ET553XXYB - 500mA Low Dropout LDO

General Description

The ET553XXYB series are CMOS-based low-dropout, low-power linear regulators, offering 500mA with low dropout voltage, high ripple rejection, high output accuracy and low supply current. The ET553XXYB series consist of an accurate voltage-reference block, an error amplifier, a voltage-setting resistor net, a PMOSFET pass device, a thermal-shutdown circuit, and a current limit circuit with short protection.

The ET553XXYB series use a type of outstanding CMOS process to minimize the supply current. A low on-resistance PMOS pass device is equipped for lower dropout voltage. ET553XXYB also possess the EN function to save more energy and extend the battery life.

Features

- Wide Input Voltage Range: 1.9V to 5.5V
- Output Current: 500mA optional
- Output Voltage Range: 1.0V to 3.6V (Fixed output)
- Very Low IQ: 50μA
- Excellent Load / Line Transient Response
- Built-in Over Current Protection and Thermal Shutdown circuit
- Built-in Inrush Current Suppression circuit and Current Limit
- Built-in Auto-discharging circuit
- Package No. and MSL Level:

Part No.	Package	MSL
ET553XXYB	DFN4(1×1)	Level 1

Applications

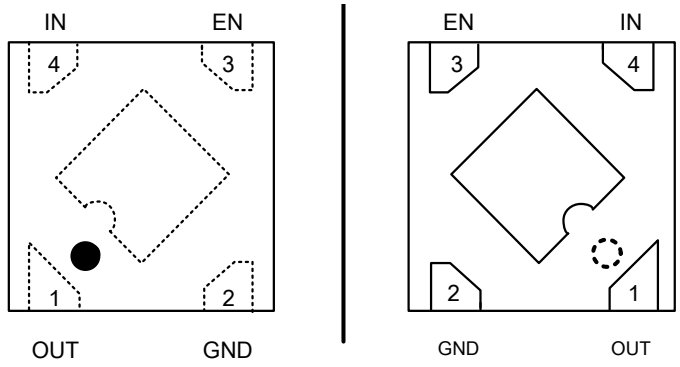
- Constant-voltage power supply for battery-powered device
- Constant-voltage power supply for TV, notebook PC and home electric appliance
- Constant-voltage power supply for portable equipment

Device Information

ET 553 XX Y B

XX Output Voltage		**Y** Package		**B** Auto-discharge Function	
XX	Fixed Output Voltage	Y	DFN4(1×1)	B	Auto-discharge

Pin Configuration



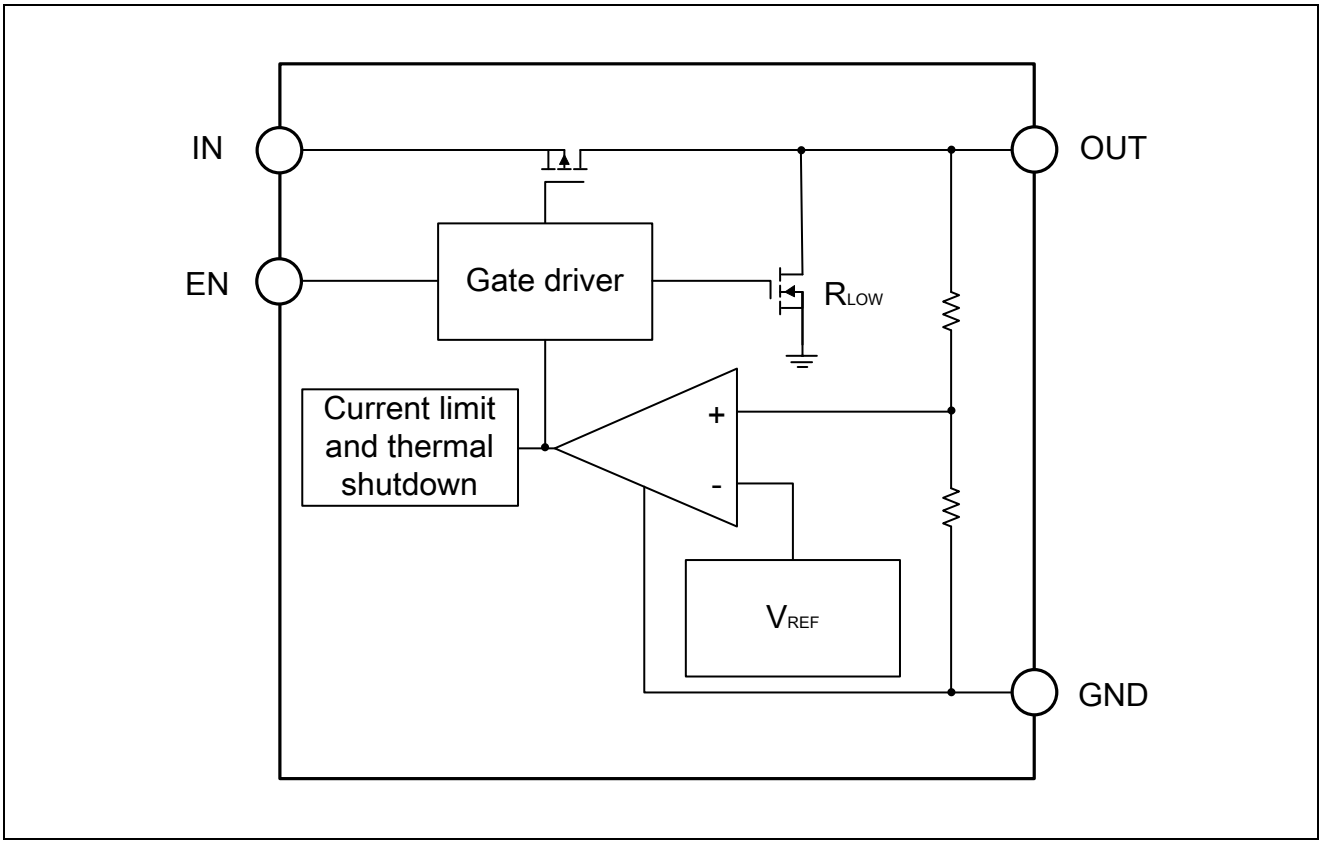
Pin Function

Pin NO	Symbol	Pin Description
1	OUT	Output Pin
2	GND	Power Supply Ground
3	EN	Chip Enable Pin (Active “H”)
4	IN	Power Supply Input Voltage
-	Thermal Pad	Connect to GND. Do not connect to any potential other than GND

Mark Specification

Part No.	Marking	VOUT	Auto Discharge Function
ET55310YB	XT	1.0V	Y
ET55311YB	XI	1.1V	Y
ET55312YB	XA	1.2V	Y
ET55313YB	XL	1.3V	Y
ET55315YB	XB	1.5V	Y
ET55316YB	XN	1.6V	Y
ET55317YB	XJ	1.7V	Y
ET55318YB	XC	1.8V	Y
ET55320YB	X2	2.0V	Y
ET55325YB	XF	2.5V	Y
ET55327YB	XP	2.7V	Y
ET55328YB	XD	2.8V	Y
ET55329YB	XS	2.9V	Y
ET55330YB	XG	3.0V	Y
ET55333YB	XE	3.3V	Y
ET55336YB	XR	3.6V	Y

Block Diagram



Functional Description

Input Capacitor

A 2.2μF capacitor is recommended to connect between 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 IN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is 2.2μF, ceramic capacitor is recommended, 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.

EN Pin Operation

The ET553XXYB is turned on by setting the EN pin to “H”. Since the EN pin is neither pulled down or float, The ET553XXYB is closed.

