OUTLINE

The R1211x is a CMOS-based PWM step-up DC/DC converter controller with low supply current. The R1211x consists of an oscillator, a PWM control circuit, a reference voltage unit, an error amplifier, a reference current unit, a protection circuit, and an under voltage lockout (UVLO) circuit. A low ripple and high efficiency step-up DC/DC converter can be configured by only adding few external components, such as an inductor, a diode, a power MOSFET, divider resistors, and capacitors. The R1211x002B/D has a built-in phase compensation, while the R1211x002A/C can set a phase compensation externally. The R1211x002B/D has stand-by mode. The max duty cycle is internally fixed at 90% typically. A soft-start function is built-in, and a soft-starting time is set at 9 ms typically (R1211x002A/B, 700 kHz) or 10.5 ms typically (R1211x002A/C, 300 kHz). The R1211x has a latch-type protection circuit, which latches the external driver in off-state if the maximum duty cycle continues for a specified time after soft-starting time. The protection delay time can be set with an external capacitor. To release the protection, turn the power off and back on (power source voltage lower than UVLO detector threshold) or make the device into standby mode and back to active mode using the CE pin.

FEATURES

- Input Voltage Range ............................................ 2.5 V to 6.0 V
- Oscillator Frequency (PWM Control) ................... 300 kHz, 700 kHz
- Maximum Duty Cycle........................................... Typ. 90%
- Standby Current .............................................. Typ. 0 µA (R1211x002B/D)
- Feedback Voltage ............................................. 1.0 V
- Feedback Voltage Accuracy ..........................±1.5%
- UVLO Threshold Level ...................................... Typ. 2.2 V (Hysteresis Typ. 0.13 V)
- Feedback Voltage Temperature Coefficient .......±150 ppm/°C
- Built-in Latch-type Protection Circuit ................. Protection delay time can be set with an external capacitor
- Packages ............................................................. SON-6, SOT-23-6W

APPLICATIONS

- Constant Voltage Power Source for Portable Equipment
- Constant Voltage Power Source for LCD and CCD
In the R1211x, the oscillator frequency, the optional function, and the package type are user-selectable options.

### Selection Guide

<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>R1211D002x-TR-FE</td>
<td>SON-6</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R1211N002x-TR-FE</td>
<td>SOT-23-6W</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

x: Designation of Oscillator Frequency and Optional Function  
(A) 700 kHz, with AMPOUT pin (External Phase Compensation Type)  
(B) 700 kHz, with CE pin (Internal Phase Compensation Type, with Standby)  
(C) 300 kHz, with AMPOUT pin (External Phase Compensation Type)  
(D) 300 kHz, with CE pin (Internal Phase Compensation Type, with Standby)
PIN CONFIGURATIONS

Top View
6 5 4
1 2 3

Bottom View
4 5 6
1 2 3

SON-6 Pin Configuration
SOT-23-6W Pin Configuration

PIN DESCRIPTIONS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Pin Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELAY</td>
<td>Pin for External Capacitor (for Setting Output Delay Time of Protection)</td>
</tr>
<tr>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>EXT</td>
<td>External FET Drive Pin (CMOS Output)</td>
</tr>
<tr>
<td>V\text{IN}</td>
<td>Power Supply Pin</td>
</tr>
<tr>
<td>V\text{FB}</td>
<td>Feedback Pin for Monitoring Output Voltage</td>
</tr>
<tr>
<td>AMP\text{OUT}</td>
<td>Amplifier Output Pin</td>
</tr>
<tr>
<td>CE</td>
<td>Chip Enable Pin (*&quot;H&quot; Active)</td>
</tr>
</tbody>
</table>

* Tab suspension leads in the parts have GND level. (They are connected to the reverse side of this IC.) Do not connect to other wires or land patterns.
## ABSOLUTE MAXIMUM RATINGS

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IN}$</td>
<td>$V_{IN}$ Pin Voltage</td>
<td>6.5</td>
<td>V</td>
</tr>
<tr>
<td>$V_{EXT}$</td>
<td>EXT Pin Output Voltage</td>
<td>$-0.3 \sim V_{IN}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DLY}$</td>
<td>DELAY Pin Voltage</td>
<td>$-0.3 \sim V_{IN}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{AMP}$</td>
<td>AMPOUT Pin Voltage</td>
<td>$-0.3 \sim V_{IN}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CE}$</td>
<td>CE Pin Input Voltage</td>
<td>$-0.3 \sim V_{IN}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$V_{FB}$</td>
<td>$V_{FB}$ Pin Voltage</td>
<td>$-0.3 \sim V_{IN}+0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$I_{AMP}$</td>
<td>AMPOUT Pin Current</td>
<td>±10</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{EXT}$</td>
<td>EXT Pin Inductor Drive Output Current</td>
<td>±50</td>
<td>mA</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power Dissipation (Standard Land Pattern)*</td>
<td>SOT-23-6W 430</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SON-6 500</td>
<td></td>
</tr>
<tr>
<td>$T_{opt}$</td>
<td>Operating Temperature Range</td>
<td>$-40 \sim +85$</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>Storage Temperature Range</td>
<td>$-55 \sim +125$</td>
<td>°C</td>
</tr>
</tbody>
</table>

