

## LOW NOISE Dual 300mA LDO

NO. EA-131-111020

### OUTLINE

The RP150K Series are CMOS-based dual voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting Output Voltage, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance, and a chip enable function prolongs the battery life of each system. The line transient response and load transient response of the RP150 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 (1%). Since the packages for these ICs are DFN(PLP)2020-8 package, 2ch LDO regulators are included in each packages, high density mounting of the ICs on boards is possible.

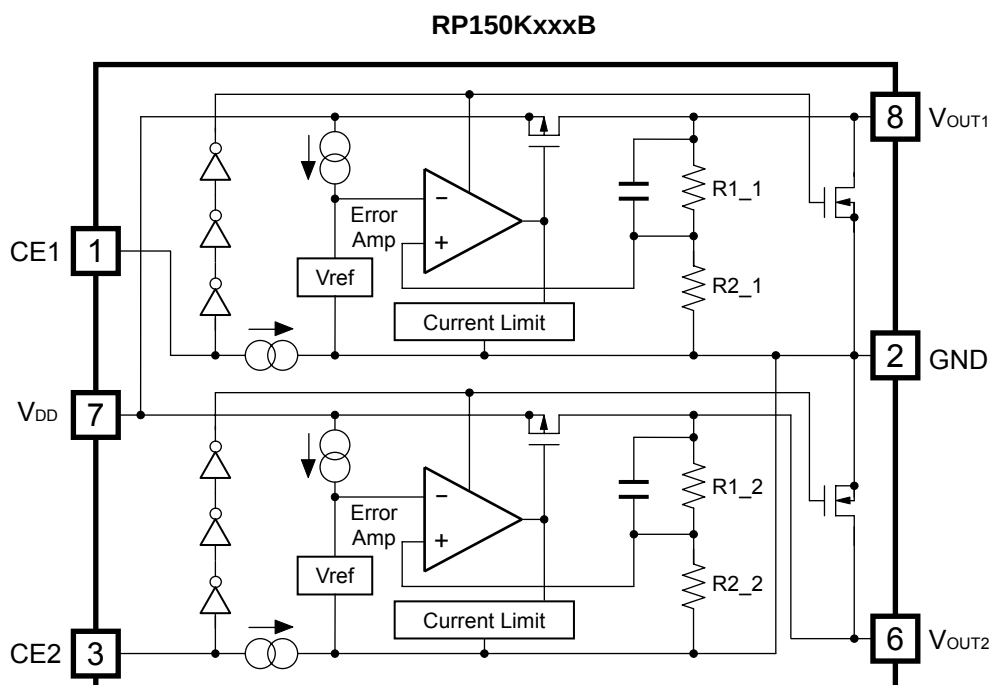
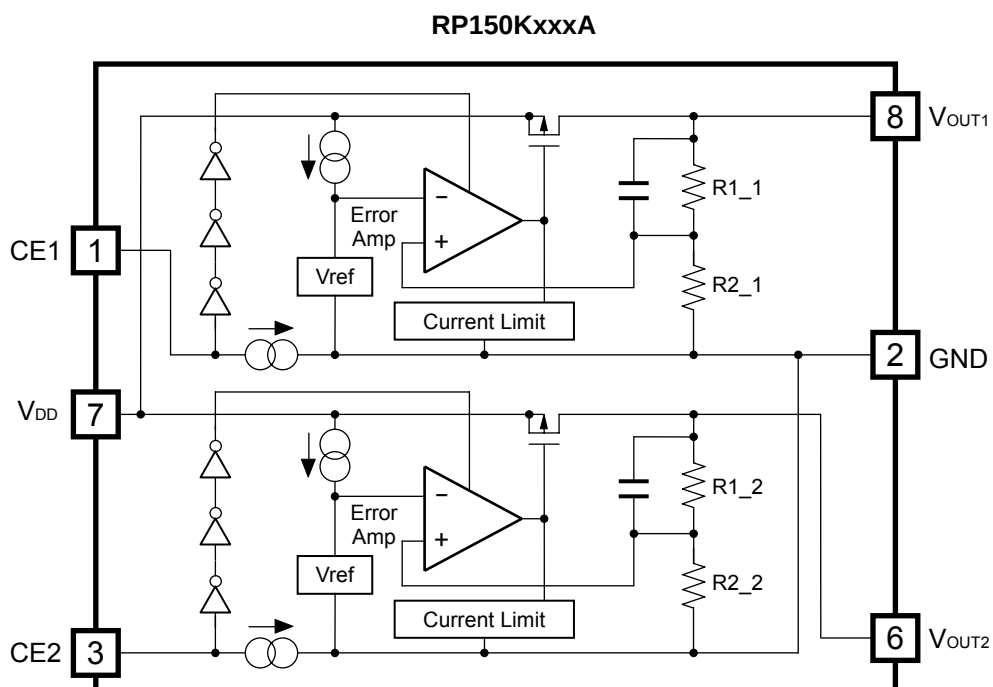
### FEATURES

- Supply Current ..... Typ.  $24\mu\text{A} \times 2$  (VR1&VR2)
- Standby Current ..... Typ.  $0.1\mu\text{A} \times 2$  (VR1&VR2)
- Dropout Voltage..... Typ. 0.21V ( $I_{\text{OUT}}=300\text{mA}$ ,  $V_{\text{OUT}}=2.8\text{V}$ )  
Typ. 0.24V ( $I_{\text{OUT}}=300\text{mA}$ ,  $V_{\text{OUT}}=2.5\text{V}$ )
- Ripple Rejection ..... Typ. 80dB ( $f=1\text{kHz}$ )
- Temperature-Drift Coefficient of Output Voltage ..... Typ.  $\pm 30\text{ppm}/^\circ\text{C}$
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy .....  $\pm 1.0\%$
- Input Voltage Range..... 2.5V to 5.25V
- Output Voltage Range..... 1.5V to 3.3V (0.1V steps)  
(For details, please refer to MARK INFORMATION.)
- Package ..... DFN(PLP)2020-8
- Built-in Fold Back Protection Circuit..... Typ. 50mA
- Built-in Auto Discharge Function ..... B Version
- Ceramic capacitors are recommended to be used with this IC ....  $C_{\text{IN}}=C_{\text{OUT}}=1.0\mu\text{F}$  or more

### APPLICATIONS

- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

## BLOCK DIAGRAMS



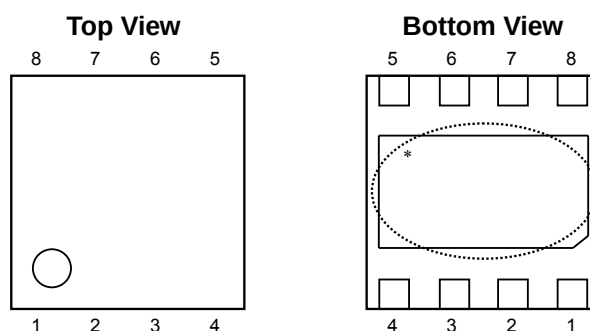
## SELECTION GUIDE

The output voltage, auto discharge function, package, and the taping type, etc. for the ICs can be selected at the user's request.

| Product Name                                                                                                                                                                                                                                                 | Package        | Quantity per Reel | Pb Free | Halogen Free |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|---------|--------------|
| RP150Kxxx*-TR                                                                                                                                                                                                                                                | DFN(PLP)2020-8 | 5,000 pcs         | Yes     | Yes          |
| xxx: The combination of output voltage for each channel can be designated by serial numbers. (from 001)<br>The output voltage for each channel can be set in the range from 1.5V to 3.3V in 0.1V steps.<br>(For details, please refer to MARK INFORMATIONs.) |                |                   |         |              |
| * : The auto discharge function at off state are options as follows.<br>(A) without auto-discharge function at off state<br>(B) with auto-discharge function at off state                                                                                    |                |                   |         |              |

## PIN CONFIGURATIONS

### • DFN(PLP)2020-8



## PIN DESCRIPTIONS

### • DFN(PLP)2020-8

| Pin No. | Symbol            | Description                    |
|---------|-------------------|--------------------------------|
| 1       | CE1               | Chip Enable Pin 1 ("H" Active) |
| 2       | GND               | Ground Pin                     |
| 3       | CE2               | Chip Enable Pin 2 ("H" Active) |
| 4       | NC                | No Connection                  |
| 5       | NC                | No Connection                  |
| 6       | V <sub>OUT2</sub> | Output Pin 2                   |
| 7       | V <sub>DD</sub>   | Input Pin                      |
| 8       | V <sub>OUT1</sub> | Output Pin 1                   |

\*) Tab is GND level. (They are connected to the reverse side of this IC.)

The tab is better to be connected to the GND, but leaving it open is also acceptable.

## ABSOLUTE MAXIMUM RATINGS

| Symbol     | Item                                | Rating                 | Unit               |
|------------|-------------------------------------|------------------------|--------------------|
| $V_{IN}$   | Input Voltage                       | 6.0                    | V                  |
| $V_{CE}$   | Input Voltage (CE Pin)              | 6.0                    | V                  |
| $V_{OUT}$  | Output Voltage                      | $-0.3$ to $V_{IN}+0.3$ | V                  |
| $I_{OUT1}$ | Output Current 1                    | 400                    | mA                 |
| $I_{OUT2}$ | Output Current 2                    | 400                    | mA                 |
| $P_D$      | Power Dissipation (DFN(PLP)2020-8)* | 880                    | mW                 |
| $T_{opt}$  | Operating Temperature Range         | $-40$ to $85$          | $^{\circ}\text{C}$ |
| $T_{stg}$  | Storage Temperature Range           | $-55$ to $125$         | $^{\circ}\text{C}$ |

\*) 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.

## ELECTRICAL CHARACTERISTICS

### • RP150KxxxA/B

$V_{IN}$ =Set  $V_{OUT}+1V$  for higher output of the regulator pair,  $I_{OUT}=1mA$ ,  $C_{IN}=C_{OUT}=1\mu F$ , unless otherwise noted.

VR1/VR2

$T_{opt}=25^{\circ}C$

| Symbol                          | Item                                            | Conditions                                                                                                                         | Min.                                      | Typ.          | Max.          | Unit             |
|---------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------|---------------|------------------|
| $V_{OUT}$                       | Output Voltage                                  | $V_{IN}=\text{Set } V_{OUT}+1V$<br>$I_{OUT}=1mA$                                                                                   | $V_{OUT} > 2.0V$                          | $\times 0.99$ | $\times 1.01$ | V                |
|                                 |                                                 |                                                                                                                                    | $V_{OUT} \leq 2.0V$                       | -20           | +20           | mV               |
| $I_{OUT}$                       | Output Current                                  |                                                                                                                                    | 300                                       |               |               | mA               |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load Regulation                                 | $1mA \leq I_{OUT} \leq 200mA$                                                                                                      |                                           | 20            | 40            | mV               |
| $V_{DIF}$                       | Dropout Voltage                                 | $I_{OUT}=300mA$                                                                                                                    | $1.5V \leq \text{Set } V_{OUT} < 1.7V$    | 0.40          | 1.00          | V                |
|                                 |                                                 |                                                                                                                                    | $1.7V \leq \text{Set } V_{OUT} < 2.0V$    | 0.34          | 0.80          |                  |
|                                 |                                                 |                                                                                                                                    | $2.0V \leq \text{Set } V_{OUT} < 2.5V$    | 0.29          | 0.50          |                  |
|                                 |                                                 |                                                                                                                                    | $2.5V \leq \text{Set } V_{OUT} < 2.8V$    | 0.24          | 0.38          |                  |
|                                 |                                                 |                                                                                                                                    | $2.8V \leq \text{Set } V_{OUT} \leq 3.3V$ | 0.21          | 0.34          |                  |
| $I_{SS}$                        | Supply Current                                  | $I_{OUT}=0mA$                                                                                                                      |                                           | 24            | 33            | $\mu A$          |
| $I_{standby}$                   | Standby Current                                 | $V_{CE}=0V$                                                                                                                        |                                           | 0.1           | 3.0           | $\mu A$          |
| $\Delta V_{OUT}/\Delta V_{IN}$  | Line Regulation                                 | Set $V_{OUT}+0.5V \leq V_{IN} \leq 5.0V$<br>(In case that $V_{OUT} \leq 2.0V$ ,<br>$2.5V \leq V_{IN} \leq 5.0V$ )                  |                                           | 0.02          | 0.10          | %/V              |
| RR                              | Ripple Rejection                                | $f=1kHz$ , Ripple 0.2Vp-p<br>$V_{IN}=\text{Set } V_{OUT}+1V$ , $I_{OUT}=30mA$<br>(In case that $V_{OUT} \leq 2.0V$ , $V_{IN}=3V$ ) |                                           | 80            |               | dB               |
| $V_{IN}$                        | Input Voltage*                                  |                                                                                                                                    | 2.5                                       |               | 5.25          | V                |
| $\Delta V_{OUT}/\Delta T_{opt}$ | Output Voltage Temperature Coefficient          | $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$                                                                                       |                                           | $\pm 30$      |               | ppm/ $^{\circ}C$ |
| $I_{SC}$                        | Short Current Limit                             | $V_{OUT}=0V$                                                                                                                       |                                           | 50            |               | mA               |
| $I_{PD}$                        | CE Pull-down Current                            |                                                                                                                                    | 0.05                                      | 0.3           | 0.6           | $\mu A$          |
| $V_{CEH}$                       | CE Input Voltage "H"                            |                                                                                                                                    | 1.5                                       |               | 6.0           | V                |
| $V_{CEL}$                       | CE Input Voltage "L"                            |                                                                                                                                    |                                           |               | 0.3           | V                |
| en                              | Output Noise                                    | BW=10Hz to 100kHz                                                                                                                  |                                           | 30            |               | $\mu V_{rms}$    |
| $R_{LOW}$                       | Low Output Nch Tr. ON Resistance (of B version) | $V_{IN}=4.0V$<br>$V_{CE}=0V$                                                                                                       |                                           | 30            |               | $\Omega$         |

\*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.

