RICOH

LOW NOISE 150mA LDO REGULATOR

RP103 SERIES

Preliminary

NO. EA-149-070309

OUTLINE

The RP103 Series are CMOS-based voltage regulator ICs with high output voltage accuracy, extremely low supply current, low ON-resistance, and high ripple rejection. Each of these ICs consists of a voltage reference unit, an error amplifier, resistor-net for voltage setting, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage and a chip enable function. The line transient response and load transient response of the RP103 Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

The output voltage of these ICs is fixed with high accuracy. Since the packages for these ICs are PLP1010-4, SOT23-5, SC82-AB, therefore high density mounting of the ICs on boards is possible.

FEATURES

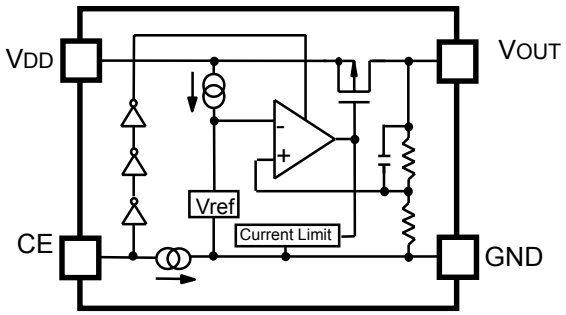
- Low Supply Current ..... TYP. 36μA
- Standby Mode ..... TYP. 0.1μA
- Low Dropout Voltage ..... TYP. 0.210V (I_{OUT}=150mA, 2.8V Output type)
- High Ripple Rejection ..... TYP. 75dB (f=1kHz)
- Low Temperature-Drift Coefficient of Output Voltage ..... TYP. ±30ppm/°C
- Excellent Line Regulation ..... TYP. 0.02%/V
- High Output Voltage Accuracy ..... ±1.0%
- Small Packages PLP1010-4, SOT-23-5, SC-82AB
- Output Voltage 1.2V, 1.3V, 1.5V, 1.8V, 1.85V, 1.9V, 2.0V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 2.9V, 3.0V, 3.1V, 3.3V
- Built-in Fold Back Protection Circuit ..... TYP. 40mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ..... C_{IN}=C_{OUT}=0.47μF or more

APPLICATIONS

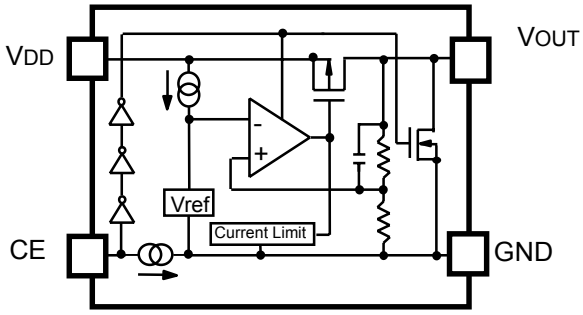
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

RP103xxx1B



RP103xxx1D



SELECTION GUIDE

The output voltage, version, and the taping type for the ICs can be selected at the user's request.
The selection can be made with designating the part number as shown below;

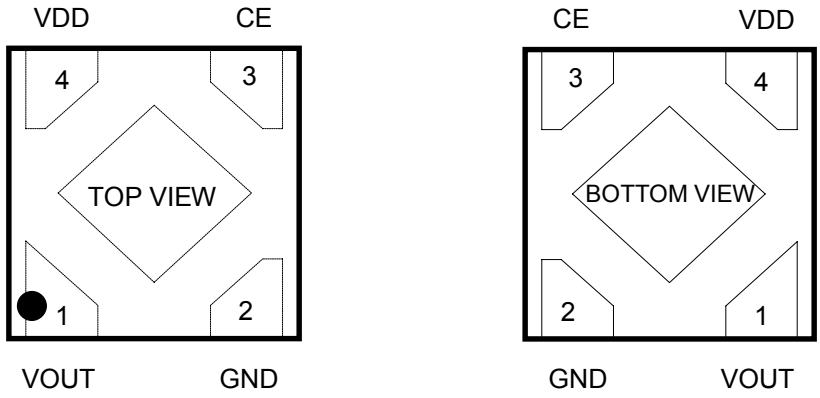
RP103xxx1x-xx ←Part Number
↑ ↑ ↑ ↑
a b c d

Code	Contents
a	Designation of Package Type: K: PLP1010-4 N: SOT-23-5 Q: SC-82AB
b	Setting Output Voltage (V_{OUT}): 1.2V, 1.3V, 1.5V, 1.8V, 1.85V, 1.9V, 2.0V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 2.9V, 3.0V, 3.3V Exception:1.85V=RP103x181x5, 2.85V=RP103x281x5
c	Designation of Active Type: B: active high type* D: active high, with auto discharge*
d	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)

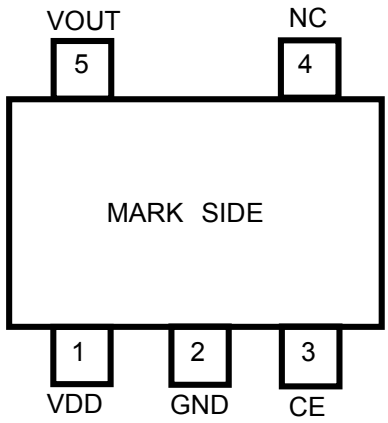
*When the mode is into standby with CE signal, auto-discharge transistor turns on, and it makes the turn-off speed faster than normal type.

PIN CONFIGURATION

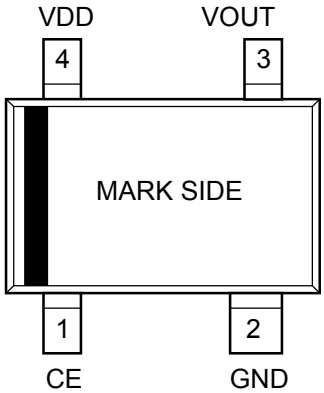
● **PLP1010-4**



● **SOT-23-5**



● **SC-82AB**



PIN DESCRIPTIONS

- **RP103K**

Pin No.	Symbol	Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin (“H” Active)
4	V_{DD}	Input Pin

Tab is GND level. (They are connected to the reverse side of this IC.)
Do not connect to other wires or land patterns.

- **RP103N**

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin (“H” Active)
4	NC	No Connection
5	V_{OUT}	Output Pin

- **RP103Q**

Pin No.	Symbol	Description
1	CE	Chip Enable Pin (“H” Active)
2	GND	Ground Pin
3	V_{OUT}	Output Pin
4	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating		Unit
V_{IN}	Input Voltage	6.0		V
V_{CE}	Input Voltage (CE Pin)	6.0		V
V_{OUT}	Output Voltage	−0.3~V_{IN}+0.3		V
I_{OUT}	Output Current	180		mA
P_D	Power Dissipation	PLP1010-4 *1	400	mW
		SOT-23-5 (Free Air) *2	250	
		SC-82AB *2	380	
Topt	Operating Temperature Range	−40~85		°C
Tstg	Storage Temperature Range	−55~125		°C

*1: This value is under evaluation.
*2: For Power Dissipation, please refer to PACKAGE INFORMATION (from p.8) to be described

ELECTRICAL CHARACTERISTICS

- **RP103xxx**
- **V_{IN}= Set V_{OUT}+ 1V for V_{OUT} options greater than 1.5V. V_{IN}=2.5V for V_{OUT} ≤1.5V. I_{OUT}=1mA, C_{IN}=C_{OUT}=0.47µF, unless otherwise noted.**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{OUT}	Output Voltage	(*1)	V_{OUT} ×0.99 (-20mV)		V_{OUT} ×1.01 (20mV)	V
I_{OUT}	Output Current		150			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	1mA ≦ I_{OUT} ≦ 150mA		10	40	mV
V_{DIF}	Dropout Voltage	Please see the data sheet below				
I_{SS}	Supply Current	I_{OUT} = 0mA		36	48	µA
Istandby	Supply Current (Standby)	V_{CE} = 0V		0.1	1.0	µA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	Set V_{OUT}+0.5V≤V_{IN}≤5.0V		0.02	0.10	%/V
RR	Ripple Rejection	f=1kHz ,Ripple 0.2Vp-p V_{IN}=Set V_{OUT} +1V, I_{OUT}=30mA (In case that V_{OUT}≤2.0V, V_{IN}=3V)		75		dB
V_{IN}	Input Voltage	(*2)	1.70		5.25	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±30		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		40		mA
I_{PD}	CE Pull-down Current			0.3		µA
V_{CEH}	CE Input Voltage “H”		1.5			V
V_{CEL}	CE Input Voltage “L”				0.3	V
en	Output Noise	BW = 10Hz to 100kHz I_{OUT}=30mA		60		µVrms

