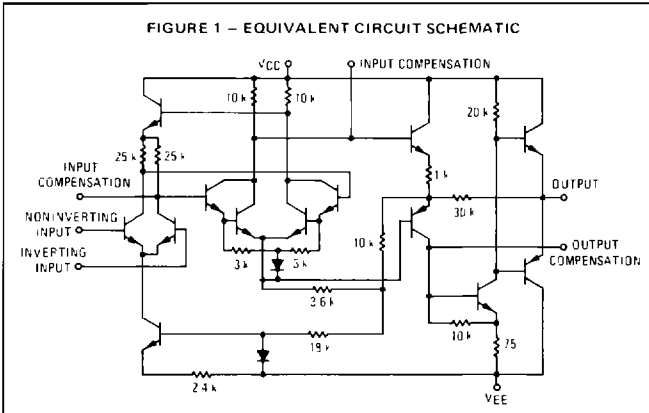| MC1709 |
| MC1709A |
| MC1709C |

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 — $\pm 3.0 \mu V/^{o}C$ typical (MC1709)
- Large Output Voltage Swing — ± 14 V typical @ ± 15 V Supply
- Low Output Impedance — z_O = 150 ohms typical

OPERATIONAL AMPLIFIER

**SILICON MONOLITHIC
INTEGRATED CIRCUIT**

PIN CONNECTIONS

(Top View)
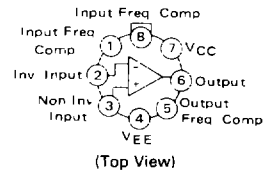
G SUFFIX
METAL PACKAGE
CASE 601

MAXIMUM RATINGS (T_A = +25°C unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+18	Vdc
	V_{EE}	−18	
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°C		4.6	mW/°C
Plastic Dual In-Line Packages (MC1709C only)		625	mW
Derate above T_A = +25°C		5.0	mW/°C
Ceramic Dual In-Line Package		750	mW/°C
Derate above T_A = +25°C		6.0	mW/°C
Operating Ambient MC1709A, MC1709	T_A	−55 to +125	°C
Temperature Range MC1709C		0 to +70	
Storage Temperature Range	T_{stg}		°C
Metal and Ceramic Packages		−65 to +150	
Plastic Packages		−55 to +125	

P1 SUFFIX
PLASTIC PACKAGE
CASE 626
(MC1709C Only)
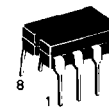
U SUFFIX
CERAMIC PACKAGE
CASE 693

FIGURE 1 – EQUIVALENT CIRCUIT SCHEMATIC

(Top View)
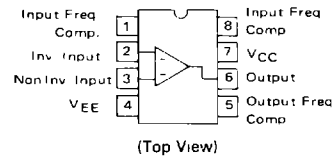
ORDERING INFORMATION

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

MC1709, MC1709A, MC1709C

2

ELECTRICAL CHARACTERISTICS (unless otherwise noted, +9.0 V ≤ V$_{CC}$ ≤ 15 V, −9.0 V ≥ V$_{EE}$ ≥ −15 V, T$_A$ = 25°C)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (R$_S$ ≤ 10 kΩ)	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	−	kΩ
Output Resistance	r$_o$	−	150	−	−	150	−	Ω
Power Supply Currents (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V)	I$_{CC}$, I$_{EE}$	−	2.5	3.6	−	−	−	mA
Power Consumption (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V)	P$_C$	−	75	108	−	80	165	mW
Transient Response (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V) See Figure 8								
Risetime	t$_{TLH}$	−	−	1.5	−	0.3	1.0	μs
Overshoot	OS	--	−	30	−	10	30	%

ELECTRICAL CHARACTERISTICS (unless otherwise noted, +9.0 V ≤ V$_{CC}$ ≤ 15 V, −9.0 V ≥ V$_{EE}$ ≥ −15 V, T$_A$ = −55°C to +125°C)

