

74LVC4245A-Q100

Octal dual supply translating transceiver; 3-state

Rev. 1 — 20 October 2014

Product data sheet

1. General description

The 74LVC4245A-Q100 is an octal dual supply translating transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. It is designed to interface between a 3 V and 5 V bus in a mixed 3 V and 5 V supply environment.

The device features an output enable input (pin \overline{OE}) for easy cascading and a send/receive input (pin DIR) for direction control. Pin \overline{OE} controls the outputs so that the buses are effectively isolated.

In suspend mode, when $V_{CC(A)}$ is zero, there is no current flow from one supply to the other supply. The A-outputs must be set 3-state and the voltage on the A-bus must be smaller than V_{diode} (typical 0.7 V).

$V_{CC(A)} \geq V_{CC(B)}$, except in suspend mode.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - ◆ Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- 5 V tolerant inputs/outputs, for interfacing with 5 V logic
- Wide supply voltage range:
 - ◆ 3 V bus ($V_{CC(B)}$): 1.5 V to 3.6 V
 - ◆ 5 V bus ($V_{CC(A)}$): 1.5 V to 5.5 V
- CMOS low-power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- High-impedance when $V_{CC(A)} = 0\text{ V}$
- Complies with JEDEC standard no. JESD8B/JESD36
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- Multiple package options

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVC4245AD-Q100	-40 °C to +125 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
74LVC4245APW-Q100	-40 °C to +125 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1
74LVC4245ABQ-Q100	-40 °C to +125 °C	DHVQFN24	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 × 5.5 × 0.85 mm	SOT815-1

