RICOH

RP151K SERIES

300mA Dual LDO with VD

NO. EA-132-111020

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

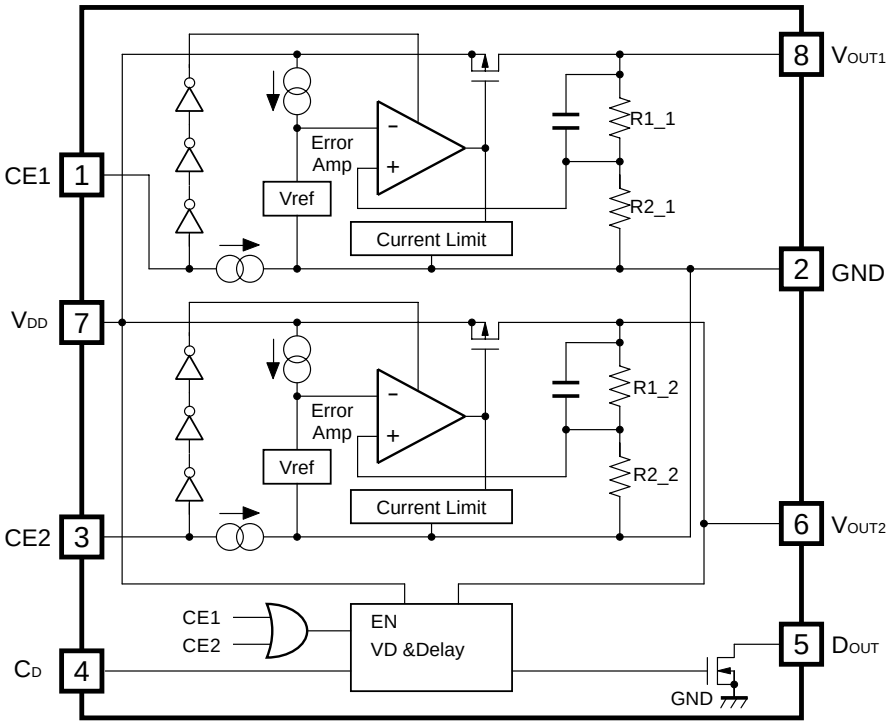
- Supply Current ..... Typ. 24μA×2 (VR1&VR2)
- Standby Current ..... Typ. 0.1μA×2
- Dropout Voltage ..... Typ. 0.21V (I_{OUT}=300mA, V_{OUT}=2.8V)
  Typ. 0.24V (I_{OUT}=300mA, V_{OUT}=2.5V)
- Ripple Rejection ..... Typ. 80dB (f=1kHz)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±30ppm/°C
- Line Regulation ..... Typ. 0.02%/V
- Output Voltage Accuracy ..... ±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 INFORMATIONS.)
- 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}=1.0μF or more
- Detector Threshord ..... Set V_{OUT2}×92%
- Output Delay Time for release ..... Typ. 10ms (C_D=0.01μF)

APPLICATIONS

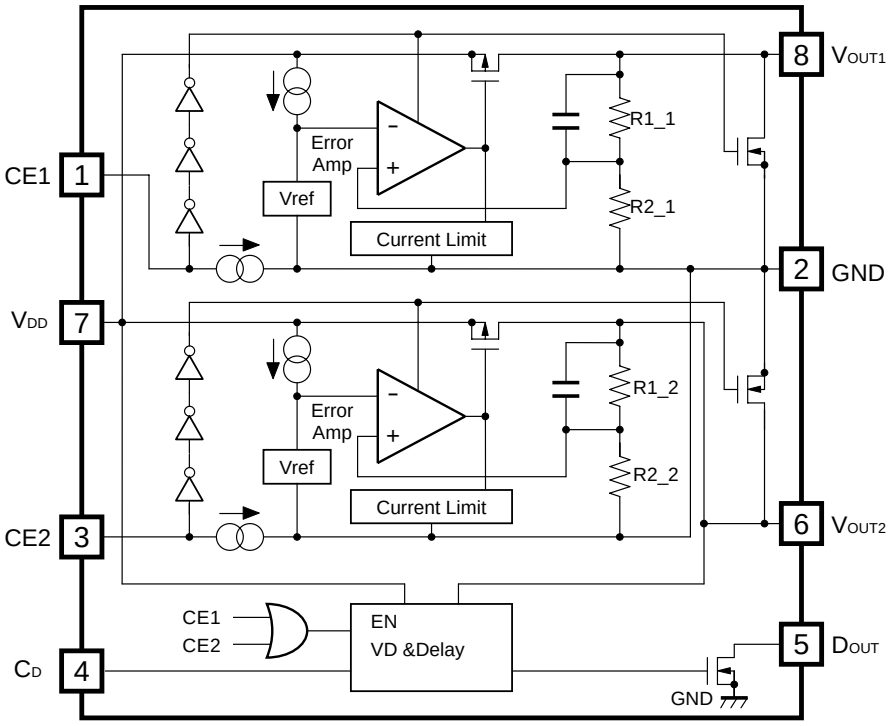
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

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.

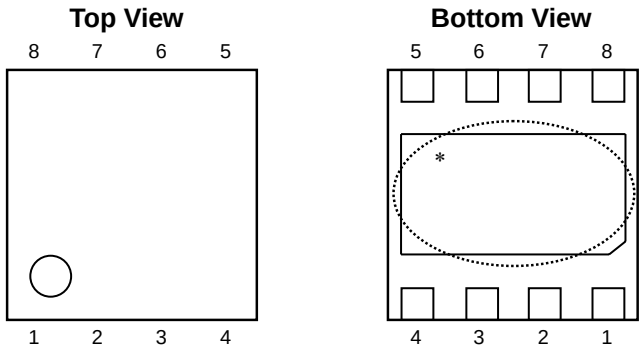
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP151Kxxx∗-TR	DFN(PLP)2020-8	5,000 pcs	Yes	Yes

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.)

∗ : Designation of Mask Option:
(A) without auto-discharge function at off state
(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	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
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	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}=Set V_{OUT}+1V for higher output of the regulator pair,
I_{OUT}=1mA, C_{IN}=C_{OUT}=1μF, unless otherwise noted.

VR

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}=Set V_{OUT}+1V I_{OUT}=1mA	V_{OUT} > 2.0V	×0.99		×1.01	V
			V_{OUT} ≤ 2.0V	−20		20	mV
I_{OUT}	Output Current			300			mA
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	1mA ≤ I_{OUT} ≤ 200mA			20	40	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.5V ≤ Set V_{OUT} < 1.7V		0.40	1.00	V
			1.7V ≤ Set V_{OUT} < 2.0V		0.34	0.80	
			2.0V ≤ Set V_{OUT} < 2.5V		0.29	0.50	
			2.5V ≤ Set V_{OUT} < 2.8V		0.24	0.38	
			2.8V ≤ Set V_{OUT} ≤ 3.3V		0.21	0.34	
I_{SS}	Supply Current	I_{OUT}=0mA			24	33	μA
Istandby	Standby Current	V_{CE}=0V			0.1	3.0	μA
ΔV_{OUT}/ ΔV_{IN}	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 5.0V (In case that V_{OUT} ≤ 2.0V, 2.5V ≤ V_{IN} ≤ 5.0V)			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA (In case that V_{OUT} ≤ 2.0V, V_{IN}=3V)			80		dB
V_{IN}	Input Voltage*			2.5		5.25	V
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	−40°C ≤ Topt ≤ 85°C			±30		ppm /°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		μVrms
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

Topt=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 1.0μF 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.

C_D external components, especially capacitor C4, as close as possible to the ICs and make wiring as short as possible. (Refer to TYPICAL APPLICATION)

Phase Compensation

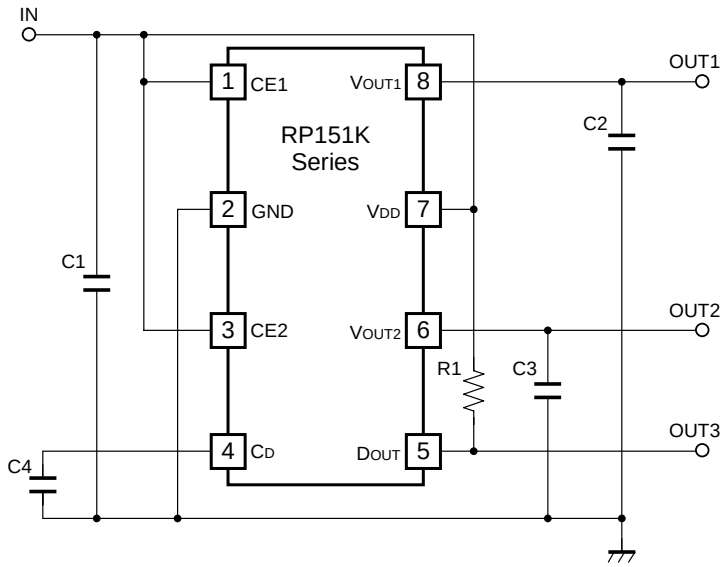
In these ICs, phase compensation is made for securing stable operation even if the load current is varied.

For this purpose, connect capacitors with a capacitance value as much as 1.0μF 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)

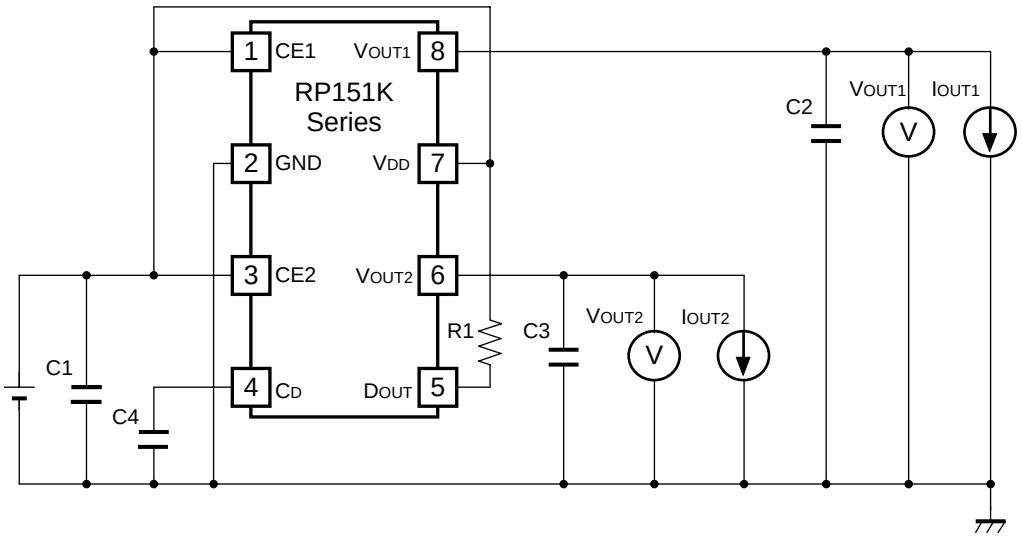
External Capacitor; Ceramic Type		C1, C2, C3
1.0μF	Kyocera	CM05X5R105KD6AB
	TDK	C1005JB0J105K
	Murata	GRM155B31A105KE15

External Capacitor for delay time C4

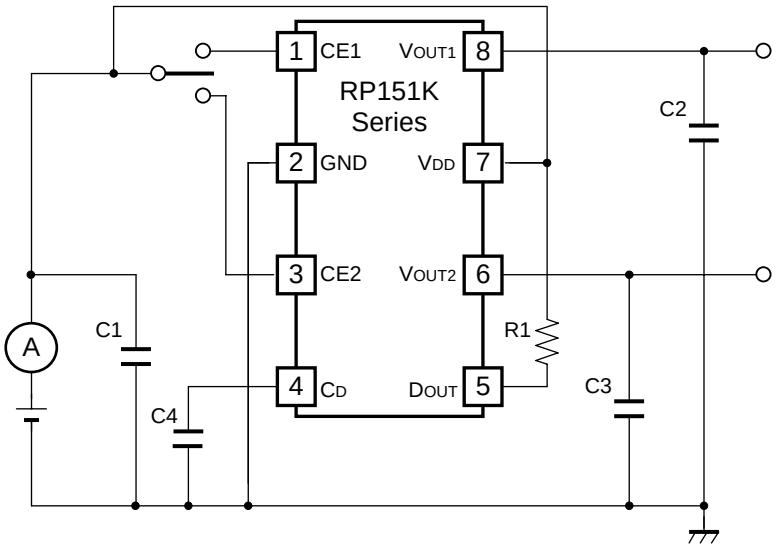
Output delay time (t_D) can be set accordance with the capacitance C_D of external capacitor as below.

