RICOH

R1172x SERIES

SUPER LOW ON RESISTANCE / LOW VOLTAGE 1A LDO

NO.EA-122-111027

OUTLINE

The R1172x Series are CMOS-based positive voltage regulator ICs. The R1172x Series have features of super low dropout, 1A output current capability. Even the output voltage is set at 1.5V, on resistance of internal FET is typically 0.32Ω. Therefore, applications that require a large current at small dropout are suitable for the R1172x series. Low input voltage is acceptable and low output voltage can be set. The minimum input voltage is 1.4V, and the lowest set output voltage is 0.8V. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor net for setting output voltage, a current limit circuit at over-current, a chip enable circuit, a thermal-shutdown circuit, and so on. A stand-by mode with ultra low consumption current can be realized with the chip enable pin. The output voltage of R1172 is fixed in the IC.

Since the packages for these ICs are SOT-23-5, SOT-89-5, HSON-6, and HSOP-6J with high power dissipation, high density mounting of the ICs on boards is possible.

FEATURES

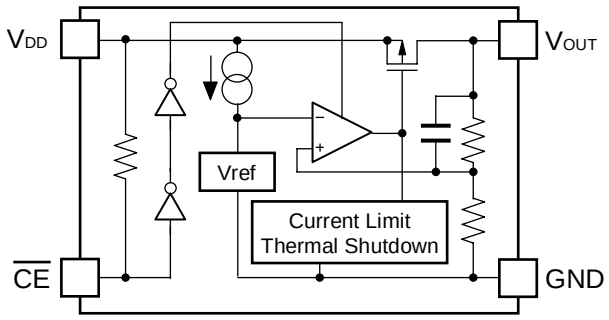
- Output Current 1A
- Supply Current ..... Typ. 60μA
- Standby Current ..... Typ. 0.1μA
- Input Voltage Range ..... 1.4V to 6.0V
- Output Voltage..... 0.8V to 5.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Dropout Voltage..... Typ. 0.32V (V_{OUT}=1.5V, I_{OUT}=1A)
  Typ. 0.18V (V_{OUT}=2.8V, I_{OUT}=1A)
- Ripple Rejection ..... Typ. 70dB (V_{OUT}=2.8V)
- Output Voltage Accuracy..... ±2.0%
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±100ppm/°C
- Line Regulation ..... Typ. 0.05%/V
- Load Regulation ..... Typ. 15mV at I_{OUT}=300mA, Typ. 50mV at I_{OUT}=1A
- Packages SOT-23-5, SOT-89-5, HSON-6, HSOP-6J
- Built-in Inrush current limit circuit ..... Typ. 500 mA
- Built-in Fold-Back Protection Circuit ..... Typ. 250mA (Current at short mode)
- Built-in Thermal Shutdown Circuit ..... Thermal Shutdown Temperature ; Typ. 150°C
  Released Temperature ; Typ. 120°C
- Built-in Auto Discharge Function ..... D Version
- Output capacitors ..... C_{IN}=C_{OUT}=Tantalum 4.7μF (V_{OUT} < 1.0V)
  C_{IN}=C_{OUT}=Ceramic 4.7μF (V_{OUT} ≧ 1.0V)

APPLICATIONS

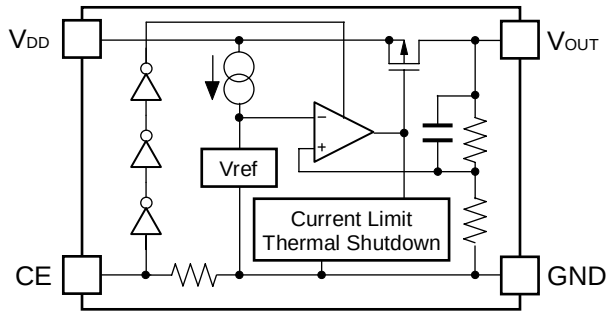
- Local Power source for Notebook PC.
- Local Power source for portable communication equipments, cameras, and VCRs.
- Local Power source for home appliances.

BLOCK DIAGRAMS

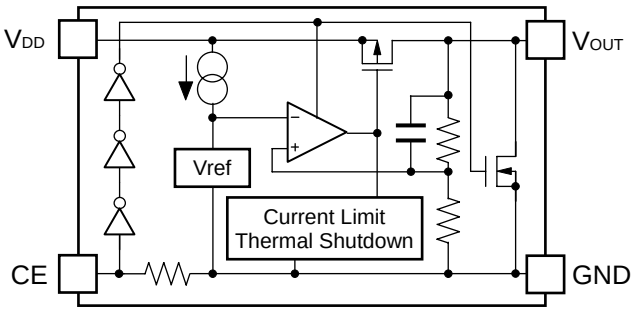
R1172xxx1A



R1172xxx1B



R1172xxx1D



SELECTION GUIDE

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

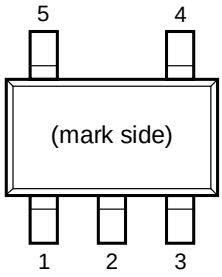
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1172Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
R1172Hxx1∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
R1172Dxx2∗-TR-FE	HSON-6	3,000 pcs	Yes	Yes
R1172Sxx1∗-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 0.8V(08) to 5.0V(50) in 0.1V steps.
(HSOP-6J : 0.8V to 3.5V)
(For other voltages, please refer to MARK INFORMATIONS.)

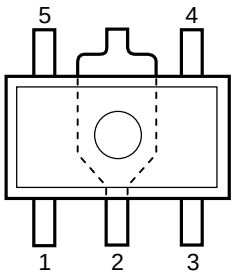
∗ : CE pin polarity and auto discharge function at off state are options as follows.
(A) "L" active, without auto discharge function at off state
(B) "H" active, without auto discharge function at off state
(D) "H" active, with auto discharge function at off state

PIN CONFIGURATIONS

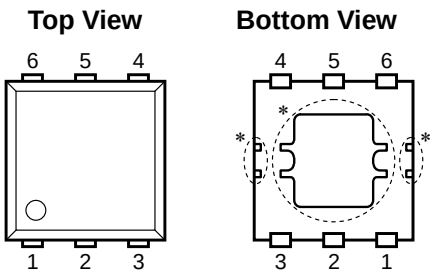
● SOT-23-5



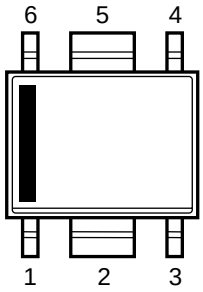
● SOT-89-5



● HSON-6



● HSOP-6J



PIN DESCRIPTIONS

• SOT-23-5

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

• SOT-89-5

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

• HSON-6

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

∗) Tab and tab suspension leads in the ◌ parts are GND level.
(They are connected to the reverse side of the IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.
The tab suspension leads should be open and do not connect to other wires or land patterns.

∗1) The V_{OUT} pin and V_{DD} pin must be wired each other when it is mounted on board.

• **HSOP-6J**

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

∗1) The GND pin must be wired together when it is mounted on board.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.5	V
V_{CE}	Input Voltage ($\overline{CE}$ or CE Input Pin)	−0.3 to 6.5	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
P_D	Power Dissipation (SOT-23-5) *	420	mW
	Power Dissipation (SOT-89-5) *	900	
	Power Dissipation (HSON-6) *	900	
	Power Dissipation (HSOP-6J) *	1700	
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

- **R1172xxx1A**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage			1.4		6.0	V
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V, V_{CE}=0V, I_{OUT} =0A			60	100	μA
Istandby	Standby Current	V_{IN}= 6.0V, V_{CE}=V_{IN}			0.1	1.0	μA
V_{OUT}	Output Voltage	V_{IN}–V_{OUT}=1.0V, I_{OUT}=100mA	V_{OUT} > 1.5V	×0.98		×1.02	V
			V_{OUT} ≦ 1.5V	–30		+30	mV
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	V_{IN}–V_{OUT}=0.3V, 1mA ≦ I_{OUT} ≦ 300mA, If V_{OUT} ≦ 1.1V, then V_{IN}=1.4V		–15	15	30	mV
		V_{IN}–V_{OUT}=0.3V, 1mA ≦ I_{OUT} ≦ 1A, If V_{OUT} ≦ 1.1V, then V_{IN}=1.7V			50		
V_{DIF}	Dropout Voltage	Refer to Dropout Voltage Table					
ΔV_{OUT}/ ΔV_{IN}	Line Regulation	I_{OUT}=100mA, V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V, If V_{OUT} ≦ 0.9V, 1.4V ≦ V_{IN} ≦ 6.0V			0.05	0.20	%/V
RR	Ripple Rejection	f=1kHz (V_{OUT} ≦ 4.0V) f=1kHz (V_{OUT} > 4.0V) Ripple 0.5Vp-p, V_{IN}–V_{OUT}=1.0V, I_{OUT}=100mA If V_{OUT} ≦ 1.2V, V_{IN}–V_{OUT}=1.5V, I_{OUT}=100mA			70 60		dB
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=100mA, –40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	V_{IN}–V_{OUT}=1.0V		1			A
I_{SC}	Short Current Limit	V_{OUT}=0V			250		mA
R_{PU}	Pull-up Resistance for $\overline{CE}$ pin			1.9	5.0	15.0	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"			1.0		6.0	V
V_{CEL}	$\overline{CE}$ Input Voltage "L"			0		0.4	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C
en	Output Noise	BW=10Hz to 100kHz			30		μVrms

- **R1172xxx1B/D**

Topt=25°C

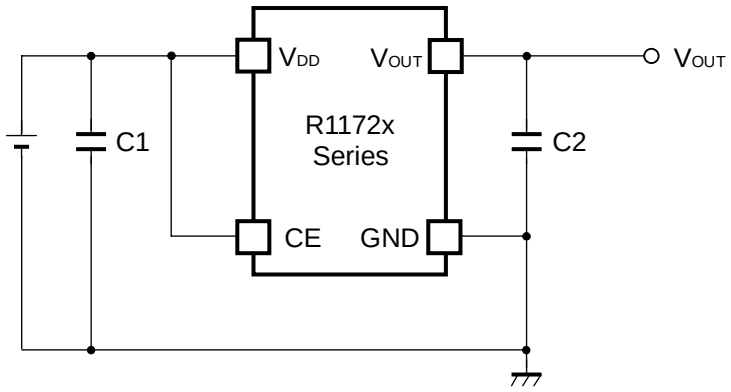
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage			1.4		6.0	V
I_{SS}	Supply Current	$V_{IN}-V_{OUT}$=1.0V, $V_{IN}=V_{CE}$, I_{OUT}=0A			60	100	μA
$I_{standby}$	Standby Current	V_{IN}= 6.0V, V_{CE}=0V			0.1	1.0	μA
V_{OUT}	Output Voltage	$V_{IN}-V_{OUT}$=1.0V, I_{OUT}=100mA	V_{OUT} > 1.5V	×0.98		×1.02	V
			V_{OUT} ≦ 1.5V	−30		+30	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$V_{IN}-V_{OUT}$=0.3V 1mA ≦ I_{OUT} ≦ 300mA If V_{OUT} ≦ 1.1V, then V_{IN}=1.4V		−15	15	30	mV
		$V_{IN}-V_{OUT}$=0.3V 1mA ≦ I_{OUT} ≦ 1A If V_{OUT} ≦ 1.1V, then V_{IN}=1.7V			50		
V_{DIF}	Dropout Voltage	Refer to Dropout Voltage Table					
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=100mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V If V_{OUT} ≦ 0.9V, 1.4V ≦ V_{IN} ≦ 6.0V			0.05	0.20	%/V
RR	Ripple Rejection	f=1kHz (V_{OUT} ≦ 4.0V) f=1kHz (V_{OUT} > 4.0V) Ripple 0.5Vp-p, $V_{IN}-V_{OUT}$=1.0V I_{OUT}=100mA If V_{OUT} ≦ 1.2V, $V_{IN}-V_{OUT}$=1.5V, I_{OUT}=100mA			70 60		dB
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=100mA −40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	$V_{IN}-V_{OUT}$=1.0V		1			A
I_{SC}	Short Current Limit	V_{OUT}=0V			250		mA
R_{PD}	Pull-down Resistance for CE pin			1.9	5.0	15.0	MΩ
V_{CEH}	CE Input Voltage "H"			1.0		6.0	V
V_{CEL}	CE Input Voltage "L"			0		0.4	V
T_{TSD}	Thermal Shutdown Temperature	Junction Temperature			150		°C
T_{TSR}	Thermal Shutdown Released Temperature	Junction Temperature			120		°C
en	Output Noise	BW=10Hz to 100kHz			30		μVrms

