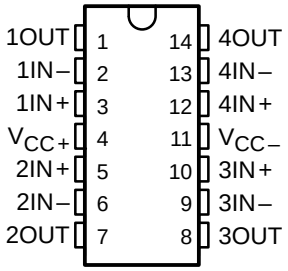
SLOS101 – D2517, FEBRUARY 1979 – REVISED SEPTEMBER 1990

- **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)

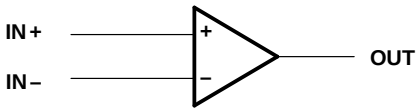


description

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 is also 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.

symbol (each amplifier)

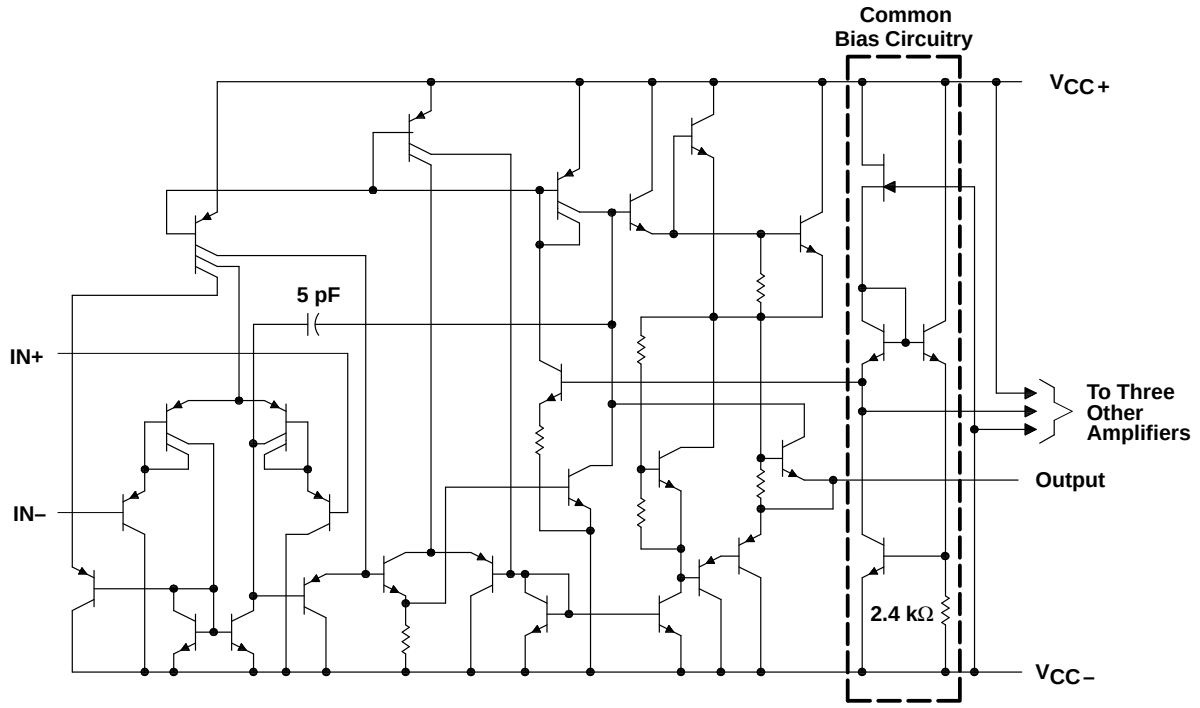


AVAILABLE OPTIONS

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).

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 V_{CC+} (see Note 1)	18	18	V
Supply voltage V_{CC-} (see Note 1)	–18	–18	V
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
Continuous total power dissipation	See Dissipation Rating Table		
Operating free-air temperature range	– 40 to 85	0 to 70	°C
Storage temperature range	– 65 to 150	– 65 to 150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260	260	°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 then V_{CC+} or more negative than V_{CC-}.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
D	950 mW	7.6 mW/°C	608 mW	494 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

recommended operating conditions

	MIN	MAX	UNIT
Single-supply voltage, V_{CC}	5	30	V
Dual-supply voltage, V_{CC+}	2.5	15	V
Dual-supply voltage, V_{CC-}	−2.5	−15	V

