

8-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation and 3-State Output

FEATURES

- **Control Input V_{IH}/V_{IL} Levels are Referenced to V_{CCA} Voltage**
- **Power-Supply Range: V_{CCA} and V_{CCB} : 1.65V to 5.5V**
- **Latch-up performance exceeds 100mA per JESD 78, Class II**
- **V_{CC} Isolation: If Either V_{CC} is at GND, Both Ports are in the High-Impedance State**
- **I_{OFF} : Supports Partial-Power-Down Mode Operation**
- **Extended Temperature: -40°C to +125°C**

APPLICATIONS

- Handset
- Smartphone
- Tablet
- Desktop PC

DESCRIPTION

This 8-bit non-inverting bus transceiver is a bidirectional voltage-level translator and can be used to establish digital switching compatibility between mixed-voltage systems. It uses two separate configurable power-supply rails, Both $V_{CC(A)}$ and $V_{CC(B)}$ supporting operating voltages from 1.65 V to 5.5 V, A ports, DIR and \overline{OE} tracks the V_{CCA} supply and B ports tracks the V_{CCB} supply. This allows the support of both lower and higher logic signal levels while providing bidirectional translation capabilities between any of the 1.8V, 2.5V, 3.3V and 5.5V voltage nodes.

The RS8T245 is designed for asynchronous communication between two data buses. The logic levels of the direction-control (DIR) input and the output-enable (\overline{OE}) input activate either the B-port outputs or the A-port outputs or place both output ports into the high-impedance mode. 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 on both A and B ports is always active and must have a logic HIGH or LOW level applied to prevent excess I_{CC} and I_{CCZ} .

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.

The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, all 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, the minimum value of the resistor is determined by the current-sinking capability of the driver.

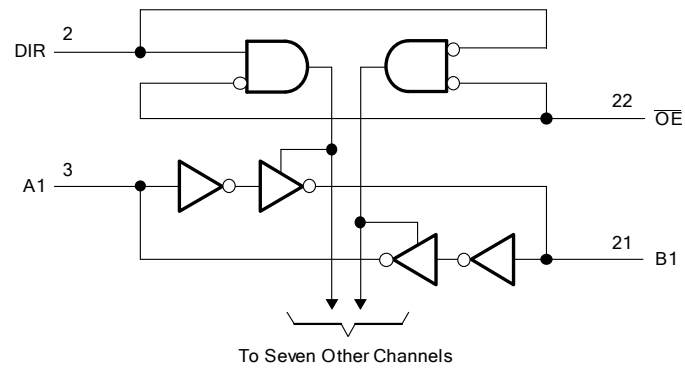
The RS8T245 is designed so that the control pins (DIR and \overline{OE}) are supplied by V_{CCA} . It operates over an ambient temperature range of -40°C to +125°C.

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS8T245	TSSOP24(24)	7.80mm × 4.40mm
	SOP24(24)	15.40mm × 7.50mm

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

Functional Block Diagram



Function Table

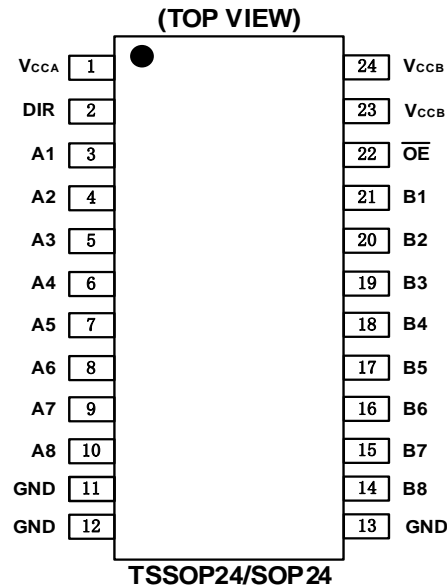
CONTROL INPUTS		OUTPUT CIRCUITS		OPERATION
\overline{OE}	DIR	A PORT	B PORT	
L	L	Enabled	Hi-Z	B data to A bus
L	H	Hi-Z	Enabled	A data to B bus
H	X	Hi-Z	Hi-Z	Isolation

