

## ET5H2XX - High Input Very-Low I<sub>Q</sub> 300mA LDO

### General Description

ET5H2XX series are the high input very low IQ 300mA LDO with enable function that operates from 1.8V~5V, is designed specifically for portable battery-powered applications which require ultra-low quiescent current. The very-low consumption of type 2.5μA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

ET5H2XX series are offered SOT89-3, SOT89-5, SOT23-5, SOT23-3, DNF4(1×1) packages

### Features

- Wide input voltage range from 2.5V to 36V
- Up to 300mA Load Current
- Very low I<sub>Q</sub> is 2.5μA typical
- Fixed Output Voltage are 1.8V,2.5V,2.8V,3.0V,3.3V,3.6V,5V,etc
- Low dropout is 1000mV at 300mA Load @V<sub>OUT</sub>=3.3V
- Excellent load/line transient response
- High Ripple Rejection: 60dB at 1KHz

### Device information

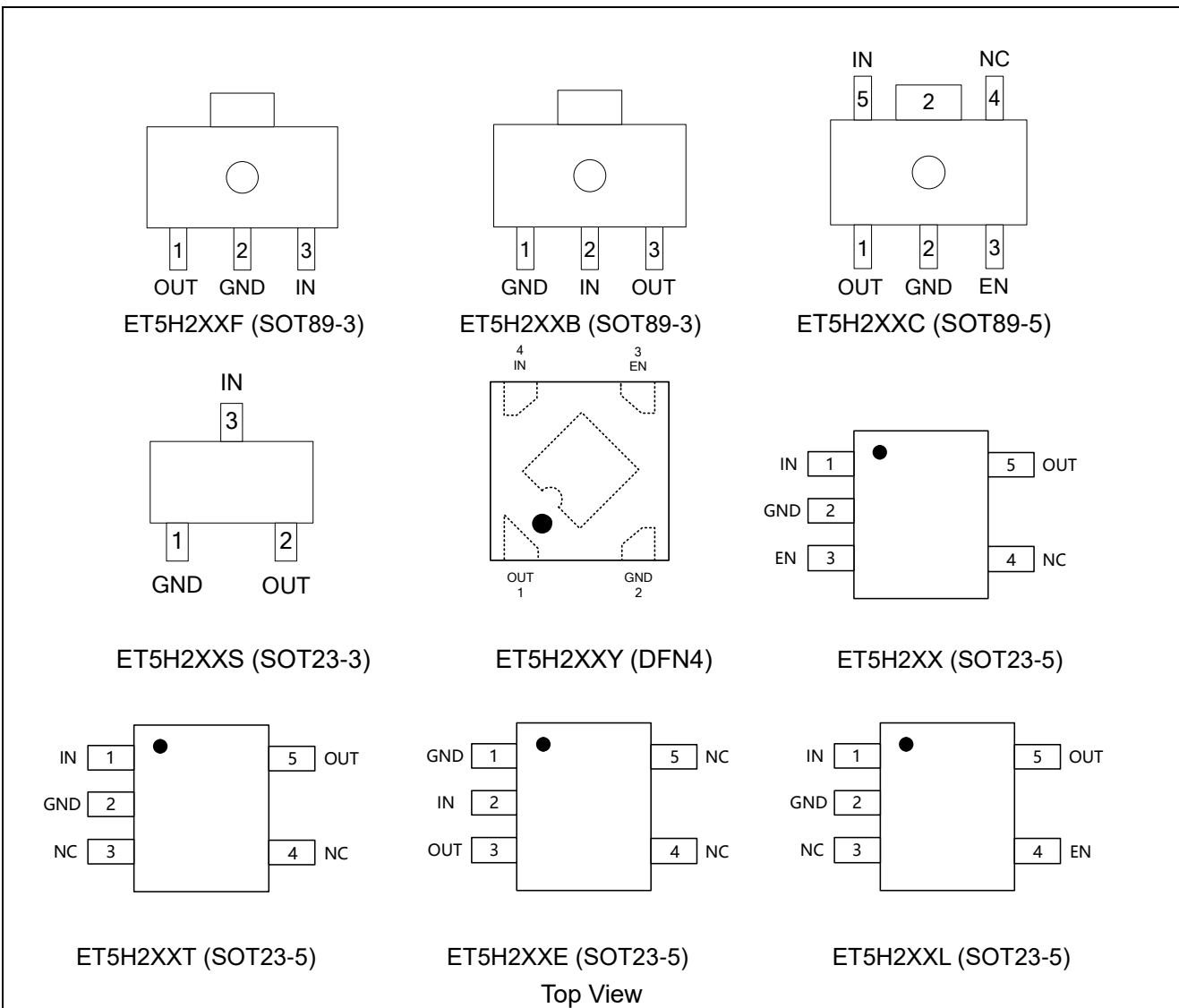
| Part No. | Package           | Packing Option          | MSL |
|----------|-------------------|-------------------------|-----|
| ET5H2XXB | SOT89-3           | Tape and Reel, 1K/Reel  | 3   |
| ET5H2XXF |                   | Tape and Reel, 1K/Reel  | 3   |
| ET5H2XXC | SOT89-5           | Tape and Reel, 1K/Reel  | 3   |
| ET5H2XXS | SOT23-3           | Tape and Reel, 3K/Reel  | 3   |
| ET5H2XXT | SOT23-5           | Tape and Reel, 3K/Reel  | 3   |
| ET5H2XXE |                   | Tape and Reel, 3K/Reel  | 3   |
| ET5H2XXL |                   | Tape and Reel, 3K/Reel  | 3   |
| ET5H2XX  | SOT23-5 (Default) | Tape and Reel, 3K/Reel  | 3   |
| ET5H2XXY | DFN4              | Tape and Reel, 10K/Reel | 1   |

# ET5H2XX

## Mark Specification Label

| Part No. | Marking |     |         |      |         |         |     |     |     | V <sub>OUT</sub> |
|----------|---------|-----|---------|------|---------|---------|-----|-----|-----|------------------|
|          | SOT89-3 |     | SOT23-3 | DFN4 | SOT89-5 | SOT23-5 |     |     |     |                  |
|          | XXB     | XXF | XXS     | XXY  | XXC     | XX      | XXT | XXE | XXL |                  |
| ET5H218  | 18B     | 18F | 18S     | CX   | 18C     | 18      | 18T | 18E | 18L | 1.8V             |
| ET5H225  | 25B     | 25F | 25S     | FX   | 25C     | 25      | 25T | 25E | 25L | 2.5V             |
| ET5H228  | 28B     | 28F | 28S     | DX   | 28C     | 28      | 28T | 28E | 28L | 2.8V             |
| ET5H230  | 30B     | 30F | 30S     | GX   | 30C     | 30      | 30T | 30E | 30L | 3.0V             |
| ET5H233  | 33B     | 33F | 33S     | EX   | 33C     | 33      | 33T | 33E | 33L | 3.3V             |
| ET5H236  | 36B     | 36F | 36S     | RX   | 36C     | 36      | 36T | 36E | 36L | 3.6V             |
| ET5H250  | 50B     | 50F | 50S     | ZX   | 50C     | 50      | 50T | 50E | 50L | 5.0V             |

