Very High PSRR Low Noise 300mA RF LDO

General Description

The ET515XXYB family of low-dropout (LDO), low-power linear regulators offers very high power supply rejection ratio (PSRR) while maintaining very low 40μA ground current, suitable for RF applications. The family uses an advanced CMOS process and a PMOSFET pass device to achieve fast start-up, very low noise, excellent transient response, and excellent PSRR performance. The ET515XXYB is stable with a 1.0μF ceramic output capacitor, and uses a precision voltage reference and feedback loop to achieve a worst-case accuracy of 2% over all load, line, process, and temperature variations. It is fully specified from T_J =–40°C to +150°C and is offered in a small DFN4 package, which is ideal for small form factor portable equipment such as wireless handsets and PDAs.

The ET515XXYB is available in standard fixed output voltages of 1.05V (ET515105YB), 1.1V (ET51511YB), 1.2V (ET51512YB), 1.3V (ET51513YB), 1.5V (ET51515YB), 1.6V (ET51516YB), 1.7V (ET51517YB), 1.8V (ET51518YB), 2.2V (ET51522YB), 2.5V (ET51525YB), 2.7V (ET51527YB), 2.8V (ET51528YB), 2.9V (ET51529YB), 3.0V (ET51530YB), 3.3V (ET51533YB), 3.45V (ET515345YB), and custom voltage options (50mV step options between 0.8V and 5.0V are available upon request).

Features

- Wide Input Voltage Range: 1.9V to 6.0V
- Up to 300mA Load Current
- Standard Fixed Output Voltage Options: 1.05V, 1.1V,1.2V, 1.3V,1.5V,1.6V, 1.8V, 2.5V, 2.7V, 2.8V, 3.0V, and 3.3V,etc.
- Other Output Voltage Options Available on Request
- Very Low IQ: 40μA
- Ultra Low Dropout: 250mV at 300mA Load@V_{OUT}=2.8V
- Very High PSRR: 75db at 1KHz
- Ultra Low Noise: 45uVrms at 1.2V output
- Ultra-Fast Start-Up Time: 25μs
- Excellent Load/Line Transient Response
- Line Regulation: 0.03% typical
- Package:

Part No.	Package	MSL
ET515XXYB	DFN4(1mm x 1mm)	Level 1

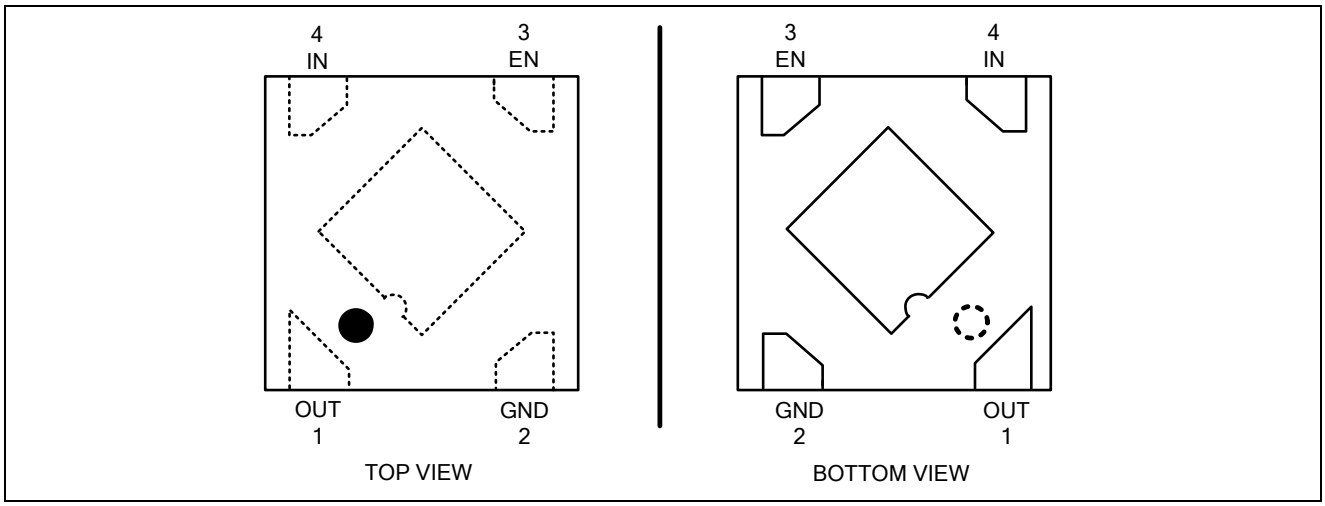
Applications

- Smart Phones and Cellular Phones
- PDAs
- MP3/MP4 Player
- Digital Still Cameras
- Portable instruments

Mark Specification

Part No.	Marking	V_{OUT}	Auto Discharge Function
ET515105YB	VX	1.05V	Y
ET51511YB	IX	1.1V	Y
ET51512YB	AX	1.2V	Y
ET51513YB	LX	1.3V	Y
ET51515YB	BX	1.5V	Y
ET51516YB	NX	1.6V	Y
ET51517YB	KX	1.7V	Y
ET51518YB	CX	1.8V	Y
ET51522YB	QX	2.2V	Y
ET51525YB	FX	2.5V	Y
ET51527YB	PX	2.7V	Y
ET51528YB	DX	2.8V	Y
ET51529YB	SX	2.9V	Y
ET51530YB	GX	3.0V	Y
ET51533YB	EX	3.3V	Y
ET515345YB	YX	3.45V	Y

