

Product Preview

Dual BiMOS Operational Amplifier

For Microprocessor Applications and Other
Low-Supply Voltage and Low-Input Current Applications

Features:

- Below 5-V supply at 400 μ A supply current
- 1-pA (typ.) input current
- Rail-to-rail output swing
- Easily feasible for use as a (1) dual op amp;
(2) dual comparator; and (3) op amp and comparator
- Ideally suited for CMOS and QMOS applications
- +5-V characteristics for microprocessor applications
- ± 1 V, ± 10 V operation feasible

The RCA CA5422* is an integrated circuit operational amplifier that combines PMOS transistors and bipolar transistors on a single monolithic chip. The CA5422 BiMOS operational amplifier features gate-protected PMOS transistors in the input circuit to provide very high input impedance, very low input currents. The CA5422 is a dual monolithic integrated circuit in which each amplifier has unique characteristics. This device is capable of operating at a total supply voltage from 2 to 20 volts, either single or dual supply. Characteristics are available for +5-V microprocessor applications.

An internal network on Amplifier A features a unique guard-banding technique for reducing the doubling of leakage current for every 10°C increase in temperature up to 85°C.

Bootstrapping terminals provided on Amplifier A null the input currents on either/both input terminal(s). Access terminals are available for connections to an external capacitor for additional frequency compensation. The input offset voltage can also be reduced on Amplifier A through external nulling terminals. The PMOS input stages for the first amplifier result in common-mode input voltage capability from 0.45 volt below the negative supply terminal, to approximately $V+ - 0.5$ V, an important attribute for single-supply applications. The output stage is an OTA-type amplifier that can swing essentially from rail-to-rail with an infinite load resistor.

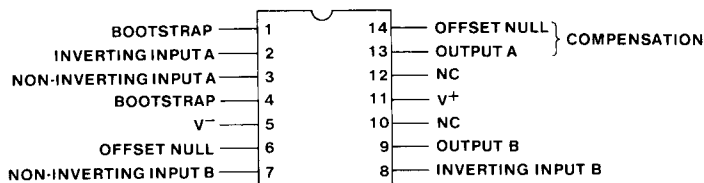
Applications

- pH probe amplifiers
- Picoammeters
- Electrometer (High Z) instruments
- Portable equipment
- Inaccessible field equipment
- Battery-dependent equipment
(medical and military)
- Humidity sensors
- Ionization chambers
- Piezo-electric pre-amplifiers
(charge amplifiers)
- Battery monitoring systems
- Photodiode amplifiers (IR)
- Signal-processing amplifiers for
microprocessor applications

The second amplifier provides an overall gain of 300 with inputs compatible with other BiMOS operational amplifiers. Its output can swing to within 0.3 V (typ.) from the positive rail and down to 3 mV (typ.) from the negative rail with a 2K load resistor. The output driving current of 2 mA (min.) is provided by using non-linear current mirrors.

The CA5422 is available in a 16-lead dual-in-line plastic package (E suffix).

*Formerly RCA Developmental Type No. 11214.



92CS-39415

TERMINAL ASSIGNMENT

CA5422

MAXIMUM RATINGS, Absolute-Maximum Values ($T_C = 25^\circ\text{C}$):

DC SUPPLY VOLTAGE (BETWEEN V^+ and V^- TERMINALS)	22 V
DIFFERENTIAL-MODE INPUT VOLTAGE	± 15 V
COMMON-MODE DC INPUT VOLTAGE	($V^+ + 8$ V) to ($V^- - 0.5$ V)
INPUT-TERMINAL CURRENT	1 mA
DEVICE DISSIPATION:	
WITHOUT HEAT SINK -	
Up to 55°C	630 mW
Above 55°C	Derate linearly 6.67 mW/ $^\circ\text{C}$
WITH HEAT SINK -	
Up to 110°C	630 mW
Above 110°C	Derate linearly 16.7 mW/ $^\circ\text{C}$
TEMPERATURE RANGE:	
OPERATING (ALL TYPES)	-55 to $+125^\circ\text{C}$
STORAGE (ALL TYPES)	-65 to $+150^\circ\text{C}$
OUTPUT SHORT-CIRCUIT DURATION*	Indefinite
LEAD TEMPERATURE (DURING SOLDERING):	
At distance $1/16 \pm 1/32$ in. (1.59 ± 0.79 mm) from case for 10 s max.	$+265^\circ\text{C}$

*Short circuit may be applied to ground or to either supply.

