RICOH

RP105x SERIES

Low Voltage 400mA LDO Regulator

NO.EA-179-130418

OUTLINE

The RP105x Series are 400mA output type CMOS-based voltage regulator ICs with capability of low input voltage (Min. 0.9V) and low output voltage (Min. 0.6V). These ICs are remarkably improved the performance at low input voltage compared with conventional low voltage LDOs, and two power supply voltage type. (Another power source, V_{BIAS} pin voltage must be Min. 2.4V). Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit to avoid the destruction, a UVLO circuit with monitoring input voltage, and so on.

The RP105x Series have the ultra low on resistance output driver, the on resistance is Typ. 0.4Ω (V_{OUT}=0.8V, I_{OUT}=300mA). The built-in driver is Nch MOSFET, thus the load transient response is excellent, (under the condition of the current between 1mA and 400mA, tr=0.5µs, the undershoot level is approximately 50mV).

The output voltage of these ICs is fixed with high accuracy. Since the packages for these ICs are DFN(PLP)1212-6, SOT-23-5 and SC-88A (Non-promotion) therefore high density mounting of the ICs on boards is possible.

FEATURES

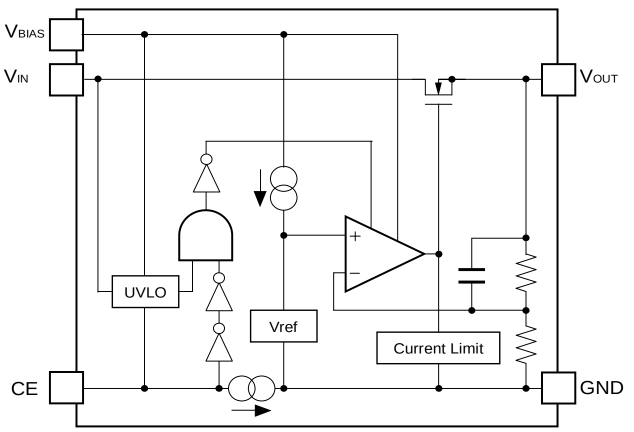
- Supply Current .... Typ. 28µA
- Supply Current (Standby Mode).................................. Typ. 0.1 µA
- Ripple Rejection .... Typ. 80dB (f=1kHz, V_{IN} Ripple)
  Typ. 50dB (f=1kHz, V_{BIAS} Ripple)
- Output Voltage Range.. 0.6V to 1.5V (0.1V steps)
  (For other voltages, please refer to MARK INFORMATIONS.)
- Input Voltage Range (V_{BIAS})... 2.4V to 5.25V (V_{OUT} < 0.8V)
  Set V_{OUT}+1.6V to 5.25V (V_{OUT} ≥ 0.8V)
- Input Voltage Range (V_{IN}) .... 0.9V to V_{BIAS} (V_{OUT} < 0.8V)
  Set V_{OUT}+0.1V to V_{BIAS} (V_{OUT} ≥ 0.8V)
- Output Voltage Accuracy.. Typ. ±15mV (Topt=25°C)
- Temperature-Drift Coefficient of Output Voltage .... Typ. ±50ppm/°C
- Dropout Voltage .... Typ. 180mV (I_{OUT}=400mA, V_{OUT}=1.5V, V_{BIAS}=3.6V)
- Line Regulation .... Typ. 0.02%/V
- Packages .... DFN(PLP)1212-6, SC-88A (Non-promotion),
  SOT-23-5
- Built-in Fold Back Protection Circuit .... Typ. 120mA (Current at short mode)
- Ceramic capacitors are recommended........................ C_{BIAS}=C_{IN}=1.0µF or more, C_{OUT}=2.2µF or more

APPLICATIONS

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

BLOCK DIAGRAMS

RP105xxxxB



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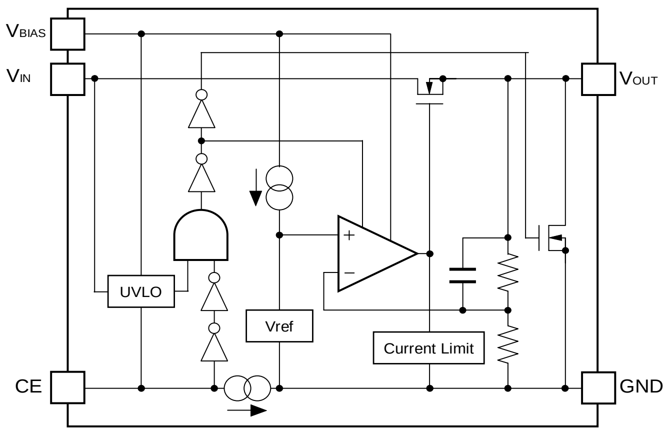


SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP105Kxx1∗-TR	DFN(PLP)1212-6	5,000 pcs	Yes	Yes
RP105Qxx2∗-TR-FE	SC-88A (Non-promotion)	3,000 pcs	Yes	Yes
RP105Nxx1∗-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range from 0.6V(06) to 1.5V(15) in 0.1V steps.
(For other voltages, please refer to MARK INFORMATIONS.)

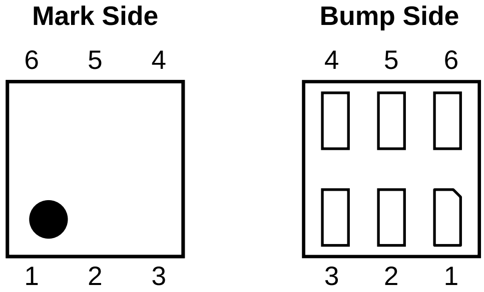
∗ : CE pin polarity and auto discharge function at off state are options as follows.
(B) "H" active, without auto discharge function at off state
(D) "H" active, with auto discharge function at off state

The products scheduled to be discontinued : "Non-promotion"

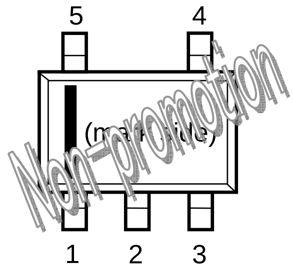
These products will be discontinued in the future. We advise you to select other products.

PIN CONFIGURATIONS

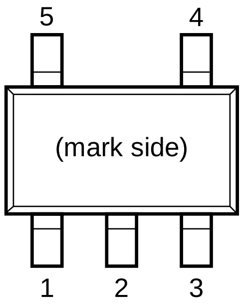
● DFN(PLP)1212-6



● SC-88A



● SOT-23-5



PIN DESCRIPTIONS

● **DFN(PLP)1212-6**

Pin No	Symbol	Pin Description
1	V_{BIAS}	Input Pin 1
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{IN}	Input Pin 2
5	NC	No Connection
6	V_{OUT}	Output Pin

● **SC-88A (Non-promotion)**

Pin No	Symbol	Pin Description
1	V_{BIAS}	Input Pin 1
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{IN}	Input Pin 2
5	CE	Chip Enable Pin ("H" Active)

● **SOT-23-5**

Pin No	Symbol	Pin Description
1	V_{IN}	Input Pin 2
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{BIAS}	Input Pin 1
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{BIAS}	Input Voltage	6.0	V
V_{IN}	Input Voltage (for Driver)	-0.3 to $V_{BIAS}+0.3$	V
V_{CE}	Input Voltage (CE Pin)	6.0	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current	500	mA
P_D	Power Dissipation (DFN(PLP)1212-6) *	400	mW
	Power Dissipation (SC-88A) * (Non-promotion)	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_{BIAS}=V_{CE}=3.6V, V_{IN}=Set V_{OUT}+0.5V, I_{OUT}=1mA, C_{BIAS}=C_{IN}=1.0µF, C_{OUT}=2.2µF, unless otherwise noted.

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

• **RP105x** Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	Topt=25°C	Set V_{OUT} –15mV		Set V_{OUT} +15mV	V
		–40°C ≤ Topt ≤ 85°C	Set V_{OUT} –20mV		Set V_{OUT} +20mV	V
I_{OUT}	Output Current		400			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≤ I_{OUT} ≤ 400mA		30	50	mV
V_{DIF}	Dropout Voltage	Please refer to following data				
I_{SS}	Supply Current	I_{OUT}=0mA		28	40	µA
Istandby	Standby Current	V_{CE}=0V		0.1	3.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	2.4V ≤ V_{BIAS} ≤ 5.0V		0.02	0.1	%/V
		Set V_{OUT}+0.3V ≤ V_{IN} ≤ 2.4V		0.02	0.1	
RR	Ripple Rejection	I_{OUT}=30mA, f=1kHz V_{IN} Ripple 0.2Vp-p		80		dB
		I_{OUT}=30mA, f=1kHz V_{BIAS} Ripple 0.2Vp-p		50		
V_{BIAS}	Input Voltage*	V_{OUT} < 0.8V	2.4		5.25	V
		V_{OUT} ≥ 0.8V	Set V_{OUT}+1.6		5.25	
V_{IN}	Input Voltage (for Driver)*	V_{OUT} < 0.8V	0.9		V_{BIAS}	V
		V_{OUT} ≥ 0.8V	Set V_{OUT}+0.1		V_{BIAS}	
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	–40°C ≤ Topt ≤ 85°C		±50		ppm /°C
I_{SC}	Short Current Limit	V_{OUT}=0V		120		mA
I_{CEPD}	CE Pull-down Constant Current			1.0		µA
V_{CEH}	CE Input Voltage "H"		0.8			V
V_{CEL}	CE Input Voltage "L"				0.3	V
V_{IN_UVLO}	V_{IN} Under Voltage Lock Out	I_{OUT}=1.0µA		Set V_{OUT} +50mV	Set V_{OUT} +100mV	V
tdelay	Detector Delay Time			100		µs
en	Output Noise	BM=10Hz to 100kHz I_{OUT}=30mA, Set V_{OUT}=0.6V		70		µVrms
R_{LOW}	Nch On Resistance For auto discharge (only D version)	V_{BIAS}=3.6V, V_{CE}="L"		50		Ω

*) If Input Voltage range is between 5.25V and 5.50V, the total operational time must be within 500hrs.
All of units are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

• Dropout Voltage

Set V_{OUT}	V_{BIAS}	V_{GS}	V_{DIF} (I_{OUT}=300mA) (V)		V_{DIF} (I_{OUT}=400mA) (V)	
			Typ.	Max.	Typ.	Max.
0.6V	3.6V	3.0V	0.115	0.180	0.180	0.320
0.7V	3.6V	2.9V	0.120	0.190	0.180	0.320
0.8V	3.6V	2.8V	0.120	0.190	0.180	0.300
0.9V	3.6V	2.7V	0.120	0.190	0.180	0.300
1.0V	3.6V	2.6V	0.120	0.190	0.180	0.280
1.1V	3.6V	2.5V	0.130	0.200	0.180	0.280
1.2V	3.6V	2.4V	0.130	0.200	0.180	0.280
1.3V	3.6V	2.3V	0.130	0.200	0.180	0.260
1.4V	3.6V	2.2V	0.130	0.200	0.180	0.260
1.5V	3.6V	2.1V	0.130	0.200	0.180	0.260

• Dropout Voltage (V_{GS}(V), V_{DIF}(V), I_{OUT}=200mA)

Topt=25℃

Set V_{OUT}	V_{BIAS}=2.5V		V_{BIAS}=3.0V		V_{BIAS}=3.3V		V_{BIAS}=3.6V		V_{BIAS}=4.2V		V_{BIAS}=5.0V	
	V_{GS} (V)	V_{DIF} (V)	V_{GS} (V)	V_{DIF} (V)	V_{GS} (V)	V_{DIF} (V)	V_{GS} (V)	V_{DIF} (V)	V_{GS} (V)	V_{DIF} (V)	V_{GS} (V)	V_{DIF} (V)
0.6V	1.9	0.094	2.4	0.093	2.7	0.093	3.0	0.092	3.6	0.092	4.4	0.091
0.7V	1.8	0.094	2.3	0.093	2.6	0.093	2.9	0.092	3.5	0.092	4.3	0.092
0.8V	1.7	0.098	2.2	0.093	2.5	0.093	2.8	0.092	3.4	0.092	4.2	0.092
0.9V	1.6	0.098	2.1	0.094	2.4	0.093	2.7	0.092	3.3	0.092	4.1	0.092
1.0V			2.0	0.094	2.3	0.093	2.6	0.092	3.2	0.092	4.0	0.092
1.1V			1.9	0.096	2.2	0.094	2.5	0.094	3.1	0.093	3.9	0.093
1.2V			1.8	0.098	2.1	0.096	2.4	0.095	3.0	0.095	3.8	0.094
1.3V			1.7	0.098	2.0	0.096	2.3	0.095	2.9	0.095	3.7	0.095
1.4V			1.6	0.098	1.9	0.096	2.2	0.095	2.8	0.095	3.6	0.095
1.5V					1.8	0.096	2.1	0.095	2.7	0.095	3.5	0.095

