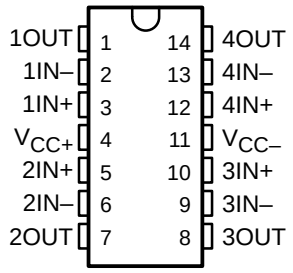
SLOS101C – FEBRUARY 1979 – REVISED FEBRUARY 2002

- **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 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.

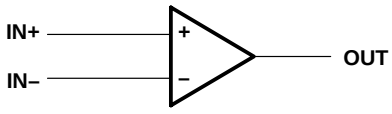
The MC3303 is characterized for operation from –40°C to 85°C, and the MC3403 is characterized for operation from 0°C to 70°C.

AVAILABLE OPTIONS

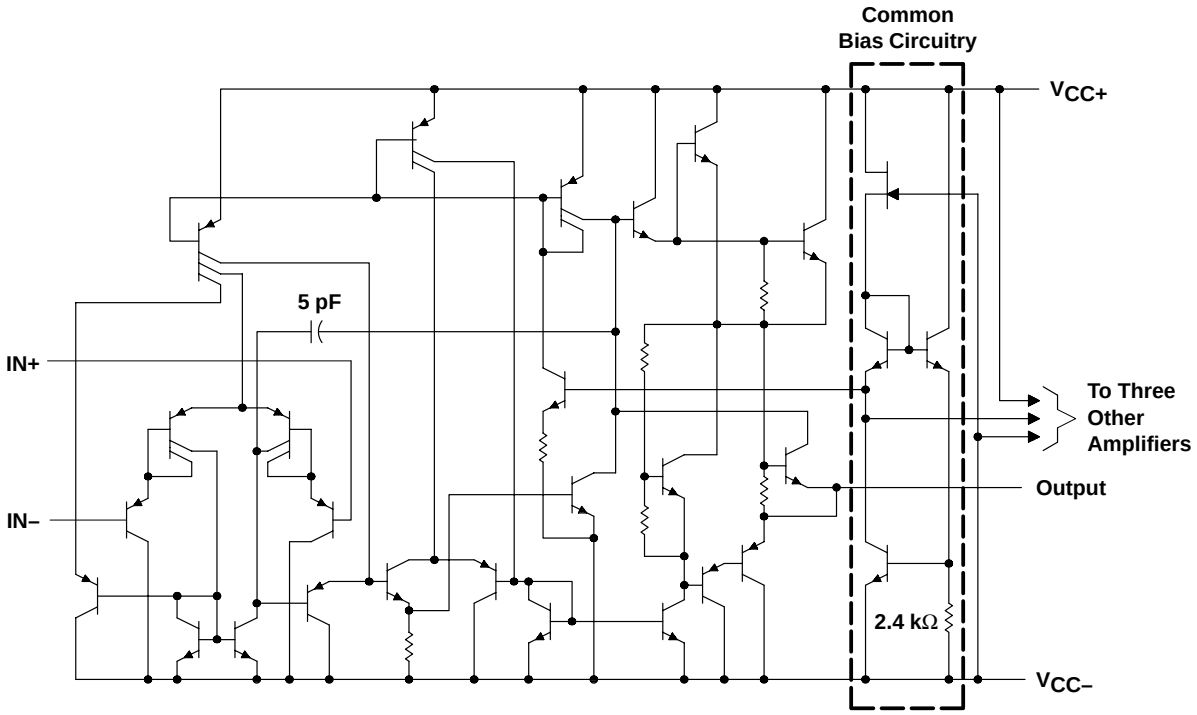
T_A	V_{IO}MAX AT 25°C	PACKAGE			
		PLASTIC SMALL OUTLINE (D, NS)	PLASTIC SHRINK SMALL OUTLINE (DB)	PLASTIC DIP (N)	PLASTIC THIN SHRINK SMALL OUTLINE (PW)
0°C to 70°C	10 mV	MC3403D MC3403NS	MC3403DB	MC3403N	MC3403PW
–40°C to 85°C	8 mV	MC3303D	—	MC3303N	MC3303PW

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)



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.

