

# Matched quad high-performance low-voltage operational amplifier

NE/SA5234

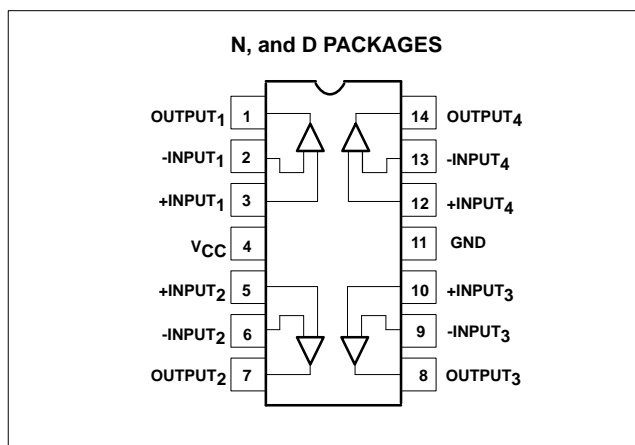
## DESCRIPTION

The NE/SA5234 is a matched, low voltage, high performance quad operational amplifier. Among its unique input and output rail-to-rail operation, particularly critical in low voltage applications. The output swings to less than 50mV of both rails across the entire power supply range. The NE/SA5234 is capable of delivering 5.5V peak-to-peak across a 600Ω load and will typically draw only 700μA per amplifier. The bandwidth is 2.5MHz and the 1% settling time is 1.4μs.

## FEATURES

- Wide common-mode input voltage range: 250mV beyond both rails
- Output swing within 50mV of both rails
- Functionality to 1.8V typical
- Low current consumption: 700μA per amplifier
- ±15mA output current capability
- Unity gain bandwidth: 2.5MHz
- Slew rate: 0.8V/μs
- Low noise: 25nV/√Hz
- Electrostatic discharge protection
- Short-circuit protection
- Output inversion prevention

## PIN CONFIGURATION



## APPLICATIONS

- Automotive electronics
- Signal conditioning and sensing amplification
- Portable instrumentation
  - Test and measurement
  - Medical monitors and diagnostics
  - Remote meters
- Audio equipment
- Security systems
- Communications
  - Pagers
  - Cellular telephone
  - LAN
  - 5V Datacom bus
- Error amplifier in motor drives
- Transducer buffer amplifier

## ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
14-Pin Plastic Small Outline (SO) package	0 to +70°C	NE5234D	0175D
14-Pin Plastic Dual In-Line Package (DIP)	0 to +70°C	NE5234N	0405B
14-Pin Plastic Small Outline (SO) package	-40 to +85°C	SA5234D	0175D
14-Pin Plastic Dual In-Line Package (DIP)	-40 to +85°C	SA5234N	0405B

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## ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNITS
$V_{CC}$	Single supply voltage	7	V
$V_{ESD}$	ESD protection voltage at any pin <sup>5</sup> human body model robot model	2000 200	V V
$V_S$	Dual supply voltage	$\pm 3.5$	V
$V_{DP}$	Voltage at any device pin <sup>1</sup>	$V_S \pm 0.5$	V
$I_{DP}$	Current into any device pin <sup>1</sup>	$\pm 50$	mA
$V_{IN}$	Differential input voltage <sup>2</sup>	0.5	V
$V_{CM}$	Common-mode input voltage (positive)	$V_{CC} + 0.5$	V
$V_{CM}$	Common-mode input voltage (negative)	$V_{EE} - 0.5$	V
$P_D$	Power dissipation <sup>3</sup>	500	mW
$T_J$	Operating junction temperature <sup>3</sup>	+150	°C
$V_{SC}$	Supply voltage allowing indefinite output short circuit to either rail <sup>3,4</sup>	7	V
$T_{STG}$	Storage temperature range	-65 to +150	°C
$T_{SOLD}$	Lead soldering temperature (10sec max)	+300	°C
$\theta_{JA}$	Thermal impedance 14 pin Plastic DIP 14 pin Plastic SO	80 115	°C/W °C/W

