OUTLINE

The R5510Hxxxx Series are CMOS-based voltage regulator (VR) ICs equipped with a voltage detector (V_{DET}). VR function of the R5510Hxxxx has features of high ripple rejection, low dropout voltage, high output voltage accuracy, and ultra-low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a current limit circuit, and a voltage detector. Each of the R5510HxxxxL/M/N types includes also a chip enable circuit. The output of built-in voltage detector is Nch open drain type. The R5510HxxxxD type has a pin for connecting external capacitor to set a certain reset delay time instead of chip enable control pin. VR Output Voltage of the R5510HxxxxE/F/G types is adjustable with external resistors.

The regulator output voltage except R5510HxxxxE/F/G types and the detector threshold voltage are fixed in the IC. Low supply current by the merit of CMOS process and built-in transistors with low ON-resistance make low dropout voltage. These regulators in the R5510Hxxxx Series are remarkable improvement on the current regulators in terms of ripple rejection, input transient response, and load transient response. Furthermore, the R5510Hxxxx A to G series can supervise input voltage by the built-in detector. R5510HxxxxH/J/K types can supervise V_{SEN} pin voltage by the built-in detector.

Thus, the R5510Hxxxx series are suitable for power supply for CD-drives, DVD-drives, and so forth.

Since the package for these ICs is the SOT-89-5 package, high density mounting of the ICs on boards is possible.

FEATURES

- Ultra-Low Supply Current ........................................... Typ. 150\(\mu\)A (VR), Typ. 10\(\mu\)A (VD)
- Low Standby Current .................................................. Typ. 0.1\(\mu\)A (VR) for L/M/N type
- High Ripple Rejection .................................................... Typ. 60dB (f=1kHz) (VR)
- Output Current ............................................................. Min. 300mA (V_{IN}=V_{OUT}+1V)
- Output Voltage (VR) ......................................................... Stepwise setting with a step of 0.1V in the range of 2.5V to 5.0V
- High Output Voltage Accuracy ......................................... ±2.0% (VR) except E/F/G type,
  ±2.0% (Reference Voltage for adjustable VR) for E/F/G type
  ±2.5% (VD)* Output type of VD is Nch open drain.

- Low Dropout Voltage .................................................... Typ. 0.2V (I_{OUT}=100mA) (VR)
- Small Package ............................................................... SOT-89-5
- Built-in Current Limit Circuits (VR)
- Low Temperature-drift Coefficient of Output Voltage... Typ. ±100ppm/°C
- Absolute Maximum Voltage ............................................. 9V
- Built-in Reset Delay Circuits ......................................... L/E/H (no delay time), M/F/J (delay time; 10ms), N/G/K (delay time; 50ms)
  or Used with External Capacitor for Setting Reset Delay time........ D type
- Monitoring $V_{DD}$ voltage ........................................ Except H/J/K type
- or monitoring sense pin ($V_{SEN}$) voltage......................... H/J/K type

APPLICATIONS
- Power source for CD-drives and DVD-drives.

BLOCK DIAGRAMS
**SELECTION GUIDE**

The output voltage, the usage of pin No.5 (as a kind of types in the R5510Hxxxx series), the taping type can be selected at the user’s request. The selection can be made by designating the part number as follows:

R5510Hxxxx-xx → Part Number

↑↑↑

a b c

<table>
<thead>
<tr>
<th>Code</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Serial Number for Voltage Setting</td>
</tr>
</tbody>
</table>
| b    | Designation of option;  
|      | L: Built-in Chip Enable Circuit (VDET output delay time is typically 0.5ms.)  
|      | M: Built-in Chip Enable Circuit (VDET output delay time is set typically at 10ms.)  
|      | N: Built-in Chip Enable Circuit (VDET output delay time is set typically at 50ms.)  
|      | D: Used with External Capacitor for setting output delay  
|      | E: Output Voltage Adjustable Regulator (VDET output delay time is typically 0.5ms.)  
|      | F: Output Voltage Adjustable Regulator (VDET output delay time is set typically at 10ms.)  
|      | G: Output Voltage Adjustable Regulator (VDET output delay time is set typically at 50ms.)  
|      | H: Voltage Detector with Individual Sense pin (VDET output delay time is typically 0.5ms.)  
|      | J: Voltage Detector with Individual Sense pin (VDET output delay time is set typically at 10ms.)  
|      | K: Voltage Detector with Individual Sense Pin (VDET output delay time is set typically at 50ms.)  |
| c    | Designation of Taping Type;  
|      | T1 or T2 (Refer to Taping Specifications) |

