10ns, Rail-to-Rail, High-Speed Comparator

1 FEATURES

- **High Speed: 10ns**
- **Rail-to-Rail I/O**
- **Supply Voltage: 2.7 V to 5.5 V**
- **Push-Pull CMOS Output Stage**
- **Shutdown (RS8931S Only)**
- **Micro Packages: SOT23-5, SOP8, SOT23-6, and MSOP8**
- **Low Supply Current: 2.5mA**

2 APPLICATIONS

- **Automatic Test Equipment**
- **Wireless Base Stations**
- **Threshold Detectors**
- **Zero-Crossing Detectors**
- **Window Comparators**

3 DESCRIPTIONS

The RS893X family of push-pull output comparators feature a fast 10ns propagation delay and operation from 2.7 V to 5.5 V. Beyond-the-rails input common-mode range makes it an ideal choice for low-voltage applications. The rail-to-rail output directly drives either CMOS or TTL logic.

Microsize packages provide options for portable and space-restricted applications. The RS8931 is available in SOT23-5 package. The RS8932 is available in SOP8 and MSOP8 packages. The RS8931S is available in SOT23-6 package.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS8931	SOT23-5	2.90mm×1.60mm
RS8932	SOP8	4.90mm×3.90mm
	MSOP8	3.00mm×3.00mm
RS8931S	SOT23-6	2.90mm×1.60mm

(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	2024/04/18	Preliminary version completed
A.0.1	2024/07/24	Update Electrical Characteristics
A.1	2024/09/06	1. Changed the Orderable Device of RS8933 to RS8931S 2. Update Electrical Characteristics
A.2	2024/12/11	Update MSL
A.3	2025/01/21	1. Add RS8932BXK/RS8932BXM Orderable Device 2. Update I_Q and t_{pd} PARAMETER 3. Add Typical Characteristics Figure 13

5 PACKAGE/ORDERING INFORMATION (1)

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking (2)	MSL (3)	Package Qty
RS8931XF	SOT23-5	5	1	-40°C ~125°C	8931	MSL1	Tape and Reel, 3000
RS8931SXH	SOT23-6	6	1	-40°C ~125°C	8931S	MSL1	Tape and Reel, 3000
RS8932XK	SOP8	8	2	-40°C ~125°C	RS8932	MSL1	Tape and Reel, 4000
RS8932BXK	SOP8	8	2	-40°C ~125°C	RS8932B	MSL1	Tape and Reel, 4000
RS8932BXM	MSOP8	8	2	-40°C ~125°C	RS8932B	MSL1	Tape and Reel, 4000

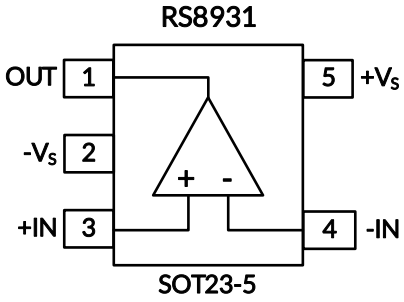
NOTE:

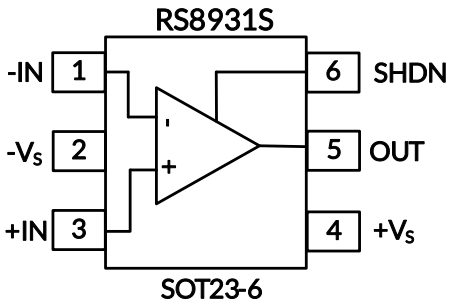
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(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

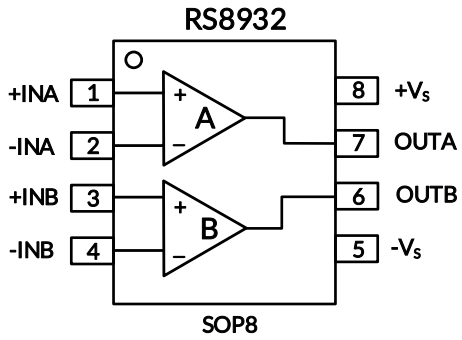


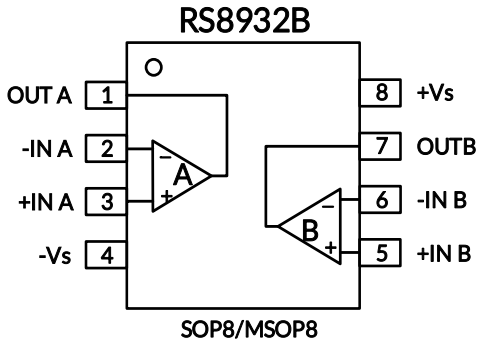


Pin Description

NAME	PIN		I/O (1)	DESCRIPTION
	SOT23-5	SOT23-6		
OUT	1	5	O	Output.
$-V_S$	2	2	-	Negative Power Supply.
+IN	3	3	I	Non-Inverting Input.
-IN	4	1	I	Inverting Input.
$+V_S$	5	4	-	Positive Power Supply.
SHDN	-	6	-	Shutdown (Only for RS8931S). If this pin is floating, the device will be in idle mode. When SHDN = "low", the part is active; When SHDN = "high", the part is in shutdown.

(1) I=Input, O=Output.





