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# R5322N SERIES

## 120mA 2ch LDO REGULATORS

NO.EA-077-0606

## OUTLINE

The R5322N Series are voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection by CMOS process. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting Output Voltage, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance, and a chip enable function and prolong the battery life of each system. The line transient response and load transient response of the R5322N Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output voltage of these ICs is internally fixed with high accuracy. Since the package for these ICs is SOT-23-6W package, and include 2ch LDO regulators each, high density mounting of the ICs on boards is possible.

## FEATURES

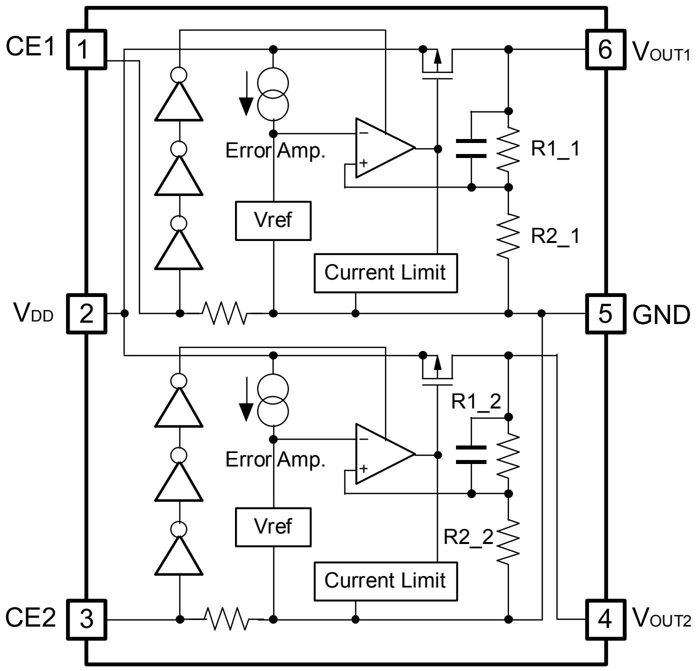
- Ultra-Low Supply Current............................................Typ. 75μA (VR1, VR2)
- Standby Current.........................................................Typ. 0.1μA (VR1, VR2)
- Output Voltage ...........................................................1.5V to 4.0V
- Low Dropout Voltage...................................................Typ. 0.15V ($I_{OUT}$=100mA ,$V_{OUT}$=3.0V)
- High Ripple Rejection .................................................Typ. 75dB (f=1kHz)
- High Output Voltage Accuracy ...................................±2.0%
- Low Temperature-Drift Coefficient of Output Voltage....Typ. ±100ppm/°C
- Excellent Line Regulation ..........................................Typ.0.05%/V
- Small Packages .......................................................SOT-23-6W
- Built-in chip enable circuit (A/B: active high)
- Built-in fold-back protection circuit ..............................Typ. 40mA (Current at short mode)

## APPLICATIONS

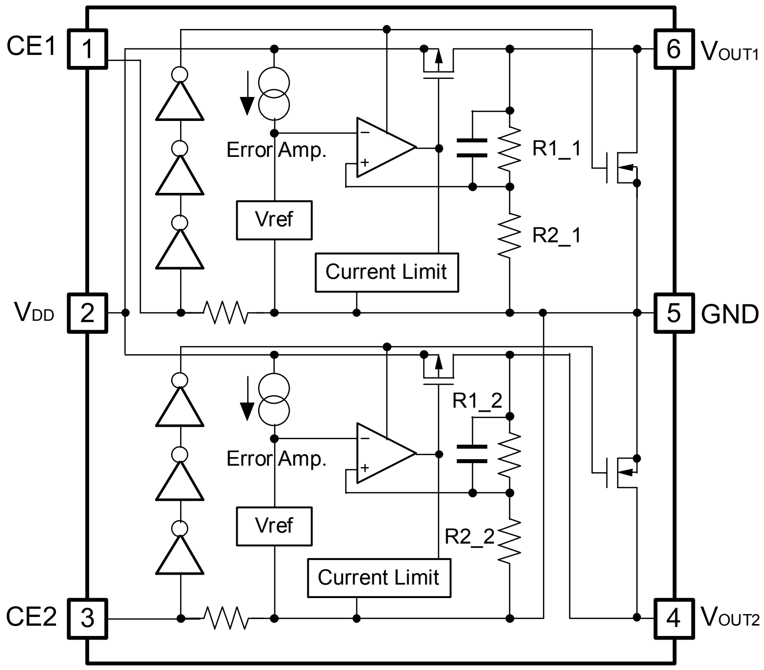
- Power source for cellular phones such as GSM, CDMA and various kinds of PCS.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

# BLOCK DIAGRAMS

**R5322NxxxA**




**R5322NxxxB**



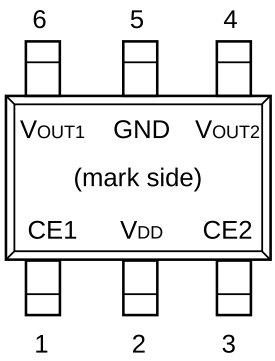
## SELECTION GUIDE

The output voltage, mask option, and the taping type for the ICs can be selected at the user's request.
The selection can be made with designating the part number as shown below;

```
R5322Nxxxx-xx-x ←Part Number
      ↑ ↑  ↑  ↑
      a b  c  d
```

| Code | Contents |
|---|---|
| a | Setting combination of 2ch Output Voltage ($V_{OUT}$) :<br>Serial Number for Voltage Setting, Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible for each channel. |
| b | Designation of Mask Option :<br>A Version: without auto discharge function at OFF state.<br>B Version: with auto discharge function at OFF state. |
| c | Designation of Taping Type :<br>Ex. TR (refer to Taping Specifications; TR type is the standard direction.) |
| d | Designation of Composition of pin plating.<br>-F : Lead free plating |

# PIN CONFIGURATION




# PIN DESCRIPTIONS

- **SOT-23-6W**

| Pin No | Symbol | Pin Description |
|---|---|---|
| 1 | CE1 | Chip Enable Pin 1 |
| 2 | $V_{DD}$ | Input Pin |
| 3 | CE2 | Chip Enable Pin 2 |
| 4 | $V_{OUT2}$ | Output Pin 2 |
| 5 | GND | Ground Pin |
| 6 | $V_{OUT1}$ | Output Pin 1 |

# ABSOLUTE MAXIMUM RATINGS

| Symbol | Item | Rating | Unit |
|---|---|---|---|
| $V_{IN}$ | Input Voltage | 6.5 | V |
| $V_{CE}$ | Input Voltage (CE Pin) | $-0.3$ to $V_{IN}+0.3$ | V |
| $V_{OUT}$ | Output Voltage | $-0.3$ to $V_{IN}+0.3$ | V |
| $I_{OUT1}$ | Output Current 1 | 130 | mA |
| $I_{OUT2}$ | Output Current 2 | 130 | mA |
| $P_D$ | Power Dissipation (SOT-23-6W) *Note1 | 430 | mW |
| Topt | Operating Temperature Range | $-40$ to 85 | °C |
| Tstg | Storage Temperature Range | $-55$ to 125 | °C |

Note1: For Power Dissipation please refer to PACKAGE INFORMATION to be described.



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# ELECTRICAL CHARACTERISTICS

- **R5322NxxxA/B**

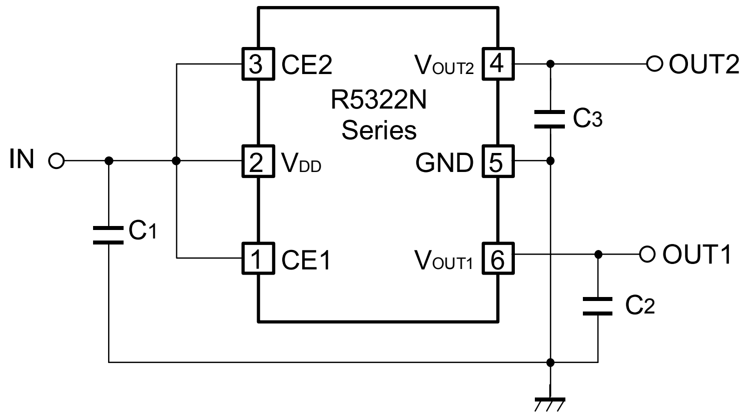
Topt=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output voltage | $V_{IN}$=Set $V_{OUT}$+1V, 1mA ≦ $I_{OUT}$ ≦ 30mA | ×0.98 | | ×1.02 | V |
| $I_{OUT}$ | Output Current | $V_{IN}$–$V_{OUT}$=1.0V | 120 | | | mA |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load regulation | $V_{IN}$=Set $V_{OUT}$+1V, 1mA ≦ $I_{OUT}$ ≦ 120mA | | 12 | 40 | mV |
| $V_{DIF}$ | Dropout Voltage | Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE | | | | |
| $I_{SS}$ | Supply Current | $V_{IN}$=Set $V_{OUT}$+1V | | 75 | 150 | μA |
| Istandby | Supply Current (Standby) | $V_{IN}$=$V_{CE}$=Set $V_{OUT}$+1V | | 0.1 | 1.0 | μA |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line regulation | Set $V_{OUT}$+0.5V ≦ $V_{IN}$ ≦ 6.0V<br>$I_{OUT}$=30mA<br>(In case that $V_{OUT}$ ≦ 1.6, 2.2V ≦ $V_{IN}$ ≦ 6.0)) | | 0.05 | 0.20 | %/V |
| RR | Ripple Rejection | f=1kHz,Ripple 0.5Vp-p, $V_{IN}$=Set $V_{OUT}$+1V,$I_{OUT}$=30mA | | 75 | | dB |
| $V_{IN}$ | Input Voltage | | 2.2 | | 6.0 | V |
| $\Delta V_{OUT}/\Delta Topt$ | Output Voltage Temperature Coefficient | $I_{OUT}$=30mA<br>–40°C ≦ Topt ≦ 85°C | | ±100 | | ppm /°C |
| Ilim | Short Current Limit | $V_{OUT}$=0V | | 40 | | mA |
| $R_{PD}$ | CE Pull-down Resistance | | 1.5 | 4.0 | 16.0 | MΩ |
| $V_{CEH}$ | CE Input Voltage "H" | | 1.5 | | $V_{IN}$ | V |
| $V_{CEL}$ | CE Input Voltage "L" | | 0.0 | | 0.3 | V |
| en | Output Noise | BW=10Hz to 100kHz | | 30 | | μVrms |
| $R_{LOW}$ | Low Output Nch Tr. ON Resistance (of B version) | $V_{CE}$=0V | | 70 | | Ω |

- **Electrical Characteristics by Output Voltage**

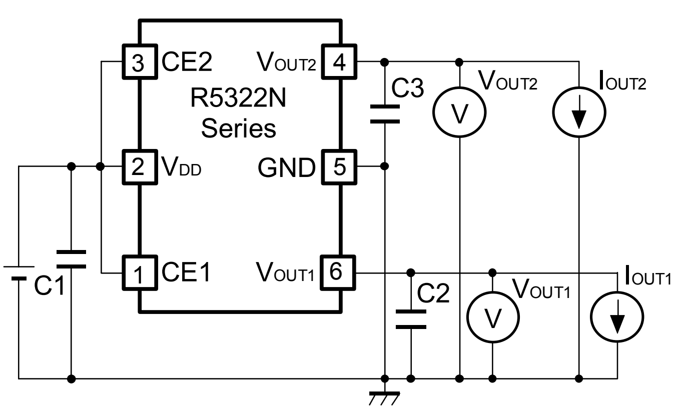
| Output Voltage $V_{OUT}$ (V) | Dropout Voltage $V_{DIF}$(V) | | |
|---|---|---|---|
| | Condition | Typ. | Max. |
| 1.5V ≦ $V_{OUT}$ < 1.6V | $I_{OUT}$ = 120mA | 0.36 | 0.70 |
| 1.7V ≦ $V_{OUT}$ < 1.8V | | 0.30 | 0.50 |
| 1.9V ≦ $V_{OUT}$ < 2.0V | | 0.28 | 0.45 |
| 2.1V ≦ $V_{OUT}$ < 2.7V | | 0.24 | 0.40 |
| 2.8V ≦ $V_{OUT}$ < 4.0V | | 0.18 | 0.30 |

