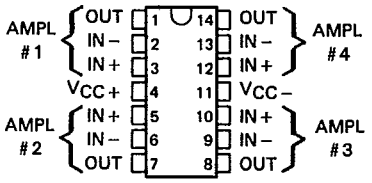
MC3303, MC3403
QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

T-79-10

D2517, FEBRUARY 1979—REVISED MAY 1988

- 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, MC3403 . . . D, J, OR N PACKAGE
(TOP VIEW)



2

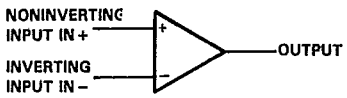
Operational Amplifiers

description

The MC3303 and the MC3403 are quadruple operational amplifiers similar in performance to the uA741 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 uA741.

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

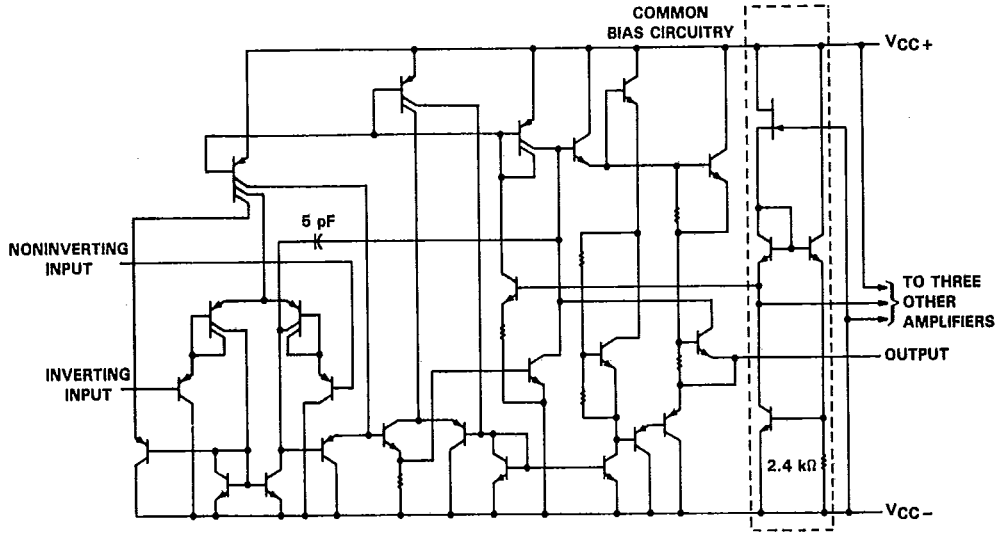
T_A	V_{IO} MAX AT 25°C	PACKAGE		
		SMALL-OUTLINE (D)	CERAMIC DIP (J)	PLASTIC DIP (N)
0°C to 70°C	10 mV	MC3403D	MC3403J	MC3403N
−40°C to 85°C	8 mV	MC3303D	MC3303J	MC3303N

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

MC3303, MC3403
QUADRUPLE LOW-POWER OPERATIONAL AMPLIFIERS

schematic (each amplifier)

T-79-10



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 60 seconds	J package	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or N package	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 the noninverting input terminal with respect to the inverting terminal.
3. Neither input must ever be more positive then V_{CC+} or more negative than V_{CC-}.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ 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
J	1025 mW	8.2 mW/°C	656 mW	533 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW

TEXAS INSTRUMENTS
POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

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

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}	Temperature 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} = ±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} = ±15 V to ±2.5 V			150			150	μV/V
I_{CC}	Supply current	No load, V_O = 2.5 V		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_{IPP} = 30 mV, V_{OPP} = 2 V, f = 10 kHz		1%		