$t_D=10^6 \times C4_{(S)}$

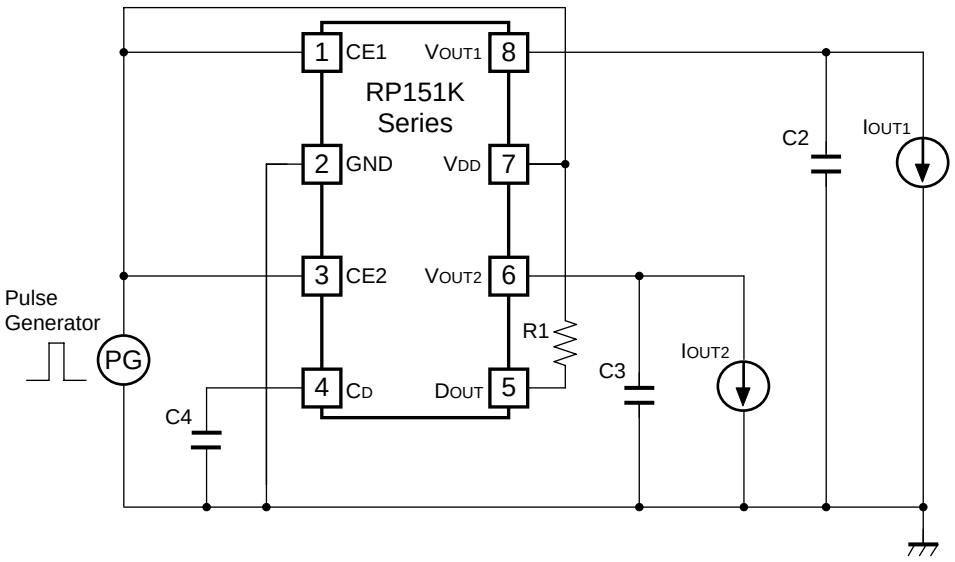
TEST CIRCUITS



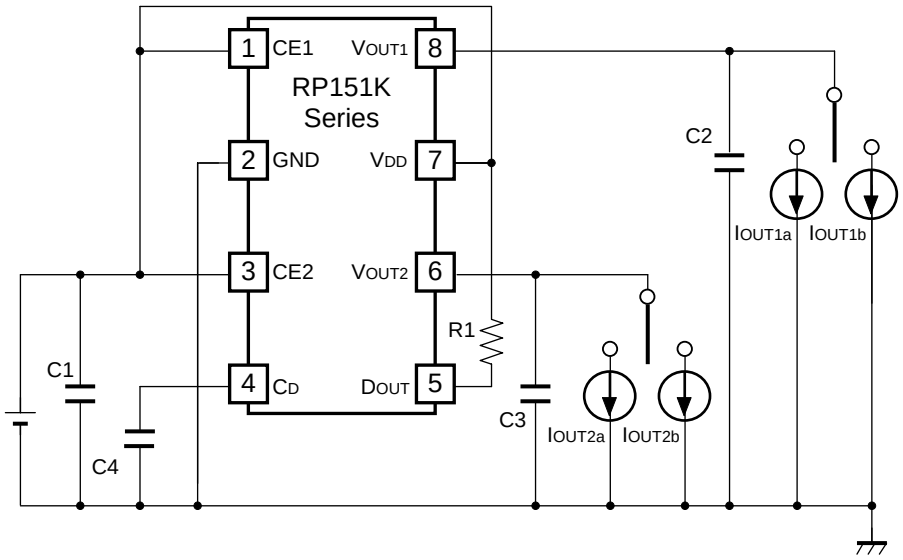
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

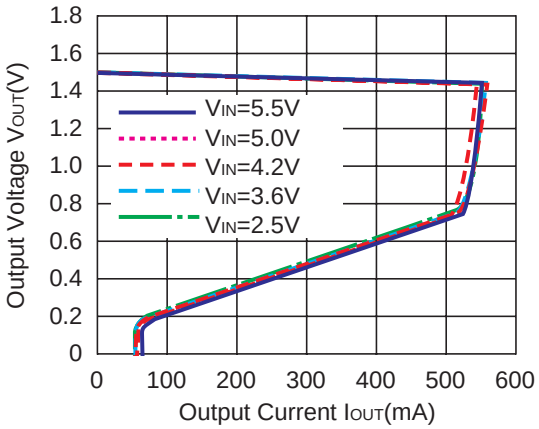


Test Circuit for Load Transient Response

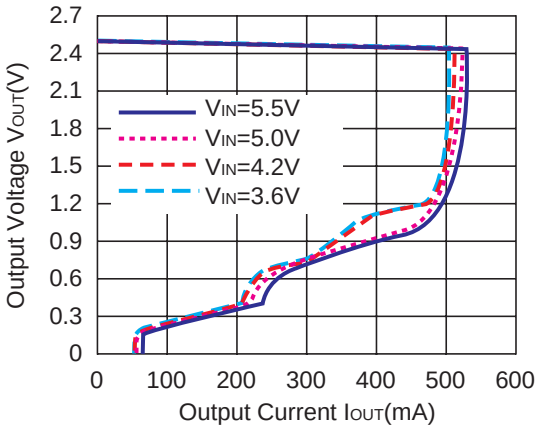
TYPICAL CHARACTERISTICS

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

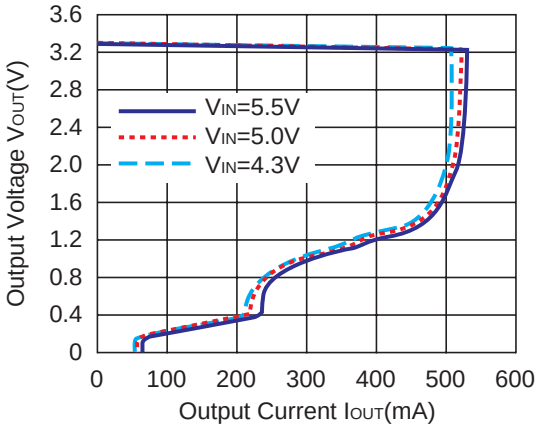
1.5V(VR1/VR2)



2.5V(VR1/VR2)

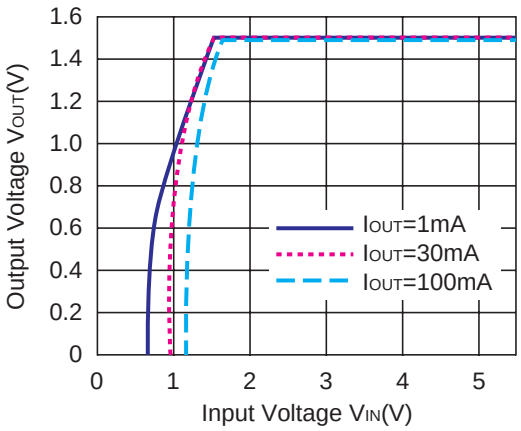


3.3V(VR1/VR2)

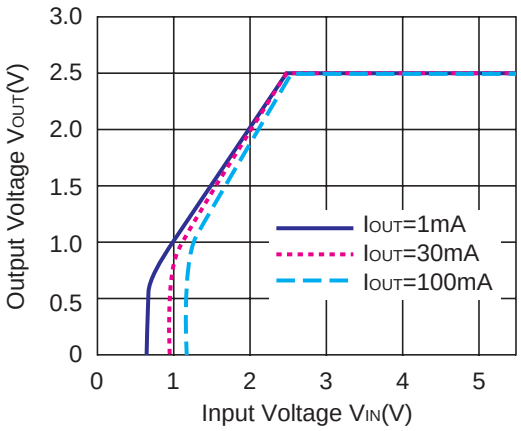


2) Output Voltage vs. Input Voltage (Topt=25°C)

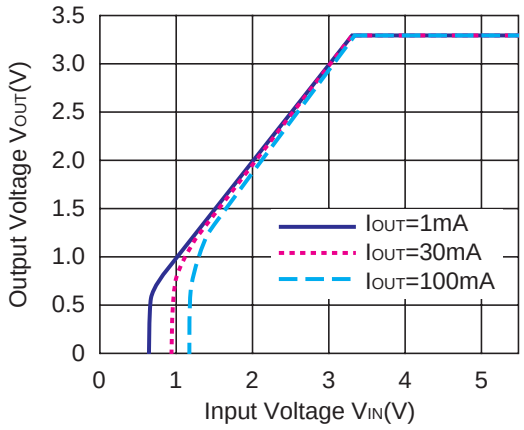
1.5V(VR1/VR2)



2.5V(VR1/VR2)

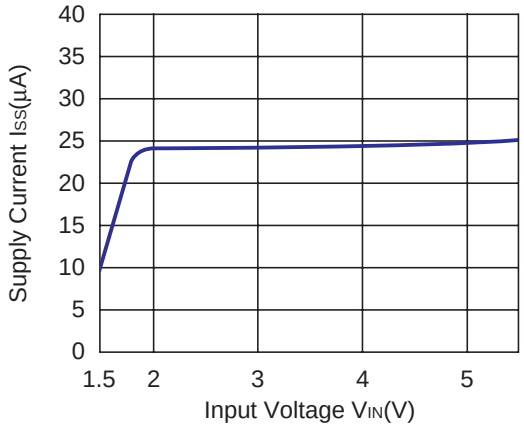


3.3V(VR1/VR2)

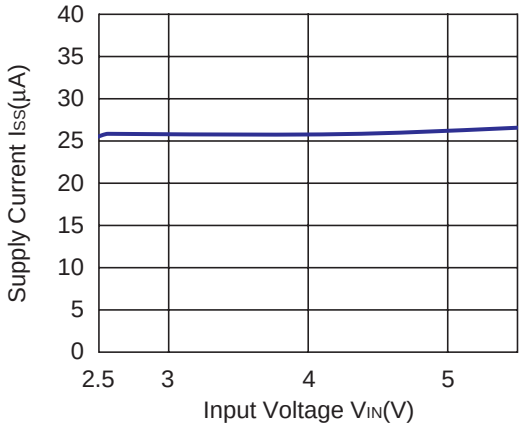


3) Supply Current vs. Input Voltage (T_{opt}=25°C)

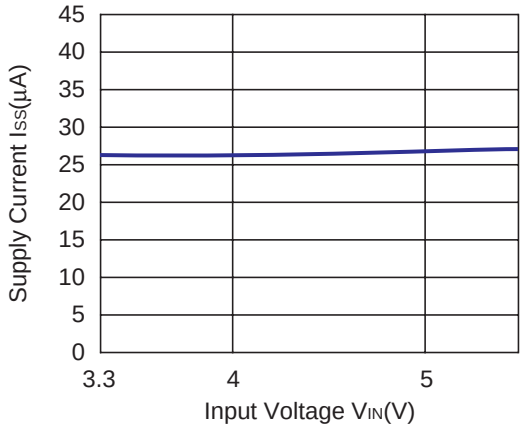
1.5V(VR1/VR2)



2.5V(VR1/VR2)

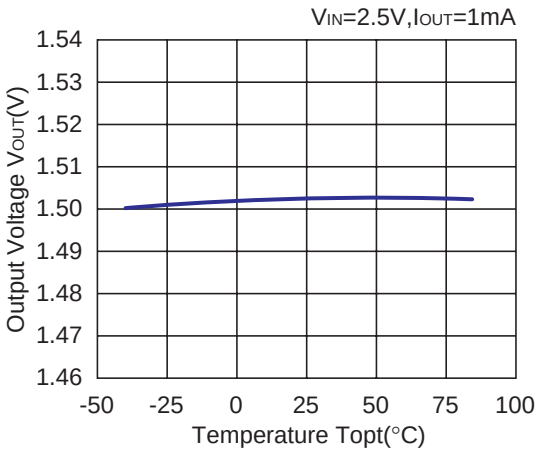


3.3V(VR1/VR2)

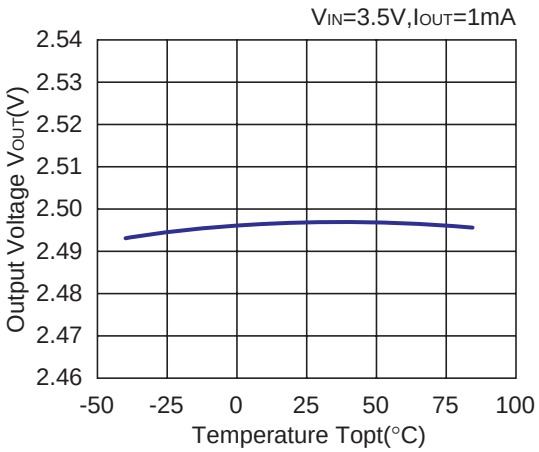


4) Output Voltage vs. Temperature

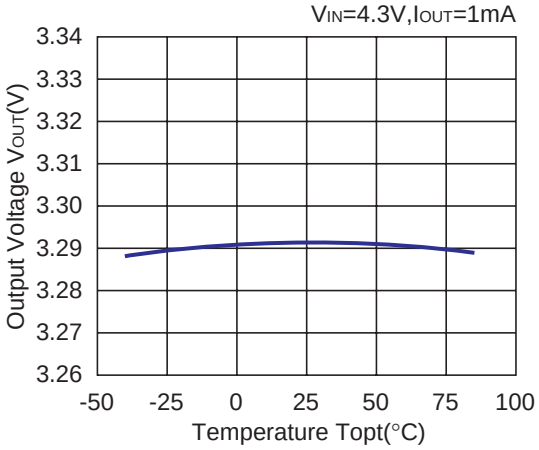
1.5V(VR1/VR2)



2.5V(VR1/VR2)

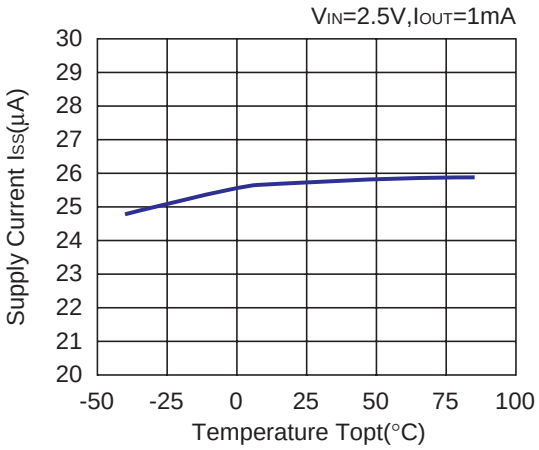


3.3V(VR1/VR2)

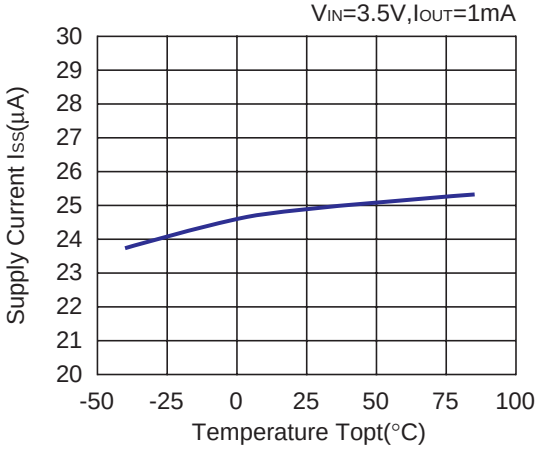


5) Supply Current vs. Temperature

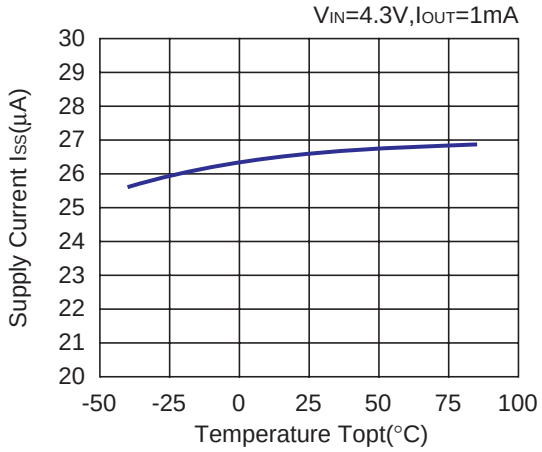
1.5V(VR1/VR2)



