

## LM432 Dual Op Amp with On-Chip Fixed 2.5V Reference

Check for Samples: [LM432](#)

### FEATURES

- Dual Op Amp Circuitry
- (Typical for  $V_S = 5V$ )
- Input Offset Voltage 0.6mV
- Input Offset Current 1nA
- Input Bias Current 3nA
- Common-Mode Input Voltage Range 0V to  $V_S - 1V$
- Power Supply Current 150 $\mu A$
- Reference Circuitry
- Reference Voltage 2.5V
- Reference Voltage Deviation ( $-40^{\circ}C$  to  $85^{\circ}C$ ) 4mV
- Sink Current Capability 0.2mA to 10mA

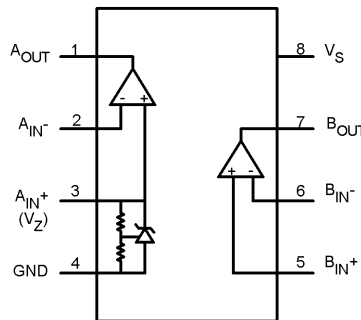
### APPLICATIONS

- Low Cost Charging Circuitry
- Power Supplies and Adapters

### DESCRIPTION

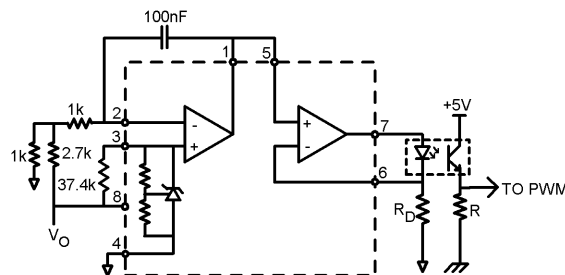
The LM432 integrates two operational amplifiers and one 2.5V reference. The reference is based on the LMV431 adjustable shunt regulator with the output voltage adjusted to a fixed 2.5V. The Op Amps are similar to the LM358 with a common-mode input range that includes ground. Integrating the reference and Op Amps creates a solution for low cost charging applications.

### Connection Diagram



**Figure 1. 8-Pin SOIC (Top View)**  
See Package Number D

### Application Circuit



**Figure 2. Optocoupler Driver Circuit for Power Supply Isolation**



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### Absolute Maximum Ratings<sup>(1)(2)(3)</sup>

Supply Voltage ( $V_S$ )	20V
Storage Temperature	-65°C to 150°C
Junction Temperature ( $T_J$ )	150°C
ESD Human Body Model	2kV
Input Voltage Range	-0.3V to 20V

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.

(2) All voltages are measured with respect to GND = 0V<sub>DC</sub>, unless otherwise specified.

(3) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.

### Operating Ratings<sup>(1)(2)</sup>

Temperature Range	-40°C to 85°C
Supply Voltage <sup>(3)</sup>	2.5V to 16V
Thermal Resistance( $\theta_{JA}$ )	162°C/W

(1) Operating Rating indicate conditions for which the device is functional. These rating do not ensure specific performance limits. For ensured specifications and test conditions, see the [Electrical Characteristics](#). The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

(2) All voltages are measured with respect to GND = 0V<sub>DC</sub>, unless otherwise specified.

(3) Minimum value of operating voltage is for Amplifier B only.

### Electrical Characteristics

The following specifications apply for both amplifiers at  $V_S = 5V$ ,  $V_{CM} = 2.5V$ ,  $V_O = 2.5V$ ,  $R_L = \infty$ , and  $T_J = 25^\circ C$ , unless otherwise noted.

Symbol	Parameter	Conditions	Min <sup>(1)</sup>	Typ <sup>(2)</sup>	Max <sup>(1)</sup>	Units
<b>OP Amp Circuitry</b>						
$V_{OS}$	Input Offset Voltage	Amplifier B only	-4	0.6	4	mV
$I_{OS}$	Input Offset Current	Amplifier B only		1	50	nA
$I_B$	Input Bias Current	Amplifier B only		3	150	nA
$V_{CM}$	Common-Mode Input Voltage Range	Amplifier B only, CMRR > 50dB	0		$V_S - 1$	V
$I_S$	Power Supply Current	Total for both amplifiers		150	500	$\mu A$
$A_V$	Voltage Gain	$V_S = 16V$ , $1V < V_O < 11V$ , $R_L = 10k\Omega$ connected to $V_S/2$	65	100		dB
$V_{OL}$	Output Voltage Low			2	50	mV
$V_{OH}$	Output Voltage High		$V_S - 1.5$	$V_S - 1.3$		V
$I_{SOURCE}$	Output Current Source		20	30		mA
$I_{SINK}$	Output Current Sink		5	11		mA
<b>Reference Circuitry For Op Amp A</b> (The following specifications apply for $I_Z = 200\mu A$ and $T_J = 25^\circ C$ , unless otherwise noted.)						
$V_Z$	Reference Voltage at IN <sup>+</sup> Terminal		2.450	2.5	2.550	V
$V_{ZDEV}$	Reference Voltage Deviation at IN <sup>+</sup> Terminal Over Temperature <sup>(3)(4)</sup>	$-40^\circ C \leq T_J \leq 85^\circ C$		4	65	mV
$I_Z$ (MIN)	Minimum Cathode Current for Regulation at IN <sup>+</sup> ( $V_Z$ ) Terminal			150	200	$\mu A$
$r_z$	Dynamic Output Impedance <sup>(5)</sup>	$200\mu A < I_Z < 1mA$ , Freq = 0Hz		0.2		$\Omega$

(1) Ensured to Average Outgoing Quality Level (AOQL).

(2) Typicals represent the most likely parametric norm.

(3) Reference voltage deviation,  $V_{ZDEV}$ , is defined as the maximum variation of the reference input voltage over the full temperature range.

(4) Typical Temperature drift  $\Delta V/\Delta T = 12.8ppm/^\circ C$

(5) The Dynamic Output Impedance,  $r_z$ , is defined as  $r_z = \Delta V_Z/\Delta I_Z$ .

## REVISION HISTORY

Changes from Revision C (March 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format .....	<a href="#">2</a>

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM432MA/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	SN   CU SN	Level-1-260C-UNLIM	-40 to 85	LM432 MA	<a href="#">Samples</a>
LM432MAX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	SN   CU SN	Level-1-260C-UNLIM	-40 to 85	LM432 MA	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM432MAX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM432MAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.



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