Revision History

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

VERSION	Change Date	Change Item
A.0	2020/08/01	Initial version completed
A.1	2021/03/25	Add SOP24 package
A.2	2021/07/14	Changed TSSOP24 Package quantities in Page 7 @ A.1 Version

PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	TYPE ⁽¹⁾	FUNCTION
TSSOP24/SOP24			
3	A1	I/O	Input/output A1. Reference to V _{CCA} .
4	A2	I/O	Input/output A2. Reference to V _{CCA} .
5	A3	I/O	Input/output A3. Reference to V _{CCA} .
6	A4	I/O	Input/output A4. Reference to V _{CCA} .
7	A5	I/O	Input/output A5. Reference to V _{CCA} .
8	A6	I/O	Input/output A6. Reference to V _{CCA} .
9	A7	I/O	Input/output A7. Reference to V _{CCA} .
10	A8	I/O	Input/output A8. Reference to V _{CCA} .
14	B8	I/O	Input/output B8. Reference to V _{CCB} .
15	B7	I/O	Input/output B7. Reference to V _{CCB} .
16	B6	I/O	Input/output B6. Reference to V _{CCB} .
17	B5	I/O	Input/output B5. Reference to V _{CCB} .
18	B4	I/O	Input/output B4. Reference to V _{CCB} .
19	B3	I/O	Input/output B3. Reference to V _{CCB} .
20	B2	I/O	Input/output B2. Reference to V _{CCB} .
21	B1	I/O	Input/output B1. Reference to V _{CCB} .
2	DIR	I	Direction-control signal.
11,12,13	GND	G	Ground.
22	\overline{OE}	I	Output Enable (Active Low). Pull \overline{OE} high to place all outputs in 3-state mode. Referenced to V _{CCA} .
1	V _{CCA}	P	A-port supply voltage. $1.65V \leq V_{CCA} \leq 5.5V$
23,24	V _{CCB}	P	B-port supply voltage. $1.65V \leq V_{CCB} \leq 5.5V$

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

SPECIFICATIONS

Absolute Maximum Ratings

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

SYMBOL	PARAMETER		MIN	MAX	UNIT
V _{CCA}	Supply Voltage Range		-0.5	6.5	V
V _{CCB}	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	
		Control inputs	-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	6.5	V
		B port	-0.5	6.5	
V _O ⁽²⁾⁽³⁾	Voltage range applied to any output in the high or low 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

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}	V_{CCO}	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})	Data inputs (5)	1.65V to 1.95V		$V_{CCI} \times 0.65$			V
		2.3V to 2.7V		1.7			
		3V to 3.6V		2			
		4.5V to 5.5V		$V_{CCI} \times 0.7$			
Low-level input Voltage (V_{IL})	Data inputs (5)	1.65V to 1.95V				$V_{CCI} \times 0.35$	V
		2.3V to 2.7V				0.7	
		3V to 3.6V				0.8	
		4.5V to 5.5V				$V_{CCI} \times 0.3$	
High-level input Voltage (V_{IH})	Control inputs (referenced to V_{CCA}) (6)	1.65V to 1.95V		$V_{CCA} \times 0.65$			V
		2.3V to 2.7V		1.7			
		3V to 3.6V		2			
		4.5V to 5.5V		$V_{CCA} \times 0.7$			
Low-level input Voltage (V_{IL})	Control inputs (referenced to V_{CCA}) (6)	1.65V to 1.95V				$V_{CCA} \times 0.35$	V
		2.3V to 2.7V				0.7	
		3V to 3.6V				0.8	
		4.5V to 5.5V				$V_{CCA} \times 0.3$	
Input voltage (V_i)	Control inputs			0		5.5	V
Input/output voltage (V_{IO})	Active state			0		V_{CCO}	V
	3-state			0		5.5	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	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	
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, $V_{IH \text{ min}} = V_{CCI} \times 0.7 \text{ V}$, $V_{IL \text{ max}} = V_{CCI} \times 0.3 \text{ V}$.

