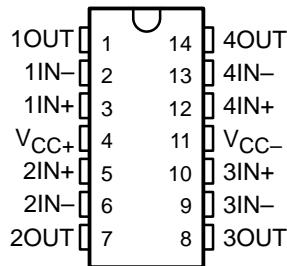


# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

- Wide Range of Supply Voltages, Single Supply . . . 3 V to 36 V or Dual Supplies
- Class AB Output Stage
- True Differential Input Stage
- Low Input Bias Current
- Internal Frequency Compensation
- Short-Circuit Protection
- Designed to Be Interchangeable With Motorola MC3303, MC3403

MC3303 . . . D, N, OR PW PACKAGE  
MC3403 . . . D, DB, N, NS, OR PW PACKAGE  
(TOP VIEW)



## description

The MC3303 and the MC3403 are quadruple operational amplifiers similar in performance to the  $\mu$ A741, but with several distinct advantages. They are designed to operate from a single supply over a range of voltages from 3 V to 36 V. Operation from split supplies also is possible, provided the difference between the two supplies is 3 V to 36 V. The common-mode input range includes the negative supply. Output range is from the negative supply to  $V_{CC} - 1.5$  V. Quiescent supply currents are less than one-half those of the  $\mu$ A741.

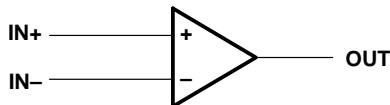
The MC3303 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and the MC3403 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

## AVAILABLE OPTIONS

$T_A$	$V_{IO\text{MAX}}$ AT $25^{\circ}\text{C}$	PACKAGE			
		PLASTIC SMALL OUTLINE (D, NS)	PLASTIC SHRINK SMALL OUTLINE (DB)	PLASTIC DIP (N)	PLASTIC THIN SHRINK SMALL OUTLINE (PW)
$0^{\circ}\text{C}$ to $70^{\circ}\text{C}$	10 mV	MC3403D MC3403NS	MC3403DB	MC3403N	MC3403PW
$-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$	8 mV	MC3303D	—	MC3303N	MC3303PW

The D package is available taped and reeled. Add R suffix to the device type (e.g., MC3403DR). The DB, NS, and PW packages are only available taped and reeled.

## logic diagram (each amplifier)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

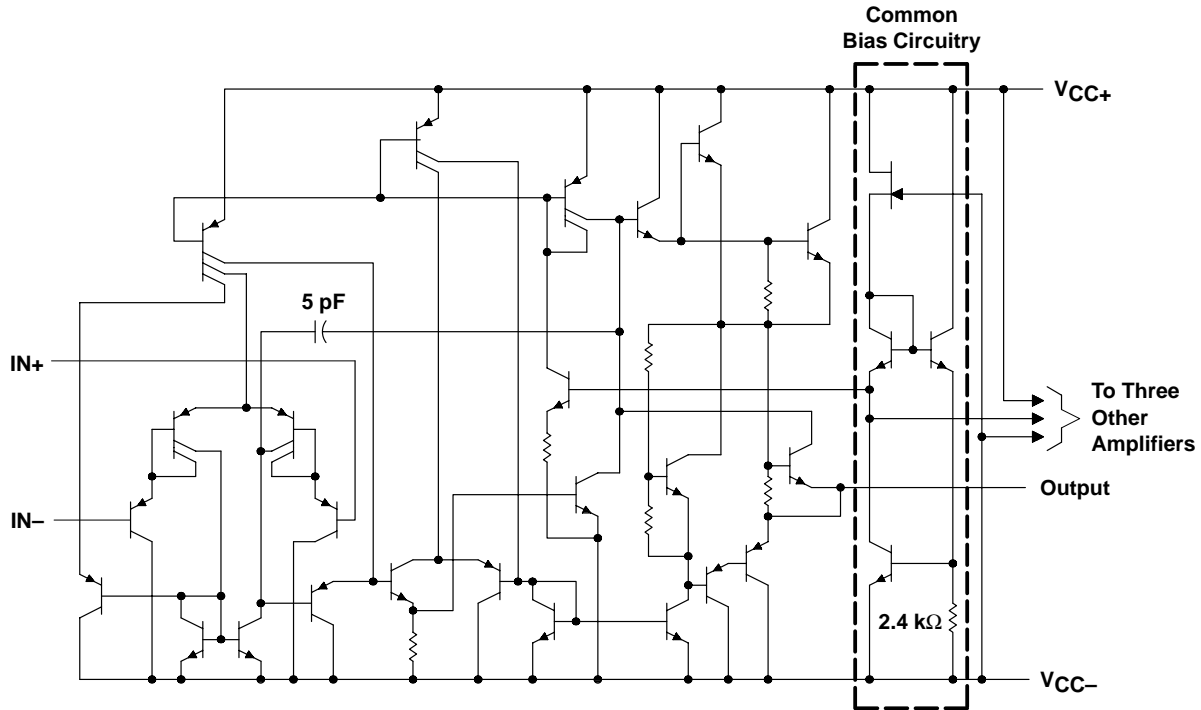
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2002, Texas Instruments Incorporated

# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

## schematic (each amplifier)



Component values shown are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage (see Note 1): $V_{CC+}$ .....	18 V
$V_{CC-}$ .....	-18 V
Supply voltage, $V_{CC+}$ with respect to $V_{CC-}$ .....	36 V
Differential input voltage (see Note 2) .....	$\pm 36$ V
Input voltage (see Notes 1 and 3) .....	$\pm 18$ V
Package thermal impedance, $\theta_{JA}$ (see Note 4):	
D package .....	86°C/W
DB package .....	96°C/W
N package .....	80°C/W
NS package .....	76°C/W
PW package .....	113°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. These voltage values are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. Neither input must ever be more positive than  $V_{CC+}$  or more negative than  $V_{CC-}$ .
  4. The package thermal impedance is calculated in accordance with JESD 51-7.

# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

## recommended operating conditions

		MIN	MAX	UNIT	
V <sub>CC</sub>	Supply voltage	5	30	V	
Dual-supply voltage		V <sub>CC+</sub>	2.5	15	V
		V <sub>CC-</sub>	-2.5	-15	V
T <sub>A</sub>	Operating free-air temperature	MC3303	-40	85	°C
		MC3403	0	70	

**electrical characteristics at specified free-air temperature, V<sub>CC+</sub> = 14 V, V<sub>CC-</sub> = 0 V for MC3303, V<sub>CC±</sub> = ±15 V for MC3403 (unless otherwise noted)**

PARAMETER	TEST CONDITION†	MC3303			MC3403			UNIT		
		MIN	TYP	MAX	MIN	TYP	MAX			
V <sub>IO</sub>	Input offset voltage	See Note 5	25°C	2	8	2	10	mV		
				Full range	10	12				
α <sub>VIO</sub>	Temperature coefficient of input offset voltage	See Note 5	Full range	10	10	μV/°C				
I <sub>IO</sub>	Input offset current	See Note 5	25°C	30	75	30	50	nA		
				Full range	250	200				
α <sub>IIO</sub>	Temperature coefficient of input offset current	See Note 5	Full range	50	50	pA/C				
I <sub>IB</sub>	Input bias current	See Note 5	25°C	-0.2	-0.5	-0.2	-0.5	μA		
				Full range	-1	-0.8				
V <sub>ICR</sub>	Common-mode input voltage range‡		25°C	V <sub>CC-</sub> to 12	V <sub>CC-</sub> to 12.5	V <sub>CC-</sub> to 13	V <sub>CC-</sub> to 13.5	V		
V <sub>OM</sub>	Peak output voltage swing	R <sub>L</sub> = 10 kΩ	25°C	12	12.5	±12	±13.5	V		
			25°C	10	12	±10	±13			
			Full range	10	±10					
A <sub>VD</sub>	Large-signal differential voltage amplification	V <sub>O</sub> = ±10 V, R <sub>L</sub> = 2 kΩ	25°C	20	200	20	200	V/mV		
			Full range	15	15					
B <sub>OM</sub>	Maximum-output-swing bandwidth	V <sub>OPP</sub> = 20 V, A <sub>VD</sub> = 1, THD ≤ 5%, R <sub>L</sub> = 2 kΩ	25°C	9	9	kHz				
B <sub>1</sub>	Unity-gain bandwidth	V <sub>O</sub> = 50 mV, R <sub>L</sub> = 10 kΩ	25°C	1	1	MHz				
φ <sub>m</sub>	Phase margin	C <sub>L</sub> = 200 pF, R <sub>L</sub> = 2 kΩ	25°C	60°	60°					
r <sub>i</sub>	Input resistance	f = 20 Hz	25°C	0.3	1	0.3	1	MΩ		
r <sub>o</sub>	Output resistance	f = 20 Hz	25°C	75	75	Ω				
CMRR	Common-mode rejection ratio	V <sub>IC</sub> = V <sub>ICRmin</sub>	25°C	70	90	70	90	dB		
k <sub>SVS</sub>	Supply voltage sensitivity (ΔV <sub>IO</sub> /ΔV <sub>CC</sub> )	V <sub>CC±</sub> = ±2.5 to ±15 V	25°C	30	150	30	150	μV/V		
I <sub>OS</sub>	Short-circuit output current§		25°C	±10	±30	±45	±10	±30	±45	mA
I <sub>CC</sub>	Total supply current	No load, See Note 5	25°C	2.8	7	2.8	7	mA		

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified. Full range for T<sub>A</sub> is -40°C to 85°C for MC3303, and 0°C to 70°C for MC3403.

