ET5H8ADJY - High Input Very-Low I_Q 150mA LDO

General Description

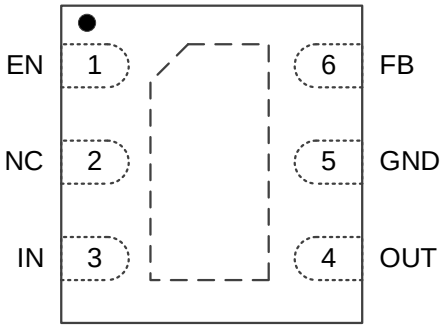
The ET5H8ADJY is a low dropout, 150mA load with enable function LDO. It operates from 2.5V~24V. The quiescent current is 7μA with no load. The devices feature integrated short-circuit and over-current protection. They are quite suitable for standby microprocessor control-unit systems.
ET5H8ADJY offers DFN6 (2mm × 2mm) package.

Features

- Input Voltage Range from 2.5V to 24V
- 150mA Load Current
- I_Q is 7μA Typical
- ADJ Output Voltage Range 1.0~5.5V
- Low Dropout is 420mV at 150mA @V_{OUT} = 3.3V
- Over-temperature Protection
- Current-limit Protection
- ESD Protection Complies with JESD22 Standard
  -- HBM: ±2000V Pass (JEDEC JS-001)
  -- CDM: ±1500V Pass (JEDEC JS-002)
- Part No. and Package Information

Part No.	Package	Packing Option	MSL
ET5H8ADJY	DFN6 (2mm × 2mm)	Tape and Reel, 3K/ Reel	1

Pin Configuration

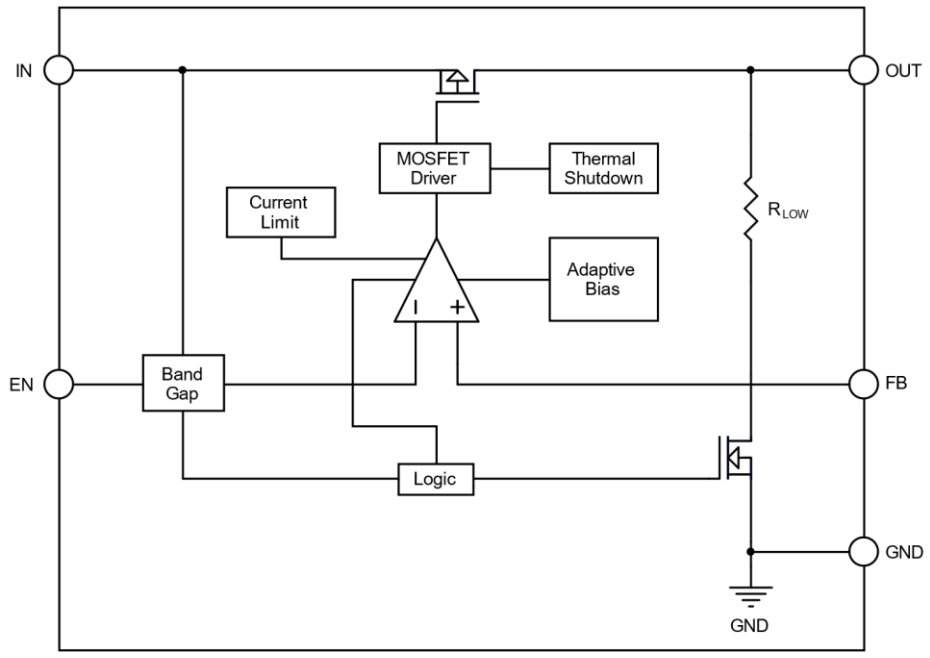


Top View

Pin Function

Pin No.	Pin Name	Pin Function
1	EN	Enable Input Pin
2	NC	No Connect
3	IN	Input Pin
4	OUT	Output Pin
5	GND	Ground Pin
6	FB	Feedback Pin

Block Diagram



Functional Description

Input Capacitor

A 1μF~10μF ceramic capacitor is recommended to connect between IN and GND pins to decouple input power supply glitch and noise. 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 from 1μF to 10μF, 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.

