# ETQ553ADJYB - 500mA Low Dropout LDO

## General Description

The ETQ553ADJYB is a 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 ETQ553ADJYB 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 ETQ553ADJYB 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. ETQ553ADJYB also possess the EN function to save more energy and extend the battery life.

ETQ553ADJYB operates over an ambient temperature range of -40°C to +105°C.

## Features

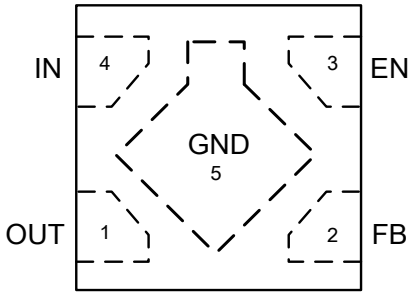
- Wide Input Voltage Range: 1.9V to 5.5V
- Output Current Up to 500mA
- Adjust Output Voltage Range: 1.0V to 3.6V (externally set)
- Very Low IQ: 50μA
- Excellent Load / Line Transient Response
- Built-in Over Current Protection and Thermal Shutdown circuit
- Built-in Inrush Current Suppression circuit and Current Limit
- Built-in Auto-discharging circuit
- Automotive AEC-Q100 Grade 2 Qualified
- Part No. and package

| Part No. | Package | MSL |
|---|---|---|
| ETQ553ADJYB | DFN4 (1.2×1.2) | Level 1 |

## Applications

- Automotive constant-voltage power supply
- Automotive infotainment and cluster
- Automotive power supply for body electronics and lighting

## Pin Configuration

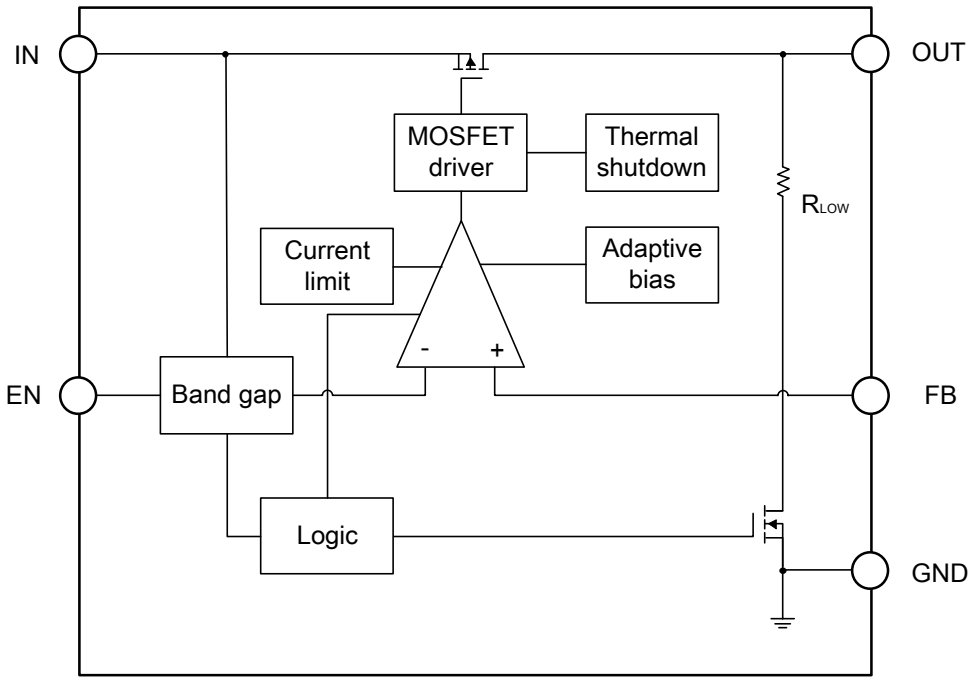



TOP VIEW

## Pin Function

| Pin No. | Pin Name | Pin Function |
|---|---|---|
| 4 | IN | Supply input pin |
| 5 | GND | Ground |
| 3 | EN | Enable control input, active high |
| 2 | FB | Set the output voltage |
| 1 | OUT | Output pin |

## 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 ETQ553ADJYB is turned on by setting the EN pin to “H”. Since the EN pin is neither pulled down or float, The ETQ553ADJYB VOUT 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 +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.

### 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:

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

## Absolute Maximum Ratings

| Symbol | Item | Rating | Unit |
|---|---|---|---|
| $V_{IN}$ | Input Voltage (1) | -0.3 to 6.0 | V |
| $V_{EN}$ | Input Voltage (EN Pin) (1) | -0.3 to 6.0 | V |
| $V_{FB}$ | Input Voltage (FB Pin) (1) | -0.3 to 6.0 | V |
| $V_{OUT}$ | Output Voltage (1) | -0.3 to 6.0 | V |
| $T_J$ | Max Junction Temperature | +150 | °C |
| $T_{STG}$ | Storage Temperature Range | -65 to +150 | °C |
| ESD | HBM Max Capability (2) | ± 4000 | V |
| | CDM Max Capability (2) | ± 1500 | V |
| $I_{LU}$ | Latch up Current Maximum Rating (2) | ± 200 | mA |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

***Note1***. Refer to Electrical Characteristics and Application Information for Safe Operating Area.

***Note2***. This device series incorporates ESD protection and is tested by the following methods:

HBM tested per AEC-Q100-002(EIA/JESD22-A114);

CDM tested per AEC-Q100-011(EIA/JESD22-C101);

Latch up Current Maximum Rating tested per AEC-Q100-004(EIA/JESD78E).

## Thermal Characteristics

| Symbol | Package | Ratings | Value | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | DFN4 | Thermal Characteristics, Thermal Resistance, Junction-to-Air | 180 | °C/W |

## Recommended Operating Conditions

| Symbol | Item | Rating | Unit |
|---|---|---|---|
| $V_{IN}$ | Input Voltage | 1.9 to 5.5 | V |
| $I_{OUT}$ | Output Current | 0 to 500 | mA |
| $T_A$ | Operating Ambient Temperature | -40 to 105 | °C |
| $C_{IN}$ | Effective Input Ceramic Capacitor Value | 1 to 10 | uF |
| $C_{OUT}$ | Effective Output Ceramic Capacitor Value | 1 to 10 | uF |

## Electrical Characteristics

$V_{IN}$ = $V_{SET}$ + 1.0V, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_A$ = -40°C ~ 105°C, unless otherwise noted.
Typical values are at $T_A$ = +25°C.

