

# General-Purpose High-Voltage Open-Drain Output Dual Comparator

## 1 FEATURES

- **Supply Range: 2.8V to 36V**
- **Low Supply Current**  
**185μA (TYP) per channel at  $V_s = 36V$**
- **Common-Mode Input Voltage Range**  
**Includes Ground**
- **Low Output Saturation Voltage**
- **Open-Drain Output for Maximum Flexibility**
- **-40°C to 125°C Operating Temperature Range**
- **Micro SIZE PACKAGES: SOP8、MSOP8**

## 2 APPLICATIONS

- **Hysteresis Comparators**
- **Factory Automation & Control**
- **Industrial Equipment**
- **Test and Measurement**
- **Cordless Power Tool**
- **Vacuum Robot**
- **Wireless Infrastructure**

## 3 DESCRIPTIONS

The RS8920 is the dual comparator version, and the outputs can be connected to other open-collector outputs to achieve wired-AND relationships. It can operate from 2.8V to 36V, and have low power consuming 185μA (TYP) per channel.

The RS8920 consist of two independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Quiescent current is independent of the supply voltage. Input common mode voltage is 1.5V lower than  $V_+$ . The device is the most cost-effective solutions for applications where low offset voltage, high supply voltage capability, low supply current, and space saving are the primary specifications in circuit design for portable consumer products.

The RS8920 is available in Green SOP8, MSOP8 packages. It operates over an ambient temperature range of -40°C to 125°C.

Device Information <sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS8920	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.

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## 4 Revision History

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

VERSION	Change Date	Change Item
A.0	2023/11/28	Preliminary version completed
A.1	2024/02/02	Initial version completed

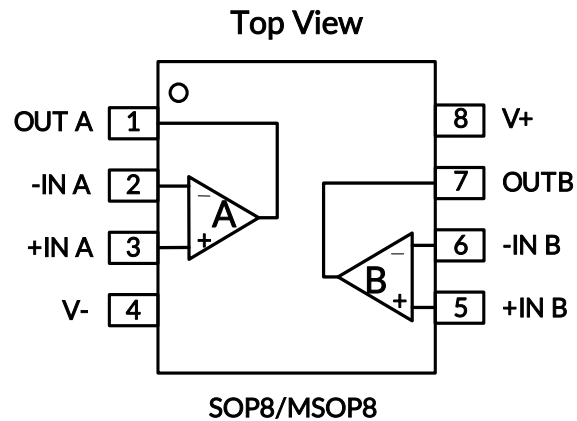
## 5 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking <sup>(2)</sup>	MSL <sup>(3)</sup>	Package Qty
RS8920XK-G	SOP8	8	2	-40°C ~125°C	RS8920	MSL1	Tape and Reel,4000
RS8920XM-G	MSOP8	8	2	-40°C ~125°C	RS8920	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) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

## 6 Pin Configuration and Functions (Top View)



### Pin Description

NAME	PIN	I/O <sup>(1)</sup>	DESCRIPTION
	SOP8/MSOP8		
OUTA	1	O	Output, channel A
-INA	2	I	Inverting input, channel A
+INA	3	I	Noninverting input, channel A
V-	4	P	Negative (lowest) power supply
+INB	5	I	Noninverting input, channel B
-INB	6	I	Inverting input, channel B
OUTB	7	O	Output, channel B
V+	8	P	Positive (highest) power supply

(1) I=Input, O=Output, P=Power.

## 7 SPECIFICATIONS

### 7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

			MIN	MAX	UNIT
Voltage	Supply, $V_S = (V+) - (V-)$			40	V
	Signal input pin <sup>(2)</sup>		(V-)-0.3	(V+) +0.3	
	Signal output pin <sup>(3)</sup>		(V-)-0.3	(V+) +0.3	
Current	Signal input pin <sup>(2)</sup>		-10	10	mA
	Signal output pin <sup>(3)</sup>		-20	20	mA
	Output short-circuits <sup>(4)</sup>		Continuous		
$\theta_{JA}$	Package thermal impedance <sup>(5)</sup>	SOP8		110	°C/W
		MSOP8		170	
Temperature	Operating range, $T_A$		-40	125	°C
	Junction, $T_J$ <sup>(6)</sup>		-40	150	
	Storage, $T_{stg}$		-55	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  $\pm 20$ mA or less.

