RICOH

R1118x SERIES

AUTOMATIC MODE SHIFT / 150mA LOW VOLTAGE REGULATOR

NO.EA-175-120404

OUTLINE

R1118x Series are CMOS-based voltage regulator ICs with ultra low supply current (Typ.5.5μA), and remarkable improved transient response compared with the conventional low supply current voltage regulator. The supply current of these ICs is automatically shifts between fast mode and low power mode, it depending on the load current. The current threshould is fixed internally. R1118x shifts from low power mode to fast response mode at I_{OUT}=7mA (Typ.) and shifts fast response mode to low power mode at I_{OUT}=2mA (Typ.).

These ICs are capable of the low input voltage (Min.1.4V) and the output voltage range from 0.8V is possible. The output voltage of R1118x is fixed in the IC.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resister net for setting output voltage, a current limit circuits for over-current.

A standby mode with ultra low supply current can be realized with the chip enable function.

Since the packages for these ICs are SOT-23-5 (Limited) and DFN(PLP)1612-4B, therefore high density mounting of the ICs on boards is possible.

FEATURES

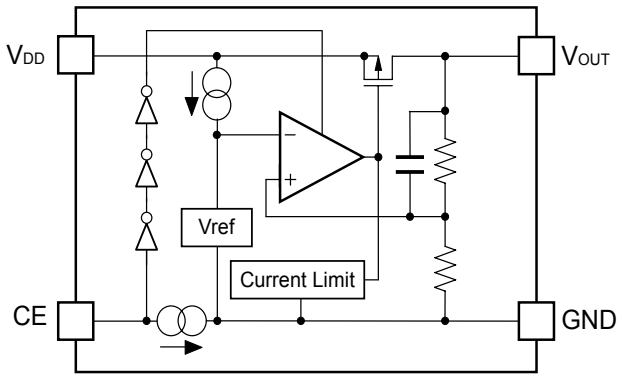
- Supply Current (Low power Mode) ..... Typ. 5.5μA (I_{OUT}=0mA)
- Supply Current (Fast Mode)..... Typ. 50μA (I_{OUT}=11mA)
- Supply Current (Standby Mode)..... Typ. 0.1 μA
- Ripple Rejection ..... Typ. 70dB (f=1kHz)
  Typ. 60dB (f=10kHz)
- Input Voltage Range..... 1.4V to 6.0V
- Output Voltage Range..... 0.8V to 4.2V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy..... ±1.0% (1.5V < V_{OUT} ≦ 3.5V, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Dropout Voltage..... Typ. 0.27V (I_{OUT}=150mA, V_{OUT}=2.8V)
- Line Regulation ..... Typ. 0.02%/V
- Packages..... DFN(PLP)1612-4B, SOT-23-5 (Limited)
- Built-in Fold Back Protection Circuit..... Typ. 40mA
- Ceramic capacitors are recommended to be used with this IC 1.0μF

APPLICATIONS

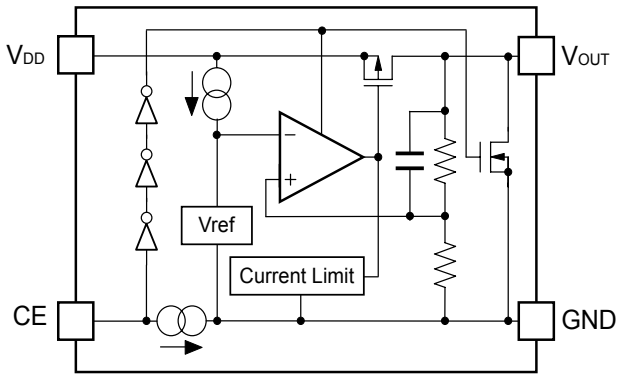
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

R1118xxx1B



R1118xxx1D



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1118Kxx1∗-TR	DFN(PLP)1612-4B	5,000 pcs	Yes	Yes
R1118Nxx1∗-TR-FE	SOT-23-5 (Limited)	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 0.8V(08) to 4.2V(42) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : CE pin polarity and auto discharge function at off state are options as follows.
(B) "H" active, without auto discharge function at off state
(D) "H" active, with auto discharge function at off state

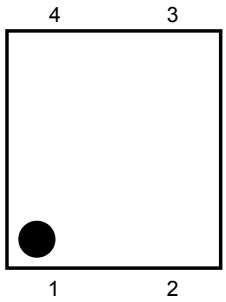
The products scheduled to be discontinued (be sold to limited customer) : "Limited"

These products will be discontinued in the future. You can not select these products newly.
We will provide these products to the customer who has been using or has ordered them before.
But we recommend changing to other products as soon as possible.

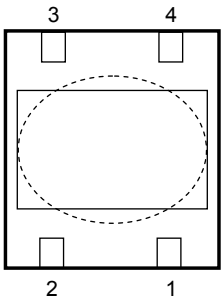
PIN CONFIGURATIONS

● **DFN(PLP)1612-4B**

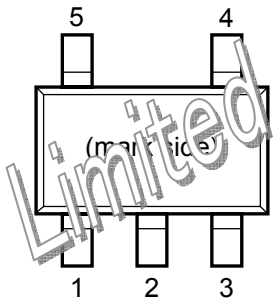
Top View



Bottom View



● **SOT-23-5**



PIN DESCRIPTIONS

● **DFN(PLP)1612-4B**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{DD}	Input Pin

∗) 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.

● **SOT-23-5 (Limited)**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	NC	No Connection
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to 6.5	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
I_{OUT}	Output Current (DC)	180	mA
P_D	Power Dissipation (DFN(PLP)1612-4B)*	580	mW
	Power Dissipation (SOT-23-5) (Limited)*	420	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	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.

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.

ELECTRICAL CHARACTERISTICS

- **R1118xxx1B/D**

  V_{IN}=Set V_{OUT}+1V, I_{OUT}=1mA, unless otherwise noted.

  The specification in ☐ is checked and guaranteed by design engineering at −40°C ≦ Topt ≦ 85°C, unless otherwise noted.

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	V_{OUT} ≦ 1.5V	−15		15	mV
			1.5V < V_{OUT} ≦ 3.5V	×0.99		×1.01	V
			3.5V < V_{OUT}	×0.985		×1.015	V
		−40°C ≦ Topt ≦ 85°C	V_{OUT} ≦ 1.5V	−40		30	mV
			1.5V < V_{OUT} ≦ 3.5V	×0.973		×1.02	V
			3.5V < V_{OUT}	×0.968		×1.025	V
I_{OUT}	Output Current			150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≦ I_{OUT} ≦ 150mA				80	mV
V_{DIF}	Dropout Voltage	Refer to the following table					
I_{SS1}	Supply Current (Low Power Mode)	I_{OUT}=0mA			5.5	16	μA
I_{SS2}	Supply Current (Fast Mode)	I_{OUT}=11mA			50	105	μA
Istandby	Standby Current	V_{IN}=6.0V, V_{CE}=GND			0.1	1.0	μA
I_{OUTH}	Fast Mode Current Threshold	I_{OUT}=1μA→30mA			7	12	mA
I_{OUTL}	Low Power Mode Current Threshold	I_{OUT}=30mA→1μA		1	2		mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V (In case that V_{OUT} ≦ 0.9V, V_{IN} ≧ 1.4V)			±0.02	±0.2	%/V
RR	Ripple Rejection	Ripple 0.2Vp-p I_{OUT}=30mA (In case that V_{OUT}<1.5V, V_{IN}=Set V_{OUT}+1.5V)	f=1kHz		70		dB
			f=10kHz		60		
V_{IN}	Input Voltage			1.4		6.0	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
I_{PD}	CE Pull-down Current			0.01	0.3	0.6	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			100		μVrms
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{CE}=0V			40		Ω

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

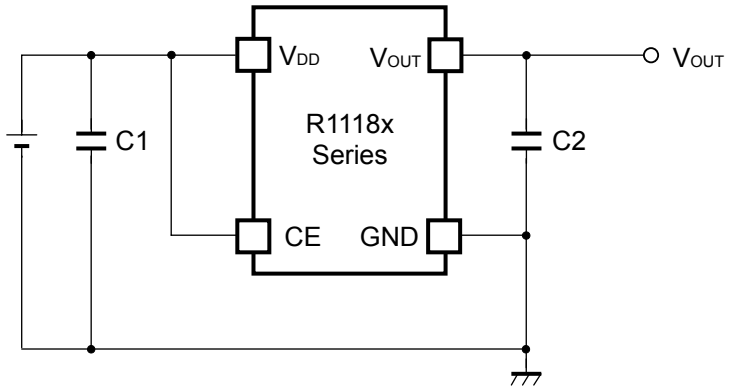
- **Dropout Voltage by Output Voltage**

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	0.82	1.06
0.9 ≦ V_{OUT} < 1.0		0.74	0.98
1.0 ≦ V_{OUT} < 1.2		0.66	0.90
1.2 ≦ V_{OUT} < 1.5		0.54	0.77
1.5 ≦ V_{OUT} < 2.0		0.45	0.64
2.0 ≦ V_{OUT} < 2.8		0.34	0.49
2.8 ≦ V_{OUT}		0.27	0.37

The specification in ☐ is checked and guaranteed by design engineering at −40°C ≦ Topt ≦ 85°C, unless otherwise noted.

