ET5H6ADJ - High Input Ultra-high PSRR 300mA LDO

General Description

ET5H6ADJ is a high input voltage and ultra-high PSRR 300mA LDO with enable function that output adjustable from 1.0V~5.0V, which is designed specifically for portable battery-powered applications which require low quiescent current. The consumption of type 50uA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

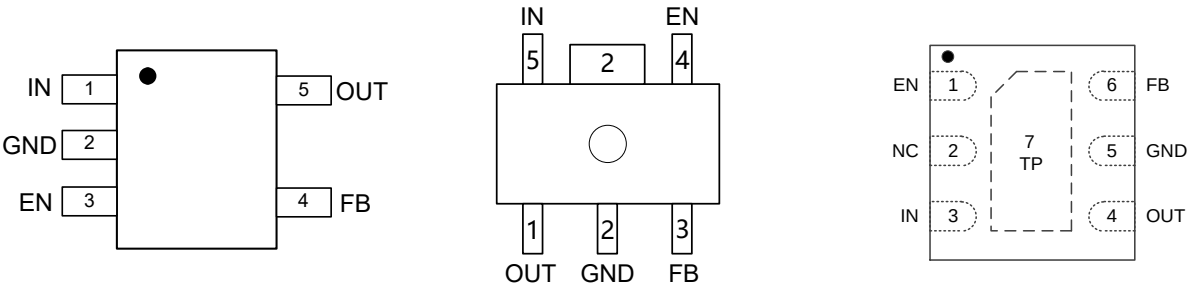
ET5H6ADJ offered SOT89-5, SOT23-5, DFN6 packages.

Features

- Wide Input Voltage Range from 3V to 24V
- Up to 300mA Load Current
- Low I_Q is 50μA Typical
- ADJ Output Voltage Range 1.0V~5.0V
- Very Low Dropout is 330mV at 150mA Load @V_{OUT} = 3.3V
- Excellent Load/Line Transient Response
- Ultra-High Ripple Rejection: 90dB at 1kHz
- Part No. and Package Information

Part No.	Package	MSL
ET5H6ADJ	SOT23-5	3
ET5H6ADJC	SOT89-5	3
ET5H6ADJY	DFN6 (2mm×2mm)	1

Pin Configuration



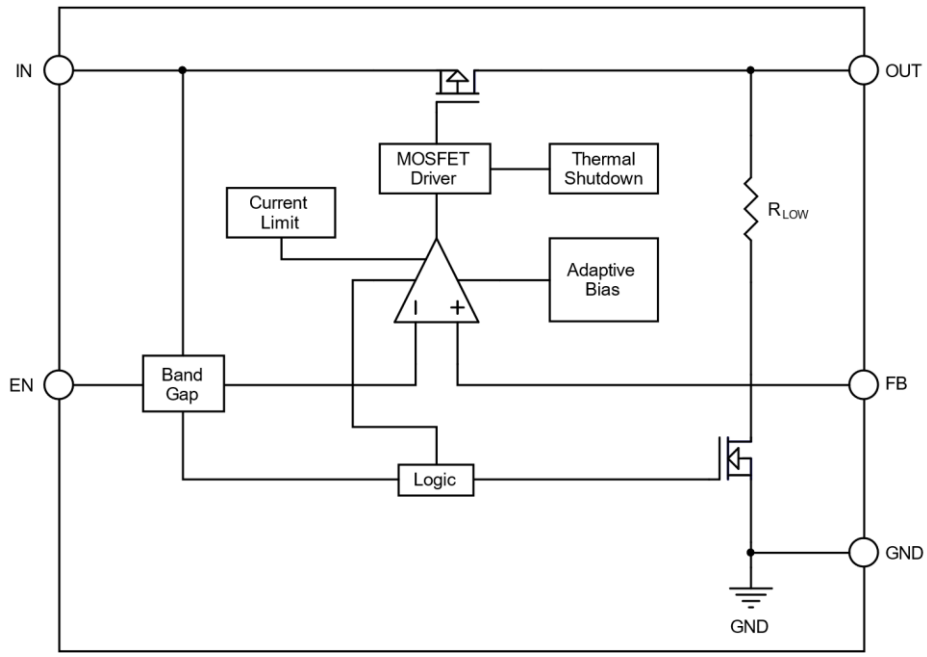
(ET5H6ADJ)SOT23-5 (ET5H6ADJC)SOT89-5 (ET5H6ADJY)DFN6

