ETQ5H2XXM1 - High Input Very-Low IQ 300mA LDO

General Description

ETQ5H2XXM1 is the high input very low IQ 300mA LDO with enable function, is designed specifically for automotive applications. There have very-low power consumption of type 2.5μA and dynamic transient boost feature improves device transient response.

ETQ5H2XXM1 offered ESOP8 package and operates ambient temperature range of -40°C to +125°C.

Features

- Wide Input Voltage Range from 2.8V to 36V
- Up to 300mA Load Current
- Very low I_Q is 2.5μA Typical
- Fixed Output Voltage are 1.8V,2.5V,2.8V,3.0V,3.3V,3.6V,4.0V, 5.0V and etc
- Low Dropout is 1000mV at 300mA Load @V_{OUT}=3.3V
- Excellent Load/Line Transient Response
- High Ripple Rejection: 60dB at 1KHz
- Automotive AEC-Q100 Qualified:
  -- Device Temperature Grade 1: -40°C to +125°C Ambient Operating Temperature Range
  -- Device HBM ESD Classification ±2KV Pass
  -- Device CDM ESD Classification level ±1.5KV Pass

Applications

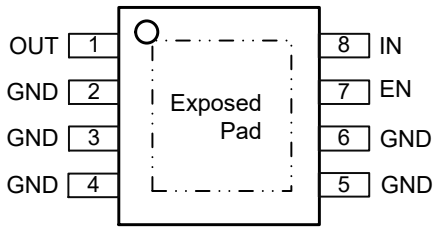
- Automotive constant-voltage power supply
- Automotive infotainment and cluster

Device information

ETQ 5H2 XX M1

Q	XX Output Voltage		Package	Packing Option	MSL
AEC-Q100 Qualified	XX	Output X.XV For example, 50 is 5.0V output	ESOP8	Tape and Reel, 4K/Reel	3

Pin Configuration



Top View

Figure 1. Pin Configuration

Pin Function

Pin No.	Pin Name	Pin Function
1	OUT	Output pin.
2,3,4,5,6	GND	Ground.
7	EN	ON/OFF control, “H” active
8	IN	Supply input pin.

Block Diagram

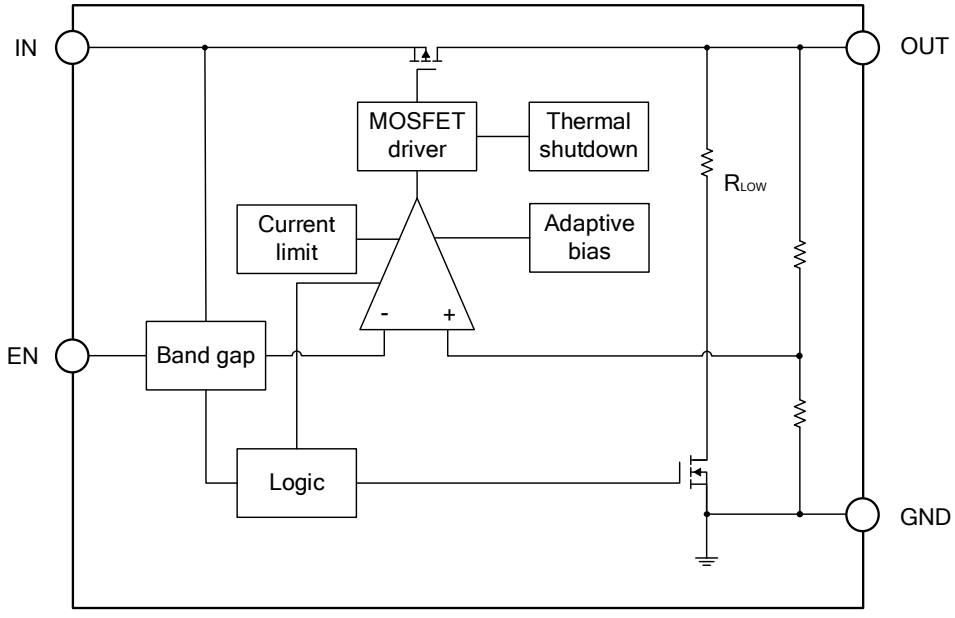


Figure 2. Block Diagram

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. 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 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 ETQ5H2XXM1 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 ETQ5H2XXM1 uses a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (VDO), 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. VDO 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 125°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 125°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.

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.

Current-Limit Protection

The ETQ5H2XXM1 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.
- 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.

