OUTLINE

The RP151 Series are CMOS-based dual voltage regulator (LDO) ICs equipped with a voltage detector (VD). LDO function has features of high output voltage accuracy, low supply current, low dropout, and high ripple rejection. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting Output Voltage, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance, and a chip enable function prolongs the battery life of each system. The line transient response and load transient response of the RP151 Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output of built-in voltage detector is Nch open drain type.

The output voltage of these ICs is internally fixed with high accuracy (1%). Since the packages for these ICs are DFN(PLP)2020-8 package, dual LDO regulators and VD are included in each packages, high density mounting of the ICs on boards is possible.

FEATURES

- Supply Current .......................................................... Typ. 24μA×2 (VR1&VR2)
- Standby Current .......................................................... Typ. 0.1μA×2
- Dropout Voltage .......................................................... Typ. 0.21V (IOUT=300mA, VOUT=2.8V)
  Typ. 0.24V (IOUT=300mA, VOUT=2.5V)
- Ripple Rejection .......................................................... Typ. 80dB (f=1kHz)
- Temperature-Drift Coefficient of Output Voltage ........... Typ. ±30ppm/°C
- Line Regulation ........................................................... Typ. 0.02%/V
- Output Voltage Accuracy .............................................. ±1.0%
- Input Voltage Range .................................................... 2.5V to 5.25V
- Output Voltage Range ................................................... 1.5V to 3.3V (0.1V steps)
  (For details, please refer to MARK INFORMATIONS.)
- Package ................................................................. DFN(PLP)2020-8
- Built-in Fold Back Protection Circuit ............................ Typ. 50mA
- Built-in Auto Discharge function .................................. B Version
- Ceramic capacitors are recommended to be used with this IC ... CIN=COUT=1.0μF or more
- Detector Threshold ..................................................... Set VOUT2×92%
- Output Delay Time for release ...................................... Typ. 10ms (C0=0.01μF)

APPLICATIONS

- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.
RP151K

BLOCK DIAGRAMS

RP151KxxxA

RP151KxxxB

Limited Product
## SELECTION GUIDE

The output voltage, and auto discharge function, etc. 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>RP151Kxxx+-TR</td>
<td>DFN(PLP)2020-8</td>
<td>5,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xxx: The combination of output voltage for each channel can be designated by serial numbers. (from 001)

- The output voltage for each channel can be set in the range from 1.5V to 3.3V in 0.1V steps.
  (For details, please refer to MARK INFORMATIONS.)

*: Designation of Mask Option:
- (A) without auto-discharge function at off state
- (B) with auto-discharge function at off state
PIN CONFIGURATIONS

- DFN(PLP)2020-8

Top View

Bottom View

PIN DESCRIPTIONS

- DFN(PLP)2020-8

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CE1</td>
<td>Chip Enable Pin 1  (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>3</td>
<td>CE2</td>
<td>Chip Enable Pin 2  (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>4</td>
<td>CD</td>
<td>Delay Select Input Pin</td>
</tr>
<tr>
<td>5</td>
<td>DOUT</td>
<td>VD Output Pin</td>
</tr>
<tr>
<td>6</td>
<td>VOUT2</td>
<td>Output Pin 2</td>
</tr>
<tr>
<td>7</td>
<td>VDD</td>
<td>Input Pin</td>
</tr>
<tr>
<td>8</td>
<td>VOUT1</td>
<td>Output Pin 1</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.
## ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN</td>
<td>Input Voltage</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>VCE</td>
<td>Input Voltage (CE Pin)</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>VOUT</td>
<td>Output Voltage</td>
<td>−0.3 to VIN+0.3</td>
<td>V</td>
</tr>
<tr>
<td>DOUT</td>
<td>Output Voltage (VD Output Pin Voltage)</td>
<td>−0.3 to 6.0</td>
<td>V</td>
</tr>
<tr>
<td>IOUT1</td>
<td>Output Current 1</td>
<td>400</td>
<td>mA</td>
</tr>
<tr>
<td>IOUT2</td>
<td>Output Current 2</td>
<td>400</td>
<td>mA</td>
</tr>
<tr>
<td>PD</td>
<td>Power Dissipation (DFN(PLP)2020-8)*</td>
<td>880</td>
<td>mW</td>
</tr>
<tr>
<td>Topt</td>
<td>Operating Temperature Range</td>
<td>−40 to 85</td>
<td>°C</td>
</tr>
<tr>
<td>Tstg</td>
<td>Storage Temperature Range</td>
<td>−55 to 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

- RP151KxxxA/B

\( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1\text{V} \) for higher output of the regulator pair,
\( I_{\text{OUT}} = 1\text{mA}, C_{\text{IN}} = C_{\text{OUT}} = 1\mu\text{F} \), unless otherwise noted.