Enable

The ET5H8ADJY delivers the output power when it is set to enable state. When it works in disable state, there is no output power and the operation quiescent current is almost zero. The enable pin (EN) is active high.

Dropout Voltage

The ET5H8ADJY uses a PMOS pass transistor to achieve low dropout. When (V_{IN} - V_{OUT}) is less than the dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DROP} scales approximately with output current because the PMOS device behaves like a resistor in dropout mode. As with any linear regulator, PSRR and transient response degrade as (V_{IN} - V_{OUT}) approaches dropout operation.

Adjustable Output Voltage (FB)

One can select an output voltage between 1.0V to 5.5V by using an external resistor divider. Calculate the output voltage using the following equation, where V_{FB} = 0.6 V.

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

Thermal Shutdown

Thermal shutdown protection disables the output when the junction temperature rises to approximately 155°C. Disabling the device eliminates the power dissipated by the device, allowing the device to cool. When the junction temperature cools to approximately 130°C, the output circuitry is again enabled.

Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, protecting the LDO from damage as a result of overheating. Activating the thermal shutdown feature usually indicates excessive power dissipation as a result of the product of the (V_{IN} - V_{OUT}) voltage and the load current. For reliable operation, limit junction temperature to 155°C maximum.

Thermal Considerations

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula:

$$\mathbf{P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}}$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance.

Current-Limit Protection

The ET5H8ADJY provides current limit function to prevent the device from damages during over-load or shorted-circuit condition. This current is detected by an internal sensing transistor.

Layout Guidelines

- Place input and output capacitors as close to the device as possible.
- Use copper planes for device connections in order to optimize thermal performance.
- Place thermal vias around the device to distribute heat.
- Do not place a thermal via directly beneath the thermal pad of the DRV package. A via can wick solder or solder paste away from the thermal pad joint during the soldering process, leading to a compromised solder joint on the thermal pad.

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage (1)	-0.3 ~ 28	V
V_{OUT}	Output Voltage	-0.3 ~ 6	V
V_{EN}	Chip Enable Input	-0.3 ~ 12	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65 ~ +150	°C
ESD	HBM Capability (2)	2000	V
	CDM Capability (2)	1500	V

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:

ESD Human Body Model tested per JEDEC JS-001;

CDM tested per JEDEC JS-002;

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	DFN6 (2mm × 2mm)	Thermal Characteristics, Thermal Resistance, Junction-to-Air	66.7	°C/W
Power Dissipation @25°C	DFN6 (2mm × 2mm)	PCB Board Dimension: 50mm x 50mm (2layer) Copper :1OZ	1500	mW

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.5 to 24	V
I_{OUT}	Output Current	0 to 150	mA
T_J	Operating Junction Temperature	-40 to 125	°C
C_{IN}	Input Capacitor Value	1 to 10	μF
C_{OUT}	Output Capacitor Value	1 to 10	μF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

(V_{IN} = V_{OUT} + 2V; I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C.)[3]

