# Precision, Ultralow Noise, RRIO, Zero-Drift Operational Amplifiers

## 1 FEATURES

- **Low Offset Voltage: ±1.2 µV Typical**
- **Low Offset Voltage Drift: ±0.1 µV/°C Typical**
- **Low Noise: 0.15 $\mu V_{PP}$ at f = 0.1Hz to 10Hz**
- **Open-Loop Gain: 140 dB Typical**
- **CMRR: 125 dB Typical**
- **PSRR: 125 dB Typical**
- **Gain Bandwidth Product: 3.7 MHz**
- **Single-Supply Operation: 2.2 V to 5.5 V**
- **Dual-Supply Operation: ±1.1 V to ±2.75 V**
- **Rail-to-Rail Input and Output**
- **Unity-Gain Stable**

## 2 APPLICATIONS

- **Thermocouple/Thermopile**
- **Load Cell and Bridge Transducers**
- **Precision Instrumentation**
- **Electronic Scales**
- **Medical Instrumentation**
- **Handheld Test Equipment**

## 3 DESCRIPTION

The RS8531/RS8532 are ultralow noise, zero-drift operational amplifiers featuring rail-to-rail input and output swing. With an offset voltage of ±1.2 µV, offset voltage drift of ±0.1 µV/°C, and typical noise of 0.15 $\mu V_{PP}$ (0.1Hz to 10Hz), the RS8531/RS8532 are well suited for applications in which error sources cannot be tolerated.

The RS8531/RS8532 have a wide operating supply range of 2.2 V to 5.5 V, high gain, and excellent CMRR and PSRR specifications, which make it ideal for applications that require precision amplification of low level signals, such as position and pressure sensors, strain gages, and medical instrumentation.

The RS8531/RS8532 are specified over the extended industrial temperature range (−40°C to +125°C). The RS8531 is available in SOT23-5 and MSOP8 packages. The RS8532 is available in SOP8 and MSOP8 packages.

**Device Information (1)**

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| RS8531 | SOT23-5 | 2.90mm×1.60mm |
| | MSOP8 | 3.00mm×3.00mm |
| RS8532 | SOP8 | 4.90mm×3.90mm |
| | MSOP8 | 3.00mm×3.00mm |

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

# Table of Contents

**1 FEATURES** ..... 1
**2 APPLICATIONS** ..... 1
**3 DESCRIPTION** ..... 1
**4 REVISION HISTORY** ..... 3
**5 PACKAGE/ORDERING INFORMATION** (1) ..... 4
**6 PIN CONFIGURATION AND FUNCTIONS** ..... 5
**7 SPECIFICATIONS** ..... 6
7.1 Absolute Maximum Ratings ..... 6
7.2 ESD Ratings ..... 6
7.3 Recommended Operating Conditions ..... 6
7.4 Electrical Characteristics ..... 7
7.5 Typical Characteristics ..... 9
**8 APPLICATION AND IMPLEMENTATION** ..... 12
8.1 Applications Information ..... 12
8.2 Input Protection ..... 12
8.3 Rail-to-Rail Input and Output ..... 12
8.4 Noise Considerations ..... 13
8.4.1 1/f Noise ..... 13
8.4.2 Source Resistance ..... 13
8.4.3 Voltage Noise Density with Different Gain Configurations ..... 13
8.4.4 Residual Voltage Ripple ..... 14
8.5 Comparator Operation ..... 15
**9 LAYOUT** ..... 18
9.1 Layout Guidelines ..... 18
9.2 Layout Example ..... 18
**10 PACKAGE OUTLINE DIMENSIONS** ..... 19
**11 TAPE AND REEL INFORMATION** ..... 22

# 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 | 2024/10/24 | Preliminary version completed |
| A.1 | 2025/05/13 | Initial version completed |
| A.2 | 2025/05/27 | Delete contents related to RS8531B |
| A.3 | 2026/11/11 | Add $T_J$ and $T_{stg}$ parameters in Absolute Maximum Ratings |

# 5 PACKAGE/ORDERING INFORMATION (1)

| Orderable Device | Package Type | Pin | Channel | Op Temp(°C) | Device Marking (2) | MSL (3) | Package Qty |
|---|---|---|---|---|---|---|---|
| RS8531XF | SOT23-5 | 5 | 1 | -40°C ~125°C | 8531 | MSL1 | Tape and Reel, 3000 |
| RS8531XM | MSOP8 | 8 | 1 | -40°C ~125°C | RS8531 | MSL1 | Tape and Reel, 3000 |
| RS8532XK | SOP8 | 8 | 2 | -40°C ~125°C | RS8532 | MSL1 | Tape and Reel, 4000 |
| RS8532XM | MSOP8 | 8 | 2 | -40°C ~125°C | RS8532 | MSL1 | Tape and Reel, 4000 |

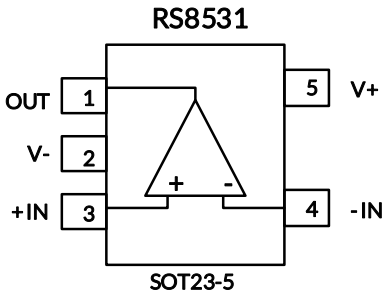
NOTE:

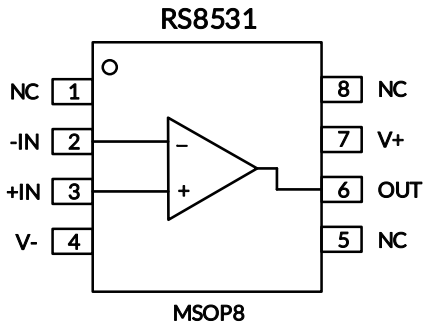
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(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.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

# 6 PIN CONFIGURATION AND FUNCTIONS

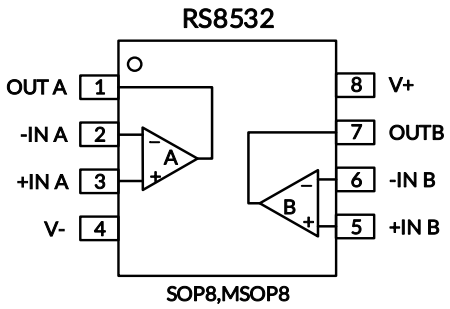



## PIN DESCRIPTION

| NAME | PIN | | I/O (1) | DESCRIPTION |
|---|---|---|---|---|
| | RS8531 | | | |
| | SOT23-5 | MSOP8 | | |
| NC | - | 1,5,8 | - | No internal connection (can be left floating) |
| -IN | 4 | 2 | I | Negative (inverting) input |
| +IN | 3 | 3 | I | Positive (noninverting) input |
| V- | 2 | 4 | - | Negative (lowest) power supply |
| OUT | 1 | 6 | O | Output |
| V+ | 5 | 7 | - | Positive (highest) power supply |

(1) I = Input, O = Output.




