ET553XX - 500mA Low Dropout LDO

General Description

The ET553XX 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 ET553XX 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 ET553XX 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. ET553XX 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 or externally set)
- 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: DFN4 (1×1), DFN4 (1.2×1.2), SOT23-5，SOT89-5

Applications

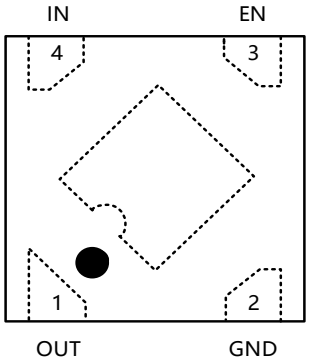
- Constant-voltage power supply for battery-powered device
- Constant-voltage power supply for TV, notebook PC and home electric appliance
- Constant-voltage power supply for portable equipment

Device Information

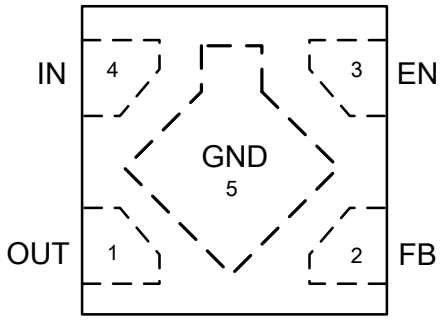
ET 553 XX/ADJ X B

XX/ADJ Output Voltage	**Y** Package		**B** Auto-Discharging Function	**MSL**
XX - Fixed X.XV **ADJ** - Adjustable by resistive divider	**Y**	DFN4(1X1)	**B** - Available	1
	Y(ADJ)	DFN4(1.2X1.2)		1
	T	SOT89-5		3
	/	SOT23-5		3

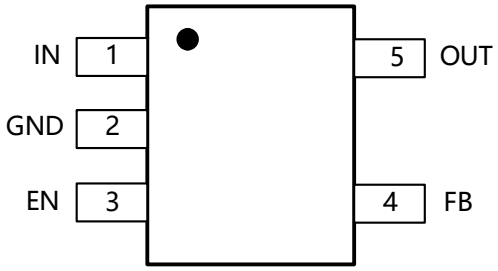
Pin Configuration



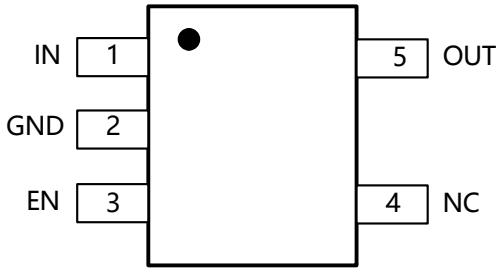
DFN4(1X1) (Fixed version**)**



DFN4(1.2X1.2) (ADJ version**)**

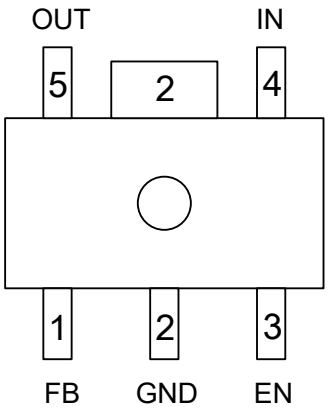


ET553ADJ (ADJ version)



ET553XX (Fixed version)

SOT23-5



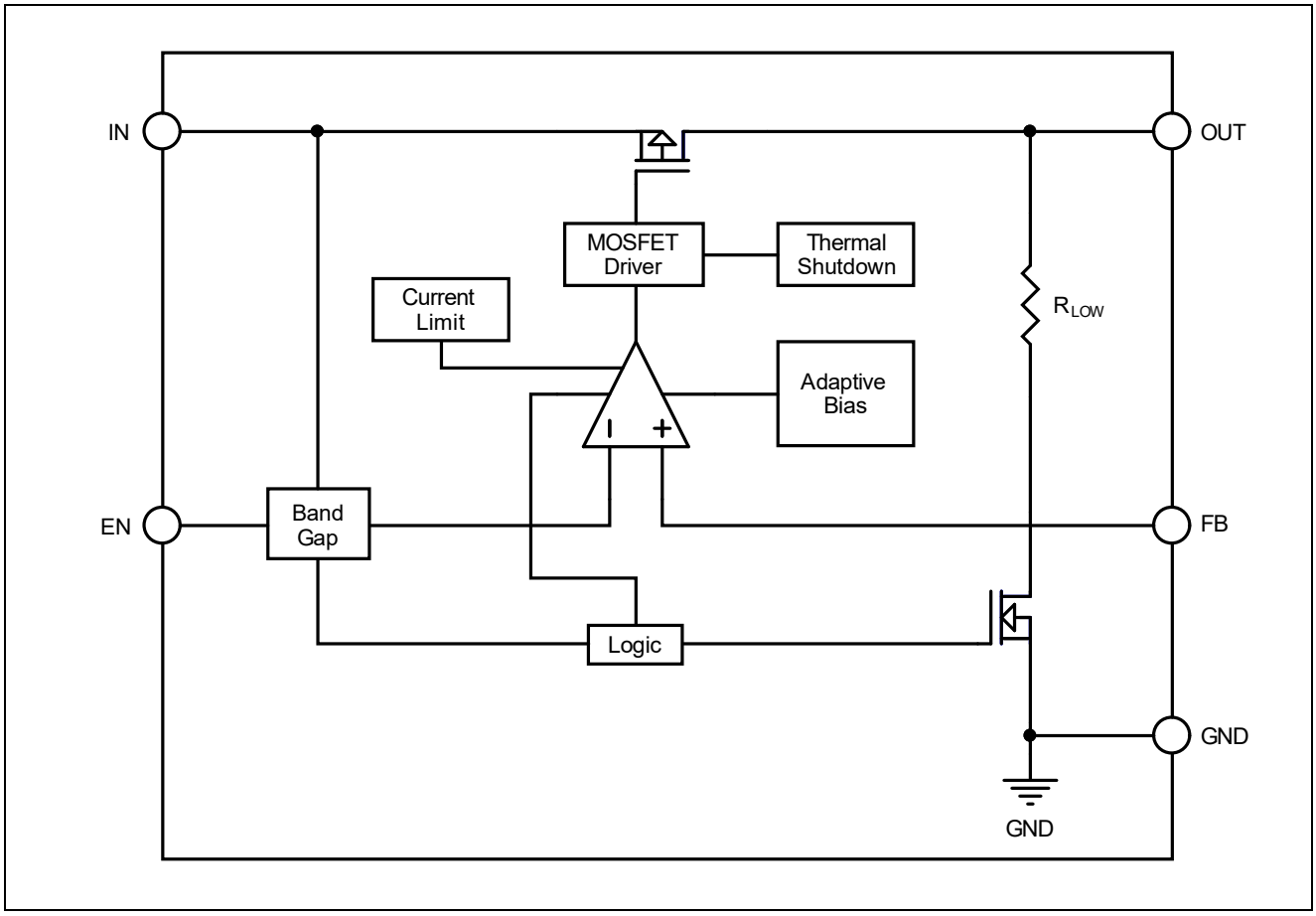
SOT89-5 (ADJ version**)**

TOP VIEW

Pin Function

Pin No.				Pin Name	Pin Function
DFN4(1×1)	DFN4(1.2×1.2)	SOT23-5	SOT89-5		
2	5	2	2	GND	Ground
4	4	1	4	IN	Supply input pin
1	1	5	5	OUT	Output pin
3	3	3	3	EN	Enable control input, active high
/	2	4 (NC)	1	FB	Set the output voltage

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 ET553XX is turned on by setting the EN pin to “H”. Since the EN pin is neither pulled down or float, The ET553XX is closed.

Current Limit Protection

When output current of VOUT pin is higher than current limit threshold or the VOUT 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 +130°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 VOUT in very short time. The Auto-Discharging function is optional.