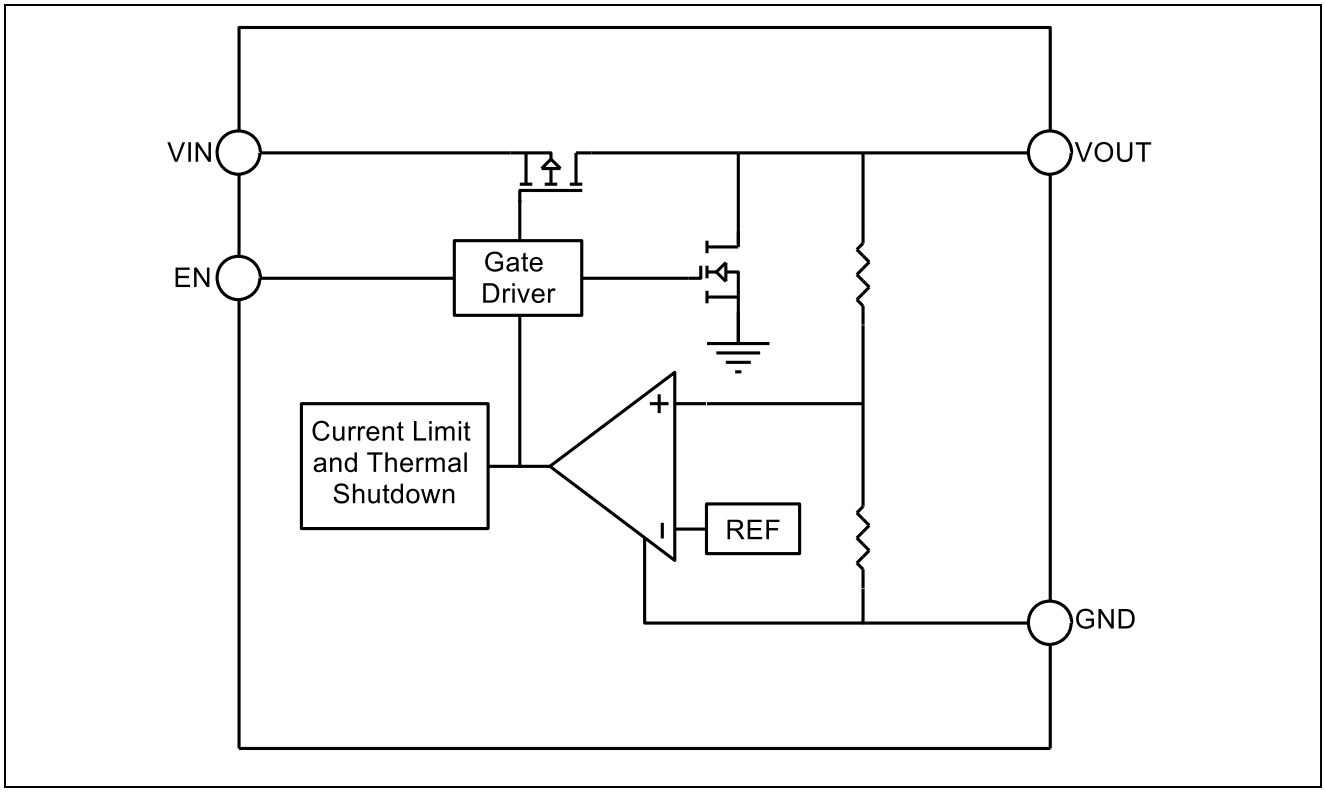
Pin Configuration



Pin Function

Pin No.	Pin Name	Pin Function
4	IN	Supply input pin. Must be closely decoupled to GND with a 1μF or greater ceramic capacitor
2	GND	Ground pin
3	EN	Enable control input, active high. Do not leave EN floating
1	OUT	Output pin. Bypass a 1μF ceramic capacitor from this pin to ground

Block Diagram



Functional Description

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between V_{IN} and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF to 4.7μF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance

may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins.

ON/OFF Input Operation

The ET515XXYB is turned on by setting the EN pin high, and is turned off by pulling it low. If this feature is not used, the EN pin should be tied to IN pin to keep the regulator output on at all time.

High PSRR and Low Noise

RF circuits such as LNA (low-noise amplifier), up/down-converter, mixer, PLL, VCO, and IF stage, require low noise and high PSRR LDOs. The temperature-compensated crystal oscillator circuit requires very high PSRR at RF power amplifier burst frequency. For instance, minimum 65dB PSRR at 217Hz is recommended for the GSM handsets.

The ET515XXYB, with PSRR of 75dB at 1KHz, is suitable for most of these applications that require high PSRR and low noise.

Ultra Fast Start-up

After enabled, the ET515XXYB is able to provide full power in as little as tens of microseconds, typically 25μs. This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

Fast Transient Response

Fast transient response LDOs can also extend battery life. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDOs.

The ET515XXYB's fast transient response from 1 to 300mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

The ET515XX, consuming only around 40μA for all input range and output loading, provides great power saving in portable and low power applications.

Current Limit Protection

When output current at the OUT pin is higher than current limit threshold or the OUT pin is short-circuit to GND, the current limit protection will be triggered and clamp the output current to approximately 500mA to prevent over-current and to protect the regulator from damage due to overheating.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +155°C, allowing the device to cool down. When the junction temperature reduces to approximately +130°C the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

Absolute Maximum Ratings

Parameter	Rating	Unit
IN Voltage	-0.3 to 6.5	V
Other Pin Voltage	-0.3 to V_{IN}+0.3	V
Maximum Load Current	500	mA
$R_{\theta JA}$	250	°C/W
$R_{\Psi jc}$ (1)	139	°C/W
Operating Junction Temperature	-40 to 150	°C
Storage Temperature	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)	260	°C

Note1: Test at TA=25℃with the component mounted on 5*5mm, FR4, 2layer, Top and Bottom layer 1oz.

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.9 to 6.0	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to 85	°C
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 4.7	uF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 4.7	uF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}		1.9		6.0	V
Dropout Voltage	V_{DROP}	V_{OUT} = 1.05V, I_{OUT} = 300mA		750	850	mV
		V_{OUT} = 1.1V, I_{OUT} = 300mA		700	800	
		V_{OUT} = 1.2V, I_{OUT} = 300mA		700	800	
		V_{OUT} = 1.3V, I_{OUT} = 300mA		700	800	
		V_{OUT} = 1.5V, I_{OUT} = 300mA		600	730	
		V_{OUT} = 1.6V, I_{OUT} = 300mA		500	650	
		V_{OUT} = 1.7V, I_{OUT} = 150mA		450	620	
		V_{OUT} = 1.8V, I_{OUT} = 300mA		380	520	
		V_{OUT} = 2.2V, I_{OUT} = 300mA		350	490	
		V_{OUT} = 2.5V, I_{OUT} = 300mA		280	450	
		V_{OUT} = 2.8V, I_{OUT} = 300mA		250	400	
		V_{OUT} = 2.9V, I_{OUT} = 300mA		250	400	
		V_{OUT} = 3.0V, I_{OUT} = 300mA		240	390	
		V_{OUT} = 3.3V, I_{OUT} = 300mA		210	360	
		V_{OUT} = 3.45V, I_{OUT} =300mA		200	350	

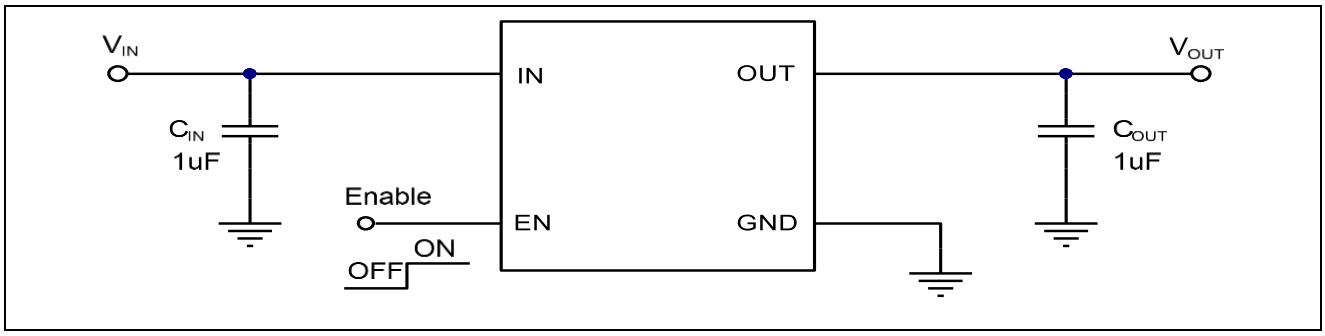
Electrical Characteristics(Continued)

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DC Supply Quiescent Current	I_{Q_ON}	Active mode: V_{EN}=V_{IN}		42	70	μA
DC Supply Shutdown Current	$I_{Q\ OFF}$	V_{EN}=0V		0.01	1	μA
Regulated Output Voltage	V_{OUT}	I_{OUT}=1mA, -40°C≤T_A≤85°C	-2		2	%
Output Voltage Line Regulation	Reg_{LINE}	V_{IN} = V_{OUT} +1V to 5.5V, I_{OUT} = 10mA		0.03	0.2	%/V
Output Voltage Load Regulation	Reg_{LOAD}	I_{OUT} from 1mA to 300mA		15	40	mV
Current Limit	I_{LIM}		300			mA
Power Supply Rejection Ratio	PSRR	f=1kHz, C_{OUT}=1μF, I_{OUT}=20mA		75		dB
		f=10kHz, C_{OUT}=1μF, I_{OUT}=30mA		65		
Output Noise	e_N	10Hz to 100kHz, I_{OUT} =200mA,V_{OUT}=2.8V, C_{OUT} = 1μF		70		$μV_{RMS}$
		10Hz to 100kHz, I_{OUT} =200mA,V_{OUT}=1.2V, C_{OUT} = 1μF		45		
Soft-start Time	T_{ON}	From Enable to Power On		25		μs
EN Low Threshold	V_{ENL}				0.3	V
EN High Threshold	V_{ENH}		1.5			V
EN pull-down resistance	R_{PD}		0.8	1	1.3	MΩ
Over-temperature Shutdown Threshold	T_{TSD}			155		°C
Over-temperature Shutdown Hysteresis	T_{TSR}			20		°C

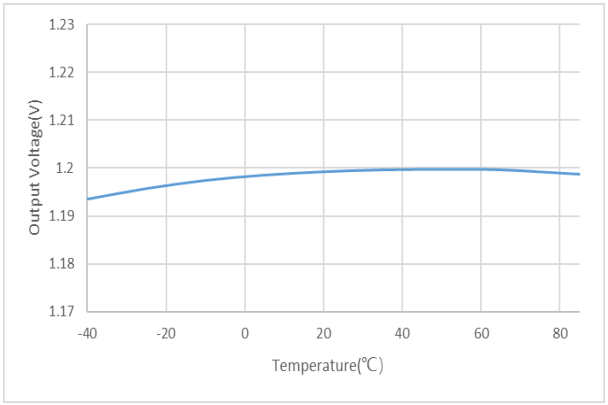
Note:Test at+25°C.Specifications over the temperature range are guaranteed by design and characterization.