(*1) Vout ≦ 2.0V, ±20mV accuracy
(*2) Max. Input Voltage is 5.5V during 500 hours

Dropout Voltage

V_{OUT} (V)	Dropout Voltage (V)		
	Condition	TYP.	MAX.
1.2V ≦ V_{OUT}< 1.5V	I_{OUT}=150mA	0.500	0.620
1.5V ≦ V_{OUT}< 1.7V		0.380	0.470
1.7V ≦ V_{OUT}< 2.0V		0.340	0.420
2.0V ≦ V_{OUT}< 2.5V		0.280	0.360
2.5V ≦ V_{OUT}< 2.8V		0.220	0.300
2.8V ≦ V_{OUT} ≦ 3.3V		0.210	0.270

TECHNICAL NOTES

When using these ICs, consider the following points:

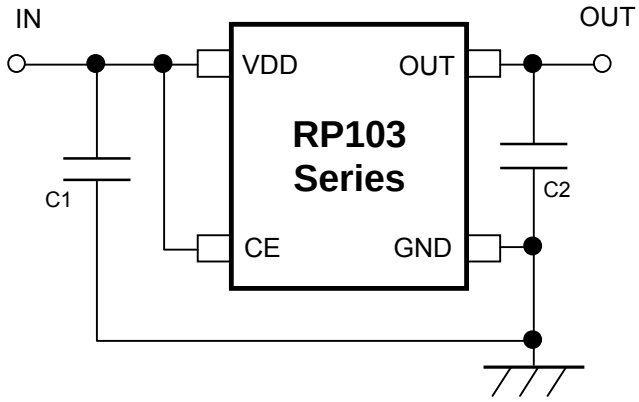
Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C_{OUT} with good frequency characteristics and 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 with a capacitance value as much as 0.47μF or more between V_{DD} 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.



(External Components)

Output Capacitor 0.47μF MURATA: GRM155B30J474KE18B

POWER DISSIPATION (SOT-23-5)

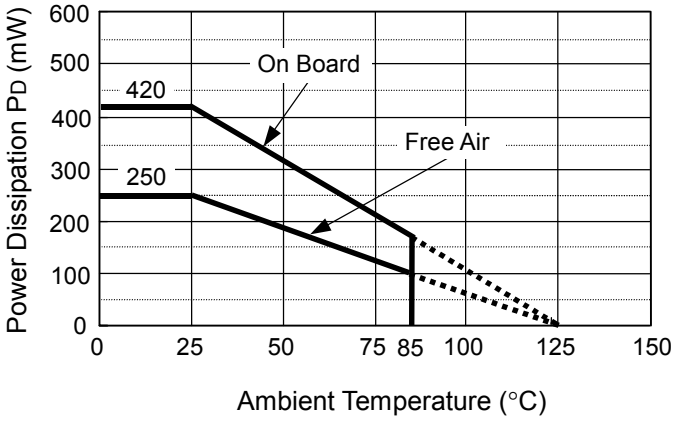
This specification is at mounted on board. Power Dissipation (PD) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

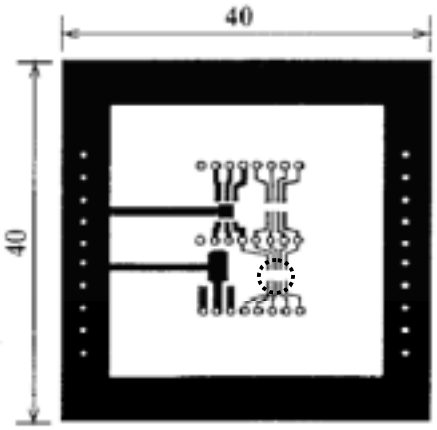
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm*40mm*1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

Measurement Result (Topt=25°C, Tjmax=125°C)

	Standard Test Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja = (125-25°C)/0.42W= 263°C/W	400°C/W



Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)

POWER DISSIPATION (SC-82AB)

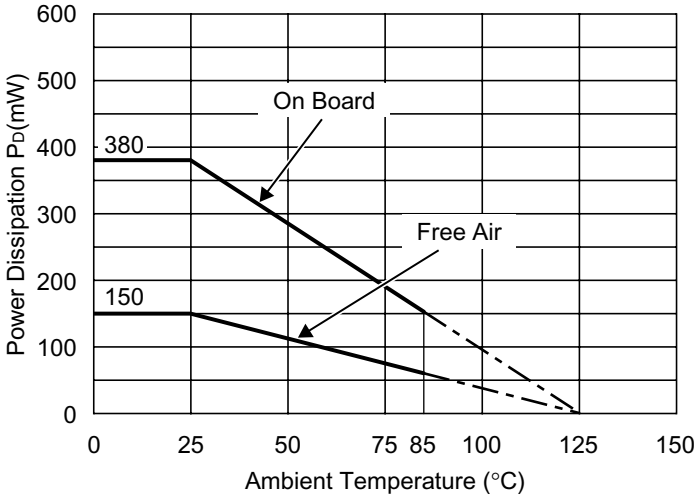
This specification is at mounted on board. Power Dissipation (PD) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

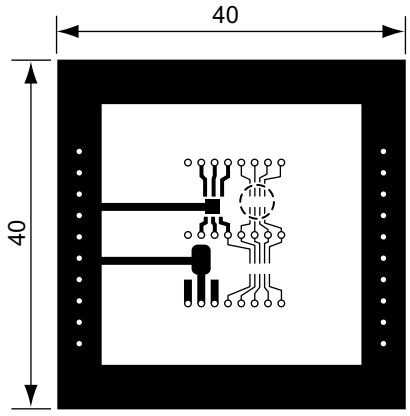
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

Measurement Result (Topt=25°C,Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	380mW	150mW
Thermal Resistance	θja=(125−25°C)/0.38W=263°C/W	667°C/W



Power Dissipation

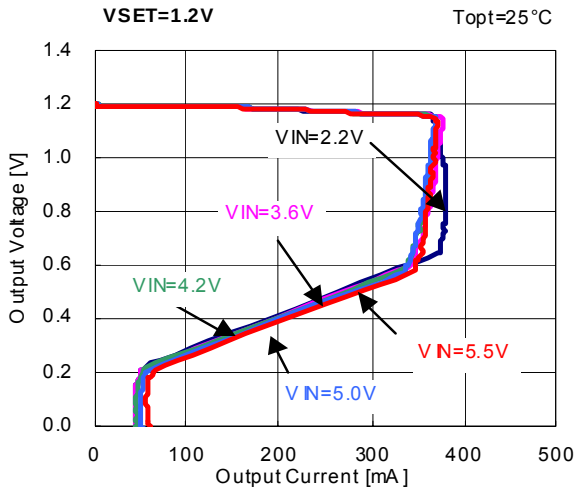


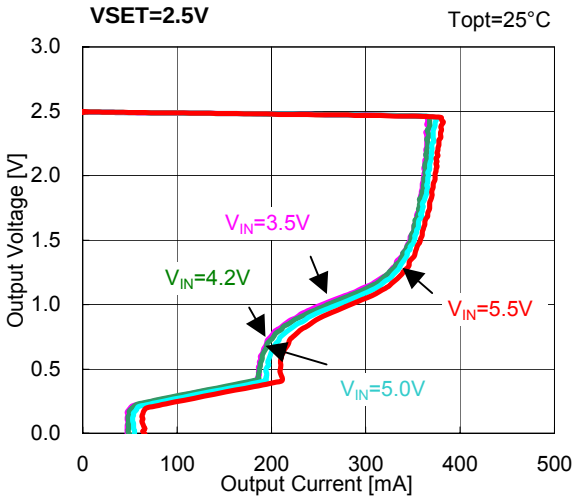
Measurement Board Pattern

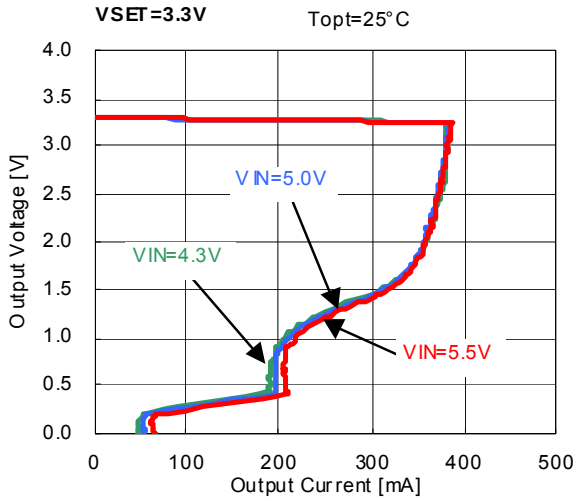
IC Mount Area (Unit : mm)

