

# μA798

## DUAL OPERATIONAL AMPLIFIER

### FAIRCHILD LINEAR INTEGRATED CIRCUITS

**GENERAL DESCRIPTION** — The μA798 is a monolithic pair of independent, high gain, internally frequency compensated operational amplifiers designed to operate from a single power supply or dual power supplies over a wide range of voltages. The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage. They are constructed using the Fairchild Planar\* epitaxial process.

- INPUT COMMON MODE VOLTAGE RANGE INCLUDES GROUND OR NEGATIVE SUPPLY
- OUTPUT VOLTAGE CAN SWING NEAR GROUND OR NEGATIVE SUPPLY
- INTERNALLY COMPENSATED
- WIDE POWER SUPPLY RANGE: SINGLE SUPPLY OF 3.0 TO 36 V  
DUAL SUPPLY OF ±1.5 TO ±18 V
- CLASS AB OUTPUT STAGE FOR MINIMAL CROSSOVER DISTORTION
- SHORT CIRCUIT PROTECTED OUTPUT
- HIGH OPEN LOOP GAIN — 200 k
- EXCEEDS 1458 TYPE PERFORMANCE
- OPERATION SPECIFIED AT ±15 V AND +5 V POWER SUPPLIES
- HIGH OUTPUT CURRENT SINK CAPABILITY 0.8 mA AT  $V_{OUT} = 400$  mV

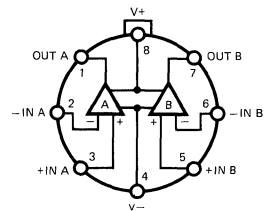
#### ABSOLUTE MAXIMUM RATINGS

Supply Voltage Between $V+$ and $V-$	36 V
Differential Input Voltage (Note 1)	±30 V
Input Voltage ( $V-$ ) (Note 1)	-0.3 V ( $V-$ ) to $V+$
Internal Power Dissipation (Note 2)	
Metal Can, Hermetic Mini DIP	500 mW
Molded Mini DIP	310 mW
Operating Temperature Range	
Commercial (C)	0° C to +70° C
Military (M)	-55° C to +125° C
Storage Temperature Range	
Molded Package (9T)	-55° C to +125° C
Hermetic Package (5S, 6T)	-65° C to +150° C
Pin Temperature	
Molded Package (Soldering, 10 s)	260° C
Hermetic Package (Soldering, 60 s)	300° C
Output Short-Circuit Duration	Note 5

#### CONNECTION DIAGRAMS

##### 8-PIN METAL CAN (TOP VIEW)

PACKAGE OUTLINE 5S  
PACKAGE CODE H

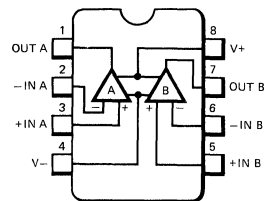


#### ORDER INFORMATION

TYPE	PART NO.
μA798	μA798HM
μA798C	μA798HC

#### 8-PIN MINI DIP (TOP VIEW)

PACKAGE OUTLINE 6T 9T  
PACKAGE CODE R T



#### ORDER INFORMATION

TYPE	PART NO.
μA798	μA798RM
μA798C	μA798RC
μA798C	μA798TC

\*Planar is a patented Fairchild process.

# FAIRCHILD • $\mu$ A798

$\mu$ A798

**ELECTRICAL CHARACTERISTICS:**  $V_S = \pm 15$  V,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

CHARACTERISTICS	CONDITION	MIN	TYP	MAX	UNITS
Input Offset Voltage			2.0	5.0	mV
Input Offset Current			10	25	nA
Input Bias Current			-50	-100	nA
Input Impedance	$f = 20$ Hz	0.3	1.0		M $\Omega$
Input Common Mode Voltage Range		+13 to $-V_S$	+13.5 to $-V_S$		V
Common Mode Rejection Ratio	$R_S \leq 10$ k $\Omega$	70	90		dB
Large Signal Open Loop Voltage Gain	$V_{OUT} = \pm 10$ V, $R_L = 2$ k $\Omega$	50	200		V/mV
Power Bandwidth	$A_V = 1$ , $R_L = 2$ k $\Omega$ , $V_{OUT} = 20$ V pk-pk		9.0		kHz
Small Signal Bandwidth	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		1.0		MHz
Slew Rate	$A_V = 1$ , $V_{IN} = -10$ V to +10 V		0.6		V/ $\mu$ s
Rise Time	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		0.3		$\mu$ s
Fall Time	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		0.3		$\mu$ s
Overshoot	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		20		%
Phase Margin	$A_V = 1$ , $R_L = 2$ k $\Omega$ , $C_L = 200$ pF		60		Degree
Crossover Distortion	$V_{IN} = 30$ mV pk-pk, $V_{OUT} = 2$ V pk-pk		0.1		%
Output Voltage Range	$R_L = 10$ k $\Omega$	$\pm 13$	$\pm 14$		V
	$R_L = 2$ k $\Omega$	$\pm 12$	$\pm 13.5$		V
Individual Output Short Circuit Current	(Notes 3 and 5)	$\pm 20$	$\pm 30$		mA
Output Impedance	$f = 20$ Hz		800		$\Omega$
Power Supply Rejection Ratio	Positive		30	150	$\mu$ V/V
	Negative		30	150	$\mu$ V/V
Power Supply Current	$V_{OUT} = 0$ , $R_L = \infty$		2.0	3.0	mA
Channel Separation	$f = 1$ kHz to 20 kHz (Input Referenced)		-120		dB