## PIN DESCRIPTION

| NAME | PIN | I/O (1) | DESCRIPTION |
|---|---|---|---|
| | SOP8/MSOP8 | | |
| -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, Vs=(V+) - (V-) | | 0 | 6 | V |
| | Signal input pin (2) | | (V-) -0.5 | (V+) +0.5 | |
| | Signal output pin (3) | | (V-) -0.5 | (V+) +0.5 | |
| | Differential input voltage | | (V-) - (V+) | (V+) - (V-) | |
| Current | Signal input pin (2) | | -10 | 10 | mA |
| | Signal output pin (3) | | -10 | 10 | mA |
| | Output short-circuit (4) | | Continuous | | |
| $\theta_{JA}$ | Package thermal impedance (5) | SOT23-5 | | 230 | °C/W |
| | | SOP8 | | 110 | |
| | | MSOP8 | | 170 | |
| Temperature | Operating range, $T_A$ | | -40 | 125 | °C |
| | Junction, $T_J$ (6) | | | 150 | °C |
| | Storage, $T_{stg}$ | | -65 | 150 | °C |

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V 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 0.5V beyond the supply rails should be current-limited to ±10mA or less.
(4) Short-circuit to ground, one amplifier per package.
(5) The package thermal impedance is calculated in accordance with JESD-51.
(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.

## 7.2 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), ANSI/ESDA/JEDEC JS001-2024 | ±4000 | V |
| | | Charged-Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2022 | ±1000 | |



**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, Vs= (V+) - (V-) | Single-supply | 2.2 | | 5.5 | V |
| | Dual-supply | ±1.1 | | ±2.75 | |

## 7.4 Electrical Characteristics

At $T_A$ = +25°C, $V_S$= 5V, $R_L$ = 10kΩ, Full [9] = -40°C to +125°C, unless otherwise noted. [1]

| PARAMETER | | CONDITIONS | $T_A$ | RS8531, RS8532 | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | MIN[2] | TYP[3] | MAX[2] | |
| **POWER SUPPLY** | | | | | | | |
| $V_S$ | Operating Voltage Range | | Full | 2.2 | | 5.5 | V |
| $I_Q$ | Quiescent Current per Amplifier | $V_S$ = ±2.5V, $I_O$=0mA | 25°C | | 1.5 | 1.9 | mA |
| | | | Full | | | 2.1 | |
| PSRR | Power-Supply Rejection Ratio | $V_S$ = 2.2V to 5.5V | 25°C | 95 | 125 | | dB |
| | | | Full | 90 | | | |
| **INPUT** | | | | | | | |
| $V_{OS}$ | Input Offset Voltage | $V_S$ = 2.2V, $V_{CM}$ = 1.1V | 25°C | -10 | ±1.2 | 10 | µV |
| | | $V_S$ = 5V, $V_{CM}$ = 2.5V | 25°C | -15 | ±2 | 15 | |
| Vos Tc | Input Offset Voltage Drift | | Full | | ±0.1 | | µV/°C |
| IB | Input Bias Current [4] [5] | $V_{CM}$ = 2.5V | 25°C | | 100 | | pA |
| $I_{OS}$ | Input Offset Current [4] | $V_{CM}$ = 2.5V | 25°C | | 100 | | pA |
| $A_{OL}$ | Open-Loop Voltage Gain | $V_{OUT}$ = 0.1 V to 4.9 V | 25°C | 105 | 140 | | dB |
| | | | Full | 100 | | | |
| $V_{CM}$ | Common-Mode Voltage Range | | Full | (V-) | | (V+) | V |
| CMRR | Common-Mode Rejection Ratio | $V_{CM}$=0V to 5V | 25°C | 105 | 125 | | dB |
| | | | Full | 100 | | | |
| **OUTPUT** | | | | | | | |
| $V_{OH}$ | Output Swing from Positive Rail | Vs=5V, $R_{LOAD}$ = 10kΩ to $V_S$/2 | 25°C | | 5 | 20 | mV |
| $V_{OL}$ | Output Swing from Negative Rail | Vs=5V, $R_{LOAD}$ = 10kΩ to $V_S$/2 | 25°C | | 5 | 20 | |
| $I_{SC}$ | Short-Circuit Current [6] [7] | Source | 25°C | 20 | 40 | | mA |
| | | Sink | | 30 | 50 | | |
| **AC SPECIFICATIONS** | | | | | | | |
| SR | Slew Rate [8] | G=1, $C_L$ = 100 pF | 25°C | | 0.7 | | V/µs |
| GBW | Gain-Bandwidth Product | G=11, $V_{IN}$ = 50 mV | 25°C | | 3.7 | | MHz |
| $t_S$ | Settling Time, 0.1% | G=1, $V_{IN}$ =2 V Step | 25°C | | 25 | | µs |
| $t_{OR}$ | Overload Recovery Time | $V_{IN}$ · Gain ≥ $V_S$, G=11 | 25°C | | 1.5 | | µs |
| $t_{ON}$ | Turn On Time | | 25°C | | 60 | | µs |
| PM | Phase Margin | $R_L$=10K, $C_L$= 50pF | 25°C | | 60 | | ° |
| GM | Gain Margin | $R_L$=10K, $C_L$= 50pF | 25°C | | 10 | | dB |
| $C_{LOAD}$ | Capacitive Load Drive | | | | 100 | | pF |
| **NOISE** | | | | | | | |
| En | Input Voltage Noise | $V_S$ = 5V, f = 0.1Hz to 10Hz | 25°C | | 0.15 | | µVpp |
| en | Input Voltage Noise Density [4] | f = 1kHz | 25°C | | 5.5 | | nV/√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, unless otherwise noted.