## Pin Configuration

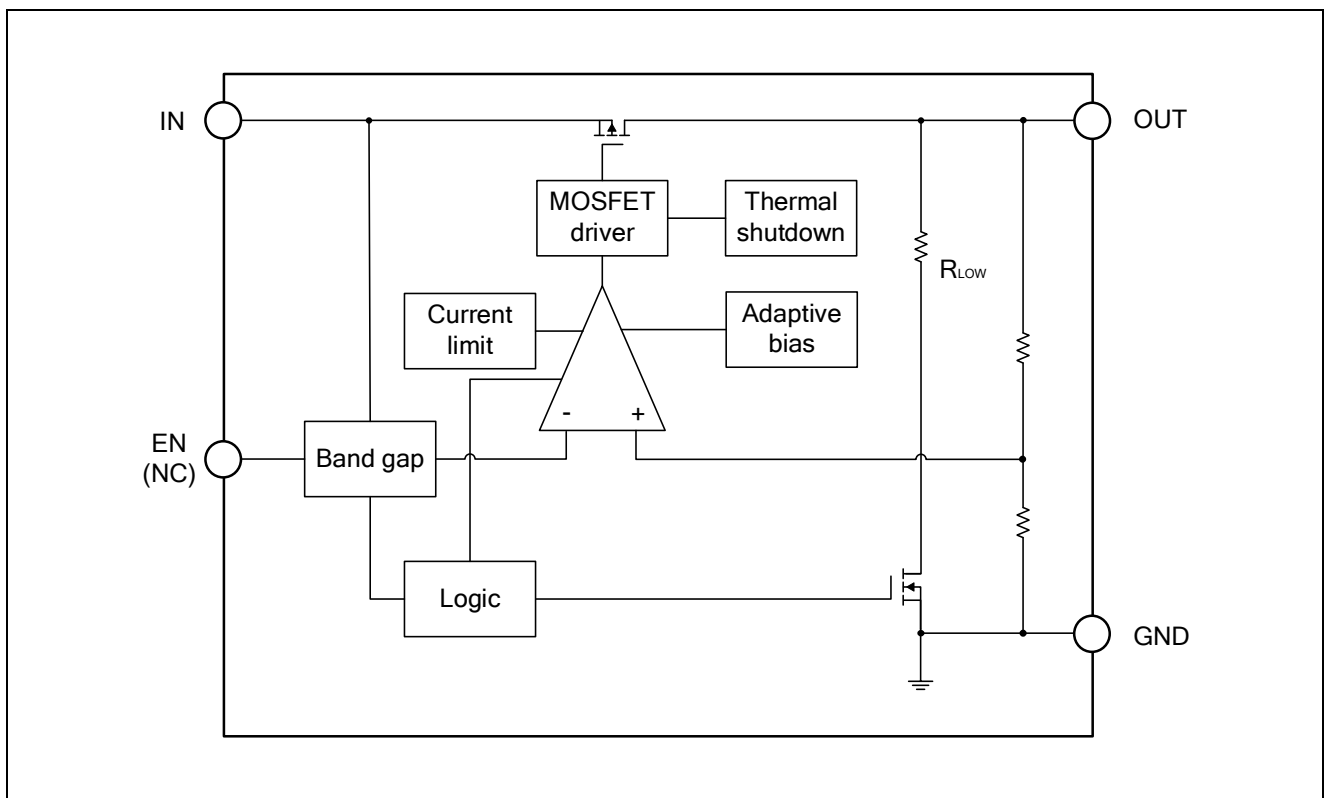


# ET5H2XX

## Pin Function

| Pin No. |     |         |      |         |         |      |      |     | Pin Name | Pin Function                       |
|---------|-----|---------|------|---------|---------|------|------|-----|----------|------------------------------------|
| SOT89-3 |     | SOT23-3 | DFN4 | SOT89-5 | SOT23-5 |      |      |     |          |                                    |
| XXF     | XXB | XXS     | XXY  | XXC     | XX      | XXT  | XXE  | XXL |          |                                    |
| 2       | 1   | 1       | 2    | 2       | 2       | 2    | 1    | 2   | GND      | Ground.                            |
| 3       | 2   | 3       | 4    | 5       | 1       | 1    | 2    | 1   | IN       | Supply input pin.                  |
| 1       | 3   | 2       | 1    | 1       | 5       | 5    | 3    | 5   | OUT      | Output pin.                        |
|         |     |         | 3    | 3       | 3       |      |      | 4   | EN       | Enable control input, active high. |
|         |     |         |      | 4       | 4       | 3, 4 | 4, 5 | 3   | NC       | No connection.                     |

## Block Diagram



## Functional Description

### Input Capacitor

A 1 $\mu$ F~10 $\mu$ F 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 1 $\mu$ F to 10 $\mu$ F, Equivalent Series Resistance (ESR) is from 5m $\Omega$  to 100m $\Omega$ , 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 (If EN PIN Exist)

The ET5H2XX 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 ET5H2XX 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:

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

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

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For recommended operating conditions the maximum junction temperature is 150°C and T<sub>A</sub> is the ambient temperature. The junction to ambient thermal resistance (θ<sub>JA</sub>) is layout dependent.

For SOT89-3 package, the thermal resistance (θ<sub>JA</sub>) is 135°C/W on the test board. The maximum power dissipation at T<sub>A</sub> = 25°C can be calculated by the following formula:

$$P_{D(MAX)} = (150^{\circ}\text{C} - 25^{\circ}\text{C}) / (135^{\circ}\text{C} / \text{W}) = 0.925\text{W for SOT89-3 package}$$

The maximum power dissipation depends on the operating ambient temperature for fixed T<sub>J(MAX)</sub> and thermal resistance (θ<sub>JA</sub>). The derating curve in Figure 6 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

## Current-Limit Protection

The ET5H2XX 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.

## Absolute Maximum Ratings

| Symbol                          | Rating                              | Value   | Unit |
|---------------------------------|-------------------------------------|---------|------|
| V <sub>IN</sub>                 | Input Voltage <sup>(1)</sup>        | -0.3~44 | V    |
| V <sub>OUT</sub>                | Output Voltage                      | -0.3~6  | V    |
| V <sub>EN</sub>                 | Chip Enable Input (If EN PIN Exist) | -0.3~44 | V    |
| T <sub>J(MAX)</sub>             | Maximum Junction Temperature        | 150     | °C   |
| T <sub>STG</sub>                | Storage Temperature                 | -65~150 | °C   |
| V <sub>ESD</sub> <sup>(2)</sup> | HBM Capability                      | ±2000   | V    |
|                                 | CDM Capability                      | ±1500   | V    |
| I <sub>LU</sub> <sup>(2)</sup>  | 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 Human Body Model tested per EIA/JESD22-A114;

CDM tested per JESD22-C101;

Latch up Current Maximum Rating tested per JEDEC78.

