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### 150 mA Low Voltage Dual-Channel LDO Regulator with Sequence Control

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NO.EA-200-160707

#### OUTLINE

The RP152x is a 150 mA dual-channel LDO regulator that provides high ripple rejection, low dropout voltage, high output voltage accuracy, and low supply current. Internally, the RP152x consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a short current limit circuit, and a chip enable circuit. Moreover, the RP152xxxxC consists of a start-up sequence circuit.

The RP152x is available in fixed output voltage options. Besides the low supply current by CMOS, the RP152x offers a low dropout voltage by built-in low ON resistance  $r_{ON}$  as well as an extended battery life by a chip enable function. Compared with the existing CMOS-based regulators, the RP152x is further improved in ripple rejection, line transient response, and load transient response. All these features allow the RP152x to become ideal power sources for hand-held communication equipment.

The RP152x is offered in a 6-pin SOT-23-6 package and a 6-pin DFN1212-6 package. Both packages are equipped with two LDOs which can achieve high-density mounting.

#### FEATURES

- Supply Current ..... Typ. 40  $\mu$ A x 2
- Standby Current ..... Typ. 0.1  $\mu$ A x 2
- Ripple Rejection ..... Typ. 70 dB, f = 1 kHz
- Input Voltage Range ..... 1.4 V to 5.25 V
- Output Voltage Range ..... 0.8 V to 3.6 V, 0.1 V step
- Output Voltage Accuracy .....  $\pm 1.0\%$ ,  $V_{SET} > 2.0$  V,  $T_a = 25^\circ\text{C}$
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 80$  ppm/ $^\circ\text{C}$
- Dropout Voltage ..... Typ. 0.20 V,  $I_{OUT} = 150$  mA,  $V_{SET} = 2.8$  V
- Line Regulation ..... Typ. 0.02%/V
- Packages ..... DFN1212-6, SOT-23-6
- Short-current Limit ..... Typ. 40 mA
- Ceramic Capacitor Compatible ..... 0.22  $\mu$ F or more

#### APPLICATIONS

- Battery-powered Equipment
- Portable Communication Equipment, Cameras
- Home Electrical Appliances

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## RP152x

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### SELECTION GUIDE

The set output voltage, the package type, the auto-discharge function<sup>1</sup> and the start-up sequence control are user-selectable options.

#### Selection Guide

| Product Name     | Package   | Quantity per Reel | Pb Free | Halogen Free |
|------------------|-----------|-------------------|---------|--------------|
| RP152Lxxx*-TR    | DFN1212-6 | 5,000 pcs         | Yes     | Yes          |
| RP152Nxxx*-TR-FE | SOT-23-6  | 3,000 pcs         | Yes     | Yes          |

xxx: Specify the combination of set output voltage ( $V_{SET}$ ) within the range of 0.8 V to 3.6 V in 0.1 V step.

\*: Specify the auto-discharge function and the start-up sequence control.

(A) Auto-discharge function not included

(B) Auto-discharge function included

(C) Start-up sequence control and Auto-discharge function included

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<sup>1</sup> Auto-discharge function quickly lowers the output voltage to 0 V by releasing the electrical charge accumulated in the external capacitor when the chip enable signal is switched from the active mode to the standby mode.

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**BLOCK DIAGRAMS**



**RP152xxxxA Block Diagram**



**RP152xxxxB Block Diagram**



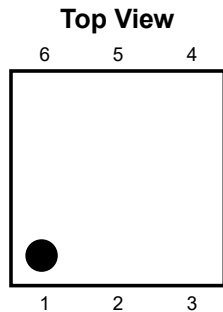
**RP152xxxxC Block Diagram**

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**RP152x**

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**PIN DESCRIPTIONS****DFN1212-6 Pin Configuration****SOT-23-6 Pin Configuration****DFN1212-6 Pin Description**

| Pin No. | Symbol | Description                    |
|---------|--------|--------------------------------|
| 1       | VOUT1  | Output Pin 1                   |
| 2       | VOUT2  | Output Pin2                    |
| 3       | GND    | Ground Pin                     |
| 4       | CE2    | Chip Enable Pin 2, Active-high |
| 5       | VDD    | Input Pin                      |
| 6       | CE1    | Chip Enable Pin 1, Active-high |

\* The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left floating.

**SOT-23-6 Pin Description**

| Pin No. | Symbol | Description                    |
|---------|--------|--------------------------------|
| 1       | CE1    | Chip Enable Pin 1, Active-high |
| 2       | VDD    | Input Pin                      |
| 3       | CE2    | Chip Enable Pin 2, Active-high |
| 4       | VOUT2  | Output Pin2                    |
| 5       | GND    | Ground Pin                     |
| 6       | VOUT1  | Output Pin 1                   |

## ABSOLUTE MAXIMUM RATINGS

### Absolute Maximum Ratings

| Symbol                   | Item   | Rating               | Unit |    |
|--------------------------|--|----------------------|------|----|
| $V_{IN}$                 | Input Voltage  | -0.3 to 6.0          | V    |    |
| $V_{CE}$                 | CE Pin Input Voltage                                   | -0.3 to 6.0          | V    |    |
| $V_{OUT1}$<br>$V_{OUT2}$ | Output Voltage   | -0.3 to $V_{IN}+0.3$ | V    |    |
| $I_{OUT1}$<br>$I_{OUT2}$ | Output Current   | 180                  | mA   |    |
| $P_D$                    | Power Dissipation (Standard Land Pattern) <sup>1</sup> | DFN1212-6            | 600  | mW |
|                          |  | SOT-23-6             | 420  |    |
| $T_j$                    | Junction Temperature                                   | -40 to 125           | °C   |    |
| $T_{stg}$                | Storage Temperature Range                              | -55 to 125           | °C   |    |

#### 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

### Recommended Operating Conditions

| Symbol   | Item                        | Rating       | Unit |
|----------|-----------------------------|--------------|------|
| $V_{IN}$ | Input Voltage <sup>2</sup>  | 1.40 to 5.25 | V    |
| $T_a$    | Operating Temperature Range | -40 to 85    | °C   |

#### RECOMMENDED OPERATING CONDITIONS

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.

<sup>1</sup> Refer to *POWER DISSIPATION* in *SUPPLEMENTARY ITEMS* for detailed information.

<sup>2</sup> In case of operating the device beyond 5.25 V, do not exceed 5.5 V with 500 total operating hours.

## RP152x

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## ELECTRICAL CHARACTERISTICS

$V_{IN} = V_{SET} + 1.0 \text{ V}$  ( $V_{SET} > 1.5 \text{ V}$ ),  $V_{IN} = 2.5 \text{ V}$  ( $V_{SET} \leq 1.5 \text{ V}$ ),  $I_{OUT} = 1 \text{ mA}$ ,  $C_{IN} = C_{OUT} = 0.22 \mu\text{F}$ , unless otherwise noted.

The specifications surrounded by   are guaranteed by Design Engineering at  $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ .

### RP152x Electrical Characteristics

( $T_a = 25^\circ\text{C}$ )

| Symbol                                  | Item  | Conditions  |   | Min.  | Typ.     | Max.  | Unit                  |
|---|---|---|---|---|----------|---|-----------------------|
| $V_{OUT}$                               | Output Voltage                                  | $T_a = 25^\circ\text{C}$  | $V_{SET} > 2.0 \text{ V}$   | $\times 0.99$   |          | $\times 1.01$   | V                     |
|   |   |   | $V_{SET} \leq 2.0 \text{ V}$                                      | -20   |          | 20  | mV                    |
|   |   | $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$  | $V_{SET} > 2.0 \text{ V}$   | <span style="border: 1px solid black; padding: 0 2px;">×0.97</span> |          | <span style="border: 1px solid black; padding: 0 2px;">×1.03</span> | V                     |
|   |   |   | $V_{SET} \leq 2.0 \text{ V}$                                      | <span style="border: 1px solid black; padding: 0 2px;">-60</span>   |          | <span style="border: 1px solid black; padding: 0 2px;">60</span>    | mV                    |
| $I_{OUT}$                               | Output Current                                  |   | <span style="border: 1px solid black; padding: 0 2px;">150</span> |   |          | mA  |                       |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Load Regulation                                 | $1 \text{ mA} \leq I_{OUT} \leq 150 \text{ mA}$   |   | <b>Refer to Product-specific Electrical Characteristics</b>         |          |   |                       |
| $V_{DIF}$                               | Dropout Voltage                                 | $I_{OUT} = 150 \text{ mA}$  |   |   |          |   |                       |
| $I_{SS}$                                | Supply Current                                  | $I_{OUT} = 0 \text{ mA}$  |   |   | 40       | <span style="border: 1px solid black; padding: 0 2px;">60</span>    | $\mu\text{A}$         |
| Istandby                                | Standby Current                                 | $V_{CE} = 0 \text{ V}$  |   |   | 0.1      | 1.0   | $\mu\text{A}$         |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$  | Line Regulation                                 | $V_{SET} + 0.5 \text{ V} \leq V_{IN} \leq 5.0 \text{ V}$  |   |   | 0.02     | <span style="border: 1px solid black; padding: 0 2px;">0.10</span>  | %/V                   |
| RR                                      | Ripple Rejection                                | f = 1 kHz, Ripple 0.2 Vp-p<br>$V_{IN} = V_{SET} + 1.0 \text{ V}$ , $I_{OUT} = 30 \text{ mA}$<br>Notes: $V_{IN} = 3.0 \text{ V}$ when $V_{SET} \leq 2.0 \text{ V}$ |   |   | 70       |   | dB                    |
| $\frac{\Delta V_{OUT}}{\Delta T_a}$     | Output Voltage Temperature Coefficient          | $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$  |   |   | $\pm 80$ |   | ppm/ $^\circ\text{C}$ |
| $I_{SC}$                                | Short Current Limit                             | $V_{SET} = 0 \text{ V}$   |   |   | 40       |   | mA                    |
| $I_{PD}$                                | CE Pull-down Current                            |   |   |   | 0.3      |   | $\mu\text{A}$         |
| $V_{CEH}$                               | CE Input Voltage "H"                            |   |   | <span style="border: 1px solid black; padding: 0 2px;">1.0</span>   |          |   | V                     |
| $V_{CEL}$                               | CE Input Voltage "L"                            |   |   |   |          | <span style="border: 1px solid black; padding: 0 2px;">0.4</span>   | V                     |
| en                                      | Output Noise                                    | BW = 10 Hz to 100 kHz   |   |   | 60       |   | $\mu\text{Vrms}$      |
| $R_{LOW}$                               | Low Output Nch Tr. ON Resistance (RP152xxxxB/C) | $V_{IN} = 4.0 \text{ V}$ ,<br>$V_{CE} = 0 \text{ V}$  | RP152xxxxC (VR2)  |   | 10       |   | $\Omega$              |
|   |   |   | Others  |   | 50       |   |                       |

All test items listed under *ELECTRICAL CHARACTERISTICS* are done under the pulse load condition ( $T_j \approx T_a = 25^\circ\text{C}$ ) except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient.

Product-specific Electrical Characteristics VOUT1

| Product Name | V <sub>OUT1</sub> (Ta = 25°C) |       |       | V <sub>OUT1</sub> (-40°C ≤ Ta ≤ 85°C) |       |       | ΔV <sub>OUT1</sub> /ΔI <sub>OUT</sub> |      | V <sub>DIF1</sub> |       |
|--------------|-------------------------------|-------|-------|---------------------------------------|-------|-------|---------------------------------------|------|-------------------|-------|
|              | Min.                          | Typ.  | Max.  | Min.                                  | Typ.  | Max.  | Typ.                                  | Max. | Typ.              | Max.  |
| RP152x001x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x002x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                    | 55   | 0.270             | 0.460 |
| RP152x003x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x004x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                    | 50   | 0.390             | 0.620 |
| RP152x005x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x006x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x007x   | 2.822                         | 2.850 | 2.879 | 2.765                                 | 2.850 | 2.936 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x008x   | 2.822                         | 2.850 | 2.879 | 2.765                                 | 2.850 | 2.936 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x009x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x010x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x011x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                    | 55   | 0.270             | 0.460 |
| RP152x012x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x013x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x014x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x015x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x016x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x017x   | 2.475                         | 2.500 | 2.525 | 2.425                                 | 2.500 | 2.575 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x018x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                    | 55   | 0.270             | 0.460 |
| RP152x019x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x020x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x021x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                    | 50   | 0.390             | 0.620 |
| RP152x022x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x023x   | 2.475                         | 2.500 | 2.525 | 2.425                                 | 2.500 | 2.575 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x024x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x025x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x026x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x027x   | 2.277                         | 2.300 | 2.323 | 2.231                                 | 2.300 | 2.369 | 15                                    | 60   | 0.230             | 0.390 |
| RP152x028x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x029x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x030x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                    | 50   | 0.310             | 0.550 |
| RP152x031x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                    | 55   | 0.270             | 0.460 |
| RP152x032x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                    | 50   | 0.390             | 0.620 |
| RP152x033x   | 3.069                         | 3.100 | 3.131 | 3.007                                 | 3.100 | 3.193 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x034x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                    | 55   | 0.270             | 0.460 |
| RP152x035x   | 2.475                         | 2.500 | 2.525 | 2.425                                 | 2.500 | 2.575 | 15                                    | 60   | 0.200             | 0.350 |
| RP152x036x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                    | 50   | 0.390             | 0.620 |
| RP152x037x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                    | 60   | 0.190             | 0.320 |
| RP152x038x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                    | 50   | 0.390             | 0.620 |
| RP152x039x   | 2.079                         | 2.100 | 2.121 | 2.037                                 | 2.100 | 2.163 | 15                                    | 60   | 0.230             | 0.390 |
| RP152x040x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                    | 60   | 0.200             | 0.350 |

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**RP152x**

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NO.EA-200-160707

**Product-specific Electrical Characteristics VOUT1 (continued)**

| Product Name | V <sub>OUT1</sub> (T <sub>a</sub> = 25°C) |       |       | V <sub>OUT1</sub> (-40°C ≤ T <sub>a</sub> ≤ 85°C) |       |       | ΔV <sub>OUT1</sub> / ΔI <sub>OUT</sub> |      | V <sub>DIF1</sub> |       |
|--------------|---|-------|-------|---|-------|-------|--|------|-------------------|-------|
|              | Min.                                      | Typ.  | Max.  | Min.  | Typ.  | Max.  | Typ.                                   | Max. | Typ.              | Max.  |
| RP152x041x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x042x   | 1.180                                     | 1.200 | 1.220 | 1.140   | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x043x   | 1.280                                     | 1.300 | 1.320 | 1.240   | 1.300 | 1.360 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x044x   | 1.080                                     | 1.100 | 1.120 | 1.040   | 1.100 | 1.160 | 15                                     | 50   | 0.440             | 0.720 |
| RP152x045x   | 2.772                                     | 2.800 | 2.828 | 2.716   | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x046x   | 2.772                                     | 2.800 | 2.828 | 2.716   | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x047x   | 2.475                                     | 2.500 | 2.525 | 2.425   | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x048x   | 2.475                                     | 2.500 | 2.525 | 2.425   | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x049x   | 1.480                                     | 1.500 | 1.520 | 1.440   | 1.500 | 1.560 | 15                                     | 50   | 0.310             | 0.550 |
| RP152x050x   | 2.376                                     | 2.400 | 2.424 | 2.328   | 2.400 | 2.472 | 15                                     | 60   | 0.230             | 0.390 |
| RP152x051x   | 0.980                                     | 1.000 | 1.020 | 0.940   | 1.000 | 1.060 | 10                                     | 40   | 0.440             | 0.720 |
| RP152x052x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x053x   | 2.574                                     | 2.600 | 2.626 | 2.522   | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x054x   | 2.475                                     | 2.500 | 2.525 | 2.425   | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x055x   | 2.970                                     | 3.000 | 3.030 | 2.910   | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x056x   | 2.574                                     | 2.600 | 2.626 | 2.522   | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x057x   | 3.069                                     | 3.100 | 3.131 | 3.007   | 3.100 | 3.193 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x058x   | 0.880                                     | 0.900 | 0.920 | 0.840   | 0.900 | 0.960 | 10                                     | 40   | 0.500             | 0.800 |
| RP152x059x   | 2.871                                     | 2.900 | 2.929 | 2.813   | 2.900 | 2.987 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x060x   | 1.180                                     | 1.200 | 1.212 | 1.140   | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x061x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x062x   | 2.475                                     | 2.500 | 2.525 | 2.425   | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |



Product-specific Electrical Characteristics VOUT2

| Product Name | V <sub>OUT2</sub> (Ta = 25°C) |       |       | V <sub>OUT2</sub> (-40°C ≤ Ta ≤ 85°C) |       |       | ΔV <sub>OUT2</sub> / ΔI <sub>OUT</sub> |      | V <sub>DIF2</sub> |       |
|--------------|-------------------------------|-------|-------|---------------------------------------|-------|-------|--|------|-------------------|-------|
|              | Min.                          | Typ.  | Max.  | Min.                                  | Typ.  | Max.  | Typ.                                   | Max. | Typ.              | Max.  |
| RP152x001x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x002x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x003x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x004x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x005x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x006x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x007x   | 2.822                         | 2.850 | 2.879 | 2.765                                 | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x008x   | 2.574                         | 2.600 | 2.626 | 2.522                                 | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x009x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x010x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x011x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                     | 50   | 0.310             | 0.550 |
| RP152x012x   | 2.574                         | 2.600 | 2.626 | 2.522                                 | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x013x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x014x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x015x   | 2.475                         | 2.500 | 2.525 | 2.425                                 | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x016x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x017x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x018x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x019x   | 2.574                         | 2.600 | 2.626 | 2.522                                 | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x020x   | 1.780                         | 1.800 | 1.820 | 1.740                                 | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x021x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x022x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x023x   | 2.475                         | 2.500 | 2.525 | 2.425                                 | 2.500 | 2.575 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x024x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x025x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x026x   | 3.069                         | 3.100 | 3.131 | 3.007                                 | 3.100 | 3.193 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x027x   | 2.772                         | 2.800 | 2.828 | 2.716                                 | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x028x   | 0.980                         | 1.000 | 1.020 | 0.940                                 | 1.000 | 1.060 | 10                                     | 40   | 0.440             | 0.720 |
| RP152x029x   | 1.480                         | 1.500 | 1.520 | 1.440                                 | 1.500 | 1.560 | 15                                     | 50   | 0.310             | 0.550 |
| RP152x030x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x031x   | 2.673                         | 2.700 | 2.727 | 2.619                                 | 2.700 | 2.781 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x032x   | 2.970                         | 3.000 | 3.030 | 2.910                                 | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x033x   | 3.069                         | 3.100 | 3.131 | 3.007                                 | 3.100 | 3.193 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x034x   | 2.574                         | 2.600 | 2.626 | 2.522                                 | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x035x   | 1.180                         | 1.200 | 1.220 | 1.140                                 | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x036x   | 2.871                         | 2.900 | 2.929 | 2.813                                 | 2.900 | 2.987 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x037x   | 1.980                         | 2.000 | 2.020 | 1.940                                 | 2.000 | 2.060 | 15                                     | 60   | 0.270             | 0.460 |
| RP152x038x   | 2.822                         | 2.850 | 2.879 | 2.765                                 | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x039x   | 3.267                         | 3.300 | 3.333 | 3.201                                 | 3.300 | 3.399 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x040x   | 2.822                         | 2.850 | 2.879 | 2.765                                 | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |

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**RP152x**

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NO.EA-200-160707

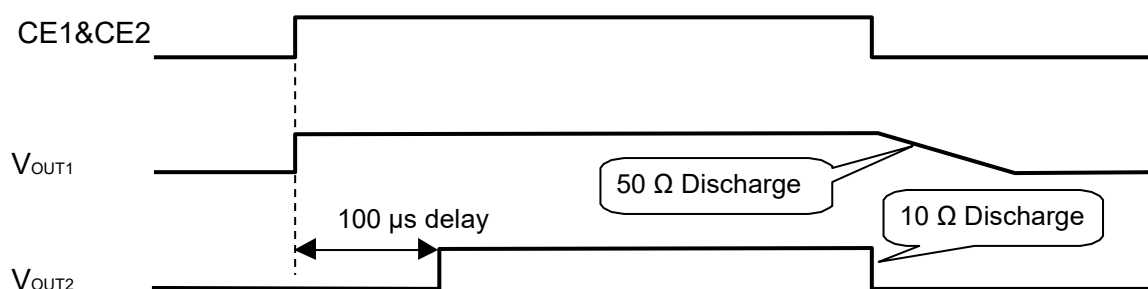
**Product-specific Electrical Characteristics VOUT2 (continued)**

| Product Name | V <sub>OUT2</sub> (T <sub>a</sub> = 25°C) |       |       | V <sub>OUT2</sub> (-40°C ≤ T <sub>a</sub> ≤ 85°C) |       |       | ΔV <sub>OUT2</sub> / ΔI <sub>OUT</sub> |      | V <sub>DIF2</sub> |       |
|--------------|---|-------|-------|---|-------|-------|--|------|-------------------|-------|
|              | Min.                                      | Typ.  | Max.  | Min.  | Typ.  | Max.  | Typ.                                   | Max. | Typ.              | Max.  |
| RP152x041x   | 2.970                                     | 3.000 | 3.030 | 2.910   | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x042x   | 2.574                                     | 2.600 | 2.626 | 2.522   | 2.600 | 2.678 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x043x   | 2.772                                     | 2.800 | 2.828 | 2.716   | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x044x   | 1.480                                     | 1.500 | 1.520 | 1.440   | 1.500 | 1.560 | 15                                     | 50   | 0.310             | 0.550 |
| RP152x045x   | 3.267                                     | 3.300 | 3.333 | 3.201   | 3.300 | 3.399 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x046x   | 2.970                                     | 3.000 | 3.030 | 2.910   | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x047x   | 2.772                                     | 2.800 | 2.828 | 2.716   | 2.800 | 2.884 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x048x   | 3.168                                     | 3.200 | 3.232 | 3.104   | 3.200 | 3.296 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x049x   | 2.822                                     | 2.850 | 2.879 | 2.765   | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x050x   | 2.871                                     | 2.900 | 2.929 | 2.813   | 2.900 | 2.987 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x051x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x052x   | 2.822                                     | 2.850 | 2.879 | 2.765   | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x053x   | 2.673                                     | 2.700 | 2.727 | 2.619   | 2.700 | 2.781 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x054x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x055x   | 2.822                                     | 2.850 | 2.879 | 2.765   | 2.850 | 2.936 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x056x   | 2.970                                     | 3.000 | 3.030 | 2.910   | 3.000 | 3.090 | 15                                     | 60   | 0.190             | 0.320 |
| RP152x057x   | 1.780                                     | 1.800 | 1.820 | 1.740   | 1.800 | 1.860 | 15                                     | 55   | 0.270             | 0.460 |
| RP152x058x   | 0.880                                     | 0.900 | 0.920 | 0.840   | 0.900 | 0.960 | 10                                     | 40   | 0.500             | 0.800 |
| RP152x059x   | 2.871                                     | 2.900 | 2.929 | 2.813   | 2.900 | 2.987 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x060x   | 1.180                                     | 1.200 | 1.212 | 1.140   | 1.200 | 1.260 | 15                                     | 50   | 0.390             | 0.620 |
| RP152x061x   | 2.871                                     | 2.900 | 2.929 | 2.813   | 2.900 | 2.987 | 15                                     | 60   | 0.200             | 0.350 |
| RP152x062x   | 3.069                                     | 3.100 | 3.131 | 3.007   | 3.100 | 3.193 | 15                                     | 60   | 0.190             | 0.320 |

