RICOH

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SOT23-6 150mA 2ch LDO REGULATORS

R5323N SERIES

OUTLINE

The R5323N 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 prolongs the battery life of each system. The line transient response and load transient response of the R5323N 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-23-6 package, 2ch LDO regulators are included in each package, high density mounting of the ICs on boards is possible.

FEATURES

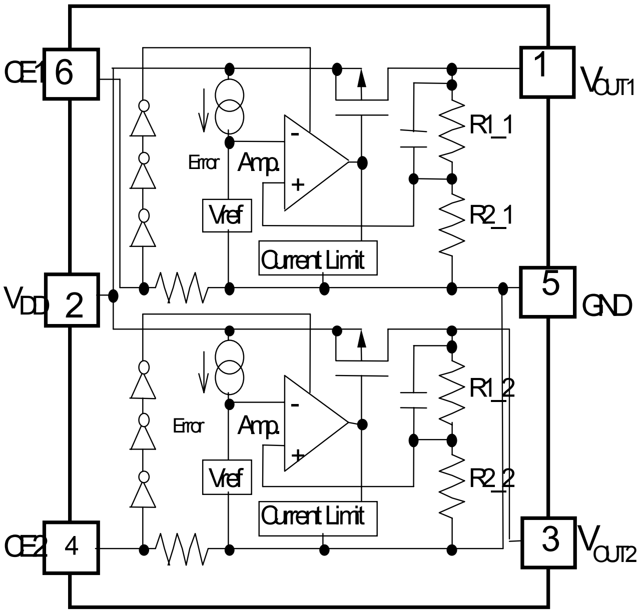
- Low Supply Current .... TYP. 90µA(VR1,VR2)
- Standby Mode .... TYP. 0.1µA(VR1,VR2)
- Low Dropout Voltage .... TYP. 0.22V(I_{OUT}=150mA Output Voltage=3.0V Type)
- High Ripple Rejection .... TYP. 75dB(V_{OUT}≤2.4V), TYP. 70dB(V_{OUT}≥2.5V) (f=1kHz)
.... TYP. 65dB(V_{OUT}≤2.4V), TYP. 60dB(V_{OUT}≥2.5V) (f=10kHz)
- Low Temperature-Drift Coefficient of Output Voltage TYP. ±100ppm/°C
- Excellent Line Regulation .... TYP. 0.02%/V
- High Output Voltage Accuracy.................................. ±2.0%
- Small Package SOT-23-6
- 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)
- Ceramic Capacitor is recommended. (1µF or more)

APPLICATIONS

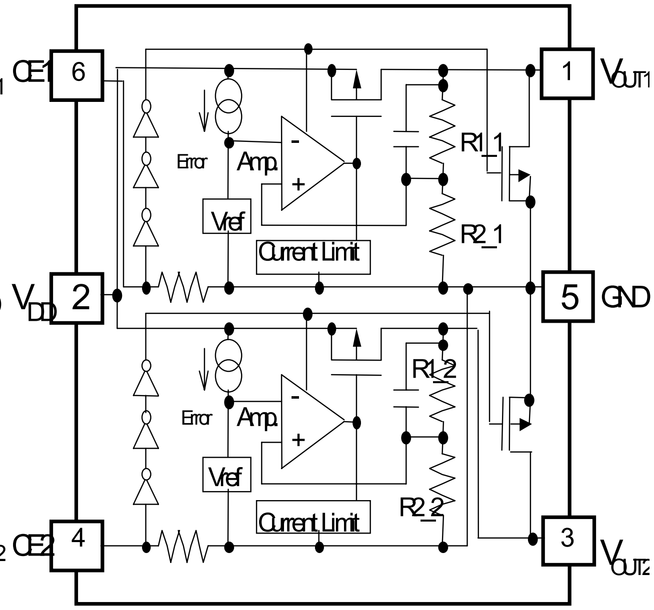
- Power source for handheld communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

■ BLOCK DIAGRAM

R5323NXXXA



R5323NXXXB



■ SELECTION GUIDE

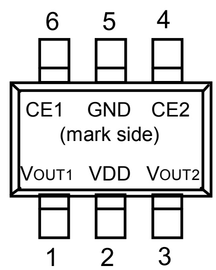
The output voltage, mask option, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R5323NXXXX-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-23-6



■ PIN DESCRIPTION

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

■ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Input Voltage	V_{IN}	6.5	V
Input Voltage(CE Pin)	V_{CE}	-0.3 ~ V_{IN}+0.3	V
Output Voltage	V_{OUT}	-0.3 ~ V_{IN}+0.3	V
Output Current 1	I_{OUT1}	200	mA
Output Current 2	I_{OUT2}	200	mA
Power Dissipation	P_D	250	mW
Operating Temperature Range	Topt	-40 ~ 85	°C
Storage Temperature Range	Tstg	-55 ~ 125	°C

■ ELECTRICAL CHARACTERISTICS

● R5323NXXXA/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	150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = Set V_{OUT}+1V 1mA ≤ I_{OUT} ≤ 150mA		15	40	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS}	Supply Current	V_{IN} = Set V_{OUT}+1V		90	120	μA
Istandby	Supply Current (Standby)	V_{IN} = Set V_{OUT}+1V V_{CE} = GND		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≤ V_{IN} ≤ 6V I_{OUT} = 30mA		0.02	0.10	%/V
RR	Ripple Rejection	Ripple 0.5Vp-p V_{IN} = Set V_{OUT}+1V I_{OUT} = 30mA (In case that V_{OUT}≤1.7V, V_{IN} = Set V_{OUT}+1.2V)		75 *Note1 65 *Note2		dB
V_{IN}	Input Voltage		2.0		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		0.7	2.0	8.0	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		60		Ω

Note1: f=1kHz, 70dB as to V_{OUT}≥2.5V Output type.

Note2: f=10kHz, 60dB as to V_{OUT}≥2.5V Output type.

● ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	TYP.	MAX.
V_{OUT} = 1.5	I_{OUT} = 150mA	0.38	0.70
V_{OUT} = 1.6		0.35	0.65
V_{OUT} = 1.7		0.33	0.60
1.8 ≤ V_{OUT} ≤ 2.0		0.32	0.55
2.1 ≤ V_{OUT} ≤ 2.7		0.28	0.50
2.8 ≤ V_{OUT} ≤ 4.0		0.22	0.35

*Recommended Ceramic capacitor for Output: GRM219R61A105K(Murata)

General Example of External Components

Ceramic Capacitors: C1608X5R0J105K (TDK)

GRM188R60J105K (Murata)

■ TEST CIRCUITS

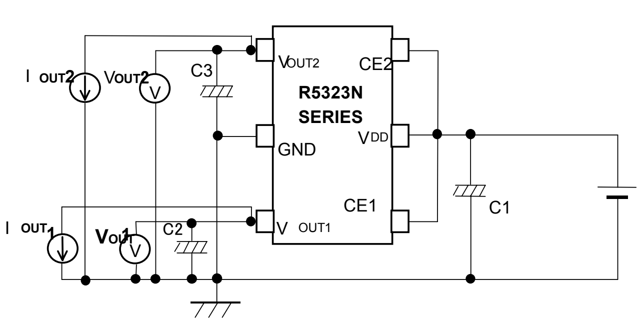


Fig.1 Standard test Circuit

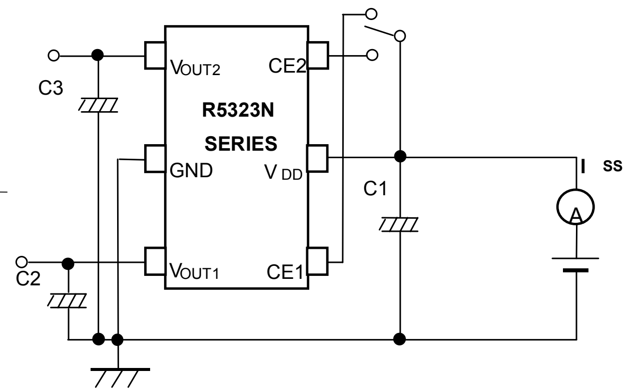


Fig.2 Supply Current Test Circuit

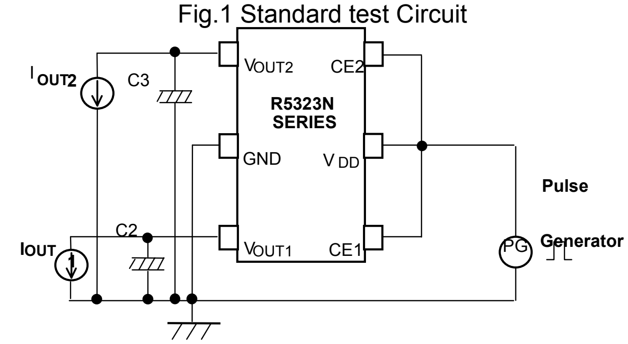


Fig.3 Ripple Rejection, Line Transient Response Test Circuit

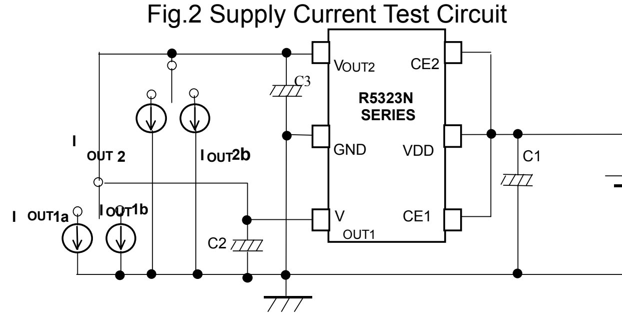
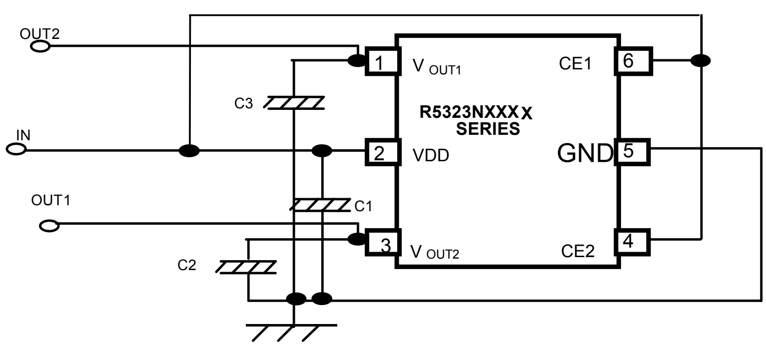