* 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

R1211x002A Electrical Characteristics

<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></td>
<td>2.5</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{FB}</td>
<td>Feedback Voltage</td>
<td>V_{IN}=3.3V</td>
<td>0.985</td>
<td>1.00</td>
<td>1.015</td>
<td>V</td>
</tr>
<tr>
<td>ΔV_{FB}/ΔT_{opt}</td>
<td>V_{FB} Voltage Temperature Coefficient</td>
<td>(-40^\circ C \leq T_{opt} \leq 85^\circ C)</td>
<td>±150</td>
<td>ppm/^\circ C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{FB}</td>
<td>V_{FB} Input Current</td>
<td>V_{IN}=6V, V_{FB}=0V or 6V</td>
<td>–0.1</td>
<td>0.1</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>f_{OSC}</td>
<td>Oscillator Frequency</td>
<td>V_{IN}=3.3V, V_{DLY}=V_{FB}=0V</td>
<td>595</td>
<td>700</td>
<td>805</td>
<td>kHz</td>
</tr>
<tr>
<td>Δf_{OSC}/ΔT_{opt}</td>
<td>Oscillator Frequency Temperature Coefficient</td>
<td>(-40^\circ C \leq T_{opt} \leq 85^\circ C)</td>
<td>±1.4</td>
<td>kHz/^\circ C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{DD1}</td>
<td>Supply Current 1</td>
<td>V_{IN}=6V, V_{DLY}=V_{FB}=0V, EXT at no load</td>
<td>600</td>
<td>900</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>maxdty</td>
<td>Maximum Duty Cycle</td>
<td>V_{IN}=3.3V, EXT &quot;H&quot; side</td>
<td>82</td>
<td>90</td>
<td>94</td>
<td>%</td>
</tr>
<tr>
<td>R_{EXTH}</td>
<td>EXT &quot;H&quot; ON Resistance</td>
<td>V_{IN}=3.3V, I_{EXT}=20mA</td>
<td>5</td>
<td>10</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>R_{EXTL}</td>
<td>EXT &quot;L&quot; ON Resistance</td>
<td>V_{IN}=3.3V, I_{EXT}=20mA</td>
<td>3</td>
<td>6</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>I_{DLY1}</td>
<td>Delay Pin Charge Current</td>
<td>V_{IN}=3.3V, V_{DLY}=V_{FB}=0V</td>
<td>2.5</td>
<td>5.0</td>
<td>7.5</td>
<td>µA</td>
</tr>
<tr>
<td>I_{DLY2}</td>
<td>Delay Pin Discharge Current</td>
<td>V_{IN}=V_{FB}=2.5V, V_{DLY}=0.1V</td>
<td>2.5</td>
<td>5.5</td>
<td>9.0</td>
<td>mA</td>
</tr>
<tr>
<td>V_{DLY}</td>
<td>Delay Pin Detector Threshold</td>
<td>V_{IN}=3.3V, V_{FB}=0V, V_{DLY}=0V→2V</td>
<td>0.95</td>
<td>1.00</td>
<td>1.05</td>
<td>V</td>
</tr>
<tr>
<td>T_{START}</td>
<td>Soft-start Time</td>
<td>V_{IN}=3.3V at 90% of rising edge</td>
<td>4.5</td>
<td>9.0</td>
<td>13.5</td>
<td>ms</td>
</tr>
<tr>
<td>V_{UVLO}</td>
<td>UVLO Detector Threshold</td>
<td>V_{IN}=2.5V→2V, V_{DLY}=V_{FB}=0V</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td>V</td>
</tr>
<tr>
<td>V_{HYST}</td>
<td>UVLO Detector Hysteresis</td>
<td>V_{IN}=2V→2.5V, V_{DLY}=V_{FB}=0V</td>
<td>0.08</td>
<td>0.13</td>
<td>0.18</td>
<td>V</td>
</tr>
<tr>
<td>I_{AMP1}</td>
<td>AMP &quot;H&quot; Output Current</td>
<td>V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=0.9V</td>
<td>0.45</td>
<td>0.90</td>
<td>1.50</td>
<td>mA</td>
</tr>
<tr>
<td>I_{AMP2}</td>
<td>AMP &quot;L&quot; Output Current</td>
<td>V_{IN}=3.3V, V_{AMP}=1V, V_{FB}=1.1V</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td>µA</td>
</tr>
</tbody>
</table>

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.
### R1211x002B Electrical Characteristics

