National Semiconductor

Precision Networks

RA201 Precision Instrumentation Amplifier Resistor Network

General Description

The RA201 is a family of precision instrumentation amplifier networks. This device, when combined with 3 operational amplifiers, provides a precision instrumentation amplifier with common-mode rejection up to 100 dB. All gain setting resistors are provided within the device. This feature assures excellent thermal tracking and thermal matching of all resistors. This network is manufactured using a high stability thin-film technology. Thin-film resistors provide tracking temperature coefficients of better than 5 ppm/°C. The thin-film resistors are laser trimmed to guarantee resistor matching to 0.05% for the RA201-2, and 0.1% for the RA201-1.

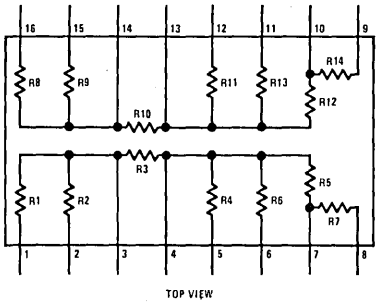
Other applications include process control interfacing and precision decade dividers.

Features

- Gain programmable
- Matching accuracies to 0.05%
- Matching temperature coefficient to 5 ppm/°C
- Absolute temperature coefficient to 80 ppm/°C
- Close thermal proximity of all resistors
- Standard dual-in-line package
- Low-cost

Connection Diagram

Dual-In-Line Package

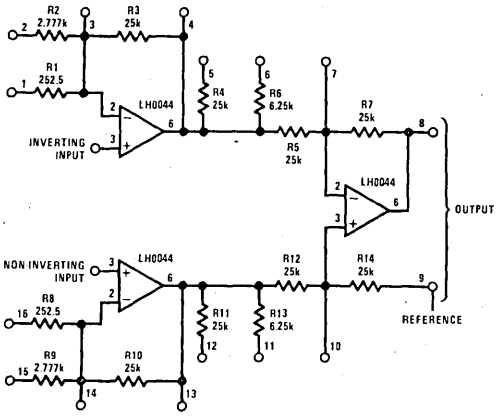


TOP VIEW

R1 = 252.525 . . Ω
R2 = 2.777 . . . kΩ
R3 = 25k
R4 = 25k
R5 = 25k
R6 = 6.25k
R7 = 25k
R8 = 252.525 . . . Ω
R9 = 2.777 . . . kΩ
R10 = 25k
R11 = 25k
R12 = 25k
R13 = 6.25k
R14 = 25k

R3:R2 = 9:1
R3:R1 = 99:1
R3||R2 = 2.50k
R3||R1 = 250.0Ω
R5||R6 = 5.0k

Typical Application



Overall Gain	Input Stage Gain	Output Stage Gain	Jumper Pins on RA201
X1	X1	X1	
X2	X1	X2	5 to 7, 12 to 10
X5	X1	X5	6 to 7, 11 to 10
X10	X10	X1	2 to 15
X20	X10	X2	2 to 15, 5 to 7, 12 to 10
X50	X10	X5	2 to 15, 6 to 7, 11 to 10
X100	X100	X1	1 to 16
X200	X100	X2	1 to 16, 5 to 7, 12 to 10
X500	X100	X5	1 to 16, 6 to 7, 11 to 10
X995	X199	X5	1 to 14, 6 to 7, 11 to 10

Precision Instrumentation Amplifier

Absolute Maximum Ratings

Rated Voltage Between Sections	200V
Rated Voltage Across Resistors	(Note 1)
Package Power Dissipation at 25°C (See Curve)	2.0W
Individual Resistor Power at 25°C	0.25W
Operating Temperature Range	
RA201-1N, RA201-2N	−25°C to +85°C
RA201-1D, RA201-2D	−55°C to +125°C
Storage Temperature Range	−55°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics $T_A = 25°C$ (Note 2)

Parameter	Conditions; Resistors Tested	Typ.	RA201-2 Max.	RA201-1 Max.	Units
Input Stage × 10	R2:R3	1:9	±0.01	±0.2	%
	R9:R10	1:9	±0.01	±0.2	%
Input Stage × 100	R1:R3	1:99	±1.0	±1.0	%
	R8:R10	1:99	±1.0	±1.0	%
Output Stage × 1	R7:R5	1:1	±0.05	±0.1	%
	R14:R12	1:1	±0.05	±0.1	%
Output Stage × 2	(R4||R5):R7	1:2	±0.05	±0.1	%
	(R12||R11):R14	1:2	±0.05	±0.1	%
Output Stage × 5	(R6||R5):R7	1:5	±0.05	±0.1	%
	(R12||R13):R14	1:5	±0.05	±0.1	%
Output Stage CMRR	(R7:R5):(R14:R12), (Note 3)	1:1	±0.05	±0.1	%
Absolute Tolerance	R3, R10	25kΩ	±5.0	±5.0	%
Absolute Tempco		80			ppm/°C

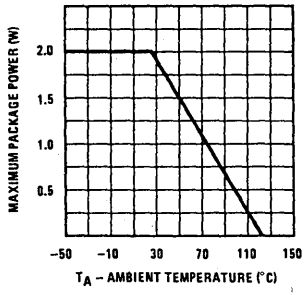
Note 1: Rated voltage is limited by the individual resistor power rating of 0.25W. For example, a 25k resistor could withstand a maximum of $V = \sqrt{(0.25)(25{,}000)} = 79V$. This rating may need to be reduced to be consistent with maximum package power if several resistors are dissipating power simultaneously.

Note 2: Resistor ratios shown apply at $T_A = 25°C$; for $T_{MIN} \leq T_A \ T_{MAX}$ the ratio tolerances are double the specifications shown.

