

3MHz, BiMOS Microprocessor Operational Amplifiers with MOSFET Input/CMOS Output

November 1996

Features

- **MOSFET Input Stage provides**
 - Very High $Z_i = 1.5T\Omega$ ($1.5 \times 10^{12}\Omega$) (Typ)
 - Very Low $I_i = 5pA$ (Typ) at 15V Operation
 $= 2pA$ (Typ) at 5V Operation
- **Ideal for Single Supply Applications**
- **Common Mode Input Voltage Range Includes Negative Supply Rail; Input Terminals Can be Swung 0.5V Below Negative Supply Rail**
- **CMOS Output Stage Permits Signal Swing to Either (or Both) Supply Rails**
- **CA5260A, CA5260 Have Full Military Temperature Range Guaranteed Specifications for $V_+ = 5V$**
- **CA5260A, CA5260 are Guaranteed to Operate Down to 4.5V for A_{OL}**
- **Fully Guaranteed to Operate from $-55^\circ C$ to $125^\circ C$ at $V_+ = 5V, V_- = GND$**

Applications

- **Ground Referenced Single Supply Amplifiers**
- **Fast Sample-Hold Amplifiers**
- **Long Duration Timers/Monostables**
- **Ideal Interface with Digital CMOS**
- **High Input Impedance Wideband Amplifiers**
- **Voltage Followers (e.g., Follower for Single Supply D/A Converter)**
- **Voltage Regulators (Permits Control of Output Voltage Down to 0V)**
- **Wien Bridge Oscillators**
- **Voltage Controlled Oscillators**
- **Photo Diode Sensor Amplifiers**
- **5V Logic Systems**
- **Microprocessor Interface**

Description

The CA5260A and CA5260 are integrated-circuit operational amplifiers that combine the advantage of both CMOS and bipolar transistors on a monolithic chip. The CA5260 series circuits are dual versions of the popular CA5160 series. They are designed and guaranteed to operate in microprocessor or logic systems that use +5V supplies.

Gate-protected P-Channel MOSFET (PMOS) transistors are used in the input circuit to provide very-high-input impedance, very-low-input current, and exceptional speed performance. The use of PMOS field-effect transistors in the input stage results in common-mode input-voltage capability down to 0.5V below the negative-supply terminal, an important attribute in single-supply applications.

A complementary-symmetry MOS (CMOS) transistor-pair, capable of swinging the output voltage to within 10mV of either supply-voltage terminal (at very high values of load impedance), is employed as the output circuit.

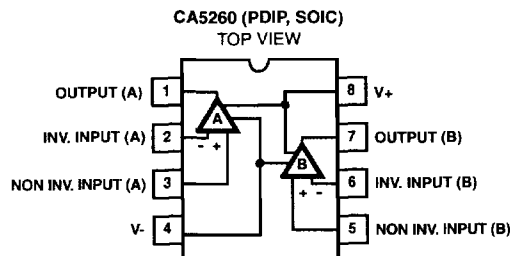
The CA5260 Series circuits operate at supply voltages ranging from 4.5V to 16V, or $\pm 2.25V$ to $\pm 8V$ when using split supplies.

The CA5260, CA5260A have guaranteed specifications for 5V operation over the full military temperature range of $-55^\circ C$ to $125^\circ C$.

Ordering Information

| PART NUMBER (BRAND) | TEMP. RANGE ($^\circ C$) | PACKAGE | PKG. NO. |
|---------------------|----------------------------|-------------------------|----------|
| CA5260AE | -55 to 125 | 8 Ld PDIP | E8.3 |
| CA5260AM (5260A) | -55 to 125 | 8 Ld SOIC | M8.15 |
| CA5260AM96 (5260A) | -55 to 125 | 8 Ld SOIC Tape and Reel | M8.15 |
| CA5260E | -55 to 125 | 8 Ld PDIP | E8.3 |
| CA5260M (5260) | -55 to 125 | 8 Ld SOIC | M8.15 |
| CA5260M96 (5260) | -55 to 125 | 8 Ld SOIC Tape and Reel | M8.15 |

Pinout



CA5260, CA5260A

Absolute Maximum Ratings

| | |
|--|------------------------|
| 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°C to 125°C |
|-------------------|----------------|

Thermal Information

| | |
|--|----------------------------------|
| Thermal Resistance (Typical, Note 2) | θ_{JA} (°C/W) |
| PDIP Package | 96 |
| SOIC Package | 157 |
| Maximum Junction Temperature (Die) | 175°C |
| Maximum Junction Temperature (Plastic Package) | 150°C |
| Maximum Storage Temperature Range | -65°C to 150°C |
| Maximum Lead Temperature (Soldering 10s) | 300°C (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:

- Short circuit may be applied to ground or to either supply.
- 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, V+ = 5V, V- = 0V, T_A = 25°C, Unless Otherwise Specified

| PARAMETER | SYMBOL | TEST CONDITIONS | TYPICAL VALUES | | UNITS |
|---|----------------|---|----------------|---------|-------|
| | | | CA5260 | CA5260A | |
| Input Resistance | R _I | | 1.5 | 1.5 | TΩ |
| Input Capacitance | C _I | f = 1MHz | 4.3 | 4.3 | pF |
| Unity Gain Crossover Frequency | f _T | | 3 | 3 | MHz |
| Slew Rate | SR | V _{OUT} = 2.5V _{P-P} | 5 | 5 | V/μs |
| Transient Response | t _r | C _L = 25pF, R _L = 2kΩ (Voltage Follower) | 0.09 | 0.09 | μs |
| | | | Overshoot | OS | 10 |
| Settling Time (T ₀ < 0.1%, V _{IN} = 4V _{P-P}) | t _S | C _L = 25pF, R _L = 2kΩ (Voltage Follower) | 1.8 | 1.8 | μs |

Electrical Specifications

T_A = 25°C, V+ = 5V, V- = 0V

| PARAMETER | SYMBOL | TEST CONDITIONS | CA5260 | | | CA5260A | | | UNITS |
|------------------------------------|---------------------|---|--------|------|------|---------|------|------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | V _{IO} | V _O = 2.5V | - | 2 | 15 | - | 1.5 | 4 | mV |
| Input Offset Current | I _{IO} | V _O = 2.5V | - | 1 | 10 | - | 1 | 10 | pA |
| Input Current | I _I | V _O = 2.5V | - | 2 | 15 | - | 2 | 15 | pA |
| Common Mode Rejection Ratio | CMRR | V _{CM} = 0 to 1V | 70 | 85 | - | 80 | 85 | - | dB |
| | | V _{CM} = 0 to 2.5V | 50 | 55 | - | 50 | 55 | - | dB |
| Common Mode Input Voltage Range | V _{ICR+} | | 2.5 | 3 | - | 2.5 | 3 | - | V |
| | V _{ICR-} | | - | -0.5 | 0 | - | -0.5 | 0 | V |
| Power Supply Rejection Ratio | PSRR | ΔV+ = 1V; ΔV- = 1V | 70 | 84 | - | 75 | 84 | - | dB |
| Large Signal Voltage Gain (Note 3) | A _{OL} | R _L = ∞, V _O = 0.5 to 4V | 105 | 111 | - | 107 | 113 | - | dB |
| | | R _L = 10kΩ, V _O = 0.5 to 3.6V | 80 | 86 | - | 83 | 86 | - | dB |
| Source Current | I _{SOURCE} | V _O = 0V | 1.75 | 2.2 | - | 1.75 | 2.2 | - | mA |
| Sink Current | I _{SINK} | V _O = 5V | 1.70 | 2 | - | 1.70 | 2 | - | mA |
| Output Voltage | V _{OM+} | R _L = ∞ | 4.99 | 5 | - | 4.99 | 5 | - | V |
| | V _{OM-} | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| | V _{OM+} | R _L = 10kΩ | 4.4 | 4.7 | - | 4.4 | 4.7 | - | V |
| | V _{OM-} | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| | V _{OM+} | R _L = 2kΩ | 3 | 3.4 | - | 3 | 3.4 | - | V |
| | V _{OM-} | | - | 0 | 0.01 | - | 0 | 0.01 | V |

3

OPERATIONAL
AMPLIFIERS

CA5260, CA5260A

Electrical Specifications $T_A = 25^\circ\text{C}$, $V_+ = 5\text{V}$, $V_- = 0\text{V}$ (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | CA5260 | | | CA5260A | | | UNITS |
|----------------|---------------------|---------------------|--------|------|------|---------|------|------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Supply Current | I_{SUPPLY} | $V_O = 0\text{V}$ | - | 1.60 | 2.0 | - | 1.60 | 2.0 | mA |
| | | $V_O = 2.5\text{V}$ | - | 1.80 | 2.25 | - | 1.80 | 2.25 | mA |

NOTE:

3. For $V_+ = 4.5\text{V}$ and $V_- = \text{GND}$; $V_{\text{OUT}} = 0.5\text{V}$ to 3.2V at $R_L = 10\text{k}\Omega$.

Electrical Specifications $T_A = -55^\circ\text{C}$ to 125°C , $V_+ = 5\text{V}$, $V_- = 0\text{V}$

| PARAMETER | SYMBOL | TEST CONDITIONS | CA5260 | | | CA5260A | | | UNITS |
|------------------------------------|---------------------|--|--------|------|------|---------|------|------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | V_{IO} | $V_O = 2.5\text{V}$ | - | 3 | 20 | - | 2 | 15 | mV |
| Input Offset Current | I_{IO} | $V_O = 2.5\text{V}$ | - | 1 | 10 | - | 1 | 10 | nA |
| Input Current | I_{I} | $V_O = 2.5\text{V}$ | - | 2 | 15 | - | 2 | 15 | nA |
| Common Mode Rejection Ratio | CMRR | $V_{\text{CM}} = 0$ to 1V | 60 | 78 | - | 65 | 78 | - | dB |
| | | $V_{\text{CM}} = 0$ to 2.5V | 50 | 60 | - | 50 | 60 | - | dB |
| Common Mode Input Voltage Range | $V_{\text{ICR}+}$ | | 2.5 | 3 | - | 2.5 | 3 | - | V |
| | $V_{\text{ICR}-}$ | | - | -0.5 | 0 | - | -0.5 | 0 | V |
| Power Supply Rejection Ratio | PSRR | $\Delta V_+ = 1\text{V}$; $\Delta V_- = 1\text{V}$ | 60 | 65 | - | 62 | 65 | - | dB |
| Large Signal Voltage Gain (Note 4) | A_{OL} | $R_L = \infty$, $V_O = 0.5$ to 4V | 70 | 78 | - | 70 | 78 | - | dB |
| | | $R_L = 10\text{k}\Omega$, $V_O = 0.5$ to 3.6V | 60 | 65 | - | 60 | 65 | - | dB |
| Source Current | I_{SOURCE} | $V_O = 0\text{V}$ | 1.3 | 1.6 | - | 1.3 | 1.6 | - | mA |
| Sink Current | I_{SINK} | $V_O = 5\text{V}$ | 1.2 | 1.4 | - | 1.2 | 1.4 | - | mA |
| Output Voltage | $V_{\text{OM}+}$ | $R_L = \infty$ | 4.99 | 5 | - | 4.99 | 5 | - | V |
| | $V_{\text{OM}-}$ | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| | $V_{\text{OM}+}$ | $R_L = 10\text{k}\Omega$ | 4.2 | 4.4 | - | 4.2 | 4.4 | - | V |
| | $V_{\text{OM}-}$ | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| | $V_{\text{OM}+}$ | $R_L = 2\text{k}\Omega$ | 2.5 | 2.7 | - | 2.5 | 2.7 | - | V |
| | $V_{\text{OM}-}$ | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| Supply Current | I_{SUPPLY} | $V_O = 0\text{V}$ | - | 1.65 | 2.2 | - | 1.65 | 2.2 | mA |
| | | $V_O = 2.5\text{V}$ | - | 1.95 | 2.35 | - | 1.95 | 2.35 | mA |

NOTE:

4. For $V_+ = 4.5\text{V}$ and $V_- = \text{GND}$; $V_{\text{OUT}} = 0.5\text{V}$ to 3.2V at $R_L = 10\text{k}\Omega$.

Electrical Specifications Each Amplifier at $T_A = 25^\circ\text{C}$, $V_+ = 15\text{V}$, $V_- = 0\text{V}$. Unless Otherwise Specified