# TYPICAL APPLIATION



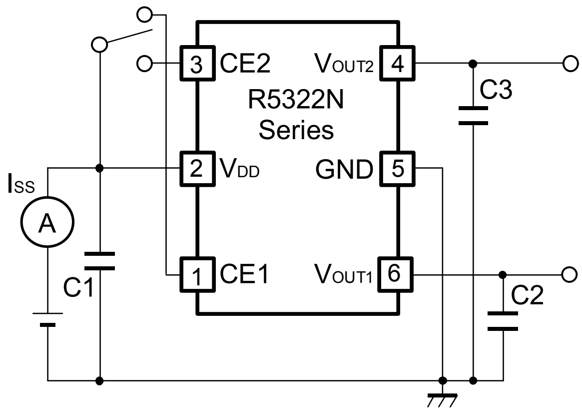

(External Components)
Output Capacitor; Tantalum Type

# TEST CIRCUIT



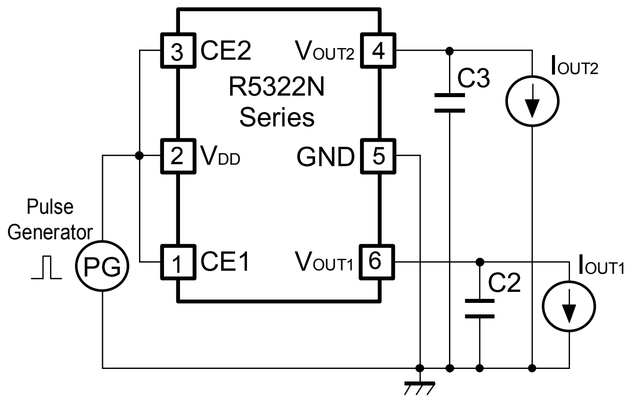

$C_1$= Tantal 1.0μF
$C_2$= $C_3$=Tantal 2.2μF

**Fig.1 Standard test Circuit**



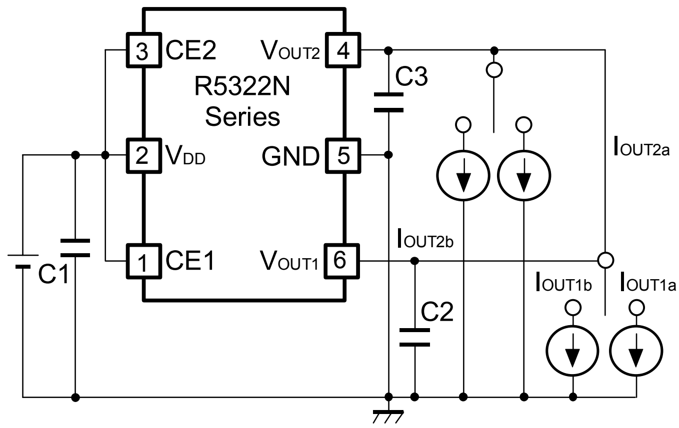

$C_1$= 1.0μF
$C_2$= $C_3$=2.2μF

**Fig.2 Supply Current Test Circuit**




$C_2$= $C_3$=2.2μF

**Fig.3 Ripple Rejection, Line Transient Response Test Circuit**



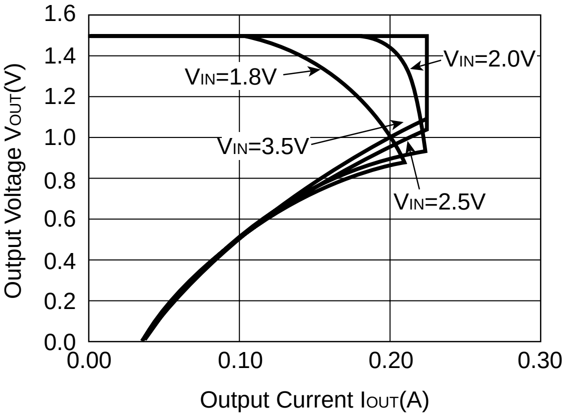

$C_1$= 1.0μF
$C_2$= $C_3$=2.2μF

**Fig.4 Load Transient Response Test Circuit**

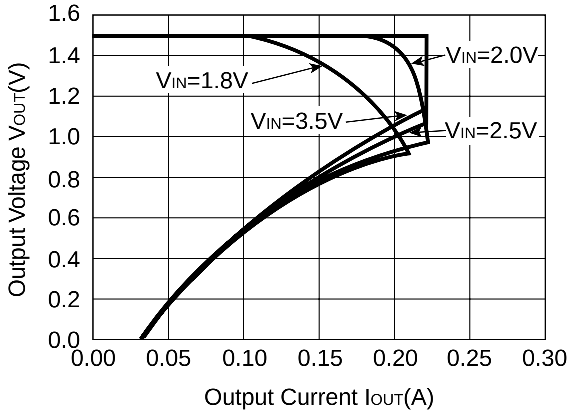
# TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