Top View

Pin Function

Pin Name	Pin Function
IN	Supply Input Pin.
OUT	Output Pin.
EN	ON/OFF Control, Active “H”
GND	Ground.
FB	Set the Output Voltage by Using Divider Resistors
TP	Thermal Pad. Only be connect to GND or floating, can’t be connected to other pins

Block Diagram



Functional Description

Input Capacitor

A 1μF~10uF ceramic capacitor is recommended to connect between VIN 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 VIN 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 ET5H6ADJ 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 ET5H6ADJ uses a PMOS pass transistor to achieve low dropout. When (V_{IN} - V_{OUT}) is less than the dropout voltage (V_{DO}), 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_{DO} 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.

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 150°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:

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

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.

For recommended operating condition specifications the maximum junction temperature is 150°C and T_A is

the ambient temperature. The junction to ambient thermal resistance, θ_{JA}, is layout dependent. For SOT89-5 package, the thermal resistance θ_{JA} is 100°C/W on the test board. The maximum power dissipation at T_A = 25°C can be calculated by the following formula:

$P_{D(MAX)}$ = (150°C - 25°C) / (100°C / W) = 1.25W for SOT89-5 package

The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA}.

Current-Limit Protection

The ET5H6ADJ 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. 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.
- Thermal pad only be connected to GND or floating, can’t be connected to other pins.

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage (1)	-0.3~30	V
V_{OUT}	Output Voltage	-0.3~6	V
V_{EN}	Chip Enable Input	-0.3~30	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65~150	°C
V_{ESD} (2)	HBM Capability	±2000	V
	CDM Capability	±1500	V
I_{LU} (2)	Latch up Current Maximum Rating	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:

ESD HBM tested per JEDEC JS-001;

ESD CDM tested per JEDEC JS-002;

Latch up Current Maximum Rating tested per JEDEC JESD78F.

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
θ_{JA}	SOT89-5	Thermal Characteristics, Thermal Resistance, Junction-to-Air	100	°C/W
	SOT23-5		312	
	DNF6 (2mm × 2mm)		125	

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3 to 24	V
I_{OUT}	Output Current	0 to 300	mA
T_J	Operating Junction Temperature	-40 to 125	°C
C_{IN}	Effective Input Ceramic Capacitor Value	1 to 10	uF
C_{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	uF
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} = 2.2μF, unless otherwise noted. Typical values are at T_A = +25°C.) (3)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating Input Voltage (4)		3		24	V
V_{FB}	FB Voltage	I_{OUT} = 1mA, 25°C	0.591	0.600	0.609	V
		I_{OUT} = 1mA, -40~125°C	0.588		0.612	V
$Line_{REG}$	Line Regulation (7)	V_{OUT} + 2 ≤ V_{IN} ≤ 24V I_{OUT} = 10mA		0.05	0.20	%/V
$V_{LoadREG}$	Load Regulation T_A = +25°C (7)	1mA ≤ I_{OUT} ≤ 300mA, V_{IN} = V_{OUT} + 2V		20	40	mV
V_{DROP}	Dropout Voltage (5) (7) T_A = +25°C	I_{OUT} = 300mA		600	950	mV
		I_{OUT} = 150mA		270	450	mV
$I_{_LMT}$	Current Limit	V_{IN} = V_{OUT} + 2V, T_A = +25°C	350	600	900	mA
$I_{_SHORT}$	Short Current Limit	V_{IN} = V_{OUT} + 2V, T_A = +25°C	80	150	220	mA
I_Q	Quiescent Current	I_{OUT} = 0mA, T_A = +25°C		60	90	μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, T_A = +25°C		0.1	1	μA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage “H”	1.0			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage “L”			0.4	V
I_{EN}	EN Pin Current	V_{EN} = 0-24V		1		uA
PSRR	Power Supply Rejection Ratio V_{IN} =V_{OUT}+2V I_{OUT} = 20mA	f = 1 kHz	70	90		dB
eN	Output Noise Voltage(6)	V_{IN} = V_{OUT} + 2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, (V_{OUT} = 3.3V) C_{OUT} = 1μF		70	95	μVrms
R_{DIS}	Output discharge FET Rdson	V_{EN} < V_{IL}(Output Disable)	40	100	160	Ω
T_{SD}	Thermal Shutdown Temperature(6)	Temperature Increasing from T_A = +25°C	130	155	180	°C
T_{SDH}	Thermal Shutdown Hysteresis(6)	Temperature Falling from TSD	15	25	35	°C

