

# RS2G86 Dual 2-Input Exclusive-OR Gate

## 1 FEATURES

- **Operating Voltage Range:**1.65V to 5.5V
- **Low Power Consumption:**1μA (Max)
- **Operating Temperature Range:**  
-40°C to +125°C
- **Inputs Accept Voltage to 5.5V**
- **High Output Drive:** ±24mA at V<sub>CC</sub>=3.0V
- **Micro SIZE PACKAGE:** MSOP-8

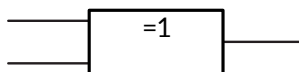
## 2 APPLICATIONS

- AV Receiver
- Blu-ray Player and Home Theater
- Digital Picture Frame (DPF)
- High-Speed Data Acquisition and Generation
- Personal Navigation Device (GPS)
- Portable Media Player

### LOGIC SYMBOL



### IEE/IEC LOGIC SYMBOL



## 3 DESCRIPTIONS

The RS2G86 Dual 2-input exclusive-OR gate is designed for 1.65V to 5.5V V<sub>CC</sub> operation.

The RS2G86 device performs the Boolean function  $Y = \bar{A}B + A\bar{B}$  in positive logic. The device is fully specified for partial-power-down applications using I<sub>off</sub>. The I<sub>off</sub> circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The RS2G86 is available in Green MSOP-8 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) |
|-------------|---------|-----------------|
| RS2G86      | MSOP-8  | 3.00mm×3.00mm   |

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

## 4 FUNCTION TABLE

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | H | L      |
| L      | H | H      |
| H      | L | H      |
| L      | L | L      |

H=High Voltage Level

L=Low Voltage Level

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## 5 Revision History

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

| Version | Change Date | Change Item                                                                                     |
|---------|-------------|-------------------------------------------------------------------------------------------------|
| A.1     | 2021/01/21  | Initial version completed                                                                       |
| A.2     | 2021/12/21  | Added the TAPE AND REEL INFORMATION                                                             |
| A.3     | 2023/09/20  | 1. Update $V_{IH}$ , $V_{IL}$ PARAMETER<br>2. Update ESD Ratings<br>3. Add MSL on Page 5@RevA.2 |

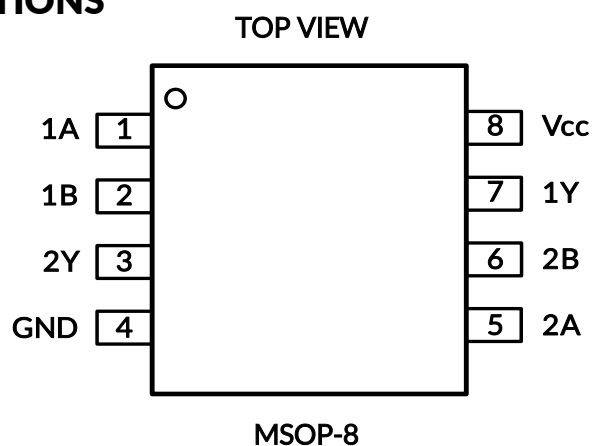
**6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>**

| <b>PRODUCT</b> | <b>ORDERING NUMBER</b> | <b>TEMPERATURE RANGE</b> | <b>PACKAGE LEAD</b> | <b>PACKAGE MARKING <sup>(2)</sup></b> | <b>MSL <sup>(3)</sup></b> | <b>PACKAGE OPTION</b> |
|----------------|------------------------|--------------------------|---------------------|---------------------------------------|---------------------------|-----------------------|
| RS2G86         | RS2G86XM               | -40°C ~+125°C            | MSOP-8              | RS2G86                                | MSL3                      | 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.