(6) For V_{CCA} values not specified in the data sheet, $V_{IH \text{ min}} = V_{CCA} \times 0.7 \text{ V}$, $V_{IL \text{ max}} = V_{CCA} \times 0.3 \text{ V}$.

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING ⁽¹⁾	MSL ⁽²⁾	PACKAGE OPTION
RS8T245	RS8T245YTSS24	-40°C ~+125°C	TSSOP24	RS8T245	MSL3	Tape and Reel,4000
	RS8T245YS24	-40°C ~+125°C	SOP24	RS8T245	MSL3	Tape and Reel,1200

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.

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 μA 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 μA V _I = V _{IL}	1.65V to 4.5V	1.65V to 4.5V	Full			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		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, \overline{OE} = V _{IH}	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	1.65V to 5.5V	Full			15	μA
			5V	0V	Full			15	
			0V	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			15	μA
			5V	0V	Full			-2	
			0V	5V	Full			15	
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			25	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	
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 Control inputs		V _I = V _{CCA} or GND	3.3V	3.3V	+25°C		4		pF
C _{IO}	A port		3.3V	3.3V	+25°C		8.5		pF
	B port		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.

Switching Characteristics

 $V_{CCA}=1.8V\pm 0.15V$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	An	Bn	1.7	21.6	1.3	9.1	1.0	7.4	0.8	7.1	ns
t _{PHL}											
t _{PLH}	Bn	An	0.9	23.5	0.8	23.6	0.7	23.3	0.7	23.3	ns
t _{PHL}											
t _{PHZ}	\overline{OE}	An	1.5	29.5	1.5	29.4	1.5	29.3	1.4	29.1	ns
t _{PLZ}											
t _{PHZ}	\overline{OE}	Bn	2.4	32.2	1.9	12.9	1.7	12.0	1.3	10.2	ns
t _{PLZ}											
t _{PZH}	\overline{OE}	An	0.4	23.8	0.4	23.7	0.4	23.7	0.4	23.7	ns
t _{PZL}											
t _{PZH}	\overline{OE}	Bn	1.8	31.9	1.5	16	1.2	12.6	0.9	10.8	ns
t _{PZL}											

 $V_{CCA}=2.5V\pm 0.2V$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	An	Bn	1.5	21.2	1.2	9.0	0.8	6.7	0.6	4.8	ns
t _{PHL}											
t _{PLH}	Bn	An	1.2	9.2	1.0	9.0	1.0	8.9	0.9	8.8	ns
t _{PHL}											
t _{PHZ}	\overline{OE}	An	1.4	8.8	1.4	8.9	1.4	8.8	1.4	8.8	ns
t _{PLZ}											
t _{PHZ}	\overline{OE}	Bn	2.3	29.6	1.8	11.0	1.7	9.3	0.9	6.9	ns
t _{PLZ}											
t _{PZH}	\overline{OE}	An	1.0	10.8	1.0	10.9	1.0	10.9	1.0	10.9	ns
t _{PZL}											
t _{PZH}	\overline{OE}	Bn	1.7	28.2	1.5	12.9	1.2	9.4	1.0	6.9	ns
t _{PZL}											

Switching Characteristics

 $V_{CCA}=3.3V\pm 0.3V$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	An	Bn	1.5	21.2	1.1	8.8	0.8	6.3	0.5	5.1	ns
t_{PHL}											
t_{PLH}	Bn	An	0.8	7.2	0.8	6.2	0.7	6.1	0.6	6.0	ns
t_{PHL}											
t_{PHZ}	\overline{OE}	An	1.6	8.2	1.6	8.2	1.6	8.2	1.6	8.2	ns
t_{PLZ}											
t_{PHZ}	\overline{OE}	Bn	2.1	29.0	1.7	10.3	1.5	8.5	0.8	6.3	ns
t_{PLZ}											
t_{PZH}	\overline{OE}	An	0.8	8.1	0.8	8.1	0.8	8.1	0.8	8.1	ns
t_{PZL}											
t_{PZH}	\overline{OE}	Bn	1.8	27.7	1.4	12.4	1.1	8.5	0.9	6.4	ns
t_{PZL}											

