RICOH

RP102 SERIES

LOW NOISE 300mA LDO REGULATOR

E20060919

OUTLINE

The RP102 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, a resistor-net for voltage setting, a current limit circuit and a chip enable circuit.

These ICs perform with low dropout voltage and "chip enable" function. The line transient response and load transient response of the RP102 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 SOT23-5, PLP1820-6(Under Development), and WL-CSP-4-P2(Under Development), therefore high density mounting of the ICs on boards is possible.

FEATURES

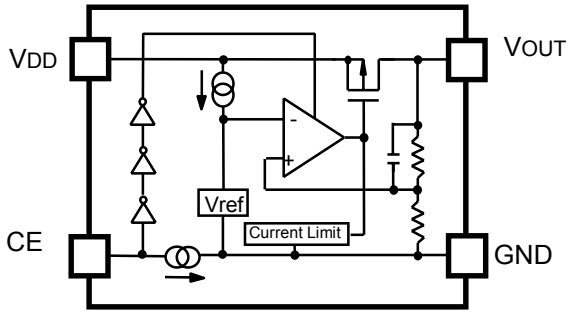
- Low Supply Current ..... Typ. 50μA
- Standby Mode ..... Typ. 0.1μA
- Low Dropout Voltage ..... Typ. 0.12V (I_{OUT}=300mA 3.3V Output type)
  ..... Typ. 0.14V (I_{OUT}=300mA 2.5V Output type)
- High Ripple Rejection ..... Typ. 80dB (f=1kHz 2.5V Output type)
- Low Temperature-Drift Coefficient of Output Voltage ..... Typ. ±20ppm/°C
- Excellent Line Regulation ..... Typ. 0.02%/V
- High Output Voltage Accuracy ..... ±1.0%
- Small Packages ..... WL-CSP-4-P2 (Under development), SOT-23-5, PLP1820-6(Under Development)
- Output Voltage 1.2V, 1.3V, 1.5V, 1.8V, 2.5V, 2.6V, 2.8V, 2.85V, 2.9V, 3.0V, 3.3V
- Built-in Fold Back Protection Circuit ..... Typ. 50mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC ..... C_{IN}=C_{OUT}=1μF or more

APPLICATIONS

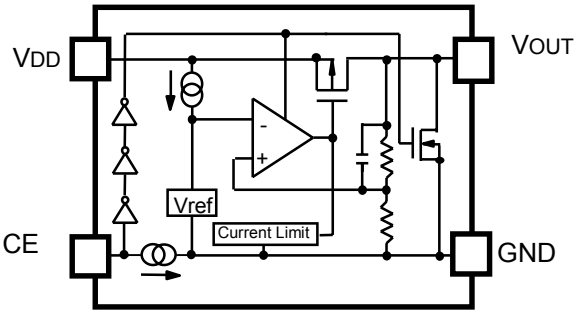
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS

RP102xxx1B



RP102xxx1D



SELECTION GUIDE

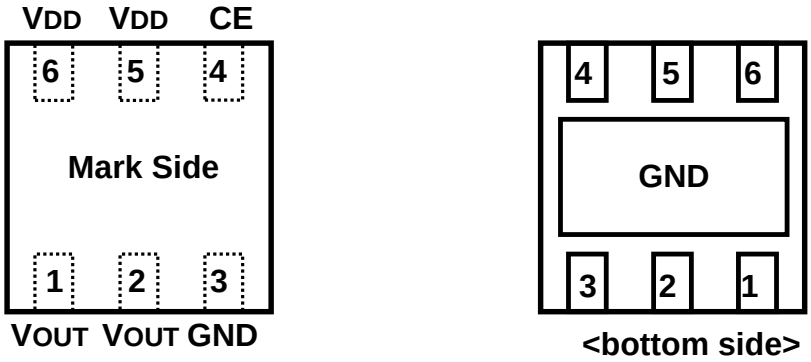
The output voltage, version, and the taping type for the ICs can be selected at the user's request.
The selection can be made with designating the part number as shown below;

RP102xxx1xx-xx ←Part Number
↑ ↑ ↑ ↑ ↑
a b c d e

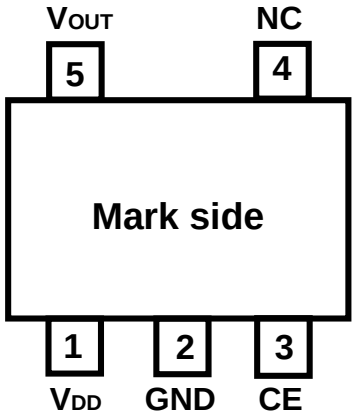
Code	Contents
a	Designation of Package Type: K: PLP1820-6(Under Development) N: SOT-23-5 Z: WL-CSP4-P2(Under Development)
b	Setting Output Voltage (V_{OUT}): 1.2V, 1.3V, 1.5V, 1.8V, 2.5V, 2.6V, 2.8V, 2.85V, 2.9V,3.0V, 3.3V
c	Designation of Active Type: B: active high type D: active high, with auto discharge
d	Designation of 50mV step of Output Voltage Type: Ex. If VOUT=2.85 this digit is described as 5. (RP102X281X5-TR)
e	Designation of Taping Type: Ex. TR (refer to Taping Specifications; TR type is the standard direction.)

PIN CONFIGURATION

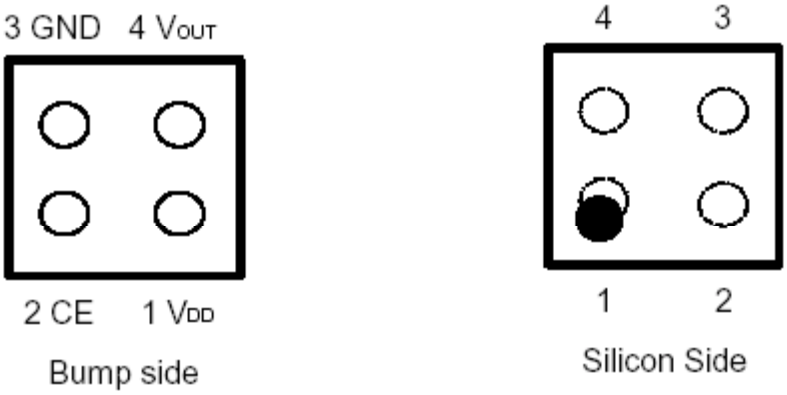
- **PLP1820-6**



- **SOT-23-5**



- **WL-CSP4-P2**



PIN DESCRIPTIONS

- **RP102K**

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

- **RP102N**

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

- **RP102Z**

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

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating		Unit
V_{DD}	Input Voltage	6.0		V
V_{CE}	Input Voltage (CE Pin)	6.0		V
V_{OUT}	Output Voltage	$-0.3 \sim V_{DD} + 0.3$		V
I_{OUT}	Output Current	400		mA
P_D	Power Dissipation	PLP1820-6 (Under Development)	880 *	mW
		SOT-23-5 (Free Air)	250	
		WLCSP4-P2 (Under Development)	530 *	
Topt	Operating Temperature Range	−40~85		°C
Tstg	Storage Temperature Range	−55~125		°C

Measurement Conditions;
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-holes: ϕ0.54mm * 30pcs(PLP1820-6)

ELECTRICAL CHARACTERISTICS

- **RP102xxx**
- **V_{IN}= Set V_{OUT}+ 1V for V_{OUT} options grater than 1.5V. V_{IN}=2.5V for V_{OUT}≤1.5V. I_{OUT}=1mA, CIN=COUT=1µF, 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		300			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		50	70	µA
Istandby	Supply Current (Standby)	V_{CE} = 0V		0.1	2.0	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)		80		dB
V_{DD}	Input Voltage		1.7		5.0	V
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±20		ppm /°C
I_{LIM}	Short Current Limit	V_{OUT} = 0V		50		mA
I_{PD}	CE Pull-down Current		0.05	0.30	0.60	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		30		µVrms
Rlow	Nch On Resistance For auto discharge (D version)	V_{IN}=4.0V V_{CE}=0V		30		Ω

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

- **Dropout Voltage**

V_{OUT} (V)	Dropout Voltage					
	Condition	TYP.	MAX.	Condition	TYP.	MAX.
1.2V ≦ V_{OUT} <1.5V	I_{OUT}=150mA	145	500	I_{OUT}=300mA	290	500
1.5V ≦ V_{OUT} < 1.7V		110	160		220	320
1.7V ≦ V_{OUT} < 2.0V		100	140		200	280
2.0V ≦ V_{OUT} < 2.5V		85	120		170	240
2.5V ≦ V_{OUT} < 2.8V		70	100		140	200
2.8V ≦ V_{OUT} ≦ 3.3V		60	95		120	190

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.)

