1A Low Dropout LDO with Adjustable Output

General Description

The ETQ5A0ADJY3B is CMOS-based low-dropout, low-power linear regulators, offering 1A with low dropout voltage, high ripple rejection, high output accuracy and low supply current. The ETQ5A0ADJY3B 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 ETQ5A0ADJY3B 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. ETQ5A0ADJY3B also possess the CE function to save more energy and extend the battery life.

The ETQ5A0ADJY3B output voltage can be adjusted from 0.8 V to 4.3 V using two external resistors.

The ETQ5A0ADJY3B is available in the DFN8 package (3mm × 3mm).

Features

- Wide Input Voltage Range: 1.8 V to 5.5 V
- Output Current: 1.0 A
- Adjustable Output Voltage Range: 0.8 V to 4.3 V
- Very Low IQ: 110 μA
- Excellent Load/Line Transient Response
- Built-in over-current Protection and Thermal Shutdown Circuit
- Built-in Auto-discharging Circuit
- Reverse Current Protection
- Automotive AEC-Q100 Grade 2 Qualified
  - -- Ambient Temperature Range of -40°C to +105°C
  - -- ESD HBM 4 KV PASS
  - -- ESD CDM 1.5 KV PASS
- Part No. and Package

Part No.	Package	MSL
ETQ5A0ADJY3B	DFN8 (3mm × 3mm).	Level 1

Applications

- Automotive Constant-voltage Power Supply
- Constant-voltage Power Supply for Industrial Applications

Pin Configuration

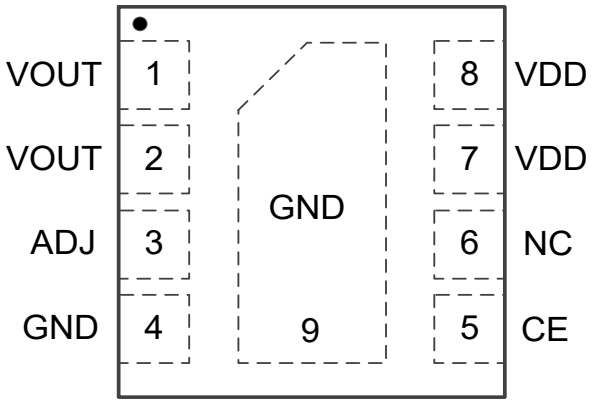


Fig 1. Top View

Pin Function

Pin	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	V_{OUT}	Output Pin
3	ADJ	Feedback Voltage Input. This pin is used to set the desired output voltage via an external resistive divider. The feedback reference voltage is 0.8 V typically.
4	GND	Ground Pin
5	CE	Chip Enable Pin
6	NC	No Connect
7	V_{DD}	Input Pin
8	V_{DD}	Input Pin
9	GND	Thermal Pad and Ground Pin

