

MONOLITHIC OPERATIONAL AMPLIFIER

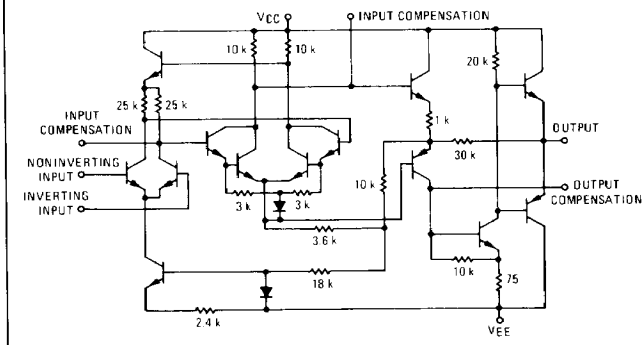
... designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

- 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}	± 5.0	Volts
Input Common-Mode Range	V_{ICR}	± 10	Volts
Output Load Current	I_L	10	mA
Output Short-Circuit Duration	t_S	5.0	s
Power Dissipation (Package Limitation)	P_D		
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
Derate above $T_A = +25^{\circ}C$		6.0	mW/ $^{\circ}C$
Operating Ambient Temperature Range	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

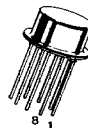
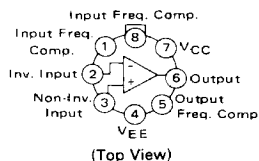


MC1709
MC1709A
MC1709C

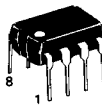
OPERATIONAL AMPLIFIER

SILICON MONOLITHIC
INTEGRATED CIRCUIT

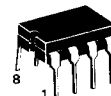
PIN CONNECTIONS



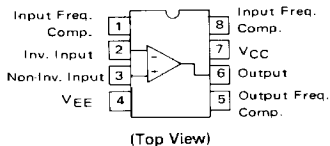
G SUFFIX
METAL PACKAGE
CASE 601



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, $+9.0\text{ V} \leq V_{CC} \leq 15\text{ V}$, $-9.0\text{ V} \geq V_{EE} \geq -15\text{ V}$, $T_A = 25^\circ\text{C}$)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage ($R_S \leq 10\text{ k}\Omega$)	V_{IO}	—	0.6	2.0	—	1.0	5.0	mV
Input Offset Current	I_{IO}	—	10	50	—	50	200	nA
Input Bias Current	I_{IB}	—	100	200	—	200	500	nA
Input Resistance	r_i	350	700	—	150	400	—	$\text{k}\Omega$
Output Resistance	r_o	—	150	—	—	150	—	Ω
Power Supply Currents ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$)	I_{CC}/I_{EE}	—	2.5	3.6	—	—	—	mA
Power Consumption ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$)	P_C	—	75	108	—	80	165	mW
Transient Response ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$) See Figure 8								
Risetime	t_{RLH}	—	—	1.5	—	0.3	1.0	μs
Overshoot	OS	—	—	30	—	10	30	%

ELECTRICAL CHARACTERISTICS (unless otherwise noted, $+9.0\text{ V} \leq V_{CC} \leq 15\text{ V}$, $-9.0\text{ V} \geq V_{EE} \geq -15\text{ V}$, $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage ($R_S \leq 10\text{ k}\Omega$)	V_{IO}	—	—	3.0	—	—	6.0	mV
Average Temperature Coefficient of Input Offset Voltage ($R_S = 50\text{ }\Omega$, $T_A = 25^\circ\text{C}$ to 125°C) ($R_S = 50\text{ }\Omega$, $T_A = -55^\circ\text{C}$ to 25°C) ($R_S = 50\text{ }\Omega$, $T_A = -55^\circ\text{C}$ to 125°C) ($R_S = 10\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ to 125°C) ($R_S = 10\text{ k}\Omega$, $T_A = -55^\circ\text{C}$ to 25°C) ($R_S = 10\text{ k}\Omega$, $T_A = -55^\circ\text{C}$ to 125°C)	$\Delta V_{IO}/\Delta T$	—	1.8 1.8 — 2.0 4.8 —	10 10 — 15 25 —	— — — — — —	— — 3.0 — — 6.0	— — — — — —	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ($T_A = -55^\circ\text{C}$) ($T_A = 125^\circ\text{C}$)	I_{IO}	— —	40 3.5	250 50	— —	100 20	500 200	nA
Average Temperature Coefficient of Input Offset Current ($T_A = -55^\circ\text{C}$ to 25°C) ($T_A = 25^\circ\text{C}$ to 125°C)	$\Delta I_{IO}/\Delta T$	— —	0.45 0.08	2.8 0.5	— —	— —	— —	nA/ $^\circ\text{C}$
Input Bias Current ($T_A = -55^\circ\text{C}$)	I_{IB}	—	300	600	—	500	1500	nA
Input Resistance ($T_A = -55^\circ\text{C}$)	r_i	85	170	—	40	100	—	$\text{k}\Omega$
Input Common-Mode Voltage Range ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$)	V_{ICR}	± 8.0	± 10	—	± 8.0	± 10	—	V
Common Mode Rejection Ratio ($R_S \leq 10\text{ k}\Omega$)	CMRR	80	110	—	70	90	—	dB
Supply Voltage Rejection Ratio ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$, $R_S \leq 10\text{ k}\Omega$)	PSRR	—	40	100	—	25	150	$\mu\text{V}/\text{V}$
Large Signal Voltage Gain ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$, $R_L \geq 2.0\text{ k}\Omega$, $V_O = \pm 15\text{ V}$)	A_V	25	45	70	25	45	70	V/mV
Output Voltage Range ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$) ($R_L \geq 10\text{ k}\Omega$) ($R_L \geq 2.0\text{ k}\Omega$)	V_{OR}	— ± 12 ± 10	— ± 14 ± 13	— — —	— ± 12 ± 10	— ± 14 ± 13	— — —	V
Power Supply Currents ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$) ($T_A = -55^\circ\text{C}$) ($T_A = 125^\circ\text{C}$)	I_{CC}/I_{EE}	— —	2.7 2.1	4.5 3.0	— —	— —	— —	mA
Power Consumption ($V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$) ($T_A = -55^\circ\text{C}$) ($T_A = 125^\circ\text{C}$)	P_C	— —	81 63	135 90	— —	— —	— —	mW