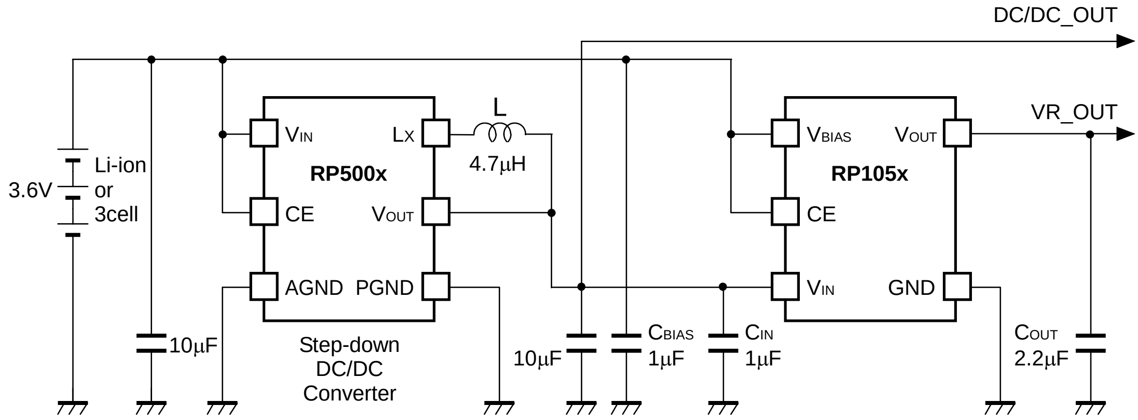
The specification in ☐ is checked and guaranteed by design engineering at –40°C ≤ Topt ≤ 85°C.
All of units are tested and specified under load conditions such that Tj≈Topt=25°C except for Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient items.

⧄ V_{BIAS} pin voltage must be equal or more than Set V_{OUT}+1.6V.

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)

C_{OUT}	: Ceramic Capacitor	2.2μF	MURATA: GRM155B30J225ME15
C_{BIAS}, C_{IN}	: 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 for C_{OUT} with the capacity of equal or more than 2.2μF.
(Note: If tantalum capacitors are connected as C_{OUT}, and if the equivalent series resister (ESR) value is large, 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

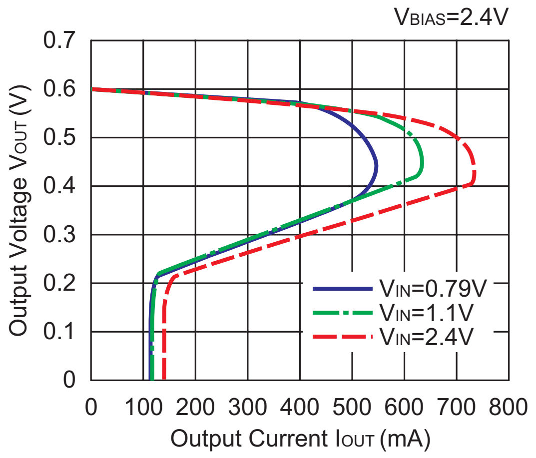
Make V_{BIAS}, V_{IN}, and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0μF or more between V_{BIAS} pin and GND pin, between V_{IN} pin and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible. V_{IN} source is supposed to be the output of the DC/DC converter. The value should be equal or lower than V_{BIAS} voltage.

TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF, Topt=25°C)

RP105x06xx



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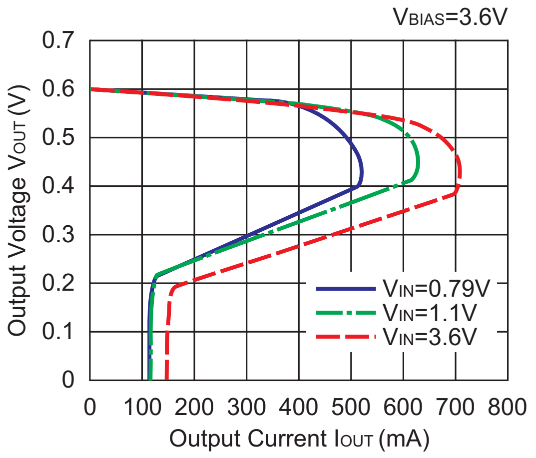

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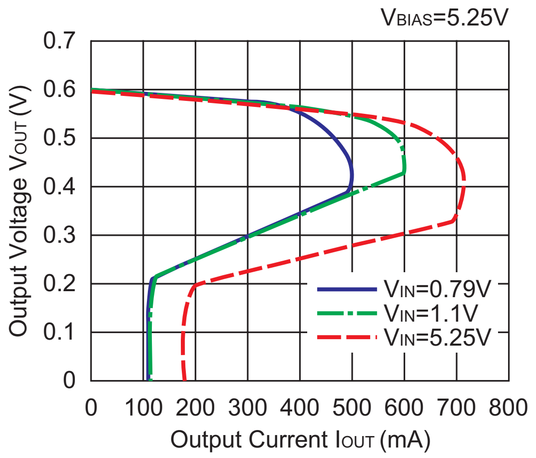

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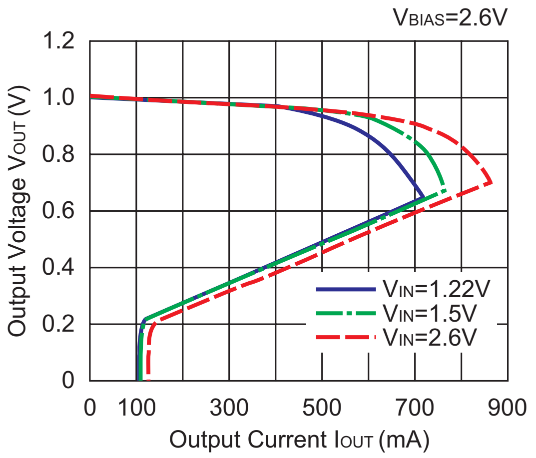

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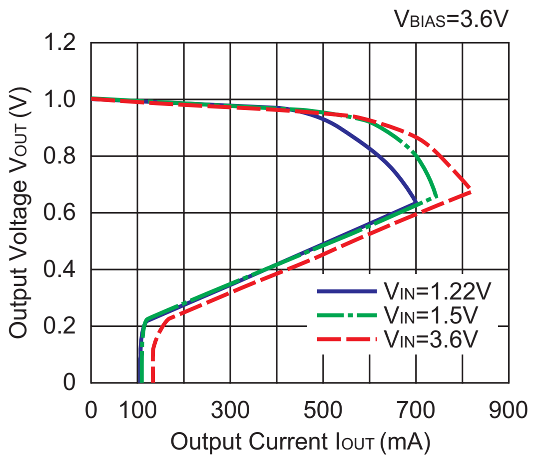

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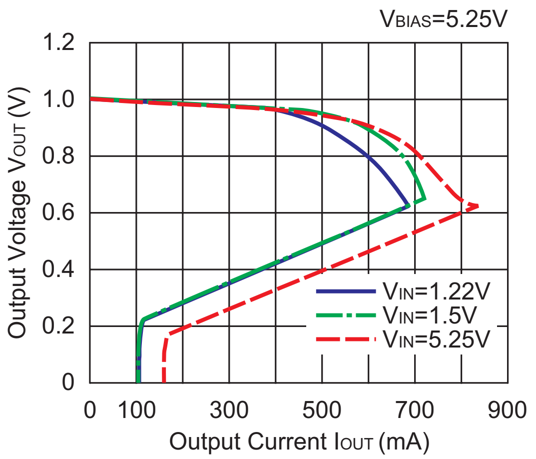

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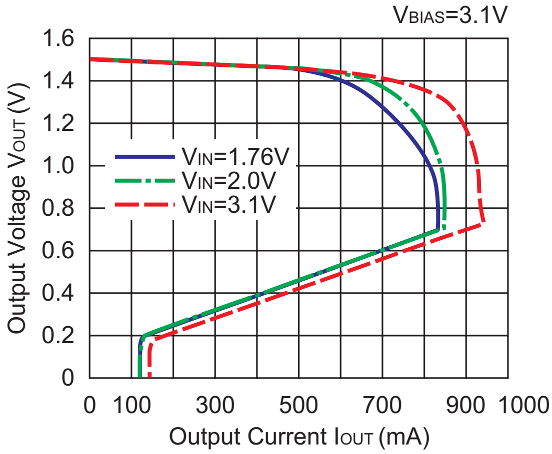

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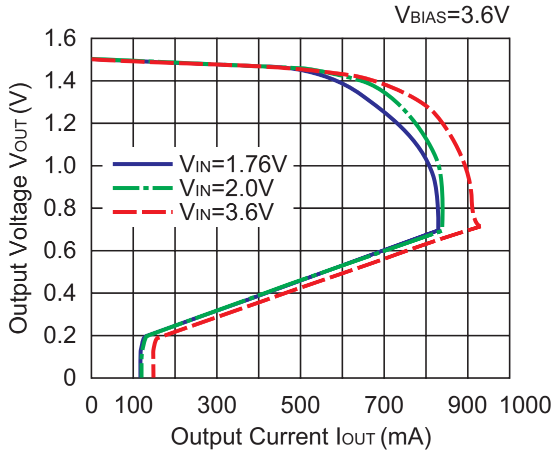

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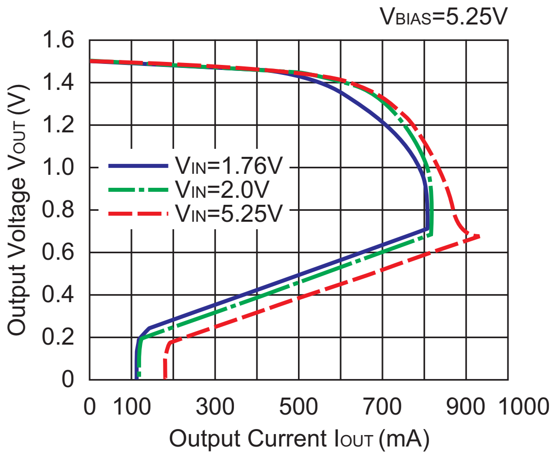
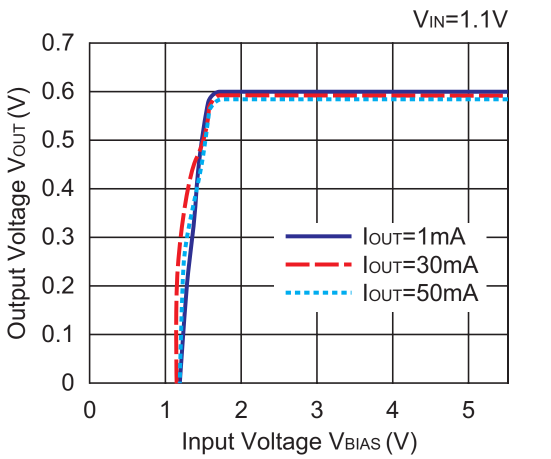


2) Output Voltage vs. Input Voltage (C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF, Topt=25°C)

RP105x06xx



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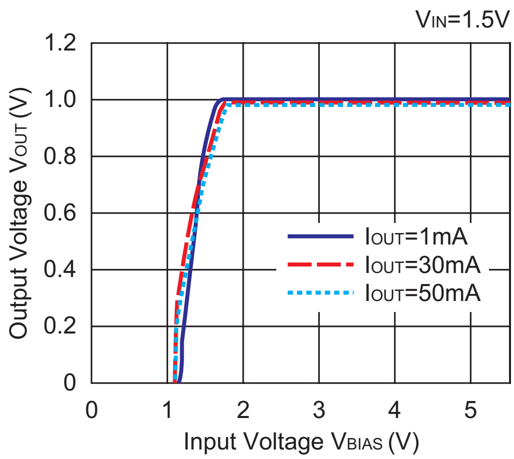

