ANALOG DEVICES

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
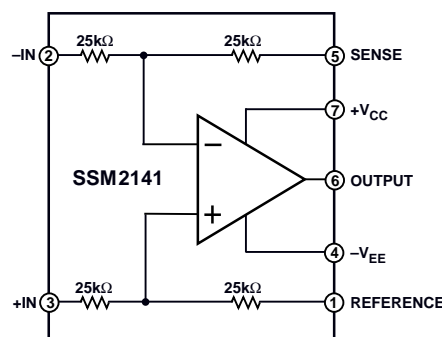**Low Cost**
Complements SSM2142 Differential Line Driver

APPLICATIONS
Line Receivers
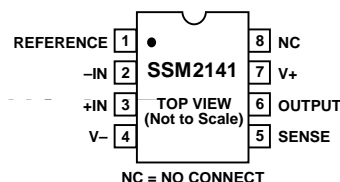**Summing Amplifiers**
Buffer Amplifiers–Drives 600 Ω Load

FUNCTIONAL BLOCK DIAGRAM

PIN CONNECTIONS

8-Pin Plastic Mini-DIP
(P Suffix)
Narrow Body SO
(S Suffix)

NC = NO CONNECT

GENERAL DESCRIPTION
The SSM2141 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 SSM2141 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—inadequate for high-performance audio.

The SSM2141 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 SSM2141 complements the SSM2142 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 SSM2141 include summing signals, differential preamplifiers, and 600 Ω low distortion buffer amplifiers. For similar performance with G = 1/2, see SSM2143.

REV. B

SSM2141–SPECIFICATIONS

ELECTRICAL CHARACTERISTICS (@ $V_S = \pm 18$ V, $T_A = +25°C$, unless otherwise noted)

Parameter	Symbol	Conditions	Min	SSM2141 Typ	Max	Units
OFFSET VOLTAGE	V_{OS}	$V_{CM} = 0$ V	–1000	25	1000	µV
GAIN ERROR		No Load, $V_{IN} = \pm 10$ V, $R_S = 0$ Ω		0.001	0.01	%
INPUT VOLTAGE RANGE	IVR	(Note 1)	±10			V
COMMON-MODE REJECTION	CMR	$V_{CM} = \pm 10$ V	80	100		dB
POWER SUPPLY REJECTION RATIO	PSRR	$V_S = \pm 6$ V to ± 18 V		0.7	15	µV/V
OUTPUT SWING	V_O	$R_L = 2$ kΩ	±13	±14.7		V
SHORT-CIRCUIT CURRENT LIMIT	I_{SC}	Output Shorted to Ground	+45/–15			mA
SMALL-SIGNAL BANDWIDTH (–3 dB)	BW	$R_L = 2$ kΩ		3		MHz
SLEW RATE	SR	$R_L = 2$ kΩ	6	9.5		V/µs
TOTAL HARMONIC DISTORTION	THD	$R_L = 100$ kΩ $R_L = 600$ Ω		0.001 0.01		%
CAPACITIVE LOAD DRIVE CAPABILITY	C_L	No Oscillation		300		pF
SUPPLY CURRENT	I_{SY}	No Load		2.5	3.5	mA

NOTES
[1]Input Voltage Range Guaranteed by CMR test.
Specifications subject to change without notice.

ELECTRICAL CHARACTERISTICS (@ $V_S = \pm 18$ V, $-40°C \leq T_A \leq +85°C$)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
OFFSET VOLTAGE	V_{OS}	$V_{CM} = 0$ V	–2500	200	2500	µV
GAIN ERROR		No Load, $V_{IN} = \pm 10$ V, $R_S = 0$ Ω		0.002	0.02	%
INPUT VOLTAGE RANGE	IVR	(Note 1)	±10			V
COMMON-MODE REJECTION	CMR	$V_{CM} = \pm 10$ V	75	90		dB
POWER SUPPLY REJECTION RATIO	PSRR	$V_S = \pm 6$ V to ± 18 V		1.0	20	µV/V
OUTPUT SWING	V_O	$R_L = 2$ kΩ	±13	±14.7		V
SLEW RATE	SR	$R_L = 2$ kΩ		9.5		V/µs
SUPPLY CURRENT	I_{SY}	No Load		2.6	4.0	mA

NOTES
[1]Input Voltage Range Guaranteed by CMR test.
Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . ±18 V
Input Voltage[1] . . . . 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

Package Type	θ_{JA}[2]	θ_{JC}	Units
8-Pin Plastic DIP (P)	103	43	°C/W

NOTES
[1]For supply voltages less than ±18 V, the absolute maximum input voltage is equal to the supply voltage.
[2]θ_{JA} is specified for worst case mounting conditions, i.e., θ_{JA} is specified for device in socket for P-DIP package.

