ET631XXS - Ultra-Low IQ 150mA LDO

General Description

The ET631XXS series of CMOS low dropout regulators are designed specifically for portable battery-powered applications which require ultra-low quiescent current. The ultra-low consumption of type 0.6uA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

The device is available in small SOT23-3 packages.

Features

- Operating Input Voltage Range From 2.2V to 5.5V
- Fixed Output Voltage Range From 1.1V to 3.6V (0.05V Steps)
- Ultra-Low Quiescent Current Typical 0.6uA
- Low Dropout is Typical 240mV at 150mA@V_{OUT}=1.8V
- High Output Voltage Accuracy ±1%
- Stable with Ceramic Capacitors 1uF
- Over-Current Protection
- Thermal Shutdown Protection
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant
- Package Information:

Part No.	Package	MSL
ET631XXS	SOT23-3	Level 3

Applications

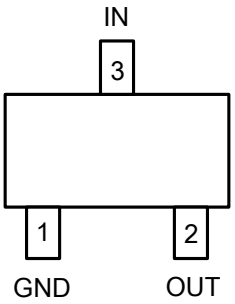
- Battery Powered Equipments
- Portable Communication Equipments
- Cameras, Image Sensors and Camcorders
- Label Information

Device Information

ET 631 XX S

XX Output Voltage		**S** Package	
XX	Output Voltage For example, 18 is 1.8V output	S	SOT23-3

Pin Configuration

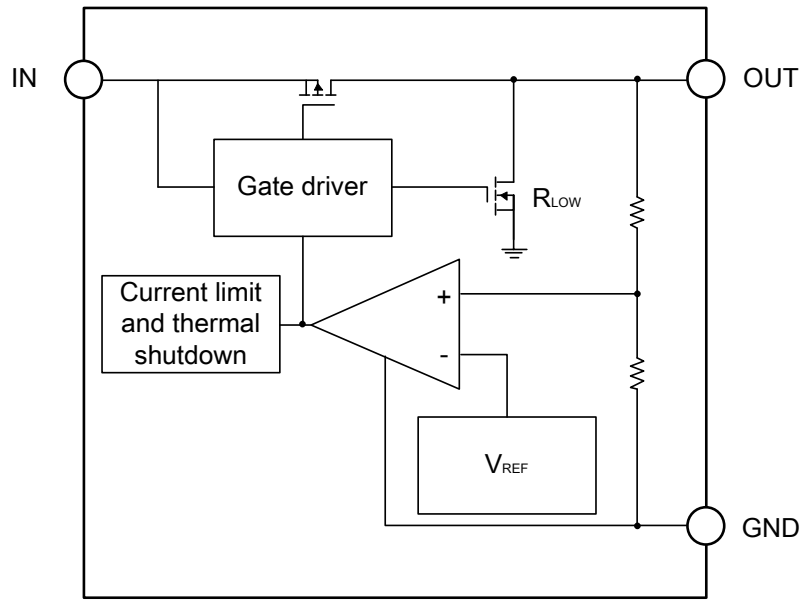


Top view

Pin Function

Pin No.	Pin Name	Pin Function
1	GND	Ground
2	OUT	Output pin. A 1μF low-ESR capacitor should be connected to this pin to ground.
3	IN	Supply input pin. Must be closely decoupled to GND with a 1μF or greater ceramic capacitor

Block Diagram



Functional Description

General

The ET631XXS is a high performance 150mA Linear Regulator with Ultra Low IQ. This device delivers low Noise and high Power Supply Rejection Ratio with excellent dynamic performance due to employing the Dynamic Quiescent Current adjustment which assure ultra low IQ consumption at no-load state. These parameters make this device very suitable for various battery powered applications.

Input Capacitor

It is recommended to connect at least a 1μF Ceramic X5R or X7R capacitor between IN and GND pins of the device. This capacitor will provide a low impedance path for any unwanted AC signals or Noise superimposed onto constant Input Voltage. The good input capacitor will limit the influence of input trace inductances and source resistance during sudden load current changes.

Higher capacitance and lower ESR Capacitors will improve the overall line transient response.

Output Capacitor

The ET631XXS does not require a minimum Equivalent Series Resistance (ESR) for the output capacitor. The X5R and X7R types have the lowest capacitance variations over temperature thus they are recommended.

There is recommended connect the output capacitor as close as possible to the output pin of the regulator.

Current Limit Protection

When output current at the OUT pin is higher than current limit threshold, the current limit protection will be triggered and clamp the output current to approximately 300mA to prevent over-current and to protect the regulator from damage due to overheating.

Thermal shutdown Protection

When the die temperature exceeds the Thermal Shutdown point (T_{SD} = 155°C typical) the device goes to disabled state and the output voltage is not delivered until the die temperature decreases to 135°C. The Thermal Shutdown feature provides a protection from a catastrophic device failure at accidental overheating. This protection is not intended to be used as a substitute for proper heat sinking.

Power Dissipation and Heat sinking

The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material and the ambient temperature affect the rate of junction temperature rise for the part. The maximum power dissipation the ET631XXS device can handle is given by:

$$P_{D(MAX)} = \frac{\left[T_{J(MAX)} - T_A\right]}{R_{\theta JA}}$$

Absolute Maximum Ratings

Symbol	Parameters (Items)	Value	Unit
V_{IN}	IN Voltage(1)	-0.3 to 6.0	V
V_{OUT}	Output Voltage	-0.3 to V_{IN}+0.3	V
P_D	Maximum Power Consumption	350	mW
$R_{\theta JA}$	Junction-to-ambient thermal resistance	345	°C/W
T_J	Operating Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 150	°C
V_{ESD}	Human Body Model (JESD22-A114)	±4000	V
	Charged Device Model (JESD22-C101)	±1500	
I_{LU}	Latch up Current Maximum Rating (JESD78E)	±200	mA

Note1: Refer to ELECTRICAL CHARACTERISTIS for safe operating area.

Recommended Operating Conditions

Symbol	Parameters	Rating	Unit
V_{IN}	Input Voltage	2.2 to 5.5	V
I_{OUT}	Output Current	0 to 150	mA
T_A	Operating Ambient Temperature	-40 to 85	ºC
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 4.7	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 4.7	μF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

VOLTAGE VERSION 1.1V

(V_{IN}=2.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	1.085	1.1	1.115	V
		-40°C≤T_A≤85°C	1.070	1.1	1.130	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=2.5V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=2.5V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3) (5)			1100	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=2.5V+200mVVpp Modulation, I_{OUT}=150mA(4)		55		dB
e_N	Output Noise	V_{IN}=2.5V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		55		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

VOLTAGE VERSION 1.2V

(V_{IN}=2.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	1.185	1.2	1.215	V
		-40°C≤T_A≤85°C	1.170	1.2	1.230	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=2.5V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=2.5V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3) (5)			1000	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=2.5V+200mVVpp		55		dB

		Modulation, I_{OUT}=150mA[4]				
e_N	Output Noise	V_{IN}=2.5V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF[4]		55		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising[4]		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown[4]		20		°C

VOLTAGE VERSION 1.5V

(V_{IN}=2.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) [2]

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	1.485	1.5	1.515	V
		-40°C≤T_A≤85°C	1.470	1.5	1.530	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=2.5V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=2.5V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA [3] [5]			700	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=2.5V+200mVVpp Modulation, I_{OUT}=150mA[4]		55		dB
e_N	Output Noise	V_{IN}=2.5V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF[4]		60		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising[4]		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown[4]		20		°C

VOLTAGE VERSION 1.8V

(V_{IN}=2.8V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) [2]

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	1.782	1.8	1.818	V
		-40°C≤T_A≤85°C	1.764	1.8	1.836	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=2.8V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage	I_{OUT} from 1mA to 150mA,		5	20	mV

	Load Regulation	V_{IN}=2.8V				
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3)		240	340	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=2.8V+200mVVpp Modulation, I_{OUT}=150mA(4)		55		dB
e_N	Output Noise	V_{IN}=2.8V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		70		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

VOLTAGE VERSION 2.5V

(V_{IN}=3.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	2.475	2.5	2.525	V
		-40°C≤T_A≤85°C	2.450	2.5	2.550	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=3.5V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=3.5V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3)		180	280	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=3.5V+200mVVpp Modulation, I_{OUT}=150mA(4)		45		dB
e_N	Output Noise	V_{IN}=3.5V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		85		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

VOLTAGE VERSION 2.8V

(V_{IN}=3.8V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	2.772	2.8	2.828	V
		-40°C≤T_A≤85°C	2.744	2.8	2.856	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=3.8V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=3.8V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3)		170	270	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=3.8V+200mVVpp Modulation, I_{OUT}=150mA(4)		45		dB
e_N	Output Noise	V_{IN}=3.8V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		90		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

VOLTAGE VERSION 3.0V

(V_{IN}=4.0V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	2.970	3.0	3.030	V
		-40°C≤T_A≤85°C	2.940	3.0	3.060	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=4.0V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=4.0V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3)		170	270	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=4.0V+200mVVpp Modulation, I_{OUT}=150mA(4)		45		dB

e_N	Output Noise	V_{IN}=4.0V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		93		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

VOLTAGE VERSION 3.3V

(V_{IN}=4.3V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.) (2)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.2		5.5	V
V_{OUT}	Regulated Output Voltage	T_A=25°C	3.267	3.3	3.333	V
		-40°C≤T_A≤85°C	3.234	3.3	3.366	
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=4.3V to 5.5V, I_{OUT}=1mA		0.05	0.20	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 150mA, V_{IN}=4.3V		5	20	mV
V_{DROP}	Dropout Voltage	I_{OUT}=150mA (3)		160	260	mV
I_{LIMIT}	Current Limit	T_A=25°C	200	400	600	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V	70	170	270	mA
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0mA		0.6	0.9	μA
PSRR	Power Supply Rejection Ratio	f=1kHz, V_{IN}=4.3V+200mVVpp Modulation, I_{OUT}=150mA(4)		45		dB
e_N	Output Noise	V_{IN}=4.3V, f=10Hz to 100kHz, I_{OUT}=1mA, C_{OUT}=1μF(4)		95		μV_{RMS}
T_{TSD}	Over-temperature Shutdown Threshold	T_J rising(4)		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown(4)		20		°C

Note2: Here V_{IN} means internal circuit can work normal. If V_{IN}<V_{OUT}, Output voltage follow V_{IN} (I_{OUT}=1mA), circuit is safety.