TYPICAL APPLICATION



(External Components)

Ceramic Capacitor C2	1.0μF	TDK	C1005JB0J105K
		Kyocera	CM05X5R105K06AB

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 a capacitor C2 with 1.0μF or more.

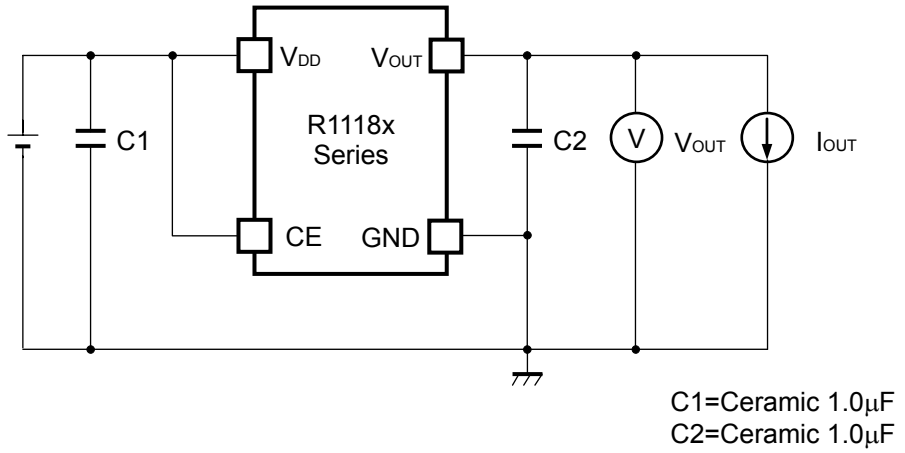
If a tantalum capacitor is used, and its ESR (Equivalent Series Resistance) of C2 is large, the loop oscillation may result. Because of this, select C2 carefully considering its frequency characteristics.

PCB Layout

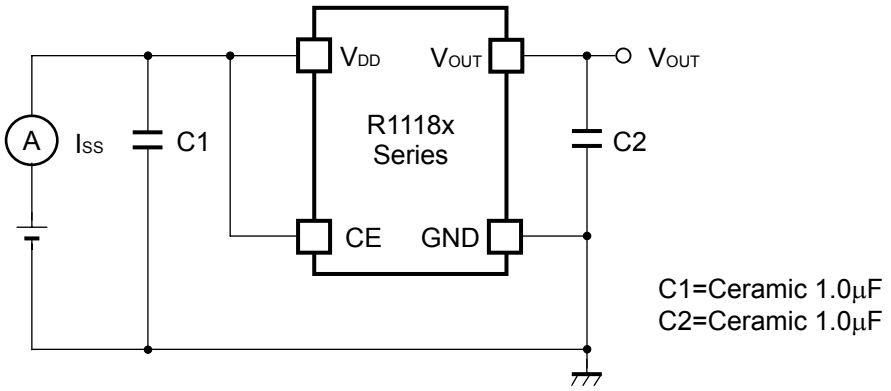
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0μF or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

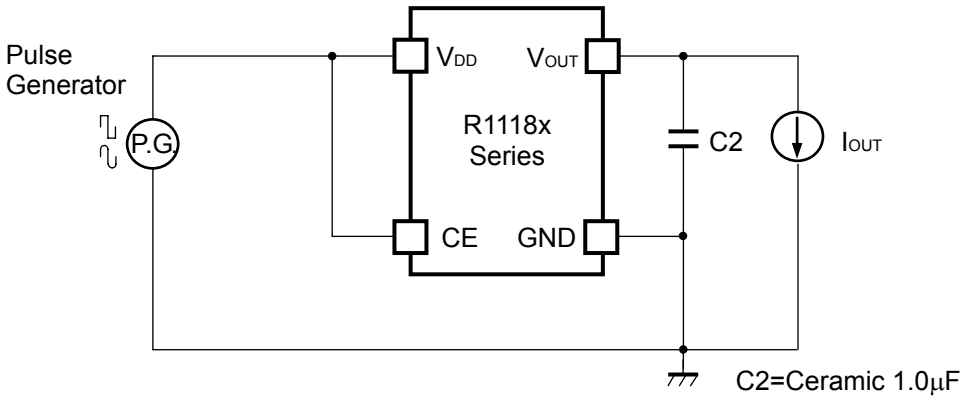
TEST CIRCUITS



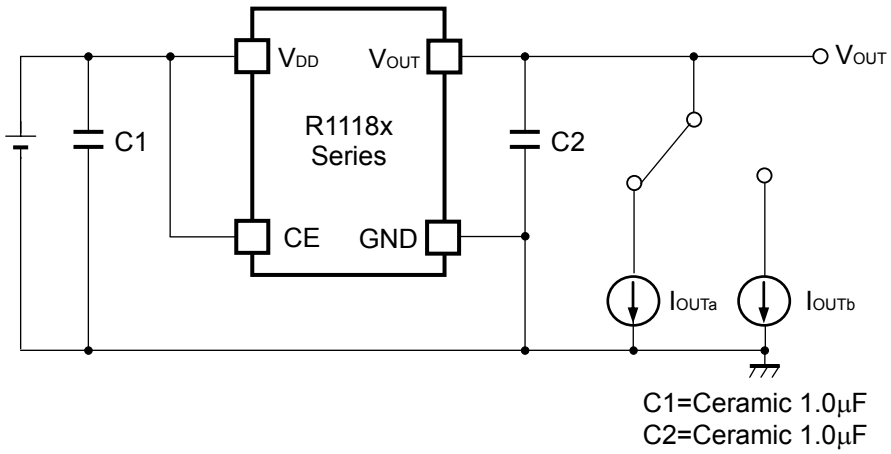
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection



Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

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

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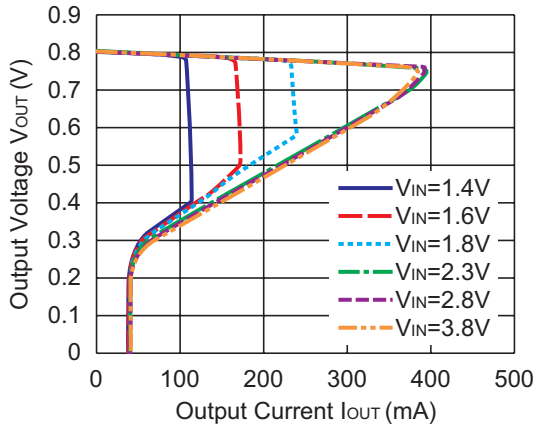

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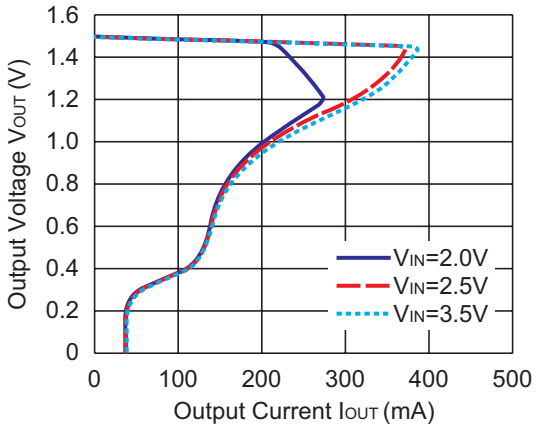

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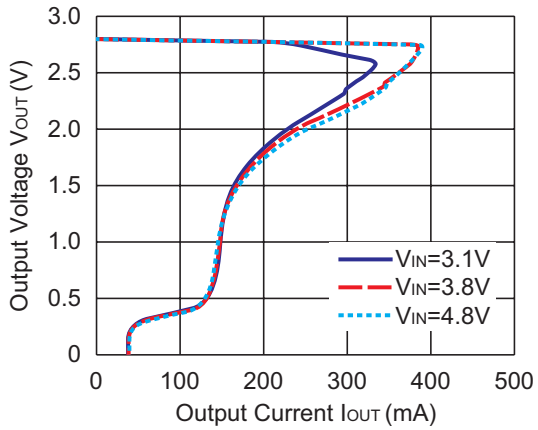

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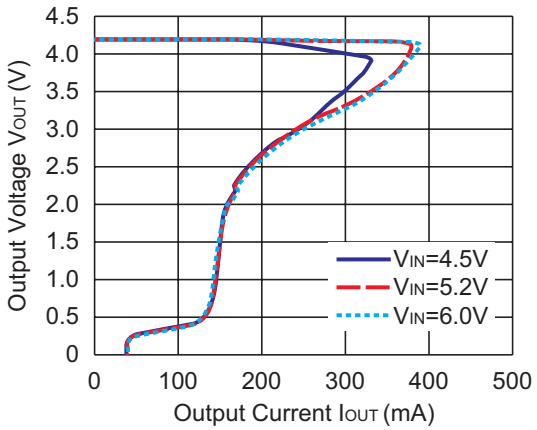

