

## 150mA VOLTAGE REGULATOR (Wide Input Voltage Range)

NO.EA-152-111026

### OUTLINE

The R1514x series are CMOS-based positive voltage regulator (VR) ICs featuring 150mA output current. The R1514xxxxB has features of high input voltage and ultra-low supply current. A peak current limit circuit, a short current limit circuit, and a thermal shutdown circuit are built in the R1514x series.

The operating temperature is  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  and the maximum input voltage is 36V, the R1514x series are very suitable for power source of car accessories.

The regulator output voltage is fixed in the R1514xxxxB and can be selected with a step of 0.1V in the range of 2.0V to 12.0V. Output voltage accuracy is  $\pm 2\%$ .

The packages for these ICs are the SOT-89-5 for space saving and the HSOP-6J for higher power applications.

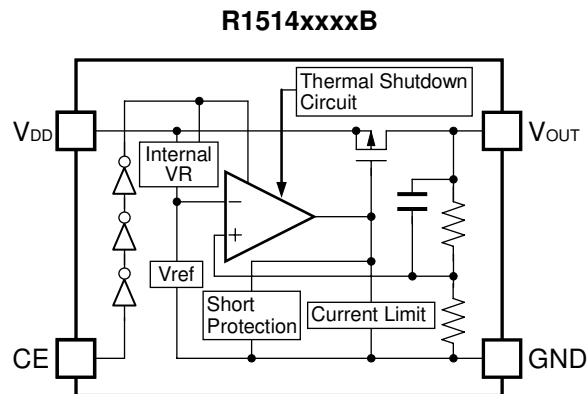
### FEATURES

- Input Voltage ..... Max. 36V
- Supply Current ..... Typ.  $9\mu\text{A}$
- Standby Current ..... Typ.  $0.1\mu\text{A}$
- Temperature-Drift Coefficient of Output Voltage ... Typ.  $\pm 100\text{ppm}/^{\circ}\text{C}$
- Output Current ..... Min. 150mA ( $V_{\text{IN}}=V_{\text{OUT}}+3.0\text{V}$ ; R1514x050B)
- Line Regulation ..... Typ. 0.05%/V
- Output Voltage Accuracy.....  $\pm 2\%$
- Output Voltage Range..... 2.0V to 12.0V (0.1V steps)  
(For other voltages, please refer to MARK INFORMATIONS.)
- Packages ..... SOT-89-5, HSOP-6J
- Built-in Peak Current Limit Circuit
- Built-in Short Current Limit Circuit
- Built-in Thermal Shutdown Circuit
- Operating Temperature .....  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$

### APPLICATIONS

- Power source for home appliances such as refrigerators, rice cookers, electric water warmers, etc.
- Power source for car audio equipment, car navigation system, ETC system, etc.
- Power source for notebook PCs, digital TVs, cordless phones, and private LAN system, etc.
- Power source for office equipment machines such as copiers, printers, facsimiles, scanners, projectors, etc.

## BLOCK DIAGRAM



## SELECTION GUIDE

The output voltage, package for the ICs can be selected at the user's request.

| Product Name     | Package  | Quantity per Reel | Pb Free | Halogen Free |
|------------------|----------|-------------------|---------|--------------|
| R1514HxxxB-T1-FE | SOT-89-5 | 1,000 pcs         | Yes     | Yes          |
| R1514SxxxB-E2-FE | HSOP-6J  | 1,000 pcs         | Yes     | Yes          |

xxx : The output voltage can be designated in the range of 2.0V(020) to 12.0V(120) in 0.1V steps.  
(For other voltages, please refer to MARK INFORMATIONS.)

## PIN CONFIGURATIONS



## PIN DESCRIPTIONS

### • SOT-89-5

| Pin No. | Symbol    | Description                  |
|---------|-----------|------------------------------|
| 1       | $V_{OUT}$ | Output Pin                   |
| 2       | GND*      | Ground Pin                   |
| 3       | CE        | Chip Enable Pin ("H" Active) |
| 4       | GND*      | Ground Pin                   |
| 5       | $V_{DD}$  | Input Pin                    |

\*) The GND pin must be wired together when it is mounted on board.

### • HSOP-6J

| Pin No. | Symbol    | Description                  |
|---------|-----------|------------------------------|
| 1       | $V_{OUT}$ | Output Pin                   |
| 2       | GND*      | Ground Pin                   |
| 3       | CE        | Chip Enable Pin ("H" Active) |
| 4       | GND*      | Ground Pin                   |
| 5       | GND*      | Ground Pin                   |
| 6       | $V_{DD}$  | Input Pin                    |

\*) The GND pin must be wired together when it is mounted on board.

## ABSOLUTE MAXIMUM RATINGS

| Symbol    | Item                            | Rating                       | Unit |
|-----------|---------------------------------|------------------------------|------|
| $V_{IN}$  | Input Voltage                   | -0.3 to 50                   | V    |
| $V_{IN}$  | Peak Input Voltage *1           | 60                           | V    |
| $V_{CE}$  | Input Voltage (CE Pin)          | -0.3 to $V_{IN}+0.3 \leq 50$ | V    |
| $V_{OUT}$ | Output Voltage                  | -0.3 to $V_{IN}+0.3 \leq 50$ | V    |
| $I_{OUT}$ | Output Current                  | 250                          | mA   |
| $P_D$     | Power Dissipation (SOT-89-5) *2 | 900                          | mW   |
|           | Power Dissipation (HSOP-6J) *2  | 1700                         |      |
| $T_{opt}$ | Operating Temperature Range     | -40 to 105                   | °C   |
| $T_{stg}$ | Storage Temperature Range       | -55 to 125                   | °C   |

