# 800mA LDO REGULATOR
# R1170X series

## ■ OUTLINE

The R1170 Series are positive voltage regulator ICs by CMOS process. The R1170 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 R1170 Series are suitable for various power sources for portable appliances.

Since the packages for these ICs are the SOT-89-5 package or HSON6, high density mounting of the ICs on boards is possible.

## ■ FEATURES

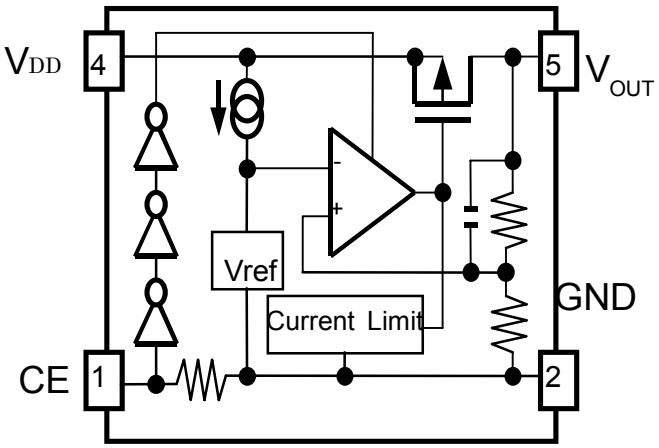
- ●Ultra-Low Supply Current• • • • • • • • TYP. 80μA
- ●Low Standby Current • • • • • • • • • • • • TYP. 0.1μA
- ●Output Current • • • • • • • • • • • • • • • • MIN. 800mA($V_{IN}$=$V_{OUT}$+1.0V)
- ●Output Voltage • • • • • • • • • • • • • Stepwise setting with a step of 0.1V in the range of 1.5V to 4.0V
- ●High Output Voltage Accuracy• • • • ±2.0%
- ●Low Dropout Voltage• • • • • • • • • • • • TYP. 0.12V($V_{OUT}$=3.0V, $I_{OUT}$=300mA)
- ●Line Regulation• • • • • • • • • • • • TYP. 0.05%/V
- ●Small Package • • • • • • • • • • • • • • • • SOT-89-5, HSON6
- ●Built-in Current Limit Circuit
- ●Built-in Thermal Shunt Circuit
- ●Low Temperature-drift Coefficient of Output Voltage • • • • • • • • • TYP.±100ppm/°C

## ■ APPLICATIONS

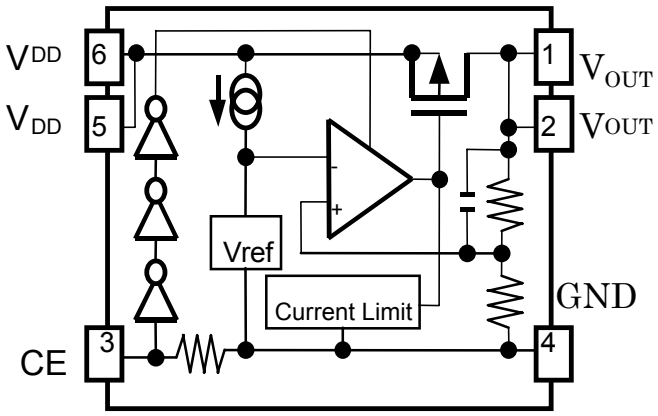
- ●Local Power source for Notebook PC.
- ●Local Power source for portable appliances, cameras, and videos.
- ●Local Power source for equipment of battery-use.
- ●Local Power source for home appliances.

## ■ BLOCK DIAGRAMS

R1170H Series




R1170D Series




## ■ SELECTION GUIDE

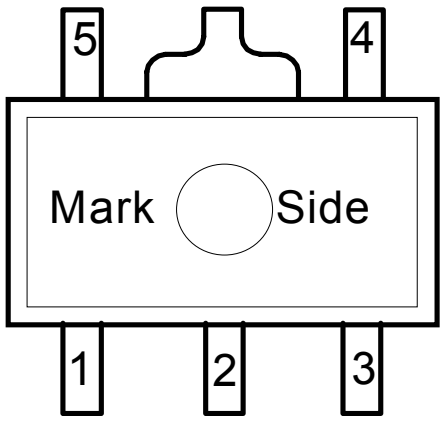
The output voltage, the chip-enable polarity, the taping type can be selected at the user's request. The selection can be made with the part number as follows;

R1170X XXXX-XX ← Part Number
↑ ↑ ↑ ↑
a b c d

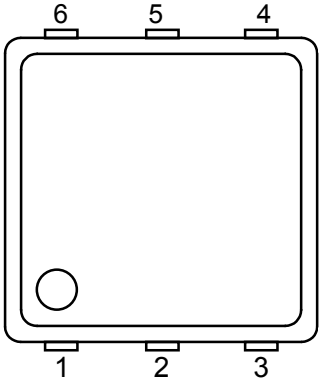
| Code | Contents |
|---|---|
| a | Package Type; H: SOT89-5, D: HSON-6P |
| b | Designation of Output Voltage(VOUT)<br>Stepwise setting with 0.1V increment in the range from 1.5V to 4.0V |
| c | Designation of option;<br>A: Built-in Chip Enable Circuit, Active at "L"<br>B: Built-in Chip Enable Circuit, Active at "H" |
| d | Designation of Taping Type;<br>T1 or T2 (SOT89-5), TR(HSON-6) (Refer to Taping Specifications) |

## ■ PIN CONFIGURATION

● SOT-89-5



● HSON-6P




## ■ PIN DESCRIPTION

SOT89-5

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

HSON-6P

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

## ■ ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 7.0 | V |
| Input Voltage(CE or CE Input Pin)*Note | $V_{CE}$ | -0.3 ~ $V_{IN}$+0.3 | V |
| Output Voltage | $V_{OUT}$ | -0.3 ~ $V_{IN}$+0.3 | V |
| Output Current | $I_{OUT}$ | 1.2 | A |
| Power Dissipation | $P_D$ | Internally limited | |
| Operating Temperature | $T_{opt}$ | -40 ~ 85 | °C |
| Storage Temperature | $T_{stg}$ | -55 ~ 125 | °C |

## ■ ELECTRICAL CHARACTERISTICS

●R1170XxxxA

(Topt=25°C)

| Item | Symbol | Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | | | 6.0 | V |
| Supply Current1 | $I_{SS1}$ | $V_{IN}$-$V_{OUT}$=1.0V<br>$V_{CE}$=GND | | 80 | 160 | μA |
| Standby Current | Istb | $V_{IN}$=$V_{CE}$=6.0V | | 0.1 | 1.0 | μA |
| Output voltage | $V_{OUT}$ | $V_{IN}$-$V_{OUT}$=1.0V<br>$I_{OUT}$=100mA | x0.98 | | x1.02 | V |
| Output Current | $I_{OUT1}$ | $V_{IN}$-$V_{OUT}$=1.0V | 800 | | | mA |
| Load regulation | $\Delta V_{OUT}$/<br>$\Delta I_{OUT}$ | $V_{IN}$-$V_{OUT}$=1.0V<br>1mA≤$I_{OUT}$≤300mA | | 30 | 100 | mV |
| Dropout Voltage | $V_{DIF}$ | $I_{OUT}$=300mA | Refer to Dropout Voltage Table | | | |
| Line regulation | $\Delta V_{OUT}$/<br>$\Delta V_{IN}$ | $I_{OUT}$=100mA<br>$V_{OUT}$+0.5V≤$V_{IN}$≤8.0V | | 0.05 | 0.30 | %/V |
| Ripple Rejection | RR | f=1kHz,Ripple 0.5Vp-p<br>$V_{IN}$-$V_{OUT}$=1.0V | | 50 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}$/<br>$\Delta T$ | $I_{OUT}$=10mA<br>-40°C ≤ Topt ≤ 85°C | | ±100 | | ppm<br>/°C |
| Short Current Limit | $I_{LIM}$ | $V_{OUT}$=0V | | 40 | | mA |
| Pull-up resistance for $\overline{CE}$ pin | $R_{PU}$ | | 1.25 | 2.50 | 5.00 | MΩ |
| $\overline{CE}$ Input Voltage "H" | $V_{CEH}$ | | 1.50 | | $V_{IN}$ | V |
| $\overline{CE}$ Input Voltage "L" | $V_{CEL}$ | | 0.00 | | 0.25 | V |
| Thermal Shutdown Detector Threshold Temperature | $T_{TSD}$ | Junction Temperature | | 150 | | °C |
| Thermal Shutdown Released Temperature | $T_{TSR}$ | Junction Temperature | | 120 | | °C |