Fig.4 Load Transient Response Test Circuit

■ TYPICAL APPLICATION

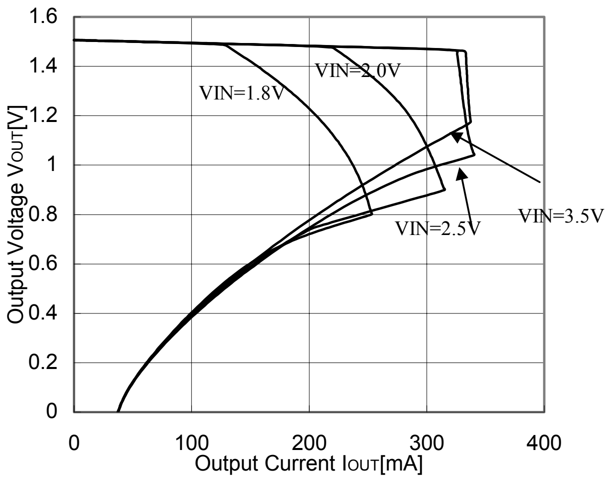


(External Components) Output Capacitor; Ceramic Type

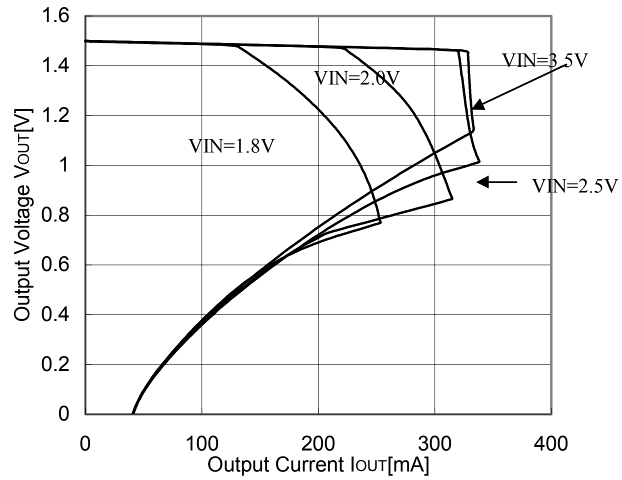
■ TYPICAL CHARACTERISTICS

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

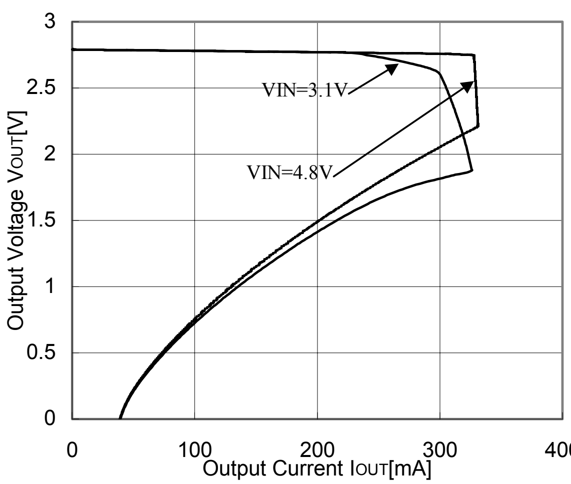
1.5V(VR1)



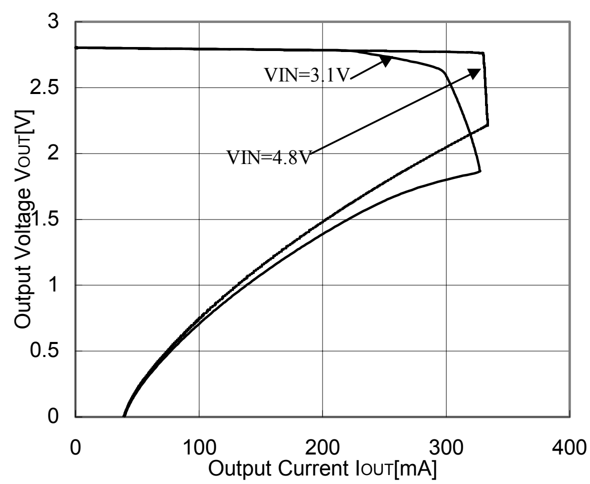
1.5V(VR2)



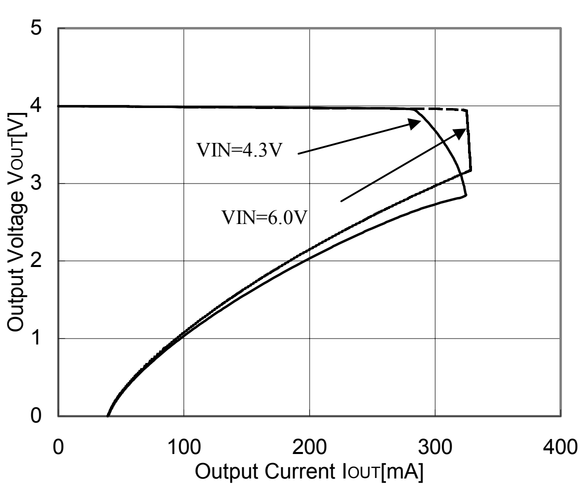
2.8V(VR1)



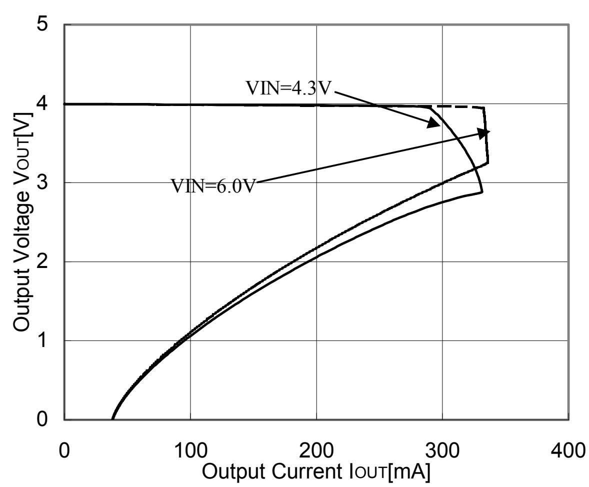
2.8V(VR2)



4.0V(VR1)

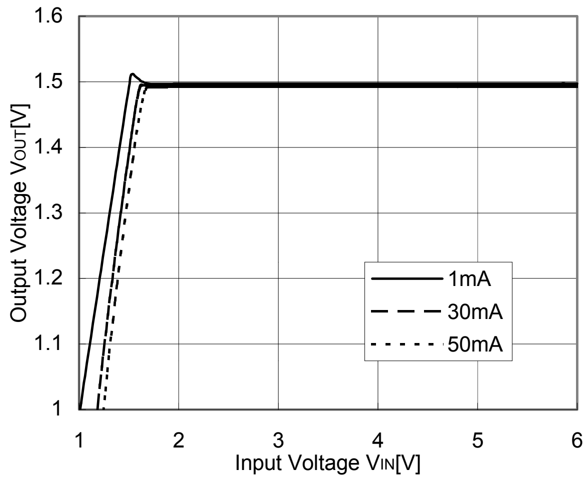


4.0V(VR2)

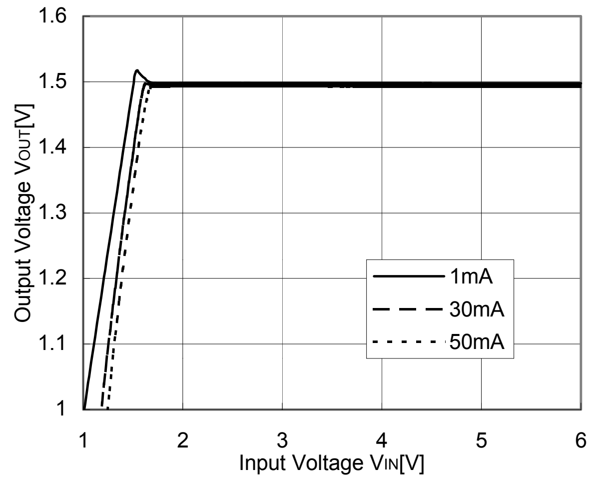


2) Output Voltage vs. Input Voltage (Topt=25°C)

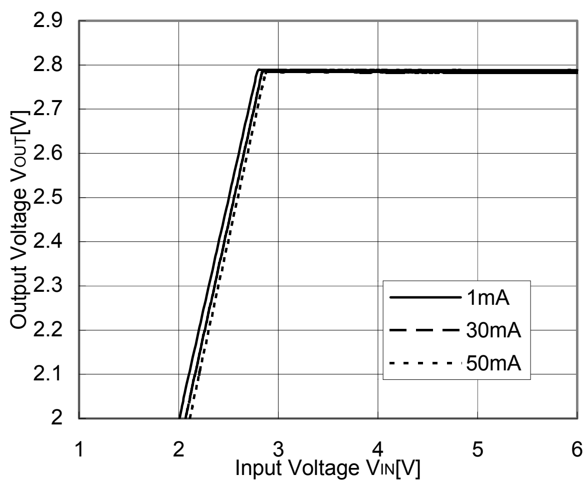
1.5V(VR1)



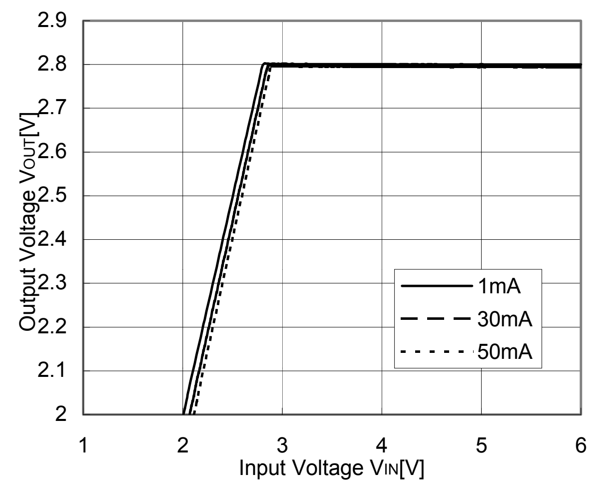
1.5V(VR2)



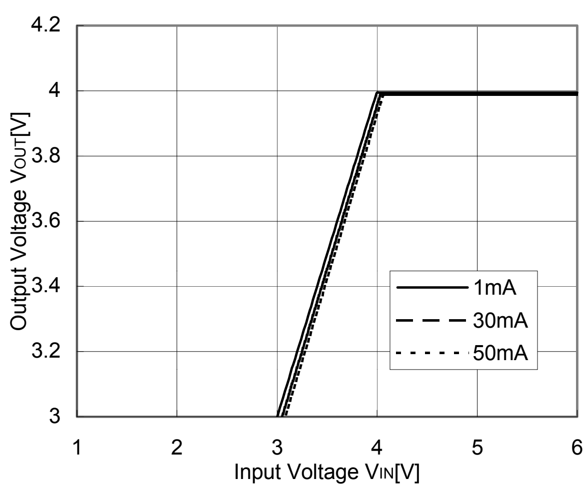
2.8V(VR1)



