

Precision, 20-MHz, 1-pA, Low-Noise, RRIO, CMOS Operational Amplifier

General Description

ET85201 is a single low-voltage (1.8 V to 5.5 V) operational amplifier (op amp) with very low noise and wide bandwidth capabilities while operating on a low quiescent current of only 1.7 mA.

ET85201 is ideal for low-power, single-supply applications. Low-noise (7 nV/ $\sqrt{\text{Hz}}$) and high speed operation also make it well-suited for driving sampling analog-to-digital converters (ADCs). Other applications include signal conditioning and sensor amplification.

ET85201 features a linear input stage with zero-crossover distortion that delivers excellent common-mode rejection ratio (CMRR) of typically 114 dB over the full input range. The input common mode range extends 100 mV beyond the negative and positive supply rails. The output voltage typically swings within 10 mV of the rails.

Features

- Precision with Zero-Crossover Distortion:
 - Low Offset Voltage: 250 μV (Maximum)
 - High CMRR: 114 dB
 - Rail-to-Rail I/O
- Low noise: 7 nV/ $\sqrt{\text{Hz}}$ at 10 kHz
- Wide Bandwidth: 20 MHz
- Slew Rate: 10 V/ μs
- Quiescent Current: 1.7 mA/Ch
- Single-Supply Voltage Range: 1.8 V to 5.5 V
- Unity-Gain Stable

Applications

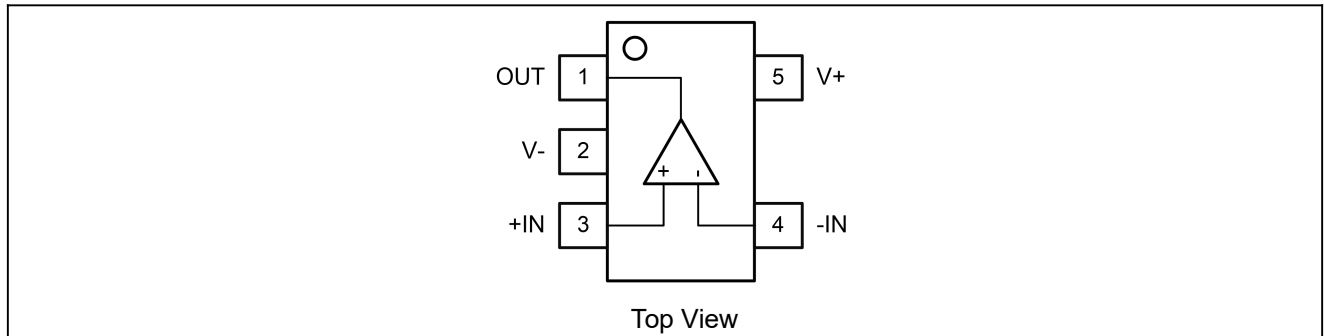
- High-Z Sensor Signal Conditioning
- Transimpedance Amplifiers
- Test and Measurement Equipment
- Programmable Logic Controllers (PLCs)
- Motor Control Loops
- Communications
- Input/Output ADC/DAC Buffers
- Active Filters

ET85201

Device information

Part No.	Package	Packing Option	MSL
ET85201EA	SOT23-5	Tape and Reel , 3k/Reel	3

Pin Configuration



Pin Function

Pin Number	Symbol	Descriptions
1	OUT	Output
2	V-	Negative supply
3	+IN	Non-inverting input
4	-IN	Inverting input
5	V+	Positive supply

ET85201

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 to 6	V
V _{IN}	Signal input terminals Voltage ⁽¹⁾	(V ₋)-0.5 to (V ₊)+0.5	V
I _{IN}	Signal input terminals Current ⁽¹⁾	-10 to +10	mA
I _{SC}	Output short-circuit Current ⁽²⁾	Continuous	mA
V _{ESD}	ESD (Human Body Model)	±4000	V
	ESD (Component Discharge Model)	±1000	V
	ESD (Machine Model)	±200	V
T _{STG}	Storage Temperature Range	-65 to +150	°C
T _{J(MAX)}	Max Junction Temperature Range	+150	°C
T _A	Operating Temperature Range	-40 to +125	°C