- **Dropout Voltage by Output Voltage**

Topt=25°C

Output Voltage V_{OUT} (V)	Dropout Voltage V_{DIF} (V)		
	I_{OUT}=300mA		I_{OUT}=1A
	Typ.	Max.	Typ.
0.8 ≦ V_{OUT} < 0.9	0.33	0.57	0.72
0.9 ≦ V_{OUT} < 1.0	0.22	0.47	0.64
1.0 ≦ V_{OUT} < 1.5	0.18	0.32	0.56
1.5 ≦ V_{OUT} < 2.6	0.10	0.15	0.32
2.6 ≦ V_{OUT}	0.05	0.10	0.18

TYPICAL APPLICATION (R1172xxx1B/D)



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 good frequency characteristics and ESR (Equivalent Series Resistance).

The recommendation value is as follows.

Output Voltage	C2 recommendation value	Components Recommendation		
V_{OUT} < 1.0V	Tantalum 4.7μF or more			
1.0 ≦ V_{OUT} ≦ 3.3V	Ceramic 4.7μF or more	Kyocera Murata Murata	4.7μF (1608) 4.7μF (1608) 10μF (1608)	Part Number : CM105X5R475M06AB Part Number : GRM188R60J475KE19B Part Number : GRM188B30G106ME46B
3.3V < V_{OUT}	Ceramic 4.7μF or more	Kyocera Murata	4.7μF (thin 2012) 10μF (2012)	Part Number : CT21X5R475M06AB Part Number : GRM21BB30J106K

* If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics.
* Depending on the capacitor size, manufacturer, and part number, the bias characteristics and temperature characteristics are different. Evaluate the circuit with actual using capacitors.

PCB Layout

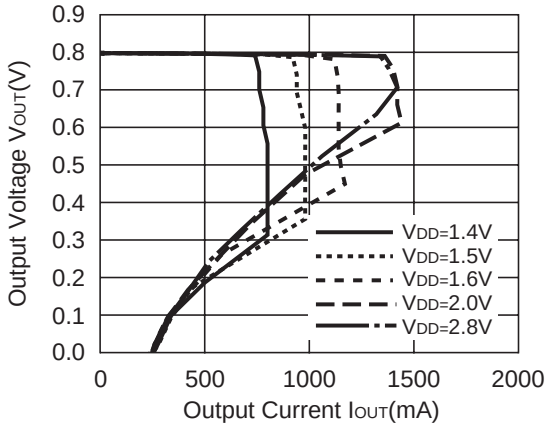
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 4.7μF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25℃)

R1172x081x



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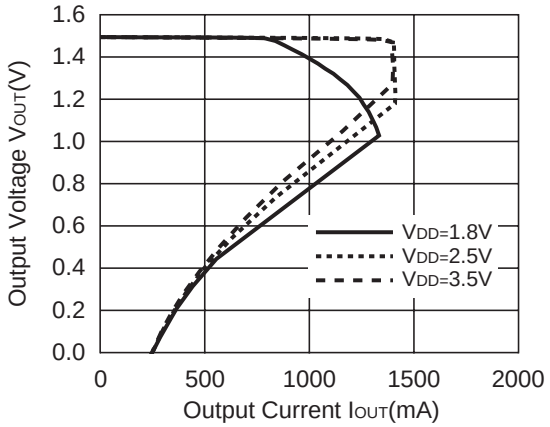

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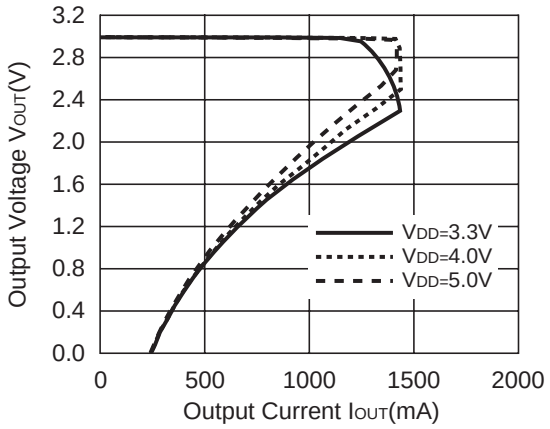

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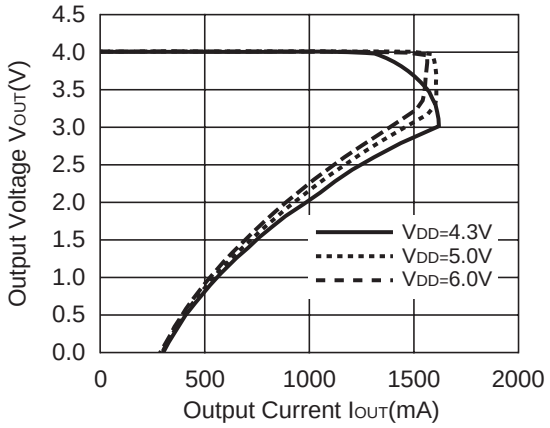

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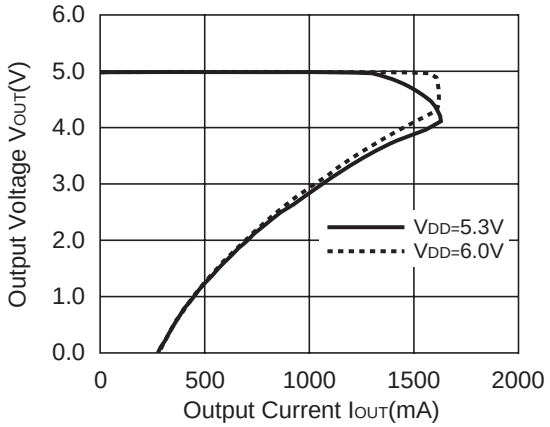

2) Output Voltage vs. Input Voltage (Topt=25℃)

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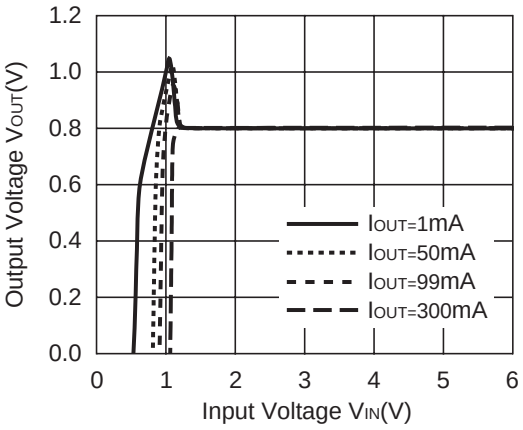

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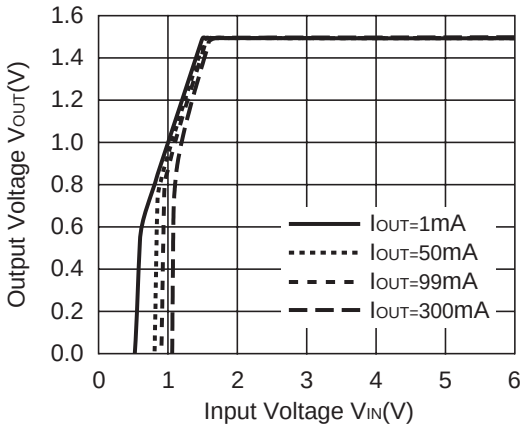

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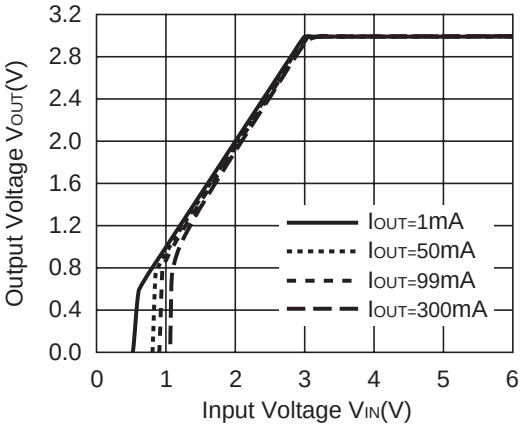

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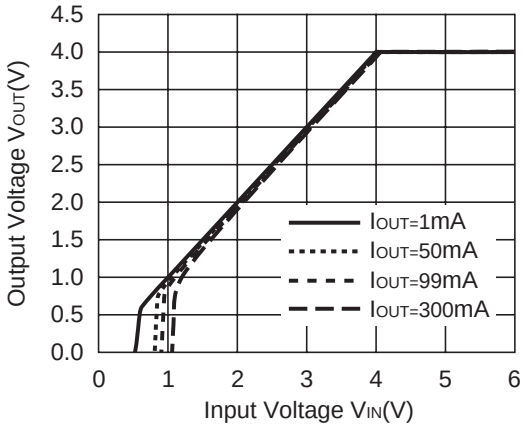

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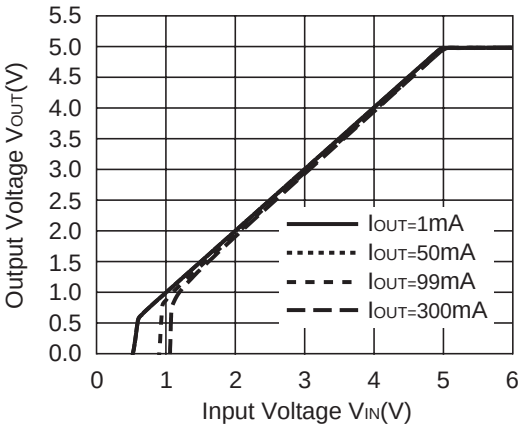
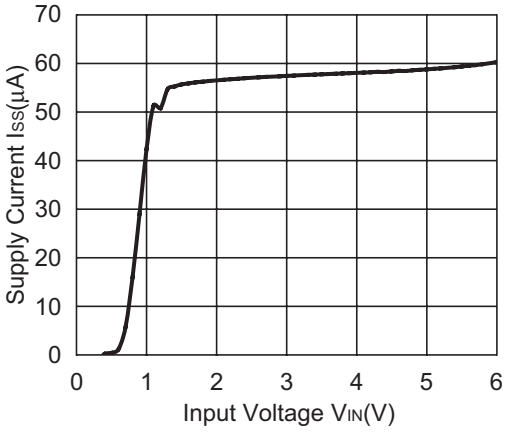


3) Supply Current vs. Input Current (Topt=25℃)

