300mA SMALL DUAL LDO REGULATOR

NO. EA-202-120524

OUTLINE

The RP154x 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 short current limit circuit, a chip enable circuit, and so on.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance. Low supply current and a chip enable function prolongs the battery life of each system. The ripple rejection, line transient response and load transient response of the RP154x 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. Since the packages for these ICs are SOT-23-6 and DFN1216-8, and dual LDO regulators are included in each package, high density mounting of the ICs on boards is possible.

FEATURES

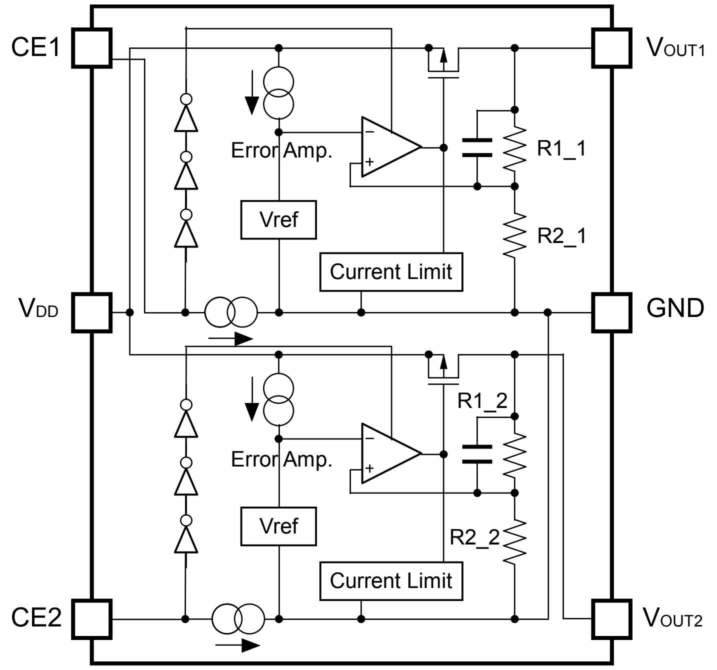
- Supply Current .... Typ. 50μA×2 (VR1&VR2)
- Standby Current .... Typ. 0.1μA×2 (VR1&VR2)
- Input Voltage Range.. 1.4V to 5.25V
- Output Voltage Range.. 0.8V to 3.6V (0.1V steps)
  (For details, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy.. ±1.0% (V_{SET}>2.0V, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±80ppm/°C
- Dropout Voltage.. Typ. 0.24V (I_{OUT}=300mA, V_{SET}=2.5V)
- Ripple Rejection .... Typ. 75dB (f=1kHz)
- Line Regulation .... Typ. 0.02%/V
- Packages DFN1216-8, SOT-23-6
- Built-in Fold Back Protection Circuit.................................... Typ. 60mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC .... 1.0μF or more

APPLICATIONS

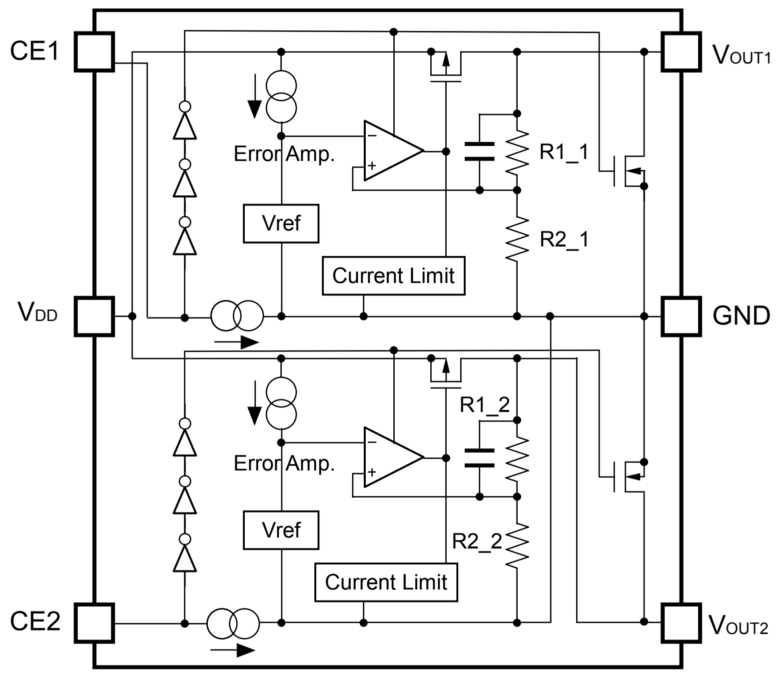
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

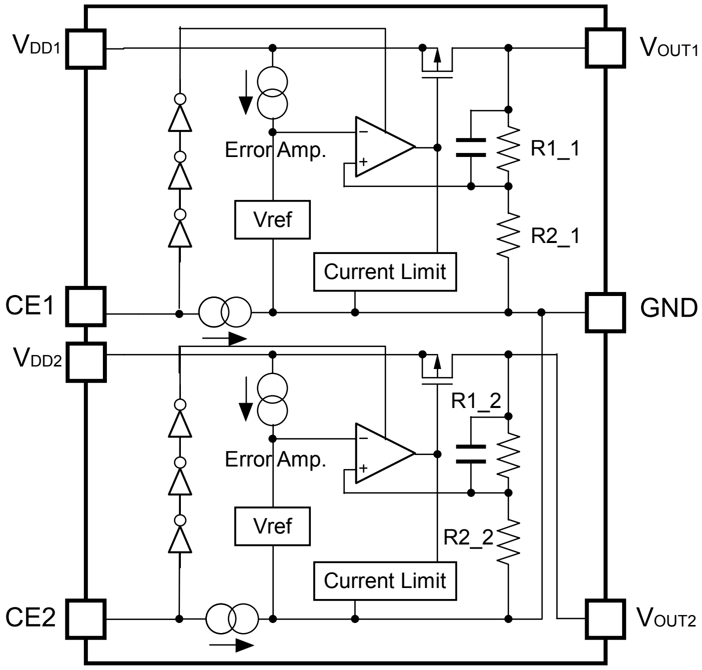
RP154NxxxA



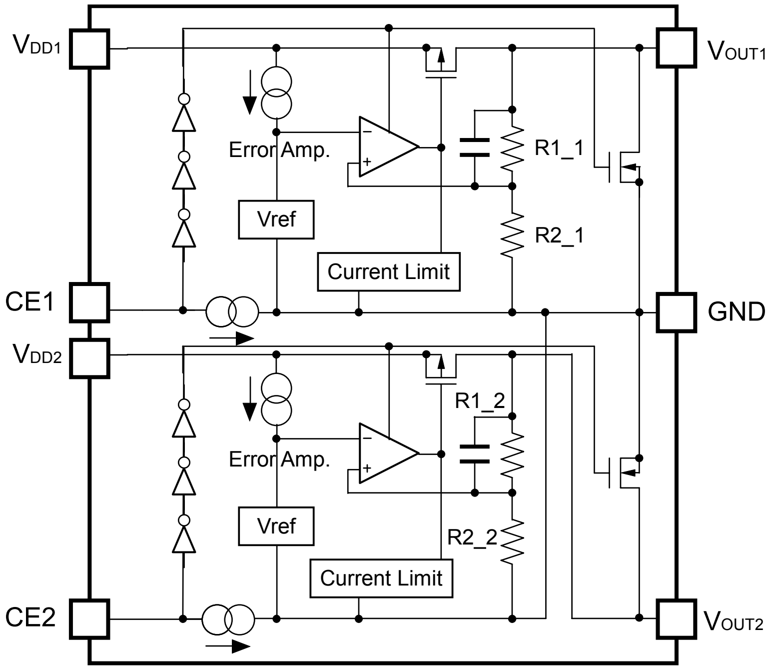
RP154NxxxB



RP154LxxxA



RP154LxxxB



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP154Lxxx∗-E2	DFN1216-8	5,000 pcs	Yes	Yes
RP154Nxxx∗-TR-FE	SOT-23-6	3,000 pcs	Yes	Yes

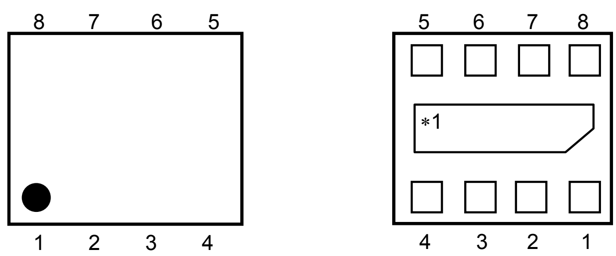
xxx: The combination of set output voltage for each channel can be designated by serial numbers. (from 001)
The set output voltage for each channel can be set in the range from 0.8V to 3.6V in 0.1V steps.
(For details, please refer to MARK INFORMATIONS.)

∗ : The auto discharge function at off state are options as follows.
(A) without auto-discharge function at off state
(B) with auto-discharge function at off state

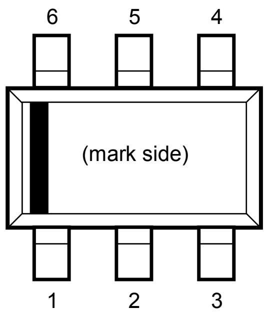
PIN CONFIGURATIONS

- **DFN1216-8**

Top View **Bottom View**



- **SOT-23-6**



PIN DESCRIPTIONS

- **DFN1216-8**

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

∗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.
∗2) The GND pin must be wired together when it is mounted on board.

- **SOT-23-6**

Pin No.	Symbol	Description
1	CE1	Chip Enable Pin 1 ("H" Active)
2	V_{DD}	Input Pin
3	CE2	Chip Enable Pin 2 ("H" Active)
4	V_{OUT2}	Output Pin 2
5	GND	Ground Pin
6	V_{OUT1}	Output Pin 1

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	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	400	mA
P_D	Power Dissipation (DFN1216-8)*	625	mW
	Power Dissipation (SOT-23-6)*	420	
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.

POWER DISSIPATION (DFN1216-8)

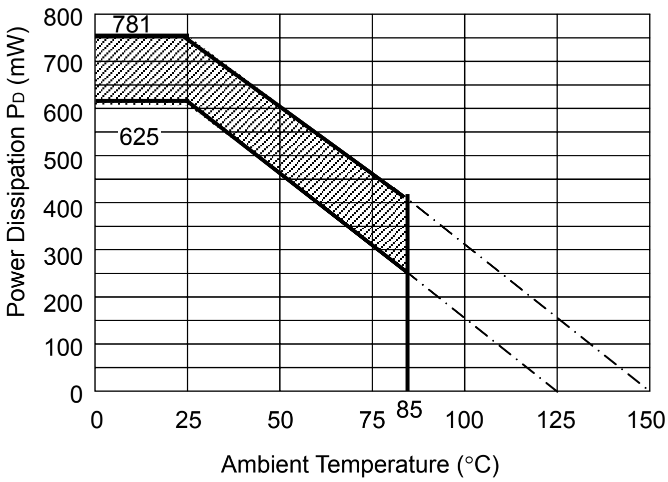
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

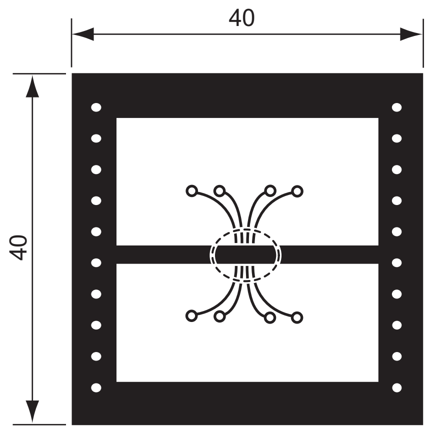
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-holes	φ0.5mm × 28pcs

Measurement Results (Topt=25°C, Tjmax=125°C)

	Standard Land Pattern
Power Dissipation	625mW
Thermal Resistance	θja=(125−25°C)/0.625W=160°C/W
Thermal Resistance	θjc=26°C/W



Power Dissipation



Measurement Board Pattern

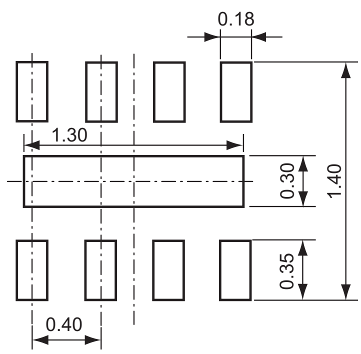
IC Mount Area (Unit: mm)

The above graph shows the Power Dissipation of the package based on Tjmax=125°C and Tjmax=150°C. Operating the IC in the shaded area in the graph might have an influence it's lifetime. Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

Operating time	Estimated years*
13,000hrs	9 years

*The volume is calculated on the supposition that operating four hours/day.