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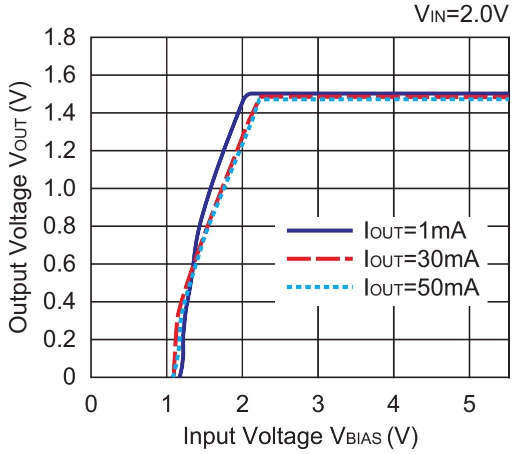

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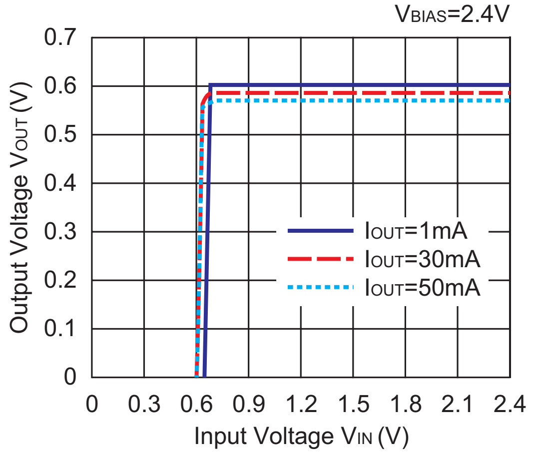

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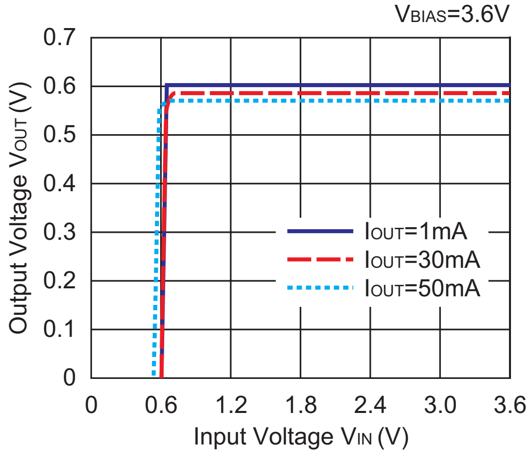

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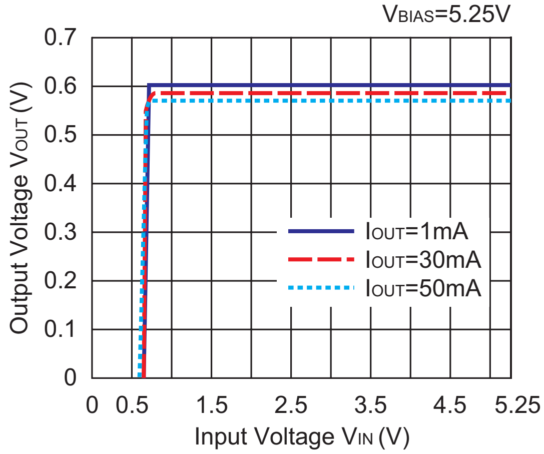

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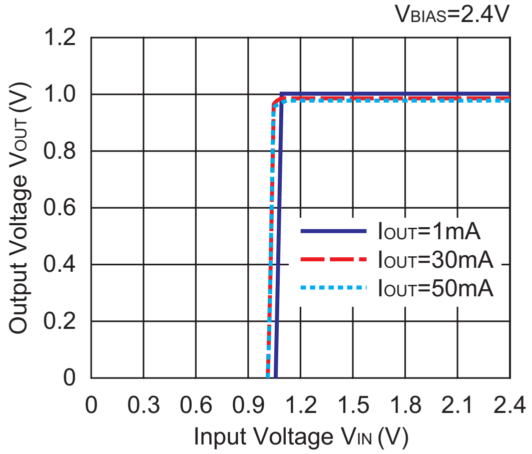

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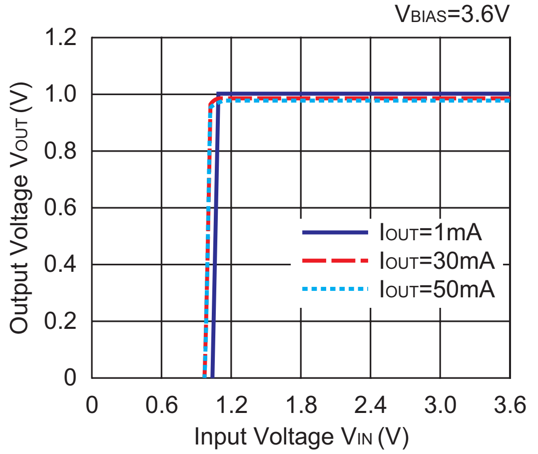

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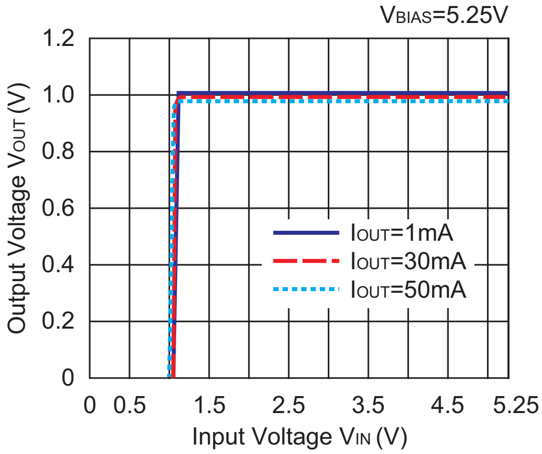

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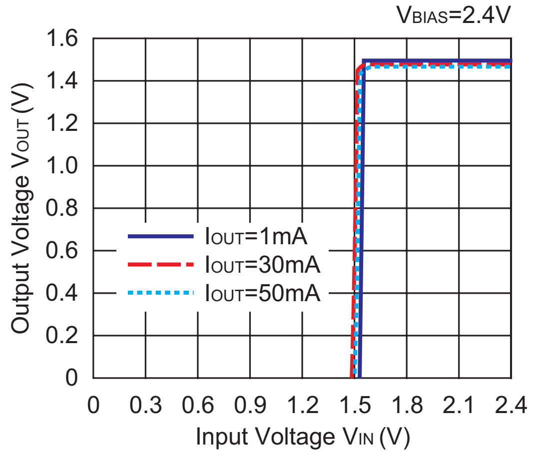

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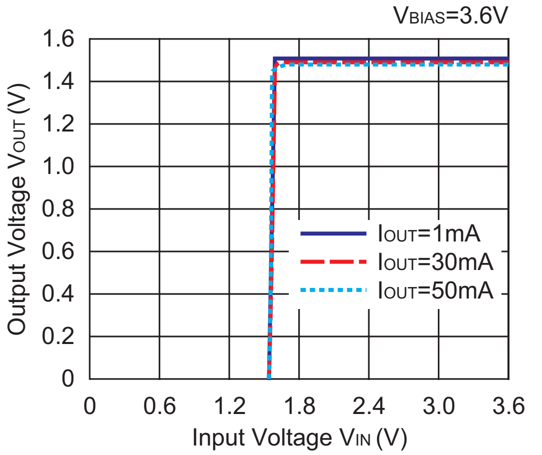

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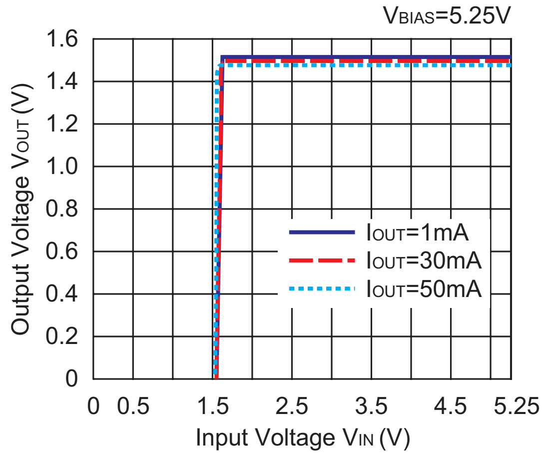
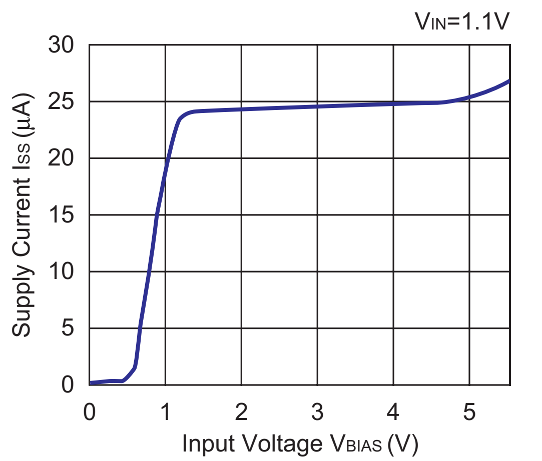


3) Supply Current vs. Input Voltage (C_{BIAS}=C_{IN}=C_{OUT}=none, T_{opt}=25°C)

RP105x06xx



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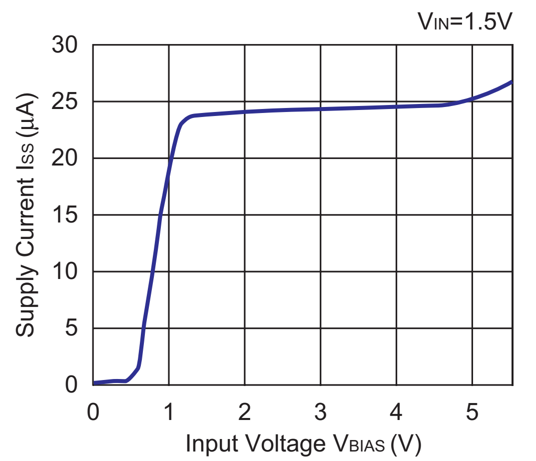

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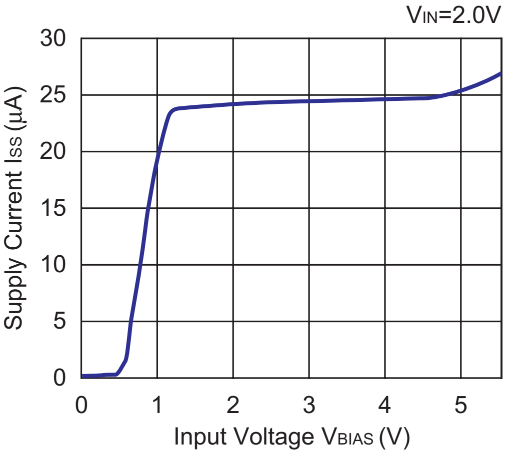

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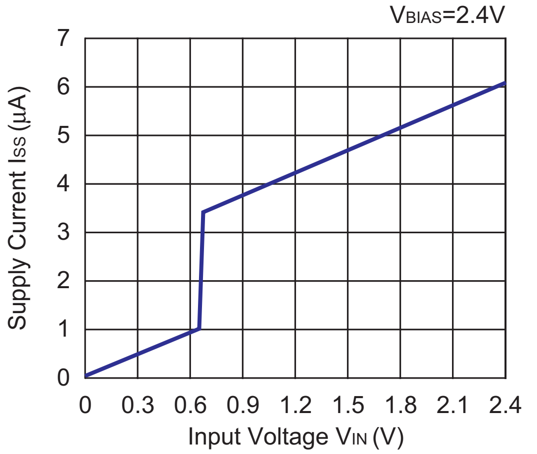

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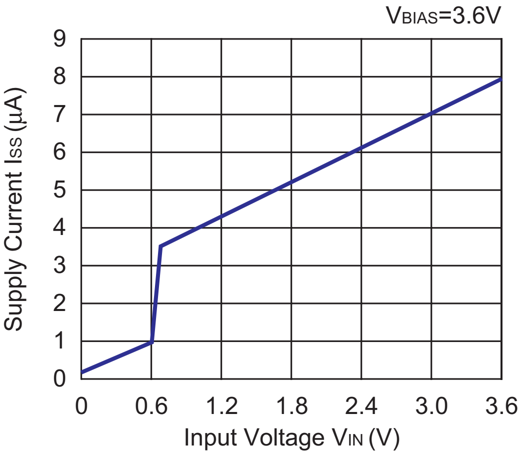

