SLOS096 – 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**

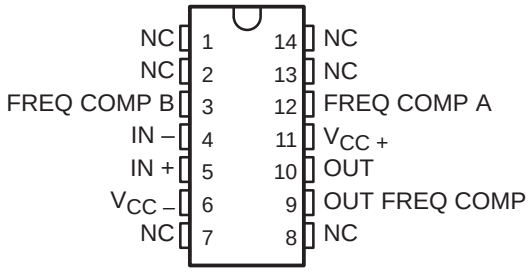
description

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.

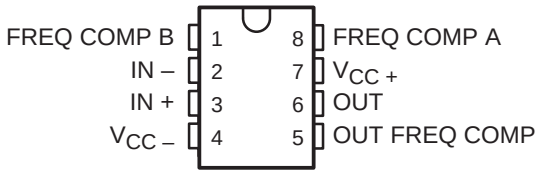
The uA709A circuit features improved offset characteristics, reduced input-current requirements, and lower power dissipation when compared to the uA709 circuit. In addition, maximum values of the average temperature coefficients of offset voltage and current are specified for the uA709A.

The uA709C is characterized for operation from 0°C to 70°C. The uA709AM and uA709M are characterized for operation over the full military temperature range of –55°C to 125°C.

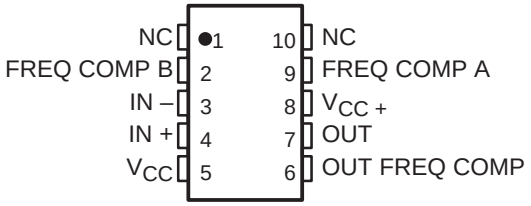
uA709AM, uA709M . . . J OR W PACKAGE
(TOP VIEW)



uA709AM, uA709M . . . JG PACKAGE
uA709C . . . D, JG, OR P PACKAGE
(TOP VIEW)

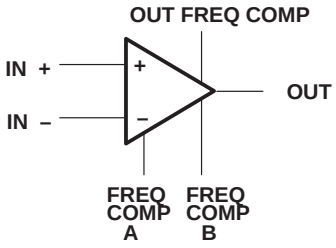


uA709AM, uA709M . . . U FLAT PACKAGE
(TOP VIEW)