| Symbol | Item | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage[3] | | 1.9 | | 5.5 | V |
| $V_{FB}$ | FB Voltage | $T_A$ = 25°C | 0.784 | 0.800 | 0.818 | V |
| | | $T_A$ = -40°C ~ 105°C | 0.776 | 0.800 | 0.824 | V |
| $\Delta V_{OUT}$ /$\Delta I_{OUT}$ | Load Regulation | $V_{IN}$ = $V_{SET}$ + 1V, 1mA ≤ $I_{OUT}$ ≤ 0.5A | | 20 | 50 | mV |
| $V_{DROP}$ | Dropout Voltage[4] | 1.0V ≤ $V_{SET}$ < 1.6V, $I_{OUT}$ = 0.5A, $V_{OUT}$ dropping to 0.98×$V_{SET}$ | | | 900 | mV |
| | | 1.7V ≤ $V_{SET}$ < 2.6V, $I_{OUT}$ = 0.5A, $V_{OUT}$ dropping to 0.98×$V_{SET}$ | | 350 | 500 | mV |
| | | 2.6 ≤ $V_{SET}$ < 3.6V, $I_{OUT}$ = 0.5A, $V_{OUT}$ dropping to 0.98×$V_{SET}$ | | 260 | 400 | mV |
| $I_{QON}$ | Supply Current | $I_{OUT}$ = 0mA | | 50 | 85 | μA |
| $I_{QOFF}$ | Standby Current | $V_{EN}$ = 0V | | 0 | 1 | μA |
| $\Delta V_{OUT}$ /$\Delta V_{IN}$ | Line Regulation | $V_{SET}$ + 0.5V ≤ $V_{IN}$ ≤ 5.5V ($V_{IN}$ ≥ 1.4V) | | 0.02 | | %/V |
| PSRR | Power Supply Rejection Ratio[5] | f = 1kHz, Ripple 0.2Vp-p, $V_{IN}$ = $V_{SET}$ + 1.0V, $I_{OUT}$ = 30mA | | 80 | -- | dB |
| eN | Output Noise Voltage[5] | $I_{OUT}$ = 1mA,f = 10Hz to 100KHz | | 20*$V_{OUT}$ | | $\mu V_{RMS}$ |
| $I_{LIM}$ | Output Current Limit | $V_{IN}$ = $V_{SET}$+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 | | 0.9 | | | V |
| $V_{IL}$ | EN Input Voltage Low | | | | 0.40 | V |
| $R_{DIS}$ | Auto-discharge Resistance | $V_{IN}$=4V, $V_{EN}$=0V, $I_{OUT}$=10mA | | 80 | | Ω |
| $T_{SHDN}$ | Thermal Shutdown Temperature[5] | | | 155 | | °C |
| $T_{SDR}$ | Thermal Shutdown Released Temperature[5] | | | 130 | | °C |

***Note3***. Here $V_{IN}$ means internal circuit can work normal. If $V_{IN}$<$V_{OUT}$, Output voltage follow $V_{IN}$, circuit is safety.

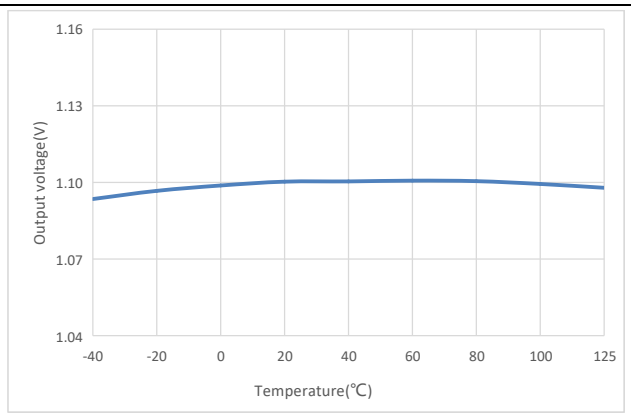
***Note4***. $V_{DROP}$ FT test method: test the $V_{OUT}$ voltage at $V_{SET}$+$V_{DROPMAX}$ with 500mA output current.

***Note5***. Guaranteed by design and characterization. not a FT item.

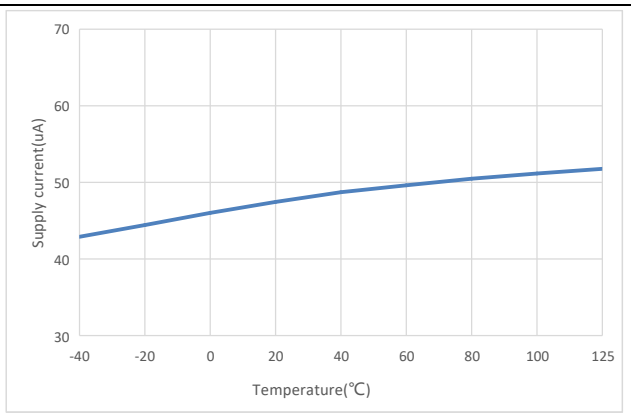
## Typical Characteristics

### (1) VOLTAGE VERSION 1.1V

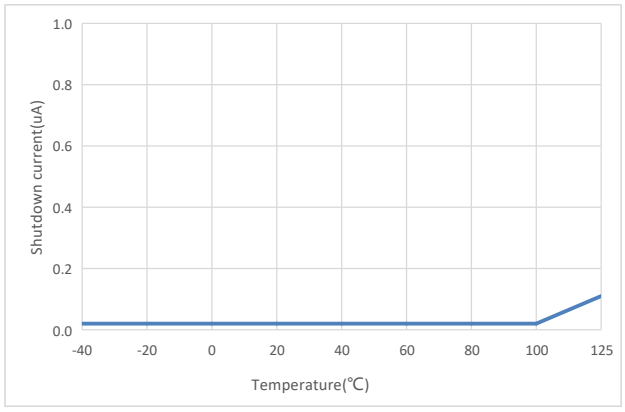
$V_{IN}$ = $V_{SET}$ + 1.0V, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 1μF, unless otherwise noted, $T_A$ = 25°C.