Current Limit Protection

When output current of OUT pin is higher than current limit threshold or the OUT pin is direct short to GND, the current limit protection will be triggered and clamp the output current at a predesigned level to prevent over-current and thermal damage.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +155°C, allowing to cool down. When the junction temperature reduce to approximately +125°C the output circuit 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.

Auto Discharging

When the EN pin set to “L”, the output circuit will be disable immediately, and the Auto-Discharging circuit will be turned on to discharge the electric charge on output capacitor, and decrease the voltage of OUT in very short time. The Auto-Discharging function is optional.

Absolute Maximum Ratings

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage (IN Pin)	-0.3 to 6.0	V
V_{EN}	Input Voltage (EN Pin)	-0.3 to 6.0	V
V_{OUT}	Output Voltage (OUT Pin)	-0.3 to 6.0	V
T_J	Junction Temperature Range	-40 to +150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
V_{ESD}	HBM (ESDA/JEDEC JS-001-2017)	±4.0	KV
	CDM (ESDA/JEDEC JS-002-2014)	±1.5	KV
I_{LU}	Latch up Current Maximum Rating (JESD78E)	±200	mA

Thermal Characteristics

Symbol	Ratings	Value	Unit
$R_{\theta JA}$	Thermal Resistance, Junction-to-Air	208	°C/W
P_{DMAX}	Power Dissipation	600	mW

Recommended Operating Conditions

Symbol	Parameters	Min	Max	Unit
V_{IN}	Input Voltage	1.9	5.5	V
I_{OUT}	Output Current	0	500	mA
T_A	Operating Ambient Temperature	−40	85	°C
C_{IN}	Input Ceramic Capacitor Value	0.47	4.7	uF
C_{OUT}	Output Ceramic Capacitor Value	0.47	4.7	uF
ESR	Input and Output Capacitor Equivalent Series Resistance	5	100	mΩ

Electrical Characteristics

V_{IN} = V_{OUT} + 1.0V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 2.2μF, (unless otherwise noted). T_A = 25°C.

Symbol	Item	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage[1]		1.9		5.5	V
V_{OUT}	Output Voltage		×0.98		×1.02	V
V_{DROP}	Dropout Voltage[2]	1.0V ≤ V_{OUT} < 1.6V, I_{OUT} = 0.5A, V_{OUT} dropping to 0.98×V_{OUT}			900	mV
		1.7V ≤ V_{OUT} < 2.6V, I_{OUT} = 0.5A, V_{OUT} dropping to 0.98×V_{OUT}		350	500	mV
		2.6 ≤ V_{OUT} < 3.6V, I_{OUT} = 0.5A, V_{OUT} dropping to 0.98×V_{OUT}		260	400	mV
I_{Q_ON}	Supply Current	I_{OUT} = 0mA		50	85	μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V		0.01	1	μA
Reg_{LINE}	Line Regulation	V_{OUT} + 0.5V ≤ V_{IN} ≤ 5.5V (V_{IN} ≥ 1.4V)		0.02		%/V
Reg_{LOAD}	Load Regulation	V_{IN} = V_{OUT} + 1V, 1mA ≤ I_{OUT} ≤ 0.5A		20	50	mV
PSRR	Power Supply Rejection Ratio[3]	f = 1kHz, Ripple 0.2Vp-p, V_{IN} = V_{OUT} + 1.0V, I_{OUT} = 30mA		80		dB
e_N	Output Noise Voltage[3]	I_{OUT}= 1mA, f=10Hz to 100KHz		20* V_{OUT}		μV_{RMS}
I_{LIMIT}	Output Current Limit	V_{IN} = V_{OUT}+1V		700	1200	mA
I_{SC}	Short Current Limit	V_{OUT} = 0V		150	240	mA
R_{PD}	EN Pull-down Resistance			1M		Ω
V_{IH}	EN Input Voltage High		0.90			V
V_{IL}	EN Input Voltage Low				0.40	V
R_{DIS}	Auto-discharge Resistance	V_{IN} = 4V, V_{EN} = 0V		80		Ω
T_{SD}	Thermal Shutdown Temperature[3]			155		°C
T_{SR}	Thermal Shutdown Released Temperature[3]			130		°C

Notes:

1: The maximum input voltage should take into account the maximum power consumption ($P_{D(MAX)}$).The calculation formula is as follows:

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT}) \times I_{OUT}$$

The maximum power consumption of the DFN4 is 600mW.

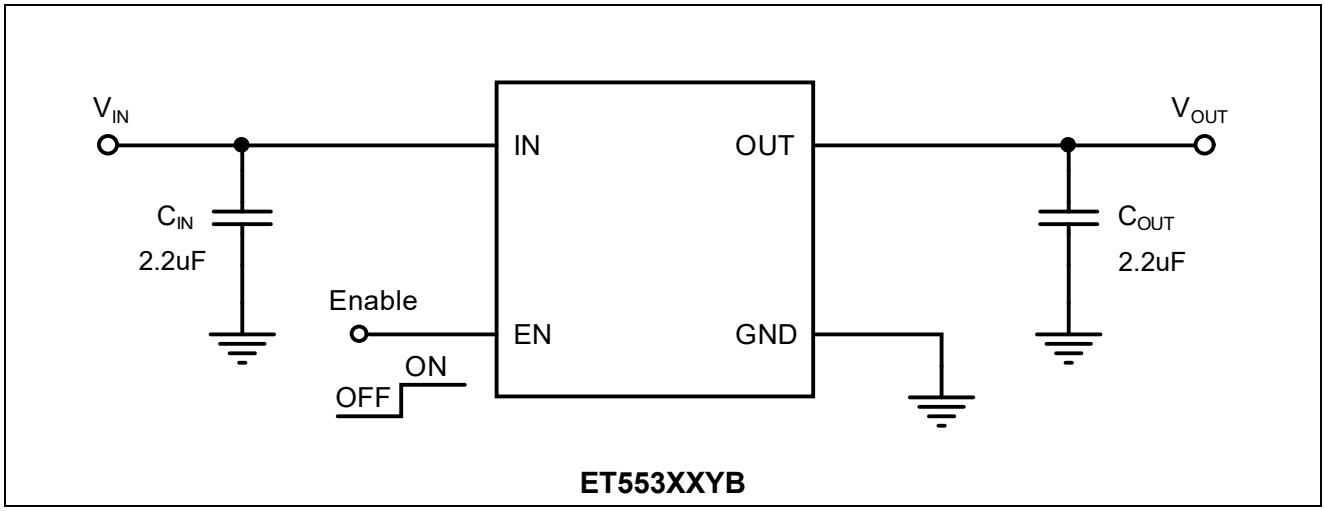
$$V_{IN(MAX)} = 600mW / I_{OUT} + V_{OUT}$$

For example:If V_{OUT}= 1.0V, I_{OUT}=500mA, The maximum input voltage is $V_{IN(MAX)}$=600mW / 500mA+1.0=2.2V

2: V_{DROP} FT test method: test the V_{OUT} voltage at V_{OUT} +$V_{DROPMAX}$ with output current.

3: Guaranteed by design and characterization, not a FT item.