Application Circuits

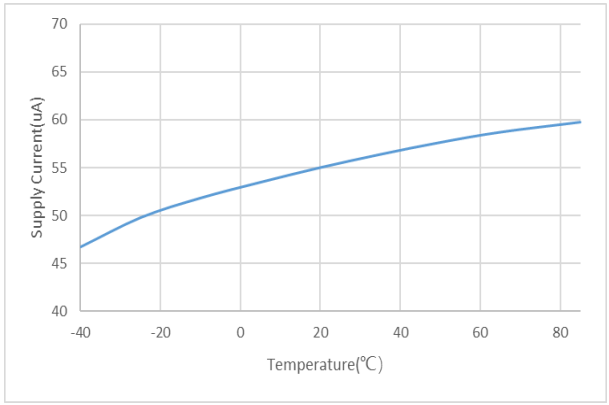


Typical Characteristics

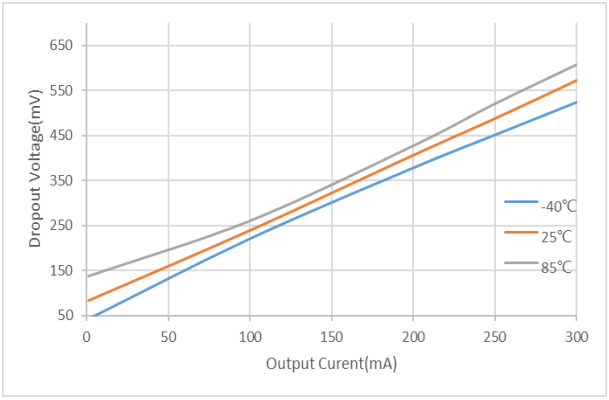
(ET51512YB, V_{IN} = 2.2V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



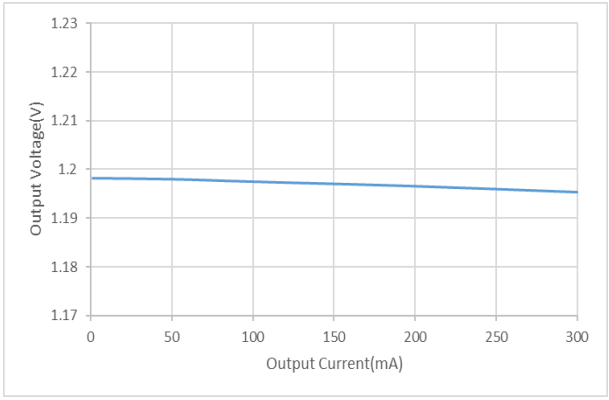
Output Voltage VS Temperature



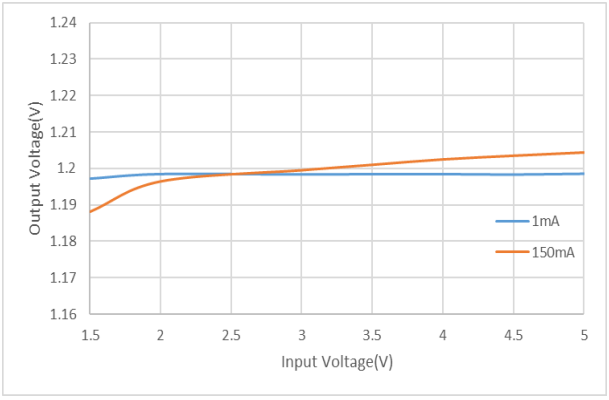
Supply Current VS Temperature



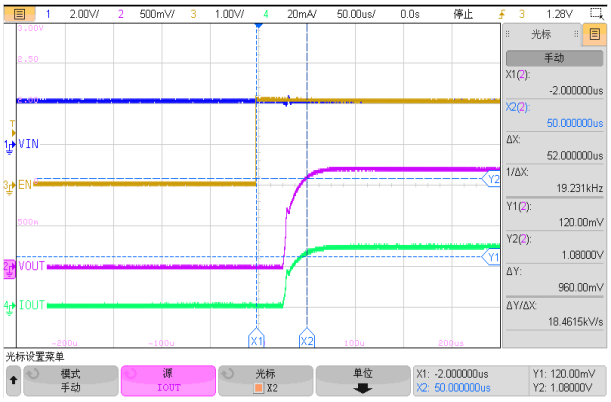
Dropout Voltage VS Output Current



Output Voltage VS Output Current



Output Voltage VS V_{IN} Input Voltage



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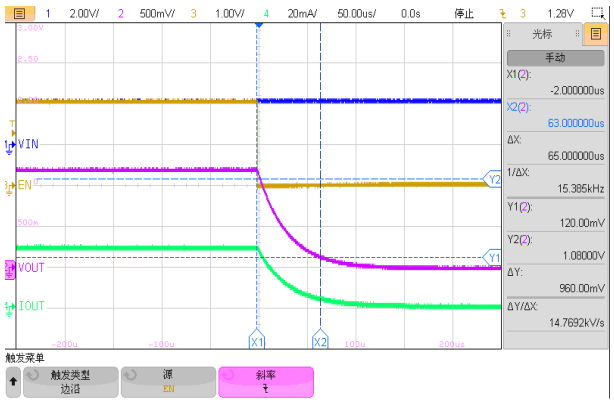
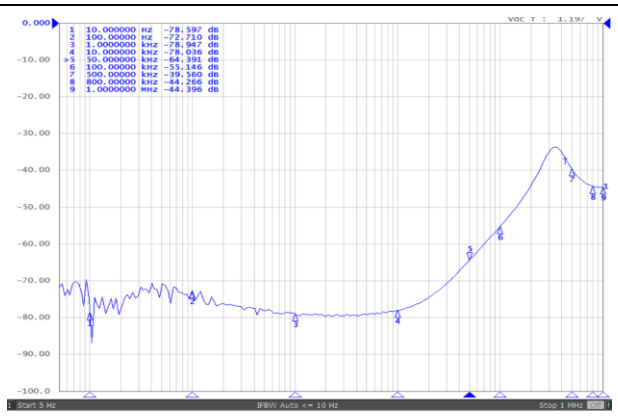
Typical Characteristics(Continued)

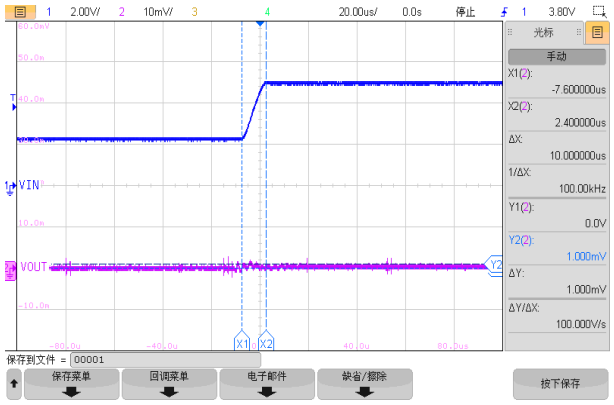
(ET51512YB,V_{IN} = 2.2V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