RECOMMENDED LAND PATTERN



(Unit: mm)

POWER DISSIPATION (SOT-23-6)

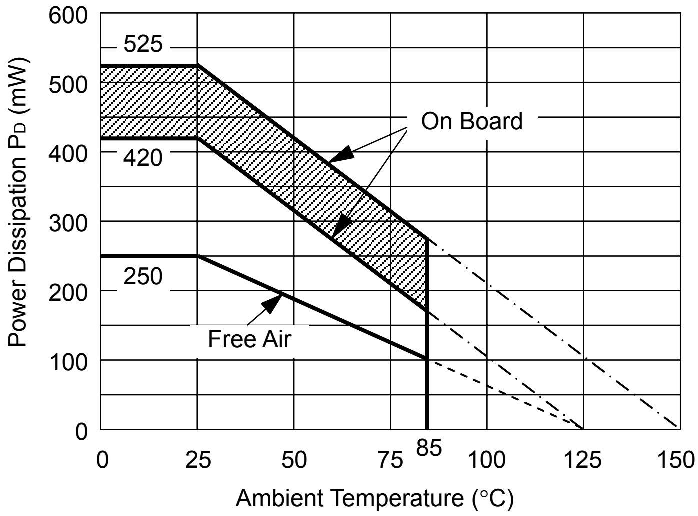
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

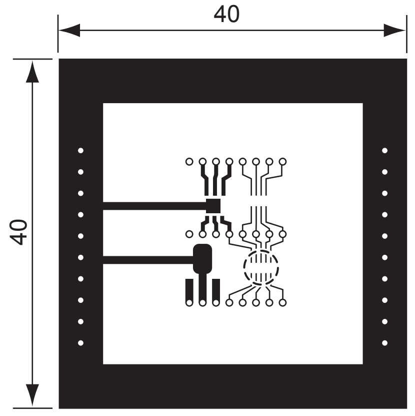
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-holes	ϕ0.5mm × 44pcs

Measurement Results (Topt=25°C, Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja=(125−25°C)/0.42W=238°C/W	400°C/W



Power Dissipation



Measurement Board Pattern

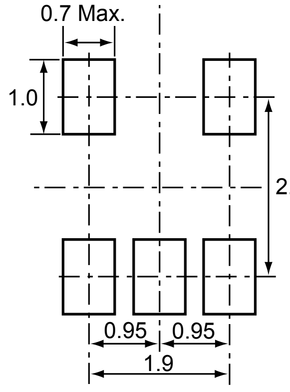
IC Mount Area (Unit: mm)

The above graph shows the Power Dissipation of the package based on Tjmax=125°C and Tjmax=150°C.
Operating the IC in the shaded area in the graph might have an influence it's lifetime.
Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

Operating time	Estimated years∗
13,000hrs	9years

∗The volume is calculated on the supposition that operating four hours/day.

RECOMMENDED LAND PATTERN



(Unit: mm)

ELECTRICAL CHARACTERISTICS

- **RP154x**

V_{IN}=V_{SET}+1.0V (V_{SET} > 1.5V), V_{IN}=2.5V (V_{SET} ≤ 1.5V) , I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted.
V_{SET} is Set Output Voltage.
The specification in ☐ is checked and guaranteed by design engineering at –40°C ≤ Topt ≤ 85°C.

VR1/VR2 Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{SET} > 2.0V	×0.99		×1.01	V
			V_{SET} ≤ 2.0V	–20		+20	mV
		–40°C ≤ Topt ≤ 85°C	V_{SET} > 2.0V	×0.97		×1.03	V
			V_{SET} ≤ 2.0V	–60		+60	mV
I_{OUT}	Output Current			300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA			15	40	mV
V_{DIF}	Dropout Voltage	Refer to the following table.					
I_{SS}	Supply Current	I_{OUT}=0mA			50	75	μA
$I_{standby}$	Standby Current	V_{CE}=0V			0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET}+0.5V ≤ V_{IN} ≤ 5.25V (V_{IN} ≥ 1.4V)			0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.2Vp-p V_{IN}=V_{SET}+1V, I_{OUT}=30mA (In case that V_{SET} ≤ 2.0V, V_{IN}=3V)			75		dB
V_{IN}	Input Voltage*			1.40		5.25	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C			±80		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V			60		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			75		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of B version)	V_{IN}=4.0V, V_{CE}=0V			50		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.

All of unit are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient and Thermal Shutdown.

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.

- **Dropout Voltage by Set Output Voltage**

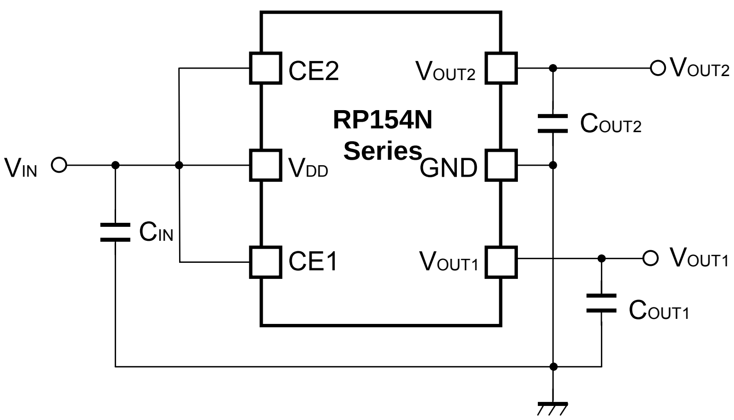
Topt=25°C

Set Output Voltage V_{SET} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
V_{SET}=0.8	I_{OUT}=300mA	0.56	0.72
V_{SET}=0.9		0.51	0.65
$1.0 \leq V_{SET} < 1.2$		0.46	0.59
$1.2 \leq V_{SET} < 1.4$		0.39	0.50
$1.4 \leq V_{SET} < 1.7$		0.35	0.44
$1.7 \leq V_{SET} < 2.1$		0.30	0.39
$2.1 \leq V_{SET} < 2.5$		0.26	0.34
$2.5 \leq V_{SET} < 3.0$		0.25	0.30
$3.0 \leq V_{SET} \leq 3.6$		0.22	0.29

The specification in [ ] is checked and guaranteed by design engineering at -40°C ≤ Topt ≤ 85°C.

TYPICAL APPLICATIONS

- **RP154NxxxA/B**

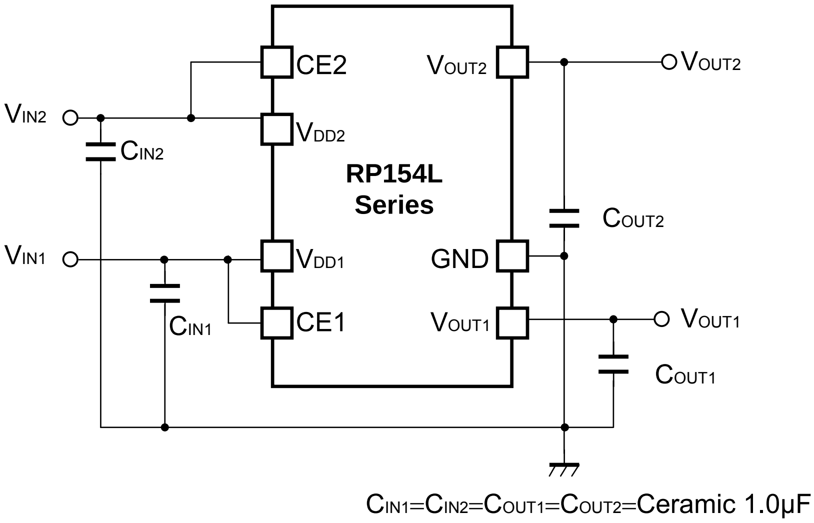


$C_{IN}=C_{OUT1}=C_{OUT2}$=Ceramic 1.0μF

(External Components)

C_{OUT1}, C_{OUT2} Ceramic 1.0μF MURATA: GRM155B31A105KE15

- **RP154LxxxA/B**



(External Components)

C_{OUT1}, C_{OUT2} Ceramic 1.0μF MURATA: GRM155B31A105KE15

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

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

For this purpose, use capacitors (1.0μF or more) for C_{OUT1} and C_{OUT2} 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. If the tantalum capacitor is used and its ESR (equivalent series resistance) is too large, the output may be unstable, therefore, fully evaluation is necessary.

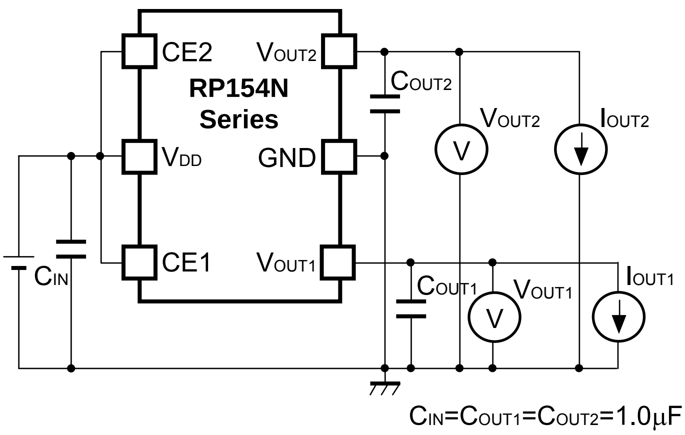
PCB Layout

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 1.0μF or more between V_{DD} and GND pin, and as close as possible to the pins (C_{IN1}/C_{IN2}).

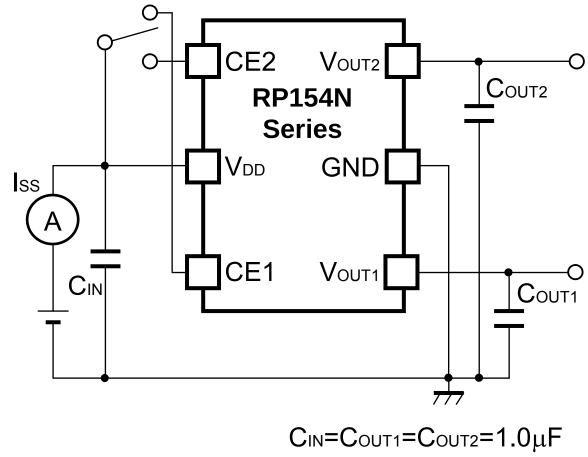
Set external components, especially the output capacitors, as close as possible to the ICs, and make wiring as short as possible (C_{OUT1}/C_{OUT2}).

