2.0A/1.5A LDO REGULATOR

NO. EA-125-111027

OUTLINE

The R1171x Series are CMOS-based positive voltage regulator ICs. The R1171x Series have features of low dropout voltage, high output voltage accuracy, low consumption current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor net for setting output voltage, a current limit circuit at short mode, a chip enable circuit, and thermal shutdown circuit. The output voltage of R1171 is fixed in the IC.

Low consumption current by the merit of CMOS process and built-in transistors with low ON-resistance make low dropout voltage and chip enable function prolongs the battery life. These regulators are remarkable improvement on the current regulators in terms of input transient response, and load transient response.

Thus, the R1171x Series are suitable for various power sources.

Since the packages for these ICs are high wattage HSOP-6J package, TO-252-5-P1, high density mounting of the ICs on boards is possible.

FEATURES

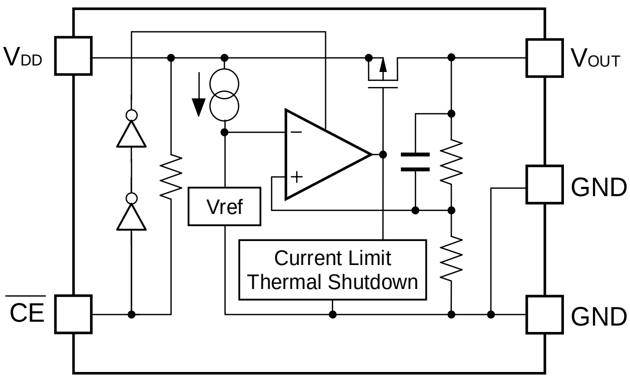
- Supply Current .... Typ. 130μA
- Standby Current .... Typ. 0.1μA
- Output Current .... Min. 1.5A (V_{IN}=V_{OUT}+1.0V, R1171Sxx1A/B)
  Min. 2.0A (V_{IN}=V_{OUT}+1.0V, R1171Jxx1C/D)
- Input Voltage .... 2.1V to 6.0V
- Output Voltage .... 1.5V to 5.0V (0.1V steps) (R1171Sxx1A/B)
  1.8V to 5.0V (0.1V steps) (R1171Jxx1C/D)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy.. ± 2.0%
- Dropout Voltage .... Typ. 0.09V (V_{OUT}=3.0V, I_{OUT}=300mA)
- Temperature-drift Coefficient of Output Voltage........... Typ. ± 100ppm/°C
- Line Regulation .... Typ. 0.05%/V
- Packages HSOP-6J, TO-252-5-P1
- Built-in Current Limit Circuit
- Built-in Thermal Shutdown Circuit
- Ceramic capacitor for phase compensation .... C_{IN}=C_{OUT}=Ceramic 10μF (V_{OUT}<1.8V)
  C_{IN}=C_{OUT}=Ceramic 4.7μF (V_{OUT} ≧ 1.8V)

APPLICATIONS

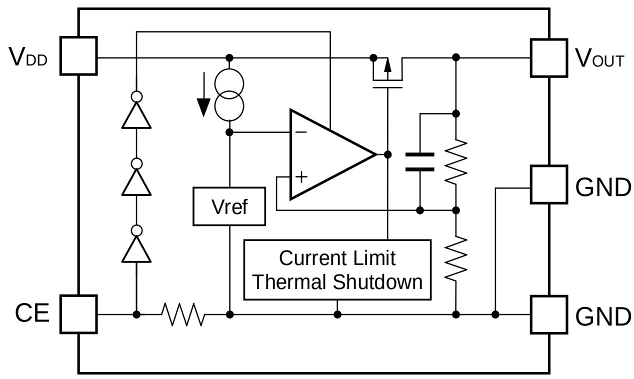
- Local Power source for Notebook PC.
- Local Power source for portable appliances, cameras, and videos.
- Local Power source for equipment of battery-use.
- Local Power source for home appliances.

BLOCK DIAGRAMS

R1171xxx1A/C



R1171xxx1B/D



SELECTION GUIDE

The output voltage, chip enable polarity, package for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1171Sxx1∗-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes
R1171Jyy1$-T1-F	TO-252-5-P1	3,000 pcs	Yes	No

xx: The output voltage can be designated in the range from 1.5V(15) to 5.0V(50) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

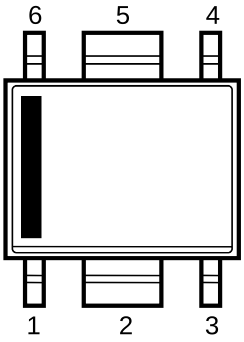
yy: The output voltage can be designated in the range from 1.8V(18) to 5.0V(50) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : CE pin polarity are options as follows.
(A) "L" active
(B) "H" active

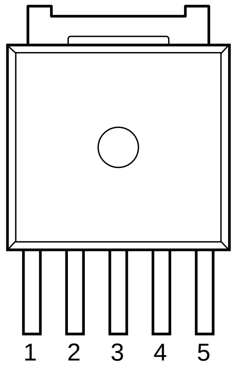
$: CE pin polarity are options as follows.
(C) "L" active
(D) "H" active

PIN CONFIGURATIONS

● HSOP-6J



● TO-252-5-P1



PIN DESCRIPTIONS

● **HSOP-6J**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	$\overline{CE}$ or CE	Chip Enable Pin
4	NC	No Connection
5	GND	Ground Pin
6	V_{DD}	Input Pin

● **TO-252-5-P1**

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	$\overline{CE}$ or CE	Chip Enable Pin
3	GND	Ground Pin
4	GND	Ground Pin
5	V_{DD}	Input Pin

∗) No.3 and No.4 pins must be wired short each other and connected to the GND plane when it is mounted on board.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	7.0	V
V_{CE}	Input Voltage ($\overline{CE}$ or CE Input Pin)	–0.3 to V_{IN}+0.3	V
V_{OUT}	Output Voltage	–0.3 to V_{IN}+0.3	V
P_D	Power Dissipation (HSOP-6J)[*1]	1700	mW
	Power Dissipation (TO-252-5-P1)[*1]	1900	
Topt	Operating Temperature	–40 to 85	°C
Tstg	Storage Temperature	–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

- **R1171Sxx1A**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	V_{IN}–V_{OUT}=1.0V, I_{OUT}=200mA		×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 300mA			10	60	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.5 ≦ V_{OUT}<1.6		0.16	0.35	V
			1.6 ≦ V_{OUT}<1.7		0.14	0.32	
			1.7 ≦ V_{OUT}<1.8		0.13	0.28	
			1.8 ≦ V_{OUT}<2.0		0.12	0.24	
			2.0 ≦ V_{OUT}<2.5		0.10	0.21	
			2.5 ≦ V_{OUT} ≦ 5.0		0.09	0.18	
I_{SS}	Supply Current	V_{IN}–V_{OUT} =1.0V, V_{CE}=0V			130	320	μA
$I_{standby}$	Standby Current	V_{IN}–V_{OUT}=1.0V, V_{IN}=V_{CE}			0.1	2.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=200mA		Refer to the following table			
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p					
V_{IN}	Input Voltage			2.1		6.0	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	V_{IN}–V_{OUT}=1.0V		1.5			A
I_{SC}	Short Current Limit	V_{OUT}=0V			200		mA
R_{PU}	Pull-up resistance for $\overline{CE}$ pin			2.5	5.0	10.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"			1.2		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"			0		0.25	V
T_{TSD}	Thermal Shutdown Detector Threshold Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C

- **Line Regulation by Output Voltage**

Topt=25°C

Output Voltage V_{OUT} (V)	Line Regulation $\Delta V_{OUT}/\Delta V_{IN}$ (%/V)		
	Condition	Typ.	Max.
1.5 ≦ V_{OUT} < 1.6	I_{OUT}=200mA, 2.1V ≦ V_{IN} ≦ 6.0V	0.05	0.30
1.6 ≦ V_{OUT} ≦ 5.0	I_{OUT}=200mA, V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V		

- **Ripple Rejection by Output Voltage**

Topt=25°C

Output Voltage V_{OUT} (V)	Ripple Rejection RR (dB)	
	Condition	Typ.
1.5 ≦ V_{OUT} < 4.7	f=1kHz, Ripple 0.5Vp-p, V_{IN}–V_{OUT}=1.0V	50
4.7 ≦ V_{OUT} ≦ 5.0	f=1kHz, Ripple 0.5Vp-p, V_{IN}=5.75V	

- **R1171Sxx1B**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Reference Voltage for Adjustable Voltage Regulator	$V_{IN}-V_{OUT}$=1.0V I_{OUT}=200mA		×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}-V_{OUT}$=1.0V 1mA ≦ I_{OUT} ≦ 300mA			10	60	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.5 ≦ V_{OUT}<1.6		0.16	0.35	V
			1.6 ≦ V_{OUT}<1.7		0.14	0.32	
			1.7 ≦ V_{OUT}<1.8		0.13	0.28	
			1.8 ≦ V_{OUT}<2.0		0.12	0.24	
			2.0 ≦ V_{OUT}<2.5		0.10	0.21	
			2.5 ≦ V_{OUT} ≦ 5.0		0.09	0.18	
I_{SS}	Supply Current	$V_{IN}-V_{OUT}$=1.0V, $V_{CE}=V_{IN}$			130	320	μA
$I_{standby}$	Standby Current	$V_{IN}-V_{OUT}$=1.0V, V_{CE}=0V			0.1	2.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=200mA		Refer to the following table			
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p					
V_{IN}	Input Voltage			2.1		6.0	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	$V_{IN}-V_{OUT}$=1.0V		1.5			A
I_{SC}	Short Current Limit	V_{OUT}=0V			200		mA
R_{PD}	Pull-down resistance for CE pin			2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage "H"			1.2		V_{IN}	V
V_{CEL}	CE Input Voltage "L"			0		0.25	V
T_{TSD}	Thermal Shutdown Detector Threshold Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C

