*RP200Q (SC-88A) is the discontinued product as of January 2017.

RICOH

RP200x SERIES

3-MODE 300mA LDO REGULATOR

NO.EA-182-170126

OUTLINE

The RP200x Series consist of CMOS-based voltage regulator ICs with high output voltage accuracy, low dropout voltage 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 pin. Other two modes are realized with ECO Function. Fast Response Mode (Fast Mode) and Fast and Low Power auto-change Mode (Auto ECO Mode) are alternative with Auto Eco pin (AE pin). Supply current of IC itself at light load is automatically reduced at Auto ECO Mode compared with Fast Mode. The output voltage is maintained between Fast Mode and Auto ECO Mode.

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

Since the packages for these ICs are SOT-23-5, SC-88A, thin DFN(PLP)1212-6, and WLCSP-4-P5, high density mounting of the ICs on boards is possible. RP200Q (SC-88A), RP200K (DFN(PLP)1212-6) and RP200N (SOT-23-5) has 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

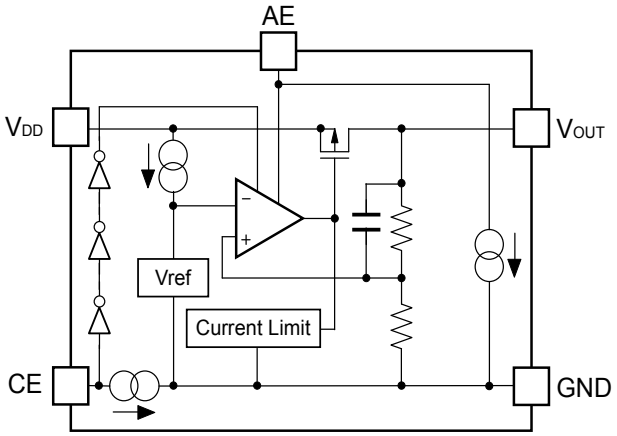
- Supply Current (Low power Mode) ..... Typ. 1.0μA ($V_{OUT} \leq 1.85V$)
- Supply Current (Fast Mode)..... Typ. 55μA
- Supply Current (Standby Mode) ..... Typ. 0.1 μA
- Ripple Rejection ..... Typ. 70dB (f=1kHz)
- Input Voltage Range ..... 1.4V to 5.25V
- Output Voltage Range..... 0.8V to 4.0V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy..... ±1.0% ($V_{OUT} > 2.0V$, T_{opt}=25°C)
- Temperature-Drift Coefficient of Output Voltage ..... Typ. ±50ppm/°C
- Dropout Voltage ..... Typ. 0.23V (I_{OUT}=300mA, V_{OUT}=2.8V)
- Line Regulation ..... Typ. 0.02%/V
- Packages ..... WLCSP-4-P5, DFN(PLP)1212-6, SC-88A, SOT-23-5
- Built-in Fold Back Protection Circuit ..... Typ. 50mA (Current at short mode)
- Ceramic capacitors are recommended..... 1.0μF

APPLICATIONS

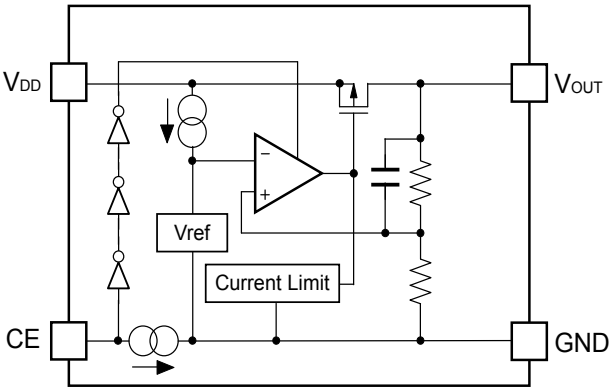
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

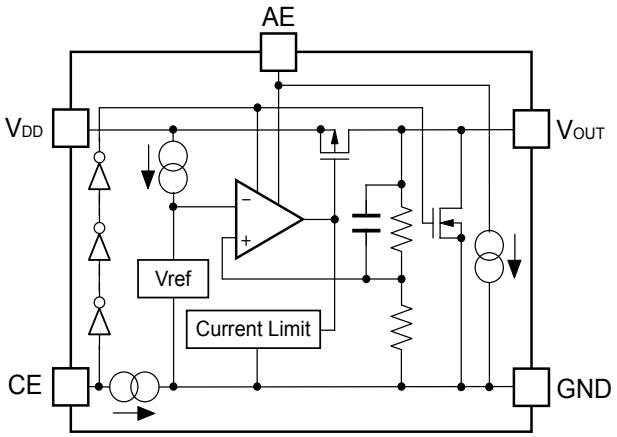
RP200K/N/QxxxB



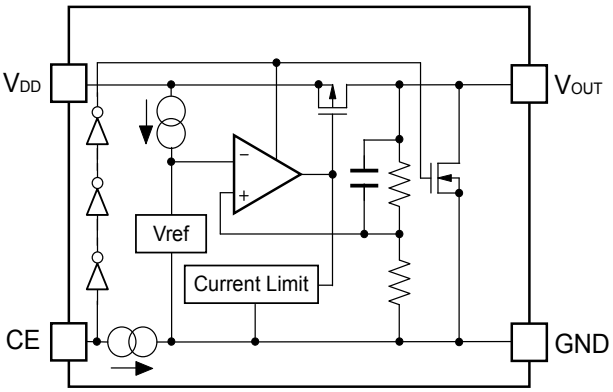
RP200Zxx1B



RP200K/N/QxxxD



RP200Zxx1D



SELECTION GUIDE

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

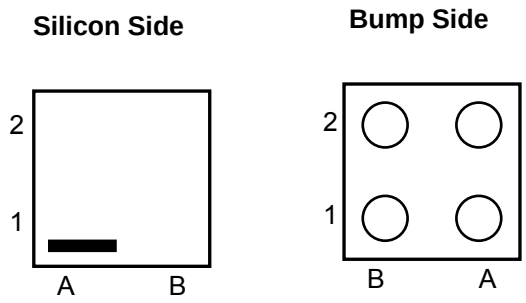
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP200Zxx1∗-TR-F	WLCSP-4-P5	5,000 pcs	Yes	Yes
RP200Kxx1∗-TR	DFN(PLP)1212-6	5,000 pcs	Yes	Yes
RP200Qxx2∗-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP200Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 0.8V(08) to 4.0V(40) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

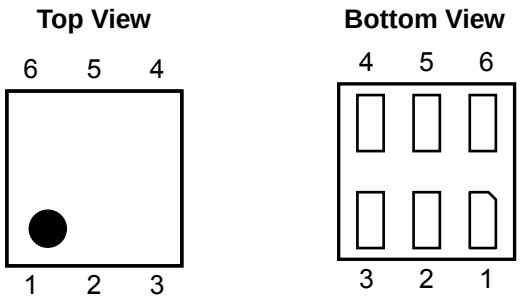
∗ : The auto discharge function at off state are options as follows.
(B) without auto discharge function at off state
(D) with auto discharge function at off state

PIN CONFIGURATIONS

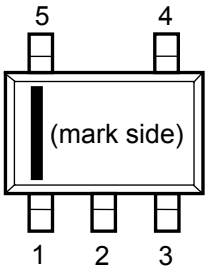
● **WLCSP-4-P5**



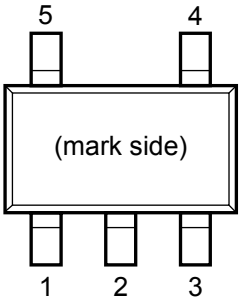
● **DFN(PLP)1212-6**



● **SC-88A**



● **SOT-23-5**



- **WLCSP-4-P5**

Pin No	Symbol	Pin Description
A1	V_{DD}	Input Pin
A2	V_{OUT}	Output Pin
B1	CE	Chip Enable Pin ("H" Active)
B2	GND	Ground Pin

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

Pin No	Symbol	Pin Description
1	AE	Auto ECO Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{DD}	Input Pin
5	NC	No Connection
6	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	CE	Chip Enable Pin ("H" Active)

- **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
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to 6.0	V
V_{AE}	Input Voltage (AE Pin)	−0.3 to 6.0	V
V_{OUT}	Output Voltage	−0.3 to V_{IN}+0.3	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation (WLCSP-4-P5) *	278	mW
	Power Dissipation (DFN(PLP)1212-6) *	400	
	Power Dissipation (SC-88A) *	380	
	Power Dissipation (SOT-23-5) *	420	
Topt	Operating Temperature Range	−40 to 85	°C
Tstg	Storage Temperature Range	−55 to 125	°C

∗) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

ELECTRICAL CHARACTERISTICS

V_{IN}=Set V_{OUT}+1V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1μF, unless otherwise noted.

The specification in ☐ is checked and guaranteed by design engineering at −40°C ≦ Topt ≦ 85°C.

- **RP200x**

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage (Fast Mode)	I_{OUT}=5mA Topt=25°C	V_{OUT} > 2.0V	×0.99		×1.01	V
			V_{OUT} ≤ 2.0V	−20		20	mV
		I_{OUT}=5mA −40°C ≤ Topt ≤ 85°C	V_{OUT} > 2.0V	×0.975		×1.015	V
			V_{OUT} ≤ 2.0V	−50		30	mV
I_{OUT}	Output Current			300			mA
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	1mA ≤ I_{OUT} ≤ 10mA	V_{OUT} > 2.0V	−1.0		1.0	%
			V_{OUT} ≤ 2.0V	−20		20	mV
		10mA ≤ I_{OUT} ≤ 300mA			35	80	mV
V_{DIF}	Dropout Voltage	I_{OUT}=300mA	0.8V ≤ V_{OUT} < 0.9V		0.62	0.85	V
			0.9V ≤ V_{OUT} < 1.0V		0.55	0.78	
			1.0V ≤ V_{OUT} < 1.5V		0.48	0.70	
			1.5V ≤ V_{OUT} < 2.6V		0.34	0.50	
			2.6V ≤ V_{OUT} ≤ 4.0V		0.23	0.35	
I_{SS1}	Supply Current (Low Power Mode) *1	I_{OUT}=0mA	V_{OUT} ≤ 1.85V		1.0	4.0	μA
			V_{OUT} > 1.85V		1.5	4.0	
I_{SS2}	Supply Current (Fast Mode)	I_{OUT}=10mA			55		μA
Istandby	Standby Current	V_{CE}=GND			0.1	1.0	μA
I_{OUTH}	Fast Mode switch-over current	I_{OUT}=Light load to Heavy load				8.0	mA
I_{OUTL}	Low Power Mode switch-over current	I_{OUT}=Heavy load to Light load		1.0	2.0		mA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	V_{OUT}+0.5V≤V_{IN}≤5.0V, V_{IN} ≥ 1.4V	I_{OUT}=1mA (Low Power Mode)			0.50	%/V
			I_{OUT}=10mA (Fast Mode)		0.02	0.20	
RR	Ripple Rejection (Fast Mode)	f=1kHz, Ripple 0.2Vp-p V_{IN}=V_{OUT}+1V, I_{OUT}=30mA (In case that V_{OUT} ≤ 1.2V, V_{IN}=2.2V)			70		dB
V_{IN}	Input Voltage*2			1.40		5.25	V
ΔV_{OUT} /ΔTopt	Output Voltage Temperature Coefficient	−40°C ≤ Topt ≤ 85°C			±50		ppm /°C
I_{SC}	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

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{CEL}	CE Input Voltage "L"				0.4	V
I_{AEPD}	AE Pull-down Constant Current*3			0.1		μA
V_{AEH}	AE Input Voltage "H"*3		1.0			V
V_{AEL}	AE Input Voltage "L"*3				0.4	V
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	V_{IN}=4.0V, V_{CE}=0V		50		Ω

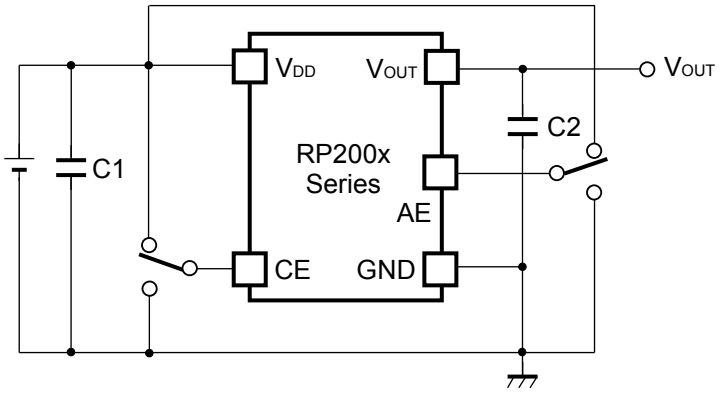
All of units are tested and specified under load conditions such that Tj≈T_{opt}=25°C except for Ripple Rejection, Output Voltage Temperature Coefficient.