## 7 PIN CONFIGURATIONS



## PIN DESCRIPTION

| PIN    | NAME            | I/O TYPE <sup>(1)</sup> | FUNCTION              |
|--------|-----------------|-------------------------|-----------------------|
| MSOP-8 |                 |                         |                       |
| 1      | 1A              | I                       | Channel 1 logic input |
| 2      | 1B              | I                       | Channel 1 logic input |
| 3      | 2Y              | O                       | Logic level output    |
| 4      | GND             | -                       | Ground                |
| 5      | 2A              | I                       | Channel 2 logic input |
| 6      | 2B              | I                       | Channel 2 logic input |
| 7      | 1Y              | O                       | Logic level output    |
| 8      | V <sub>cc</sub> | -                       | Power Supply          |

(1) I=input, O=output.

## 8 Specifications

### 8.1 Absolute Maximum Ratings <sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted) <sup>(1)(2)</sup>

|                  |                                                                                             | MIN               | MAX                  | UNIT |
|------------------|---------------------------------------------------------------------------------------------|-------------------|----------------------|------|
| V <sub>CC</sub>  | Supply voltage range                                                                        | -0.5              | 6.5                  | V    |
| V <sub>I</sub>   | Input voltage range <sup>(2)</sup>                                                          | -0.5              | 6.5                  | V    |
| V <sub>O</sub>   | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | -0.5              | 6.5                  | V    |
| V <sub>O</sub>   | Voltage range applied to any output in the high or low state <sup>(2)(3)</sup>              | -0.5              | V <sub>CC</sub> +0.5 | V    |
| I <sub>IK</sub>  | Input clamp current                                                                         | V <sub>I</sub> <0 | -50                  | mA   |
| I <sub>OK</sub>  | Output clamp current                                                                        | V <sub>O</sub> <0 | -50                  | mA   |
| I <sub>O</sub>   | Continuous output current                                                                   |                   | ±50                  | mA   |
|                  | Continuous current through V <sub>CC</sub> or GND                                           |                   | ±100                 | mA   |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(4)</sup>                                                    | MSOP-8            | 170                  | °C/W |
| T <sub>J</sub>   | Junction temperature <sup>(5)</sup>                                                         | -65               | 150                  | °C   |
| T <sub>stg</sub> | Storage temperature                                                                         | -65               | 150                  | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of V<sub>CC</sub> is provided in the *Recommended Operating Conditions table*.
- (4) The package thermal impedance is calculated in accordance with JESD-51.
- (5) The maximum power dissipation is a function of T<sub>J(MAX)</sub>, R<sub>θJA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any ambient temperature is P<sub>D</sub> = (T<sub>J(MAX)</sub> - T<sub>A</sub>) / R<sub>θJA</sub>. All numbers apply for packages soldered directly onto a PCB.

### 8.2 ESD Ratings

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

|                    |                         | VALUE                                                   | UNIT    |
|--------------------|-------------------------|---------------------------------------------------------|---------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), MIL-STD-883K METHOD 3015.9      | ±2000 V |
|                    |                         | Charged-device model (CDM), ANSI/ESDA/JEDEC JS-002-2018 | ±1000 V |
|                    |                         | Machine Model (MM), JESD22-A115C (2010)                 | ±200 V  |



#### 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.

## 9 ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (TYP values are at  $T_A = +25^\circ\text{C}$ , Full= $-40^\circ\text{C}$  to  $125^\circ\text{C}$ , unless otherwise noted.)<sup>(1)</sup>