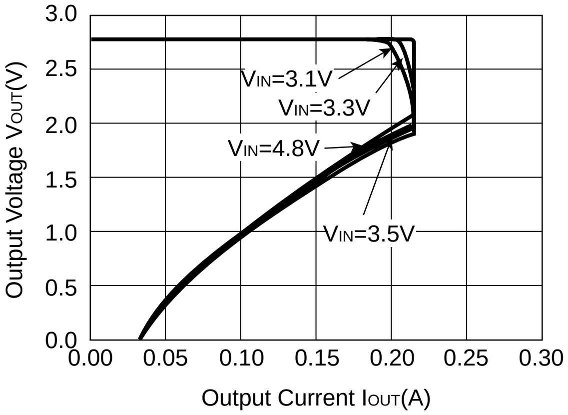
**1.5V (VR1)**



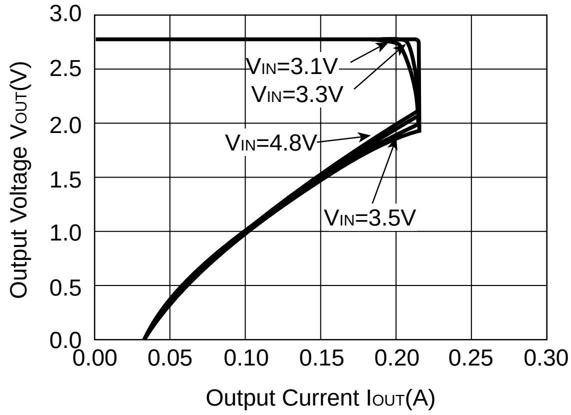

**1.5V (VR2)**



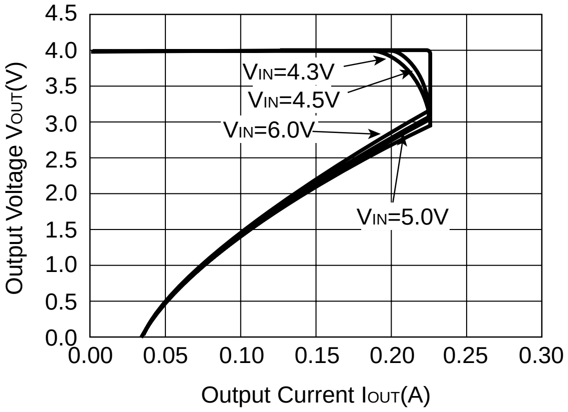

**2.8V (VR1)**



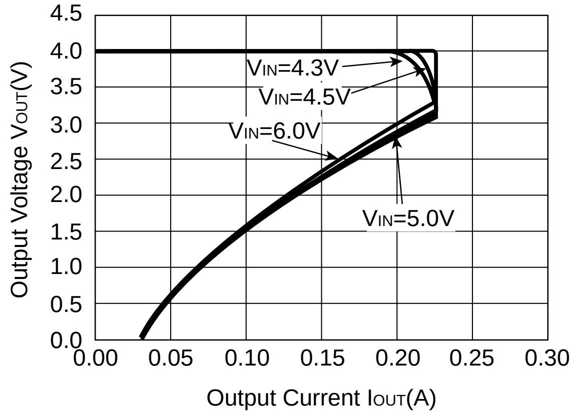

**2.8V (VR2)**




**4.0V (VR1)**

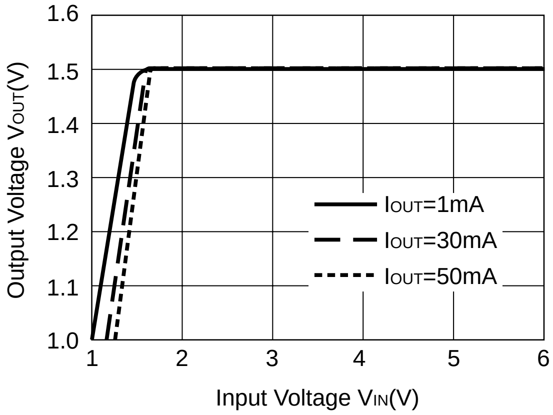



**4.0V (VR2)**

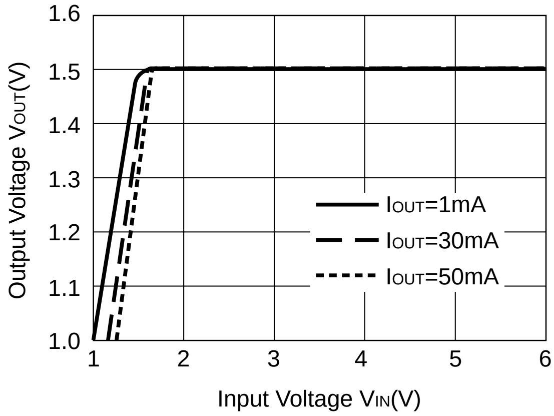


2) Output Voltage vs. Input Voltage

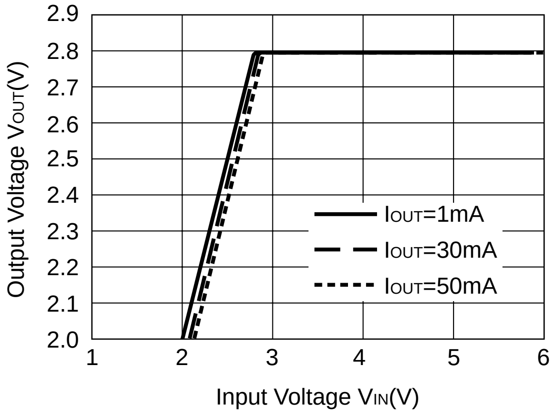
**1.5V (VR1)**



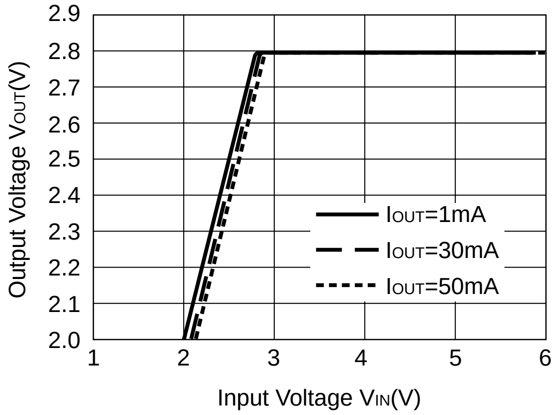

**1.5V (VR2)**



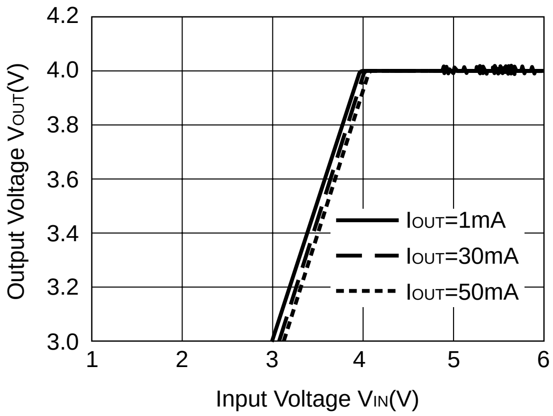

**2.8V (VR1)**



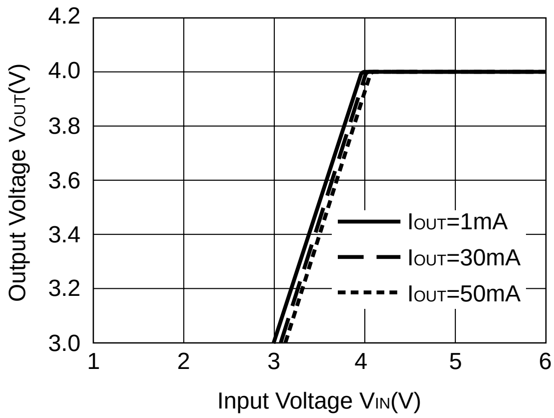

**2.8V (VR2)**




**4.0V (VR1)**

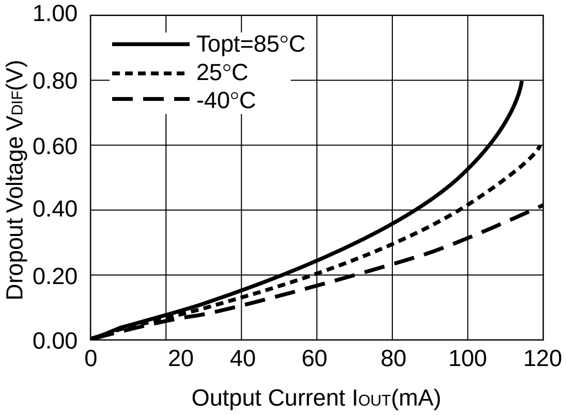



**4.0V (VR2)**

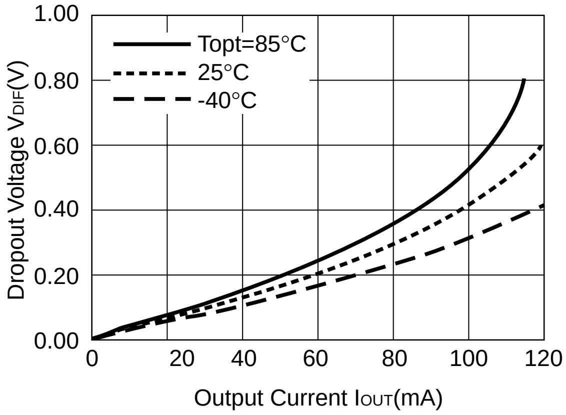


3) Dropout Voltage vs. Temperature

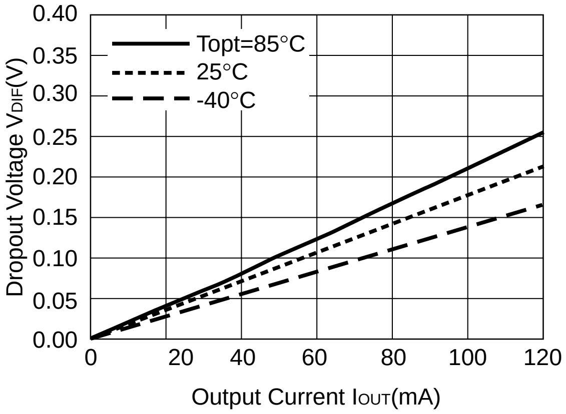
**1.5V (VR1)**



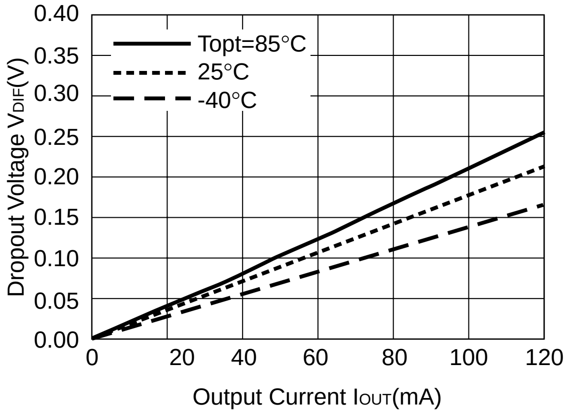

**1.5V (VR2)**



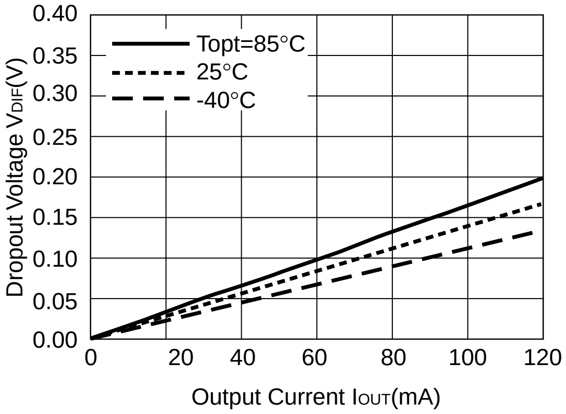

**2.8V (VR1)**



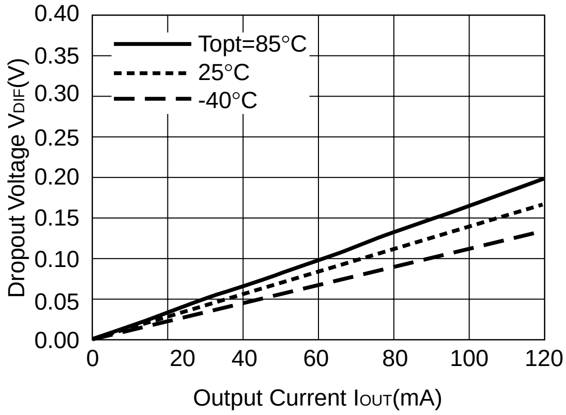

