SOT23-6W 120mA 2ch LDO REGULATORS

R5322N SERIES

APPLICATION MANUAL

NO. EA-077-0012

R5322N SERIES

OUTLINE

The R5322N Series are voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection by CMOS process. 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 and prolong the battery life of each system. The line transient response and load transient response of the R5322N 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 is SOT-23-6W package, and include 2ch LDO regulators each, high density mounting of the ICs on boards is possible.

FEATURES

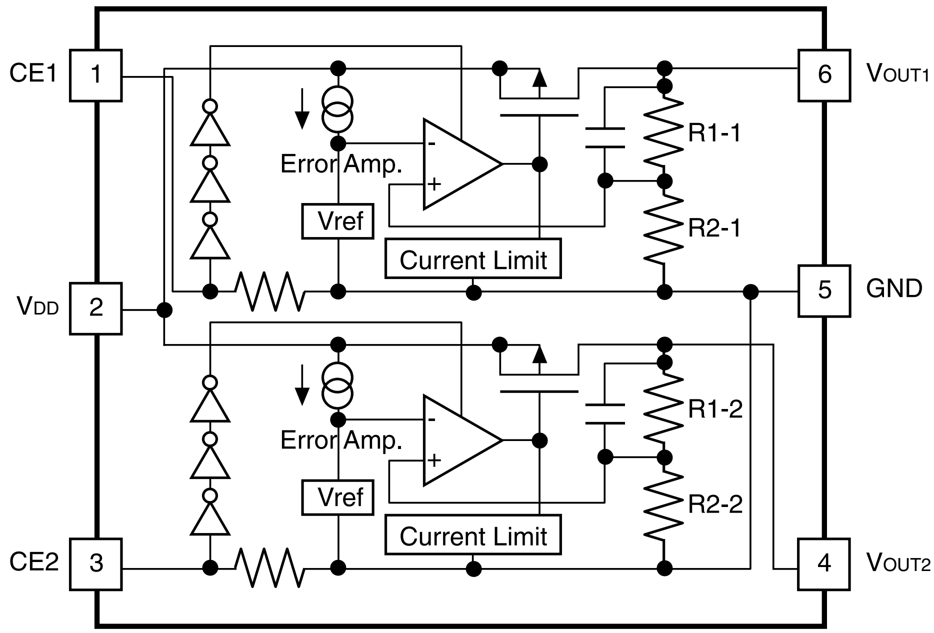
- Ultra-Low Supply Current .... TYP. 75μA (VR1,VR2)
- Standby Mode .... TYP. 0.1μA (VR1,VR2)
- Low Dropout Voltage .... TYP. 0.15V (I_{OUT}=100mA Output Voltage=3.0V Type)
- High Ripple Rejection .... TYP. 75dB (f=1kHz)
- Low Temperature-Drift Coefficient of Output Voltage..... TYP. ±100ppm/°C
- Excellent Line Regulation.. TYP. 0.05%/V
- High Output Voltage Accuracy .... ±2.0%
- Small Package SOT-23-6W
- Output Voltage.. Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible
- Built-in chip enable circuit (A/B: active high)
- Built-in fold-back protection circuit.................................. TYP. 40mA (Current at short mode)

APPLICATIONS

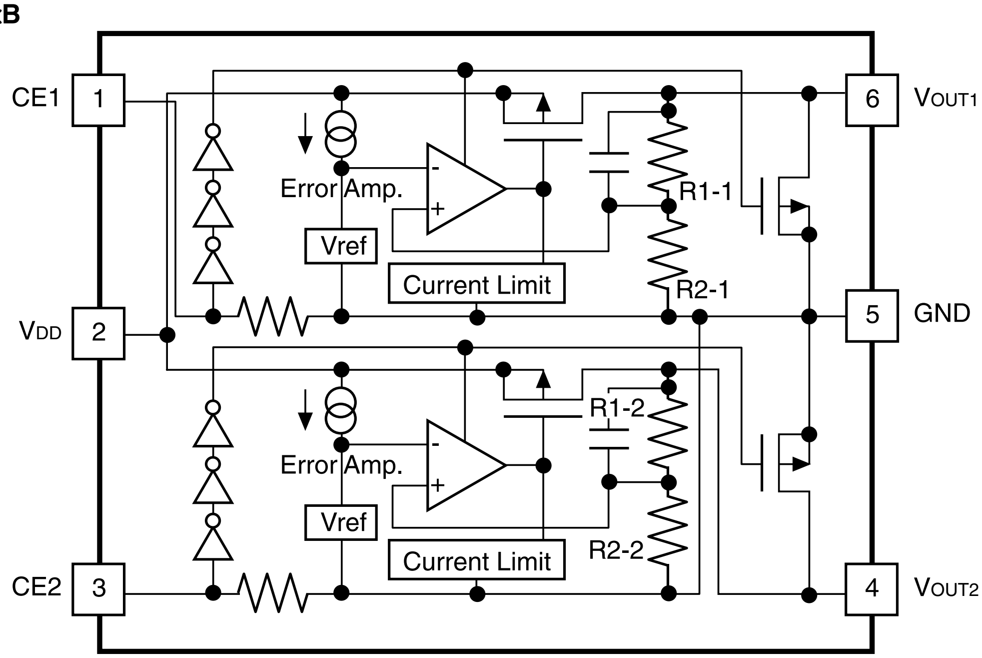
- Power source for cellular phones such as GSM, CDMA and various kinds of PCS.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAM

- **R5322N××××A**



- **R5322N××××B**



SELECTION GUIDE

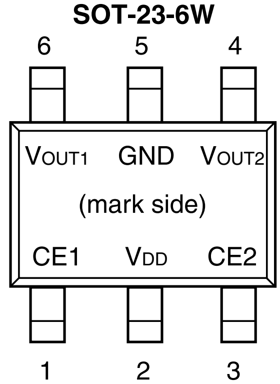
The output voltage, mask option, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R5322Nxxxx-xx ←Part Number
↑ ↑ ↑
a b c

Code	Contents
a	Setting combination of 2ch Output Voltage (V_{OUT}) : Serial Number for Voltage Setting, Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V is possible for each channel.
b	Designation of Mask Option : A version: without auto discharge function at OFF state. B version: with auto discharge function at OFF state.
c	Designation of Taping Type : Ex. TR (refer to Taping Specifications; TR type is the standard direction.)

PIN CONFIGURATION

SOT-23-6W



PIN DESCRIPTION

Pin No.	Symbol	Description
1	CE1	Chip Enable Pin 1
2	V_{DD}	Input Pin
3	CE2	Chip Enable Pin 2
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	6.5	V
V_{CE}	Input Voltage (CE Pin)	-0.3 ~ V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3 ~ V_{IN}+0.3	V
I_{OUT1}	Output Current 1	130	mA
I_{OUT2}	Output Current 2	130	mA
P_D	Power Dissipation	250	mW
Topt	Operating Temperature Range	-40 ~ 85	°C
Tstg	Storage Temperature Range	-55 ~ 125	°C

ELECTRICAL CHARACTERISTICS

- **R5322N×××A/B**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	V_{IN} = Set V_{OUT}+1V 1mA ≤ I_{OUT} ≤ 30mA	V_{OUT} ×0.98		V_{OUT} ×1.02	V
I_{OUT}	Output Current	V_{IN} – V_{OUT} = 1.0V	120			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT}+1V 1mA ≤ I_{OUT} ≤ 120mA		12	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLT-AGE				
I_{SS}	Supply Current	V_{IN} = Set V_{OUT}+1V		75	150	μA
Istandby	Supply Current (Standby)	V_{IN} = V_{CE} = Set V_{OUT}+1V		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 6V I_{OUT} = 30mA (In case that V_{OUT} ≤ 1.6V, 2.2V≤ V_{IN} ≤ 6V)		0.05	0.20	%/V
RR	Ripple Rejection	f = 1kHz, Ripple 0.5Vp-p V_{IN} = Set V_{OUT}+1V, I_{OUT} = 30mA		75		dB
V_{IN}	Input Voltage		2.2		6.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	I_{OUT} = 30mA -40°C ≤ Topt ≤ 85°C		±100		ppm /°C
Ilim	Short Current Limit	V_{OUT} = 0V		40		mA
R_{PD}	CE Pull-down Resistance		1.5	4	16	MΩ
V_{CEH}	CE Input Voltage "H"		1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"		0.0		0.3	V
en	Output Noise	BW=10Hz to 100kHz		30		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of B version)	V_{CE}=0V		70		Ω

- **ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE**

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	TYP.	MAX.
$1.5 \leq V_{OUT} \leq 1.6$	I_{OUT} = 120mA	0.36	0.70
$1.7 \leq V_{OUT} \leq 1.8$		0.30	0.50
$1.9 \leq V_{OUT} \leq 2.0$		0.28	0.45
$2.1 \leq V_{OUT} \leq 2.7$		0.24	0.40
$2.8 \leq V_{OUT} \leq 4.0$		0.18	0.30

