800mA LDO REGULATOR

NO.EA-084-111027

OUTLINE

The R1170x Series are positive voltage regulator ICs by CMOS process. The R1170x Series have features of high ripple rejection, 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-shunt circuit. Output Voltage of R1170 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 prolong the battery life. These regulators are remarkable improvement on the current regulators in terms of ripple rejection, input transient response, and load transient response.

Maximum Output Current is large for its compact size.

Thus, the R1170x Series are suitable for various power sources for portable appliances.

Since the packages for these ICs are the SOT-89-5 package, HSON-6, or HSOP-6J, high density mounting of the ICs on boards is possible.

FEATURES

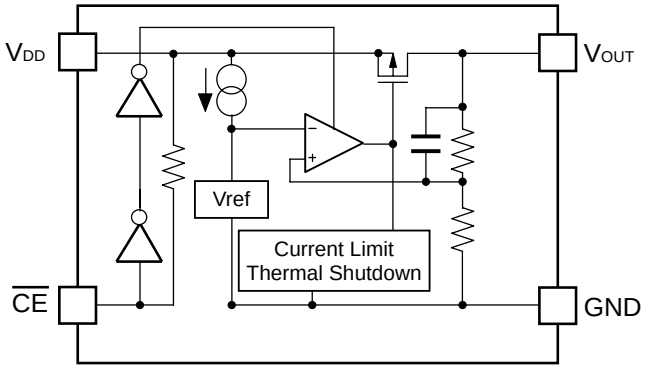
- Supply Current ..... Typ. 80μA
- Standby Current ..... Typ. 0.1μA
- Output Current ..... Min. 800mA (V_{IN}=V_{OUT}+1.0V)
- Dropout Voltage ..... Typ. 0.12V (V_{OUT}=3.0V, I_{OUT}=300mA)
- Output Voltage Accuracy..... ±2.0%
- Temperature-Drift Coefficient of Output Voltage ..... Typ.±100ppm/°C
- Line Regulation ..... Typ. 0.05%/V
- Output Voltage ..... 1.5V to 5.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Packages HSON-6, SOT-89-5, HSOP-6J
- Built-in Current Limit Circuit
- Built-in Thermal Shutdown Circuit
- Ceramic capacitors are recommended to be used with this IC

APPLICATIONS

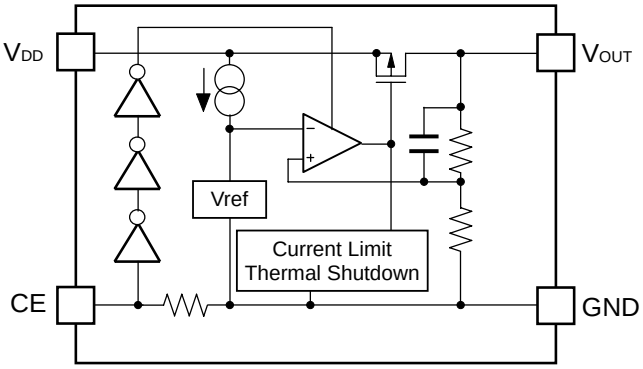
- Local Power source for Notebook PC.
- Local Power source for portable appliances, cameras, and videos.
- Local Power source for equipment of battery-use.
- Local Power source for home appliances.

BLOCK DIAGRAMS

R1170xxx1A



R1170Dxxx1B



SELECTION GUIDE

The output voltage, the 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
R1170Dxx1∗-TR-FE	HSON-6	3,000 pcs	Yes	Yes
R1170Hxx1∗-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
R1170Sxx1∗-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes

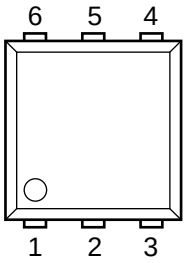
xx: The output voltage can be designated in the range from 1.5V(15) to 5.0V(50) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

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

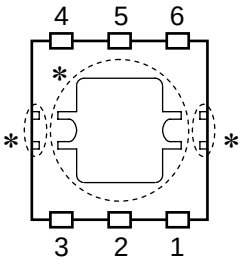
PIN CONFIGURATION

● **HSON-6**

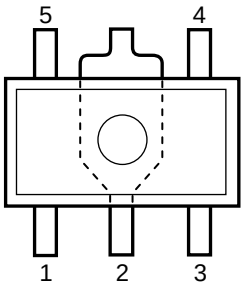
Top View



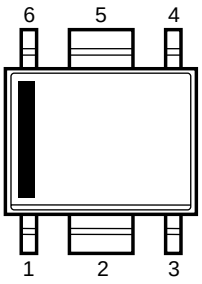
Bottom View



● **SOT-89-5**



● **HSOP-6J**



PIN DESCRIPTION

● **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.

● **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

- **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	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 (HSON-6)*	900	mW
	Power Dissipation (SOT-89-5)*	900	
	Power Dissipation (HSOP-6J)*	1700	
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

- **R1170xxxxA**

Topt=25°C

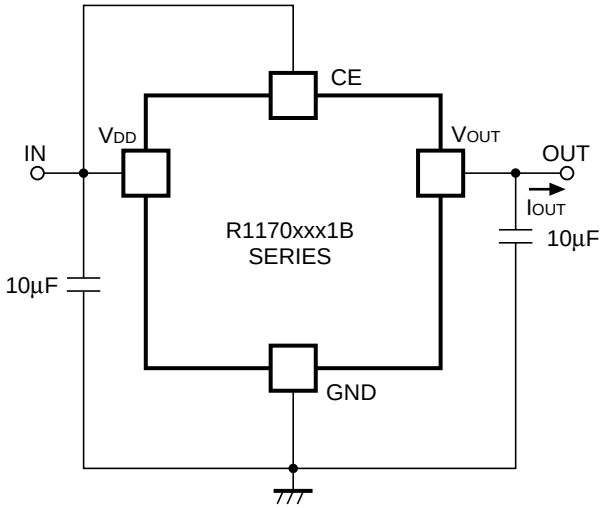
Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage					6.0	V
I_{SS}	Supply Current	V_{IN}–V_{OUT}=1.0V, V_{CE}=GND			80	160	μA
Istandby	Standby Current	V_{IN}=V_{CE}=6.0V			0.1	1.0	μA
V_{OUT}	Output voltage	V_{IN}–V_{OUT}=1.0V I_{OUT}=100mA		×0.98		×1.02	V
ΔV_{OUT}/ ΔI_{OUT}	Load regulation	V_{IN}–V_{OUT}=1.0V 1mA ≦ I_{OUT} ≦ 300mA			30	100	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	V_{OUT}=1.5V		0.35	0.45	V
			V_{OUT}=1.6V		0.30	0.35	
			V_{OUT}=1.7V		0.25	0.30	
			1.8V ≦ V_{OUT} ≦ 2.0V		0.20	0.25	
			2.1V ≦ V_{OUT} ≦ 2.4V		0.15	0.20	
			2.5V ≦ V_{OUT} ≦ 5.0V		0.12	0.18	
ΔV_{OUT}/ ΔV_{IN}	Line regulation	I_{OUT}=100mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V			0.05	0.30	%/V
RR	Ripple Rejection	1.5V ≦ V_{OUT} ≦ 4.7V: f=1kHz, V_{IN}–V_{OUT}=1.0V Ripple 0.5Vp-p			50		dB
		4.8V ≦ V_{OUT} ≦ 5.0V: f=1kHz, V_{IN}=5.7V Ripple 0.5Vp-p			50		
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=10mA, V_{IN}–V_{OUT}=1.0V –40°C ≦ Topt ≦ 85°C			±100		ppm/ °C
I_{LIM}	Output Current	V_{IN}–V_{OUT}=1.0V		800			mA
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
R_{PU}	Pull-up resistancefor $\overline{CE}$ pin			1.25	2.50	5.00	MΩ
V_{CEH}	$\overline{CE}$ Input Voltage "H"			1.50		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