(4) Short-circuit from output to  $V_{CC}$  can cause excessive heating and eventual destruction.

(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), MIL-STD-883K METHOD 3015.9	$\pm 1500$	V
		Charged-device model (CDM), ANSI/ESDA/JEDEC JS-002-2022	$\pm 1500$	



#### 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	2.8		36	V
	Dual-supply	$\pm 1.4$		$\pm 18$	

## 7.4 ELECTRICAL CHARACTERISTICS

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 1.4\text{V}$  to  $\pm 18\text{V}$ , Full =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.)<sup>(1)</sup>

PARAMETER		CONDITIONS	TEMP	RS8920			UNIT
				MIN <sup>(2)</sup>	TYP <sup>(3)</sup>	MAX <sup>(2)</sup>	
$V_S$	Operating Voltage Range			2.8		36	V
$I_Q$	Quiescent Current	$V_S = 36\text{V}$ , no load	$25^\circ\text{C}$		370	450	$\mu\text{A}$
			Full		390		
$V_{OS}$	Input offset voltage	$V_{CM} = 0\text{V}$	$25^\circ\text{C}$	-4.5	$\pm 0.8$	4.5	mV
			Full		$\pm 2$		
	Input Hysteresis		$25^\circ\text{C}$		2		mV
$I_B$	Input Bias Current <sup>(4)(5)</sup>	$V_{CM} = 0\text{V}$	$25^\circ\text{C}$		$\pm 20$		pA
$I_{OS}$	Input Offset Current <sup>(4)</sup>	$V_{CM} = 0\text{V}$	$25^\circ\text{C}$		$\pm 20$		pA
$ V_{ID} $	Maximum Differential Input Voltage		Full			$(V_+) - (V_-)$	V
$ I_{ID} $	Maximum Input Difference Bias Current	$V_S = \pm 18\text{V}$ , $V_{ID} = \pm 18\text{V}$	$25^\circ\text{C}$		2	100	nA
			Full		100		
$V_{CM}$	Common-Mode Voltage Range <sup>(6)</sup>		Full	$V_-$		$(V_+) - 1.5$	V
CMRR	Common Mode Rejection Ratio	$V_S = \pm 18\text{V}$ , $V_{CM} = V_-$ to $(V_+) - 1.5\text{V}$	$25^\circ\text{C}$		116		dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.8\text{V}$ to $36\text{V}$	$25^\circ\text{C}$		110		dB
$A_{VD}$	Large signal differential voltage amplification	$V_S = 36\text{V}$ , $V_{OUT} = 0.1\text{V}$ to $28.8\text{V}$ , $R_L = 120\text{k}\Omega$ to $V_S$	$25^\circ\text{C}$		100		dB
$V_{OL}$	Low-Level output voltage	$I_{sink} = 8\text{mA}$ , $V_{ID} = -0.2\text{V}$	$25^\circ\text{C}$		160	500	mV
			Full		320		
$I_{SINK}$	Output Short-Circuit Current	$V_{OL} = (V_-) + 1.5\text{V}$ , $V_{ID} = -0.2\text{V}$	$25^\circ\text{C}$	40	50	60	mA
$I_{OH-LKG}$	High-Level Output Leakage Current	$V_{OH} = 2.8\text{V}$ , $V_{ID} = 0.2\text{V}$	$25^\circ\text{C}$		2	20	nA
			Full		42		
		$V_{OH} = 36\text{V}$ , $V_{ID} = 0.2\text{V}$	$25^\circ\text{C}$		5	20	nA
			Full		100		

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  $25^\circ\text{C}$ . 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) Any input voltage should not be lower than  $(V_-) - 0.3\text{V}$ . The maximum input common mode voltage is  $(V_+) - 1.5\text{V}$ , but it will not be damaged when the upper limit of the input voltage reaches  $36\text{V}$ .