4. Functional diagram

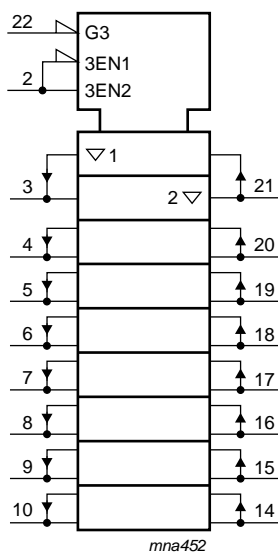


Fig 1. IEC Logic symbol

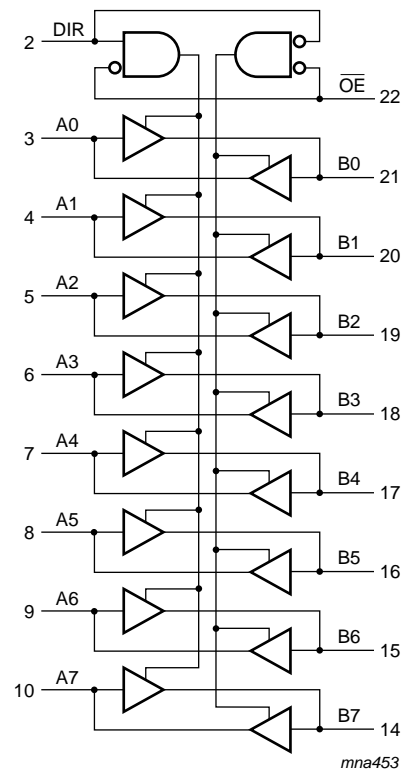
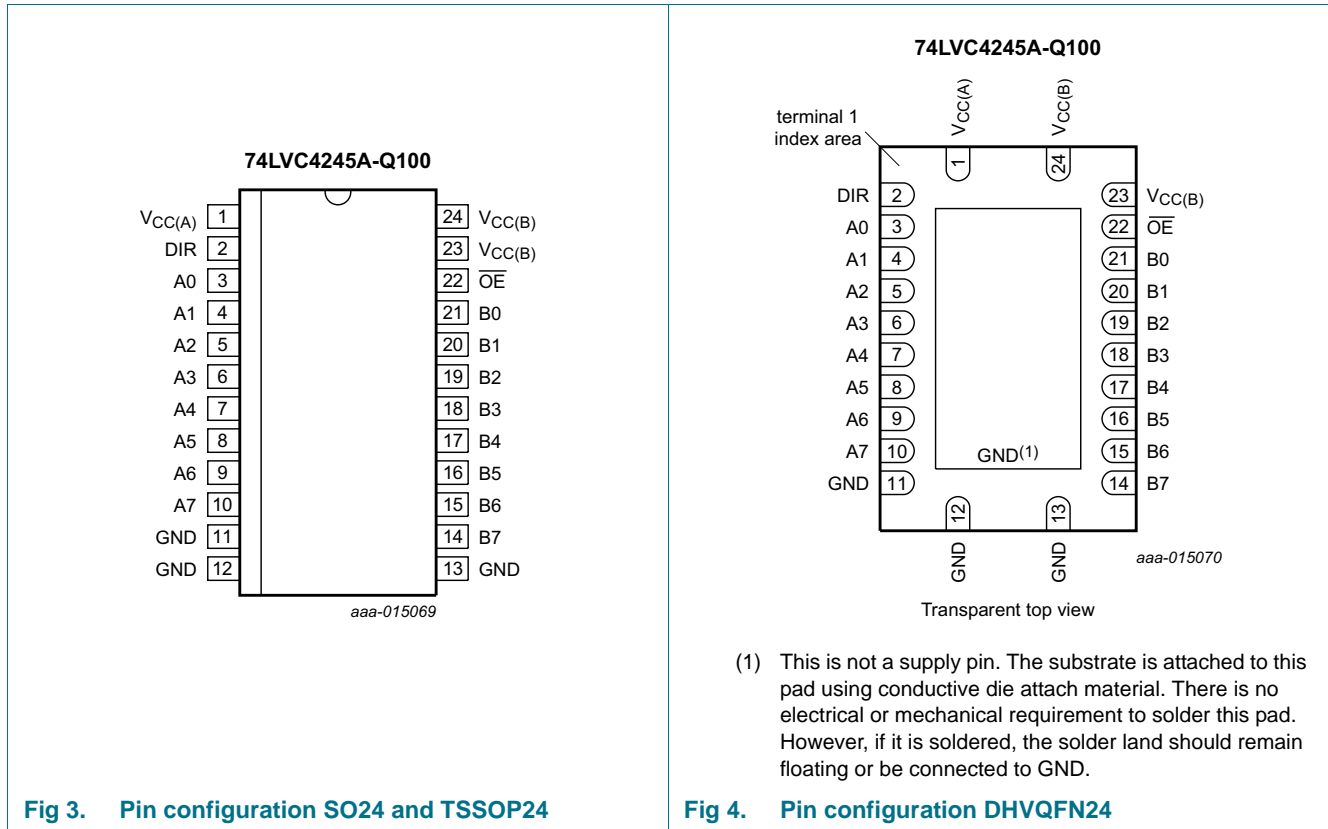


Fig 2. Logic diagram

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
V _{CC(A)}	1	supply voltage (5 V bus)
V _{CC(B)}	23, 24	supply voltage (3 V bus)
GND	11, 12, 13	ground (0 V)
DIR	2	direction control
A[0:7]	3, 4, 5, 6, 7, 8, 9, 10	data input or output
B[0:7]	21, 20, 19, 18, 17, 16, 15, 14	data input or output
OE	22	output enable input (active LOW)

6. Functional description

Table 3. Functional table^[1]

Input		Input/output	
OE	DIR	An	Bn
L	L	A = B	input
L	H	input	B = A
H	X	Z	Z

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

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC(A)}$	supply voltage A		-0.5	+6.5	V
$V_{CC(B)}$	supply voltage B		-0.5	+4.6	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	$V_O > V_{CCO}$ or $V_O < 0$ V	^[3] -	±50	mA
V_O	output voltage	output HIGH or LOW state	^[1] -0.5	$V_{CC} + 0.5$	V
		output 3-state	^[1] -0.5	+6.5	V
I_O	output current	$V_O = 0$ V to V_{CCO}	^[3] -	±50	mA
I_{CC}	supply current		-	100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C	^[2] -	500	mW

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

[2] For SO24 packages: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
 For TSSOP24 packages: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.
 For DHVQFN24 packages: above 60 °C the value of P_{tot} derates linearly with 4.5 mW/K.

[3] V_{CCO} is the supply voltage associated with the output.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC(A)}$	supply voltage A	$V_{CC(A)} \geq V_{CC(B)}$; see Figure 5 for maximum speed performance	1.5	-	5.5	V
$V_{CC(B)}$	supply voltage B	$V_{CC(A)} \geq V_{CC(B)}$; see Figure 5 for low-voltage applications	1.5	-	3.6	V
V_I	input voltage	for control inputs	0	-	5.5	V

Table 5. Recommended operating conditions ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _O	output voltage	output HIGH or LOW state	0	-	V _{CC}	V
		output 3-state	0	-	5.5	V
T _{amb}	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC(B)} = 2.7 V to 3.0 V	-	-	20	ns/V
		V _{CC(B)} = 3.0 V to 3.6 V	-	-	10	ns/V
		V _{CC(A)} = 3.0 V to 4.5 V	-	-	20	ns/V
		V _{CC(A)} = 4.5 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).