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

Note4: The minimum operating voltage is 3.0V. V_{DROP} = $V_{IN(min)}$ - V_{OUT}.

Note5: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} + $V_{DROPMAX}$ with 300mA output current.

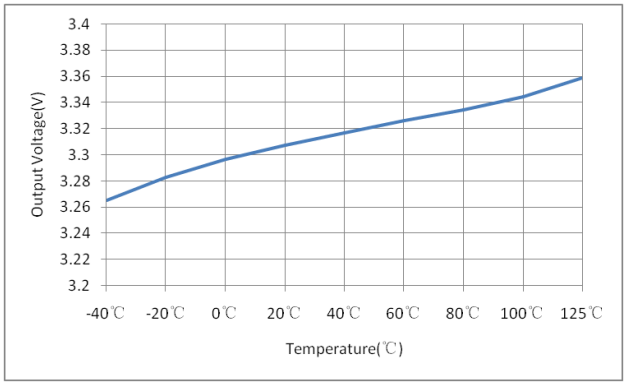
Note6: Guaranteed by design and characterization. not a FT item.

Note7: At high temperatures, the maximum load current can be calculated according to the following formula：

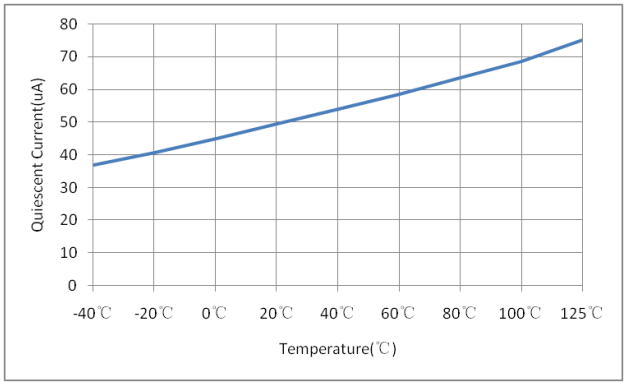
$$I_{OUT_MAX} = (T_J - T_A) / R_{\theta JA} / (V_{IN} - V_{OUT})$$

Typical Characteristics

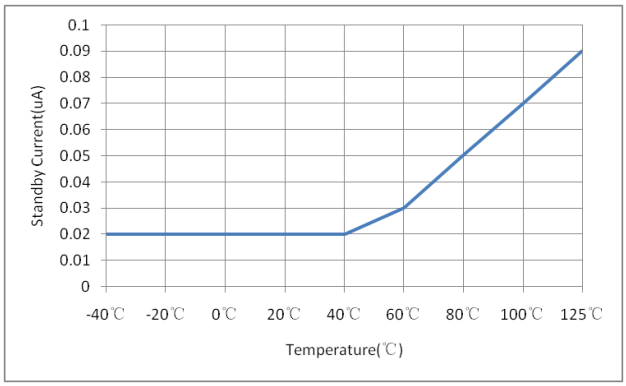
Voltage set 3.3V (V_{IN} = V_{OUT} + 2V, I_{OUT} = 10mA, R1 = 200kΩ, R2 = 900kΩ，C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C).