∗1) The value of supply current is excluding the Pull-down constant current of CE Pin and AE Pin.
∗2) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.
∗3) Applied to RP200K/N/Q

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.

TYPICAL APPLICATION



(External Components)
C1, C2 : Ceramic Capacitor 1.0μF MURATA: GRM155B31A105KE15

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with 1.0μF or more and good ESR (Equivalent Series Resistance).
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

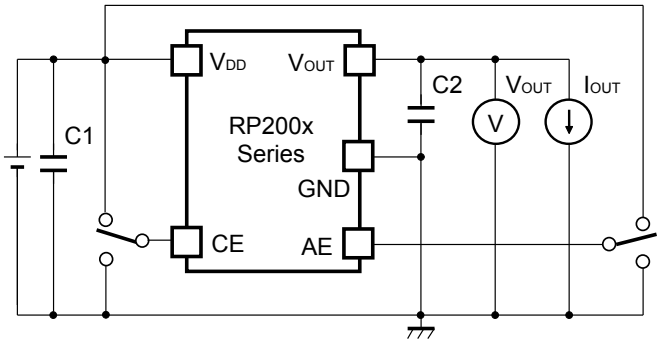
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0μF or more between V_{DD} and GND pin, and as close as possible to the pins.

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

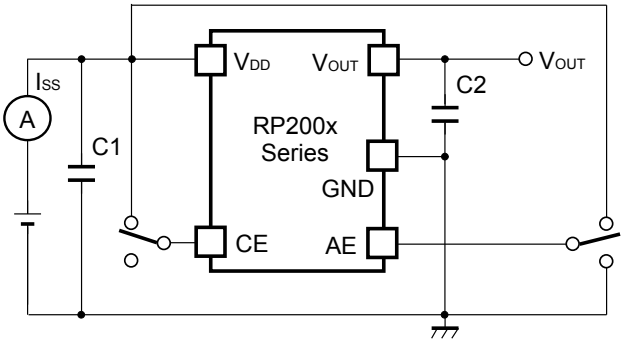
Impedance of Input Pin (CE Pin and AE Pin)

In those ICs, there is a pull-down constant current in the CE Pin and the AE Pin.
However, if those pins are floating and wired long that produce the noise environment, it might miss-operation of ICs. For this purpose, please make sure enough evaluation of ICs.

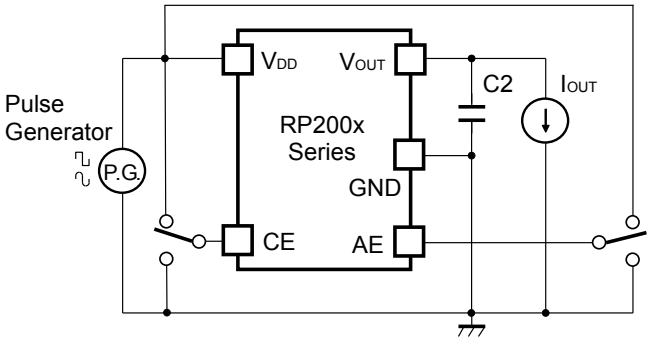
TEST CIRCUITS



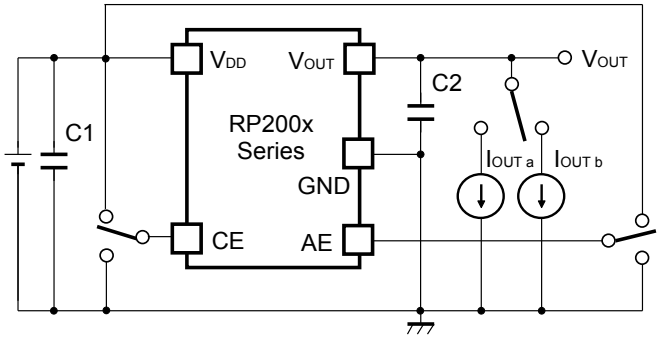
Basic Test Circuit



Test Circuit for Supply Current



Test Circuit for Ripple Rejection

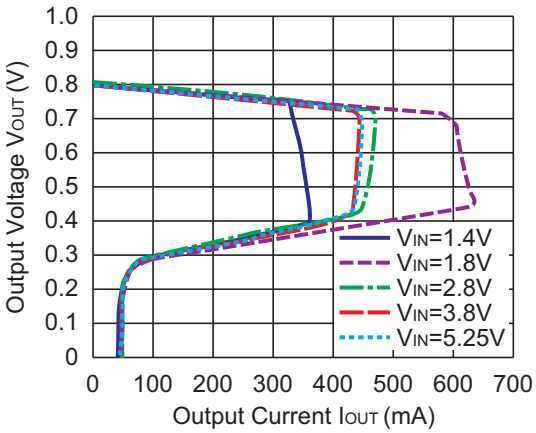


Test Circuit for Load Transient Response

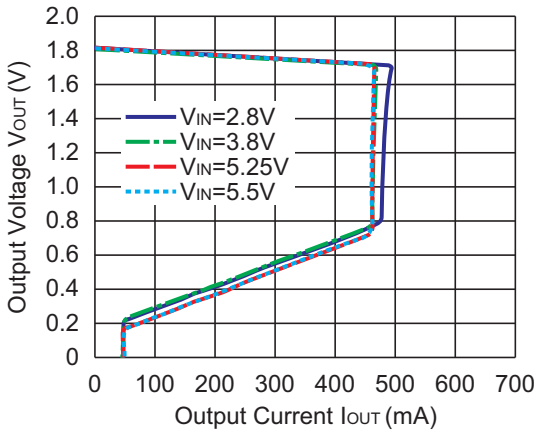
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=1.0µF, C2=1.0µF, Topt=25°C)

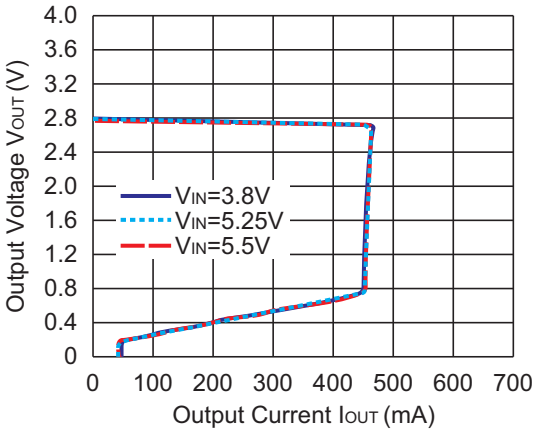
RP200x08xx



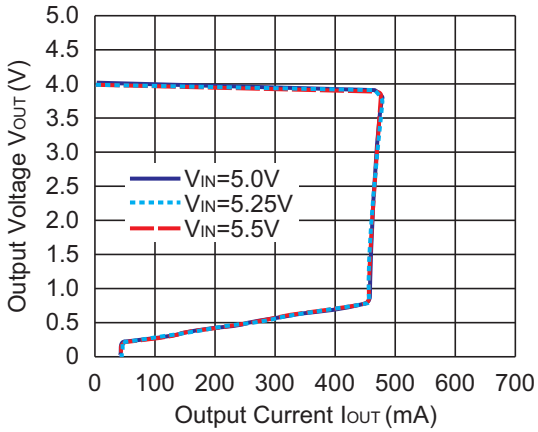
RP200x18xx



RP200x28xx

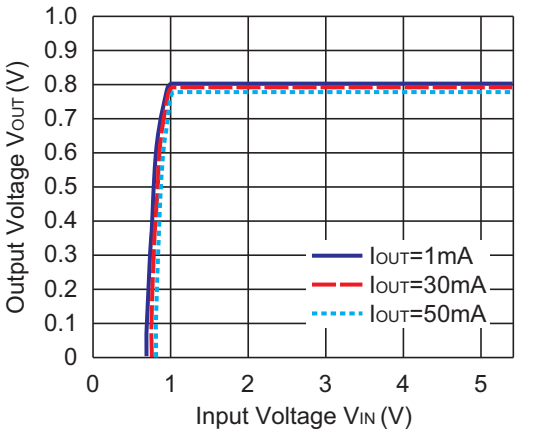


RP200x40xx



2) Output Voltage vs. Input Voltage (C1=1.0µF, C2=1.0µF, Topt=25°C)

RP200x08xx



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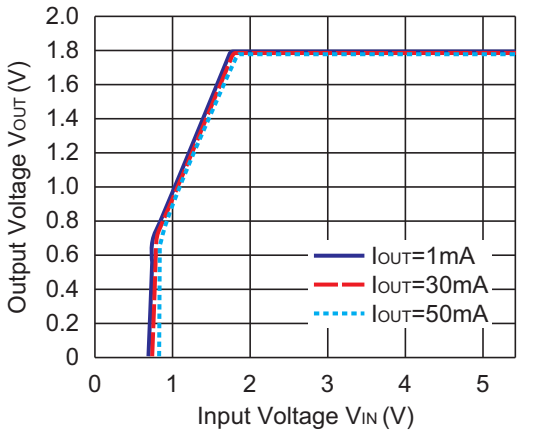

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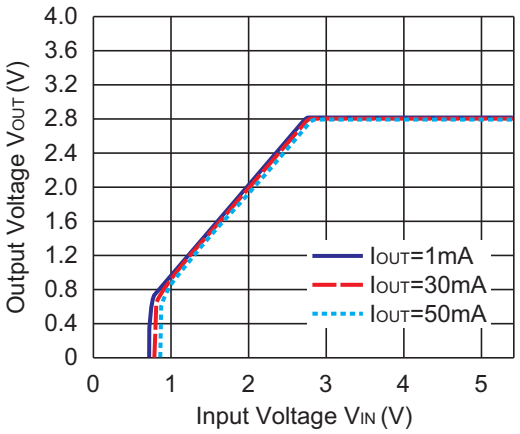

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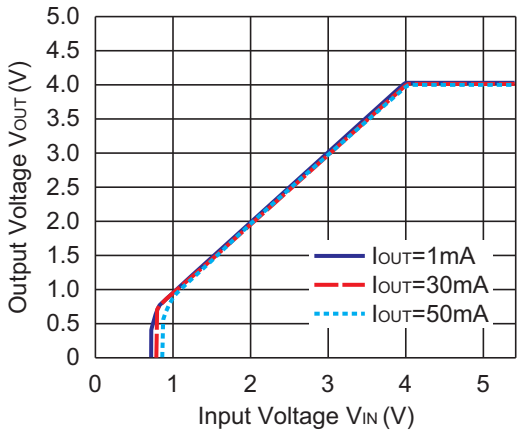
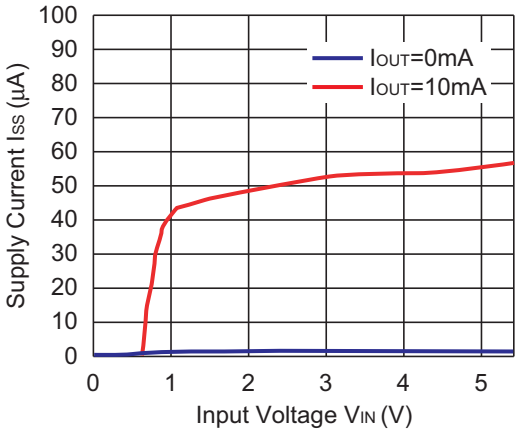


3) Supply Current vs. Input Voltage (C1=1.0µF, C2=1.0µF, Topt=25°C)

RP200x08xx



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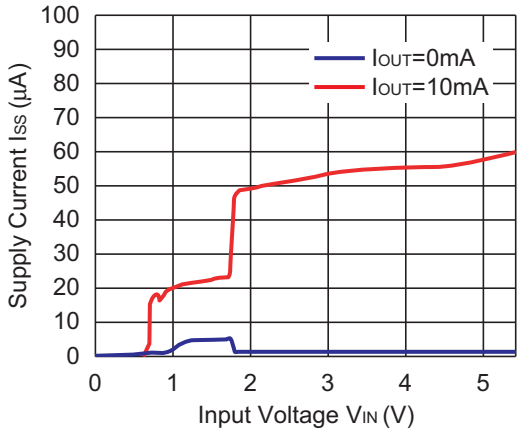