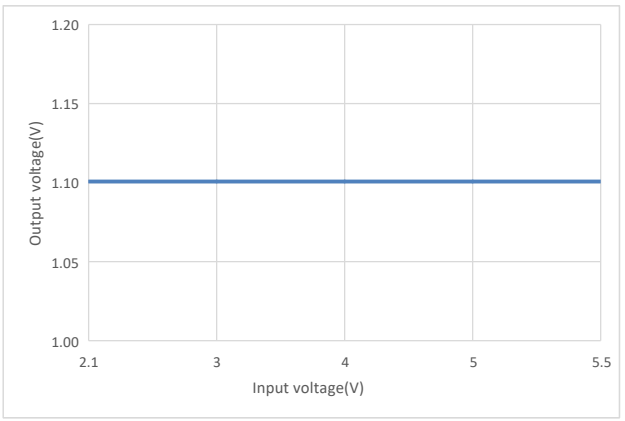

Output Voltage VS Temperature



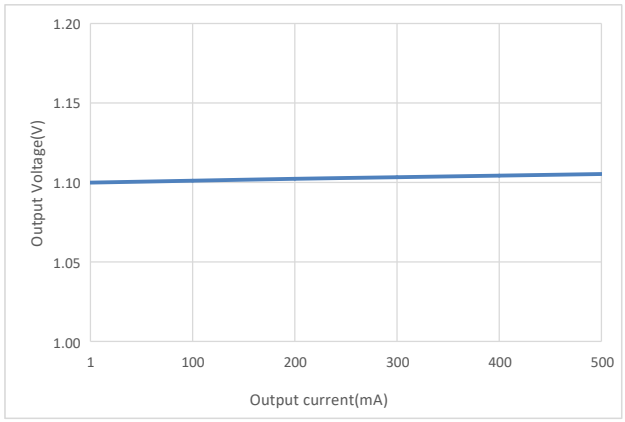

Supply Current VS Temperature



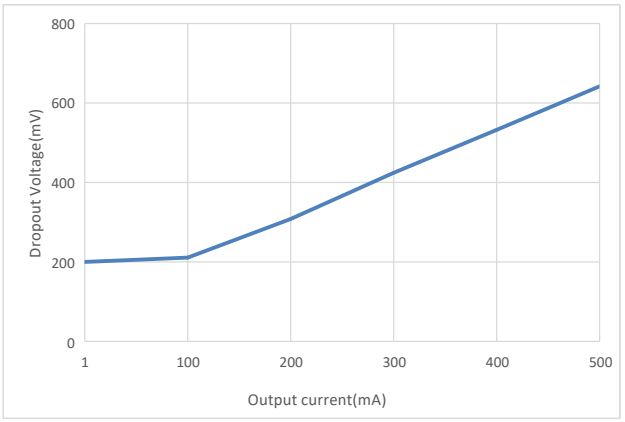

Shutdown Current VS Temperature



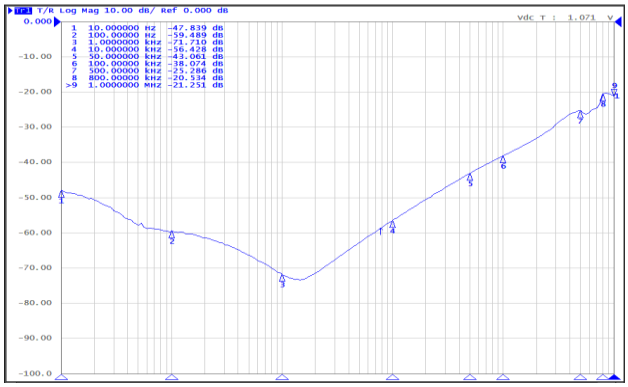

Output Voltage VS Input Voltage



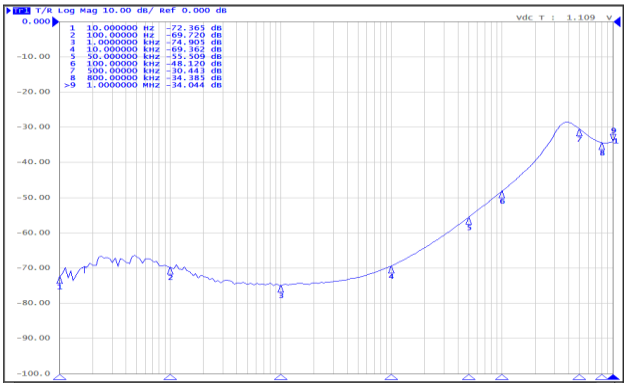

Output Voltage VS Output Current



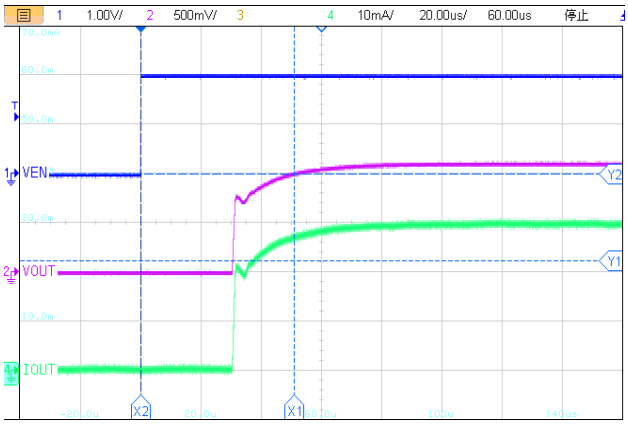

Dropout Voltage VS Output Current



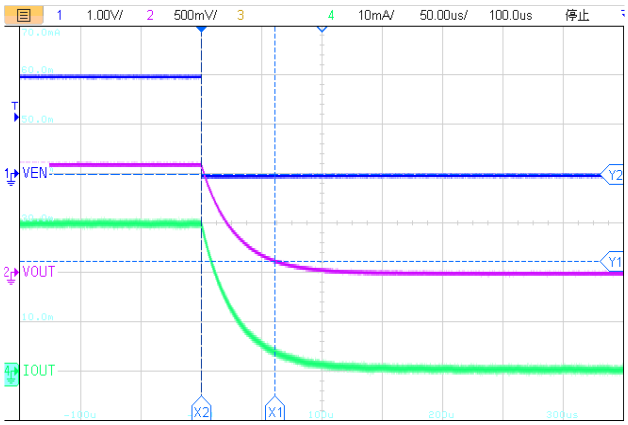
PSRR Test ($I_{OUT}$=30mA)



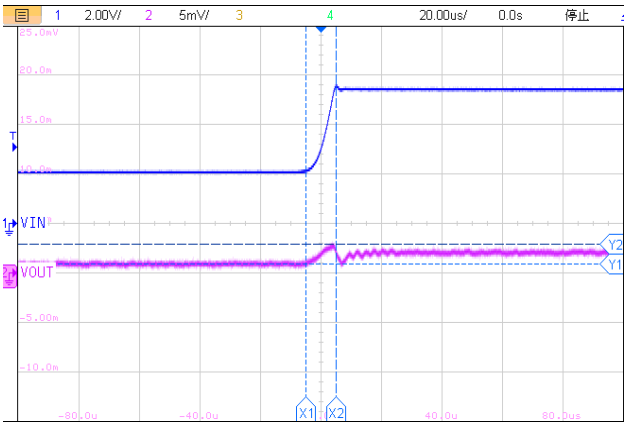
PSRR Test ($I_{OUT}$=0.5A)



