

300mA Dual LDO with VD

NO. EA-132-130501

OUTLINE

The RP151 Series are CMOS-based dual voltage regulator (LDO) ICs equipped with a voltage detector (VD).

LDO function has features of 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 RP151 Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output of built-in voltage detector is Nch open drain type.

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, dual LDO regulators and VD are included in each packages, high density mounting of the ICs on boards is possible.

FEATURES

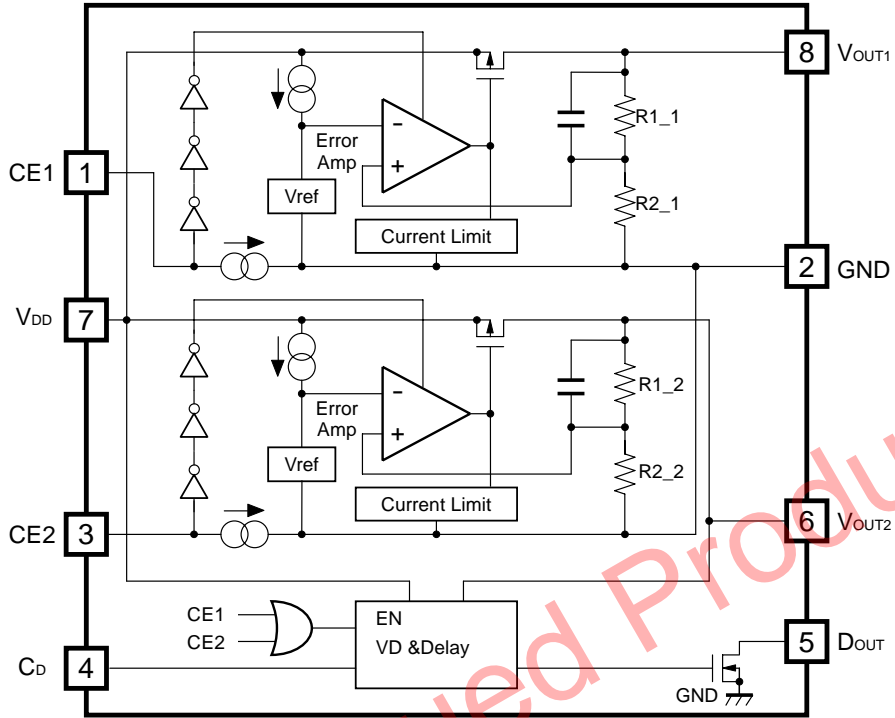
- Supply Current Typ. 24 μ A \times 2 (VR1&VR2)
- Standby Current Typ. 0.1 μ A \times 2
- Dropout Voltage Typ. 0.21V ($I_{OUT}=300mA$, $V_{OUT}=2.8V$)
Typ. 0.24V ($I_{OUT}=300mA$, $V_{OUT}=2.5V$)
- Ripple Rejection Typ. 80dB ($f=1kHz$)
- Temperature-Drift Coefficient of Output Voltage Typ. $\pm 30ppm/^{\circ}C$
- 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 ... $C_{IN}=C_{OUT}=1.0\mu F$ or more
- Detector Threshold Set $V_{OUT2}\times 92\%$
- Output Delay Time for release Typ. 10ms ($C_D=0.01\mu F$)

APPLICATIONS

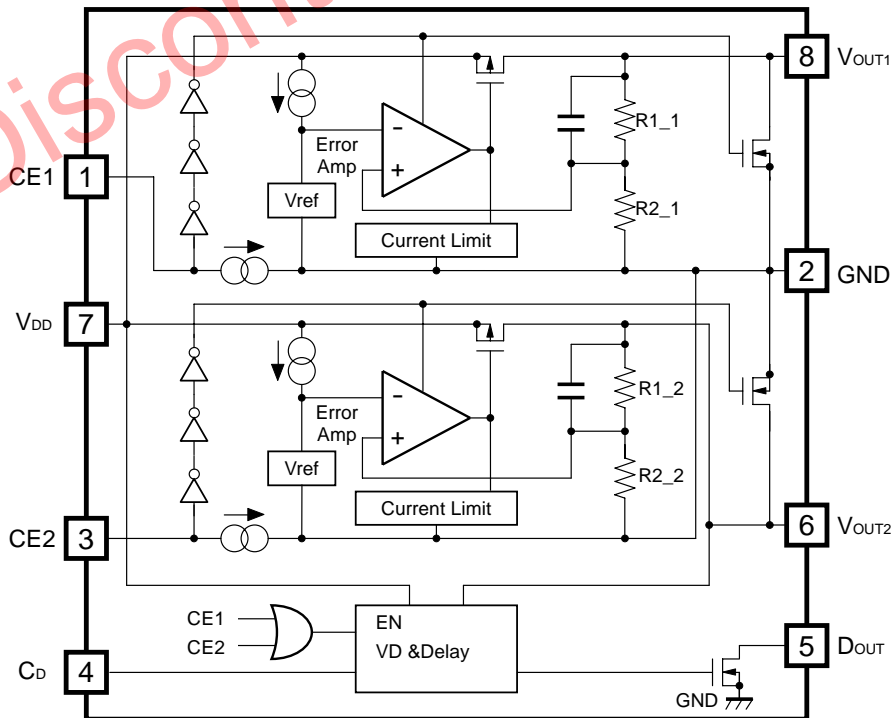
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

RP151KxxxA



RP151KxxxB



SELECTION GUIDE

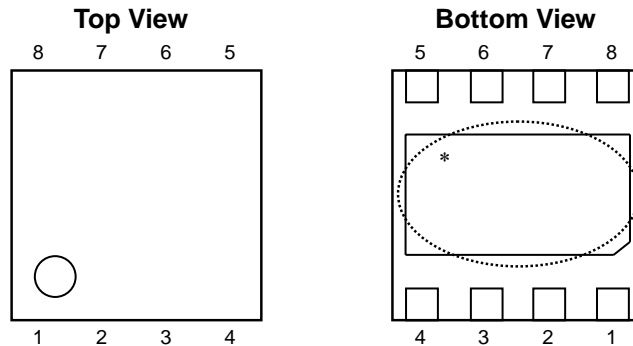
The output voltage, and auto discharge function, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP151Kxxx*-TR	DFN(PLP)2020-8	5,000 pcs	Yes	Yes
<p>xxx: The combination of output voltage for each channel can be designated by serial numbers. (from 001) The output voltage for each channel can be set in the range from 1.5V to 3.3V in 0.1V steps. (For details, please refer to MARK INFORMATIONS.)</p> <p>* : Designation of Mask Option: (A) without auto-discharge function at off state (B) with auto-discharge function at off state</p>				

Discontinued Product

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	C _D	Delay Select Input Pin
5	D _{OUT}	VD Output Pin
6	V _{OUT2}	Output Pin 2
7	V _{DD}	Input Pin
8	V _{OUT1}	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
D _{OUT}	Output Voltage (VD Output Pin Voltage)	-0.3 to 6.0	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	°C
T _{stg}	Storage Temperature Range	-55 to 125	°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

• RP151KxxxA/B

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

VR

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

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	$V_{IN} = \text{Set } V_{OUT} + 1V$ $I_{OUT} = 1mA$	$V_{OUT} > 2.0V$	$\times 0.99$		$\times 1.01$ V	
			$V_{OUT} \leq 2.0V$	-20		20 mV	
I_{OUT}	Output Current		300			mA	
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	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	μA	
$I_{standby}$	Standby Current	$V_{CE} = 0V$		0.1	3.0	μA	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	Set $V_{OUT} + 0.5V \leq V_{IN} \leq 5.0V$ (In case that $V_{OUT} \leq 2.0V$, $2.5V \leq V_{IN} \leq 5.0V$)		0.02	0.10	%/V	
RR	Ripple Rejection	$f = 1kHz$, Ripple 0.2Vp-p $V_{IN} = \text{Set } V_{OUT} + 1V$, $I_{OUT} = 30mA$ (In case that $V_{OUT} \leq 2.0V$, $V_{IN} = 3V$)		80		dB	
V_{IN}	Input Voltage*		2.5		5.25	V	
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 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	μA	
V_{CEH}	CE Input Voltage "H"		1.5			V	
V_{CEL}	CE Input Voltage "L"				0.3	V	
en	Output Noise	BW = 10Hz to 100kHz		30		μV_{rms}	
R_{LOW}	Low Output Nch Tr. ON Resistance (B version only)	$V_{IN} = 4.0V$, $V_{CE} = 0V$		30		Ω	

*) 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.

VD

T_{opt}=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V _{DET}	Detector Threshold	% of nominal V _{OUT2}	90	92		%
+V _{DET}	Released Voltage	% of nominal V _{OUT2}		94	96	%
V _{HYS}	Detector Threshold Hysteresis	% of nominal V _{OUT2}		2		%
V _{OL}	D _{OUT} Output Voltage "L"	I _L =0.25mA		0.02	0.1	V
I _{DOUT}	D _{OUT} Output Leakage Current				1	μA
t _D	Reset Delay Time	C _D =0.01μF		10		ms
R _D	Delay Circuit Resistance		0.96	1.35	1.63	MΩ
V _{TCD}	C _D Pin Threshold Voltage	V _{DD} =3.6V	1.7	1.9	2.1	V

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 C_1 between V_{DD} and GND pin, and as close as possible to the pins.

Set the output capacitors C_2 and C_3 for phase compensation, as close as possible to the ICs, and make wiring as short as possible.

C_D external components, especially capacitor C_4 , as close as possible to the ICs and make wiring as short as possible. (Refer to TYPICAL APPLICATION)

Phase Compensation

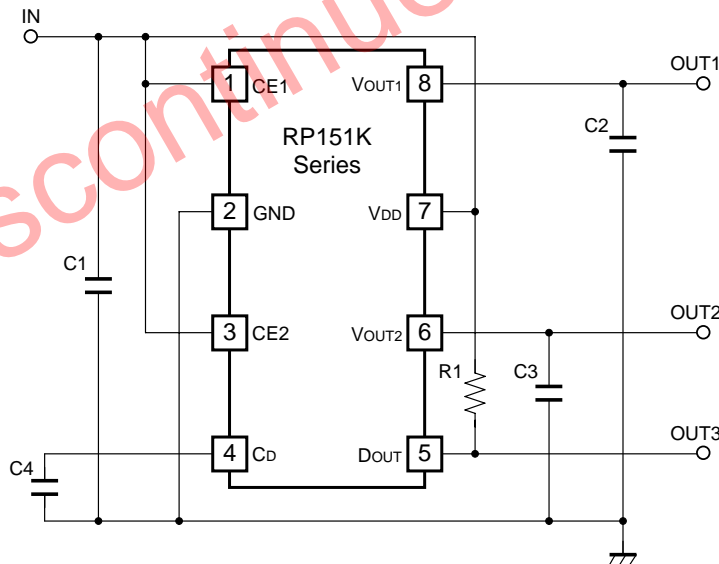
In these ICs, phase compensation is made for securing stable operation even if the load current is varied.

For this purpose, connect capacitors with a capacitance value as much as $1.0\mu\text{F}$ or more as C_2 and C_3 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)

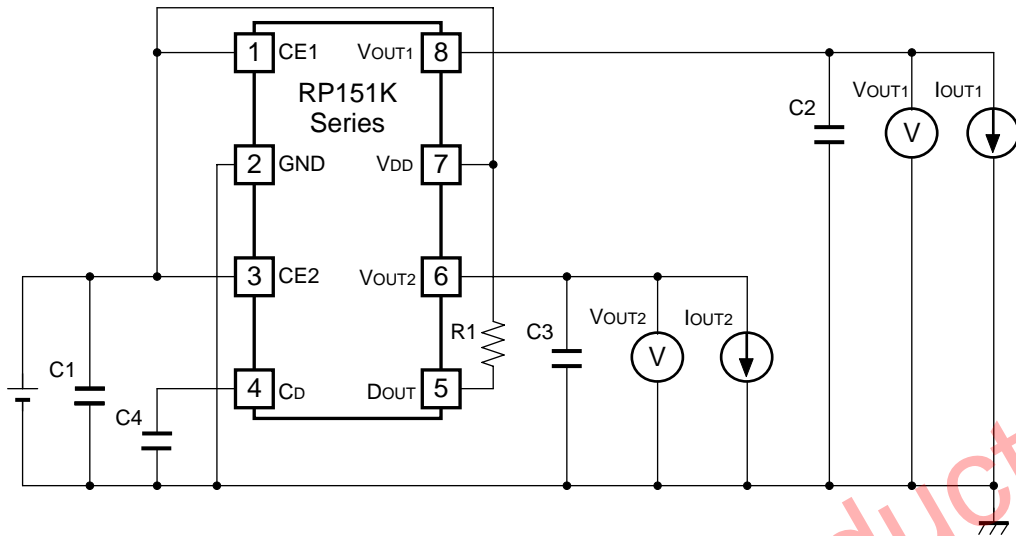
External Capacitor; Ceramic Type	C_1, C_2, C_3
$1.0\mu\text{F}$	Kyocera CM05X5R105KD6AB
	TDK C1005JB0J105K
	Murata GRM155B31A105KE15

External Capacitor for delay time C_4

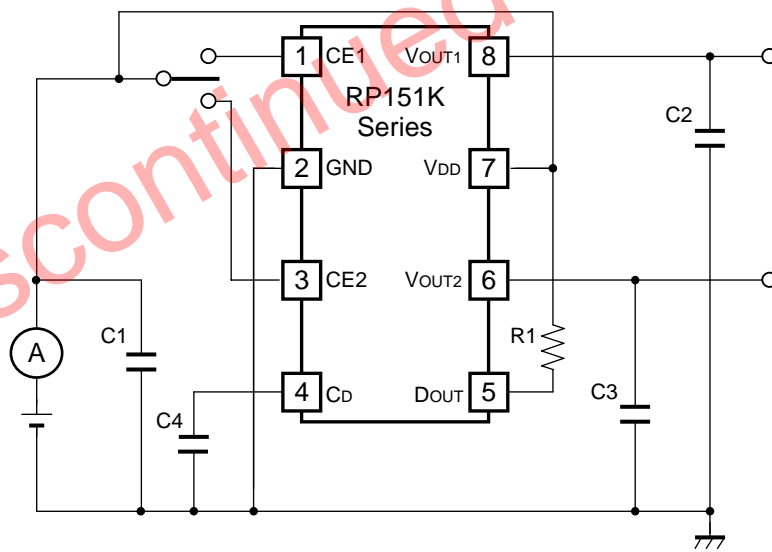
Output delay time (t_D) can be set accordance with the capacitance C_D of external capacitor as below.

