RICOH

3-MODE 300mA LDO REGULATOR

RP200x SERIES

NO. EA-182-080911

Preliminary

OUTLINE

The RP200x Series consist of CMOS-based voltage regulator ICs with high output voltage accuracy and low supply current. These ICs perform with the chip enable function and realize a standby mode with ultra low supply current. To prevent the destruction by over current, the current limit circuit is included. The RP200x Series have 3-mode. One is standby mode with CE or standby control pin. Other two modes are realized with FMODE pin™. Fast Transient Mode (FT mode) and Fast mode and Low Power auto-change Mode (Auto ECO mode) are alternative with Auto-Eco pin (AE pin). Consumption current of IC itself at light load is automatically reduced at Auto ECO Mode compared with Fast Transient Mode. The output voltage is maintained between FT mode and Auto ECO mode.

Without FMODE pin type is also available. It is an LDO regulator with Auto ECO mode. (RP200Z in WLCSP.)

Since the packages for these ICs are SOT23-5, SC-88A, thin DFN(PLP)1212-6, and WLCSP-4-P5 packages, high density mounting of the ICs on boards is possible. RP200Q(SC-88A), RP200K (DFN(PLP)1212-6) and RP200N (SOT23-5) has Auto ECO pin (AE pin), then if the AE pin is "H", fast mode is available. If the AE pin is set at "L" level, auto ECO mode operation is available.

FEATURES

Ultra-Low Supply Current..... Typ. 1.0μA (Iout=0mA, V_{OUT}≤1.85V at Auto ECO mode),
..... Typ. 55μA (Iout=10mA at Auto ECO mode)
Low Dropout Voltage..... Typ. 0.23V (I_{OUT}=300mA Output Voltage=3.0V Type)
High Ripple Rejection ..... Typ. 70dB (f=1kHz, Fast Mode)
Excellent Line Regulation ..... Typ. 0.02%/V (I_{OUT}=10mA)
High Output Voltage Accuracy ..... ±1%
Small Package ..... DFN(PLP)1212-6, WLCSP-4-P5, SC-88A, SOT23-5
Output Voltage Range..... Stepwise setting with a step of 0.1V
in the range of 0.8V to 4.0V is possible
Input Voltage Range 1.40V to 5.25V
Built-in fold-back protection circuit ..... Typ. 50mA (Current at short mode)
Performs with Ceramic Capacitors ..... C_{IN}=1.0μF,C_{OUT}=Ceramic 1.0μF

APPLICATIONS

Power source for electrical appliances such as cameras, VCRs and hand-held communication equipment
Power source for battery-powered equipment

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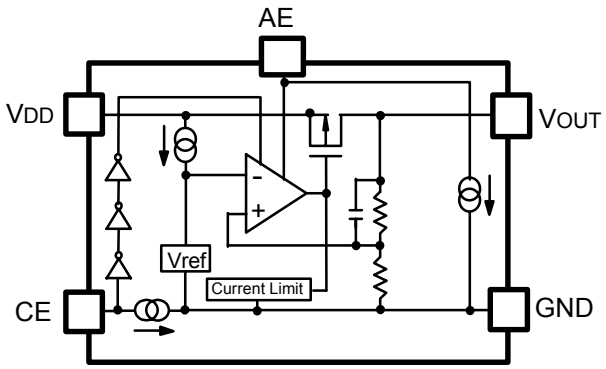
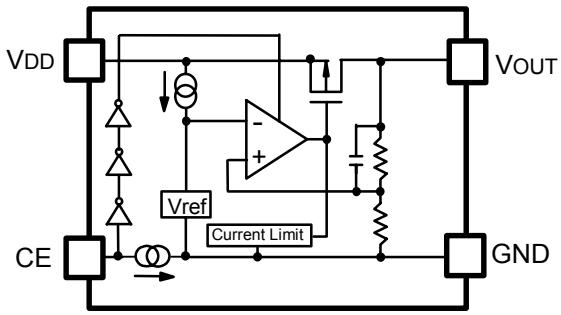
BLOCK DIAGRAM

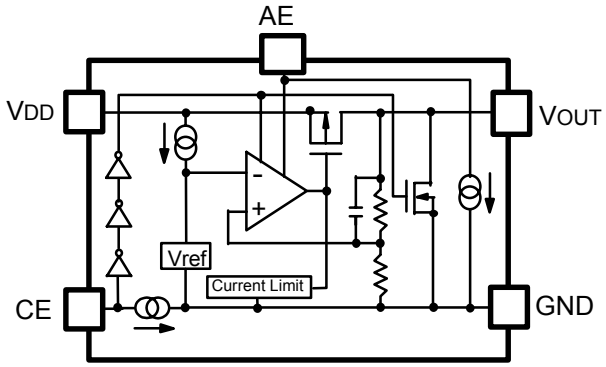
RP200K/N/Qxx1B



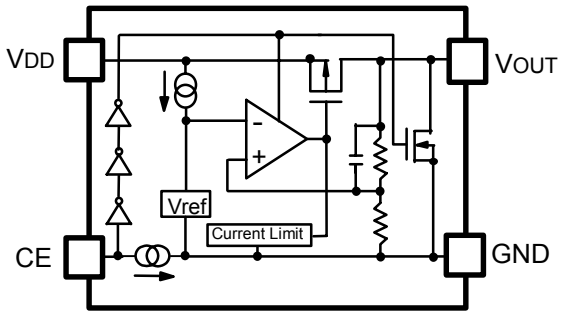
RP200Zxx1B



RP200K/N/Qxx1D



RP200Zxx1D



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SELECTION GUIDE

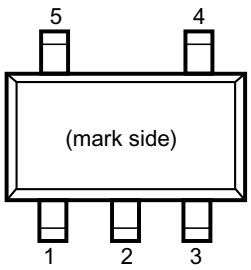
The output voltage, the auto-discharge function, the package and the taping type for the ICs can be selected at the user's request. The selection can be available by designating the part number as shown below;

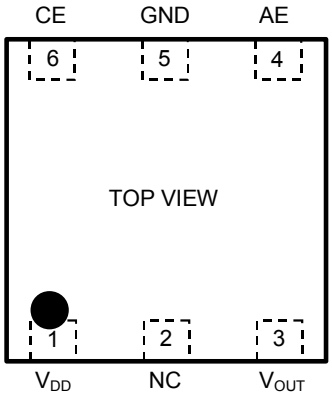
RP200xxxxx-xx ←Part Number
↑ ↑ ↑↑ ↑
a b a' c d

Code	Contents
a, a'	Designation of Package Type: a=N, a'=1: SOT-23-5 a=Z, a'=1: WLCSP-4-P5 a=K, a'=1: DFN(PLP)1212-6 a=Q, a'=2: SC-88A
b	Setting Output Voltage (V_{OUT}): Stepwise setting with a step of 0.1V in the range of 0.8V to 4.0V is possible. New options: 2.85V type: RP200x281x5-xx, 1.85V type: RP200x181x5-xx.
c	Designation of Chip Enable Options: D: "H" active and with auto-discharge function.
d	Designation of Taping Type: Refer to Taping Specifications: TR type is the standard direction.

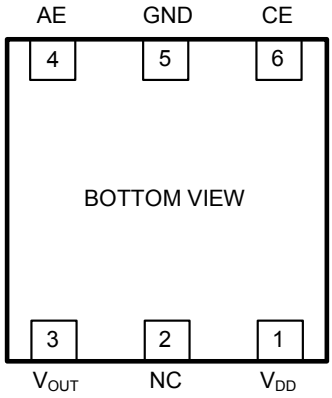
PIN CONFIGURATIONS

- **SOT-23-5**





- **DFN(PLP)1212-6**



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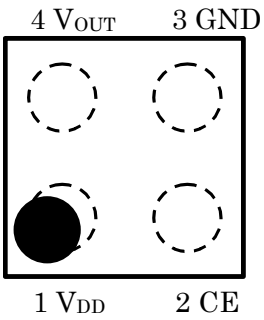
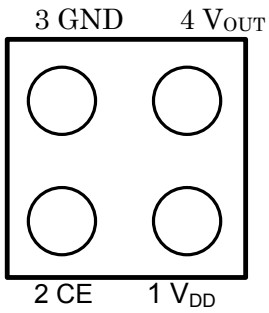
WLCSP-4-P5

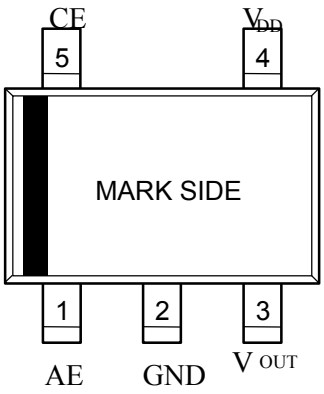


Silicon side



Bump side

SC-88A



PIN DESCRIPTIONS

- **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" active)
4	AE	Auto ECO pin ("L" active)
5	V_{OUT}	Output pin

- **DFN(PLP)1212-6**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	NC	No Connection
3	V_{OUT}	Output pin
4	CE	Chip Enable Pin
5	GND	Ground Pin
6	AE	Auto ECO pin

WLCSP-4-P5

Pin No.	Symbol	Pin Description
1	V_{DD}	Input Pin
2	CE	Chip Enable pin
3	GND	Ground pin
4	V_{OUT}	Output pin

SC-88A

Pin No.	Symbol	Pin Description
1	AE	Auto ECO pin
2	GND	Ground pin
3	V_{OUT}	Output pin
4	V_{DD}	Input Pin
5	V_{OUT}	Output pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{ECO}	Input Voltage (ECO Pin)	−0.3 ~ 6.0	V
V_{CE}	Input Voltage (CE Pin)	−0.3 ~ 6.0	V
V_{OUT}	Output Voltage	−0.3 ~ V_{IN}+0.3	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation	420(SOT23-5) T.B.D. (PLP(DFN)1212-6) T.B.D. (WLCSP-4-P5) T.B.D (SC-88A	mW
Topt	Operating Temperature Range	−40 ~ 85	°C
Tstg	Storage Temperature Range	−55 ~ 125	°C

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ELECTRICAL CHARACTERISTICS

RP200xxx1D

Unless otherwise noted, VIN =Set VOUT+1V, IOUT=1mA, CIN=COUT=1uF,

values indicate -40°C ≦ Ta ≦ 85°C, unless otherwise noted. Ta=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	I_{OUT}=5mA(Fast Mode)	Set Vout>2.0V	×0.99		×1.01	V
			Set Vout≦2.0V	-20mV		+20mV	
		IOUT=5mA(Fast Mode)	Set Vout>2.0V	**x 0.975**		**x 1.015**	
			Set Vout≦2.0V	**-50mV**		**30mV**	
ΔV_{OUT}	Output Voltage Deviation between Fast Mode and Auto ECO Mode	1mA(Auto ECO, Low Power Mode)≦ I_{OUT} ≦5mA (Fast Mode)				0.5	%
I_{OUT}	Output Current			**300**			mA
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	1mA≦I_{OUT} ≦10mA	Set Vout>2.0V	-1.0		1.0	%
			Set Vout≦2.0V	-20		20	mV
		10mA≦I_{OUT} ≦300mA			35	**80**	**mV**
V_{DIF}	Dropout Voltage	Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE					
I_{SS1}	Supply Current (IOUT=0mA)*Note1	Set V_{OUT} ≦ 1.85V			1.0	**4.0**	µA
		Set V_{OUT} > 1.85V			1.5	**4.0**	
I_{SS2}	Supply Current (IOUT=10mA)	Fast mode (both w, w/o Auto ECO)			55		µA
Istandby	Supply Current (Standby)	V_{CE} = GND			0.1	1.0	µA
IOUTH	Fast Mode switch-over current	IOUT=Light load to Heavy load				**8.0**	mA
IOUTL	Low Power Mode switch-over current	IOUT=Heavy load to Light load		**1.0**	2.0		mA
ΔV_{OUT}/ ΔV_{IN}	Line Regulation	Set V_{OUT}+0.5V ≦ V_{IN} ≦ 5.0V, (Low Power Mode) I_{OUT} = 1mA, V_{IN} >1.4V		**-0.05**		**0.05**	%/V
		Set V_{OUT} + 0.5V ≦ V_{IN} ≦ 5.0V, (Fast Mode), I_{OUT} = 30mA, V_{IN} > 1.4V		**-0.2**	±0.02	**0.20**	
RR	Ripple Rejection (Fast Mode)	f = 1kHz, Ripple 0.2Vp-p, I_{OUT} = 30mA If V_{OUT} ≦ 1.2V, then V_{IN} = 2.2V			70		dB
V_{IN}	Input Voltage			**1.40**		**5.25**	V
ΔV_{OUT}/ ΔT	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±50		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V			50		mA
I_{CEPD}	CE Pull-down Constant Current				0.1		µA
V_{CEH}	CE Input Voltage “H”			**1.0**			V
V_{CEL}	CE Input Voltage “L”					**0.4**	V
I_{AEPD}	AE pull-down constant current	(Only applied to RP200K/N/Q)			0.1		µA
V_{AEH}	AE Input Voltage “H”	(Only applied to RP200K/N/Q)		**1.0**			V
V_{AEL}	AE Input Voltage “L”	(Only applied to RP200K/N/Q)				**0.4**	V
R_{LOW}	Nch Tr. On Resistance for auto-discharge function	V_{CE}=0V VIN=4.0V			50		Ω

Note 1) Except for the pull-down current for AE pin and CE pin, All limits except for the ripple rejection and output voltage temperature coefficient are tested under the pulse load (Ta=Tj=25°C).

