



74LVC1T45

Single-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation

GENERAL DESCRIPTION

The 74LVC1T45 is a single-bit, dual-supply bus transceiver with configurable voltage translation. The device has two separate configurable power-supply rails. The A and B ports track the V_{CCA} supply and V_{CCB} supply respectively. The supply voltage pins accept voltage range from 1.65V to 5.5V, which makes the device suitable for low voltage bidirectional translation voltage nodes of 1.8V, 2.5V, 3.3V, and 5V.

The 74LVC1T45 features that two data buses can communicate asynchronously. Either the A port outputs or the B port outputs can be activated by DIR logic levels. The DIR input circuit is supplied by V_{CCA} . When B port outputs are activated, the device allows the data to transmit from A bus to B bus. On the contrary, when A port outputs are activated, the device allows the data to transmit from B bus to A bus. The input circuit is always active on the two ports. A logic level of high or low must be set to avoid excessive supply current.

FEATURES

- V_{CCA} Supply Voltage Range: 1.65V to 5.5V
- V_{CCB} Supply Voltage Range: 1.65V to 5.5V
- DIR Input Circuit Referenced to V_{CCA}
- +32mA/-32mA Output Current
- Data Rates
 - ◆ 420Mbps (3.3V to 5V Translation)
 - ◆ 210Mbps (Translate to 3.3V)
 - ◆ 140Mbps (Translate to 2.5V)
 - ◆ 75Mbps (Translate to 1.8V)
- Outputs in High-Impedance State when V_{CCA} or $V_{CCB} = 0V$
- -40°C to +125°C Operating Temperature Range
- Available in Green SC70-6, SOT-23-6 Packages

APPLICATIONS

Personal Electronic Devices
Industrial and Enterprise Devices
Telecommunications

74LVC1T45

Single-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation

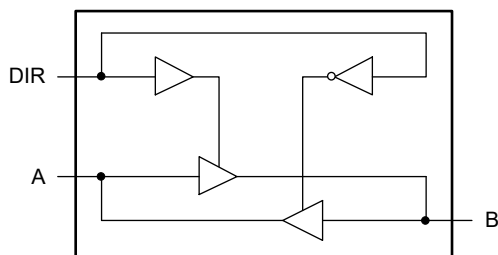
RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range, V_{CCA} 1.65V to 5.5V
 Supply Voltage Range, V_{CCB} 1.65V to 5.5V
 Input Voltage Range, V_i 0V to 5.5V
 Output Voltage Range, V_o
 High-Impedance State 0V to 5.5V
 High-State or Low-State
 A Ports 0V to V_{CCA}
 B Ports 0V to V_{CCB}
 High-State or Low-State Output Current, I_o ± 32 mA

Input Transition Rise or Fall Rate, $\Delta t/\Delta V$

Data Inputs
 $V_{CCI} = 1.65V$ to 1.95V 20ns/V (MAX)
 $V_{CCI} = 2.3V$ to 2.7V 20ns/V (MAX)
 $V_{CCI} = 3V$ to 3.6V 10ns/V (MAX)
 $V_{CCI} = 4.5V$ to 5.5V 5ns/V (MAX)
 Control Input
 $V_{CCI} = 1.65V$ to 5.5V 5ns/V (MAX)
 Operating Temperature Range $-40^\circ C$ to $+125^\circ C$

LOGIC DIAGRAM



FUNCTION TABLE

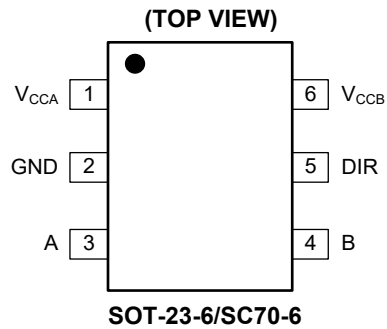
SUPPLY VOLTAGE	CONTROL INPUT	INPUT/OUTPUT ⁽¹⁾	
V_{CCA}, V_{CCB}	DIR ⁽²⁾	A	B
1.65V to 5.5V	L	A = B	Input
1.65V to 5.5V	H	Input	B = A
GND ⁽³⁾	X	Z	Z

H = High Voltage Level
 L = Low Voltage Level
 X = Don't Care
 Z = High-Impedance State

NOTES:

1. The input circuit of the data I/O is always active.
2. The DIR input circuit is referenced to V_{CCA} .
3. If at least one of V_{CCA} or V_{CCB} is at GND level, the outputs in High-Impedance State.

PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
SOT-23-6/SC70-6		
1	V _{CCA}	Supply Voltage on A Port.
2	GND	Ground.
3	A	Input/Output. It tracks the V _{CCA} supply.
4	B	Input/Output. It tracks the V _{CCB} supply.
5	DIR	Direction Control Input. It tracks the V _{CCA} supply.
6	V _{CCB}	Supply Voltage on B Port.

ELECTRICAL CHARACTERISTICS

(Full = -40°C to +125°C, typical values are at T_A = +25°C. V_{CCI} is the supply voltage associated with the data input port. V_{CCO} is the supply voltage associated with the data output port, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS	
Supply Voltage	V _{CCA}		Full	1.65		5.5	V	
	V _{CCB}		Full	1.65		5.5		
High-Level Input Voltage	V _{IH}	Data and DIR inputs	V _{CCI} = 1.65V to 1.95V	Full	0.65 × V _{CCI}		V	
			V _{CCI} = 2.3V to 2.7V	Full	1.7			
			V _{CCI} = 3V to 3.6V	Full	2			
			V _{CCI} = 4.5V to 5.5V	Full	0.7 × V _{CCI}			
Low-Level Input Voltage	V _{IL}	Data and DIR inputs	V _{CCI} = 1.65V to 1.95V	Full		0.35 × V _{CCI}	V	
			V _{CCI} = 2.3V to 2.7V	Full		0.7		
			V _{CCI} = 3V to 3.6V	Full		0.8		
			V _{CCI} = 4.5V to 5.5V	Full		0.3 × V _{CCI}		
High-Level Output Voltage	V _{OH}	V _I = V _{IH}	V _{CCO} = 1.65V to 4.5V, I _{OH} = -100μA	Full	V _{CCO} - 0.03	V _{CCO} - 0.01	V	
			V _{CCO} = 1.65V, I _{OH} = -4mA	Full	1.37	1.53		
			V _{CCO} = 2.3V, I _{OH} = -8mA	Full	2.00	2.17		
			V _{CCO} = 3V, I _{OH} = -24mA	Full	2.44	2.69		
			V _{CCO} = 4.5V, I _{OH} = -32mA	Full	3.98	4.2		
Low-Level Output Voltage	V _{OL}	V _I = V _{IL}	V _{CCO} = 1.65V to 4.5V, I _{OL} = 100μA	Full		0.01	0.03	V
			V _{CCO} = 1.65V, I _{OL} = 4mA	Full		0.07	0.24	
			V _{CCO} = 2.3V, I _{OL} = 8mA	Full		0.1	0.25	
			V _{CCO} = 3V, I _{OL} = 24mA	Full		0.25	0.45	
			V _{CCO} = 4.5V, I _{OL} = 32mA	Full		0.28	0.50	
			V _{CCO} = 5.5V, I _{OL} = 32mA	Full		0.27	0.47	
Input Leakage Current	I _I	V _I = V _{CCA} or GND, V _{CCA} = V _{CCB} = 1.65V to 5.5V	Full		±0.01	±1	μA	
Power-Off Leakage Current	I _{OFF}	V _I or V _O = 0V to 5.5V	A port, V _{CCA} = 0V, V _{CCB} = 0V to 5.5V	Full		±0.01	±1	μA
			B port, V _{CCB} = 0V, V _{CCA} = 0V to 5.5V	Full		±0.01	±1	
Off-State Output Current ⁽¹⁾	I _{OZ}	V _{CCA} = V _{CCB} = 1.65V to 5.5V, V _O = V _{CCO} or GND	Full		±0.01	±1	μA	
Supply Current	I _{CCA}	V _I = V _{CCI} or GND, I _O = 0A	V _{CCA} = V _{CCB} = 1.65V to 5.5V	Full		0.4	2	μA
			V _{CCA} = 5V, V _{CCB} = 0V	Full		0.01	2	
	V _{CCA} = 0V, V _{CCB} = 5V		Full	-2	-0.01			
	V _{CCA} = V _{CCB} = 1.65V to 5.5V		Full		0.4	2		
	V _{CCA} = 5V, V _{CCB} = 0V		Full	-2	-0.01			
I _{CCB}	V _{CCA} = 5V, V _{CCB} = 0V	Full	-2	-0.01				
I _{CCA} + I _{CCB}	V _{CCA} = 0V, V _{CCB} = 5V	Full		0.01	2			
Additional Supply Current	ΔI _{CCA}	A port at V _{CCA} - 0.6V, DIR at V _{CCA} , B port = open, V _{CCA} = V _{CCB} = 3V to 5.5V	DIR at V _{CCA} - 0.6V, A port at V _{CCA} or GND, B port = open, V _{CCA} = V _{CCB} = 3V to 5.5V	Full		0.2	10	μA
			B port at V _{CCB} - 0.6V, DIR at GND, A port = open, V _{CCA} = V _{CCB} = 3V to 5.5V	Full		0.2	10	
	ΔI _{CCB}			Full		0.2	10	
Input Capacitance	C _I	V _{CCA} = V _{CCB} = 3.3V, DIR input, V _I = V _{CCA} or GND	+25°C		4		pF	
Input/Output Capacitance	C _{IO}	V _{CCA} = V _{CCB} = 3.3V, A and B ports, V _O = V _{CCA/B} or GND	+25°C		5		pF	