Block Diagram

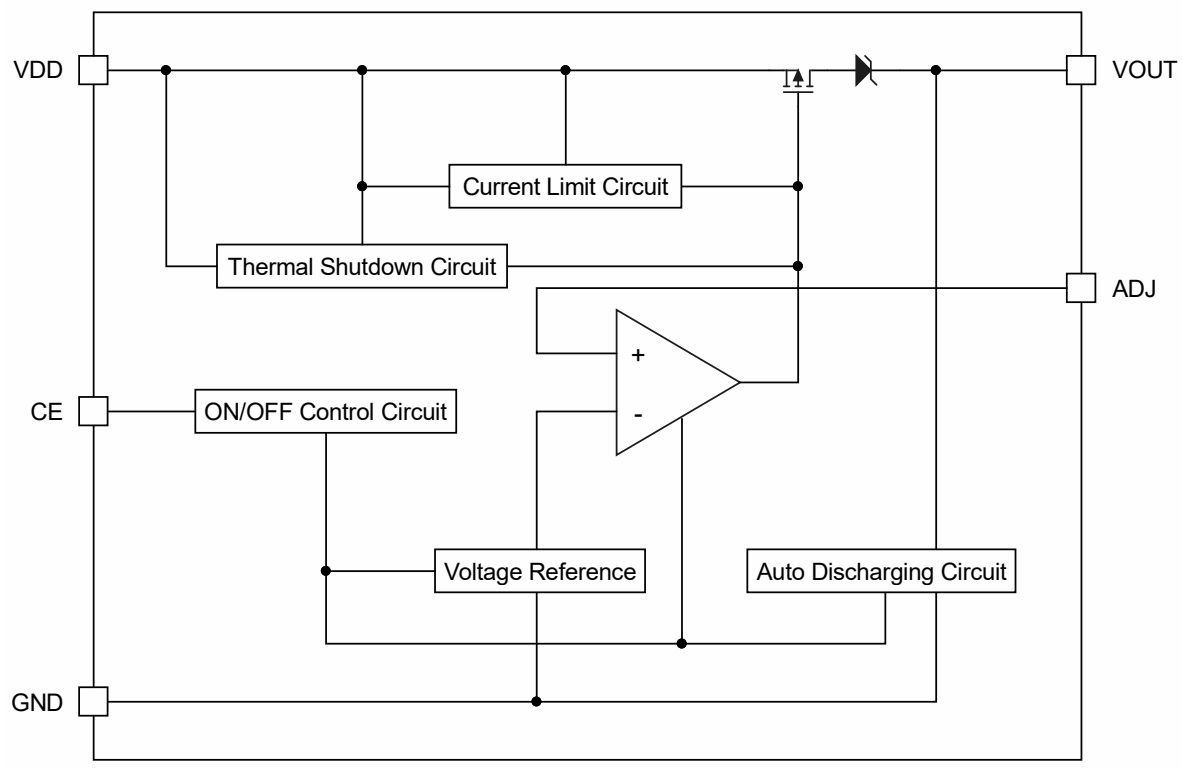


Fig 2. Block Diagram

Functional Description

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between V_{DD} 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_{DD} and GND.

Please pay attention, in the case of high impedance of the power supply, the input capacitance of the IC is small or the capacitor is not connected, the oscillation may occur. When the capacitance value of the output capacitor is greater than the capacitance value of the input capacitor, it is possible to generate oscillation.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is 1μF, 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 V_{OUT} and GND pins.

CE Pin Operation

The ETQ5A0ADJY3B is turned on by setting the CE pin to “H”. When the CE pin is used, connect the CE pin with V_{DD} to keep the LDO in operating mode.

Current Limit Protection

When output current of V_{OUT} pin is higher than current limit threshold or the V_{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 the device to cool down. When the junction temperature reduces to approximately +120°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.

Reverse Current Protection Circuit

Under normal conditions, when V_{OUT} is higher than V_{DD}, the parasitic diode of Pch output transistor becomes forward direction. As a result, the current flows from V_{OUT} pin to V_{DD} pin.
The ETQ5A0ADJY3B switches the mode to the reverse current protection mode before V_{DD} becomes lower than V_{OUT} by connecting the parasitic diode of Pch output transistor to the backward direction, and connecting the gate to V_{OUT} pin. As a result, the Pch output transistor is turned off. However, from V_{OUT} pin to GND pin, via the internal divider resistors, very small current I_{REV} flows.

Auto Discharging

When the CE 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 V_{OUT} 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 30kΩ and 100kΩ. The output voltage is calculated by:

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

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	-0.3 to 6	V
V_{CE}	Input Voltage (CE Pin)	-0.3 to 6	V
V_{OUT}	Output Voltage	-0.3 to V_{IN} + 0.3	V
I_{MAX}	Maximum Load Current	1000	mA
P_D	Maximum Power Consumption (50mm*50mm 2layer 1oz)	2.5	W
T_J	Operating Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 150	°C
T_{SOLD}	Lead Temperature (Soldering, 5 sec)	260	°C

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	DFN8 (3×3)	Thermal Characteristics, Thermal Resistance, Junction-to-Air	50	°C/W