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 4	25°C		2	8		2	10	mV
			Full range			10			12	
α_{VIO}	Temperature coefficient of input offset voltage	See Note 4	Full range		10			10		µV/°C
I_{IO}	Input offset current	See Note 4	25°C		30	75		30	50	nA
			Full range			250			200	
α_{IIO}	Temperture coefficient of input offset current	See Note 4	Full range		50			50		pA/C
I_{IB}	Input bias current	See Note 4	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 4	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 directly linked 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 4: 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	pA
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

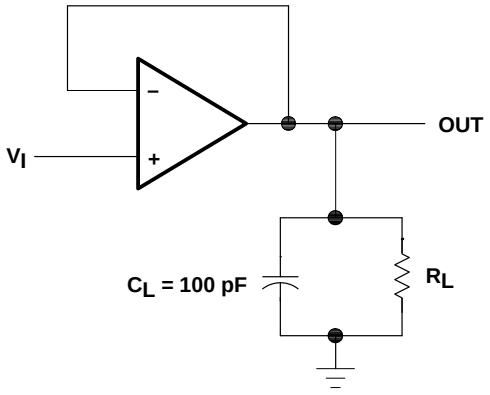


Figure 1. Unity-Gain Amplifier

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
I_{IB}	Input bias current	vs Free-air temperature	2
		vs Supply voltage	3
$V_{O(PP)}$	Maximum peak-to-peak output voltage	vs Supply voltage	4
		vs Frequency	5
A_{VD}	Large-signal differential voltage amplification	vs Frequency	6
	Large-signal pulse response	vs Time	7