**PIN CONFIGURATION**

![SOT-89-5 Pin Configuration Diagram]
### PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V\textsubscript{OUT}</td>
<td>Voltage Regulator Output Pin</td>
</tr>
<tr>
<td>2</td>
<td>V\textsubscript{DD}</td>
<td>Input and Sense Pin of Voltage Detector</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>4</td>
<td>V\textsubscript{DET}</td>
<td>Voltage Detector Output Pin (When Voltage detector detects the lowering voltage than setting threshold level, the output voltage level is &quot;L&quot;. While V\textsubscript{DD} Input level at reset detection or before crossing threshold level from higher voltage than it, the output voltage level is &quot;H&quot;.)</td>
</tr>
<tr>
<td>5</td>
<td>CE</td>
<td>(L/M/N type) Chip Enable Pin</td>
</tr>
<tr>
<td></td>
<td>CD</td>
<td>(D type) Pin for External Capacitor for Setting Output Delay of Voltage Detector</td>
</tr>
<tr>
<td></td>
<td>ADJ</td>
<td>(E/F/G type) Adjustable Regulator feedback Input Pin (Connect to resistor voltage divider.)</td>
</tr>
<tr>
<td></td>
<td>V\textsubscript{SEN}</td>
<td>(H/J/K type) Sense Pin for Voltage Detector</td>
</tr>
</tbody>
</table>

### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V\textsubscript{IN}</td>
<td>Input Voltage</td>
<td>9.0</td>
<td>V</td>
</tr>
<tr>
<td>V\textsubscript{CE}</td>
<td>Input Voltage (CE Input Pin)*Note</td>
<td>-0.3 ~ V\textsubscript{IN}+0.3</td>
<td>V</td>
</tr>
<tr>
<td>V\textsubscript{SEN}</td>
<td>Input Voltage (V\textsubscript{SEN} Input Pin)</td>
<td>-0.3 ~ V\textsubscript{SEN}+0.3</td>
<td>V</td>
</tr>
<tr>
<td>V\textsubscript{OUT}</td>
<td>Output Voltage (V\textsubscript{OUT} Output Pin)</td>
<td>-0.3 ~ 9.0</td>
<td>V</td>
</tr>
<tr>
<td>I\textsubscript{OUT}</td>
<td>Output Current</td>
<td>450</td>
<td>mA</td>
</tr>
<tr>
<td>P\textsubscript{D}</td>
<td>Power Dissipation</td>
<td>500</td>
<td>mW</td>
</tr>
<tr>
<td>T\textsubscript{OPT}</td>
<td>Operating Temperature Range</td>
<td>-40 ~ 85</td>
<td>°C</td>
</tr>
<tr>
<td>T\textsubscript{STG}</td>
<td>Storage Temperature Range</td>
<td>-55 ~ 125</td>
<td>°C</td>
</tr>
</tbody>
</table>

*Note: This item is for R5510xxxL/M/N Version.
ELECTRICAL CHARACTERISTICS

- **R5510HxxxxL/M/N**
  
<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>Input Voltage</td>
<td>V_{IN}-V_{OUT}=1.0V V_{IN}=V_{CE}</td>
<td>8.0</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{SS1}</td>
<td>Supply Current1</td>
<td>V_{IN}=V_{OUT}-0.16V V_{CE}=0V</td>
<td>150</td>
<td>300</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>I_{SS2}</td>
<td>Supply Current2</td>
<td>V_{IN}=V_{OUT}+2.0V V_{CE}=0V</td>
<td>10</td>
<td>20</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>I_{SS3}</td>
<td>Supply Current3</td>
<td></td>
<td>10</td>
<td>20</td>
<td>µA</td>
<td></td>
</tr>
</tbody>
</table>