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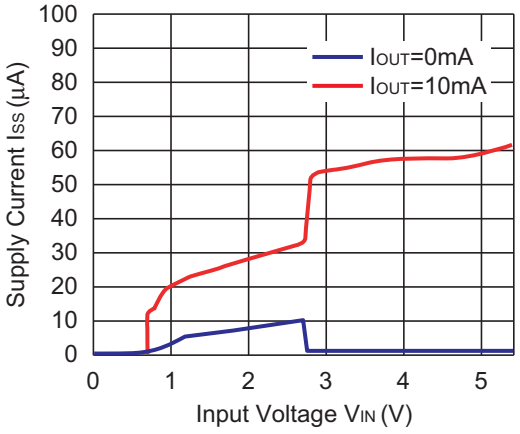

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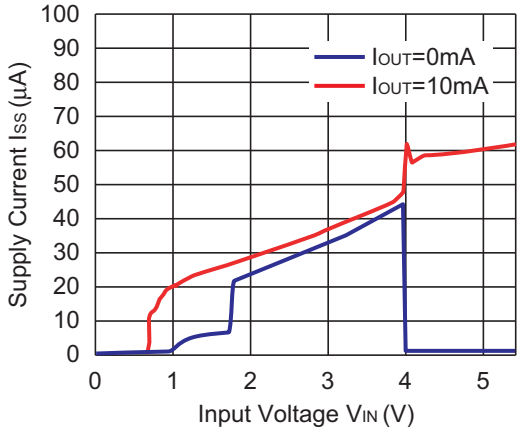
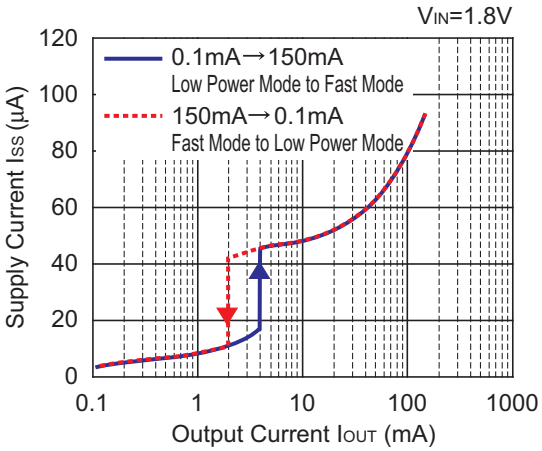


4) Supply Current vs. Output Current (C1=1.0µF, C2=1.0µF, Topt=25°C)

RP200x08xx



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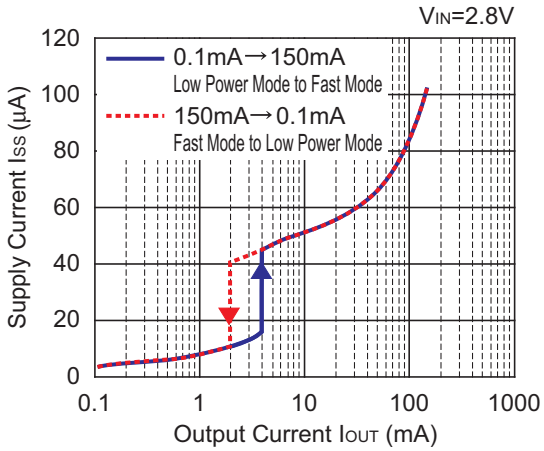

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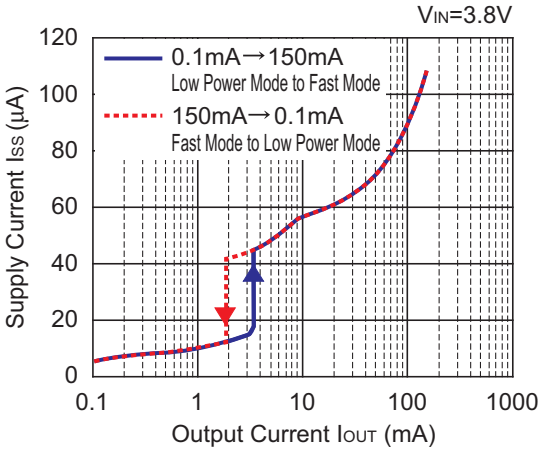
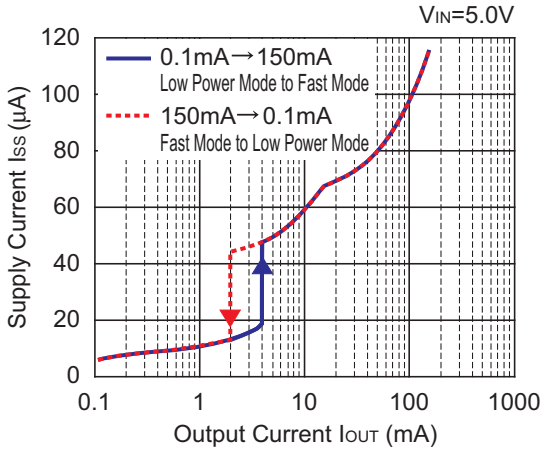
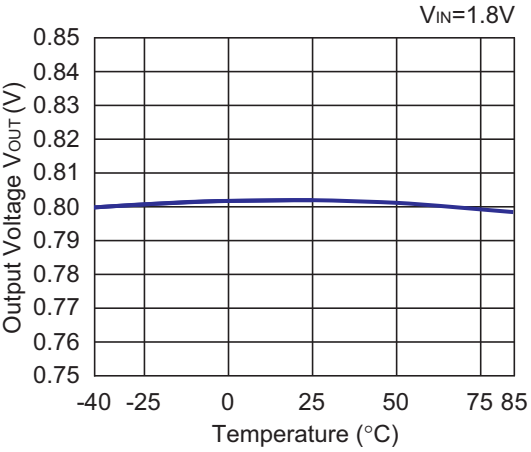


RP200x40xx



5) Output Voltage vs. Temperature (C1=1.0µF, C2=1.0µF, IOUT=5mA)

RP200x08xx



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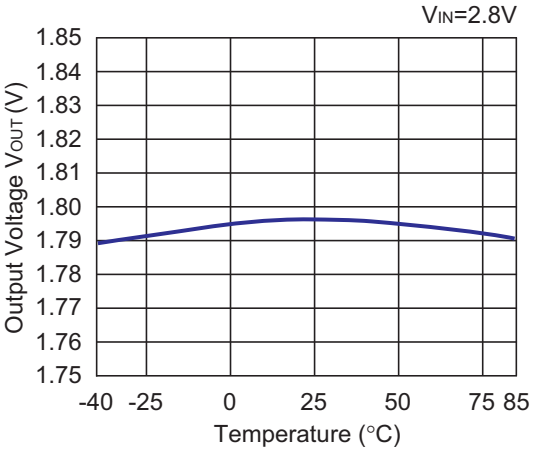
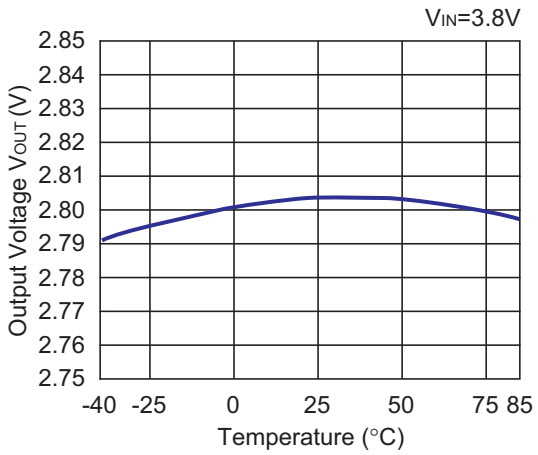
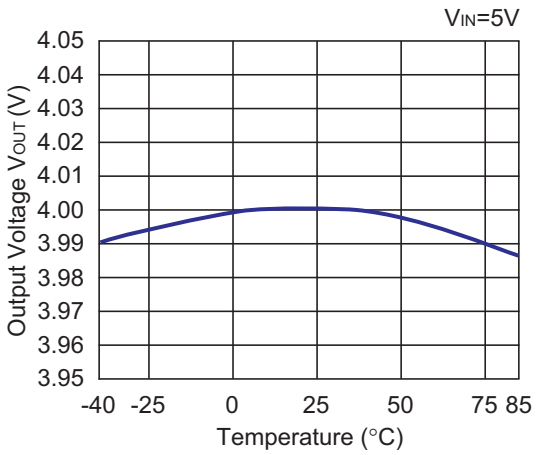


RP200x28xx



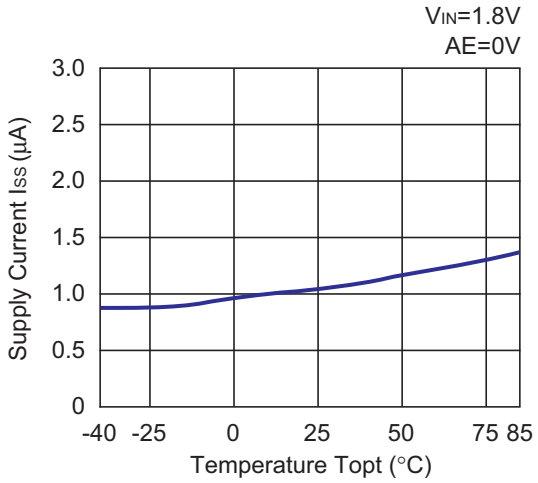
RP200x40xx



6) Supply Current vs. Temperature (C1=1.0µF, C2=1.0µF)

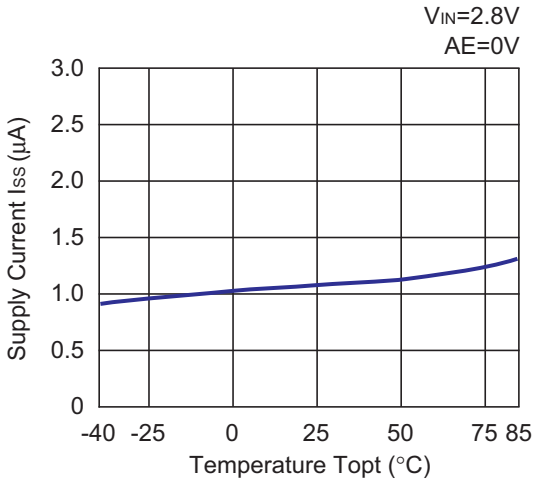
RP200x08xx

(Auto ECO Low Power Mode)



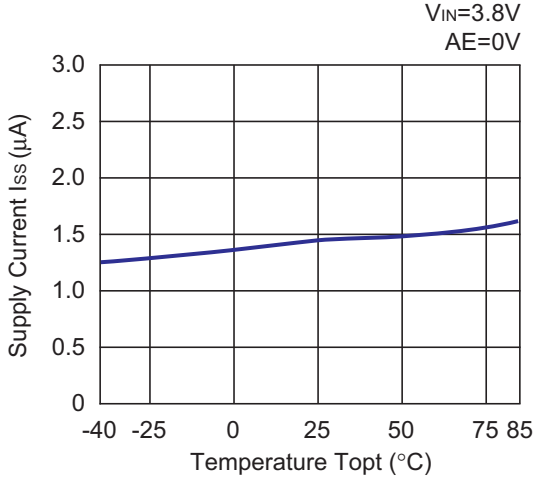
RP200x18xx

(Auto ECO Low Power Mode)



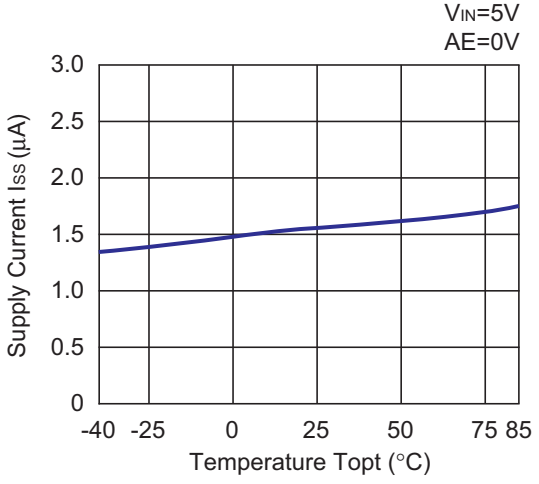
RP200x28xx

(Auto ECO Low Power Mode)