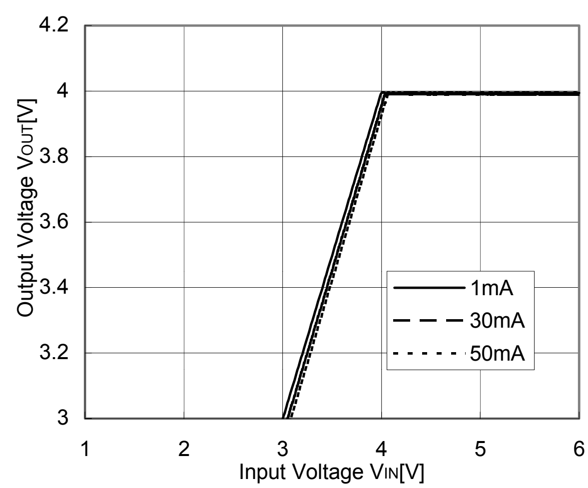
2.8V(VR2)



4.0V(VR1)

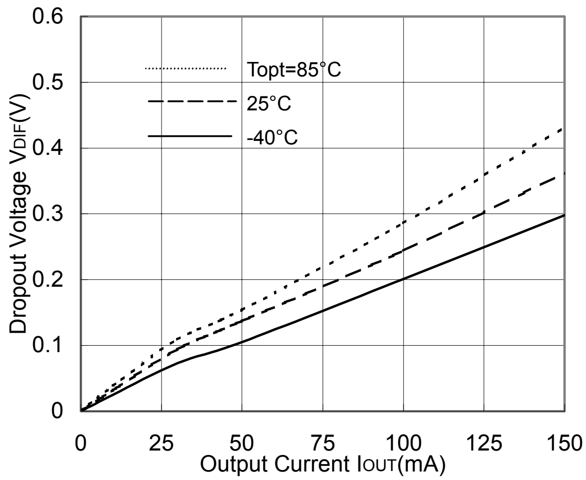


4.0V(VR2)

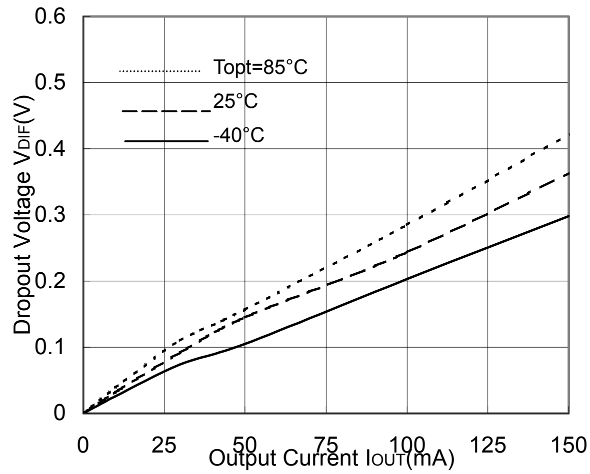


3) Dropout Voltage vs. Temperature

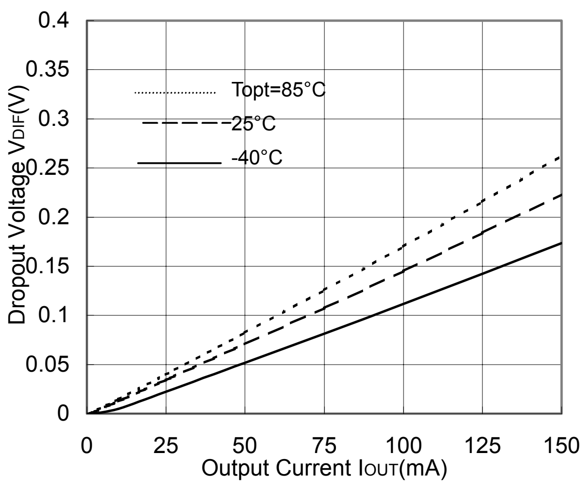
1.5V(VR1)



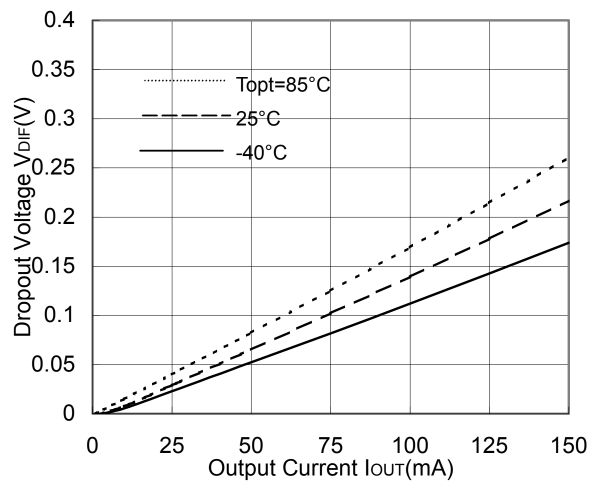
1.5V(VR2)



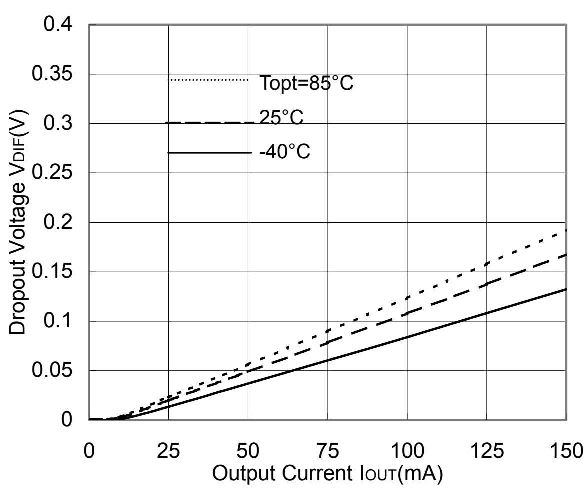
2.8V(VR1)



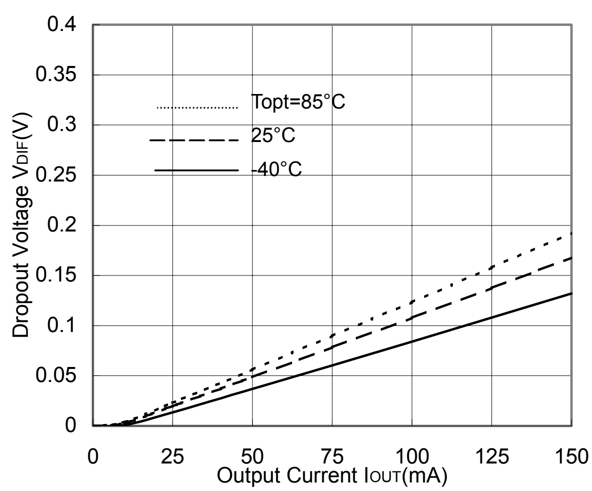
2.8V(VR2)



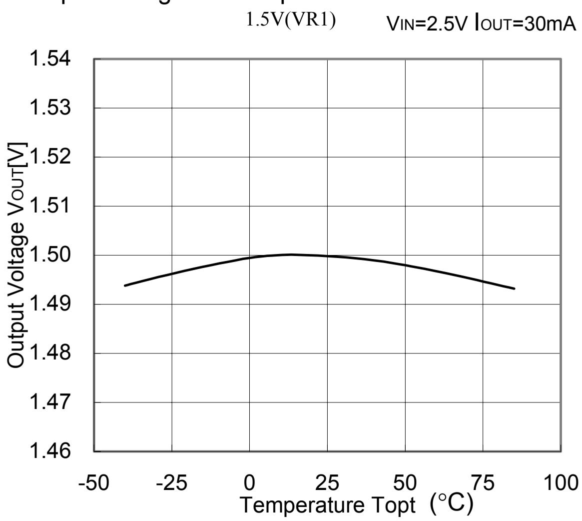
4.0V(VR1)

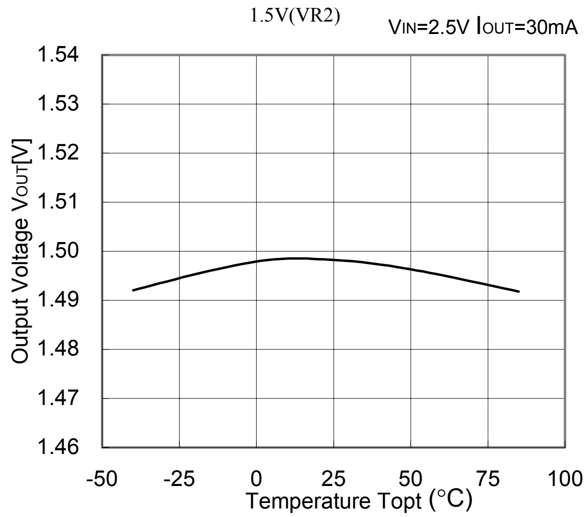


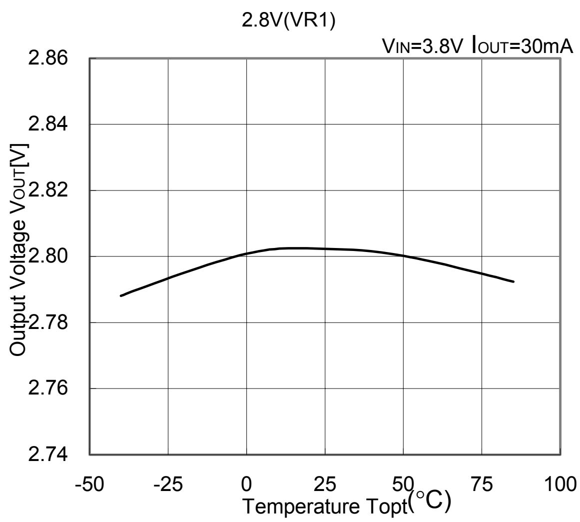
4.0V(VR2)