NOTE: 1. For I/O ports, the parameter I_{OZ} includes the input leakage current.

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74LVC1T45

DYNAMIC CHARACTERISTICS

(For test circuit see Figure 1. Minimum and maximum values are at $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}												UNITS
			1.8V \pm 0.15V			2.5V \pm 0.2V			3.3V \pm 0.3V			5V \pm 0.5V			
			MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	
$V_{CCA} = 1.8V \pm 0.15V$															
Propagation Delay	t_{PLH}	A to B	1.5	6	13	1	4.5	9	1	4	7.5	1	4	7	ns
	t_{PHL}		1.5	6	13	1	4.5	8.5	1	4	7.5	1	4	7	
	t_{PLH}	B to A	1.5	6	13	1	5	12	1	5	11.5	1	5	11	
	t_{PHL}		1.5	6	13	1	5	12	1	5	11.5	1	5	11.5	
Disable Time	t_{PHZ}	DIR to A	3	10.5	16	3	10.5	16	3	10.5	16	3	10.5	16	ns
	t_{PLZ}		2.5	7	11.5	2.5	7.5	11.5	2.5	7	12	2.5	8.5	13	
	t_{PHZ}	DIR to B	3	14	22	2.5	9	14	2.5	6	11	2.5	5.5	9	
	t_{PLZ}		3	10	17	2	6	11	2.5	6.5	10	2	5	8	
Enable Time ⁽²⁾	t_{PZH}	DIR to A		16	30		11	23		11.5	21.5		10	19	ns
	t_{PZL}			20	35		14	26		11	22.5		10.5	20.5	
	t_{PZH}	DIR to B		13	24.5		12	20.5		11	19.5		12.5	20	
	t_{PZL}			16.5	29		15	24.5		14.5	23.5		14.5	23	
$V_{CCA} = 2.5V \pm 0.2V$															
Propagation Delay	t_{PLH}	A to B	1	5	12	1	3.5	7.5	1	3	6	0.7	3	5.5	ns
	t_{PHL}		1	5	12	1	3.5	7.5	1	3	6	0.7	3	5.5	
	t_{PLH}	B to A	1	4.5	9	1	3.5	7.5	1	3.5	7	1	3.5	7	
	t_{PHL}		1	4.5	8.5	1	3.5	7.5	1	3.5	7	0.9	3.5	7	
Disable Time	t_{PHZ}	DIR to A	2	7	10	2	7	10	2	7	10	2	7.5	11	ns
	t_{PLZ}		1.5	3.5	8	1.5	3.5	8	1.5	3.5	8	1.5	4	8	
	t_{PHZ}	DIR to B	3.5	12.5	20.5	2.5	7.5	12	2.5	5	10	2	4	7.5	
	t_{PLZ}		3	9	16	2	5	10	2.5	5.5	9	2	4	7	
Enable Time ⁽²⁾	t_{PZH}	DIR to A		13.5	25		8.5	17.5		9	16		7.5	14	ns
	t_{PZL}			17	29		11	19.5		8.5	17		7.5	14.5	
	t_{PZH}	DIR to B		8.5	20		7	15.5		6.5	14		7	13.5	
	t_{PZL}			12	22		10.5	17.5		10	16		10.5	16.5	

