Seamless Low Supply Current 150mA LDO REGULATOR

OUTLINE

The R1182x Series are CMOS-based positive voltage regulator ICs with high output voltage accuracy and low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit which prevents the destruction by excess current, and so on.

The output voltage of these ICs is fixed with high accuracy.

The R1182x Series has low dropout voltage caused by built in low on resistance transistor. Further, the consumption current of IC itself is Typ. 3.0μA at no load, at the same time, compared with the conventional low supply current regulator, transient response is improved in all the load range by our original seamless technology.

Since the packages for these ICs are SOT-23-5 and ultra small DFN(PLP)16-6, high density mounting of the ICs on boards is possible.

FEATURES

- Supply Current ......................................................................Typ. 3μA
  (Except the current through CE pull-down circuit)
- Standby Current ..............................................................Typ. 0.1μA
- Input Voltage Range .........................................................1.5V to 6.0V
- Output Voltage Range ......................................................1.2V to 4.0V (0.1V steps)
- Dropout Voltage ..............................................................Typ. 0.23V (IOUT=150mA, 3.0V Output type)
- Output Voltage Accuracy ...............................................±1.0% (VOUT>1.5V)
  ±15mV (VOUT ≤ 1.5V)
- Temperature-Drift Coefficient of Output Voltage.....Typ. ±100ppm/°C
- Line Regulation ..............................................................Typ. 0.1%/V
- Packages ........................................................................DFN(PLP)16-6, SOT-23-5
- Built-in Fold Back Protection Circuit ................................Typ. 50mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC (0.1μF or more)

APPLICATIONS

- Stable voltage reference.
- Power source for electrical appliances such as cameras, camcorders, mobile communication equipment.
- Power source for battery-powered equipment.
BLOCK DIAGRAMS

R1182xxx1B

VDD

GND

Vref

Current Limit

R1182xxx1D

VDD

GND

Vref

Current Limit

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>R1182Kxx1*-TR</td>
<td>DFN(PLP)1616-6</td>
<td>5,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R1182Nxx1*-TR-FE</td>
<td>SOT-23-5</td>
<td>3,000 pcs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

xx: The output voltage can be designated in the range from 1.2V(12) to 4.0V(40) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

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

- DFN(PLP)1616-6
  - Top View
  - Bottom View

- SOT-23-5
  - (Mark side)

PIN DESCRIPTIONS

- DFN(PLP)1616-6

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V_{DD}</td>
<td>Input Pin</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>3</td>
<td>CE</td>
<td>Chip Enable Pin (&quot;H&quot; Active)</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>6</td>
<td>V_{OUT}</td>
<td>Output pin</td>
</tr>
</tbody>
</table>

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

- SOT-23-5

<table>
<thead>
<tr>
<th>Pin No</th>
<th>Symbol</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground Pin</td>
</tr>
<tr>
<td>2</td>
<td>V_{DD}</td>
<td>Input Pin</td>
</tr>
<tr>
<td>3</td>
<td>V_{OUT}</td>
<td>Output pin</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>5</td>
<td>CE</td>
<td>Chip Enable Pin (&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>IOUT</td>
<td>Output Current</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>P_D</td>
<td>Power Dissipation (DFN(PLP)1616-6) †</td>
<td>640</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Power Dissipation (SOT-23-5) †</td>
<td>420</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

## R1182xxx1B/D

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>Output Voltage</td>
<td>V_{IN}=Set V_{OUT}+1V, I_{OUT}=1mA</td>
<td>V_{OUT} &gt; 1.5V</td>
<td>×0.99</td>
<td>×1.01</td>
<td>V</td>
</tr>
<tr>
<td>IOUT</td>
<td>Output Current</td>
<td>V_{IN}–V_{OUT}=1.0V</td>
<td>150</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔI_{OUT}</td>
<td>Load Regulation</td>
<td>V_{IN}=Set V_{OUT}+1V, 1mA ≤ I_{OUT} ≤ 150mA</td>
<td>30</td>
<td>80</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

