DESCRIPTION
The MP8103 is a single supply, dual rail-to-rail output operational amplifier. This amplifier provides 600KHz bandwidth while consuming an incredibly low 14µA of supply current. The MP8103 can operate with a single supply voltage as low as 1.8V. The input common mode can go below the negative rail. The maximum supply voltage is 5.5V which allows the device to operate from ±0.9V to ±2.75V or a single supply. The MP8103 is available in an 8-pin 3mm x 5mm MSOP package.

FEATURES
• Single Supply Operation: 1.8V to 5.5V
• 600KHz –3dB Bandwidth
• 14µA Supply Current
• Rail-to-Rail Output
• Unity-Gain Stable
• Input Common Mode to Ground
• Drives Up to 1000pF of Capacitive Loads
• High Slew Rate: 0.1V/µs
• Available in a MSOP8 Package

APPLICATIONS
• Portable Equipment
• PDAs
• Pagers
• Cordless Phones
• Handheld GPS
• Consumer Electronics
• Smoke Detector
• Portable Medical Equipment

TYPICAL APPLICATION

*“MPS” and “The Future of Analog IC Technology” are Registered Trademarks of Monolithic Power Systems, Inc.*
MP8103 – DUAL ULTRA LOW POWER, 1.8V, 600KHz OP AMP

PACKAGE REFERENCE

<table>
<thead>
<tr>
<th>Part Number*</th>
<th>Package</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP8103DK</td>
<td>MSOP8</td>
<td>–40°C to +85°C</td>
</tr>
</tbody>
</table>

* For Tape & Reel, add suffix –Z (eg. MP8103DK–Z)
For RoHS Compliant Packaging, add suffix –LF (eg. MP8103DK–LF–Z)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V+ to V–)......................... +6.0V
Differential Input Voltage (V\text{IN+} – V\text{IN–})........... +6.0V
Input Voltage (V\text{IN+} + 0.3V, V\text{IN–} – 0.3V

Recommended Operating Conditions

Supply Voltage .................................. +1.8V to +5.5V
Operating Temperature .............–40°C to +85°C

Thermal Resistance

\( \theta_{JA} \) \( \theta_{JC} \)
MSOP8 .................................. 150... 65... °C/W

Notes:
1) Exceeding these ratings may damage the device.
2) The device is not guaranteed to function outside of its operating conditions.
3) Measured on approximately 1” square of 1 oz copper.

ELECTRICAL CHARACTERISTICS

\( V_+ = +5V, \ V_- = 0V, \ V_{CM} = V+/2, \ R_L = 10k\Omega, \ T_A = +25°C \), unless otherwise noted.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Offset Voltage</td>
<td>V_{OS}</td>
<td></td>
<td>–5</td>
<td>1</td>
<td>+5</td>
<td>mV</td>
</tr>
<tr>
<td>Input Offset Voltage Temp Coefficient</td>
<td>I_{B}</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
<td>µV/°C</td>
</tr>
<tr>
<td>Input Bias Current (^{(4)})</td>
<td>I_{B}</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>pA</td>
</tr>
<tr>
<td>Input Offset Current (^{(4)})</td>
<td>I_{OS}</td>
<td></td>
<td>0.2</td>
<td></td>
<td></td>
<td>pA</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>V_{CM}</td>
<td>CMRR &gt; 60dB</td>
<td>0</td>
<td>3.8</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Common-Mode Rejection Ratio</td>
<td>CMRR</td>
<td>0 &lt; V_{CM} &lt; 3.5V</td>
<td>82</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio</td>
<td>PSRR</td>
<td>Supply Voltage change of 1.0V</td>
<td>80</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Large Signal Voltage Gain</td>
<td>A_{VOL}</td>
<td>( R_L = 100k\Omega, \ V_{OUT} = 5.0 ) Peak to Peak</td>
<td>60</td>
<td>88</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Maximum Output Voltage Swing</td>
<td>V_{OUT}</td>
<td>( R_L = 10k\Omega )</td>
<td></td>
<td>V+ – 23mV</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Minimum Output Voltage Swing</td>
<td>V_{OUT}</td>
<td>( R_L = 10k\Omega )</td>
<td></td>
<td>V– + 19mV</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Gain-Bandwidth Product (^{(4)})</td>
<td>GBW</td>
<td>( R_L = 200k\Omega, C_L = 2pF, )</td>
<td>200</td>
<td></td>
<td></td>
<td>KHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{OUT} = 0 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(~-3dB) Bandwidth</td>
<td>BW</td>
<td>( A_v = 1, \ C_L = 2pF, )</td>
<td>600</td>
<td></td>
<td></td>
<td>KHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( R_L = 1M\Omega )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slew Rate (^{(4)})</td>
<td>SR</td>
<td>( A_v = 1, \ C_L = 2pF, )</td>
<td>0.1</td>
<td></td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( R_L = 1M\Omega )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Circuit Current</td>
<td>I_{SC}</td>
<td>Source</td>
<td>20</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sink</td>
<td>20</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Supply Current</td>
<td></td>
<td>No Load</td>
<td>14</td>
<td>22</td>
<td></td>
<td>µA</td>
</tr>
</tbody>
</table>