Application Circuits



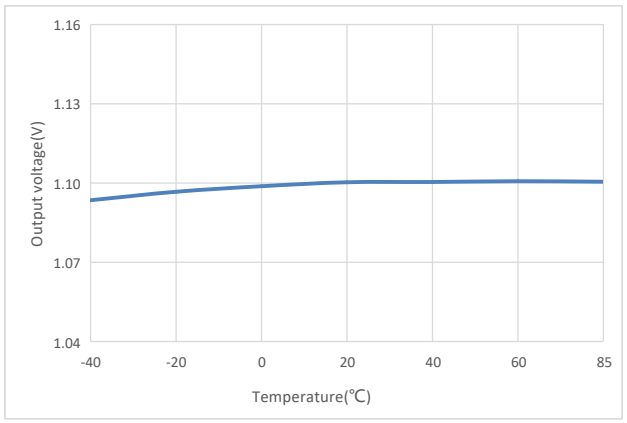
ET553XXYB

***:** The C_{IN} and C_{OUT} capacitance value is for reference only

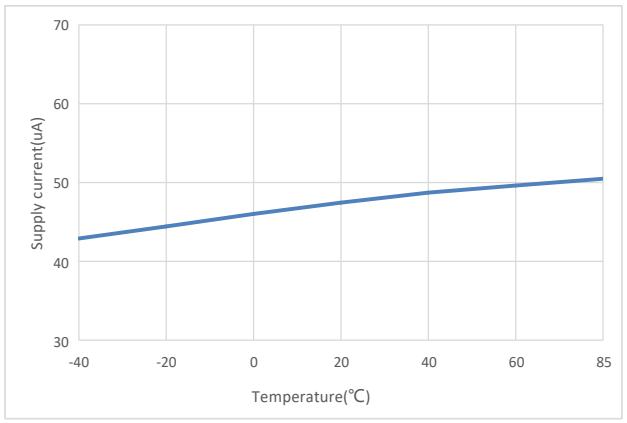
Typical Characteristics

(1) VOLTAGE VERSION 1.1V

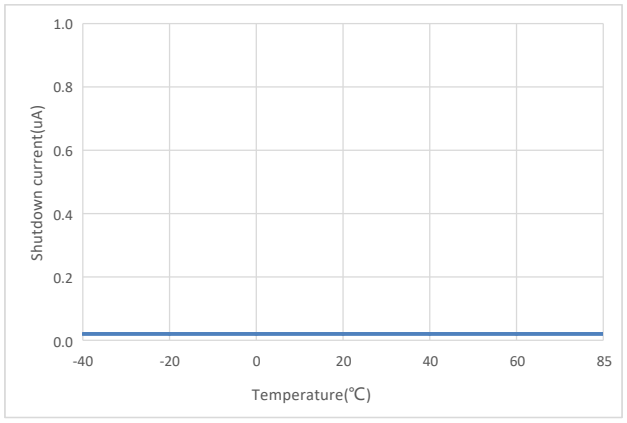
$V_{IN} = V_{SET} + 1.0V$, $I_{OUT} = 1mA$, $C_{IN} = C_{OUT} = 2.2\mu F$, (unless otherwise noted). $T_A = 25°C$.



