

1. General Description

The EM74LVC245A; EM74LVCH245A are 8-bit transceivers with 3-state outputs. The device features an output enable ($\overline{OE}$) and send/receive (DIR) for direction control. A HIGH on $\overline{OE}$ causes the outputs to assume a high-impedance OFF-state. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial power down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

2. Features and Benefits

- Wide supply voltage range from 1.2 V to 5.5 V
- Direct interface with TTL levels
- CMOS low power dissipation
- Overvoltage tolerant inputs to 5.5 V
- Bus hold on all data inputs (EM74LVCH245A only)
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standards:
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A (2.3 V to 2.7 V)
 - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 Class 3A exceeds 6000 V
 - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V

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Octal buffer/line driver; 3-state

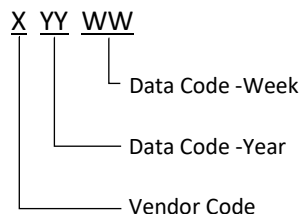
3. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Quantity
EM74LVC245AD	LVC245A XYWW	SOP-20L	plastic small outline package; 20 leads; body width 7.5 mm	3000
EM74LVCH245AD	LVCH245A XYWW			
EM74LVC245APW	LVC245A XYWW	TSSOP-20L	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	3000
EM74LVCH245APW	LVCH245A XYWW			

MARKING INFORMATION

NOTE: XYWW = Vendor Code and Data Code.