\*1) Duration time=200ms

\*2) 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

### • R1514xxxxB

T<sub>opt</sub>=25°C

| Symbol                               | Item                                   | Conditions   | Min.                         | Typ. | Max.            | Unit   |
|--------------------------------------|--|--|------------------------------|------|-----------------|--------|
| V <sub>IN</sub>                      | Input Voltage                          |  | 4                            |      | 36              | V      |
| I <sub>SS</sub>                      | Supply Current                         | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V, I <sub>OUT</sub> =0mA                                     |                              | 9    | 20              | μA     |
| I <sub>standby</sub>                 | Standby Current                        | V <sub>IN</sub> =36V, V <sub>CE</sub> =0V  |                              | 0.1  | 1.0             | μA     |
| V <sub>OUT</sub>                     | Output Voltage                         | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V, I <sub>OUT</sub> =1mA                                     | ×0.98                        |      | ×1.02           | V      |
| I <sub>OUT</sub>                     | Output Current                         | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V  | Refer to the following table |      |                 |        |
| ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub> | Load Regulation                        | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V,<br>1mA ≤ I <sub>OUT</sub> ≤ 40mA                          | Refer to the following table |      |                 |        |
| ΔV <sub>OUT</sub> /ΔV <sub>IN</sub>  | Line Regulation                        | V <sub>OUT</sub> +1.5V ≤ V <sub>IN</sub> ≤ 36V, I <sub>OUT</sub> =1mA                              |                              | 0.05 | 0.20            | %/V    |
| V <sub>DIF</sub>                     | Dropout Voltage                        | I <sub>OUT</sub> =20mA   | Refer to the following table |      |                 |        |
| ΔV <sub>OUT</sub> /ΔT <sub>opt</sub> | Output Voltage Temperature Coefficient | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V, I <sub>OUT</sub> =1mA<br>−40°C ≤ T <sub>opt</sub> ≤ 105°C |                              | ±100 |                 | ppm/°C |
| I <sub>SC</sub>                      | Short Current Limit                    | V <sub>OUT</sub> =0V   |                              | 50   |                 | mA     |
| V <sub>CEH</sub>                     | CE Input Voltage "H"                   |  | 1.5                          |      | V <sub>IN</sub> | V      |
| V <sub>CEL</sub>                     | CE Input Voltage "L"                   |  | 0                            |      | 0.3             | V      |
| T <sub>TSD</sub>                     | Thermal Shutdown Temperature           | Junction Temperature   |                              | 150  |                 | °C     |
| T <sub>TSR</sub>                     | Thermal Shutdown Released Temperature  | Junction Temperature   |                              | 125  |                 | °C     |

### • Output Current by Output Voltage

T<sub>opt</sub>=25°C

| Output Voltage<br>V <sub>OUT</sub> (V) | Output Current I <sub>OUT</sub> (mA)    |      |
|--|---|------|
|  | Conditions                              | Min. |
| 2.0 ≤ V <sub>OUT</sub> < 3.0           | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V | 100  |
| 3.0 ≤ V <sub>OUT</sub> < 5.0           |   | 120  |
| 5.0 ≤ V <sub>OUT</sub> ≤ 12.0          |   | 150  |

### • Load Regulation by Output Voltage

T<sub>opt</sub>=25°C

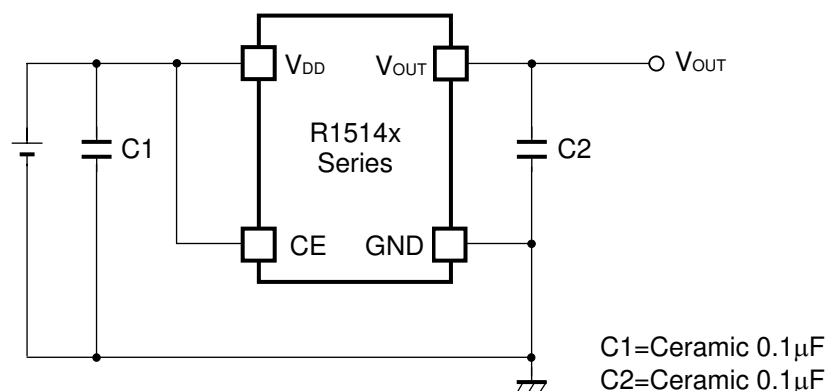
| Output Voltage<br>V <sub>OUT</sub> (V) | Load Regulation ΔV <sub>OUT</sub> /ΔI <sub>OUT</sub> (mV) |      |      |
|--|---|------|------|
|  | Conditions  | Typ. | Max. |
| 2.0 ≤ V <sub>OUT</sub> < 5.0           | V <sub>IN</sub> =V <sub>OUT</sub> +3.0V                   | 10   | 25   |
| 5.0 ≤ V <sub>OUT</sub> ≤ 12.0          | 1mA ≤ I <sub>OUT</sub> ≤ 40mA                             | 20   | 35   |

### • Dropout Voltage by Output Voltage

T<sub>opt</sub>=25°C

| Output Voltage<br>V <sub>OUT</sub> (V) | Dropout Voltage V <sub>DIF</sub> (V) |      |      |      |
|--|--------------------------------------|------|------|------|
|  | Conditions                           | Typ. | Max. |      |
| V <sub>OUT</sub> =2.0                  | I <sub>OUT</sub> =20mA               |      | 2.0  |      |
| V <sub>OUT</sub> =2.1                  |                                      |      | 1.9  |      |
| V <sub>OUT</sub> =2.2                  |                                      |      | 1.8  |      |
| V <sub>OUT</sub> =2.3                  |                                      |      | 1.7  |      |
| V <sub>OUT</sub> =2.4                  |                                      |      | 1.6  |      |
| V <sub>OUT</sub> =2.5                  |                                      |      | 1.5  |      |
| V <sub>OUT</sub> =2.6                  |                                      |      | 1.4  |      |
| V <sub>OUT</sub> =2.7                  |                                      |      | 1.3  |      |
| V <sub>OUT</sub> =2.8                  |                                      |      | 1.2  |      |
| V <sub>OUT</sub> =2.9                  |                                      |      | 1.1  |      |
| V <sub>OUT</sub> =3.0                  |                                      |      | 1.0  |      |
| V <sub>OUT</sub> =3.1                  |                                      |      | 0.9  |      |
| V <sub>OUT</sub> =3.2                  |                                      |      | 0.8  |      |
| V <sub>OUT</sub> =3.3                  |                                      |      | 0.7  |      |
| V <sub>OUT</sub> =3.4                  |                                      |      | 0.6  |      |
| V <sub>OUT</sub> =3.5                  |                                      |      | 0.5  |      |
| V <sub>OUT</sub> =3.6                  |                                      |      | 0.4  |      |
| 3.7 ≤ V <sub>OUT</sub> < 4.0           |                                      |      | 0.35 | 0.60 |
| 4.0 ≤ V <sub>OUT</sub> < 5.0           |                                      |      | 0.25 | 0.40 |
| 5.0 ≤ V <sub>OUT</sub> ≤ 12.0          |                                      |      | 0.20 | 0.35 |