Output Voltage

The output voltage is adjustable using external 2 resistors. For better performance of the circuit, the R2 value need to be between 100kΩ and 1MΩ. The output voltage is calculated by:

$$\mathbf{VOUT = (1+R1/R2)\times 0.8\ (V)}$$

Absolute Maximum Ratings

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage (IN Pin)	6.0	V
V_{EN}	Input Voltage (EN Pin)	-0.3 to 6.0	V
V_{FB}	Input Voltage (FB 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	Package	Ratings	Value	Unit
$R_{\theta JA}$	DFN4(1×1)	Thermal Characteristics, Thermal Resistance, Junction-to-Air	250	°C/W
	DFN4(1.2×1.2)		180	°C/W
	SOT23-5		250	°C/W
	SOT89-5		70	°C/W

Electrical Characteristics

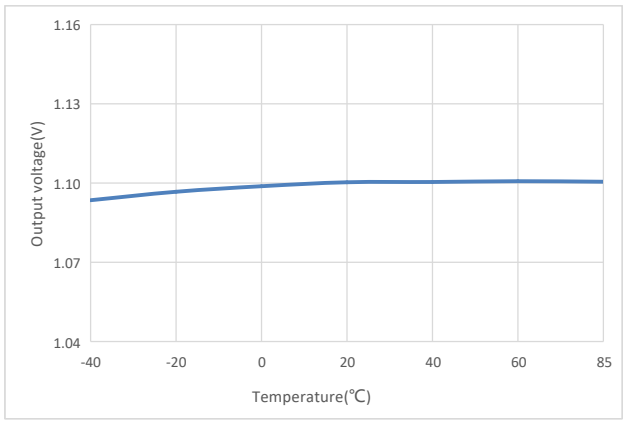
$V_{IN} = V_{SET} + 1.0V$, $I_{OUT} = 1mA$, $C_{IN} = C_{OUT} = 2.2\mu F$, (unless otherwise noted). $T_A = 25°C$.

Symbol	Item	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage		1.9		5.5	V
V_{OUT}	Output Voltage		×0.98		×1.02	V
V_{FB}	FB Voltage	$T_A = 25°C$	0.784	0.800	0.818	V
		$T_A = -40°C \sim 85°C$	0.776	0.800	0.824	V
ΔV_{OUT} /ΔI_{OUT}	Load Regulation	$V_{IN} = V_{SET} + 1V$, $1mA \le I_{OUT} \le 0.5A$		20	50	mV
V_{DIF}	Dropout Voltage	$1.0V \le V_{SET} < 1.6V$, $I_{OUT} = 0.5A$, V_{OUT} dropping to $0.98 \times V_{SET}$			900	mV
		$1.7V \le V_{SET} < 2.6V$, $I_{OUT} = 0.5A$, V_{OUT} dropping to $0.98 \times V_{SET}$		350	500	mV
		$2.6 \le V_{SET} < 3.6V$, $I_{OUT} = 0.5A$, V_{OUT} dropping to $0.98 \times V_{SET}$		260	400	mV
I_{SS}	Supply Current	$I_{OUT} = 0mA$		50	85	μA
$I_{Standby}$	Standby Current	$V_{EN} = 0V$		0	1	μA
ΔV_{OUT} /ΔV_{IN}	Line Regulation	$V_{SET} + 0.5V \le V_{IN} \le 5.5V$ ($V_{IN} \ge 1.4V$)		0.02		%/V
PSRR	Power Supply Rejection Ratio	f = 1kHz, Ripple 0.2Vp-p, $V_{IN} = V_{SET} + 1.0V$, $I_{OUT} = 30mA$		80		dB
I_{LIM}	Output Current Limit	$V_{IN} = V_{SET}+1V$		700	1200	mA
I_{Short}	Short Current Limit	$V_{OUT} = 0V$		150	240	mA
R_{PD}	EN Pull-down Resistance			1M		Ω
V_{IH}	EN Input Voltage High		0.9			V
V_{IL}	EN Input Voltage Low				0.40	V
R_{DIS}	Auto-discharge Resistance	$V_{IN} = 4V$, $V_{EN} = 0V$		80		Ω
T_{TSD}	Thermal Shutdown Temperature			155		°C
T_{TSR}	Thermal Shutdown Released Temperature			130		°C

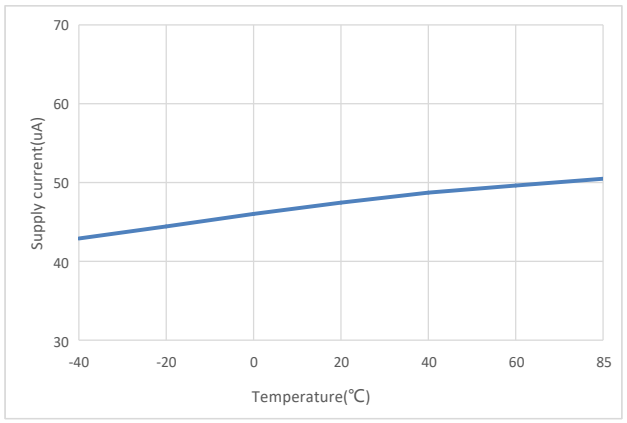
Typical Characteristics

(1) VOLTAGE VERSION 1.1V

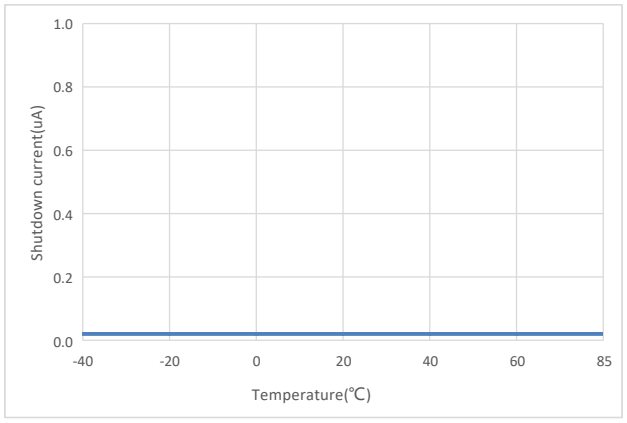
$V_{IN} = V_{SET} + 1.0V$, $I_{OUT} = 1mA$, $C_{IN} = C_{OUT} = 2.2\mu F$, (unless otherwise noted). $T_A = 25°C$.