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## Thermal Characteristics

| Symbol           | Package | Ratings                                                                                | Value | Unit |
|------------------|---------|----------------------------------------------------------------------------------------|-------|------|
| R <sub>θJA</sub> | SOT89-3 | Thermal Characteristics,<br>Thermal Resistance,<br>Junction-to-Air                     | 135   | °C/W |
|                  | SOT89-5 |                                                                                        | 80    |      |
|                  | SOT23-5 |                                                                                        | 250   |      |
|                  | SOT23-3 |                                                                                        | 360   |      |
|                  | DFN4    |                                                                                        | 250   |      |
| P <sub>D</sub>   | SOT89-3 | Power Dissipation @25°C<br>PCB board dimension:<br>40mm x 40mm (2layer)<br>Copper :1OZ | 920   | mW   |
|                  | SOT89-5 |                                                                                        | 1500  |      |
|                  | SOT23-5 |                                                                                        | 500   |      |
|                  | SOT23-3 |                                                                                        | 420   |      |
|                  | DFN4    |                                                                                        | 500   |      |

## Recommended Operating Conditions

| Symbol           | Item                                                          | Rating    | Unit |
|------------------|---------------------------------------------------------------|-----------|------|
| V <sub>IN</sub>  | Input Voltage                                                 | 2.5 to 36 | V    |
| I <sub>OUT</sub> | Output Current                                                | 0 to 300  | mA   |
| T <sub>A</sub>   | Operating Ambient Temperature                                 | -40 to 85 | °C   |
| C <sub>IN</sub>  | Effective Input Ceramic Capacitor Value                       | 1 to 10   | μF   |
| C <sub>OUT</sub> | Effective Output Ceramic Capacitor Value                      | 1 to 10   | μF   |
| ESR              | Input and Output Capacitor Equivalent Series Resistance (ESR) | 5 to 100  | mΩ   |

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## Electrical Characteristics

( $V_{IN} = V_{OUT} + 2V$ ;  $I_{OUT} = 10mA$ ,  $C_{IN} = C_{OUT} = 1.0\mu F$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

| Symbol       | Parameter                                           | Test Conditions                                                                                                | Min | Typ  | Max  | Unit          |
|--------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----|------|------|---------------|
| $V_{IN}$     | Operating Input Voltage <sup>(3)</sup>              |                                                                                                                | 2.5 |      | 36   | V             |
| $V_{OUT}$    | Output Voltage                                      | $T_A = +25^\circ C$                                                                                            | -2% |      | +2%  | V             |
|              |                                                     | $-40^\circ C \leq T_A \leq 85^\circ C$                                                                         | -3% |      | +3%  |               |
| $I_Q$        | Quiescent Current                                   | $I_{OUT} = 0mA$                                                                                                |     | 2.5  | 4.5  | $\mu A$       |
| $I_{Q\_OFF}$ | Standby Current                                     | $V_{EN} = 0V$ , $T_A = 25^\circ C$                                                                             |     | 0.1  | 1    | $\mu A$       |
| $Line_{REG}$ | Line Regulation                                     | $V_{IN} = V_{OUT} + 1V$ to $36V$ ,<br>$I_{OUT} = 10mA$<br>( $\Delta V_{OUT} / \Delta V_{IN} / V_{OUT}$ )       |     | 0.05 | 0.20 | %/V           |
| $V_{DROP}$   | Dropout Voltage<br>$I_{OUT} = 300mA$ <sup>(4)</sup> | $V_{OUT} = 1.8V$                                                                                               |     | 1350 | 1650 | mV            |
|              |                                                     | $V_{OUT} = 2.5V$                                                                                               |     | 1150 | 1450 |               |
|              |                                                     | $V_{OUT} = 2.8V$                                                                                               |     | 1100 | 1400 |               |
|              |                                                     | $V_{OUT} = 3.0V$                                                                                               |     | 1050 | 1350 |               |
|              |                                                     | $V_{OUT} = 3.3V$                                                                                               |     | 1000 | 1300 |               |
|              |                                                     | $V_{OUT} = 3.6V$                                                                                               |     | 950  | 1250 |               |
|              |                                                     | $V_{OUT} = 5V$                                                                                                 |     | 900  | 1200 |               |
| $Load_{REG}$ | Load Regulation                                     | $1mA \leq I_{OUT} \leq 300mA$ ,<br>$V_{IN} = V_{OUT} + 2V$                                                     |     |      | 40   | mV            |
| $I_{LMT}$    | Current Limit                                       | $V_{IN} = V_{OUT} + 2V$                                                                                        | 300 | 450  |      | mA            |
| $V_{ENH}$    | EN Pin Threshold Voltage<br>(If EN PIN Exist)       | EN Input Voltage "H"                                                                                           | 1.2 |      |      | V             |
| $V_{ENL}$    | EN Pin Threshold Voltage<br>(If EN PIN Exist)       | EN Input Voltage "L"                                                                                           |     |      | 0.4  | V             |
| $I_{EN}$     | EN Pin Current<br>(If EN PIN Exist)                 | $V_{EN} = 0 \sim 36V$                                                                                          |     | 1    |      | $\mu A$       |
| PSRR         | Power Supply Rejection Ratio <sup>(5)</sup>         | $f = 1 kHz$ , $V_{IN} = V_{OUT} + 1V$<br>$I_{OUT} = 20mA$                                                      |     | 60   |      | dB            |
| $e_N$        | Output Noise Voltage <sup>(5)</sup>                 | $V_{IN} = V_{OUT} + 2V$ , $I_{OUT} = 1mA$ ,<br>$f = 10Hz$ to $100KHz$ ,<br>$V_{OUT} = 3V$ , $C_{OUT} = 1\mu F$ |     | 100  |      | $\mu V_{rms}$ |
| $T_{SD}$     | Thermal Shutdown Temperature <sup>(5)</sup>         | Temperature Increasing<br>from $T_A = +25^\circ C$                                                             |     | 155  |      | $^\circ C$    |
| $T_{SDH}$    | Thermal Shutdown Hysteresis <sup>(5)</sup>          | Temperature Falling from TSD                                                                                   |     | 30   |      | $^\circ C$    |

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

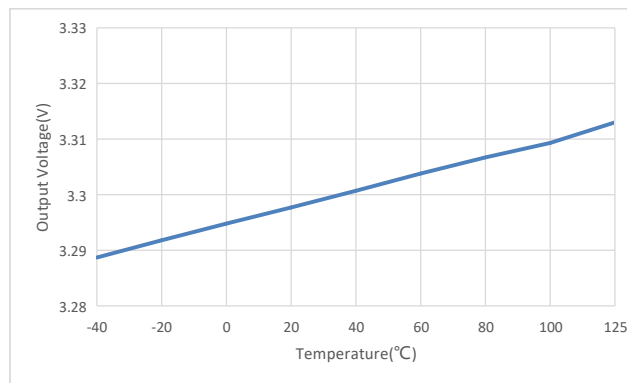
**Note5.** Guaranteed by design and characterization. not a FT item.

# ET5H2XX

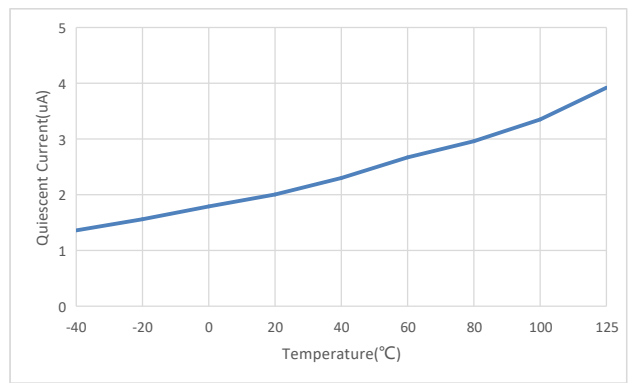
## Typical Characteristics

VOLTAGE VERSION 3.3V

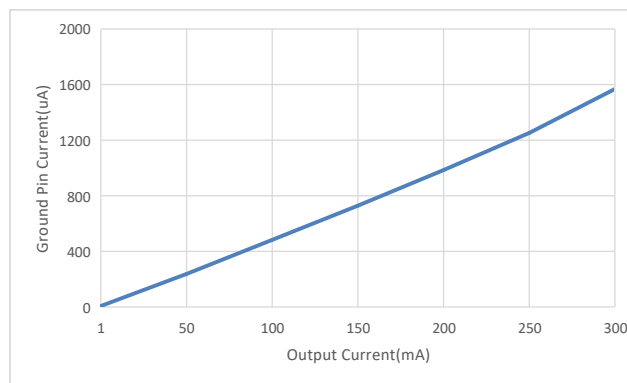
( $V_{IN} = V_{OUT} + 2V$ ,  $I_{OUT} = 10mA$ ,  $C_{IN} = C_{OUT} = 1.0\mu F$ , Typical values are at  $T_A = 25^\circ C$ , unless otherwise noted.)