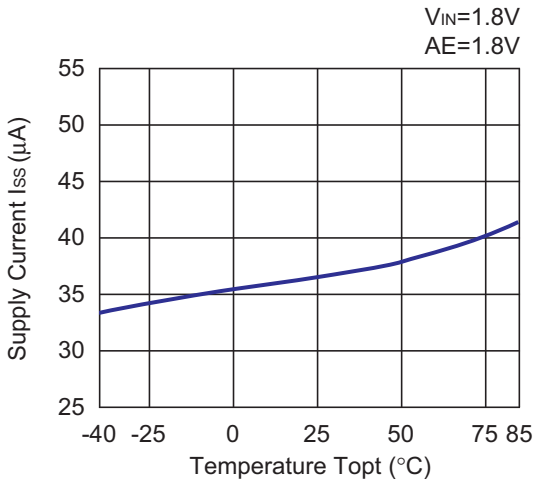


RP200x40xx

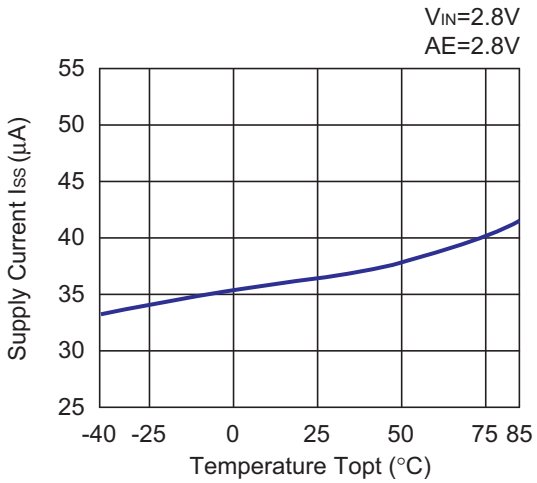
(Auto ECO Low Power Mode)



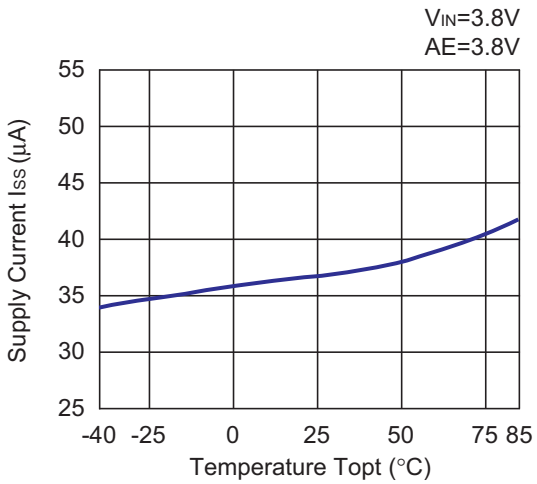
RP200x08xx (Fixed Fast Mode)



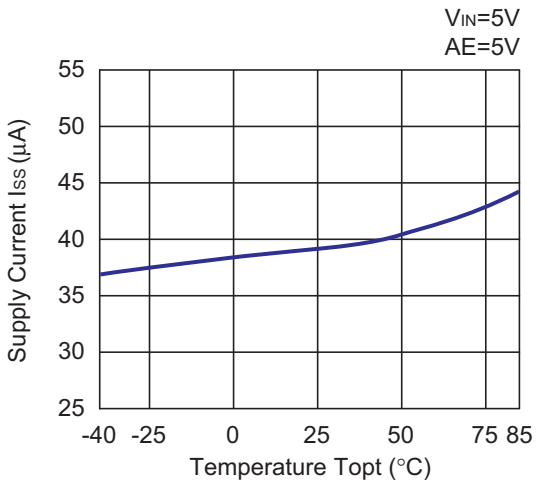
RP200x18xx (Fixed Fast Mode)



RP200x28xx (Fixed Fast Mode)

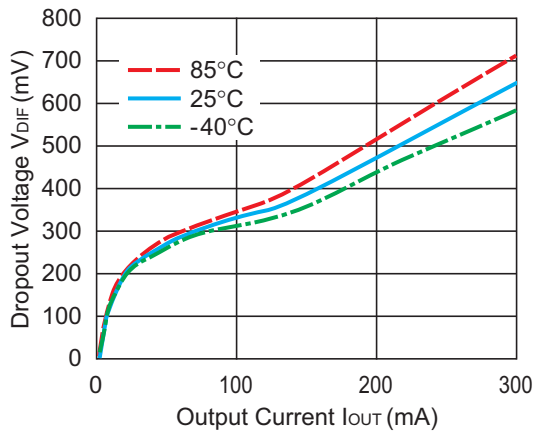


RP200x40xx (Fixed Fast Mode)

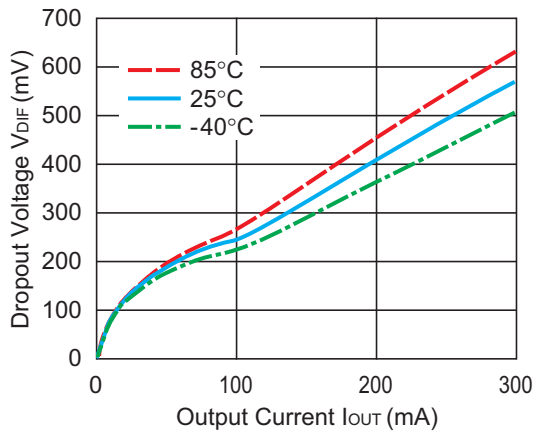


7) Dropout Voltage vs. Output Current (C1=1.0µF, C2=1.0µF)

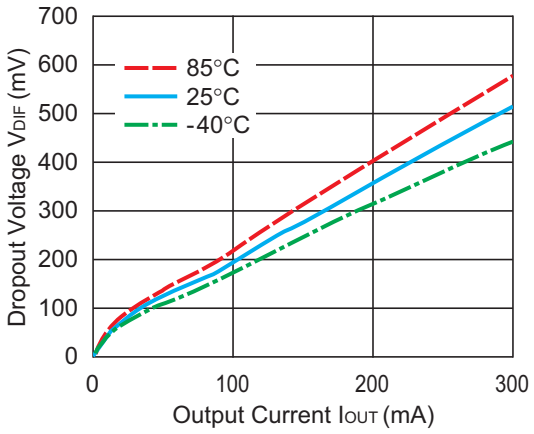
RP200x08xx



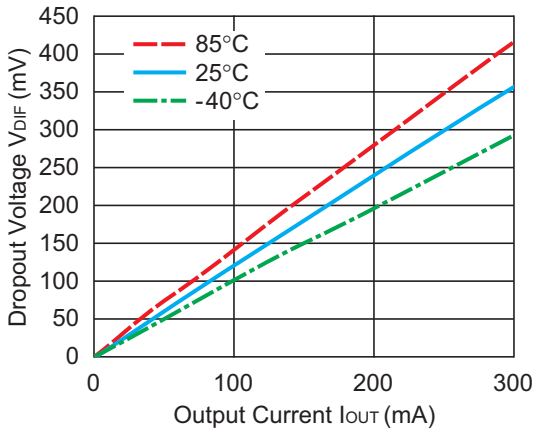
RP200x09xx



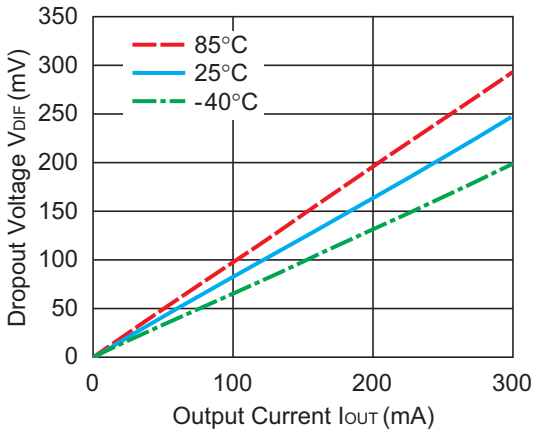
RP200x10xx



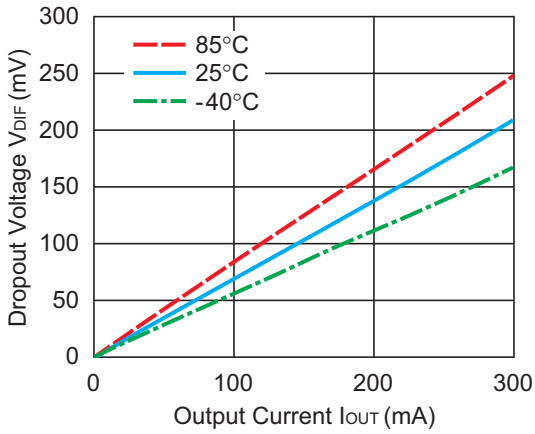
RP200x15xx



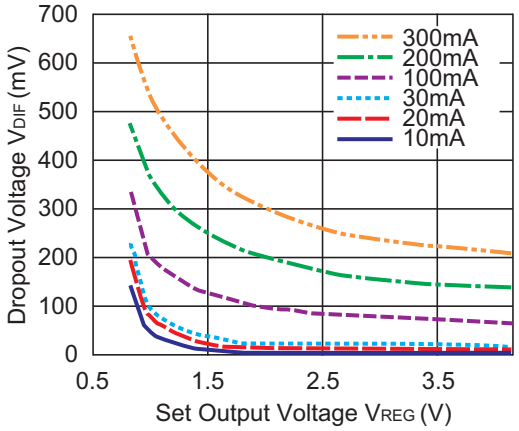
RP200x26xx



RP200x40xx

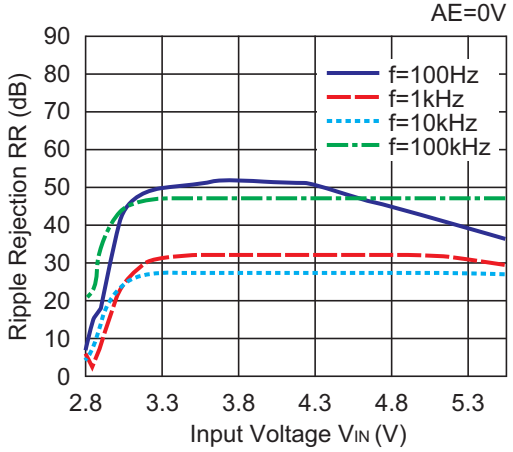


8) Dropout Voltage vs Set Output Voltage

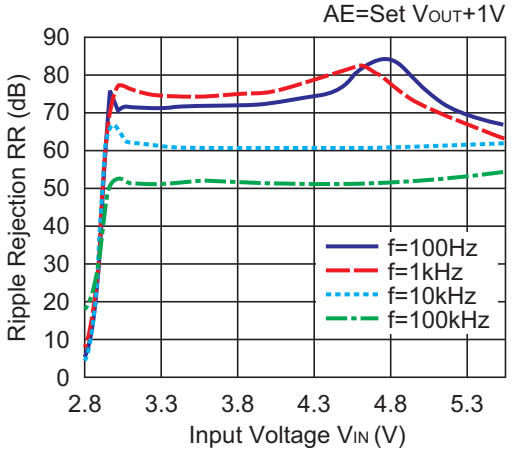


9) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=1.0μF, Ripple=0.2Vp-p, Topt=25°C)

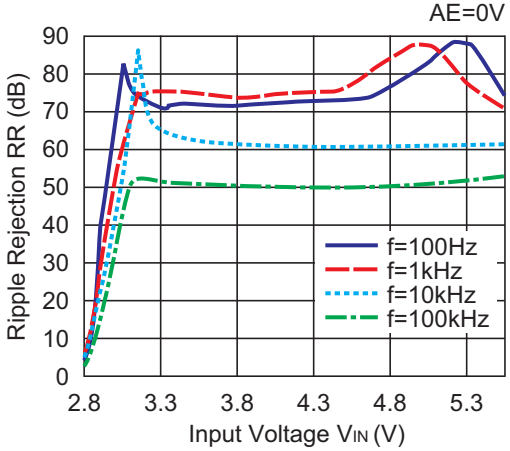
RP200x28xx
(Auto ECO Low Power Mode)
IOUT=1mA
AE=0V