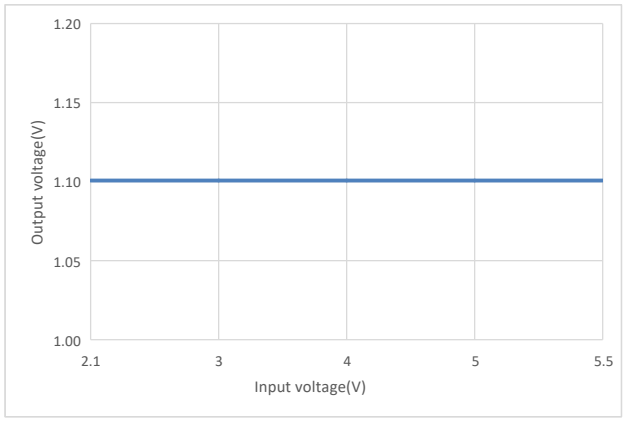
Output Voltage VS Temperature



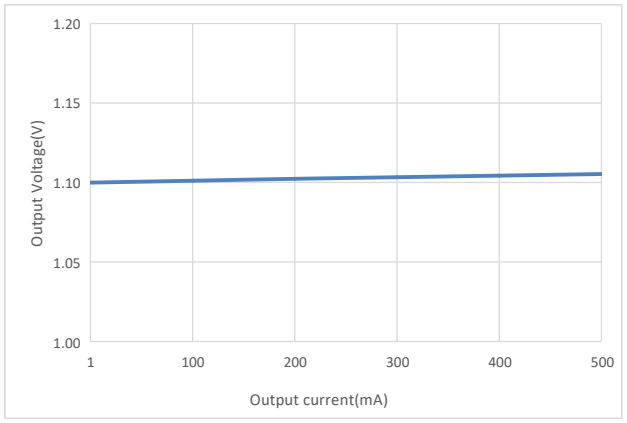
Supply Current VS Temperature



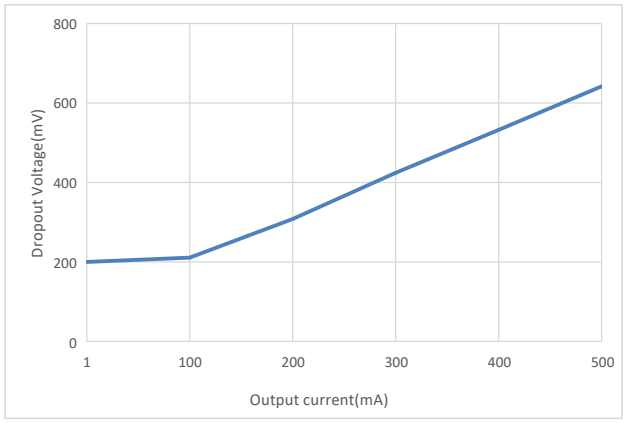
Shutdown Current VS Temperature



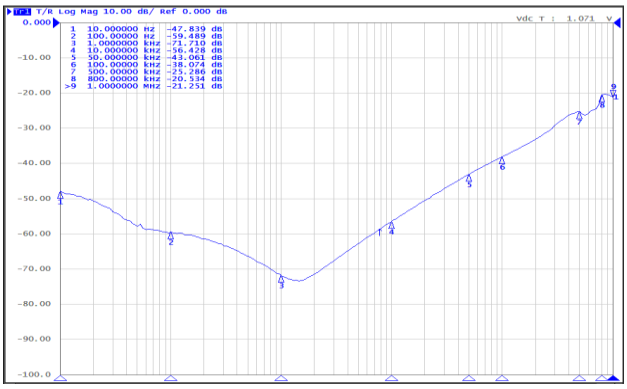
Output Voltage VS Input Voltage



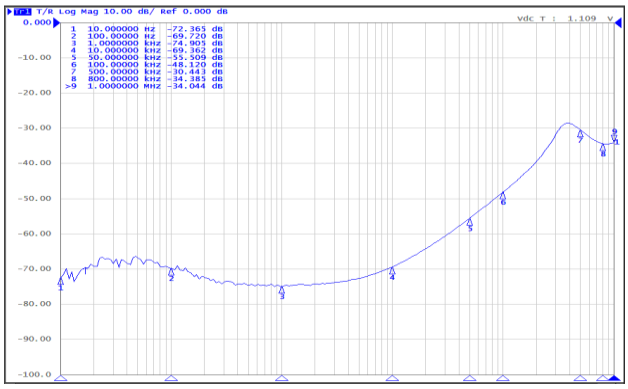
Output Voltage VS Output Current



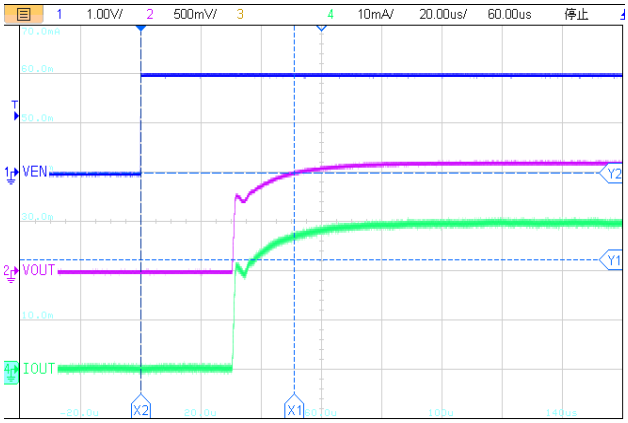
Dropout Voltage VS Output Current



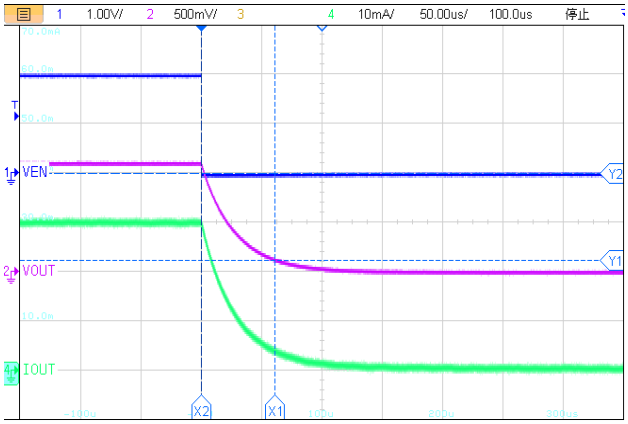
PSRR Test(I_{OUT}=30mA)



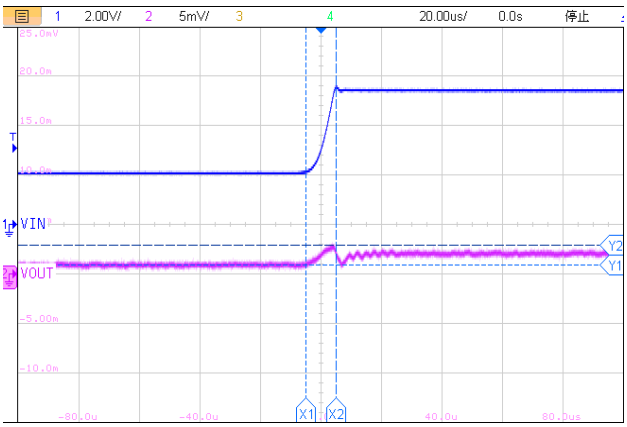
PSRR Test(I_{OUT}=0.5A)



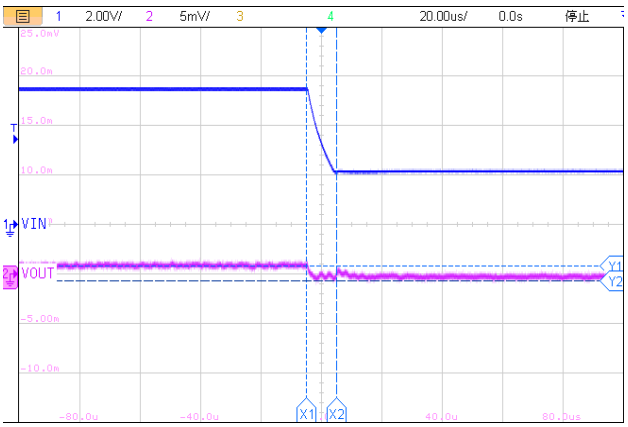
t $_{ON}$=51us(I_{OUT}=30mA)



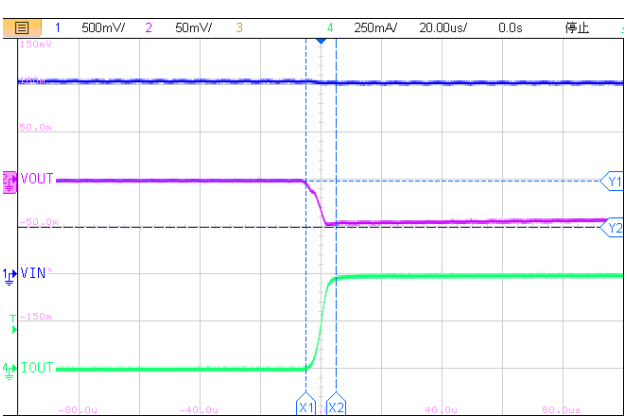
t $_{OFF}$=61us(I_{OUT}=30mA)



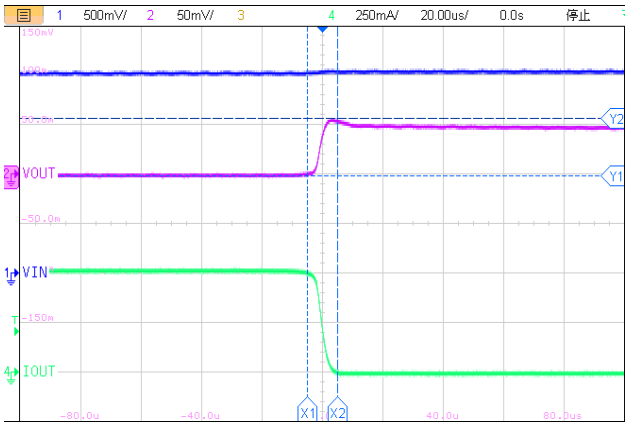
Line transient(2.1~5.5V t=10us ΔV=2mV)



Line transient(5.5~2.1V t=10us ΔV=1.5mV)



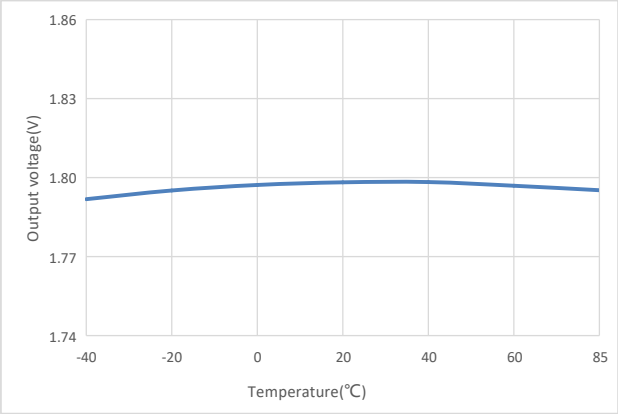
Load transient(1mA~0.5A t=10us ΔV=48.75mV)



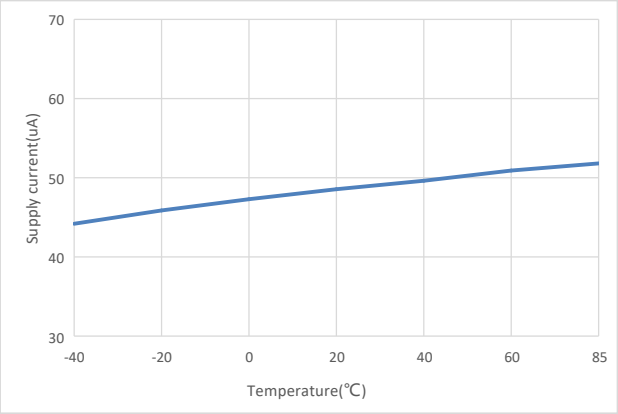
Load transient(0.5A~1mA t=10us ΔV=57.5mV)

(2) VOLTAGE VERSION 1.8V

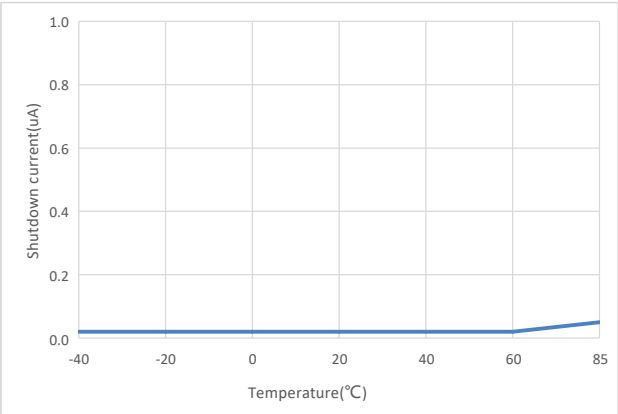
V_{IN} = V_{SET} + 1.0V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 2.2μF, (unless otherwise noted). T_A = 25°C.



