

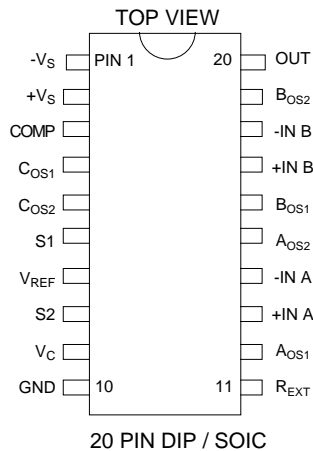
**FEATURES**

- **broadcast quality video multiplier**
- **30 MHz at -1.0 dB video and control channel bandwidth**
- **one external frequency compensation adjustment**
- **ultra low differential gain and differential phase, (typically 0.01 % and 0.01 deg.)**
- **external DC offset and span trims**
- **20 pin PDIP and SOIC packaging**

**APPLICATIONS**

- Production switcher video mixers
- Linear Keyers

**PIN CONNECTIONS**



**PIN DESIGNATION**

- 1 -V<sub>S</sub> negative supply voltage
- 2 +V<sub>S</sub> positive supply voltage
- 3 COMP output freq'y comp'n R-C
- 4 C<sub>OS1</sub> control input offset adjust
- 5 C<sub>OS2</sub> control input offset adjust
- 6 S1 span adjust
- 7 V<sub>REF</sub> 0.5volt reference input
- 8 S2 span adjust
- 9 V<sub>C</sub> control signal input
- 10 GND ground
- 11 R<sub>EXT</sub> current setting resistor
- 12 A<sub>OS1</sub> A black level adjust (OFFSET)
- 13 +IN A A video + input signal
- 14 -IN A A video - signal input
- 15 A<sub>OS2</sub> A black level adjust (OFFSET)
- 16 B<sub>OS1</sub> B black level adjust (OFFSET)
- 17 +IN B B video + signal input
- 18 -IN B B video - signal input
- 19 B<sub>OS2</sub> B black level adjust (OFFSET)
- 20 OUT multiplier output

Revision Date: January 1994.

**DESCRIPTION**

The GT4122 multiplier is a monolithic dual-channel, broadcast quality video mixer.

Featuring two wideband video inputs and a single control input, the GT4122 achieves high quality video mixing of the two video input signals to a single output by implementing the function:

$$V_{OUT} = V_A \cdot V_C + V_B (1 - V_C)$$

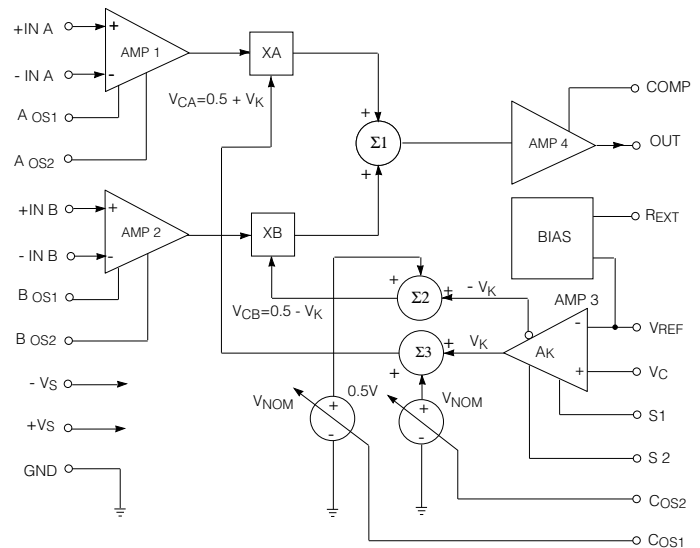
where V<sub>C</sub> is the control input voltage, which may be varied continuously over the control range and V<sub>A</sub> and V<sub>B</sub> are the video input signals.

The GT4122 operates with power supply voltages of ±10 volts and typically draws 24 mA of current. The GT4122 is available in a 20 pin DIP and 20 pin SOIC packaging.

An Application Note entitled 'Using the GT4122 and GT4124 Video Mixer ICs' (Gennum Document 520-44) is available from Gennum Corporation.