- **R1170xxxxB**

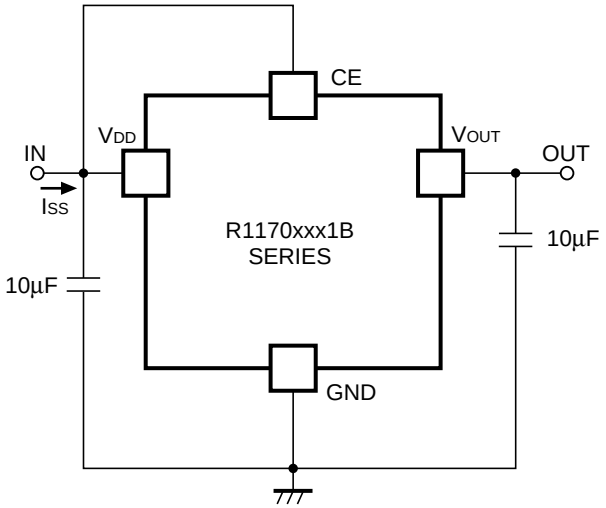
Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{IN}	Input voltage					6.0	V
I_{SS}	Supply Current	$V_{IN}-V_{OUT}$=1.0V,$V_{CE}=V_{IN}$			80	160	μA
$I_{standby}$	Standby Current	V_{IN}=6.0V,V_{CE}=GND			0.1	1.0	μA
V_{OUT}	Reference Voltage for Adjustable Voltage Regulator	$V_{IN}-V_{OUT}$=1.0V I_{OUT}=100mA		×0.98		×1.02	V
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	$V_{IN}-V_{OUT}$=1.0V 1mA ≦ I_{OUT} ≦ 300mA			30	100	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	V_{OUT}=1.5V		0.35	0.45	
			V_{OUT}=1.6V		0.30	0.35	
			V_{OUT}=1.7V		0.25	0.30	
			1.8V ≦ V_{OUT} ≦ 2.0V		0.20	0.25	
			2.1V ≦ V_{OUT} ≦ 2.4V		0.15	0.20	
			2.5V ≦ V_{OUT} ≦ 5.0V		0.12	0.18	
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	I_{OUT}=100mA V_{OUT}+0.5V ≦ V_{IN} ≦ 6.0V			0.05	0.30	%/V
RR	Ripple Rejection	1.5V ≦ V_{OUT} ≦ 4.7V: f=1kHz, $V_{IN}-V_{OUT}$=1.0V Ripple 0.5Vp-p			50		dB
		4.8V ≦ V_{OUT} ≦ 5.0V: f=1kHz, V_{IN}=5.7V Ripple 0.5Vp-p			50		
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=10mA, $V_{IN}-V_{OUT}$=1.0V −40°C ≦ Topt ≦ 85°C			±100		ppm/°C
I_{LIM}	Output Current	$V_{IN}-V_{OUT}$=1.0V		800			mA
I_{SC}	Short Current Limit	V_{OUT}=0V			40		mA
R_{PD}	Pull-down resistance for CE pin			1.25	2.50	5.00	MΩ
V_{CEH}	CE Input Voltage "H"			1.5		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

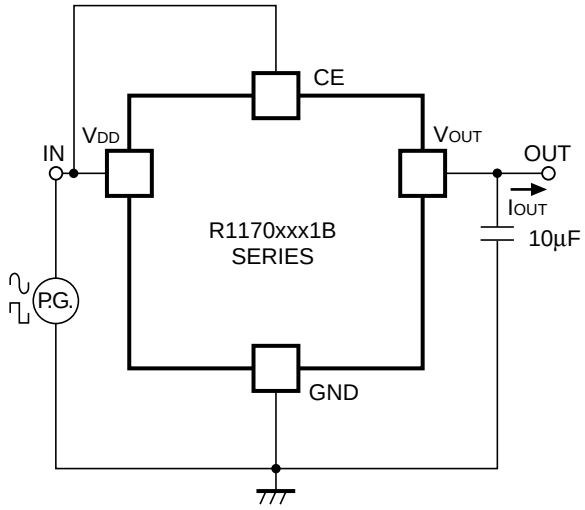
TEST CIRCUITS



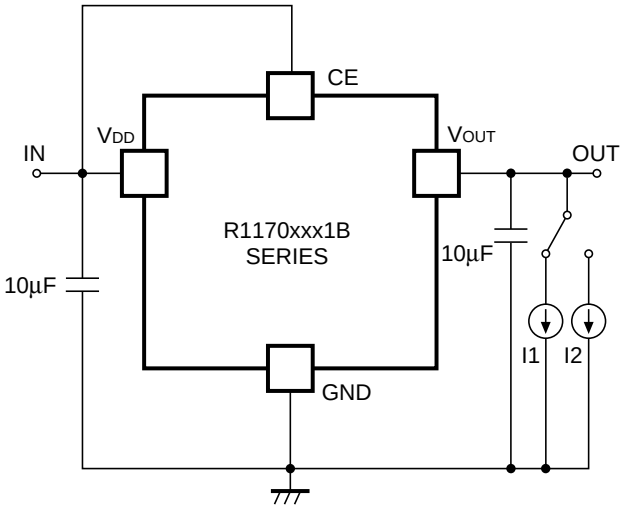
Standard Test Circuit



Supply Current Test Circuit



Test Circuit for Ripple Rejection,
Input Transient Response



Test Circuit for Load Transient Response

Technical Notes on External Components and Typical Application

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 as much as 10µF Capacitor as C_L.

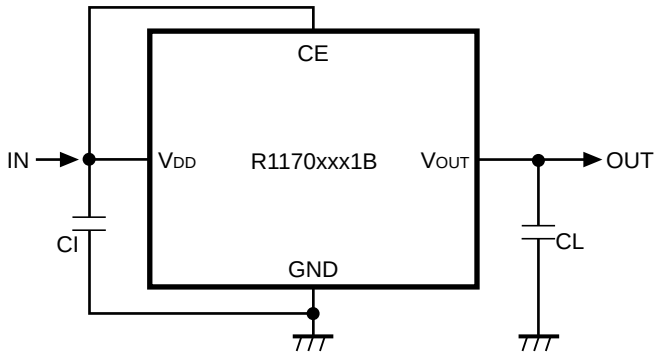
If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics. Further, refer to the Typical Characteristics No. 12.

Mounting on PCB

Make V_{DD} and GND lines sufficient. If their impedance is high, a current flows, the noise picked up or unstable operation may result. Further use as much as 10µF capacitor between V_{DD} pin and GND pin as close as possible.

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)



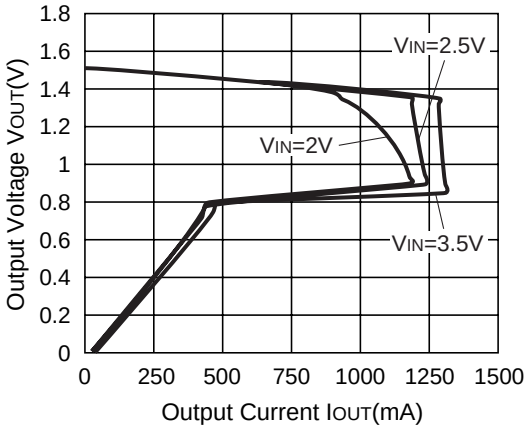
CI=10µF(Ceramic), CL=10µF(Ceramic)

Example of the typical application of R1170xxxxB

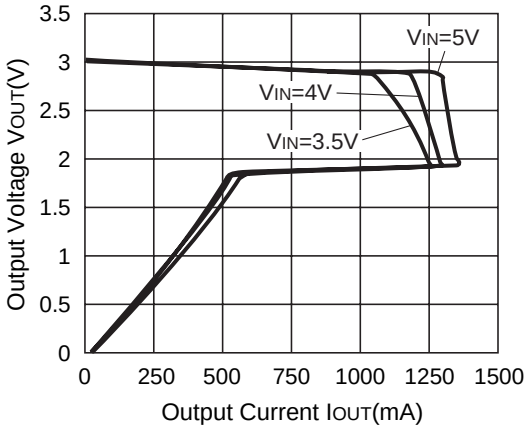
TYPICAL CHARACTERISTICS

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

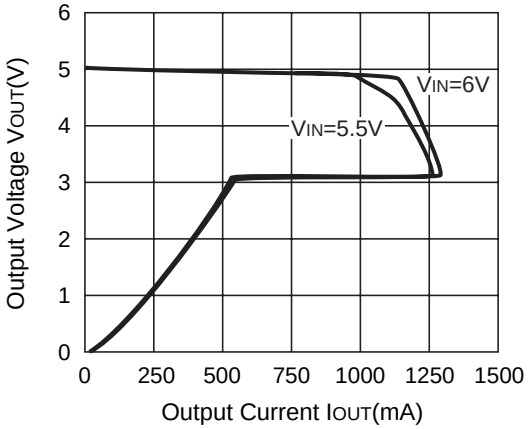
R1170x151B



R1170x301B

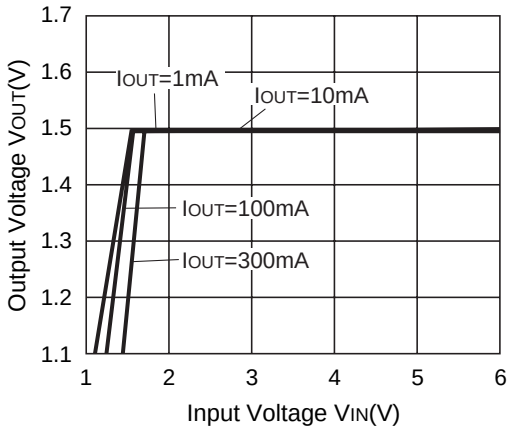


R1170x501B

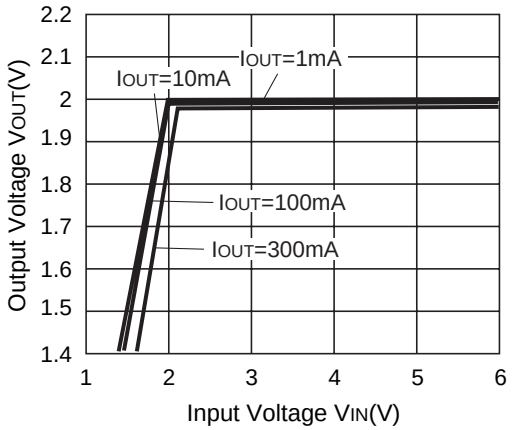


2) Output Voltage vs. Input Voltage (Topt=25°C)