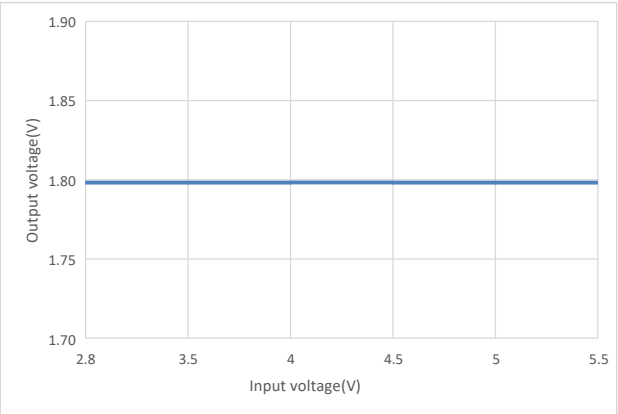
Output Voltage VS Temperature



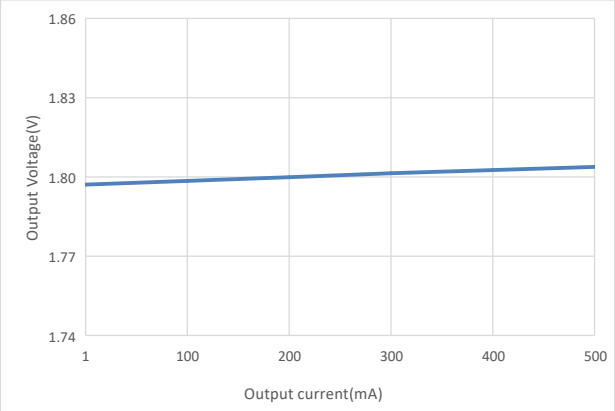
Supply Current VS Temperature



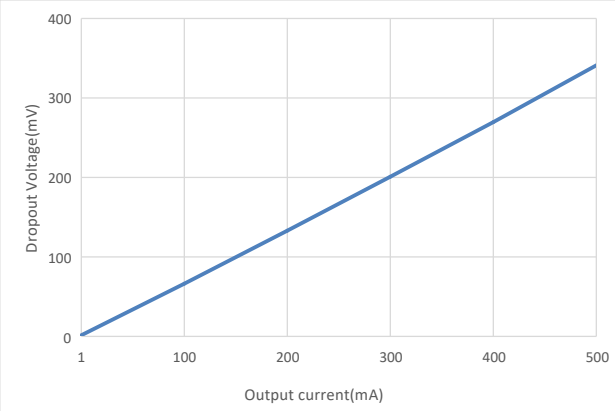
Shutdown Current VS Temperature



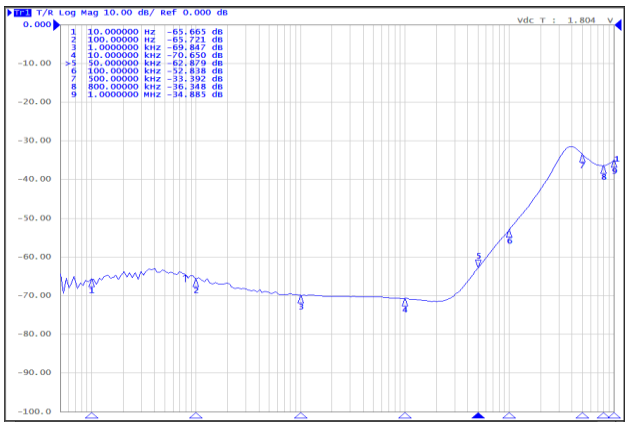
Output Voltage VS Input Voltage



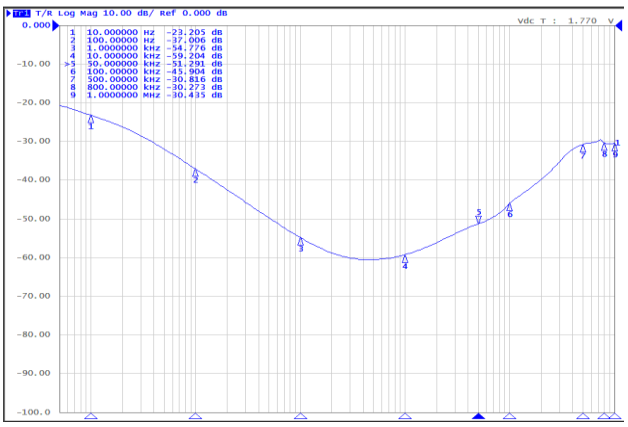
Output Voltage VS Output Current



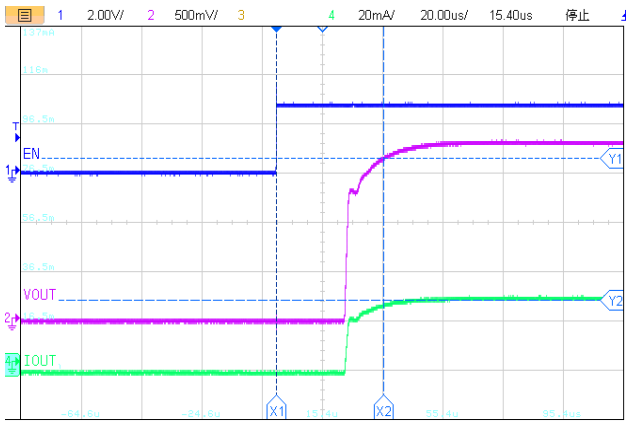
Dropout Voltage VS Output Current



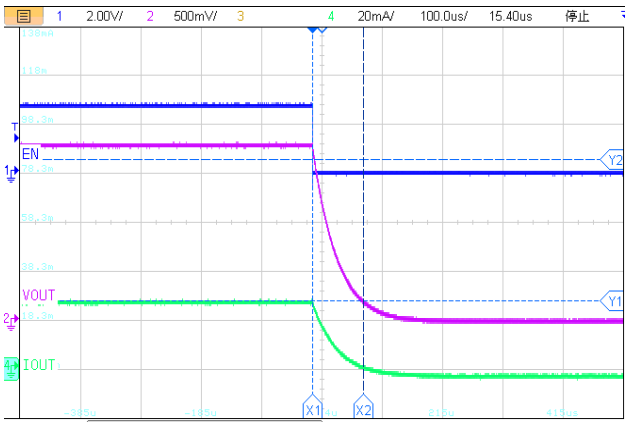
PSRR Test(I_{OUT}=30mA)