### Symbols and Conditions

- **VR**
  - \( V_{\text{OUT}} > 2.0\text{V} \)
  - \( V_{\text{OUT}} \leq 2.0\text{V} \)

### Table: Symbol and Item 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_{\text{OUT}} )</td>
<td>Output Voltage</td>
<td>( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1\text{V} ) ( I_{\text{OUT}} = 1\text{mA} )</td>
<td>( \times 0.99 )</td>
<td>( \times 1.01 )</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>( I_{\text{OUT}} )</td>
<td>Output Current</td>
<td>300</td>
<td></td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{OUT}}/\Delta I_{\text{OUT}} )</td>
<td>Load Regulation</td>
<td>( 1\text{mA} \leq I_{\text{OUT}} \leq 200\text{mA} )</td>
<td>20</td>
<td>40</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>( V_{\text{DIFF}} )</td>
<td>Dropout Voltage</td>
<td>( I_{\text{OUT}} = 300\text{mA} )</td>
<td>1.5V ( \leq ) Set ( V_{\text{OUT}} ) (&lt; 1.7\text{V} )</td>
<td>0.40</td>
<td>1.00</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.7V ( \leq ) Set ( V_{\text{OUT}} ) (&lt; 2.0\text{V} )</td>
<td>0.34</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.0V ( \leq ) Set ( V_{\text{OUT}} ) (&lt; 2.5\text{V} )</td>
<td>0.29</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.5V ( \leq ) Set ( V_{\text{OUT}} ) (&lt; 2.8\text{V} )</td>
<td>0.24</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.8V ( \leq ) Set ( V_{\text{OUT}} ) (&lt; 3.3\text{V} )</td>
<td>0.21</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>( I_{\text{ISS}} )</td>
<td>Supply Current</td>
<td>( I_{\text{OUT}} = 0\text{mA} )</td>
<td>24</td>
<td>33</td>
<td></td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>( I_{\text{standby}} )</td>
<td>Standby Current</td>
<td>( V_{\text{CE}} = 0\text{V} )</td>
<td>0.1</td>
<td>3.0</td>
<td></td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>( \Delta V_{\text{OUT}}/\Delta V_{\text{IN}} )</td>
<td>Line Regulation</td>
<td>( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1\text{V} ), ( I_{\text{OUT}} = 30\text{mA} ) ( I_{\text{OUT}} = 0\text{mA} ) ( V_{\text{CE}} = 0\text{V} )</td>
<td>0.02</td>
<td>0.10</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td>( R_{\text{R}} )</td>
<td>Ripple Rejection</td>
<td>( f = 1\text{kHz} ), Ripple 0.2Vp-p</td>
<td>80</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>( V_{\text{IN}} )</td>
<td>Input Voltage</td>
<td>2.5</td>
<td>5.25</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{OUT}}/\Delta T_{\text{OPT}} )</td>
<td>Output Voltage Temperature Coefficient</td>
<td>( -40^\circ \text{C} \leq T_{\text{OPT}} \leq 85^\circ \text{C} )</td>
<td>( \pm 30 )</td>
<td></td>
<td></td>
<td>ppm /\text{C}</td>
</tr>
<tr>
<td>( I_{\text{SC}} )</td>
<td>Short Current Limit</td>
<td>( V_{\text{OUT}} = 0\text{V} )</td>
<td>50</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>( I_{\text{PD}} )</td>
<td>CE Pull-down Current</td>
<td>0.05</td>
<td>0.3</td>
<td>0.6</td>
<td></td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>( V_{\text{CEH}} )</td>
<td>CE Input Voltage &quot;H&quot;</td>
<td>1.5</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{CEL}} )</td>
<td>CE Input Voltage &quot;L&quot;</td>
<td>0.3</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>en</td>
<td>Output Noise</td>
<td>BW=10Hz to 100kHz</td>
<td>30</td>
<td></td>
<td></td>
<td>( \mu\text{Vrms} )</td>
</tr>
<tr>
<td>( R_{\text{LOW}} )</td>
<td>Low Output Nch Tr. ON Resistance ( (\text{B version only}) )</td>
<td>( V_{\text{IN}} = 4.0\text{V}, V_{\text{CE}} = 0\text{V} )</td>
<td>30</td>
<td></td>
<td></td>
<td>( \Omega )</td>
</tr>
</tbody>
</table>