The following specification apply for  $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$

Input Offset Voltage				6.0	mV
Average Temperature Coefficient of Input Offset Voltage			10		$\mu$ V/ $^\circ\text{C}$
Input Offset Current				200	nA
Average Temperature Coefficient of Input Offset Current			50		pA/ $^\circ\text{C}$
Input Bias Current				-300	nA
Large Signal Open Loop Voltage Gain	$R_L = 2$ k $\Omega$ , $V_{OUT} = \pm 10$ V	25	300		V/mV
Output Voltage Range	$R_L = 2$ k $\Omega$	$\pm 10$			V

**ELECTRICAL CHARACTERISTICS:**  $V_S = +5.0$  V and Ground,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

CHARACTERISTICS	CONDITION	MIN	TYP	MAX	UNITS
Input Offset Voltage			2.0	5.0	mV
Input Offset Current			10	30	nA
Input Bias Current			-70	-150	nA
Large Signal Open Loop Voltage Gain	$R_L = 2$ k $\Omega$	20	200		V/mV
Power Supply Rejection Ratio				150	$\mu$ V/V
Output Voltage Range (Note 4)	$R_L = 10$ k $\Omega$	4.0			V pk-pk
	$R_L = 10$ k $\Omega$ , $5.0$ V $\leq V_S \leq 30$ V	(V+) -1.5			V pk-pk
Output Sink Current	$V_{IN} = 1.0$ V, $V_{OUT} = 200$ mV	0.35			mA
Power Supply Current			2.0	3.0	mA

**NOTES:**

- For supply voltage less than 30 V between  $V_+$  and  $V_-$ , the absolute maximum input voltage is equal to the supply voltage.
- Rating applies to ambient temperature up to  $70^\circ\text{C}$ . Above  $T_A = 70^\circ\text{C}$ , derate linearly 6.3 mW/ $^\circ\text{C}$  for the Metal Can (5S) and Hermetic Mini DIP (6T), 5.6 mW/ $^\circ\text{C}$  for the Molded Mini DIP (9T).
- Not to exceed maximum package power dissipation.
- Output will swing to ground.
- Indefinite on shorts to ground or  $V_-$  supply. Shorts to  $V_+$  supply may result in power dissipation exceeding the absolute maximum rating.