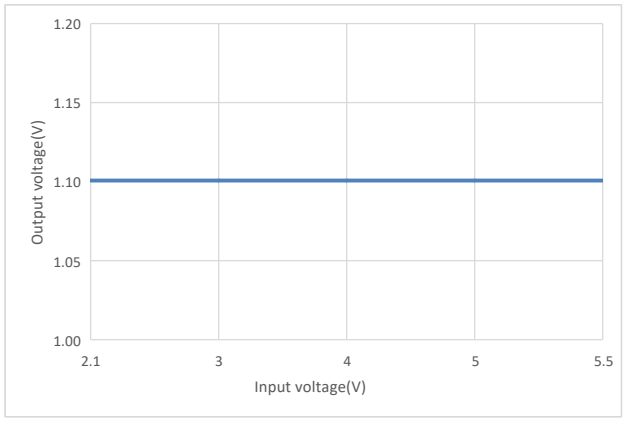
Output Voltage VS Temperature



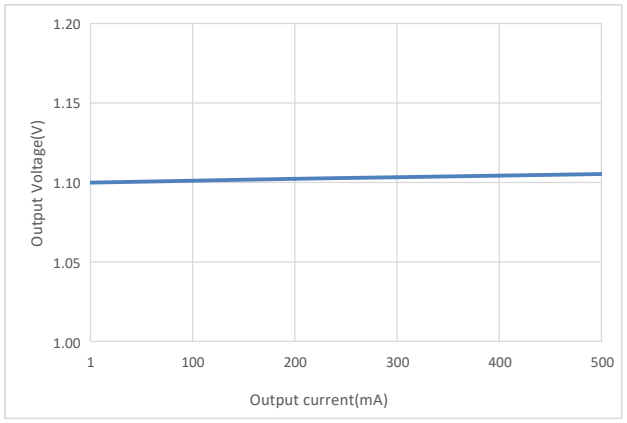
Supply Current VS Temperature



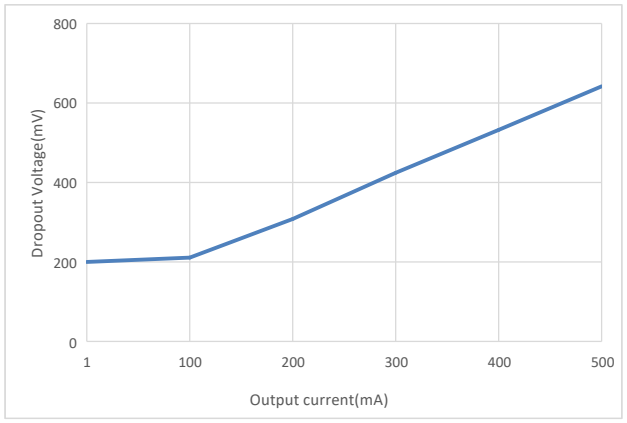
Shutdown Current VS Temperature



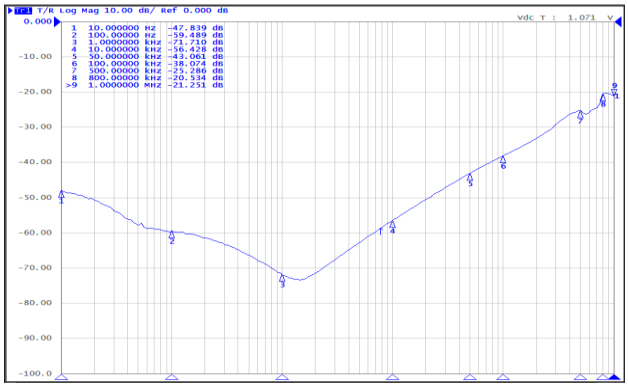
Output Voltage VS Input Voltage



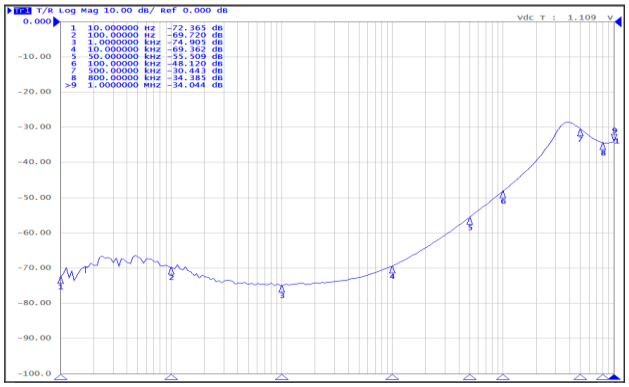
Output Voltage VS Output Current



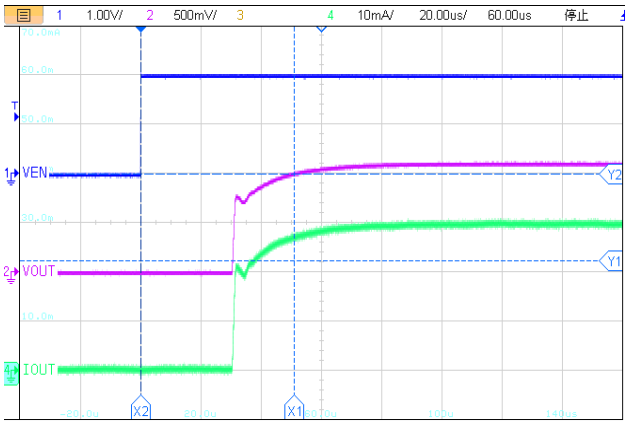
Dropout Voltage VS Output Current



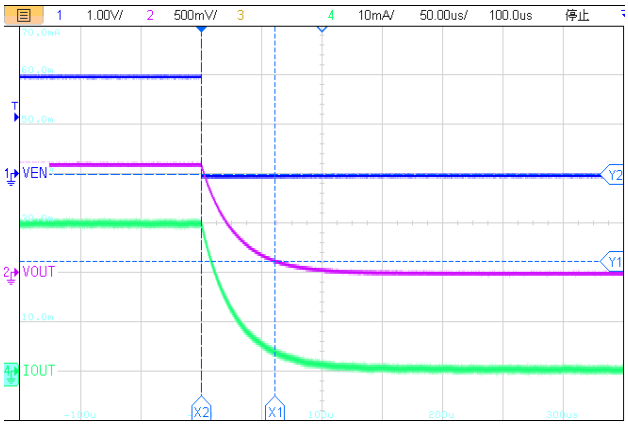
PSRR Test(I_{OUT}=30mA)



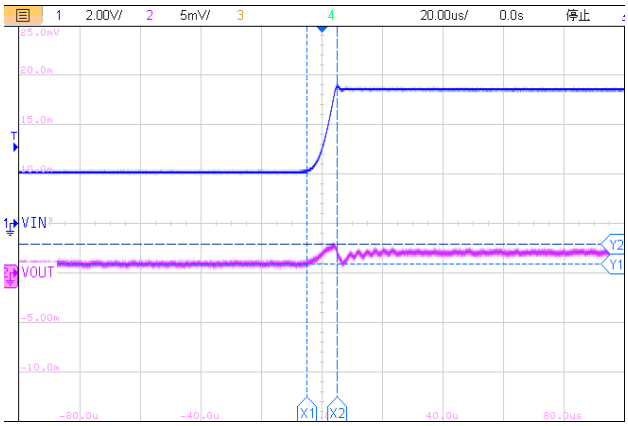
PSRR Test(I_{OUT}=0.5A)



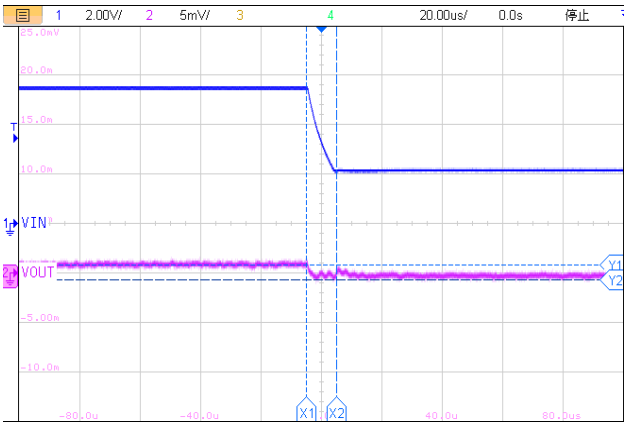
t_{ON}=51us(I_{OUT}=30mA)



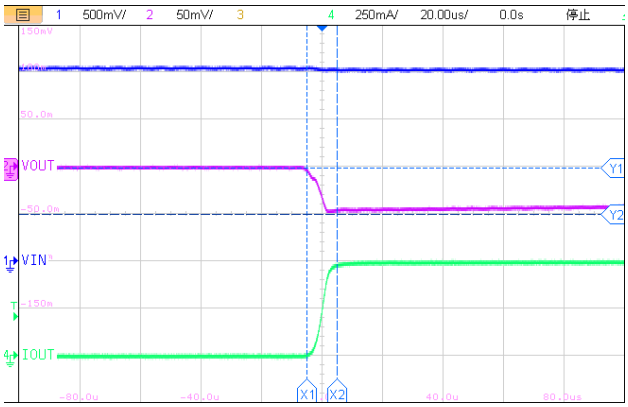
t_{OFF}=61us(I_{OUT}=30mA)



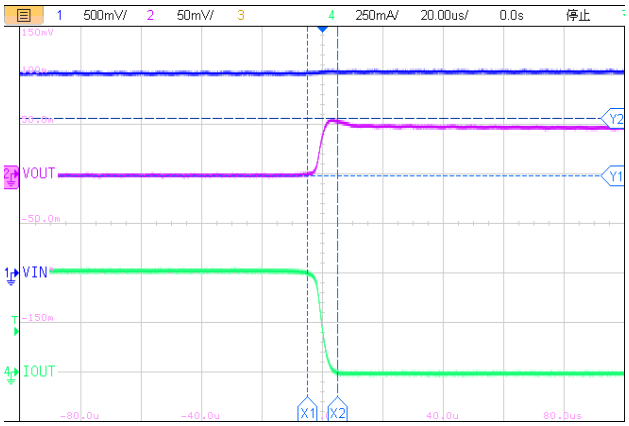
Line transient(2.1~5.5V t=10us ΔV=2mV)