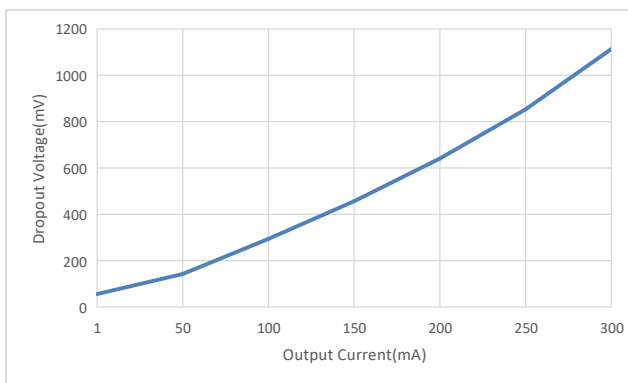
Output Voltage VS Temperature



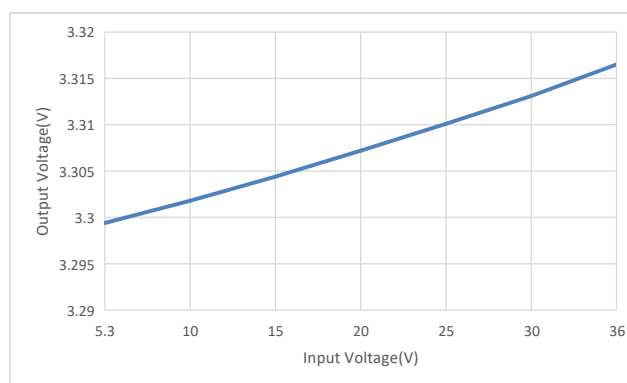
Quiescent Current VS Temperature



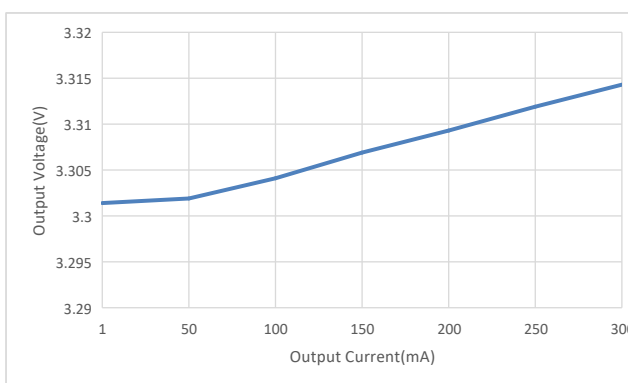
Ground Pin Current VS Output Current



Dropout Voltage VS Output Current

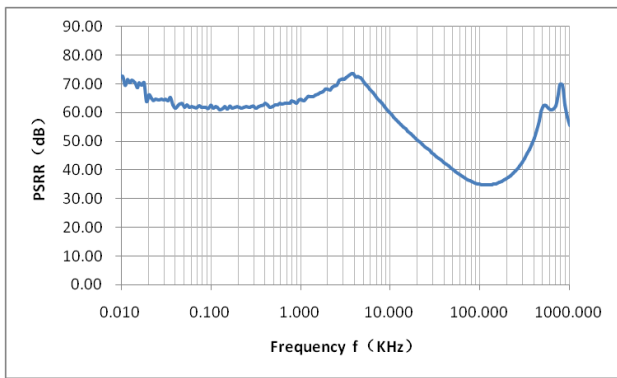


Output Voltage VS Input Voltage

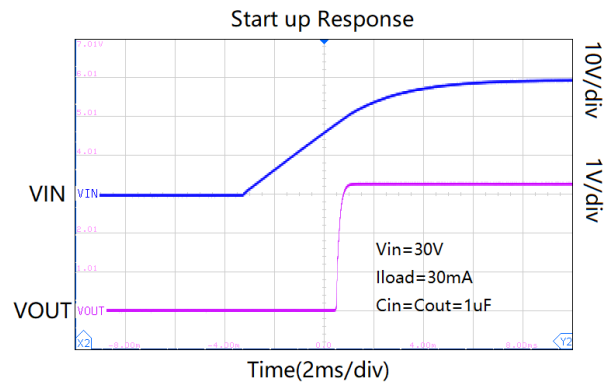


Output Voltage VS Output Current

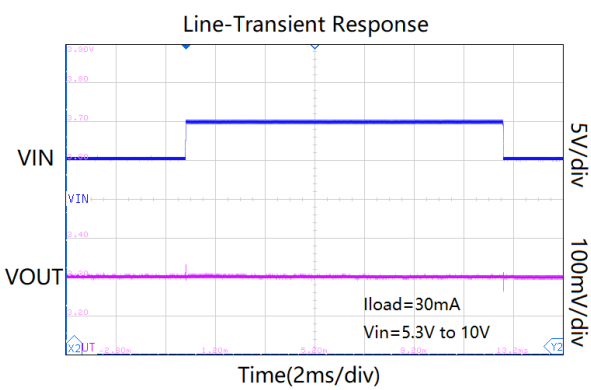
# ET5H2XX



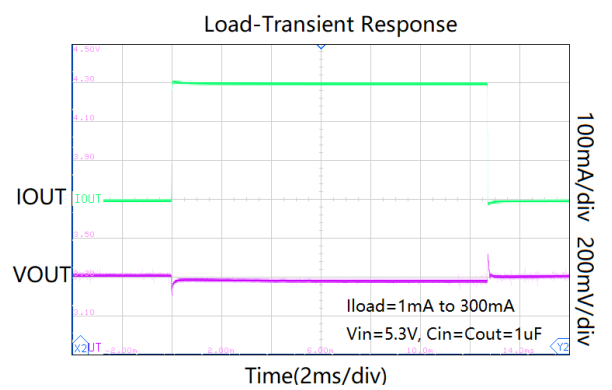
PSRR



Start-up Response



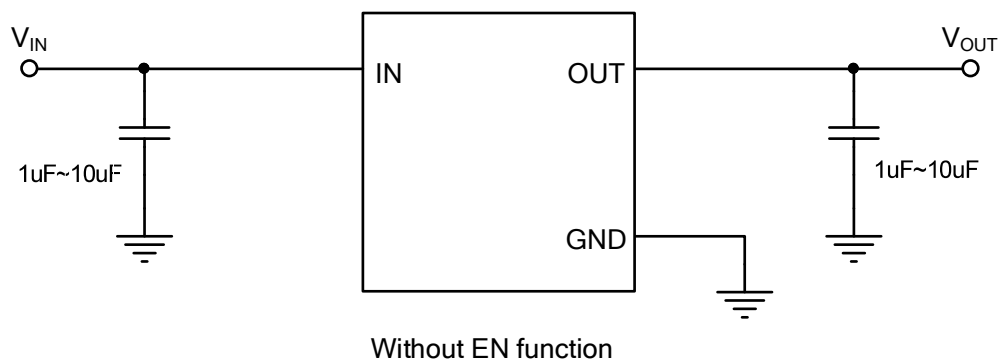
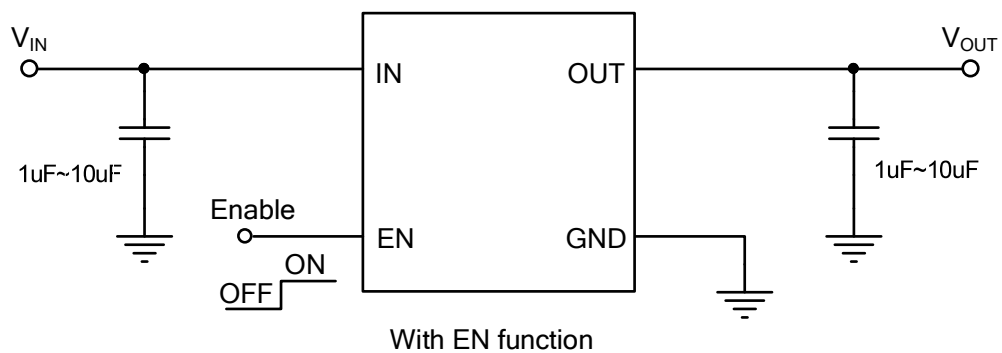
Line-Transient Response