**ORDERING INFORMATION**

Part No.	Package Type	Temperature
GT4122 - CDF	20 PDIP	0° to 70°C
GT4122 - CKF	20 SOIC	0° to 70°C



Device Function:  $V_{OUT} = V_{INA} \cdot [V_{NOM} + A_K (V_C - V_{REF})] + V_{INB} \cdot [V_{NOM} - A_K (V_C - V_{REF})]$

**FUNCTIONAL BLOCK DIAGRAM**

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## ABSOLUTE MAXIMUM RATINGS

PARAMETER	VALUE
Supply Voltage ( $V_S$ )	$\pm 13.5$ V
Operating Temperature Range	$0^\circ \text{C} \leq T_A \leq 70^\circ \text{C}$
Storage Temperature Range	$-65^\circ \text{C} \leq T_S \leq 150^\circ \text{C}$
Lead Temperature (Soldering, 10 Sec)	$260^\circ \text{C}$
Video Input Voltage ( $V_A, V_B$ ) to ground	$\pm 5$ V
Control Input Voltage ( $V_C$ ) to ground	$\pm 5$ V
Video Input Differential Voltage ( $V_A - V_B$ )	$\pm 5$ V
Control Input Differential Voltage ( $V_C - V_{REF}$ )	$\pm 5$ V

## ELECTRICAL CHARACTERISTICS ( $+V_S = -V_S = 10\text{V}$ , $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ unless otherwise shown)

	PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER SUPPLIES	Supply Voltage	$\pm V_S$	Operating Range	$\pm 9$	$\pm 10$	$\pm 12$	volts
	+ Supply Current	$I^+$	$R_{EXT} = 1 \text{ k}\Omega$	-	24	28	mA
	- Supply Current	$I^-$	$R_{EXT} = 1 \text{ k}\Omega$	-	18	20	mA
SIGNAL CHANNEL	Bandwidth	BW	at $\pm 0.1$ dB $V_{SIG} = 150 \text{ mVp-p}$	25	30	-	MHz
	Frequency Response		DC - 10 MHz	-	$\pm 0.05$	-	dB
	Differential Gain	$\partial g$	$V_{IN} = 40 \text{ IRE at } 3.58 \text{ MHz}$	-	0.01	0.03	%
	Differential Phase	$\partial p$	$V_{IN} = 40 \text{ IRE at } 3.58 \text{ MHz}$	-	0.01	0.03	degrees
	Signal to Noise	S/N	$V_{SIG} = 1 \text{ volt, BW} = 5 \text{ MHz}$	64	70	-	dB
	Gain - open loop	$A_{OL}$	100 kHz ( $\beta = 0\%$ )	54	60	66	dB
	Gain - closed loop	$A_{CL}$	100 kHz ( $\beta = 100\%$ )	-0.01	-0.005	-	dB
	Delay	$t_d \text{ SIG}$		-	-	10	ns
	Off Isolation & Crosstalk	$V_A \text{ or } B/V_O$	$f_{SIG} = 5 \text{ MHz (see note 1)}$	80	85	-	dB
$V_C/V_A \text{ or } B$		$f_{SIG} = 5 \text{ MHz (see note 2)}$	90	95	-	dB	
CONTROL CHANNEL	Bandwidth	BW	at $\pm 0.1$ dB $V_{SIG} = 150 \text{ mVp-p}$	25	30	-	MHz
	Delay	$t_d \text{ CONT}$		-	-	10	ns
	Linearity			-	1	-	%
	Control Breakthrough		$V_{CONT} = 0-1 \text{ V } f = 1-10 \text{ MHz}$	-	-55	-50	dB
	Crossfade Balance		$V_{CONT} = 0-1 \text{ V } f = 3.58 \text{ MHz}$	-	3	5	mVpp
	Control Range	$V_{CONT}$		0	-	+5	V

NOTE: 1  $V_A \text{ or } B = 1 \text{ Vp-p}$  output taken from OUTPUT

2  $V_{CONT} = 1 \text{ Vp-p}$  output taken from  $V_A \text{ or } V_B$

## DETAILED DESCRIPTION

The GT4122 is a broadcast quality monolithic integrated circuit specifically designed to linearly mix two video signals under the control of a third signal.

Referring to the block diagram, the input signals are applied to conventional differential amplifiers (AMP1 and AMP2). Each amplifier has provisions for individually adjusting the DC offset (OFFSET).

Following each input amplifier, the signals are applied to linear multiplier circuits (XA and XB) whose outputs are the product of the incoming signals and controlling voltages ( $V_{CA}$ ) or ( $V_{CB}$ ). The controlling voltage  $V_{CA}$  is the sum of a nominal 0.5V source ( $V_{NOM}$ ) and a variable source  $V_K$  while  $V_{CB}$  is made up of the sum of the nominal voltage  $V_{NOM}$  and  $-V_K$ .