R1172x081x



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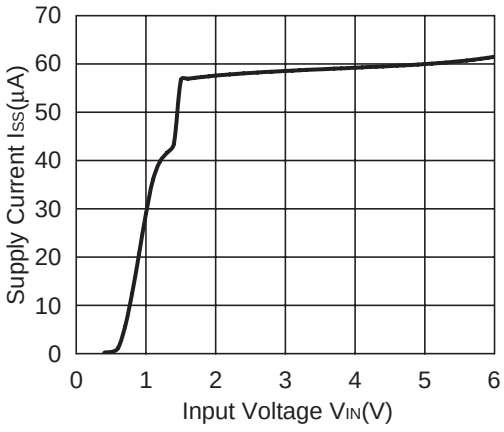

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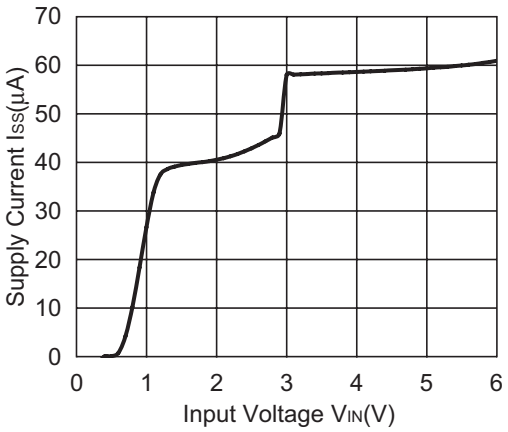

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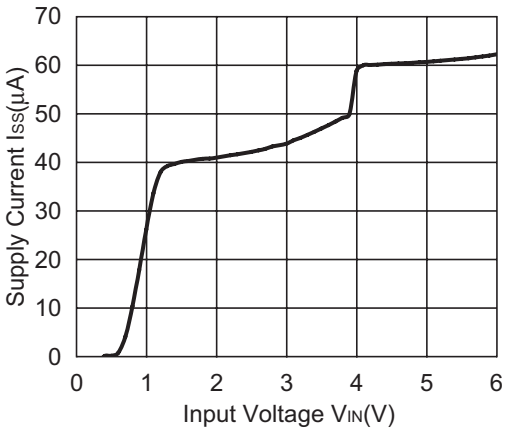

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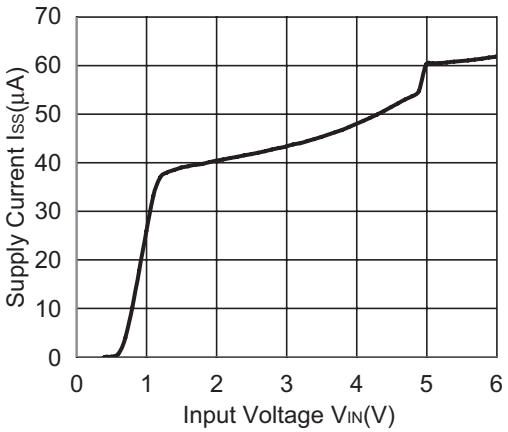
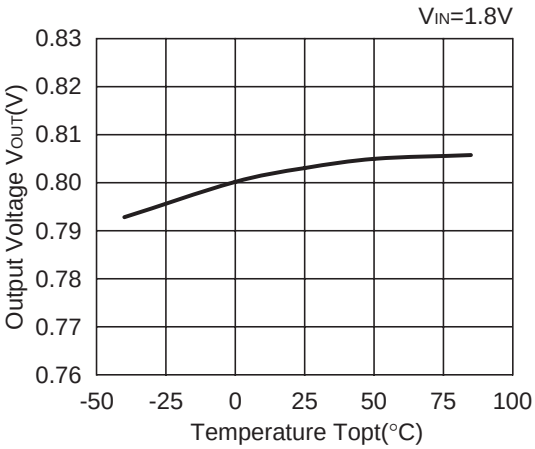


4) Output Voltage vs. Temperature (I_{OUT}=100mA)

R1172x081x



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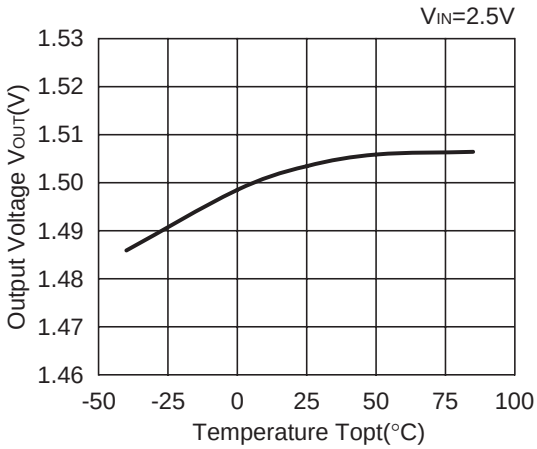

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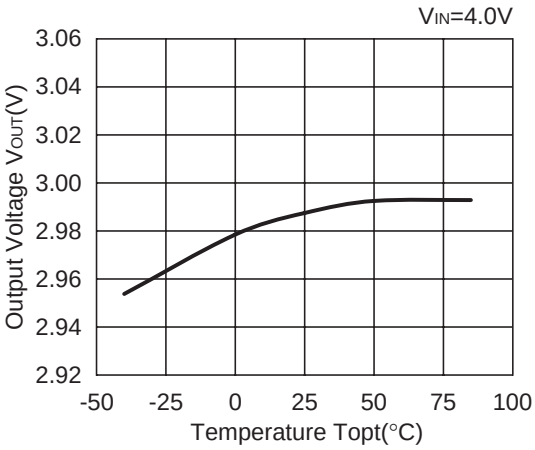

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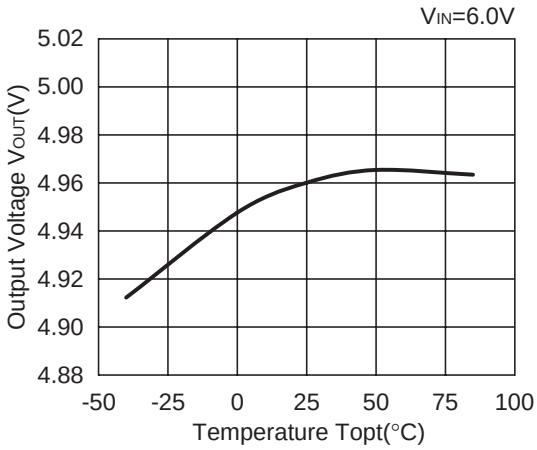
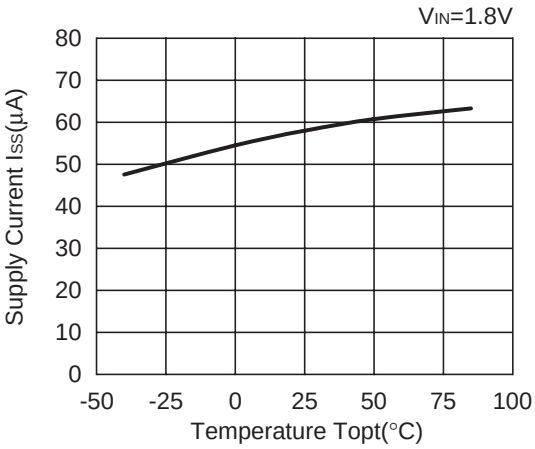
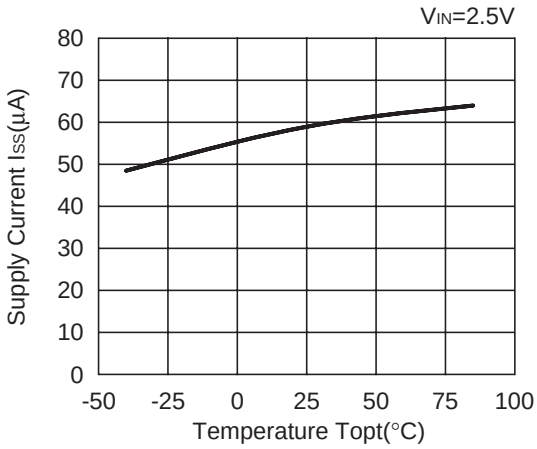