#### 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.

## TECHNICAL NOTES

When using these ICs, consider the following points:

### PCB Layout

Make  $V_{DD}$  and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result.

Connect a capacitor with a capacitance value as much as  $1.0\mu\text{F}$  or more as  $C1$  between  $V_{DD}$  and GND pin, and as close as possible to the pins.

Set the output capacitors  $C2$  and  $C3$  for phase compensation, as close as possible to the ICs, and make wiring as short as possible.

### Phase Compensation

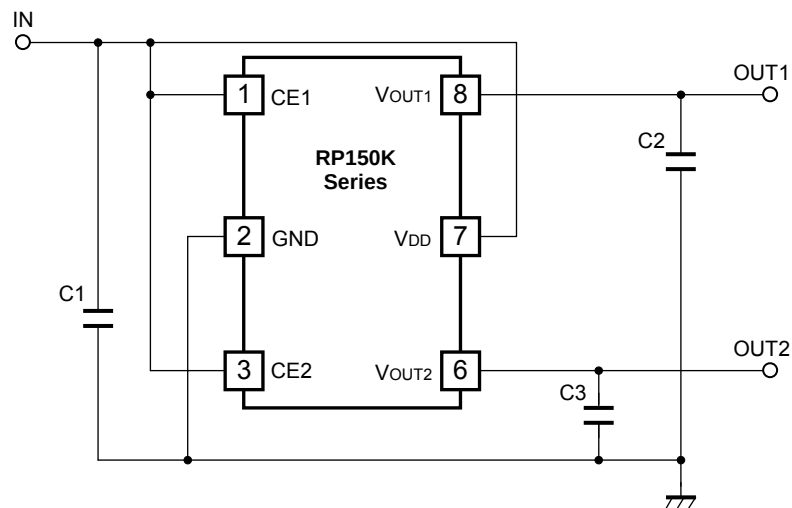
In these ICs, phase compensation is made for securing stable operation even if the load current is varied.

For this purpose, connect capacitors with a capacitance value as much as  $1.0\mu\text{F}$  or more as  $C2$  and  $C3$  with good frequency characteristics and ESR (Equivalent Series Resistance) between  $V_{OUT}$  and GND pin, and as close as possible to the pins.

If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics.

Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit with actual using capacitors.

## TYPICAL APPLICATIONS

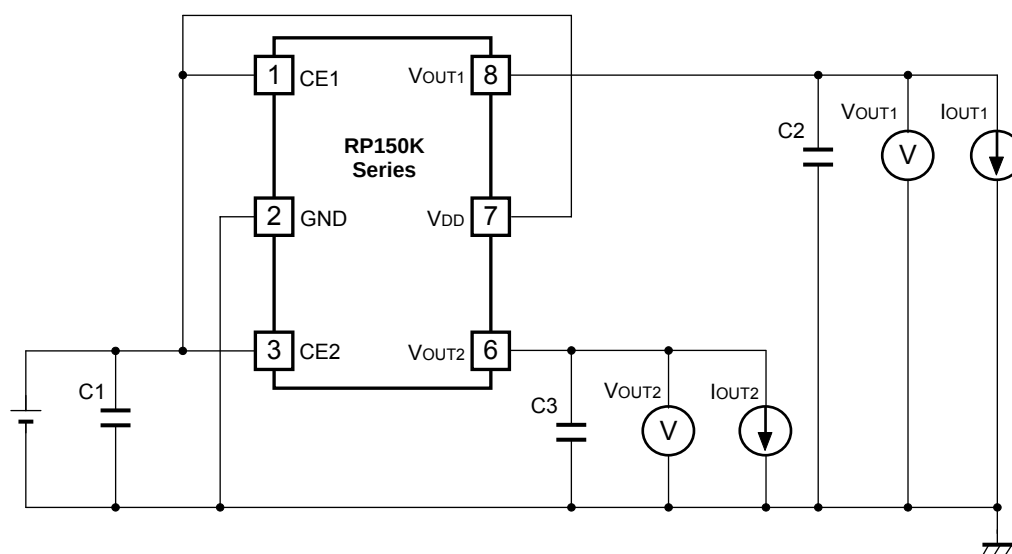


(External Components)

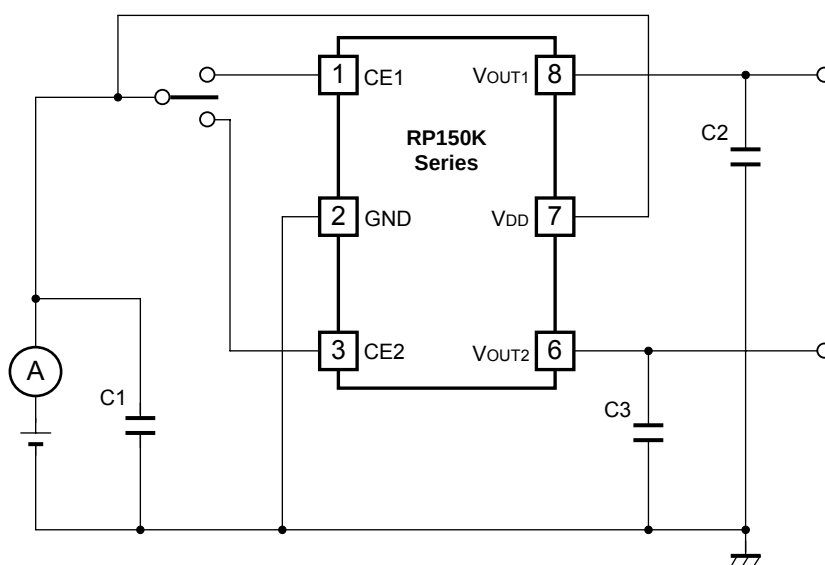
Output Capacitor ; Ceramic Type

|                   |         |                   |
|-------------------|---------|-------------------|
| 1.0 $\mu\text{F}$ | Kyocera | CM05X5R105KD6AB   |
|                   | TDK     | C1005JB0J105K     |
|                   | Murata  | GRM155B31A105KE15 |

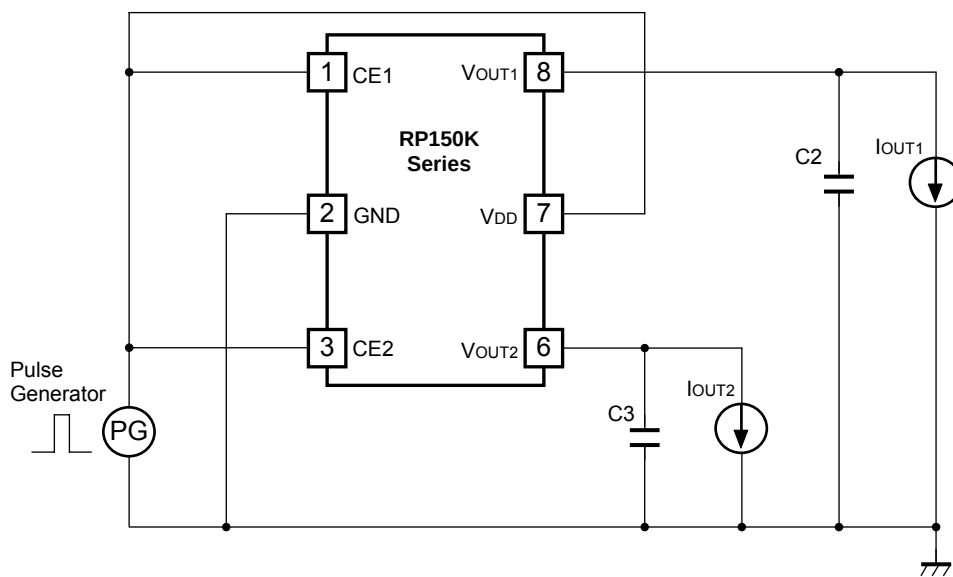
## TEST CIRCUITS



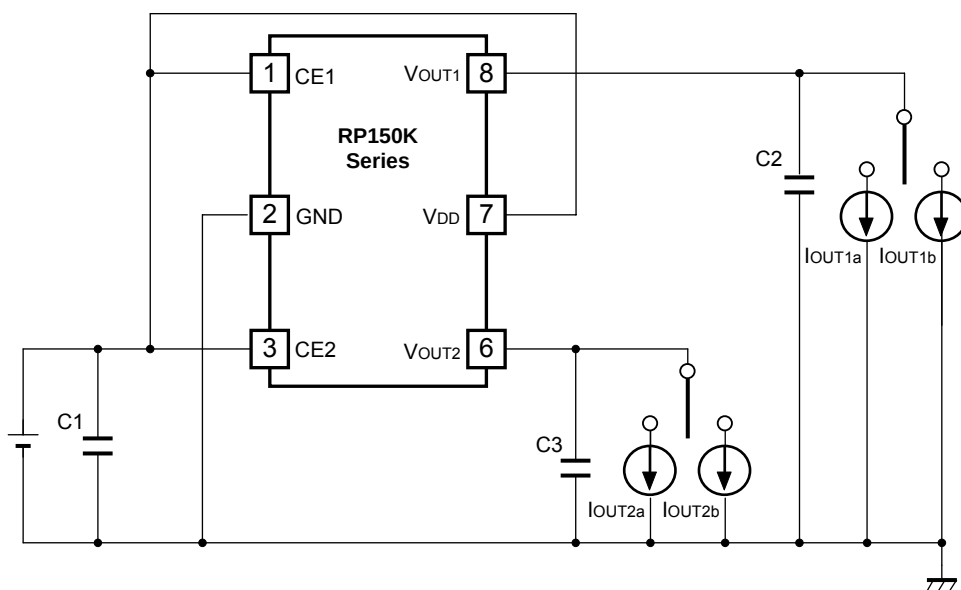
Standard test Circuit



Supply Current Test Circuit



**Ripple Rejection Test Circuit**

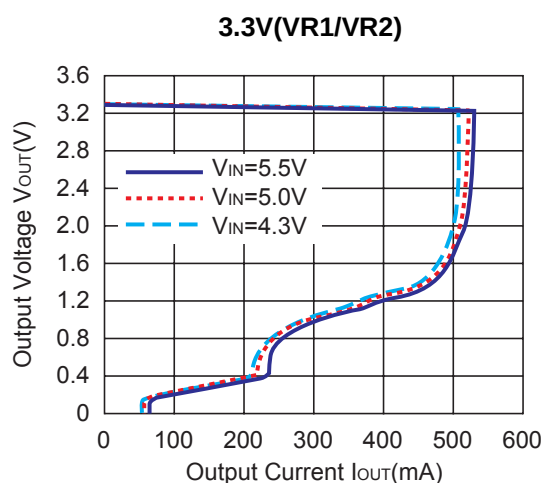
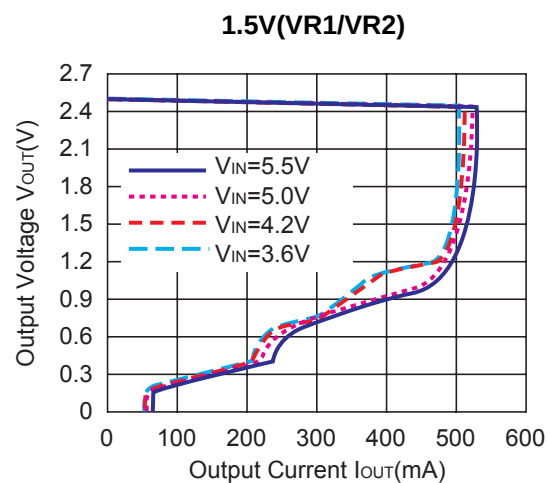
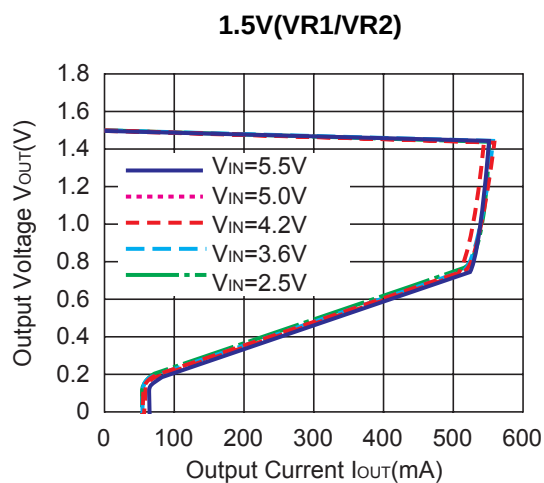


**Load Transient Response Test Circuit**

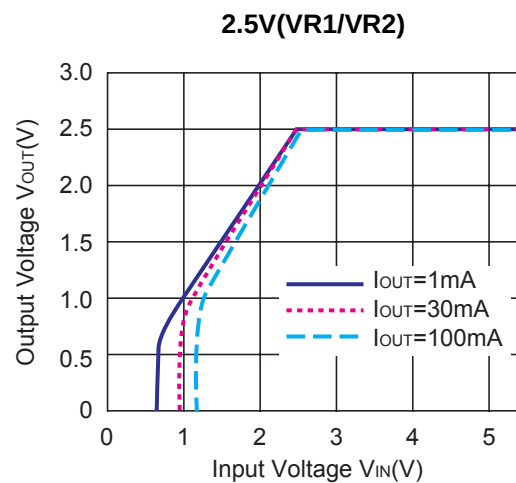
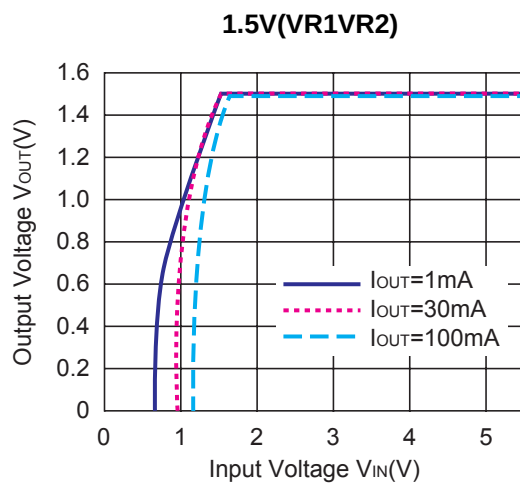


