



十速

**TR9001**

***DATA SHEET***

***Rev 1.2***

**tenx** reserves the right to change or discontinue the manual and online documentation to this product herein to improve reliability, function or design without further notice. **tenx** does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others. **tenx** products are not designed, intended, or authorized for use in life support appliances, devices, or systems. If Buyer purchases or uses tenx products for any such unintended or unauthorized application, Buyer shall indemnify and hold tenx and its officers, employees, subsidiaries, affiliates and distributors harmless against all claims, cost, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use even if such claim alleges that tenx was negligent regarding the design or manufacture of the part.

---

## AMENDMENT HISTORY

Version	Date	Description
1.0	Feb, 2012	New release.
1.1	June, 2012	The method to save the current consumption of idle OP Amp.
1.2	Aug, 2016	Modify functional block diagram

# CONTENTS

<b>AMENDMENT HISTORY .....</b>	<b>2</b>
<b>CONTENTS.....</b>	<b>3</b>
<b>GENERAL DESCRIPTION .....</b>	<b>4</b>
<b>FEATURES .....</b>	<b>4</b>
<b>APPLICATION.....</b>	<b>4</b>
<b>Functional Block Diagram .....</b>	<b>5</b>
<b>Pin Assignment.....</b>	<b>5</b>
<b>Pin Description .....</b>	<b>6</b>
<b>Absolute Maximum Ratings.....</b>	<b>6</b>
<b>Electrical Characteristics (VDD=5V, Ta=25°C).....</b>	<b>7</b>
<b>Package Information.....</b>	<b>8</b>

## GENERAL DESCRIPTION

The TR9001 is a CMOS quad micro power operational amplifier. This cost-effective device is suitable for high gain, low frequency, and low power applications, especially ideal for battery powered systems where  $\mu\text{A}$  range of standby current is essential for long battery life span. It also provides high performance operation at low supply voltages, and is ideal as a low power line signal monitor/detector, and alarm systems in car.

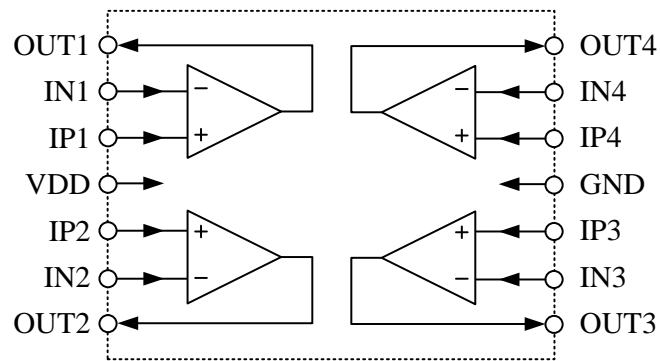
## FEATURES

1. Quad micro power op amp
2. Wide range of supply voltage: 1.6V~5.5V
3. High input impedance
4. Single supply operation
5. Low current consumption:  $<5 \mu\text{A}$  per amp
6. Rail to rail output
7. Provides both sink and source output drive capability
8. Pin compatible with LM324 (14-pin DIP)
9. 14-pin DIP/SOP package

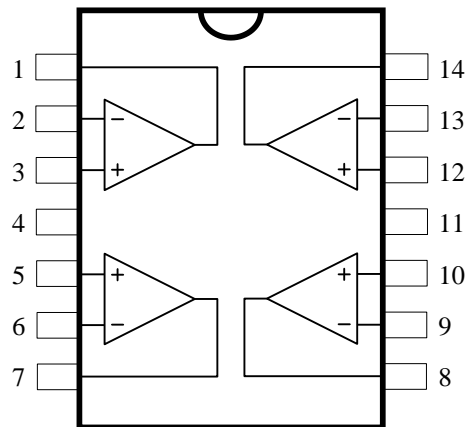
## APPLICATION

1. Battery powered system
2. Sensor amplifier
3. Low power gain blocks
4. Low power comparators
5. Signal detectors
6. Car alarm systems