●R1170xxxxB

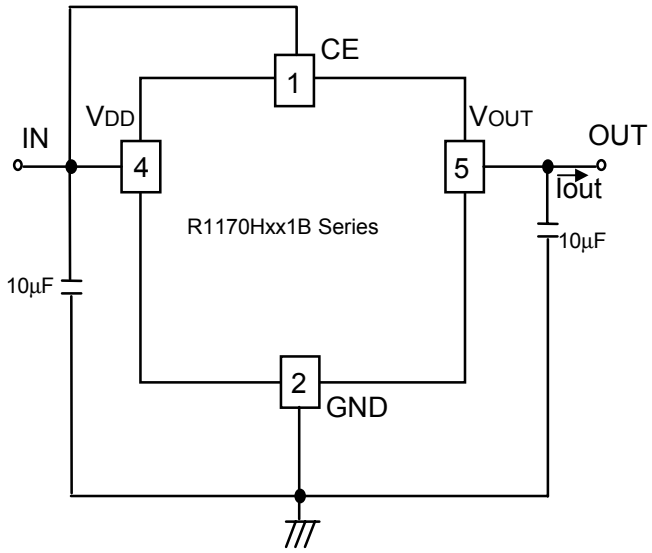
(Topt=25°C)

| Item | Symbol | Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Input voltage | $V_{IN}$ | | | | 6.0 | V |
| Supply Current1 | $I_{SS1}$ | $V_{IN}$-$V_{OUT}$=1.0V $V_{CE}$=$V_{IN}$ | | 80 | 160 | μA |
| Standby Current | Istb | $V_{IN}$=6.0V, $V_{CE}$=GND | | 0.1 | 1.0 | μA |
| Reference Voltage for Adjustable Voltage Regulator | $V_{OUT}$ | $V_{IN}$-$V_{OUT}$=1.0V $I_{OUT}$=100mA | x0.98 | | x1.02 | V |
| Output Current | $I_{OUT1}$ | $V_{IN}$-$V_{OUT}$=1.0V | 800 | | | mA |
| Load regulation | $\Delta V_{OUT}$/ $\Delta I_{OUT}$ | $V_{IN}$-$V_{OUT}$=1.0V 1mA≤$I_{OUT}$≤300mA | | 30 | 100 | mV |
| Dropout Voltage | $V_{DIF}$ | $I_{OUT}$=300mA | Refer to Dropout Voltage Table | | | |
| Line regulation | $\Delta V_{OUT}$/ $\Delta V_{IN}$ | $I_{OUT}$=100mA $V_{OUT}$+0.5V≤$V_{IN}$≤8.0V | | 0.05 | 0.30 | %/V |
| Ripple Rejection | RR | f=1kHz,Ripple 0.5Vp-p | | 50 | | dB |
| Output Voltage Temperature Coefficient | $\Delta V_{OUT}$/ $\Delta T$ | -40°C≤Topt≤85°C | | ±100 | | ppm /°C |
| Short Current Limit | $I_{LIM}$ | $V_{OUT}$=0V | | 40 | | mA |
| Pull-down resistance for CE pin | $R_{PD}$ | | 1.25 | 2.5 | 5 | MΩ |
| CE Input Voltage “H” | $V_{CEH}$ | | 1.5 | | $V_{IN}$ | V |
| CE Input Voltage “L” | $V_{CEL}$ | | 0 | | 0.25 | V |
| Thermal Shutdown Detector Threshold Temperature | $T_{TSD}$ | Junction Temperature | | 150 | | °C |
| Thermal Shutdown Released Temperature | $T_{TSR}$ | Junction Temperature | | 120 | | °C |

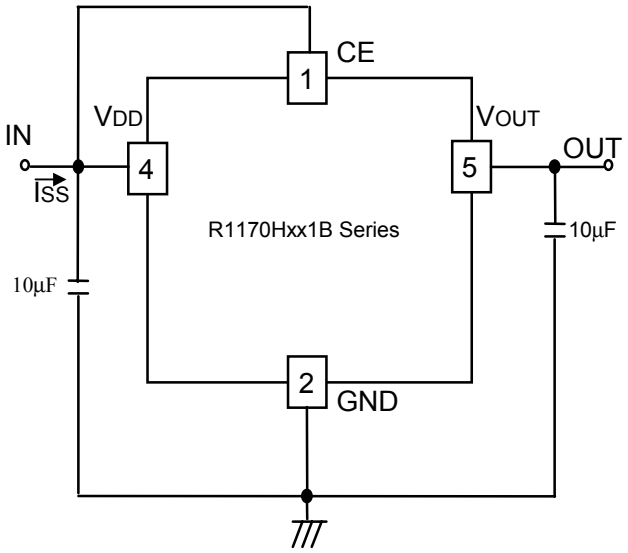
●Dropout Voltage by Output Voltage (Topt=25°C)

| Output Voltage $V_{OUT}$(V) | Dropout Voltage (V) | |
|---|---|---|
| | TYP. | MAX. |
| $V_{OUT}$=1.5 | 0.35 | 0.45 |
| $V_{OUT}$=1.6 | 0.30 | 0.35 |
| $V_{OUT}$=1.7 | 0.25 | 0.30 |
| 1.8≤$V_{OUT}$≤2.0 | 0.20 | 0.25 |
| 2.1≤$V_{OUT}$≤2.4 | 0.15 | 0.20 |
| 2.5≤$V_{OUT}$≤4.0 | 0.12 | 0.18 |

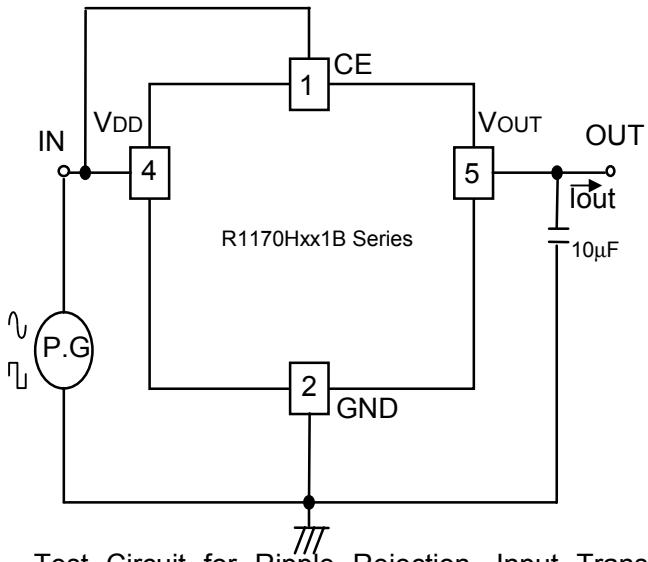
## ■ TEST CIRCUITS



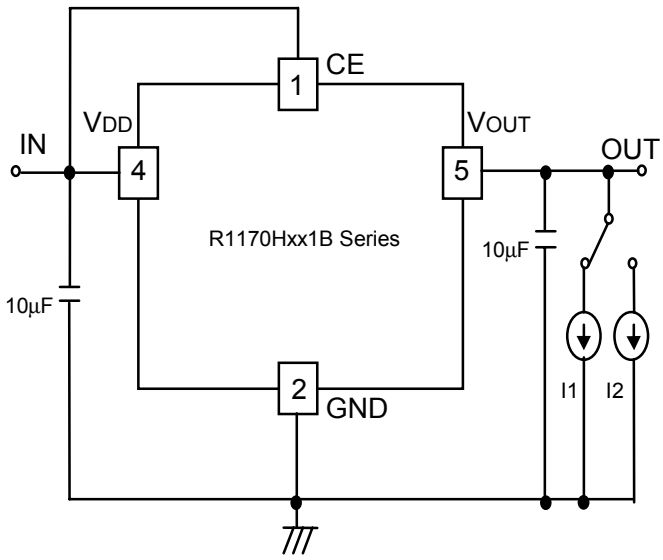

Standard Test Circuit




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 Output capacitor for securing stable operation even if the load current is varied. For this purpose, use as much as 10μF Capacitor as $C_L$.

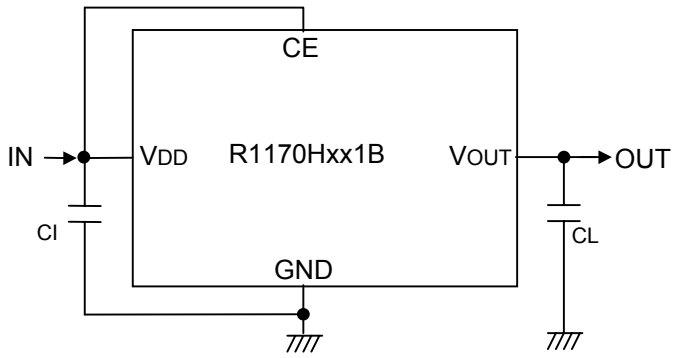
If you use a tantalum type capacitor and ESR value of the capacitor is large, output might be unstable. Evaluate your circuit with considering frequency characteristics. Further, refer to the Typical Characteristics No.12.

Mounting on PCB

Make $V_{DD}$ and GND lines sufficient. If the impedance of these is high, current flows, the noise might be picked up or be a cause of unstable operation. Further use as much as 10μF Capacitor between $V_{DD}$ pin and GND pin as close as possible.