Note1: Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5 V beyond the supply rails should 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 _{θJA}	SOT23-5	Thermal Characteristics, Thermal Resistance, Junction-to-Air	219.3	°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

ET85201

Electrical Characteristics

$V_S = (V+) - (V-) = 1.8 \text{ V to } 5.5 \text{ V}$ ($\pm 0.9 \text{ V to } \pm 2.75 \text{ V}$), $T_A = 25^\circ\text{C}$, $R_L = 10 \text{ k}\Omega$ 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			± 60	± 250	μV
$\Delta V_{OS} / \Delta T$	Input offset voltage vs temperature	$V_S = 5.5 \text{ V}, T_A = -40^\circ\text{C to } +125^\circ\text{C}$		± 1.5	± 5	$\mu\text{V}/^\circ\text{C}$
PSRR	Input offset voltage vs power supply	$V_S = 1.8 \text{ to } 5.5 \text{ V}$		± 5	± 20	$\mu\text{V/V}$
INPUT VOLTAGE RANGE						
V_{CM}	Common-mode voltage range	$V_S = 1.8 \text{ V to } 5.5 \text{ V}$	$(V-) - 0.1$		$(V+) + 0.1$	V
CMRR	Common-mode rejection ratio	$V_S = 5.5 \text{ V},$ $(V-) - 0.1 \text{ V} < V_{CM} < (V+) + 0.1 \text{ V}$	100	114		dB
INPUT BIAS CURRENT						
I_B	Input bias current ⁽³⁾	$T_A = 25^\circ\text{C}$		± 1		pA
I_{OS}	Input offset current ⁽³⁾	$T_A = 25^\circ\text{C}$		± 1		pA
NOISE						
E_n	Input voltage noise (peak to peak)	$f = 0.1 \text{ Hz to } 10 \text{ Hz}$		2.8		μV_{PP}
e_n	Input voltage noise density	$f = 1 \text{ kHz}$		8.5		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10 \text{ kHz}$		7		
i_n	Input current noise density ⁽³⁾	$f = 1 \text{ kHz}$		0.6		$\text{fA}/\sqrt{\text{Hz}}$
INPUT CAPACITANCE						
C_{ID}	Differential			5		pF
C_{IC}	Common-mode			4		pF
OPEN-LOOP GAIN						
A_{OL}	Open-loop voltage gain	$0.1 \text{ V} < V_O < (V+) - 0.1 \text{ V},$ $R_L = 10 \text{ k}\Omega,$	114	128		dB
		$0.2 \text{ V} < V_O < (V+) - 0.2 \text{ V},$ $R_L = 2 \text{ k}\Omega,$	108	125		
PM	Phase margin	$V_S = 5 \text{ V}, C_L = 50 \text{ pF}$		47		°

ET85201

Electrical Characteristics (Continued)