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ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

Output Voltage V_{OUT} (V)	Dropout Voltage (V)		
	Condition	Typ.	Max.
0.8 ≦ V_{OUT} < 0.9	I_{OUT} = 300mA	0.62	**0.85**
0.9 ≦ V_{OUT} < 1.0		0.55	**0.78**
1.0 ≦ V_{OUT} < 1.5		0.48	**0.70**
1.5 ≦ V_{OUT} < 2.6		0.34	**0.50**
2.6 ≦ V_{OUT}		0.23	**0.35**

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, be sure to use a 1.0µF or more ceramic capacitor as C_{OUT}.

(Test these ICs with as same external components as ones to be used on the PCB.)

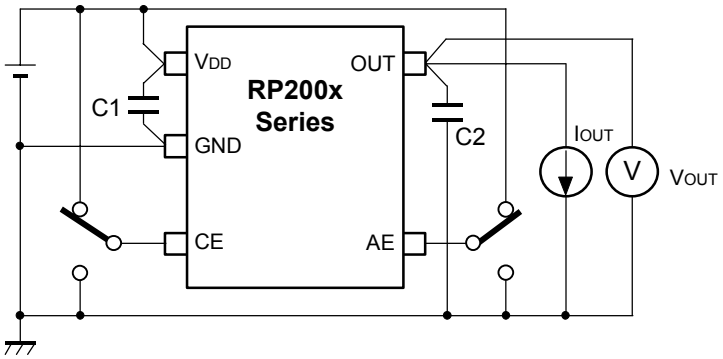
When a tantalum capacitor is used with this IC, if the equivalent series resistor (ESR) of the capacitor is large, output voltage may be unstable. Fully evaluation is necessary.

PCB Layout

Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with as much as 1.0µF capacitor between V_{DD} and GND pin as close as possible.

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

TYPICAL APPLICATION



∗External Components Ex.: C1: Ceramic Capacitor 1.0µF

C2: Ceramic Capacitor 1.0µF (Murata GRM155B31A105KE15)

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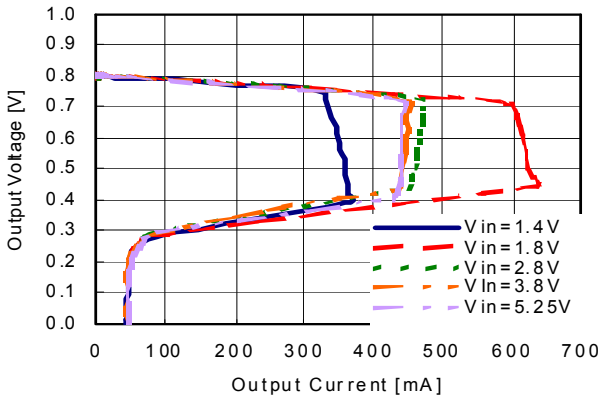
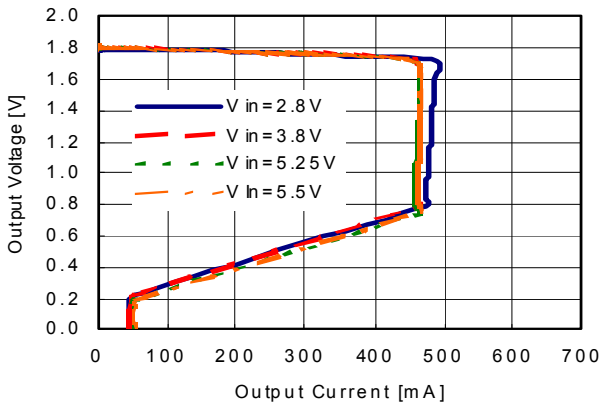
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

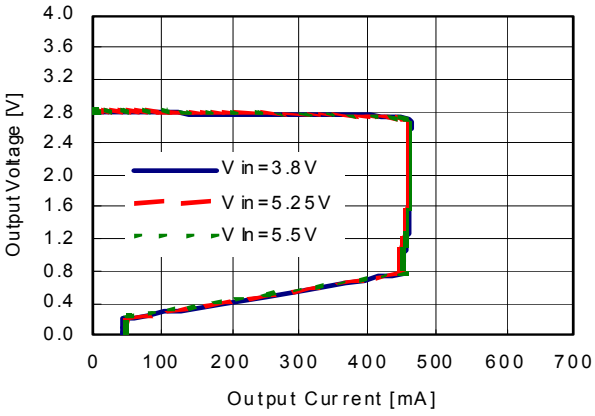
RP200x08xx



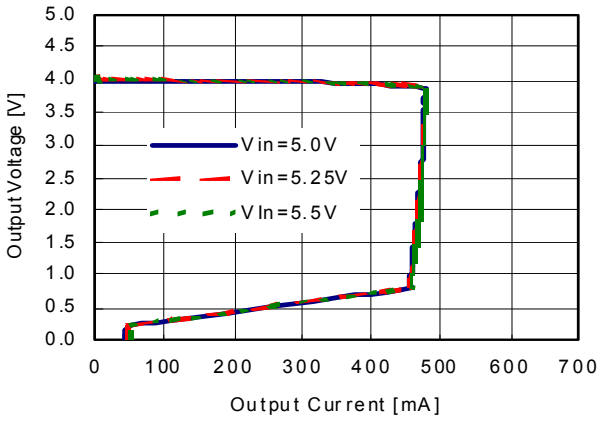
RP200x18xx



RP200x28xx

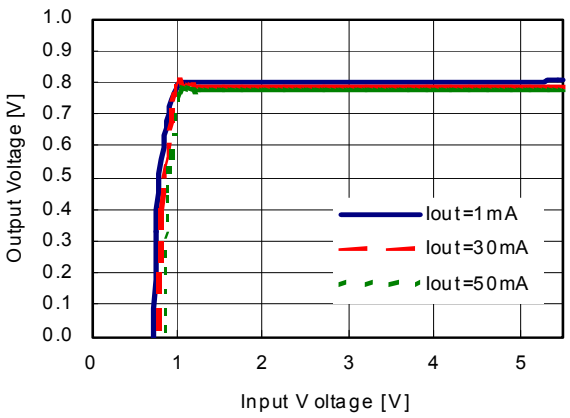


RP200x40xx



2) Output Voltage vs. Input Voltage

RP200x08xx



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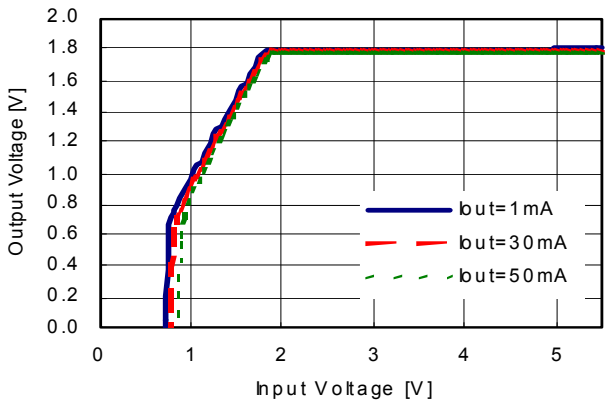

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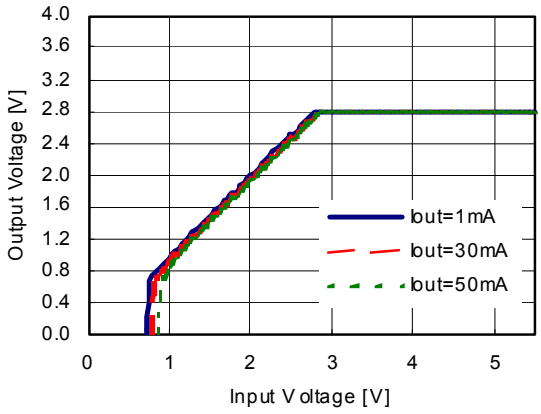

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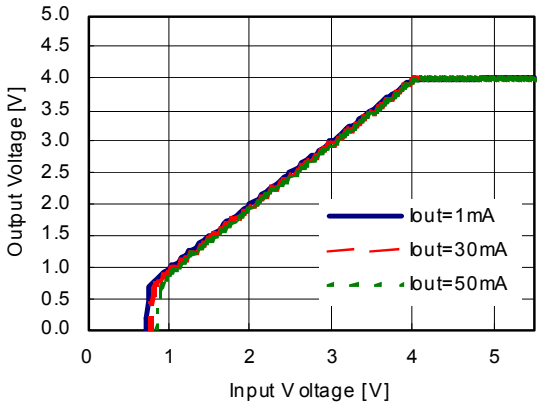
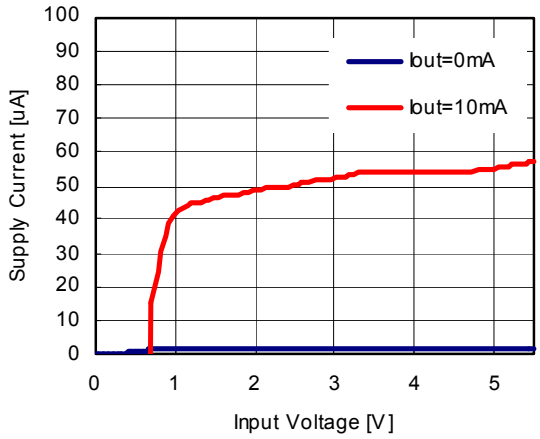


3) Supply Current vs. Input Voltage

RP200x08xx



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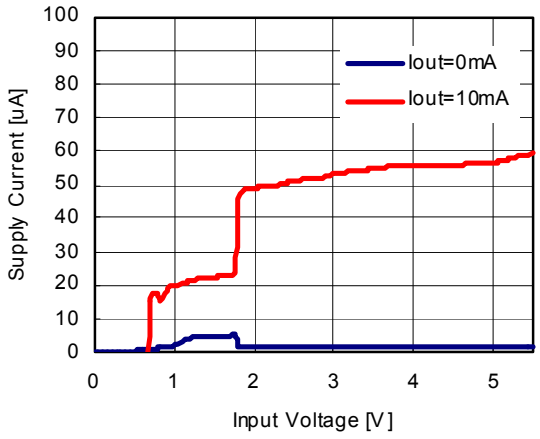

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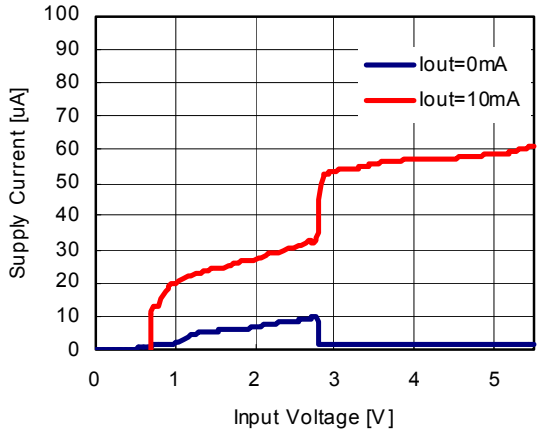