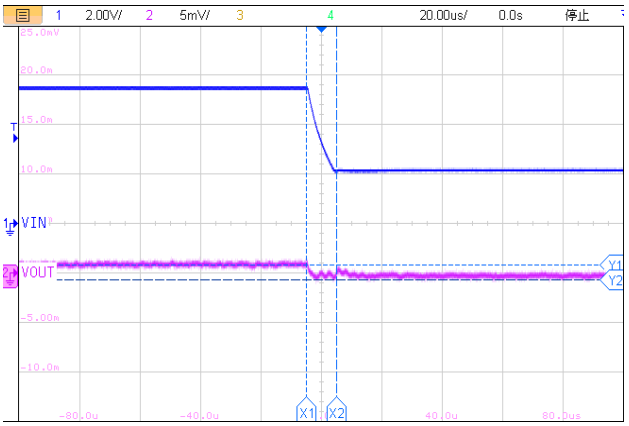

t $_{ON}$=51us ($I_{OUT}$=30mA)



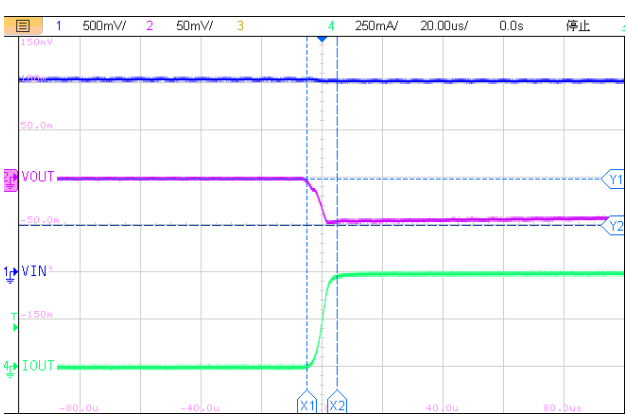

t $_{OFF}$=61us ($I_{OUT}$=30mA)



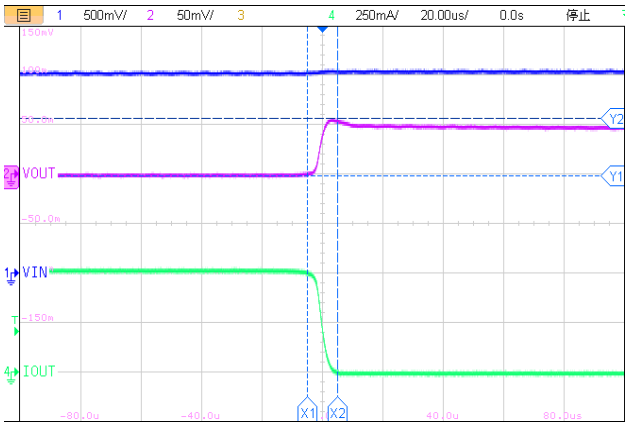

Line transient (2.1~5.5V t=10us ΔV=2mV)




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



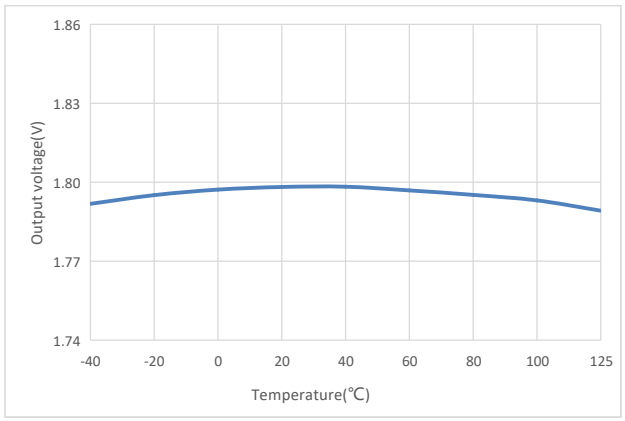

Load transient (1mA~0.5A t=10us ΔV=48.75mV)



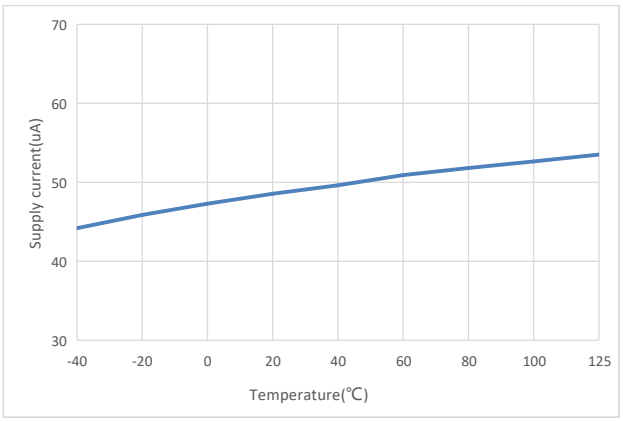

Load transient (0.5A~1mA t=10us ΔV=57.5mV)

### (2) VOLTAGE VERSION 1.8V

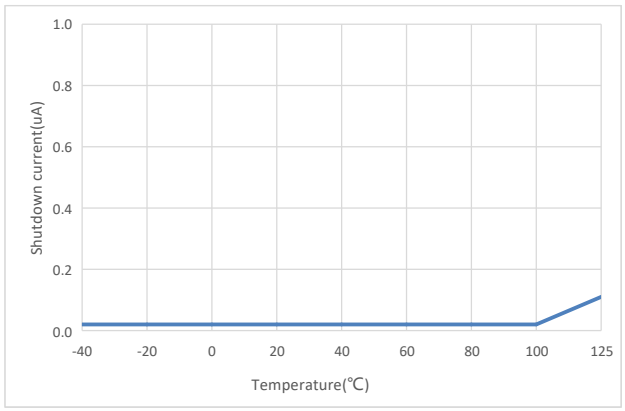
$V_{IN}$ = $V_{SET}$ + 1.0V, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 1μF, unless otherwise noted, $T_A$ = 25°C.



