</td>
<td>0.20</td>
</tr>
<tr>
<td>$\Delta V_{FB}/\Delta T_{opt}$</td>
<td>$V_{FB}$ Voltage Temperature Coefficient</td>
<td>$V_{IN}=V_{CE}=3.6V$, $-40°C \leq T_{opt} \leq 85°C$</td>
<td></td>
<td></td>
<td>$\pm 150$</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>$I_{FB}$</td>
<td>$V_{FB}$ Input Current</td>
<td>$V_{IN}=Input voltage Max$, $V_{FB}=0V$ or $V_{IN}$</td>
<td></td>
<td></td>
<td>$-0.1$</td>
<td>0.1</td>
</tr>
<tr>
<td>$R_{ON}$</td>
<td>Switch ON Resistance</td>
<td>$V_{IN}=3.6V$, $I_{LX}=100mA$</td>
<td></td>
<td></td>
<td>1.35</td>
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<tr>
<td>$I_{LXleak}$</td>
<td>Switch Leakage Current</td>
<td>$V_{LX}=24V$</td>
<td></td>
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<td>0</td>
<td>3.0</td>
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<tr>
<td>$I_{LXlim}$</td>
<td>Switch Current Limit</td>
<td>$V_{IN}=3.6V$</td>
<td></td>
<td></td>
<td>400</td>
<td>700</td>
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<tr>
<td>$V_{f}$</td>
<td>Diode Forward Voltage</td>
<td>$I_{DIODE}=100mA$</td>
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<td></td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>$I_{DIODe leak}$</td>
<td>Diode Leakage Current</td>
<td>$V_{OUT}=24V$, $V_{LX}=0V$</td>
<td></td>
<td></td>
<td>10</td>
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<tr>
<td>$f_{osc}$</td>
<td>Oscillator Frequency</td>
<td>$V_{IN}=3.6V$, $V_{OUT}=V_{FB}=0V$</td>
<td>$R1201\times xx1A/2A$</td>
<td>1.0</td>
<td>1.2</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$R1201\times xx3A/4A$</td>
<td>0.83</td>
<td>1.0</td>
<td>1.17</td>
</tr>
<tr>
<td>Maxduty</td>
<td>Maximum Duty Cycle</td>
<td>$V_{IN}=3.6V$, $V_{OUT}=V_{FB}=0V$</td>
<td>86</td>
<td>91</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>$V_{OVPI}$</td>
<td>OVP Detector Threshold</td>
<td>$V_{IN}=3.6V$, $V_{OUT}$ rising</td>
<td>$R1201\times xx1A/2A$</td>
<td>8.9</td>
<td>9.5</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$R1201\times xx1A/2A$</td>
<td>13.4</td>
<td>14.0</td>
<td>14.6</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$R1201\times xx4A/43A$</td>
<td>17.9</td>
<td>18.5</td>
<td>19.1</td>
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<tr>
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<td></td>
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<td>$R1201\times xx5A/53A$</td>
<td>20.0</td>
<td>20.6</td>
<td>21.2</td>
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<tr>
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<td></td>
<td></td>
<td>$R1201\times xx5A/54A$</td>
<td>21.0</td>
<td>21.6</td>
<td>22.2</td>
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<tr>
<td>$\Delta V_{OVPI}/\Delta T_{opt}$</td>
<td>$V_{OVPI}$ Voltage Temperature Coefficient</td>
<td>$V_{IN}=V_{CE}=3.6V$, $-40°C \leq T_{opt} \leq 85°C$</td>
<td></td>
<td></td>
<td>$\pm 150$</td>
<td>ppm/°C</td>
</tr>
</tbody>
</table>

---

* R1201L (DFN1616-6) is the limited product. As of March in 2014.
### RECOMMENDED OPERATING CONDITIONS  (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;OVVP2&lt;/sub&gt;</td>
<td>OVP Released Voltage</td>
<td>$V_{IN}$=3.6V, $V_{OUT}$ falling</td>
<td>R1201x021A/023A</td>
<td>V&lt;sub&gt;OVVP1&lt;/sub&gt;</td>
<td>−0.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1201x031A/033A</td>
<td>V&lt;sub&gt;OVVP1&lt;/sub&gt;</td>
<td>−0.75</td>
<td>V</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>R1201x041A/043A</td>
<td>V&lt;sub&gt;OVVP1&lt;/sub&gt;</td>
<td>−1.0</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1201x051A/053A</td>
<td>V&lt;sub&gt;OVVP1&lt;/sub&gt;</td>
<td>−1.1</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1201x052A/054A</td>
<td>V&lt;sub&gt;OVVP1&lt;/sub&gt;</td>
<td>−1.15</td>
<td>V</td>
</tr>
</tbody>
</table>

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**TYPICAL APPLICATIONS**

![Typical Applications Diagram]

(External Components)  
C2: R1201x02xAA/03xAA/04xAA  0.22μF  
C2: R1201x05xA      1.0μF

- **LED Current setting**
  
  When CE pin input is "H" (Duty=100%), LED current can be set with feedback resistor (R1)  
  
  \[ I_{LED} = \frac{V_{FB}}{R1} \]

- **LED Dimming Control**
  
  The LED brightness can be controlled by inputting the PWM signal to the CE pin. If the CE pin input is "L" in the fixed time (Typ.0.5ms), the IC becomes the standby mode and turns OFF LEDs.