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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 Ω
Output Resistance	r_o	—	150	—	Ω
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}	± 12 ± 10	± 14 ± 13	— —	V
Input Common-Mode Voltage Range	V_{ICR}	± 8.0	± 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_{LH} OS	— —	0.3 10	— —	μs %

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

TYPICAL CHARACTERISTICS

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

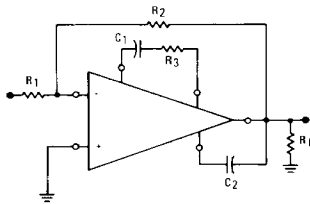


Fig. No.	Curve No.	Test Conditions				
		$R_1(\Omega)$	$R_2(\Omega)$	$R_3(\Omega)$	$C_1(\text{pF})$	$C_2(\text{pF})$
3	1	10 k	10 k	1.5 k	5.0 k	200
	2	10 k	100 k	1.5 k	500	20
	3	10 k	1.0 M	1.5 k	100	3.0
	4	1.0 k	1.0 M	0	10	3.0
4	1	1.0 k	1.0 M	0	10	3.0
	2	10 k	1.0 M	1.5 k	100	3.0
	3	10 k	100 k	1.5 k	500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

MC1709, MC1709A, MC1709C

FIGURE 3 – LARGE SIGNAL SWING versus FREQUENCY

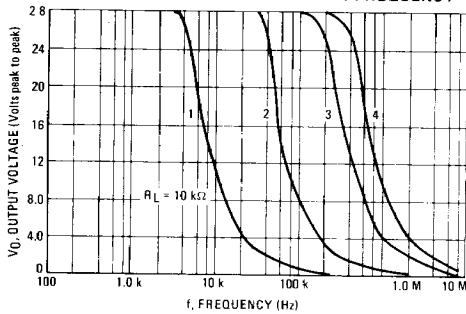


FIGURE 4 – CLOSED LOOP VOLTAGE GAIN versus FREQUENCY

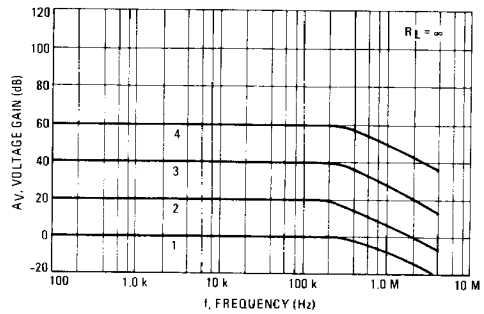


FIGURE 5 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

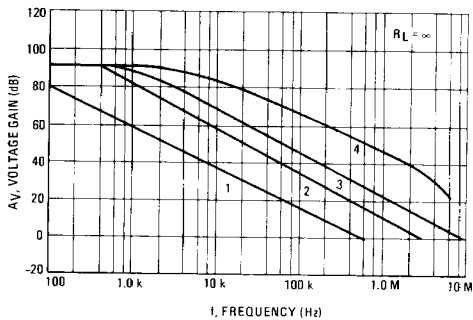


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

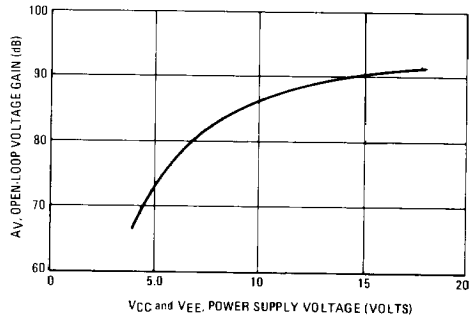


FIGURE 7 – SLEW RATE versus CLOSED LOOP GAIN USING RECOMMENDED COMPENSATION NETWORKS

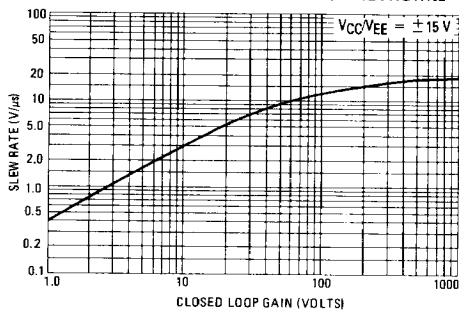


FIGURE 8 – TRANSIENT RESPONSE TEST CIRCUIT

