RICOH

300mA LDO REGULATOR R1130XxxxA/B/C Series

■ OUTLINE

The R1130Xxxxx Series are voltage regulator (VR) ICs by CMOS process. VR function has features of high ripple rejection, low dropout voltage, high output voltage accuracy, and ultra-low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, and a current limit circuit. Each of the R1130xxxxA/B type includes also a chip enable circuit.

Output Voltage of the R1130xxxxC type is adjustable with external resistors.

Output Voltage of R1130xxxxA/B is fixed in the IC. Low supply current by the merit of CMOS process and built-in transistors with low ON-resistance make low dropout voltage. These regulators in the R1130xxxxx Series 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 R1130xxxxx series are suitable for power supply for CD-drives, DVD-drives, and so forth.

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

■ FEATURES

●Ultra-Low Supply Current• • • • • • • • TYP. 50μA
●Low Standby Current • • • • • • • • • • • TYP. 0.1μA (VR) for A type
●High Ripple Rejection • • • • • • • • • • TYP. 60dB(f=1kHz)(VR)
●Output Current • • • • • • • • • • • • • • • MIN. 300mA(Vin=Vout+1V)
●Output Voltage (VR) • • • • • • • • • • Stepwise setting with a step of 0.1V in the range of 1.5 to 5.0V(A/B Version)
　　　　　　　　　　　　　　　　　　　　　　(Reference 1.8V(C Version))
●High Output Voltage Accuracy• • • • ±2.0%(VR) for A/B type,
　　　　　　　　　　　　　　　±2.0%(Reference Voltage for adjustable VR) for C type
●Low Dropout Voltage• • • • • • • • • • • TYP. 0.2V(I_{OUT}=100mA)(VR)
●Small Packages • • • • • • • • • • • • • • SOT-89-5, HSON-6P
●Built-in Current Limit Circuit
●Low Temperature-drift Coefficient of Output Voltage • • • • • • • • • • TYP.±100ppm/°C
●Absolute Maximum Voltage • • • • • • 9V
●Internal Phase Compensation (small output capacitance such as 0.1uF Ceramic can be used with.)

■ APPLICATIONS

●Power source for CD-drives and DVD-drives, HDD.
●Local Power source for Notebook PC.

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■ BLOCK DIAGRAMS

●R1130HXXXA

●R1130DXXXA

● R1130HXXXB

●R1130DXXXB

●R1130HXXXC

●R1130DXXXC
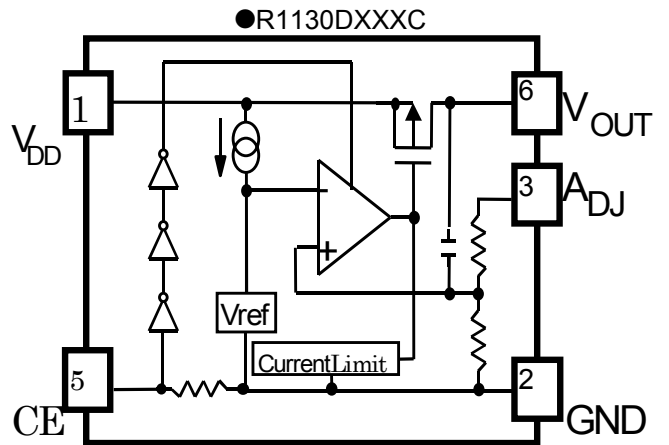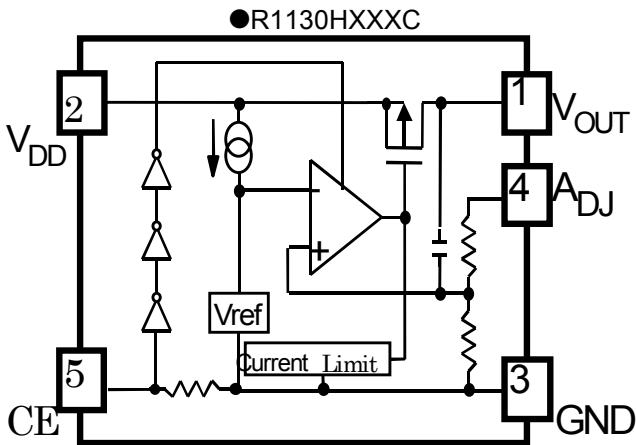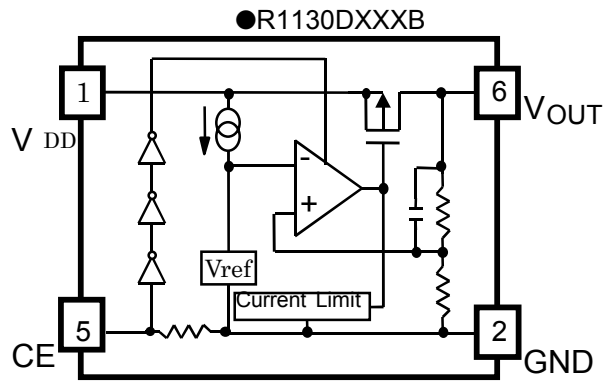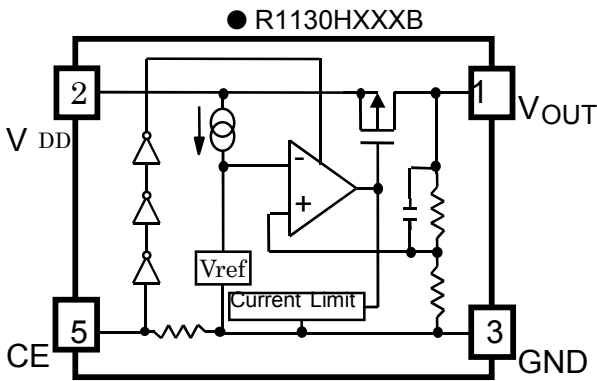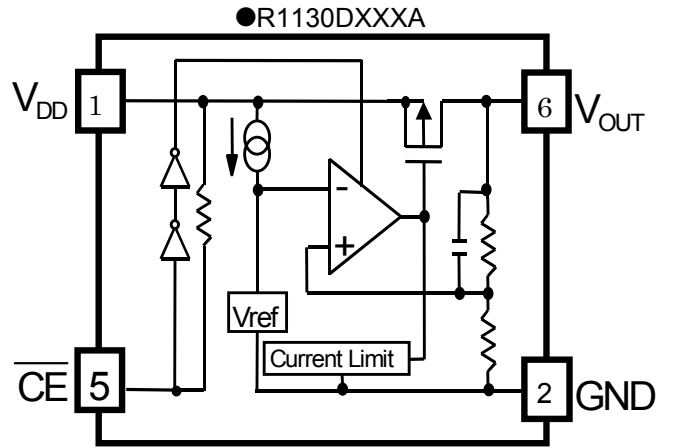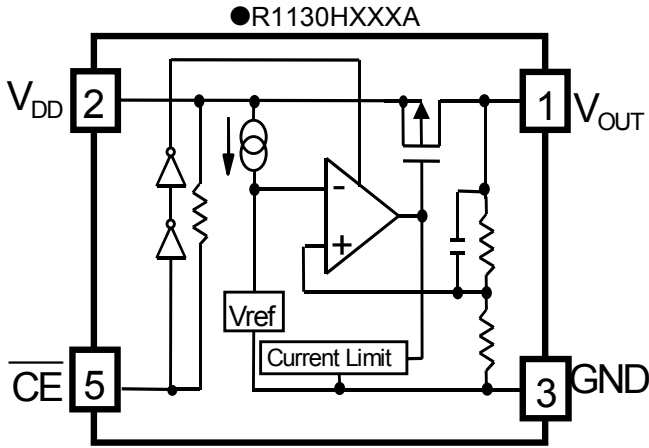
■ SELECTION GUIDE