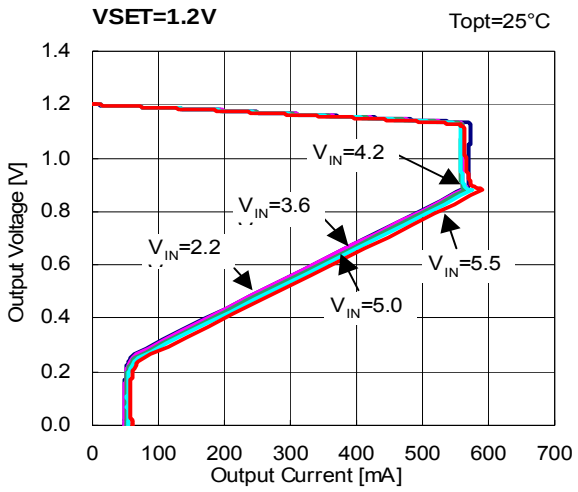
PCB Layout

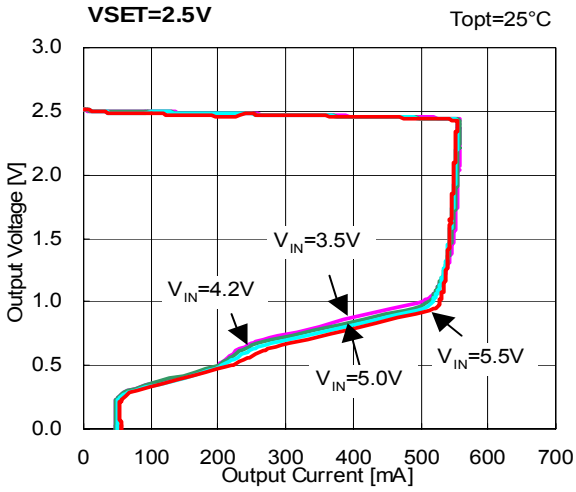
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0µF or more between V_{DD} and GND pin, and as close as possible to the pins.

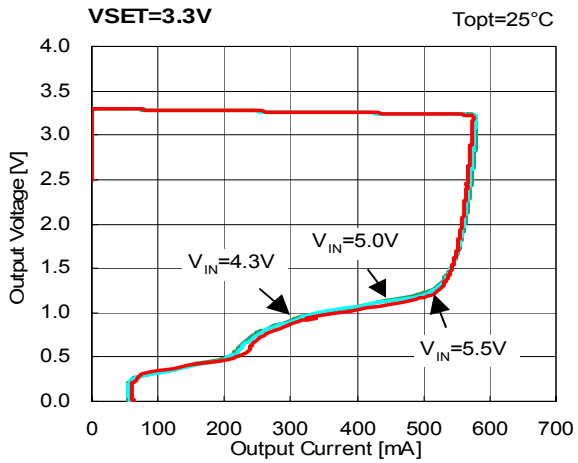
Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible.

TYPICAL CHARACTERISTICS

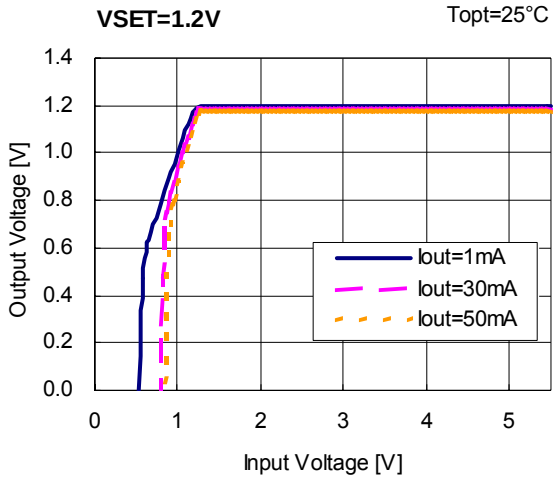
1) Output Voltage vs. Output Current (Cin=1.0uF, Cout=1.0uF)

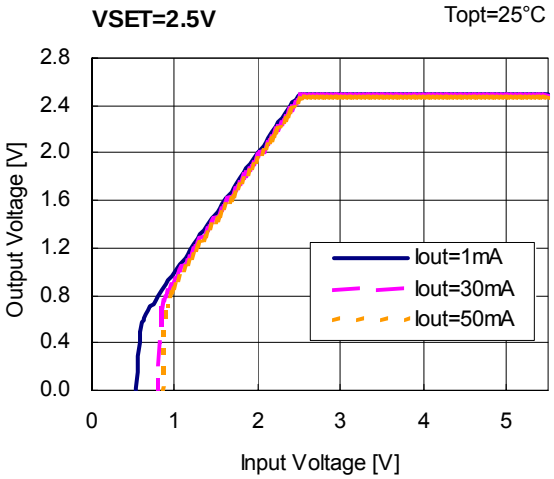


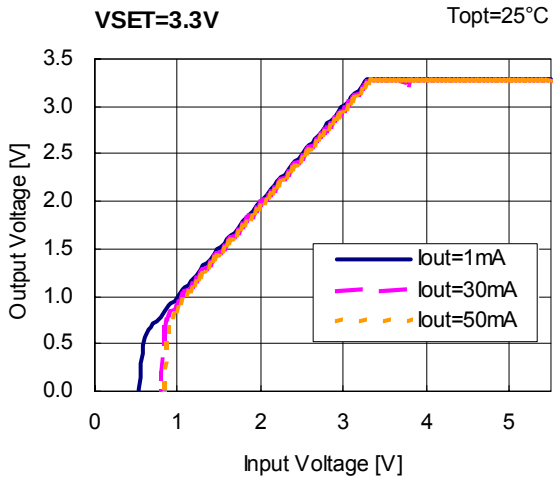




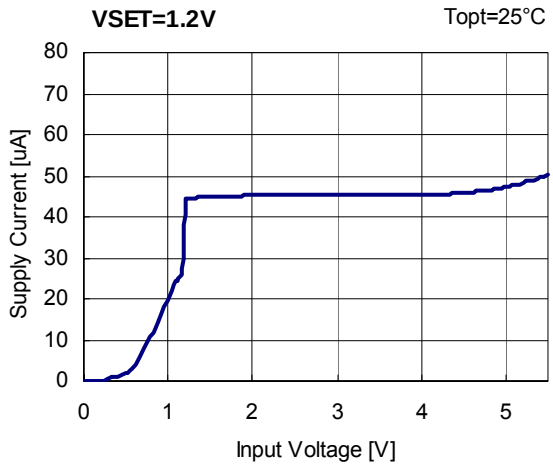
2) Output Voltage vs. Input Voltage (Cin=1.0uF , Cout=1.0uF)

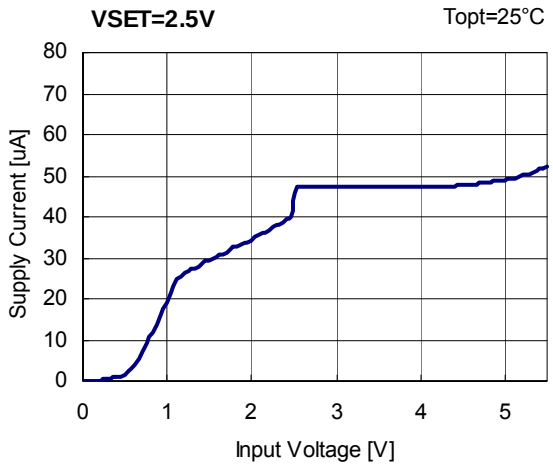


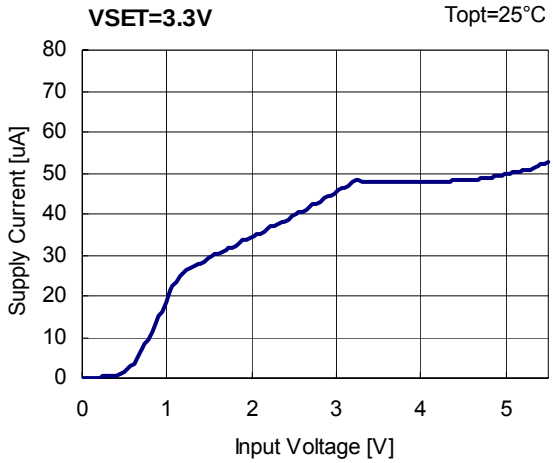




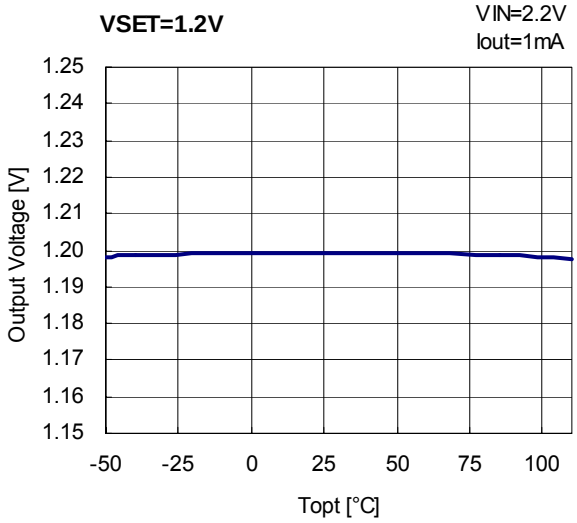
3) Supply Current vs. Input Voltage (Cin=1.0uF, Cout=1.0uF)