‡ The V<sub>ICR</sub> limits are linked directly, volt-for-volt, to supply voltage; the positive limit is 2 V less than V<sub>CC+</sub>.

§ Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

NOTE 5: V<sub>IO</sub>, I<sub>IO</sub>, I<sub>IB</sub>, and I<sub>CC</sub> are defined at V<sub>O</sub> = 0 for MC3403 and V<sub>O</sub> = 7 V for MC3303.



# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

electrical characteristics,  $V_{CC+} = 5\text{ V}$ ,  $V_{CC-} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	MC3303			MC3403			UNIT	
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$	Input offset voltage	$V_O = 2.5\text{ V}$			10	2	10	mV	
$I_{IO}$	Input offset current	$V_O = 2.5\text{ V}$			75	30	50	nA	
$I_{IB}$	Input bias current	$V_O = 2.5\text{ V}$			-0.5	-0.2	-0.5	$\mu\text{A}$	
$V_{OM}$	Peak output voltage swing‡	$R_L = 10\text{ k}\Omega$			3.3	3.5	3.3	3.5	V
		$R_L = 10\text{ k}\Omega$ , $V_{CC+} = 5\text{ V to }30\text{ V}$			$V_{CC+} - 1.7$		$V_{CC+} - 1.7$		
$A_{VD}$	Large-signal differential voltage amplification	$V_O = 1.7\text{ V to }3.3\text{ V}$ , $R_L = 2\text{ k}\Omega$			20	200	20	200	V/mV
$k_{SVS}$	Supply-voltage sensitivity ( $\Delta V_{IO}/\Delta V_{CC\pm}$ )	$V_{CC\pm} = \pm 2.5\text{ V to } \pm 15\text{ V}$			150			$\mu\text{V/V}$	
$I_{CC}$	Supply current	$V_O = 2.5\text{ V}$ , No load			2.5	7	2.5	7	mA
$V_{O1}/V_{O2}$	Crosstalk attenuation	$f = 1\text{ kHz to }20\text{ kHz}$			120		120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified.

‡ Output will swing essentially to ground.

operating characteristics,  $V_{CC+} = 14\text{ V}$ ,  $V_{CC-} = 0\text{ V}$  for MC3303,  $V_{CC\pm} = \pm 15\text{ V}$  for MC3403,  $T_A = 25^\circ\text{C}$ ,  $A_{VD} = 1$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS				TYP	UNIT	
SR	Slew rate at unity gain	$V_I = \pm 10\text{ V}$ ,	$C_L = 100\text{ pF}$ ,	$R_L = 2\text{ k}\Omega$ ,	See Figure 1	0.6	V/ $\mu\text{s}$
$t_r$	Rise time	$\Delta V_O = 50\text{ mV}$ ,	$C_L = 100\text{ pF}$ ,	$R_L = 10\text{ k}\Omega$ ,	See Figure 1	0.35	$\mu\text{s}$
$t_f$	Fall time	$\Delta V_O = 50\text{ mV}$ ,	$C_L = 100\text{ pF}$ ,	$R_L = 10\text{ k}\Omega$ ,	See Figure 1	0.35	$\mu\text{s}$
	Overshoot factor	$\Delta V_O = 50\text{ mV}$ ,	$C_L = 100\text{ pF}$ ,	$R_L = 10\text{ k}\Omega$ ,	See Figure 1	20	%
	Crossover distortion	$V_I(PP) = 30\text{ mV}$ ,	$V_{OPP} = 2\text{ V}$ ,	$f = 10\text{ kHz}$		1	%