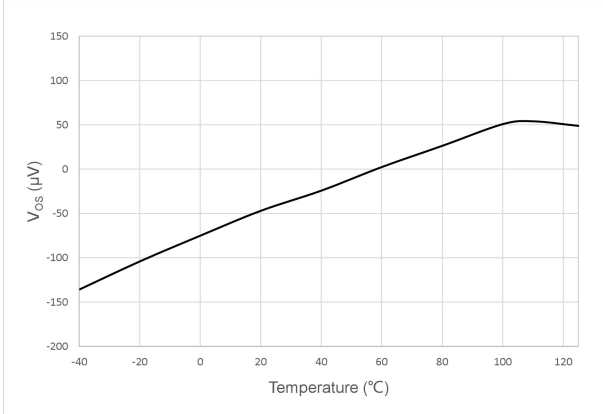
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
FREQUENCY RESPONSE,V _S = 5 V, C _L = 50 pF						
GBP	Gain-bandwidth product	Unity gain		20		MHz
SR	Slew rate	G =+1		10		V/μs
t _s	Settling time ⁽³⁾	To 0.1%,2V step, G = +1		0.25		μs
		To 0.01%, 2V step, G = +1		0.32		
t _{OR}	Overload recovery time	V _{IN} × gain > V _S		100		ns
THD+N	Total harmonic distortion + noise	V _O = 4 V _{pp} , G = 1, <i>f</i> = 1 kHz, R _L = 10 kΩ		0.0004		%
		V _O = 2 V _{pp} , G = 1, <i>f</i> = 1 kHz, R _L = 600Ω		0.0005		%
OUTPUT						
V _O	Voltage output swing from supply rails	R _L = 10 kΩ, T _A = 25°C		10	20	mV
		R _L = 2 kΩ, T _A = 25°C		25	35	
		R _L = 10 kΩ, T _A = -40°C to 125°C			30	
		R _L = 2 kΩ, T _A = -40°C to 125°C			45	
I _{SC}	Short-circuit current	V _S = 5.5 V		±70		mA
Z _O	Open-loop output impedance ⁽³⁾	I _O = 0mA, <i>f</i> = 1MHz		90		Ω
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, V _S = 5.5 V		1.7	2.0	mA
		I _O = 0 mA, V _S = 5.5 V, T _A = -40°C to 125°C			2.15	

Note3:Guaranteed by design.

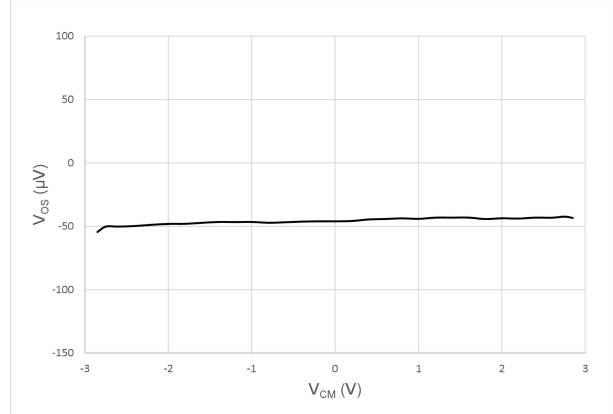
ET85201

Typical Characteristics

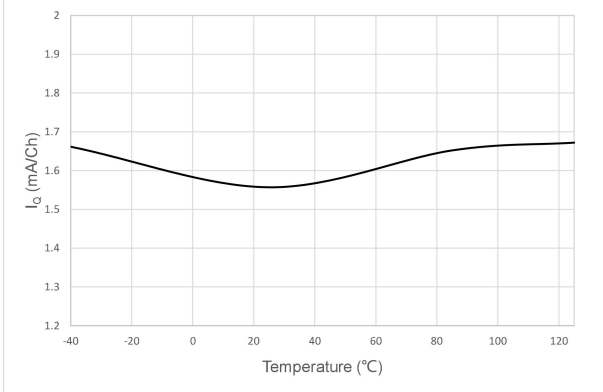
$V_S = 5.5\text{ V}(\pm 2.75\text{V})$, $V_{CM} = V_{OUT} = V_S/2$, and $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)