<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_{DIFF}</td>
<td>Dropout Voltage</td>
<td>I_{OUT}=150mA</td>
<td>1.2 ≤ V_{OUT} &lt; 1.3</td>
<td>0.60</td>
<td>0.82</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.3 ≤ V_{OUT} &lt; 1.4</td>
<td>0.53</td>
<td>0.75</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.4 ≤ V_{OUT} &lt; 1.5</td>
<td>0.46</td>
<td>0.67</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.5 ≤ V_{OUT} &lt; 2.0</td>
<td>0.43</td>
<td>0.60</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.0 ≤ V_{OUT} &lt; 2.8</td>
<td>0.31</td>
<td>0.40</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.8 ≤ V_{OUT} &lt; 4.0</td>
<td>0.23</td>
<td>0.29</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>V_{OUT}=4.0</td>
<td>0.19</td>
<td>0.23</td>
<td>V</td>
</tr>
<tr>
<td>I_{SS}</td>
<td>Supply Current</td>
<td>V_{IN}=Set V_{OUT}+1V, I_{OUT}=0mA</td>
<td>3.0</td>
<td>7.0</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>I_{STAND-BY}</td>
<td>Standby Current</td>
<td>V_{IN}=Set V_{OUT}+1V, V_{CE}=GND</td>
<td>0.1</td>
<td>1.0</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔV_{IN}</td>
<td>Line Regulation</td>
<td>Set V_{OUT}+0.5V ≤ V_{IN} ≤ 6.0V, I_{OUT}=30mA</td>
<td>0.1</td>
<td>0.3</td>
<td>%/V</td>
<td></td>
</tr>
<tr>
<td>V_{IN}</td>
<td>Input Voltage</td>
<td></td>
<td>1.5</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>ΔV_{OUT}/ΔT_{OPT}</td>
<td>Output Voltage Temperature Coefficient</td>
<td>I_{OUT}=30mA</td>
<td>-40°C ≤ T_{OPT} ≤ 85°C</td>
<td>±100</td>
<td>ppm/°C</td>
<td></td>
</tr>
<tr>
<td>I_{SC}</td>
<td>Short Current Limit</td>
<td>V_{OUT}=0V</td>
<td>50</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{PD}</td>
<td>CE Pull-down Current</td>
<td></td>
<td>0.05</td>
<td>0.30</td>
<td>0.55</td>
<td>μA</td>
</tr>
<tr>
<td>V_{CEH}</td>
<td>CE Input Voltage &quot;H&quot;</td>
<td></td>
<td>1.0</td>
<td>6.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{CEL}</td>
<td>CE Input Voltage &quot;L&quot;</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_{LOW}</td>
<td>Nch Tr. On resistance for auto discharge function (Only applied to D Version)</td>
<td>V_{CE}=0V</td>
<td>50</td>
<td>Ω</td>
<td></td>
<td></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.
TYPICAL APPLICATIONS

(External components)
Output capacitor : Ceramic type
Input capacitor : Ceramic type

Output Capacitor: 0.1\(\mu\)F
- Kyocera CM05B104K06AB
- Murata GRM155B31C104KA87B

1.0\(\mu\)F
- Kyocera CM05X5R105K06AB
- TDK C1005JB0J105K
- Murata GRM155B30J105KE18B

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, be sure to use a 0.1\(\mu\)F or more capacitor C2 (Ceramic type).

If a tantalum capacitor is used, and its ESR (Equivalent Series Resistance) of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

Mounting on Board
Make VDD and GND lines sufficient. If their impedance is high, pick-up the noise or unstable operation may result.
Connect the capacitor C1 with a 0.1\(\mu\)F or more between VDD and GND as close as possible.
Set external components, especially the output capacitor C2, as close as possible to the ICs and make wiring as short as possible. (Refer to the typical application)
TEST CIRCUITS

Fig.1 Standard test Circuit

Fig.2 Supply Current Test Circuit

Fig.3 Ripple Rejection, Line Transient Response Test Circuit

C1=Ceramic 1.0μF
C2=Ceramic 1.0μF
TYPICAL CHARACTERISTICS

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

- **R1182x121x**
  - **VDD=1.5V**
  - **VDD=1.8V**
  - **VDD=2.2V**
  - **VDD=2.7V**
  - **VDD=3.2V**

- **R1182x281x**
  - **VDD=3.1V**
  - **VDD=3.5V**
  - **VDD=3.8V**
  - **VDD=4.8V**

- **R1182x401x**
  - **VDD=4.3V**
  - **VDD=5.0V**
  - **VDD=6.0V**

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

- **R1182x121x**
  - **IOUT=1mA**
  - **IOUT=30mA**
  - **IOUT=100mA**

- **R1182x281x**
  - **IOUT=1mA**
  - **IOUT=30mA**
  - **IOUT=100mA**
3) Supply Current vs. Input Voltage