Set an Output capcitor between $V_{OUT}$ pin and GND pin for phase compensation as close as possible. (Refer to the example of typical application)

Example of the typical application of R1170HxxxB

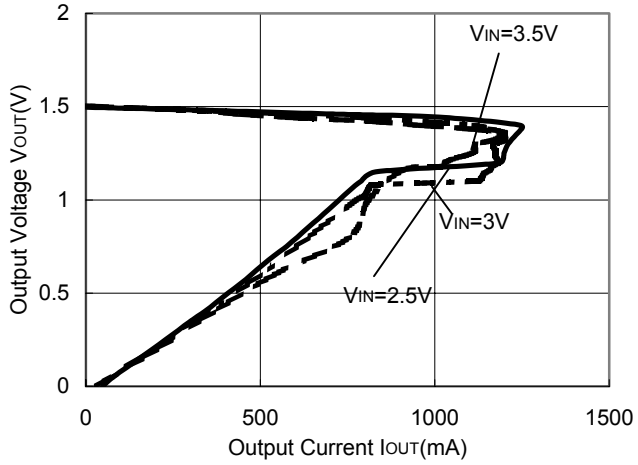



CI=10μF(Ceramic), CL=10μF(Ceramic)

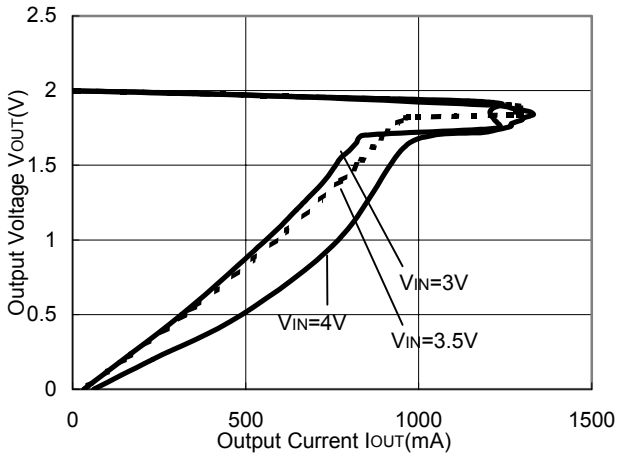
## ■ TYPICAL CHARACTERISTICS

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

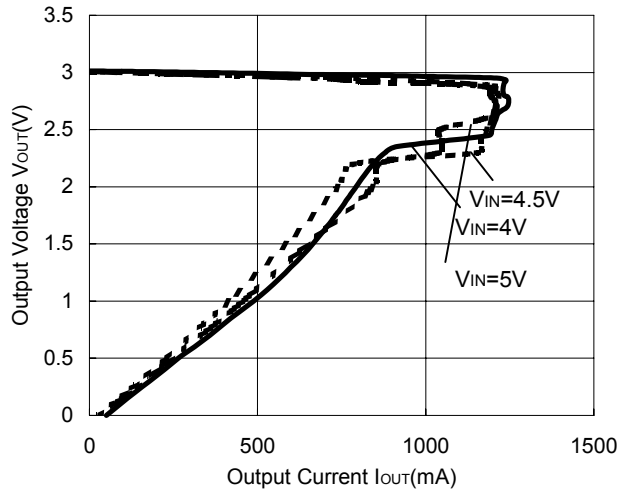
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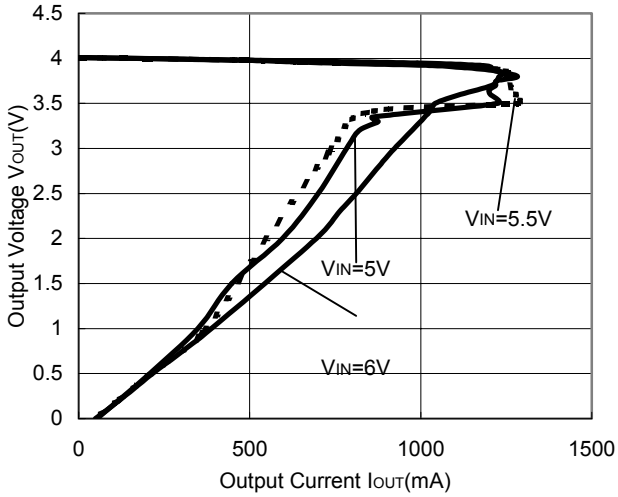

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R1170X301B

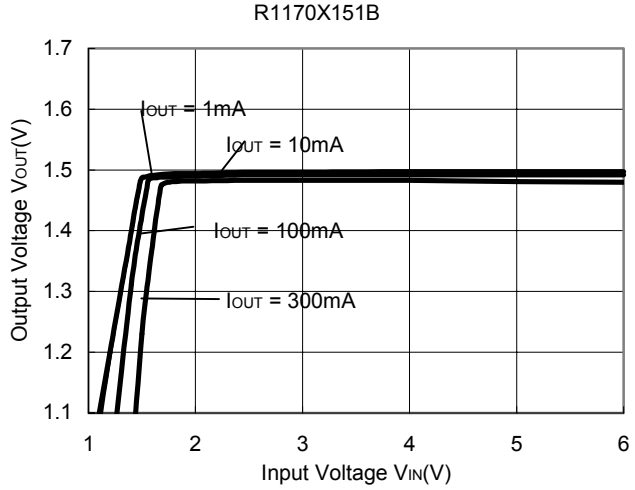



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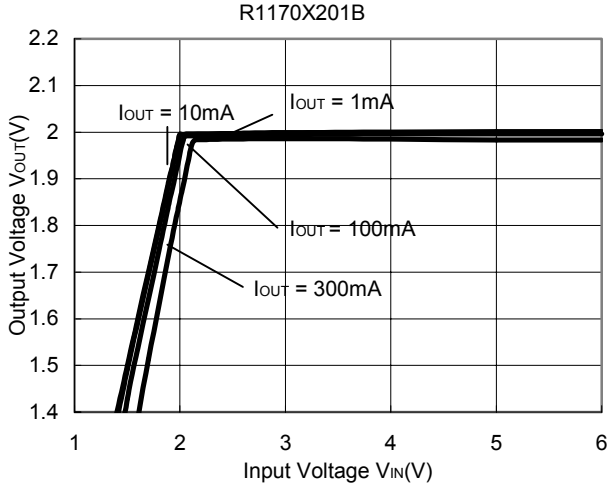



2)Output Voltage vs. Input Voltage(Topt=25°C)

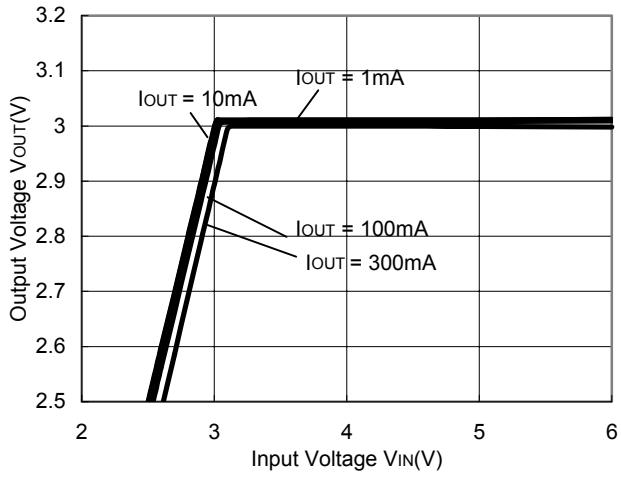
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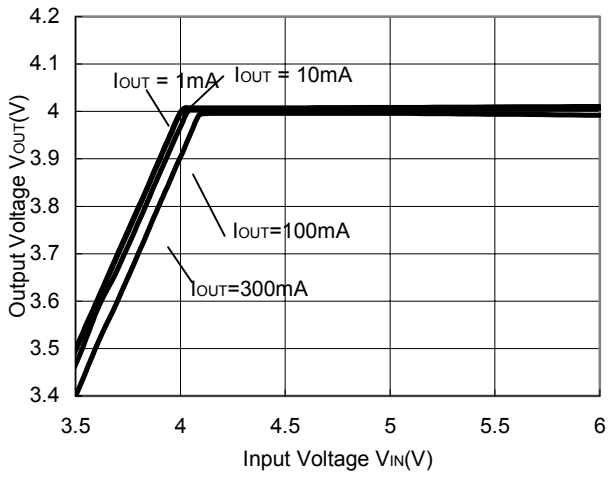