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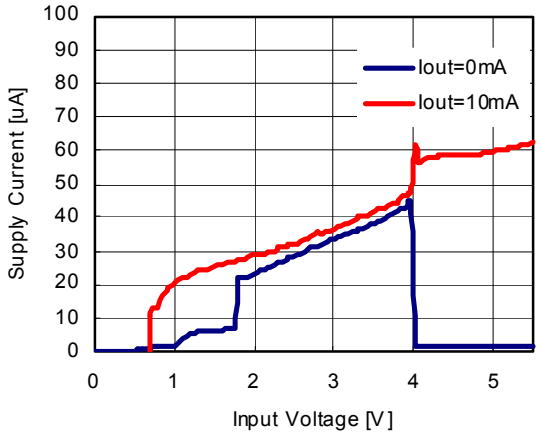

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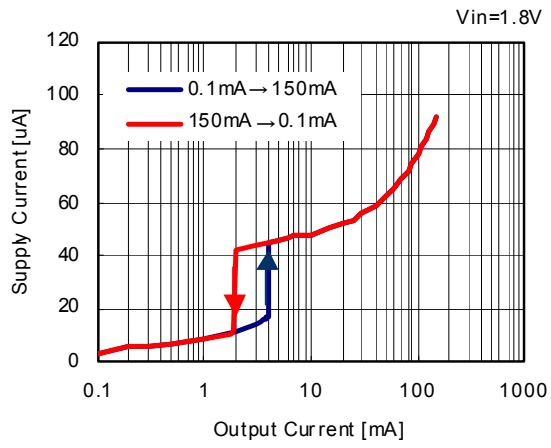
4) Supply Current vs. Output Current

RP200x08xx



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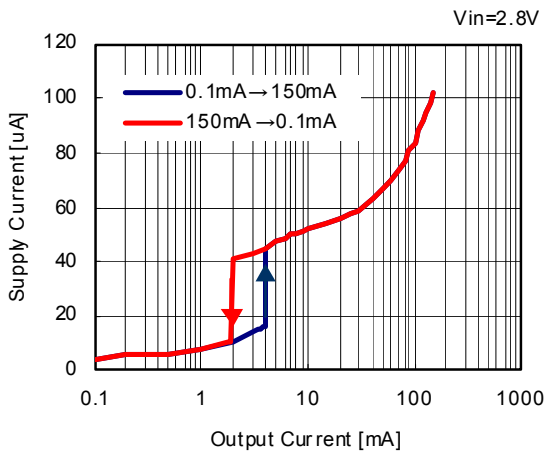

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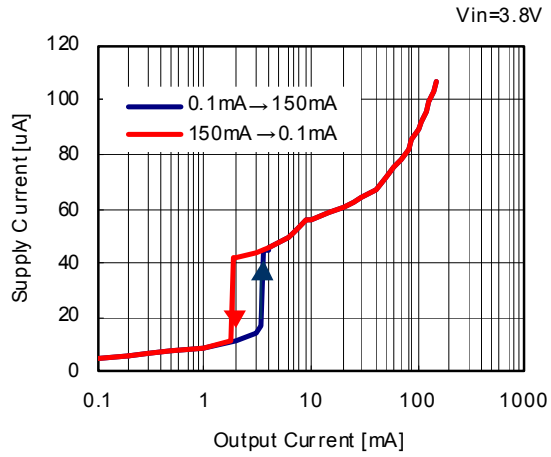

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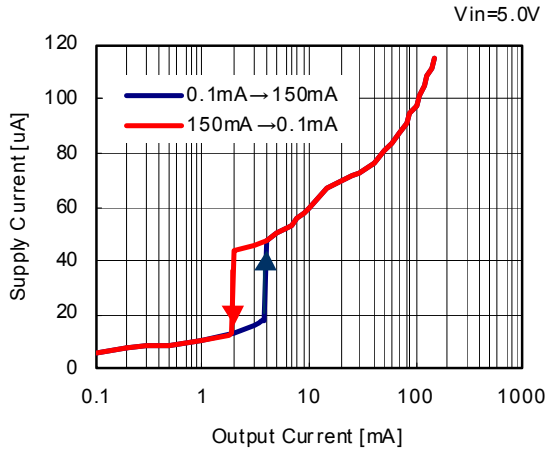
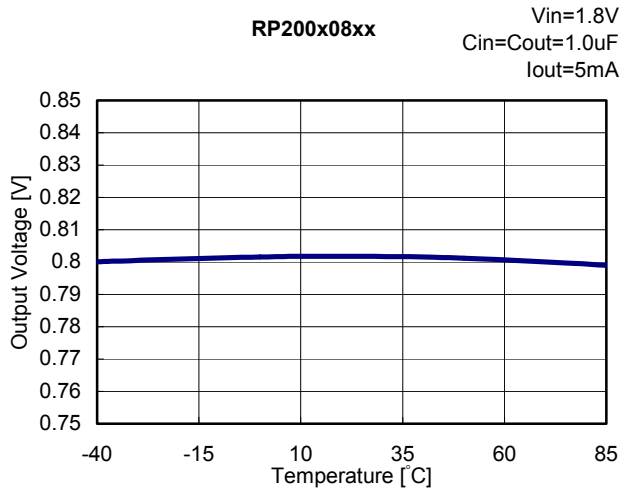
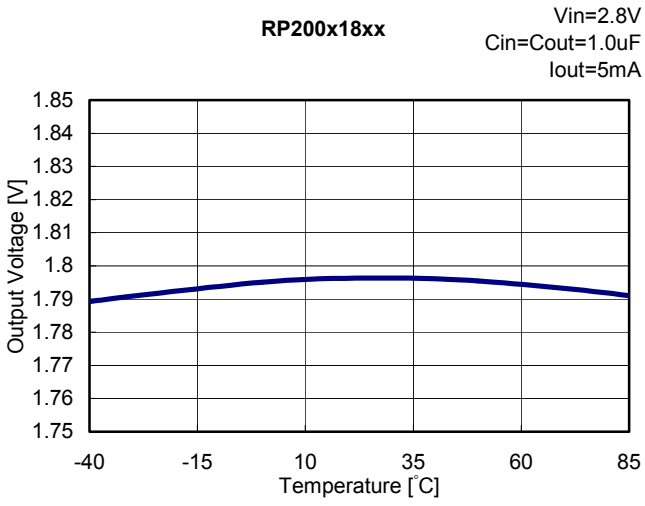


5) Output Voltage vs. Temperature

RP200x08xx



RP200x18xx



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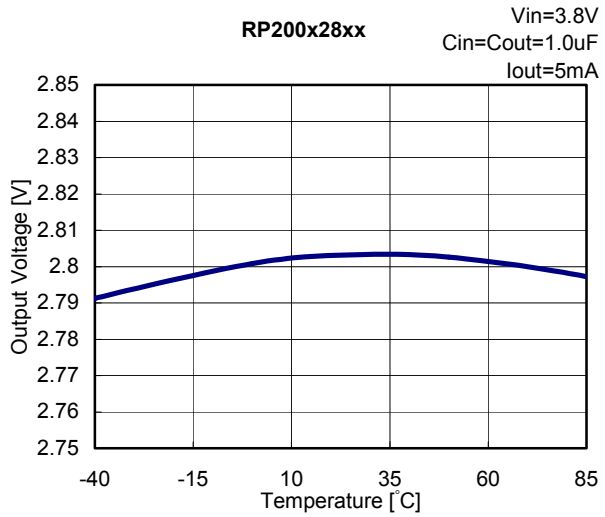
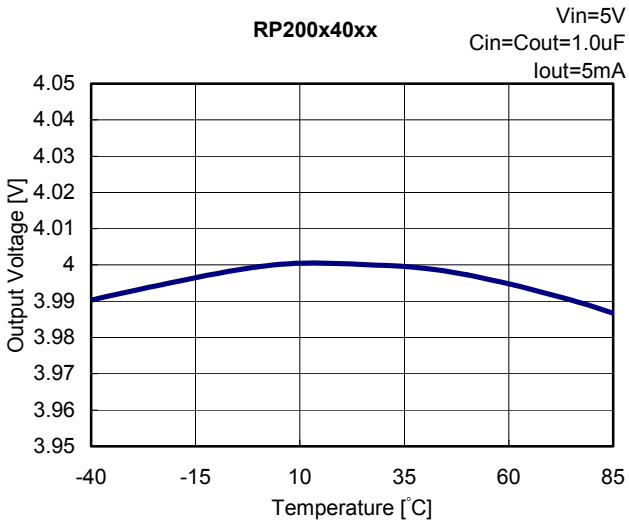
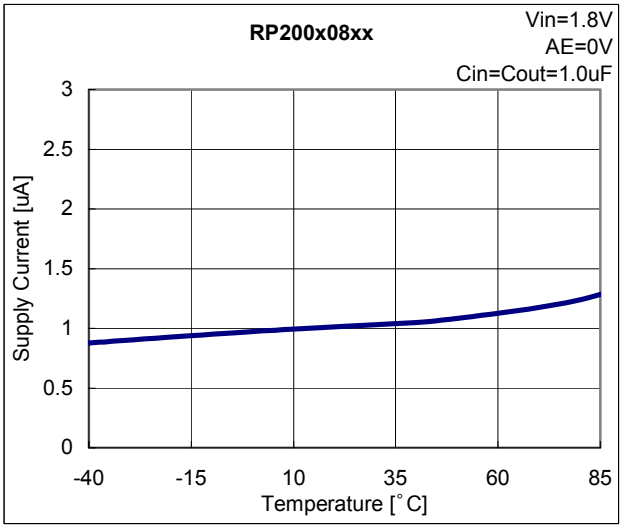
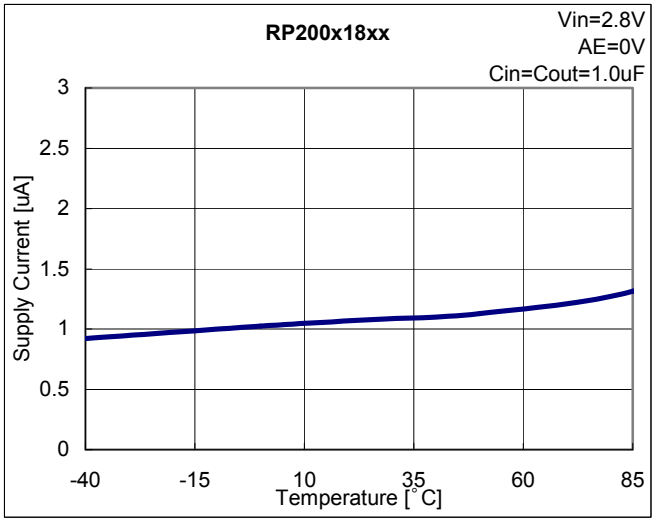
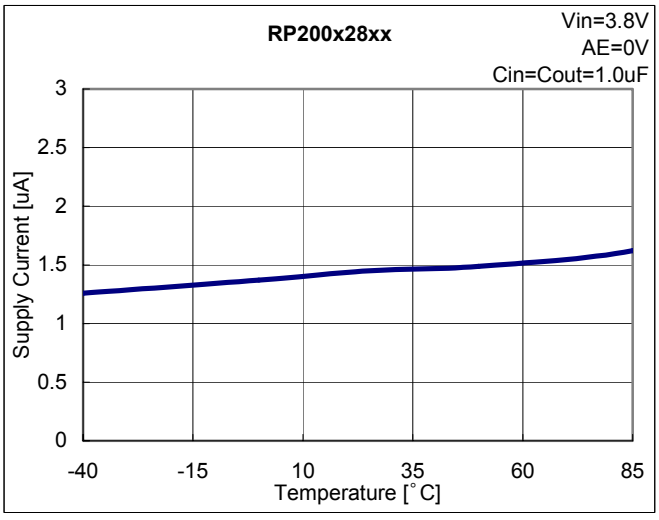


