Octal Bus Transceiver with 3-State Outputs

1 FEATURES

- **Power-Supply Range: 2V to 5.5V**
- **V_{CC} Isolation: If V_{CC} is at GND, Both Ports are in the High-Impedance State**
- **I_{OFF}: Supports Partial-Power-Down Mode Operation**
- **Inputs are TTL-voltage compatible**
- **Extended Temperature: -40°C to +125°C**
- **Micro Size Packages: TSSOP20, SOP20**

2 APPLICATIONS

- **Factory Automation and Control**
- **Grid Infrastructure**
- **Multi-Function Printers**
- **Motor Drives**
- **Telecom Infrastructure**

3 DESCRIPTIONS

The RS245T 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.

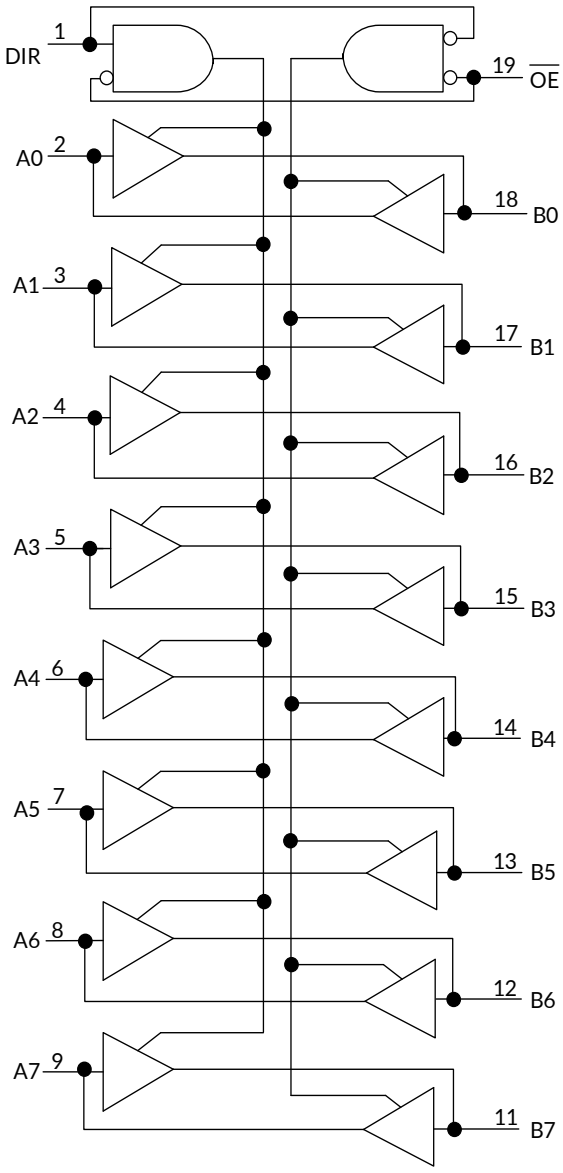
It operates over an ambient temperature range of -40°C to +125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS245T	TSSOP20	6.50mm×4.40mm
	SOP20	12.80mm×7.50mm

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

4 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

NOTE:
H=HIGH voltage level
L=LOW voltage level
X=Don't care
Z=High impedance OFF-state

Table of Contents

5 Revision History

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

VERSION	Change Date	Change Item
A.1	2023/09/18	Initial version completed
A.1.1	2024/02/26	Modify packaging naming
A.2	2024/05/17	Update KEY PARAMETER LIST OF TAPE AND REEL

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (2)	MSL(3)	PACKAGE OPTION
RS245T	RS245TXTSS20	-40°C ~+125°C	TSSOP20	RS245T	MSL3	Tape and Reel, 4000
	RS245TXS20	-40°C ~+125°C	SOP20	RS245T	MSL3	Tape and Reel, 1500

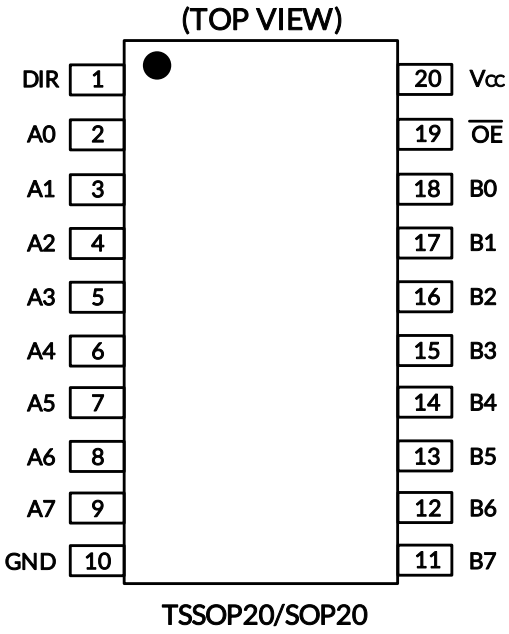
NOTE:

(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.