Pin Description

NAME	PIN		I/O (1)	DESCRIPTION
	RS8932	RS8932B		
	SOP8	SOP8/MSOP8		
+INA	1	3	I	Non-Inverting Input of Channel A.
-INA	2	2	I	Inverting Input of Channel A.
+INB	3	5	I	Non-Inverting Input of Channel B
-INB	4	6	I	Inverting Input of Channel B.
$-V_S$	5	4	-	Negative Power Supply.
OUTB	6	7	O	Output of Channel B.
OUTA	7	1	O	Output of Channel A.
$+V_S$	8	8	-	Positive 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-)			6	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)		-55	55	mA
	Output short-circuit (4)		Continuous		
θ_{JA}	Package thermal impedance (5)	SOT23-5		230	°C/W
		SOP8		110	
		MSOP8		170	
		SOT23-6		230	
Temperature	Operating range, T_A		-40	125	°C
	Junction, T_J (6)		-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 shouid be current-limited to 10 mA 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 ±55mA 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)	±3000	V
		Charged-Device Model (CDM)	±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	2.7		5.5	V
	Dual-supply	±1.35		±2.75	

7.4 Electrical Characteristics

(At T_A = +25°C, V_S = 2.7V to 5.5V, Full = -40°C to +125°C, unless otherwise noted.) (1)

PARAMETER		CONDITIONS	TEMP	RS893X			UNIT
				MIN (2)	TYP (3)	MAX (2)	
V_{CC}	Operating Voltage Range			2.7		5.5	V
I_Q	Quiescent Current/Channel	V_S=5V, V_{CM}=0V	+25°C		2.5	4.2	mA
			Full			4.5	
PSRR	Power Supply Rejection Ratio	V_S = 2.7V to 5.5V	+25°C		80		dB
			Full		70		
INPUT							
V_{OS}	Input offset voltage	V_{CM}=V_S/2	+25°C	-5	±1	5	mV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift		Full		5		µV/°C
	Input Hysteresis		+25°C		1.5		mV
IB	Input Bias Current (4)(5)	V_{CM}=V_S/2	+25°C		±2	±100	pA
			Full		±12	±300	
I_{OS}	Input Offset Current (4)	V_{CM}=V_S/2	+25°C		±12	±100	pA
V_{CM}	Common-Mode Voltage Range		Full	(-V_S)-0.2		(+V_S)+0.2	V
CMRR	Common Mode Rejection Ratio	V_S = ±2.75V, V_{CM} = -0.2V to (+V_S) + 0.2V	+25°C		75		dB
			Full		65		
		V_S = ±1.35V, V_{CM} = -0.2V to (+V_S) + 0.2V	+25°C		65		
			Full		60		
OUTPUT							
V_{OH}, V_{OL}	Output Voltage Swing from Rail	Vs=5V, I_{OUT} = ±1mA	+25°C		25	40	mV
			Full			50	
I_{OUT}	Output Short-Circuit Current	V_S = 2.7V, R_L = 2Ω to GND	+25°C	15	25		mA
			Full	10			
		V_S = 5.5V, R_L = 2Ω to GND	+25°C	65	89		
			Full	55			
Shutdown							
t_{OFF}	Shutdown Turn-Off Time	V_S=5.5V	+25°C		5		ns
t_{ON}	Shutdown Turn-On Time	V_S=5.5V	+25°C		110		ns
V_{IL}	SHDN Low Threshold Comparator is enabled	Vs=2.7V to 3.6V	Full			(+V_S)-1.8	V
		Vs=4.5V to 5.5V				(+V_S)-2.3	
V_{IH}	SHDN High Threshold Comparator is disabled	Vs=2.7V to 3.6V	Full	(+V_S)-0.7			V
		Vs=4.5V to 5.5V		(+V_S)-0.9			
$I_{B(SHDN)}$	SHDN Input Bias Current		Full		0.01	1	µA
$I_{Q(SHDN)}$	Shutdown Quiescent Current		Full		0.5	5	µA

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.

7.5 Switching Characteristics

(At T_A = +25°C, V_S = ±2.5V, C_L = 15pF, unless otherwise specified.) (1)

PARAMETER		CONDITIONS	TEMP	MIN(2)	TYP(3)	MAX(2)	UNIT
t_{pd}	Propagation Delay Time (4) (5)	Underdrive=100mV, Overdrive =50mV	25°C		10	15	ns
		Underdrive=100mV, Overdrive =100mV	25°C		9	14	
Δt_{sk}	Propagation Delay Skew (6)	Overdrive =50mV	25°C		0.7		
t_R	Rise Time (7)		25°C		2.2		
t_F	Fall Time (7)		25°C		2.5		

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) Not production tested.

(5) Propagation delay cannot be accurately measured with low overdrive on automatic test equipment. This parameter is ensured by characterization and testing at 100 mV overdrive.

(6) The difference between the propagation delay going high and the propagation delay going low.

(7) Measured between 10% of V_S and 90% of V_S.

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°C, Vs=5 V, and input overdrive = 100 mV unless otherwise noted.

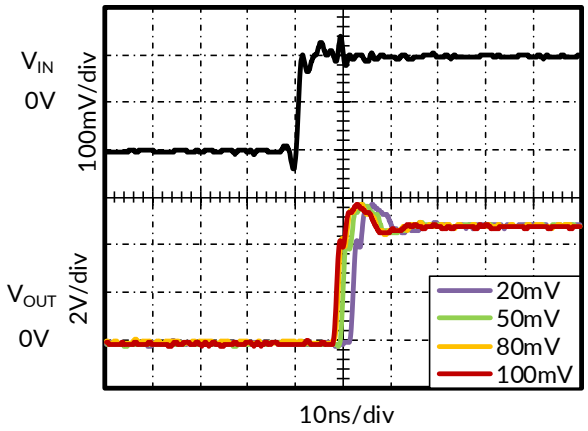


Figure 1. Output Response for Various Overdrive Voltages (L-H)