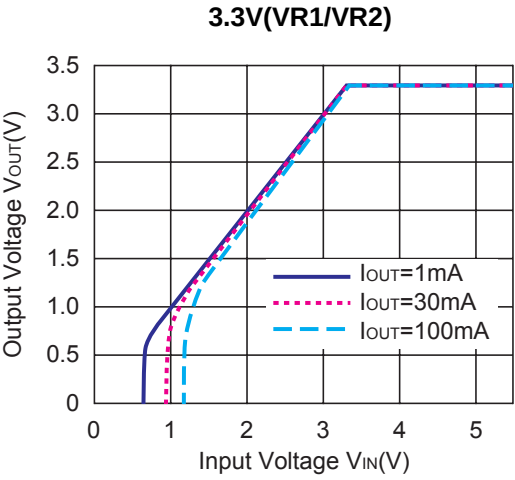
## TYPICAL CHARACTERISTICS

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

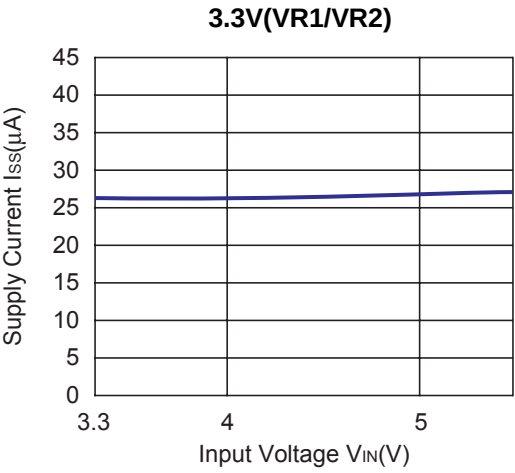
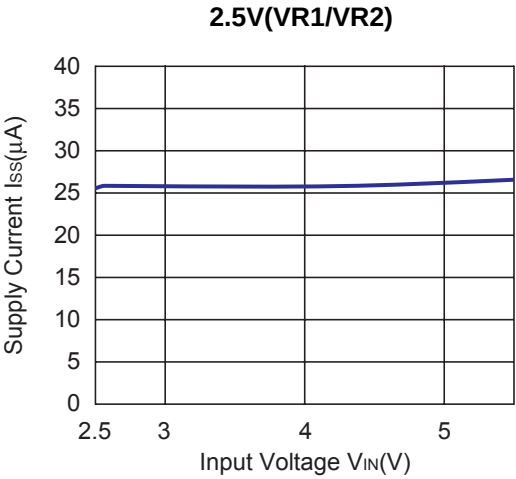
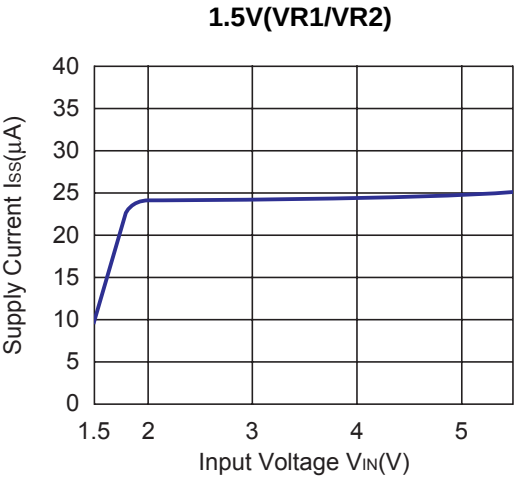


### 2) Output Voltage vs. Input Voltage ( $T_{opt}=25^{\circ}\text{C}$ )



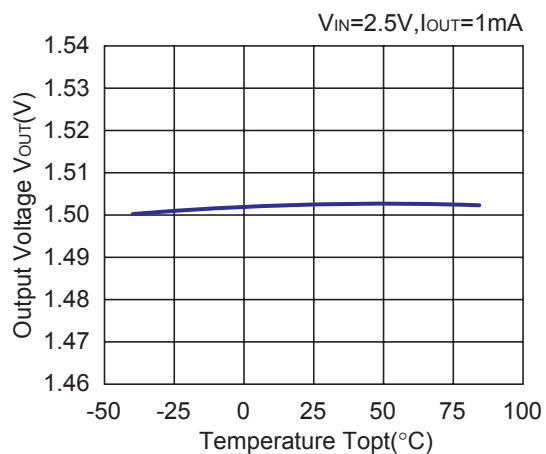


3) Supply Current vs. Input Voltage ( $T_{opt}=25^{\circ}C$ )

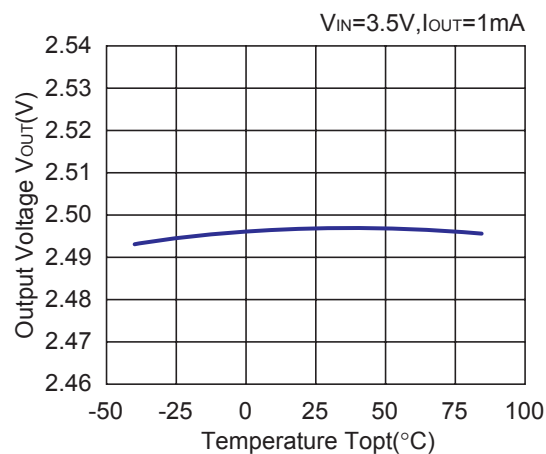


#### 4) Output Voltage vs. Temperature

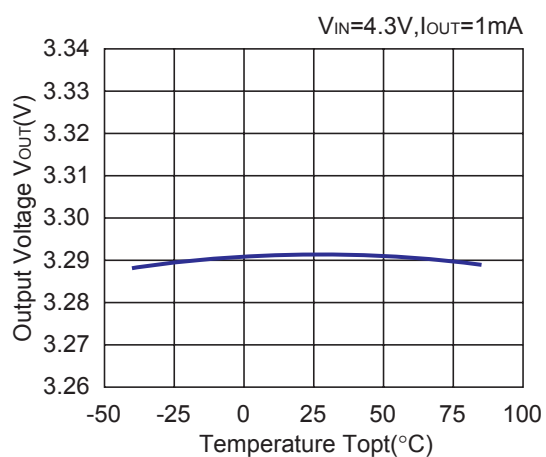
##### 1.5V(VR1/VR2)



##### 2.5V(VR1/VR2)

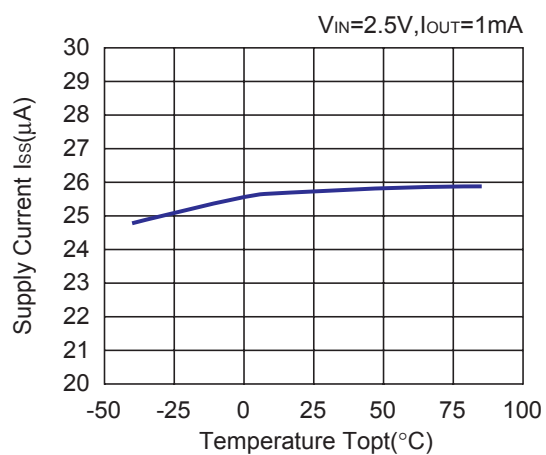


##### 3.3V(VR1/VR2)

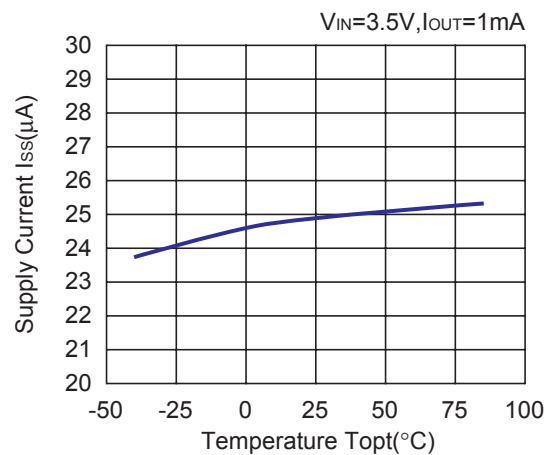


#### 5) Supply Current vs. Temperature

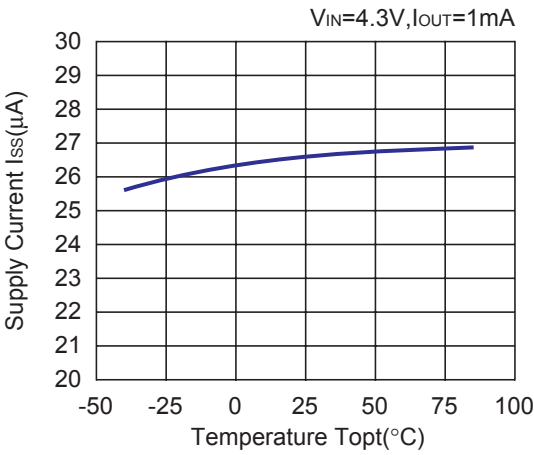
##### 1.5V(VR1/VR2)



##### 2.5V(VR1/VR2)

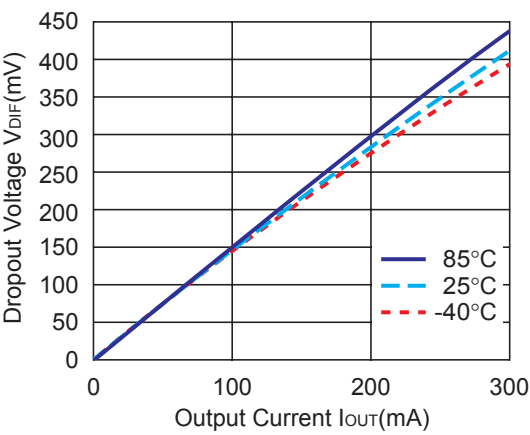


3.3V(VR1/VR2)

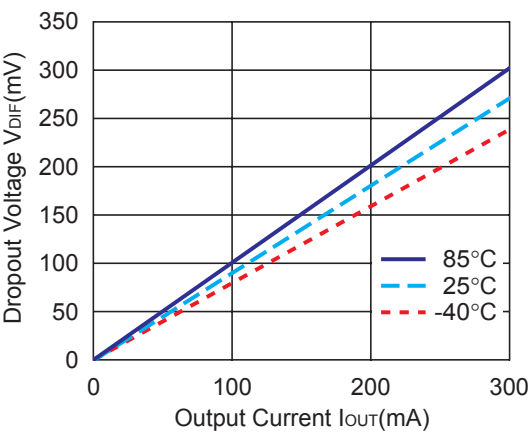


6) Dropout Voltage vs. Output Current

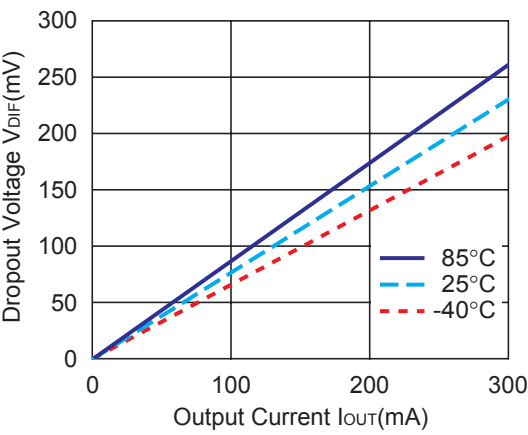
1.5V(VR1/VR2)



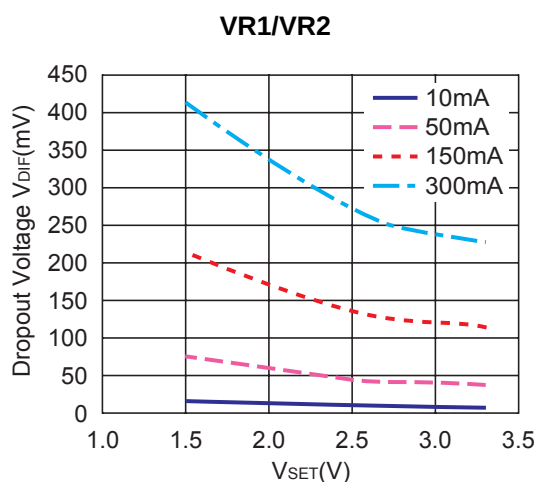
2.5V(VR1/VR2)