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



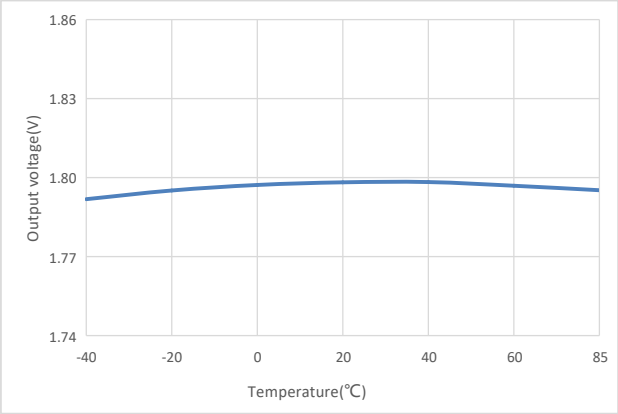
Load transient(1mA~0.5A t=10us ΔV=48.75mV)



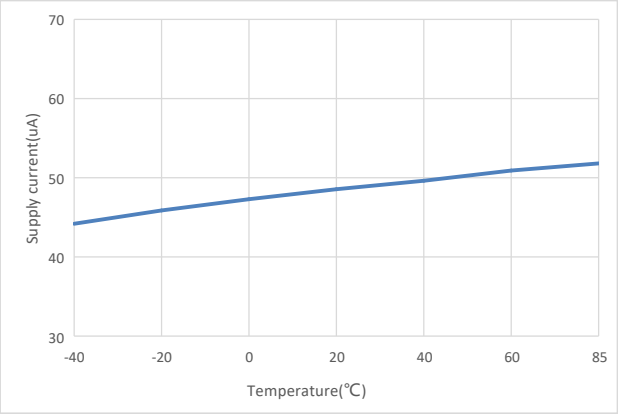
Load transient(0.5A~1mA t=10us ΔV=57.5mV)

(2) VOLTAGE VERSION 1.8V

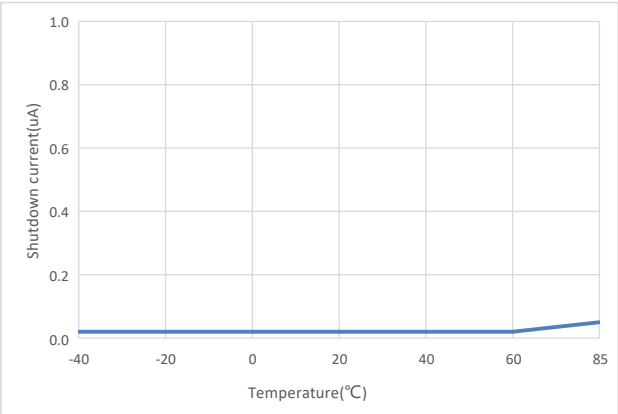
V_{IN} = V_{SET} + 1.0V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 2.2μF, (unless otherwise noted). T_A = 25°C.



