

**MONOLITHIC OPERATIONAL AMPLIFIER**

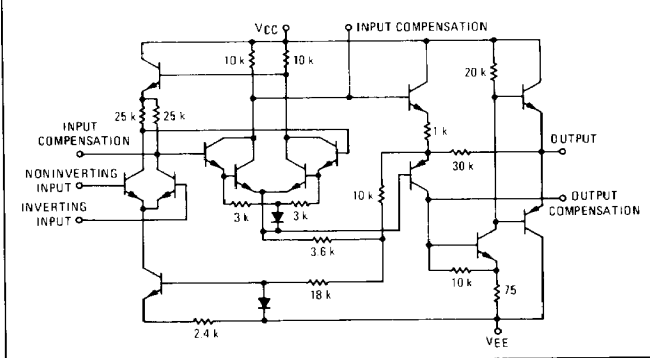
... designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

- High-Performance Open Loop Gain Characteristics  
 $A_{VOL} = 45,000$  typical
- Low Temperature Drift  $- \pm 3.0 \mu V/^{\circ}C$  typical (MC1709)
- Large Output Voltage Swing  $- \pm 14$  V typical @  $\pm 15$  V Supply
- Low Output Impedance  $- z_O = 150$  ohms typical

**MAXIMUM RATINGS** ( $T_A = +25^{\circ}C$  unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$ $V_{EE}$	+18 -18	Vdc
Input Differential Voltage Range	$V_{IDR}$	$\pm 5.0$	Volts
Input Common-Mode Range	$V_{ICR}$	$\pm 10$	Volts
Output Load Current	$I_L$	10	mA
Output Short-Circuit Duration	$t_S$	5.0	s
Power Dissipation (Package Limitation)	PD		
Metal Can		680	mW
Derate above $T_A = +25^{\circ}C$		4.6	mW/ $^{\circ}C$
Plastic Dual In-Line Packages (MC1709C only)		625	mW
Derate above $T_A = +25^{\circ}C$		5.0	mW/ $^{\circ}C$
Ceramic Dual In-Line Package		750	mW/ $^{\circ}C$
Derate above $T_A = +25^{\circ}C$		6.0	mW/ $^{\circ}C$
Operating Ambient Temperature Range	MC1709A, MC1709 MC1709C $T_A$	-55 to +125 0 to +70	$^{\circ}C$
Storage Temperature Range	$T_{stg}$	-65 to +150 -55 to +125	$^{\circ}C$

**FIGURE 1 - EQUIVALENT CIRCUIT SCHEMATIC**

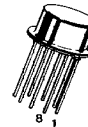
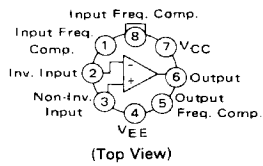


**MC1709**  
**MC1709A**  
**MC1709C**

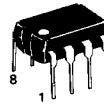
**OPERATIONAL AMPLIFIER**

**SILICON MONOLITHIC INTEGRATED CIRCUIT**

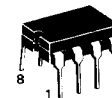
**PIN CONNECTIONS**



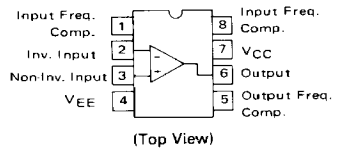
**G SUFFIX**  
**METAL PACKAGE**  
**CASE 601**



**P1 SUFFIX**  
**PLASTIC PACKAGE**  
**CASE 626**  
**(MC1709C Only)**



**U SUFFIX**  
**CERAMIC PACKAGE**  
**CASE 693**



**ORDERING INFORMATION**

Device	Temperature Range	Package
MC1709CG MC1709CU MC1709CP1	0°C to -70°C	Metal Can Ceramic DIP Plastic DIP
MC1709G,AG MC1709AU	-55°C to +125°C	Metal Can Ceramic DIP