Symbol	Parameter	Conditions	Min	Typ ^[1]	Max	Unit
T_{amb} = -40 °C to +85 °C						
V _{IH}	HIGH-level input voltage	V _{CC(B)} = 2.7 V to 3.6 V	2.0	-	-	V
		V _{CC(A)} = 4.5 V to 5.5 V	2.0	-	-	V
V _{IL}	LOW-level input voltage	V _{CC(B)} = 2.7 V to 3.6 V	-	-	0.8	V
		V _{CC(A)} = 4.5 V to 5.5 V	-	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}				
		V _{CC(B)} = 2.7 V to 3.6 V; I _O = -100 μA	V _{CC(B)} - 0.2	V _{CC(B)}	-	V
		V _{CC(B)} = 2.7 V; I _O = -12 mA	V _{CC(B)} - 0.5	-	-	V
		V _{CC(B)} = 3.0 V; I _O = -24 mA	V _{CC(B)} - 0.8	-	-	V
		V _{CC(A)} = 4.5 V to 5.5 V; I _O = -100 μA	V _{CC(A)} - 0.2	V _{CC(A)}	-	V
		V _{CC(A)} = 4.5 V; I _O = -12 mA	V _{CC(A)} - 0.5	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}				
		V _{CC(B)} = 2.7 V to 3.6 V; I _O = 100 μA	-	-	0.20	V
		V _{CC(B)} = 2.7 V; I _O = 12 mA	-	-	0.40	V
		V _{CC(B)} = 3.0 V; I _O = 24 mA	-	-	0.55	V
		V _{CC(A)} = 4.5 V to 5.5 V; I _O = 100 μA	-	-	0.20	V
		V _{CC(A)} = 4.5 V; I _O = 12 mA	-	-	0.40	V
I _I	input leakage current	V _I = 5.5 V or GND	-	±0.1	±5	μA
I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ^[2]				
		V _{CC(B)} = 3.6 V; V _O = V _{CC(B)} or GND	-	±0.1	±5	μA
		V _{CC(A)} = 5.5 V; V _O = V _{CC(A)} or GND	-	±0.1	±5	μA
I _{CC}	supply current	I _O = 0 A				
		V _{CC(B)} = 3.6 V; other inputs at V _{CC(B)} or GND	-	0.1	10	μA
		V _{CC(A)} = 5.5 V; other inputs at V _{CC(A)} or GND	-	0.1	10	μA

Table 6. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ ^[1]	Max	Unit
ΔI_{CC}	additional supply current	per control pin; $I_O = 0$ A [3]				
		$V_{CC(B)} = 2.7$ V to 3.6 V; $V_I = V_{CC(B)} - 0.6$ V; other inputs at $V_{CC(B)}$ or GND	-	5	500	μ A
		$V_{CC(A)} = 4.5$ V to 5.5 V; $V_I = V_{CC(A)} - 0.6$ V; other inputs at $V_{CC(A)}$ or GND	-	5	500	μ A
C_I	input capacitance		-	4.0	-	pF
$C_{I/O}$	input/output capacitance	An and Bn	-	5.0	-	pF
$T_{amb} = -40$ °C to $+125$ °C						
V_{IH}	HIGH-level input voltage	$V_{CC(B)} = 2.7$ V to 3.6 V	2.0	-	-	V
		$V_{CC(A)} = 4.5$ V to 5.5 V	2.0	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC(B)} = 2.7$ V to 3.6 V	-	-	0.8	V
		$V_{CC(A)} = 4.5$ V to 5.5 V	-	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$V_{CC(B)} = 2.7$ V to 3.6 V; $I_O = -100$ μ A	$V_{CC(B)} - 0.3$	-	-	V
		$V_{CC(B)} = 2.7$ V; $I_O = -12$ mA	$V_{CC(B)} - 0.65$	-	-	V
		$V_{CC(B)} = 3.0$ V; $I_O = -24$ mA	$V_{CC(B)} - 1.0$	-	-	V
		$V_{CC(A)} = 4.5$ V to 5.5 V; $I_O = -100$ μ A	$V_{CC(A)} - 0.3$	-	-	V
		$V_{CC(A)} = 4.5$ V; $I_O = -12$ mA	$V_{CC(A)} - 0.65$	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$V_{CC(B)} = 2.7$ V to 3.6 V; $I_O = 100$ μ A	-	-	0.30	V
		$V_{CC(B)} = 2.7$ V; $I_O = 12$ mA	-	-	0.60	V
		$V_{CC(B)} = 3.0$ V; $I_O = 24$ mA	-	-	0.80	V
		$V_{CC(A)} = 4.5$ V to 5.5 V; $I_O = 100$ μ A	-	-	0.30	V
		$V_{CC(A)} = 4.5$ V; $I_O = 12$ mA	-	-	0.60	V
I_I	input leakage current	$V_I = 5.5$ V or GND	-	-	± 20	μ A
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL} [2]				
		$V_{CC(B)} = 3.6$ V; $V_O = V_{CC(B)}$ or GND	-	-	± 20	μ A
		$V_{CC(A)} = 5.5$ V; $V_O = V_{CC(A)}$ or GND	-	-	± 20	μ A
I_{CC}	supply current	$I_O = 0$ A				
		$V_{CC(B)} = 3.6$ V; other inputs at $V_{CC(B)}$ or GND	-	-	40	μ A
		$V_{CC(A)} = 5.5$ V; other inputs at $V_{CC(A)}$ or GND	-	-	40	μ A