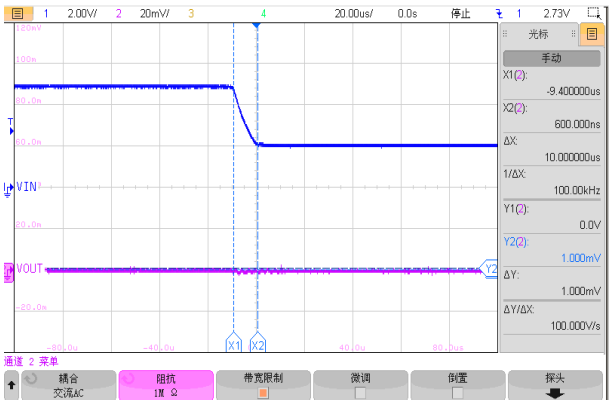
T_{OFF}



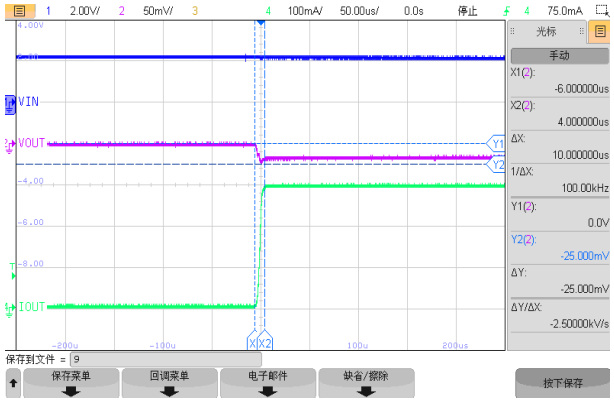
PSRR



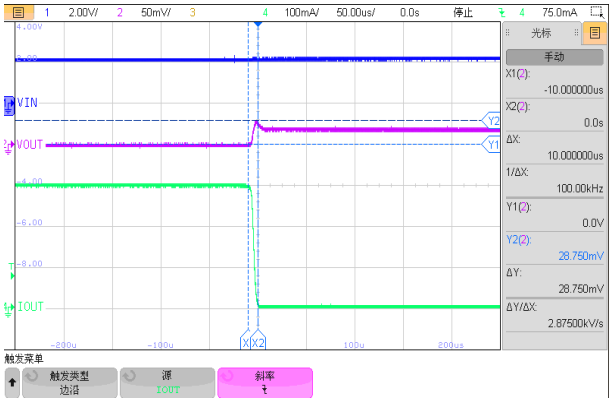
Input Transient(2.2~5V t=10us 1mA)



Input Transient(5~2.2V t=10us 10mA)



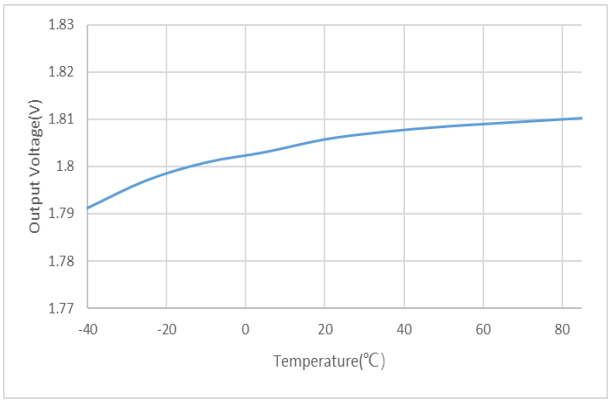
Load Transient(1mA~300mA t=10us)



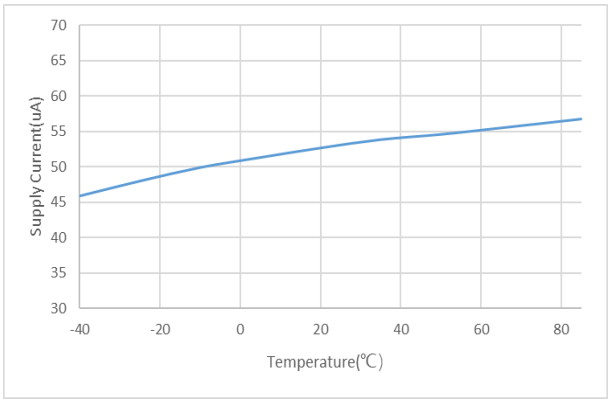
Load Transient(300mA~1mA t=10us)

Typical Characteristics(Continued)

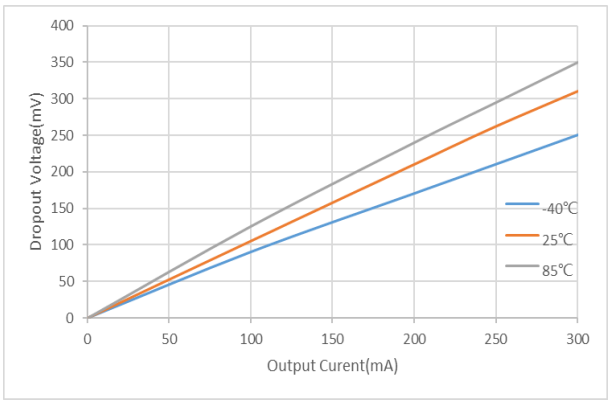
(ET51518YB,V_{IN} = 2.8V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



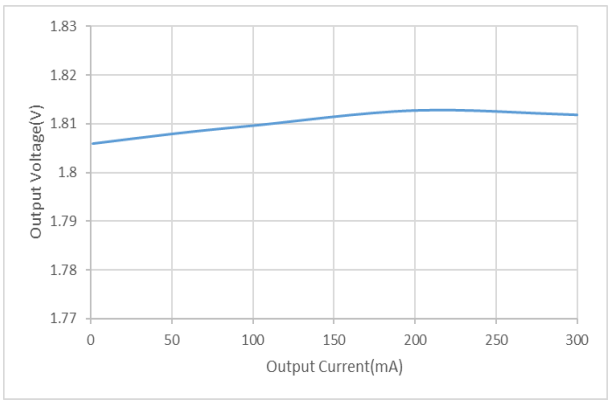
Output Voltage VS Temperature



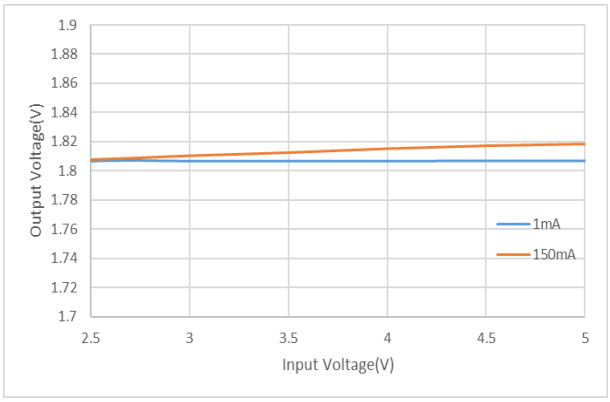
Supply Current VS Temperature



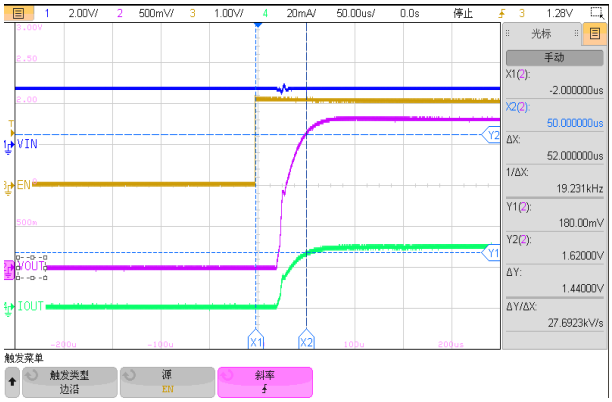
Dropout Voltage VS Output Current



Output Voltage VS Output Current



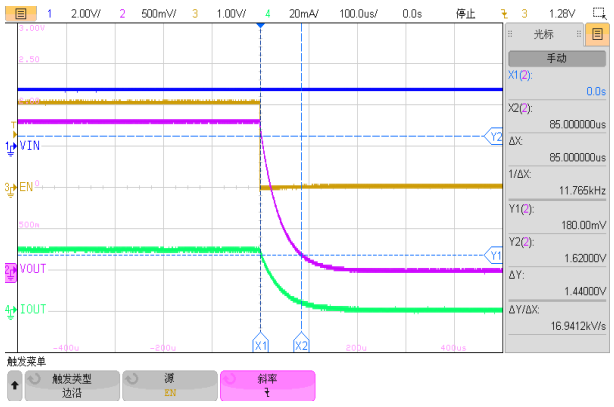
Output Voltage VS V_{IN} Input Voltage



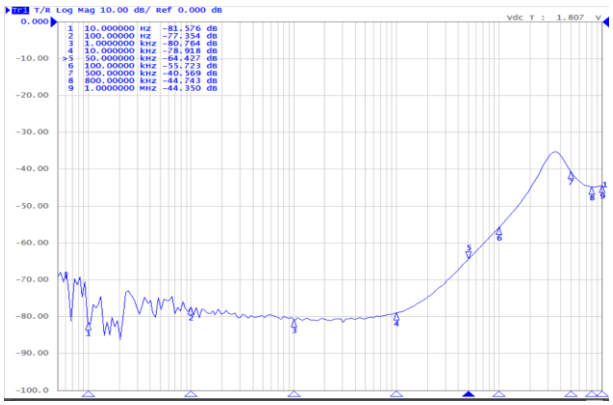
T_{ON}

Typical Characteristics(Continued)