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.8 to 5.5	V
I_{OUT}	Output Current	0 to 1000	mA
T_A	Operating Ambient Temperature	-40 to 105	°C
C_{IN}	Effective Input Ceramic Capacitor Value	1 to 10	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	μF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

Electrical Characteristics

(Unless otherwise noted, V_{IN} = V_{SET} + 1.0 V, T_A = -40°C~105°C, C_{IN} = C_{OUT} = 1uF (effective capacitance[4]); Typical values are at V_{IN} = V_{SET} + 1.0V, T_A = 25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Operation Range	V_{IN} [1]	$V_{IN} \geq V_{SET}$ + 0.5V	1.8		5.5	V
Output Voltage	V_{OUT}	I_{OUT} = 1mA, T_A =25°C	×0.98		×1.02	V
		I_{OUT} = 1mA~1A, T_A = 25°C	-30		30	mV
Dropout Voltage	V_{DROP} [2]	V_{OUT} = 1.8V, I_{OUT} = 1A	110	175	260	mV
		V_{OUT} = 2.8V, I_{OUT} = 1A	90	160	240	
		V_{OUT} = 3.3V, I_{OUT} = 1A	70	140	200	
Supply Quiescent Current	I_{Q_ON}	Active Mode: V_{CE} = High, I_{OUT} = 0mA	70	110	150	µA
Supply Shutdown Current	$I_{Q\ OFF}$	V_{CE} = 0V		1	30	µA
Output Voltage Line Regulation	Reg_{LINE}	V_{SET} + 0.5V ≤ V_{IN} ≤ 5.5V ($V_{IN} \geq$ 1.8V), I_{OUT} = 10mA (ΔV_{OUT} / ΔV_{IN} / V_{OUT})		0.02	0.1	%/V
Output Voltage Load Regulation	Reg_{LOAD}	I_{OUT} from 1mA to 1A V_{IN} = Vset + 0.5V (ΔV_{OUT})		5	30	mV
Line Transient (The absolute value of the output change)	V_{TRLN} [3]	V_{OUT} = 3.3V, I_{OUT} = 1mA, V_{IN} = 4.3V to 5.5V in 10us, T_A = 25°C		15	30	mv
		V_{OUT} = 3.3V, I_{OUT} = 1mA, V_{IN} = 5.5V to 4.3V in 10us, T_A = 25°C		15	30	
Load Transient (The absolute value of the output change)	V_{TRLD} [3]	V_{OUT} = 3.3V, V_{IN} = 4.3V, I_{OUT} from 1mA to 1Ain 10us, T_A = 25°C		75	120	mv
		V_{OUT} = 3.3V, V_{IN} = 4.3V, I_{OUT} from 1Ato 1mA in 10us, T_A = 25°C		75	120	
Output Current	I_{OUT}		1000			mA
Output Limit Current	I_{LIMIT} [3]	V_{OUT} = 3.3V, V_{IN} = 4.3V, T_A = 25°C	1050	1400	2000	mA
Short Current Limit	I_{SHORT}	V_{OUT} = 0V, T_A = 25°C	60	130	200	mA
Inrush Current Limit	I_{RUSH}	V_{OUT} = 3.3V, V_{IN} = 4.3V, T_A = 25°C	400	600	800	mA
Power Supply Rejection Ratio	PSRR [3]	f = 1kHz, C_{OUT} = 1µF, I_{OUT} = 20mA, V_{OUT} = 3.3V, T_A = 25°C		70		dB

Electrical Characteristics (Continued)