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

R1130X XXXX-XX ← Part Number
　　　 ↑　↑　↑　↑
　　　 a　b　c　d

Code	Contents
a	Package Type; H: SOT89-5, D: HSON6
b	Serial Number for Voltage Setting
c	Designation of option; 　A: Fixed Output Voltage Regulator with $\overline{CE}$ 　　 pin ("L" enable) 　B: Fixed Output Voltage Regulator with CE 　　 pin ("H" enable) 　C: Output Voltage Adjustable Regulator with 　　 CE pin ("H" enable)
d	Designation of Taping Type; 　T1 or T2 (Refer to Taping Specifications) for SOT89-5 　TR or TL for HSON-6P

■ PIN CONFIGURATION

● SOT-89-5

● HSON-6P

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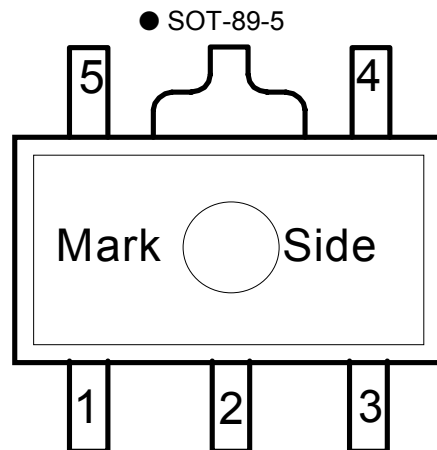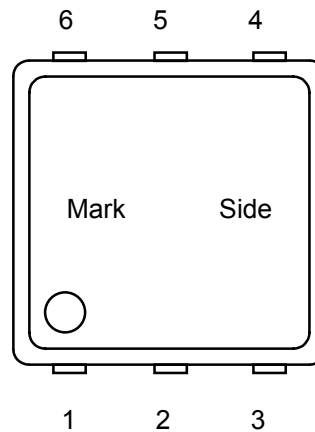
■ PIN DESCRIPTION
SOT89-5

Pin No.	Symbol	Description
1	V_{OUT}	Voltage Regulator Output Pin
2	V_{DD}	Input Pin
3	GND	Ground Pin
4	N.C.(A/B type)	No Connection
	ADJ(C type)	Adjustable Regulator feedback Input Pin (Connect to resistor voltage divider.)
5	$\overline{CE}$ (A type) or CE(B/C type)	Chip Enable Pin

HSON-6P

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	N.C.(A/B type)	No Connection
	ADJ(C type)	Adjustable Regulator feedback Input Pin (Connect to resistor voltage divider.)
4	N.C.	No Connection
5	$\overline{CE}$ (A type) or CE(B/C type)	Chip Enable Pin
6	V_{OUT}	Voltage Regulator Output Pin

■ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Input Voltage	V_{IN}	9.0	V
Input Voltage($\overline{CE}$ or CE Input Pin)	V_{CE}	-0.3 ~ V_{IN}+0.3	V
Input Voltage(ADJ Input Pin)	V_{ADJ}	-0.3 ~ V_{IN}+0.3	V
Output Voltage	V_{OUT}	-0.3 ~ V_{IN}+0.3	V
Output Current	I_{OUT}	450	mA
Power Dissipation (SOT-89-5)	P_D	500	mW
Power Dissipation (HSON6)	P_D	400	mW
Operating Temperature	T_{opt}	-40 ~ 85	°C
Storage Temperature	T_{stg}	-55 ~ 125	°C

■ ELECTRICAL CHARACTERISTICS

● R1130XxxxA   (Topt=25°C)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{IN}	Input Voltage		2.5		8.0	V
I_{SS1}	Supply Current1	V_{IN}-V_{OUT}=1.0V V_{IN}=GND		50	100	μA
I_{stby}	Standby Current	V_{IN}-V_{OUT}=1.0V V_{IN}=V_{CE}		0.1	1.0	μA
V_{OUT}	Output voltage	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤80mA	x0.98	Set V_{OUT}	x1.02	V
I_{OUT1}	Output Current	Refer to the table of Input Voltage by Set Output Voltage	300			mA
ΔV_{OUT}/ ΔI_{OUT}	Load regulation	V_{IN}-V_{OUT}=1.0V 1mA≤I_{OUT}≤80mA		40	80	mV
V_{DIF}	Dropout Voltage	I_{OUT}=100mA	Refer to the Table of Dropout Voltage by Set Output Voltage			
ΔV_{OUT}/ ΔV_{IN}	Line regulation	I_{OUT}=80mA, Set V_{OUT}≥2.0V:V_{OUT}+0.5V≤V_{IN}≤8.0V Set V_{OUT}≤1.9V:2.5V≤V_{IN}≤8.0V		0.1	0.2	%/V
RR	Ripple Rejection	f=1kHz,Ripple 0.5Vp-p, I_{OUT}=80mA Set V_{OUT}≥1.8V:V_{IN}-V_{OUT}=1.0V Set V_{OUT}≤1.7V: V_{IN}=2.8V		60		dB
ΔV_{OUT}/ ΔT	Output Voltage Temperature Coefficient	I_{OUT}=10mA, V_{IN}-V_{OUT}=1.0V -40°C ≤ Topt ≤ 85°C		±100		ppm /°C
I_{LIM}	Short Current Limit	Set V_{OUT}≤3.9V, V_{OUT}=0V		70		mA
		Set V_{OUT}≥4.0V, V_{OUT}=0V		50		
R_{PU}	Pull-up resistance for CE pin		2.5	5.0	10.0	MΩ
V_{CEH}	CE Input Voltage "H"	V_{IN}=2.5V	1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"	V_{IN}=2.5V	0.00		0.25	V

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●R1130XxxxB

(Topt=25°C)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{IN}	Input Voltage		2.5		8.0	V
I_{SS1}	Supply Current1	$V_{IN}-V_{OUT}=1.0V$ $V_{IN}=V_{CE}$		50	100	μA
I_{stby}	Standby Current	$V_{IN}-V_{OUT}=1.0V$ $V_{IN}=GND$		0.1		μA
V_{OUT}	Output voltage	$V_{IN}-V_{OUT}=1.0V$ $1mA≤I_{OUT}≤80mA$	x0.98	Set V_{OUT}	x1.02	V
I_{OUT1}	Output Current	Refer to the table of Input Voltage by Set Output Voltage	300			mA
$ΔV_{OUT}/ΔI_{OUT}$	Load regulation	$V_{IN}-V_{OUT}=1.0V$ $1mA≤I_{OUT}≤80mA$		40	80	mV
V_{DIF}	Dropout Voltage	$I_{OUT}=100mA$	Refer to the Table of Dropout Voltage by Set Output Voltage			
$ΔV_{OUT}/ΔV_{IN}$	Line regulation	$I_{OUT}=80mA$ Set $V_{OUT}≥2.0V$:$V_{OUT}+0.5V≤V_{IN}≤8V$ Set $V_{OUT}≤1.9V$:$2.5V≤V_{IN}≤8.0V$		0.1	0.2	%/V
RR	Ripple Rejection	f=1kHz,Ripple 0.5Vp-p, $I_{OUT}=80mA$ Set $V_{OUT}≥1.8V$:$V_{IN}-V_{OUT}=1.0V$ Set $V_{OUT}≤1.7V$: $V_{IN}=2.8V$		60		dB
$ΔV_{OUT}/ΔTopt$	Output Voltage Temperature Coefficient	$I_{OUT}=10mA$, $V_{IN}-V_{OUT}=1.0V$ -40°C ≤ Topt ≤ 85°C		±100		ppm /°C
I_{LIM}	Short Current Limit	Set $V_{OUT}≤3.9V$, $V_{OUT}=0V$		70		mA
		Set $V_{OUT}≥4.0V$, $V_{OUT}=0V$		50		
R_{PD}	Pull-down resistance for CE pin		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"	$V_{IN}=2.5V$	1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"	$V_{IN}=2.5V$	0		0.25	V

