High Common-Mode Rejection
Differential Line Receiver

SSM2141

FEATURES
High Common-Mode Rejection
DC: 100 dB typ
60 Hz: 100 dB typ
20 kHz: 70 dB typ
40 kHz: 62 dB typ
Low Distortion: 0.001% typ
Fast Slew Rate: 9.5 V/µs typ
Wide Bandwidth: 3 MHz typ
Low Cost
Complements SSM2142 Differential Line Driver

APPLICATIONS
Line Receivers
Summing Amplifiers
Buffer Amplifiers—Drives 600 Ω Load

GENERAL DESCRIPTION
The SSM 2141 is an integrated differential amplifier intended to receive balanced line inputs in audio applications requiring a high level of noise immunity and optimum common-mode rejection. The SSM 2141 typically achieves 100 dB of common-mode rejection (CMR), whereas implementing an op amp with four off-the-shelf precision resistors will typically achieve only 40 dB of CMR—inefficient for high-performance audio.

The SSM 2141 achieves low distortion performance by maintaining a large slew rate of 9.5 V/µs and high open-loop gain. Distortion is less than 0.002% over the full audio bandwidth. The SSM 2141 complements the SSM 2142 balanced line driver. Together, these devices comprise a fully integrated solution for equivalent transformer balancing of audio signals without the problems of distortion, EMI fields, and high cost.

Additional applications for the SSM 2141 include summing signals, differential preamplifiers, and 600 Ω low distortion buffer amplifiers. For similar performance with G = 1/2, see SSM 2143.

REV. C

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One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 617/329-4700
Fax: 781/461-3113
COMPARABLE PARTS
View a parametric search of comparable parts.

DOCUMENTATION
Application Notes
• AN-938: Digital and Analog Measurement Units for Digital CMOS Microphone Preamplifier ASICs
Data Sheet
• SSM2141: High Common-Mode Rejection Differential Line Receiver Data Sheet

REFERENCE MATERIALS
Informational
• Advantiv™ Advanced TV Solutions

DESIGN RESOURCES
• SSM2141 Material Declaration
• PCN-PDN Information
• Quality And Reliability
• Symbols and Footprints

DISCUSSIONS
View all SSM2141 EngineerZone Discussions.

SAMPLE AND BUY
Visit the product page to see pricing options.

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Submit a technical question or find your regional support number.

DOCUMENT FEEDBACK
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### SSM2141 - SPECIFICATIONS

#### ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFSET VOLTAGE</td>
<td>V&lt;sub&gt;OS&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CM&lt;/sub&gt; = 0 V</td>
<td>-1000</td>
<td>25</td>
<td>1000</td>
<td>µV</td>
</tr>
<tr>
<td>GAIN ERROR</td>
<td></td>
<td>No Load, V&lt;sub&gt;IN&lt;/sub&gt; = ±10 V, R&lt;sub&gt;S&lt;/sub&gt; = 0 Ω</td>
<td>0.001</td>
<td>0.01</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>INPUT VOLTAGE RANGE</td>
<td>IVR</td>
<td>(Note 1)</td>
<td>±10</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>COMMON-MODE REJECTION</td>
<td>CMR</td>
<td>V&lt;sub&gt;CM&lt;/sub&gt; = ±10 V</td>
<td>80</td>
<td>100</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>POWER SUPPLY REJECTION RATIO</td>
<td>PSRR</td>
<td>V&lt;sub&gt;S&lt;/sub&gt; = ±6 V to ±18 V</td>
<td>0.7</td>
<td>15</td>
<td></td>
<td>µV/V</td>
</tr>
<tr>
<td>OUTPUT SWING</td>
<td>V&lt;sub&gt;O&lt;/sub&gt;</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 2 kΩ</td>
<td>±13</td>
<td>±14.7</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>SHORT-CIRCUIT CURRENT LIMIT</td>
<td>I&lt;sub&gt;SC&lt;/sub&gt;</td>
<td>Output Shorted to Ground</td>
<td>+45/-15</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>SMALL-SIGNAL BANDWIDTH (-3 dB)</td>
<td>BW</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 2 kΩ</td>
<td>3</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>SLEW RATE</td>
<td>SR</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 2 kΩ</td>
<td>6</td>
<td>9.5</td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td>TOTAL HARMONIC DISTORTION</td>
<td>THD</td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 100 kΩ</td>
<td>0.001</td>
<td></td>
<td>0.01</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 600 Ω</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPACITIVE LOAD DRIVE CAPABILITY</td>
<td>C&lt;sub&gt;L&lt;/sub&gt;</td>
<td>No Oscillation</td>
<td>300</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>SUPPLY CURRENT</td>
<td>I&lt;sub&gt;SY&lt;/sub&gt;</td>
<td>No Load</td>
<td>2.5</td>
<td>3.5</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

