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CA5470

May 2001

Quad, 14MHz, Microprocessor BiMOS-E Operational Amplifier with MOSFET Input/Bipolar Output

Features

- **High Speed CMOS Input Stage Provides**
  - **Very High Z_I . . . . . 5TΩ (5 x $10^{12}\Omega$) (Typ)**
  - **Very Low I_I . . . . . 0.5pA (Typ) at 5V Operation**
  - **Very Low I_{IO} . . . . . 0.5pA (Typ) at 5V Operation**
- **ESD Protection to 2000V**
- **3V to 16V Power Supply Operation**
- **Fully Guaranteed Specifications Over Full Military Range**
- **Wide BW (14MHz); High SR (5V/μs) at 5V Supply**
- **Wide V_{ICR} Range From -0.5V to 3.7V (Typ) at 5V Supply**
- **Ideally Suited for CMOS and HCMOS Applications**

Applications

- **Bar Code Readers**
- **Photodiode Amplifiers (IR)**
- **Microprocessor Buffering**
- **Ground Reference Single Supply Amplifiers**
- **Fast Sample and Hold**
- **Timers**
- **Voltage Controlled Oscillators**
- **Voltage Followers**
- **V to I Converters**
- **Peak Detectors**
- **Precision Rectifiers**
- **5V Logic Systems**
- **3V Logic Systems**

Description

The CA5470 is an operational amplifier that combines the advantages of both high speed CMOS and bipolar transistors on a single monolithic chip. It is constructed in the BiMOS-E process which adds drain-extension implants to 3μm polygate CMOS, enhancing both the voltage capability and providing vertical bipolar transistors for broadband analog/digital functions. This process lends itself easily to high speed operational amplifiers, comparators, analog switches and interface peripherals, resulting in twice the speed of the conventional CMOS transistors having similar feature size.

BiMOS-E are broadbased bipolar transistors that have high transconductance, gains more constant with current level, stable "precision" base-emitter offset voltages and superior drive capability. Excellent interface with environmental potentials enable use in 5V logic systems and future 3.3V logic systems. Refer to Application Note AN8811.

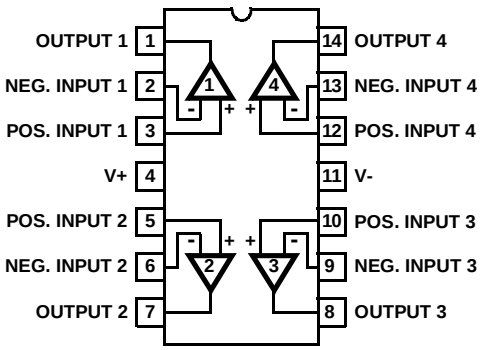
ESD capability exceeds the standard 2000V level. The CA5470 series can operate with single supply voltages from 3V to 16V or $\pm$1.5V to $\pm$8V. They have guaranteed specifications at both 5V and $\pm$7.5V at room temperature as well as over the full -55^{o}C to 125^{o}C military range.

Part Number Information

PART NUMBER (BRAND)	TEMP. RANGE (^{o}C)	PACKAGE	PKG. NO.
CA5470E	-55 to 125	14 Ld PDIP	E14.3
CA5470M (5470)	-55 to 125	14 Ld SOIC	M14.15
CA5470M96 (5470)	-55 to 125	14 Ld SOIC Tape and Reel	M14.15

Pinout

CA5470 (PDIP, SOIC)
TOP VIEW



CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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File Number **1946.4**

Absolute Maximum Ratings

DC Supply Voltage (Between V+ And V- Terminals) 16V
Differential Input Voltage 8V
Input Voltage . . . . . (V+ +8V) to (V- -0.5V)
Input Current. 1mA
Output Short Circuit Duration (Note 1) . . . . . Indefinite

Operating Conditions

Temperature Range . . . . . -55^oC to 125^oC

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} ($^oC/W$)
PDIP Package	80
SOIC Package	175

Maximum Junction Temperature (Die) . . . . . 175^oC
Maximum Junction Temperature (Plastic Package) . . . . . 150^oC
Maximum Storage Temperature Range . . . . . -65^oC to 150^oC
Maximum Lead Temperature (Soldering 10s). . . . . 300^oC
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. Short circuit may be applied to ground or to either supply.
2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

Typical Values Intended Only for Design Guidance at V+ = 5V, V- = 0V, $T_A = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	TYPICAL VALUES	UNITS
Input Resistance	R_I		5	TΩ
Input Capacitance	C_I	f = 1MHz	3.1	pF
Unity Gain Crossover Frequency	f_T		14	MHz
Slew Rate	SR	$V_{OUT} = 3.65V_{P-P}$	5	V/µs
Transient Response:		C_L = 25pF, R_L= 2kΩ (Voltage Follower)		
Rise Time/Fall Time	t_r		27/25	ns
Overshoot	OS		20	%
Settling Time (To <0.1%, $V_{IN} = 4V_{P-P}$)	t_S	C_L = 25pF, R_L= 2kΩ (Voltage Follower)	1	µs
Full Power BW, SR = 5V/µs	FPBW	A_V = 1, $V_{OUT} = 3.65V_{P-P}$	436	kHz

