# Dual 2μV $V_{OS}$, 17μA, Zero-Drift, CMOS Operational Amplifier

## General Description

ET85302 uses auto calibration technique to simultaneously provide low offset voltage (15 μV, max) and near-zero drift over time and temperature at only 32μA (max) per amplifier of quiescent current. The ET85302 features rail-to-rail input and output in addition to near-flat 1/f noise, making this amplifier ideal for many applications and much easier to design into a system. ET85302 is optimized for low-voltage operation as low as 1.8 V (±0.9 V) and up to 5.5 V (±2.75 V).

ET85302 is specified for the extended industrial / automotive temperature range (-40°C to +125°C). It is offered in a SOP8/MSO8/DFN8(2×2) package.

## Features

- Rail-to-rail input and output
- Low input offset voltage: 2 μV
- Zero Drift: 0.02 μV/°C
- Low noise:1.1 $\mu V_{PP}$, 0.1 Hz to 10 Hz
- Low quiescent current: 17 μA/Ch
- Internal EMI filter
- Supply Voltage: 1.8 V to 5.5 V

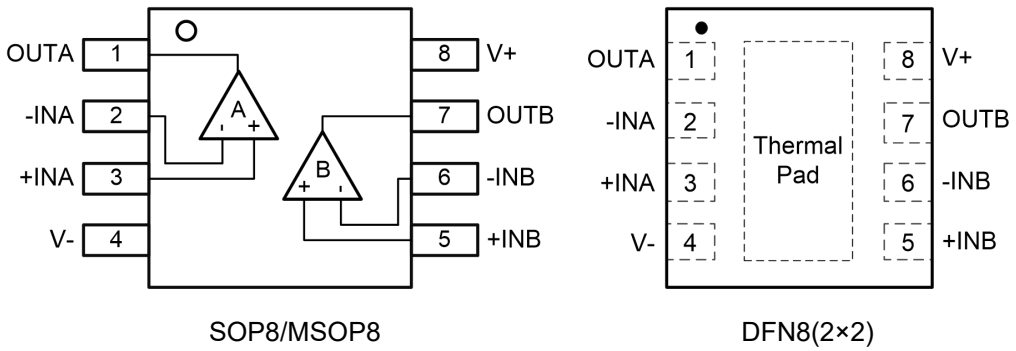
## Applications

- Temperature Measurements
- Battery-Powered Instruments
- Transducer Applications
- Electronic Scales
- Medical Instrumentation
- Handheld Test Equipment
- Current Sense

## Device information

| Part No. | Package | Packing Option | Marking | MSL |
|---|---|---|---|---|
| ET85302M | SOP8 | Tape and Reel , 4k/Reel | 853M XXXXX | 3 |
| ET85302U | MSOP8 | Tape and Reel , 4k/Reel | 853U XXXXX | 3 |
| ET85302Y1 | DFN8(2×2) | Tape and Reel , 3k/Reel | 853Y1 XXXXX | 1 |

## Pin Configuration




SOP8/MSOP8 DFN8(2×2)

Top View

## Pin Function

| Pin Number | Symbol | Descriptions |
|---|---|---|
| 1,7 | OUT | Output |
| 4 | V- | Negative supply |
| 3,5 | +IN | Non-inverting input |
| 2,6 | -IN | Inverting input |
| 8 | V+ | Positive supply |
| - | Thermal Pad | Connect thermal pad to V- |

## Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are only stress ratings, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions are not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_S$ | Supply Voltage | 0 ~ 7 | V |
| $V_{IN}$ | Signal input terminals Voltage(1) | (V-)-0.3V ~ (V+)+0.3 | V |
| $I_{IN}$ | Signal input terminals Current(1) | -10 ~ 10 | mA |
| $I_{SC}$ | Output short-circuit current(2) | Continuous | mA |
| $V_{ESD}$ | ESD (Human Body Model) | ±4000 | V |
| $T_{STG}$ | Storage Temperature Range | -40 to +150 | °C |
| $T_{J(MAX)}$ | Max Junction Temperature Range | +150 | °C |

***Note1***: Input pins are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3 V beyond the supply rails must be current limited to 10 mA or less.