Note3: V_{DROP} FT test method: Test the V_{OUT} voltage at V_{SET}+$V_{DROPMAX}$ with 150mA output current.

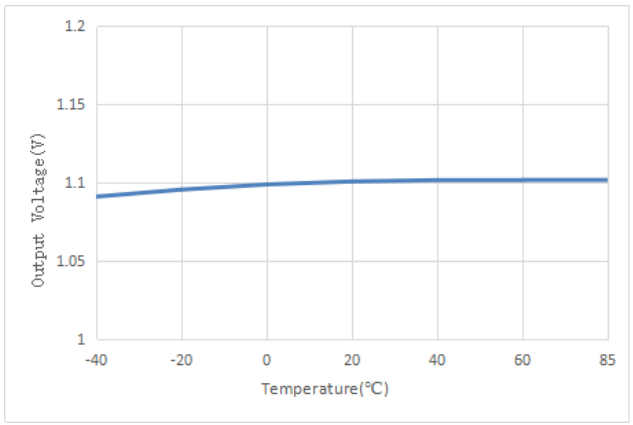
Note4: Guaranteed by design and characterization. Not a FT item.

Note5: The minimum operating voltage is 2.2V. V_{DROP}=$V_{IN(MIN)}$-V_{OUT}.

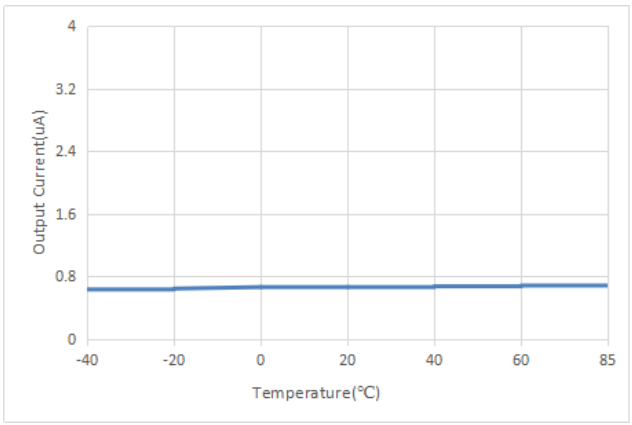
Typical Characteristics

(1) VOLTAGE VERSION 1.1V

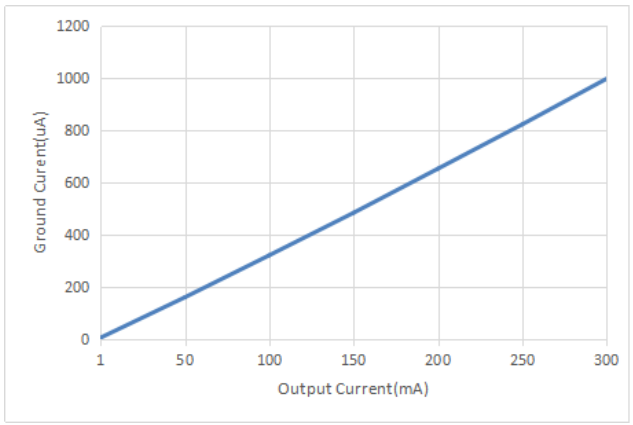
(V_{IN}=2.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



