OUTLINE

The R5325x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current (Typ. 3.0μA), low dropout, and fast transient response. 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 R5325x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The supply current at no load of R5325x Series is remarkably reduced compared with R5323x Series. The mode change signal to reduce the supply current is not necessary.

The output voltage of these ICs is internally fixed with high accuracy (±1.0%). Since the packages for these ICs are SOT-23-6 and DFN(PLP)1820-6 package, dual LDO regulators are included in each, high density mounting of the ICs on boards is possible.

FEATURES

- Supply Current .............................................................. Typ. 3.0μA (VR1, VR2)
- Standby Current ............................................................ Typ. 0.1μA (VR1, VR2)
- Dropout Voltage ............................................................ Typ. 0.2V (I_{OUT}=150mA ,V_{OUT}=3.0V)
- Ripple Rejection ............................................................ Typ. 55dB (f=1kHz)
- Input Voltage ................................................................. 1.5V to 6.0V
- Output Voltage Range ................................................... 1.2V to 4.0V (0.1V steps)
- Output Voltage Accuracy ............................................... ±1.0%
- Temperature-Drift Coefficient of Output Voltage .......... Typ. ±100ppm/°C
- Line Regulation ............................................................. Typ.0.1%/V
- Packages ..................................................................... DFN(PLP)1820-6, SOT-23-6
- Built-in fold-back protection circuit .............................. Typ. 50mA (Current at short mode)
- Ceramic Capacitor is recommended. ............................. 0.1μF or more
- Built-in chip enable circuit (active “H”)
- Fast Transient Response Time from large load current to small load current. (50% less than R5323x)

APPLICATIONS

- Power source for handheld communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.
BLOCK DIAGRAMS
SELECTION GUIDE

The output voltage, auto discharge function, package, 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>R5325Kxxx*-TR</td>
<td>DFN(PLP)1820-6</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R5325Nxxx*-TR-FE</td>
<td>SOT-23-6</td>
<td>3,000 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 1.2V to 4.0V in 0.1V steps.
(For details, please refer to MARK INFORMATIONS.)

*: The auto discharge function at off state are options as follows.
(A) without auto discharge function at off state
(B) with auto discharge function at off state
PIN CONFIGURATION

- DFN(PLP)1820-6

   Top View
   6 5 4
   1 2 3

   Bottom View
   4 5 6
   1 2 3

- SOT-23-6

   (mark side)
   6 5 4
   1 2 3

PIN DESCRIPTIONS

- DFN(PLP)1820-6

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VOUT2</td>
<td>Output Pin 2</td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>Input Pin</td>
</tr>
<tr>
<td>3</td>
<td>VOUT1</td>
<td>Output Pin 1</td>
</tr>
<tr>
<td>4</td>
<td>CE1</td>
<td>Chip Enable Pin 1 (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>6</td>
<td>CE2</td>
<td>Chip Enable Pin 2 (&quot;H&quot; Active)</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>VOUT1</td>
<td>Output Pin 1</td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>Input Pin</td>
</tr>
<tr>
<td>3</td>
<td>VOUT2</td>
<td>Output Pin 2</td>
</tr>
<tr>
<td>4</td>
<td>CE2</td>
<td>Chip Enable Pin 2 (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>6</td>
<td>CE1</td>
<td>Chip Enable Pin 1 (&quot;H&quot; Active)</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>VIN</td>
<td>Input Voltage</td>
<td>6.5</td>
<td>V</td>
</tr>
<tr>
<td>VCE</td>
<td>Input Voltage (CE Pin)</td>
<td>−0.3 to 6.5</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>IOUT1, IOUT2</td>
<td>Output Current</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>PD</td>
<td>Power Dissipation (DFN(PLP)1820-6) *</td>
<td>880</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Power Dissipation (SOT-23-6) *</td>
<td>420</td>
<td></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.

### ABSOLUTE MAXIMUM RATINGS

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.