NC – No internal connection

symbol

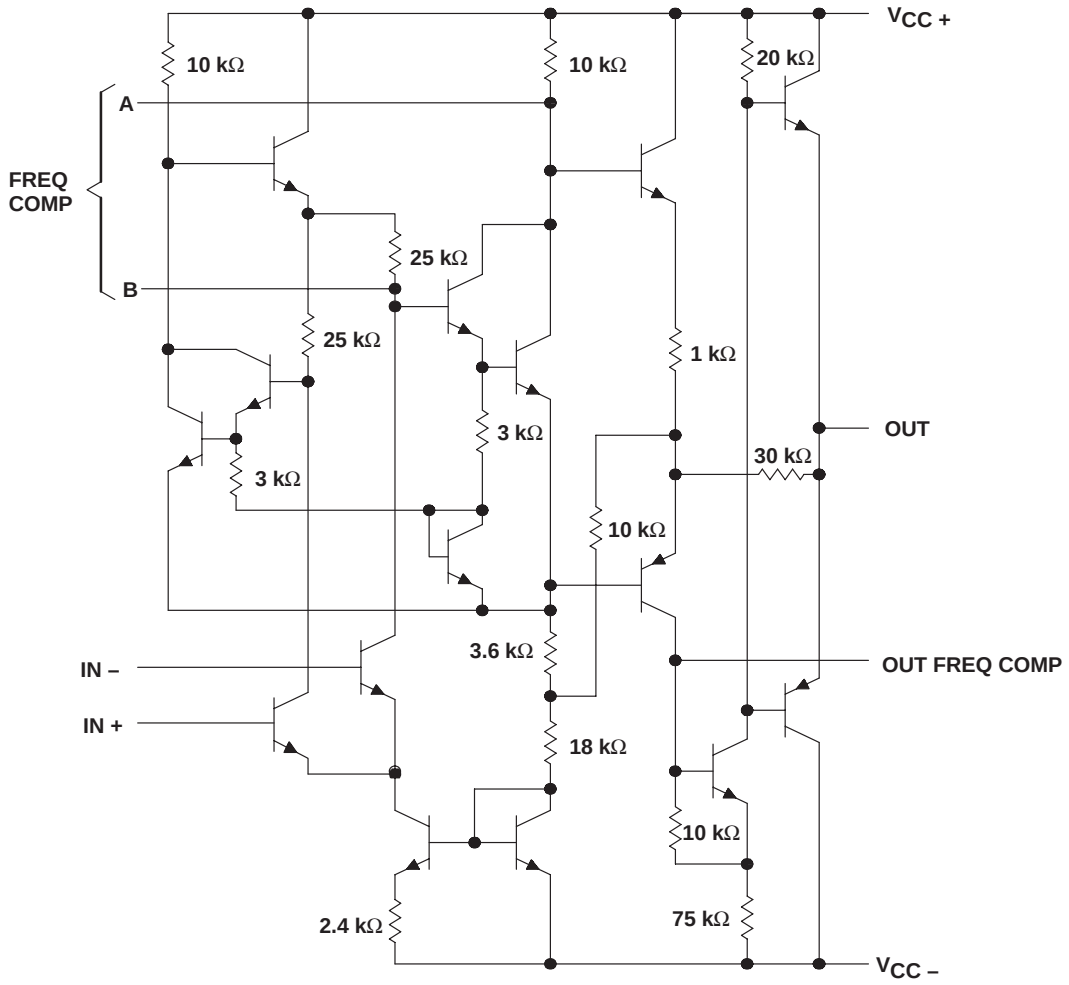


AVAILABLE OPTIONS

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	uA709CD	—	uA709CJG	uA709CP	—	—
–55°C to 125°C	5 mV	—	uA709MJ	uA709MJG	—	uA709MU	uA709MW
	2 mV		uA709AMJ	uA709AMJG		uA709AMU	uA709AMW

The D package is available taped and reeled. Add the suffix R to the device type when ordering, (e.g., uA709CDR).

schematic



Component values shown are nominal.

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

		uA709C	uA709M uA709AM	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 power dissipation		See Dissipation Rating Table		
Operating free-air temperature range		0 to 70	−55 to 125	°C
Storage temperature range		−65 to 150	−65 to 150	°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J, JG, U, or W package	300	300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or P package	260		°C

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.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	300 mW	N/A	N/A	300 mW	N/A
J (uA709_M)	300 mW	11.0 mW/°C	123°C	300 mW	275 mW
JG (uA709_M)	300 mW	8.4 mW/°C	114°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/°C	94°C	300 mW	135 mW
W	300 mW	8.0 mW/°C	113°C	300 mW	200 mW

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

PARAMETER		TEST CONDITIONS†	T_A‡	uA709AMC			uA709M			UNIT
				MIN	TYP§	MAX	MIN	TYP§	MAX	
V_{IO}	Input offset voltage	V_O = 0, $R_S \le 10$ kΩ	25°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 Ω	Full range		1.8	10		3		µV/°C
		V_O = 0, R_S = 10 kΩ	Full range		4.8	25		6		
I_{IO}	Input offset current	V_O = 0	25°C		10	50		50	200	nA
			–55°C		40	250		100	500	
			125°C		3.5	50		20	200	
α_{VIO}	Average temperature coefficient of input offset voltage	V_O = 0	–55°C to 25°C		0.45	2.8				nA/°C
			25°C to 125°C		0.08	0.5				
I_{IB}	Input bias current	V_O = 0	25°C		0.1	0.2		0.2	0.5	µA
			–55°C		0.3	0.6		0.5	1.5	
V_{ICR}	Common-mode input voltage range	$V_{CC\pm}$ = ±15 V	25°C	±8	±10		±8	±10		V
			Full range	±8			±8			
$V_{O(PP)}$	Maximum peak-to-peak output voltage swing	$V_{CC\pm}$ = ±15 V, $R_L \ge 10$ kΩ	25°C	24	28		24	28		V
			Full range	24			24			
		$V_{CC\pm}$ = ±15 V, R_L = 2 kΩ	25°C	20	26		20	26		
		$V_{CC\pm}$ = ±15 V, $R_L \ge 2$ kΩ	Full range	20			20			
A_{VD}	Large-signal differential voltage amplification	$V_{CC\pm}$ = ±15 V, $R_L \ge 2$ kΩ, V_O = ± 10 V	25°C		45			45		V/mV
			Full range	25		70	25		70	
r_i	Input resistance		25°C	350	750		150	400		kΩ
			–55°C	85	185		40	100		
r_o	Output resistance	V_O = 0, See Note 5	25°C		150			150		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}$min	25°C	80	110		70	90		dB
			Full range	80			70			
k_{SVS}	Power supply sensitivity ($\Delta V_{IO} / \Delta V_{CC}$)	V_{CC} = ± 9 V to ± 15 V	25°C		40	100		25	150	µV/V
			Full range			100			150	
I_{CC}	Supply current	$V_{CC\pm}$ = ±15 V, No load, V_O = 0	25°C		2.5	3.6		2.6	5.5	mA
			–55°C		2.7	4.5				
			125°C		2.1	3				
P_D	Total power dissipation	$V_{CC\pm}$ = ±15 V, No load, V_O = 0	25°C		75	108		78	165	mW
			–55°C		81	135				
			125°C		63	90				