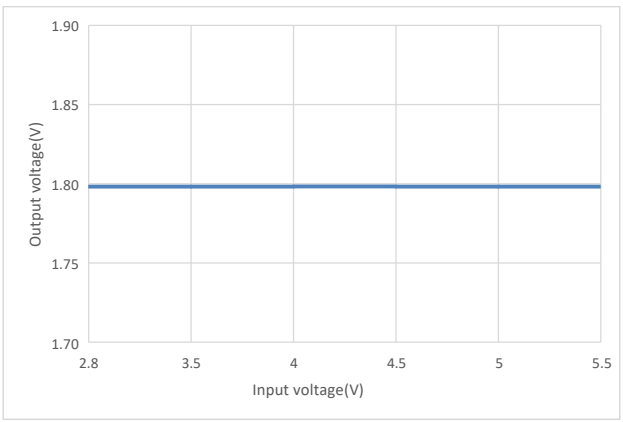

Output Voltage VS Temperature



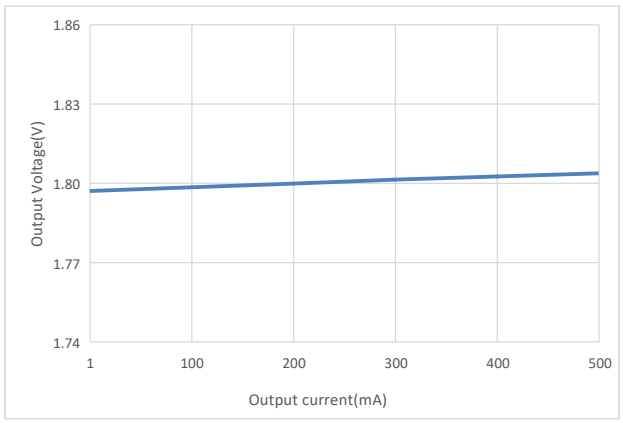

Supply Current VS Temperature



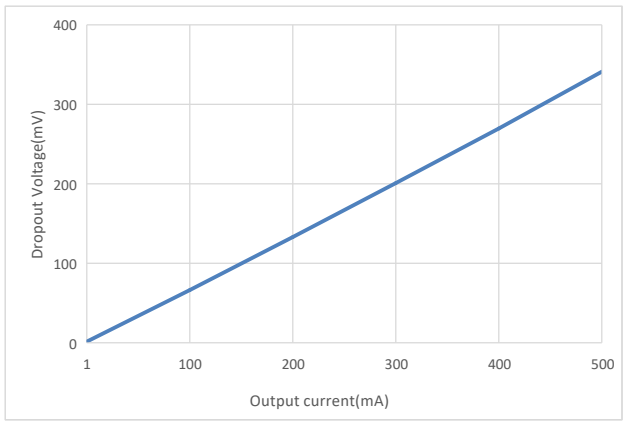

Shutdown Current VS Temperature



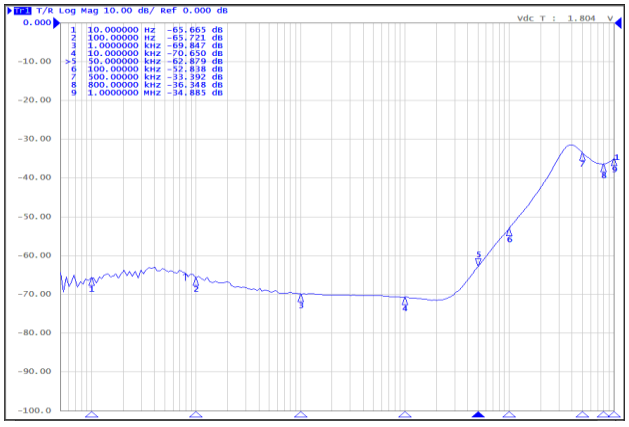

Output Voltage VS Input Voltage



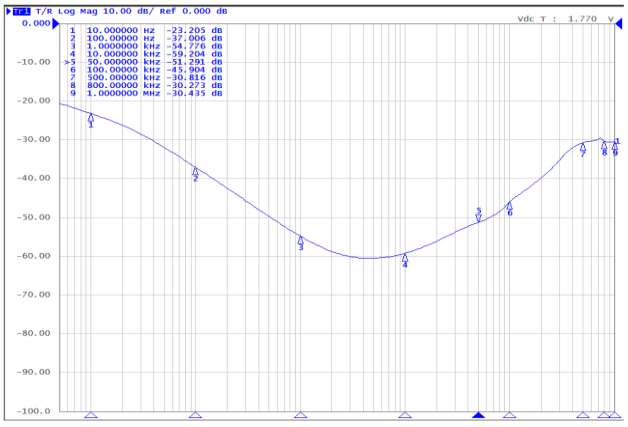

Output Voltage VS Output Current



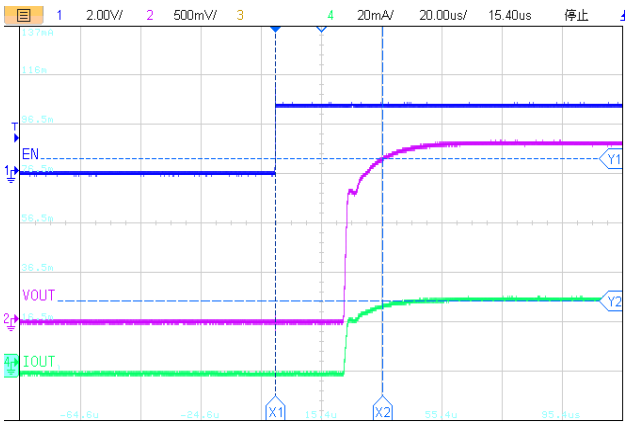

Dropout Voltage VS Output Current



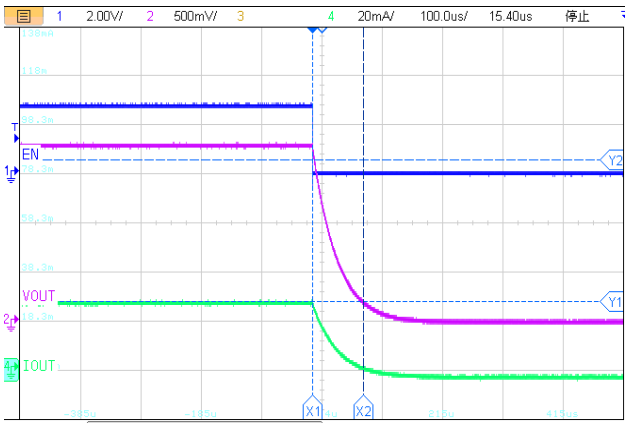
PSRR Test ($I_{OUT}$=30mA)



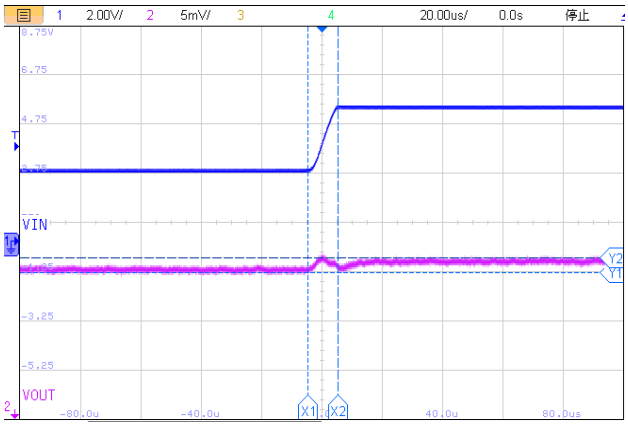
PSRR Test ($I_{OUT}$=0.5A)