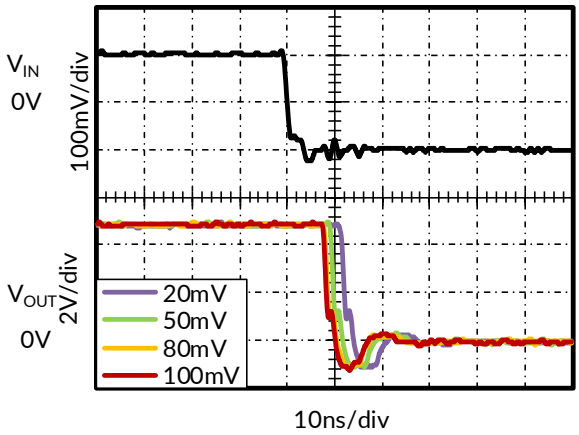


Figure 2. Output Response for Various Overdrive Voltages (H-L)

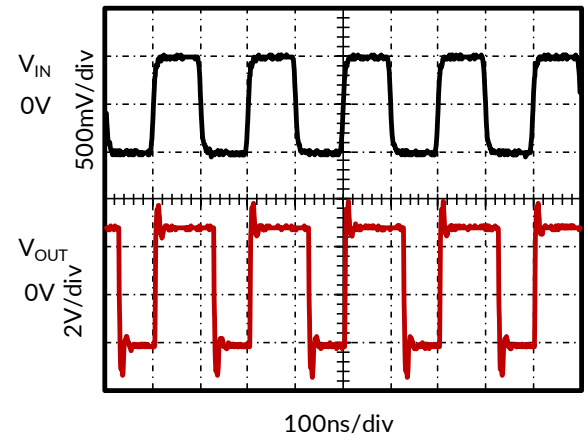


Figure 3. Response to 5MHz Square Wave

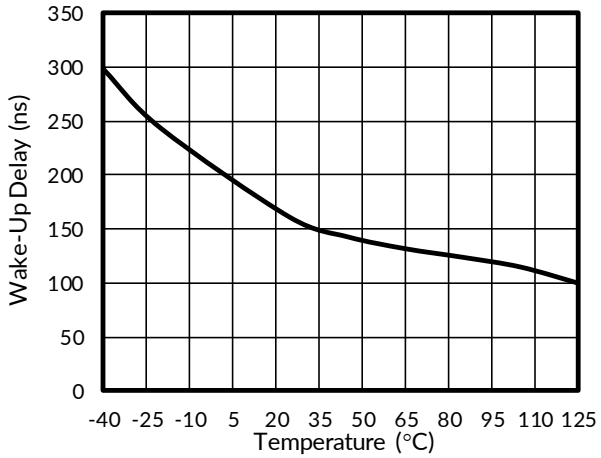


Figure 4. Wake-Up Delay vs Temperature

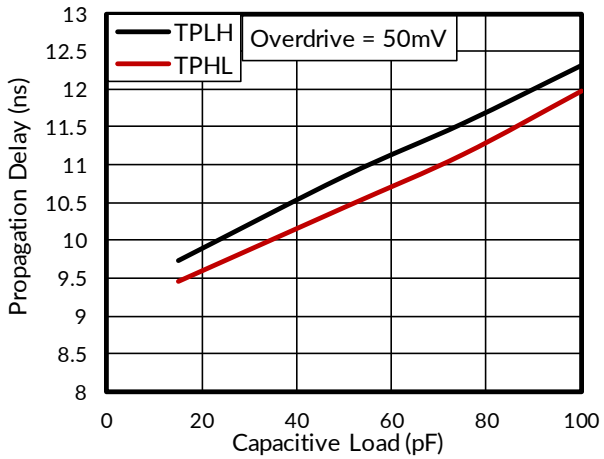


Figure 5. Propagation Delay vs Capacitive Load

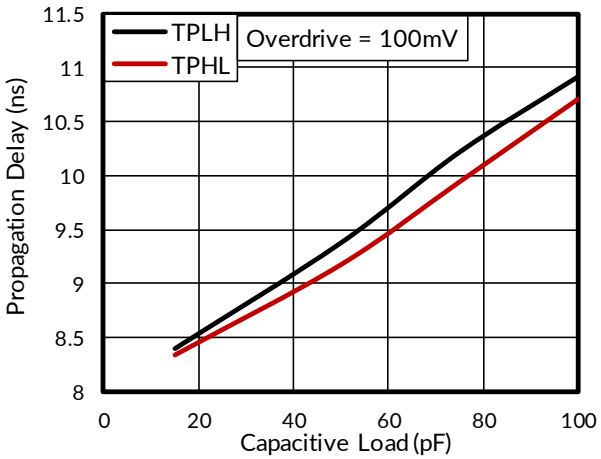


Figure 6. Propagation Delay vs Capacitive Load

Typical Characteristics (Continued)

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, Vs=5 V, and input overdrive = 100 mV unless otherwise noted.