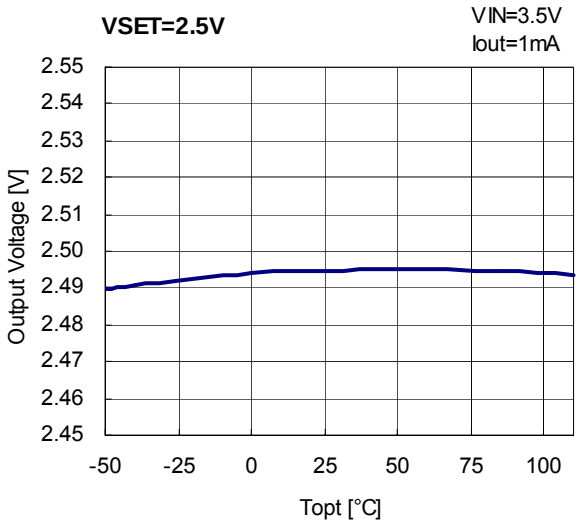


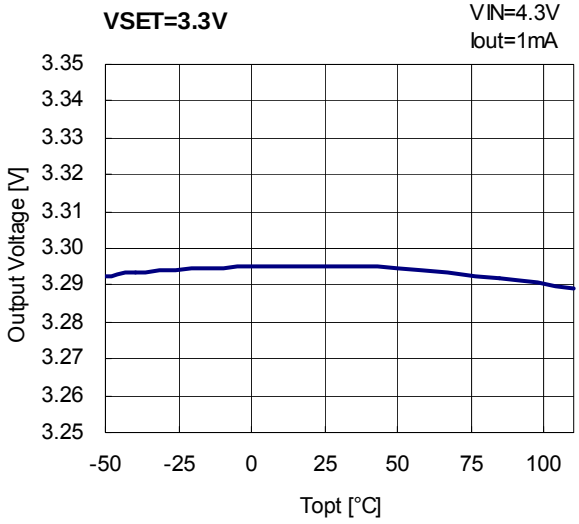




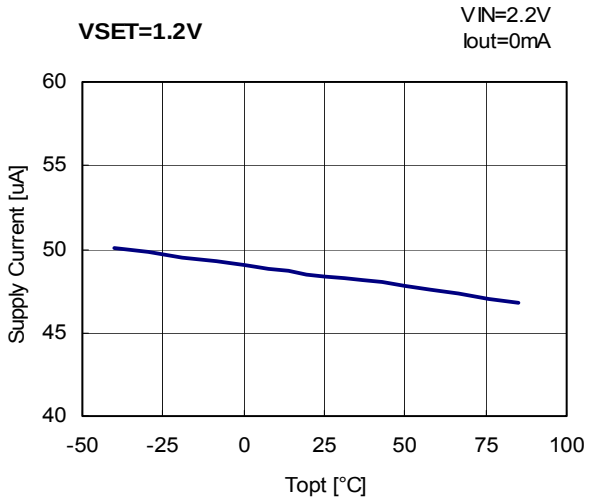
4) Output Voltage vs. Temperature (Cin=1.0uF , Cout=1.0uF)

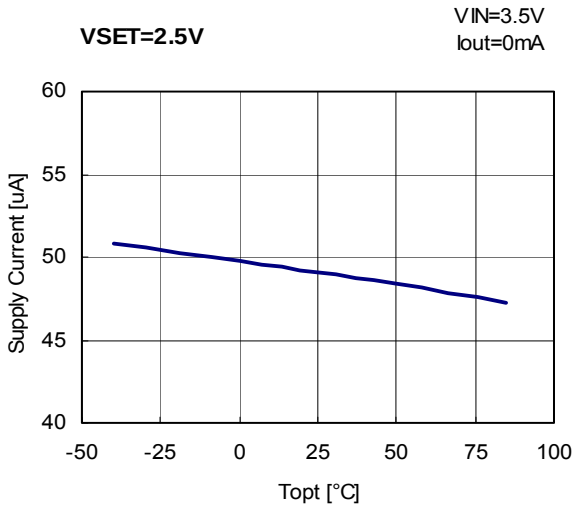


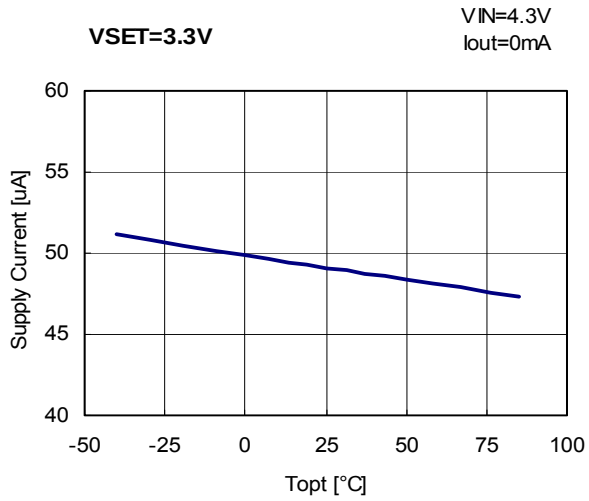




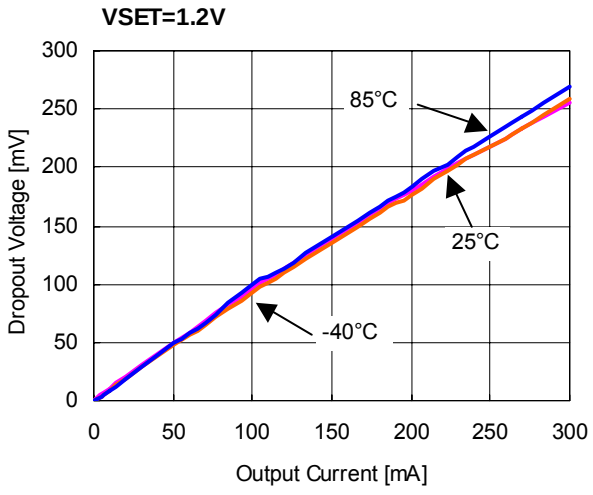
5) Supply Current vs. Temperature (Cin=1.0uF , Cout=1.0uF)

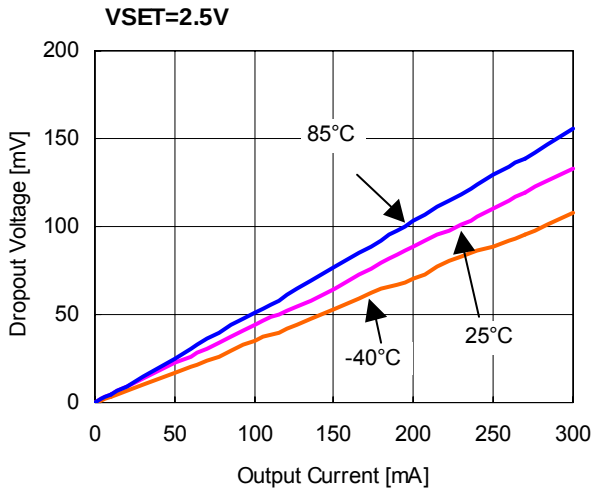




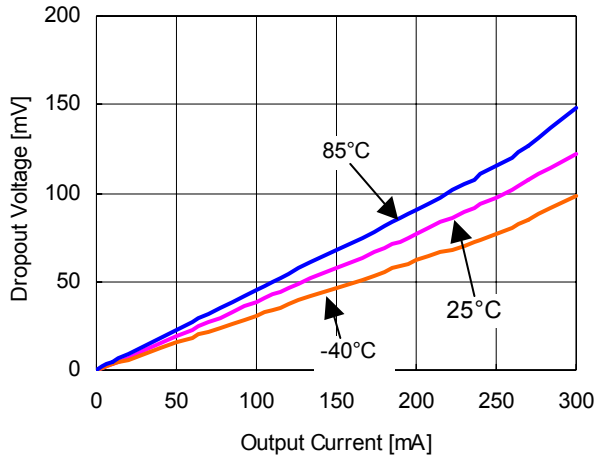


6) Dropout Voltage vs. Output Current (Cin=1.0uF , Cout=1.0uF)

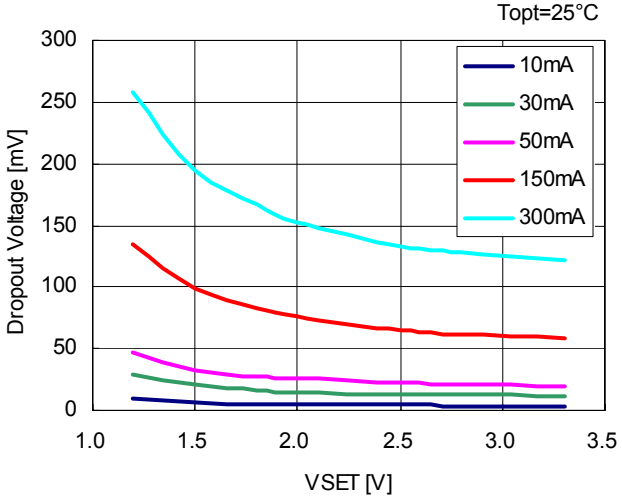




VSET=3.3V



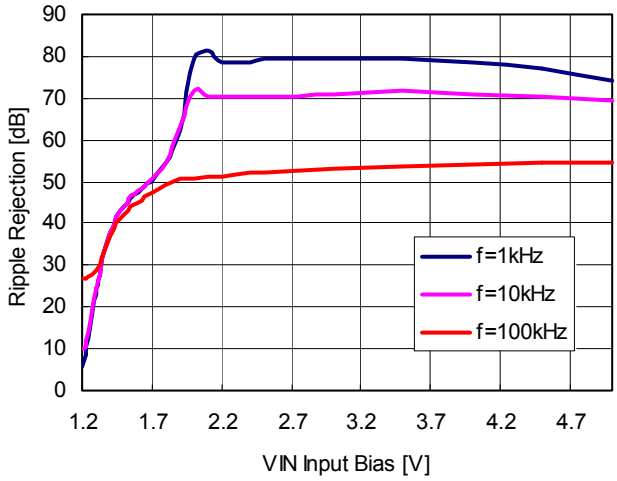
7) Dropout Voltage vs. VSET (Cin=1.0uF , Cout=1.0uF)



8) Ripple Rejection vs. Input Bias (Cin=none , Cout=1.0uF)

