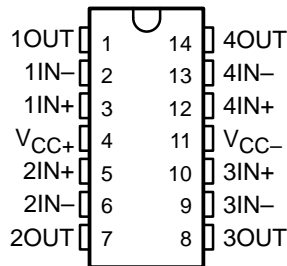


# MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

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.

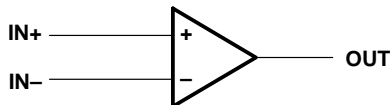
The MC3303 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and the MC3403 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

## 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**

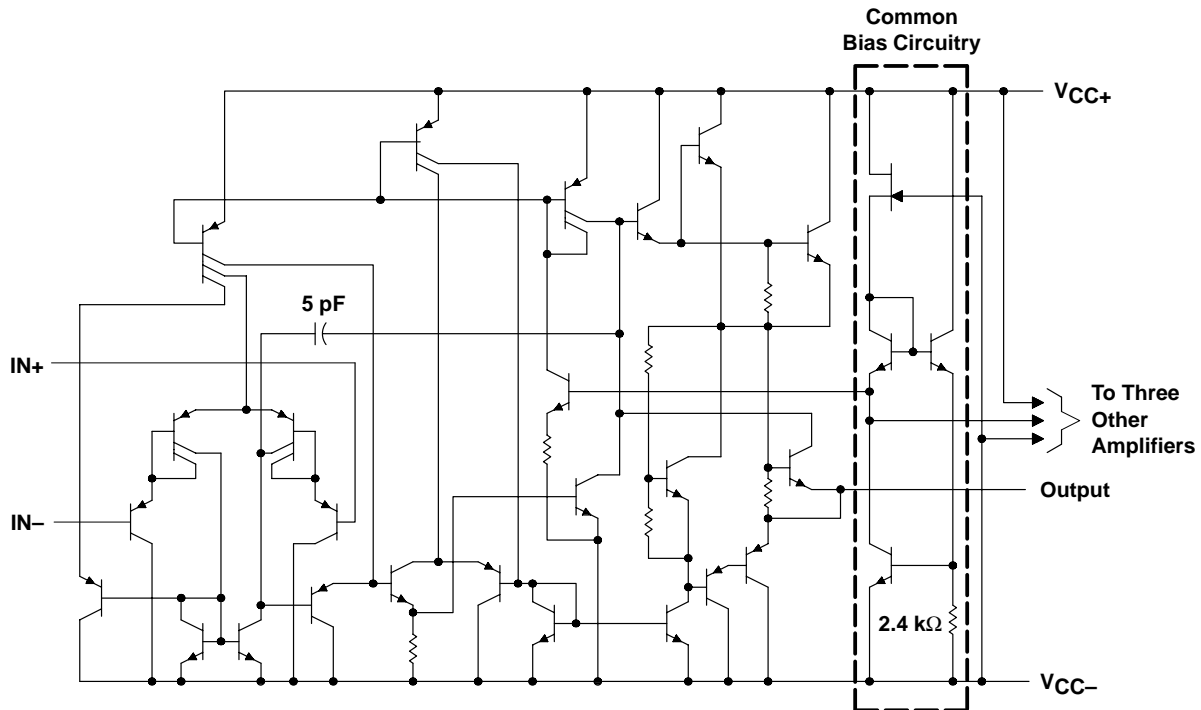
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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>V<sub>IO</sub></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>I<sub>IO</sub></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



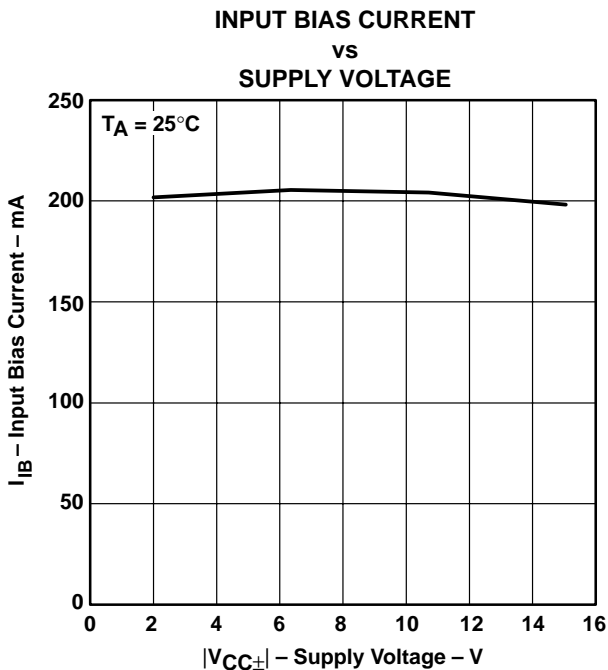
Figure 5

† 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†



† 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	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC3303NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC3303PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303PWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303PWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3303PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC3403NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC3403NSLE	OBSOLETE	SO	NS	14		TBD	Call TI	Call TI
MC3403NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

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>
MC3403PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403PWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403PWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC3403PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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 - 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)

<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.