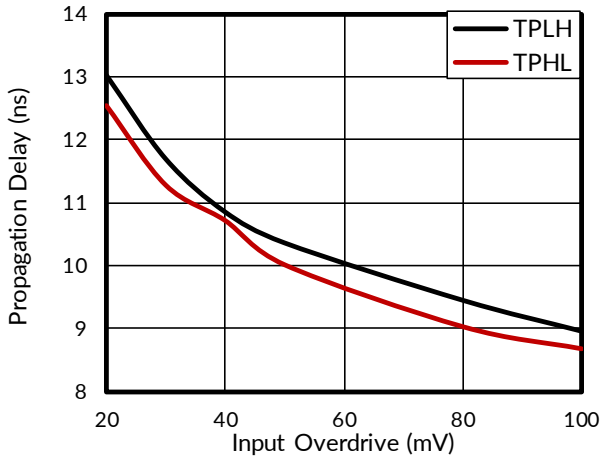


Figure 7. Propagation Delay vs Input Overdrive

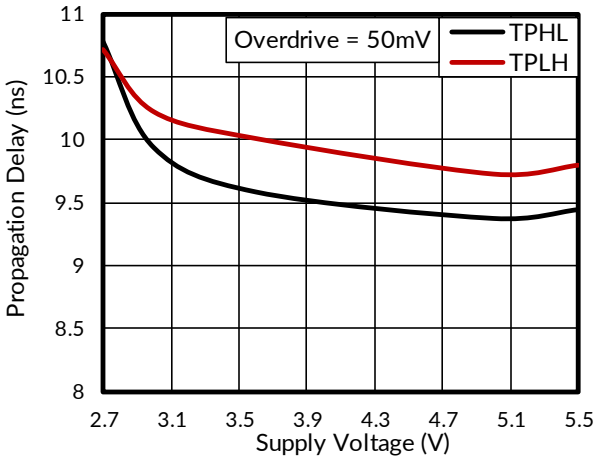


Figure 8. Propagation Delay vs Supply Voltage

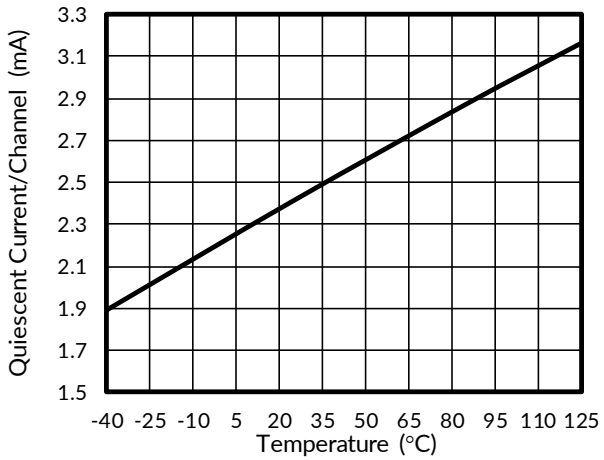


Figure 9. Quiescent Current vs Temperature

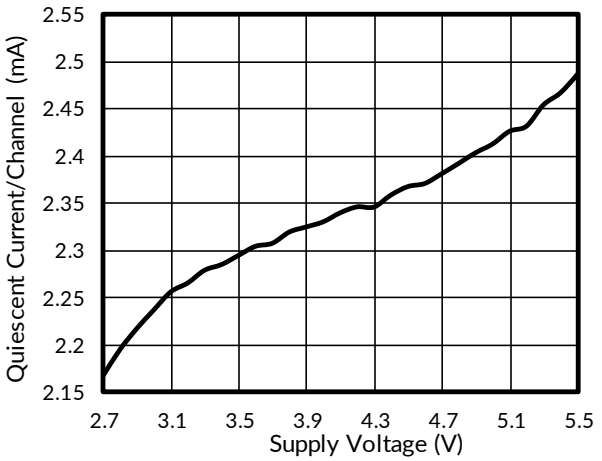


Figure 10. Quiescent Current vs Supply Voltage

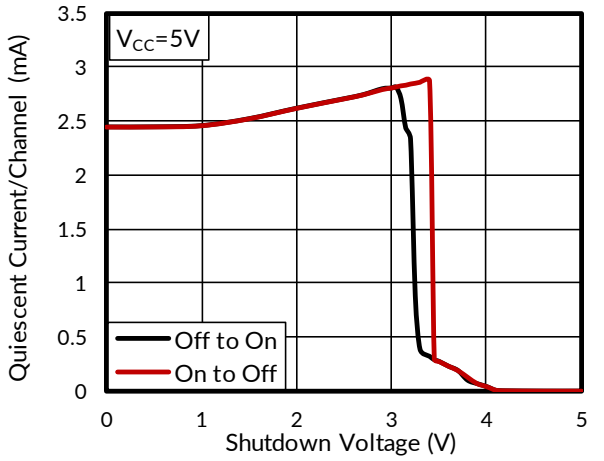


Figure 11. Quiescent Current vs Shutdown Voltage

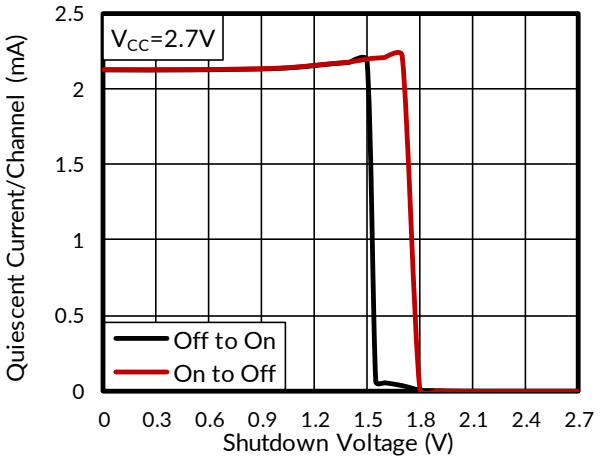


Figure 12. Quiescent Current vs Shutdown Voltage

Typical Characteristics (Continued)

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, Vs=5 V, and input overdrive = 100 mV unless otherwise noted.

