Precision Operational Amplifiers

1 FEATURES

- **Low Offset Voltage: ±0.2mV (TYP)**
- **Low Bias Current: ±10pA (TYP)**
- **Gain Bandwidth Product: 2MHz**
- **Low Quiescent Current: 1mA (TYP)**
- **Overload Recovery Time: 1.6μs**
- **Supply Voltage Range: 3.3V to 32V**
- **No External Components Required**
- **Extended Temperature: -40°C to +125°C**
- **Micro SIZE PACKAGES: SOP8**

2 APPLICATIONS

- **Optical Network Control Circuits**
- **Sensors and Controls**
- **Wireless Base Station Control Circuits**
- **Cellular and Cordless Phones**
- **Photodiode Amplification**
- **Precision Filters**
- **Instrumentation**
- **A/D Converters**
- **Laptops and PDAs**
- **Medical and Industrial Instrumentation**

3 DESCRIPTIONS

The RS862X is a low noise, low offset voltage and high voltage operational amplifier, which can be designed into a wide range of applications. The RS862X has a gain-bandwidth product of 2MHz, a slew rate of 1.2V/μs and a quiescent current of 1mA at wide power supply range.

The RS862X is designed to provide optimal performance in low noise systems. It provides rail-to rail output swing into heavy loads.

The RS862X is available in Green SOP8 packages. It operates over an ambient temperature range of -40°C to +125°C under single power supplies of 3.3V to 32V or dual power supplies of ±1.65V to ±16V.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS8621	SOP8	4.90mm x 3.90mm
RS8622	SOP8	4.90mm x 3.90mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

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4 Revision History

Note: Page numbers for previous revisions may different from page numbers in the current version.

Version	Change Date	Change Item
A.0	2023/05/11	Preliminary version completed
A.1	2023/07/03	1. Delete MSOP-8 Package 2. Update the minimum Operating Voltage to 3.3V 3. Update ELECTRICAL CHARACTERISTICS
A.1.1	2024/03/01	Modify packaging naming

5 PACKAGE/ORDERING INFORMATION (1)

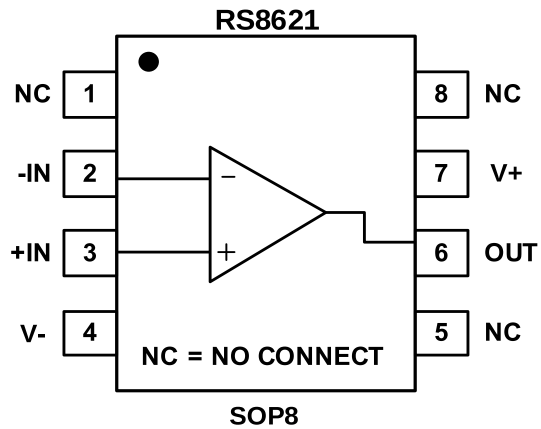
Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking (2)	Package Qty
RS8621XK	SOP8	8	1	-40°C ~125°C	RS8621	Tape and Reel,4000
RS8622XK	SOP8	8	2	-40°C ~125°C	RS8622	Tape and Reel,4000

NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

6 Pin Configuration and Functions (Top View)

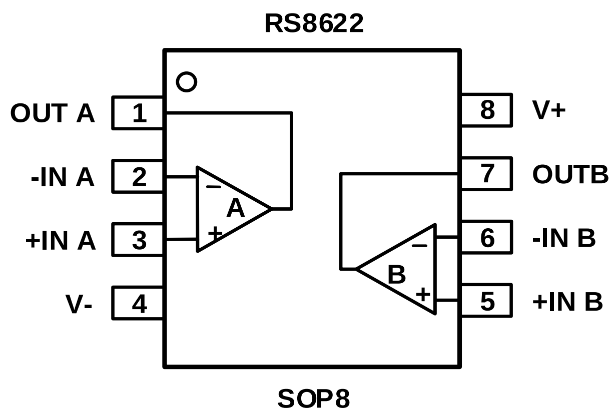


Pin Description

NAME	PIN	I/O (1)	DESCRIPTION
	RS8621		
	SOP8		
-IN	2	I	Negative (inverting) input
+IN	3	I	Positive (noninverting) input
NC (2)	1,5,8	-	No internal connection (can be left floating)
OUT	6	O	Output
V-	4	-	Negative (lowest) power supply
V+	7	-	Positive (highest) power supply

(1) I = Input, O = Output.
(2) There is no internal connection. Typically, GND is the recommended connection to a heat spreading plane.

Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN	I/O (1)	DESCRIPTION
	RS8622		
	SOP8		
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
-INB	6	I	Inverting input, channel B
+INB	5	I	Noninverting input, channel B
OUTA	1	O	Output, channel A
OUTB	7	O	Output, channel B
V-	4	-	Negative (lowest) power supply
V+	8	-	Positive (highest) power supply

(1) I = Input, O = Output.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

			MIN	MAX	UNIT
Voltage	Supply, V_S= (V+) - (V-)			36	V
	Signal input pin (2)		(V-) -0.3	(V+) +0.3	
	Signal output pin (3)		(V-) -0.3	(V+) +0.3	
Current	Signal input pin (2)		-10	10	mA
	Signal output pin (3)		-10	10	mA
θ_{JA}	Package thermal impedance (4)	SOP8		110	°C/W
Temperature	Operating range, T_A		-40	125	°C
	Junction, T_J (5)		-40	150	
	Storage, T_{stg}		-65	150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.
(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.3V beyond the supply rails should be current-limited to ±10mA or less.
(4) The package thermal impedance is calculated in accordance with JESD-51.
(5) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V
		Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002(2)	±1000	
		Machine Model (MM)	±200	

(1) JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250 V CDM allows safe manufacturing with a standard ESD control process.

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

7.3 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
Supply voltage, V_S= (V+) - (V-)	Single-supply	3.3		32	V
	Dual-supply	±1.65		±16	

7.4 ELECTRICAL CHARACTERISTICS

(At T_A=+25°C, V_S=3.3V to 32V, R_L=10kΩ connected to V_S/2, and V_{OUT}=V_S/2, V_{CM}=V_S/2, Full [9] = -40°C to +125°C, unless otherwise noted.) [1]

PARAMETER		CONDITIONS	T_J	RS862X MIN[2]	RS862X TYP[3]	RS862X MAX[2]	UNIT
POWER SUPPLY							
V_S	Operating Voltage Range		25°C	3.3		32	V
I_Q	Quiescent Current Per Amplifier	V_S=±2.5V, I_O=0mA	25°C		1	1.5	mA
		V_S=±16V, I_O=0mA	25°C		1.4	1.8	
PSRR	Power-Supply Rejection Ratio	V_S=5V to 32V	25°C	82	100		dB
INPUT							
V_{OS}	Input Offset Voltage	V_S=5V, V_{CM}=V_S/2	25°C	-0.4	±0.2	0.4	mV
			Full		±1		
		V_S=32V, V_{CM}=V_S/2	25°C	-0.9	±0.4	0.9	
			Full		±1		
V_{OS} Tc	Input Offset Voltage Average Drift	V_{CM}= V_S/2	Full		±5		μV/°C
IB	Input Bias Current [4] [5]	V_{CM}=0V	25°C		±10		pA
I_{OS}	Input Offset Current [4]	V_{CM}=0V	25°C		±10		pA
V_{CM}	Common-Mode Voltage Range		25°C	(V-)		(V+)-2	V
CMRR	Common-Mode Rejection Ratio	V_S= ±16V V_{CM}=(V-) to (V+)-2V	25°C	87	115		dB
OUTPUT							
A_{OL}	Open-Loop Voltage Gain	R_L=10KΩ, V_O=(V-)+0.5V to (V+)-0.5V	25°C	117	150		dB
V_{OH}	Output Swing from Rail	V_S=±16V, R_L=10KΩ	25°C	15.7			V
V_{OL}						-15.7	V
I_{SOURCE}	Output Source Current [6] [7]	V_S=10V	25°C	65	142		mA
I_{SINK}	Output Sink Current [6] [7]			45	103		
C_{LOAD}	Capacitive Load Drive		25°C		1		nF
FREQUENCY RESPONSE							
SR	Slew Rate [8]	G=+1, C_L=100pF	25°C		1.2		V/μs
GBW	Gain-Bandwidth Product	G=10, VPPvin=50mV, R_L=10KΩ	25°C		2		MHz
t_S	Settling Time,0.1%	V_S=±16V, G=+1, C_L=100pF, Step=7V	25°C		8		μs
t_{OR}	Overload Recovery Time	V_{IN}·Gain≥V_S, G=-100	25°C		1.6		μs
t_{ON}	Turn On Time	G=1	25°C		75		μs
NOISE							
E_n	Input Voltage Noise	f = 0.1Hz to 10Hz, V_S=±2.5V	25°C		4.3		μVpp
e_n	Input Voltage Noise Density [4]	f = 1KHz	25°C		14		nV/$\sqrt{Hz}$

NOTE:

(1) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device.