2) Output Voltage vs. Input Voltage (Topt=25°C)

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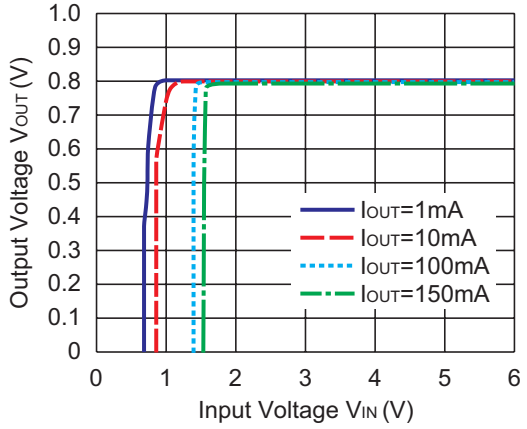

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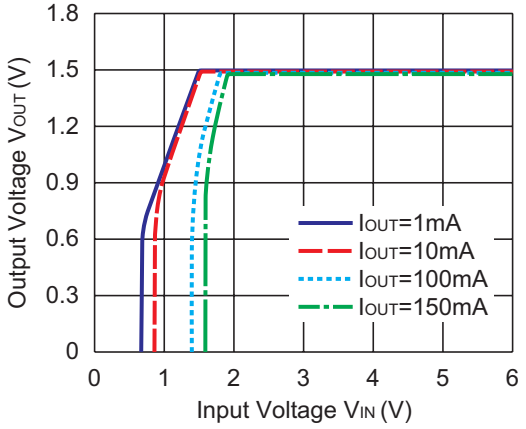

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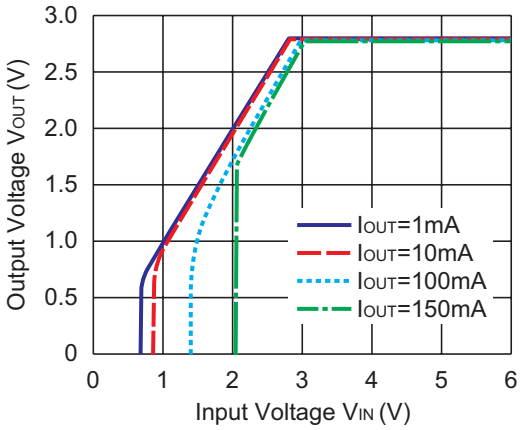

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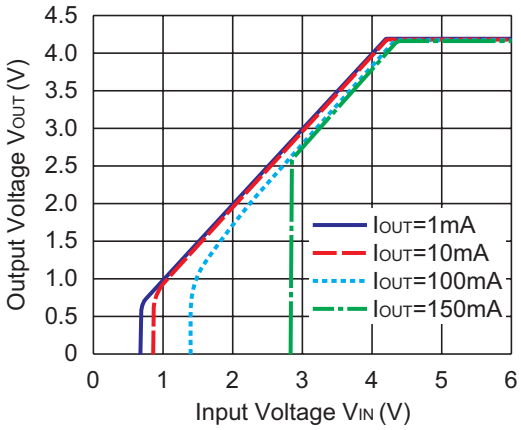
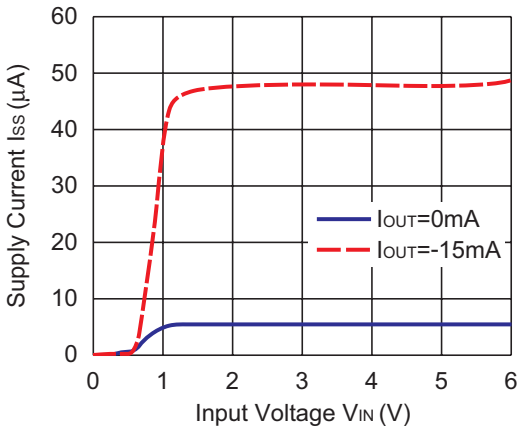


3) Supply Current vs. Input Voltage (Topt=25°C)

R1118x081x



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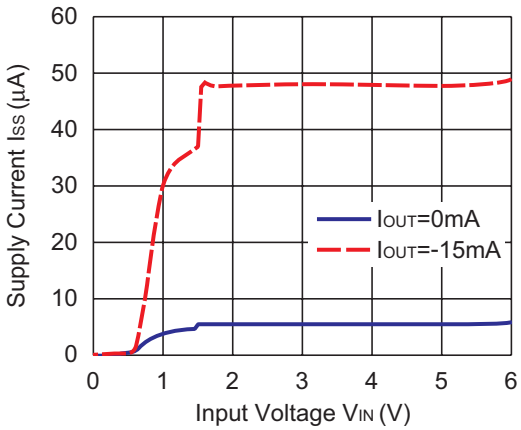

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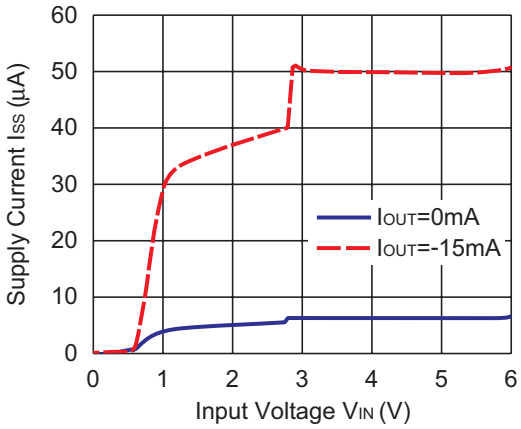

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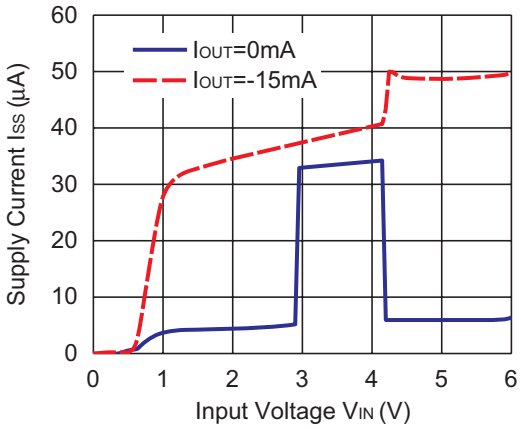
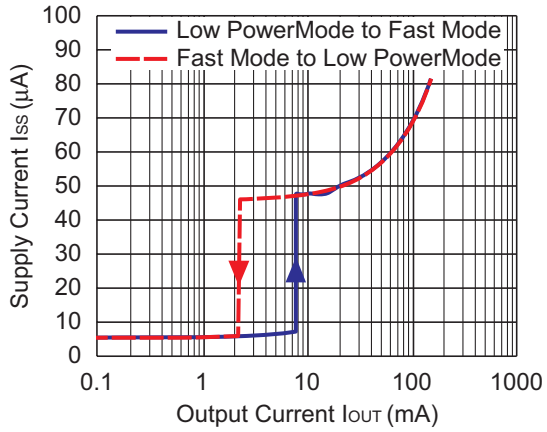


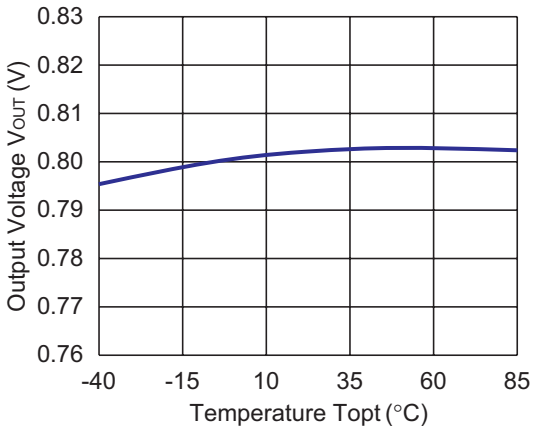
4) Supply Current vs. Output Current (Topt=25°C)

R1118x



5) Output Voltage vs. Temperature

R1118x081x



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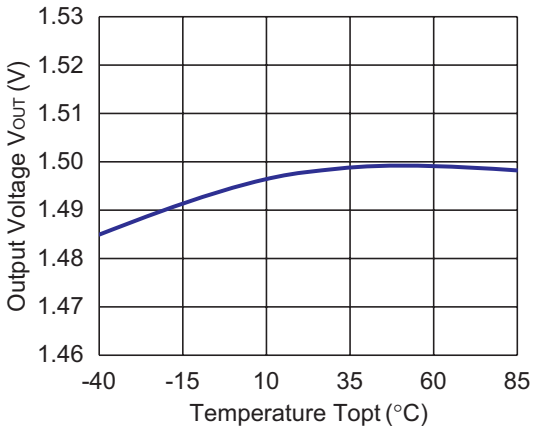