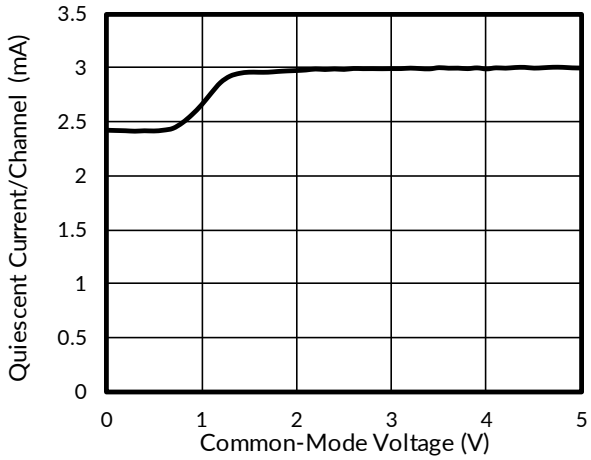


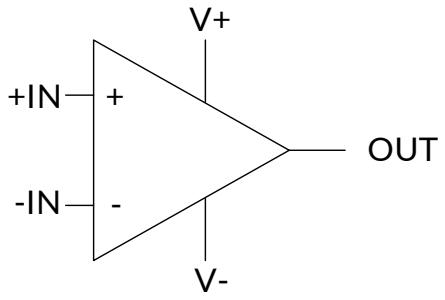
Figure 13. Quiescent Current vs Common-Mode Voltage

8 DETAILED DESCRIPTION

8.1 Overview

The RS893X devices both feature high-speed response and include 1.5mV of internal hysteresis for improved noise immunity with an input common-mode range that extends 0.2V beyond the power-supply rails.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Operating Voltage

The RS893X comparators are specified for use on a single supply from 2.7 V to 5.5 V (or a dual supply from ±1.35 V to ±2.75 V) over a temperature range of −40°C to +125°C. These devices continue to function below this range, but performance is not specified.

8.3.2 Input Overvoltage Protection

Device inputs are protected by electrostatic discharge (ESD) diodes that conduct if the input voltages exceed the power supplies by more than approximately 300mV. Momentary voltages greater than 300mV beyond the power supply can be tolerated if the input current is limited to 10 mA. This limiting is easily accomplished with a small input resistor in series with the comparator, as shown in Figure 14.

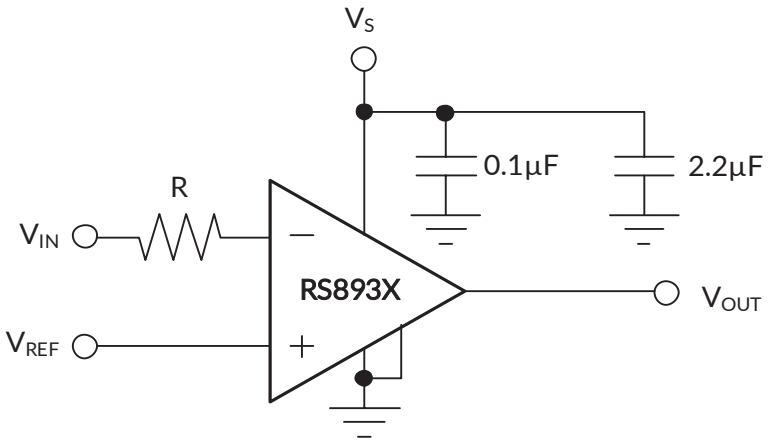


Figure 14. Input Current Protection for Voltages Exceeding the Supply Voltage

8.4 Device Functional Modes

8.4.1 Shutdown

A shutdown pin allows the device to go into idle when it is not in use. When the shutdown pin is high, the device draws approximately 0.5μA, and the output goes to high impedance. When the shutdown pin is low, the RS893X is active. When the RS893X shutdown feature is not used, connect the shutdown pin to the most negative supply, as shown in Figure 15. Exiting shutdown mode requires approximately 100ns. The RS8931 and RS8932 does not have the shutdown feature.

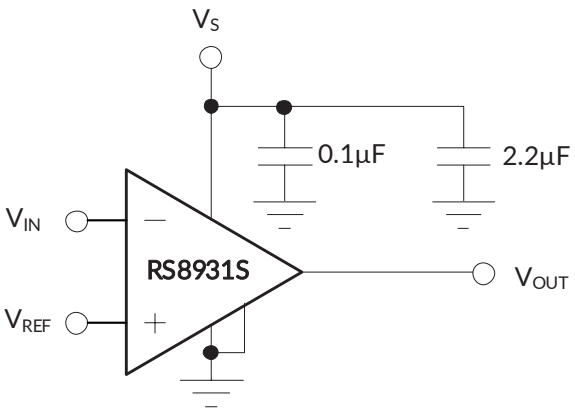


Figure 15. Basic Connections for the RS8931S

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

9.1.1 Adding External Hysteresis

The RS893X has a robust performance when used with a good layout. However, comparator inputs have little noise immunity within the range of a specified offset voltage (±5 mV). For slow-moving or noisy input signals, the comparator output can cause an undesirable switch state as input signals move through the switching threshold. In such applications, the 1.5mV of internal hysteresis of the RS893X might not be sufficient. For greater noise immunity, external hysteresis can be added by connecting a small amount of feedback to the positive input. Figure 16 shows a typical topology used to introduce 25 mV of additional hysteresis, for a total of 1.5mV hysteresis when operating from a single 5V supply. Use Equation 1 to calculate the approximate total hysteresis.

$$V_{HYST} = \frac{(V+) \times R_1}{R_1 + R_2} + 1.5mV \quad (1)$$

The total hysteresis, V_{HYST}, sets the value of the transition voltage required to switch the comparator output, by enlarging the threshold region, thereby reducing sensitivity to noise.

