

## Rail-to-Rail Dual Op Amp

### Features

- Small Footprint MSOP-8 Package
- 350  $\mu$ A Supply Current per Op Amp at 2.2V Supply
- Guaranteed 2.2V, 5V, and 15V Performance
- 750 kHz Gain-Bandwidth Product at 2.2V Supply
- 0.01% Total Harmonic Distortion at 1 kHz (15V, 2 k $\Omega$ )
- Drives 200 pF at 5V and Greater Supply Voltages

### Applications

- Battery-Powered Instrumentation
- PCMCIA, USB Peripherals
- Portable Computers and PDAs

### General Description

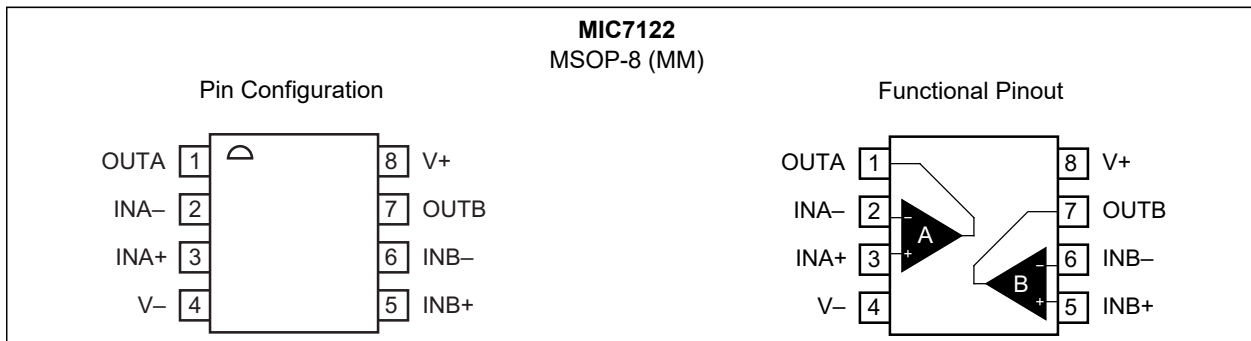
The MIC7122 is a dual high-performance CMOS operational amplifier featuring rail-to-rail inputs and outputs.

The input common-mode range extends beyond the rails by 300 mV, and the output voltage swings to within 150  $\mu$ V of both rails when driving a 100 k $\Omega$  load.

The amplifiers operate from 2.2V to 15V and are fully specified at 2.2V, 5V, and 15V. Gain bandwidth and slew rate are 750 kHz and 0.7 V/ $\mu$ s, respectively at a 2.2V supply.

The MIC7122 is available in an 8-lead MSOP package.

### Package Type



# MIC7122

---

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

|  |                                    |
|--|------------------------------------|
| Supply Voltage ( $V_{V+} - V_{V-}$ ).....                            | +16.5V                             |
| Differential Input Voltage ( $V_{IN+} - V_{IN-}$ ).....              | ±10V                               |
| I/O Pin Voltage ( $V_{IN}$ , $V_{OUT}$ <a href="#">Note 1</a> )..... | $V_{V+} + 0.3V$ to $V_{V-} - 0.3V$ |
| ESD Rating ( <a href="#">Note 2</a> ).....                           | 1 kV                               |

### Operating Ratings ‡

|   |               |
|---|---------------|
| Supply Voltage ( $V_{V+} - V_{V-}$ )..... | +2.2V to +15V |
|---|---------------|

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ **Notice:** The device is not guaranteed to function outside its operating ratings.

**Note 1:** I/O Pin Voltage is any external voltage to which an input or output is referenced.

**2:** Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5 k $\Omega$  in series with 100 pF.

## DC ELECTRICAL CHARACTERISTICS (2.2V)

$V_{V+} = +2.2V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                         | Sym.       | Min. | Typ. | Max. | Units                        | Conditions  |
|------------------------------------|------------|------|------|------|------------------------------|---|
| Input Offset Voltage               | $V_{OS}$   | —    | 0.5  | 9    | mV                           | —   |
| Input Offset Voltage Average Drift | $TCV_{OS}$ | —    | 3.0  | —    | $\mu\text{V}/^\circ\text{C}$ | —   |
| Input Bias Current                 | $I_B$      | —    | 1.0  | 10   | pA                           | —   |
|                                    |            | —    | 64   | 500  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
| Input Offset Current               | $I_{OS}$   | —    | 0.5  | 5    | pA                           | —   |
|                                    |            | —    | 32   | 250  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
| Input Resistance                   | $R_{IN}$   | —    | >1   | —    | $\text{T}\Omega$             | —   |
| Common-Mode Rejection Ratio        | CMRR       | 45   | 65   | —    | dB                           | $-0.3V \leq V_{CM} \leq 2.5V$ , <a href="#">Note 2</a>  |
| Power Supply Rejection Ratio       | PSRR       | 60   | 85   | —    | dB                           | $V_{V+} =  V_{V-}  = 1.1V$ to $2.5V$ , $V_{OUT} = V_{CM} = 0$   |
| Common-Mode Input Capacitance      | $C_{IN}$   | —    | 3    | —    | pF                           | —   |
| Output Swing                       | $V_O$      | —    | 0.15 | 1    | mV                           | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |
|                                    |            | —    | —    | 1    |                              | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$ |
|                                    |            | —    | 0.15 | 1    |                              | Output low, $R_L = 100\text{ k}\Omega$  |
|                                    |            | —    | —    | 1    |                              | Output low, $R_L = 100\text{ k}\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                    |
|                                    |            | —    | 8    | 33   |                              | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |
|                                    |            | —    | —    | 50   |                              | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
|                                    |            | —    | 8    | 33   |                              | Output low, $R_L = 2\text{ k}\Omega$  |
|                                    |            | —    | —    | 50   |                              | Output low, $R_L = 2\text{ k}\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                      |
|                                    |            | —    | 26   | 110  |                              | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$  |
|                                    |            | —    | —    | 165  |                              | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$          |
|                                    |            | —    | 26   | 110  |                              | Output low, $R_L = 600\Omega$   |
|                                    |            | —    | —    | 165  |                              | Output low, $R_L = 600\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
| Output Short-Circuit Current       | $I_{SC}$   | 20   | 50   | —    | mA                           | Sinking or sourcing, <a href="#">Note 3</a>   |
| Supply Current                     | $I_S$      | —    | 0.7  | 1.6  | mA                           | Both amplifiers   |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** CMRR is determined as follows: The maximum  $\Delta V_{OS}$  over the  $V_{CM}$  range is divided by the magnitude of the  $V_{CM}$  range. The measurement points are:  $V_{CM} = V_{V-} - 0.3V$ ,  $(V_{V+} - V_{V-})/2$ , and  $V_{V+} + 0.3V$ .