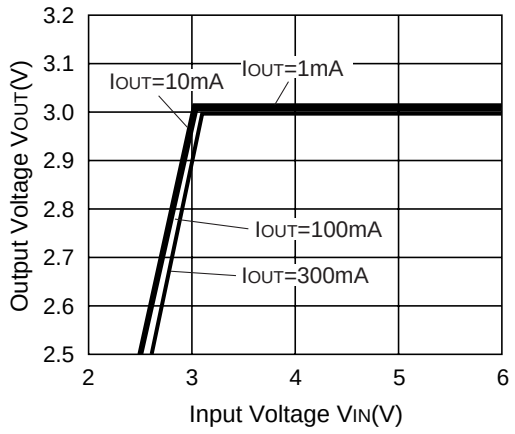
R1170x151B



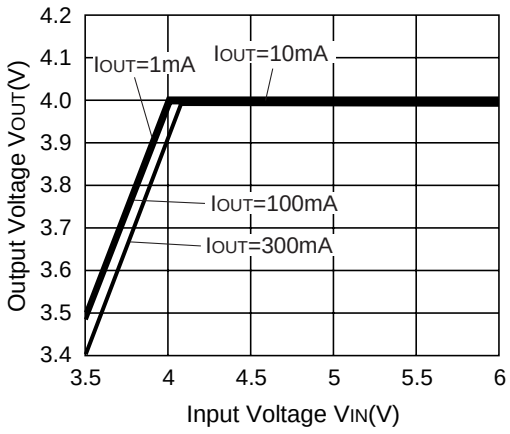
R1170x201B



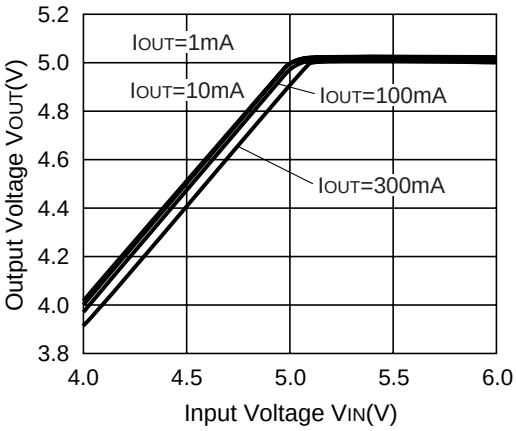
R1170x301B



R1170x401B

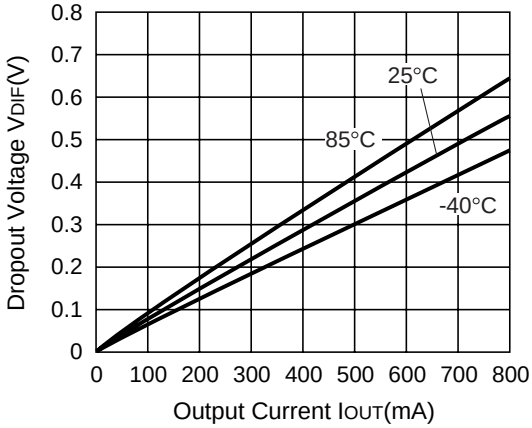


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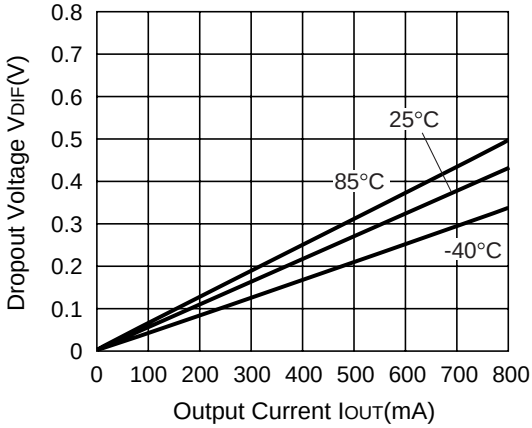


3) Dropout Voltage vs. Output Current

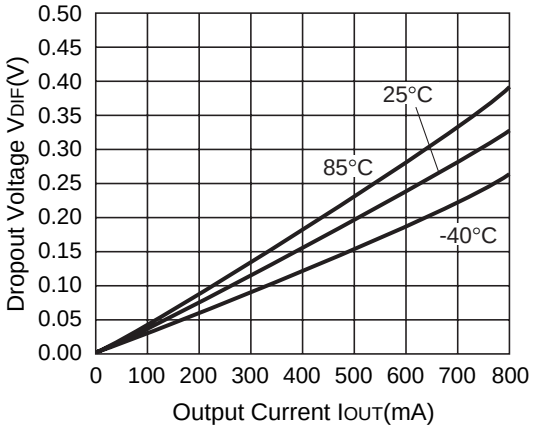
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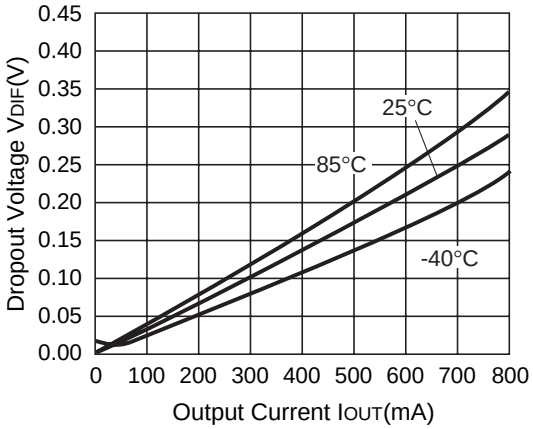
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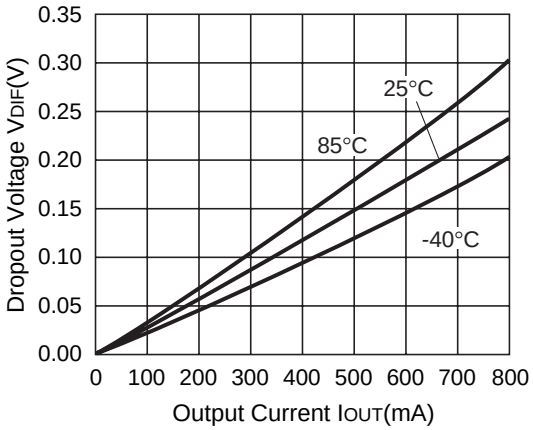
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R1170x401B

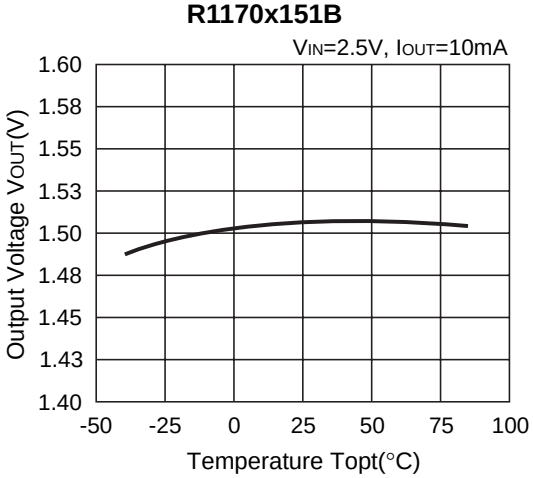


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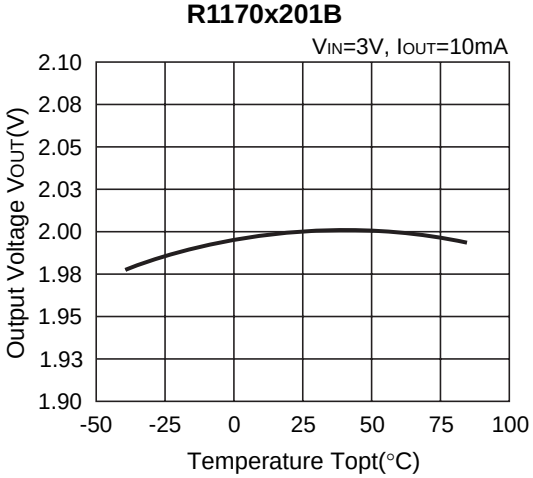