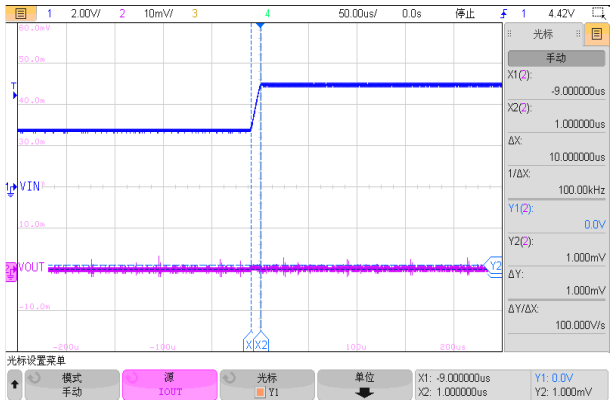
(ET51518YB,V_{IN} = 2.8V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



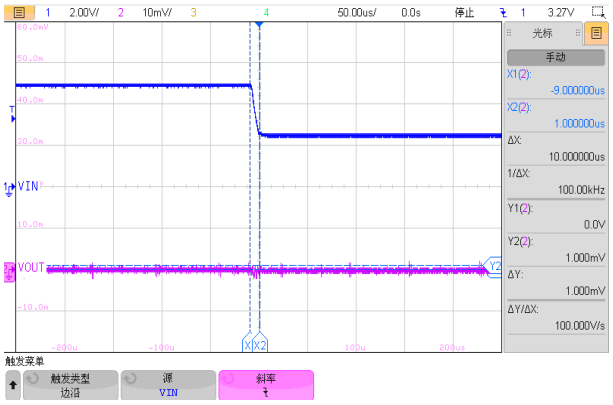
T_{OFF}



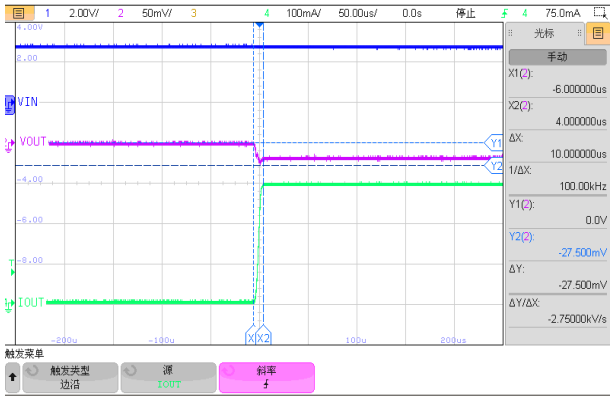
PSRR



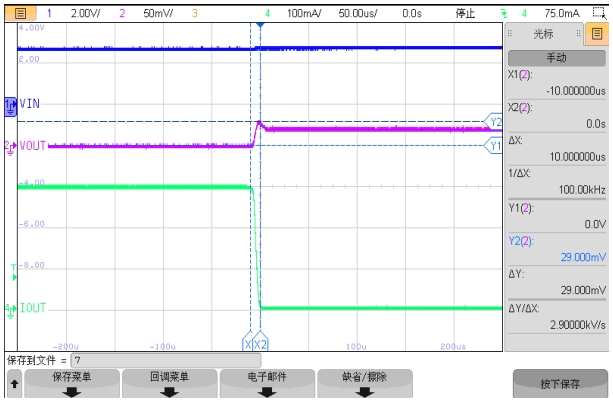
Input Transient(2.8~5V t=10us 1mA)



Input Transient(5~2.8V t=10us 10mA)



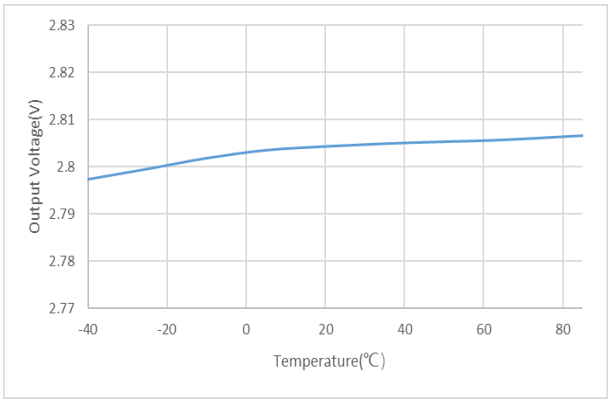
Load Transient(1mA~300mA t=10us)



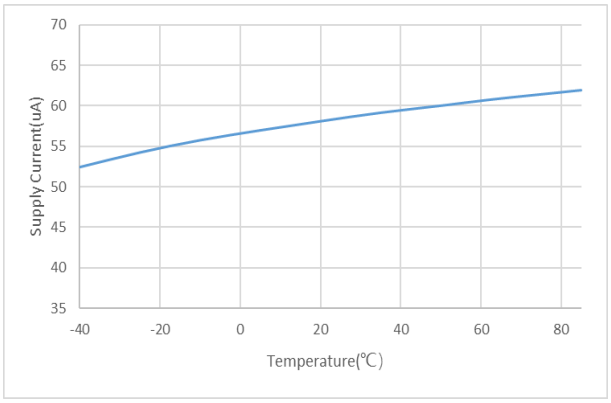
Load Transient(300mA~1mA t=10us)

Typical Characteristics(Continued)

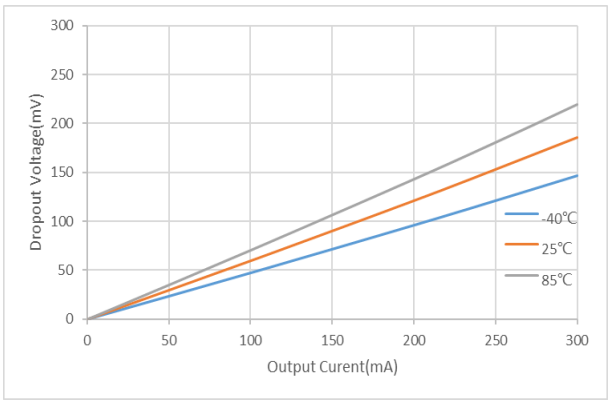
(ET51528YB,V_{IN} = 3.8V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