  The current of LEDs when the CE pin is "H" input (Duty=100%) is shown by the above expression. The current of LEDs can be controlled by Duty of the PWM signal of the input CE pin. The current of LEDs when High-Duty of the CE input is Hduty reaches the value as calculatable following formula.

  \[ I_{LED} = \text{Hduty} \times \frac{V_{FB}}{R1} \]

  The frequency of the PWM signal is using the range between 200Hz to 300kHz.
  
  When controlling the LED brightness by the PWM signal of 20kHz or less; The increasing or decreasing of the inductor current might be make a sounds in the hearable sound wave area. In that case, please use the PWM signal in the high frequency area.
**Soft-Start**

The output of the error amplifier starts from 0V and the inrush current is suppressed when starting by the CE pin "H" input. Moreover, the inrush current can be suppressed by gradually enlarging Duty of the PWM signal to the CE pin.

**Selection of Inductors**

The peak current of the inductor at normal mode can be calculated as next formula:

\[
I_{L_{\text{max}}} = 1.25 \times I_{\text{LED}} \times \frac{V_{\text{OUT}}}{V_{\text{IN}}} + 0.5 \times V_{\text{IN}} \times (V_{\text{OUT}} - V_{\text{IN}}) / (L \times V_{\text{OUT}} \times f_{\text{osc}})
\]

When the start-up or dimming control by CE pin, transient current flows, the peak current must be equal or less than the current limit of the IC. The peak current should not beyond the rating current of the inductor. When 4LEDs are driven with \(V_{\text{IN}}=3.6\)V, the recommended inductance value is 22\(\mu\)H or more.

**Selection of Capacitors**

Set 1\(\mu\)F or more value bypass capacitor C1 between \(V_{\text{IN}}\) pin and GND pin as close as possible.
Set 0.22\(\mu\)F or more capacitor C2 between \(V_{\text{OUT}}\) pin and GND pin.
As for R1201x05xA version, set 1\(\mu\)F or more capacitor C2 between \(V_{\text{OUT}}\) pin and GND pin.
OPERATION OF STEP-UP DC/DC CONVERTER AND OUTPUT CURRENT

**<Basic Circuit>**

![Basic Circuit Diagram]

**<Current through L>**

**Discontinuous mode**

- \(\Delta i_1 = \frac{V_{IN} \times t_{on}}{L}\)  
  Formula 1

**Continuous mode**

- \(\Delta i_2 = \frac{(V_{OUT} - V_{IN}) \times t_{open}}{L}\)  
  Formula 2

There are two operation modes of the step-up PWM control-DC/DC converter. That is the continuous mode and discontinuous mode by the continuousness inductor.

When the transistor turns ON, the voltage of inductor \(L\) becomes equal to \(V_{IN}\) voltage. The increase value of inductor current \((i1)\) will be

\[
\Delta i_1 = \frac{V_{IN} \times t_{on}}{L}
\]

As the step-up circuit, during the OFF time (when the transistor turns OFF) the voltage is continually supply from the power supply. The decrease value of inductor current \((i2)\) will be

\[
\Delta i_2 = \frac{(V_{OUT} - V_{IN}) \times t_{open}}{L}
\]

At the PWM control-method, the inductor current become continuously when \(t_{open}=t_{off}\), the DC/DC converter operate as the continuous mode.

*R1201L (DFN1616-6) is the limited product. As of March in 2014.*
In the continuous mode, the variation of current of i1 and i2 is same at regular condition.

\[ V_{IN} \times \frac{t_{on}}{L} = (V_{OUT} - V_{IN}) \times \frac{t_{off}}{L} \]

Formula 3

The duty at continuous mode will be

\[ \text{duty} \% = \frac{t_{on}}{(t_{on} + t_{off})} = \frac{(V_{OUT} - V_{IN})}{V_{OUT}} \]

Formula 4

The average of inductor current at \( t_f = t_{off} \) will be

\[ I_{L1(\text{Ave.})} = V_{IN} \times \frac{t_{on}}{2 \times L} \]

Formula 5

If the input voltage = output voltage, the \( I_{OUT} \) will be

\[ I_{OUT} = V_{IN}^2 \times \frac{t_{on}}{2 \times L \times V_{OUT}} \]

Formula 6

If the \( I_{OUT} \) value is larger than above the calculated value (Formula 6), it will become the continuous mode. At this status, the peak current (\( I_{Lx_{max}} \)) of inductor will be

\[ I_{Lx_{max}} = I_{OUT} \times \frac{V_{OUT}}{V_{IN} + V_{IN} \times \frac{t_{on}}{2 \times L}} \]

\[ I_{Lx_{max}} = I_{OUT} \times \frac{V_{OUT}}{V_{IN} + V_{IN} \times T \times \frac{(V_{OUT} - V_{IN})}{2 \times L \times V_{OUT}}} \]

Formula 7

The peak current value is larger than the \( I_{OUT} \) value. In case of this, selecting the condition of the input and the output and the external components by considering of \( I_{Lx_{max}} \) value.