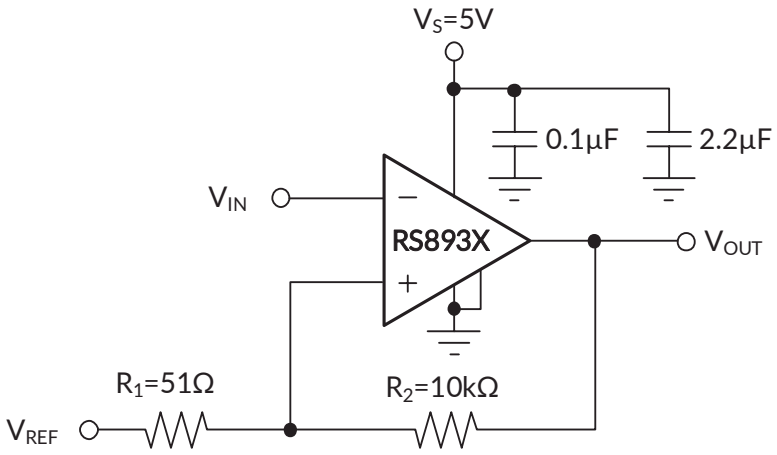


Figure 16. Adding Hysteresis to the RS893X

9.2 Typical Application

9.2.1 Relaxation Oscillator

The RS893X can easily be configured as a simple and inexpensive relaxation oscillator. In Figure 17, the R_2 network sets the trip threshold at 1/3 and 2/3 of the supply. Because this circuit is a high-speed circuit, the resistor values are low to minimize the effects of parasitic capacitance. The positive input alternates between 1/3 of V+ and 2/3 of V+, depending on whether the output is low or high. The time to charge (or discharge) is $0.69 \times R_1C$. Therefore, the period is $1.38 \times R_1C$. For 62 pF and 1kΩ as shown in Figure 17, the output is calculated to 10.9MHz. An implementation of this circuit oscillated at 9.6MHz. Parasitic capacitance and component tolerances explain the difference between theory and actual performance.

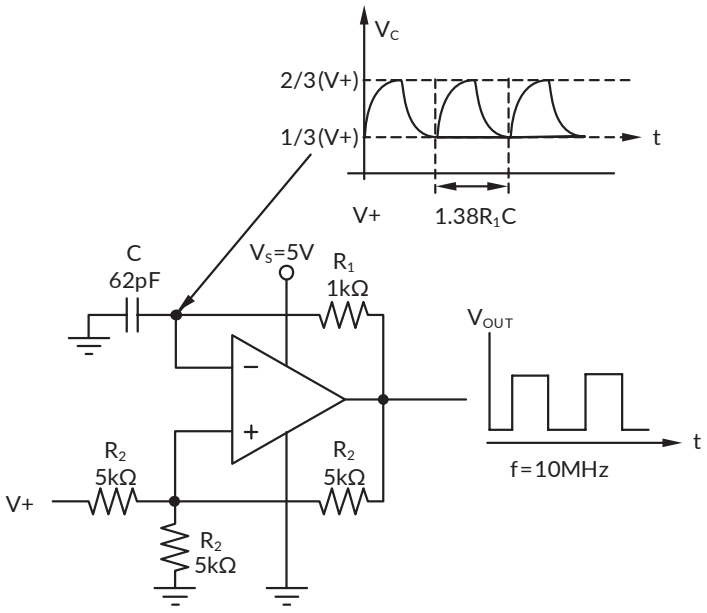


Figure 17. Relaxation Oscillator

9.2.1.1 Design Requirements

For hysteresis of 1/3 of V+ and threshold levels between 1/3 of V+ and 2/3 of V+, the resistors connected to the comparator positive input must be equal in value. The resistor value must be kept low enough so it does not create additional time constant because of the input capacitor and board parasitic capacitor. The value of the charging resistor, R_1, must be relatively low for high-frequency switching without drawing high current and affecting the output high and low level. The value of the charging capacitor must be high enough to avoid errors cause by parasitic capacitance.

9.2.1.2 Detailed Design Procedure

For the positive input, +IN = 1/3 V_{OUT} + 1/3 V+ = 1/3 V+ if V_{OUT} is low and assuming V_{OL} is very close to GND. Or, +IN = 1/3 V_{OUT} + 1/3 V+ = 1/3 V+ = 2/3 V+ if V_{OUT} is high and assuming V_{OH} is very close to V+.

For the negative input, the capacitor charges to 2/3 V+ and discharges to 1/3 V+ exponentially at the same rate with a time constant of R_1C.

10 POWER SUPPLY RECOMMENDATIONS

The RS893X comparators are specified for use on a single supply from 2.7 V to 5.5 V (or a dual supply from ±1.35 V to ±2.75 V) over a temperature range of −40°C to 125°C. These devices continue to function below this range, but performance is not specified.

Place bypass capacitors close to the power-supply pins to reduce noise coupling in from noisy or high-impedance power supplies.

11 LAYOUT

11.1 Layout Guidelines

For any high-speed comparator or amplifier, proper design and printed-circuit board (PCB) layout are necessary for optimal performance. Excess stray capacitance on the active input, or improper grounding, can limit the maximum performance of high-speed circuitry.

Minimizing resistance from the signal source to the comparator input is necessary to minimize the propagation delay of the complete circuit. The source resistance, along with input and stray capacitance, creates an RC filter that delays voltage transitions at the input, and reduces the amplitude of high-frequency signals. The input capacitance of the RS893X, along with stray capacitance from an input pin to ground, results in several picofarads of capacitance.

The location and type of capacitors used for power-supply bypassing are critical to high-speed comparators. The suggested 2.2µF tantalum capacitor does not need to be as close to the device as the 0.1µF capacitor, and may be shared with other devices. The 2.2µF capacitor buffers the power-supply line against ripple, and the 0.1µF capacitor provides a charge for the comparator during high-frequency switching.

