2-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation and 3-State Outputs

FEATURES

- **Control Input threshold Referenced to V_{CCA} Voltage**
- **Power-Supply Range:**
  V_{CCA} and V_{CCB}: 1.65V to 5.5V
- **V_{CC} Isolation: If Either V_{CC} is at GND, Both Ports are in the High-Impedance State**
- **Low power consumption, 4uA Max**
- **Output drives up to ±24mA@3.0V**
- **No Power-Supply Sequencing Required: Either V_{CCA} or V_{CCB} can be Ramped First**
- **I_{OFF}: Supports Partial-Power-Down Mode Operation**
- **Extended Temperature: -40°C to +125°C**

APPLICATIONS

- **Industrial**
- **Enterprise**
- **Telecom, such as VOIP**
- **Personal electronic**

DESCRIPTION

The RS2T45 is 2-bit non-inverting bus transceiver uses two separate configurable power supply rails. The A port and DIR are designed to track V_{CCA}, which supporting operating voltages from 1.65V to 5.5V, and the B port supporting operating voltages from 1.65V to 5.5V while it tracks the V_{CCB} supply. This allows for universal low-voltage bidirectional translation between any of the 1.8V, 2.5V, 3.3V and 5V voltage nodes.

The RS2T45 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input activate either the B-port outputs or the A-port outputs. The device transmits data from the A bus to the B bus when the B-port outputs are activated and from the B bus to the A bus when the A-port outputs are activated. The input circuitry is always active on both A and B ports and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ}.

The RS2T45 is available in Green SOT23-8, MSOP-8 and VSSOP-8 packages. It operates over an ambient temperature range of -40°C to +125°C.

Functional Block Diagram
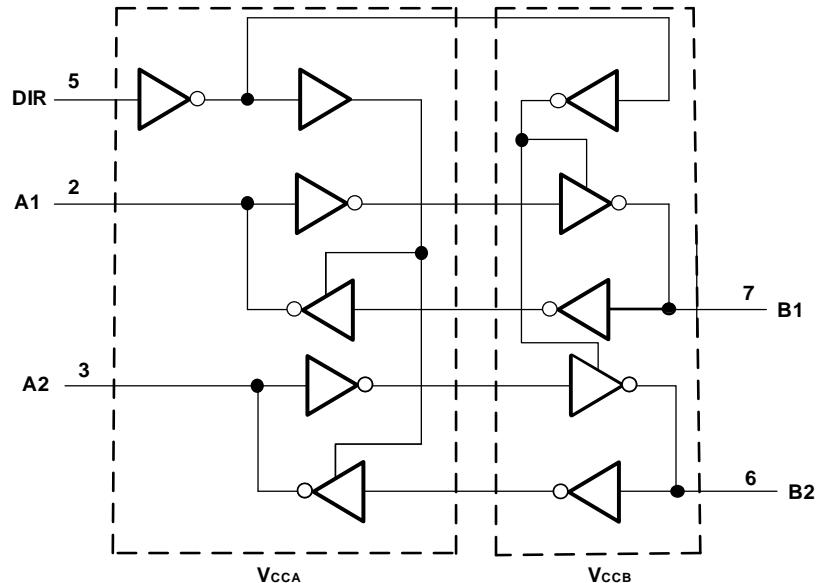
Revision History

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

VERSION	Change Date	Change Item
A.1	2020/11/29	Initial version completed

PIN CONFIGURATIONS

TOP VIEW

SOT23-8/MSOP-8/VSSOP-8
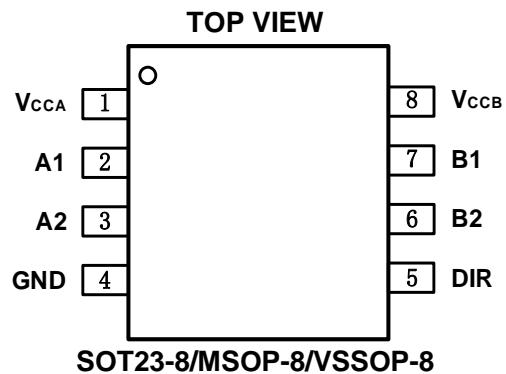
PIN DESCRIPTION

PIN	NAME	TYPE [1]	FUNCTION
SOT23-8/MSOP-8/VSSOP-8			
1	V_{CCA}	P	A Port Supply Voltage.1.65V ≤ V_{CCA} ≤ 5.5V
2	A1	I/O	Input/output A1. Reference to V_{CCA}.
3	A2	I/O	Input/output A2. Reference to V_{CCA}.
4	GND	–	Ground.
5	DIR	I	Direction control. Referenced to V_{CCA}.
6	B2	I/O	Input/output B2. Reference to V_{CCB}.
7	B1	I/O	Input/output B1. Reference to V_{CCB}.
8	V_{CCB}	P	B Port Supply Voltage.1.65V ≤ V_{CCB} ≤ 5.5V.

(1)   I=input, O=output, I/O=input and output, P=power

Function Table [2]

CONTROL INPUTS [1]	OUTPUT CIRCUITS		OPERATION
DIR [3]	A PORT	B PORT	
L	Enabled	Hi-Z	B data to A bus
H	Hi-Z	Enabled	A data to B bus

Note:
(1) The input circuit of the data I/O is always active.
(2) When either V_{CCA} or V_{CCB} is at GND level, the device goes into suspend mode.
(3) H=High voltage level, L=Low voltage level, X=don't care, Z=high-impedance OFF-state.