4) Output Voltage vs. Temperature

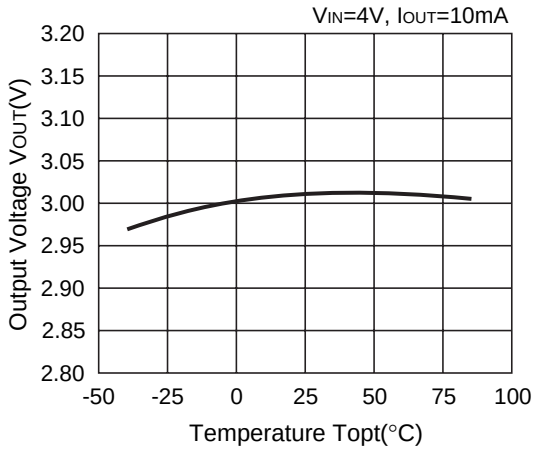
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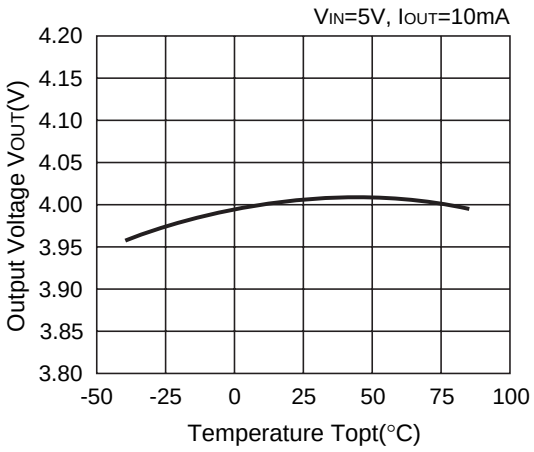
R1170x201B



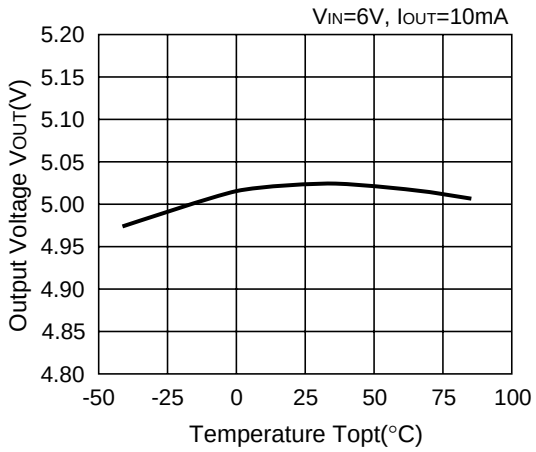
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R1170x401B

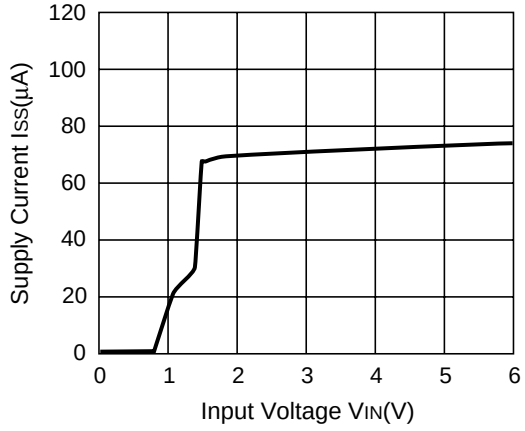


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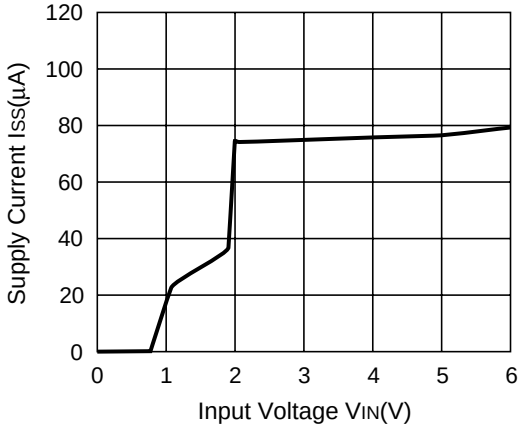


5) Supply Current vs. Input Voltage (Topt=25°C)