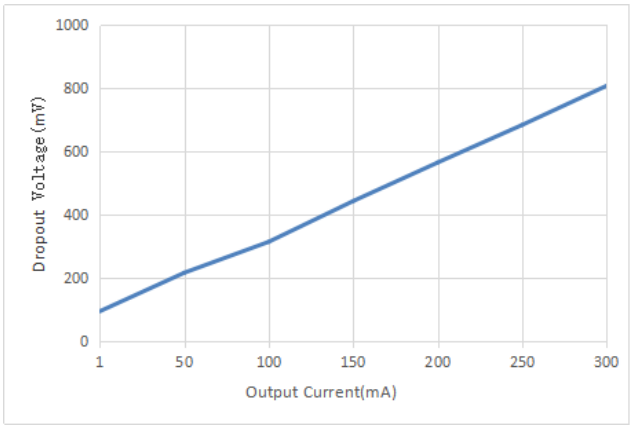
Output Voltage VS Temperature



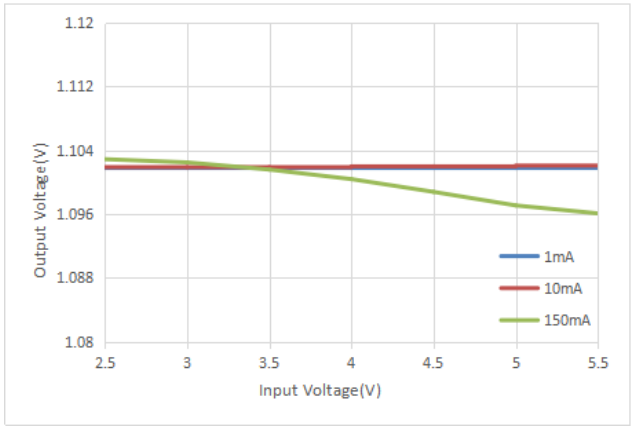
Supply Current VS Temperature



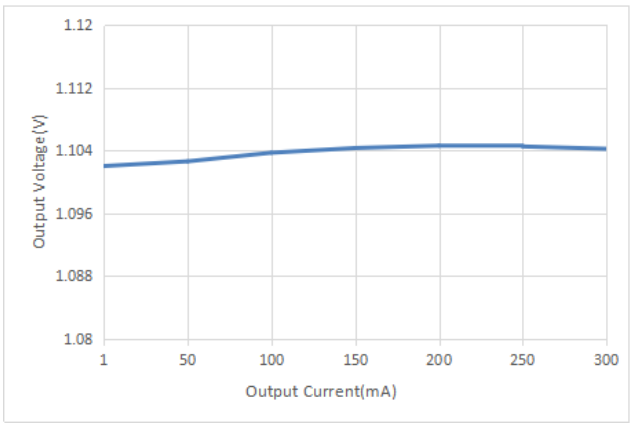
Ground Current VS Output Current



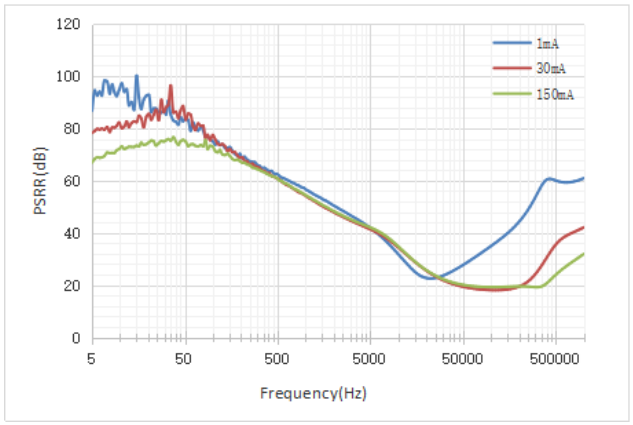
Dropout Voltage VS Output Current



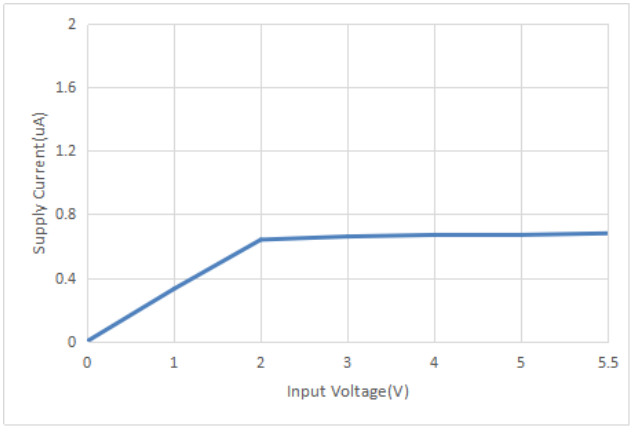
Output Voltage VS Input Voltage



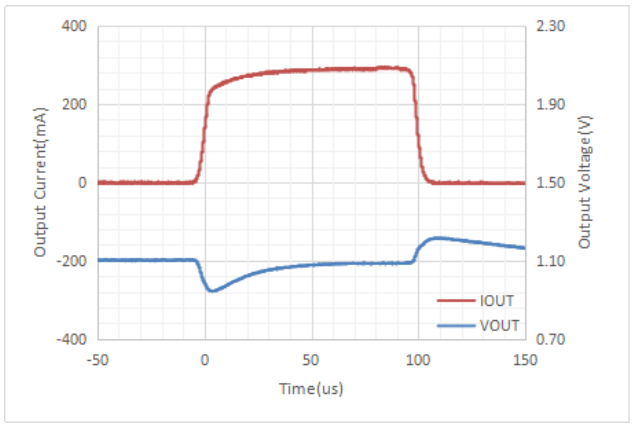
Output Voltage VS Output Current



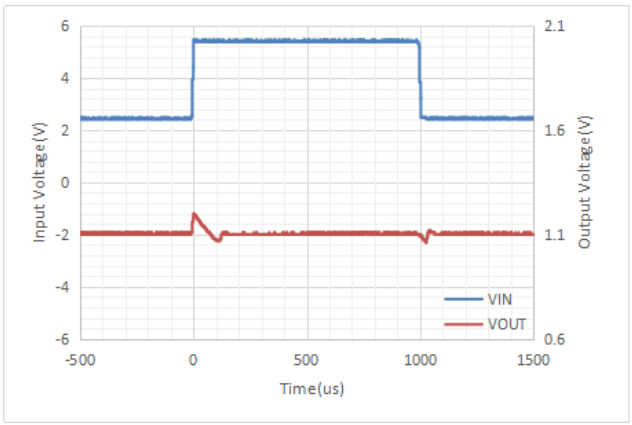
PSRR VS Output Current



Supply Current VS Input Voltage



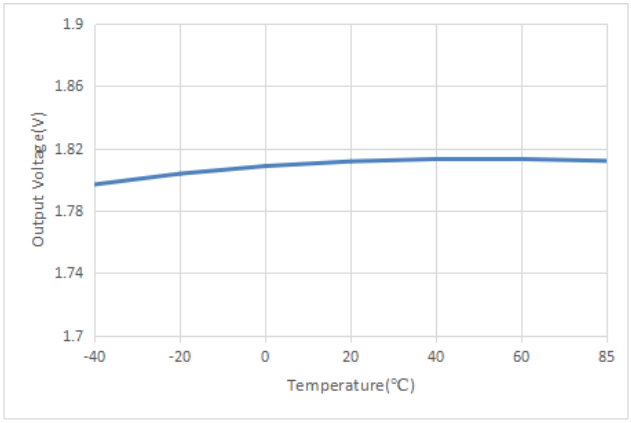
Load Transient Response



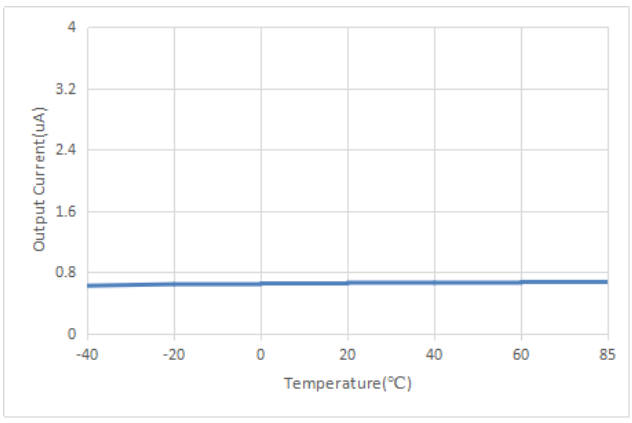
Line Transient Response

(2) VOLTAGE VERSION 1.8V

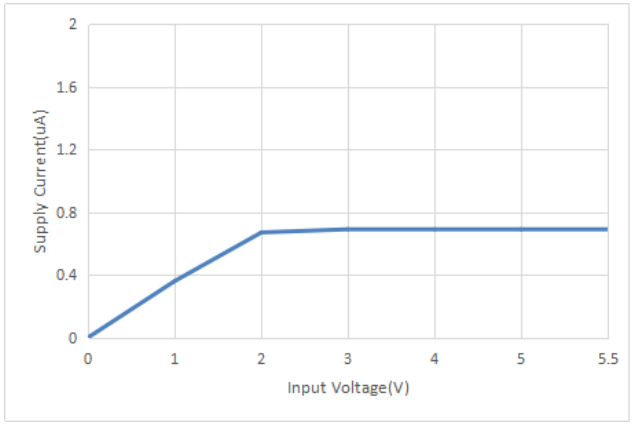
(V_{IN}=2.8V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