 $V_{CCA}=5V\pm 0.5V$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB}=1.8V \pm 0.15V$		$V_{CCB}=2.5V \pm 0.2V$		$V_{CCB}=3.3V \pm 0.3V$		$V_{CCB}=5V \pm 0.5V$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	An	Bn	1.5	21.3	1.0	8.8	0.7	6.0	0.4	4.2	ns
t_{PHL}											
t_{PLH}	Bn	An	0.7	7.0	0.4	4.8	0.3	4.5	0.3	4.3	ns
t_{PHL}											
t_{PHZ}	\overline{OE}	An	0.3	5.4	0.3	5.4	0.3	5.4	0.3	5.4	ns
t_{PLZ}											
t_{PHZ}	\overline{OE}	Bn	2.0	28.7	1.6	9.6	1.4	8.0	0.7	5.6	ns
t_{PLZ}											
t_{PZH}	\overline{OE}	An	0.7	6.3	0.7	6.3	0.7	6.3	0.7	6.3	ns
t_{PZL}											
t_{PZH}	\overline{OE}	Bn	1.5	27.6	1.3	11.4	1.0	8.1	0.9	6.0	ns
t_{PZL}											

Operating Characteristics

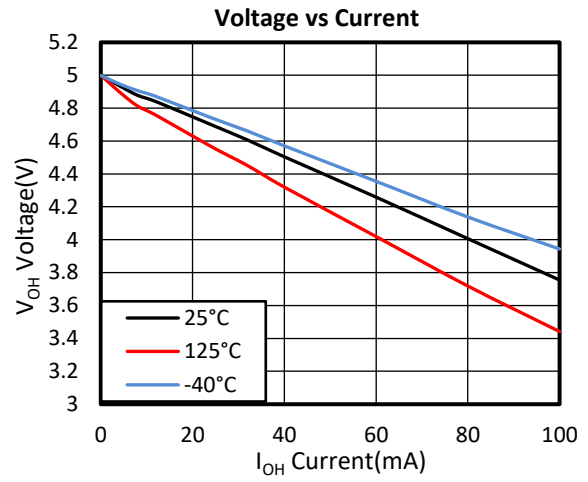
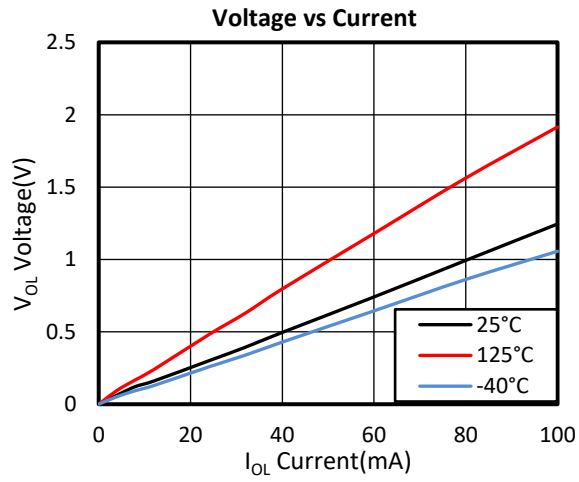
 $T_A=25^\circ C$

PARAMETER	TEST 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					
$C_{pdA}^{(1)}$	A-port input, B-port output	2	2	2	3	pF				
	B-port input, A-port output									
$C_{pdB}^{(1)}$	A-port input, B-port output						12	13	13	16
	B-port input, A-port output						13	13	14	16
		2	2	2	3					

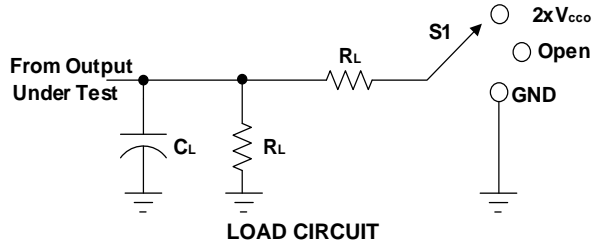
(1) Power dissipation capacitance per transceiver

Typical Characteristics

At $T_A = +25^\circ\text{C}$, $V_{CCA}=5\text{V}$, $V_{CCB}=5\text{V}$, unless otherwise noted.