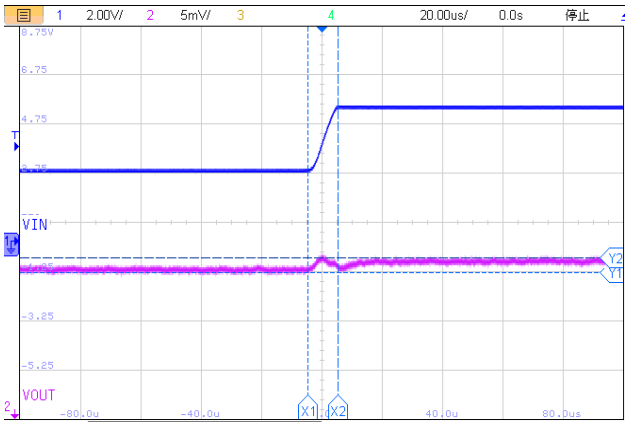
PSRR Test(I_{OUT}=0.5A)



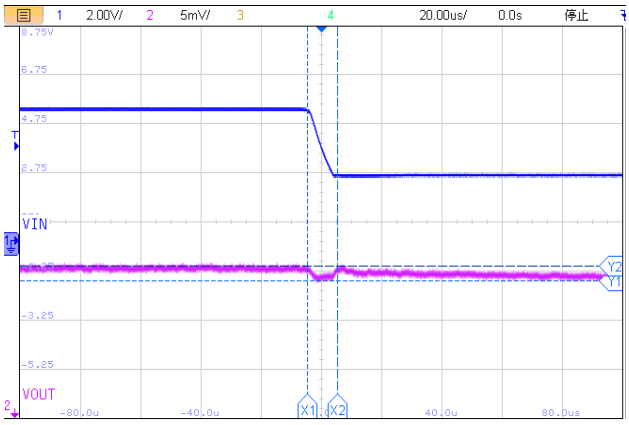
t_{ON}=35.8us(I_{OUT}=30mA)



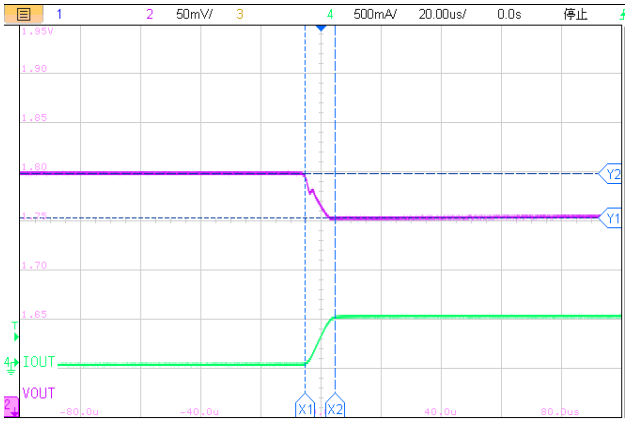
t_{OFF}=84us(I_{OUT}=30mA)



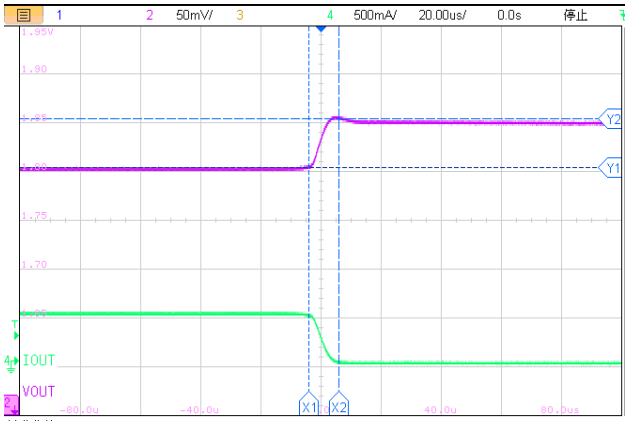
Line transient(2.8~5.5V t=10us ΔV=1.5mV)



Line transient(5.5~2.8V t=10us ΔV=1.5mV)



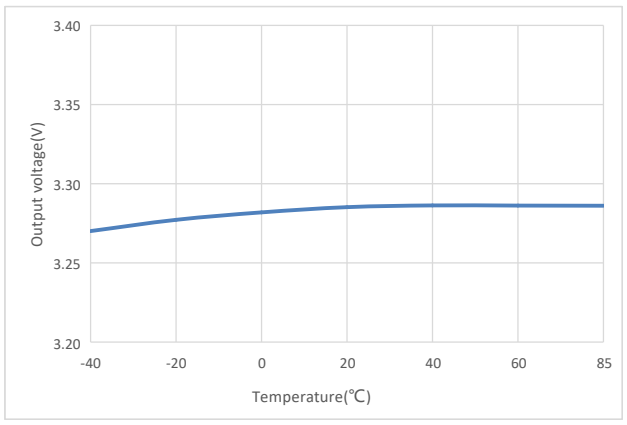
Load transient(1mA~0.5A t=10us ΔV=45mV)



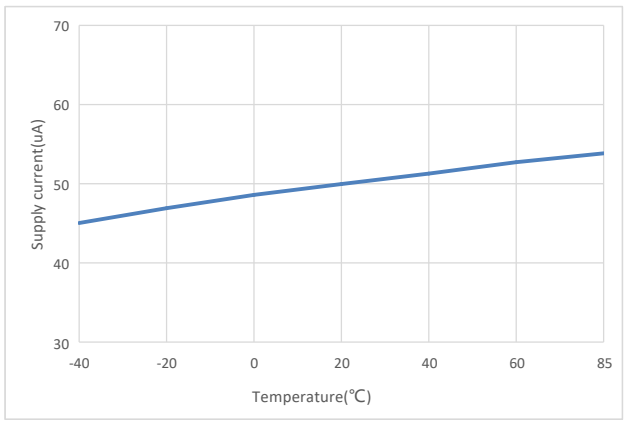
Load transient(0.5A~1mA t=10us ΔV=50mV)

(3)VOLTAGE VERSION 3.3V

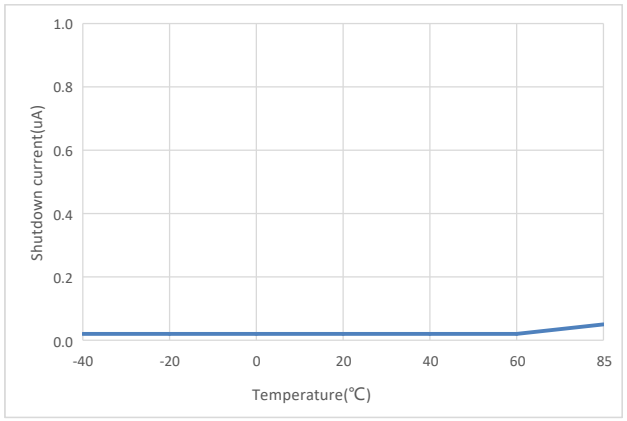
V_{IN} = V_{SET} + 1.0V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 2.2μF, (unless otherwise noted). T_A = 25°C.