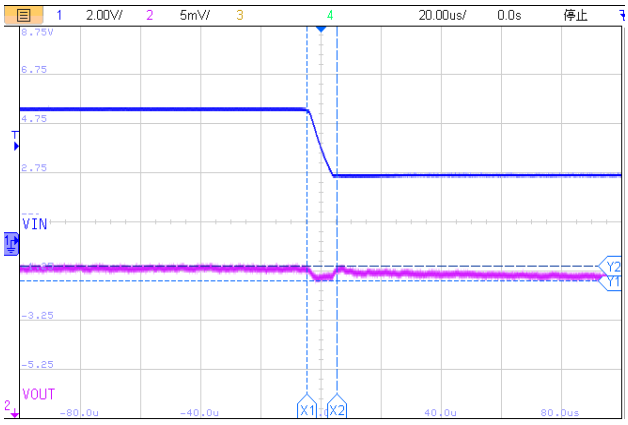

$t_{ON}$=35.8us ($I_{OUT}$=30mA)



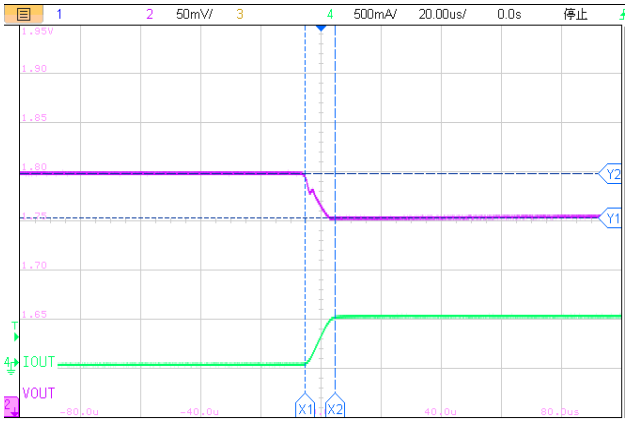

$t_{OFF}$=84us ($I_{OUT}$=30mA)



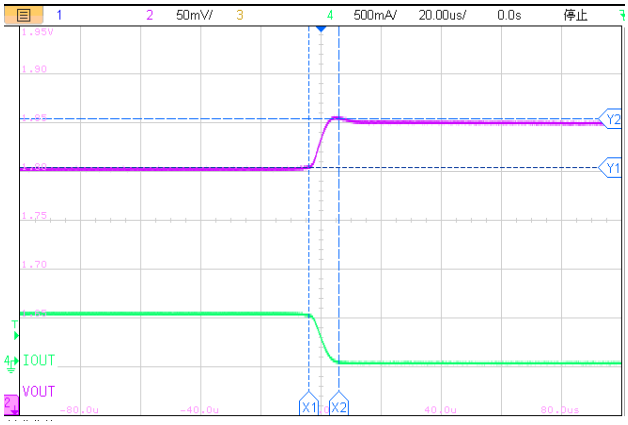

Line transient (2.8~5.5V t=10us ΔV=1.5mV)




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



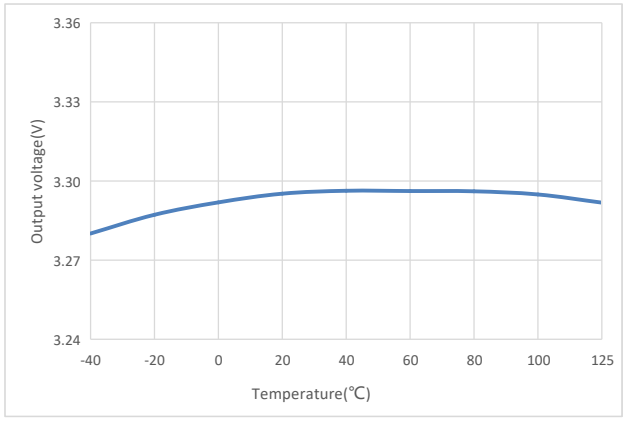

Load transient (1mA~0.5A t=10us ΔV=45mV)



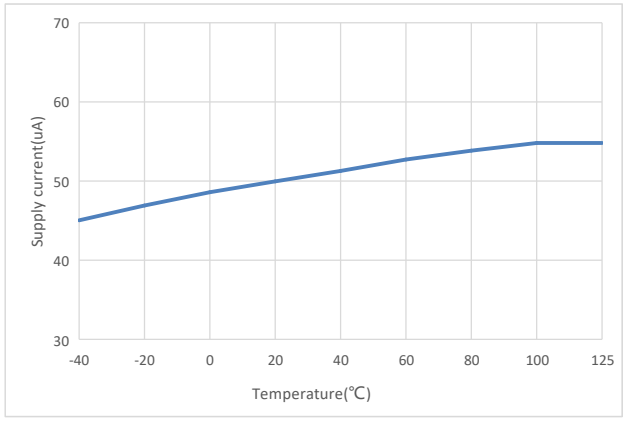

Load transient (0.5A~1mA t=10us ΔV=50mV)

### (3) VOLTAGE VERSION 3.3V

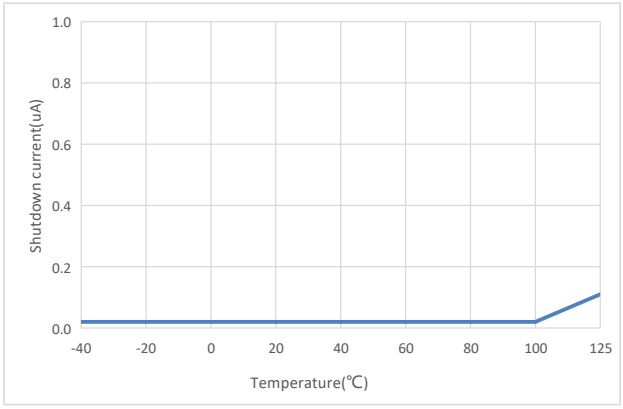
$V_{IN}$ = $V_{SET}$ + 1.0V, $I_{OUT}$ = 1mA, $C_{IN}$ = $C_{OUT}$ = 1μF, unless otherwise noted, $T_A$ = 25°C.