**NOTES**

1. Input Voltage Range Guaranteed by CMR test.
2. Specifications subject to change without notice

#### ELECTRICAL CHARACTERISTICS

@ V<sub>S</sub> = ±18 V, -40°C ≤ T<sub>A</sub> ≤ +85°C

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<td>V&lt;sub&gt;CM&lt;/sub&gt; = 0 V</td>
<td>-2500</td>
<td>200</td>
<td>2500</td>
<td>µV</td>
</tr>
<tr>
<td>GAIN ERROR</td>
<td></td>
<td>No Load, V&lt;sub&gt;IN&lt;/sub&gt; = ±10 V, R&lt;sub&gt;S&lt;/sub&gt; = 0 Ω</td>
<td>0.002</td>
<td>0.02</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>INPUT VOLTAGE RANGE</td>
<td>IVR</td>
<td>(Note 1)</td>
<td>±10</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>COMMON-MODE REJECTION</td>
<td>CMR</td>
<td>V&lt;sub&gt;CM&lt;/sub&gt; = ±10 V</td>
<td>75</td>
<td>90</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>POWER SUPPLY REJECTION RATIO</td>
<td>PSRR</td>
<td>V&lt;sub&gt;S&lt;/sub&gt; = ±6 V to ±18 V</td>
<td>1.0</td>
<td>20</td>
<td></td>
<td>µV/V</td>
</tr>
<tr>
<td>OUTPUT SWING</td>
<td>V&lt;sub&gt;O&lt;/sub&gt;</td>
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<td></td>
<td></td>
<td>V/µs</td>
</tr>
<tr>
<td>SUPPLY CURRENT</td>
<td>I&lt;sub&gt;SY&lt;/sub&gt;</td>
<td>No Load</td>
<td>2.6</td>
<td>4.0</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

**NOTES**

1. Input Voltage Range Guaranteed by CMR test.
2. Specifications subject to change without notice
**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage: ±18 V

Input Voltage: Supply Voltage

Output Short-Circuit Duration: Continuous

Storage Temperature Range: P Package: -65°C to +150°C

Lead Temperature (Soldering, 60 sec): +300°C

Junction Temperature: +150°C

Operating Temperature Range: -40°C to +85°C

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**Typical Performance Characteristics**

- **Small Signal Transient Response**
  
  $T_A = +25°C$
  
  $V_B = ±15V$

- **Large Signal Transient Response**
  
  $T_A = +25°C$
  
  $V_B = ±15V$

- **Common-Mode Rejection vs. Frequency**

- **Power Supply Rejection vs. Frequency**

- **Total Harmonic Distortion vs. Frequency**

- **Dynamic Intermodulation Distortion vs. Frequency**

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**NOTES**

1 For supply voltages less than ±18 V, the absolute maximum input voltage is equal to the supply voltage.

2 $\theta_J$ is specified for worst case mounting conditions, i.e., $\theta_J$ is specified for device in socket for P-DIP package.
SSM2141 - Typical Performance Characteristics

Input Offset Voltage vs. Temperature

Closed-Loop Gain vs. Frequency

Closed-Loop Output Impedance vs. Frequency

Gain Error vs. Temperature

Slew Rate vs. Temperature

Supply Current vs. Temperature

Supply Current vs. Supply Voltage

Maximum Output Voltage vs. Output Current (Source)

Maximum Output Voltage vs. Output Current (Sink)
**APPLICATIONS INFORMATION**

The SSM 2141 represents a versatile analog building block. In order to capitalize on fast settling time, high slew rate, and high CMR, proper decoupling and grounding techniques must be employed. For decoupling, place 0.1 μF capacitor located within close proximity from each supply pin to ground.
MAINTAINING COMMON-MODE REJECTION

In order to achieve the full common-mode rejection capability of the SSM2141, the source impedance must be carefully controlled. Slight imbalances of the source resistance will result in a degradation of DC CMR— even a 5 $\Omega$ imbalance will degrade CMR by 20 dB. Also, the matching of the reactive source impedance must be matched in order to preserve the CMRR over frequency.

**Figure 1.** Precision Difference Amplifier. Rejects Common-Mode Signal = $\frac{E_1 + E_2}{2}$ by 100 dB

**Figure 2.** Precision Unity Gain Inverting Amplifier

**Figure 3.** Precision Summing Amplifier

**Figure 4.** Precision Summing Amplifier with Gain

**Figure 5.** Suitable Instrumentation Amplifier Requirements can be Addressed by Using an Input Stage Consisting of $A_1$, $A_2$, $R_1$ and $R_2$
OUTLINE DIMENSIONS

Compliant to JEDEC Standards MS-001
Controlling dimensions are in inches; millimeter dimensions (in parentheses) are rounded-off inch equivalents for reference only and are not appropriate for use in design. Corner leads may be configured as whole or half leads.

Figure 6. 8-Lead Plastic Dual In-Line Package [PDIP] Narrow Body (N-8)
Dimensions shown in inches and (millimeters)

Compliant to JEDEC Standards MS-012-AA
Controlling dimensions are in millimeters; inch dimensions (in parentheses) are rounded-off millimeter equivalents for reference only and are not appropriate for use in design.

Figure 7. 8-Lead Standard Small Outline Package [SOIC_N] Narrow Body (R-8)
Dimensions shown in millimeters and (inches)
# SSM2141

## ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSM2141PZ</td>
<td>$-40^\circ C \leq T_A \leq +85^\circ C$</td>
<td>8-Lead PDIP</td>
<td>N-8</td>
</tr>
<tr>
<td>SSM2141SZ</td>
<td>$-40^\circ C \leq T_A \leq +85^\circ C$</td>
<td>8-Lead SOIC_N</td>
<td>R-8</td>
</tr>
<tr>
<td>SSM2141SZ-REEL</td>
<td>$-40^\circ C \leq T_A \leq +85^\circ C$</td>
<td>8-Lead SOIC_N</td>
<td>R-8</td>
</tr>
</tbody>
</table>

1 Z = RoHS Compliant Part.

## REVISION HISTORY

6/11—Rev. B to Rev. C
- Updated Outline Dimensions ......................................................... 7
- Changes to Ordering Guide ............................................................ 8

5/91—Rev. A to Rev. B