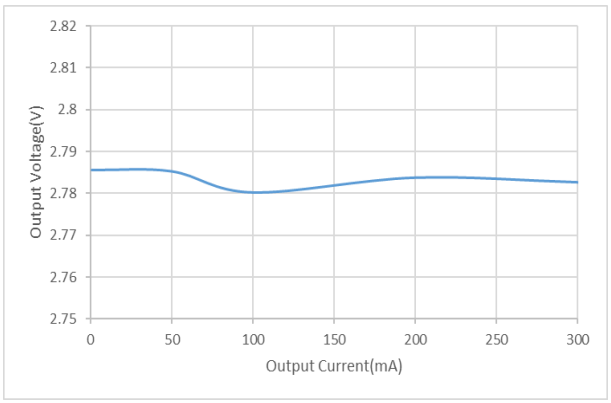
Output Voltage VS Temperature



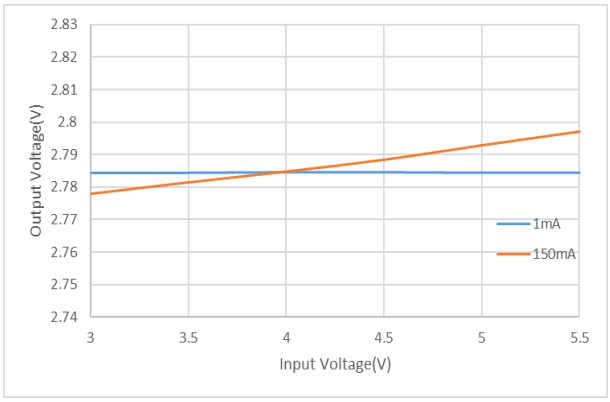
Supply Current VS Temperature



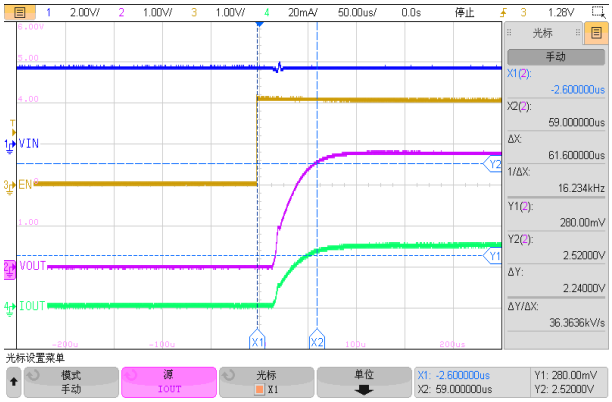
Dropout Voltage VS Output Current



Output Voltage VS Output Current



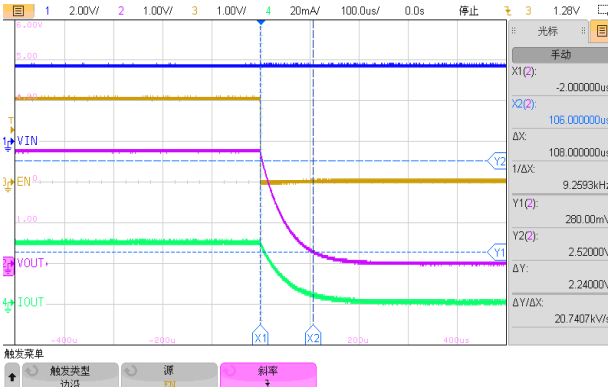
Output Voltage VS V_{IN} Input Voltage



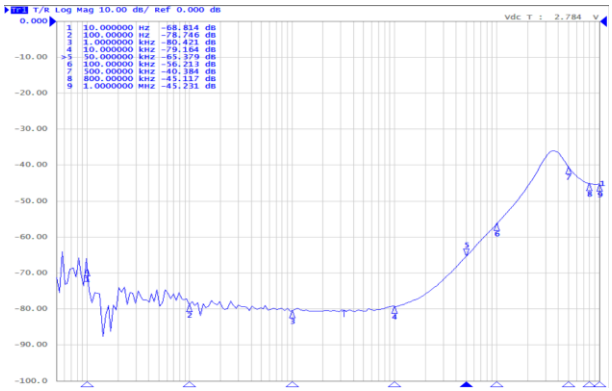
T_{ON}

Typical Characteristics(Continued)

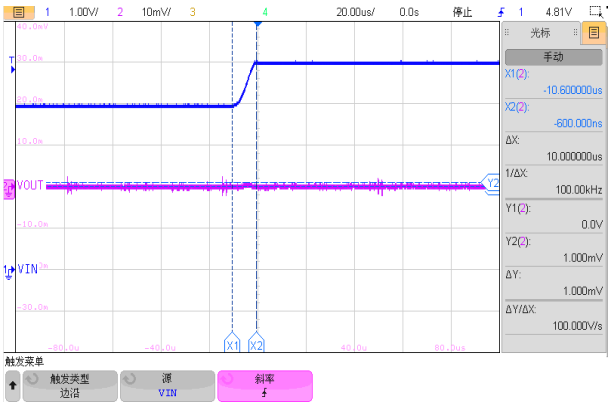
(ET51528YB,V_{IN} = 3.8V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



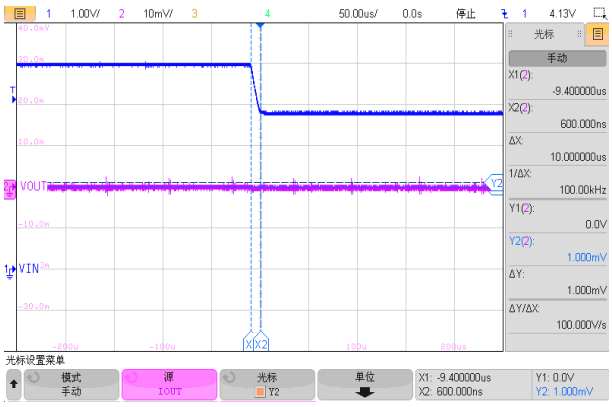
T_{OFF}



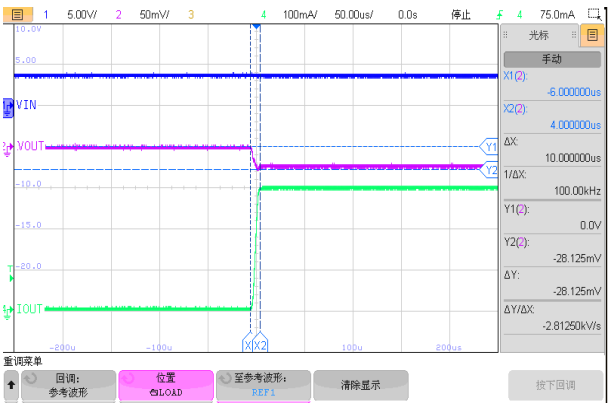
PSRR



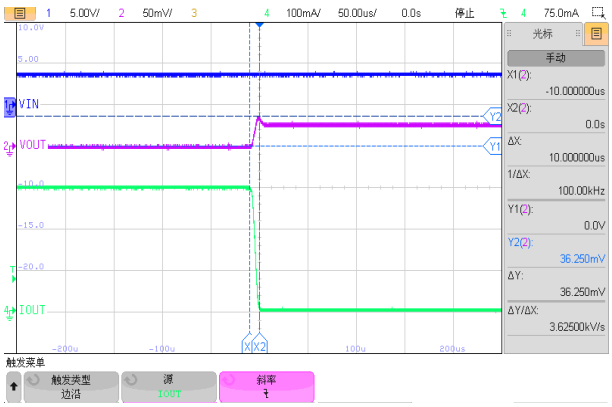
Input Transient(3.8~5V t=10us 1mA)



Input Transient(5~3.8V t=10us 10mA)



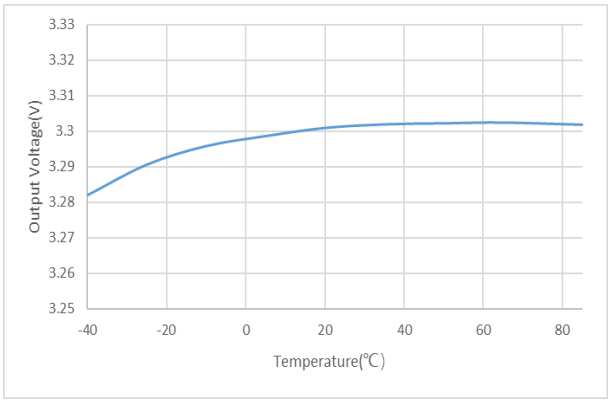
Load Transient(1mA~300mA t=10us)