ORDERING GUIDE

Model	Operating Temperature Range	Package Description	Package Option
SSM2141P	XIND (–40°C ≤ T_A ≤ +85°C)	8-Pin Plastic DIP	N-8
SSM2141S	XIND (–40°C ≤ T_A ≤ +85°C)	8-Pin Narrow Body SO	SO-8

Typical Performance Characteristics
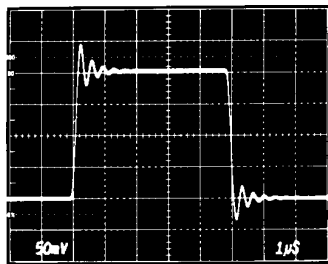
$T_A = +25°C$
$V_S = ±15V$

Small Signal Transient Response
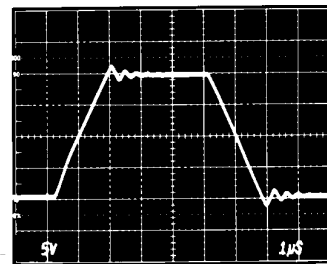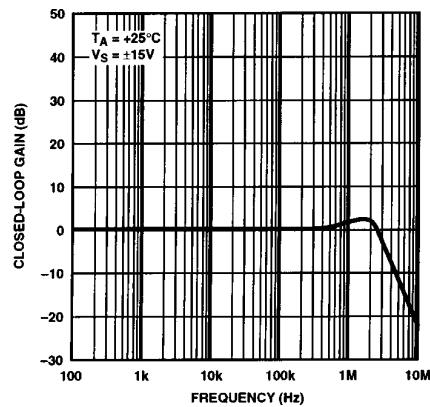

$T_A = +25°C$
$V_S = ±15V$

Large Signal Transient Response
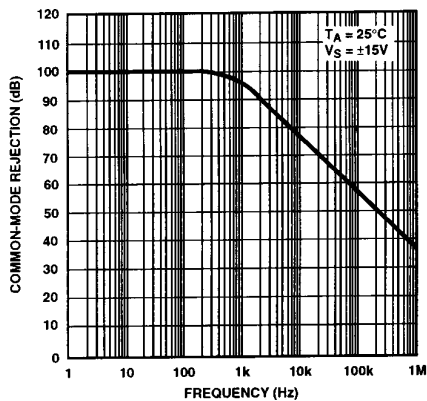
Common-Mode Rejection vs. Frequency
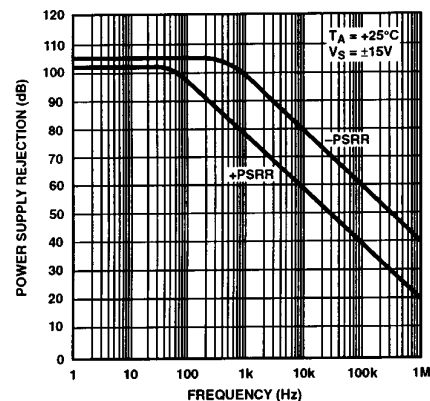
Power Supply Rejection vs. Frequency
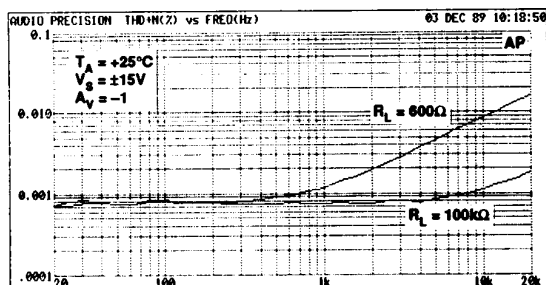
Total Harmonic Distortion vs. Frequency
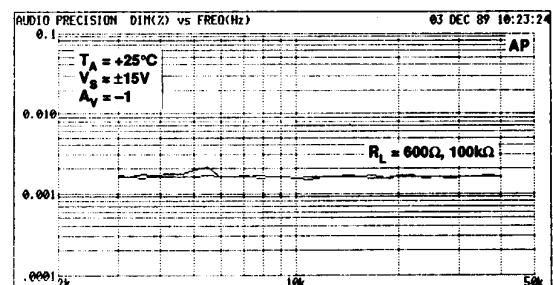
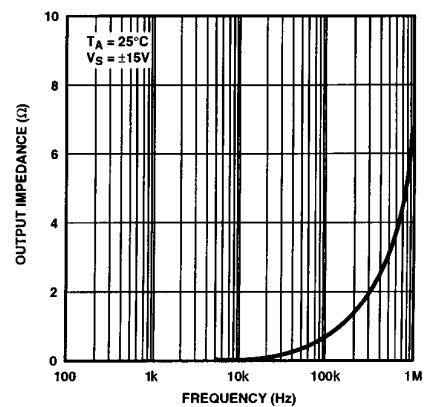*Dynamic Intermodulation Distortion vs. Frequency*