5) Supply Current vs. Temperature

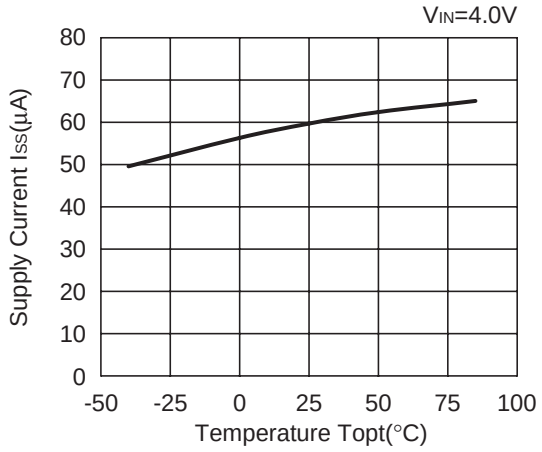
R1172x081x



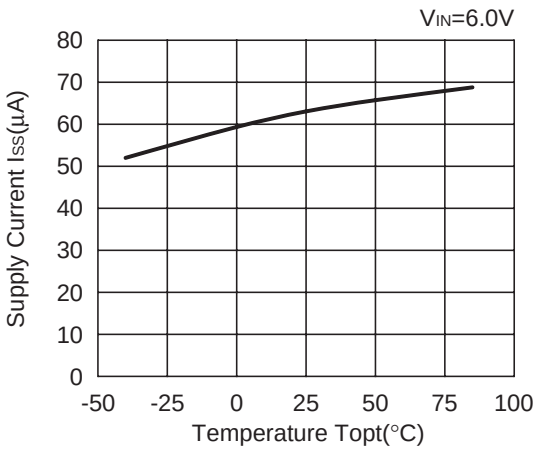
R1172x151x



R1172x301x

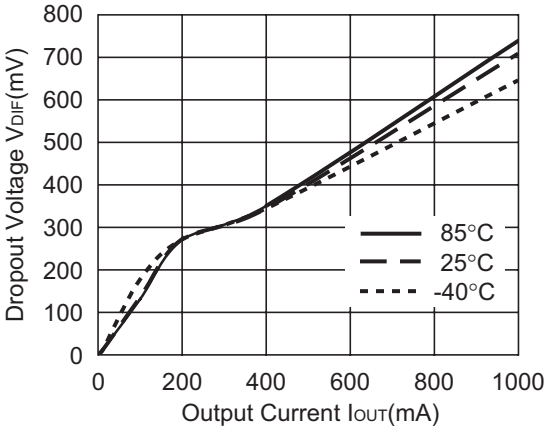


R1172x501x

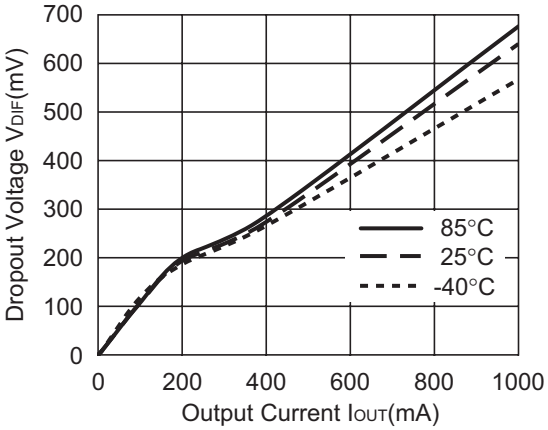


6) Dropout Voltage vs. Output Current

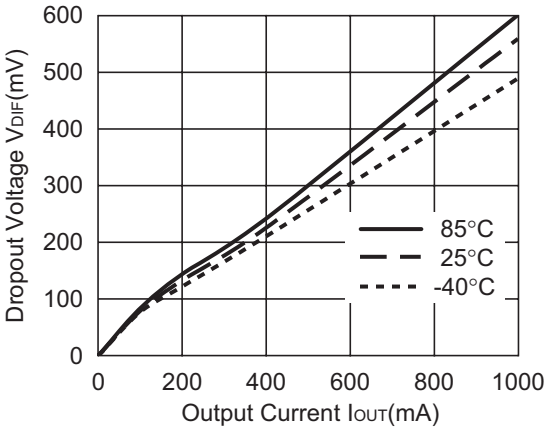
R1172x081x



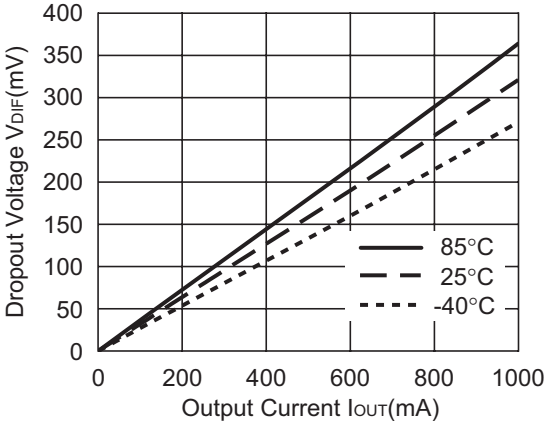
R1172x091x



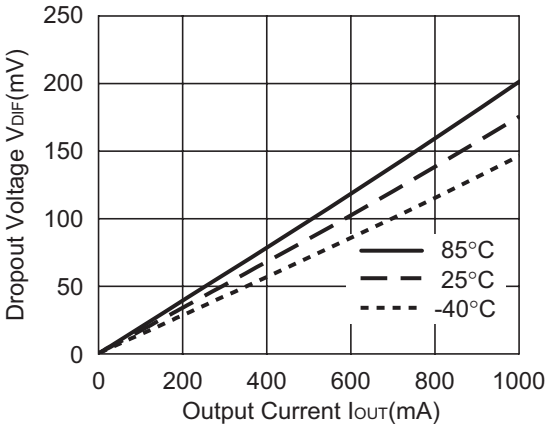
R1172x101x



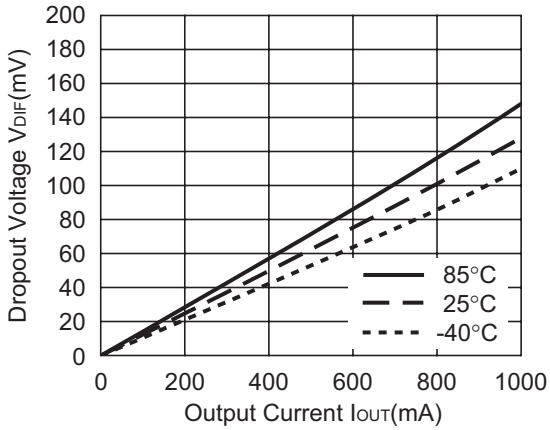
R1172x151x



R1172x301x

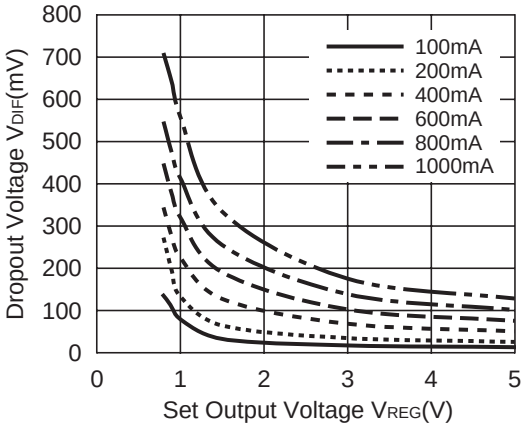


R1172x501x



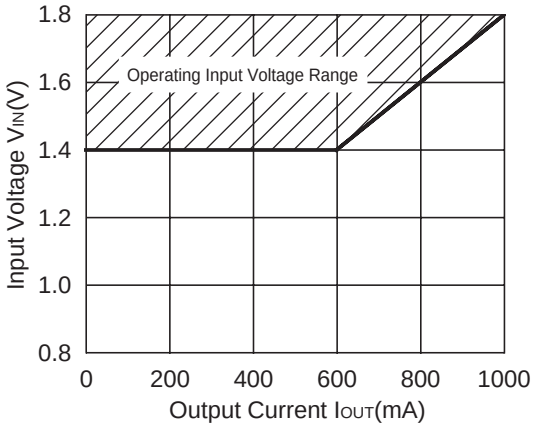
7) Dropout Voltage vs. Set Output Voltage