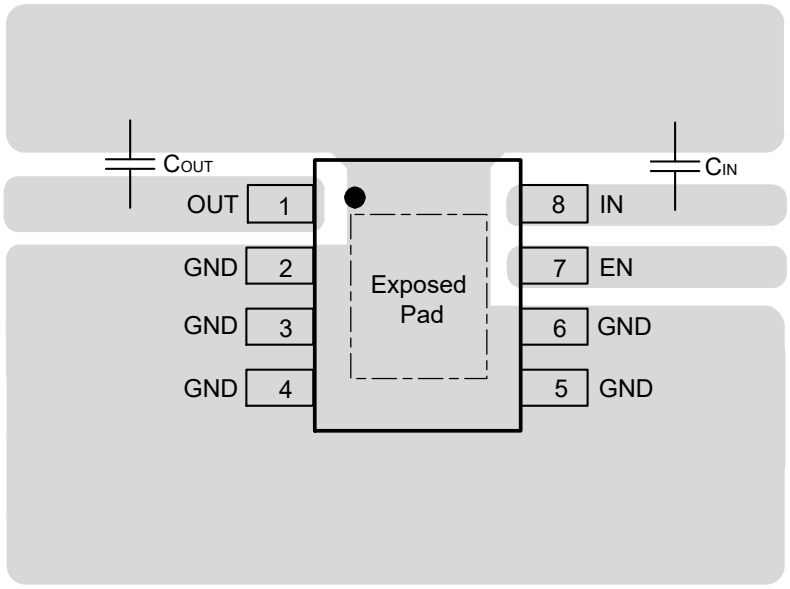


Figure 3. ESOP8 Layout Guidelines

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage (1)	-0.3~44	V
V_{OUT}	Output Voltage	-0.3~6	V
V_{EN}	Chip Enable Input	-0.3~44	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:

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
$R_{\theta JA}$	ESOP8	Thermal Characteristics, Thermal Resistance, Junction-to-Air	50	°C/W
P_D	ESOP8	Max Power Dissipation @25°C	2.5	W

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.8 to 36	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to 125	°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

(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.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating Input Voltage (3)		2.8		36	V
V_{OUT}	Output Voltage	I_{OUT}=1mA, T_A = +25°C	-2%		+2%	V
		I_{OUT}=1mA, T_A = -40~125°C	-3%		+3%	
I_Q	Quiescent Current	I_{OUT} = 0mA, T_A = +25°C		2.5	4.5	μA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, T_A = +25°C		0.1	1	μA
$Line_{REG}$	Line Regulation	V_{IN} = V_{OUT} +2V to 36V, I_{OUT} = 1mA, T_A = -40~125°C (ΔV_{OUT} / ΔV_{IN} / V_{OUT})		0.05	0.20	%/V
$Load_{REG}$	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA, V_{IN} =V_{OUT}+2V			40	mV
V_{DROP}	Dropout Voltage I_{OUT}=300mA (4)	V_{OUT}=1.8V		1350	1850	mV
		V_{OUT} = 2.5V		1150	1650	
		V_{OUT} = 2.8V		1100	1600	
		V_{OUT} = 3.0V		1050	1550	
		V_{OUT} = 3.3V		1000	1500	
		V_{OUT} = 3.6V		950	1450	
		V_{OUT} = 5V		900	1400	
I_{LMT}	Current Limit	V_{IN} =V_{OUT}+2V, R_{OUT}=1Ω	350	450		mA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage “H”	1.2			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage “L”			0.4	V
I_{EN}	EN Pin Current	V_{EN}=0~36V		1		μA
PSRR	Power Supply Rejection Ratio (5)	f = 1 kHz， V_{IN} =V_{OUT}+1V I_{OUT} = 20mA		60		dB
e_N	Output Noise Voltage (5)	V_{IN} = V_{OUT}+2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, V_{OUT} =3V, C_{OUT} = 1μF		100		μVrms
T_{SD}	Thermal Shutdown Temperature (5)	Temperature Increasing from T_A=+25°C		155		°C
T_{HYS}	Thermal Shutdown Hysteresis (5)	Temperature Falling from TSD		30		°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.