The explanation above is based on the ideal calculation, and the loss caused by \( L_x \) switch and the external components are not included.

The actual maximum output current will be between 50% and 80% by the above calculations. Especially, when the IL is large or \( V_{IN} \) is low, the loss of \( V_{IN} \) is generated with on resistance of the switch. Moreover, it is necessary to consider \( V_f \) of the diode (approximately 0.8V) about \( V_{OUT} \).
**TYPICAL CHARACTERISTICS**

1) Efficiency vs. Output Current Characteristics \( (f_{osc}=1.2\text{MHz}) \)

### 2LEDs

![Graph of Efficiency vs. Output Current for 2LEDs](image)

### 3LEDs

![Graph of Efficiency vs. Output Current for 3LEDs](image)

### 4LEDs

![Graph of Efficiency vs. Output Current for 4LEDs](image)

### 5LEDs

![Graph of Efficiency vs. Output Current for 5LEDs](image)

- **4LEDs (\(V_{IN}=3.6V\))**

![Graph of Efficiency vs. Output Current for 4LEDs (\(V_{IN}=3.6V\))](image)

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* R1201L (DFN1616-6) is the limited product. As of March in 2014.
2) Efficiency vs. Output Current Characteristics \((f_{\text{osc}}=1.0\text{MHz})\)

### 2LEDs

- \(\text{VIN}=1.8\text{V}\)
- \(\text{VIN}=3.6\text{V}\)
- \(\text{VIN}=5.0\text{V}\)

### 3LEDs

- \(\text{VIN}=2.8\text{V}\)
- \(\text{VIN}=3.6\text{V}\)
- \(\text{VIN}=5.0\text{V}\)

### 4LEDs

- \(\text{VIN}=2.8\text{V}\)
- \(\text{VIN}=3.6\text{V}\)
- \(\text{VIN}=5.0\text{V}\)

### 5LEDs

- \(\text{VIN}=2.8\text{V}\)
- \(\text{VIN}=3.6\text{V}\)
- \(\text{VIN}=5.0\text{V}\)

#### 4LEDs \((\text{VIN}=3.6\text{V})\)

- LQH32CN220K53 (3.2x2.5x1.55)
- VLF3010ST-220 (3.0x2.8x1.0)
- LQH2MCN220K02 (2.0x1.6x0.9)

* R1201L (DFN1616-6) is the limited product. As of March in 2014.
3) PWM Dimming Duty Cycle vs. Output Current (R1=10Ω)

![Graph showing PWM Dimming Duty Cycle vs. Output Current](image)

4) Output Current Ripple during PWM Dimming

- **f=10kHz**
  - CE Input Voltage
  - Output Current

- **f=50kHz**
  - CE Input Voltage
  - Output Current

- **f=300kHz**
  - CE Input Voltage
  - Output Current

* R1201L (DFN1616-6) is the limited product. As of March in 2014.
5) Diode Forward Voltage vs. Temperature

![Diode Forward Voltage vs. Temperature](image1)

6) $V_{FB}$ Voltage vs. Temperature

![$V_{FB}$ Voltage vs. Temperature](image2)

7) Supply Current vs. Temperature ($f_{osc}=1.2\text{MHz}$)

![Supply Current vs. Temperature ($f_{osc}=1.2\text{MHz}$)](image3)

8) Supply Current vs. Temperature ($f_{osc}=1.0\text{MHz}$)

![Supply Current vs. Temperature ($f_{osc}=1.0\text{MHz}$)](image4)

9) Oscillator Frequency vs. Temperature ($f_{osc}=1.2\text{MHz}$)

![Oscillator Frequency vs. Temperature ($f_{osc}=1.2\text{MHz}$)](image5)

10) Oscillator Frequency vs. Temperature ($f_{osc}=1.0\text{MHz}$)

![Oscillator Frequency vs. Temperature ($f_{osc}=1.0\text{MHz}$)](image6)

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* R1201L (DFN1616-6) is the limited product. As of March in 2014.
11) Maxduty vs. Temperature

12) UVLO Output Voltage vs. Temperature

13) OVP Voltage vs. Temperature

14) Switch ON Resistance vs. Temperature

* R1201L (DFN1616-6) is the limited product. As of March in 2014.
15) Lx Current Limit vs. Temperature

![Graph showing Lx Current Limit vs. Temperature with different voltage levels (VIN=1.8V, VIN=2.5V, VIN=3.6V, VIN=5.5V)]

16) OVP Operating Output Voltage Waveform

![Graph showing OVP Operating Output Voltage Waveform for R1201x04xA with time (t) in ms and output voltage (Vout) in V]
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