Load-Transient Response

# ET5H2XX

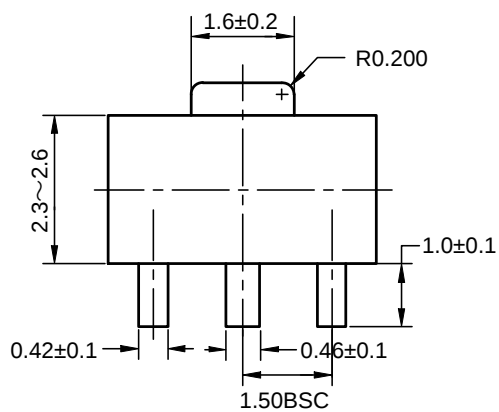
## Application Circuits



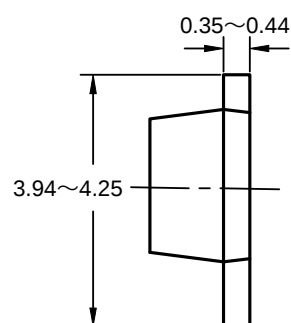
# ET5H2XX

## Package Dimension

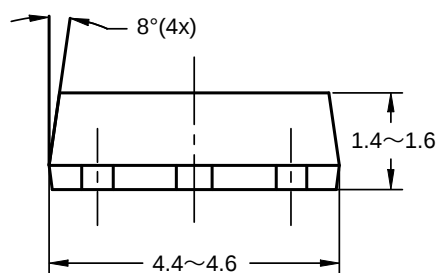
SOT89-3



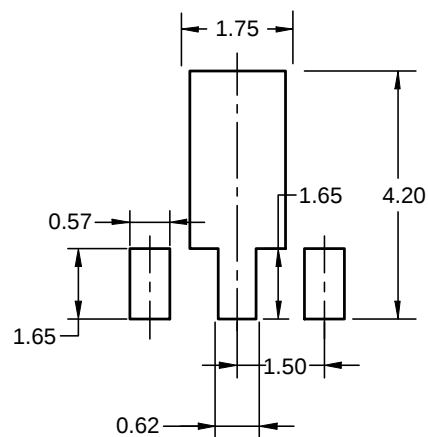
Top View



Side View



Side View

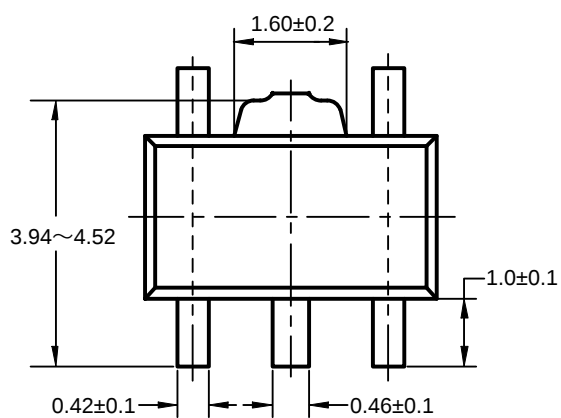


Recommended Land Pattern

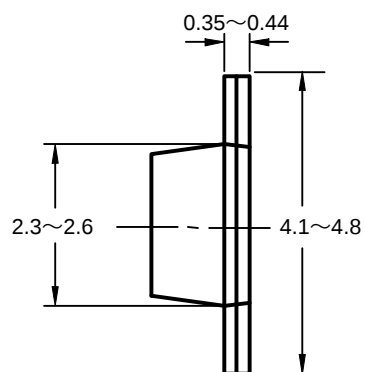
Unit: mm

# ET5H2XX

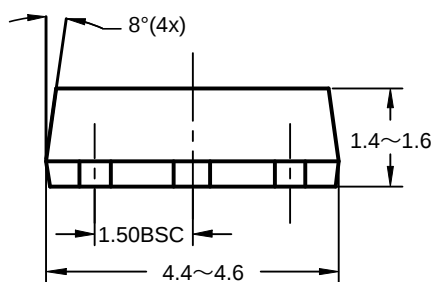
SOT89-5



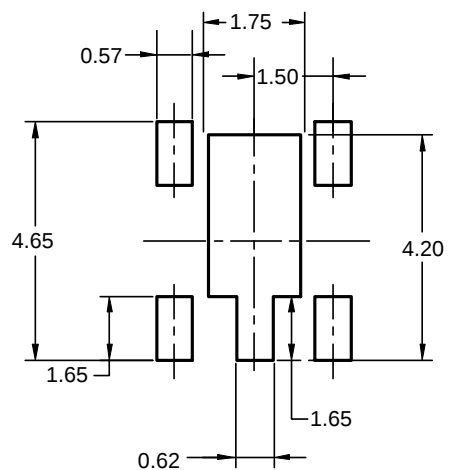
Top View



Side View



Side View

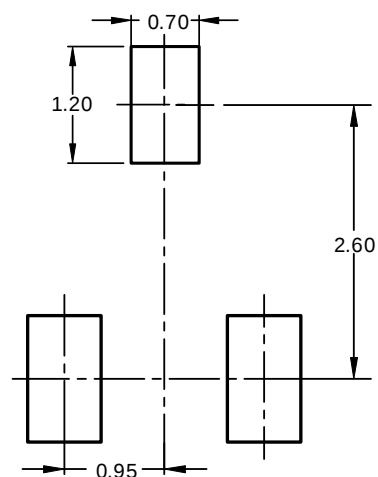
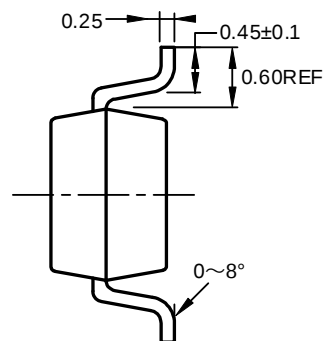
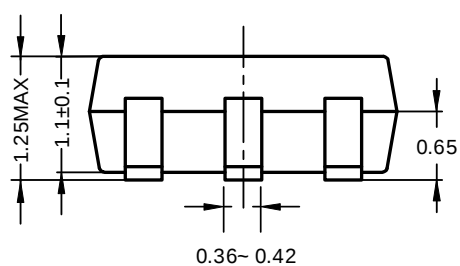
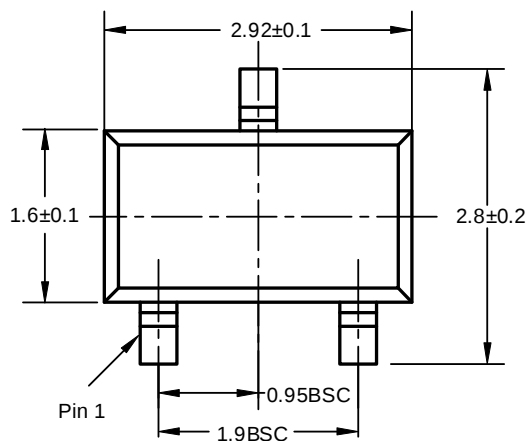


Recommended Land Pattern

Unit: mm

# ET5H2XX

SOT23-3

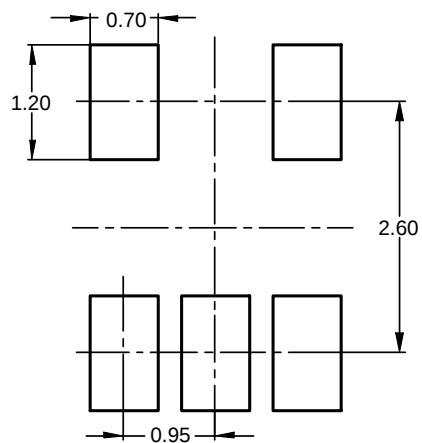
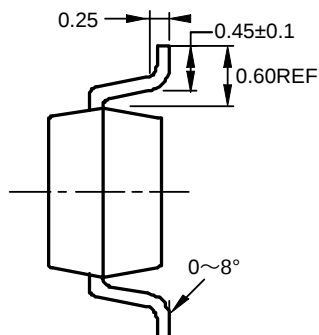
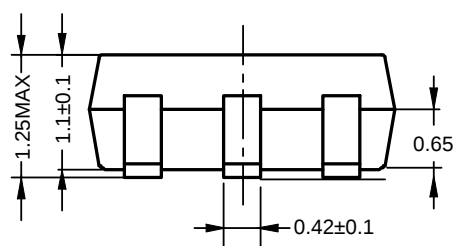
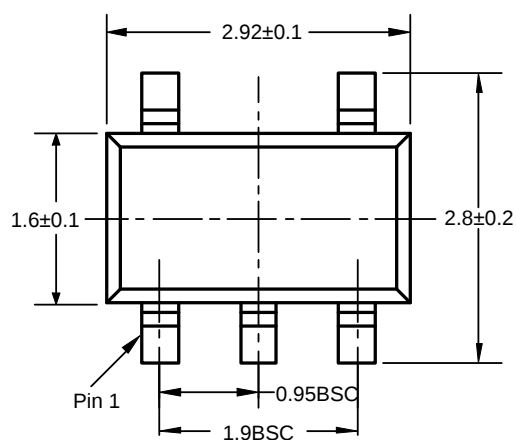


**Recommended Land Pattern**

Unit: mm

# ET5H2XX

SOT23-5

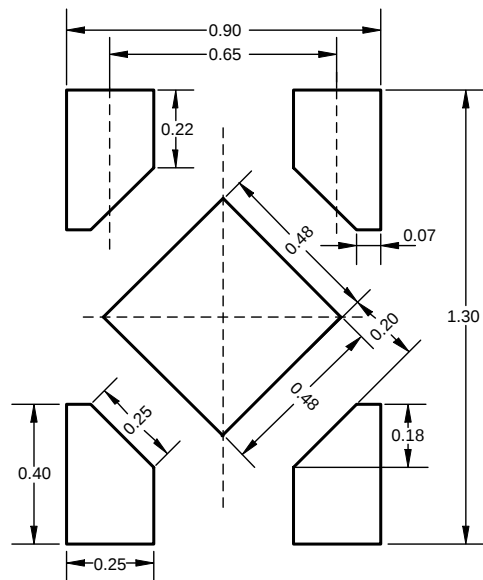
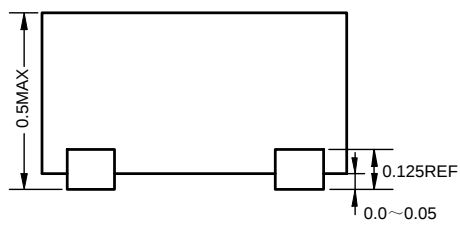
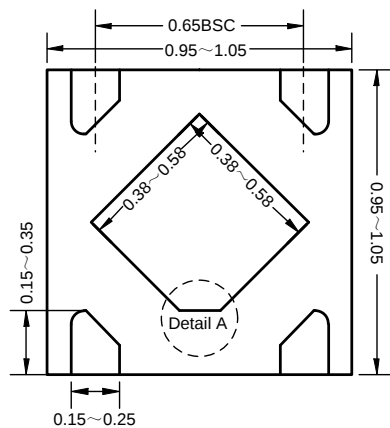