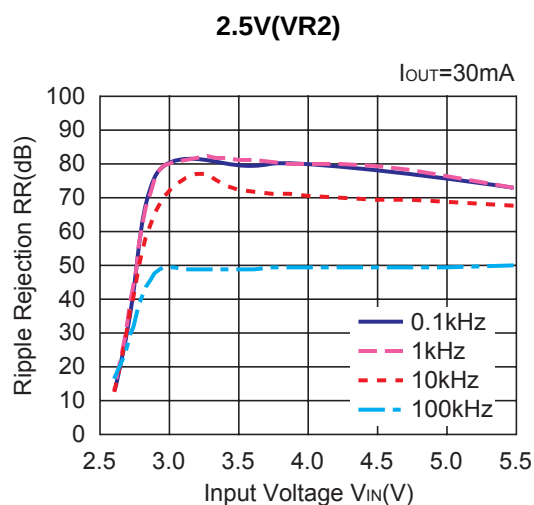
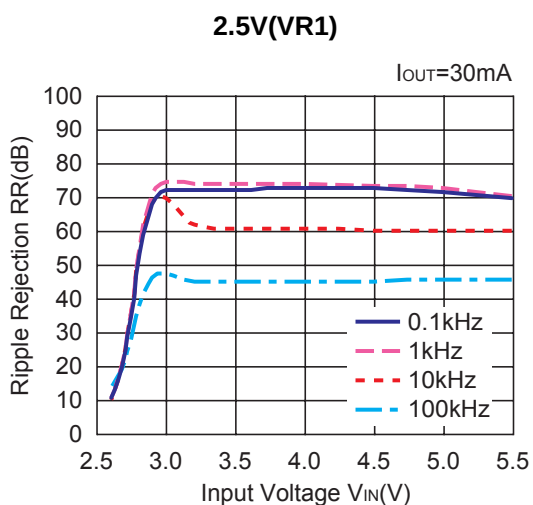
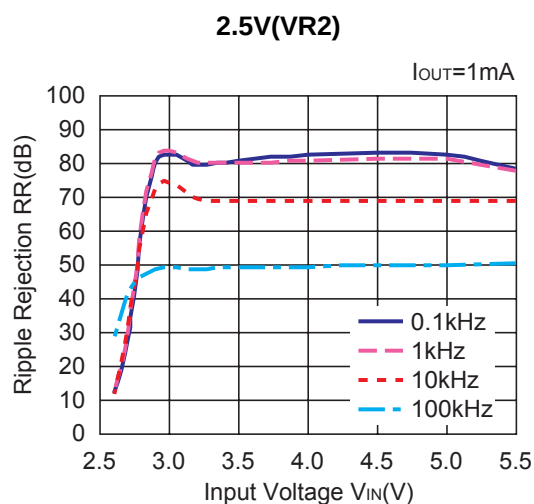
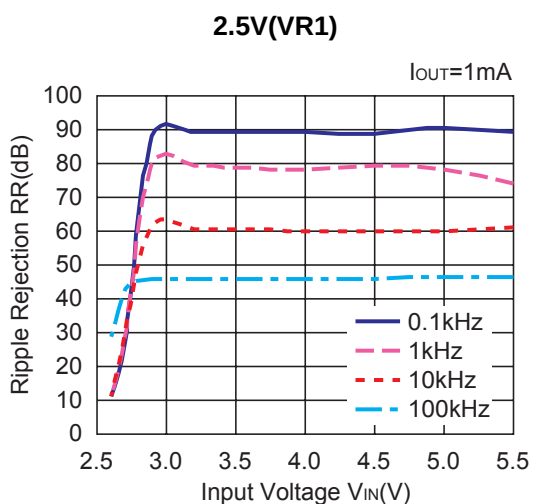
3.3V(VR1/VR2)

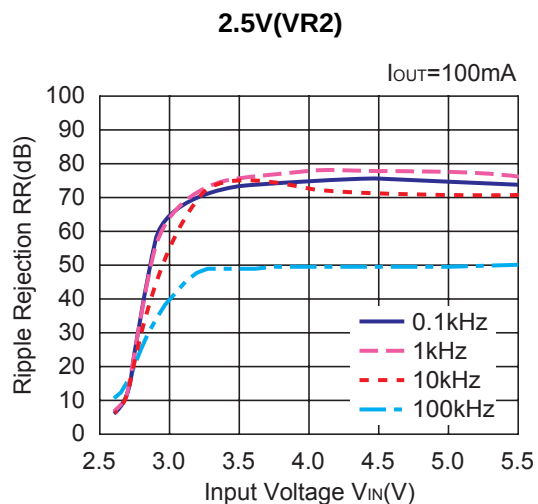
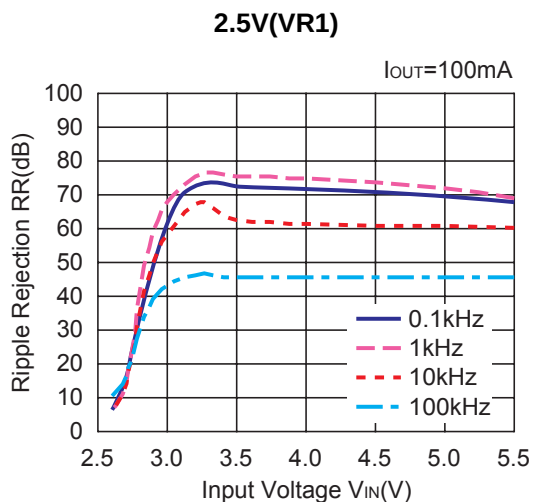


## 7) Dropout Voltage vs. VR\_VSET

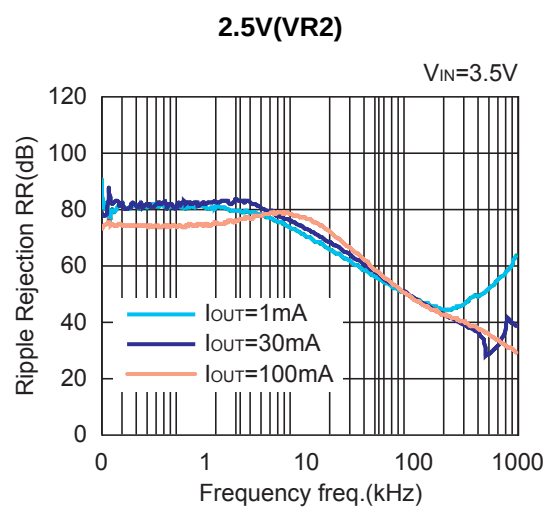
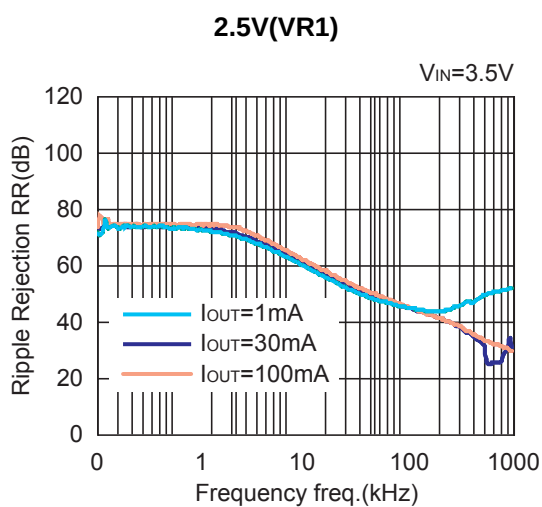
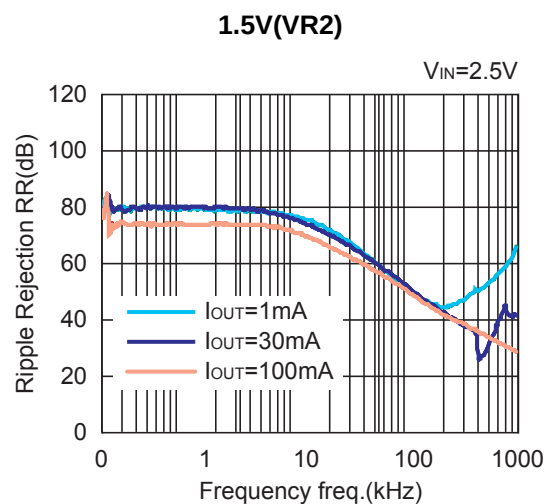
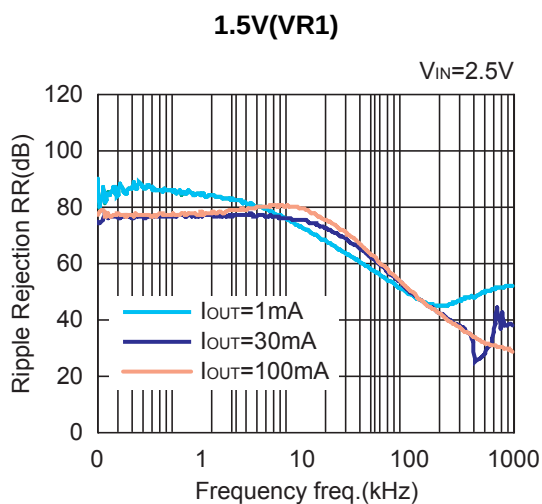


## 8) Ripple Rejection vs. Input Bias (Input Ripple=0.5Vp-p, $T_{opt}=25^{\circ}\text{C}$ )

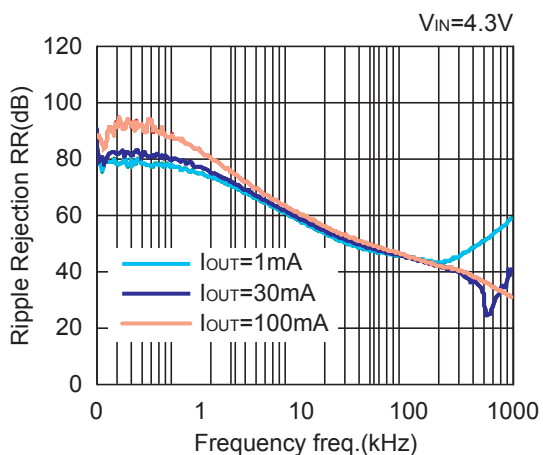




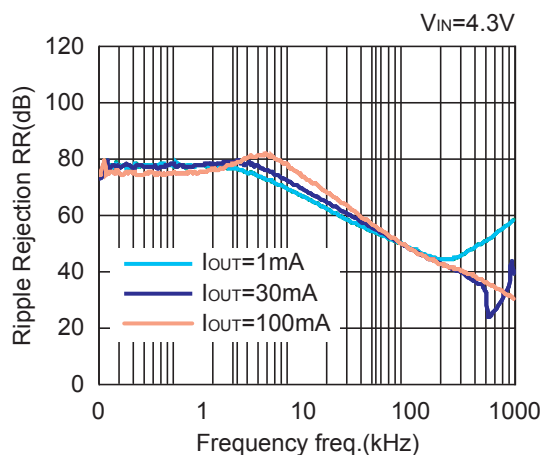
### 9) Ripple Rejection vs. Frequency (Ripple=0.5Vp-p)



3.3V(VR1)

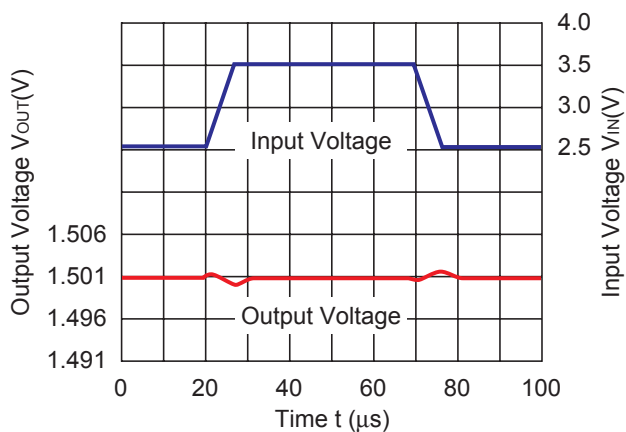


3.3V(VR2)

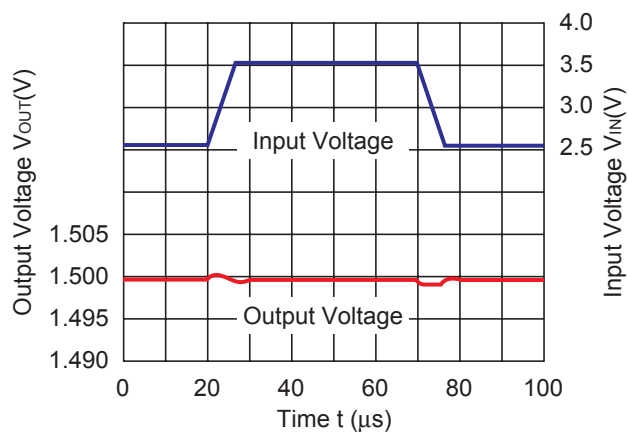


# 10) Input Transient Response ( $t_r=t_f=5\mu s$ , $T_{opt}=25^\circ C$ )

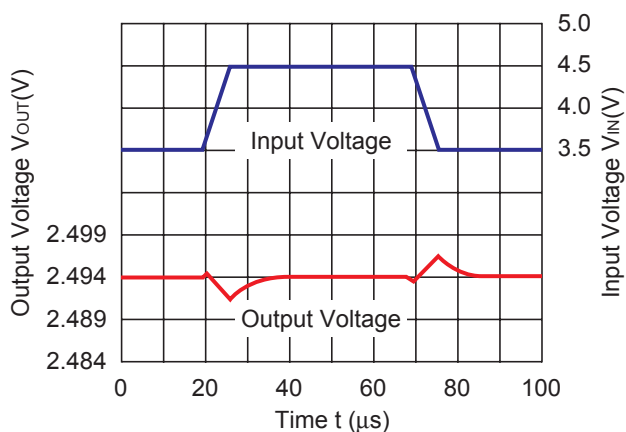
1.5V(VR1)



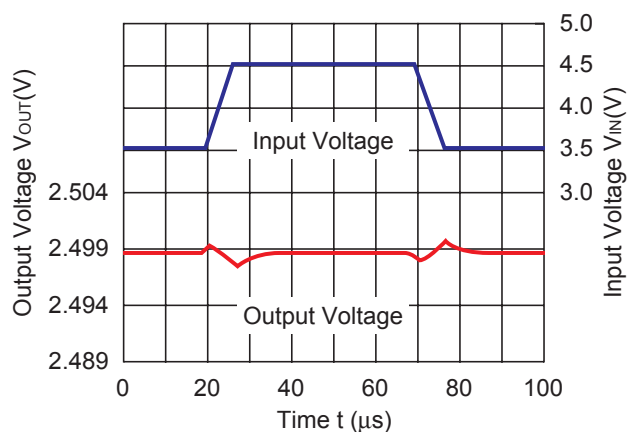
1.5V(VR2)



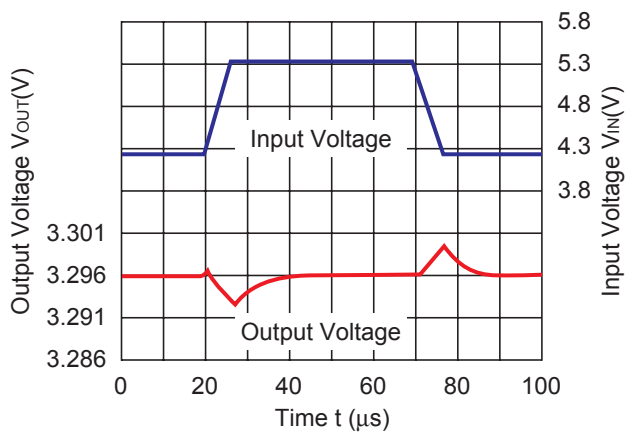
2.5V(VR1)