* The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.
<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>-VDET</td>
<td>Detector Threshold</td>
<td>% of nominal VOUT2</td>
<td>90</td>
<td>92</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>+VDET</td>
<td>Released Voltage</td>
<td>% of nominal VOUT2</td>
<td>94</td>
<td>96</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>VHYS</td>
<td>Detector Threshold Hysteresis</td>
<td>% of nominal VOUT2</td>
<td>2</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>VDH</td>
<td>DOUT Output Voltage &quot;L&quot;</td>
<td>L=0.25mA</td>
<td>0.02</td>
<td>0.1</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>IDOUT</td>
<td>DOUT Output Leakage Current</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>tD</td>
<td>Reset Delay Time</td>
<td>CD=0.01μF</td>
<td></td>
<td>10</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>RD</td>
<td>Delay Circuit Resistance</td>
<td></td>
<td>0.96</td>
<td>1.35</td>
<td>1.63</td>
<td>MΩ</td>
</tr>
<tr>
<td>VTCRD</td>
<td>CD Pin Threshold Voltage</td>
<td>VDD=3.6V</td>
<td>1.7</td>
<td>1.9</td>
<td>2.1</td>
<td>V</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.
TECHNICAL NOTES

When using these ICs, consider the following points:

PCB Layout

Make VDD and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result.

Connect a capacitor with a capacitance value as much as 1.0μF or more as C1 between VDD and GND pin, and as close as possible to the pins.

Set the output capacitors C2 and C3 for phase compensation, as close as possible to the ICs, and make wiring as short as possible.

Co external components, especially capacitor C4, as close as possible to the ICs and make wiring as short as possible. (Refer to TYPICAL APPLICATION)

Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied.

For this purpose, connect capacitors with a capacitance value as much as 1.0μF or more as C2 and C3 with good frequency characteristics and ESR (Equivalent Series Resistance) between VOUT and GND pin, and as close as possible to the pins.

If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable.

Evaluate your circuit with considering frequency characteristics.

Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit with actual using capacitors.

TYPICAL APPLICATIONS

![TYPICAL APPLICATION Diagram]

(External Components)

<table>
<thead>
<tr>
<th>External Capacitor; Ceramic Type</th>
<th>C1, C2, C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0μF Kyocera</td>
<td>CM05X5R105KD6AB</td>
</tr>
<tr>
<td>TDK</td>
<td>C1005JB0J105K</td>
</tr>
<tr>
<td>Murata</td>
<td>GRM155B31A105KE15</td>
</tr>
</tbody>
</table>

External Capacitor for delay time C4

Output delay time (tD) can be set accordance with the capacitance C0 of external capacitor as below.

\[ tD = 10^6 \times C4(\mu F) \]
TEST CIRCUITS

Basic Test Circuit

Test Circuit for Supply Current
Test Circuit for Ripple Rejection

Test Circuit for Load Transient Response
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (T_{opt}=25^\circ C)

- **1.5V (VR1/VR2)**
  - VIN=5.5V
  - VIN=5.0V
  - VIN=4.2V
  - VIN=3.6V
  - VIN=2.5V

- **2.5V (VR1/VR2)**

- **3.3V (VR1/VR2)**
  - VIN=5.5V
  - VIN=5.0V
  - VIN=4.3V

2) Output Voltage vs. Input Voltage (T_{opt}=25^\circ C)

- **1.5V (VR1/VR2)**
  - I_{OUT}=1mA
  - I_{OUT}=30mA
  - I_{OUT}=100mA

- **2.5V (VR1/VR2)**
3) Supply Current vs. Input Voltage (Topt=25°C)

**3.3V (VR1/VR2)**

<table>
<thead>
<tr>
<th>Input Voltage V_in(V)</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Current I_ssa(μA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1.5V (VR1/VR2)**

<table>
<thead>
<tr>
<th>Input Voltage V_in(V)</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Current I_ssa(μA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2.5V (VR1/VR2)**