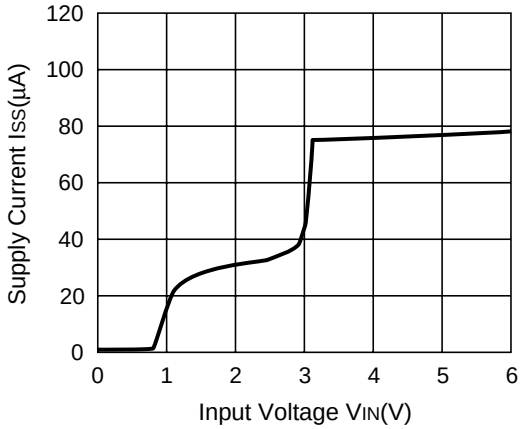
R1170x151B



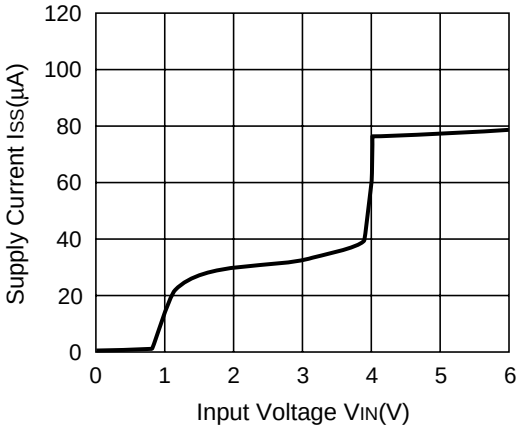
R1170x201B



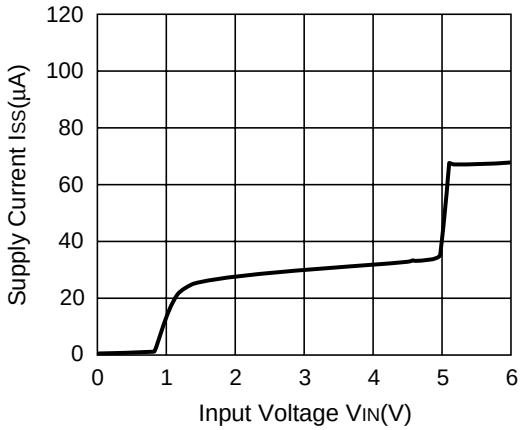
R1170x301B



R1170x401B

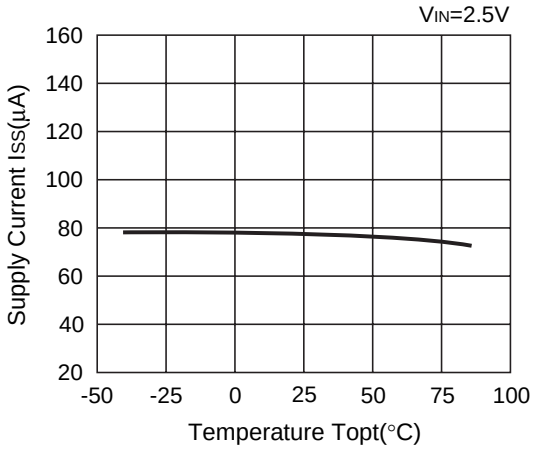


R1170x501B

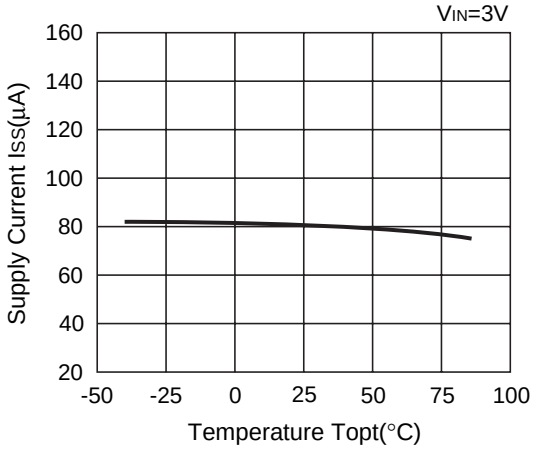


6) Supply Current vs. Temperature

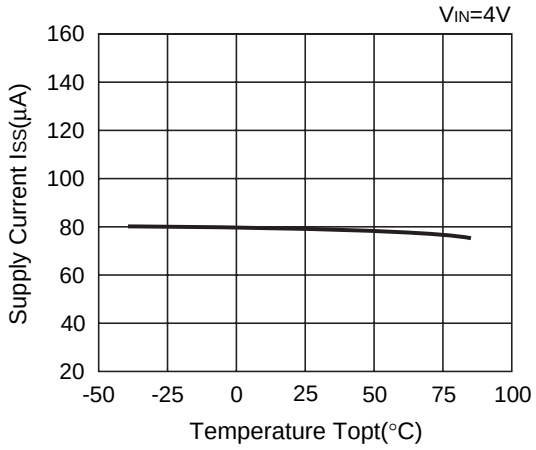
R1170x151B



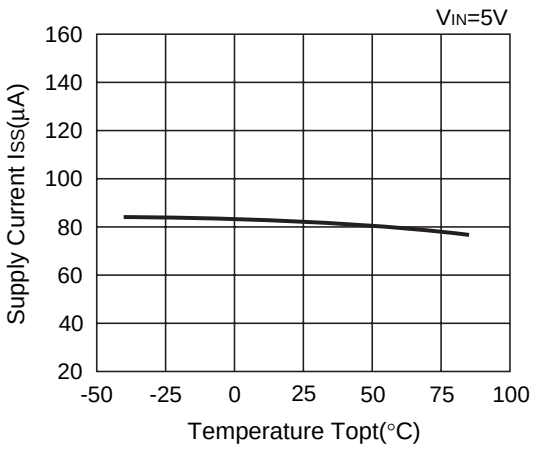
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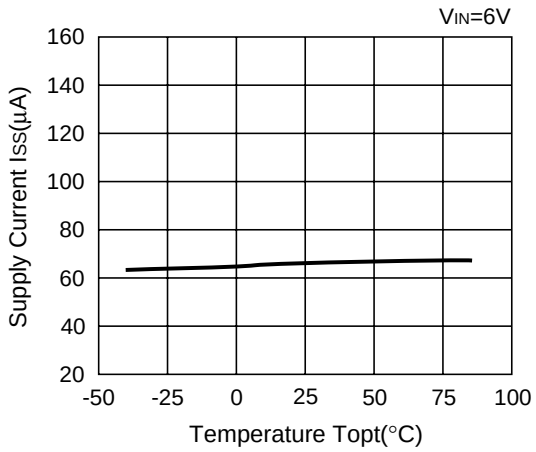
R1170x301B