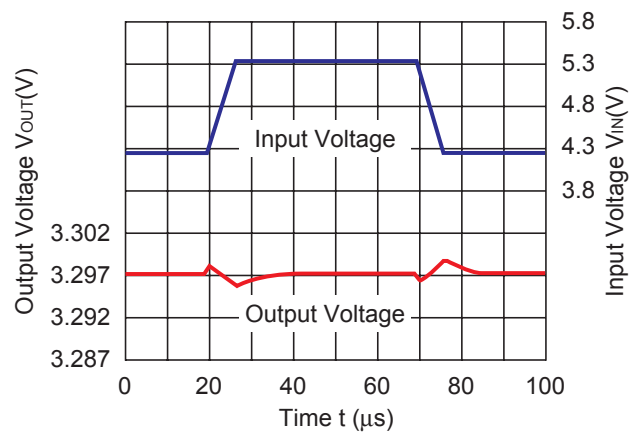
2.5V(VR2)



3.3V(VR1)

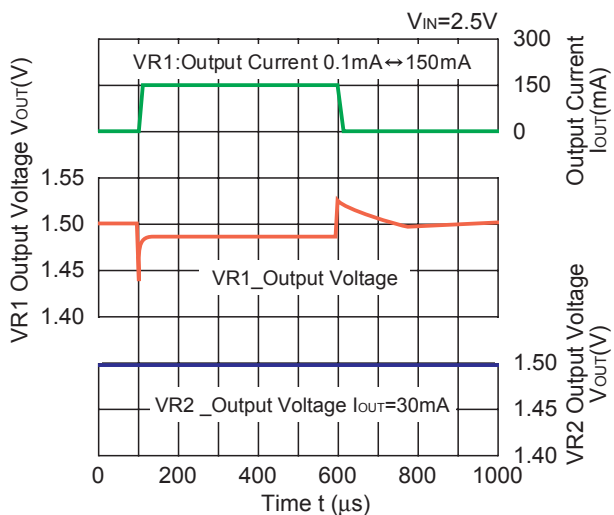


3.3V(VR2)

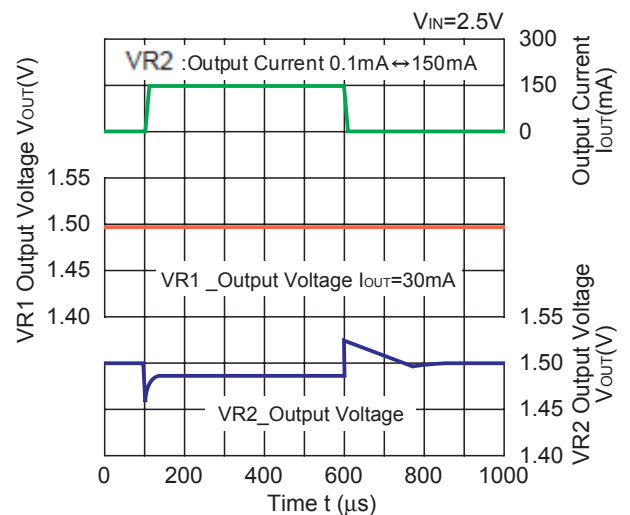


# 11) Load Transient Response ( $t_r=t_f=500ns$ , $T_{opt}=25^\circ C$ )

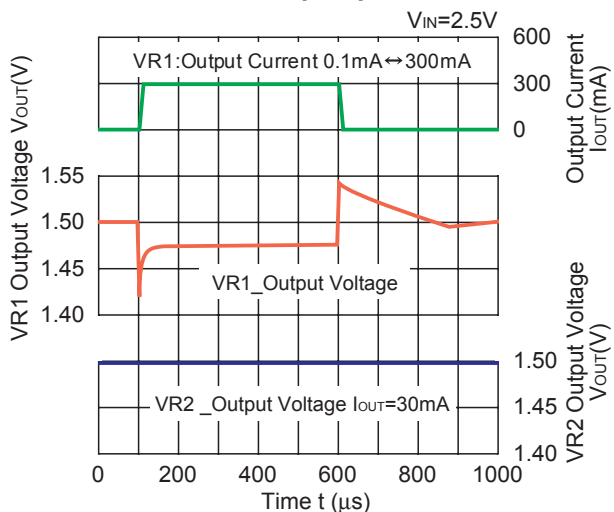
1.5V(VR1)



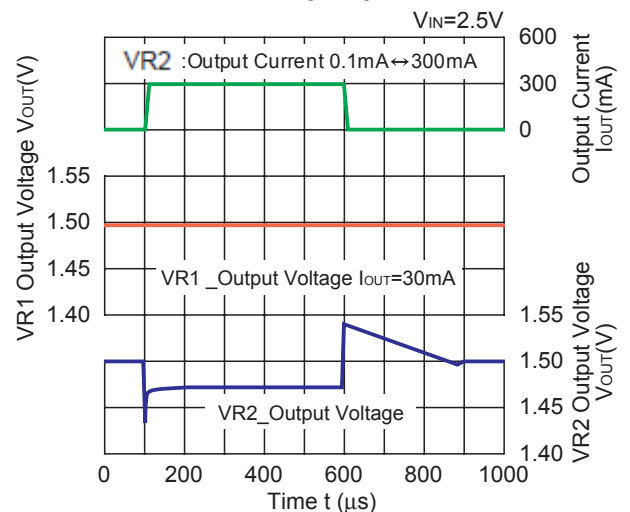
1.5V(VR2)



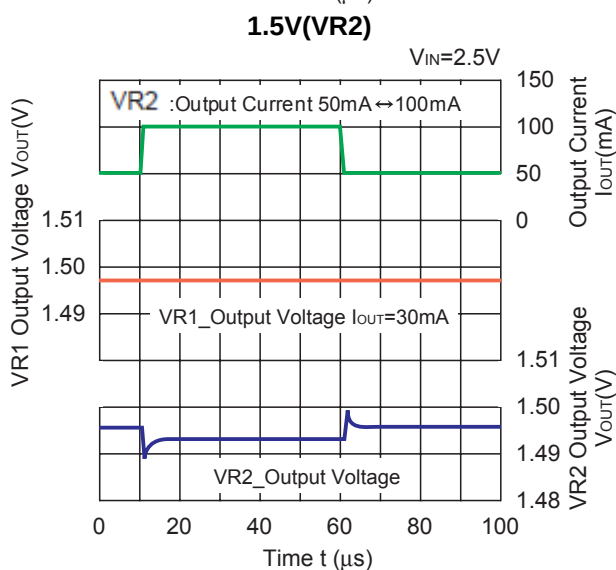
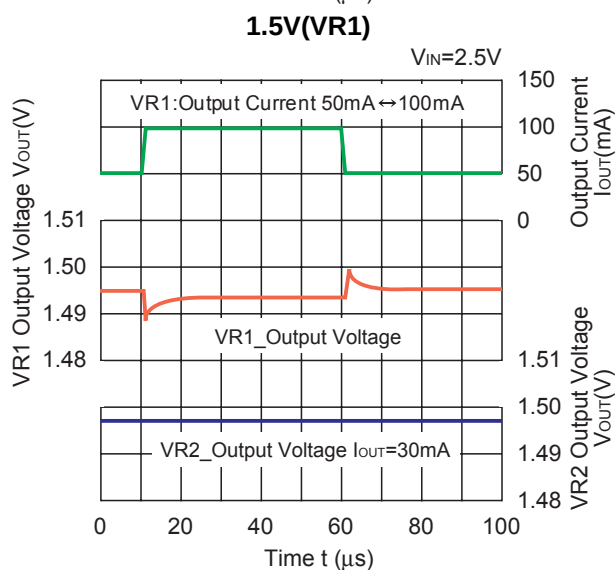
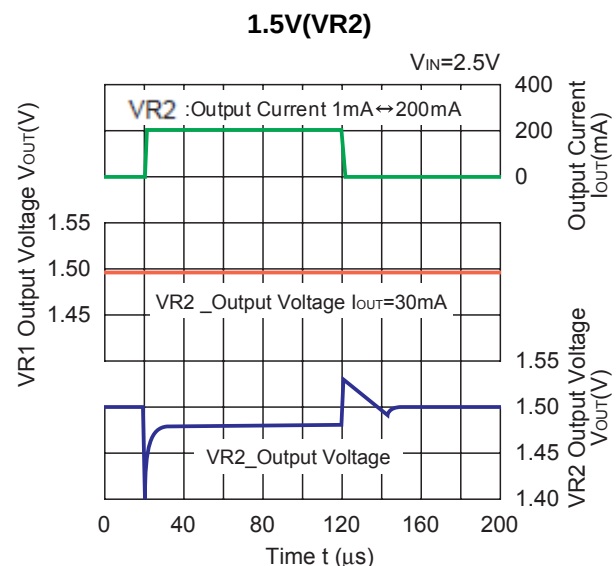
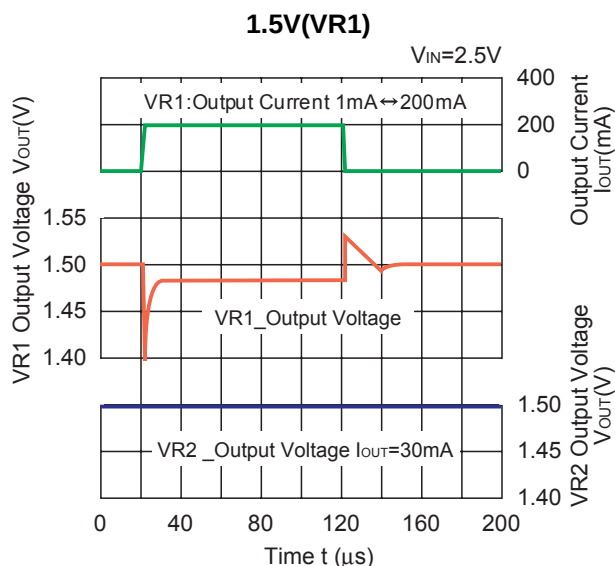
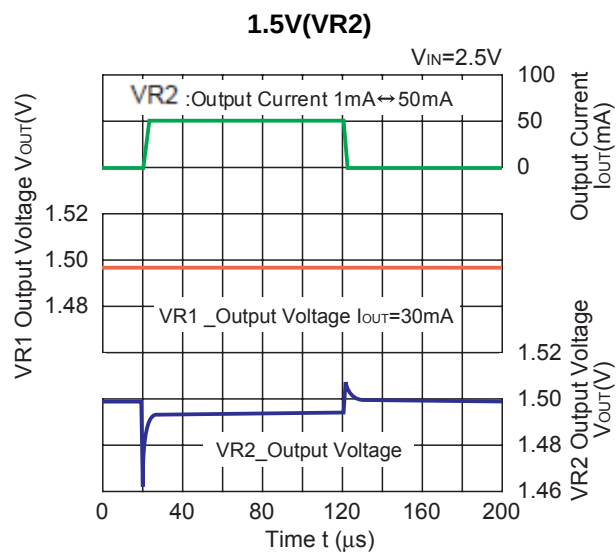
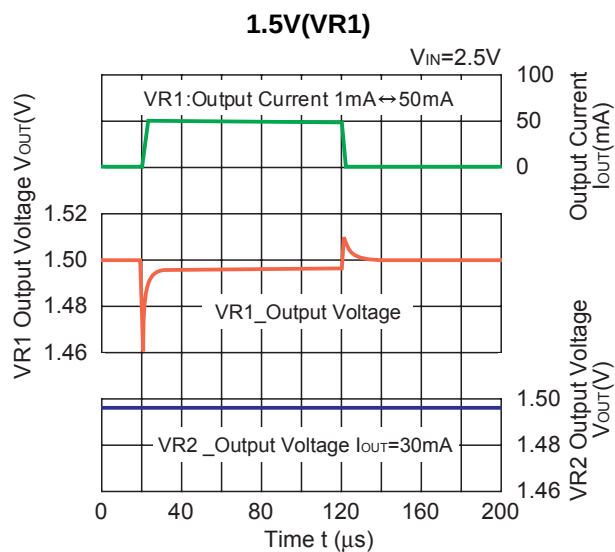
1.5V(VR1)