TYPICAL CHARACTERISTICS

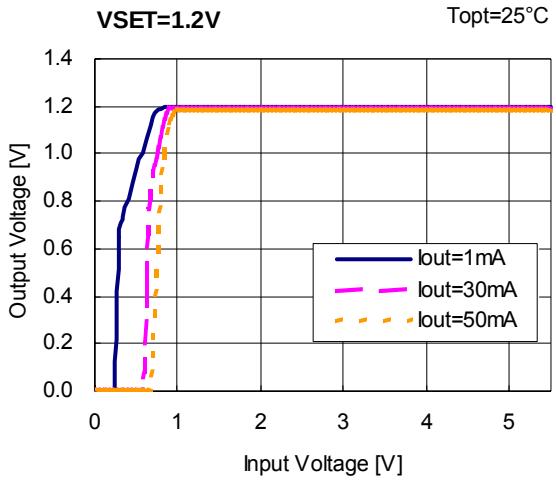
1) Output Voltage vs. Output Current Cin=0.47uF, Cout=0.47uF

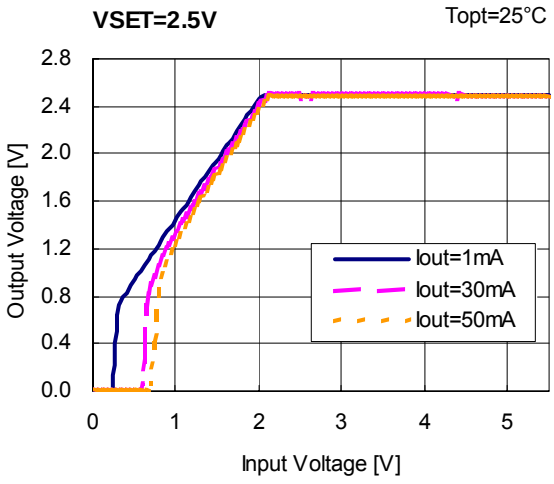


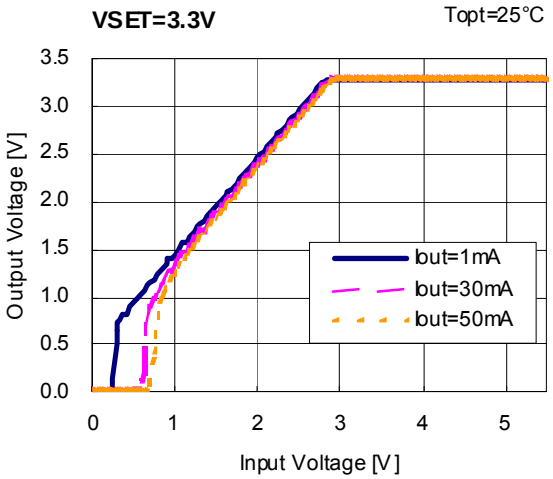




2) Output Voltage vs. Input Voltage Cin=0.47uF, Cout=0.47uF

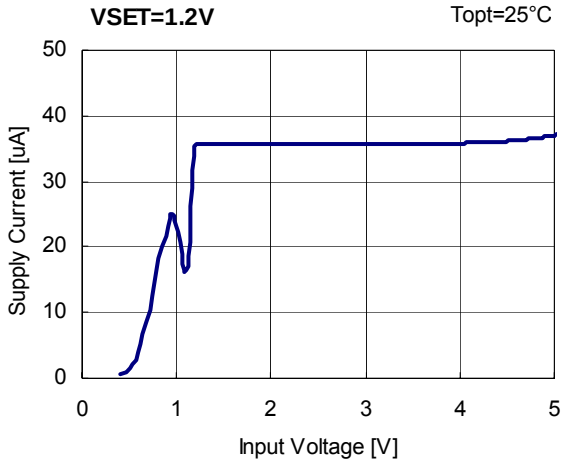


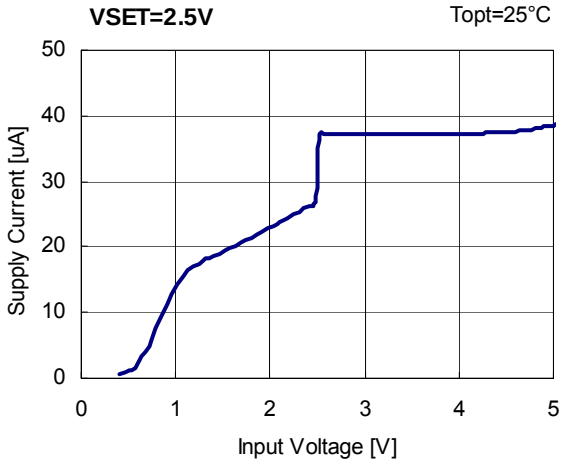


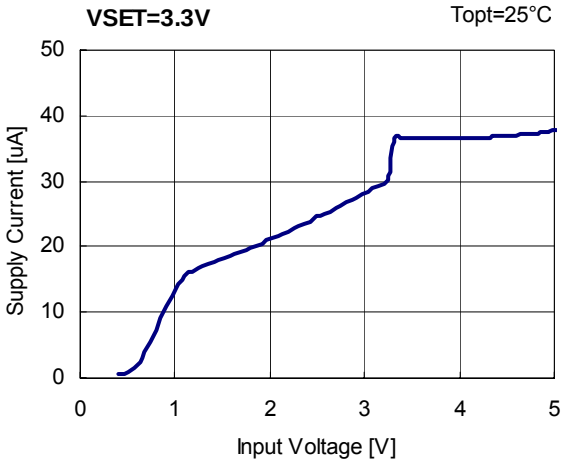


3) Supply Current vs. Input Voltage

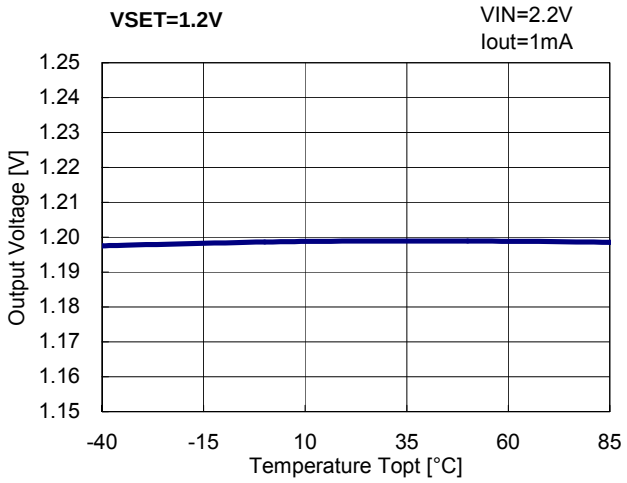
Cin=0.47uF , Cout=0.47uF

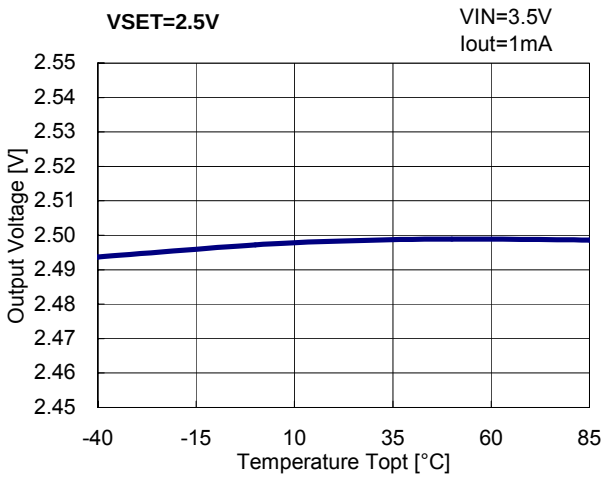


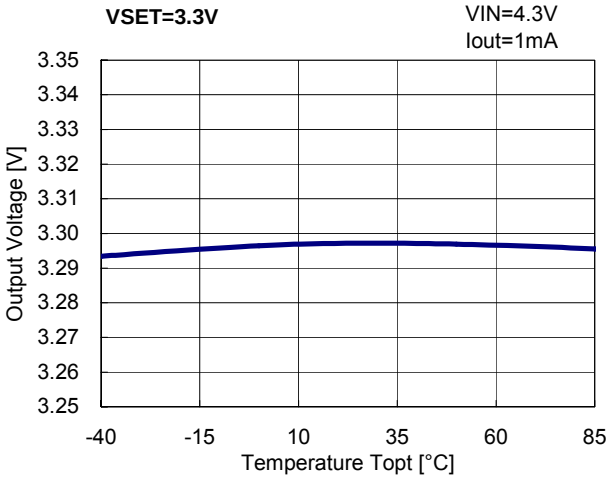




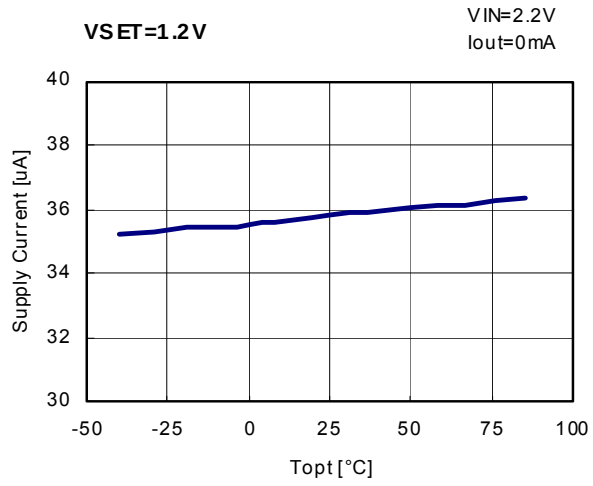
4) Output Voltage vs. Temperature Cin=0.47uF, Cout=0.47uF