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, $V_{CC\pm}$ = ±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	
$\alpha_{V_{IO}}$	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	
$\alpha_{I_{IO}}$	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
		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				TYP	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	ΔV_O = 50 mV,	C_L = 100 pF,	R_L = 10 kΩ,	See Figure 1	0.35	µs
	Overshoot factor	ΔV_O = 50 mV,	C_L = 100 pF,	R_L = 10 kΩ,	See Figure 1	20	%
	Crossover distortion	$V_{I(PP)}$ = 30 mV,	V_{OPP} = 2 V,	f = 10 kHz		1	%

PARAMETER MEASUREMENT INFORMATION

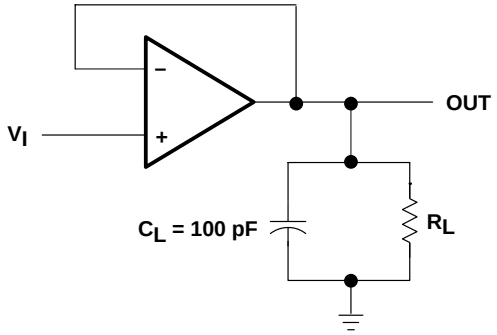


Figure 1. Unity-Gain Amplifier

TYPICAL CHARACTERISTICS†

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE

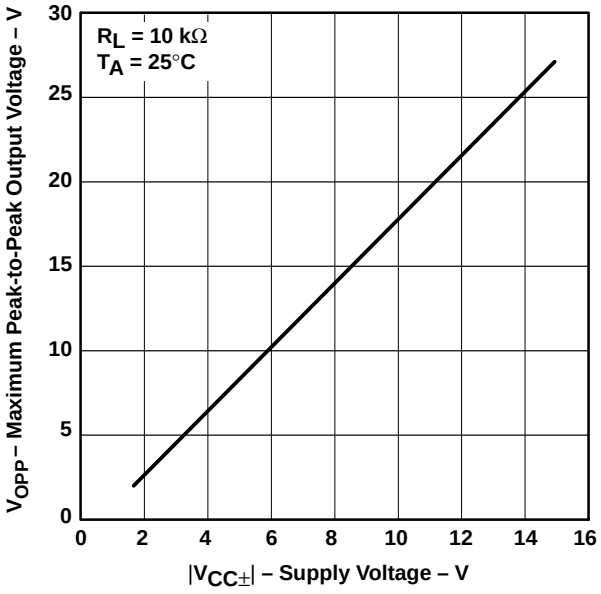


Figure 2

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

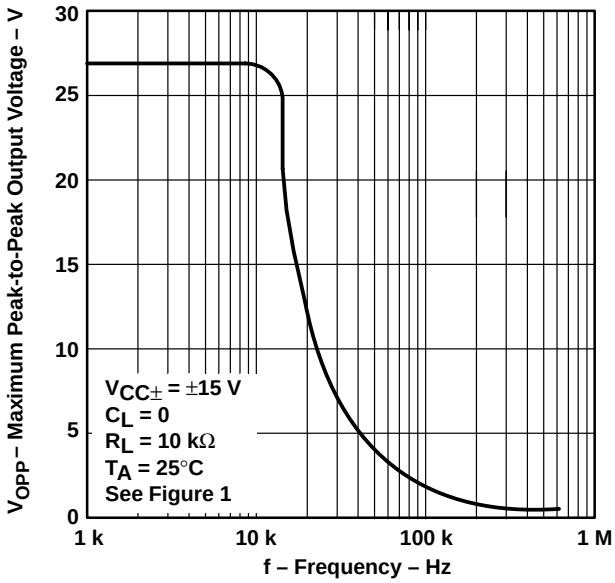


Figure 3

LARGE-SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREQUENCY

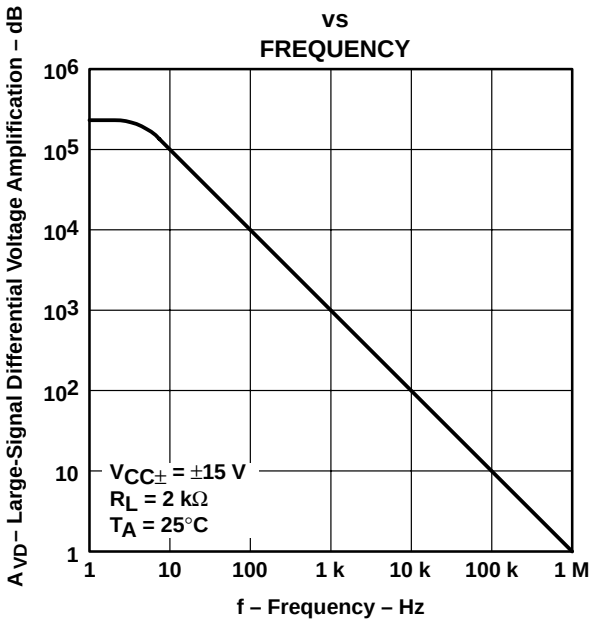


Figure 4

VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE

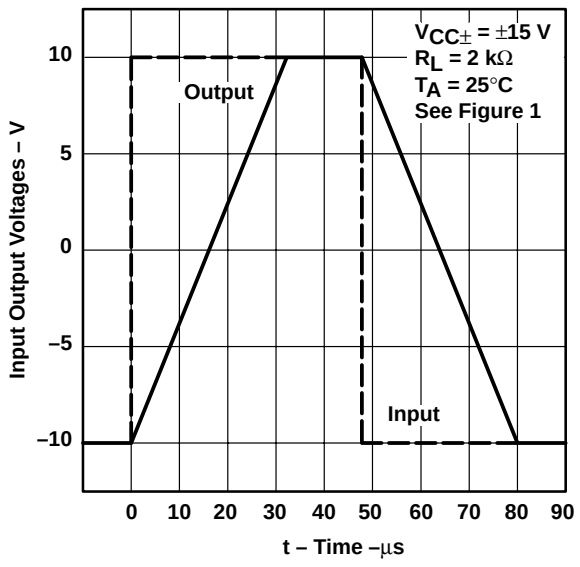


Figure 5

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

TYPICAL CHARACTERISTICS†

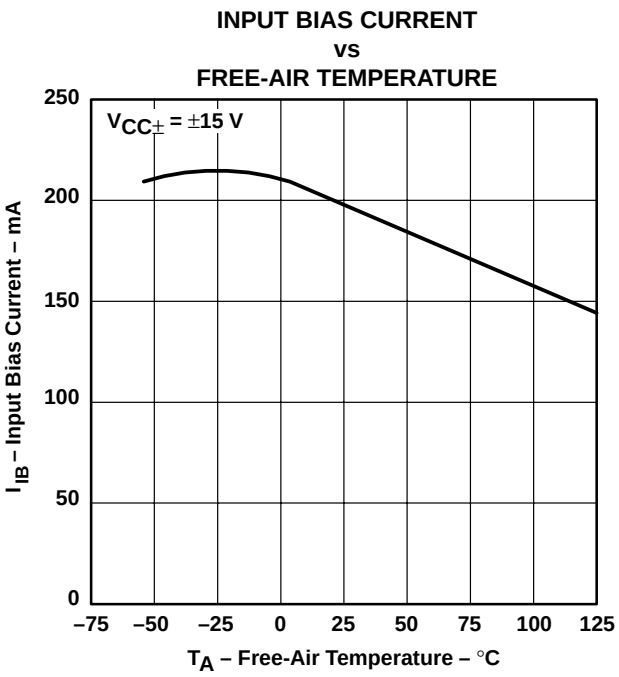


Figure 6

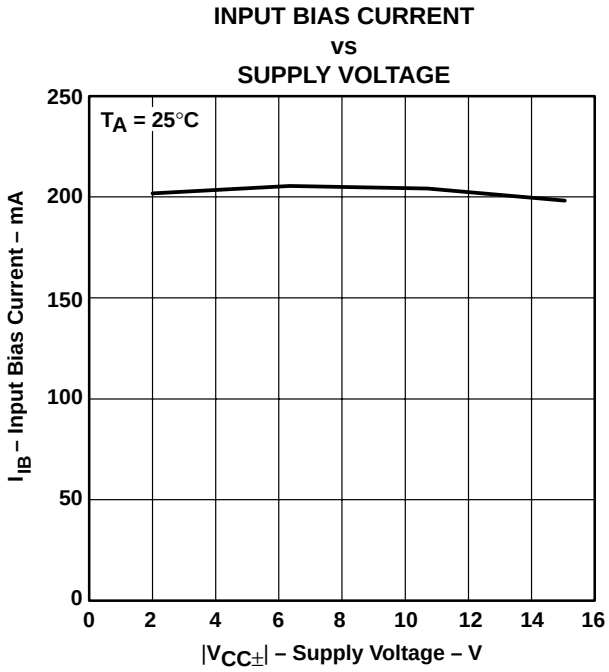


Figure 7

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

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