***Note2***: Short-circuit to ground, one amplifier per package.

## Thermal Characteristics

| Symbol | Package | Ratings | Value | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | SOP8 | Thermal Characteristics, Thermal Resistance, Junction-to-Air | 124 | °C/W |
| | MSOP8 | | 180 | °C/W |
| | DFN8(2×2) | | 80 | °C/W |

## Recommended Operating Conditions

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_S$ | Supply Voltage: (V+) - (V-) | 1.8(±0.9) ~ 5.5(±2.75) | V |
| $T_A$ | Operating Temperature Range | -40 ~ +125 | °C |

## Electrical Characteristics

$V_S$ = (V+) – (V-) = 1.8 V to 5.5 V (±0.9 V to ±2.75 V), $T_A$ = 25°C, $R_L$ = 10 kΩ connected to $V_S$/2, and $V_{CM}$ = $V_{OUT}$ = $V_S$/2 (unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFFSET VOLTAGE** | | | | | | |
| $V_{OS}$ | Input offset voltage | $V_S$ = 5 V | | 2 | 15 | µV |
| $\Delta V_{OS}/\Delta T$ | Input offset voltage vs temperature | $T_A$ = –40°C to +125°C | | 0.02 | | µV/°C |
| PSRR | Input offset voltage vs power supply | $V_S$ = 1.8 to 5.5 V | | 1 | 8 | µV/V |
| **INPUT VOLTAGE RANGE** | | | | | | |
| $V_{CM}$ | Common-mode voltage range | | (V-)-0.1 | | (V+)+0.1 | V |
| CMRR | Common-mode rejection ratio | (V-) - 0.1 V < $V_{CM}$ < (V+) + 0.1 V | 102 | 115 | | dB |
| **INPUT BIAS CURRENT** | | | | | | |
| $I_B$ | Input bias current | $V_S$ = 5 V | | ±70 | | pA |
| | | $T_A$ = –40°C to +125°C | | ±150 | | pA |
| $I_{OS}$ | Input offset current | | | ±140 | | pA |
| **NOISE** | | | | | | |
| $E_n$ | Input voltage noise (peak to peak) | $f$ = 0.1 Hz to 10 Hz | | 1.1 | | $\mu V_{PP}$ |
| $e_n$ | Input voltage noise density | $f$ = 1 kHz | | 55 | | nV/√Hz |
| $i_n$ | Input current noise density[(3)] | $f$ = 10 Hz | | 100 | | fA/√Hz |
| **INPUT CAPACITANCE** | | | | | | |
| $C_{ID}$ | Differential | | | 2 | | pF |
| $C_{IC}$ | Common-mode | | | 4 | | pF |
| **OPEN-LOOP GAIN** | | | | | | |
| $A_{OL}$ | Open-loop voltage gain | (V-) + 0.1 V < $V_O$ < (V+) - 0.1 V | 102 | 130 | | dB |

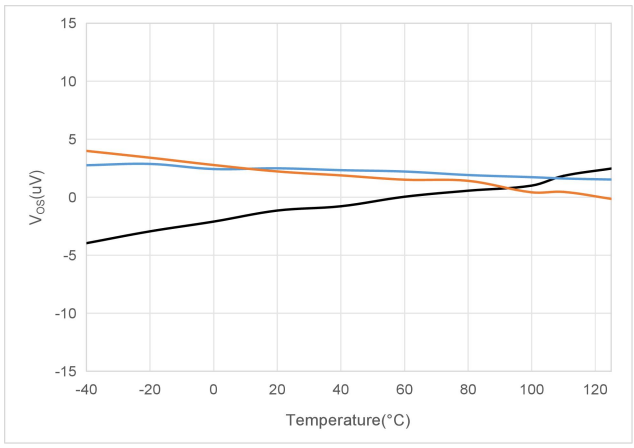
## Electrical Characteristics (Continued)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **FREQUENCY RESPONSE** | | | | | | |
| GBP | Gain-bandwidth product | CL = 100 pF | | 350 | | kHz |
| SR | Slew rate | G = 1 | | 0.16 | | V/μs |
| **OUTPUT** | | | | | | |
| $V_O$ | Voltage output swing from supply rails | $T_A$= –40°C to +125°C | | 30 | 70 | mV |
| $I_{SC}$ | Short-circuit current | | | ±5 | | mA |
| $Z_O$ | Open-loop output impedance(3) | f = 350 kHz, $I_O$ = 0 mA | | 2 | | kΩ |
| **POWER SUPPLY** | | | | | | |
| $V_S$ | Specified voltage range | | 1.8 (±0.9) | | 5.5 (±2.75) | V |
| $I_Q$ | Quiescent current per amplifier | $I_O$ = 0 mA | | 17 | 32 | μA |
| Ton | Turn-on time | $V_S$ = 5 V | | 100 | | μs |

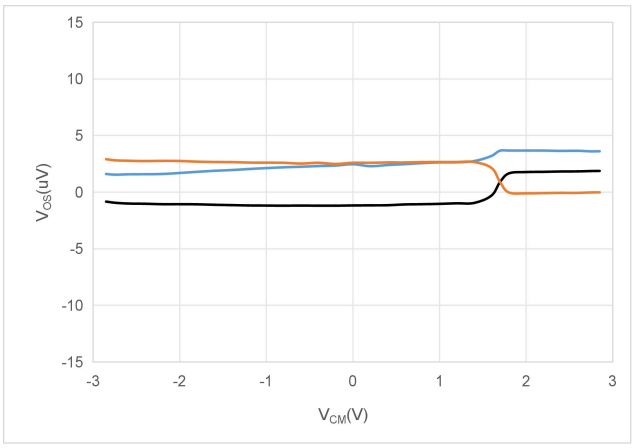
***Note3***: Guaranteed by design.