TEST CIRCUITS

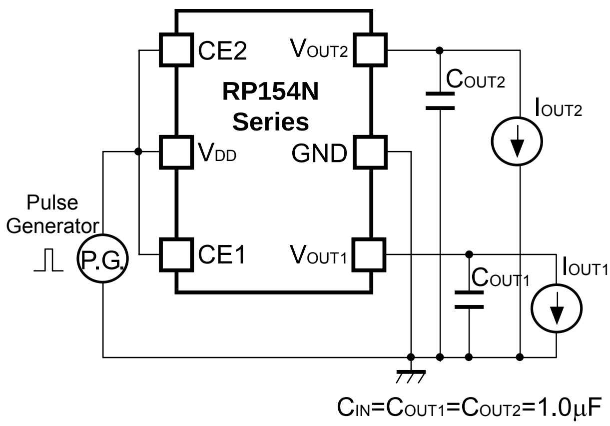
- **RP154NxxxA/B**



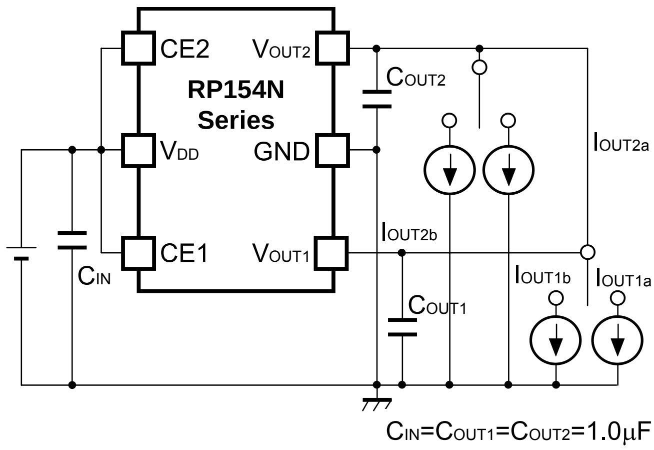
Basic Test Circuit



Supply Current Test Circuit

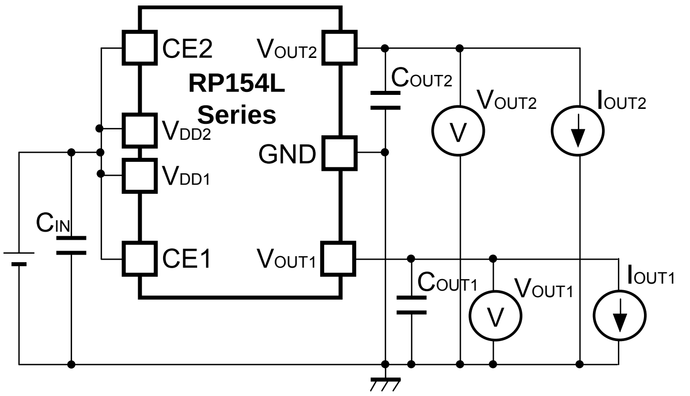


Ripple Rejection & Line Transient Response Test Circuit



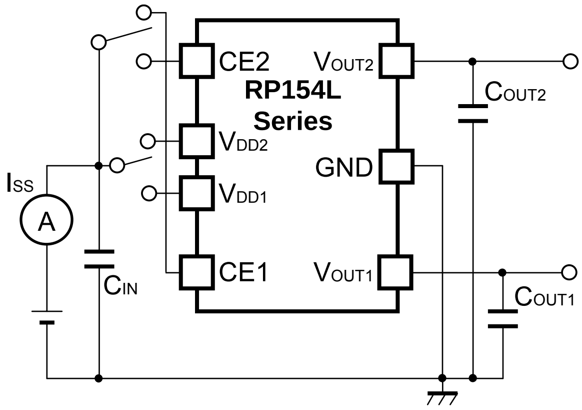
Load Transient Response Test Circuit

- **RP154LxxxA/B**



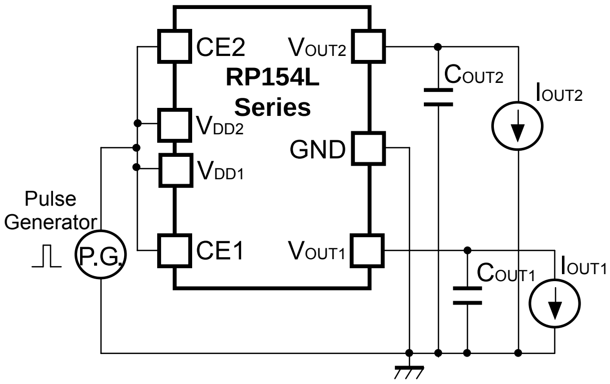
$C_{IN}=C_{OUT1}=C_{OUT2}=1.0\mu F$

Basic Test Circuit



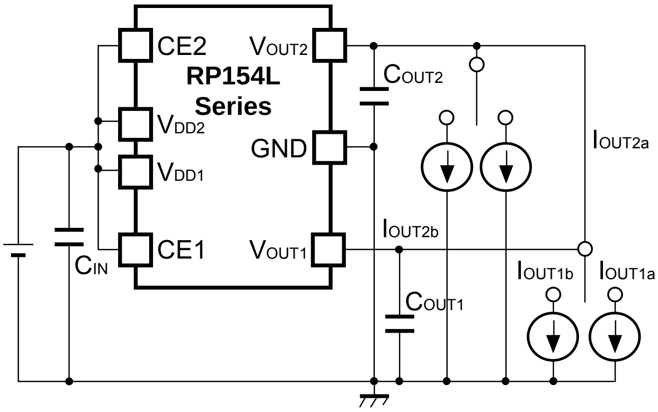
$C_{IN}=C_{OUT1}=C_{OUT2}=1.0\mu F$

Supply Current Test Circuit



$C_{OUT1}=C_{OUT2}=1.0\mu F$

Ripple Rejection & Line Transient Response Test Circuit



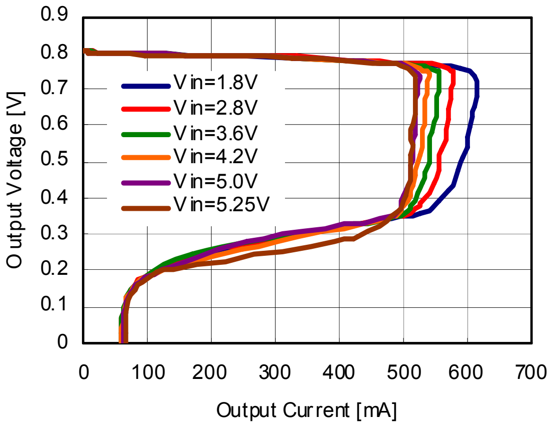
$C_{IN}=C_{OUT1}=C_{OUT2}=1.0\mu F$

Load Transient Response Test Circuit

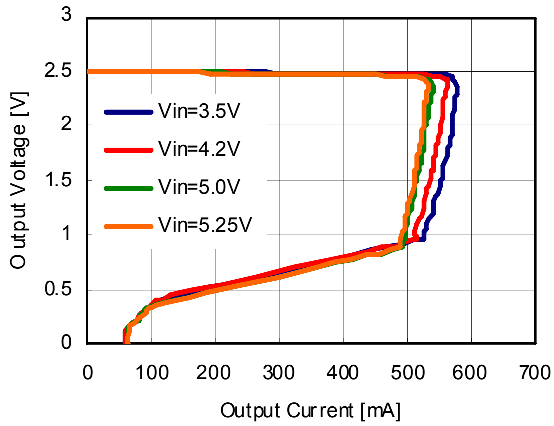
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, Topt=25°C)

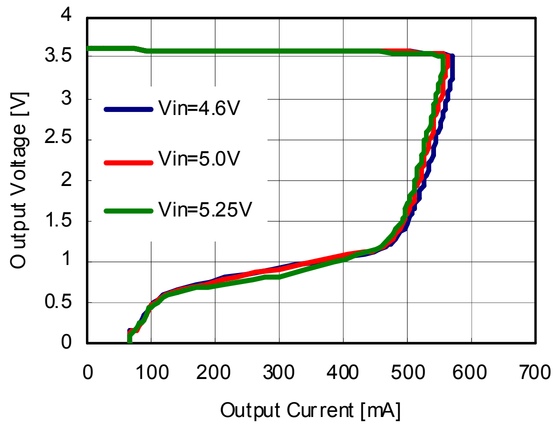
0.8V(VR1/VR2)



2.5V(VR1/VR2)

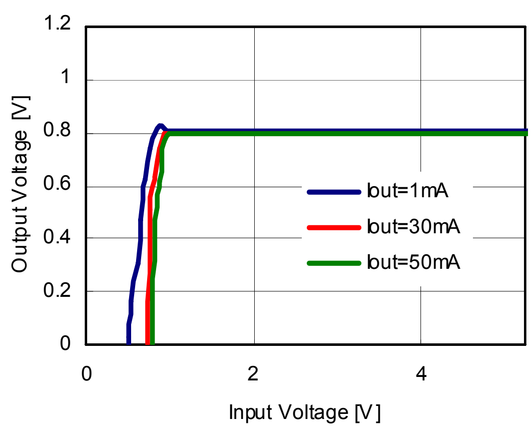


3.6V(VR1/VR2)

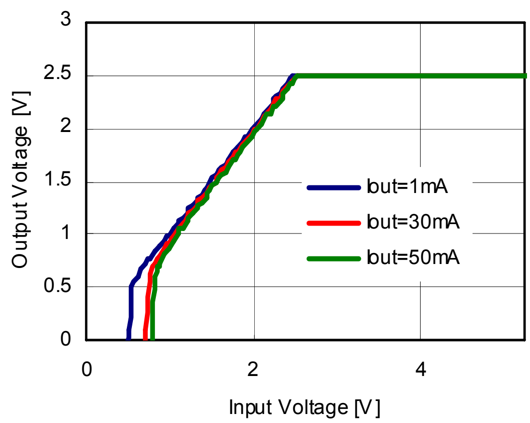


2) Output Voltage vs. Input Voltage (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, Topt=25°C)

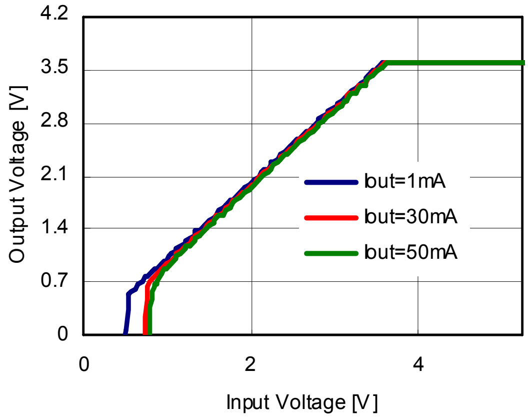
0.8V(VR1/VR2)



2.5V(VR1/VR2)

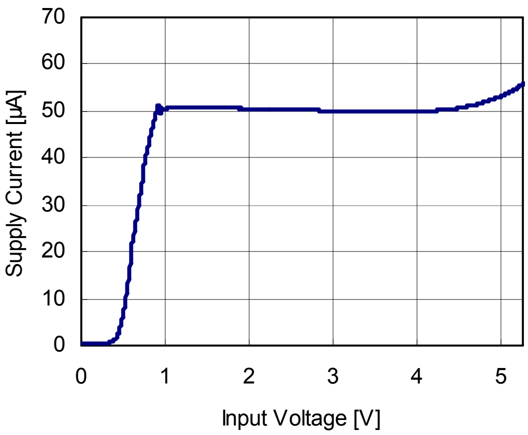


3.6V(VR1/VR2)

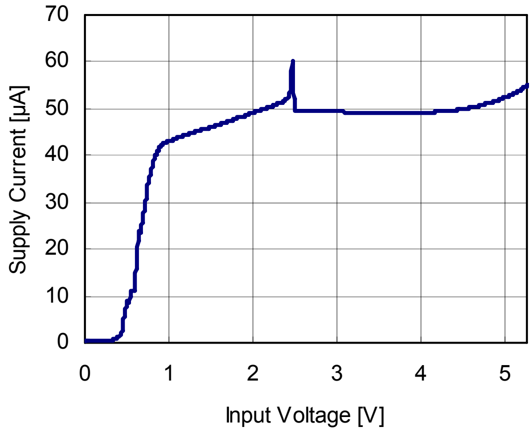


3) Supply Current vs. Input Voltage (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, T_{opt}=25°C)

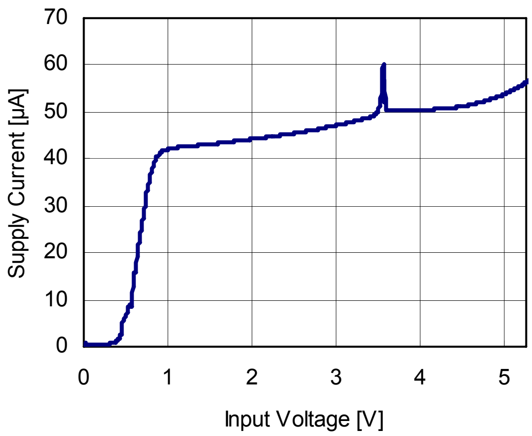
0.8V(VR1/VR2)



2.5V(VR1/VR2)

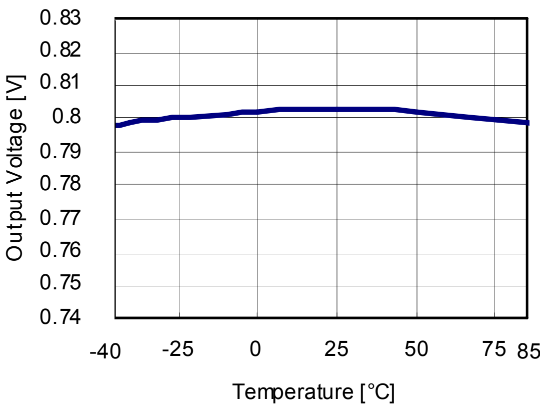


3.6V(VR1/VR2)

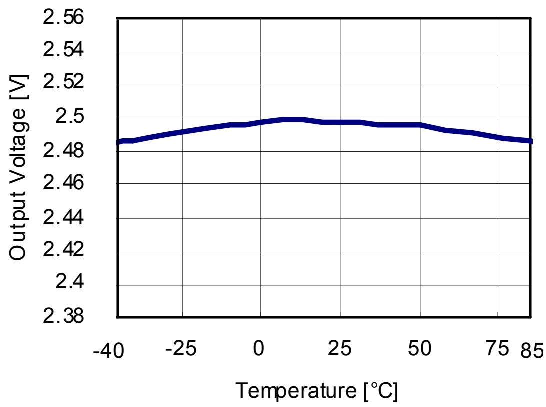


4) Output Voltage vs. Temperature (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, I_{OUT}=5mA)

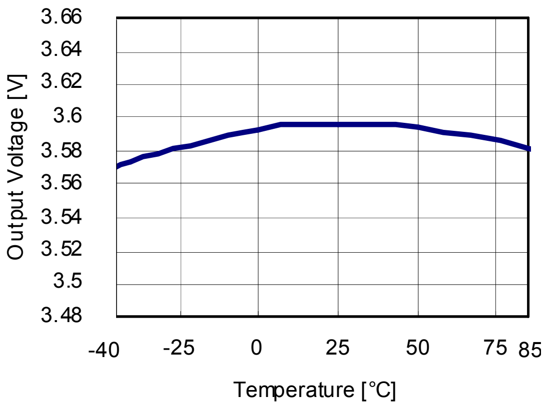
0.8V(VR1/VR2)



2.5V(VR1/VR2)

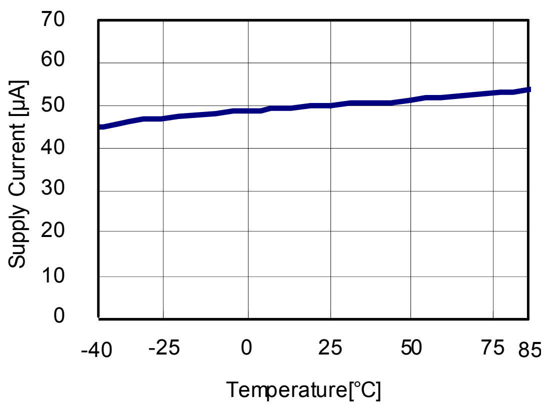


3.6V(VR1/VR2)