$$t_D = 10^6 \times C_{4(s)}$$

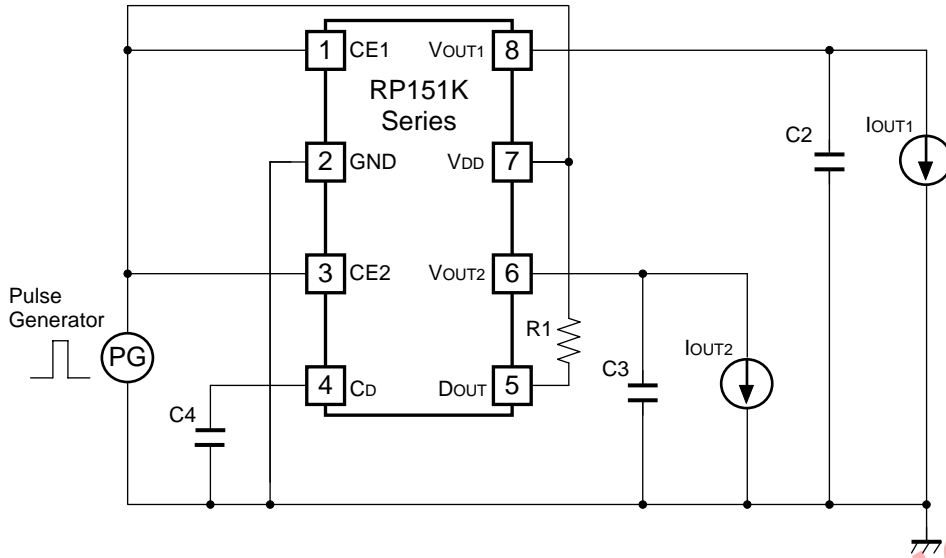
TEST CIRCUITS



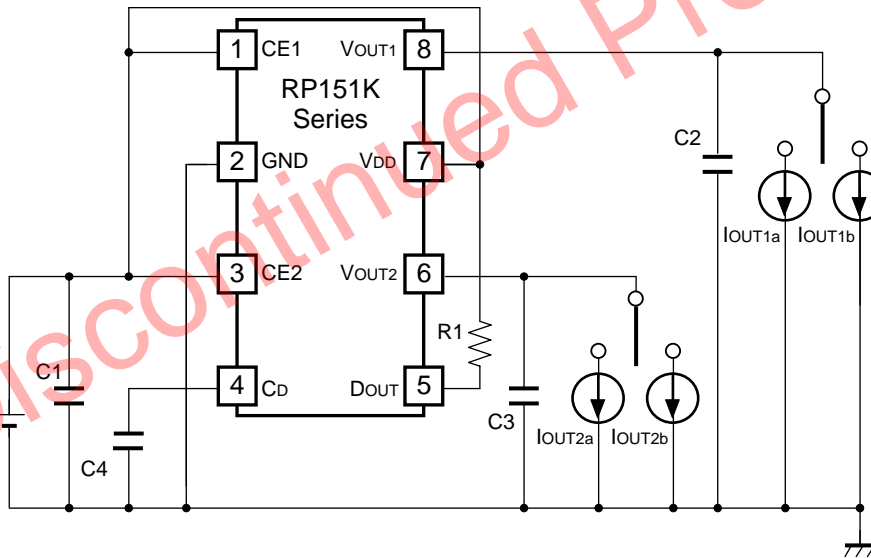
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

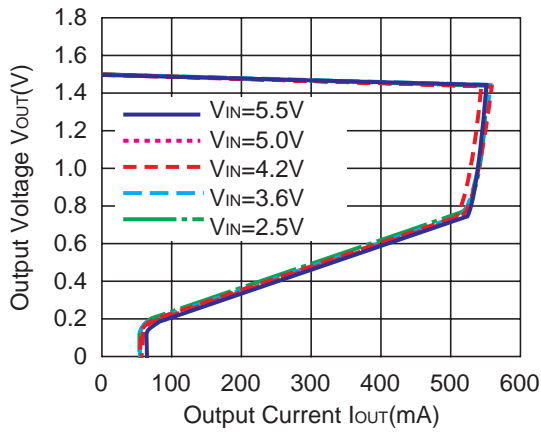


Test Circuit for Load Transient Response

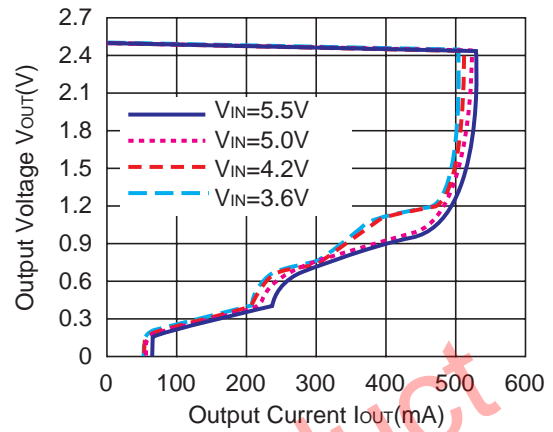
TYPICAL CHARACTERISTICS

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

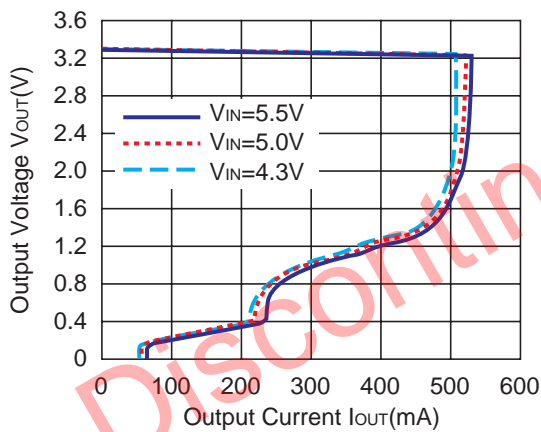
1.5V(VR1/VR2)



2.5V(VR1/VR2)

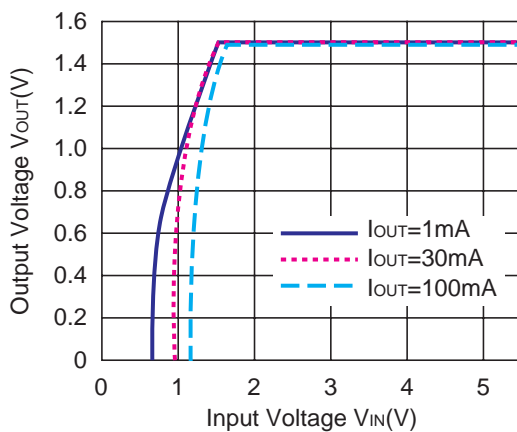


3.3V(VR1/VR2)

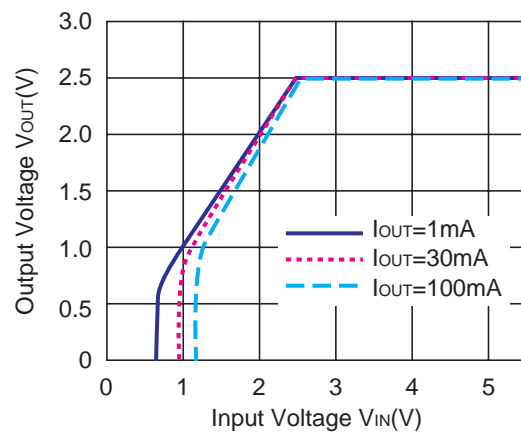


2) Output Voltage vs. Input Voltage ($T_{opt}=25^{\circ}\text{C}$)

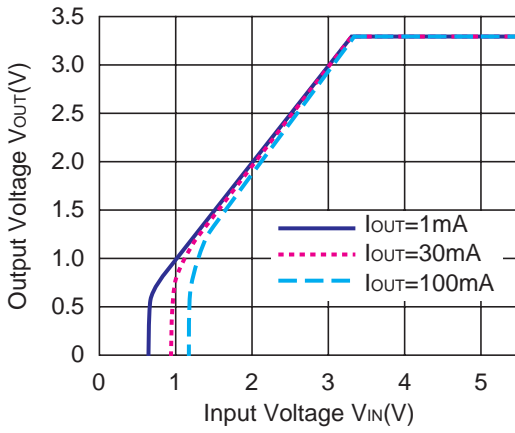
1.5V(VR1/VR2)



2.5V(VR1/VR2)

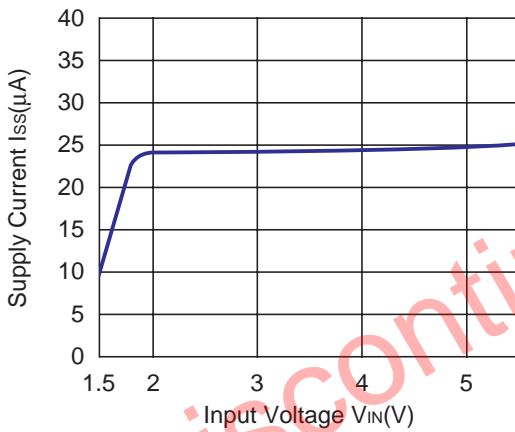


3.3V(VR1/VR2)

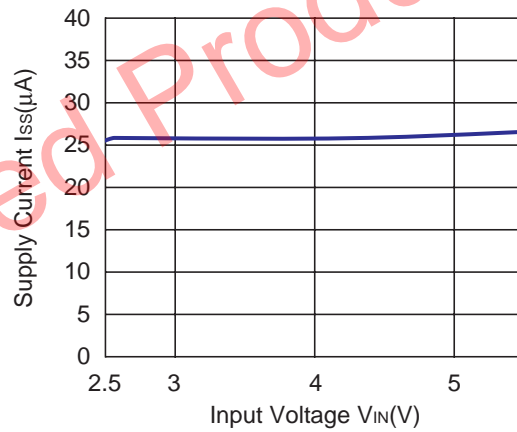


3) Supply Current vs. Input Voltage (Topt=25°C)

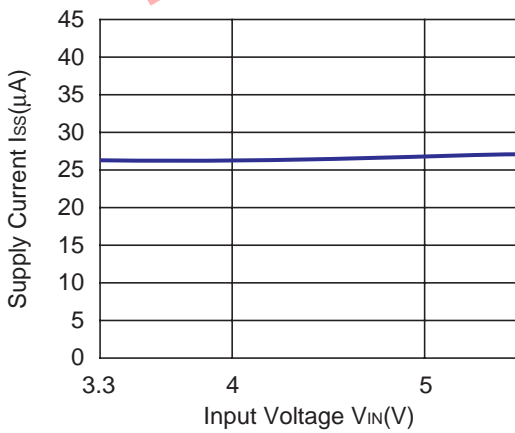
1.5V(VR1/VR2)



2.5V(VR1/VR2)



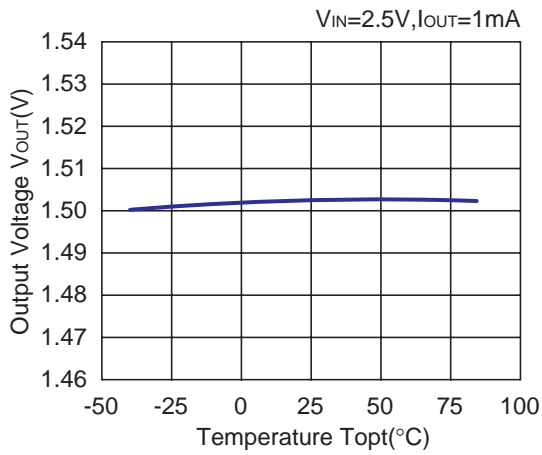
3.3V(VR1/VR2)



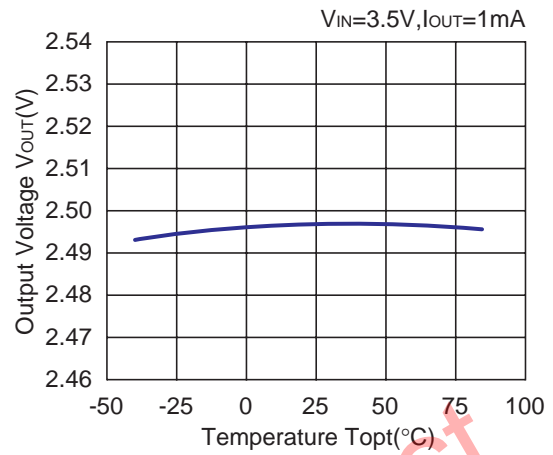
Discontinued Product

4) Output Voltage vs. Temperature

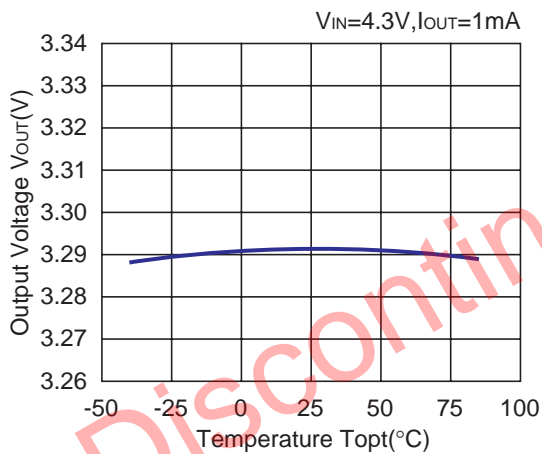
1.5V(VR1/VR2)



2.5V(VR1/VR2)

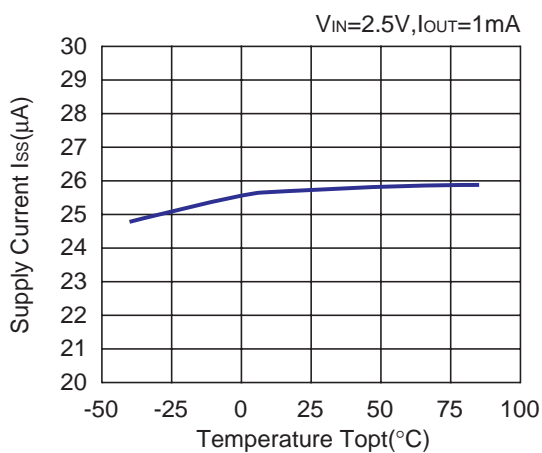


3.3V(VR1/VR2)