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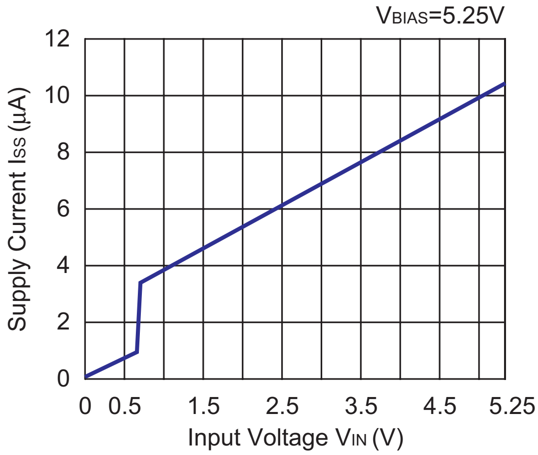
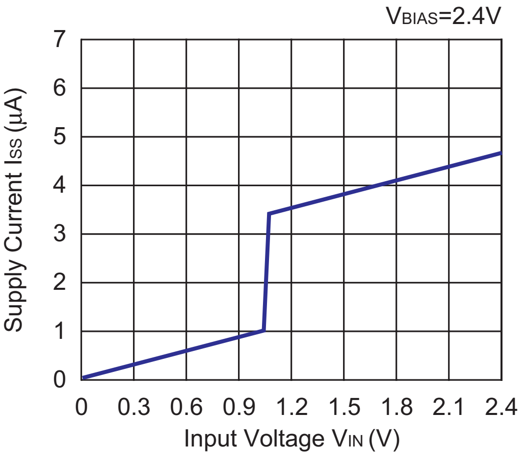
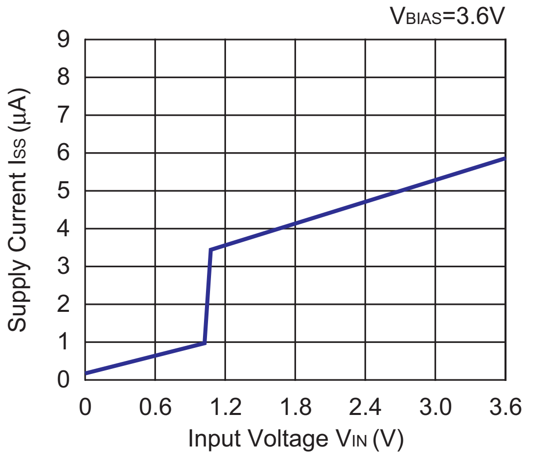


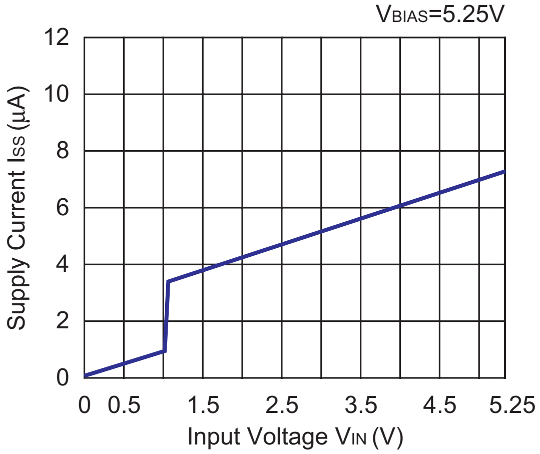
RP105x10xx



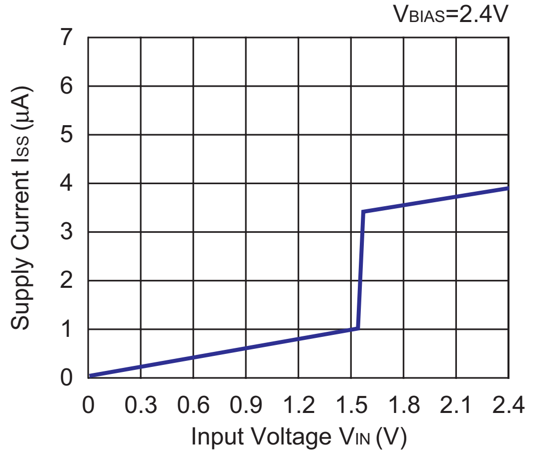
RP105x10xx



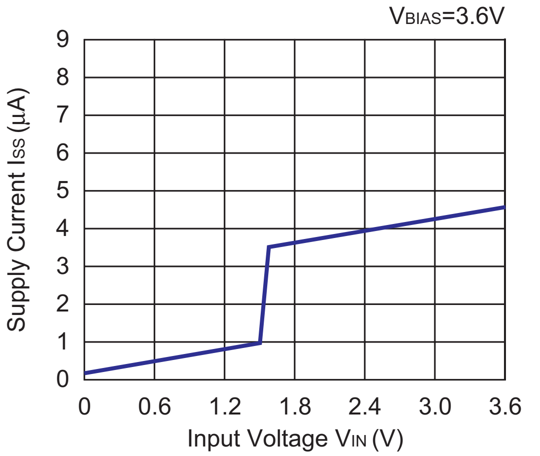
RP105x10xx



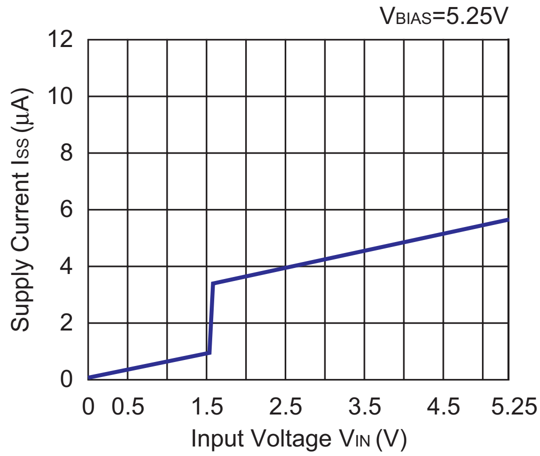
RP105x15xx



RP105x15xx

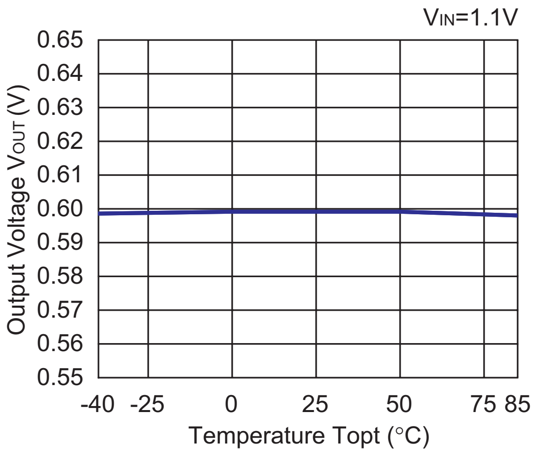


RP105x15xx

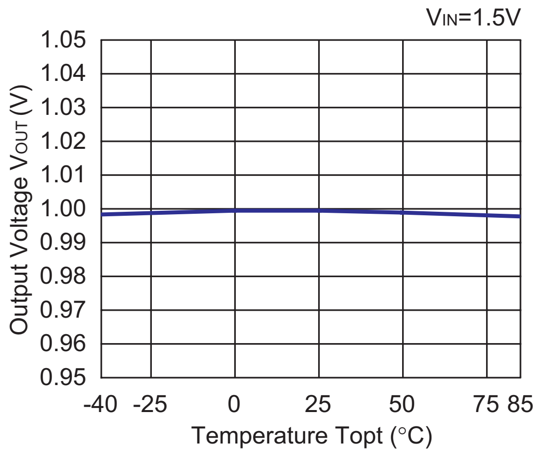


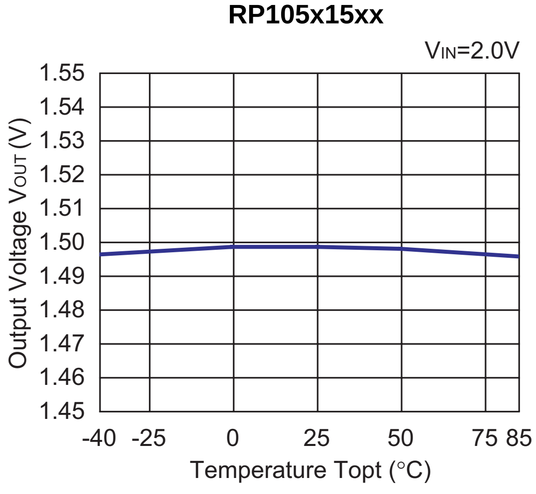
4) Output Voltage vs. Temperature (C_{BIAS}=1.0μF, C_{IN}=C_{OUT}=2.2μF, I_{OUT}=1mA, V_{BIAS}=3.6V)

RP105x06xx

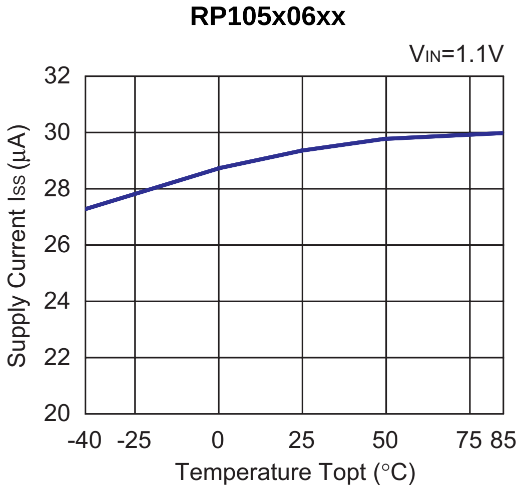


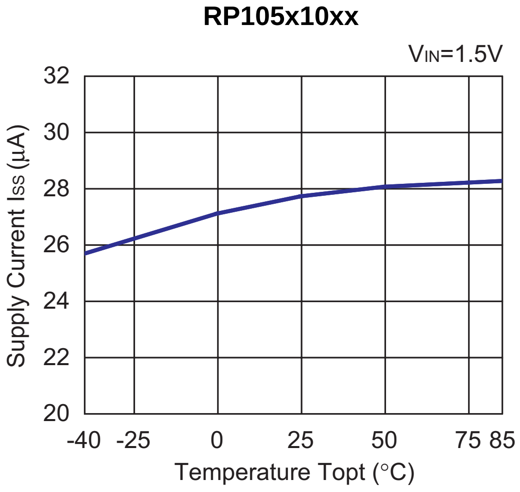
RP105x10xx

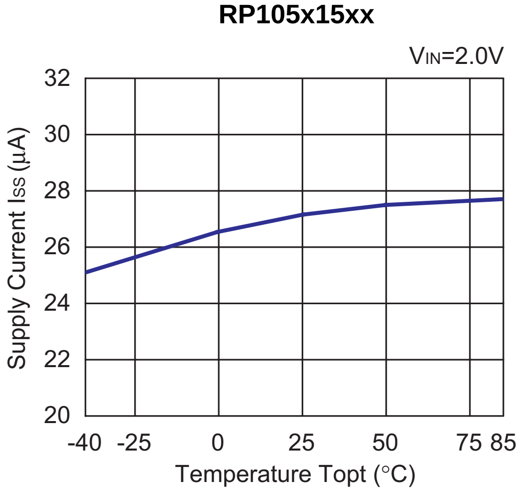




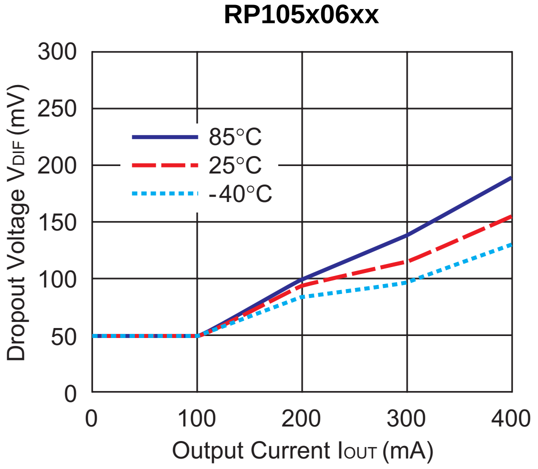
5) Supply Current vs. Temperature (C_{BIAS}=C_{IN}=C_{OUT}=none, V_{BIAS}=3.6V)