4. Function Diagram

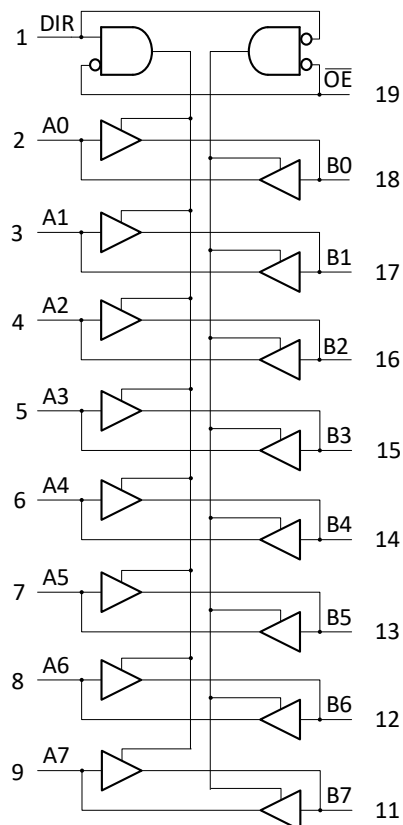


Fig. 1. Logic symbol

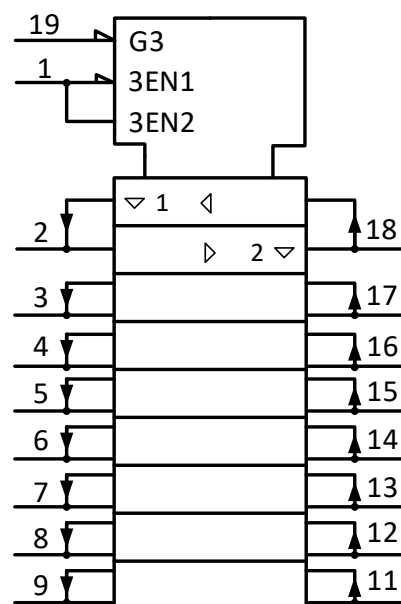
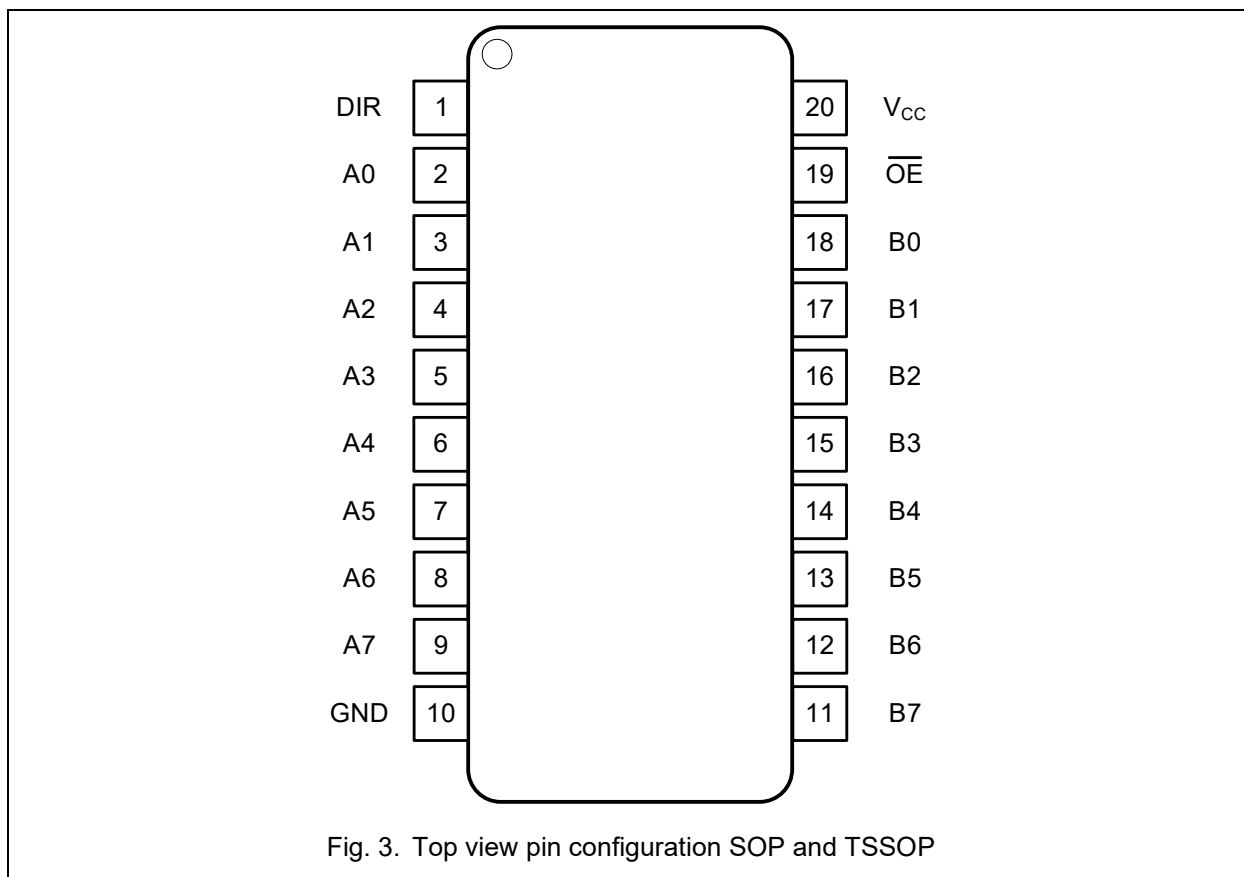


Fig. 2. IEC logic symbol

5. Pinning Information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
DIR	1	Direction control
A0, A1, A2, A3, A4, A5, A6, A7	2, 3, 4, 5, 6, 7, 8, 9	Data input/output
GND	10	Ground (0 V)
B7, B6, B5, B4, B3, B2, B1, B0	11, 12, 13, 14, 15, 16, 17, 18	Data input/output
$\overline{OE}$	19	Output enable input (active LOW)
V _{CC}	20	Supply voltage

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Octal bus transceiver; 3-state

6. Functional Description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

Input		Input/output	
$\overline{OE}$	DIR	An	Bn
L	L	An = Bn	input
L	H	input	Bn = An
H	X	Z	Z

7. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Table 4. Absolute Maximum Ratings