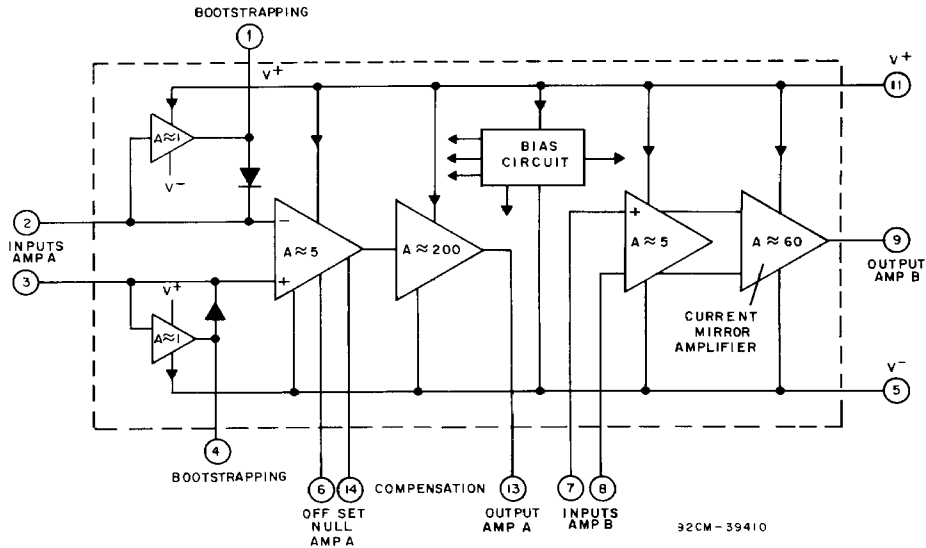


Fig. 1 - Block diagram of the CA5422.

ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN

At $V^+ = 5$, $V^- = 0$, $T_A = 25^\circ\text{C}$ Unless Otherwise Specified

CHARACTERISTIC		LIMITS						UNITS	
		AMPLIFIER A			AMPLIFIER B				
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Input Offset Voltage	$ V_{IO} $	—	1.8	10	—	2.8	10	mV	
Input Offset Current	$ I_{IO} $	—	0.02	4*	—	0.3	15	pA	
Input Bias Current	$ I_{IB} $	—	0.16	5*	—	0.4	25	pA	
Large-Signal Voltage Gain $V_O = 0.5\text{ V to }3.5\text{ V}$, $R_L = \infty$	A_{OL}	60	75	—	50	58	—	dB	
Common-Mode Rejection Ratio $V_{ICRA} = 0\text{ to }4\text{ V}$, $V_{ICRB} = 0\text{ to }3\text{ V}$	CMRR	60	75	—	45	60	—	dB	
Common-Mode Input Voltage Range	V_{ICR}^+	4	4.5	—	3	3.5	—	V	
	V_{ICR}^-	0	-0.5	—	0	-0.5	—		
Power Supply Rejection Ratio $\Delta V_{IO}/\Delta V$, $\Delta V = 2$	PSRR	70	85	—	50	60	—	dB	
Device Dissipation	P_D	—	9	—	—	—	—	mW	
Input Offset Voltage Temperature Drift	$\Delta V_{IO}/\Delta T$	—	20	—	—	20	—	$\mu\text{V}/^\circ\text{C}$	
Bootstrap Current to Null Input Current		—	20	—	—	—	—	μA	
I_{OUT}^+ to Gnd		30	50	—	2	3	—	μA	
I_{OUT}^- to +5 V		1.5	3.6	—	2	2.5	—	mA	
Gain-Bandwidth Product	f_t	—	160	—	—	1	—	kHz	
Slew Rate	SR	—	0.25	—	—	1	—	V/ μs	
Maximum Output Voltage Swing $R_L = \infty$	V_{OUT}							V	
	V_{OM}^+	4.8	4.9	—	4.8	4.95	—		
	V_{OM}^-	—	-0.04	-0.1	—	-0.003	-0.01		
	$R_L = 10\text{ k}\Omega$	V_{OM}^+	0.4	0.5	—	4.8	4.9		—
		V_{OM}^-	—	-0.03	-0.1	—	-0.003		-0.01
	$R_L = 2\text{ k}\Omega$	V_{OM}^+	0.075	0.1	—	4.45	4.7		—
V_{OM}^-		—	-0.035	-0.09	—	-0.003	-0.01		
Supply Current $V_O = 0.2\text{ V to }4.9\text{ V}$	I^+	—	400	700	—	400	700	μA	

*This specification is limited by high-speed production test equipment rather than the device.