**3:** Continuous short circuit may exceed absolute maximum  $T_J$  under some conditions.

# MIC7122

## AC ELECTRICAL CHARACTERISTICS (2.2V)

$V_{V+} = +2.2V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters               | Sym.     | Min. | Typ. | Max. | Units            | Conditions             |
|--------------------------|----------|------|------|------|------------------|------------------------|
| Slew Rate                | SR       | —    | 0.7  | —    | V/ $\mu\text{s}$ | —                      |
| Gain-Bandwidth Product   | GBWP     | —    | 750  | —    | kHz              | —                      |
| Phase Margin             | $\phi_m$ | —    | 80   | —    | °                | $C_L = 0\text{ pF}$    |
|                          |          | —    | 40   | —    |                  | $C_L = 200\text{ pF}$  |
| Gain Margin              | $G_M$    | —    | 10   | —    | dB               | —                      |
| Interamplifier Isolation | —        | —    | 90   | —    | dB               | <a href="#">Note 2</a> |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** Referenced to input.

## DC ELECTRICAL CHARACTERISTICS (5V)

$V_{V+} = +5.0V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                         | Sym.       | Min. | Typ. | Max. | Units                        | Conditions  |
|------------------------------------|------------|------|------|------|------------------------------|---|
| Input Offset Voltage               | $V_{OS}$   | —    | 0.5  | 9    | mV                           | —   |
| Input Offset Voltage Average Drift | $TCV_{OS}$ | —    | 3.0  | —    | $\mu\text{V}/^\circ\text{C}$ | —   |
| Input Bias Current                 | $I_B$      | —    | 1.0  | 10   | pA                           | —   |
|                                    |            | —    | 64   | 500  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                   |
| Input Offset Current               | $I_{OS}$   | —    | 0.5  | 5    | pA                           | —   |
|                                    |            | —    | 32   | 250  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                   |
| Input Resistance                   | $R_{IN}$   | —    | >1   | —    | $\text{T}\Omega$             | —   |
| Common-Mode Rejection Ratio        | CMRR       | 55   | 75   | —    | dB                           | $-0.3V \leq V_{CM} \leq 5.3V$ , <a href="#">Note 2</a>                |
| Power Supply Rejection Ratio       | PSRR       | 55   | 100  | —    | dB                           | $V_{V+} =  V_{V-}  = 2.5V\text{ to }7.5V$ ,<br>$V_{OUT} = V_{CM} = 0$ |
| Common-Mode Input Capacitance      | $C_{IN}$   | —    | 3    | —    | pF                           | —   |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** CMRR is determined as follows: The maximum  $\Delta V_{OS}$  over the  $V_{CM}$  range is divided by the magnitude of the  $V_{CM}$  range. The measurement points are:  $V_{CM} = V_{V-} - 0.3V$ ,  $(V_{V+} - V_{V-})/2$ , and  $V_{V+} + 0.3V$ .

**3:** Continuous short circuit may exceed absolute maximum  $T_J$  under some conditions.

## DC ELECTRICAL CHARACTERISTICS (5V) (CONTINUED)

$V_{V+} = +5.0V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters   | Sym.  | Min.                         | Typ.     | Max. | Units | Conditions  |     |    |   |
|--------------|-------|------------------------------|----------|------|-------|---|-----|----|---|
| Output Swing | $V_O$ | —                            | 0.3      | 1.0  | mV    | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |     |    |   |
|              |       | —                            | —        | 1.5  |       | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$ |     |    |   |
|              |       | —                            | 0.3      | 1.0  |       | Output low, $R_L = 100\text{ k}\Omega$  |     |    |   |
|              |       | —                            | —        | 1.5  |       | Output low, $R_L = 100\text{ k}\Omega$<br>$-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                   |     |    |   |
|              |       | —                            | 13       | 50   |       | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |     |    |   |
|              |       | —                            | —        | 75   |       | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |     |    |   |
|              |       | —                            | 13       | 50   |       | Output low, $R_L = 2\text{ k}\Omega$  |     |    |   |
|              |       | —                            | —        | 75   |       | Output low, $R_L = 2\text{ k}\Omega$<br>$-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                     |     |    |   |
|              |       | —                            | 40       | 165  |       | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$  |     |    |   |
|              |       | —                            | —        | 250  |       | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$          |     |    |   |
|              |       | —                            | 40       | 165  |       | Output low, $R_L = 600\Omega$   |     |    |   |
|              |       | —                            | —        | 250  |       | Output low, $R_L = 600\Omega$<br>$-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$  |     |    |   |
|              |       | Output Short-Circuit Current | $I_{SC}$ | 40   |       | 140   | —   | mA | Sinking or sourcing, <a href="#">Note 3</a> |
|              |       | Supply Current               | $I_S$    | —    |       | 0.8   | 1.8 | mA | Both amplifiers                             |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** CMRR is determined as follows: The maximum  $\Delta V_{OS}$  over the  $V_{CM}$  range is divided by the magnitude of the  $V_{CM}$  range. The measurement points are:  $V_{CM} = V_{V-} - 0.3V$ ,  $(V_{V+} - V_{V-})/2$ , and  $V_{V+} + 0.3V$ .

