RS2G241 Dual Buffer and Driver With 3-State Outputs

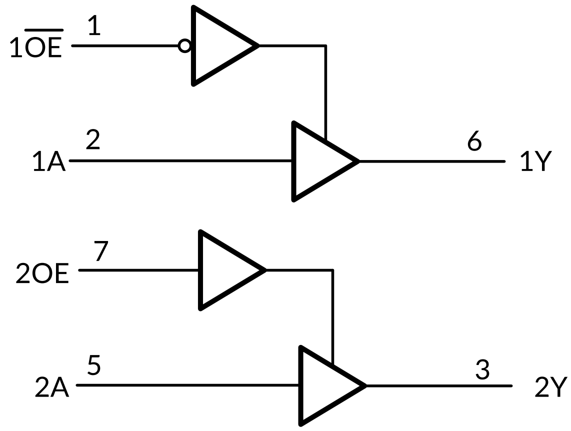
1 FEATURES

- **Operating Voltage Range: 1.65V to 5.5V**
- **Low Power Consumption: 1µA (Max)**
- **Operating Temperature Range: -40°C to +125°C**
- **Input Accept Voltage to 5.5V**
- **High Output Drive: ±24mA at V_{CC}=3.0V**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Micro Size Packages: MSOP8, VSSOP8**

2 APPLICATIONS

- **AC Receiver**
- **Blu-ray Players and Home Theaters**
- **Desktops or Notebook PCs**
- **Digital Video Cameras (DVC)**
- **Mobile Phones**
- **Personal Navigation Device (GPS)**
- **Portable Media Player**

Functional Block Diagram



3 DESCRIPTIONS

This dual buffer and line driver is designed for 1.65V to 5.5V V_{CC} operation.

The RS2G241 device is designed specifically to improve both the performance and density of 3-state memory-address drivers, clock drivers, and bus-oriented receivers and transmitters.

The RS2G241 device is organized as two 1bit line drivers with separate output-enable ($1\overline{OE}$, 2OE) inputs. When $1\overline{OE}$ is low and 2OE is high, the device passes data from the A inputs to the Y outputs. When $1\overline{OE}$ is high and 2OE is low, the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor, and OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking or the current-sourcing capability of the driver.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2G241	MSOP8	3.00mm×3.00mm
	VSSOP8	2.00mm×2.30mm

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

Table of Contents

4 REVISION HISTORY

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

Version	Change Date	Change Item
A.1	2023/07/06	Initial version completed
A.1.1	2024/02/29	Modify packaging naming
A.2	2024/04/22	Update font

5 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS2G241	RS2G241XM	-40°C ~+125°C	MSOP8	RS2G241	MSL3	Tape and Reel, 4000
	RS2G241XVS8	-40°C ~+125°C	VSSOP8	2241	MSL3	Tape and Reel, 3000

NOTE:

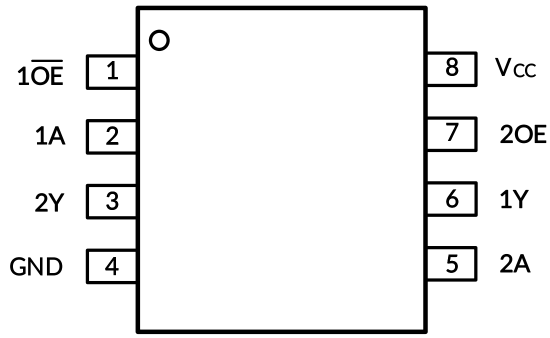
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(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 CONFIGURATIONS

TOP VIEW



MSOP8/VSSOP8

PIN DESCRIPTION

PIN	NAME	TYPE (1)	FUNCTION
MSOP8/VSSOP8			
1	$1\overline{OE}$	I	Output enable (Active low)
2	1A	I	Input
3	2Y	O	Output
4	GND	–	Ground.
5	2A	I	Input
6	1Y	O	Output
7	2OE	I	Output enable (Active high)
8	V_{CC}	P	Power pin

(1) I=input, O=output, P=power.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1) (2)

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		-0.5	6.5	V
V_I	Input voltage range (2)		-0.5	6.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state (2)		-0.5	6.5	V
V_O	Voltage range applied to any output in the high or low state (2) (3)		-0.5	V_{CC}+0.5	V
I_{IK}	Input clamp current	V_I<0		-50	mA
I_{OK}	Output clamp current	V_O<0		-50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance (4)	MSOP8		170	°C/W
		VSSOP8		205	K/W
T_J	Junction temperature (5)		-65	150	°C
T_{stg}	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_{CC} 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 $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

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

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

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

ESD SENSITIVITY CAUTION

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

8 ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range (Full=-40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.) [1]

8.1 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}=1.65V to 1.95V	0.65 x V_{CC}		V
		V_{CC}=2.3V to 2.7V	1.7		
		V_{CC}=3V to 3.6V	2		
		V_{CC}=4.5V to 5.5V	0.7 x V_{CC}		
Low-Level Input Voltage	V_{IL}	V_{CC}=1.65V to 1.95V		0.35 x V_{CC}	V
		V_{CC}=2.3V to 2.7V		0.7	
		V_{CC}=3V to 3.6V		0.8	
		V_{CC}=4.5V to 5.5V		0.3 x V_{CC}	
Input Voltage	V_I		0	5.5	V
Output Voltage	V_O		0	V_{CC}	V
Input Transition Rise or Fall	Δt/Δv	V_{CC}=1.8V ± 0.15V, 2.5V ± 0.2V		20	ns/V
		V_{CC}=3.3V ± 0.3V		10	
		V_{CC}=5V ± 0.5V		5	
Operating Temperature	T_A		-40	125	°C

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

8.2 DC Characteristics

PARAMETER		TEST CONDITIONS	V_{CC}	TEMP	MIN(2)	TYP(3)	MAX(2)	UNIT
V_{OH}		I_{OH} = -100µA	1.65V to 5.5V	Full	V_{CC}-0.1			V
		I_{OH} = -4mA	1.65V		1.2			
		I_{OH} = -8mA	2.3V		1.9			
		I_{OH} = -16mA	3V		2.4			
		I_{OH} = -24mA			2.3			
		I_{OH} = -32mA	4.5V		3.8			
V_{OL}		I_{OL} = 100µA	1.65V to 5.5V	Full			0.1	V
		I_{OL} = 4mA	1.65V				0.45	
		I_{OL} = 8mA	2.3V				0.3	
		I_{OL} = 16mA	3V				0.4	
		I_{OL} = 24mA					0.55	
		I_{OL} = 32mA	4.5V				0.55	
I_I	A or $\overline{OE}$ input	V_I=5.5V or GND	0V to 5.5V	+25°C		±0.1	±1	µA
				Full			±5	
I_{off}		V_I or V_O=5.5V	0	+25°C		±0.1	±1	µA
				Full			±10	
I_{CC}		V_I=5.5V or GND, I_O=0	1.65V to 5.5V	+25°C		0.1	1	µA
				Full			10	
ΔI_{CC}		One input at V_{CC}-0.6V, Other inputs at V_{CC} or GND	3V to 5.5V	Full			500	µA
Input Capacitance (C_i)		V_I=V_{CC} or GND	3.3V	+25°C		4		pF

(1) All unused inputs of the device must be held at V_{CC} 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.

8.3 Switching Characteristics, C_L=15pF

over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.) (1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}=1.8V±0.15V	V_{CC}=2.5V±0.2V	V_{CC}=3.3V±0.3V	V_{CC}=5V±0.5V	UNIT
			TYP	TYP	TYP	TYP	
t_{pd}	A	Y	6.5	4.0	4.2	2.2	ns

8.4 Switching Characteristics, C_L=30pF or 50pF

over recommended operating free-air temperature range (-40°C to 125°C, unless otherwise noted.) (1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}=1.8V±0.15V	V_{CC}=2.5V±0.2V	V_{CC}=3.3V±0.3V	V_{CC}=5V±0.5V	UNIT
			TYP	TYP	TYP	TYP	
t_{pd}	A	Y	8.9	5.5	4.3	3.1	ns
t_{en}	$\overline{OE}$	Y	9.8	6.0	5.4	3.5	ns
t_{dis}	$\overline{OE}$	Y	7.7	4.6	4.6	3.3	ns

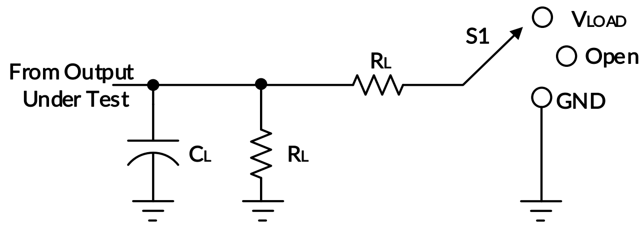
8.5 Operating Characteristics

T_A=25°C

PARAMETER			TEST CONDITIONS	V_{CC}=1.8V	V_{CC}=2.5V	V_{CC}=3.3V	V_{CC}=5V	UNIT
				TYP	TYP	TYP	TYP	
C_{pd}	Power Dissipation Capacitance	Output Enabled	f=10MHz	18	18	19	21	pF
		Output Disabled		2	2	2	4	

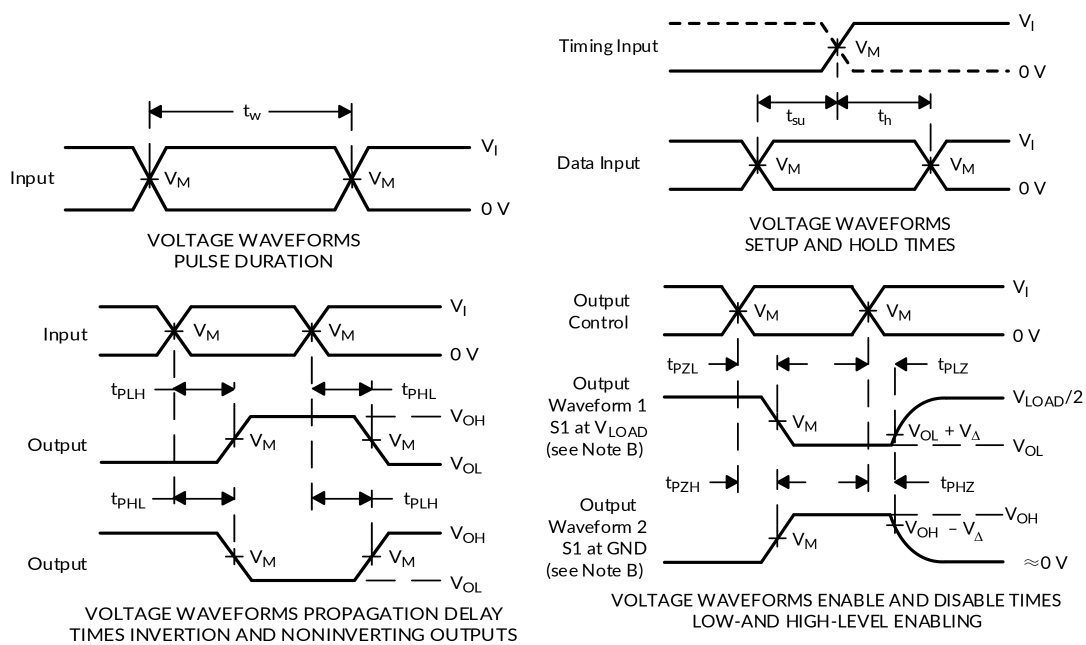
(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

9 PARAMETER MEASUREMENT INFORMATION



TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PIZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

V_{CC}	INPUTS		V_M	V_{LOAD}	C_L		R_L		V_Δ
	V_I	t_r/t_f							
1.8V±0.15V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	30pF	1MΩ	1kΩ	0.15V
2.5V±0.2V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	30pF	1MΩ	500Ω	0.15V
3.3V±0.3V	3V	≤2.5ns	1.5V	6V	15pF	50pF	1MΩ	500Ω	0.3V
5V±0.5V	V_{CC}	≤2.5ns	$V_{CC}/2$	2 x V_{CC}	15pF	50pF	1MΩ	500Ω	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 ≤ 10 MHz, Z_O = 50 Ω.
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

10 DETAILED DESCRIPTION

10.1 Overview

The RS2G241 device is designed specifically to improve both the performance and density of 3-state memory-address drivers, clock drivers, and bus-oriented receivers and transmitters. The RS2G241 device is organized as two 1-bit line drivers with separate output-enable ($1\overline{OE}$, 2OE) inputs. When $1\overline{OE}$ is low and 2OE is high, the device passes data from the A inputs to the Y outputs. When $1\overline{OE}$ is high and 2OE is low, the outputs are in the high-impedance state.

The RS2G241 is also an effective redriver, with a maximum output current drive of 32 mA.

10.2 Functional Block Diagram

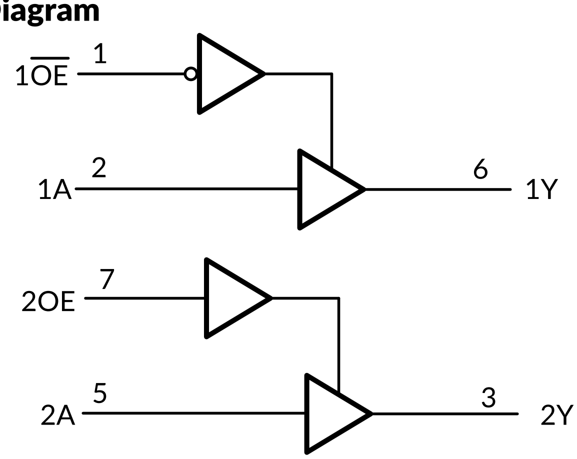


Figure 2. Logic Diagram (Positive Logic)

10.3 Feature Description

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor, and OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sinking or the current-sourcing capability of the driver.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

10.4 Device Functional Modes

Table 1 and Table 2 list the functional modes of the RS2G241.

Table 1. Gate 1 Functional Table

INPUTS		OUTPUT
$1\overline{OE}$	1A	1Y
L	H	H
L	L	L
H	X	Z

Table 2. Gate 2 Functional Table

INPUTS		OUTPUT
2OE	2A	2Y
H	H	H
H	L	L
L	X	Z

11 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.

11.1 Application Information

Typical Application shows a simple application where a physical push button is connected to the RS2G241. The push button is in a physical location far enough away from the processor that the input signal is weak and needs to be redriven. The RS2G241 acts as a redriver, providing a strong input signal to the processor with as little as 1ns of propagation delay.

11.2 Typical Application

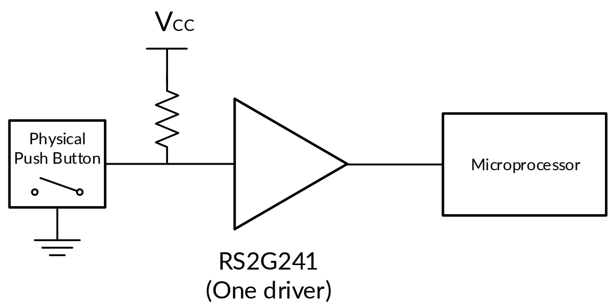


Figure 3. RS2G241 Application

11.2.1 Design Requirements

This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive also creates fast edges into light loads, so routing and load conditions must be considered to prevent ringing.

11.2.2 Detailed Design Procedure

1. Recommended Input Conditions
   - Rise time and fall time specs. See ($\Delta t/\Delta V$) in Recommended Operating Conditions.
   - Specified high and low levels. See (V_{IH} and V_{IL}) in Recommended Operating Conditions.
   - Inputs are overvoltage tolerant allowing them to go as high as (V_I max) in Recommended Operating Conditions at any valid V_{CC}.
2. Recommend Output Conditions
   - Load currents must not exceed (I_O max) per output and must not exceed (Continuous current through V_{CC} or GND) total current for the part. These limits are located in Absolute Maximum Ratings.
   - Outputs must not be pulled above VCC during normal operation or 5.5 V in high-z state.

12 POWER SUPPLY RECOMMENDATIONS

The power supply pin should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1µF capacitor is recommended and if there are multiple V_{CC} terminals then 0.01µF or 0.022µF capacitors are recommended for each power terminal. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1µF and 1µF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible.

13 LAYOUT

13.1 Layout Guidelines

When using multiple bit logic devices inputs should not ever float. In many cases, functions or parts of functions of digital logic devices are unused; for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. Specified below are the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally, they will be tied to GND or V_{CC} whichever make more sense or is more convenient.