In a high-speed circuit, fast rising and falling switching transients create voltage differences across lines that would be at the same potential at DC. To reduce this effect, use a ground plane to reduce difference in voltage potential within the circuit board. A ground plane has the advantage of minimizing the effect of stray capacitances on the circuit board by providing a more desirable path for the current to flow. With a signal trace over a ground plane, at high-frequency the return current (in the ground plane) tends to flow right under the signal trace. Breaks in the ground plane (as simple as through-hole leads and vias) increase the inductance of the plane, making it less effective at higher frequencies. Breaks in the ground plane for necessary vias must be spaced randomly.

11.2 Layout Example

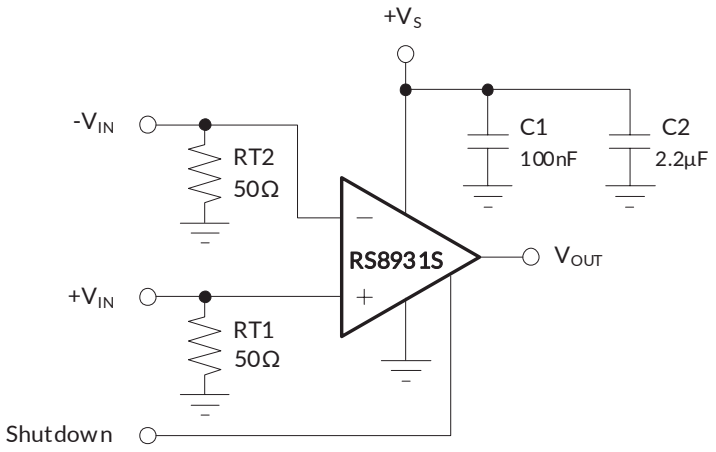
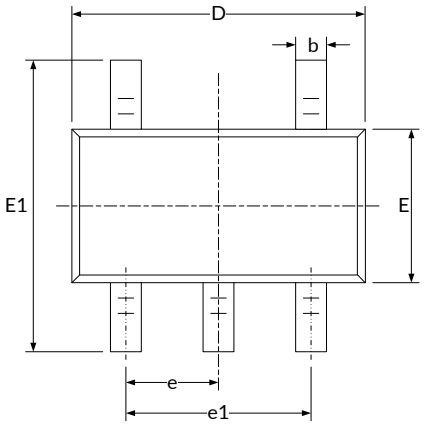
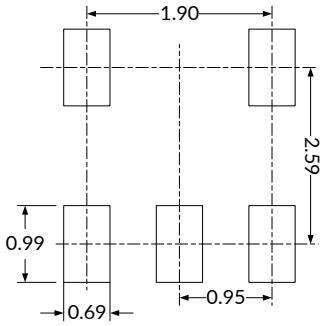


Figure 18. Layout Schematic

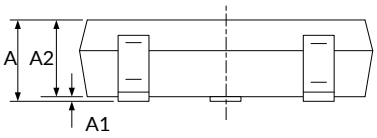
12 PACKAGE OUTLINE DIMENSIONS

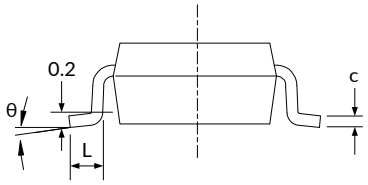
SOT23-5 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



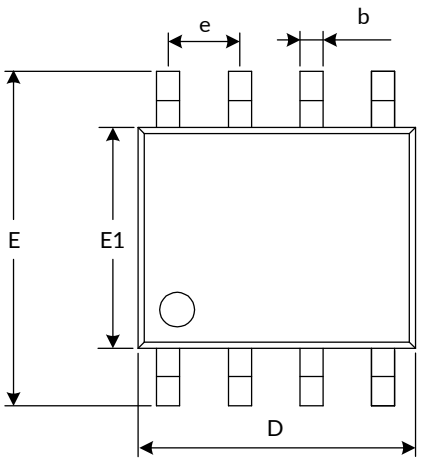


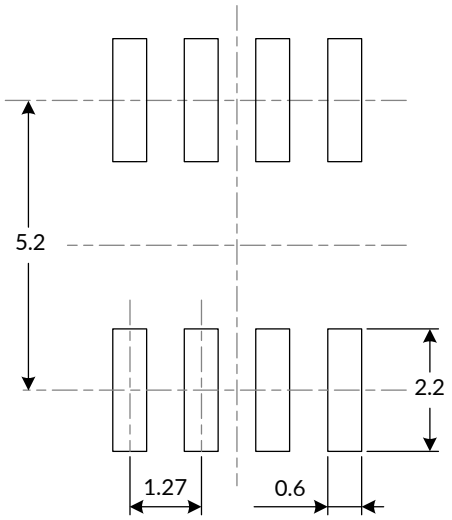
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D (1)	2.820	3.020	0.111	0.119
E (1)	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 (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:

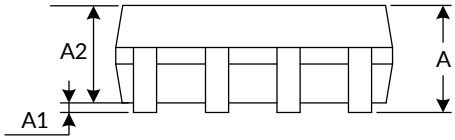
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

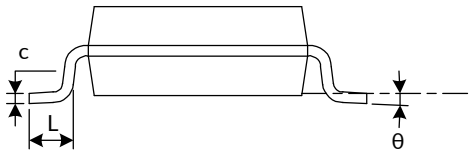
SOP8 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