$V_K$  and  $-V_K$  are themselves proportional to the difference between an externally applied reference voltage ( $V_{REF}$ ) and an externally applied CONTROL voltage ( $V_C$ ). The voltages  $V_K$  and  $-V_K$  are produced by a differential amplifier (AMP3) whose gain is  $A_K$ . This gain can be altered by two external resistors,  $R_{EXT}$  and  $R_{SPAN}$  according to the following formula:

$$A_K \approx \frac{0.85 \cdot R_{EXT}}{R_{SPAN}} \quad [1k\Omega < R_{EXT} < 3k\Omega]$$

Note that  $R_{EXT}$  is connected between the  $R_{EXT}$  pin and ground and  $R_{SPAN}$  is connected between the pins S1 and S2.

Each of the voltages ( $+V_K$  and  $-V_K$ ) is applied to summing circuits ( $\Sigma 2$  and  $\Sigma 3$ ) whose second inputs are DC voltage sources that can also be slightly varied. The nominal value of these voltage sources is 0.5 volts.

When they are exactly 0.5V and when  $V_C = V_{REF}$ , the gain of each signal channel of the mixer is 0.5 (50%).

By connecting the ends of an external potentiometer (CONTROL OFFSET) between the offset pins COS1 and COS2, the voltage sources can be altered differentially. If a second potentiometer (50% GAIN) is connected between the wiper of the CONTROL OFFSET potentiometer and the supply voltage, the voltage sources can be varied in a common mode fashion. In this way not only can the control range of the mixer be varied but also the point at which 50% of each input signal appears at the output.

The outputs from the multiplier circuits (XA and XB) are then applied to a summing circuit ( $\Sigma 1$ ) whose output feeds a wideband amplifier (AMP4) and presents the mixed signals to the outside world.

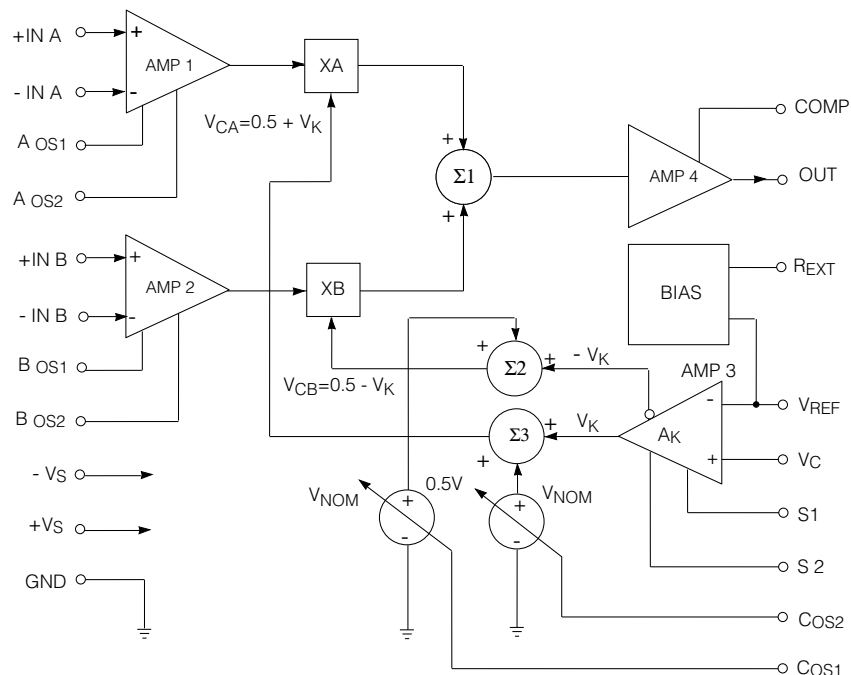
Although there are two separate differential inputs, the usual operational amplifier gain-setting methods can be applied to determine the closed loop gain of the mixer. Usually the mixer will be configured for unity gain by connecting both inverting inputs ( $-IN A$ ,  $-IN B$ ) to the common output (OUT). In this case, the general transfer function is:

$$V_O = V_A \cdot [V_{NOM} + A_K \cdot (V_C - V_{REF})] + V_B \cdot [V_{NOM} - A_K \cdot (V_C - V_{REF})]$$

(Unity gain configuration)

Where  $V_A$  and  $V_B$  are the input analog signals applied to  $+IN A$  and  $+IN B$  respectively, and  $V_C$  is the CONTROL voltage.