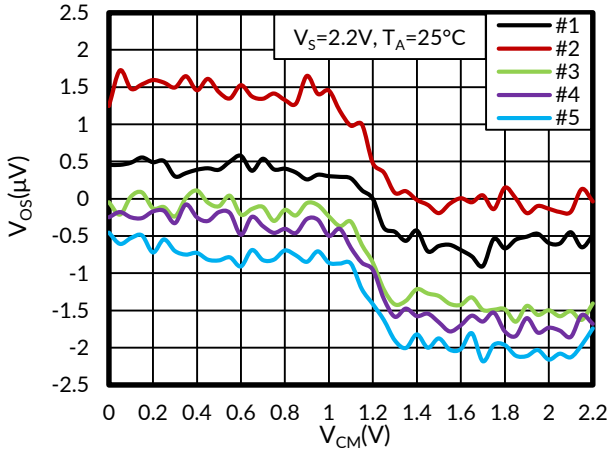



**Figure 1. Input Offset Voltage vs Common-Mode Voltage**

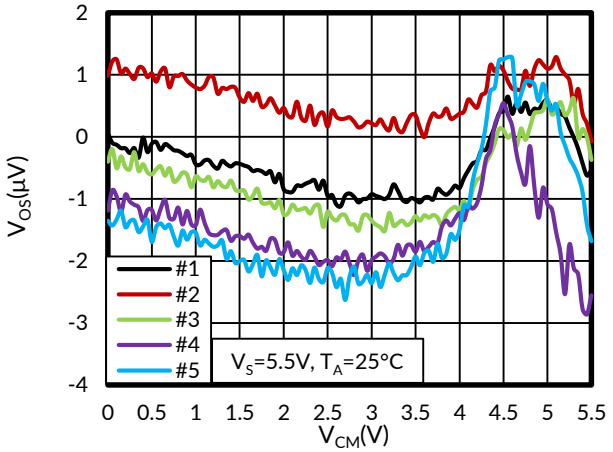



**Figure 2. Input Offset Voltage vs Common-Mode Voltage**

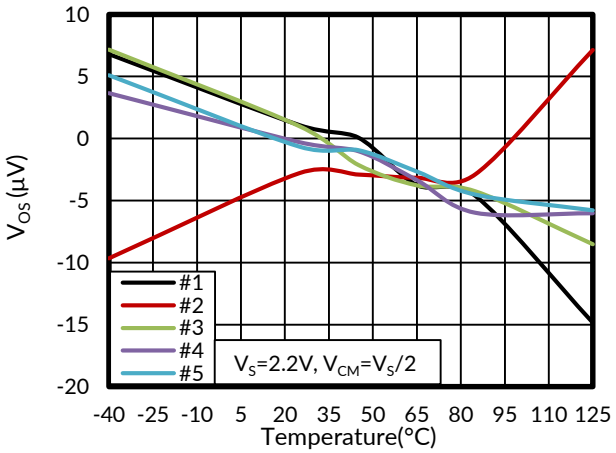



**Figure 3. Input Offset Voltage vs Temperature**

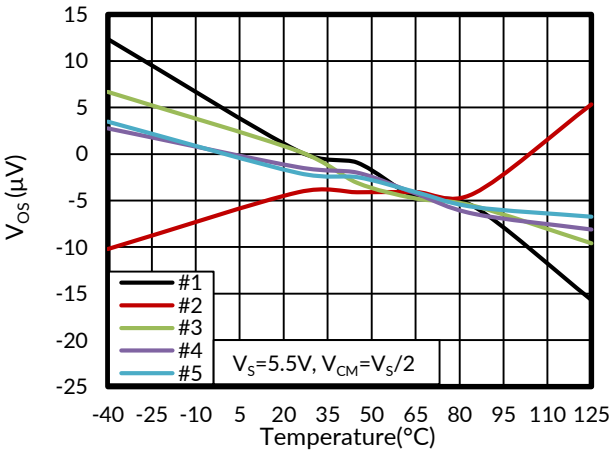



**Figure 4. Input Offset Voltage vs Temperature**

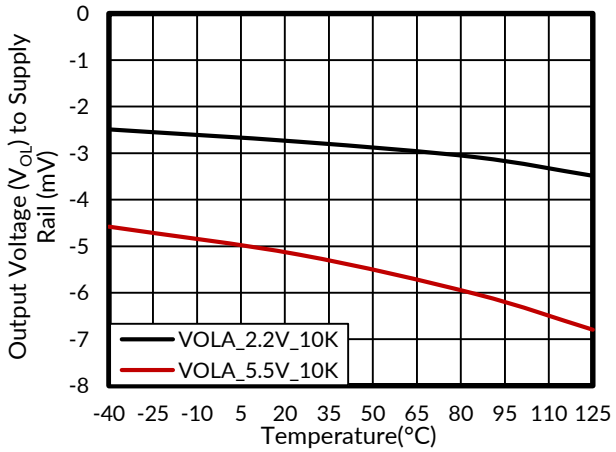



**Figure 5. Output Voltage ($V_{OL}$) to Supply Rail vs Temperature**

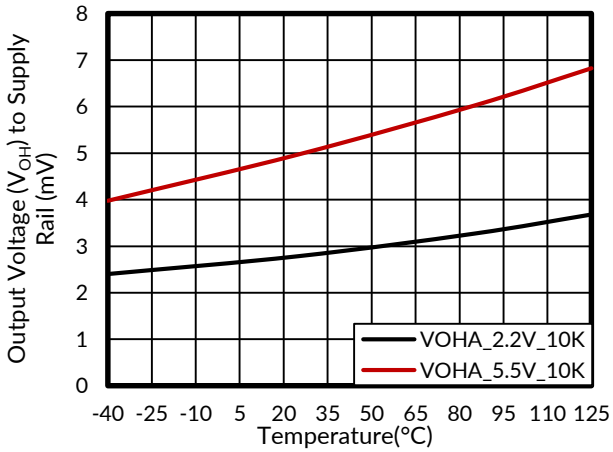



**Figure 6. Output Voltage ($V_{OH}$) to Supply Rail vs Temperature**

## 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, unless otherwise noted.

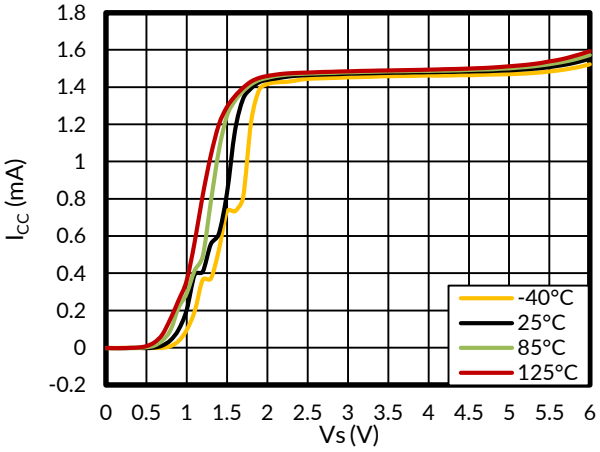



**Figure 7. Supply Current vs Supply Voltage**

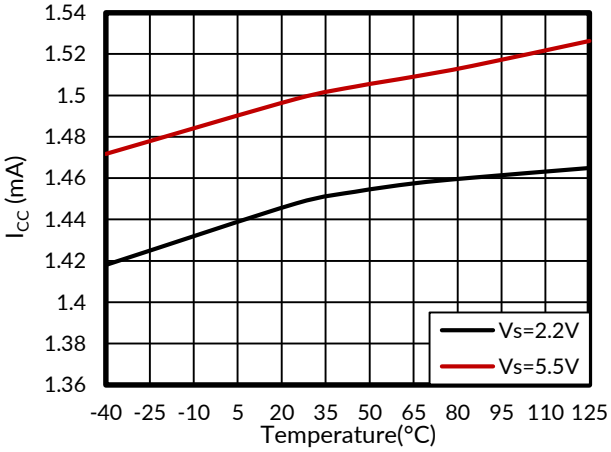



**Figure 8. Supply Current vs Temperature**

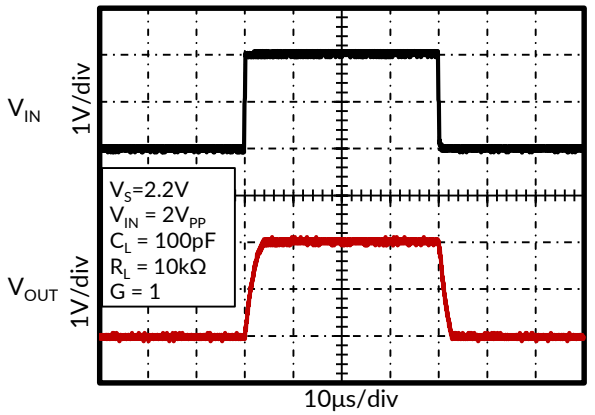



**Figure 9. Large Signal Transient Response**

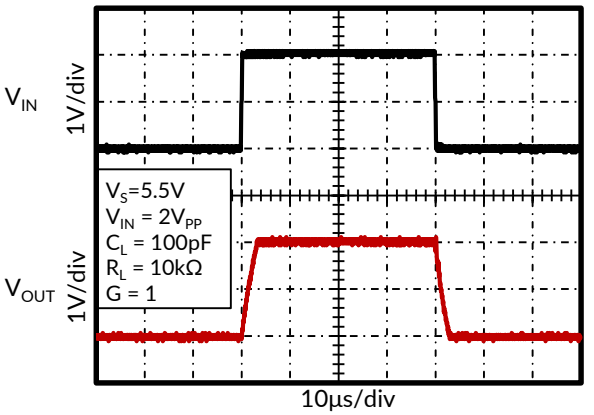



**Figure 10. Large Signal Transient Response**

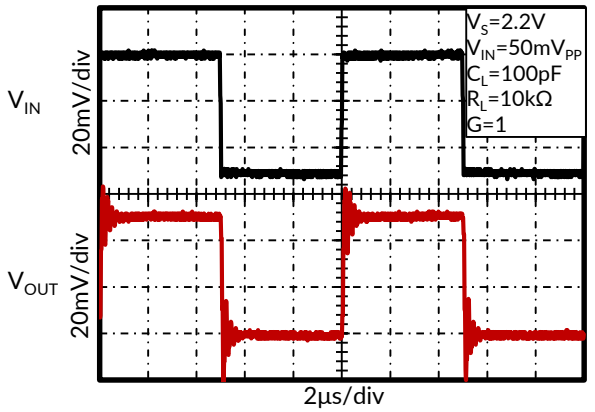



**Figure 11. Small Signal Transient Response**

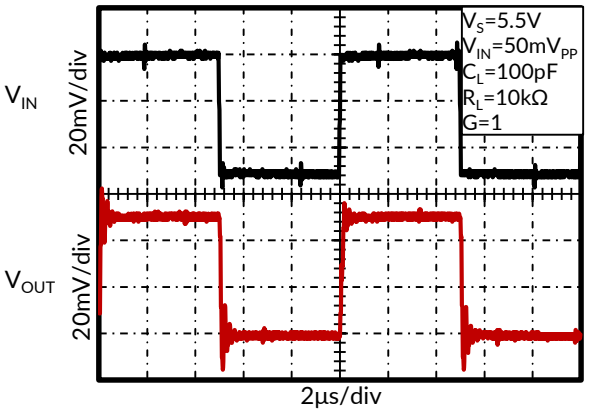



**Figure 12. Small Signal Transient Response**

## 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, unless otherwise noted.

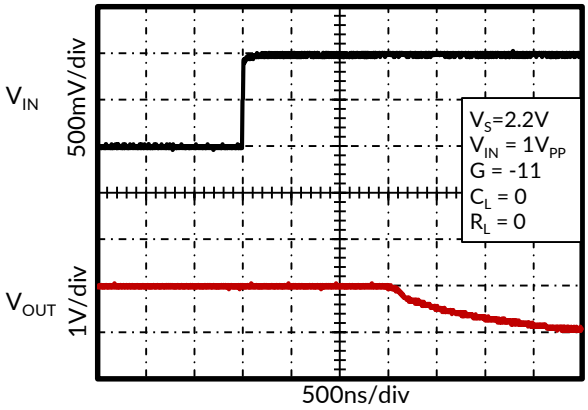



**Figure 13. Positive Overload Recovery**

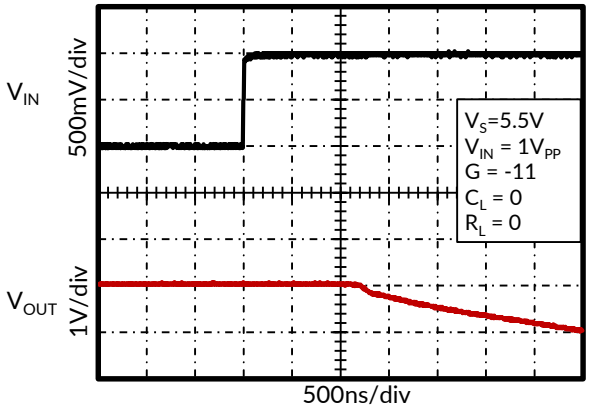



**Figure 14. Positive Overload Recovery**

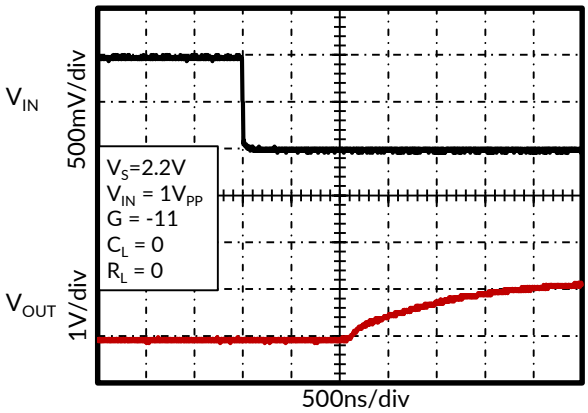