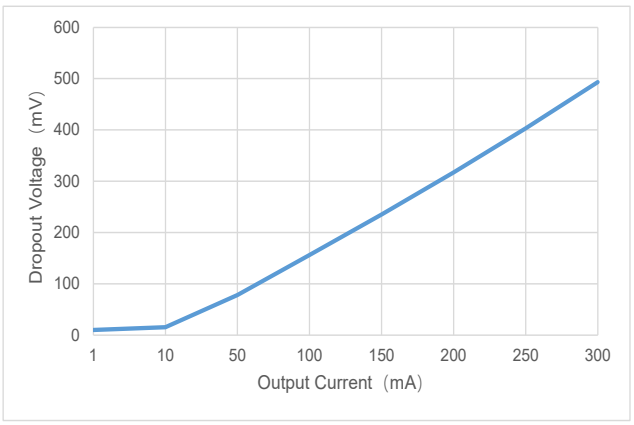
Output Voltage VS Temperature



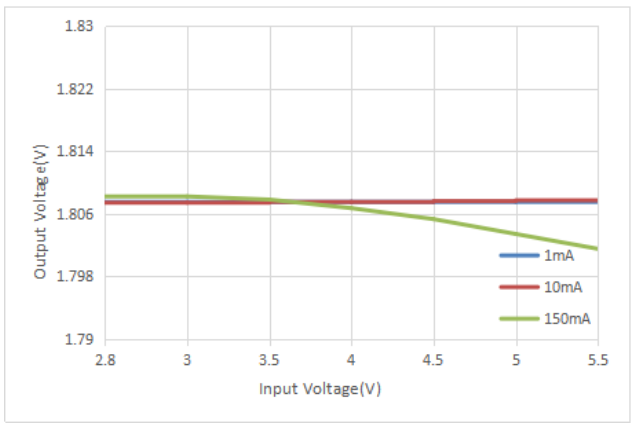
Supply Current VS Temperature



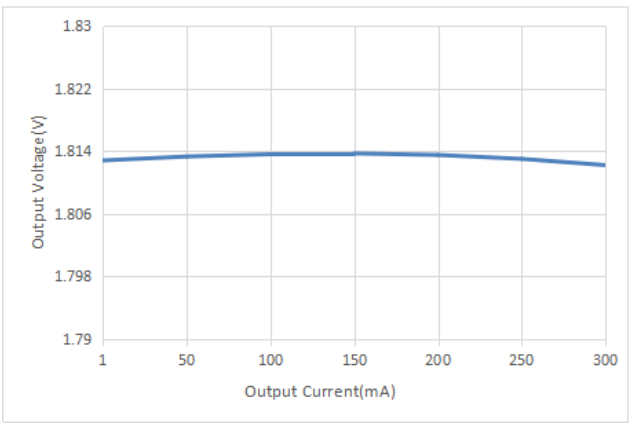
Supply Current VS Input Voltage



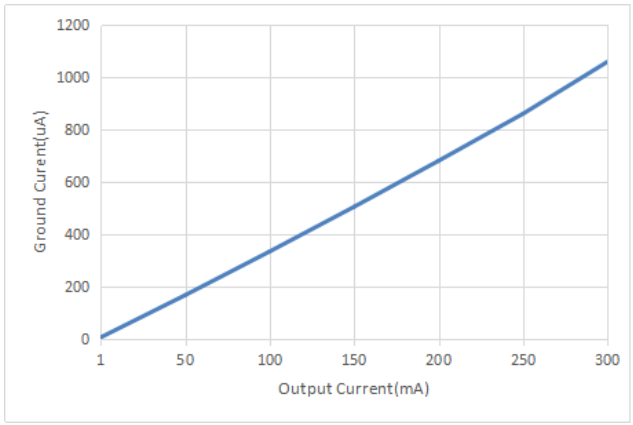
Dropout Voltage VS Output Current



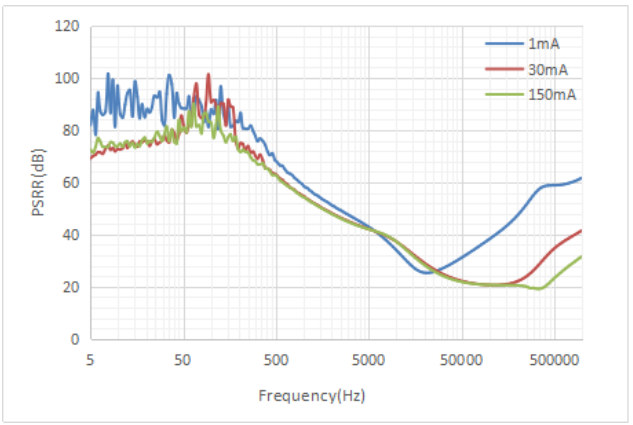
Output Voltage VS Input Voltage



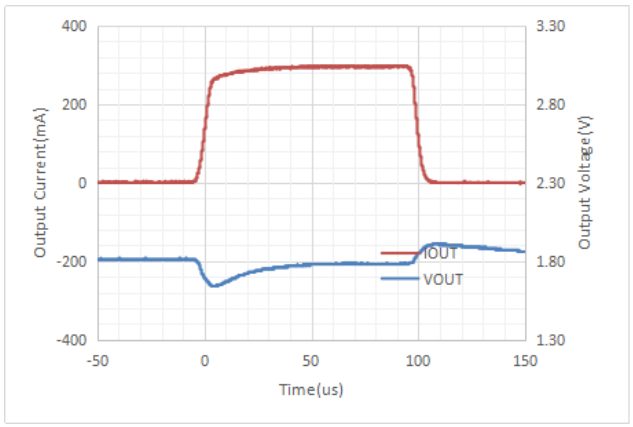
Output Voltage VS Output Current



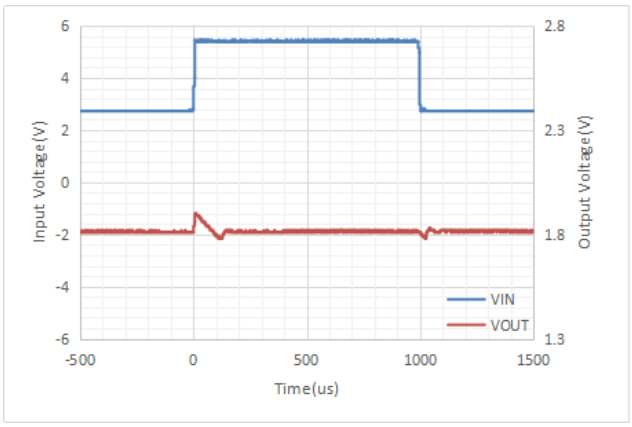
Ground Current VS Output Current



PSRR VS Output Current



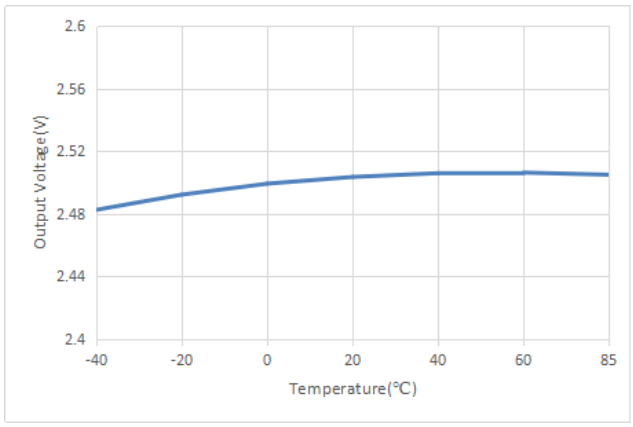
Load Transient Response



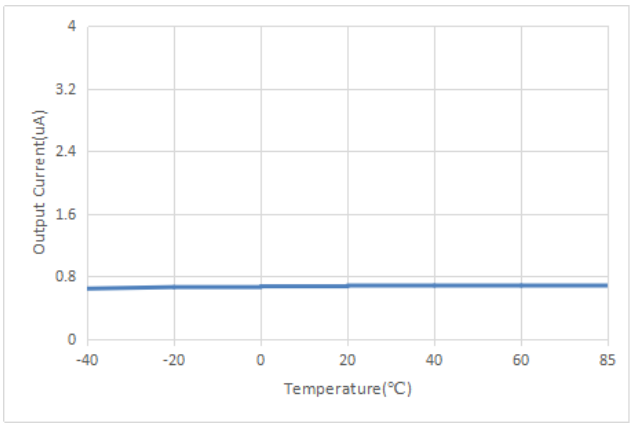
Line Transient Response

(3) VOLTAGE VERSION 2.5V

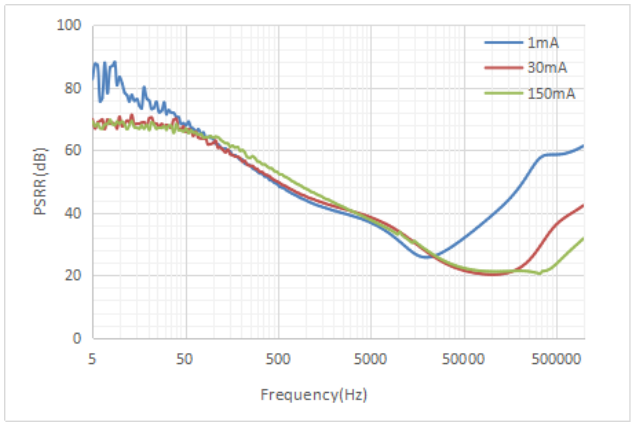
(V_{IN}=3.5V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