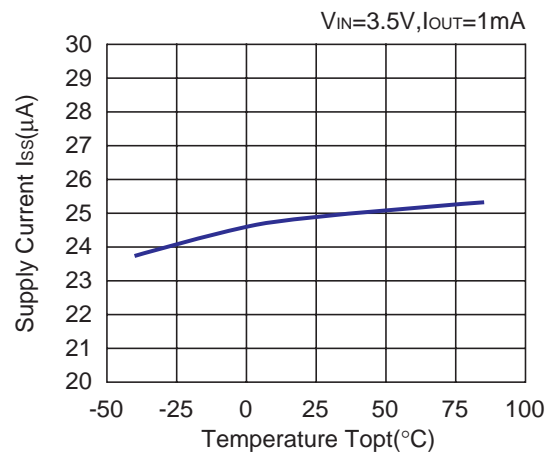


5) Supply Current vs. Temperature

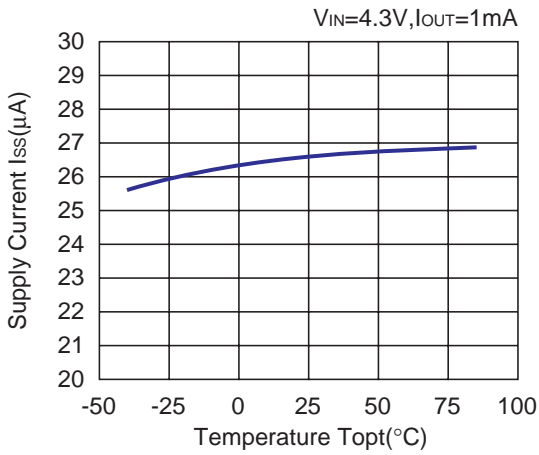
1.5V(VR1/VR2)



2.5V(VR1/VR2)

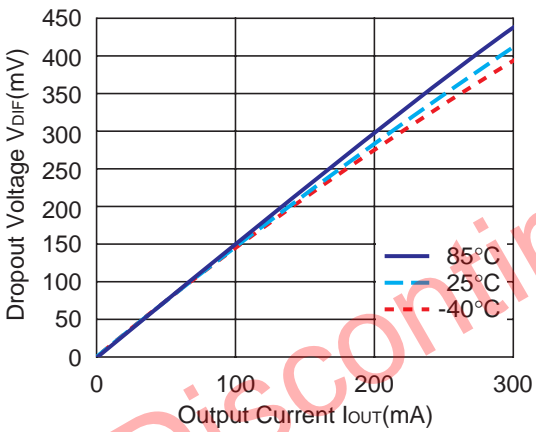


3.3V(VR1/VR2)

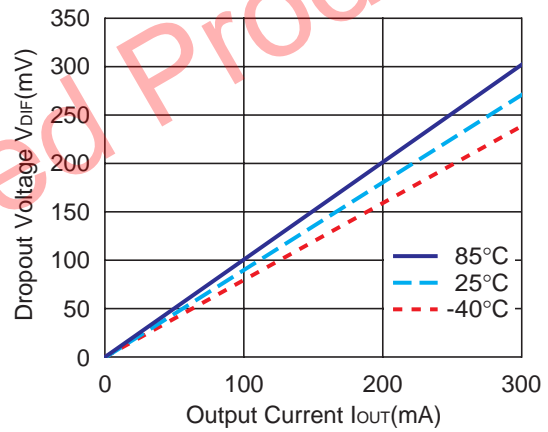


6) Dropout Voltage vs. Output Current

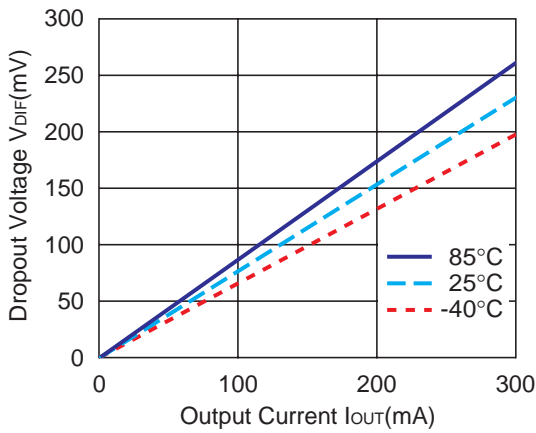
1.5V(VR1/VR2)



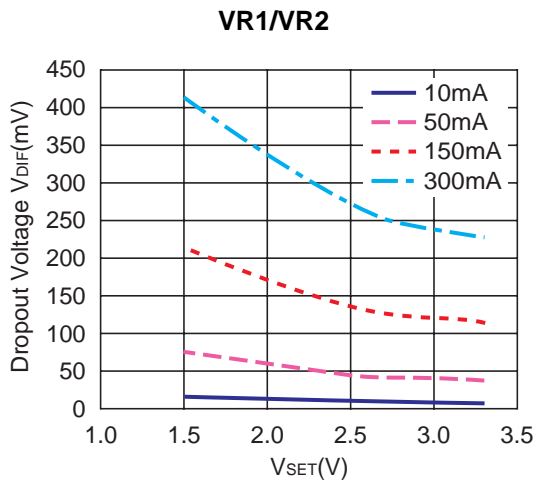
2.5V(VR1/VR2)



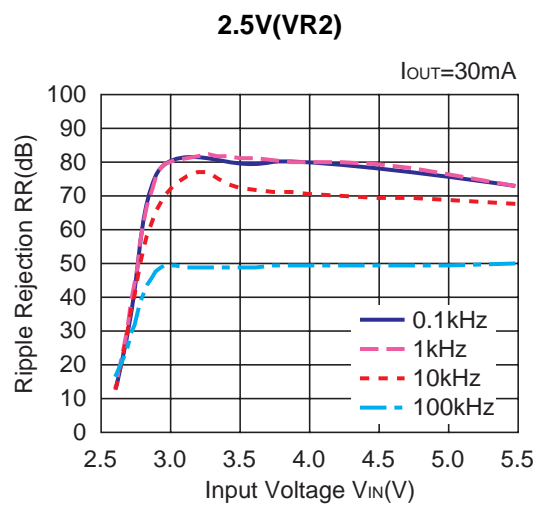
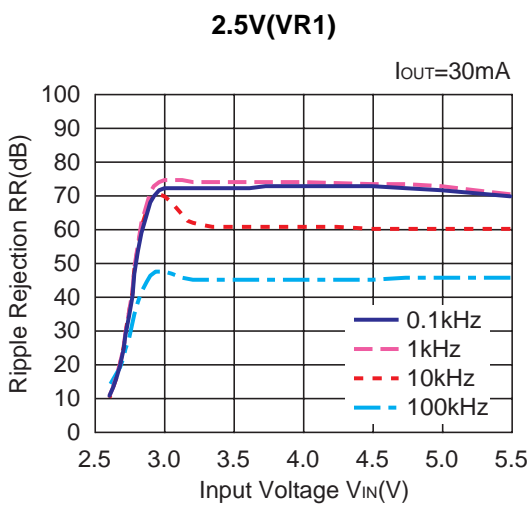
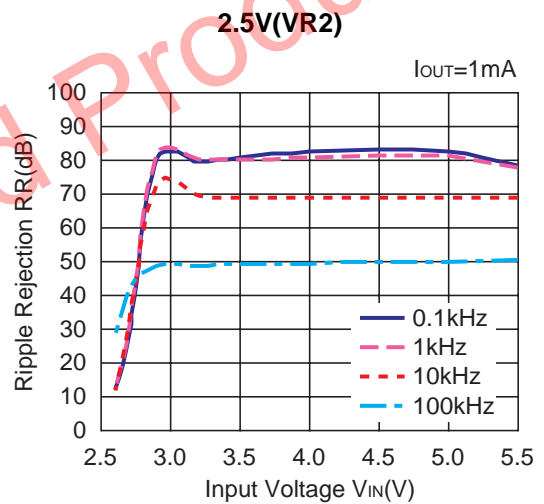
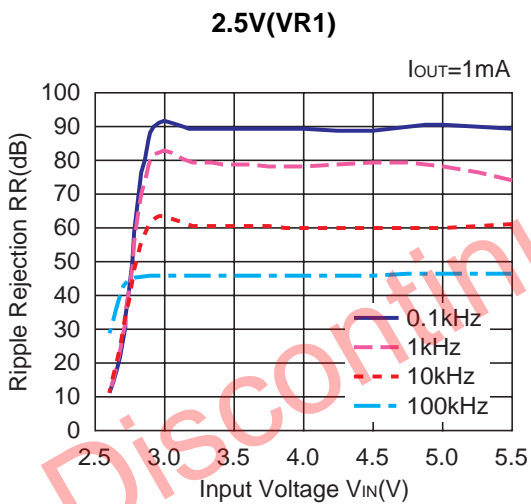
3.3V(VR1/VR2)

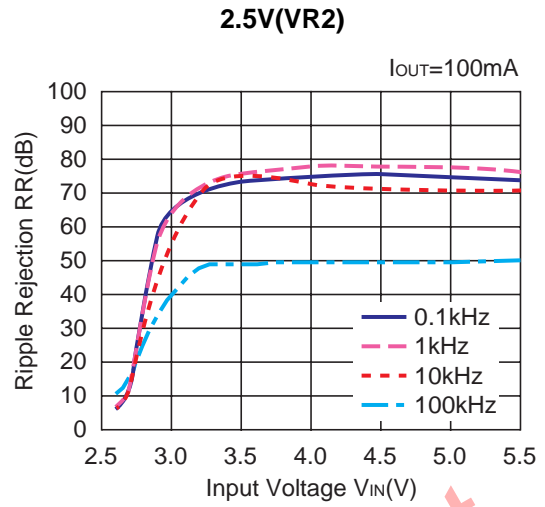
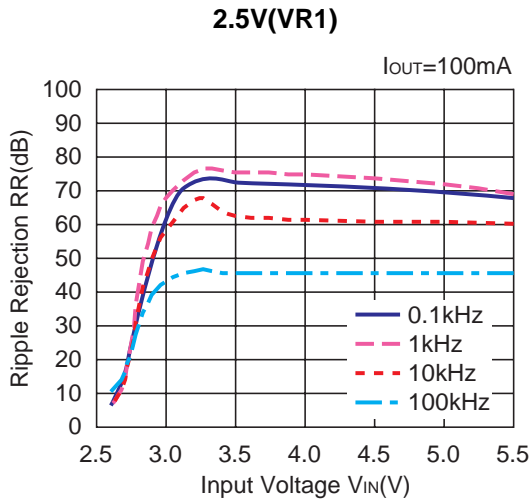


7) Dropout Voltage vs. VR_VSET

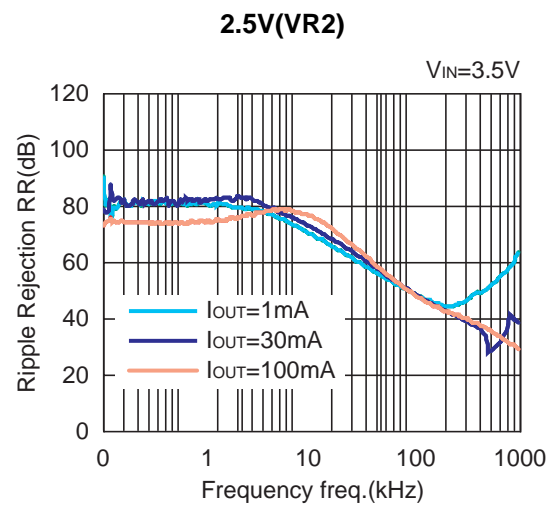
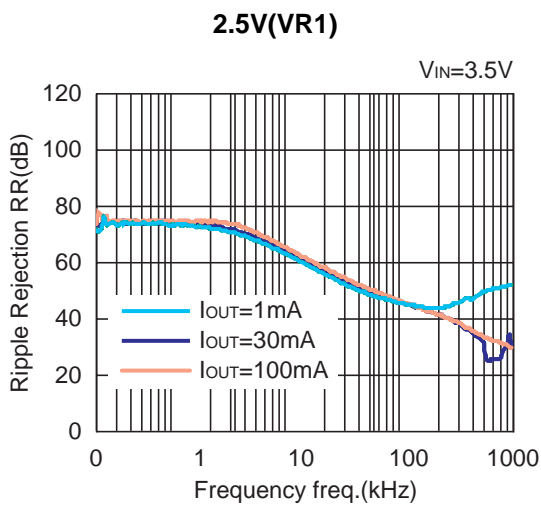
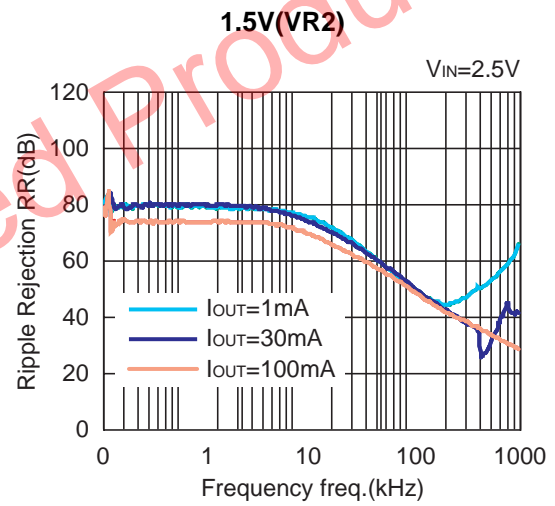
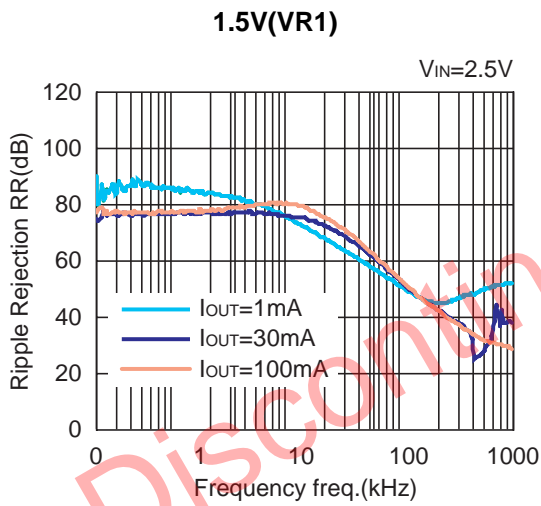


8) Ripple Rejection vs. Input Bias (Input Ripple=0.5Vp-p, T_{opt}=25°C)