3) Supply Current vs. Input Voltage
4) Output Voltage vs. Temperature (I_{OUT}=30mA)

**R1182x121x**

*VIN=2.2V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 1.16
    - -40: 1.17
    - 0: 1.18
    - 25: 1.20
    - 50: 1.22
    - 75: 1.23

*VIN=3.8V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 2.95
    - 0: 2.90
    - 25: 2.85
    - 50: 2.80
    - 75: 2.75

*VIN=5V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 4.15
    - 0: 4.10
    - 25: 4.05
    - 50: 4.00
    - 75: 3.95

5) Supply Current vs. Temperature ($T_{opt}=25^\circ C$)

**R1182x121x**

*VIN=2.2V*

- Supply Current $I_{SS}($μA$)$
  - Temperature $T_{opt}(^\circ C)$
  - $I_{SS}($μA$)$:
    - -25: 0
    - -40: 1
    - 0: 2
    - 25: 3
    - 50: 4
    - 75: 5

*VIN=3.8V*

- Supply Current $I_{SS}($μA$)$
  - Temperature $T_{opt}(^\circ C)$
  - $I_{SS}($μA$)$:
    - -25: 8
    - -40: 9
    - 0: 10
    - 25: 9
    - 50: 8
    - 75: 7

**R1182x281x**

*VIN=2.2V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 1.23
    - 0: 1.22
    - 25: 1.20
    - 50: 1.18
    - 75: 1.17

*VIN=3.8V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 2.95
    - 0: 2.90
    - 25: 2.85
    - 50: 2.80
    - 75: 2.75

*VIN=5V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 4.15
    - 0: 4.10
    - 25: 4.05
    - 50: 4.00
    - 75: 3.95

**R1182x401x**

*VIN=5V*

- Output Voltage $V_{OUT}(V)$
  - Temperature $T_{opt}(^\circ C)$
  - $V_{OUT}(V)$:
    - -25: 4.20
    - 0: 4.15
    - 25: 4.10
    - 50: 4.05
    - 75: 4.00

- Supply Current $I_{SS}($μA$)$
  - Temperature $T_{opt}(^\circ C)$
  - $I_{SS}($μA$)$:
    - -25: 10
    - -40: 9
    - 0: 8
    - 25: 7
    - 50: 6
    - 75: 5
6) Dropout Voltage vs. Output Current

**R1182x401x**

![Graph showing dropout voltage vs. output current for R1182x401x at different temperatures.]

**R1182x121x**

![Graph showing dropout voltage vs. output current for R1182x121x at different temperatures.]

**R1182x281x**

![Graph showing dropout voltage vs. output current for R1182x281x at different temperatures.]

**R1182x**

![Graph showing dropout voltage vs. output current for R1182 at different temperatures.]

Limited Product
7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

![Dropout Voltage vs. Set Output Voltage](image)

8) Ripple Rejection vs. Input Bias Voltage (Ripple=0.2Vp-p)

**R1182x281x**

- **I_{out}=1mA**
  - 100Hz, 1kHz, 10kHz, 100kHz

- **I_{out}=10mA**
  - 100Hz, 1kHz, 10kHz, 100kHz

- **I_{out}=100mA**
  - 100Hz, 1kHz, 10kHz, 100kHz

Limited Product
9) Ripple Rejection vs. Frequency ($C_{\text{OUT}}=\text{ceramic} 0.1\mu\text{F}$)

- **R1182x121x**
  - $V_{\text{IN}}=2.2\text{VDC}+0.2\text{Vp-p}$
  - $I_{\text{OUT}}=1\text{mA}$
  - $I_{\text{OUT}}=30\text{mA}$
  - $I_{\text{OUT}}=100\text{mA}$

- **R1182x281x**
  - $V_{\text{IN}}=3.8\text{VDC}+0.2\text{Vp-p}$
  - $I_{\text{OUT}}=1\text{mA}$
  - $I_{\text{OUT}}=30\text{mA}$
  - $I_{\text{OUT}}=100\text{mA}$