DYNAMIC CHARACTERISTICS (continued)

(For test circuit see Figure 1. Minimum and maximum values are at $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}												UNITS
			$1.8\text{V} \pm 0.15\text{V}$			$2.5\text{V} \pm 0.2\text{V}$			$3.3\text{V} \pm 0.3\text{V}$			$5\text{V} \pm 0.5\text{V}$			
			MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	MIN ⁽¹⁾	TYP	MAX ⁽¹⁾	
$V_{CCA} = 3.3\text{V} \pm 0.3\text{V}$															
Propagation Delay	t_{PLH}	A to B	1	5	11.5	1	3.5	7	0.7	3	5.5	0.7	2.5	5	ns
	t_{PHL}		1	5	11.5	1	3.5	7	0.8	3	5.5	0.7	2.5	5	
	t_{PLH}	B to A	1	4	7.5	1	3	6	0.7	3	5.5	0.6	3	5.5	
	t_{PHL}		1	4	7.5	1	3	6	0.8	3	5.5	0.7	3	5.5	
Disable Time	t_{PHZ}	DIR to A	2	4	8.5	2	4	8.5	2	4	8.5	2	4	8.5	ns
	t_{PLZ}		1.5	3.5	8	1.5	3.5	8	1.5	4	8	1.5	4	8	
	t_{PHZ}	DIR to B	3.5	12.5	20	2.5	8	12	2.5	5	10	2	4	7.5	
	t_{PLZ}		3	8	15.5	2	4.5	10	2	5.5	8.5	1.5	3.5	7.5	
Enable Time ⁽²⁾	t_{PZH}	DIR to A		12	23		7.5	16		8.5	14		6.5	13	ns
	t_{PZL}			16.5	27.5		11	18		8	15.5		7	13	
	t_{PZH}	DIR to B		8.5	19.5		7	15		7	13.5		6.5	13	
	t_{PZL}			9	20		7.5	15.5		7	14		6.5	13.5	
$V_{CCA} = 5\text{V} \pm 0.5\text{V}$															
Propagation Delay	t_{PLH}	A to B	1	5	11	1	3.5	7	0.6	3	5.5	0.5	2.5	5	ns
	t_{PHL}		1	5	11.5	0.9	3.5	7	0.7	3	5.5	0.5	2.5	4.5	
	t_{PLH}	B to A	1	4	7	0.7	3	5.5	0.7	2.5	5	0.5	2.5	5	
	t_{PHL}		1	4	7	0.7	3	5.5	0.7	2.5	5	0.5	2.5	4.5	
Disable Time	t_{PHZ}	DIR to A	1.5	4	6.5	1.5	4	6.5	1.5	4	6.5	1.5	4	7	ns
	t_{PLZ}		1	3	5.5	1	3	5.5	1	3	5.5	1	3	5.5	
	t_{PHZ}	DIR to B	3.5	12	19.5	2.5	8	12.5	2.5	5	10	2	4	7.5	
	t_{PLZ}		3	9.5	16	2	5.5	9	2	5.5	8.5	1.5	3.5	6	
Enable Time ⁽²⁾	t_{PZH}	DIR to A		13.5	23		8.5	14.5		8	13.5		6	11	ns
	t_{PZL}			16	26.5		11	18		7.5	15		6.5	12	
	t_{PZH}	DIR to B		8	16.5		6.5	12.5		6	11		5.5	10.5	
	t_{PZL}			9	18		7.5	13.5		7	12		6.5	11.5	