# MC1709, MC1709A, MC1709C

## ELECTRICAL CHARACTERISTICS (unless otherwise noted, +9.0 V ≤ V<sub>CC</sub> ≤ 15 V, -9.0 V ≥ V<sub>EE</sub> ≥ -15 V, T<sub>A</sub> = 25°C)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (R <sub>S</sub> ≤ 10 kΩ)	V <sub>IO</sub>	—	0.6	2.0	—	1.0	5.0	mV
Input Offset Current	I <sub>IO</sub>	—	10	50	—	50	200	nA
Input Bias Current	I <sub>IB</sub>	—	100	200	—	200	500	nA
Input Resistance	r <sub>i</sub>	350	700	—	150	400	—	kΩ
Output Resistance	r <sub>o</sub>	—	150	—	—	150	—	Ω
Power Supply Currents (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V)	I <sub>CC</sub> /I <sub>EE</sub>	—	2.5	3.6	—	—	—	mA
Power Consumption (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V)	P <sub>C</sub>	—	75	108	—	80	165	mW
Transient Response (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V) See Figure 8								
Risetime	T <sub>RLH</sub>	—	—	1.5	—	0.3	1.0	μs
Overshoot	OS	—	—	30	—	10	30	%



## ELECTRICAL CHARACTERISTICS (unless otherwise noted, +9.0 V ≤ V<sub>CC</sub> ≤ 15 V, -9.0 V ≥ V<sub>EE</sub> ≥ -15 V, T<sub>A</sub> = -55°C to +125°C)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (R <sub>S</sub> ≤ 10 kΩ)	V <sub>IO</sub>	—	—	3.0	—	—	6.0	mV
Average Temperature Coefficient of Input Offset Voltage (R <sub>S</sub> = 50 Ω, T <sub>A</sub> = 25°C to 125°C) (R <sub>S</sub> = 50 Ω, T <sub>A</sub> = -55°C to 25°C) (R <sub>S</sub> = 50 Ω, T <sub>A</sub> = -55°C to 125°C) (R <sub>S</sub> = 10 kΩ, T <sub>A</sub> = 25°C to 125°C) (R <sub>S</sub> = 10 kΩ, T <sub>A</sub> = -55°C to 25°C) (R <sub>S</sub> = 10 kΩ, T <sub>A</sub> = -55°C to 125°C)	ΔV <sub>IO</sub> /ΔT	—	1.8	10	—	—	—	μV/°C
Input Offset Current (T <sub>A</sub> = -55°C) (T <sub>A</sub> = 125°C)	I <sub>IO</sub>	—	40	250	—	100	500	nA
Average Temperature Coefficient of Input Offset Current (T <sub>A</sub> = -55°C to 25°C) (T <sub>A</sub> = 25°C to 125°C)	ΔI <sub>IO</sub> /ΔT	—	0.45	2.8	—	—	—	nA/°C
Input Bias Current (T <sub>A</sub> = -55°C)	I <sub>IB</sub>	—	300	600	—	500	1500	nA
Input Resistance (T <sub>A</sub> = -55°C)	r <sub>i</sub>	85	170	—	40	100	—	kΩ
Input Common-Mode Voltage Range (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V)	V <sub>ICR</sub>	±8.0	±10	—	±8.0	±10	—	V
Common Mode Rejection Ratio (R <sub>S</sub> ≤ 10 kΩ)	CMRR	80	110	—	70	90	—	dB
Supply Voltage Rejection Ratio (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V, R <sub>S</sub> ≤ 10 kΩ)	PSRR	—	40	100	—	25	150	μV/V
Large Signal Voltage Gain (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V, R <sub>L</sub> ≥ 2.0 kΩ, V <sub>O</sub> = ±15 V)	A <sub>V</sub>	25	45	70	25	45	70	V/mV
Output Voltage Range (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V) (R <sub>L</sub> ≥ 10 kΩ) (R <sub>L</sub> ≥ 2.0 kΩ)	V <sub>OR</sub>	±12 ±10	±14 ±13	—	±12 ±10	±14 ±13	—	V
Power Supply Currents (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V) (T <sub>A</sub> = -55°C) (T <sub>A</sub> = 125°C)	I <sub>CC</sub> /I <sub>EE</sub>	—	2.7 2.1	4.5 3.0	—	—	—	mA
Power Consumption (V <sub>CC</sub> = 15 V, V <sub>EE</sub> = -15 V) (T <sub>A</sub> = -55°C) (T <sub>A</sub> = 125°C)	P <sub>C</sub>	—	81 63	135 90	—	—	—	mW