7 PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	TYPE (1)	FUNCTION
TSSOP20/SOP20			
2	A0	I/O	Input/output
3	A1	I/O	Input/output
4	A2	I/O	Input/output
5	A3	I/O	Input/output
6	A4	I/O	Input/output
7	A5	I/O	Input/output
8	A6	I/O	Input/output
9	A7	I/O	Input/output
11	B7	I/O	Input/output
12	B6	I/O	Input/output
13	B5	I/O	Input/output
14	B4	I/O	Input/output
15	B3	I/O	Input/output
16	B2	I/O	Input/output
17	B1	I/O	Input/output
18	B0	I/O	Input/output
1	DIR	I	Direction control
10	GND	G	Ground.
19	$\overline{OE}$	I	Output Enable (Active Low). Pull $\overline{OE}$ high to place all outputs in 3-state mode.
20	V_{CC}	P	supply voltage. $2V \le V_{CC} \le 5.5V$

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

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

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

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_{CC}	Supply Voltage Range		-0.5	6	V
V_I(2)	Input Voltage Range		-0.5	V_{CC}+0.5	V
V_O(2)(3)	Output Voltage Range		-0.5	V_{CC}+0.5	V
I_{IK}	Input clamp current	V_I<0 or V_I >V_{CC}		±20	mA
I_{OK}	Output clamp current	Vo<0 or V_O>V_{CC}		±20	mA
I_O	Continuous output current	V_O= 0 to V_{CC}		±50	mA
	Continuous current through V_{CC} or GND			±100	mA
θ_{JA}	Package thermal impedance (4)	TSSOP20		40	°C/W
		SOP20		40	
T_J	Junction Temperature (5)		-40	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_{CC} are 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.

8.3 Recommended Operating Conditions

V_{CC} is the supply voltage associated with the input port and output port. (1)(2)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage	V_{CC}		2		5.5	V
High-Level Input Voltage	V_{IH}	V_{CC}=2V	1.2			V
		V_{CC}=3.3V	1.5			
		V_{CC}=4.5V to 5.5V	2			
Low-Level Input Voltage	V_{IL}	V_{CC}=2V			0.5	V
		V_{CC}=3.3V			0.65	
		V_{CC}=4.5V to 5.5V			0.8	
Input Voltage	V_I		0		V_{CC}	V
Output Voltage	V_O		0		V_{CC}	V
High-Level Output Current	I_{OH}				-24	mA
Low-Level Output Current	I_{OL}				24	mA
Input transition rise or fall rate	Δt/Δv				8	ns/V
Operating free-air Temperature	T_A		-40		125	°C

(1) All unused or driven (floating) data inputs (I/Os) of the device must be held at logic HIGH or LOW (preferably V_{CC} or GND) to ensure proper device operation and minimize power.

(2) All unused control inputs must be held at V_{CC} or GND to ensure proper device operation and minimize power consumption.

8.4 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).

PARAMETER	CONDITIONS	VCC	TEMP	MIN(1)	TYP(2)	MAX(1)	UNIT
V_{OH}	I_{OH} = -50μA	2V to 5.5V	Full	VCC-0.1			V
	I_{OH} = -24mA	3.3V		2.45			
		4.5V		3.76			
		5.5V		4.76			
	I_{OH} = -50mA	5.5V		3.85			
V_{OL}	I_{OL} = 50μA	2V to 5.5V				0.1	V
	I_{OL} = 24mA	3.3V				0.89	
		4.5V				0.73	
		5.5V				0.69	
	I_{OL} = 50mA	5.5V				1.65	
I_I	V_I = V_{CC} or GND	5.5V	+25°C			±1	μA
			Full			±2	
I_{OZ} (3)	V_O = V_{CC} or GND, V_I = V_{IH} or V_{IL}	5.5V	+25°C			±1	μA
			Full			±5	
I_{CC}	V_I = V_{CC} or GND (4) I_O = 0	5.5V	+25°C			4	μA
			Full			40	
ΔI_{CC}	One input at 3.4 V, Other inputs at GND or V_{CC}	5.5V	+25°C		0.6		mA
			Full			1.5	
C_I	V_I = V_{CC} or GND	5V	+25°C		7		pF
C_O	V_O = V_{CC} or GND	5V	+25°C		8		pF

(1) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(2) 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.
(3) For I/O ports, the parameter I_{OZ} includes the input leakage current.
(4) Hold all unused data inputs of the device at V_{CCI} or GND to assure proper device operation.