† All characteristics are specified under open-loop with zero common-mode input voltage unless otherwise specified.
‡ Full range for uA709C is 0°C to 70°C. Full range for uA709AM and uA709M is –55°C to 125°C.
§ All typical values are at $V_{CC\pm}$ = ±15 V.
NOTE 5: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

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

PARAMETER		TEST CONDITIONS†	T_A‡	uA709C			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	$V_{CC\pm}$ = ±9 V to ±15 V, V_O = 0	25°C		2	7.5	mV
			Full range			10	
I_{IO}	Input offset current	$V_{CC\pm}$ = ±9 V to ±15 V, V_O = 0	25°C		100	500	nA
			Full range			750	
I_{IB}	Input bias current	$V_{CC\pm}$ = ±9 V to ±15 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
$V_{O(PP)}$	Maximum peak-to-peak output voltage swing	$R_L \geq 10$ kΩ	25°C	24	28		V
			Full range	24			
		R_L = 2 kΩ	25°C	20	26		
		$R_L \geq 2$ kΩ	Full range	20			
A_{VD}	Large-signal differential voltage amplification	$R_L \leq 2$ kΩ, V_O = ± 10 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	$V_{IC} = V_{ICR}$ min	25°C	65	90		dB
k_{SVS}	Supply voltage sensitivity	V_{CC} = ±9 V to ±15 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. Full range for uA709AM and uA709M is –55°C to 125°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, $V_{CC\pm}$ = ± 9 V to ± 15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS†		uA709C uA709M uA709AM			UNIT
				MIN	TYP	MAX	
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

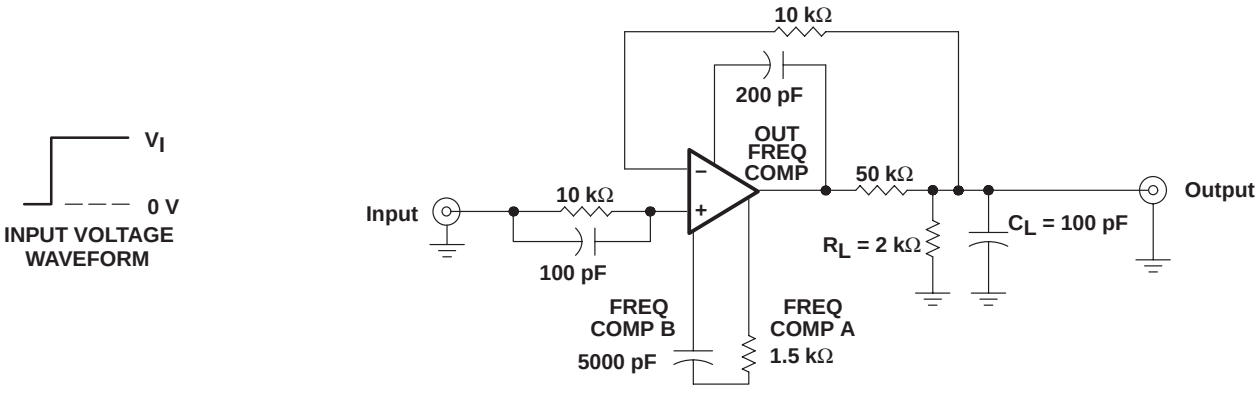


Figure 1. Rise Time and Slew Rate Test Circuit

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
UA709CP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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