<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;IN&lt;/sub&gt;</td>
<td>Operating Input Voltage</td>
<td></td>
<td>2.5</td>
<td>6.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;FB&lt;/sub&gt;</td>
<td>Feedback Voltage</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V</td>
<td>0.985</td>
<td>1.000</td>
<td>1.015</td>
<td>V</td>
</tr>
<tr>
<td>ΔV&lt;sub&gt;FB&lt;/sub&gt;/ΔTopt</td>
<td>VFB Voltage Temperature Coefficient</td>
<td>−40°C ≤ Topt ≤ 85°C</td>
<td>±150</td>
<td></td>
<td></td>
<td>ppm/°C</td>
</tr>
<tr>
<td>I&lt;sub&gt;FB&lt;/sub&gt;</td>
<td>VFB Input Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;FB&lt;/sub&gt;=0V or 6V</td>
<td>−0.1</td>
<td>0.1</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>f&lt;sub&gt;Osc&lt;/sub&gt;</td>
<td>Oscillator Frequency</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V, V&lt;sub&gt;DLY&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=0V</td>
<td>595</td>
<td>700</td>
<td>805</td>
<td>kHz</td>
</tr>
<tr>
<td>Δf&lt;sub&gt;Osc&lt;/sub&gt;/ΔTopt</td>
<td>Oscillator Frequency Temperature Coefficient</td>
<td>−40°C ≤ Topt ≤ 85°C</td>
<td>±1.4</td>
<td></td>
<td></td>
<td>kHz/°C</td>
</tr>
<tr>
<td>I&lt;sub&gt;DD1&lt;/sub&gt;</td>
<td>Supply Current 1</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;DLY&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=0V, EXT at no load</td>
<td>600</td>
<td>900</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>maxdty</td>
<td>Maximum Duty Cycle</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V, EXT &quot;H&quot; side</td>
<td>82</td>
<td>90</td>
<td>94</td>
<td>%</td>
</tr>
<tr>
<td>R&lt;sub&gt;EXTH&lt;/sub&gt;</td>
<td>EXT &quot;H&quot; ON Resistance</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V, I&lt;sub&gt;EXT&lt;/sub&gt;=−20mA</td>
<td>5</td>
<td>10</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>R&lt;sub&gt;EXTL&lt;/sub&gt;</td>
<td>EXT &quot;L&quot; ON Resistance</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V, I&lt;sub&gt;EXT&lt;/sub&gt;=20mA</td>
<td>3</td>
<td>6</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>I&lt;sub&gt;DLY1&lt;/sub&gt;</td>
<td>Delay Pin Charge Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=2.5V, V&lt;sub&gt;DLY&lt;/sub&gt;=0V</td>
<td>2.5</td>
<td>5.0</td>
<td>7.5</td>
<td>μA</td>
</tr>
<tr>
<td>I&lt;sub&gt;DLY2&lt;/sub&gt;</td>
<td>Delay Pin Discharge Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=2.5V, V&lt;sub&gt;DLY&lt;/sub&gt;=0.1V</td>
<td>2.5</td>
<td>5.5</td>
<td>9.0</td>
<td>mA</td>
</tr>
<tr>
<td>V&lt;sub&gt;DLY&lt;/sub&gt;</td>
<td>Delay Pin Detector Threshold</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V, V&lt;sub&gt;FB&lt;/sub&gt;=0V, V&lt;sub&gt;DLY&lt;/sub&gt;=0V→2V</td>
<td>0.95</td>
<td>1.00</td>
<td>1.05</td>
<td>V</td>
</tr>
<tr>
<td>T&lt;sub&gt;START&lt;/sub&gt;</td>
<td>Soft-start Time</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=3.3V</td>
<td>4.5</td>
<td>9.0</td>
<td>13.5</td>
<td>ms</td>
</tr>
<tr>
<td>V&lt;sub&gt;UVLO&lt;/sub&gt;</td>
<td>UVLO Detector Threshold</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=2.5V→2V, V&lt;sub&gt;DLY&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=0V</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;HYS&lt;/sub&gt;</td>
<td>UVLO Detector Hysteresis</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=2V→2.5V, V&lt;sub&gt;DLY&lt;/sub&gt;=V&lt;sub&gt;FB&lt;/sub&gt;=0V</td>
<td>0.08</td>
<td>0.13</td>
<td>0.18</td>
<td>V</td>
</tr>
<tr>
<td>I&lt;sub&gt;STB&lt;/sub&gt;</td>
<td>Standby Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;Ce&lt;/sub&gt;=0V</td>
<td>0</td>
<td>1</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>I&lt;sub&gt;Ceh&lt;/sub&gt;</td>
<td>CE &quot;H&quot; Input Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;Ce&lt;/sub&gt;=6V</td>
<td>−0.5</td>
<td>0.5</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>I&lt;sub&gt;Cel&lt;/sub&gt;</td>
<td>CE &quot;L&quot; Input Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;Ce&lt;/sub&gt;=0V</td>
<td>−0.5</td>
<td>0.5</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>V&lt;sub&gt;Ceh&lt;/sub&gt;</td>
<td>CE &quot;H&quot; Input Voltage</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=6V, V&lt;sub&gt;Ce&lt;/sub&gt;=0V→6V</td>
<td>1.5</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V&lt;sub&gt;Cel&lt;/sub&gt;</td>
<td>CE &quot;L&quot; Input Voltage</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=2.5V, V&lt;sub&gt;Ce&lt;/sub&gt;=2V→0V</td>
<td>0.3</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

**RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)**

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<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>$V_{IN}=3.3V$</td>
<td>2.5</td>
<td>6.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{FB}$</td>
<td>$V_{FB}$ Voltage Tolerance</td>
<td>$V_{FB}=0V$</td>
<td>0.985</td>
<td>1.000</td>
<td>1.015</td>
<td>V</td>
</tr>
<tr>
<td>$\Delta V_{FB}/\Delta T_{opt}$</td>
<td>$V_{FB}$ Voltage Temperature Coefficient</td>
<td>$-40^\circ C \leq T_{opt} \leq 85^\circ C$</td>
<td></td>
<td>$\pm 150$</td>
<td>ppm/$^\circ C$</td>
<td></td>
</tr>
<tr>
<td>$I_{FB}$</td>
<td>$V_{FB}$ Input Current</td>
<td>$V_{IN}=6V$, $V_{FB}=0V$ or $6V$</td>
<td>$-0.1$</td>
<td>$0.1$</td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td>$f_{OSC}$</td>
<td>Oscillator Frequency</td>
<td>$V_{IN}=3.3V$, $V_{DLY}=V_{FB}=0V$</td>
<td>240</td>
<td>300</td>
<td>360</td>
<td>kHz</td>
</tr>
<tr>
<td>$\Delta f_{OSC}/\Delta T_{opt}$</td>
<td>Oscillator Frequency Temperature Coefficient</td>
<td>$-40^\circ C \leq T_{opt} \leq 85^\circ C$</td>
<td></td>
<td>$\pm 0.6$</td>
<td></td>
<td>kHz/$^\circ C$</td>
</tr>
<tr>
<td>$I_{DD1}$</td>
<td>Supply Current 1</td>
<td>$V_{IN}=6V$, $V_{DLY}=V_{FB}=0V$, EXT at no load</td>
<td>300</td>
<td>500</td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td>maxdty</td>
<td>Maximum Duty Cycle</td>
<td>$V_{IN}=3.3V$, EXT &quot;H&quot; side</td>
<td>82</td>
<td>90</td>
<td>94</td>
<td>%</td>
</tr>
<tr>
<td>$R_{EXTH}$</td>
<td>EXT &quot;H&quot; ON Resistance</td>
<td>$V_{IN}=3.3V$, $I_{EXT}=-20mA$</td>
<td>5</td>
<td>10</td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$R_{EXTL}$</td>
<td>EXT &quot;L&quot; ON Resistance</td>
<td>$V_{IN}=3.3V$, $I_{EXT}=20mA$</td>
<td>3</td>
<td>6</td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$I_{DLY1}$</td>
<td>Delay Pin Charge Current</td>
<td>$V_{IN}=3.3V$, $V_{DLY}=V_{FB}=0V$</td>
<td>2.0</td>
<td>4.5</td>
<td>7.0</td>
<td>$\mu A$</td>
</tr>
<tr>
<td>$I_{DLY2}$</td>
<td>Delay Pin Discharge Current</td>
<td>$V_{IN}=2.5V$, $V_{DLY}=0.1V$</td>
<td>2.5</td>
<td>5.5</td>
<td>9.0</td>
<td>mA</td>
</tr>
<tr>
<td>$V_{DLY}$</td>
<td>Delay Pin Detector Threshold</td>
<td>$V_{IN}=3.3V$, $V_{FB}=0V$, $V_{DLY}=0V \rightarrow 2V$</td>
<td>0.95</td>
<td>1.00</td>
<td>1.05</td>
<td>V</td>
</tr>
<tr>
<td>$T_{START}$</td>
<td>Soft-start Time</td>
<td>$V_{IN}=3.3V$</td>
<td>5.0</td>
<td>10.5</td>
<td>16.0</td>
<td>ms</td>
</tr>
<tr>
<td>$V_{UVLO}$</td>
<td>UVLO Detector Threshold</td>
<td>$V_{IN}=2.5V \rightarrow 2V$, $V_{DLY}=V_{FB}=0V$</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td>V</td>
</tr>
<tr>
<td>$V_{HYS}$</td>
<td>UVLO Detector Hysteresis</td>
<td>$V_{IN}=2V \rightarrow 2.5V$, $V_{DLY}=V_{FB}=0V$</td>
<td>0.08</td>
<td>0.13</td>
<td>0.18</td>
<td>V</td>
</tr>
<tr>
<td>$I_{AMP1}$</td>
<td>AMP &quot;H&quot; Output Current</td>
<td>$V_{IN}=3.3V$, $V_{AMP}=1V$, $V_{FB}=0.9V$</td>
<td>0.45</td>
<td>0.90</td>
<td>1.50</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{AMP2}$</td>
<td>AMP &quot;L&quot; Output Current</td>
<td>$V_{IN}=3.3V$, $V_{AMP}=1V$, $V_{FB}=1.1V$</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>$\mu A$</td>
</tr>
</tbody>
</table>

