
150mA DUAL LDO REGULATOR WITH 2 INPUT PINS

NO. EA-201-090818

OUTLINE

The RP153L Series are CMOS-based 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 RP153L Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output voltage of these ICs is internally fixed with high accuracy. Since the package for these ICs are DFN1216-8, dual LDO regulators are included in each package are high density mounting of the ICs on boards is possible.

In RP153L, the power supply of each circuit can be individually supplied. The transient response characteristic of D and E Version is improved.

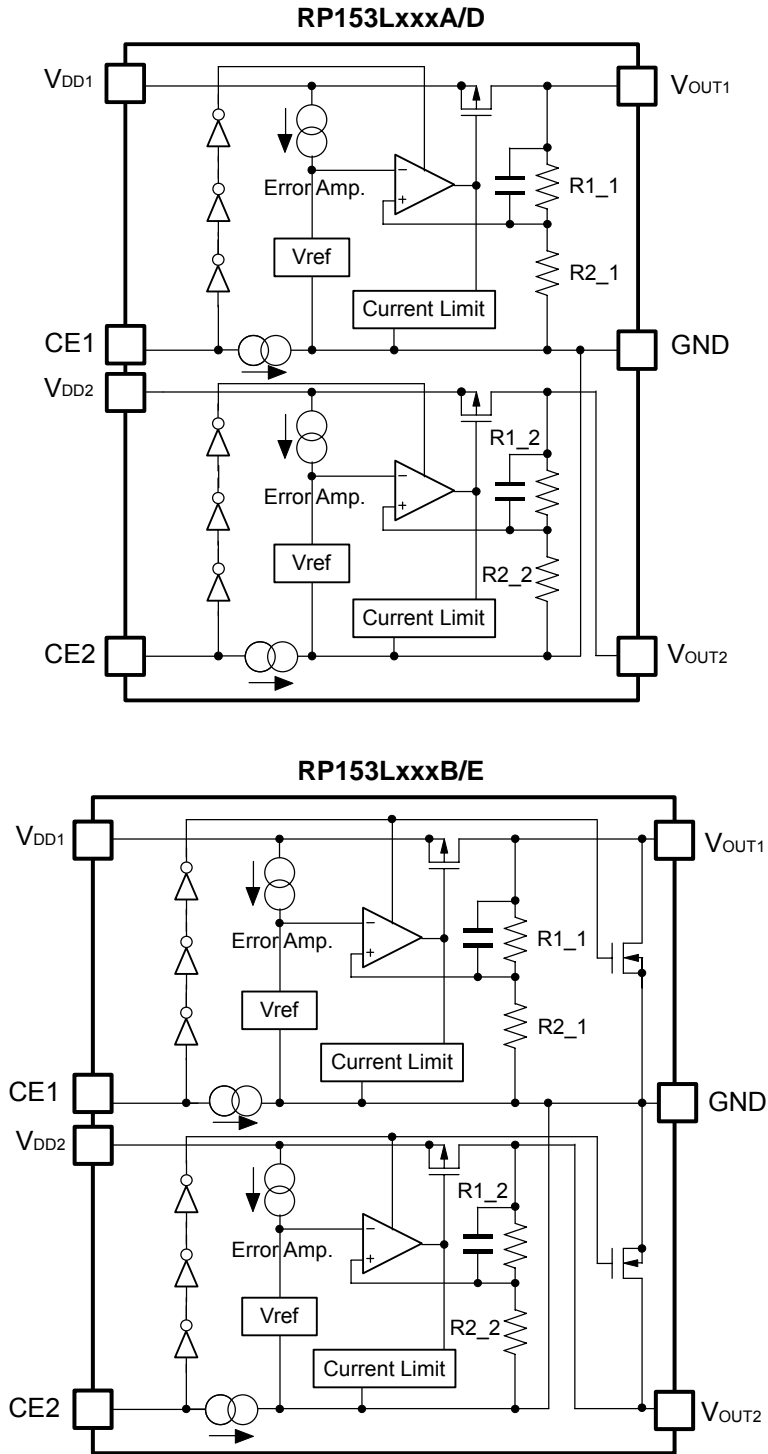
FEATURES

- Supply Current Typ. 40 μ A \times 2 (VR1&VR2)
- Supply Current (D/E Version)..... Typ. 85 μ A \times 2 (VR1&VR2)
- Standby Current Typ. 0.1 μ A \times 2 (VR1&VR2)
- Ripple Rejection Typ. 70dB (f=1kHz)
- Input Voltage Range..... 1.4V to 5.25V
- Output Voltage Range..... 0.8V to 3.6V
- Output Voltage Accuracy..... \pm 1.0% ($V_{OUT}>2.0V$, $T_{opt}=25^{\circ}C$)
- Temperature-Drift Coefficient of Output Voltage Typ. \pm 80ppm/ $^{\circ}C$
- Dropout Voltage..... Typ. 0.22V ($I_{OUT}=150mA$, $V_{OUT}=2.8V$)
- Line Regulation Typ. 0.02%/V
- Packages DFN1216-8
- Built-in Fold Back Protection Circuit..... Typ. 40mA
- Ceramic capacitors are recommended to be used with this IC 0.22 μ 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*, and the taping type for the ICs can be selected at the user's request.

The selection can be made with designating the part number as shown below;

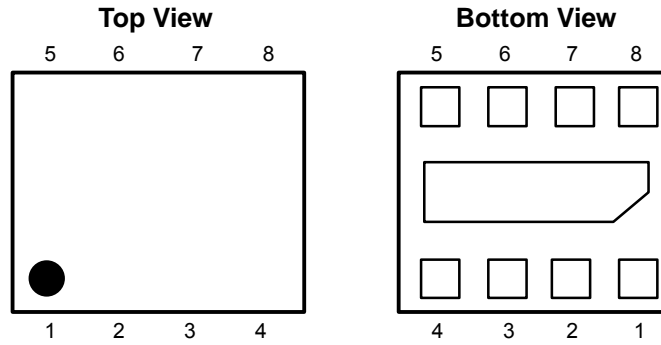
RP153LXXXX-XX-X ←Part Number
 ↑ ↑ ↑ ↑ ↑
 a b c d e

Code	Contents
a	Designation of Package Type: L: DFN1216-8
b	Setting combination of 2ch Output Voltage (V_{OUT}): Serial Number for Voltage setting from 001, Stepwise setting in the range of 0.8V to 3.6V is possible for each channel.
c	Designation of Mask Option: A: without auto-discharge function* B: with auto-discharge function* D: without auto-discharge function*, (the transient response improved type) E: with auto-discharge function*, (the transient response improved type)
d	Designation of Taping Type: Ex. E2 (refer to Taping Specifications; E2 type is the standard direction.)
e	Designation of composition of plating: None : Pd plating (DFN1216-8)

*) When the mode is into standby with CE signal, auto discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATIONS

- DFN1216-8*



PIN DESCRIPTIONS

- DFN1216-8*

Pin No.	Symbol	Description
1	GND	Ground Pin
2	V _{OUT1}	Output Pin 1
3	V _{OUT2}	Output Pin 2
4	GND	Ground Pin
5	CE2	Chip Enable Pin 2 ("H" Active)
6	V _{DD2}	Input Pin 2
7	V _{DD1}	Input Pin 1
8	CE1	Chip Enable Pin 1 ("H" Active)

*) 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)	-0.3 to 6.0	V
V_{OUT1}, V_{OUT2}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT1}, I_{OUT2}	Output Current	180	mA
P_D	Power Dissipation (DFN1216-8)*	625	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

• RP153L

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

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$.