(Unless otherwise noted, V_{IN} = V_{SET} + 1.0 V, T_A = -40 °C ~105 °C, C_{IN} = C_{OUT} = 1uF (effective capacitance(4)); Typical values are at V_{IN} = V_{SET} + 1.0V, T_A = 25 °C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Noise	e_N (3)	10Hz to 100kHz, I_{OUT} = 30mA, C_{OUT} = 1μF, T_A = 25°C		50* V_{OUT}	80* V_{OUT}	μV_{RMS}
CE Low Threshold	V_{IL}	V_{IN} = 1.8 to 5.5V			0.3	V
CE High Threshold	V_{IH}	V_{IN} = 1.8 to 5.5V	1			V
CE Pull-down Current	I_{CE}	V_{IN} = 4.3V, V_{CE} = 4.3V, T_A =25°C		0.3	1	μA
Output Resistance of Auto Discharge at Off State	R_{LOW}	V_{EN} = 0V, V_{IN} = 4V, V_{OUT} = 3V	30	60	100	Ω
Thermal Shutdown Temperature	T_{TSD} (3)	Junction Temperature Rising	135	155	175	°C
Thermal Shutdown Released Hysteresis	T_{HYS} (3)	Junction Temperature Falling from Shutdown	20	40	60	°C
ESD	HBM	Reference: AEC-Q100-002	±4000			V
	CDM	Reference: AEC-Q100-011	±1500			V

Note1: V_{IN} means internal circuit can work normal. If V_{IN} <V_{OUT}, Reverse current protection circuit will work.

Note2: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET}+$V_{DROPMAX}$ with output current.

Note3: Guaranteed by design and characterization. not a FT item.

Note4: Effective capacitance, including the effect of DC bias, tolerance and temperature.

Application Circuits

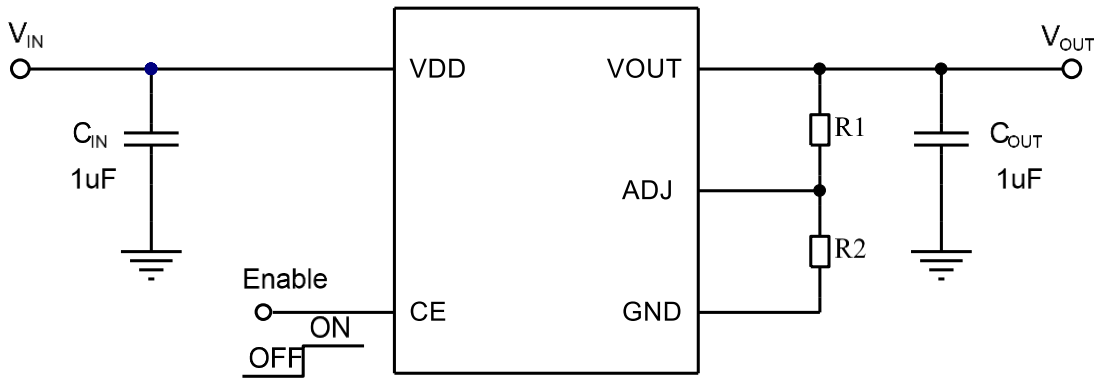


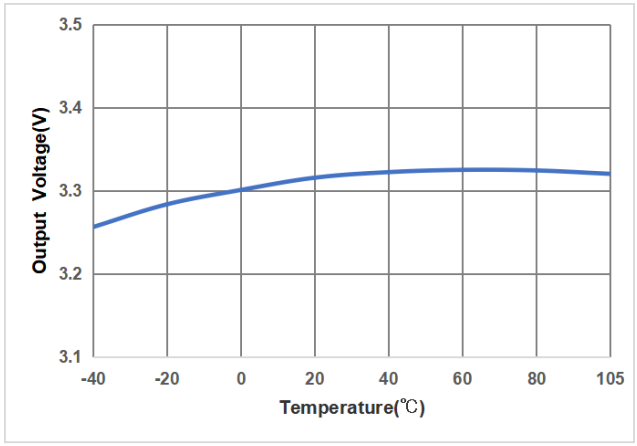
Fig 3. Application Circuits

*: V_{OUT} = (1 + R1 / R2) × 0.8V, 2 recommend 30KΩ ~ 100KΩ.

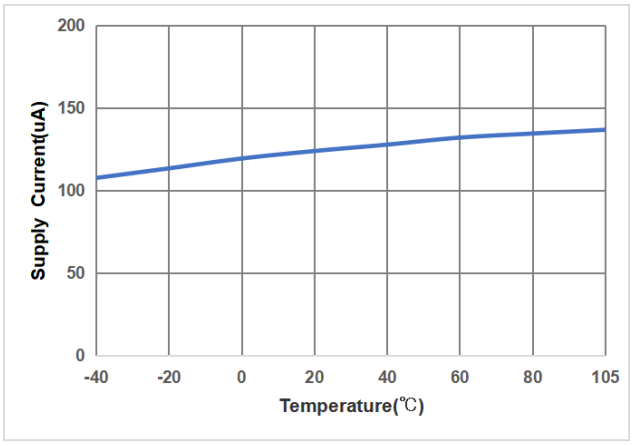
Typical Characteristics

VOLTAGE VERSION 3.3V

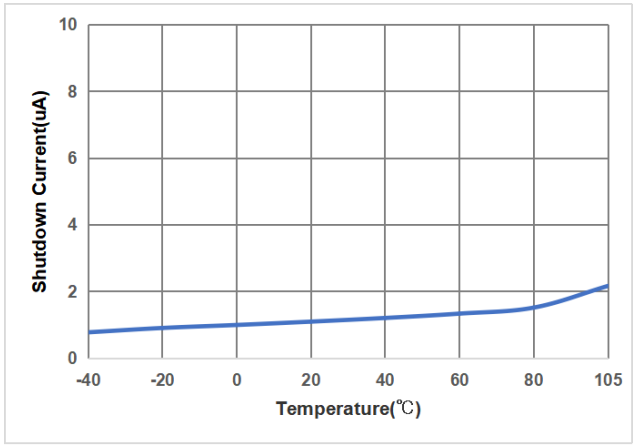
(V_{IN} = V_{EN} = 4.3V, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = 25°C.)