### 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.
## ELECTRICAL CHARACTERISTICS

### R5325xxxxA/B

<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}} + 1V ), ( I_{\text{OUT}} = 1mA )</td>
<td>( V_{\text{OUT}} \geq 1.5V )</td>
<td>( V_{\text{OUT}} &lt; 1.5V )</td>
<td>-15mV, +15mV</td>
<td>V</td>
</tr>
<tr>
<td>( I_{\text{OUT}} )</td>
<td>Output Current</td>
<td>( V_{\text{IN}} = V_{\text{OUT}} = 1.0V )</td>
<td>150</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{OUT}} / \Delta I_{\text{OUT}} )</td>
<td>Load regulation</td>
<td>( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1V ), ( 1mA \leq I_{\text{OUT}} \leq 150mA )</td>
<td>30</td>
<td>80</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{DIFF}} )</td>
<td>Dropout Voltage</td>
<td>( I_{\text{OUT}} = 150mA )</td>
<td>1.2V ( \leq V_{\text{OUT}} &lt; 1.3V )</td>
<td>0.55</td>
<td>0.85</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.3V ( \leq V_{\text{OUT}} &lt; 1.4V )</td>
<td>0.48</td>
<td>0.74</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.4V ( \leq V_{\text{OUT}} &lt; 1.5V )</td>
<td>0.43</td>
<td>0.68</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5V ( \leq V_{\text{OUT}} &lt; 2.0V )</td>
<td>0.40</td>
<td>0.59</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.0V ( \leq V_{\text{OUT}} &lt; 2.8V )</td>
<td>0.27</td>
<td>0.39</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.8V ( \leq V_{\text{OUT}} &lt; 4.0V )</td>
<td>0.21</td>
<td>0.28</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( V_{\text{OUT}} = 4.0V )</td>
<td>0.17</td>
<td>0.23</td>
<td>V</td>
</tr>
<tr>
<td>( I_{\text{SS}} )</td>
<td>Supply Current</td>
<td>( V_{\text{IN}} = \text{Set } V_{\text{OUT}} + 1V ), ( I_{\text{OUT}} = 0mA )</td>
<td>3</td>
<td>7</td>
<td>µA</td>
<td></td>
</tr>
<tr>
<td>( I_{\text{standby}} )</td>
<td>Standby Current</td>
<td>( V_{\text{IN}} = 6V ), ( V_{\text{CE}} = \text{GND} )</td>
<td>0.1</td>
<td>1.0</td>
<td>µA</td>
<td></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}} + 0.5V ), ( I_{\text{OUT}} = 30mA )</td>
<td>0.1</td>
<td>0.3</td>
<td>%/V</td>
<td></td>
</tr>
<tr>
<td>( RR )</td>
<td>Ripple Rejection</td>
<td>( f = 1kHz ), Ripple 0.5Vp-p</td>
<td>55</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_{\text{IN}} )</td>
<td>Input Voltage</td>
<td></td>
<td>1.5</td>
<td>6.0</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>( I_{\text{OUT}} = 30mA ), -40°C ( \leq T_{\text{opt}} \leq 85°C )</td>
<td>( \pm 100 )</td>
<td>ppm</td>
<td>/°C</td>
<td></td>
</tr>
<tr>
<td>( I_{\text{SC}} )</td>
<td>Short Current Limit</td>
<td>( V_{\text{OUT}} = 0V )</td>
<td>50</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{\text{PD}} )</td>
<td>CE Pull-down Constant Current</td>
<td></td>
<td>0.15</td>
<td>0.30</td>
<td>0.55</td>
<td>µA</td>
</tr>
<tr>
<td>( V_{\text{CEH}} )</td>
<td>CE Input Voltage “H”</td>
<td></td>
<td>1.0</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{CEL}} )</td>
<td>CE Input Voltage “L”</td>
<td></td>
<td>0</td>
<td>0.4</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>µVrms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R_{\text{LOW}} )</td>
<td>Low Output Nch Tr. ON Resistance (of B version)</td>
<td>( V_{\text{CE}} = 0V )</td>
<td>50</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TYPICAL APPLICATION