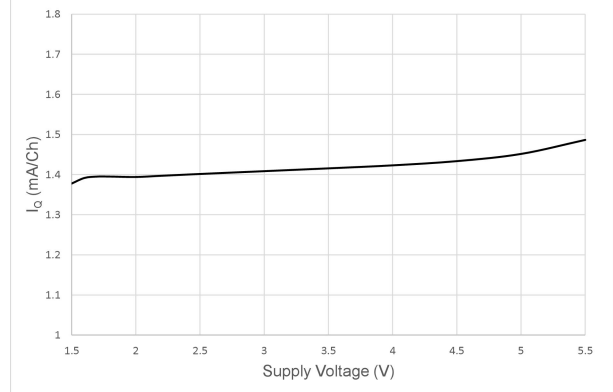
Offset Voltage vs Temperature



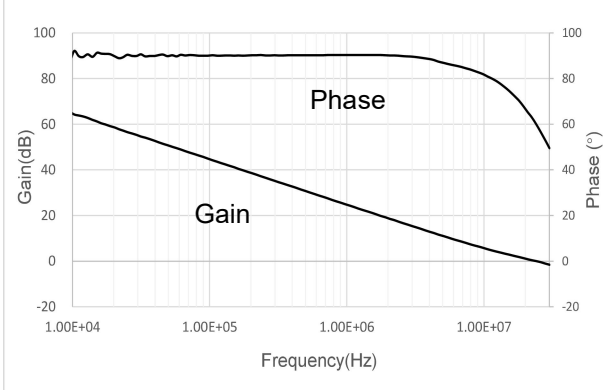
Offset Voltage vs Common-Mode Voltage



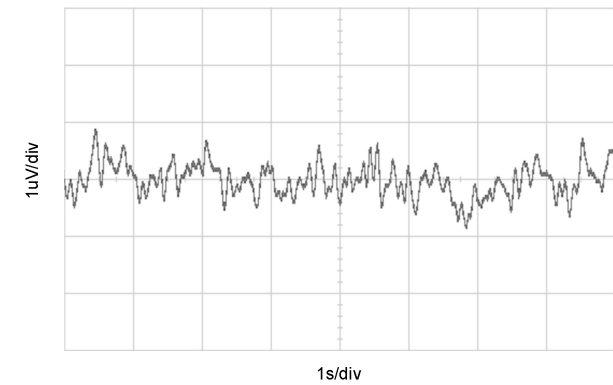
Quiescent Current vs Temperature



Quiescent Current vs Supply Voltage



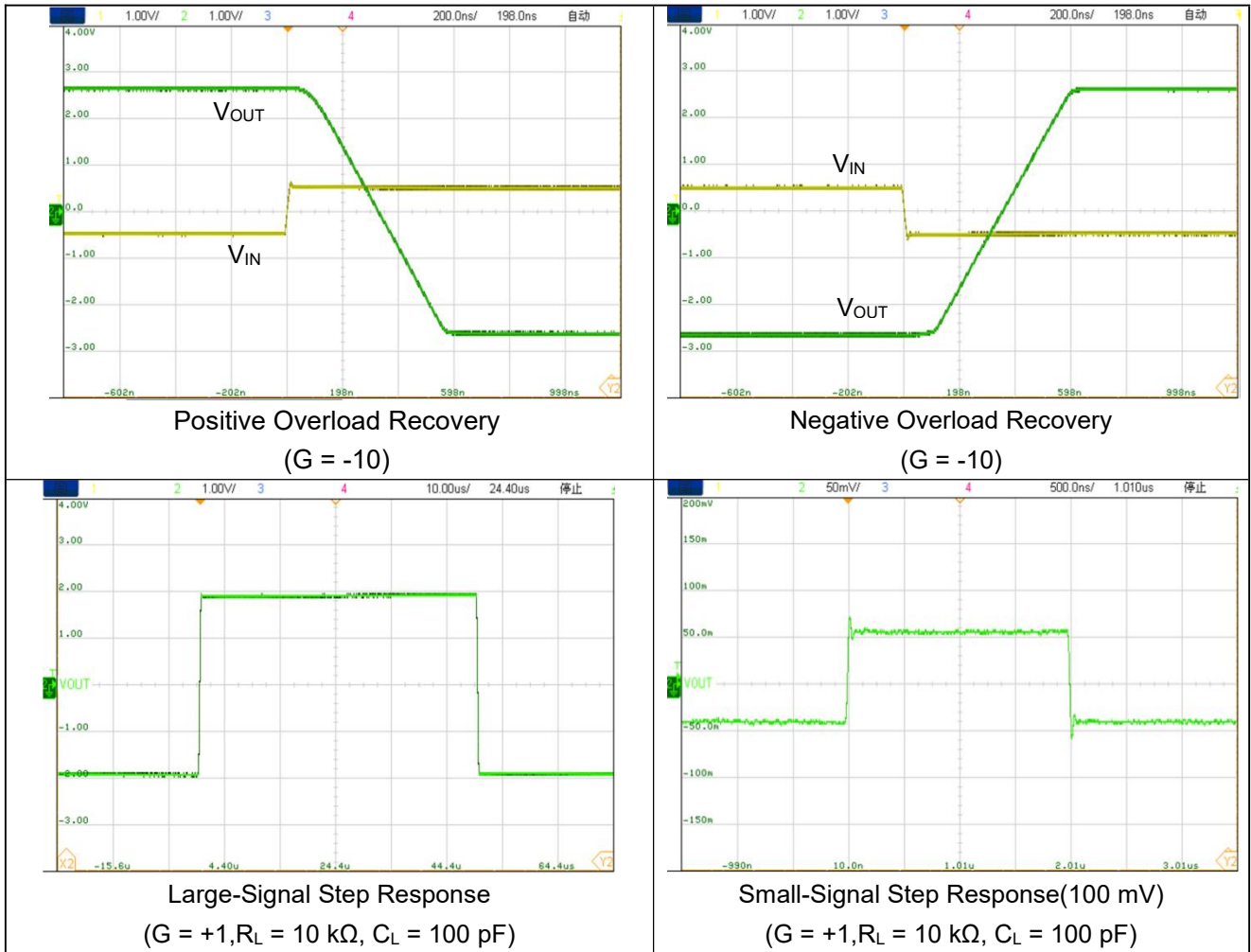
Open-Loop Gain vs Frequency



0.1 Hz to 10 Hz Noise

ET85201

Typical Characteristics (Continued)



ET85201

Functional Description

Overview

ET85201 is a high-speed, precision amplifier, perfectly suited to drive 12-, 14-, and 16-bit analog-to-digital converters. Low output impedance with flat frequency characteristics and zero-crossover distortion circuitry enable high linearity over the full input common mode range, achieving true rail-to-rail input from a 1.8 V to 5.5 V single supply.

Operating Voltage

ET85201 is unity-gain stable and can operate on a single-supply voltage (1.8 V to 5.5 V), or a split-supply voltage (± 0.9 V to ± 2.75 V), making it highly versatile and easy to use. The power-supply pins should have local bypass ceramic capacitors (typically 0.001 μ F to 0.1 μ F). ET85201 is fully specified from 1.8 V to 5.5 V and over the extended temperature range of -40°C to 125°C .

Rail-to-Rail Input

ET85201 features true rail-to-rail input operation, with supply voltages as low as ± 0.9 V (1.8 V). ET85201 includes an internal charge-pump that powers the amplifier input stage with an internal supply rail at approximately 1.6 V above the external supply (V_{S+}). This internal supply rail allows the single differential input pair to operate and remain very linear over a very wide input common mode range. A unique zero-crossover input topology eliminates the input offset transition region typical of many rail-to-rail, complementary input stage operational amplifiers. This topology allows the ET85201 to provide superior common-mode performance ($\text{CMRR} > 110$ dB, typical) over the entire common-mode input range, which extends 100 mV beyond both power-supply rails. When driving analog-to-digital converters (ADCs), the highly linear V_{CM} range of the ET85201 assures maximum linearity and lowest distortion.