(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(4) This parameter is ensured by design and/or characterization and is not tested in production.

(5) Positive current corresponds to current flowing into the device.

(6) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

(7) Short circuit test is a momentary test.

(8) Number specified is the slower of positive and negative slew rates.

(9) Specified by characterization only.

7.5 TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At T_A= +25°C, V_S= ±16V, unless otherwise noted.

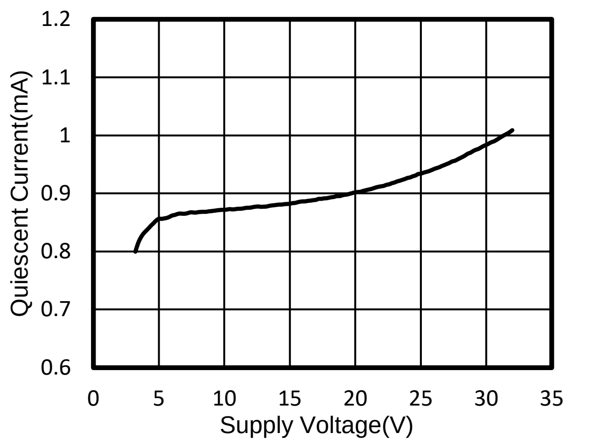


Figure 1. Supply Voltage vs Quiescent Current

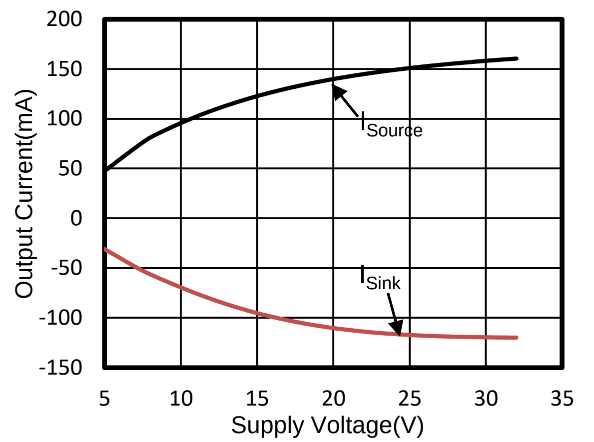


Figure 2. Supply Voltage vs Output Current

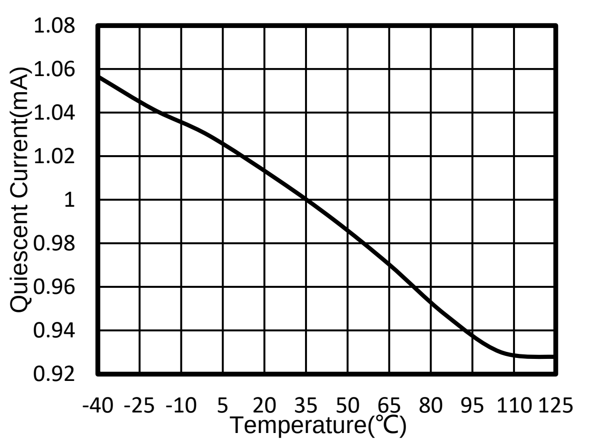


Figure 3. Quiescent Current vs Temperature

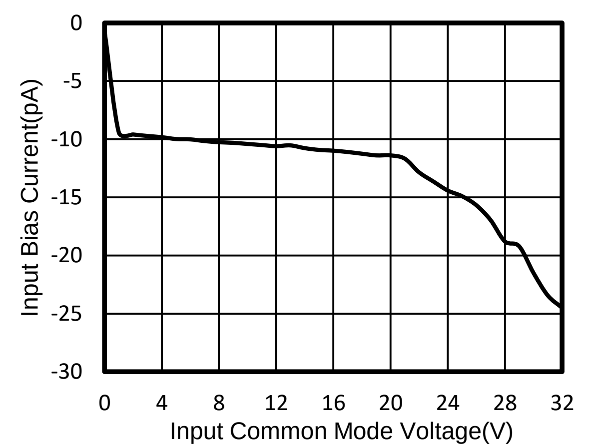


Figure 4. Input Bias Current vs Input Common Mode Voltage

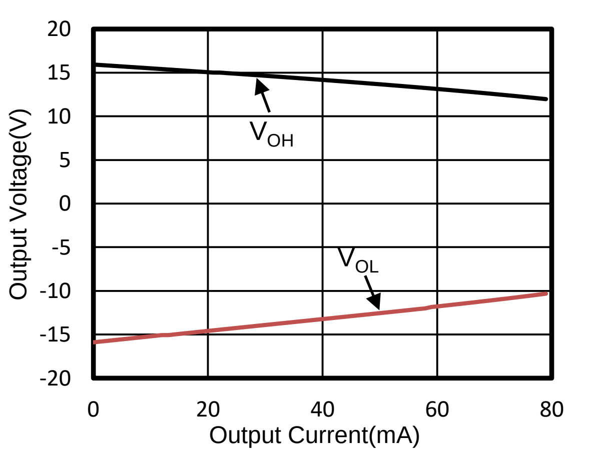


Figure 5. Output Voltage vs Output Current

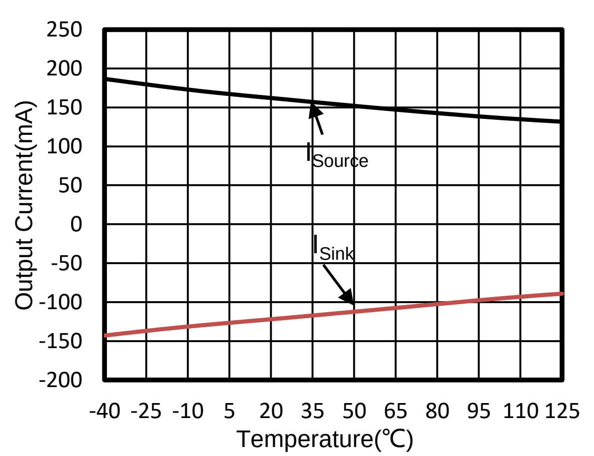


Figure 6. Output Current vs Temperature

TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.
At T_A= +25°C, V_S= ±16V, unless otherwise noted.

