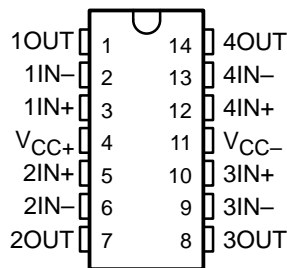


MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

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- 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 μ 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 μ A741.

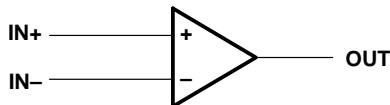
The MC3303 is characterized for operation from -40°C to 85°C , and the MC3403 is characterized for operation from 0°C to 70°C .

AVAILABLE OPTIONS

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

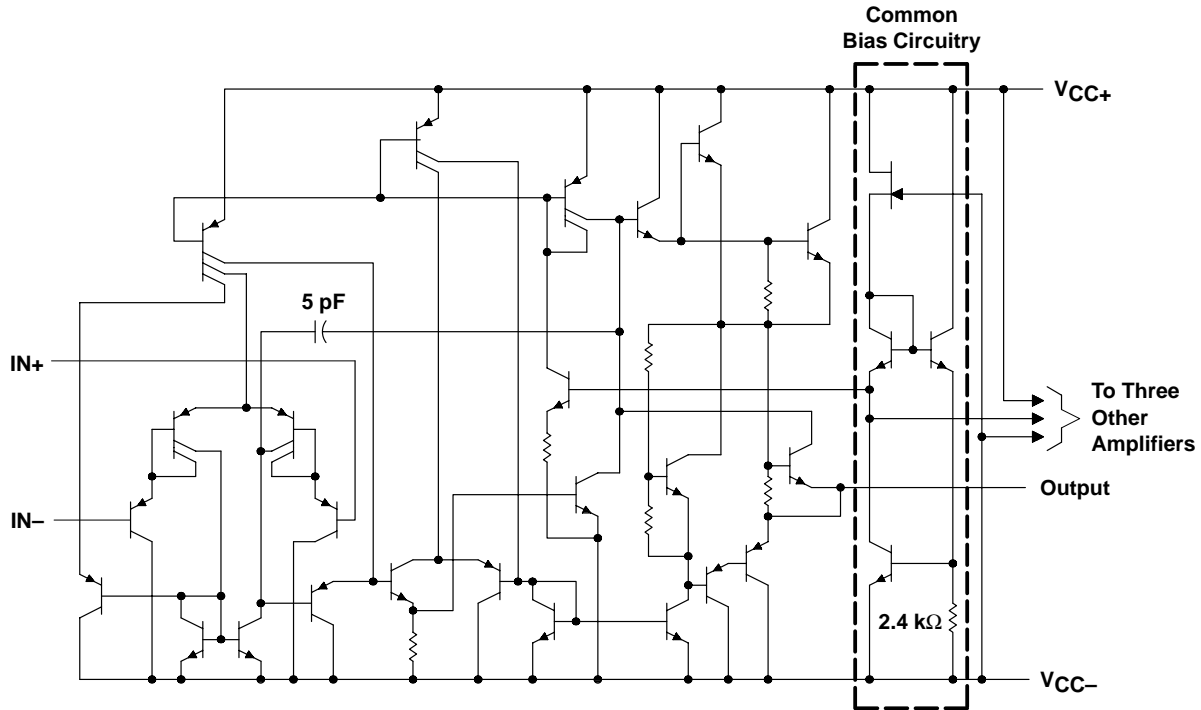
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MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

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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)	± 36 V
Input voltage (see Notes 1 and 3)	± 18 V
Package thermal impedance, θ_{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

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recommended operating conditions

		MIN	MAX	UNIT	
V _{CC}	Supply voltage	5	30	V	
Dual-supply voltage		V _{CC+}	2.5	15	V
		V _{CC-}	-2.5	-15	V
T _A	Operating free-air temperature	MC3303	-40	85	°C
		MC3403	0	70	

electrical characteristics at specified free-air temperature, V_{CC+} = 14 V, V_{CC-} = 0 V for MC3303, V_{CC±} = ±15 V for MC3403 (unless otherwise noted)