TEST CIRCUITS

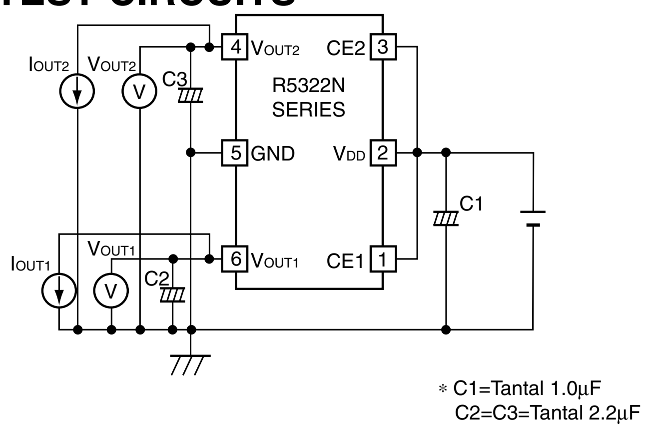


Fig.1 Standard test Circuit

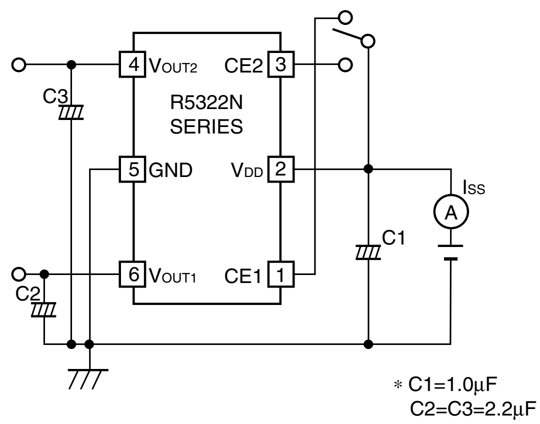


Fig.2 Supply Current Test Circuit

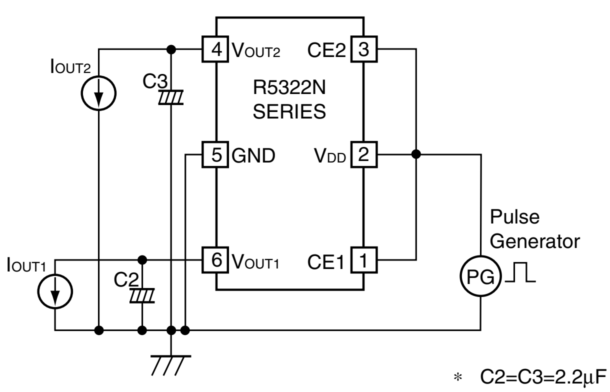


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

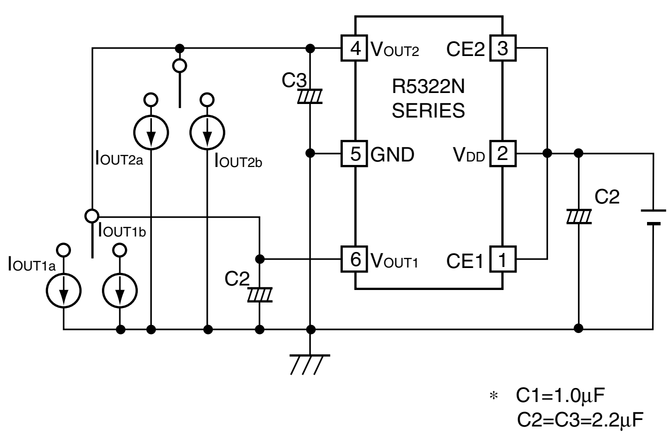
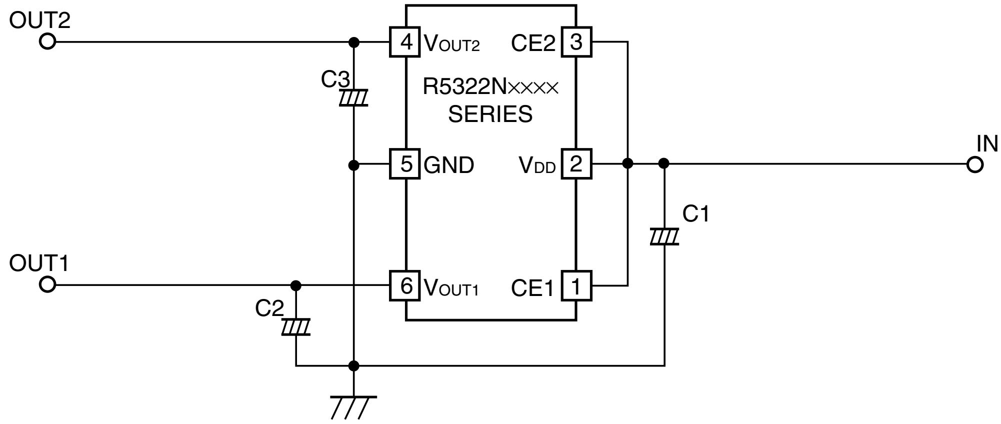


Fig.4 Load Transient Response Test Circuit

RICOH

TYPICAL APPLICATION

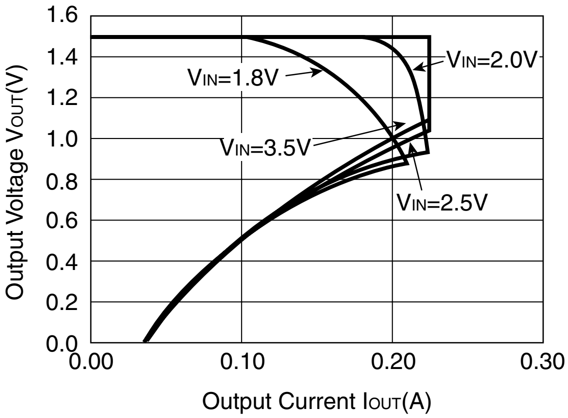


(External Components) Output Capacitor; Tantalum Type

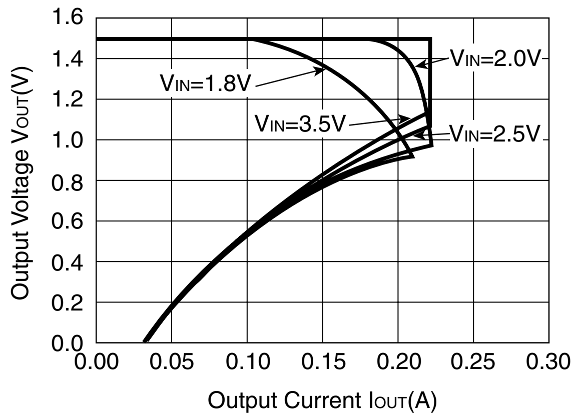
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

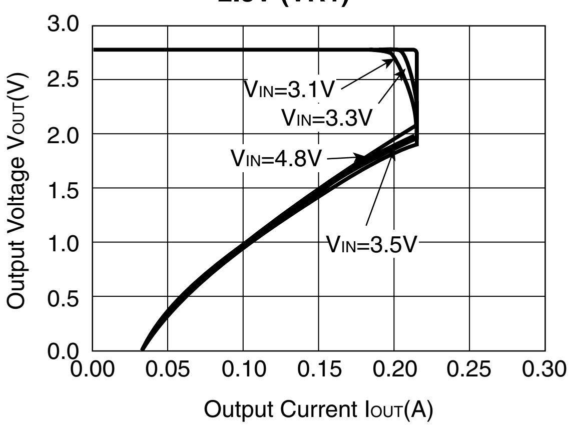
1.5V (VR1)



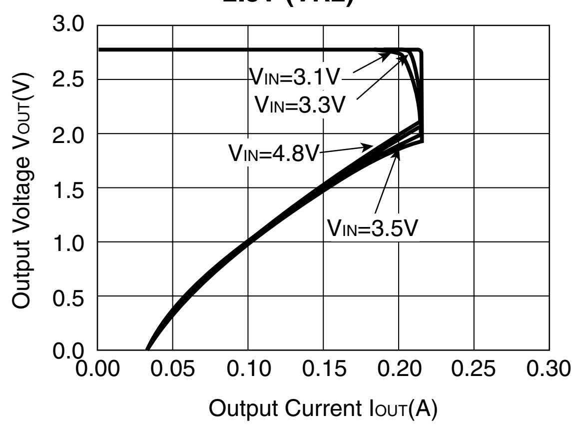
1.5V (VR2)



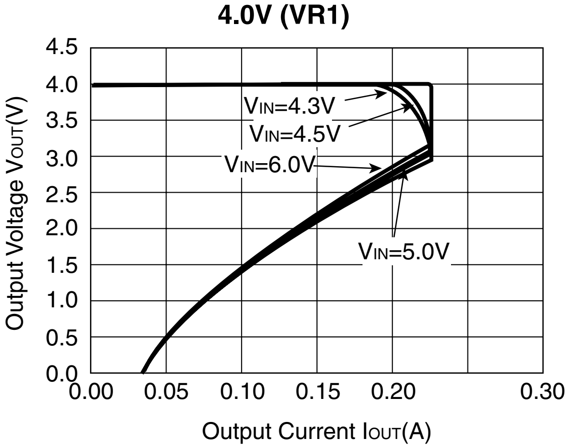
2.8V (VR1)



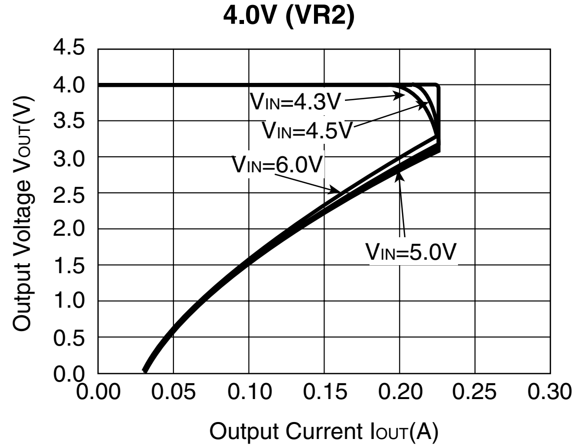
2.8V (VR2)



4.0V (VR1)

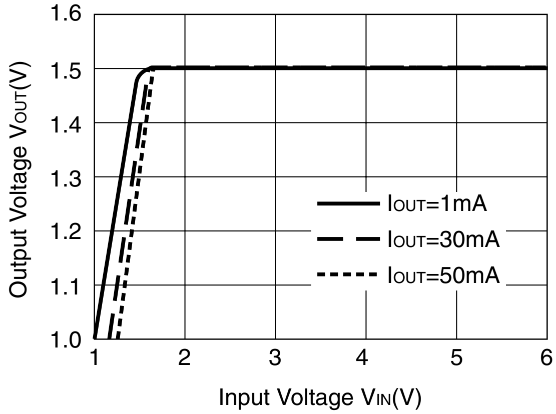


4.0V (VR2)

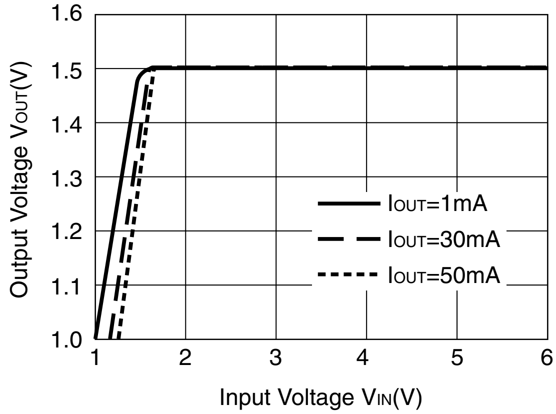


2) Output Voltage vs. Input Voltage

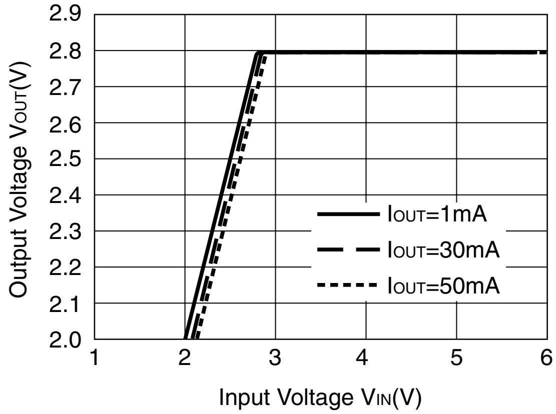
1.5V (VR1)



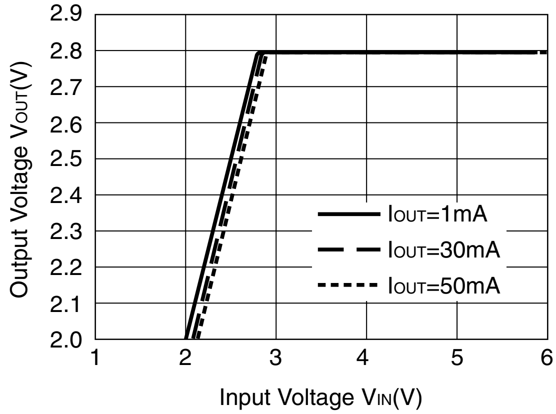
1.5V (VR2)