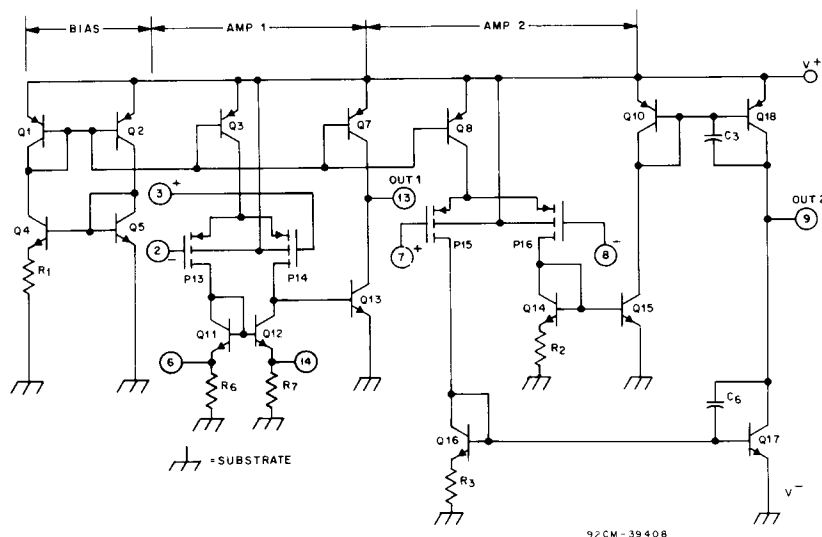


Fig. 2 - Simplified amplifier schematic diagram. (Input protection network not shown)

CA5422

ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN

At $V^+ = 1$, $V^- = 1$, $T_A = 25^\circ\text{C}$ Unless Otherwise Specified

CHARACTERISTIC		LIMITS						UNITS
		AMPLIFIER A			AMPLIFIER B			
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	$ V_{IO} $	—	2	10	—	5	15	mV
Input Offset Current	$ I_{IO} $	—	0.02	4*	—	0.3	10	pA
Input Bias Current	$ I_{IB} $	—	0.2	5*	—	0.5	15	pA
Large-Signal Voltage Gain	A_{OL}		TBE			TBE		
Common-Mode Rejection Ratio $V_{CM} = -0.2$ to -1 V	CMRR	65	70	—	TBE	TBE	—	dB
Common-Mode Input Voltage Range	V_{ICR}^{+}	0.2	0.5	—	TBE	TBE	—	V
	V_{ICR}^{-}	-1	-1.3	—	TBE	TBE	—	
Power Supply Rejection Ratio $\Delta V^{+} = 1$ V, $\Delta V^{-} = 1$ V	PSRR	60	75	—	50	60	—	dB
Output Current								
Source, $V_O = -1$ V	I_{SOURCE}	TBE				TBE		
Sink, $V_O = +1$ V	I_{SINK}	TBE				TBE		
Maximum Output Voltage Swing	V_{OUT}							V
	$R_L = \infty$ V_{OM}^{+} V_{OM}^{-}	TBE			0.9 -0.85	0.95 -0.91	— —	
	$R_L =$ V_{OM}^{+} V_{OM}^{-}	TBE			TBE			
	$R_L =$ V_{OM}^{+} V_{OM}^{-}	TBE			TBE			
Supply Current	I^{+}	—	300	700	—	300	700	μA

*This specification is limited by high-speed production test equipment rather than the device.

ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN

At $V^+ = 10$, $V^- = 10$, $T_A = 25^\circ\text{C}$ Unless Otherwise Specified

CHARACTERISTIC		LIMITS						UNITS
		AMPLIFIER A			AMPLIFIER B			
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage, $V_O = 1$ V	$ V_{IO} $	—	3.5	15	—	5	20	mV
Input Offset Current	$ I_{IO} $	—	0.3	4*	—	0.7	10	pA
Input Bias Current	$ I_{IB} $	—	0.5	5*	—	2	15	pA
Large-Signal Voltage Gain $V_O = \pm 7$ V	A_{OL}							
	$R_L = \infty$	70	75	—	60	63	—	dB
	$R_L = 10$ k Ω	60	70	—	35	40	—	
Common-Mode Rejection Ratio $V_{CM} = -10$ V to +5 V $V_{CM} = -10$ V to +9 V	CMRR							dB
		75	80	—	60	70	—	
		60	70	—	TBE	TBE	—	
Common-Mode Input Voltage Range	V_{ICR}^+	9	9.3	—	TBE	TBE	—	V
	V_{ICR}^-	-10	-10.3	—	TBE	TBE	—	
Power Supply Rejection Ratio $\Delta V^+ = 1$ V, $\Delta V^- = 1$ V	PSRR	60	75	—	60	70	—	dB
Output Current								
Source, $V_O = -10$ V	I_{SOURCE}	90	120	—	2000	5000	—	μ A
Sink, $V_O = +10$ V	I_{SINK}	2000	5000	—	2000	4000	—	
Maximum Output Voltage Swing $R_L = \infty$ $R_L = 10$ k Ω $R_L = 2$ k Ω	V_{OUT}							V
	V_{OM}^+	9.7	9.9	—	9.8	9.85	—	
	V_{OM}^-	-9.9	-10	—	-9.9	-9.9	—	
	V_{OM}^+	0.5	0.6	—	9.8	9.85	—	
	V_{OM}^-	-9.5	-9.95	—	-9.9	-9.9	—	
	V_{OM}^+	—	—	—	8	8.5	—	
	V_{OM}^-	-9	-9.5	—	-8	-9.5	—	
Supply Current	I^+	—	700	2000	—	700	2000	μ A

*This specification is limited by high-speed production test equipment rather than the device.

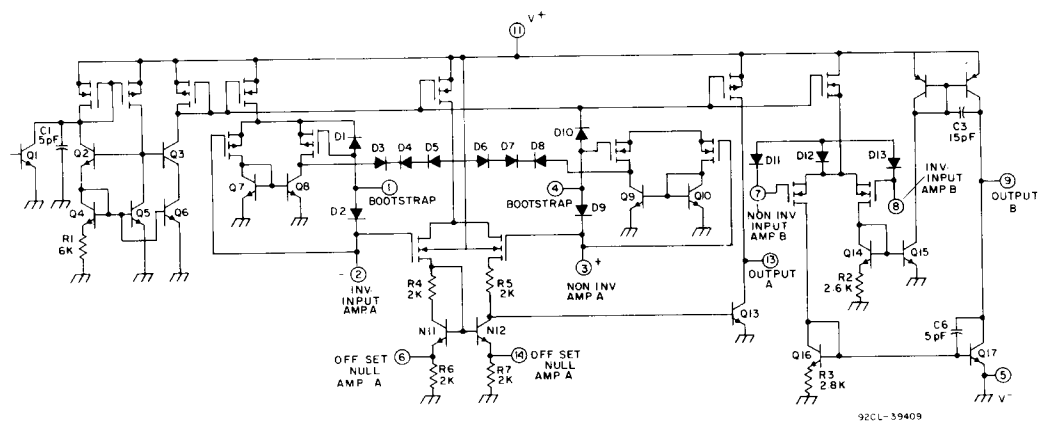


Fig. 3 - Complete schematic diagram of the amplifier.

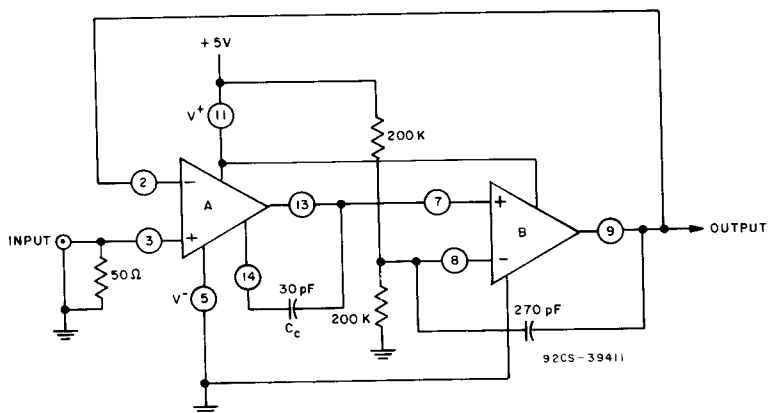


Fig. 4 - The CA5422 large and small-signal response circuit for the combined Amplifiers A and B.