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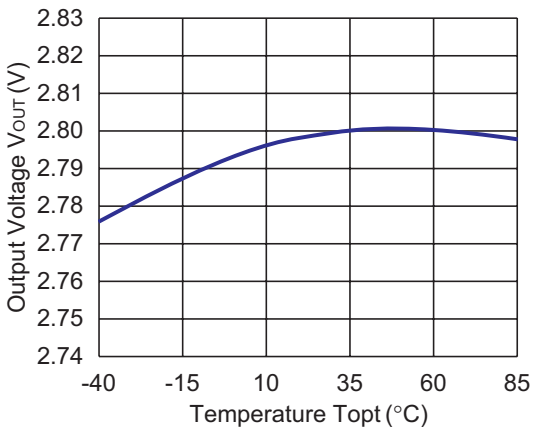

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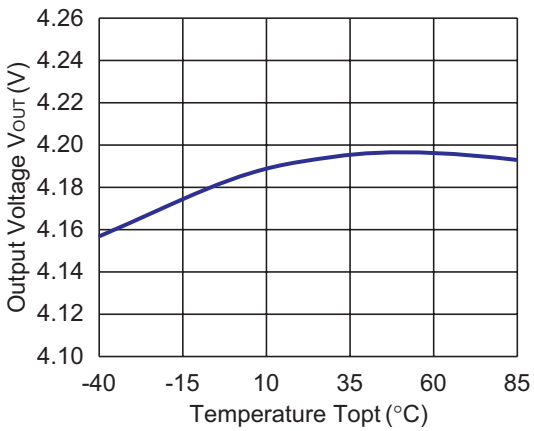

6) Supply Current vs. Temperature

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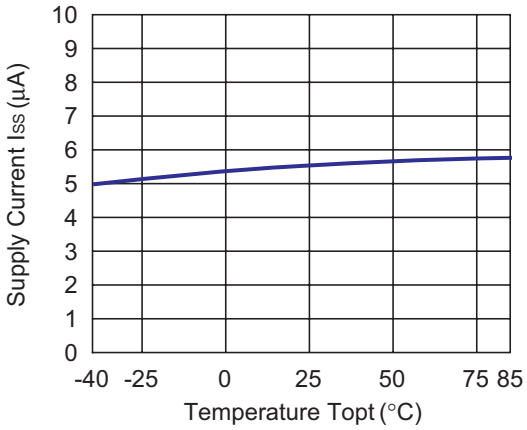

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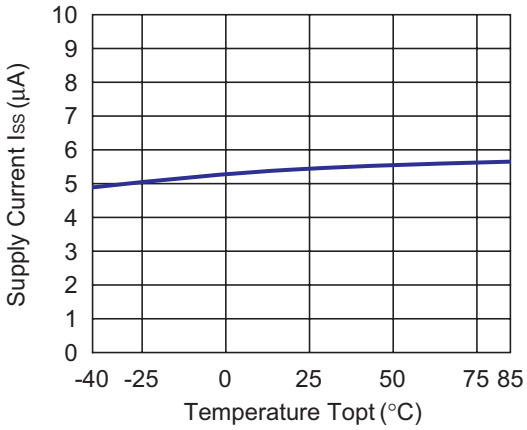

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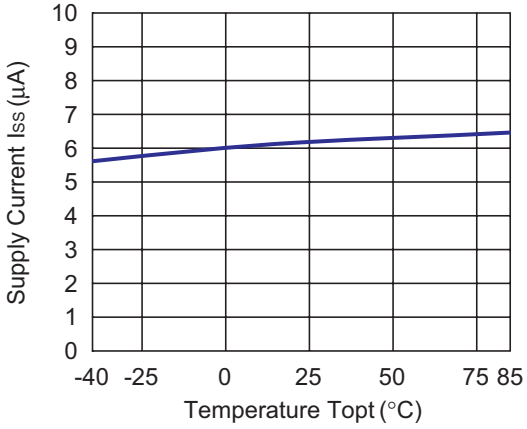

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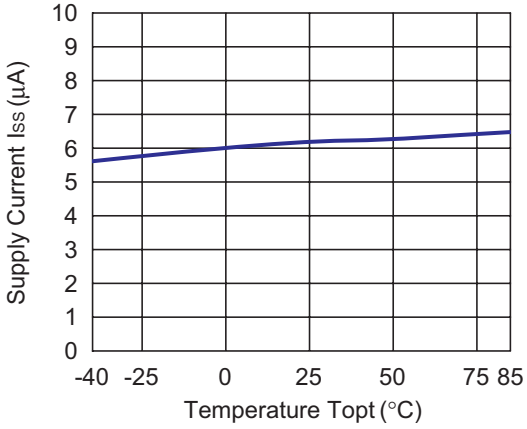

7) Dropout Voltage vs. Output Current

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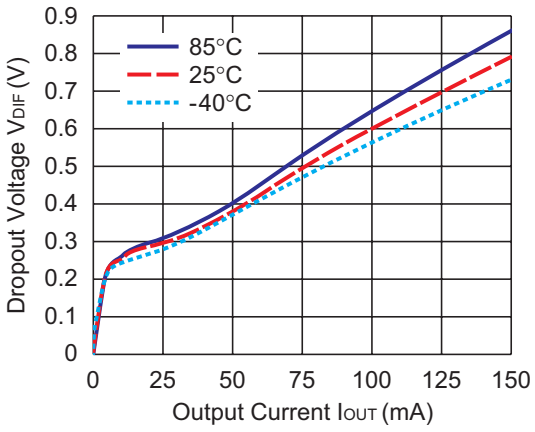

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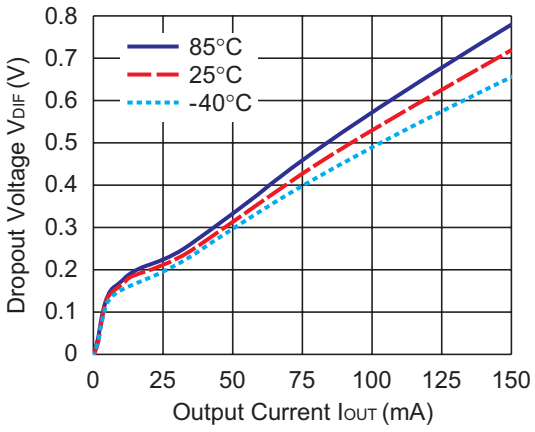

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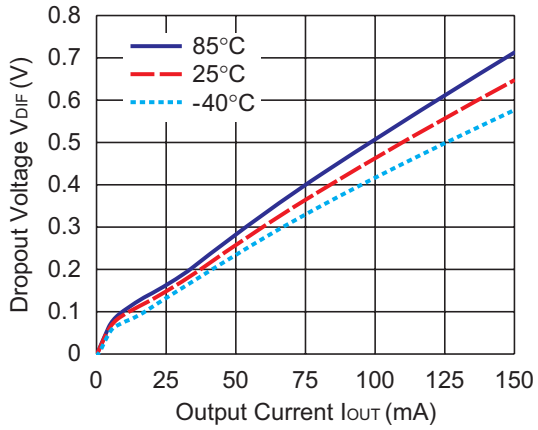

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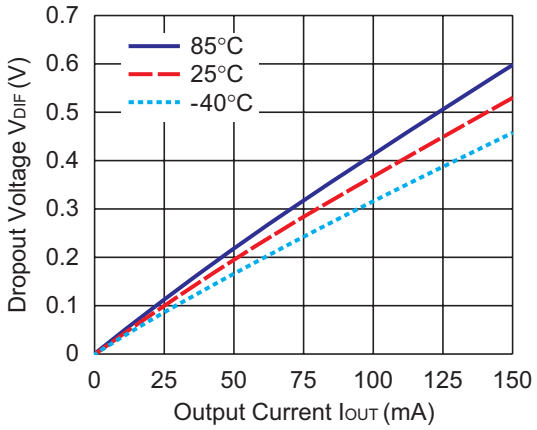

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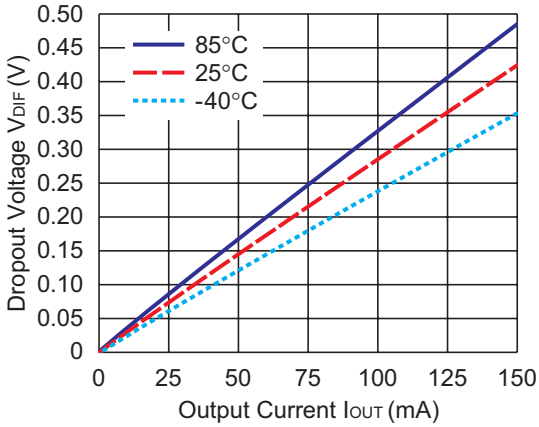

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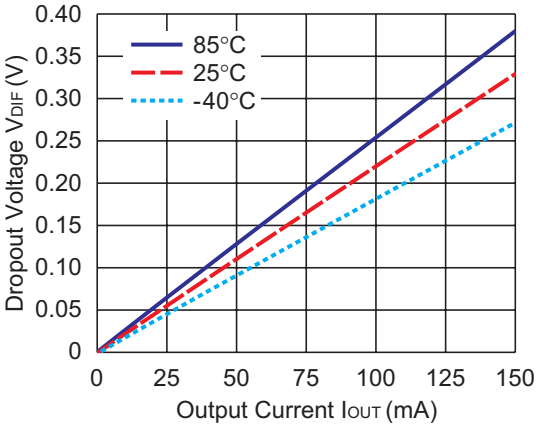