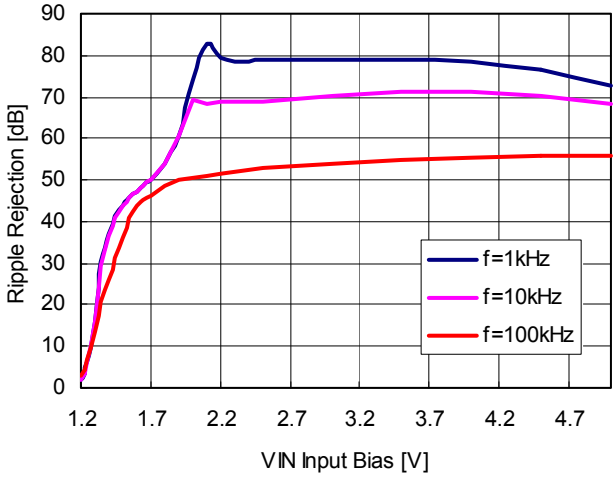
VSET=1.2V

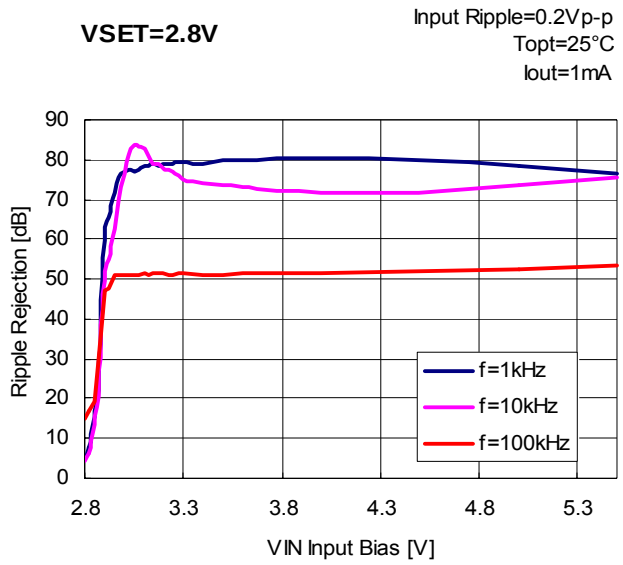
Input Ripple=0.2Vp-p
Topt=25°C
Iout=1mA

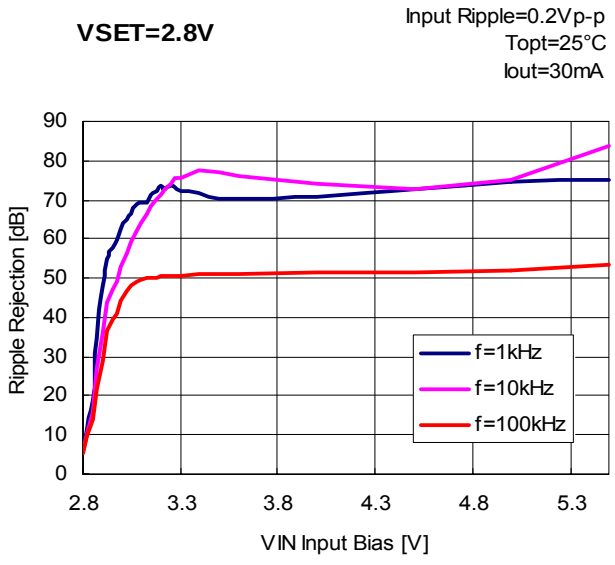


VSET=1.2V

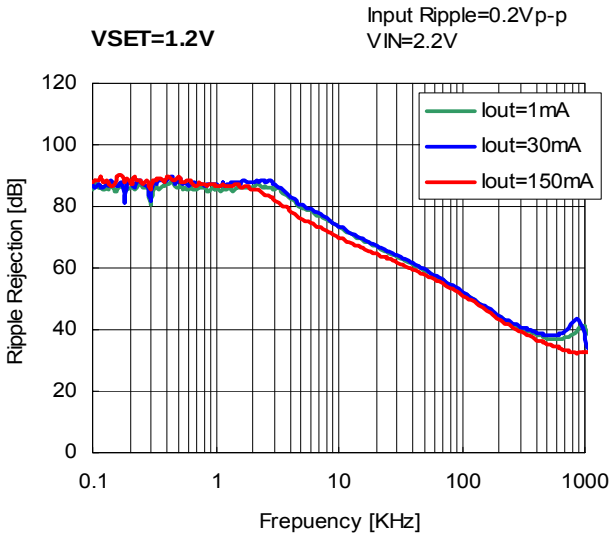
Input Ripple=0.2Vp-p
Topt=25°C
Iout=30mA

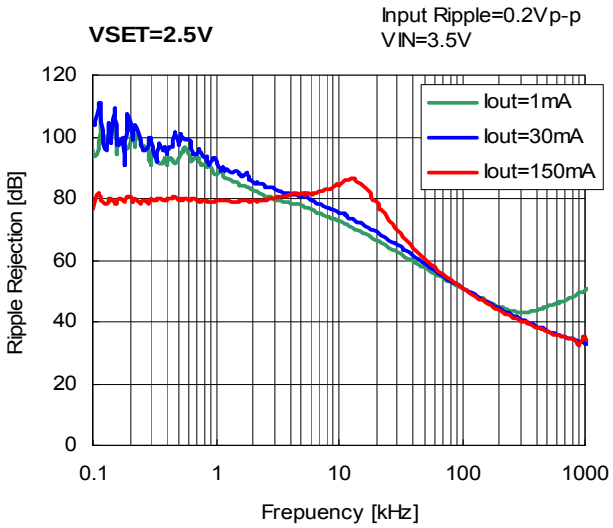


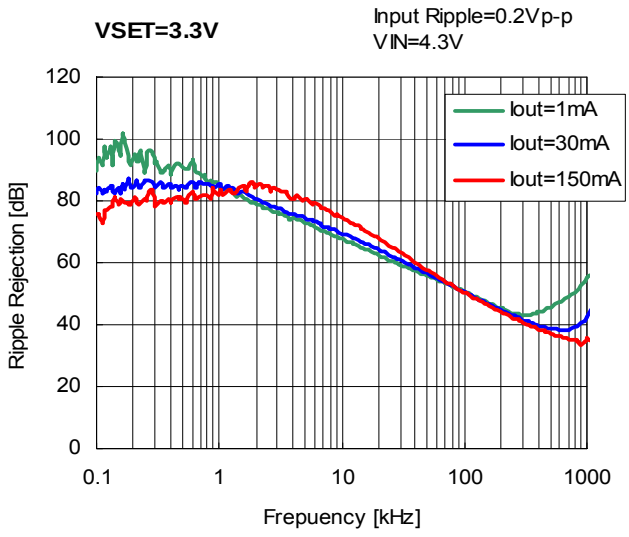


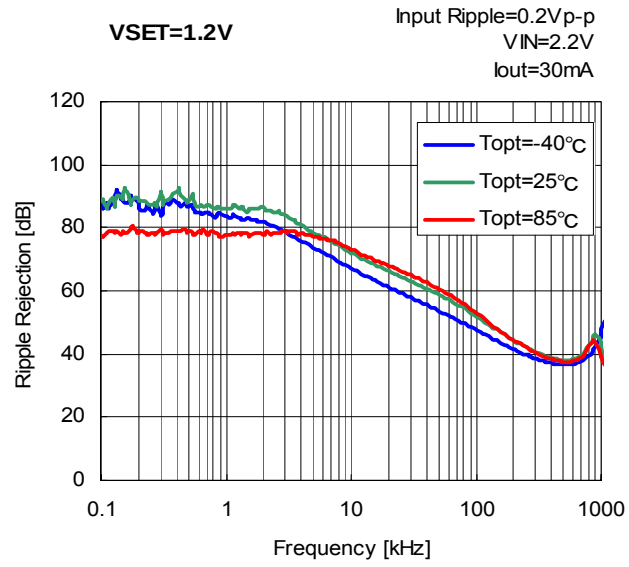


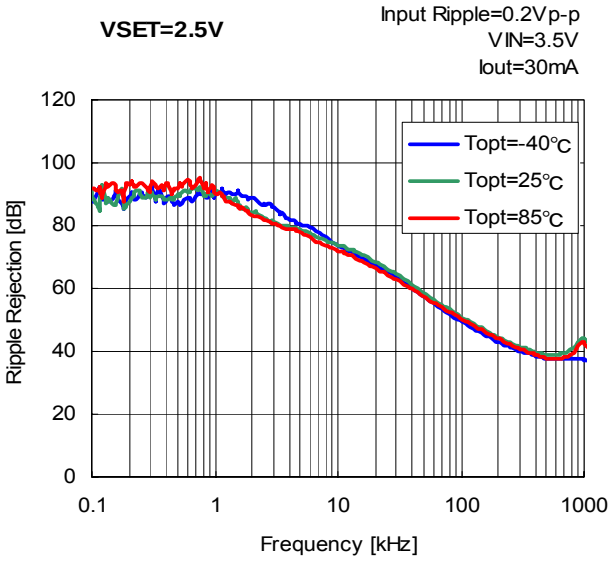
9) Ripple Rejection vs. Frequency (Cin=none, Cout=1.0uF)

