

3-MODE 150mA LDO REGULATOR

NO.EA-234-170126

OUTLINE

The RP201x 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 RP201x 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. (RP201Z 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. RP201Q (SC-88A), RP201K (DFN(PLP)1212-6) and RP201N (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. 1.0 μ A ($V_{OUT} \leq 1.85V$)
- Supply Current (Fast Mode)..... Typ. 55 μ A
- Supply Current (Standby Mode) Typ. 0.1 μ A
- 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..... $\pm 1.0\%$ ($V_{OUT} > 2.0V$, $T_{opt}=25^{\circ}C$)
- Temperature-Drift Coefficient of Output Voltage Typ. $\pm 50ppm/^{\circ}C$
- Dropout Voltage Typ. 0.12V ($I_{OUT}=150mA$, $V_{OUT}=2.8V$)
- 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 1.0 μ F or more

APPLICATIONS

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

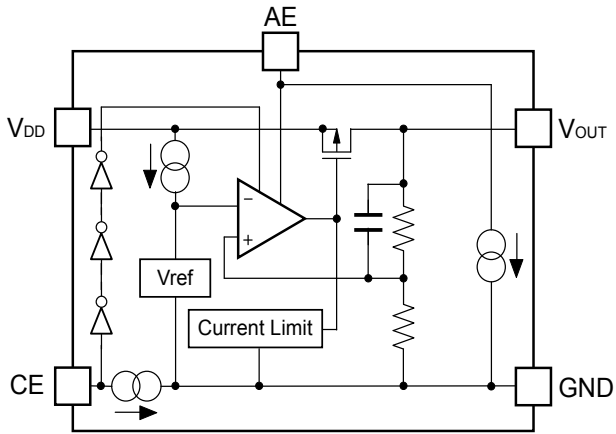
*RP201Q (SC-88A) and RP201N (SOT-23-5) are the discontinued products as of January 2017.

RP201x

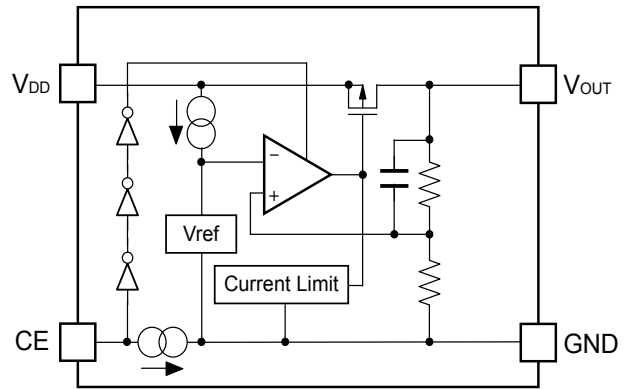
NO.EA-234-170126

BLOCK DIAGRAMS

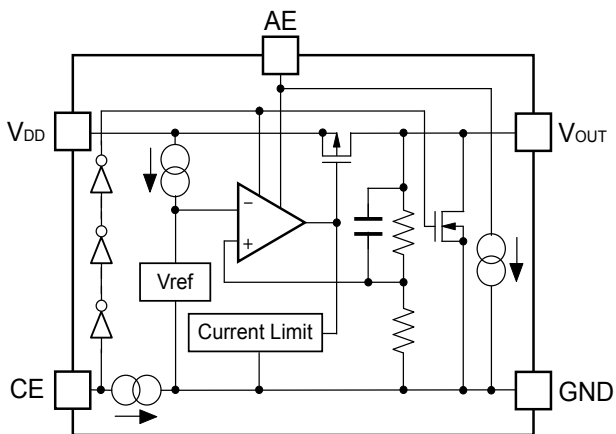
RP201K/N/QxxxB



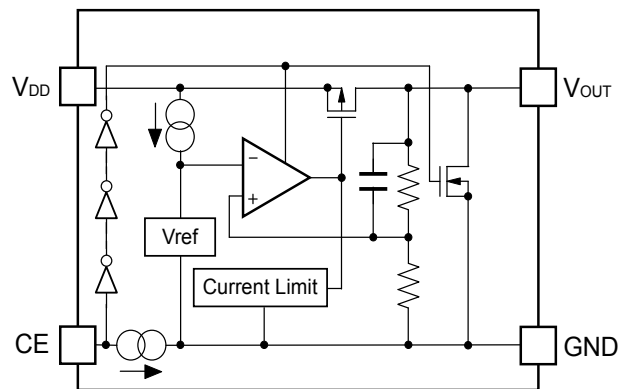
RP201Zxx1B



RP201K/N/QxxxD



RP201Zxx1D



*RP201Q (SC-88A) and RP201N (SOT-23-5) are the discontinued products as of January 2017.

RP201x

NO.EA-234-170126

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
RP201Zxx1*-TR-F	WLCSP-4-P5	5,000 pcs	Yes	Yes
RP201Kxx1*-TR	DFN(PLP)1212-6	5,000 pcs	Yes	Yes
RP201Qxx2*-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP201Nxx1*-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.)

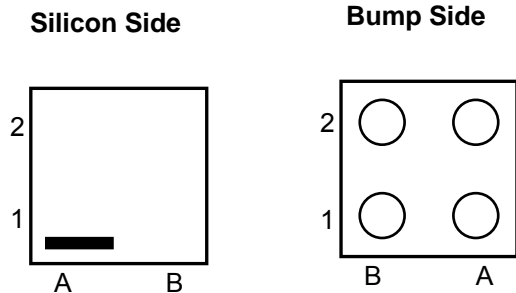
* : The auto discharge function at off state are options as follows.
(B) without auto discharge function at off state
(D) with auto discharge function at off state

RP201x

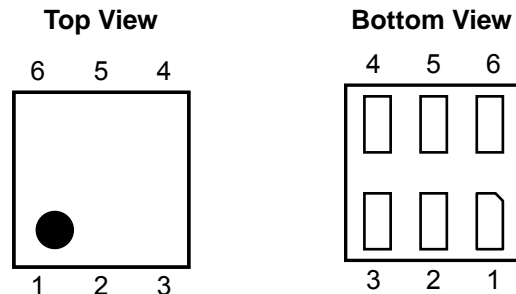
NO.EA-234-170126

PIN CONFIGURATIONS

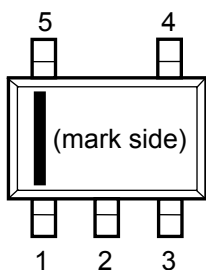
• WLCSP-4-P5



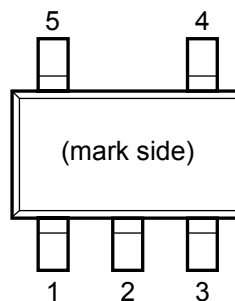
• DFN(PLP)1212-6



• SC-88A



• SOT-23-5



PIN DESCRIPTIONS

• 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

*RP201Q (SC-88A) and RP201N (SOT-23-5) are the discontinued products as of January 2017.

RP201x

NO.EA-234-170126

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	
T_{opt}	Operating Temperature Range	-40 to 85	°C
T_{stg}	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 $V_{OUT}+1V$, $I_{OUT}=1mA$, $C_{IN}=C_{OUT}=1\mu F$, unless otherwise noted.

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$.

● RP201x

$T_{opt}=25^{\circ}C$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{OUT}	Output Voltage (Fast Mode)	$I_{OUT}=5mA$ $T_{opt}=25^{\circ}C$	$V_{OUT} > 2.0V$	$\times 0.99$		$\times 1.01$	V
			$V_{OUT} \leq 2.0V$	-20		20	mV
		$I_{OUT}=5mA$ $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{OUT} > 2.0V$	×0.975		×1.015	V
			$V_{OUT} \leq 2.0V$	-50		30	mV
I_{OUT}	Output Current		150			mA	
$\Delta V_{OUT} / \Delta I_{OUT}$	Load Regulation	$1mA \leq I_{OUT} \leq 10mA$	$V_{OUT} > 2.0V$	-1.0		1.0	%
			$V_{OUT} \leq 2.0V$	-20		20	mV
		$10mA \leq I_{OUT} \leq 150mA$			18	40	mV
V_{DIF}	Dropout Voltage	$I_{OUT}=150mA$	$0.8V \leq V_{OUT} < 0.9V$			*4	V
			$0.9V \leq V_{OUT} < 1.0V$			*4	
			$1.0V \leq V_{OUT} < 1.5V$		0.24	0.40	
			$1.5V \leq V_{OUT} < 2.6V$		0.17	0.25	
			$2.6V \leq V_{OUT} \leq 4.0V$		0.12	0.18	
I_{SS1}	Supply Current (Low Power Mode)*1	$I_{OUT}=0mA$	$V_{OUT} \leq 1.85V$		1.0	4.0	μA
			$V_{OUT} > 1.85V$		1.5	4.0	
I_{SS2}	Supply Current (Fast Mode)	$I_{OUT}=10mA$		55		μA	
$I_{standby}$	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	
$\Delta V_{OUT} / \Delta V_{IN}$	Line Regulation	$V_{OUT}+0.5V \leq V_{IN} \leq 5.0V$, $V_{IN} \geq 1.4V$	$I_{OUT}=1mA$ (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 $V_{OUT} \leq 1.2V$, $V_{IN}=2.2V$)		70		dB	
V_{IN}	Input Voltage*2		1.40		5.25	V	
$\Delta V_{OUT} / \Delta T_{opt}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 50		ppm/ $^{\circ}C$	
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	

*RP201Q (SC-88A) and RP201N (SOT-23-5) are the discontinued products as of January 2017.

RP201x

NO.EA-234-170126

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V _{CEL}	CE Input Voltage "L"				0.4	V
I _{AE PD}	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

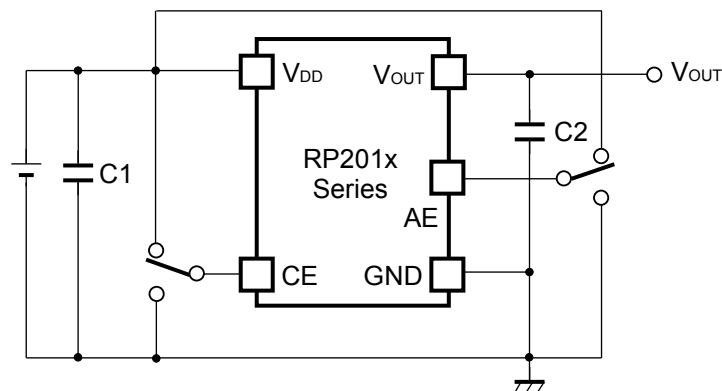
All of units are tested and specified under load conditions such that T_j≈T_{opt}=25°C except for Ripple Rejection, Output Voltage Temperature Coefficient.

- *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 RP201K/N/Q
- *4) V_{IN} ≥ 1.4V condition is dominant against this specification.

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 1.0 μ F 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 1.0 μ F 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 1.0 μ F 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)

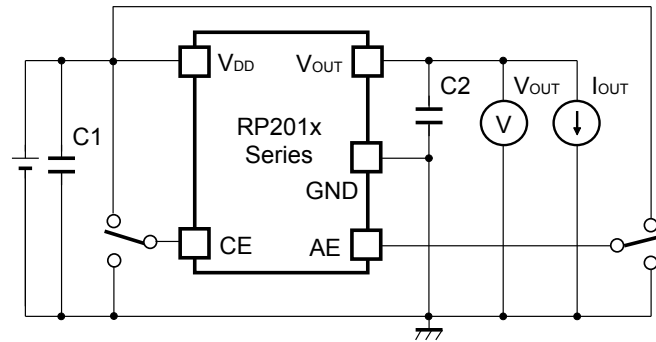
In those ICs, there is a pull-down constant current in the CE Pin and the AE Pin.

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.