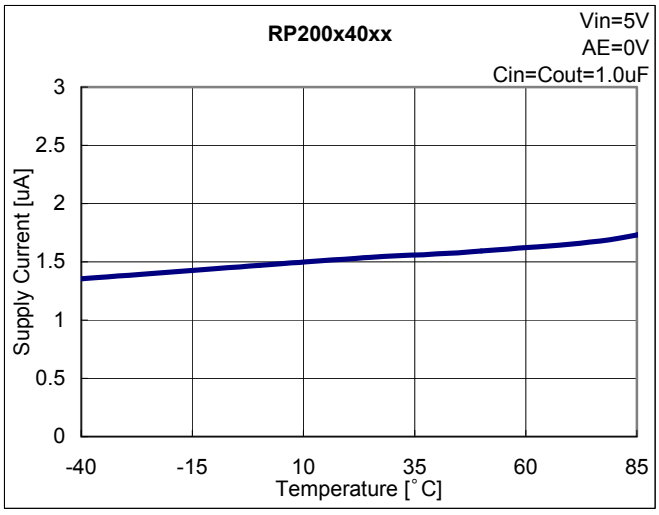


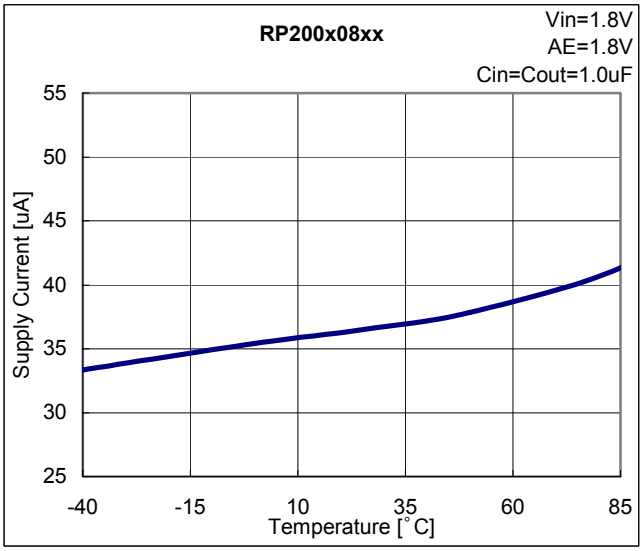
6) Supply Current vs. Temperature

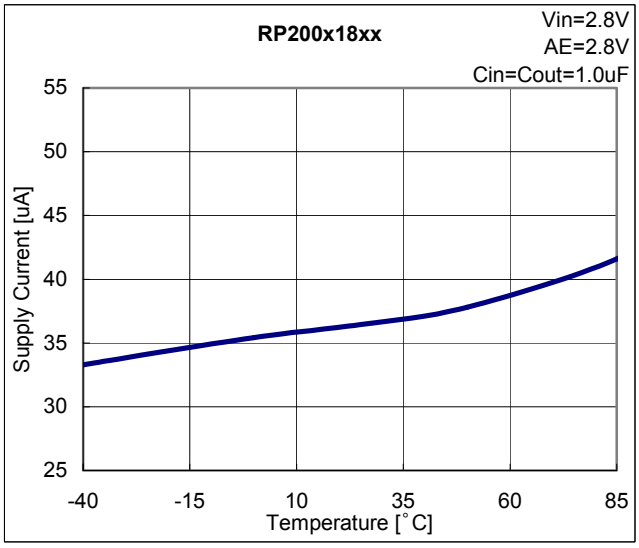


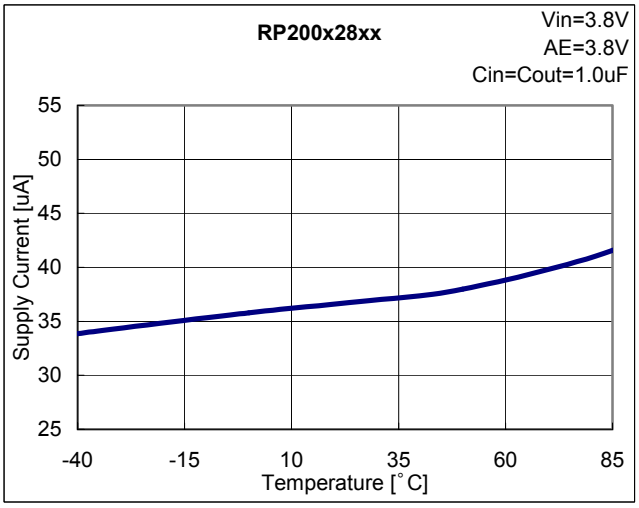


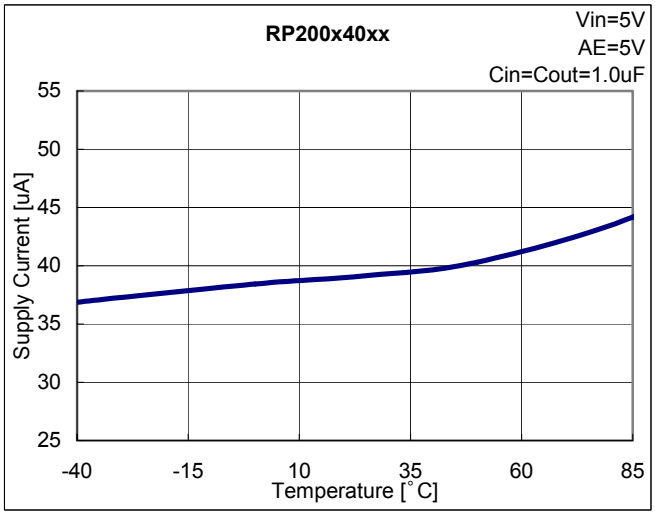




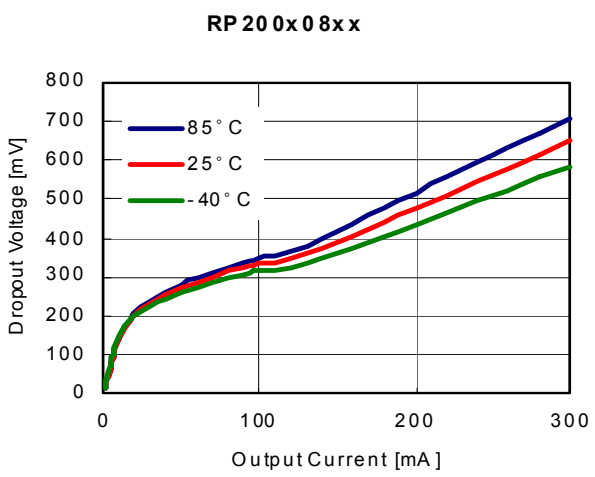


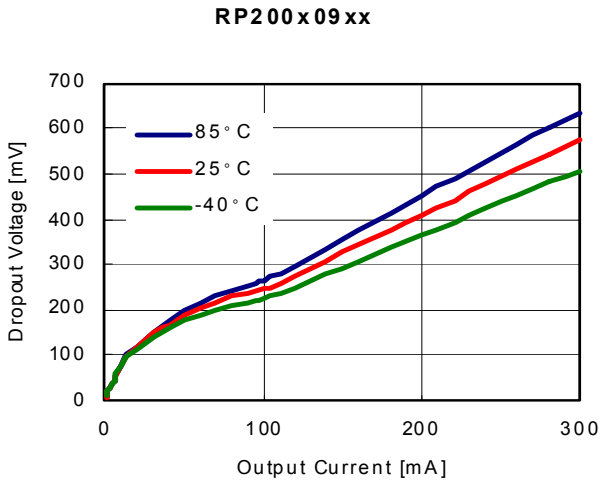




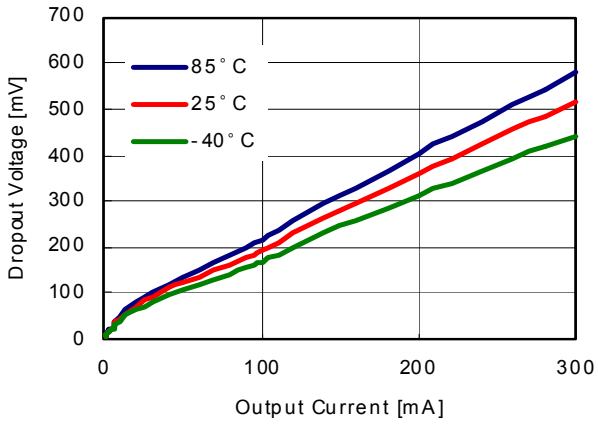


7) Dropout Voltage vs. Output Current

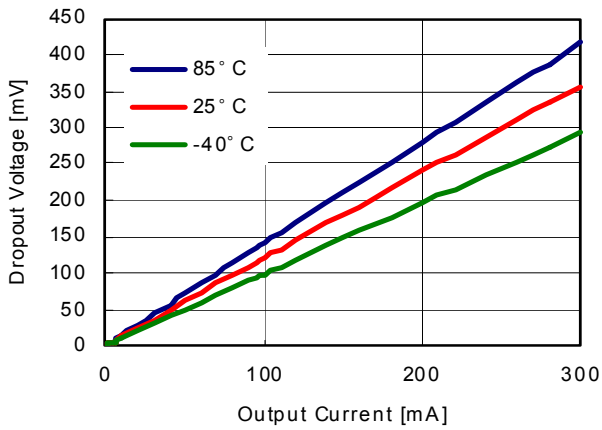




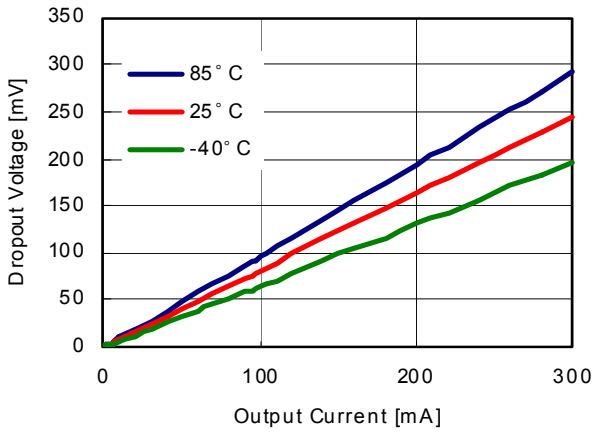
RP200x10xx



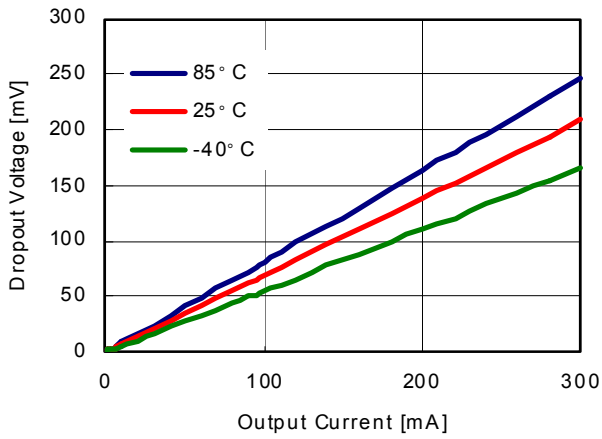
RP200x15xx



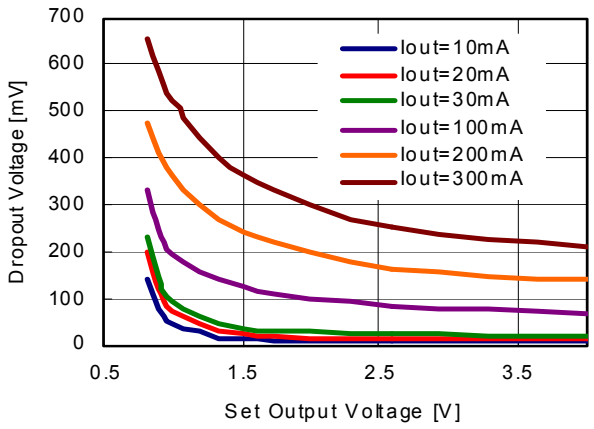
RP200x26xx



RP200x40xx



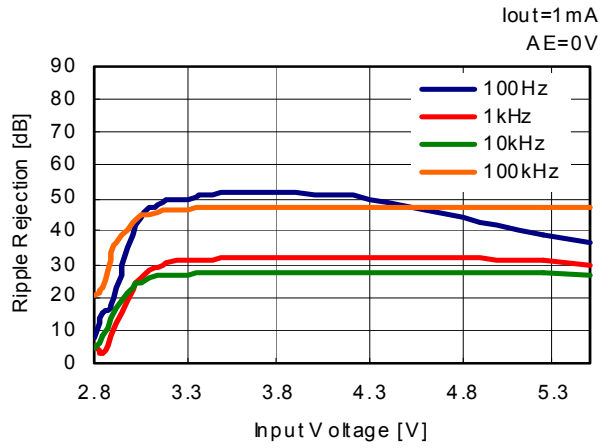
8) Dropout Voltage vs. Set Output Voltage