**3:** Continuous short circuit may exceed absolute maximum  $T_J$  under some conditions.

# MIC7122

## AC ELECTRICAL CHARACTERISTICS (5V)

$V_{V+} = +5.0V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                | Sym.     | Min. | Typ. | Max. | Units            | Conditions   |
|---------------------------|----------|------|------|------|------------------|--|
| Total Harmonic Distortion | THD      | —    | 0.05 | —    | %                | $f = 1\text{ kHz}$ , $A_V = -2$ , $R_L = 2\text{ k}\Omega$ , $V_{OUT} = 4.0\text{ V}_{PP}$ |
| Slew Rate                 | SR       | —    | 0.6  | —    | V/ $\mu\text{s}$ | —  |
| Gain-Bandwidth Product    | GBWP     | —    | 465  | —    | kHz              | —  |
| Phase Margin              | $\phi_m$ | —    | 85   | —    | °                | $C_L = 0\text{ pF}$  |
|                           |          | —    | 40   | —    |                  | $C_L = 200\text{ pF}$  |
| Gain Margin               | $G_M$    | —    | 10   | —    | dB               | —  |
| Interamplifier Isolation  | —        | —    | 90   | —    | dB               | <a href="#">Note 2</a>   |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** Referenced to input.

## DC ELECTRICAL CHARACTERISTICS (15V)

$V_{V+} = +15V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                         | Sym.       | Min. | Typ. | Max. | Units                        | Conditions   |
|------------------------------------|------------|------|------|------|------------------------------|--|
| Input Offset Voltage               | $V_{OS}$   | —    | 0.5  | 9    | mV                           | —  |
| Input Offset Voltage Average Drift | $TCV_{OS}$ | —    | 3.0  | —    | $\mu\text{V}/^\circ\text{C}$ | —  |
| Input Bias Current                 | $I_B$      | —    | 1.0  | 10   | pA                           | —  |
|                                    |            | —    | 64   | 500  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                    |
| Input Offset Current               | $I_{OS}$   | —    | 0.5  | 5    | pA                           | —  |
|                                    |            | —    | 32   | 250  |                              | $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                    |
| Input Resistance                   | $R_{IN}$   | —    | >1   | —    | T $\Omega$                   | —  |
| Common-Mode Rejection Ratio        | CMRR       | 60   | 85   | —    | dB                           | $-0.3V \leq V_{CM} \leq 15.3V$ , <a href="#">Note 2</a>                |
| Power Supply Rejection Ratio       | PSRR       | 55   | 100  | —    | dB                           | $V_{V+} =  V_{V-}  = 2.5V\text{ to }7.5V$ , $V_{OUT} = V_{CM} = 0$     |
| Large Signal Voltage Gain          | $A_V$      | —    | 340  | —    | V/mV                         | Sourcing or sinking, $R_L = 2\text{ k}\Omega$ , <a href="#">Note 3</a> |
|                                    |            | —    | 300  | —    |                              | Sourcing or sinking, $R_L = 600\Omega$ , <a href="#">Note 3</a>        |
| Common-Mode Input Capacitance      | $C_{IN}$   | —    | 3    | —    | pF                           | —  |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** CMRR is determined as follows: The maximum  $\Delta V_{OS}$  over the  $V_{CM}$  range is divided by the magnitude of the  $V_{CM}$  range. The measurement points are:  $V_{CM} = V_{V-} - 0.3V$ ,  $(V_{V+} - V_{V-})/2$ , and  $V_{V+} + 0.3V$ .

**3:**  $R_L$  connected to 7.5V. Sourcing:  $7.5V \leq V_{OUT} \leq 12.5V$ . Sinking:  $2.5V \leq V_{OUT} \leq 7.5V$ .

**4:** Continuous short circuit may exceed absolute maximum  $T_J$  under some conditions.

## DC ELECTRICAL CHARACTERISTICS (15V) (CONTINUED)

$V_{V+} = +15V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                   | Sym.     | Min. | Typ. | Max. | Units | Conditions  |
|------------------------------|----------|------|------|------|-------|---|
| Output Swing                 | $V_O$    | —    | 0.8  | 2    | mV    | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |
|                              |          | —    | —    | 3    |       | Output high, $R_L = 100\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$ |
|                              |          | —    | 0.8  | 2    |       | Output low, $R_L = 100\text{ k}\Omega$  |
|                              |          | —    | —    | 3    |       | Output low, $R_L = 100\text{ k}\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                    |
|                              |          | —    | 40   | 80   |       | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$   |
|                              |          | —    | —    | 120  |       | Output high, $R_L = 2\text{ k}\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
|                              |          | —    | 40   | 80   |       | Output low, $R_L = 2\text{ k}\Omega$  |
|                              |          | —    | —    | 120  |       | Output low, $R_L = 2\text{ k}\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$                                      |
|                              |          | —    | 130  | 270  |       | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$  |
|                              |          | —    | —    | 400  |       | Output high, $R_L = 600\Omega$ , specified as $V_{V+} - V_{OUT}$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$          |
|                              |          | —    | 130  | 270  |       | Output low, $R_L = 600\Omega$   |
|                              |          | —    | —    | 400  |       | Output low, $R_L = 600\Omega$ , $-40^\circ\text{C} \leq T_J \leq +85^\circ\text{C}$   |
| Output Short-Circuit Current | $I_{SC}$ | 50   | 250  | —    | mA    | Sinking or sourcing, <a href="#">Note 4</a>   |
| Supply Current               | $I_S$    | —    | 0.9  | 2.0  | mA    | Both amplifiers   |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** CMRR is determined as follows: The maximum  $\Delta V_{OS}$  over the  $V_{CM}$  range is divided by the magnitude of the  $V_{CM}$  range. The measurement points are:  $V_{CM} = V_{V-} - 0.3V$ ,  $(V_{V+} - V_{V-})/2$ , and  $V_{V+} + 0.3V$ .