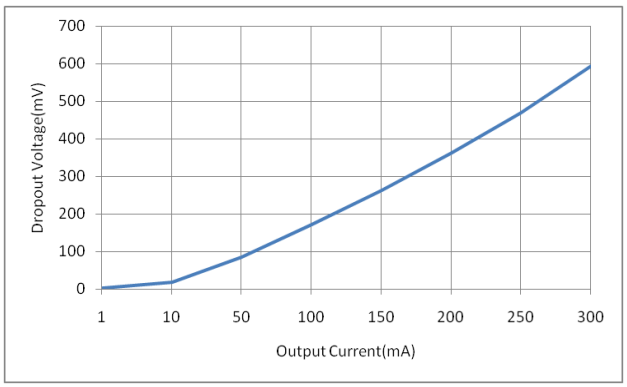
Output Voltage VS Temperature



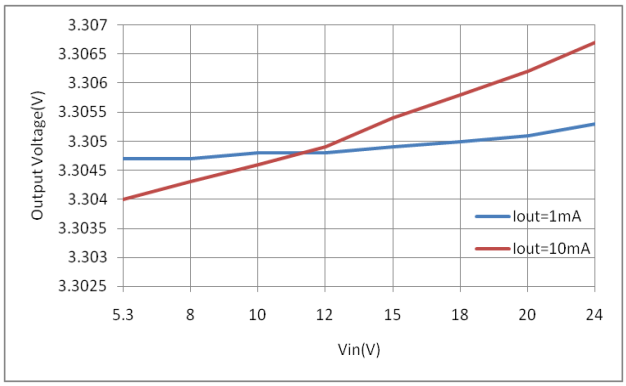
Quiescent Current VS Temperature



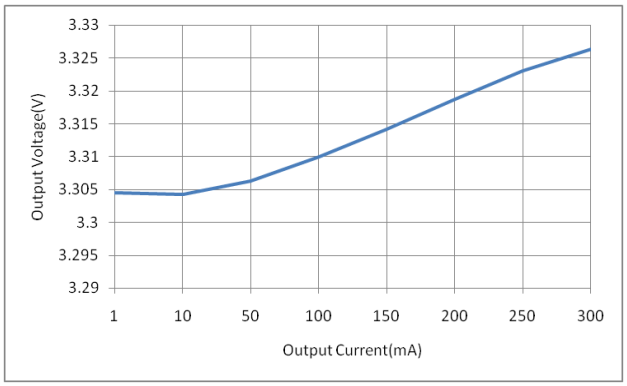
Standby Current VS Temperature



Dropout Voltage VS Output Current



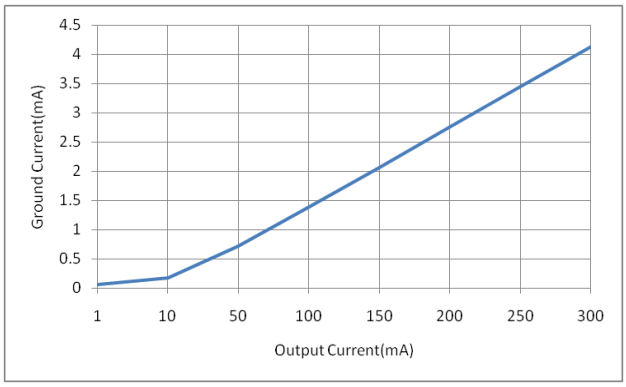
Output Voltage VS Input Voltage



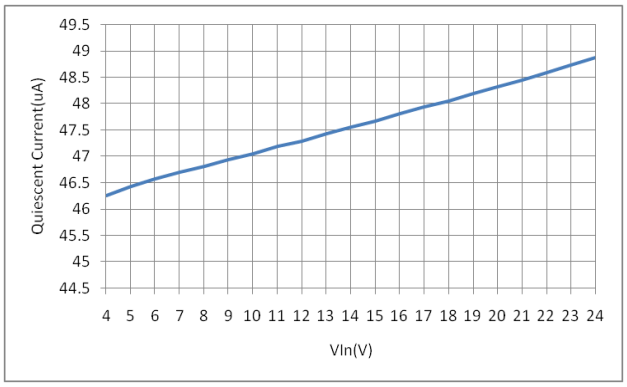
Output Voltage VS Output Current

Typical Characteristics (Continued)