VR1/VR2

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

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage	$T_{opt} = 25^{\circ}C$	$V_{OUT} > 2.0V$	$\times 0.99$		$\times 1.01$	V
			$V_{OUT} \leq 2.0V$	-20		+20	mV
		$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{OUT} > 2.0V$	×0.97		×1.03	V
			$V_{OUT} \leq 2.0V$	-60		+60	mV
I_{OUT}	Output Current		150			mA	
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$1mA \leq I_{OUT} \leq 150mA$	$0.8V \leq V_{OUT} < 1.1V$		10	40	mV
			$1.1V \leq V_{OUT} < 1.6V$		15	50	
			$1.6V \leq V_{OUT} < 2.0V$		15	55	
			$2.0V \leq V_{OUT} \leq 3.6V$		15	60	
V_{DIF}	Dropout Voltage	Refer to the following table.					
I_{SS}	Supply Current	$I_{OUT} = 0mA$	RP153LxxxA/B		40	60	μA
			RP153LxxxD/E		85	120	
Istandby	Standby Current	$V_{CE} = 0V$		0.1	1.0	μA	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	Set $V_{OUT} + 0.5V \leq V_{IN} \leq 5.0V$		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 $V_{OUT} \leq 2.0V$, $V_{IN} = 3V$)		70		dB	
V_{IN}	Input Voltage*		1.40		5.25	V	
$\frac{\Delta V_{OUT}}{\Delta T_{opt}}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 80		ppm/ $^{\circ}C$	
I_{lim}	Short Current Limit	$V_{OUT} = 0V$		40		mA	
I_{PD}	CE Pull-down Current			0.3		μA	
V_{CEH}	CE Input Voltage "H"		1.0			V	
V_{CEL}	CE Input Voltage "L"				0.4	V	
en	Output Noise	BW=10Hz to 100kHz		60		μV_{rms}	
R_{LOW}	Low Output Nch Tr. ON Resistance (of B/E Version)	$V_{IN} = 4.0V$, $V_{CE} = 0V$		50		Ω	

All of units are tested and specified under load conditions such that $T_j \approx T_{opt} = 25^{\circ}C$ except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

*) 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.

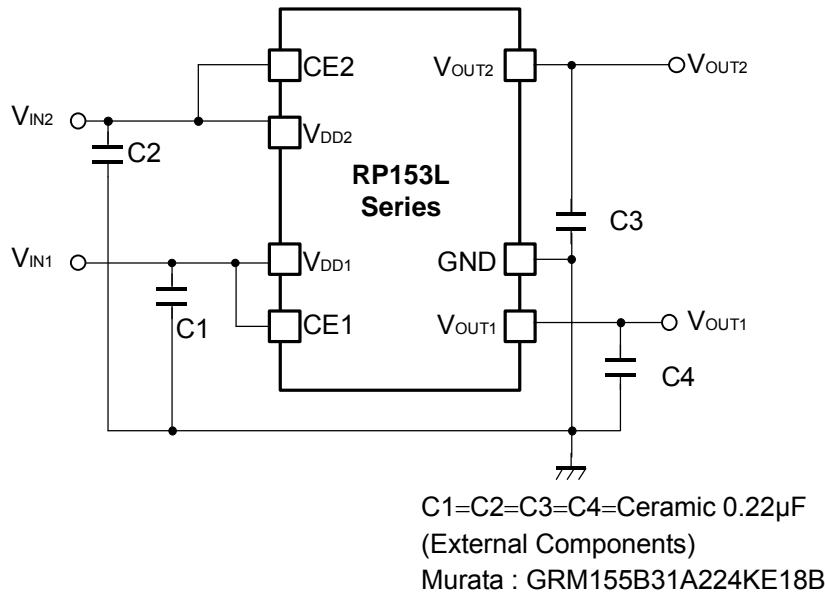
- Dropout Voltage by Output Voltage

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
$V_{OUT}=0.8$	$I_{OUT}=150mA$	0.63	0.87
$V_{OUT}=0.9$		0.55	0.80
$1.0 \leq V_{OUT} < 1.2$		0.50	0.72
$1.2 \leq V_{OUT} < 1.4$		0.42	0.62
$1.4 \leq V_{OUT} < 1.7$		0.37	0.55
$1.7 \leq V_{OUT} < 2.1$		0.30	0.46
$2.1 \leq V_{OUT} < 2.5$		0.25	0.39
$2.5 \leq V_{OUT} < 3.0$		0.23	0.35
$3.0 \leq V_{OUT} \leq 3.6$		0.21	0.32

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.

TYPICAL APPLICATIONS



TECHNICAL NOTES

When using these ICs, consider the following points:

PCB Layout

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

For this purpose, use capacitors (0.22µF or more) for C3 and C4 with good frequency characteristics and ESR (Equivalent Series Resistance).

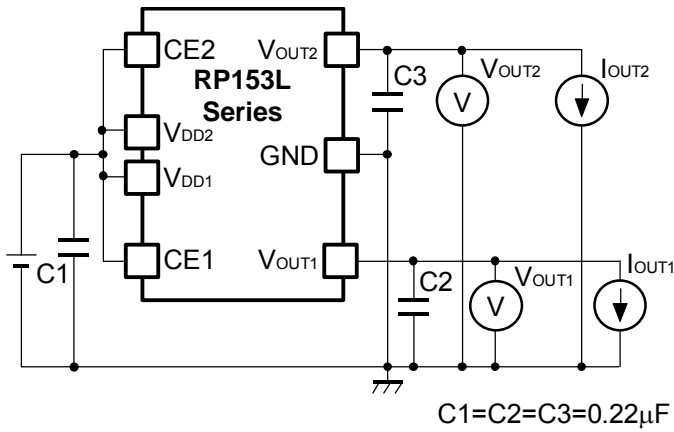
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

Phase Compensation

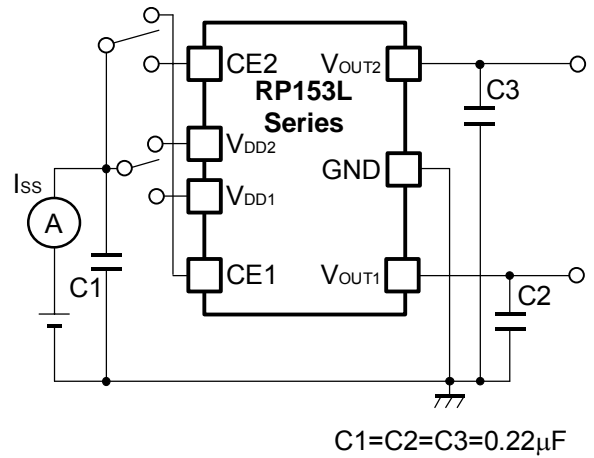
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect capacitors with a capacitance value as much as 0.22µF or more between V_{DD} and GND pin, and as close as possible to the pins (C1/C2).

Set external components, especially the output capacitors, as close as possible to the ICs, and make wiring as short as possible (C3/C4).

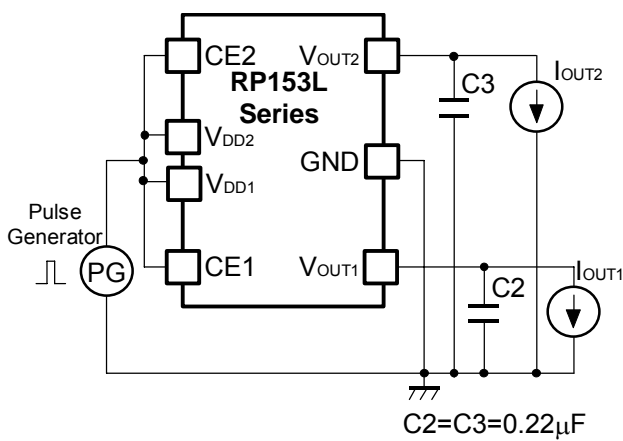
TEST CIRCUITS



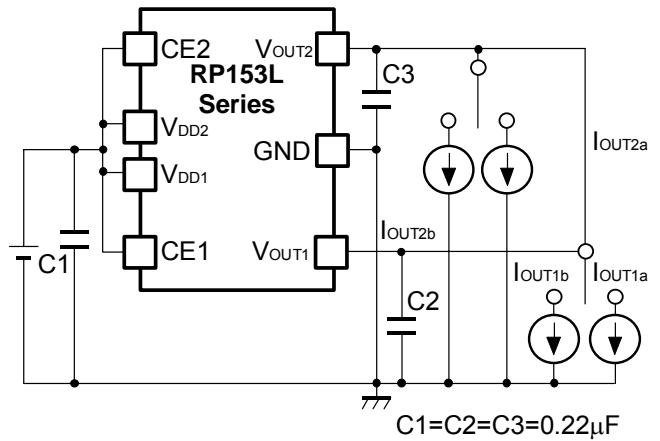
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection
& Line Transient Response