SPECIFICATIONS

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) [1]

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_{CCA}[3]	Supply Voltage Range		-0.5	6.5	V
V_{CCB}[3]	Supply Voltage Range		-0.5	6.5	V
V_I[2]	Input Voltage Range	A port	-0.5	6.5	V
		B port	-0.5	6.5	
V_O[2]	Voltage range applied to any output in the high-impedance or power-off state	A port	-0.5	V_{CCA}+0.5	V
		B port	-0.5	V_{CCB}+0.5	
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_{CCA}, V_{CCB} or GND			±100	mA
T_J	Junction Temperature			150	°C
T_{stg}	Storage temperature		-65	+150	

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	±3000	V
		Machine Model (MM)	±400	V

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING [1]	MSL [2]	PACKAGE OPTION
RS2T45	RS2T45XH8	-40°C ~+125°C	SOT23-8	2T45	MSL3	Tape and Reel,3000
	RS2T45XM	-40°C ~+125°C	MSOP-8	RS2T45	MSL3	Tape and Reel,4000
	RS2T45XVS8	-40°C ~+125°C	VSSOP-8	2T45	MSL3	Tape and Reel,3000

NOTE:

(1) 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.

(2) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

Recommended Operating Conditions

V_{CCI} is the supply voltage associated with the input port. V_{CCO} is the supply voltage associated with the output port.

PARAMETER		V_{CCI}[(1)]	V_{CCO}[(2)]	MIN	TYP	MAX	UNIT
Supply voltage [(1)]	V_{CCA}			1.65		5.5	V
	V_{CCB}			1.65		5.5	
High-level input Voltage (V_{IH})	A&B-port I/Os [(5)]	1.65V to 1.95V		V_{CCI} x0.65			V
		2.3V to 2.7V		1.7			
		3V to 3.6V		2			
		4.5V to 5.5V		V_{CCI} x0.7			
Low-level input Voltage (V_{IL})	A&B-port I/Os [(5)]	1.65V to 1.95V				V_{CCI} x0.35	V
		2.3V to 2.7V				0.7	
		3V to 3.6V				0.8	
		4.5V to 5.5V				V_{CCI} x0.3	
High-level input Voltage (V_{IH})	DIR (referenced to V_{CCA})[(6)]	1.65V to 1.95V		V_{CCA}x0.65			V
		2.3V to 2.7V		1.7			
		3V to 3.6V		2			
		4.5V to 5.5V		V_{CCA} x0.7			
Low-level input Voltage (V_{IL})	DIR (referenced to V_{CCA}) [(6)]	1.65V to 1.95V				V_{CCA} x0.35	V
		2.3V to 2.7V				0.7	
		3V to 3.6V				0.8	
		4.5V to 5.5V				V_{CCA} x0.3	
V_I	Input voltage			0		5.5	V
V_O	Output voltage			0		V_{CCO}	V
High-level output current (I_{OH})			1.65V to 1.95V			-4	mA
			2.3V to 2.7V			-8	
			3V to 3.6V			-24	
			4.5V to 5.5V			-32	
Low-level output current (I_{OL})			1.65V to 1.95V			4	mA
			2.3V to 2.7V			8	
			3V to 3.6V			24	
			4.5V to 5.5V			32	
Input transition rise or fall rate($\Delta t/\Delta v$)	Data inputs [(3)]	1.65V to 1.95V				20	ns/V
		2.3V to 2.7V				20	
		3V to 3.6V				10	
		4.5V to 5.5V				5	
	Control input	1.65 V to 5.5 V				5	
T_A Operating free-air temperature				-40		125	°C

(1) V_{CCI} is the V_{CC} associated with the data input port.
(2) V_{CCO} is the V_{CC} associated with the output port.
(3) All unused or driven (floating) data inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably V_{CCI} or GND) to ensure proper device operation and minimize power.
(4) All unused control inputs must be held at V_{CCA} or GND to ensure proper device operation and minimize power consumption.
(5) For V_{CCI} values not specified in the data sheet, V_{IH} min = V_{CCI} × 0.7 V, V_{IL} max = V_{CCI} × 0.3 V.
(6) For V_{CCA} values not specified in the data sheet, V_{IH} min = V_{CCA} × 0.7 V, V_{IL} max = V_{CCA} × 0.3 V.

Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted) [1] [2] [3]