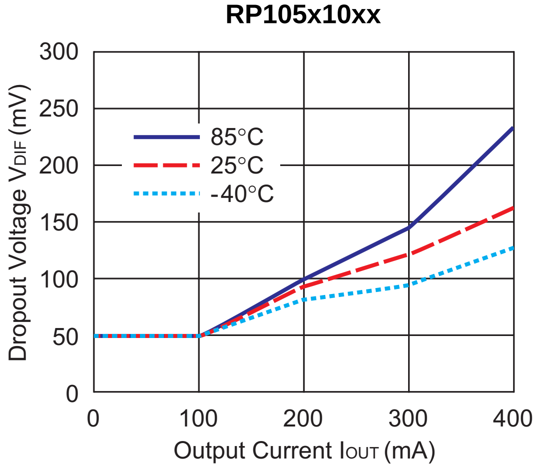


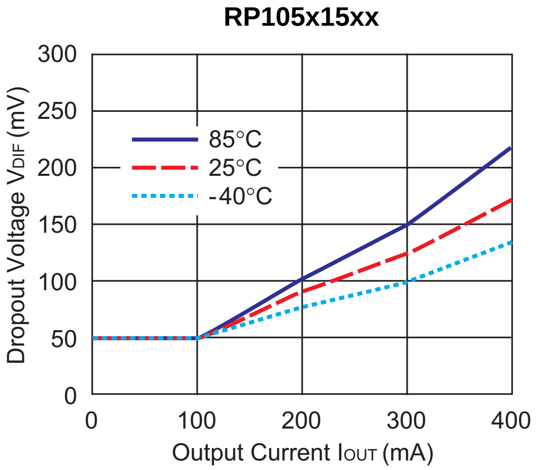




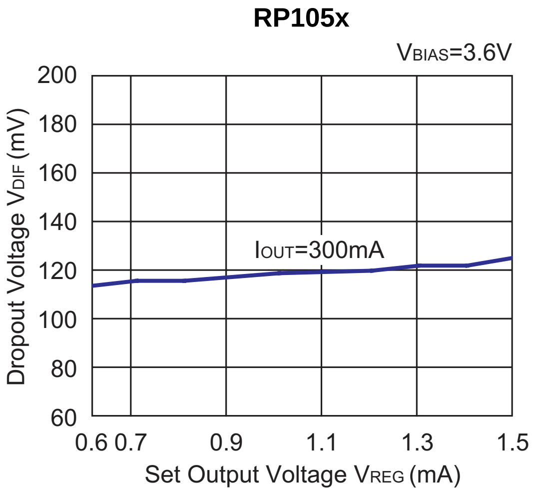
6) Dropout Voltage vs. Output Current (C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF)







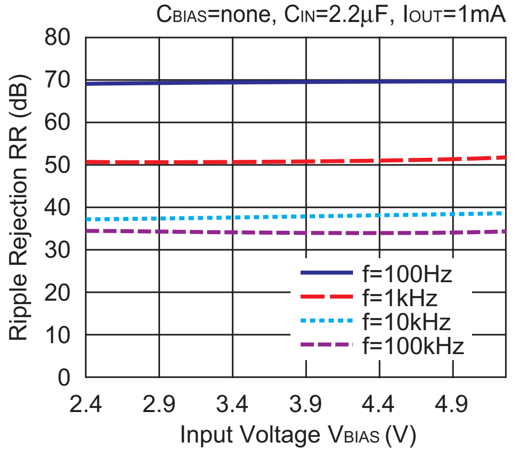
7) Dropout Voltage vs. Set Output Voltage



8) Ripple Rejection vs. Input Bias Voltage (C_{OUT}=2.2µF, Ripple=0.2Vp-p, T_{opt}=25°C)

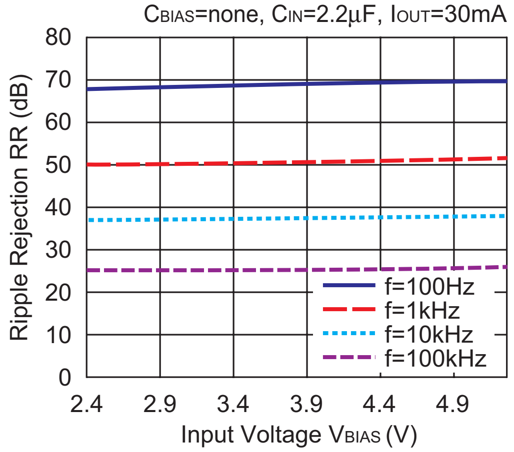
RP105x10xx

C_{BIAS}=none, C_{IN}=2.2µF, I_{OUT}=1mA



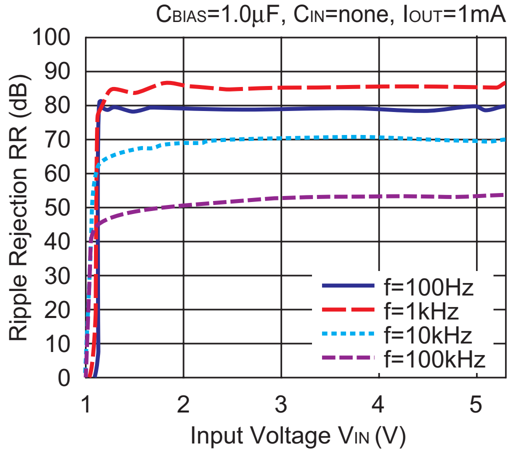
RP105x10xx

C_{BIAS}=none, C_{IN}=2.2µF, I_{OUT}=30mA



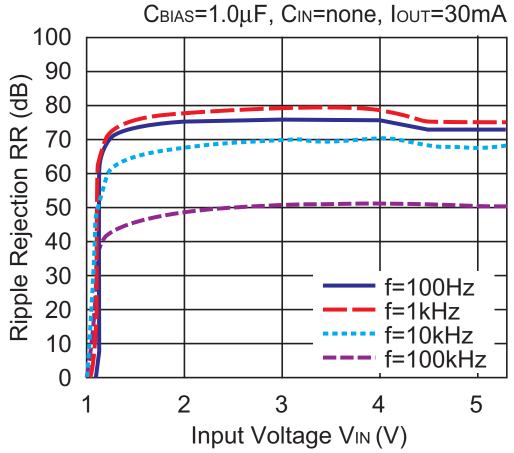
RP105x10xx

C_{BIAS}=1.0µF, C_{IN}=none, I_{OUT}=1mA



RP105x10xx

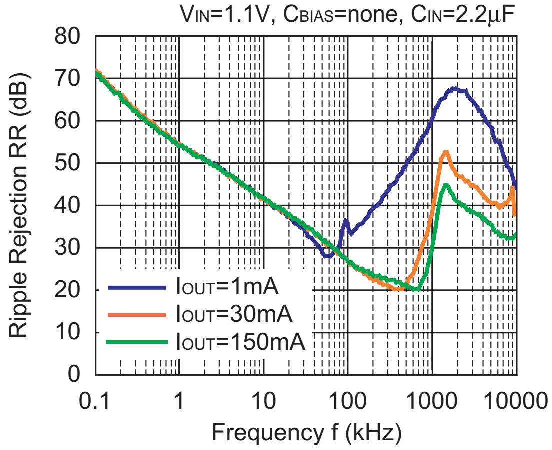
C_{BIAS}=1.0µF, C_{IN}=none, I_{OUT}=30mA



9) Ripple Rejection vs. Frequency (V_{BIAS}=3.6V, C_{OUT}=2.2µF, T_{opt}=25°C)

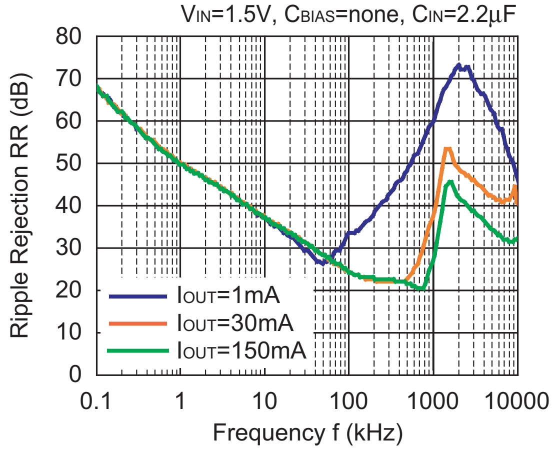
RP105x06xx

V_{IN}=1.1V, C_{BIAS}=none, C_{IN}=2.2µF



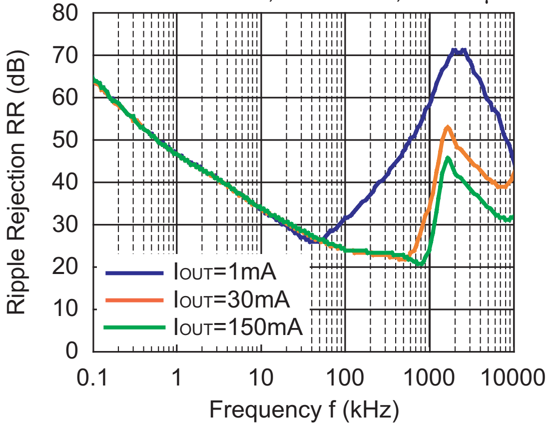
RP105x10xx

V_{IN}=1.5V, C_{BIAS}=none, C_{IN}=2.2µF



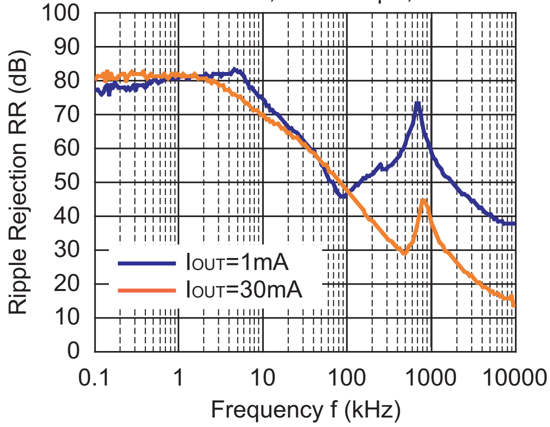
RP105x15xx

V_{IN}=2.0V, C_{BIAS}=none, C_{IN}=2.2µF



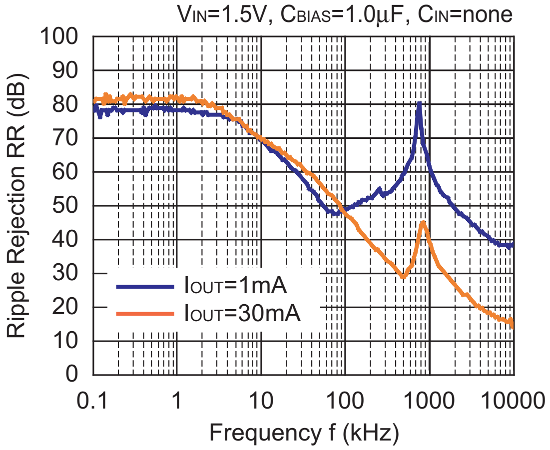
RP105x06xx

V_{IN}=1.1V, C_{BIAS}=1.0µF, C_{IN}=none



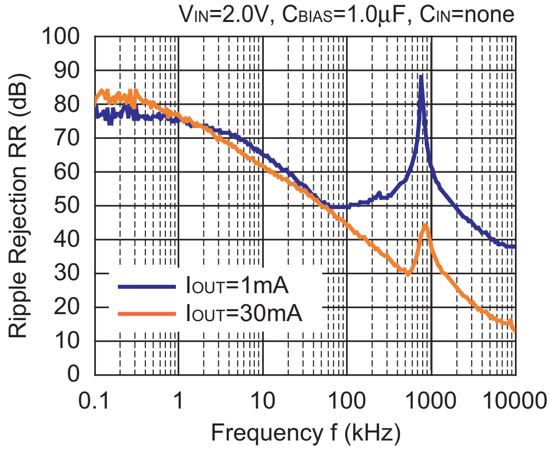
RP105x10xx

V_{IN}=1.5V, C_{BIAS}=1.0µF, C_{IN}=none



RP105x15xx

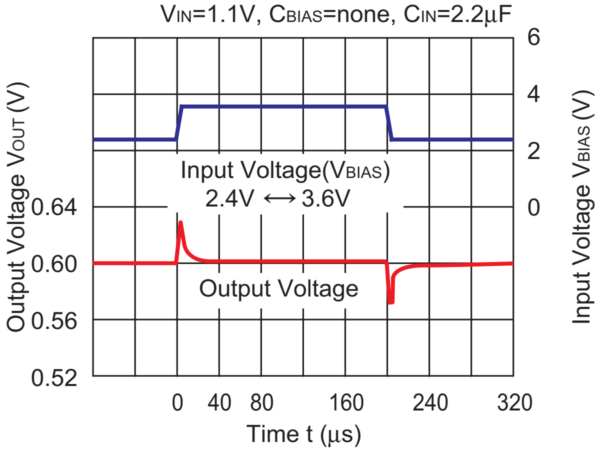
V_{IN}=2.0V, C_{BIAS}=1.0µF, C_{IN}=none