R1170x401B

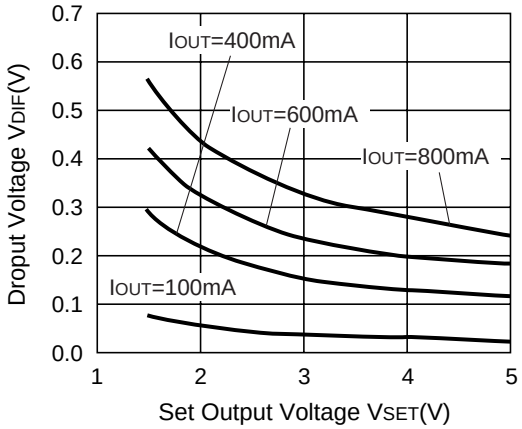


R1170x501B



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

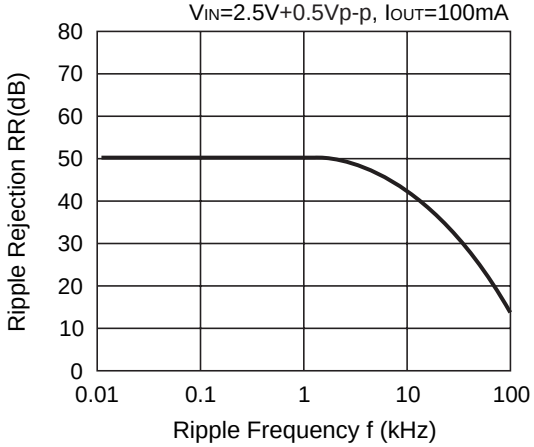
R1170x



8) Ripple Rejection vs. Frequency

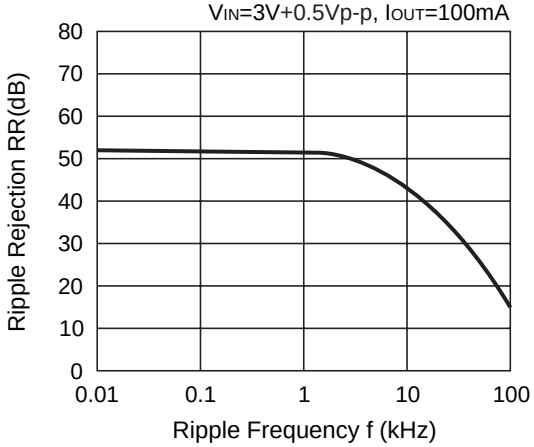
R1170x151B

V_{IN}=2.5V+0.5Vp-p, I_{OUT}=100mA



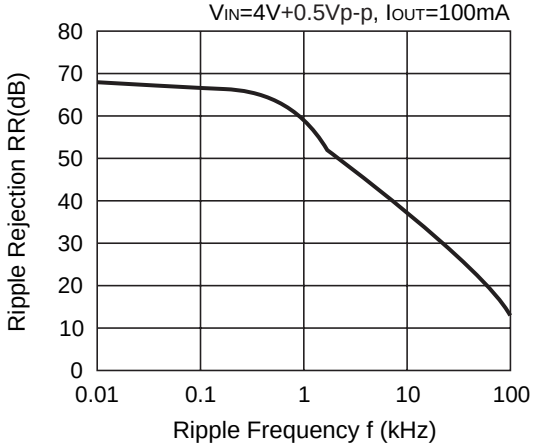
R1170x201B

V_{IN}=3V+0.5Vp-p, I_{OUT}=100mA



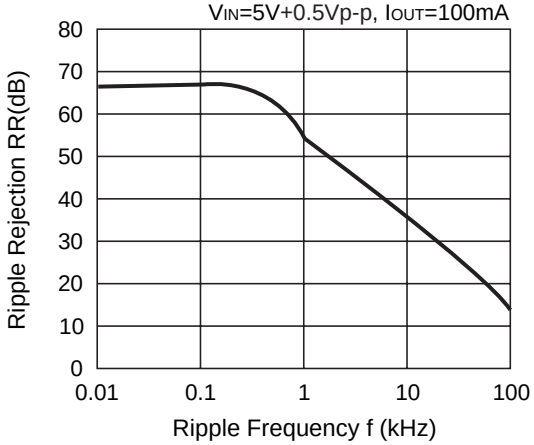
R1170x301B

V_{IN}=4V+0.5Vp-p, I_{OUT}=100mA



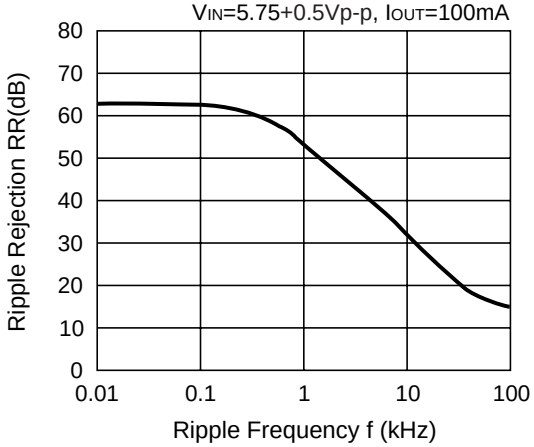
R1170x401B

V_{IN}=5V+0.5Vp-p, I_{OUT}=100mA



R1170x501B

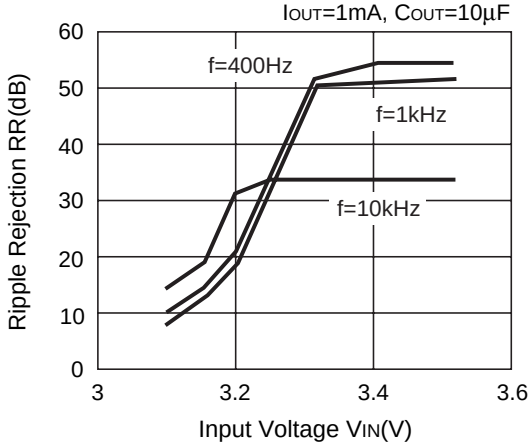
V_{IN}=5.75+0.5Vp-p, I_{OUT}=100mA



9) Ripple Rejection vs. Input Voltage

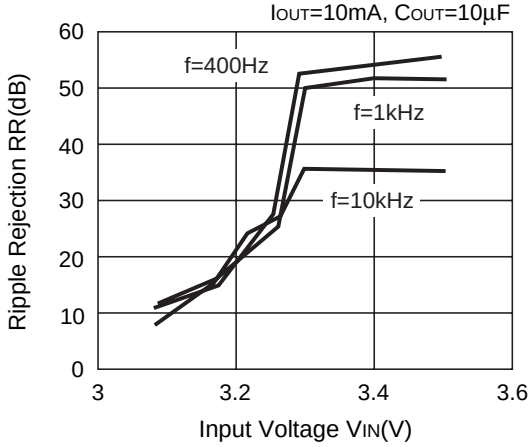
R1170x301B

