

QUAD LOW POWER OPERATIONAL AMPLIFIERS

MC3303/3403/3503

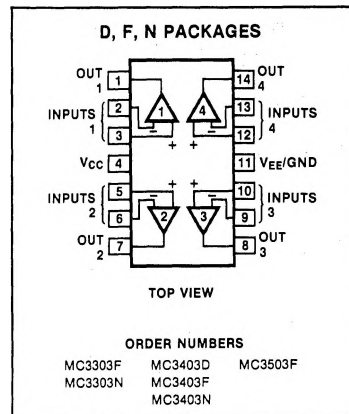
DESCRIPTION

The MC3403 is a quad operational amplifier with true differential inputs. The device has electrical characteristics similar to the popular μ A741. However, the MC3403 has several distinct advantages over standard operational amplifier types in single supply applications. The MC3403 can operate at supply voltages as low as 3.0V or as high as 32V. The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

FEATURES

- Short circuit protected outputs
- Class AB output stage for minimal cross-over distortion
- True differential input stage
- Single supply operation: 3.0 to 32V
- Split supply operation: ± 1.5 to ± 16 V
- Low input bias currents: 500nA max
- Four amplifiers per package
- Internally compensated

PIN CONFIGURATION



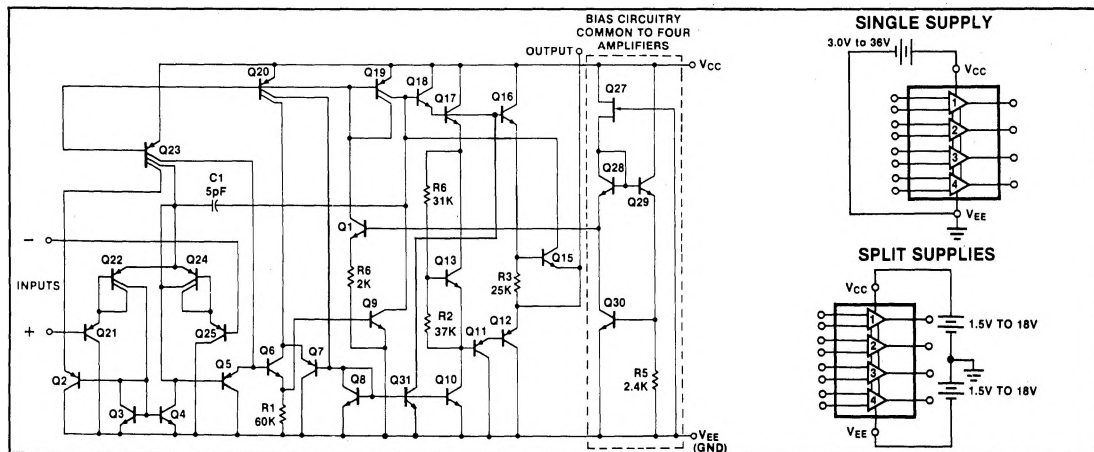
ABSOLUTE MAXIMUM RATINGS

SYMBOL AND PARAMETER	RATING	UNIT
Power supply voltages (3)		
V_{CC} Single supply	36	Vdc
V_{CC} Split supplies	+ 18	Vdc
V_{EE}	- 18	Vdc
V_{IDR} Input differential voltage range ⁽¹⁾	± 36	Vdc
V_{ICR} Input common mode voltage range ^(1,2)	± 18	Vdc
T_{stg} Storage temperature range		°C
Ceramic package	- 65 to + 150	
Plastic package	- 55 to + 125	
T_A Operating ambient temperature range		°C
MC3503	- 55 to + 125	
MC3403	0 to + 70	
MC3303	- 40 to + 85	
T_J Junction temperature		°C
Ceramic package	175	
Plastic package	150	

NOTES

1. Split power supplies.
2. For supply voltages less than ± 15 V, the absolute maximum input voltage is equal to the supply voltage.
3. Device not functional for single supply > 32 V or split supply $> \pm 16$ V

CIRCUIT SCHEMATIC (1/4 Shown)



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ELECTRICAL CHARACTERISTICS ($V_{CC} = +15V$, $V_{EE} = -15V$ for MC3503, MC3403; $V_{CC} = +14V$, $V_{EE} = GND$ for MC3303.
 $T_A = 25^\circ C$ unless otherwise noted)

