

## 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

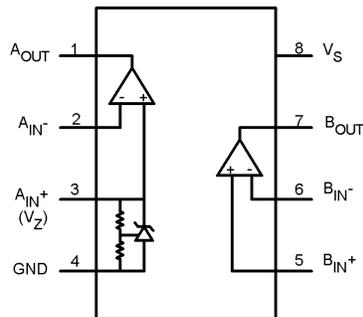
### APPLICATIONS

- Low Cost Charging Circuitry
- Power Supplies and Adapters

### DESCRIPTION

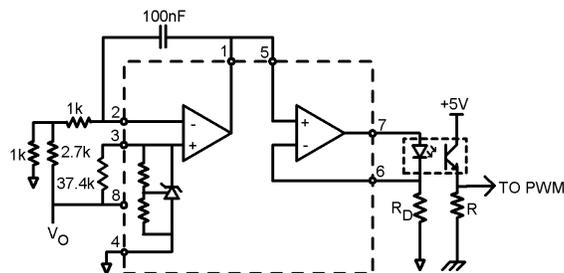
The LM432 integrates two operational amplifiers and one 2.5V reference. The reference is based on the LMV431 adjustable shunt regulator with the output voltage adjusted to a fixed 2.5V. The Op Amps are similar to the LM358 with a common-mode input range that includes ground. Integrating the reference 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 $IN^+$ Terminal		2.450	2.5	2.550	V
$V_{ZDEV}$	Reference Voltage Deviation at $IN^+$ 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 $IN^+$ ( $V_Z$ ) 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  $r_z = \Delta V_Z/\Delta I_Z$ .

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**REVISION HISTORY**

<b>Changes from Revision C (March 2013) to Revision D</b>	<b>Page</b>
<hr/> <ul style="list-style-type: none"><li>• Changed layout of National Data Sheet to TI format .....</li></ul> <hr/>	<hr/> <b>2</b> <hr/>

**PACKAGING INFORMATION**

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

**OBSELETE:** 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)

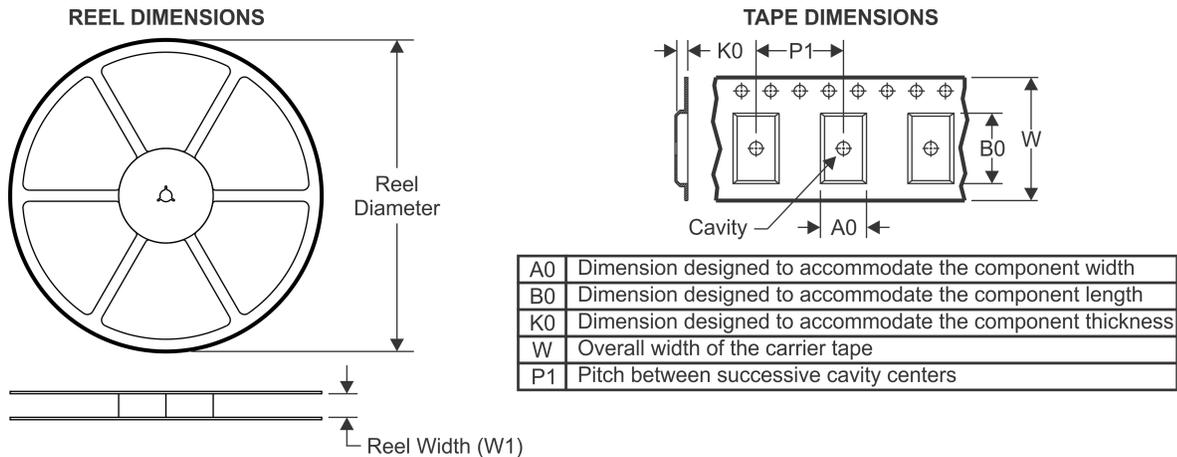
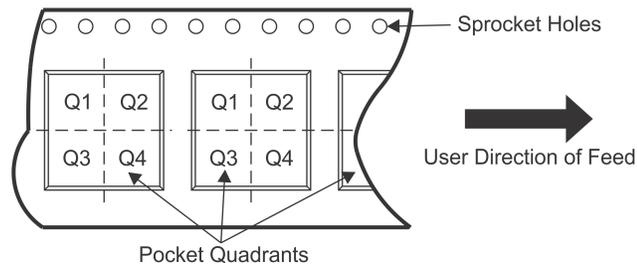
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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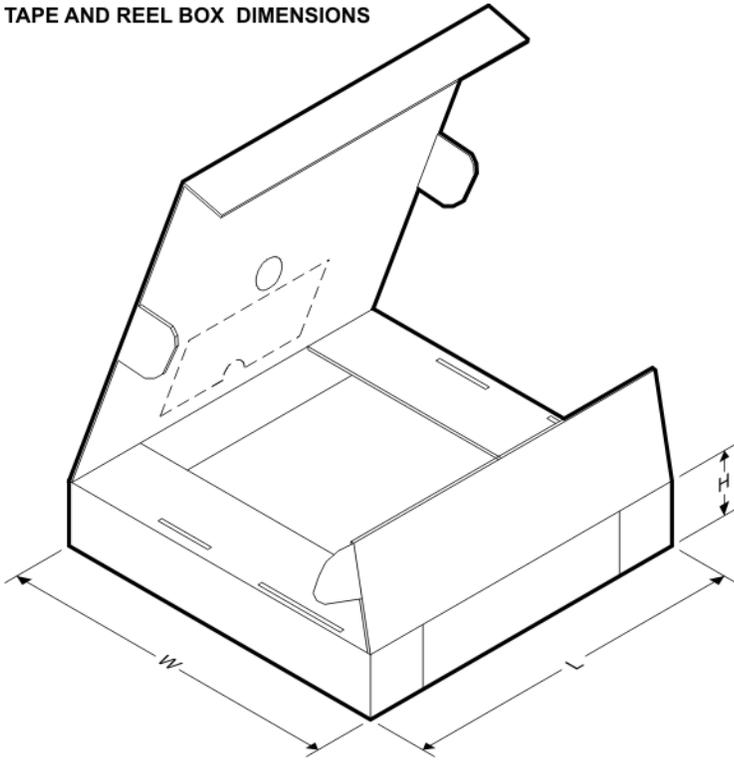


**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
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	SOIC	D	8	2500	367.0	367.0	35.0
LM432MAX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0



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