**2.8V (VR2)**



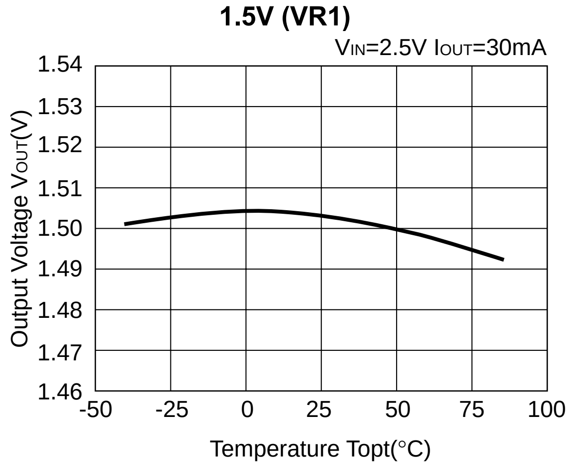

**4.0V (VR1)**

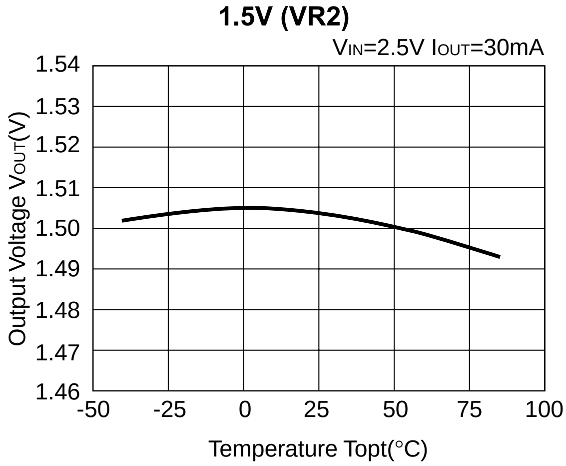


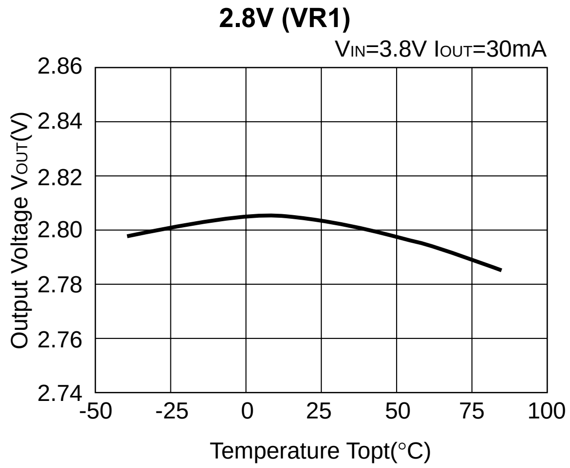

**4.0V (VR2)**

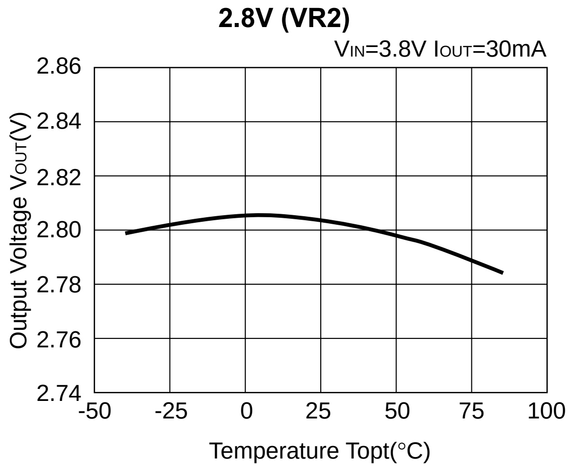


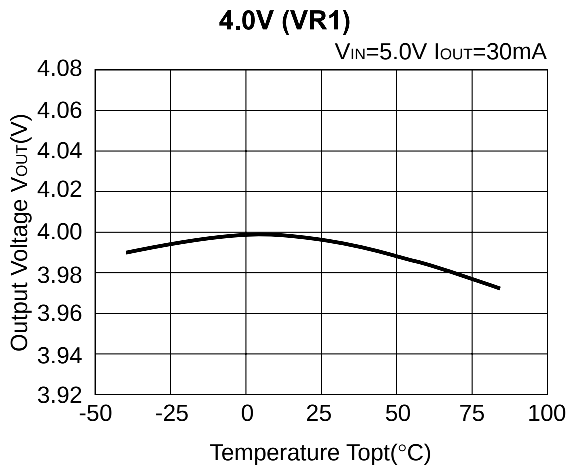
4) Output Voltage vs. Temperature

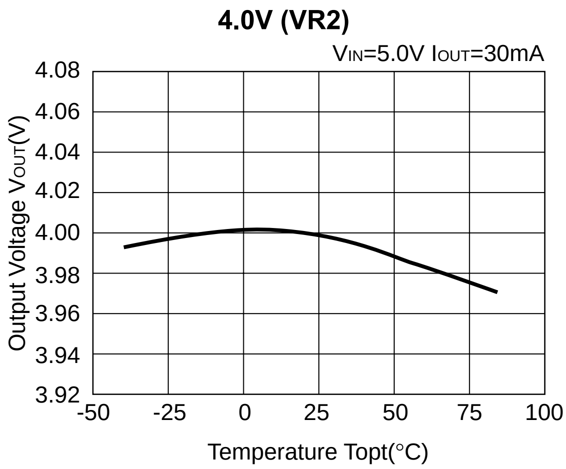


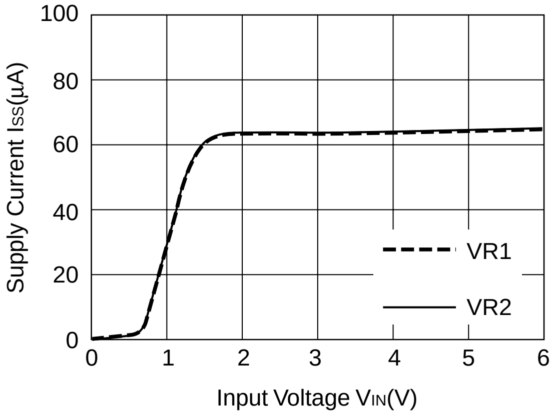



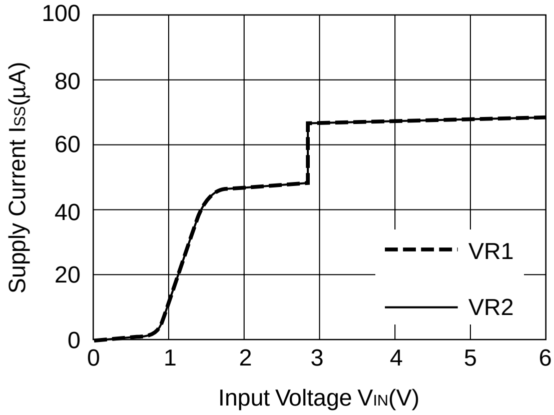



5) Supply Current vs. Input Voltage

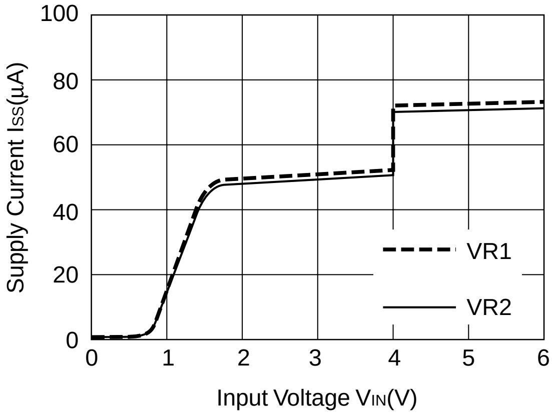
**1.5V**




**2.8V**

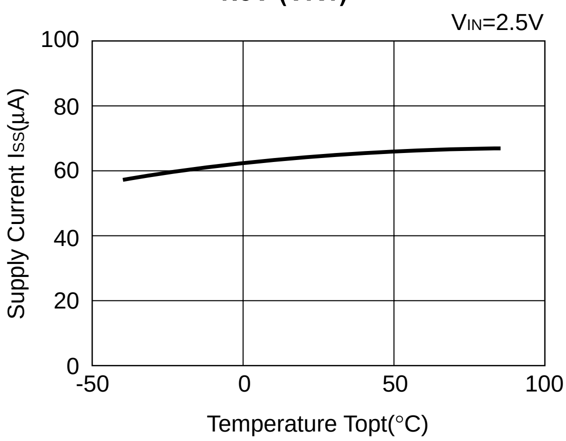



**4.0V**

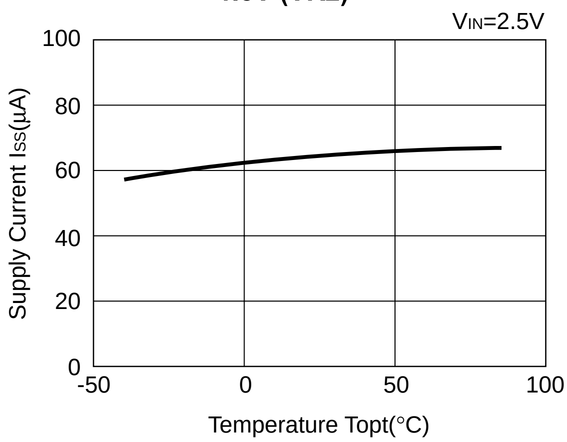



6) Supply Current vs. Temperature

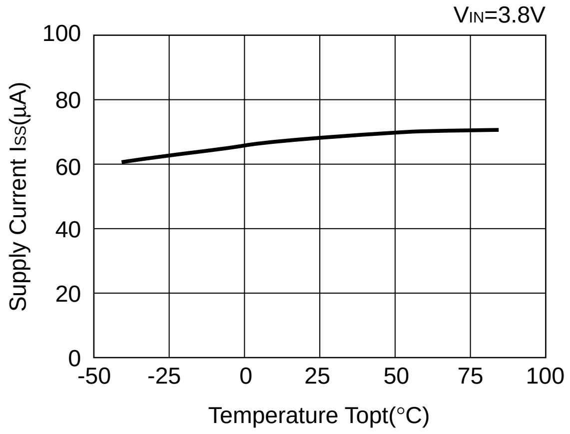
**1.5V (VR1)**



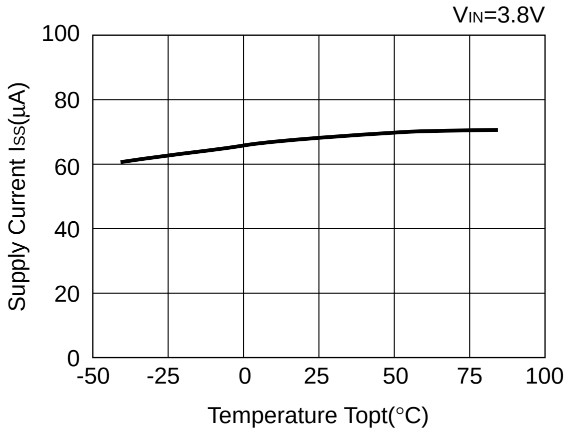

**1.5V (VR2)**



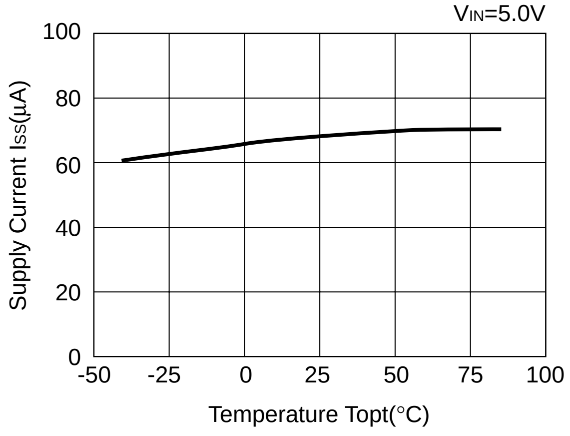
2.8V (VR1)



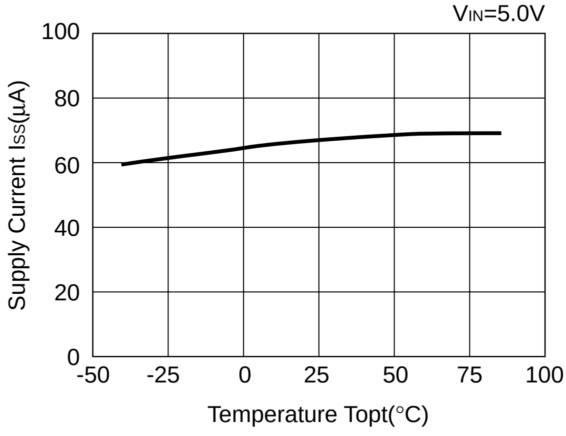

2.8V (VR2)




4.0V (VR1)

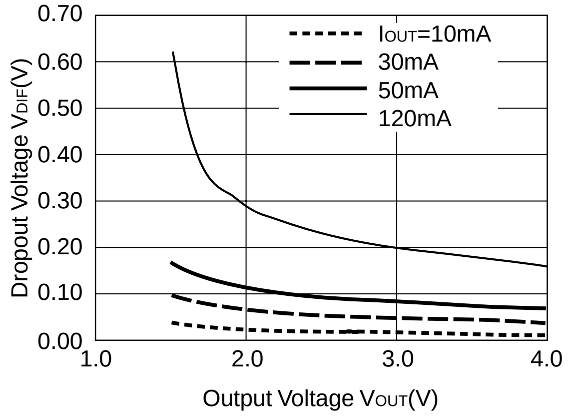



4.0V (VR2)

