RICOH

R5326x SERIES

Automatic Mode Shift Dual 150mA LDO

EA-0911-2006

OUTLINE

The R5326X Series are CMOS-based voltage regulator ICs with high output voltage accuracy, Typ. 5.5μA low supply current, and remarkably improved transient response compared with the conventional low supply current voltage regulators. The supply current of IC itself is automatically shifts between fast mode and low power mode depending on the load current. (The current threshold is fixed internally.) Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting the output voltage, a current limit circuit for preventing from the destruction by an over current, and so on.

The chip enable function realizes the standby mode with ultra low supply current.

Since the packages for these ICs are SOT-23-6 and PLP1820-6, and chip size package, WLCSP-6, 2ch LDO regulators are included in each package, high density mounting of the ICs on boards is possible.

FEATURES

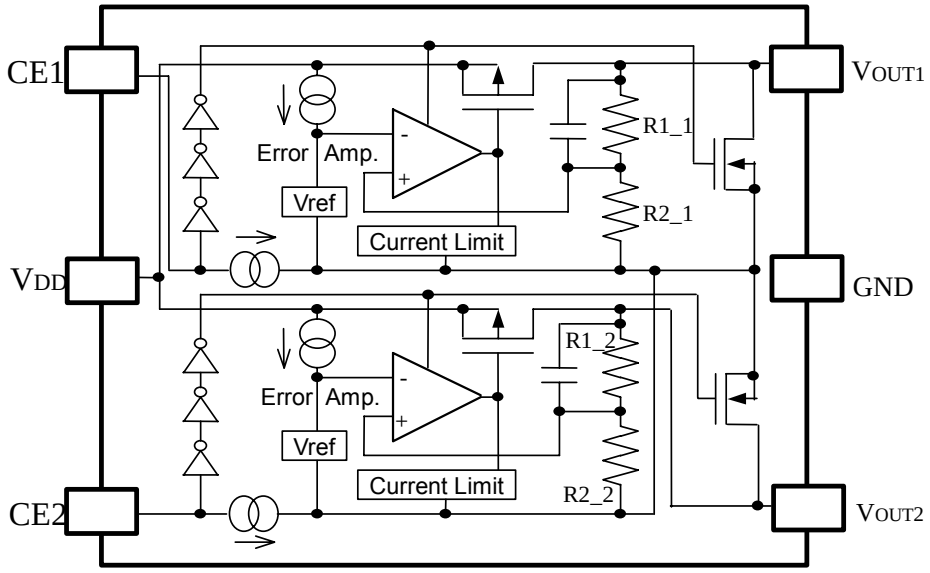
- Low Supply Current.....Typ. 5.5μA (VR1, VR2) (Iout=0mA)
  .....Typ. 50μA (VR1, VR2) (Iout=10mA)
- Standby Mode.....Typ. 0.1μA (VR1, VR2)
- Low Dropout Voltage.....Typ. 0.19V (I_{OUT}=150mA Output Voltage=3.0V Type)
- High Ripple Rejection.....Typ. 70dB (f=1kHz)
  Typ. 60dB (f=10kHz)
- Excellent Line Regulation.....Typ. 0.02%/V
- Small Packages .....SOT-23-6/PLP1820-6 /WLCSP-6
- Output Voltage .....Stepwise setting with a step of 0.1V in the range of 0.8V to 4.2V is possible
- Input Voltage.....1.4V to 6.0V
- Built-in chip enable circuit (A/B: active high)
- Built-in fold-back protection circuit.....Typ. 50mA (Current at short mode)
- Ceramic Capacitor is recommended. .....1.0μF to 3.3μF (Depending on V_{IN} and set V_{OUT}. Refer to the electrical characteristics table.]

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 DIAGRAMS

R5326XxxxB



SELECTION GUIDE

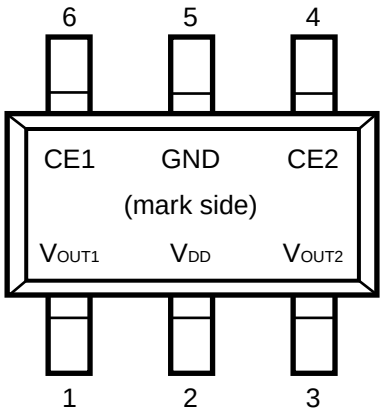
The output voltage, mask option, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R5326Xxxxx-xx-(F) ←Part Number
↑↑ ↑↑ ↑
a b c d e

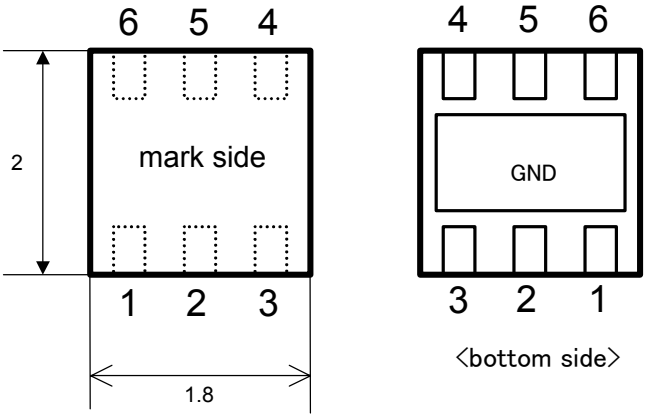
Code	Contents
a	Designation of Package Type: N: SOT23-6 K: PLP1820-6 Z: WLCSP-6
b	Setting combination of 2ch Output Voltage (V_{OUT}): Serial Number for Voltage Setting, Stepwise setting with a step of 0.1V in the range of 0.8V to 4.2V is possible for each channel.
c	Designation of Mask Option: A version: without auto discharge function at OFF state. B version: with auto discharge function at OFF state.
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; for SOT23-6 and PLP1820-6) E2 (for WLCSP-6)
e	SOT23-6 and WLCSP6: -F (Pb-free plating) PLP1820-6: no extension (No plating, genuine Pb-free)

PIN CONFIGURATION

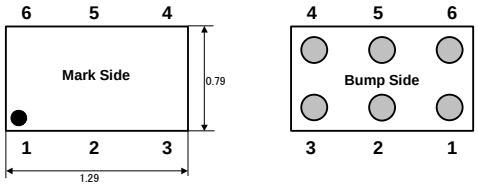
SOT-23-6



PLP1820– 6



WLCSP-6



PIN DESCRIPTION

SOT23-6

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

PLP1820-6

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

WLCSP-6

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

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Pin)	-0.3~6.5	V
V_{OUT}	Output Voltage	-0.3~V_{IN}+0.3	V
I_{OUT1}	Output Current 1	200	mA
I_{OUT2}	Output Current 2	200	mA
P_D	Power Dissipation (SOT-23-6)	250	mW
	Power Dissipation (PLP1820-6)*Note1	880	
	Power Dissipation (WLCSP-6)*Note1	633	
Topt	Operating Temperature Range	-40~85	°C
Tstg	Storage Temperature Range	-55~125	°C

Note1: Mounted on board. Conditions: Board material FR4, Board dimensions 40*40*1.6(mm)
Metal rate: 50%(2-layer) with thermal via holes:(ϕ0.54mm*30 for PLP1820-6, ϕ0.5mm*44 for WLCSP-6), wind velocity=0m/s

ELECTRICAL CHARACTERISTICS

R5326XxxxA/B

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage (*1)	V_{IN}=Set V_{OUT}+1V I_{OUT}=1mA	V_{OUT} ×0.99 (-15mV)		V_{OUT} ×1.01 (+15mV)	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			80	mV
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE				
I_{SS0}	Supply Current	V_{IN}=Set V_{OUT}+1V, I_{OUT}=0mA		5.5	16	µA
I_{SS10}	Supply Current	V_{IN}=Set V_{OUT}+1V, I_{OUT}=10mA		50		µA
Istandby	Supply Current (Standby)	V_{IN}=Set V_{OUT}+1V, V_{CE}=GND		0.1	1.0	µA
I_{OUTH}	High Mode Current threshold	V_{IN}=Set V_{OUT}+1V I_{OUT}=1µA to 30mA		3		mA
I_{OUTL}	ECO Mode Current threshold	V_{IN}=Set V_{OUT}+1V I_{OUT}=30mA to 1µA		0.6		mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V≤V_{IN}≤6V I_{OUT}=30mA	-0.20	0.02	0.20	%/V
RR	Ripple Rejection	Ripple 0.2Vp-p, V_{IN}=Set V_{OUT}+1V, I_{OUT}=30mA f=1kHz f=10kHz (In case that V_{OUT}<1.5V, V_{IN}=Set V_{OUT}+1.5V)		70 60		dB
V_{IN}	Input Voltage		1.4		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		50		mA
R_{PD}	CE Pull-down Constant Current		0.15	0.30	0.45	µA
V_{CEH}	CE Input Voltage "H"		1.0		6.0	V
V_{CEL}	CE Input Voltage "L"		0.0		0.4	V
en	Output Noise	BW=10Hz to 100kHz		30		µVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of B version)	V_{CE}=0V		40		Ω

(*1) While V_{OUT} ≦ 1.5V, the tolerance is ±15mV

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt=25°C

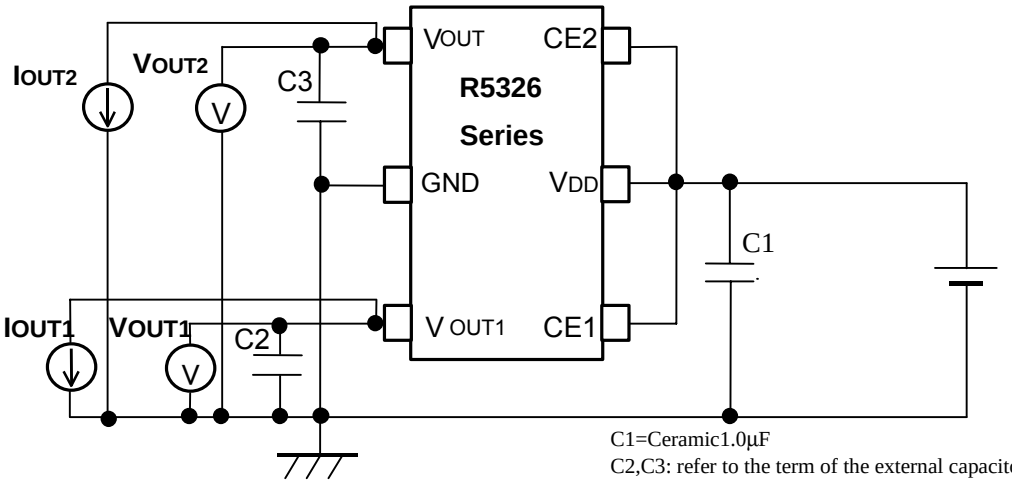
Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	Condition	Typ.	Max.
0.8≤V_{OUT}<0.9	I_{OUT}=150mA	0.62	0.87
0.9≤V_{OUT}<1.0		0.58	0.78
1.0≤V_{OUT}<1.2		0.48	0.69
1.2≤V_{OUT}<1.5		0.40	0.59
1.5≤V_{OUT}<2.0		0.31	0.48
2.0≤V_{OUT}<2.8		0.22	0.37
2.8≤V_{OUT}		0.19	0.27

* Recommended Ceramic capacitor for Output:

		Minimum Input Voltage	
		1.4V≤ V_{INMIN}<1.65V	1.65 V≤ V_{INMIN}
Output Voltage Range	0.8V≤V_{OUT}<1.2V	3.3µF or more	2.2µF or more
	1.2V≤V_{OUT}≤4.2V	3.3µF or more	1.0 µF or more

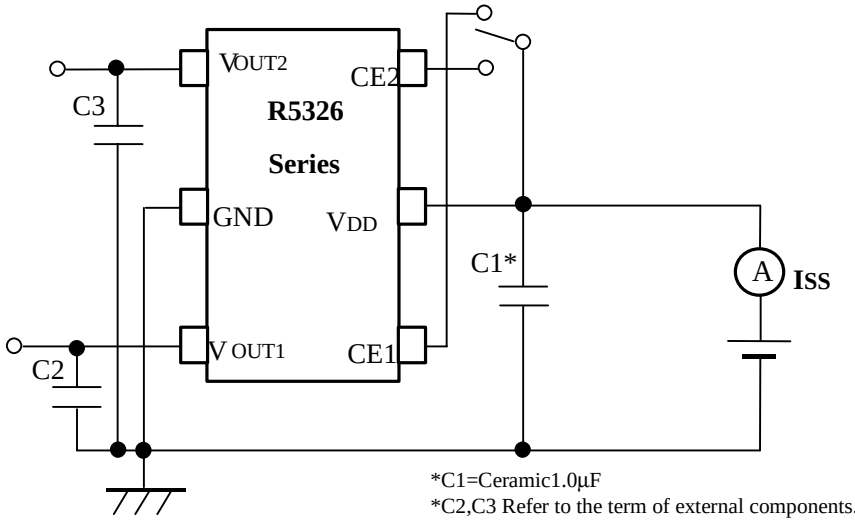
*Output Capacitors
3.3µF (Murata) GRM219B31A335KE18B
2.2µF (Murata) GRM155B30J225M
1.0µF (Murata) GRM155B31A105KE15