Note:
4) Guaranteed by design.
PIN FUNCTIONS

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUT1</td>
<td>Output of First Op-Amp.</td>
</tr>
<tr>
<td>2</td>
<td>IN1-</td>
<td>Inverting Input of First Op-Amp.</td>
</tr>
<tr>
<td>3</td>
<td>IN1+</td>
<td>Non-Inverting Input of First Op-Amp.</td>
</tr>
<tr>
<td>4</td>
<td>V-</td>
<td>Ground or Supply Return Pin.</td>
</tr>
<tr>
<td>5</td>
<td>IN2+</td>
<td>Non-Inverting Input of Second Op-Amp.</td>
</tr>
<tr>
<td>6</td>
<td>IN2-</td>
<td>Inverting Input of Second Op-Amp.</td>
</tr>
<tr>
<td>7</td>
<td>OUT2</td>
<td>Output of Second Op-Amp.</td>
</tr>
<tr>
<td>8</td>
<td>V+</td>
<td>Supply Voltage.</td>
</tr>
</tbody>
</table>

TEST CIRCUITS

Notes: Close S3 for positive gain. Input signal to RF(+Av) connector.
The gain $Av = 1 + \frac{R_{FB}}{R_{IN}}$.
For unity gain, remove $R_{IN}$ and short $R_{FB}$.
Open S3 for negative gain. Input signal to RF(-Av) connector.
The gain $Av = -\frac{R_{FB}}{R_{IN}}$.
S1 and S2 are switches for possible resistor and capacitor load connections.

Figure 1—AC Test Circuit
Figure 2—Positive Power Supply Rejection Ratio Measurement
TYPICAL PERFORMANCE CHARACTERISTICS

\( T_A = +25^\circ \text{C}, \) unless otherwise noted.

**Output Voltage vs. Output Current**

- **Sourcing**
- **Sinking**

**Output Voltage vs. Input Current**

**Short Circuit Current vs. Supply Voltage**

- **Sourcing**
- **Sinking**

**Offset Voltage vs. Common Mode Voltage**

\( R_{\text{FB}} = 50k\Omega, \ V_- = -5\text{V to } 0\text{V}, \ V_+ = 0\text{V to } +5\text{V} \)

**Offset Voltage vs. Supply Voltage**

\( R_{\text{FB}} = 50k\Omega, \ V_- = -2.5\text{V to } 0\text{V}, \ V_+ = +2.5\text{V to } 0\text{V} \)
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ C$, unless otherwise noted.

