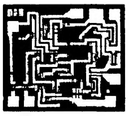
MC1709
MC1709C

OPERATIONAL AMPLIFIERS

MONOLITHIC OPERATIONAL AMPLIFIER

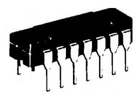


. . . designed for use as a summing amplifier, integrator, or amplifier with operating characteristics as a function of the external feedback components.

- High-Performance Open Loop Gain Characteristics
  A_{VOL} = 45,000 typical
- Low Temperature Drift – ±3.0 μV/°C
- Large Output Voltage Swing – ±14 V typical @ ±15 V Supply
- Low Output Impedance – Z_{out} = 150 ohms typical

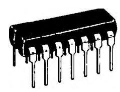
OPERATIONAL AMPLIFIER INTEGRATED CIRCUIT
MONOLITHIC SILICON

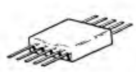
G SUFFIX
METAL PACKAGE
CASE 601
TO-99



L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116

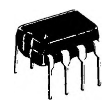
P2 SUFFIX
PLASTIC PACKAGE
CASE 605
TO 116
(MC1709C only)





F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

P1 SUFFIX
PLASTIC PACKAGE
CASE 626
(MC1709C only)



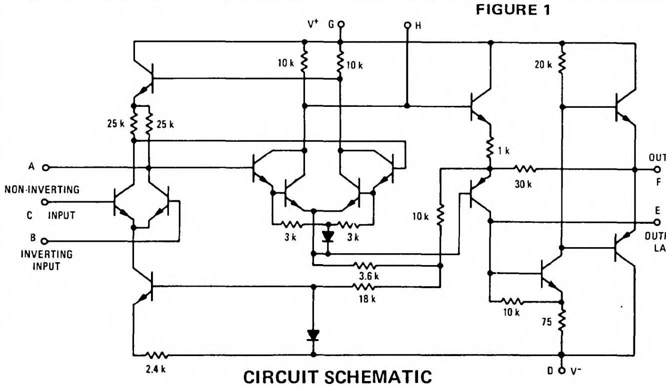
PIN CONNECTIONS

Schematic	A	B	C	D	E	F	G	H
"G" & "P1" Packages	1	2	3	4	5	6	7	8
"F" Package	2	3	4	5	6	7	8	9
"P2" & "L" Packages	3	4	5	6	9	10	11	12

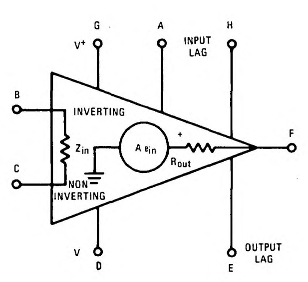
MAXIMUM RATINGS (T_A = +25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+18 -18	Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	$\pm V^+$	Volts
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
Flat Package		500	mW
Derate above T_A = +25°C		3.3	mW/°C
Plastic Dual In-Line Packages		625	mW
Derate above T_A = +25°C		5.0	mW/°C
Ceramic Dual In-Line Package		750	mW
Derate above T_A = +25°C		6.0	mW/°C
Operating Temperature Range MC1709 MC1709C	T_A	-55 to +125 0 to +75	°C
Storage Temperature Range	T_{stg}		°C
Metal and Ceramic Packages		-65 to +150	
Plastic Packages		-55 to +125	

FIGURE 1



CIRCUIT SCHEMATIC



EQUIVALENT CIRCUIT

See Packaging Information Section for outline dimensions.

ELECTRICAL CHARACTERISTICS (V^+ = +15 Vdc, V^- = −15 Vdc, T_A = +25°C unless otherwise noted)

Characteristic	Symbol	MC1709 Min	MC1709 Typ	MC1709 Max	MC1709C Min	MC1709C Typ	MC1709C Max	Unit
Open Loop Voltage Gain (R_L = 2.0 kΩ) (V_o = ±10 V, T_A = T_{low} to T_{high}) ②	A_{VOL}	25,000	45,000	70,000	15,000	45,000	–	–
Output Impedance (f = 20 Hz)	Z_{out}	–	150	–	–	150	–	Ω
Input Impedance (f = 20 Hz)	Z_{in}	150	400	–	50	250	–	kΩ
Output Voltage Swing (R_L = 10 kΩ)	V_o	±12	±14	–	±12	±14	–	V_{peak}
(R_L = 2.0 kΩ)		±10	±13	–	±10	±13	–	
Input Common-Mode Voltage Swing	CMV_{in}	±8	±10	–	±8.0	±10	–	V_{peak}
Common-Mode Rejection Ratio (f = 20 Hz)	CM_{rej}	70	90	–	65	90	–	dB
Input Bias Current (T_A = +25°C)	I_b	–	0.2	0.5	–	0.3	1.5	µA
(T_A = T_{low})		–	0.5	1.5	–	–	2.0	
Input Offset Current (T_A = +25°C)	$\|I_{io}\|$	–	0.05	0.2	–	0.1	0.5	µA
(T_A = T_{low})		–	–	0.5	–	–	0.75	
(T_A = T_{high})		–	–	0.2	–	–	0.75	
Input Offset Voltage (T_A = +25°C)	$\|V_{io}\|$	–	1.0	5.0	–	2.0	7.5	mV
(T_A = T_{low} to T_{high})		–	–	6.0	–	–	10	
Step Response								
Gain = 100, 5.0% overshoot, R_1 = 1.0 kΩ, R_2 = 100 kΩ, R_3 = 1.5 kΩ, C_1 = 100 pF, C_2 = 3.0 pF	t_f	–	0.8	–	–	0.8	–	µs
	t_{pd}	–	0.38	–	–	0.38	–	µs
	dV_{out}/dt ①	–	12	–	–	12	–	V/µs
Gain = 10, 10% overshoot, R_1 = 1.0 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 500 pF, C_2 = 20 pF	t_f	–	0.6	–	–	0.6	–	µs
	t_{pd}	–	0.34	–	–	0.34	–	µs
	dV_{out}/dt ①	–	1.7	–	–	1.7	–	V/µs
Gain = 1, 5.0% overshoot, R_1 = 10 kΩ, R_2 = 10 kΩ, R_3 = 1.5 kΩ, C_1 = 5000 pF, C_2 = 200 pF	t_f	–	2.2	–	–	2.2	–	µs
	t_{pd}	–	1.3	–	–	1.3	–	µs
	dV_{out}/dt ①	–	0.25	–	–	0.25	–	V/µs
Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = T_{low} to T_{high})	$\|TC_{Vio}\|$	–	3.0	–	–	3.0	–	µV/°C
(R_S ≤ 10 kΩ, T_A = T_{low} to T_{high})		–	6.0	–	–	6.0	–	
DC Power Dissipation (Power Supply = ±15 V, V_o = 0)	P_D	–	80	165	–	80	200	mW
Positive Supply Sensitivity (V^- constant)	S^+	–	25	150	–	25	200	µV/V
Negative Supply Sensitivity (V^+ constant)	S^-	–	25	150	–	25	200	µV/V

① dV_{out}/dt = Slew Rate

② T_{high} = +75°C for MC1709C, +125°C for MC1709; T_{low} = 0°C for MC1709C, −55°C for MC1709

TYPICAL CHARACTERISTICS

FIGURE 2 — TEST CIRCUIT
V^+ = +15 Vdc, V^- = −15 Vdc, T_A = +25°C

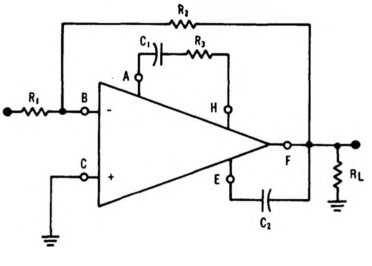


Fig. No.	Curve No.	R_1 (Ω)	R_2 (Ω)	R_3 (Ω)	C_1 (pF)	C_2 (pF)
3	1	10 k	10 k	1.5 k	5.0 k	200
	2	10 k	100 k	1.5 k	500	20
	3	10 k	1.0 M	1.5 k	100	3.0
	4	1.0 k	1.0 M	0	10	3.0
4	1	1.0 k	1.0 M	0	10	3.0
	2	10 k	1.0 M	1.5 k	100	3.0
	3	10 k	100 k	1.5 k	500	20
	4	10 k	10 k	1.5 k	5.0 k	200
5	1	0	∞	1.5 k	5.0 k	200
	2	0	∞	1.5 k	500	20
	3	0	∞	1.5 k	100	3.0
	4	0	∞	0	10	3.0

TYPICAL CHARACTERISTICS (continued)

(V^+ = +15 Vdc, V^- = -15 Vdc, T_A = +25°C unless otherwise noted.)

FIGURE 3 – LARGE SIGNAL SWING versus FREQUENCY

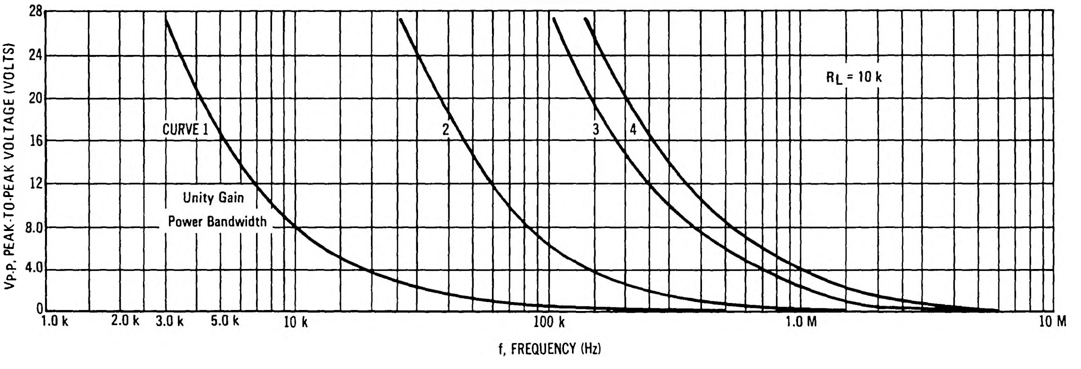


FIGURE 4 – VOLTAGE GAIN versus FREQUENCY

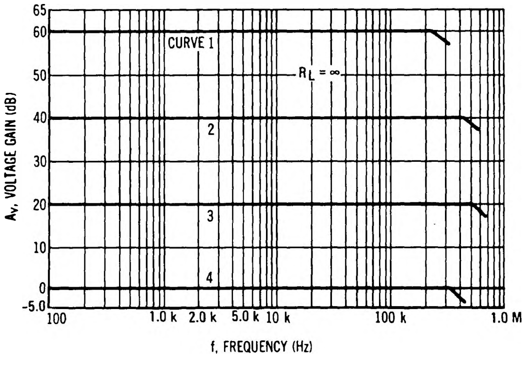


FIGURE 5 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

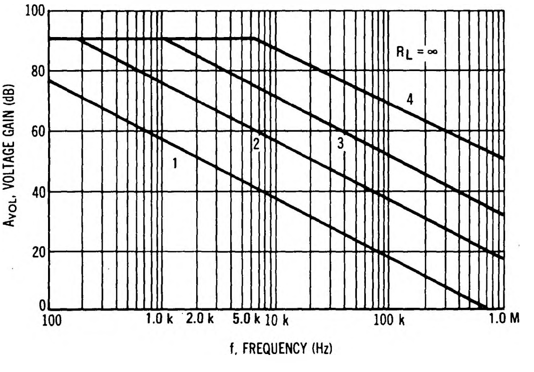


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

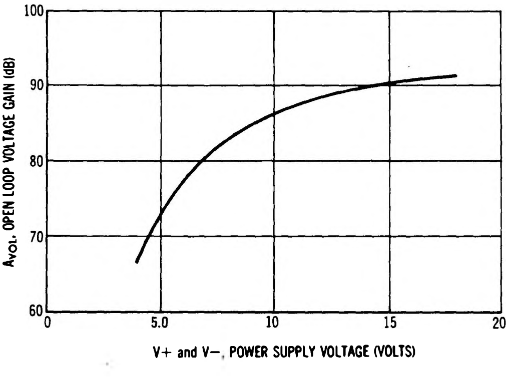
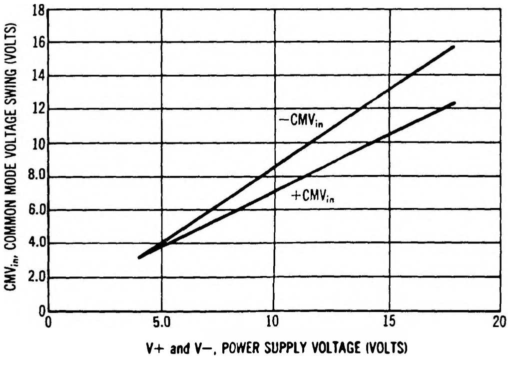


FIGURE 7 – COMMON SWING versus POWER SUPPLY VOLTAGE