SYMBOL AND PARAMETER	TEST CONDITIONS	MC3503			MC3403			MC3303			UNIT
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{IO} Input offset voltage	$T_A = T_{HIGH}$ to T_{LOW}	—	2.0	5.0	—	2.0	10	—	2.0	8.0	mV
		—	—	6.0	—	—	12	—	—	10	
I_{IO} Input offset current	$T_A = T_{HIGH}$ to T_{LOW}	—	10	50	—	10	50	—	30	75	nA
		—	—	200—	—	200—	—	250	—	—	
A_{VOL} Large signal open-loop voltage gain	$V_o = \pm 10V$, $R_L = 2.0k\Omega$	50	200	—	20	200	—	20	200	—	V/mV
	$T_A = T_{HIGH}$ to T_{LOW}	25	300	—	15	—	—	15	—	—	
I_{IB} Input bias current	$T_A = T_{HIGH}$ to T_{LOW}	—	—30	—500	—	—30	—500	—	—30	—500	nA
		—	—40	—1200	—	—	—800	—	—	—1000	
z_o Output impedance	$f = 20Hz$	—	75	—	—	75	—	—	75	—	Ω
z_i Input impedance	$f = 20Hz$	0.3	1.0	—	0.3	1.0	—	0.3	1.0	—	M Ω
V_{OR} Output voltage range	$R_L = 10k\Omega$ $R_L = 2.0k\Omega$ $R_L = 2.0k\Omega$ $T_A = T_{HIGH}$ to T_{LOW}	± 12 ± 10 ± 10	± 13.5 ± 13 —	— — —	± 12 ± 10 ± 10	± 13.5 ± 13 —	— — —	± 12 ± 10 ± 10	± 12.5 ± 12 —	— — —	V
V_{ICR} Input common mode voltage range		+13V — V_{EE}	+13.5V — V_{EE}	—	+13V — V_{EE}	+13.5V — V_{EE}	—	+12V — V_{EE}	+12.5V — V_{EE}	—	V
CMRR Common mode rejection ratio	$R_S \leq 10k\Omega$	70	90	—	70	90	—	70	90	—	dB
I_{CC}, I_{EE} Power supply current ($V_o = 0$)	$R_L = \infty$	—	2.5	4.0	—	2.5	7.0	—	2.5	7.0	mA
$\Delta I_B / \Delta T$	$T_A = T_{HIGH}$ to T_{LOW}	—	3.5	5	—	3.5	7	—	3.5	7	mA
$I_{OS\pm}$ Individual output short circuit current ²		± 10	± 30	± 45	± 10	± 20	± 45	± 10	± 30	± 45	mA
PSRR+ Positive power supply rejection ratio		—	30	150	—	30	150	—	30	150	$\mu V/V$
PSRR– Negative power supply rejection ratio		—	30	150	—	30	150	—	—	—	$\mu V/V$
$\Delta I_B / \Delta T$	$T_A = T_{HIGH}$ to T_{LOW}	—	50	—	—	50	—	—	50	—	pA/ $^\circ C$
$\Delta I_{IO} / \Delta T$	$T_A = T_{HIGH}$ to T_{LOW}	—	50	—	—	50	—	—	50	—	pA/ $^\circ C$
$\Delta V_{IO} / \Delta T$	$T_A = T_{HIGH}$ to T_{LOW}	—	10	—	—	10	—	—	10	—	$\mu V/^\circ C$
BW_p Power bandwidth	$A_v = 1$, $R_L = 2.0k\Omega$, $V_o = 20V(p-p)$ THD = 5%	—	9.0	—	—	9.0	—	—	9.0	—	kHz
BW Small signal bandwidth	$A_v = 1$, $R_L = 10k\Omega$, $V_o = 50mV$	—	1.0	—	—	1.0	—	—	1.0	—	MHz
SR Slew rate	$A_v = 1$, $V_i = -10V$ to $+10V$	—	0.6	—	—	0.6	—	—	0.6	—	V/ μs
t_{TLH} Rise time	$A_v = 1$, $R_L = 10k\Omega$, $V_o = 50mV$	—	0.35	—	—	0.35	—	—	0.35	—	μs
t_{THL} Fall time	$A_v = 1$, $R_L = 10k\Omega$, $V_o = 50mV$	—	0.35	—	—	0.35	—	—	0.35	—	μs
OS Overshoot	$A_v = 1$, $R_L = 10k\Omega$, $V_o = 50mV$	—	20	—	—	20	—	—	20	—	%
ϕ_m Phase margin	$A_v = 1$, $R_L = 2.0k\Omega$, $C_L = 200pF$	—	50	—	—	50	—	—	50	—	$^\circ$
— Crossover distortion	$V_{IN} = 30mV(p-p)$, $V_{OUT} = 2.0V(p-p)$, $f = 10kHz$	—	1.0	—	—	1.0	—	—	1.0	—	%

NOTES:

- $T_{HIGH} = 125^\circ C$ for MC3503, $70^\circ C$ for MC3303. $T_{LOW} = -55^\circ C$ for MC3503, $0^\circ C$ for MC3403, $-40^\circ C$ for MC3303.
- Not to exceed maximum package power dissipation.