**3:**  $R_L$  connected to 7.5V. Sourcing:  $7.5V \leq V_{OUT} \leq 12.5V$ . Sinking:  $2.5V \leq V_{OUT} \leq 7.5V$ .

**4:** Continuous short circuit may exceed absolute maximum  $T_J$  under some conditions.

# MIC7122

## AC ELECTRICAL CHARACTERISTICS (15V)

$V_{V+} = +15V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = 1.5V$ ,  $V_{OUT} = V_{V+}/2$ ;  $R_L = 1\text{ M}\Omega$ ;  $T_J = +25^\circ\text{C}$ ; [Note 1](#).

| Parameters                   | Sym.     | Min. | Typ. | Max. | Units                  | Conditions   |
|------------------------------|----------|------|------|------|------------------------|--|
| Total Harmonic Distortion    | THD      | —    | 0.01 | —    | %                      | $f = 1\text{ kHz}$ , $A_V = -2$ , $R_L = 2\text{ k}\Omega$ , $V_{OUT} = 8.5V_{PP}$ |
| Slew Rate                    | SR       | —    | 0.5  | —    | V/ $\mu\text{s}$       | $V_+ = 15V$ , <a href="#">Note 2</a>   |
| Gain-Bandwidth Product       | GBWP     | —    | 420  | —    | kHz                    | —  |
| Phase Margin                 | $\phi_m$ | —    | 85   | —    | °                      | $C_L = 0\text{ pF}$  |
|                              |          | —    | 40   | —    |                        | $C_L = 200\text{ pF}$  |
| Gain Margin                  | $G_M$    | —    | 10   | —    | dB                     | —  |
| Input-Referred Voltage Noise | $e_n$    | —    | 37   | —    | nV/ $\sqrt{\text{Hz}}$ | $f = 1\text{ kHz}$ , $V_{CM} = 1V$   |
| Input-Referred Current Noise | $i_n$    | —    | 1.5  | —    | fA/ $\sqrt{\text{Hz}}$ | $f = 1\text{ kHz}$   |
| Interamplifier Isolation     | —        | —    | 90   | —    | dB                     | <a href="#">Note 3</a>   |

**Note 1:** All limits guaranteed by testing or statistical analysis.

**2:** Device connected as a voltage follower with a 10V step input. The value is the positive or negative slew rate, whichever is slower.

**3:** Referenced to input.



## TEMPERATURE SPECIFICATIONS

| Parameters                           | Sym.          | Min. | Typ. | Max. | Units | Conditions         |
|--------------------------------------|---------------|------|------|------|-------|--------------------|
| <b>Temperature Ranges</b>            |               |      |      |      |       |                    |
| Operating Junction Temperature Range | $T_J$         | -40  | —    | +125 | °C    | —                  |
| Storage Temperature                  | $T_S$         | -65  | —    | +150 | °C    | —                  |
| Maximum Junction Temperature Range   | $T_J$         | —    | —    | +150 | °C    | —                  |
| Lead Temperature                     | —             | —    | —    | +260 | °C    | Soldering, 10 sec. |
| Maximum Power Dissipation            | —             | —    | —    | —    | —     | —                  |
| <b>Package Thermal Resistance</b>    |               |      |      |      |       |                    |
| MSOP-8                               | $\theta_{JA}$ | —    | 200  | —    | °C/W  | Note 1             |

**Note 1:** Thermal resistance,  $\theta_{JA}$ , applies to a part soldered on a printed-circuit board.

# MIC7122

---

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

**TABLE 2-1: PIN FUNCTION TABLE**

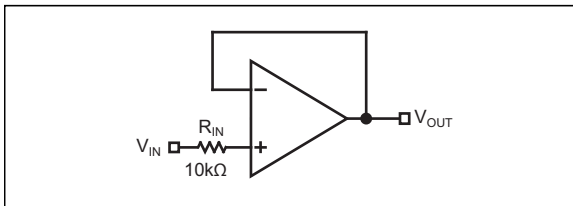
| Pin Number | Pin Name | Description   |
|------------|----------|---|
| 1          | OUTA     | Op Amp A Output.  |
| 2          | INA-     | Op Amp A Inverting Input.   |
| 3          | INA+     | Op Amp A Non-Inverting Input.   |
| 4          | V-       | Negative Supply: Negative supply for split supply application or ground for single supply applications. |
| 5          | INB+     | Op Amp B Non-Inverting Input.   |
| 6          | INB-     | Op Amp B Inverting Input.   |
| 7          | OUTB     | Op Amp B Output.  |
| 8          | V+       | Positive Supply.  |

## 3.0 APPLICATION INFORMATION

### 3.1 Input Common-Mode Voltage

The MIC7122 tolerates input overdrive by at least 300 mV beyond either rail without producing phase inversion.