PARAMETER		CONDITIONS	V_{CCA}	V_{CCB}	TEMP	MIN	TYP	MAX	UNIT
V_{OH}		$I_{OH} = -100\ \mu A\ \ V_I = V_{IH}$	1.65V to 4.5V	1.65V to 4.5V	Full	V_{CCO} - 0.1			V
		$I_{OH} = -4mA\ \ \ \ V_I = V_{IH}$	1.65V	1.65V		1.2			
		$I_{OH} = -8mA\ \ \ \ V_I = V_{IH}$	2.3V	2.3V		1.9			
		$I_{OH} = -24mA\ \ V_I = V_{IH}$	3V	3V		2.4			
		$I_{OH} = -32mA\ \ V_I = V_{IH}$	4.5V	4.5V		3.8			
V_{OL}		$I_{OL} = 100\ \mu A\ \ \ V_I = V_{IL}$	1.65V to 4.5V	1.65V to 4.5V				0.1	V
		$I_{OL} = 4mA\ \ \ \ \ \ V_I = V_{IL}$	1.65V	1.65V				0.45	
		$I_{OL} = 8mA\ \ \ \ \ \ V_I = V_{IL}$	2.3V	2.3V				0.3	
		$I_{OL} = 24mA\ \ \ \ V_I = V_{IL}$	3V	3V				0.55	
		$I_{OL} = 32mA\ \ \ \ V_I = V_{IL}$	4.5V	4.5V				0.55	
I_I	DIR Input leakage current	$V_I = V_{CCA}$ or GND	1.65V to 5.5V	1.65V to 5.5V	+25°C			±1	μA
					Full			±2	
I_{off}	A or B Port	V_I or V_O= 0 to 5.5V	0V	0V to 5.5V	+25°C			±1	μA
			0V to 5.5V	0V	Full			±2	
I_{OZ}	A or B Port	$V_O = V_{CCO}$ or GND	1.65V to 5.5V	1.65V to 5.5V	+25°C			±1	μA
					Full			±2	
I_{CCA}	V_{CCA} supply current	$V_I = V_{CCI}$ or GND $I_O = 0$	1.65V to 5.5V	2.3V to 5.5V	Full			3	μA
			5V	0V	Full			2	
			0V	5.5V	Full			-2	
I_{CCB}	V_{CCB} supply current	$V_I = V_{CCI}$ or GND $I_O = 0$	1.65V to 5.5V	1.65V to 5.5V	Full			3	μA
			5V	0V	Full			-2	
			0V	5V	Full			2	
I_{CCA} + I_{CCB}	Combined supply current	$V_I = V_{CCI}$ or GND $I_O = 0$	1.65V to 5.5V	1.65V to 5.5V	Full			4	μA
ΔI_{CCA}	A port	One A port at V_{CCA} – 0.6 V, DIR at V_{CCA}, B port = open	3V to 5.5V	3V to 5.5V	Full			50	μA
	DIR	DIR at V_{CCA} – 0.6 V, B port = open A port at V_{CCA} or GND			Full			50	μA
ΔI_{CCB}	B port	One B port at V_{CCB} – 0.6 V, DIR at GND, A port = open	3V to 5.5V	3V to 5.5V	Full			50	μA
C_I	Input capacitance	DIR input $V_I = V_{CCA}$ or GND	3.3V	3.3V	+25°C		4		pF
C_{IO}	Input-to-output internal capacitance	A port $V_O = V_{CCA}$ or GND	3.3V	3.3V	+25°C		8.5		pF
		B port $V_O = V_{CCB}$ or GND	3.3V	3.3V	+25°C		8.5		

(1) V_{CCI} is the V_{CC} associated with the input port.
(2) V_{CCO} is the V_{CC} associated with the output port.

Timing Requirements

V_{CCA}=1.8V±0.15 V

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=1.8V ±0.15V		V_{CCB}=2.5V ±0.2V		V_{CCB}=3.3V ±0.3V		V_{CCB}=5V ±0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	3	17.5	2	9.3	1.5	7.5	1.8	9.1	ns
t_{PHL}			2	10.3	1.7	6.4	1.1	4.5	2.4	9.8	
t_{PLH}	B	A	2.3	13.8	2	14.1	1.9	14	1.9	15.1	ns
t_{PHL}			2.2	11	1.9	11.6	1.8	11.6	2.2	14.7	
t_{PHZ}	DIR	A	4	14.7	3.8	14.8	4.6	17.9	6.6	22.2	ns
t_{PLZ}			2.5	11.6	2.5	12.6	6.8	30.5	5.3	18.5	
t_{PHZ}	DIR	B	5.6	16.6	3.9	9.2	4.5	10	3.6	10.7	ns
t_{PLZ}			4.6	17.6	4.4	11	9.4	23.9	4.1	10.1	
t_{PZH}	DIR	A		29.7		22.2		20.1		17.6	ns
t_{PZL}				19.2		17.1		18.1		18.4	
t_{PZH}	DIR	B		24.8		18.3		16		14.8	ns
t_{PZL}				17.9		18.9		20.1		21.7	

V_{CCA}=2.5V±0.2 V

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB}=1.8V ±0.15V		V_{CCB}=2.5V ±0.2V		V_{CCB}=3.3V ±0.3V		V_{CCB}=5V ±0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2.2	15.2	1.3	7.6	1.4	7	1.1	5.1	ns
t_{PHL}			1.7	10.5	1.4	7.3	1.4	5.9	0.9	4.5	
t_{PLH}	B	A	1.8	8.2	1.4	7.7	1.4	8	0.9	6.8	ns
t_{PHL}			2	7.7	1.6	8.8	2	10.5	1.3	8.7	
t_{PHZ}	DIR	A	9.9	26.7	9.9	25.9	12.6	36.5	12.2	30.8	ns
t_{PLZ}			7.5	33.9	7.4	33.6	6.5	29.5	3.8	21.8	
t_{PHZ}	DIR	B	21.5	78.2	13	36.5	17.6	45.9	9.1	27	ns
t_{PLZ}			22.4	108.7	18.2	54.7	14	42	6.8	20	
t_{PZH}	DIR	A		29.2		16.3		14.3		10.2	ns
t_{PZL}				16.1		13.2		13.8		12.9	
t_{PZH}	DIR	B		21.9		13		10.7		8.7	ns
t_{PZL}				10.5		11		10.8		12.3	