I_{OUT}=1mA, C_{OUT}=10µF



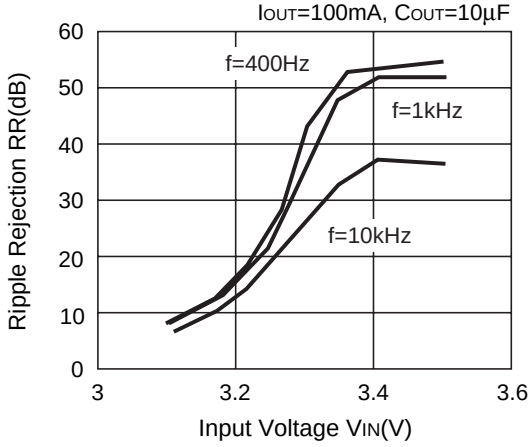
R1170x301B

I_{OUT}=10mA, C_{OUT}=10µF



R1170x301B

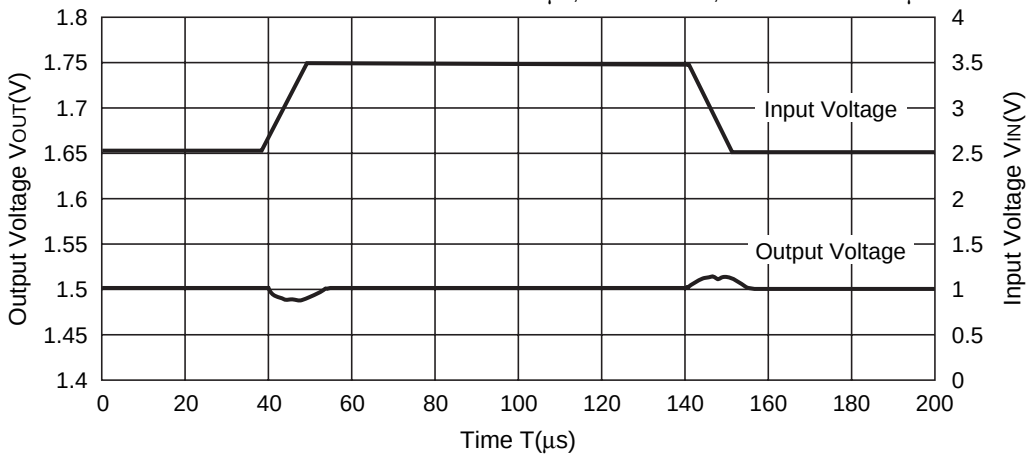
I_{OUT}=100mA, C_{OUT}=10µF



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

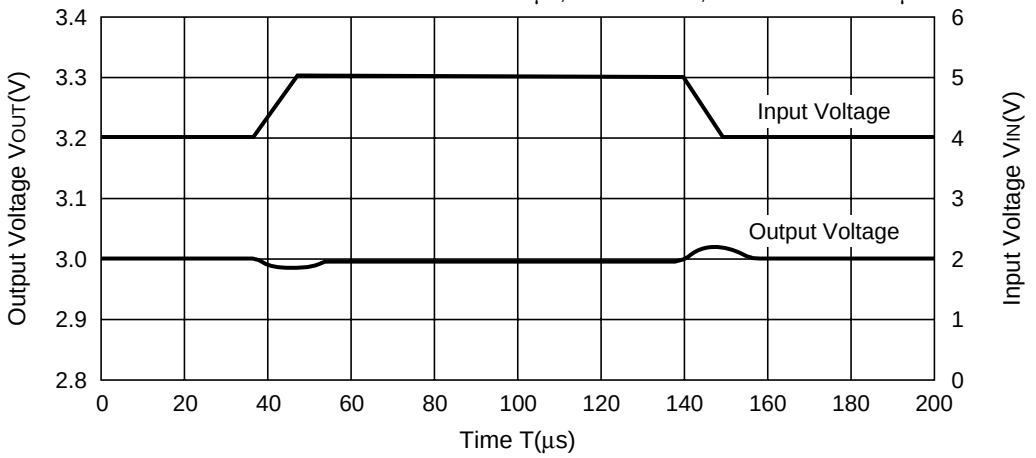
R1170x151B

tr=tf=10µs, I_{OUT}=100mA, C_{OUT}=Ceramic 10µF



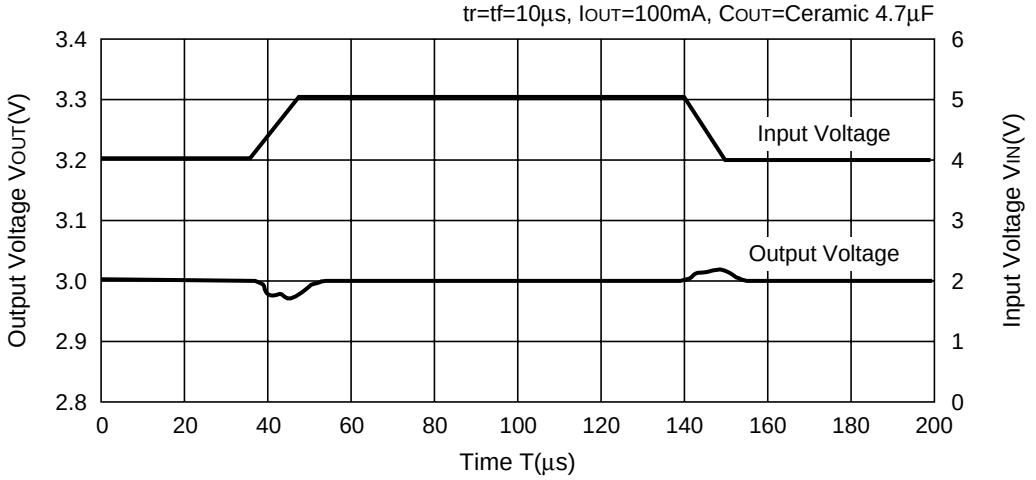
R1170x301B

tr=tf=10µs, I_{OUT}=100mA, C_{OUT}=Ceramic 10µF



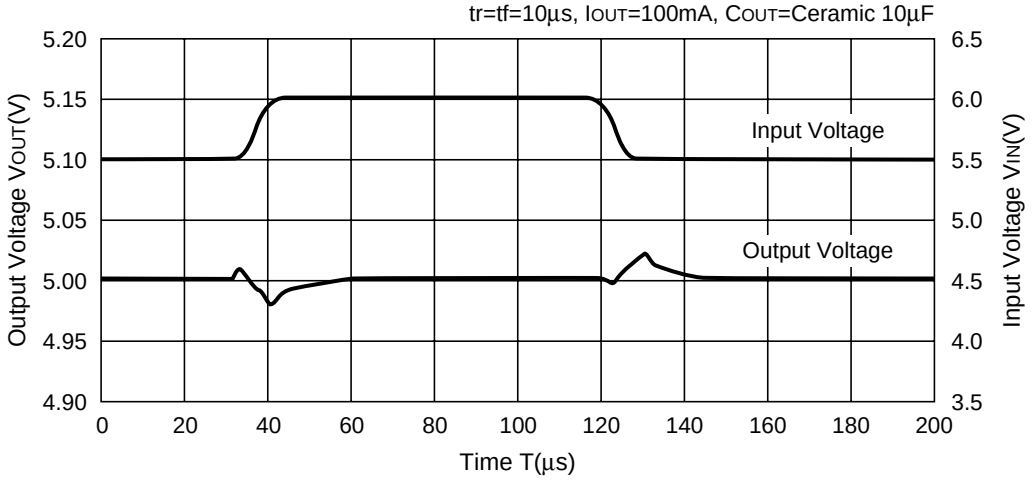
R1170x301B

tr=tf=10µs, I_{OUT}=100mA, C_{OUT}=Ceramic 4.7µF



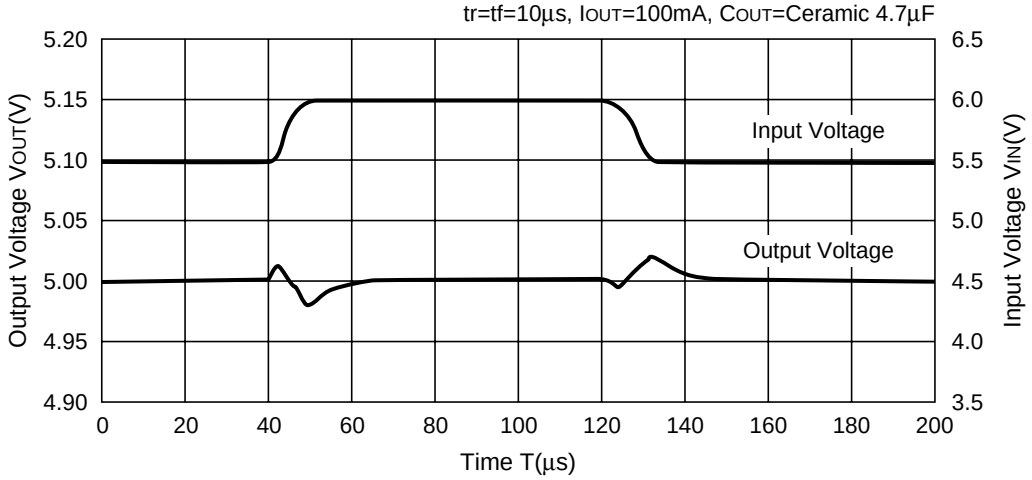
R1170x501B

tr=tf=10µs, I_{OUT}=100mA, C_{OUT}=Ceramic 10µF



R1170x501B

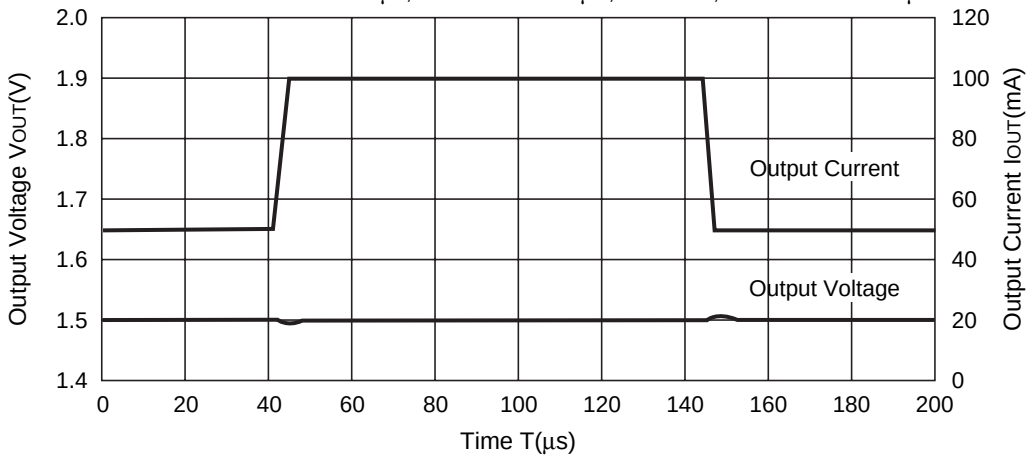
tr=tf=10µs, I_{OUT}=100mA, C_{OUT}=Ceramic 4.7µF