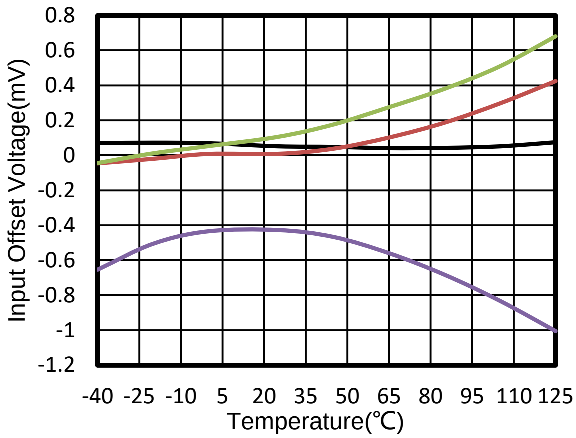


Figure 7. Input Offset Voltage vs Temperature

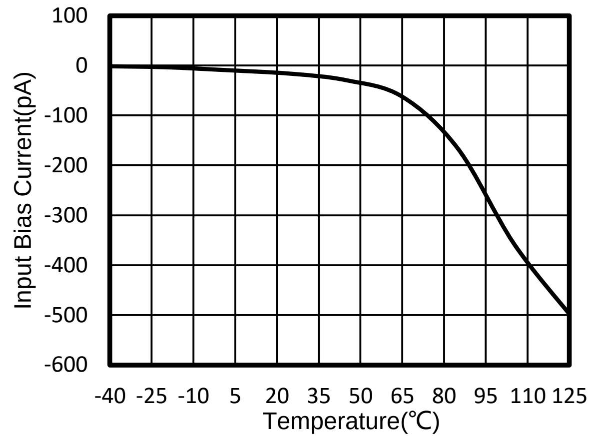


Figure 8. Input Bias Current vs Temperature

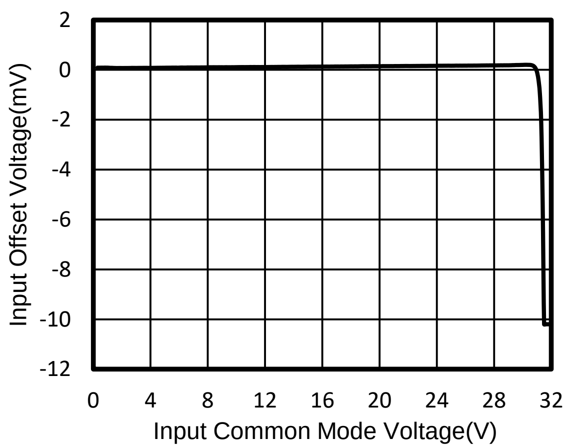


Figure 9. Input Offset Voltage vs Input Common Mode Voltage

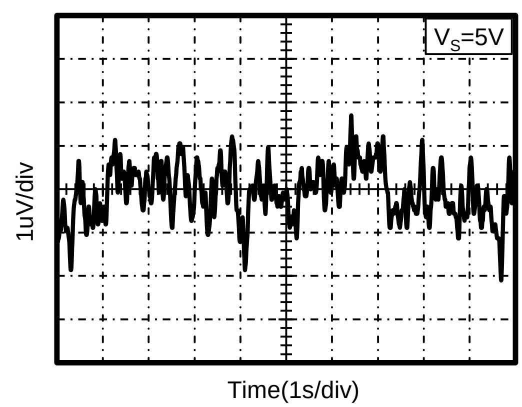


Figure 10. 0.1Hz to 10Hz Input Voltage Noise

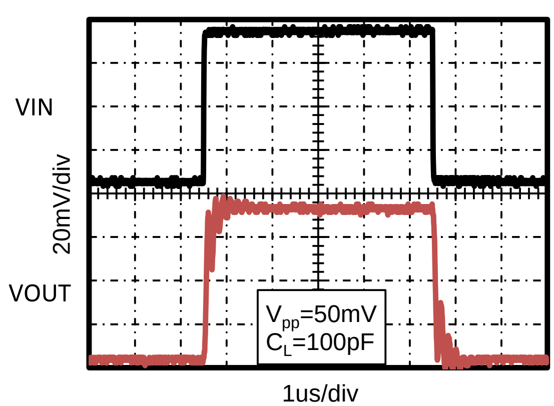


Figure 11. Small-Signal Step Response

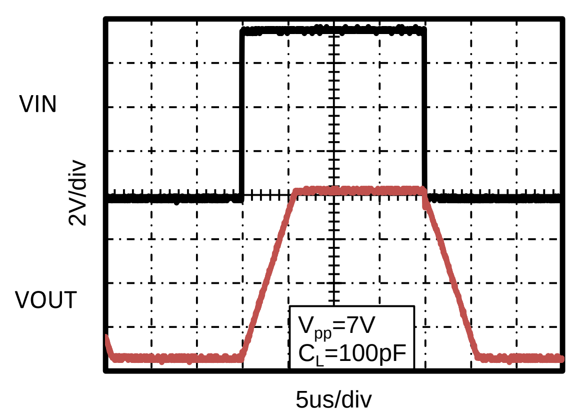


Figure 12. Large-Signal Step Response

8 Application and Implementation

Information in the following applications sections is not part of the RUNIC component specification, and RUNIC does not warrant its accuracy or completeness. RUNIC's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Power Supply Bypassing and Layout

The RS862X operates from either a single 3.3V to 32V supply or dual ±1.65V to ±16V supplies. For single-supply operation, bypass the power supply V+ with a 0.1μF ceramic capacitor which should be placed close to the V+ pin. For dual-supply operation, both the V+ and the V- supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 10μF tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the operational amplifier's inputs and output. To decrease stray capacitance, minimize trace lengths and widths by placing external components as close to the device as possible. Use surface-mount components whenever possible.