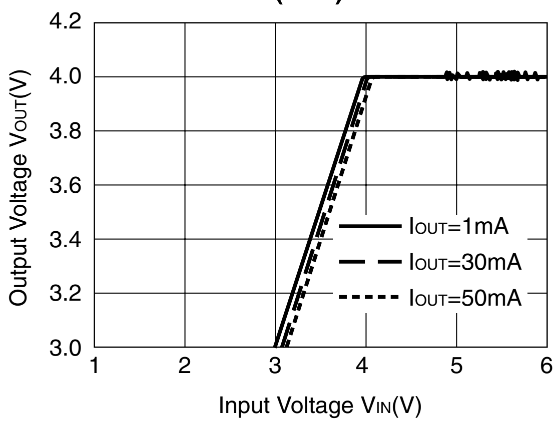
2.8V (VR1)



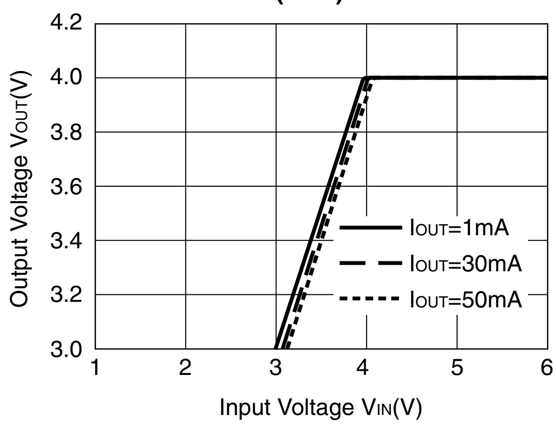
2.8V (VR2)



4.0V (VR1)

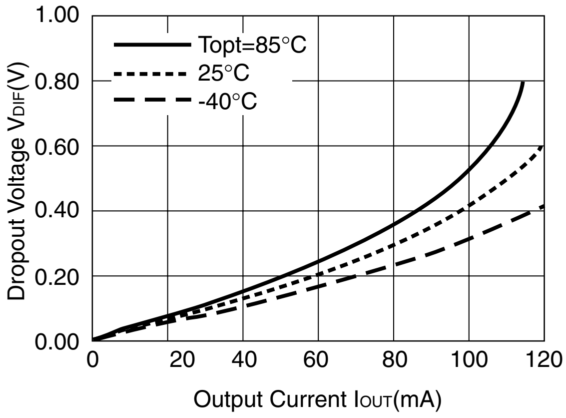


4.0V (VR2)

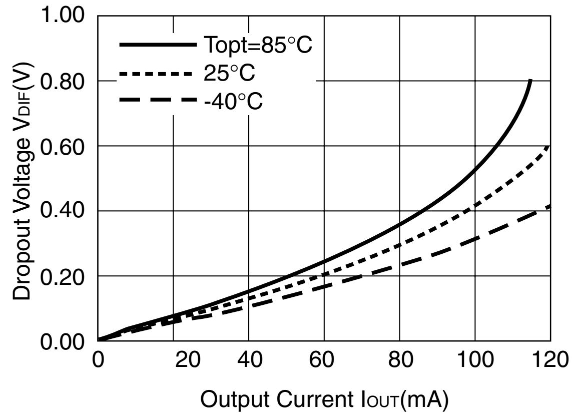


3) Dropout Voltage vs. Temperature

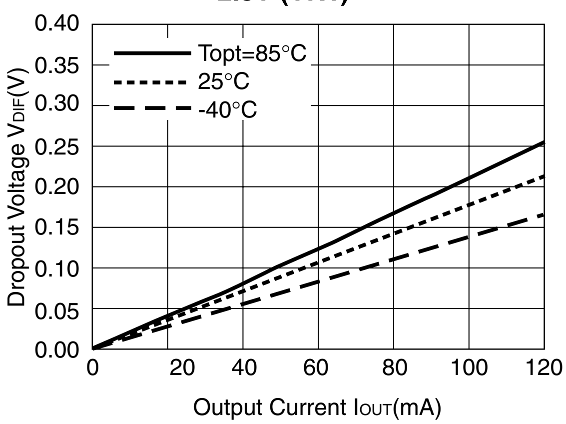
1.5V (VR1)



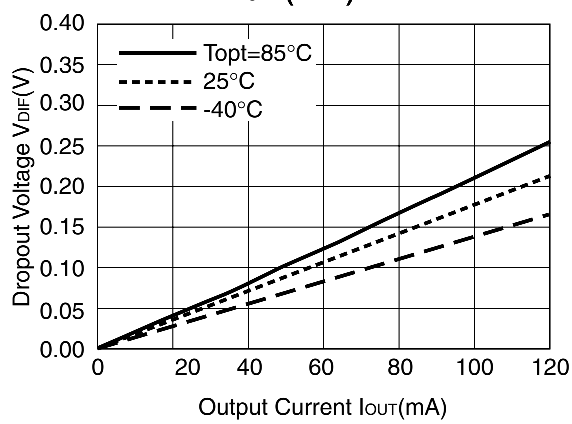
1.5V (VR2)



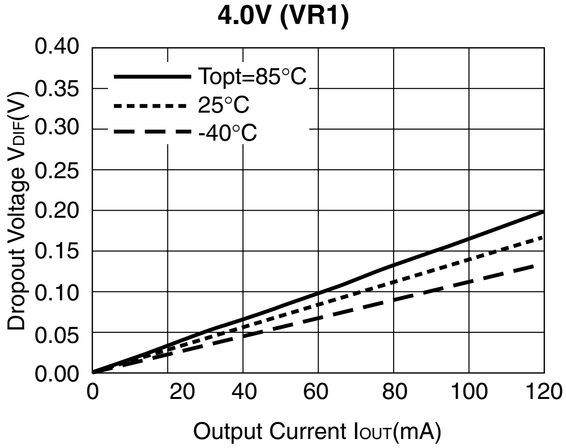
2.8V (VR1)



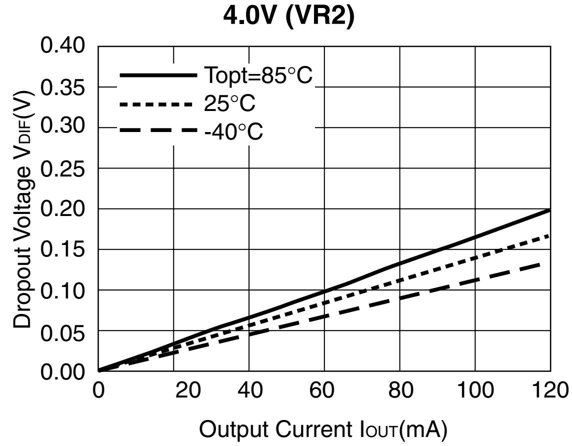
2.8V (VR2)



4.0V (VR1)

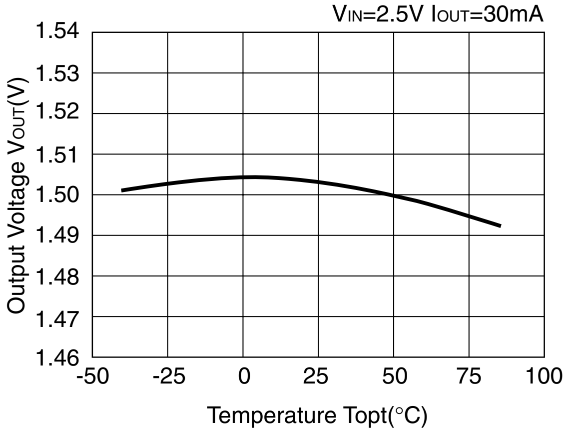


4.0V (VR2)

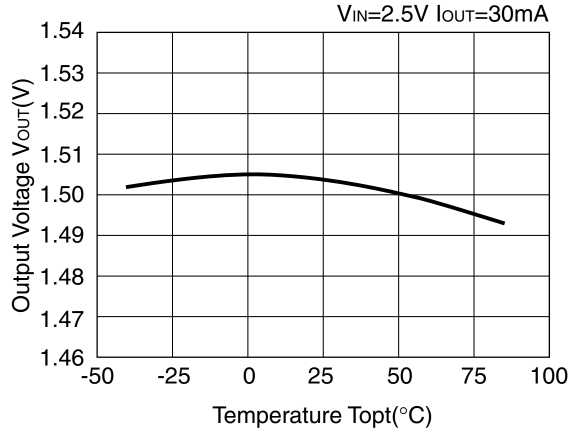


4) Output Voltage vs. Temperature

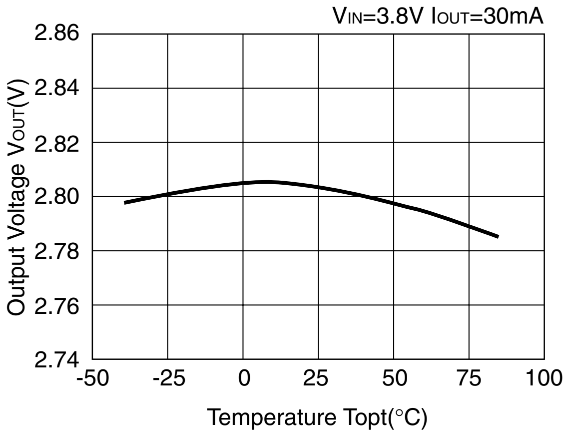
1.5V (VR1)



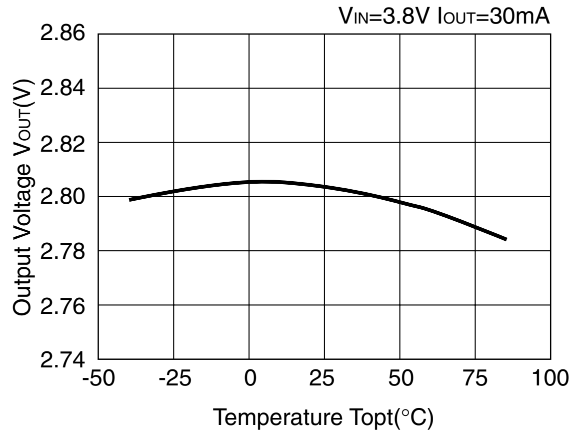
1.5V (VR2)



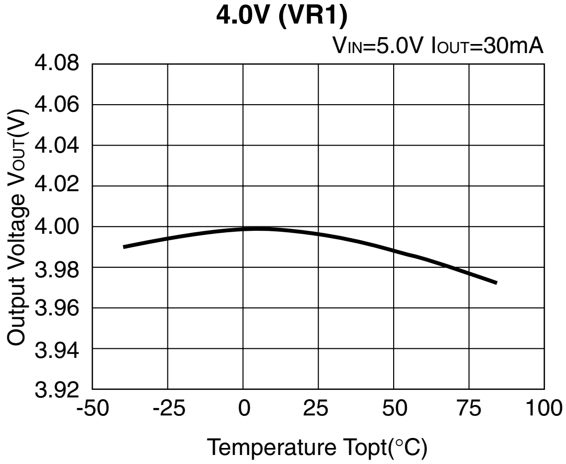
2.8V (VR1)