V_CCA=3.3V±0.3 V

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_CCB=1.8V ±0.15V		V_CCB=2.5V ±0.2V		V_CCB=3.3V ±0.3V		V_CCB=5V ±0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_PLH	A	B	2.1	15.5	1.4	8	0.8	6.7	0.6	4.3	ns
t_PHL			1.9	11.8	1.3	7	0.9	5.9	0.9	5.2	
t_PLH	B	A	1.5	7.5	1	5.1	0.8	7	0.7	5.9	ns
t_PHL			1.6	6.4	1.8	7.6	0.8	5	1.4	9	
t_PHZ	DIR	A	3.5	8.8	3	7.3	3.6	9.5	5.8	12.4	ns
t_PLZ			2.7	8.4	1.6	5.6	3.5	9.1	2.6	6.8	
t_PHZ	DIR	B	6.8	25	3.8	10	3.8	11.4	4.1	11.6	ns
t_PLZ			5	21.8	2.9	7.8	3.8	11.4	2	5.9	
t_PZH	DIR	A		25.1		12.8		11.2		8.2	ns
t_PZL				12.7		10.1		10.4		10.1	
t_PZH	DIR	B		23.2		12.2		10		8.1	ns
t_PZL				9.2		9.3		9.2		10.2	

V_CCA=5V±0.5 V

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_CCB=1.8V ±0.15V		V_CCB=2.5V ±0.2V		V_CCB=3.3V ±0.3V		V_CCB=5V ±0.5V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_PLH	A	B	2.1	16.6	1	7.4	0.6	5.2	0.7	5.1	ns
t_PHL			1.8	12.2	0.9	6.2	1.1	7.2	0.8	5.6	
t_PLH	B	A	1.4	7.2	1	5.1	0.8	5.3	0.7	5.5	ns
t_PHL			1.5	6.3	1.1	5.8	0.9	5.2	1	7	
t_PHZ	DIR	A	4.6	11.9	2.6	6.3	5.8	14.6	5.8	14.3	ns
t_PLZ			2.7	11.2	5.9	22.4	4.2	15.7	7.4	30.3	
t_PHZ	DIR	B	10.6	44.4	2.9	11.5	2.6	22.5	6.6	17.2	ns
t_PLZ			12.4	43.7	14.8	43.7	10.6	29.8	13.1	36.9	
t_PZH	DIR	A		24.2		6.3		8		6.7	ns
t_PZL				10.9		8.6		9.5		9	
t_PZH	DIR	B		20.8		5.5		6.4		6.1	ns
t_PZL				7		7		7.6		7.7	

Operating Characteristics

T_A=25°C

PARAMETER [1]		CONDITIONS	V_CCA=V_CCB =1.8V	V_CCA=V_CCB =2.5V	V_CCA=V_CCB =3.3V	V_CCA=V_CCB =5V	UNIT
			TYP	TYP	TYP	TYP	
C_pdA	A port input B port output	C_L=0pF f=10MHz t_r=t_f=1ns	2	2	2	3	pF
	B port input A port output		12	13	13	16	
C_pdB	A port input B port output	C_L=0pF f=10MHz t_r=t_f=1ns	13	13	14	16	pF
	B port input A port output		2	2	2	3	