## Typical Characteristics

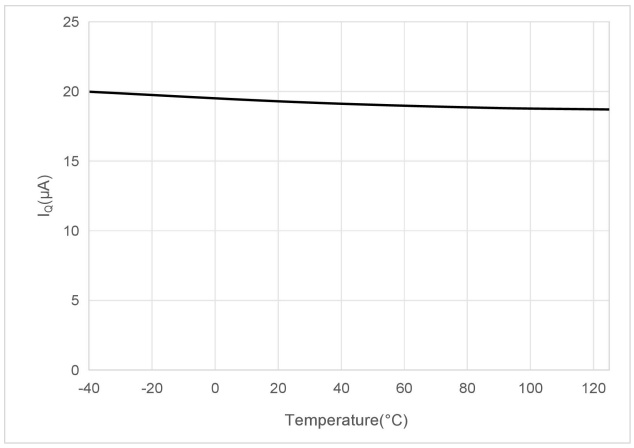
$V_S$ = 5.5 V(±2.75V), $V_{CM}$ = $V_{OUT}$ = $V_S$/2, and $R_L$ = 10kΩ connected to $V_S$/2,$T_A$ = 25°C (unless otherwise noted)



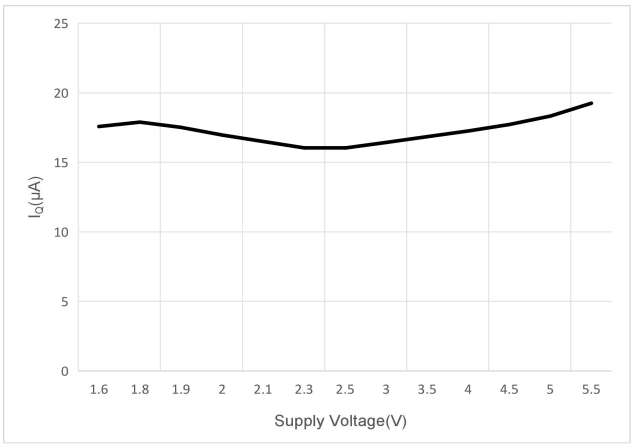

Offset Voltage vs Temperature



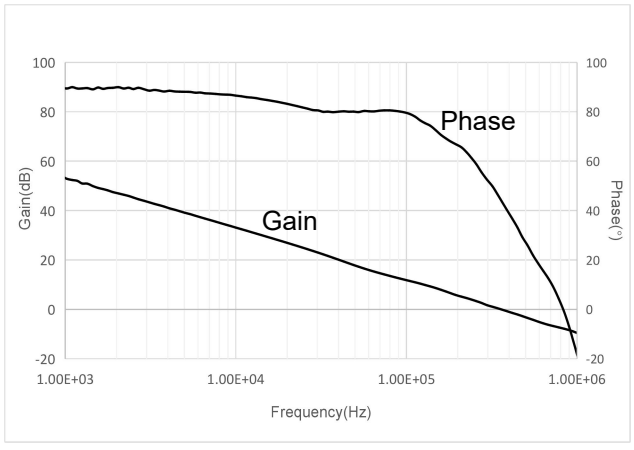

Offset Voltage vs Common-Mode Voltage



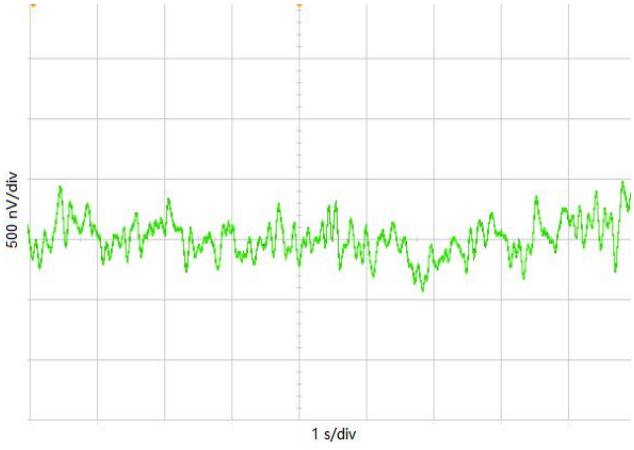

Quiescent Current vs Temperature




Quiescent Current vs Supply Voltage

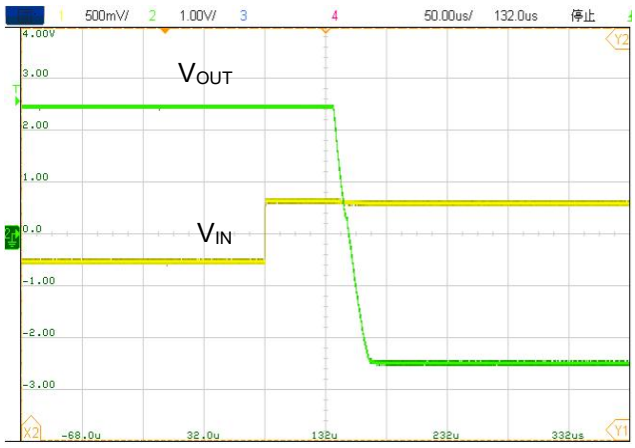



Open-Loop Gain vs Frequency



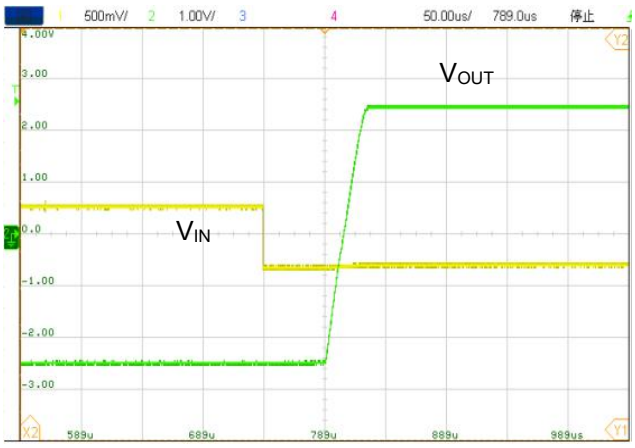

0.1 Hz to 10 Hz Noise

## Typical Characteristics (Continued)



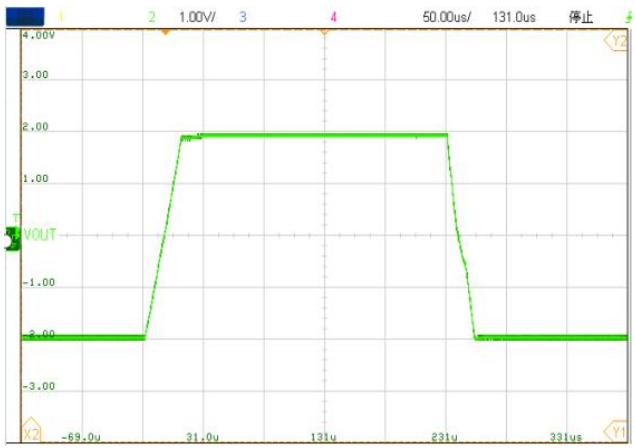