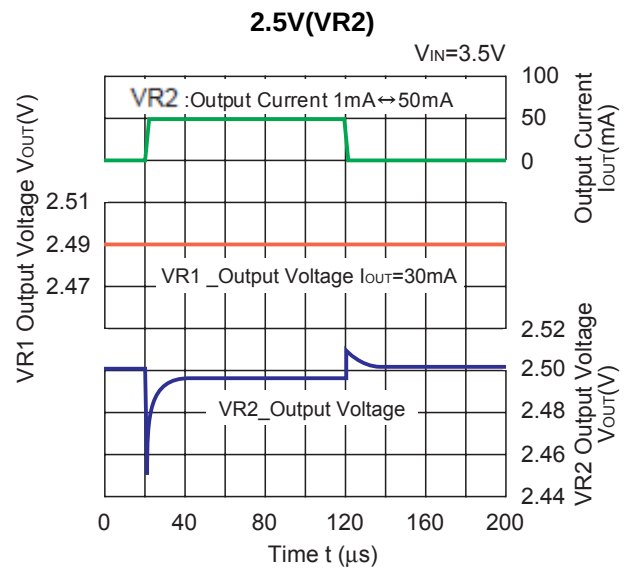
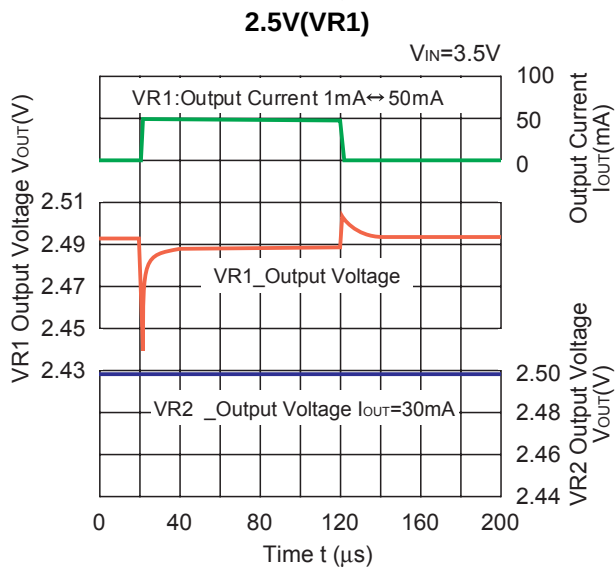
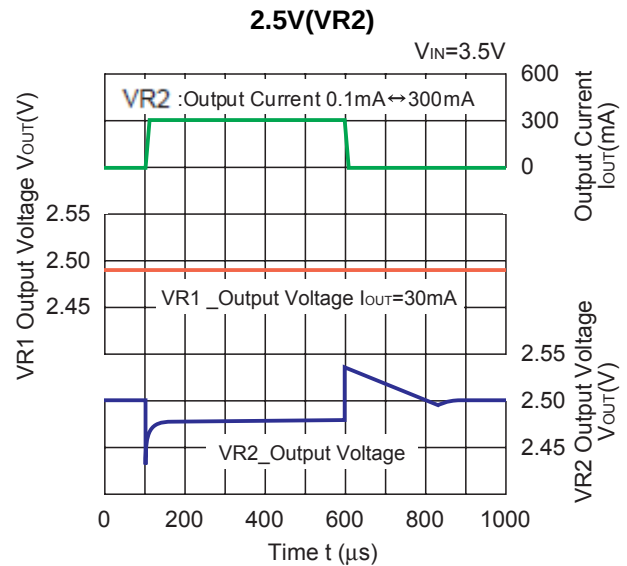
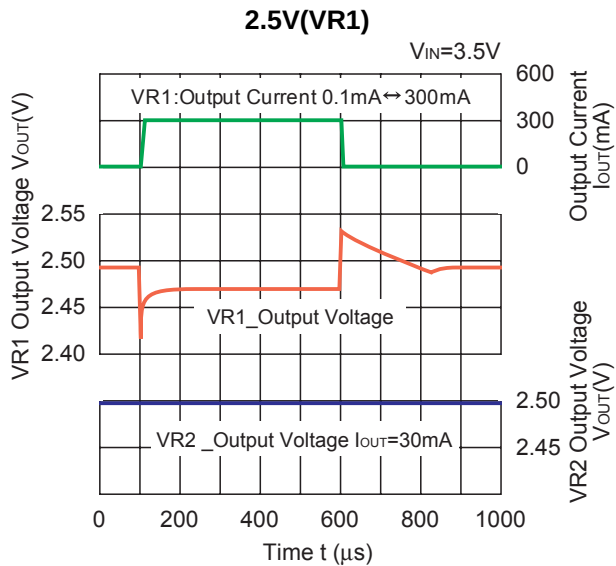
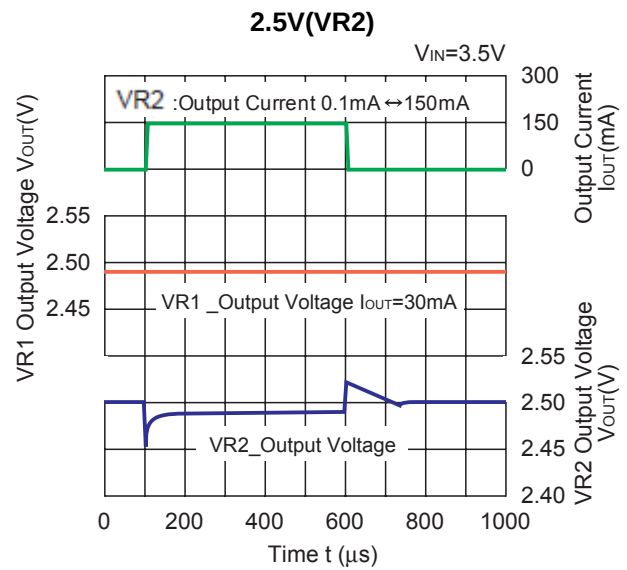
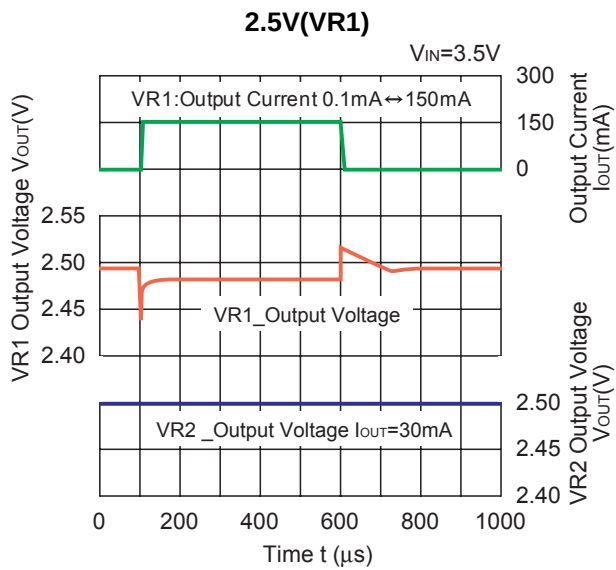


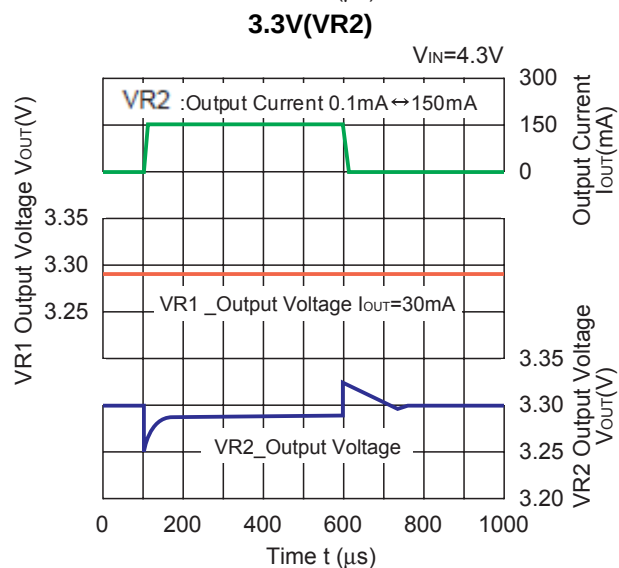
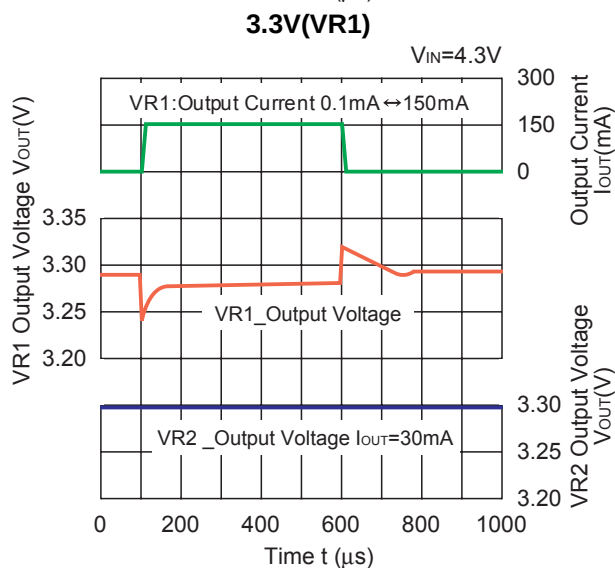
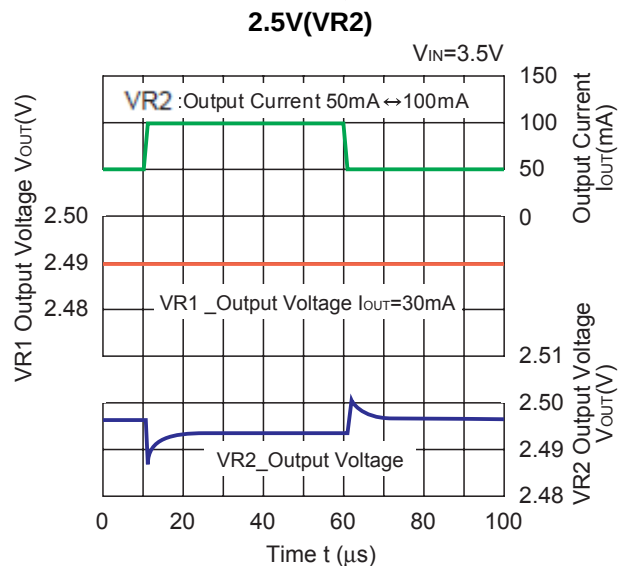
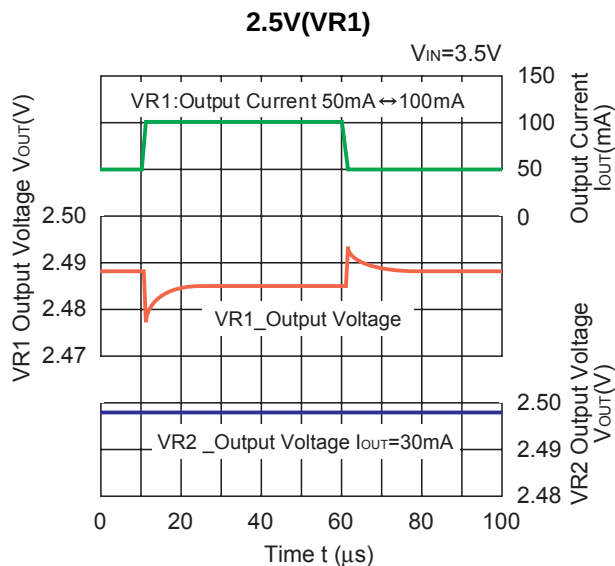
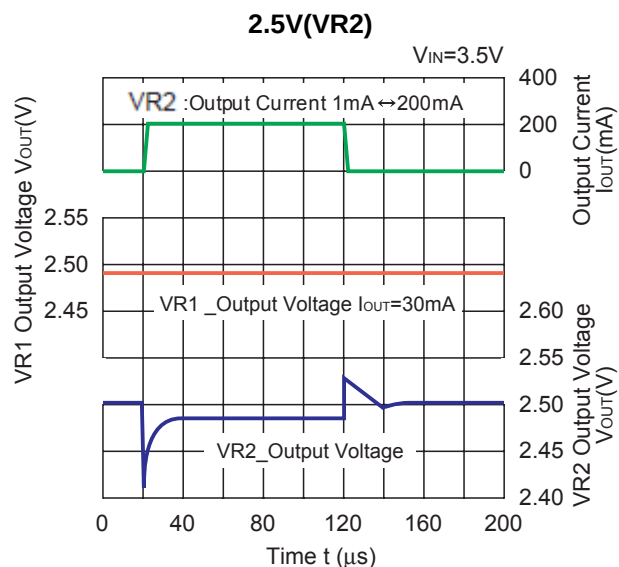
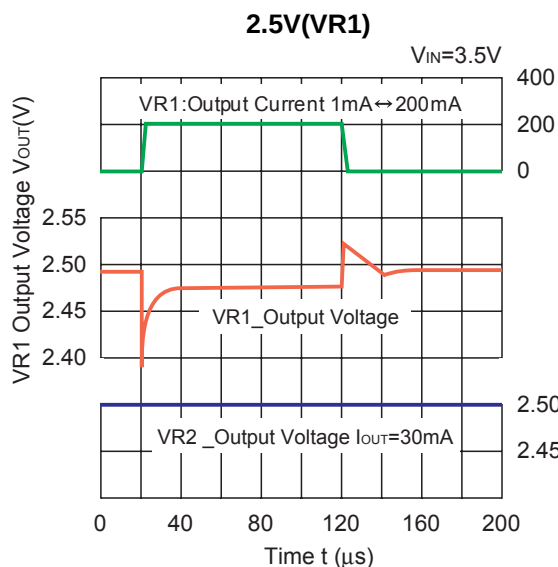
1.5V(VR2)