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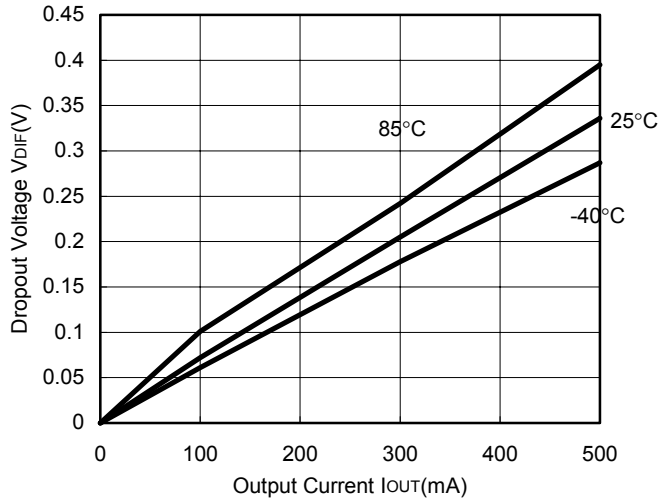



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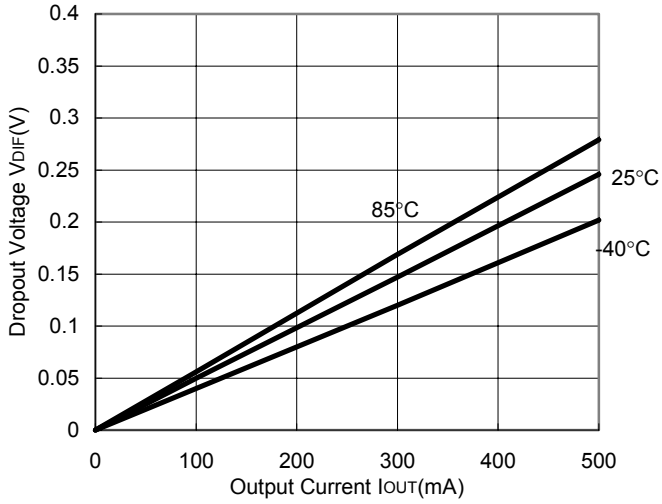



3)Dropout Voltage vs. Output Current

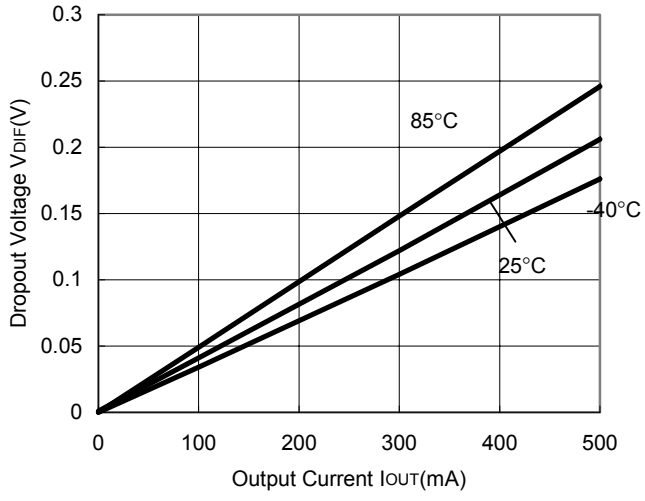
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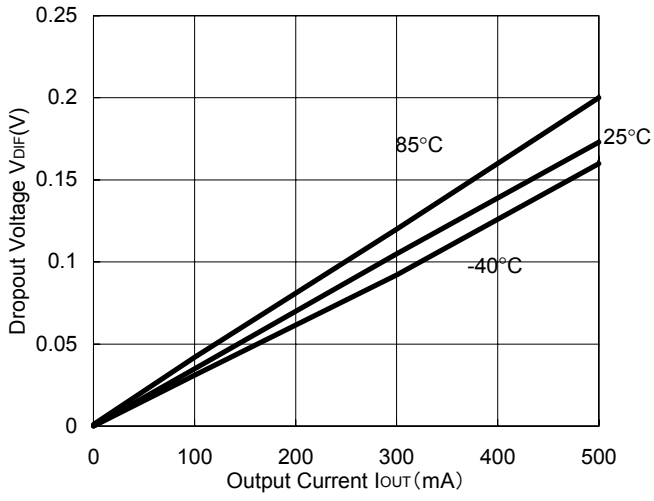

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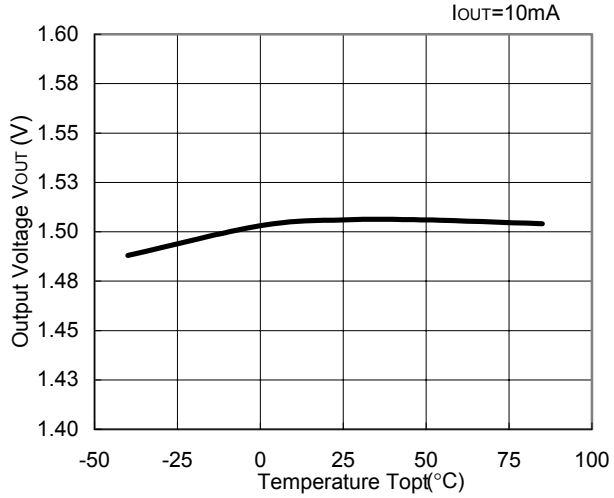


4)Output Voltage vs. Temperature

R1170X151B

$V_{IN}$=2.5V

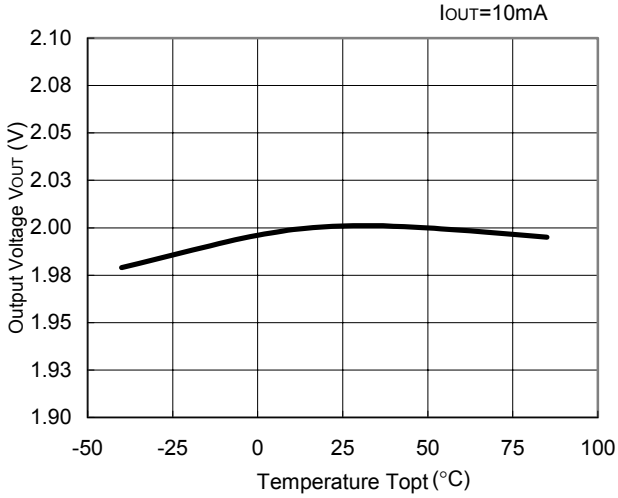
$I_{OUT}$=10mA




R1170X201B

$V_{IN}$=3V

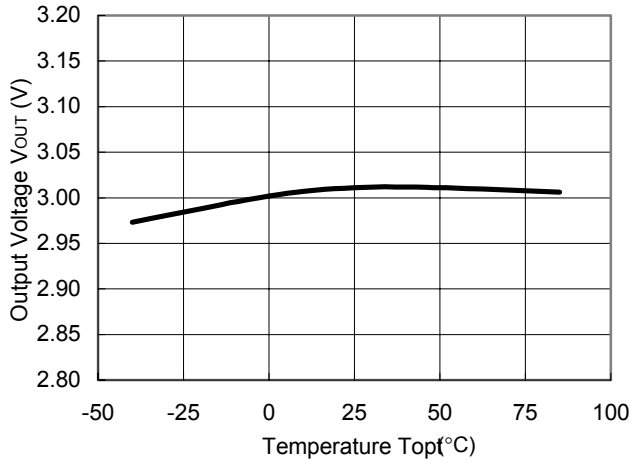
$I_{OUT}$=10mA




R1170X301B

$V_{IN}$=4V

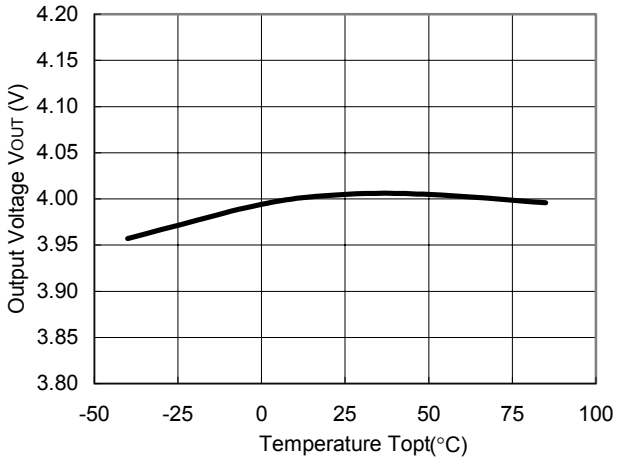
$I_{OUT}$=10mA




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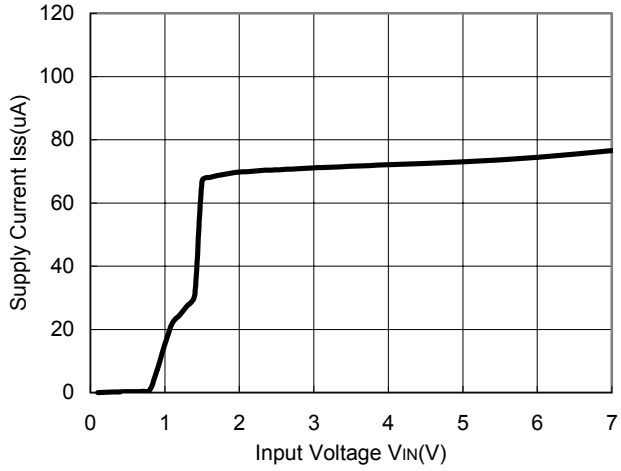
$V_{IN}$=5V