## 7.5 SWITCHING CHARACTERISTICS

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 2.5\text{V}$ ,  $C_L = 15\text{pF}$ , unless otherwise specified.)

PARAMETER		CONDITIONS	TEMP	RS8920			UINT
				MIN <sup>(1)</sup>	TYP <sup>(2)</sup>	MAX <sup>(1)</sup>	
$T_{PHL}$	Propagation Delay H to L <sup>(3)</sup>	Overdrive = 20mV	25°C		65		ns
		Overdrive = 100mV	25°C		40		
$t_{FALL}$	Fall Time	Overdrive = 20mV	25°C		10		
		Overdrive = 100mV	25°C		10		

NOTE:

- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- (2) 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.
- (3) High-to-low and low-to-high refers to the transition at the input.

## SWITCHING CHARACTERISTICS

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 18\text{V}$ ,  $C_L = 15\text{pF}$ , unless otherwise specified.)

PARAMETER		CONDITIONS	TEMP	RS8920			UINT
				MIN <sup>(1)</sup>	TYP <sup>(2)</sup>	MAX <sup>(1)</sup>	
$T_{PHL}$	Propagation Delay H to L <sup>(3)</sup>	Overdrive = 20mV	25°C		75		ns
		Overdrive = 100mV	25°C		55		
$t_{FALL}$	Fall Time	Overdrive = 20mV	25°C		50		
		Overdrive = 100mV	25°C		50		

NOTE:

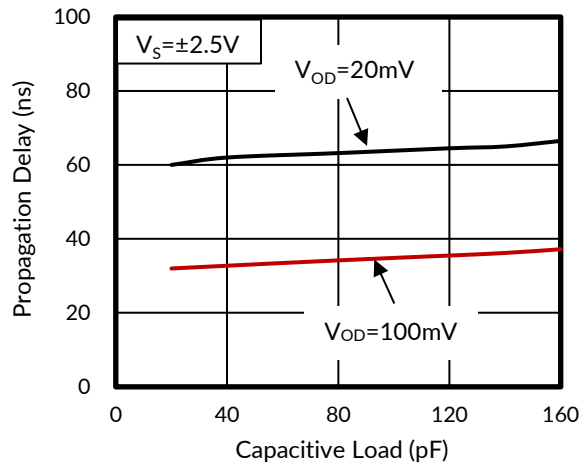
- (1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- (2) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.
- (3) High-to-low and low-to-high refers to the transition at the input.



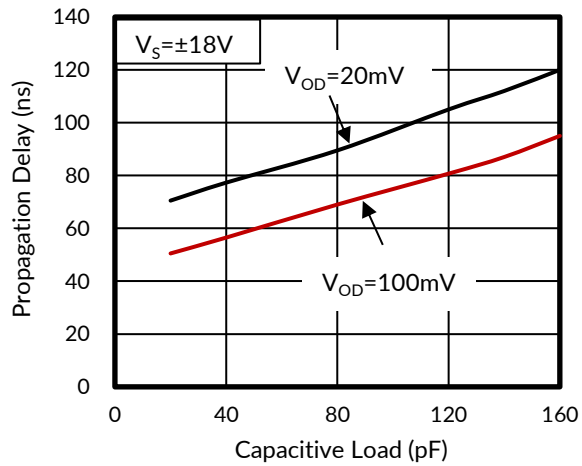
## 7.6 TYPICAL CHARACTERISTICS

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.

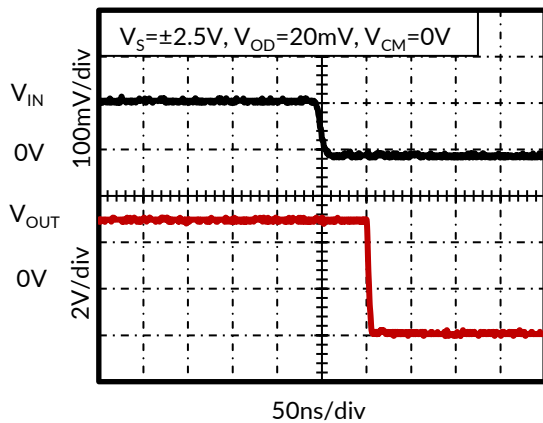
At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 18\text{V}$ ,  $C_L = 15\text{pF}$ , unless otherwise noted.