**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.
### R1211x002D Electrical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>V\text{IN}</td>
<td>Operating Input Voltage</td>
<td></td>
<td>2.5</td>
<td>6.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V\text{FB}</td>
<td>V\text{FB} Voltage Tolerance</td>
<td>\text{V\text{IN}}=3.3V</td>
<td>0.985</td>
<td>1.000</td>
<td>1.015</td>
<td>V</td>
</tr>
<tr>
<td>\Delta V\text{FB}/ \Delta T_{\text{Typ}}</td>
<td>V\text{FB} Voltage Temperature Coefficient</td>
<td>\text{\text{V\text{IN}}=6V, V\text{FB}=0V or 6V}</td>
<td>-0.1</td>
<td>0.1</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>I\text{FB}</td>
<td>V\text{FB} Input Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f_{\text{OSC}}</td>
<td>Oscillator Frequency</td>
<td>\text{\text{V\text{IN}}=3.3V, V\text{DLY}=V\text{FB}=0V}</td>
<td>240</td>
<td>300</td>
<td>360</td>
<td>kHz</td>
</tr>
<tr>
<td>\Delta f_{\text{OSC}}/ \Delta T_{\text{Typ}}</td>
<td>Oscillator Frequency Temperature Coefficient</td>
<td>\text{\text{V\text{IN}}=3.3V, V\text{FB}=0V}</td>
<td>\pm 0.6</td>
<td></td>
<td></td>
<td>kHz/°C</td>
</tr>
<tr>
<td>I_{\text{DD1}}</td>
<td>Supply Current 1</td>
<td>\text{\text{V\text{IN}}=6V, V\text{DLY}=V\text{FB}=0V, EXT at no load}</td>
<td>300</td>
<td>500</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>max\text{dty}</td>
<td>Maximum Duty Cycle</td>
<td>\text{\text{V\text{IN}}=3.3V, EXT &quot;H&quot; side}</td>
<td>82</td>
<td>90</td>
<td>94</td>
<td>%</td>
</tr>
<tr>
<td>R_{\text{EXTH}}</td>
<td>EXT &quot;H&quot; ON Resistance</td>
<td>\text{\text{V\text{IN}}=3.3V, I\text{EXT}=-20mA}</td>
<td>5</td>
<td>10</td>
<td></td>
<td>\Omega</td>
</tr>
<tr>
<td>R_{\text{EXTL}}</td>
<td>EXT &quot;L&quot; ON Resistance</td>
<td>\text{\text{V\text{IN}}=3.3V, I\text{EXT}=20mA}</td>
<td>3</td>
<td>6</td>
<td></td>
<td>\Omega</td>
</tr>
<tr>
<td>I_{\text{DLY1}}</td>
<td>Delay Pin Charge Current</td>
<td>\text{\text{V\text{IN}}=3.3V, V\text{DLY}=V\text{FB}=0V}</td>
<td>2.0</td>
<td>4.5</td>
<td>7.0</td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>I_{\text{DLY2}}</td>
<td>Delay Pin Discharge Current</td>
<td>\text{\text{V\text{IN}}=V\text{FB}=2.5V, V\text{DLY}=0.1V}</td>
<td>2.5</td>
<td>5.5</td>
<td>9.0</td>
<td>mA</td>
</tr>
<tr>
<td>V_{\text{DLY}}</td>
<td>Delay Pin Detector Threshold</td>
<td>\text{\text{V\text{IN}}=3.3V, V\text{DLY}=V\text{FB}=0V}</td>
<td>0.95</td>
<td>1.00</td>
<td>1.05</td>
<td>V</td>
</tr>
<tr>
<td>T_{\text{START}}</td>
<td>Soft-start Time</td>
<td>\text{\text{V\text{IN}}=3.3V}</td>
<td>5.0</td>
<td>10.5</td>
<td>16.0</td>
<td>ms</td>
</tr>
<tr>
<td>V_{\text{UVLO}}</td>
<td>UVLO Detector Threshold</td>
<td>\text{\text{V\text{IN}}=2.5V\rightarrow2V, V\text{DLY}=V\text{FB}=0V}</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td>V</td>
</tr>
<tr>
<td>V_{\text{VHY}}</td>
<td>UVLO Detector Hysteresis</td>
<td>\text{\text{V\text{IN}}=2V\rightarrow2.5V, V\text{DLY}=V\text{FB}=0V}</td>
<td>0.08</td>
<td>0.13</td>
<td>0.18</td>
<td>V</td>
</tr>
<tr>
<td>I_{\text{STB}}</td>
<td>Standby Current</td>
<td>\text{\text{V\text{IN}}=6V, V_{\text{CE}}=0V}</td>
<td>0</td>
<td>1</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>I_{\text{CEH}}</td>
<td>CE &quot;H&quot; Input Current</td>
<td>\text{\text{V\text{IN}}=6V, V_{\text{CE}}=6V}</td>
<td>-0.5</td>
<td>0.5</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>I_{\text{CEL}}</td>
<td>CE &quot;L&quot; Input Current</td>
<td>\text{\text{V\text{IN}}=6V, V_{\text{CE}}=0V}</td>
<td>-0.5</td>
<td>0.5</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>V_{\text{CEH}}</td>
<td>CE &quot;H&quot; Input Voltage</td>
<td>\text{\text{V\text{IN}}=6V, V_{\text{CE}}=0V\rightarrow6V}</td>
<td>1.5</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V_{\text{CEL}}</td>
<td>CE &quot;L&quot; Input Voltage</td>
<td>\text{\text{V\text{IN}}=2.5V, V_{\text{CE}}=2V\rightarrow0V}</td>
<td>0.3</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

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### 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.
TYPICAL APPLICATIONS AND TECHNICAL NOTES

R1211x002A/R1211x002B Typical Application

NMOS: IRF7601 (International Rectifier)
Inductor: VLF504012MT-100M (TDK: 10 μH) R1211x002A
VLF504012MT-220M (TDK: 22 μH) R1211x002B
Diode: CRS10130A (TOSHIBA)
C1: 4.7 μF (Ceramic) R1: Output Voltage Setting Resistor 1
C2: 0.22 μF (Ceramic) R2: Output Voltage Setting Resistor 2
C3: 10 μF (Ceramic) R3: 30 kΩ
C4: 680 pF (Ceramic) R4: 30 kΩ
C5: 2200 pF (Ceramic)