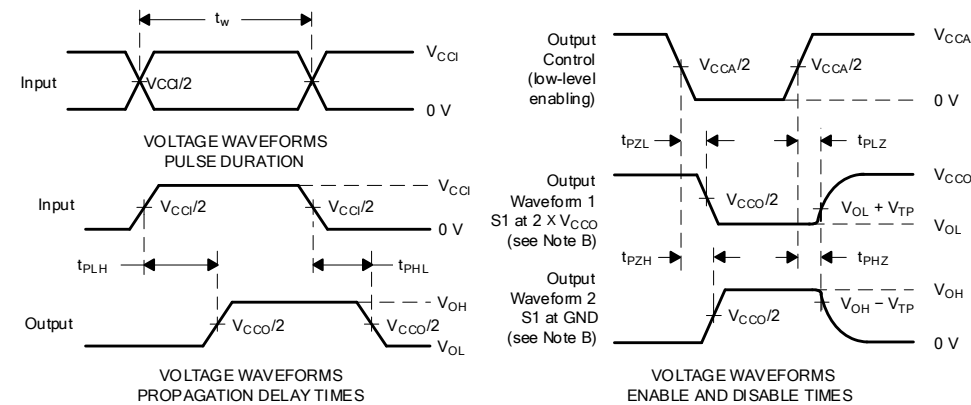


Parameter Measurement Information



TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC0}$
t_{PHZ}/t_{PZH}	GND

V_{CC}	C_L	R_L	V_{TP}
$1.8V \pm 0.15V$	15pF	2k Ω	0.15V
$2.5V \pm 0.2V$	15pF	2k Ω	0.15V
$3.3V \pm 0.3V$	15pF	2k Ω	0.3V
$5V \pm 0.5V$	15pF	2k Ω	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, $Z_o = 50 \Omega$, $dv/dt \geq 1V/ns$.
 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. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

Application Information

The RS8T245 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.