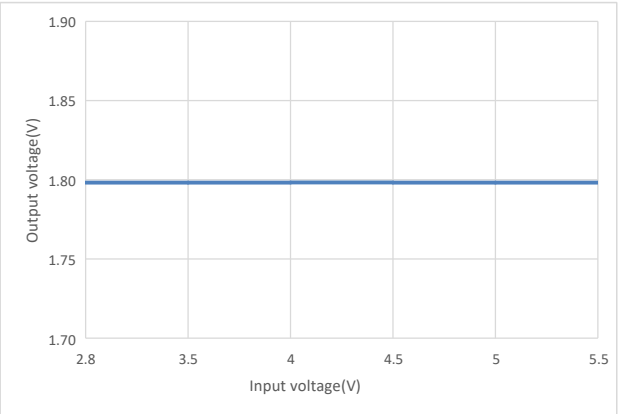
Output Voltage VS Temperature



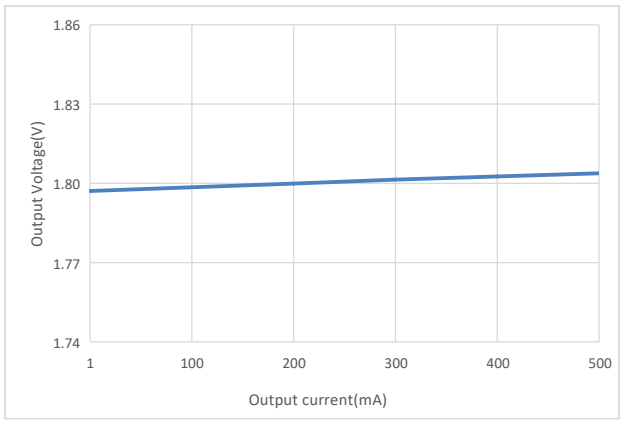
Supply Current VS Temperature



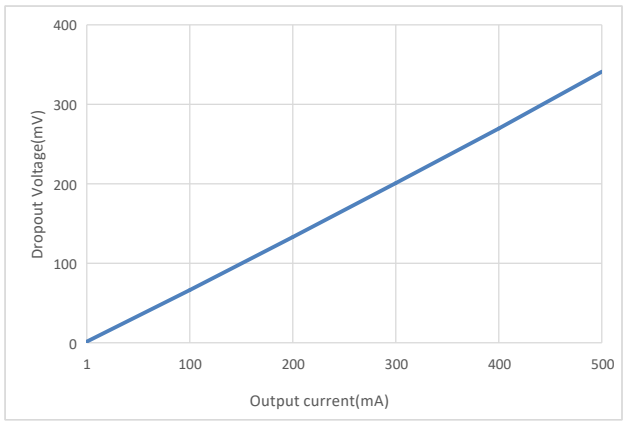
Shutdown Current VS Temperature



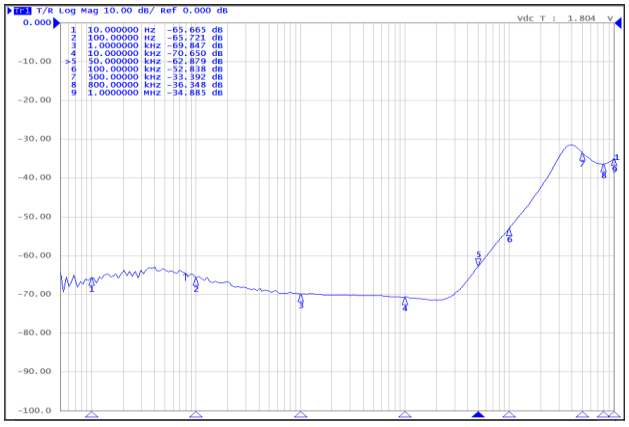
Output Voltage VS Input Voltage



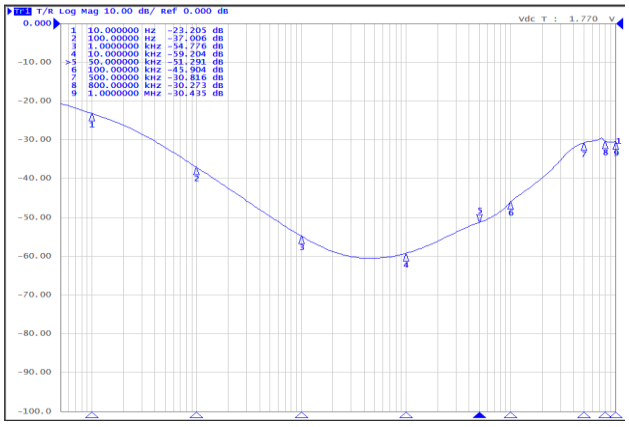
Output Voltage VS Output Current



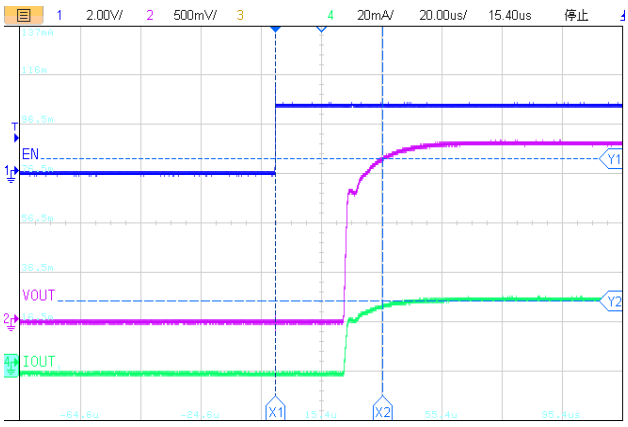
Dropout Voltage VS Output Current



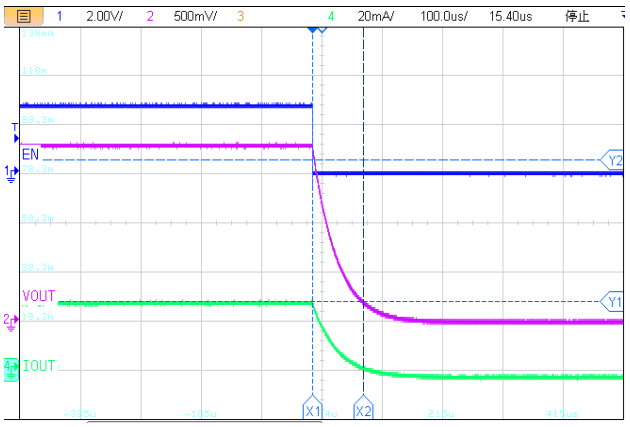
PSRR Test(I_{OUT}=30mA)



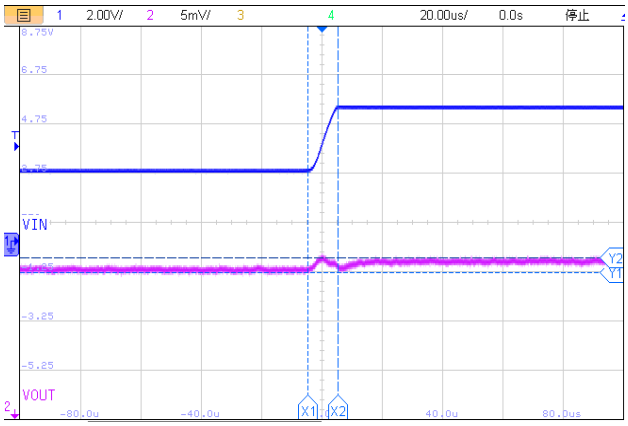
PSRR Test(I_{OUT}=0.5A)



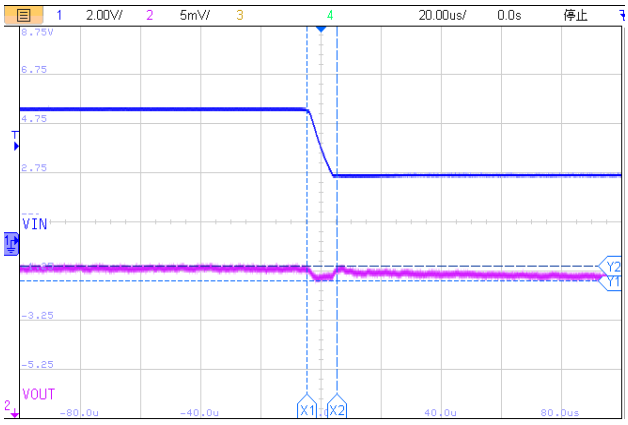
t_{ON}=35.8us(I_{OUT}=30mA)



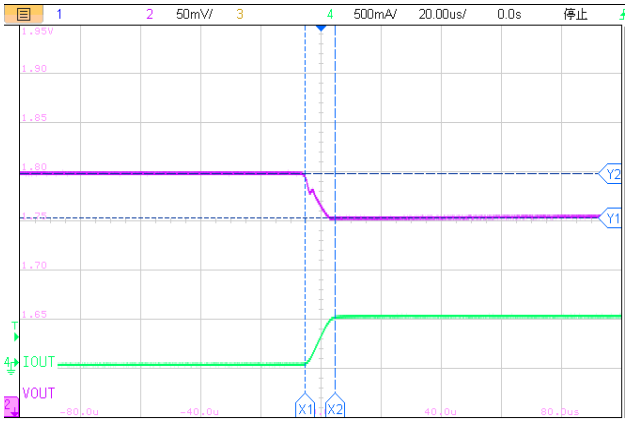
t_{OFF}=84us(I_{OUT}=30mA)



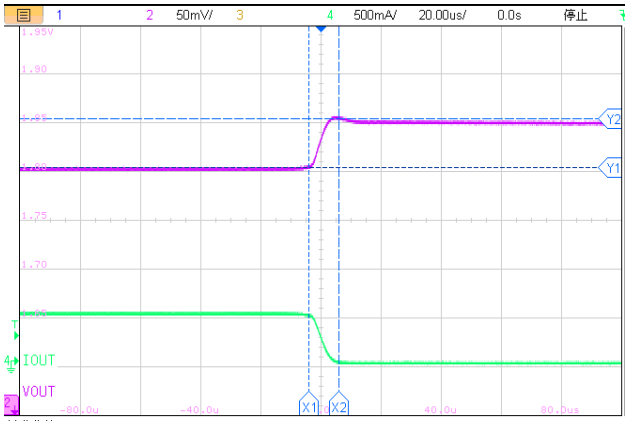
Line transient(2.8~5.5V t=10us ΔV=1.5mV)



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



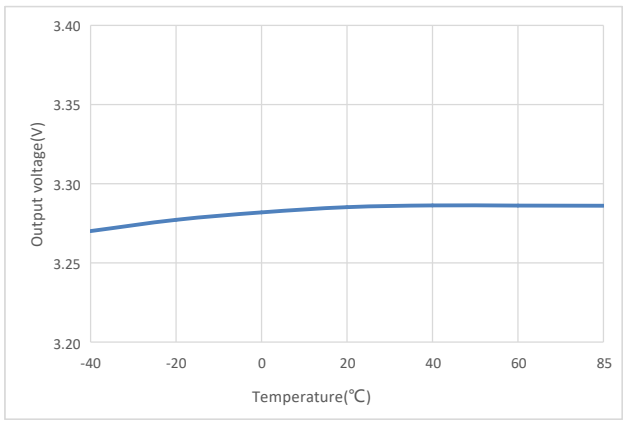
Load transient(1mA~0.5A t=10us ΔV=45mV)



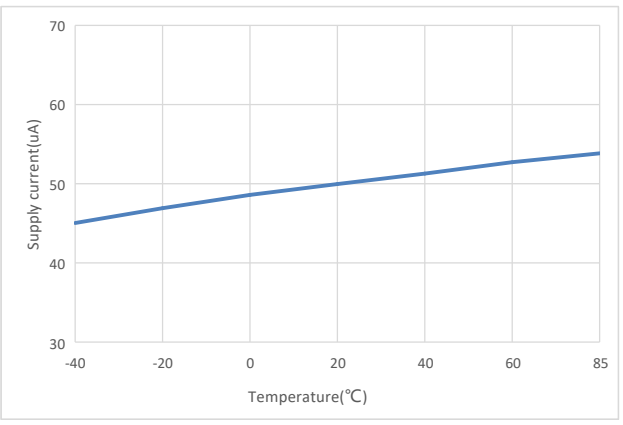
Load transient(0.5A~1mA t=10us ΔV=50mV)

(3)VOLTAGE VERSION 3.3V

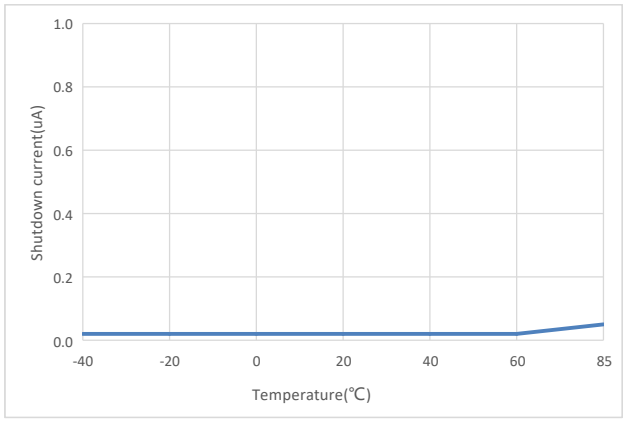
V_{IN} = V_{SET} + 1.0V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 2.2μF, (unless otherwise noted). T_A = 25°C.