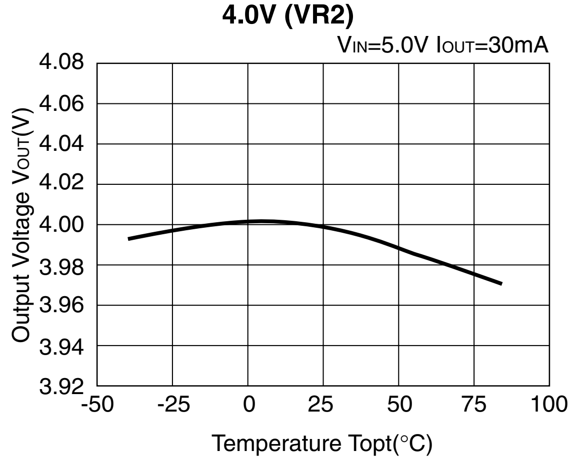
2.8V (VR2)



4.0V (VR1)

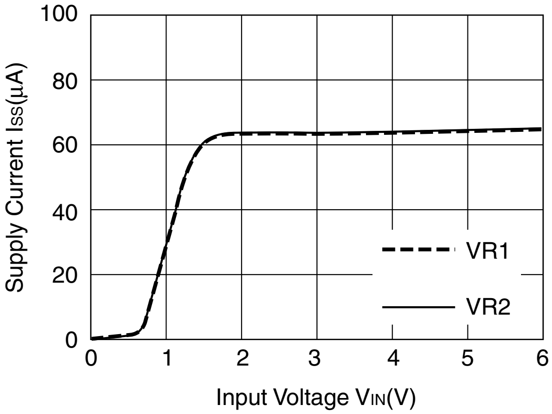


4.0V (VR2)

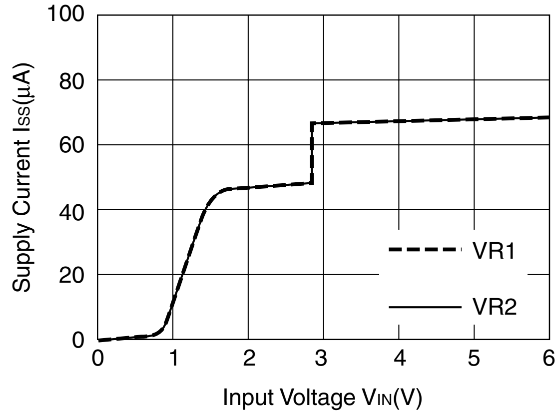


5) Supply Current vs. Input Voltage

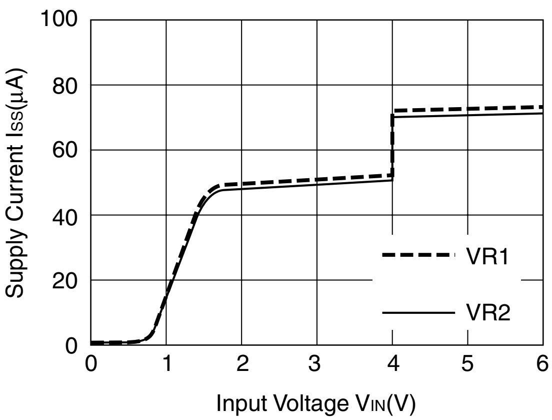
1.5V



2.8V

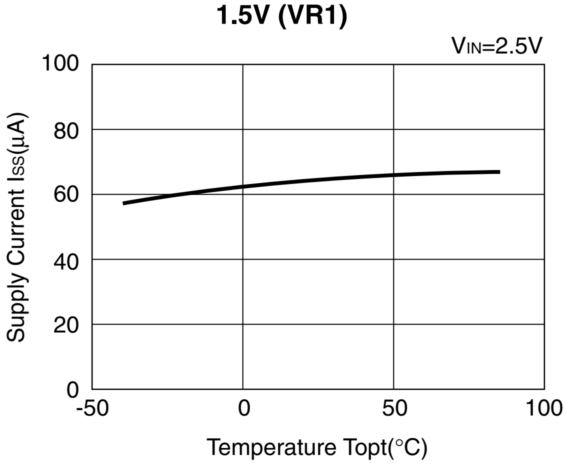


4.0V

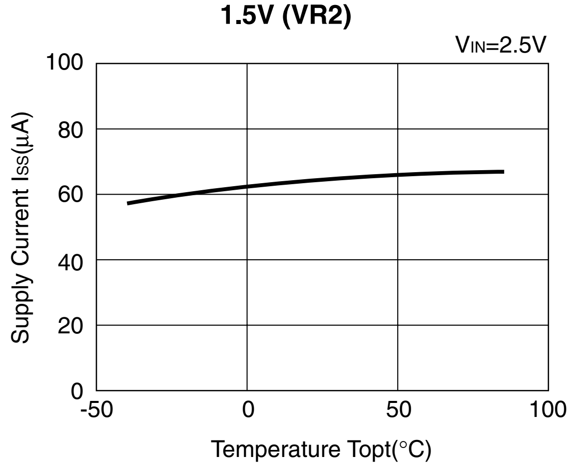


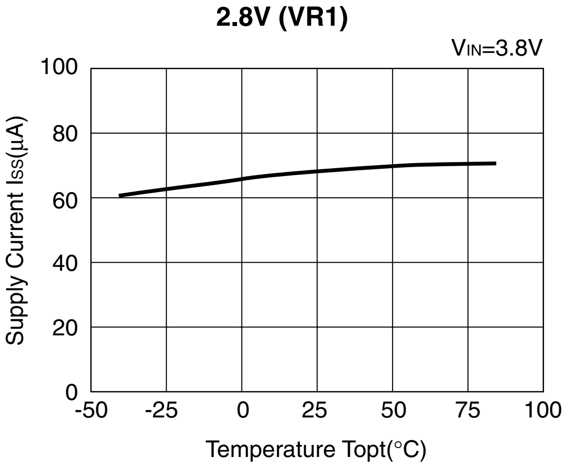
6) Supply Current vs. Temperature

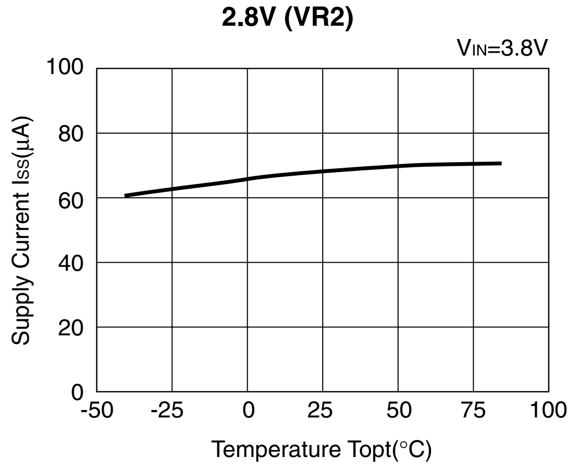
1.5V (VR1)

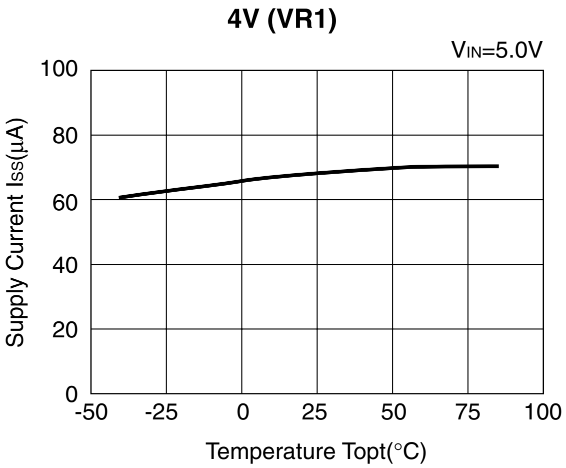


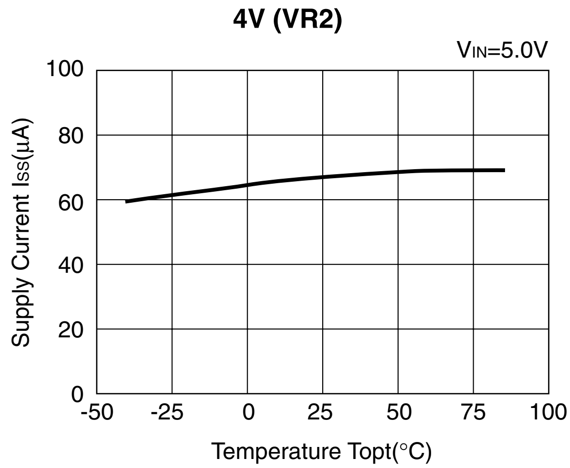
1.5V (VR2)



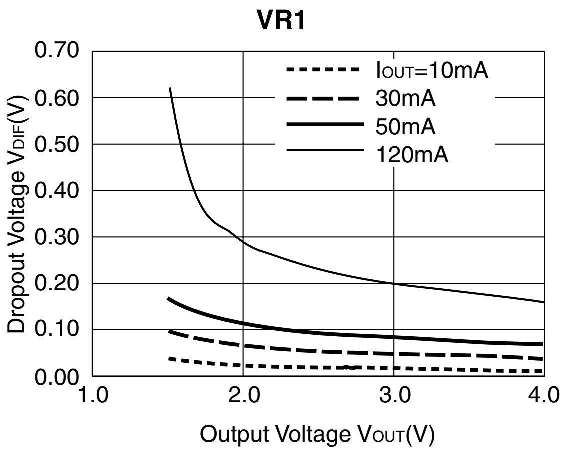


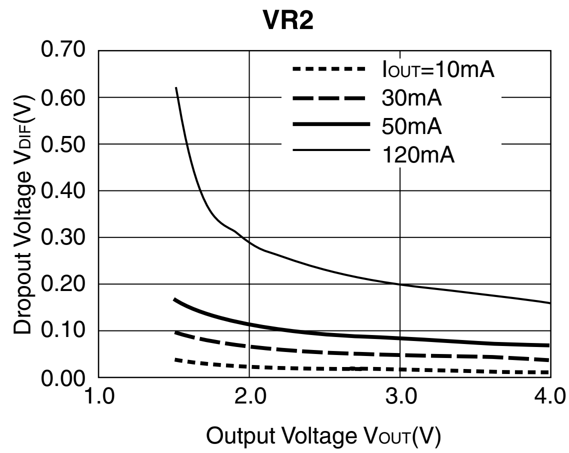






7) Dropout Voltage vs. Set Output Voltage

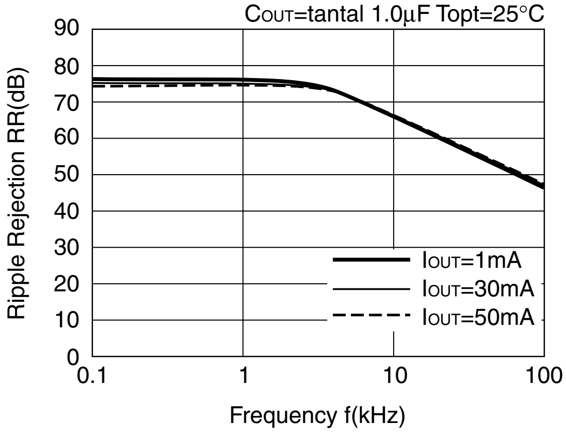




8) Ripple Rejection vs. Frequency

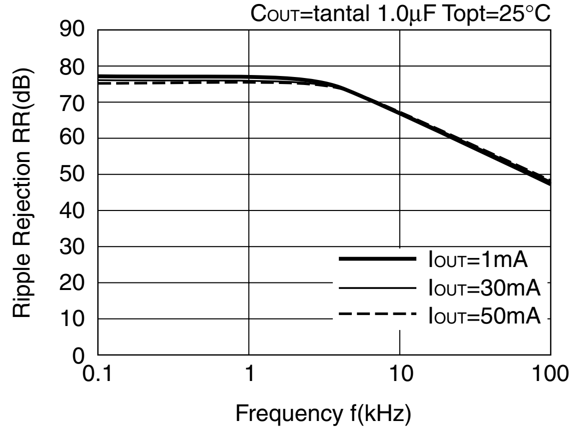
1.5V (VR1)