R1172xxx1x



8) 0.8V Output type, Operating Input Voltage Range

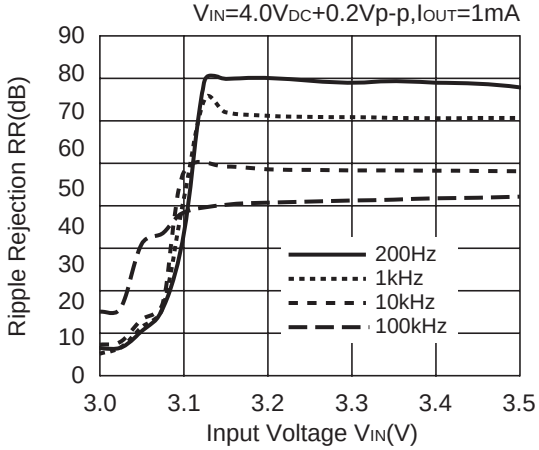
R1172x081x



9) Ripple Rejection vs. Input Bias

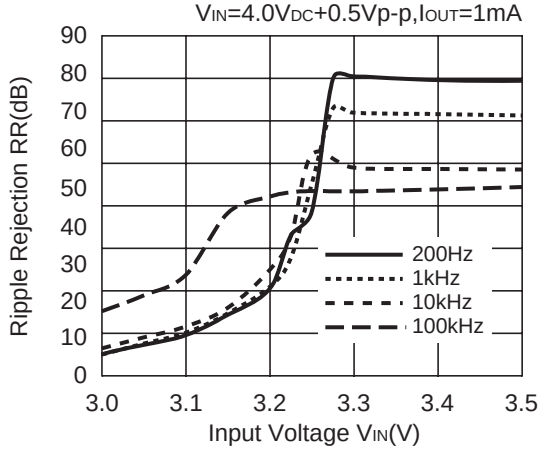
R1172x301x

VIN=4.0VDC+0.2Vp-p,IOUT=1mA



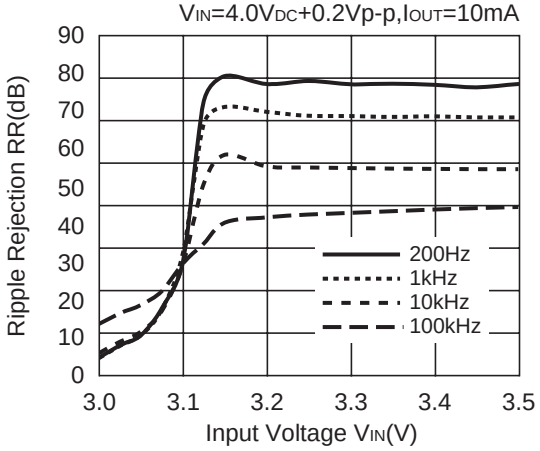
R1172x301x

VIN=4.0VDC+0.5Vp-p,IOUT=1mA



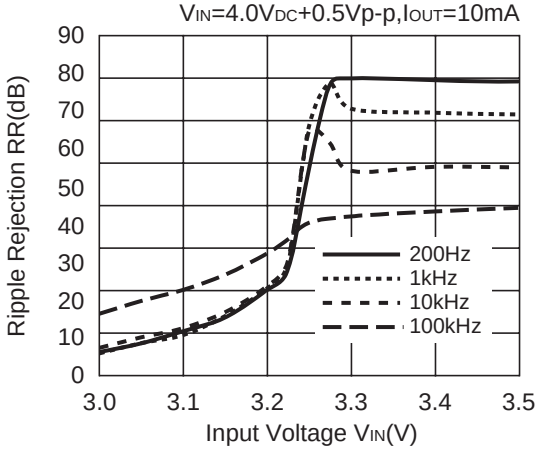
R1172x301x

V_{IN}=4.0V_{DC}+0.2Vp-p,I_{OUT}=10mA



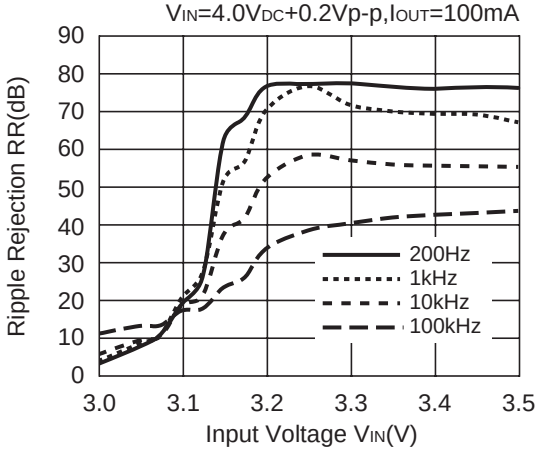
R1172x301x

V_{IN}=4.0V_{DC}+0.5Vp-p,I_{OUT}=10mA



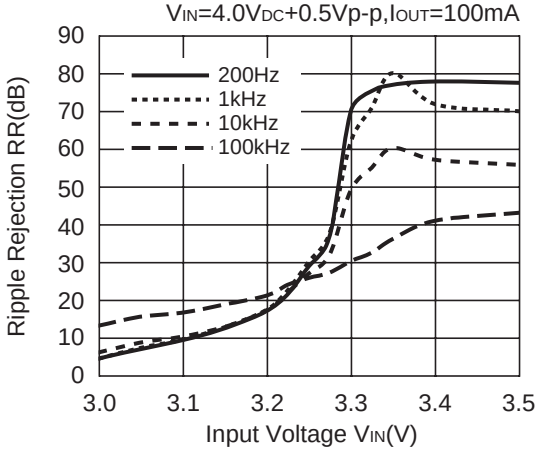
R1172x301x

V_{IN}=4.0V_{DC}+0.2Vp-p,I_{OUT}=100mA



R1172x301x

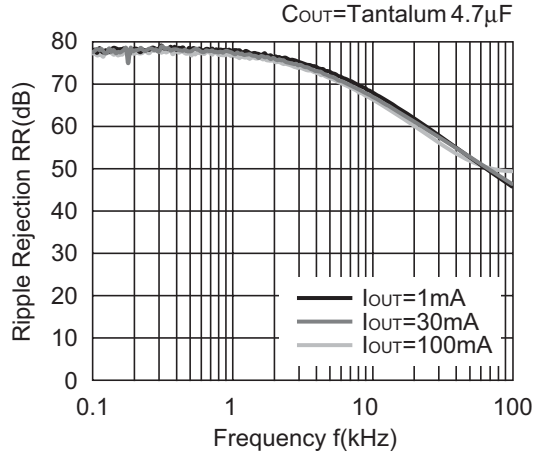
V_{IN}=4.0V_{DC}+0.5Vp-p,I_{OUT}=100mA



10) Ripple Rejection vs. Frequency

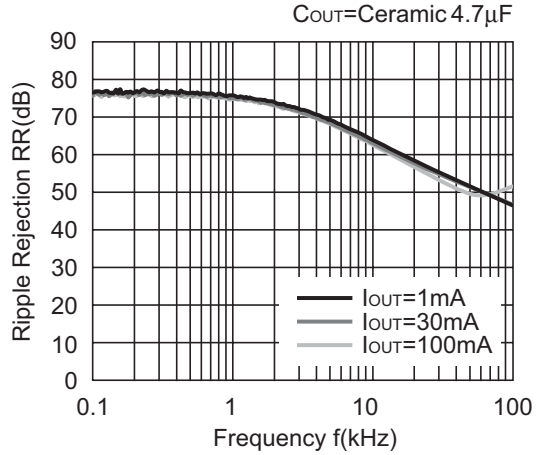
R1172x081x

V_{IN}=1.8V_{DC}+0.5Vp-p,
C_{OUT}=Tantalum 4.7µF

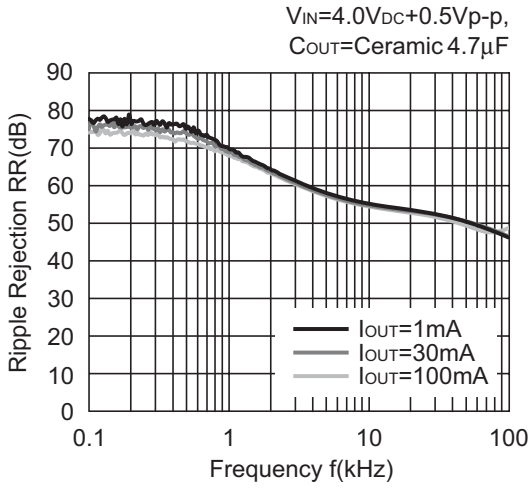


R1172x101x

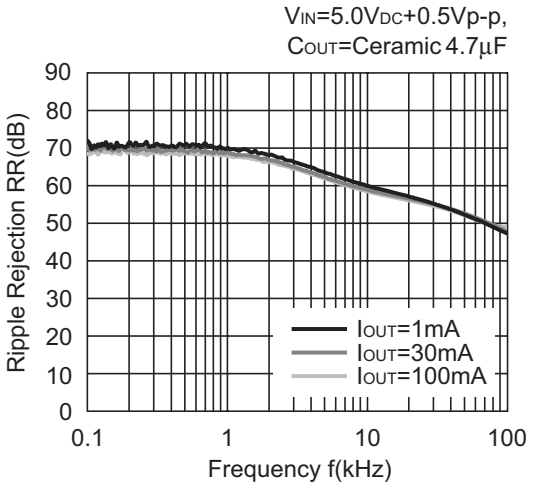
V_{IN}=2.0V_{DC}+0.5Vp-p,
C_{OUT}=Ceramic 4.7µF



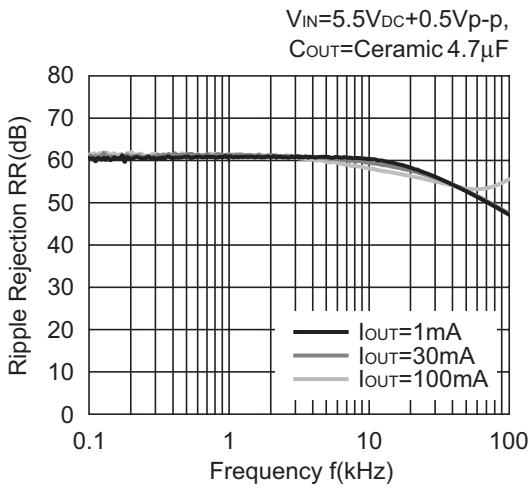
R1172x301x



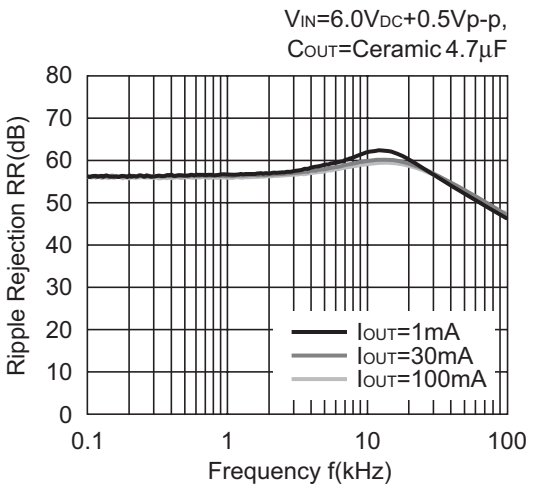
R1172x401x



R1172x451x

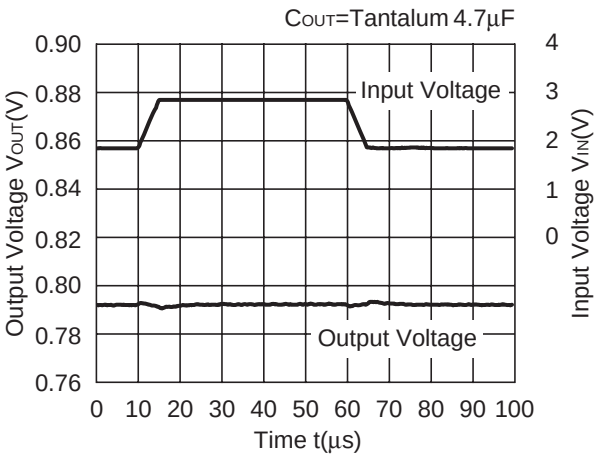


R1172x501x

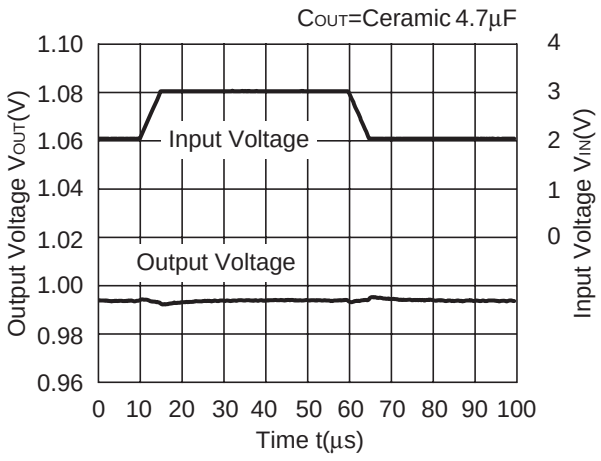


11) Line Transient Response (tr=tf=5µs, IOUT=100mA)

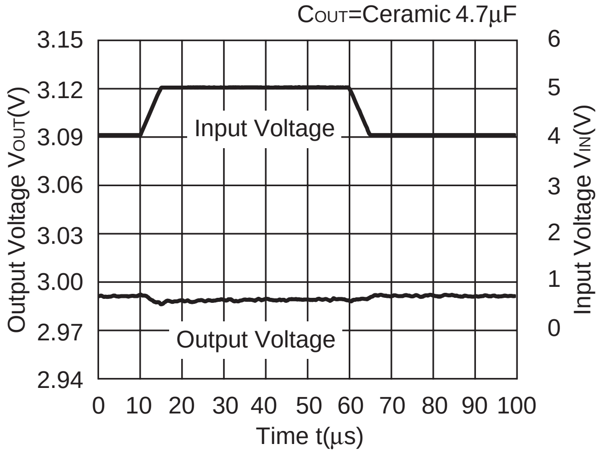
R1172x081x



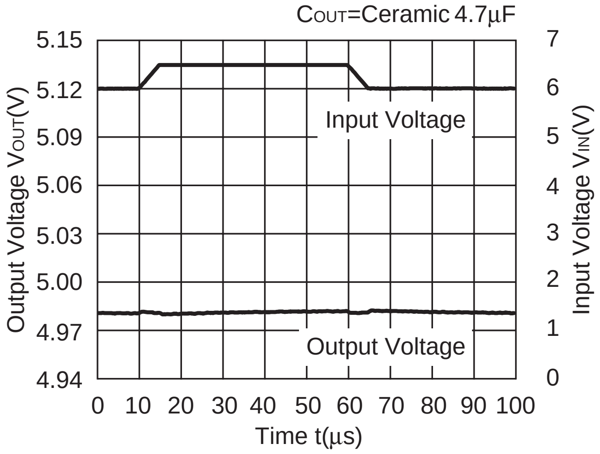
R1172x101x



R1172x301x

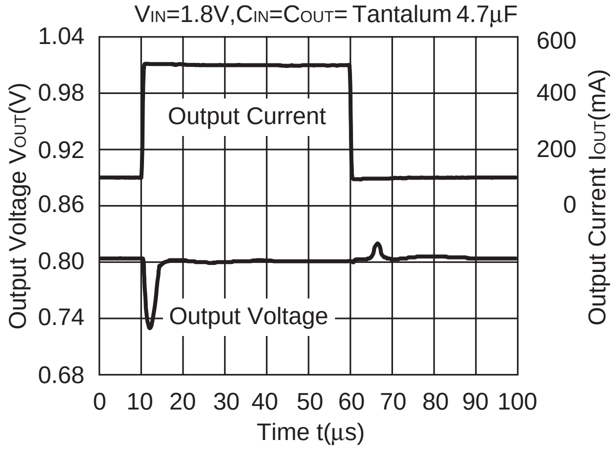


R1172x501x

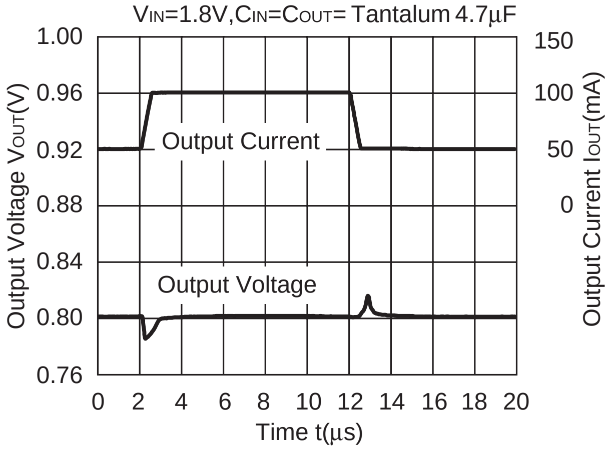


12) Load Transient Response (tr=tf=500ns)