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

Output Voltage $V_{OUT}(V)$	Dropout Voltage (V)	
	TYP.	MAX.
$V_{OUT}=1.5$	1.00	1.05
$V_{OUT}=1.6$	0.90	0.95
$V_{OUT}=1.7$	0.80	0.85
$V_{OUT}=1.8$	0.70	0.75
$V_{OUT}=1.9$	0.60	0.65
$V_{OUT}=2.0$	0.50	0.60
$V_{OUT}=2.1$	0.40	0.55
$2.2V≤V_{OUT}≤2.5V$	0.30	0.49
$2.6V≤V_{OUT}≤3.3V$	0.25	0.34
$3.4V≤V_{OUT}≤5.0V$	0.20	0.28

●Input Voltage by Set Output Voltage (Topt=25°C)

Output Voltage $V_{OUT}(V)$	Input Voltage (V)
$1.5V≤V_{OUT}≤1.9V$	$V_{IN}=V_{OUT}+1.5V$
$2.0V≤V_{OUT}≤2.7V$	$V_{IN}=V_{OUT}+1.3V$
$2.8V≤V_{OUT}≤5.0V$	$V_{IN}=V_{OUT}+1.0V$

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● R1130xxxxC

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{IN}	Input voltage		2.5		8.0	V
I_{SS1}	Supply Current	$V_{IN}-V_{OUT}=1.0V$, $V_{IN}=V_{CE}$		50	100	μA
Istby	Standby Current	$V_{IN}-V_{OUT}=1.0V$ $V_{IN}=GND$		0.1	1.0	μA
V_{OUT}	Reference Voltage for Adjustable Voltage Regulator	$V_{OUT}=V_{ADJ}$, $V_{IN}-V_{OUT}=1.0V$ $I_{OUT}=80mA$	1.764	1.800	1.836	V
I_{OUT1}	Output Current	$V_{OUT}=V_{ADJ}$, $V_{IN}-V_{OUT}=1.5V$	300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	$V_{IN}=2.5V$, $V_{OUT}=V_{ADJ}$ $1mA \leq I_{OUT} \leq 80mA$		40	80	mV
V_{DIF}	Dropout Voltage	$I_{OUT}=100mA$, $V_{OUT}=V_{ADJ}$		0.70	0.75	V
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	$I_{OUT}=80mA$, $V_{OUT}=V_{ADJ}$ $2.5V \leq V_{IN} \leq 8V$		0.1	0.2	%/V
RR	Ripple Rejection	f=1kHz,Ripple 0.5Vp-p, $I_{OUT}=80mA$,$V_{IN}-V_{OUT}=1.0V$ $V_{OUT}=V_{ADJ}$, $I_{OUT}=80mA$		60		dB
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	$I_{OUT}=10mA$, $V_{IN}-V_{OUT}=1.0V$ $-40°C \leq Topt \leq 85°C$		±100		ppm/°C
I_{LIM}	Short Current Limit	$V_{OUT}=0V$		70		mA
R_{PD}	Pull-down resistance for CE pin		2.5	5	10	MΩ
V_{CEH}	CE Input Voltage "H"	$V_{IN}=2.5V$	1.5		V_{IN}	V
V_{CEL}	CE Input Voltage "L"	$V_{IN}=2.5V$	0		0.25	V

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■ TEST CIRCUITS

Standard Test Circuit
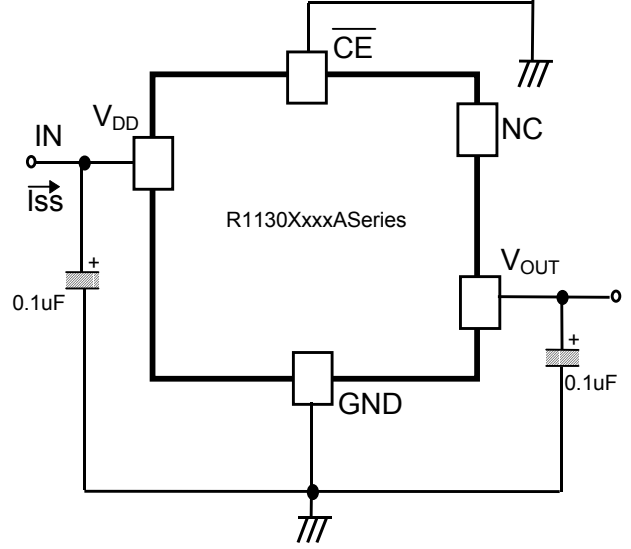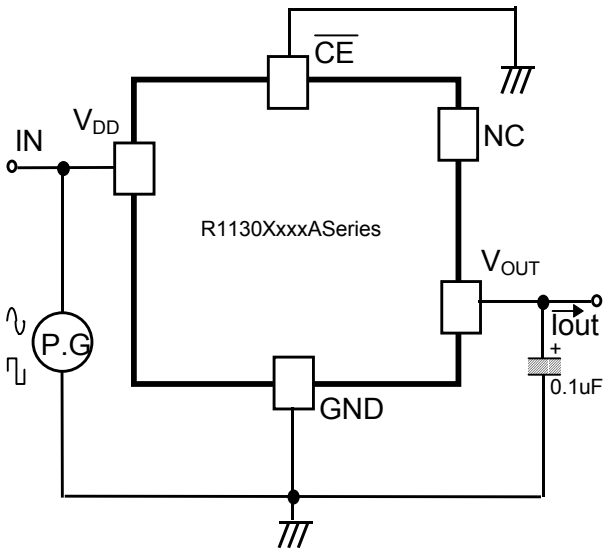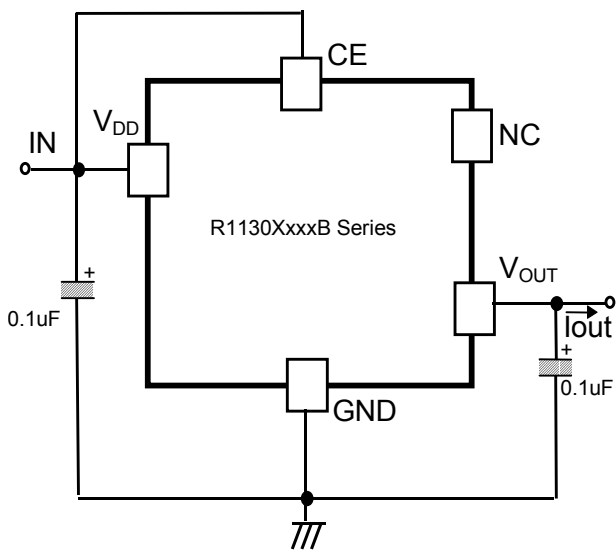
Test Circuit for Supply Current