2.5V(VR1/VR2)

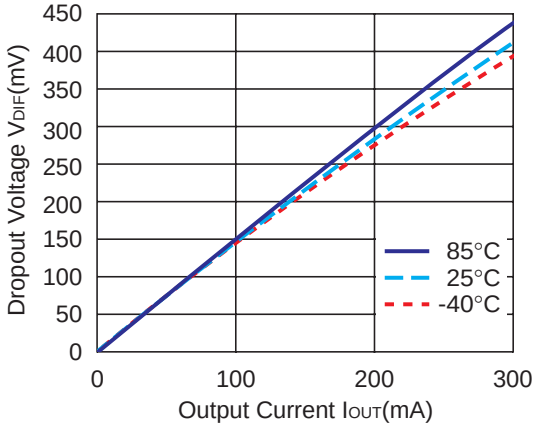


3.3V(VR1/VR2)

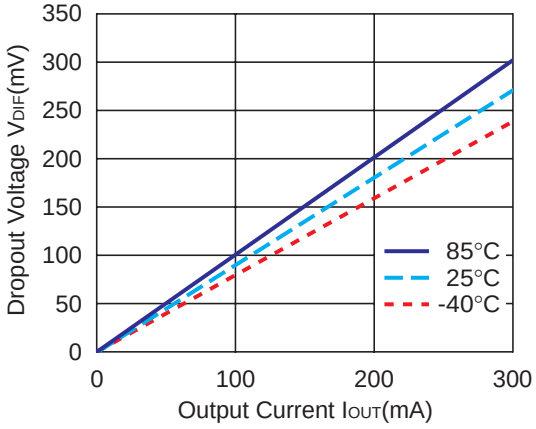


6) Dropout Voltage vs. Output Current

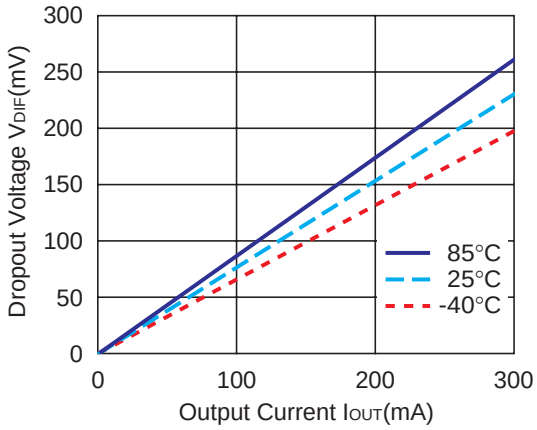
1.5V(VR1/VR2)



2.5V(VR1/VR2)

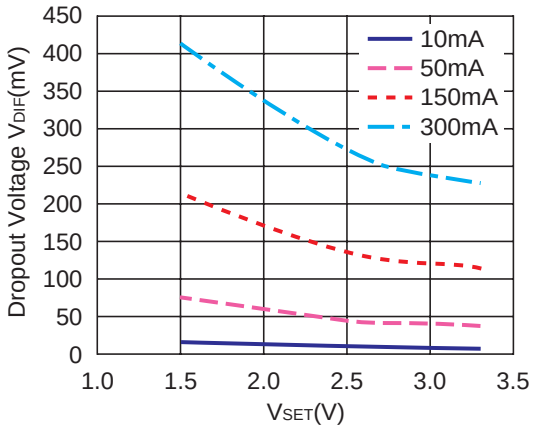


3.3V(VR1/VR2)



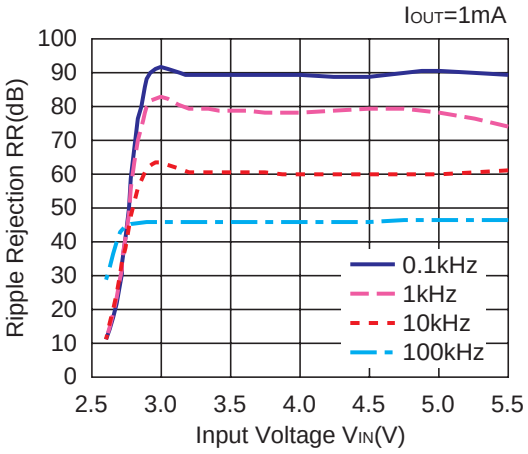
7) Dropout Voltage vs. VR_V_{SET}

VR1/VR2

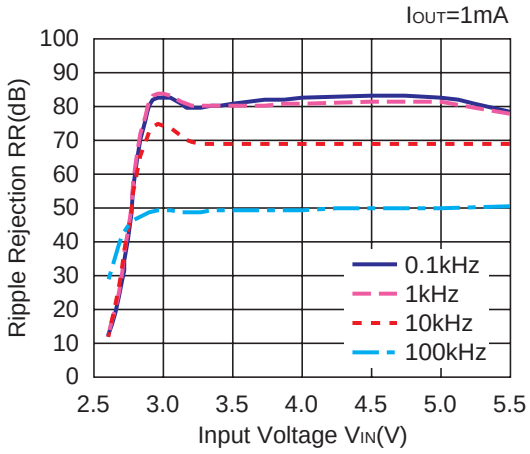


8) Ripple Rejection vs. Input Bias (Input Ripple=0.5Vp-p, T_{opt}=25°C)

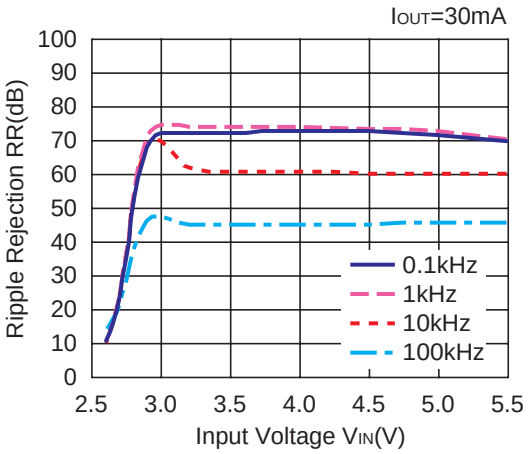
2.5V(VR1)



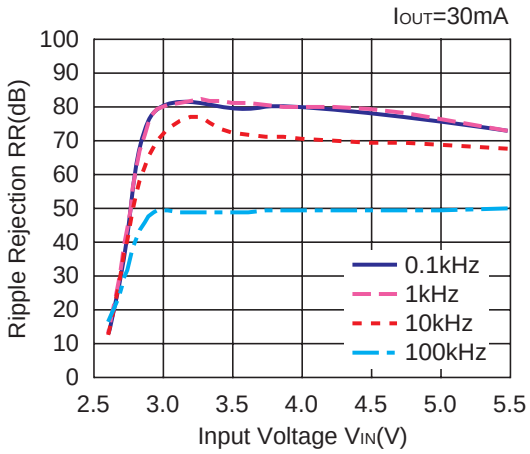
2.5V(VR2)



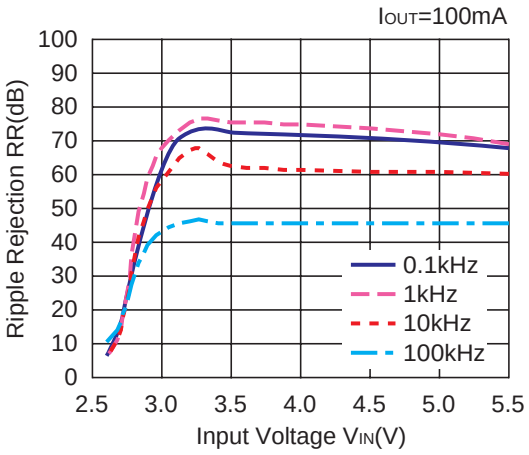
2.5V(VR1)



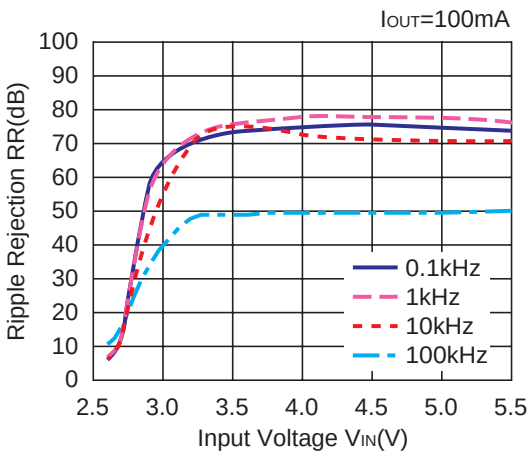
2.5V(VR2)



2.5V(VR1)

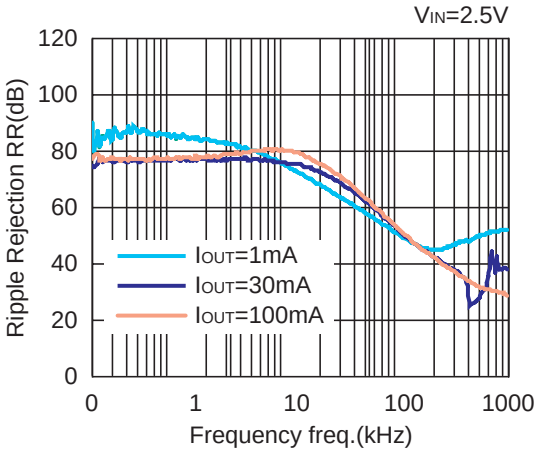


2.5V(VR2)

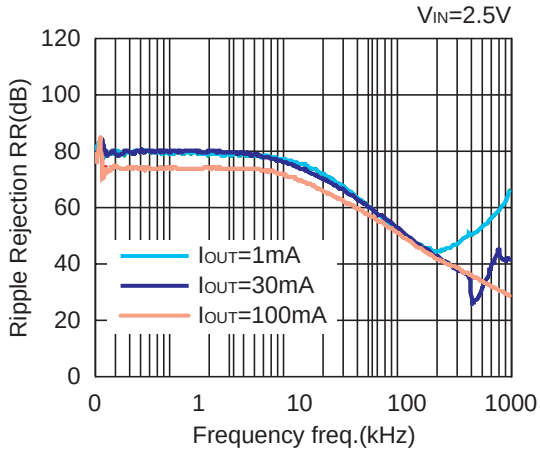


9) Ripple Rejection vs. Frequency (Ripple=0.5Vp-p)

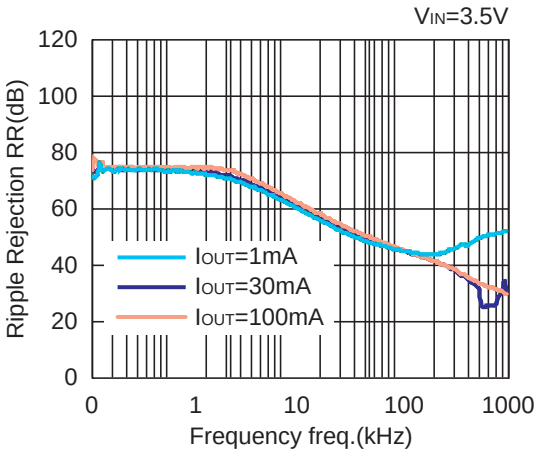
1.5V(VR1)



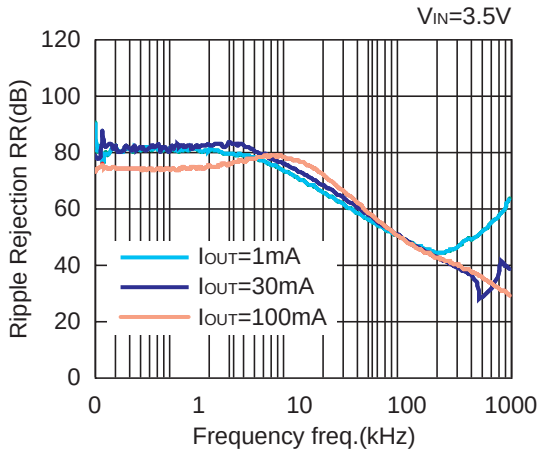
1.5V(VR2)



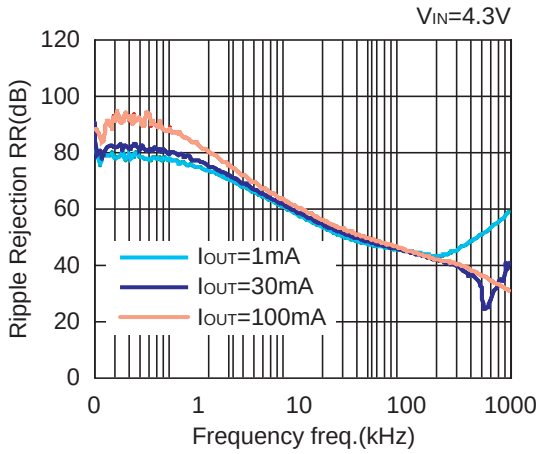
2.5V(VR1)



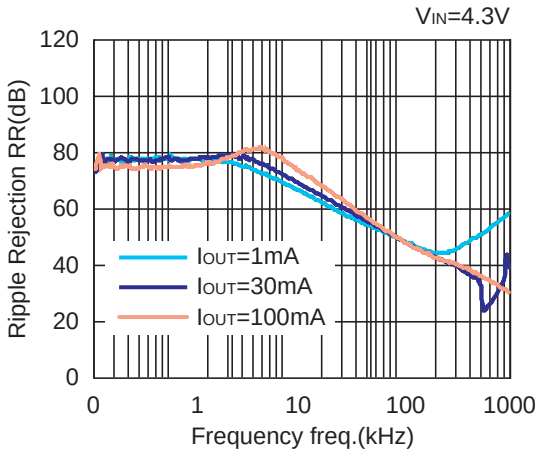
2.5V(VR2)



3.3V(VR1)