(1) Power dissipation capacitance per transceiver

Typical Characteristics
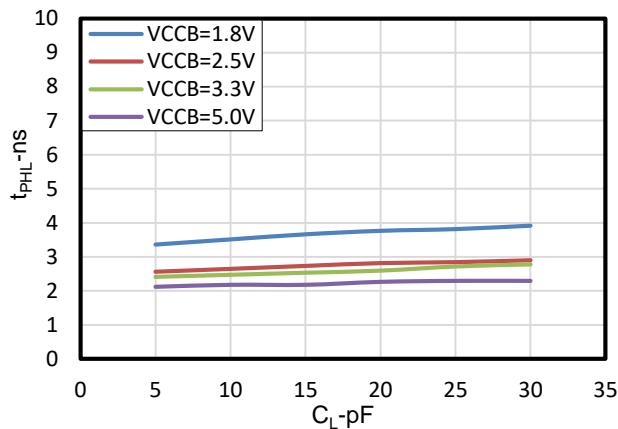

T_A = 25°C, V_{CCA} = 1.8 V
Figure 1. Typical Propagation Delay of High-to-Low (A to B) vs Load Capacitance
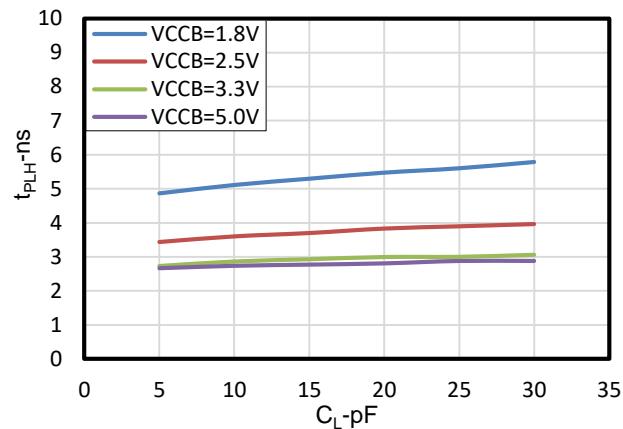
T_A = 25°C, V_{CCA} = 1.8 V
Figure 2. Typical Propagation Delay Low-to-High (B to A) vs Load Capacitance
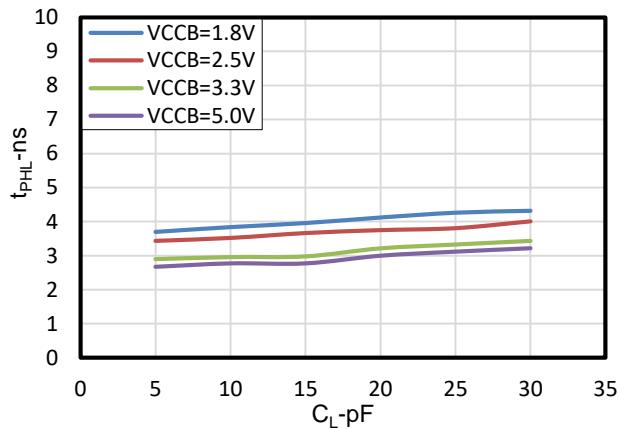
T_A = 25°C, V_{CCA} = 2.5 V
Figure 3. Typical Propagation Delay High-to-Low (A to B) vs Load Capacitance
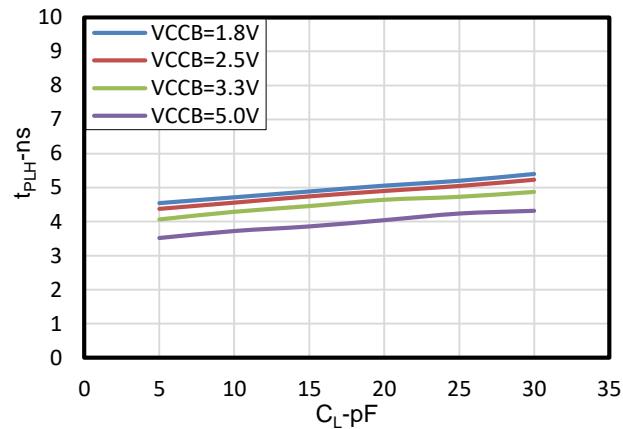
T_A = 25°C, V_{CCA} = 2.5 V
Figure 4. Typical Propagation Delay Low-to-High (B to A) vs Load Capacitance
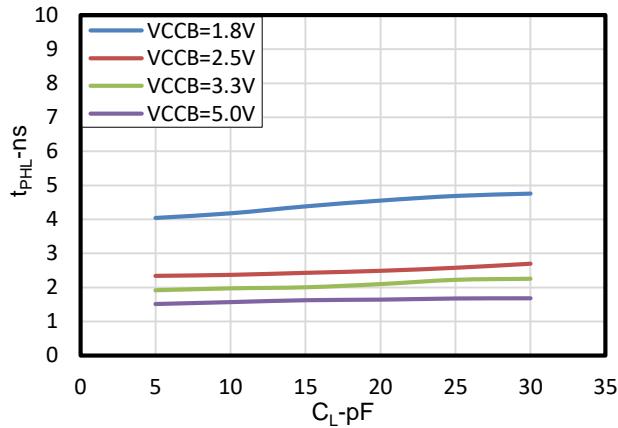
T_A = 25°C, V_{CCA} = 3.3 V
Figure 5. Typical Propagation Delay High-to-Low (A to B) vs Load Capacitance
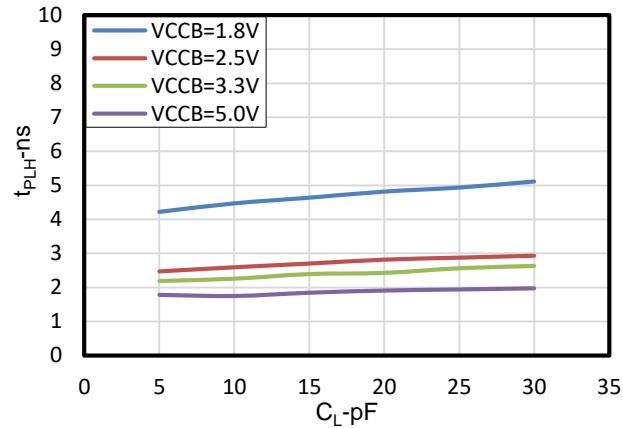
T_A = 25°C, V_{CCA} = 3.3 V
Figure 6. Typical Propagation Delay Low-to-High (B to A) vs Load Capacitance
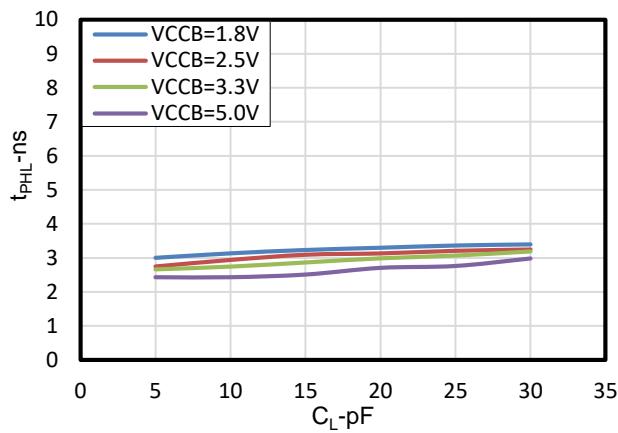
T_A = 25°C, V_{CCA} = 5 V
Figure 7. Typical Propagation Delay High-to-Low (A to B) vs Load Capacitance
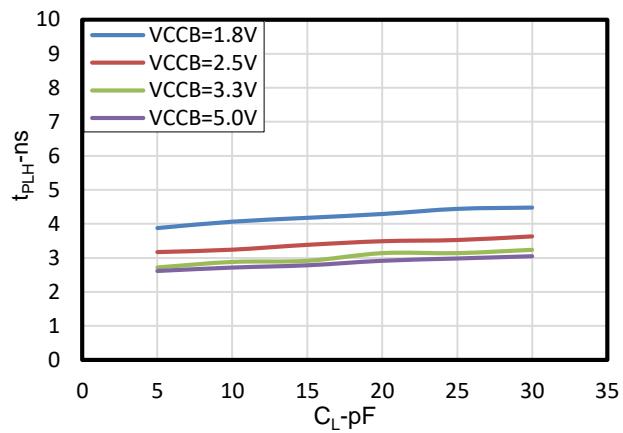
T_A = 25°C, V_{CCA} = 5 V
Figure 8. Typical Propagation Delay Low-to-High (B to A) vs Load Capacitance