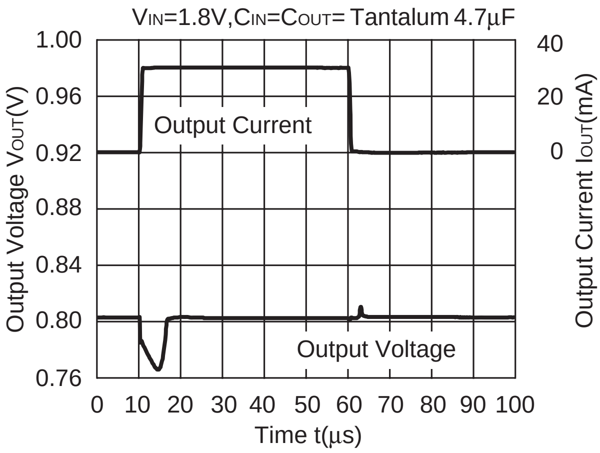
R1172x081x



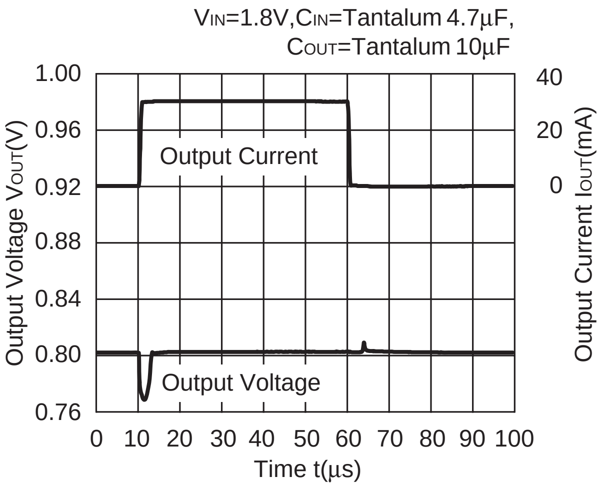
R1172x081x



R1172x081x

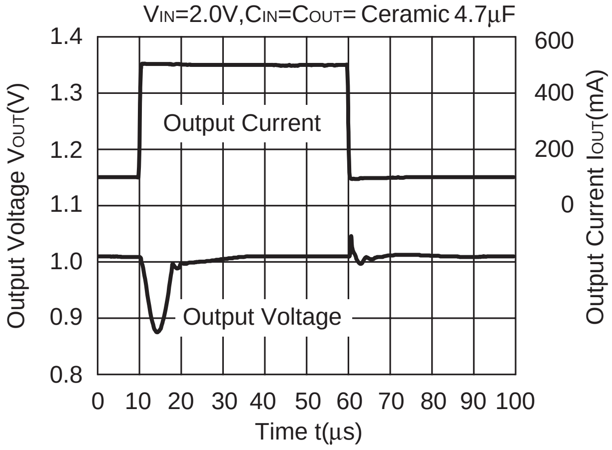


R1172x081x



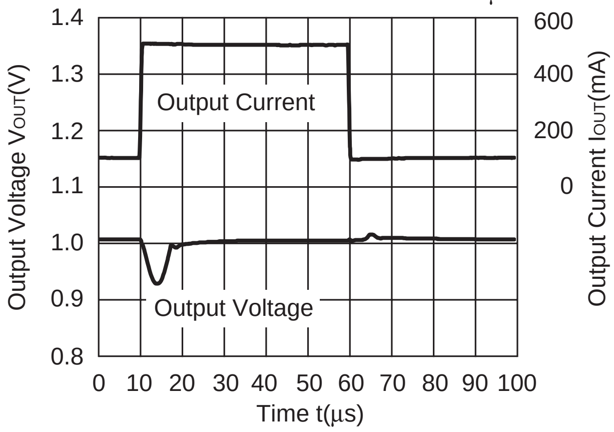
R1172x101x

V_{IN}=2.0V,C_{IN}=C_{OUT}= Ceramic 4.7μF



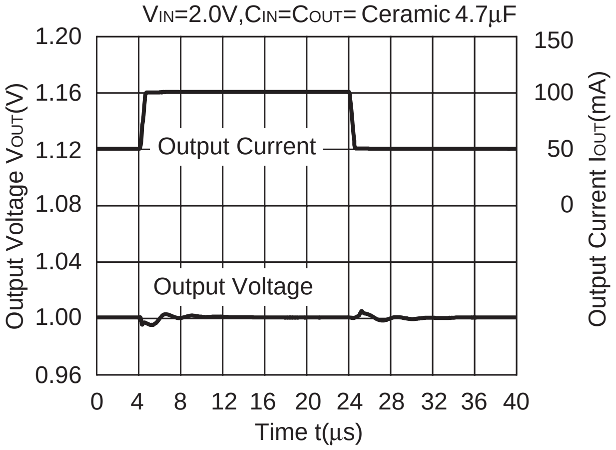
R1172x101x

V_{IN}=2.0V,C_{IN}=Ceramic 4.7μF,
C_{OUT}=Ceramic 10μF



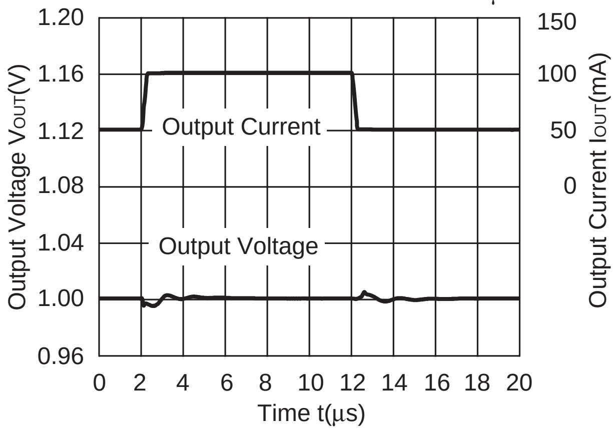
R1172x101x

V_{IN}=2.0V,C_{IN}=C_{OUT}= Ceramic 4.7μF



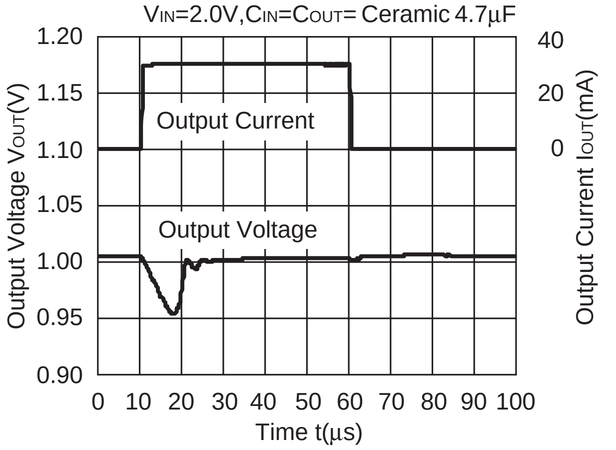
R1172x101x

V_{IN}=2.0V,C_{IN}=Ceramic 4.7μF,
C_{OUT}=Ceramic 10μF



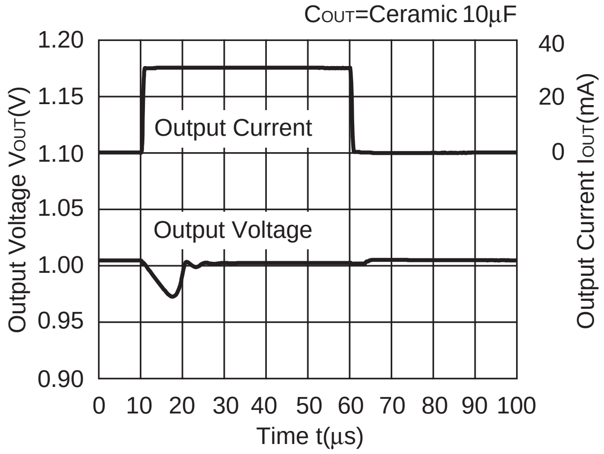
R1172x101x

V_{IN}=2.0V,C_{IN}=C_{OUT}= Ceramic 4.7μF



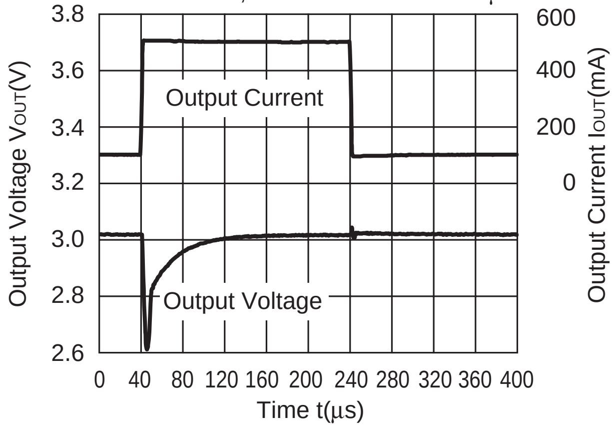
R1172x101x

V_{IN}=2.0V,C_{IN}=Ceramic 4.7μF,
C_{OUT}=Ceramic 10μF



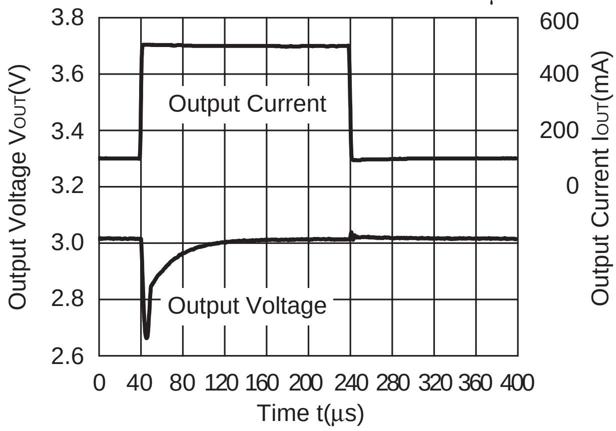
R1172x301x

V_{IN}=4.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



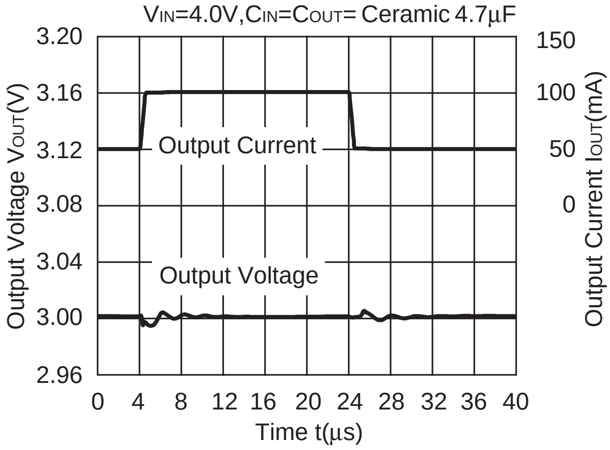
R1172x301x

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



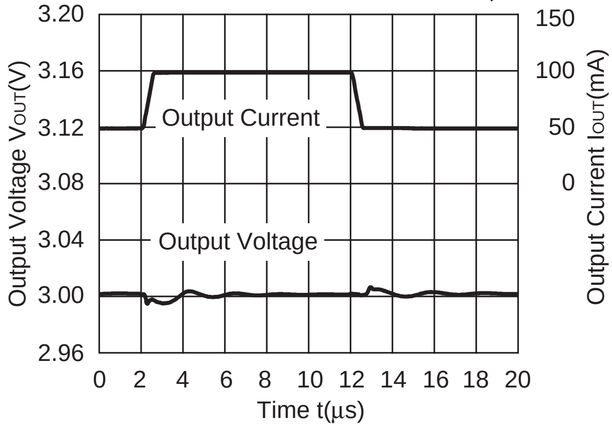
R1172x301x

V_{IN}=4.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