INPUT BIAS CURRENT† vs FREE-AIR TEMPERATURE

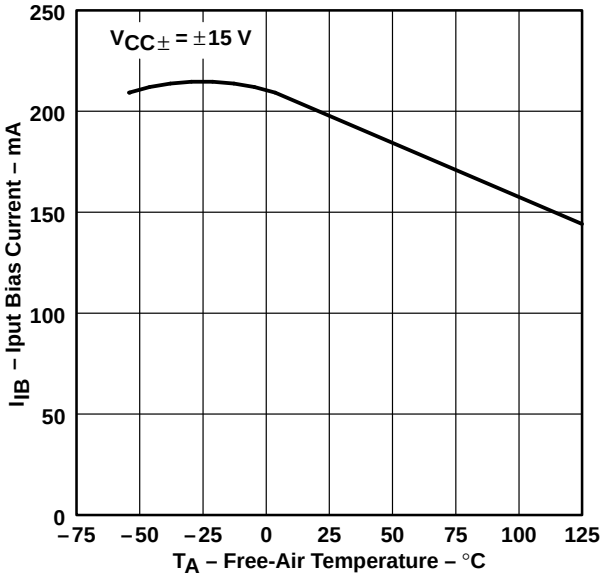


Figure 2

INPUT BIAS CURRENT vs SUPPLY VOLTAGE

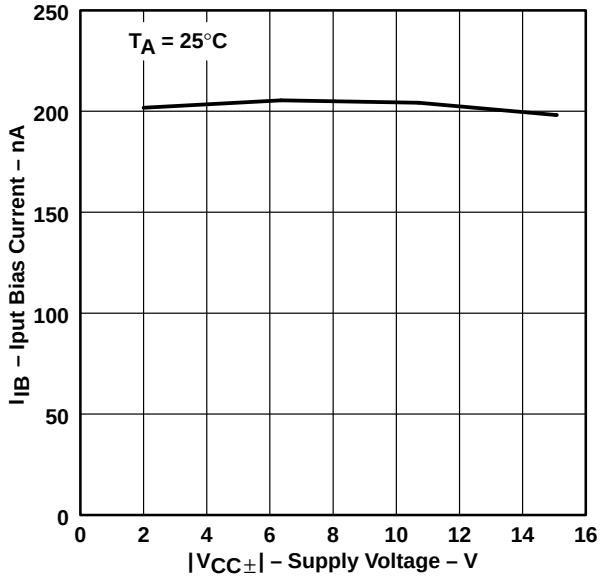


Figure 3

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE

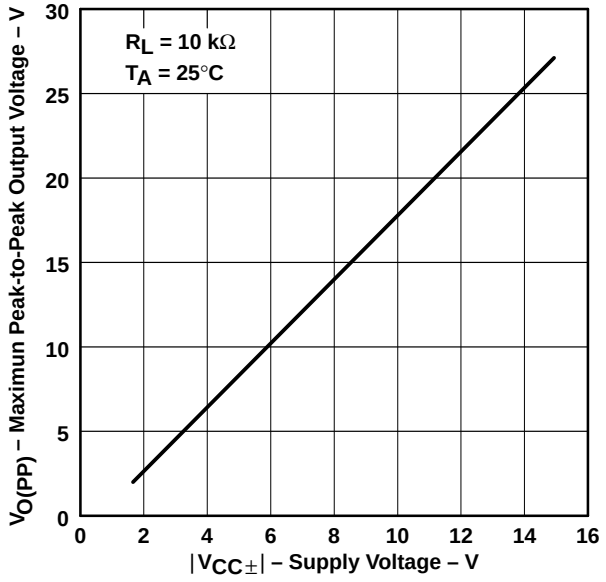


Figure 4

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

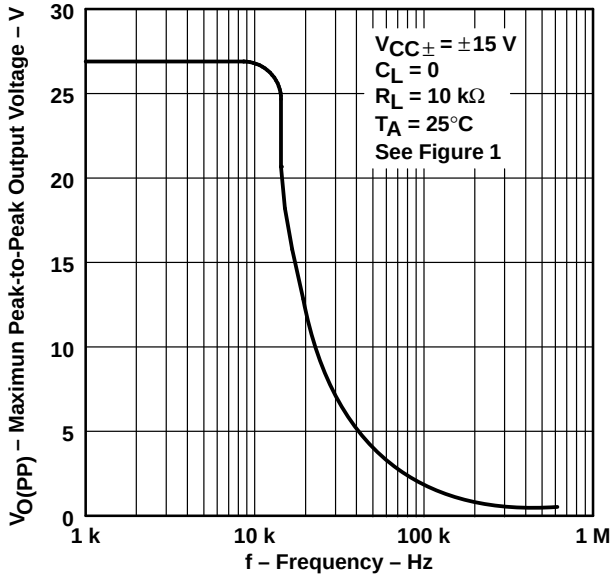


Figure 5

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREQUENCY

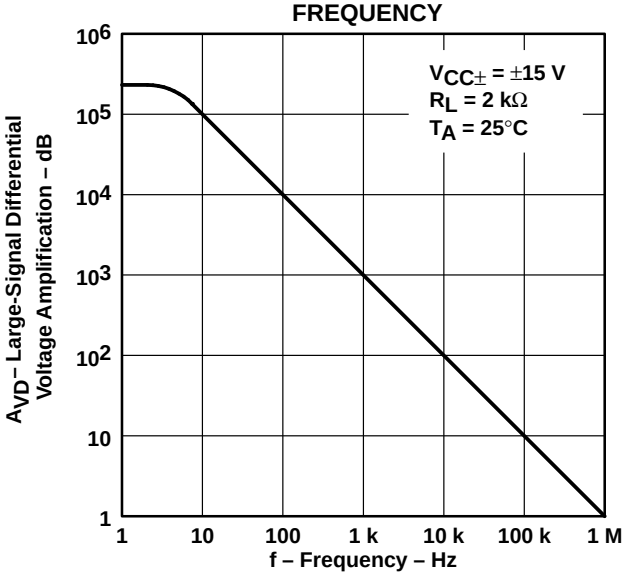


Figure 6

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

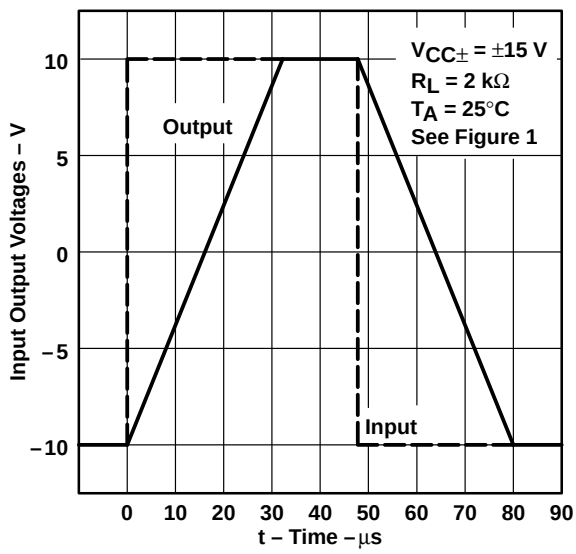


Figure 7

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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