# FAIRCHILD • $\mu$ A798

## $\mu$ A798C

**ELECTRICAL CHARACTERISTICS:**  $V_S = \pm 15$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

CHARACTERISTICS	CONDITION	MIN	TYP	MAX	UNITS
Input Offset Voltage			2.0	6.0	mV
Input Offset Current			10	50	nA
Input Bias Current			-50	-250	nA
Input Impedance	$f = 20$ Hz	0.3	1.0		M $\Omega$
Input Common Mode Voltage Range		+13 to $-V_S$	+13.5 to $-V_S$		V
Common Mode Rejection Ratio	$R_S \leq 10$ k $\Omega$	70	90		dB
Large Signal Open Loop Voltage Gain	$V_{OUT} = \pm 10$ V, $R_L = 2$ k $\Omega$	20	200		V/mV
Power Bandwidth	$A_V = 1$ , $R_L = 2$ k $\Omega$ , $V_{OUT} = 20$ V pk-pk		9.0		kHz
Small Signal Bandwidth	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		1.0		MHz
Slew Rate	$A_V = 1$ , $V_{IN} = -10$ V to +10 V		0.6		V/ $\mu$ s
Rise Time	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		0.3		$\mu$ s
Fall Time	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		0.3		$\mu$ s
Overshoot	$A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_{OUT} = 50$ mV		20		%
Phase Margin	$A_V = 1$ , $R_L = 2$ k $\Omega$ , $C_L = 200$ pF		60		Degree
Crossover Distortion	$V_{IN} = 30$ mV pk-pk, $V_{OUT} = 2$ V pk-pk $f = 10$ kHz		0.1		%
Output Voltage Range	$R_L = 10$ k $\Omega$	$\pm 13$	$\pm 14$		V
	$R_L = 2$ k $\Omega$	$\pm 12$	$\pm 13.5$		V
Individual Output Short Circuit Current	(Notes 3 and 5)	$\pm 10$	$\pm 30$		mA
Output Impedance	$f = 20$ Hz		800		$\Omega$
Power Supply Rejection Ratio	Positive		30	150	$\mu$ V/V
	Negative		30	150	$\mu$ V/V
Power Supply Current	$V_{OUT} = 0$ , $R_L = \infty$		2.0	4.0	mA
Channel Separation	$f = 1$ kHz to 20 kHz (Input Referenced)		-120		dB

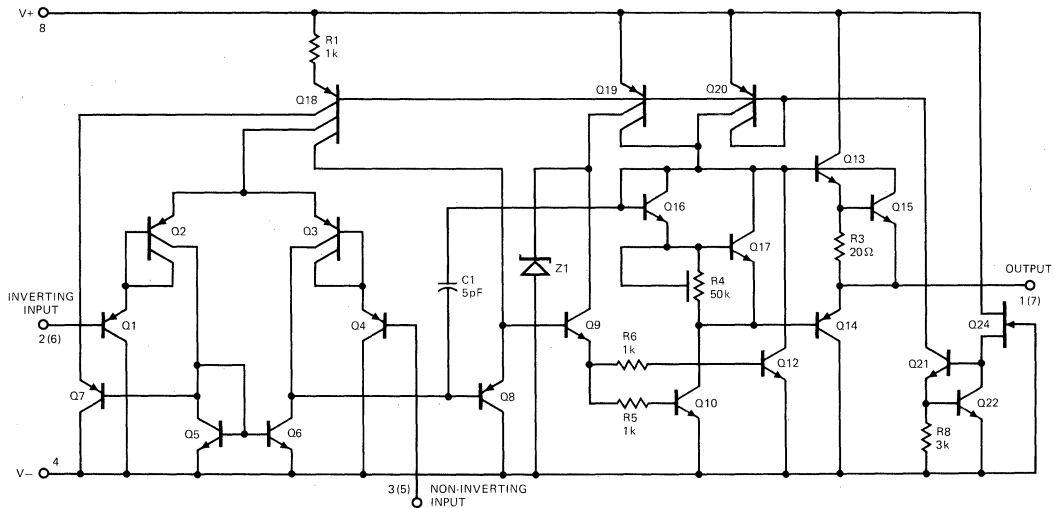
The following specification apply for  $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$

Input Offset Voltage				7.5	mV
Average Temperature Coefficient of Input Offset Voltage			10		$\mu$ V/ $^\circ\text{C}$
Input Offset Current				200	nA
Average Temperature Coefficient of Input Offset Current			50		pA/ $^\circ\text{C}$
Input Bias Current				-400	nA
Large Signal Open Loop Voltage Gain	$R_L = 2$ k $\Omega$ , $V_{OUT} = \pm 10$ V	15			V/mV
Output Voltage Range	$R_L = 2$ k $\Omega$	$\pm 10$			V

**ELECTRICAL CHARACTERISTICS:**  $V_S = \pm 5.0$  V and Ground,  $T_A = 25^\circ\text{C}$  unless otherwise noted.

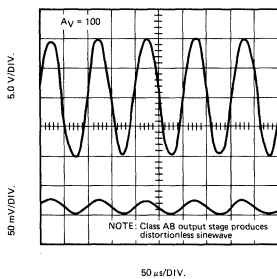
CHARACTERISTICS	CONDITION	MIN	TYP	MAX	UNITS
Input Offset Voltage			2.0	7.5	mV
Input Offset Current			10	50	nA
Input Bias Current			-80	-250	nA
Large Signal Open Loop Voltage Gain	$R_L = 2$ k $\Omega$	20	200		V/mV
Power Supply Rejection Ratio				150	$\mu$ V/V
Output Voltage Range	$R_L = 10$ k $\Omega$	4.0			V pk-pk
	$R_L = 10$ k $\Omega$ , $5.0$ V $\leq V_S \leq 30$ V	(V+) -1.5			V pk-pk
Output Sink Current	$V_{IN} = 1.0$ V, $V_{OUT} = 200$ mV	0.35			mA
Power Supply Current			2.0	4.0	mA

