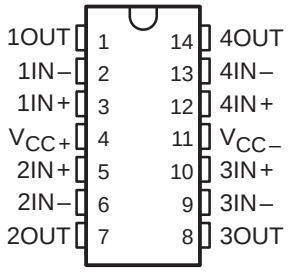
SLOS101A – FEBRUARY 1979 – REVISED MAY 1999

- **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**

D OR N PACKAGE
(TOP VIEW)

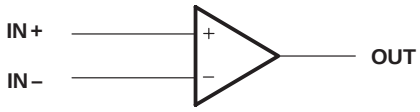


description

The MC3303 and the MC3403 are quadruple operational amplifiers similar in performance to the μA741, 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 μA741.

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.

logic diagram (each amplifier)



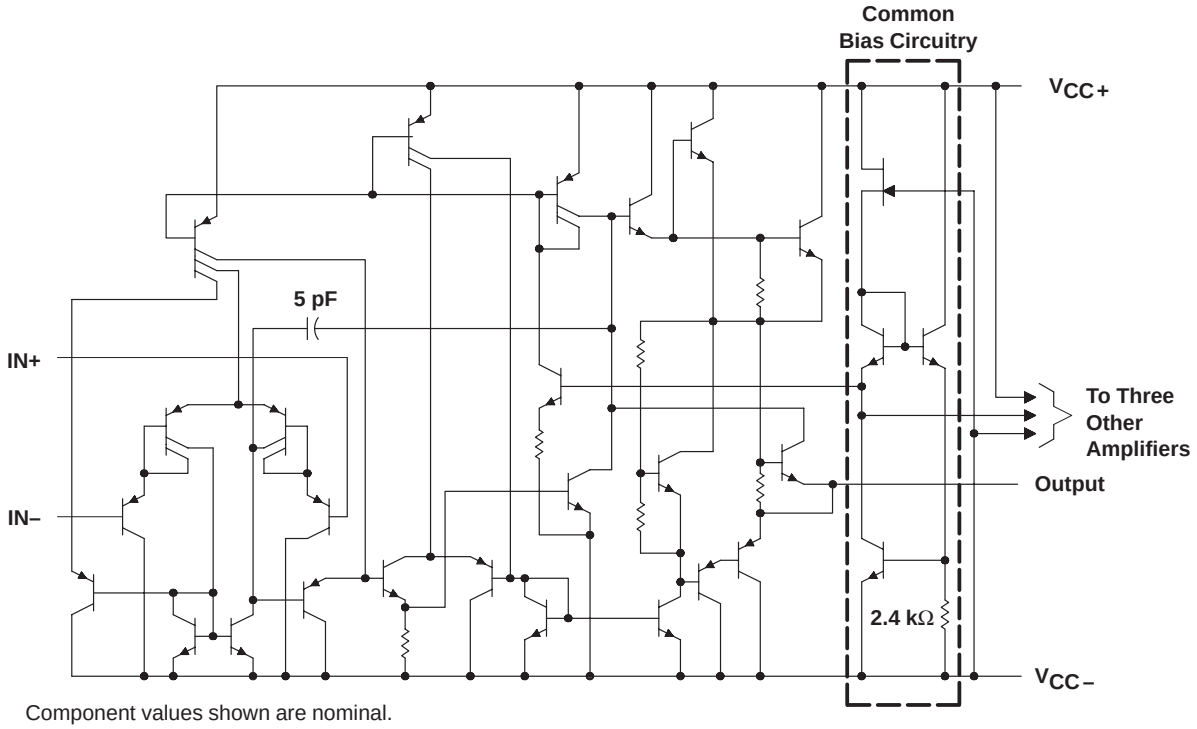
AVAILABLE OPTIONS

T_A	V_{IO}MAX AT 25°C	PACKAGE	
		SMALL OUTLINE (D)	PLASTIC DIP (N)
0°C to 70°C	10 mV	MC3403D	MC3403N
–40°C to 85°C	8 mV	MC3303D	MC3303N

The D packages are available taped and reeled. Add R suffix to the device type (e.g., MC3403DR).