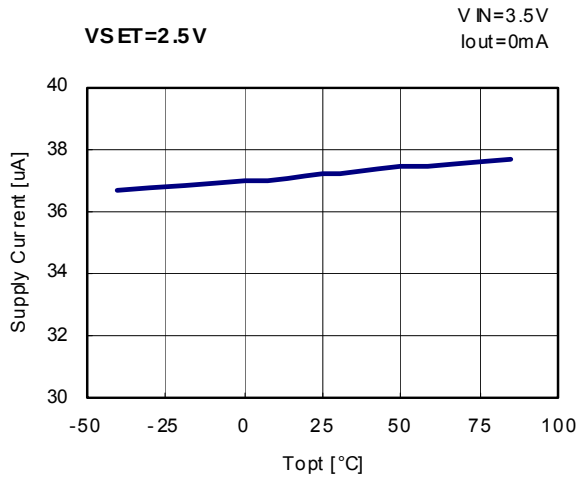


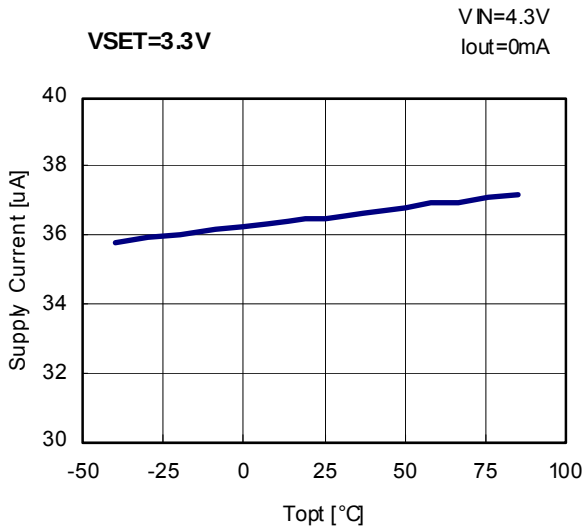




5) Supply Current vs. Temperature Cin=0.47uF, Cout=0.47uF

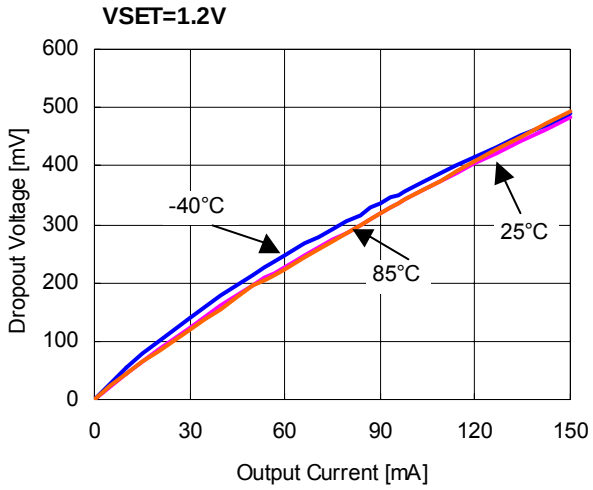


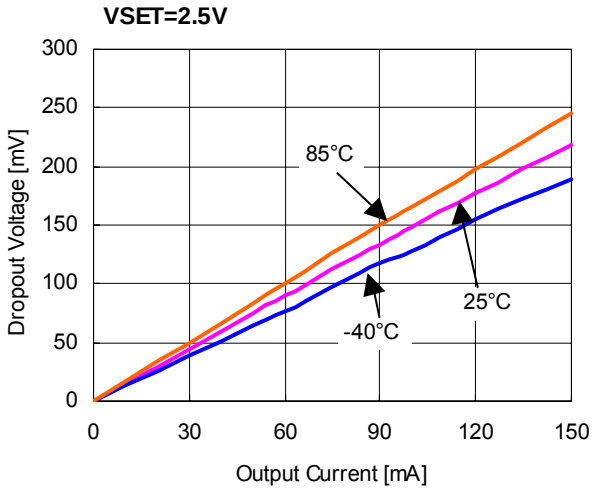


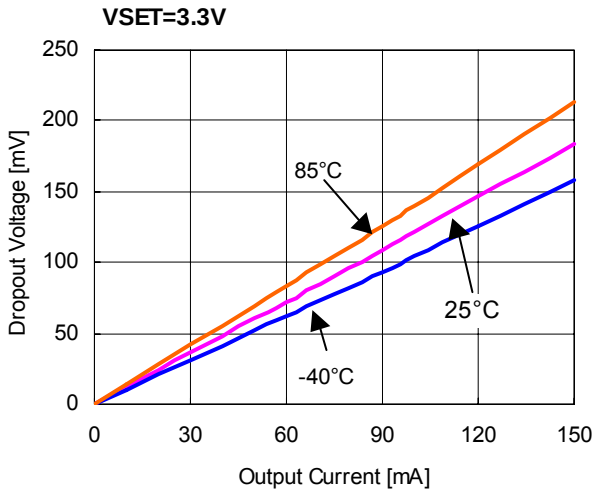


6) Dropout Voltage vs. Output Current

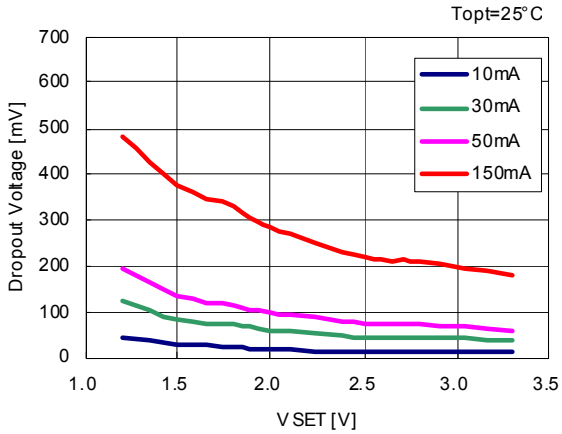
Cin=0.47uF, Cout=0.47uF



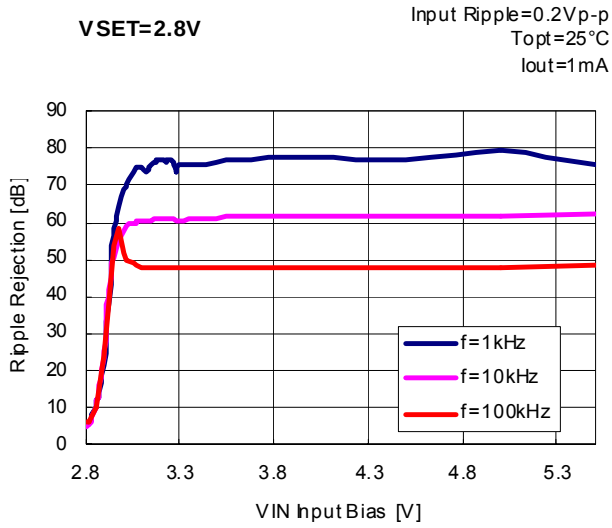


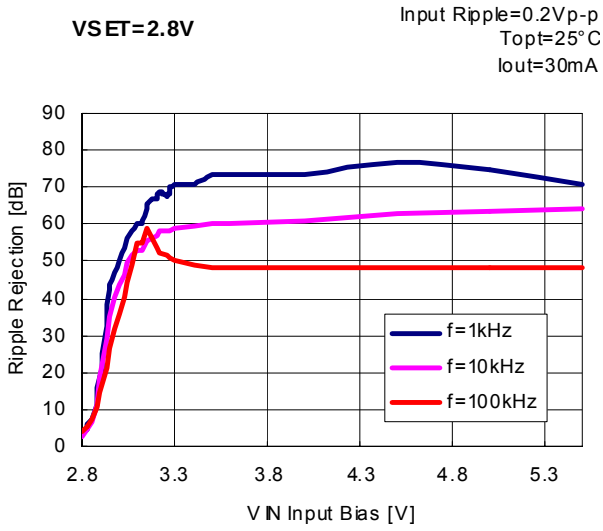


7) Dropout Voltage vs. VSET Cin=0.47uF, Cout=0.47uF

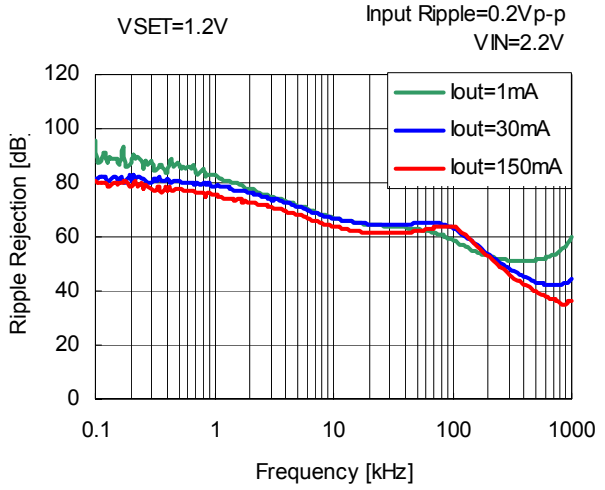


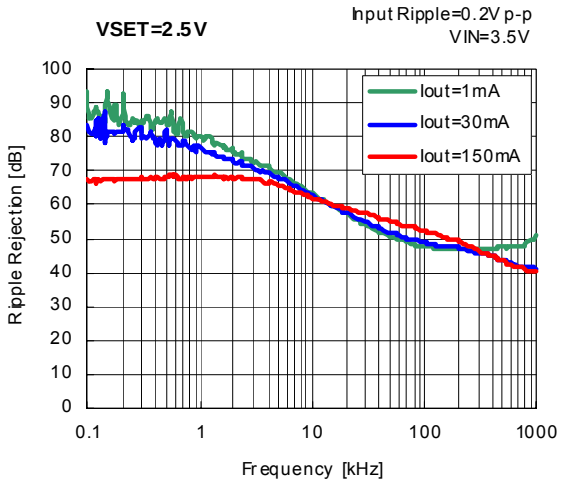
8) Ripple Rejection vs. Input Bias (Cin=none, Cout=0.47uF)

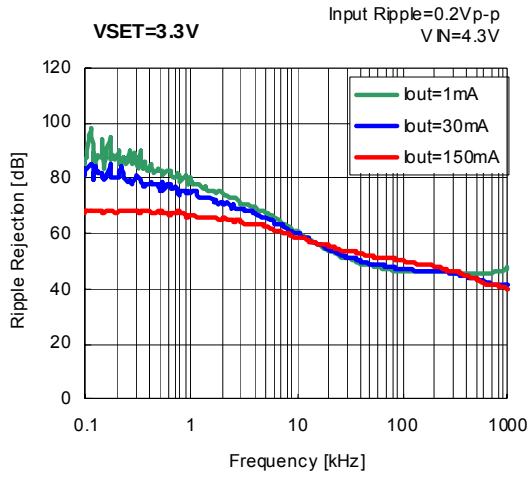




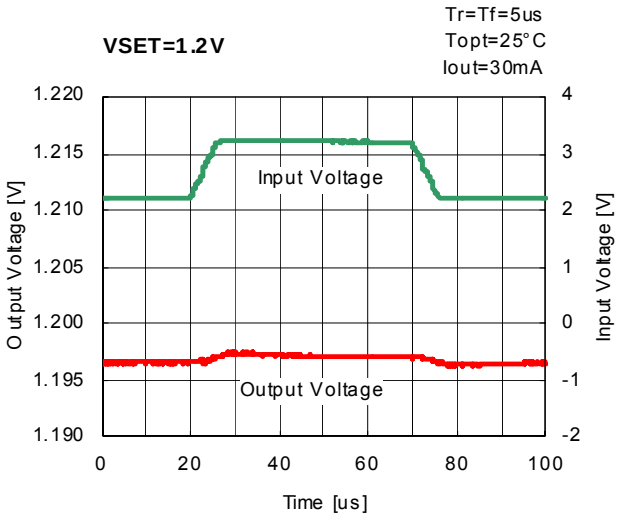
9) Ripple Rejection vs. Frequency Cin=none, Cout=0.47uF