V_{IN}=2.5V+0.5Vp-p
C_{OUT}=tantal 1.0µF Topt=25°C



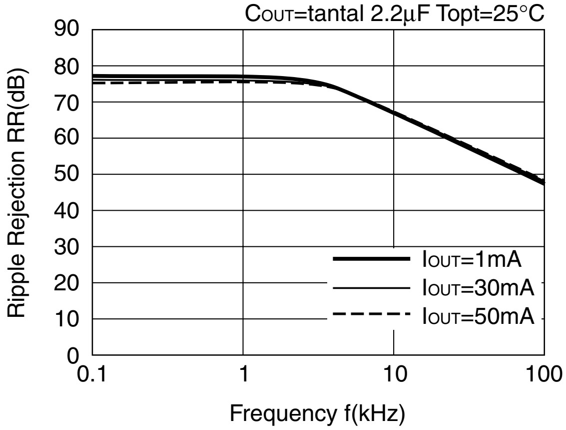
1.5V (VR2)

V_{IN}=2.5V+0.5Vp-p
C_{OUT}=tantal 1.0µF Topt=25°C



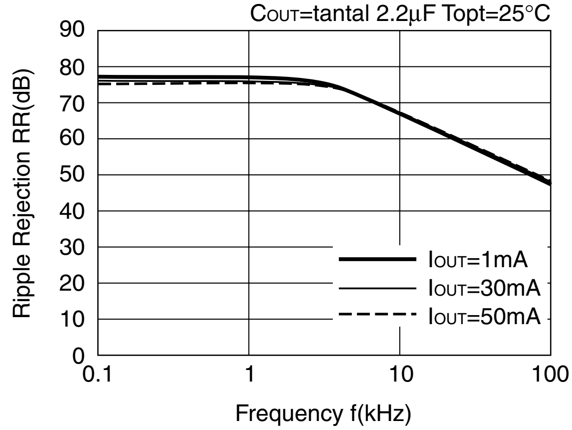
1.5V (VR1)

V_{IN}=2.5V+0.5Vp-p
C_{OUT}=tantal 2.2µF Topt=25°C



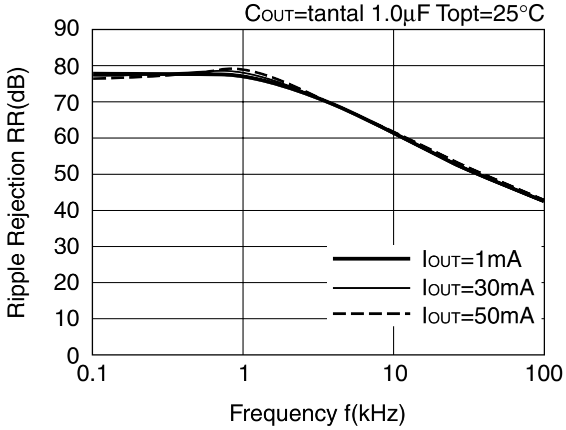
1.5V (VR2)

V_{IN}=2.5V+0.5Vp-p
C_{OUT}=tantal 2.2µF Topt=25°C



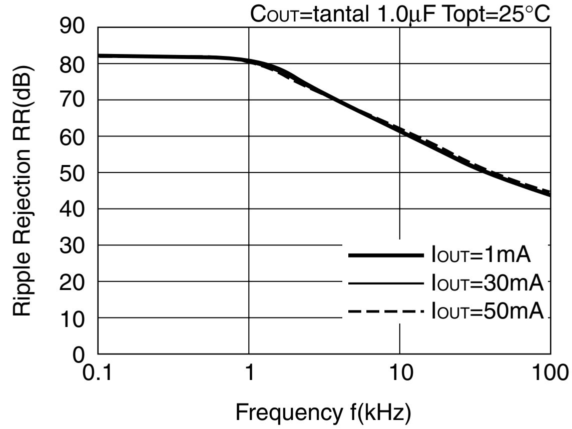
2.8V (VR1)

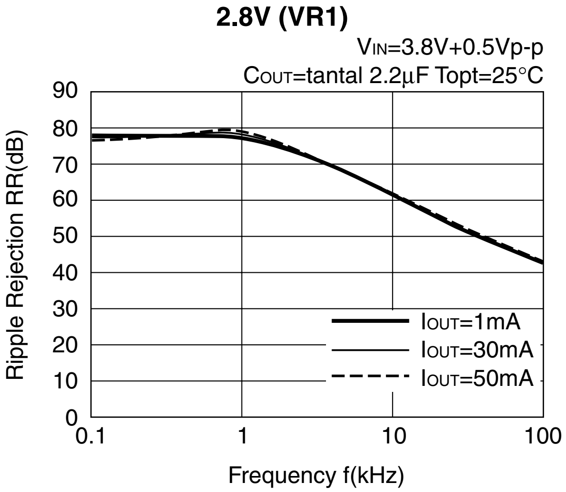
V_{IN}=3.8V+0.5Vp-p
C_{OUT}=tantal 1.0µF Topt=25°C

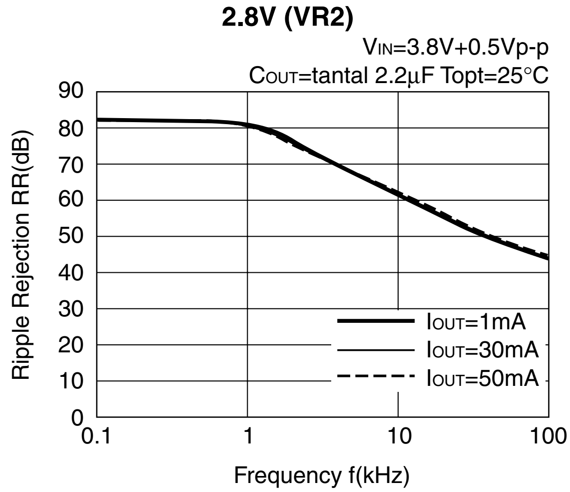


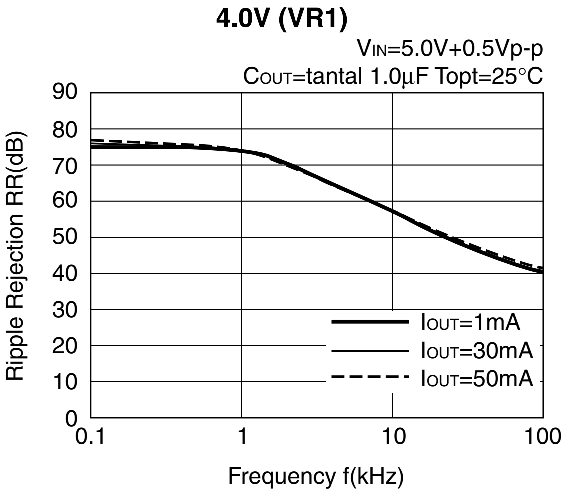
2.8V (VR2)

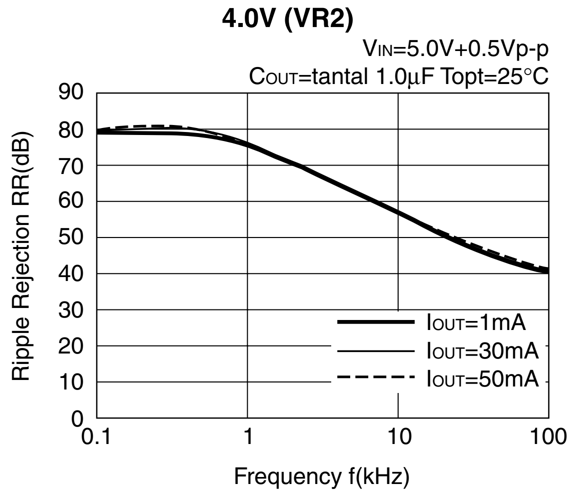
V_{IN}=3.8V+0.5Vp-p
C_{OUT}=tantal 1.0µF Topt=25°C

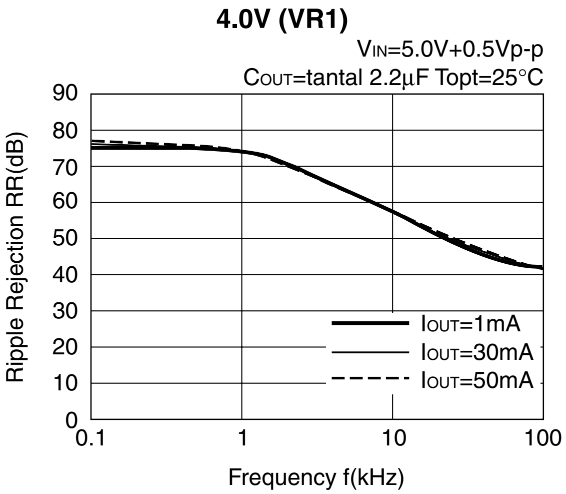


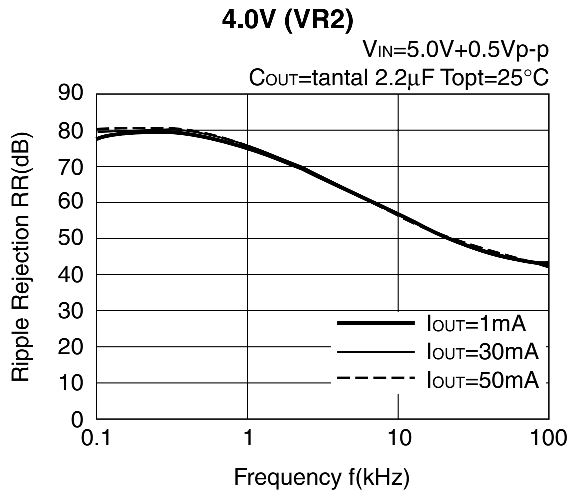

2.8V (VR1)
VIN=3.8V+0.5Vp-p
COUT=tantal 2.2µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA


2.8V (VR2)
VIN=3.8V+0.5Vp-p
COUT=tantal 2.2µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA


4.0V (VR1)
VIN=5.0V+0.5Vp-p
COUT=tantal 1.0µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA


4.0V (VR2)
VIN=5.0V+0.5Vp-p
COUT=tantal 1.0µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA

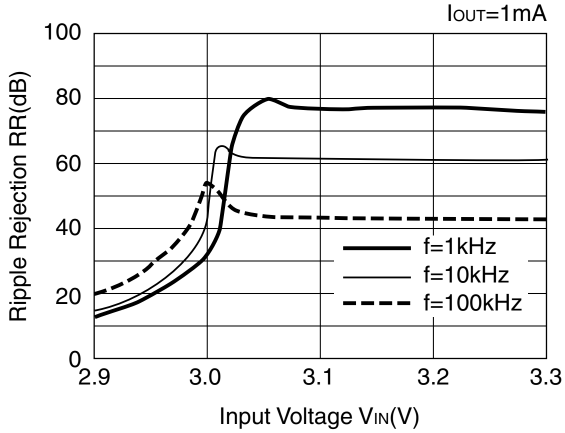

4.0V (VR1)
VIN=5.0V+0.5Vp-p
COUT=tantal 2.2µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA


4.0V (VR2)
VIN=5.0V+0.5Vp-p
COUT=tantal 2.2µF Topt=25°C
Ripple Rejection RR(dB)
Frequency f(kHz)
IOUT=1mA
IOUT=30mA
IOUT=50mA

9) Ripple Rejection vs. Input Voltage (DC bias)

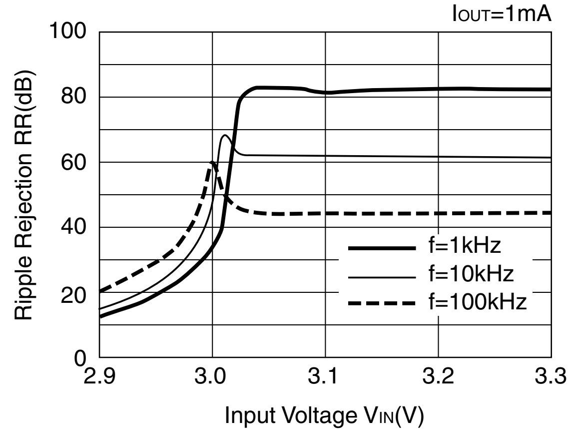
2.8V (VR1)

COUT=tantal 2.2µF
IOUT=1mA



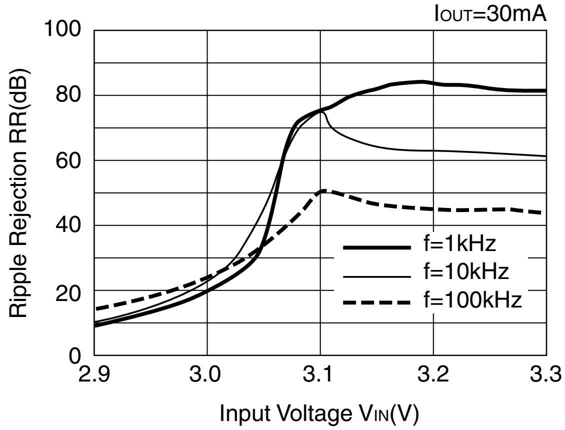
2.8V (VR2)

COUT=tantal 2.2µF
IOUT=1mA



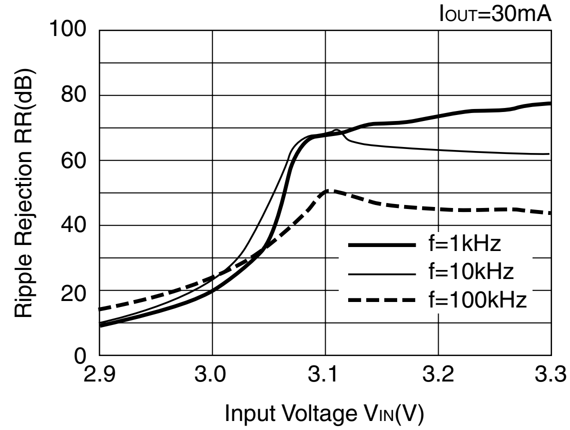
2.8V (VR1)

COUT=tantal 2.2µF
IOUT=30mA



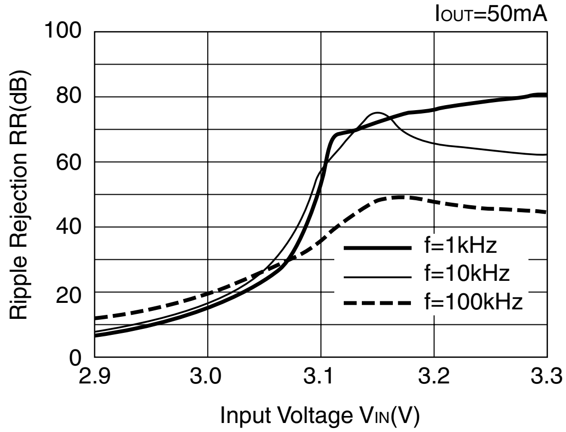
2.8V (VR2)

COUT=tantal 2.2µF
IOUT=30mA



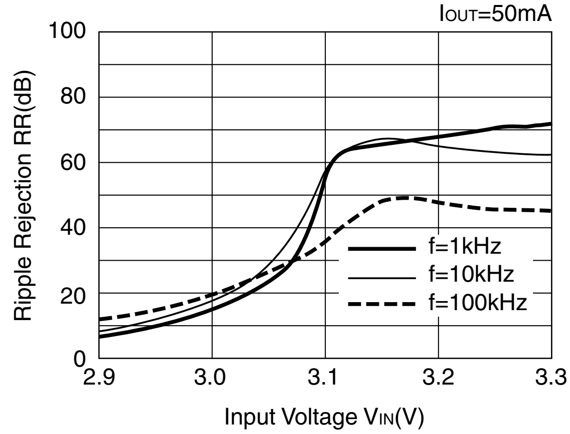
2.8V (VR1)

COUT=tantal 2.2µF
IOUT=50mA



2.8V (VR2)

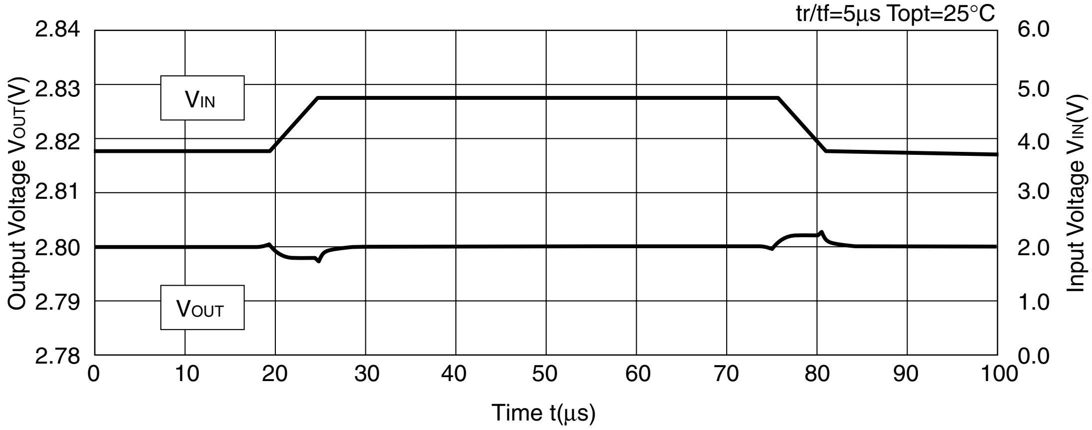
COUT=tantal 2.2µF
IOUT=50mA



10) Input Transient Response

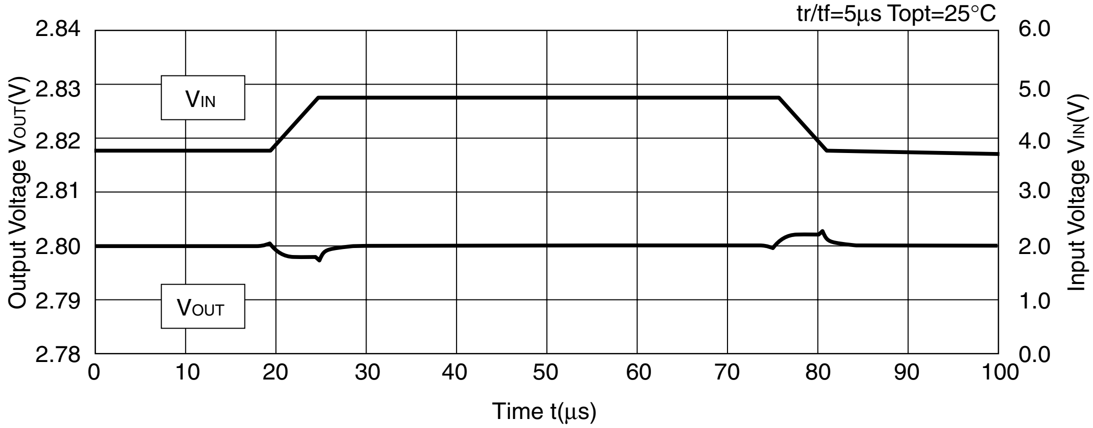
R5322N001× (2.8V, VR1)

I_{OUT}=30mA C_{OUT}=tantal 1.0µF
tr/tf=5µs Topt=25°C



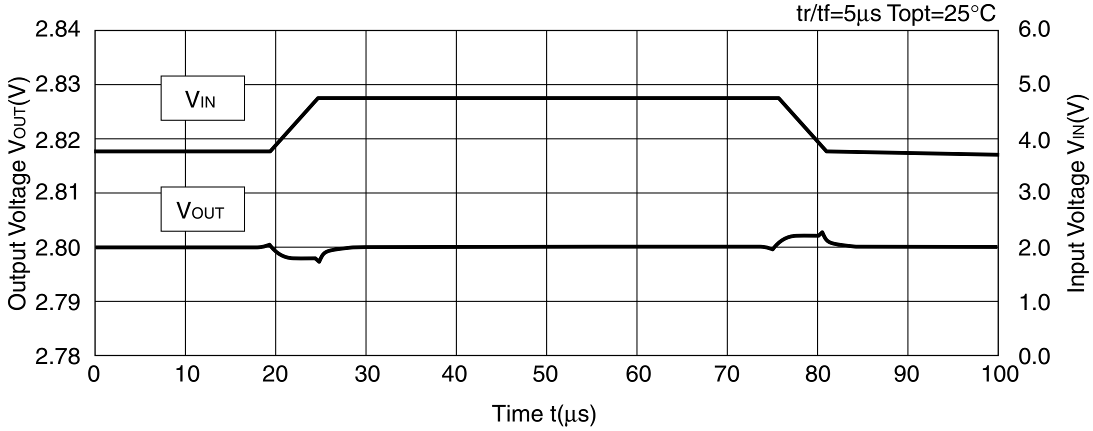
R5322N001× (2.8V, VR1)