R1211x002B/R1211x002C Typical Application

NMOS: IRF7601 (International Rectifier)
Inductor: VLF504012MT-100M (TDK: 10 μH) R1211x002B
VLF504012MT-220M (TDK: 22 μH) R1211x002D
Diode: CRS10130A (TOSHIBA)
C1: 4.7 μF (Ceramic) R1: Output Voltage Setting Resistor 1
C2: 0.22 μF (Ceramic) R2: Output Voltage Setting Resistor 2
C3: 10 μF (Ceramic) R3: 30 kΩ
C4: 680 pF (Ceramic)

[Note] These example circuits may be applied to the output voltage requirement is 15 V or less. If the output voltage requirement is 15 V or more, ratings of NMOS and diode as shown above is over the limit, therefore, choose other external components.
• Use a 1 µF or more capacitance value of bypass capacitor between VIN pin and GND, C1 as shown in the typical applications above.

• In terms of the capacitor for setting delay time of the latch protection, C2 as shown in typical applications of the previous page, connect between Delay pin and GND pin of the IC with the minimum wiring distance.

• Connect a 1 µF or more value of capacitor between VOUT and GND, C3 as shown in typical applications of the previous page. (Recommended value is from 10 µF to 22 µF.) If the operation of the composed DC/DC converter may be unstable, use a tantalum type capacitor instead of ceramic type.

• Connect a capacitor between VOUT and the dividing point, C4 as shown in typical applications of the previous page. The capacitance value of C4 depends on divider resistors for output voltage setting. Typical value is between 100 pF and 1000 pF.

• The output voltage can be set with divider resistors for voltage setting, R1 and R2 as shown in typical applications of the previous page. Refer to the next formula.
  \[
  \text{Output Voltage} = V_{FB} \times \left( \frac{R1 + R2}{R2} \right)
  \]
  \[
  R1 + R2 = 100 \text{ k}\Omega \text{ is recommended range of resistances.}
  \]

• The operation of latch protection circuit is as follows: When the IC detects maximum duty cycle, charge to an external capacitor, C2 of DELAY pin starts. And maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold, \( V_{DLY} \), outputs "L" to EXT pin and turns off the external power MOSFET. To release the latch protection operation, make the IC be standby mode with CE pin and make it active in terms of R1211x002B/D version. Otherwise, restart with power on.

• The delay time of latch protection can be calculated with C2, \( V_{DLY} \), and Delay Pin Charge Current, \( I_{DLY1} \), as in the next formula.
  \[
  t = C2 \times \frac{V_{DLY}}{I_{DLY1}}
  \]
  Once after the maximum duty is detected and released before delay time, charge to the capacitor is halt and delay pin outputs "L".

• As for R1211x002A/C version, the values and positioning of C4, C5, R3, and R4 shown in the above diagram are just an example combination. These are for making phase compensation. If the spike noise of VOUT may be large, the spike noise may be picked into VFB pin and make the operation unstable. In this case, a resistor R3, shown in typical applications of the previous page. The recommended resistance value of R3 is in the range from 10 kΩ to 50 kΩ. Then, noise level will be decreased.

• As for R1211x002B/D version, EXT pin outputs GND level at standby mode.

• Select the Power MOSFET, the diode, and the inductor within ratings (Voltage, Current, Power) of this IC. Choose the power MOSFET with low threshold voltage depending on Input Voltage to be able to turn on the FET completely. Choose the diode with low VF such as Shottky type with low reverse current IR, and with fast switching speed. When an external transistor is switching, spike voltage may be generated caused by an inductor, therefore recommended voltage tolerance of capacitor connected to VOUT is three times of setting voltage or more.

• The performance of power circuit with using this IC depends on external components. Choose the most suitable components for your application.
OUTPUT CURRENT AND SELECTION OF EXTERNAL COMPONENTS

There are two modes, or discontinuous mode and continuous mode for the PWM step-up switching regulator depending on the continuous characteristic of inductor current.

During on time of the transistor, when the voltage added on to the inductor is described as \( V_{IN} \), the current is \( V_{IN} \times t / L \). Therefore, the electric power, \( P_{ON} \), which is supplied with input side, can be described as in next formula.

\[
P_{ON} = \int_{0}^{T_{on}} V_{IN}^2 \times \frac{t}{L} \, dt \tag{Formula 1}
\]

With the step-up circuit, electric power is supplied from power source also during off time. In this case, input current is described as \( (V_{OUT} - V_{IN}) \times \frac{t}{L} \), therefore electric power, \( P_{OFF} \) is described as in next formula.

\[
P_{OFF} = \int_{0}^{T_{off}} (V_{OUT} - V_{IN}) \times \frac{t}{L} \, dt \tag{Formula 2}
\]

In this formula, \( T_f \) means the time of which the energy saved in the inductance is being emitted. Thus average electric power, \( P_{AV} \) is described as in the next formula.

\[
P_{AV} = \frac{1}{(T_{on} + T_{off})} \left( \int_{0}^{T_{on}} V_{IN}^2 \times \frac{t}{L} \, dt + \int_{0}^{T_{off}} (V_{OUT} - V_{IN}) \times \frac{t}{L} \, dt \right) \tag{Formula 3}
\]
In PWM control, when $T_f = T_{off}$ is true, the inductor current becomes continuous, then the operation of switching regulator becomes continuous mode.