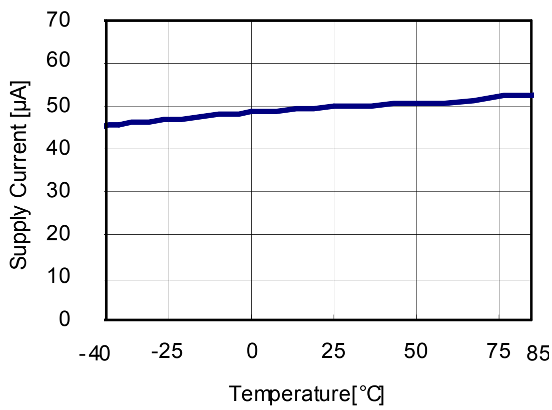


5) Supply Current vs. Temperature (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF)

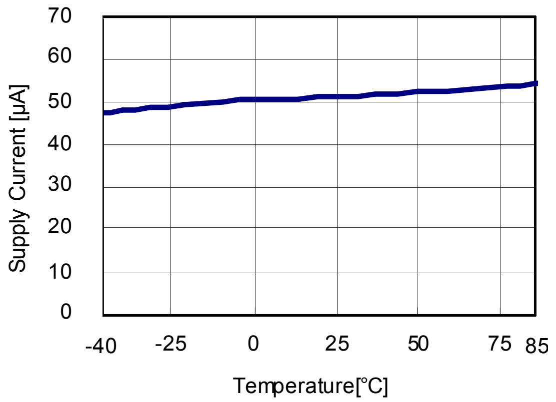
0.8V(VR1/VR2)



2.5V(VR1/VR2)

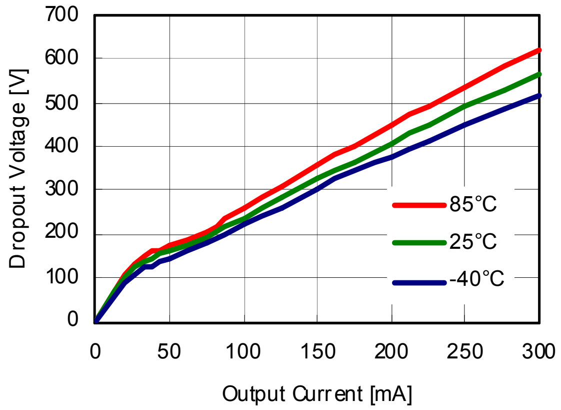


3.6V(VR1/VR2)

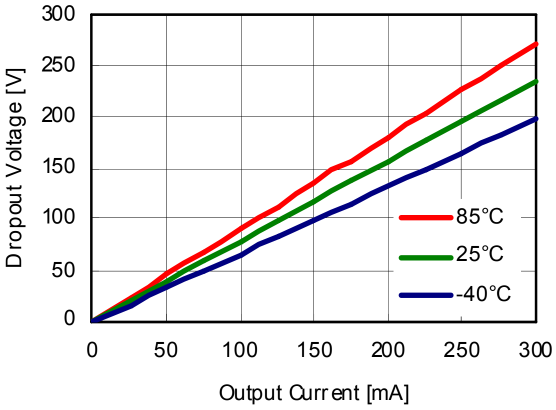


6) Dropout Voltage vs. Output Current (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF)

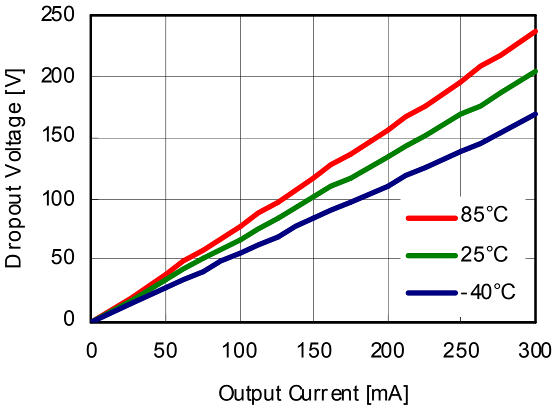
0.8V(VR1/VR2)



2.5V(VR1/VR2)



3.6V(VR1/VR2)



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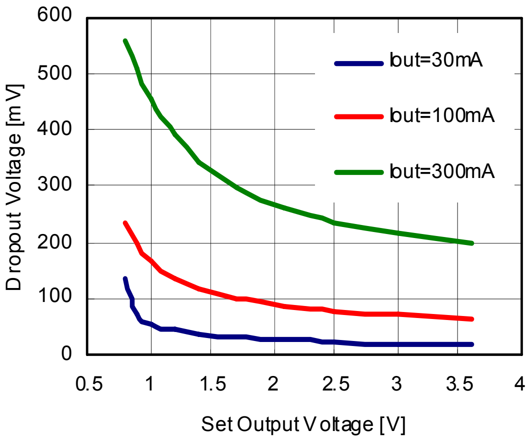
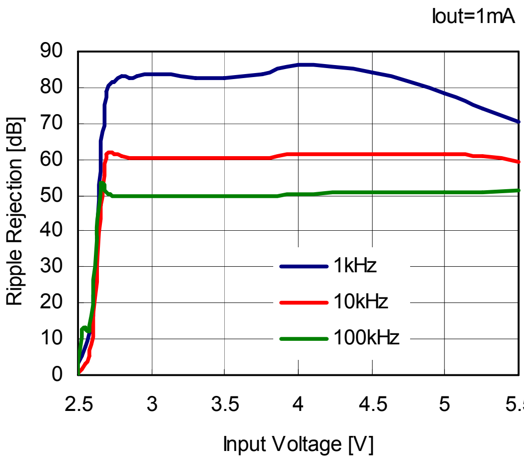
7) Dropout Voltage vs. Set Output Voltage

(VR1/VR2)

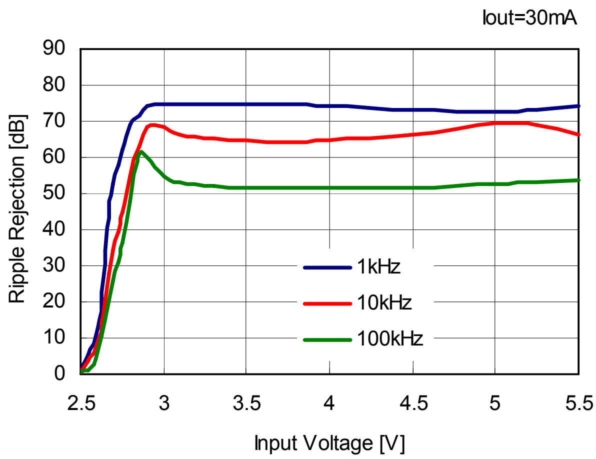


8) Ripple Rejection vs. Input Voltage (C_{IN}=none, C_{OUT1}=C_{OUT2}=1.0µF, Ripple=0.2Vp-p, T_{opt}=25°C)

2.5V(VR1/VR2)

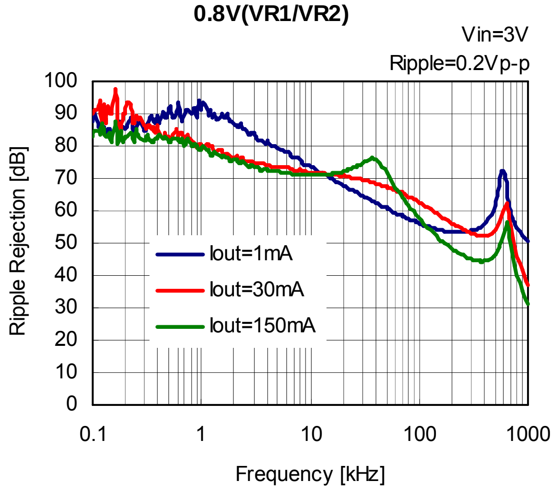


2.5V(VR1/VR2)

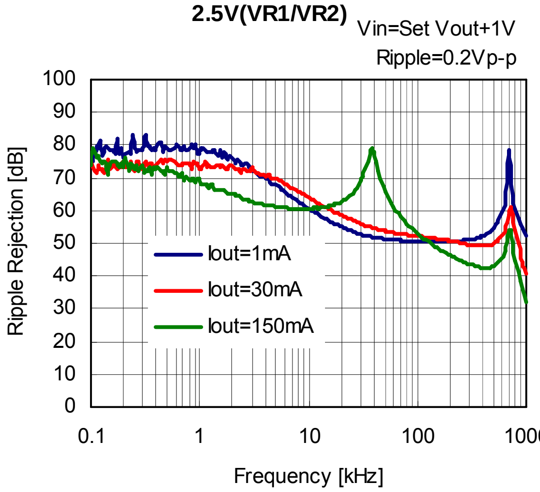


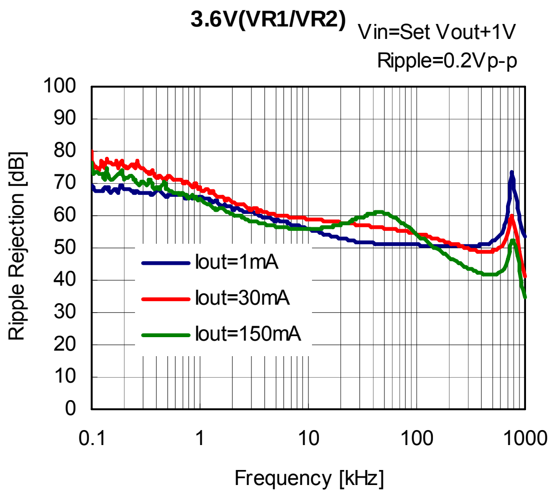
9) Ripple Rejection vs. Frequency (C_{IN}=none, C_{OUT1}=C_{OUT2}=1.0µF, T_{opt}=25°C)

0.8V(VR1/VR2)

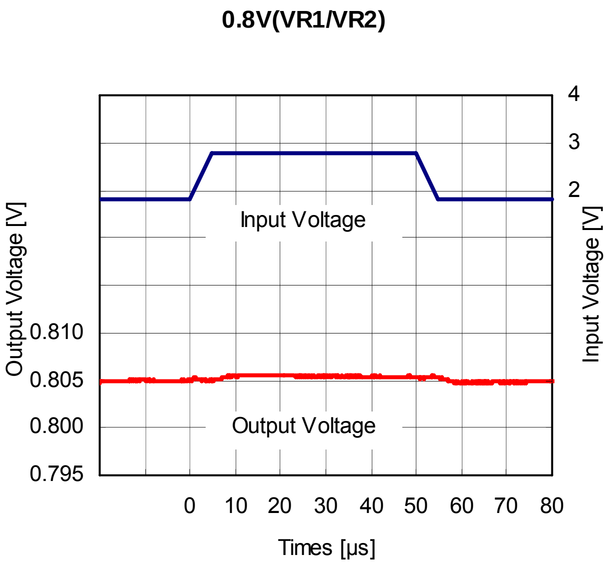


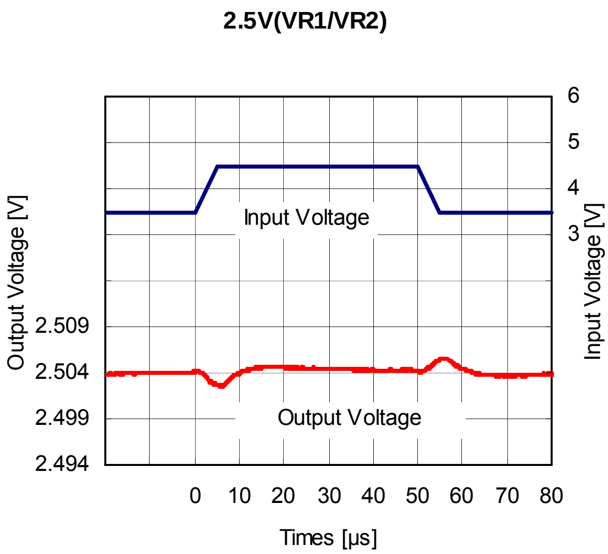
2.5V(VR1/VR2)