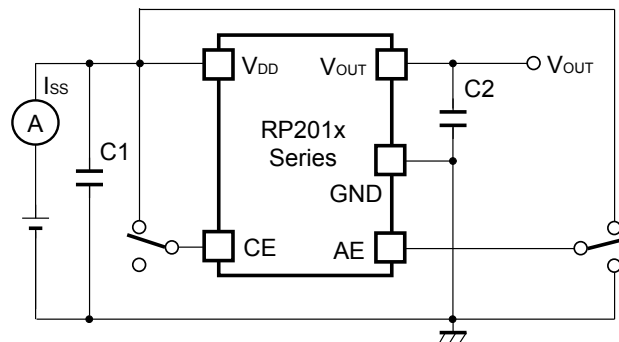
RP201x

NO.EA-234-170126

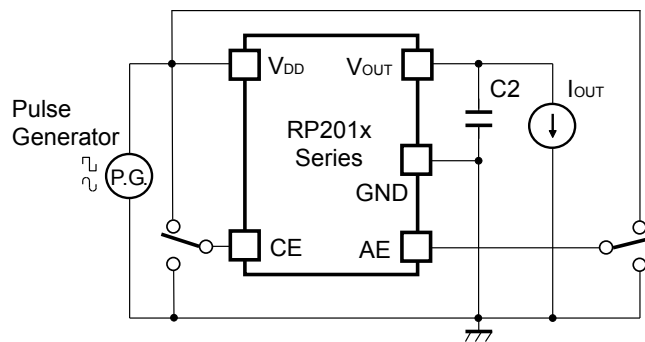
TEST CIRCUITS



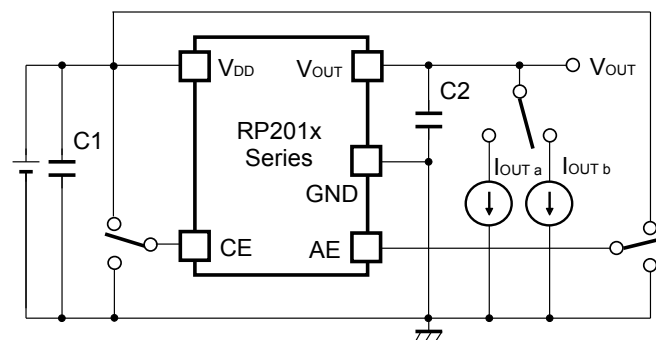
Basic Test Circuit



Test Circuit for Supply Current



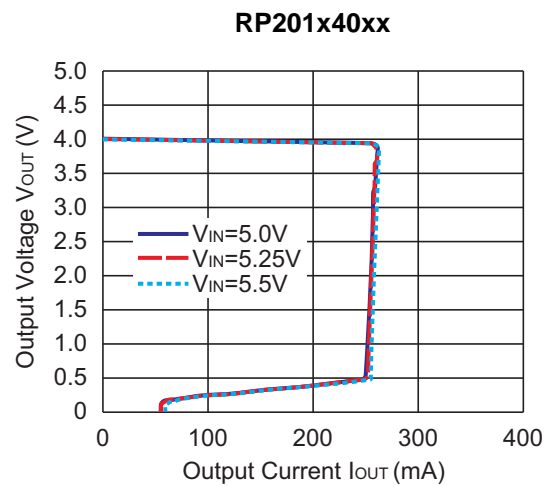
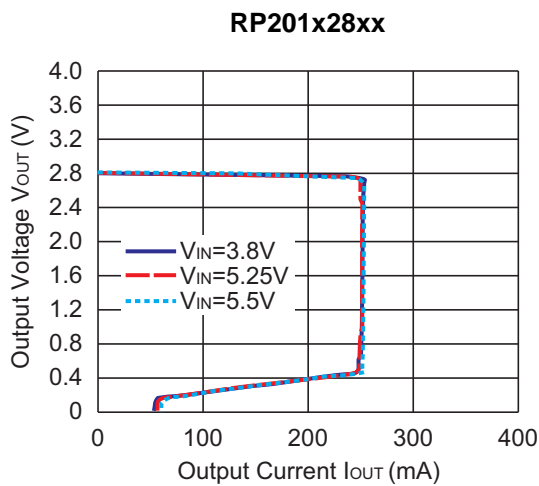
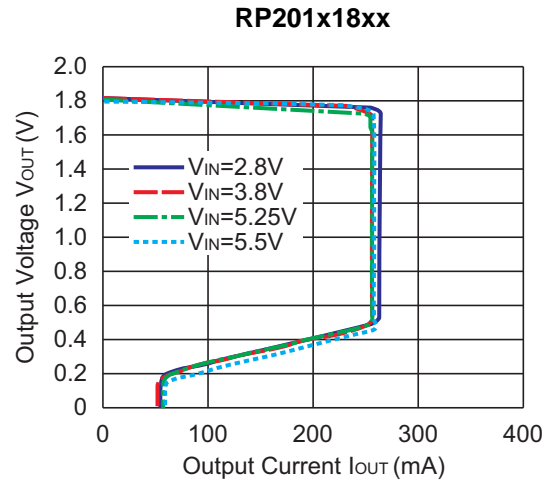
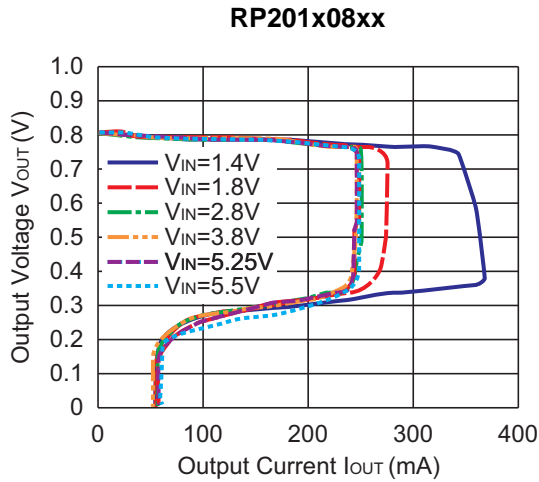
Test Circuit for Ripple Rejection



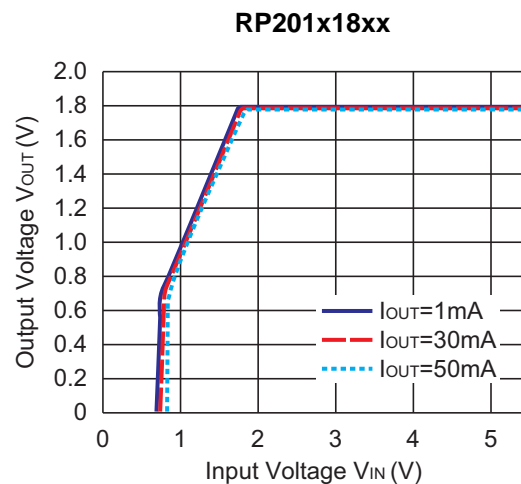
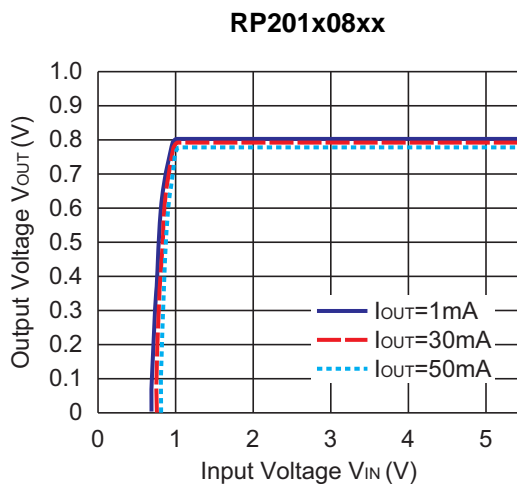
Test Circuit for Load Transient Response

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)



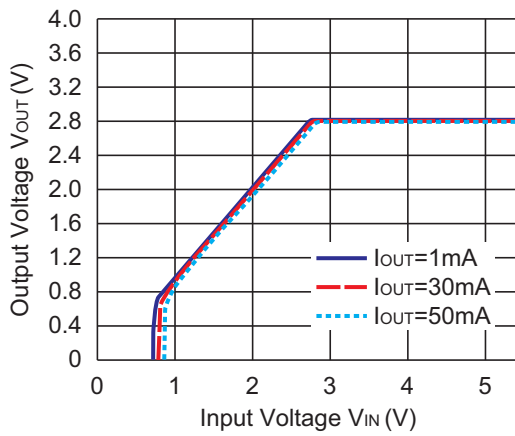
2) Output Voltage vs. Input Voltage ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)



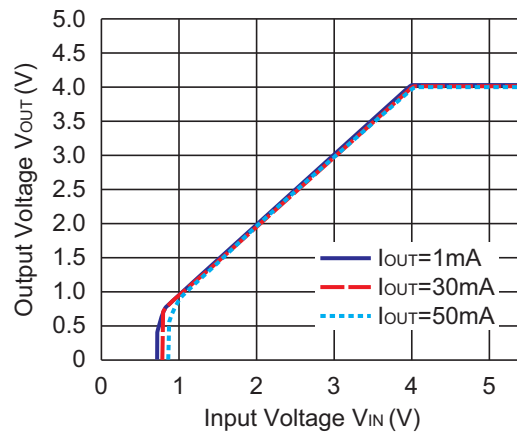
RP201x

NO.EA-234-170126

RP201x28xx

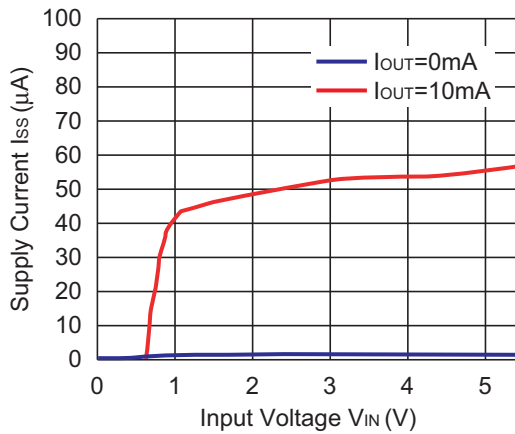


RP201x40xx

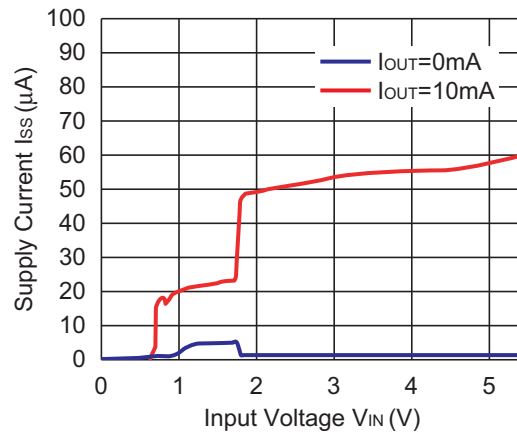


3) Supply Current vs. Input Voltage ($C1=1.0\mu\text{F}$, $C2=1.0\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)