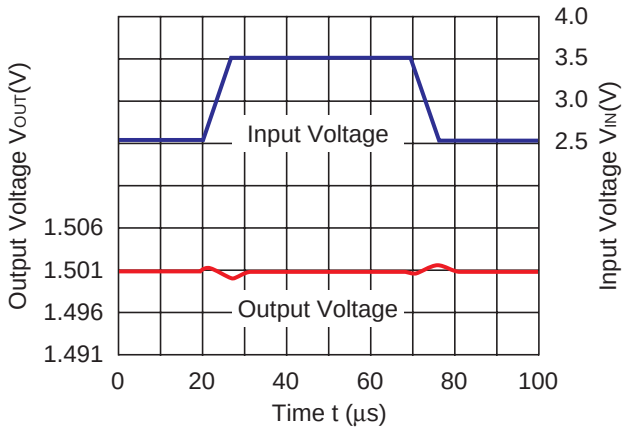


3.3V(VR2)

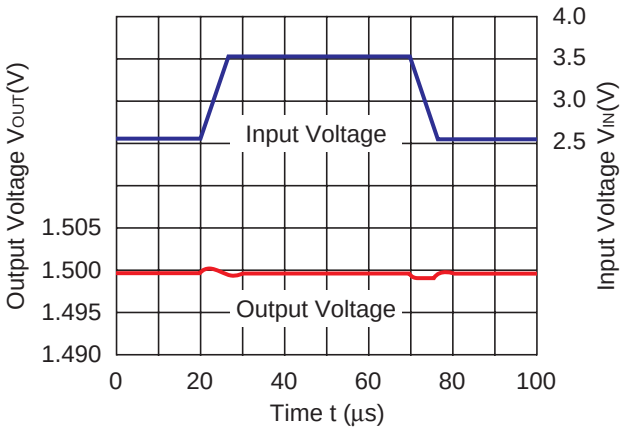


10) Input Transient Response (tr=tf=5µs, Topt=25°C)

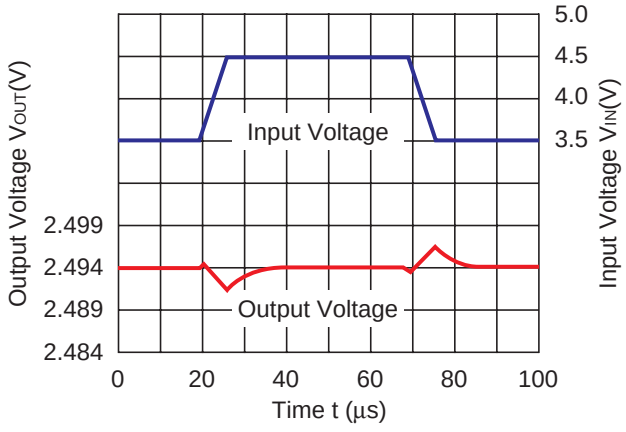
1.5V(VR1)



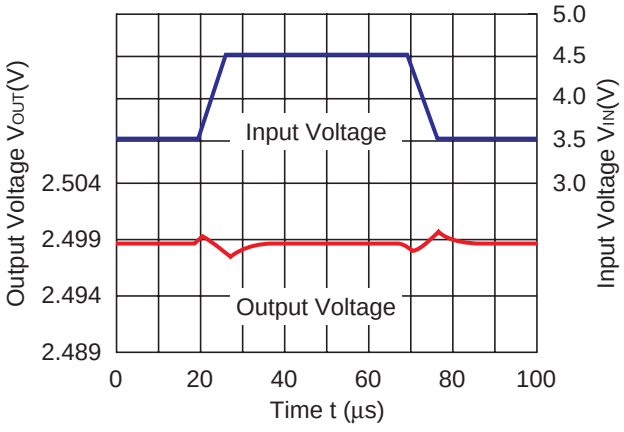
1.5V(VR2)



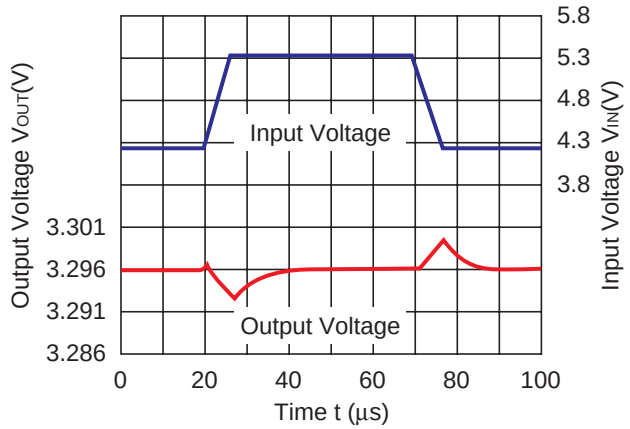
2.5V(VR1)



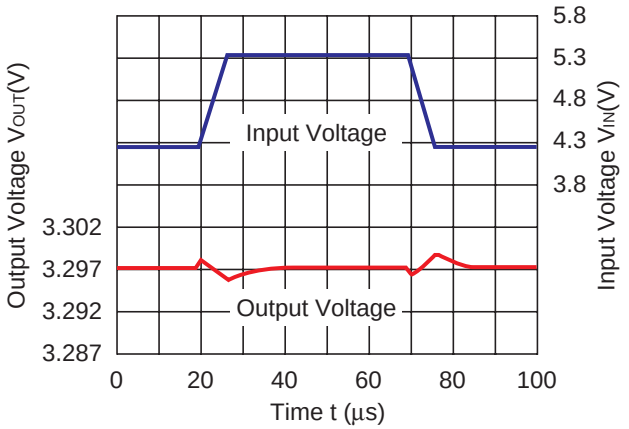
2.5V(VR2)



3.3V(VR1)

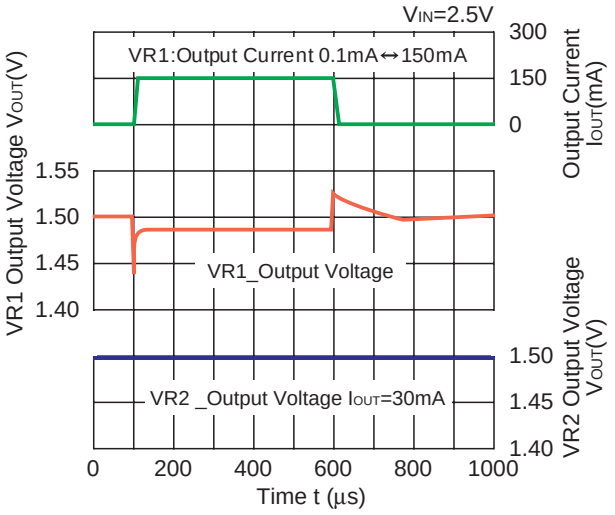


3.3V(VR2)

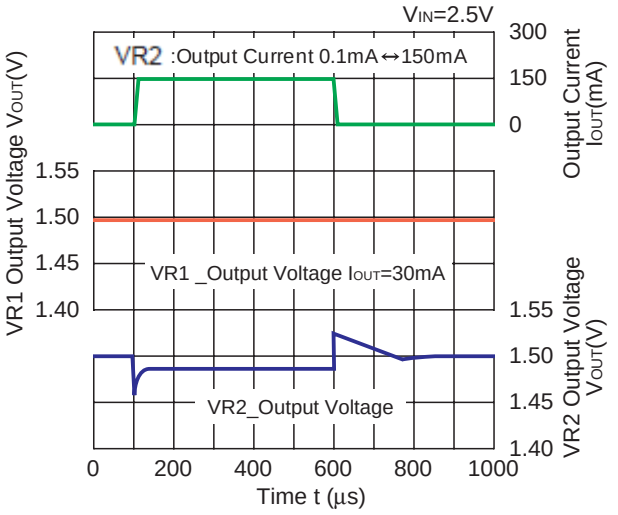


11) Load Transient Response (tr=tf=500ns, Topt=25°C)

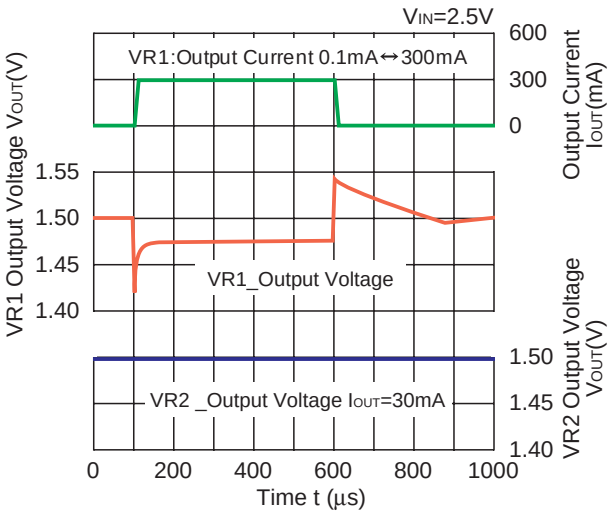
1.5V(VR1)



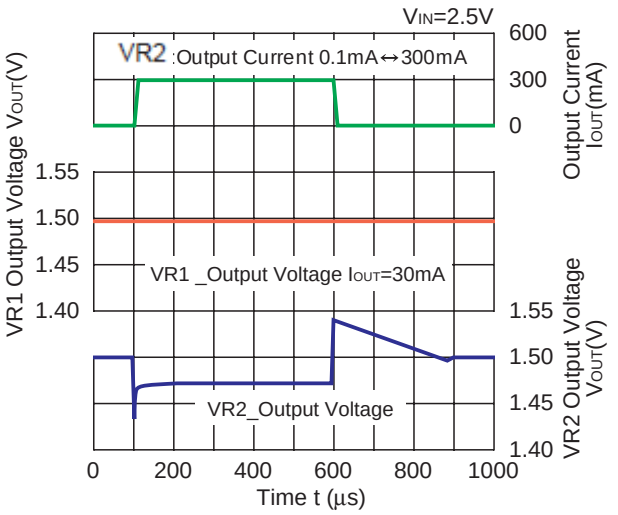
1.5V(VR2)



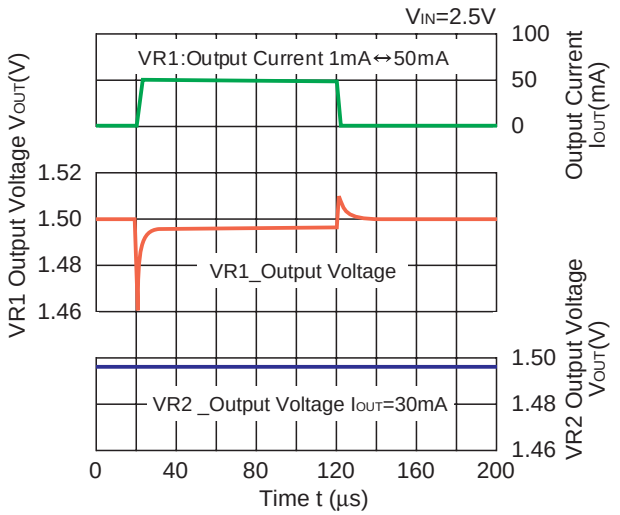
1.5V(VR1)



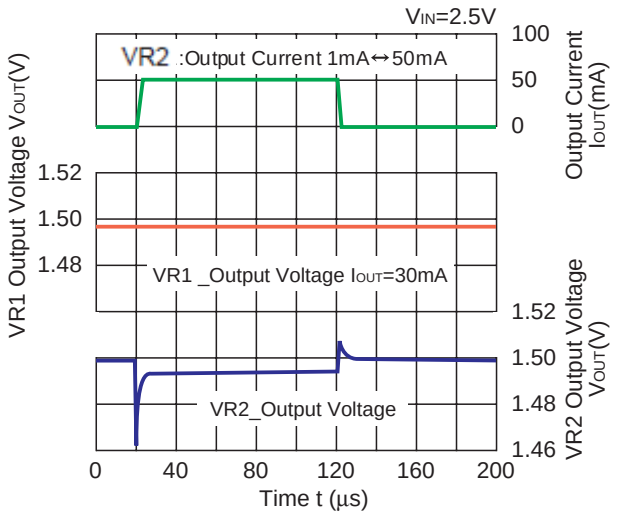
1.5V(VR2)



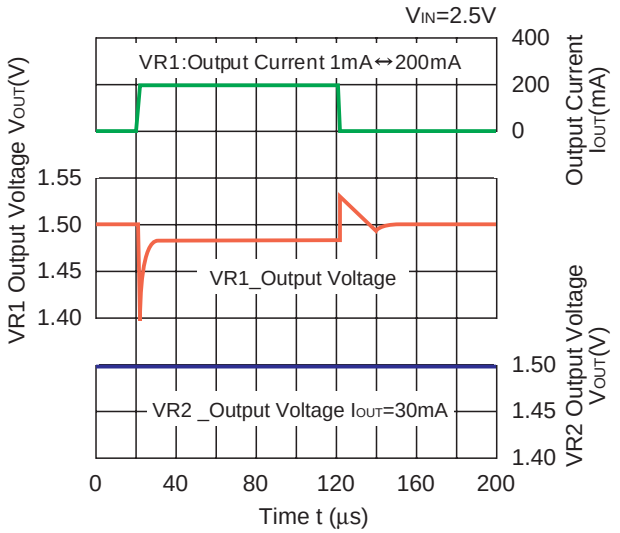
1.5V(VR1)



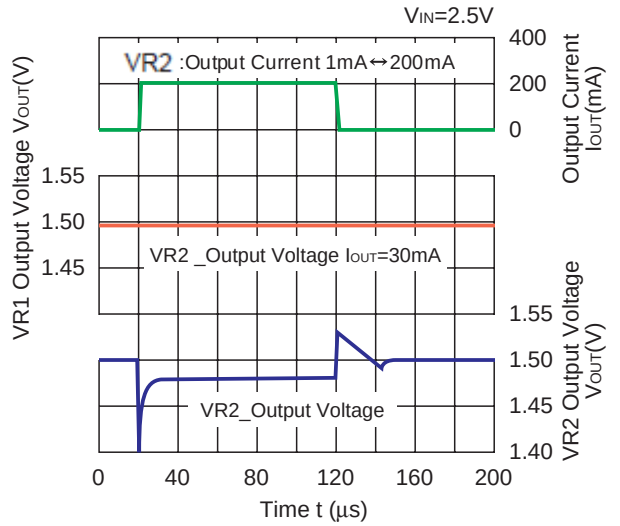
1.5V(VR2)