PARAMETER	TEST CONDITION†	MC3303			MC3403			UNIT		
		MIN	TYP	MAX	MIN	TYP	MAX			
V _{IO}	Input offset voltage	See Note 5	25°C	2	8	2	10	mV		
				Full range	10	12				
α _{V_{IO}}	Temperature coefficient of input offset voltage	See Note 5	Full range	10	10	μV/°C				
I _{IO}	Input offset current	See Note 5	25°C	30	75	30	50	nA		
				Full range	250	200				
α _{I_{IO}}	Temperature coefficient of input offset current	See Note 5	Full range	50	50	pA/C				
I _{IB}	Input bias current	See Note 5	25°C	-0.2	-0.5	-0.2	-0.5	μA		
				Full range	-1	-0.8				
V _{ICR}	Common-mode input voltage range‡		25°C	V _{CC-} to 12	V _{CC-} to 12.5	V _{CC-} to 13	V _{CC-} to 13.5	V		
V _{OM}	Peak output voltage swing	R _L = 10 kΩ	25°C	12	12.5	±12	±13.5	V		
			25°C	10	12	±10	±13			
			Full range	10	±10					
A _{VD}	Large-signal differential voltage amplification	V _O = ±10 V, R _L = 2 kΩ	25°C	20	200	20	200	V/mV		
			Full range	15	15					
B _{OM}	Maximum-output-swing bandwidth	V _{OPP} = 20 V, A _{VD} = 1, THD ≤ 5%, R _L = 2 kΩ	25°C	9	9	kHz				
B ₁	Unity-gain bandwidth	V _O = 50 mV, R _L = 10 kΩ	25°C	1	1	MHz				
φ _m	Phase margin	C _L = 200 pF, R _L = 2 kΩ	25°C	60°	60°					
r _i	Input resistance	f = 20 Hz	25°C	0.3	1	0.3	1	MΩ		
r _o	Output resistance	f = 20 Hz	25°C	75	75	Ω				
CMRR	Common-mode rejection ratio	V _{IC} = V _{ICRmin}	25°C	70	90	70	90	dB		
k _{SVS}	Supply voltage sensitivity (ΔV _{IO} /ΔV _{CC})	V _{CC±} = ±2.5 to ±15 V	25°C	30	150	30	150	μV/V		
I _{OS}	Short-circuit output current§		25°C	±10	±30	±45	±10	±30	±45	mA
I _{CC}	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_A is -40°C to 85°C for MC3303, and 0°C to 70°C for MC3403.

‡ The V_{ICR} limits are linked directly, volt-for-volt, to supply voltage; the positive limit is 2 V less than V_{CC+}.

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

NOTE 5: V_{IO}, I_{IO}, I_{IB}, and I_{CC} are defined at V_O = 0 for MC3403 and V_O = 7 V for MC3303.



MC3303, MC3403 QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

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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	μA	
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/ μs
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	μs
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	μs
	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