For the operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency current loop area small to minimize the EMI (electromagnetic interference).

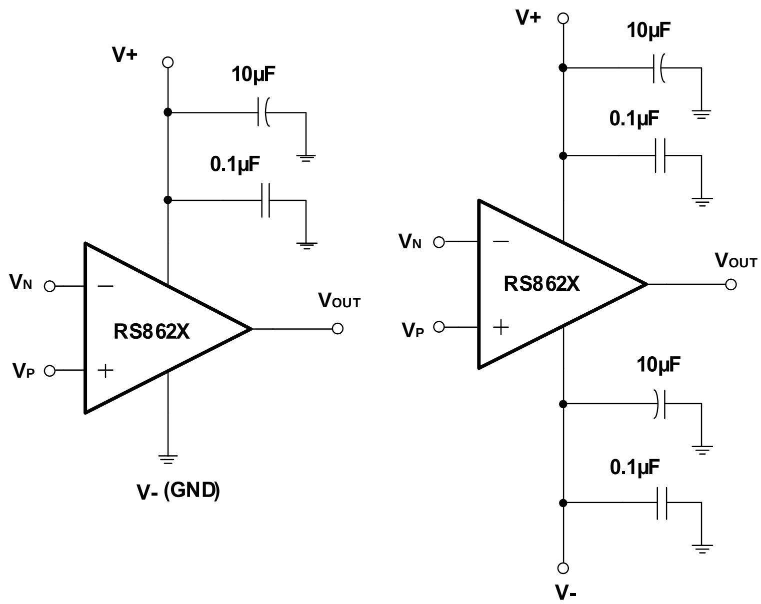


Figure 13. Amplifier with Bypass Capacitors

8.2 Grounding

A ground plane layer is important for RS862X circuit design. The length of the current path in an inductive ground return will create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance.

8.3 Input-to-Output Coupling

To minimize capacitive coupling, the input and output signal traces should not be in parallel. This helps reduce unwanted positive feedback.

8.4 Differential Amplifier

The circuit shown in Figure 14 performs the difference function. If the resistor ratios are equal ($R_4/R_3 = R_2/R_1$), then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

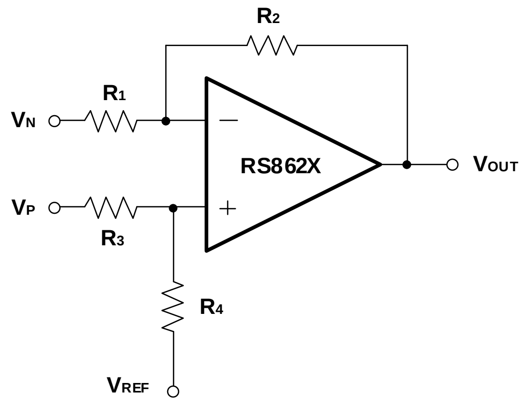


Figure 14. Differential Amplifier

8.5 Instrumentation Amplifier

The circuit in Figure 15 performs the same function as that in Figure 14 but with a high input impedance.

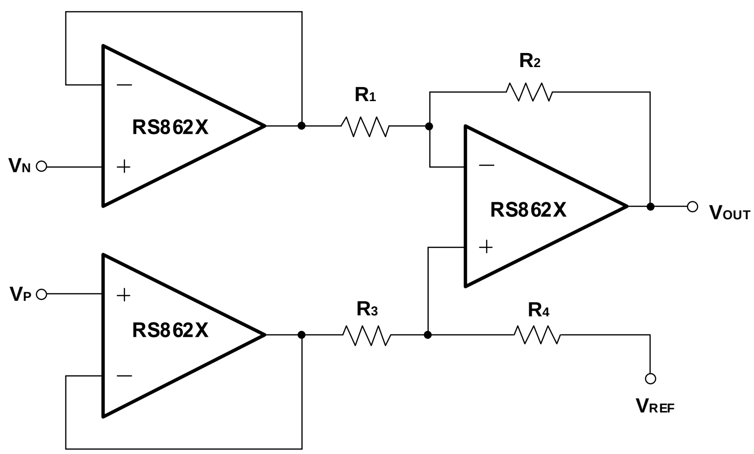


Figure 15. Instrumentation Amplifier

8.6 Active Low-Pass Filter

The low-pass filter shown in Figure 16 has a DC gain of ($-R_2/R_1$) and the -3dB corner frequency is $1/2\pi R_2C$. Make sure the filter bandwidth is within the bandwidth of the amplifier. Feedback resistors with large values can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistor values as low as possible and consistent with output loading consideration.