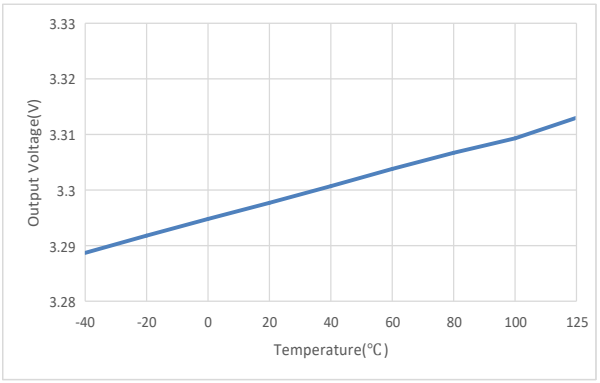
Note4. V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET}+$V_{DROPMAX}$ with 300mA output current.

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

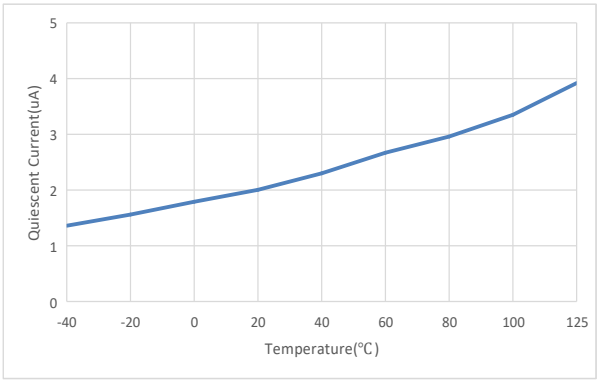
Typical Characteristics

VOLTAGE VERSION 3.3V

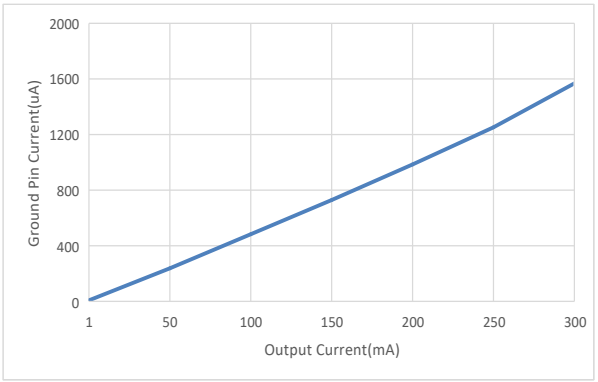
(V_{IN} =V_{OUT} + 2V, I_{OUT} = 1mA, C_{IN} = C_{OUT} = 1.0μF, Typical values are at T_A = 25°C, unless otherwise noted.)