- **Line Regulation by Output Voltage**

Topt=25°C

Output Voltage V_{OUT} (V)	Line Regulation $\Delta V_{OUT}/\Delta V_{IN}$ (%/V)		
	Condition	Typ.	Max.
1.5 ≦ V_{OUT} < 1.6	I_{OUT}=200mA, 2.1V ≦ V_{IN} ≦ 6.0V	0.05	0.30
1.6 ≦ V_{OUT} ≦ 5.0	I_{OUT}=200mA, V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V		

- **Ripple Rejection by Output Voltage**

Topt=25°C

Output Voltage V_{OUT} (V)	Ripple Rejection RR (dB)	
	Condition	Typ.
1.5 ≦ V_{OUT} < 4.7	f=1kHz, Ripple 0.5Vp-p, $V_{IN}-V_{OUT}$=1.0V	50
4.7 ≦ V_{OUT} ≦ 5.0	f=1kHz, Ripple 0.5Vp-p, V_{IN}=5.75V	

R1171Jxx1C

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$V_{IN}-V_{OUT}$=1.0V I_{OUT}=200mA		×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}-V_{OUT}$=1.0V 1mA ≦ I_{OUT} ≦ 300mA			10	60	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.8 ≦ V_{OUT}<2.0		0.12	0.24	V
			2.0 ≦ V_{OUT}<2.5		0.10	0.21	
			2.5 ≦ V_{OUT} ≦ 5.0		0.09	0.18	
I_{SS}	Supply Current	$V_{IN}-V_{OUT}$=1.0V, V_{CE}=0V			130	320	µA
$I_{standby}$	Standby Current	$V_{IN}-V_{OUT}$ =1.0V, $V_{IN}=V_{CE}$			0.1	2.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=200mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6V			0.05	0.30	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p		Refer to the following table			
V_{IN}	Input Voltage			2.1		6.0	V
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	$V_{IN}-V_{OUT}$=1.0V		2.0			A
I_{SC}	Short Current Limit	V_{OUT}=0V			200		mA
R_{PU}	Pull-up resistance for $\overline{CE}$ pin			2.5	5.0	10.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"			1.2		V_{IN}	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"			0		0.25	V
T_{TSD}	Thermal Shutdown Detector Threshold Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C

Ripple Rejection by Output Voltage

Topt=25°C

Output Voltage V_{OUT} (V)	Ripple Rejection RR (dB)	
	Condition	Typ.
1.8 ≦ V_{OUT} < 4.7	f=1kHz, Ripple 0.5Vp-p, $V_{IN}-V_{OUT}$=1.0V	50
4.7 ≦ V_{OUT} ≦ 5.0	f=1kHz, Ripple 0.5Vp-p, V_{IN}=5.75V	

- **R1171Jxx1D**

Topt=25°C

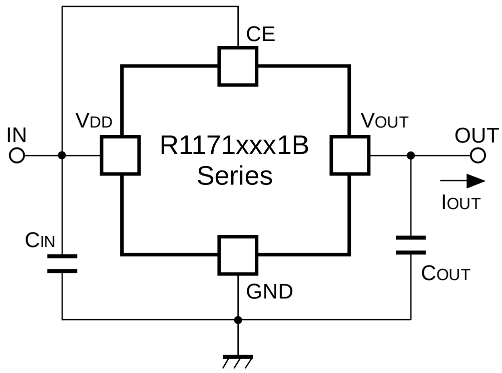
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Reference Voltage for Adjustable Voltage Regulator	V_{IN}–V_{OUT}=1.0V I_{OUT}=200mA		×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 300mA			10	60	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	1.8 ≦ V_{OUT}<2.0		0.12	0.24	V
			2.0 ≦ V_{OUT}<2.5		0.10	0.21	
			2.5 ≦ V_{OUT} ≦ 5.0		0.09	0.18	
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V, V_{CE}=V_{IN}			130	320	μA
$I_{standby}$	Standby Current	V_{IN}–V_{OUT}=1.0V, V_{CE}=0V			0.1	2.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=200mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6V			0.05	0.30	%/V
RR	Ripple Rejection	f=1kHz, Ripple 0.5Vp-p		Refer to the following table			
V_{IN}	Input Voltage			2.1		6.0	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	I_{OUT}=10mA –40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	V_{IN}–V_{OUT}=1.0V		2.0			A
I_{SC}	Short Current Limit	V_{OUT}=0V			200		mA
R_{PD}	Pull-down resistance for CE pin			2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage "H"			1.2		V_{IN}	V
V_{CEL}	CE Input Voltage "L"			0		0.25	V
T_{TSD}	Thermal Shutdown Detector Threshold Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C

- **Ripple Rejection by Output Voltage**

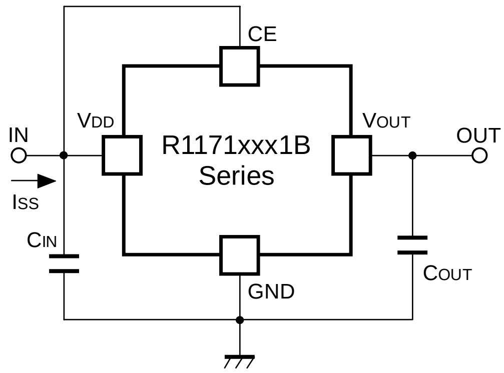
Topt=25°C

Output Voltage V_{OUT} (V)	Ripple Rejection RR (dB)	
	Condition	Typ.
1.8 ≦ V_{OUT} < 4.7	f=1kHz, Ripple 0.5Vp-p, V_{IN}–V_{OUT}=1.0V	50
4.7 ≦ V_{OUT} ≦ 5.0	f=1kHz, Ripple 0.5Vp-p, V_{IN}=5.75V	