Test Circuit for Ripple Rejection and
Input Transient Response

Test Circuit for Load Transient Response

Standard Test Circuit
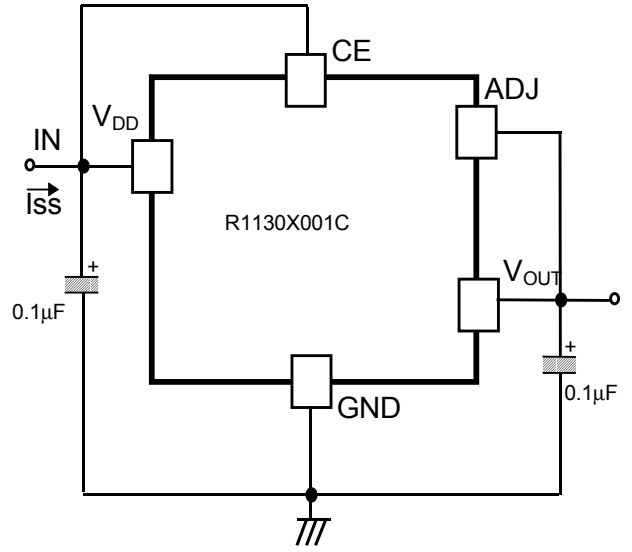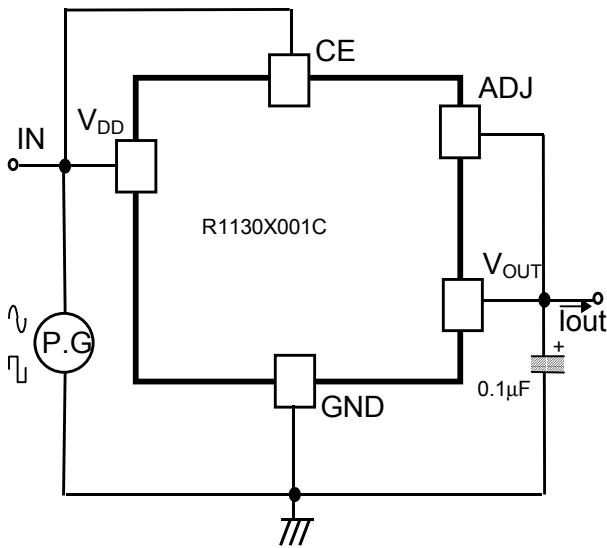
Test Circuit for Supply Current

Test Circuit for Ripple Rejection and
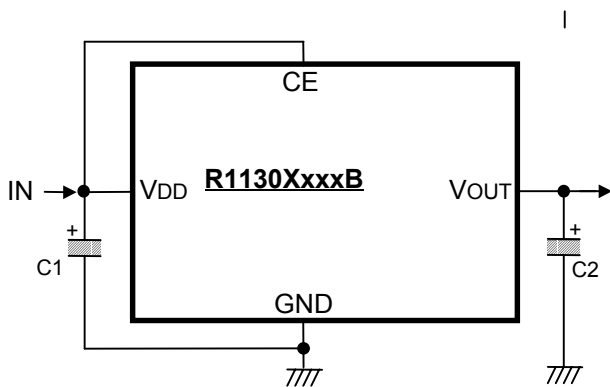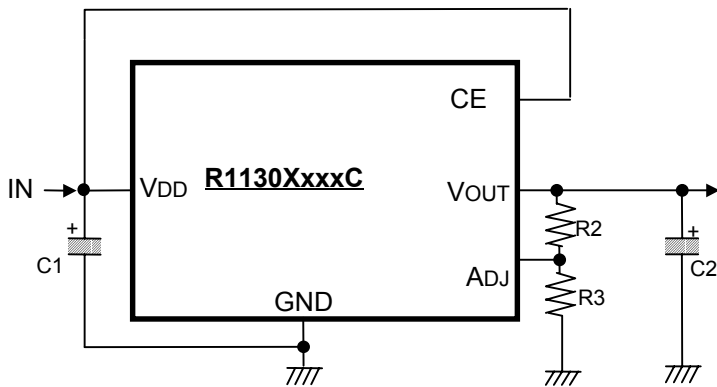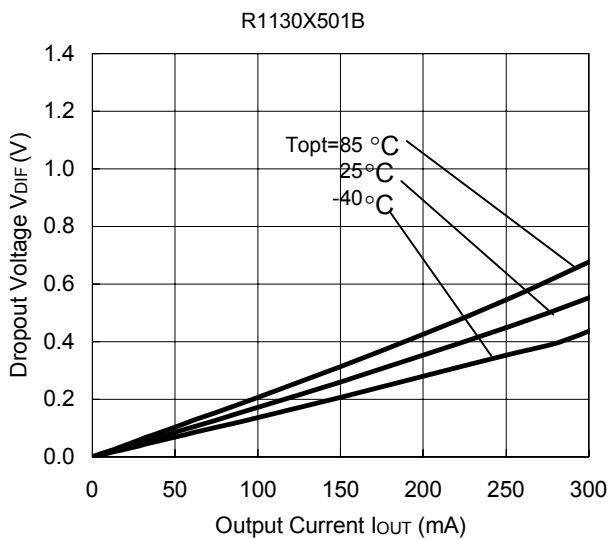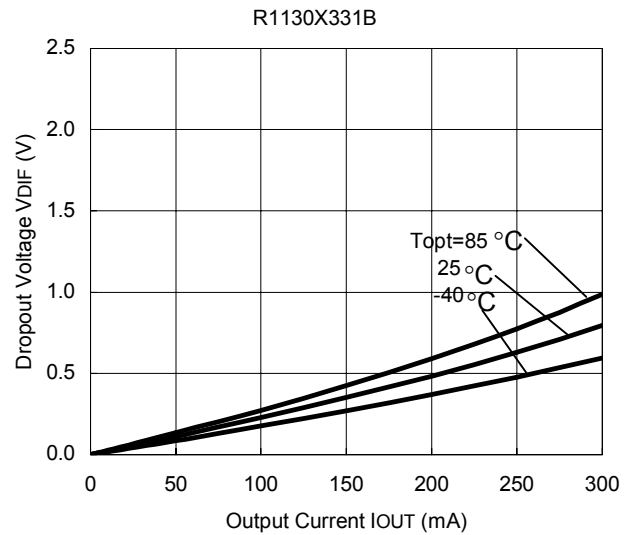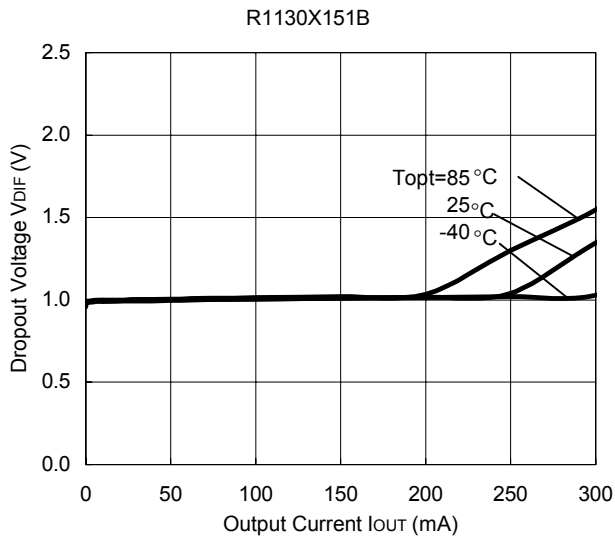Input Transient Response