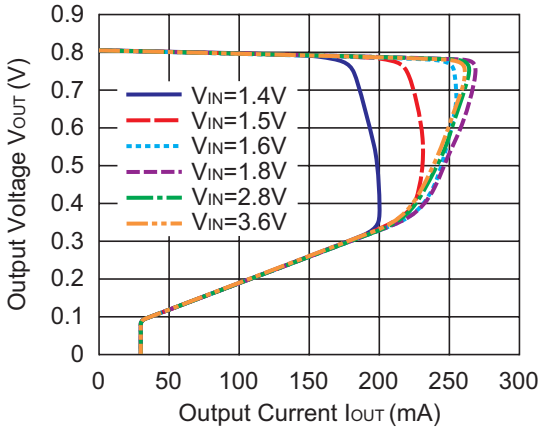


Test Circuits for Load Transient Response

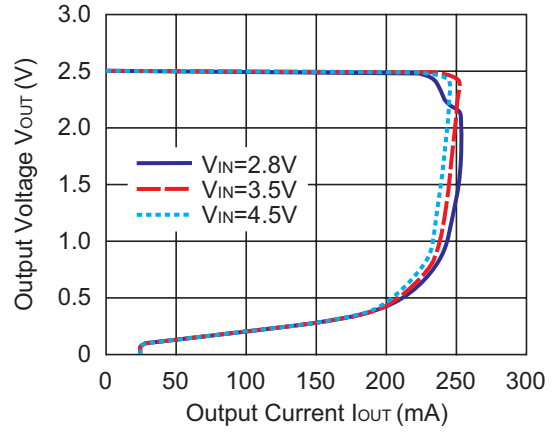
TYPICAL CHARACTERISTICS

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

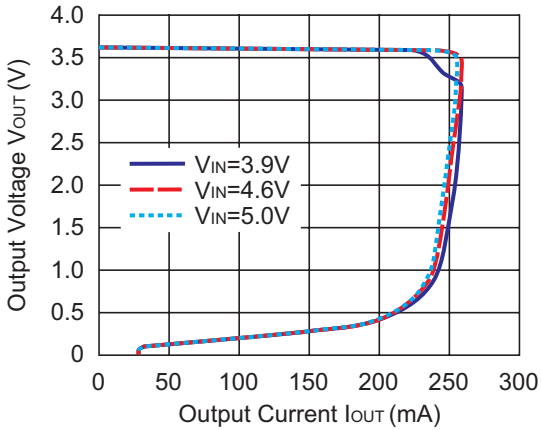
0.8V(VR1/VR2)



2.5V(VR1/VR2)

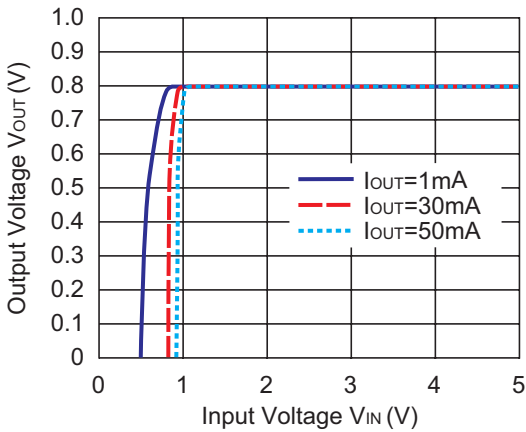


3.6V(VR1/VR2)

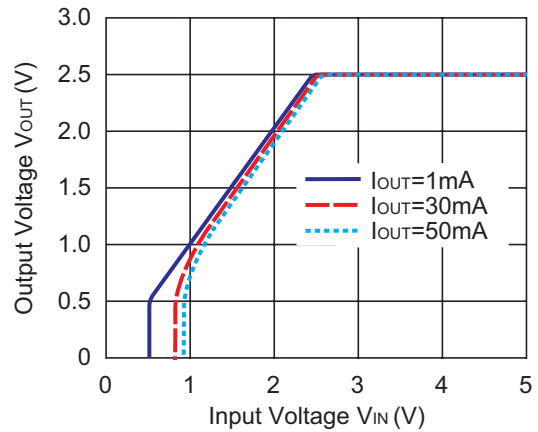


2) Output Voltage vs. Input Voltage ($T_{opt}=25^{\circ}\text{C}$)

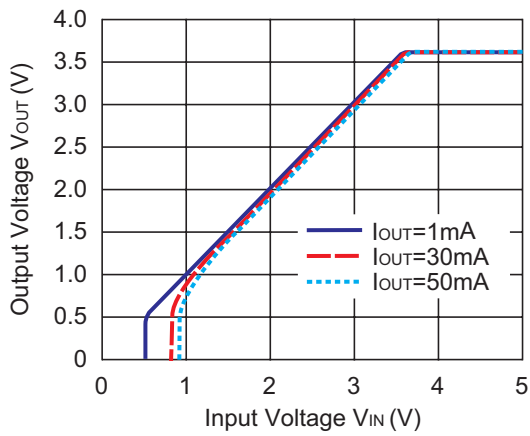
0.8V(VR1/VR2)



2.5V(VR1/VR2)

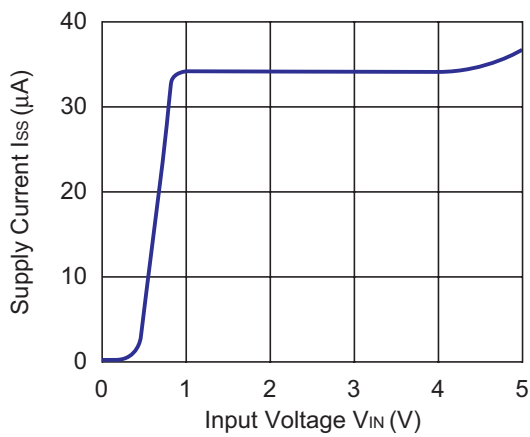


3.6V(VR1/VR2)

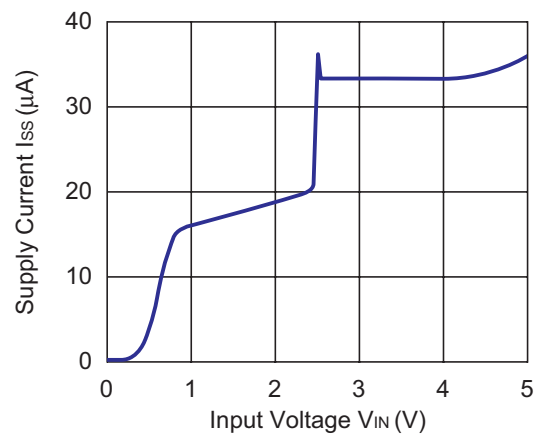


3) Supply Current vs. Input Voltage

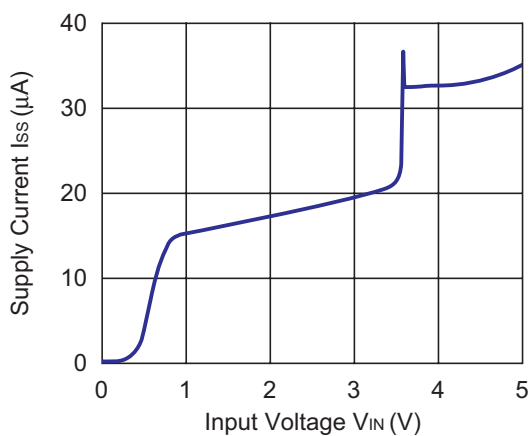
0.8V(VR1/VR2)