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN} [4]	Operating Input Voltage		2.5		24	V
V_{UVLO}	Under Voltage Lock Out	V_{IN} Rising	1.9	2.1	2.3	V
V_{UVLO_HYS}		Hysteresis	0.05	0.20	0.30	
I_{Q_ON} [5]	Quiescent Current	I_{OUT} = 0mA, 25°C		7	15	μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, 25°C		0.1	1.5	μA
V_{FB}	Reference Voltage	V_{IN} = 5V, 25°C	0.591	0.6	0.609	V
V_{DROP} [6] [8]	Dropout Voltage	I_{OUT} = 100mA, V_{OUT} = 5.0V, 25°C		200	300	mV
		I_{OUT} = 150mA, V_{OUT} = 5.0V, 25°C		310	465	
		I_{OUT} = 100mA, V_{OUT} = 3.3V, 25°C		260	390	
		I_{OUT} = 150mA, V_{OUT} = 3.3V, 25°C		420	630	
		I_{OUT} = 100mA, V_{OUT} = 1.95V, 25°C			500	
Reg_{LINE} [8]	Line Regulation	V_{OUT} + 2V ≤ V_{IN} ≤ 24V, I_{OUT} = 10mA		0.02	0.2	%/V
Reg_{LOAD} [8]	Load Regulation	1mA ≤ I_{OUT} ≤ 150mA, V_{IN} = V_{OUT} + 2V		10	40	mV
I_{LMT}	Current Limit	V_{IN} = V_{OUT} + 2V, 25°C		300	500	mA
I_{SHORT}	Short Current Limit	V_{OUT} = 0V	55	75	120	mA
V_{IH}	EN Pin Threshold Voltage	EN Input Voltage “H”	1.4			V
V_{IL}	EN Pin Threshold Voltage	EN Input Voltage “L”			0.4	V
PSRR [7]	Power Supply Rejection Ratio	f = 1 kHz, V_{IN} = V_{OUT} + 2V V_{OUT} = 3.3V, I_{OUT} = 20mA	40	50		dB
e_N [7]	Output Noise Voltage	V_{IN} = V_{OUT} + 2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, C_{OUT} = 1μF		50* V_{OUT}	80* V_{OUT}	μVrms
R_{DIS}	Output Discharge FET $R_{DS(ON)}$	V_{EN} = 0V, I_{OUT} = 10mA	15	35	70	Ω
T_{ON}	Soft-start	V_{IN} = V_{EN} = 5.3V, from V_{EN}> V_{IH} to 90% V_{OUT}, V_{OUT} = 3.3V		500	900	μs
		V_{IN} = V_{EN} = 3.3V, from V_{EN} > V_{IH} to 90% V_{OUT}, V_{OUT} = 1.95V		500	900	
T_{TSD} [7]	Thermal Shutdown Temperature	Temperature Increasing from T_A = +25°C	130	155	170	°C
T_{HYS} [7]	Thermal Shutdown Hysteresis	Temperature Falling from T_{TSD}	15	25	35	°C

Note3: Here V_{IN} means internal circuit can work normal. If $V_{IN}<V_{OUT}$, Output voltage follows V_{IN} (I_{OUT} = 1mA), circuit is safety.

Note4: The maximum input voltage should take into account the maximum power consumption (P_{D_MAX}).

Note5: V_{OUT} = 0.6V × (1 + R1 / R2); R2 = 300K ~ 1MΩ.

Note6: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} + $V_{DROPMAX}$ with 100 / 150mA output current.

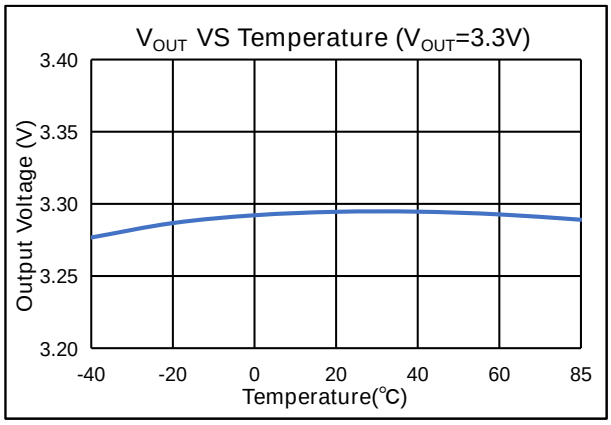
Note7: Guaranteed by design and characterization. not a FT item.

Note8: At high temperatures, the maximum load current can be calculated according to the following formula：

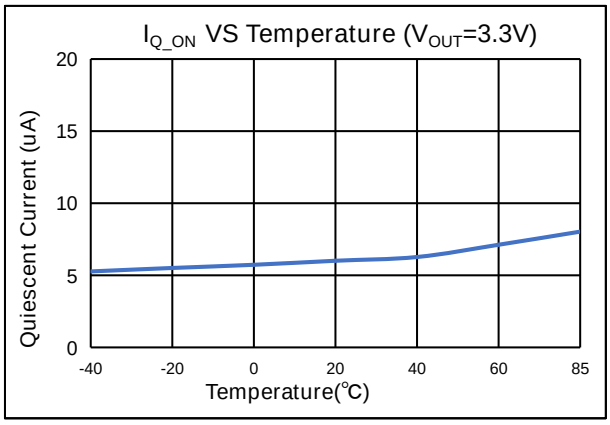
$$\mathbf{I_{OUT\_MAX} = (T_J - T_A) / R_{\theta JA} / (V_{IN} - V_{OUT})}$$