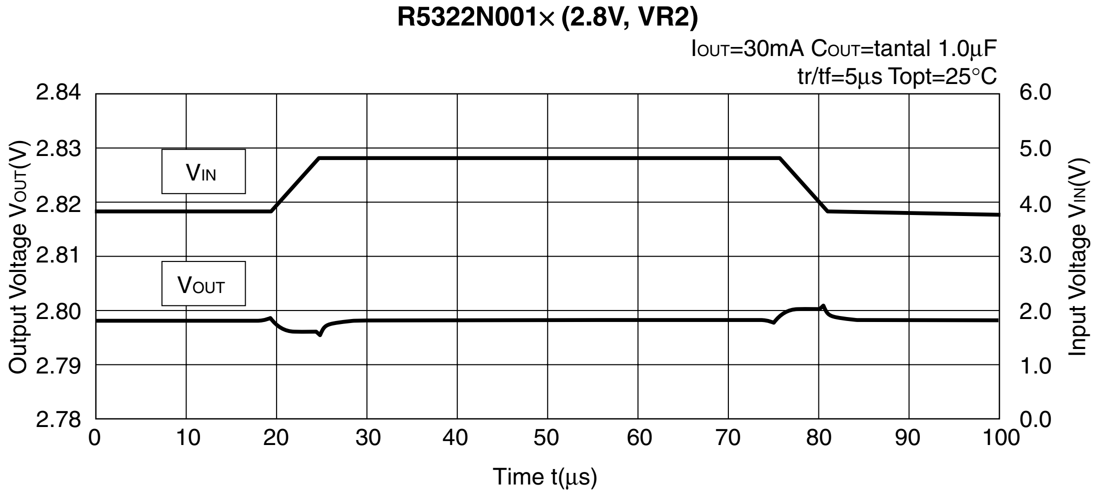
I_{OUT}=30mA C_{OUT}=tantal 2.2µF
tr/tf=5µs Topt=25°C

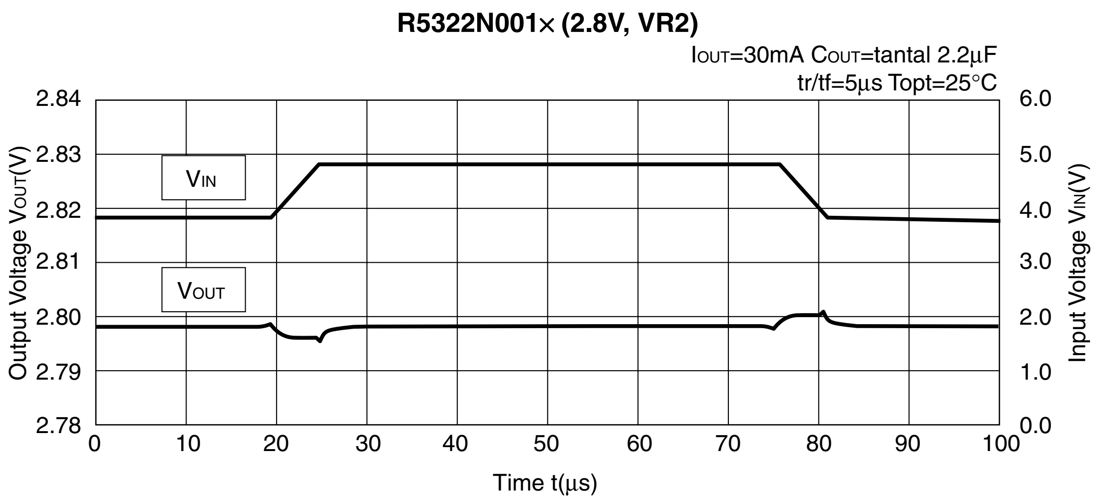


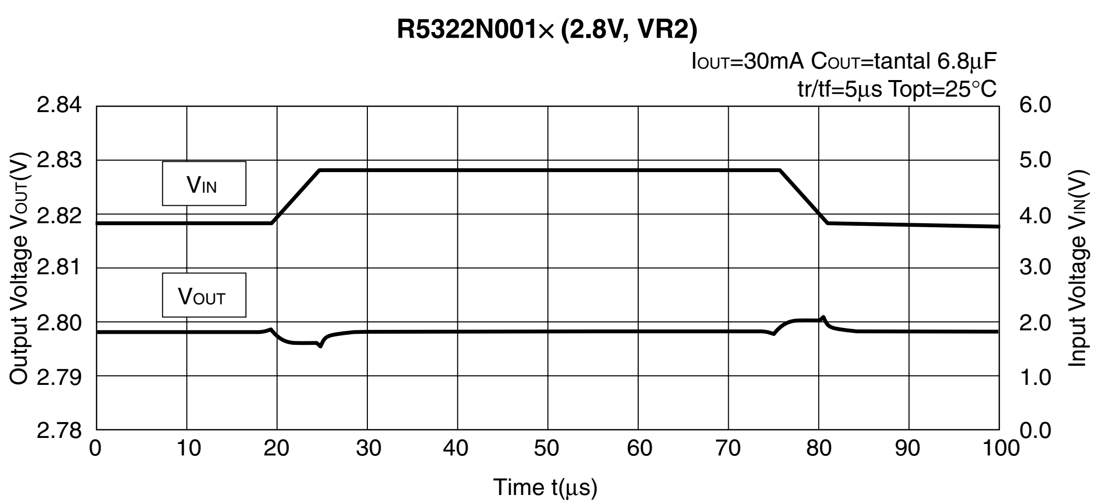
R5322N001× (2.8V, VR1)

I_{OUT}=30mA C_{OUT}=tantal 6.8µF
tr/tf=5µs Topt=25°C




R5322N001× (2.8V, VR2)
IOUT=30mA COUT=tantal 1.0µF
tr/tf=5µs Topt=25°C
VIN
VOUT
Output Voltage VOUT(V)
Input Voltage VIN(V)
Time t(µs)
2.84
2.83
2.82
2.81
2.80
2.79
2.78
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
100

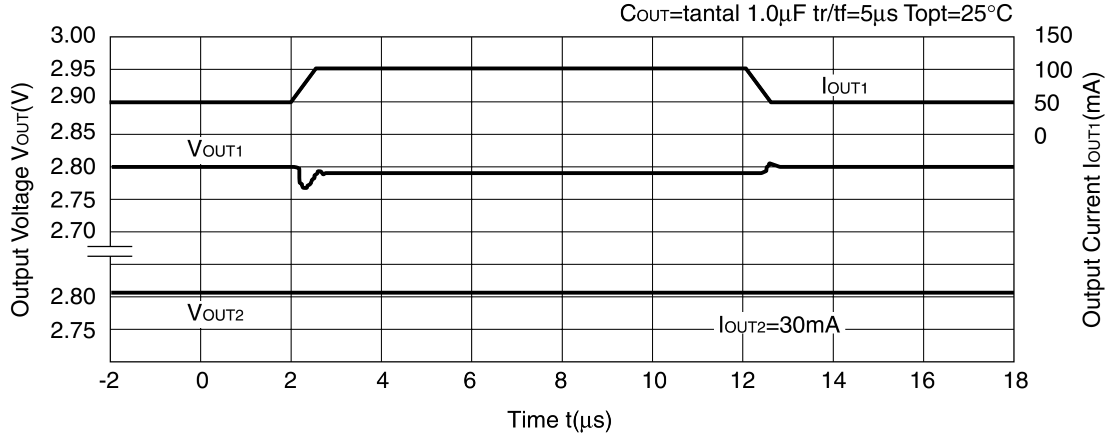

R5322N001× (2.8V, VR2)
IOUT=30mA COUT=tantal 2.2µF
tr/tf=5µs Topt=25°C
VIN
VOUT
Output Voltage VOUT(V)
Input Voltage VIN(V)
Time t(µs)
2.84
2.83
2.82
2.81
2.80
2.79
2.78
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
100


R5322N001× (2.8V, VR2)
IOUT=30mA COUT=tantal 6.8µF
tr/tf=5µs Topt=25°C
VIN
VOUT
Output Voltage VOUT(V)
Input Voltage VIN(V)
Time t(µs)
2.84
2.83
2.82
2.81
2.80
2.79
2.78
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
100

11) Load Transient Response

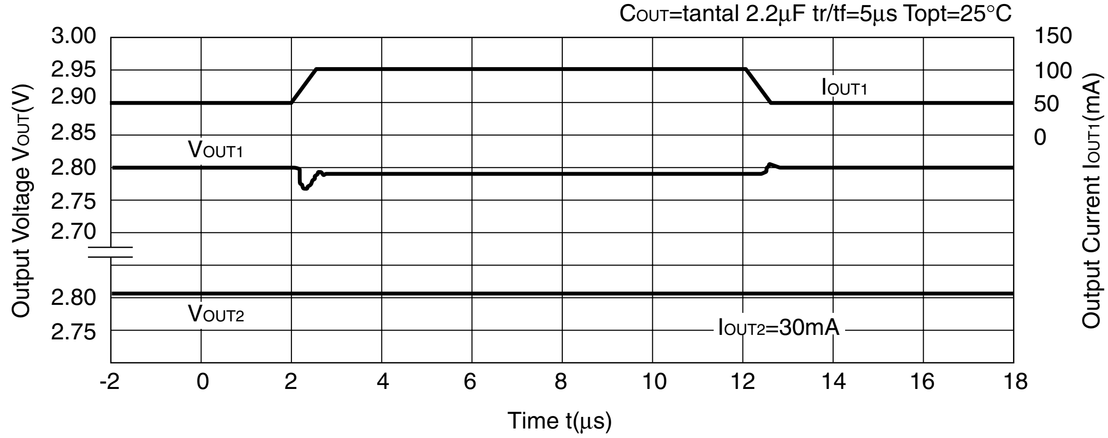
R5322N001× (VR1=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 1.0µF tr/tf=5µs Topt=25°C