# MC1709, MC1709A, MC1709C

## ELECTRICAL CHARACTERISTICS (unless otherwise noted, $V_{CC} = +15\text{ V}$ , $V_{EE} = -15\text{ V}$ , $T_A = 25^\circ\text{C}$ )

Characteristic	Symbol	MC1709C			Unit
		Min	Typ	Max	
Input Offset Voltage ( $R_S \leq 10\text{ k}\Omega$ , $9.0\text{ V} \leq V_{CC} \leq 15\text{ V}$ , $-9.0\text{ V} \geq V_{EE} \geq -15\text{ V}$ )	$V_{IO}$	—	2.0	7.5	mV
Input Offset Current	$I_{IO}$	—	100	500	nA
Input Bias Current	$I_{IB}$	—	300	1500	nA
Input Resistance	$r_i$	50	250	—	k $\Omega$
Output Resistance	$r_o$	—	150	—	$\Omega$
Power Consumption	$P_C$	—	80	200	mW
Large Signal Voltage Gain ( $R_L \geq 2.0\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$ )	$A_V$	15	45	—	V/mV
Output Voltage Range ( $R_L \geq 10\text{ k}\Omega$ ) ( $R_L \geq 2.0\text{ k}\Omega$ )	$V_{OR}$	$\pm 12$ $\pm 10$	$\pm 14$ $\pm 13$	—	V
Input Common-Mode Voltage Range	$V_{ICR}$	$\pm 8.0$	$\pm 10$	—	V
Common Mode Rejection Ratio ( $R_S \leq 10\text{ k}\Omega$ )	CMRR	65	90	—	dB
Supply Voltage Rejection Ratio ( $R_S \leq 10\text{ k}\Omega$ )	PSRR	—	25	200	$\mu\text{V/V}$
Transient Response See Figure 8 Rise Time Overshoot	$t_{RLH}$ OS	—	0.3 10	—	$\mu\text{s}$ %

## ELECTRICAL CHARACTERISTICS (unless otherwise specified, $V_{CC} = +15\text{ V}$ , $V_{EE} = -15\text{ V}$ , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ )

Parameter	Symbol	MC1709C			Unit
		Min	Typ	Max	
Input Offset Voltage ( $R_S \leq 10\text{ k}\Omega$ , $9.0\text{ V} \leq V_{CC} \leq 15\text{ V}$ , $-9.0\text{ V} \geq V_{EE} \geq -15\text{ V}$ )	$V_{IO}$	—	—	10	mV
Input Offset Current	$I_{IO}$	—	—	750	nA
Input Bias Current	$I_{IB}$	—	—	2.0	$\mu\text{A}$
Large Signal Voltage Gain ( $R_L \geq 2.0\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$ )	$A_V$	12	—	—	V/mV
Input Resistance	$r_i$	35	—	—	k $\Omega$

## TYPICAL CHARACTERISTICS

FIGURE 2 – TEST CIRCUIT  
( $V_{CC} = +15\text{ Vdc}$ ,  $V_{EE} = -15\text{ Vdc}$ ,  $T_A = +25^\circ\text{C}$ )