If the absolute maximum input voltage is exceeded, the input current should be limited to  $\pm 5$  mA maximum to prevent reducing reliability. A 10 k $\Omega$  series input resistor, used as a current limiter, will protect the input structure from voltages as large as 50V above the supply or below ground. See [Figure 3-1](#).



**FIGURE 3-1:** Input Current-Limit Protection.

### 3.2 Output Voltage Swing

Sink and source output resistances of the MIC7122 are equal. Maximum output voltage swing is determined by the load and the approximate output resistance. The output resistance is:

#### EQUATION 3-1:

$$R_{OUT} = \frac{V_{DROP}}{I_{LOAD}}$$

$V_{DROP}$  is the voltage dropped within the amplifier output stage.  $V_{DROP}$  and  $I_{LOAD}$  can be determined from the  $V_O$  (output swing) portion of the appropriate Electrical Characteristics table.  $I_{LOAD}$  is equal to the typical output high voltage minus  $V+/2$  and divided by  $R_{LOAD}$ . For example, using the [DC Electrical Characteristics \(5V\)](#) table, the typical output high voltage drops 13 mV using a 2 k $\Omega$  load (connected to  $V+/2$ ), which produces an  $I_{LOAD}$  of:

#### EQUATION 3-2:

$$\frac{5.0V - 0.013V - 2.5V}{2k\Omega} = 1.244mA$$

Because of output stage symmetry, the corresponding typical output low voltage (13 mV) also equals  $V_{DROP}$ . Then:

#### EQUATION 3-3:

$$R_{OUT} = \frac{0.013V}{0.001244A} = 10.5\Omega$$

### 3.3 Power Dissipation

The MIC7122 output drive capability requires considering power dissipation. If the load impedance is low, it is possible to damage the device by exceeding the 125°C junction temperature rating.

On-chip power consists of two components: supply power and output stage power. Supply power ( $P_S$ ) is the product of the supply voltage ( $V_S = V_{V+} - V_{V-}$ ) and supply current ( $I_S$ ). Output stage power ( $P_O$ ) is the product of the output stage voltage drop ( $V_{DROP}$ ) and the output (load) current ( $I_{OUT}$ ).

Total on-chip power dissipation is:

#### EQUATION 3-4:

$$P_D = P_S + P_O$$

Where:

$P_D$  = Total On-Chip Power

$P_S$  = Supply Power Dissipation

$P_O$  = Output Power Dissipation

#### EQUATION 3-5:

$$P_D = (V_S \times I_S) + (V_{DROP} \times I_{OUT})$$

Where:

$V_S = V_{V+} - V_{V-}$

$I_S$  = Power Supply Current

$V_{DROP} = V_{V+} - V_{OUT}$  (Sourcing Current)

$V_{DROP} = V_{OUT} - V_{V-}$  (Sinking Current)

[Equation 3-4](#) and [Equation 3-5](#) address only steady state (DC) conditions. For non-DC conditions, the user must estimate power dissipation based on the RMS value of the signal.

The task is one of determining the allowable on-chip power dissipation for operation at a given ambient temperature and power supply voltage. From this determination, one may calculate the maximum allowable power dissipation and, after subtracting  $P_S$ , determine the maximum allowable load current, which

# MIC7122

in turn can be used to determine the minimum load impedance that may safely be driven. The calculation is summarized below in Equation 3-6.

## EQUATION 3-6:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

$$\theta_{JA(MSOP-8)} = 200^\circ\text{C/W}$$

### 3.4 Driving Capacitive Loads

Driving a capacitive load introduces phase lag into the output signal and this, in turn, reduces op-amp system phase margin.

The application that is least forgiving of reduced phase margin is a unity gain amplifier. The MIC7122 can typically drive a 200 pF capacitive load connected directly to the output when configured as a unity-gain amplifier and powered with a 2.2V supply. At 15V operation the circuit typically drives 500 pF.

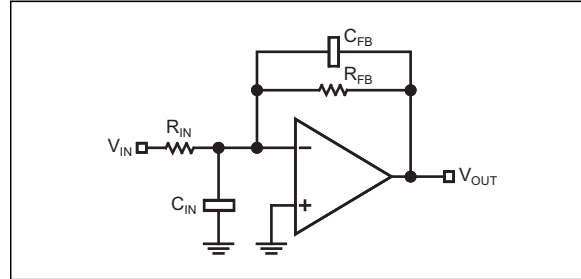
### 3.5 Using Large-Value Feedback Resistors

A large-value feedback resistor (>500 kΩ) can reduce the phase margin of a system. This occurs when the feedback resistor acts in conjunction with input capacitance to create phase lag in the feedback signal. Input capacitance is usually a combination of input circuit components and other parasitic capacitance, such as amplifier input capacitance and stray printed circuit board capacitance.