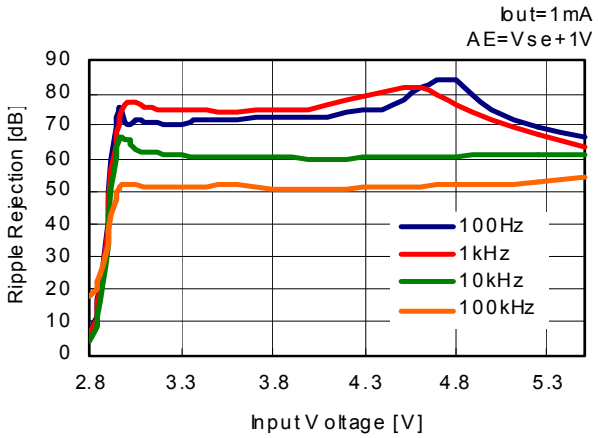
Preliminary

9) Ripple Rejection vs. Input Bias Voltage

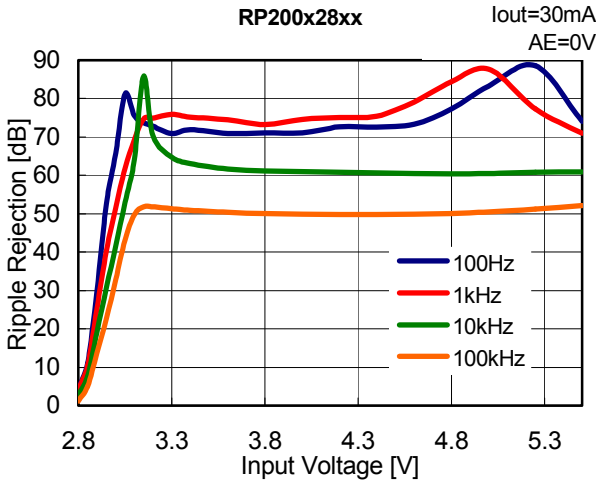
RP200x28xx



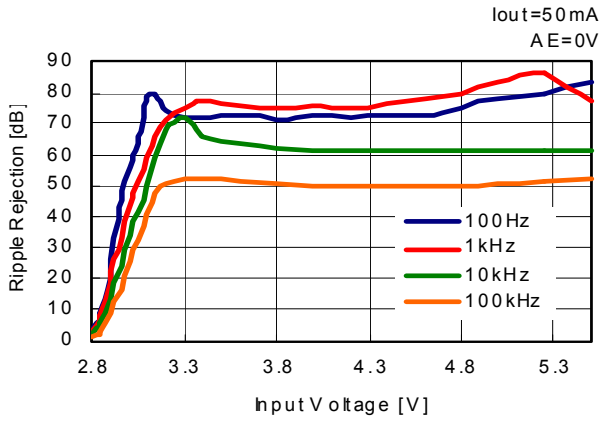
RP200x28xx



RP200x28xx

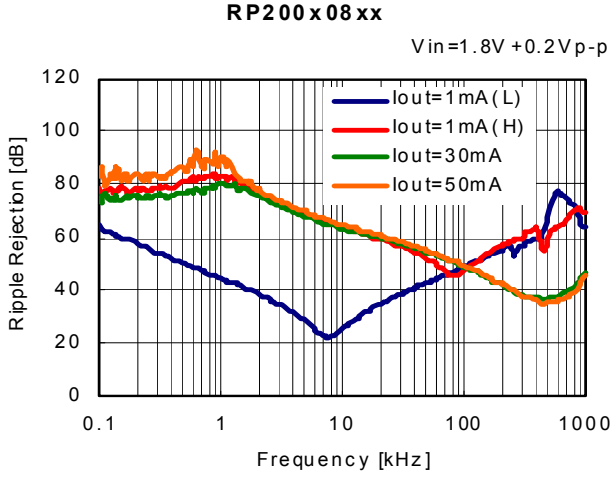


RP200x28xx

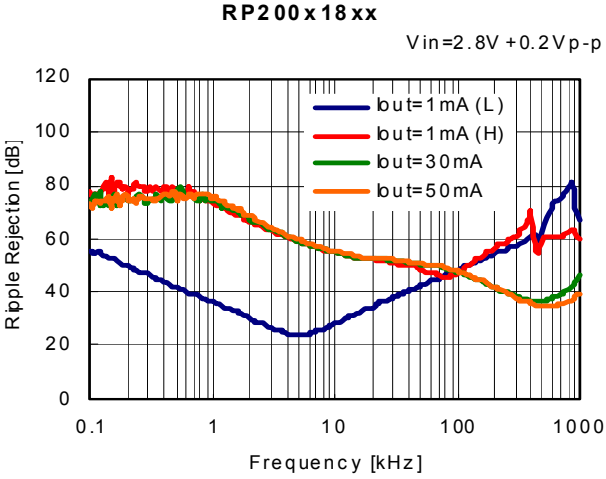


10) Ripple Rejection vs. Frequency (C_{IN}=none)