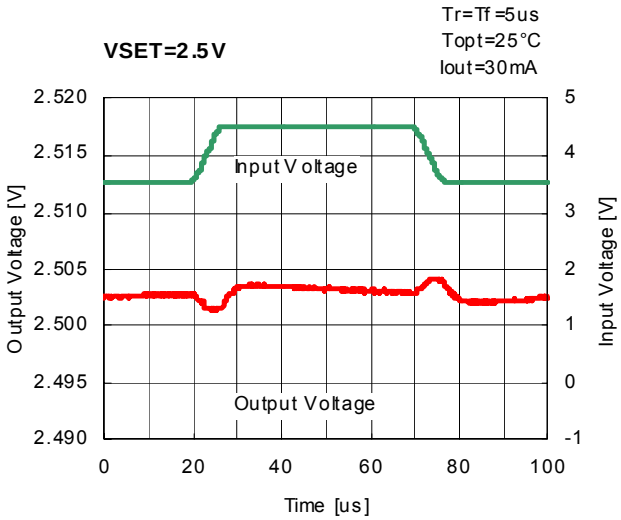


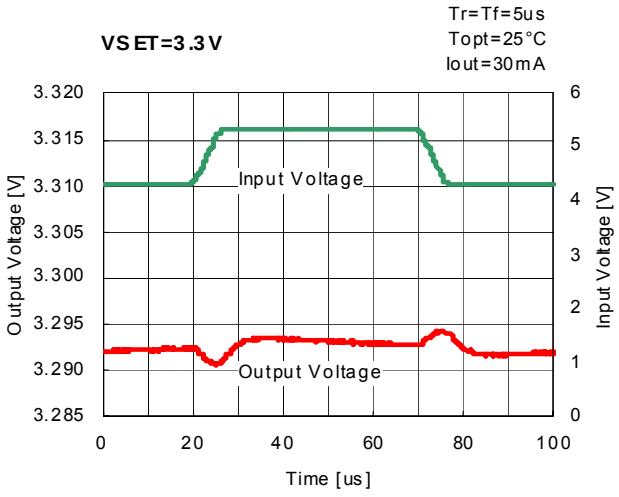




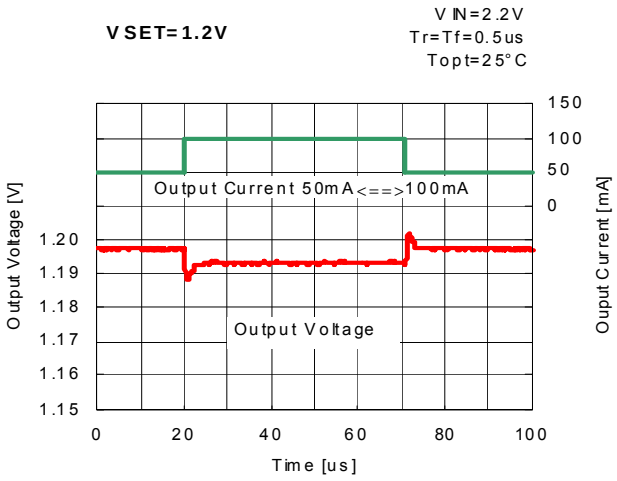
10) Input Transient Response Cin=none, Cout=0.47uF

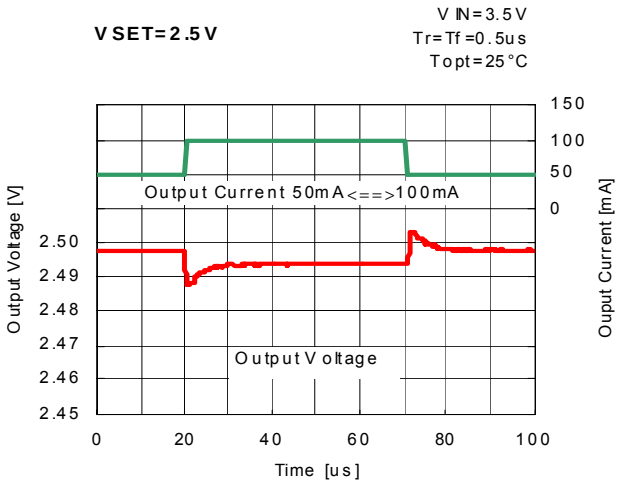


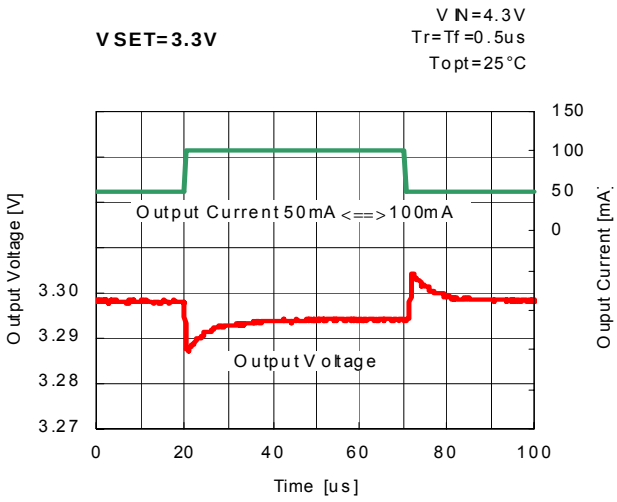


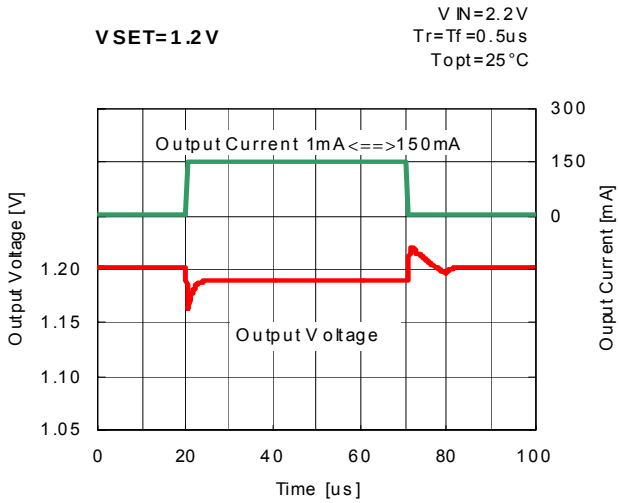


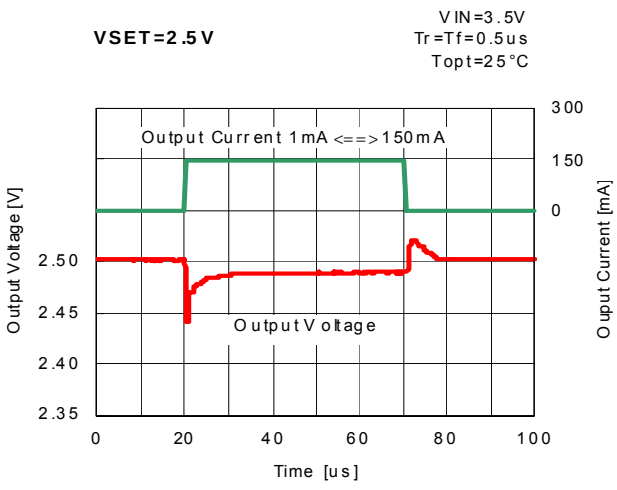
11) Load Transient Response Cin=0.47uF, Cout=0.47uF