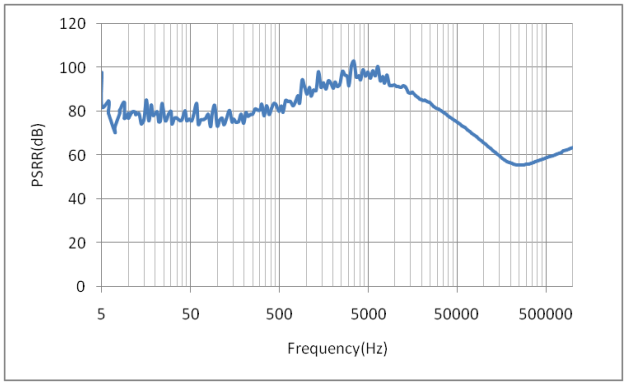
Voltage set 3.3V (V_{IN} = V_{OUT} + 2V, I_{OUT} = 10mA, R1 = 200kΩ，R2 = 900kΩ，C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C).



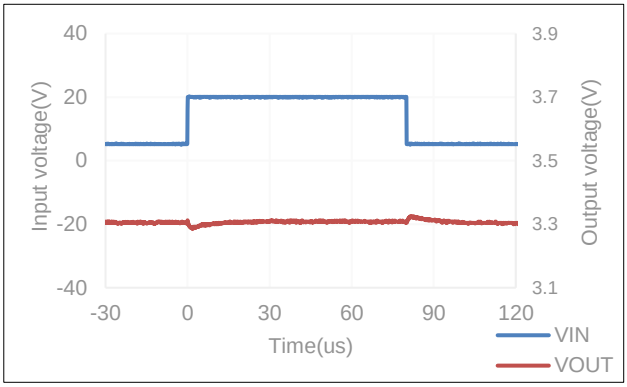
Ground Current VS Output Current



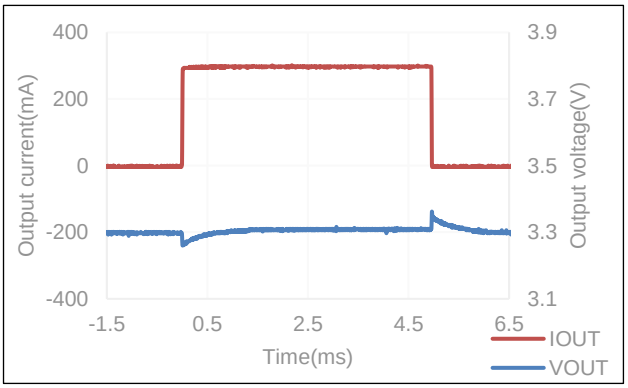
Quiescent Current VS Input Voltage



PSRR

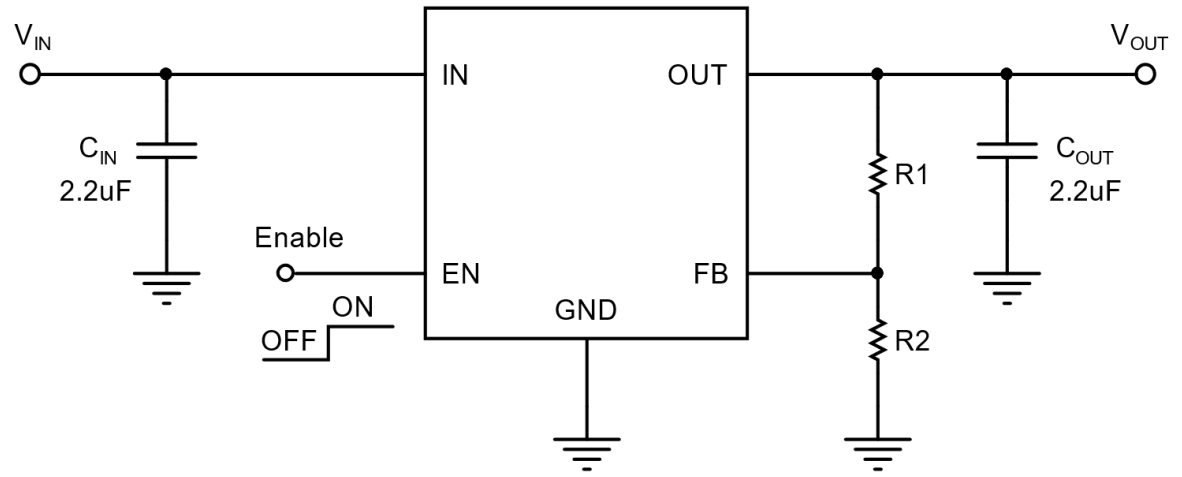


Line-Transient Response(I_{OUT} = 20mA)