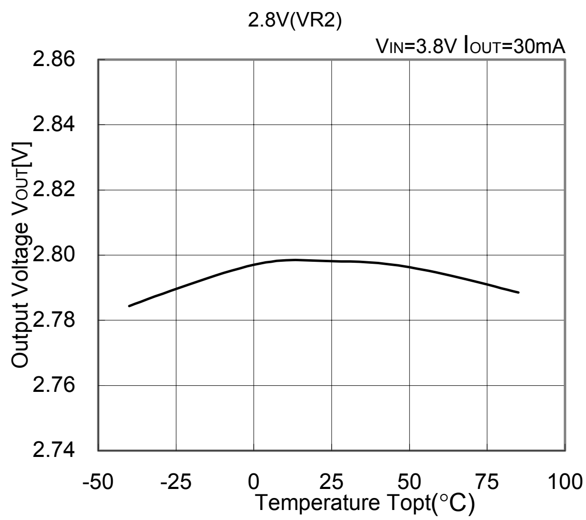


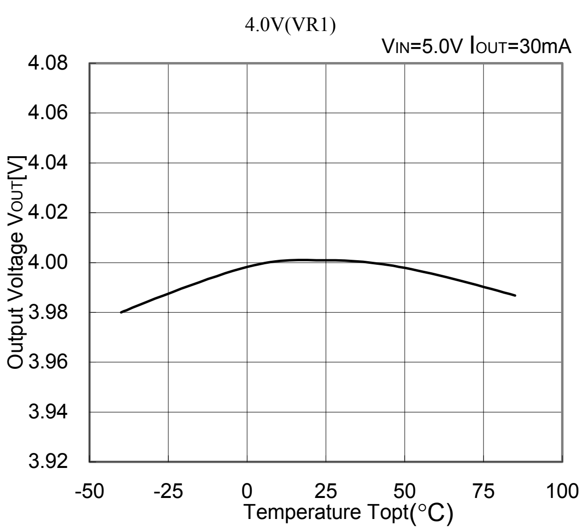
4) Output Voltage vs. Temperature

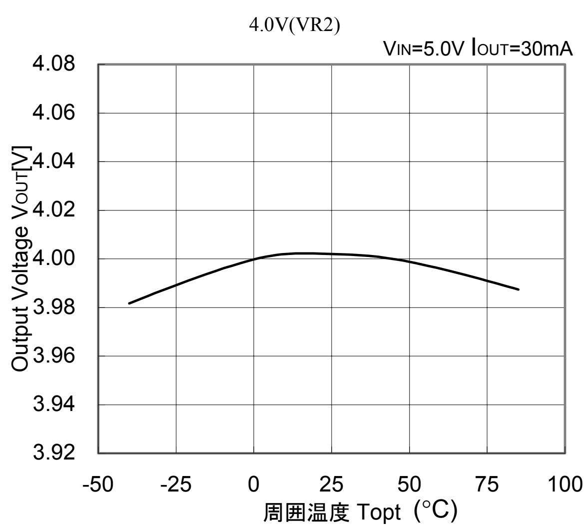




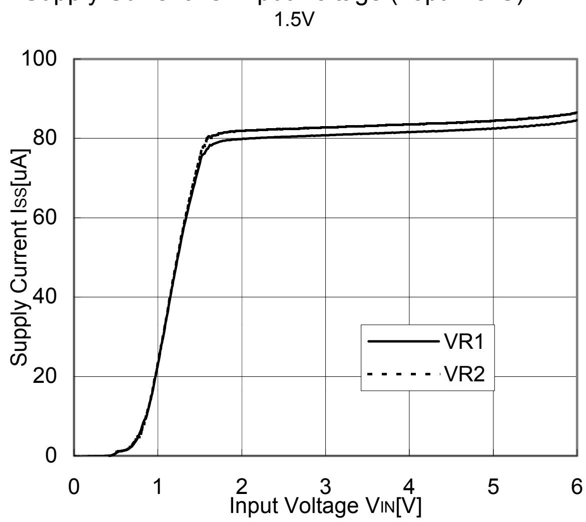


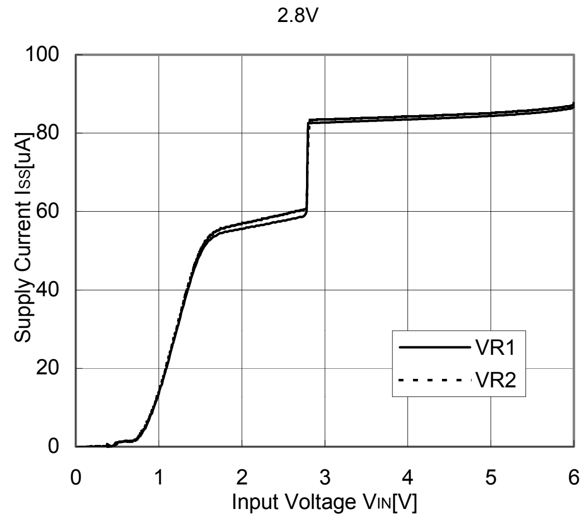


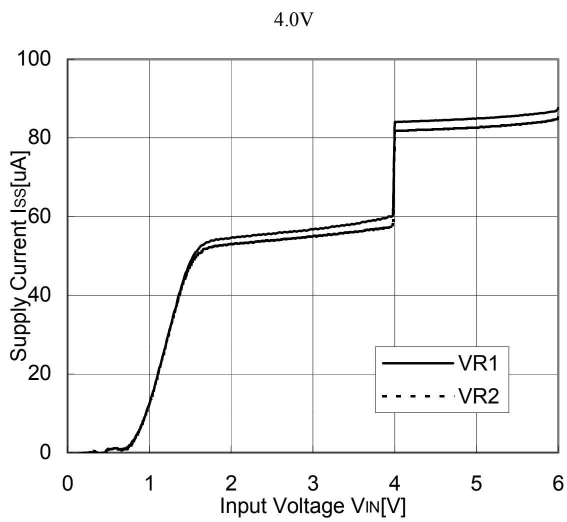




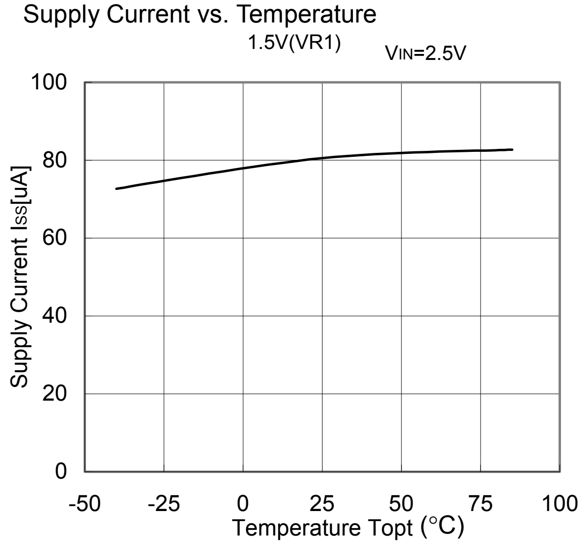
5) Supply Current vs. Input Voltage (Topt=25°C)

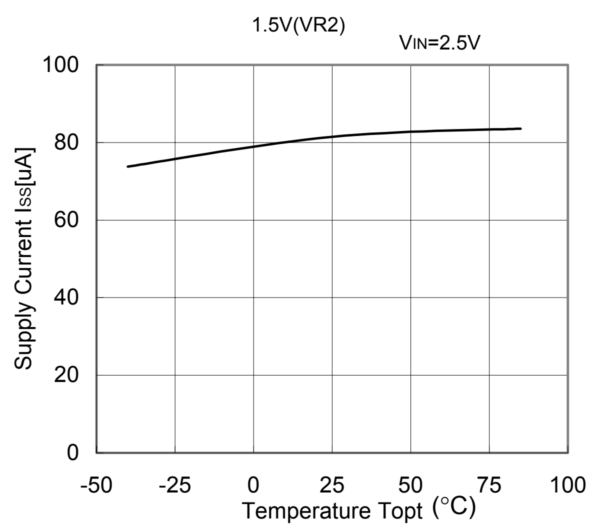




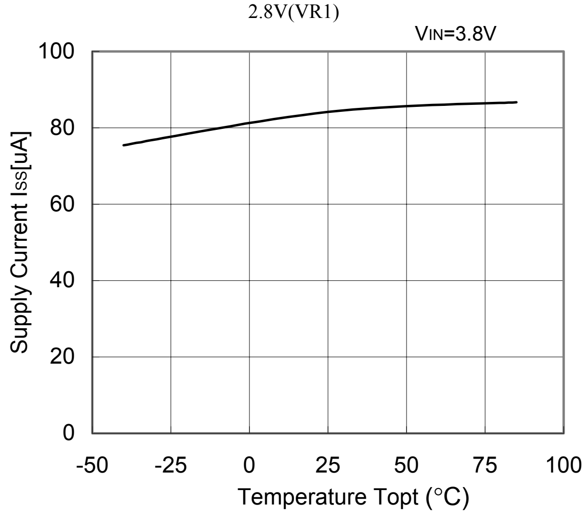


6) Supply Current vs. Temperature

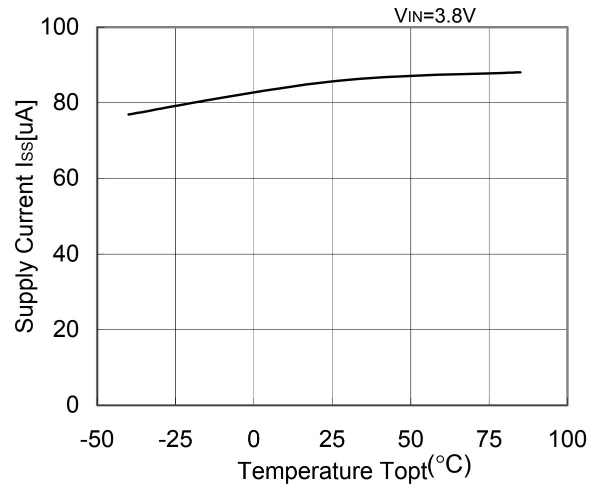




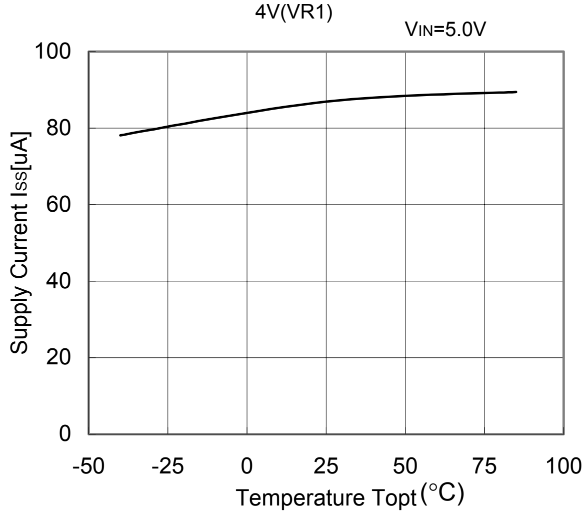
2.8V(VR1)



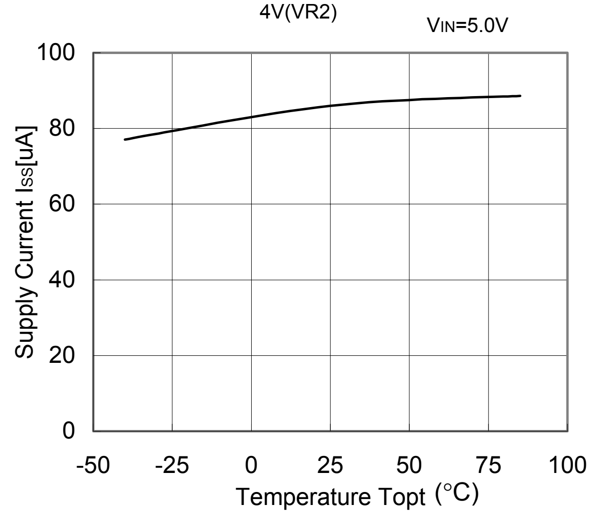
2.8V(VR2)



4V(VR1)