**Recommended Land Pattern**

Unit: mm

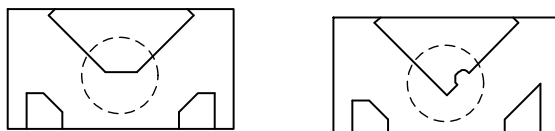
# ET5H2XX

DFN4(1x1)



**Recommended Land Pattern**

**Detail A: (PIN1 shape)**

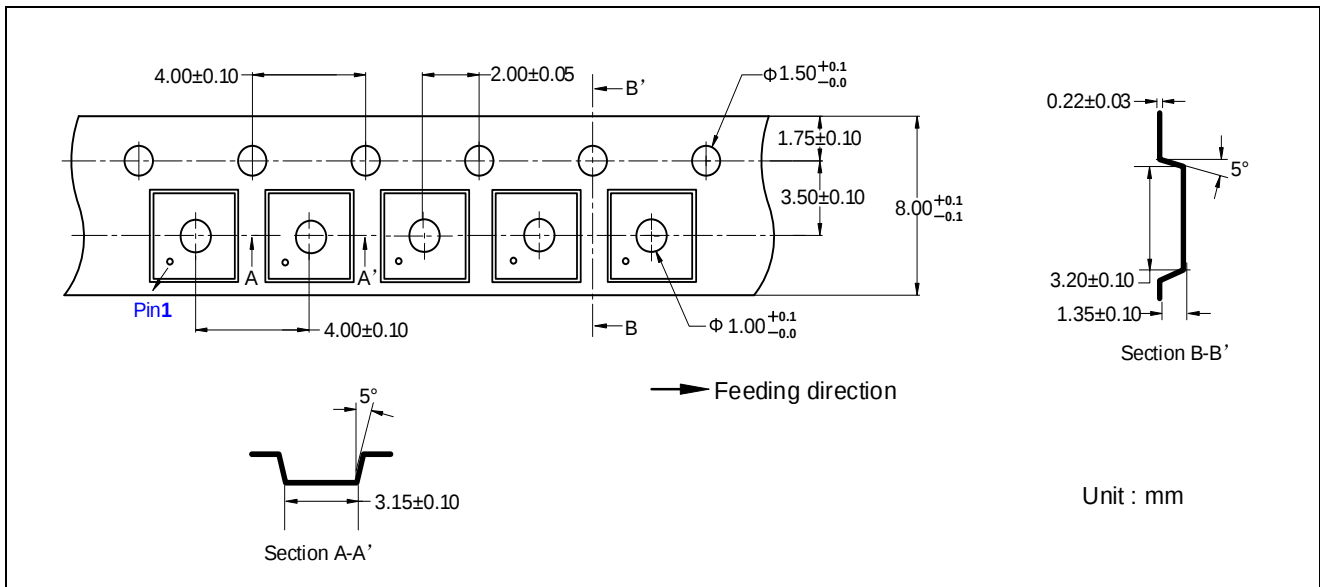


Unit: mm

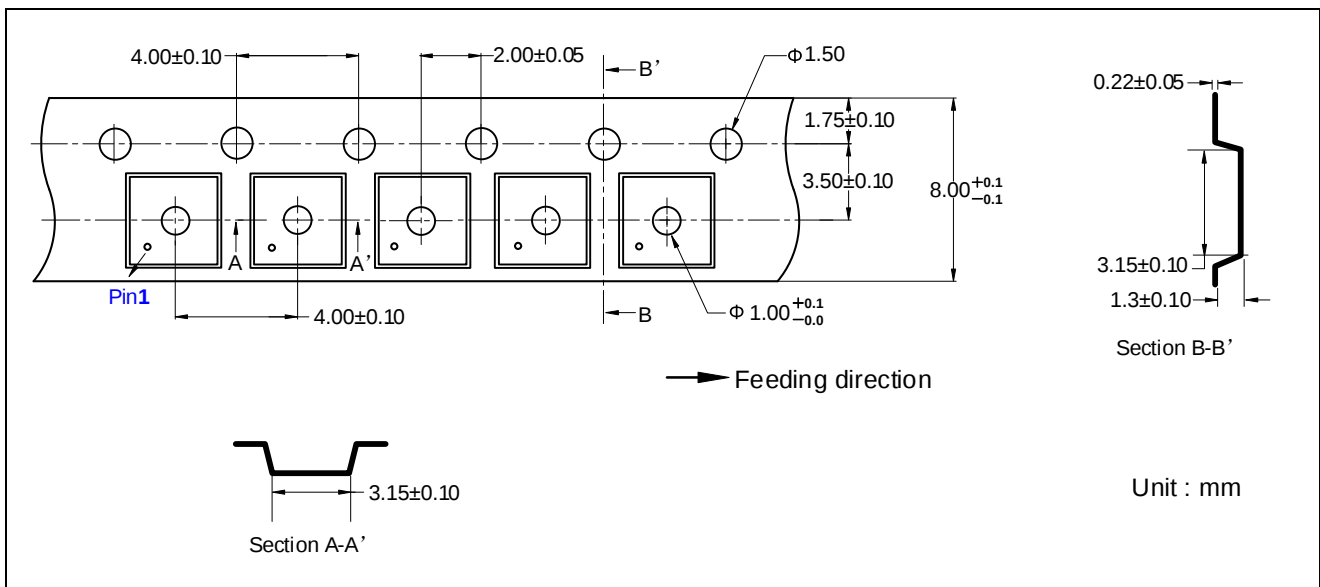


# ET5H2XX

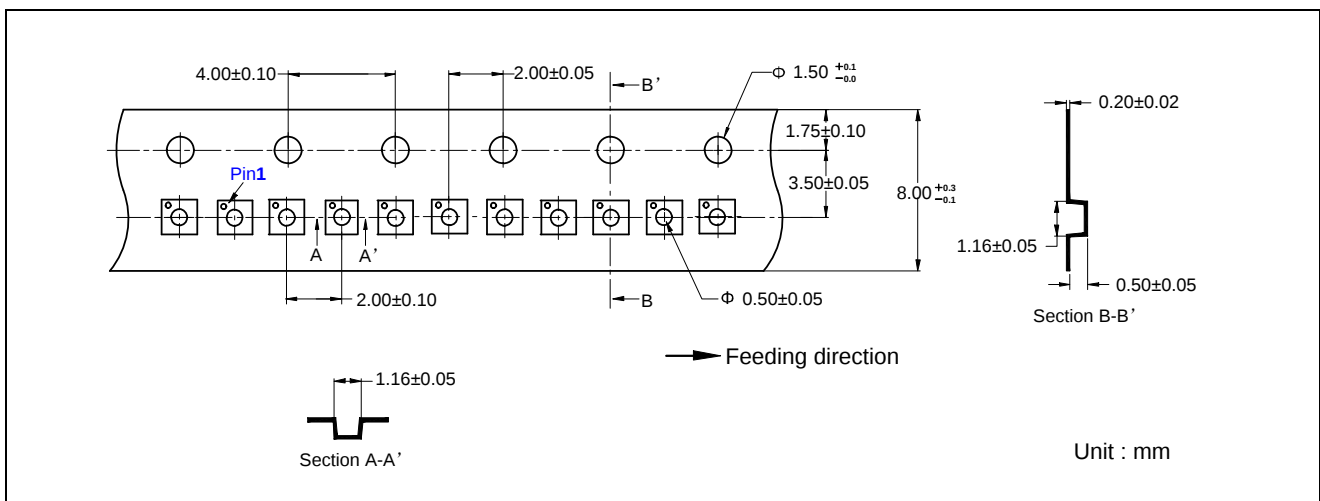
SOT23-3



SOT23-5



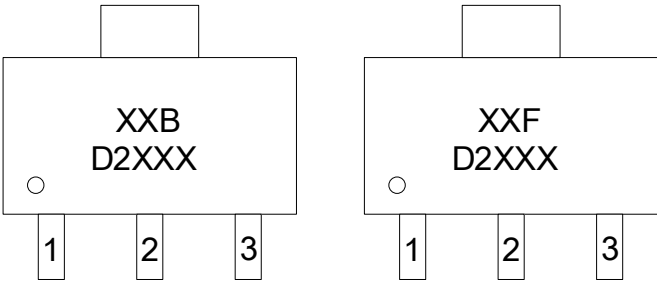
DFN4



# ET5H2XX

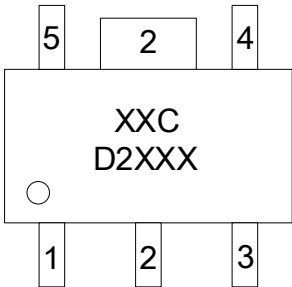
## Marking Information

SOT89-3



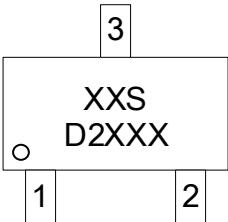
XXB/XXF - Part Number  
D2XXX - Tracking Number

SOT89-5



XXC - Part Number  
D2XXX - Tracking Number

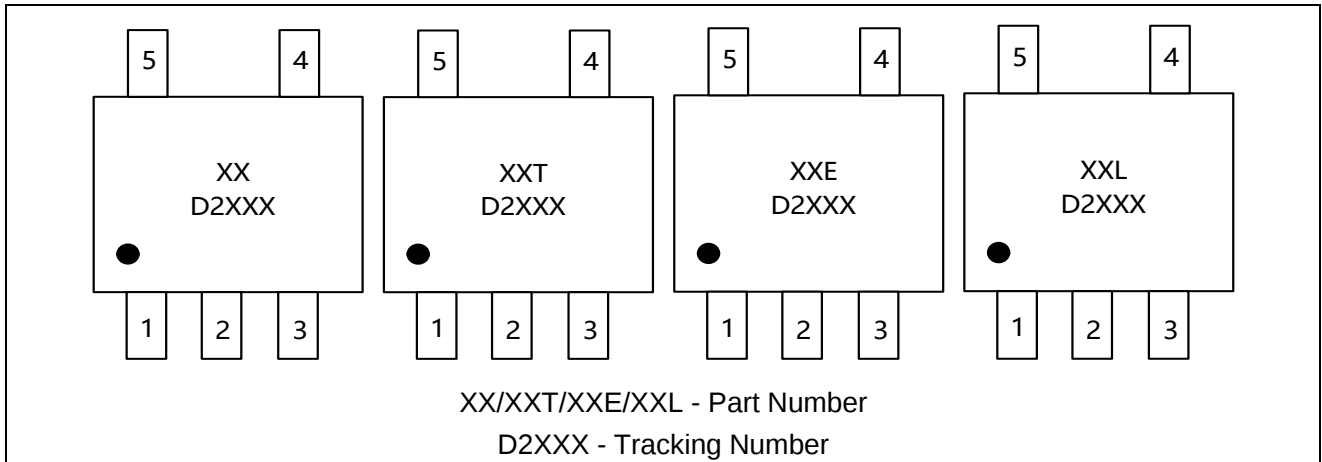
SOT23-3



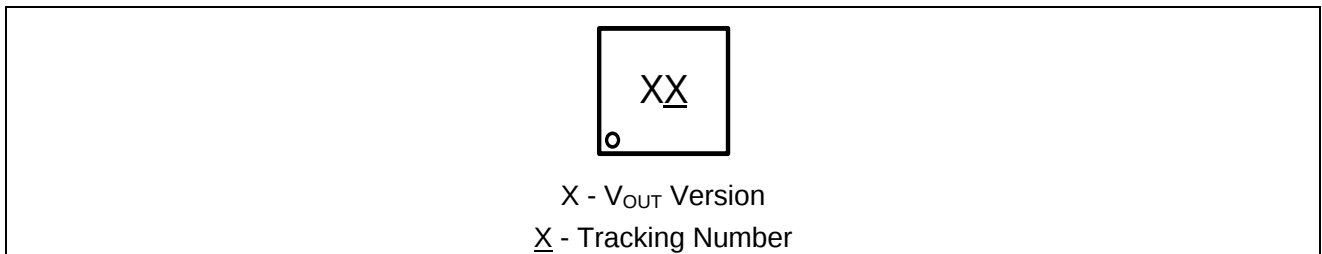
XXS - Part Number  
D2XXX - Tracking Number

# ET5H2XX

## SOT23-5



## DFN4



## Revision History and Checking Table

| Version | Date       | Revision Item                | Modifier   | Function & Spec Checking | Package & Tape Checking |
|---------|------------|------------------------------|------------|--------------------------|-------------------------|
| 0.0     | 2019-05-13 | Preliminary Version          | Liuxm      | Liuxm                    | Zhuji                   |
| 1.0     | 2019-10-22 | Released Version             | Liuxm      | Liuxm                    | Zhuji                   |
| 1.1     | 2019-11-12 | Add SOT89-5 Packge           | Liuxm      | Liuxm                    | Zhuji                   |
| 1.2     | 2019-12-13 | Update EC table              | Liuxm      | Liuxm                    | Liujy                   |
| 1.3     | 2020-03-16 | Document check and formalize | Shib       | Shib                     | Liujy                   |
| 1.4     | 2020-11-26 | Update table                 | Shib       | Shib                     | Liujy                   |
| 1.5     | 2020-12-7  | Add 3.6V voltage             | Shib       | Shib                     | Liujy                   |
| 1.6     | 2021-6-4   | Add new package type         | Liuxm      | Liuxm                    | Zhuji                   |
| 1.7     | 2022-3-4   | Update Marking Information   | Liuxm      | Liuxm                    | Liujy                   |
| 1.8     | 2023-4-5   | Update Typeset               | Shibo      | Liuxm                    | Liujy                   |
| 1.9     | 2025-5-23  | SOT23 pin number sorting     | Shibo      | Liuxm                    | Liujy                   |
| 2.0     | 2025-07-01 | Add packing Option           | Yangxiaoxu | Liuxm                    | Liujy                   |