In the continuous mode, the deviation of the current is equal between on time and off time.

$$V_{in} \times \frac{T_{on}}{L} = (V_{out} - V_{in}) \times \frac{T_{off}}{L}$$  \hspace{1cm} \text{Formula 4}

Further, the electric power, $P_{AV}$ is equal to output electric power, $V_{out} \times I_{out}$, thus,

$$I_{out} = f_{osc} \times V_{in}^2 \times \frac{T_{on}}{L} / [2 \times L \times (V_{out} - V_{in})] = V_{in}^2 \times \frac{T_{on}}{L} / [2 \times L \times V_{out}]$$  \hspace{1cm} \text{Formula 5}

When $I_{out}$ becomes more than formula 5, the current flows through the inductor, then the mode becomes continuous. The continuous current through the inductor is described as $I_{const}$, then,

$$I_{out} = f_{osc} \times V_{in}^2 \times \frac{T_{on}}{L} / [2 \times L \times (V_{out} - V_{in})] + V_{in} \times I_{const} / V_{out}$$  \hspace{1cm} \text{Formula 6}

In this moment, the peak current, $I_{Lx\text{max}}$ flowing through the inductor and the driver $T_r$ is described as follows:

$$I_{Lx\text{max}} = I_{const} + V_{in} \times \frac{T_{on}}{L}$$  \hspace{1cm} \text{Formula 7}

With the formula 4 and 6, $I_{Lx\text{max}}$ is,

$$I_{Lx\text{max}} = \frac{V_{out}}{V_{in}} \times I_{out} + V_{in} \times \frac{T_{on}}{L}$$  \hspace{1cm} \text{Formula 8}

Therefore, peak current is more than $I_{out}$. Considering the value of $I_{Lx\text{max}}$, the condition of input and output, and external components should be selected. In the formula 7, peak current $I_{Lx\text{max}}$ at discontinuous mode can be calculated. Put $I_{const} = 0$ in the formula. The explanation above is based on the ideal calculation, and the loss caused by $L_x$ switch and external components is not included. The actual maximum output current is between 50% and 80% of the calculation. Especially, when the $I_{Lx}$ is large, or $V_{in}$ is low, the loss of $V_{in}$ is generated with the on resistance of the switch. As for $V_{out}$, $V_f$ (as much as 0.3 V) of the diode should be considered.
Soft-start Operation
Soft-start operation is starting from power-on as follows:

(Step1)
The voltage level of SS is rising gradually by constant current circuit of the IC and a capacitor. $V_{\text{REF}}$ level which is input to OP AMP is also gradually rising. $V_{\text{OUT}}$ is rising up to input voltage level just after the power-on, therefore, $V_{\text{FB}}$ voltage is rising up to the setting voltage with input voltage and the ration of R1 and R2. AMPOUT is at "L", and switching does not start.

(Step2)
When the voltage level of SS becomes the setting voltage with the ration of R1 and R2 or more, switching operation starts. $V_{\text{REF}}$ level gradually increases together with SS level. $V_{\text{OUT}}$ is also rising with balancing $V_{\text{REF}}$ and $V_{\text{FB}}$. Duty cycle depends on the lowest level among AMPOUT, SS, and DTC of the 4 input terminals in the PWM comparator.
(Step 3)
When SS reaches 1 V, soft-start operation finishes. $V_{REF}$ becomes constant voltage (= 1 V). Then the switching operation becomes normal mode.

Latch Protection Operation
The operation of Latch protection circuit is as follows: When AMPOUT becomes "H" and the IC detects maximum duty cycle, charge to an external capacitor, $C_2$ of DELAY pin starts. And maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold, $V_{DLY}$, outputs "L" to EXT pin and turns off the external power MOSFET. To release the latch protection operation, make the IC be standby mode with CE pin and make it active in terms of R1211x002B/D version. Otherwise, make supply voltage down to UVLO detector threshold or lower, and make it rise up to the normal input voltage. During the soft-start time, if the duty cycle may be the maximum, protection circuit does not work and DELAY pin is fixed at GND level.
The delay time of latch protection can be calculated with $C_2$, $V_{DLY}$, and Delay Pin Charge Current, $I_{DLY}$, as in the next formula.
$$t = C_2 \times \frac{V_{DLY}}{I_{DLY}}$$
Once after the maximum duty is detected and released before delay time, charge to the capacitor is halt and delay pin outputs "L".
TEST CIRCUITS

R1211x002A/ R1211x002C Test Circuits

Oscillator Frequency, Maximum Duty Cycle, $V_{FB}$ Voltage

Consumption Current

EXT "H" ON Resistance

EXT "L" ON Resistance

DELAY Pin Charge Current
<Components>
R1: 90 kΩ
R2: 10 kΩ
R3: 30 kΩ
R4: 30 kΩ
Rout: 1 kΩ/330 Ω
Coil: VLF504012MT-220M (TDK: 22 μH)
Diode: CRS10I30A (TOSHIBA)
NMOS: IRF7601 (International Rectifier)