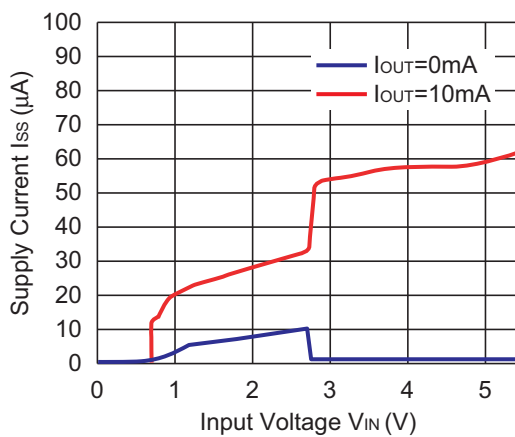
RP201x08xx



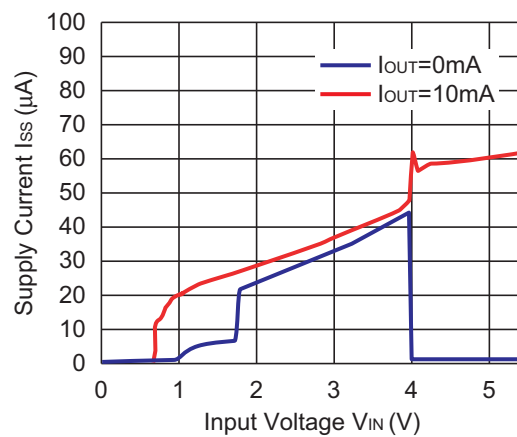
RP201x18xx



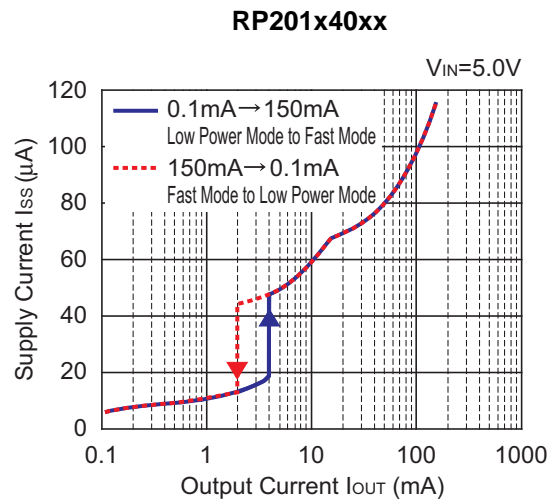
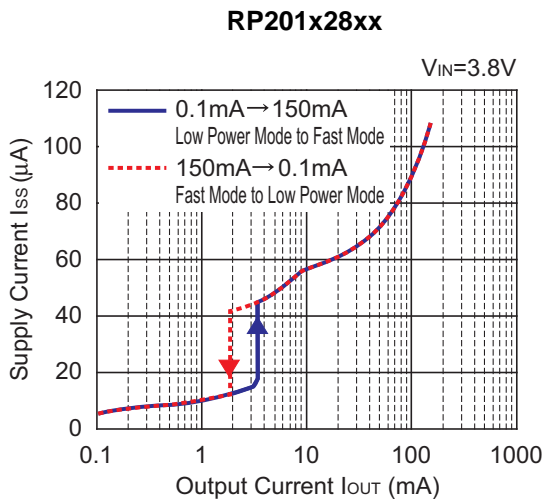
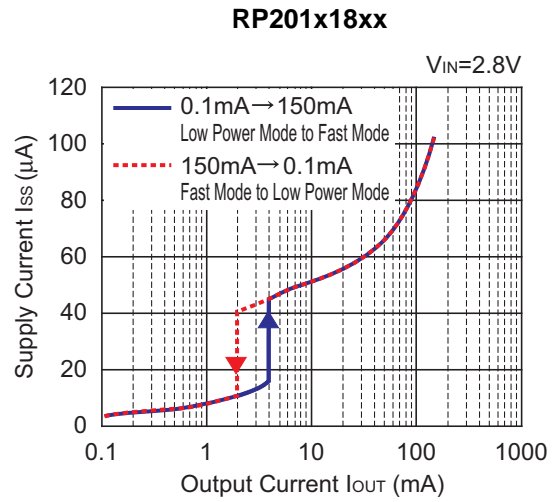
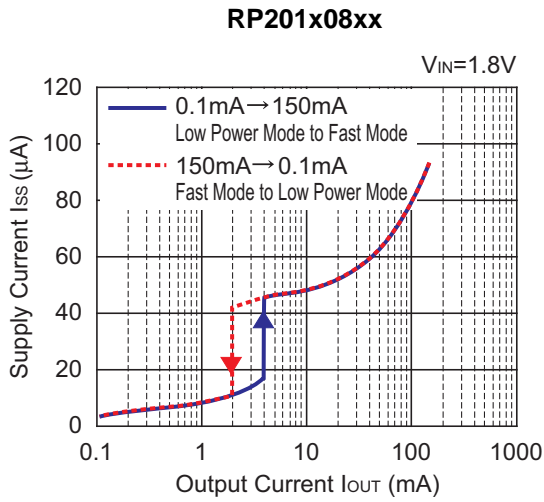
RP201x28xx



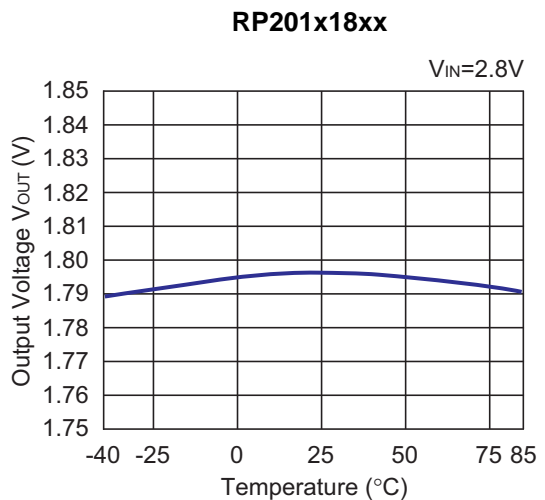
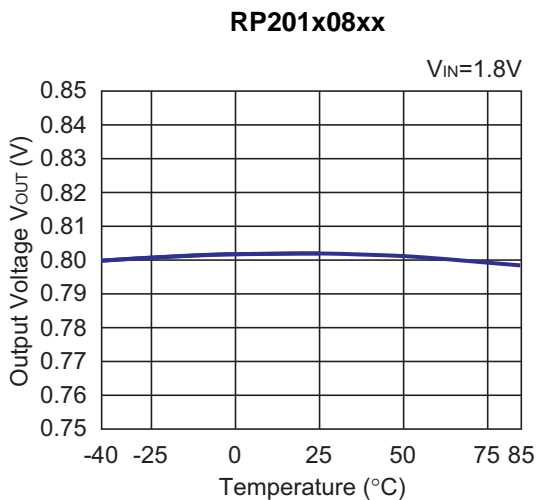
RP201x40xx



4) Supply Current vs. Output Current ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $T_{\text{opt}}=25^\circ\text{C}$)



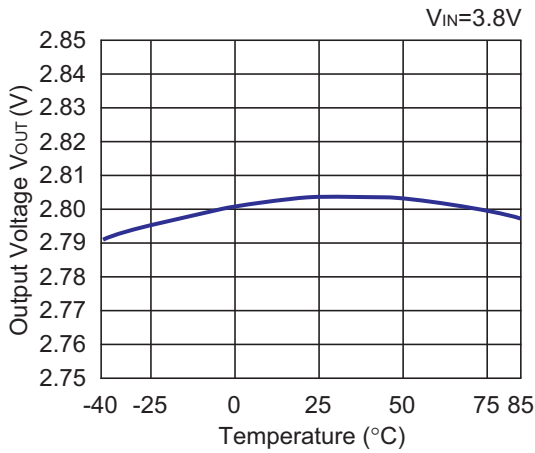
5) Output Voltage vs. Temperature ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $I_{\text{OUT}}=5\text{mA}$)



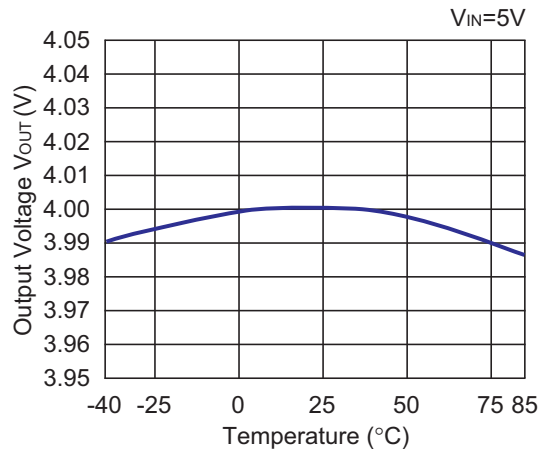
RP201x

NO.EA-234-170126

RP201x28xx



RP201x40xx

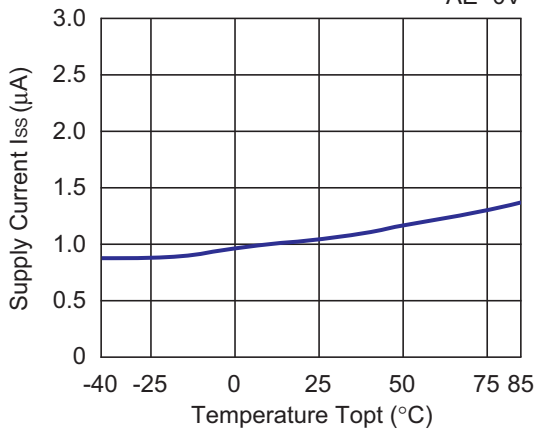


6) Supply Current vs. Temperature (C1=1.0μF, C2=1.0μF)

RP201x08xx

(Auto ECO Low Power Mode)

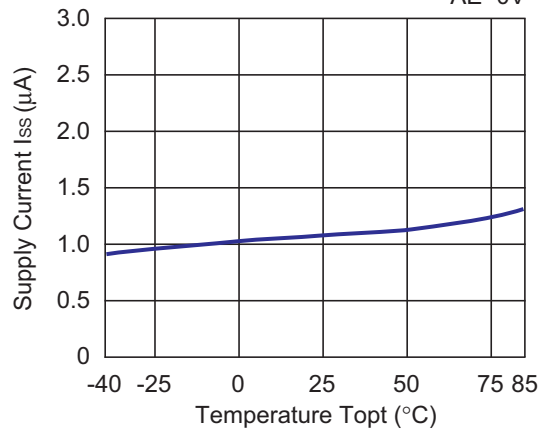
$V_{IN}=1.8V$
 $AE=0V$



RP201x18xx

(Auto ECO Low Power Mode)

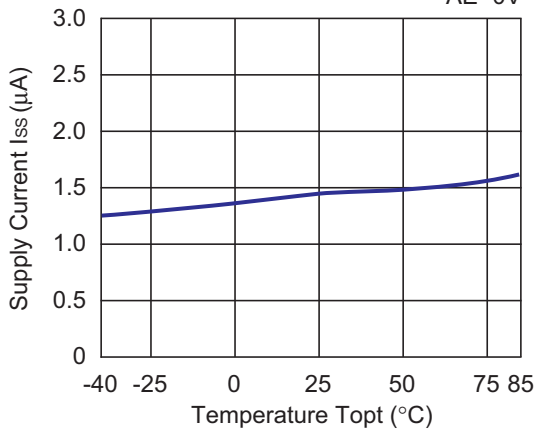
$V_{IN}=2.8V$
 $AE=0V$



RP201x28xx

(Auto ECO Low Power Mode)

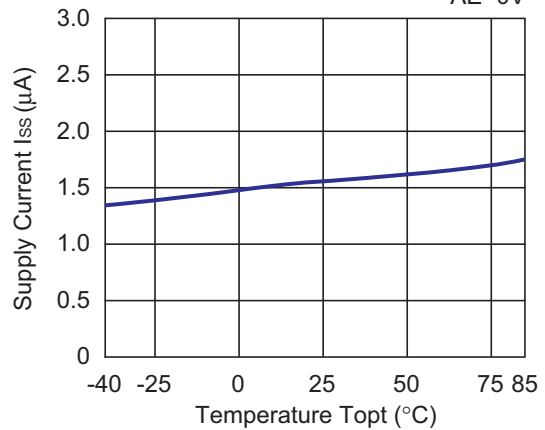
$V_{IN}=3.8V$
 $AE=0V$



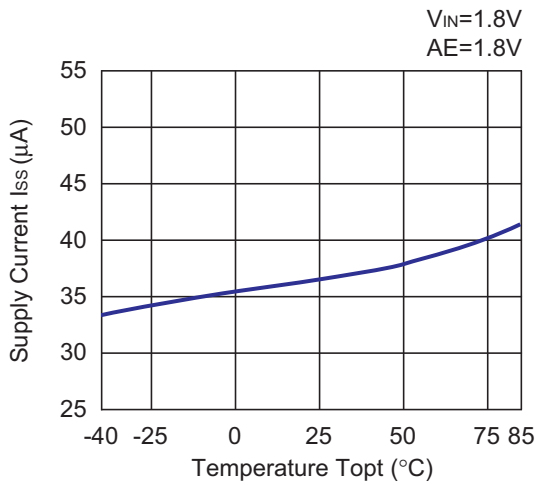
RP201x40xx

(Auto ECO Low Power Mode)