2.5V(VR1/VR2)

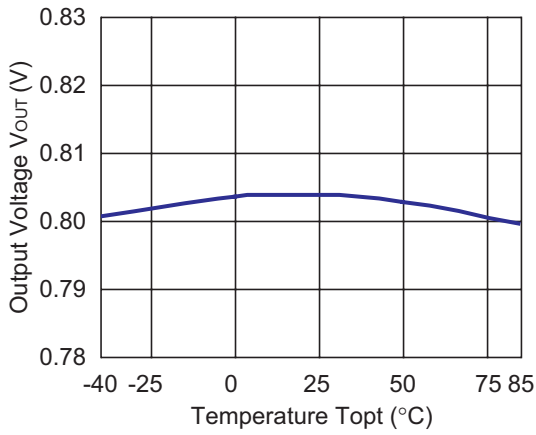


3.6V(VR1/VR2)

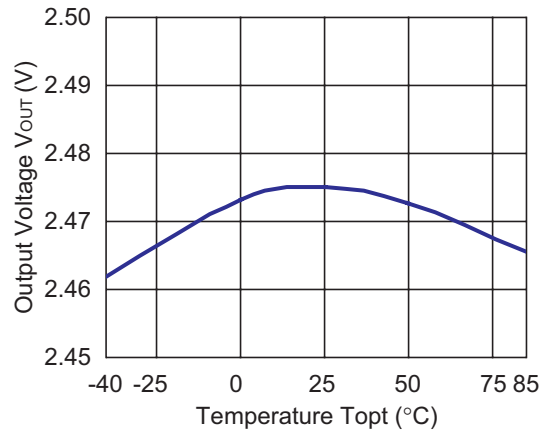


4) Output Voltage vs. Temperature

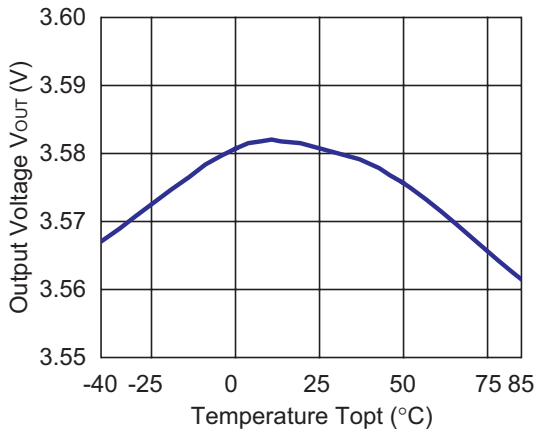
0.8V(VR1/VR2)



2.5V(VR1/VR2)

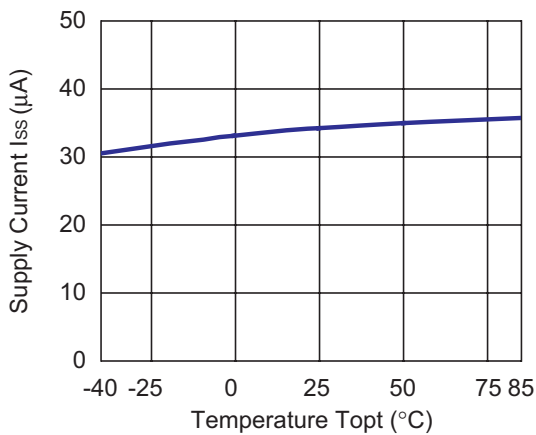


3.6V(VR1/VR2)

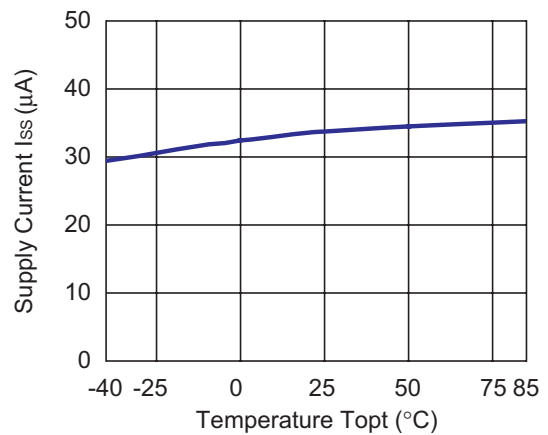


5) Supply Current vs. Temperature

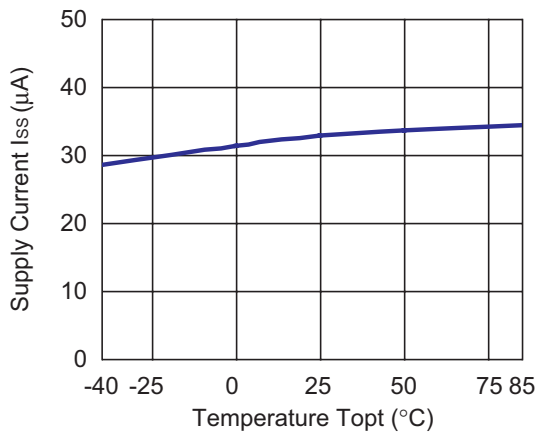
0.8V(VR1/VR2)



2.5V(VR1/VR2)

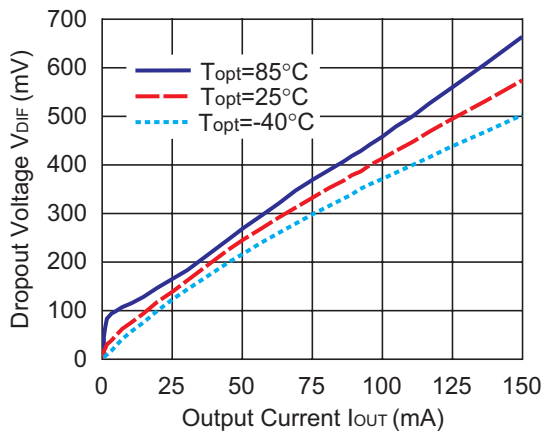


3.6V(VR1/VR2)

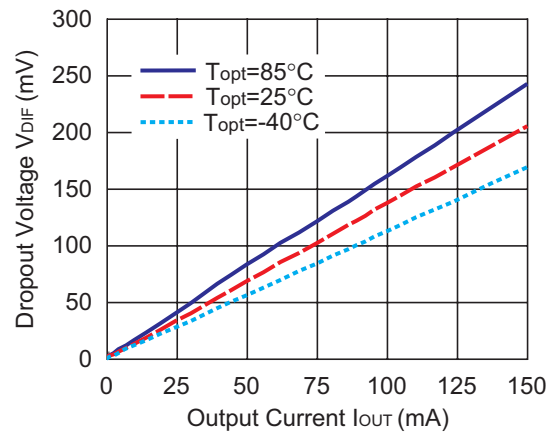


6) Dropout Voltage vs. Output Current

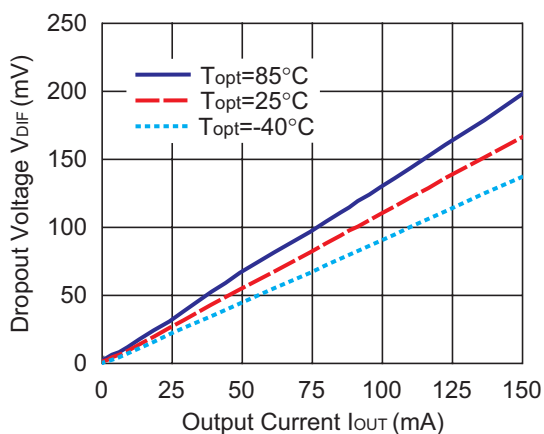
0.8V(VR1/VR2)