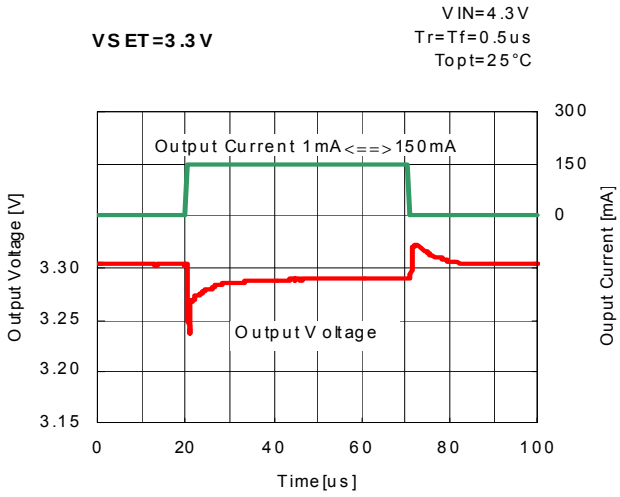




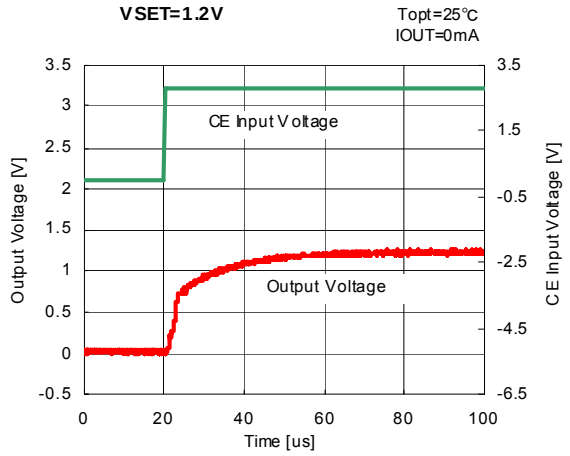


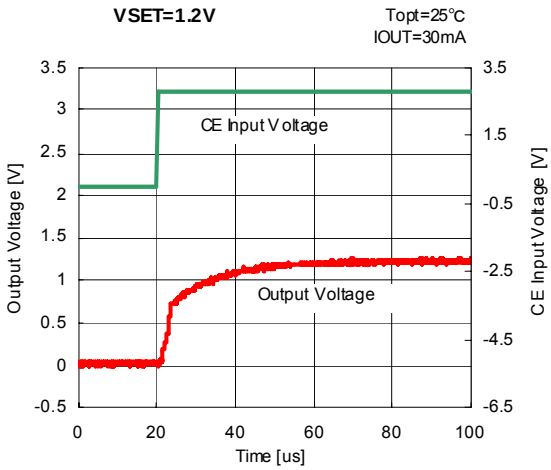


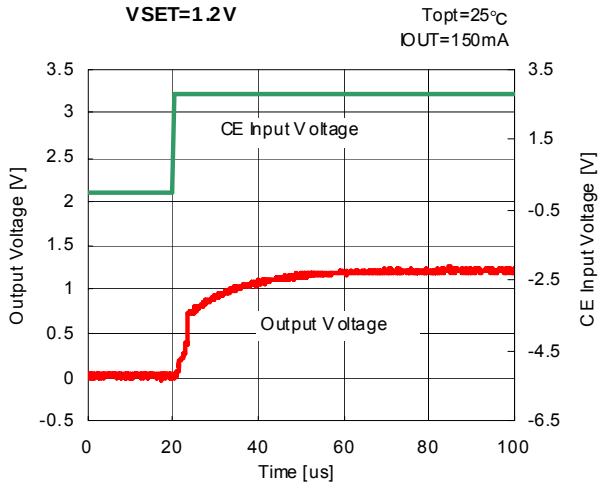


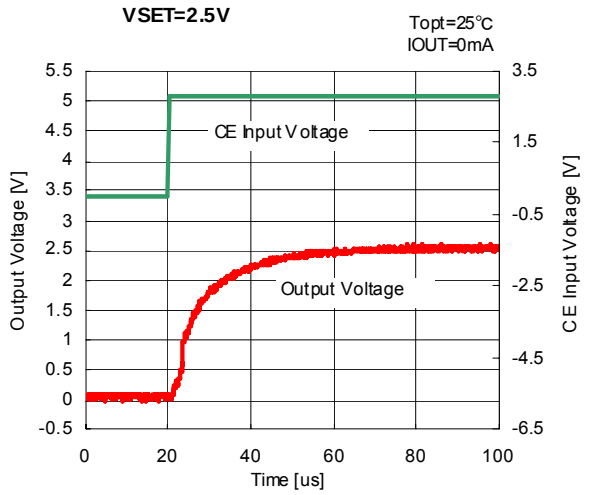


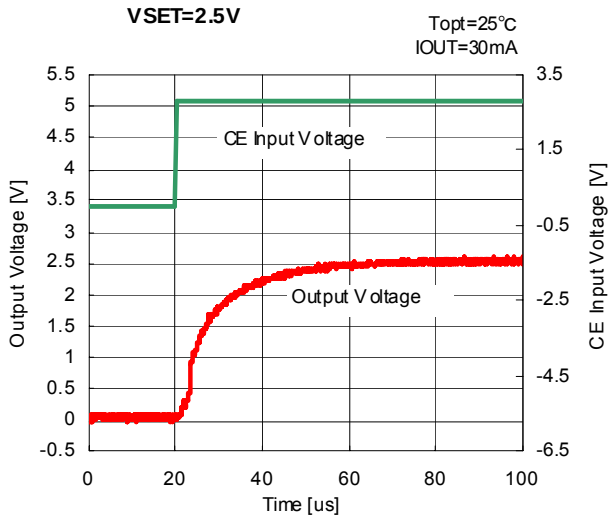
12) Turn On Speed with CE pin Cin=0.47uF, Cout=0.47uF