TEST CIRCUITS



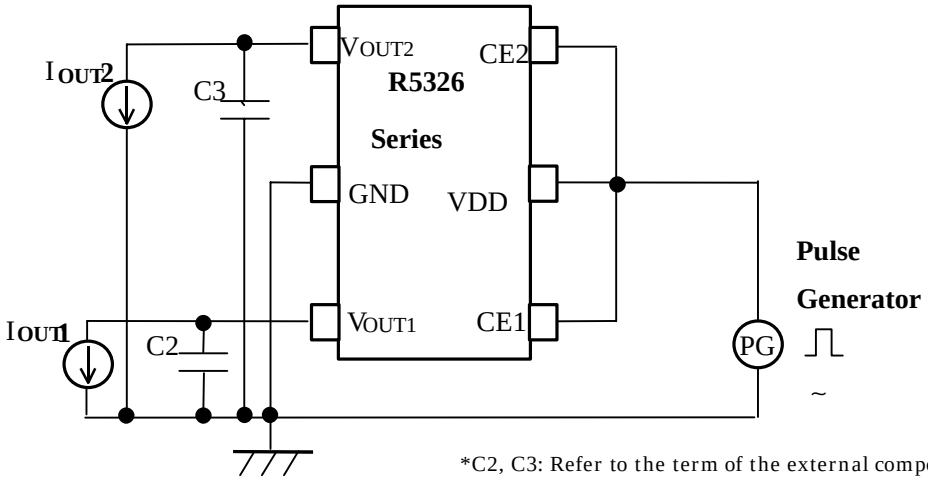
C1=Ceramic1.0µF
C2,C3: refer to the term of the external capacitors

Standard Test Circuit



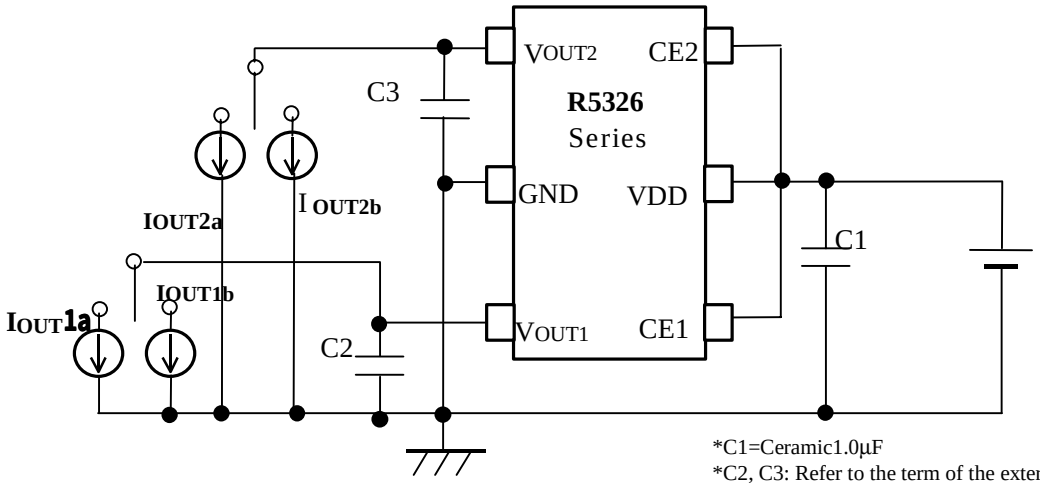
*C1=Ceramic1.0µF
*C2,C3 Refer to the term of external components.

Supply Current



*C2, C3: Refer to the term of the external components.

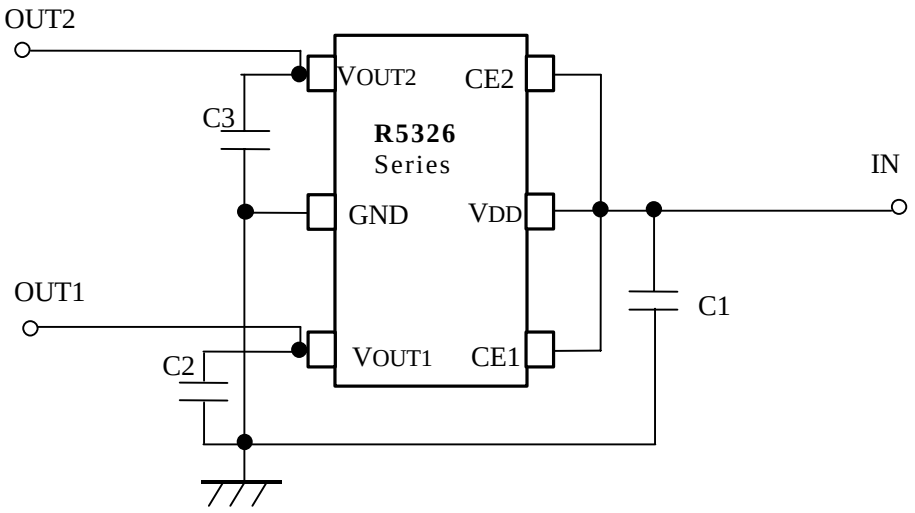
Ripple Rejection, Input Transient Response Test Circuit



*C1=Ceramic1.0µF
*C2, C3: Refer to the term of the external components

Load Transient Response Test Circuit

TYPICAL APPLICATION



(External Components) Output Capacitor; Ceramic Type
C1: 1μF Ceramic
C2, C3:

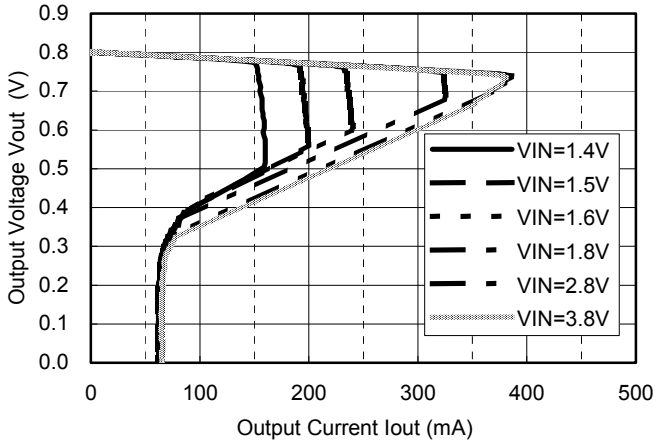
		Minimum Input Voltage	
		1.4V≤ V_{INMIN}<1.65V	1.65 V≤ V_{INMIN}
Output Voltage Range	0.8V≤V_{OUT}<1.2V	3.3μF or more	2.2μF or more
	1.2V≤V_{OUT}≤4.2V	3.3μF or more	1.0 μF or more

*Output Capacitors
3.3μF (Murata) GRM219B31A335KE18B
2.2μF (Murata) GRM155B30J225M
1.0μF (Murata) GRM155B31A105KE15

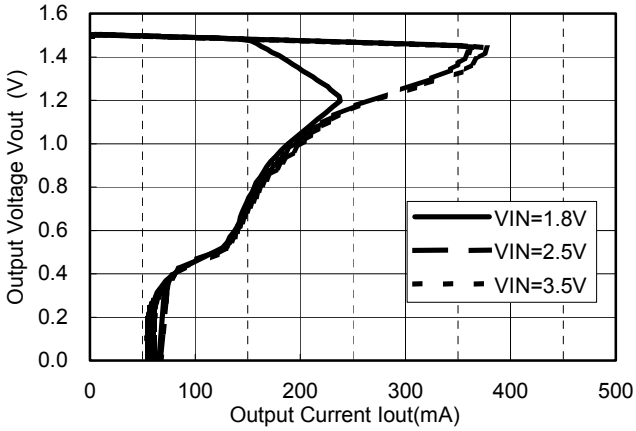
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