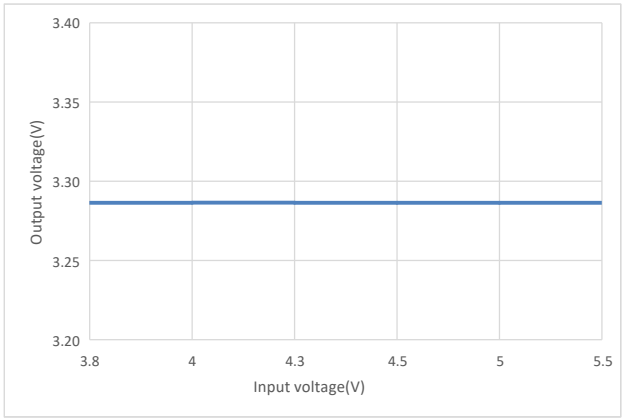

Output Voltage VS Temperature



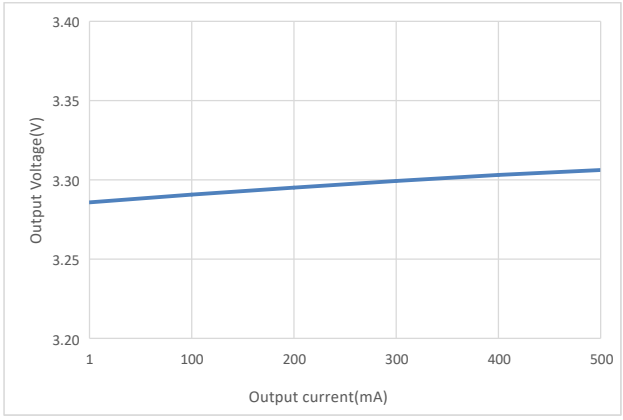

Supply Current VS Temperature



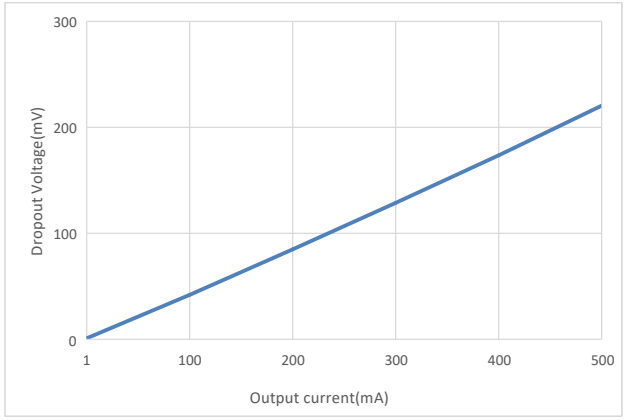

Shutdown Current VS Temperature



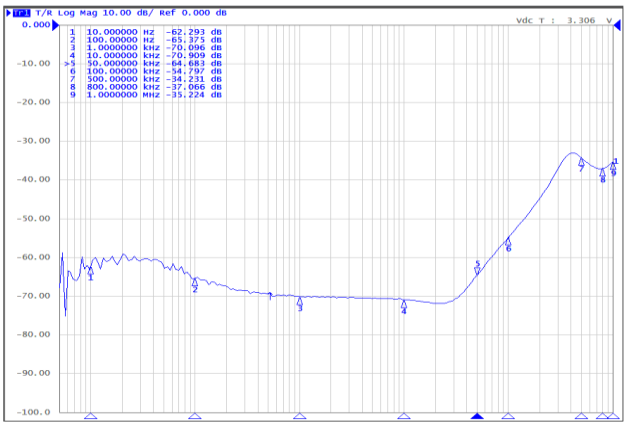

Output Voltage VS Input Voltage



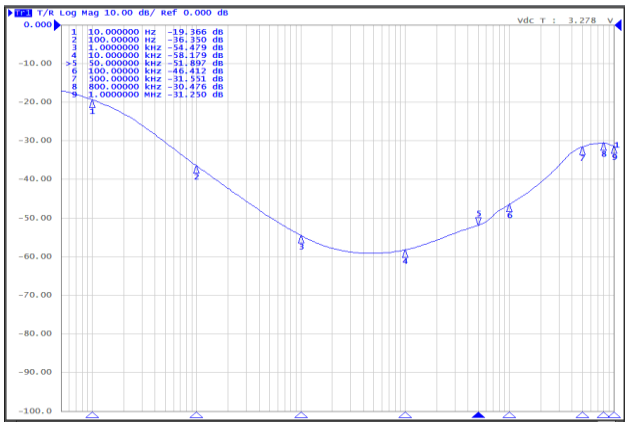

Output Voltage VS Output Current



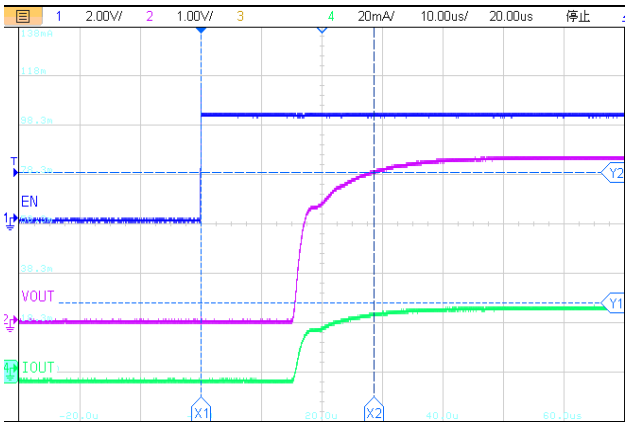

Dropout Voltage VS Output Current



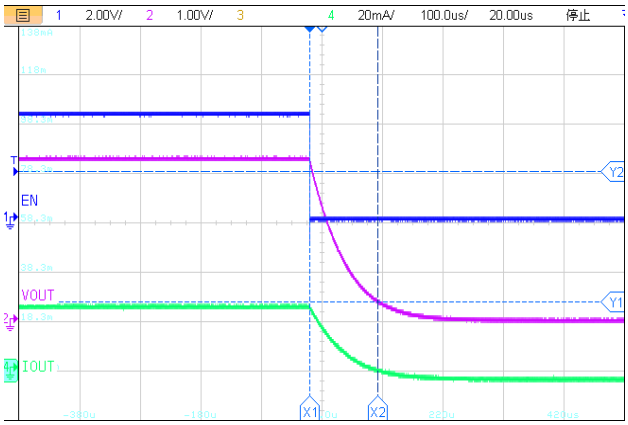

PSRR Test ($I_{OUT}$=30mA)



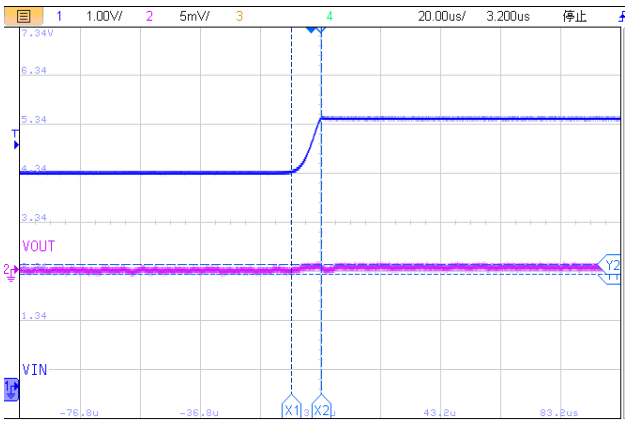

PSRR Test ($I_{OUT}$=0.5A)