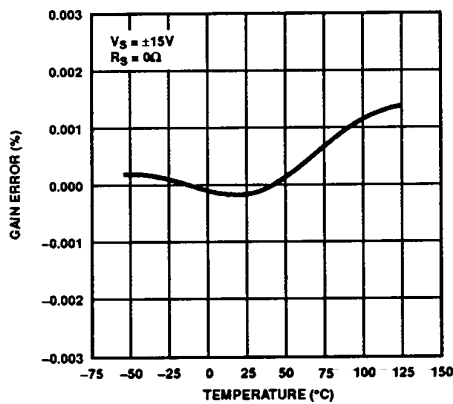# SSM2141–Typical Performance Characteristics
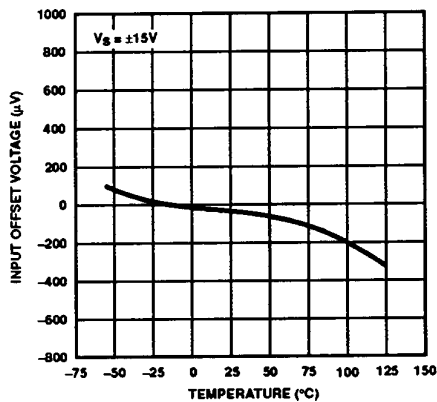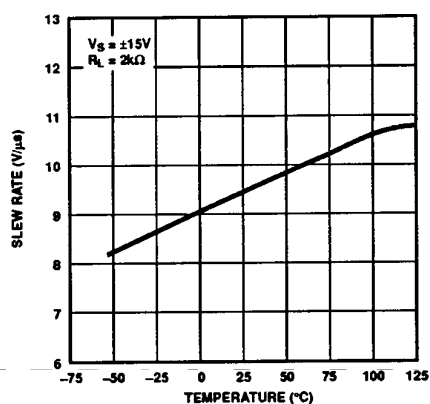

Input Offset Voltage vs. Temperature

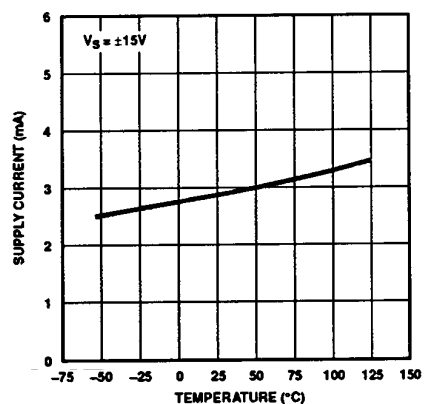Closed-Loop Gain vs. Frequency

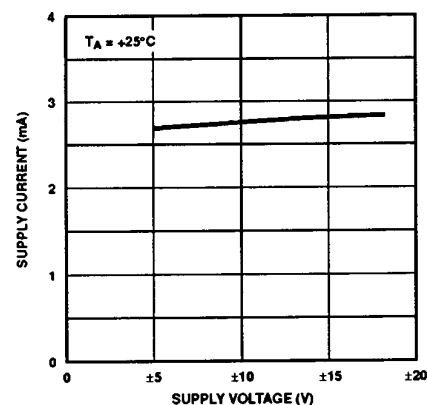

Closed-Loop Output Impedance vs. Frequency
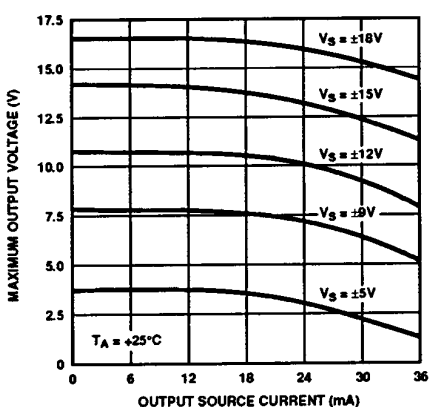