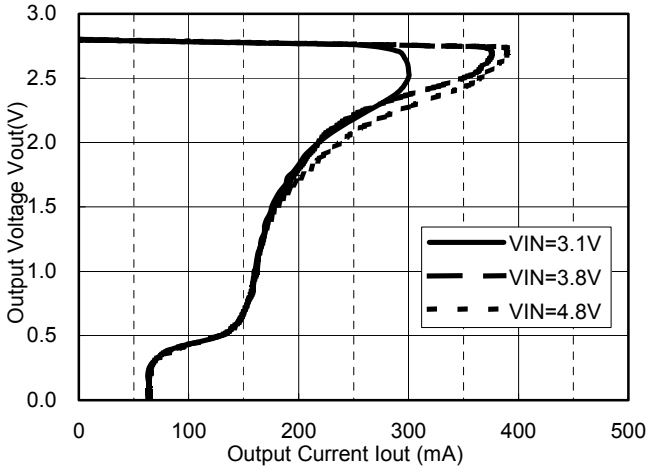
VOUT=0.8V



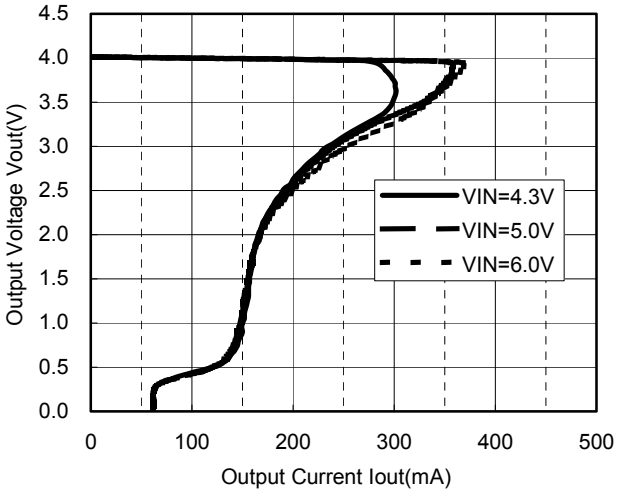
VOUT=1.5V



VOUT=2.8V

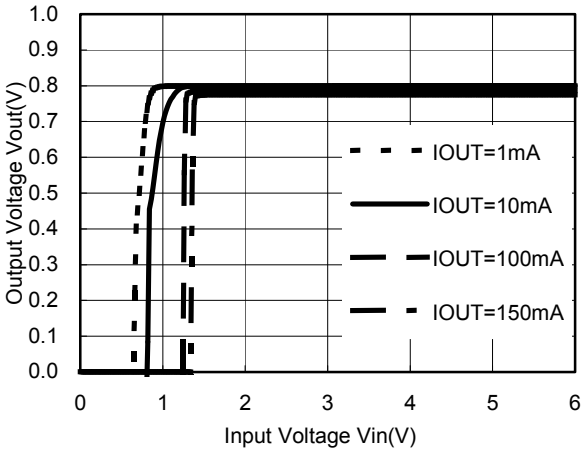


VOUT=4.0V

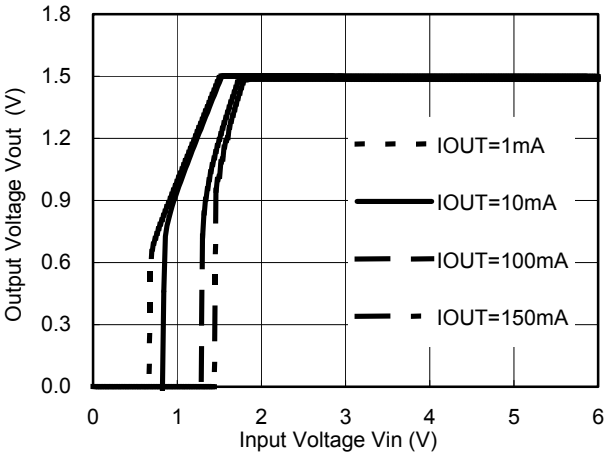


2) Input Voltage vs. Output Voltage

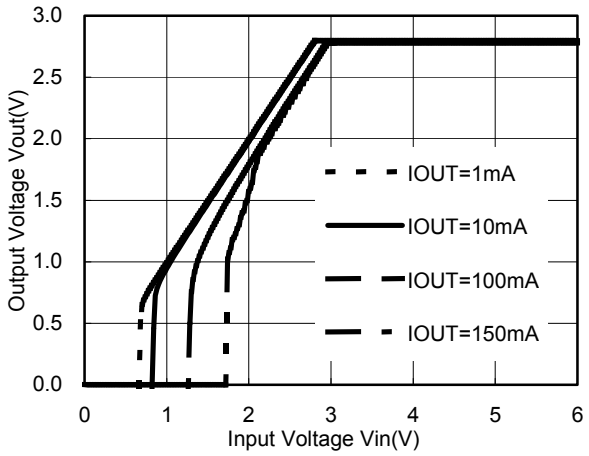
VOUT=0.8V



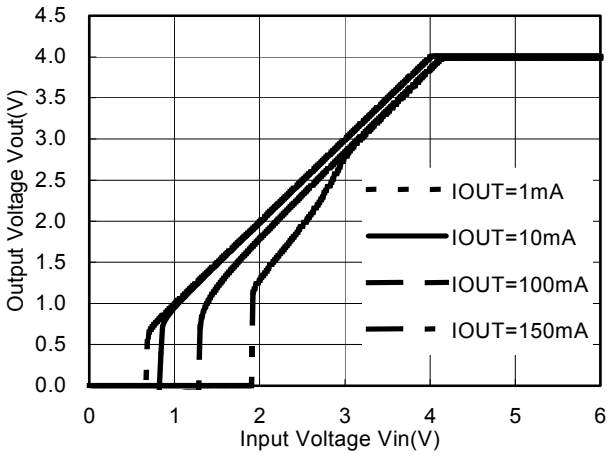
VOUT=1.5V



VOUT=2.8V

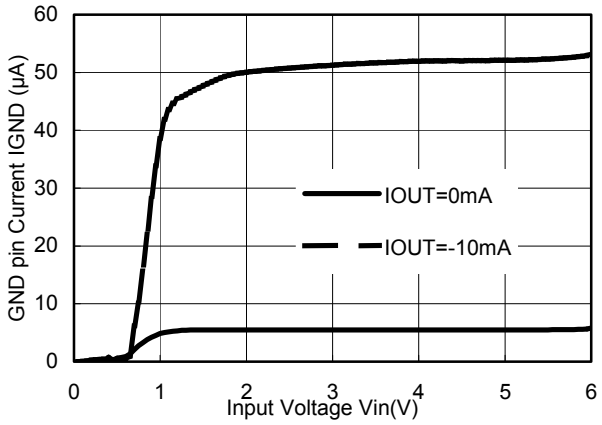


VOUT=4.0V

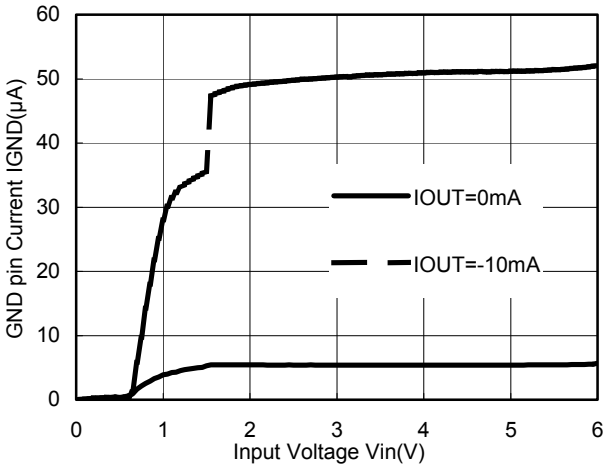


3) GND pin Current vs. Input Voltage

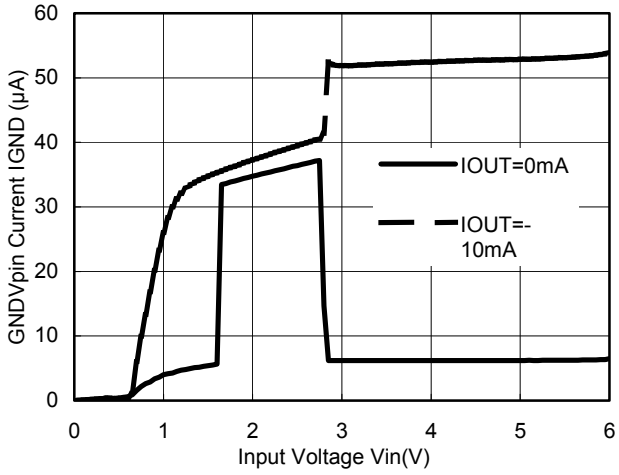
VOUT=0.8V



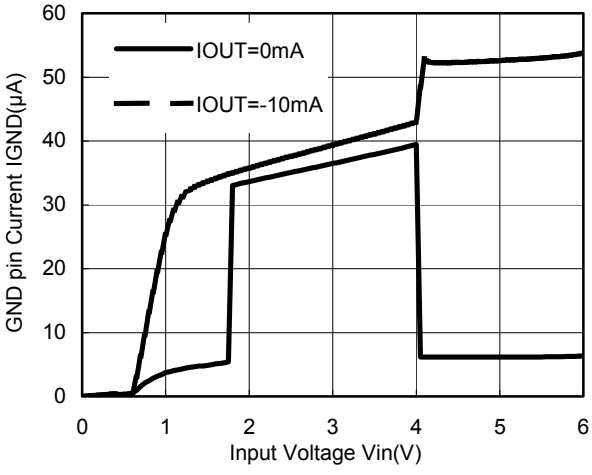
VOUT=1.5V



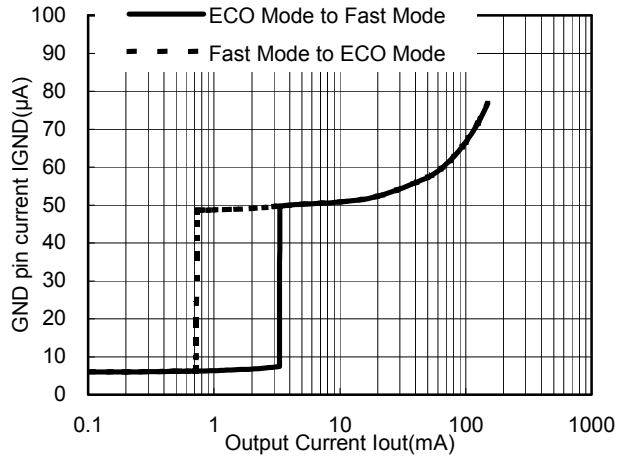
VOUT=2.8V



VOUT=4.0V

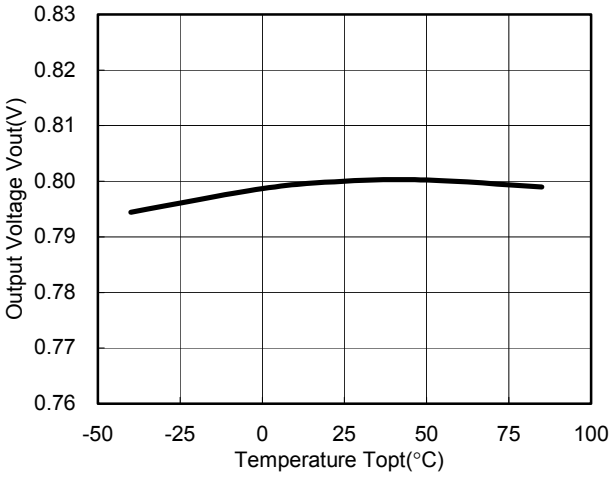


4) GND pin current vs. Output current

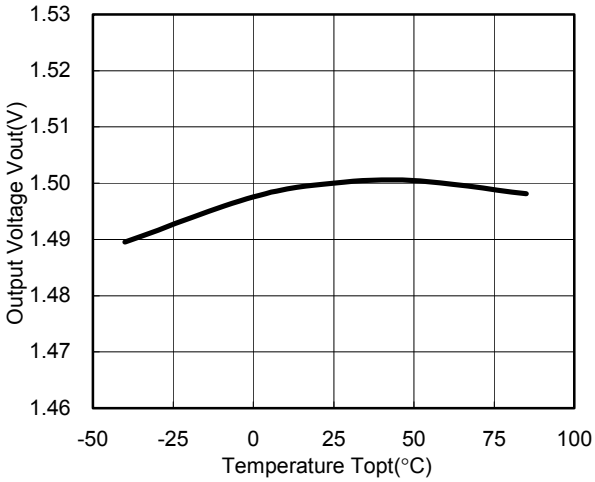


5) Output Voltage vs. Temperature

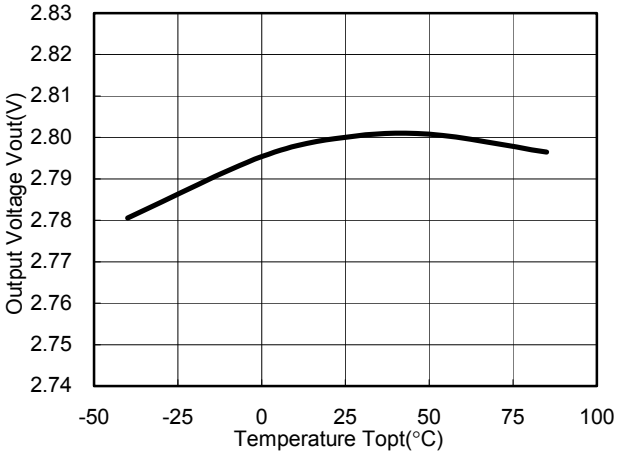
VOUT=0.8V



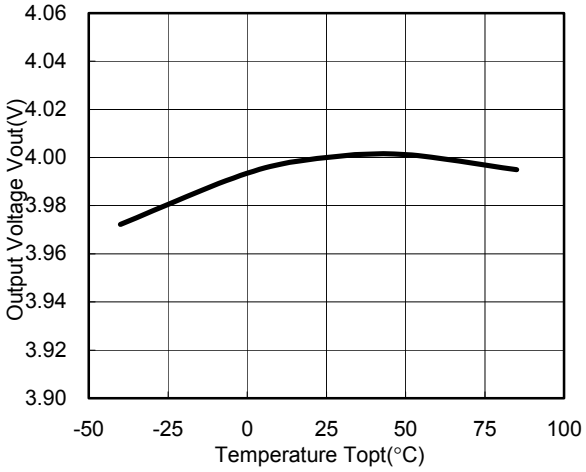
VOUT=1.5V



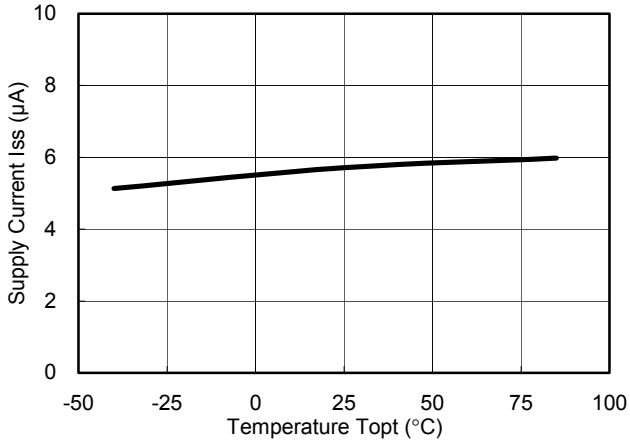
VOUT=2.8V



VOUT=4.0V

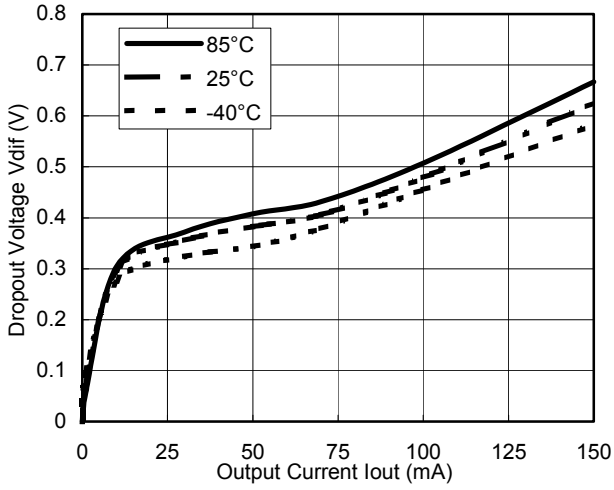


6) Supply Current vs. Temperature (Iout=0mA)