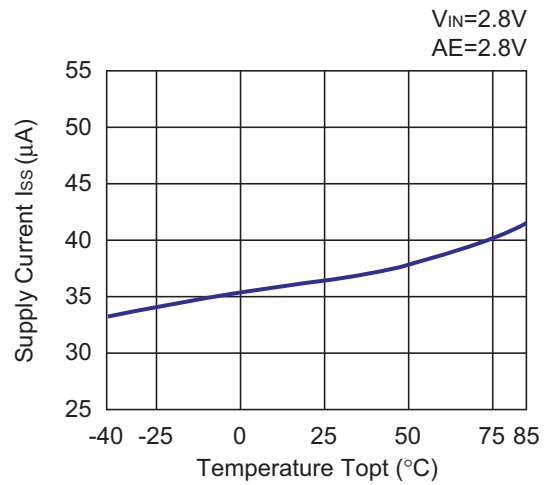
$V_{IN}=5V$
 $AE=0V$



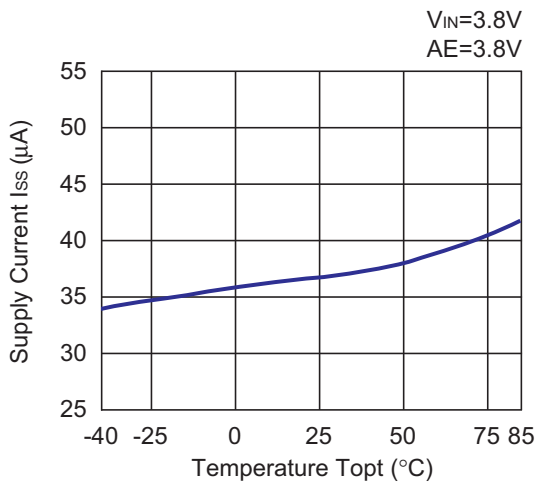
RP201x08xx (Fixed Fast Mode)



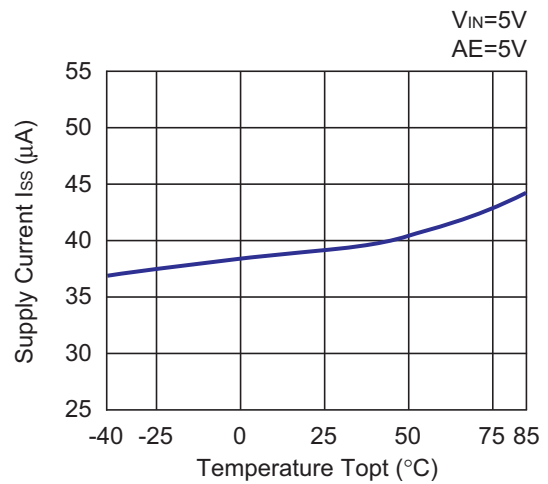
RP201x18xx (Fixed Fast Mode)



RP201x28xx (Fixed Fast Mode)

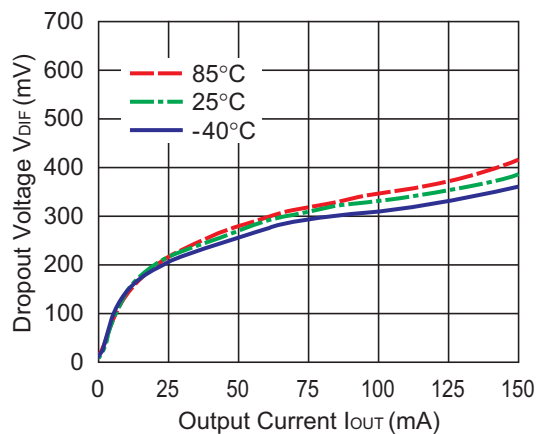


RP201x40xx (Fixed Fast Mode)

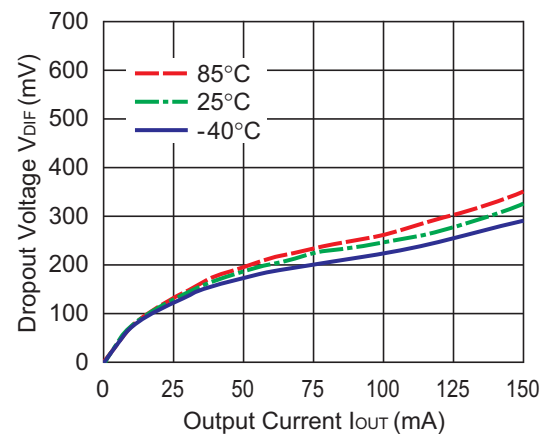


7) Dropout Voltage vs. Output Current (C1=1.0µF, C2=1.0µF)

RP201x08xx



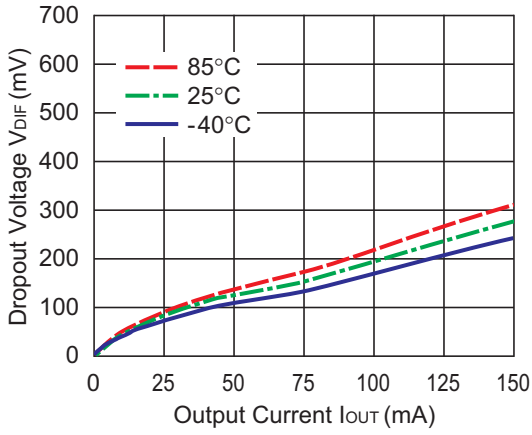
RP201x09xx



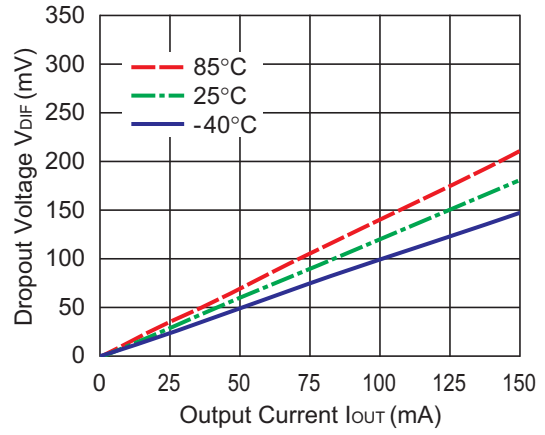
RP201x

NO.EA-234-170126

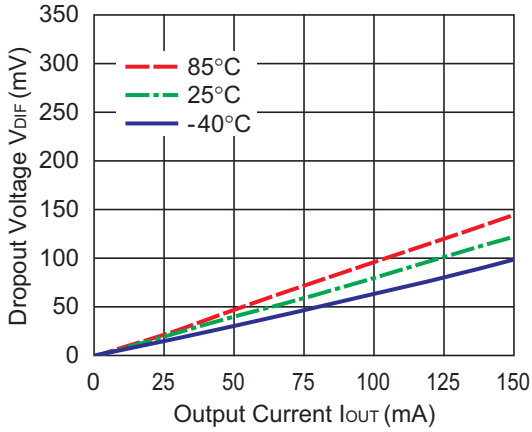
RP201x10xx



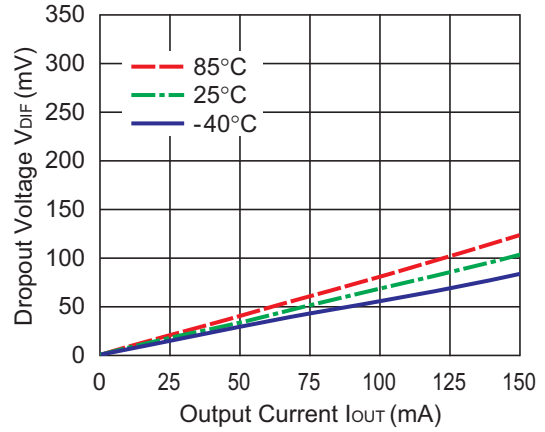
RP201x15xx



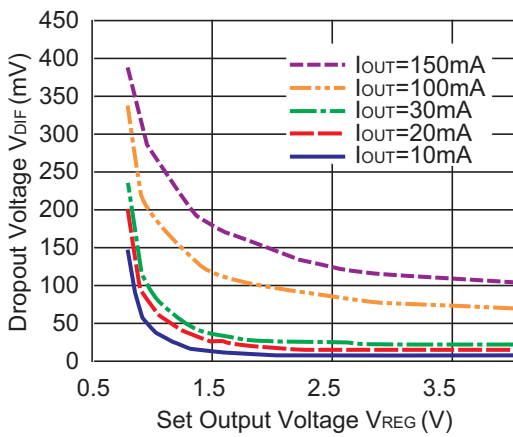
RP201x26xx



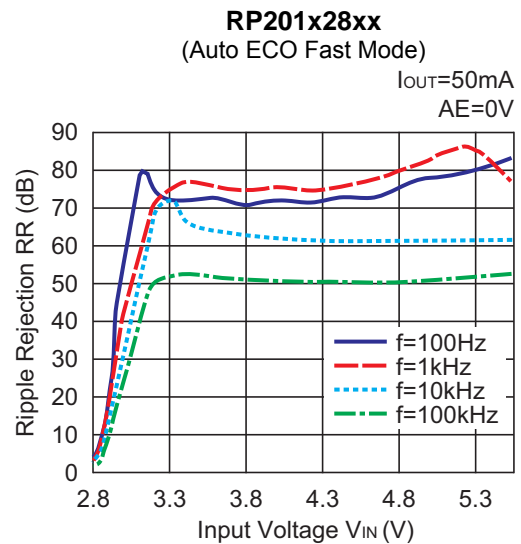
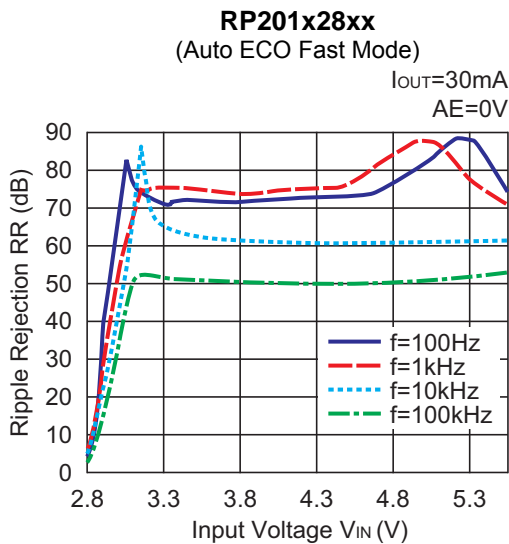
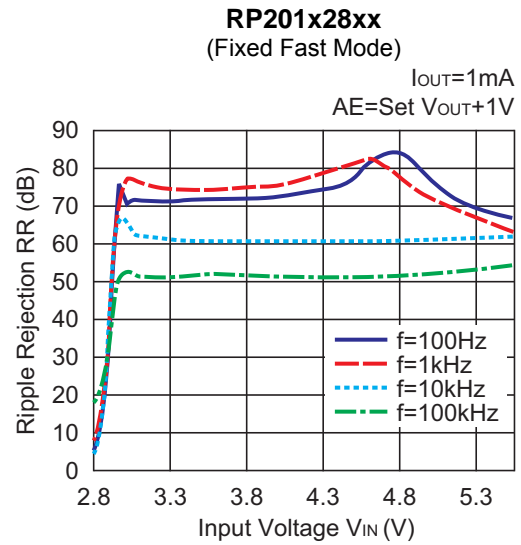
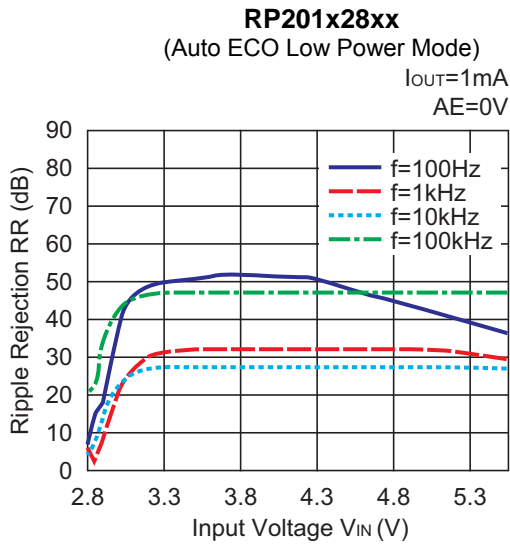
RP201x40xx