## TYPICAL APPLICATION



## TECHNICAL NOTES

When using these ICs, consider the following points:

### Phase Compensation

Phase Compensation of the R1514x Series has been made internally for stable operation even though the load current would vary. Therefore, without the capacitors, C1 and C2, the output voltage is regulated, however, for more stable operation, use capacitors as C1 and C2. Especially, if the input line is long and impedance is high, C1 is necessary. Moreover, if you use rather large C2, transient response will be improved. Recommended value is in the range from 0.1µF to 10µF. Wiring should be made as short as possible.

Connect the capacitor, C1 between V<sub>DD</sub> pin and GND pin and C2 between V<sub>OUT</sub> and GND as close as possible.

### GND wiring of mounting on board

No.2 pin and No.4 pin of SOT-89-5 package must be wired to the GND plane. No.2 pin, No.4 pin and No.5 pin of HSOP-6J package must be wired to the GND plane when it is mounted on board.

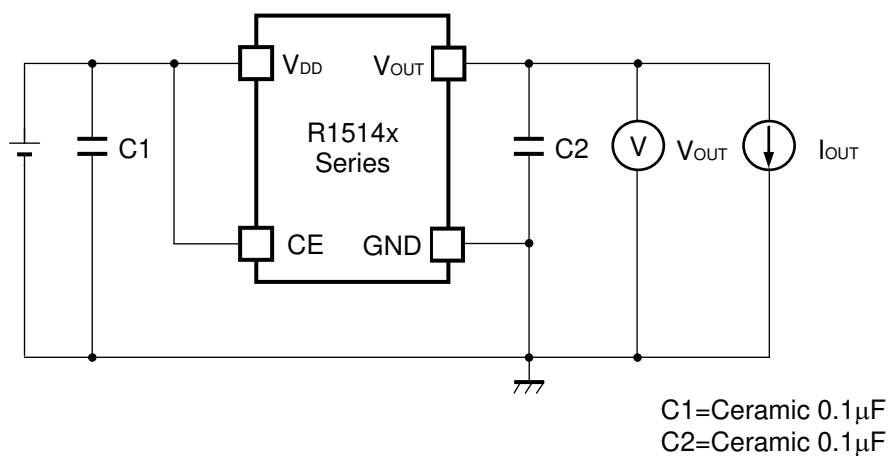
### Thermal Shutdown

Thermal shutdown function is included in the R1514x Series, if the junction temperature is equal or more than +150°C(Typ.), the operation of regulator would stop. After that, when the junction temperature is equal or less than +125°C(Typ.), the operation of regulator would restart. Unless the cause of rising temperature would remove, the regulator repeats on and off, and output waveform would be like consecutive pulses.

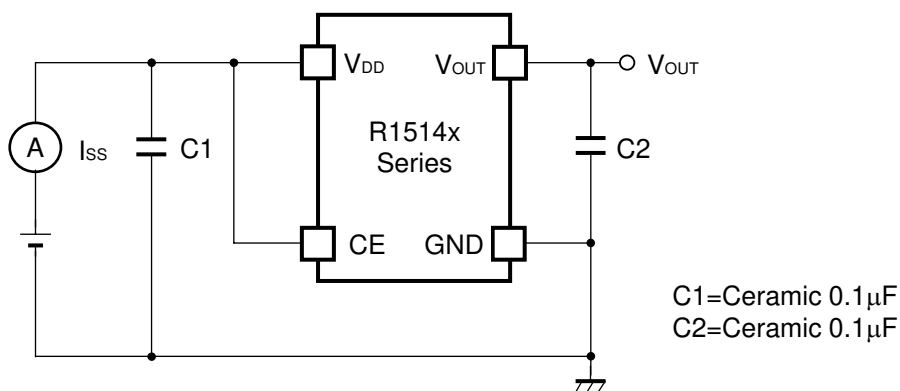
### Chip Enable Circuit

Do not make voltage level of chip enable pin keep floating level, or in between V<sub>CEH</sub> and V<sub>CEL</sub>. Otherwise, the output voltage would be unstable or indefinite, or unexpected current would flow internally.