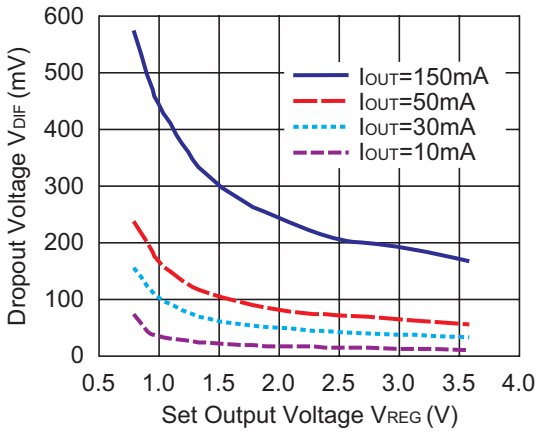
2.5V(VR1/VR2)



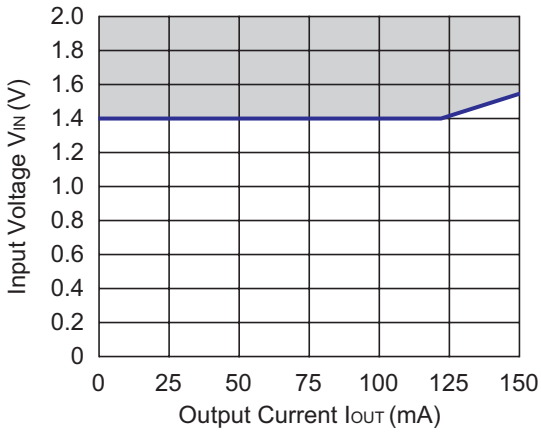
3.6V(VR1/VR2)



7) Dropout Voltage vs. Set Output Voltage

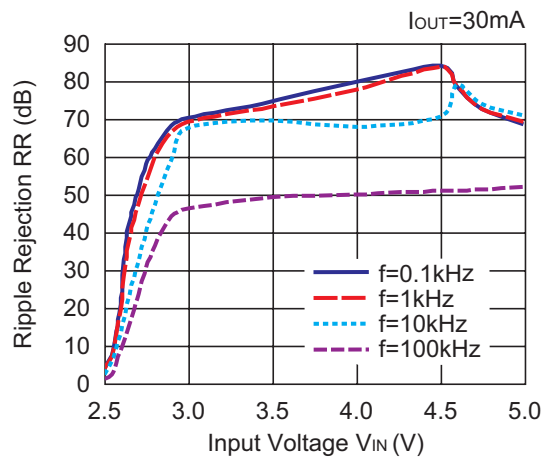
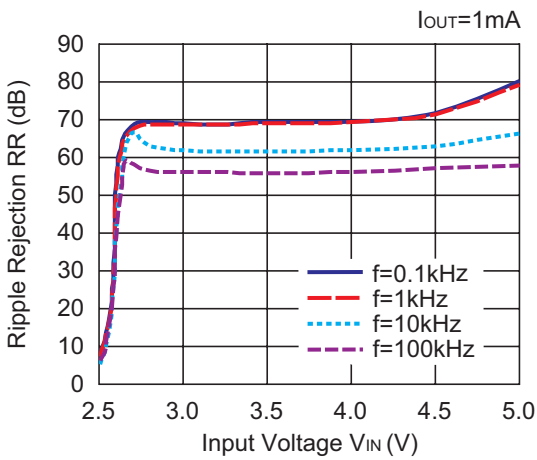


8) Minimum Operating Voltage

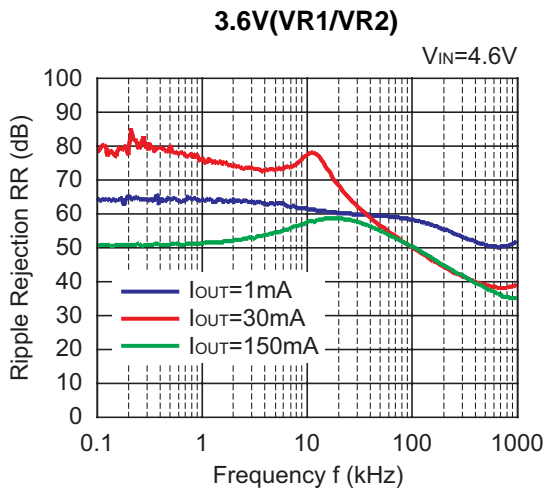
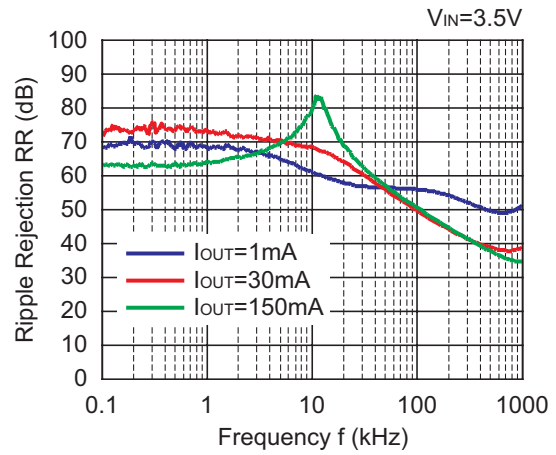
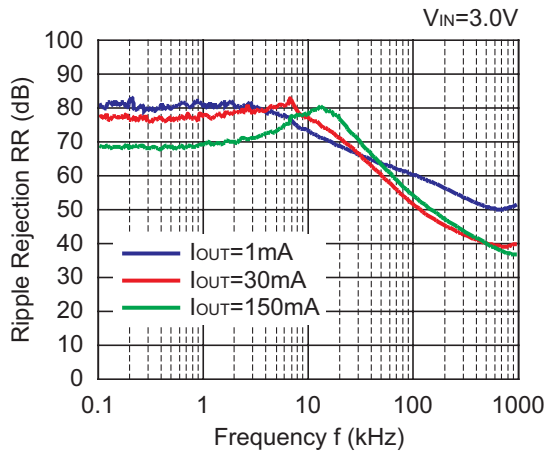


Hatched area is available for 0.8V output

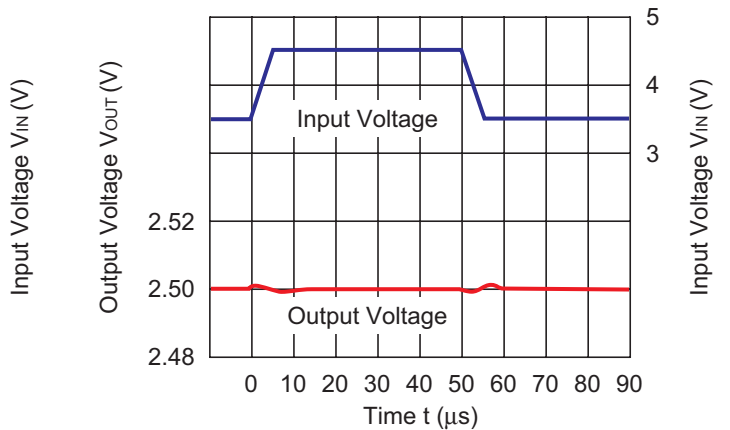
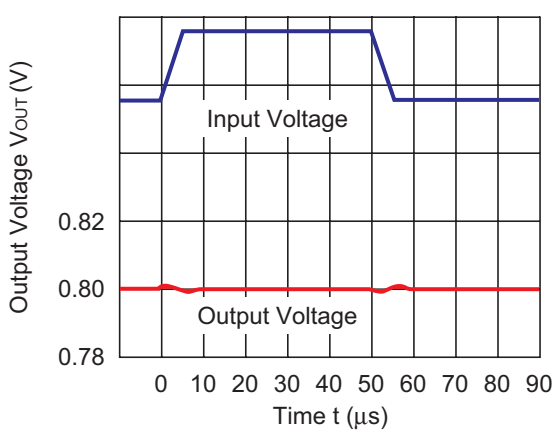
9) Ripple Rejection vs. Input Voltage (C1=none, C2=Ceramic 0.22 μ F, Ripple=0.2Vp-p, T_{opt}=25°C)
 2.5V(V_{R1}/V_{R2})