10) Input Transient Response (I_{OUT}=30mA, C_{OUT}=1.0µF, tr=tf=5µs, Topt=25°C)

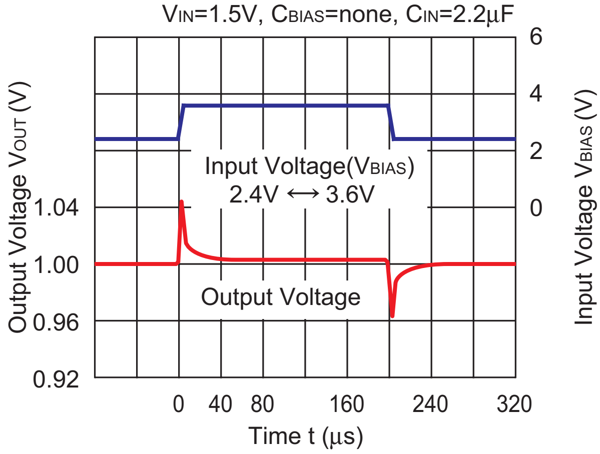
RP105x06xx

V_{IN}=1.1V, C_{BIAS}=none, C_{IN}=2.2µF



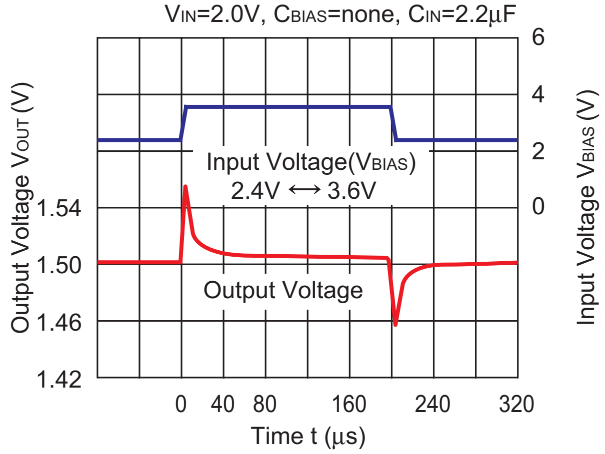
RP105x10xx

V_{IN}=1.5V, C_{BIAS}=none, C_{IN}=2.2µF



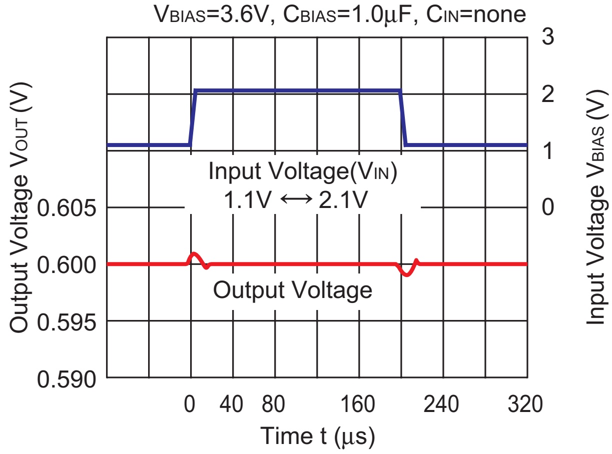
RP105x15xx

V_{IN}=2.0V, C_{BIAS}=none, C_{IN}=2.2µF



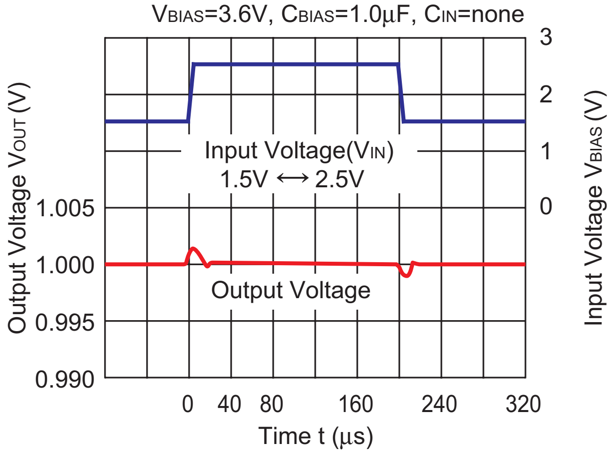
RP105x06xx

V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=none



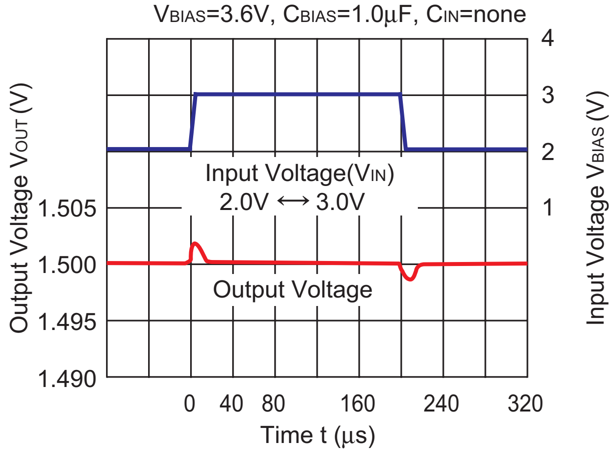
RP105x10xx

V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=none



RP105x15xx

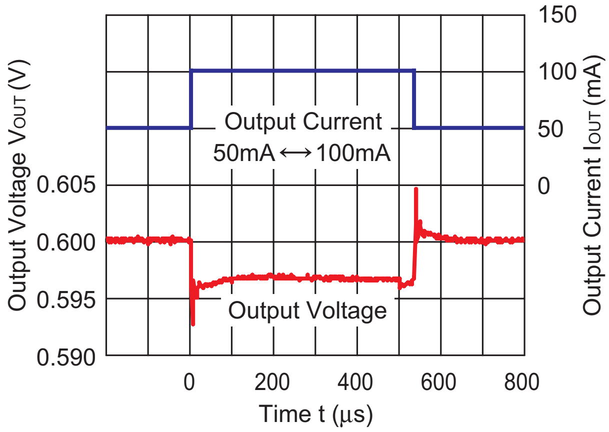
V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=none



11) Load Transient Response (V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF, tr=tf=0.5µs, Topt=25°C)

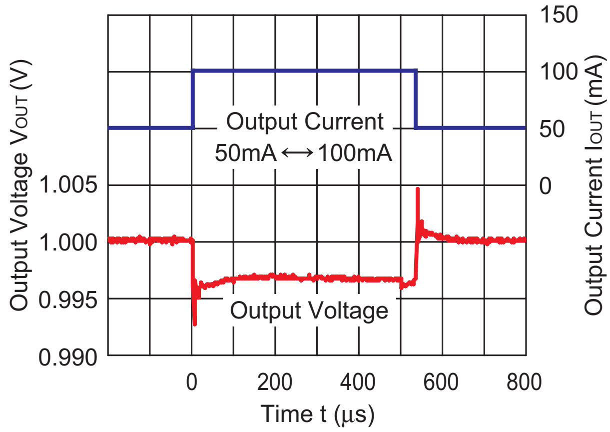
RP105x06xx

V_{IN}=1.1V

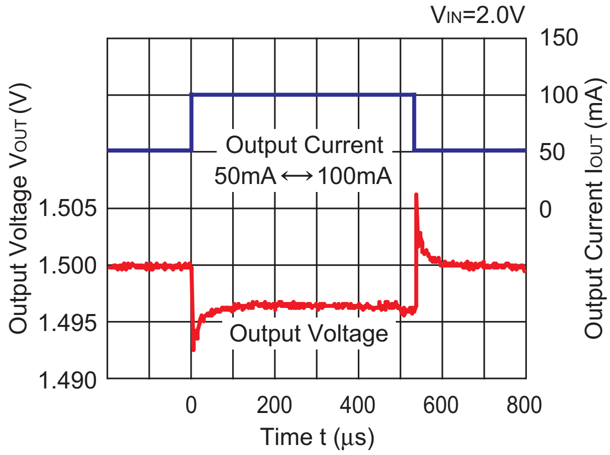


RP105x10xx

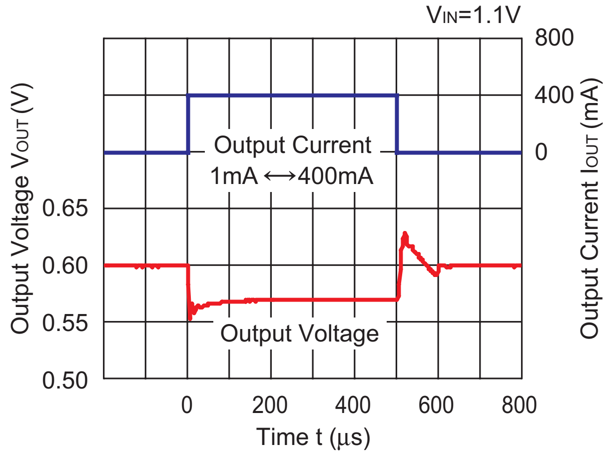
V_{IN}=1.5V



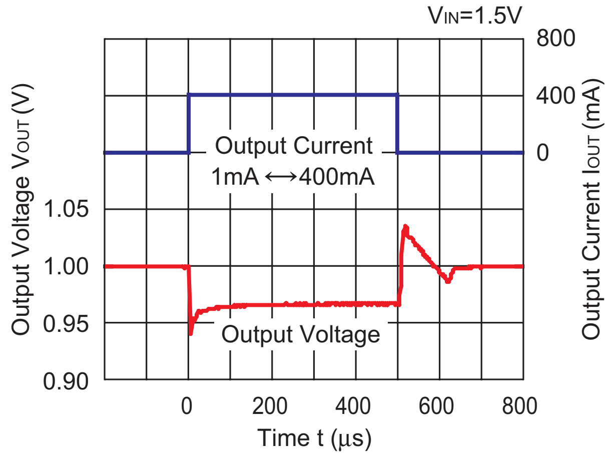
RP105x15xx



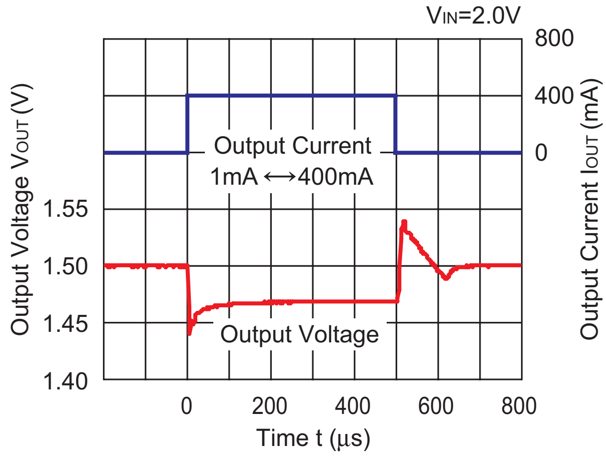
RP105x06xx



RP105x10xx

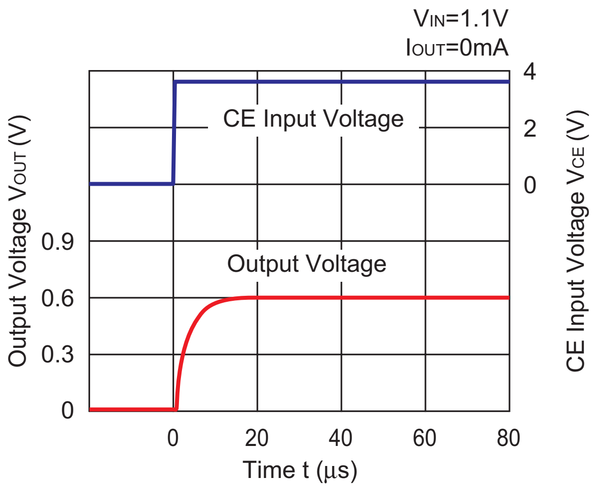


RP105x15xx

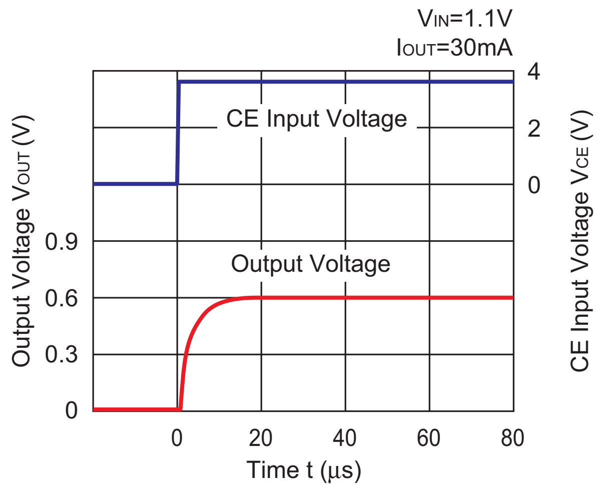


12) Turn On Speed with CE pin (V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF, Topt=25°C)