Parameter Measurement Information
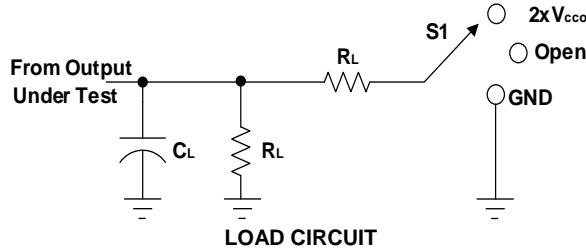
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 X V_{CCO}
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT

V_{CC}	C_L	R_L	V_{TP}
1.8V±0.15V	15pF	2kΩ	0.15V
2.5V±0.2V	15pF	2kΩ	0.15V
3.3V±0.3V	15pF	2kΩ	0.3V
5V±0.5V	15pF	2kΩ	0.3V
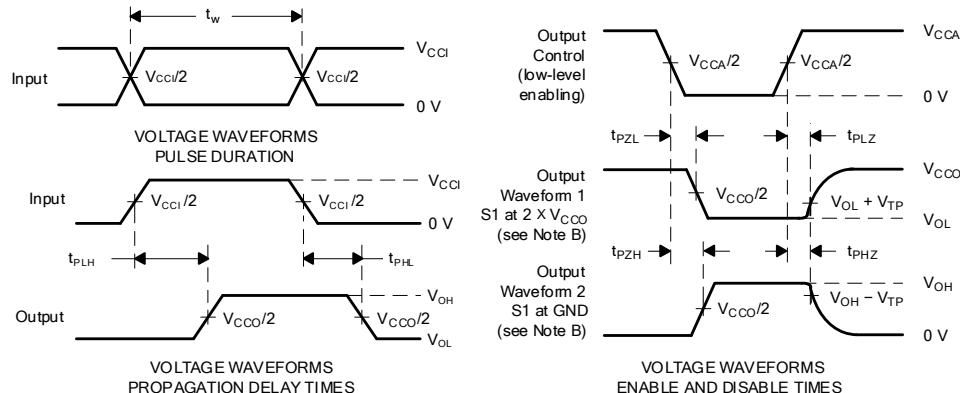
NOTES: A. C_L includes probe and jig capacitance.

    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，dv/dt≥1V/ns.

    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. V_{CCI} is the V_{CC} associated with the input port.

    I. All parameters and waveforms are not applicable to all devices.

Figure 9. Load Circuit and Voltage Waveforms

Application Information

The RS2T45 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The maximum output current can be up to 32 mA when device is powered by 5 V.
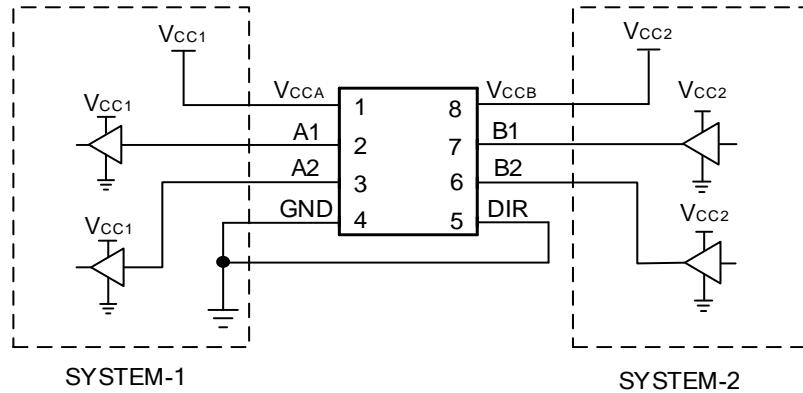

**Figure 10. Unidirectional Logic Level-Shifting Application (B to A)**
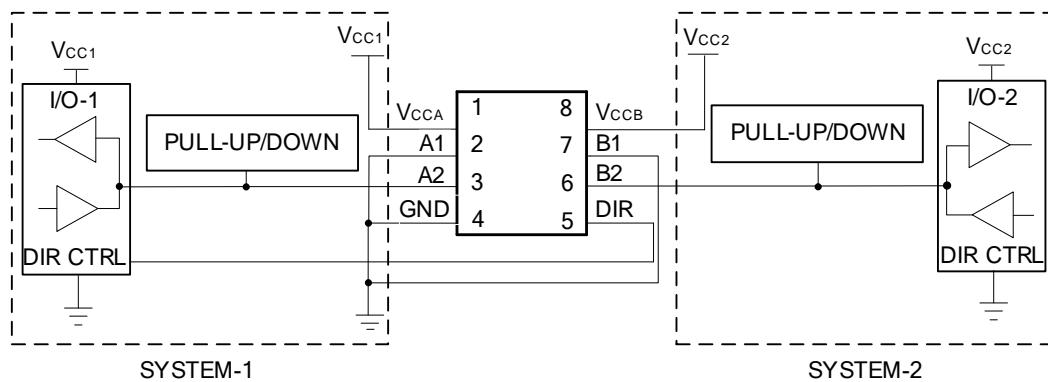
Figure 11. Bidirectional Logic Level-Shifting Application (B to A or A to B)