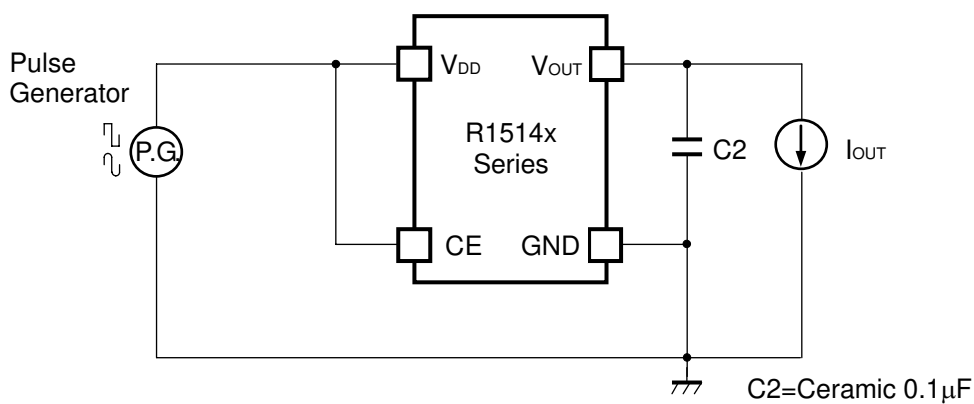
## TEST CIRCUITS



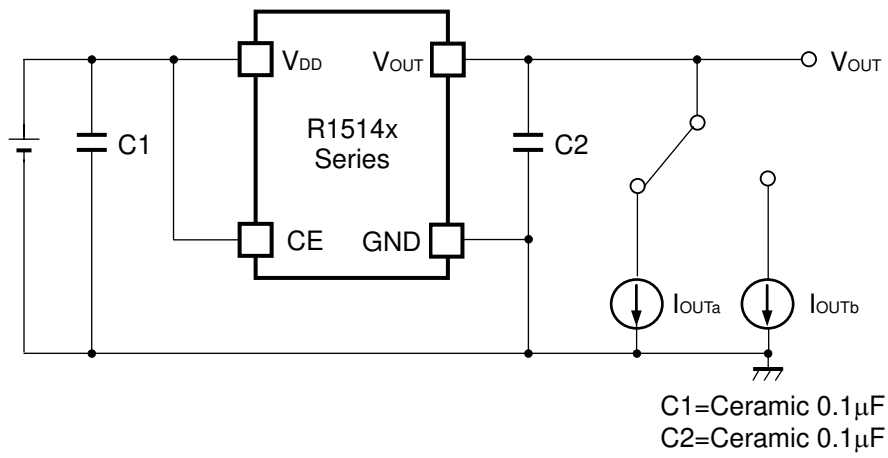
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Line Transient Response



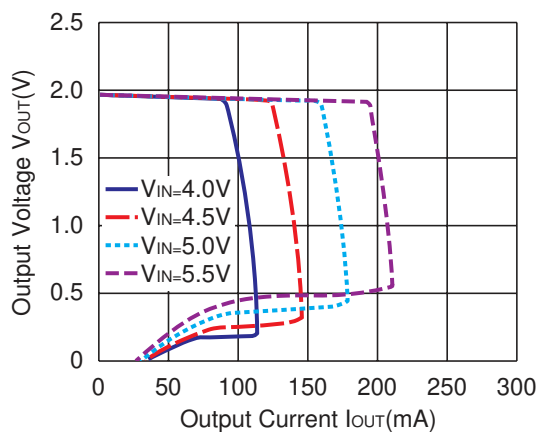
**Test Circuit for Load Transient Response**



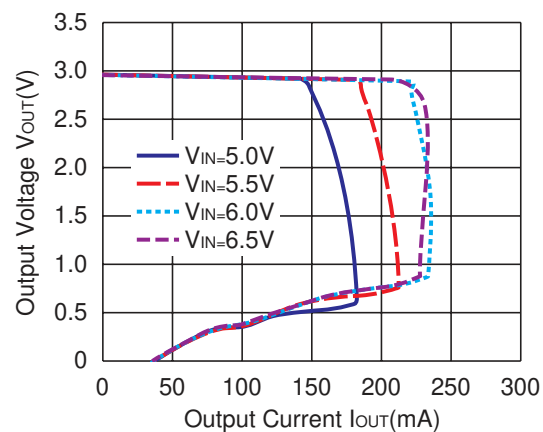
## TYPICAL CHARACTERISTICS

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

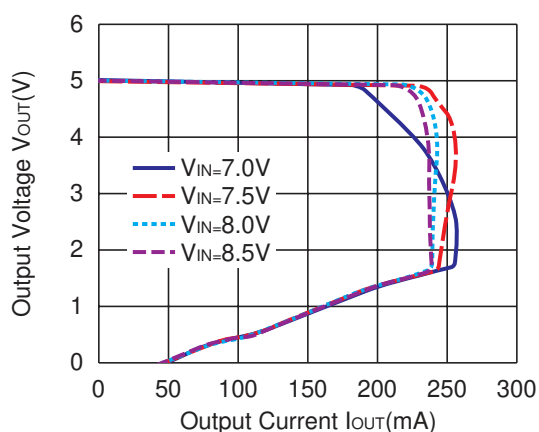
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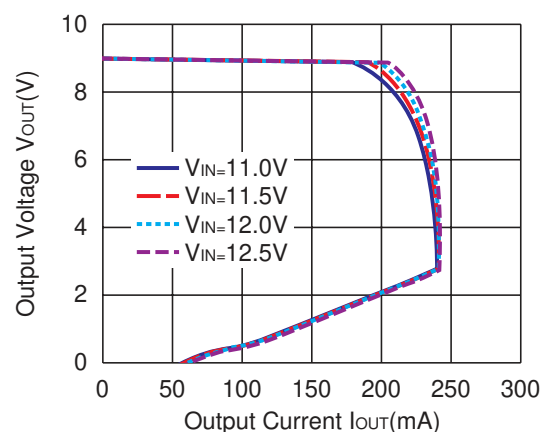
R1514x030B



R1514x050B

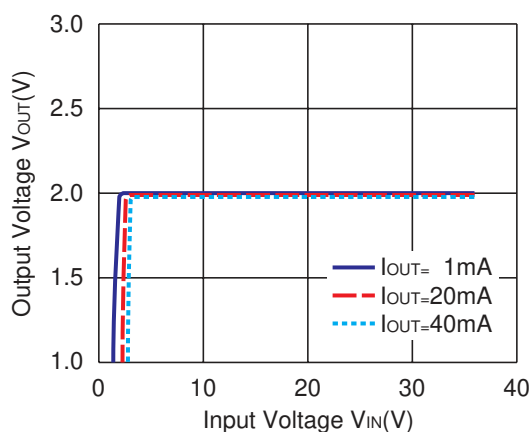


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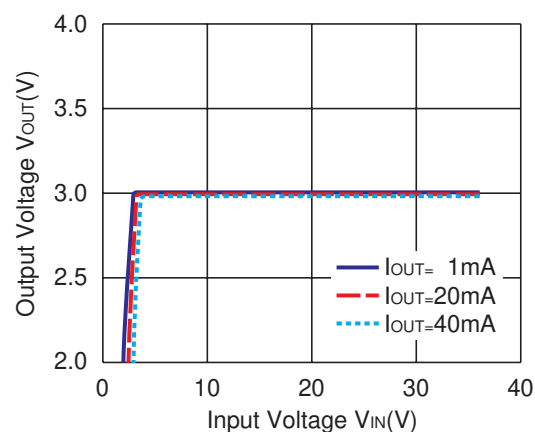