Capacitive Load and Stability

ET85201 is designed to be used in applications where driving a capacitive load is required. As with all op amps, there may be specific instances where the ET85201 can become unstable. The particular op amp circuit configuration, layout, gain, and output loading are some of the factors to consider when establishing whether an amplifier is stable in operation. An op amp in the unity-gain (1-V/V) buffer configuration and driving a capacitive load exhibits a greater tendency to become unstable than an amplifier operated at a higher noise gain. The capacitive load, in conjunction with the op amp output resistance, creates a pole within the feedback loop that degrades the phase margin. The degradation of the phase margin increases as the capacitive loading increases. When operating in the unity-gain configuration, ET85201 remains stable with a pure capacitive load up to approximately 1 nF.

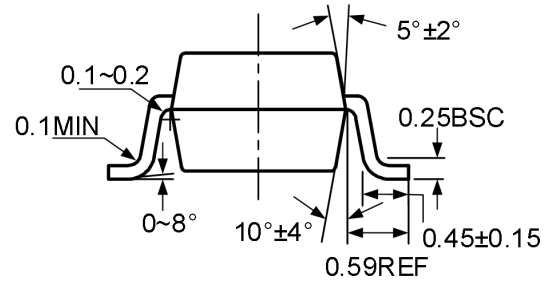
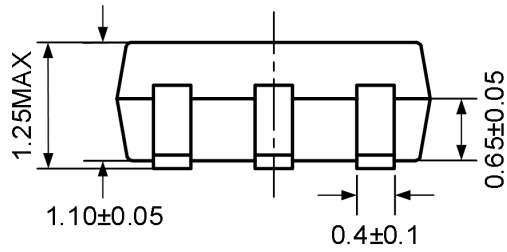
Layout Guidelines

ET85201 is a wideband amplifier. To realize the full operational performance of the device, good high frequency PCB layout practices are required. The bypass capacitors must be connected between each supply pin and ground as close to the device as possible. The bypass capacitor traces should be designed for minimum inductance.