Electrical Specifications

$T_A = 25^oC$, V+ = 5V, V- = GND

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$\|V_{IO}\|$		-	6	22	mV
Input Offset Current	$\|I_{IO}\|$		-	0.5	50 (Note 3)	pA
Input Current	I_I		-	0.5	50 (Note 3)	pA
Common Mode Input Range	V_{ICR}		3.5	-0.5 to 3.7	0	V
Common Mode Rejection Ratio	CMRR	V_{ICR} = 0V to 3.5V	55	70	-	dB
Power Supply Rejection Ratio	PSRR	ΔV = 2V	60	75	-	dB
Positive Output Voltage Swing	$V_{OM}+$	R_L = 2kΩ to GND	4	4.4	-	V
Negative Output Voltage Swing	$V_{OM}-$	R_L = 2kΩ to GND	-	0.06	0.10	V
Total Supply Current	I_{SUPPLY}	V_{OUT} = 2.5V, $R_L = \infty$	-	6	7	mA
Unity Gain Bandwidth Product	f_T		10	14	-	MHz
Slew Rate	SR		4	5	-	V/µs
Output Current						
Source to opposite supply	I_{SOURCE}		4	5.5	-	mA
Sink to opposite supply	I_{SINK}		1.0	1.2	-	mA
Open Loop Gain	A_{OL}	0.5V to 3.5V, R_L = 10kΩ	80	90	-	dB

NOTE:

3. This is the lowest value that can be tested reliably. Almost all devices will be <10pA.

Electrical Specifications $T_A = -55^oC$ to 125^oC, V+ = 5V, V- = GND

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$\|V_{IO}\|$		-	6	25	mV
Input Offset Current	$\|I_{IO}\|$		-	550	5500	pA
Input Current	I_I		-	550	11000	pA
Common Mode Input Range	V_{ICR}		3.5	-0.5 to 3.7	0	V
Common Mode Rejection Ratio	CMRR	V_{ICR} = 0V to 3.5V	50	65	-	dB
Power Supply Rejection Ratio	PSRR	ΔV = 2V	58	75	-	dB
Positive Output Voltage Swing	$V_{OM}+$	R_L = 2kΩ to GND	3.8	4.2	-	V
Negative Output Voltage Swing	$V_{OM}-$	R_L = 2kΩ to GND	-	0.08	0.11	V
Total Supply Current	I_{SUPPLY}	V_{OUT} = 2.5V	-	9	11	mA
Unity Gain Bandwidth Product	f_T		8	12	-	MHz
Slew Rate	SR		3	5	-	V/µs
Output Current						
Source to opposite supply	I_{SOURCE}		4	5.5	-	mA
Sink to opposite supply	I_{SINK}		0.8	1.2	-	mA
Open Loop Gain	A_{OL}	0.5V to 3.5V, R_L = 10kΩ	80	90	-	dB

Electrical Specifications $T_A = 25^oC$, $V_{SUPPLY} = \pm 7.5V$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$\|V_{IO}\|$		-	5	25	mV
Input Offset Current	$\|I_{IO}\|$		-	0.5	50 (Note 4)	pA
Input Current	I_I		-	1	50 (Note 4)	pA
Common Mode Input Range	V_{ICR}		5.8	-7.8 to 6.0	-7.5	V
Common Mode Rejection Ratio	CMRR	V_{ICR} = 0V to 13.3V	60	70	-	dB
Power Supply Rejection Ratio	PSRR	ΔV = 1V	60	76	-	dB
Positive Output Voltage Swing	$V_{OM}+$					
		R_L = 2kΩ to GND	6.3	6.5	-	V
		R_L = 10kΩ to GND	6.4	6.6	-	V
Negative Output Voltage Swing	$V_{OM}-$					
		R_L = 2kΩ to GND	-	-2.6	-2	V
		R_L = 10kΩ to GND	-	-7.3	-7.1	V
Total Supply Current	I_{SUPPLY}	V_{OUT} = GND, $R_L = \infty$	-	10	12	mA
Unity Gain Bandwidth Product	f_T		12	16	-	MHz
Slew Rate	SR		4	7	-	V/µs
Output Current						
Source to opposite supply	I_{SOURCE}		6.2	6.8	-	mA
Sink to opposite supply	I_{SINK}		1	1.4	-	mA
Open Loop Gain	A_{OL}	-5V to +5V, R_L = 10kΩ	80	90	-	dB