- **R1182x401x**
  - $V_{\text{IN}}=5.0\text{VDC}+0.2\text{Vp-p}$
  - $I_{\text{OUT}}=1\text{mA}$
  - $I_{\text{OUT}}=30\text{mA}$
  - $I_{\text{OUT}}=100\text{mA}$

10) Input Transient Response ($tr=tf=5\mu\text{s}$, $I_{\text{OUT}}=30\text{mA}$)

- **R1182x121x**
  - $C_{\text{OUT}}=\text{Ceramic} 0.1\mu\text{F}$

- **R1182x121x**
  - $C_{\text{OUT}}=\text{Ceramic} 1\mu\text{F}$
11) Load Transient Response (\( t_r = 0.5 \mu s \), \( C_{IN} \) = Ceramic 0.1 \( \mu F \))
**R1182x401x**

\[ V_{IN}=5.0V, C_{OUT}=1\mu F \]

![Graph showing Output Voltage vs. Time for R1182x401x](image)

**Output Current**
- 50mA
- 100mA

**Output Voltage**
- VR
- 3.6V
- 4.0V
- 4.2V

**CE Input Voltage**
- 0V
- 1.2V
- 2.4V
- 3.6V

**Time t (\(\mu s\))**
- 0
- 4
- 8
- 12
- 16
- 20
- 24
- 28
- 32
- 36

**12) Turn on speed by CE pin (C_{IN}=Ceramic 0.1\mu F)**

**R1182x121x**

\[ C_{OUT}=0.1\mu F, V_{IN}=3.3V \]

- I_{OUT}=1mA
- I_{OUT}=30mA

![Graph showing CE Input Voltage vs. Time for R1182x121x](image)

**CE Input Voltage**
- 0V
- 1.2V
- 2.4V
- 3.6V

**Output Voltage**
- VR
- 3.6V
- 4.0V
- 4.2V

**Time t (\(\mu s\))**
- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90

**R1182x281x**

\[ C_{OUT}=0.1\mu F, V_{IN}=3.3V, I_{OUT}=30mA \]

- I_{OUT}=1mA
- I_{OUT}=30mA

![Graph showing CE Input Voltage vs. Time for R1182x281x](image)

**CE Input Voltage**
- 0V
- 1.2V
- 2.4V
- 3.6V

**Output Voltage**
- VR
- 3.6V
- 4.0V
- 4.2V

**Time t (\(\mu s\))**
- 0
- 20
- 40
- 60
- 80
- 100
- 120
- 140
- 160
- 180
13) Turn-off Speed by CE pin (C_{IN}=Ceramic 0.1\mu F) (D version)

- **R1182x401x**
  - C_{OUT}=0.1\mu F, V_{IN}=6.0V, I_{OUT}=30mA
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage.

- **R1182x401x**
  - C_{OUT}=1\mu F, V_{IN}=6.0V, I_{OUT}=30mA
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage.

- **R1182x121D**
  - C_{OUT}=0.1\mu F, V_{IN}=3.3V
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage for I_{OUT}=1mA and I_{OUT}=30mA.

- **R1182x121D**
  - C_{OUT}=1\mu F, V_{IN}=3.3V
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage for I_{OUT}=1mA and I_{OUT}=30mA.

- **R1182x281D**
  - C_{OUT}=0.1\mu F, V_{IN}=3.3V
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage for I_{OUT}=1mA and I_{OUT}=30mA.

- **R1182x281D**
  - C_{OUT}=1\mu F, V_{IN}=3.3V
  - Graph showing CE Input Voltage vs. Time (\mu s) and Output Voltage vs. CE Input Voltage for I_{OUT}=1mA and I_{OUT}=30mA.
R1182x401D

C<sub>OUT</sub>=0.1μF, V<sub>IN</sub>=6.0V

- Output Voltage: 0V to 4V
- CE Input Voltage: 0V to 5V
- Time t (μs): 0 to 180

R1182x401D

C<sub>OUT</sub>=1μF, V<sub>IN</sub>=6.0V

- Output Voltage: 0V to 4V
- CE Input Voltage: 0V to 5V
- Time t (μs): 0 to 800

I<sub>OUT</sub>=1mA, I<sub>OUT</sub>=30mA
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For the conservation of the global environment, Ricoh is advancing the decrease of the negative environmental impact material.
After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive. Basically after Apr. 1, 2012, we will ship out the Power Management ICs of the Halogen Free products only. (Ricoh Halogen Free products are also Antimony Free.)

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