Positive Overload Recovery

(G = -10)




Negative Overload Recovery

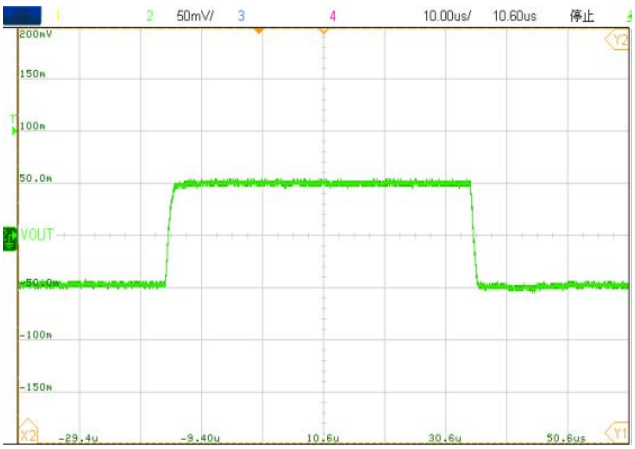
(G = -10)




Large-Signal Step Response

($G = +1, R_L = 10\ k\Omega$)

VIN




Small-Signal Step Response(100 mV)

($G = +1, R_L = 10\ k\Omega$)

## Functional Description

### Overview

ET85302 can be used with single or dual supplies from an operating range of VS = 1.8 V (±0.9 V) up to 5.5 V (±2.75 V).

### Input Voltage

The input common-mode voltage range extends 100 mV beyond the supply rails. ET85302 is designed to cover the full range without the troublesome transition region found in some other rail-to-rail amplifiers.