Load-Transient Response

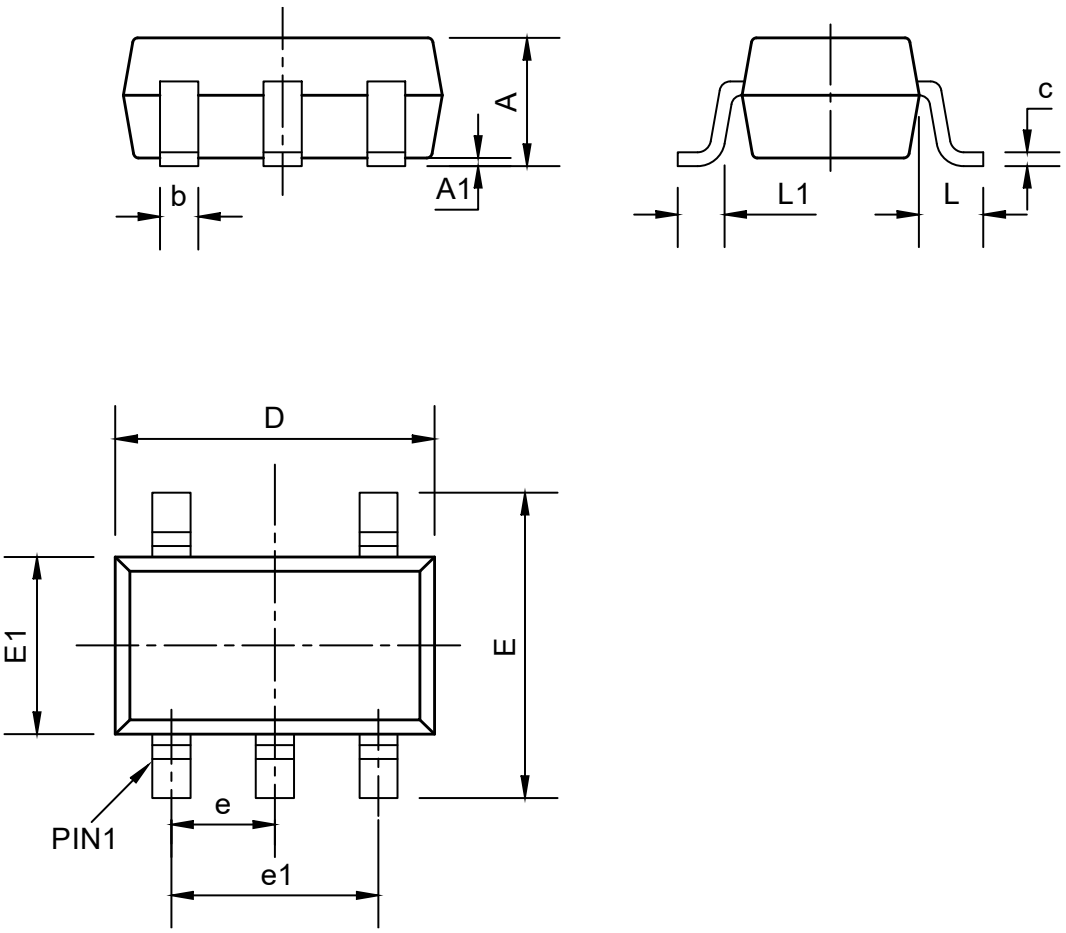
Application Circuits



Note *: V_{OUT} = 0.6V × (R1 + R2) / R2； Recommended R2 = 100K~1M
If have thermal pad, it only be connected to GND or floating, can't be connected to other pins.