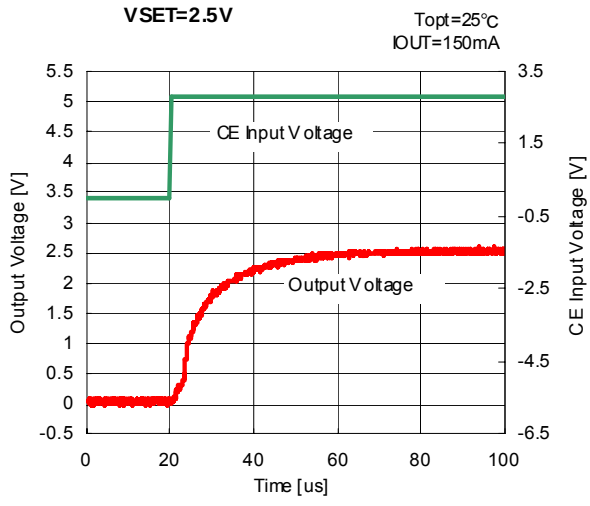


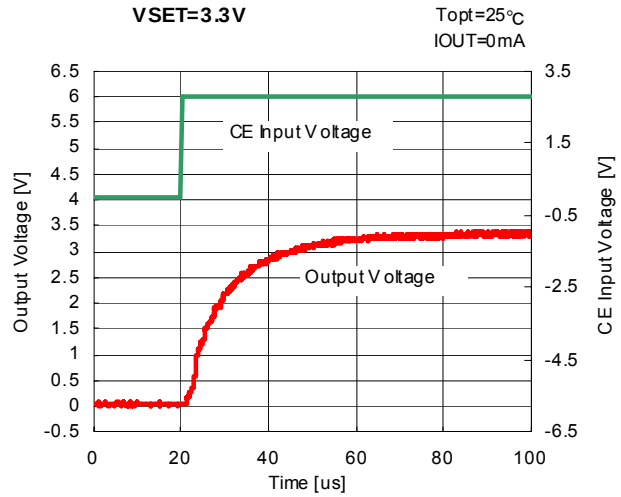


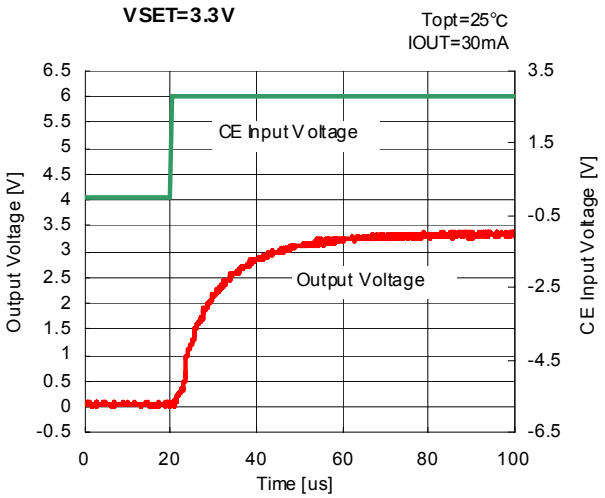


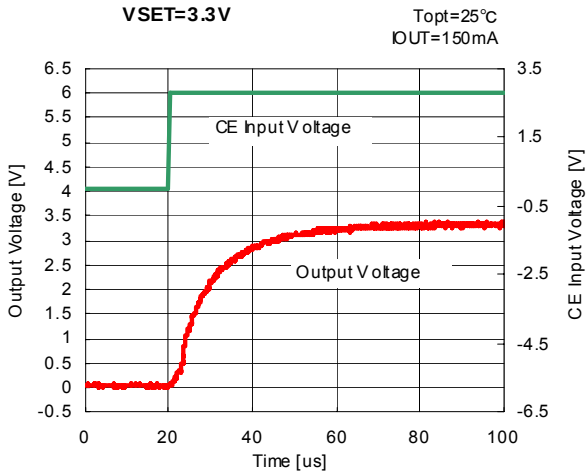




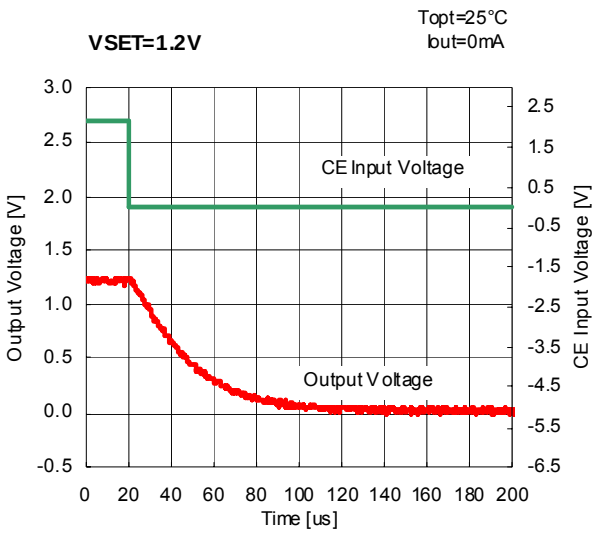


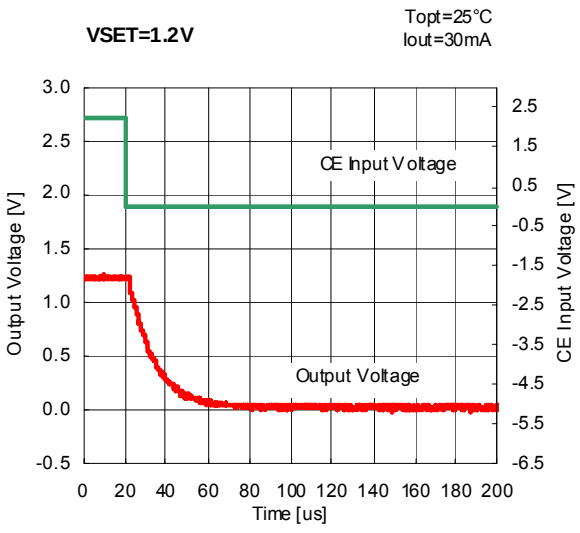






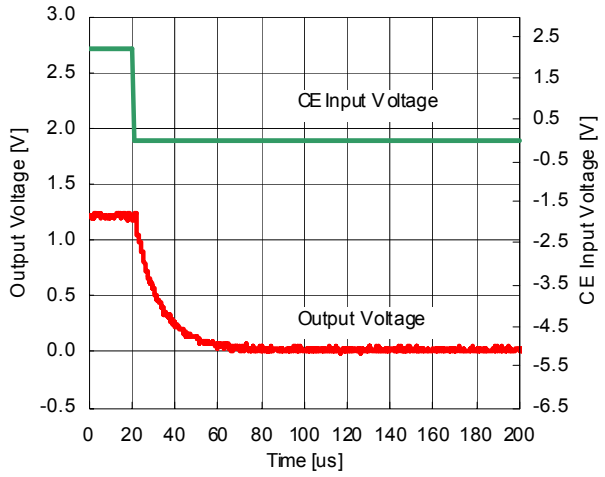
13) Turn Off Speed with CE pin (D Version) Cin=1.0uF, Cout=1.0uF





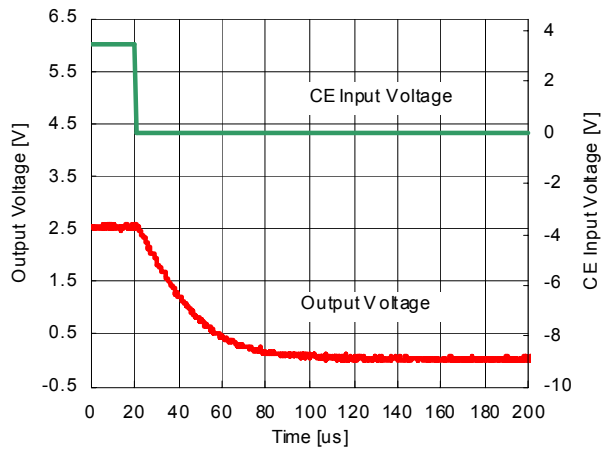
VSET=1.2V