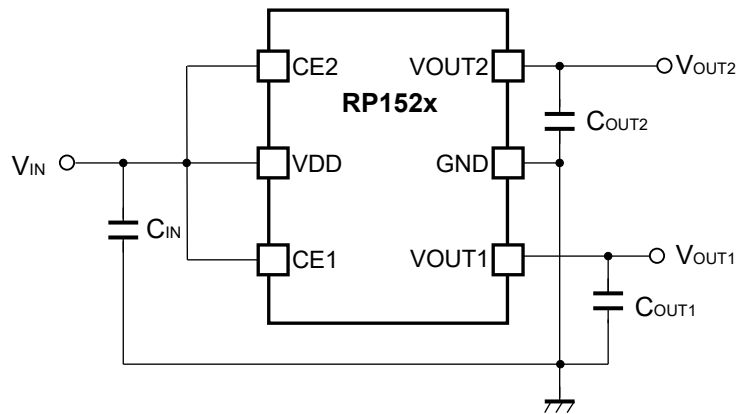
## THEORY OF OPERATION

### Start-up Sequence Circuit

The RP152xxxxC is equipped with a start-up sequence circuit. VR2 stands-up in 100  $\mu$ s delay after VR1 stands up simultaneously with CE. Moreover, to disabling is depending upon the setting output voltage and the external capacitors. VR1 reduces the output voltage by the Nch driver of about 50  $\Omega$ , and VR2 reduces the output voltage by the Nch driver of about 10  $\Omega$ .



**RP152xxxxC Start-up Sequence Circuit**

**APPLICATION INFORMATION****RP152x Typical Application Circuit****External Components**

| Symbol     | Description                                       |
|------------|---|
| $C_{IN}$   | Ceramic, 0.22 $\mu$ F, Murata: GRM155B31A224KE18B |
| $C_{OUT1}$ |   |
| $C_{OUT2}$ |   |

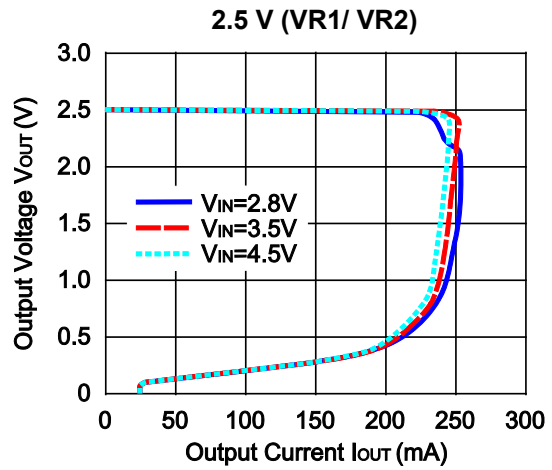
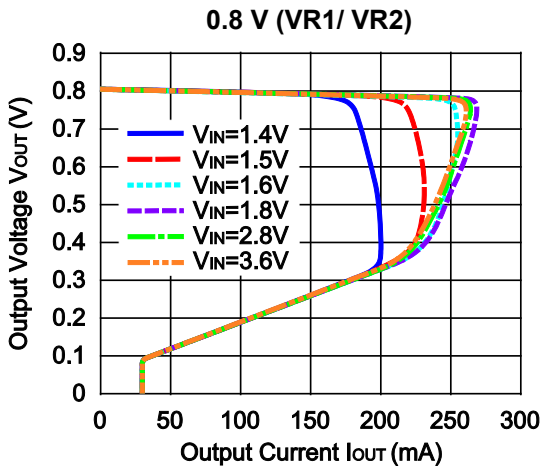
**Technical Notes on the Components Selection**

- In this device, phase compensation is provided to secure stable operation even when the load current varied. For this purpose, connect 0.22  $\mu$ F or more output capacitors ( $C_{OUT1}$ ,  $C_{OUT2}$ ) between the VOUT and GND pin with shortest-distance wiring. In case of using a tantalum type capacitor and the ESR (Equivalent Series Resistance) value of the capacitor is large, the output might be unstable. Evaluate the circuit including consideration of frequency characteristics.
- Ensure the VDD and GND lines are sufficiently robust. If their impedance is too high, noise pickup or unstable operation may result. Connect a 0.22  $\mu$ F input capacitor ( $C_{IN}$ ) between the VDD and GND pins with shortest-distance wiring. Refer to *Typical Application Circuit*.

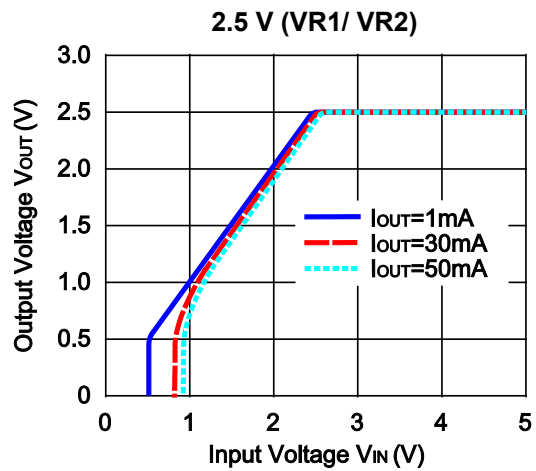
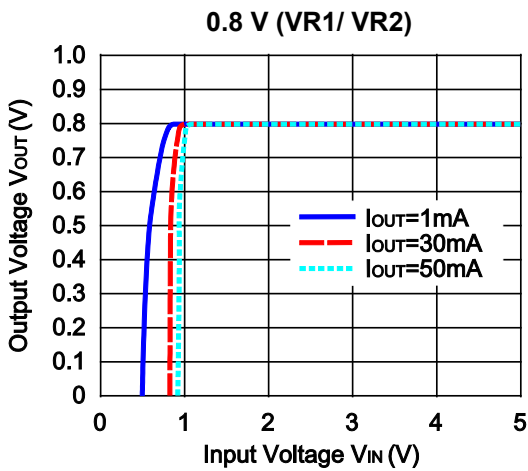
## TYPICAL CHARACTERISTICS

Notes: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

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



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





3) Supply Current vs. Input Voltage



4) Output Voltage vs. Temperature  
0.8 V (VR1/ VR2)



2.5 V (VR1/ VR2)



3.6 V (VR1/ VR2)



5) Supply Current vs. Temperature  
0.8 V (VR1/ VR2)



2.5 V (VR1/ VR2)



3.6V (VR1/VR2)



6) Dropout Voltage vs. Output Current  
0.8 V (VR1/ VR2)