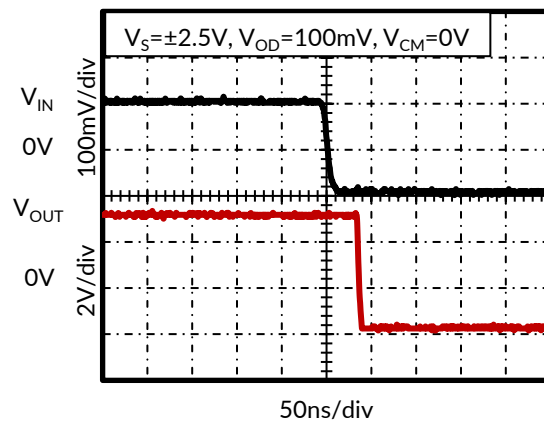
**Figure 1. Propagation Delay vs Capacitive Load**



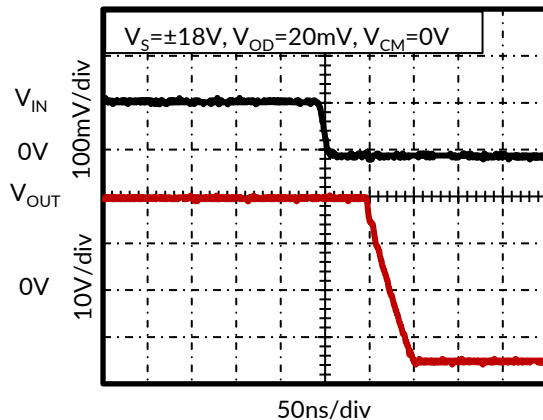
**Figure 2. Propagation Delay vs Capacitive Load**