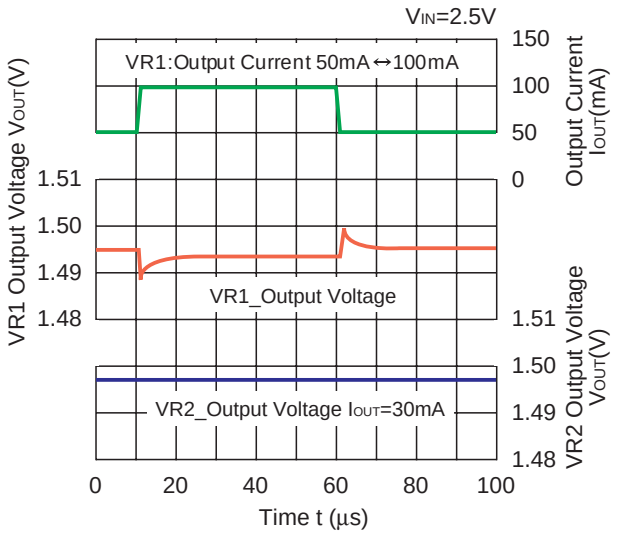
1.5V(VR1)



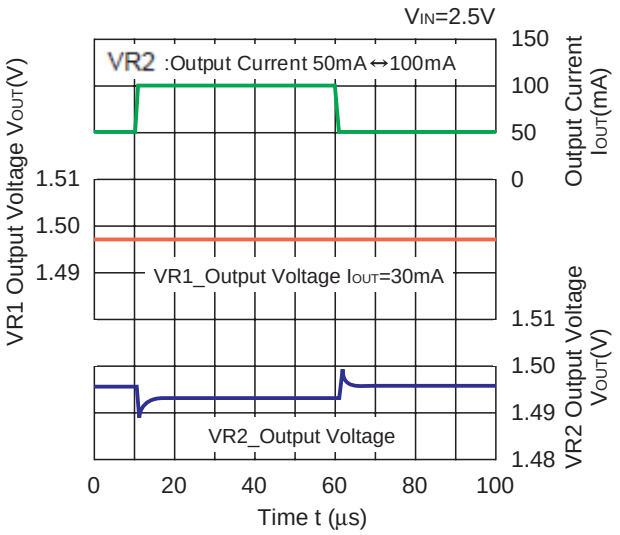
1.5V(VR2)



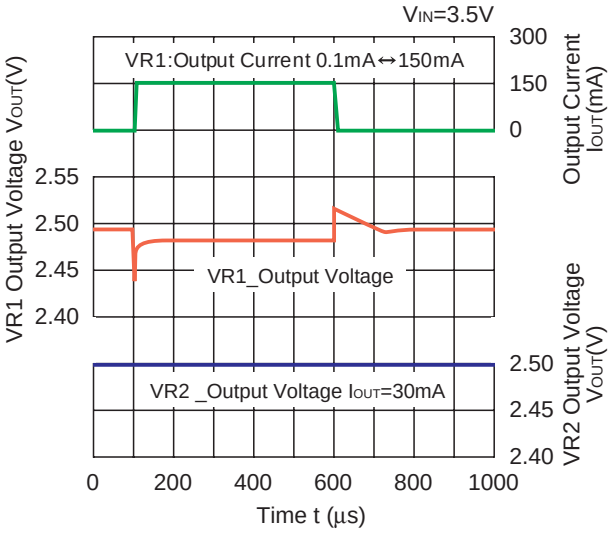
1.5V(VR1)



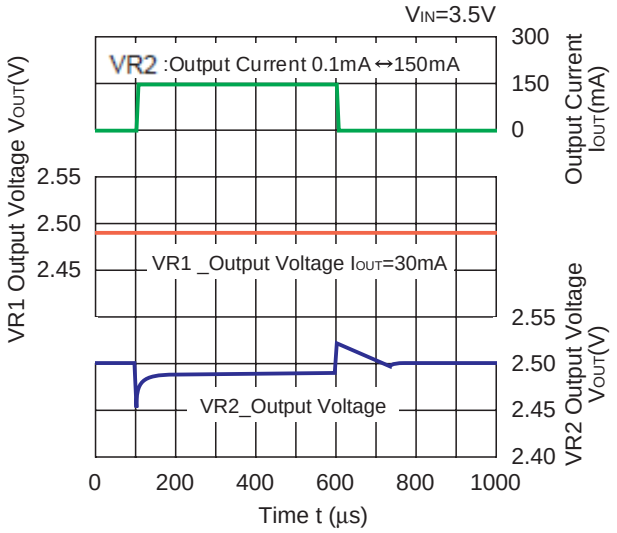
1.5V(VR2)



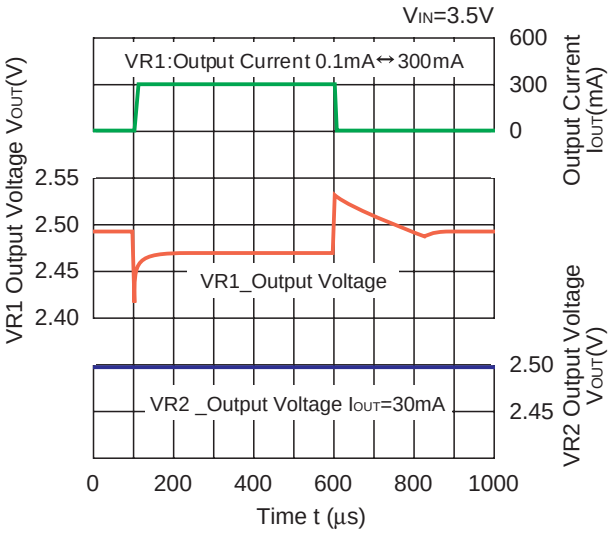
2.5V(VR1)



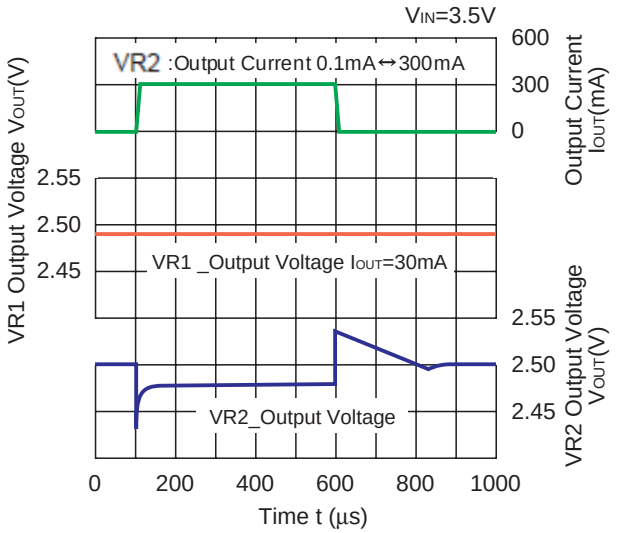
2.5V(VR2)



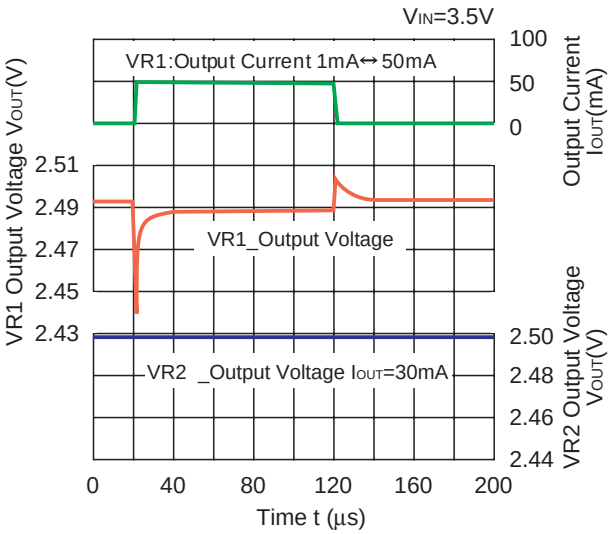
2.5V(VR1)



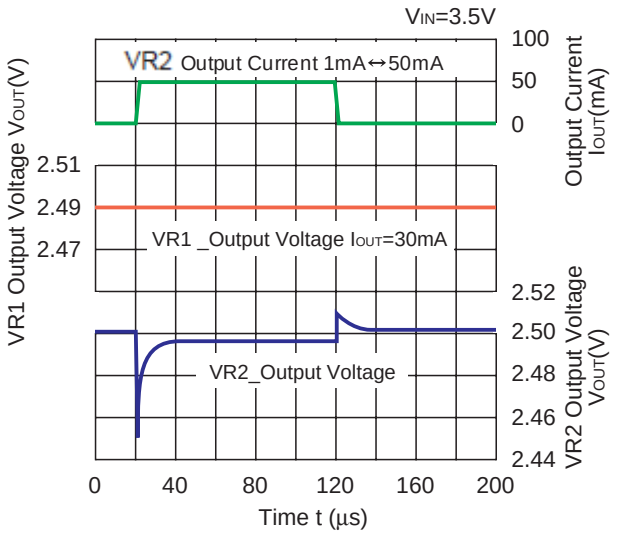
2.5V(VR2)



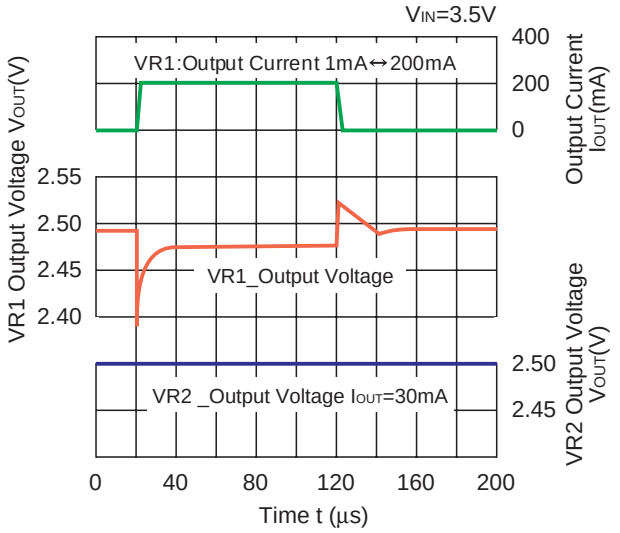
2.5V(VR1)



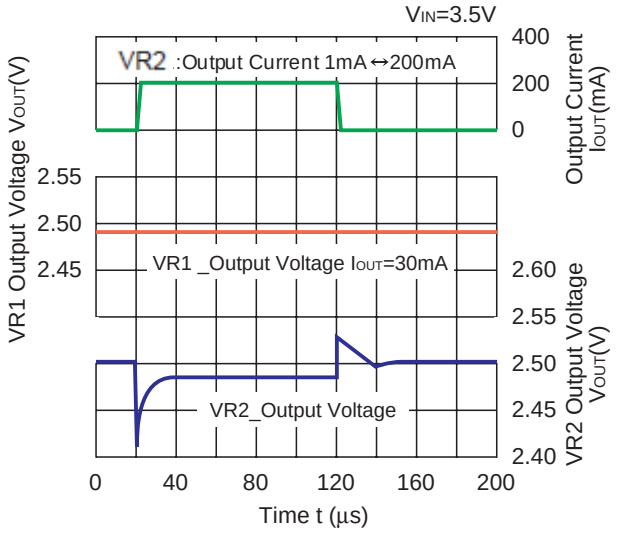
2.5V(VR2)



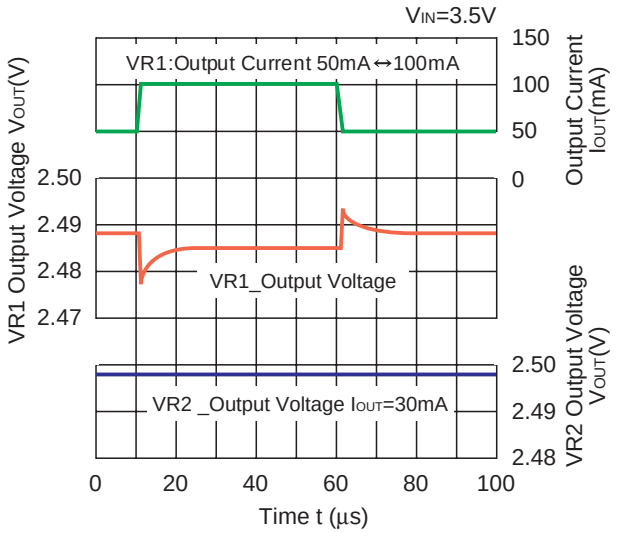
2.5V(VR1)



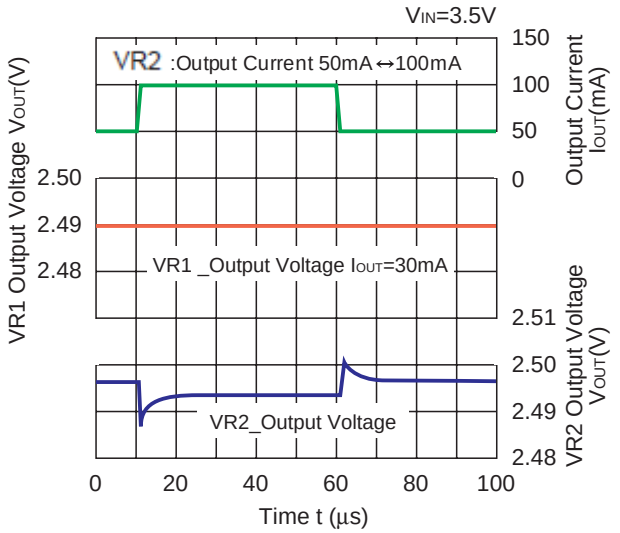
2.5V(VR2)



