Product Preview

CA5422

Dual BiMOS Operational Amplifier

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

Features:

- *Below 5-V supply at 400 μA 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.

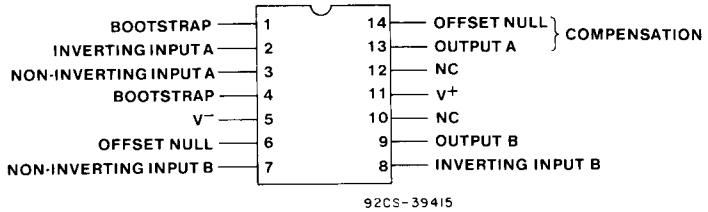
Applications

- *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

File Number **1731**

CA5422

MAXIMUM RATINGS, *Absolute-Maximum Values* ($T_C = 25°C$):

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/°C
  WITH HEAT SINK -
    Up to 110°C ..... 630 mW
    Above 110°C ..... Derate linearly 16.7 mW/°C
TEMPERATURE RANGE:
  OPERATING (ALL TYPES) ..... -55 to +125°C
  STORAGE (ALL TYPES) ..... -65 to +150°C
OUTPUT SHORT-CIRCUIT DURATION* ..... Indefinite
LEAD TEMPERATURE (DURING SOLDERING):
  At distance 1/16 ± 1/32 in. (1.59 ± 0.79 mm) from case for 10 s max. ..... +265°C

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

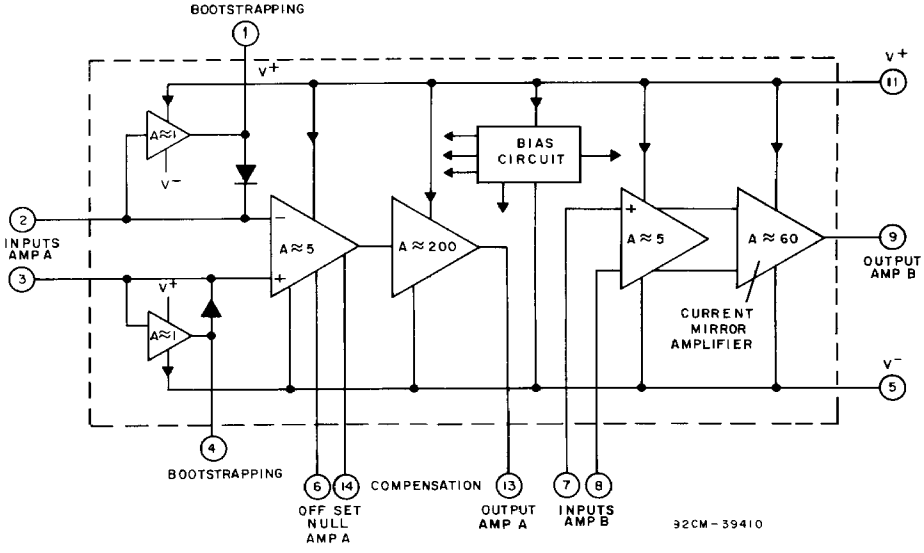


Fig. 1 - Block diagram of the CA5422.

ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN
At $V^+ = 5$, $V^- = 0$, $T_A = 25°C$ 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	$\|I_O\|$	—	0.02	4*	—	0.3	15	pA
Input Bias Current	$\|I_{IB}\|$	—	0.16	5*	—	0.4	25	pA
Large-Signal Voltage Gain $V_O = 0.5$ V to 3.5 V, $R_L = \infty$	A_{OL}	60	75	—	50	58	—	dB
Common-Mode Rejection Ratio $V_{ICR_A} = 0$ to 4 V, $V_{ICR_B} = 0$ to 3 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	—	μV/°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	V_{OUT}							V
$R_L = \infty$	V_{OM}^+	4.8	4.9	—	4.8	4.95	—	
	V_{OM}^-	—	-0.04	-0.1	—	-0.003	-0.01	
$R_L = 10$ kΩ	V_{OM}^+	0.4	0.5	—	4.8	4.9	—	
	V_{OM}^-	—	-0.03	-0.1	—	-0.003	-0.01	
$R_L = 2$ kΩ	V_{OM}^+	0.075	0.1	—	4.45	4.7	—	
	V_{OM}^-	—	-0.035	-0.09	—	-0.003	-0.01	
Supply Current $V_O = 0.2$ V to 4.9 V	I^+	—	400	700	—	400	700	μA

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

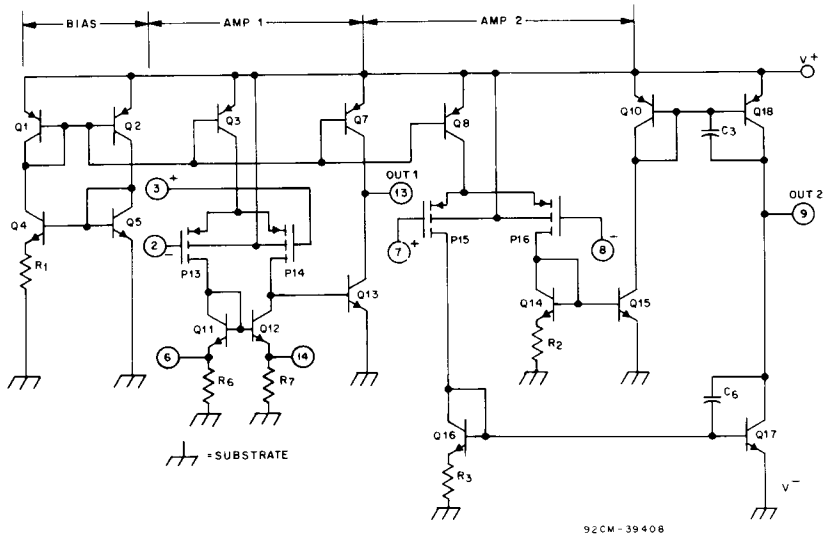


Fig. 2 - Simplified amplifier schematic diagram. (Input protection network not shown)