### 9.1 Recommended Operating Conditions

| PARAMETER                     | SYMBOL     | TEST CONDITIONS                                                    | MIN                  | MAX                  | UNIT             |
|-------------------------------|------------|--------------------------------------------------------------------|----------------------|----------------------|------------------|
| Supply voltage                | $V_{CC}$   | Operating                                                          | 1.65                 | 5.5                  | V                |
|                               |            | Data retention only                                                | 1.5                  |                      |                  |
| High-level input voltage      | $V_{IH}$   | $V_{CC}=1.65\text{V to }1.95\text{V}$                              | $0.65 \times V_{CC}$ |                      | V                |
|                               |            | $V_{CC}=2.3\text{V to }2.7\text{V}$                                | 1.7                  |                      |                  |
|                               |            | $V_{CC}=3\text{V to }3.6\text{V}$                                  | 2                    |                      |                  |
|                               |            | $V_{CC}=4.5\text{V to }5.5\text{V}$                                | $0.7 \times V_{CC}$  |                      |                  |
| Low-level input voltage       | $V_{IL}$   | $V_{CC}=1.65\text{V to }1.95\text{V}$                              |                      | $0.35 \times V_{CC}$ | V                |
|                               |            | $V_{CC}=2.3\text{V to }2.7\text{V}$                                |                      | 0.6                  |                  |
|                               |            | $V_{CC}=3\text{V to }3.6\text{V}$                                  |                      | 0.8                  |                  |
|                               |            | $V_{CC}=4.5\text{V to }5.5\text{V}$                                |                      | $0.3 \times V_{CC}$  |                  |
| Input voltage                 | $V_I$      |                                                                    | 0                    | 5.5                  | V                |
| Output voltage                | $V_O$      |                                                                    | 0                    | $V_{CC}$             | V                |
| Input transition rise or fall | $t_r, t_f$ | $V_{CC}=1.8\text{V} \pm 0.15\text{V}, 2.5\text{V} \pm 0.2\text{V}$ |                      | 20                   | ns/V             |
|                               |            | $V_{CC}=3.3\text{V} \pm 0.3\text{V}$                               |                      | 10                   |                  |
|                               |            | $V_{CC}=5\text{V} \pm 0.5\text{V}$                                 |                      | 5                    |                  |
| Operating temperature         | $T_A$      |                                                                    | -40                  | +125                 | $^\circ\text{C}$ |

(1) All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation.

## 9.2 DC Characteristics

| PARAMETER        |               | TEST CONDITIONS                                                                  | V <sub>CC</sub> | TEMP  | MIN <sup>(2)</sup>   | TYP <sup>(3)</sup> | MAX <sup>(2)</sup> | UNIT |
|------------------|---------------|----------------------------------------------------------------------------------|-----------------|-------|----------------------|--------------------|--------------------|------|
| V <sub>OH</sub>  |               | I <sub>OH</sub> = -100μA                                                         | 1.65V to 5.5V   | Full  | V <sub>CC</sub> -0.1 |                    |                    | V    |
|                  |               | I <sub>OH</sub> = -4mA                                                           | 1.65V           |       | 1.2                  |                    |                    |      |
|                  |               | I <sub>OH</sub> = -8mA                                                           | 2.3V            |       | 1.9                  |                    |                    |      |
|                  |               | I <sub>OH</sub> = -16mA                                                          | 3V              |       | 2.4                  |                    |                    |      |
|                  |               | I <sub>OH</sub> = -24mA                                                          |                 |       | 2.3                  |                    |                    |      |
|                  |               | I <sub>OH</sub> = -32mA                                                          | 4.5V            |       | 3.8                  |                    |                    |      |
| V <sub>OL</sub>  |               | I <sub>OL</sub> = 100μA                                                          | 1.65V to 5.5V   | Full  |                      |                    | 0.1                | V    |
|                  |               | I <sub>OL</sub> = 4mA                                                            | 1.65V           |       |                      |                    | 0.45               |      |
|                  |               | I <sub>OL</sub> = 8mA                                                            | 2.3V            |       |                      |                    | 0.3                |      |
|                  |               | I <sub>OL</sub> = 16mA                                                           | 3V              |       |                      |                    | 0.4                |      |
|                  |               | I <sub>OL</sub> = 24mA                                                           |                 |       |                      |                    | 0.55               |      |
|                  |               | I <sub>OL</sub> = 32mA                                                           | 4.5V            |       |                      |                    | 0.55               |      |
| I <sub>I</sub>   | A or B inputs | V <sub>I</sub> =5.5V or GND                                                      | 0V to 5.5V      | +25°C |                      | ±0.1               | ±1                 | μA   |
|                  |               |                                                                                  |                 | Full  |                      |                    | ±5                 |      |
| I <sub>off</sub> |               | V <sub>I</sub> or V <sub>O</sub> =5.5V                                           | 0V              | +25°C |                      | ±0.1               | ±1                 | μA   |
|                  |               |                                                                                  |                 | Full  |                      |                    | ±10                |      |
| I <sub>CC</sub>  |               | V <sub>I</sub> =5.5V or GND, I <sub>O</sub> =0                                   | 1.65V to 5.5V   | +25°C |                      | 0.1                | 1                  | μA   |
|                  |               |                                                                                  |                 | Full  |                      |                    | 10                 |      |
| ΔI <sub>CC</sub> |               | One input at V <sub>CC</sub> -0.6V,<br>Other inputs at V <sub>CC</sub> or<br>GND | 3V to 5.5V      | Full  |                      |                    | 500                | μA   |