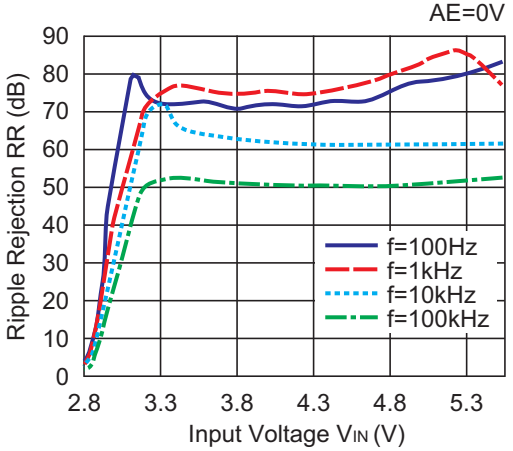
RP200x28xx
(Fixed Fast Mode)
IOUT=1mA
AE=Set VOUT+1V



RP200x28xx
(Auto ECO Fast Mode)
IOUT=30mA
AE=0V

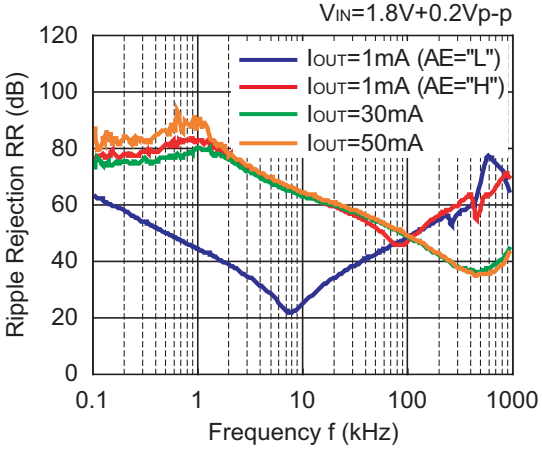


RP200x28xx
(Auto ECO Fast Mode)
IOUT=50mA
AE=0V

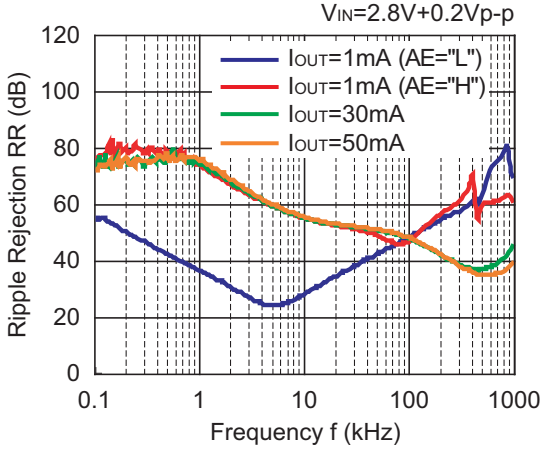


10) Ripple Rejection vs. Frequency (C1=none, C2=1.0μF, Ripple=0.2Vp-p, Topt=25°C)

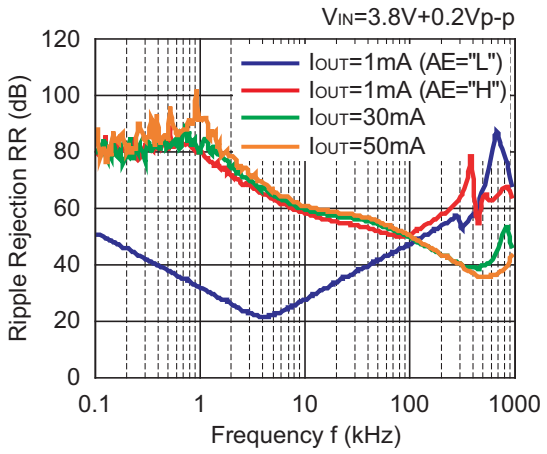
RP200x08xx
VIN=1.8V+0.2Vp-p



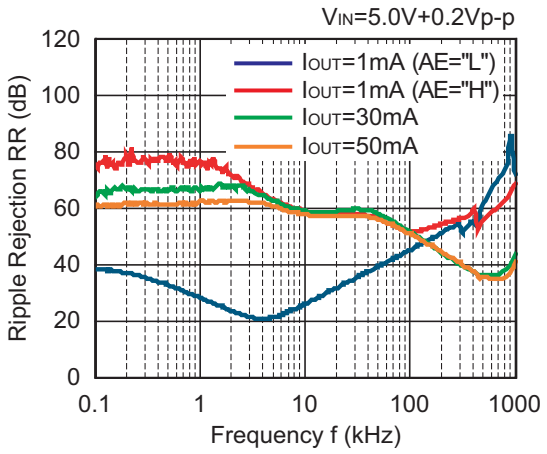
RP200x18xx
VIN=2.8V+0.2Vp-p



RP200x28xx



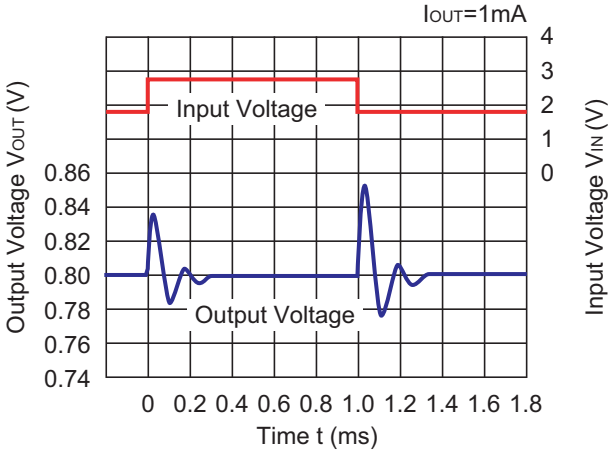
RP200x40xx



11) Input Transient Response (C1=none, C2=1.0µF, tr=tf=5µs, Topt=25°C)

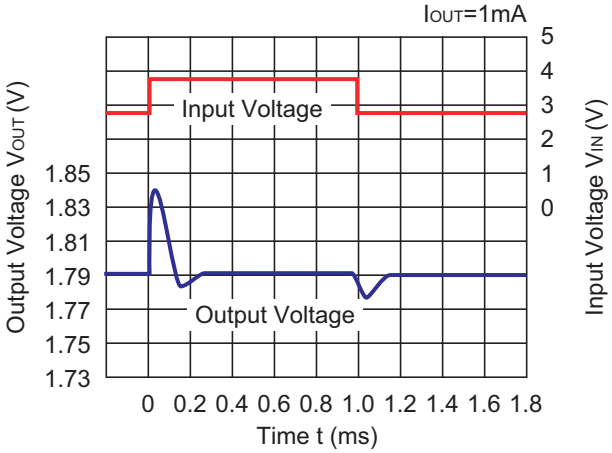
RP200x08xx

(Auto ECO Low Power Mode)



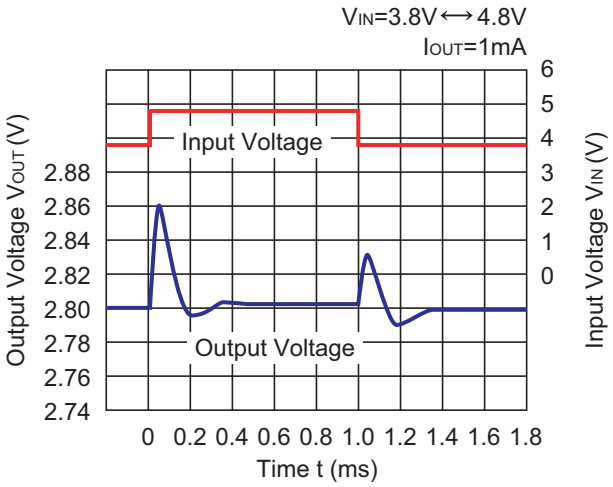
RP200x18xx

(Auto ECO Low Power Mode)



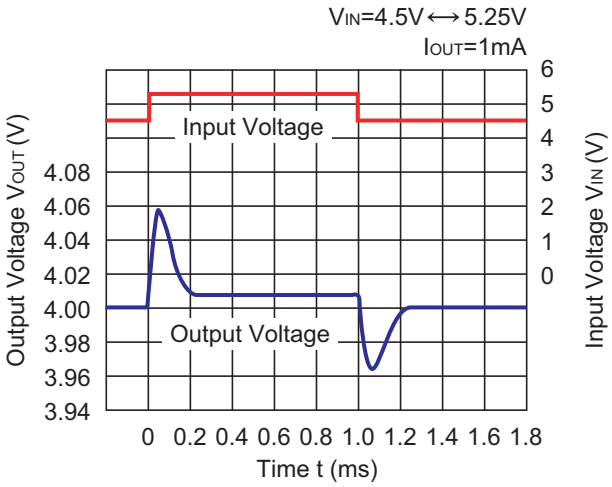
RP200x28xx

(Auto ECO Low Power Mode)

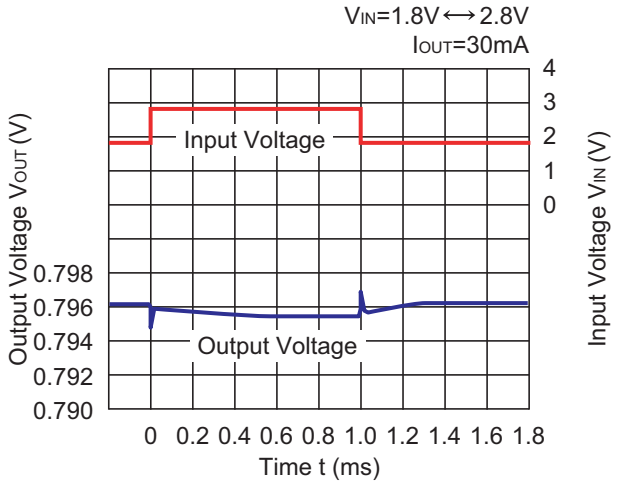


RP200x40xx

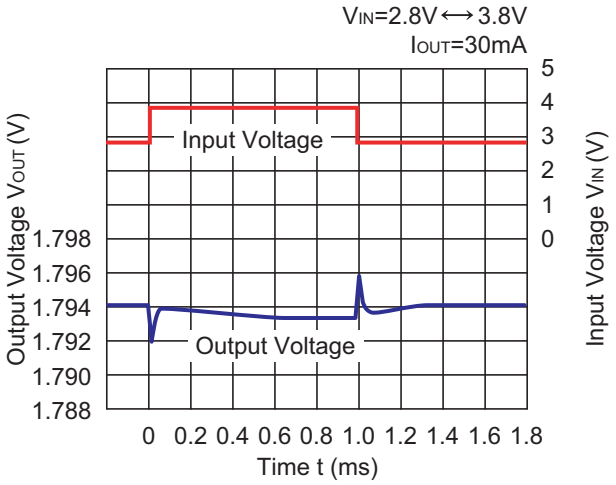
(Auto ECO Low Power Mode)



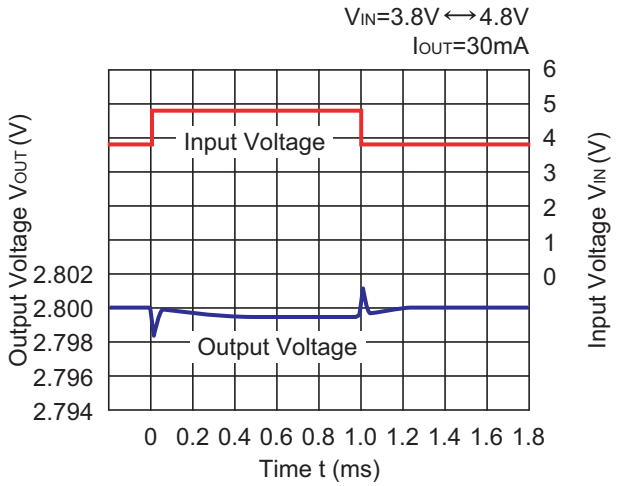
RP200x08xx (Fixed Fast Mode)