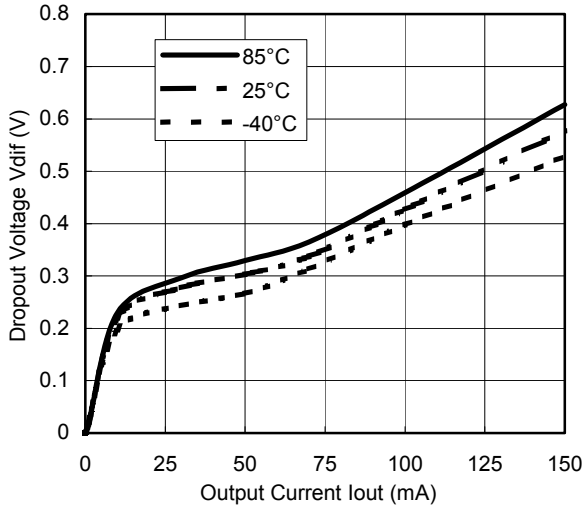


7) Dropout Voltage vs. Output Current

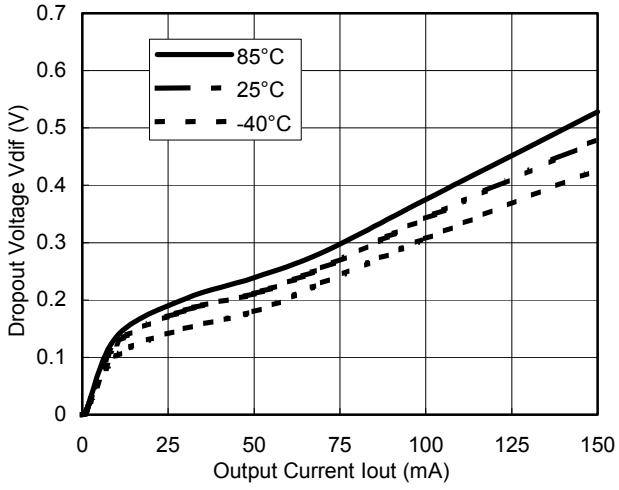
VOUT=0.8V



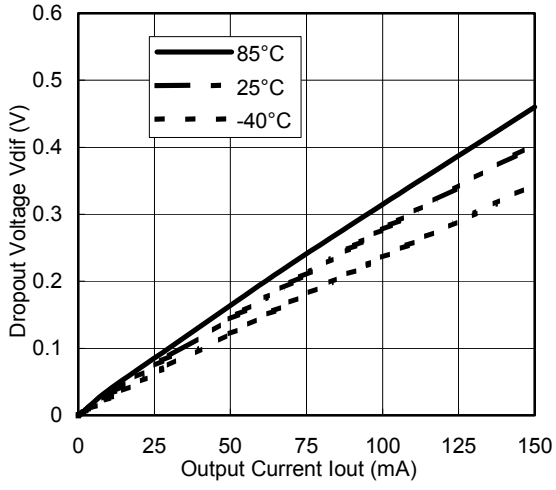
VOUT=0.9V



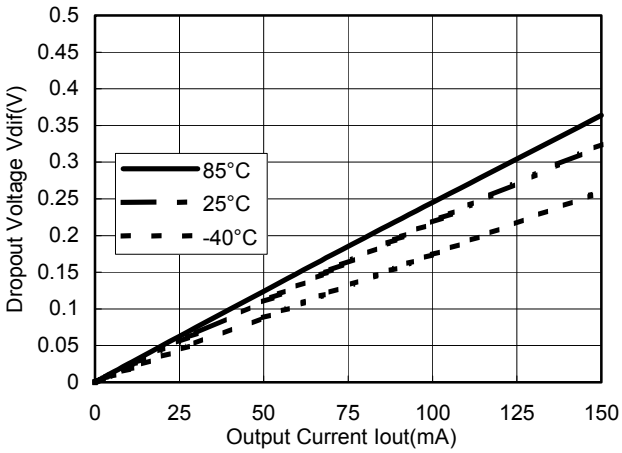
VOUT=1.0V



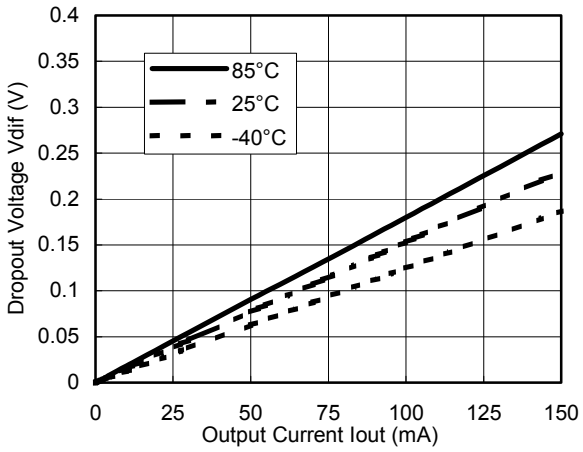
VOUT=1.2V



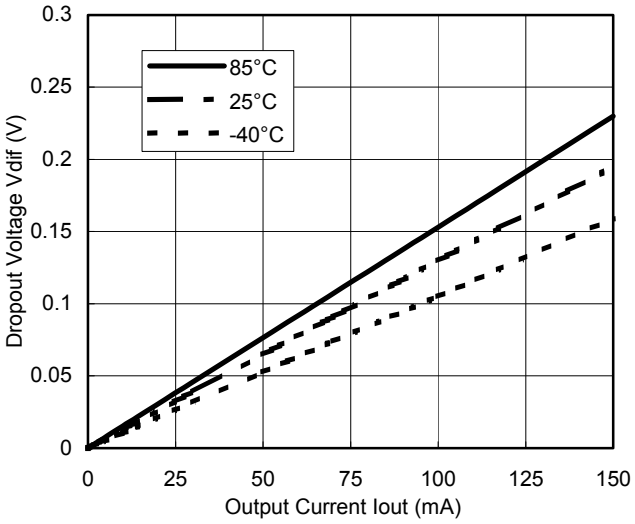
VOUT=1.5V



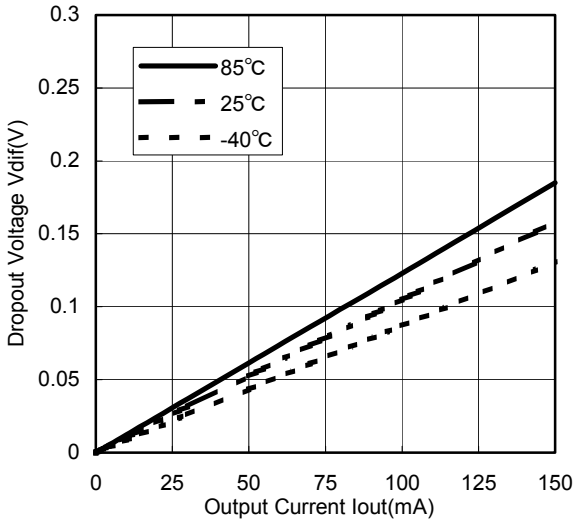
VOUT=2.0V



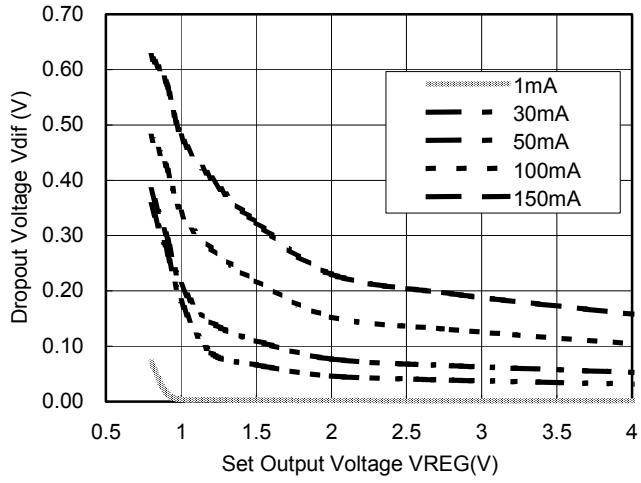
VOUT=2.8V



VOUT=4.0V

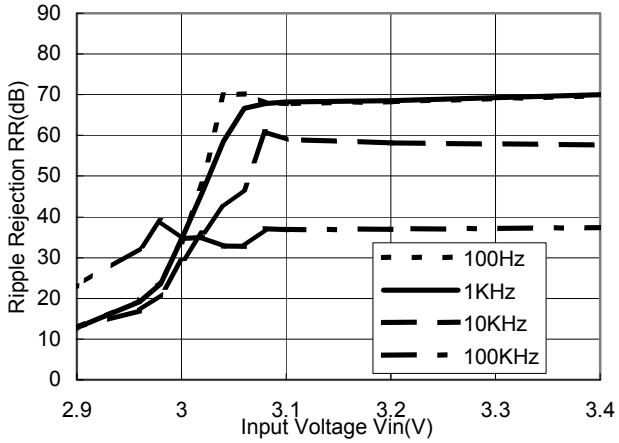


8) Dropout Voltage vs. Set Output Voltage

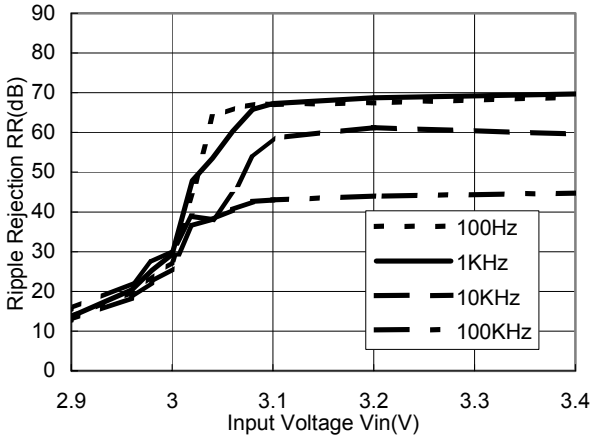


9) Ripple Rejection vs. Input Voltage (Topt=25°C, VOUT=2.8V, Ripple 0.5Vp-p, Cin=none, Cout=Ceramic 1.0μF)

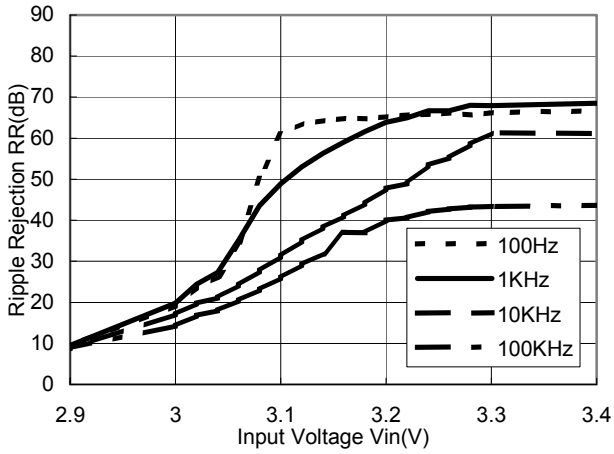
Iout=1mA



Iout=10mA

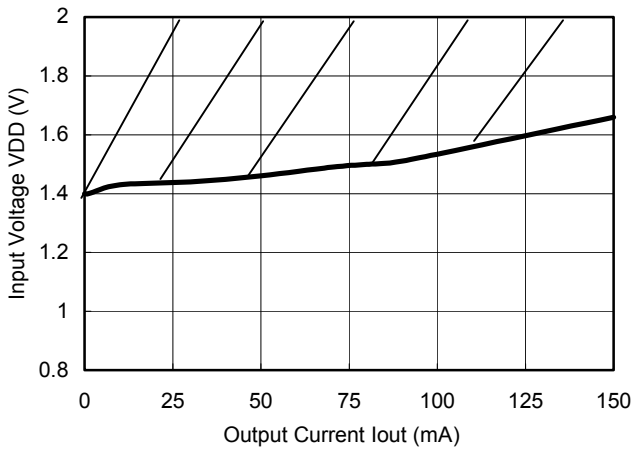


Iout=50mA



10) Minimum Operating Voltage

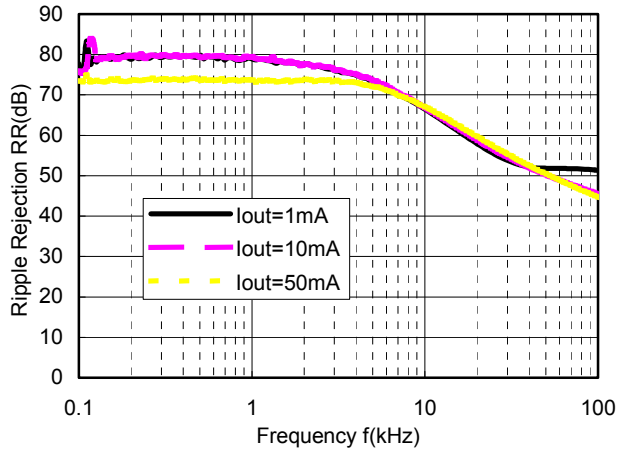
Vout=0.8V



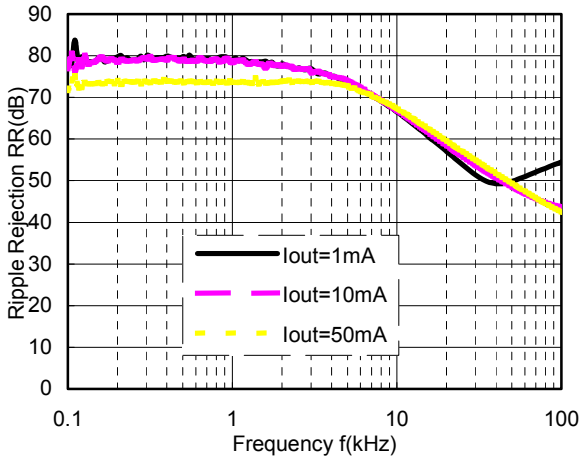
Hatched area is available for 0.8V output type.