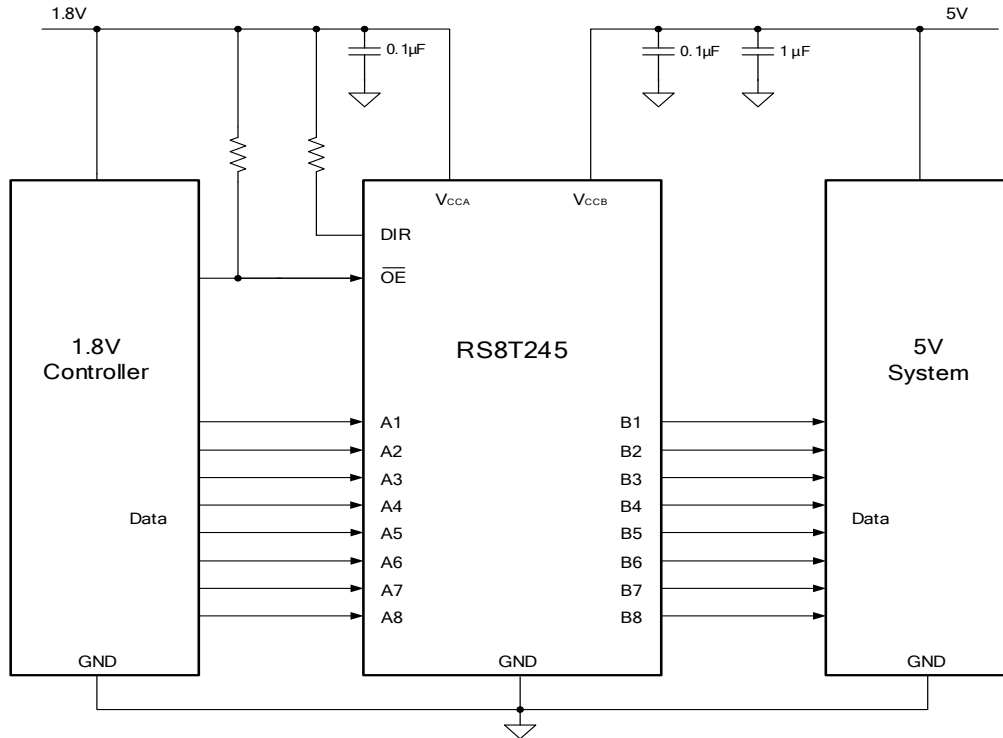
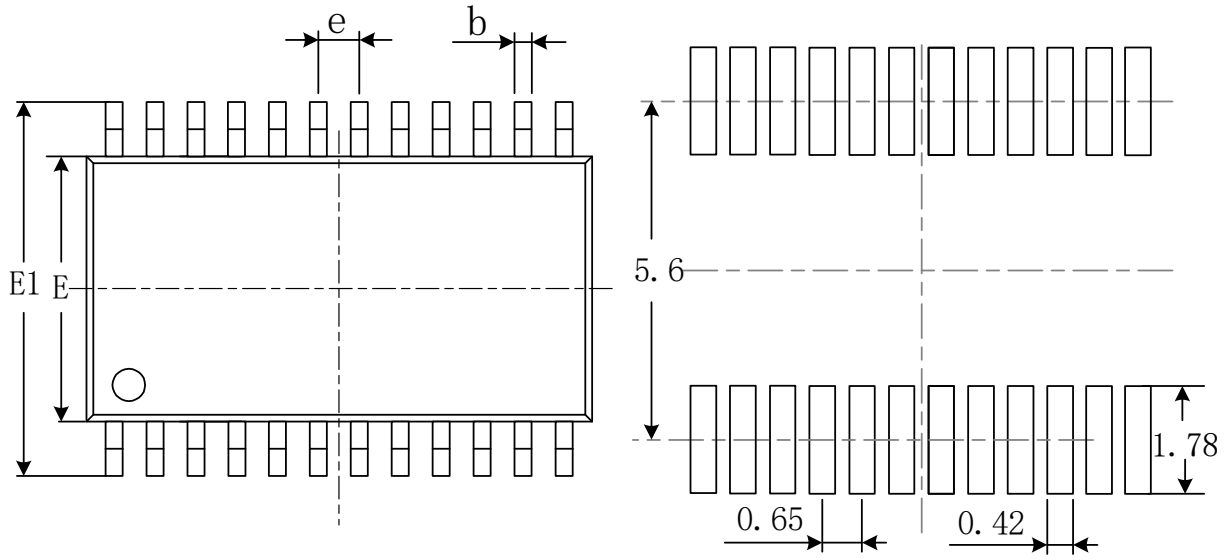