Figure 3-2 illustrates a method of compensating phase lag caused by using a large-value feedback resistor. Feedback capacitor  $C_{FB}$  introduces sufficient phase lead to overcome the phase lag caused by feedback resistor  $R_{FB}$  and input capacitance  $C_{IN}$ . The value of  $C_{FB}$  is determined by first estimating  $C_{IN}$  and then applying the following formula:

## EQUATION 3-7:

$$R_{IN} \times C_{IN} \leq R_{FB} \times C_{FB}$$

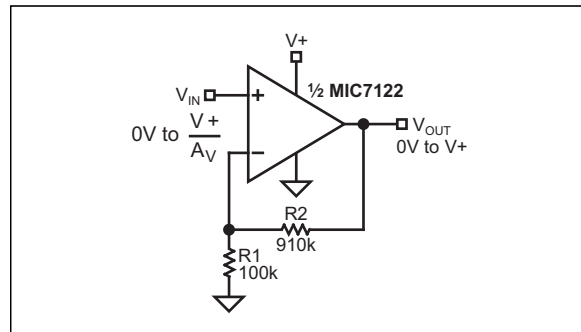


**FIGURE 3-2:** Canceling Feedback Phase Lag.

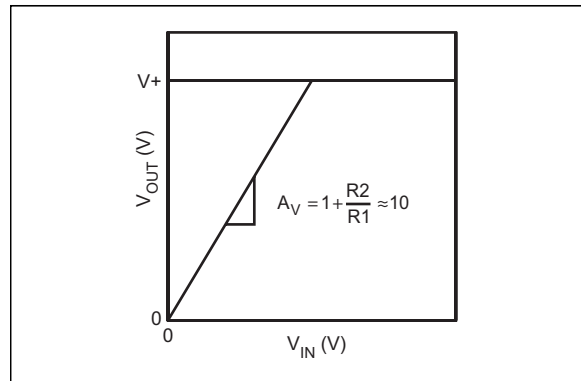
Because a significant percentage of  $C_{IN}$  may be caused by board layout, it is important to note that the correct value of  $C_{FB}$  may change when changing from a breadboard to the final circuit layout.

### 3.6 Typical Circuits

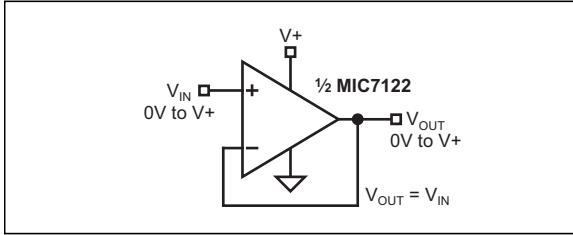
Some single-supply, rail-to-rail applications for which the MIC7122 is well suited are shown in the circuit diagrams of Figure 3-3 through Figure 3-8.



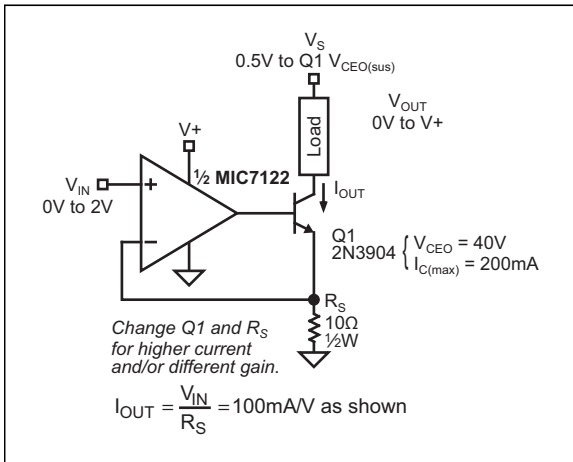
**FIGURE 3-3:** Non-Inverting Amplifier.



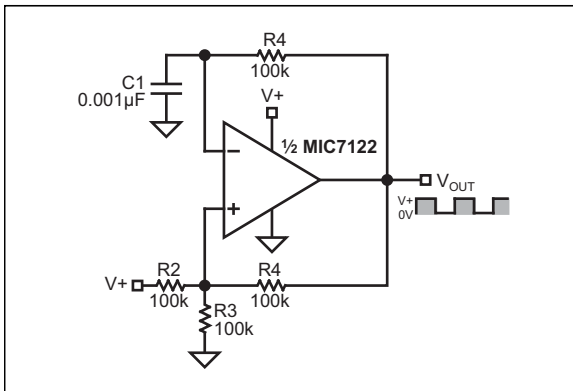
**FIGURE 3-4:** Non-Inverting Amplifier Behavior.



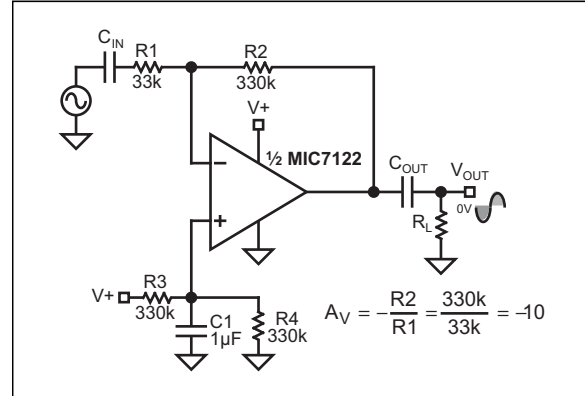
**FIGURE 3-5:** Voltage Follower/Buffer.



**FIGURE 3-6:** Voltage-Controlled Current Sink.



**FIGURE 3-7:** Square Wave Oscillator.



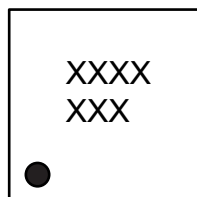
**FIGURE 3-8:** AC-Coupled Inverting Amplifier.

# MIC7122

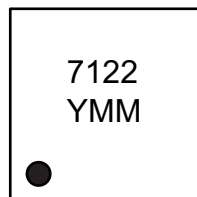
## 4.0 PACKAGE MARKING INFORMATION

### 4.1 Package Marking Information

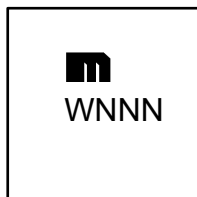
8-Lead MSOP\*  
(FRONT)



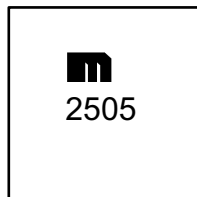
Example



8-Lead MSOP\*  
(BACK)



Example



**Legend:** XX...X Product code or customer-specific information  
Y Year code (last digit of calendar year)  
YY Year code (last 2 digits of calendar year)  
WW Week code (week of January 1 is week '01')  
NNN Alphanumeric traceability code  
Ⓔ3 Pb-free JEDEC® designator for Matte Tin (Sn)  
\* This package is Pb-free. The Pb-free JEDEC designator (Ⓔ3) can be found on the outer packaging for this package.

●, ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar ( \_ ) and/or Overbar ( ¯ ) symbol may not be to scale.

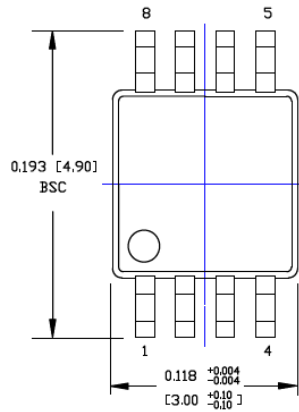
## 8-Lead MSOP Package Outline and Recommended Land Pattern

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

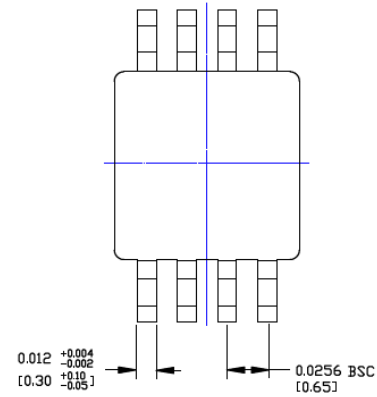
**TITLE**

8 LEAD MSOP PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

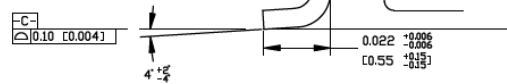
| DRAWING # | MSOP-8LD-PL-1 | UNIT | INCH [MM] |
|-----------|---------------|------|-----------|
|-----------|---------------|------|-----------|



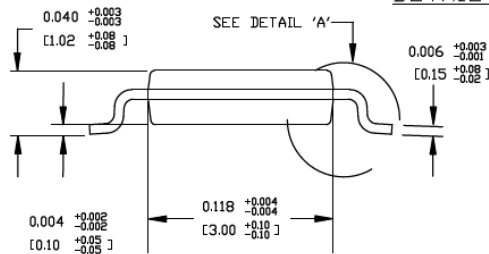
TOP VIEW



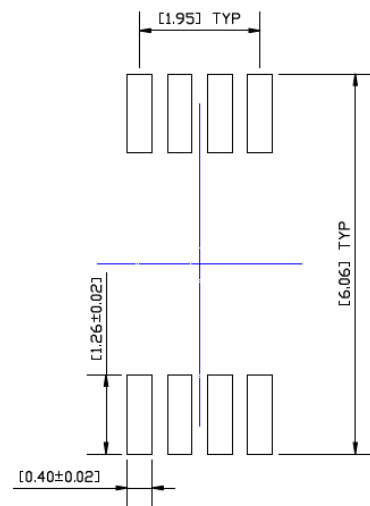
BOTTOM VIEW



DETAIL A



SIDE VIEW



RECOMMENDED LAND PATTERN

**NOTES:**

1. DIMENSIONS ARE IN INCHES [MM].
2. CONTROLLING DIMENSION: MM
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.008 [0.20] PER SIDE.

# MIC7122

---

NOTES:



## APPENDIX A: REVISION HISTORY

### Revision A (January 2020)

- Converted Micrel data sheet MIC7122 to Microchip DS20006290A.
- Minor text changes throughout.

# MIC7122

---

NOTES:

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

| <u>PART NO.</u>           |          | <u>X</u>          | <u>XX</u>                   | <u>-XX</u> |
|---------------------------|----------|-------------------|-----------------------------|------------|
| Device                    |          | Temperature Range | Package                     | Media Type |
| <b>Device:</b>            | MIC7122: |                   | Rail-to-Rail Dual Op Amp    |            |
| <b>Temperature Range:</b> | Y        | =                 | -40°C to +85°C (Industrial) |            |
| <b>Package:</b>           | MM       | =                 | 8-Pin MSOP                  |            |
| <b>Media Type:</b>        | <blank>  | =                 | 100/Tube                    |            |
|                           | TR       | =                 | 2,500/Reel                  |            |

| <b>Examples:</b>  |  |
|-------------------|--|
| a) MIC7122YMM:    | Rail-to-Rail Dual Op Amp,<br>-40°C to +85°C Temperature Range, 8-Lead MSOP, 100/Tube   |
| b) MIC7122YMM-TR: | Rail-to-Rail Dual Op Amp,<br>-40°C to +85°C Temperature Range, 8-Lead MSOP, 2500/Reel  |
| <b>Note 1:</b>    | Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option. |

# MIC7122

---

NOTES:

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

### Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TempTrackr, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, Vite, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2020, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-5491-5

For information regarding Microchip's Quality Management Systems, please visit [www.microchip.com/quality](http://www.microchip.com/quality).