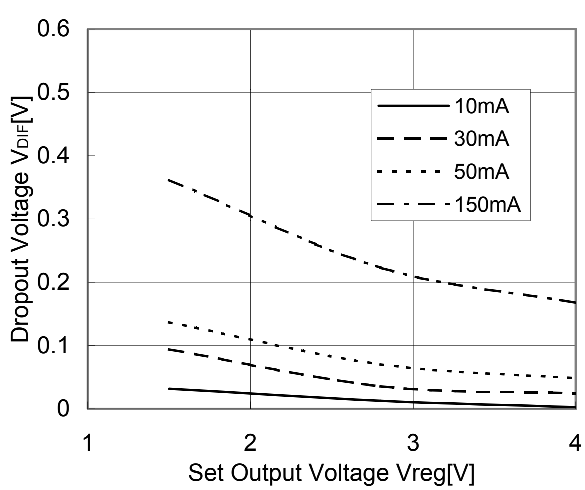
4V(VR2)



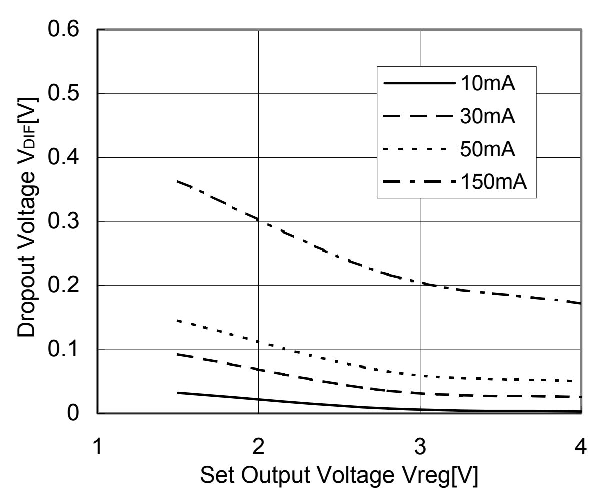
7) Dropout Voltage vs. Set Output Voltage

Topt=25°C

VR1

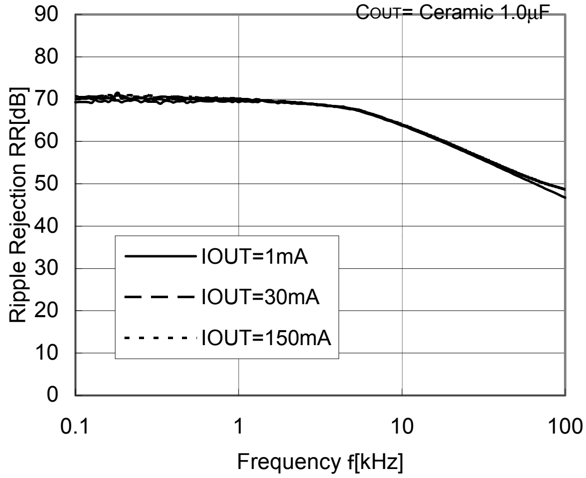


VR2

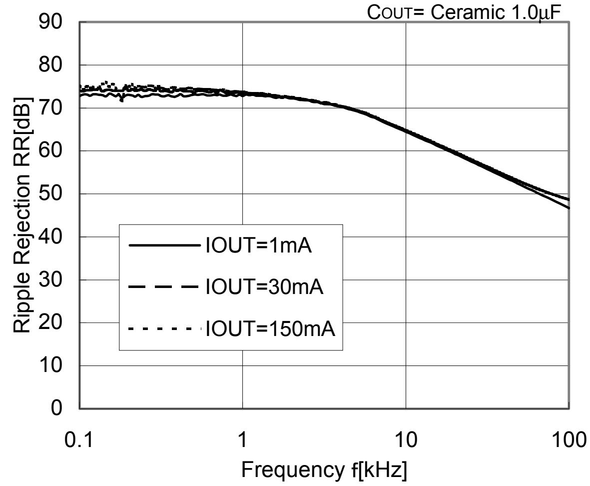


8) Ripple Rejection vs. Frequency (Topt=25°C)

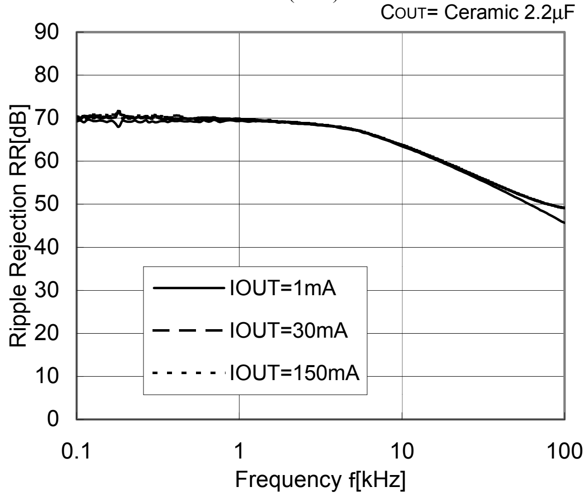
1.5V(VR1) VIN=2.5V+0.5Vp-p
COUT= Ceramic 1.0μF



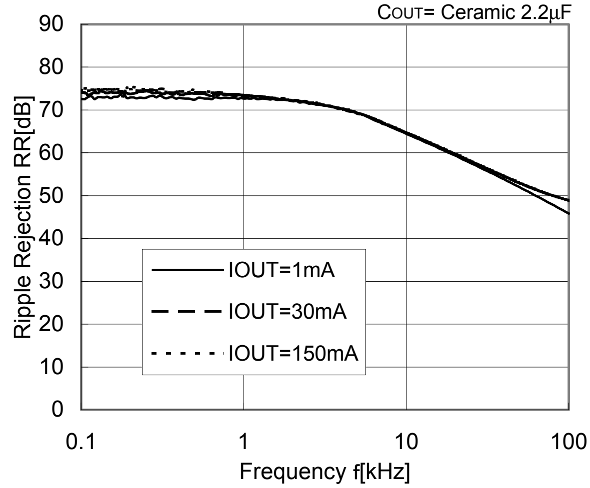
1.5V(VR2) VIN=2.5V+0.5Vp-p
COUT= Ceramic 1.0μF



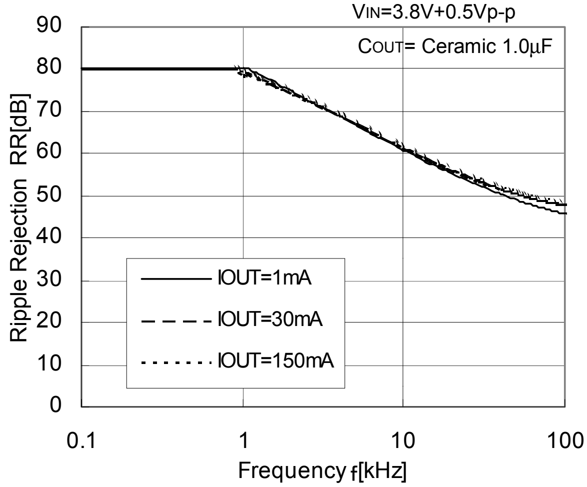
1.5V(VR1) VIN=2.5V+0.5Vp-p
COUT= Ceramic 2.2μF



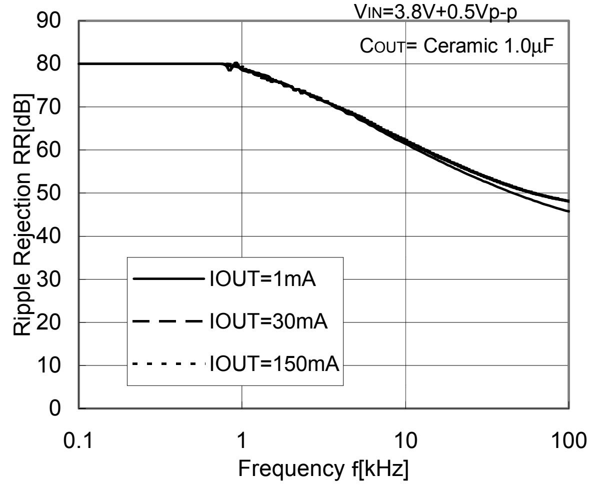
1.5V(VR2) VIN=2.5V+0.5Vp-p
COUT= Ceramic 2.2μF

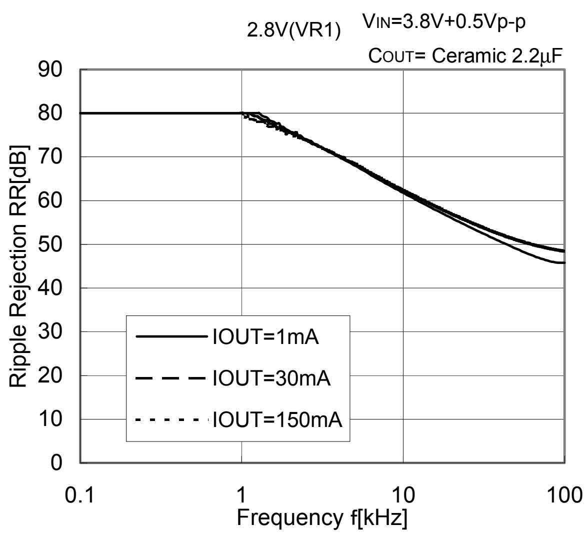


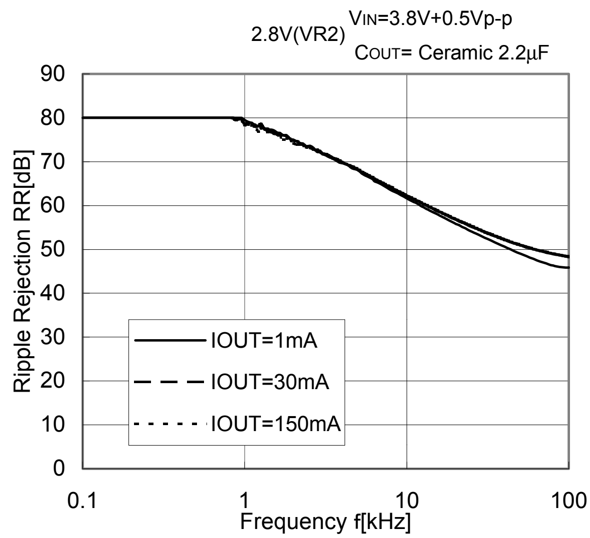
2.8V(VR1) VIN=3.8V+0.5Vp-p
COUT= Ceramic 1.0μF

