RSH4011 Quad 2-Input NAND Gate

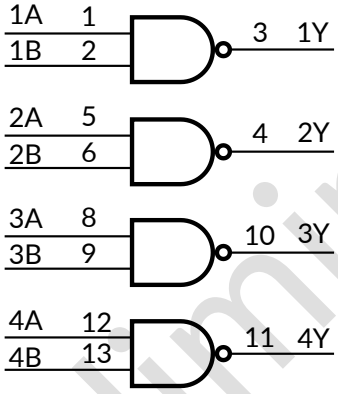
1 FEATURES

- **Fully Static Operation**
- **5V,10V and 15V Parametric Ratings**
- **Standardized Symmetrical Output Characteristics**
- **Operating Temperature Range: -40°C to +125°C**
- **Micro SIZE PACKAGES: SOP14**

2 APPLICATIONS

- **Wave and Pulse Shapers**
- **Monostable Multivibrators**
- **Astable Multivibrators**

Functional Block Diagram



3 DESCRIPTIONS

The RSH4011 is a quad 2-input NAND gate. The outputs are fully buffered for the highest noise immunity and pattern insensitivity to output impedance.

It operates over a recommended V_{CC} power supply range of 3 V to 15 V referenced to ground. Unused inputs must be connected to V_{CC}, GND, or another input.

The RSH4011 is available in Green SOP14 package. It operates over an ambient temperature range of -40°C to +125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RSH4011	SOP14	8.65mm×3.90mm

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

4 FUNCTION TABLE

INPUTS		OUTPUT
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

H=High Voltage Level
L=Low Voltage Level

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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	2026/09/04	Preliminary version completed

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6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL(3)	PACKAGE OPTION
RSH4011	RSH4011XP	-40°C ~+125°C	SOP14	RSH4011	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) 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.

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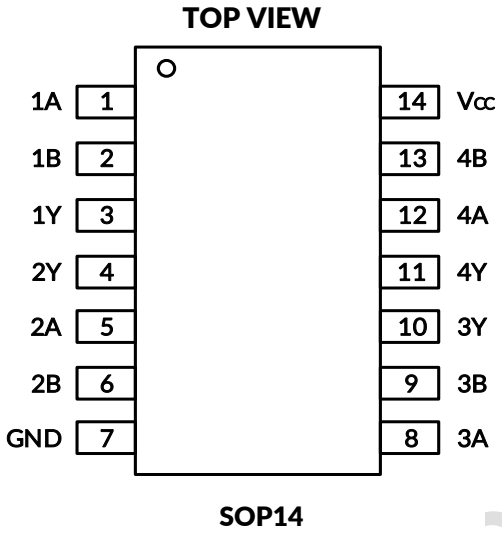
7 PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	I/O TYPE (1)	FUNCTION
SOP14			
1	1A	I	Input 1A
2	1B	I	Input 1B
3	1Y	O	Output 1Y
4	2Y	O	Output 2Y
5	2A	I	Input 2A
6	2B	I	Input 2B
7	GND	P	Ground (0V)
8	3A	I	Input 3A
9	3B	I	Input 3B
10	3Y	O	Output 3Y
11	4Y	O	Output 4Y
12	4A	I	Input 4A
13	4B	I	Input 4B
14	V_{CC}	P	Supply voltage

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

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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	18	V
V_I	Input voltage range (2)		-0.5	V_{CC}+0.5	V
Vo	Voltage range applied to any output in the high-impedance or power-off state (2)		-0.5	18	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<-0.5V		-50	mA
I_{OK}	Output clamp current	V_O<0 or V_O >V_{CC}+0.5V		±50	mA
I_O	Continuous output current			±25	mA
	Continuous current through V_{CC} or GND			±50	mA
θ_{JA}	Package thermal impedance (4)	SOP14		105	°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), MIL-STD-883K METHOD 3015.9	±2000	V
	Charged-device model (CDM), ANSI/ESDA/JEDEC JS-002-2018	±1000	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.

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9 ELECTRICAL CHARACTERISTICS

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

9.1 Recommended Operating Conditions

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Supply voltage	V_{CC}		3	15	V
Input voltage	V_I		0	15	V
Output voltage	V_O		0	V_{CC}	V
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.