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	6.5	V
I_{IK}	input clamping current	$V_I < 0$ V	-50		mA
V_I	Input voltage	[1]	-0.5	6.5	V
I_{OK}	output clamping current	$V_O < 0$ V or $V_O > V_{CC}$		± 50	mA
V_O	output voltage	output HIGH or LOW [2]	-0.5	$V_{CC}+0.5$	V
		output 3-state	-0.5	6.5	V
I_O	output current	$V_O = 0$ V to V_{CC}		± 50	mA
I_{CC}	supply current			100	mA
I_{GND}	ground current		-100		mA
P_{tot}	total power dissipation			500	mW
T_{stg}	storage temperature		-65	150	°C

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

8. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	supply voltage		1.65		5.5	V
		functional	1.2		5.5	V
V _I	input voltage		0		5.5	V
V _O	output voltage	output HIGH or LOW	0		V _{CC}	V
		output 3-state	0		5.5	V
T _{amb}	ambient temperature		-40		125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V _{CC} = 1.2 V to 2.7 V			20	ns/V
		V _{CC} = 2.7 V to 5.5 V			10	ns/V

9. Static Characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V). Typical values measured at $T_{amb} = 25^{\circ}\text{C}$ (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.2\text{ V}$	1.08			1.08		V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65V_{CC}$			$0.65V_{CC}$		V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7			1.7		V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2.0			2.0		V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$0.7V_{CC}$			$0.7V_{CC}$		V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$			0.12		0.12	V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			$0.35V_{CC}$		$0.35V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			0.7		0.7	V
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$			0.8		0.8	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			$0.3V_{CC}$		$0.3V_{CC}$	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = -100\text{ }\mu\text{A};$ $V_{CC} = 1.65\text{ V to }5.5\text{ V}$	$V_{CC} - 0.1$			$V_{CC} - 0.1$		V
		$I_O = -4\text{ mA}; V_{CC} = 1.65\text{ V}$	1.2			1.05		V
		$I_O = -8\text{ mA}; V_{CC} = 2.3\text{ V}$	1.9			1.7		V
		$I_O = -12\text{ mA}; V_{CC} = 2.7\text{ V}$	2.2			2.1		V
		$I_O = -24\text{ mA}; V_{CC} = 3.0\text{ V}$	2.4			2.2		V
		$I_O = -32\text{ mA}; V_{CC} = 4.5\text{ V}$	3.8			3.4		V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}$						
		$I_O = 100\text{ }\mu\text{A};$ $V_{CC} = 1.65\text{ V to }5.5\text{ V}$			0.1		0.1	V
		$I_O = 4\text{ mA}; V_{CC} = 1.65\text{ V}$			0.45		0.65	V
		$I_O = 8\text{ mA}; V_{CC} = 2.3\text{ V}$			0.3		0.45	V
		$I_O = 12\text{ mA}; V_{CC} = 2.7\text{ V}$			0.4		0.6	V
		$I_O = 24\text{ mA}; V_{CC} = 3.0\text{ V}$			0.55		0.8	V
		$I_O = 32\text{ mA}; V_{CC} = 4.5\text{ V}$			0.55		0.8	V
I_I	input leakage current	$V_I = V_{CC}\text{ or GND};$ $V_{CC} = 5.5\text{ V}$ [2]			± 2		± 10	μA

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Octal bus transceiver; 3-state