**Figure 15. Negative Overload Recovery**

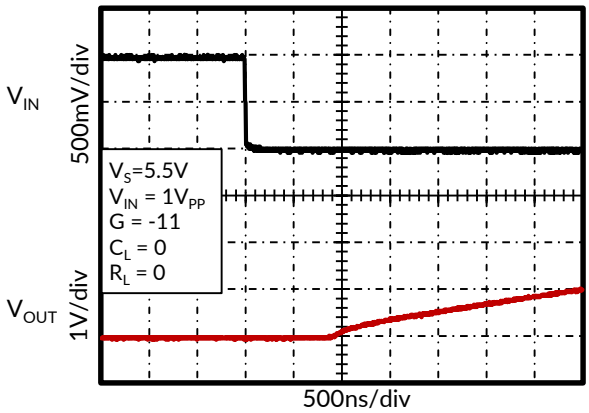



**Figure 16. Negative Overload Recovery**

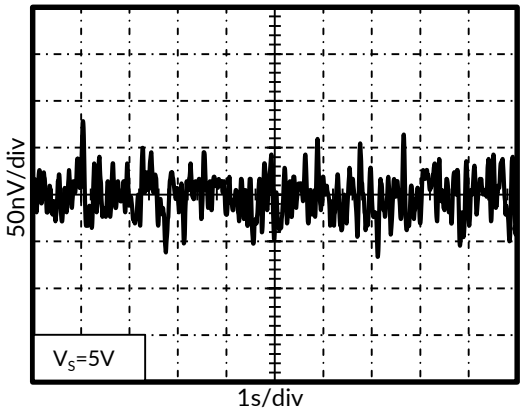



**Figure 17. 0.1Hz to 10Hz Noise**

# 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 Applications Information

The RS8531/RS8532 are precision, ultralow noise, zero-drift operational amplifiers that feature a patented chopping technique. This chopping technique offers ultralow input offset voltage of ±1.2 μV typical and input offset voltage drift of ±0.1 μV/°C typical.

Offset voltage errors due to common-mode voltage swings and power supply variations are also corrected by the chopping technique, resulting in a typical CMRR figure of 125 dB (at $V_{CM}$=0V to 5V) and a PSRR figure of 125 dB (at $V_S$=2.2 V to 5.5 V). The RS8531/RS8532 have low broadband noise of 0.15 $\mu V_{PP}$ (at f = 0.1Hz to 10Hz and $V_S$ =5 V) with no 1/f noise component. These features are ideal for amplification of low level signals in dc or subhertz high precision applications.

## 8.2 Input Protection

The RS8531/RS8532 have internal ESD protection diodes that are connected between the inputs and each supply rail. These diodes protect the input transistors in the event of electrostatic discharge and are reverse biased during normal operation. This protection scheme allows voltages as high as approximately 500 mV beyond the rails to be applied at the input of either terminal without causing permanent damage.

