

μA709AM, μA709M, μA709C **GENERAL-PURPOSE OPERATIONAL AMPLIFIERS**

D942, FEBRUARY 1971 - REVISED MAY 1988

- **Common-Mode Input Range** . . . ± 10 V Typical
- **Designed to be Interchangeable with Fairchild**
μA709A, μA709, and μA709C
- **Maximum Peak-to-Peak Output Voltage**
Swing . . . 28-V Typical with 15-V Supplies

description

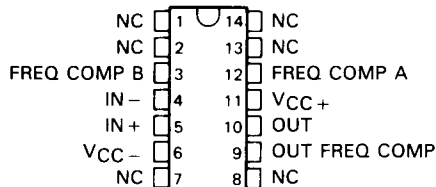
These circuits are general-purpose operational amplifiers, each having high-impedance differential inputs and a low-impedance output. Component matching, inherent with silicon monolithic circuit-fabrication techniques, produces an amplifier with low-drift and low-offset characteristics. Provisions are incorporated within the circuit whereby external components may be used to compensate the amplifier for stable operation under various feedback or load conditions. These amplifiers are particularly useful for applications requiring transfer or generation of linear or nonlinear functions.

The μA709A circuit features improved offset characteristics, reduced input-current requirements, and lower power dissipation when compared to the μA709 circuit. In addition, maximum values of the average temperature coefficients of offset voltage and current are specified for the μA709A.

The μA709AM and μA709M are characterized for operation over the full military temperature range of -55°C to 125°C . The μA709C is characterized for operation from 0°C to 70°C .

μA709AM, μA709M . . . J OR W PACKAGE

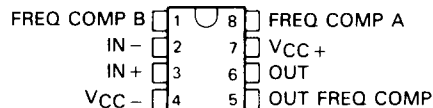
(TOP VIEW)



μA709AM, μA709M . . . JG PACKAGE

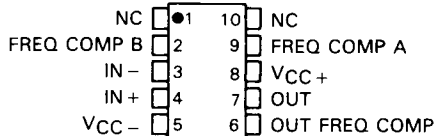
μA709C . . . D, JG, OR P PACKAGE

(TOP VIEW)



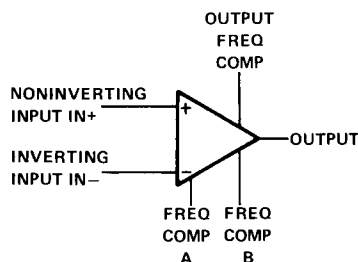
μA709AM, μA709M . . . U FLAT PACKAGE

(TOP VIEW)



NC—No internal connection

symbol



AVAILABLE OPTIONS

T _A	V _{IO} MAX AT 25°C	PACKAGE					
		SMALL OUTLINE (D)	CERAMIC (J)	CERAMIC DIP (JG)	PLASTIC DIP (P)	FLAT PACK (U)	FLAT PACK (W)
0°C to 70°C	7.5 mV	μA709CD	—	μA709CJG	μA709CP	—	—
-55°C to 125°C	5 mV	—	μA709MJ	μA709MJG	—	μA709MU	μA709MW
	2 mV	—	μA709AMJ	μA709AMJG	—	μA709AMU	μA709AMW

The D package is available taped and reeled. Add the suffix R to the device type when ordering, (e.g., μA709CDR).

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

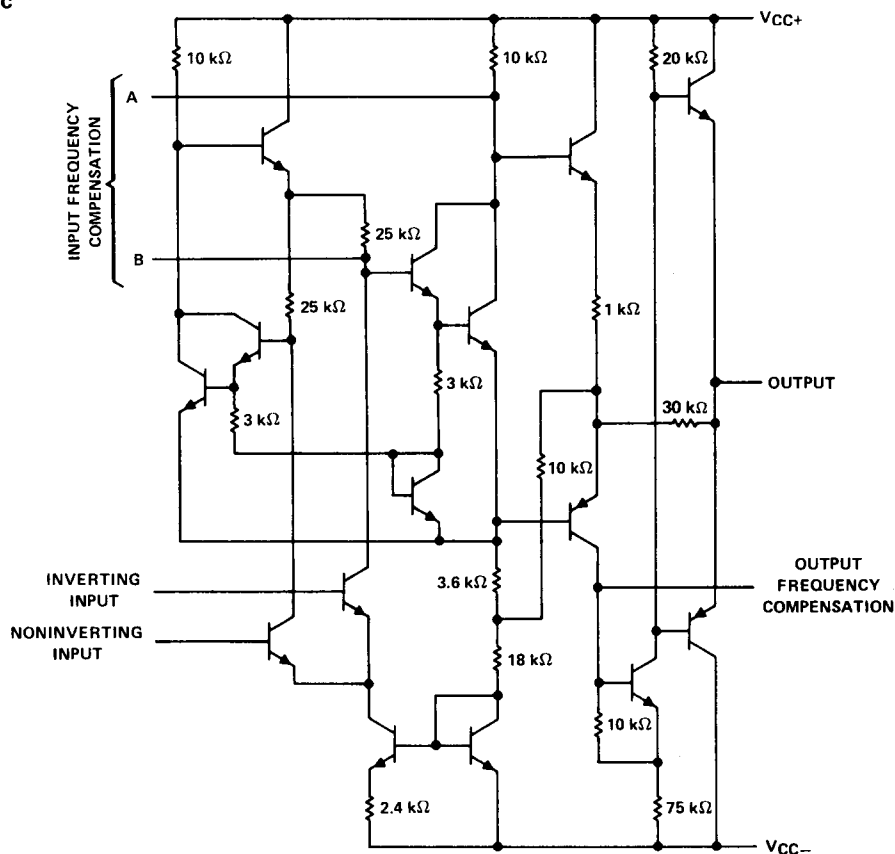
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uA709AM, uA709M, uA709C **GENERAL-PURPOSE OPERATIONAL AMPLIFIERS**