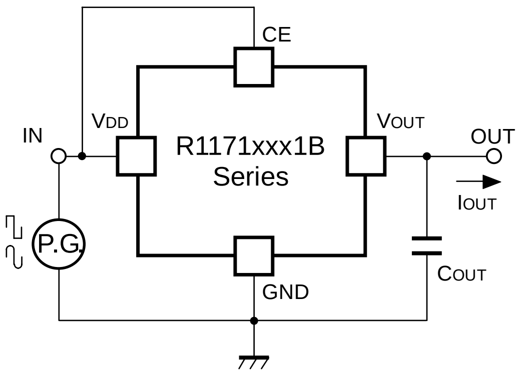
TEST CIRCUITS



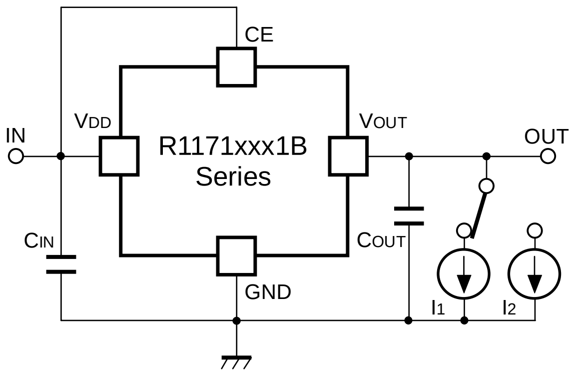
Standard Test Circuit



Supply Current Test Circuit



Test Circuit for Ripple Rejection, Input Transient Response

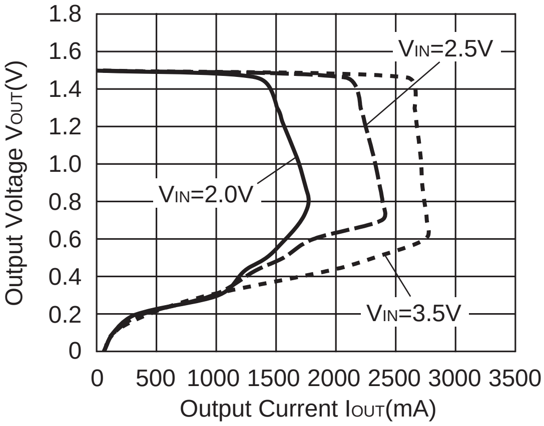


Test Circuit for Load Transient Response

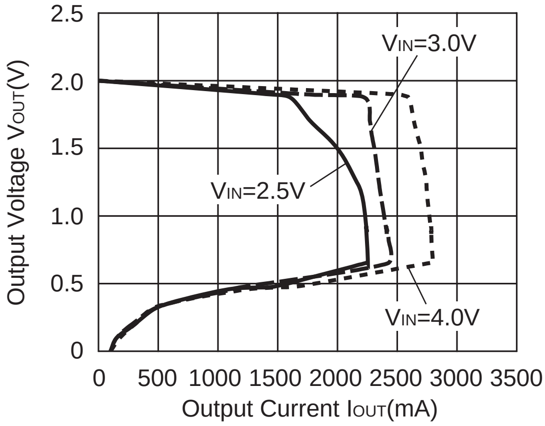
TYPICAL CHARACTERISTICS

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

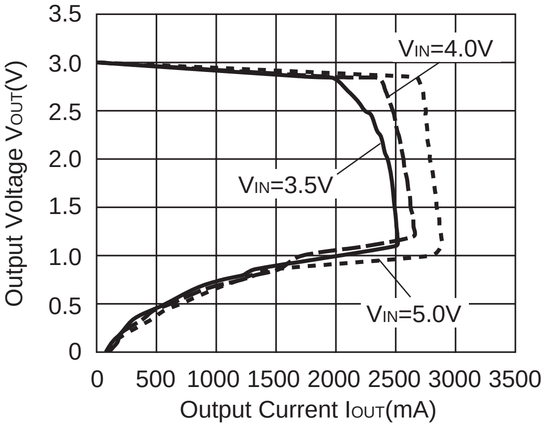
R1171S151x



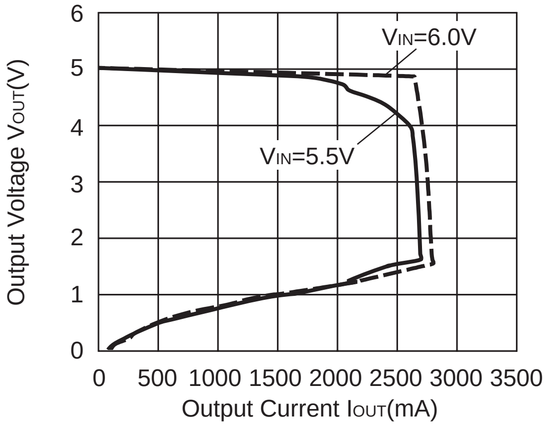
R1171S201x



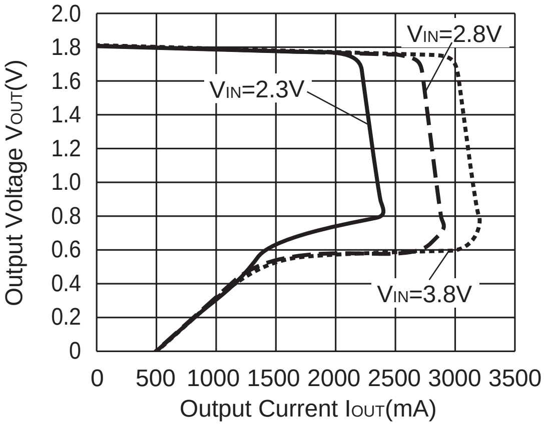
R1171S301x



R1171S501x



R1171J181x



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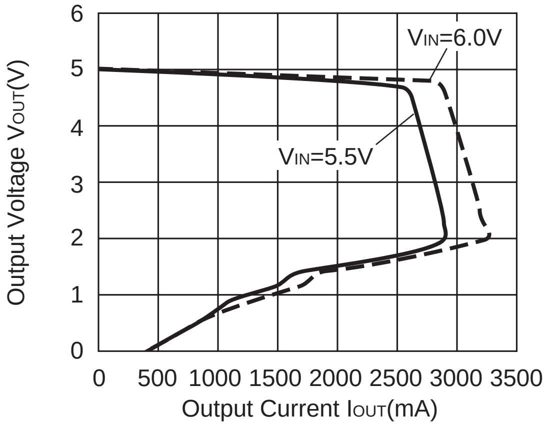
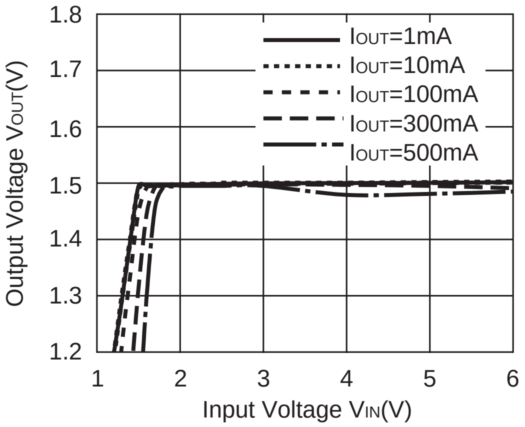


2) Output Voltage vs. Input Voltage (Topt=25°C)

R1171x151B



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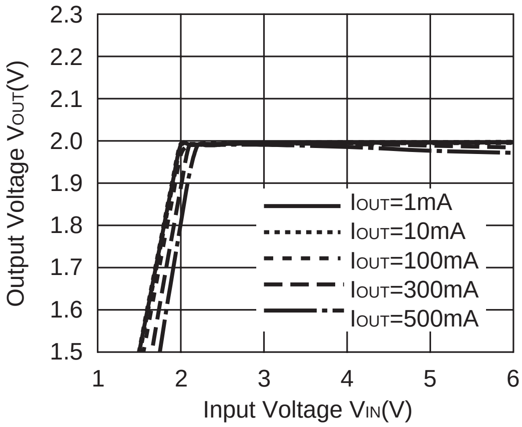

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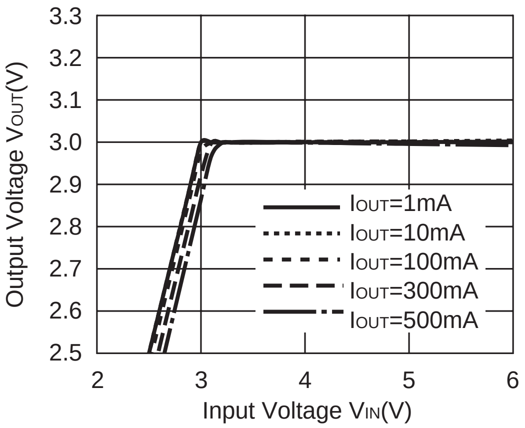

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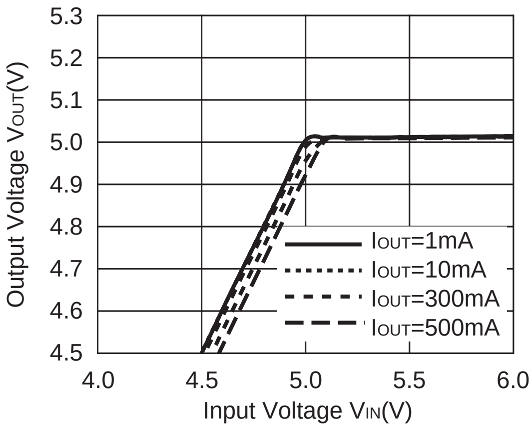
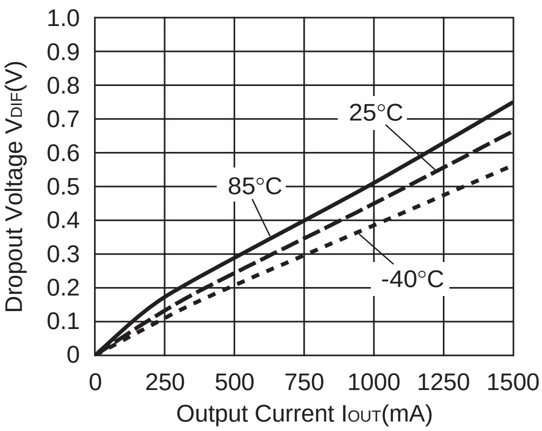
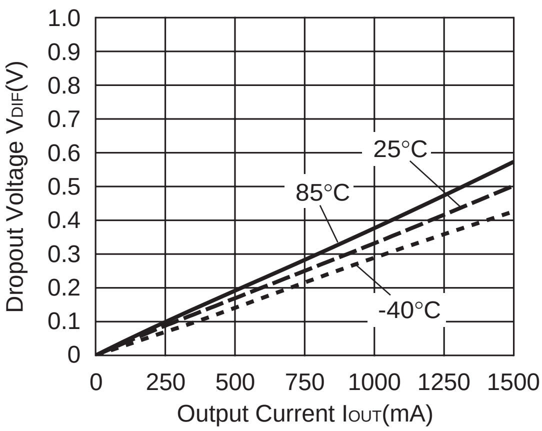


3) Dropout Voltage vs. Output Current

R1171S151x



R1171S201x



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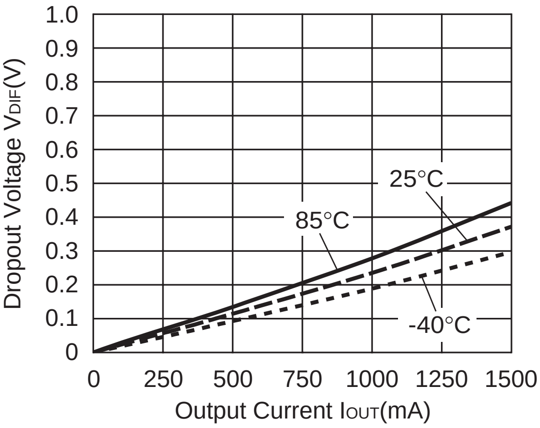

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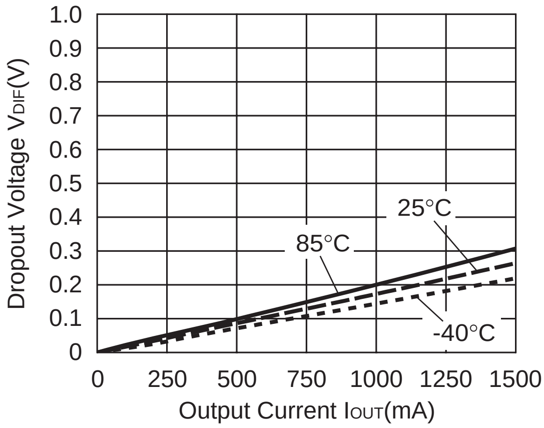
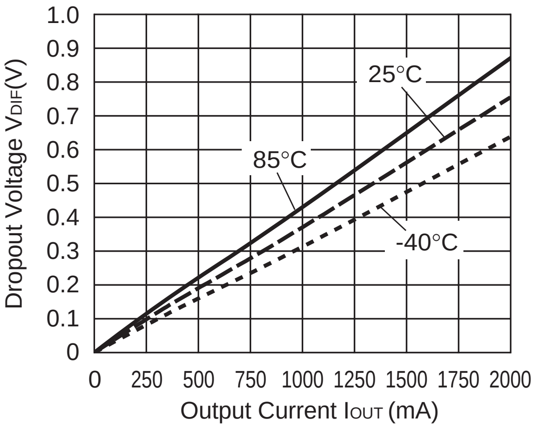