Table 6. Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ ^[1]	Max	Unit
ΔI_{CC}	additional supply current	per control pin; $I_O = 0$ A ^[3]				
		$V_{CC(B)} = 2.7$ V to 3.6 V; $V_I = V_{CC(B)} - 0.6$ V; other inputs at $V_{CC(B)}$ or GND	-	-	5000	μ A
		$V_{CC(A)} = 4.5$ V to 5.5 V; $V_I = V_{CC(A)} - 0.6$ V; other inputs at $V_{CC(A)}$ or GND	-	-	5000	μ A

[1] All typical values are measured at $V_{CC(A)} = 5.0$ V, $V_{CC(B)} = 3.3$ V and $T_{amb} = 25$ °C.[2] For transceivers, the parameter I_{OZ} includes the input leakage current.[3] $V_{CC(B)} = 2.7$ V to 3.6 V: other inputs at $V_{CC(B)}$ or GND. $V_{CC(A)} = 4.5$ V to 5.5 V: other inputs at $V_{CC(A)}$ or GND.

10. Dynamic characteristics

Table 7. Dynamic characteristicsVoltages are referenced to GND (ground = 0 V). $V_{CC(A)} = 4.5$ V to 5.5 V; $t_r = t_f \leq 2.5$ ns. For test circuit, see [Figure 8](#).

Symbol	Parameter	Conditions	$V_{CC(B)}$	-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ ^[1]	Max	Min	Max	
t_{PHL}	HIGH to LOW propagation delay	An to Bn; see Figure 6	2.7 V	1.0	3.6	6.3	1.0	8.0	ns
			3.0 V to 3.6 V	1.0	3.3	6.3	1.0	8.0	ns
		Bn to An; see Figure 6	2.7 V	1.0	3.4	6.1	1.0	8.0	ns
			3.0 V to 3.6 V	1.0	3.4	6.1	1.0	8.0	ns
t_{PLH}	LOW to HIGH propagation delay	An to Bn; see Figure 6	2.7 V	1.0	3.3	6.7	1.0	8.5	ns
			3.0 V to 3.6 V	1.0	2.8	6.5	1.0	8.5	ns
		Bn to An; see Figure 6	2.7 V	1.0	3.0	5.0	1.0	6.5	ns
			3.0 V to 3.6 V	1.0	3.0	5.0	1.0	6.5	ns
t_{PZL}	OFF-state to LOW propagation delay	\overline{OE} to An; see Figure 7	2.7 V	1.0	4.5	9.0	1.0	11.5	ns
			3.0 V to 3.6 V	1.0	4.5	9.0	1.0	11.5	ns
		\overline{OE} to Bn; see Figure 7	2.7 V	1.0	4.4	8.7	1.0	11.0	ns
			3.0 V to 3.6 V	1.0	3.8	8.1	1.0	10.5	ns
t_{PZH}	OFF-state to HIGH propagation delay	\overline{OE} to An; see Figure 7	2.7 V	1.0	4.5	8.1	1.0	10.5	ns
			3.0 V to 3.6 V	1.0	4.5	8.1	1.0	10.5	ns
		\overline{OE} to Bn; see Figure 7	2.7 V	1.0	4.3	8.7	1.0	11.0	ns
			3.0 V to 3.6 V	1.0	3.2	8.1	1.0	10.5	ns
t_{PLZ}	LOW to OFF-state propagation delay	\overline{OE} to An; see Figure 7	2.7 V	1.0	2.9	7.0	1.0	9.0	ns
			3.0 V to 3.6 V	1.0	2.9	7.0	1.0	9.0	ns
		\overline{OE} to Bn; see Figure 7	2.7 V	1.0	3.9	7.7	1.0	10.0	ns
			3.0 V to 3.6 V	1.0	3.5	7.7	1.0	10.0	ns
t_{PHZ}	HIGH to OFF-state propagation delay	\overline{OE} to An; see Figure 7	2.7 V	1.0	2.8	5.8	1.0	7.5	ns
			3.0 V to 3.6 V	1.0	2.8	5.8	1.0	7.5	ns
		\overline{OE} to Bn; see Figure 7	2.7 V	1.0	3.3	7.8	1.0	10.0	ns
			3.0 V to 3.6 V	1.0	2.9	7.8	1.0	10.0	ns