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL} ; [2] $V_{CC} = 5.5$ V; $V_O = V_{CC}$ or GND			± 5		± 10	μA
I_{OFF}	power-off leakage current	V_I or $V_O = 5.5$ V; $V_{CC} = 0$ V			± 10		± 20	μA
I_{CC}	supply current	$V_I = V_{IH}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V			10		20	μA
ΔI_{CC}	additional supply current	per input pin; $V_I = V_{CC} - 0.6$ V; $I_O = 0$ A; $V_{CC} = 2.7$ V to 5.5 V			500		5000	μA
C_i	input capacitance	Pin $\overline{OE}$		4.0				pF
		Pin nAn		7.7				pF
$C_{i/o}$	input/output capacitance	$V_{CC} = 0$ V to 5.5 V; $V_I =$ GND to V_{CC}		10				pF
I_{BHL}	bus hold LOW current	$V_I = 0.58$ V; $V_{CCI} = 1.65$ V [3][4]	25			20		μA
		$V_I = 0.70$ V; $V_{CCI} = 2.3$ V	45			45		μA
		$V_I = 0.80$ V; $V_{CCI} = 3.0$ V	100			80		μA
		$V_I = 1.35$ V; $V_{CCI} = 4.5$ V	100			100		μA
I_{BHH}	bus hold HIGH current	$V_I = 1.07$ V; $V_{CCI} = 1.65$ V [3][4]	-1			-1		μA
		$V_I = 1.70$ V; $V_{CCI} = 2.3$ V	-7			-7		μA
		$V_I = 2.00$ V; $V_{CCI} = 3.0$ V	-35			-35		μA
		$V_I = 3.15$ V; $V_{CCI} = 4.5$ V	-95			-95		μA
I_{BHLO}	bus hold LOW overdrive current	$V_{CCI} = 1.95$ V [3][5]	200			200		μA
		$V_{CCI} = 2.7$ V	300			300		μA
		$V_{CCI} = 3.6$ V	500			500		μA
		$V_{CCI} = 5.5$ V	900			900		μA
I_{BHHO}	bus hold HIGH overdrive current	$V_{CCI} = 1.95$ V [3][5]	-200			-200		μA
		$V_{CCI} = 2.7$ V	-300			-300		μA
		$V_{CCI} = 3.6$ V	-500			-500		μA
		$V_{CCI} = 5.5$ V	-900			-900		μA

[1] All typical values are measured at $V_{CC} = 3.3$ V (unless stated otherwise) and $T_{amb} = 25$ °C.

[2] The bus hold circuit is switched off when $V_I > V_{CC}$ allowing 5.5 V on the input terminal.

[3] Valid for data inputs of bus hold parts only (EM74LVCH244A). Note that control inputs do not have a bus hold circuit.

[4] The specified sustaining current at the data input holds the input below the specified V_I level.

[5] The specified overdrive current at the data input forces the data input to the opposite input state.

10. Dynamic Characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7. Typical values measured at $T_{amb} = 25^{\circ}\text{C}$ (unless otherwise noted).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn; nBn to nAn see Fig. 5 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35		40	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20		25	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15		20	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10		15	ns
t_{en}	enable time	$\overline{nOE}$ to nAn, nBn; see Fig. 6 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35		40	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20		25	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15		20	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10		15	ns
t_{dis}	disable time	$\overline{nOE}$ to nAn, nBn; see Fig. 6 [2]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$			35		40	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$			20		25	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$			15		20	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$			10		15	ns
$t_{sk(o)}$	output skew time	[3]			1		1.5	ns
C_{PD}	power dissipation capacitance	per input ; $V_{CC} = 3.3\text{ V}$ $V_I = \text{GND to }V_{CC}$ [4]		18				pF

[1] Typical values are measured at $T_{amb} = 25^{\circ}\text{C}$ and $V_{CC} = 1.8\text{ V}, 2.5\text{ V}, 3.3\text{ V}$, and 5 V respectively.

[2] t_{pd} is the same as t_{PLH} and t_{PHL} . t_{en} is the same as t_{PZL} and t_{PZH} . t_{dis} is the same as t_{PLZ} and t_{PHZ} .