8.5 Switching Characteristics

over recommended operating free-air temperature range, V_{CC} = 2 V (unless otherwise noted).

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A=25°C (1)			T_A=-40~125°C (1)			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	An or Bn	Bn or An	5.1	14.2	21.6	5.1		23.2	ns
t_{PHL}			4.2	11.7	17.6	4.2		19.5	
t_{PZH}	$\overline{OE}$	An or Bn	7.5	22.1	34.5	7.5		37.5	ns
t_{PZL}			6.1	24.3	39.2	6.1		43.1	
t_{PHZ}	$\overline{OE}$	An or Bn	4.1	9.7	15.6	4.1		17.5	ns
t_{PLZ}			3.9	9.4	14.5	3.9		16.3	

(1) This parameter is ensured by design and/or characterization and is not tested in production.

Switching Characteristics

over recommended operating free-air temperature range, V_{CC} = 3.3 V (unless otherwise noted).

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A=25°C (1)			T_A=-40~125°C (1)			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	An or Bn	Bn or An	3.3	7.6	11.5	3.3		13.1	ns
t_{PHL}			3.2	7.4	11.1	3.2		12.5	
t_{PZH}	$\overline{OE}$	An or Bn	4.2	10.6	16.2	4.2		18.5	ns
t_{PZL}			4.9	11.9	19.5	4.9		21.7	
t_{PHZ}	$\overline{OE}$	An or Bn	2.9	6.7	10.1	2.9		11.3	ns
t_{PLZ}			2.6	5.4	8.6	2.6		9.6	

(1) This parameter is ensured by design and/or characterization and is not tested in production.

Switching Characteristics

over recommended operating free-air temperature range, V_{CC} =5 V±0.5 V (unless otherwise noted).

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A=25°C (1)			T_A=-40~125°C (1)			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	An or Bn	Bn or An	3.2	6.5	10.2	3.2		11.4	ns
t_{PHL}			3.1	6.3	9.5	3.1		10.6	
t_{PZH}	$\overline{OE}$	An or Bn	3.6	7.4	11.1	3.6		12.5	ns
t_{PZL}			4.3	8.8	14.1	4.3		16.1	
t_{PHZ}	$\overline{OE}$	An or Bn	2.1	5.2	8.1	2.1		9.1	ns
t_{PLZ}			1.7	4.5	7.1	1.7		7.9	

(1) This parameter is ensured by design and/or characterization and is not tested in production.

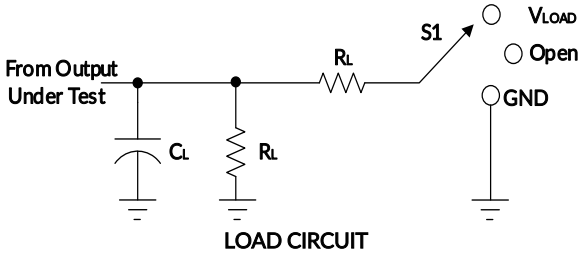
8.6 Operating Characteristics

T_A=25°C

PARAMETER		TEST CONDITIONS	V_{CC}=5V	UNIT
			TYP	
C_{pd} (1)	Power dissipation capacitance per buffer/driver	C_L = 50 pF, f = 1 MHz	30	pF

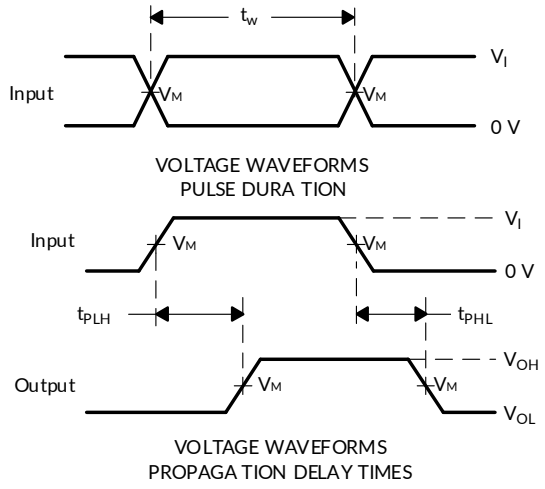
(1) Power dissipation capacitance per transceiver.