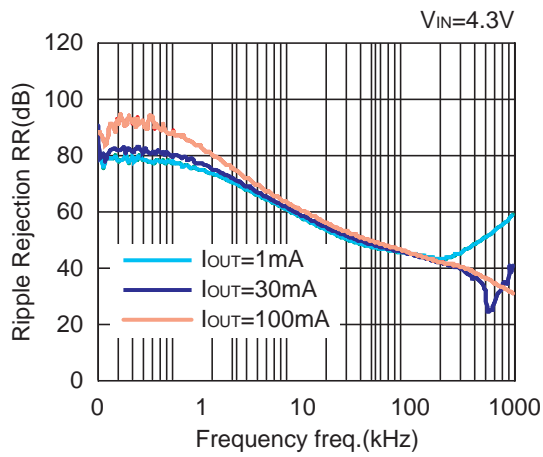




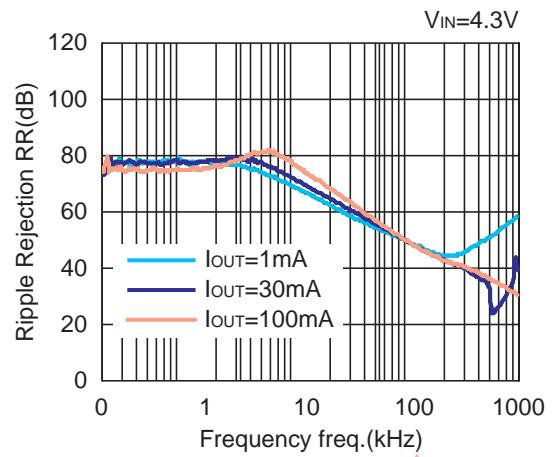
9) Ripple Rejection vs. Frequency (Ripple=0.5Vp-p)



3.3V(VR1)

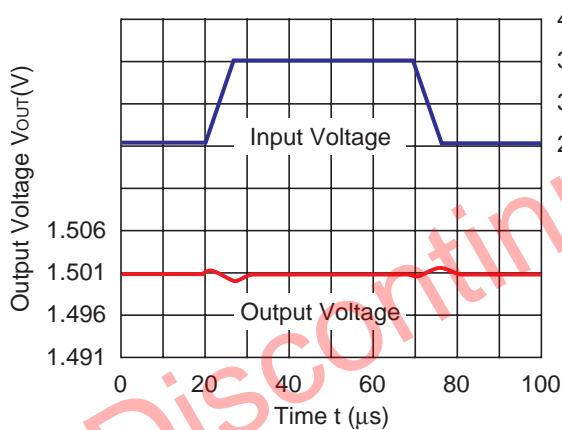


3.3V(VR2)

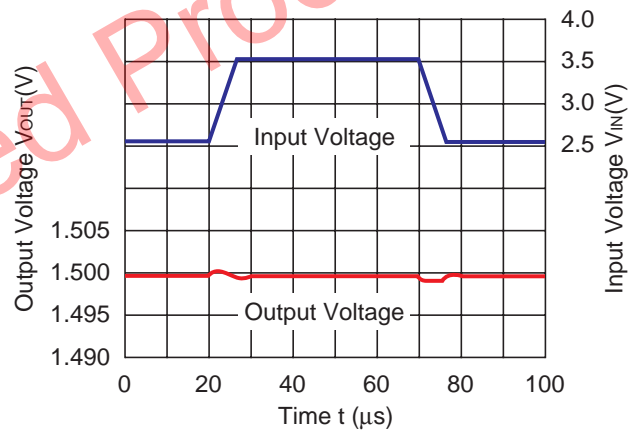


10) Input Transient Response ($t_r=t_f=5\mu s$, $T_{opt}=25^\circ C$)

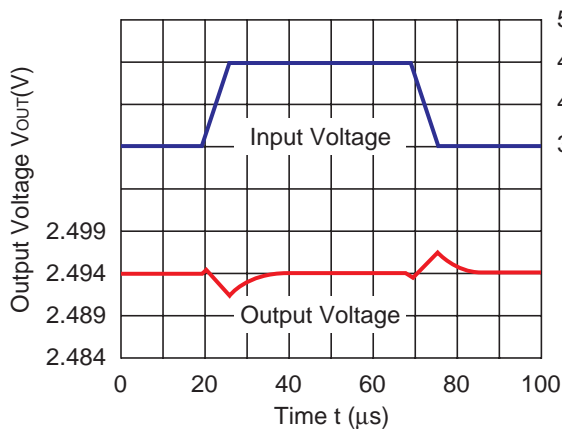
1.5V(VR1)



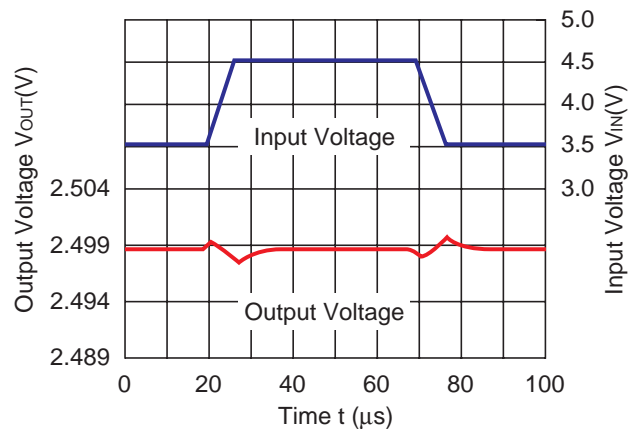
1.5V(VR2)



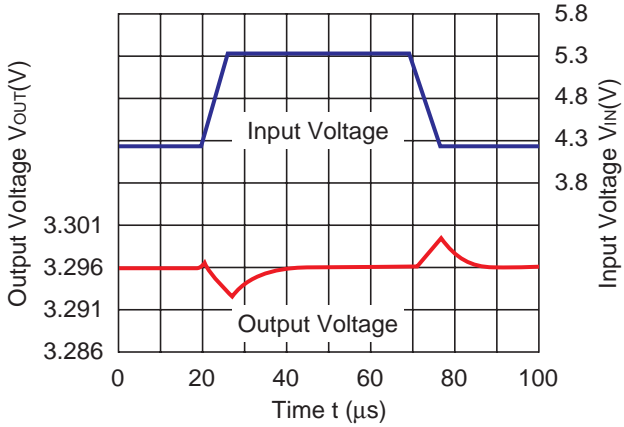
2.5V(VR1)



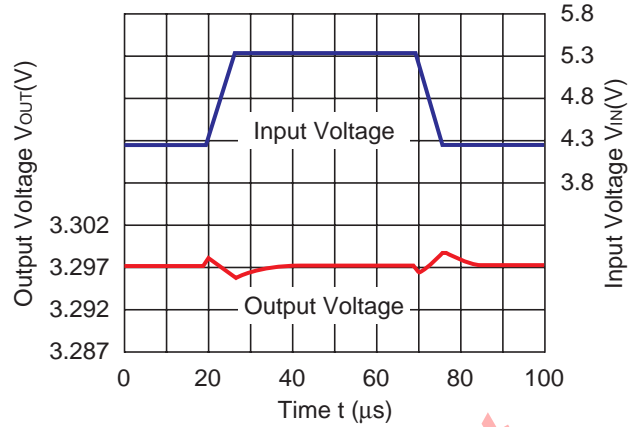
2.5V(VR2)



3.3V(VR1)

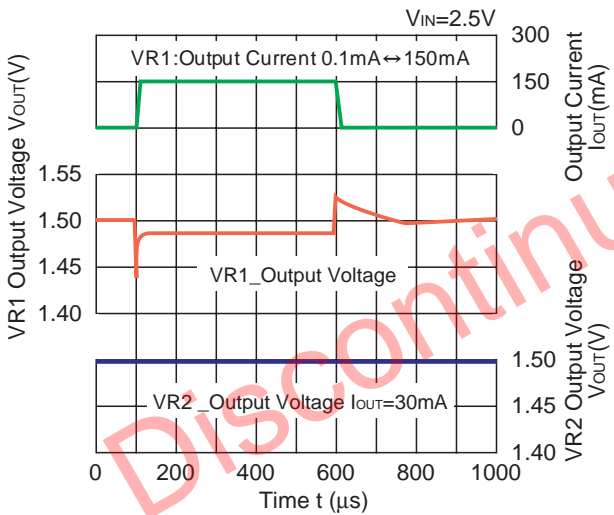


3.3V(VR2)

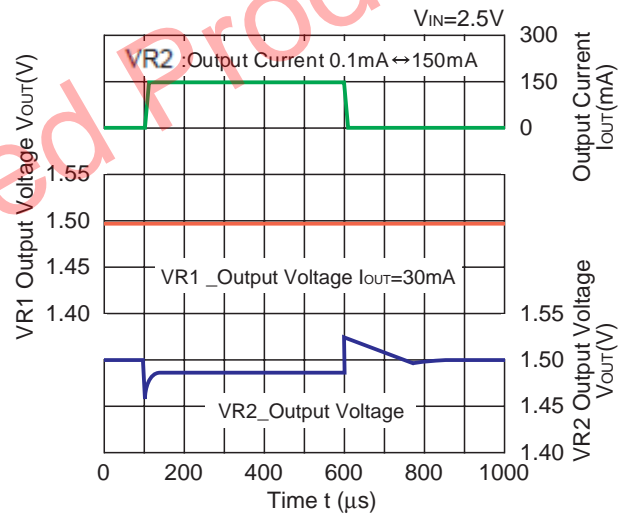


11) Load Transient Response ($t_r=t_f=500\text{ns}$, $T_{opt}=25^\circ\text{C}$)

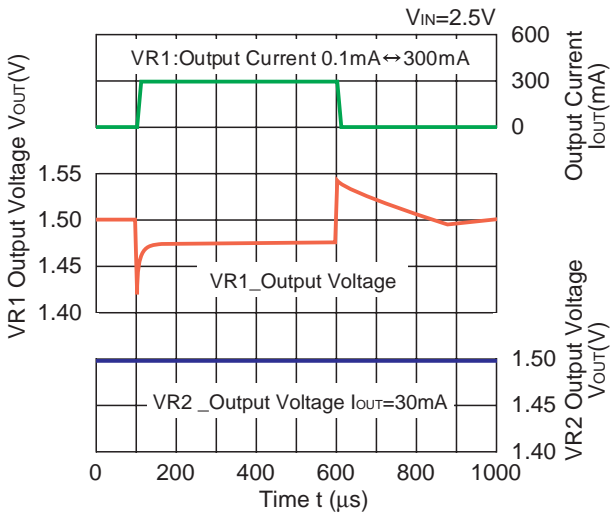
1.5V(VR1)



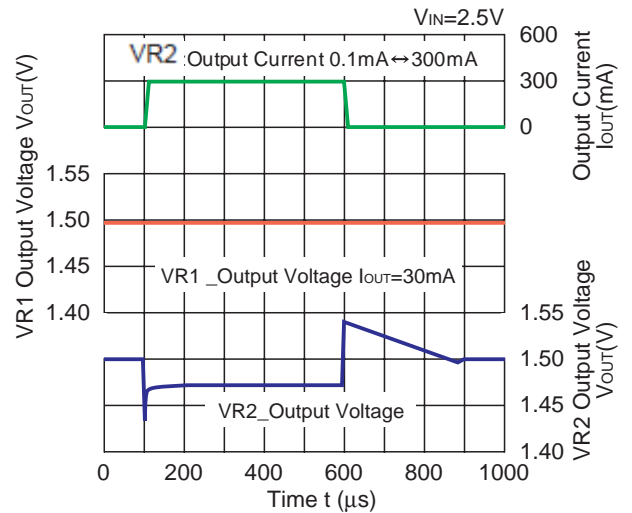
1.5V(VR2)

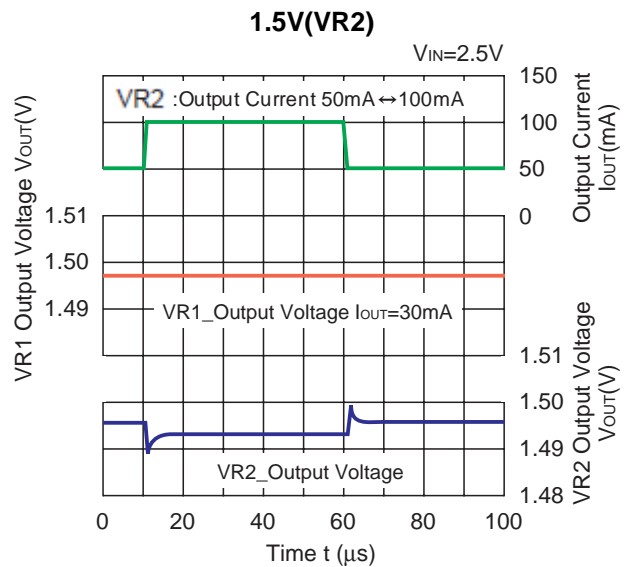
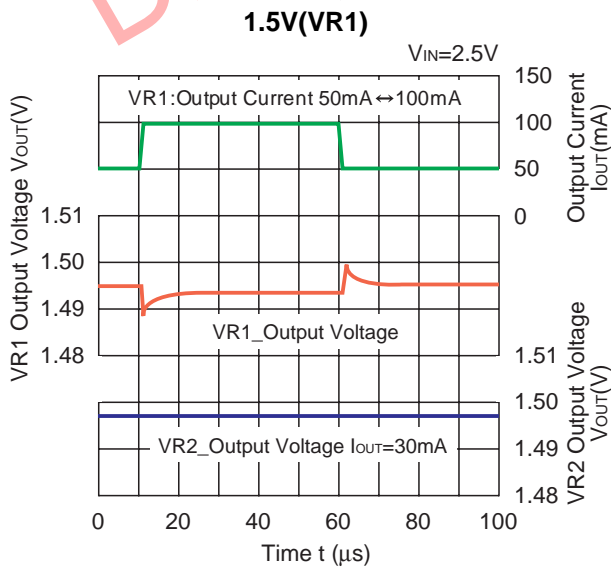
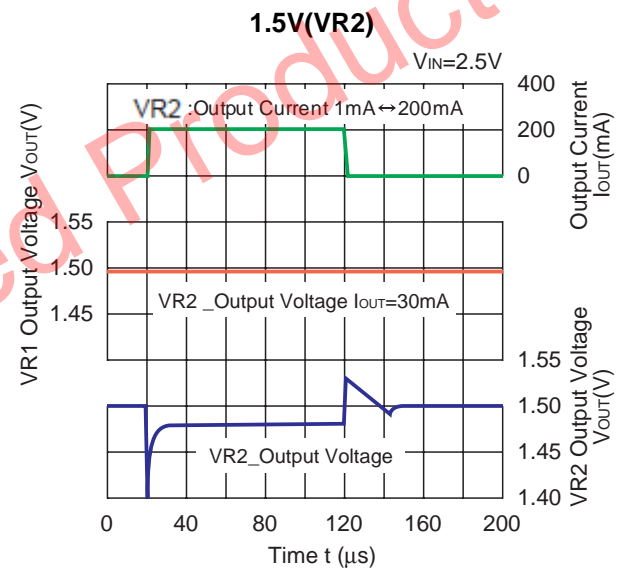
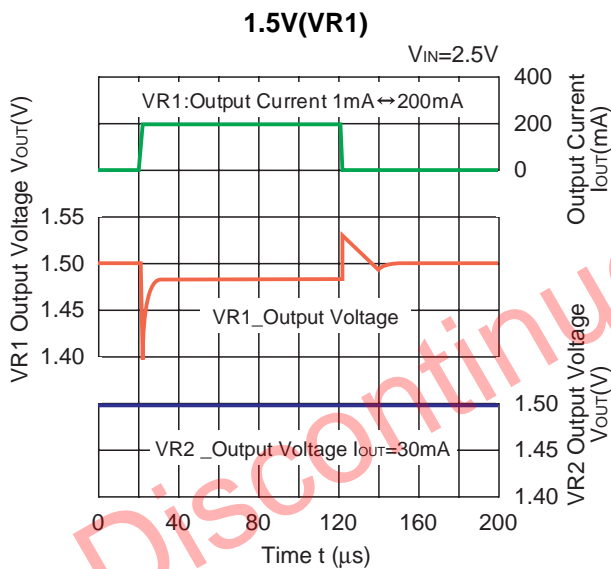
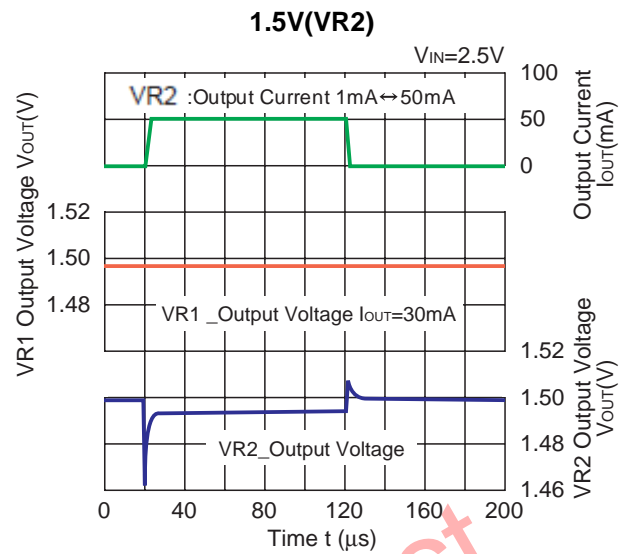
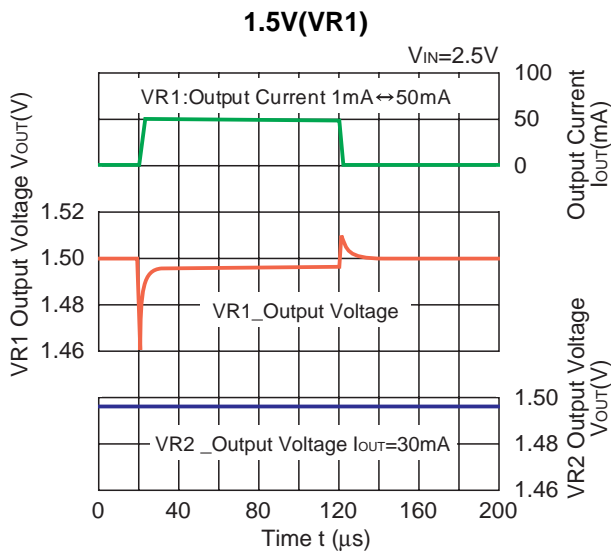