R1171J181x



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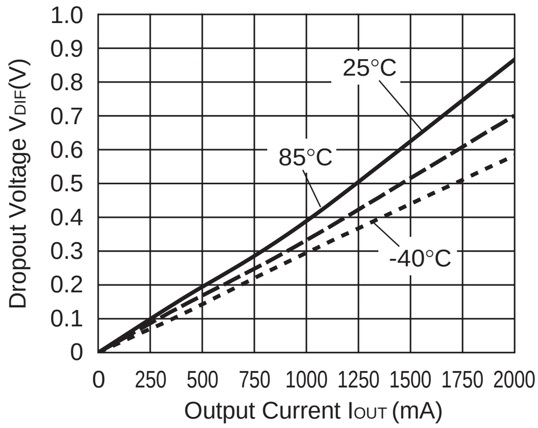

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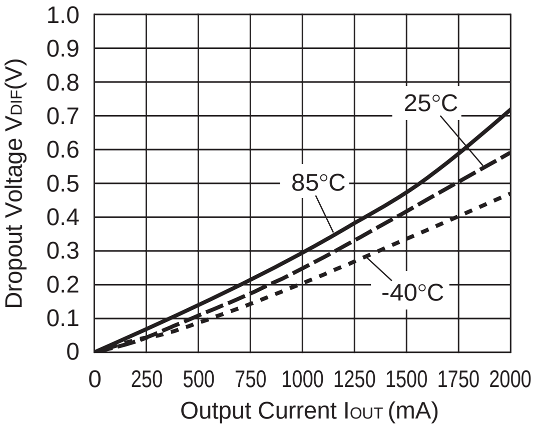
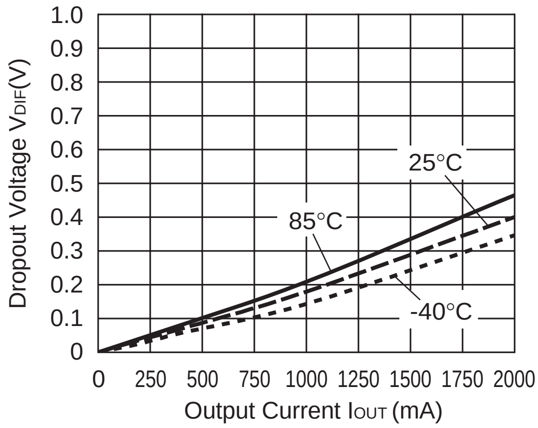
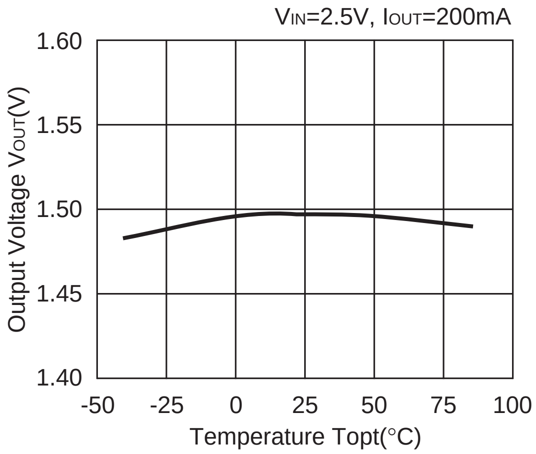


R1171J501x



4) Output Voltage vs. Temperature

R1171x151B



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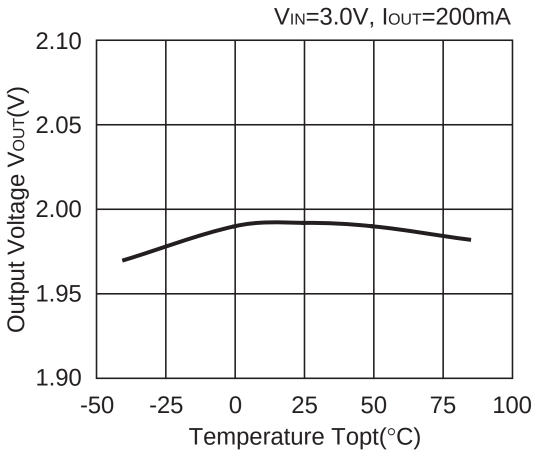
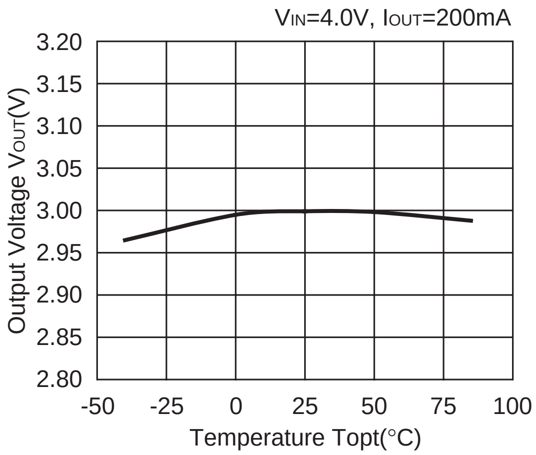


R1171x301B



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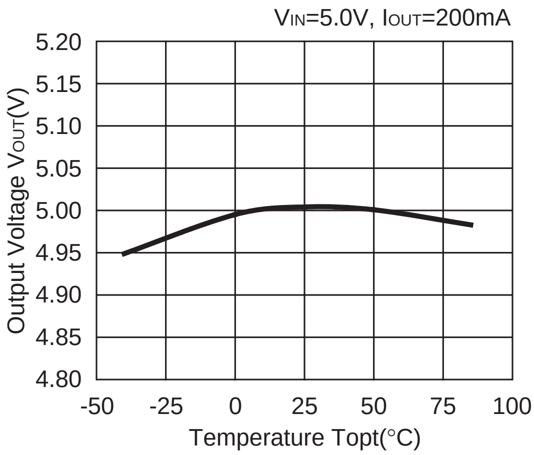
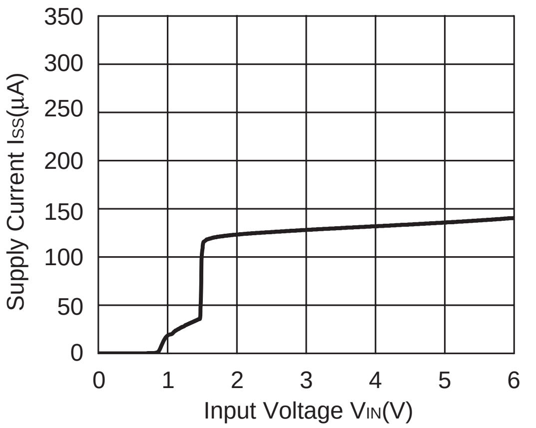


5) Supply Current vs. Input Voltage (Topt=25°C)

R1171x151B



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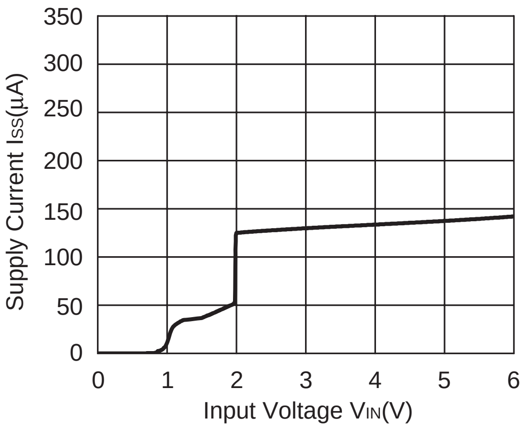

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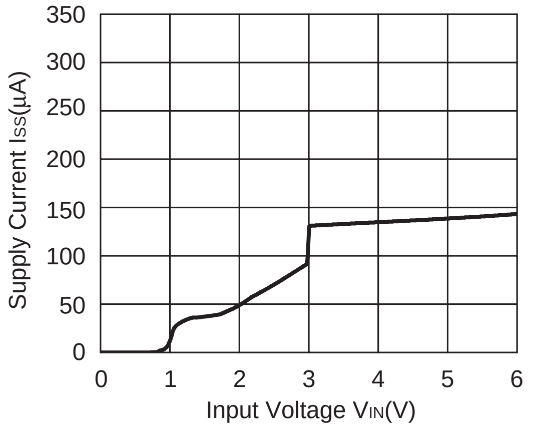

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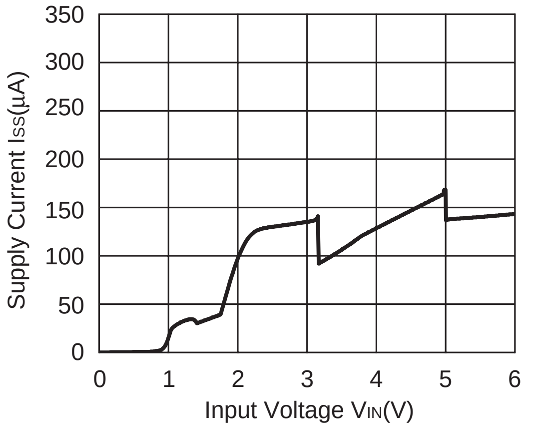
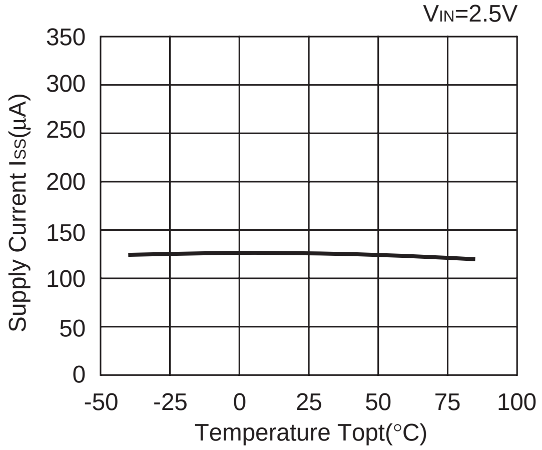