NOTES:

- Specified by design and characterization, not production tested.
- The enable time value is calculated. Calculate the enable times for the 74LVC1T45 using the following formulas:
 - t_{PZH} (DIR to A) = t_{PLZ} (DIR to B) + t_{PLH} (B to A)
 - t_{PZL} (DIR to A) = t_{PHZ} (DIR to B) + t_{PHL} (B to A)
 - t_{PZH} (DIR to B) = t_{PLZ} (DIR to A) + t_{PLH} (A to B)
 - t_{PZL} (DIR to B) = t_{PHZ} (DIR to A) + t_{PHL} (A to B)

DYNAMIC CHARACTERISTICS (continued)(For test circuit see Figure 1. All typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	$V_{CCA} = V_{CCB} = 1.8\text{V}$	$V_{CCA} = V_{CCB} = 2.5\text{V}$	$V_{CCA} = V_{CCB} = 3.3\text{V}$	$V_{CCA} = V_{CCB} = 5\text{V}$	UNITS	
			TYP	TYP	TYP	TYP		
Power Dissipation Capacitance ⁽¹⁾	C_{PDA}	$C_L = 0\text{pF}$, $f = 10\text{MHz}$, $t_R = t_F = 1\text{ns}$	A Port Input, B Port Output	3	3	4	5	pF
			B Port Input, A Port Output	19	20	21	22	
	C_{PDB}	$C_L = 0\text{pF}$, $f = 10\text{MHz}$, $t_R = t_F = 1\text{ns}$	A Port Input, B Port Output	19	20	21	22	pF
			B Port Input, A Port Output	3	3	4	5	

NOTE:

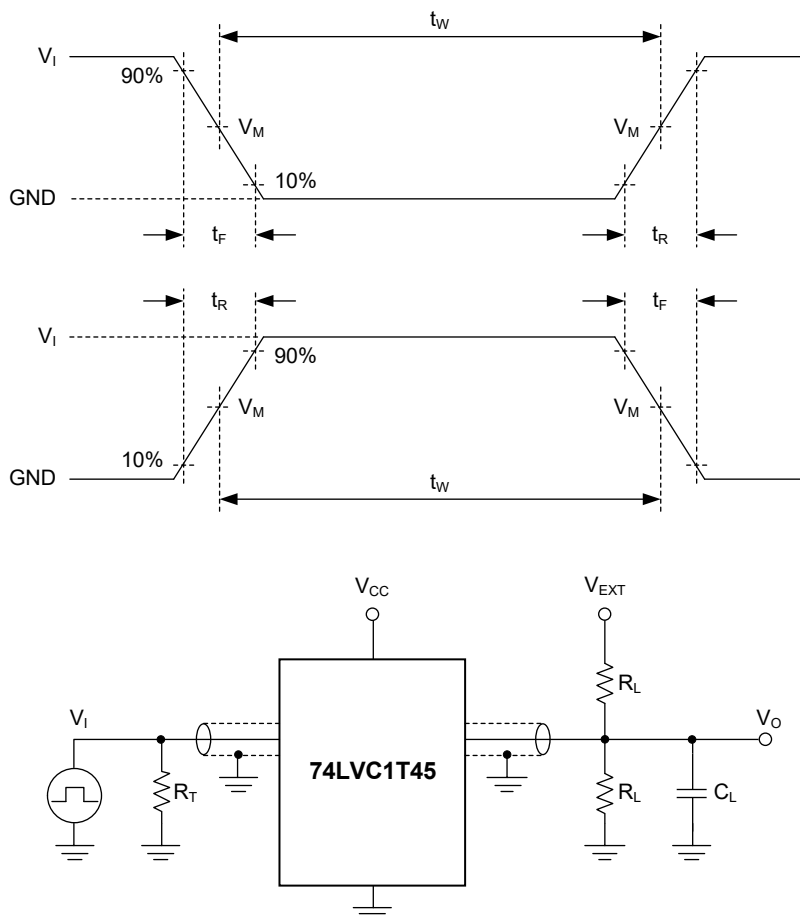
1. Power dissipation capacitance per transceiver. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$$

where:

 f_i = input frequency in MHz. f_o = output frequency in MHz. C_L = output load capacitance in pF. V_{CC} = supply voltage in Volts. N = number of inputs switching. $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

TEST CIRCUIT



Test conditions are given in Table 1.