When either input exceeds one of the supply rails by more than 500 mV, the ESD diodes become forward biased and large amounts of current begin to flow through them. Without current limiting, this excessive fault current causes permanent damage to the device. If the inputs are subjected to overvoltage conditions, insert a resistor in series with each input to limit the input current to 10 mA maximum. However, consider the resistor thermal noise effect on the entire circuit.

## 8.3 Rail-to-Rail Input and Output

The RS8531/RS8532 feature rail-to-rail input and output with a supply voltage from 2.2 V to 5.5 V. Figure 18 shows the input and output waveforms of the RS8531/RS8532 configured as a unity-gain buffer with a supply voltage of ±2.5 V and a resistive load of 10 kΩ. With an input voltage of ±2.5 V, the RS8531/RS8532 allow the output to swing very close to both rails. Additionally, the devices do not exhibit phase reversal.

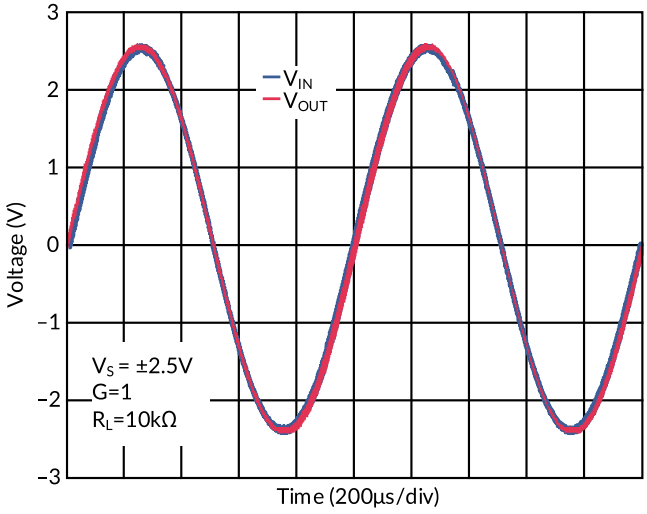



**Figure 18. Rail-to-Rail Input and Output**

## 8.4 Noise Considerations

### 8.4.1 1/f Noise

1/f noise, also known as pink noise or flicker noise, is inherent in semiconductor devices and increases as frequency decreases. At low frequency, 1/f noise is a major noise contributor and causes a significant output voltage offset when amplified by the noise gain of the circuit. However, the RS8531/RS8532 eliminate the 1/f noise internally, thus making these devices an excellent choice for dc or subhertz high precision applications. The 0.1 Hz to 10 Hz amplifier voltage noise is only 0.15 µVpp at a supply voltage of 5 V.

The low frequency 1/f noise, which appears as a slow varying offset to the RS8531/RS8532, is greatly reduced by the chopping technique. This reduction in 1/f noise allows the RS8531/RS8532 to have much lower noise at dc and low frequency compared to standard low noise amplifiers that are susceptible to 1/f noise.

### 8.4.2 Source Resistance

With 5.5 nV/$\sqrt{Hz}$ of broadband noise at 1 kHz ($V_S$ = 5 V), the RS8531/RS8532 are among the lowest noise zero-drift amplifiers currently available in the industry. Therefore, it is important to carefully select the input source resistance to maintain a total low noise.

The total input referred broadband noise (en total) from any amplifier is primarily a function of three types of noise: input voltage noise, input current noise, and thermal (Johnson) noise from the external resistors.

These uncorrelated noise sources can be summed up in a root sum squared (rss) manner using the following equation:

$$e_n \text{ total} = [\, e_n^2 + 4kTR_S + (\, i_n \times R_S)^2 \,]^{1/2}$$

where:
$e_n$ is the input voltage noise of the amplifier (V/$\sqrt{Hz}$).
k is the Boltzmann's constant (1.38 × $10^{-23}$ J/K).
T is the temperature in Kelvin (K).
$R_S$ is the total input source resistance (Ω).
$i_n$ is the input current noise of the amplifier (A/$\sqrt{Hz}$).

The total equivalent rms noise over a specific bandwidth is expressed as

$$e_{n,rms} = e_n \text{ total} \times \sqrt{BW}$$

where BW is the bandwidth in hertz.

This analysis is valid for broadband noise calculation. If the bandwidth of concern includes the chopping frequency, more complicated calculations must be made to include the effect of the noise energy spectrum at the chopping frequency (see the Residual Voltage Ripple section).

With a low source resistance of $R_S$ < 1 kΩ, the voltage noise of the amplifier dominates. As source resistance increases, the thermal noise of $R_S$ dominates. As the source resistance increases further, where $R_S$ > 100 kΩ, the current noise becomes the main contributor to the total input noise.

### 8.4.3 Voltage Noise Density with Different Gain Configurations

Figure 19 shows the voltage noise density vs closed-loop gain of a zero-drift amplifier from a leading competitor. The voltage noise density of the amplifier increases from 11 nV/$\sqrt{Hz}$ to 21 nV/$\sqrt{Hz}$ as the closed-loop gain decreases from 1000 to 1.

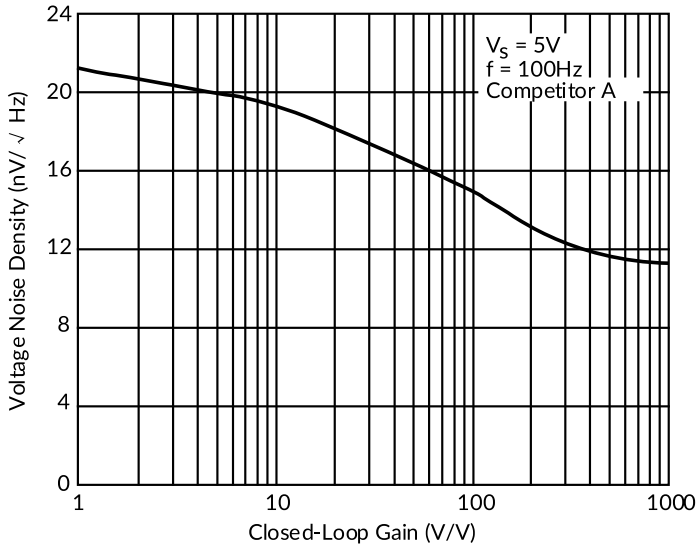



**Figure 19. Competitor A: Voltage Noise Density vs Closed-Loop Gain**

Figure 20 shows the voltage noise density vs frequency of the RS8531/RS8532 for three different gain configurations. The RS8531/RS8532 offer a constant input voltage noise density of 6 nV/√Hz to 7 nV/√Hz, regardless of the gain configuration.