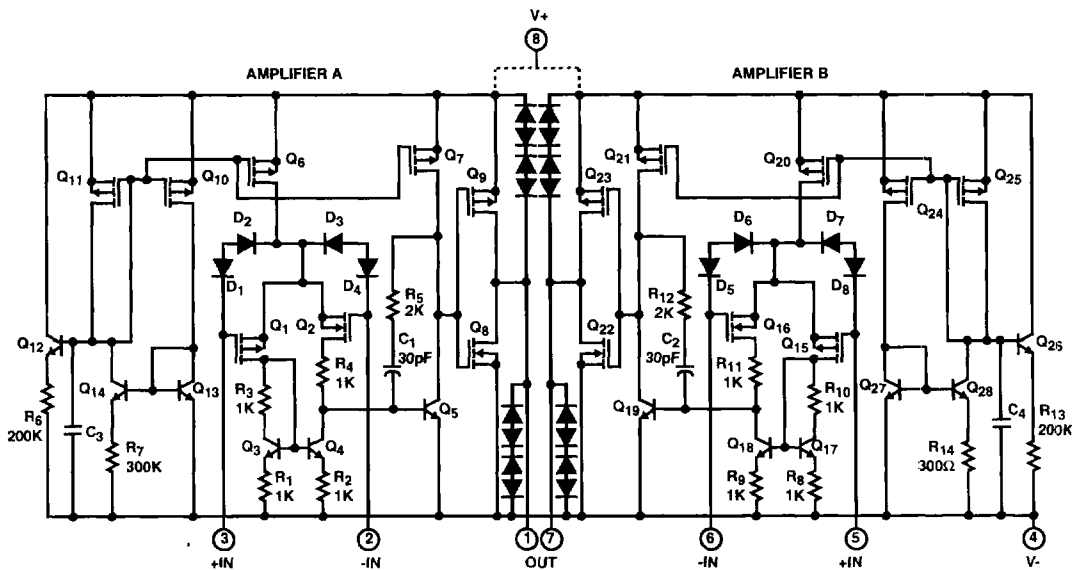
| PARAMETER | SYMBOL | TEST CONDITIONS | CA5260 | | | CA5260A | | | UNITS |
|-----------------------------|-----------------|---|--------|-----|-----|---------|-----|-----|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Input Offset Voltage | V_{IO} | $V_S = \pm 7.5$ | - | 6 | 15 | - | 2 | 5 | mV |
| Input Offset Current | I_{IO} | $V_S = \pm 7.5$ | - | 0.5 | 30 | - | 0.5 | 20 | pA |
| Input Current | I_{I} | $V_S = \pm 7.5$ | - | 5 | 50 | - | 5 | 30 | pA |
| Large Signal Voltage Gain | A_{OL} | $V_O = 10\text{V}_{\text{P-P}}$, $R_L = 10\text{k}\Omega$ | 50 | 320 | - | 50 | 320 | - | kV/V |
| | | | 94 | 110 | - | 94 | 110 | - | dB |
| Common Mode Rejection Ratio | CMRR | | 70 | 90 | - | 80 | 95 | - | dB |

CA5260, CA5260A

Electrical Specifications Each Amplifier at $T_A = 25^\circ\text{C}$, $V_+ = 15\text{V}$, $V_- = 0\text{V}$, Unless Otherwise Specified (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | CA5260 | | | CA5260A | | | UNITS |
|--|----------------------------|--|--------|------------|------|---------|------------|------|------------------------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Common Mode Input Voltage Range | V_{ICR} | | 10 | -0.5 to 12 | 0 | 10 | -0.5 to 12 | 0 | V |
| Power Supply Rejection Ratio, $\Delta V_{IO} / \Delta V_{\pm}$ | PSRR | $V_S = \pm 7.5$ | - | 32 | 320 | - | 32 | 150 | $\mu\text{V/V}$ |
| Maximum Output Voltage | V_{OM+} | $R_L = 10\text{k}\Omega$ | 11 | 13.3 | - | 11 | 13.3 | - | V |
| | V_{OM-} | | - | 0.002 | 0.01 | - | 0.002 | 0.01 | V |
| | V_{OM+} | $R_L = \infty$ | 14.99 | 15 | - | 14.99 | 15 | - | V |
| | V_{OM-} | | - | 0 | 0.01 | - | 0 | 0.01 | V |
| Maximum Output Current | I_{OM+} (Source) | $V_O = 7.5\text{V}$ | 12 | 22 | 45 | 12 | 22 | 45 | mA |
| | I_{OM-} (Sink) | | 12 | 20 | 45 | 12 | 20 | 45 | mA |
| Total Supply Current, $R_L = \infty$ | I+ | V_O (Amp A) = 7.5V V_O (Amp B) = 7.5V | - | 9 | 16.5 | - | 9 | 16.5 | mA |
| | | V_O (Amp A) = 0V V_O (Amp B) = 0V | - | 1.2 | 4 | - | 1.2 | 4 | mA |
| | | V_O (Amp A) = 0V V_O (Amp B) = 7.5V | - | 5 | 9.5 | - | 5 | 9.5 | mA |
| | | V_O (Amp A) = 7.5V V_O (Amp B) = 0V | - | 1.2 | 4 | - | 1.2 | 4 | mA |
| Input Offset Voltage Temperature Drift | $\Delta V_{IO} / \Delta T$ | | - | 8 | - | - | 6 | - | $\mu\text{V}/^\circ\text{C}$ |
| Crosstalk | | f = 1kHz | - | 120 | - | - | 120 | - | dB |

Schematic Diagram



3

OPERATIONAL
AMPLIFIERS