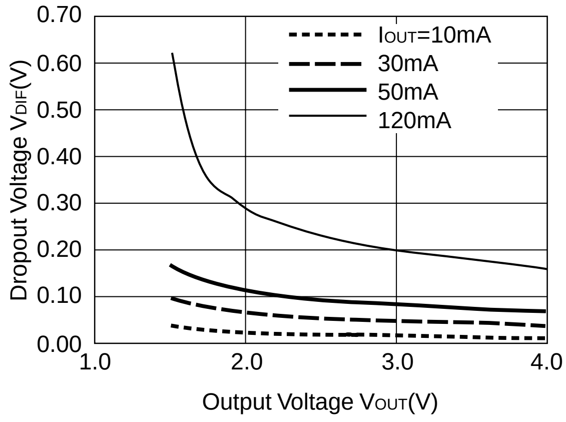



7) Dropout Voltage vs. Set Output Voltage

VR1



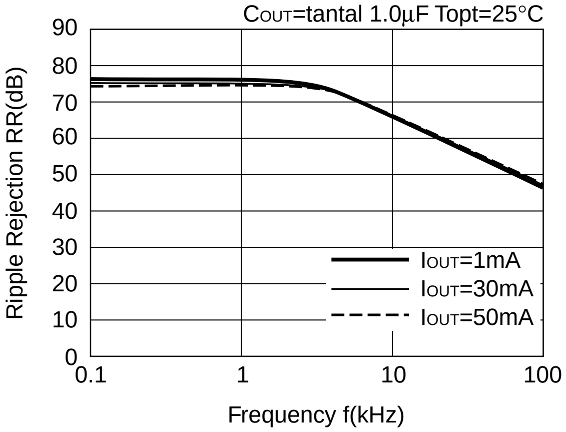

VR2



8) Ripple Rejection vs. Frequency

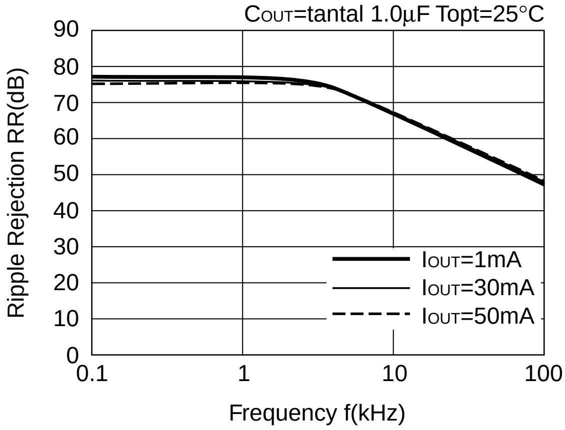
**1.5V (VR1)**

$V_{IN}$=2.5V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



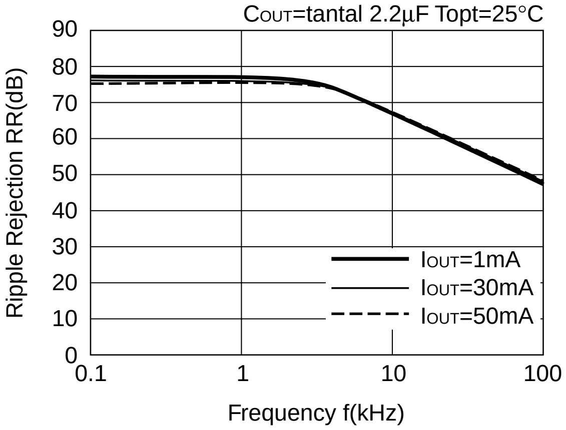

**1.5V (VR2)**

$V_{IN}$=2.5V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



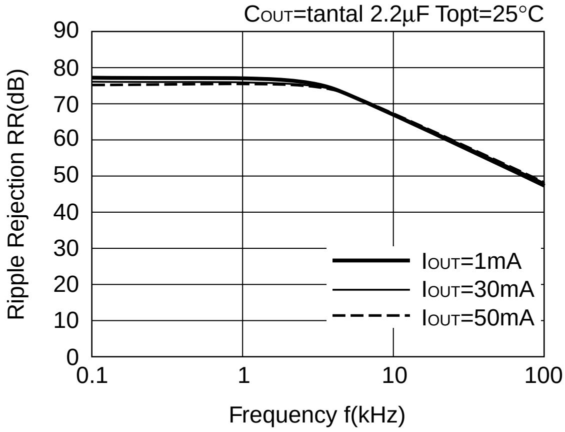

**1.5V (VR1)**

$V_{IN}$=2.5V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C



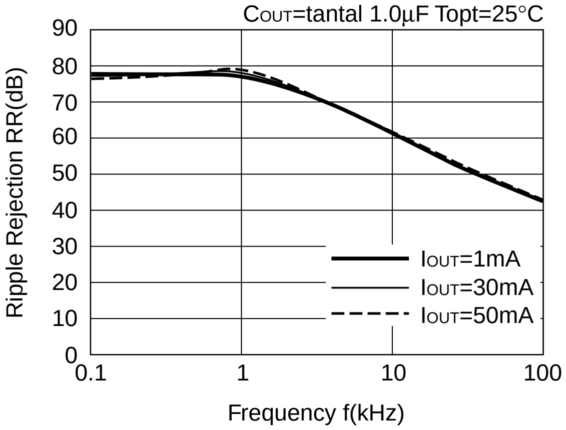

**1.5V (VR2)**

$V_{IN}$=2.5V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C



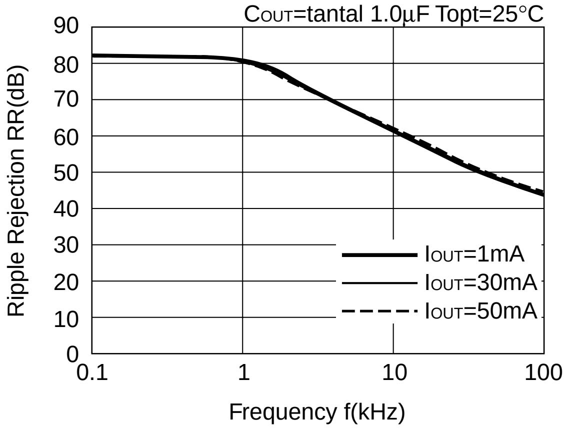

**2.8V (VR1)**

$V_{IN}$=3.8V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



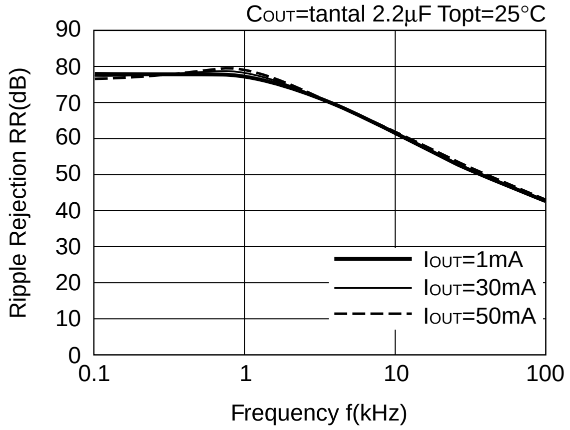

**2.8V (VR2)**

$V_{IN}$=3.8V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



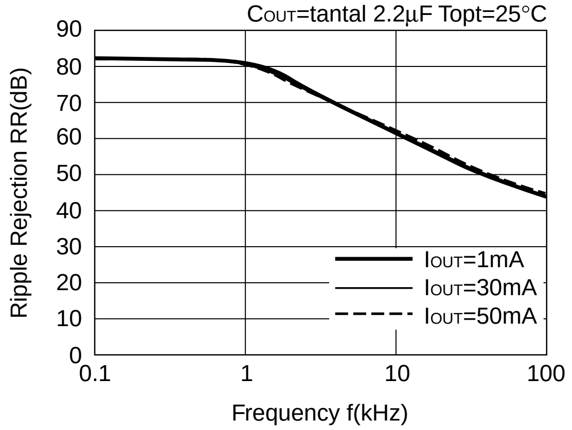
**2.8V (VR1)**

$V_{IN}$=3.8V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C



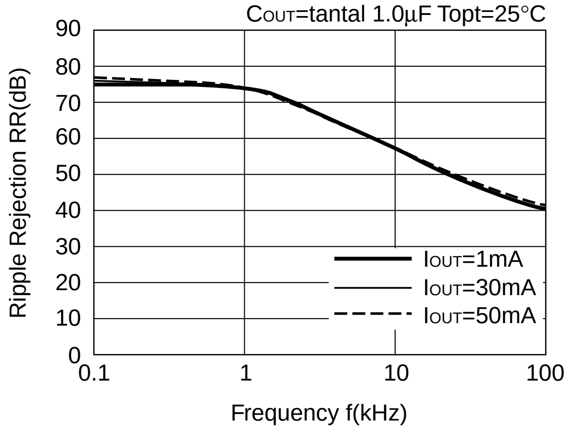

**2.8V (VR2)**

$V_{IN}$=3.8V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C



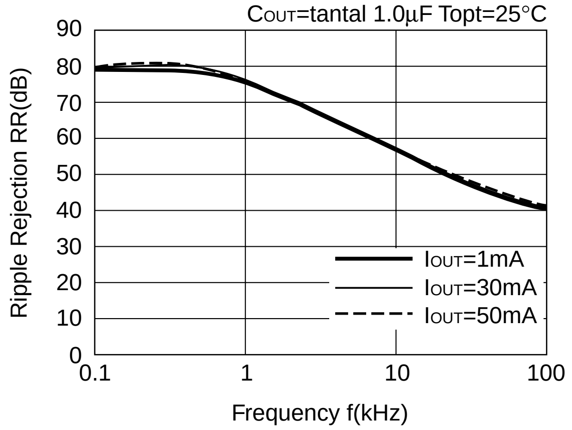

**4.0V (VR1)**

$V_{IN}$=5.0V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



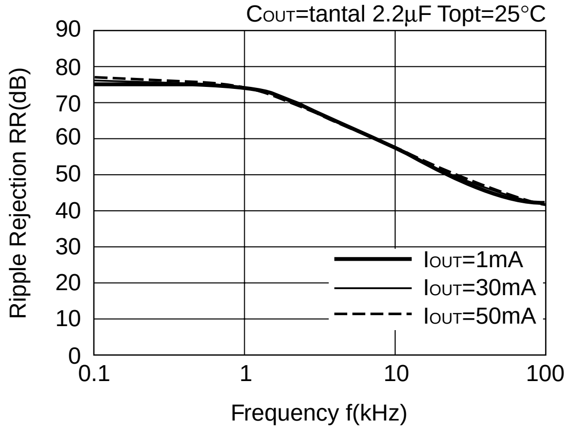

**4.0V (VR2)**

$V_{IN}$=5.0V+0.5Vp-p
$C_{OUT}$=tantal 1.0µF Topt=25°C



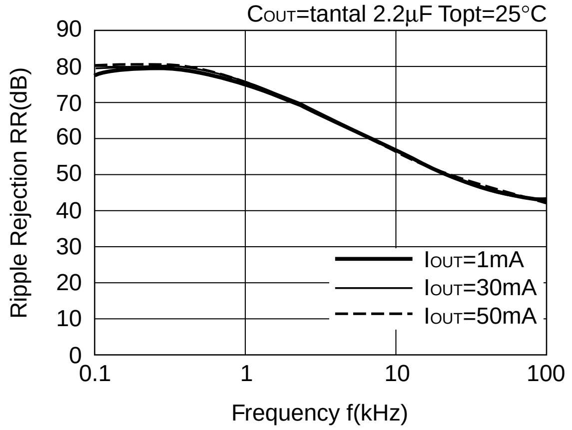

**4.0V (VR1)**

$V_{IN}$=5.0V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C



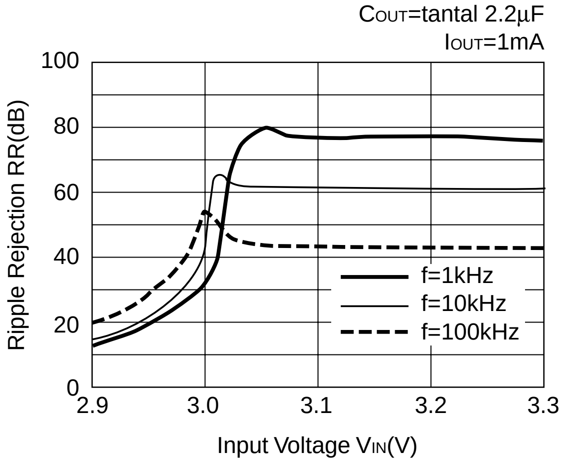

**4.0V (VR2)**

$V_{IN}$=5.0V+0.5Vp-p
$C_{OUT}$=tantal 2.2µF Topt=25°C

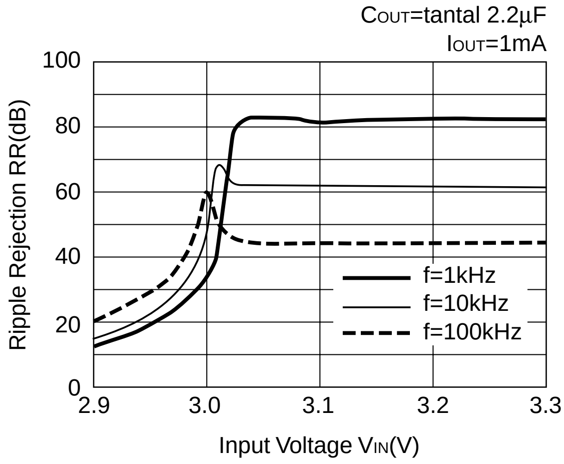


9) Ripple Rejection vs. Input Voltage (DC bias)