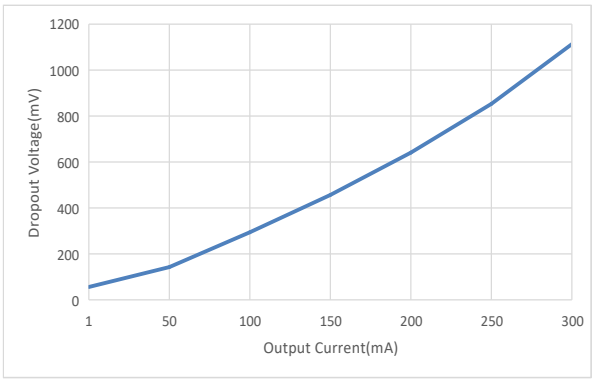
Output Voltage VS Temperature



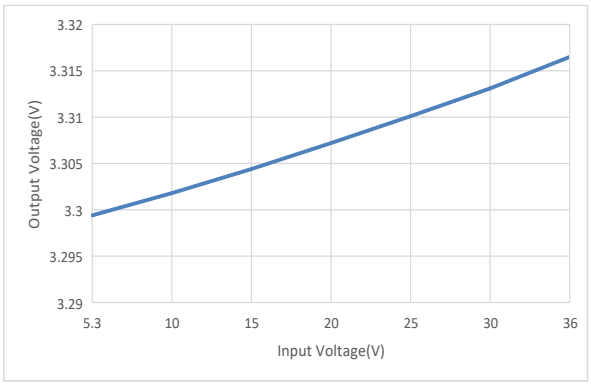
Quiescent Current VS Temperature



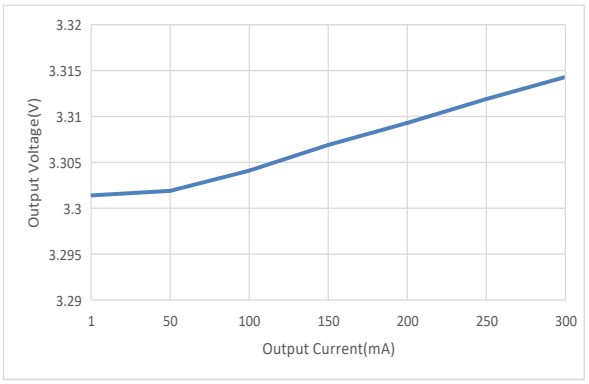
Ground Pin Current VS Output Current



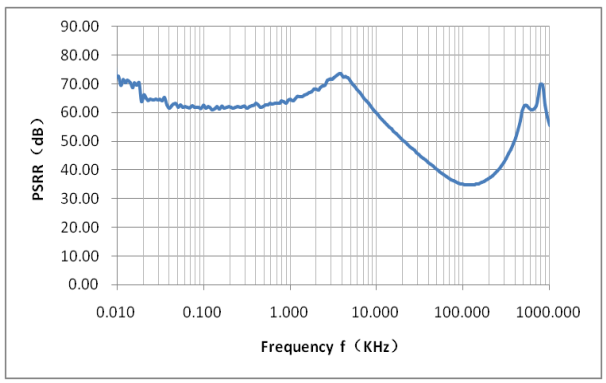
Dropout Voltage VS Output Current



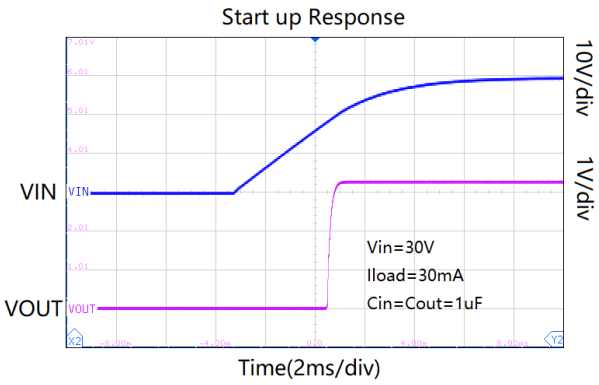
Output Voltage VS Input Voltage



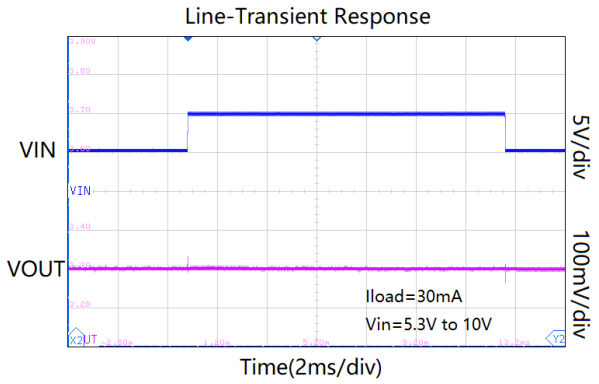
Output Voltage VS Output Current



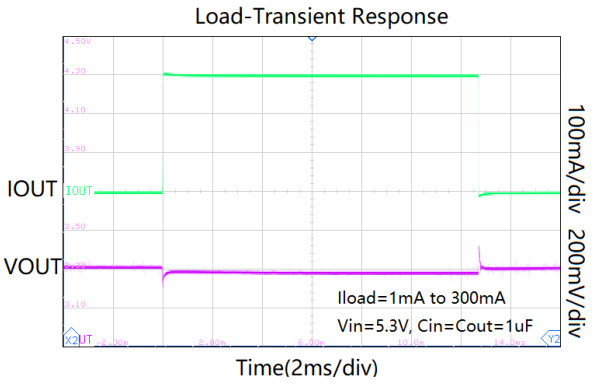
PSRR



Start-up Response



Line-Transient Response



Load-Transient Response

Application Circuits

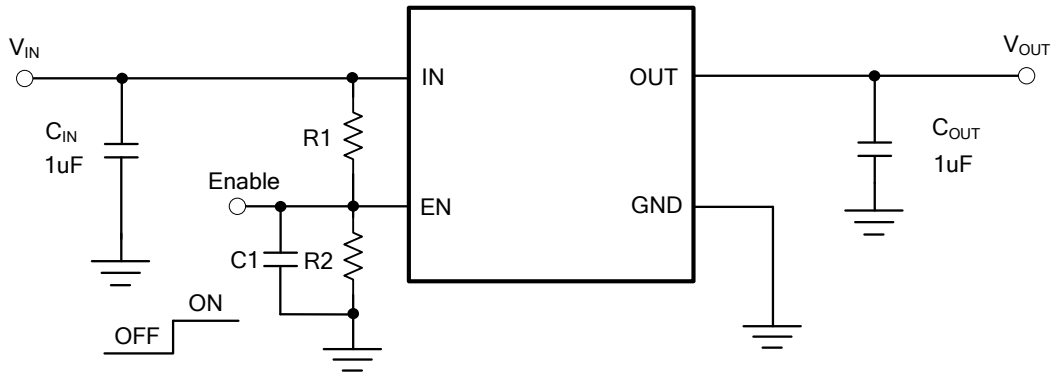


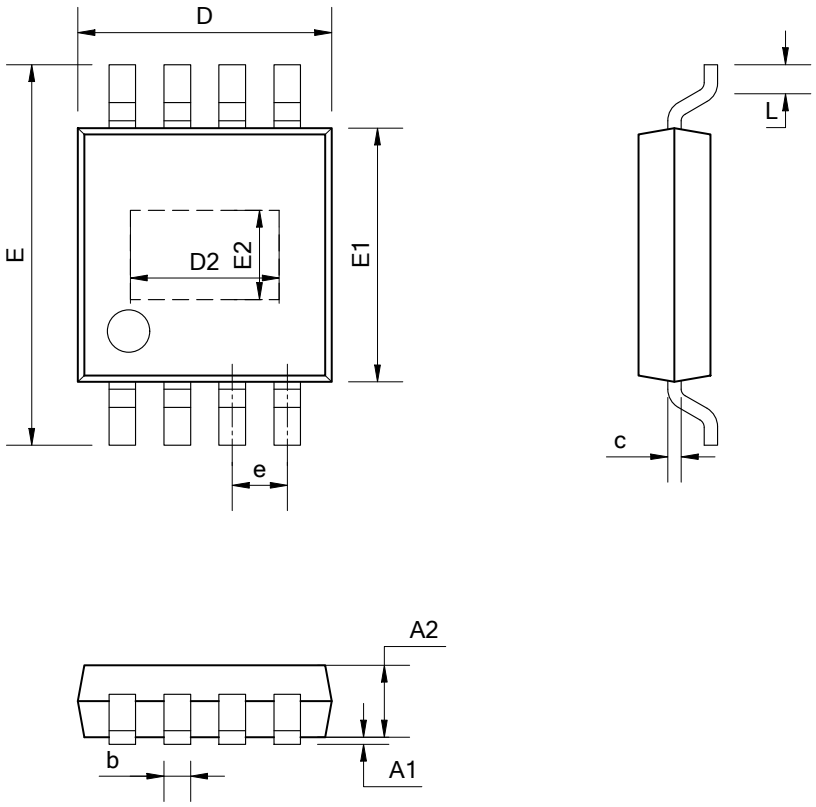
Figure 4. Application Circuits

Note6. EN pin set resistor divider structure and Capacitor(for RC delay) is recommended.