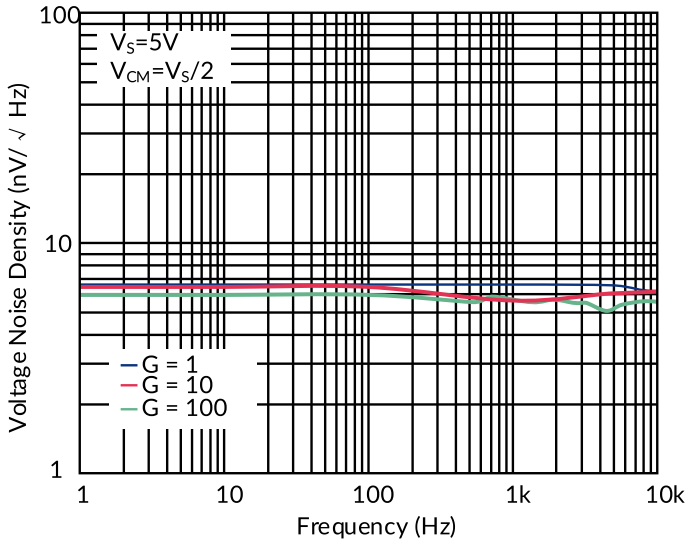



**Figure 20. Voltage Noise Density vs Frequency with Different Gain Configurations**

### 8.4.4 Residual Voltage Ripple

Although autocorrection feedback (ACFB) suppresses the chopping related voltage ripple, higher noise spectrum exists at the chopping frequency and its harmonics due to the remaining ripple. Figure 21 shows the voltage noise density of the RS8531/RS8532 configured in unity gain. A noise energy spectrum of 50 nV/√Hz can be seen at the chopping frequency of 200 kHz. This noise energy spectrum is significant when the op amp has a closed-loop frequency that is higher than the chopping frequency.

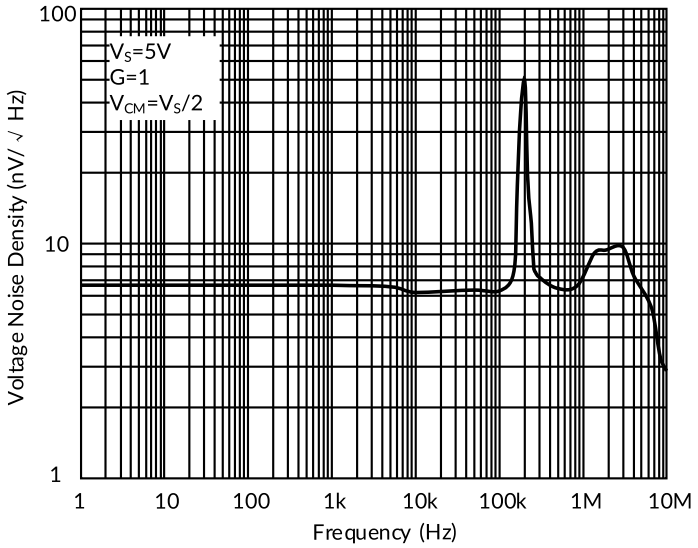



**Figure 21. Voltage Noise Density vs Frequency**

To further suppress the noise at the chopping frequency, it is recommended that a post filter be placed at the output of the amplifier.

## 8.5 Comparator Operation

Figure 22 shows the RS8532 configured as a voltage follower with an input voltage that is always kept at midpoint of the power supplies. The same configuration is applied to the unused channel. A1 and A2 indicate the placement of ammeters to measure supply current. As shown in Figure 23, as expected, in normal operating condition, $I_S$+ = $I_S$− = 3 mA for the dual RS8532 at 5 V of supplies.

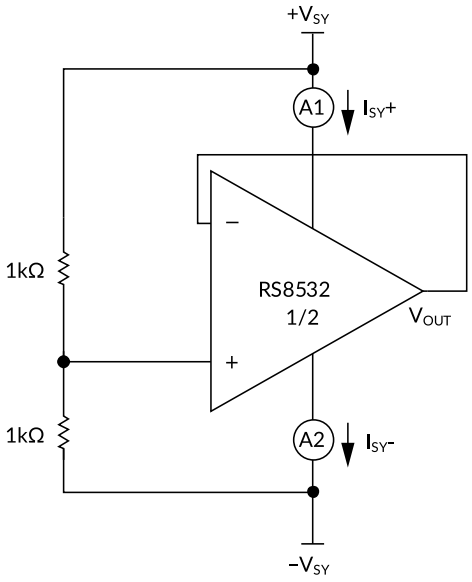



**Figure 22. Voltage Follower**

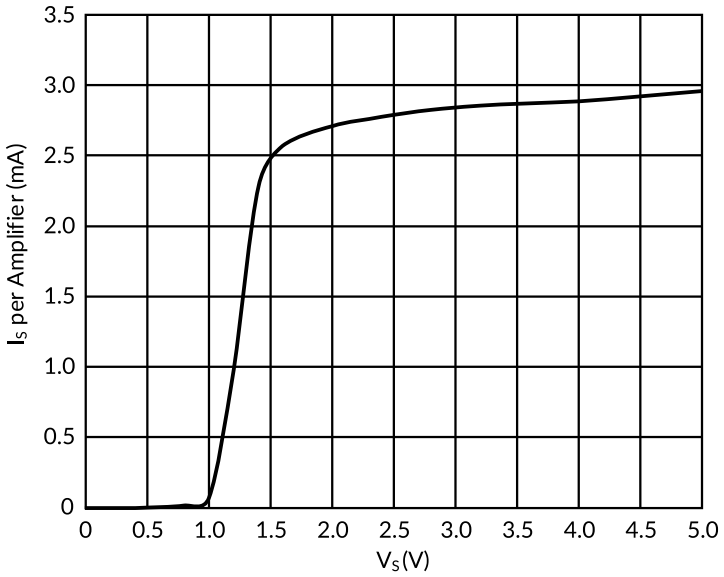



**Figure 23. Supply Current vs Supply Voltage (Voltage Follower)**

Figure 24 and Figure 25 show the RS8532 configured as comparators, with 1kΩ resistors in series with the input pins. Figure 26 shows the supply currents for both configurations. Supply currents increase slightly to 3.2 mA per dual amplifier at 5 V of supplies.