Typical Characteristics

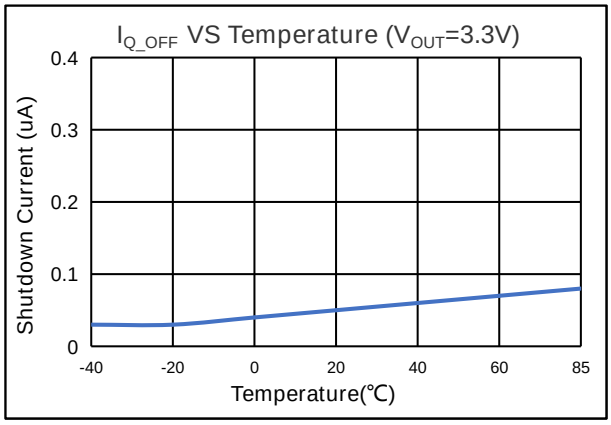
Voltage set 3.3V (V_{IN} = V_{OUT} + 2V, I_{OUT} = 1mA, R1 = 2.7MΩ, R2 = 600kΩ, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C).



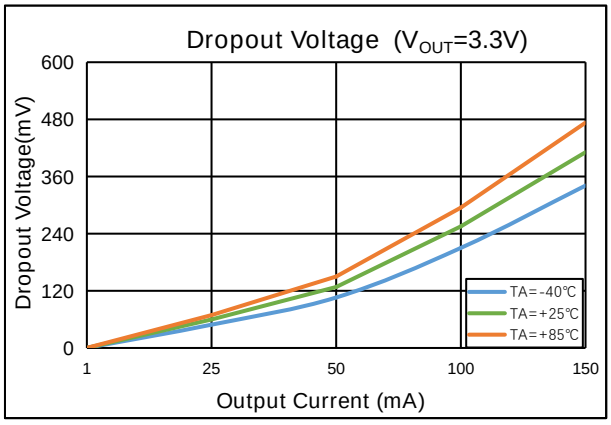
Output Voltage VS Temperature



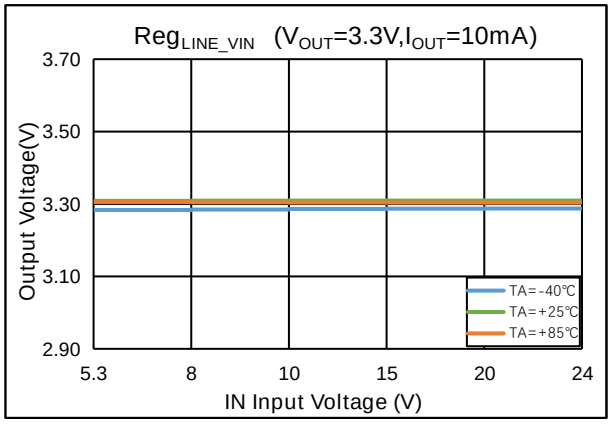
Quiescent Current VS Temperature



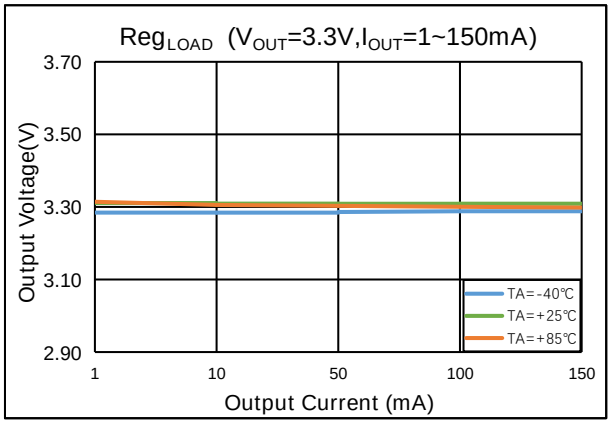
Standby Current VS Temperature



Dropout Voltage VS Output Current