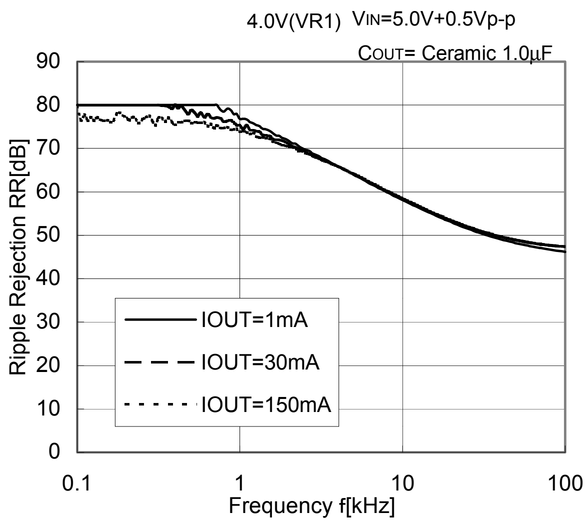


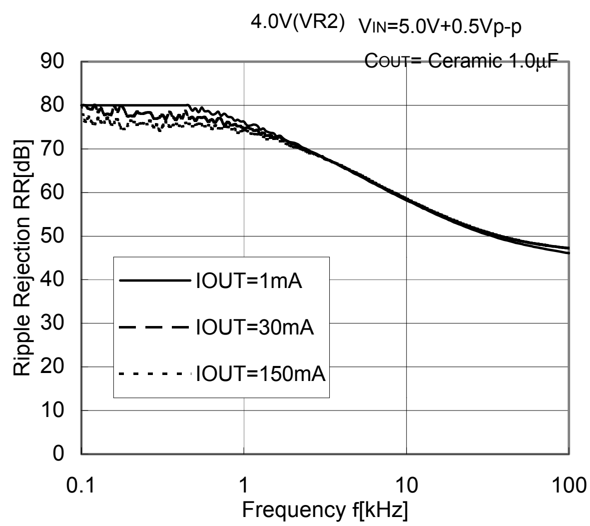
2.8V(VR2) VIN=3.8V+0.5Vp-p
COUT= Ceramic 1.0μF

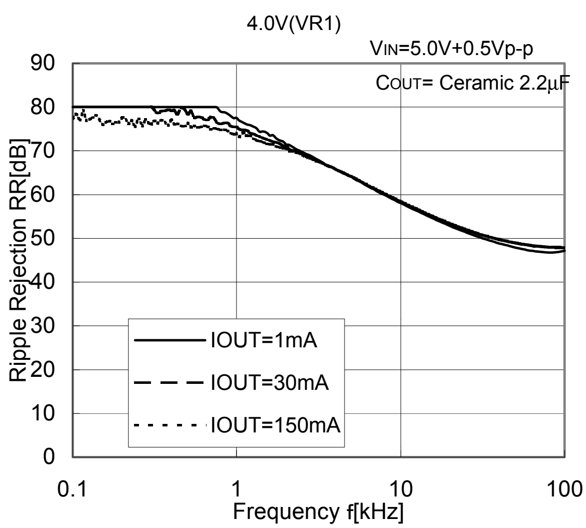


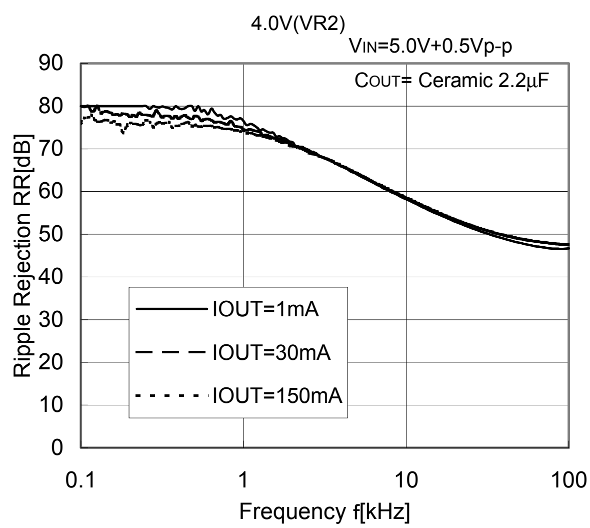

2.8V(VR1)
VIN=3.8V+0.5Vp-p
COUT= Ceramic 2.2μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA


2.8V(VR2)
VIN=3.8V+0.5Vp-p
COUT= Ceramic 2.2μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA

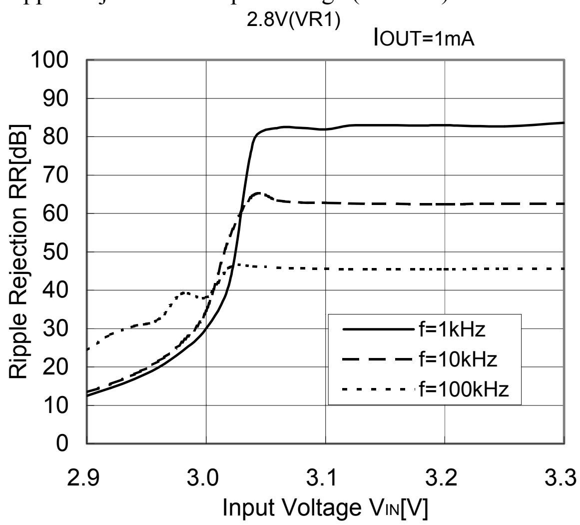

4.0V(VR1)
VIN=5.0V+0.5Vp-p
COUT= Ceramic 1.0μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA

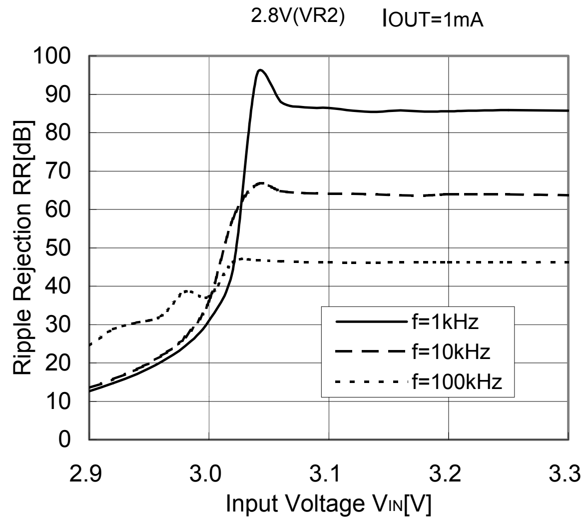

4.0V(VR2)
VIN=5.0V+0.5Vp-p
COUT= Ceramic 1.0μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA

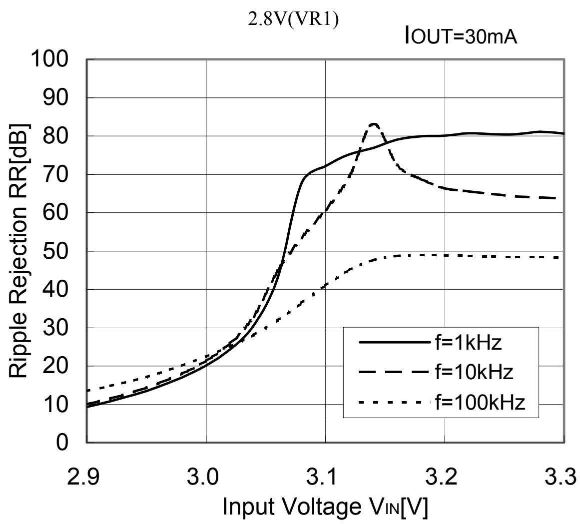

4.0V(VR1)
VIN=5.0V+0.5Vp-p
COUT= Ceramic 2.2μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA

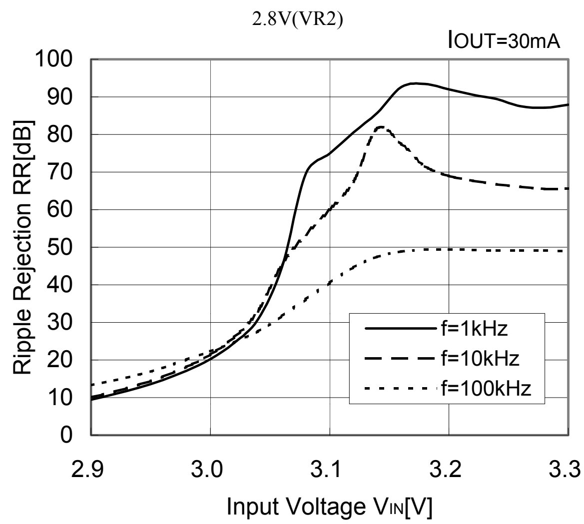

4.0V(VR2)
VIN=5.0V+0.5Vp-p
COUT= Ceramic 2.2μF
Ripple Rejection RR[dB]
Frequency f[kHz]
IOUT=1mA
IOUT=30mA
IOUT=150mA

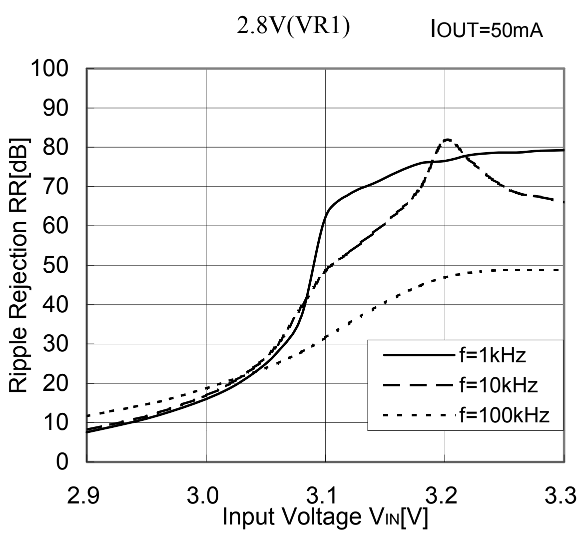
9) Ripple Rejection vs. Input Voltage (DC bias) C_{OUT} = Ceramic 1.0µF, Topt=25°C