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

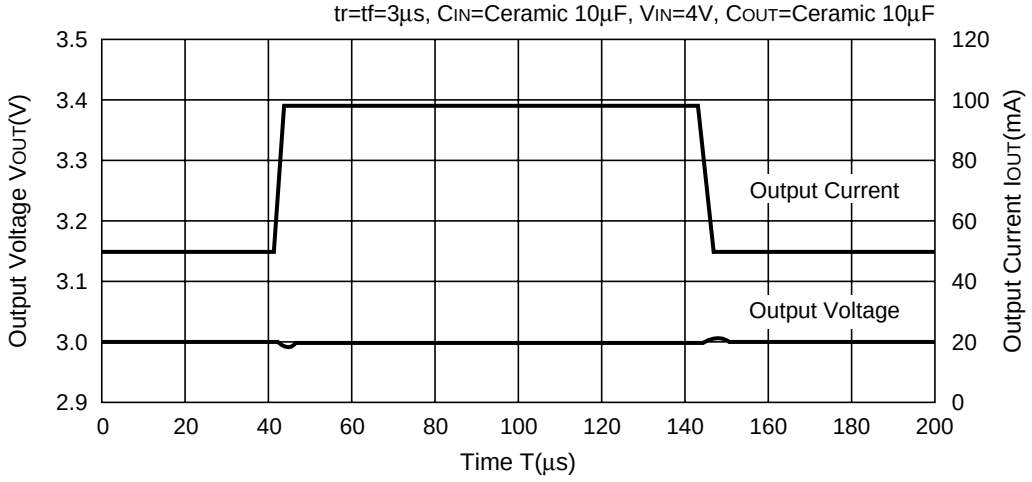
R1170x151B

tr=tf=3µs, C_{IN}=Ceramic 10µF, V_{IN}=2.5V, C_{OUT}=Ceramic 10µF



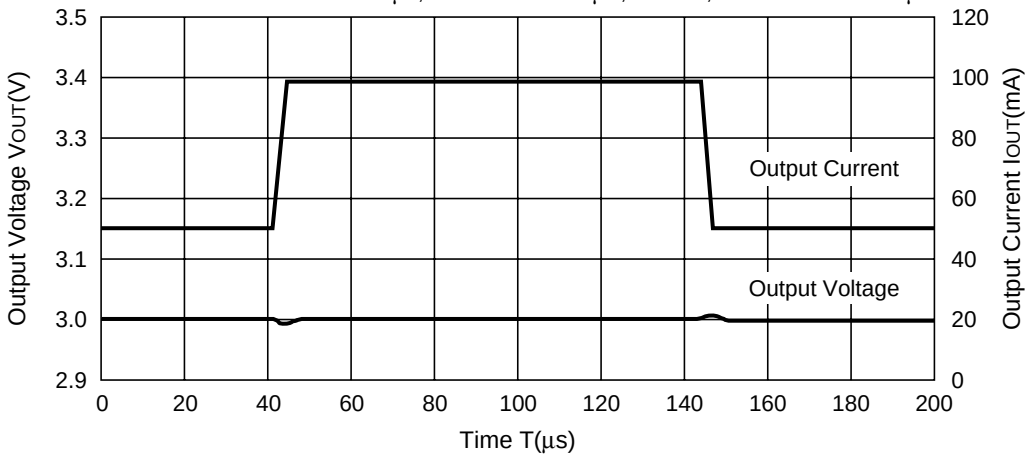
R1170x301B

tr=tf=3µs, C_{IN}=Ceramic 10µF, V_{IN}=4V, C_{OUT}=Ceramic 10µF



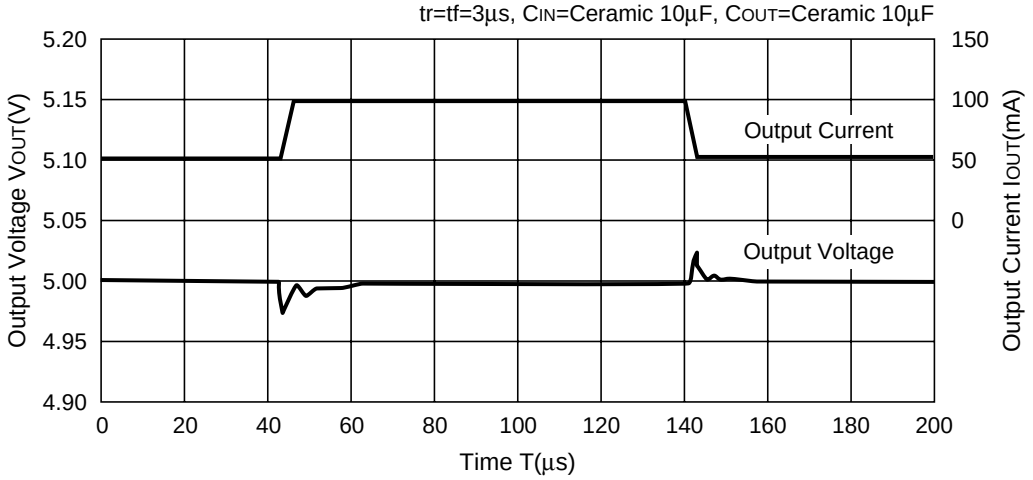
R1170x301B

tr=tf=3µs, CIN=Ceramic 10µF, VIN=4V, COUT=Ceramic 4.7µF



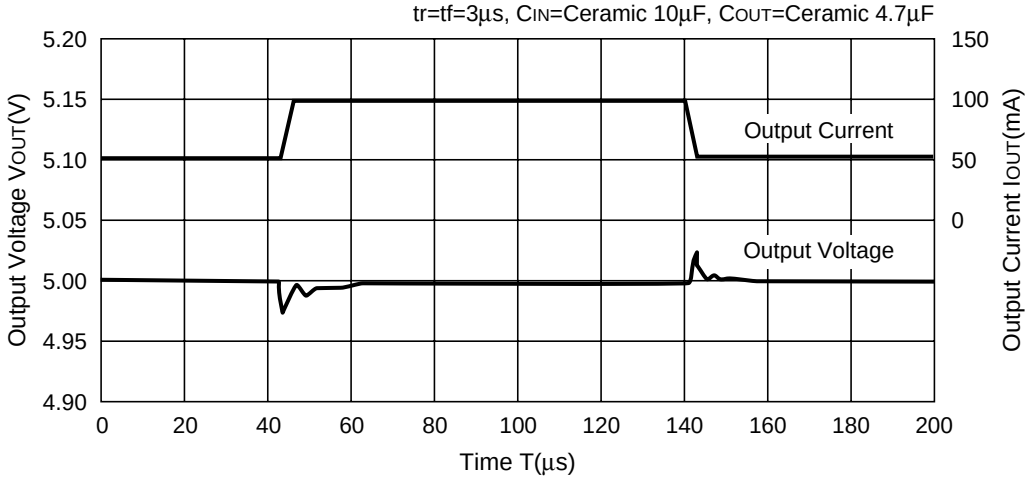
R1170x501B

tr=tf=3µs, CIN=Ceramic 10µF, COUT=Ceramic 10µF

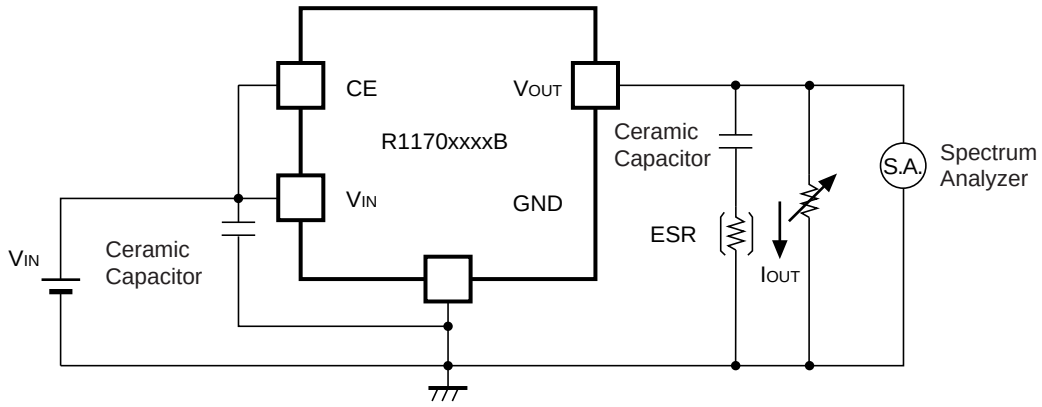


R1170x501B

tr=tf=3µs, CIN=Ceramic 10µF, COUT=Ceramic 4.7µF



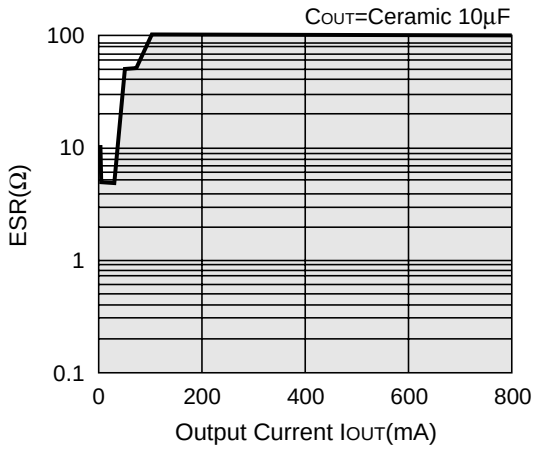
12) Stable Area (Topt=25°C, V_{IN} = Set Output Voltage+1V, C_{IN} = Ceramic 10μF)



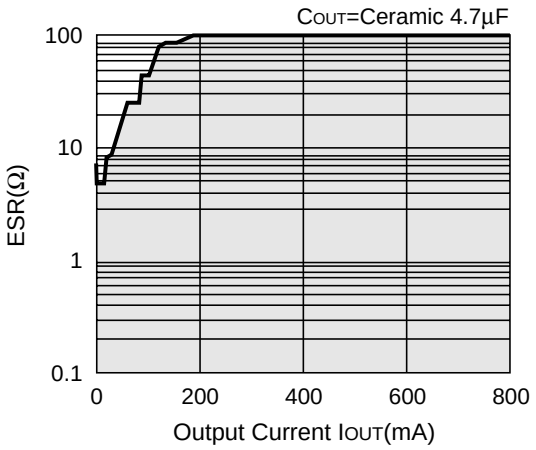
As an output capacitor for this IC, Ceramic capacitor is recommendable. However, other low ESR type capacitor can be used with this IC.

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.)

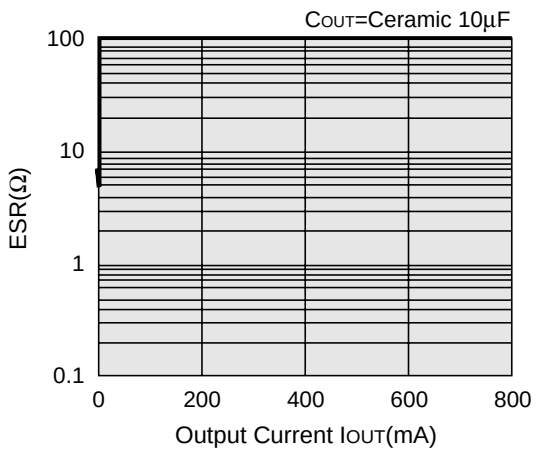
R1170x151B



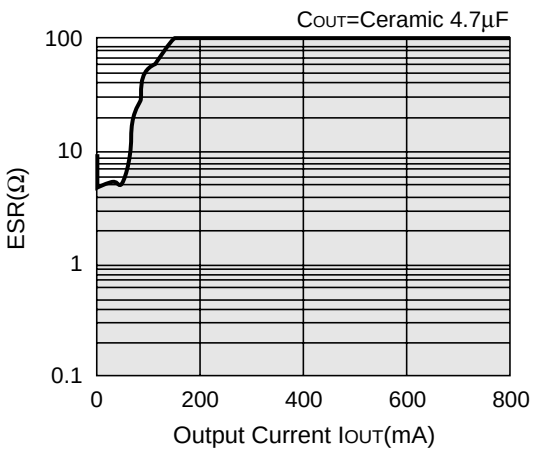
R1170x151B



R1170x301B

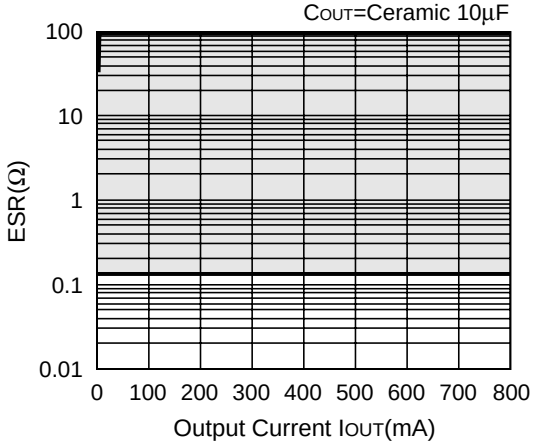


R1170x301B



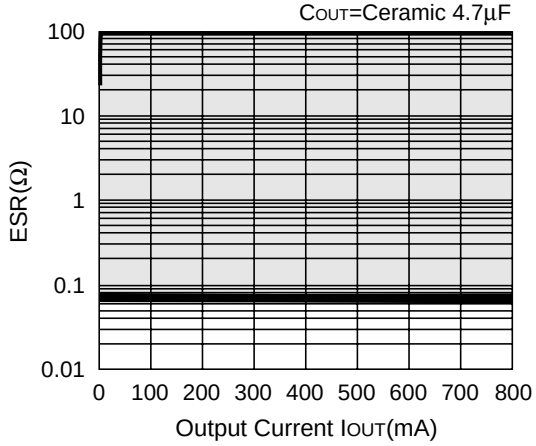
R1170x501B

C_{OUT}=Ceramic 10µF



R1170x501B

C_{OUT}=Ceramic 4.7µF



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