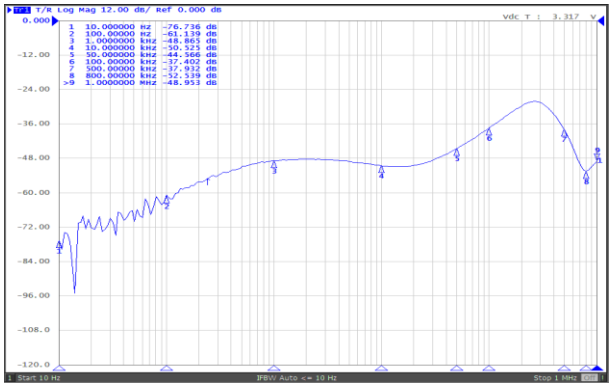
Output Voltage VS Input Voltage



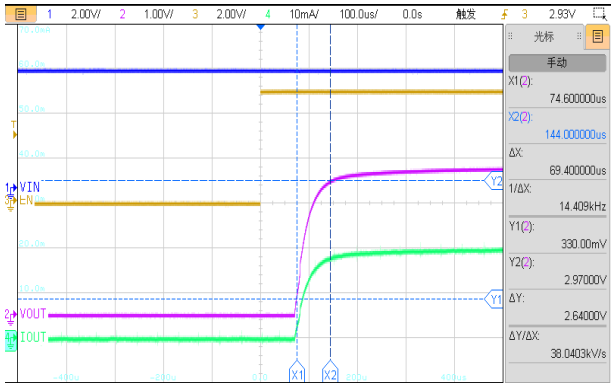
Output Voltage VS Output Current

Typical Characteristics (Continued)

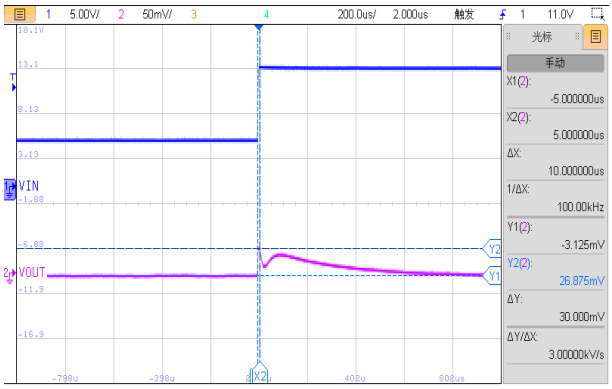
Voltage set 3.3V (V_{IN} = V_{OUT} + 2V, I_{OUT} = 1mA, R1 = 2.7MΩ, R2 = 600kΩ, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C.)



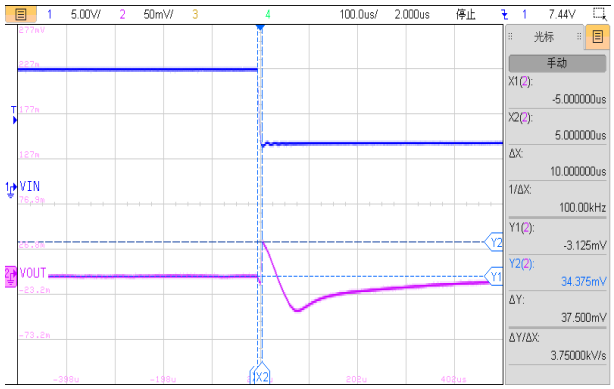
PSRR (I_{OUT} = 20mA)



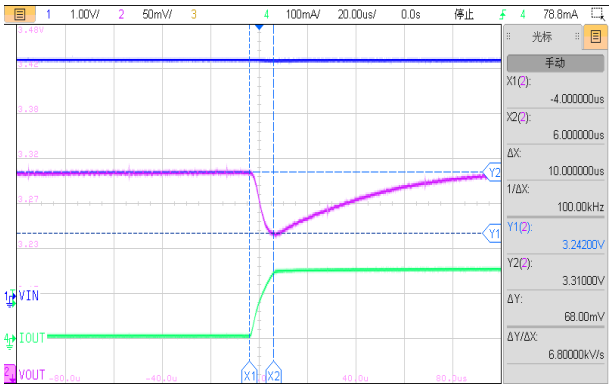
T_{ON} (I_{OUT} = 20mA)