11) Ripple Rejection vs Frequency (Cin=none)

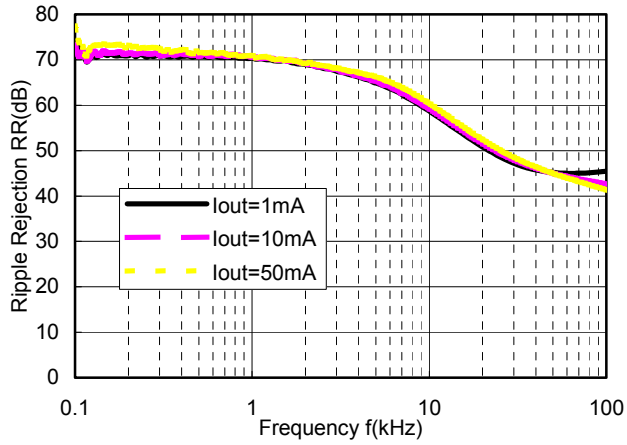
Vout=0.8V, Vin=2.2VDC+0.5Vp-p, Cout=Ceramic 2.2µF



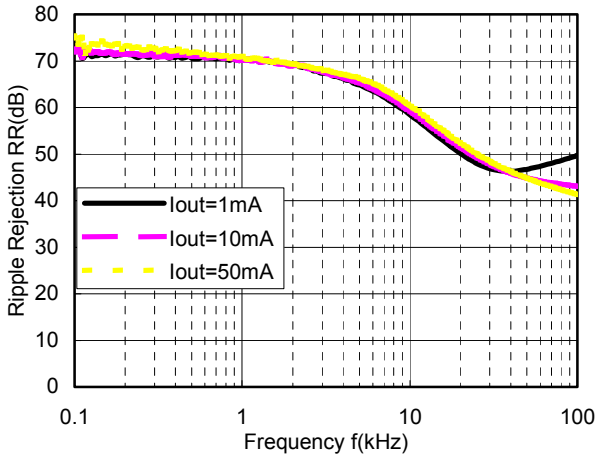
Vout=0.8V, Vin=2.2VDC+0.5Vp-p, Cout=Ceramic 3.3µF



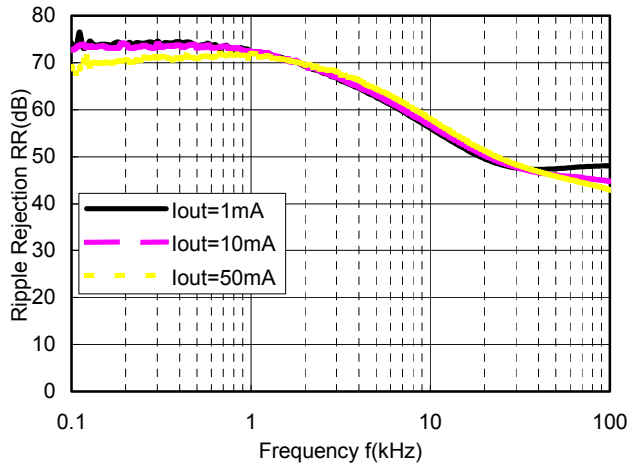
Vout=1.5V, Vin=2.5VDC+0.5Vp-p, Cout=Ceramic 1.0µF



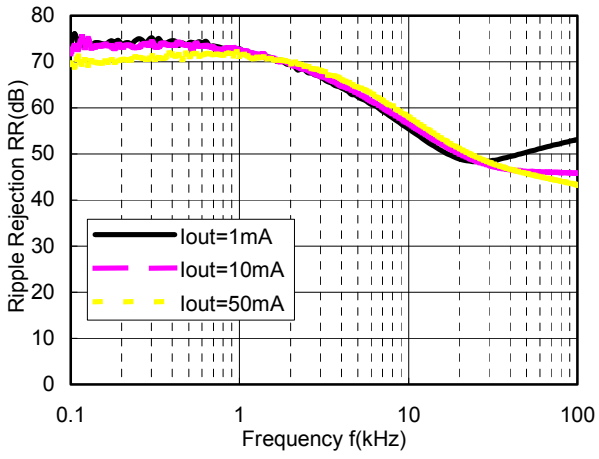
Vout=1.5V, Vin=2.5VDC+0.5Vp-p, Cout=Ceramic 2.2µF



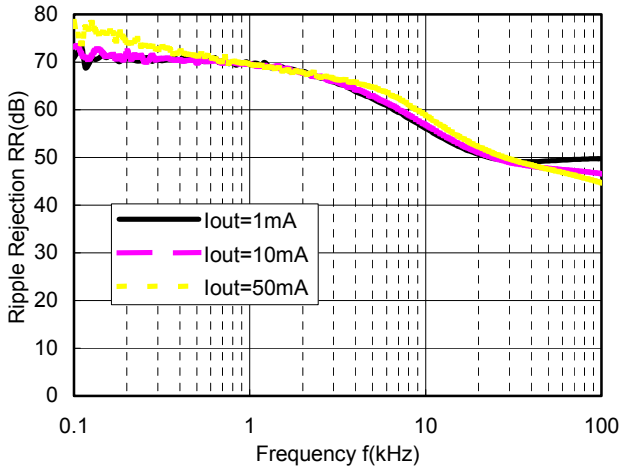
Vout=2.8V, Vin=3.8VDC+0.5Vp-p, Cout=Ceramic 1.0µF



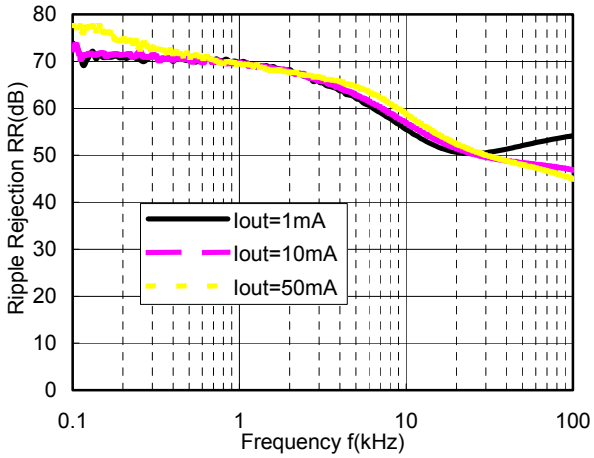
Vout=2.8V, Vin=3.8VDC+0.5Vp-p, Cout=Ceramic 2.2µF



out=4.0V, Vin=5.0VDC+0.5Vp-p, Cout=Ceramic 1.0µF

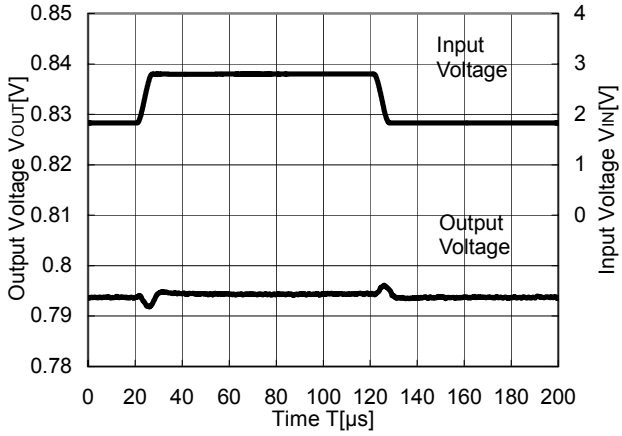


Vout=4.0V, Vin=5.0VDC+0.5Vp-p, Cout=Ceramic 2.2µF

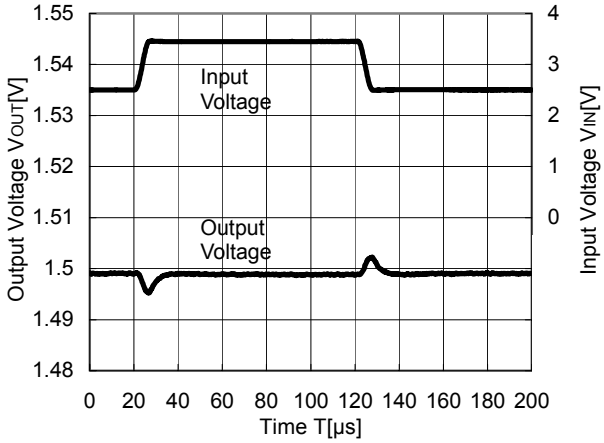


12)Input Transient Response (Iout=30mA,tr=tf=5µs, Cin=none)

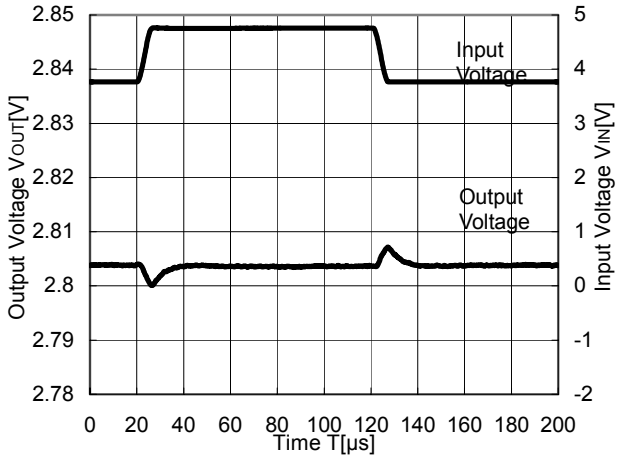
Vout=0.8V, Cout=2.2µF



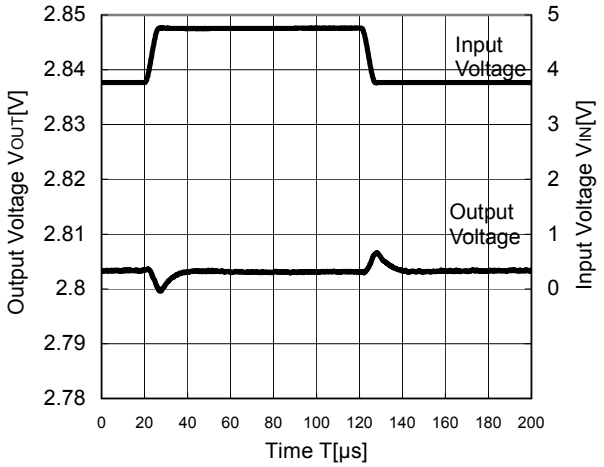
Vout=1.5V, Cout=1.0µF



Vout=2.8V, Cout=1.0µF

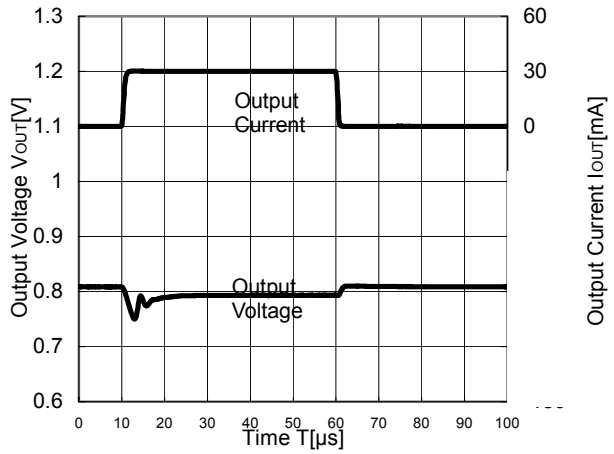


Vout=4.0V, Cout=1.0µF

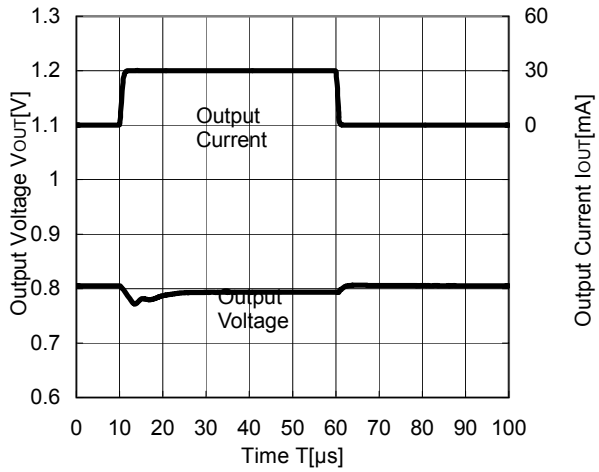


13) Load Transient Response (Tr=Tf=0.5µs, CIN=1.0µF)