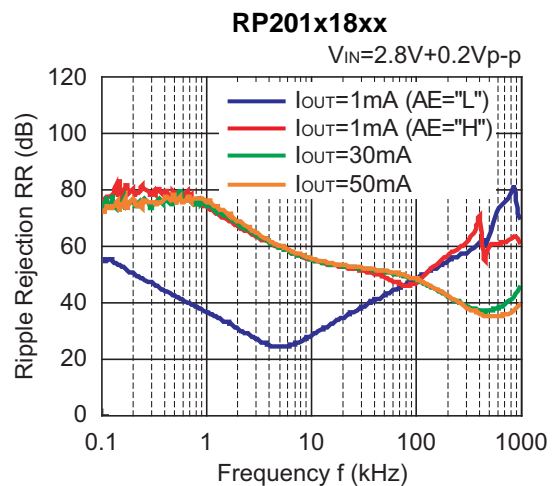
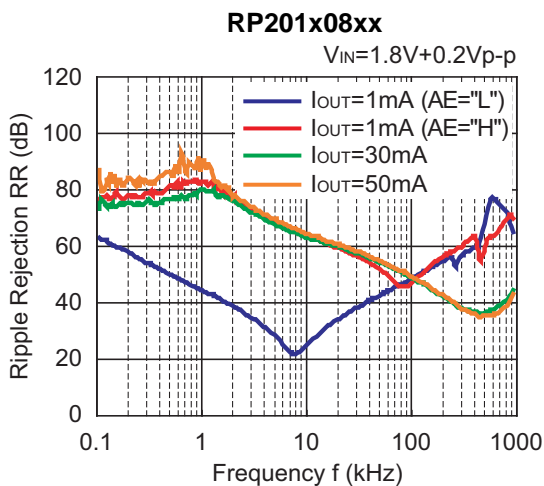
8) Dropout Voltage vs. Set Output Voltage



9) Ripple Rejection vs. Input Bias Voltage (C1=none, C2=1.0μF, Ripple=0.2V_{p-p}, T_{opt}=25°C)



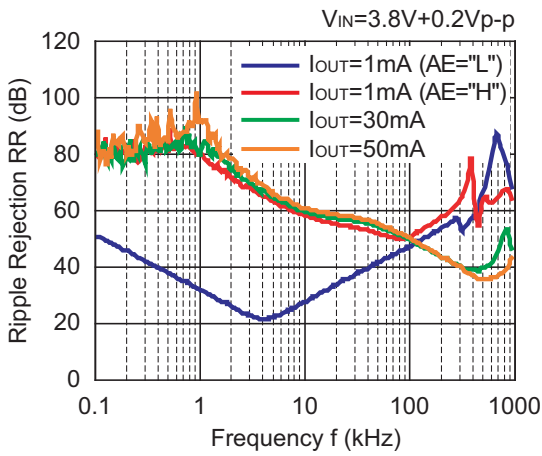
10) Ripple Rejection vs. Frequency (C1=none, C2=1.0μF, Ripple=0.2V_{p-p}, T_{opt}=25°C)



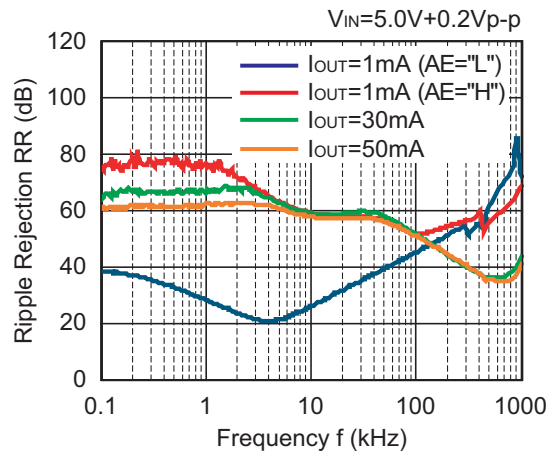
RP201x

NO.EA-234-170126

RP201x28xx



RP201x40xx



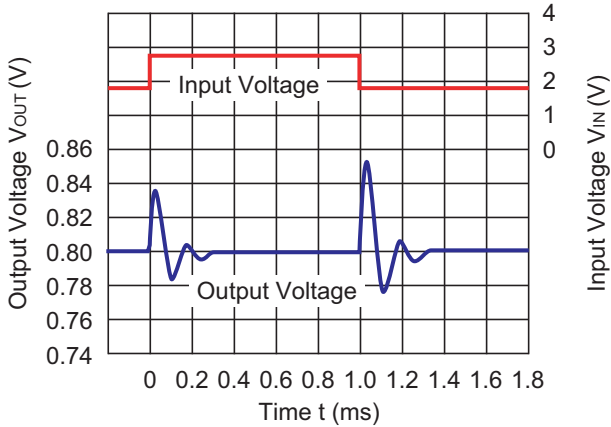
11) Input Transient Response ($C1=none$, $C2=1.0\mu F$, $t_r=t_f=5\mu s$, $T_{opt}=25^\circ C$)

RP201x08xx

(Auto ECO Low Power Mode)

$V_{IN}=1.8V \leftrightarrow 2.8V$

$I_{OUT}=1mA$

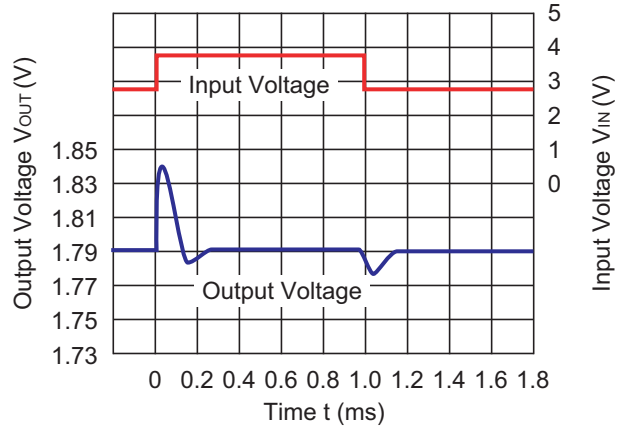


RP201x18xx

(Auto ECO Low Power Mode)

$V_{IN}=2.8V \leftrightarrow 3.8V$

$I_{OUT}=1mA$

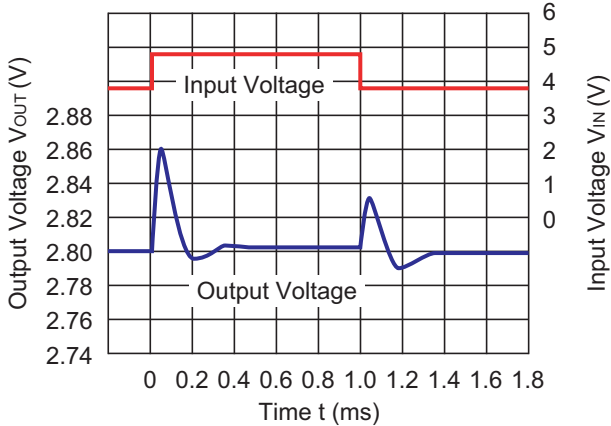


RP201x28xx

(Auto ECO Low Power Mode)

$V_{IN}=3.8V \leftrightarrow 4.8V$

$I_{OUT}=1mA$

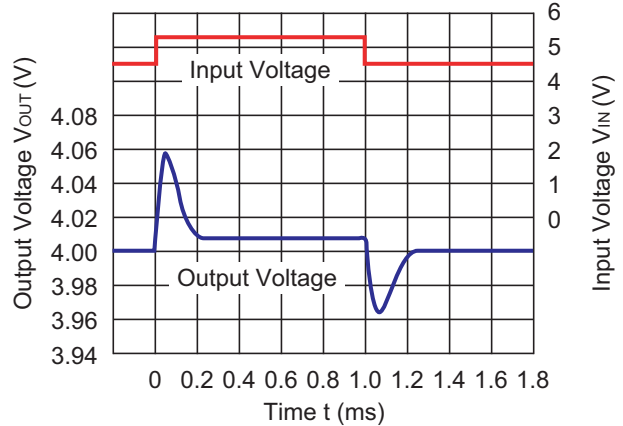


RP201x40xx

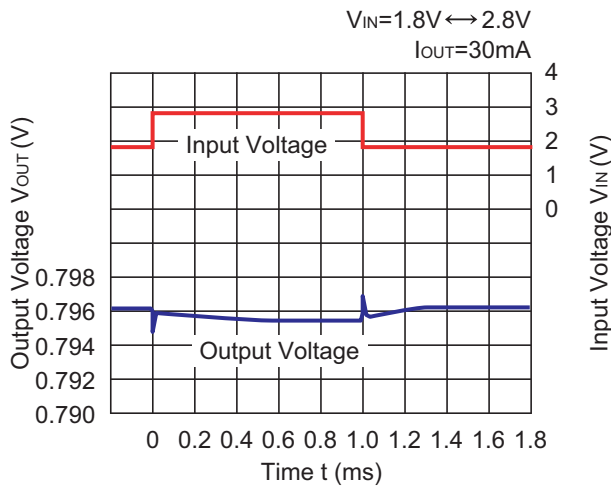
(Auto ECO Low Power Mode)

$V_{IN}=4.5V \leftrightarrow 5.25V$

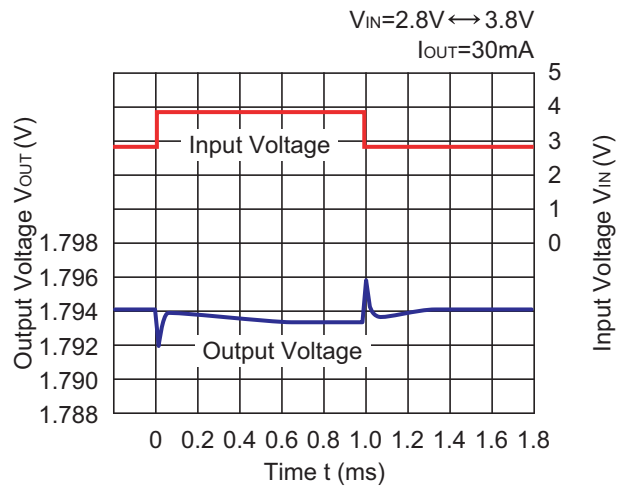
$I_{OUT}=1mA$



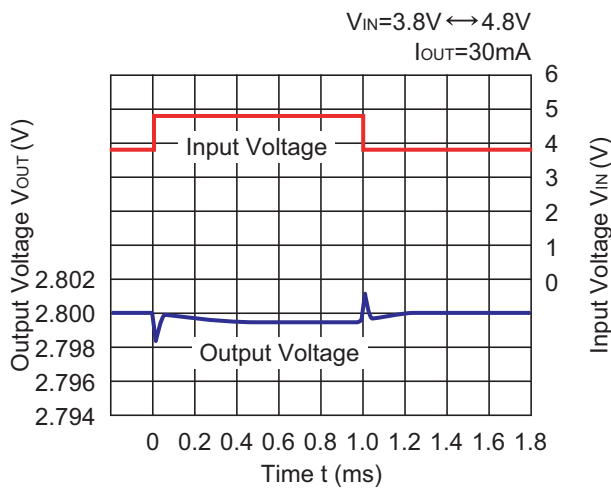
RP201x08xx (Fixed Fast Mode)



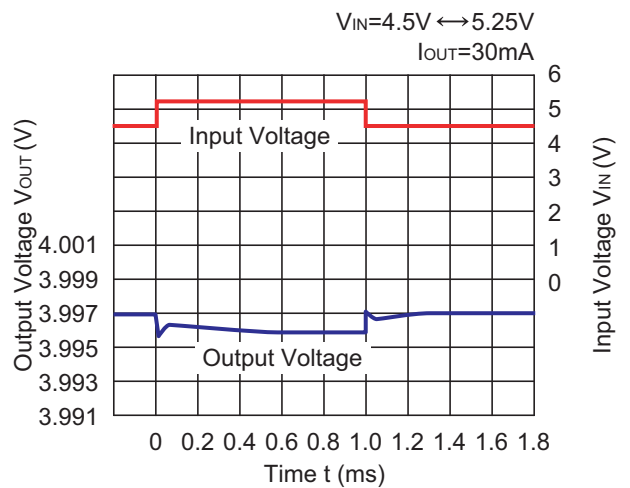
RP201x18xx (Fixed Fast Mode)



RP201x28xx (Fixed Fast Mode)