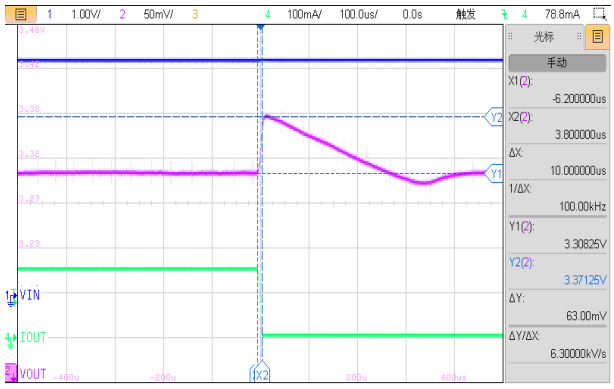
Input-Transient (5.3~13.3V, tr = 10μs, I_{OUT} = 1mA)



Input-Transient (13.3~5.3V, tf = 10μs, I_{OUT} = 1mA)

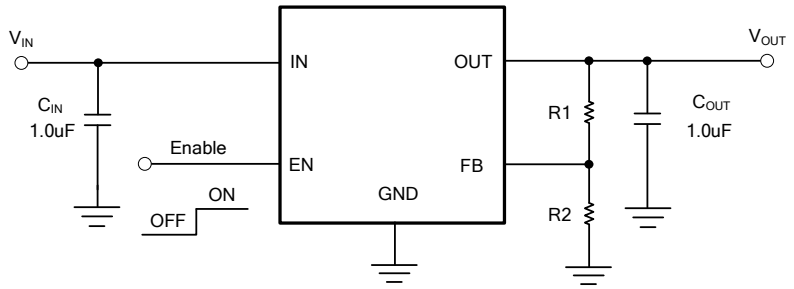


Load-Transient(V_{IN} = 5.3V, I_{OUT} = 1~50mA, tr = 10μs)



Load-Transient(V_{IN} = 5.3V, I_{OUT} = 1~150mA, tr = 10μs)

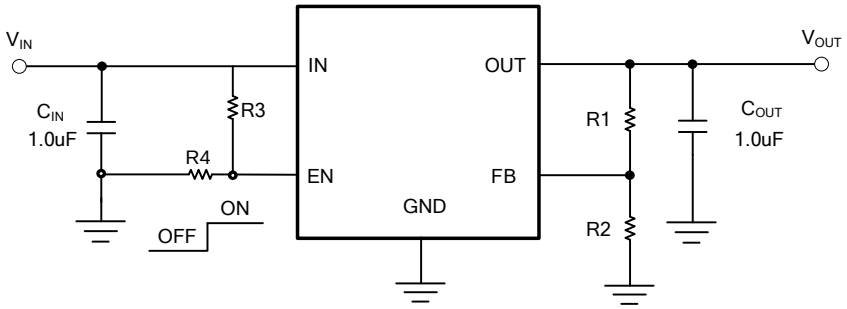
Application Circuits



1.EN controlled by GPIO [(9)]

(1). V_{EN} power on later than V_{IN}

(2). V_{EN} power on earlier than V_{IN}



2. EN connect to IN [(10)]

Note9: If EN is controlled by GPIO, the recommended sequence is as follows:

1. V_{IN} first, than V_{EN} ($V_{EN} \leq V_{IN}$, it is recommended that V_{IN} be powered on for 10us before V_{EN} is powered on)；

2. V_{EN} first, than V_{IN} ($V_{EN} \leq 6V$, it is recommended that V_{EN} be powered on for 10us before V_{IN} is powered on)；