Definitions for test circuit:

R_L : Load resistance.

C_L : Load capacitance (includes jig and probe).

R_T : Termination resistance (equals to output impedance Z_O of the pulse generator).

V_{EXT} : External voltage used to measure switching time.

Figure 1. Test Circuit for Measuring Switching Times

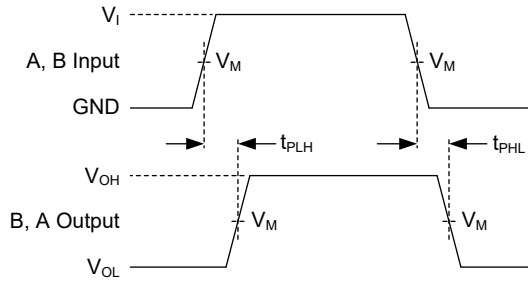
Table 1. Test Conditions

SUPPLY VOLTAGE	INPUT		LOAD		V_{EXT}			
	V_{CCA}, V_{CCB}	$V_I^{(1)}$	t_R, t_F	C_L	R_L	t_{PHZ}, t_{PZH}	$t_{PLZ}, t_{PZL}^{(2)}$	t_{PLH}, t_{PHL}
1.65V to 5.5V	V_{CCI}	$\leq 2.5\text{ns}$	15pF	2k Ω	GND	$2 \times V_{CCO}$	Open	

NOTES:

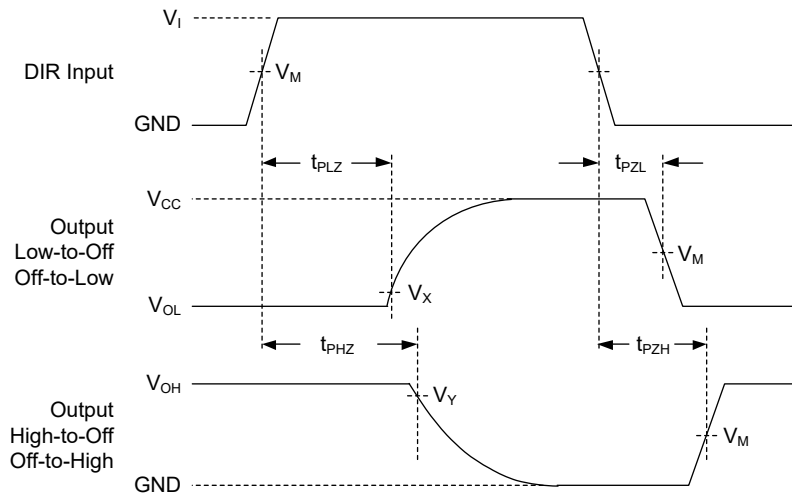
- V_{CCI} is the supply voltage related to the data input port.
- V_{CCO} is the supply voltage related to the data output port.

WAVEFORMS



Test conditions are given in Table 1.
 Measurement points are given in Table 2.
 Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 2. Input (A, B) to Output (B, A) Propagation Delay Times



Test conditions are given in Table 1.
 Measurement points are given in Table 2.
 Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 3. Enable and Disable Times

Table 2. Measurement Points

SUPPLY VOLTAGE	INPUT ⁽¹⁾		OUTPUT		
	V_{CC1}	V_M ⁽²⁾	V_M ⁽³⁾	V_X	V_Y
1.65V to 2.7V	V_{CC1}	$0.5 \times V_{CC1}$	$0.5 \times V_{CC0}$	$V_{OL} + 0.15V$	$V_{OH} - 0.15V$
3V to 5.5V	V_{CC1}	$0.5 \times V_{CC1}$	$0.5 \times V_{CC0}$	$V_{OL} + 0.3V$	$V_{OH} - 0.3V$

NOTES:

- V_{CC1} is the supply voltage related to the data input port.
- The measurement points should be V_{IH} or V_{IL} when the input rising or falling time exceeds 2.5ns.
- V_{CC0} is the supply voltage related to the data output port.