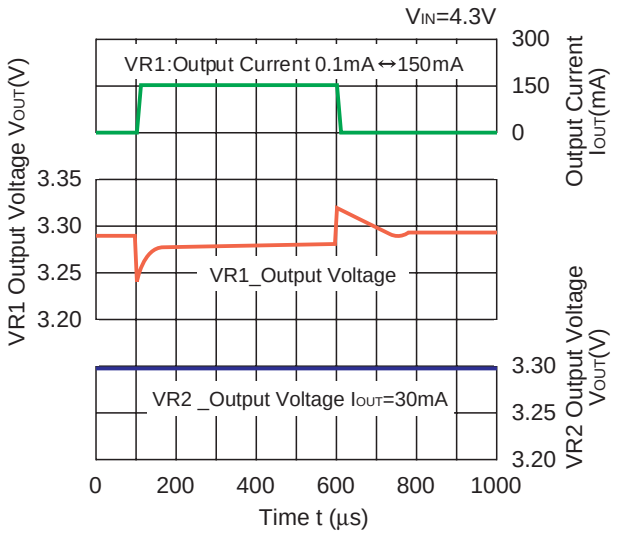
2.5V(VR1)



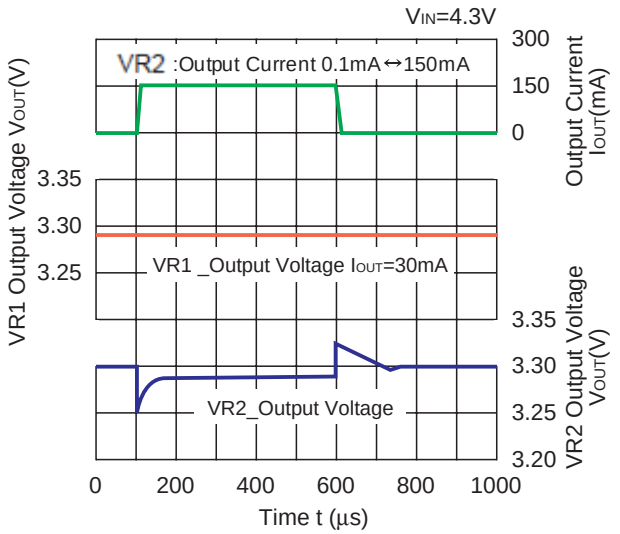
2.5V(VR2)



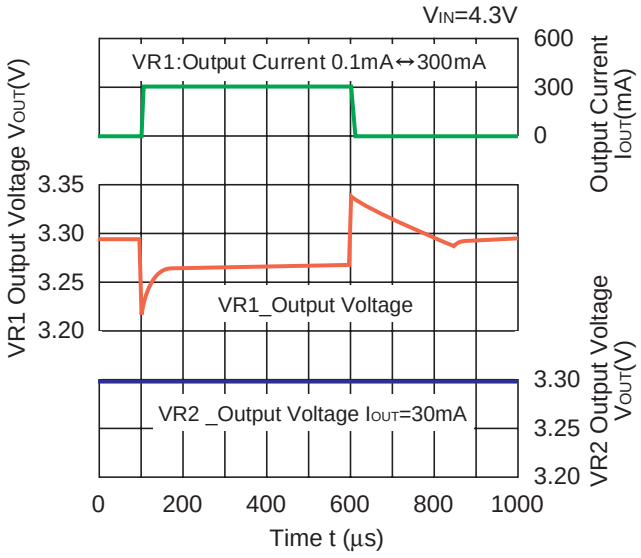
3.3V(VR1)



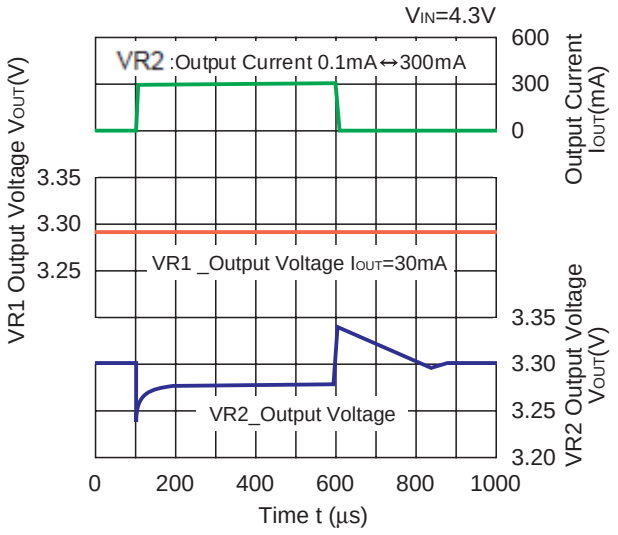
3.3V(VR2)



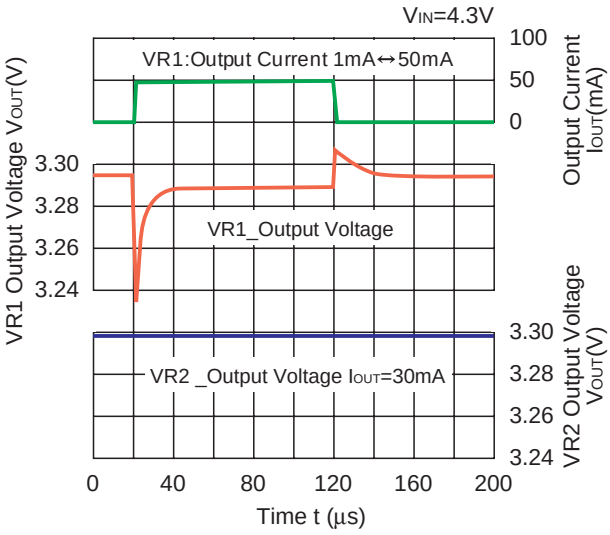
3.3V(VR1)



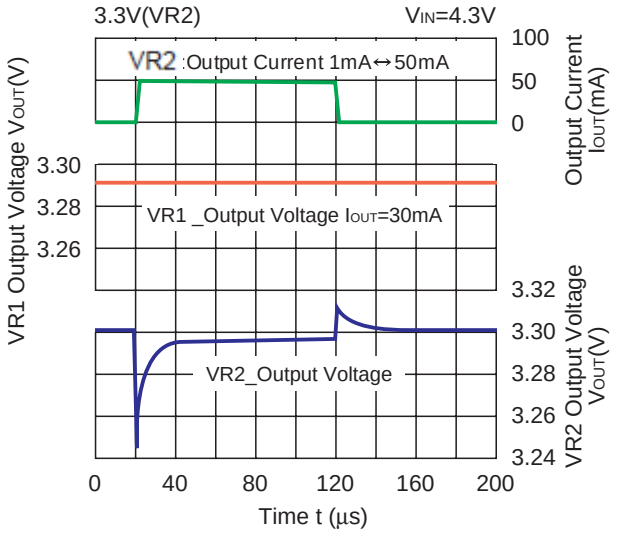
3.3V(VR2)



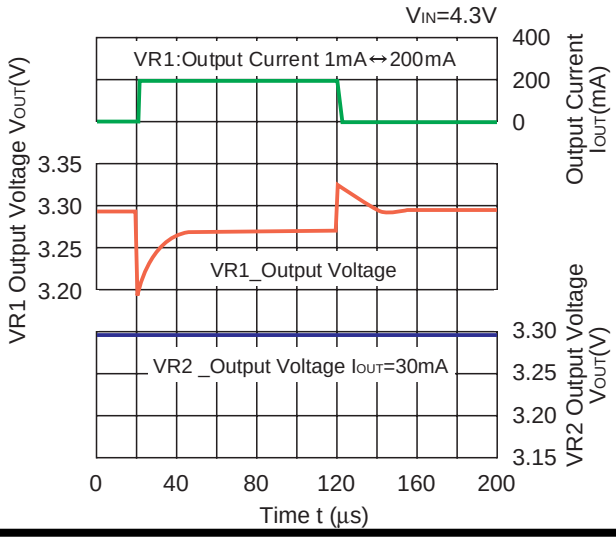
3.3V(VR1)



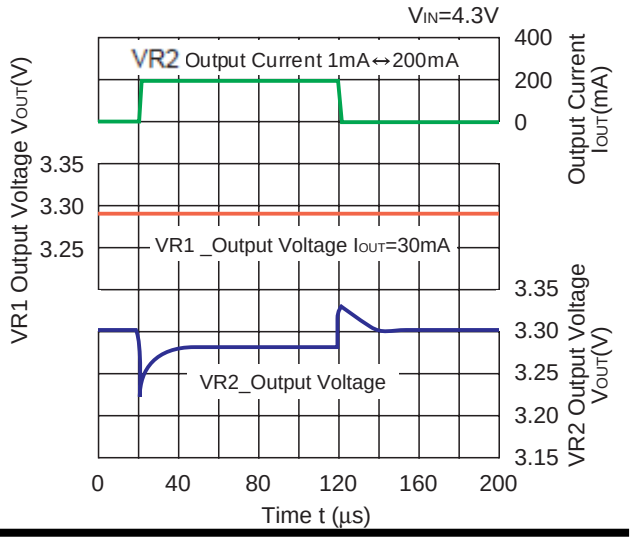
3.3V(VR2)



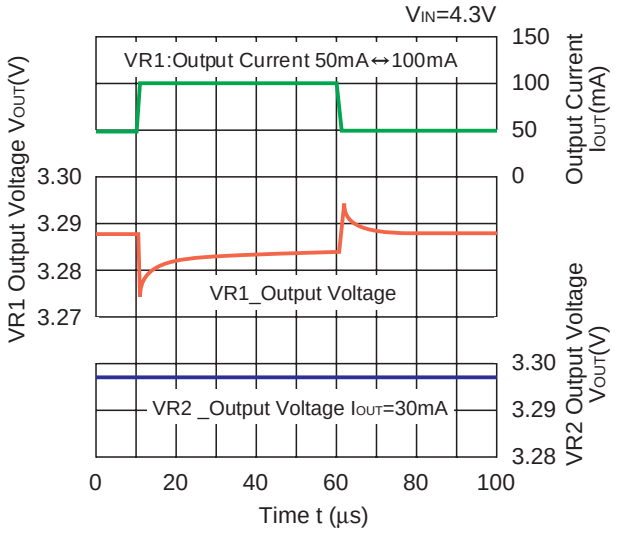
3.3V(VR1)



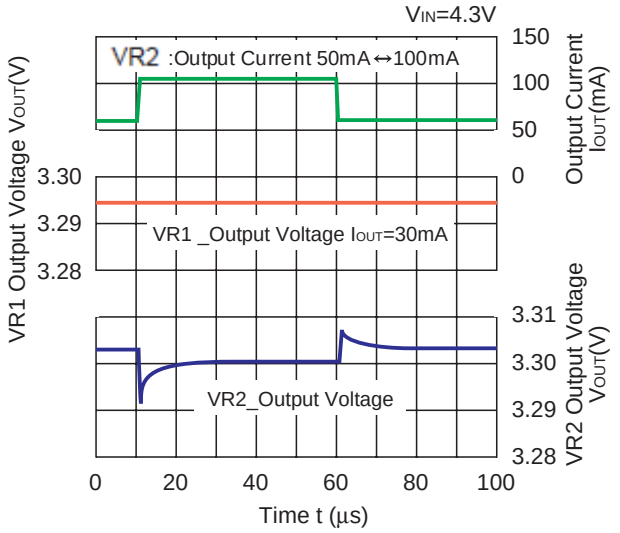
3.3V(VR2)



3.3V(VR1)

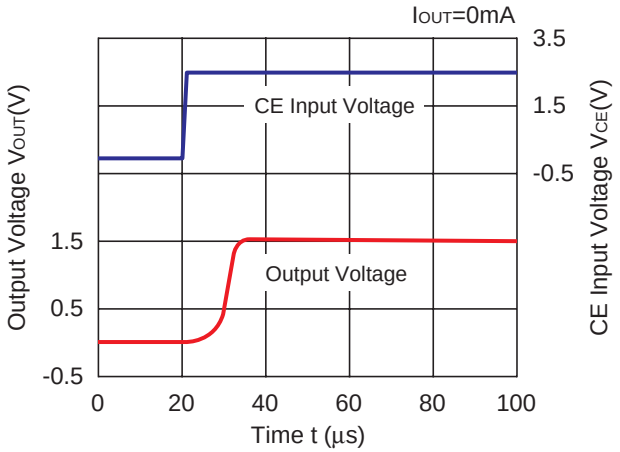


3.3V(VR2)

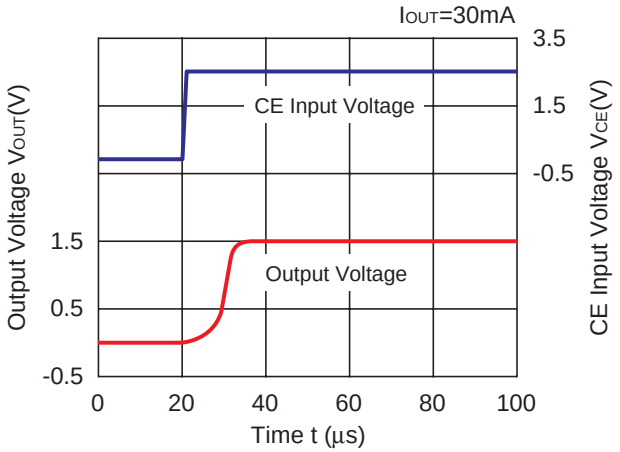


12) Turn On Speed with CE pin (Topt=25°C)

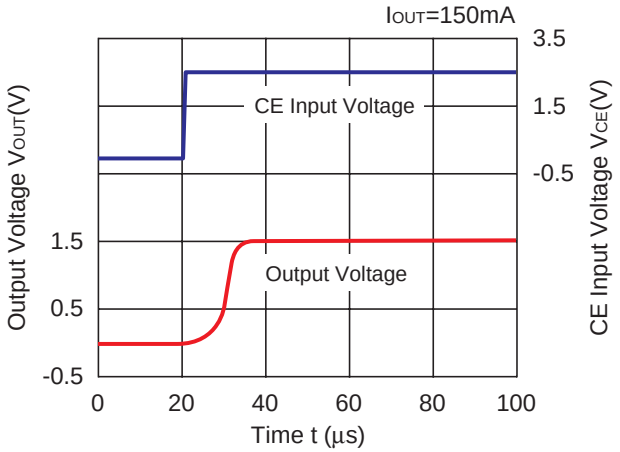
1.5V(VR1/VR2)