### Functional Block Diagram



### Pin Assignment



## Pin Description

Pin No.	Pin Name	I/O	Internal Connection	Description
1	OUT1	O	CMOS OUT	Output pin of the op amp 1
2	IN1	I	PMOS IN	Inverting input pin of the op amp 1
3	IP1	I	PMOS IN	Non-inverting input pin of the op amp 1
4	VDD			Positive power supply
5	IP2	I	PMOS IN	Non-inverting input pin of the op amp 2
6	IN2	I	PMOS IN	Inverting input pin of the op amp 2
7	OUT2	O	CMOS OUT	Output pin of the op amp 2
8	OUT3	O	CMOS OUT	Output pin of the op amp 3
9	IN3	I	PMOS IN	Inverting input pin of the op amp 3
10	IP3	I	PMOS IN	Non-inverting input pin of the op amp 3
11	GND			Negative power supply
12	IP4	I	PMOS IN	Non-inverting input pin of the op amp 4
13	IN4	I	PMOS IN	Inverting input pin of the op amp 4
14	OUT4	O	CMOS OUT	Output pin of the op amp 4

## Absolute Maximum Ratings

Parameter	Rating	Unit
Supply voltage	-0.3 to +6.0	V
Input voltage	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	
Operating temperature	-20 to +75	°C
Storage temperature	-50 to +125	

Note : These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

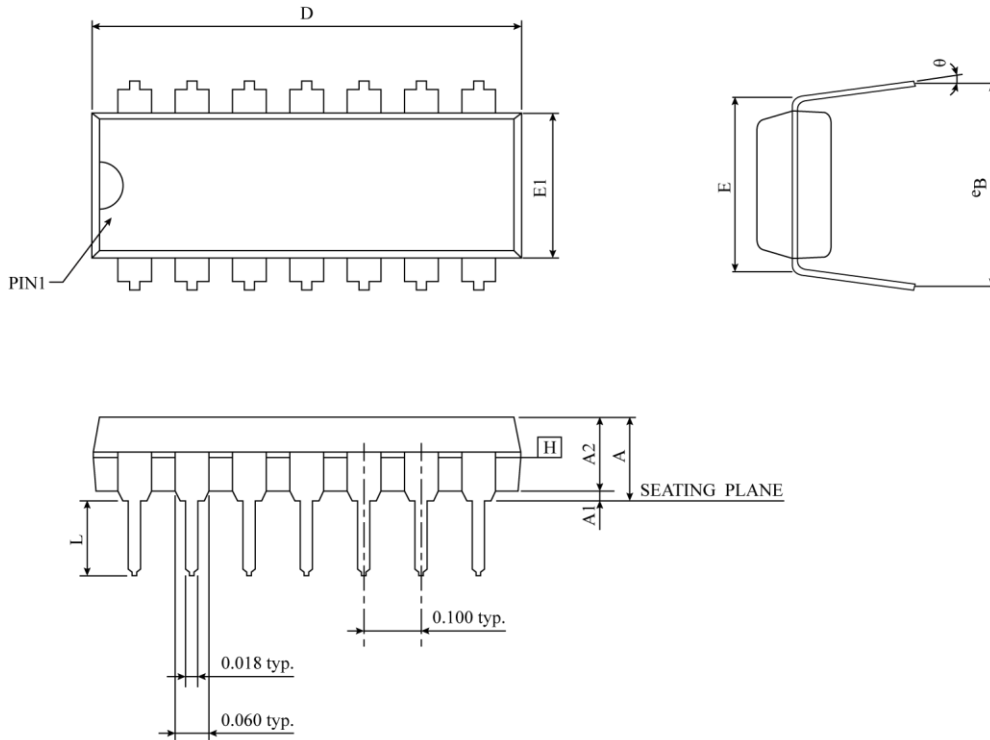
**Electrical Characteristics (VDD=5V, Ta=25°C)**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
VOS	Input Offset Voltage	Vo=1.4V			5	mv
AVOL	Large Signal Voltage Gain	RL=1 MΩ CL=100 pF		80		dB
GBW	Gain Band Width Product	RL=1 MΩ CL=100 pF		0.1		MHz
CMRR	Common Mode Rejection Ratio	Vo=1.4V Vi=0V		80		dB
PSRR	Power Supply Rejection Ratio	Vo=1.4V		80		dB
ICC	Supply Current Per Single Amplifier	Av=1 Vo=1.4V No load		3	5	μA
SR	Slew Rate at Unity Gain	No load		0.03		V/μs
Φm	Phase Margin at Unity Gain	RL=1 MΩ CL=100 pF		55		Degree
IOH	Output Source Current			-500		μA
IOL	Output Sink Current			500		μA

Note: The method to save the current consumption of idle OP Amp is to tie the inverting input pin to VDD pin and let the non-inverting input pin and output pin to be floating.

## Package Information

### 14-pin DIP (300 mil) Outline Dimensions

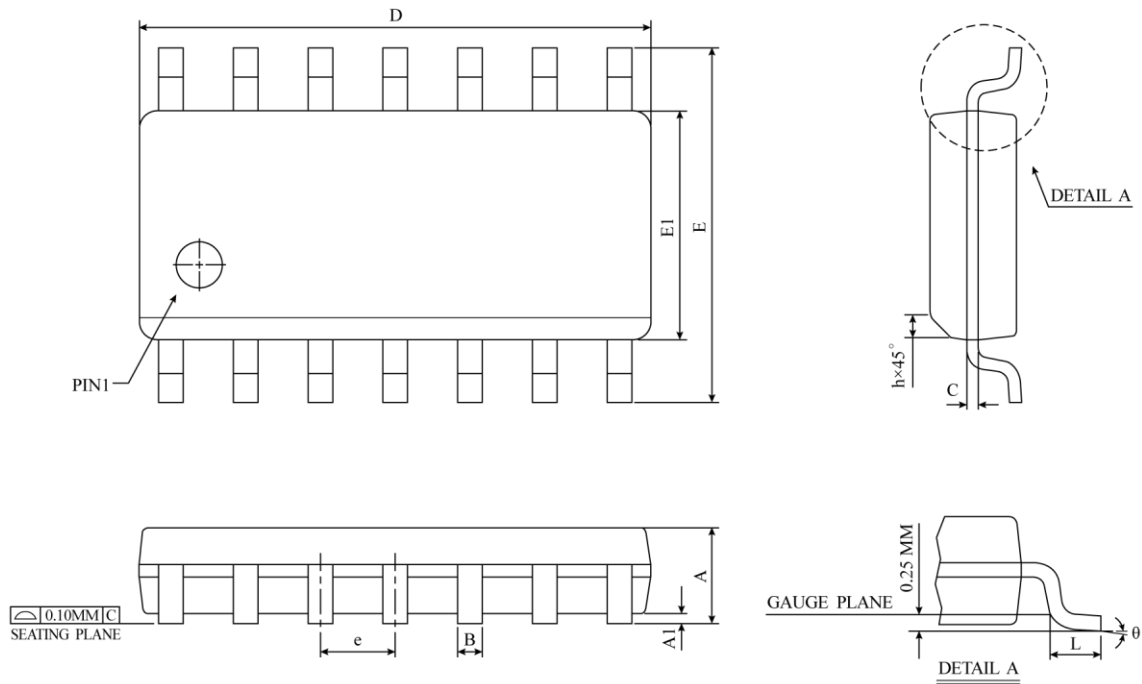


SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	5.334	-	-	0.210
A1	0.381	-	-	0.015	-	-
A2	3.175	3.302	3.429	0.125	0.130	0.135
D	18.669	19.177	19.685	0.735	0.755	0.775
E	7.620 BSC			0.300 BSC		
E1	6.223	6.350	6.477	0.245	0.250	0.255
L	2.921	3.366	3.810	0.115	0.133	0.150
eB	8.509	9.017	9.525	0.335	0.355	0.375
theta	0°	7.5°	15°	0°	7.5°	15°
JEDEC	MS-001 (AA)					

NOTES :

1. "D", "E1" DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH.
2. eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
3. POINTED OR ROUNDED LEAD TIPS ARE PREFERRED TO EASE INSERTION.
4. DISTANCE BETWEEN LEADS INCLUDING DAM BAR PROTRUSIONS TO BE .005 INCH MINIMUM.
5. DATUM PLANE  $\square$  COINCIDENT WITH THE BOTTOM OF LEAD, WHERE LEAD EXITS BODY.



**14-pin SOP (150 mil) Outline Dimensions**


SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.55	1.75	0.0532	0.0610	0.0688
A1	0.10	0.18	0.25	0.0040	0.0069	0.0098
B	0.33	0.42	0.51	0.0130	0.0165	0.0200
C	0.19	0.22	0.25	0.0075	0.0087	0.0098
D	8.55	8.65	8.75	0.3367	0.3410	0.3444
E	5.80	6.00	6.20	0.2284	0.2362	0.2440
E1	3.80	3.90	4.00	0.1497	0.1536	0.1574
e	1.27 BSC			0.050 BSC		
h	0.25	0.38	0.50	0.0099	0.0148	0.0196
L	0.40	0.84	1.27	0.0160	0.0330	0.0500
θ	0°	4°	8°	0°	4°	8°
JEDEC	MS-012 (AB)					

△ \*NOTES : DIMENSION "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.  
MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL  
NOT EXCEED 0.15 MM (0.006 INCH) PER SIDE.