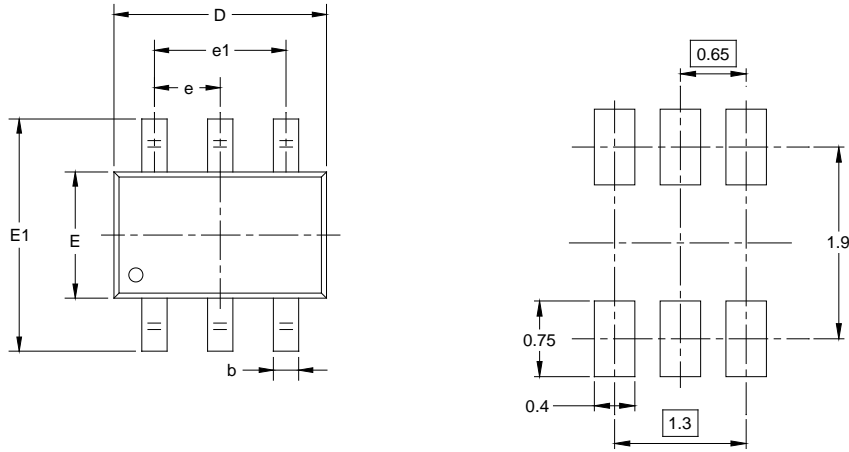
REVISION HISTORY

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

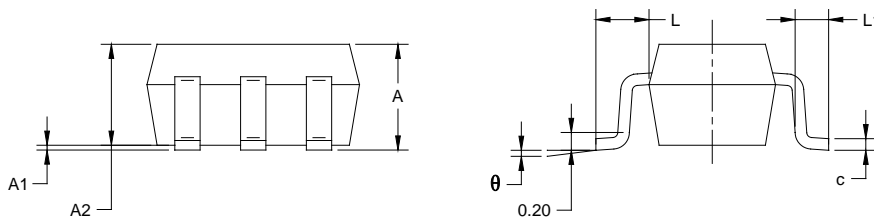
Changes from Original (DECEMBER 2022) to REV.A	Page
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PACKAGE OUTLINE DIMENSIONS

SC70-6



RECOMMENDED LAND PATTERN (Unit: mm)

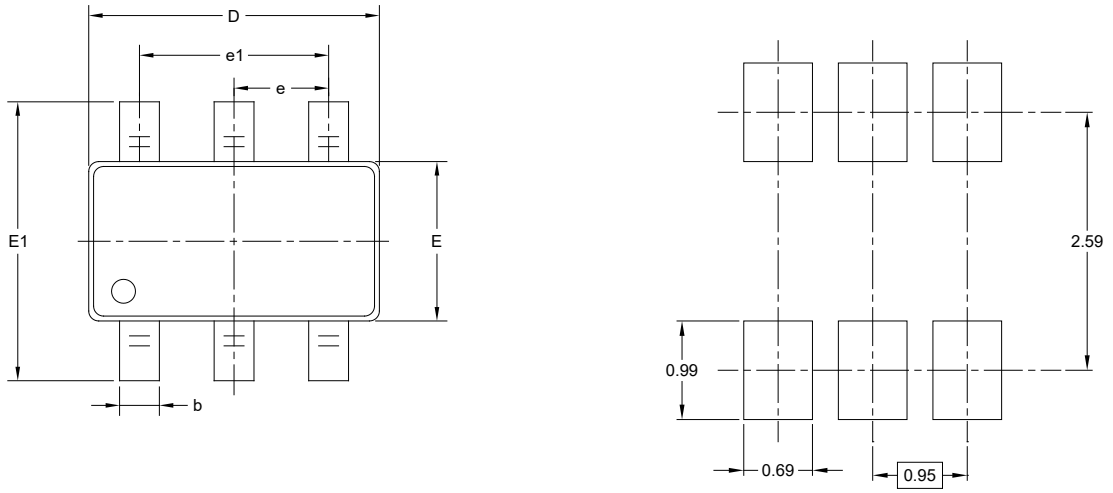


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.000	0.100	0.000	0.004
A2	0.800	1.000	0.031	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.220	0.003	0.009
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