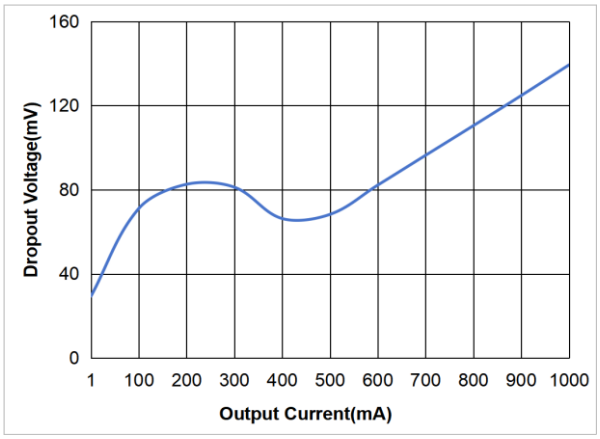
Output Voltage VS Temperature



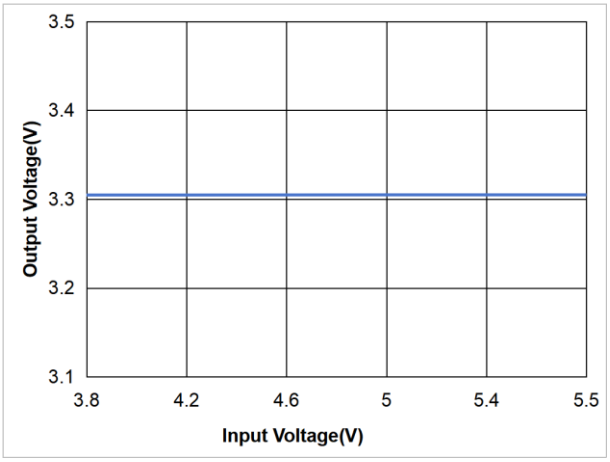
Supply Current VS Temperature



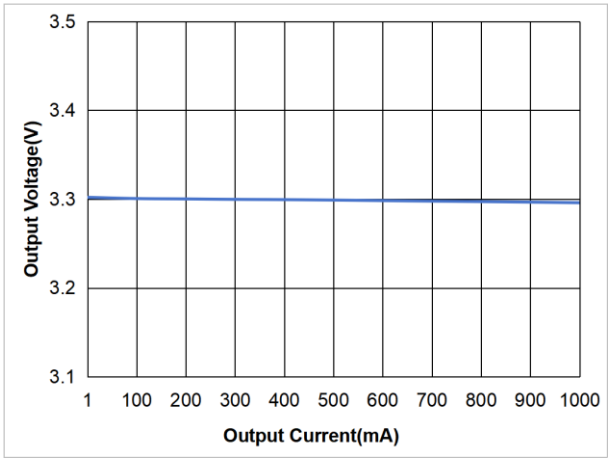
Shutdown Current VS Temperature



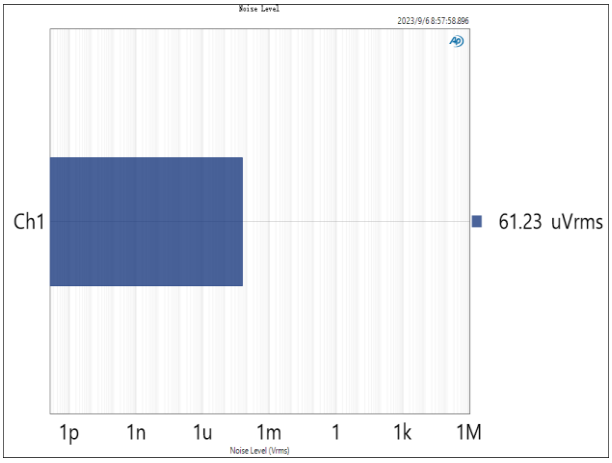
Dropout Voltage VS Output Current



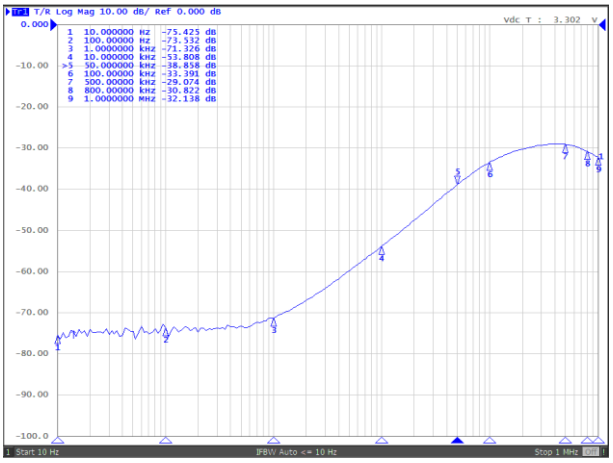
Output Voltage VS Input Voltage



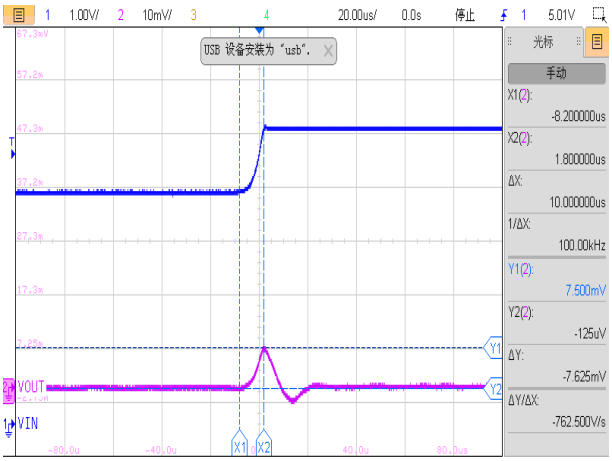
Output Voltage VS Output Current



Noise (I_{OUT} = 1A)