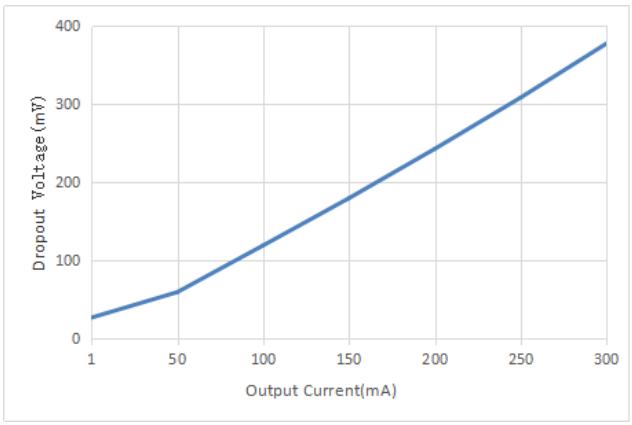
Output Voltage VS Temperature



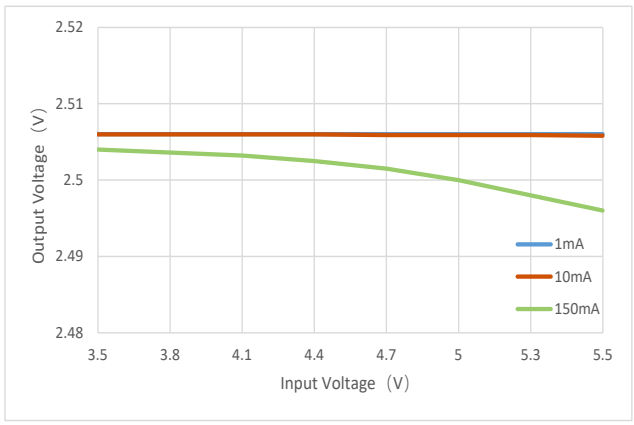
Supply Current VS Temperature



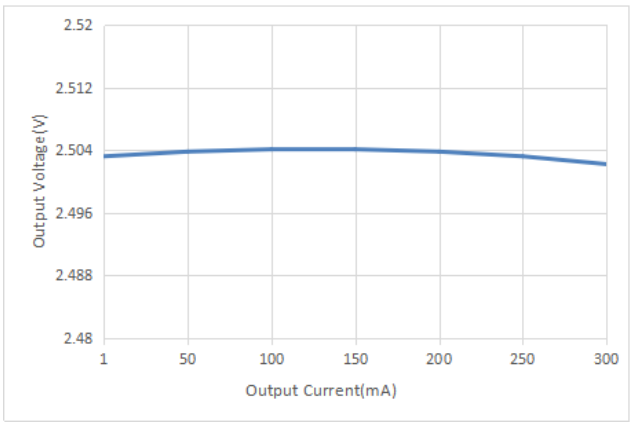
PSRR VS Output Current



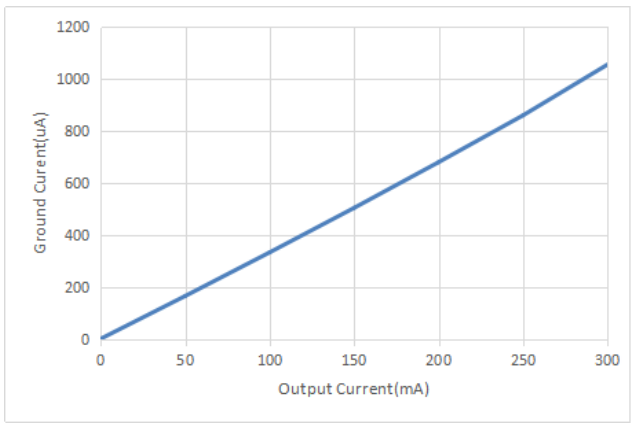
Dropout Voltage VS Output Current



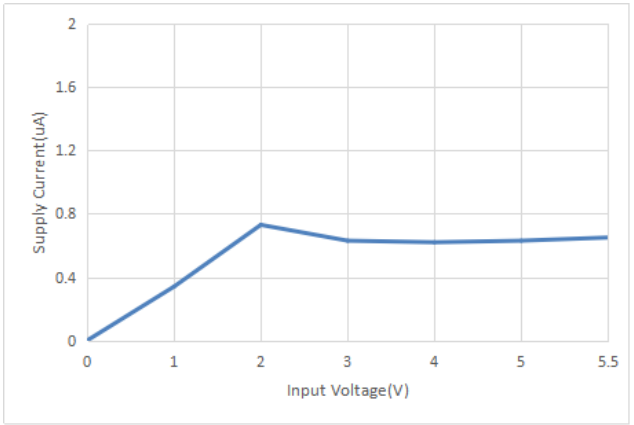
Output Voltage VS Input Voltage



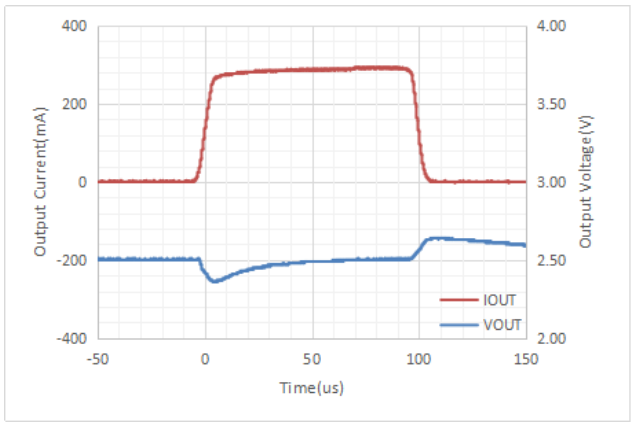
Output Voltage VS Output Current



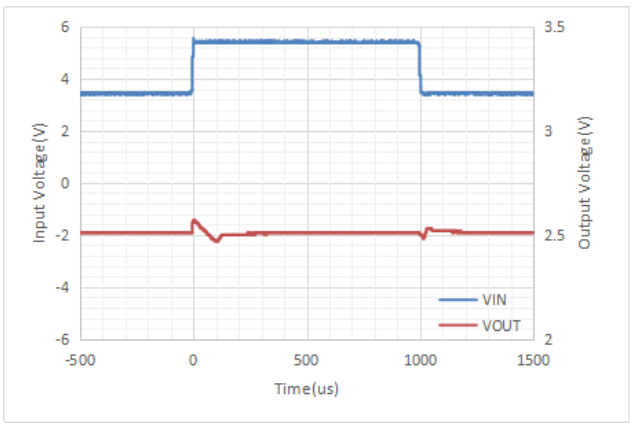
Ground Current VS Output Current



Supply Current VS Input Voltage



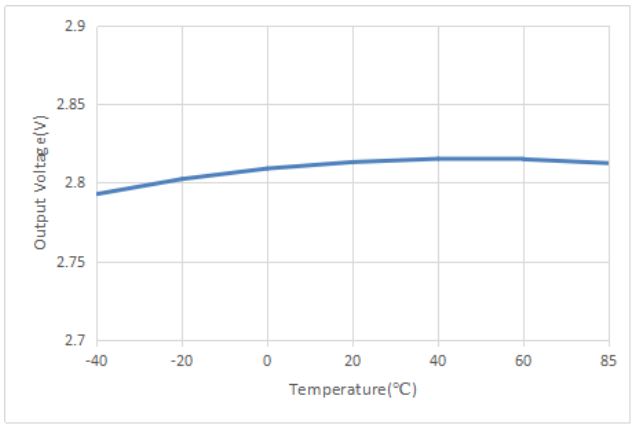
Load Transient Response



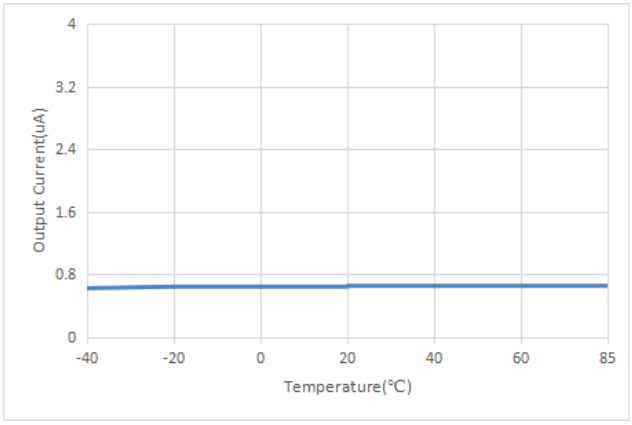
Line Transient Response

(4) VOLTAGE VERSION 2.8V

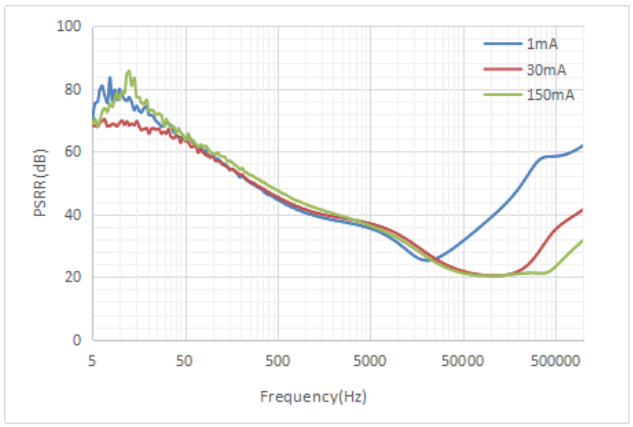
(V_{IN}=3.8V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