Characteristic	Symbol	MC1709A			MC1709			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (R$_S$ ≤ 10 kΩ)	V$_{IO}$	−	−	3.0	−	−	6.0	mV
Average Temperature Coefficient of Input Offset Voltage	−V$_{IO}$/T							μV/°C
(R$_S$ = 50 Ω, T$_A$ = 25°C to 125°C)		−	1.8	10	−	−	−	
(R$_S$ = 50 Ω, T$_A$ = −55°C to 25°C)		−	1.8	10	−	−	−	
(R$_S$ = 50 Ω, T$_A$ = −55°C to 125°C)		--	−	−	−	3.0	−	
(R$_S$ = 10 kΩ, T$_A$ = 25°C to 125°C)		−	2.0	15	−	−	−	
(R$_S$ = 10 kΩ, T$_A$ = −55°C to 25°C)		−	4.8	25	−	−	−	
(R$_S$ = 10 kΩ, T$_A$ = −55°C to 125°C)		−	−	−	−	6.0	−	
Input Offset Current	I$_{IO}$							nA
(T$_A$ = −55°C)		−	40	250	−	100	500	
(T$_A$ = 125°C)		−	3.5	50	−	20	200	
Average Temperature Coefficient of Input Offset Current	I$_{IO}$/T							nA/°C
(T$_A$ = −55°C to 25°C)		−	0.45	2.8	−	−	−	
(T$_A$ = 25°C to 125°C)		−	0.08	0.5	−	−	−	
Input Bias Current (T$_A$ = −55°C)	I$_{IB}$	−	300	600	−	500	1500	nA
Input Resistance (T$_A$ = −55°C)	r$_i$	85	170	−	40	100	−	kΩ
Input Common-Mode Voltage Range (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V)	V$_{ICR}$	±8.0	±10	−	±8.0	±10	−	V
Common Mode Rejection Ratio (R$_S$ ≤ 10 kΩ)	CMRR	80	110	--	70	90	−	dB
Supply Voltage Rejection Ratio (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V, R$_S$ ≤ 10 kΩ)	PSRR	−	40	100	−	25	150	μV/V
Large Signal Voltage Gain (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V, R$_L$ ≥ 2.0 kΩ, V$_O$ = ±15 V)	A$_V$	25	45	70	25	45	70	V/mV
Output Voltage Range (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V)	V$_{OR}$							V
(R$_L$ ≥ 10 kΩ)		±12	±14	−	±12	±14	−	
(R$_L$ ≥ 2.0 kΩ)		±10	±13	−	±10	±13	−	
Power Supply Currents (V$_{CC}$ = 15 V, V$_{EE}$ = −15 V)	I$_{CC}$/I$_{EE}$							mA
(T$_A$ = −55°C)		−	2.7	4.5	−	−	−	
(T$_A$ = 125°C)		−	2.1	3.0	−	−	−	
Power Consumption (V$_{CC}$ = 15, V$_{EE}$ = −15 V)	P$_C$							mW
(T$_A$ = −55°C)		−	81	135	−	−	−	
(T$_A$ = 125°C)		−	63	90	−	−	−	

ELECTRICAL CHARACTERISTICS (unless otherwise noted, V_{CC} = + 15 V, V_{EE} = − 15 V, T_A = 25°C)

Characteristic	Symbol	MC1709C			Unit
		Min	Typ	Max	
Input Offset Voltage (R_S ≤ 10 kΩ, 9.0 V ≤ 15 V, −9.0 V ≥ V_{EE} ≥ -15 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	−	kΩ
Output Resistance	r_O	−	150	−	Ω
Power Consumption	P_C	−	80	200	mW
Large Signal Voltage Gain (R_L ⩾ 2.0 kΩ, V_O = ±10 V)	A_V	15	45	−	V/mV
Output Voltage Range	V_{OR}				V
(R_L ⩾ 10 kΩ)		±12	±14	−	
(R_L ⩾ 2.0 kΩ)		±10	±13	−	
Input Common-Mode Voltage Range	V_{ICR}	±8.0	±10	−	V
Common Mode Rejection Ratio (R_S ≤ 10 kΩ)	CMRR	65	90	−	dB
Supply Voltage Rejection Ratio (R_S ≤ 10 kΩ)	PSRR	−	25	200	μV/V
Transient Response See Figure 8 Rise Time Overshoot	 t_{TLH} OS	 − −	 0.3 10	 − −	 μs %

ELECTRICAL CHARACTERISTICS (unless otherwise specified, V_{CC} = + 15 V, V_{EE} = − 15 V, T_A = 0°C to 70°C)

Parameter	Symbol	MC1709C			Unit
		Min	Typ	Max	
Input Offset Voltage (R_S ≤ 10 kΩ, 9.0 V ≤ V_{CC} ≤ 15 V, −9.0 V ≥ V_{EE} ≥ 15 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 ⩾ 2.0 kΩ, V_O = ±10 V)	A_V	12	−	−	V/mV
Input Resistance	r_i	35	−	−	kΩ