Topt=25°C
Iout=150mA



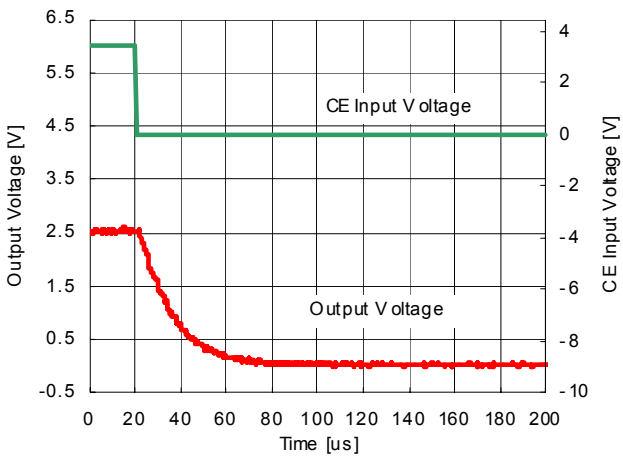
VSET=2.5V

Topt=25°C
Iout=0mA



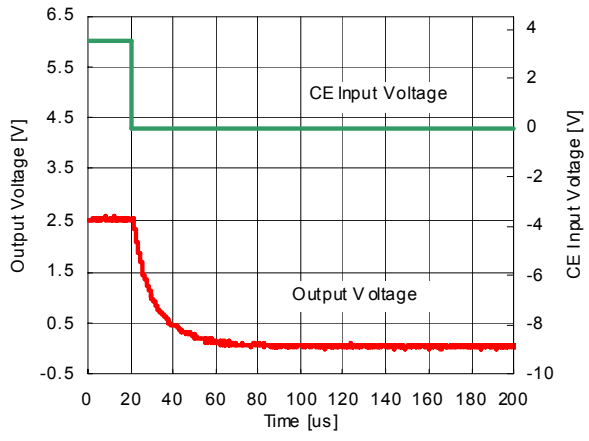
VSET=2.5V

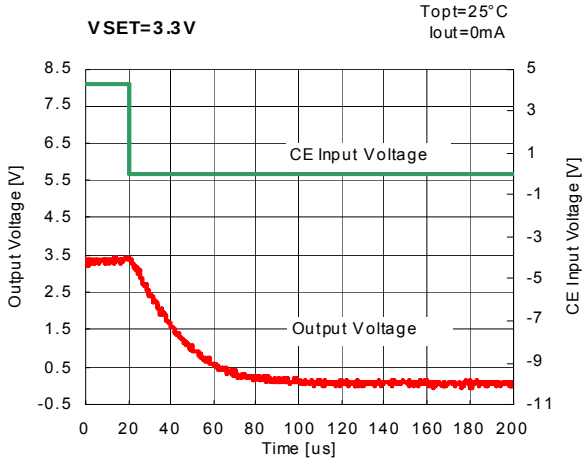
Topt=25°C
Iout=30mA

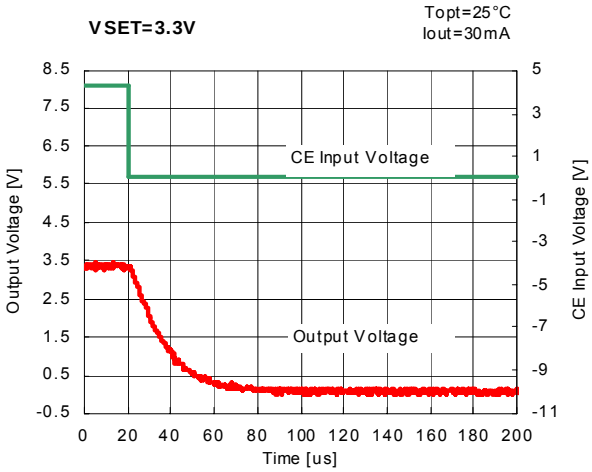


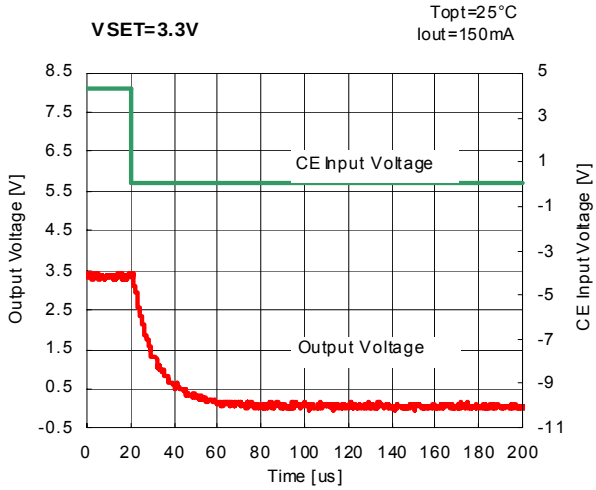
VSET=2.5V

Topt=25°C
Iout=150mA









14) ESR vs Output Current (Frequency Band: 10Hz to 2MHz Temperature: -40°C to 85°C)