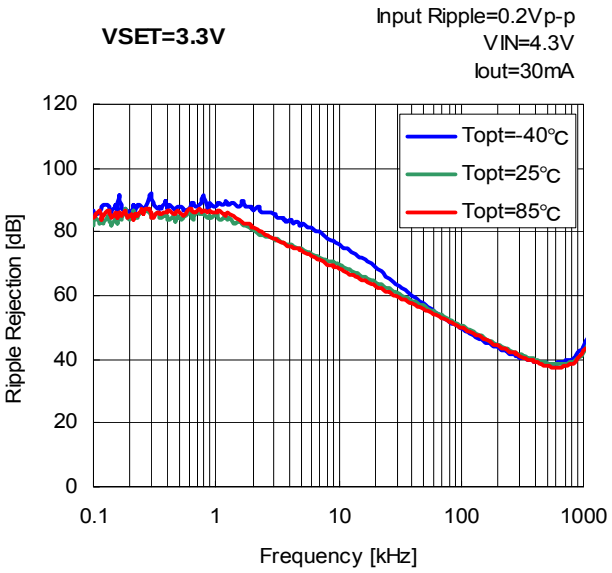




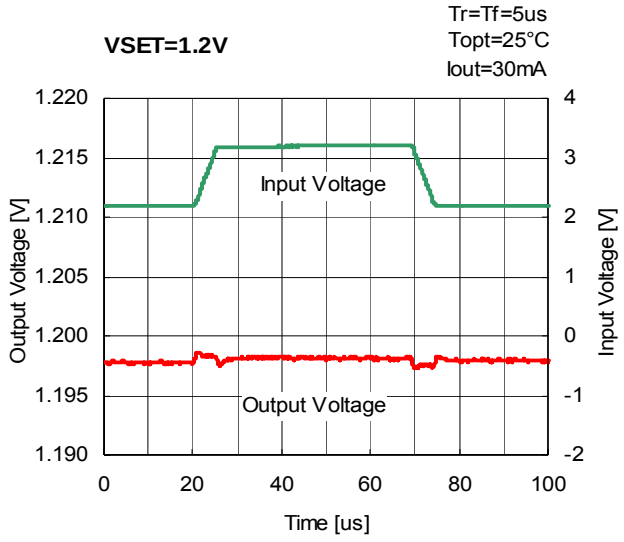


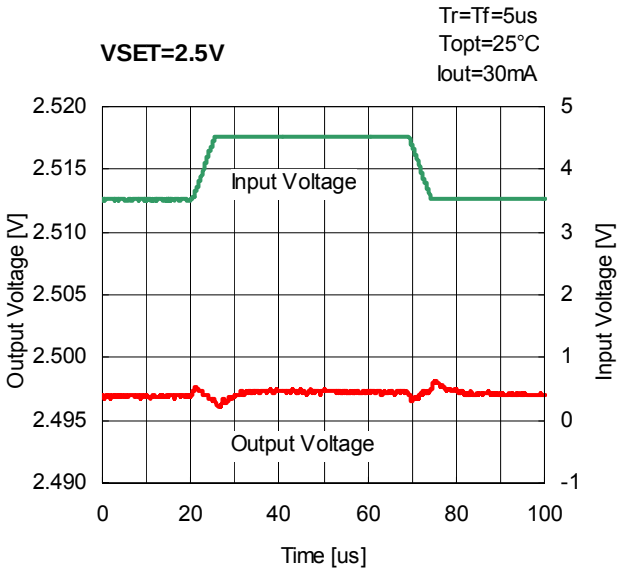


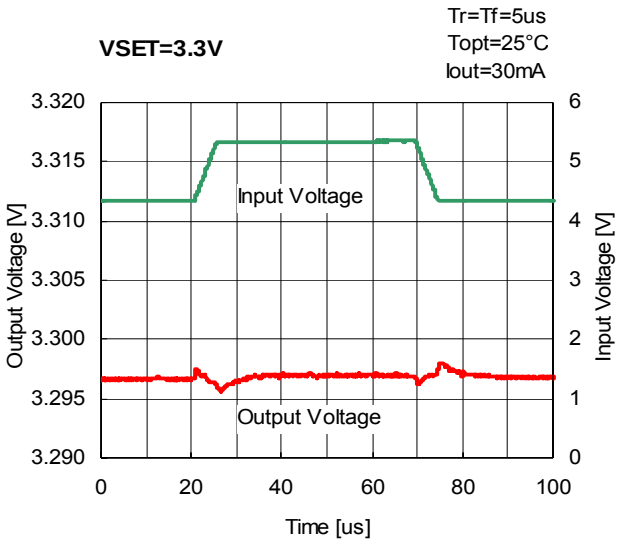




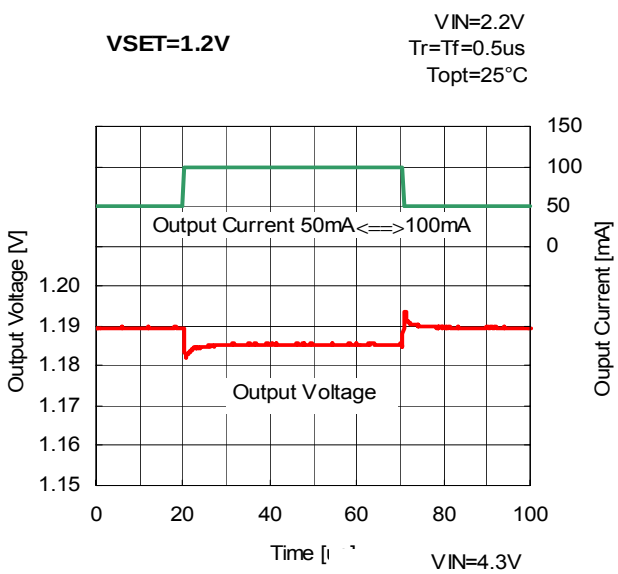
10) Input Transient Response (Cin=none, Cout=1.0uF)

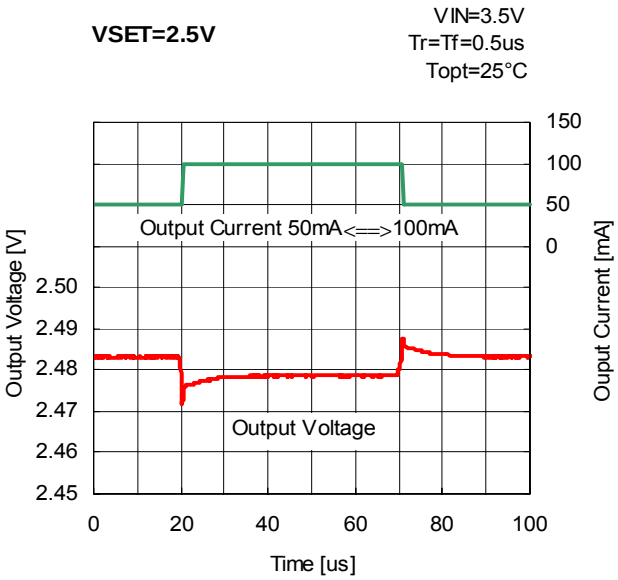


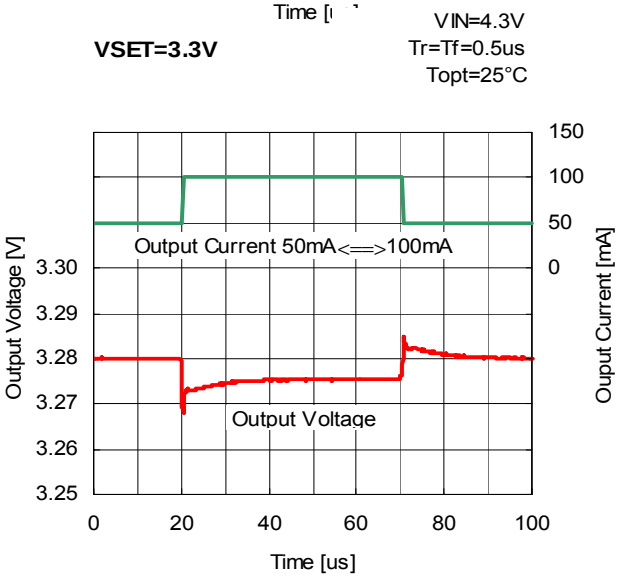




11) Load Transient Response (Cin=1.0uF, Cout=1.0uF)