6) Supply Current vs. Temperature

R1171x151B



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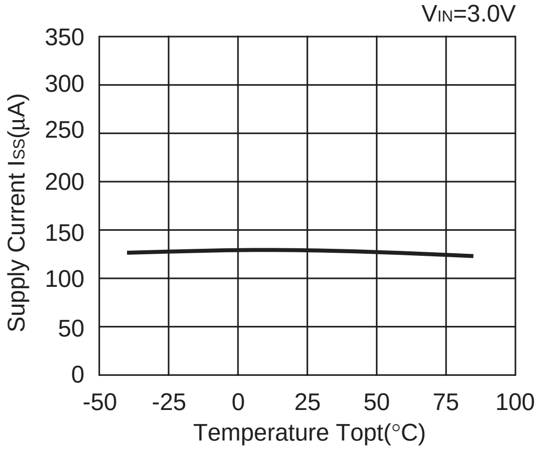

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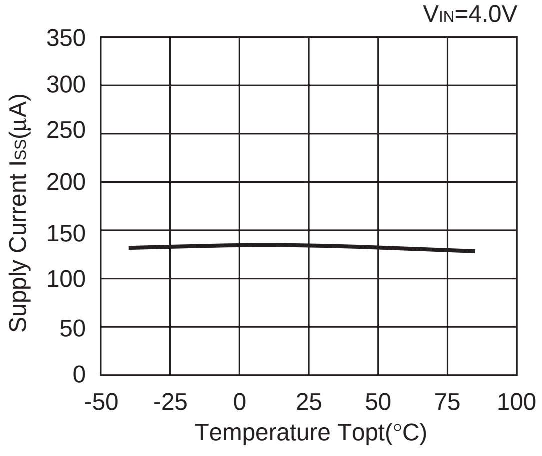

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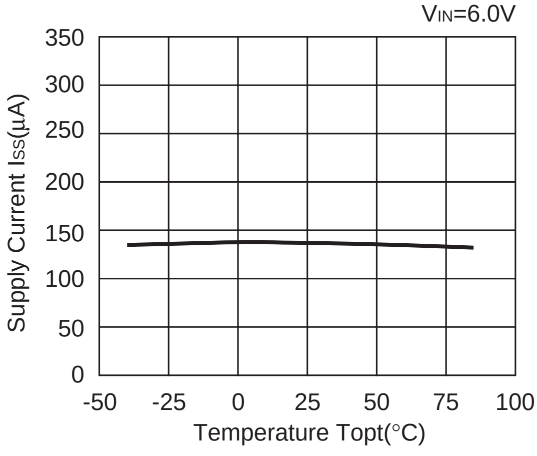
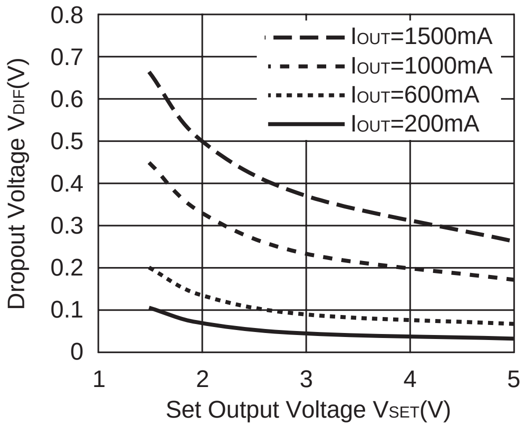
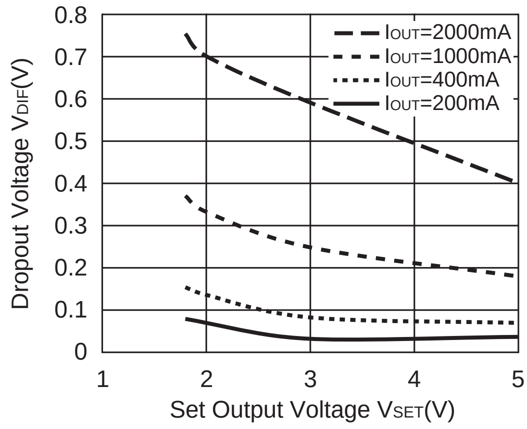


7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

R1171Sxx1x

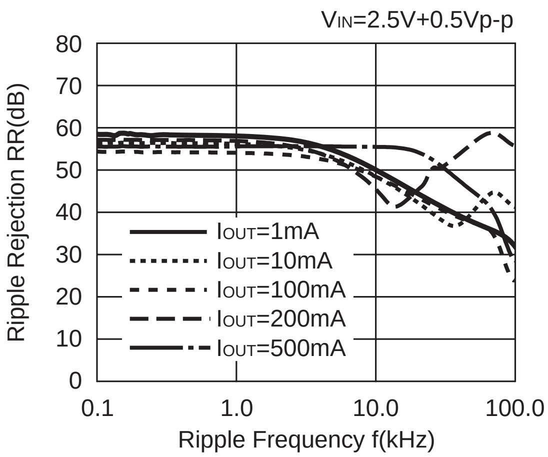


R1171Jxx1x



8) Ripple Rejection vs. Frequency

R1171x151B



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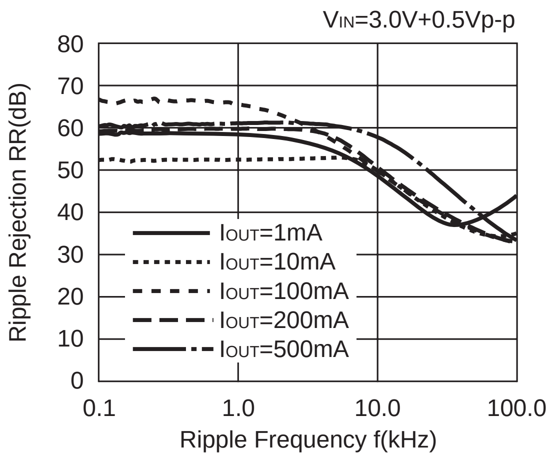

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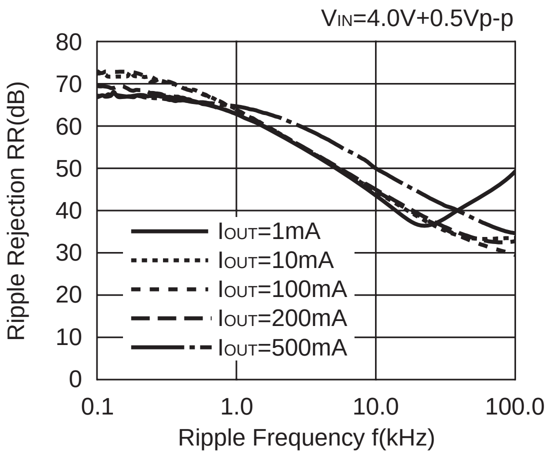

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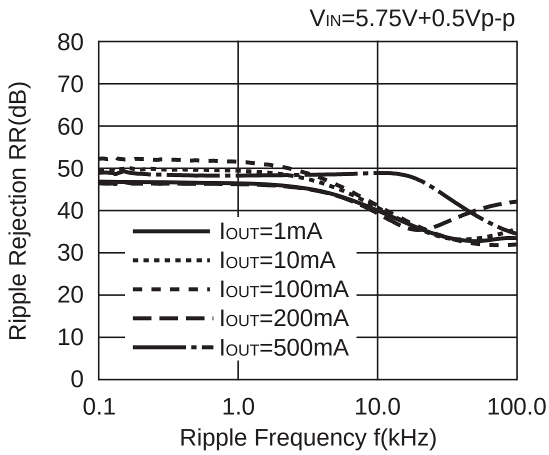
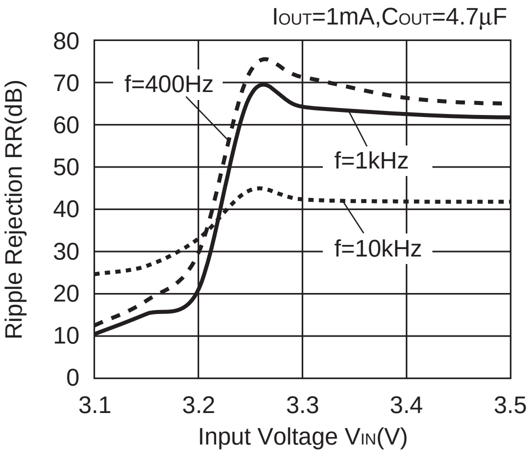


9) Ripple Rejection vs. Input Voltage

R1171x301x



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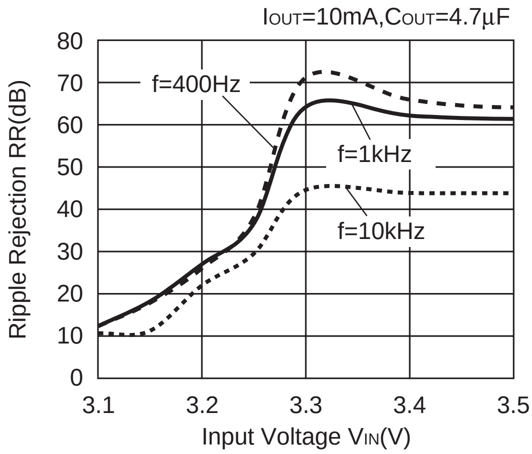

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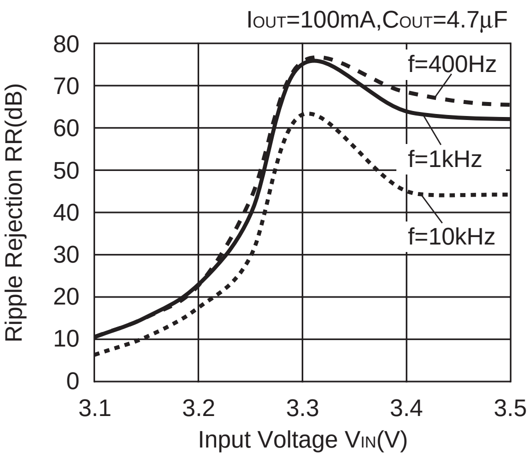