Test Circuit for Load Transient Response

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Standard Test Circuit

Test Circuit for Supply Current

Test Circuit for Ripple Rejection and
Input Transient Response
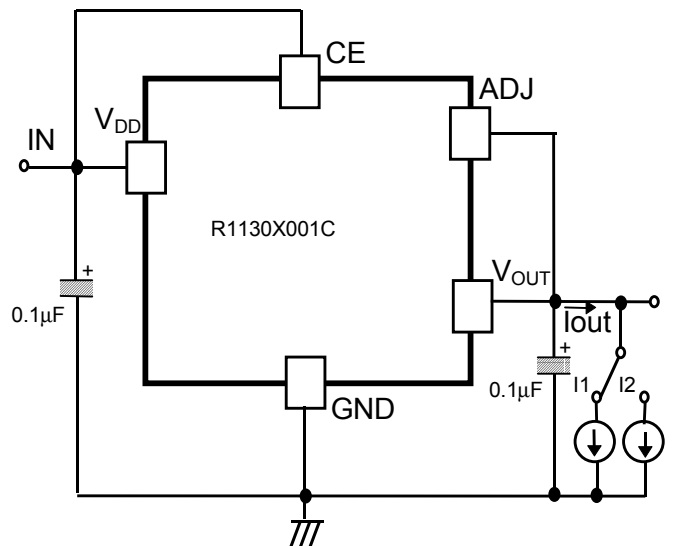
Test Circuit for Load Transient Response

■ TYPICAL APPPLICATION
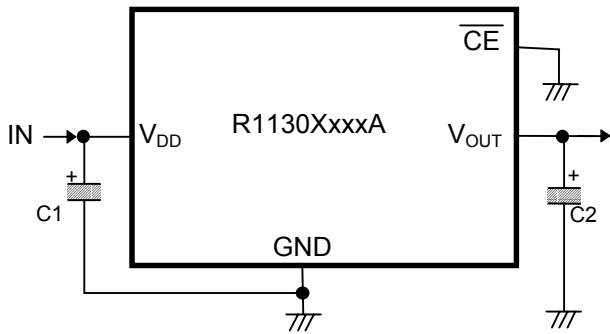
C1=C2=0.1μF

C1=C2=0.1μF

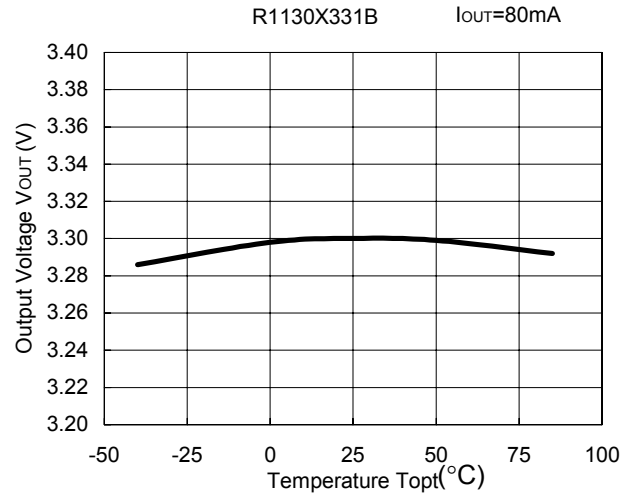C1=C2=0.1uF, R2, R3: Refer to the Technical Notes on Output Voltage setting of C type.

■ TYPICAL CHARACTERISTICS

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

R1130X151B

R1130X331B

R1130X501B
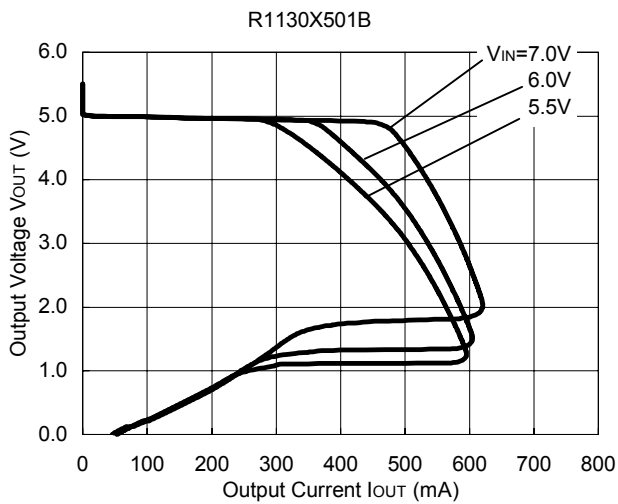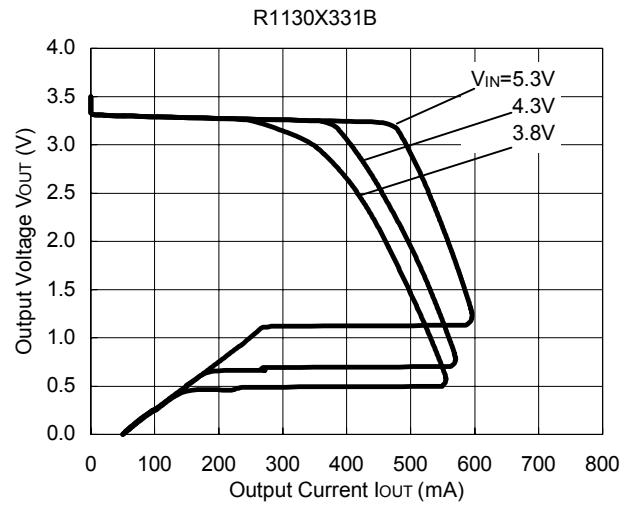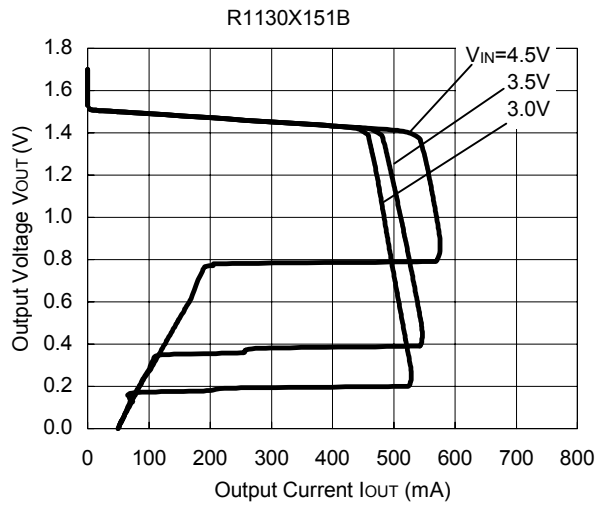
2) **Input Voltage vs. Output Voltage** (Topt=25°C)