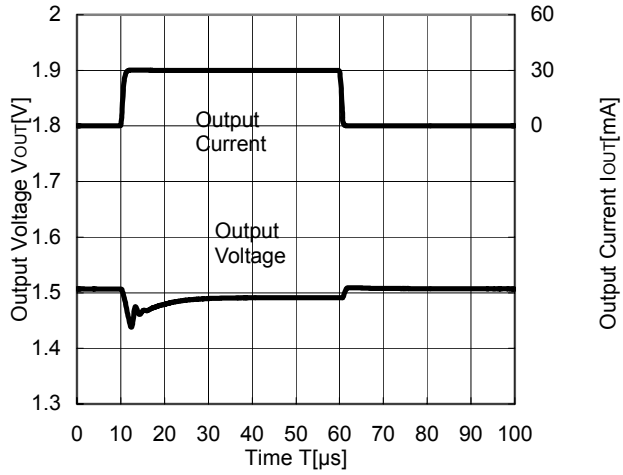
Vout=0.8V, COUT=Ceramic 2.2µF



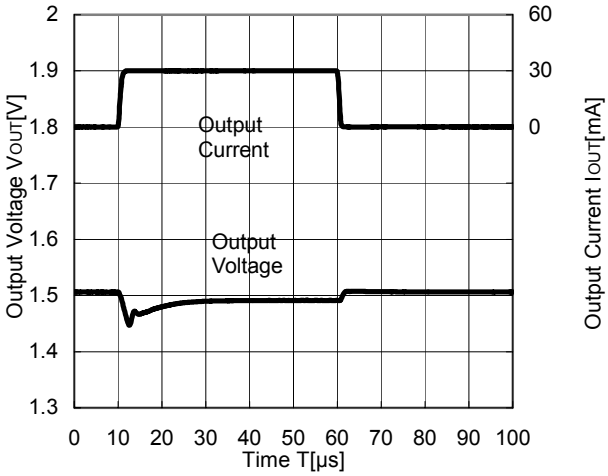
Vout=0.8V, COUT=Ceramic 3.3µF



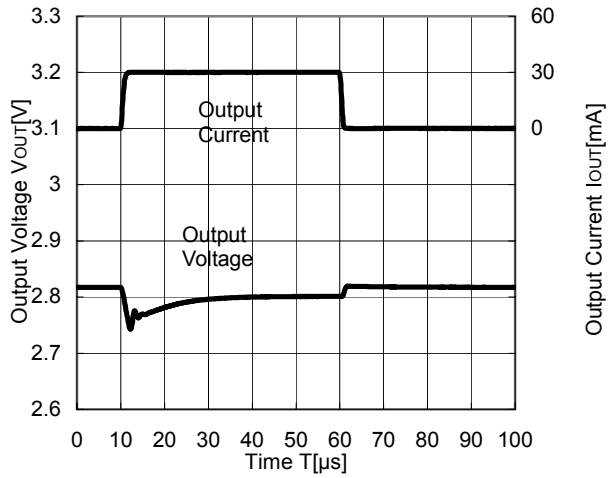
Vout=1.5V, COUT=Ceramic 1.0µF



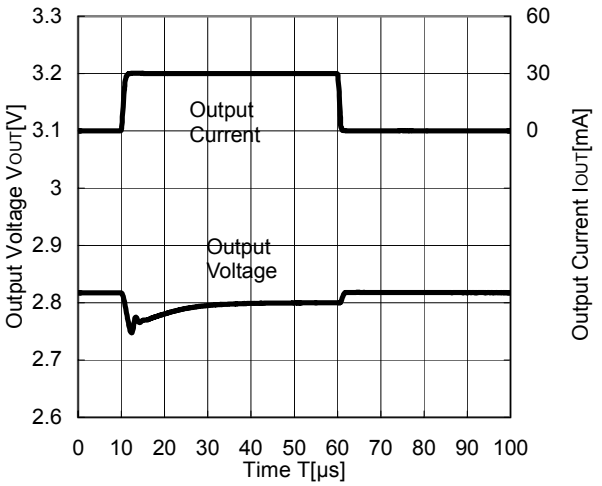
Vout=1.5V, COUT=Ceramic 2.2µF



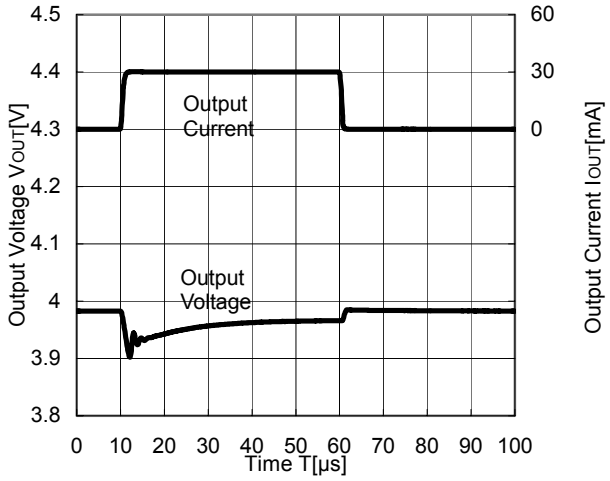
Vout=2.8V, COUT=Ceramic 1.0µF



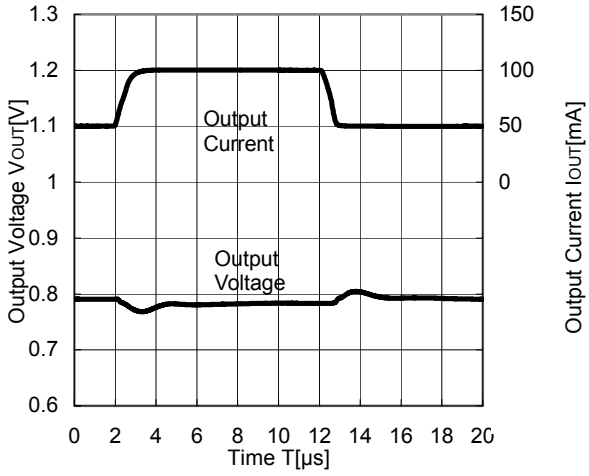
Vout=2.8V, COUT=Ceramic 2.2µF



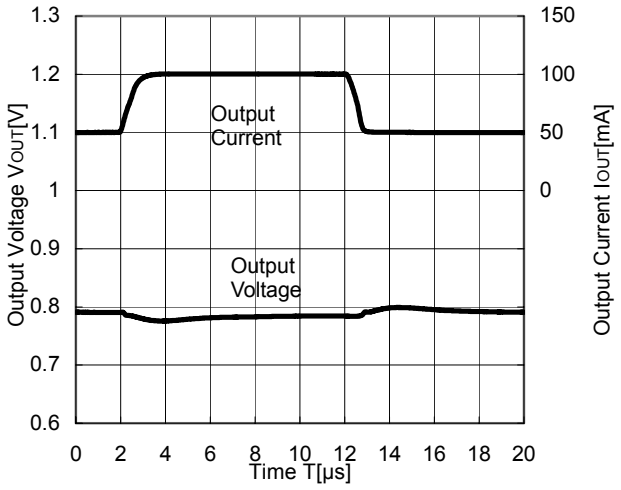
Vout=4.0V, COUT=Ceramic 1.0µF



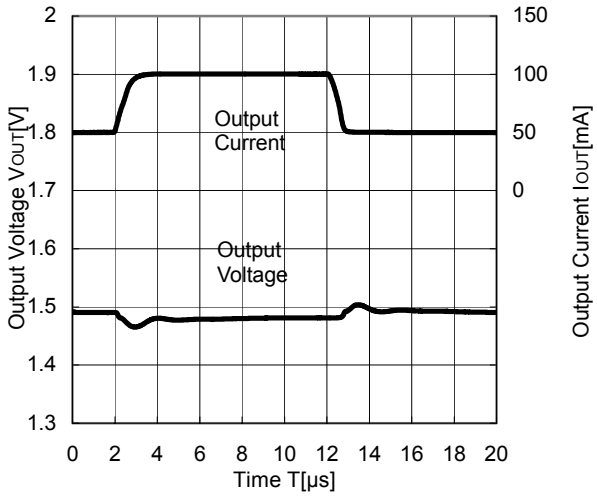
Vout=0.8V, COUT=Ceramic 2.2µF



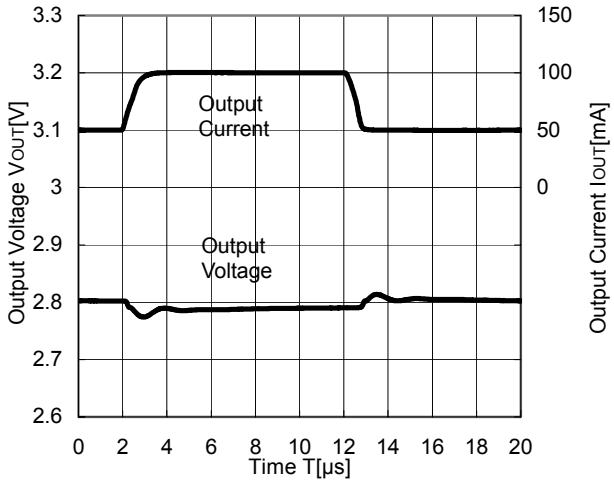
Vout=0.8V, COUT=Ceramic 3.3µF



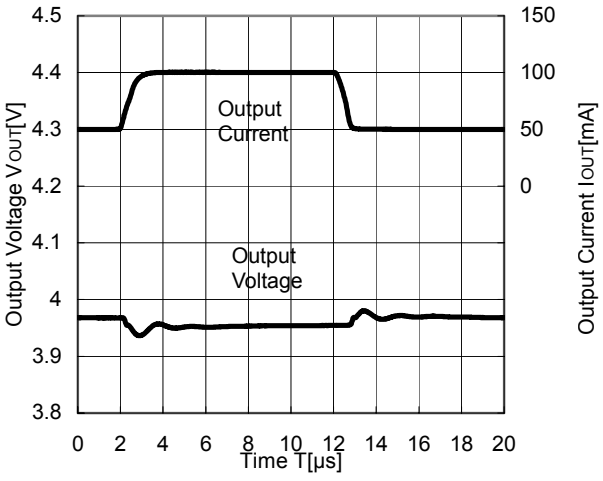
Vout=1.5V, COUT=Ceramic 1.0µF



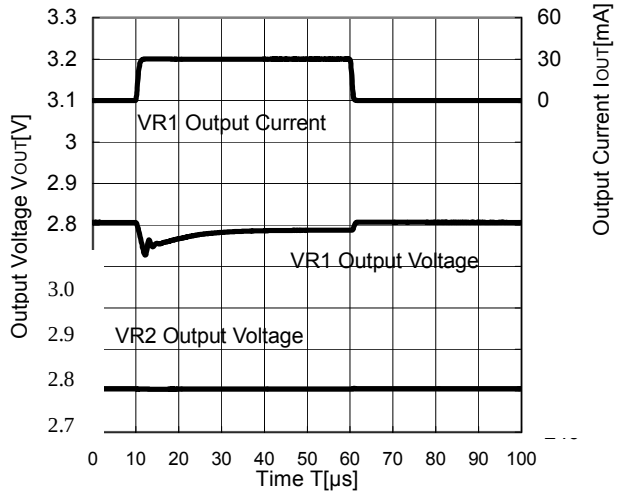
Vout=2.8V, COUT=Ceramic 1.0µF



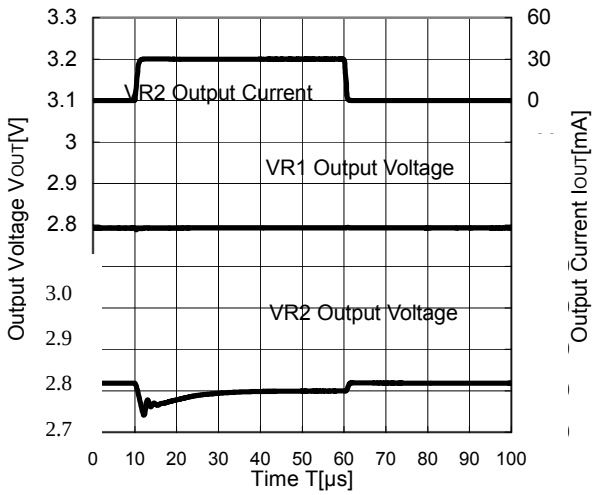
Vout=4.0V, COUT=Ceramic 1.0µF



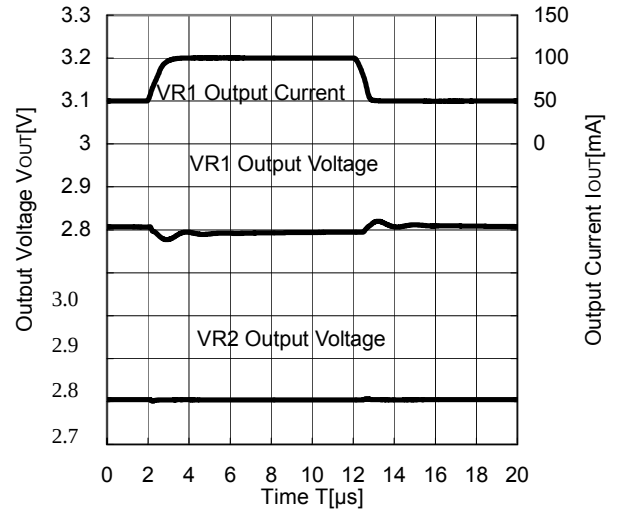
Vout=2.8V, COUT=Ceramic 1.0µF



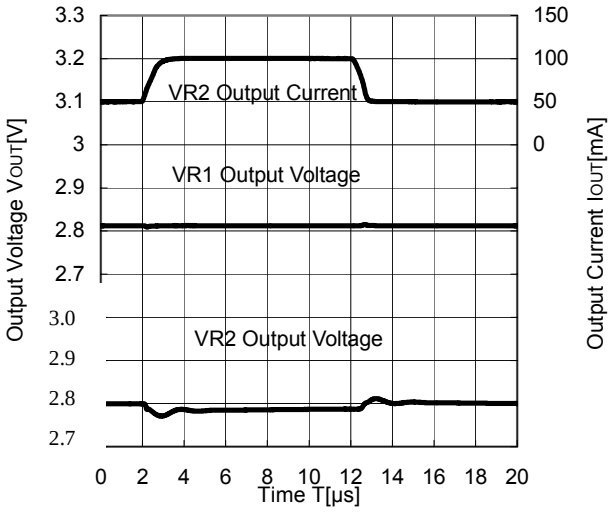
Vout=2.8V, COUT=Ceramic 1.0µF



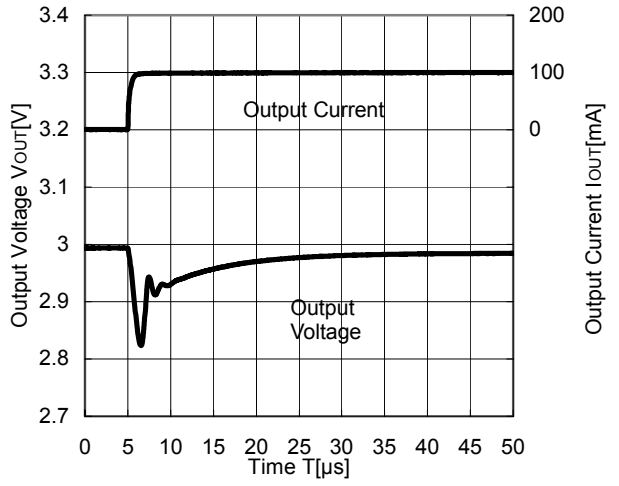