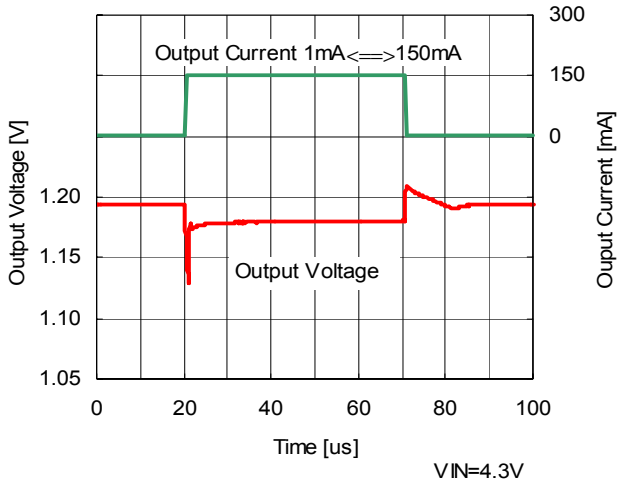






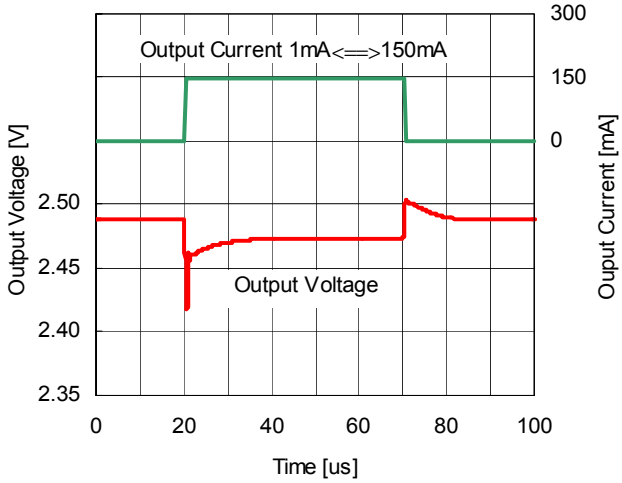
VSET=1.2V

VIN=2.2V
Tr=Tf=0.5us
Topt=25°C



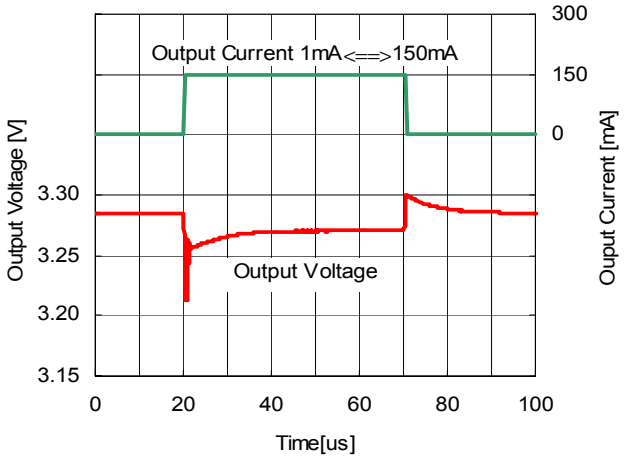
VSET=2.5V

VIN=3.5V
Tr=Tf=0.5us
Topt=25°C



VSET=3.3V

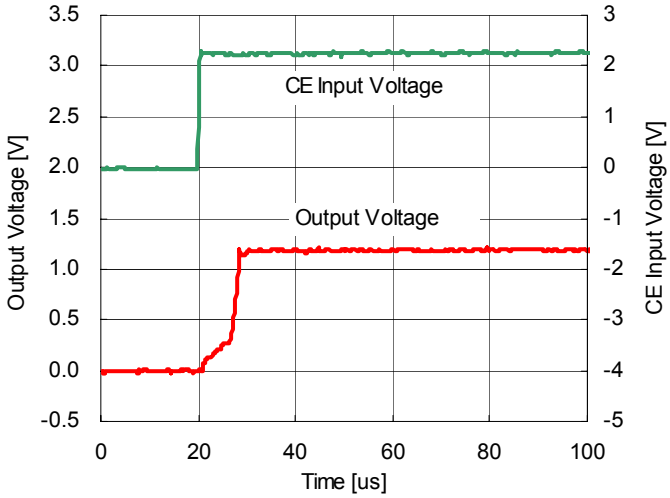
VIN=4.3V
Tr=Tf=0.5us
Topt=25°C



12) Turn On Speed with CE pin (Cin=1.0uF, Cout=1.0uF)