R1130X151B

R1130X331B

R1130X501B
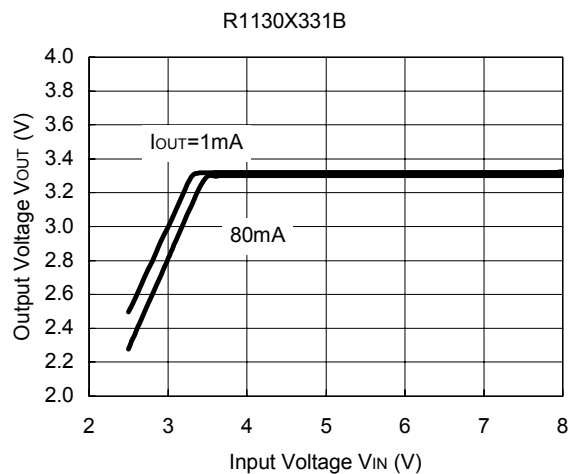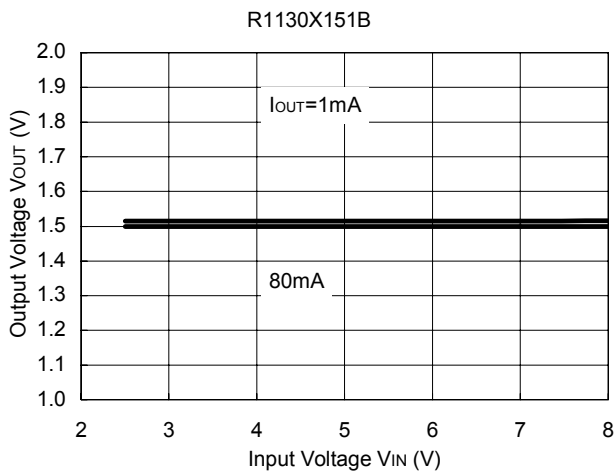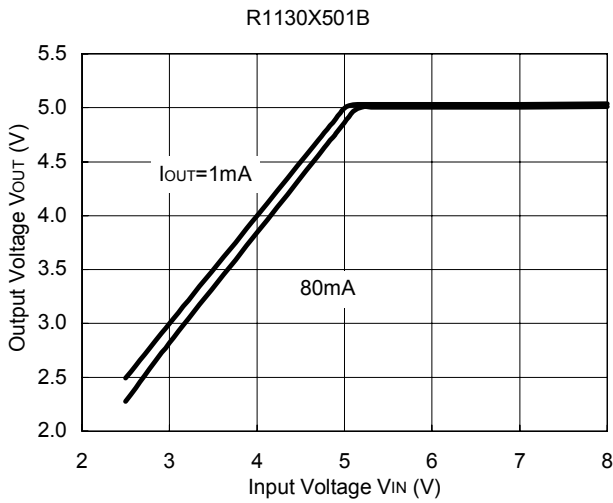
3) Dropout Voltage vs. Output Current

R1130X151B

R1130X331B

R1130X501B

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4) Output Voltage vs. Temperature

R1130X151B I_{OUT}=80mA

Output Voltage V_{OUT} (V) vs. Temperature Topt(°C)

R1130X331B I_{OUT}=80mA

Output Voltage V_{OUT} (V) vs. Temperature Topt(°C)
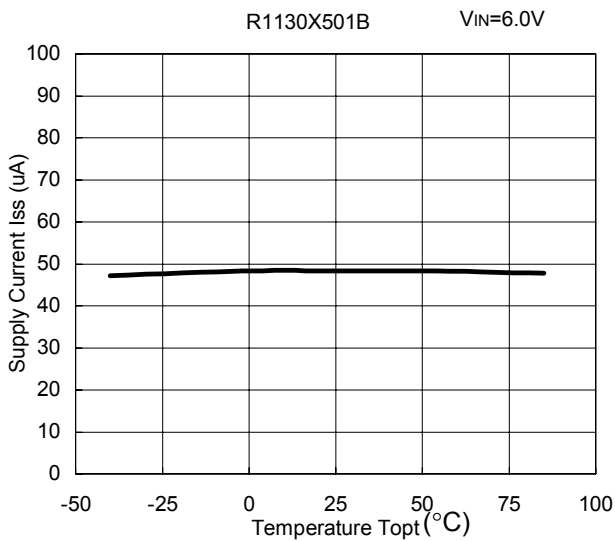
R1130X501B I_{OUT}=80mA

Output Voltage V_{OUT} (V) vs. Temperature Topt (°C)
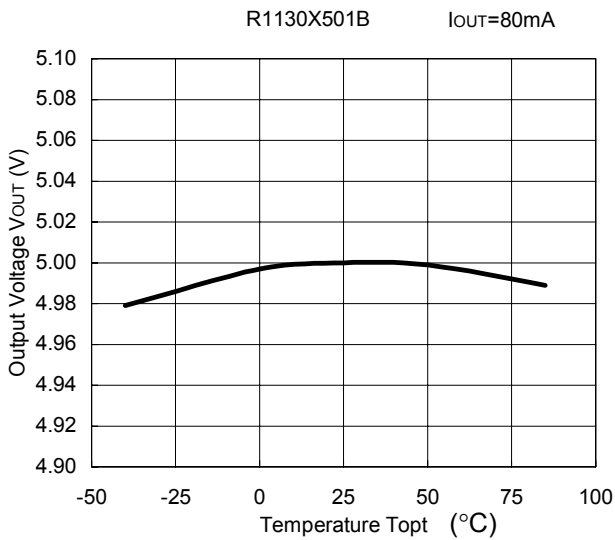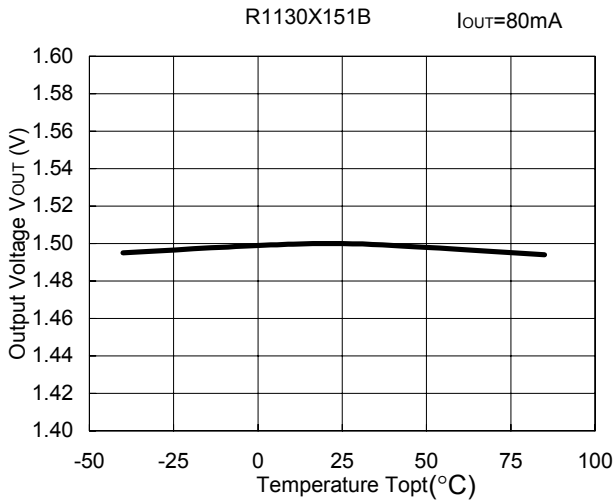
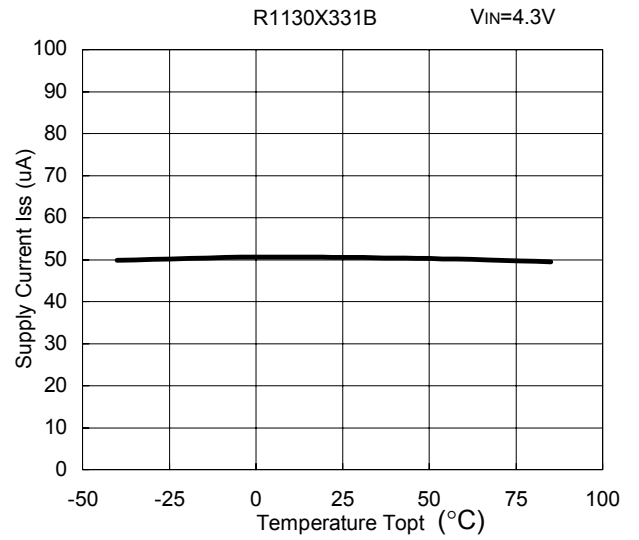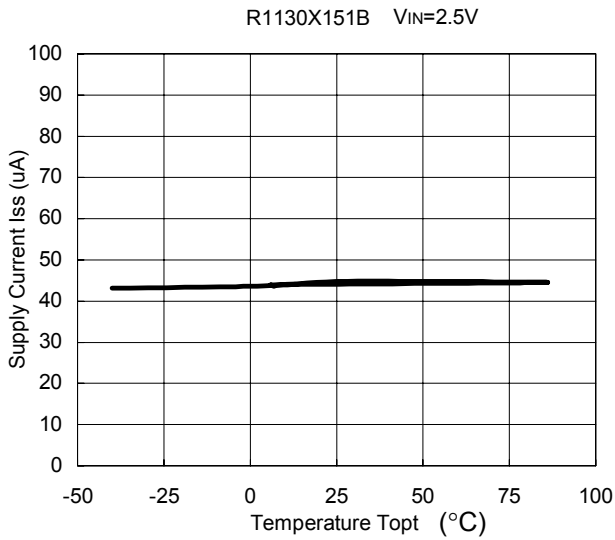## 5) Supply Current vs. Input Voltage(Topt=25°C)