$I_{OUT}$=10mA

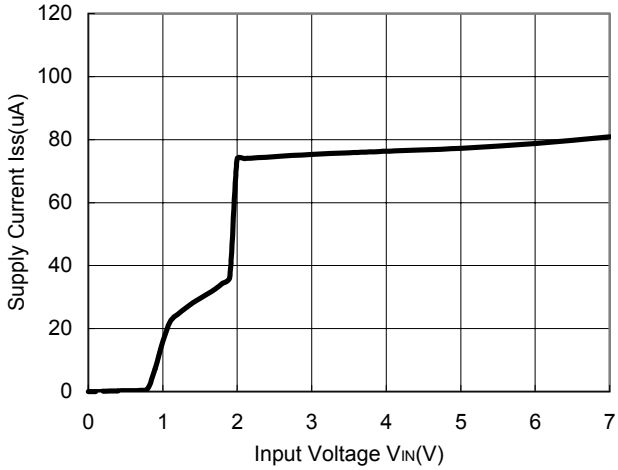



5)Supply Current vs. Input Voltage(Topt=25°C)

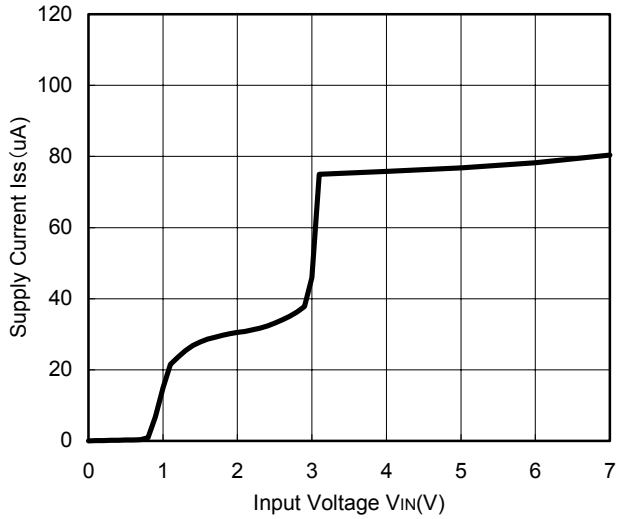
R1170X151B



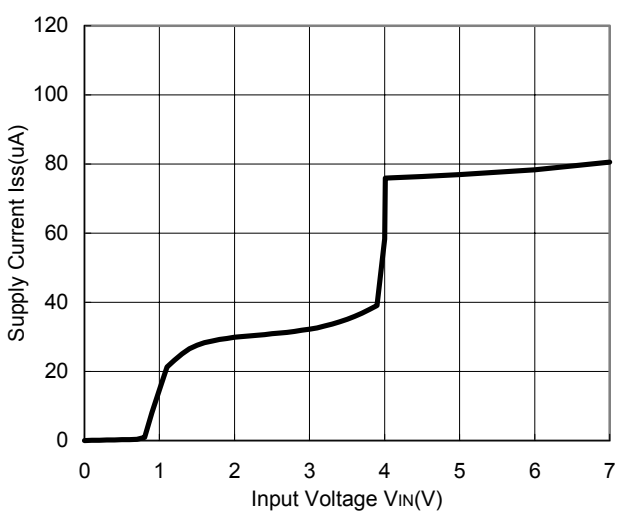

R1170X201B



R1170X301B

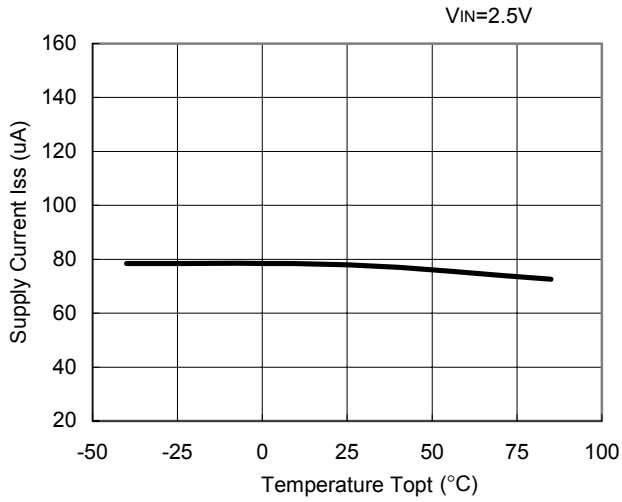



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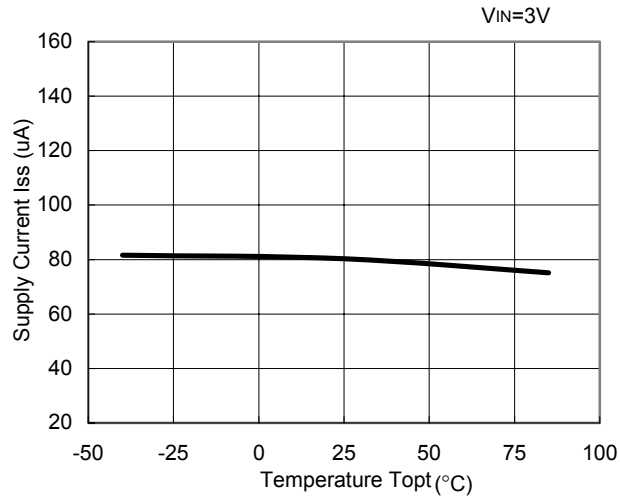



6)Supply Current vs. Temperature

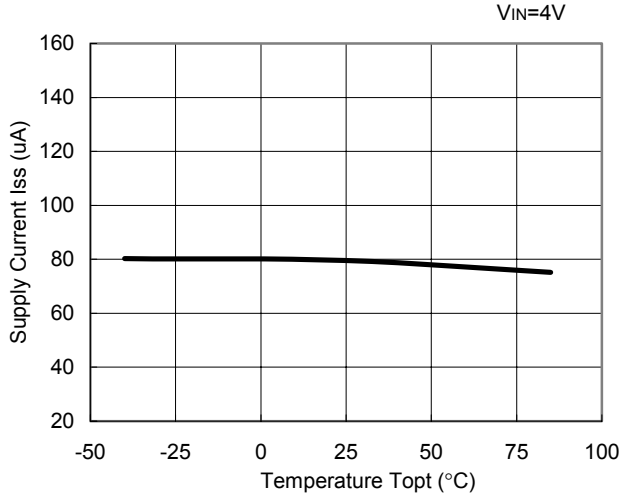
R1170X151B



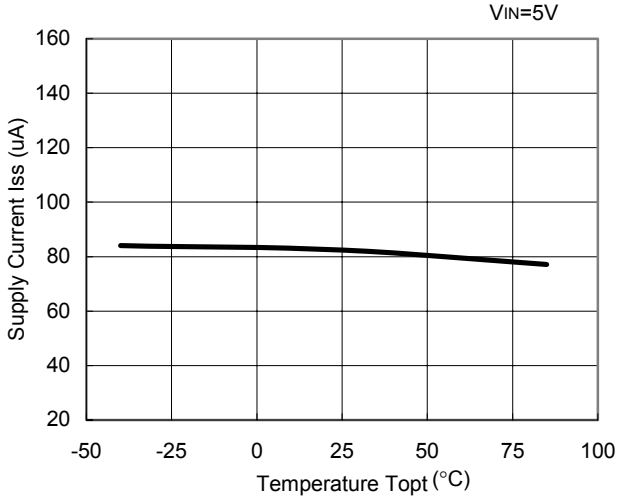

R1170X201B




R1170X301B

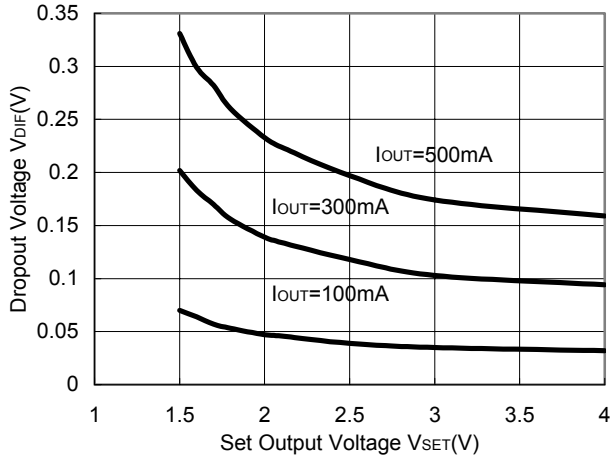



R1170X401B



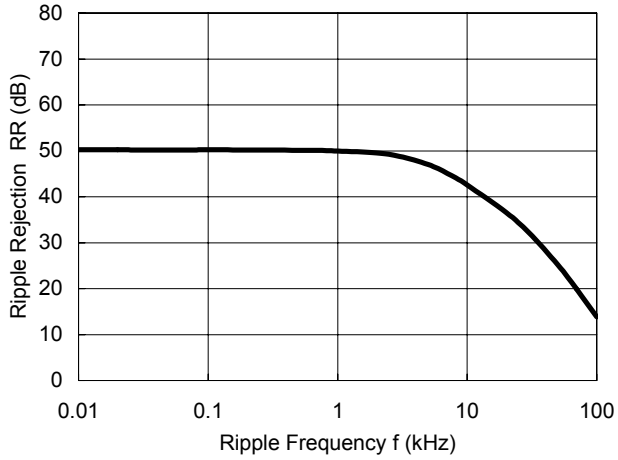
7)Dropout Voltage vs. Set Output Voltage(Topt=25°C)