## Layout Guidelines

For best operational performance of the device, use good PCB layout practices, including:

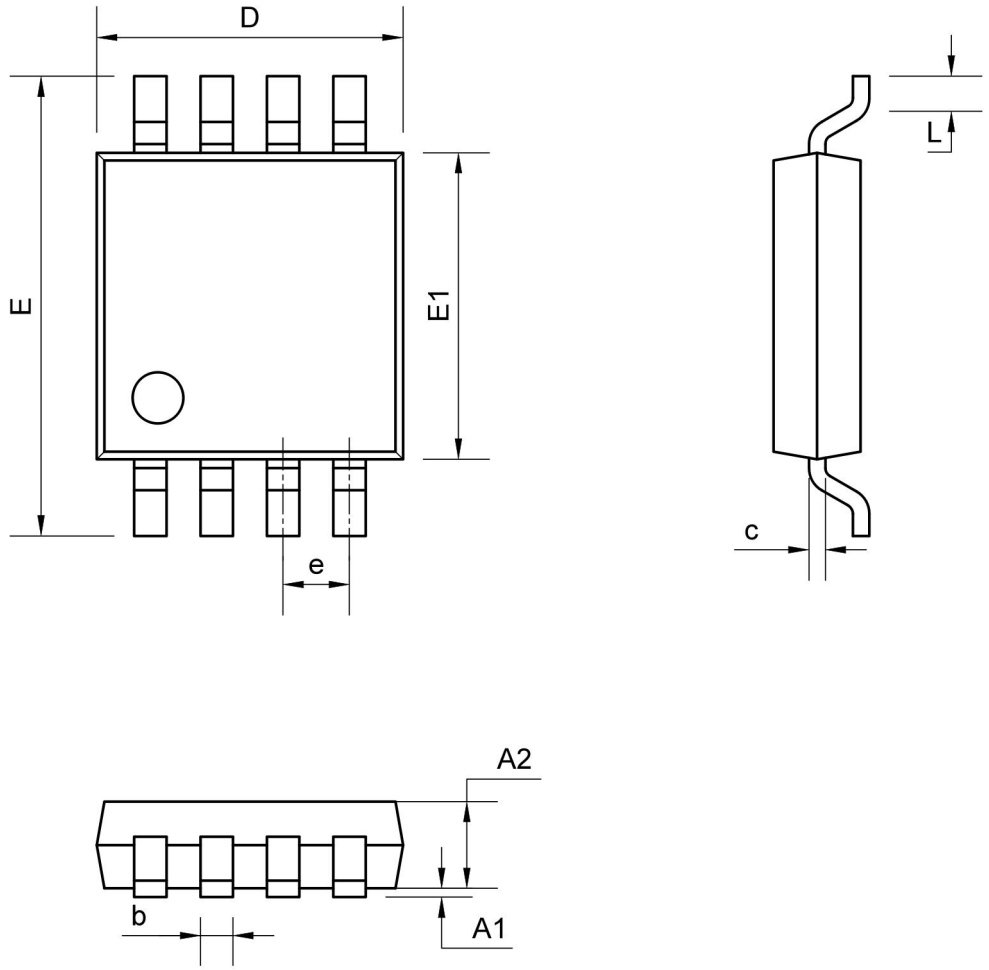
Place the external components as close to the device as possible. This configuration prevents parasitic errors (such as the Seebeck effect) from occurring.

To reduce parasitic coupling, run the input traces as far away from the supply lines and digital signal as possible. Low-ESR, 0.1μF ceramic bypass capacitors must be connected between each supply pin and ground, placed as close to the device as possible. A single bypass capacitor from V+ to ground is applicable to single supply applications.

Consider a driven, low-impedance guard ring around the critical traces. A guard ring can significantly reduce leakage currents from nearby traces that are at different potentials.