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9.2 DC Characteristics

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

PARAMETER		TEST CONDITIONS	V_{CC}	TEMP	MIN(2)	TYP(3)	MAX(2)	UNIT
V_{IH}	HIGH-level input voltage	$\|I_O\|$ < 1 μA	5V	Full	3.5			V
			10V		7			
			15V		11			
V_{IL}	LOW-level input voltage	$\|I_O\|$ < 1 μA	5V	Full			1.5	V
			10V				3	
			15V				4	
V_{OH}		$\|I_O\|$ < 1 μA	3V to 15V	Full	V_{CC}-0.1			V
		I_{OH} = -0.36mA	5V		4.6			
		I_{OH} = -0.5mA			4.55			
		I_{OH} = -0.64mA			4.5			
		I_{OH} = -1.1mA			4.3			
		I_{OH} = -1.4mA			4.15			
		I_{OH} = -1.7mA			4			
		I_{OH} = -0.9mA	10V		9.55			
		I_{OH} = -1.3mA			9.35			
		I_{OH} = -1.6mA			9.2			
		I_{OH} = -2.5mA	15V		14.45			
		I_{OH} = -3.5mA			14.2			
		I_{OH} = -4.3mA			14			
V_{OL}		$\|I_O\|$ < 1 μA	3V to 15V	Full			0.1	V
		I_{OL} = 0.36mA	5V				0.4	
		I_{OL} = 0.5mA					0.45	
		I_{OL} = 0.64mA					0.5	
		I_{OL} = 1.1mA					0.55	
		I_{OL} = 1.4mA					0.6	
		I_{OL} = 1.7mA					0.7	
		I_{OL} = 0.9mA	10V				0.45	
		I_{OL} = 1.3mA					0.65	
		I_{OL} = 1.6mA					0.8	
		I_{OL} = 2.5mA	15V				0.55	
		I_{OL} = 3.5mA					0.8	
		I_{OL} = 4.2mA					1	
I_I	A input	V_I=15V or GND	15V	25°C		±0.05	±0.5	μA
				Full			±1	
I_{CC}		V_I=V_{CC} or GND, I_O=0A	5V	25°C		0.1	0.5	μA
				Full			5	
			10V	25°C		0.1	1.5	μA
				Full			15	
			15V	25°C		0.1	2	μA
				Full			20	

(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.

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(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

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP	MIN(2)	TYP(3)	MAX(2)	UNIT
HIGH to LOW propagation delay	t_{PHL}	V_{CC}=5V, C_L=50pF	Full		20	40	ns
		V_{CC}=10V, C_L=50pF			9.7	20	
		V_{CC}=15V, C_L=50pF			6	12	
LOW to HIGH propagation delay	t_{PLH}	V_{CC}=5V, C_L=50pF	Full		21	42	ns
		V_{CC}=10V, C_L=50pF			11	22	
		V_{CC}=15V, C_L=50pF			6	12	
HIGH to LOW output transition time	t_{THL}	V_{CC}=5V, C_L=50pF	Full		15.5	31	ns
		V_{CC}=10V, C_L=50pF			8	16	
		V_{CC}=15V, C_L=50pF			6.4	13	
LOW to HIGH output transition time	t_{TLH}	V_{CC}=5V, C_L=50pF	Full		15	33	ns
		V_{CC}=10V, C_L=50pF			8	16	
		V_{CC}=15V, C_L=50pF			7	14	
Input Capacitance	C_I	V_{CC}=5V	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) 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.

9.4 Dynamic Power Dissipation

$t_r = t_f \leq 20$ ns; T_A = 25°C.

PARAMETER	SYMBOL	Vcc	TYPICAL FORMULA	WHERE
Dynamic Power Dissipation	P_D	5V	$P_D = 155 \times f_i + \Sigma(f_o \times C_L) \times V_{CC}^2$ (μW)	f_i= input frequency in MHz; f_o = output frequency in MHz; C_L = output load capacitance in pF; $\Sigma(f_o \times C_L)$ = sum of the outputs; V_{CC} = supply voltage in V.
		10V	$P_D = 880 \times f_i + \Sigma(f_o \times C_L) \times V_{CC}^2$ (μW)	
		15V	$P_D = 3307.5 \times f_i + \Sigma(f_o \times C_L) \times V_{CC}^2$ (μW)	

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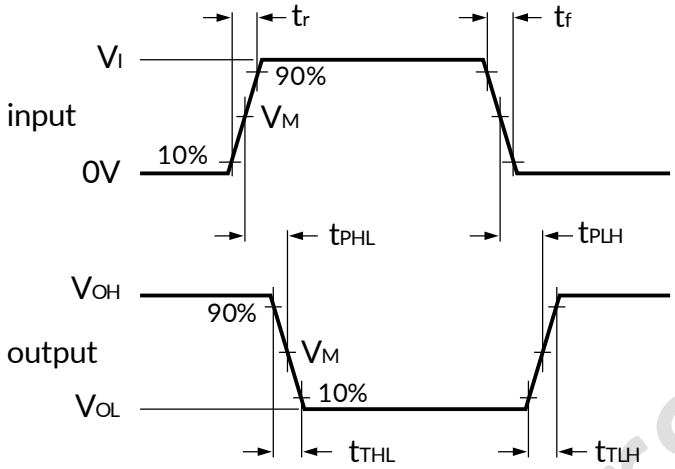
10 WAVEFORMS AND TEST CIRCUIT

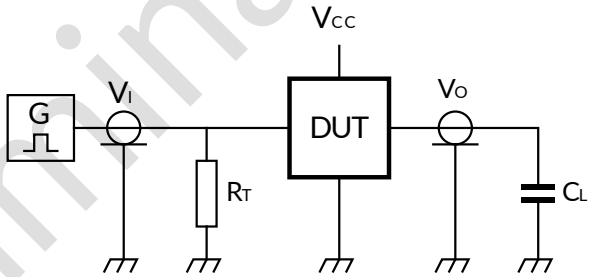


Measurement points are given in Table 1.
Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 1. Propagation delay and output transition time

Table 1. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
5 V to 15 V	0.5 V_{CC}	0.5 V_{CC}



Test data given in Table 2.
Definitions for test circuit:
DUT = Device Under Test.
C_L = load capacitance including jig and probe capacitance.
R_T = termination resistance should be equal to the output impedance Zo of the pulse generator.