schematic



Component values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	uA709AM uA709M	uA709C	UNIT
Supply voltage V_{CC+} (see Note 1)	18	18	V
Supply voltage V_{CC-} (see Note 1)	-18	-18	V
Differential input voltage (see Note 2)	± 5	± 5	V
Input voltage (either input, see Notes 1 and 3)	± 10	± 10	V
Duration of output short-circuit (see Note 4)	5	5	s
Continuous total dissipation	See Dissipation Rating Table		
Operating free-air temperature range	-55 to 125	0 to 70	°C
Storage temperature range	-65 to 150	-65 to 150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or P package		260

- NOTES: 1. All voltage values, unless otherwise noted, are with respect to the midpoint between V_{CC+} and V_{CC-} .
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 10 V, whichever is less.
4. The output may be shorted to ground or either power supply.



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GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	300 mW	N/A	N/A	300 mW	N/A
J (uA709__M)	300 mW	11.0 mW/ $^\circ\text{C}$	123 $^\circ\text{C}$	300 mW	275 mW
JG (uA709__M)	300 mW	8.4 mW/ $^\circ\text{C}$	114 $^\circ\text{C}$	300 mW	210 mW
JG (uA709C)	300 mW	N/A	N/A	300 mW	N/A
P	300 mW	N/A	N/A	300 mW	N/A
U	300 mW	5.4 mW/ $^\circ\text{C}$	94 $^\circ\text{C}$	300 mW	135 mW
W	300 mW	8.0 mW/ $^\circ\text{C}$	113 $^\circ\text{C}$	300 mW	200 mW

electrical characteristics at specified free-air temperature, $V_{CC} \pm = \pm 9\text{ V}$ to $\pm 15\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS [†]			uA709AM			uA709M			UNIT
				MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
V_{IO} Input offset voltage	$V_O = 0$	$R_S \leq 10\text{ k}\Omega$	25 $^\circ\text{C}$		0.6	2		1	5	mV
			Full range			3			6	
α_{VIO} Average temperature coefficient of input offset voltage	$V_O = 0$, $R_S = 50\ \Omega$		Full range		1.8	10		3		$\mu\text{V}/^\circ\text{C}$
	$V_O = 0$, $R_S = 10\text{ k}\Omega$		Full range		4.8	25		6		
I_{IO} Input offset current	$V_O = 0$		25 $^\circ\text{C}$		10	50		50	200	nA
			-55 $^\circ\text{C}$		40	250		100	500	
			125 $^\circ\text{C}$		3.5	50		20	200	
α_{IIO} Average temperature coefficient of input offset current	$V_O = 0$		-55 $^\circ\text{C}$ to 25 $^\circ\text{C}$		0.45	2.8				nA/ $^\circ\text{C}$
			25 $^\circ\text{C}$ to 125 $^\circ\text{C}$		0.08	0.5				
I_{IB} Input bias current	$V_O = 0$		25 $^\circ\text{C}$		0.1	0.2		0.2	0.5	μA
			-55 $^\circ\text{C}$		0.3	0.6		0.5	1.5	
V_{ICR} Common-mode input voltage range	$V_{CC} \pm = \pm 15\text{ V}$		25 $^\circ\text{C}$	± 8	± 10		± 8	± 10		V
			Full range	± 8			± 8			
V_{OPP} Maximum peak-to-peak output voltage swing	$V_{CC} \pm = \pm 15\text{ V}$, $R_L \geq 10\text{ k}\Omega$		25 $^\circ\text{C}$	24	28		24	28		V
			Full range	24			24			
			25 $^\circ\text{C}$	20	26		20	26		
			Full range	20			20			
A_{VD} Large-signal differential voltage amplification	$V_{CC} \pm = \pm 15\text{ V}$, $R_L \geq 2\text{ k}\Omega$, $V_O = \pm 10\text{ V}$		25 $^\circ\text{C}$		45			45		V/mV
			Full range	25		70	25		70	
r_i Input resistance			25 $^\circ\text{C}$	350	750		150	400		k Ω
			-55 $^\circ\text{C}$	85	185		40	100		
r_o Output resistance	$V_O = 0$, See Note 5		25 $^\circ\text{C}$		150			150		Ω
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR\text{ min}}$		25 $^\circ\text{C}$	80	110		70	90		dB
			Full range	80			70			
k_{SVS} Power supply sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	$V_{CC} = \pm 9\text{ V}$ to $\pm 15\text{ V}$		25 $^\circ\text{C}$		40	100		25	150	$\mu\text{V/V}$
			Full range			100			150	
I_{CC} Supply current	$V_{CC} \pm = \pm 15\text{ V}$, No load, $V_O = 0$		25 $^\circ\text{C}$		2.5	3.6		2.6	5.5	mA
			-55 $^\circ\text{C}$		2.7	4.5				
			125 $^\circ\text{C}$		2.1	3				
P_D Total power dissipation	$V_{CC} \pm = \pm 15\text{ V}$, No load, $V_O = 0$		25 $^\circ\text{C}$		75	108		78	165	mW
			-55 $^\circ\text{C}$		81	135				
			125 $^\circ\text{C}$		63	90				