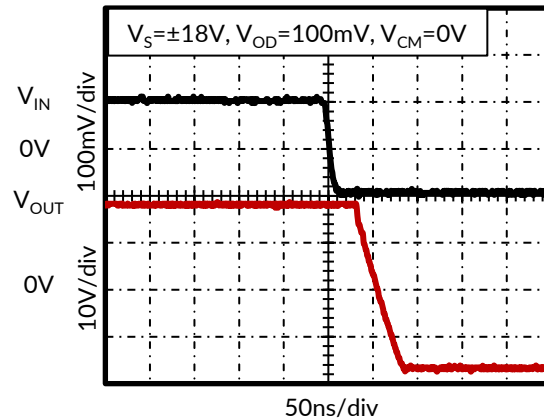
**Figure 3. Propagation Delay (H-L)**



**Figure 4. Propagation Delay (H-L)**



**Figure 5. Propagation Delay (H-L)**

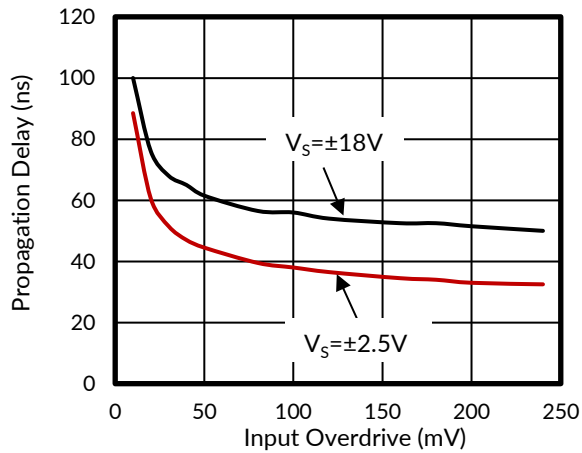


**Figure 6. Propagation Delay (H-L)**

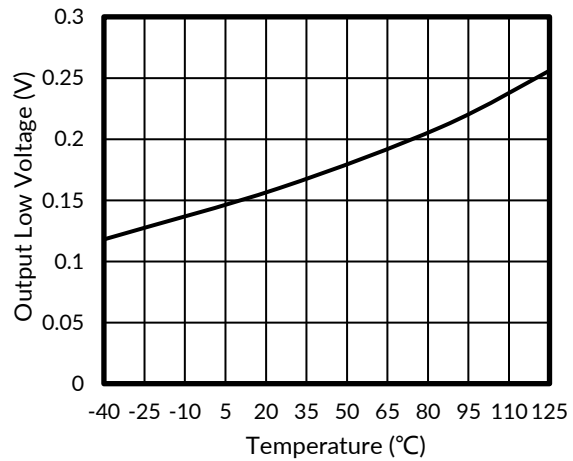
## TYPICAL CHARACTERISTICS

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.

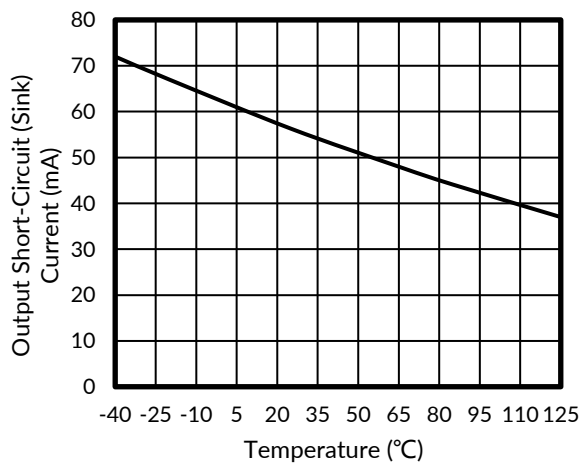
At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 18\text{V}$ ,  $C_L = 15\text{pF}$ , unless otherwise noted.



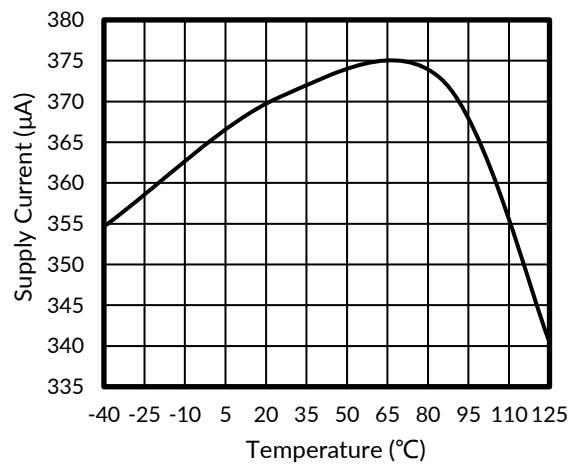
**Figure 7. Propagation Delay (H-L) vs Input Overdrive**



**Figure 8. Output Low Voltage vs Temperature**



**Figure 9. Output Short-Circuit (Sink) Current vs Temperature**



**Figure 10. Supply Current vs Temperature**

## 8 Detailed Description

### 8.1 Overview

The RS8920 family of comparators can operate up to 36V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to its low power and high speed. The open-drain output allows the user to configure the output's logic low voltage ( $V_{OL}$ ) and can be utilized to enable the comparator to be used in AND functionality.