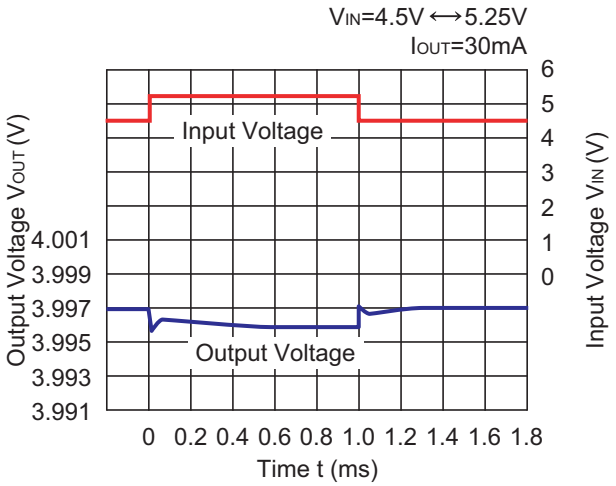
RP200x18xx (Fixed Fast Mode)



RP200x28xx (Fixed Fast Mode)



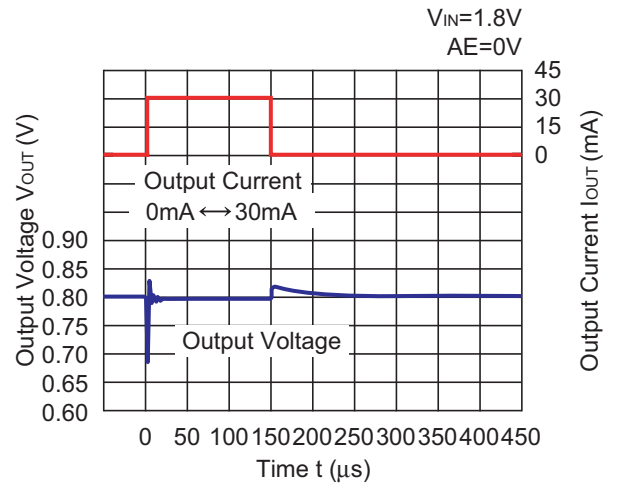
RP200x40xx (Fixed Fast Mode)



12) Load Transient Response (C1=1.0µF, C2=1.0µF, tr=tf=0.5µs, Topt=25°C)

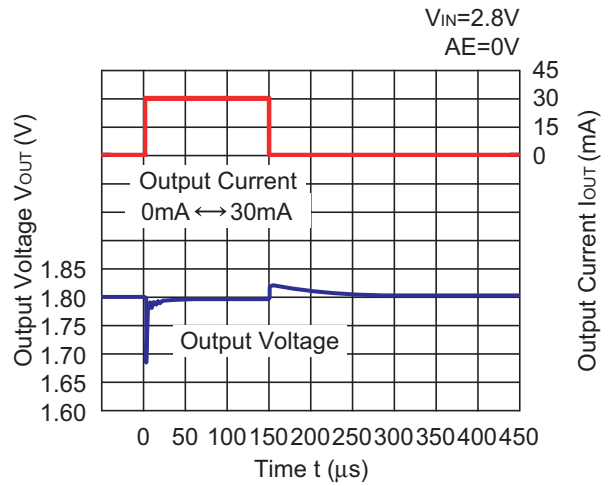
RP200x08xx

Auto ECO (Low Power Mode↔Fast Mode)



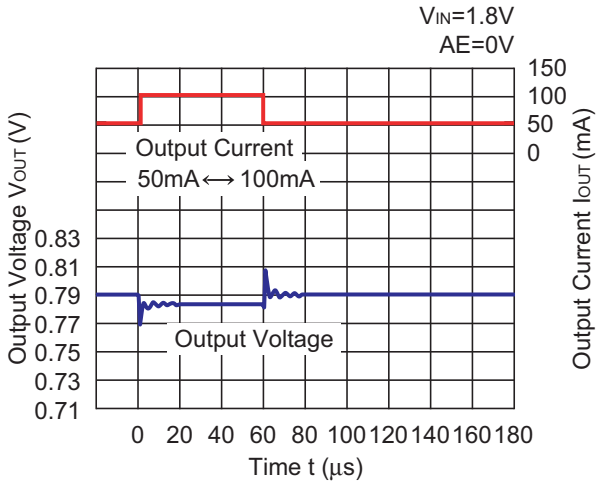
RP200x18xx

Auto ECO (Low Power Mode↔Fast Mode)



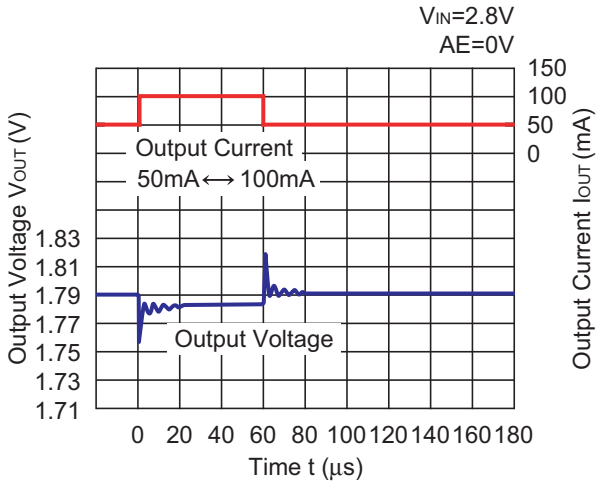
RP200x08xx

(Auto ECO Fast Mode)



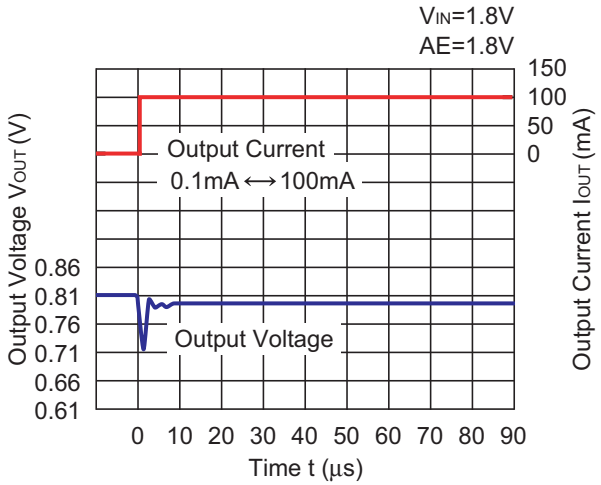
RP200x18xx

(Auto ECO Fast Mode)



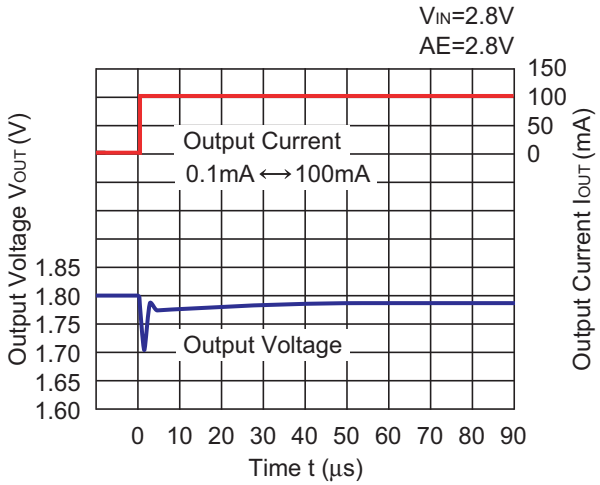
RP200x08xx

(Fixed Fast Mode)



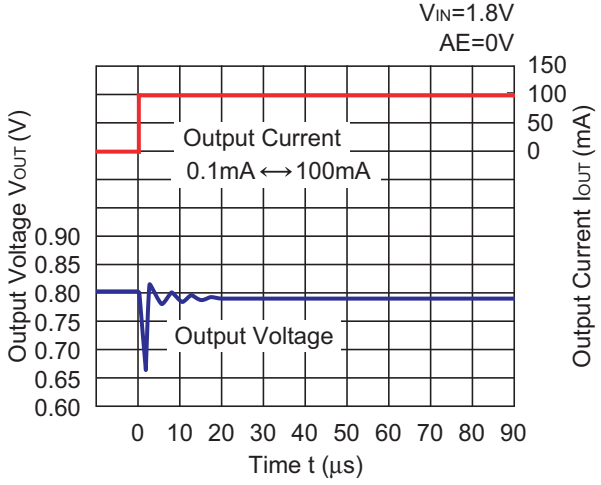
RP200x18xx

(Fixed Fast Mode)



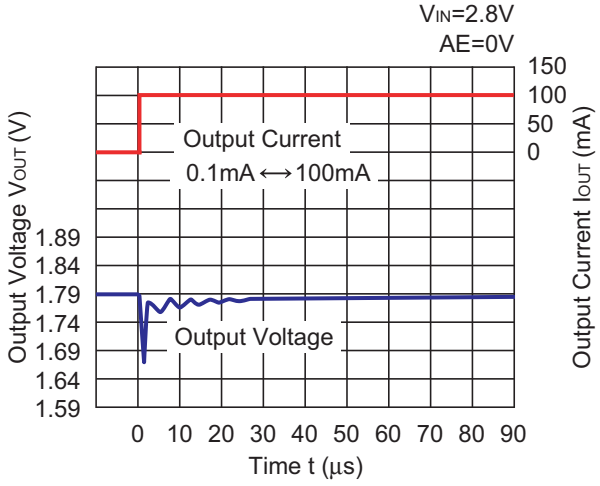
RP200x08xx

Auto ECO (Low Power Mode→Fast Mode)

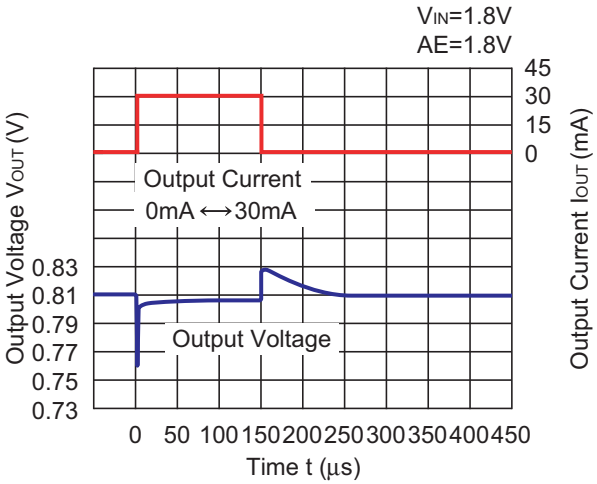


RP200x18xx

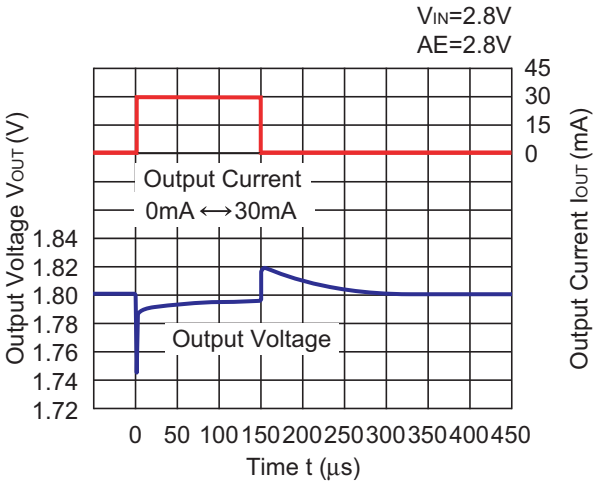
Auto ECO (Low Power Mode→Fast Mode)



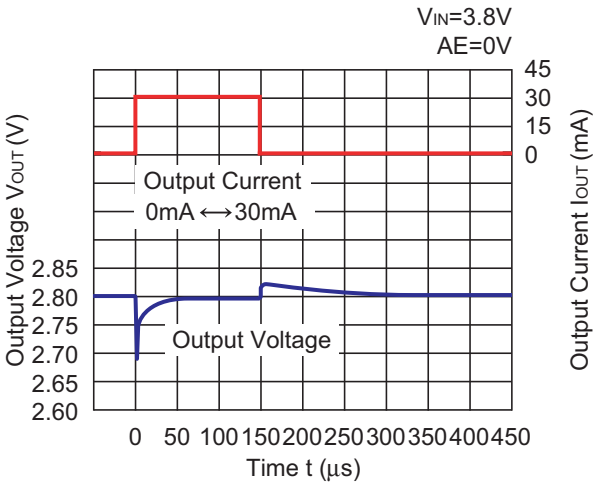
RP200x08xx
(Fixed Fast Mode)