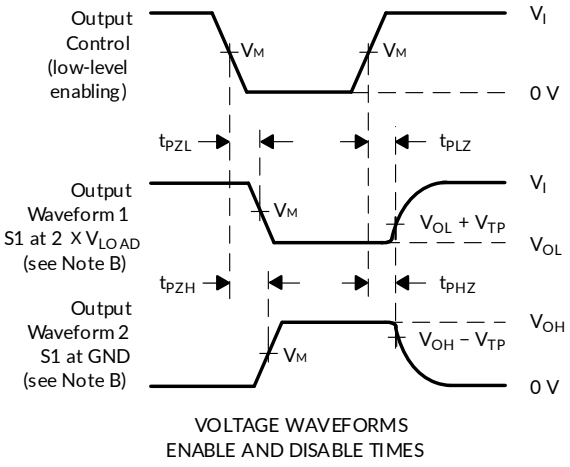
9 Parameter Measurement Information



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

V_{CC}	V_I	V_M	C_L	R_L	V_{TP}
2.0V±0.2V	V_{CC}	$V_{CC}/2$	50pF	500Ω	0.15V
3.3V±0.3V	2.7V	1.5V	50pF	500Ω	0.3V
5V±0.5V	2.7V	1.5V	50pF	500Ω	0.3V





NOTES: A. CL 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 = 50Ω, 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. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

10 Detailed Description

10.1 Overview

The RS245T is a bidirectional buffer with direction control and active low output enable. This device is commonly used in logic systems for isolation and increasing drive strength.

10.2 Feature Description

Voltage operating range from 2 V to 5.5 V is forgiving of 5V power supply rail accuracy. This device has balanced propagation delay, typically 14.2 ns, and balanced output drive of ±24 mA at 5.5 V. It has low power consumption of only 40μA maximum static supply current. The center V_{CC} and GND pin configurations minimize high-speed switching noise. Inputs are TTL-voltage compatible.

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

RS245T is a high drive CMOS device that can be used for a multitude of bus interface type applications where output drive or PCB trace length is a concern. The inputs can accept voltages to 5.5 V at any valid V_{CC} making it ideal for down translation.

11.2 Typical Application

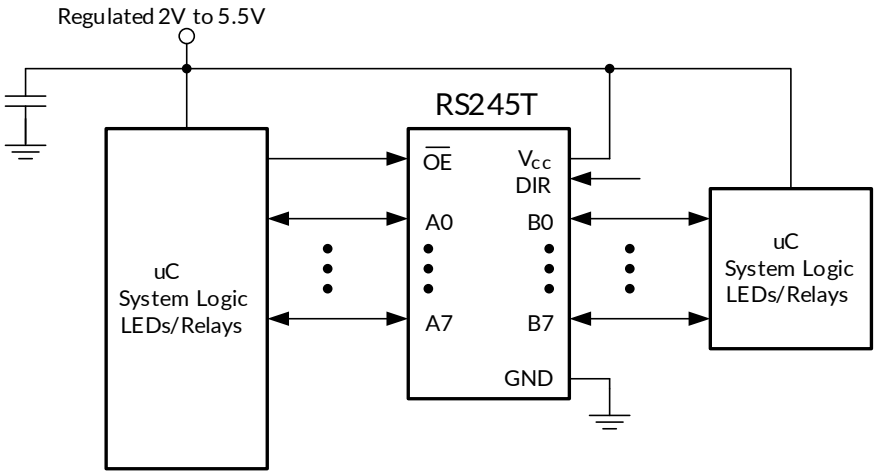


Figure 2. Application Schematic

11.3 Design Requirements

This device uses CMOS technology and has balanced output drive. Avoid bus contention because it can drive currents in excess of maximum limits. The high drive creates fast edges into light loads, so consider routing and load conditions to prevent ringing.

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 0.1uF capacitor is recommended and if there are multiple V_{CC} terminals then 0.01uF or 0.022uF capacitors are recommended for each power terminal. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. Multiple bypass capacitors may be paralleled to reject different frequencies of noise. The bypass capacitor must be installed as close to the power terminal as possible for the best results.