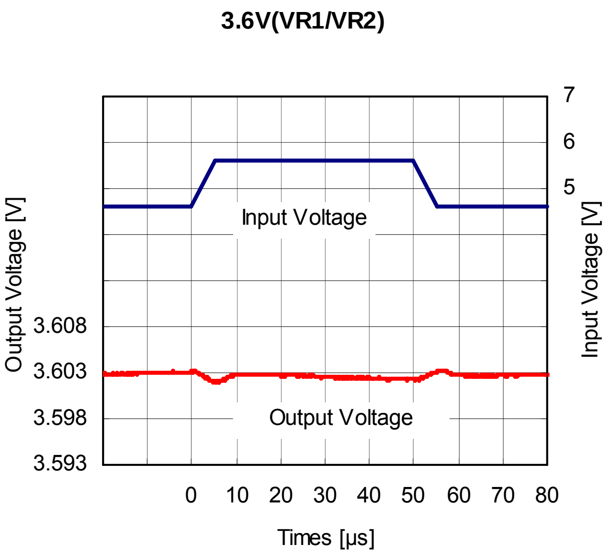




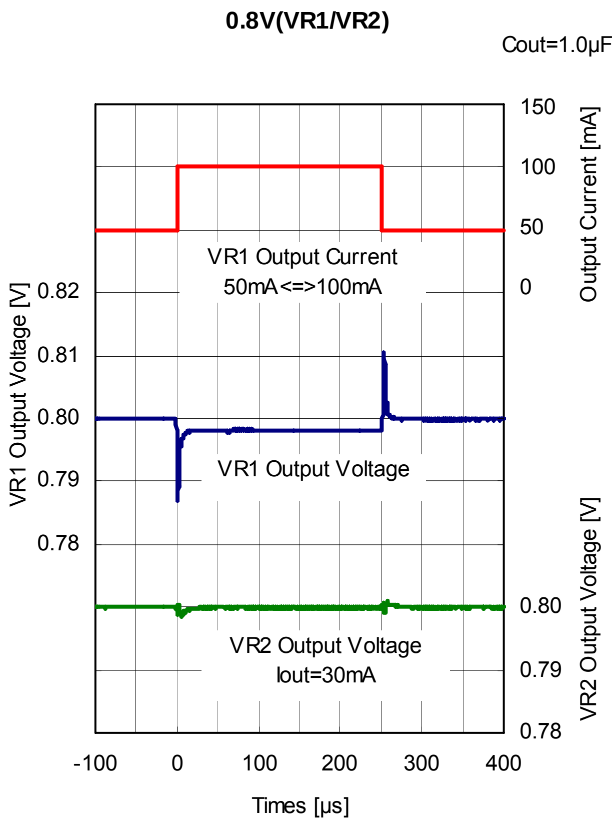
10) Input Transient Response (CIN=none, COUT1=COUT2=1.0μF, tr=tf=5μs, Topt=25°C)

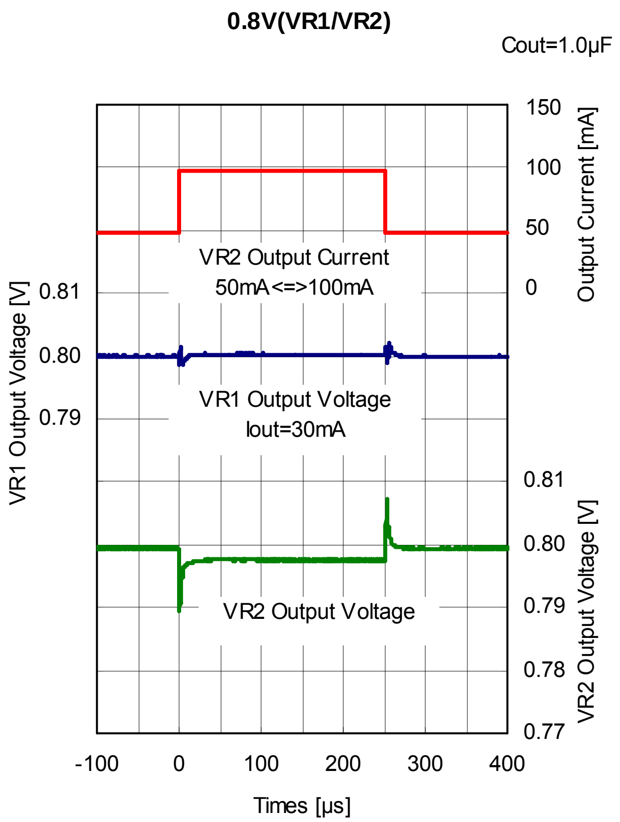


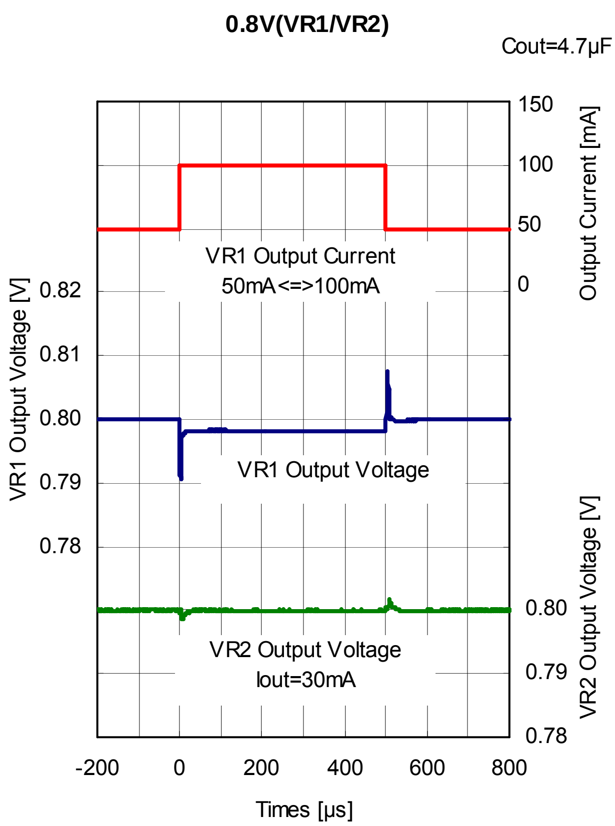


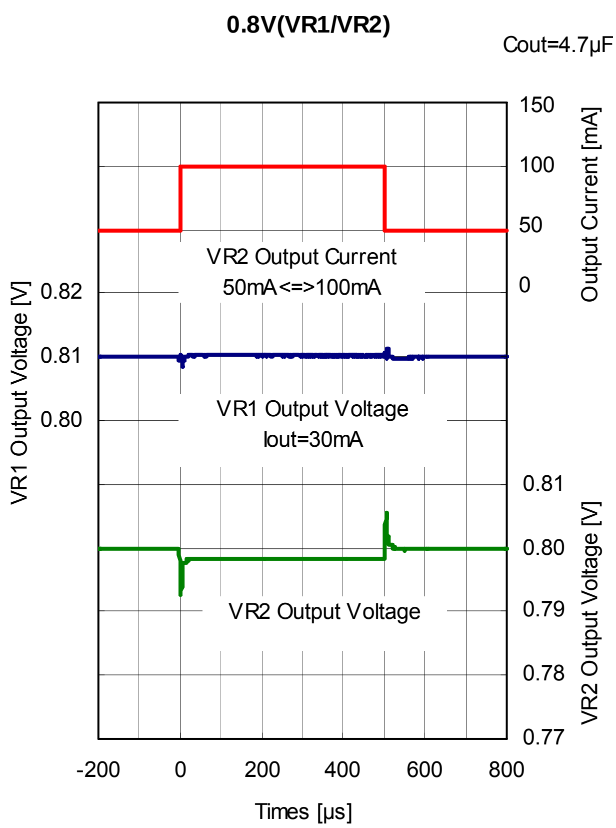


11) Load Transient Response (CIN=1.0µF, COUT1=COUT2=1.0µF, tr=tf=0.5µs, Topt=25°C)



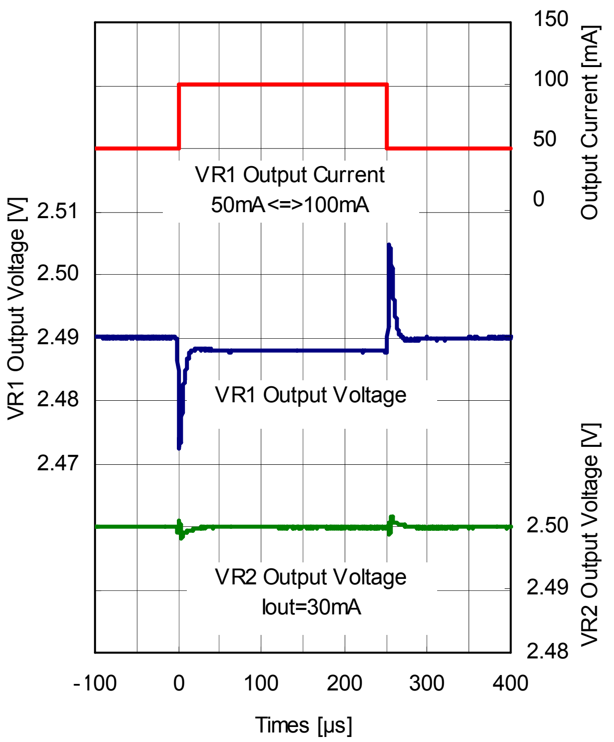






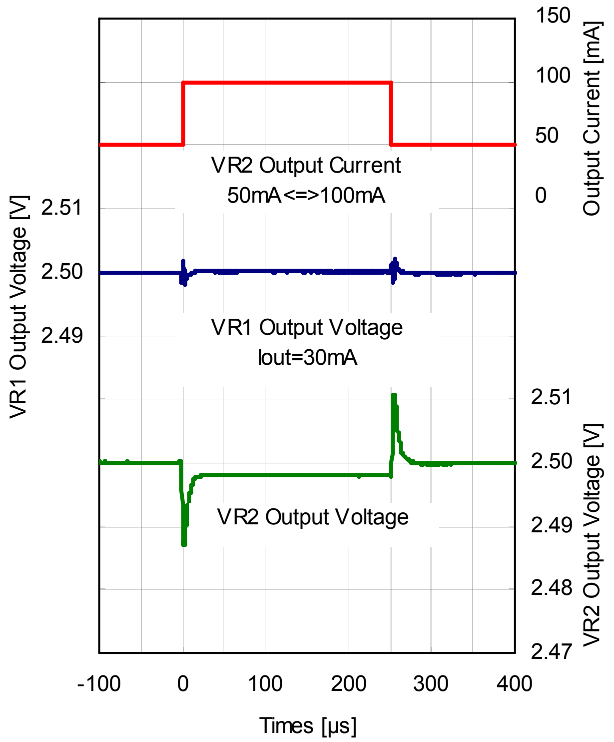
2.5V(VR1/VR2)

Cout=1.0μF



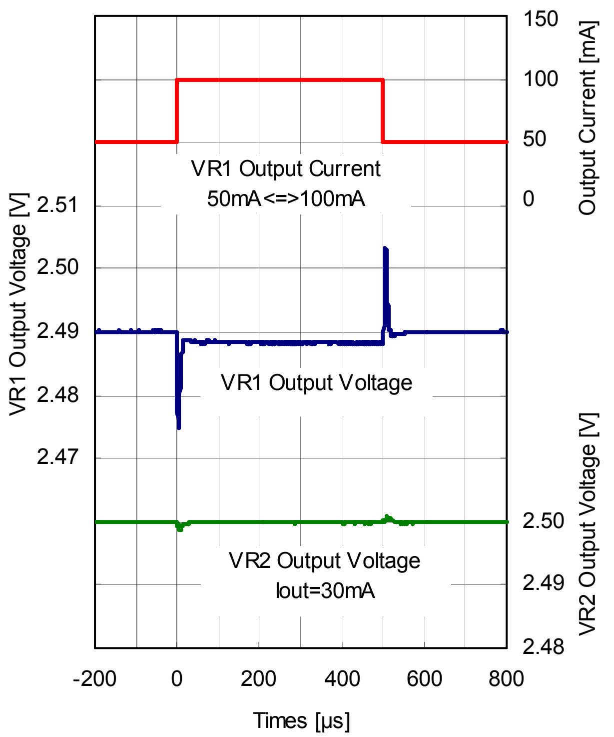
2.5V(VR1/VR2)

Cout=1.0μF



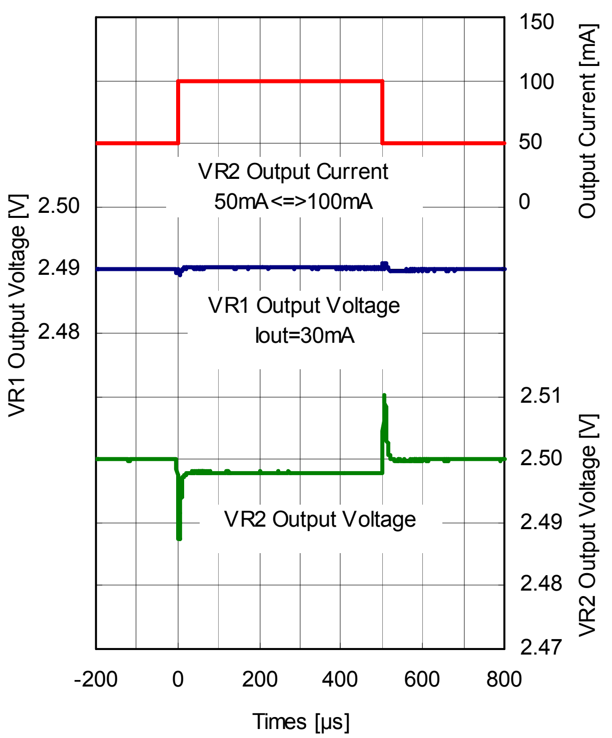
2.5V(VR1/VR2)