## PARAMETER MEASUREMENT INFORMATION

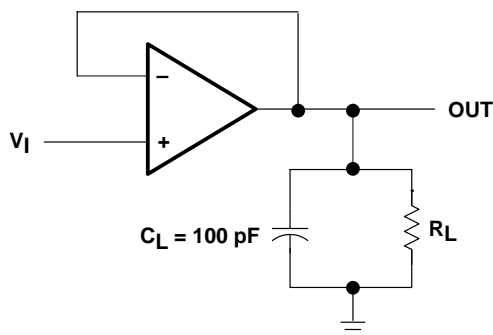


Figure 1. Unity-Gain Amplifier

TYPICAL CHARACTERISTICS†

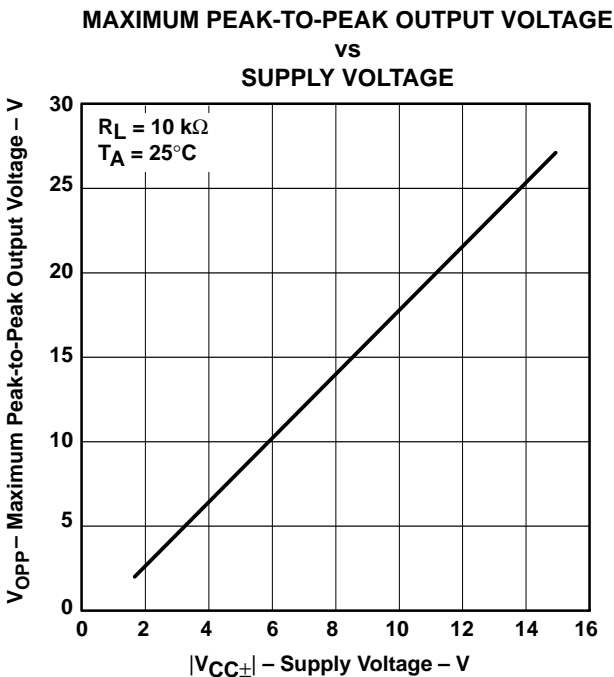


Figure 2

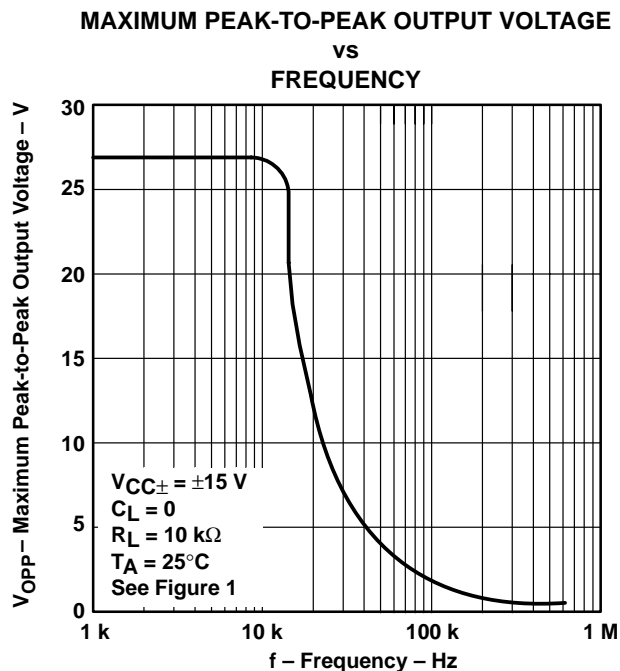


Figure 3

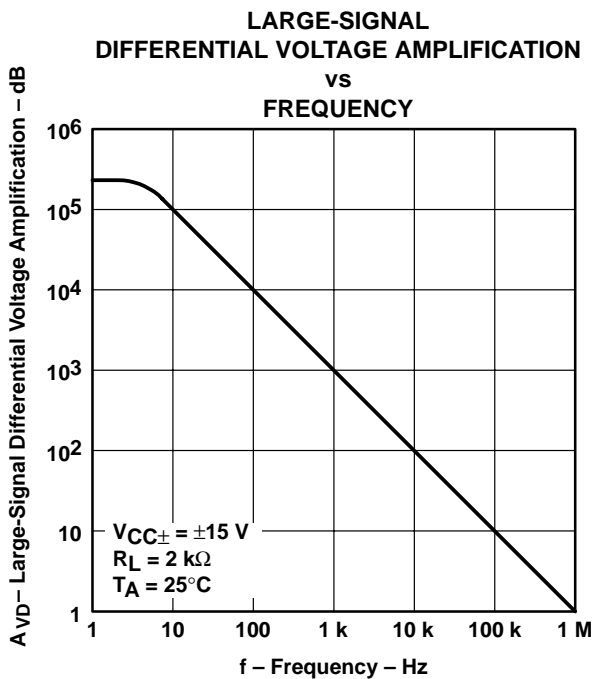


Figure 4

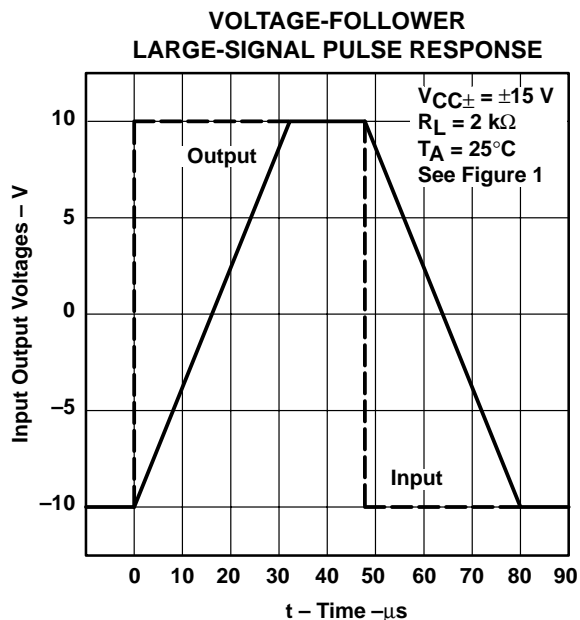


Figure 5

† Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

## TYPICAL CHARACTERISTICS†

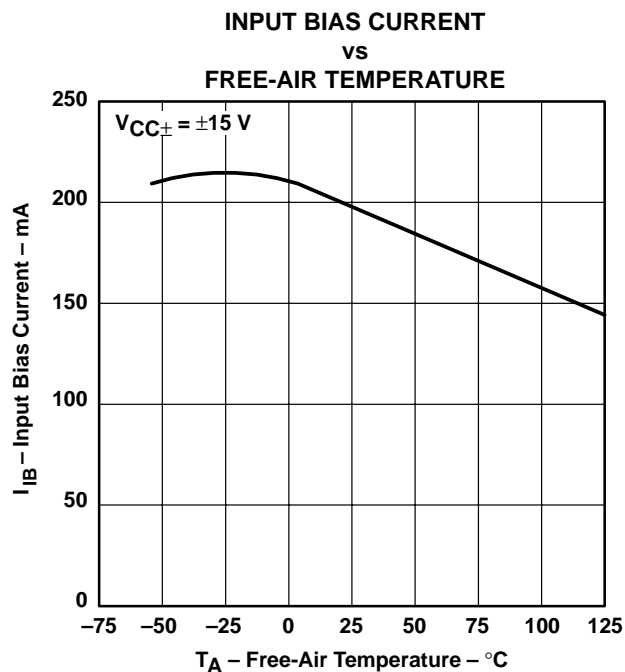


Figure 6

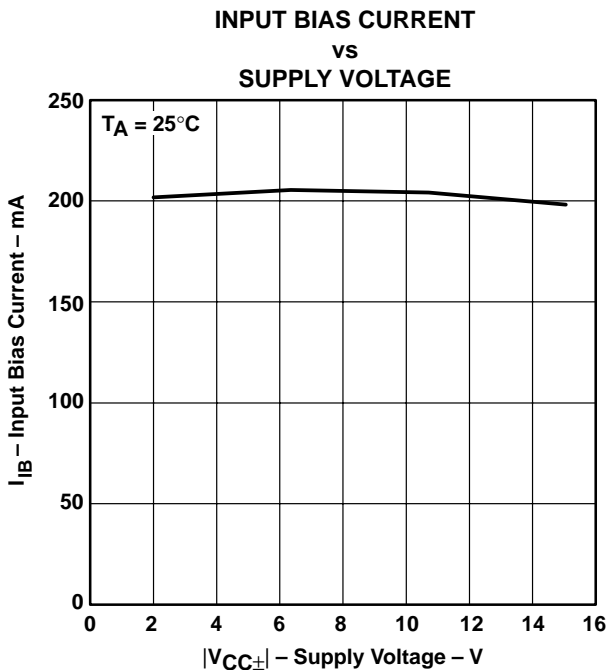


Figure 7

† Operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
MC3303D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MC3303DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MC3303N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
MC3303PW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
MC3303PWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
MC3403D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MC3403DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MC3403N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
MC3403NSLE	OBSOLETE	SO	NS	14		None	Call TI	Call TI
MC3403NSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MC3403PW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
MC3403PWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**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.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002



D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AB.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
		Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265