Note that  $V_{NOM}$  ranges between  $0.45V < V_{NOM} < 0.55$ .



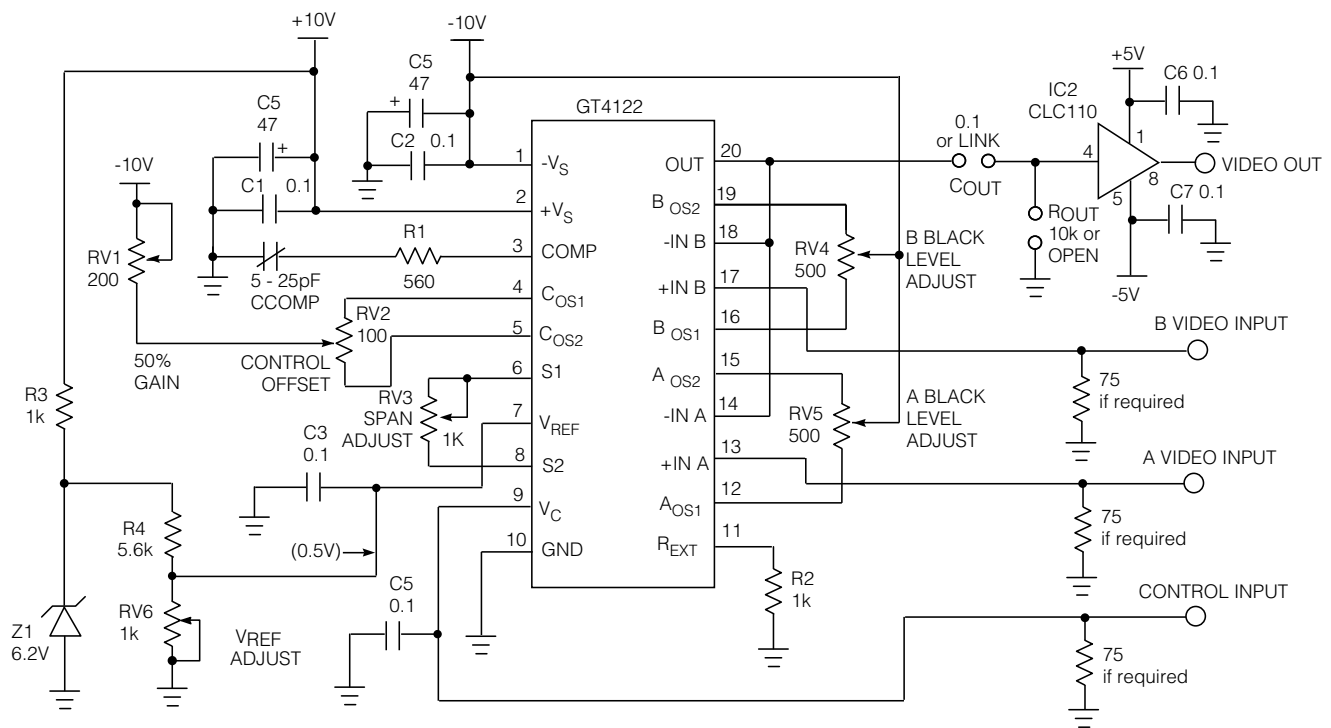
Device Function:  $V_{OUT} = V_{INA} \cdot [V_{NOM} + A_K (V_C - V_{REF})] + V_{INB} \cdot [V_{NOM} - A_K (V_C - V_{REF})]$

### FUNCTIONAL BLOCK DIAGRAM

For normal video mixer operation, the control range (SPAN) is usually 0 to 1V and will occur when  $A_K=1$ ,  $V_{REF}=0.5V$  and  $V_{NOM}=0.5$  volts. A change in  $V_C$  from 0 to 1V will then produce an effect such that the output signal contains 100% of Channel B when  $V_C$  is 0V and 100% of Channel A when  $V_C$  is 1 volt. For the above conditions, the general unity gain transfer function reduces to:

$$V_O = V_A \cdot V_C + V_B \cdot (1 - V_C)$$

Since the operation of the mixer is limited to two quadrants, no signal inversions occur if the control voltage exceeds the range zero to one volt in either direction. The topology is designed so that once the control voltage reaches either end of its range, the channel which is ON remains fully ON and the OFF channel remains fully OFF.