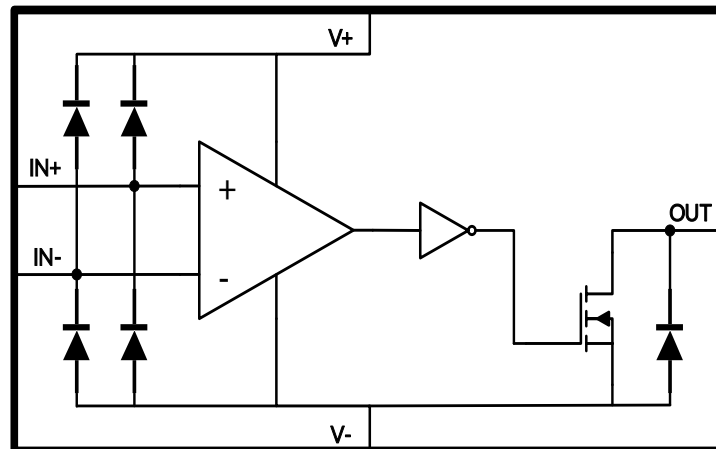


Figure 11. Functional Block Diagram

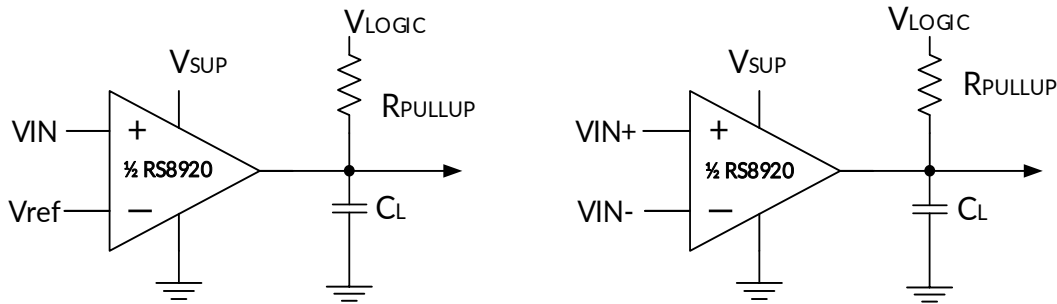
## 9 Application and Implementation

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.

### 9.1 Application Information

RS8920 is typically used to compare a single signal to a reference or two signals against each other. Many users take advantage of the open drain output (logic high with pull-up) to drive the comparison logic output to a logic voltage level to an MCU or logic device. The wide supply range and high voltage capability makes this comparator optimal for level shifting to a higher or lower voltage.

### 9.2 Typical Application



**Figure 12. Single-Ended and Differential Comparator Configurations**

### 9.3 Detailed Design Procedure

When using the device in a general comparator application, determine the following:

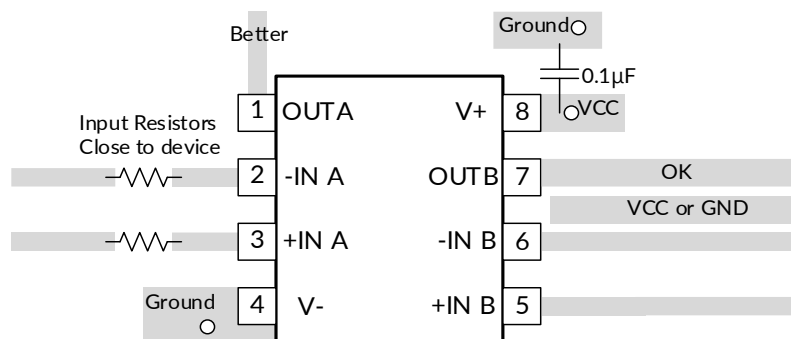
- Input Voltage Range
- Minimum Overdrive Voltage
- Output and Drive Current
- Response Time