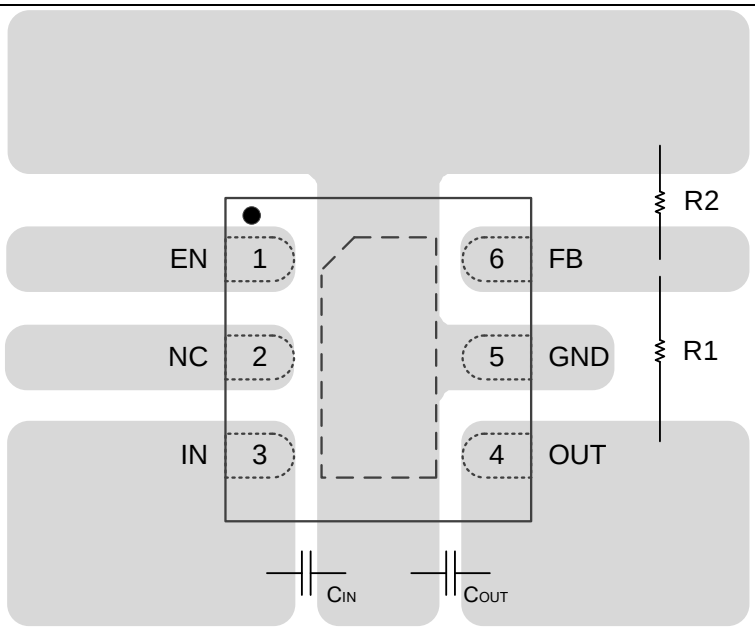
3. Recommended that V_{EN} be powered off for 10us before V_{IN} is powered off；

Note10: If EN connect to V_{IN}, resistor divider structure is recommended. R3 = 10MΩ, V_{EN} = 2-6V,

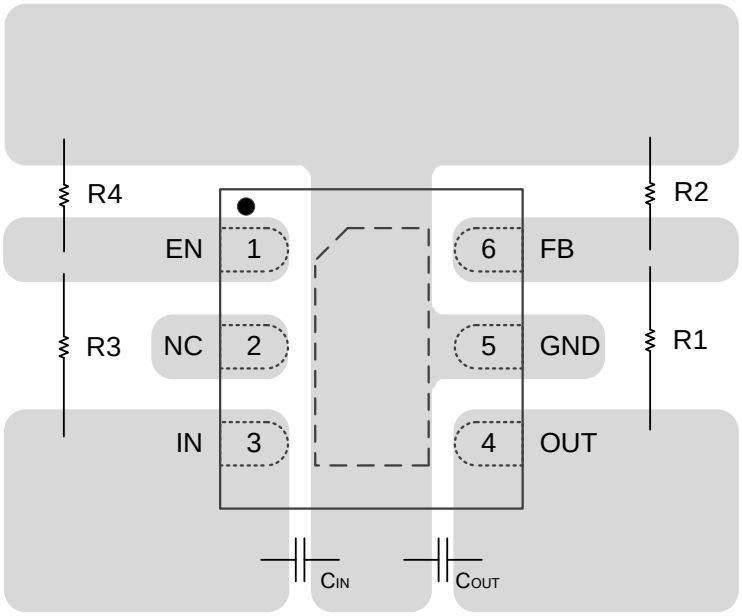
R4 = R3 / (V_{IN} / V_{EN}-1).

Note11: V_{OUT} = 0.6V × (1 + R1 / R2); Recommended R2 = 300K ~ 1MΩ.