TYPICAL CHARACTERISTICS (continued)

(V^+ = +15 Vdc, V^- = −15 Vdc, T_A = +25°C unless otherwise noted.)

FIGURE 8 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

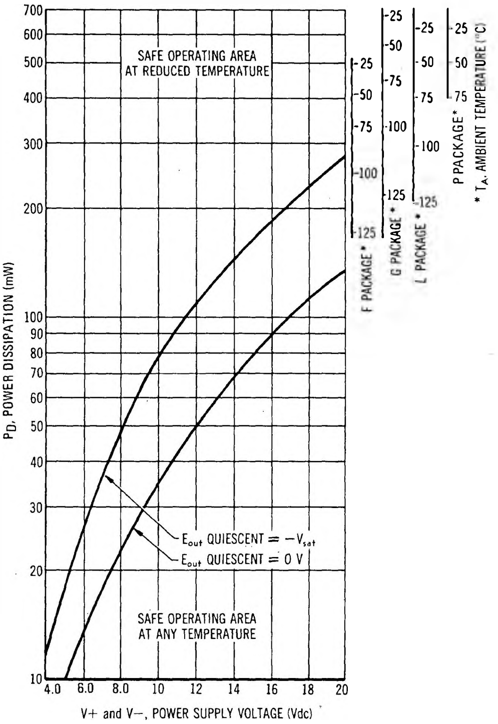


FIGURE 9 – INPUT OFFSET VOLTAGE versus TEMPERATURE

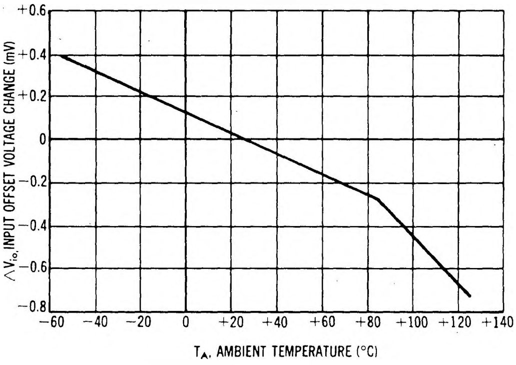
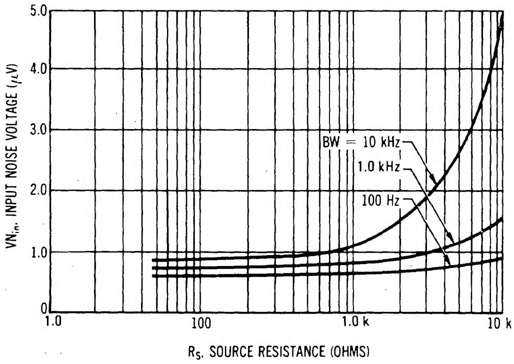


FIGURE 10 – INPUT NOISE VOLTAGE versus SOURCE RESISTANCE



See current MCC1709/1709C data sheet for standard linear chip information.

See current MCBC1709/MCB1709F data sheet for Beam-Lead device information.