Package Dimension

SOT23-5

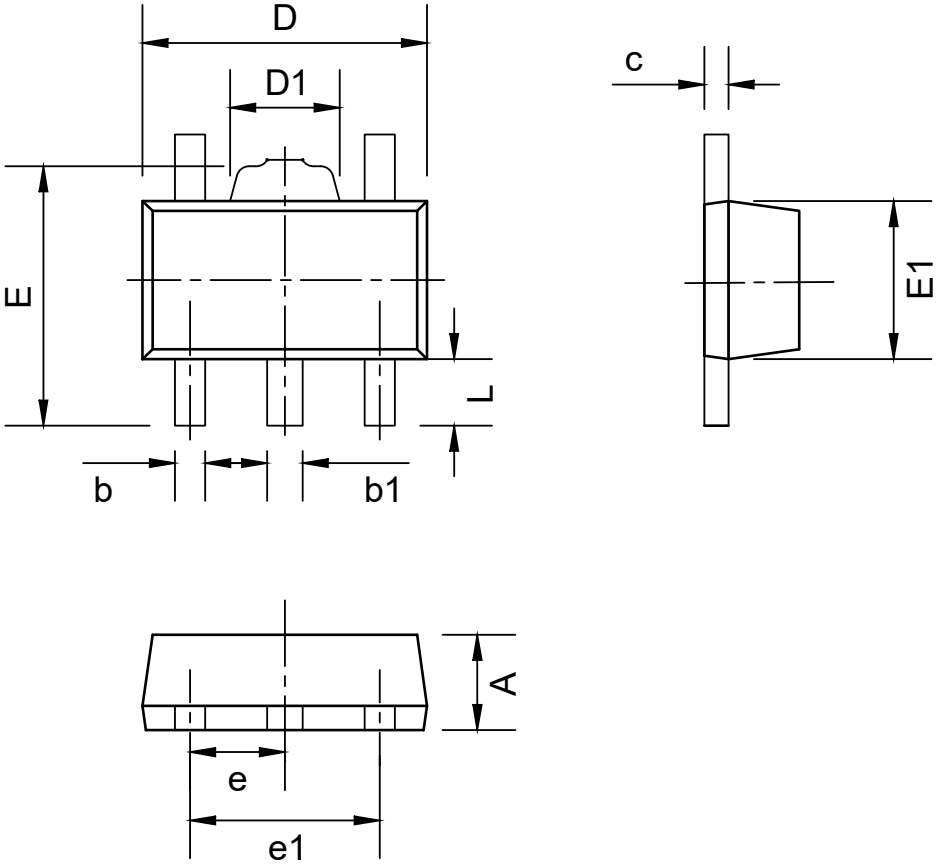


COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	MAX
A	1.05	1.25
A1	0.03	0.15
b	0.35	0.50
c	0.08	0.20
D	2.82	3.02
E	2.65	3.05
E1	1.50	1.70
e	0.95BSC	
e1	1.80	2.00
L	0.70REF	
L1	0.30	0.60