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ELECTRICAL CHARACTERISTICS FOR EQUIPMENT DESIGN
At V^+ = 1, V^- = 1, T_A = 25°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	$\|I_O\|$	—	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 ΔV^+ = 1 V, ΔV^- = 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}^+		TBE		0.9	0.95	—	
	V_{OM}^-				-0.85	-0.91	—	
R_L =	V_{OM}^+		TBE			TBE		
	V_{OM}^-							
R_L =	V_{OM}^+		TBE			TBE		
	V_{OM}^-							
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°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	$\|I_O\|$	—	0.3	4*	—	0.7	10	pA
Input Bias Current	$\|I_{IB}\|$	—	0.5	5*	—	2	15	pA
Large-Signal Voltage Gain	A_{OL}							
V_O = ±7 V, $R_L = \infty$		70	75	—	60	63	—	dB
R_L = 10 kΩ		60	70	—	35	40	—	
Common-Mode Rejection Ratio	CMRR							
V_{CM} = -10 V to +5 V		75	80	—	60	70	—	dB
V_{CM} = -10 V to +9 V		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 ΔV^+ = 1 V, ΔV^- = 1 V	PSRR	60	75	—	60	70	—	dB
Output Current								
Source, V_O = -10 V	I_{SOURCE}	90	120	—	2000	5000	—	μA
Sink, V_O = +10 V	I_{SINK}	2000	5000	—	2000	4000	—	
Maximum Output Voltage Swing	V_{OUT}							
$R_L = \infty$	V_{OM}^+	9.7	9.9	—	9.8	9.85	—	
	V_{OM}^-	-9.9	-10	—	-9.9	-9.9	—	
R_L = 10 kΩ	V_{OM}^+	0.5	0.6	—	9.8	9.85	—	V
	V_{OM}^-	-9.5	-9.95	—	-9.9	-9.9	—	
R_L = 2 kΩ	V_{OM}^+	—	—	—	8	8.5	—	
	V_{OM}^-	-9	-9.5	—	-8	-9.5	—	
Supply Current	I^+	—	700	2000	—	700	2000	μA

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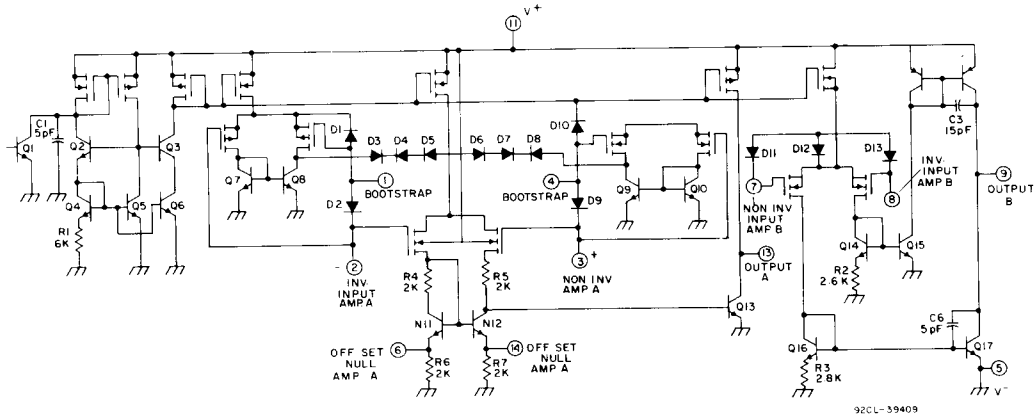

Fig. 3 - Complete schematic diagram of the amplifier.

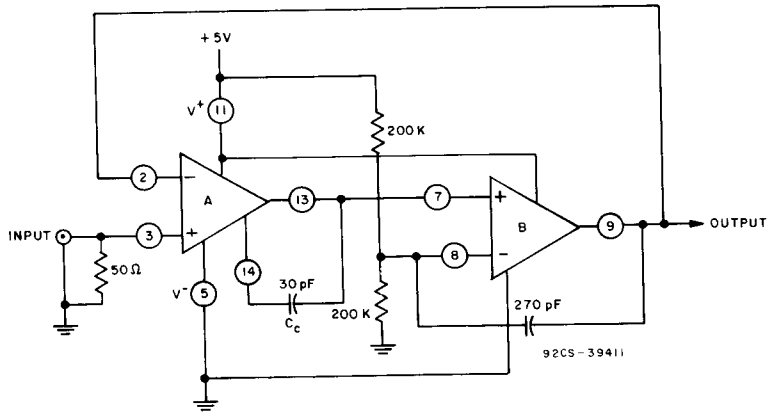

Fig. 4 - The CA5422 large and small-signal response circuit for the combined Amplifiers A and B.