NOTE: C5 is used when the CONTROL VOLTAGE ( $V_C$ ) is derived from a power supply.  
All resistors in ohms, all capacitors in  $\mu F$  unless otherwise stated.

Fig. 1 Test Circuit

## TYPICAL PERFORMANCE CURVES FOR GT4122

(Unless otherwise shown,  $V_S = \pm 10\text{ V}$ ,  $R_L = 10\text{ k}\Omega$ )

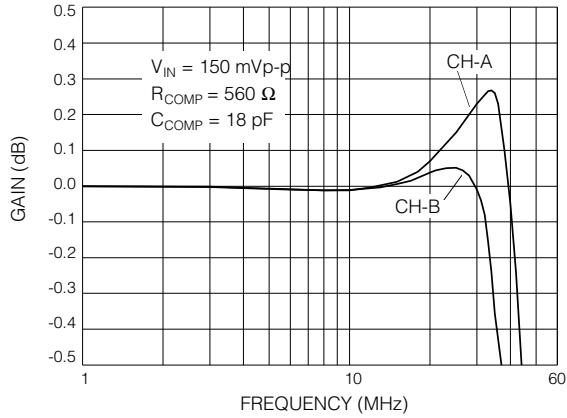


Fig. 2 Frequency Response

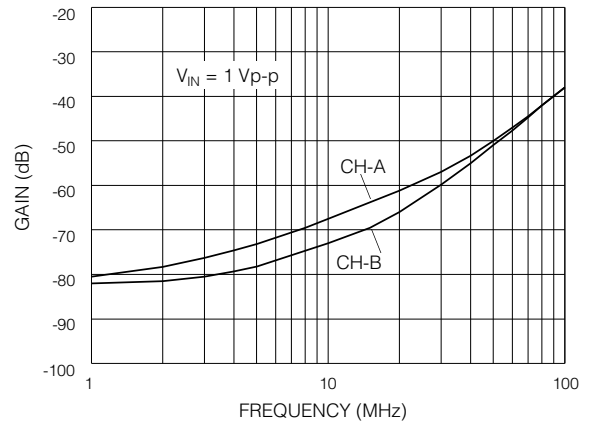


Fig. 3 Crosstalk vs Frequency

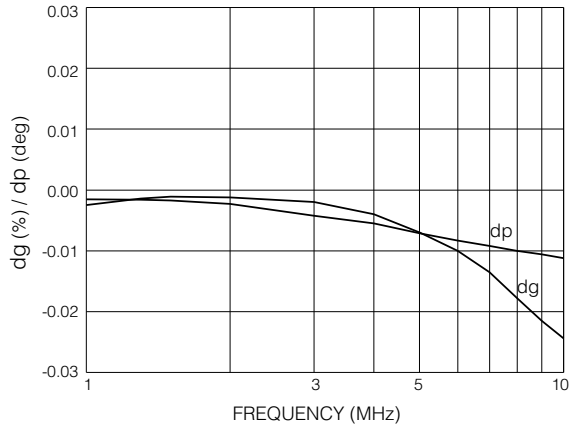


Fig. 4 Differential Gain & Phase vs Frequency

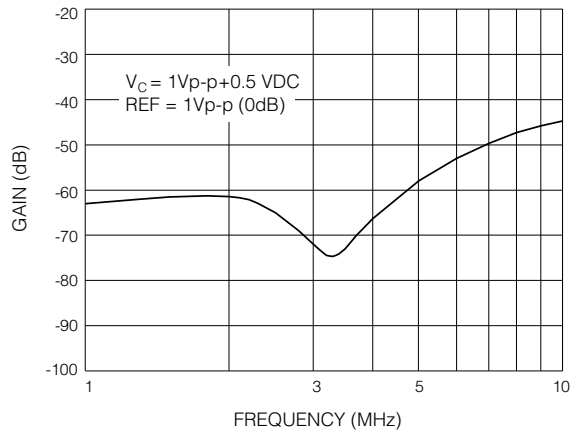


Fig. 5 Crossfade Balance vs Frequency

**CAUTION**  
ELECTROSTATIC  
SENSITIVE DEVICES  
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EXCEPT AT A STATIC-FREE WORKSTATION



### DOCUMENT IDENTIFICATION

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