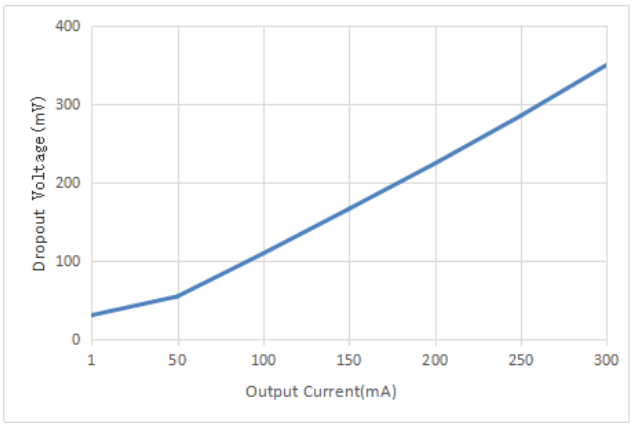
Output Voltage VS Temperature



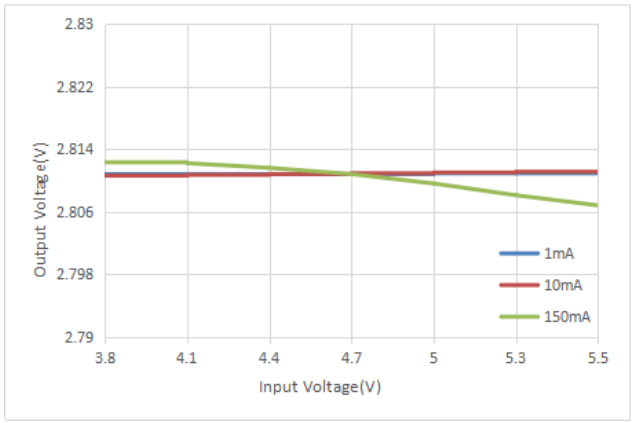
Supply Current VS Temperature



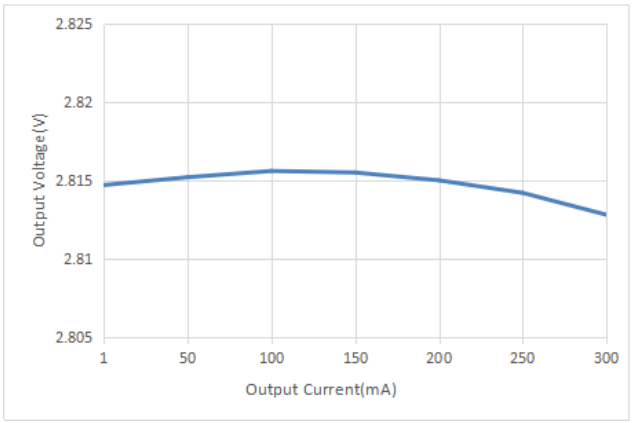
PSRR VS Output Current



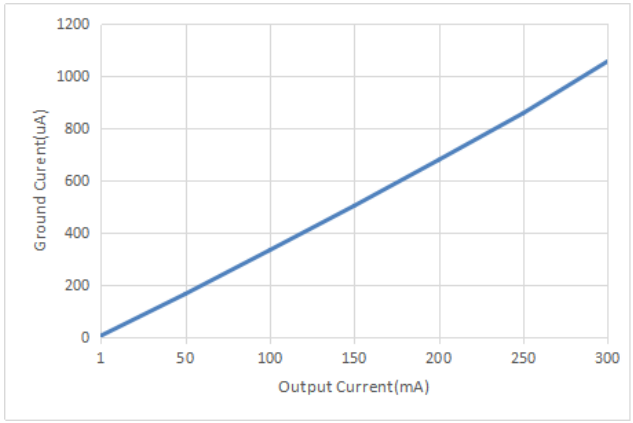
Dropout Voltage VS Output Current



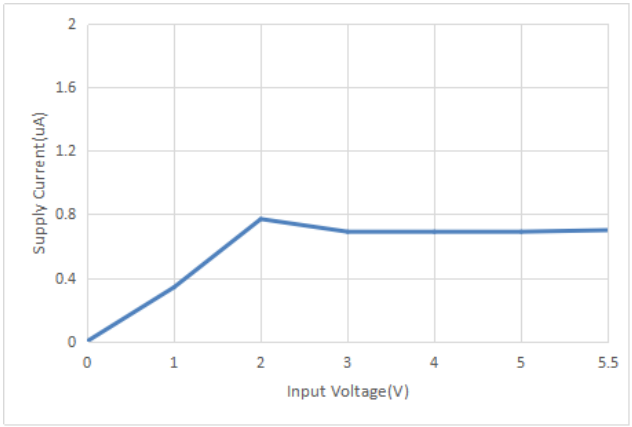
Output Voltage VS Input Voltage



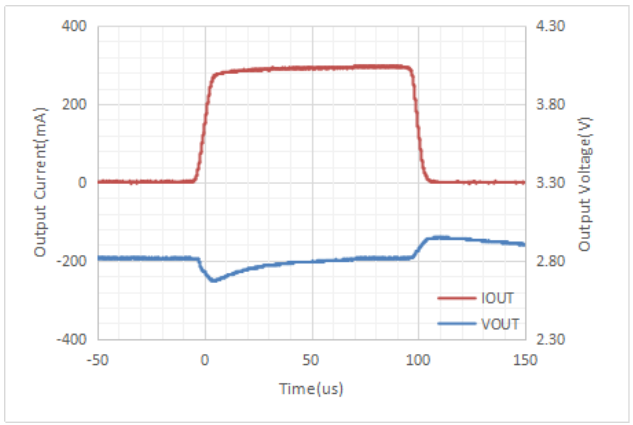
Output Voltage VS Output Current



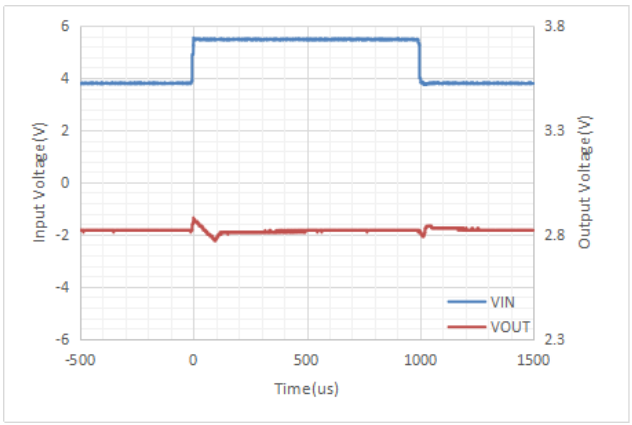
Ground Current VS Output Current



Supply Current VS Input Voltage



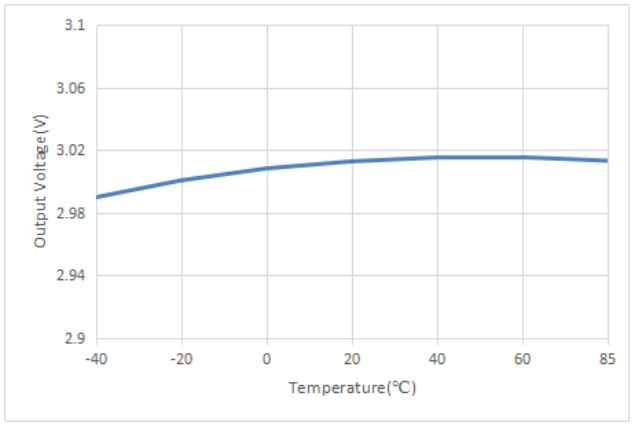
Load Transient Response



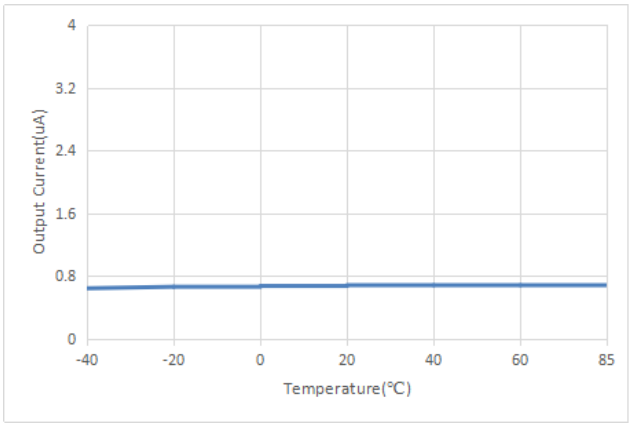
Line Transient Response

(5) VOLTAGE VERSION 3.0V

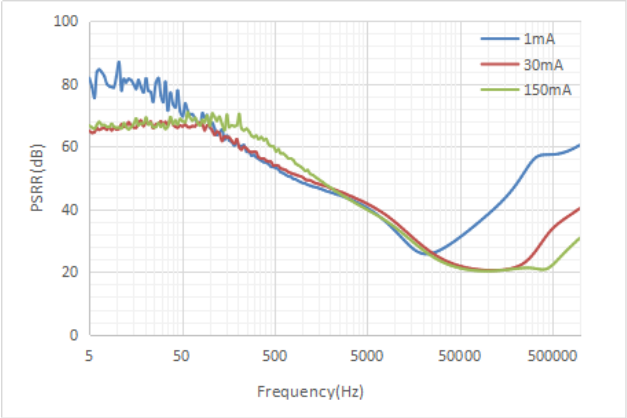
(V_{IN}=4.0V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