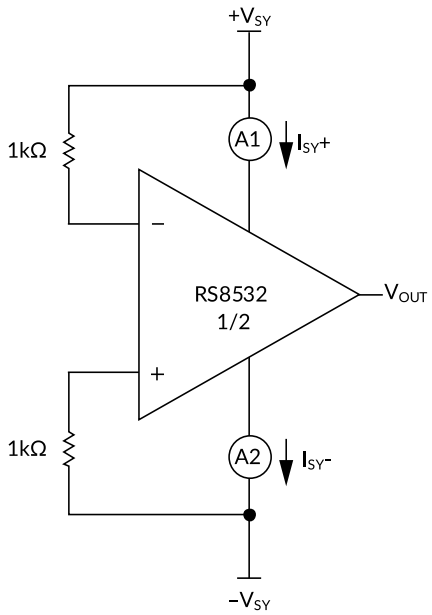



**Figure 24. Comparator A**

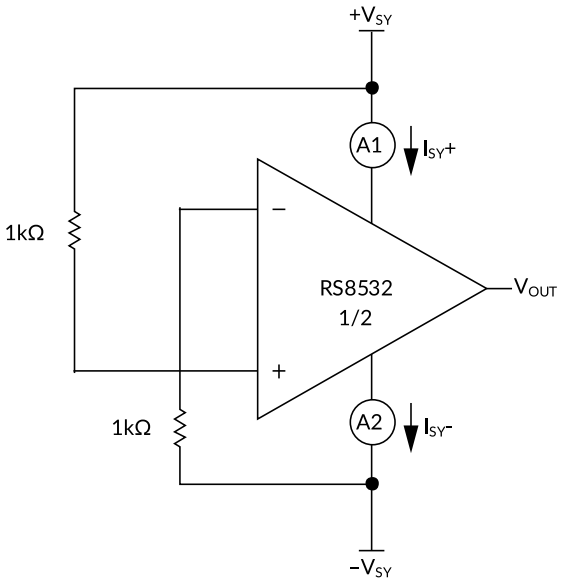



**Figure 25. Comparator B**

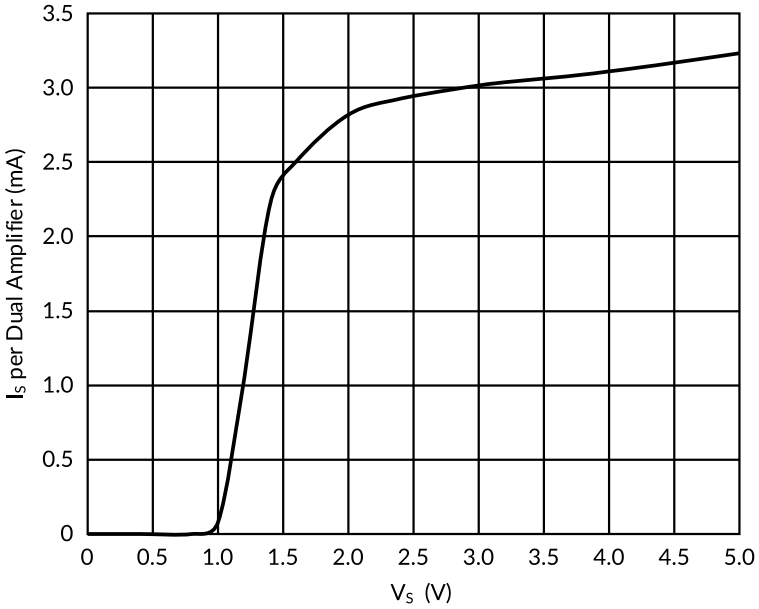



**Figure 26. Supply Current vs Supply Voltage (Comparator A and Comparator B)**

# 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 0.1μF 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

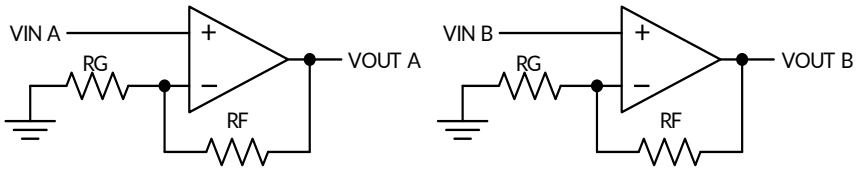



**Figure 27. Schematic Representation**

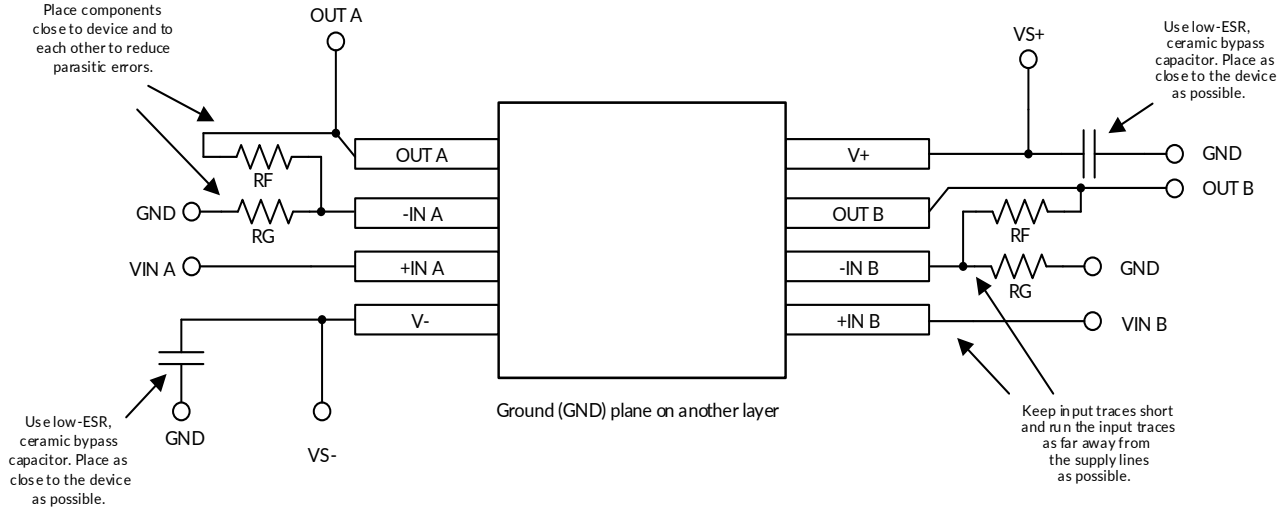
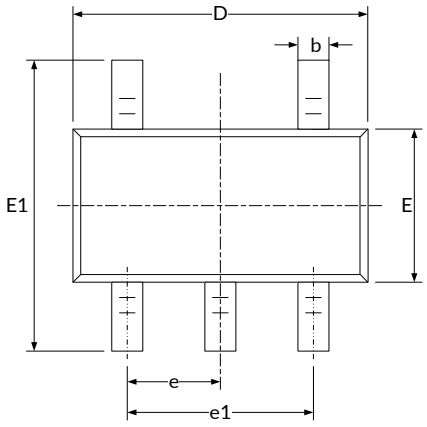


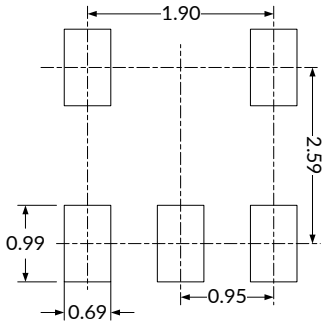

**Figure 28. Layout Example**

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

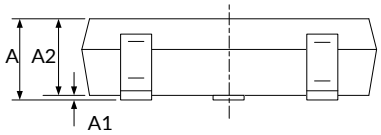
# 10 PACKAGE OUTLINE DIMENSIONS

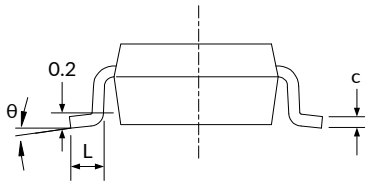
## SOT23-5 (3)




RECOMMENDED LAND PATTERN (Unit: mm)



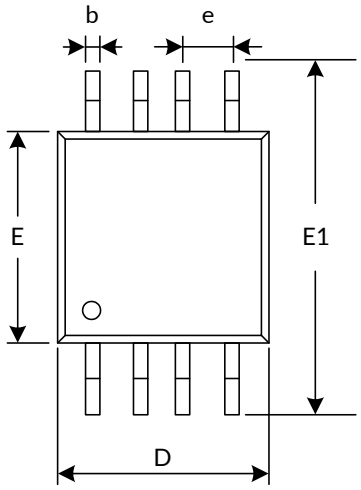



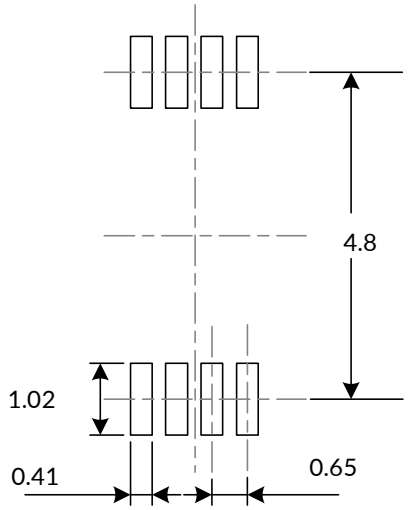

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A (1) | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D (1) | 2.820 | 3.020 | 0.111 | 0.119 |
| E (1) | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950(BSC) (2) | | 0.037(BSC) (2) | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