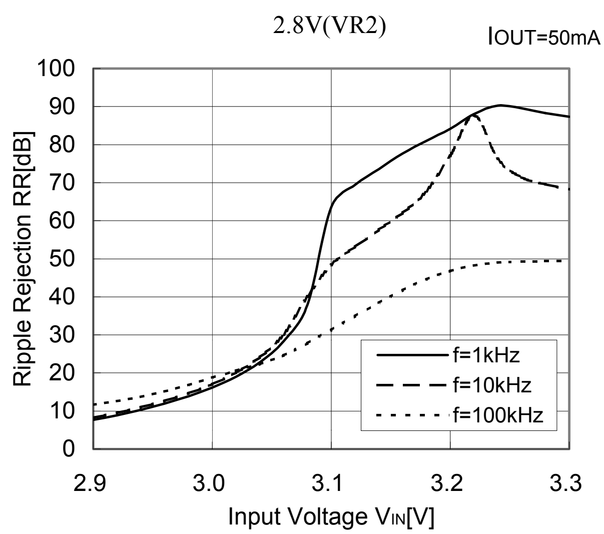








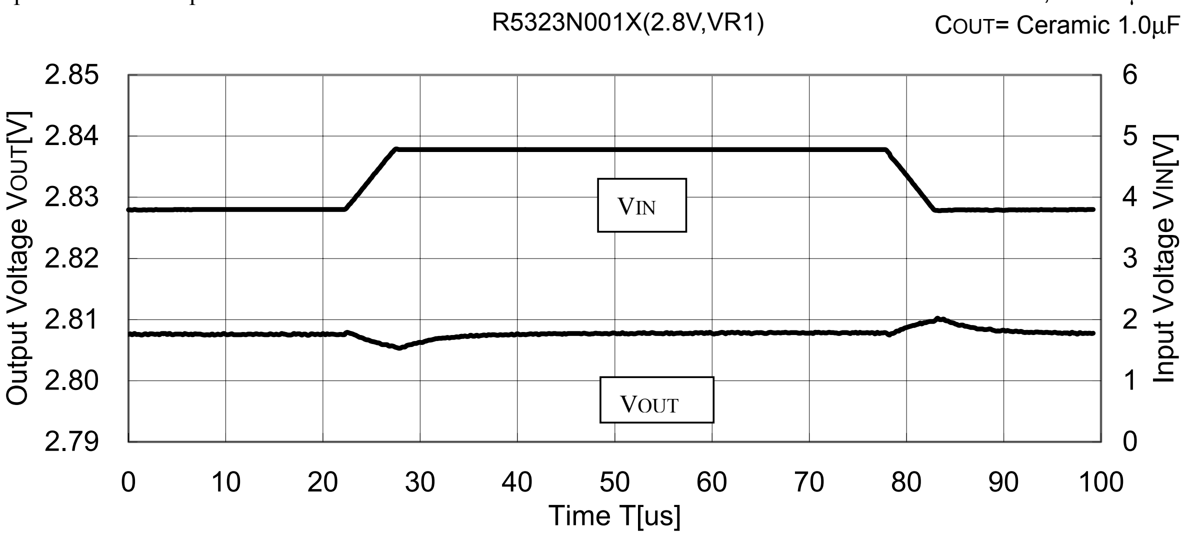




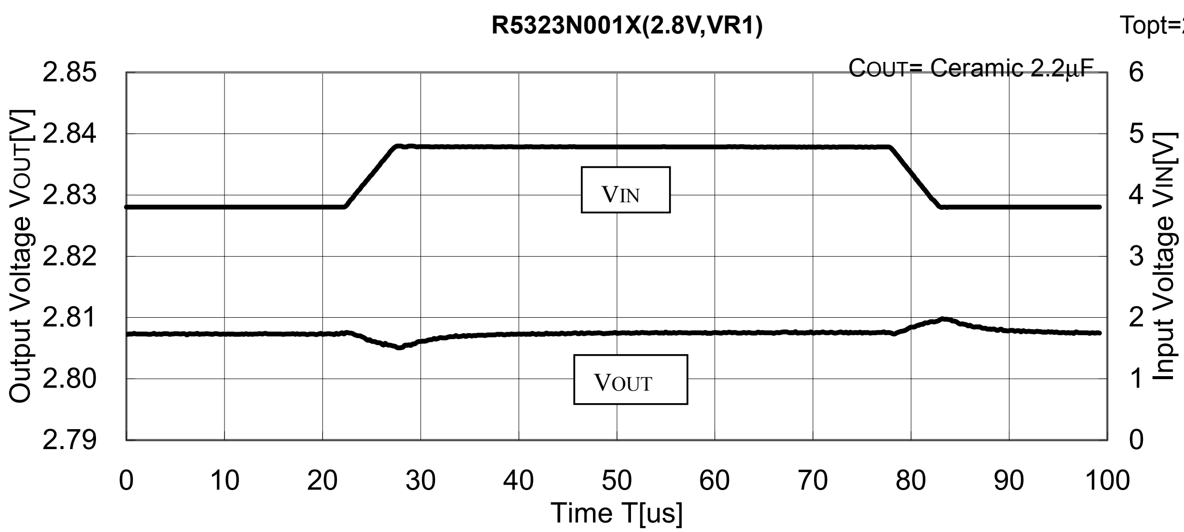
10) Input Transient Response

IOUT=30mA, tr=tf=5µs

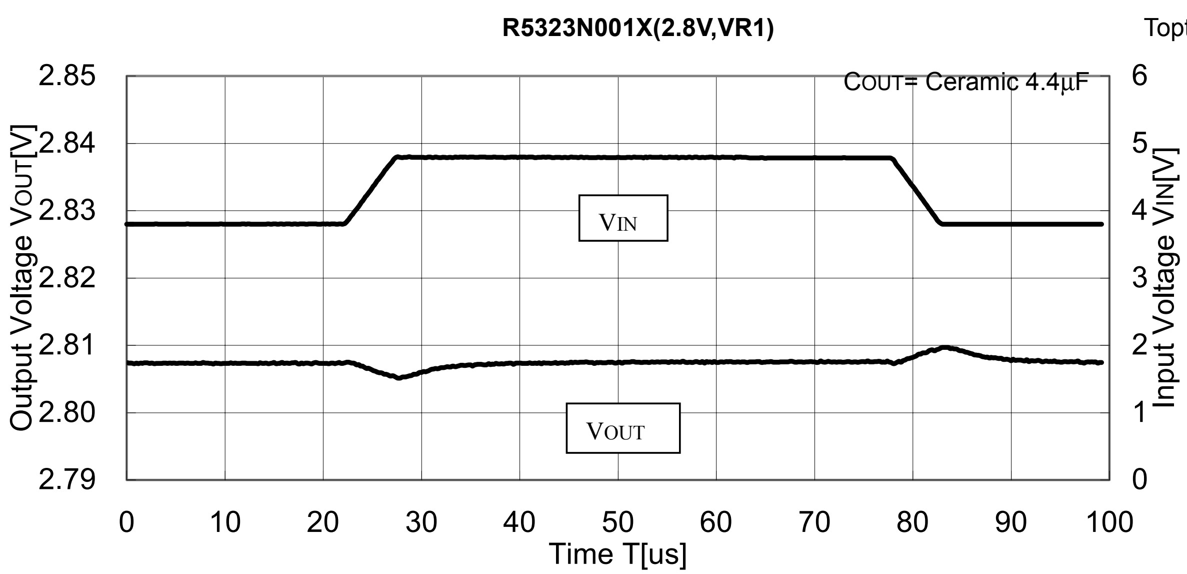
COUT= Ceramic 1.0µF



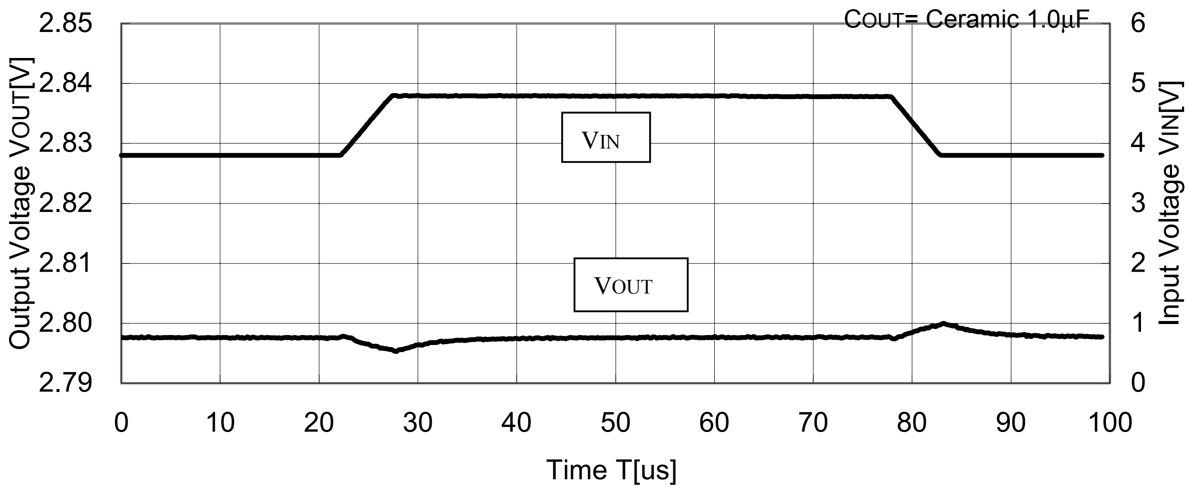
Topt=25°C



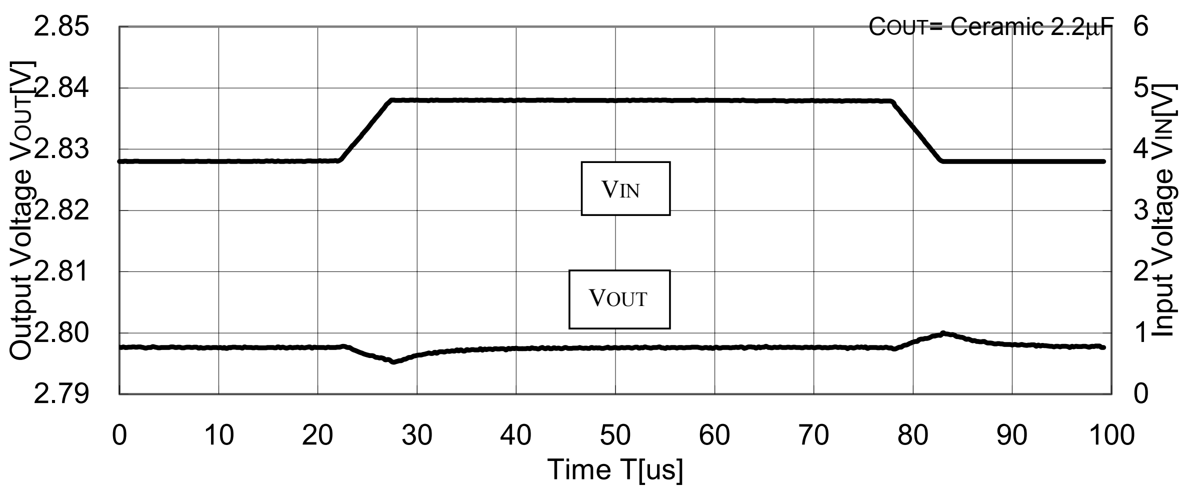
Topt=25°C



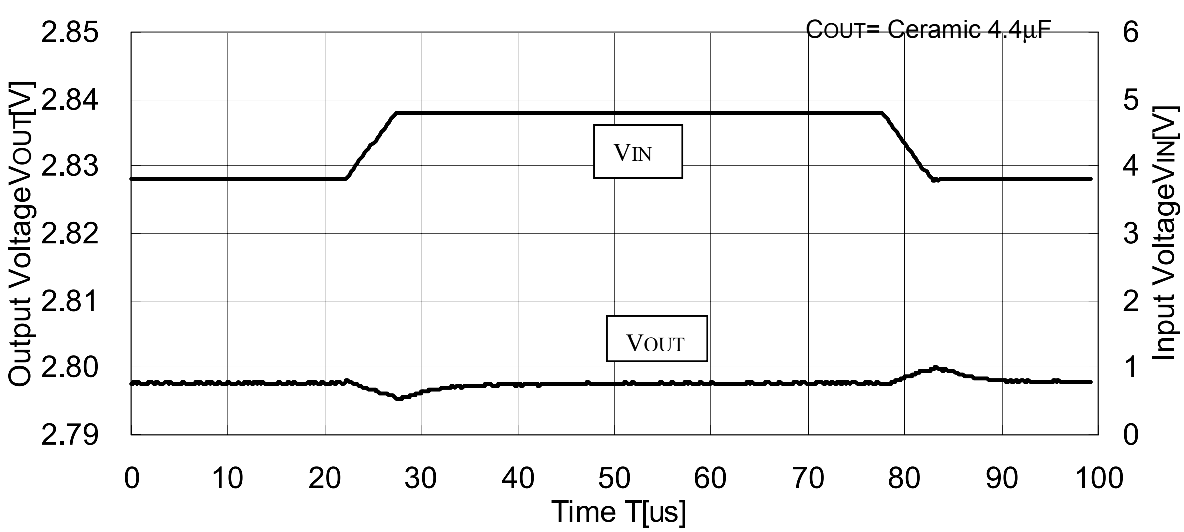
R5323N001X(2.8V,VR2) Topt=25°C



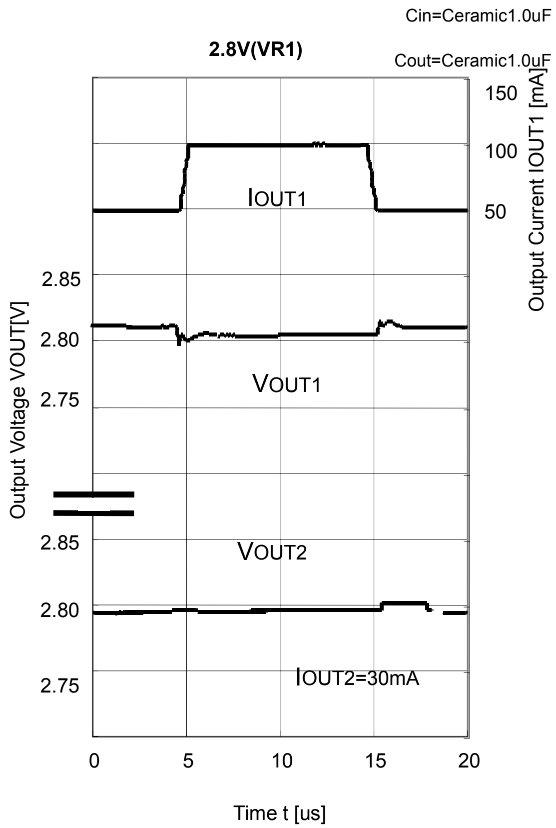
R5323N001X(2.8V,VR2) Topt=25°C

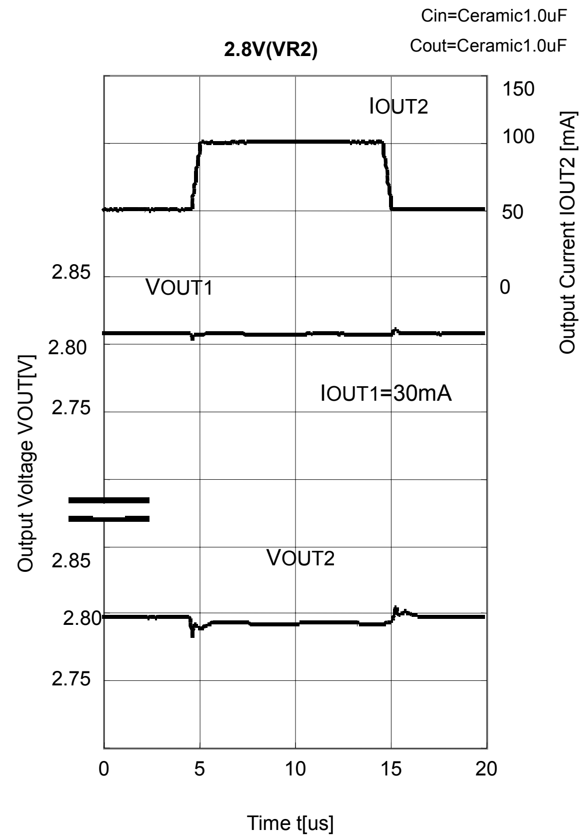


R5323N001X(2.8V,VR2) Topt=25°C



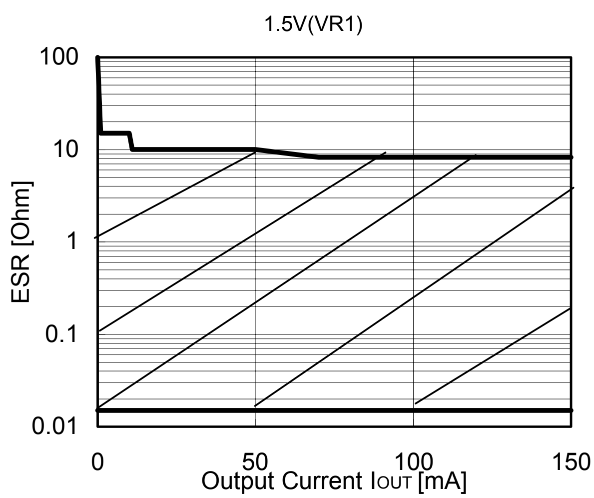
11) Load Transient Response

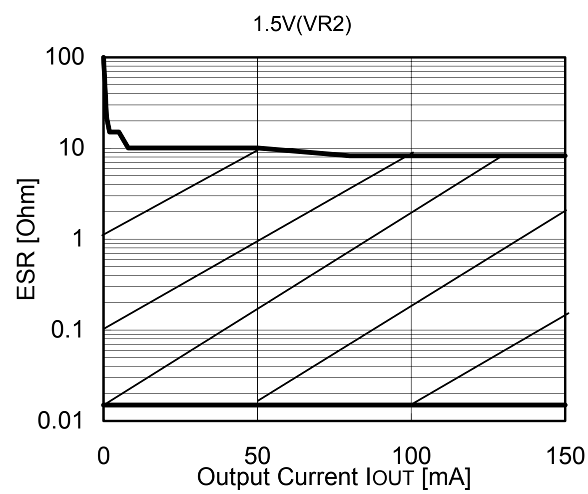