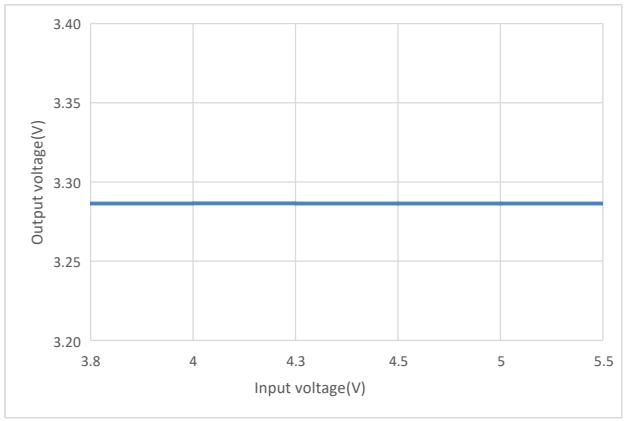
Output Voltage VS Temperature



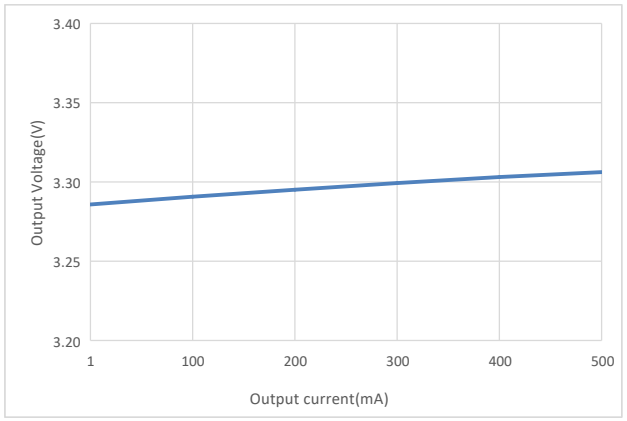
Supply Current VS Temperature



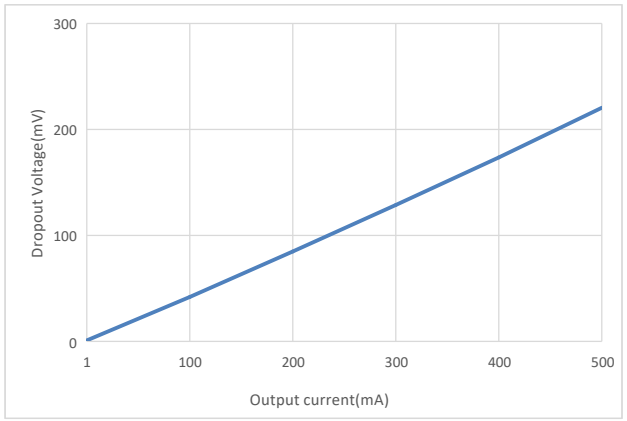
Shutdown Current VS Temperature



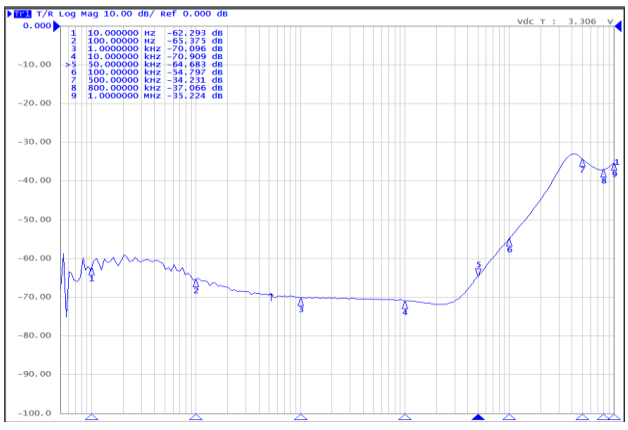
Output Voltage VS Input Voltage



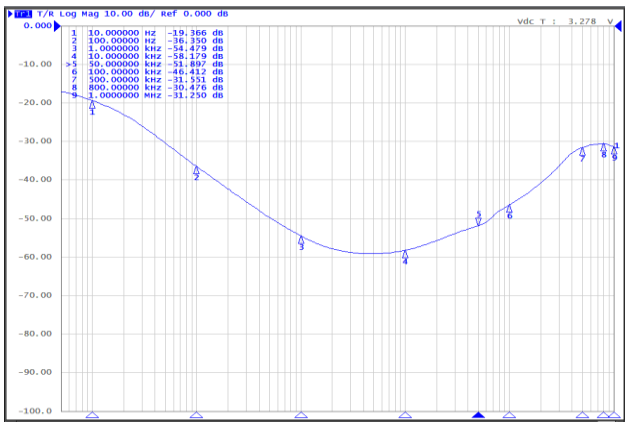
Output Voltage VS Output Current



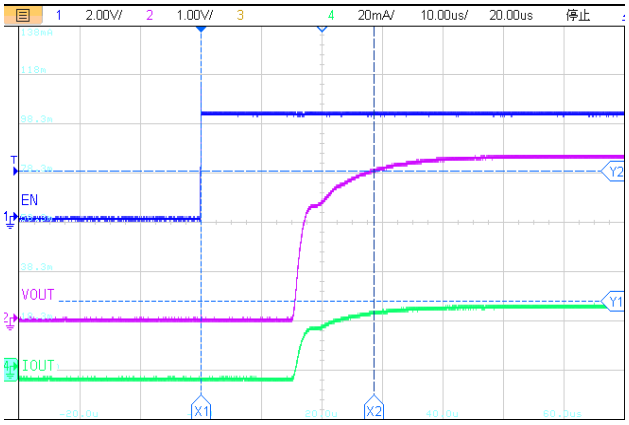
Dropout Voltage VS Output Current



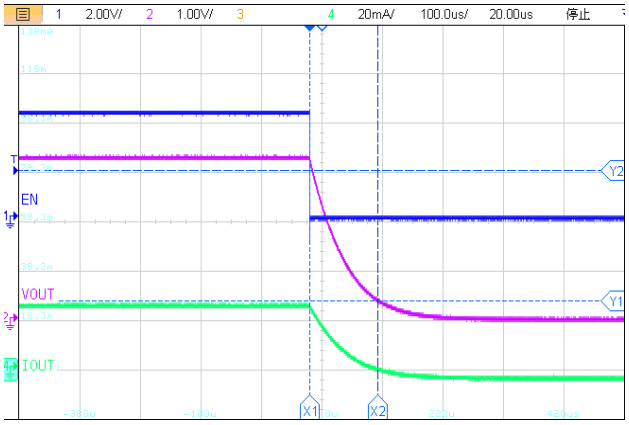
PSRR Test(I_{OUT}=30mA)



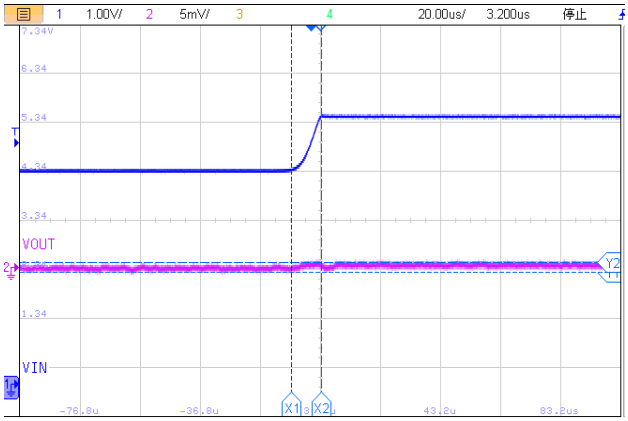
PSRR Test(I_{OUT}=0.5A)