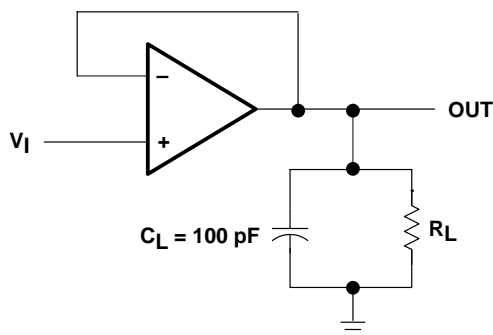


Figure 1. Unity-Gain Amplifier

TYPICAL CHARACTERISTICS†

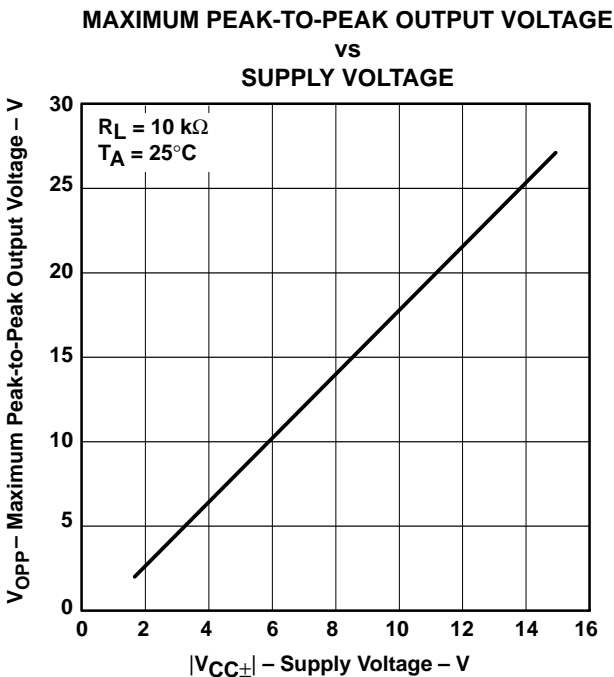


Figure 2

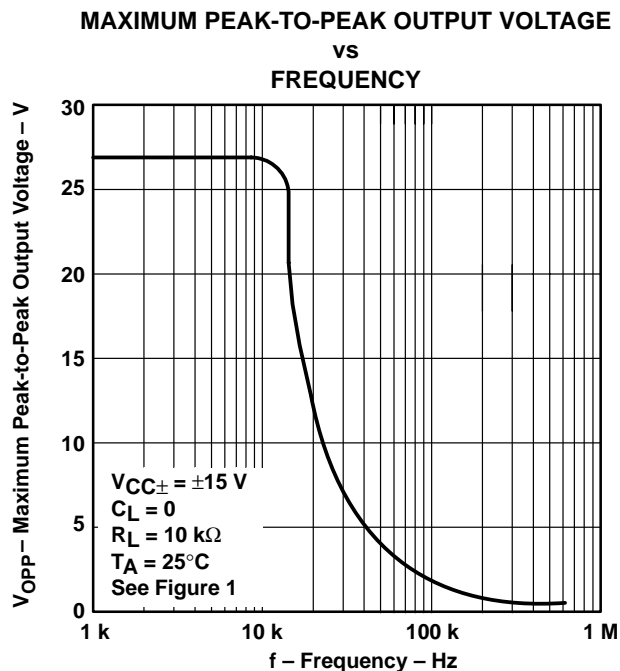


Figure 3

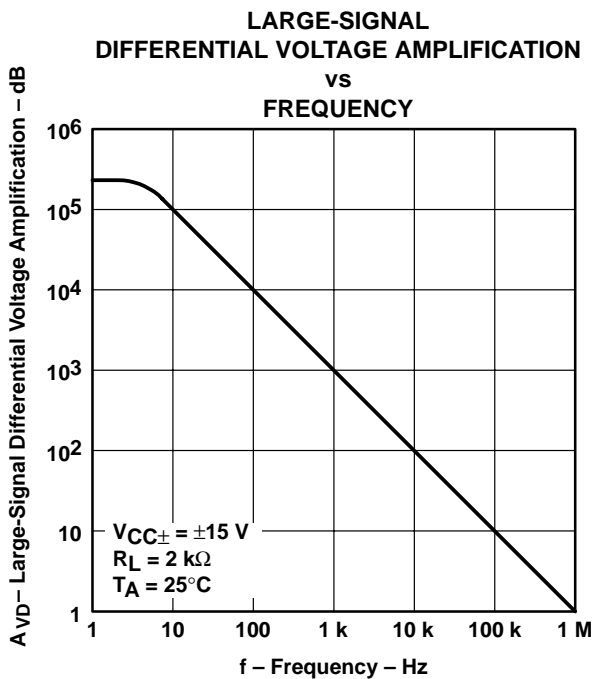


Figure 4

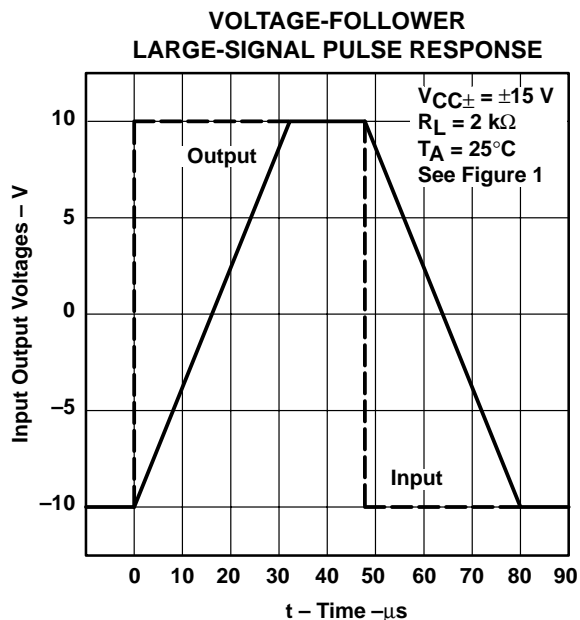


Figure 5

† 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

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TYPICAL CHARACTERISTICS†

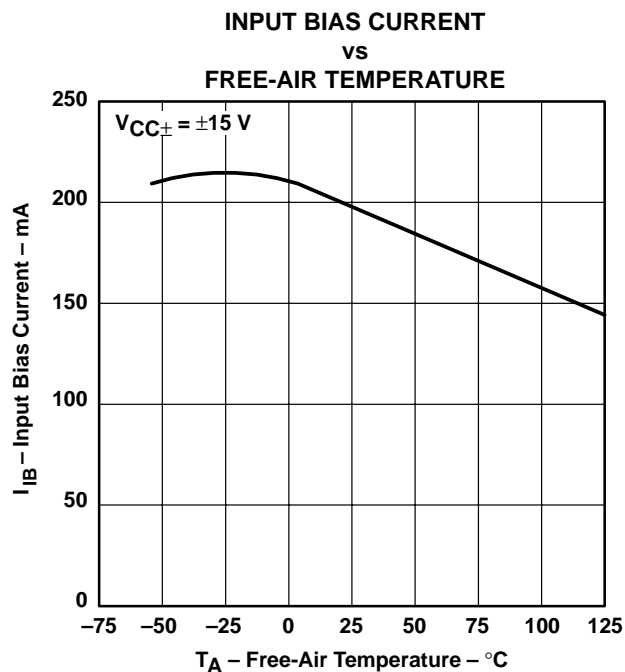


Figure 6

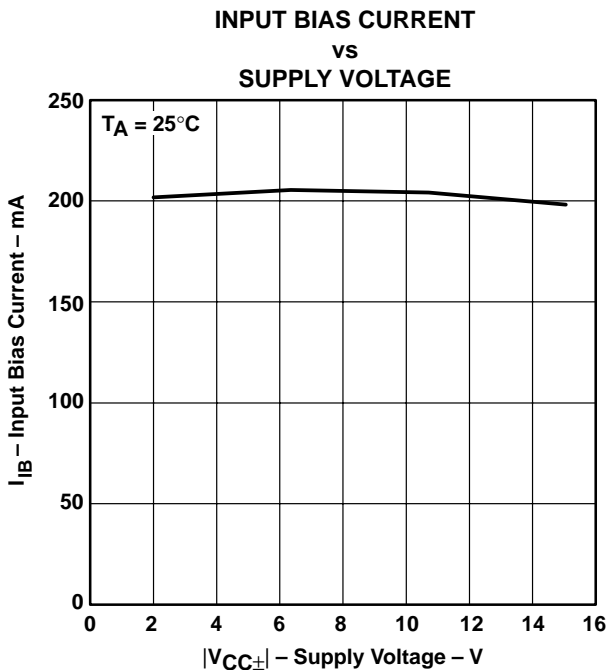


Figure 7

† 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 (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
MC3303D	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	-40 to 85	MC3303	
MC3303DR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	MC3303	Samples
MC3303N	ACTIVE	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-40 to 85	MC3303N	Samples
MC3303PW	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI	-40 to 85	M3303	
MC3303PWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	M3303	Samples
MC3403D	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI	0 to 70	MC3403	
MC3403DR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MC3403	Samples
MC3403N	ACTIVE	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	MC3403N	Samples
MC3403NSR	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	MC3403	Samples
MC3403PWR	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI	0 to 70	M3403	

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

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

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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
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

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	356.0	356.0	35.0
MC3303PWR	TSSOP	PW	14	2000	356.0	356.0	35.0
MC3403DR	SOIC	D	14	2500	353.0	353.0	32.0
MC3403NSR	SO	NS	14	2000	356.0	356.0	35.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
MC3303N	N	PDIP	14	25	506	13.97	11230	4.32
MC3403N	N	PDIP	14	25	506	13.97	11230	4.32

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.



4220202/B 12/2023

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220202/B 12/2023

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



D0014A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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.

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