### VR part

- **(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_{OUT}</td>
<td>Output voltage</td>
<td>V_{IN}-V_{OUT}=1.0V I_{OUT}=80mA</td>
<td>V_{SET} x0.98</td>
<td>V_{SET} x1.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{OUT}</td>
<td>Output Current</td>
<td>V_{IN}-V_{OUT}=1.0V</td>
<td>300</td>
<td>400</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔI_{OUT}</td>
<td>Load Regulation</td>
<td></td>
<td>60</td>
<td>120</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>V_{DRP}</td>
<td>Dropout Voltage</td>
<td>I_{OUT}=100mA</td>
<td>0.2</td>
<td>0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔV_{IN}</td>
<td>Line regulation</td>
<td>I_{OUT}=80mA V_{OUT}+0.5V V_{IN} ≤8V</td>
<td>0.1</td>
<td>0.2</td>
<td>%/V</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Ripple Rejection</td>
<td>f=1kHz, Ripple 0.5Vp-p</td>
<td>60</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔT</td>
<td>Output Voltage Temperature Coefficient</td>
<td>I_{OUT}=10mA -40°C ≤ Topt ≤ 85°C</td>
<td>±100</td>
<td>ppm</td>
<td>/°C</td>
<td></td>
</tr>
<tr>
<td>I_{MM}</td>
<td>Short Current Limit</td>
<td>V_{OUT}=0V</td>
<td>50</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R_{0}</td>
<td>Pull-down resistance for CE pin</td>
<td>V_{CEH}=0V</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>MΩ</td>
</tr>
<tr>
<td>V_{CEH}</td>
<td>CE Input Voltage “H”</td>
<td></td>
<td>1.5</td>
<td>V_{BI}</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{CEL}</td>
<td>CE Input Voltage “L”</td>
<td></td>
<td>0</td>
<td>0.25</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**Limited Product**
### R5510Hxxxx

**V<sub>SET</sub> part** *(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&lt;sub&gt;SET&lt;/sub&gt;</td>
<td>Detector Threshold</td>
<td>V&lt;sub&gt;SET&lt;/sub&gt; x0.975</td>
<td>V&lt;sub&gt;SET&lt;/sub&gt; x0.05</td>
<td>V&lt;sub&gt;SET&lt;/sub&gt; x1.025</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;HYS&lt;/sub&gt;</td>
<td>Detector Threshold Hysteresis</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;OUT&lt;/sub&gt;</td>
<td>Output Current</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;=1.5V, V&lt;sub&gt;IN&lt;/sub&gt;=0.5V</td>
<td>1.0</td>
<td>4.5</td>
<td>6.0</td>
<td>mA</td>
</tr>
<tr>
<td>V&lt;sub&gt;IR&lt;/sub&gt;</td>
<td>Minimum Operating Voltage</td>
<td></td>
<td>0.65</td>
<td>0.80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Δ-V&lt;sub&gt;SET&lt;/sub&gt;/ΔT</td>
<td>Detector Threshold Temperature Coefficient</td>
<td>-40°C≤Topt≤85°C</td>
<td>±100</td>
<td>ppm/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>Output Delay Time</td>
<td>R5510HxxxxL</td>
<td>0.5</td>
<td>1.0</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>Output Delay Time</td>
<td>R5510HxxxxM</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td>ms</td>
</tr>
<tr>
<td>t&lt;sub&gt;PLH&lt;/sub&gt;</td>
<td>Output Delay Time</td>
<td>R5510HxxxxN</td>
<td>40</td>
<td>50</td>
<td>70</td>
<td>ms</td>
</tr>
</tbody>
</table>

### R5510HxxxxD

**V<sub>SET</sub> part** *(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&lt;sub&gt;S&lt;/sub&gt;</td>
<td>Input Voltage</td>
<td></td>
<td>8</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;SSS&lt;/sub&gt;</td>
<td>Supply Current1</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;-V&lt;sub&gt;SET&lt;/sub&gt;=1.0V</td>
<td>150</td>
<td>300</td>
<td>µA</td>
<td></td>
</tr>
</tbody>
</table>
### Symbol Item Conditions Min. Typ. Max. Unit

<table>
<thead>
<tr>
<th>V_{OUT}</th>
<th>Output voltage</th>
<th>V_{IN}-V_{OUT}=1.0V, I_{OUT}=80mA</th>
<th>V_{REF} x0.98</th>
<th>V_{REF} x1.02</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{OUT}</td>
<td>Output Current</td>
<td>V_{IN}-V_{OUT}=1.0V</td>
<td>300</td>
<td>400</td>
<td>mA</td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔI_{OUT}</td>
<td>Load regulation</td>
<td>V_{IN}-V_{OUT}=1.0V, 1mA≤I_{OUT}≤80mA</td>
<td>60</td>
<td>120</td>
<td>mV</td>
</tr>
<tr>
<td>V_{DFF}</td>
<td>Dropout Voltage</td>
<td>I_{OUT}=100mA</td>
<td>0.2</td>
<td>0.3</td>
<td>V</td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔV_{IN}</td>
<td>Line regulation</td>
<td>I_{OUT}=80mA, V_{OUT}+0.5V≤V_{IN}≤8V</td>
<td>0.1</td>
<td>0.2</td>
<td>%/V</td>
</tr>
<tr>
<td>RR</td>
<td>Ripple Rejection</td>
<td>f=1kHz, Ripple 0.5Vp-p, V_{IN}-V_{OUT}=2.0V</td>
<td>60</td>
<td></td>
<td>DB</td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔT</td>
<td>Output Voltage Temperature Coefficient</td>
<td>I_{OUT}=10mA, -40°C≤Topt≤85°C</td>
<td>±100</td>
<td>ppm</td>
<td>/°C</td>
</tr>
<tr>
<td>I_{MIN}</td>
<td>Short Current Limit</td>
<td>V_{OUT}=0V</td>
<td>50</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

### Symbol Item Conditions Min. Typ. Max. Unit

| -V_{DET} | Detector Threshold | | V_{REF} x0.975 | V_{REF} x1.025 | V |
| V_{HYS} | Detector Threshold Hysteresis | | | | |
| I_{OUT2} | Output Current 2 | V_{DD}=1.5V, V_{SS}=0.5V | 1.0 | 4.5 | 6.0 | mA |
| t_{PLH} | Output Delay Time | | 500 | | µs |
| V_{MIN} | Minimum Operating Voltage | | 0.65 | 0.80 | | V |
| Δ-V_{DET}/ΔT | Detector Threshold Temperature Coefficient | -40°C≤Topt≤85°C | | | ppm | /°C |
### R5510Hxxxx

**• R5510HxxxxE/F/G (Topt=25°C)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Input voltage</td>
<td>VDD-VOUT=1.0V</td>
<td>8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>ISSH</td>
<td>Supply Current1</td>
<td></td>
<td>150</td>
<td>300</td>
<td></td>
<td>µA</td>
</tr>
</tbody>
</table>

**VR part (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>VOUT</td>
<td>Reference Voltage for Adjustable Voltage Regulator</td>
<td>VOUT=VADJ IOUT=80mA</td>
<td>1.960</td>
<td>2.000</td>
<td>2.040</td>
<td>V</td>
</tr>
<tr>
<td>ROUT</td>
<td>Output Voltage Range</td>
<td></td>
<td>2.5</td>
<td>5.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current</td>
<td></td>
<td>300</td>
<td>400</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>ΔVOUT/ΔIOUT</td>
<td>Load regulation</td>
<td></td>
<td>60</td>
<td>120</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>VREF</td>
<td>Dropout Voltage</td>
<td></td>
<td>0.2</td>
<td>0.3</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>ΔVOUT/ΔVDD</td>
<td>Line regulation</td>
<td>IOUT=80mA VOUT+0.5V≤VDD≤8V</td>
<td>0.1</td>
<td>0.2</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td>RR</td>
<td>Ripple Rejection</td>
<td>f=1kHz, Ripple 0.5Vp-p</td>
<td>60</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>ΔVOUT/ΔT</td>
<td>Output Voltage Temperature Coefficient</td>
<td>IOUT=10mA -40°C≤Topt≤85°C</td>
<td>±100</td>
<td></td>
<td></td>
<td>ppm /°C</td>
</tr>
<tr>
<td>IIM</td>
<td>Short Current Limit</td>
<td>VDD=0V</td>
<td></td>
<td>50</td>
<td></td>
<td>mA</td>
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</table>

**VSET part (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>-VSET</td>
<td>Detector Threshold</td>
<td></td>
<td>VSET ×0.975</td>
<td>VSET</td>
<td>VSET ×1.025</td>
<td></td>
</tr>
<tr>
<td>VTH</td>
<td>Detector Threshold Hysteresis</td>
<td></td>
<td>-VSET ×0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current</td>
<td>VDD=1.5V, VSS=0.5V</td>
<td>1.0</td>
<td>4.5</td>
<td>6.0</td>
<td>mA</td>
</tr>
<tr>
<td>VDD</td>
<td>Minimum Operating Voltage</td>
<td></td>
<td>0.65</td>
<td>0.80</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Δ-VSET/ΔT</td>
<td>Detector Threshold Temperature Coefficient</td>
<td>-40°C≤Topt≤85°C</td>
<td>±100</td>
<td></td>
<td></td>
<td>ppm /°C</td>
</tr>
<tr>
<td>tpLH</td>
<td>Output Delay Time (*1)</td>
<td>R5510HxxxxE</td>
<td>0.5</td>
<td>1.0</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>tpLH</td>
<td></td>
<td>R5510HxxxxF</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td>ms</td>
</tr>
<tr>
<td>tpLH</td>
<td></td>
<td>R5510HxxxxG</td>
<td>40</td>
<td>50</td>
<td>70</td>
<td>ms</td>
</tr>
</tbody>
</table>