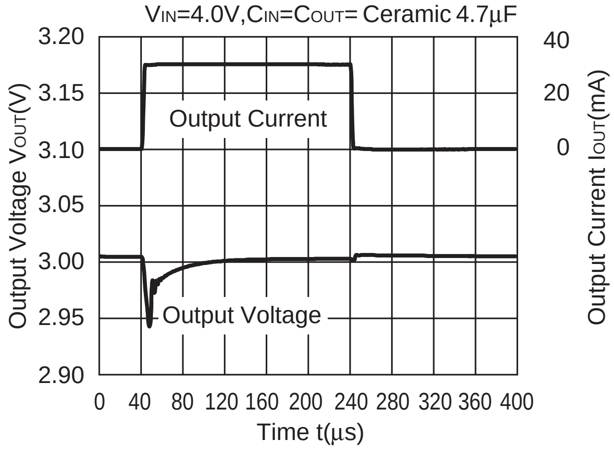
R1172x301x

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



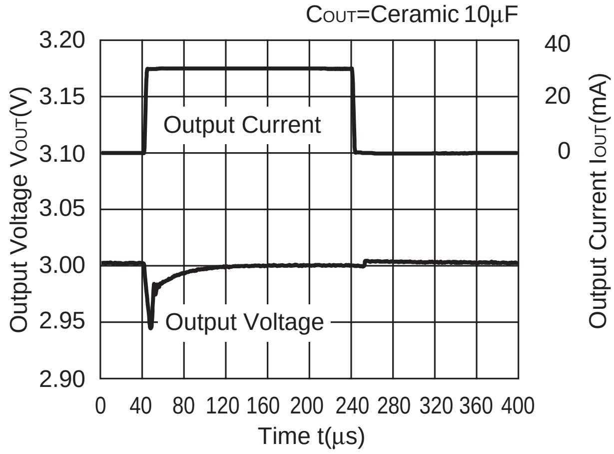
R1172x301x

V_{IN}=4.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



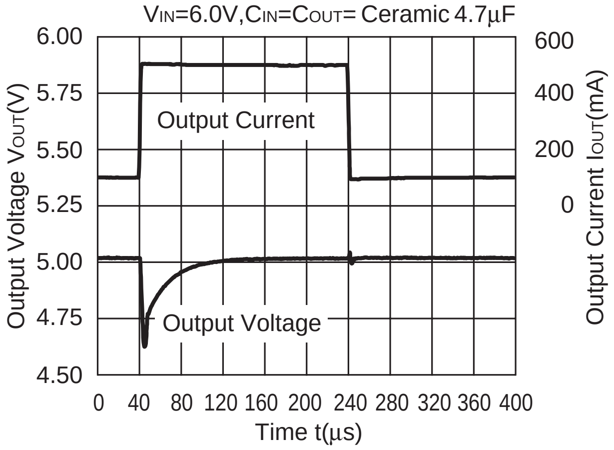
R1172x301x

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



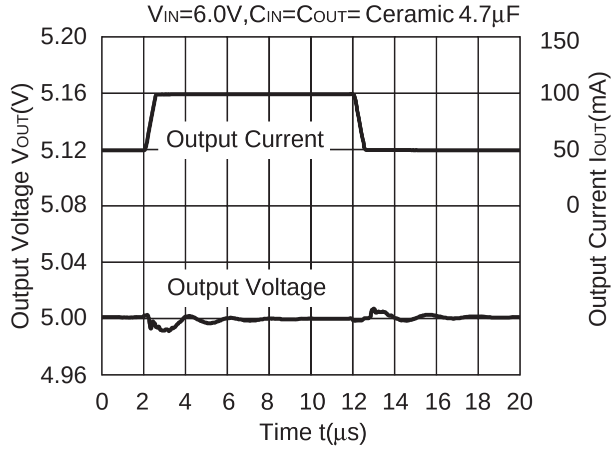
R1172x501x

V_{IN}=6.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



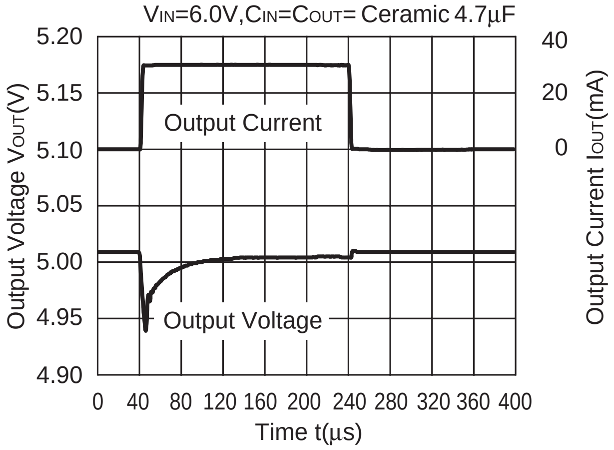
R1172x501x

V_{IN}=6.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



R1172x501x

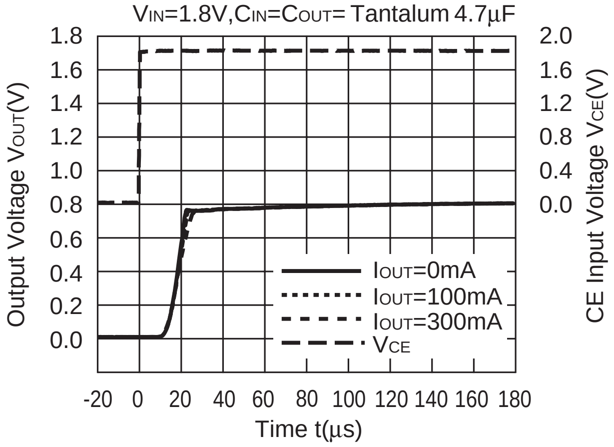
V_{IN}=6.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF



13) Turn-on speed with CE pin control

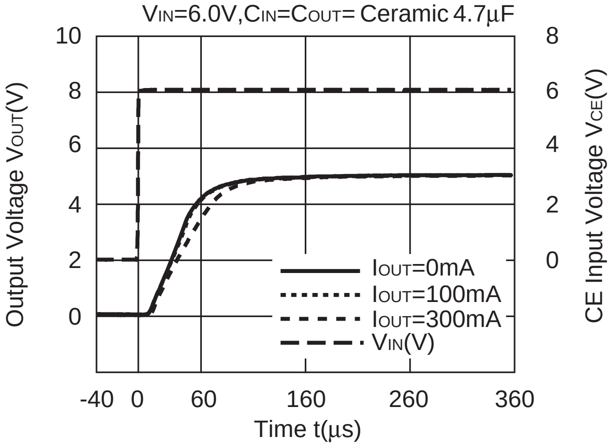
R1172x081x

V_{IN}=1.8V,C_{IN}=C_{OUT}= Tantalum 4.7µF



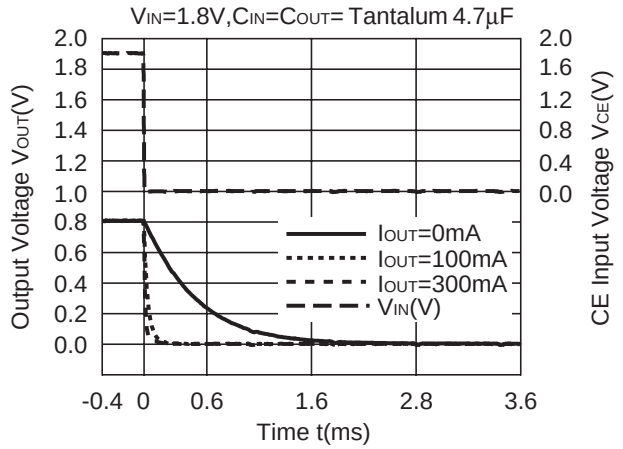
R1172x501x

V_{IN}=6.0V,C_{IN}=C_{OUT}= Ceramic 4.7µF

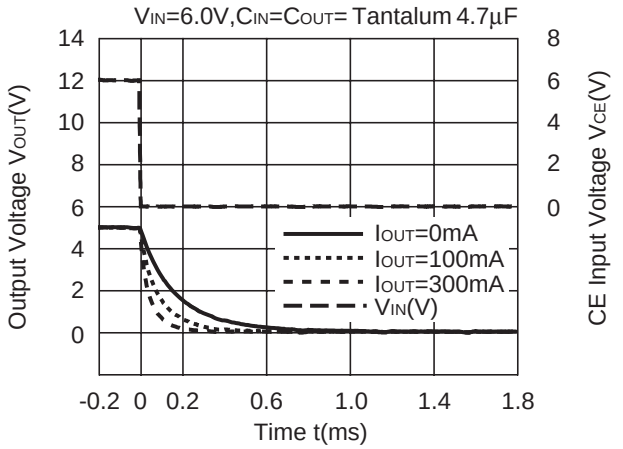


14) Turn-off speed with CE pin control

R1172x081D

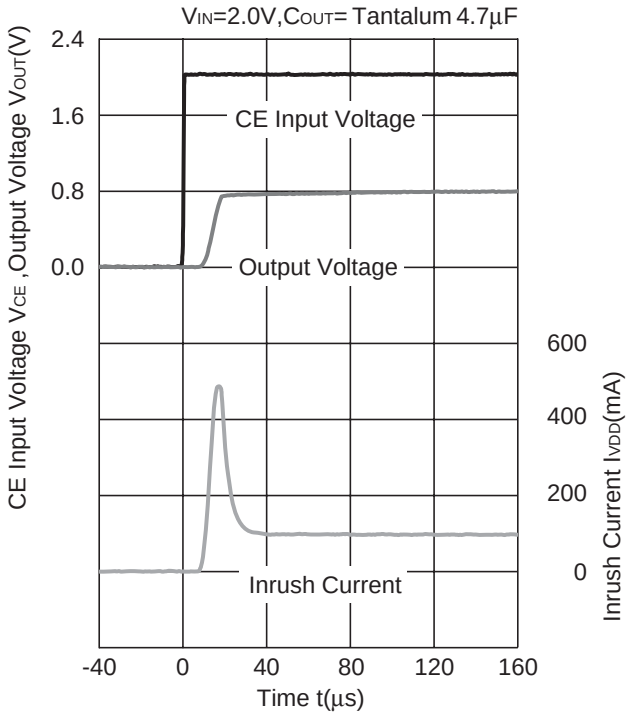


R1172x501D

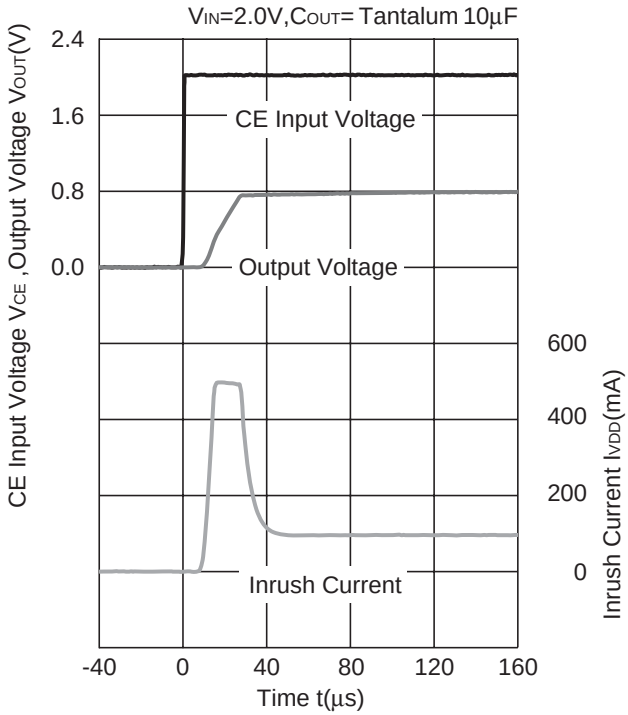


15) Inrush Current (IOUT=100mA, CIN=none)