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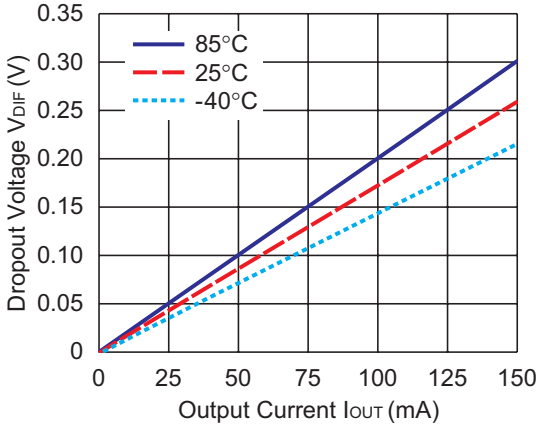

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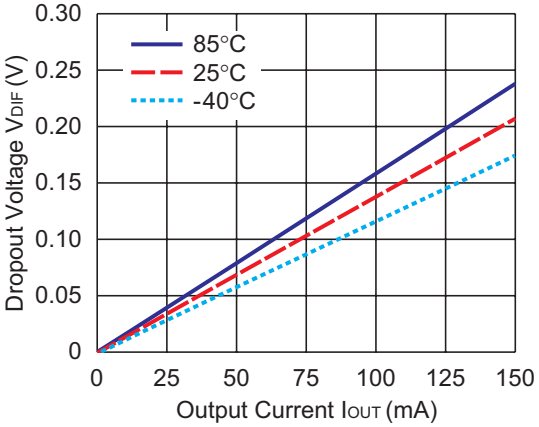
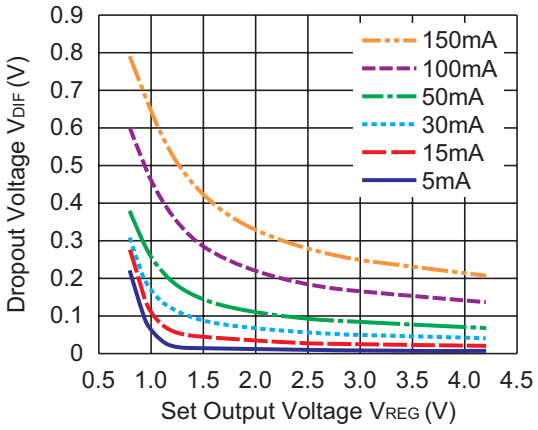
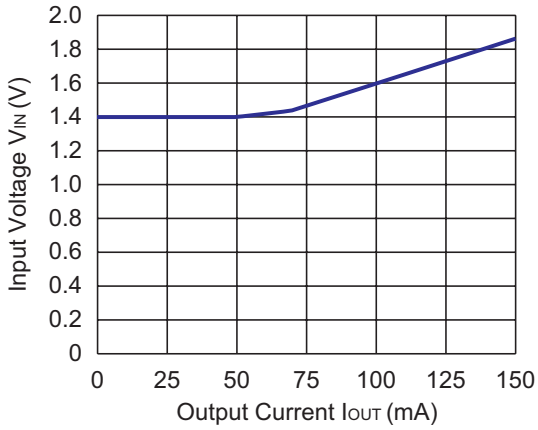


8) Dropout Voltage vs. Set Output Voltage (Topt=25°C)



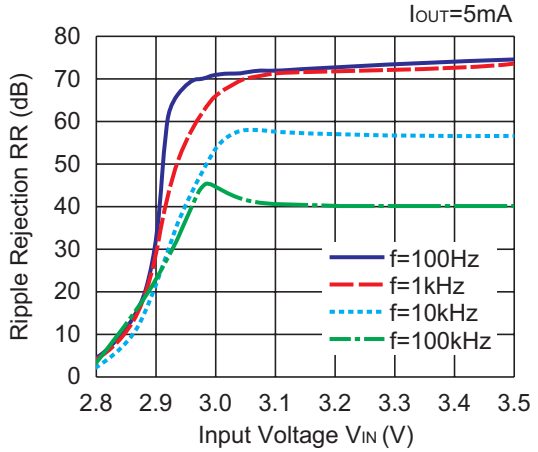
9) Minimum Operating Voltage

R1118x081x



10) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=Ceramic 1.0μF, Ripple=0.2Vp-p, Topt=25°C)

R1118x281x



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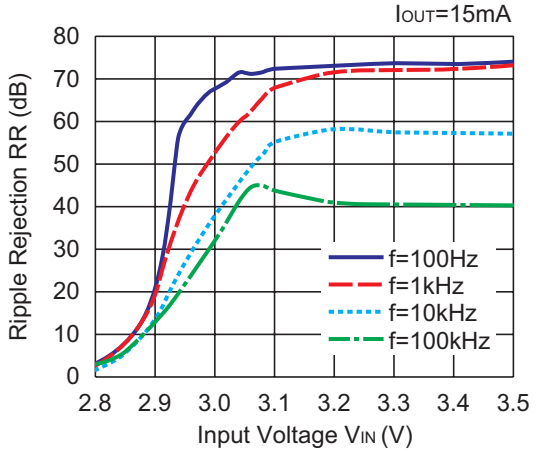

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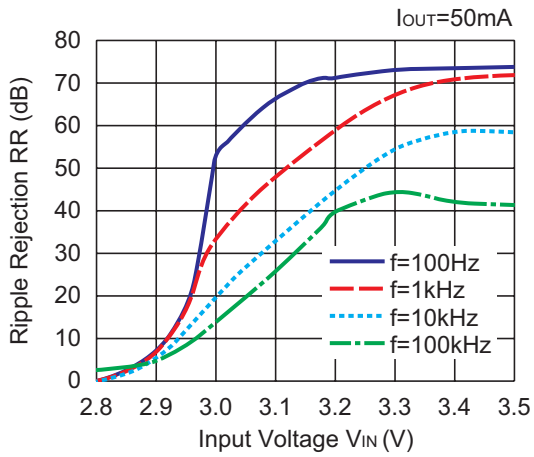
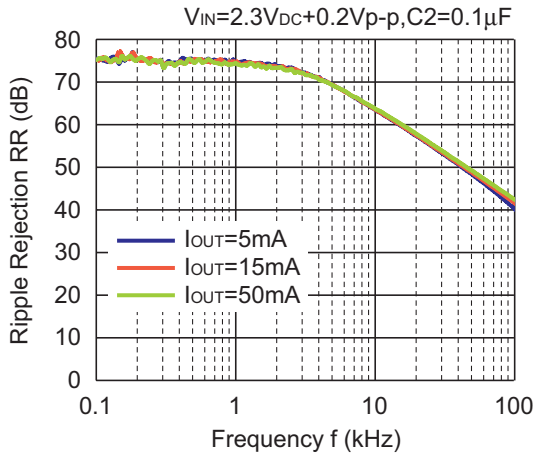


11) Ripple Rejection vs. Frequency (C1=none, Topt=25°C)

R1118x081x



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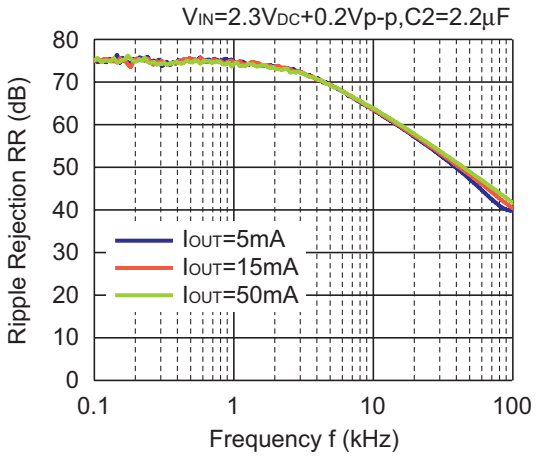

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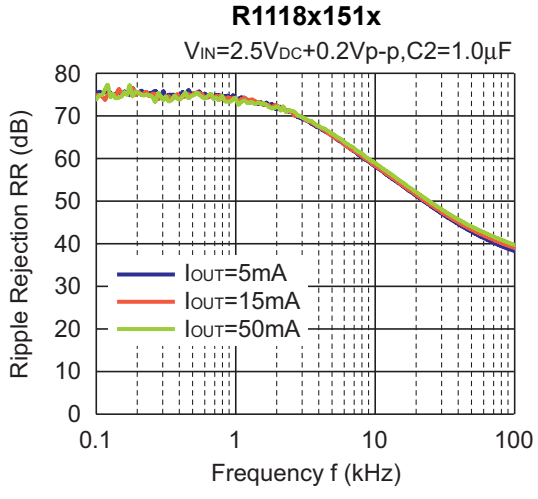