(*1) When VDET Pin is pulled up through 470kΩ to VDD, this value means the time interval from the rising edge of VDD pulse between 0.8V→(+VDET)→+2.0V to when the Output Voltage reaches to the level of (+VDET)+2.0V/2.

---

**Limited Product**
### Symbol Item Conditions Min. Typ. Max. Unit
- **Vin**: Input Voltage
  - $V_{IN} - V_{OUT} = 1.0V$
  - $V_{IN} = 8V$
- **Issh**: Supply Current 1
  - $V_{IN} - V_{OUT} = 1.0V$
  - $I_{SSH} = 150\,\mu A - 300\,\mu A$

## VR part

### Symbol Item Conditions Min. Typ. Max. Unit
- **Vout**: Output Voltage
  - $V_{IN} - V_{OUT} = 1.0V$
  - $I_{OUT} = 80mA$
  - $V_{SET} = 0.98\,V$
- **Iout**: Output Current
  - $V_{IN} - V_{OUT} = 1.0V$
  - $I_{OUT} = 300\,mA$
- **ΔVout/ΔIout**: Load Regulation
  - $V_{IN} - V_{OUT} = 1.0V$
  - $1mA \leq I_{OUT} \leq 80mA$
  - $60\,mV$
  - $120\,mV$
- **Vdth**: Dropout Voltage
  - $I_{OUT} = 100mA$
  - $0.2\,V$
  - $0.3\,V$
- **ΔVout/ΔVin**: Line Regulation
  - $I_{OUT} = 80mA$
  - $V_{OUT} + 0.5V \leq V_{IN} \leq 8V$
  - $0.1\,V$
  - $0.2\,V$
- **RR**: Ripple Rejection
  - $f = 1kHz$
  - Ripple $0.5Vp-p$
  - $V_{IN} - V_{OUT} = 2.0V$
  - $60\,dB$
- **ΔVout/ΔT**: Output Voltage Temperature Coefficient
  - $I_{OUT} = 10mA$
  - $40^\circ C \leq T_{OP} \leq 85^\circ C$
  - $\pm 100\,ppm/\circ C$
- **Ish**: Short Current Limit
  - $V_{OUT} = 0V$
  - $50\,mA$

## V007 part

### Symbol Item Conditions Min. Typ. Max. Unit
- **VSSN**: Input Voltage
  - $V_{DD} = 1.5V$, $V_{BS} = 0.5V$
  - $V_{SS} = 1.0\,V$
  - $4.5\,V$
  - $6.0\,V$
- **VDET**: Detector Threshold
  - $V_{DET} = 0.975\,V$
  - $V_{SET} = 0.975\,V$
  - $V_{DET} = 1.025\,V$
- **VHYST**: Detector Threshold Hysteresis
  - $V_{DET} = 0.05\,V$
  - $V_{DET} = -0.05\,V$
  - $V_{DET} = 1.025\,V$
- **IOUT**: Output Current
  - $V_{DD} = 1.5V$, $V_{BS} = 0.5V$
  - $0.65\,mA$
  - $0.80\,mA$
- **∆VDD/∆T**: Detector Temperature Coefficient
  - $-40^\circ C \leq T_{OP} \leq 85^\circ C$
  - $\pm 100\,ppm/\circ C$
- **tpLH**: Output Delay Time
  - $R5510HxxH$
  - $0.5\,ms$
  - $1.0\,ms$
- **tpLH**: Output Delay Time
  - $R5510HxxJ$
  - $8\,ms$
  - $13\,ms$
- **tpLH**: Output Delay Time
  - $R5510HxxK$
  - $40\,ms$
  - $50\,ms$
  - $70\,ms$
TEST CIRCUITS