R1172x081x

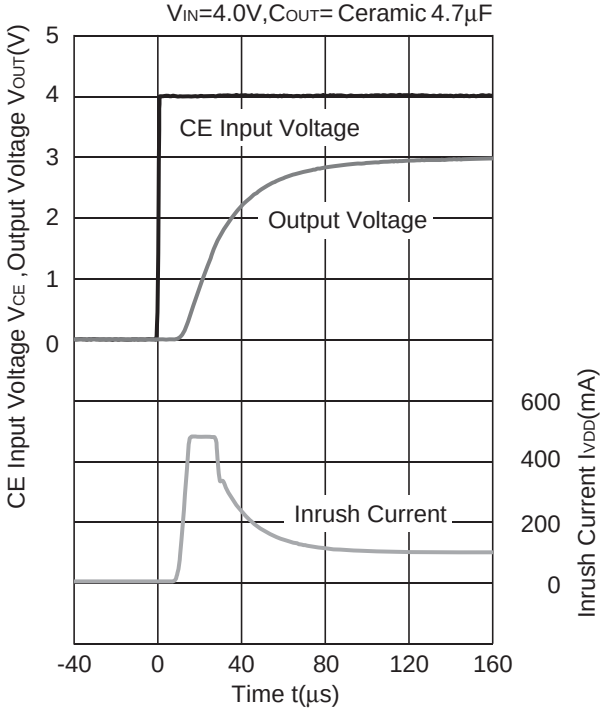


R1172x081x



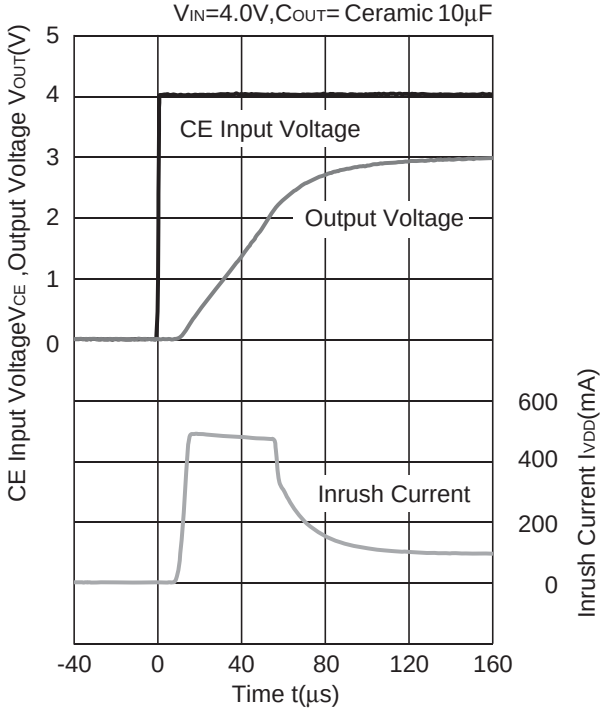
R1172x301x

V_{IN}=4.0V,C_{OUT}= Ceramic 4.7µF



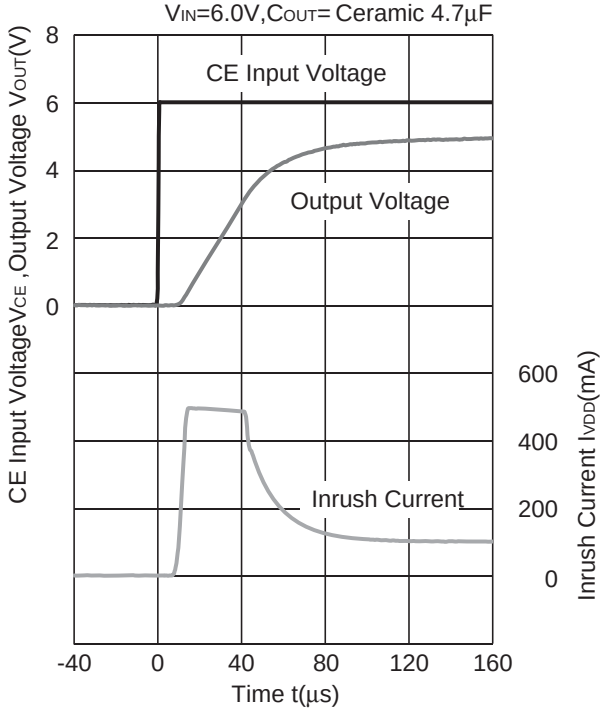
R1172x301x

V_{IN}=4.0V,C_{OUT}= Ceramic 10µF



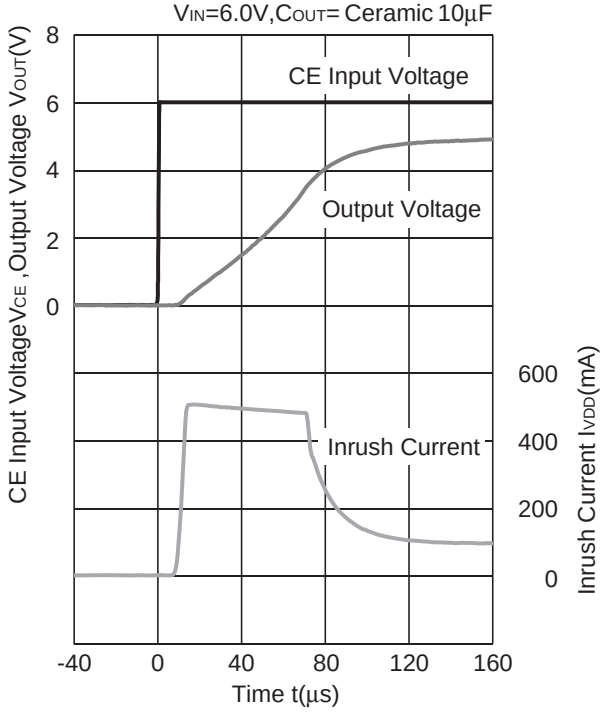
R1172x501x

V_{IN}=6.0V,C_{OUT}= Ceramic 4.7µF



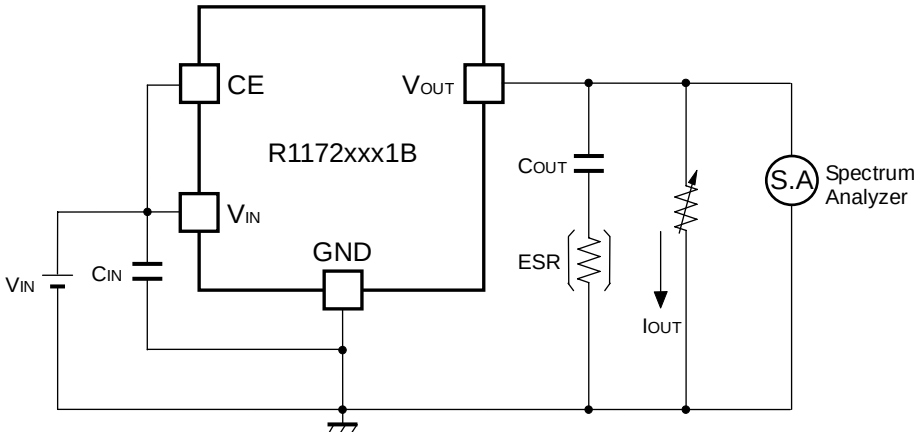
R1172x501x

V_{IN}=6.0V,C_{OUT}= Ceramic 10µF



ESR vs. Output Current

When using these ICs, consider the following points:



0.8V to 3.3V Output type: C_{OUT}=4.7µF (Kyocera CM105X5R475M06AB)
5.0V Output type : C_{OUT}=4.7µF (Kyocera CT21X5R475K06AB)

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

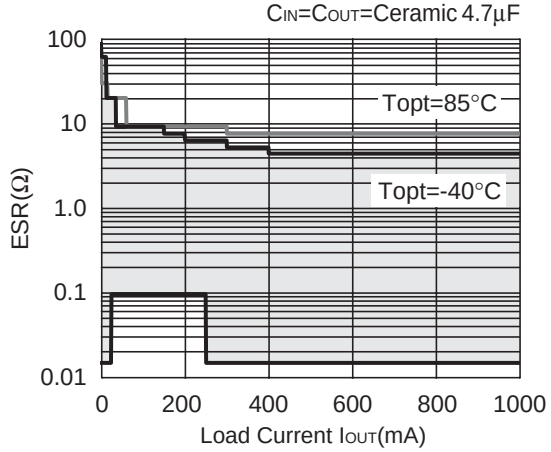
For your reference, noise level is tested, and if the noise level is 40µV or less than 40µV, the ESR values are plotted as stable area. Upper limit is described in the next five graphs, or ESR vs. Output Current. (Hatched area is the stable area.)

Measurement conditions

- V_{IN}=V_{OUT}+1V
- Frequency Band: 10Hz to 1MHz
- Temperature : 25°C

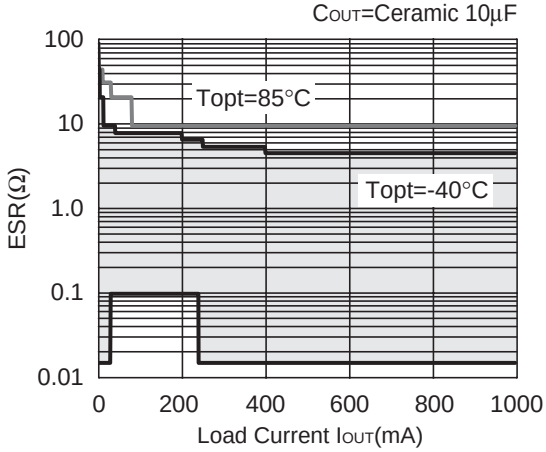
R1172x081x

V_{IN}=1.4V to 6.0V,
C_{IN}=C_{OUT}=Ceramic 4.7µF

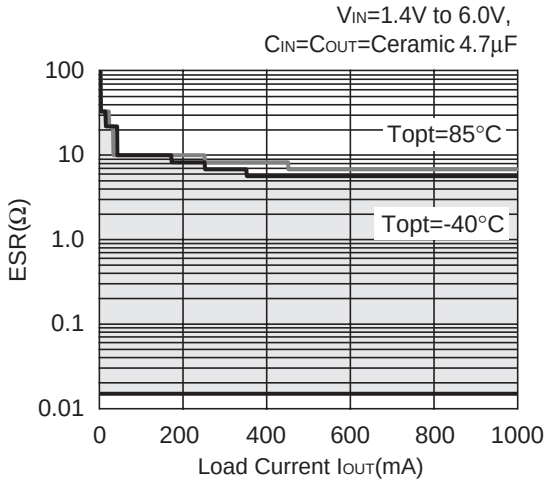


R1172x081x

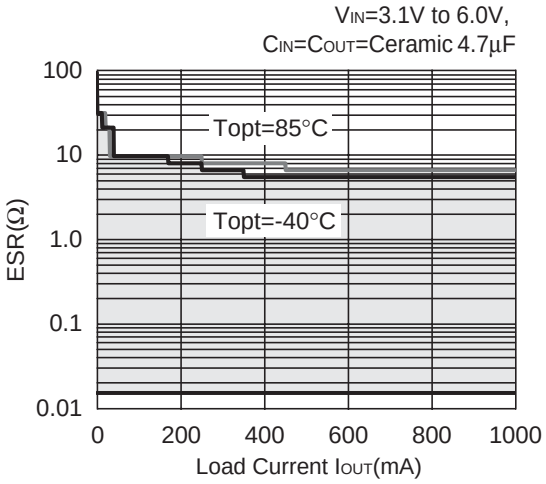
V_{IN}=1.4V to 6.0V, C_{IN}=Ceramic 4.7µF,
C_{OUT}=Ceramic 10µF



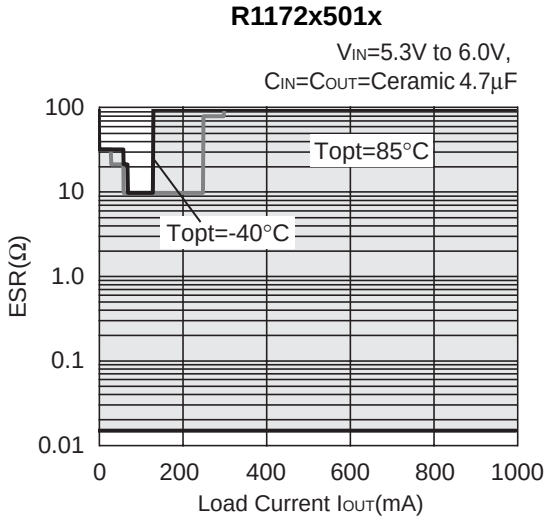
R1172x101x



R1172x301x



R1172x501x



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