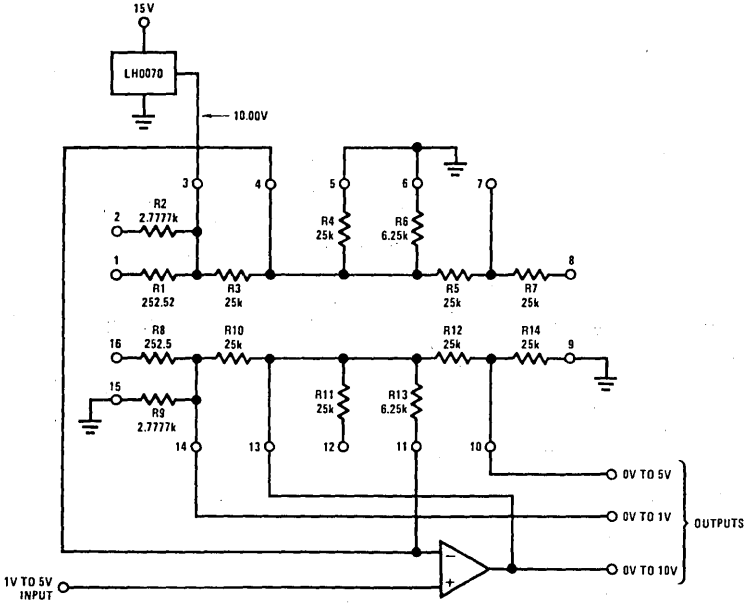
Note 3: This test guarantees the CMRR contributed by resistance mismatch. In low gain applications, all 3 amplifiers contribute strongly to the overall CMRR. In high gain applications, the degradation due to resistor mismatch and output stage CMRR are divided by the gain of the input stage.

Typical Performance Characteristics

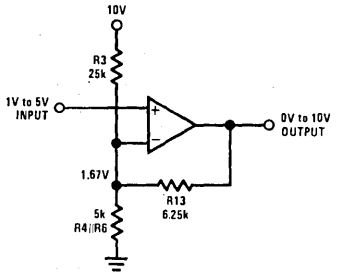
Power Derating



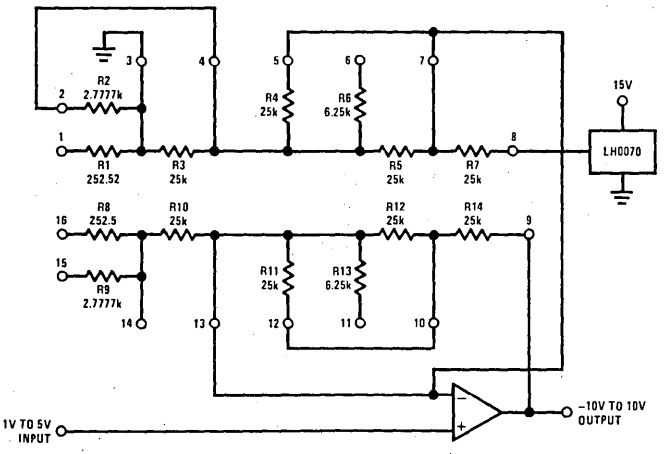
Applications Information



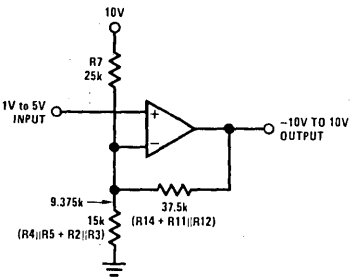
RA201 Process Control Interface No. 1



Equivalent Circuit

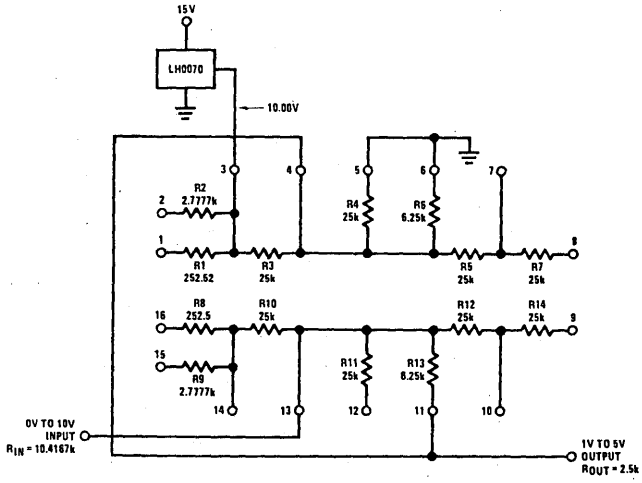


RA201 Process Control Interface No. 2

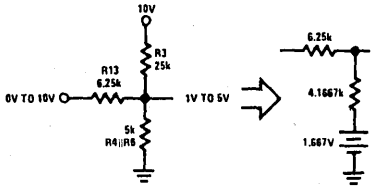


Equivalent Circuit

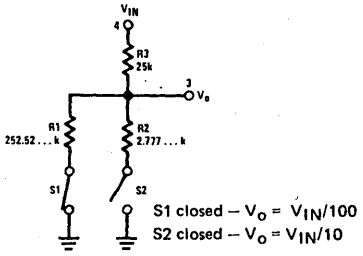
Applications Information (Continued)



RA201 Process Control Interface No. 3



Equivalent Circuit



Precision Decade Divider

Ordering Information

Part Number	Accuracy	Package	Temperature Range
RA201-1D	0.1%	D16C	−55°C to +125°C
RA201-2D	0.05%	D16C	−55°C to +125°C
RA201-1N	0.1%	N16A	−25°C to +85°C
RA201-2N	0.05%	N16A	−25°C to +85°C