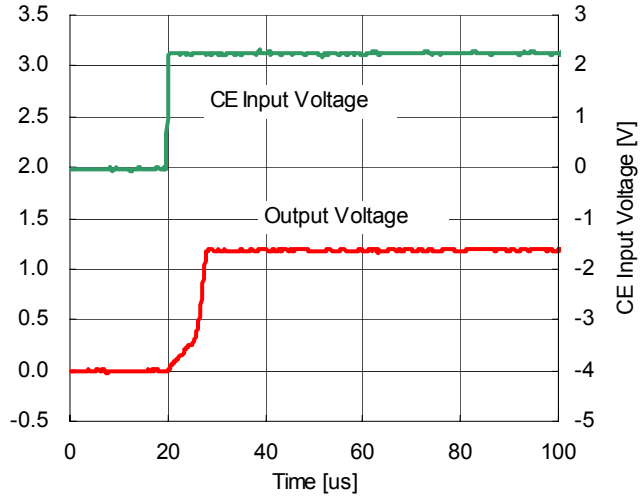
VSET=1.2V

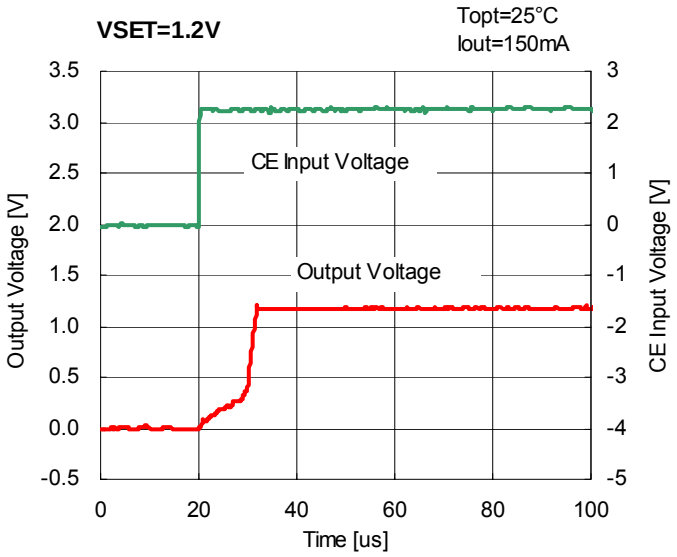
Topt=25°C
Iout=0mA

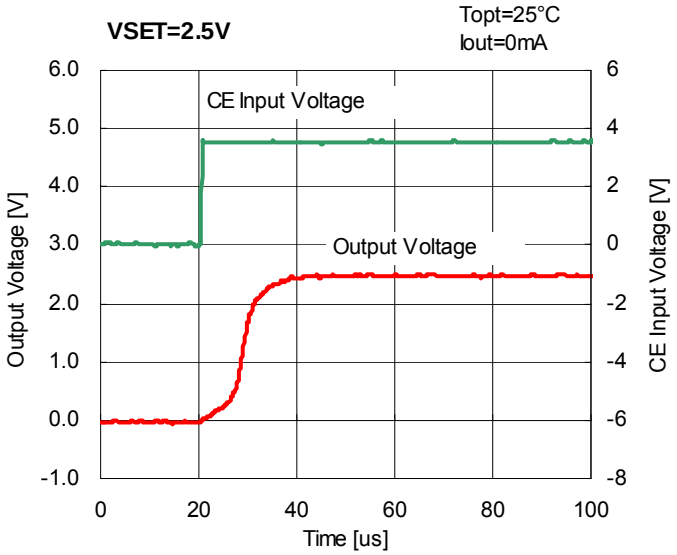


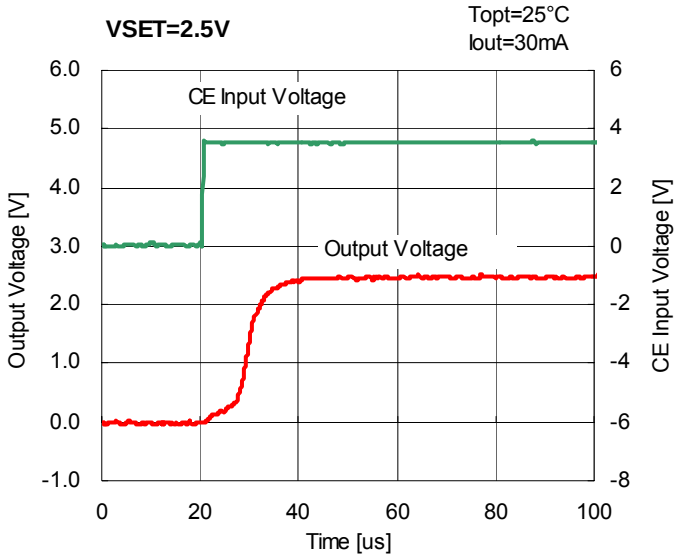
VSET=1.2V

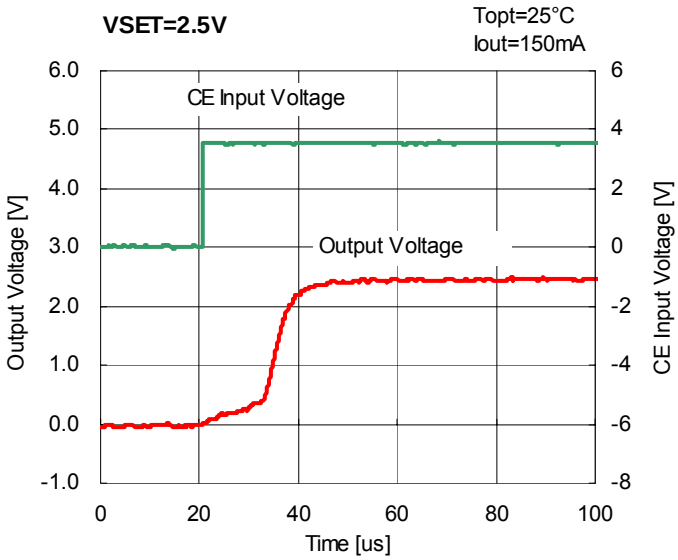
Topt=25°C
Iout=30mA

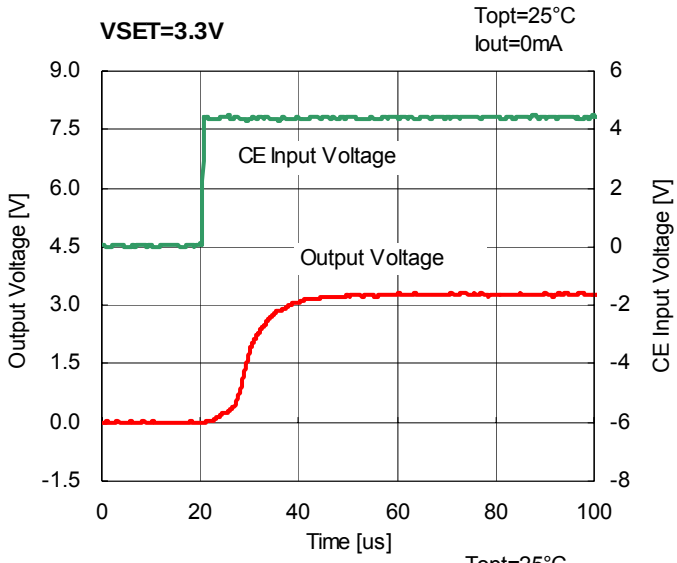


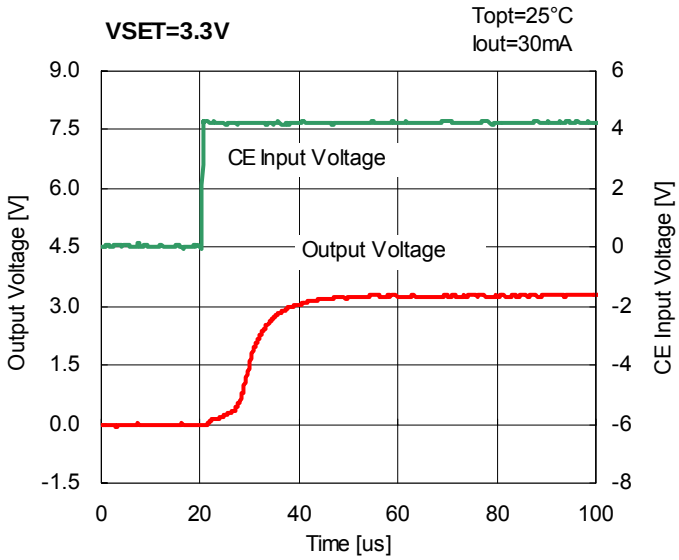

VSET=1.2V
Topt=25°C
Iout=150mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

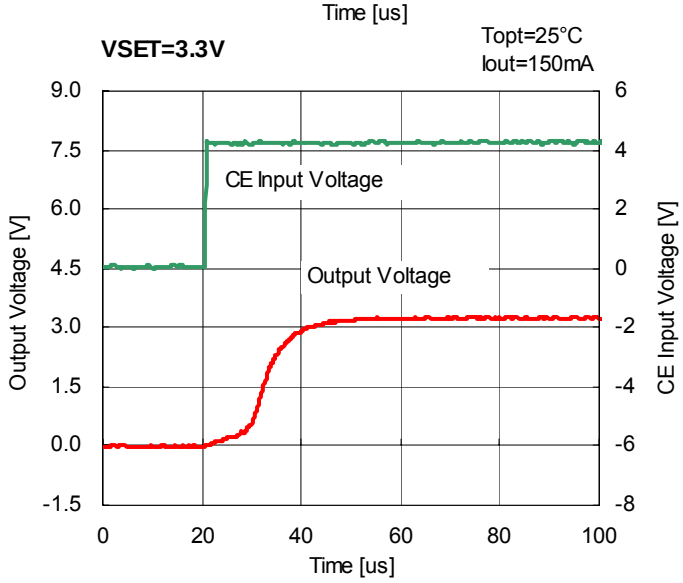

VSET=2.5V
Topt=25°C
Iout=0mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]


VSET=2.5V
Topt=25°C
Iout=30mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

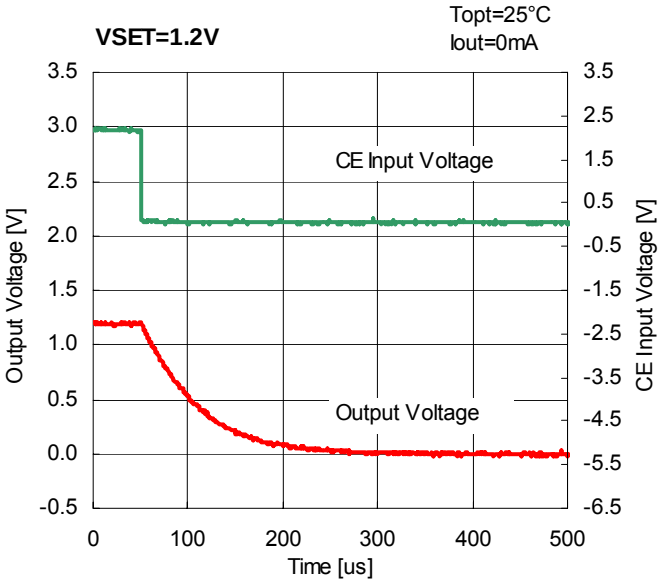

VSET=2.5V
Topt=25°C
Iout=150mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

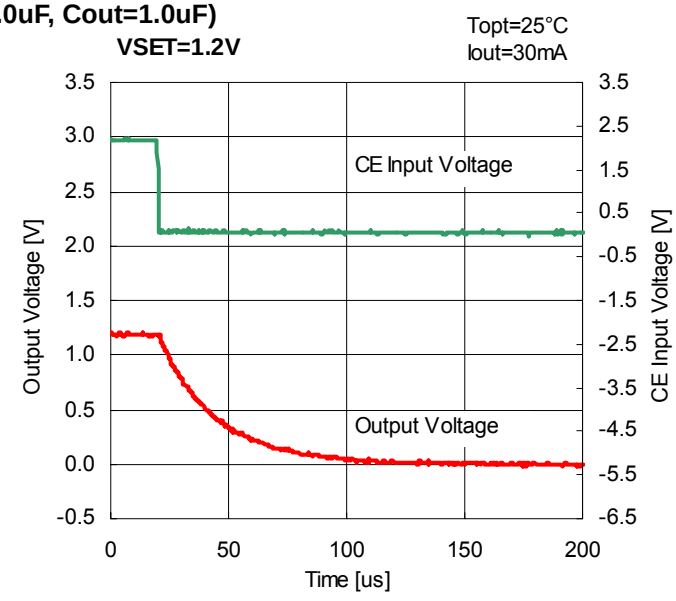


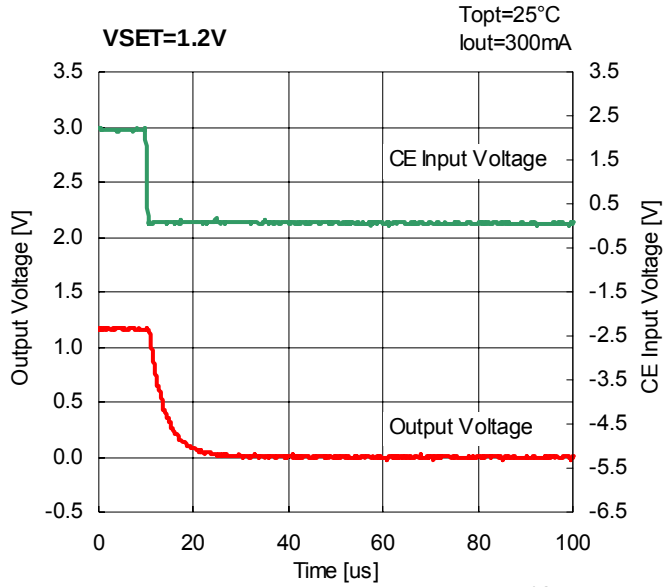


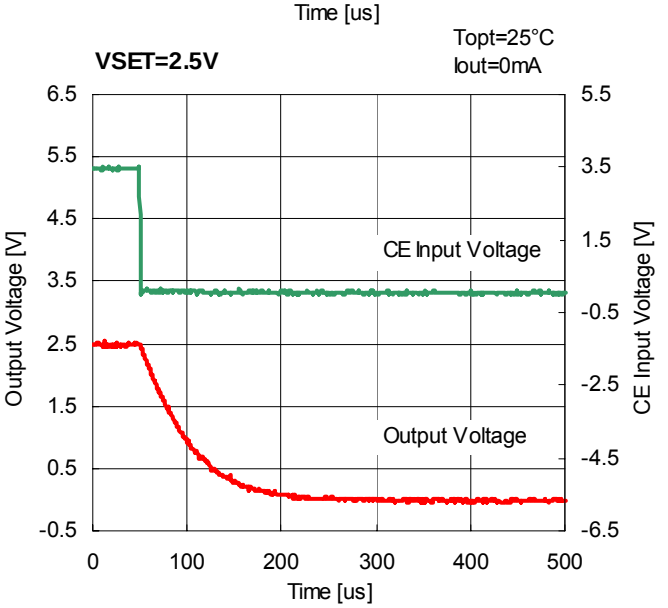


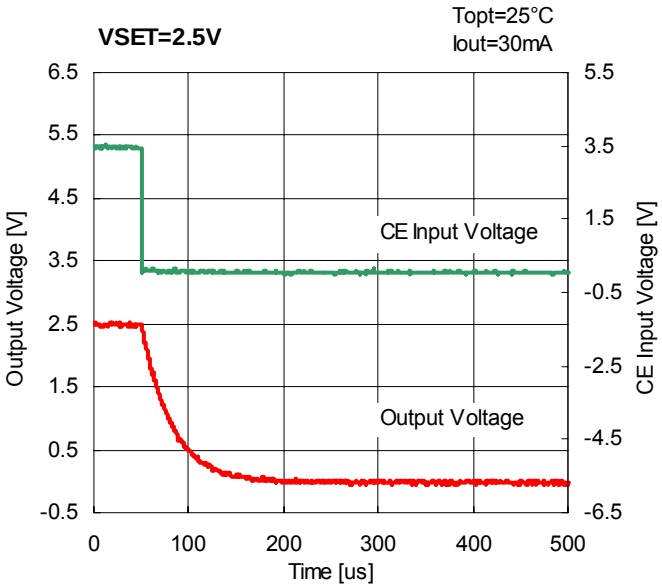
13) Turn Off Speed with CE pin (D Version) (Cin=1.0uF, Cout=1.0uF)