## 10 Layout

## 10.1 Layout Guidelines

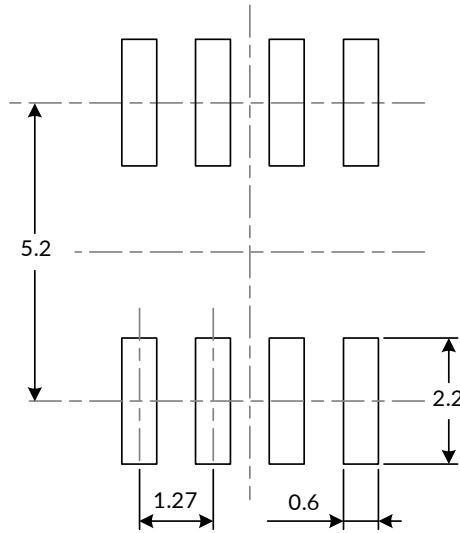
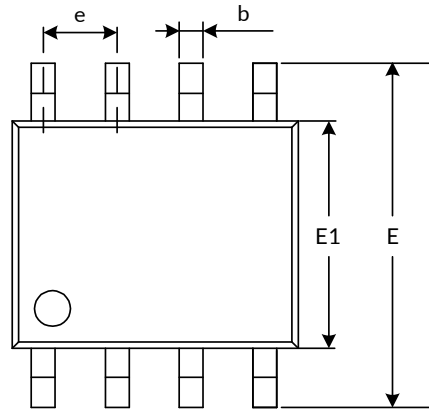
Good power supply decoupling, layout and grounding are important for RS8920 to realize the full high-speed capabilities in system. To achieve this, it is best to add a bypass capacitor between the supply voltage and ground. This should be implemented on the positive power supply and negative supply (if available). If a negative supply is not being used, do not put a capacitor between the IC's GND pin and system ground. Minimize coupling between outputs and inverting inputs to prevent output oscillations. Do not run output and inverting input traces in parallel unless there is a V<sub>CC</sub> or GND trace between output and inverting input traces to reduce coupling. When series resistance is added to inputs, place resistor close to the device.

## 10.2 Layout Example

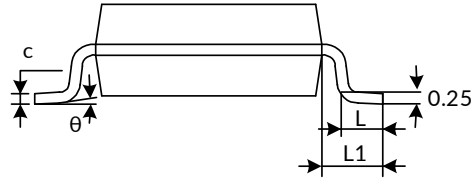
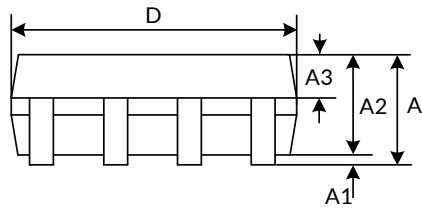


### Figure 13. RS8920 Layout Example

# 11 PACKAGE OUTLINE DIMENSIONS SOP8<sup>(4)</sup>



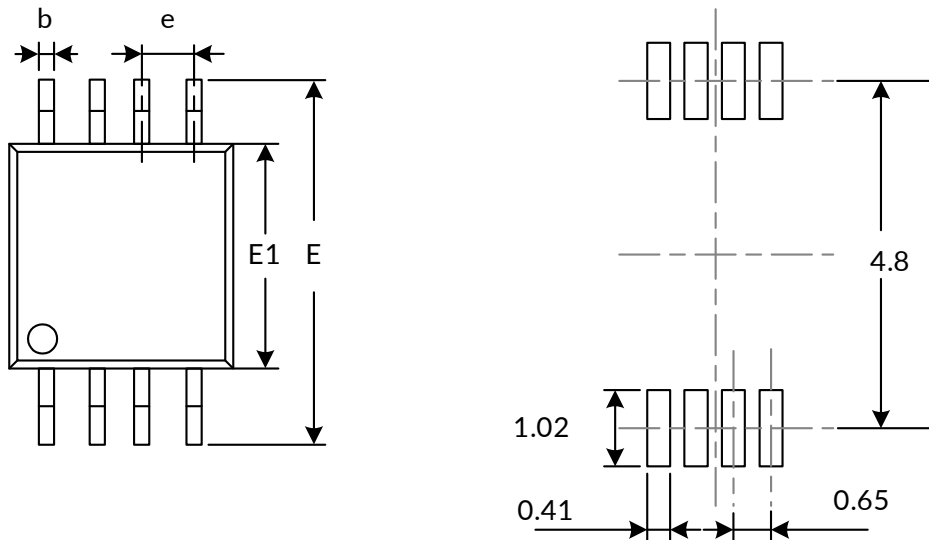
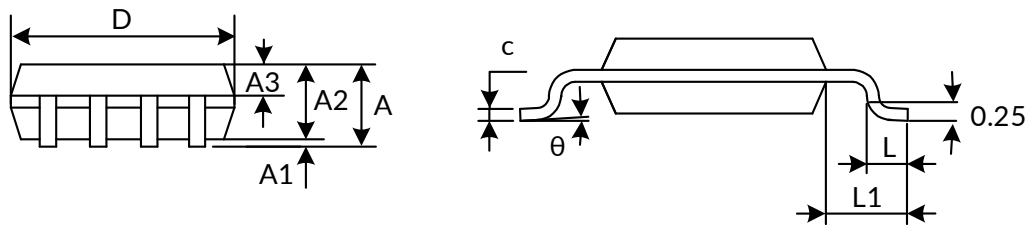
RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>		1.750		0.069
A1	0.100	0.250	0.004	0.010
A2	1.250	1.500	0.049	0.059
A3	0.600	0.700	0.024	0.028
b	0.360	0.490	0.014	0.019
c	0.190	0.250	0.007	0.010
D <sup>(1)</sup>	4.800	5.000	0.189	0.197
E1 <sup>(1)</sup>	3.800	4.000	0.150	0.157
E	5.800	6.200	0.228	0.244
e	1.270 (BSC) <sup>(2)</sup>		0.050 (BSC) <sup>(2)</sup>	
L	0.400	1.000	0.016	0.039
L1	1.050 (REF) <sup>(3)</sup>		0.041 (REF) <sup>(3)</sup>	
$\theta$	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. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