2.5 V (VR1/ VR2)



3.6 V (VR1/ VR2)

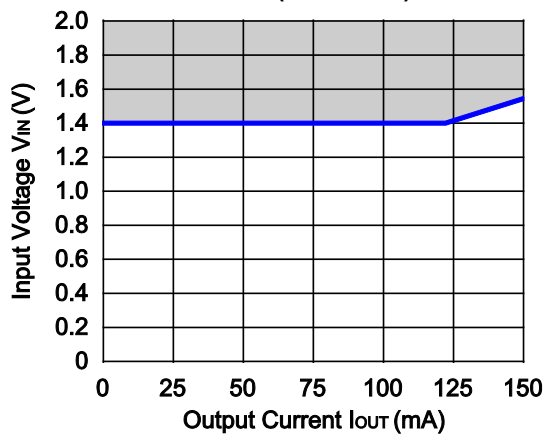




7) Dropout Voltage vs. Set Output Voltage



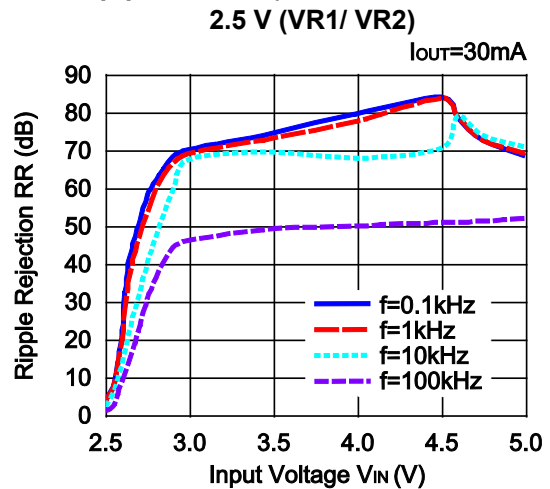
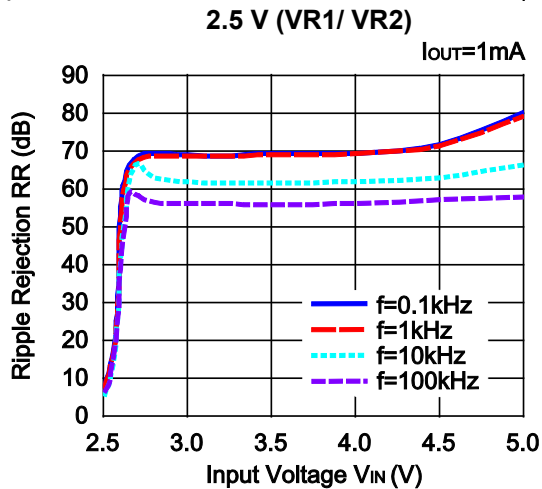
8) Minimum Operating Voltage  
0.8 V (VR1/ VR2)



The hatched area is available for a 0.8-V output device.

9) Ripple Rejection vs. Input Voltage

( $C_{IN}$  = none,  $C_{OUT1}$  =  $C_{OUT2}$  = Ceramic 0.22  $\mu\text{F}$ , Ripple = 0.2 Vp-p,  $T_a$  = 25°C)

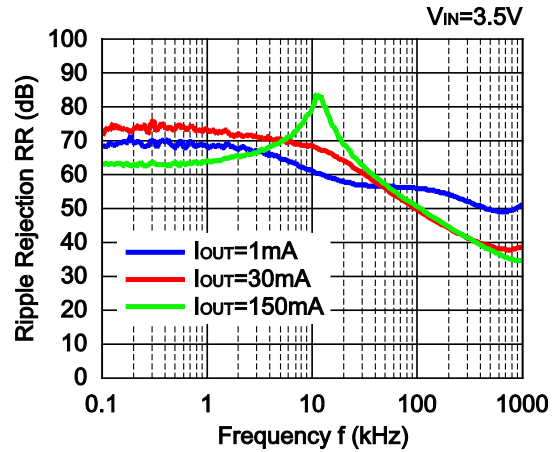
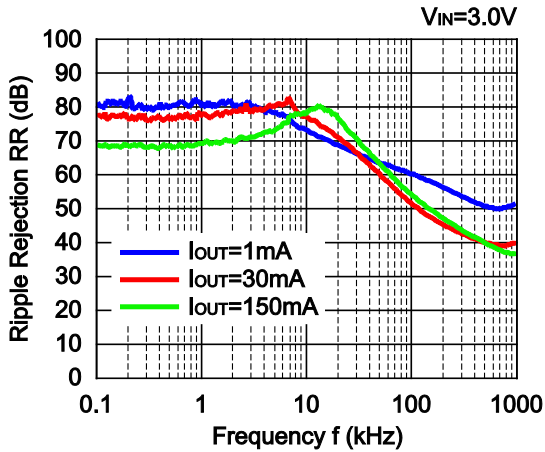


10) Ripple Rejection vs. Frequency

( $C_{IN}$  = none,  $C_{OUT1} = C_{OUT2}$  = Ceramic 0.22  $\mu$ F, Ripple = 0.2 Vp-p,  $T_a$  = 25°C)

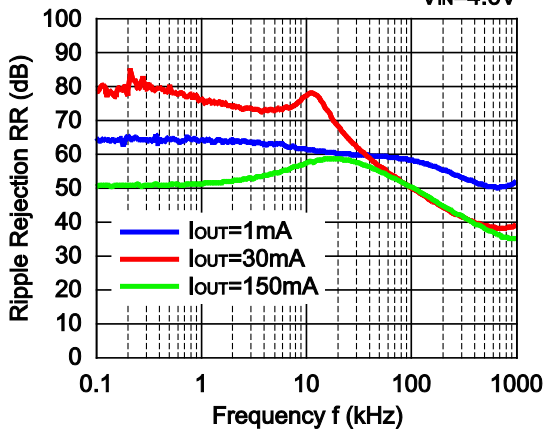
0.8 V (VR1/ VR2)

2.5 V (VR1/ VR2)



3.6 V (VR1/ VR2)

$V_{IN}=4.6V$

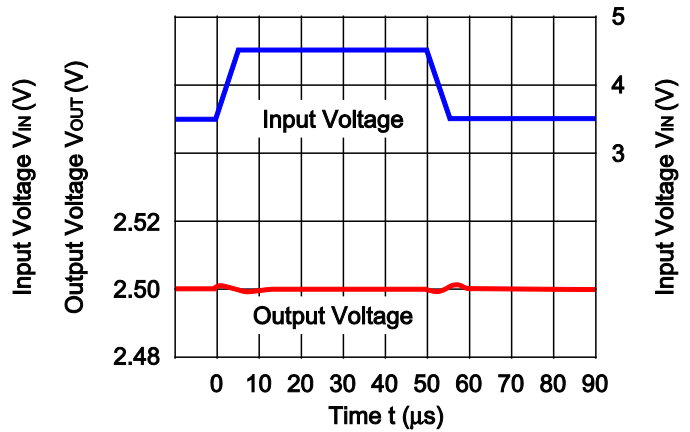
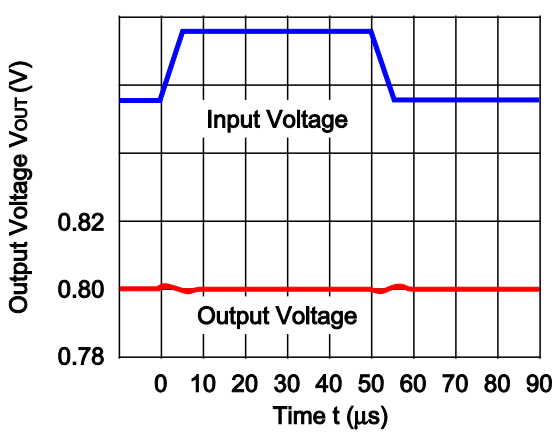


11) Input Transient Response

( $I_{OUT} = 30$  mA,  $t_r = t_f = 5$   $\mu$ s,  $C_{IN}$  = none,  $C_{OUT1} = C_{OUT2} = 0.22$   $\mu$ F,  $T_a$  = 25°C)

0.8 V (VR1/ VR2)

2.5 V (VR1/ VR2)



3.6 V (VR1/ VR2)



12) Load Transient Response ( $t_r = t_f = 0.5 \mu$ s,  $C_{IN} = C_{OUT1} = C_{OUT2} = 0.22 \mu$ F,  $T_a = 25^\circ$ C)