PARAMETER MEASUREMENT INFORMATION

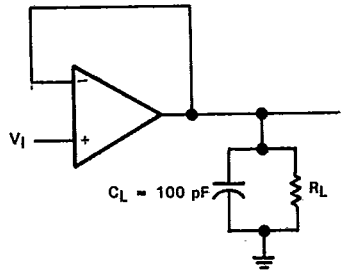


FIGURE 1. UNITY-GAIN AMPLIFIER

TEXAS INSTRUMENTS
POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

TYPICAL CHARACTERISTICS†

INPUT BIAS CURRENT
vs
FREE-AIR TEMPERATURE

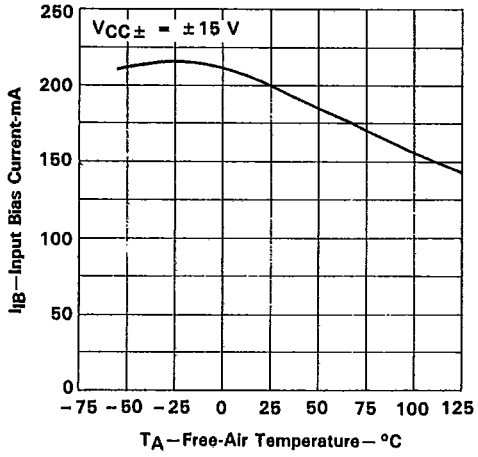


FIGURE 2

INPUT BIAS CURRENT
vs
SUPPLY VOLTAGE

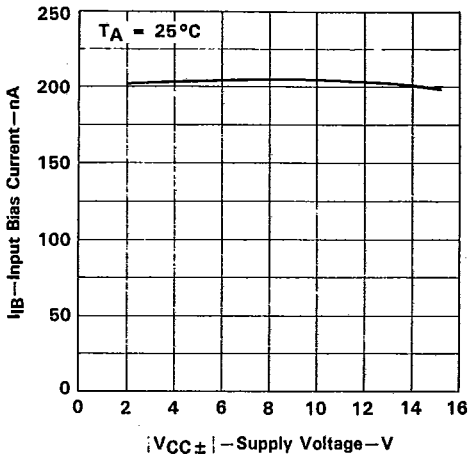


FIGURE 3

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE

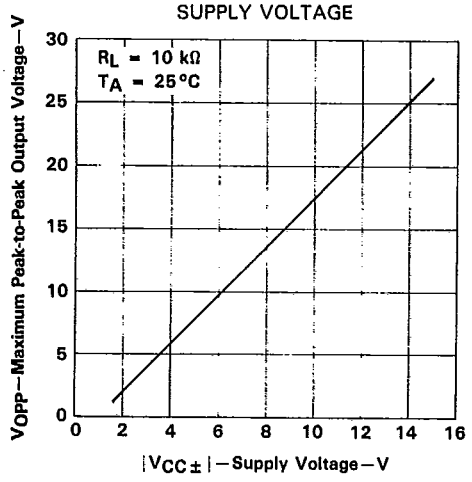


FIGURE 4

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

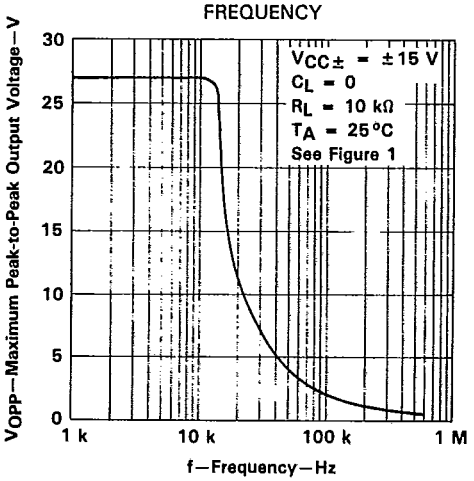


FIGURE 5

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

2 Operational Amplifiers

TYPICAL CHARACTERISTICS†

LARGE-SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREQUENCY

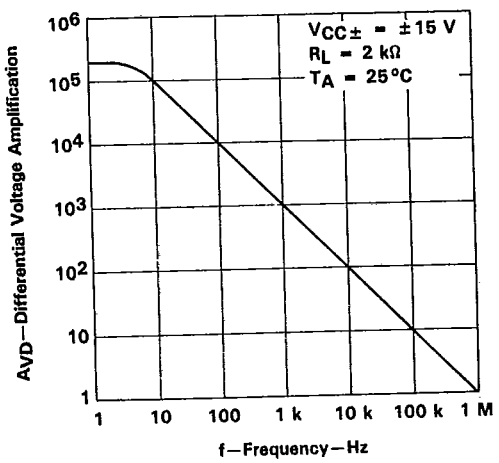


FIGURE 6

VOLTAGE-FOLLOWER
LARGE-SIGNAL PULSE RESPONSE

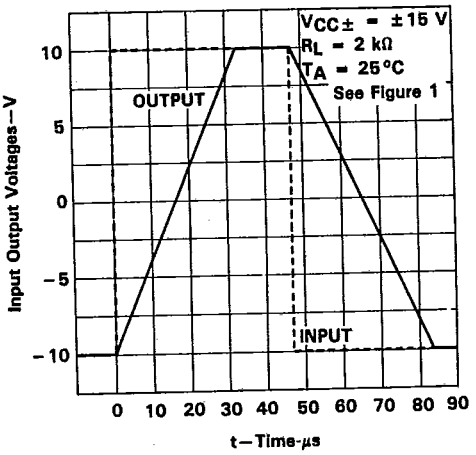


FIGURE 7

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

TEXAS INSTRUMENTS
POST OFFICE BOX 655012 • DALLAS, TEXAS 75265