## Package Dimension

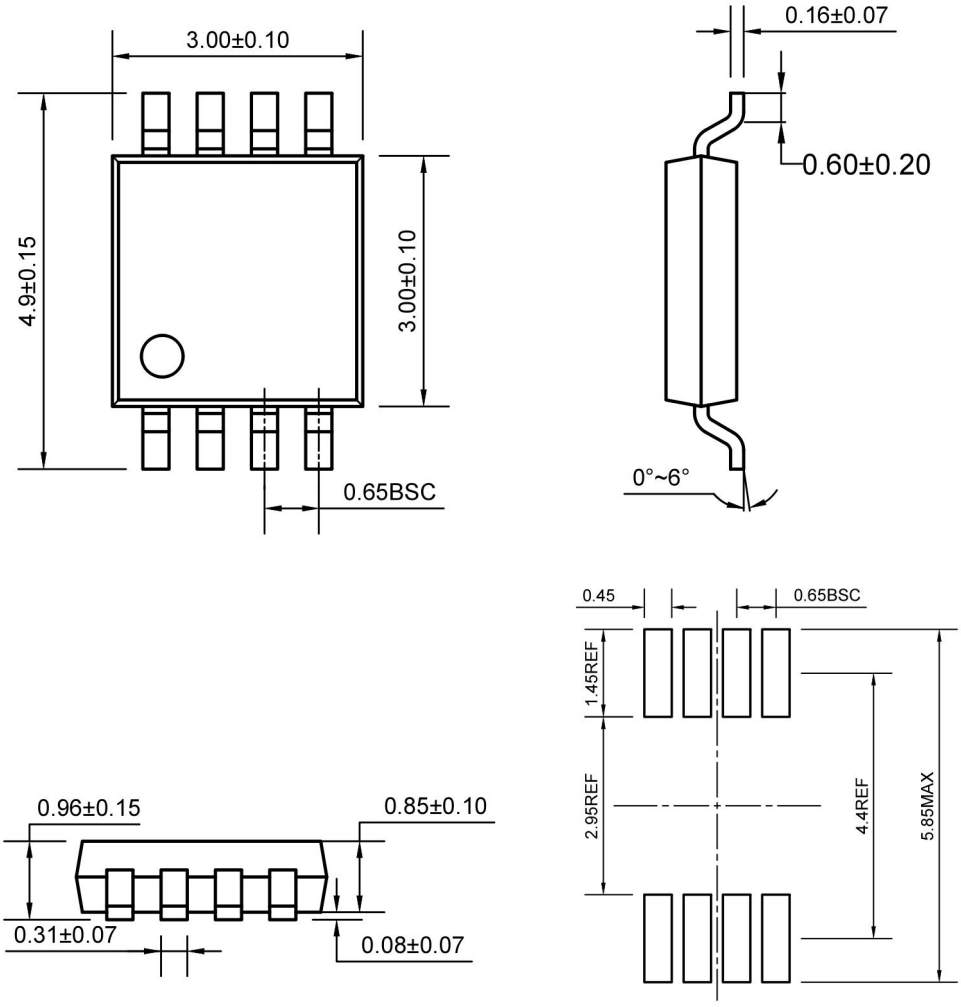
SOP8




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A1 | 0.15 | — | 0.22 |
| A2 | 1.40 | 1.55 | 1.50 |
| b | | 0.40 BSC | |
| c | 0.20 | — | 0.25 |
| D | 4.85 | 4.90 | 4.95 |
| E | 5.99 | 6.04 | 6.09 |
| E1 | 3.85 | 3.90 | 3.95 |
| e | | 1.27 BSC | |
| L | 0.50 | 0.60 | 0.70 |

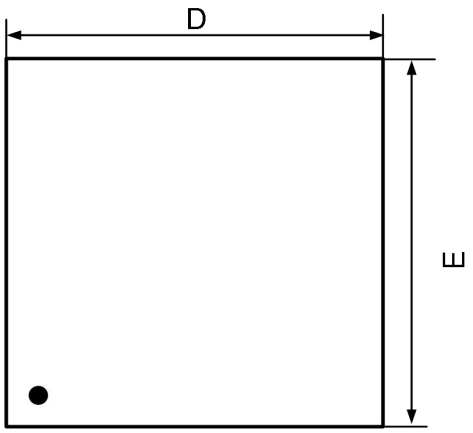
MSOP8



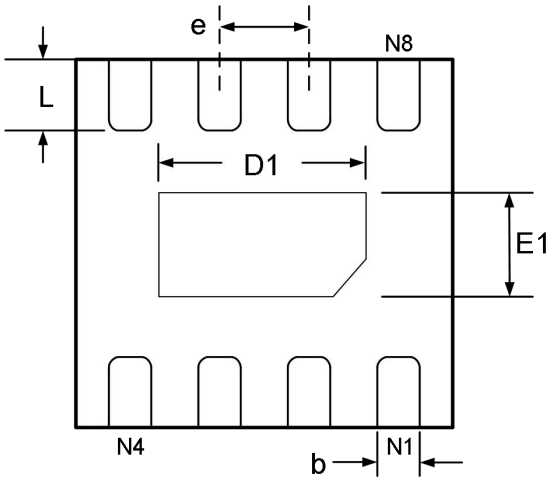

Recommended Land Pattern

Unit: mm

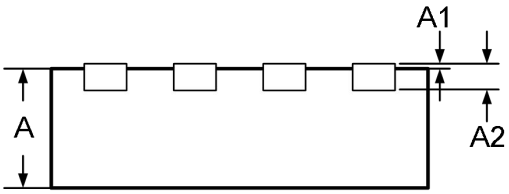
DFN8(2×2)