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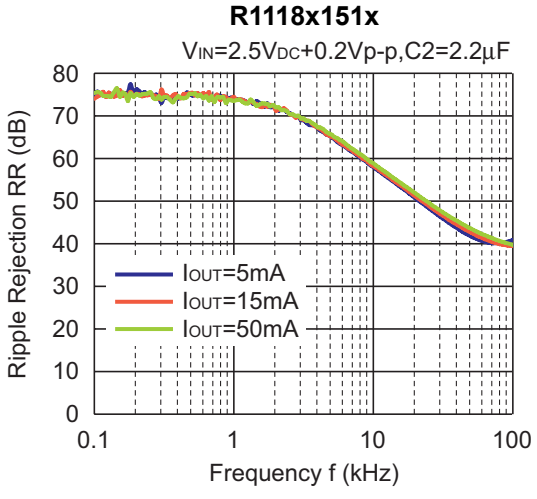

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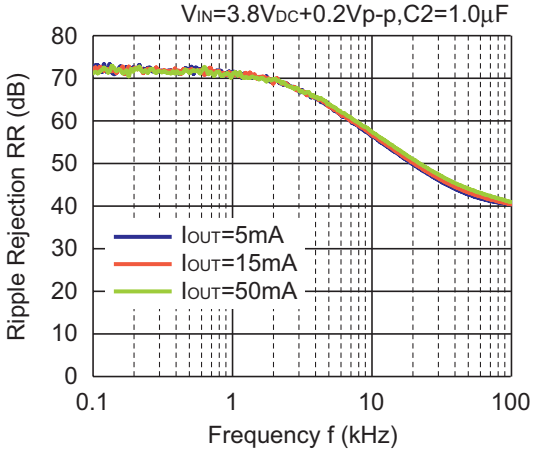

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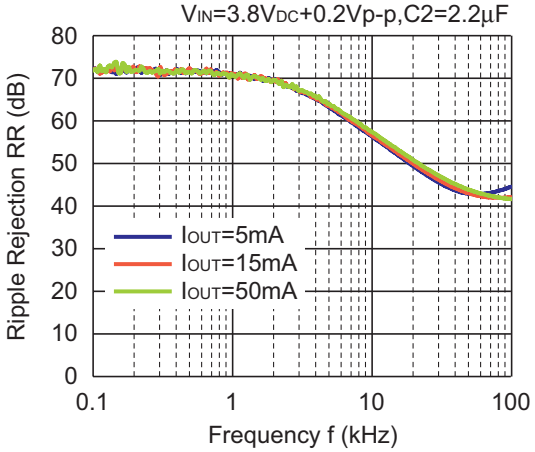

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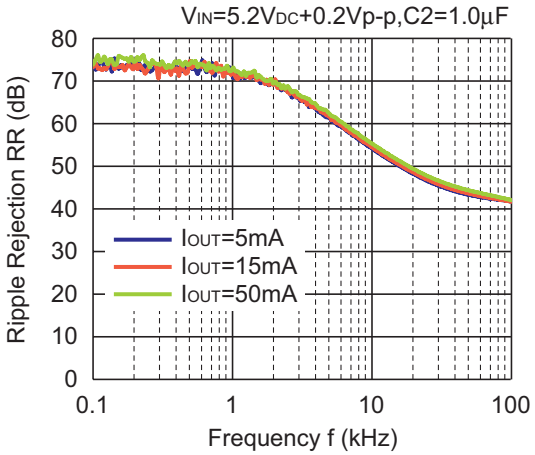

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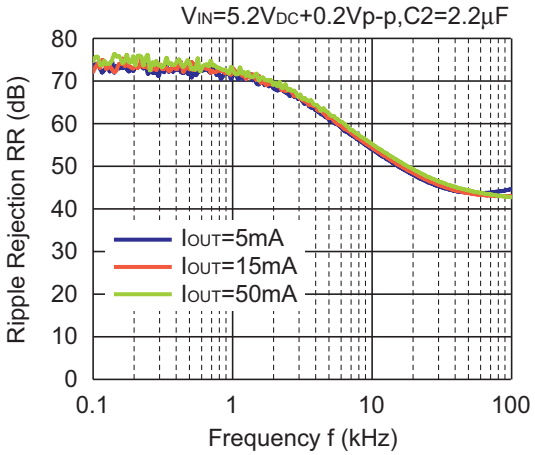
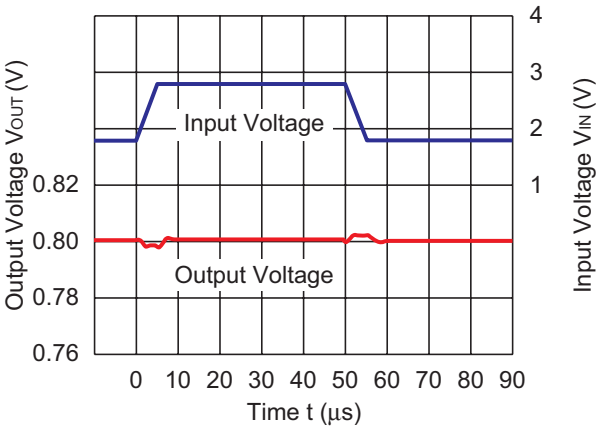


12) Input Transient Response (IOUT=30mA, tr=tf=5µs, C1=none, C2=1µF, Topt=25°C)

R1118x081x



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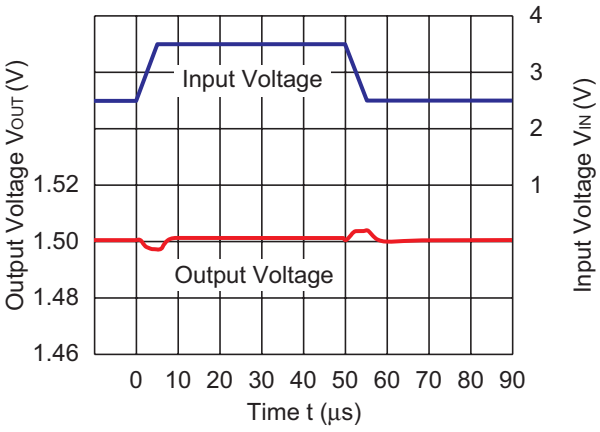

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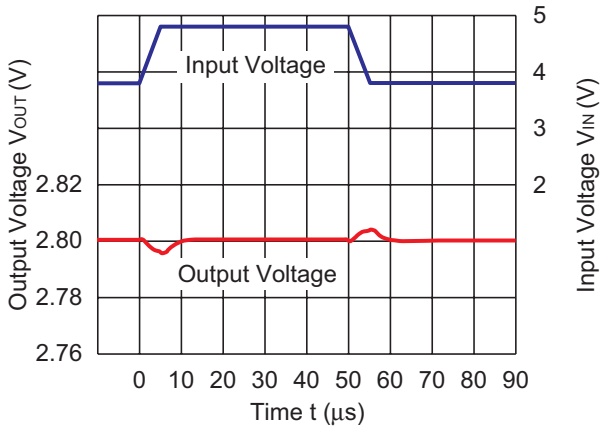

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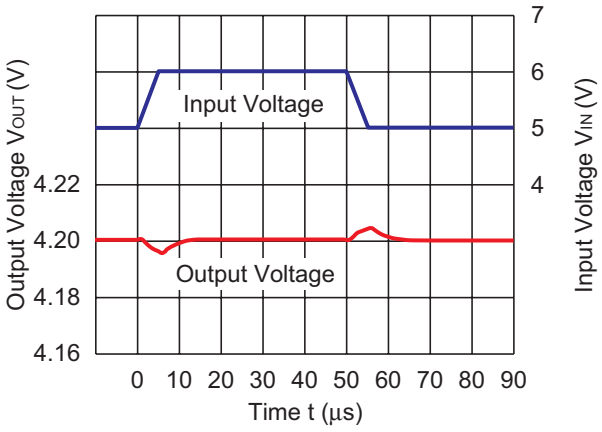
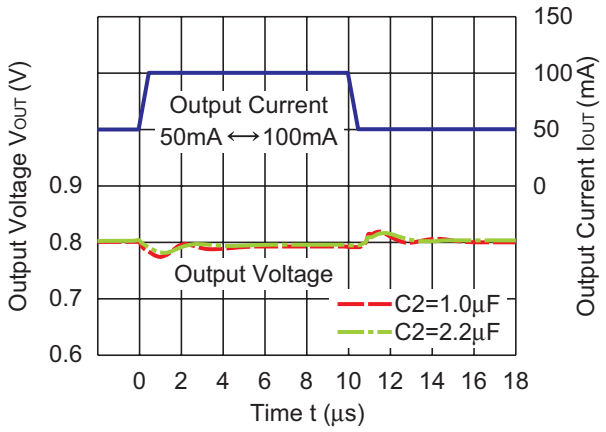
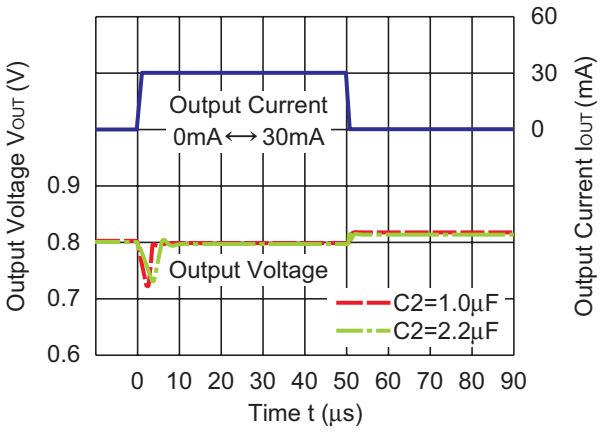