R1130X151B

Supply Current Iss (uA) vs. Input Voltage V_{IN} (V)
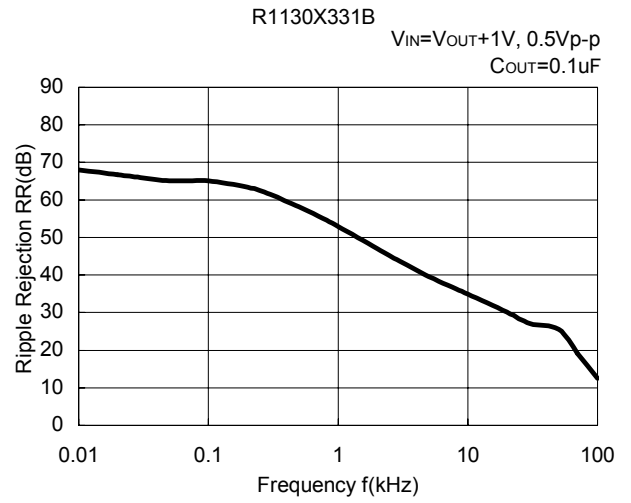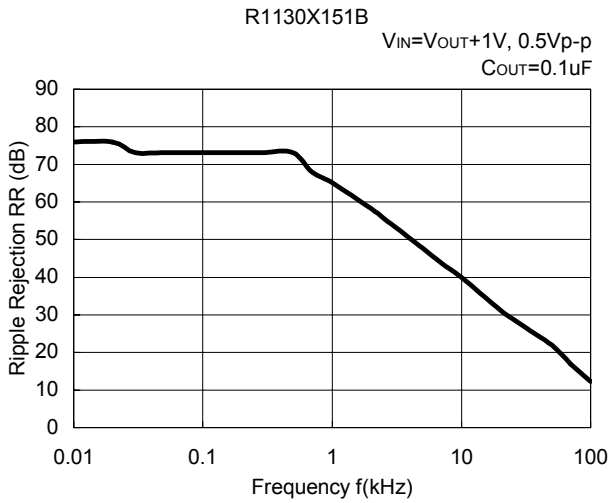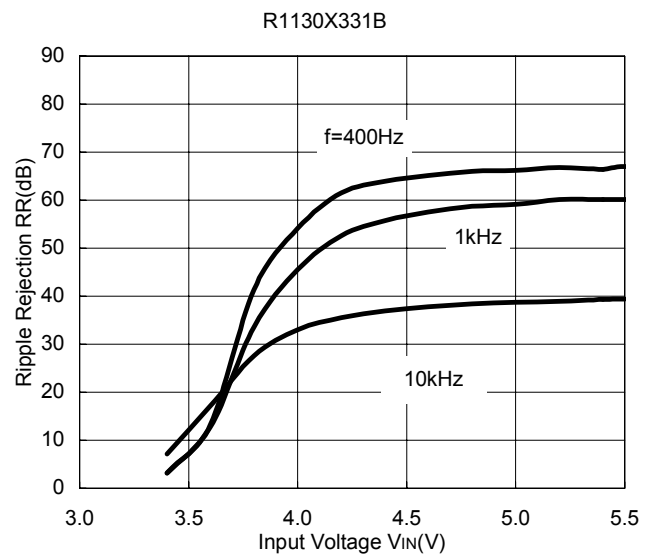
R1130X331B

Supply Current Iss (uA) vs. Input Voltage V_{IN} (V)

R1130X501B
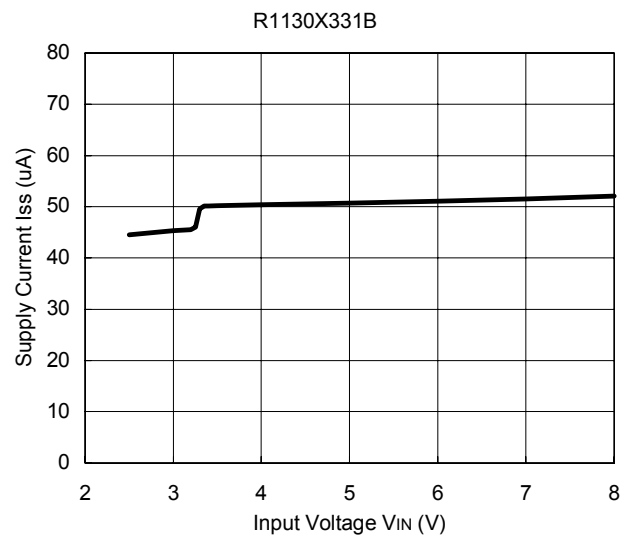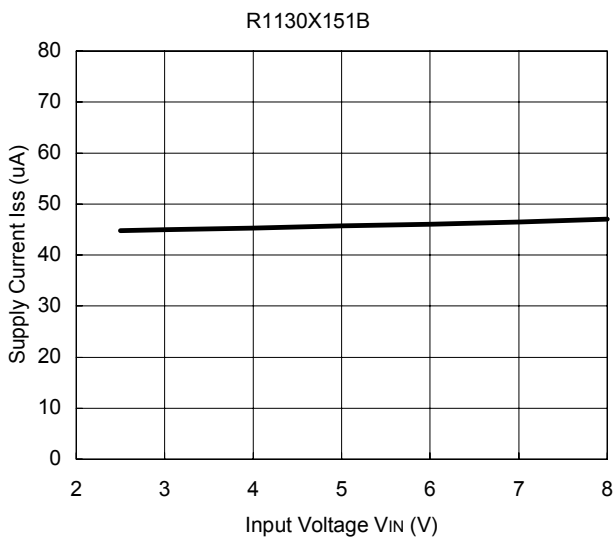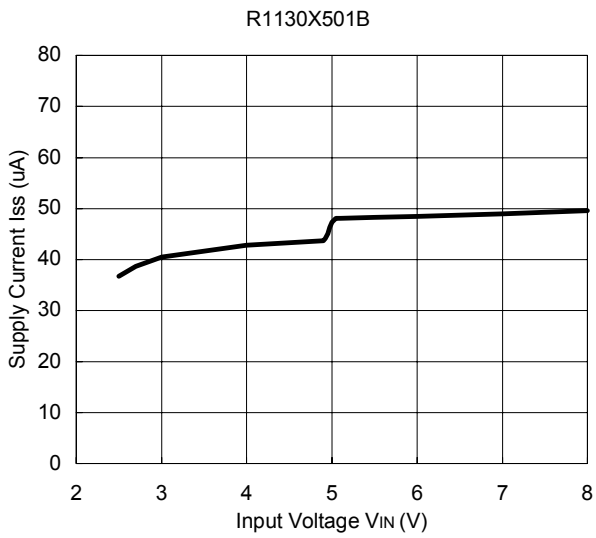
6) Supply Current vs. Temperature