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V). $V_{CC(A)} = 4.5\text{ V to }5.5\text{ V}$; $t_r = t_f \leq 2.5\text{ ns}$. For test circuit, see [Figure 8](#).

Symbol	Parameter	Conditions	$V_{CC(B)}$	-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ ^[1]	Max	Min	Max	
$t_{sk(o)}$	output skew time		[2]	-	-	1.0	-	1.5	ns
C_{PD}	power dissipation capacitance	5 V bus: Bn to An; $V_I = \text{GND to } V_{CC(A)}$; $V_{CC(A)} = 5.0\text{ V}$	[3]						
		outputs enabled	-	-	17	-	-	-	pF
		outputs disabled	-	-	5	-	-	-	pF
		3 V bus: An to Bn; $V_I = \text{GND to } V_{CC(B)}$; $V_{CC(B)} = 3.3\text{ V}$	[3]						
		outputs enabled	-	-	17	-	-	-	pF
		outputs disabled	-	-	5	-	-	-	pF

- [1] Typical values are measured at $T_{amb} = 25\text{ °C}$, $V_{CC(A)} = 5.0\text{ V}$, and $V_{CC(B)} = 2.7\text{ V}$ and 3.3 V respectively.
- [2] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
- [3] 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

11. AC waveforms

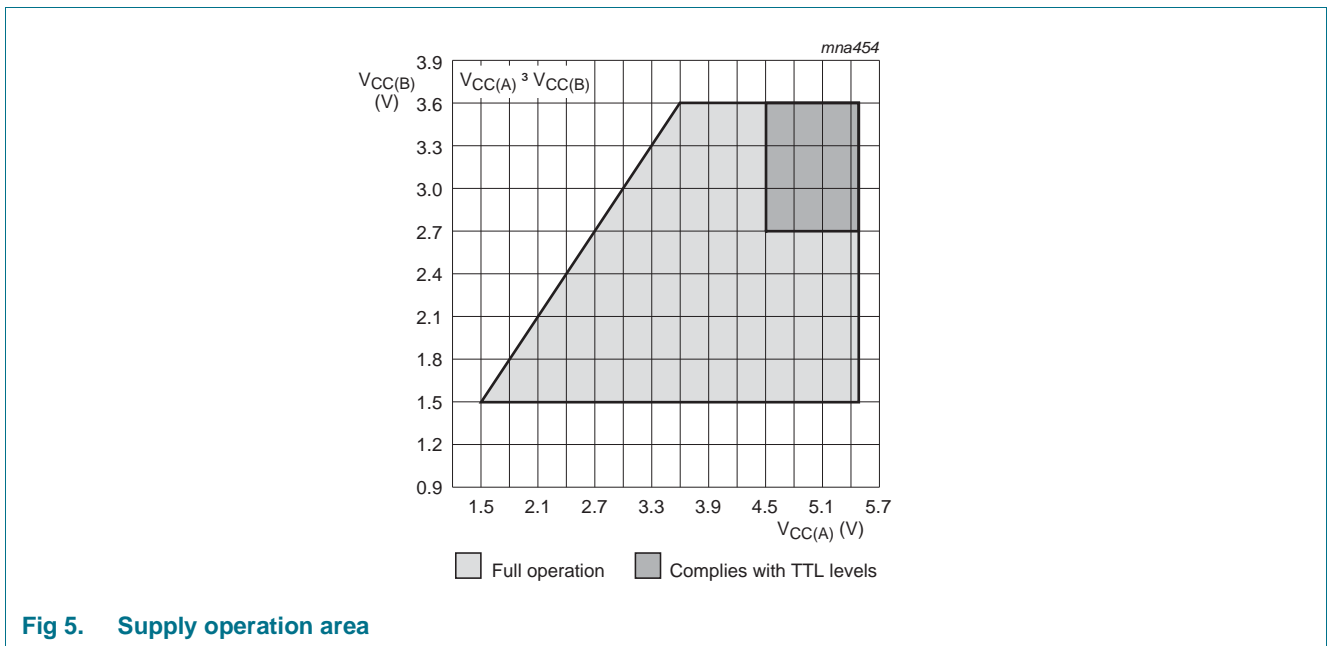
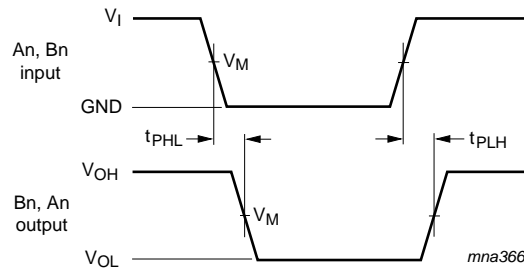