V_{EN}=2V～6V, R1=10MΩ, R2=R1/(V_{IN}/V_{EN}-1), C1= 4.7~47nF.

Package Dimension

ESOP8



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A1	0.00	0.102	0.30
A2	1.20	1.37	1.60
b	0.35	0.41	0.51
c	0.15	0.20	0.27
D	4.70	4.90	5.10
E	5.80	6.10	6.20
D2	3.00	-	3.50
E1	3.70	3.89	4.10
E2	2.10	-	2.50
e	1.17	1.27	1.37
L	0.35	0.69	0.85

Figure 5. ESOP8 Package Dimension

Marking

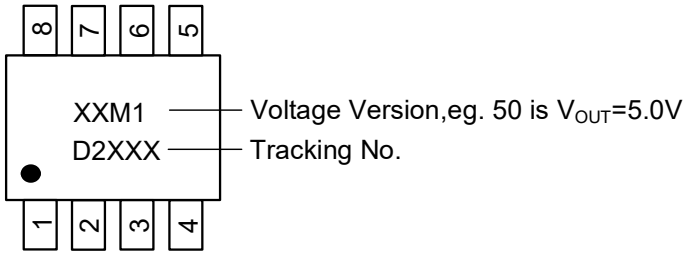


Figure 6. ESOP8 Marking Information

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2019-10-22	Released Version	Liuxm	Liuxm	Zhujl
1.1	2024-04-29	Update EC table	Yangxiaoxu	Liuxm	Liujy
1.2	2025-08-29	AEC-Q100 Version	Pengjj	Liuxm	Liujy
1.2.a	2025-09-10	Update ESOP8 Package	Pengjj	Liuxm	Liujy
1.2.b	2025-09-15	Update Package Dimension	Pengjj	Liuxm	Liujy