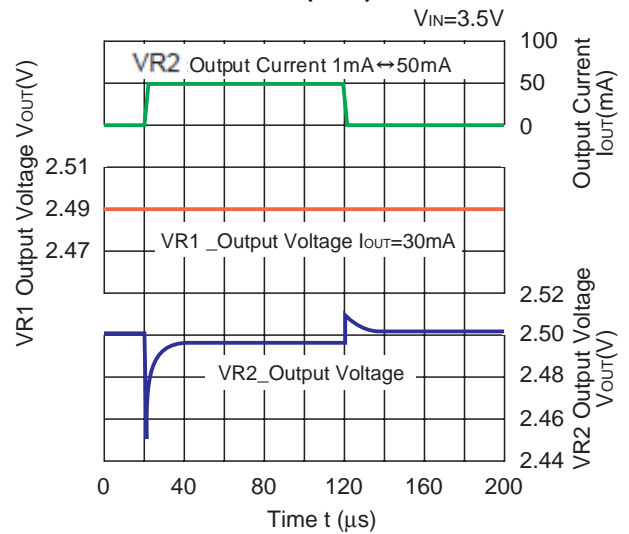
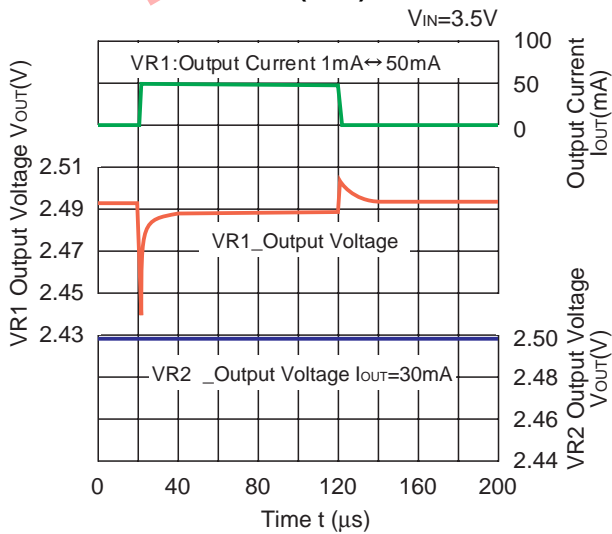
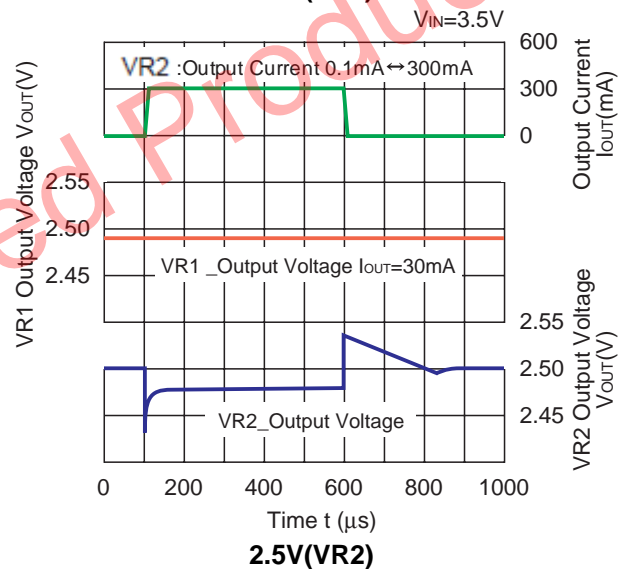
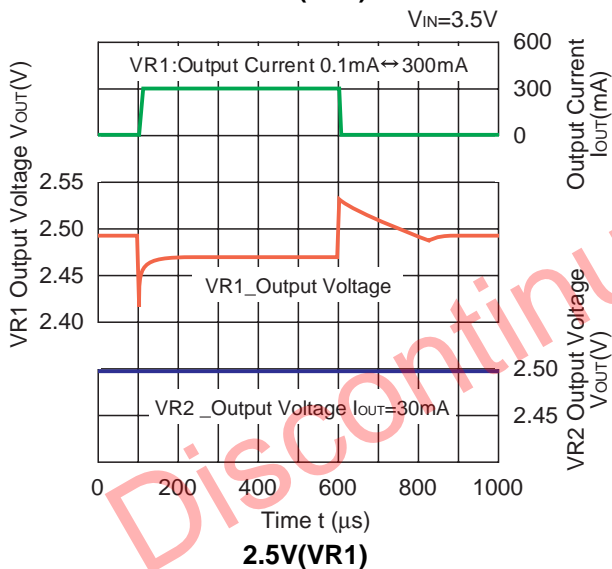
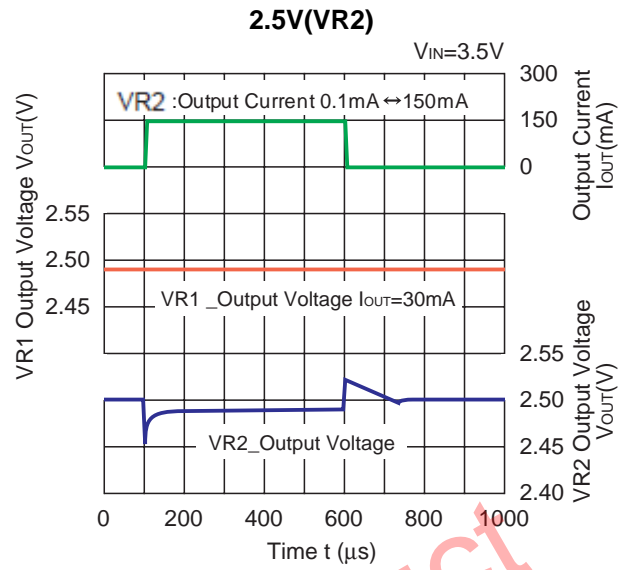
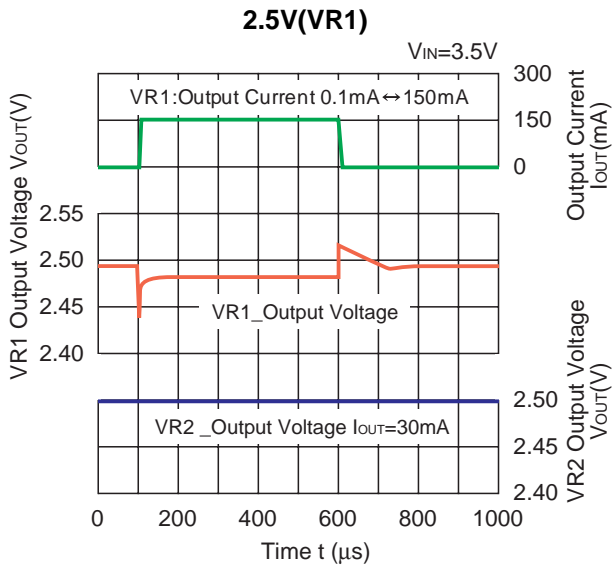
1.5V(VR1)

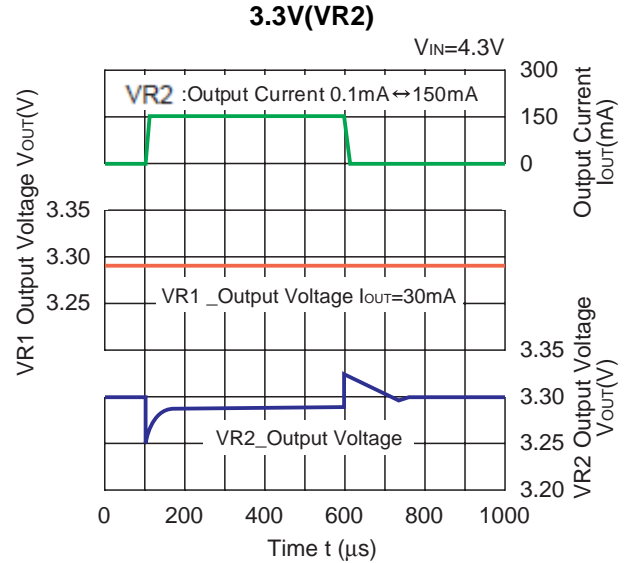
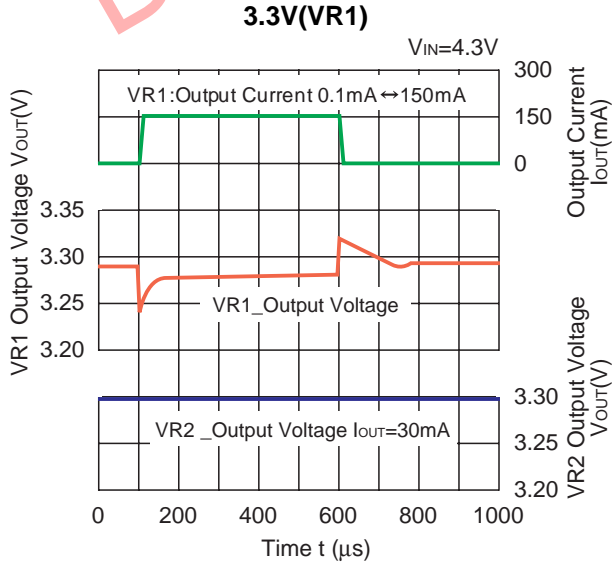
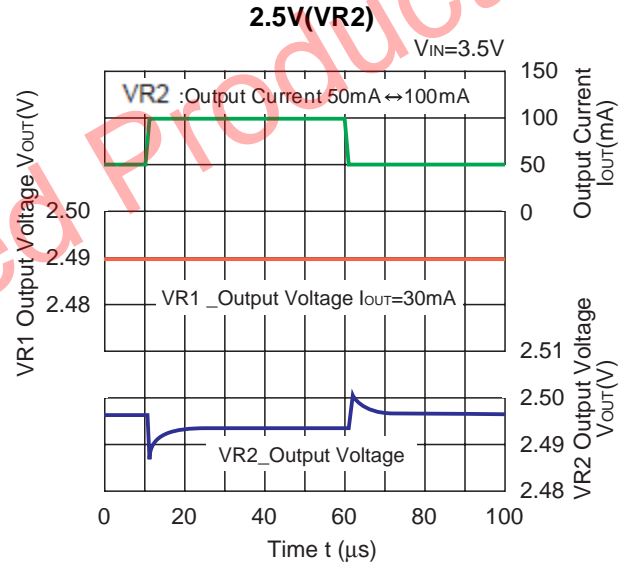
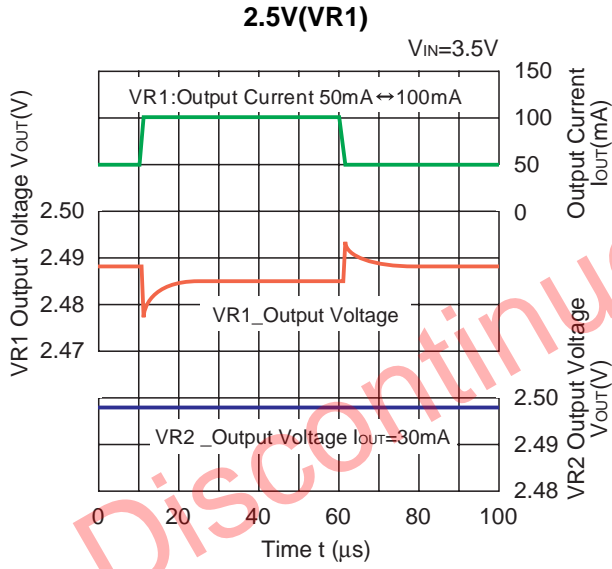
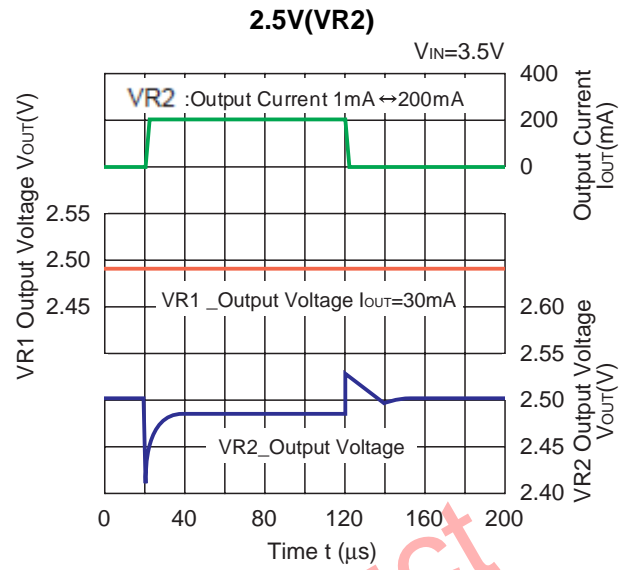
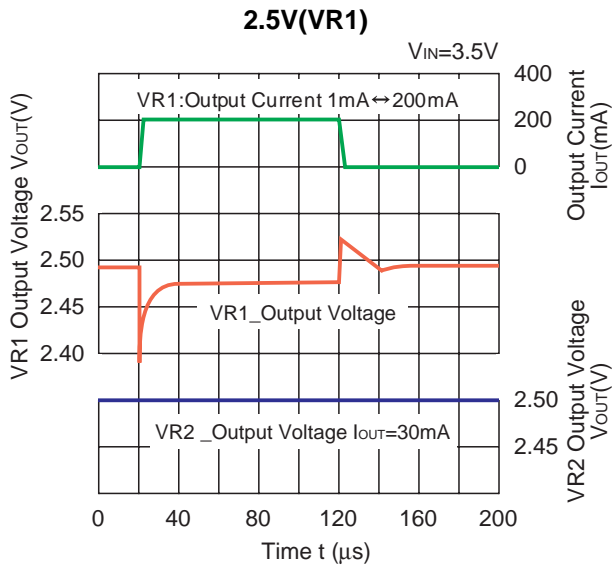