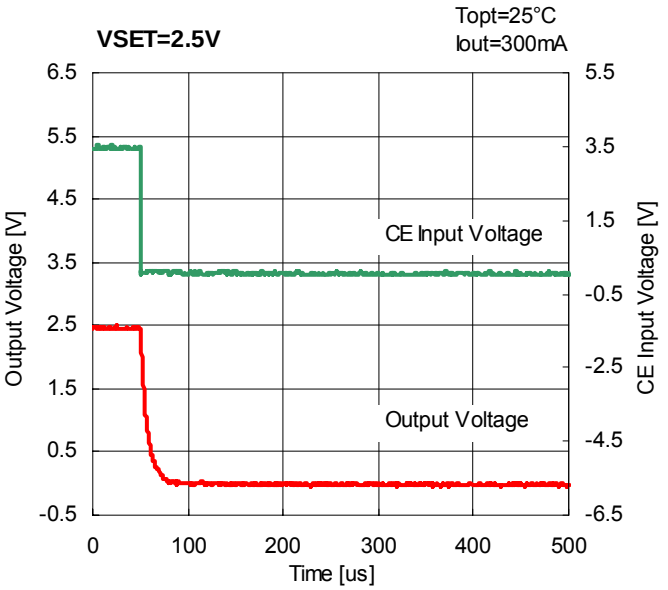


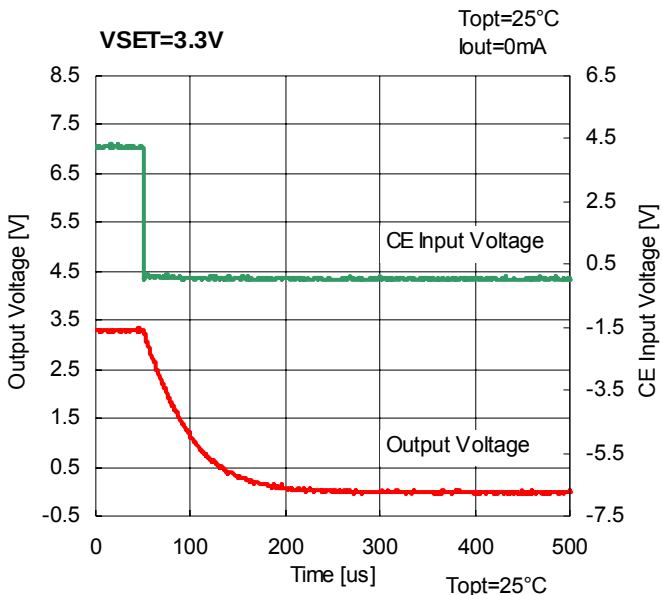


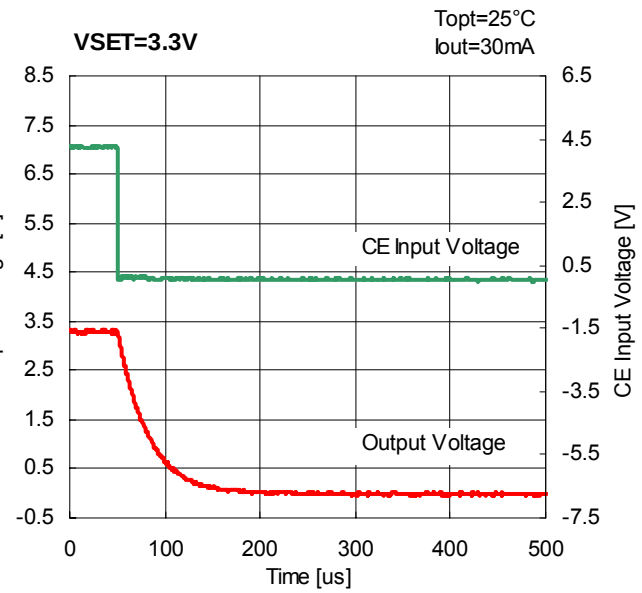

VSET=1.2V
Topt=25°C
Iout=300mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

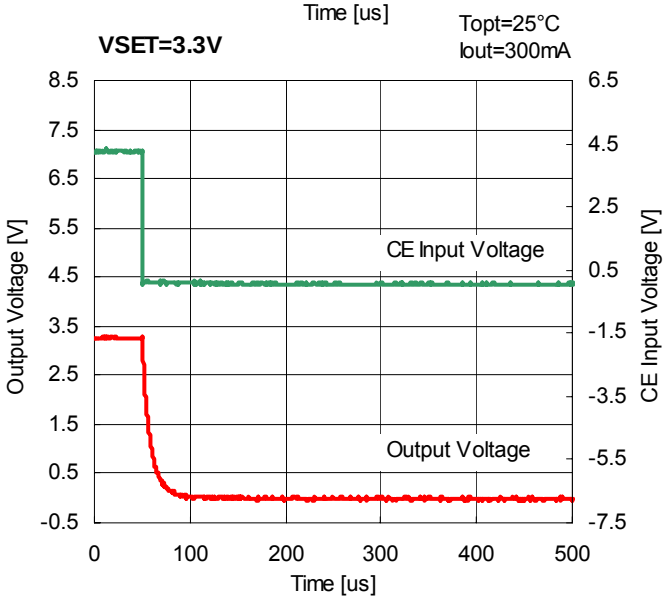

VSET=2.5V
Topt=25°C
Iout=0mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]


VSET=2.5V
Topt=25°C
Iout=30mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

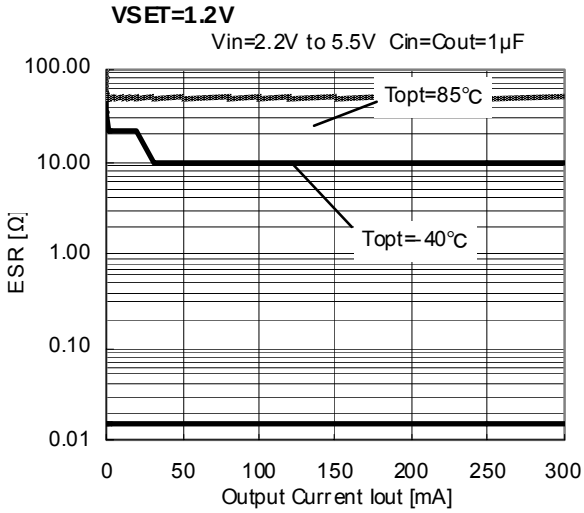

VSET=2.5V
Topt=25°C
Iout=300mA
CE Input Voltage
Output Voltage
Output Voltage [V]
CE Input Voltage [V]
Time [us]

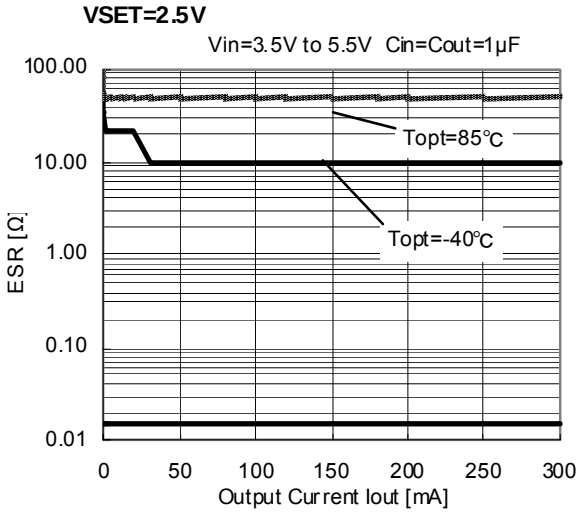




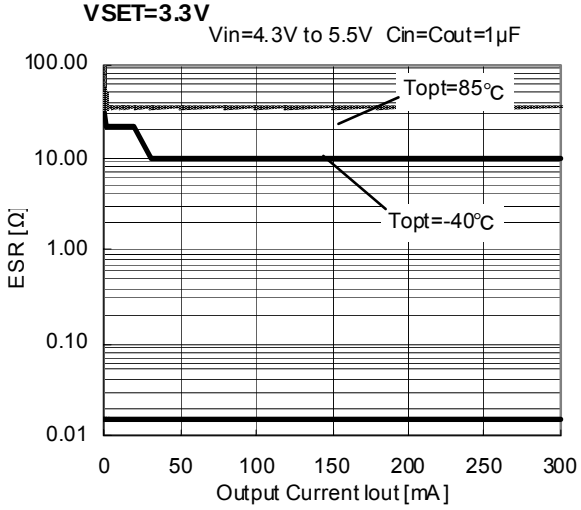


14) ESR vs Output Current (Frequency Band: 10Hz to 2MHz, Temperature: -40°C to 85°C





VSET=3.3V


Vin=4.3V to 5.5V Cin=Cout=1µF
100.00
10.00
1.00
0.10
0.01
ESR [Ω]
Topt=85°C
Topt=-40°C
0
50
100
150
200
250
300
Output Current Iout [mA]