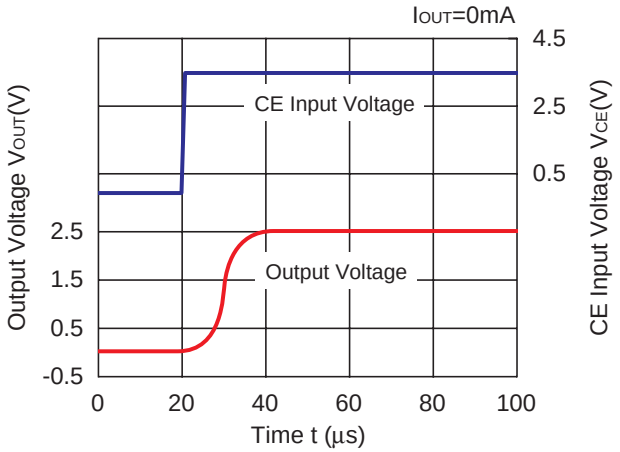
1.5V(VR1/VR2)



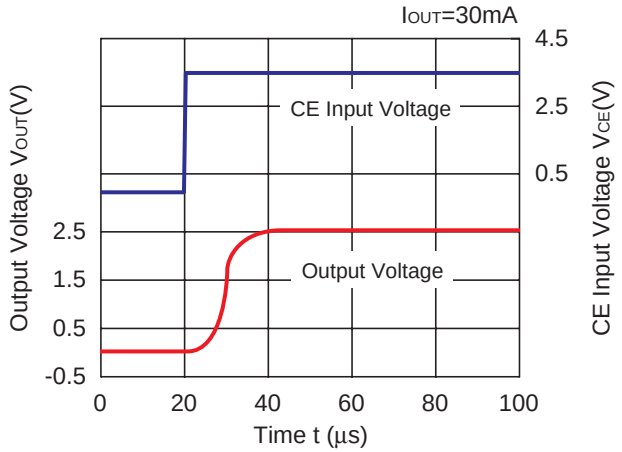
1.5V(VR1/VR2)



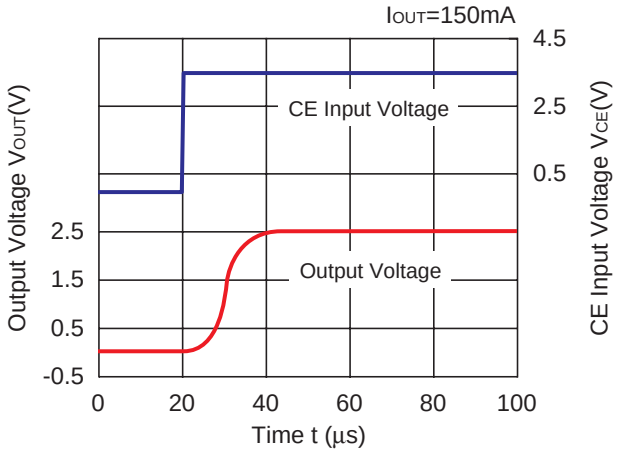
2.5V(VR1/VR2)



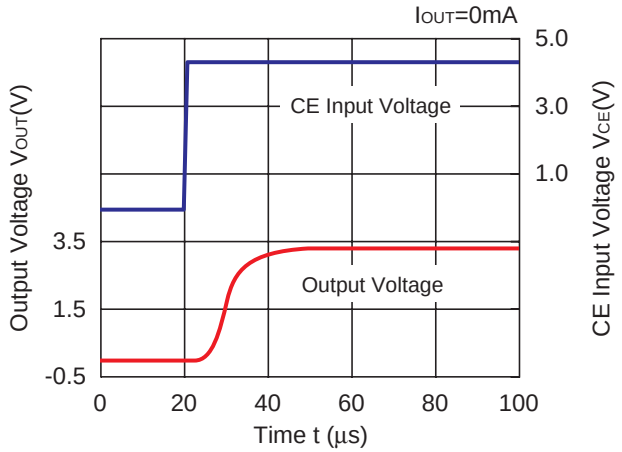
2.5V(VR1)



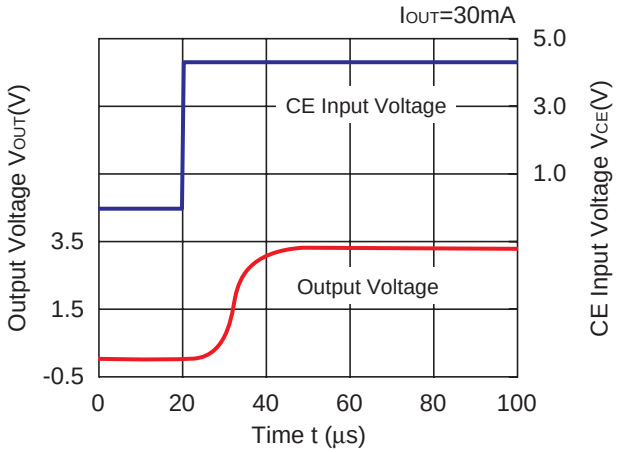
2.5V(VR1/VR2)



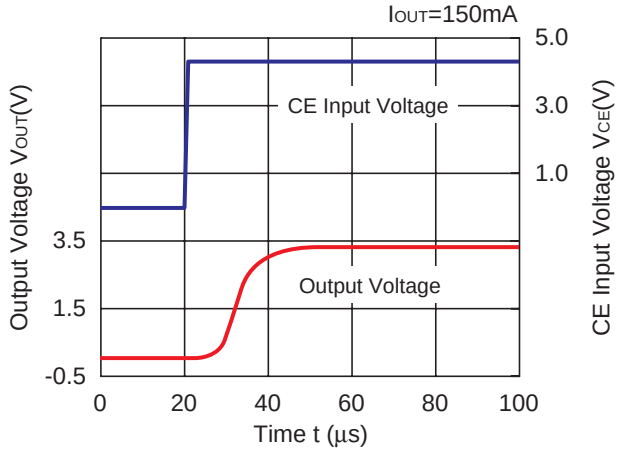
3.3V(VR1/VR2)



3.3V(VR1/VR2)

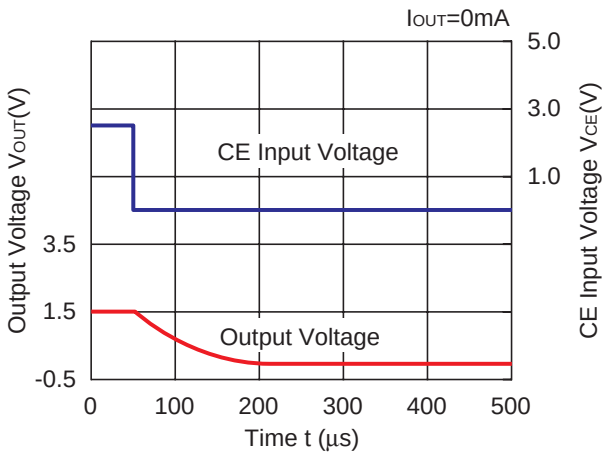


3.3V(VR1/VR2)

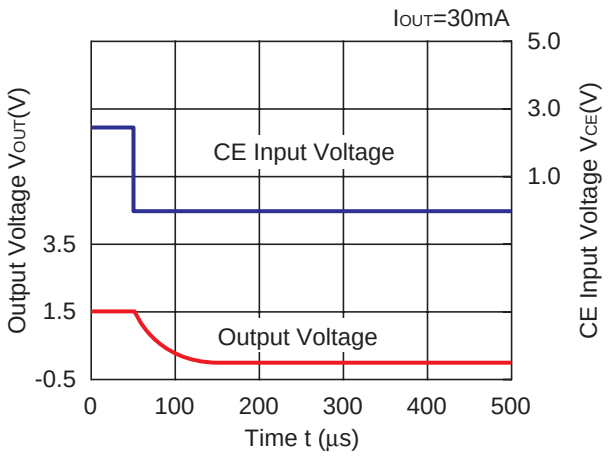


13) Tum Off Speed with CE pin (Topt=25°C)

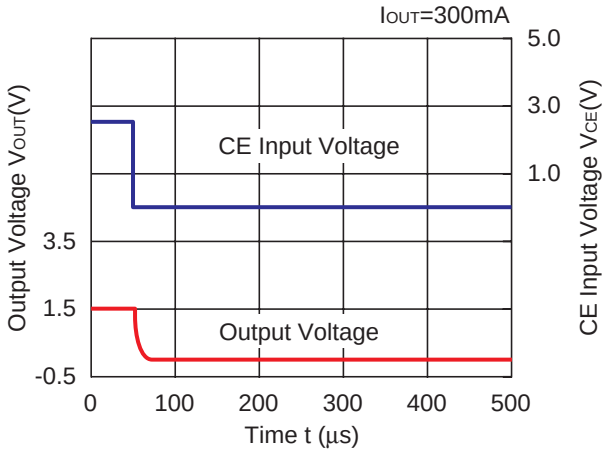
1.5V(VR1/VR2)



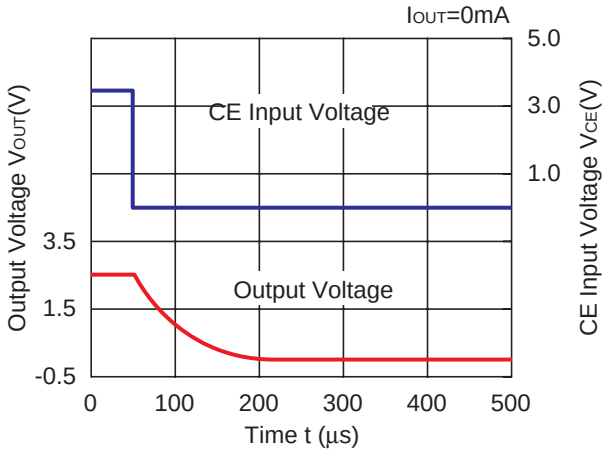
1.5V(VR1/VR2)



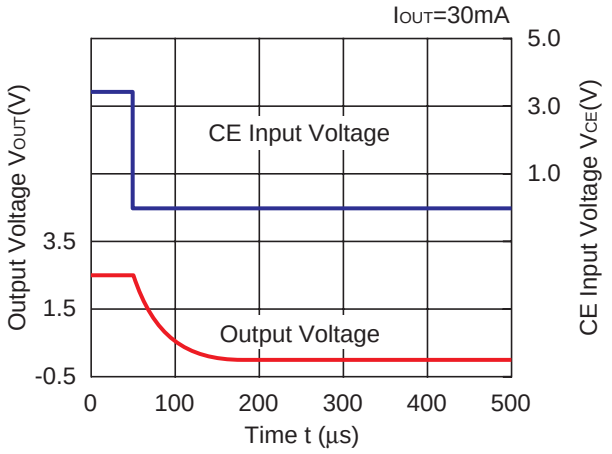
1.5V(VR1/VR2)



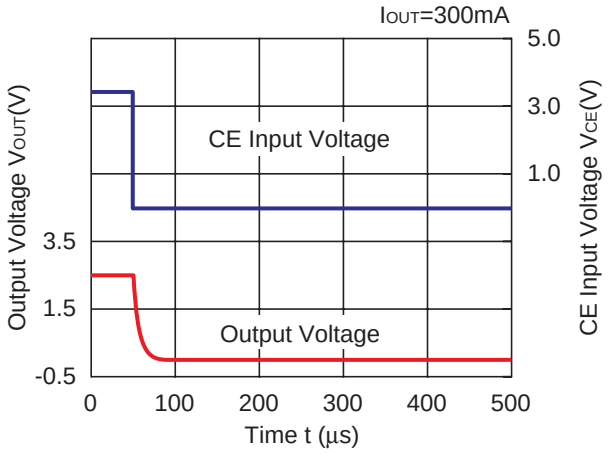
2.5V(VR1/VR2)



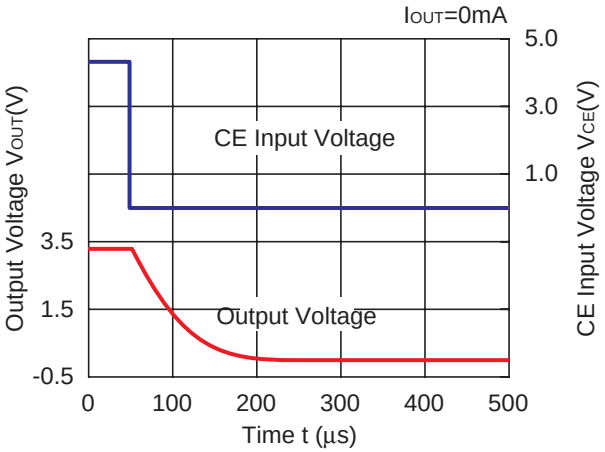
2.5V(VR1/VR2)



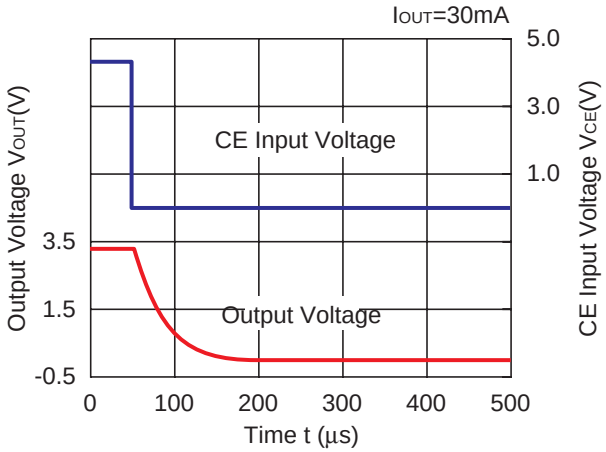
2.5V(VR1/VR2)