Vout=2.8V, COUT=Ceramic 1.0µF



Vout=2.8V, COUT=Ceramic 1.0µF

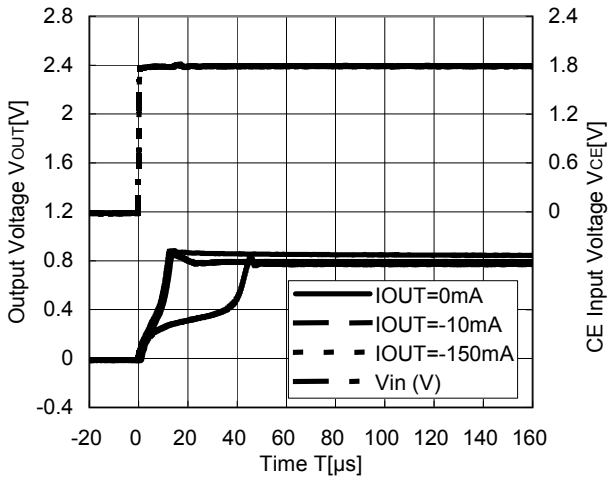


Vout=3.0V, Tr=Tf=10ns, Cout=Ceramic 1.0µF

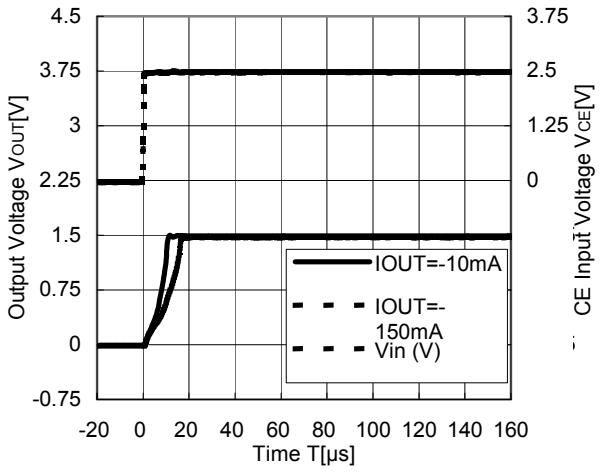


14) Turn on speed with CE signal (Cin=Ceramic 1.0µF)

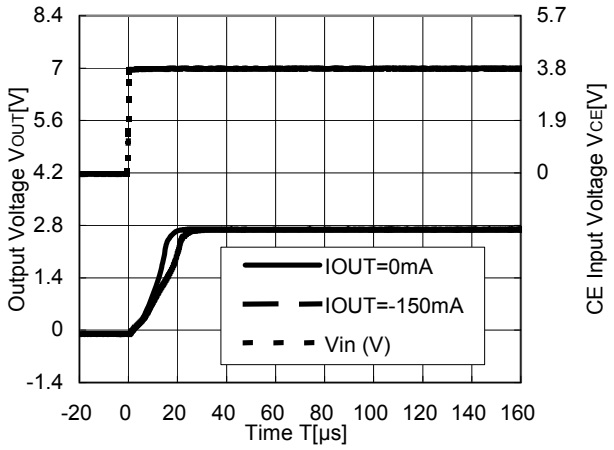
Vout=0.8V, Vin=1.8V, Cout=Ceramic 2.2µF



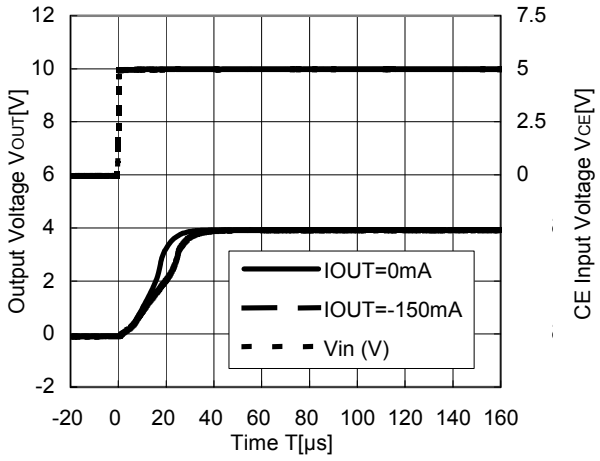
Vout=1.5V, Vin=2.5V, Cout=Ceramic 1.0µF



Vout=2.8V, Vin=3.8V, Cout=Ceramic 1.0µF

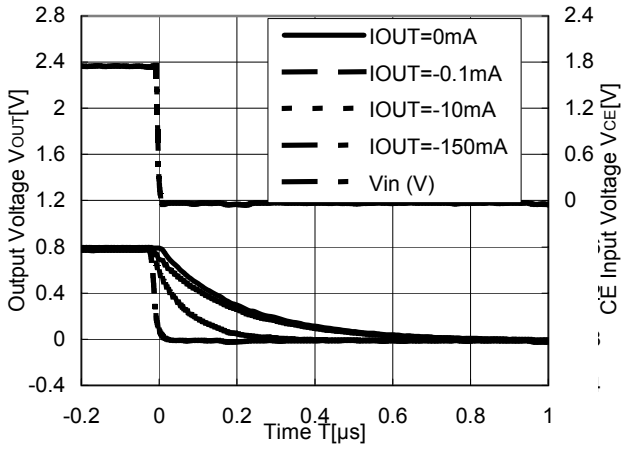


Vout=4.0V, Vin=5.0V, Cout=Ceramic 1.0µF

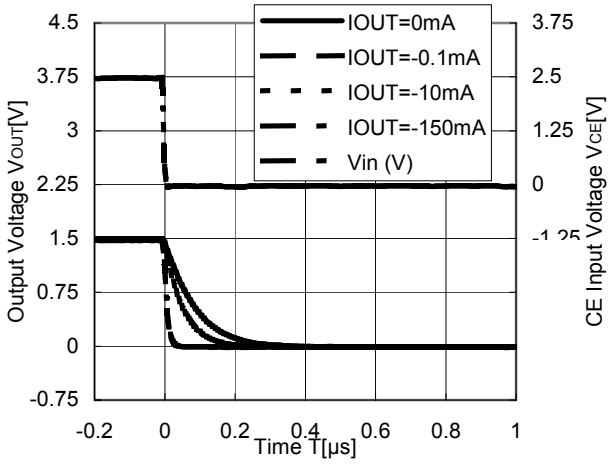


15) Turn off speed with CE signal (Cin=Ceramic 1.0µF)

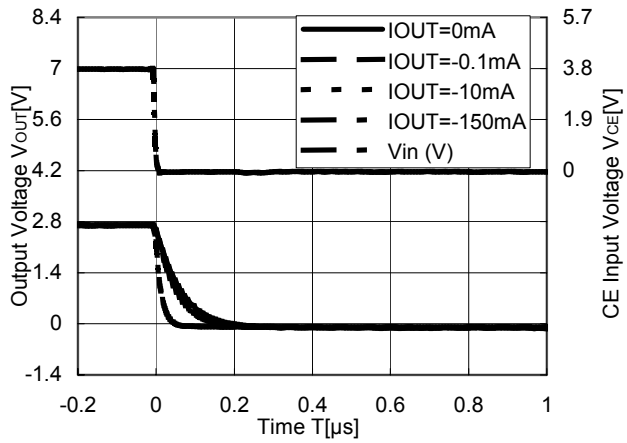
Vout=0.8V, Vin=1.8V, Cout=Ceramic 2.2µF



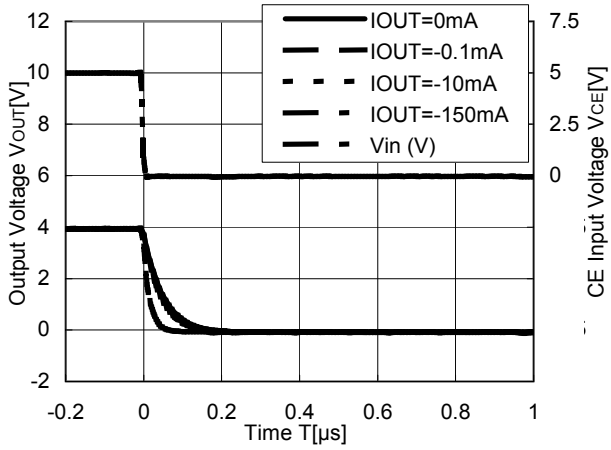
Vout=1.5V, Vin=2.5V, Cout=Ceramic 1.0µF



Vout=2.8V, Vin=3.8V, Cout=Ceramic 1.0µF

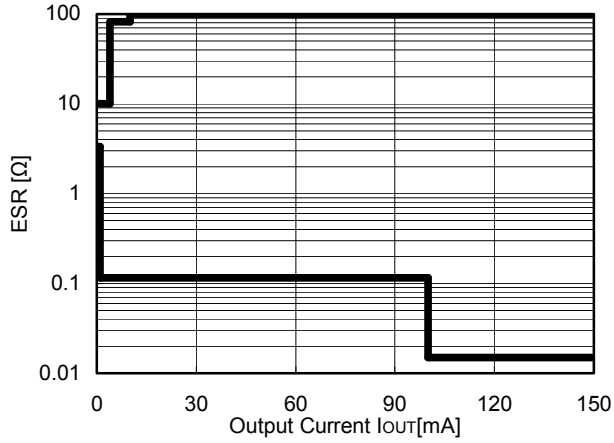


Vout=4.0V, Vin=5.0V, Cout=Ceramic 1.0µF

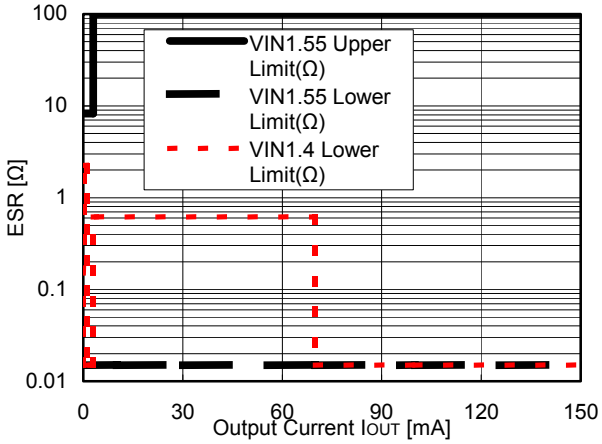


15) Acceptable Equivalent Series Resistance vs. Output Current (Inside area of the borders means the stable area. Cin=Ceramic 1.0µF)