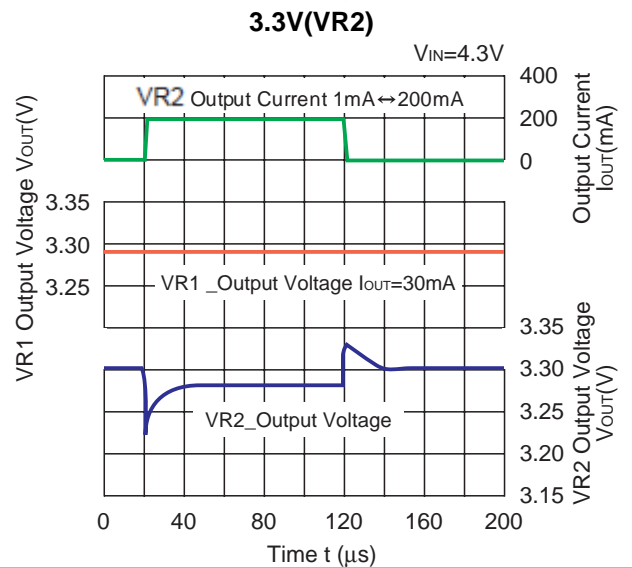
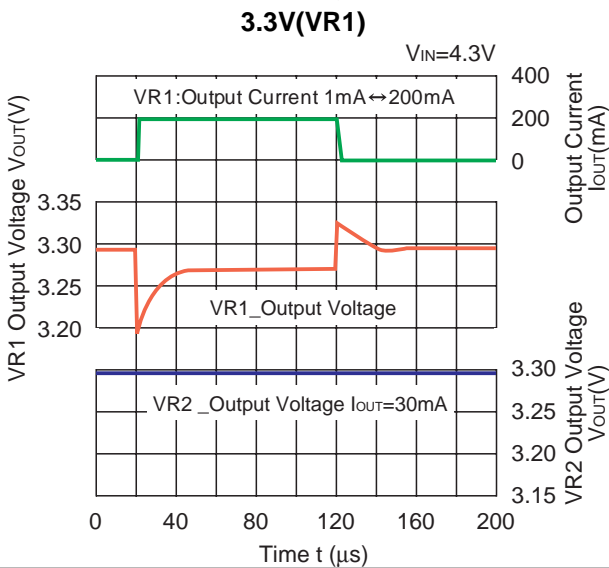
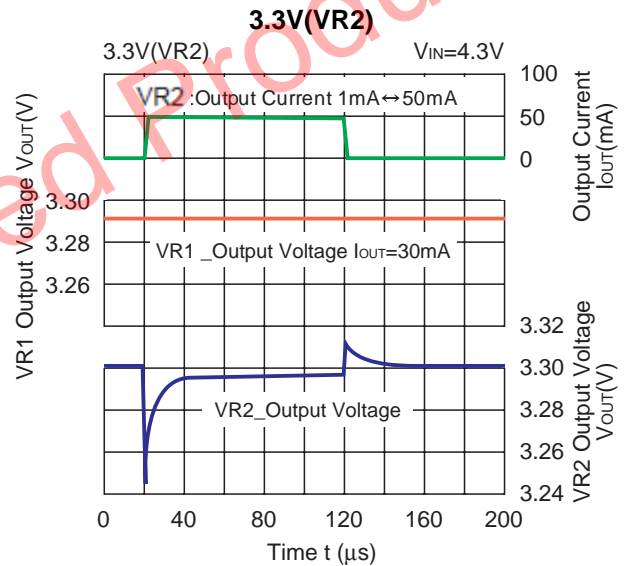
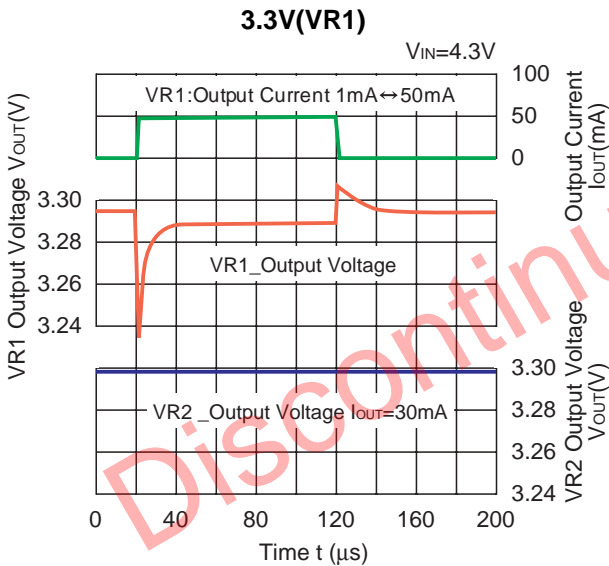
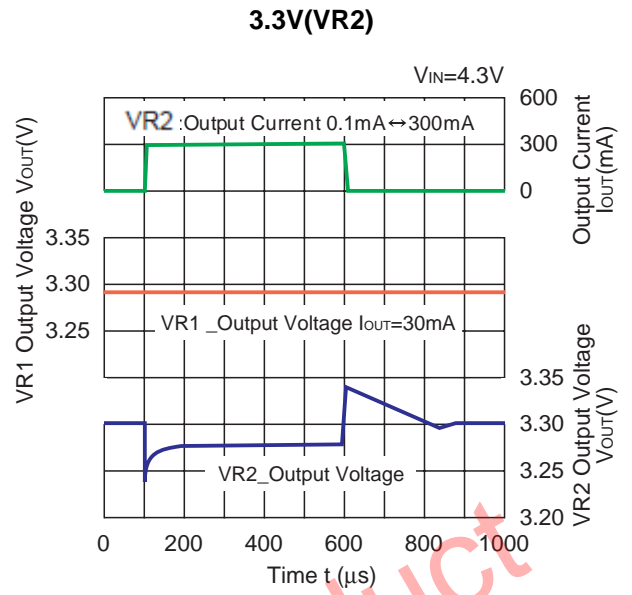
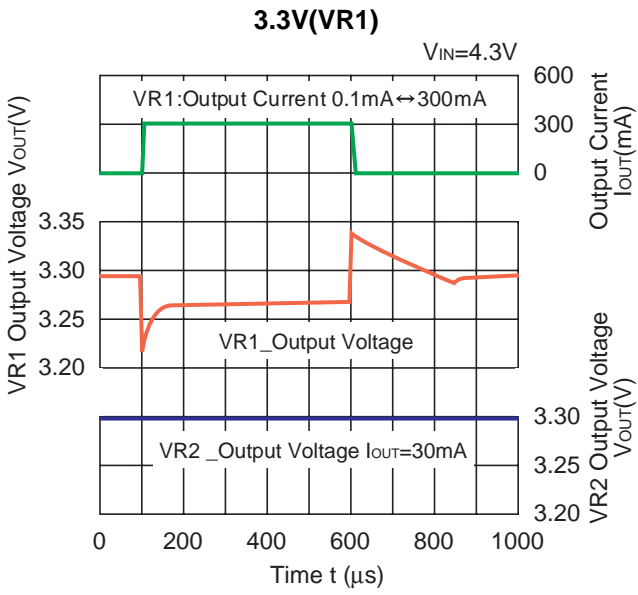
1.5V(VR2)