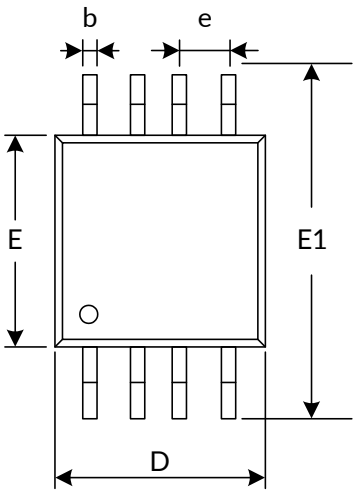


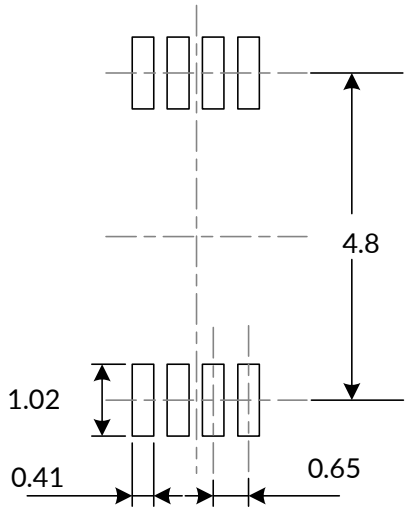
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D (1)	4.800	5.000	0.189	0.197
e	1.270(BSC) (2)		0.050(BSC) (2)	
E	5.800	6.200	0.228	0.244
E1 (1)	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

NOTE:

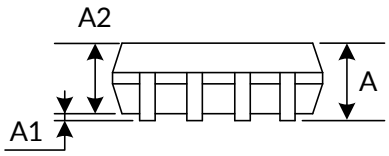
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

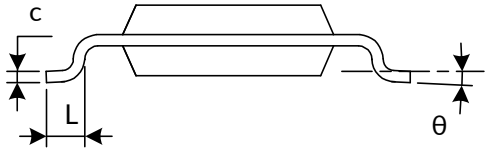
MSOP8 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



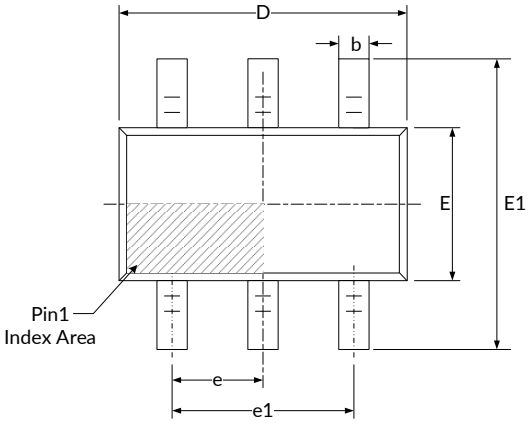


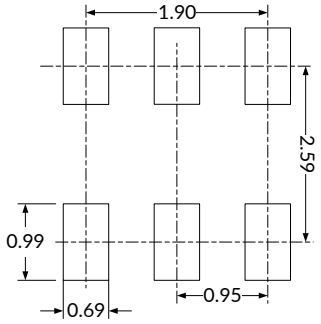
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D (1)	2.900	3.100	0.114	0.122
e	0.650(BSC) (2)		0.026(BSC) (2)	
E (1)	2.900	3.100	0.114	0.122
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.

SOT23-6 (3)





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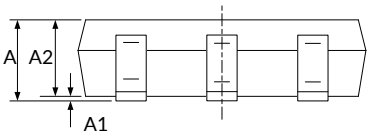
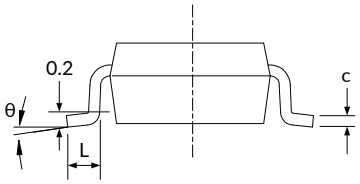




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D (1)	2.820	3.020	0.111	0.119
E (1)	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC) (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°

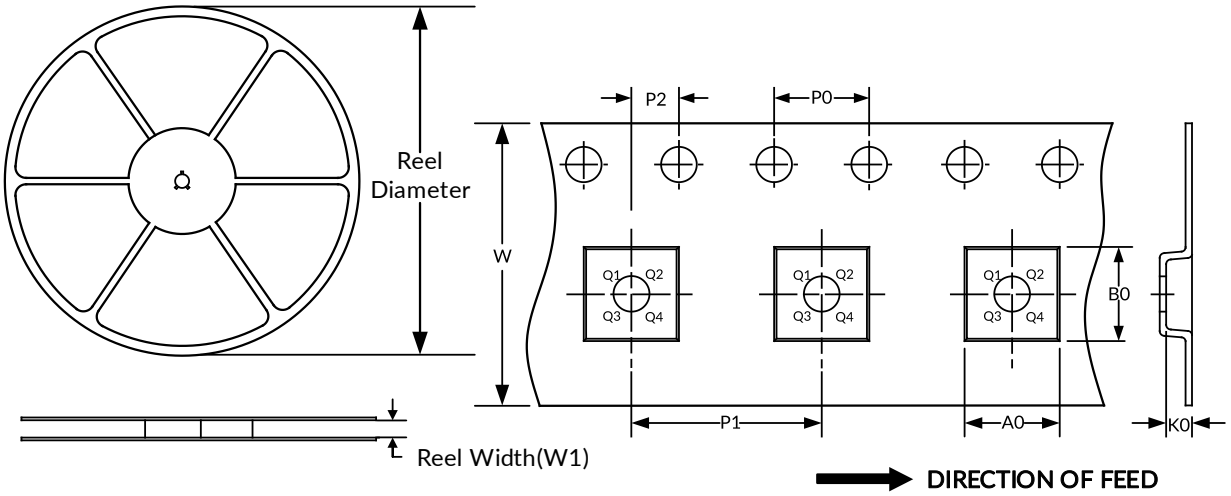
NOTE:

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.

13 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
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
SOT23-6	7”	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3

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

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