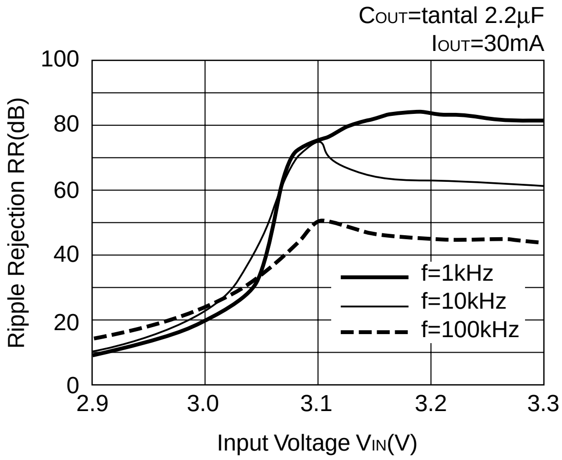
**2.8V (VR1)**



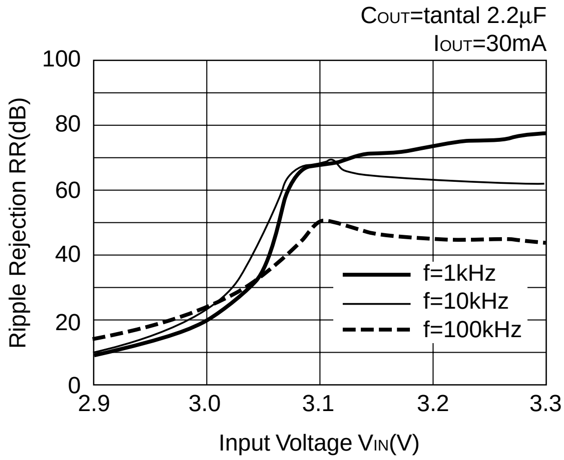

**2.8V (VR2)**



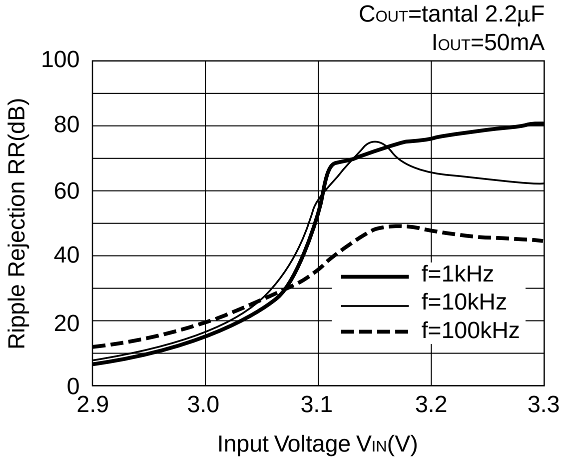

**2.8V (VR1)**



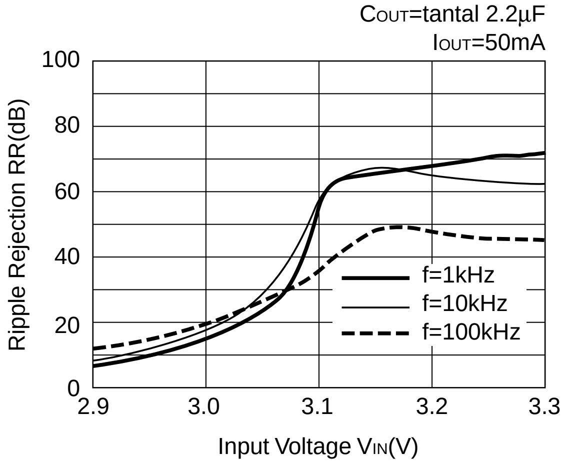

**2.8V (VR2)**



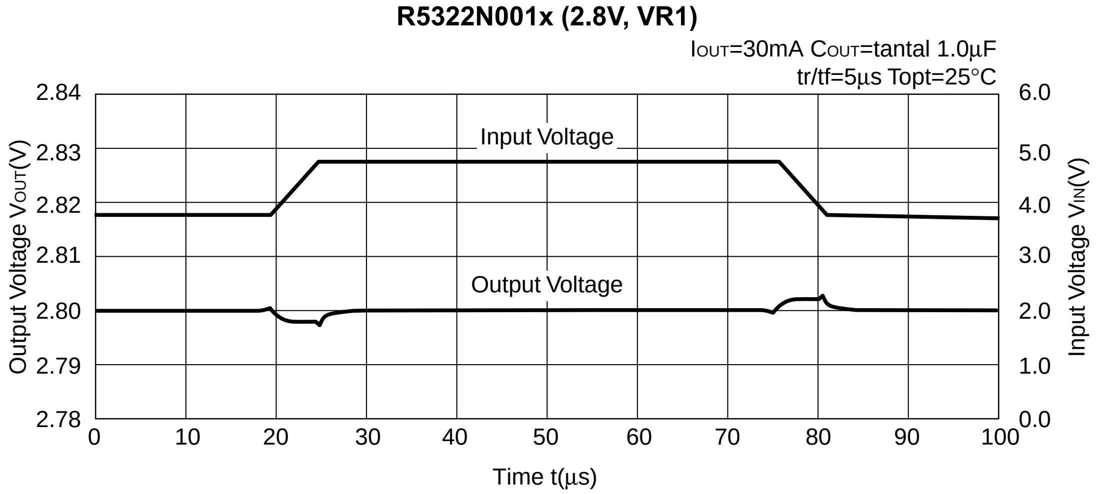

**2.8V (VR1)**

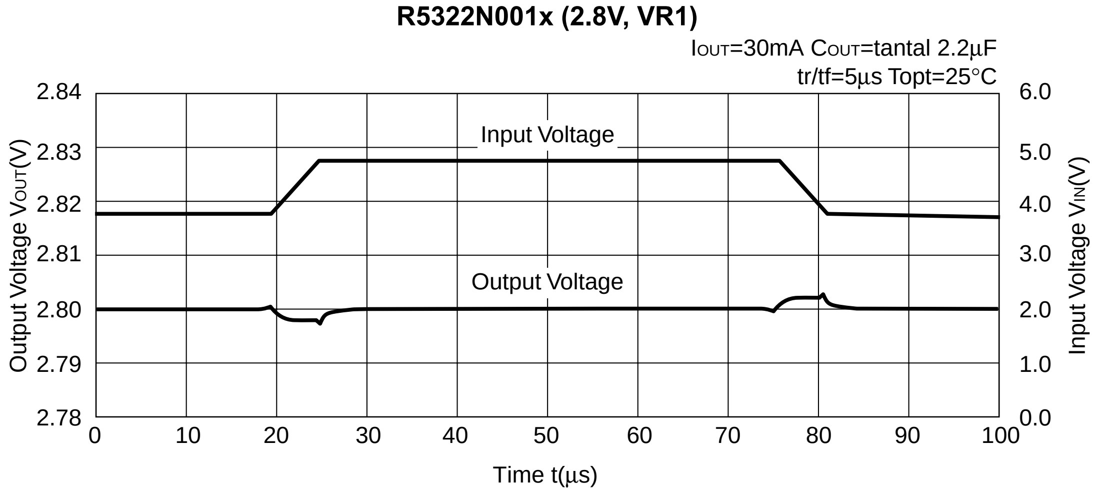


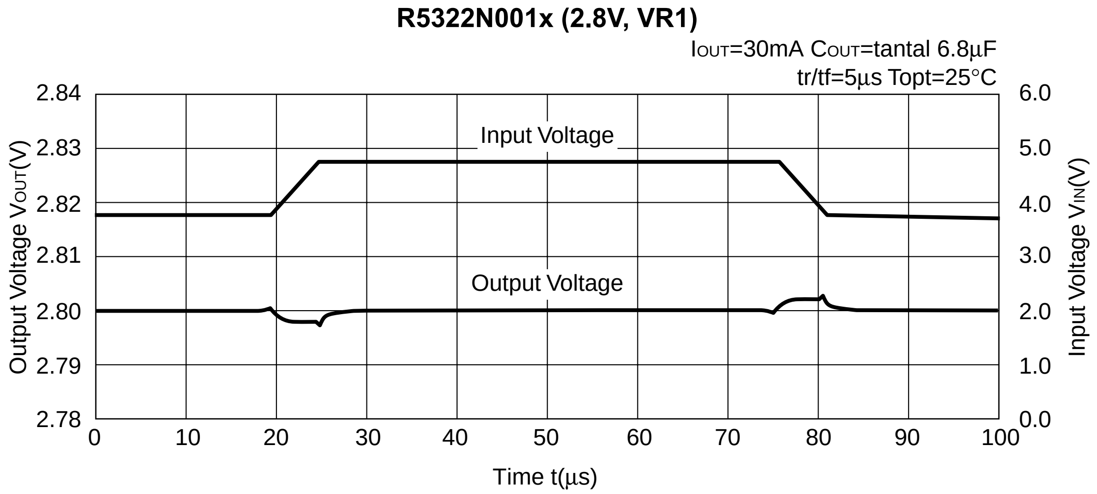

**2.8V (VR2)**



10) Input Transient Response

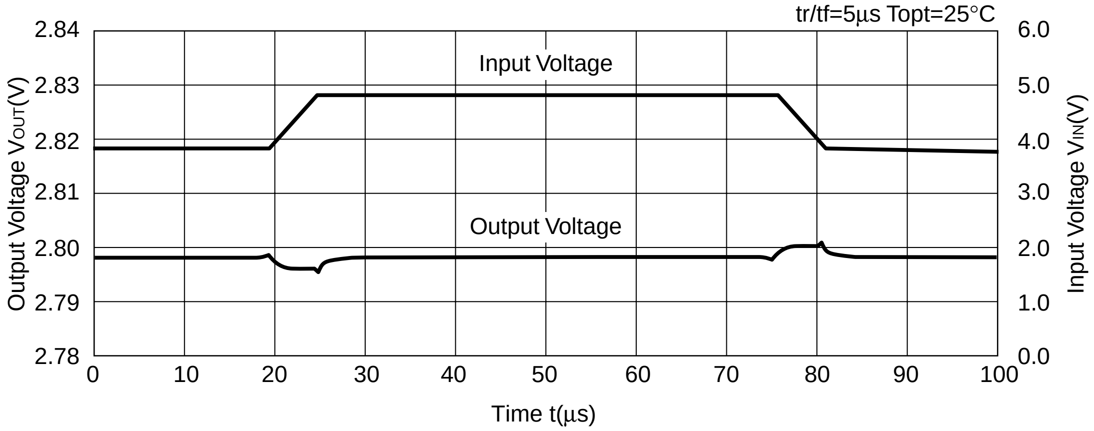


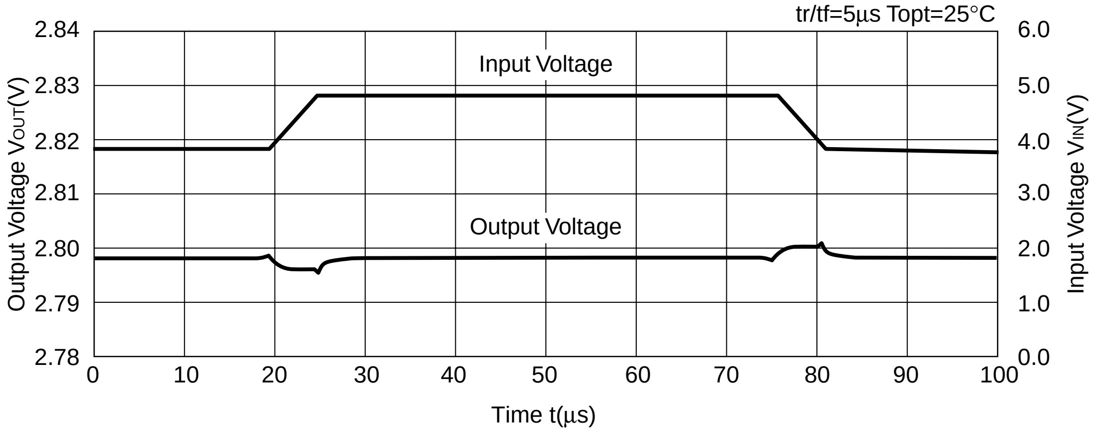
**R5322N001x (2.8V, VR2)**

$I_{OUT}$=30mA $C_{OUT}$=tantal 1.0µF
tr/tf=5µs Topt=25°C



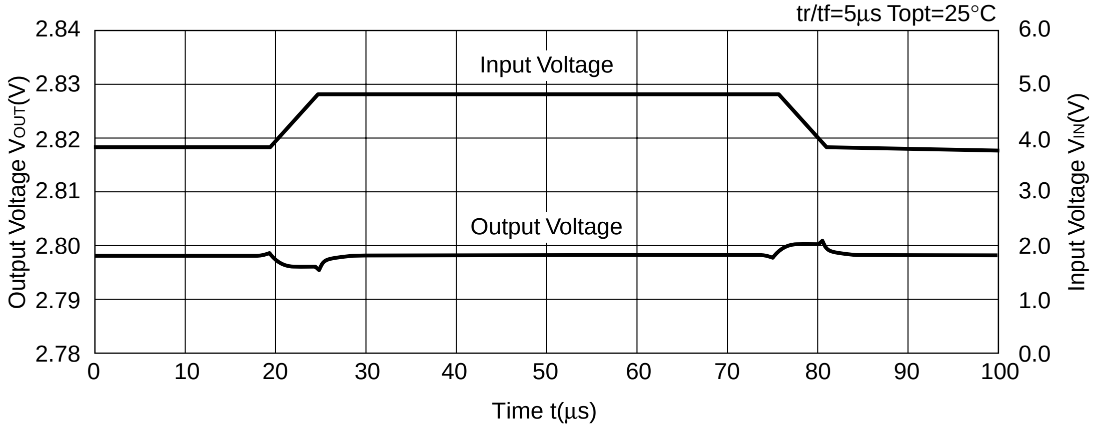

**R5322N001x (2.8V, VR2)**

$I_{OUT}$=30mA $C_{OUT}$=tantal 2.2µF
tr/tf=5µs Topt=25°C




**R5322N001x (2.8V, VR2)**

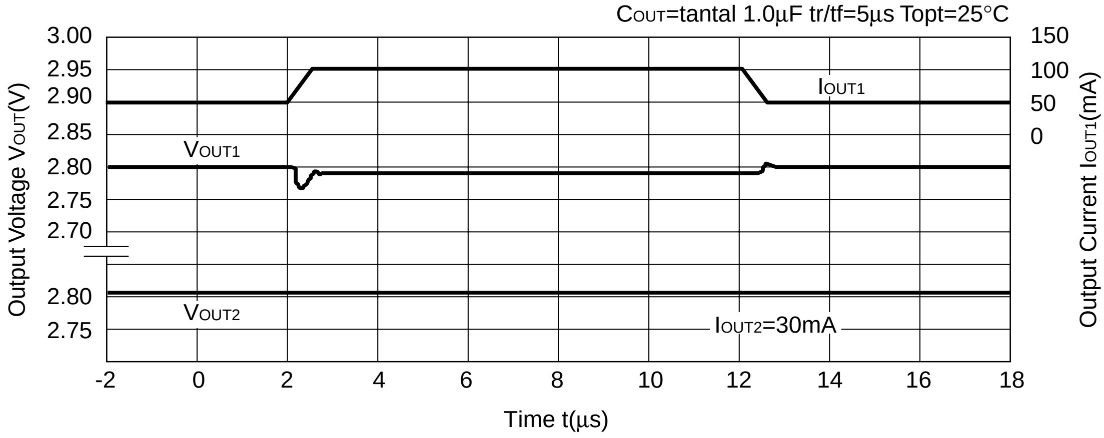
$I_{OUT}$=30mA $C_{OUT}$=tantal 6.8µF
tr/tf=5µs Topt=25°C



11) Load Transient Response

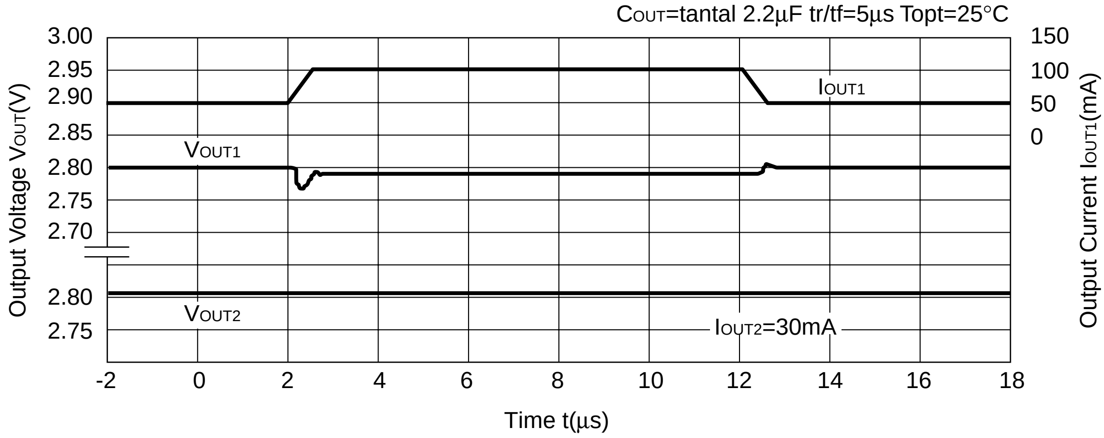