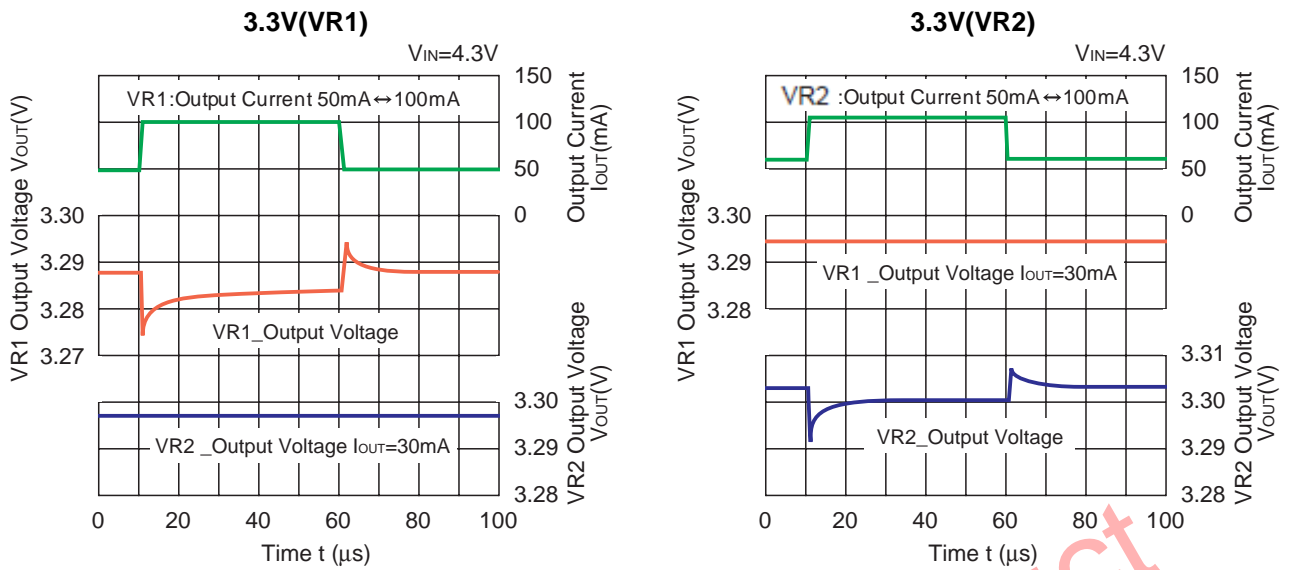




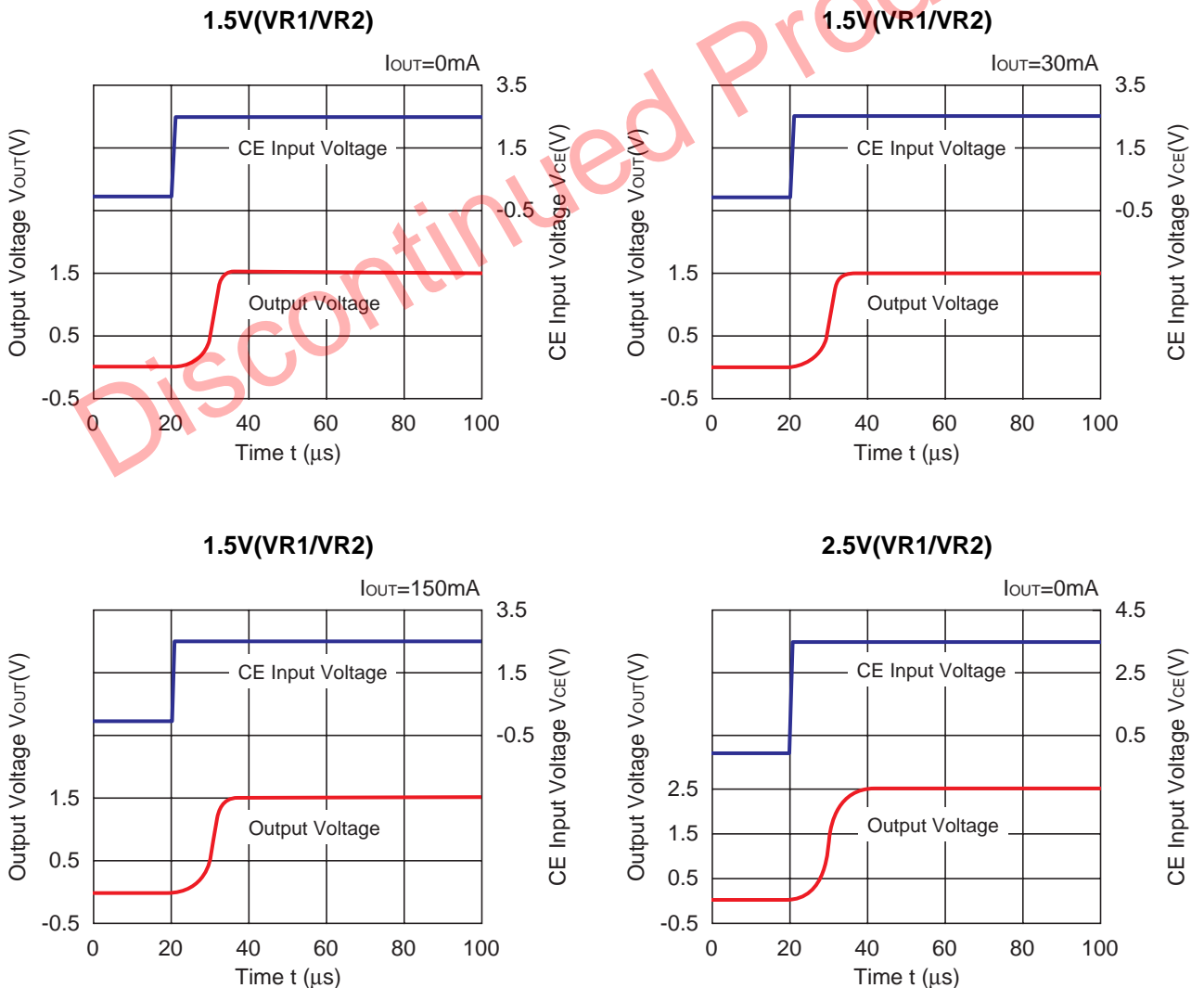




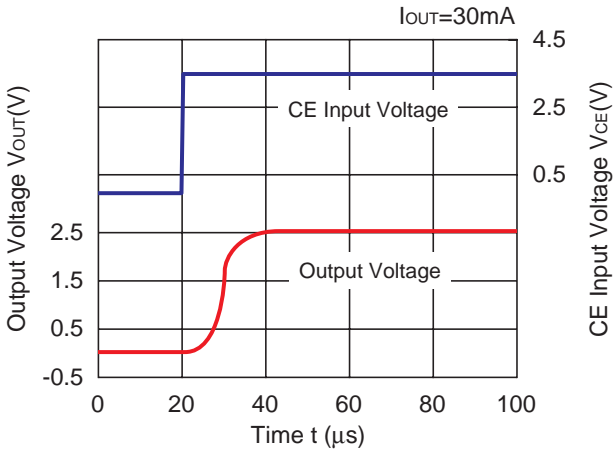




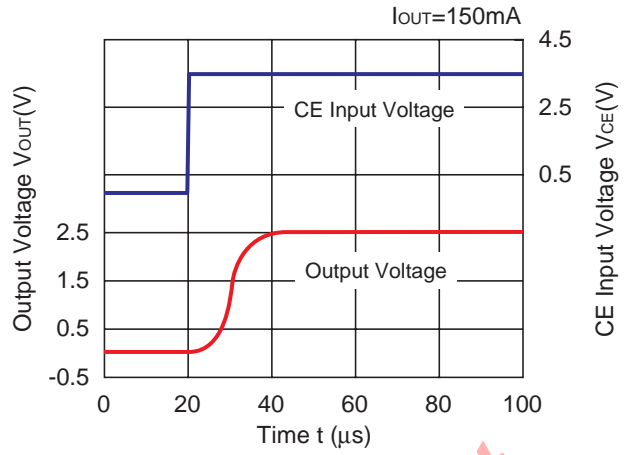
12) Turn On Speed with CE pin ($T_{opt}=25^{\circ}C$)



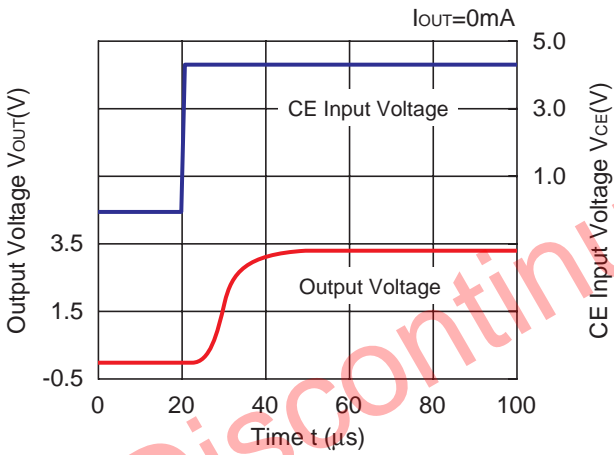
2.5V(VR1)



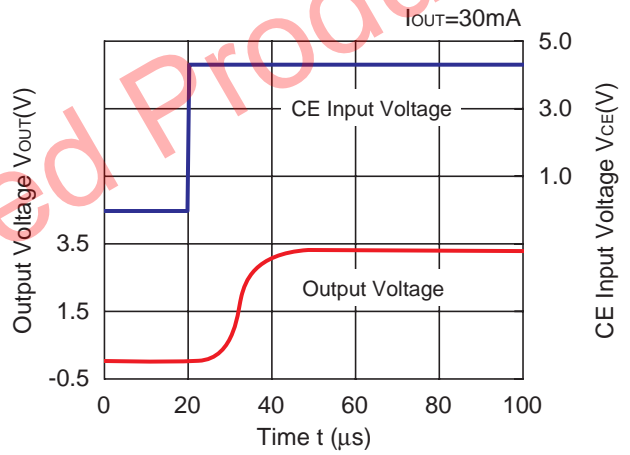
2.5V(VR1/VR2)



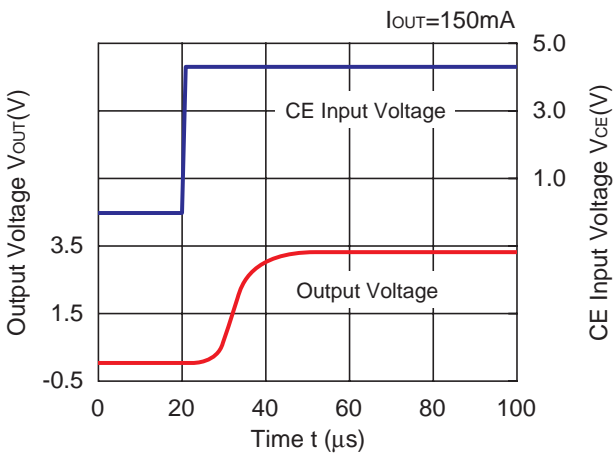
3.3V(VR1/VR2)



3.3V(VR1/VR2)

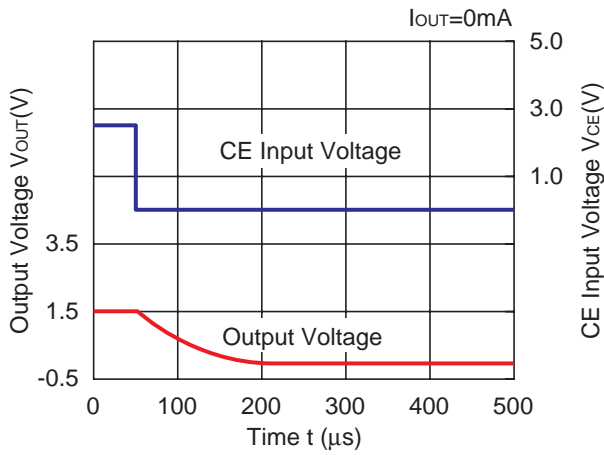


3.3V(VR1/VR2)

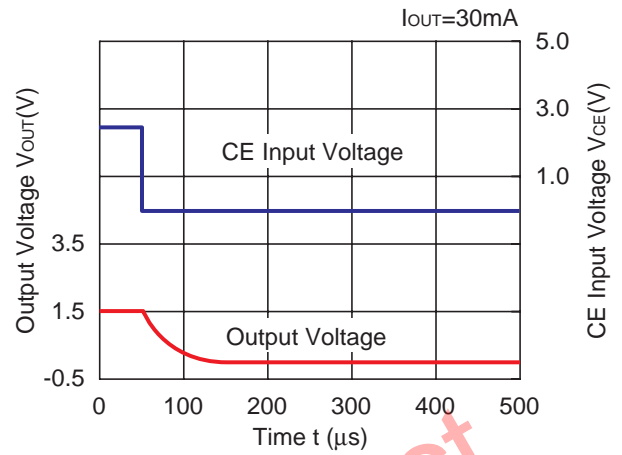


13) Turn Off Speed with CE pin ($T_{opt}=25^{\circ}\text{C}$)

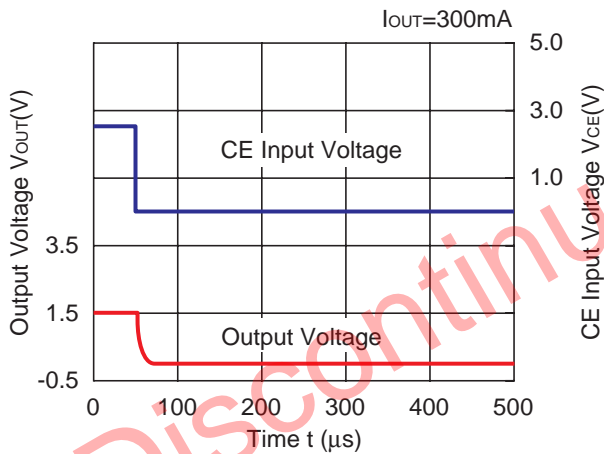
1.5V(VR1/VR2)



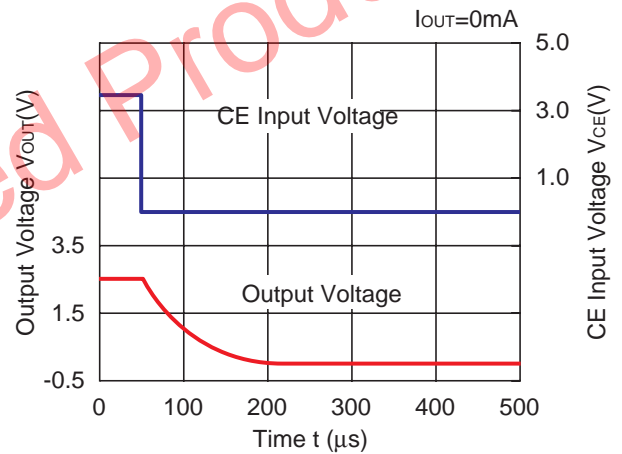
1.5V(VR1/VR2)



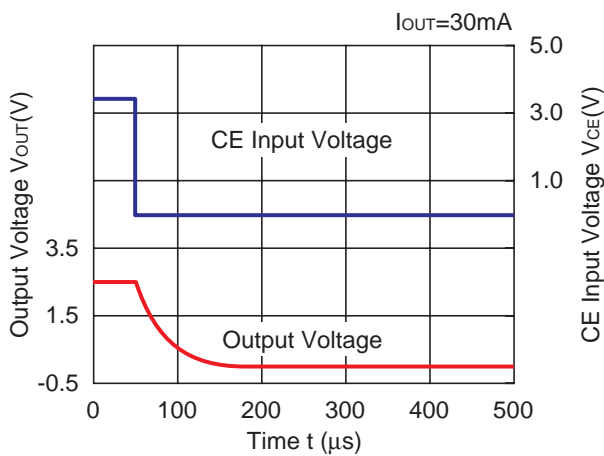
1.5V(VR1/VR2)



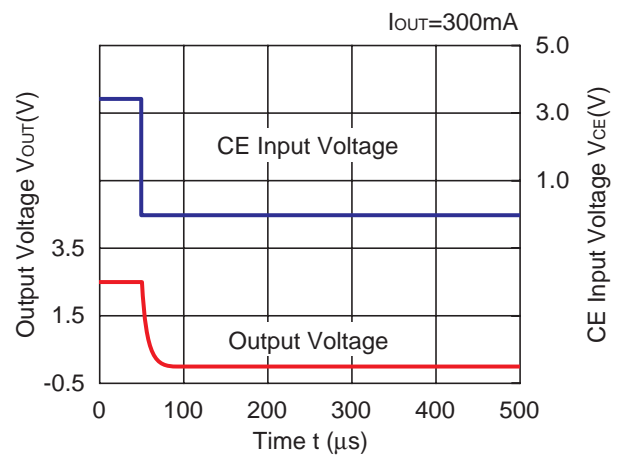
2.5V(VR1/VR2)

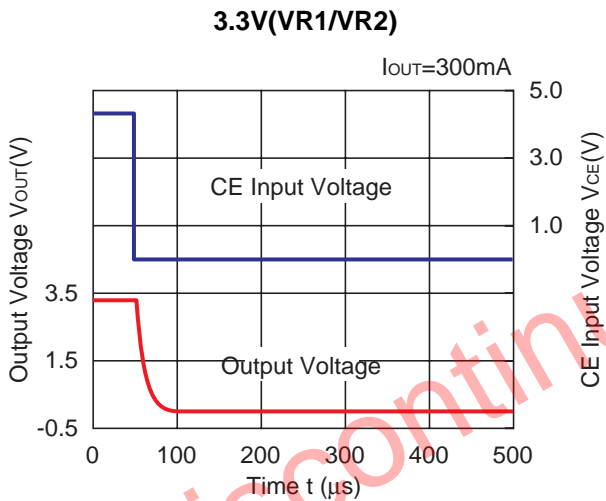
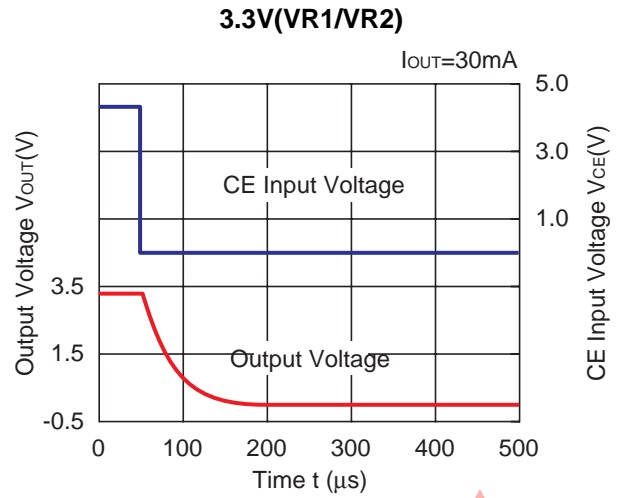
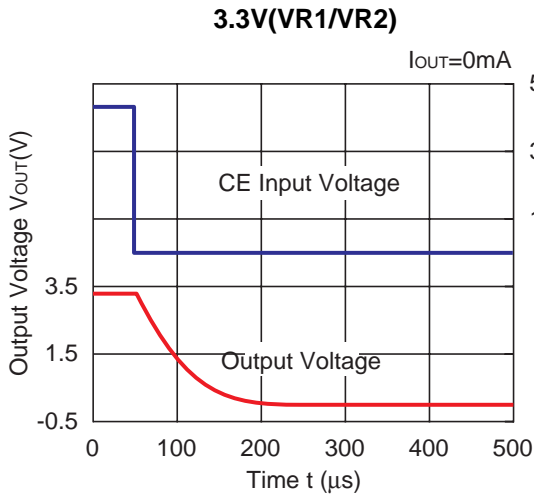