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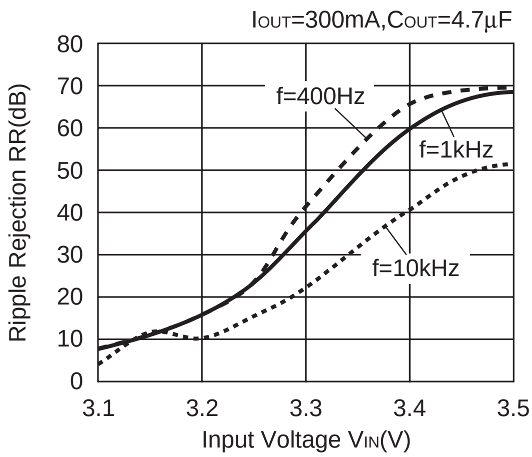
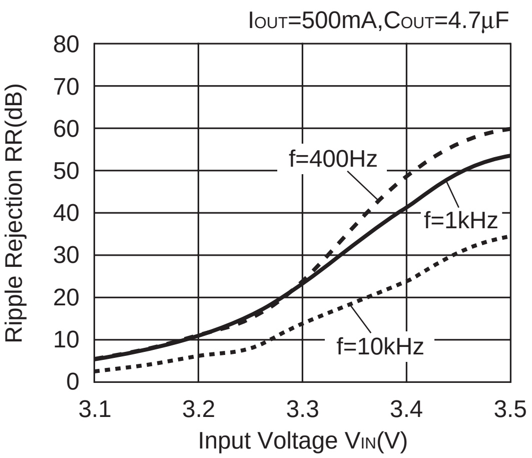


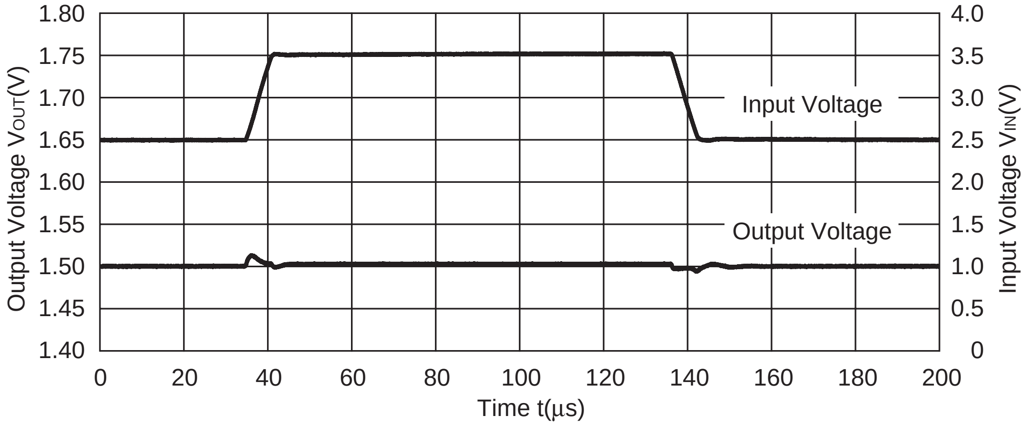
R1171x301x



10) Input Transient Response (Topt=25°C)

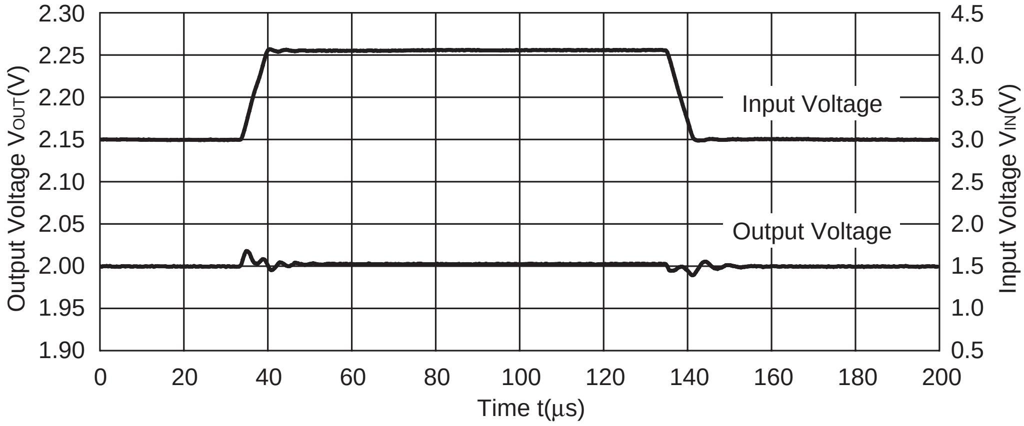
R1171x151B

tr=tf=5µs, I_{OUT}=1000mA, C_{OUT}=Ceramic 10µF



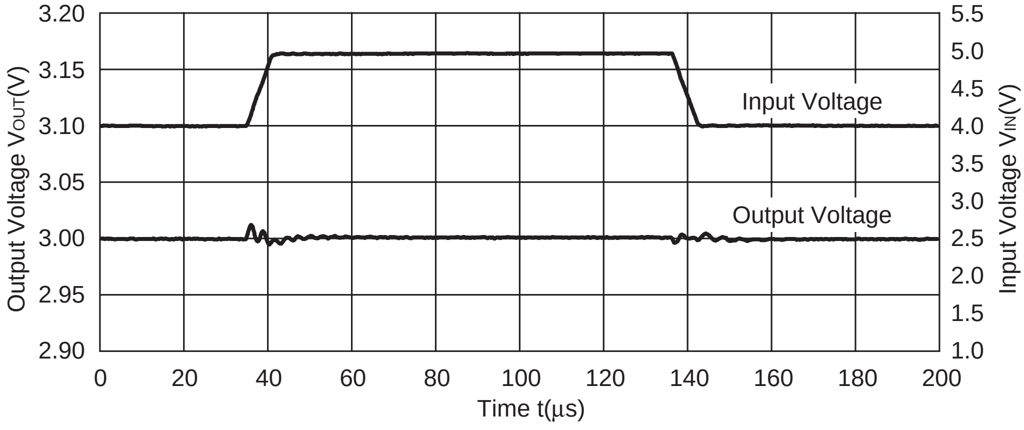
R1171x201B

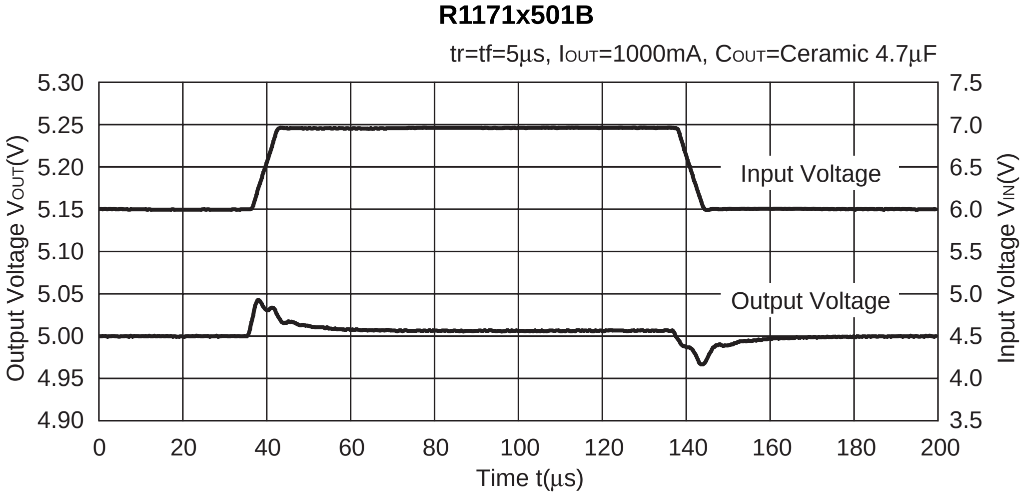
tr=tf=5µs, I_{OUT}=1000mA, C_{OUT}=Ceramic 4.7µF