[†] All characteristics are specified under open-loop with zero common-mode input voltage unless otherwise specified. Full range for uA709AM and uA709M is -55 $^\circ\text{C}$ to 125 $^\circ\text{C}$.

[‡] All typical values are at $V_{CC} \pm = \pm 15\text{ V}$.

NOTE 5: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.



uA709AM, uA709M, uA709C **GENERAL-PURPOSE OPERATIONAL AMPLIFIERS**

electrical characteristics at specified free-air temperature (unless otherwise noted $V_{CC} \pm = \pm 15 \text{ V}$)

PARAMETER	TEST CONDITIONS†	uA709C			UNIT
		MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{CC} \pm = \pm 9 \text{ V to } \pm 15 \text{ V}, V_O = 0$	25°C	2	7.5	mV
		Full range		10	
I_{IO} Input offset current	$V_{CC} \pm = \pm 9 \text{ V to } \pm 15 \text{ V}, V_O = 0$	25°C	100	500	nA
		Full range		750	
I_{IB} Input bias current	$V_{CC} \pm = \pm 9 \text{ V to } \pm 15 \text{ V}, V_O = 0$	25°C	0.3	1.5	μA
		Full range		2	
V_{ICR} Common-mode input voltage range		25°C	±8	±10	V
V_{OPP} Maximum peak-to-peak output voltage swing	$R_L \geq 10 \text{ k}\Omega$	25°C	24	28	V
		Full range	24		
	$R_L = 2 \text{ k}\Omega$	25°C	20	26	
	$R_L \geq 2 \text{ k}\Omega$	Full range	20		
A_{VD} Large-signal differential voltage amplification	$R_L \leq 2 \text{ k}\Omega, V_O = \pm 10 \text{ V}$	25°C	15	45	V/mV
		Full range	12		
r_i Input resistance		25°C	50	250	kΩ
		Full range	35		
r_o Output resistance	$V_O = 0$, See Note 5	25°C	150		Ω
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR} \text{ min}$	25°C	65	90	dB
k_{SVS} Supply voltage sensitivity	$V_{CC} = \pm 9 \text{ V to } \pm 15 \text{ V}$	25°C	25	200	μV/V
P_D Total power dissipation	$V_O = 0$, No load	25°C	80	200	mW

† All characteristics are specified under open-loop operation with zero volts common-mode voltage unless otherwise specified. Full range for uA709C is 0°C to 70°C.

NOTE 5: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

operating characteristics $V_{CC} \pm = \pm 9 \text{ V to } \pm 15 \text{ V}, T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		uA709AM uA709M uA709C		UNIT
				MIN	TYP	
t _r	Rise time	V _I = 20 mV, R _L = 2 kΩ, See Figure 1	C _L = 0	0.3	1	μs
	Overshoot factor		C _L = 100 pF	6%	30%	

PARAMETER MEASUREMENT INFORMATION

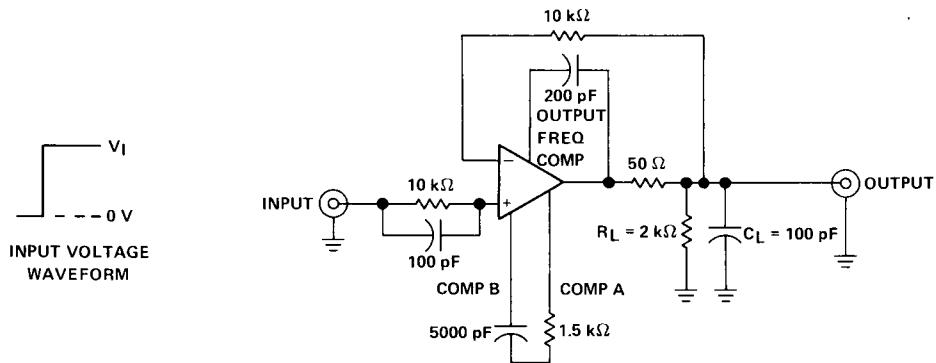


FIGURE 1. RISE TIME AND SLEW RATE