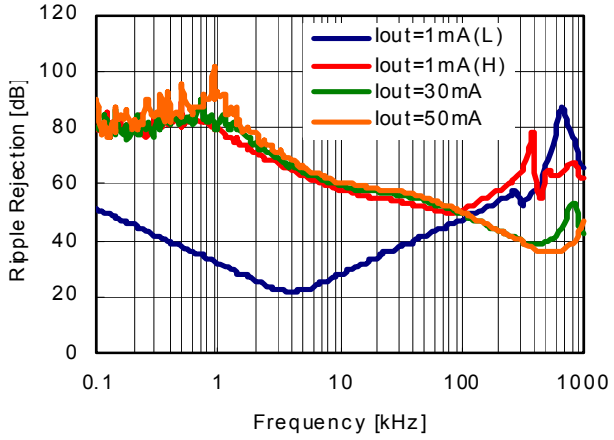
RP200x08xx



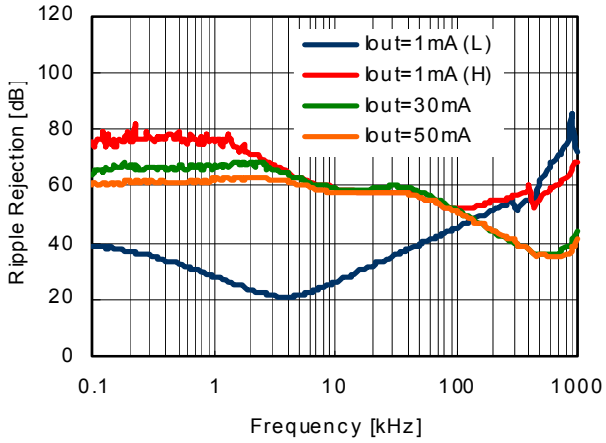
RP200x18xx



RP200x28xx

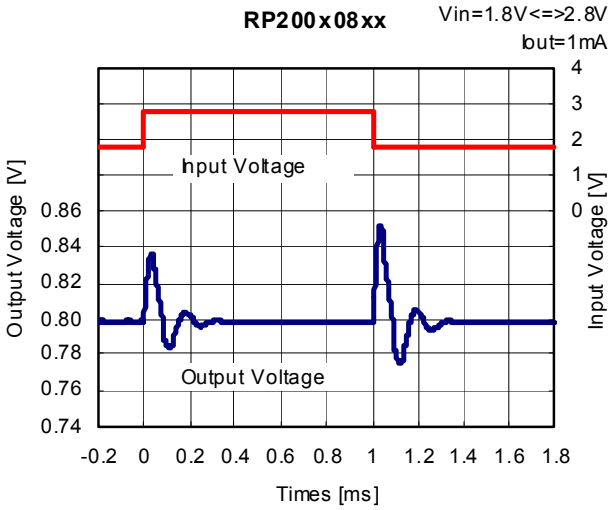


RP200x40xx

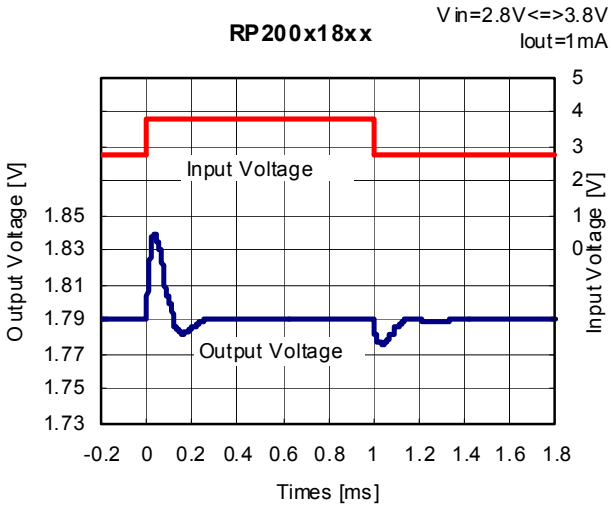


11) Input Transient Response

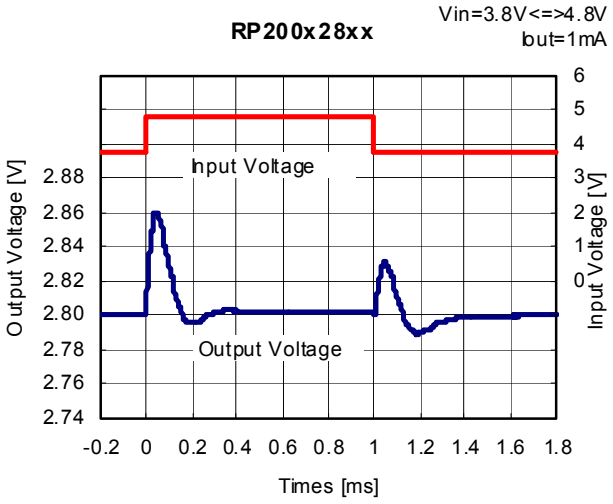
RP200x08xx



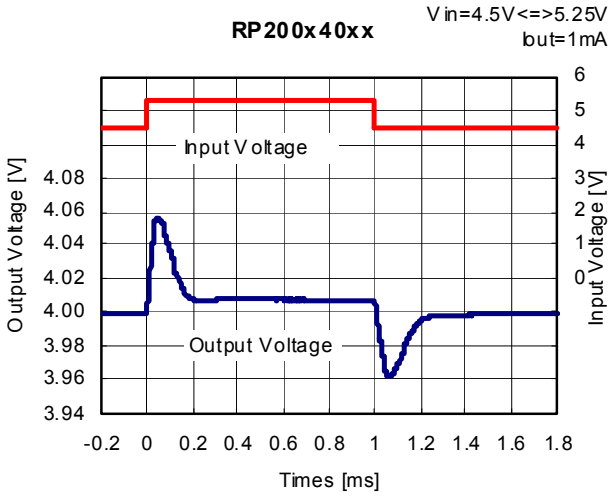
RP200x18xx



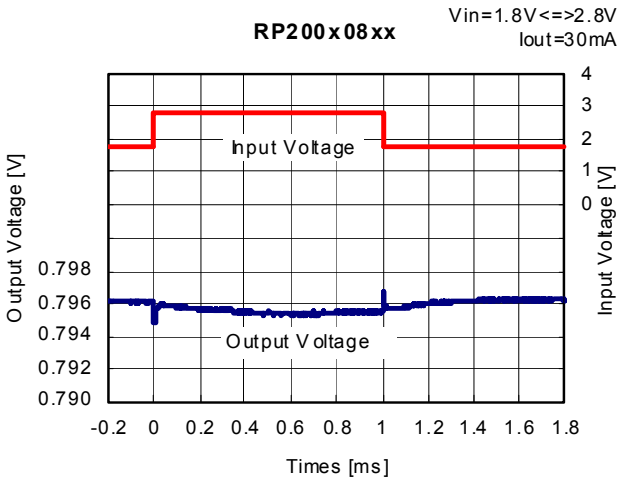
RP200x28xx

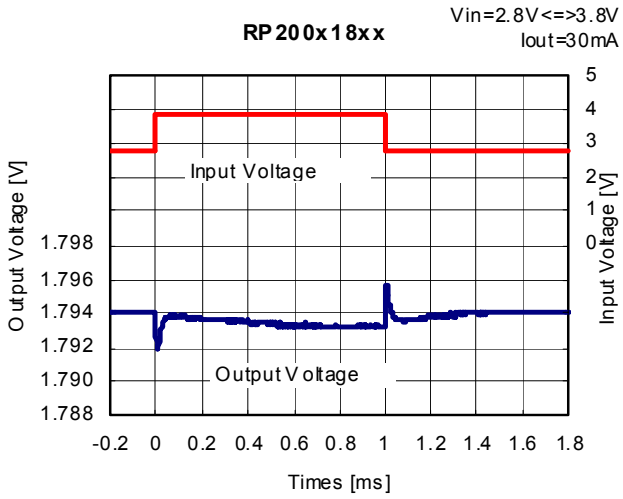


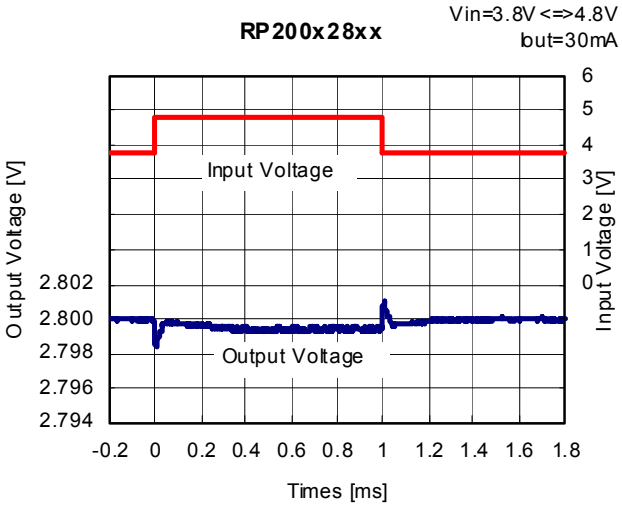
RP200x40xx

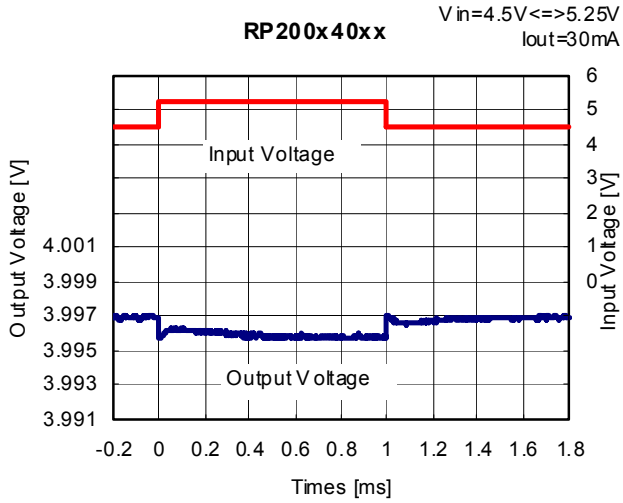


Preliminary

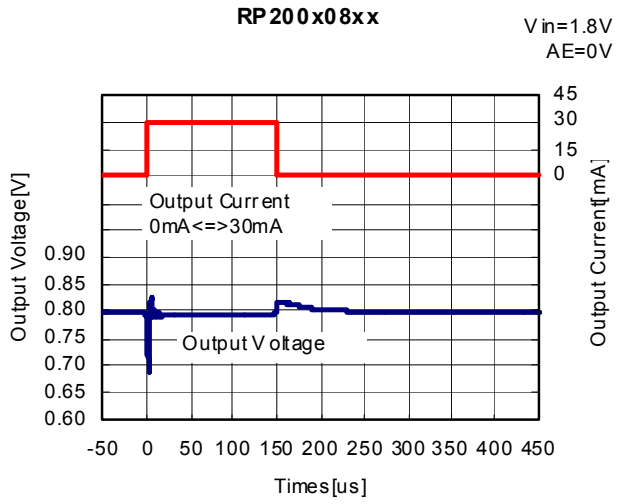


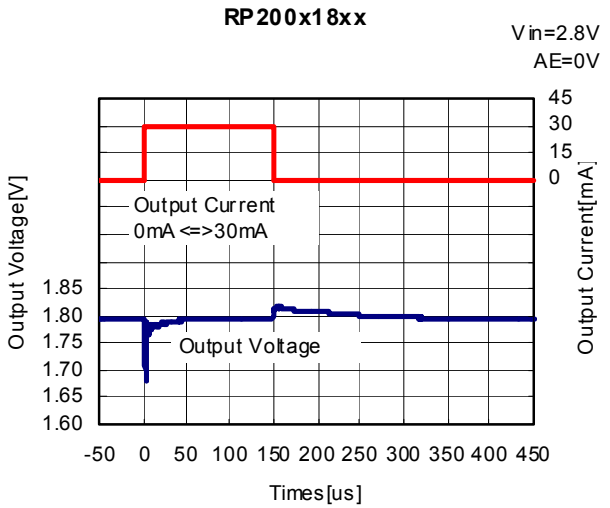






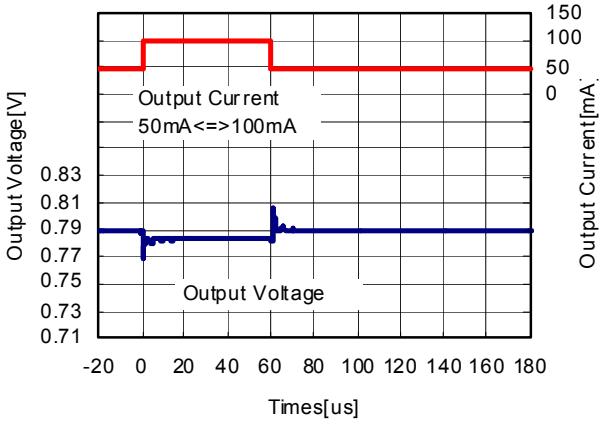
12) Load Transient Response



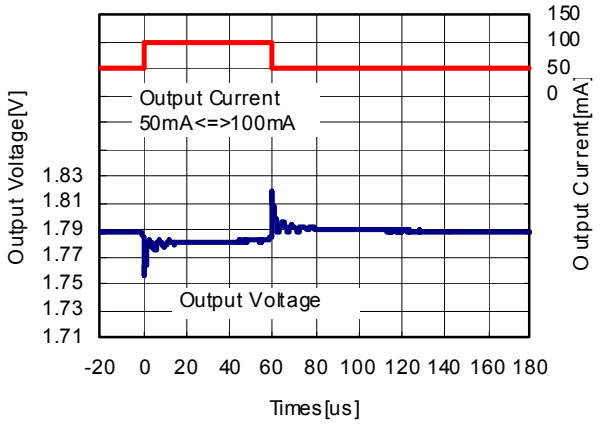


Preliminary

RP200x08xx



RP200x18xx



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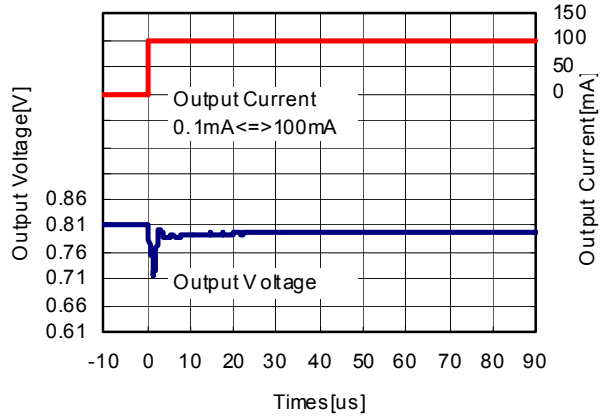

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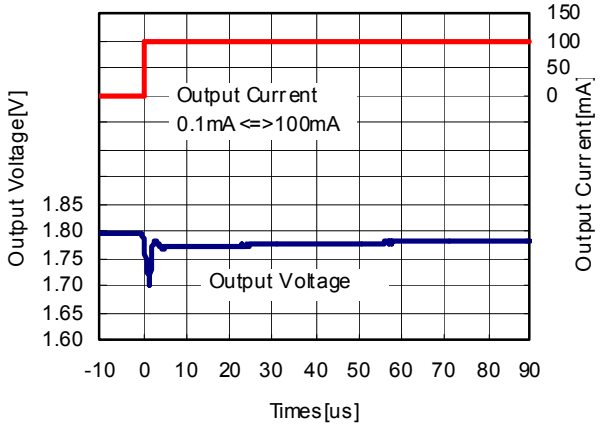
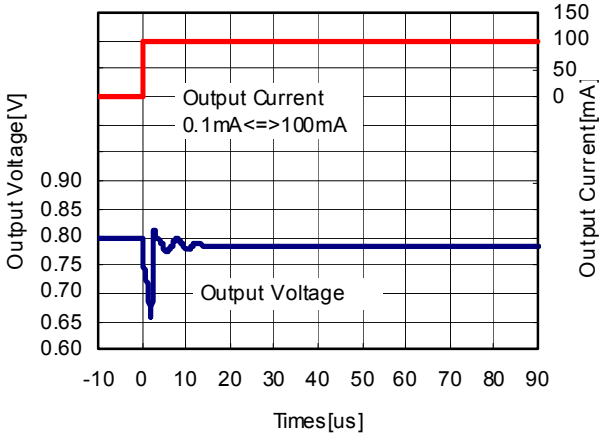
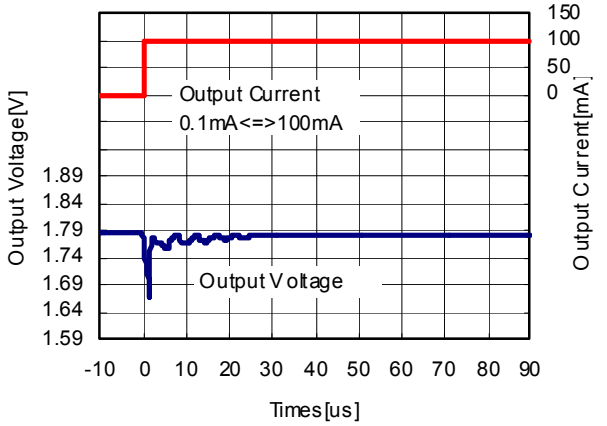