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

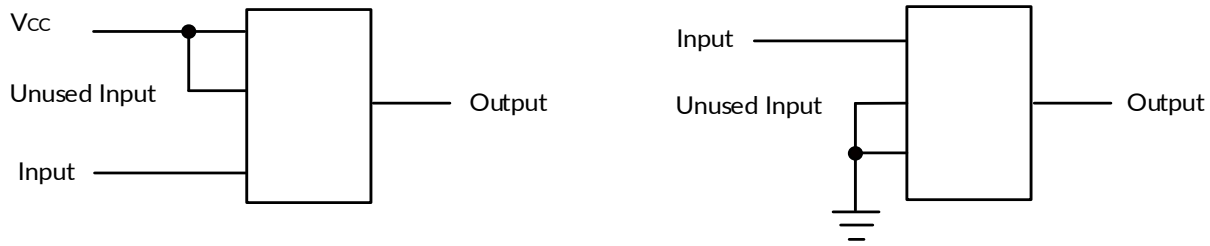
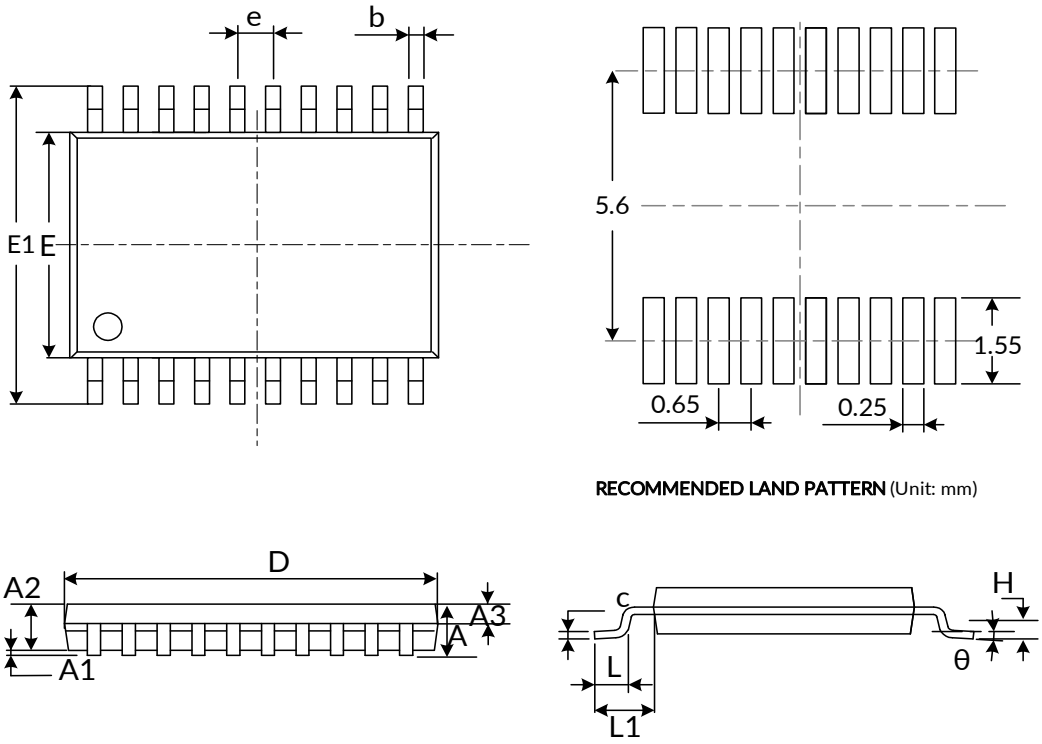


Figure 3. Layout Diagram

14 PACKAGE OUTLINE DIMENSIONS

TSSOP20 (4)



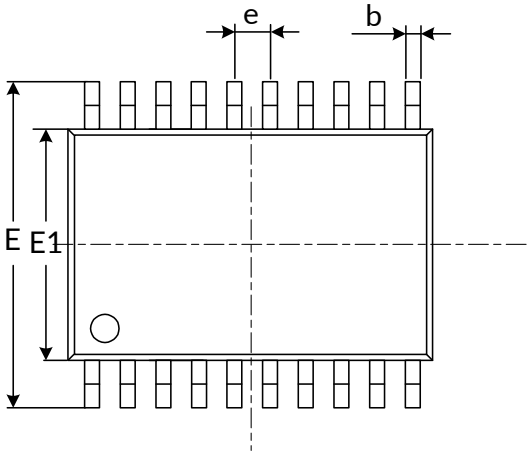
RECOMMENDED LAND PATTERN (Unit: mm)