R1170XXXXB

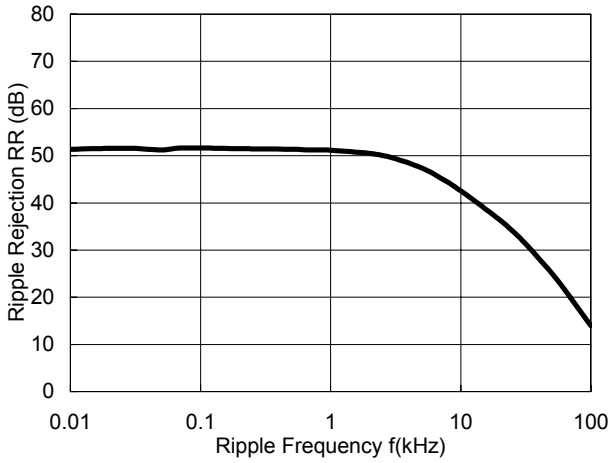



8)Ripple Rejection vs. Frequency

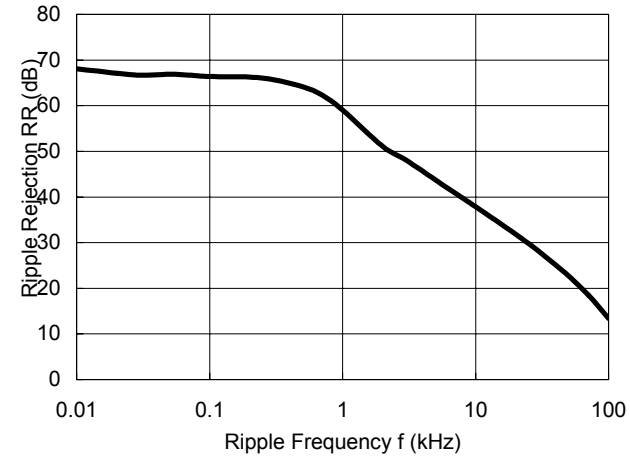
R1170X151B VIN=2.5V+0.5Vp-p IOUT=100mA



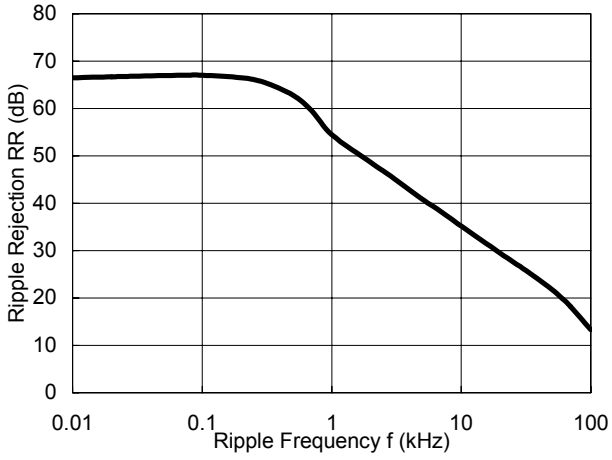

R1170X201B VIN=3V+0.5Vp-p IOUT=100mA



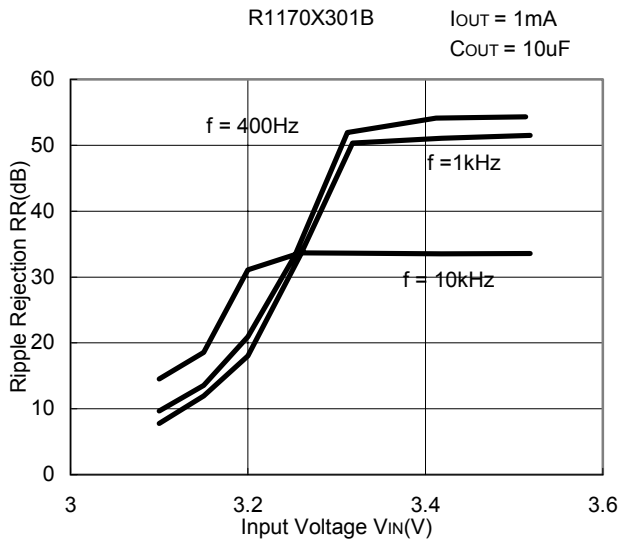

R1170X301B VIN=4V+0.5Vp-p IOUT=100mA