1/2 OF EQUIVALENT CIRCUIT

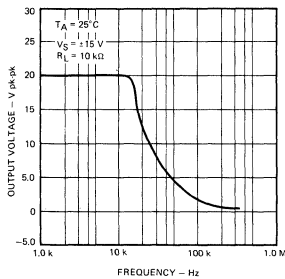


TYPICAL PERFORMANCE CURVES

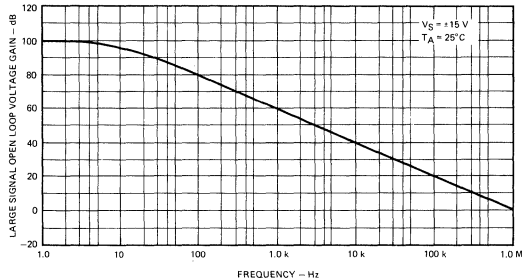
SINEWAVE RESPONSE



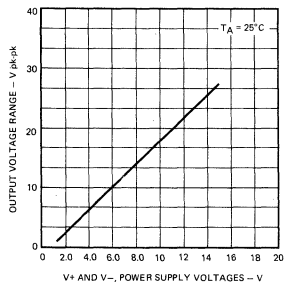
OUTPUT VOLTAGE AS A FUNCTION OF FREQUENCY



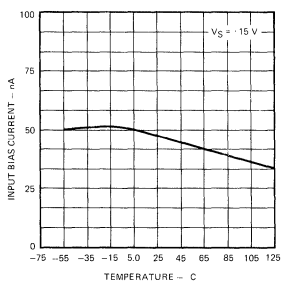
LARGE SIGNAL OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



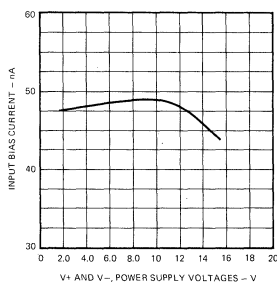
OUTPUT SWING AS A FUNCTION OF SUPPLY VOLTAGE



INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE

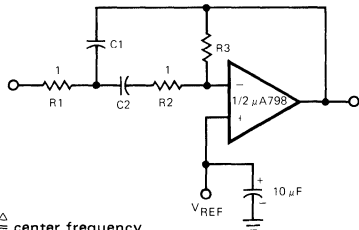


INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



TYPICAL APPLICATIONS

MULTIPLE FEEDBACK BANDPASS FILTER



$f_o \triangleq$  center frequency

$BW \triangleq$  Bandwidth

R in  $k\Omega$

C in  $\mu F$

$Q = \frac{f_o}{BW} < 10$

$C1 = C2 = \frac{Q}{3}$

$R1 = R2 = 1$   
 $R3 = 9Q^2 - 1$  } Use scaling factors in these expressions.

Design example:

given:  $Q = 5, f_o = 1 \text{ kHz}$

Let  $R1 = R2 = 10 \text{ k}\Omega$

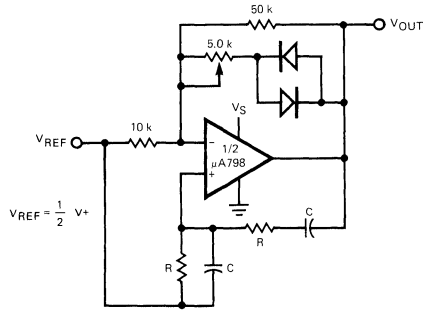
then  $R3 = 9(5)^2 - 10$

$R3 = 215 \text{ k}\Omega$

$C = \frac{5}{3} = 1.6 \text{ nF}$

If source impedance is high or varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