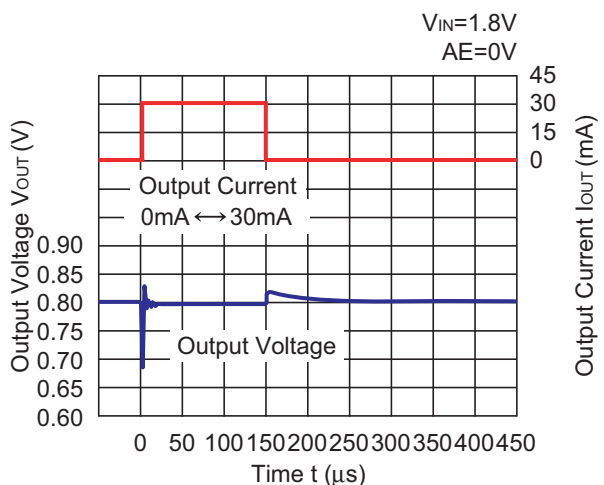
RP201x40xx (Fixed Fast Mode)



12) Load Transient Response ($C1=1.0\mu F$, $C2=1.0\mu F$, $t_r=t_f=5\mu s$, $T_{opt}=25^\circ C$)

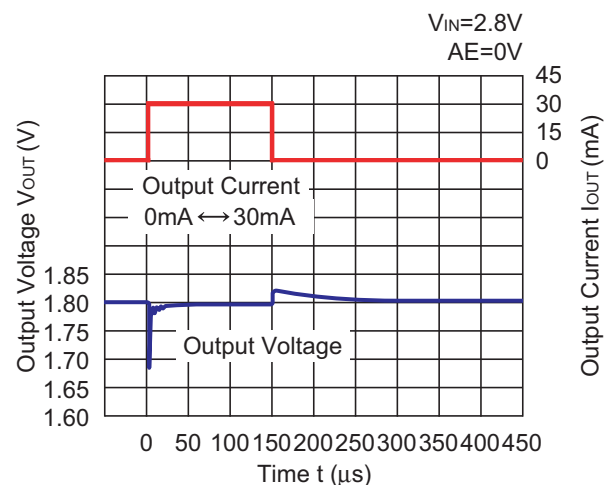
RP201x08xx

Auto ECO (Low Power Mode \leftrightarrow Fast Mode)



RP201x18xx

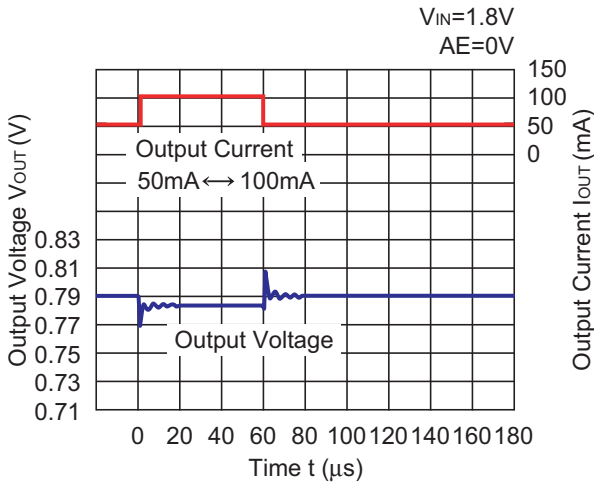
Auto ECO (Low Power Mode \leftrightarrow Fast Mode)



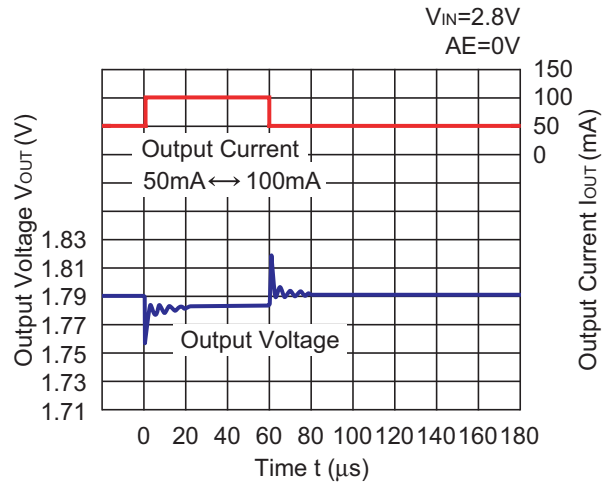
RP201x

NO.EA-234-170126

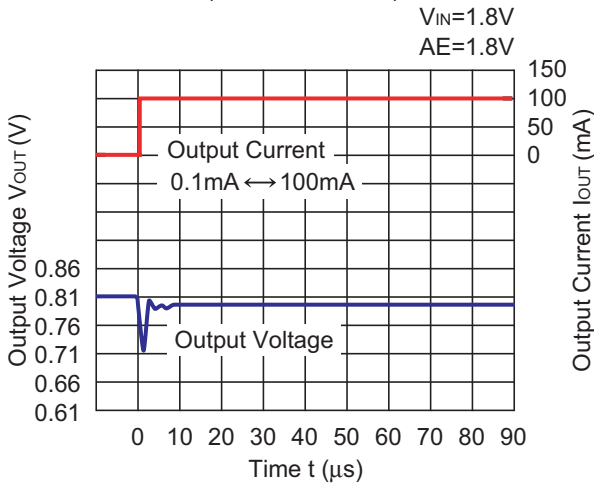
RP201x08xx
(Auto ECO Fast Mode)



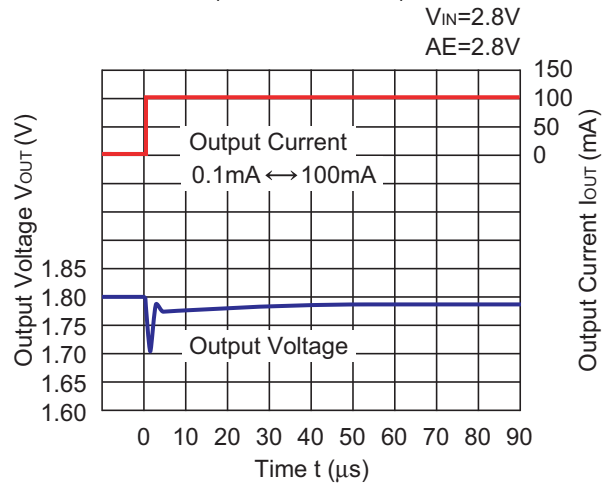
RP201x18xx
(Auto ECO Fast Mode)



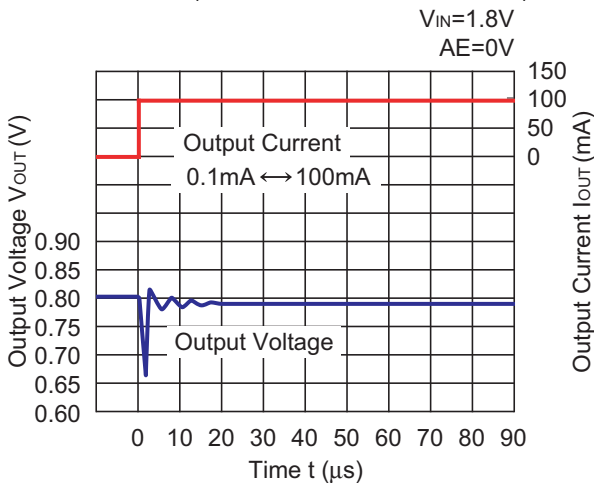
RP201x08xx
(Fixed Fast Mode)



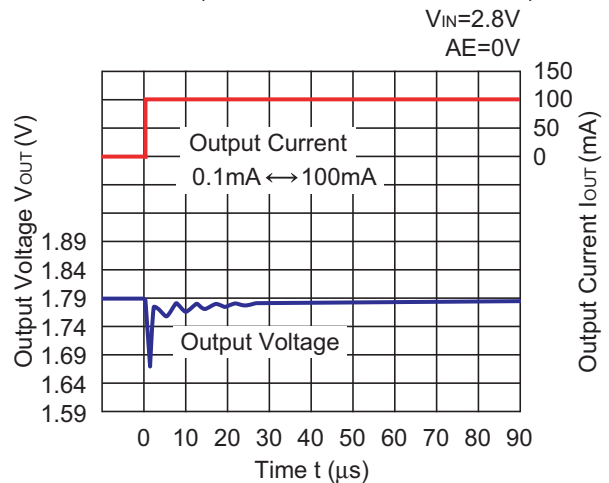
RP201x18xx
(Fixed Fast Mode)



RP201x08xx
Auto ECO (Low Power Mode → Fast Mode)

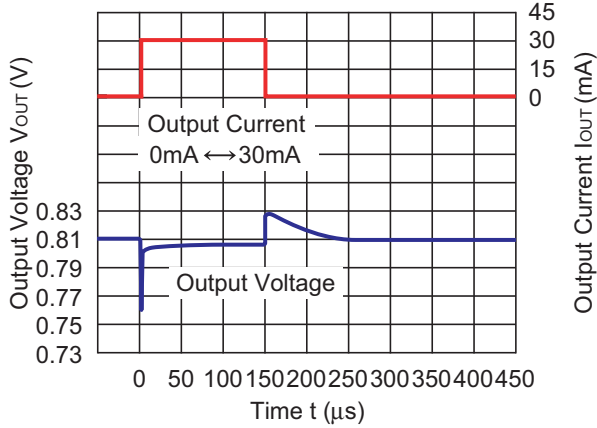


RP201x18xx
Auto ECO (Low Power Mode → Fast Mode)



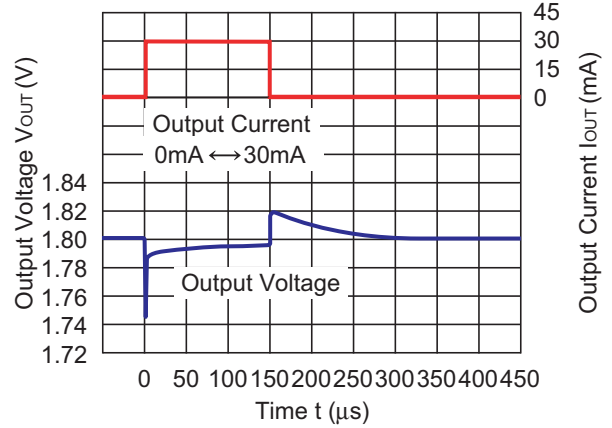
RP201x08xx
(Fixed Fast Mode)

$V_{IN}=1.8V$
 $AE=1.8V$



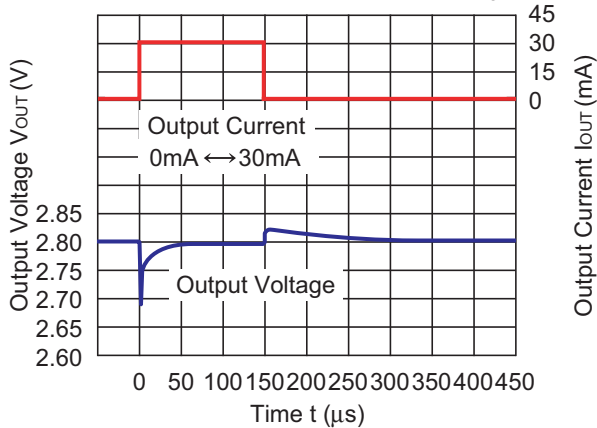
RP201x18xx
(Fixed Fast Mode)

$V_{IN}=2.8V$
 $AE=2.8V$



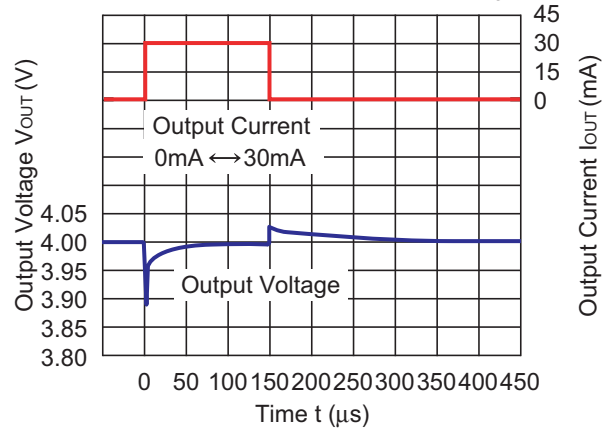
RP201x28xx
Auto ECO (Low Power Mode↔Fast Mode)

