Zero-Drift, Single-Supply, Rail-to-Rail Input/Output Dual Operational Amplifiers

General Description

ET85502 is a dual high-precision amplifiers featuring rail-to-rail input and output swings respectively,has ultra low offset, drift, and bias current. Either single or dual supplies can be used in the range from 2.7V to 5V with a single supply.

ET85502 provides the benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. These new zero-drift amplifiers combine low cost with high accuracy. No external capacitors are required.

ET85502 is perfectly suited for applications where error sources cannot be tolerated, since the offset voltage is only 1μV and the drift is 0.005 μV/°C. With nearly zero drift over operating temperature range, medical equipment, temperature, position and pressure sensors, and strain gauge amplifiers all benefit greatly . The rail-to-rail input and output swings provided by the ET85502 make both high-side and low-side sensing easy.

ET85502 is specified for the extended industrial/automotive temperature range (-40°C to +125°C) .

ET85502 is available in MSOP8 and SOP8 packages.

Features

- Low offset voltage : 1 μV
- Input offset drift : 0.005 μV/°C
- Overload recovery time : 50 μs
- Low supply current : 770 μA/CH
- High gain, CMRR, PSRR : 130 dB
- Ultra low input bias current : 20 pA
- No external capacitors required
- 2.7 V to 5.0 V single-supply operation

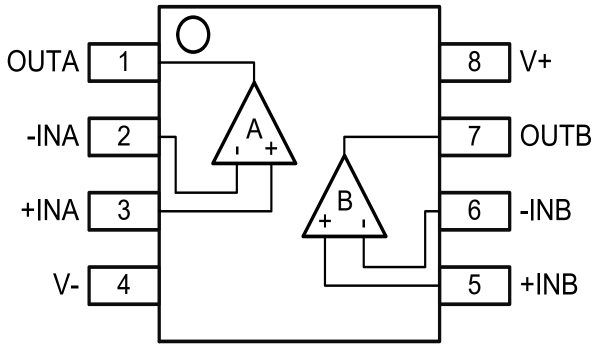
Applications

- Temperature sensors
- Pressure sensors
- Precision current sensing
- Strain gauge amplifiers
- Medical instrumentation
- Thermocouple amplifiers

Device information

Part No.	Package	Tape / Reel
ET85502M	SOP8	Tape and Reel 4K
ET85502U	MSOP8	Tape and Reel 4K

Pin Configuration



Top View

Pin Function

	Pin Number	Pin Name	Descriptions
ET85502M ET85502U	1	OUTA	Output
	2	-INA	Inverting input
	3	+INA	Non-inverting input
	4	V-	Negative supply
	5	+INB	Non-inverting input
	6	-INB	Inverting input
	7	OUTB	Output
	8	V+	Positive supply

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.

Parameter	Rating	Unit
Supply Voltage [1]	6.0	V
Input Voltage	GND-0.3V to Vs+0.3	V
Differential Input Voltage	±5.0	V
ESD (Human Body Model)	±2000	V
Storage Temperature Range	-40 to +150	°C
Max Junction Temperature Range	+150	°C
Lead Temperature Range (Soldering, 60 sec)	300	°C

Note1: All voltage values, except differential voltage are with respect to network terminal.

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	SOP8	Thermal Characteristics, Thermal Resistance, Junction-to-Air	150	°C/W
	MSOP8		210	°C/W

Recommended Operating Conditions

Parameter	MIN	MAX	Unit
Supply Voltage (V_S)	2.7	5.0	V
Operating Temperature (T_A)	-40	125	°C

Electrical Characteristics

V_S = 5 V, V_{CM} = 2.5 V, V_O = 2.5 V, T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	µV
		−40°C ≤ T_A ≤ +125°C			10	µV
Input Bias Current	I_B			10	50	pA
		−40°C ≤ T_A ≤ +85°C		160	300	pA
		−40°C ≤ T_A ≤ +125°C		2.5	4	nA
Input Offset Current	I_{OS}			20	70	pA
		−40°C ≤ T_A ≤ +85°C		30	150	pA
		−40°C ≤ T_A ≤ +125°C		150	400	pA
Input Voltage Range	V_{IN}		0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to +5 V	120	140		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Large Signal Voltage Gain [(2)]	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 4.7 V	125	145		dB
		−40°C ≤ T_A ≤ +125°C	120	135		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.005	0.04	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	4.99	4.998		V
		R_L = 100 kΩ to GND @−40°C to +125°C	4.99	4.997		V
		R_L = 10 kΩ to GND	4.95	4.98		V
		R_L = 10 kΩ to GND @−40°C to +125°C	4.95	4.975		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	10	mV
		R_L = 100 kΩ to V+ @−40°C to +125°C		2	10	mV
		R_L = 10 kΩ to V+		10	30	mV
		R_L = 10 kΩ to V+ @−40°C to +125°C		15	30	mV
Output Short-Circuit Limit Current	I_{SC}		±25	±50		mA
		−40°C to +125°C		±40		mA
Output Current	I_O			±30		mA
		−40°C to +125°C		±15		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	120	130		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		770	975	µA
		−40°C ≤ T_A ≤ +125°C		1067	1264	µA

DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.4		V/μs
Overload Recovery Time				0.05	0.3	ms
Gain Bandwidth Product	GBP			1.5		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz		1.0		μV p-p
	e_n p-p	0 Hz to 1 Hz		0.32		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		42		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		2		fA/√Hz

Note(2): Gain testing is dependent upon test bandwidth.