13) Load Transient Response (tr=tf=500ns, C1=1.0µF, Topt=25°C)

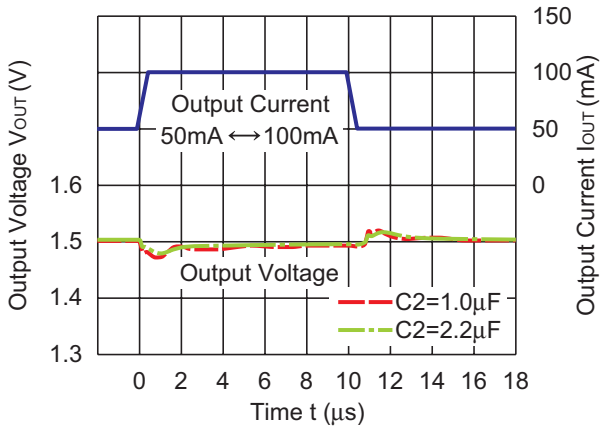
R1118x081x (Fast Mode)



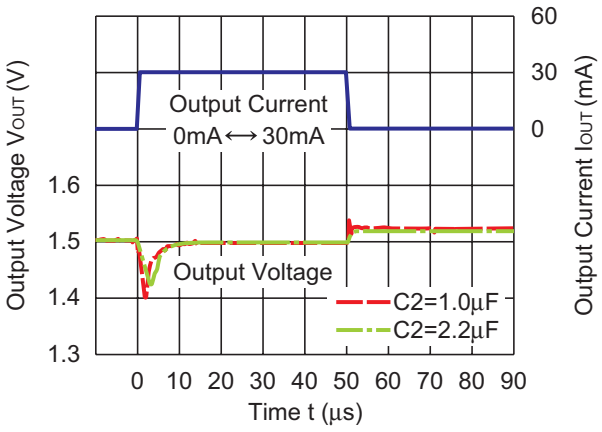
R1118x081x (Low Power Mode→Fast Mode)



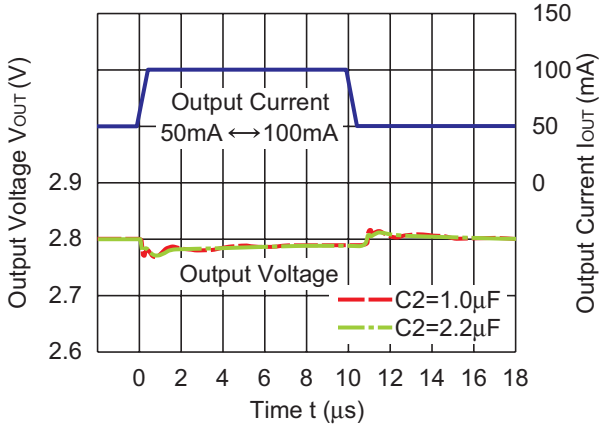
R1118x151x (Fast Mode)



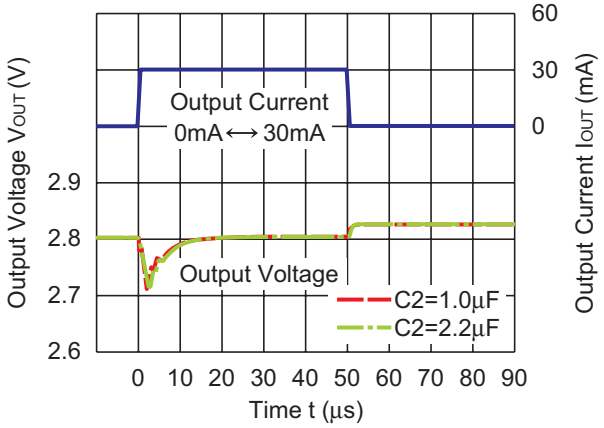
R1118x151x (Low Power Mode→Fast Mode)



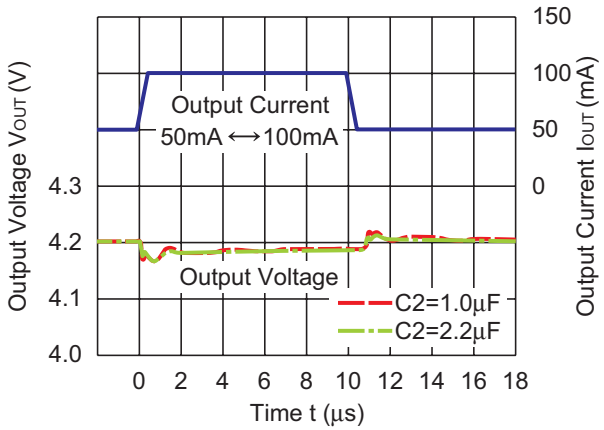
R1118x281x
(Fast Mode)



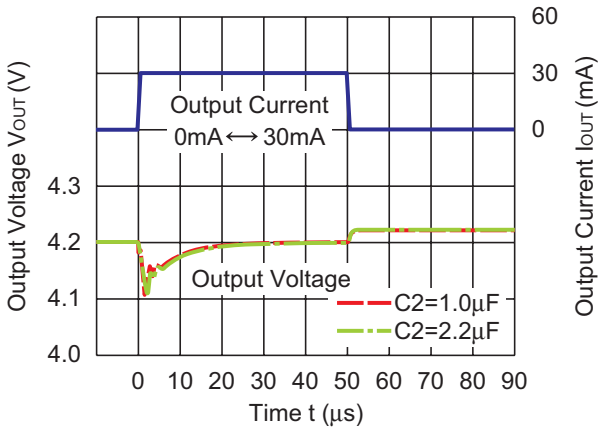
R1118x281x
(Low Power Mode→Fast Mode)



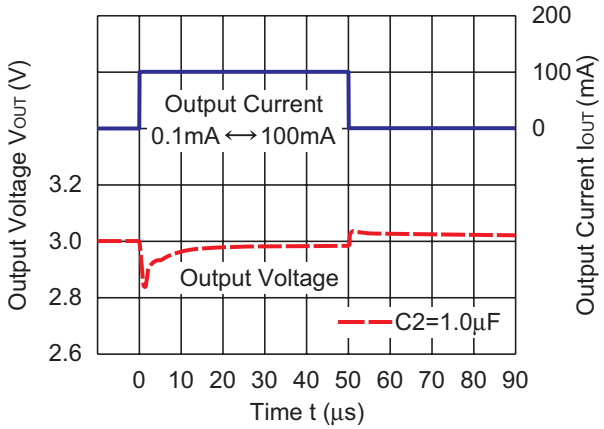
R1118x421x
(Fast Mode)



R1118x421x
(Low Power Mode→Fast Mode)

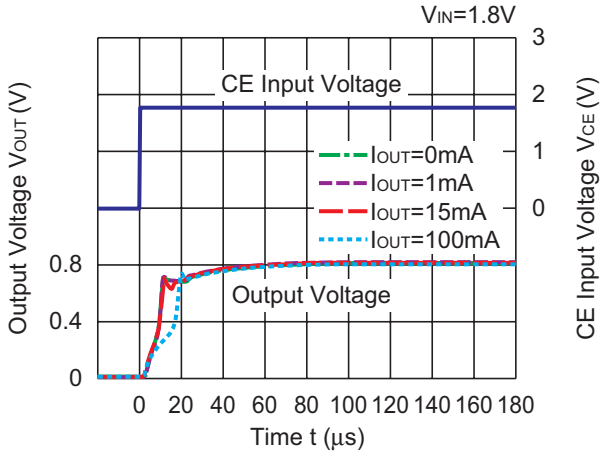


R1118x301x
(Low Power Mode→Fast Mode)

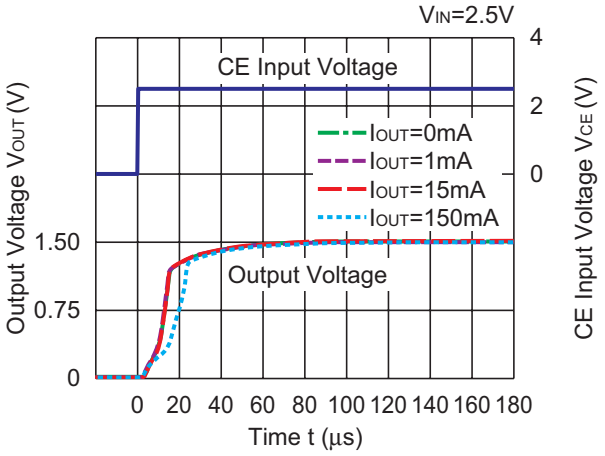


14) Turn On Speed with CE pin (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