# MICROCHIP

## Worldwide Sales and Service

### AMERICAS

**Corporate Office**  
2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
Fax: 480-792-7277  
Technical Support:  
<http://www.microchip.com/support>  
Web Address:  
[www.microchip.com](http://www.microchip.com)

#### Atlanta

Duluth, GA  
Tel: 678-957-9614  
Fax: 678-957-1455

#### Austin, TX

Tel: 512-257-3370

#### Boston

Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

#### Chicago

Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

#### Dallas

Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

#### Detroit

Novi, MI  
Tel: 248-848-4000

#### Houston, TX

Tel: 281-894-5983

#### Indianapolis

Noblesville, IN  
Tel: 317-773-8323  
Fax: 317-773-5453  
Tel: 317-536-2380

#### Los Angeles

Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608  
Tel: 951-273-7800

#### Raleigh, NC

Tel: 919-844-7510

#### New York, NY

Tel: 631-435-6000

#### San Jose, CA

Tel: 408-735-9110  
Tel: 408-436-4270

#### Canada - Toronto

Tel: 905-695-1980  
Fax: 905-695-2078

### ASIA/PACIFIC

**Australia - Sydney**  
Tel: 61-2-9868-6733

**China - Beijing**  
Tel: 86-10-8569-7000

**China - Chengdu**  
Tel: 86-28-8665-5511

**China - Chongqing**  
Tel: 86-23-8980-9588

**China - Dongguan**  
Tel: 86-769-8702-9880

**China - Guangzhou**  
Tel: 86-20-8755-8029

**China - Hangzhou**  
Tel: 86-571-8792-8115

**China - Hong Kong SAR**  
Tel: 852-2943-5100

**China - Nanjing**  
Tel: 86-25-8473-2460

**China - Qingdao**  
Tel: 86-532-8502-7355

**China - Shanghai**  
Tel: 86-21-3326-8000

**China - Shenyang**  
Tel: 86-24-2334-2829

**China - Shenzhen**  
Tel: 86-755-8864-2200

**China - Suzhou**  
Tel: 86-186-6233-1526

**China - Wuhan**  
Tel: 86-27-5980-5300

**China - Xian**  
Tel: 86-29-8833-7252

**China - Xiamen**  
Tel: 86-592-2388138

**China - Zhuhai**  
Tel: 86-756-3210040

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-3090-4444

**India - New Delhi**  
Tel: 91-11-4160-8631

**India - Pune**  
Tel: 91-20-4121-0141

**Japan - Osaka**  
Tel: 81-6-6152-7160

**Japan - Tokyo**  
Tel: 81-3-6880-3770

**Korea - Daegu**  
Tel: 82-53-744-4301

**Korea - Seoul**  
Tel: 82-2-554-7200

**Malaysia - Kuala Lumpur**  
Tel: 60-3-7651-7906

**Malaysia - Penang**  
Tel: 60-4-227-8870

**Philippines - Manila**  
Tel: 63-2-634-9065

**Singapore**  
Tel: 65-6334-8870

**Taiwan - Hsin Chu**  
Tel: 886-3-577-8366

**Taiwan - Kaohsiung**  
Tel: 886-7-213-7830

**Taiwan - Taipei**  
Tel: 886-2-2508-8600

**Thailand - Bangkok**  
Tel: 66-2-694-1351

**Vietnam - Ho Chi Minh**  
Tel: 84-28-5448-2100

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4450-2828  
Fax: 45-4485-2829

**Finland - Espoo**  
Tel: 358-9-4520-820

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Garching**  
Tel: 49-8931-9700

**Germany - Haan**  
Tel: 49-2129-3766400

**Germany - Heilbronn**  
Tel: 49-7131-72400

**Germany - Karlsruhe**  
Tel: 49-721-625370

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Germany - Rosenheim**  
Tel: 49-8031-354-560

**Israel - Ra'anana**  
Tel: 972-9-744-7705

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Italy - Padova**  
Tel: 39-049-7625286

**Netherlands - Drunen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Norway - Trondheim**  
Tel: 47-7288-4388

**Poland - Warsaw**  
Tel: 48-22-3325737

**Romania - Bucharest**  
Tel: 40-21-407-87-50

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**Sweden - Gothenberg**  
Tel: 46-31-704-60-40

**Sweden - Stockholm**  
Tel: 46-8-5090-4654

**UK - Wokingham**  
Tel: 44-118-921-5800  
Fax: 44-118-921-5820

## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for [Operational Amplifiers - Op Amps](#) category:*

*Click to view products by [Micrel](#) manufacturer:*

Other Similar products are found below :

[LM258AYDT](#) [LM358SNG](#) [430227FB](#) [UPC824G2-A](#) [LT1678IS8](#) [042225DB](#) [058184EB](#) [UPC259G2-A](#) [NTE925](#) [AZV358MTR-G1](#)  
[AP4310AUMTR-AG1](#) [HA1630D02MMEL-E](#) [HA1630S01LPEL-E](#) [SCY33178DR2G](#) [NJU77806F3-TE1](#) [NCV20034DR2G](#) [LM324EDR2G](#)  
[LM2902EDR2G](#) [NTE7155](#) [NTE778S](#) [NTE871](#) [NTE924](#) [NTE937](#) [MCP6V17T-E/MNY](#) [MCP6V19-E/ST](#) [MCP6V36UT-E/LTY](#)  
[MXD8011HF](#) [MCP6V17T-E/MS](#) [SCY6358ADR2G](#) [LTC2065HUD#PBF](#) [NJM2904CRB1-TE1](#) [2SD965T-R](#) [RS6332P XK](#) [BDM8551](#)  
[BDM321](#) [MD1324](#) [COS8052SR](#) [COS8552SR](#) [COS8554SR](#) [COS2177SR](#) [COS2353SR](#) [COS724TR](#) [ASOPD4580S-R](#) [RS321BKXF](#)  
[ADA4097-1HUIZ-RL7](#) [NCV4333DTBR2G](#) [EL5420CRZ-T7A](#) [AS324MTR-E1](#) [AS358MMTR-G1](#) [MCP6491T-ELTY](#)