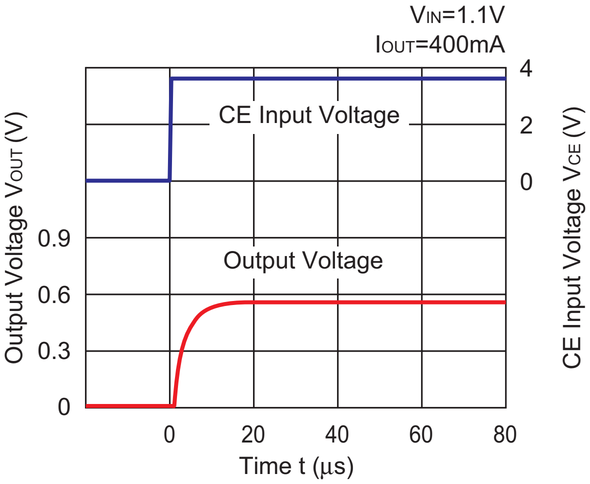
RP105x06xx



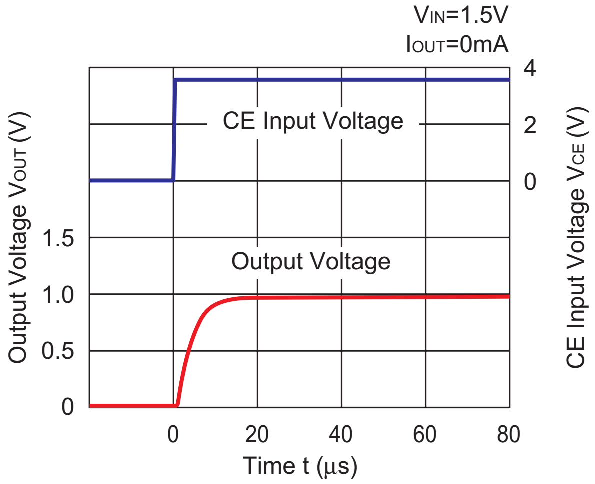
RP105x06xx



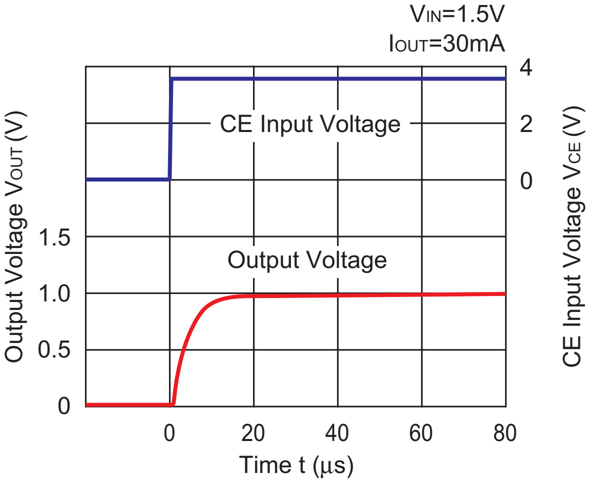
RP105x06xx



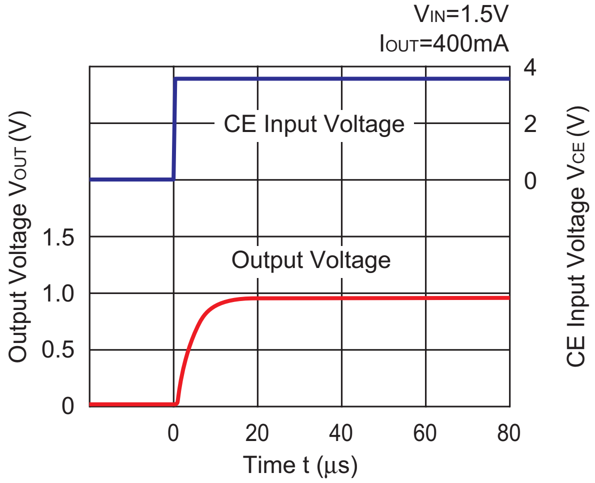
RP105x10xx



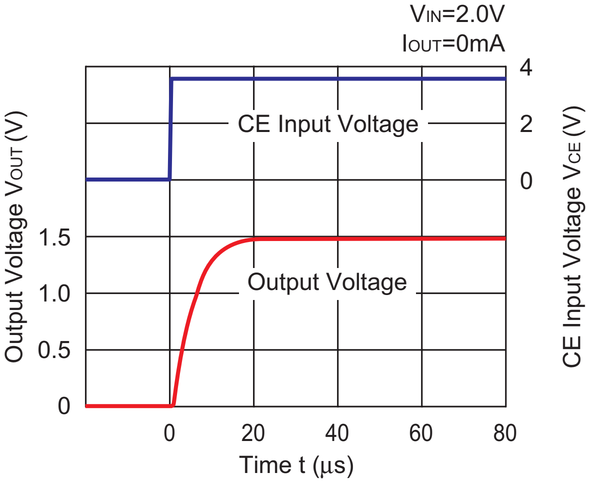
RP105x10xx



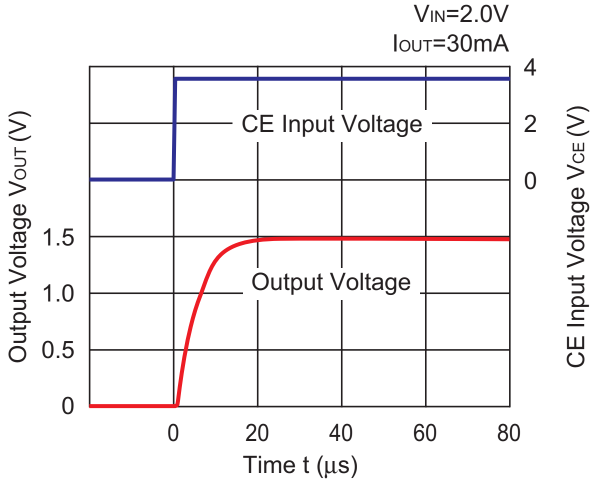
RP105x10xx



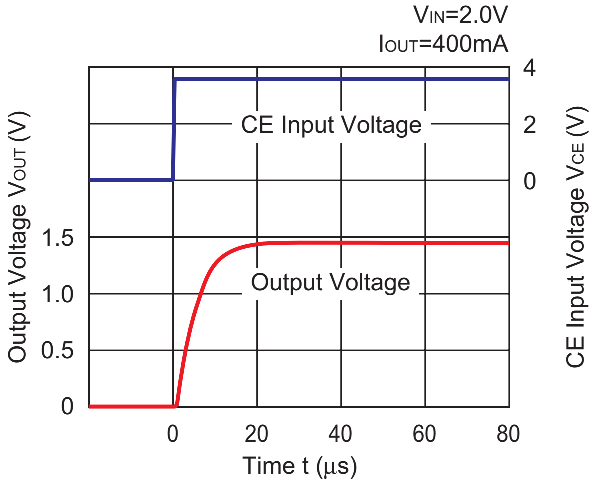
RP105x15xx



RP105x15xx

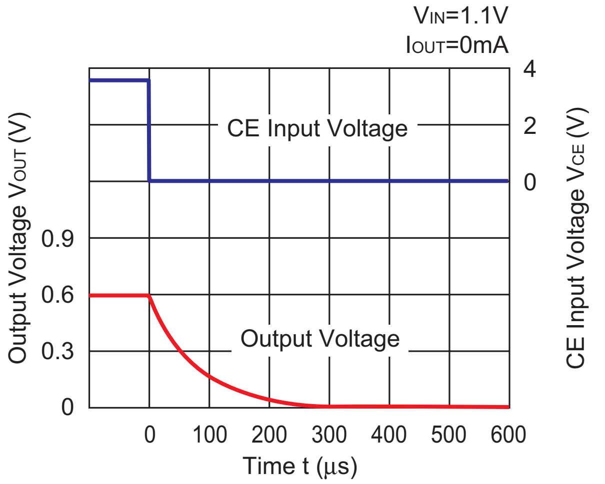


RP105x15xx

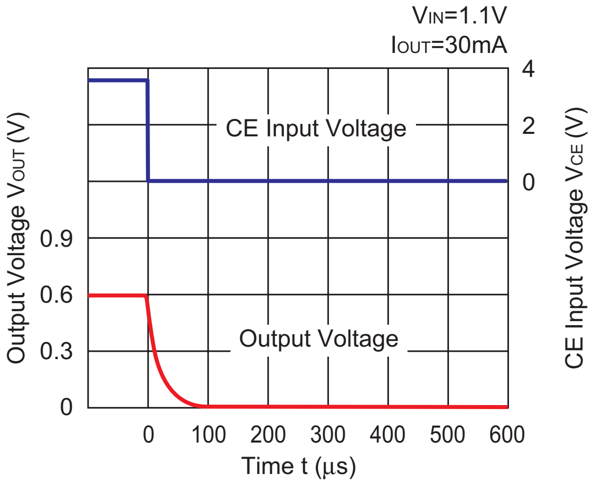


13) Turn Off Speed with CE Pin (V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=C_{OUT}=2.2µF, Topt=25°C)