13.2 Layout Example

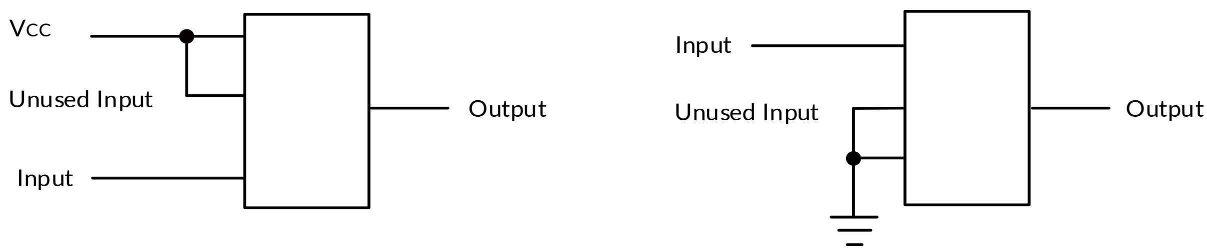
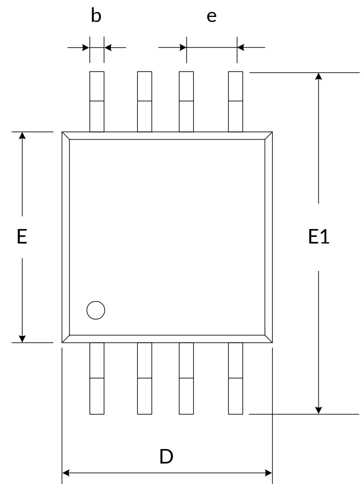
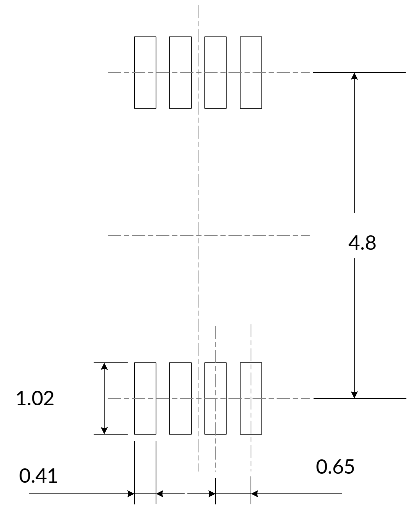


Figure 4. Layout Diagram

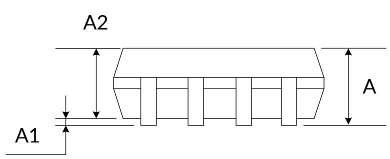
14 PACKAGE OUTLINE DIMENSIONS

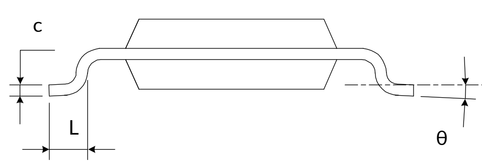
MSOP8 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



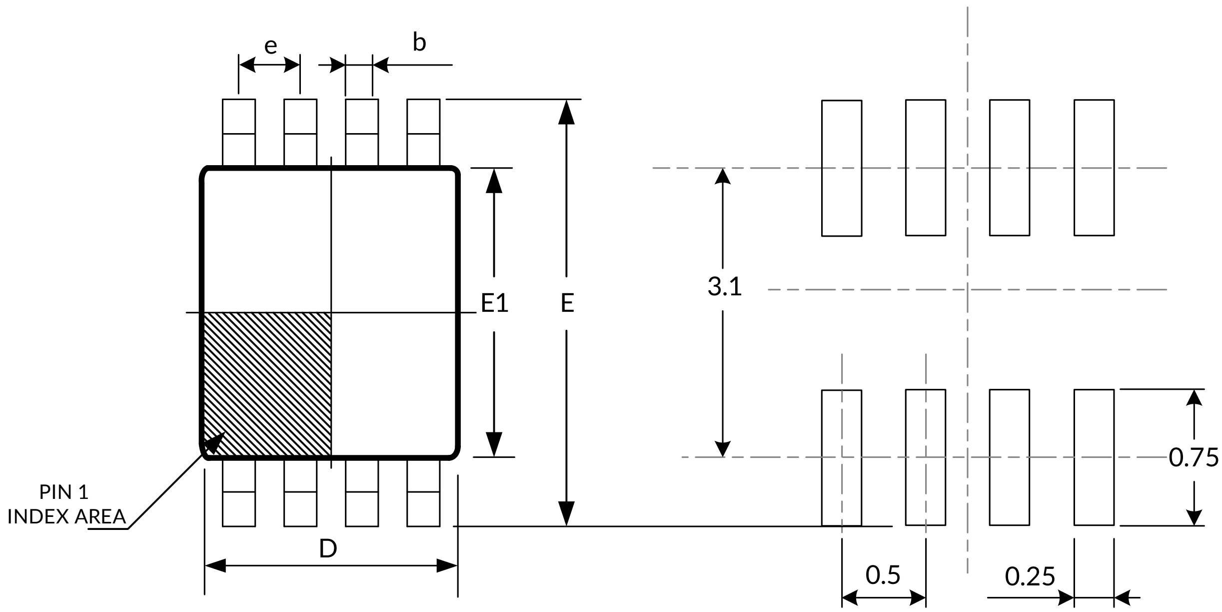


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D (1)	2.900	3.100	0.114	0.122
e	0.650(BSC) (2)		0.026(BSC) (2)	
E (1)	2.900	3.100	0.114	0.122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

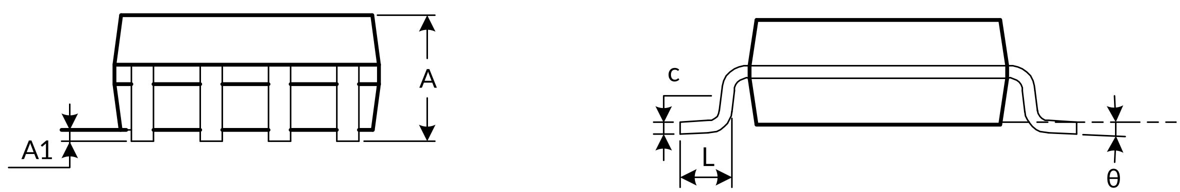
NOTE:

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.

VSSOP8 (3)



RECOMMENDED LAND PATTERN (Unit: mm)

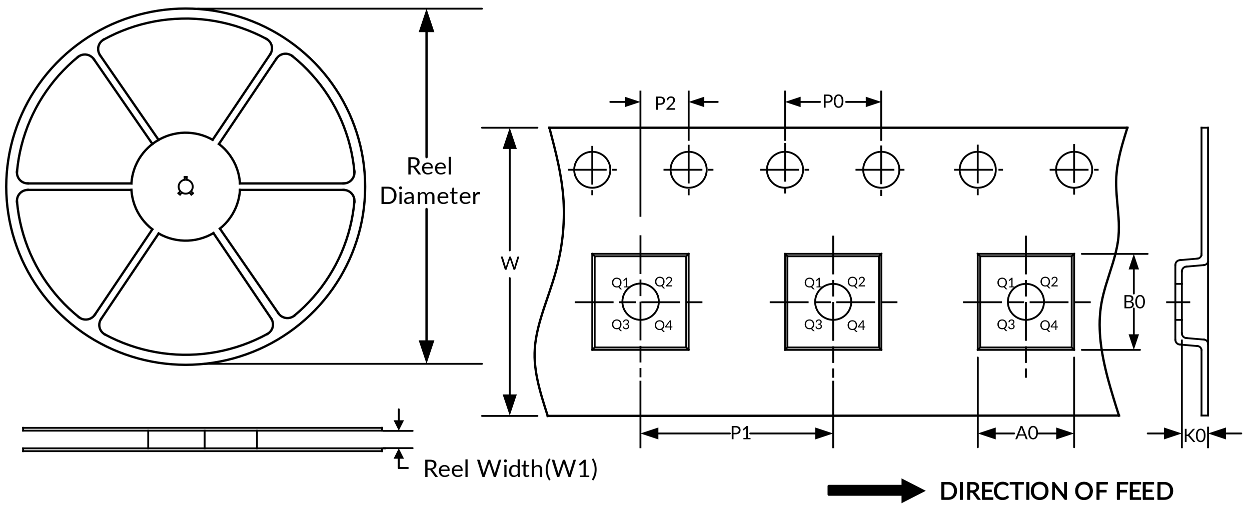


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.600	0.900	0.024	0.085
A1	0.000	0.100	0.000	0.004
b	0.170	0.250	0.007	0.010
c	0.100	0.200	0.004	0.008
D (1)	1.900	2.100	0.075	0.083
e	0.500 (BSC) (2)		0.020 (BSC) (2)	
E	3.000	3.200	0.118	0.126
E1 (1)	2.200	2.400	0.087	0.095
L	0.200	0.350	0.008	0.014
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.

15 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
MSOP8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1
VSSOP8	7"	9.5	2.25	3.35	1.40	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.

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.