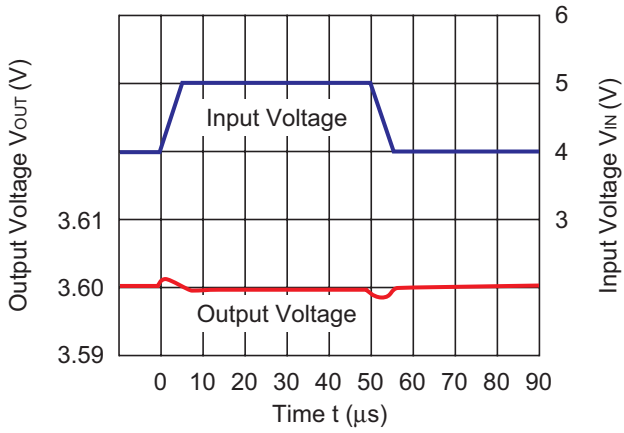
10) Ripple Rejection vs. Frequency (C1=none, C2=Ceramic 0.22 μ F, Ripple=0.2Vp-p, T_{opt}=25°C)
0.8V(VR1/VR2) 2.5V(VR1/VR2)



11) Input Transient Response (I_{OUT}=30mA, tr=tf=5 μ s, C1=none, C2=0.22 μ F, T_{opt}=25°C)
0.8V(VR1/VR2) 2.5V(VR1/VR2)

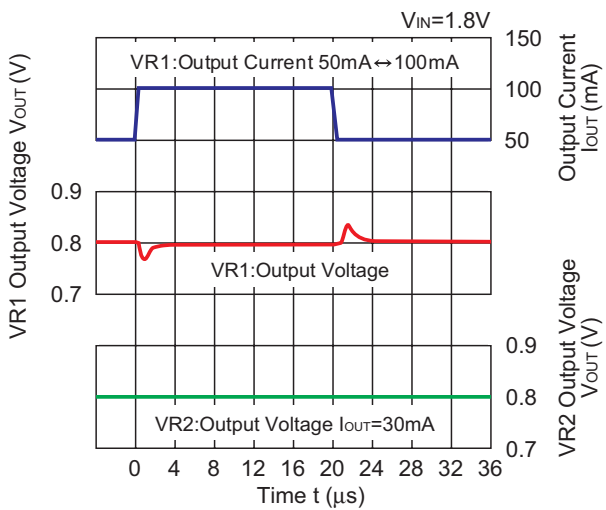


3.6V(VR1/VR2)

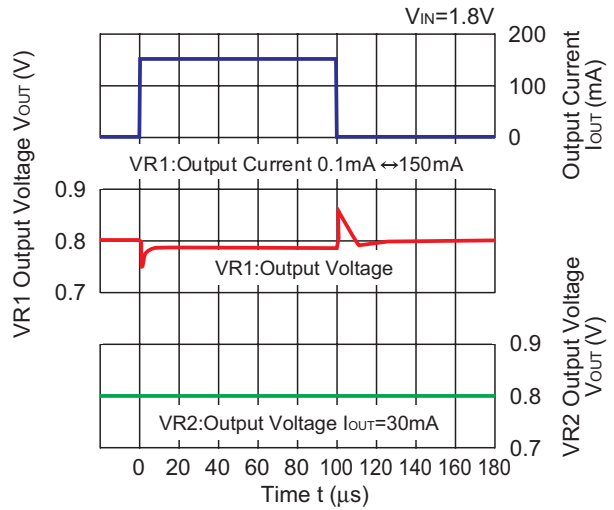


12) Load Transient Response ($t_r=t_f=500\mu s$, $C_1=C_2=0.22\mu F$, $T_{opt}=25^\circ C$)

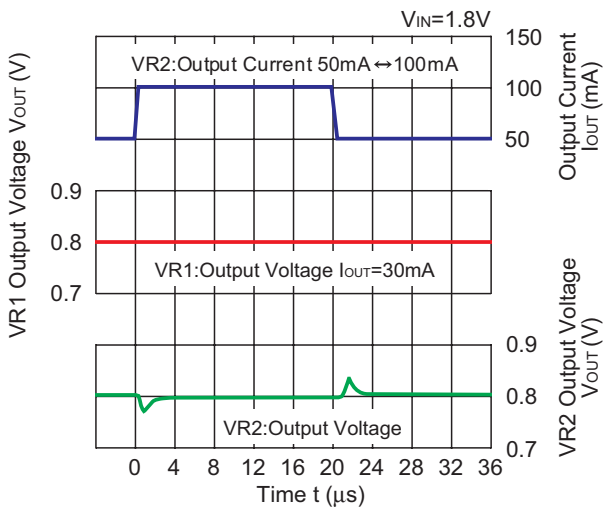
0.8V(VR1/VR2)



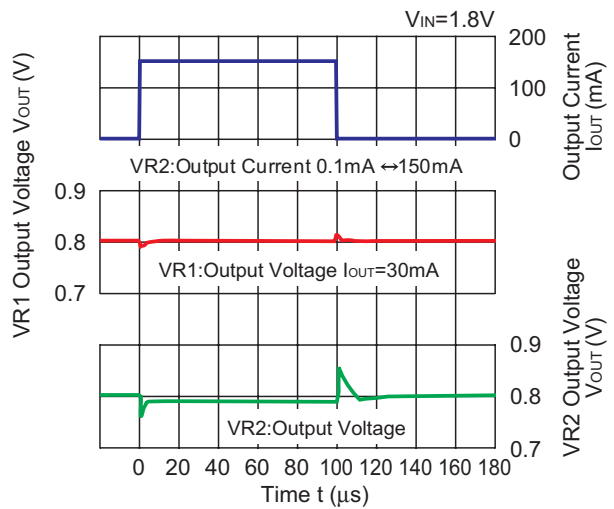
0.8V(VR1/VR2)



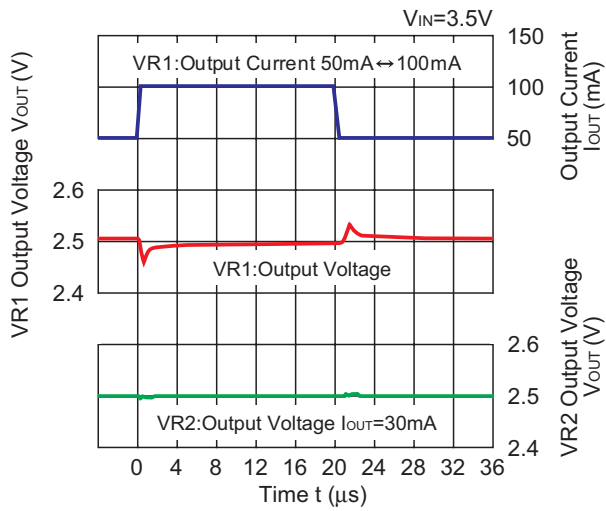
0.8V(VR1/VR2)



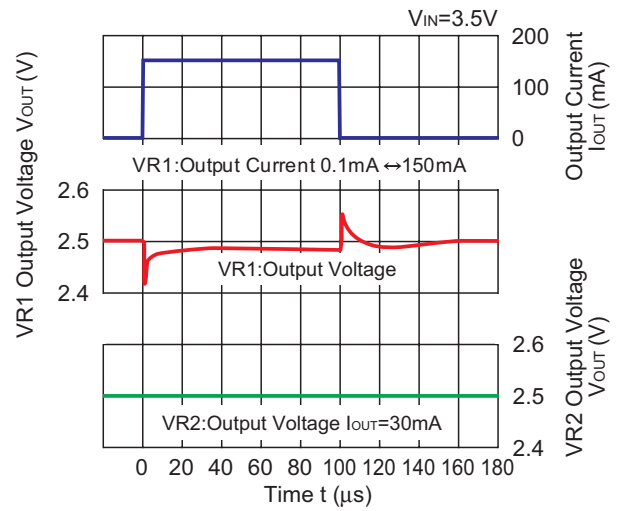
0.8V(VR1/VR2)