R5510HxxxL/M/N Series

Standard Test Circuit

VDD

1

2

3

5

VOUT

IOUT

IN

0.1 µF

GND

CE

470kΩ

R5510HxxxL/M/N Series

Test Circuit for Ripple Rejection and Input Transient Response

VDD

1

2

P.G

3

5

VOUT

IOUT

IN

0.1 µF

GND

CE

470kΩ

R5510HxxxL/M/N Series

Test Circuit for Supply Current

VDD

1

2

3

5

VOUT

ISS

IN

0.1 µF

GND

CE

0.1 µF

R5510HxxxL/M/N Series

Test Circuit for Load Transient Response

VDD

1

2

3

5

VOUT

IOUT

IN

0.1 µF

GND

CE

470kΩ

R5510HxxxL/M/N Series

Test Circuit for Ripple Rejection and Input Transient Response

VDD

1

2

P.G

3

5

VOUT

IOUT

IN

0.1 µF

GND

CE

470kΩ

R5510HxxxL/M/N Series

Test Circuit for Load Transient Response

VDD

1

2

3

5

VOUT

IOUT

IN

0.1 µF

GND

CE

470kΩ

R5510HxxxL/M/N Series

Test Circuit for Ripple Rejection and Input Transient Response
Standard Test Circuit

Test Circuit for Supply Current

Test Circuit for Ripple Rejection and Input Transient Response

Test Circuit for Load Transient Response

Limited Product
R5510Hxxxx

**Standard Test Circuit**

- VDD
- 1
- 2
- 5
- 3
- VOUT
- IOUT
- IN
- 0.1µF
- IN
- GND
- 470kΩ

**The Test Circuit for Supply Current**

- VDD
- 1
- 2
- 5
- 3
- VOUT
- 0.1µF
- IS
- VSEN
- GND
- 470kΩ

**Test Circuit for Ripple Rejection and Input Transient Response**

- VDD
- 1
- 2
- 5
- 3
- VOUT
- 0.1µF
- ISS
- IN
- VSEN
- GND
- 470kΩ

**Test Circuit for Load Transient Response**

- VDD
- 1
- 2
- 5
- 3
- VOUT
- 0.1µF
- I1
- I2
- VSEN
- GND
- 470kΩ

Limited Product
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

- **R5510H (VR=5.0V)**
- **R5510H (VR=4.5V)**

2) Input Voltage vs. Output Voltage (Topt=25°C)

- **R5510H (VR=5.0V)**
- **R5510H (VR=4.5V)**
3) Dropout Voltage vs. Output Current

**R5510H (VR=5.0V)**

- Dropout Voltage (V) vs. Output Current (mA)
- Different temperatures: 85°C, 25°C, -40°C

**R5510H (VR=4.5V)**

- Dropout Voltage (V) vs. Output Current (mA)
- Different temperatures: 85°C, 25°C, -40°C

**R5510H (VR=3.5V)**

- Dropout Voltage (V) vs. Output Current (mA)
- Different temperatures: 85°C, 25°C, -40°C

**R5510H (VR=2.5V)**

- Dropout Voltage (V) vs. Output Current (mA)
- Different temperatures: 85°C, 25°C, -40°C

---

RICOH
4) **Output Voltage vs. Temperature**

**R5510H (VR=5.0V)**

![Graph showing output voltage vs. temperature for R5510H (VR=5.0V)]

- Temperature Topt (°C) vs. Output Voltage VROUT (V)
- Temperature range: -40°C to 85°C
- Data points for specific voltages are indicated.

**R5510H (VR=4.5V)**

![Graph showing output voltage vs. temperature for R5510H (VR=4.5V)]

- Temperature Topt (°C) vs. Output Voltage VROUT (V)
- Temperature range: -40°C to 85°C
- Data points for specific voltages are indicated.

**R5510H (VR=3.5V)**

![Graph showing output voltage vs. temperature for R5510H (VR=3.5V)]

- Temperature Topt (°C) vs. Output Voltage VROUT (V)
- Temperature range: -40°C to 85°C
- Data points for specific voltages are indicated.

**R5510H (VR=2.5V)**

![Graph showing output voltage vs. temperature for R5510H (VR=2.5V)]

- Temperature Topt (°C) vs. Output Voltage VROUT (V)
- Temperature range: -40°C to 85°C
- Data points for specific voltages are indicated.

5) **Supply Current vs. Input Voltage (Topt=25°C)**

**R5510H (VR=5.0V, -VDET=6.0V)**

![Graph showing supply current vs. input voltage for R5510H (VR=5.0V, -VDET=6.0V)]

- Input Voltage VIN (V) vs. Supply Current Iss (µA)
- Data points for specific voltages are indicated.