Fig 5. Supply operation area

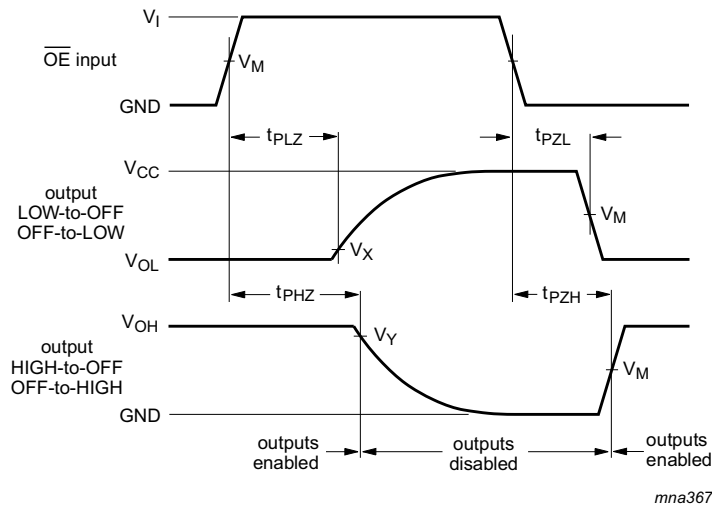


$V_M = 1.5 \text{ V}$ at $2.7 \text{ V} \leq V_{CC(B)} \leq 3.6 \text{ V}$.

$V_M = 0.5 V_{CC(A)}$ at $V_{CC(A)} \geq 4.5 \text{ V}$.

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

Fig 6. Input (An, Bn) to output (Bn, An) propagation delays



$V_M = 1.5 \text{ V}$ at $2.7 \text{ V} \leq V_{CC(B)} \leq 3.6 \text{ V}$.

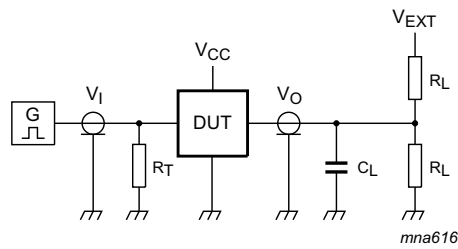
$V_M = 0.5 V_{CC(A)}$ at $V_{CC(A)} \geq 4.5 \text{ V}$.

$V_X = V_{OL} + 0.3 \text{ V}$ at $V_{CC(B)} \geq 2.7 \text{ V}$.

$V_Y = V_{OH} - 0.3 \text{ V}$ at $V_{CC(B)} \geq 2.7 \text{ V}$.

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

Fig 7. 3-state enable and disable times



Test data is given in [Table 8](#). 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 output impedance Z_o of the pulse generator.