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

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

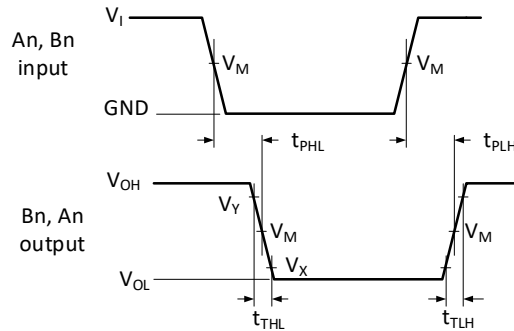
N = number of inputs switching

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

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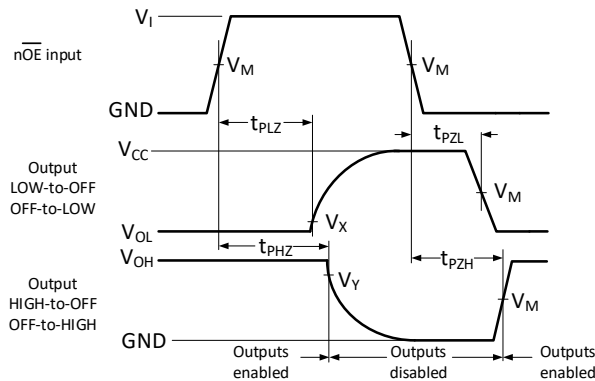
10.1. Waveforms and test circuit



Measurement points are given in Table 8.

V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 4. Input (An, Bn) to output (Bn, An) propagation delays and output transition times



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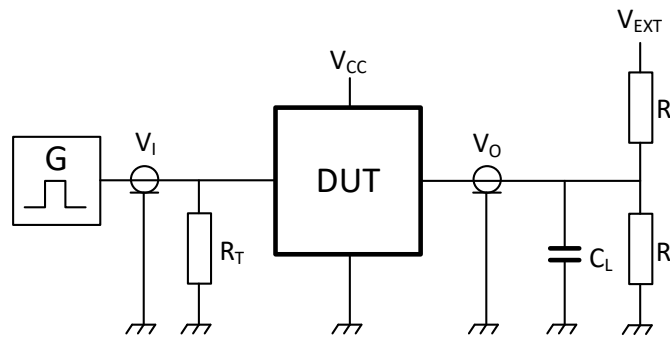
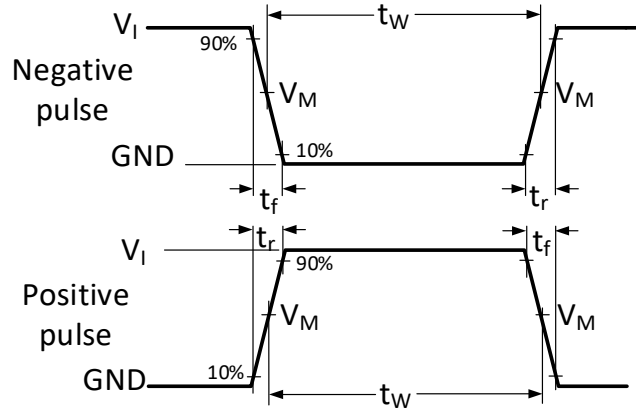
Fig. 5. 3-state enable and disable times

Table 8. Measurement points

Supply voltage	Input		Output		
V_{CC}	V_I	V_M	V_M	V_X	V_Y
1.65 V to 1.95 V	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
3.0 V to 3.6 V	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
4.5 V to 5.5 V	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$

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Octal bus transceiver; 3-state



Test data is given in Table 9.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