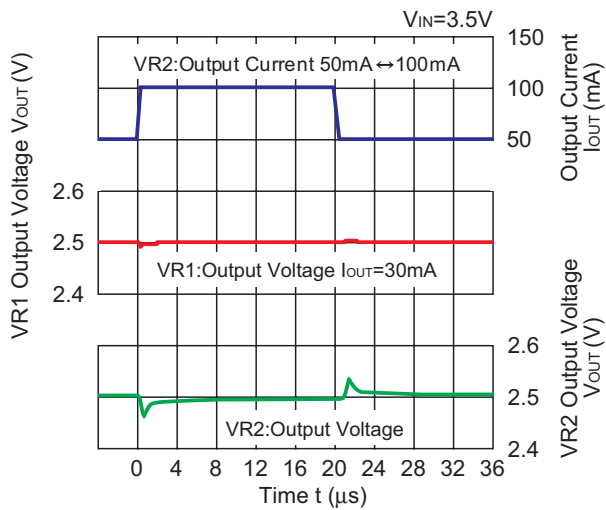
2.5V(VR1/VR2)



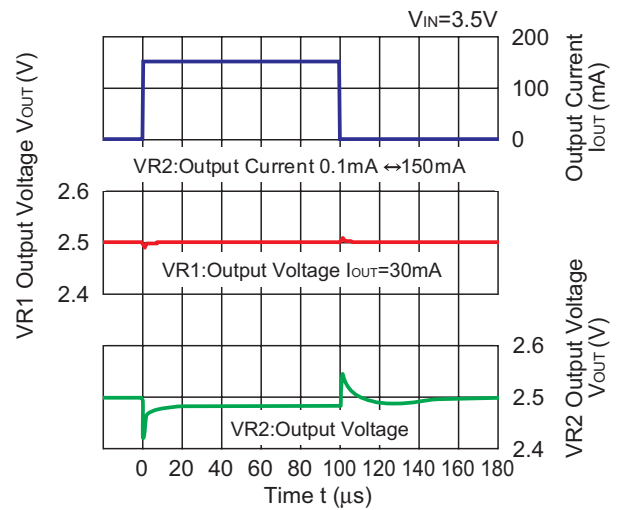
2.5V(VR1/VR2)



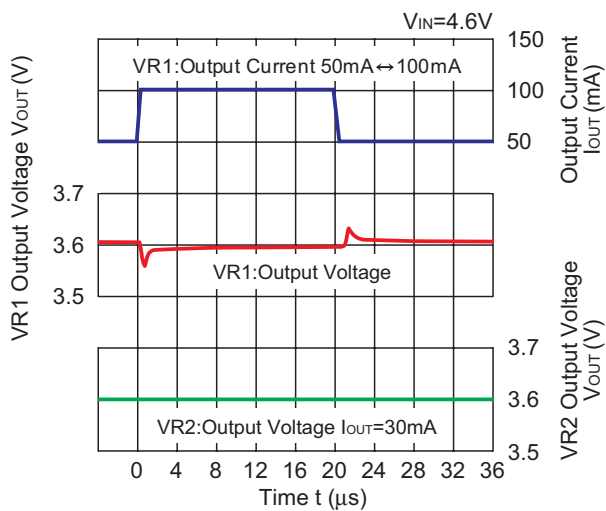
2.5V(VR1/VR2)



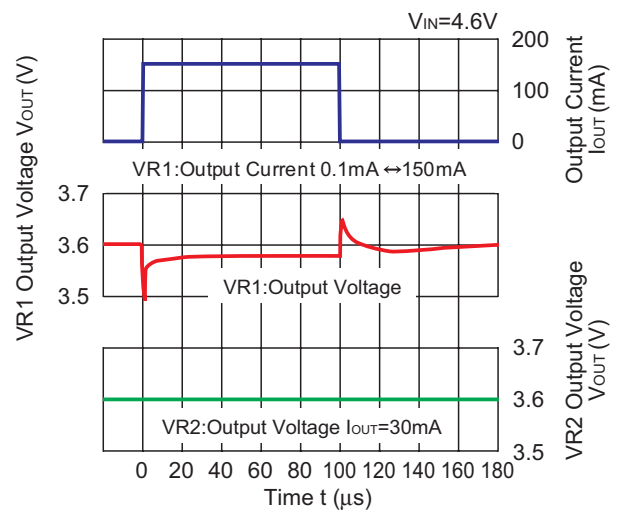
2.5V(VR1/VR2)



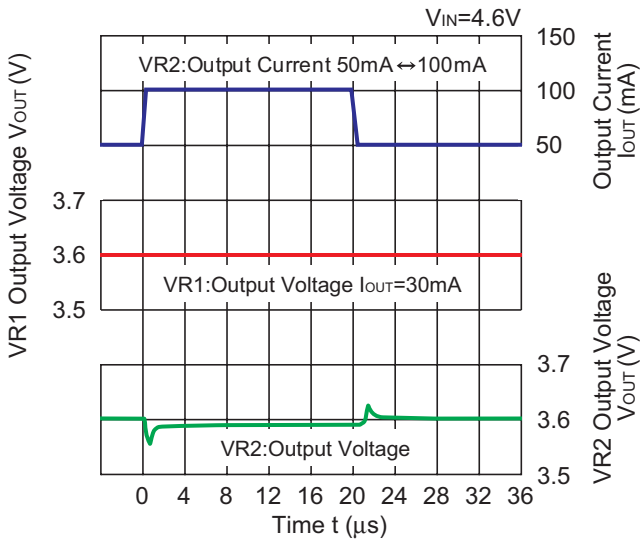
3.6V(VR1/VR2)



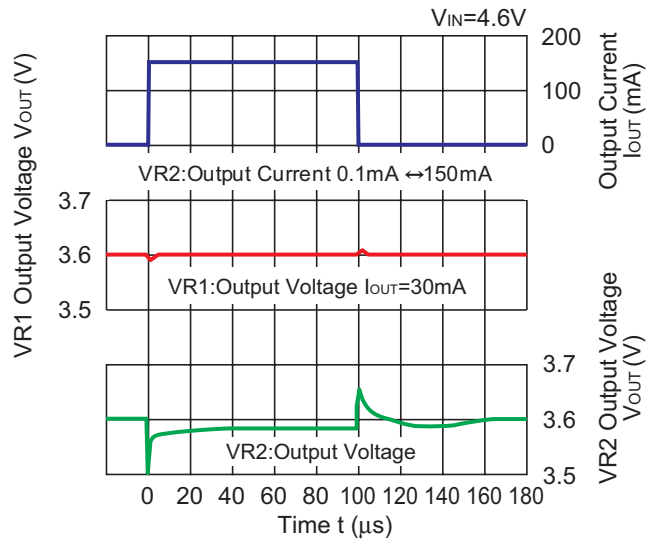
3.6V(VR1/VR2)



3.6V(VR1/VR2)

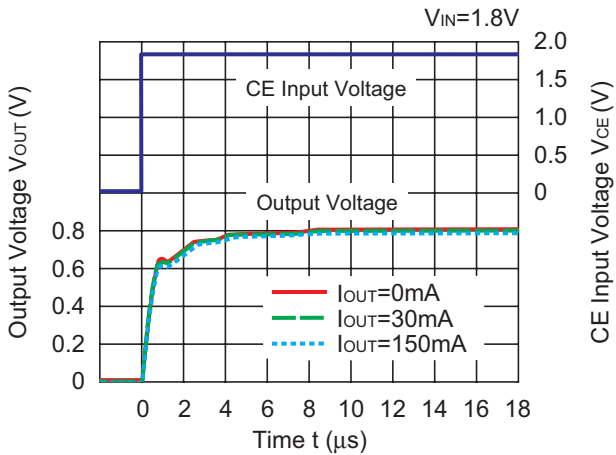


3.6V(VR1/VR2)