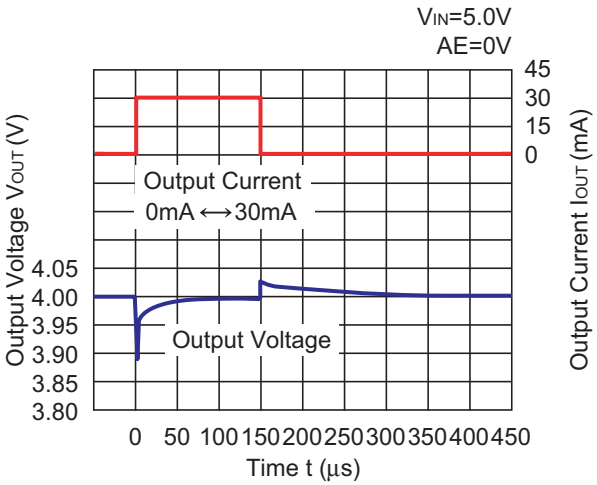
RP200x18xx
(Fixed Fast Mode)



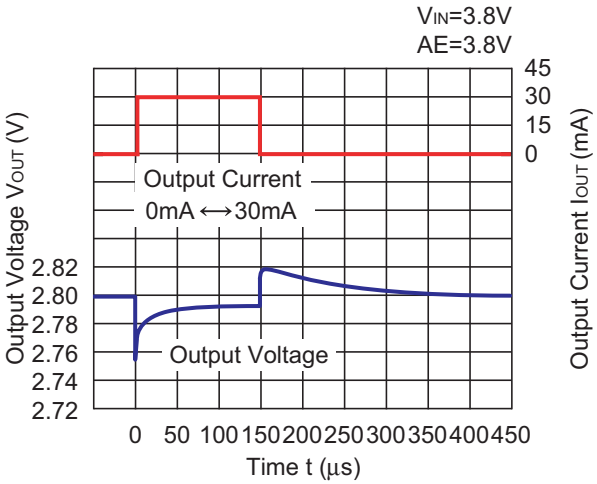
RP200x28xx
Auto ECO (Low Power Mode↔Fast Mode)



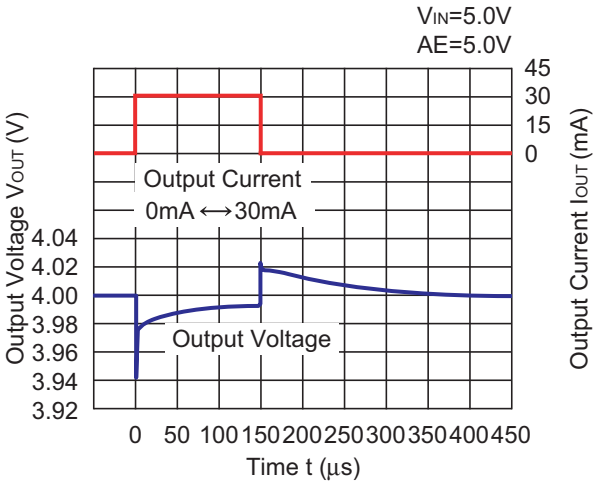
RP200x40xx
Auto ECO (Low Power Mode↔Fast Mode)



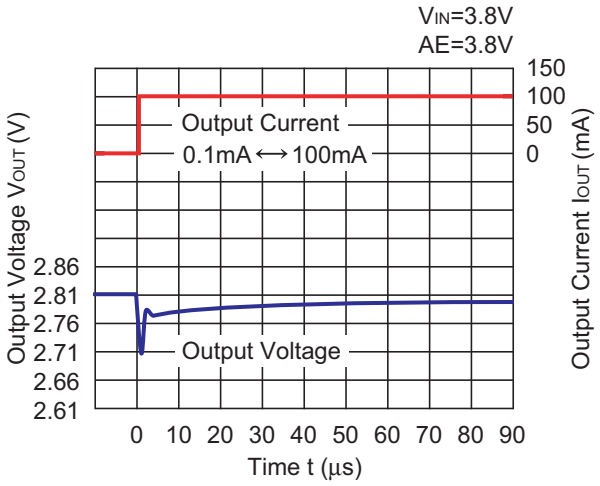
RP200x28xx
(Fixed Fast Mode)



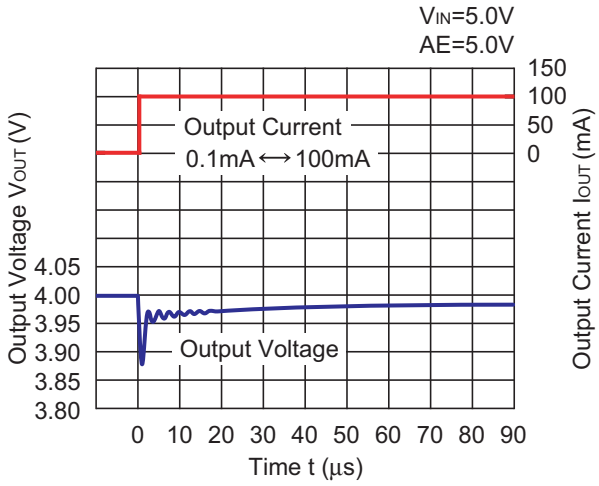
RP200x40xx
(Fixed Fast Mode)



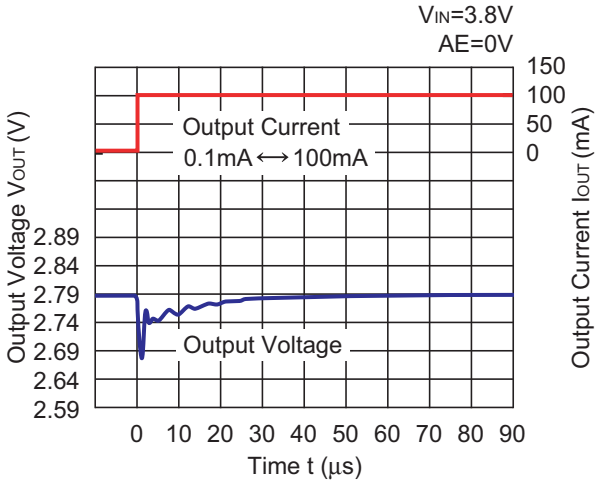
RP200x28xx
(Fixed Fast Mode)



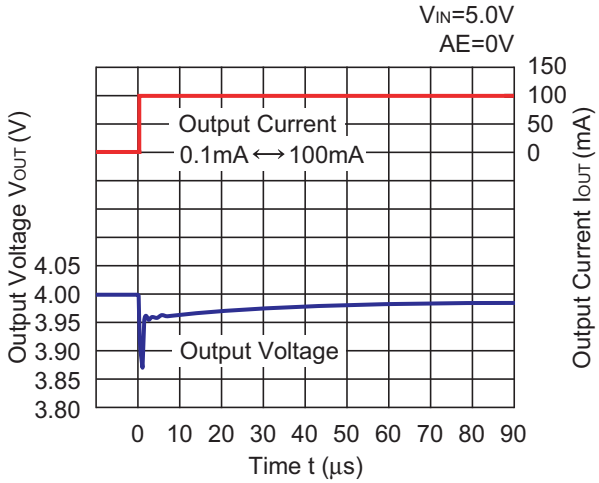
RP200x40xx
(Fixed Fast Mode)



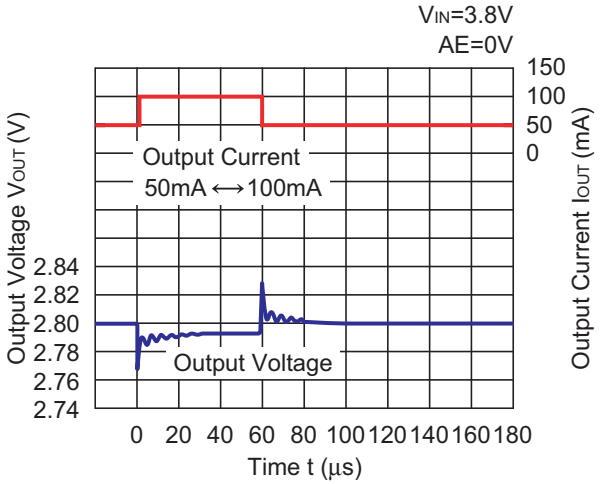
RP200x28xx
Auto ECO (Low Power Mode→Fast Mode)



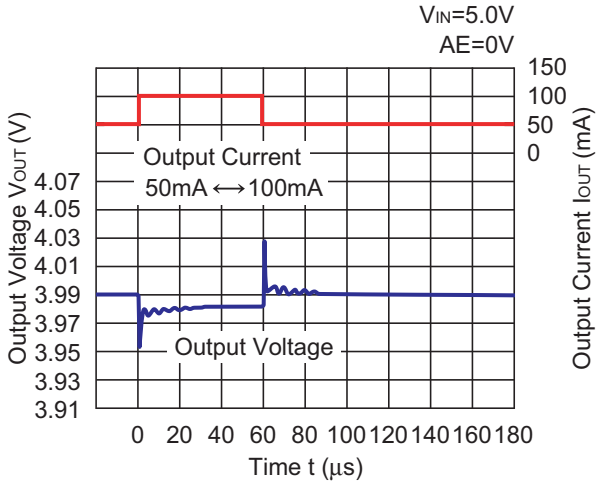
RP200x40xx
Auto ECO (Low Power Mode→Fast Mode)



RP200x28xx
(Auto ECO Fast Mode)

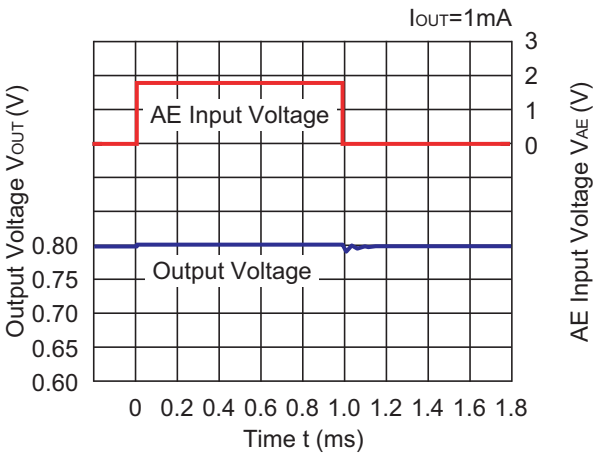


RP200x40xx
(Auto ECO Fast Mode)

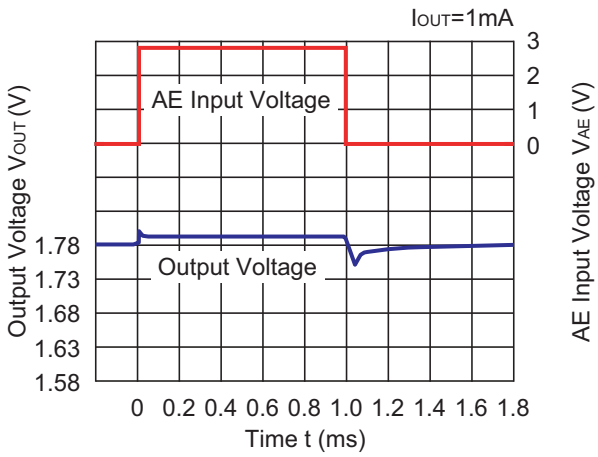


13) AE Switch Transient Response (C1=1.0µF, C2=1.0µF, tr=tf=0.5µs, Topt=25°C)