**R5510H (VR=4.5V, -VDET=5.5V)**

![Graph showing supply current vs. input voltage for R5510H (VR=4.5V, -VDET=5.5V)]

- Input Voltage VIN (V) vs. Supply Current Iss (µA)
- Data points for specific voltages are indicated.
6) Supply Current vs. Temperature

- **R5510H (VR=5.0V, -VDET=6.0V)**
- **R5510H (VR=4.5V, -VDET=5.5V)**

7) Ripple Rejection vs. Frequency

- **R5510H (VR=5.0V)**
- **R5510H (VR=4.5V)**
8) Ripple Rejection vs. Input Voltage (DC Bias)

9) Input Transient Response
10) Load Transient Response

**R5510H (VR=2.5V)**

<table>
<thead>
<tr>
<th>Time (µs)</th>
<th>Output Voltage VOUT (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.57</td>
</tr>
<tr>
<td>1</td>
<td>2.55</td>
</tr>
<tr>
<td>2</td>
<td>2.53</td>
</tr>
<tr>
<td>3</td>
<td>2.51</td>
</tr>
<tr>
<td>4</td>
<td>2.49</td>
</tr>
<tr>
<td>5</td>
<td>2.47</td>
</tr>
<tr>
<td>6</td>
<td>2.45</td>
</tr>
</tbody>
</table>

**Input Voltage VIN (V)**

- VIN=6V
- CIN=1.0µF
- COUT=0.1µF

**Output Current IOUT (mA)**

- IOUT=80mA
- tr=tf=5µs
- COUT=0.1µF

**R5510H (VR=5.0V)**

<table>
<thead>
<tr>
<th>Time (µs)</th>
<th>Output Voltage VOUT (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.2</td>
</tr>
<tr>
<td>1</td>
<td>5.1</td>
</tr>
<tr>
<td>2</td>
<td>5.0</td>
</tr>
<tr>
<td>3</td>
<td>4.9</td>
</tr>
<tr>
<td>4</td>
<td>4.8</td>
</tr>
<tr>
<td>5</td>
<td>4.7</td>
</tr>
<tr>
<td>6</td>
<td>4.6</td>
</tr>
<tr>
<td>7</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**Output Current IOUT (mA)**

- VIN=5.5V
- CIN=1.0µF
- COUT=0.1µF

**R5510H (VR=4.5V)**

<table>
<thead>
<tr>
<th>Time (µs)</th>
<th>Output Voltage VOUT (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.3</td>
</tr>
<tr>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>2</td>
<td>4.1</td>
</tr>
<tr>
<td>3</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>3.9</td>
</tr>
<tr>
<td>5</td>
<td>3.8</td>
</tr>
<tr>
<td>6</td>
<td>3.7</td>
</tr>
<tr>
<td>7</td>
<td>3.6</td>
</tr>
</tbody>
</table>

**Output Current IOUT (mA)**

- VIN=5.3V
- CIN=1.0µF
- COUT=0.1µF

**Limited Product**
R5510H (VR=3.5V)

VIN=4.5V
CIN=1.0µF
COUT=0.1µF

Output Current IOUT (mA)
Output Voltage VOUT (V)

R5510H (VR=2.5V)

VIN=4.5V
CIN=1.0µF
COUT=0.1µF

Output Current IOUT (mA)
Output Voltage VOUT (V)
11) Detector Threshold vs. Temperature

![Graph showing Detector Threshold vs. Temperature for R5510H (-VDET=5.5V) and R5510H (-VDET=3.5V).]

<table>
<thead>
<tr>
<th>Temperature Topt (°C)</th>
<th>R5510H (-VDET=5.5V)</th>
<th>R5510H (-VDET=3.5V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-40</td>
<td>5.3</td>
<td>3.4</td>
</tr>
<tr>
<td>35</td>
<td>5.4</td>
<td>3.5</td>
</tr>
<tr>
<td>85</td>
<td>5.5</td>
<td>3.6</td>
</tr>
<tr>
<td>10</td>
<td>5.6</td>
<td>3.7</td>
</tr>
<tr>
<td>15</td>
<td>5.7</td>
<td>3.8</td>
</tr>
<tr>
<td>60</td>
<td>5.8</td>
<td>3.9</td>
</tr>
</tbody>
</table>

12) Detector Output Voltage vs. Input Voltage

![Graph showing Detector Output Voltage vs. Input Voltage for R5510H (-VDET=5.5V pull-up to VDD) and R5510H (-VDET=5.5V pull-up to 5V).]