### 2) Output Voltage vs. Input Voltage ( $T_{opt}=25^{\circ}\text{C}$ )

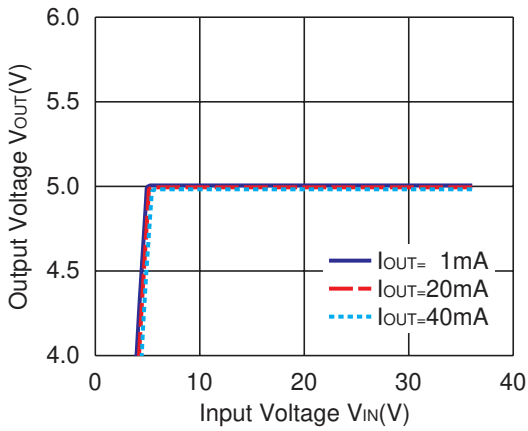
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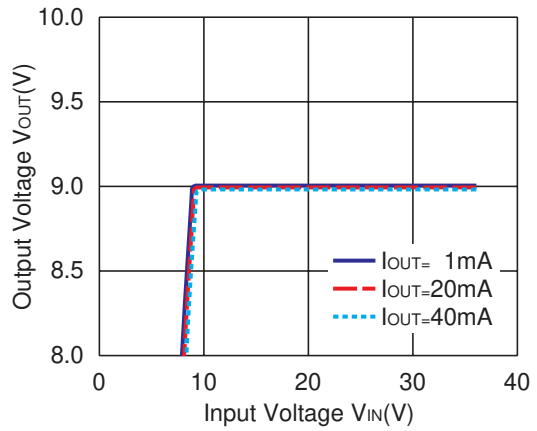
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R1514x050B

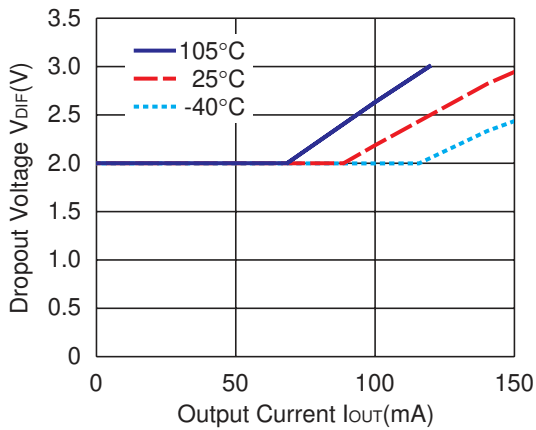


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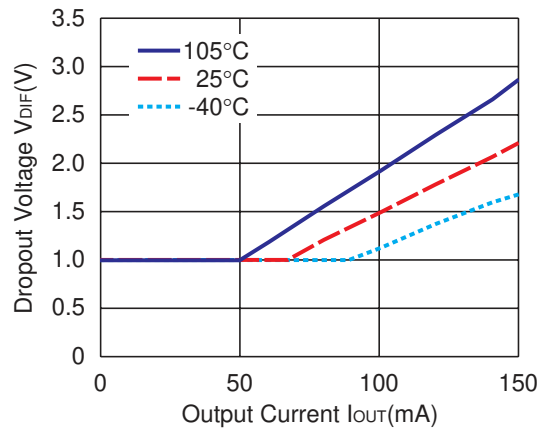


3) Dropout Voltage vs. Output Current

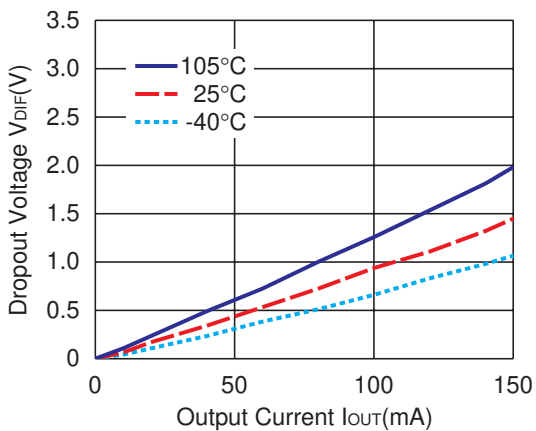
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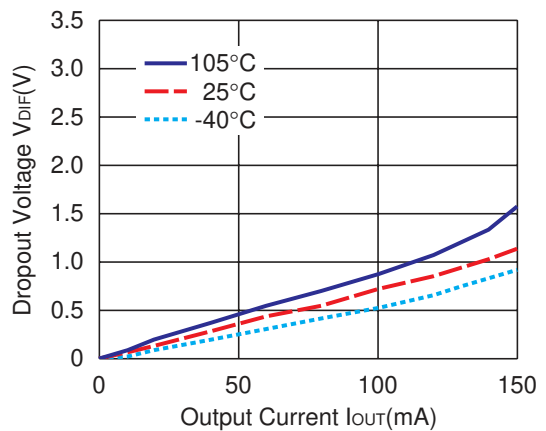
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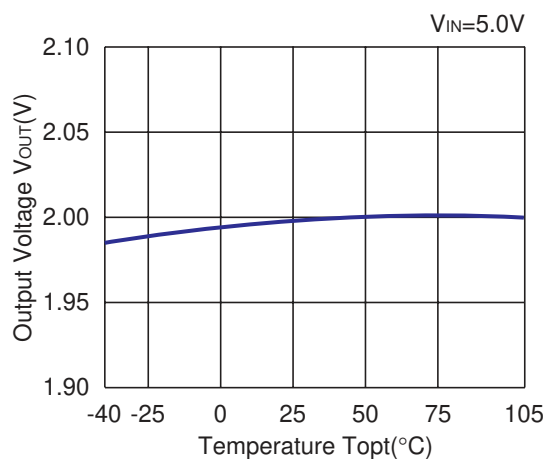