TOP VIEW




BOTTOM VIEW



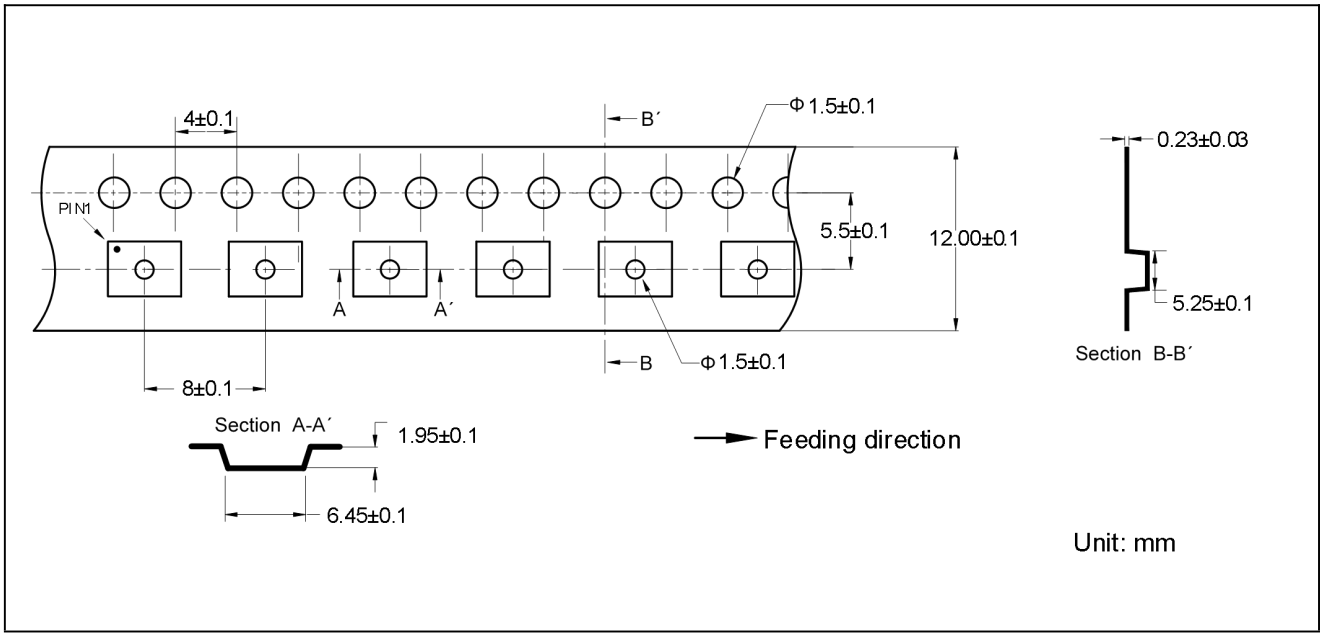

SIDE VIEW

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

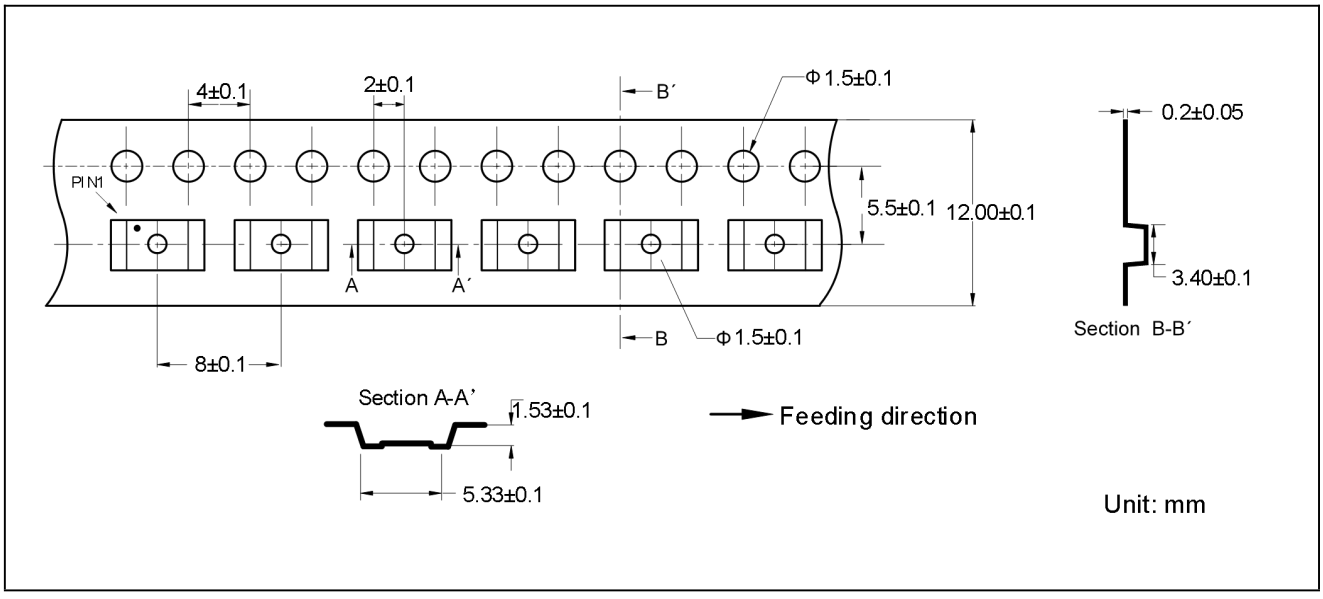
| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.70 | 0.75 | 0.80 |
| A1 | 0.00 | - | 0.05 |
| A2 | | 0.2 REF | |
| D | 1.90 | 2.00 | 2.10 |
| D1 | 1.10 | - | 1.70 |
| E | 1.90 | 2.00 | 2.10 |
| E1 | 0.50 | - | 1.00 |
| b | 0.18 | 0.23 | 0.28 |
| e | | 0.50 BSC | |
| L | 0.20 | 0.30 | 0.40 |