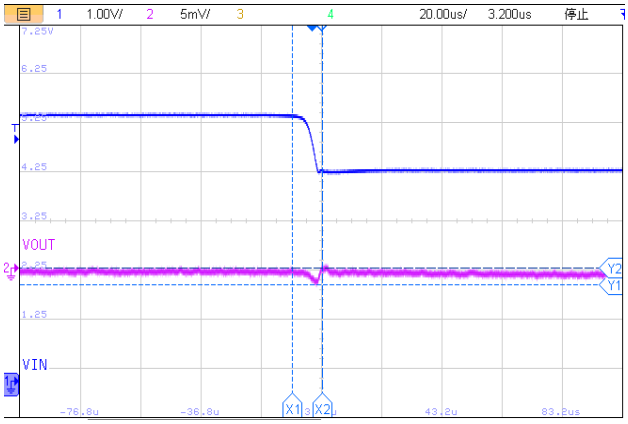
t ON=28.6us(IOUT=30mA)



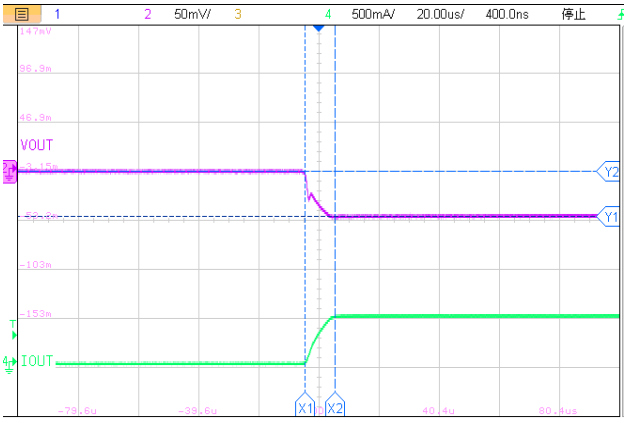
t OFF=112us(IOUT=30mA)



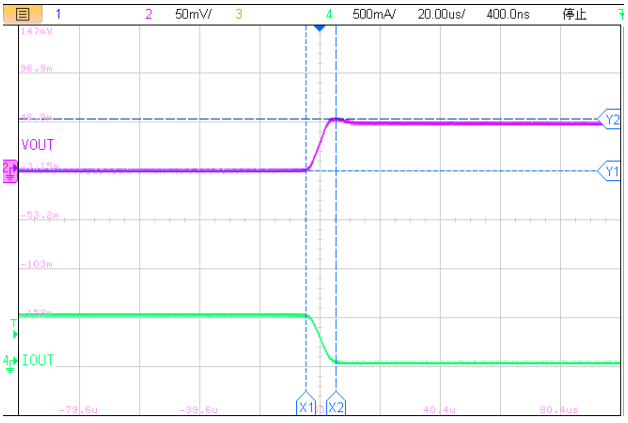
Line transient(4.3~5.5V t=10us ΔV=1.0mV)



Line transient(5.5~4.3V t=10us ΔV=1.7mV)



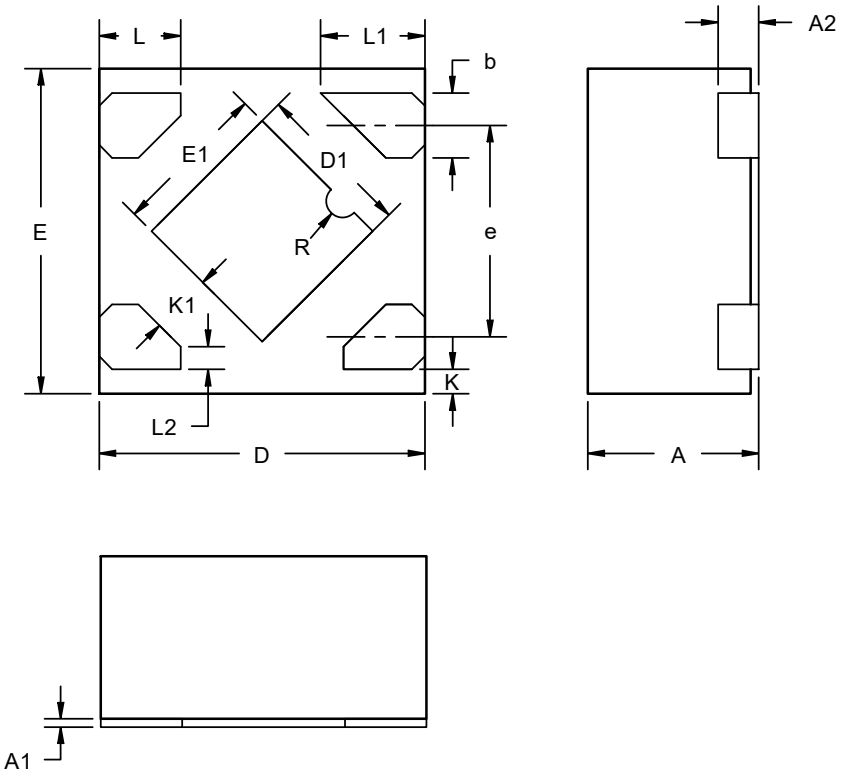
Load transient(1mA~0.5A t=10us ΔV=46.25mV)



Load transient(0.5A~1mA t=10us ΔV=52.5mV)

Package Dimension

DFN4 (1mm × 1mm)

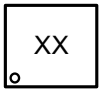


Dimensions Table (Units: mm)

SYMBOL	MIN	NOM	MAX
A	0.34	0.37	0.40
A1	0.00	0.02	0.05
A3		0.100REF	
b	0.20	0.25	0.30
D	0.95	1.00	1.05
E	0.95	1.00	1.05
D2	0.38	0.43	0.48
E2	0.38	0.43	0.48
e	0.60	0.65	0.70
K		0.05REF	
K1	0.195	-	-
L	0.20	0.25	0.30
L1	0.27	0.32	0.37
L2		0.07REF	
R		0.049REF	

Marking

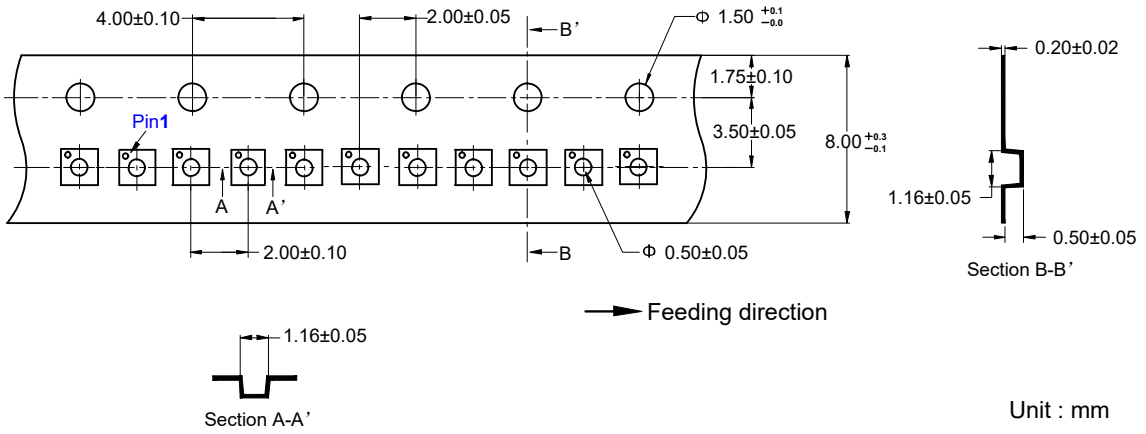
DFN4 Package



$X^{(1)}$ = Track Number

$X^{(2)}$ = V_{OUT} Version

Tape Information



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2022-8-11	Preliminary Version	Liuxm	Liuxm	Liujy
1.0	2023-02-15	Official Version	Tugz	Liuxm	Liujy