(1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation.

(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.

## 9.3 AC Characteristics

(T<sub>A</sub> = -40°C to +125°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)<sup>(1)</sup>

| PARAMETER                     | SYMBOL          | TEST CONDITIONS             |                                            | MIN <sup>(2)</sup> | TYP <sup>(3)</sup> | MAX <sup>(2)</sup> | UNIT |
|-------------------------------|-----------------|-----------------------------|--------------------------------------------|--------------------|--------------------|--------------------|------|
| Propagation Delay             | t <sub>pd</sub> | V <sub>CC</sub> =1.8V±0.15V | C <sub>L</sub> =30pF, R <sub>L</sub> =1kΩ  |                    | 14.2               |                    | ns   |
|                               |                 | V <sub>CC</sub> =2.5V±0.2V  | C <sub>L</sub> =30pF, R <sub>L</sub> =500Ω |                    | 11.1               |                    |      |
|                               |                 | V <sub>CC</sub> =3.3V±0.3V  | C <sub>L</sub> =50pF, R <sub>L</sub> =500Ω |                    | 6.7                |                    |      |
|                               |                 | V <sub>CC</sub> =5V±0.5V    | C <sub>L</sub> =50pF, R <sub>L</sub> =500Ω |                    | 5.3                |                    |      |
| Input Capacitance             | C <sub>i</sub>  | V <sub>CC</sub> =3.3V       | V <sub>I</sub> =V <sub>CC</sub> or GND     |                    | 4                  |                    | pF   |
| Power dissipation capacitance | C <sub>pd</sub> | V <sub>CC</sub> =1.8V       | f=10MHz                                    |                    | 20                 |                    | pF   |
|                               |                 | V <sub>CC</sub> =2.5V       |                                            |                    | 21                 |                    |      |
|                               |                 | V <sub>CC</sub> =3.3V       |                                            |                    | 22                 |                    |      |
|                               |                 | V <sub>CC</sub> =5V         |                                            |                    | 25                 |                    |      |

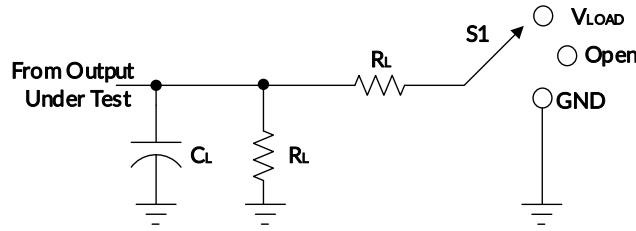
(1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation.

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

(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.

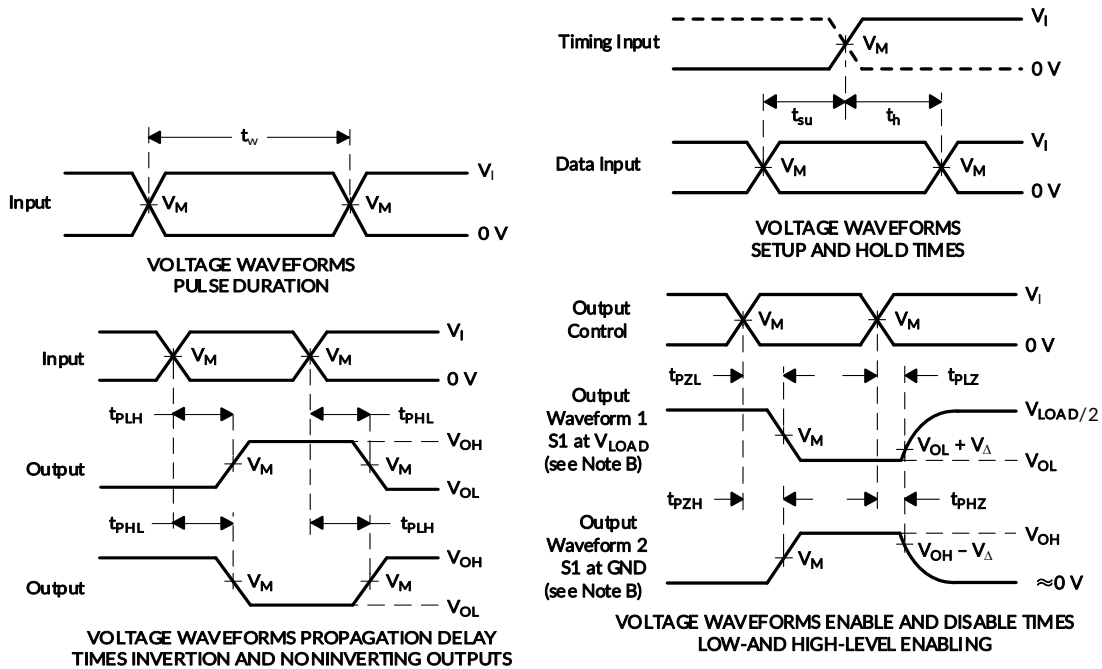


# 10 Parameter Measurement Information



| TEST              | S1         |
|-------------------|------------|
| $t_{PLH}/t_{PHL}$ | Open       |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND        |

| $V_{CC}$         | INPUTS   |              | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|------------------|----------|--------------|------------|-------------------|-------|--------------|--------------|
|                  | $V_I$    | $t_r/t_f$    |            |                   |       |              |              |
| $1.8V \pm 0.15V$ | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF  | 1k $\Omega$  | 0.15V        |
| $2.5V \pm 0.2V$  | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF  | 500 $\Omega$ | 0.15V        |
| $3.3V \pm 0.3V$  | 3V       | $\leq 2.5ns$ | 1.5V       | 6V                | 50pF  | 500 $\Omega$ | 0.3V         |
| $5V \pm 0.5V$    | $V_{CC}$ | $\leq 2.5ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 50pF  | 500 $\Omega$ | 0.3V         |

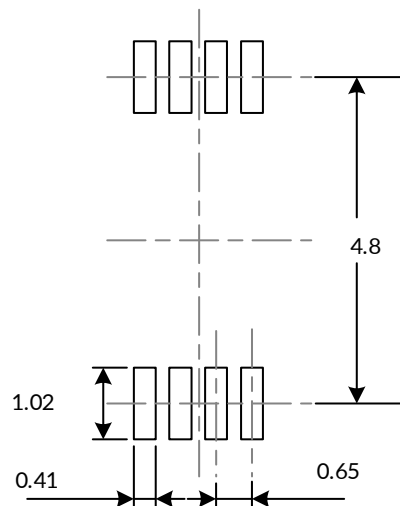
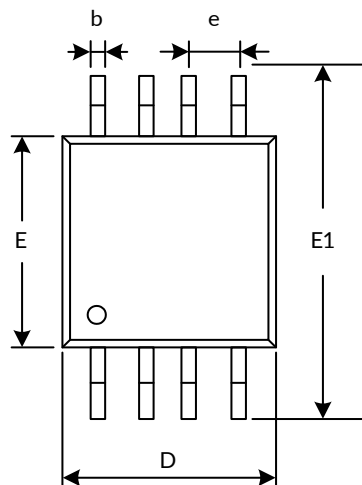


- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_o = 50 \Omega$ .
  - D. The outputs are measured one at a time, with one transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - H. All parameters and waveforms are not applicable to all devices.

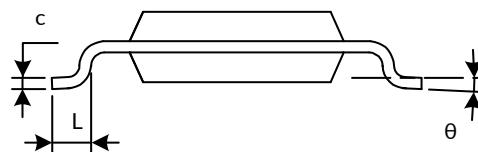
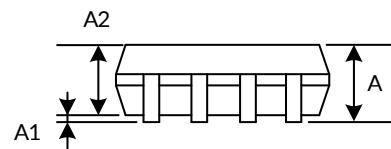
**Figure 1. Load Circuit and Voltage Waveforms**

# 11 PACKAGE OUTLINE DIMENSIONS

## MSOP-8 <sup>(3)</sup>



RECOMMENDED LAND PATTERN (Unit: mm)



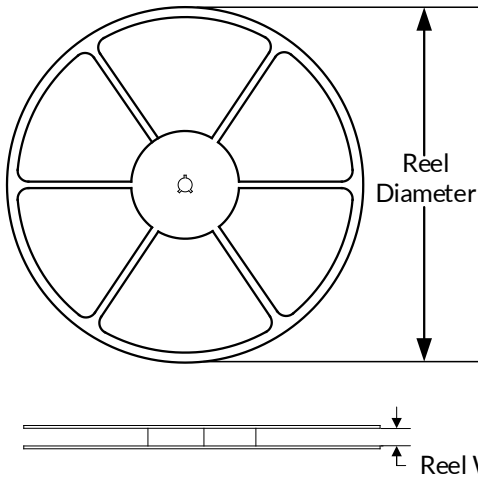
| Symbol           | Dimensions In Millimeters |       | Dimensions In Inches      |       |
|------------------|---------------------------|-------|---------------------------|-------|
|                  | Min                       | Max   | Min                       | Max   |
| A <sup>(1)</sup> | 0.820                     | 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 <sup>(1)</sup> | 2.900                     | 3.100 | 0.114                     | 0.122 |
| e                | 0.650(BSC) <sup>(2)</sup> |       | 0.026(BSC) <sup>(2)</sup> |       |
| E <sup>(1)</sup> | 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 |
| $\theta$         | 0°                        | 6°    | 0°                        | 6°    |

NOTE:

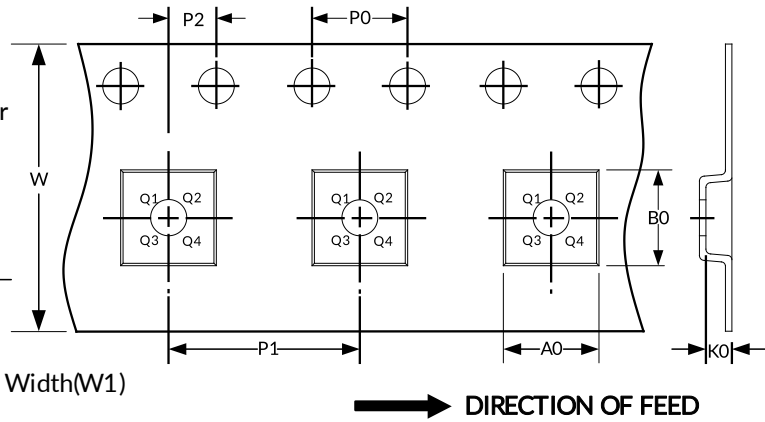
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

## 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 |
|--------------|---------------|-----------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| MSOP-8       | 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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