<table>
<thead>
<tr>
<th>Input Voltage V_in(V)</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Current I_ssa(μA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3.3V (VR1/VR2)**

<table>
<thead>
<tr>
<th>Input Voltage V_in(V)</th>
<th>3.3</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Current I_ssa(μA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4) Output Voltage vs. Temperature

1.5V(VR1/VR2)

Vin=2.5V, Iout=1mA

2.5V(VR1/VR2)

Vin=3.5V, Iout=1mA

3.3V(VR1/VR2)

Vin=4.3V, Iout=1mA

5) Supply Current vs. Temperature

1.5V(VR1/VR2)

Vin=2.5V, Iout=1mA

2.5V(VR1/VR2)

Vin=3.5V, Iout=1mA
6) Dropout Voltage vs. Output Current

3.3V (VR1/VR2)

Vin=4.3V, Iout=1mA

Temperature Topt (°C)

Supply Current Iss (μA)

Dropout Voltage VDIF (mV)

Output Current IOUT (mA)

1.5V (VR1/VR2)

2.5V (VR1/VR2)

Limited Product
7) Dropout Voltage vs. VR\_VSET

8) Ripple Rejection vs. Input Bias (Input Ripple=0.5Vp-p, T_{opt}=25^\circ C)

*2.5V(\text{VR1})*

*2.5V(\text{VR2})*
9) Ripple Rejection vs. Frequency (Ripple=0.5Vp-p)

1.5V(VR1)

2.5V(VR1)

2.5V(VR2)

2.5V(VR2)
10) Input Transient Response \((t_r^r_{t_f}=5\mu s, T_{opt}=25^\circ C)\)

- **1.5V (VR1)**
  - Input Voltage
  - Output Voltage

- **1.5V (VR2)**
  - Input Voltage
  - Output Voltage

- **2.5V (VR1)**
  - Input Voltage
  - Output Voltage

- **2.5V (VR2)**
  - Input Voltage
  - Output Voltage
11) Load Transient Response (\(t_r=t_f=500\text{ns}, T_{opt}=25^\circ\text{C}\))

**1.5V\(\text{VR1}\)**

Input Voltage:
- \(V_{\text{IN}}=2.5\text{V}\)

Output Voltage and Current:
- VR1: Output Current 0.1mA → 150mA
- VR1 Output Voltage
- VR2: Output Current 30mA
- VR2 Output Voltage

**1.5V\(\text{VR2}\)**

Input Voltage:
- \(V_{\text{IN}}=2.5\text{V}\)

Output Voltage and Current:
- VR2: Output Current 0.1mA → 150mA
- VR2 Output Voltage
- VR2 Output Voltage
- VR1 Output Current 30mA
- VR1 Output Voltage

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Limited Product
2.5V(3R1)  
VR1: Output Current 1mA → 200mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 40 80 120 160 200  
2.5V(2R2)  
VR1: Output Current 1mA → 200mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 40 80 120 160 200  
3.3V(3R1)  
VR1: Output Current 50mA → 100mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 20 40 60 80 100  
3.3V(2R2)  
VR1: Output Current 50mA → 100mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 20 40 60 80 100  
VR1 Output Voltage VOUT(V)  
VR2 Output Voltage VOUT(V)  
Output Current IOUT(mA)  
VR1: Output Current 1mA → 200mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 40 80 120 160 200  
VR1 Output Voltage VOUT(V)  
VR2 Output Voltage VOUT(V)  
Output Current IOUT(mA)  
VR1: Output Current 50mA → 100mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 20 40 60 80 100  
VR1 Output Voltage VOUT(V)  
VR2 Output Voltage VOUT(V)  
Output Current IOUT(mA)  
VR1: Output Current 0.1mA → 150mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 200 600 800 1000  
VR1 Output Voltage VOUT(V)  
VR2 Output Voltage VOUT(V)  
Output Current IOUT(mA)  
VR1: Output Current 0.1mA → 150mA  
VR2: Output Voltage  
VR1 Output Voltage  
VR2 Output Voltage  
Time t (μs)  
0 200 600 800 1000  
VIN=3.5V  
VIN=4.3V  
Limited Product
12) Turn On Speed with CE pin (Topt=25°C)

1.5V(VR1/VR2)

- IOUT=0mA
- IOUT=30mA
- IOUT=150mA
- IOUT=0mA
13) Turn Off Speed with CE pin ($T_{opt}=25^\circ C$)