WEIN BRIDGE OSCILLATOR



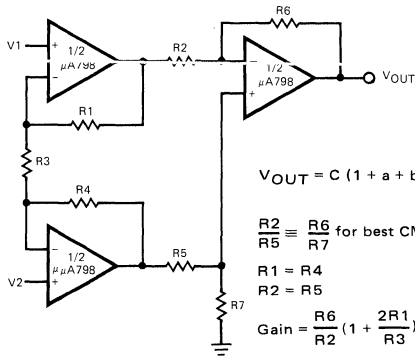
$V_{REF} = \frac{1}{2} V^+$

$f_o = \frac{1}{2\pi RC}$  for  $f_o = 1 \text{ kHz}$

R = 16  $k\Omega$

C = 0.01  $\mu F$

HIGH IMPEDANCE DIFFERENTIAL AMPLIFIER



$V_{OUT} = C(1 + a + b)(V_2 - V_1)$

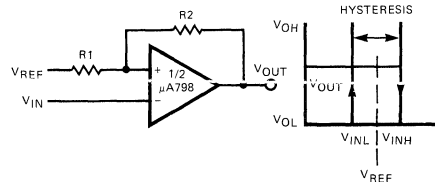
$\frac{R_2}{R_5} \equiv \frac{R_6}{R_7}$  for best CMRR

$R_1 = R_4$

$R_2 = R_5$

Gain =  $\frac{R_6}{R_2} (1 + \frac{2R_1}{R_3}) = C(1 + a + b)$

COMPARATOR WITH HYSTERESIS

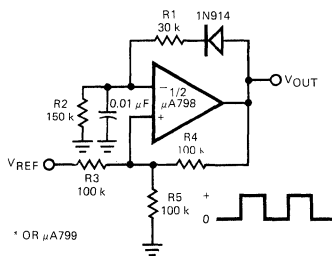


$V_{INL} = \frac{R_1}{R_1 + R_2} (V_{OL} - V_{REF}) + V_{REF}$

$V_{INH} = \frac{R_1}{R_1 + R_2} (V_{OH} - V_{REF}) + V_{REF}$

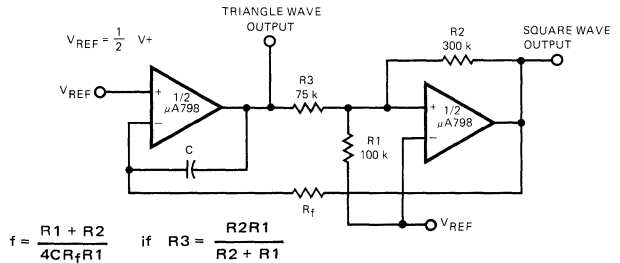
$H = \frac{R_1}{R_1 + R_2} (V_{OH} - V_{OL})$

PULSE GENERATOR



\* OR  $\mu$ A798

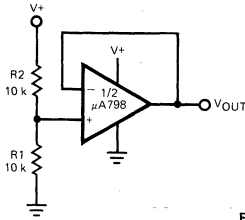
FUNCTION GENERATOR



$f = \frac{R_1 + R_2}{4CR_4R_1}$  if  $R_3 = \frac{R_2R_1}{R_2 + R_1}$

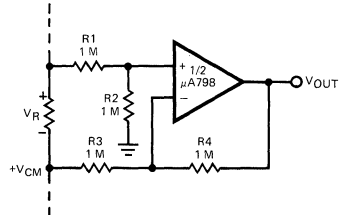
TYPICAL APPLICATIONS (Cont'd)

VOLTAGE REFERENCE



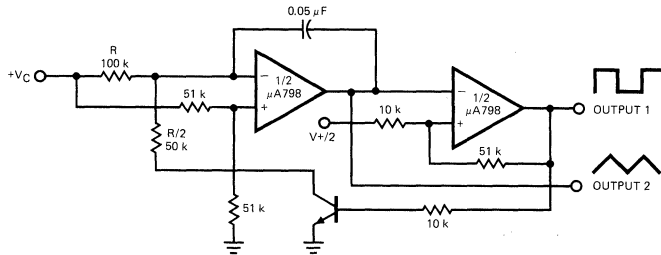
$$V_{OUT} = \frac{R1}{R1 - R2} = \frac{V+}{2}$$

GROUND REFERENCING A DIFFERENTIAL INPUT SIGNAL



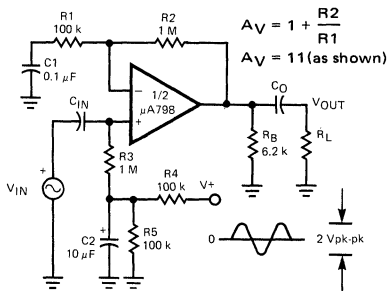
$$V_{OUT} = V_R$$

VOLTAGE CONTROLLED OSCILLATOR



\*Wide Control Voltage Range:  
 $0V_{DC} \leq V_C \leq 2(V+ - 1.5V_{DC})$

AC COUPLED NON-INVERTING AMPLIFIER



AC COUPLED INVERTING AMPLIFIER