NOTE:

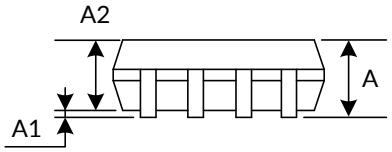
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

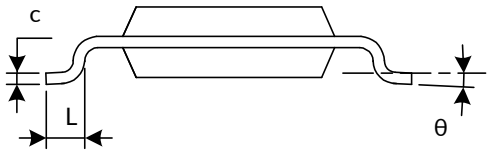
## MSOP8 (3)




RECOMMENDED LAND PATTERN (Unit: mm)



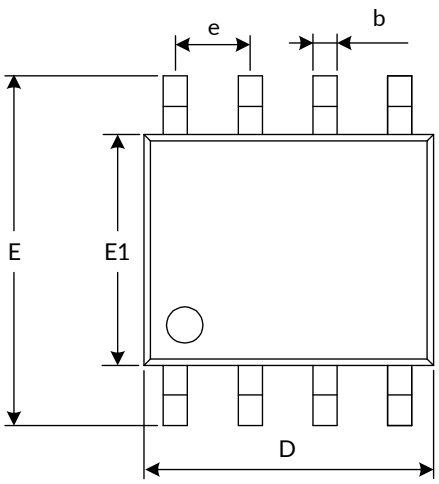



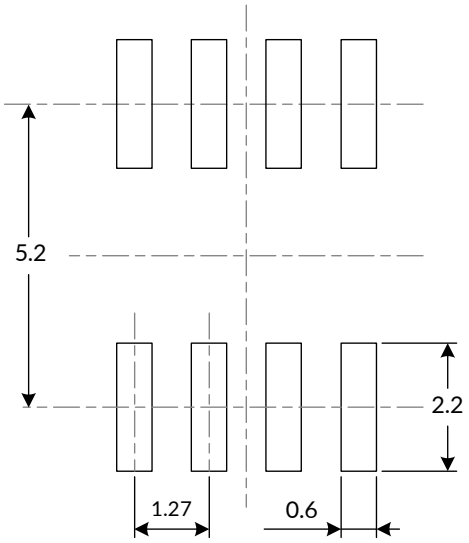

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A (1) | 0.820 | 1.100 | 0.032 | 0.043 |
| A1 | 0.020 | 0.150 | 0.001 | 0.006 |
| A2 | 0.750 | 0.950 | 0.030 | 0.037 |
| b | 0.250 | 0.380 | 0.010 | 0.015 |
| c | 0.090 | 0.230 | 0.004 | 0.009 |
| D (1) | 2.900 | 3.100 | 0.114 | 0.122 |
| e | 0.650(BSC) (2) | | 0.026(BSC) (2) | |
| E (1) | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 4.750 | 5.050 | 0.187 | 0.199 |
| L | 0.400 | 0.800 | 0.016 | 0.031 |
| θ | 0° | 6° | 0° | 6° |

NOTE:

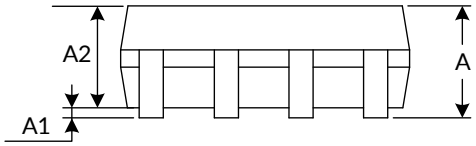
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

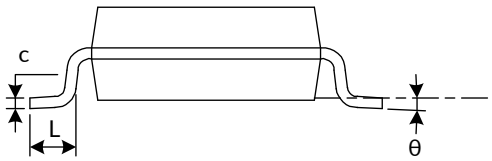
## SOP8 (3)




RECOMMENDED LAND PATTERN (Unit: mm)




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A (1) | 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 (1) | 4.800 | 5.000 | 0.189 | 0.197 |
| e | 1.270(BSC) (2) | | 0.050(BSC) (2) | |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 (1) | 3.800 | 4.000 | 0.150 | 0.157 |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

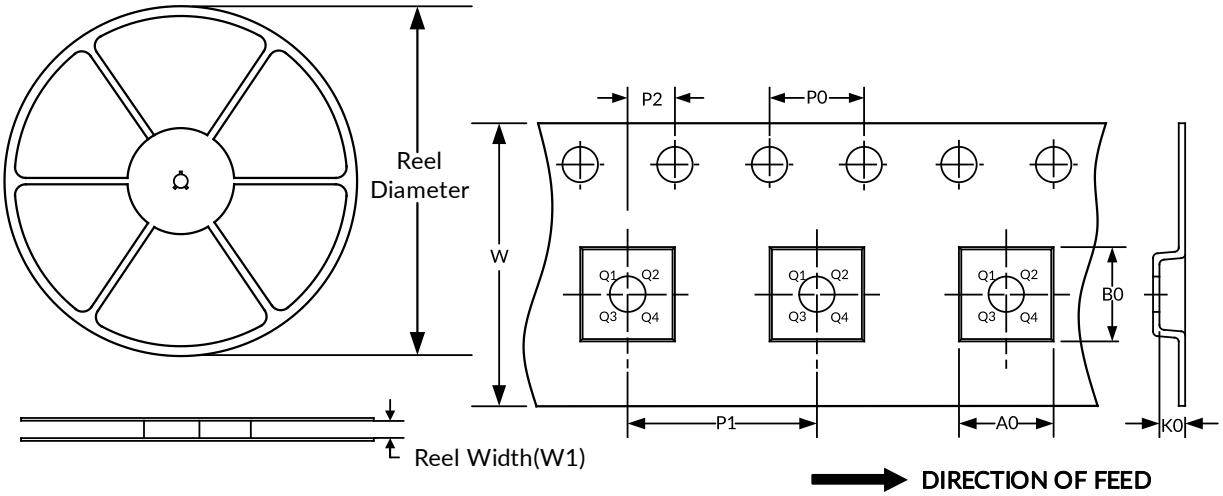
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

# 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| SOT23-5 | 7” | 9.5 | 3.20 | 3.20 | 1.40 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |
| MSOP8 | 13” | 12.4 | 5.20 | 3.30 | 1.50 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| 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.

# IMPORTANT NOTICE AND DISCLAIMER

Jiangsu RUNIC Technology Co., Ltd. will accurately and reliably provide technical and reliability data (including data sheets), design resources (including reference designs), application or other design advice, WEB tools, safety information and other resources, without warranty of any defect, and will not make any express or implied warranty, including but not limited to the warranty of merchantability Implied warranty that it is suitable for a specific purpose or does not infringe the intellectual property rights of any third party.

These resources are intended for skilled developers designing with RUNIC products You will be solely responsible for: (1) Selecting the appropriate products for your application; (2) Designing, validating and testing your application; (3) Ensuring your application meets applicable standards and any other safety, security or other requirements; (4) RUNIC and the RUNIC logo are registered trademarks of RUNIC INCORPORATED. All trademarks are the property of their respective owners; (5) For change details, review the revision history included in any revised document. The resources are subject to change without notice. Our company will not be liable for the use of this product and the infringement of patents or third-party intellectual property rights due to its use.