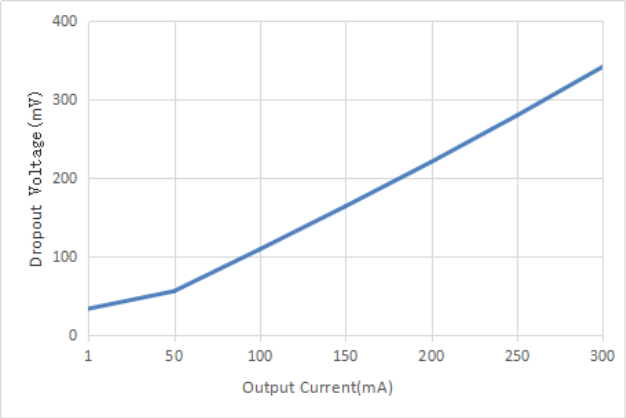
Output Voltage VS Temperature



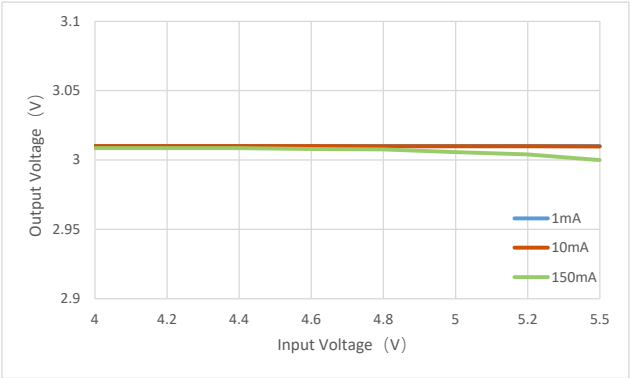
Supply Current VS Temperature



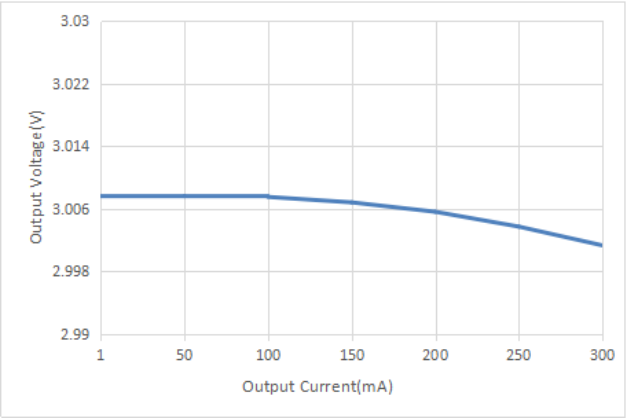
PSRR VS Output Current



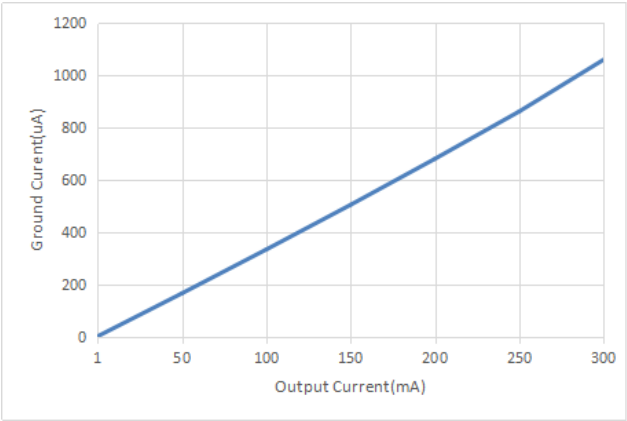
Dropout Voltage VS Output Current



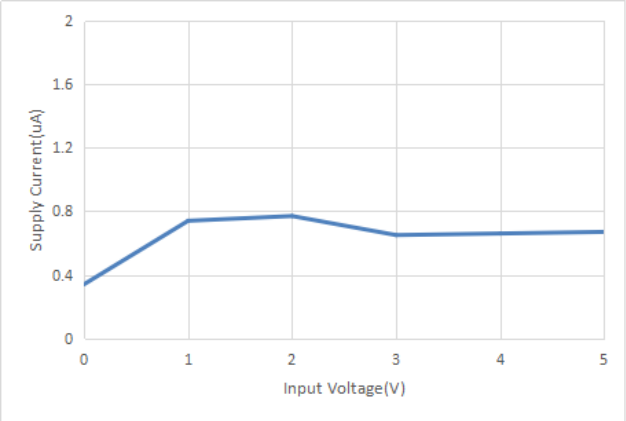
Output Voltage VS Input Voltage



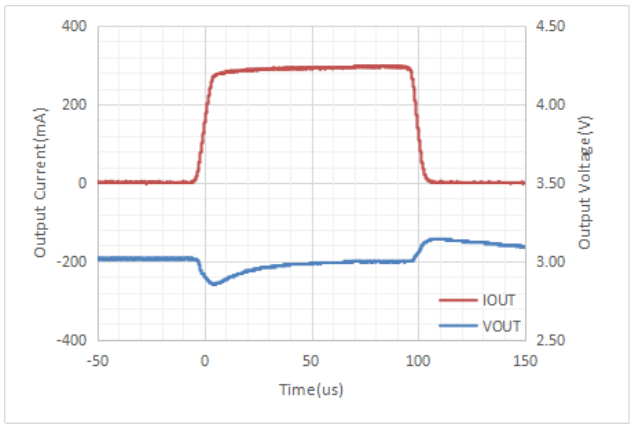
Output Voltage VS Output Current



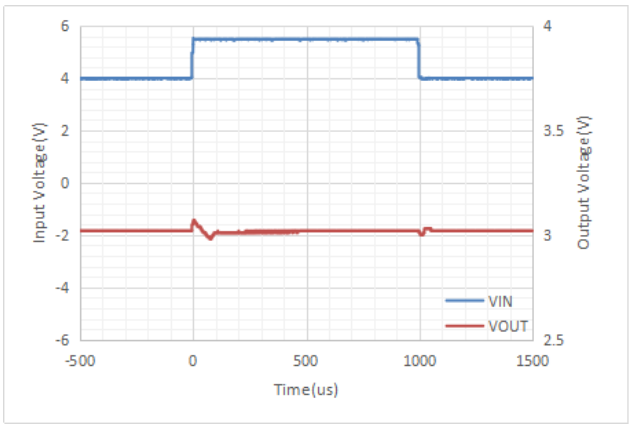
Ground Current VS Output Current



Supply Current VS Input Voltage



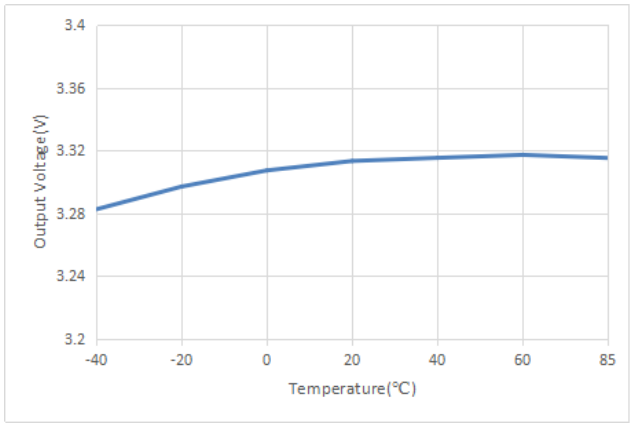
Load Transient Response



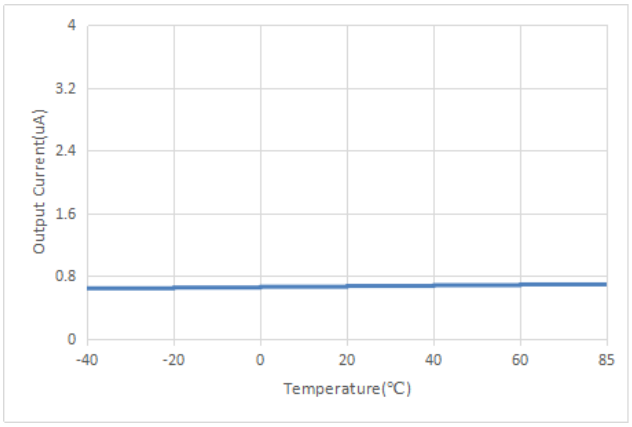
Line Transient Response

(6) VOLTAGE VERSION 3.3V

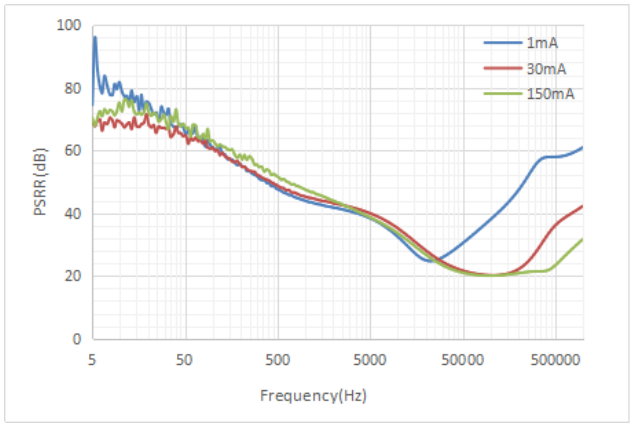
(V_{IN}=4.3V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=+25°C.)