**R5322N001x (VR1=2.8V)**

$I_{OUT}$=50mA ⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 1.0µF tr/tf=5µs Topt=25°C



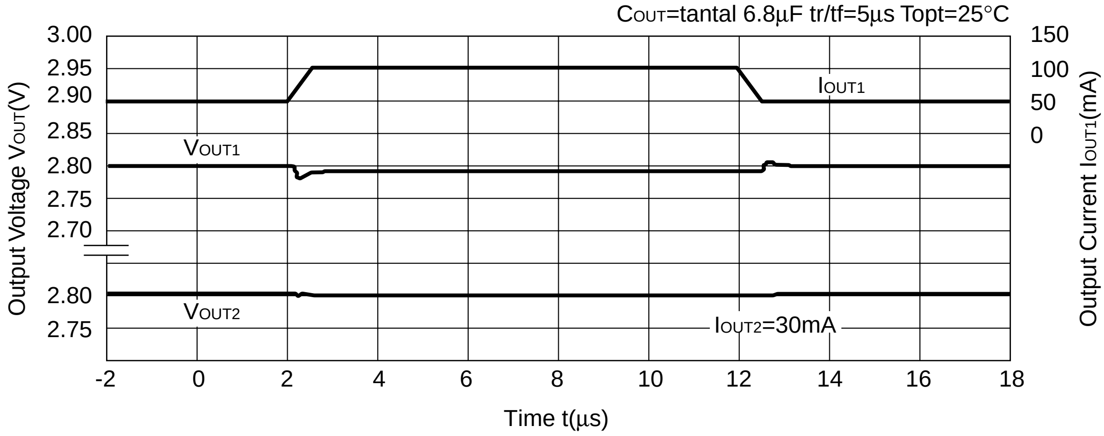

**R5322N001x (VR1=2.8V)**

$I_{OUT}$=50mA ⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 2.2µF tr/tf=5µs Topt=25°C



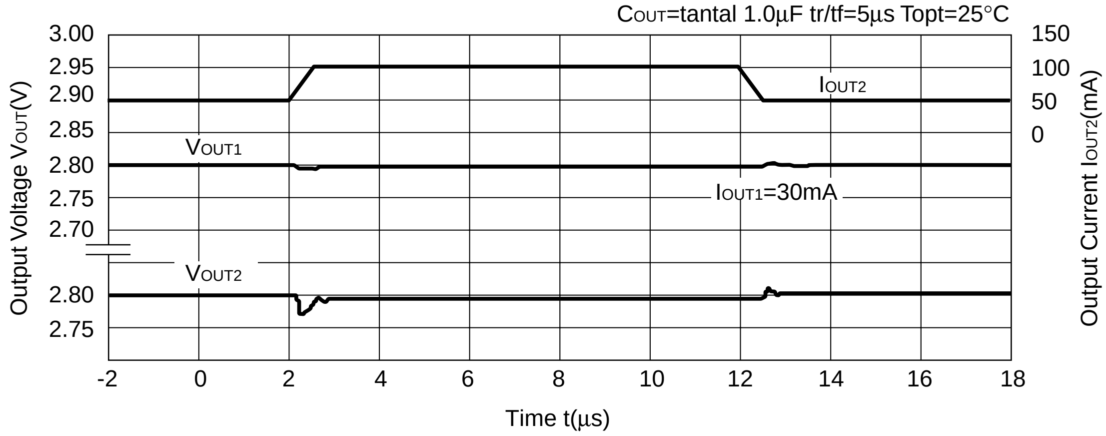

**R5322N001x (VR1=2.8V)**

$I_{OUT}$=50mA ⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 6.8µF tr/tf=5µs Topt=25°C



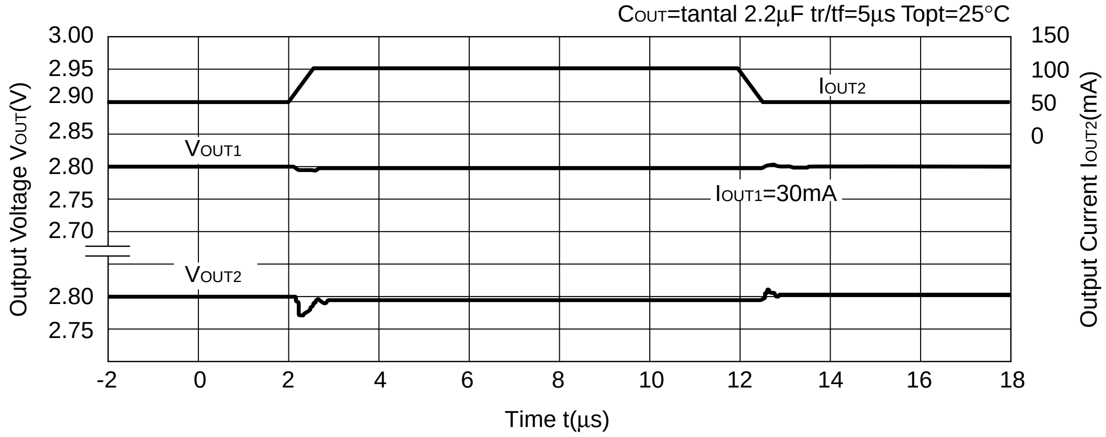
**R5322N001x (VR2=2.8V)**

$I_{OUT}$=50mA⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 1.0µF tr/tf=5µs Topt=25°C



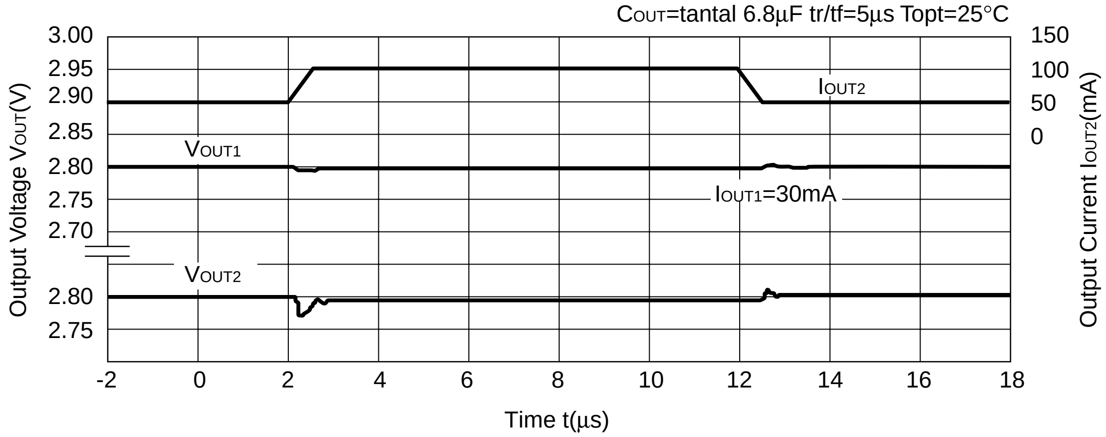

**R5322N00x (VR2=2.8V)**

$I_{OUT}$=50mA⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 2.2µF tr/tf=5µs Topt=25°C




**R5322N00x (VR2=2.8V)**

$I_{OUT}$=50mA⇔100mA $V_{IN}$=3.8V $C_{IN}$=tantal 1.0µF
$C_{OUT}$=tantal 6.8µF tr/tf=5µs Topt=25°C