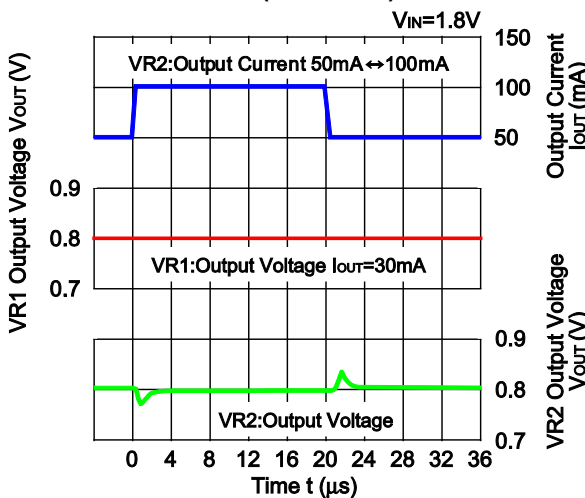
0.8 V (VR1/ VR2)



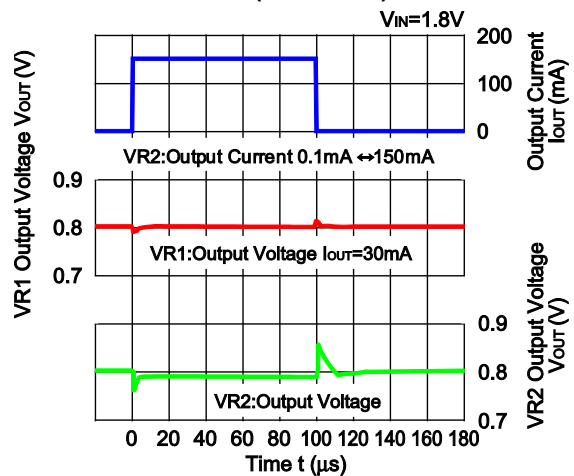
0.8 V (VR1/ VR2)

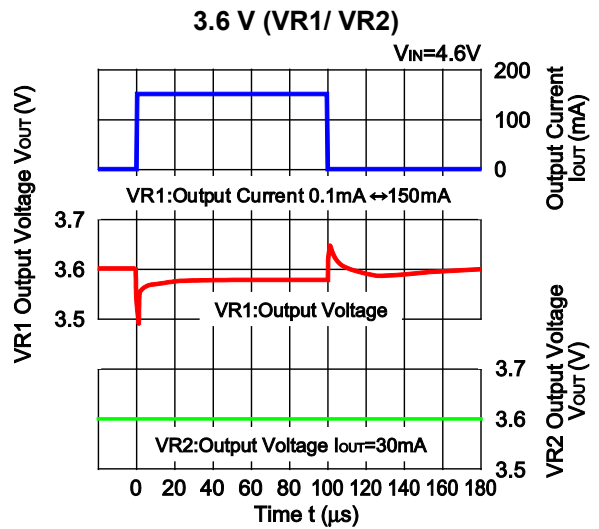
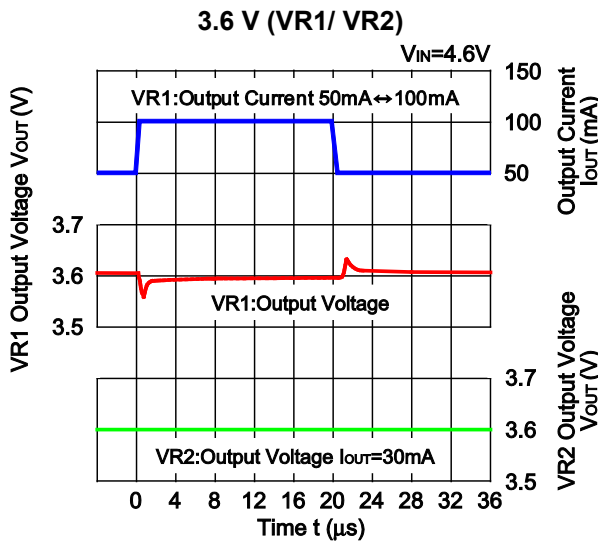
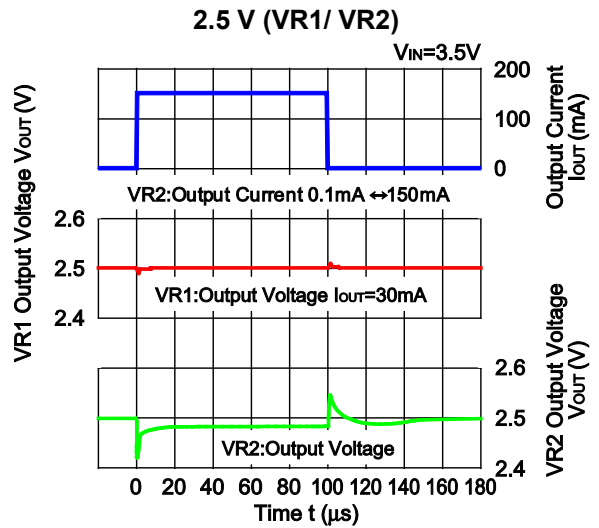
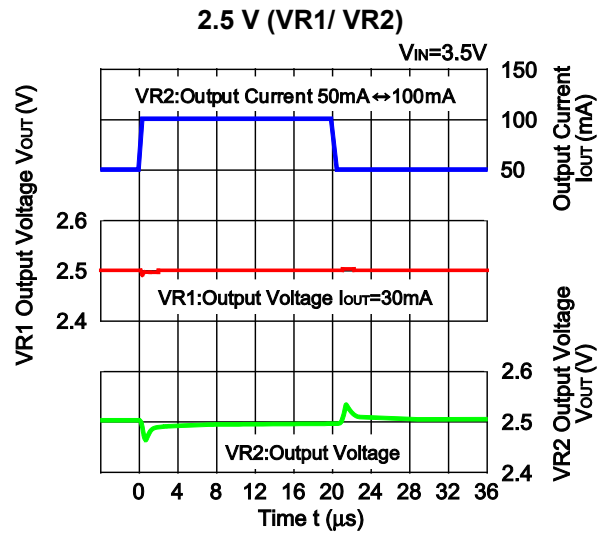
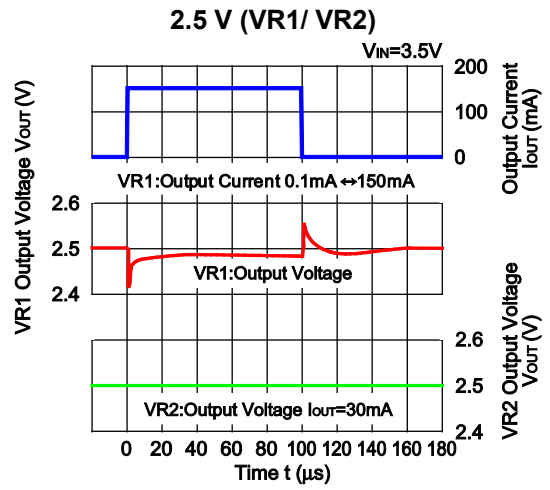