<table>
<thead>
<tr>
<th>Input Voltage VIN (V)</th>
<th>R5510H (-VDET=5.5V pull-up to VDD)</th>
<th>R5510H (-VDET=5.5V pull-up to 5V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
13) Nch Driver Output Current vs. Vos

R5510H (-VDET=5.5V)

R5510H (-VDET=3.5V)
14) Nch Driver Output Current vs. Input Voltage

**R5510H (-VDET=5.5V)**

- T_{op}=40°C
- 25°C
- 85°C

**R5510H (-VDET=3.5V)**

- T_{op}=40°C
- 25°C
- 85°C

**R5510H (-VDET=2.5V)**

- T_{op}=40°C
- 25°C
- 85°C

V_{DS} (V)

Output Current I_{OUT} (mA)

V_{IN} (V)

Input Voltage VIN (V)

Output Current I_{OUT} (mA)

Topt=-40°C

Limited Product
15) C D Pin Threshold vs. Temperature

- $V_{DET}=5.5V$
  - $VDD=6.05V$
  - $H \rightarrow L$
  - $L \rightarrow H$

- $V_{DET}=4.5V$
  - $VDD=4.95V$
  - $H \rightarrow L$
  - $L \rightarrow H$

- $V_{DET}=3.5V$
  - $VDD=3.85V$
  - $H \rightarrow L$
  - $L \rightarrow H$

- $V_{DET}=2.5V$
  - $VDD=2.75V$
  - $H \rightarrow L$
  - $L \rightarrow H$

16) C D Pin Output Current vs. Input Voltage

R5510H ($V_{DET}=5.5V$)

R5510H ($V_{DET}=3.5V$)
17) CD Pin Output Current vs. VDD

- **R5510H (-VDET=2.5V)**
  - VDD=5.0V
  - VDD=4.5V
  - VDD=4.0V
  - VDD=3.5V
  - VDD=3.0V
  - VDD=2.5V
  - VDD=2.0V
  - VDD=1.5V

- **R5510H (-VDET=5.5V)**
  - VDD=5.0V
  - VDD=4.5V
  - VDD=4.0V
  - VDD=3.5V
  - VDD=3.0V
  - VDD=2.5V
  - VDD=2.0V
  - VDD=1.5V

- **R5510H (-VDET=3.5V)**
  - VDD=3.0V
  - VDD=2.5V
  - VDD=2.0V
  - VDD=1.5V

Limited Product
18) Output Delay Time vs. Temperature (D version)

- **R5510H** (-VDET=5.5V)  
  External Capacitance=100pF

- **R5510H** (-VDET=3.5V)  
  External Capacitance=220pF

19) Output Delay Time vs. Temperature

- **R5510HxxxN/G/K**  
  - VDET=2.5V
  - VDET=5.5V

- **R5510HxxxM/F/J**  
  - VDET=2.5V
  - VDET=5.5V

Temperature Topt (°C): -40, 35, 85, 10, 15, 60
20) tpHL vs. Temperature

Temperature Topt (°C)

-40 35 85 10

Detection Delay Time tpLH (µs)

tpLH=50ms
tpLH=10ms
tpLH=0ms

Limited Product
(1) Reference Graph for Setting Reset Delay Time for D Type

*Reference Graph

![Reference Graph](image)

(2) Notes on Output Voltage Settings for E/F/G type

The Output Voltage of Regulator in R5510HxxxE/F/G may be adjustable for any output voltage between its 2V reference and its Vref setting level. An external pair of resistors is required, as shown in Figure 1.

The complete equation for the output voltage is described step by step as follows:

\[
I_2 = I_c + I_3 \\
I_3 = 2.0/R_3 \\
I_2 = I_c + 2.0/R_3 \\
V_{OUT} = 2.0 + R_2 \times I_2
\]
then put Equation (3) into Equation (4), then
\[ V_{\text{OUT}} = 2.0 + R2 \times (Ic + 2.0/R3) \]
\[ = 2.0 \times (1 + R2/R3) + R2 \times Ic \]
where 2 \times term, or R2 \times Ic will produce an error in V_{\text{OUT}}.

**TYPICAL APPLICATION**

![Typical application diagrams](image)
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