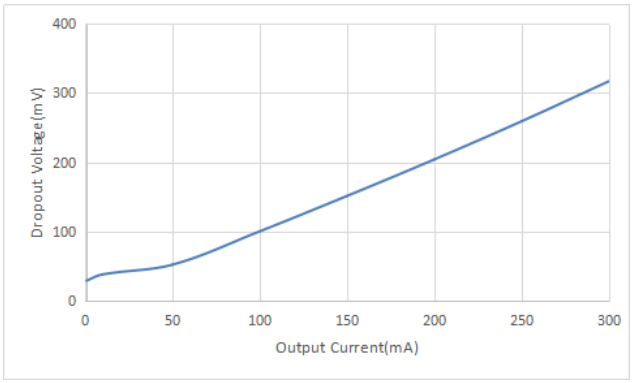
Output Voltage VS Temperature



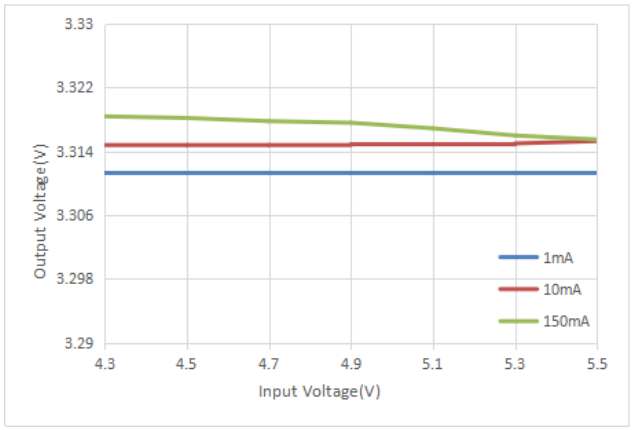
Supply Current VS Temperature



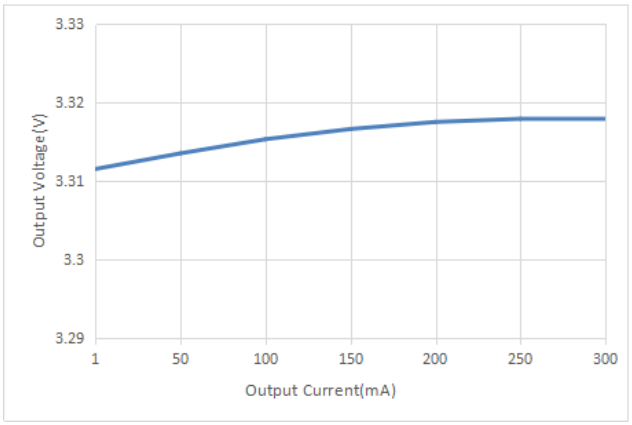
PSRR VS Output Current



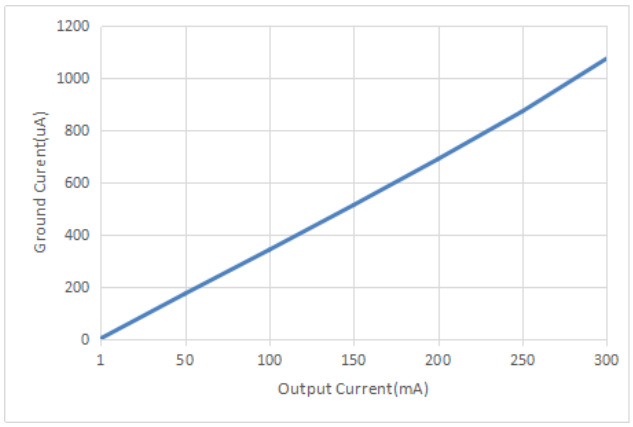
Dropout Voltage VS Output Current



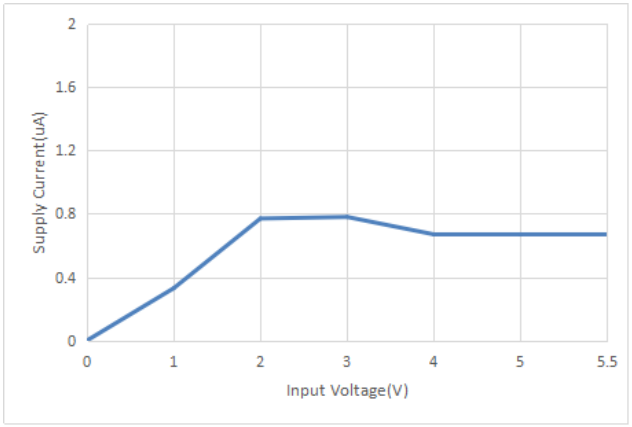
Output Voltage VS Input Voltage



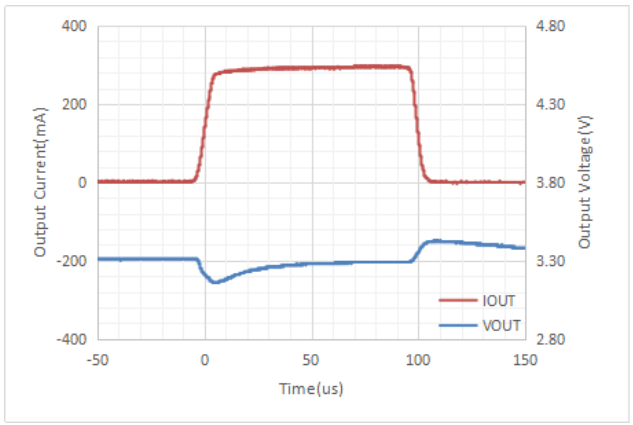
Output Voltage VS Output Current



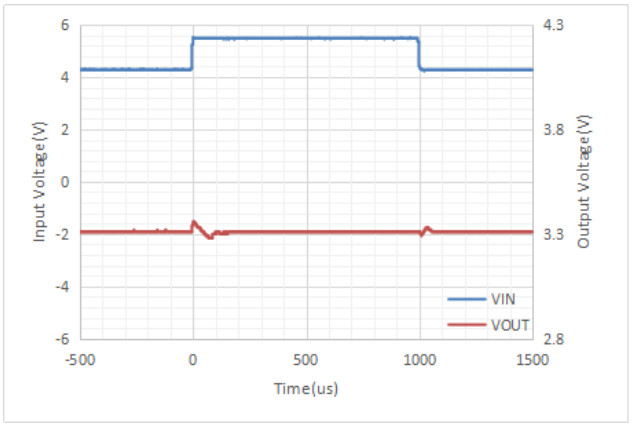
Ground Current VS Output Current



Supply Current VS Input Voltage

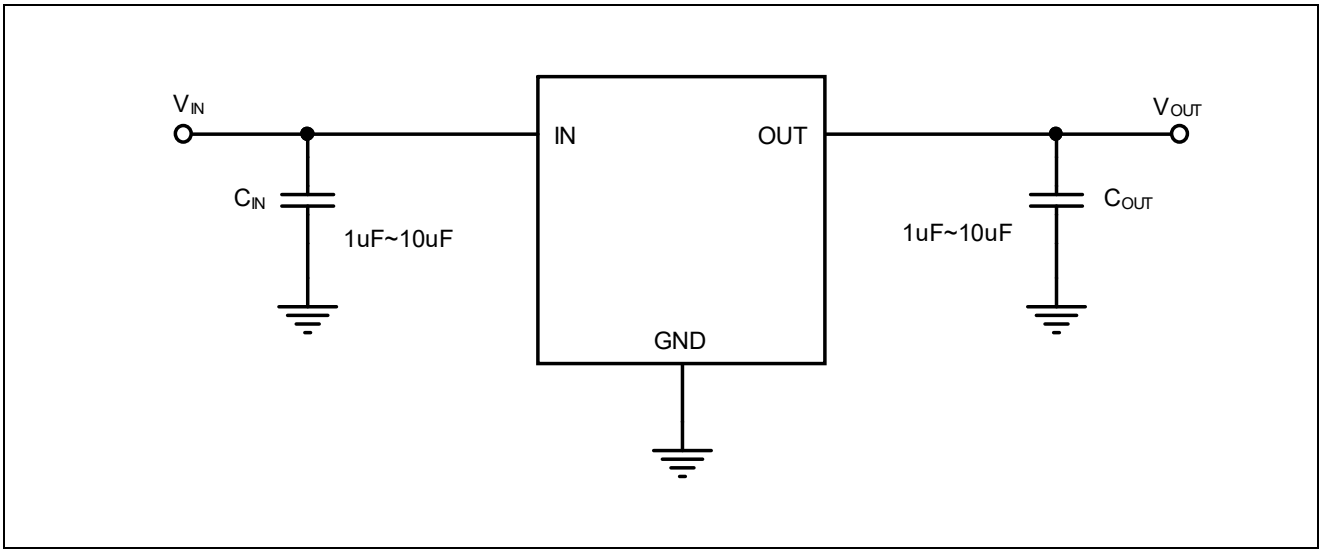


Load Transient Response

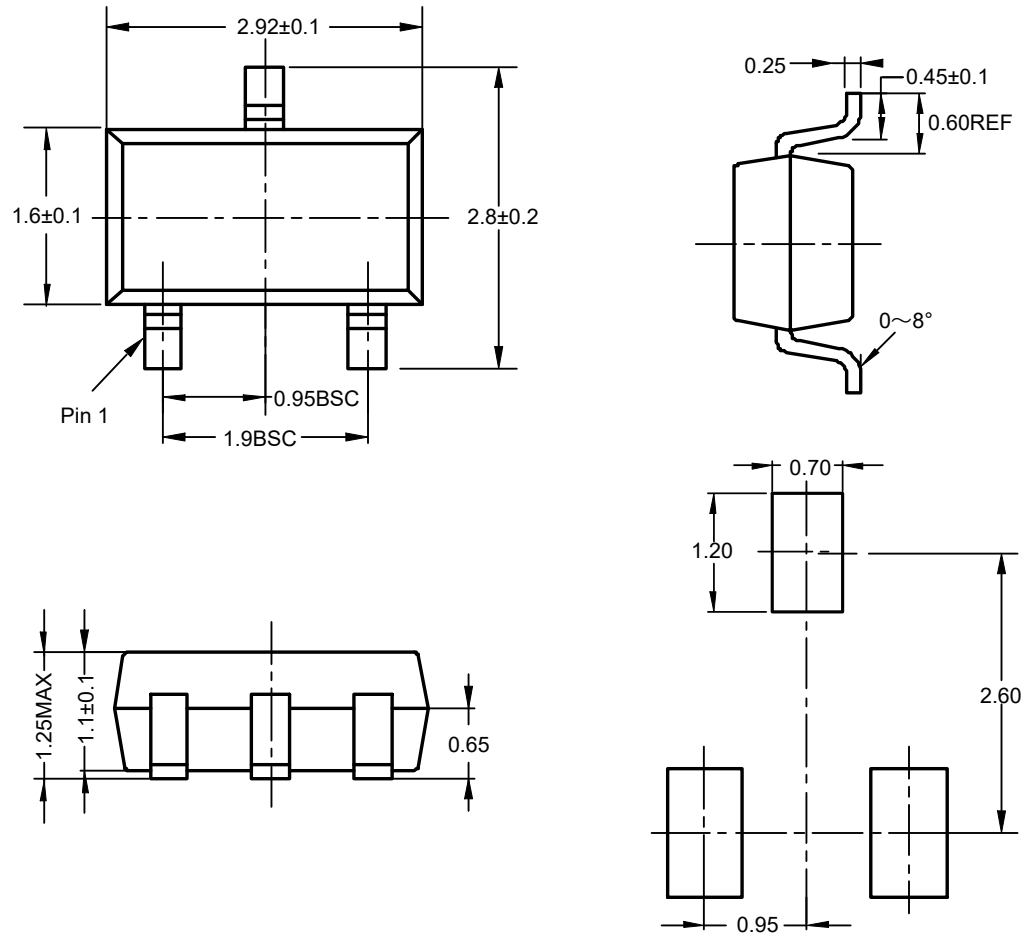


Line Transient Response

Application Circuits



Package Dimension



Recommended Land Pattern

Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2019-01-11	Original Version	Liuxm	Liuxm	Zhujl
1.1	2022-10-19	Update Typeset	Yang Xiao Xu	Liuxm	Yang Xiao Xu
1.2	2023-10-10	Update package picture	Shibo	Liuxm	Liujy