$V_{IN}=3.8V$
 $AE=0V$



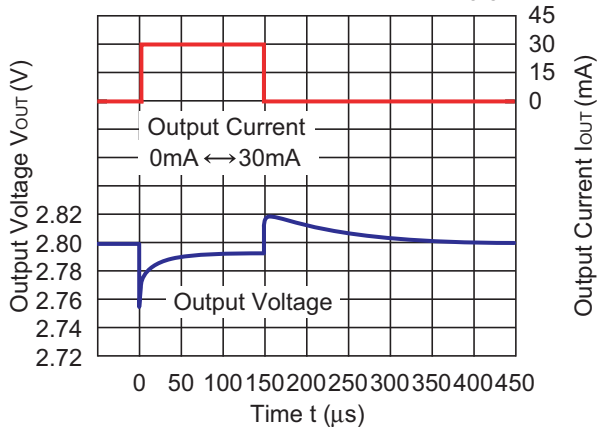
RP201x40xx
Auto ECO (Low Power Mode↔Fast Mode)

$V_{IN}=5.0V$
 $AE=0V$



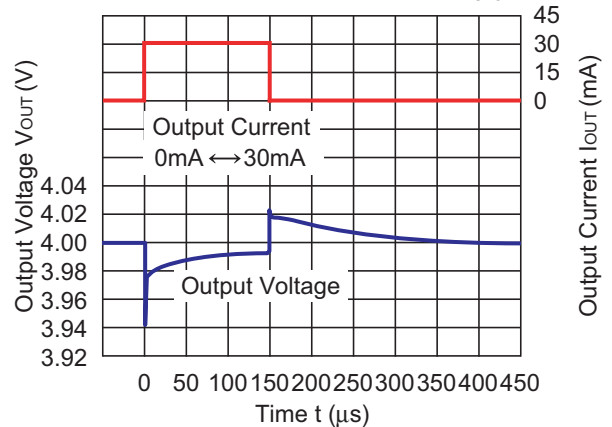
RP201x28xx
(Fixed Fast Mode)

$V_{IN}=3.8V$
 $AE=3.8V$



RP201x40xx
(Fixed Fast Mode)

$V_{IN}=5.0V$
 $AE=5.0V$

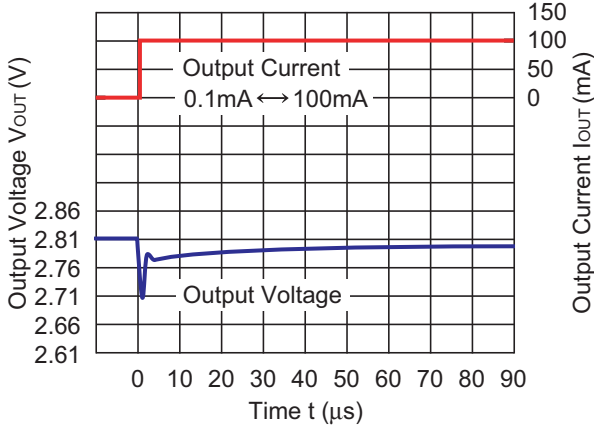


RP201x

NO.EA-234-170126

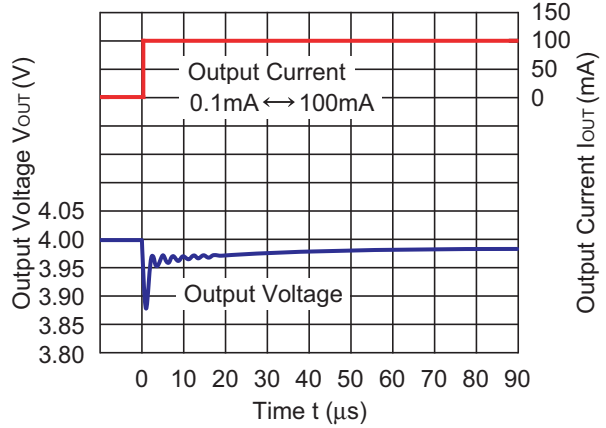
RP201x28xx
(Fixed Fast Mode)

$V_{IN}=3.8V$
 $AE=3.8V$



RP201x40xx
(Fixed Fast Mode)

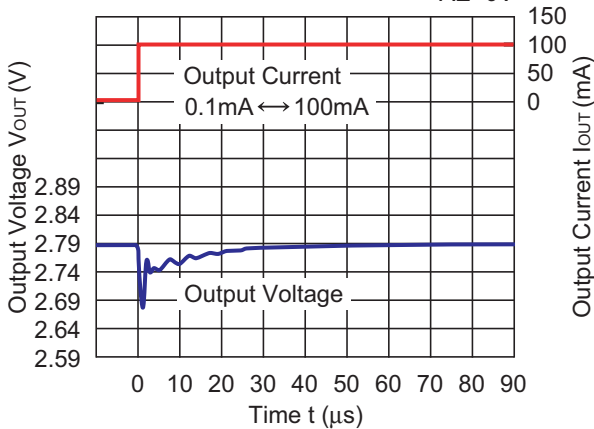
$V_{IN}=5.0V$
 $AE=5.0V$



RP201x28xx

Auto ECO (Low Power Mode→Fast Mode)

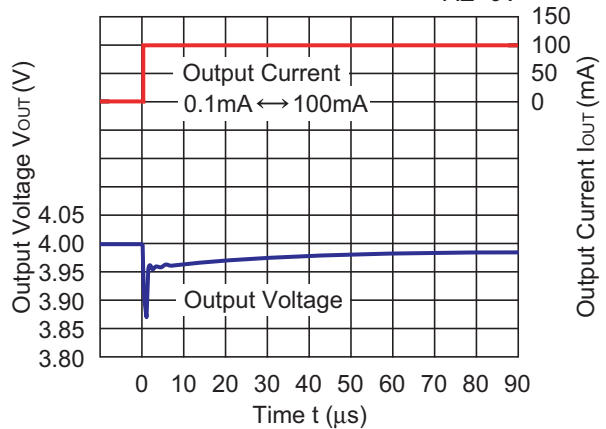
$V_{IN}=3.8V$
 $AE=0V$



RP201x40xx

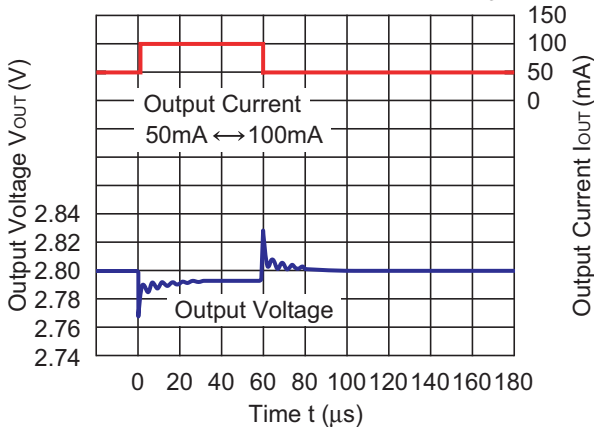
Auto ECO (Low Power Mode→Fast Mode)

$V_{IN}=5.0V$
 $AE=0V$



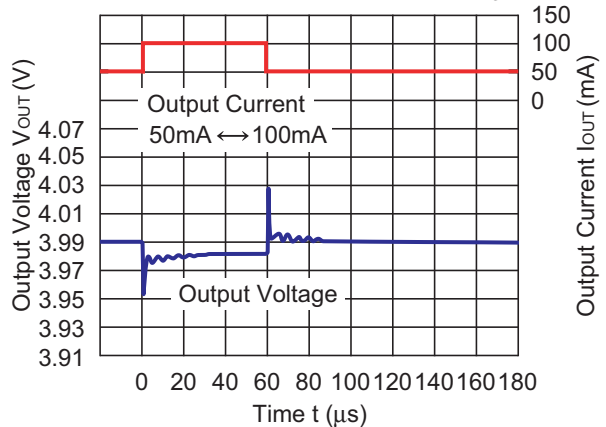
RP201x28xx
(Auto ECO Fast Mode)

$V_{IN}=3.8V$
 $AE=0V$

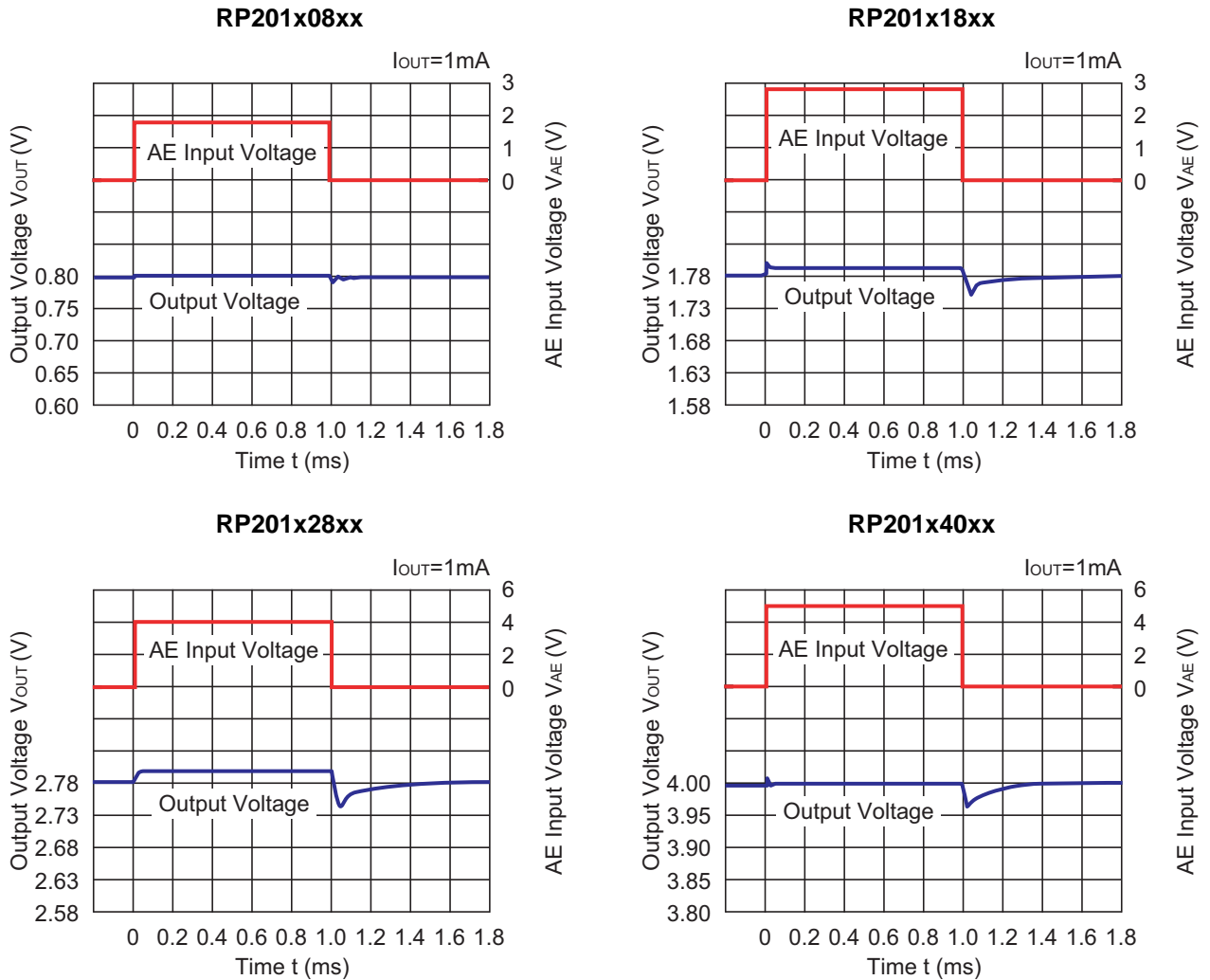


RP201x40xx
(Auto ECO Fast Mode)