PCB Layout Guide



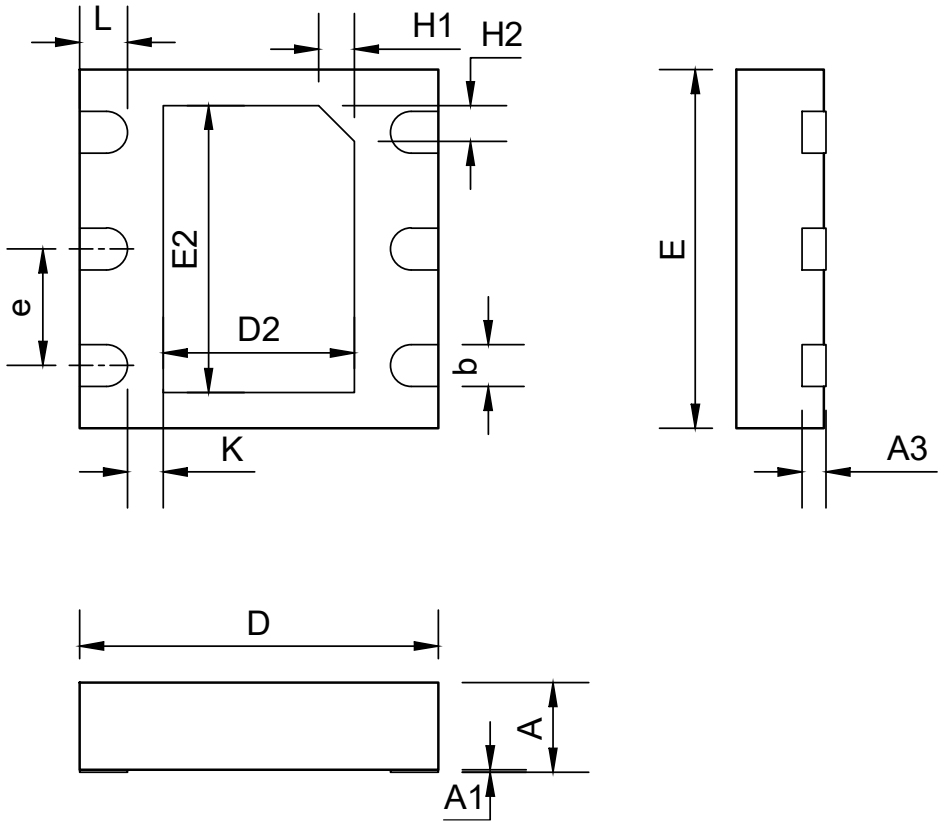
1.EN Controlled by GPIO



2. EN Connect to IN

Package Dimension

DFN6

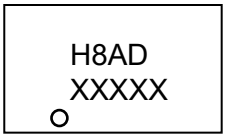


COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	--	0.05
A3	0.18	--	0.25
b	0.25	0.30	0.35
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.90	1.00	1.10
E2	1.50	1.60	1.70
e	0.65BSC		
H1	0.25	0.30	0.35
H2	0.20	0.25	0.30
L	0.20	0.25	0.30
k	0.20	--	--

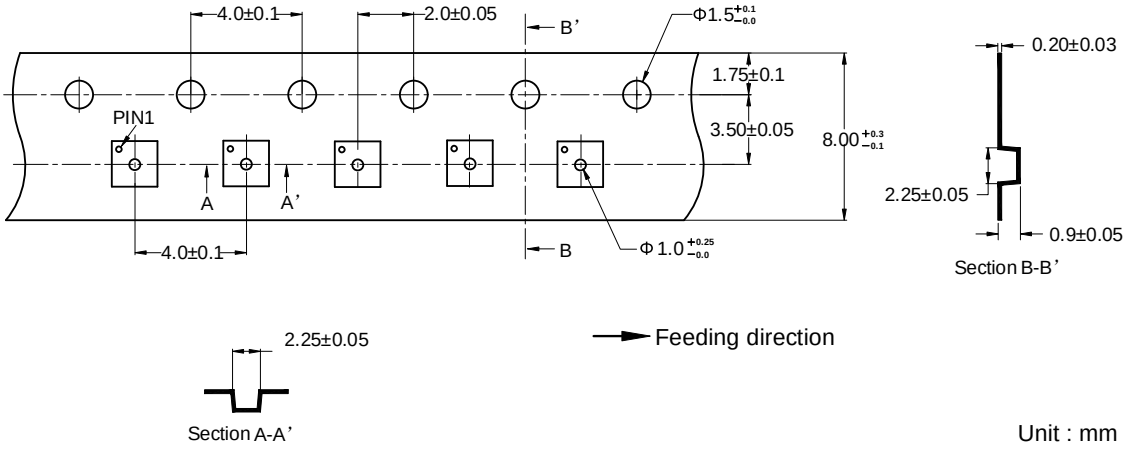
Marking



H8AD = Part Number

XXXXX = Tracking Number

Tape Information



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2024-11-14	Preliminary Version	Chensb	Liuxm	Tugz
1.0	2025-02-28	Official Version	Pengjj	Liuxm	Liujy
1.1	2025-05-13	Update EC table	Yangxiaoxu	Liuxm	Liujy
1.2	2025-05-13	Update Typical Characteristics	Pengjj	Liuxm	Liujy
1.3	2025-05-13	Update Electrical Characteristics	Pengjj	Liuxm	Liujy
1.4	2025-07-28	Update Package Dimension	Pengjj	Liuxm	Liujy
1.4.a	2026-03-16	Update Format	Yuyf	Yangxx	Liujy
1.4.b	2026-07-13	Update V_{OUT} Range	Yangxx	Yangxx	Liujy