R1130X151B VIN=2.5V

R1130X331B VIN=4.3V

R1130X501B VIN=6.0V

7) Ripple Rejection vs. Frequency

R1130X151B
$V_{IN}=V_{OUT}+1V$, 0.5Vp-p
$C_{OUT}=0.1uF$

R1130X331B
$V_{IN}=V_{OUT}+1V$, 0.5Vp-p
$C_{OUT}=0.1uF$

R1130X501B $V_{IN}=V_{OUT}+1V$, 0.5Vp-p
$C_{OUT}=0.1uF$
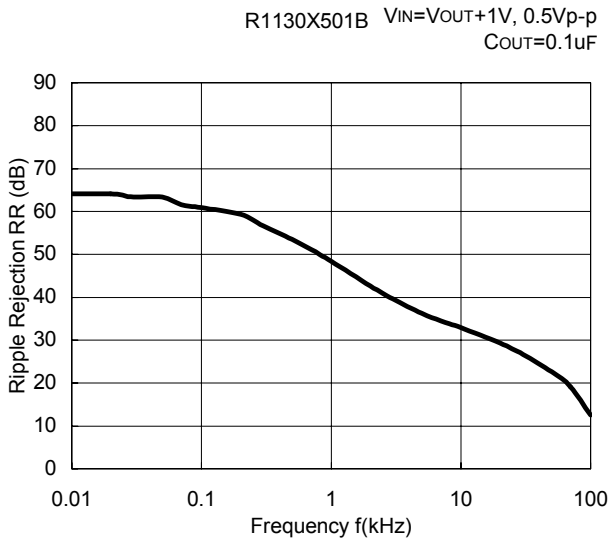
8) Ripple Rejection vs. Input Voltage

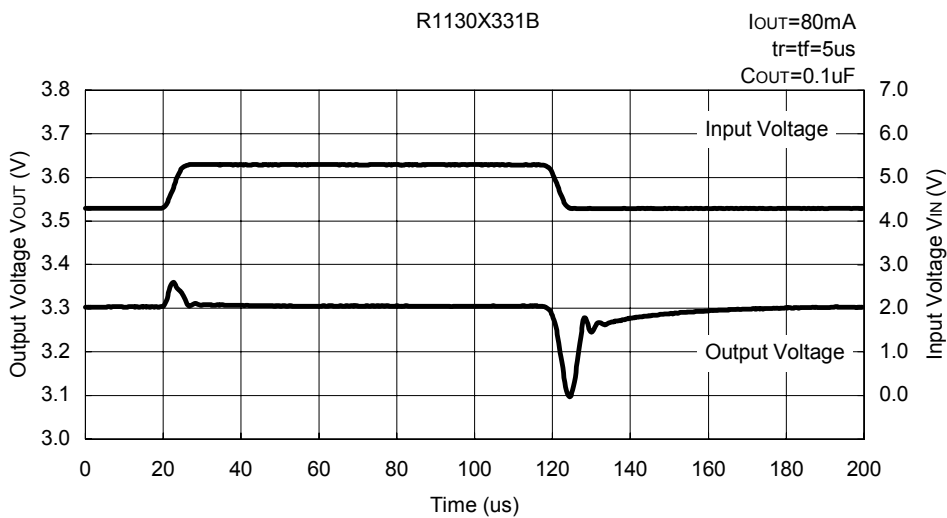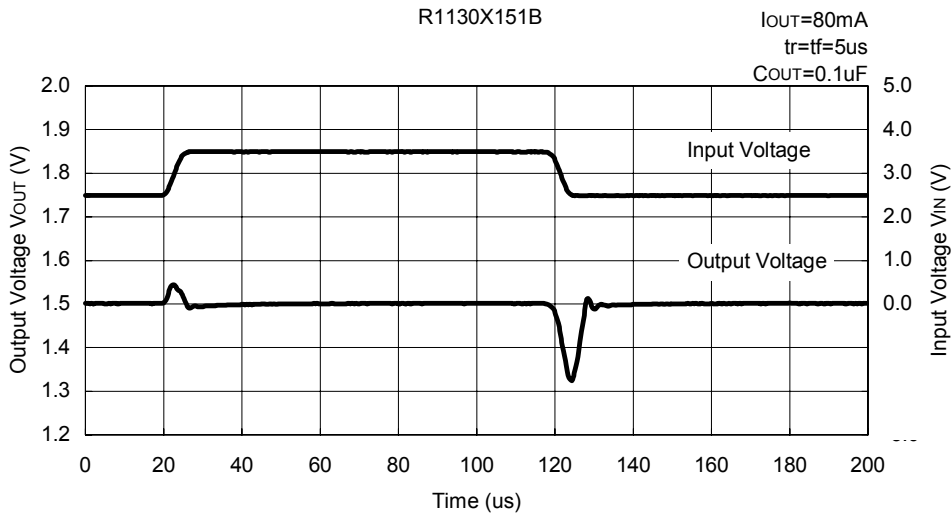R1130X151B

R1130X331B

R1130X501B

9) Input Transient Response

R1130X151B

I_{OUT}=80mA
tr=tf=5us
C_{OUT}=0.1uF

R1130X331B

I_{OUT}=80mA
tr=tf=5us
C_{OUT}=0.1uF

R1130X501B   I_OUT=80mA
                   tr=tf=5us
                   C_OUT=0.1uF

Input Voltage

Output Voltage

X-axis: Time (us), Left Y-axis: Output Voltage V_OUT (V), Right Y-axis: Input Voltage V_IN (V)

10) Load Transient Response

R1130X151B   V_IN=2.5V
                   C_IN=1.0uF
                   C_OUT=0.1uF

Output Current

Output Voltage

X-axis: Time (us), Left Y-axis: Output Voltage V_OUT (V), Right Y-axis: Output Current I_OUT (mA)

R1130X331B   V_IN=4.3V
                   C_IN=1.0uF
                   C_OUT=0.1uF

Output Current

Output Voltage

X-axis: Time (us), Left Y-axis: Output Voltage V_OUT (V), Right Y-axis: Output Current I_OUT (mA)

RICOH

R1130X501B V_{IN}=6.0V
C_{IN}=1.0uF
C_{OUT}=0.1uF
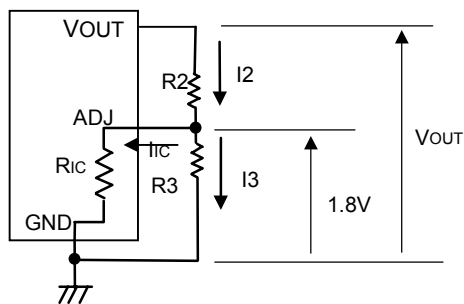

■ **APPENDIX**

* Technical Notes on Output Voltage Setting of C type

Figure 1. Adjustable Regulator (C type)

   The Output Voltage of Regulator in R1130XXXXC may be adjustable for any output voltage between its 1.8V reference and its V_{DD} setting level. An external pair of resistors is required, as shown in Figure 1.

The complete equation for the output voltage is described step by step as follows;

$I_2 = I_{IC} + I_3$ ••• (1)

$I_3 = 1.8/R_3$ ••• (2)

Thus,

$I_2 = I_{IC} + 1.8/R_3$ ••• (3)

Therefore,

$V_{OUT} = 1.8 + R_2 \times I_2$ ••• (4)

Put Equation (3) into Equation (4), then

$V_{OUT} = 1.8 + R_2 \times (I_{IC} + 2.0/R_3)$
$= 1.8 \times (1 + R_2/R_3) + R_2 \times I_{IC}$ ••• (5)

In 2nd term, or $R_2 \times I_{IC}$ will produce an error in V_{OUT}.

In Equation (5),

$I_{IC} = 1.8/R_{IC}$ ••• (6)

$R_2 \times I_{IC} = R_2 \times 2.0/R_{IC}$
$= 1.8 \times R_2/R_{IC}$ ••• (7)

For better accuracy, choosing R_2 (<<R_{IC}) reduces this error.

RICOH

* Adjustable Resister Dependence of Output Voltage

R1130X001C

R3=10kOhm, Topt=25°C

R1130X001C

R3=100kOhm, Topt=25°C