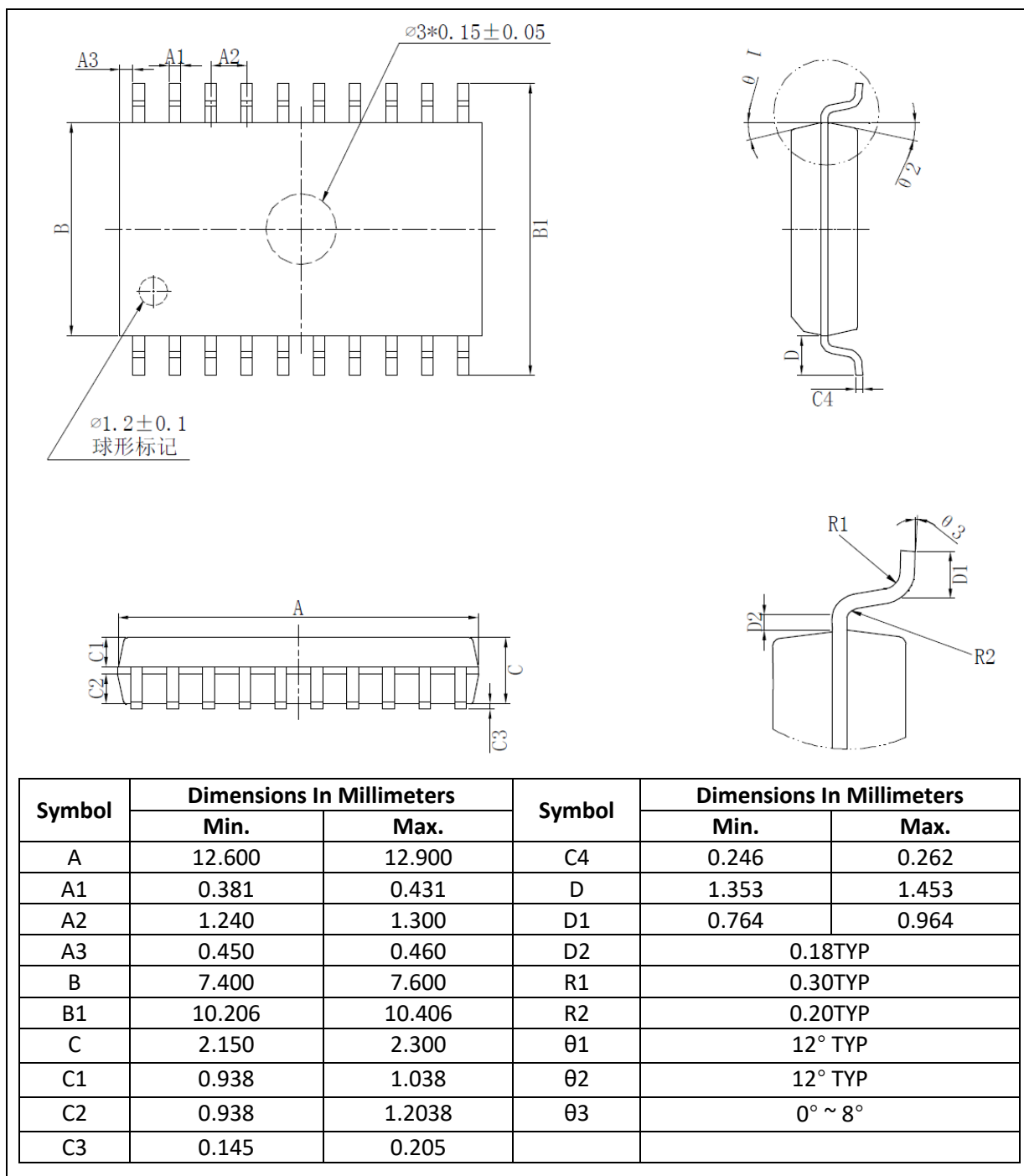
Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}		
	V_I	$t_r = t_f$	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
1.65V to 1.95V	V_{CC}	≤ 2 ns	15 pF	2k Ω	open	GND	2 V_{CC}
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	15 pF	2k Ω	open	GND	2 V_{CC}
3.0 V to 3.6 V	V_{CC}	≤ 2 ns	15 pF	2k Ω	open	GND	2 V_{CC}
4.5 V to 5.5 V	V_{CC}	≤ 2 ns	15 pF	2k Ω	open	GND	2 V_{CC}

11. Package Outline

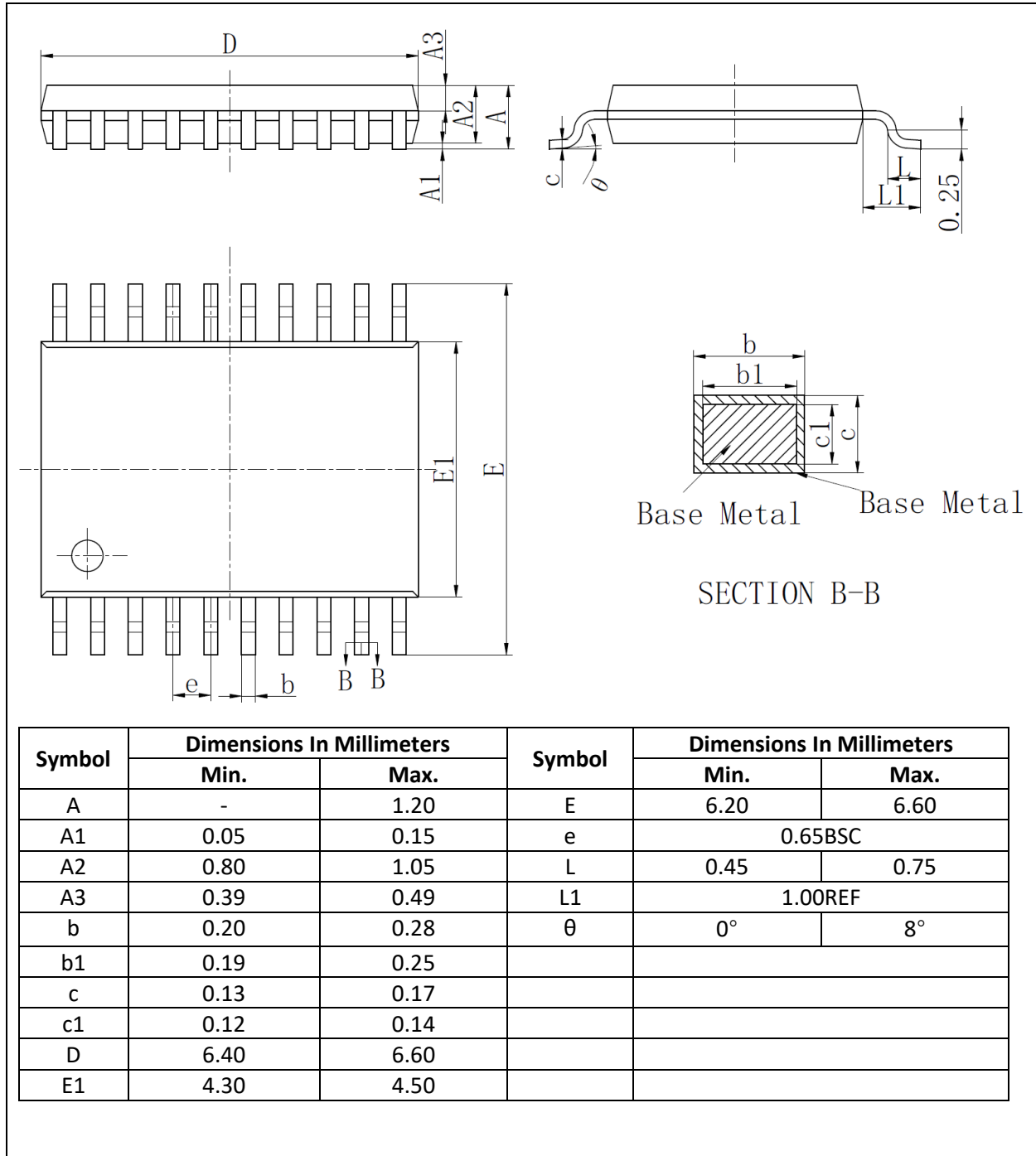
SOP-20L



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TSSOP-20L



12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charged Device Model

13. Revision History

Table 11. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EM74LVC_LVCH245A Rev. 0.1	Feb 18, 2025	Draft datasheet		