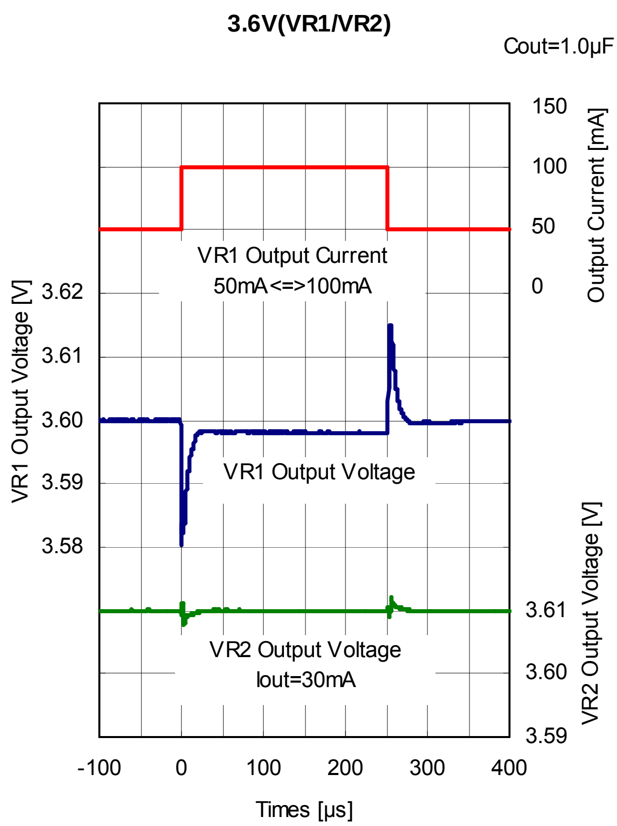
Cout=4.7μF

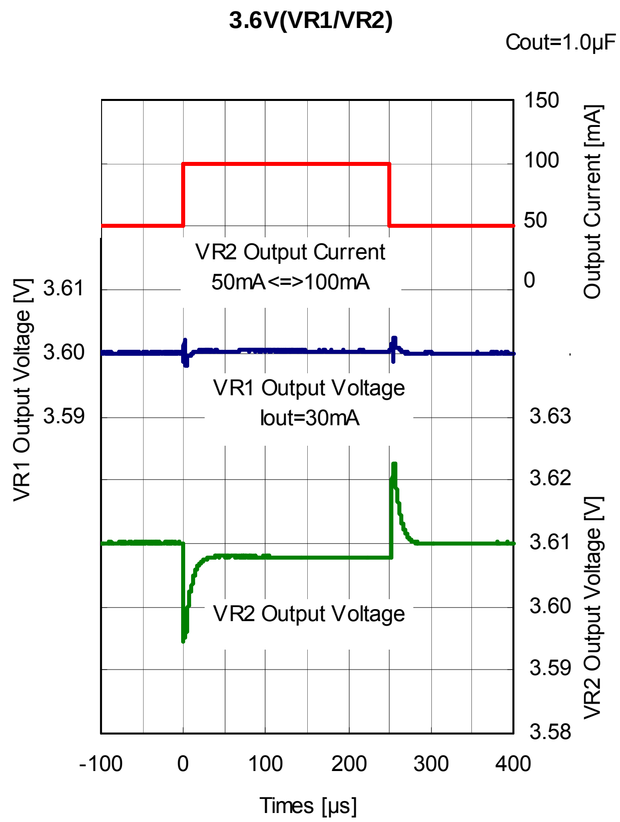


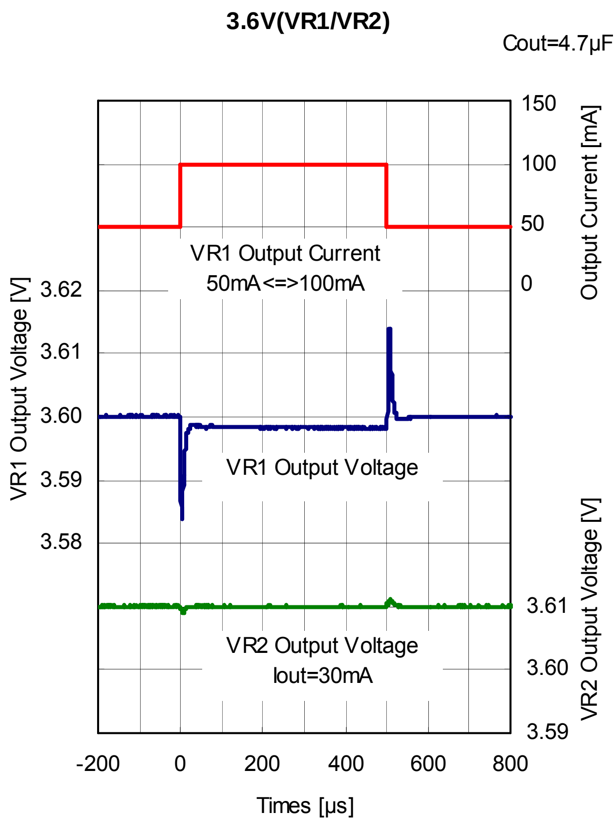
2.5V(VR1/VR2)

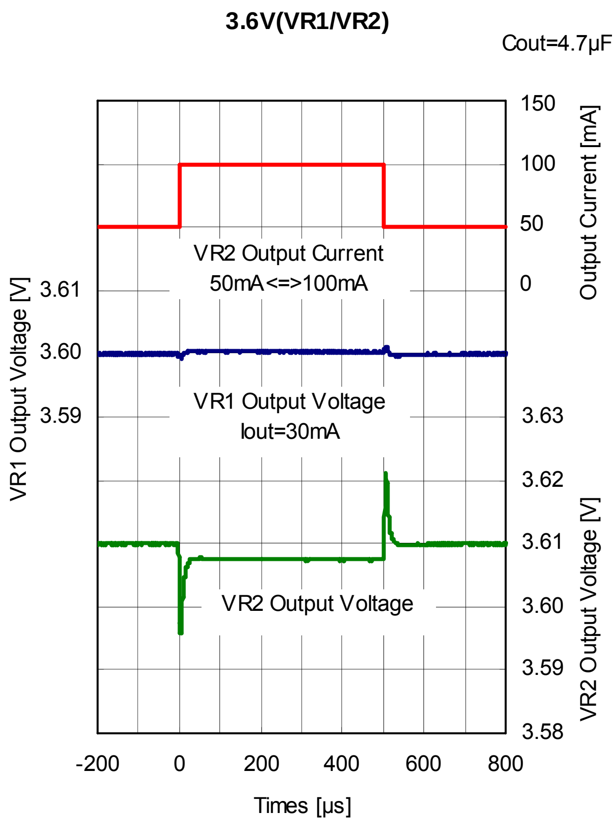
Cout=4.7μF



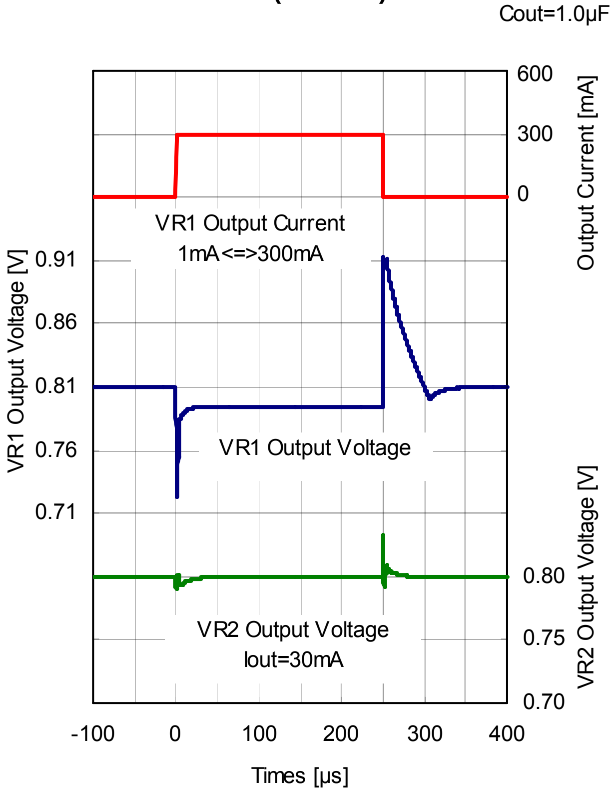

3.6V(VR1/VR2)
Cout=1.0μF
VR1 Output Current
50mA<=>100mA
VR1 Output Voltage
VR2 Output Voltage
Iout=30mA
VR1 Output Voltage [V]
Output Current [mA]
VR2 Output Voltage [V]
Times [μs]


3.6V(VR1/VR2)
Cout=1.0μF
VR2 Output Current
50mA<=>100mA
VR1 Output Voltage
Iout=30mA
VR2 Output Voltage
VR1 Output Voltage [V]
Output Current [mA]
VR2 Output Voltage [V]
Times [μs]

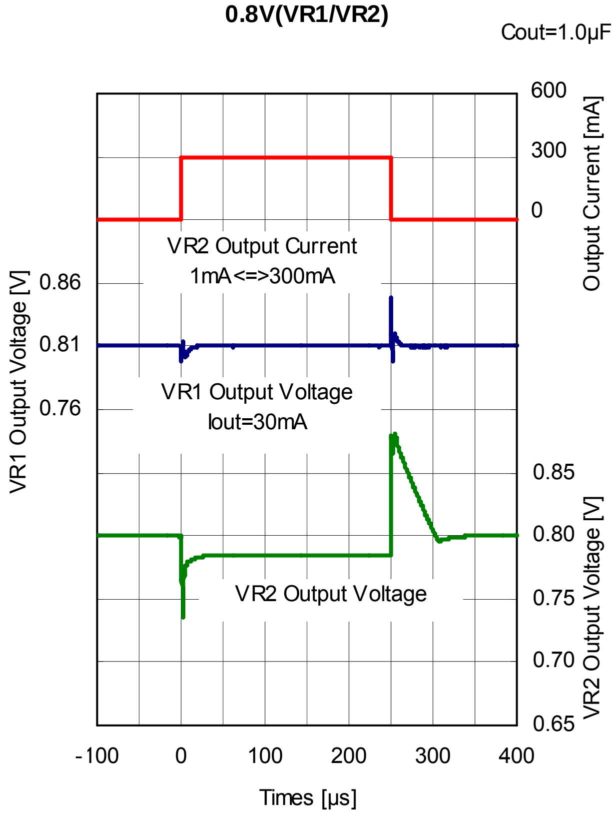

3.6V(VR1/VR2)
Cout=4.7μF
VR1 Output Current
50mA<=>100mA
VR1 Output Voltage
VR2 Output Voltage
Iout=30mA
VR1 Output Voltage [V]
Output Current [mA]
VR2 Output Voltage [V]
Times [μs]


3.6V(VR1/VR2)
Cout=4.7μF
VR2 Output Current
50mA<=>100mA
VR1 Output Voltage
Iout=30mA
VR2 Output Voltage
VR1 Output Voltage [V]
Output Current [mA]
VR2 Output Voltage [V]
Times [μs]

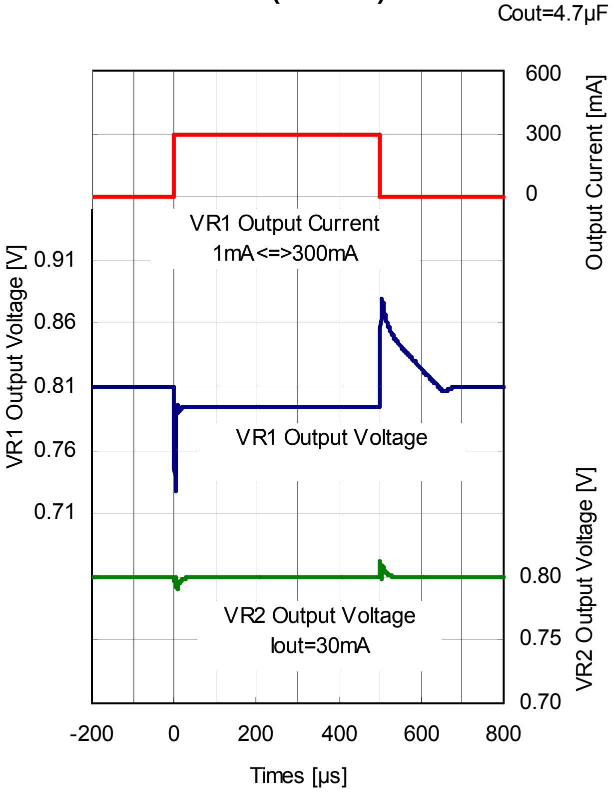
0.8V(VR1/VR2)



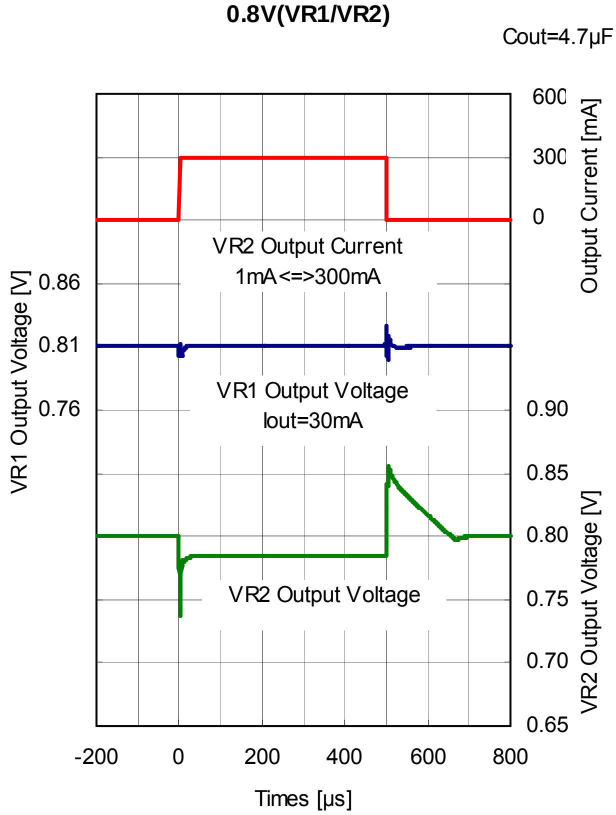
0.8V(VR1/VR2)