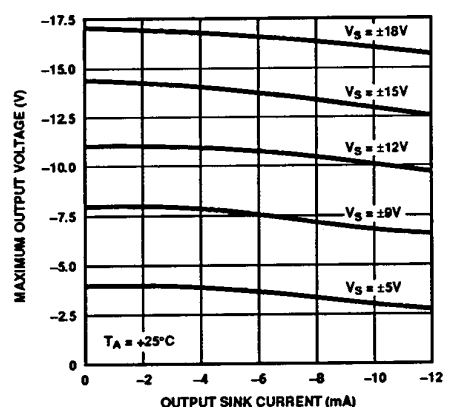Gain Error vs. Temperature

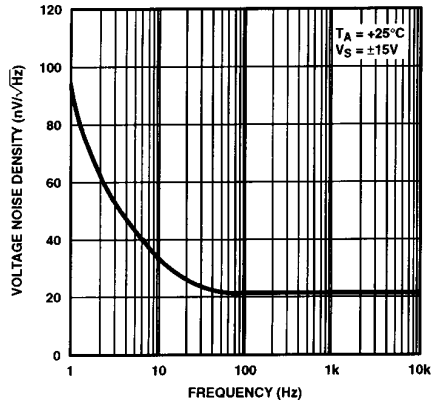Slew Rate vs. Temperature

Supply Current vs. Temperature

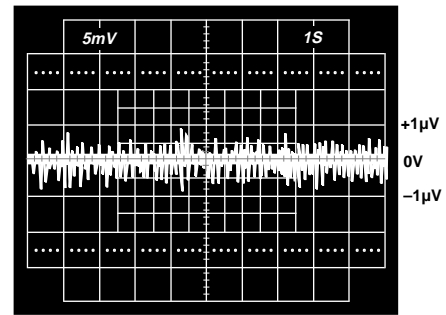Supply Current vs. Supply Voltage

Maximum Output Voltage vs. Output Current (Source)

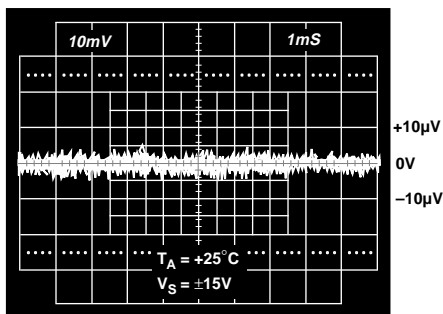

Maximum Output Voltage vs. Output Current (Sink)
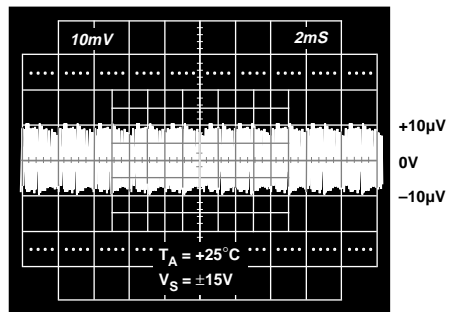
Voltage Noise Density vs. Frequency

0.1 TO 10Hz PEAK-TO-PEAK NOISE

Low Frequency Voltage Noise

NOTE: EXTERNAL AMPLIFIER GAIN = 1000;
THEREFORE, VERTICAL SCALE = 10µV/DIV.

Voltage Noise from 0 kHz to 1 kHz

NOTE: EXTERNAL AMPLIFIER GAIN = 1000;
THEREFORE, VERTICAL SCALE = 10µV/DIV.