(External Components)
Output Capacitor; Ceramic Type

<table>
<thead>
<tr>
<th>Value</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1µF</td>
<td>Kyocera</td>
<td>CM05B104K06AB</td>
</tr>
<tr>
<td></td>
<td>Murata</td>
<td>GRM155B31C104KA87B</td>
</tr>
<tr>
<td>1.0µF</td>
<td>Kyocera</td>
<td>CM05X5R105K06AB</td>
</tr>
<tr>
<td></td>
<td>TDK</td>
<td>C1005JB0J105K</td>
</tr>
<tr>
<td></td>
<td>Murata</td>
<td>GRM155B30J105KE18B</td>
</tr>
</tbody>
</table>

1. Mounting on PCB
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 0.1µF or more as C1 between VDD and GND pin, and as close as possible to the pins.
Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

2. Phase Compensation
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 and C3 with good frequency characteristics and ESR (Equivalent Series Resistance).
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

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.
TEST CIRCUIT

Fig.1 Standard test Circuit

Fig.2 Supply Current Test Circuit

Fig.3 Ripple Rejection, Line Transient Response Test Circuit

Fig.4 Load Transient Response Test Circuit
TYPICAL CHARACTERISTICS

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

- 1.2V (VR1/VR2)
- 2.8V (VR1/VR2)
- 4.0V (VR1/VR2)

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

- 1.2V (VR1/VR2)
- 2.8V (VR1/VR2)
3) Dropout Voltage vs. Output Current

- **4.0V (VR1/VR2)**

- **1.2V (VR1/VR2)**

- **2.8V (VR1/VR2)**
4) Output Voltage vs. Temperature (I_{out}=30mA)

1.2V (VR1/VR2)

2.8V (VR1/VR2)

4.0V (VR1/VR2)

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

1.2V (VR1/VR2)

2.8V (VR1/VR2)
4.0V (VR1/VR2)

6) Supply Current vs. Temperature

1.2V (VR1/VR2)

2.8V (VR1/VR2)

4.0V (VR1/VR2)
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

8) Ripple Rejection vs. Frequency (Topt=25°C, C_{out}=0.1\mu F)

- 1.2V (VR1/VR2)  
  - VR1/VR2

- 2.8V (VR1/VR2)  
  - VR1/VR2

- 4.0V (VR1/VR2)  
  - VR1/VR2
9) Ripple Rejection vs. Input Voltage (DC bias) (Topt=25°C, Ripple 0.2Vp-p)

2.8V (VR1/VR2)

Input Voltage (Vin[mV])

Ripple Rejection (dB)

Io=1mA

2.8V (VR1/VR2)

Input Voltage (Vin[mV])

Ripple Rejection (dB)

Io=10mA

2.8V (VR1/VR2)

Input Voltage (Vin[mV])

Ripple Rejection (dB)

Io=100mA

10) Input Transient Response (CIN=none, tr=tf=5µs, IOUT=30mA)

1.2V (VR1/VR2)

Output Voltage (Vo(V))

Input Voltage (Vin(V))

C2=1=Ceramic 0.1µF

Time (us)

1.2V (VR1/VR2)

Output Voltage (Vo(V))

Input Voltage (Vin(V))

C2=1=Ceramic 1.0µF

Time (us)
11) Load Transient Response (Cin=Ceramic 0.1µF)
12) Turn on Speed by CE signal (C=Ceramic 0.1μF)

2.8V (VR1/VR2)

1.2V (VR1/VR2)

2.8V (VR1/VR2)

1.2V (VR1/VR2)
13) Turn-off Speed with CE Signal (B version) ($C_{in}$=Ceramic 0.1µF)

- 4.0V (VR1/VR2)
- 1.2V (VR1/VR2)
- 2.8V (VR1/VR2)
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http://www.ricoh.com/LSI/