Fig 8. Test circuit for measuring switching times

Table 8. Test data

Supply voltage		Input	Load		V_{EXT}		
$V_{CC(A)}$	$V_{CC(B)}$	V_I [1]	C_L	R_L	t_{PLH} , t_{PHL}	t_{PZH} , t_{PHZ}	t_{PZL} , t_{PLZ} [2]
< 2.7 V	< 2.7 V	V_{CCI}	50 pF	500 Ω	open	GND	$2 \times V_{CCO}$
-	2.7 V to 3.6 V	2.7 V	50 pF	500 Ω	open	GND	$2 \times V_{CCO}$
4.5 V to 5.5 V	-	3.0 V	50 pF	500 Ω	open	GND	$2 \times V_{CCO}$

[1] V_{CCI} is the supply voltage associated with the data input port.

[2] V_{CCO} is the supply voltage associated with the output port.

12. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1

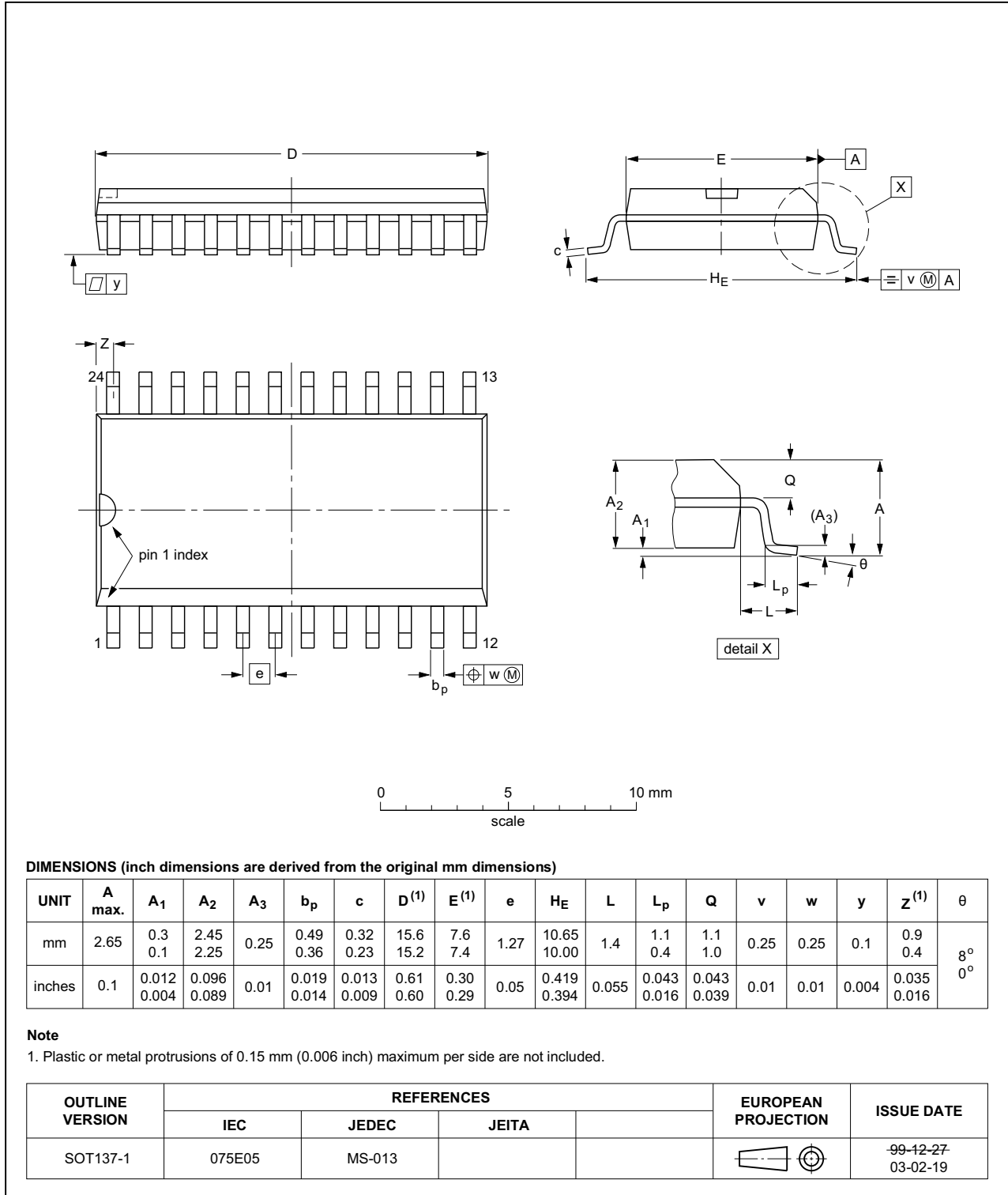


Fig 9. Package outline SOT137-1 (SO24)