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ELECTRICAL CHARACTERISTICS ($V_{CC} = 5.0V$, $V_E = GND$, $T_A = 25^\circ C$ unless otherwise noted.)

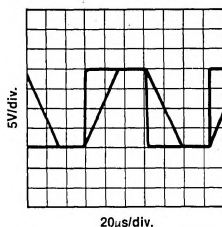
SYMBOL AND PARAMETER	TEST CONDITIONS	MC3503			MC3403			MC3303			UNIT
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{IO} Input offset voltage		—	2.0	5.0	—	2.0	10	—	—	10	mV
I_{IO} Input offset current		—	30	50	—	30	50	—	—	75	nA
I_{IB} Input bias current		—	—200	—500	—	—200	—500	—	—	—500	nA
A_{VOL} Large signal open-loop voltage gain	$R_L = 2.0k\Omega$	10	200	—	10	200	—	10	200	—	V/mV
PSRR Power supply rejection ratio		—	—	150	—	—	150	—	—	150	$\mu V/V$
V_{OR} Output voltage range ⁽³⁾	$R_L = 10k\Omega$, $V_{CC} = 5.0V$, $R_L = 10k\Omega$, $5.0V \leq V_{CC} \leq 30V$	3.3	3.5	—	3.3	3.5	—	3.3	3.5	—	Vp-p
		$V_{CC} - 1.7$	$V_{CC} - 1.5$	—	$V_{CC} - 1.7$	$V_{CC} - 1.5$	—	$V_{CC} - 1.7$	$V_{CC} - 1.5$	—	
I_{CC} Power supply current		—	2.5	4.0	—	2.5	7.0	—	2.5	7.0	mA
— Channel separation	$f = 1.0kHz$ to $20kHz$ (Input referenced)	—	—120	—	—	—120	—	—	—120	—	dB

NOTE

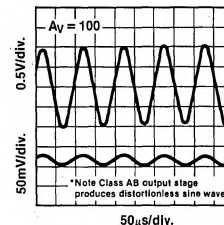
3. Output will swing to ground.

TYPICAL PERFORMANCE CURVES

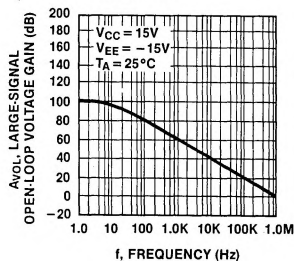
INVERTER PULSE RESPONSE



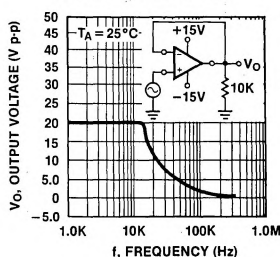
SINE WAVE RESPONSE



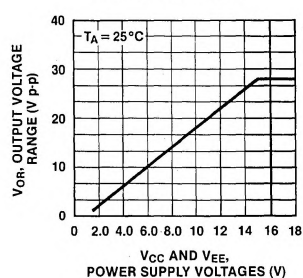
OPEN LOOP FREQUENCY RESPONSE



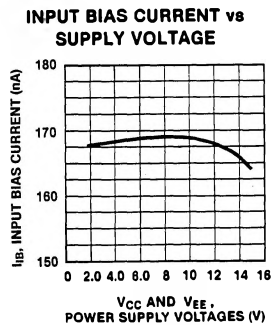
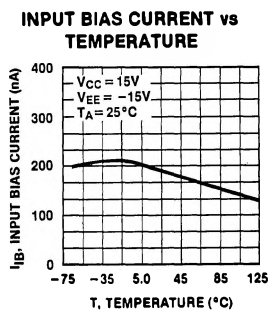
POWER BANDWIDTH



OUTPUT SWING vs SUPPLY VOLTAGE



TYPICAL PERFORMANCE CURVES (Continued)



*For additional information, consult the Applications Section.