Figure 2. Test circuit for measuring switching times

Table 2. Test data

Supply voltage	Input		Load
V_{CC}	V_I	t_r, t_f	C_L
5 V to 15 V	V_{CC} or GND	≤ 20 ns	50 pF

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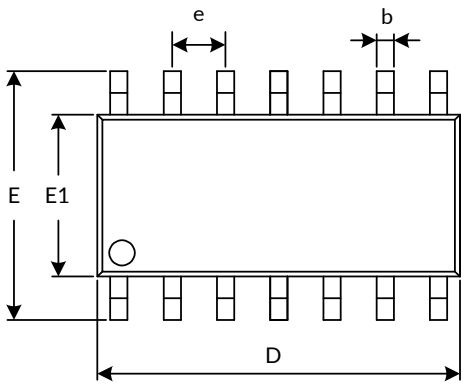
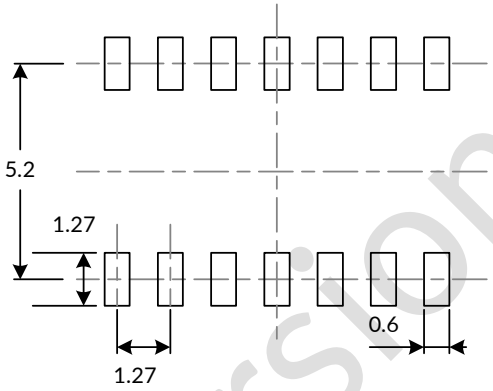
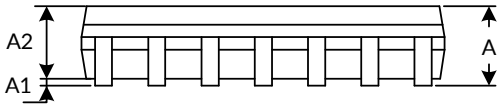
11 PACKAGE OUTLINE DIMENSIONS

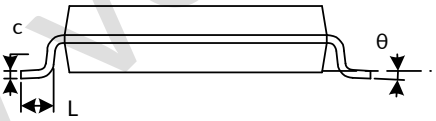
SOP14 (3)





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.750		0.069
A1	0.100	0.250	0.004	0.010
A2	1.300	1.500	0.051	0.059
b	0.390	0.470	0.015	0.019
c	0.200	0.240	0.008	0.009
D (1)	8.550	8.750	0.336	0.344
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	0.500	0.800	0.020	0.031
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.

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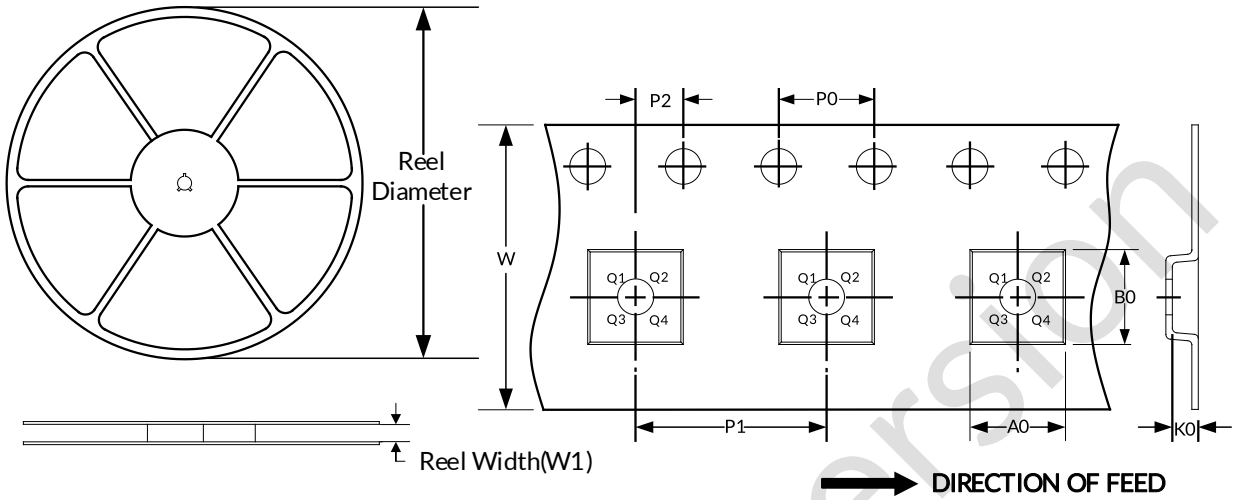
12 TAPE AND REEL INFORMATION

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
SOP14	13”	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	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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