## Tape Information

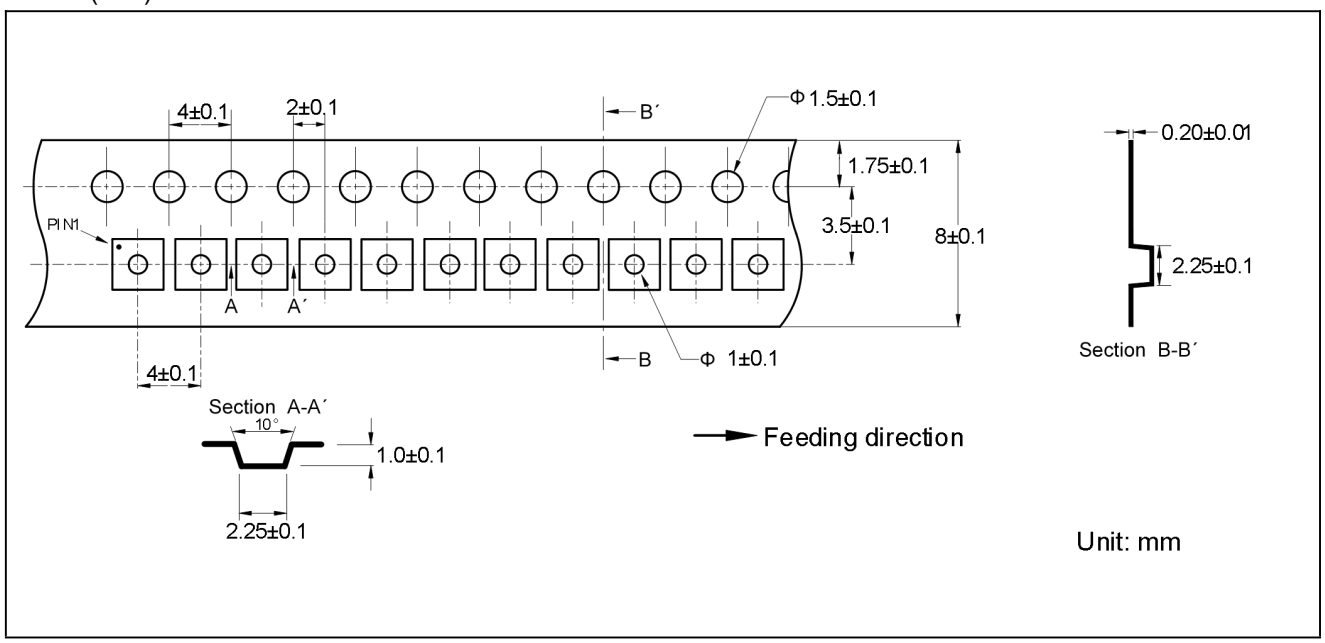
SOP8




MSOP8



DFN8(2×2)




## Revision History and Checking Table

| Version | Date | Revision Item | Modifier | Function & Spec Checking | Package & Tape Checking |
|---|---|---|---|---|---|
| 1.0 | 2025-03-05 | Original Version | Huyt | Chenh | Liujy |
| 1.1 | 2026-05-08 | Add ET85302Y1 | Huyt | Chenh | Liujy |
| | | | | | |