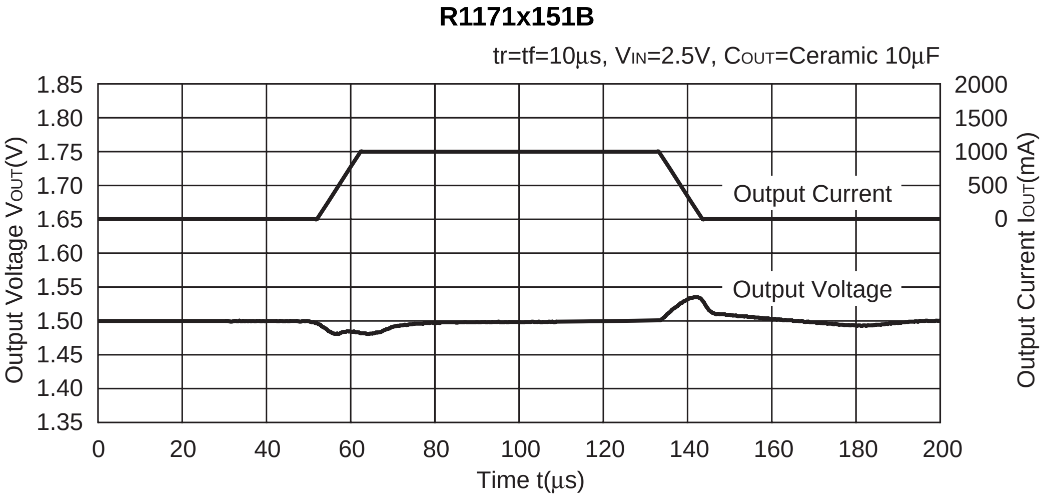
R1171x301B

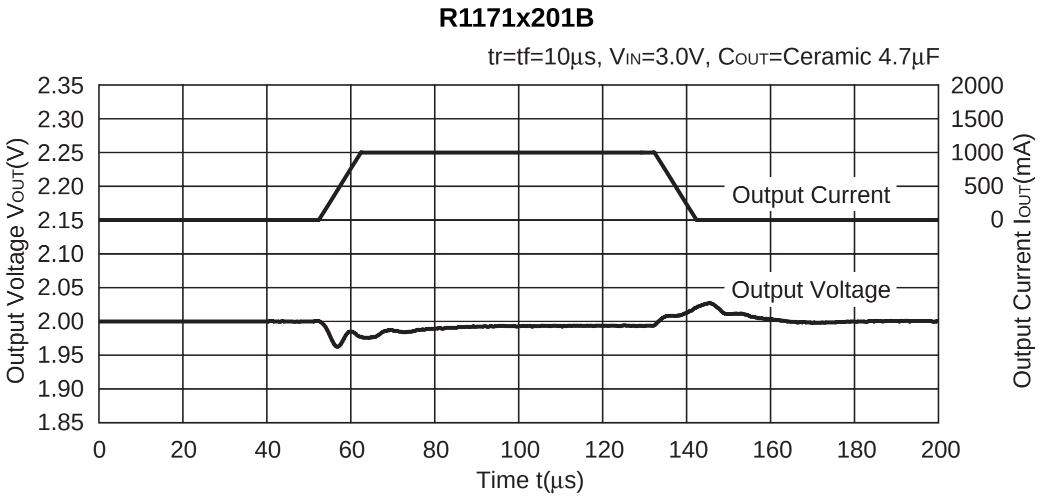
tr=tf=5µs, I_{OUT}=1000mA, C_{OUT}=Ceramic 4.7µF





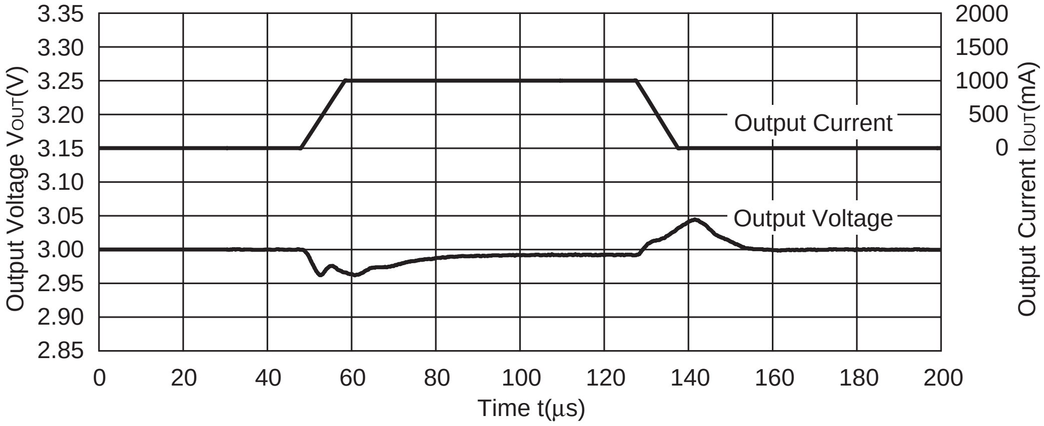
11) Load Transient Response (Topt=25°C)





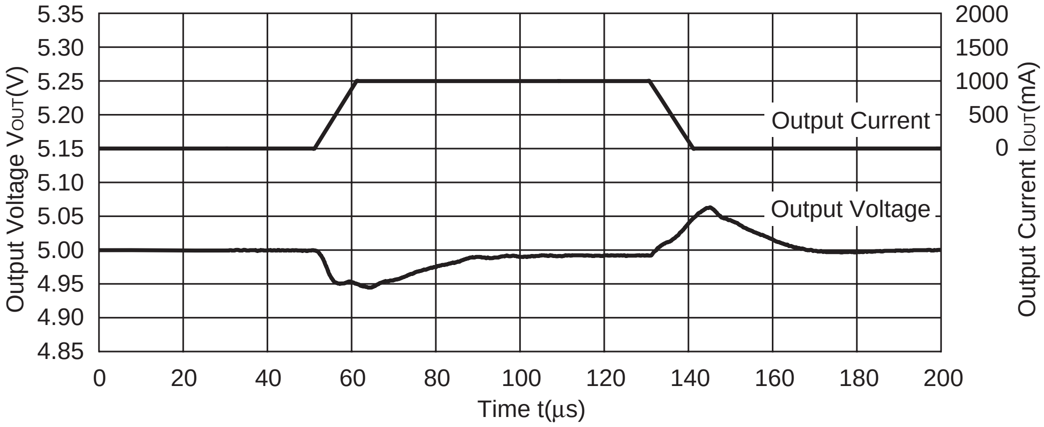
R1171x301B

tr=tf=10µs, V_{IN}=4.0V, C_{OUT}=Ceramic 4.7µF



R1171x501B

tr=tf=10µs, V_{IN}=6.0V, C_{OUT}=Ceramic 4.7µF



Technical Notes on External Components and Typical Application

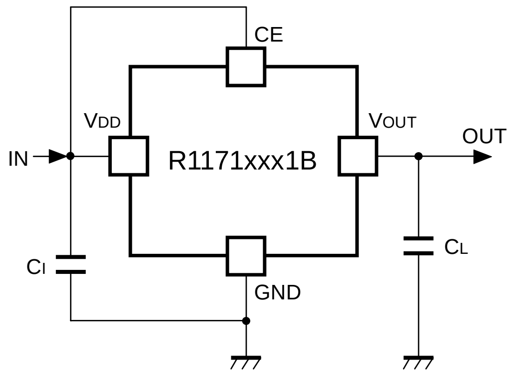
1. Phase Compensation

In these ICs, phase compensation is made with the output capacitor for securing stable operation even if the load current is varied. For this purpose, use a capacitor with the capacitance range from 4.7μF to 10.0μF, as C_L. In case that using a tantalum capacitor and the ESR of the tantalum capacitor is too large, unstable operation may result. Fully evaluation is necessary for the whole circuit with considering the frequency characteristic.

2. Mounting on PCB

Make V_{DD} and GND lines sufficient. If their impedance is high, large current may flow and the pick-up noise or unstable operation may result. Therefore use a capacitor with a capacitance range from 4.7μF to 10.0μF between V_{DD} pin and GND pin as close as possible.

Further, set an output capacitor between V_{OUT} pin and GND pin for phase compensation as close as possible. (Refer to the example of typical application)



R1171Sxx1B Typical Application

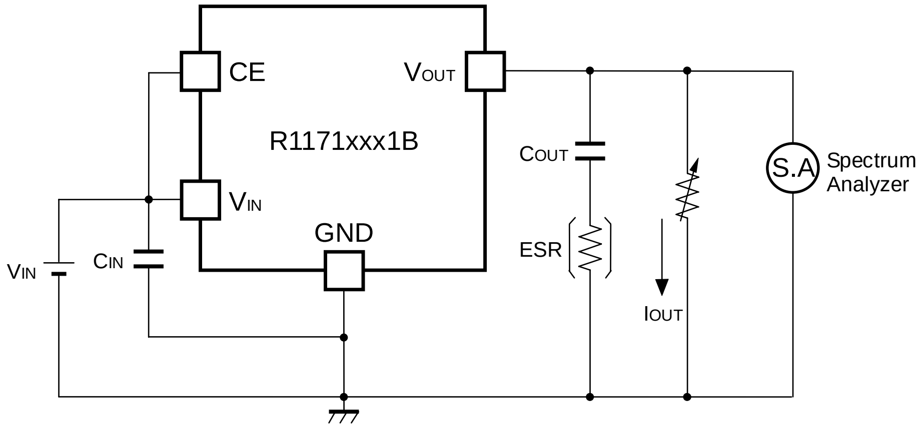
1.5V ≦ V_{OUT}<1.8V : C_I=10μF (Ceramic),C_L=10μF (Ceramic)

1.8V ≦ V_{OUT} ≦ 5.0V : C_I=4.7μF (Ceramic),C_L=4.7μF (Ceramic)

3. Output Short Protection Function

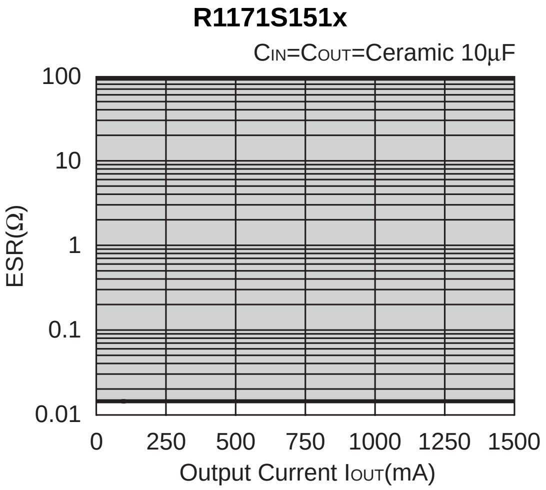
In the R1171x Series, the output short protection function is built in, further, if the output is short to the GND or other voltage line, the chip inside is heating, as a result, in case that the junction temperature becomes equal or more than 150°C (Typ.), the built-in thermal shutdown circuit works. If the junction temperature becomes equal or more than 150°C (Typ.), the IC is protected by the output short protection circuit and the thermal shutdown circuit.