**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
MC3303DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
MC3303PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
MC3403DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
MC3403NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
MC3403PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	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)
MC3303DR	SOIC	D	14	2500	346.0	346.0	33.0
MC3303PWR	TSSOP	PW	14	2000	346.0	346.0	29.0
MC3403DR	SOIC	D	14	2500	346.0	346.0	33.0
MC3403NSR	SO	NS	14	2000	346.0	346.0	33.0
MC3403PWR	TSSOP	PW	14	2000	346.0	346.0	29.0

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.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

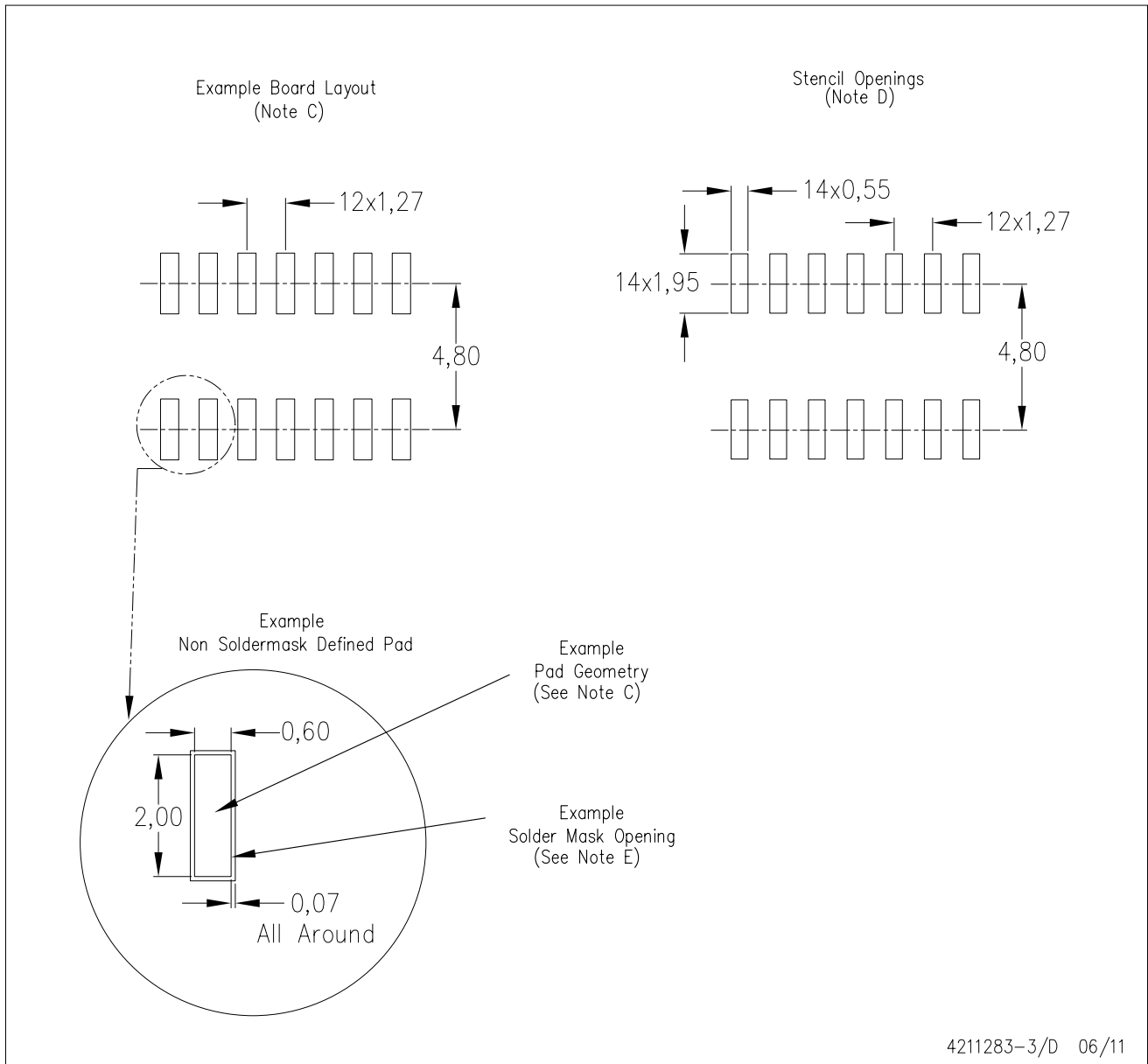
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - 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.
  - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