### NOTES:

- Each pin is protected by ESD diodes. The voltage at any pin is limited by the ESD diodes.
- The differential input of each amplifier is limited by two internal diodes, connected in parallel and opposite to each other. For more differential input range, use differential resistors in series with the input pins.
- The maximum operating junction temperature is +150°C. At elevated temperatures, devices must be derated according to the package thermal resistance and device mounting conditions. Derates above +25°C: F package at 6.7mW/°C; N package at 9.5mW/°C; D package at 6.25mW/°C.
- Simultaneous short circuits of two or more amplifiers to the positive or negative rail can exceed the power dissipation ratings and cause eventual destruction of the device.
- Guaranteed by design.

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	RATING	UNITS
$V_{CC}$	Single supply voltage	+2 to +5.5	V
$V_S$	Dual supply voltage	$\pm 1$ to $\pm 2.75$	V
$V_{CM}$	Common-mode input voltage (positive)	$V_{CC} + 0.25$	V
$V_{CM}$	Common-mode input voltage (negative)	$V_{EE} - 0.25$	V
$T_A$	Temperature NE SA	0 to +70 -40 to +85	°C °C

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## DC ELECTRICAL CHARACTERISTICS

 $V_{CC} = 2$  to  $5.5V$ ,  $V_{EE} = 0V$ ,  $T_A = 25^{\circ}C$ ;  $V_{EE} < V_{CM} < V_{CC}$ ; unless otherwise stated.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS						UNITS
			NE5234			SA5234			
			MIN	TYP	MAX	MIN	TYP	MAX	
I <sub>CC</sub>	Supply current	V <sub>CC</sub> = 5.5V		2.8	4.0		2.8	4.0	mA
		V <sub>CC</sub> = 5.5V over full temperature range		3.0	4.6		3.2	4.8	
V <sub>OS</sub>	Offset voltage			±0.2	±4		±0.2	±4	mV
		Over full temperature range		±0.4	±5		±0.6	±5	
ΔV <sub>OS</sub> /ΔT	Offset voltage drift with temperature			4			4		μV/°C
ΔV <sub>OS</sub>	Offset voltage difference between any amplifiers in the same package at the same common mode level <sup>1</sup>			0.4	3		0.4	3	mV
		Over full temperature range		0.8	4		1.2	4	
I <sub>OS</sub>	Offset current			±3	±20		±3	±30	nA
		Over full temperature range		±4	±30		±6	±60	
ΔI <sub>OS</sub> /ΔT	Offset current drift with temperature			0.02	±.3		0.03	±.3	nA/°C
I <sub>B</sub>	Input bias current <sup>1</sup>	V <sub>EE</sub> < V <sub>CM</sub> < V <sub>EE</sub> +0.5V	-200	-90		-200	-90		nA
		Over full temperature range	-225	-100		-250	-150		
		V <sub>EE</sub> +1V < V <sub>CM</sub> < V <sub>CC</sub>		25	70		25	75	
		Over full temperature range		35	100		35	120	
ΔI <sub>B</sub> /ΔT	Input bias current drift with temperature			0.5			0.5		nA/°C
ΔI <sub>B</sub>	Input bias current difference between any amplifier in the same package at the same common mode level.	V <sub>EE</sub> < V <sub>CM</sub> < V <sub>EE</sub> +0.5V		10	30		10	30	nA
		Over full temperature range		25	50		50	70	
		V <sub>EE</sub> +1V < V <sub>CM</sub> < V <sub>CC</sub>		5	20		5	20	
		Over full temperature range		15	30		25	50	
V <sub>CM</sub>	Common-mode input range	V <sub>OS</sub> ≤ 6mV	V <sub>EE</sub> -0.25		V <sub>CC</sub> +0.25	V <sub>EE</sub> -0.25		V <sub>CC</sub> +0.25	V
		V <sub>OS</sub> ≤ 6mV over full temperature range	V <sub>EE</sub> -0.1		V <sub>CC</sub> +0.1	V <sub>EE</sub> -0.1		V <sub>CC</sub> +0.1	
CMRR	Common-mode rejection ratio, small signal	V <sub>EE</sub> < V <sub>CM</sub> < V <sub>EE</sub> +0.5V, V <sub>EE</sub> +1V < V <sub>CM</sub> < V <sub>CC</sub>		100		90	100		dB
		Over full temperature range		100		80	90		
	Common-mode rejection ratio, large signal	V <sub>EE</sub> < V <sub>CM</sub> < V <sub>CC</sub>		90			100		
		Over full temperature range		80			90		
PSRR	Power supply rejection ratio	V <sub>EE</sub> < V <sub>CM</sub> < V <sub>CC</sub>	80	100		80	100		dB
		Over full temperature range	80	90		80	90		

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DC ELECTRICAL CHARACTERISTICS (continued)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS						UNITS
			NE5234			SA5234			
			MIN	TYP	MAX	MIN	TYP	MAX	
I <sub>L</sub>	Peak load current, sink and source		10	12		10	12		mA
		Over full temperature range	5	8		5	8		
A <sub>VOL</sub>	Open-loop voltage gain		90	110		90	110		dB
		Over full temperature range		90			90		
V <sub>OUT</sub>	Output voltage swing	I <sub>PEAK</sub> = 0.1mA	V <sub>EE</sub> +0.0 5		V <sub>CC</sub> -0.05	V <sub>EE</sub> +0.1		V <sub>CC</sub> -0.1	V
		I <sub>PEAK</sub> = 10mA	V <sub>EE</sub> +0.2 5		V <sub>CC</sub> -0.25	V <sub>EE</sub> +0.2 5		V <sub>CC</sub> -0.25	
		I <sub>PEAK</sub> = 5mA over full temp range	V <sub>EE</sub> +0.2 2		V <sub>CC</sub> -0.2	V <sub>EE</sub> +0.2		V <sub>CC</sub> -0.2	
	Output voltage swing for V <sub>CC</sub> = 2.75V, V <sub>EE</sub> = -2.75V	R <sub>L</sub> = 2kΩ	V <sub>EE</sub> +0.2		V <sub>CC</sub> -0.2	V <sub>EE</sub> +0.2		V <sub>CC</sub> -0.2	V
		R <sub>L</sub> = 600Ω,	V <sub>EE</sub> +0.2 5		V <sub>CC</sub> -0.25	V <sub>EE</sub> +0.2 5		V <sub>CC</sub> -0.25	

**NOTES:**  
1. These parameters are measured for  $V_{EE} < V_{CM} < V_{EE}+5\text{V}$  and for  $V_{EE}+1\text{V} < V_{CM} < V_{CC}$ . By design these parameters are intermediate for common mode ranges between the measured regions.

AC ELECTRICAL CHARACTERISTICS

$T_A = +25^\circ\text{C}$ ;  $V_{CC} = 2$  to  $5.5\text{V}$ ;  $R_L = 10\text{k}$ ;  $C_L = 100\text{pF}$ ; unless otherwise stated.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS						UNITS
			NE5234			SA/SE5234			
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate	Over full temperature range	0.5	0.8		0.5	0.8		V/μs
BW	Unity gain bandwidth: -3dB	Over full temperature range	2	2.5	4.0	2	2.5	4.0	MHz
θ <sub>M</sub>	Phase Margin	C <sub>L</sub> = 50pF		55			55		deg
t <sub>S</sub>	1% settling time	A <sub>V</sub> = 1, 1V step		1.4			1.4		μs
V <sub>N</sub>	Input referred voltage noise	A <sub>V</sub> = 1, R <sub>S</sub> = 0Ω, at 1kHz		25			25		nV/Hz 1/2
THD	Total harmonic distortion	10kHz, 1V <sub>P-P</sub> , A <sub>V</sub> = 1		0.1			0.1		%

OUTPUT INVERSION PREVENTION