# TECHNICAL NOTES

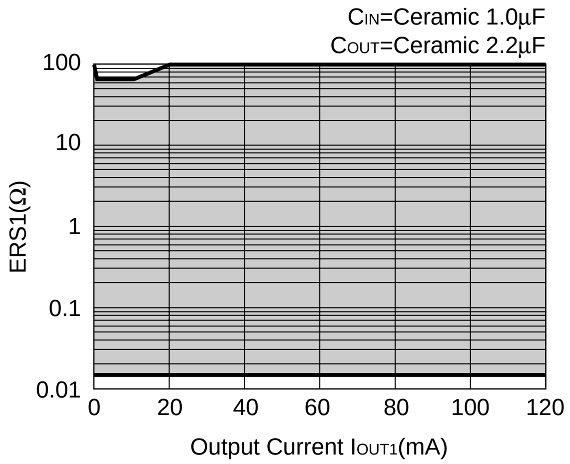
When using these ICs, consider the following points:

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 2.2µF or more capacitance $C_{OUT}$ with good frequency characteristics and ESR (Equivalent Series Resistance) of which is in the range described as follows:

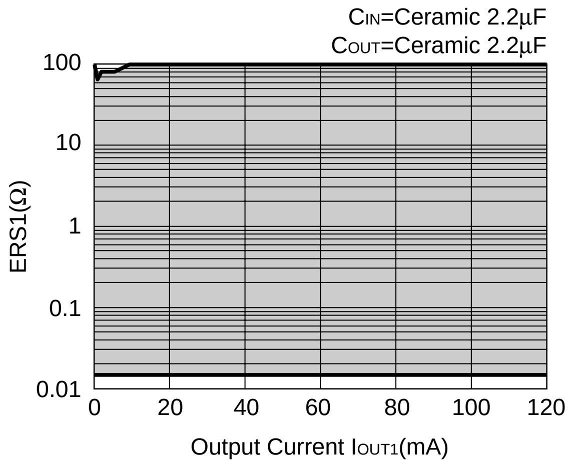
The relations between $I_{OUT}$ (Output Current) and ESR of Output Capacitor are shown below. The conditions when the white noise level is under 40µV (Avg.) are marked as the hatched area in the graph.
(Note: When a ceramic capacitor is connected to the Output Pin as Output capacitor for phase compensation, the operation might be unstable unless as much as 1W resistor is connected between the capacitor and GND instead of ESR. Test these ICs with as same external components as ones to be used on the PCB.)

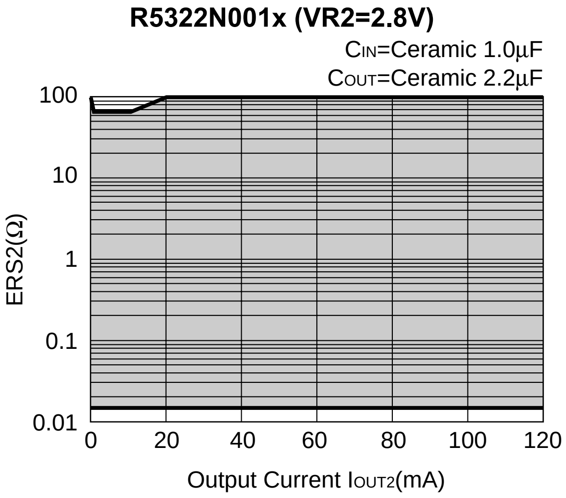
<Test conditions>
(1) $V_{IN}$=3.8V
(2) Frequency band: 10Hz to 2MHz
(3) Temperature: 25°C

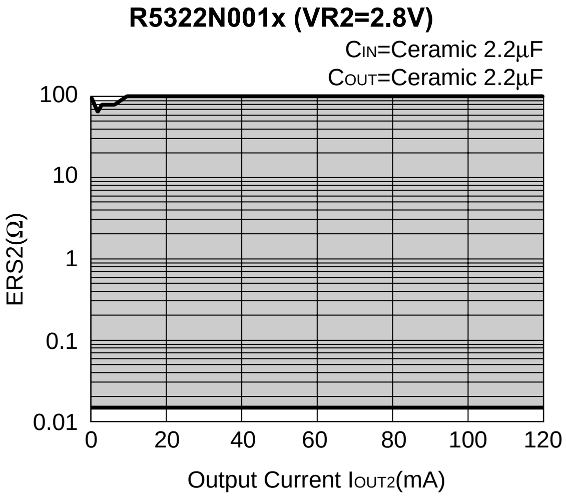
**R5322N001x (VR1=2.8V)**




**R5322N001x (VR1=2.8V)**





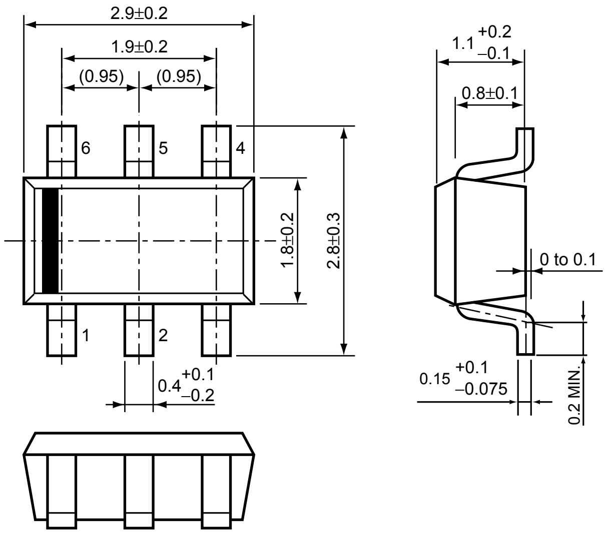




- Make $V_{DD}$ and GND line sufficient. When the impedance of these is high, the noise might be picked up or not work correctly.
- Connect the capacitor with a capacitance of 1µF or more between $V_{DD}$ and GND as close as possible.
- Set external components, especially Output Capacitor, as close as possible to the ICs and make wiring shortest.

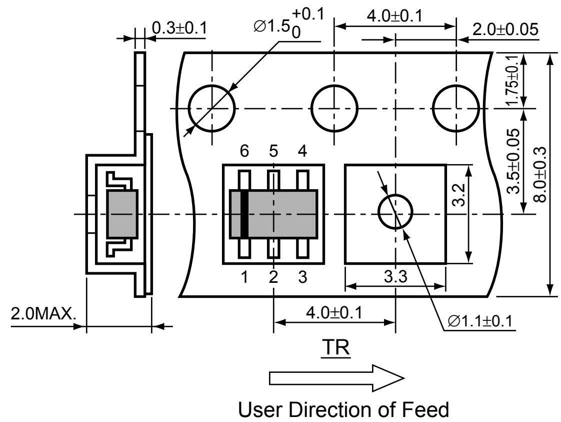
- **SOT-23-6W**

Unit: mm

## PACKAGE DIMENSIONS

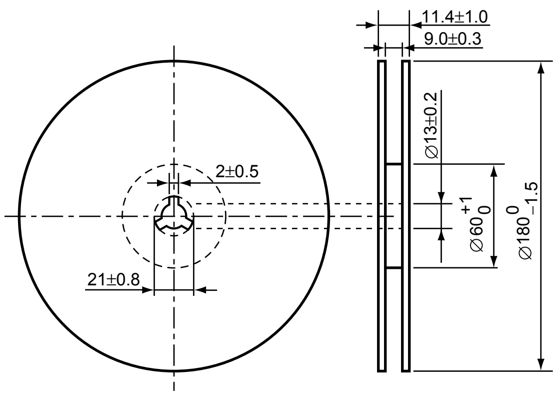



## TAPING SPECIFICATION




## TAPING REEL DIMENSIONS

(1reel=3000pcs)



# POWER DISSIPATION (SOT-23-6W)

This specification is at mounted on board. Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

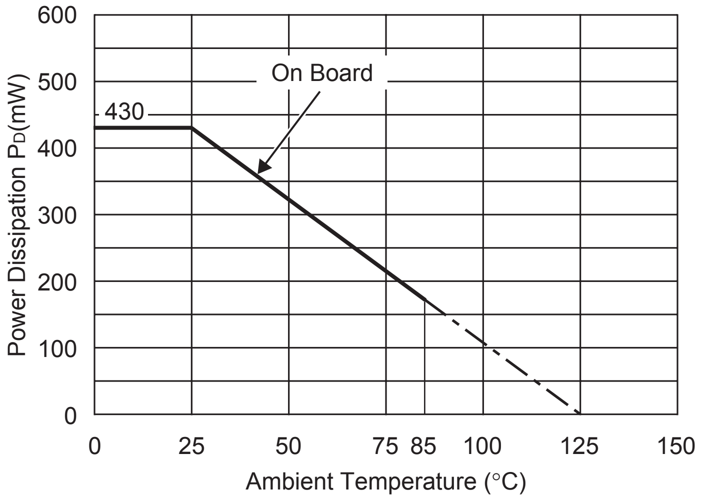
Measurement Conditions

| | Standard Land Pattern |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plactic (Double sided) |
| Board Dimensions | 40mm × 40mm × 1.6mm |
| Copper Ratio | Top side : Approx. 50% , Back side : Approx. 50% |
| Through-hole | ϕ0.5mm × 44pcs |

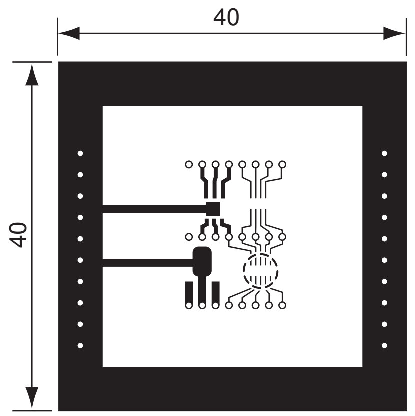
Measurement Result

(Topt=25°C,Tjmax=125°C)

| | Standard Land Pattern |
|---|---|
| Power Dissipation | 430mW |
| Thermal Resistance | θja=(125−25°C)/0.43W=233°C/W |



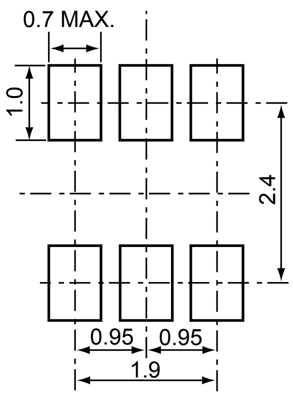

**Power Dissipation**




**Measurement Board Pattern**

IC Mount Area Unit : mm

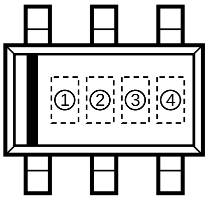
# RECOMMENDED LAND PATTERN (SOT-23-6W)




(Unit: mm)

# R5322N SERIES MARK SPECIFICATION

- **SOT-23-6W**




①, ② : Product Code (refer to Part Number vs. Product Code)

③, ④ : Lot Number

- **Part Number vs. Product Code**

| Part Number | Product Code | |
|---|---|---|
| | ① | ② |
| R5322N001B-TR | H | 0 |
| R5322N002B-TR | H | 1 |
| R5322N003B-TR | H | 2 |
| R5322N004B-TR | H | 3 |
| R5322N005B-TR | H | 4 |
| R5322N001A-TR | H | 5 |
| R5322N002A-TR | H | 6 |
| R5322N003A-TR | H | 7 |
| R5322N006B-TR | H | 8 |
| R5322N007B-TR | H | 9 |
| R5322N008B-TR | H | A |
| R5322N009B-TR | H | B |
| R5322N010B-TR | H | C |