RP200x08xx

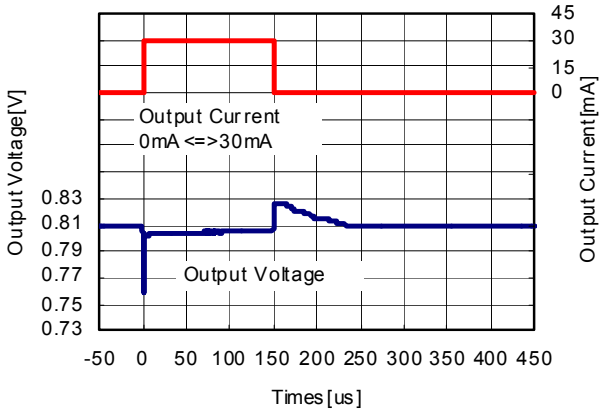


RP200x18xx

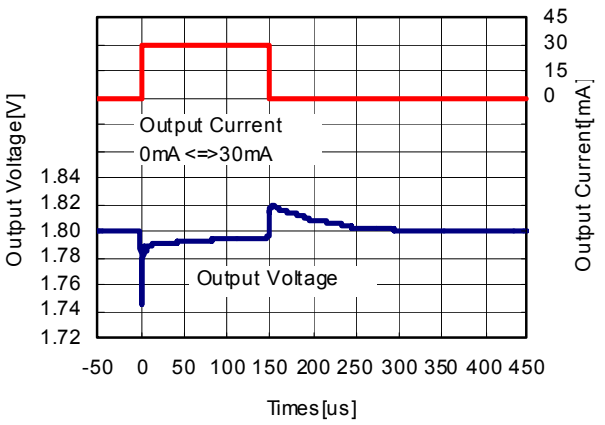


Preliminary

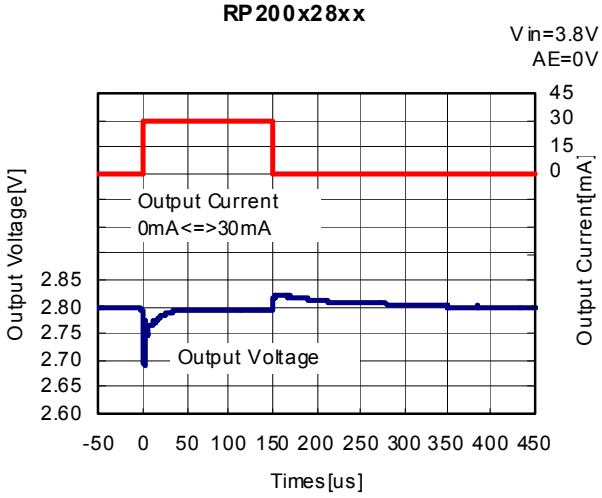
RP200x08xx



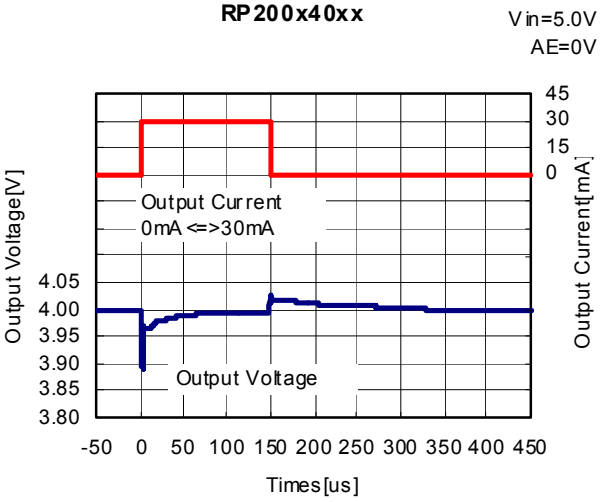
RP200x18xx



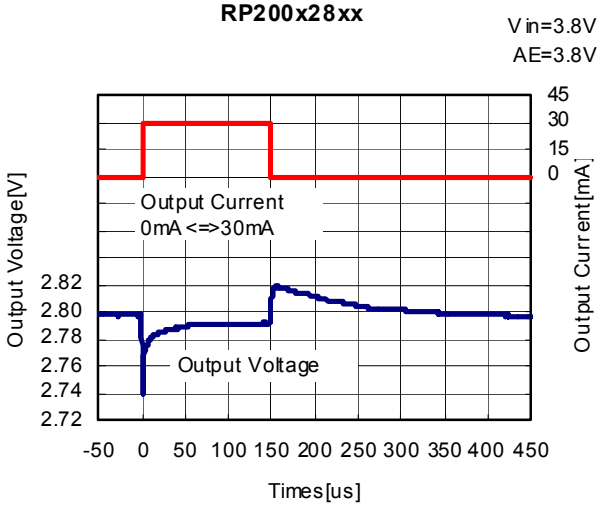
RP200x28xx



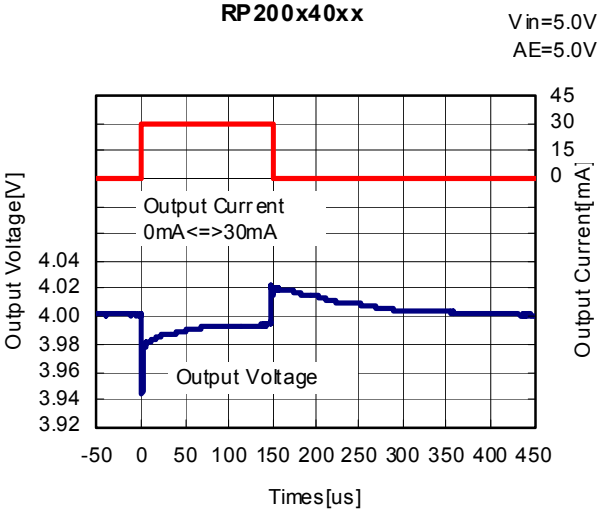
RP200x40xx



RP200x28xx

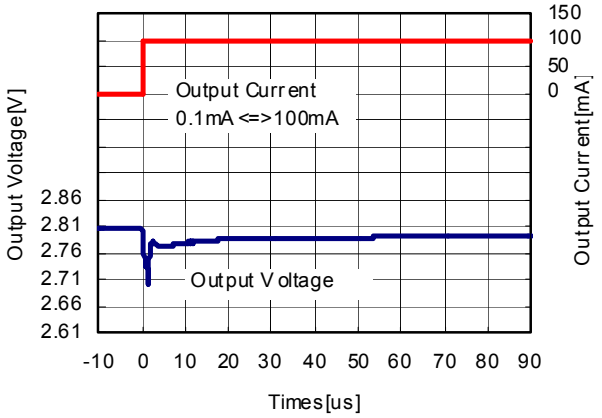


RP200x40xx

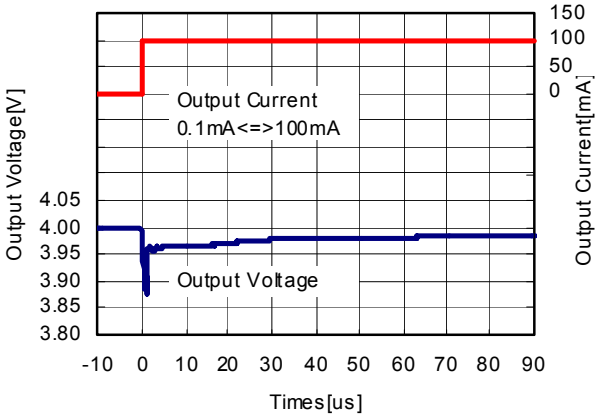


Preliminary

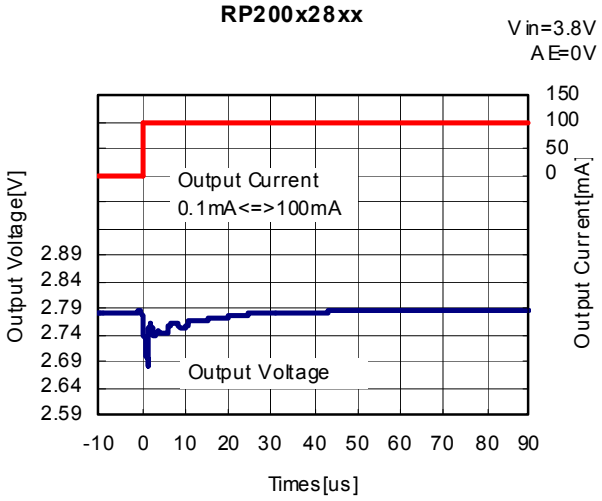
RP200x28xx



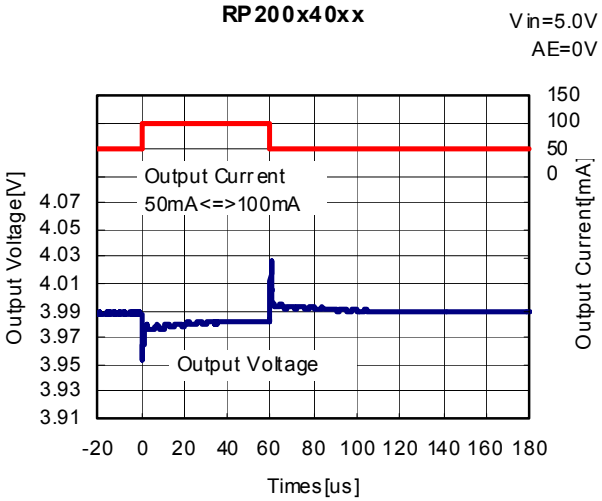
RP200x40xx



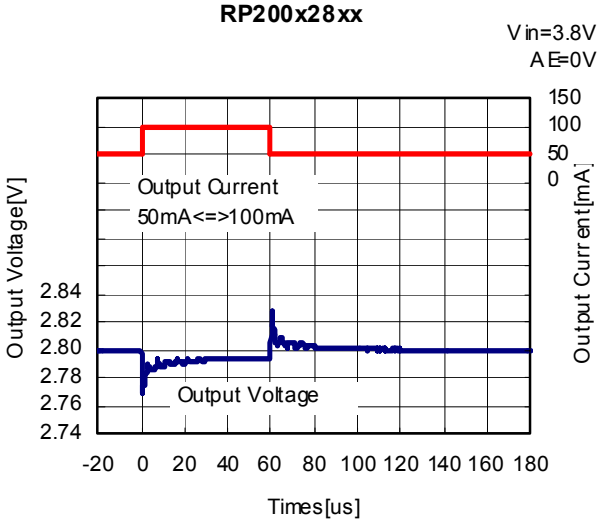
RP200x28xx



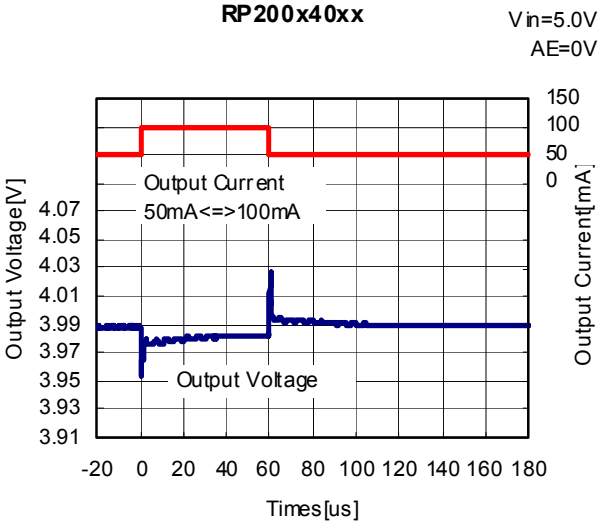
RP200x40xx



RP200x28xx



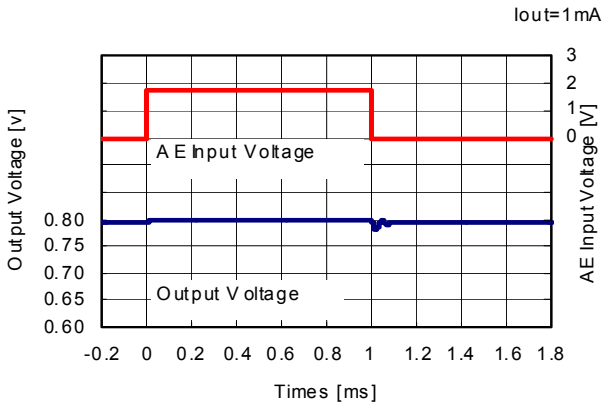
RP200x40xx



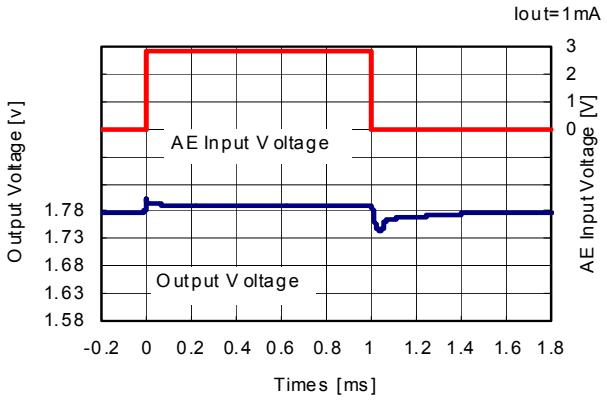
Preliminary

13)AE switch transient response (Cin=1.0uF,Cout=1.0uF,Tr=Tf=0.5us,Topt=25°C)