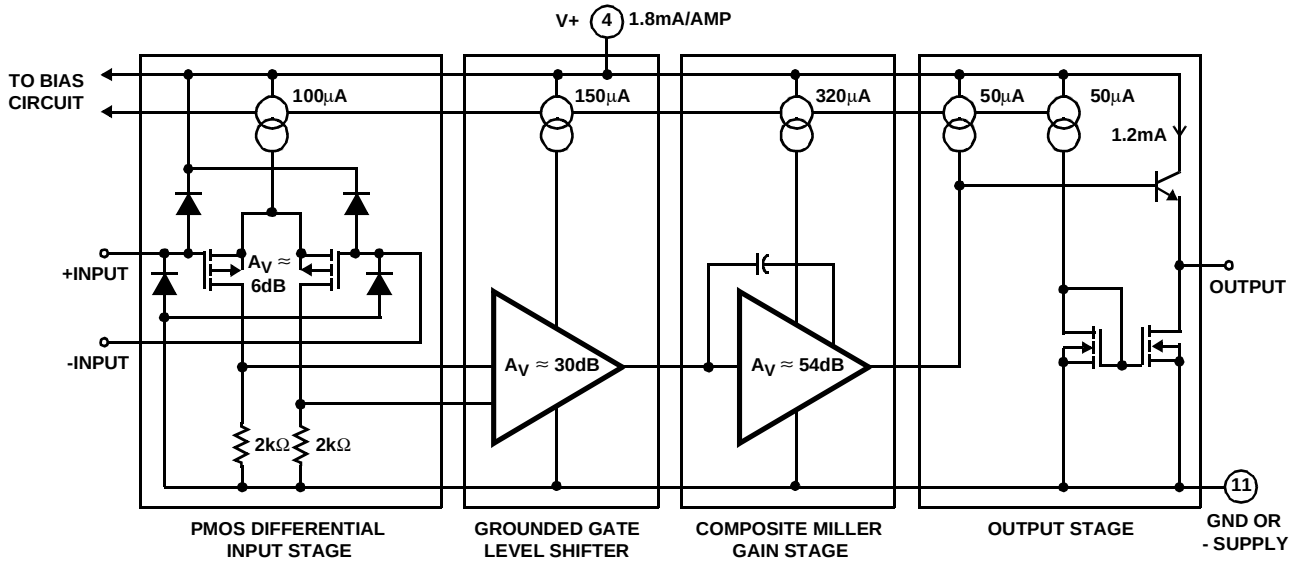
NOTE:

4. This is the lowest value that can be tested reliably. Almost all devices will be <10pA.

Electrical Specifications $T_A = -55^oC$ to 125^oC, $V_{SUPPLY} = \pm 7.5V$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$\|V_{IO}\|$		-	5	30	mV
Input Offset Current	$\|I_{IO}\|$		-	550	5500	pA
Input Current	I_I		-	1100	11000	pA
Common Mode Input Range	V_{ICR}		5.8	-7.8 to 6.0	-7.5	V
Common Mode Rejection Ratio	CMRR	V_{ICR} = 0V to 3.5V	58	70	-	dB
Power Supply Rejection Ratio	PSRR	ΔV = 1V	60	76	-	dB
Positive Output Voltage Swing	$V_{OM}+$					
		R_L = 2kΩ to GND	4.75	5.5	-	V
		R_L = 10kΩ to GND	6.1	6.4	-	V
Negative Output Voltage Swing	$V_{OM}-$					
		R_L = 2kΩ to GND	-	-2.6	-2	V
		R_L = 10kΩ to GND	-	-7.3	-7.1	V
Total Supply Current	I_{SUPPLY}	V_{OUT} = GND, $R_L = \infty$	-	12	18	mA
Unity Gain Bandwidth Product	f_T		10	15	-	MHz
Slew Rate	SR		3	7	-	V/μs
Output Current						
Source to opposite supply	I_{SOURCE}		6.2	6.8	-	mA
Sink to opposite supply	I_{SINK}		1	1.4	-	mA
Open Loop Gain	A_{OL}	-5V to +5V, R_L = 10kΩ	80	90	-	dB

Block Diagram ($^1/_4$ of CA5470)



Typical Performance Curve

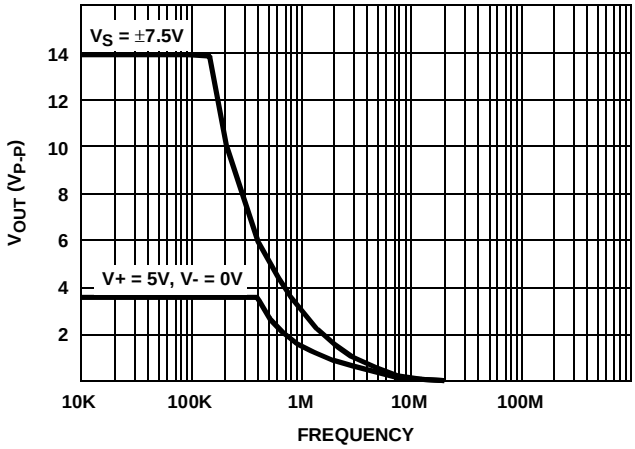


FIGURE 1. MAXIMUM OUTPUT VOLTAGE SWING vs FREQUENCY

Metallization Mask Layout

Dimensions in parentheses are in millimeters and derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

The layout represents a chip when it is part of the wafer. When the wafer is cut into chips, the cleavage angles are 57^{o} instead of 90^{o} with respect to the face of the chip. Therefore, the isolated chip is actually 7 mils (0.17mm) larger in both dimensions.