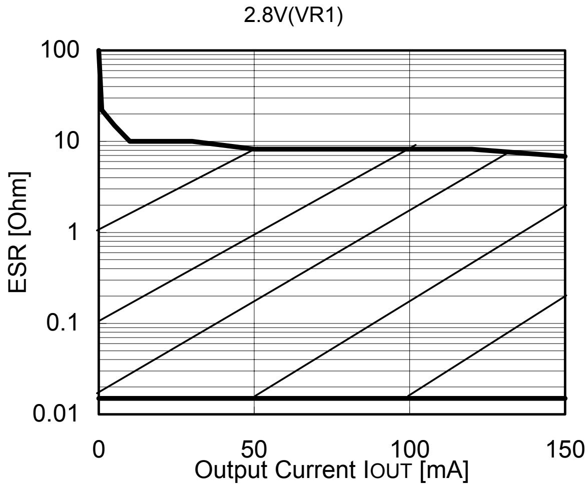
12) ESR vs. Output Current

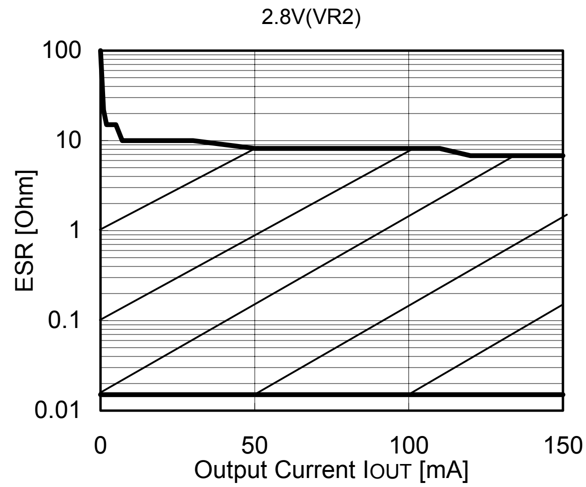
Topt=25°C
CIN = COUT =Ceramic 1.0µF, VIN=2.5V, f=10Hz to 2MHz
(BW=30Hz)



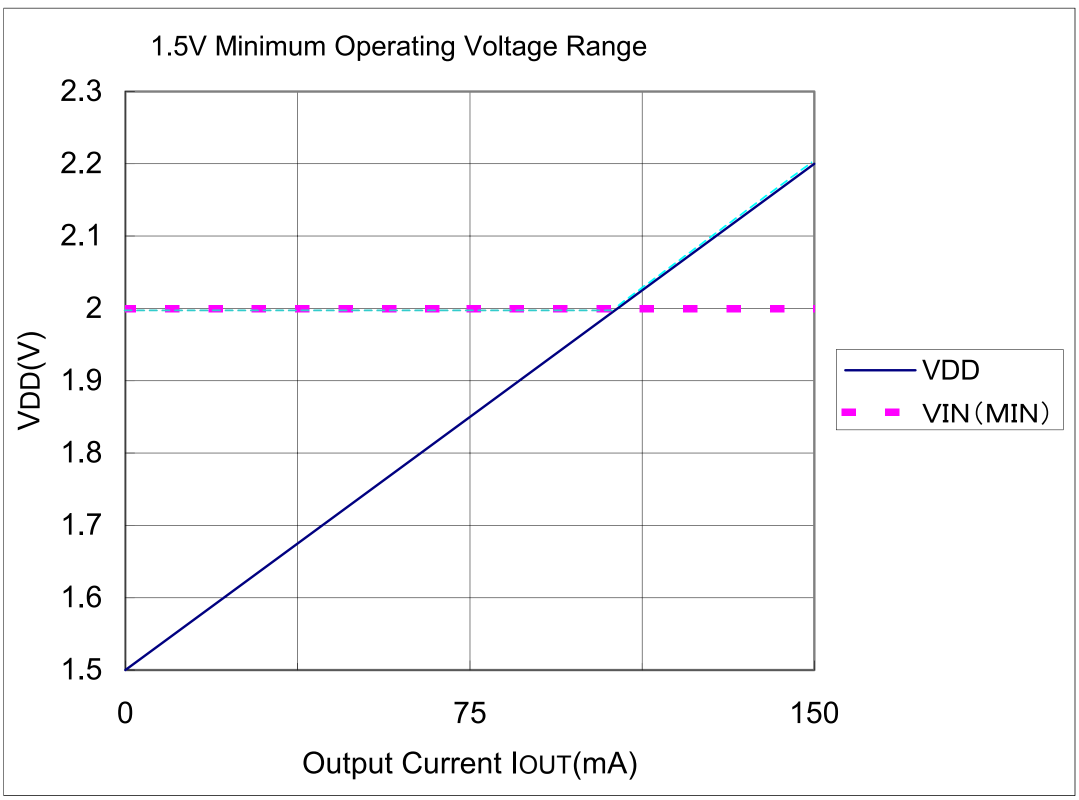


CIN = COUT =Ceramic 1.0µF, VIN=2.5V, f=10Hz to 2MHz
(BW=30Hz)





13) Minimum Operating Voltage



■ 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 1.0µF 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 in the typical characteristics above. The conditions when the white noise level is under 40µV (Avg.) are marked as the hatched area in the graph.
Test these ICs with as same external components as ones to be used on the PCB.

- 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.