TYPICAL CHARACTERISTICS

FIGURE 2 – TEST CIRCUIT

(V_{CC} = +15 Vdc, V_{EE} = -15 Vdc, T_A = +25°C)
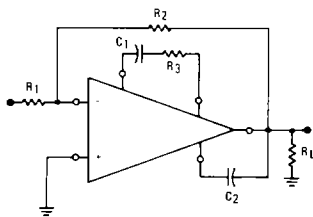
Fig. No.	Curve No.	Test Conditions				
		R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	C_1 (pF)	C_2 (pF)
3	1	10 k	10 k	1.5 k	5.0 k	200
	2	10 k	100 k	1.5 k	500	20
	3	10 k	1.0 M	1.5 k	100	3.0
	4	1.0 k	1.0 M	0	10	3.0
4	1	1.0 k	1.0 M	0	10	3.0
	2	10 k	1.0 M	1.5 k	100	3.0
	3	10 k	100 k	1.5 k	500	20
	4	10 k	10 k	1.5 k	5.0 k	200
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

FIGURE 3 — LARGE SIGNAL SWING versus FREQUENCY
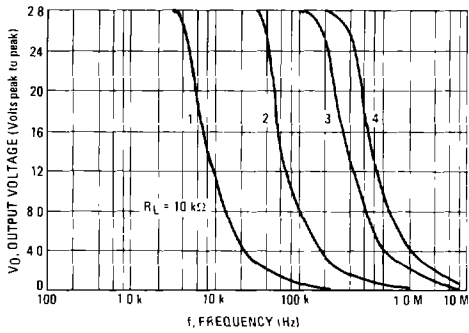

FIGURE 4 — CLOSED LOOP VOLTAGE GAIN versus FREQUENCY
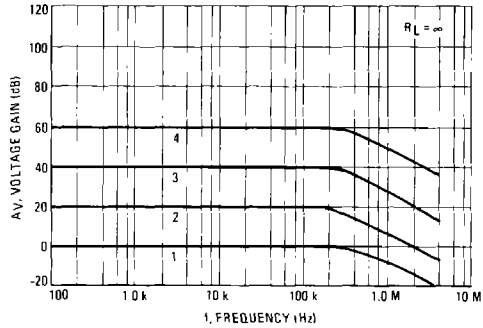

FIGURE 5 — OPEN LOOP VOLTAGE GAIN versus FREQUENCY
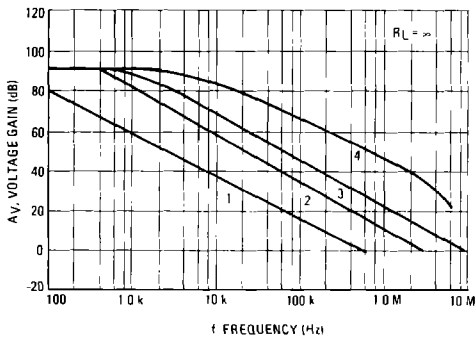

FIGURE 6 — VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

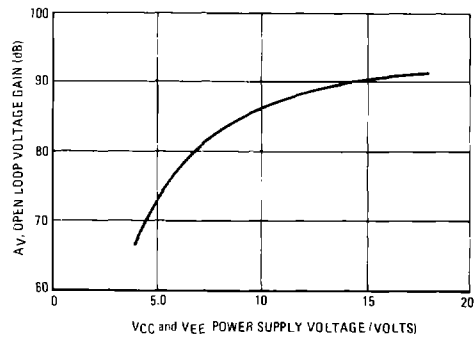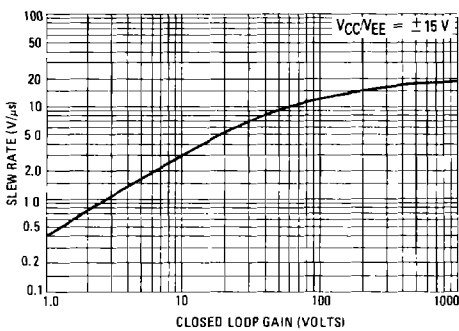**FIGURE 7 — SLEW RATE versus CLOSED LOOP GAIN USING RECOMMENDED COMPENSATION NETWORKS**

FIGURE 8 — TRANSIENT RESPONSE TEST CIRCUIT