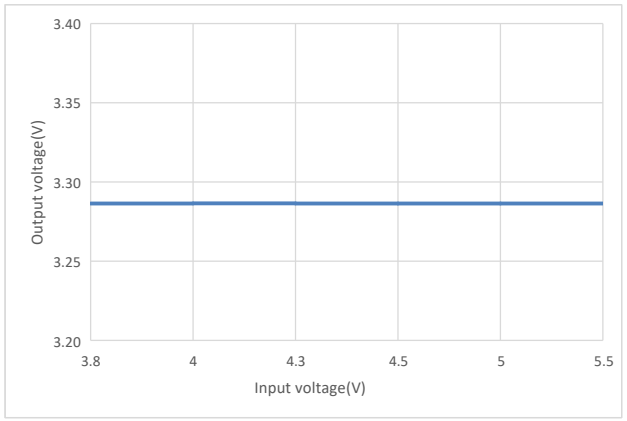
Output Voltage VS Temperature



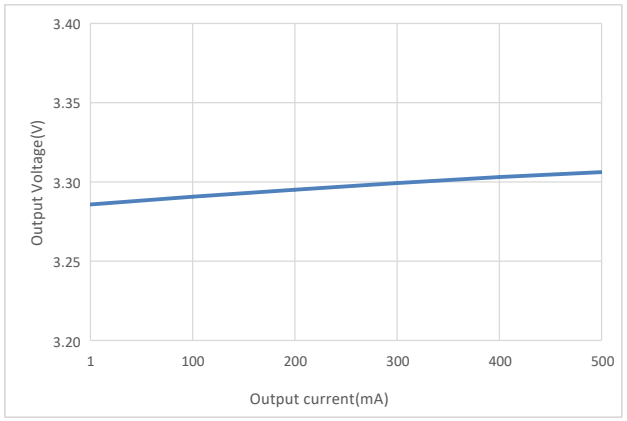
Supply Current VS Temperature



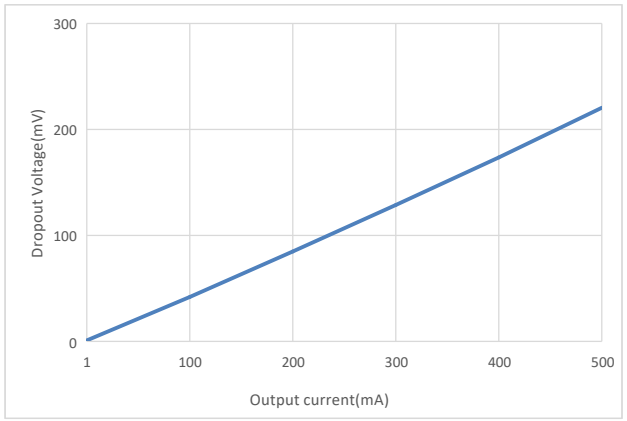
Shutdown Current VS Temperature



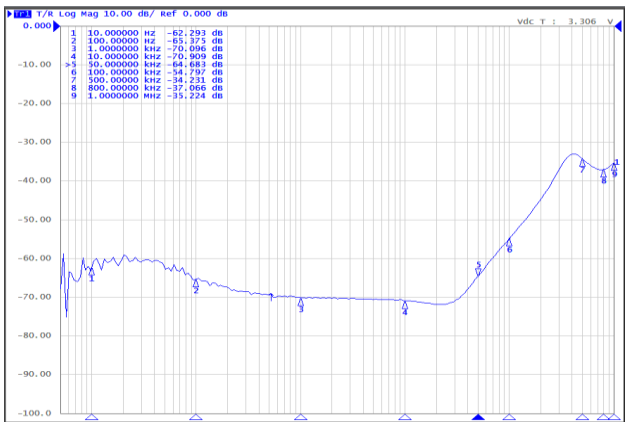
Output Voltage VS Input Voltage



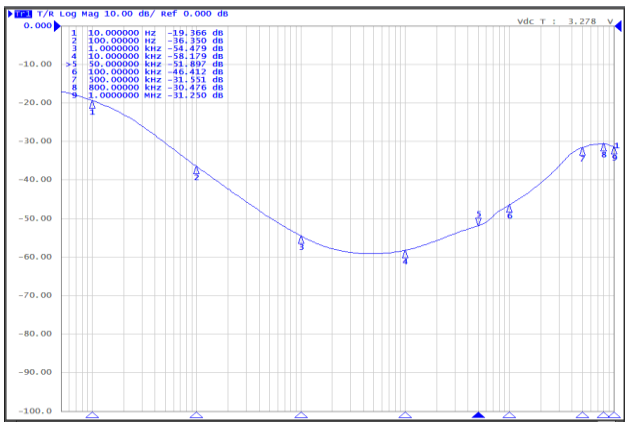
Output Voltage VS Output Current



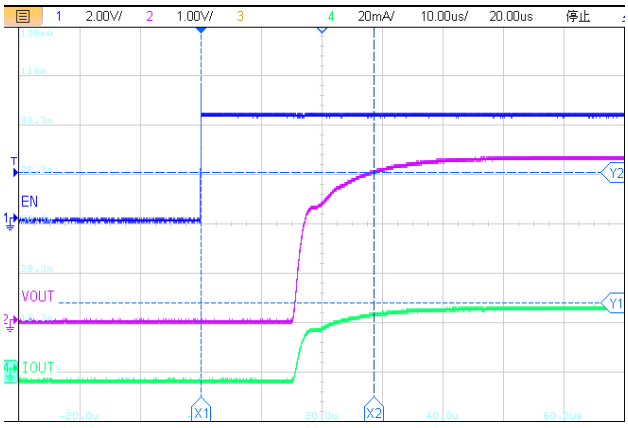
Dropout Voltage VS Output Current



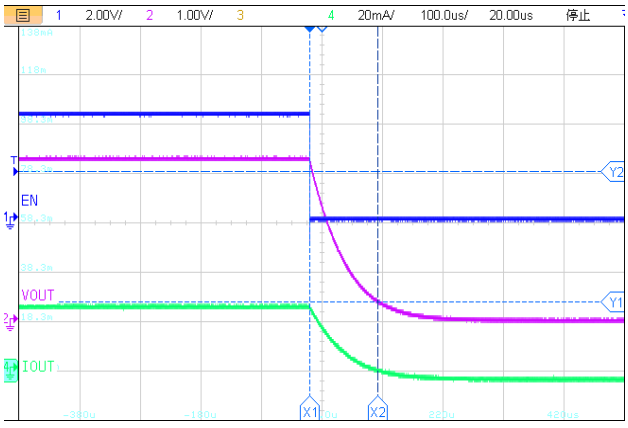
PSRR Test(I_{OUT}=30mA)



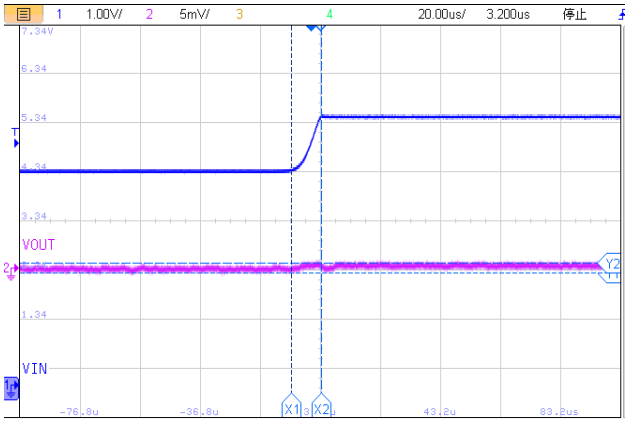
PSRR Test(I_{OUT}=0.5A)