R1118x081x



R1118x151x



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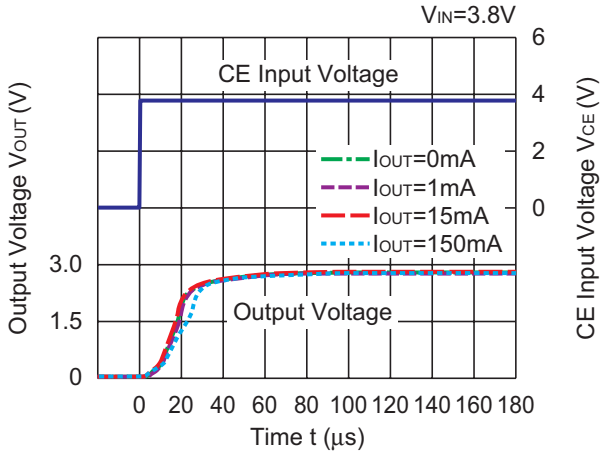

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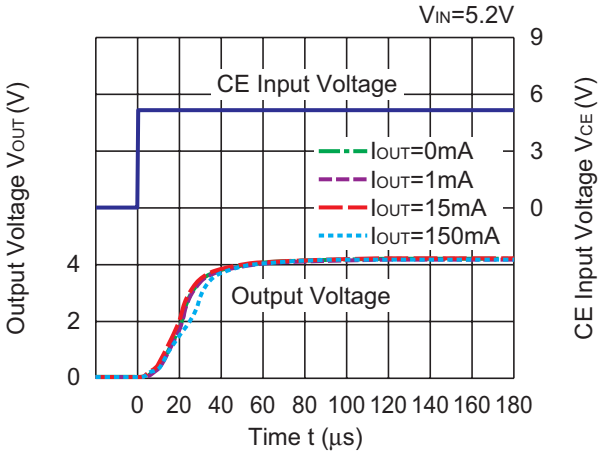
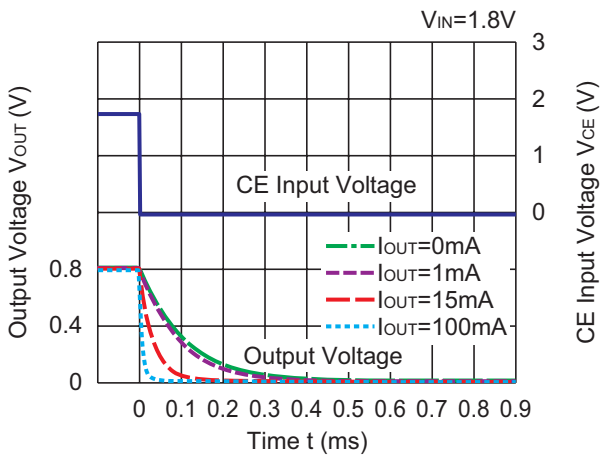
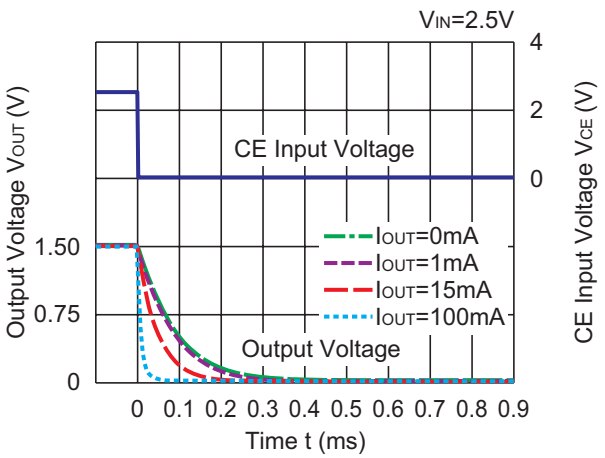


15) Turn Off Speed with CE pin (D Version) (C1=Ceramic 1.0µF, C2=Ceramic 1.0µF, Topt=25°C)

R1118x081D



R1118x151D



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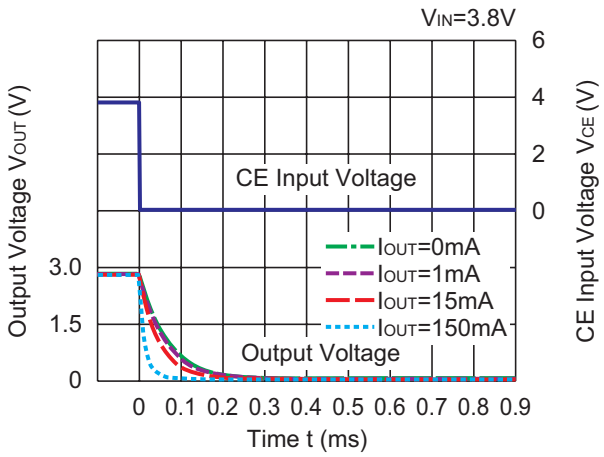

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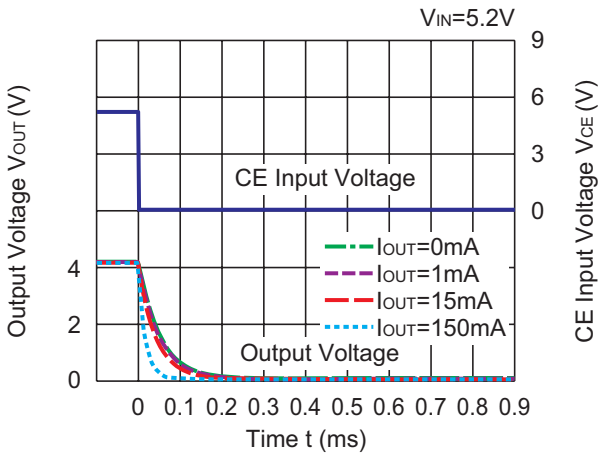


ESR vs. Output Current

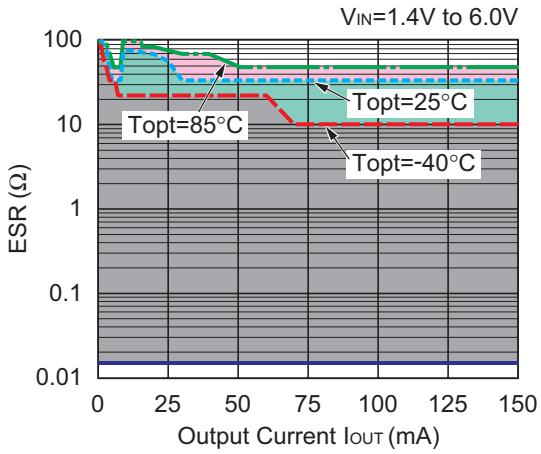
When using these ICs, consider the following points:

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.

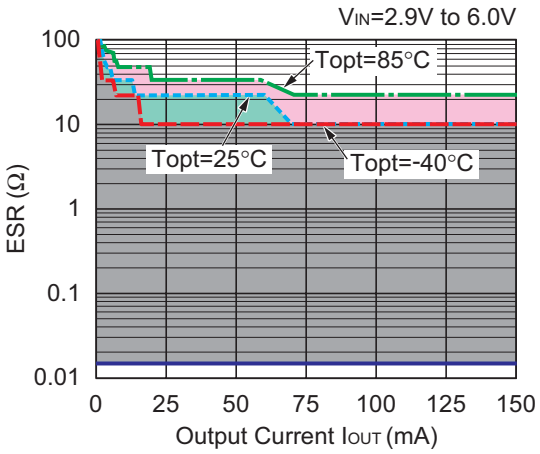
Measurement conditions

Frequency Band : 10Hz to 2MHz
Temperature : –40°C to 85°C
C1, C2 : 1.0μF (Murata, GRM155B31A105KE)

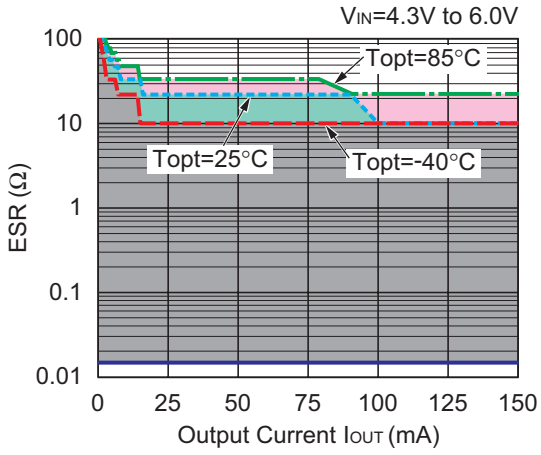
R1118x081x



R1118x281x



R1118x421x



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

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