**MSOP8<sup>(4)</sup>**

**RECOMMENDED LAND PATTERN (Unit: mm)**


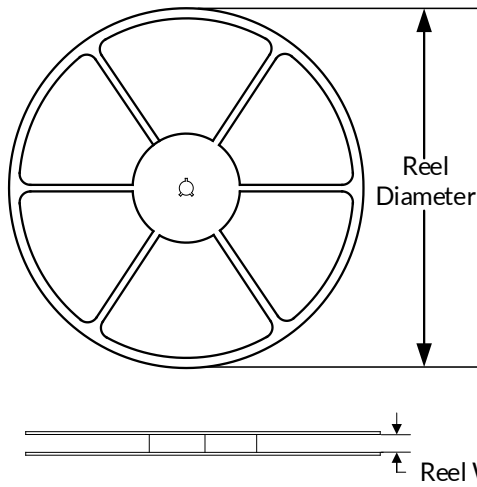
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
A3	0.300	0.400	0.012	0.016
b	0.220	0.380	0.009	0.015
c	0.150	0.190	0.006	0.007
D <sup>(1)</sup>	2.900	3.100	0.114	0.122
E1 <sup>(1)</sup>	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
e	0.650 (BSC) <sup>(2)</sup>		0.026 (BSC) <sup>(2)</sup>	
L	0.400	0.800	0.016	0.031
L1	0.950 (REF) <sup>(3)</sup>		0.037 (REF) <sup>(3)</sup>	
θ	0°	8°	0°	8°

**NOTE:**

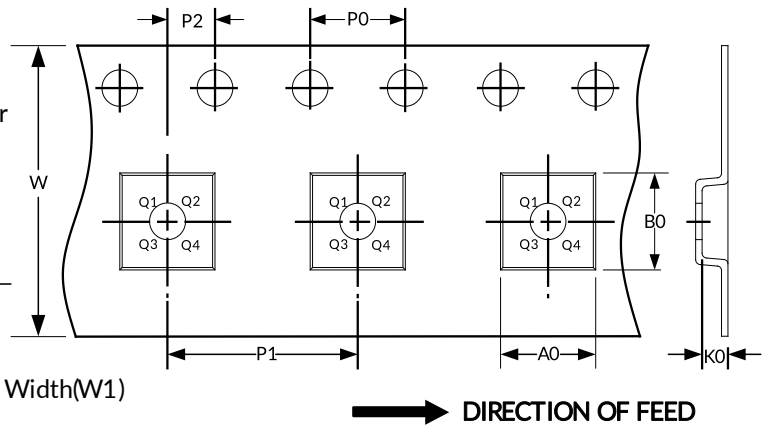
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2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

## 12 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
MSOP8	13"	12.4	5.20	3.30	1.50	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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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.