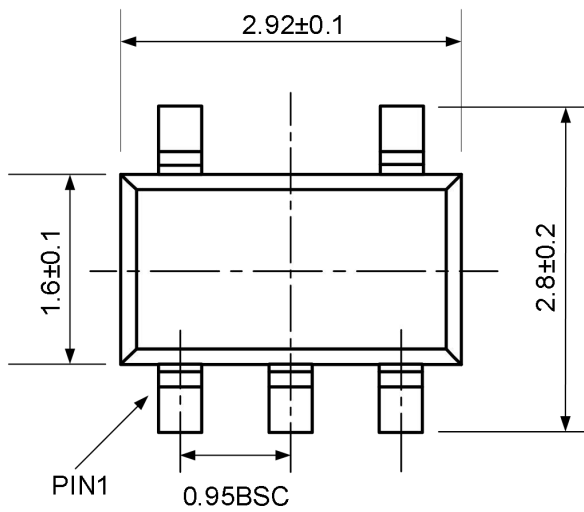
ET85201

Package Dimension

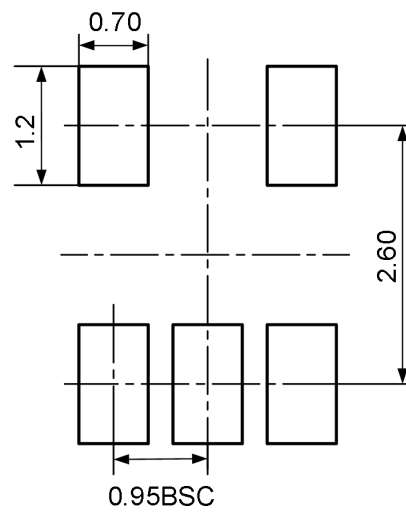
SOT23-5



SIDE VIEW



TOP VIEW

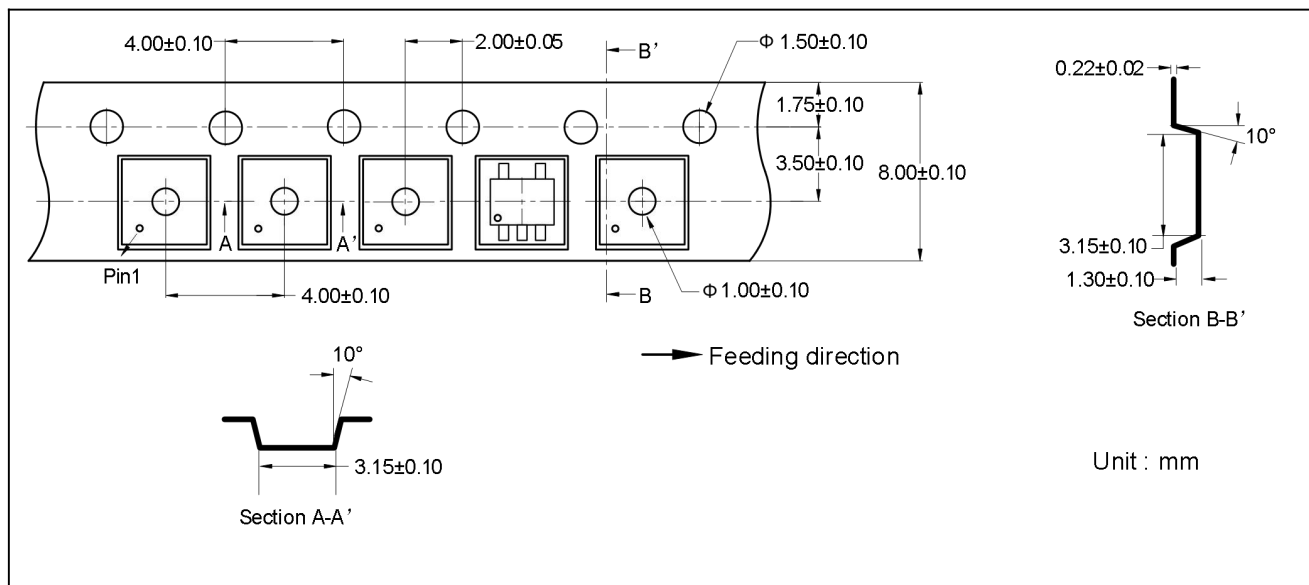


Recommended Land Pattern

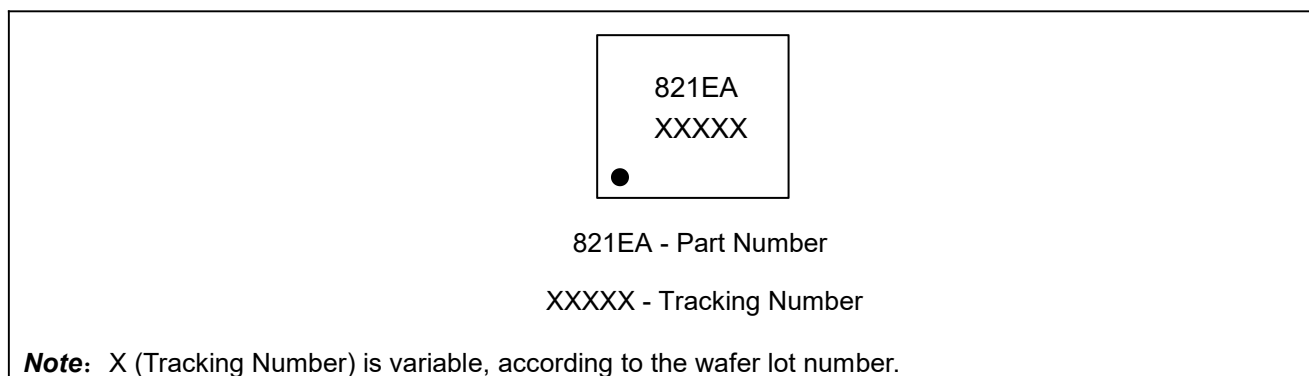
Unit: mm

ET85201

Tape Information



Marking Information



ET85201

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2025-06-18	Original Version	Huyt	Jiangxw	Liujiy