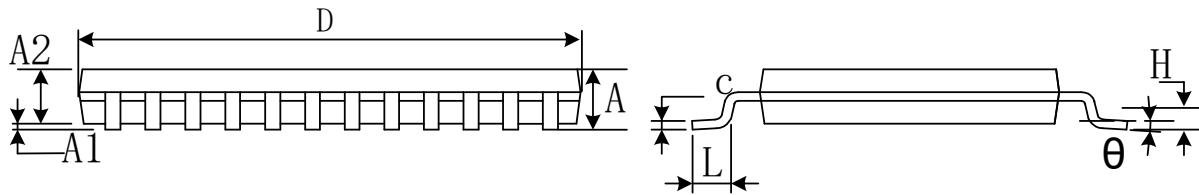
Figure 2. Typical Application Circuit

PACKAGE OUTLINE DIMENSIONS

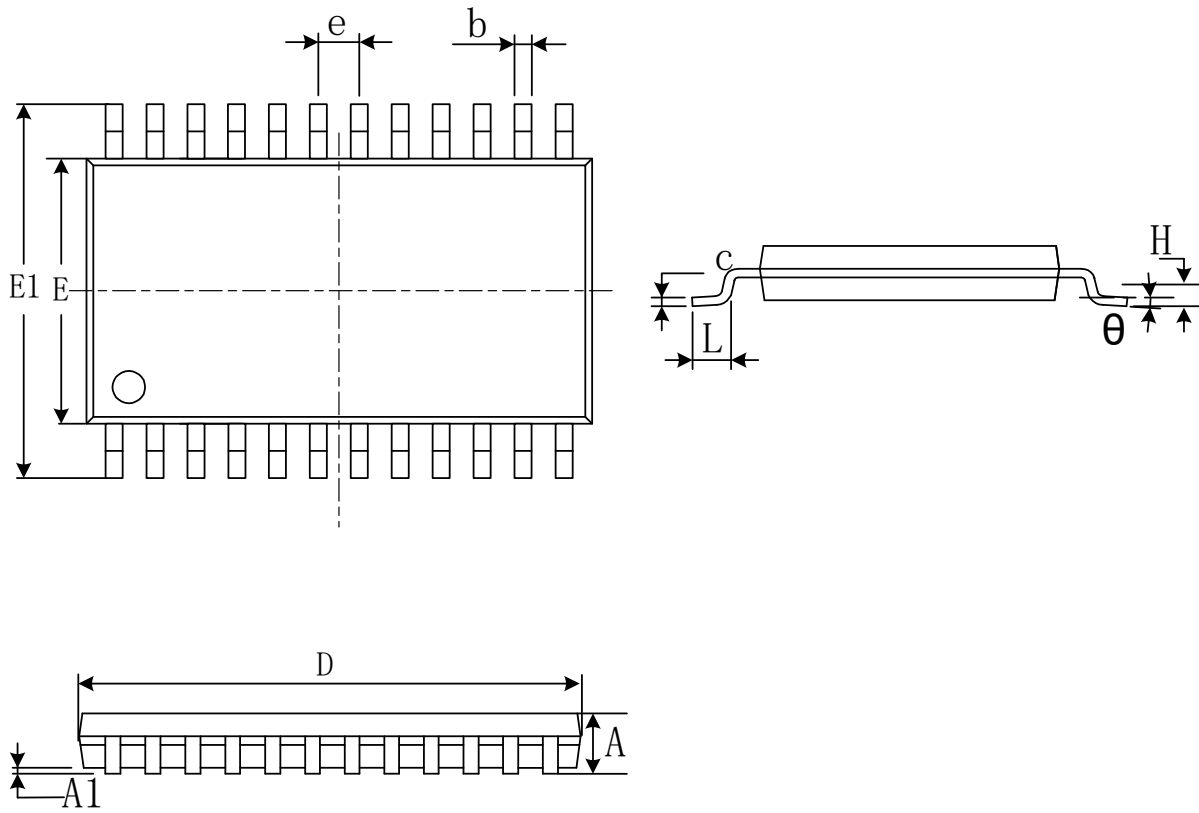
TSSOP24



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.200	0.290	0.008	0.011
c	0.130	0.170	0.005	0.007
D	7.700	7.900	0.303	0.311
E	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.260
e	0.650(BSC)		0.026(BSC)	
L	0.450	0.750	0.018	0.030
H	0.250(TYP)		0.010(TYP)	
θ	0°	8°	0°	8°

SOP24


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		2.650		0.104
A1	0.100	0.300	0.004	0.012
b	0.310	0.510	0.012	0.020
c	0.230	0.270	0.009	0.011
D	15.20	15.60	0.598	0.614
E	7.400	7.600	0.291	0.299
E1	9.970	10.63	0.393	0.419
e	1.270(BSC)		0.050(BSC)	
L	0.450	0.750	0.018	0.030
H	0.250(TYP)		0.010(TYP)	
θ	0°	8°	0°	8°