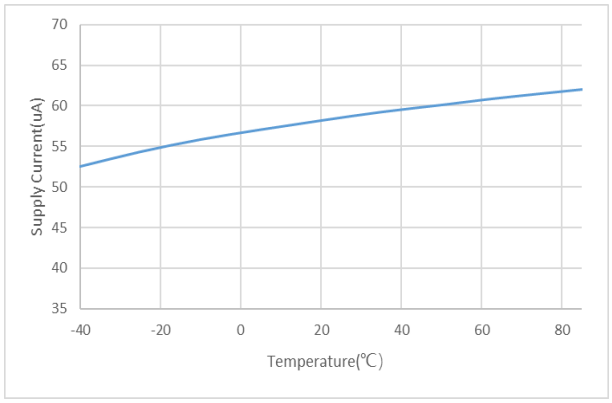
Load Transient(300mA~1mA t=10us)

Typical Characteristics(Continued)

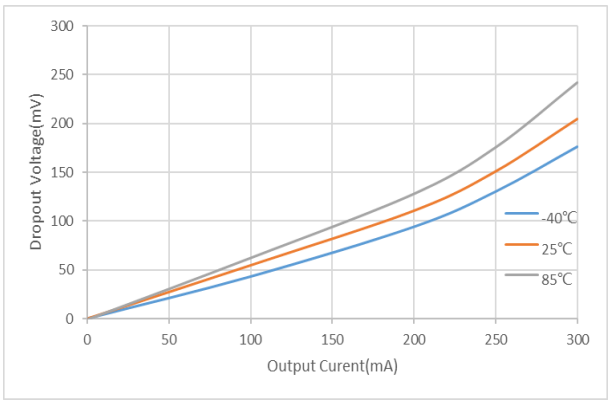
(ET51533YB,V_{IN} = 4.3V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



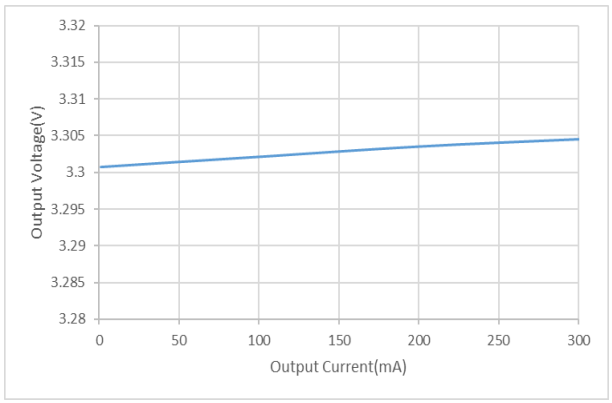
Output Voltage VS Temperature



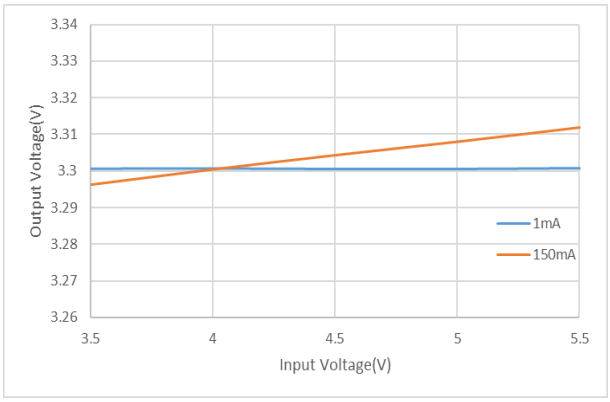
Supply Current VS Temperature



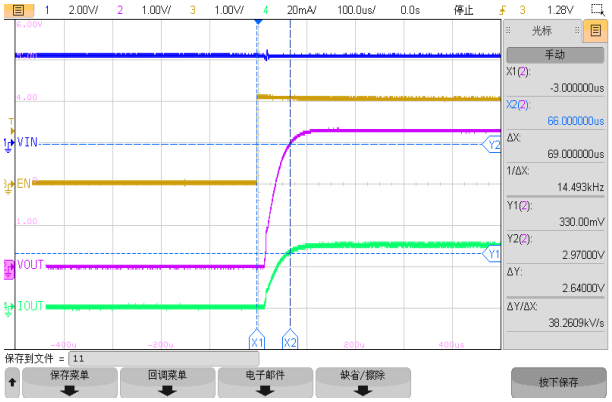
Dropout Voltage VS Output Current



Output Voltage VS Output Current



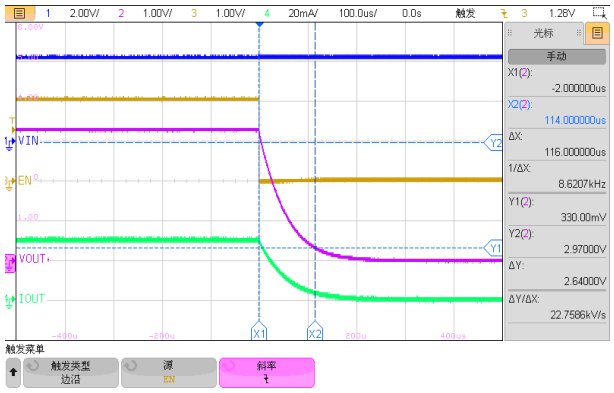
Output Voltage VS V_{IN} Input Voltage



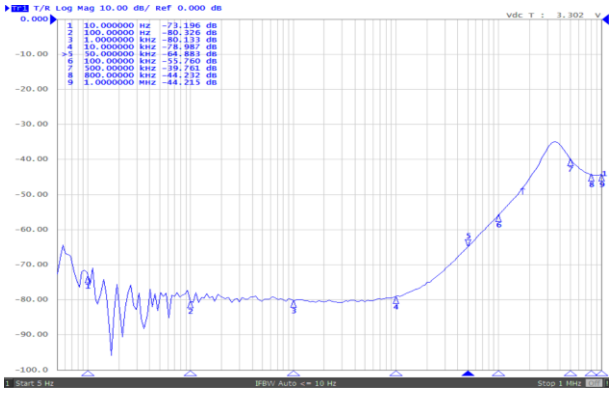
T_{ON}

Typical Characteristics(Continued)

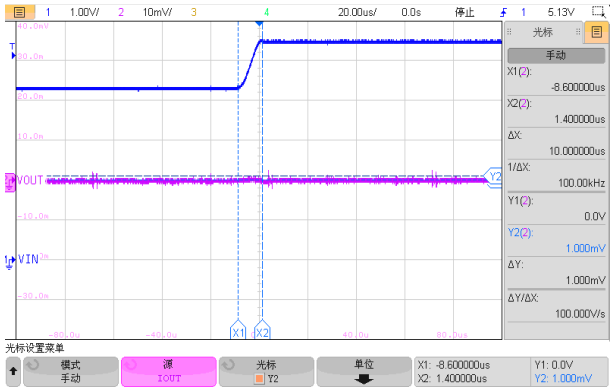
(ET51533YB,V_{IN} = 4.3V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF,T_A= 25°C)