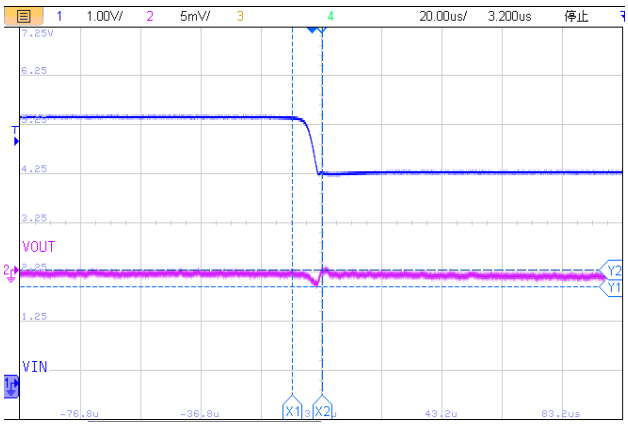

$t_{ON}$=28.6us ($I_{OUT}$=30mA)



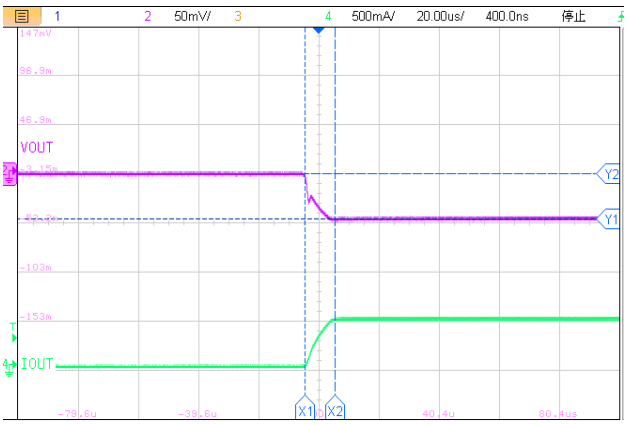

$t_{OFF}$=112us ($I_{OUT}$=30mA)



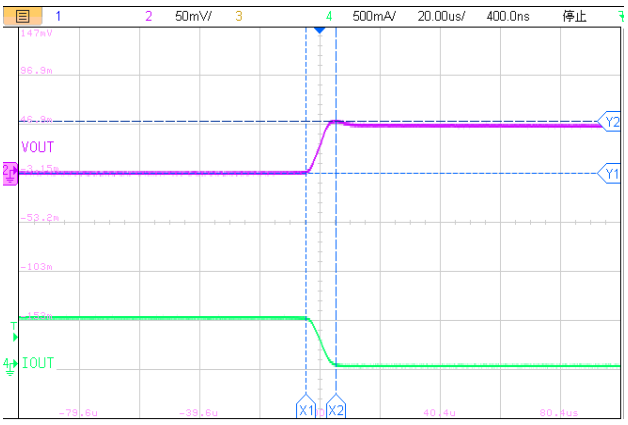

Line transient (4.3~5.5V t=10us ΔV=1.0mV)




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

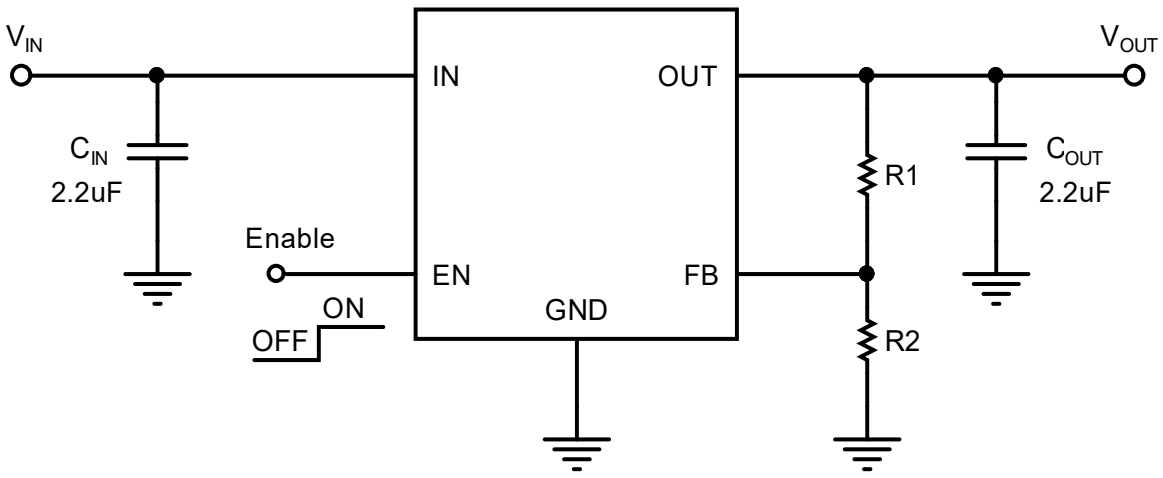



Load transient (1mA~0.5A t=10us ΔV=46.25mV)




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

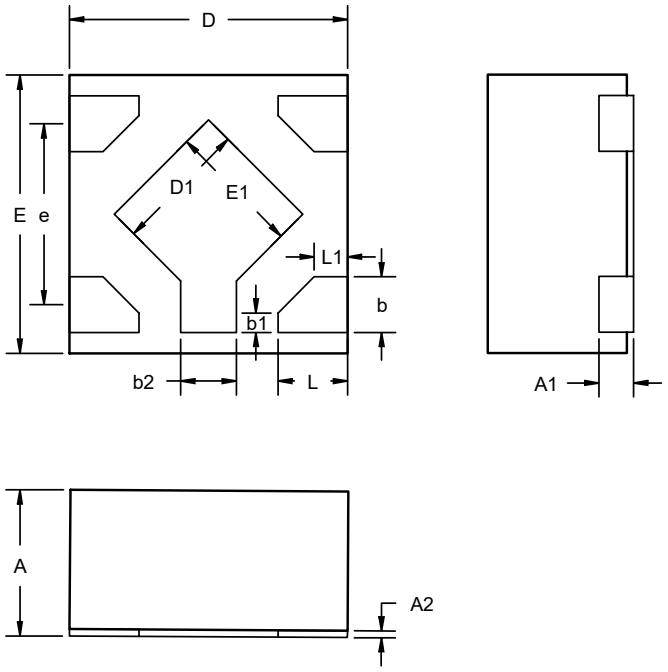
## Application Circuits




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

## Package Dimension

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 | |

## 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 | 2023-1-8 | DFN4 AEC version | Shibo | Liuxm | Liujy |
| | | | | | |