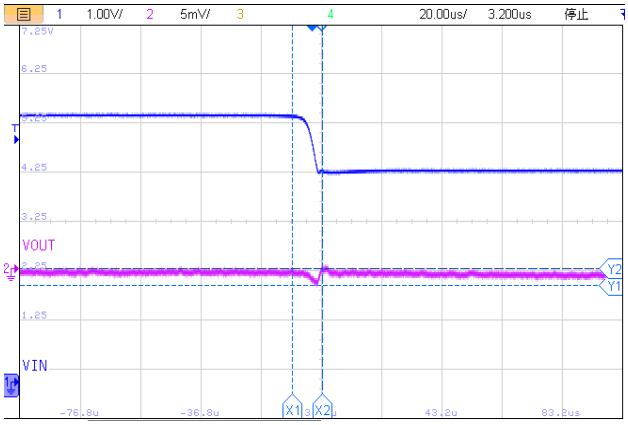
t ON=28.6us(IOUT=30mA)



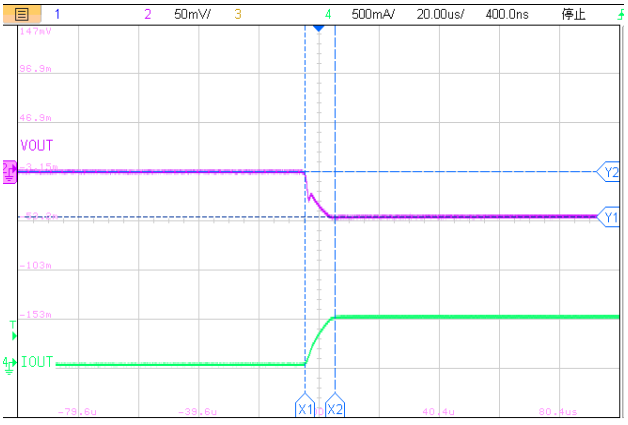
t OFF=112us(IOUT=30mA)



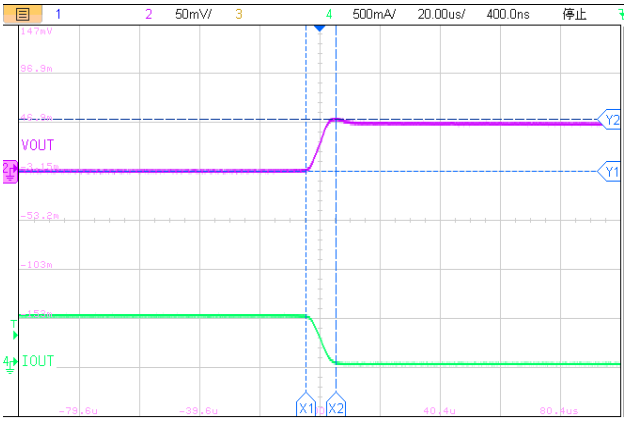
Line transient(4.3~5.5V t=10us ΔV=1.0mV)



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

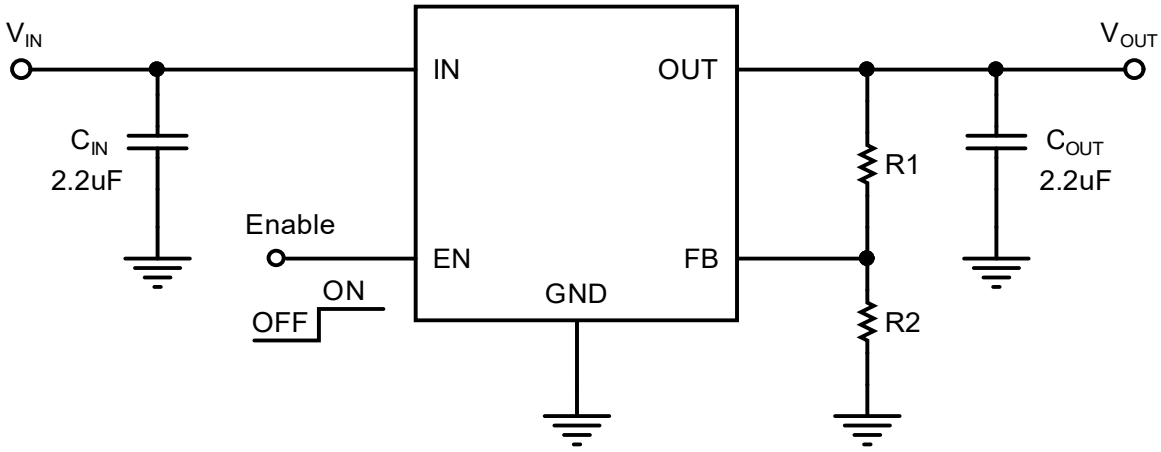


Load transient(1mA~0.5A t=10us ΔV=46.25mV)



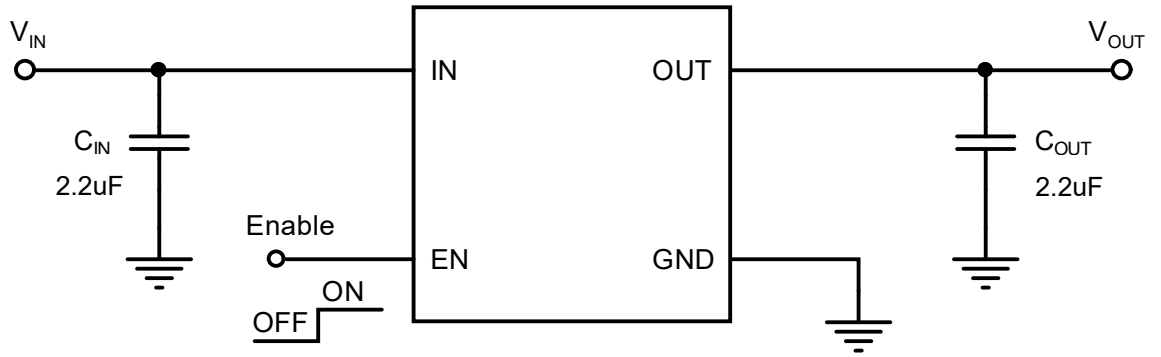
Load transient(0.5A~1mA t=10us ΔV=52.5mV)

Application Circuits



ET553ADJ (ADJ version**)**

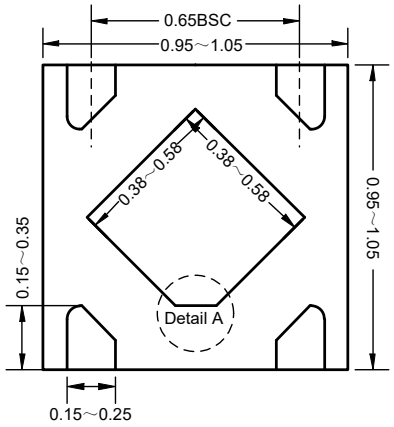
*: V_{OUT}=(1+R1/R2)×0.8V ,R2 recommend 100KΩ ~ 1MΩ.

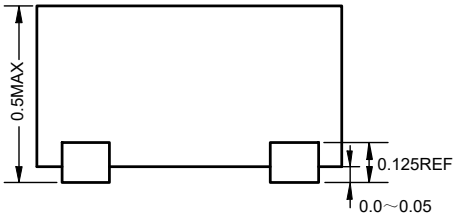


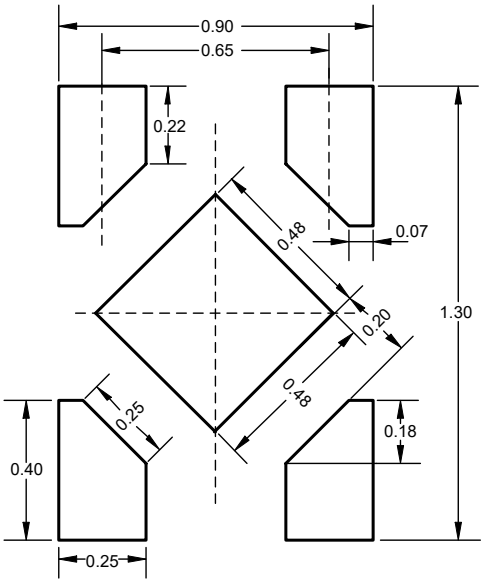
ET553XX (Fixed version**)**

Package Dimension

DFN4 (1mm × 1mm)