SOT89-5

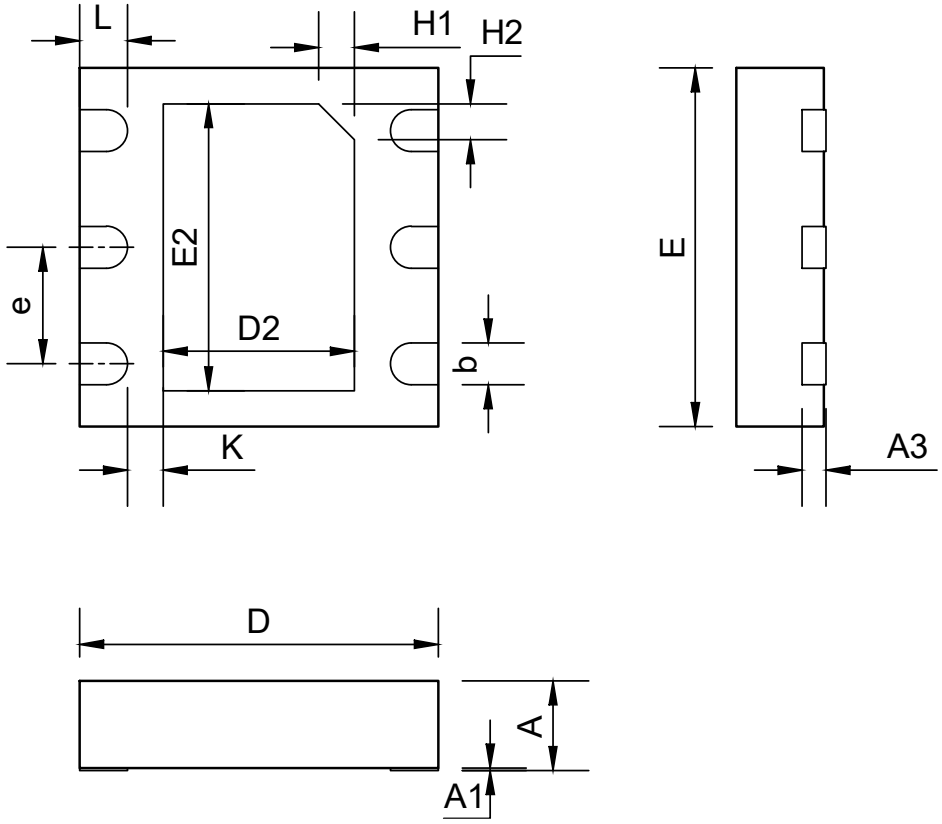


COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	MAX
A	1.40	1.60
b	0.32	0.52
b1	0.36	0.56
c	0.35	0.44
D	4.40	4.60
D1	1.40	1.80
E	3.94	4.52
E1	2.30	2.60
e	1.50BSC	
e1	2.90	3.10
L	0.90	1.10

DFN6

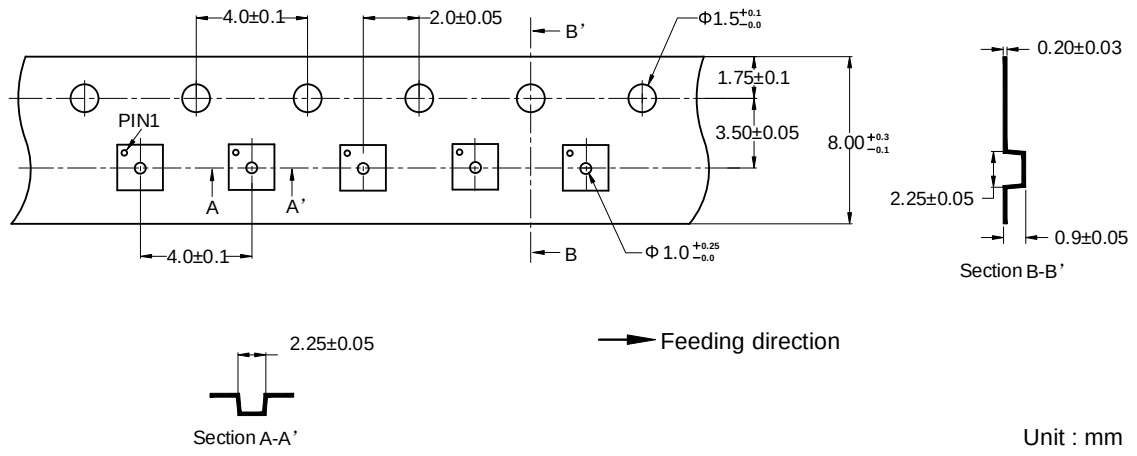


COMMON DIMENSIONS

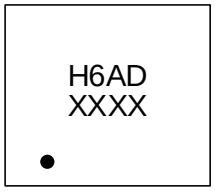
(UNITS OF MEASURE=MILLIMETER)

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	--	--

Tape Information



Marking



H= Part Number (ET5A0ADJAY2B)

O = ADJ Version

XX = Tracking Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2020-04-28	Preliminary Version	Liuxm	Shibo	Zhujl
0.1	2020-06-01	Preliminary Version	Liuxm	Shibo	Zhujl
0.2	2020-07-17	Preliminary Version	Liuxm	Shibo	Zhujl
1.0	2020-12-17	Initial Version	Liuxm	Shibo	Zhujl
1.1	2022-8-8	Update Typeset	Shibo	Shibo	Zhujl
1.2	2024-11-5	Add Thermal Pad Suggest	Shibo	Shibo	Liujy