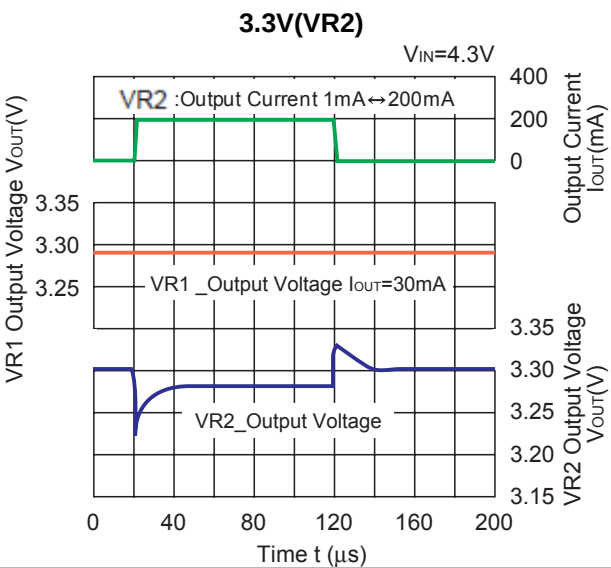
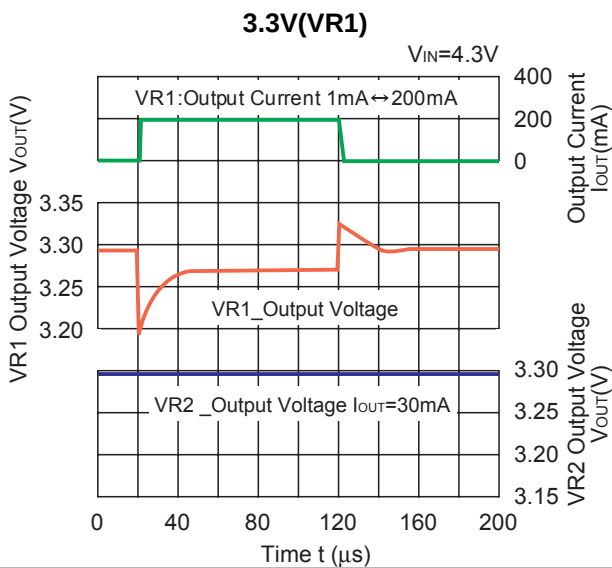
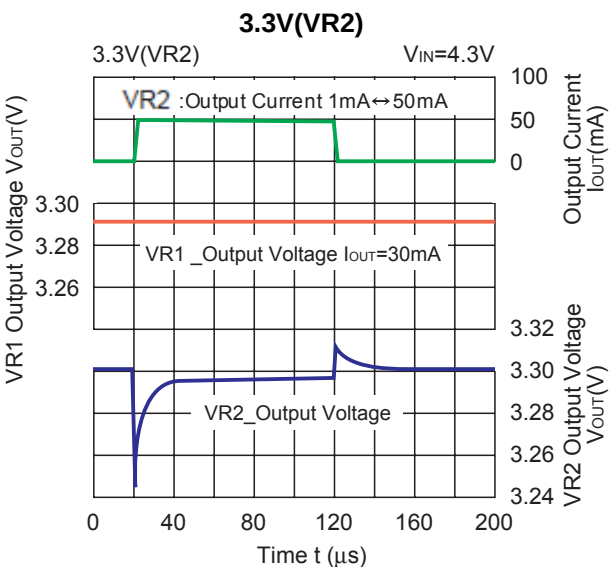
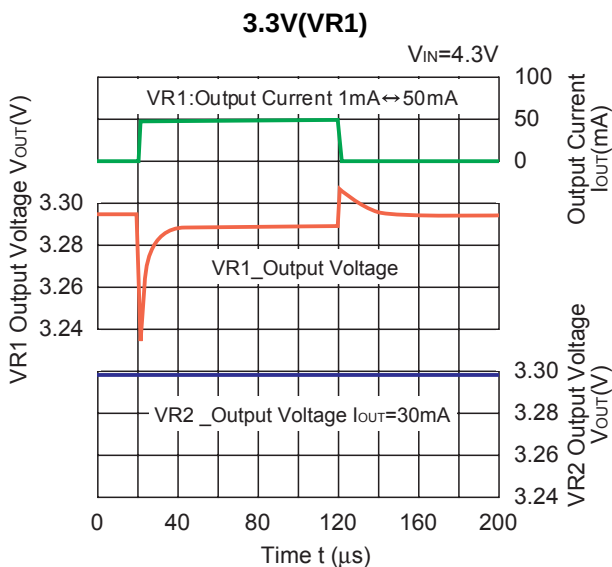
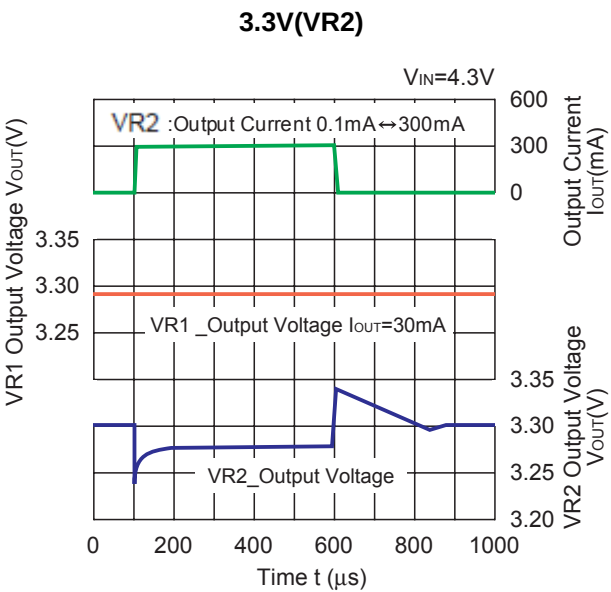
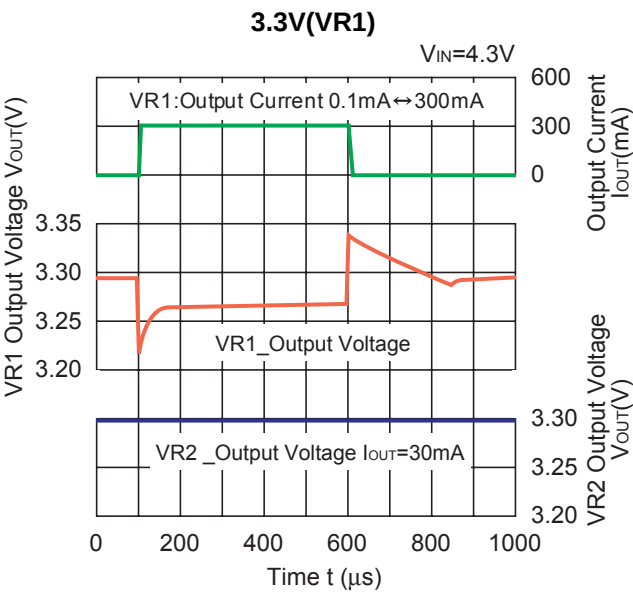


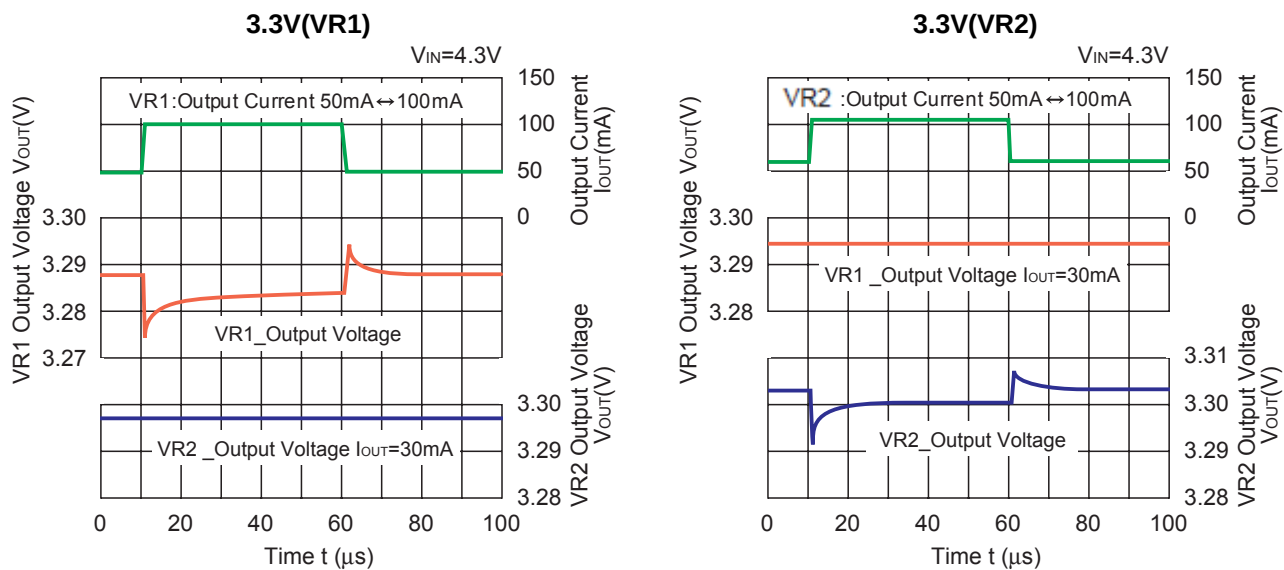




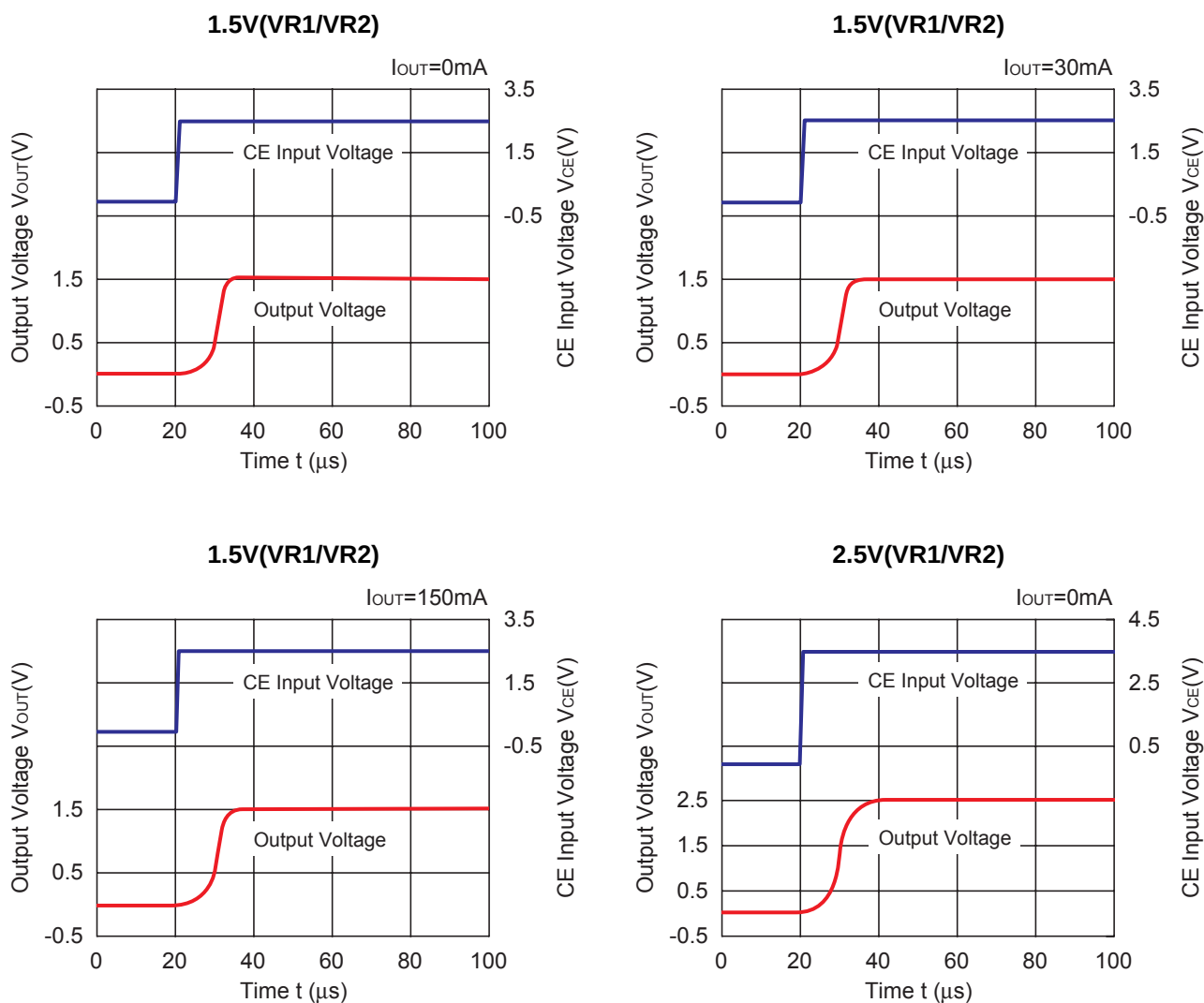




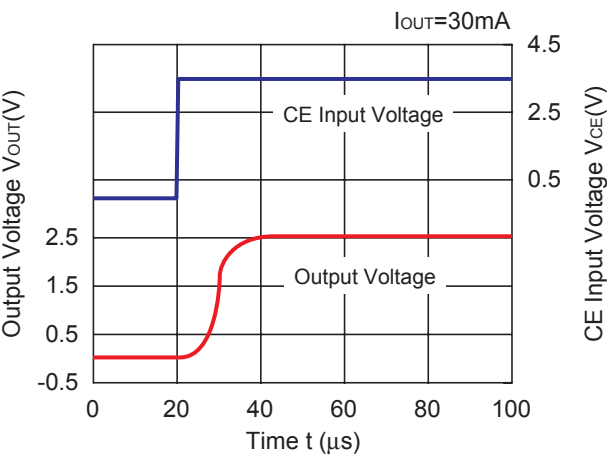




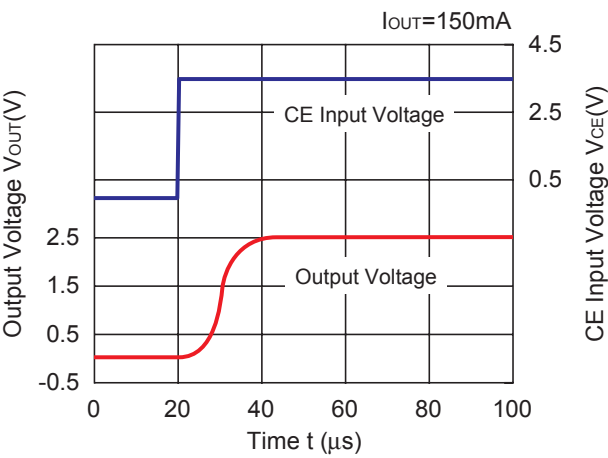
## 12) Turn On Speed with CE pin ( $T_{opt}=25^{\circ}C$ )



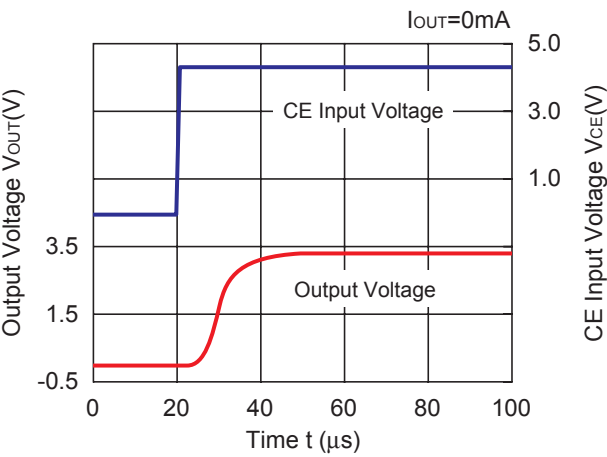
2.5V(VR1/VR2)