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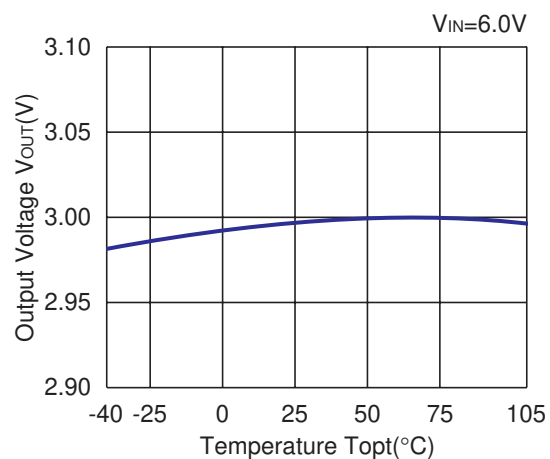


## 4) Output Voltage vs. Temperature

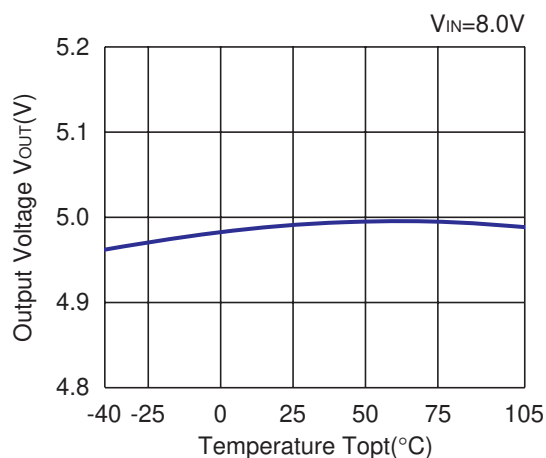
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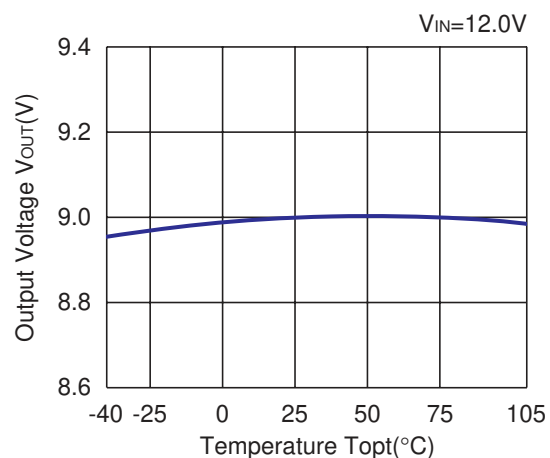
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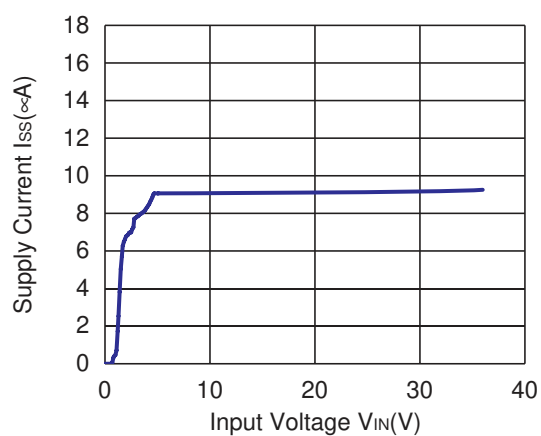
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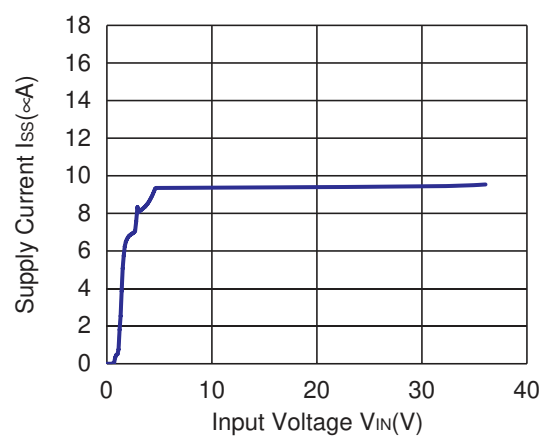
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5) Supply Current vs. Input Voltage ( $T_{opt}=25^{\circ}C$ )

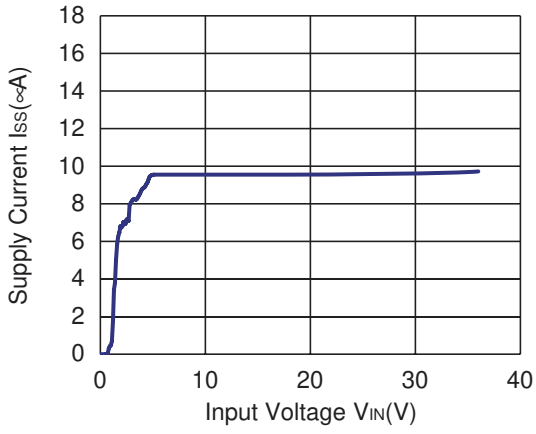
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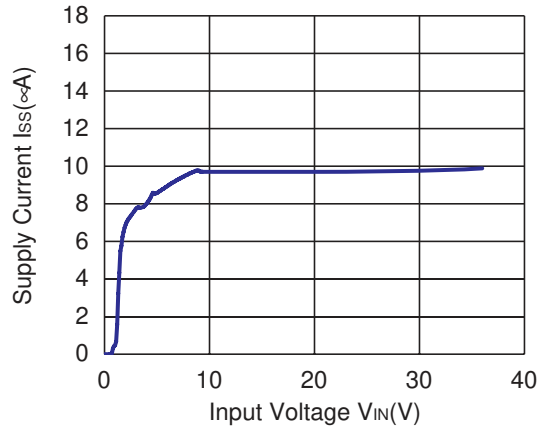
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**R1514x050B**