V_S = 2.7 V, V_{CM} = 1.35 V, V_O = 1.35 V, T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}			1	5	μV
		−40°C ≤ T_A ≤ +125°C			10	μV
Input Bias Current	I_B			10	50	pA
		−40°C ≤ T_A ≤ +85°C		160	300	pA
		−40°C ≤ T_A ≤ +125°C		2.5	4	nA
Input Offset Current	I_{OS}			10	50	pA
		−40°C ≤ T_A ≤ +85°C		30	150	
		−40°C ≤ T_A ≤ +125°C		150	400	pA
Input Voltage Range	V_{IN}		0		2.7	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to +2.7 V	115	130		dB
		−40°C ≤ T_A ≤ +125°C	110	130		dB
Large Signal Voltage Gain[(2)]	A_{VO}	R_L = 10 kΩ, V_O = 0.3 V to 4.7 V	110	140		dB
		−40°C ≤ T_A ≤ +125°C	105	130		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C ≤ T_A ≤ +125°C		0.005	0.04	μV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 100 kΩ to GND	2.685	2.697		V
		R_L = 100 kΩ to GND @−40°C to +125°C	2.685	2.696		V
		R_L = 10 kΩ to GND	2.67	2.68		V
		R_L = 10 kΩ to GND @−40°C to +125°C	2.67	2.675		V
Output Voltage Low	V_{OL}	R_L = 100 kΩ to V+		1	10	mV
		R_L = 100 kΩ to V+ @−40°C to +125°C		2	10	mV
		R_L = 10 kΩ to V+		10	20	mV
		R_L = 10 kΩ to V+ @−40°C to +125°C		15	20	mV

Output Short-Circuit Limit Current	I_{SC}		±10	±15		mA
		−40°C to +125°C		±10		mA
Output Current	I_O			±10		mA
		−40°C to +125°C		±5		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	120	130		dB
		−40°C ≤ T_A ≤ +125°C	115	130		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		764	900	μA
		−40°C ≤ T_A ≤ +125°C		1115	1279	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		0.5		V/μs
Overload Recovery Time				0.05		ms
Gain Bandwidth Product	GBP			1		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz		1.6		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		75		nV/√Hz
Current Noise Density	i_n	f = 10 Hz		2		fA/√Hz

Note(2): Gain testing is dependent upon test bandwidth.

Application Notes

Layout Guidelines

For best operational performance of the device, use good printed circuit board (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.

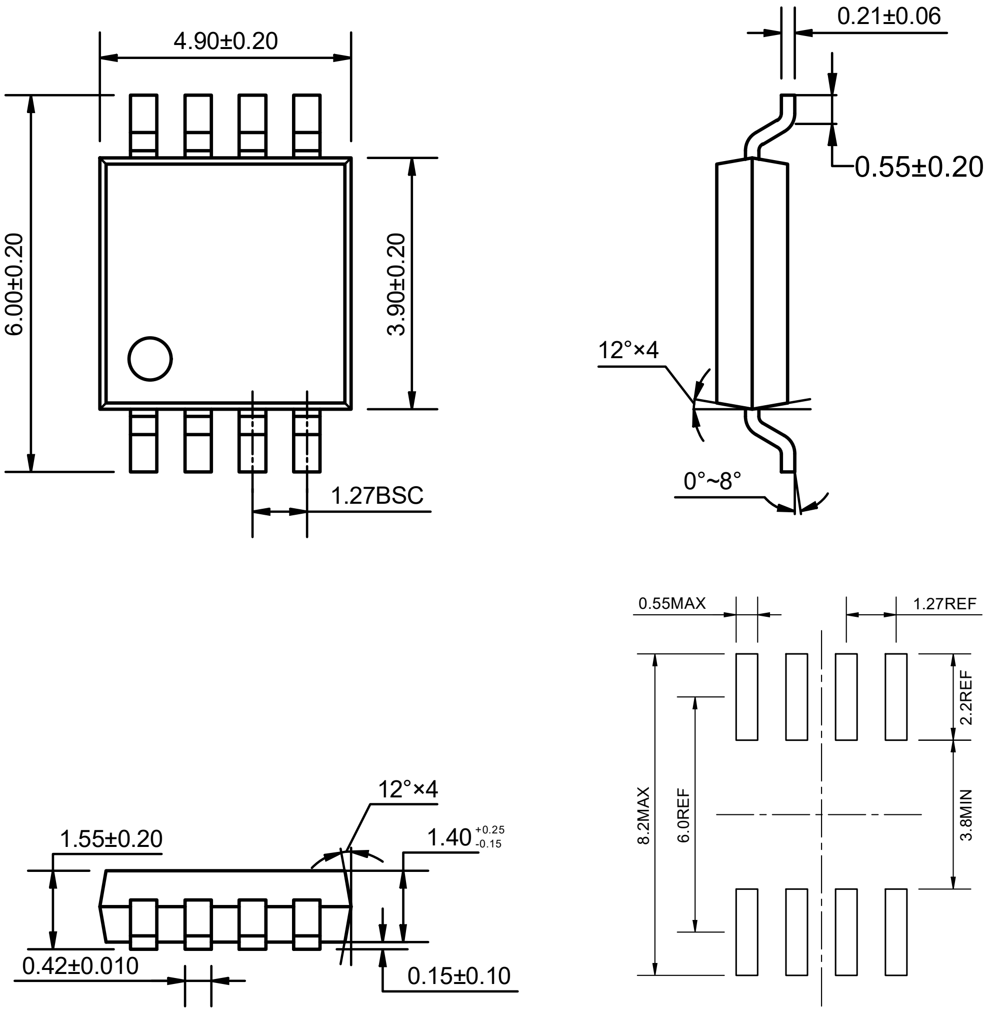
To reduce parasitic coupling, run the input traces as far away from the supply lines and digital signal as possible.