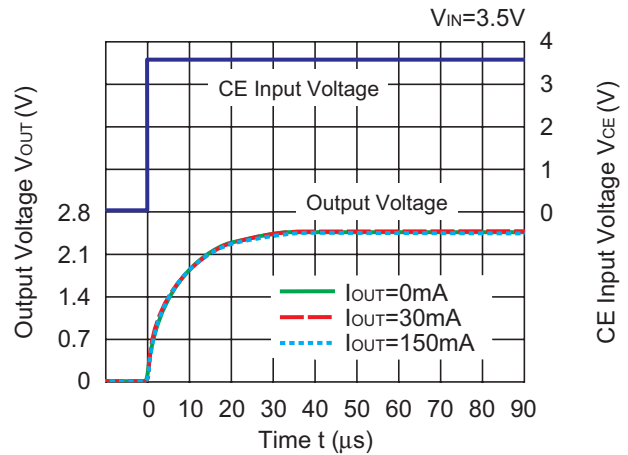


13) Turn On Speed with CE pin (C1=C2=0.22μF, T_{opt}=25°C)

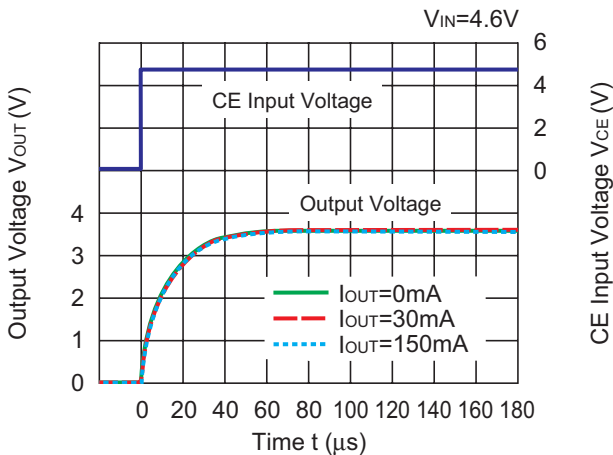
0.8V A/B Version (VR1/ VR2)



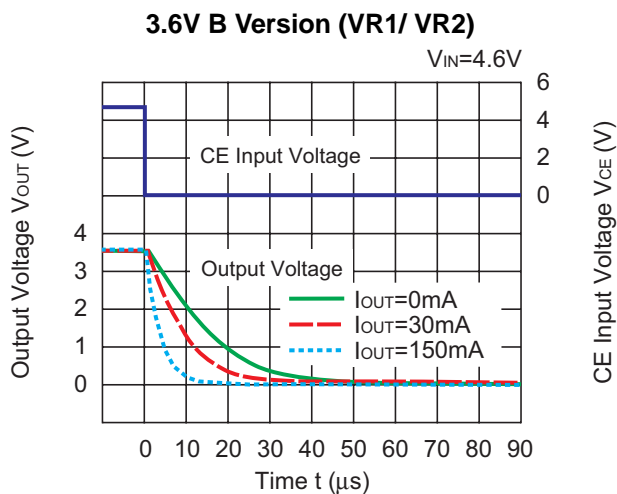
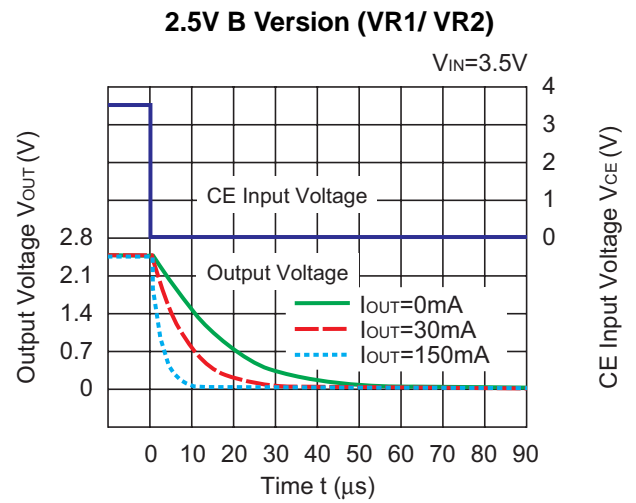
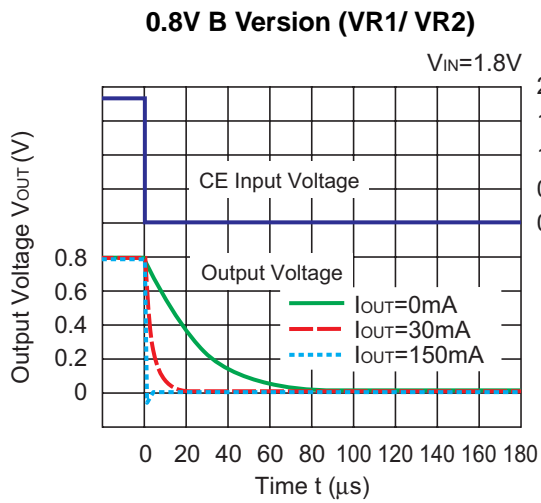
2.5V A/B Version (VR1/ VR2)



3.6V A/B Version (VR1/ VR2)



14) Turn Off Speed with CE pin ($C1=C2=0.22\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)



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 $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

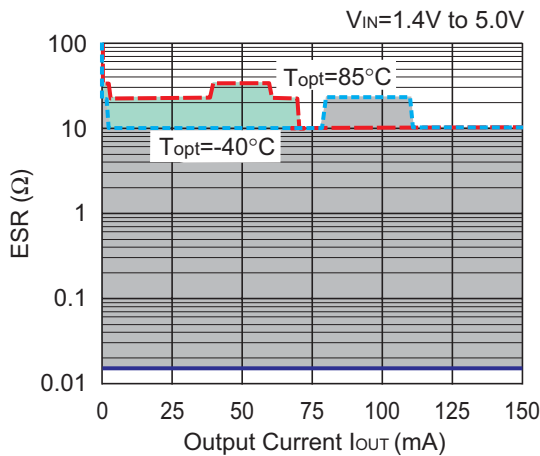
Measurement conditions

Frequency Band: 10Hz to 2MHz

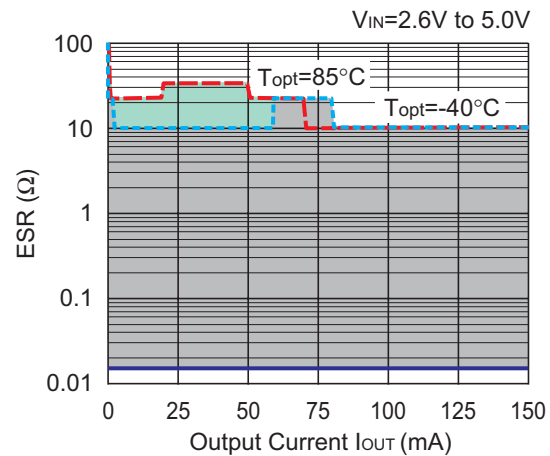
Temperature : -40°C to 85°C

C1, C2 : $0.22\mu\text{F}$ (Murata , GRM155B10J224KE01)

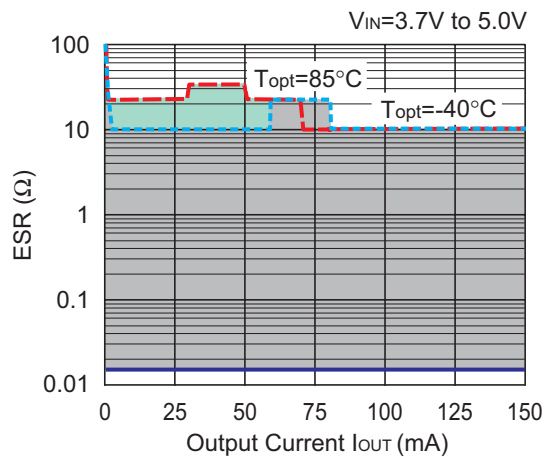
0.8V(VR1/ VR2)



2.5V(VR1/ VR2)



3.6V(VR1/ VR2)





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■ Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

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Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.