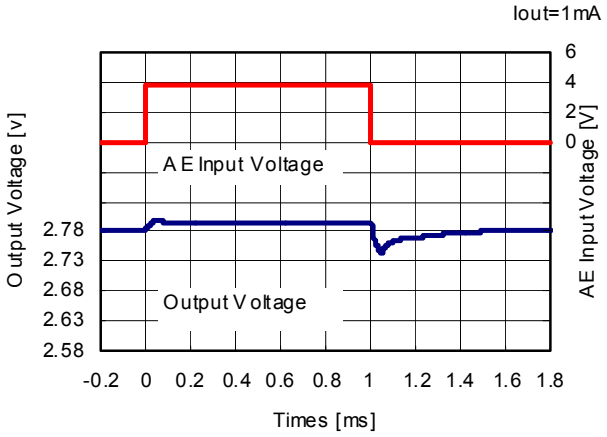
RP200x08xx



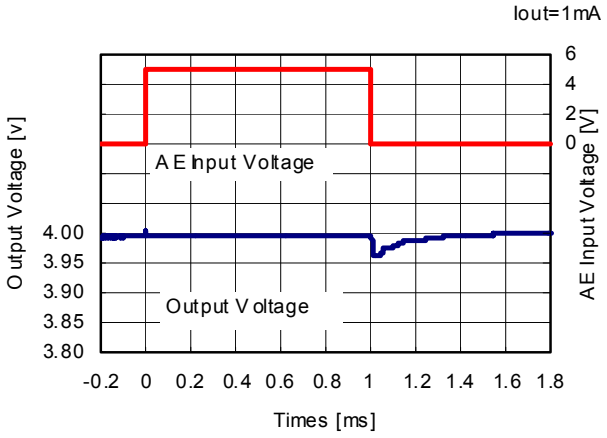
RP200x18xx



RP200x28xx

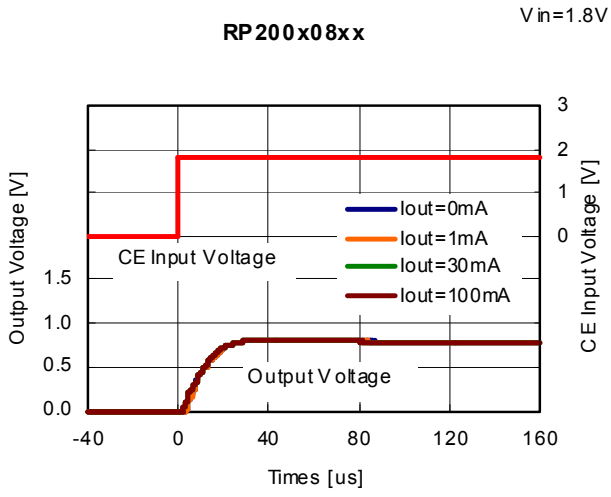


RP200x40xx

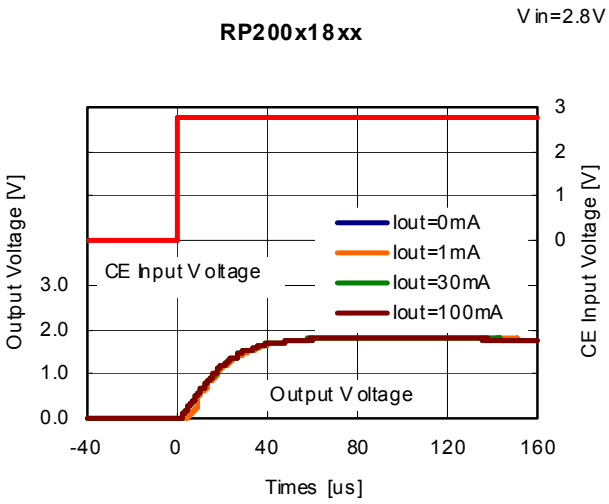


14) Turn on speed with CE pin

RP200x08xx



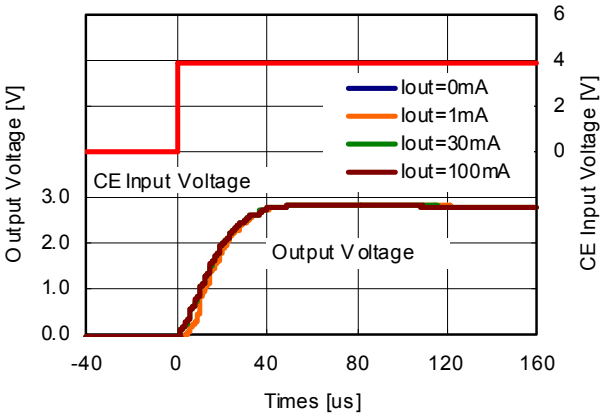
RP200x18xx



Preliminary

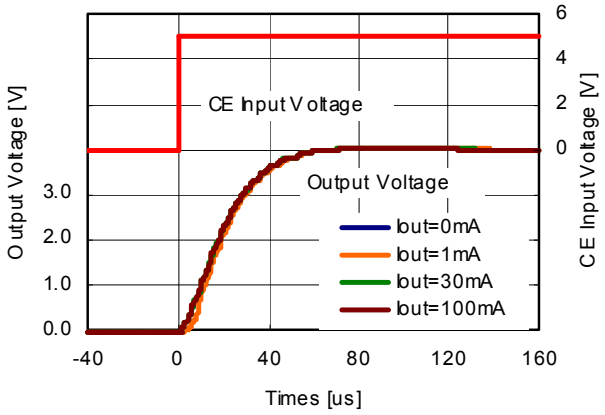
Vin=3.8V

RP200x28xx



Vin=5.0V

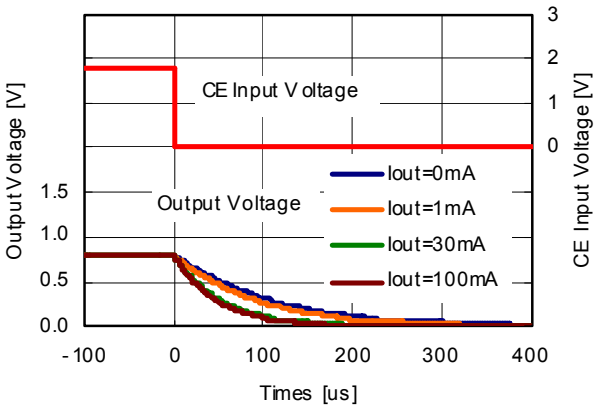
RP200x40xx



15) Turn off speed with CE pin (D version) (Cin=1.0uF,Cout=1.0uF,Topt=25°C)

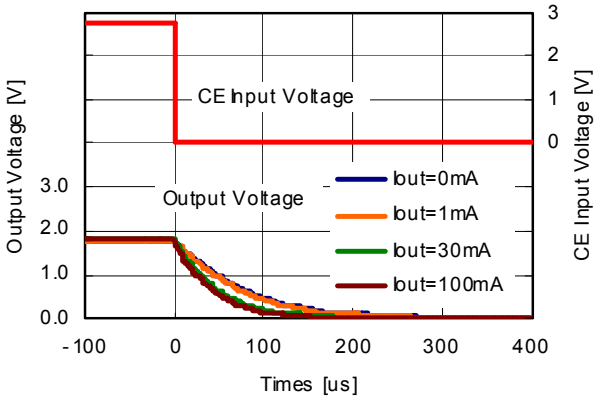
Vin=1.8V

RP200x08xx



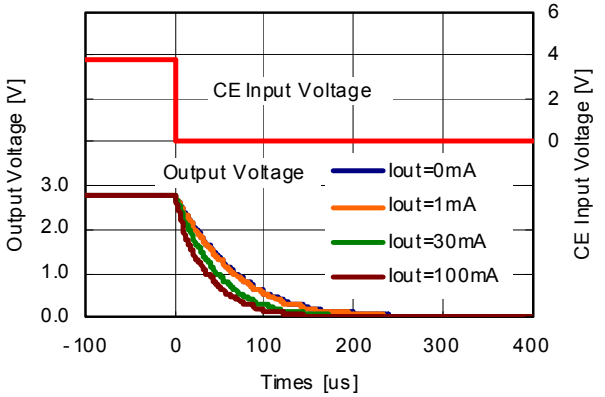
Vin=2.8V

RP200x18xx



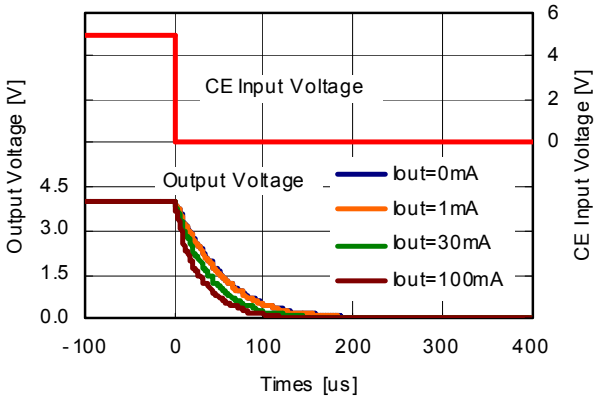
Vin=3.8V

RP200x28xx



Vin=5.0V

RP200x40xx



RICOH

Preliminary

TECHNICAL NOTES

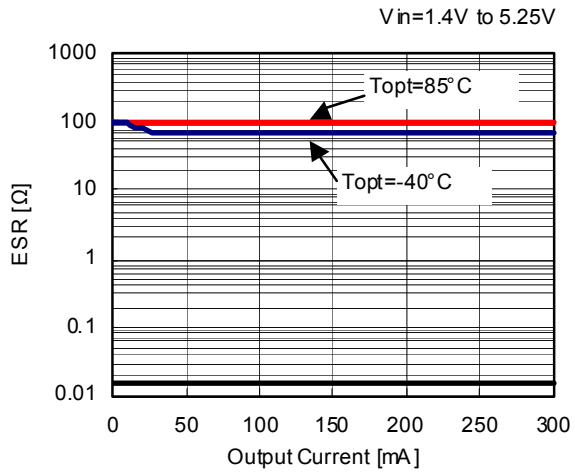
When using these ICs, consider the following points:

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, be sure to use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) in the range described as follows:

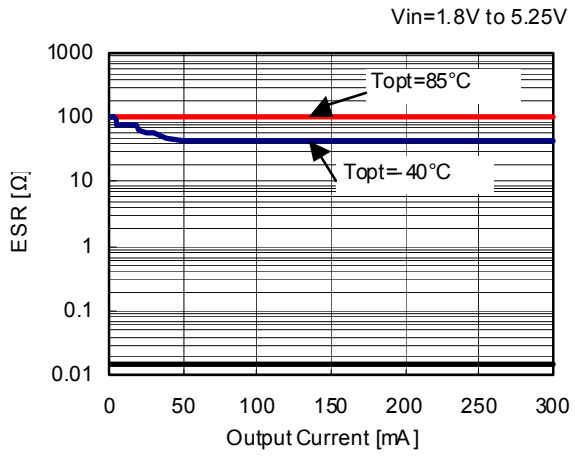
The relations between I_{OUT} (Output Current) and ESR of Output Capacitor are shown below. The conditions when the white noise level is under 40μV (Avg.) are marked as the hatched area in the graph.

<Test conditions>
Frequency band: 10Hz to 2MHz
(Cin=1.0uF,Cout=1.0uF)

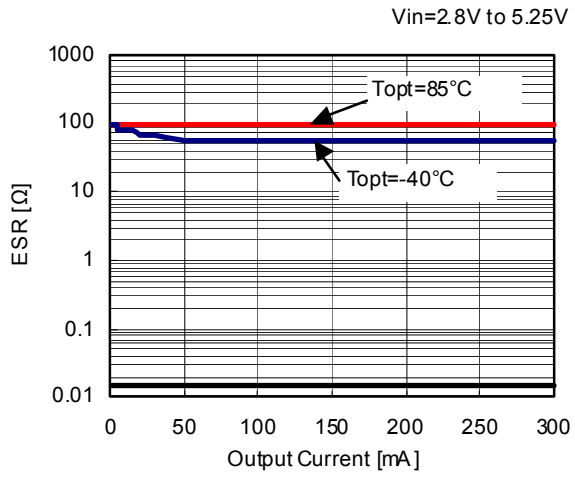
RP200x08xx



RP200x18xx



RP200x28xx



RP200x40xx