### Gain Bandwidth and Phase Margin

**V$\pm$ = +/-1.35V, Gain = 1, $R_L = 1\, \Omega$**

- **Gain vs. Frequency**
- **Phase vs. Frequency**

**V$\pm$ = +/-2.50V, Gain = 1, $R_L = 1\, \Omega$**

- **Gain vs. Frequency**
- **Phase vs. Frequency**

**V$\pm$ = +/-1.35V, Gain = 2, $R_L = 1\, \Omega$**

- **Gain vs. Frequency**
- **Phase vs. Frequency**

### Close-Loop Unity Gain Frequency Response

**V$\pm$ = +/-2.50V, Gain = 1**

- **Gain vs. Frequency**

### PSRR vs. Frequency

**V$-$ = -2.5V, V$+$ = 2.5V**

- **PSRR vs. Frequency**
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ C$, unless otherwise noted.

**Small Signal Pulse Response**

- $A_V = 1$, $V^+ = 2.5V$, $V^- = -2.5V$
- $R_L = 1M\Omega$, $C_L = 8pF$

**Small Signal Pulse Response**

- $A_V = 1$, $V^+ = 1.25V$, $V^- = -1.25V$
- $R_L = 1M\Omega$, $C_L = 8pF$

**Small Signal Pulse Response**

- $A_V = 1$, $V^+ = 2.5V$, $V^- = -2.5V$
- $R_L = 1M\Omega$, $C_L = 50pF$

**Small Signal Pulse Response**

- $A_V = 1$, $V^+ = 1.25V$, $V^- = -1.25V$
- $R_L = 1M\Omega$, $C_L = 8pF$

**Small Signal Pulse Response**

- $A_V = -1$, $V^+ = 2.5V$, $V^- = -2.5V$
- $R_L = 5k\Omega$, $C_L = 8pF$

**Small Signal Pulse Response**

- $A_V = -1$, $V^+ = 1.25V$, $V^- = -1.25V$
- $R_L = 5k\Omega$, $C_L = 8pF$
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$T_A = +25^\circ C$, unless otherwise noted.

**Large Signal Pulse Response**

- $A_v = 1$, $V_+ = 2.5V, V_- = -2.5V$
- $R_L = 1\Omega$, $C_L = 8\text{pF}$

**Large Signal Pulse Response**

- $A_v = 1$, $V_+ = 1.25V, V_- = -1.25V$
- $R_L = 1\Omega$, $C_L = 8\text{pF}$

**Rail to Rail Output Operation**

- $A_v = -2$, $V_+ = 2.5V, V_- = -2.5V$
- $R_L = 1\Omega$, $C_L = 8\text{pF}$

**Rail to Rail Output Operation**

- $A_v = 2$, $V_+ = 1.25V, V_- = -1.25V$
- $R_L = 1\Omega$, $C_L = 8\text{pF}$

**Rail to Rail Output Operation**

- $A_v = 2$, $V_+ = 2.5V, V_- = -2.5V$
- $R_L = 1\Omega$, $C_L = 8\text{pF}$

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APPLICATION INFORMATION

**Power Supply Bypassing**

Regular supply bypassing techniques are recommended. A $10\mu F$ capacitor in parallel with a $0.1\mu F$ capacitor on both the positive and negative supplies is ideal. For the best performance, all bypassing capacitors should be located as close to the op amp as possible and all capacitors should be low ESL (Equivalent Series Inductance) and low ESR (Equivalent Series Resistance). Surface mount ceramic capacitors are ideal.
PACKAGE INFORMATION

NOTICE: The information in this document is subject to change without notice. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.

MSOP8

TOP VIEW

BOTTOM VIEW

RECOMMENDED LAND PATTERN

NOTE:
1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5) PIN 1 IDENTIFICATION HAS HALF OR FULL CIRCLE OPTION.
6) DRAWING MEETS JEDEC MO-187, VARIATION AA.
7) DRAWING IS NOT TO SCALE.