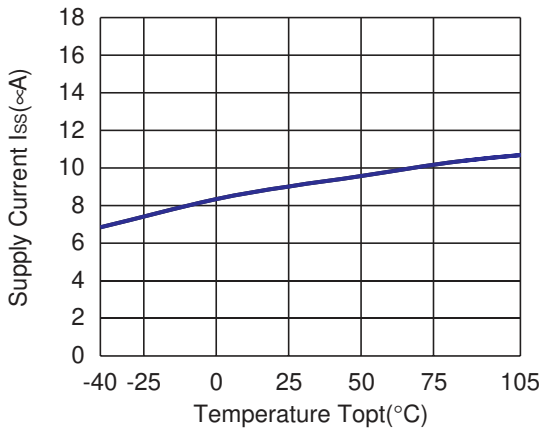


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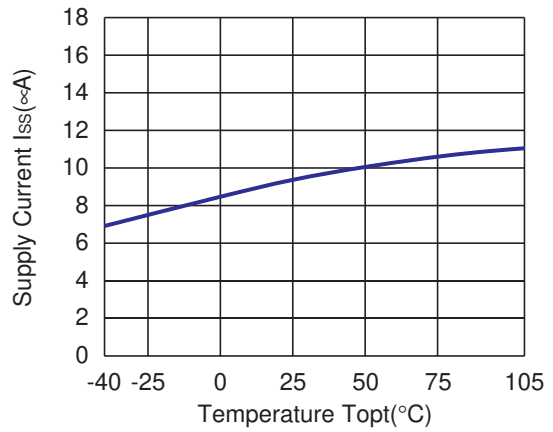


**6) Supply Current vs. Temperature**

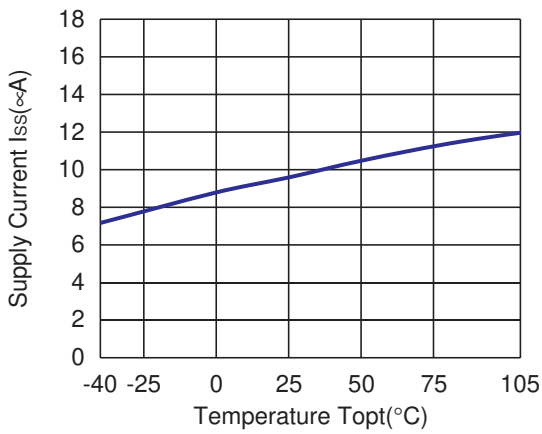
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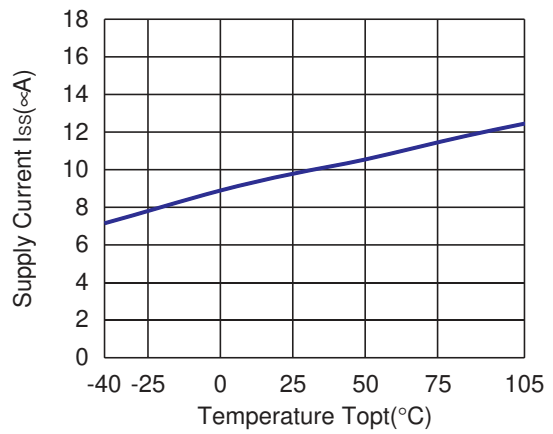
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**R1514x050B**

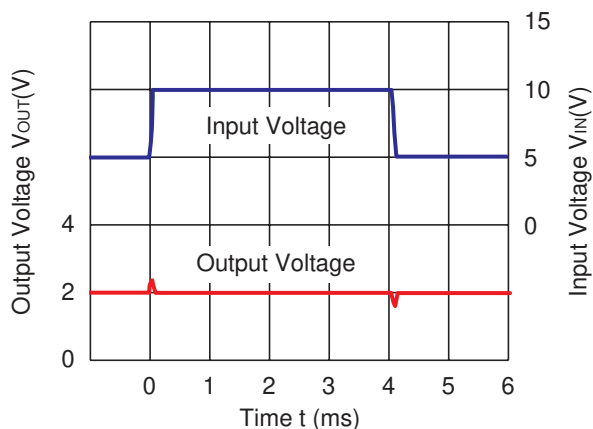


**R1514x090B**

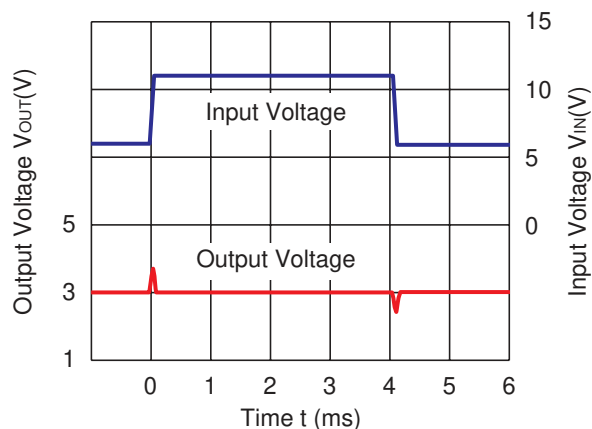


7) Input Transient Response ( $I_{OUT}=1mA$ ,  $t_r=t_f=50\mu s$ ,  $C_2=Ceramic\ 0.1\mu F$ ,  $T_{opt}=25^\circ C$ )