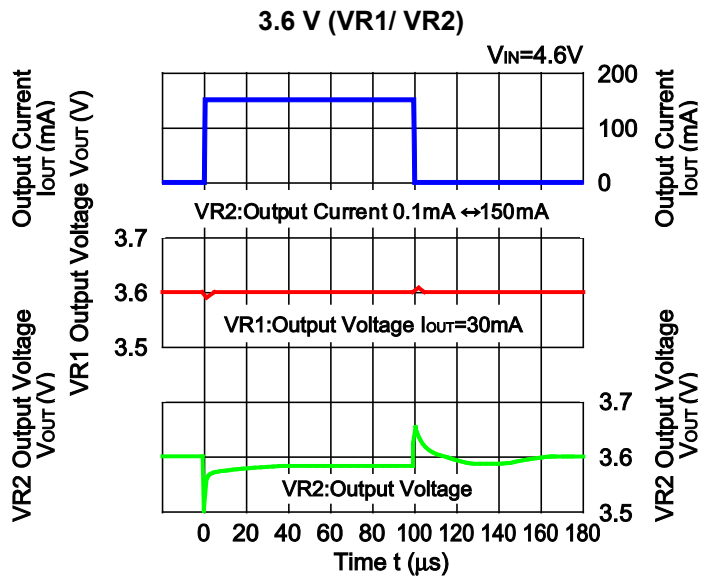
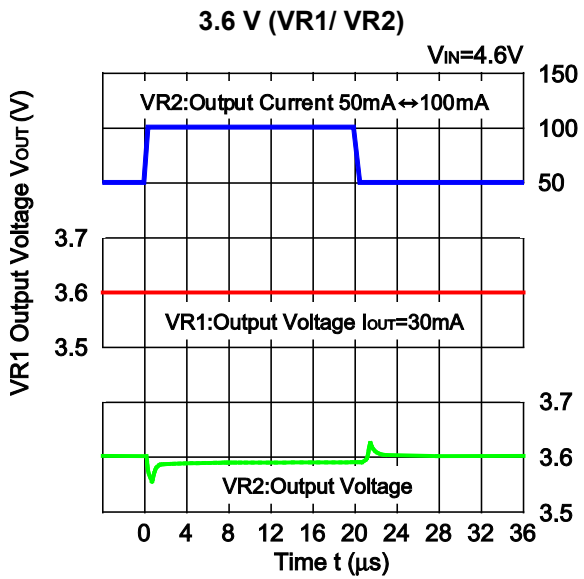
0.8 V (VR1/ VR2)



0.8 V (VR1/ VR2)

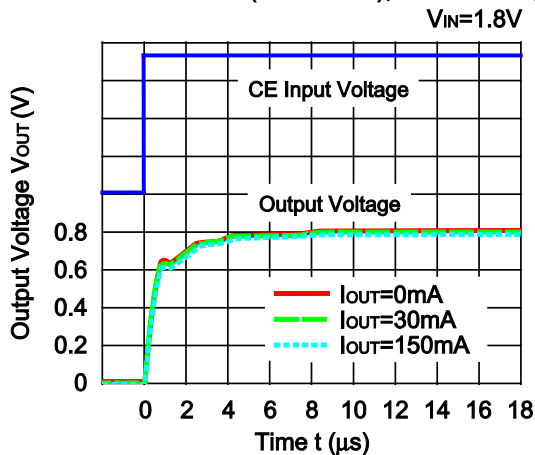




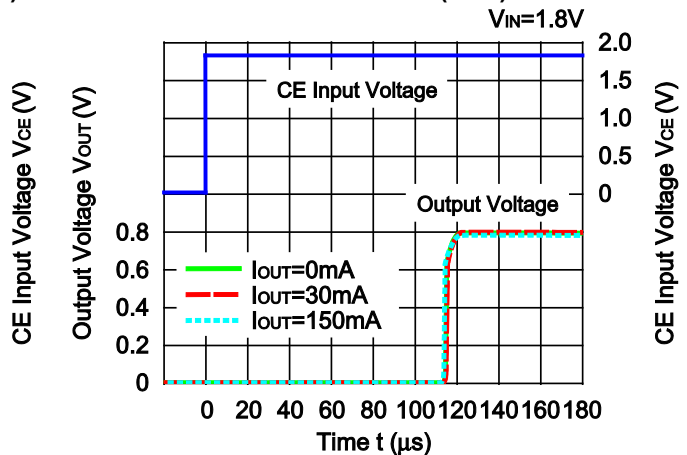


13) Turn On Speed with CE Pin ( $C_{IN} = C_{OUT1} = C_{OUT2} = 0.22 \mu F$ ,  $T_a = 25^\circ C$ )

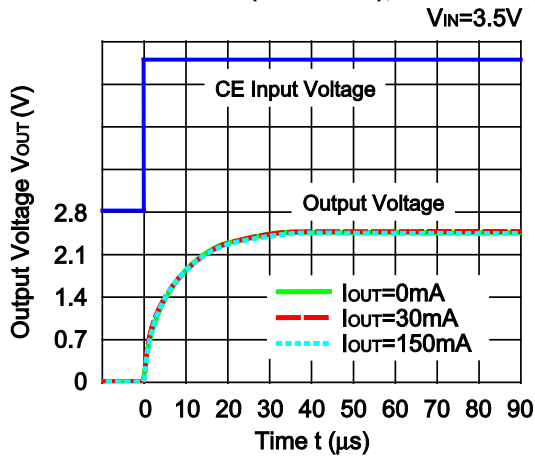
0.8 V A/B Version (VR1/ VR2), C Version (VR1)



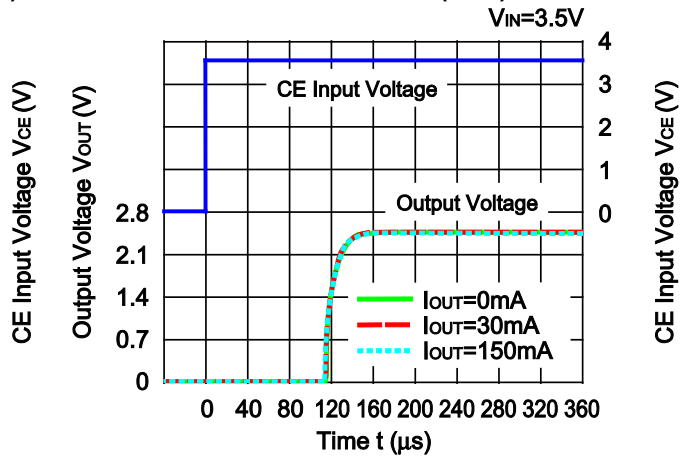
0.8 V C Version (VR2)



2.5 V A/B Version (VR1/ VR2), C Version (VR1)



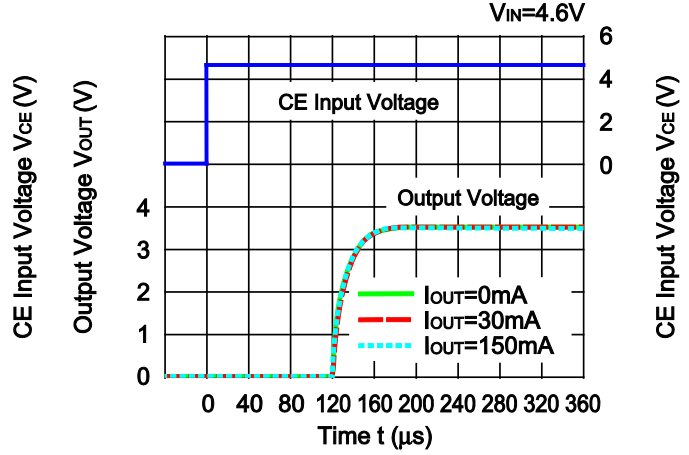
2.5 V C Version (VR2)