PACKAGE OUTLINE DIMENSIONS
SOT23-8
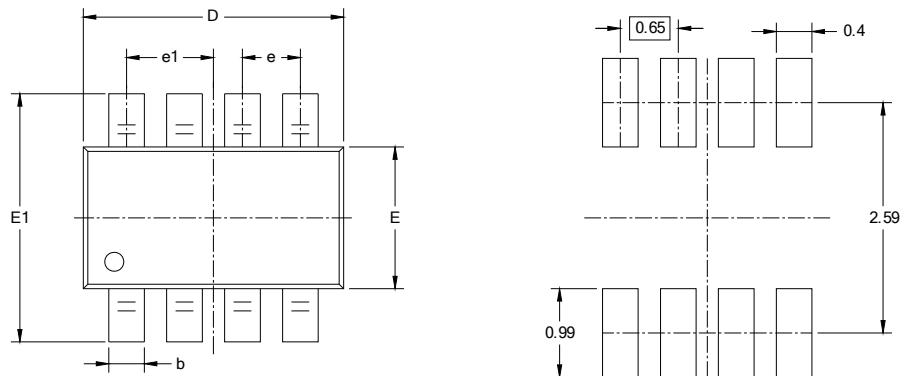
RECOMMENDED LAND PATTERN (Unit: mm)
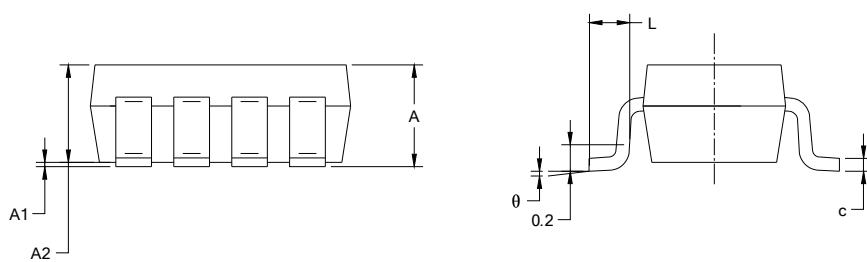
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.650(BSC)		0.026(BSC)	
e1	0.975(BSC)		0.038(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

MSOP-8
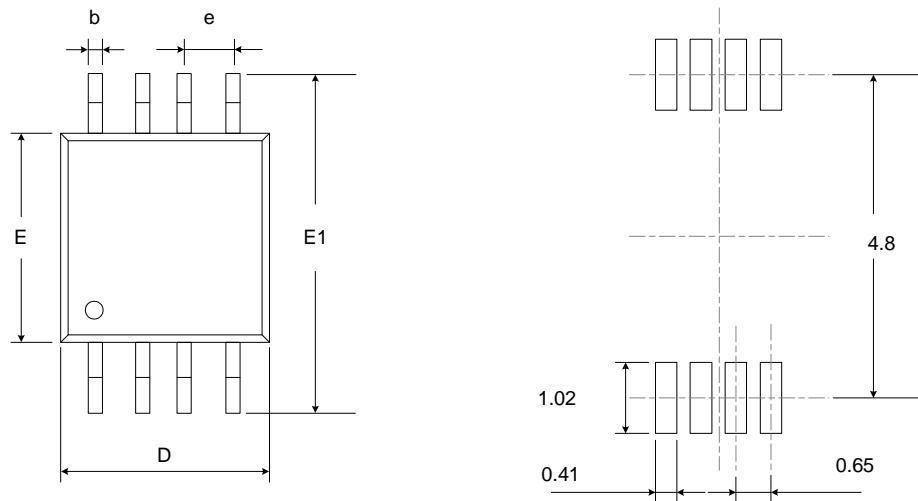
RECOMMENDED LAND PATTERN (Unit: mm)
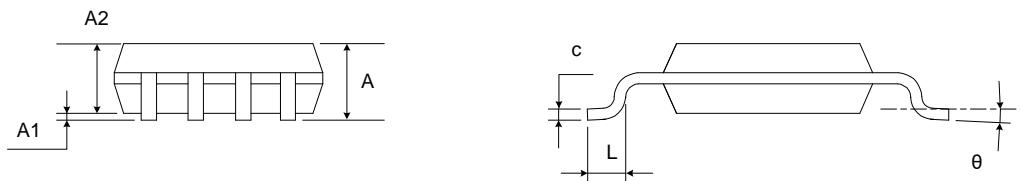
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