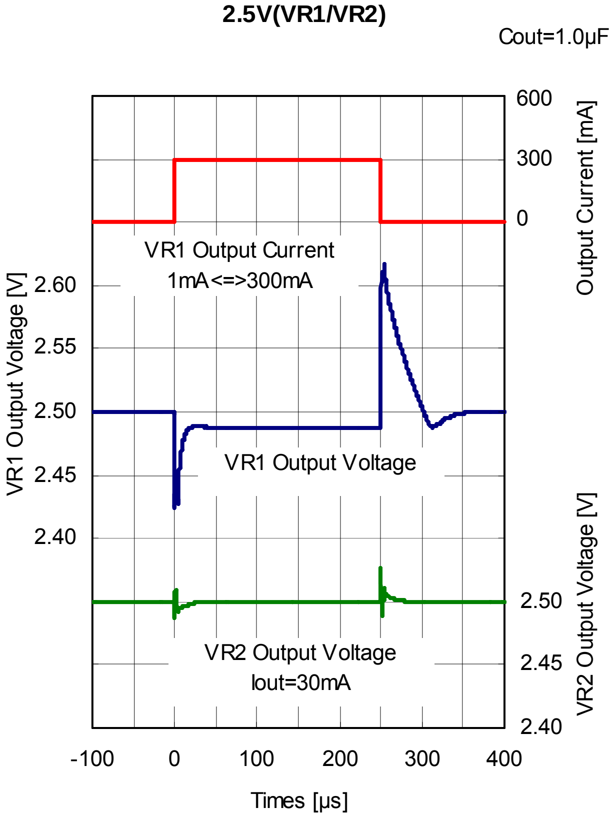
0.8V(VR1/VR2)



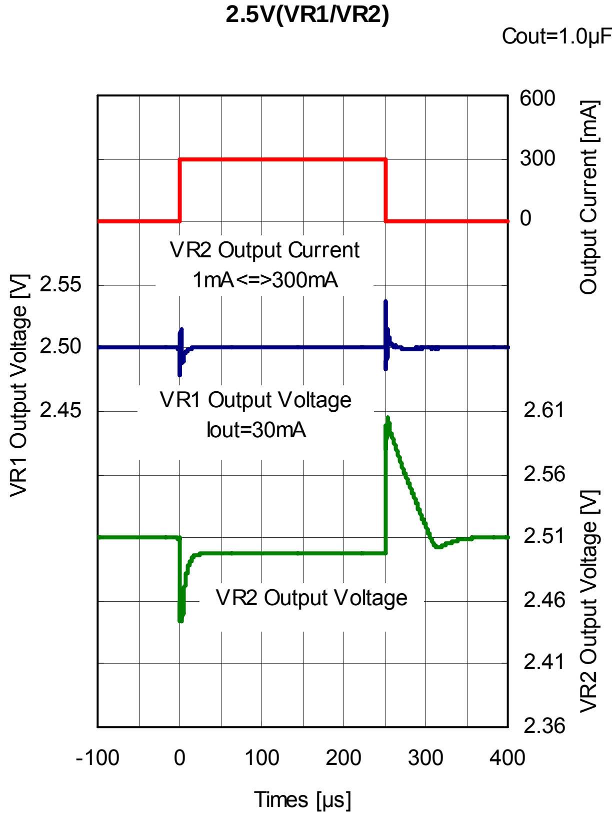
0.8V(VR1/VR2)



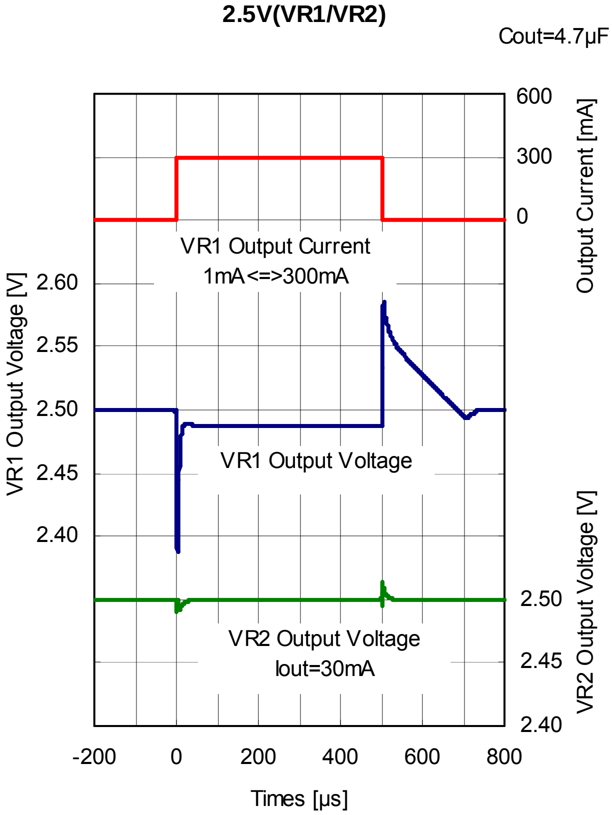
2.5V(VR1/VR2)



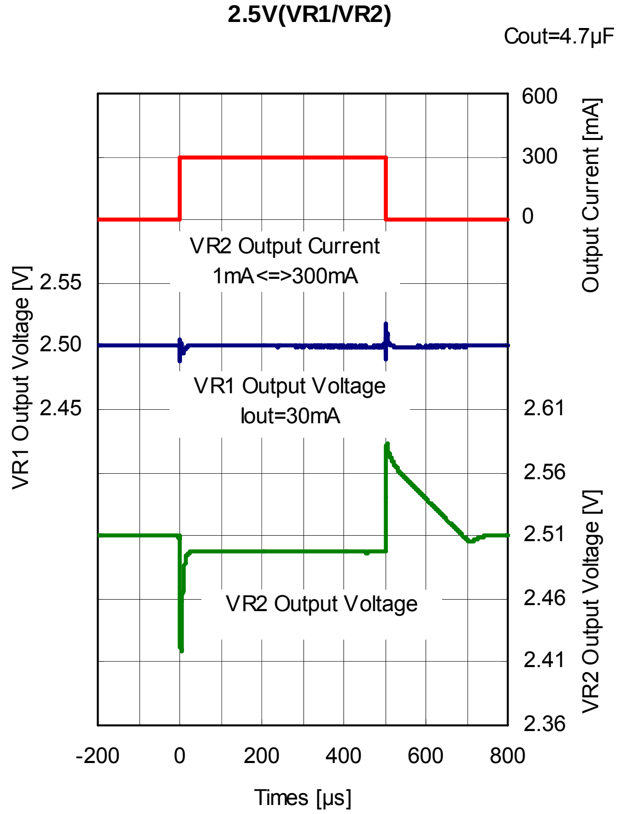
2.5V(VR1/VR2)



2.5V(VR1/VR2)

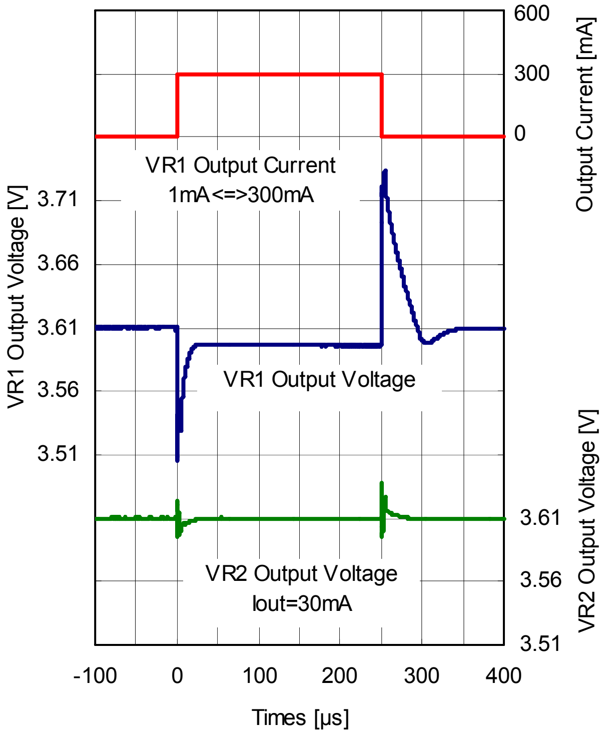


2.5V(VR1/VR2)



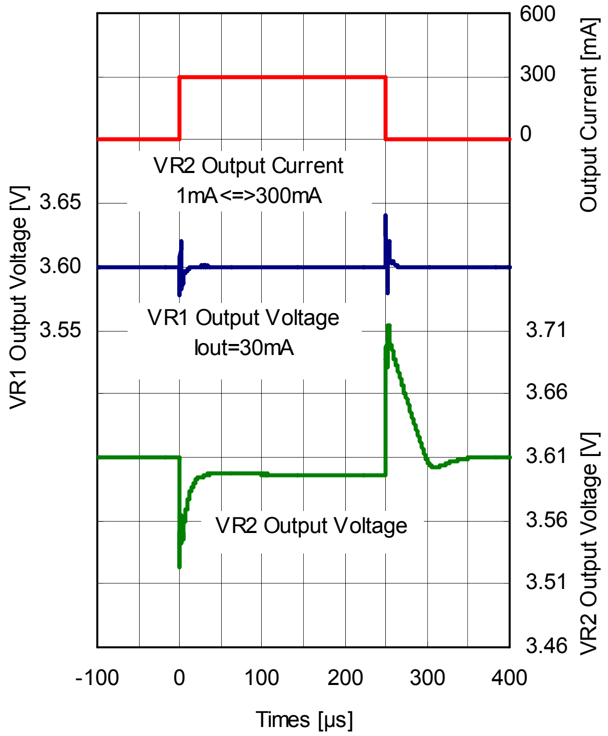
3.6V(VR1/VR2)

Cout=1.0μF



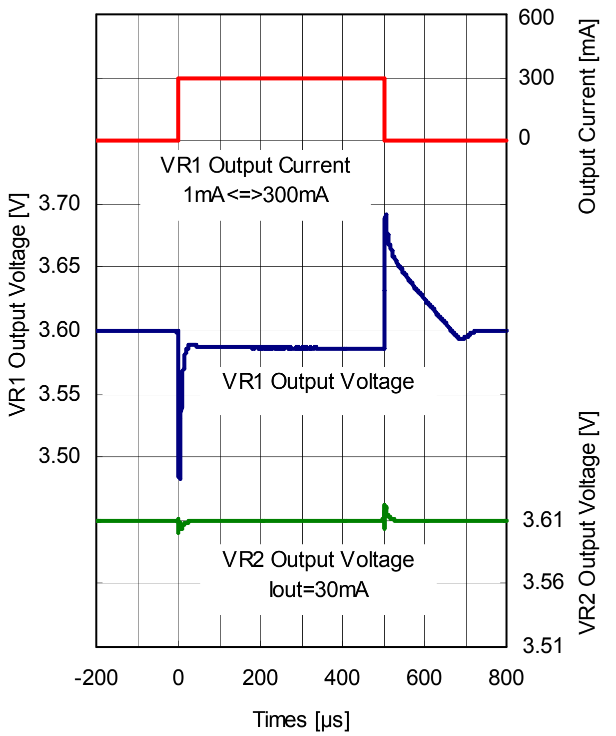
3.6V(VR1/VR2)

Cout=1.0μF



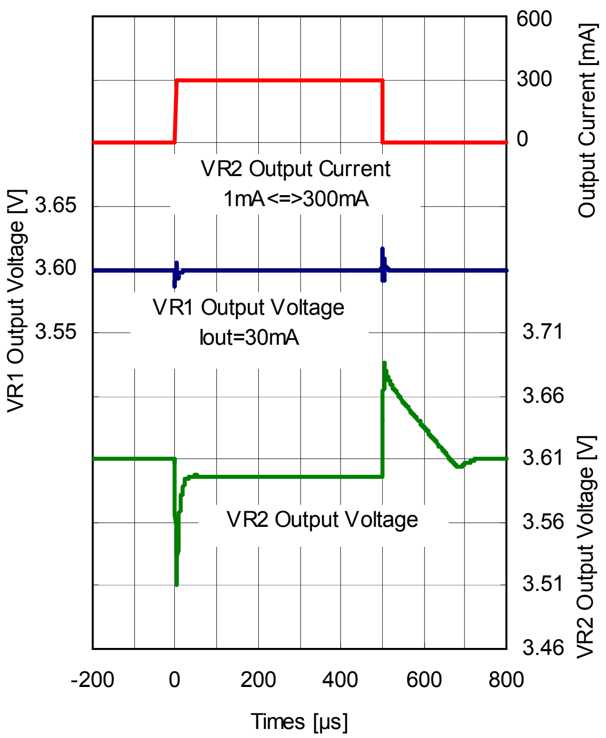
3.6V(VR1/VR2)