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

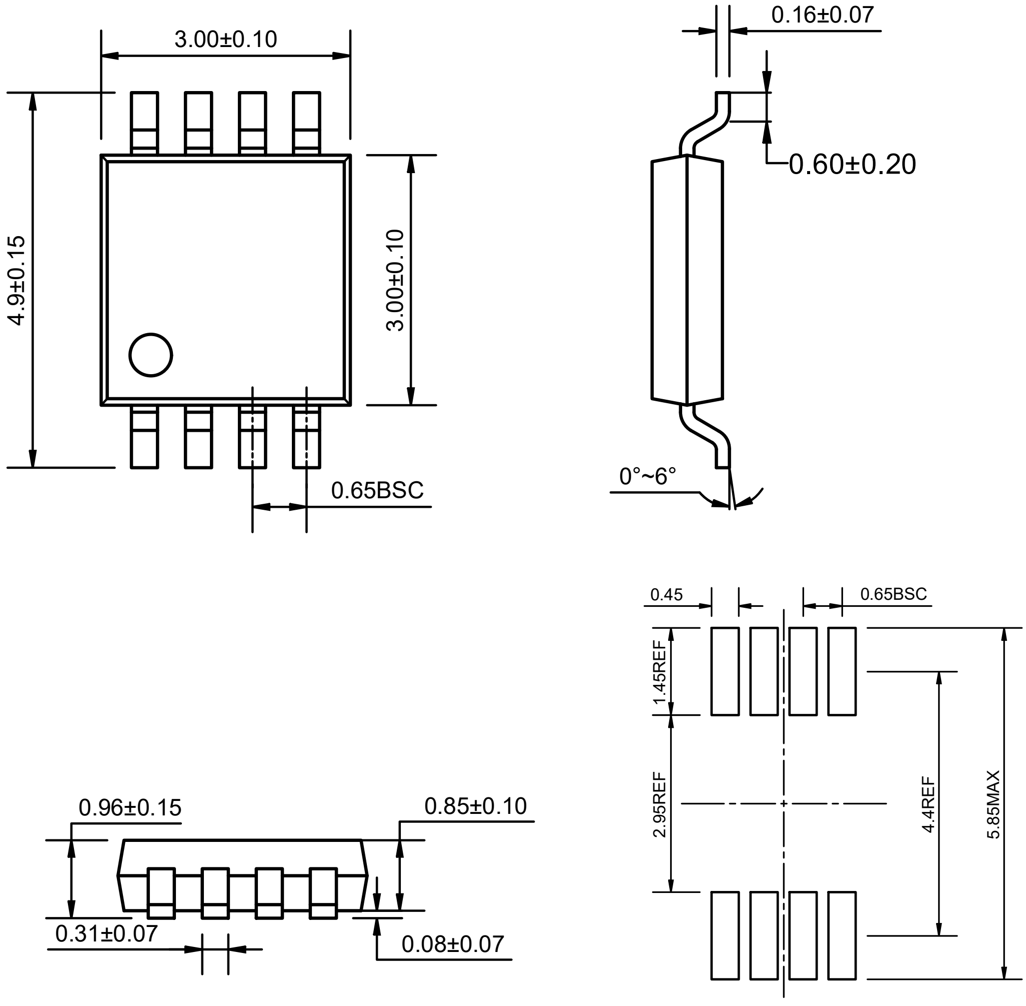
SOP8



Recommended Land Pattern

Unit: mm

MSOP8



Recommended Land Pattern

Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0	2021-4-11	Preliminary Version	Liuxm	Liuxm	Liujy
1.0	2023-2-27	Official version	Shibo	Wanggp	Liujy
1.1	2023-9-27	Naming updates	Shibo	Wanggp	Liujy