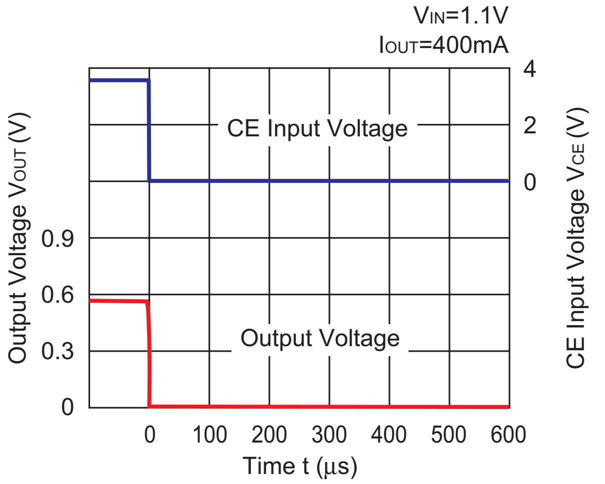
RP105x06xx



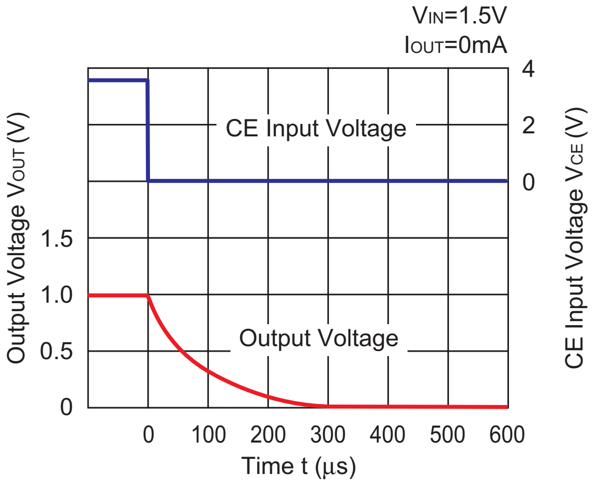
RP105x06xx



RP105x06xx

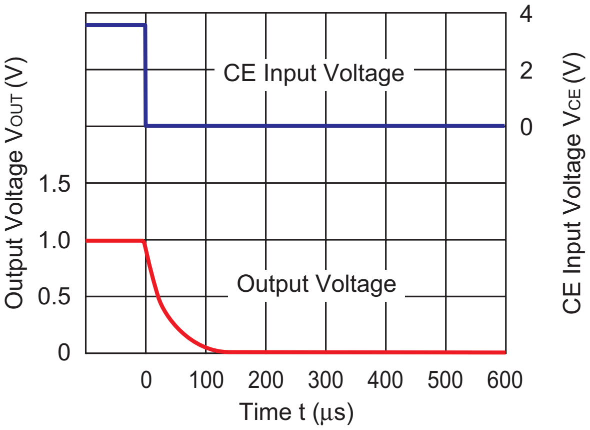


RP105x10xx



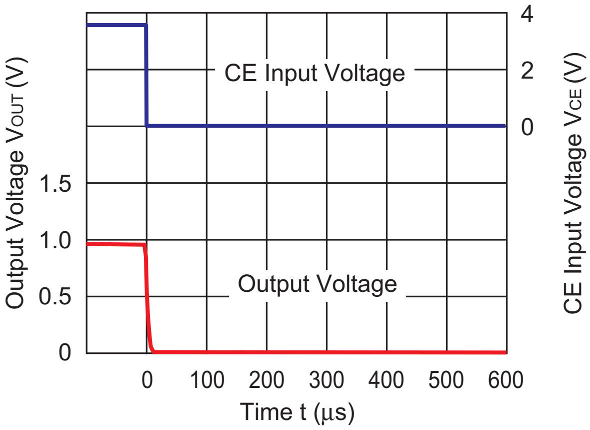
RP105x10xx

V_{IN}=1.5V
I_{OUT}=30mA



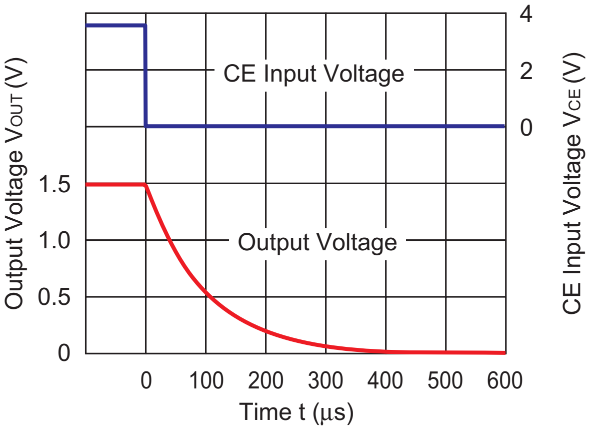
RP105x10xx

V_{IN}=1.5V
I_{OUT}=400mA



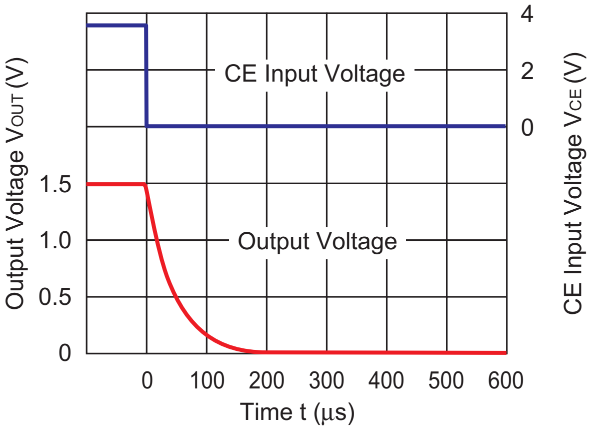
RP105x15xx

V_{IN}=2.0V
I_{OUT}=0mA



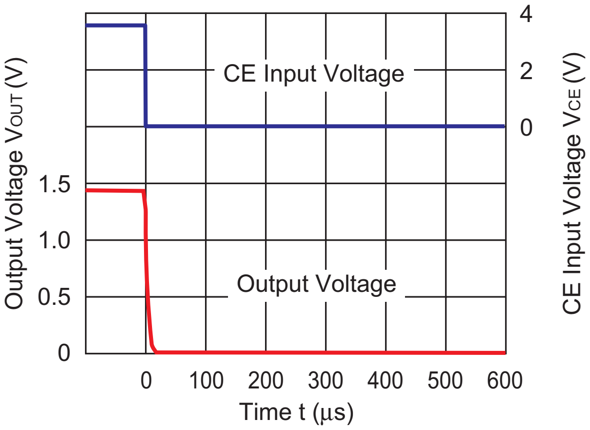
RP105x15xx

V_{IN}=2.0V
I_{OUT}=30mA



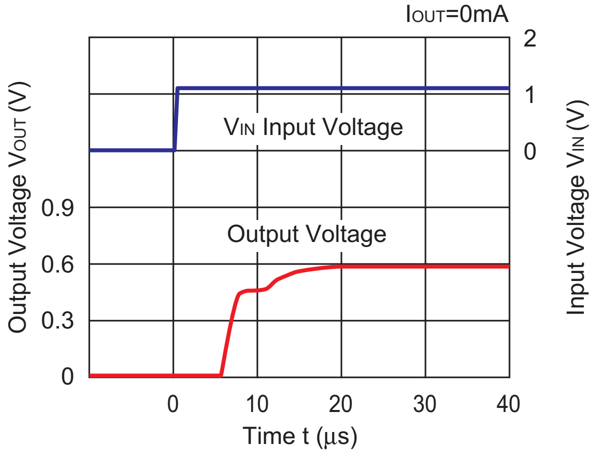
RP105x15xx

V_{IN}=2.0V
I_{OUT}=400mA

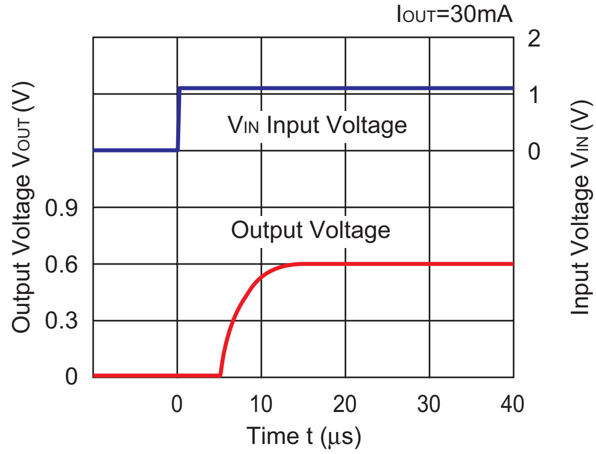


14) Turn On Transient with V_{IN} pin (V_{BIAS}=3.6V, C_{BIAS}=1.0µF, C_{IN}=none, C_{OUT}=2.2µF, Topt=25°C)

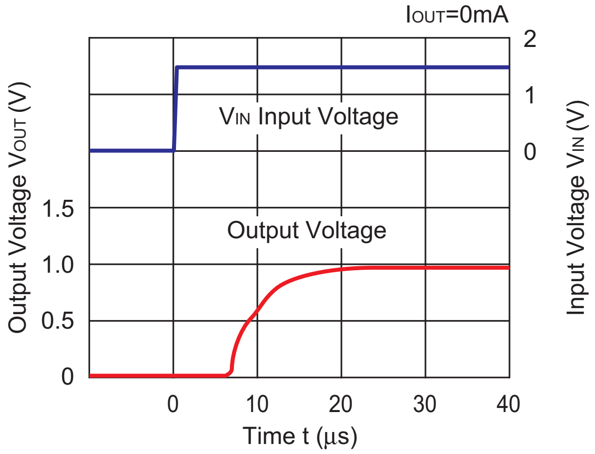
RP105x06xx



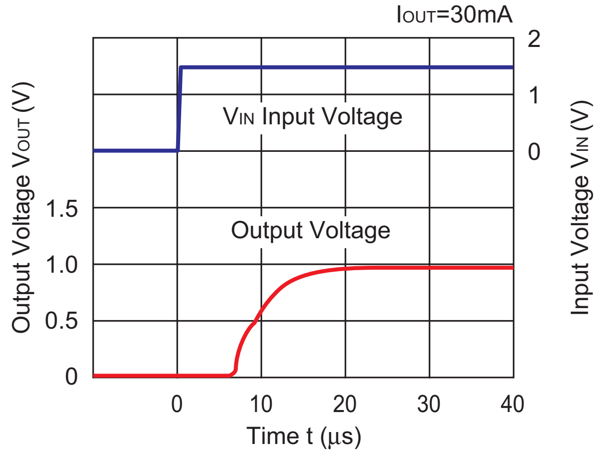
RP105x06xx



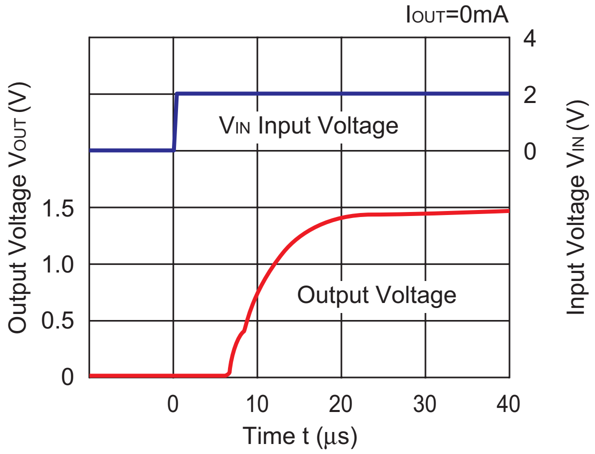
RP105x10xx



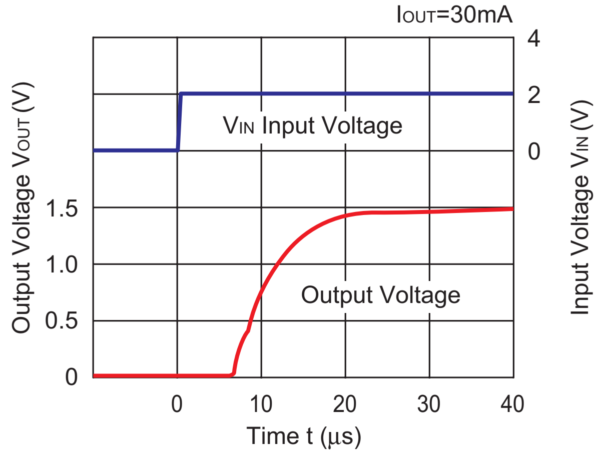
RP105x10xx



RP105x15xx



RP105x15xx

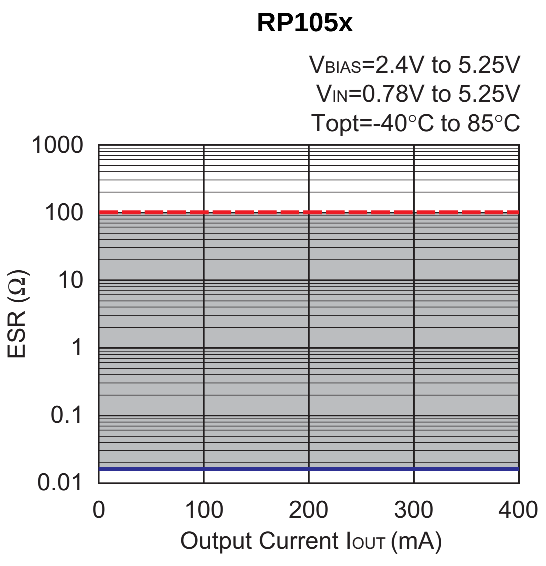


ESR vs. Output Current

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
Hatched Area	: Noise level is under 40μV (Avg.)
C_{BIAS}, C_{IN}	: 1.0μF
C_{OUT}	: 2.2μF



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RoHS Compliant
Halogen Free

For the conservation of the global environment, Ricoh is advancing the decrease of the negative environmental impact material.
After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive. Basically after Apr. 1, 2012, we will ship out the Power Management ICs of the Halogen Free products only. (Ricoh Halogen Free products are also Antimony Free.)

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