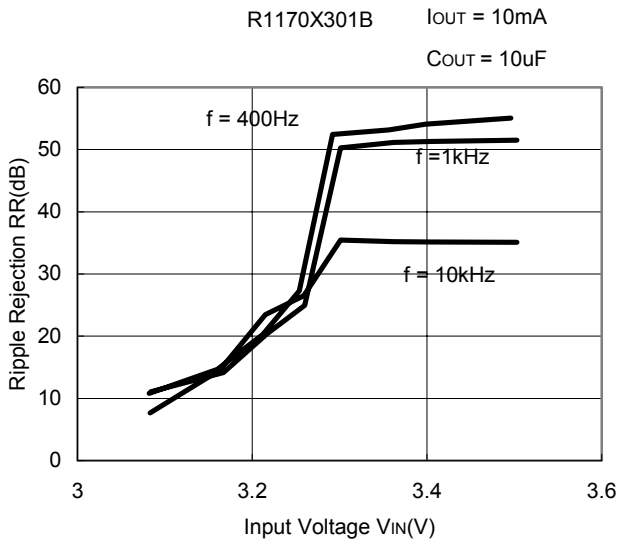


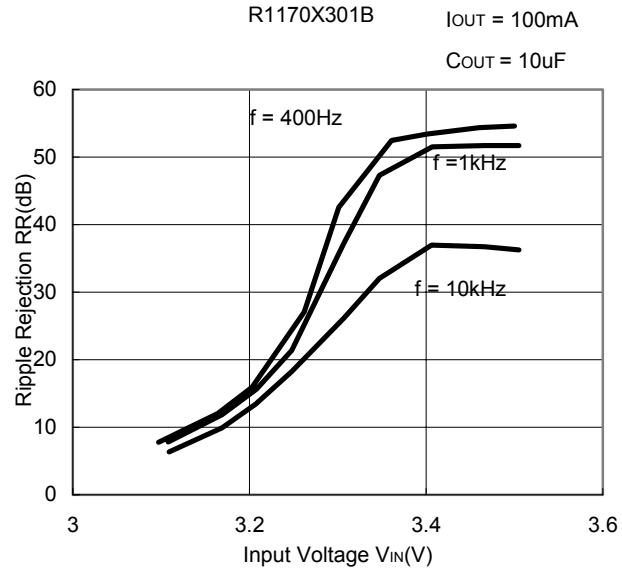

R1170X401B VIN=5V+0.5Vp-p IOUT=100mA



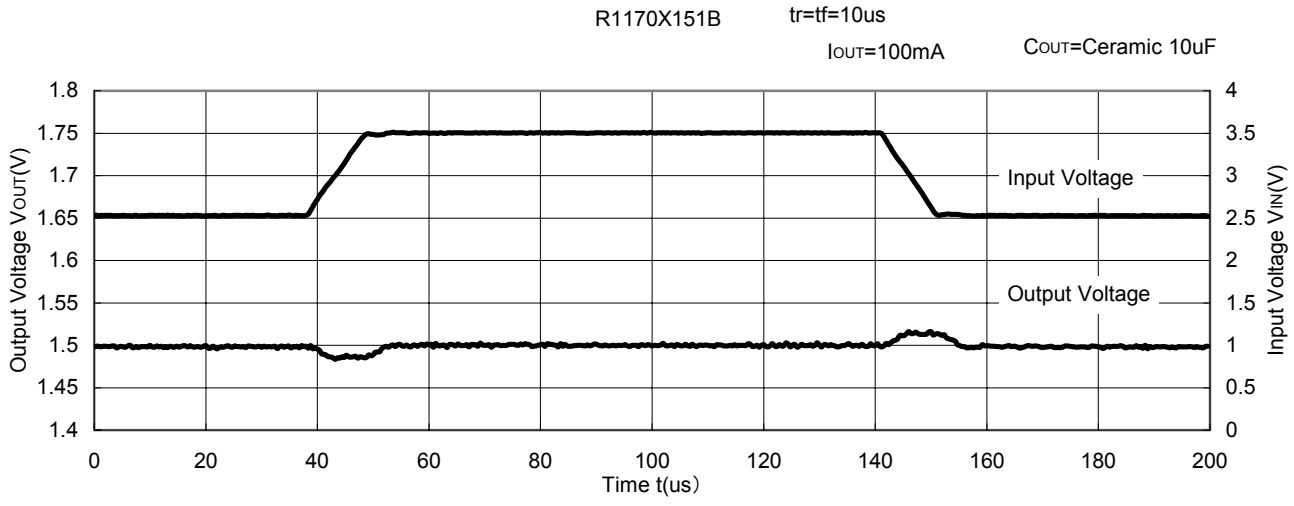
9)Ripple Rejection vs. Input Voltage

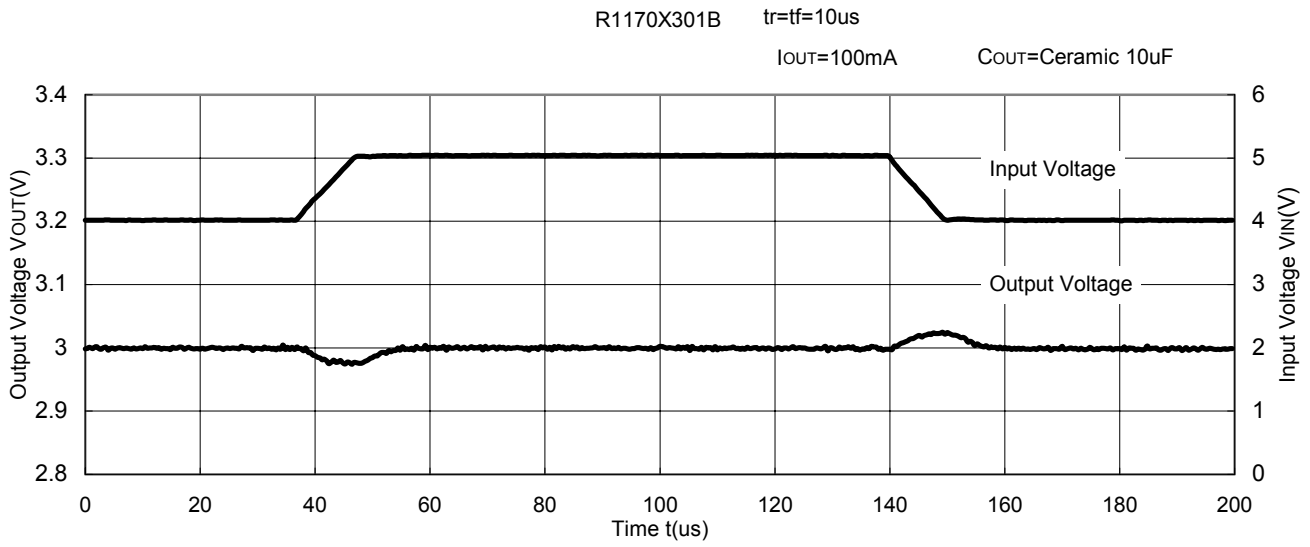


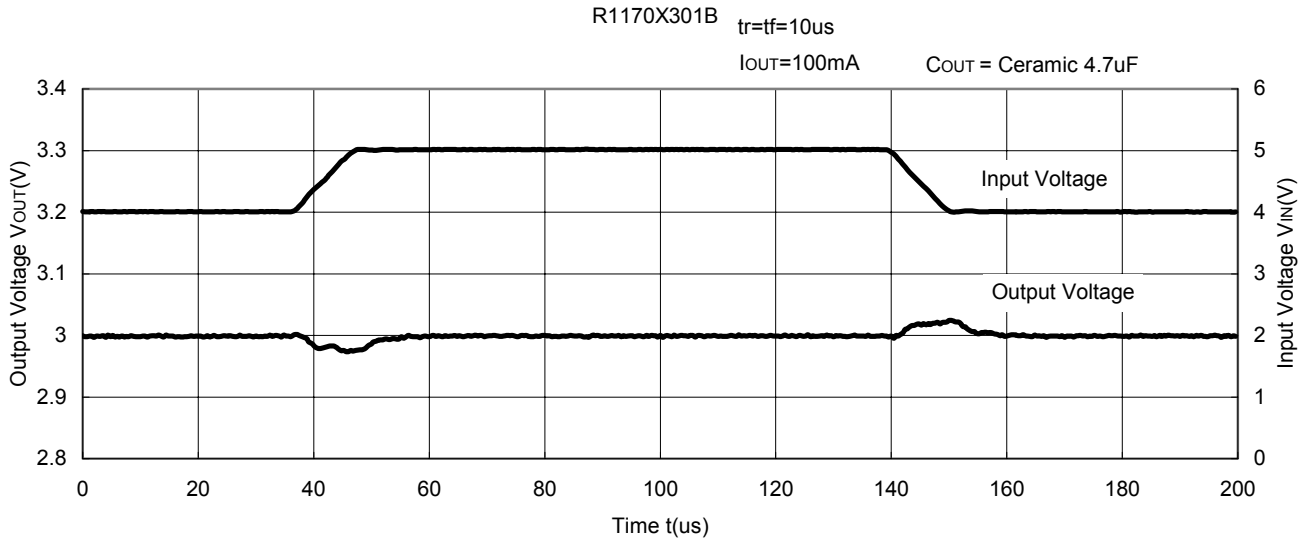



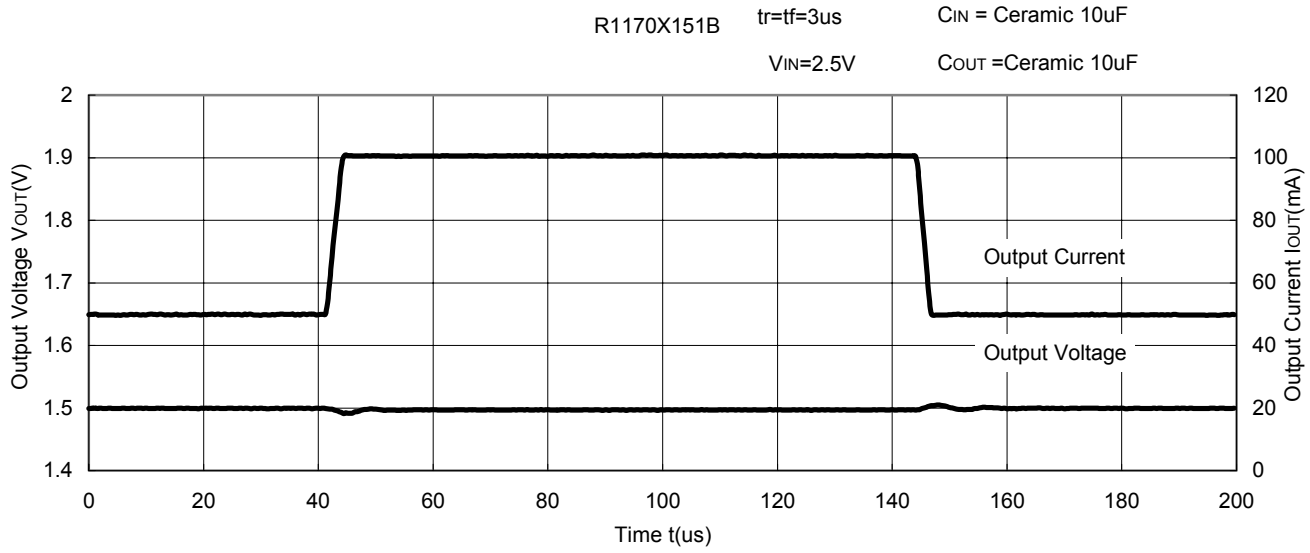

10)Input Transient Response (Topt=25°C)