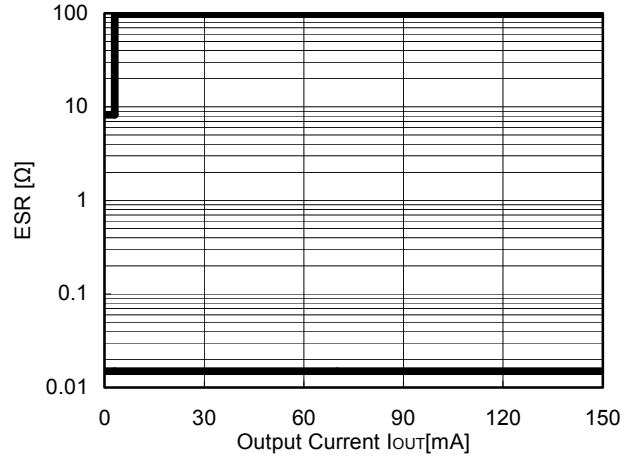
Vout=0.8V, VIN=1.4V to 6.0V, Cout=Ceramic 1.0µF murata)



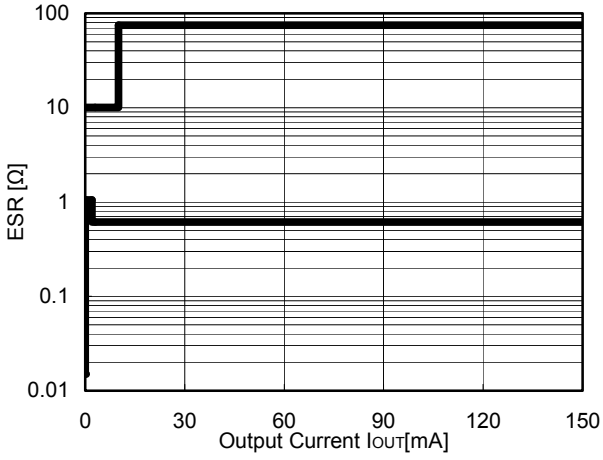
Vout=0.8V, VIN=1.55V to 6.00V, Cout=Ceramic 2.2µF murata)



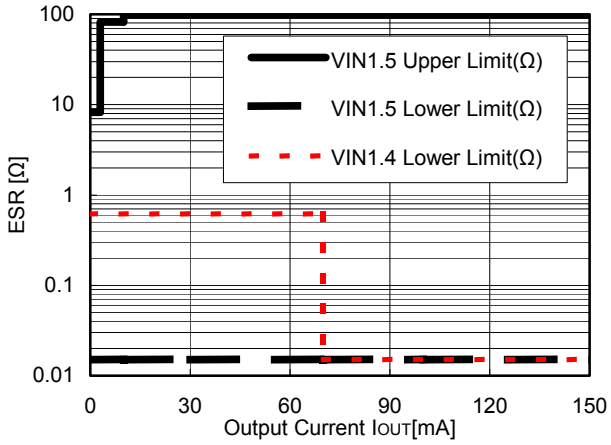
Vout=0.8V, VIN=1.4V to 6.0V, Cout=Ceramic 3.3µF murata)



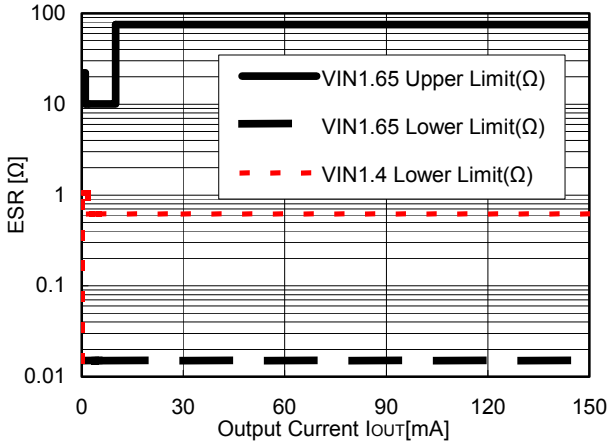
Vout=1.0V, VIN=1.4V to 6.0V, Cout=Ceramic 1.0µF murata)



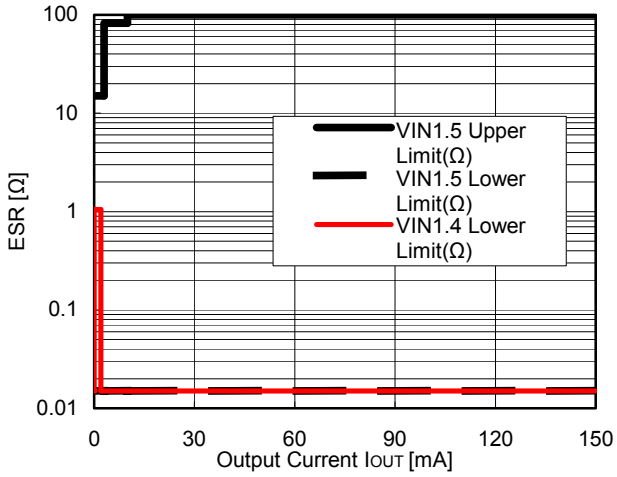
Vout=1.0V, VIN=1.5V to 6.0V, Cout=Ceramic 2.2µF murata)



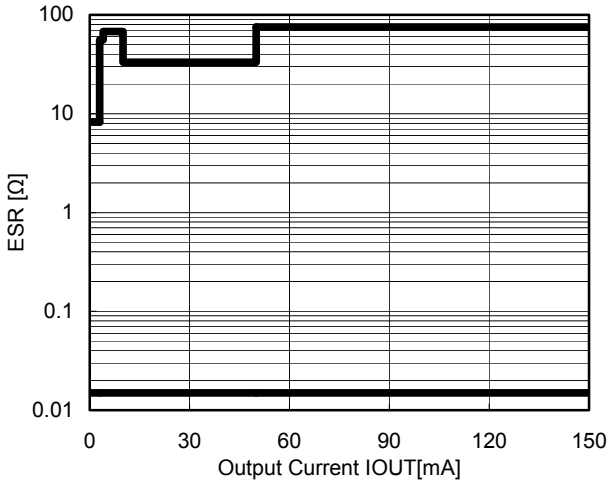
Vout=1.2V, VIN=1.65V to 6.00V, Cout=Ceramic 1.0µF murata)



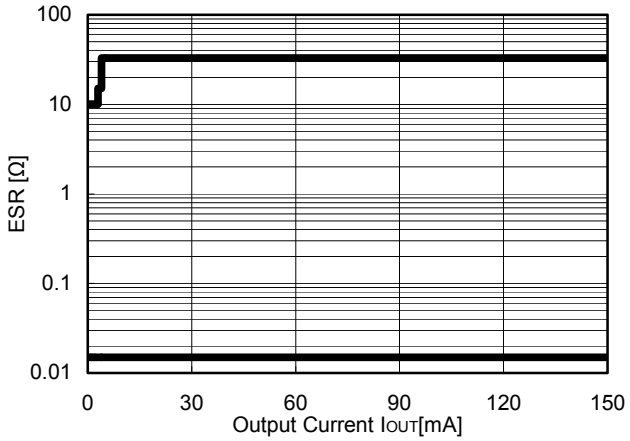
Vout=1.2V, VIN=1.5V to 6.0V, Cout=Ceramic 2.2µF murata)



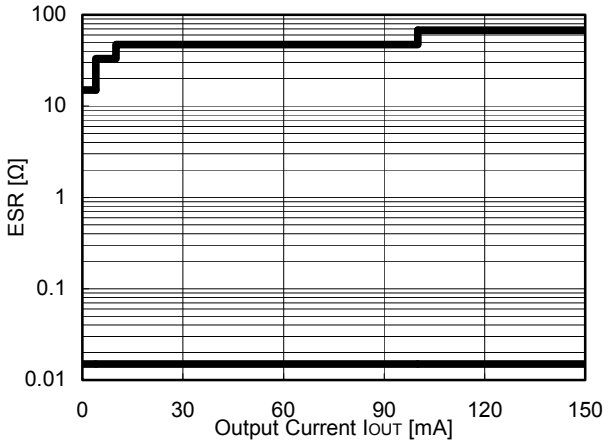
Vout=1.2V, VIN=1.4V to 6.0V, Cout=Ceramic 3.3µF murata)



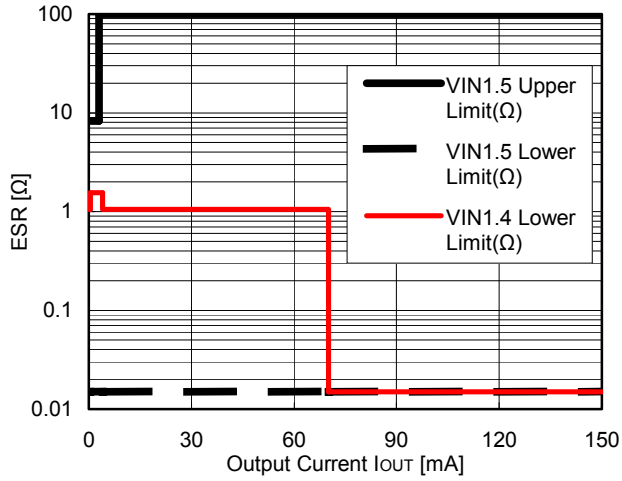
Vout=2.8V, VIN=2.8V to 6.0V, Cout=Ceramic 1.0µF murata)



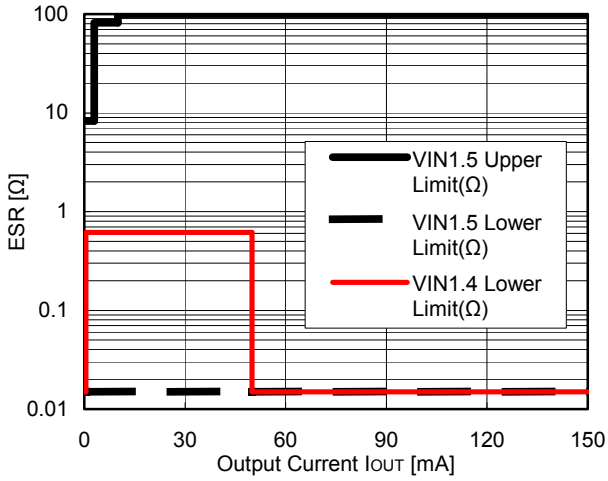
Vout=4.0V, VIN=4.0V to 6.0V, Cout=Ceramic 1.0µF murata)



Vout=0.8V, VIN=1.5V to 6.0V, Cout=Ceramic 2.2µF kyocera)



Vout=1.0V, VIN=1.5V to 6.0V, Cout=Ceramic 2.2µF kyocera)



Vout=1.2V, VIN=1.45V to 6.00V, Cout=Ceramic 2.2µF kyocera)