3.6 V A/B Version (VR1/ VR2), C Version (VR1)



3.6 V C Version (VR2)

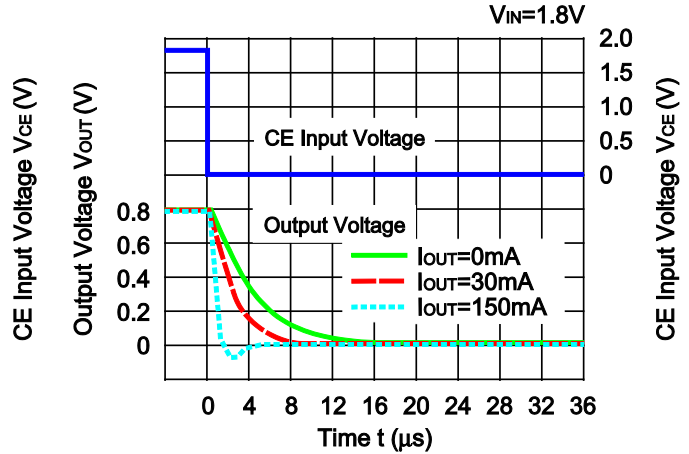


14) Turn Off Speed with CE Pin ( $C_{IN} = C_{OUT1} = C_{OUT2} = 0.22 \mu F$ ,  $T_a = 25^\circ C$ )

0.8 V B Version (VR1/ VR2), C Version (VR1)



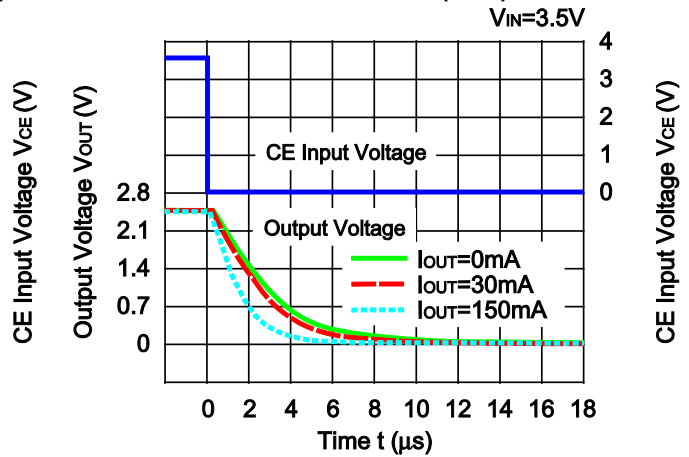
0.8 V C Version (VR2)



2.5 V B Version (VR1/ VR2), C Version (VR1)



2.5 V C Version (VR2)



3.6 V B Version (VR1/ VR2), C Version (VR1)

$V_{IN}=4.6V$



3.6 V C Version (VR2)

$V_{IN}=4.6V$



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## RP152x

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NO.EA-200-160707

### Equivalent Series Resistance (ESR) vs. Output Current

It is recommended that a ceramic type capacitor be used for the RP152x. However, other types of capacitors having lower ESR can also be used. The relation between the output current ( $I_{OUT}$ ) and the ESR of output capacitor is shown below.

#### Measurement Conditions:

- Noise Frequency Band: 10 Hz to 2 MHz
- Measurement Temperature:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Hatched Area: Noise level is  $40\ \mu\text{V}$  (avg.) or below.
- $C_{IN}$ ,  $C_{OUT1}$ ,  $C_{OUT2}$ :  $0.22\ \mu\text{F}$  (Murata: GRM155B10J224KE01)





Power Dissipation ( $P_D$ ) of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

**Measurement Conditions**

|                  | <b>Standard Land Pattern</b>                  |
|------------------|---|
| Environment      | Mounting on Board (Wind Velocity = 0 m/s)     |
| Board Material   | Glass Cloth Epoxy Plastic (Double-sided)      |
| Board Dimensions | 40 mm x 40 mm x 1.6 mm                        |
| Copper Ratio     | Top-side: Approx. 50%, Back-side: Approx. 50% |
| Through-holes    | $\phi$ : 0.5 mm x 28 pcs                      |

**Measurement Result**

( $T_a = 25^\circ\text{C}$ ,  $T_{j\text{max}} = 125^\circ\text{C}$ )

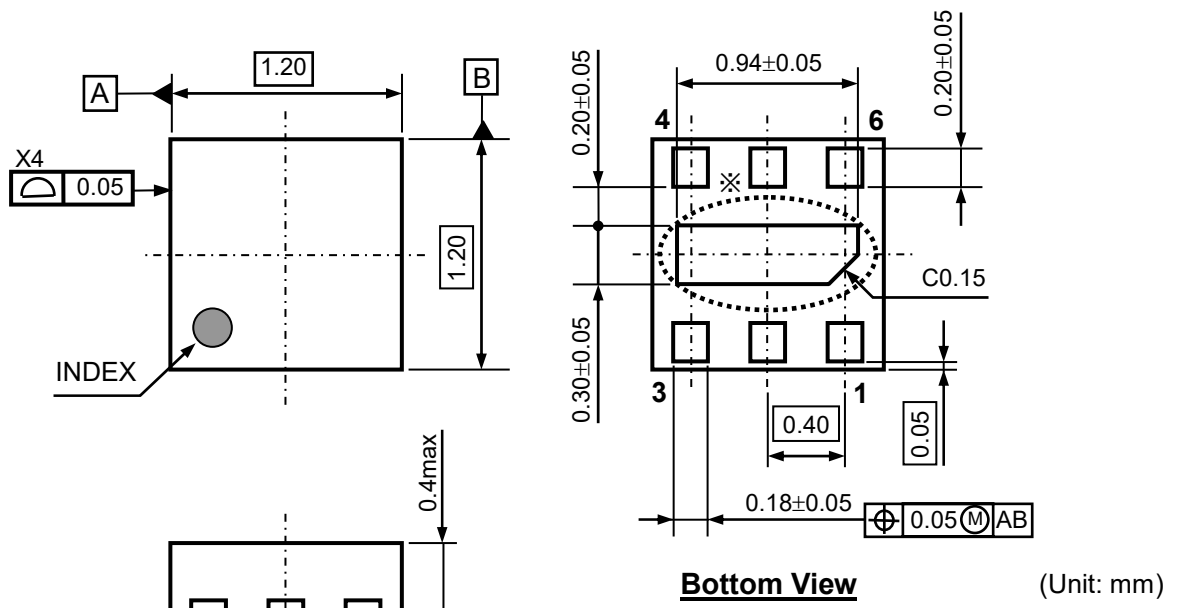
|                    | <b>Standard Land Pattern</b>   |
|--------------------|--|
| Power Dissipation  | 600 mW   |
| Thermal Resistance | $\theta_{ja} = (125 - 25^\circ\text{C}) / 0.6 \text{ W} = 167^\circ\text{C/W}$ |
|                    | $\theta_{jc} = 30^\circ\text{C/W}$   |



**Power Dissipation vs. Ambient Temperature**



**Measurement Board Pattern**



※ The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left floating.

DFN1212-6 Package Dimensions

Power Dissipation ( $P_D$ ) of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

**Measurement Conditions**

|                  | <b>Standard Land Pattern</b>                  |
|------------------|---|
| Environment      | Mounting on Board (Wind Velocity = 0 m/s)     |
| Board Material   | Glass Cloth Epoxy Plastic (Double-sided)      |
| Board Dimensions | 40 mm x 40 mm x 1.6 mm                        |
| Copper Ratio     | Top-side: Approx. 50%, Back-side: Approx. 50% |
| Through-holes    | $\phi$ 0.5 mm x 44 pcs                        |

**Measurement Result**

( $T_a = 25^\circ\text{C}$ ,  $T_{j\text{max}} = 125^\circ\text{C}$ )

|                    | <b>Standard Land Pattern</b>  | <b>Free Air</b>        |
|--------------------|---|------------------------|
| Power Dissipation  | 420 mW  | 250 mW                 |
| Thermal Resistance | $\theta_{ja} = (125 - 25^\circ\text{C}) / 0.42 \text{ W} = 238^\circ\text{C/W}$ | 400 $^\circ\text{C/W}$ |



**Power Dissipation (mW) vs. Temperature (°C)**



 IC Mount Area (Unit: mm)

**Measurement Board Pattern**



Unit : mm

SOT-23-6 Package Dimensions



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