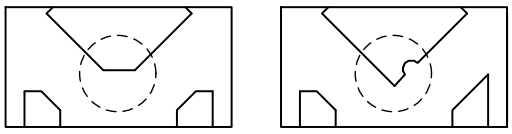






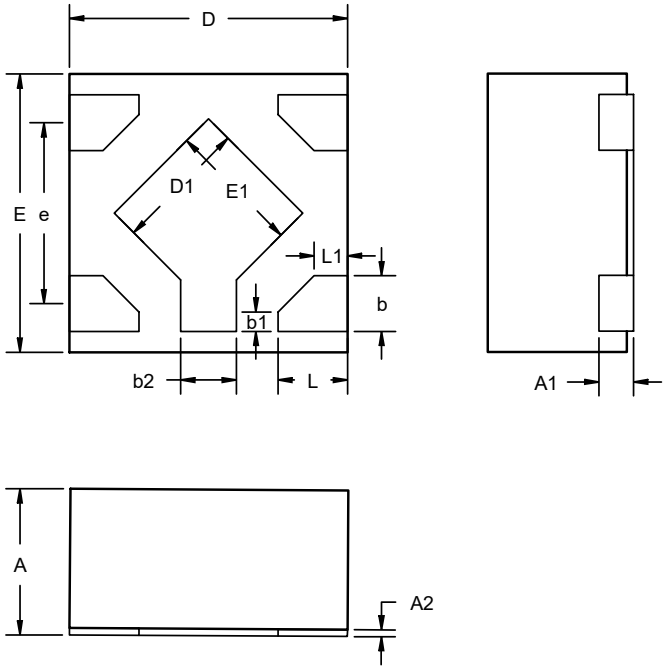
Recommended Land Pattern

Detail A: (PIN1 shape)



Unit: mm

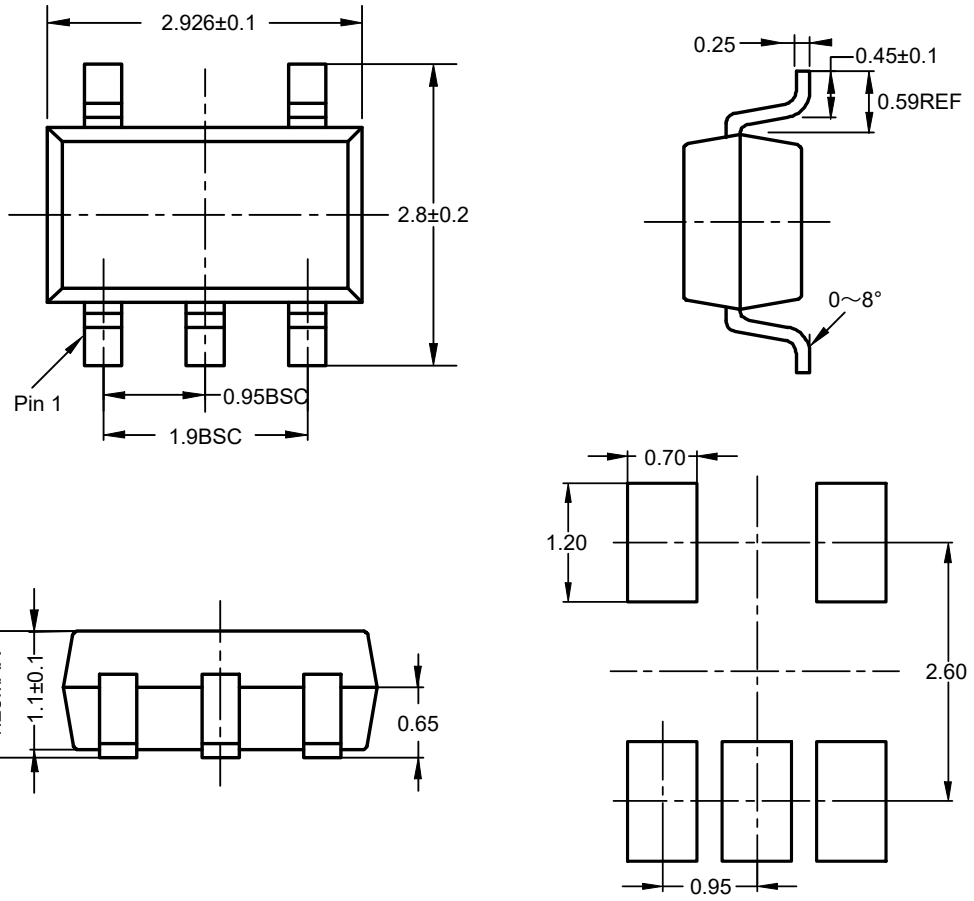
DFN4 (1.2mm × 1.2mm)



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.35	0.40	0.45
A1		0.13REF	
A2	0.00	0.02	0.05
b	0.25	0.30	0.35
b1		0.12REF	
b2	0.15	0.20	0.25
D	1.15	1.20	1.25
D1	0.58	0.63	0.68
E	1.15	1.20	1.25
E1	0.58	0.63	0.68
e		0.8BSC	
L	0.25	0.30	0.35
L1		0.12REF	

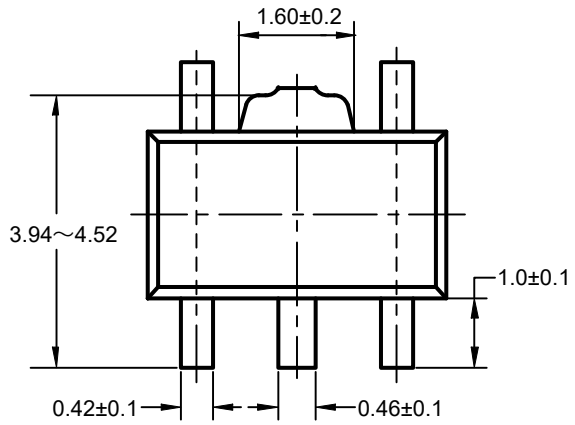
SOT23-5



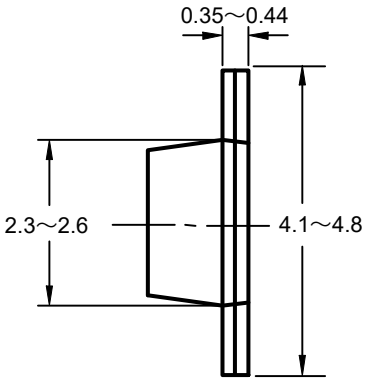
Recommended Land Pattern

Unit: mm

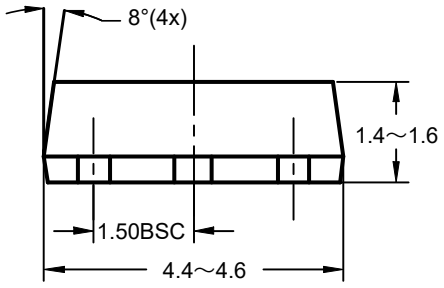
SOT89-5



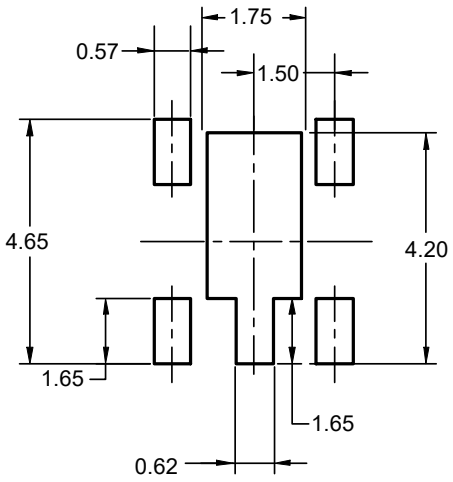
Top View



Side View



Side View



Recommended Land Pattern

Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0	2021-8-11	Preliminary Version	Liuxm	Liuxm	Liujy
1.0	2022-5-18	Official version	Shibo	Liuxm	Liujy
1.1	2022-7-18	Add SOT89-5DFN4(1.2X1.2)	Shibo	Liuxm	Liujy
1.2	2023-3-13	Add MSL, ESD, L_U information	Wangpeng	Liuxm	Liujy
1.3	2023-10-10	Update package picture	Shibo	Liuxm	Liujy