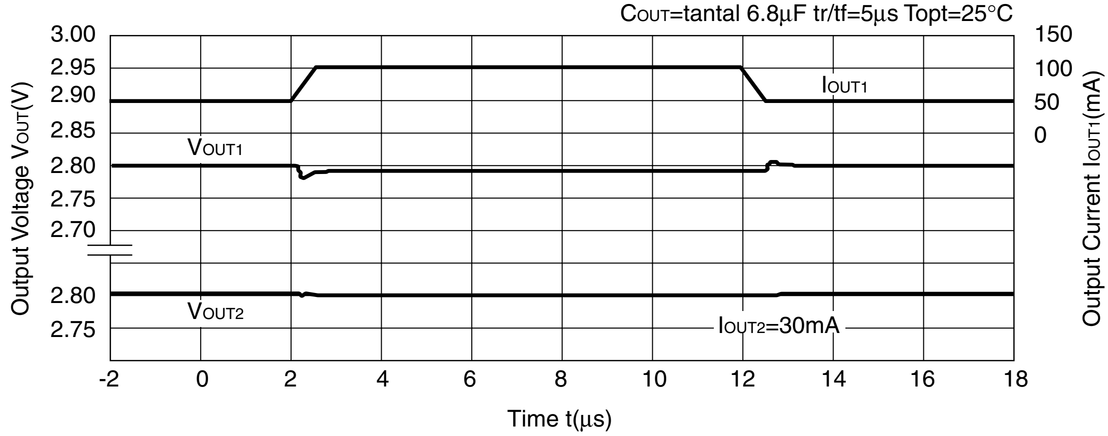
R5322N001× (VR1=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 2.2µF tr/tf=5µs Topt=25°C



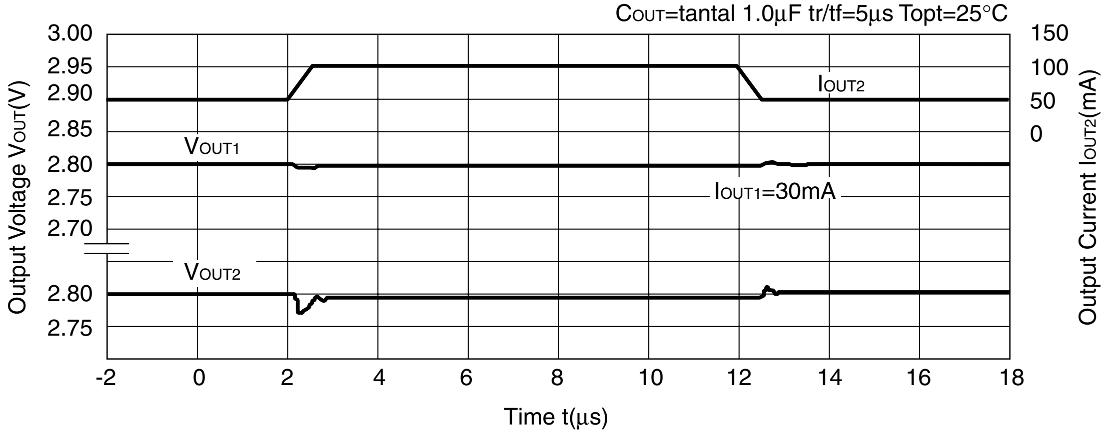
R5322N001× (VR1=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 6.8µF tr/tf=5µs Topt=25°C



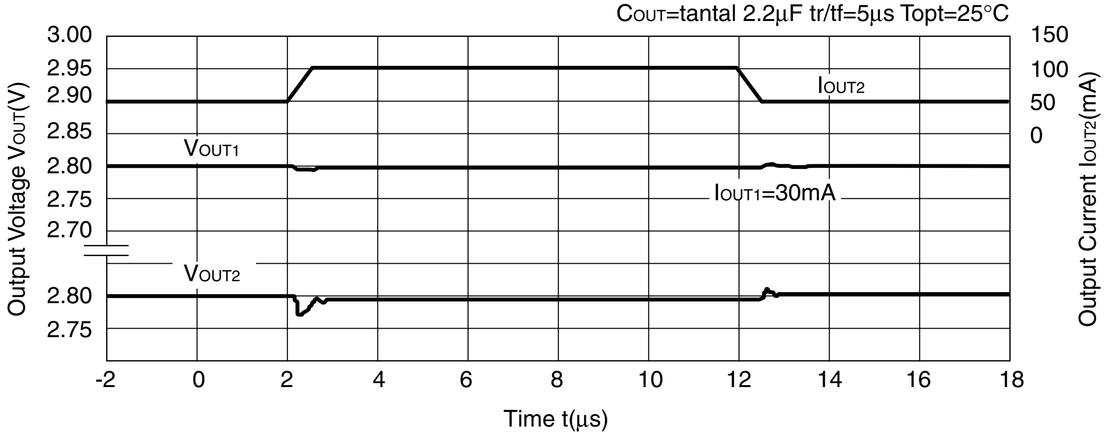
R5322N001× (VR2=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 1.0µF tr/tf=5µs Topt=25°C



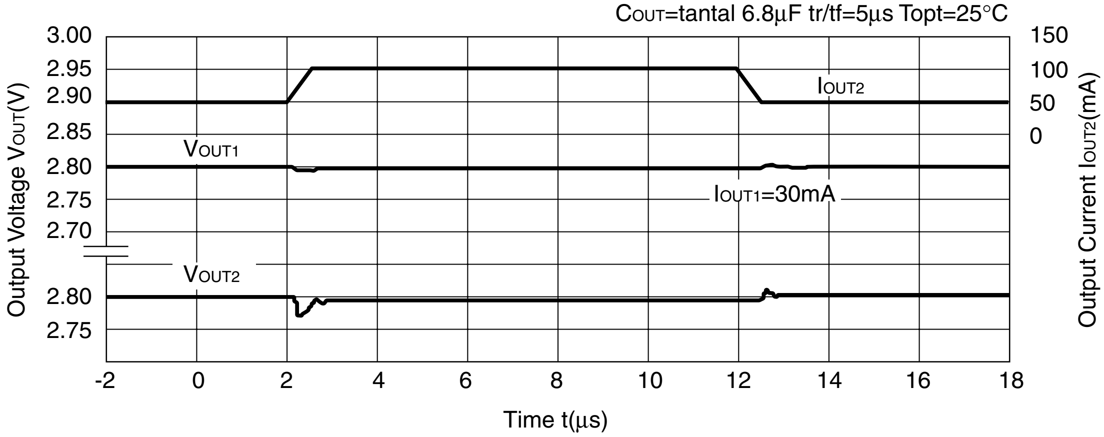
R5322N00× (VR2=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 2.2µF tr/tf=5µs Topt=25°C



R5322N00× (VR2=2.8V)

IOUT=50mA ⇔100mA VIN=3.8V CIN=tantal 1.0µF
COUT=tantal 6.8µF tr/tf=5µs Topt=25°C



TECHNICAL NOTES

When using these ICs, consider the following points:

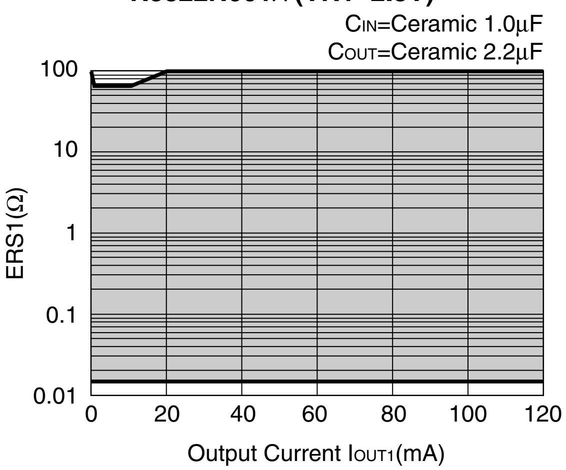
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, be sure to use a 2.2μF or more capacitance C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) of which is in the range described as follows:

The relations between I_{OUT} (Output Current) and ESR of 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.
(Note: When a ceramic capacitor is connected to the Output Pin as Output capacitor for phase compensation, the operation might be unstable unless as much as 1Ω resistor is connected between the capacitor and GND instead of ESR. Test these ICs with as same external components as ones to be used on the PCB.)

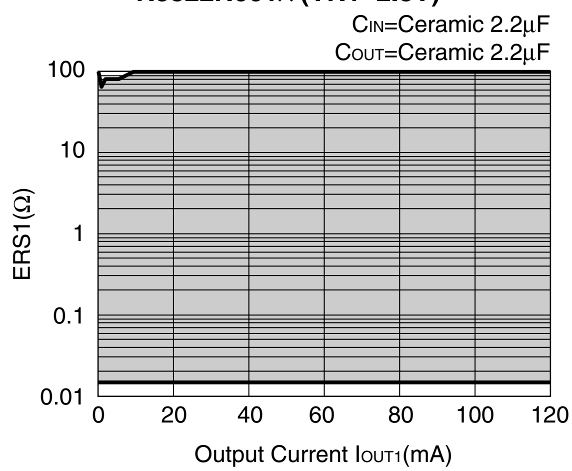
<Test conditions>

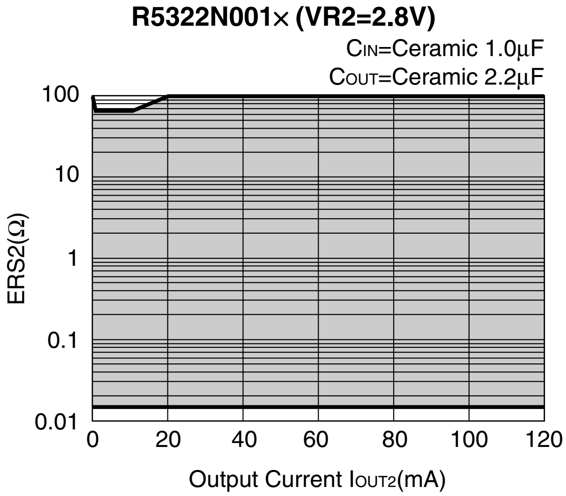
(1) V_{IN}=3.8V
(2) Frequency band: 10Hz to 2MHz
(3) Temperature: 25°C

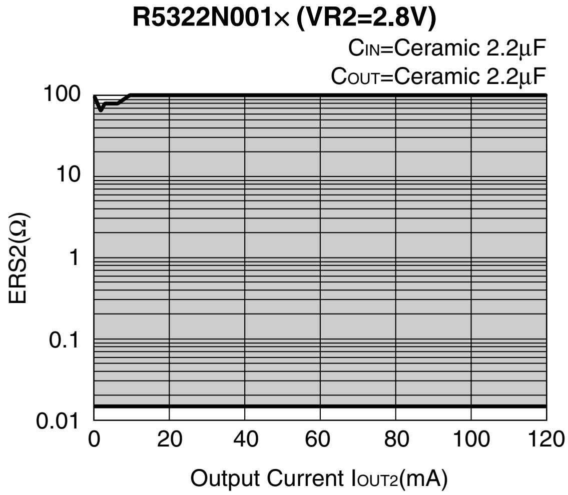
R5322N001× (VR1=2.8V)



R5322N001× (VR1=2.8V)







- Make V_{DD} and GND line sufficient. When the impedance of these is high, the noise might be picked up or not work correctly.
- Connect the capacitor with a capacitance of 1µF or more between V_{DD} and GND as close as possible.
- Set external components, especially Output Capacitor, as close as possible to the ICs and make wiring shortest.