VSSOP-8
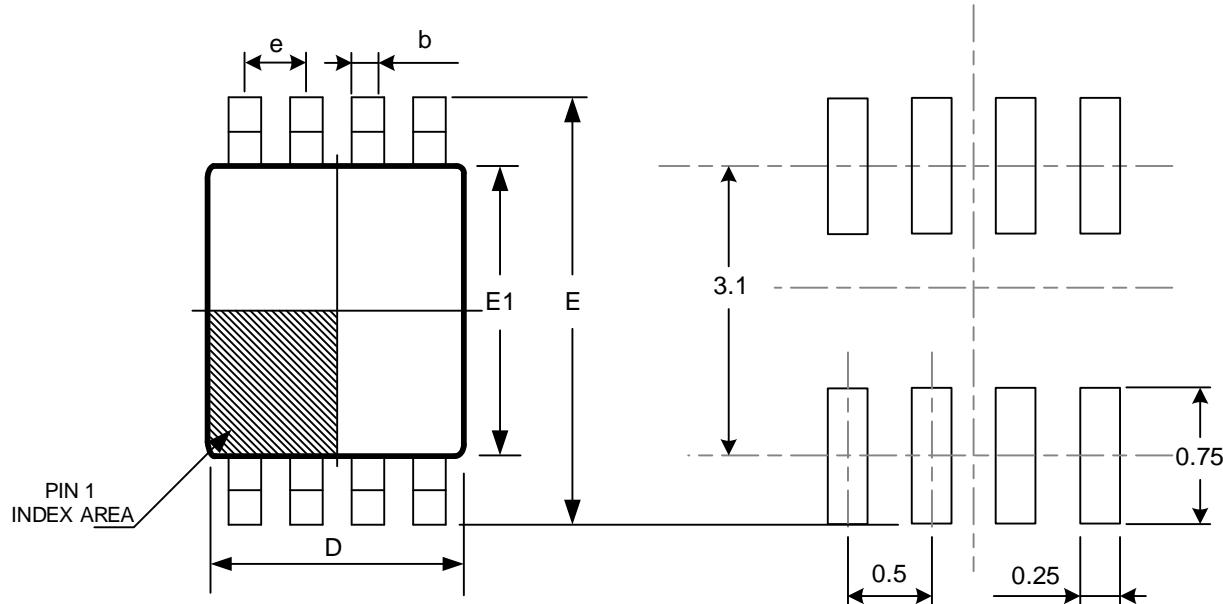
RECOMMENDED LAND PATTERN (Unit: mm)
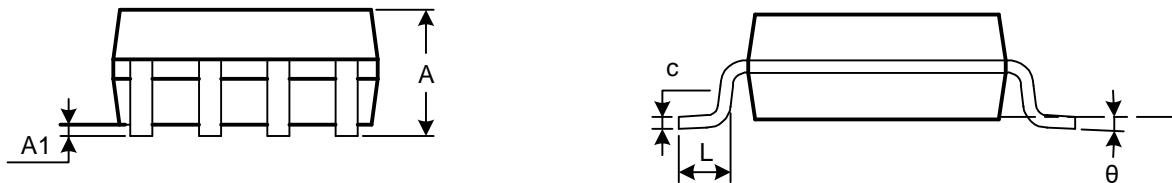
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.600	0.900	0.024	0.085
A1	0.000	0.100	0.000	0.004
b	0.170	0.250	0.007	0.010
c	0.100	0.200	0.004	0.008
D	1.900	2.100	0.075	0.083
e	0.500 (BSC)		0.020 (BSC)	
E	3.000	3.200	0.118	0.126
E1	2.200	2.400	0.087	0.095
L	0.200	0.350	0.008	0.014
θ	0°	6°	0°	6°

TAPE AND REEL INFORMATION

REEL DIMENSIONS
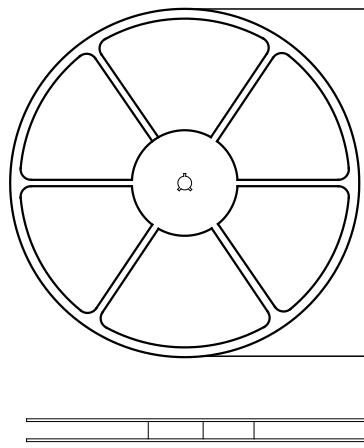
TAPE DIMENSION
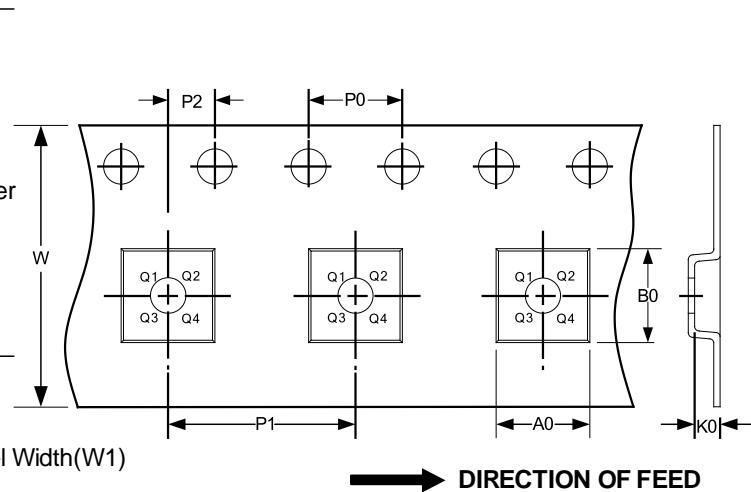
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOT23-8	7''	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
MSOP-8	13''	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1
VSSOP-8	7''	9.5	2.25	3.35	1.40	4.0	4.0	2.0	8.0	Q3

单击下面可查看定价，库存，交付和生命周期等信息

>>Runic(润石)