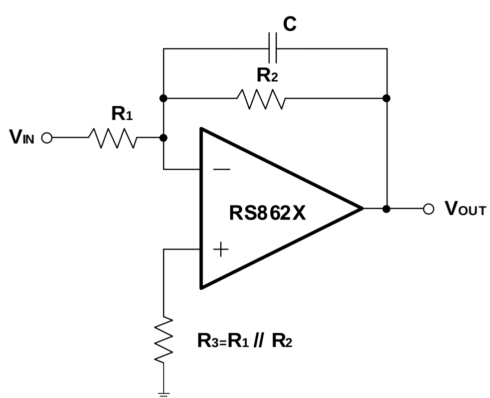


Figure 16. Active Low-Pass Filter

9 LAYOUT

9.1 Layout Guidelines

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF capacitor closely across the supply pins.

These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI susceptibility.

9.2 Layout Example

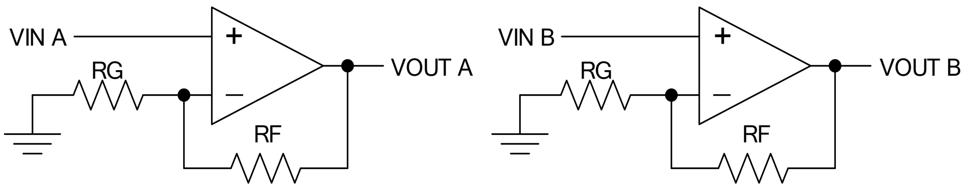


Figure 17. Schematic Representation

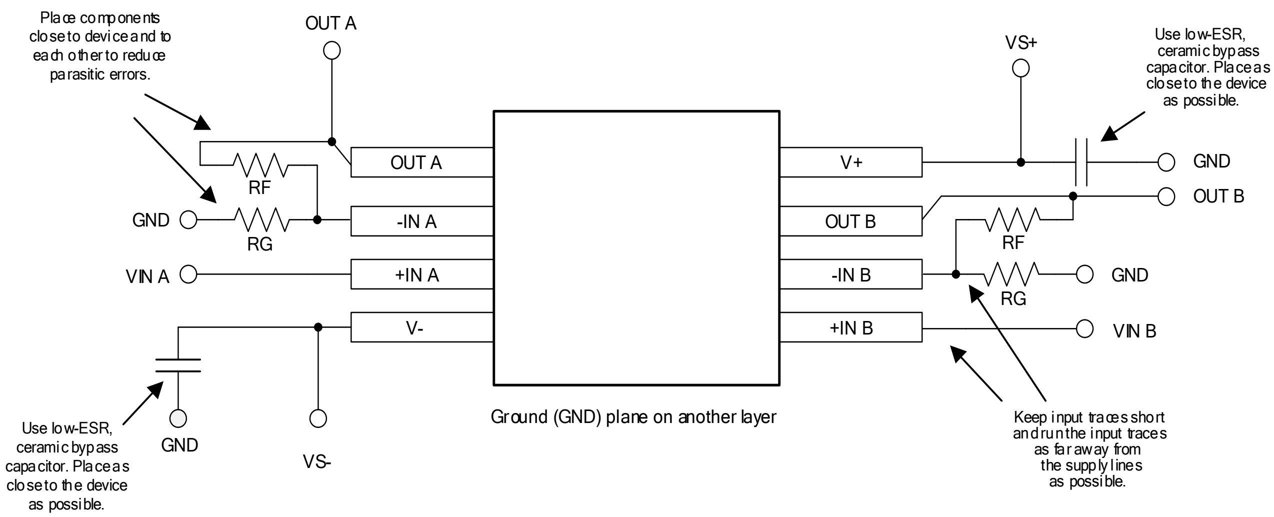
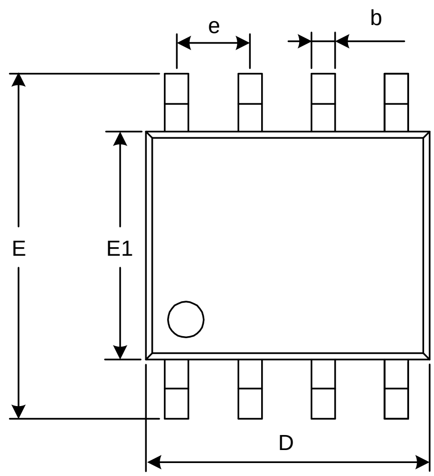