C1: 680 pF (Ceramic)
C2: 22 μF (Tantalum) + 2.2 μF (Ceramic)
C3: 2.2 μF (Ceramic) + 68 μF (Tantalum)
C4: 2200 pF (Ceramic)
C5: 22 μF (Tantalum)
R1211x002B/ R1211x002D Test Circuits

Oscillator Frequency, Maximum Duty Cycle, \( V_{FB} \) Voltage

Consumption Current

EXT "H" ON Resistance

EXT "L" ON Resistance

DELAY Pin Charge Current
<Components>
R1: 90 kΩ
R2: 10 kΩ
R3: 30 kΩ
Rout: 1 kΩ/ 330 Ω
Coil: VLF504012MT-220M (TDK: 22 μH)
Diode: CRS10I30A (TOSHIBA)
NMOS: IRF7601 (International Rectifier)

C1: 680 pF (Ceramic)
C2: 22 μF (Tantalum) + 2.2 μF (Ceramic)
C3: 2.2 μF (Ceramic) + 68 μF (Tantalum)
C5: 22 μF (Tantalum)
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

**R1211x002A**

- L=10μH, Vout=0V
- L=10μH, Vout=10V
- L=10μH, Vout=15V
- L=10μH, Vout=5V

**R1211x002B**

- L=10μH, Vout=0V
- L=10μH, Vout=10V
- L=10μH, Vout=15V
- L=10μH, Vout=5V
2) Efficiency vs. Output Current

**R1211x002A**

- \( L = 10\, \mu\text{H} \)
- \( V_{out} = 6\, \text{V} \)

**R1211x002B**

- \( L = 10\, \mu\text{H} \)
- \( V_{out} = 12\, \text{V} \)

---

- \( V_i = 2.6\, \text{V} \)
- \( V_i = 3.3\, \text{V} \)
- \( V_i = 5.0\, \text{V} \)
3) VFB Voltage vs. Input Voltage

4) Oscillator Frequency vs. Input Voltage

5) Supply Current vs. Input Voltage
6) Maximum Duty Cycle vs. Input Voltage

R1211x002C

Input Voltage Vin(V)

0 2 4 6

Supply Current(UA)

0 100 200 300 400

TopT=25°C

R1211x002C/D

Input Voltage Vin(V)

0 2 4 6

Supply Current(UA)

0 100 200 300 400

TopT=25°C

R1211x002A/B

Input Voltage Vin(V)

2 4 6

Maximum Duty Cycle(%)

60 80 85 88 90

TopT=25°C

R1211x002C/D

Input Voltage Vin(V)

2 4 6

Maximum Duty Cycle(%)

80 82 84 86 88

TopT=25°C

7) VFB Voltage vs. Temperature

R1211x002x

Temperature Ttop(T°C)

-50 -25 0 25 50 75 100

VFB Voltage(mV)

9650 9655 9660 9665 9670 9675 9680 9685 9700 9715

Vin=3.3V

RICOH
8) Oscillator Frequency vs. Temperature
   R1211x002A/B

   ![Graph 1](image1)

   ![Graph 2](image2)

9) Supply Current vs. Temperature
   R1211x002A

   ![Graph 3](image3)

   ![Graph 4](image4)
10) Maximum Duty Cycle vs. Temperature
   R1211x002A/B

   ![Graph 10](image1.png)

11) EXT "H" On Resistance vs. Temperature
    R1211x002x

   ![Graph 11](image2.png)

12) EXT "L" On Resistance vs. Temperature
    R1211x002x

   ![Graph 12](image3.png)

13) Soft-start Time vs. Temperature
    R1211x002A/B

   ![Graph 13](image4.png)
14) UVLO Detector Threshold vs. Temperature
   R1211x002x

15) AMP "H" Output Current vs. Temperature
   R1211x002A/C

16) AMP "L" Output Current vs. Temperature
   R1211x002A

17) DELAY Pin Charge Current vs. Temperature
   R1211x002A/B

   R1211x002C/D
18) DELAY Pin Detector Threshold vs. Temperature 19) DELAY Pin Discharge Current vs. Temperature

20) CE "L" Input Voltage vs. Temperature
21) CE "H" Input Voltage vs. Temperature

22) Standby Current vs. Temperature
23) Load Transient Response

R1211x002A

L=10μH
Vin=3.3V, C3=22μF
Vout=5V, Iout=1-100mA

Output Voltage (V)

Time (μsec/div)

R1211x002B

L=10μH
Vin=3.3V, C3=22μF
Vout=18V, Iout=1-60mA

Output Voltage (V)

Time (μsec/div)
24) Power-on Response
25) Turn-on speed with CE pin

R1211x002C

L=22μH
Vin=3.3V, lout=10mA

(a)Vout=15V
(b)Vout=10V
(c)Vout=5V

Output Voltage(V)

Time (5ms/div)

R1211x002D

L=22μH
Vin=3.3V, lout=10mA

(a)Vout=15V
(b)Vout=10V
(c)Vout=5V

Output Voltage(V)

Time (5ms/div)
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