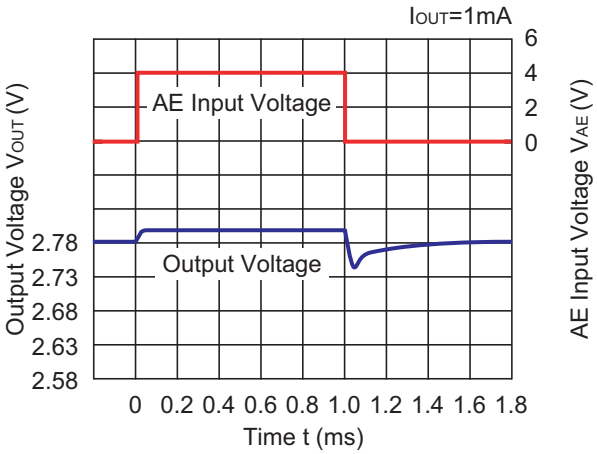
RP200x08xx



RP200x18xx



RP200x28xx



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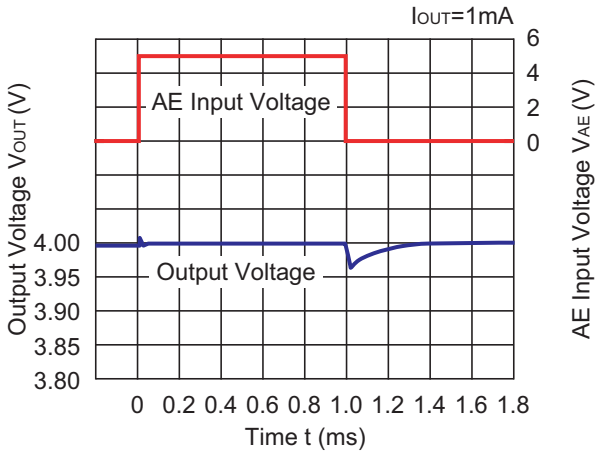
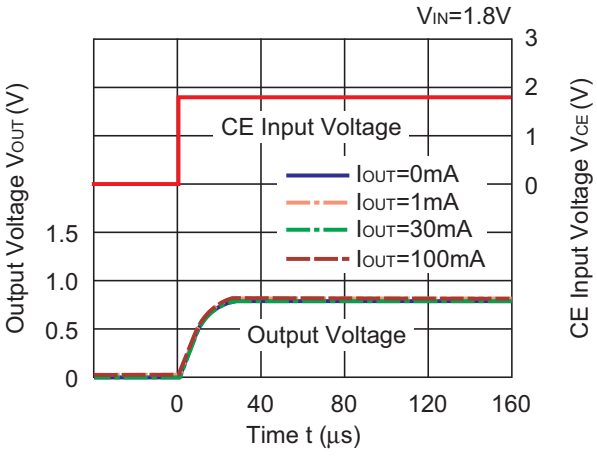


14) Turn On Speed with CE pin (C1=1.0µF, C2=1.0µF, Topt=25°C)

RP200x08xx



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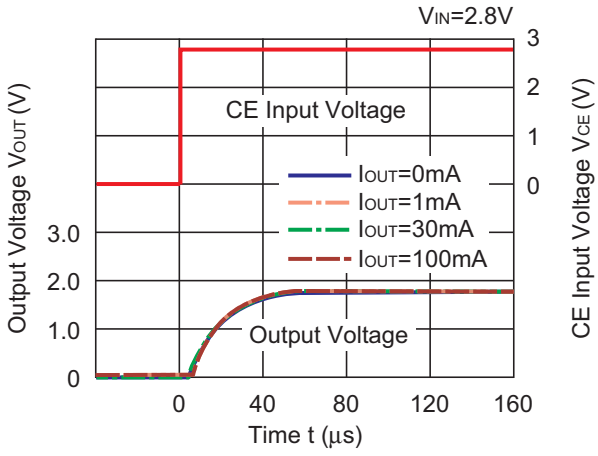

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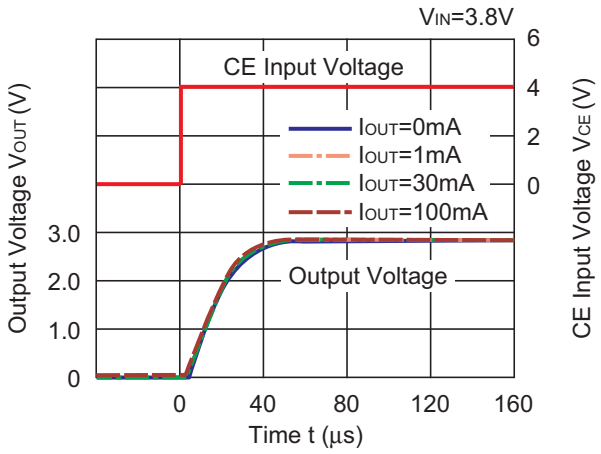

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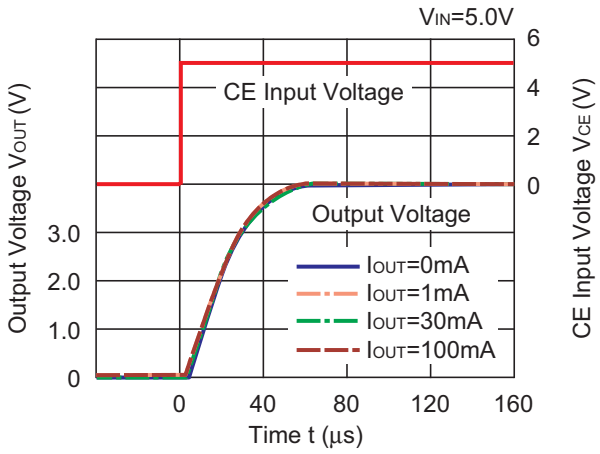
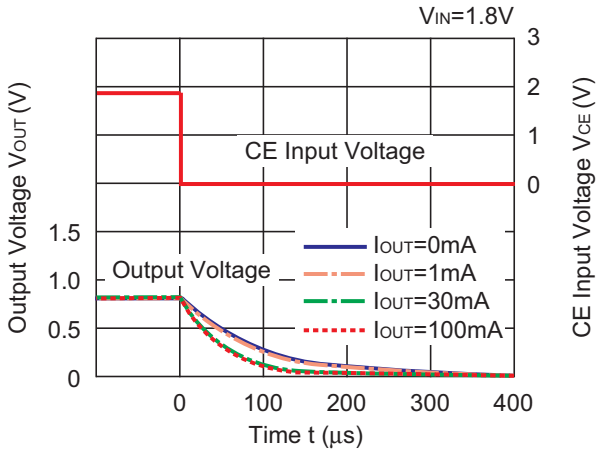


15) Turn Off Speed with CE pin (D Version) (C1=1.0µF, C2=1.0µF, Topt=25°C)

RP200x08xx



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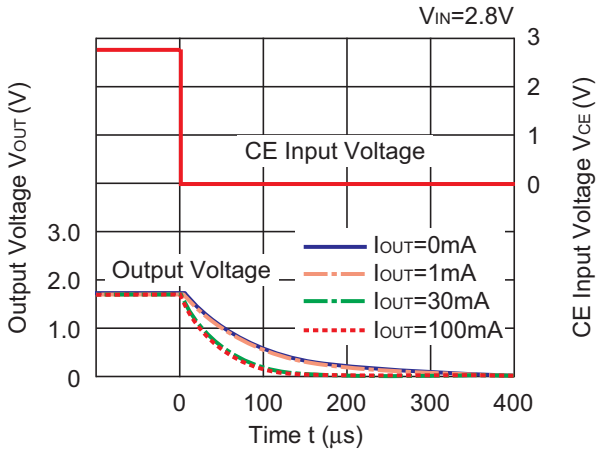

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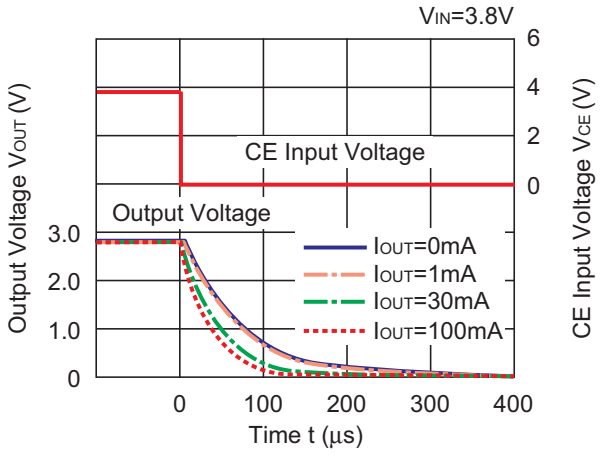
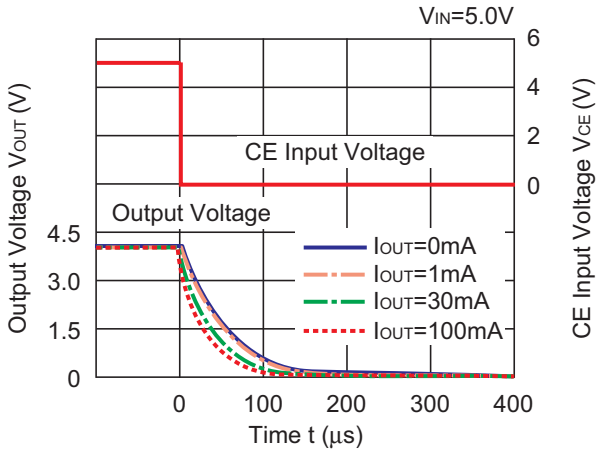


RP200x40xx



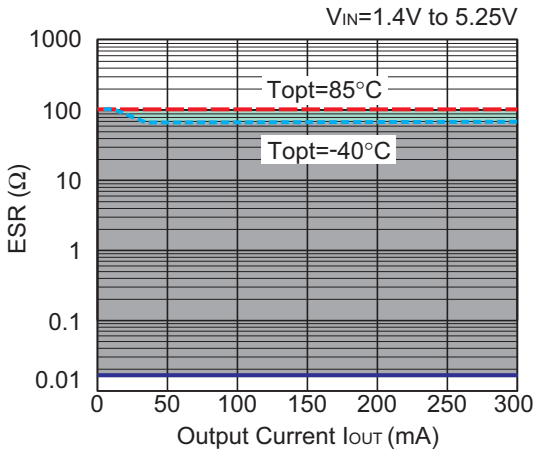
ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between I_{OUT} (Output Current) and ESR of an 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.

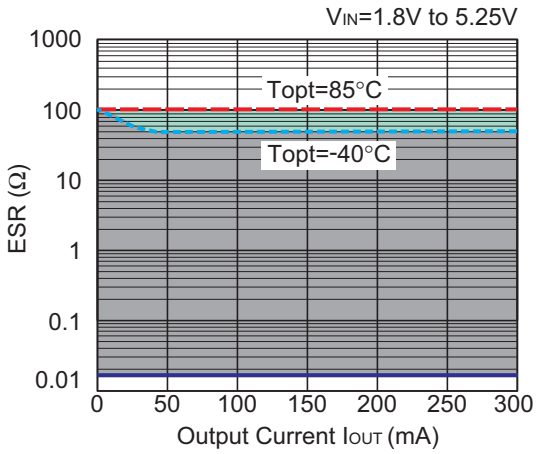
Measurement conditions

Frequency Band: 10Hz to 2MHz
Temperature : −40°C to 85°C
C1, C2 : 1.0μF

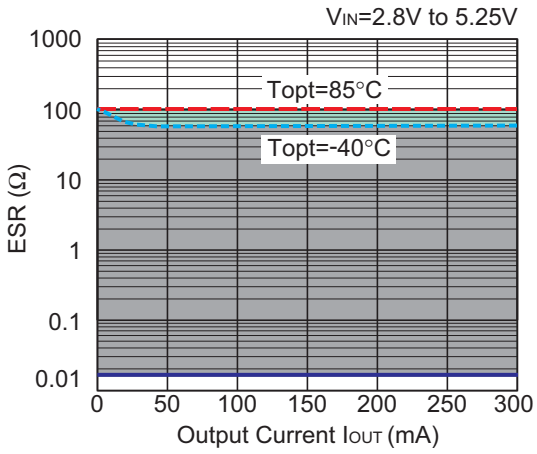
RP200x08xx



RP200x18xx



RP200x28xx



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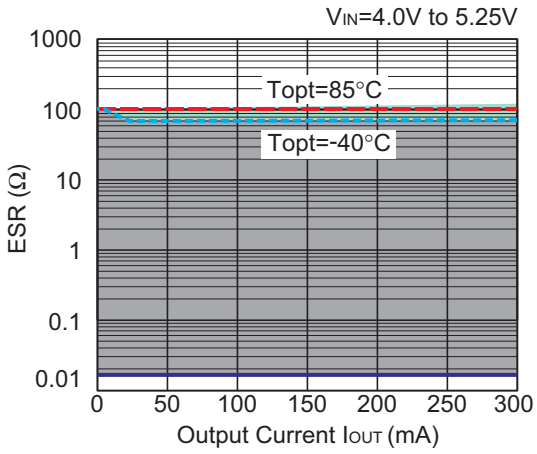

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