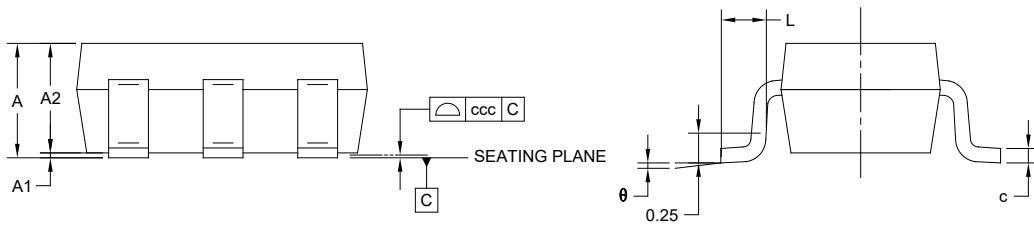
- NOTES:
 1. Body dimensions do not include mode flash or protrusion.
 2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

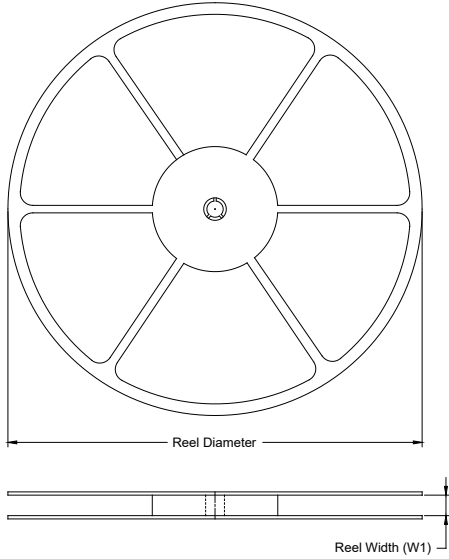
NOTES:

1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

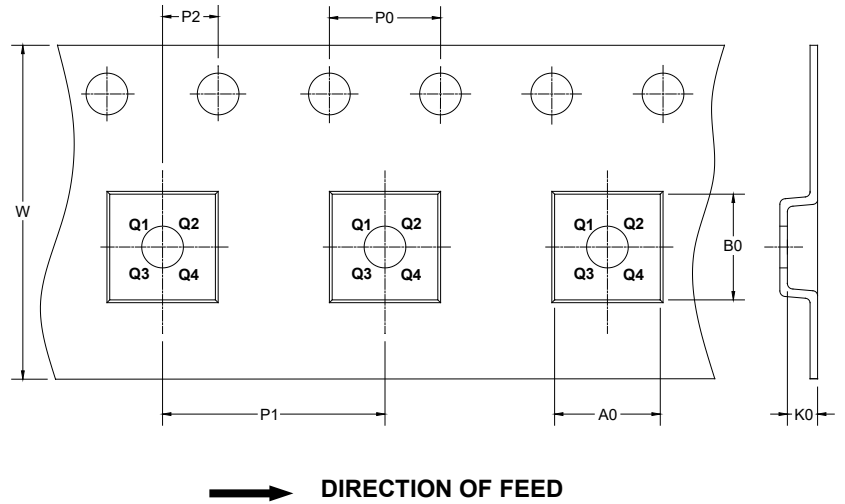
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SC70-6	7"	9.5	2.40	2.50	1.20	4.0	4.0	2.0	8.0	Q3
SOT-23-6	7"	9.5	3.23	3.17	1.37	4.0	4.0	2.0	8.0	Q3

DD0001

PACKAGE INFORMATION

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7" (Option)	368	227	224	8
7"	442	410	224	18

DD0002