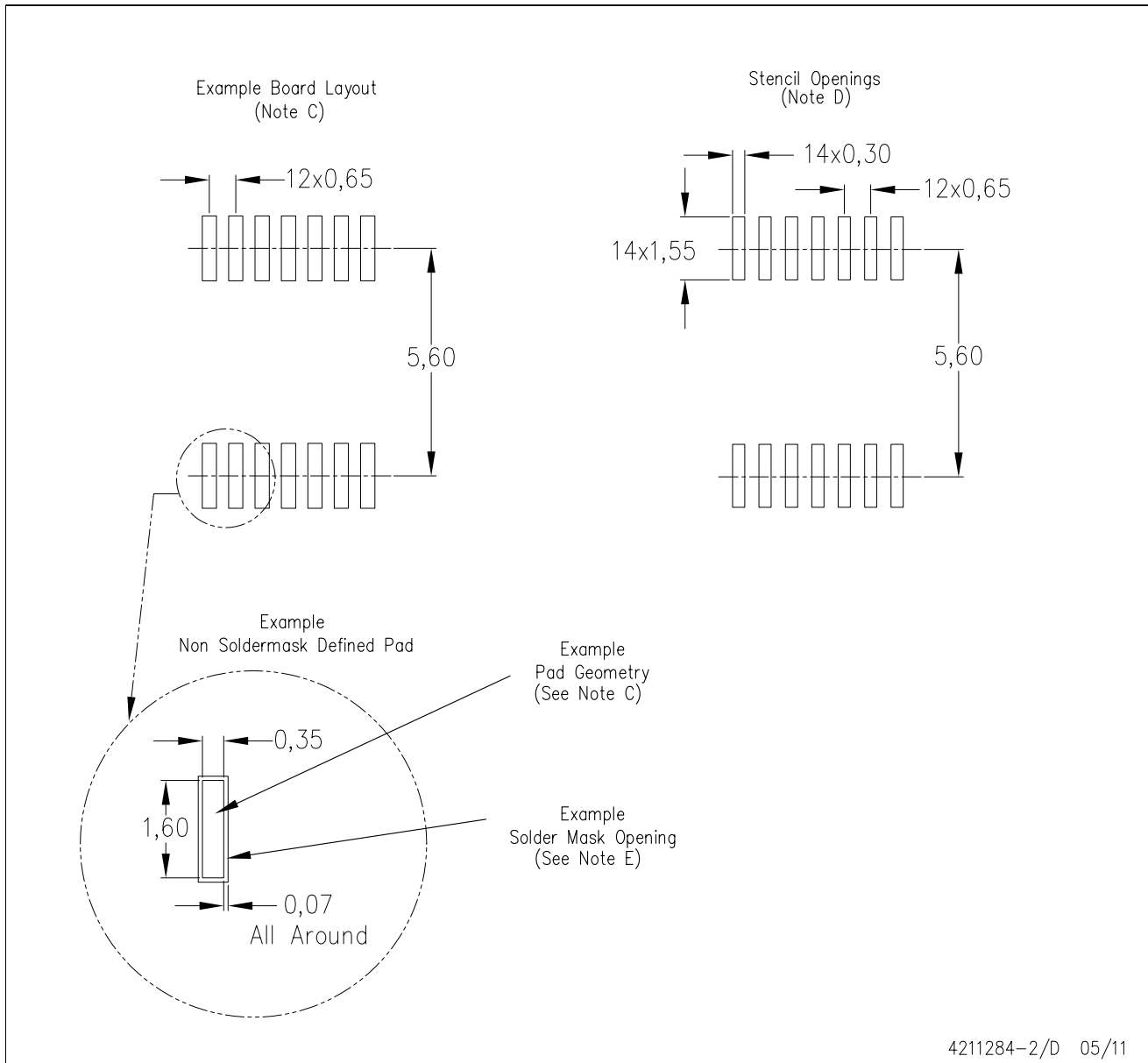


4040064-3/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# 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.



## 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 TI 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. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated