RS4G125-Q1 Quadruple Bus Buffer Gate With 3-State Outputs

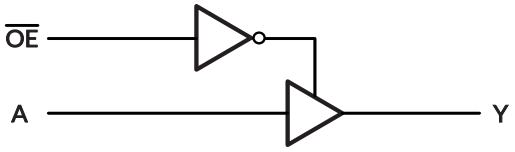
1 FEATURES

- **Qualified for Automotive Applications**
- **AEC-Q100 Qualified with the Grade 1**
- **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**
- **±24mA Output Drive at V_{CC}=3.0V**
- **Micro Size Packages: TSSOP14**

2 APPLICATIONS

- **Qualified for Automotive Applications**
- **Increase Digital Signal Drive Strength**
- **Infotainment**
- **ADAS**
- **HEV/EV Inverter**

Simplified Schematic



3 DESCRIPTIONS

The quadruple buffer is designed for 1.65V to 5.5V V_{CC} operation. The RS4G125-Q1 device is quadruple line drivers with 3-state outputs. The outputs are disabled when the output-enable ($\overline{OE}$) input is high.

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.

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

The RS4G125-Q1 is available in Green TSSOP14 packages. It operates over an ambient temperature range of -40°C to 125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS4G125-Q1	TSSOP14	5.00mm×4.40mm

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

4 FUNCTION TABLE

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

H=HIGH Logic Level
L =LOW Logic Level
X=Don't Care
Z=High-impedance OFF-state

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5 REVISION HISTORY

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

Version	Change Date	Change Item
A.0	2024/12/23	Preliminary version completed
A.1	2025/04/22	Initial version completed

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	Lead finish/Ball material (2)	MSL Peak Temp (3)	PACKAGE MARKING (4)	PACKAGE OPTION
RS4G125 -Q1	RS4G125XQ -Q1	-40°C ~125°C	TSSOP14	SN	MSL1-260°- Unlimited	RS4G125	Tape and Reel,4000

NOTE:

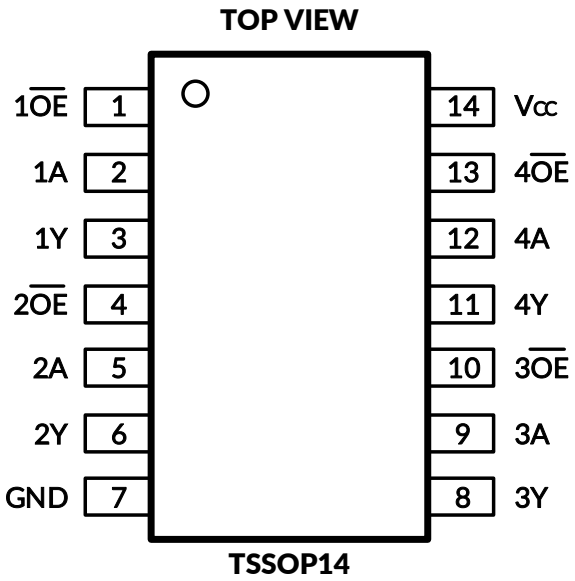
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(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.

(4) 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.

7 PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	I/O TYPE (1)	FUNCTION
TSSOP14			
1	1$\overline{OE}$	I	Output Enable for buffer 1
2	1A	I	Input of buffer 1
3	1Y	O	Output of buffer 1
4	2$\overline{OE}$	I	Output Enable for buffer 2
5	2A	I	Input of buffer 2
6	2Y	O	Output of buffer 2
7	GND	-	Ground
8	3Y	O	Output of buffer 3
9	3A	I	Input of buffer 3
10	3$\overline{OE}$	I	Output Enable for buffer 3
11	4Y	O	Output of buffer 4
12	4A	I	Input of buffer 4
13	4$\overline{OE}$	I	Output Enable for buffer 4
14	V_{CC}	-	Power Supply

(1) I=input, O=output.

8 SPECIFICATIONS

8.1 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
Vo	Voltage range applied to any output in the high-impedance or power-off state (2)		-0.5	6.5	V
Vo	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)	TSSOP14		90	°C/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.

8.2 ESD Ratings

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

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM), per AEC Q100-002 (1)	±2000	V
		Charged-Device Model (CDM), per AEC Q100-011	±1000	
		Latch-Up (LU), per AEC Q100-004	±200	mA

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

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°C, unless otherwise noted.) (1)

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	5.5	
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	2.3		
		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		0.25 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	t_r, t_f	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.

9.2 Electrical 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 $\overline{OE}$ inputs	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	0V	+25°C		±0.1	±1	μA
				Full			±10	
I_{OZ}		V_O=0V to 5.5V	3.6V	Full			10	μA
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

(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.

9.3 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
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	4.1	12.8	2.3	8.1	1.5	6.9	1.1	4.9	ns

9.4 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
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A	Y	4.8	14.6	2.8	8.5	1.8	7.2	1.2	5.2	ns
t_{en}	$\overline{OE}$	Y	5.8	17.4	3.1	9.5	2.7	8.2	2.1	6.5	ns
t_{dis}	$\overline{OE}$	Y	4.8	14.4	2.9	8.8	2.1	6.5	1.7	5.3	ns

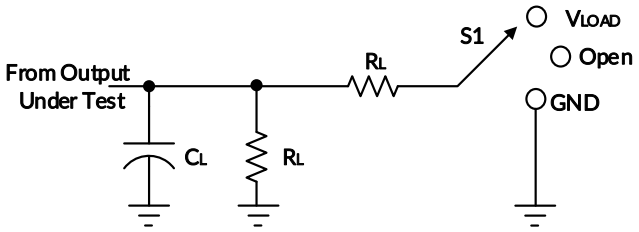
9.5 Operating Characteristics

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	

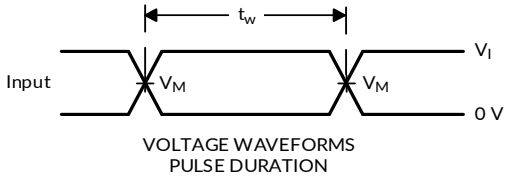
(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

10 PARAMETER MEASUREMENT INFORMATION

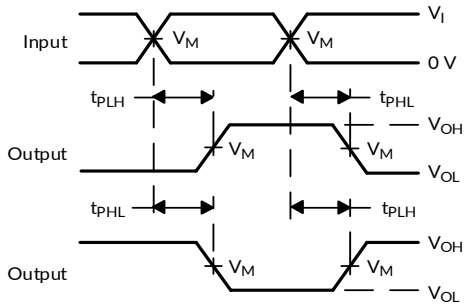


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

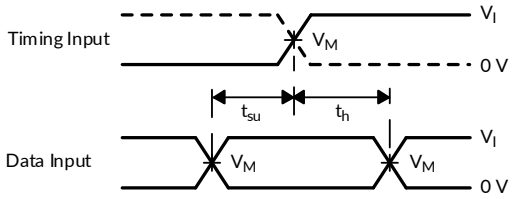
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8V±0.15V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	1MΩ	0.15V
2.5V±0.2V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	1MΩ	0.15V
3.3V±0.3V	3V	≤2.5ns	1.5V	6V	15pF	1MΩ	0.3V
5V±0.5V	V_{CC}	≤2.5ns	$V_{CC}/2$	2 x V_{CC}	15pF	1MΩ	0.3V



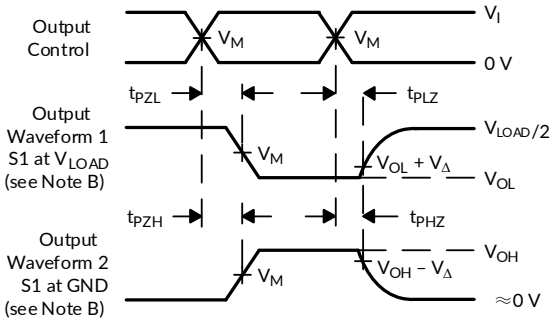
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS PROPAGATION DELAY
TIMES INVERTION AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES

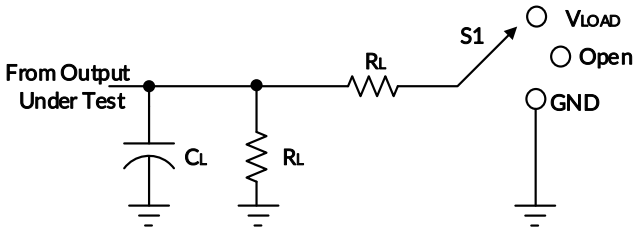


VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES
LOW-AND HIGH-LEVEL ENABLING

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.