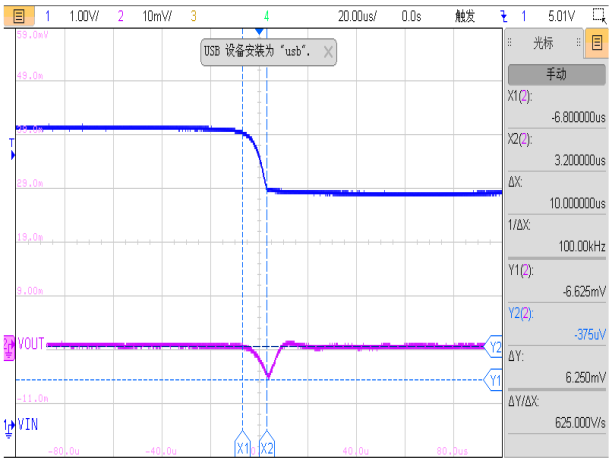


PSRR (I_{OUT} = 20mA)



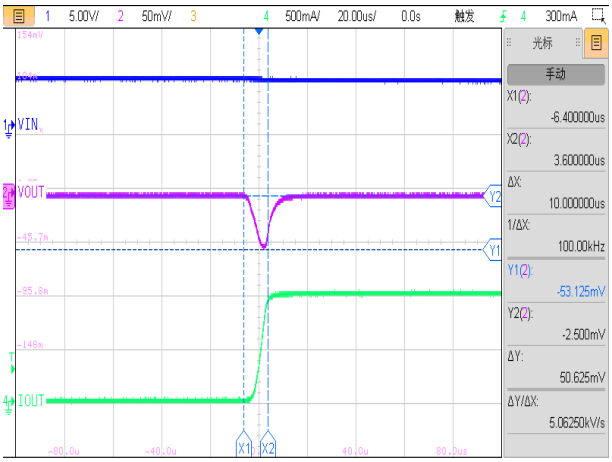
Line Transient Response

V_{IN} = 4.3V~5.5V, V_{OUT} = 3.3V, I_{OUT} = 1mA



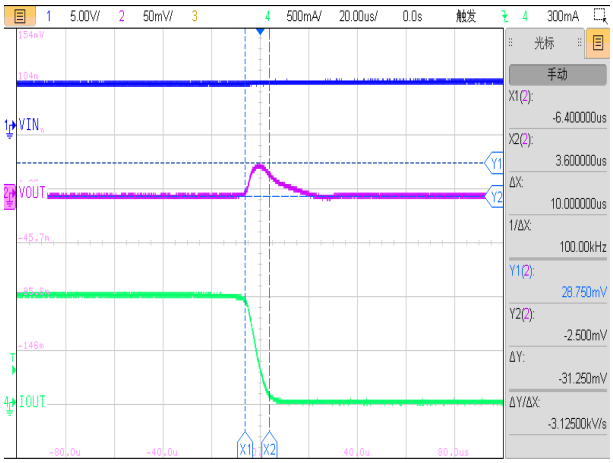
Line Transient Response

V_{IN} = 5.5V~4.3V, V_{OUT} = 3.3V, I_{OUT} = 1mA



Load Transient Response

V_{IN} = 4.3V, V_{OUT} = 3.3V, I_{OUT} = 1mA~1A

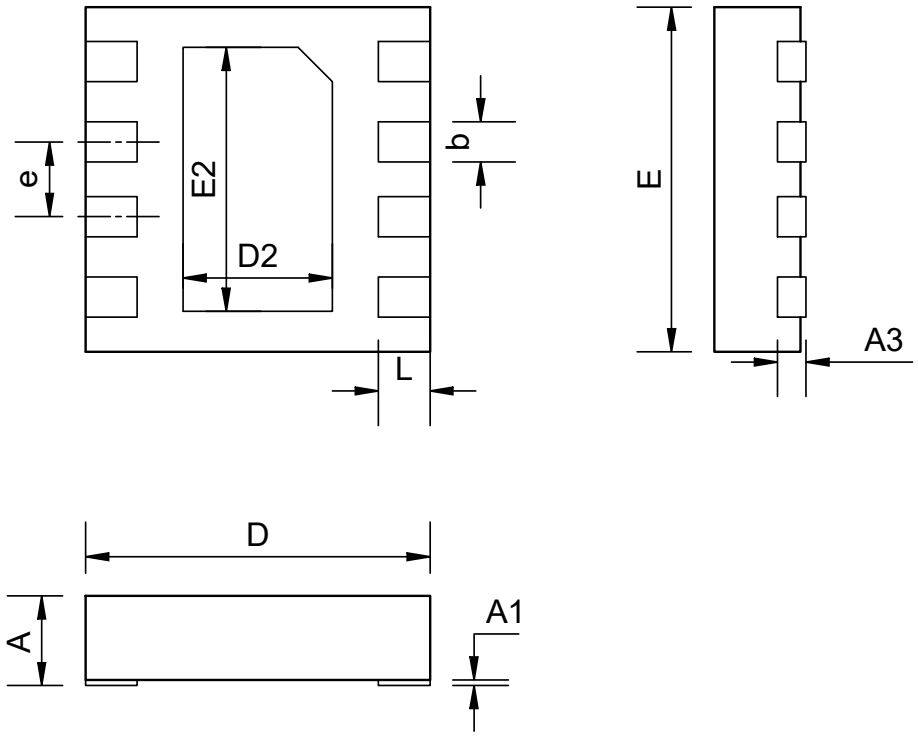


Load Transient Response

V_{IN} = 4.3V, V_{OUT} = 3.3V, I_{OUT} = 1A~1mA

Package Dimension

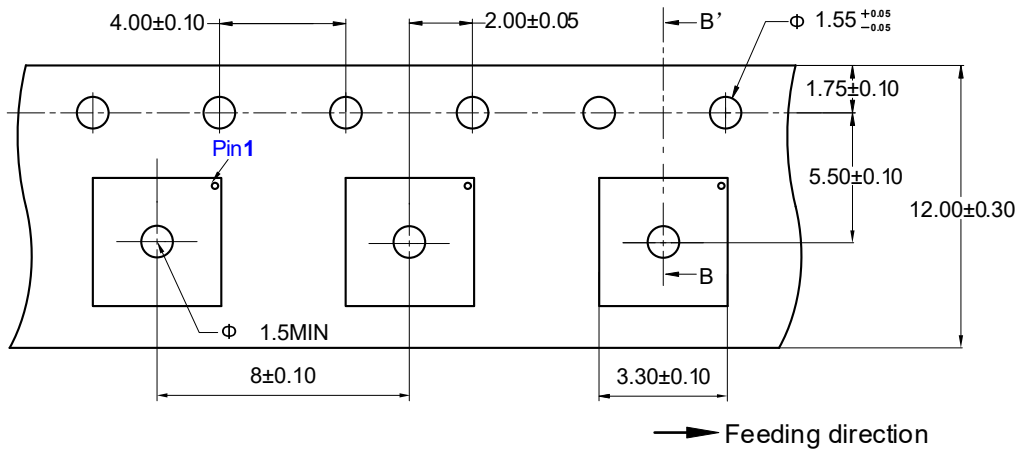
DFN8 (3mm × 3mm)



Common Dimensions
(Units of Measure = Millimeter)

Symbol	Min	Max
A	0.700	0.900
A1	0.000	0.050
A3	0.175	0.250
b	0.200	0.300
D	2.950	3.050
D2	2.100	2.350
E	2.950	3.050
E2	1.350	1.600
e	0.650	
L	0.425	0.625

Tape Information



Unit : mm

Marking Information



KO = Part Number
XX = Tracking Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2023-6-15	Initial Version	Shibo	Liuyg	Liujy
1.0	2023-9-11	Update Format and EC Table	Wangar	Tugz	Liujy
1.1	2025-1-10	Update EC Table	Licheng	Licheng	Liujy
1.1.a	2026-10-23	Add Tape and Marking	Xu tao	Yang xiaoxu	Liujy