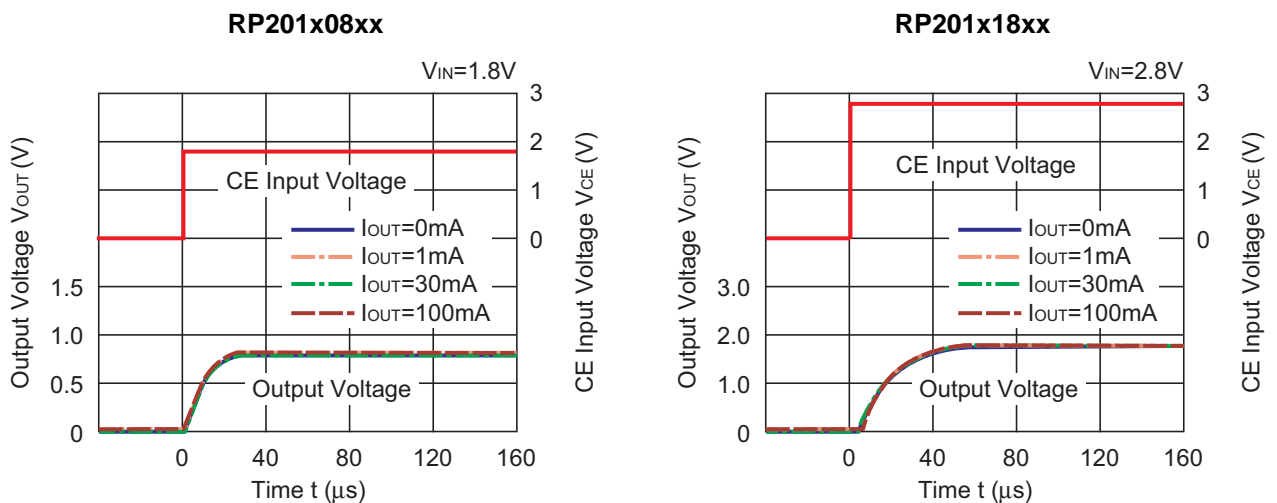
$V_{IN}=5.0V$
 $AE=0V$



13) AE Switch Transient Response ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $t_r=t_f=0.5\mu\text{s}$, $T_{opt}=25^\circ\text{C}$)

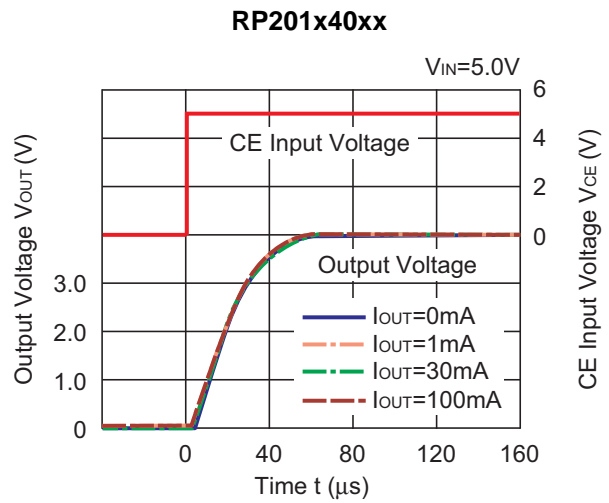
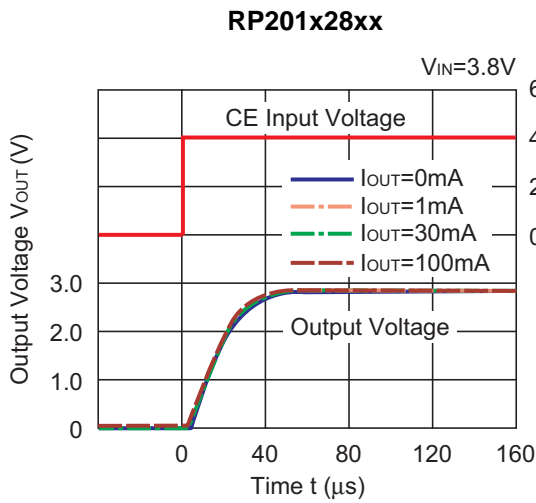


14) Turn On Speed with CE pin ($C_1=1.0\mu\text{F}$, $C_2=1.0\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

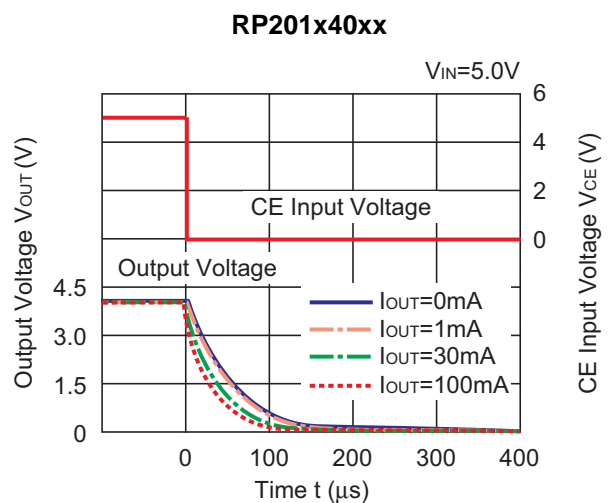
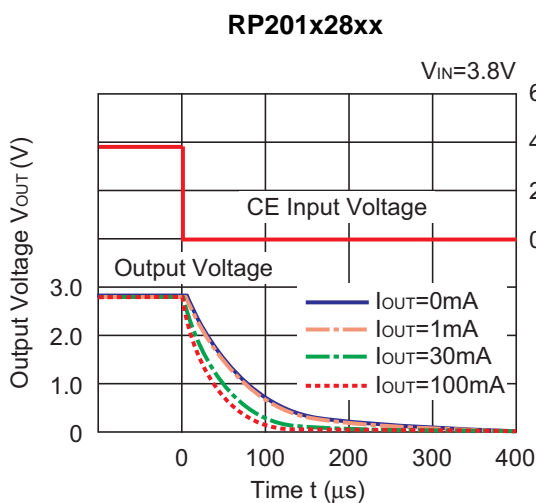
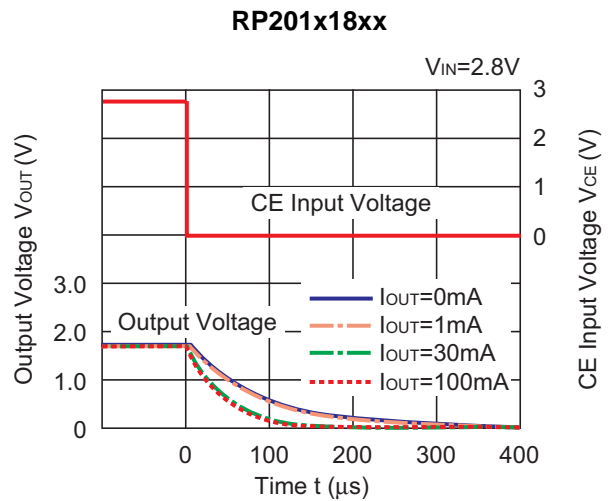
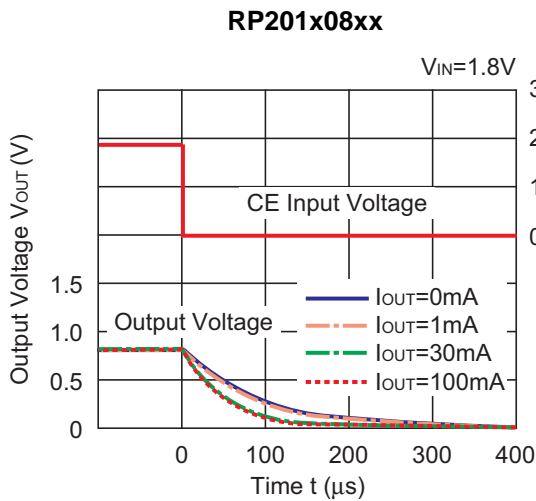


RP201x

NO.EA-234-170126



15) Turn Off Speed with CE pin (D Version) ($C1=1.0\mu F$, $C2=1.0\mu F$, $T_{opt}=25^{\circ}C$)



ESR vs. Output Current

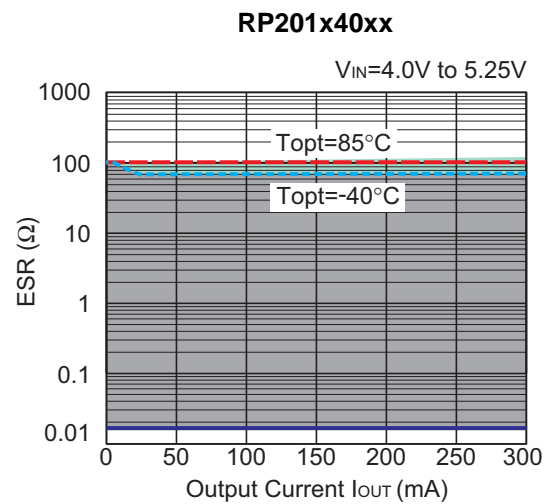
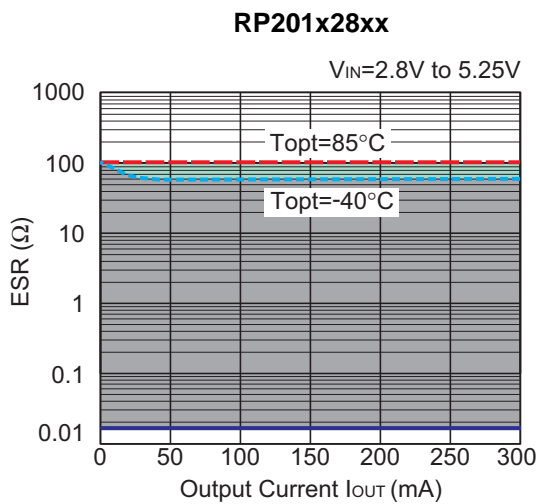
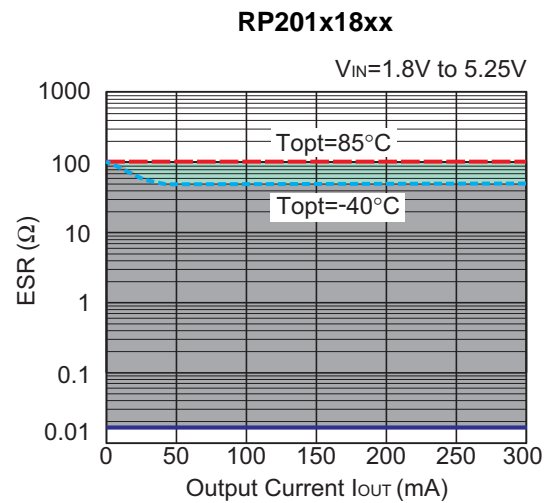
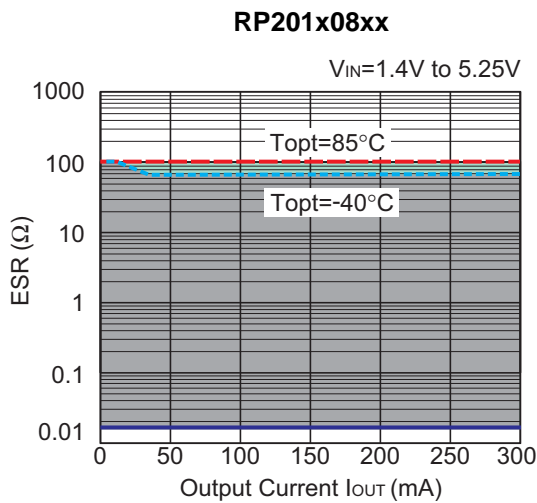
Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The conditions when the white noise level is under $40\mu\text{V}$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band: 10Hz to 2MHz

Temperature : -40°C to 85°C

C1, C2 : $1.0\mu\text{F}$





1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.
11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.



Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

RICOH RICOH ELECTRONIC DEVICES CO., LTD.

<http://www.e-devices.ricoh.co.jp/en/>

Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.

Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH INTERNATIONAL B.V. - German Branch

Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

RICOH ELECTRONIC DEVICES KOREA CO., LTD.

3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.

Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.

Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623