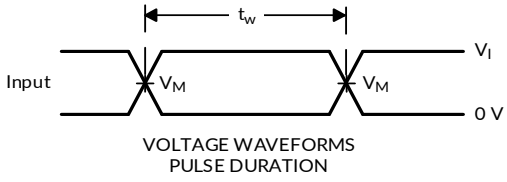
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION

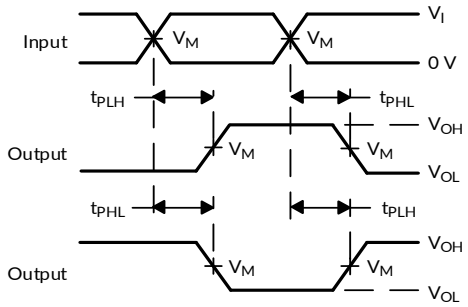


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{LOAD}
t_{PHZ}/t_{PZH}	GND

V_{CC}	INPUTS		V_M	V_{LOAD}	C_L	R_L	V_Δ
	V_I	t_r/t_f					
1.8V±0.15V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	30pF	1KΩ	0.15V
2.5V±0.2V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	30pF	500Ω	0.15V
3.3V±0.3V	3V	≤2.5ns	1.5V	6V	50pF	500Ω	0.3V
5V±0.5V	V_{CC}	≤2.5ns	$V_{CC}/2$	2 x V_{CC}	50pF	500Ω	0.3V



VOLTAGE WAVEFORMS
PULSE DURATION



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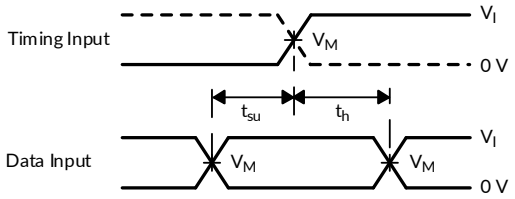
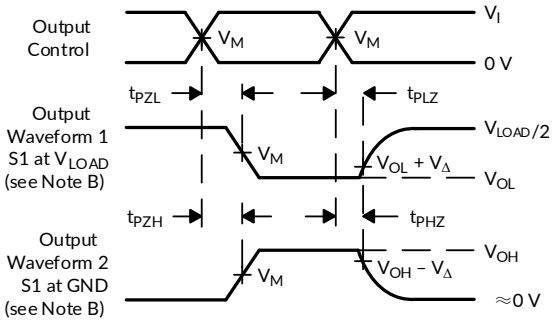
TIMES INVERTION AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



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C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω.
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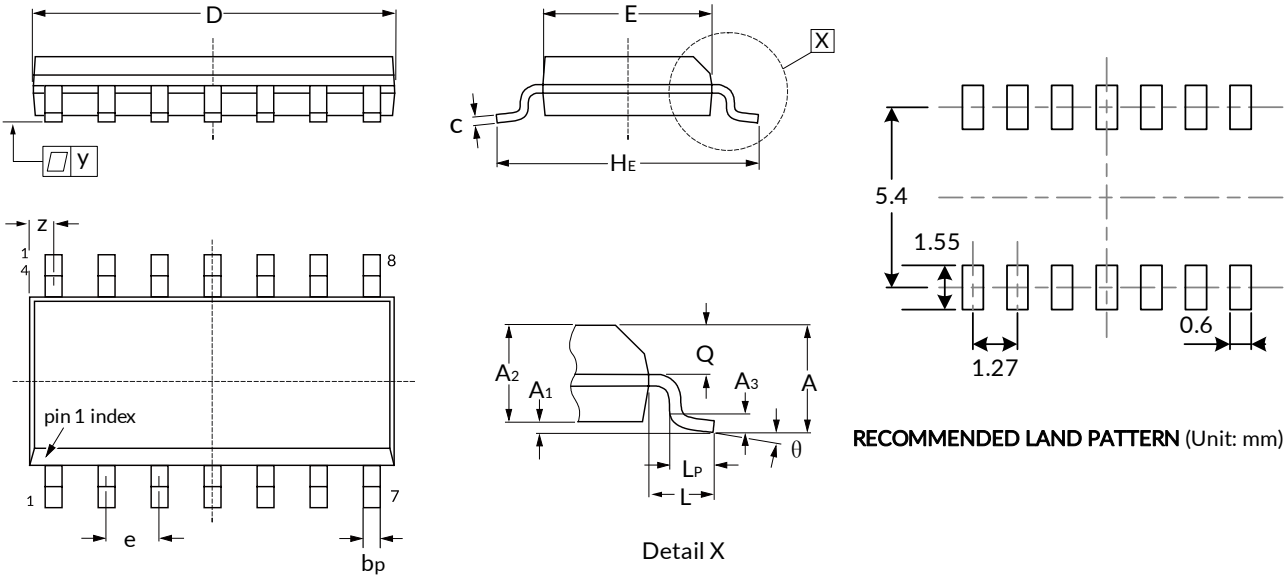
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