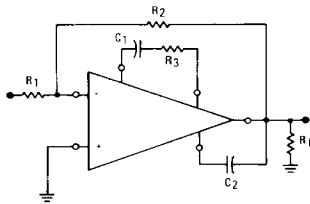


Fig. No.	Curve No.	Test Conditions				
		$R_1 (\Omega)$	$R_2 (\Omega)$	$R_3 (\Omega)$	$C_1 (\text{pF})$	$C_2 (\text{pF})$
3	1	10 k	10 k	1.5 k	5.0 k	200
	2	10 k	100 k	1.5 k	500	20
	3	10 k	1.0 M	1.5 k	100	3.0
	4	1.0 k	1.0 M	0	10	3.0
4	1	1.0 k	1.0 M	0	10	3.0
	2	10 k	1.0 M	1.5 k	100	3.0
	3	10 k	100 k	1.5 k	500	20
	4	10 k	10 k	1.5 k	5.0 k	200
5	1	0	$\infty$	1.5 k	5.0 k	200
	2	0	$\infty$	1.5 k	500	20
	3	0	$\infty$	1.5 k	100	3.0
	4	0	$\infty$	0	10	3.0

# MC1709, MC1709A, MC1709C

FIGURE 3 – LARGE SIGNAL SWING versus FREQUENCY

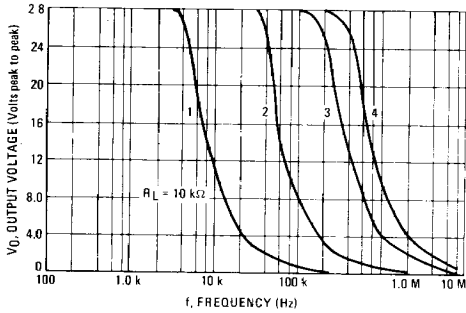


FIGURE 4 – CLOSED LOOP VOLTAGE GAIN versus FREQUENCY

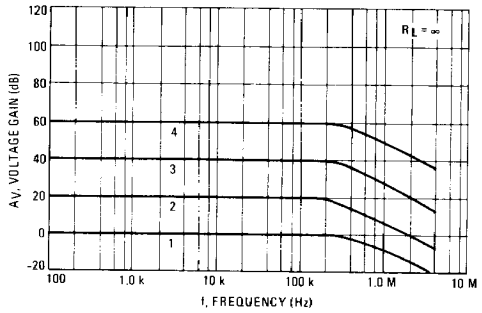


FIGURE 5 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

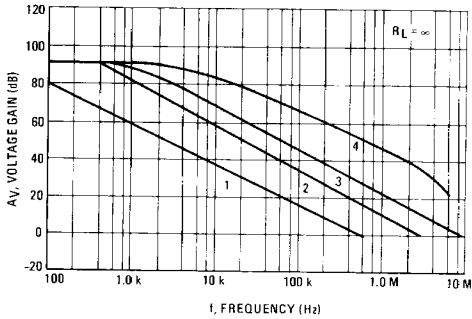


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

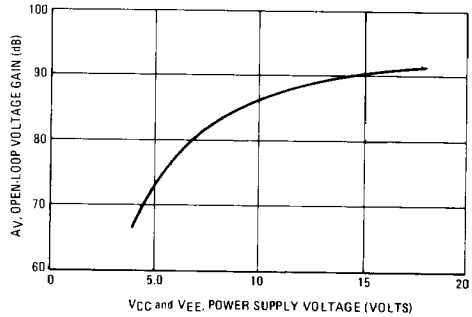


FIGURE 7 – SLEW RATE versus CLOSED LOOP GAIN USING RECOMMENDED COMPENSATION NETWORKS

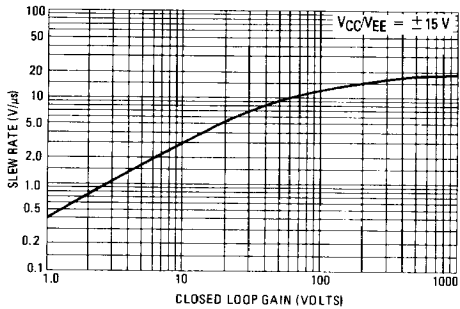


FIGURE 8 – TRANSIENT RESPONSE TEST CIRCUIT