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.

schematic (each amplifier)



Component values shown are nominal.

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

		MC3303	MC3403	UNIT
Supply voltage (see Note 1)	V_{CC+}	18	18	V
	V_{CC-}	–18	–18	
Supply voltage, V_{CC+} with respect to V_{CC-}		36	36	V
Differential input voltage (see Note 2)		±36	±36	V
Input voltage (see Notes 1 and 3)		±18	±18	V
Package thermal impedance, θ_{JA} (see Note 4)	D package	127		°C/W
	N package	78		
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260	260	°C
Storage temperature range		– 65 to 150	– 65 to 150	°C

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, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

		MIN	MAX	UNIT
Single-supply voltage, V_{CC}		5	30	V
Dual-supply voltage	V_{CC+}	2.5	15	V
	V_{CC-}	–2.5	–15	
Operating free-air temperature range, T_A	MC3303	–40	85	°C
	MC3403	0	70	

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

PARAMETER		TEST CONDITIONS†		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_{VIO}	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_{IIO}	Temperture 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
		R_L = 2 kΩ	25°C	10	12		±10	±13		
		R_L = 2 kΩ	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	$V_{IC} = V_{ICR}$min	25°C	70	90		70	90		dB
k_{SVS}	Supply voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	$V_{CC\pm}$ = ±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.

electrical characteristics, V_{CC+} = 5 V, V_{CC-} = 0 V, T_A = 25°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 V			10		2	10	mV
I_{IO}	Input offset current	V_O = 2.5 V			75		30	50	nA
I_{IB}	Input bias current	V_O = 2.5 V			−0.5		−0.2	−0.5	μA
V_{OM}	Peak output voltage swing‡	R_L = 10 kΩ	3.3	3.5		3.3	3.5		V
		R_L = 10 kΩ, V_{CC+} = 5 V to 30 V	V_{CC+} −1.7			V_{CC+} −1.7			
A_{VD}	Large-signal differential voltage amplification	V_O = 1.7 V to 3.3 V, R_L = 2 kΩ	20	200		20	200		V/mV
k_{SVS}	Supply-voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC\pm}$)	$V_{CC\pm}$ = ± 2.5 V to ±15 V			150			150	μV/V
I_{CC}	Supply current	V_O = 2.5 V, No load		2.5	7		2.5	7	mA
V_{O1}/V_{O2}	Crosstalk attenuation	f = 1 kHz to 20 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 V, V_{CC-} = 0 V for MC3303, $V_{CC\pm}$ = ±15 V for MC3403, T_A = 25°C, A_{VD} = 1 (unless otherwise noted)

PARAMETER		TEST CONDITIONS				MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	V_I = ±10 V,	C_L = 100 pF,	R_L = 2 kΩ,	See Figure 1		0.6		V/μs
t_r	Rise time	ΔV_O = 50 mV,	C_L = 100 pF,	R_L = 10 kΩ,	See Figure 1		0.35		μs
t_f	Fall time						0.35		μs
	Overshoot factor						20%		
	Crossover distortion	$V_{I(PP)}$ = 30 mV,	V_{OPP} = 2 V,	f = 10 kHz			1%		