11 PACKAGE OUTLINE DIMENSIONS

TSSOP14 (2)



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.100		0.043
A_1	0.050	0.150	0.002	0.006
A_2	0.800	0.950	0.031	0.037
A_3	0.25		0.010	
b_p	0.190	0.300	0.007	0.012
c	0.100	0.200	0.004	0.008
D (1)	4.900	5.100	0.193	0.201
E (1)	4.300	4.500	0.169	0.177
H_E	6.200	6.600	0.244	0.260
e	0.650		0.026	
L	1		0.039	
L_P	0.500	0.750	0.020	0.030
Q	0.300	0.400	0.012	0.016
Z	0.380	0.720	0.015	0.028
y	0.1		0.004	
θ	0°	8°	0°	8°

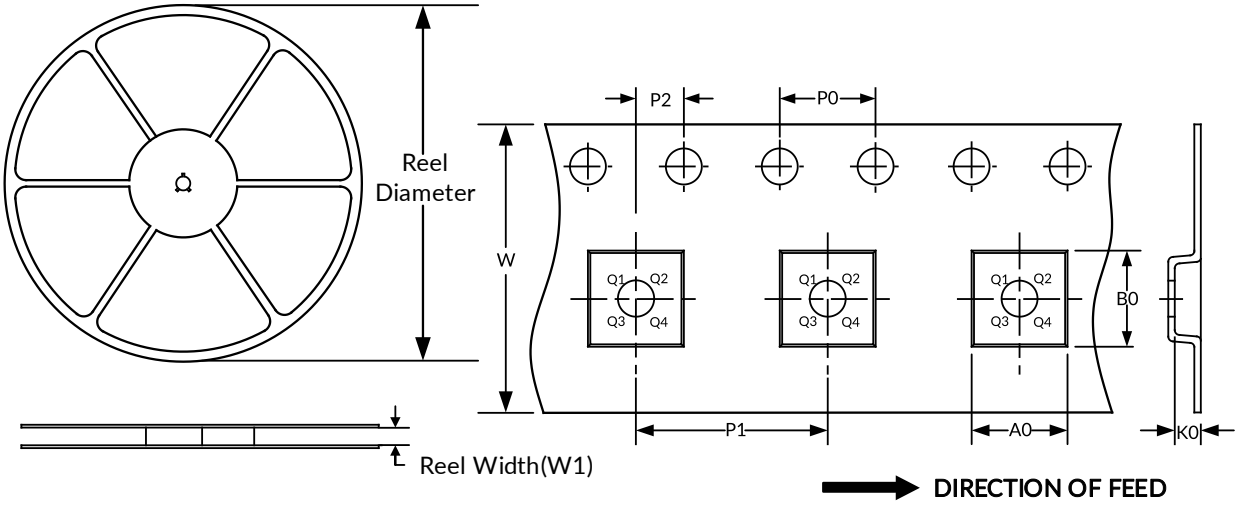
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. 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
TSSOP14	13”	12.4	6.95	5.60	1.20	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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