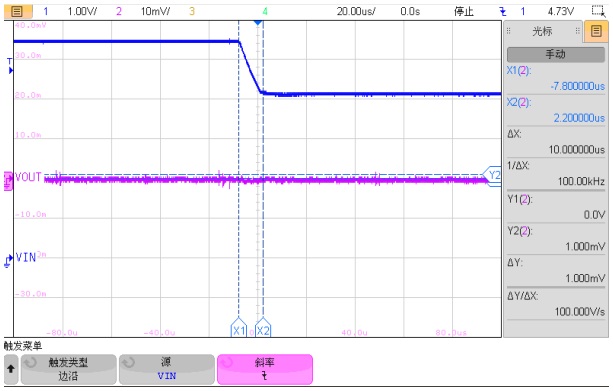
T_{OFF}



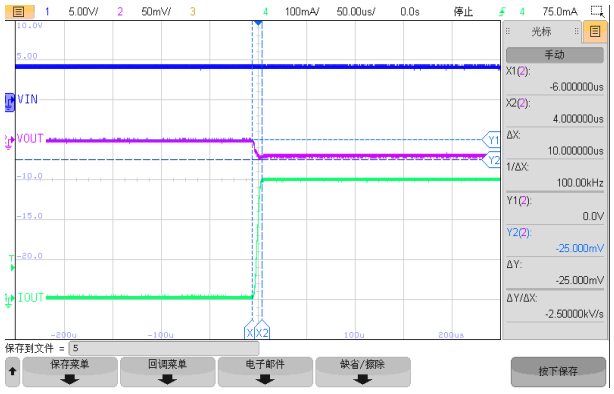
PSRR



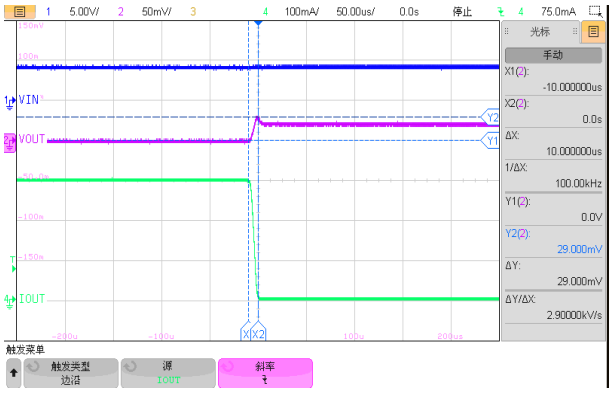
Input Transient(4.3~5.5V t=10us 1mA)



Input Transient(5.5~4.3V t=10us 10mA)



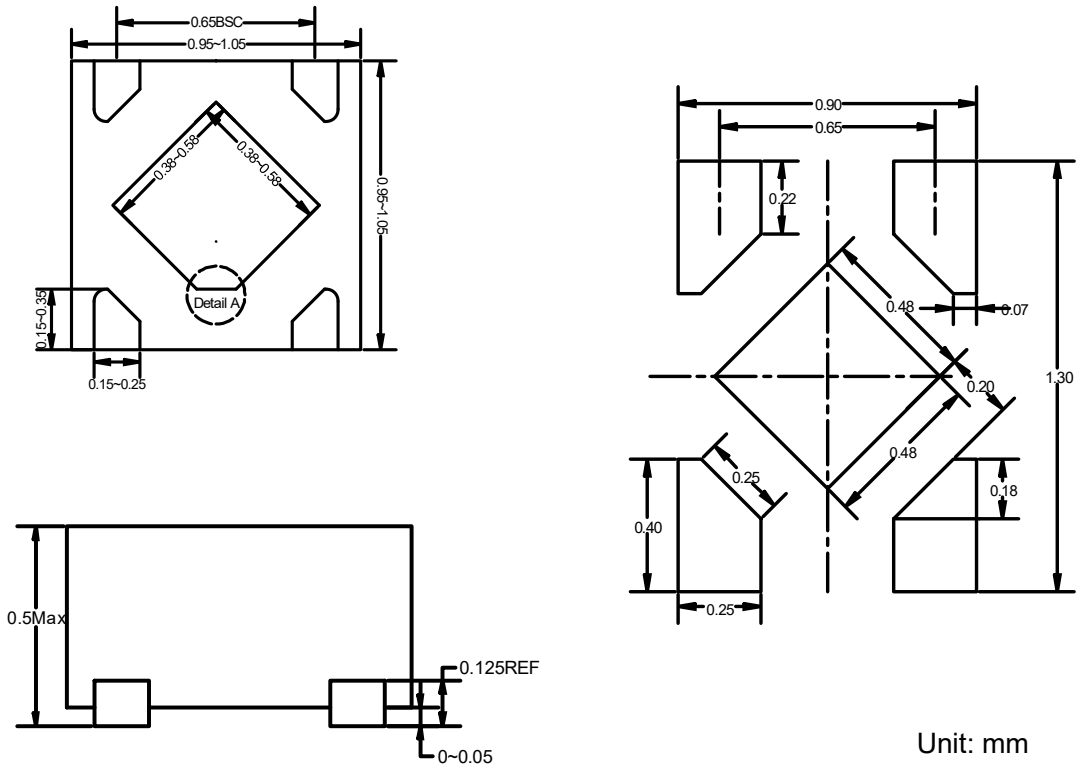
Load Transient(1mA~300mA t=10us)



Load Transient(300mA~1mA t=10us)

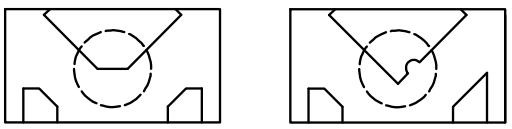
Package Dimension

DFN4（1×1）

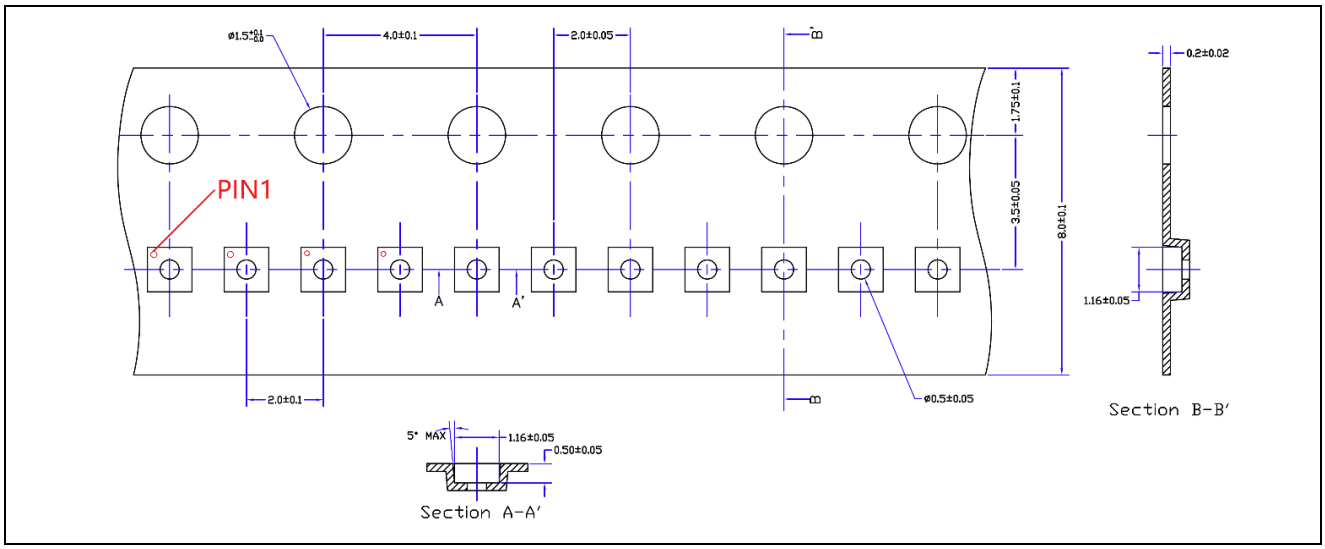


Unit: mm

Detail A: (PIN1 shape)



Tape Information



Package Information

Qty:10k/Reel

Marking

DFN4 Package

$X^{(1)}$ = V_{OUT} Version

$X^{(2)}$ = Track Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
2.3	2017-10-19	1.Add 1.6V information 2.Rearrange datasheet version	Liuxm	Zhujl	Zhujl
2.4	2017-11-16	Adjust PIN1 shape	Liuxm	Zhujl	Zhujl
2.5	2022-09-16	Update Typeset	Peng Jun Jie	Liuyg	Liujy
2.6	2022-10-31	Add $R_{\theta JA}$	Wangp	Zhujl	Zhujl
2.7	2022-11-02	Add tape information	Wangp	Zhujl	Zhujl
2.8	2023-1-13	Add Marking and $R_{\psi jc}$	Wangp	Zhujl	Zhujl
2.9	2023-6-3	Add characteristic curve	Wangp	Zhujl	Zhujl
2.10	2024-10-31	Add Package Infomation	Wangp	Liuxm	Lijy
2.11	2025-02-10	Update Output Voltage	Wangp	Liuxm	Lijy