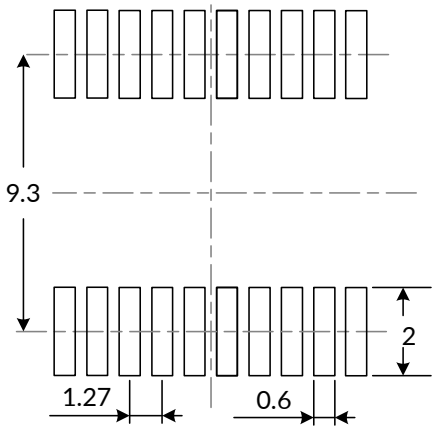
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
A3	0.390	0.490	0.015	0.020
b	0.200	0.290	0.008	0.011
c	0.130	0.170	0.005	0.007
D (1)	6.400	6.600	0.252	0.260
E (1)	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.260
e	0.650(BSC) (2)		0.026(BSC) (2)	
L	0.450	0.750	0.018	0.030
H	0.250(TYP)		0.010(TYP)	
θ	0°	8°	0°	8°
L1	1.00(REF) (3)		0.039(REF) (3)	

NOTE:

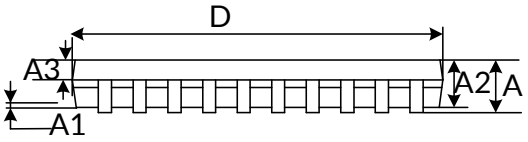
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

SOP20 (4)





RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		2.650		0.104
A1	0.100	0.300	0.004	0.012
A2	2.250	2.350	0.089	0.093
A3	0.970	1.070	0.038	0.042
b	0.390	0.470	0.015	0.019
c	0.250	0.290	0.010	0.011
D (1)	12.700	12.900	0.500	0.508
E	10.100	10.500	0.398	0.413
E1 (1)	7.400	7.600	0.291	0.299
e	1.270(BSC) (2)		0.050(BSC) (2)	
L	0.700	1.000	0.028	0.039
H	0.250(TYP)		0.010(TYP)	
θ	0°	8°	0°	8°
L1	1.400(REF) (3)		0.055(REF) (3)	

NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
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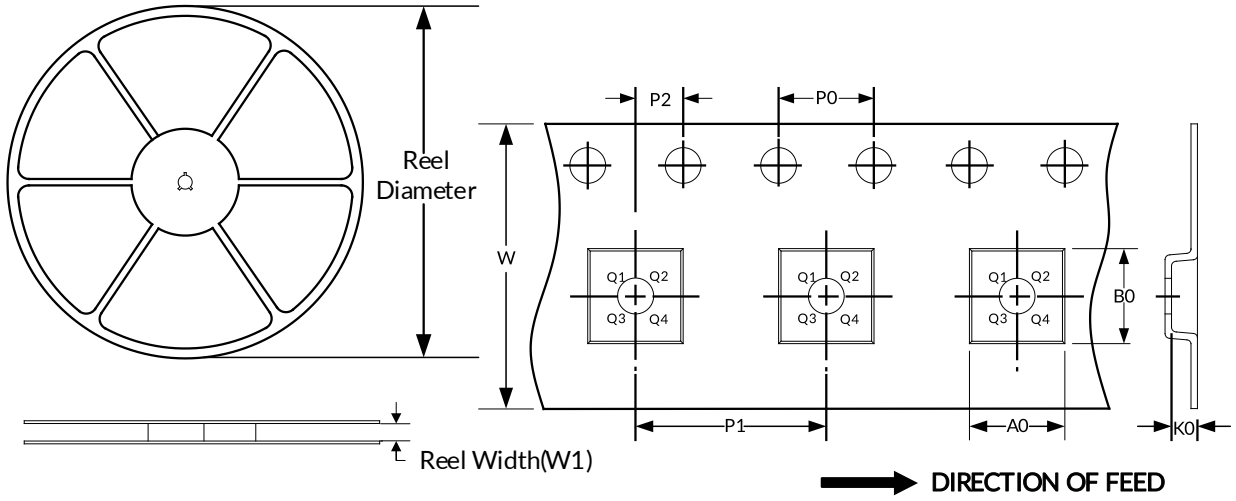
3. REF is the abbreviation for Reference.
4. This drawing is subject to change without notice.

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
TSSOP20	13”	12.4	6.75	6.95	1.20	4.0	8.0	2.0	16.0	Q1
SOP20	13”	24.4	10.75	13.55	2.65	4.0	12.0	2.0	24.0	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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