<table>
<thead>
<tr>
<th>CE Input Voltage $V_{CE}(V)$</th>
<th>Output Voltage $V_{OUT}(V)$</th>
<th>CE Input Voltage $V_{CE}(V)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.5V$ (VR1/VR2)</td>
<td>$I_{OUT}=0mA$</td>
<td>$1.5V$ (VR1/VR2)</td>
</tr>
<tr>
<td>$1.5V$ (VR1/VR2)</td>
<td>$I_{OUT}=30mA$</td>
<td>$2.5V$ (VR1/VR2)</td>
</tr>
<tr>
<td>$2.5V$ (VR1/VR2)</td>
<td>$I_{OUT}=300mA$</td>
<td>$2.5V$ (VR1/VR2)</td>
</tr>
</tbody>
</table>

Limited Product
14) Detector Threshold/Released Voltage vs. Temperature

**1.5V**

- Detector Threshold -VDET/
- Released Voltage +VDET

**2.5V**

- Detector Threshold -VDET/
- Released Voltage +VDET

### Detector Threshold/Released Voltage vs. Temperature

<table>
<thead>
<tr>
<th>Temperature T_{opt} (°C)</th>
<th>Detector Threshold -VDET</th>
<th>Released Voltage +VDET</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50</td>
<td>1.32</td>
<td>2.22</td>
</tr>
<tr>
<td>-25</td>
<td>1.34</td>
<td>2.24</td>
</tr>
<tr>
<td>0</td>
<td>1.36</td>
<td>2.26</td>
</tr>
<tr>
<td>25</td>
<td>1.38</td>
<td>2.28</td>
</tr>
<tr>
<td>50</td>
<td>1.40</td>
<td>2.30</td>
</tr>
<tr>
<td>75</td>
<td>1.42</td>
<td>2.32</td>
</tr>
<tr>
<td>100</td>
<td>1.44</td>
<td>2.34</td>
</tr>
</tbody>
</table>

**3.3V(VR1/VR2)**

- Output Voltage V_{OUT}(V)
- CE Input Voltage V_{CE}(V)

#### Output Voltage

**I_{OUT}=0mA**

- Time t (μs) from 0 to 500

#### Output Voltage

**I_{OUT}=30mA**

- Time t (μs) from 0 to 500

#### Output Voltage

**I_{OUT}=300mA**

- Time t (μs) from 0 to 500
15) CD Pin Threshold Voltage vs. Temperature

16) Delay Circuit Resistance vs. Temperature
17) Output Delay Time vs. External Capacitance

**3.3V**

- Delay Circuit Resistance $R_{CD}(\Omega)$
- Temperature $Topt(\degree C)$

**1.5V**

- External Capacitance ($\mu F$)
- Output Delay Time $tD$ and $t_{PHL}$

**2.5V**

- External Capacitance ($\mu F$)
- Output Delay Time $tD$ and $t_{PTL}$

**3.3V**

- External Capacitance ($\mu F$)
- Output Delay Time $tD$ and $t_{PTL}$
18) Nch Driver Output Current vs. Input Voltage

**1.5V**

![Graph showing Nch Driver Output Current vs. Input Voltage for 1.5V at different temperatures (-40°C, 25°C, 85°C).]

**2.5V**

![Graph showing Nch Driver Output Current vs. Input Voltage for 2.5V at different temperatures (-40°C, 25°C, 85°C).]

**3.3V**

![Graph showing Nch Driver Output Current vs. Input Voltage for 3.3V at different temperatures (-40°C, 25°C, 85°C).]

19) Nch Driver Output Current vs. $V_{DS}$

**3.3V**

![Graph showing Nch Driver Output Current vs. $V_{DS}$ for 3.3V at different temperatures (-40°C, 25°C, 85°C).]
ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between $I_{OUT}$ (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under 40$\mu$V (Avg.) are marked as the hatched area in the graph.

**Measurement conditions**
- $V_{IN} = Set \ V_{OUT} + 1V$
- Frequency Band: 10Hz to 2MHz
- Temperature: $−40°C$ to $85°C$

### 1.5V (VR1/VR2)

- $V_{IN} = 2.5V$ to $5.5V$
- $C_{IN} =$ Ceramic $1.0\mu F$

### 3.3V (VR1/VR2)

- $V_{IN} = 3.6V$ to $5.5V$
- $C_{IN} =$ Ceramic $1.0\mu F$
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