2.5V(VR1/VR2)

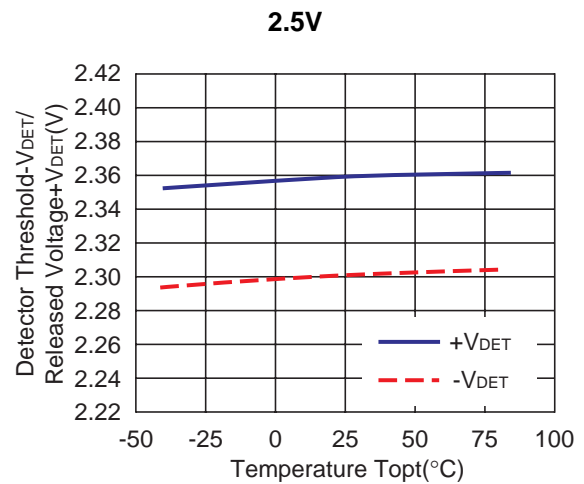
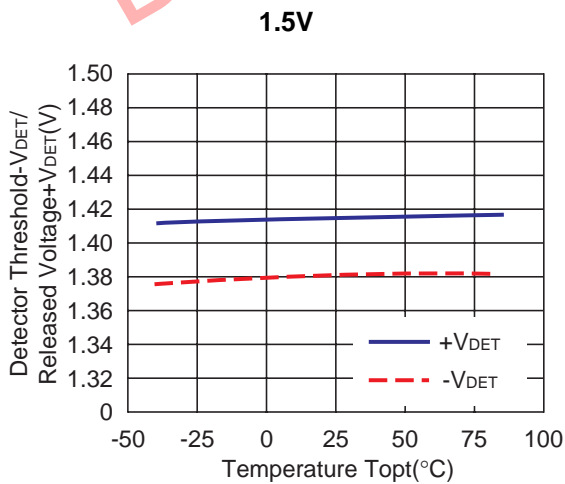


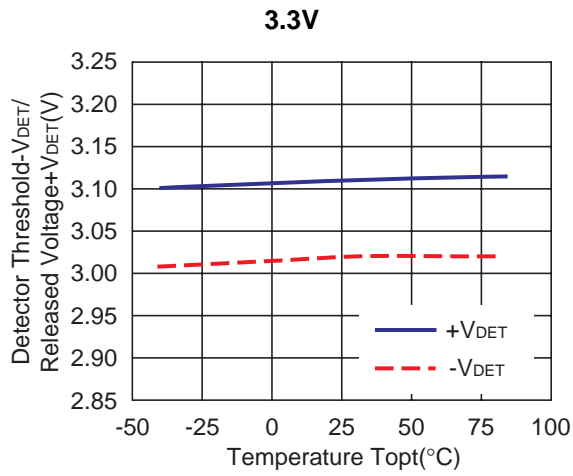
2.5V(VR1/VR2)



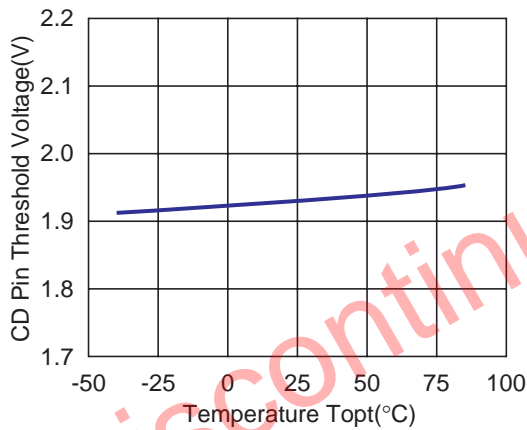


14) Detector Threshold/Released Voltage vs. Temperature

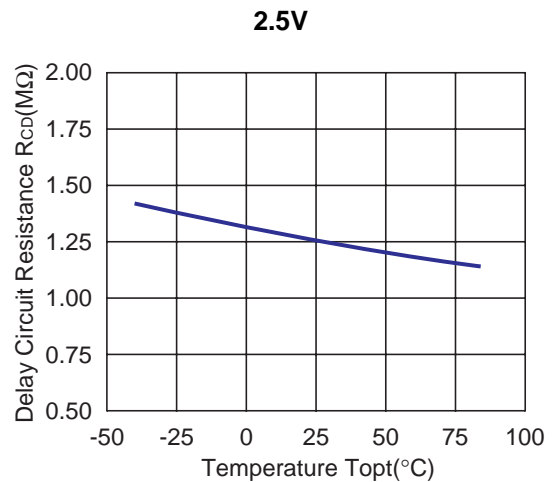
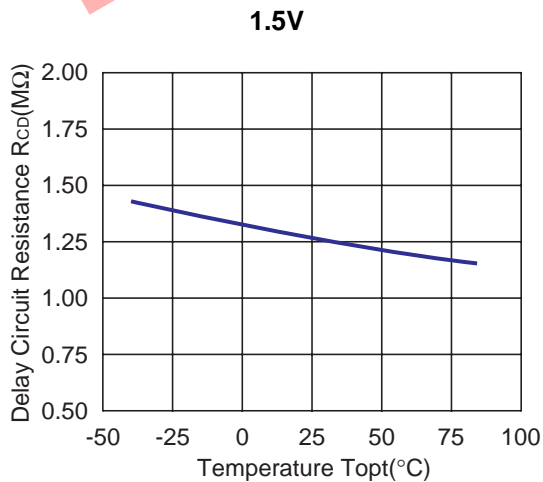


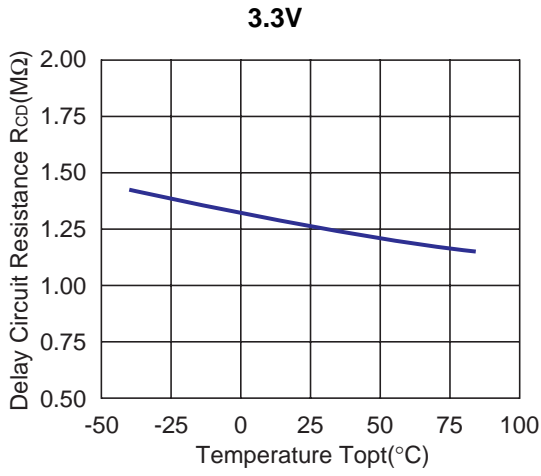


15) C_D Pin Threshold Voltage vs. Temperature

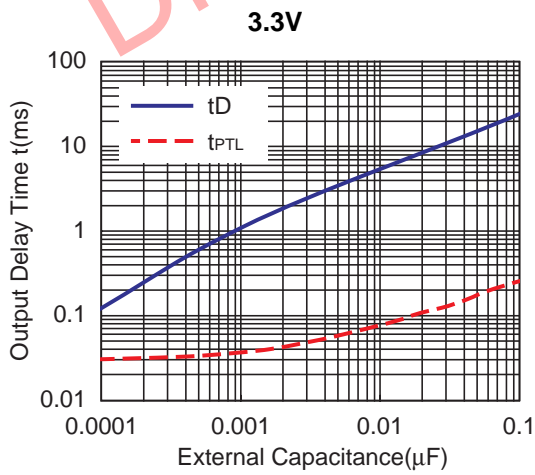
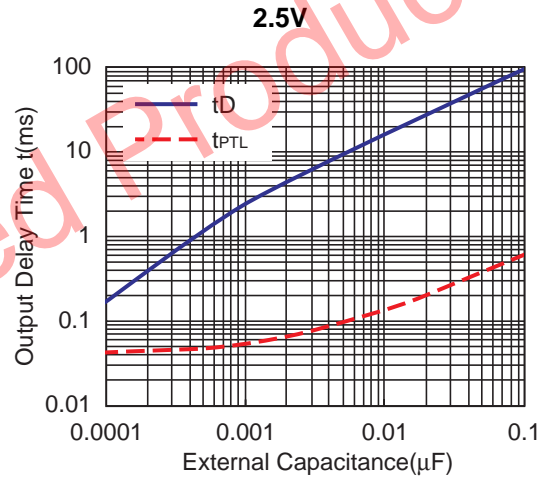
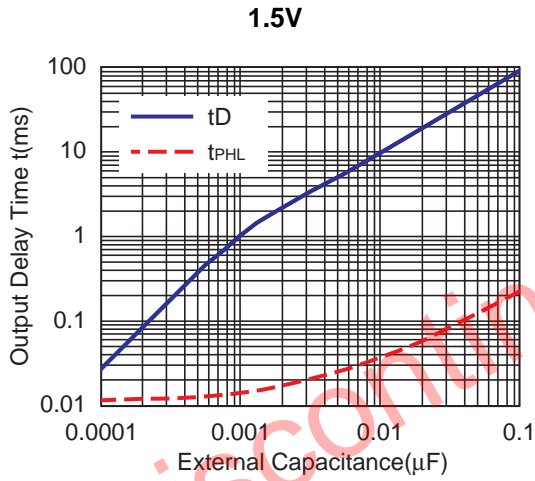


16) Delay Circuit Resistance vs. Temperature

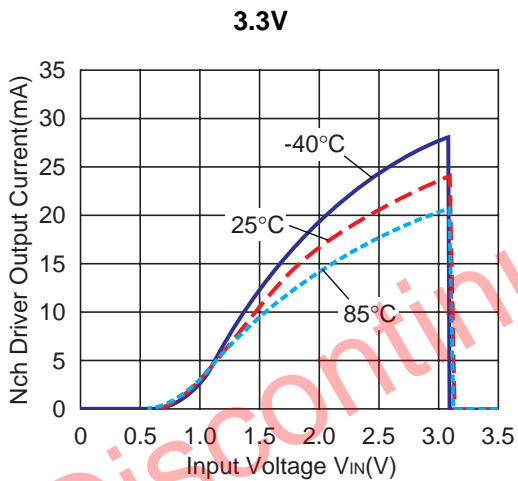
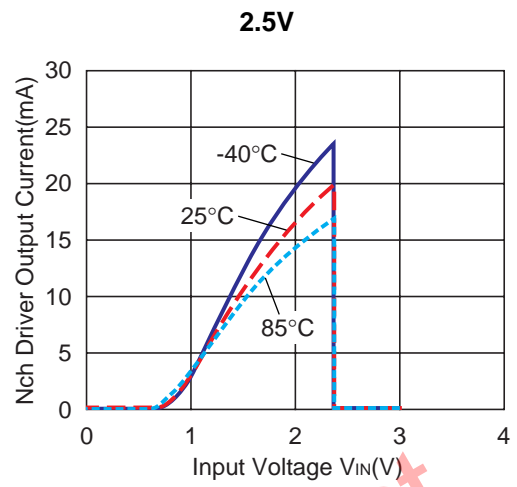
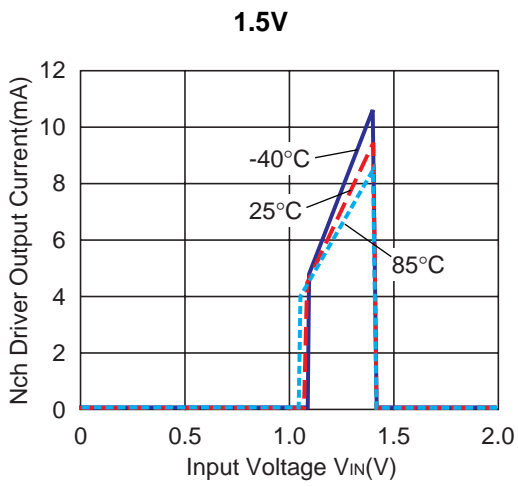




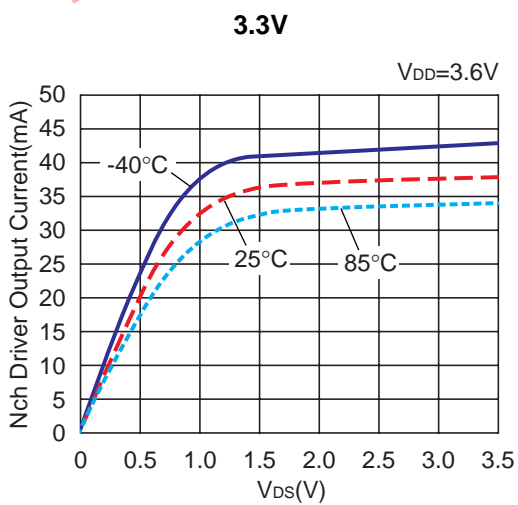
17) Output Delay Time vs. External Capacitance



18) Nch Driver Output Current vs. Input Voltage



19) Nch Driver Output Current vs. V_{DS}



ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. 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 $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph

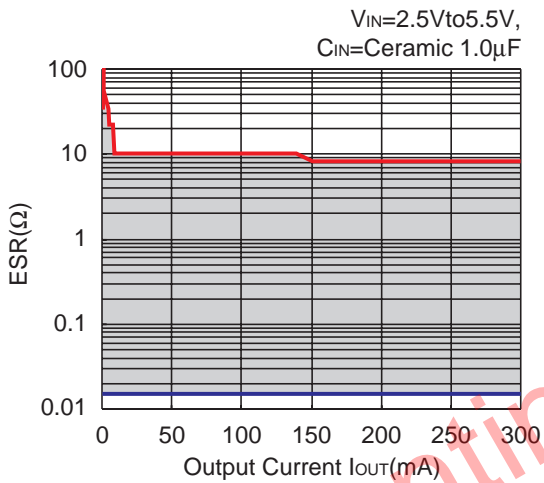
Measurement conditions

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

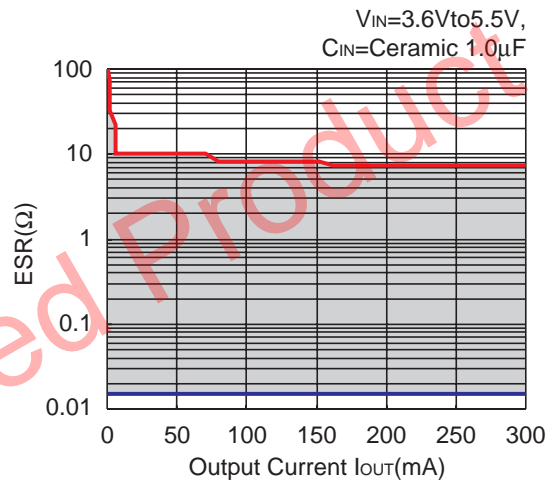
Frequency Band : 10Hz to 2MHz

Temperature : -40°C to 85°C

1.5V (VR1/VR2)



3.3V (VR1/VR2)





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Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

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