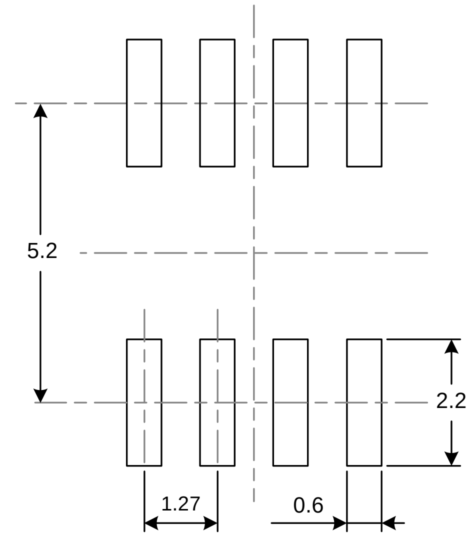
Figure 18. Layout Example

NOTE: Layout Recommendations have been shown for dual op-amp only, follow similar precautions for Single and four.

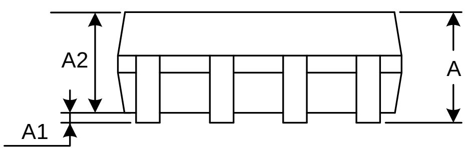
10 PACKAGE OUTLINE DIMENSIONS

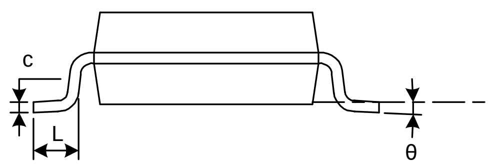
SOP8





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

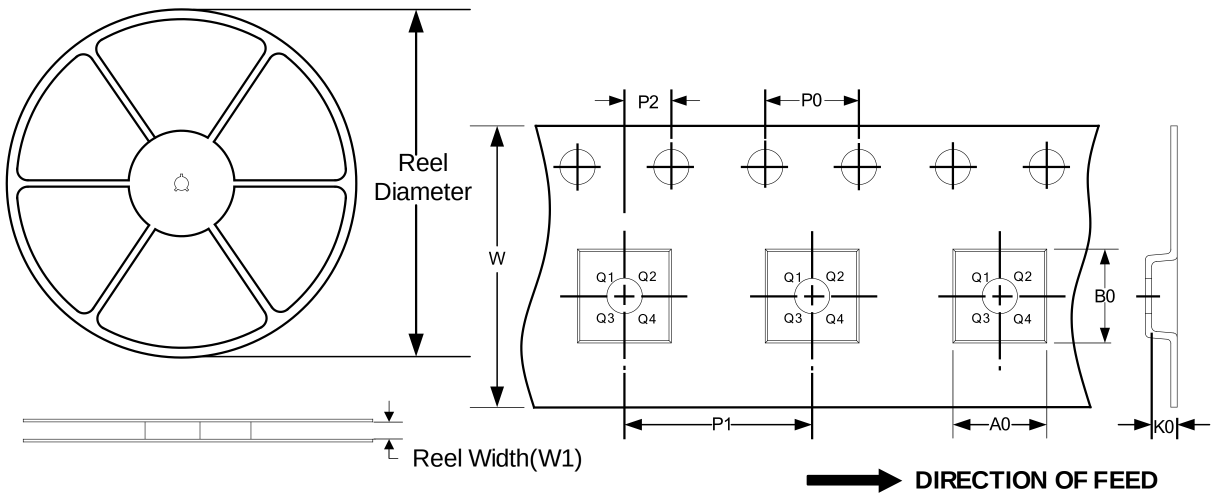
NOTE:

A. All linear dimension is in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. BSC: Basic Dimension. Theoretically exact value shown without tolerances.

11 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width(mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOP8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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