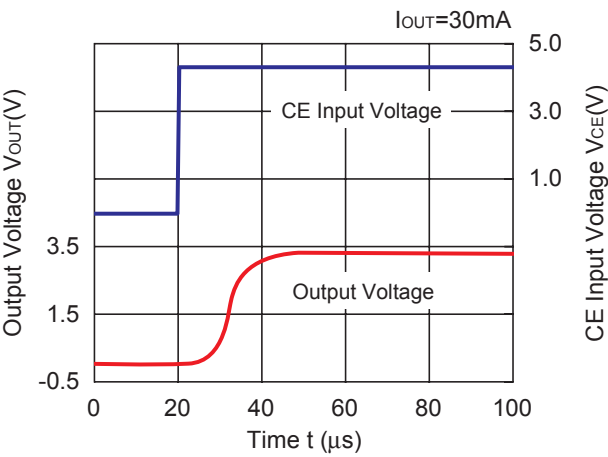
2.5V(VR1/VR2)



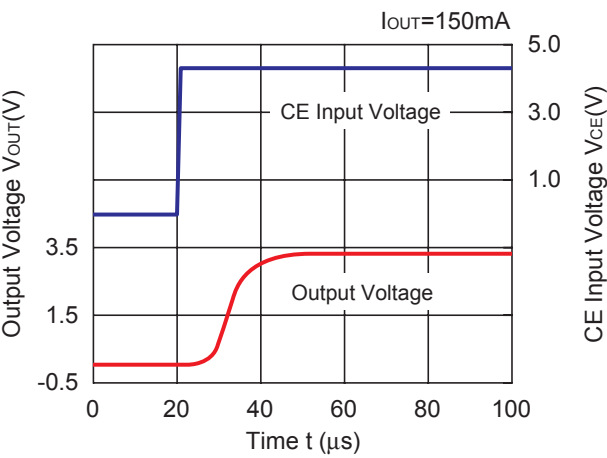
3.3V(VR1/VR2)



3.3V(VR1/VR2)

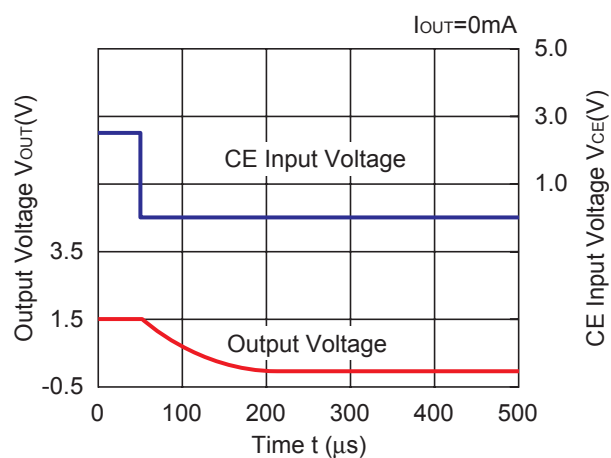


3.3V(VR1/VR2)

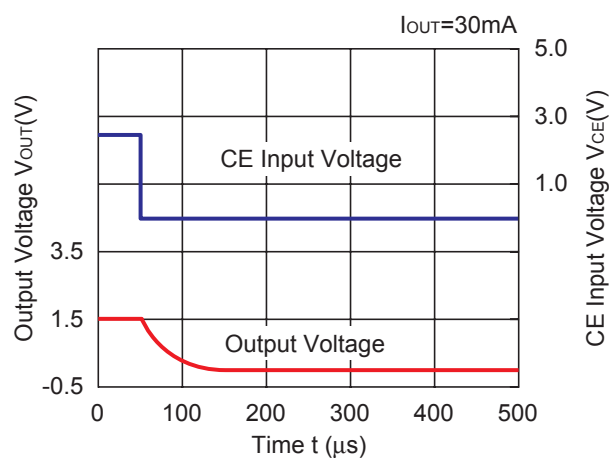


### 13) Turn Off Speed with CE pin ( $T_{opt}=25^{\circ}\text{C}$ )

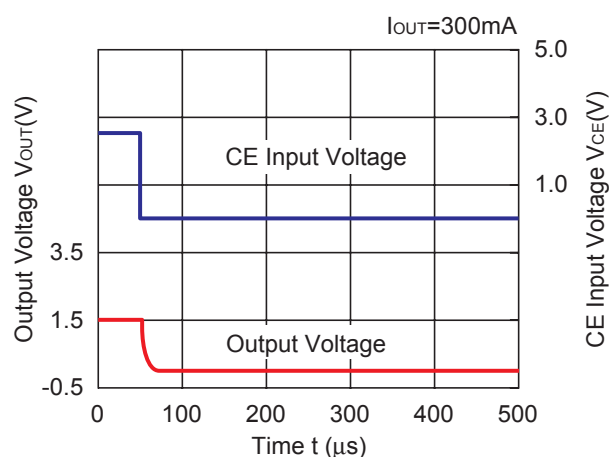
1.5V(VR1/VR2)



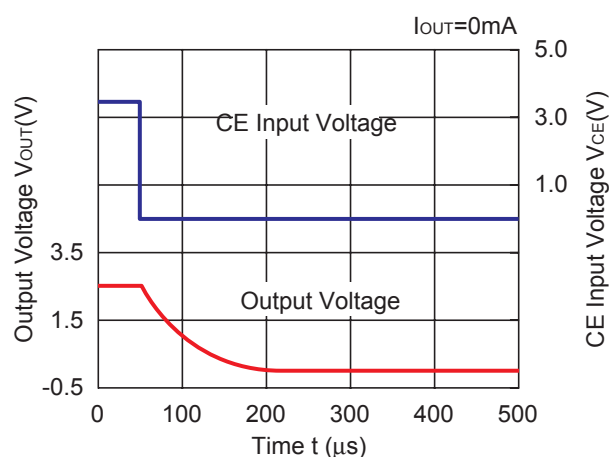
1.5V(VR1/VR2)



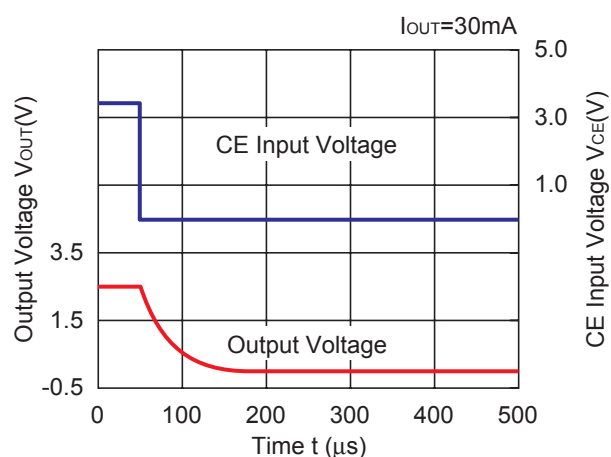
1.5V(VR1/VR2)



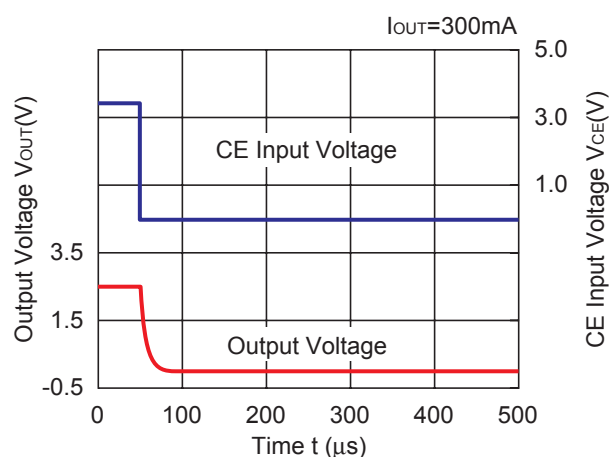
2.5V(VR1/VR2)

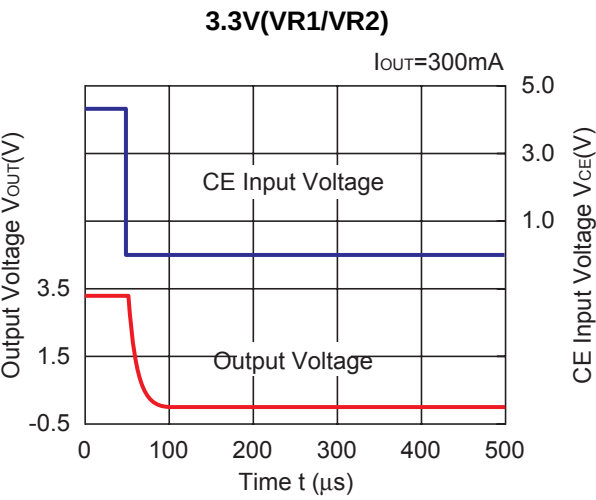
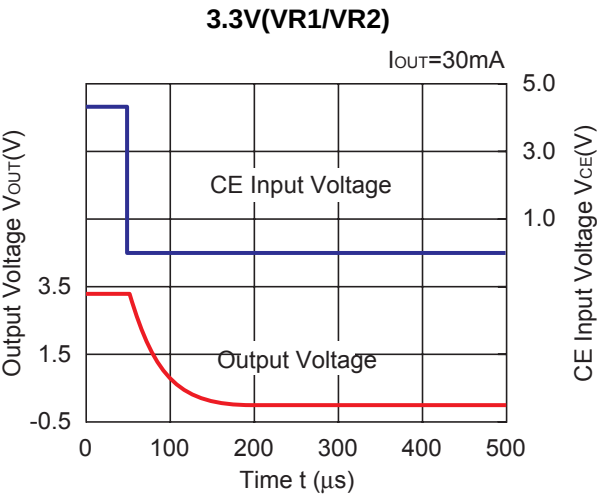
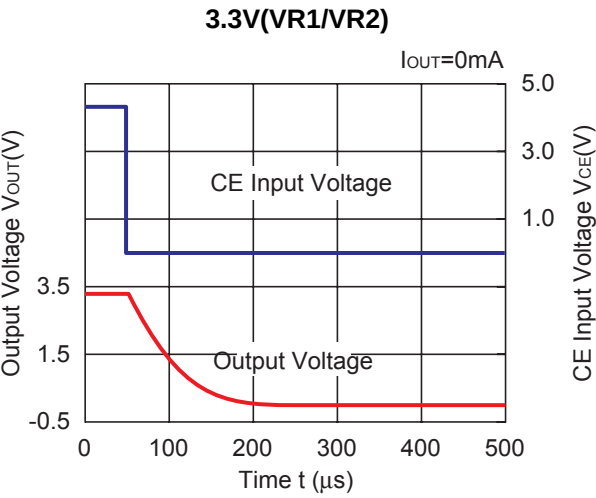


2.5V(VR1/VR2)



2.5V(VR1/VR2)







## ESR vs. Output Current

When using these ICs, consider the following points:

The relations between  $I_{OUT}$  (Output Current) and ESR of an output capacitor are shown below.

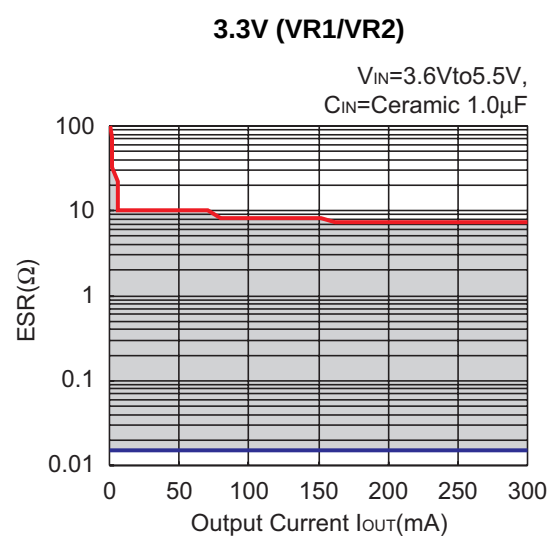
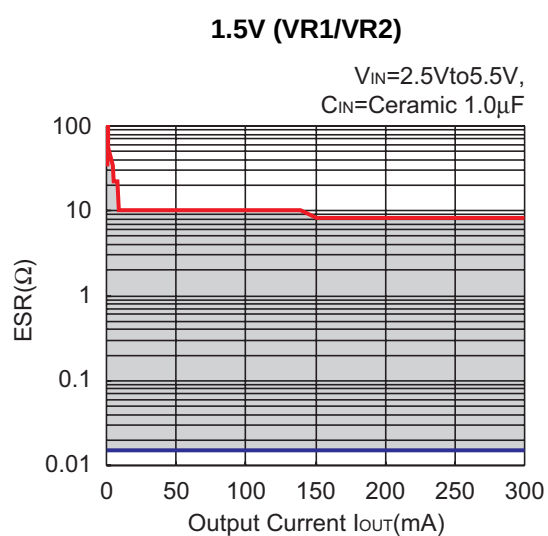
The conditions when the white noise level is under  $40\mu V$  (Avg.) are marked as the hatched area in the graph.

### Measurement conditions

$V_{IN} = \text{Set } V_{OUT} + 1V$

Frequency Band: 10Hz to 2MHz

Temperature:  $-40^{\circ}C$  to  $85^{\circ}C$





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Ricoch continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.



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### RICOH COMPANY, LTD. Electronic Devices Company

● Higashi-Shinagawa Office (International Sales)  
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan  
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

### RICOH EUROPE (NETHERLANDS) B.V.

● Semiconductor Support Centre  
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands  
P.O.Box 114, 1180 AC Amstelveen  
Phone: +31-20-5474-309 Fax: +31-20-5474-791

### RICOH ELECTRONIC DEVICES KOREA Co., Ltd.

11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea  
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

### RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.

Room403, No.2 Building, 690#Bi Bo Road, Pu Dong New district, Shanghai 201203,  
People's Republic of China  
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

### RICOH COMPANY, LTD. Electronic Devices Company

● Taipei office  
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)  
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623



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