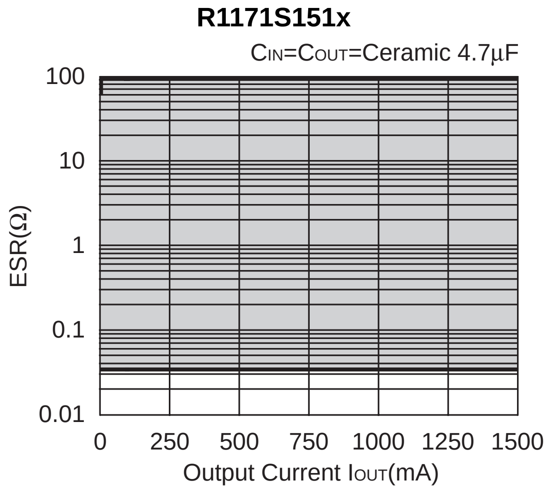
ESR vs. Output Current (Topt=25°C, V_{IN}=Set Output Voltage+1V, C_{IN}=Ceramic 10µF)



As an output capacitor for this IC, Ceramic capacitor is recommendable. However, other low ESR type capacitor can be used with this IC.

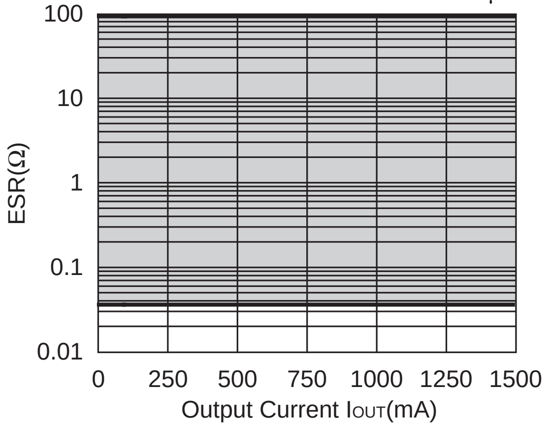
For your reference, noise level is tested with the circuit as shown above, and if the noise level is 40µV or less than 40µV, the ESR values are plotted as stable area. Upper limit is described in the next four graphs, or ESR vs. Output Current. (Hatched area is the stable area.)





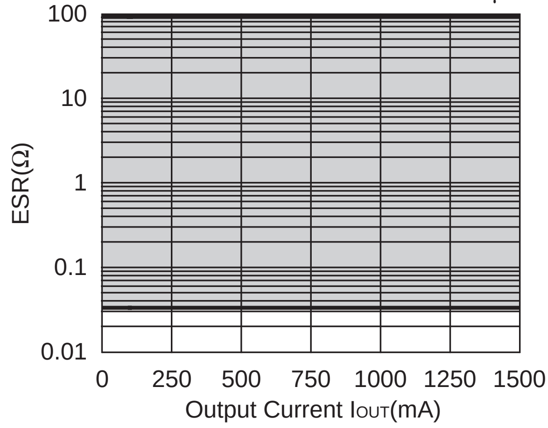
R1171S301x

C_{IN}=C_{OUT}=Ceramic 4.7µF



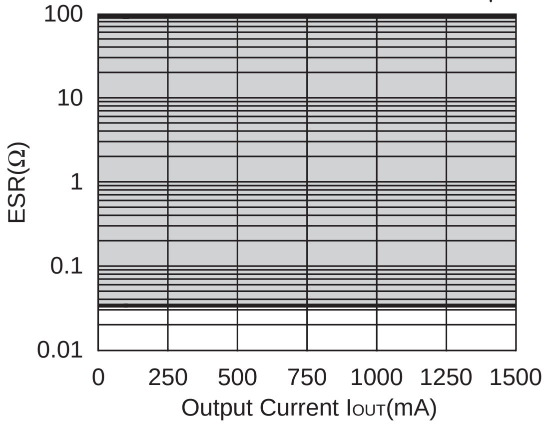
R1171S301x

C_{IN}=C_{OUT}=Ceramic 2.2µF



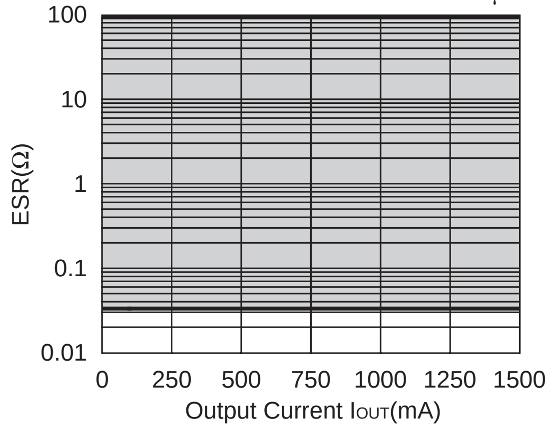
R1171S501x

C_{IN}=C_{OUT}=Ceramic 4.7µF



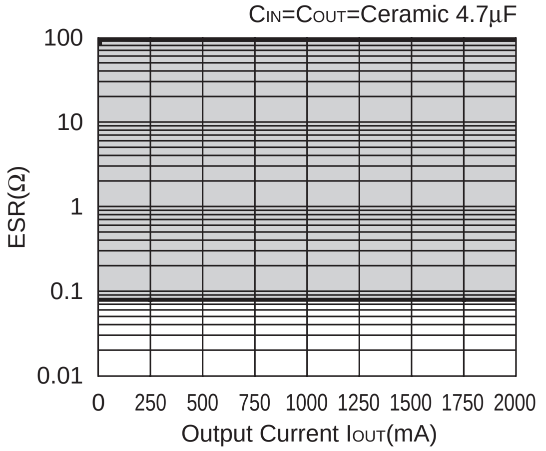
R1171S501x

C_{IN}=C_{OUT}=Ceramic 2.2µF



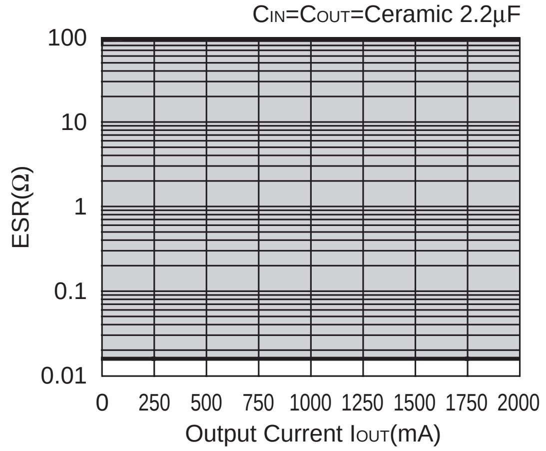
R1171J181x

C_{IN}=C_{OUT}=Ceramic 4.7µF

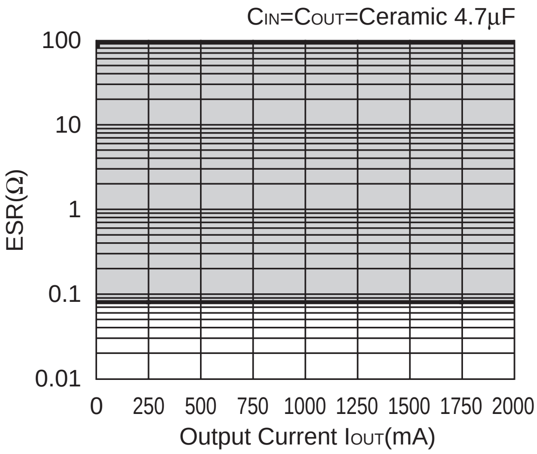


R1171J181x

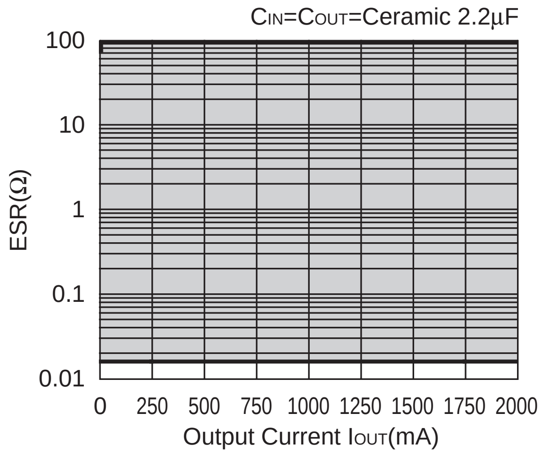
C_{IN}=C_{OUT}=Ceramic 2.2µF



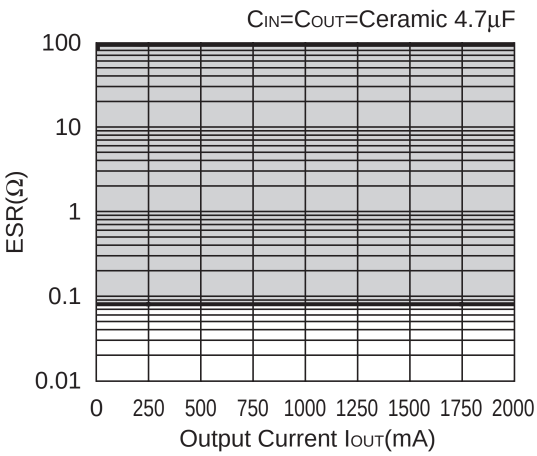
R1171J301x



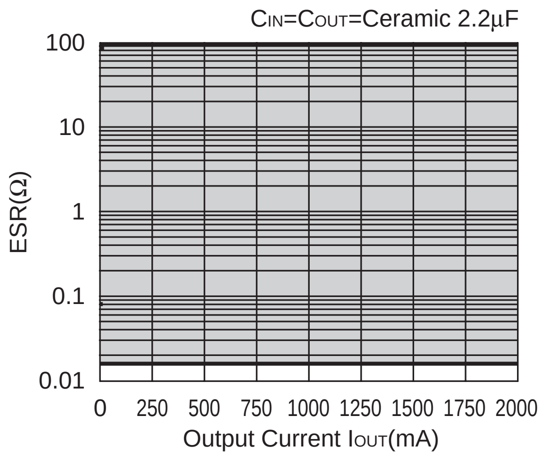
R1171J301x



R1171J501x



R1171J501x



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