Cout=4.7μF



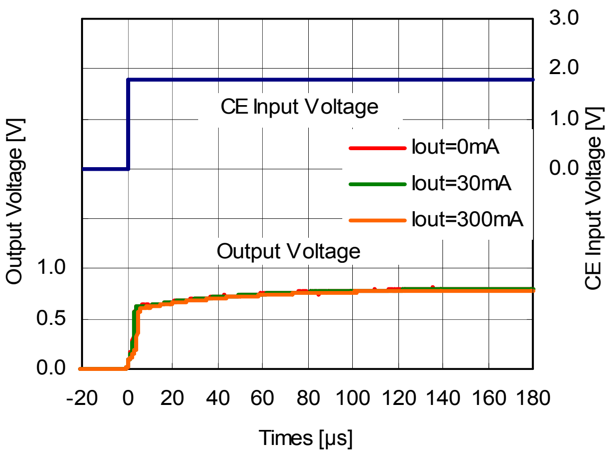
3.6V(VR1/VR2)

Cout=4.7μF

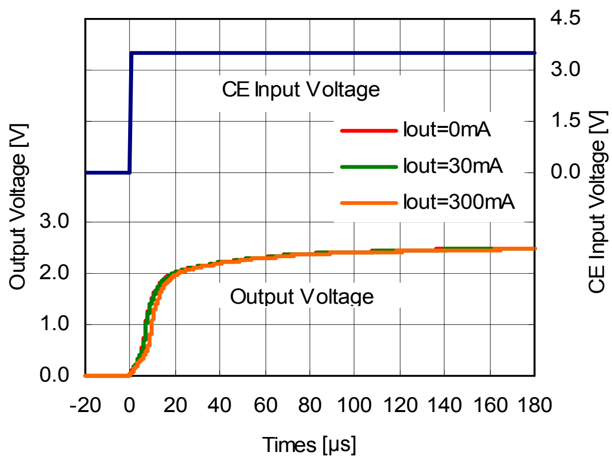


12) Turn On Speed with CE pin (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, Topt=25°C)

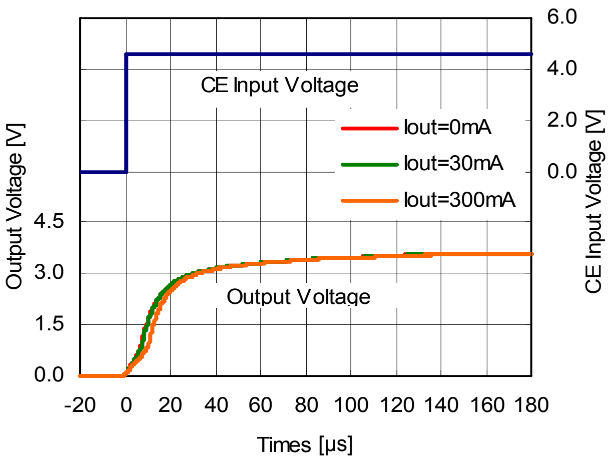
0.8V(VR1/VR2)



2.5V(VR1/VR2)

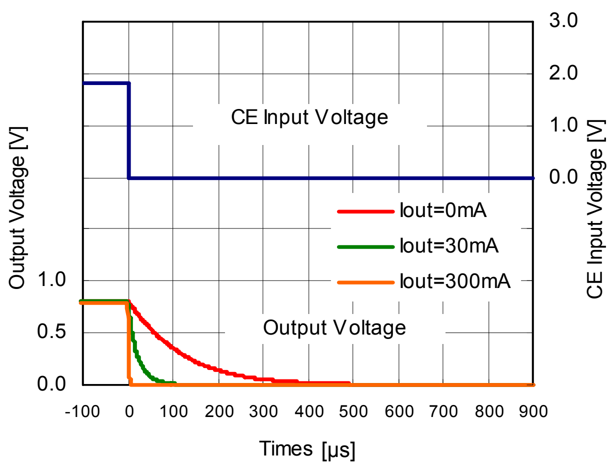


3.6V(VR1/VR2)

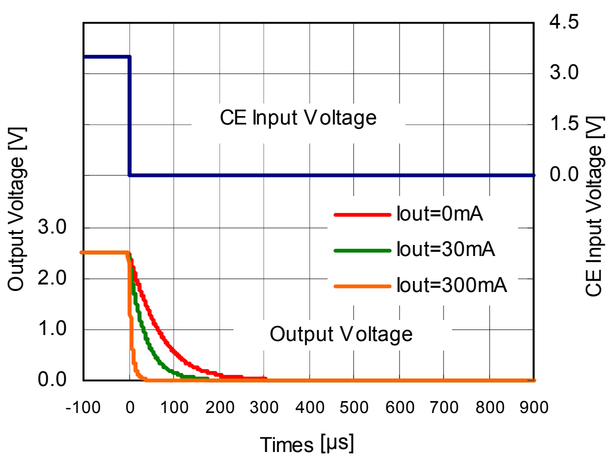


13) Turn Off Speed with CE pin (B version) (C_{IN}=1.0µF, C_{OUT1}=C_{OUT2}=1.0µF, Topt=25°C)

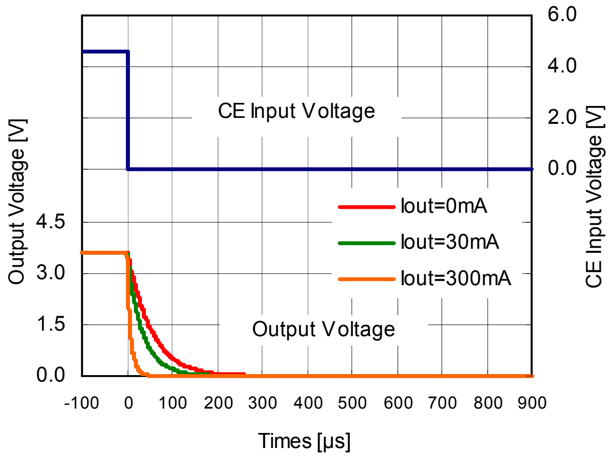
0.8V(VR1/VR2)



2.5V(VR1/VR2)

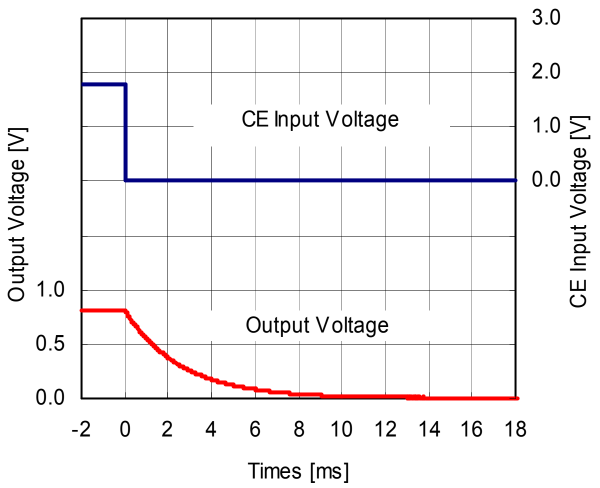


3.6V(VR1/VR2)

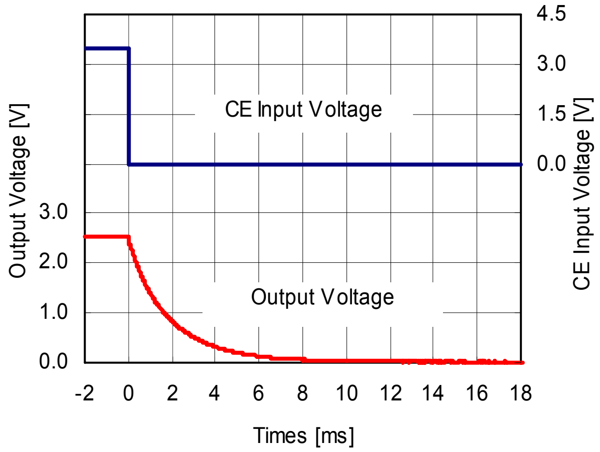


14) Turn Off Speed with CE pin (A version) (C_{IN}=1.0μF, C_{OUT1}=C_{OUT2}=1.0μF, I_{OUT}=0mA, Topt=25°C)

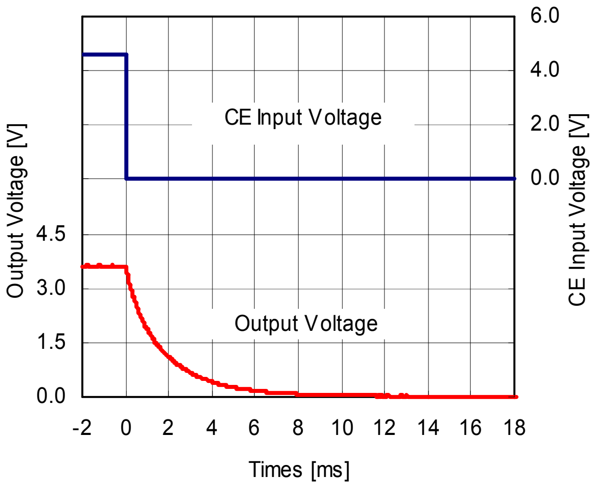
0.8V(VR1/VR2)



2.5V(VR1/VR2)



3.6V(VR1/VR2)



ESR vs. Output Current

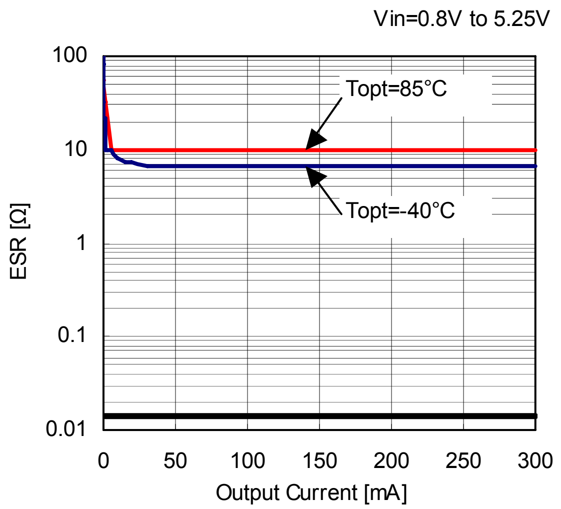
When using these ICs, consider the following points:

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.
The conditions when the white noise level is under 40µV (Avg.) are marked as the hatched area in the graph.

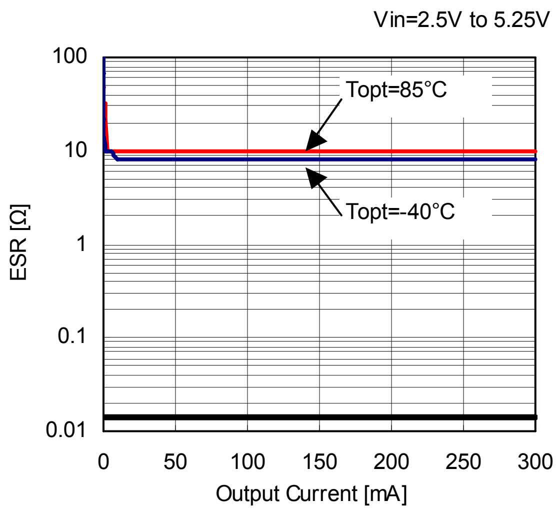
Measurement conditions

Frequency Band: 10Hz to 2MHz
Temperature : –40°C to 85°C
C_{IN}, C_{OUT1}, C_{OUT2} : 1.0µF

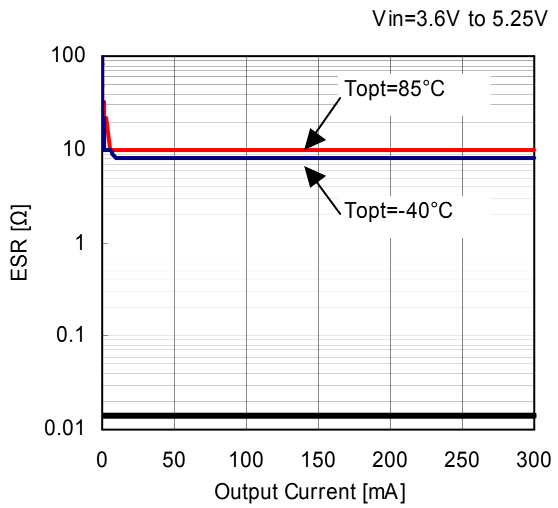
0.8V(VR1/VR2)



2.5V(VR1/VR2)



3.6V(VR1/VR2)



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RICOH COMPANY, LTD. Electronic Devices Company

日本経営品質賞 1999年度受賞

■Ricoh presented with the Japan Management Quality Award for 1999.
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.

■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.

RoHS Compliant

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.

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