PARAMETER MEASUREMENT INFORMATION

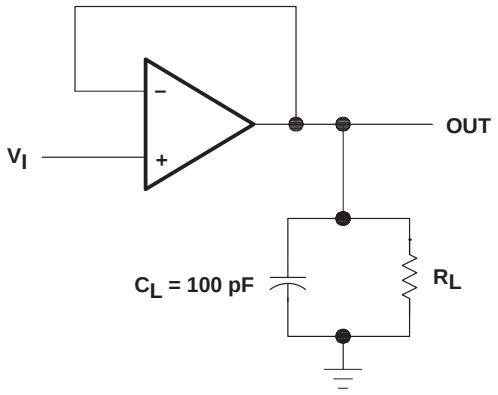


Figure 1. Unity-Gain Amplifier

TYPICAL CHARACTERISTICS†

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE

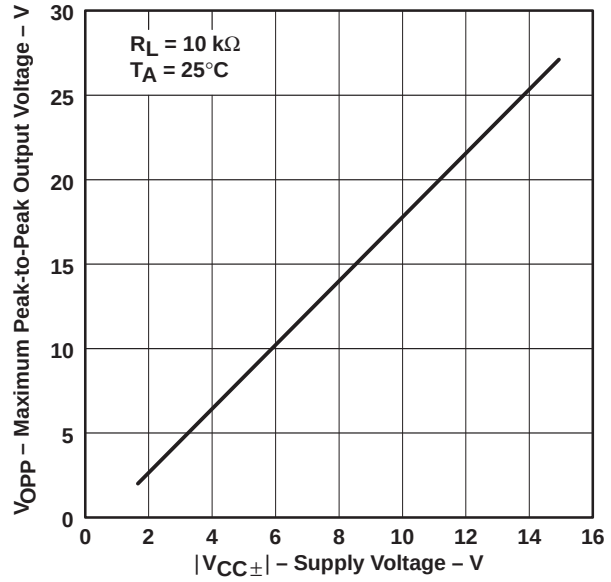


Figure 2

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

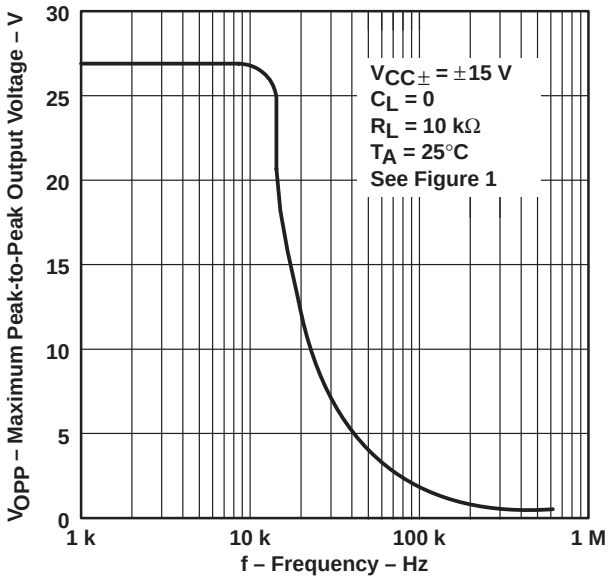


Figure 3

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREQUENCY

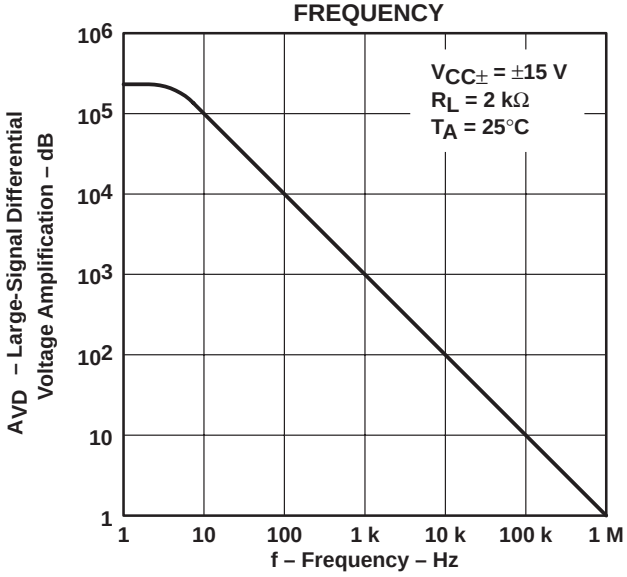


Figure 4

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

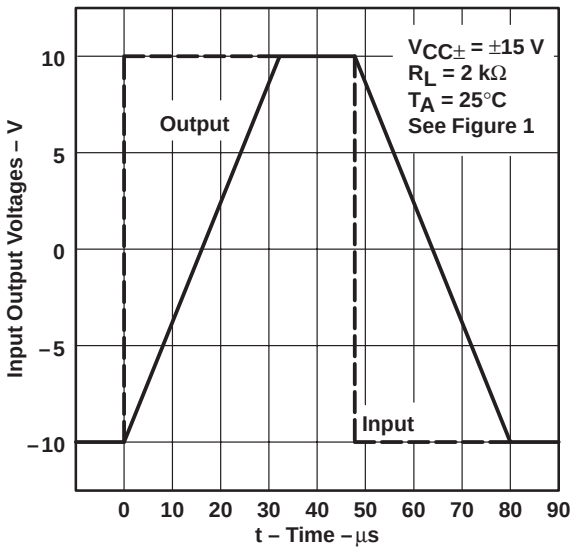


Figure 5

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

TYPICAL CHARACTERISTICS†

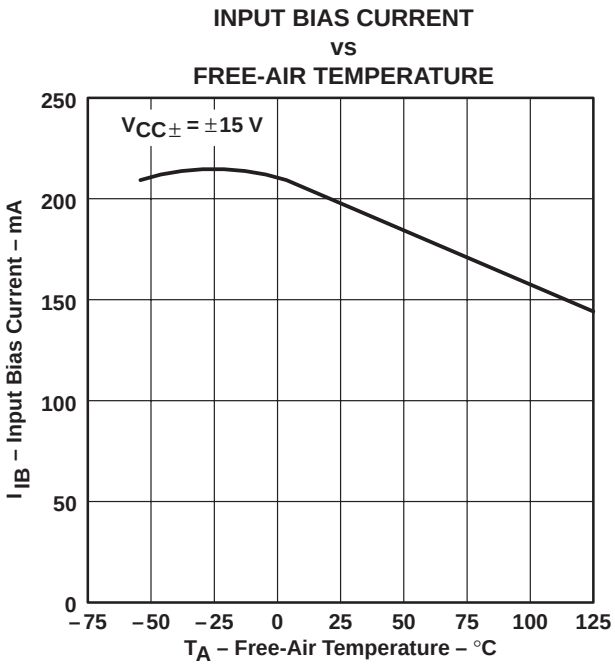


Figure 6

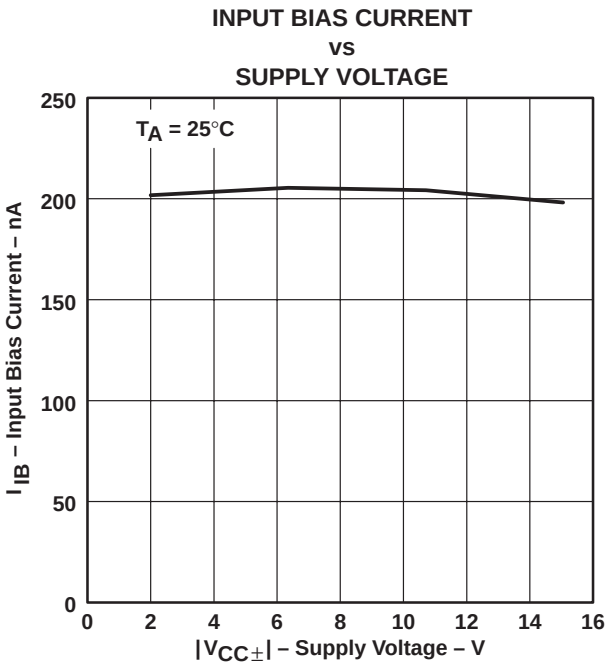


Figure 7

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

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