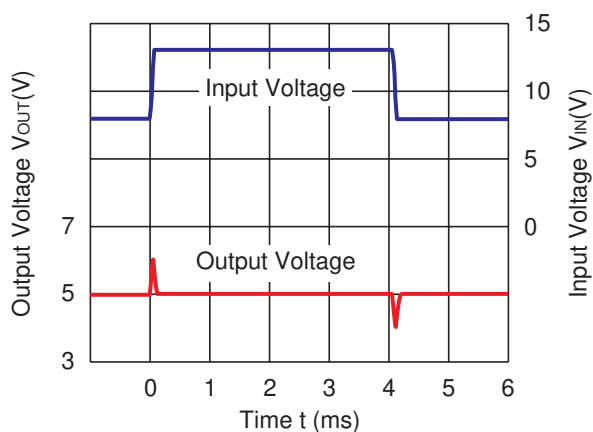
R1514x020B



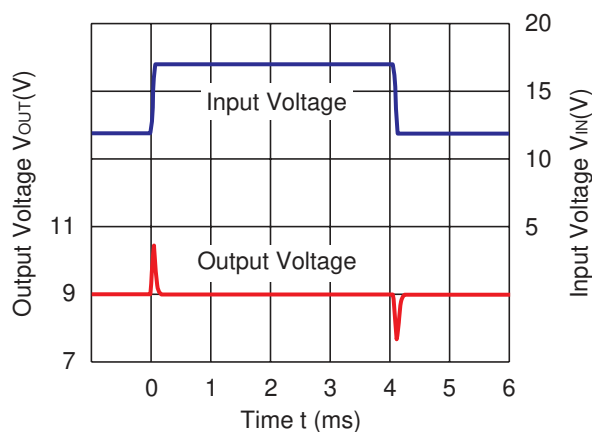
R1514x030B



R1514x050B



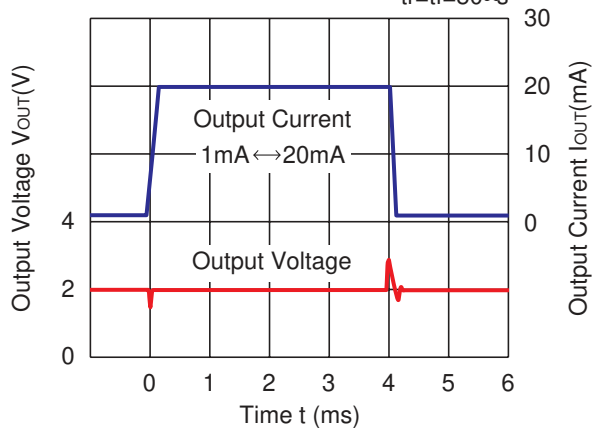
R1514x090B



8) Load Transient Response ( $C_2=Ceramic\ 0.1\mu F$ ,  $T_{opt}=25^\circ C$ )

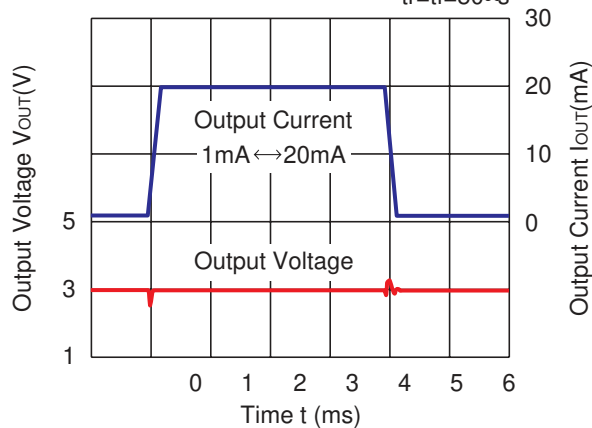
R1514x020B

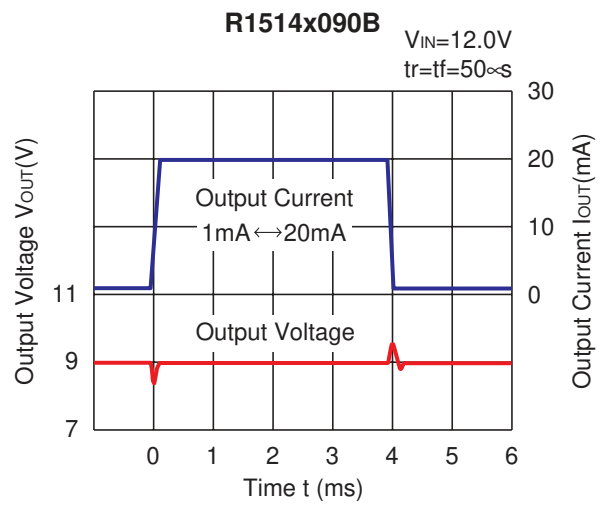
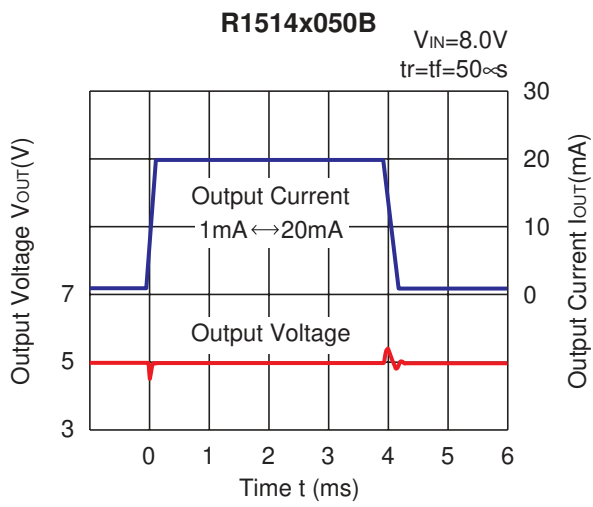
$V_{IN}=5.0V$   
 $t_r=t_f=50\mu s$



R1514x030B

$V_{IN}=6.0V$   
 $t_r=t_f=50\mu s$







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7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
11. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.



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