Voltage Noise from 0 kHz to 10 kHz

APPLICATIONS INFORMATION

The SSM2141 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.
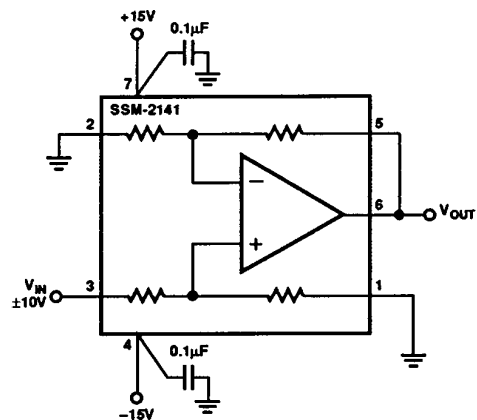
Slew Rate Test Circuit

SSM2141

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 Ω 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.
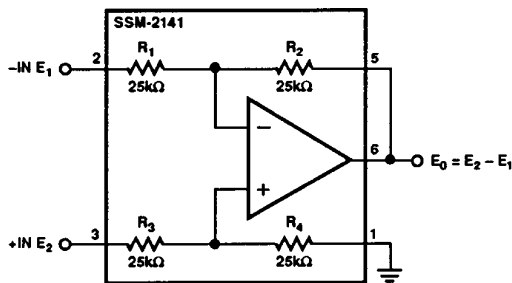

Figure 1. Precision Difference Amplifier. Rejects

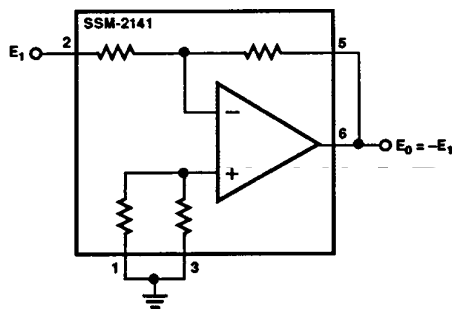Common-Mode Signal $= \dfrac{[E_1 + E_2]}{2}$ by 100 dB

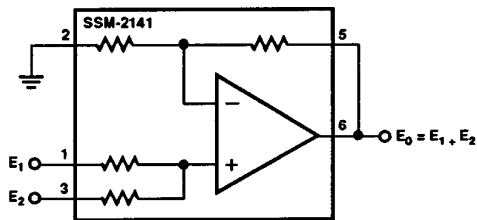Figure 2. Precision Unity Gain Inverting Amplifier

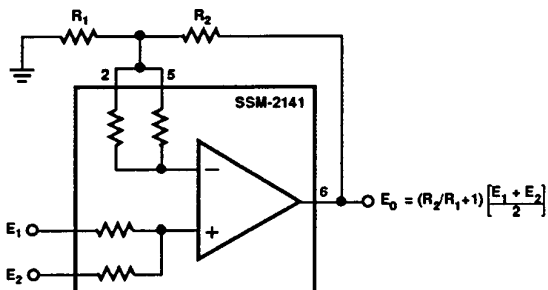Figure 3. Precision Summing Amplifier
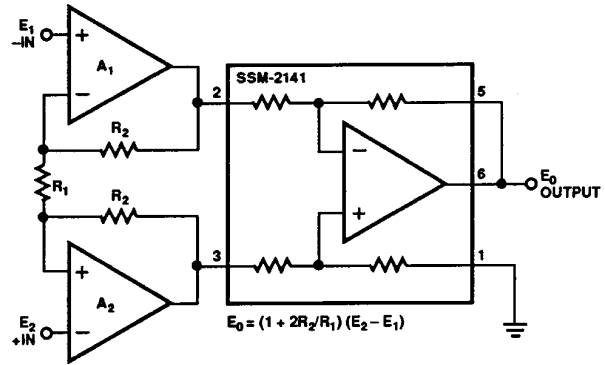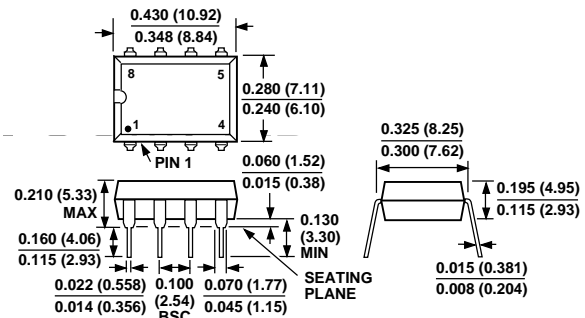

Figure 4. Precision Summing Amplifier with Gain

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

$E_0 = (1 + 2R_2/R_1)(E_2 - E_1)$

OUTLINE DIMENSIONS
Dimensions shown in inches and (mm).

8-Pin
Epoxy Mini-DIP
P-Suffix (N-8)

8-Pin Narrow Body SO
S-Suffix (SO-8)

REV. B