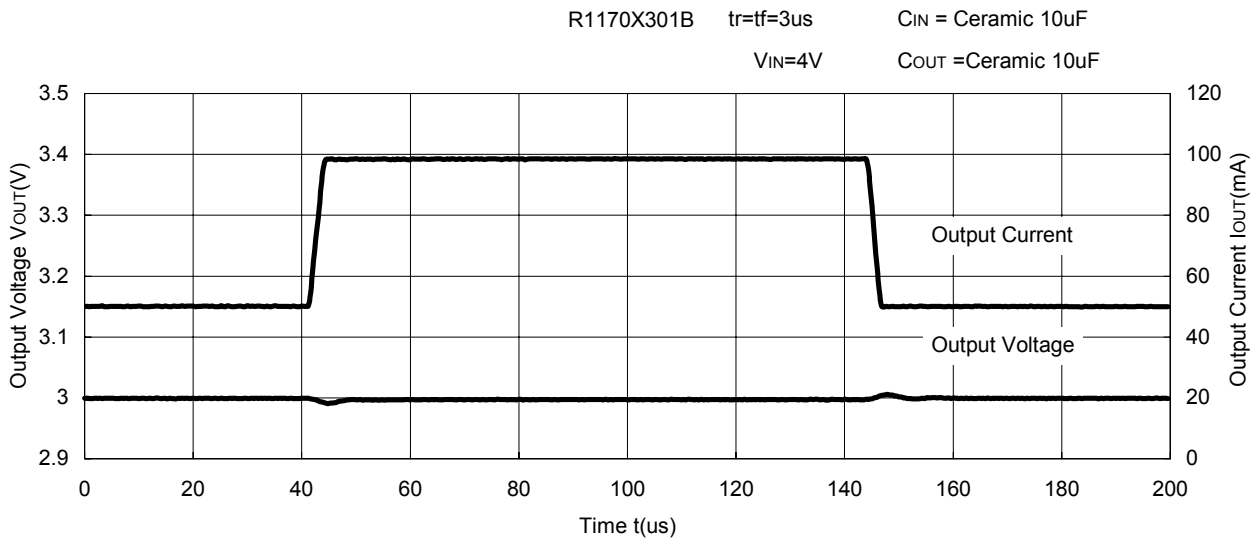


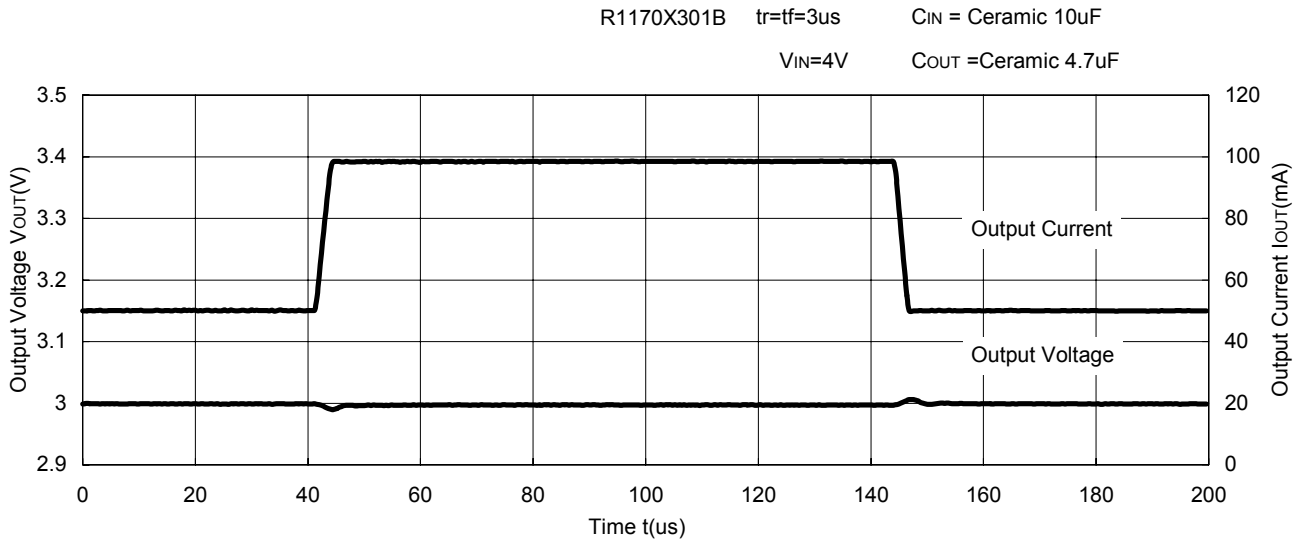


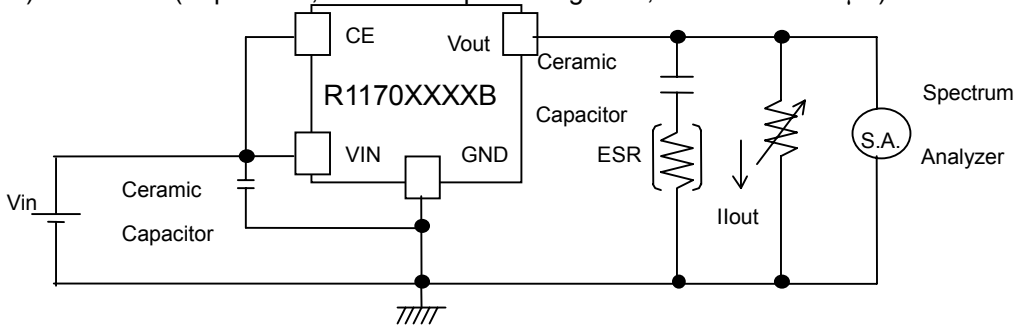

11)Load Transient ResponseTopt=25°C)






12)Stable Area(Topt=25°C,VIN=Set Output Voltage+1V,CIN=Ceramic 10μF)

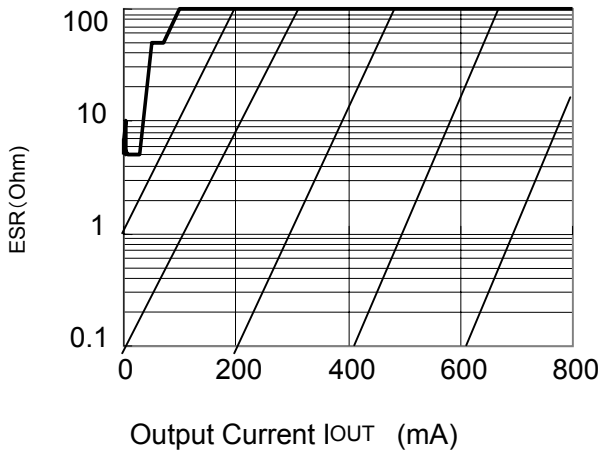



As an output capacitor for this IC, Ceramic capacitor is recommendable. However, other low ESR type capacitor can be used with this IC.

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.)

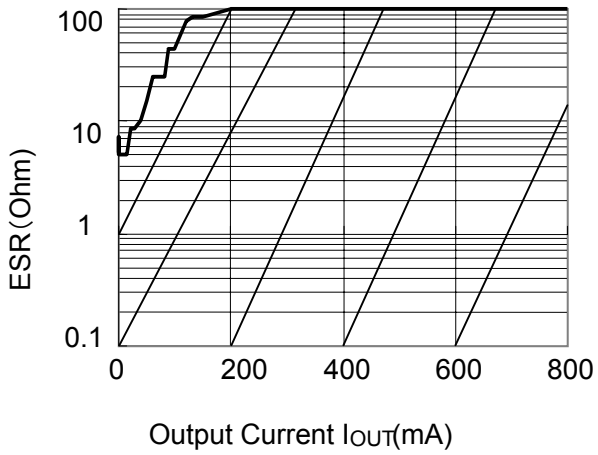
R1170X151B

C OUT=Ceramic 10uF



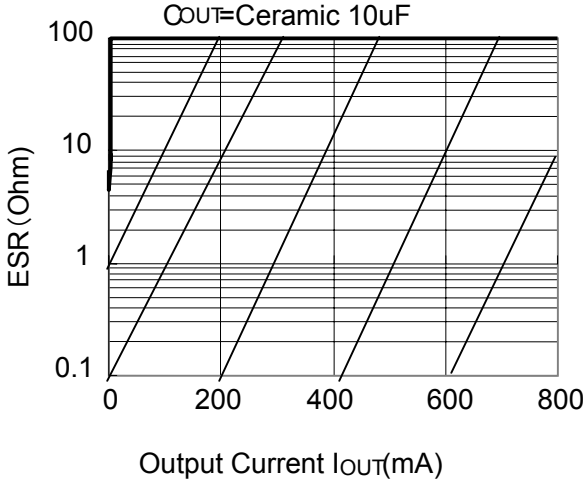

R1170X151B

C OUT =Ceramic 4.7uF



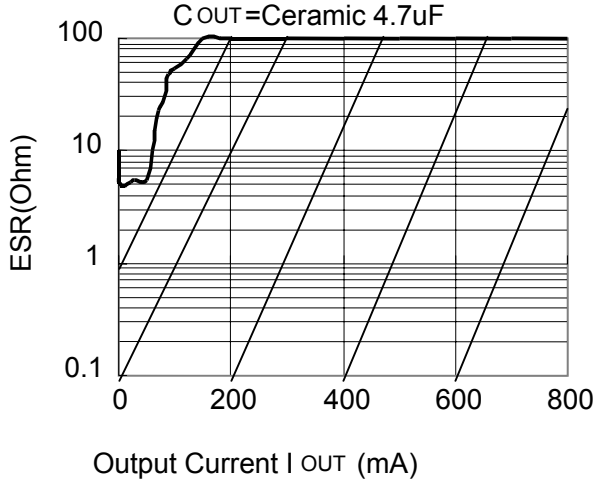

R1170X301B

COUT=Ceramic 10uF




R1170X301B

C OUT=Ceramic 4.7uF



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