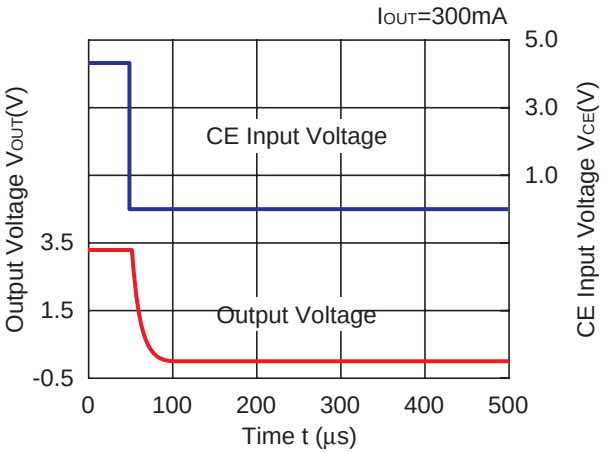
3.3V(VR1/VR2)



3.3V(VR1/VR2)

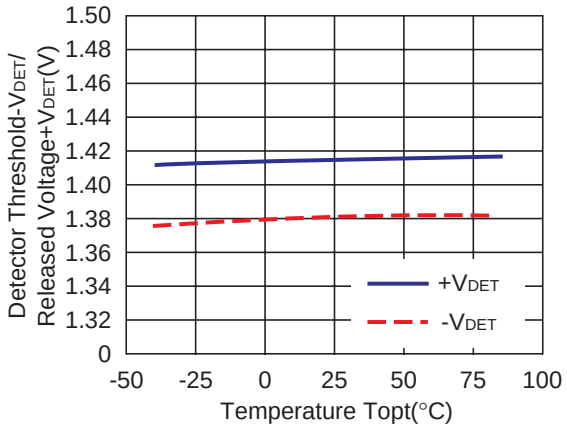


3.3V(VR1/VR2)

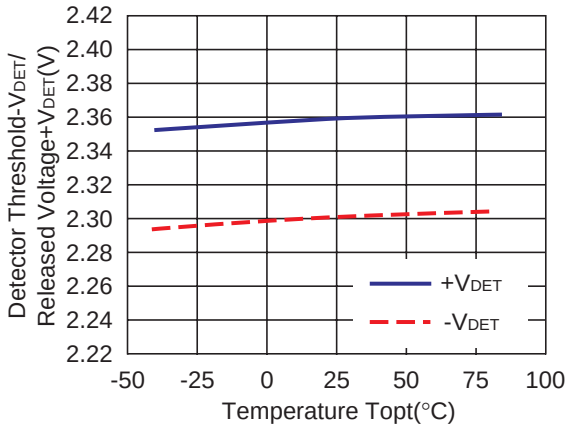


14) Detector Threshold/Released Voltage vs. Temperature

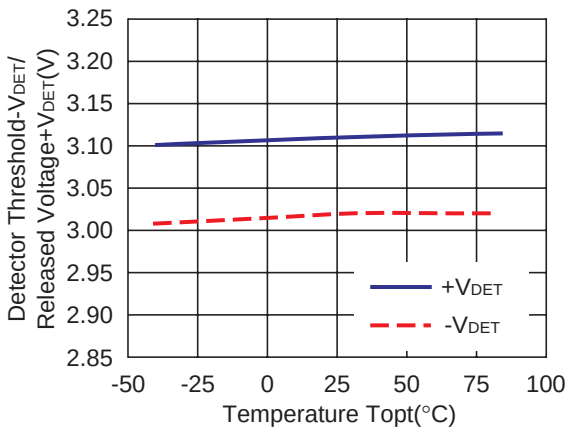
1.5V



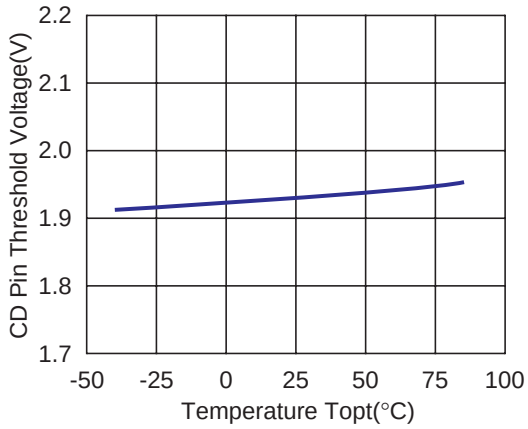
2.5V



3.3V

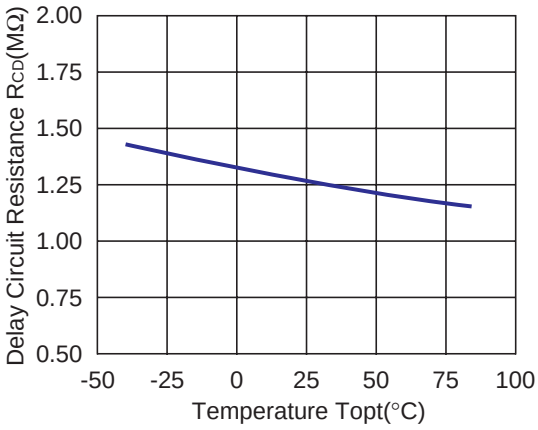


15) C_D Pin Threshold Voltage vs. Temperature

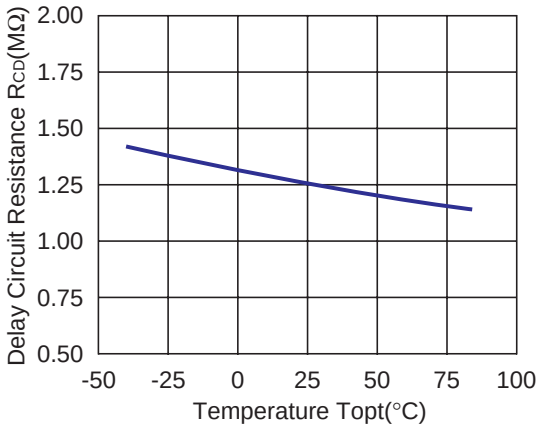


16) Delay Circuit Resistance vs. Temperature

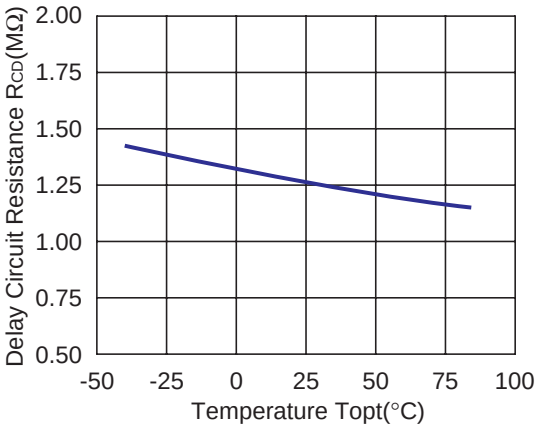
1.5V



2.5V

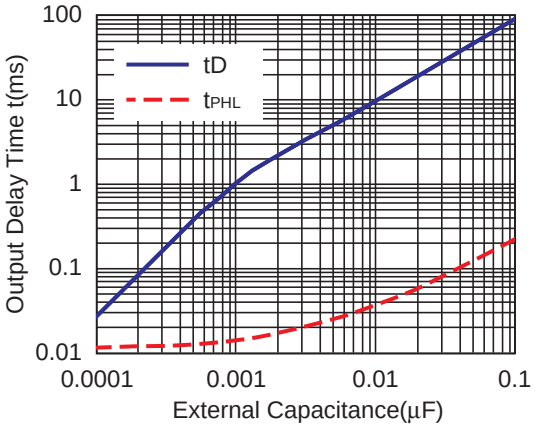


3.3V

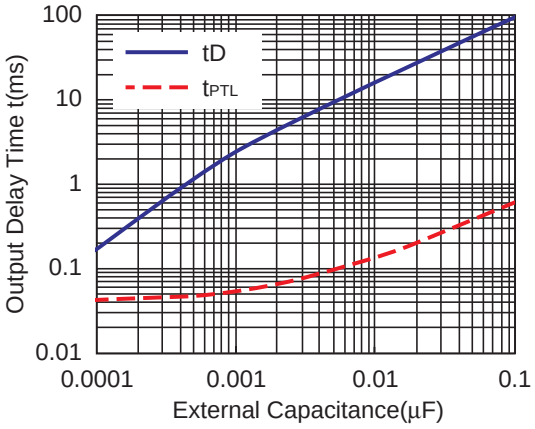


17) Output Delay Time vs. External Capacitance

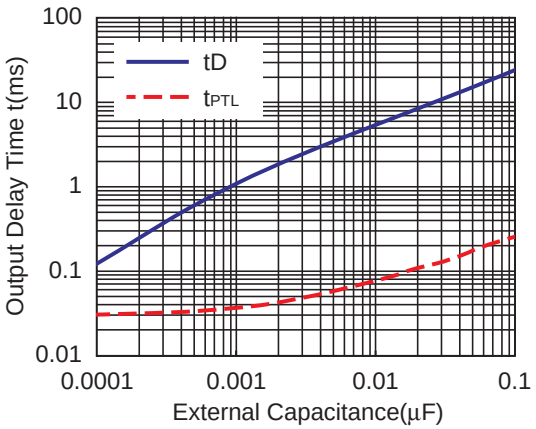
1.5V



2.5V

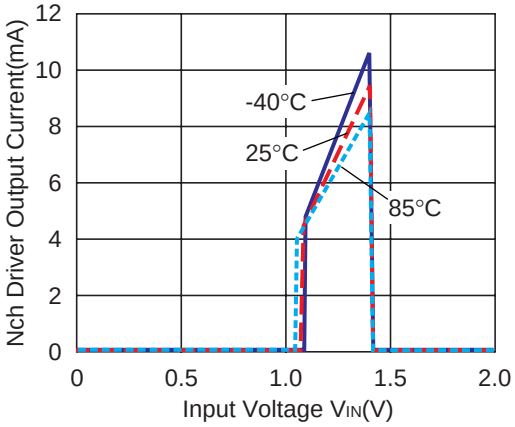


3.3V

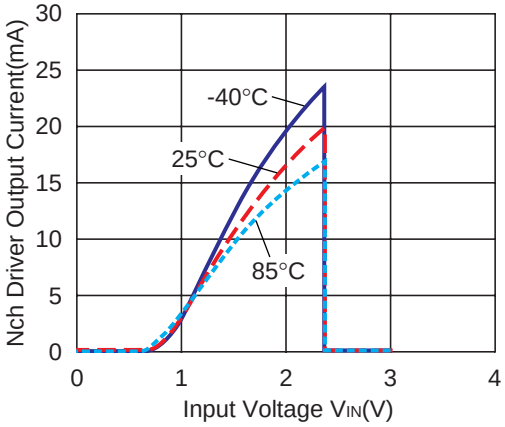


18) Nch Driver Output Current vs. Input Voltage

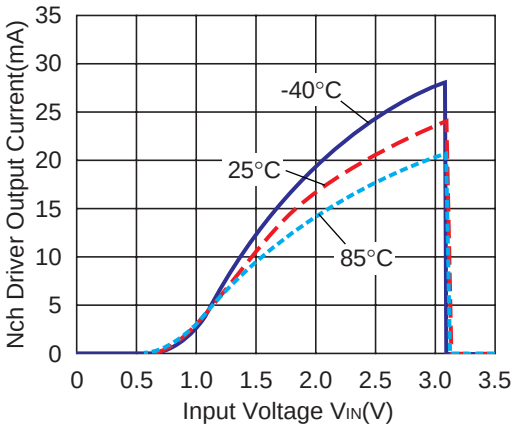
1.5V



2.5V

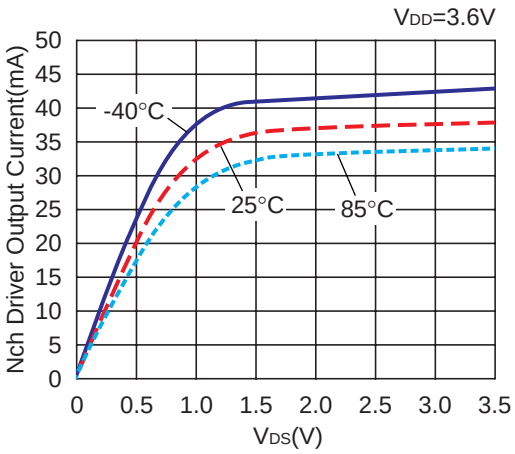


3.3V



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

3.3V



ESR vs. Output Current

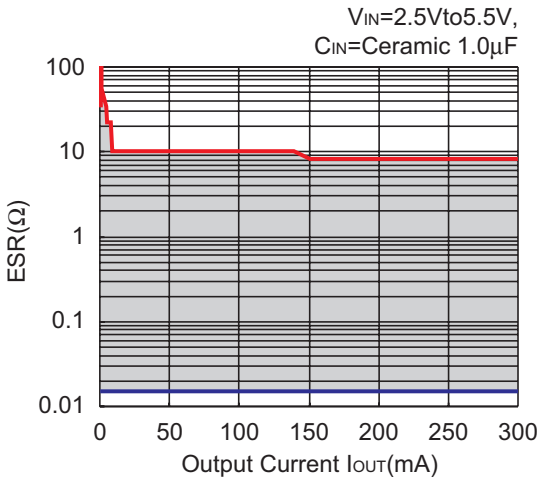
When using these ICs, consider the following points:

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 40μV (Avg.) are marked as the hatched area in the graph.

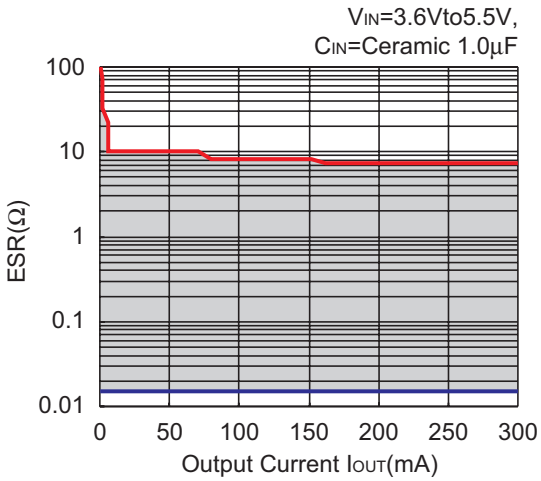
Measurement conditions

V_{IN}=Set V_{OUT}+1V
Frequency Band : 10Hz to 2MHz
Temperature : −40°C to 85°C

1.5V (VR1/VR2)



3.3V (VR1/VR2)



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