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1

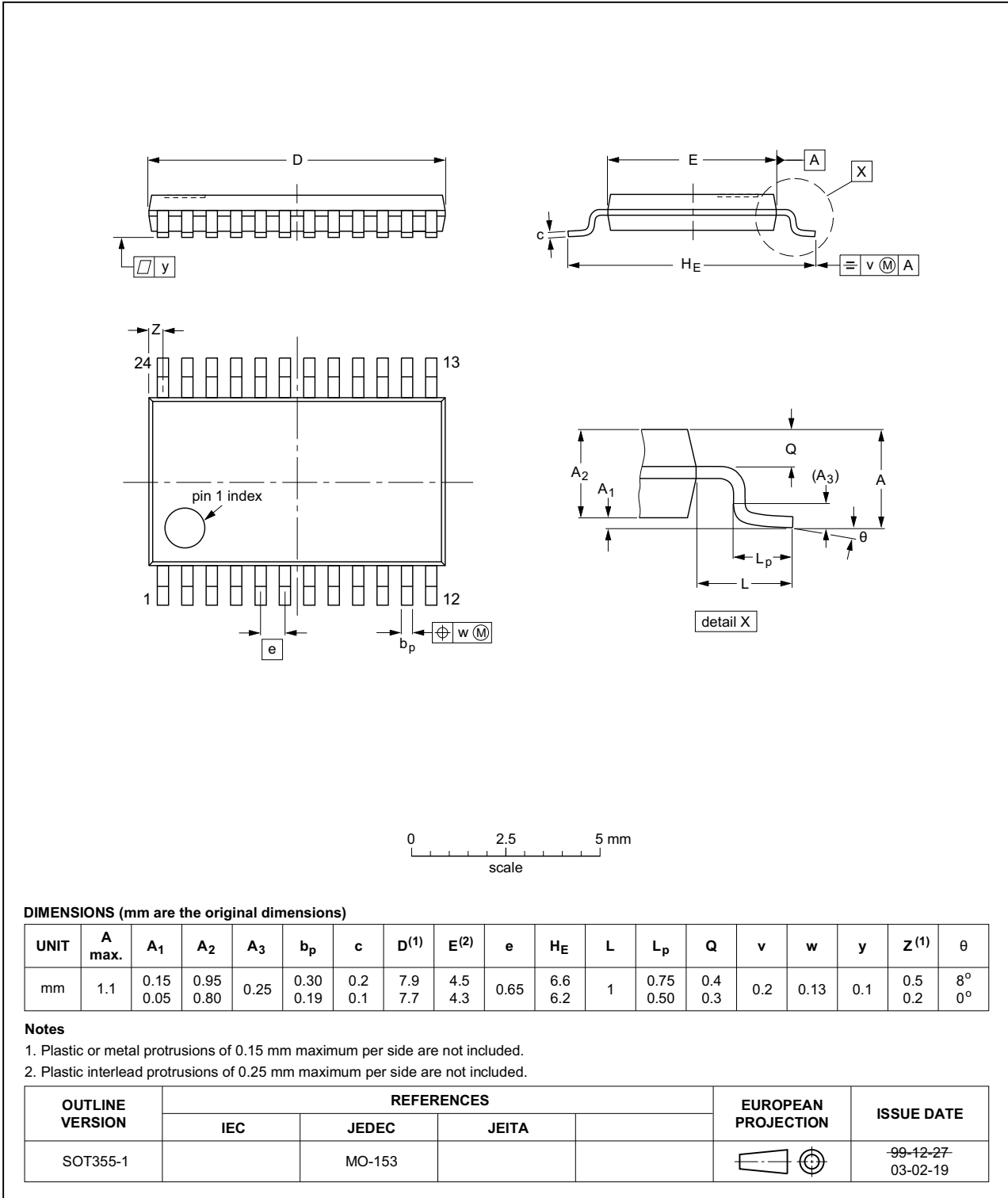


Fig 10. Package outline SOT355-1 (TSSOP24)

DHVQFN24: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm

SOT815-1

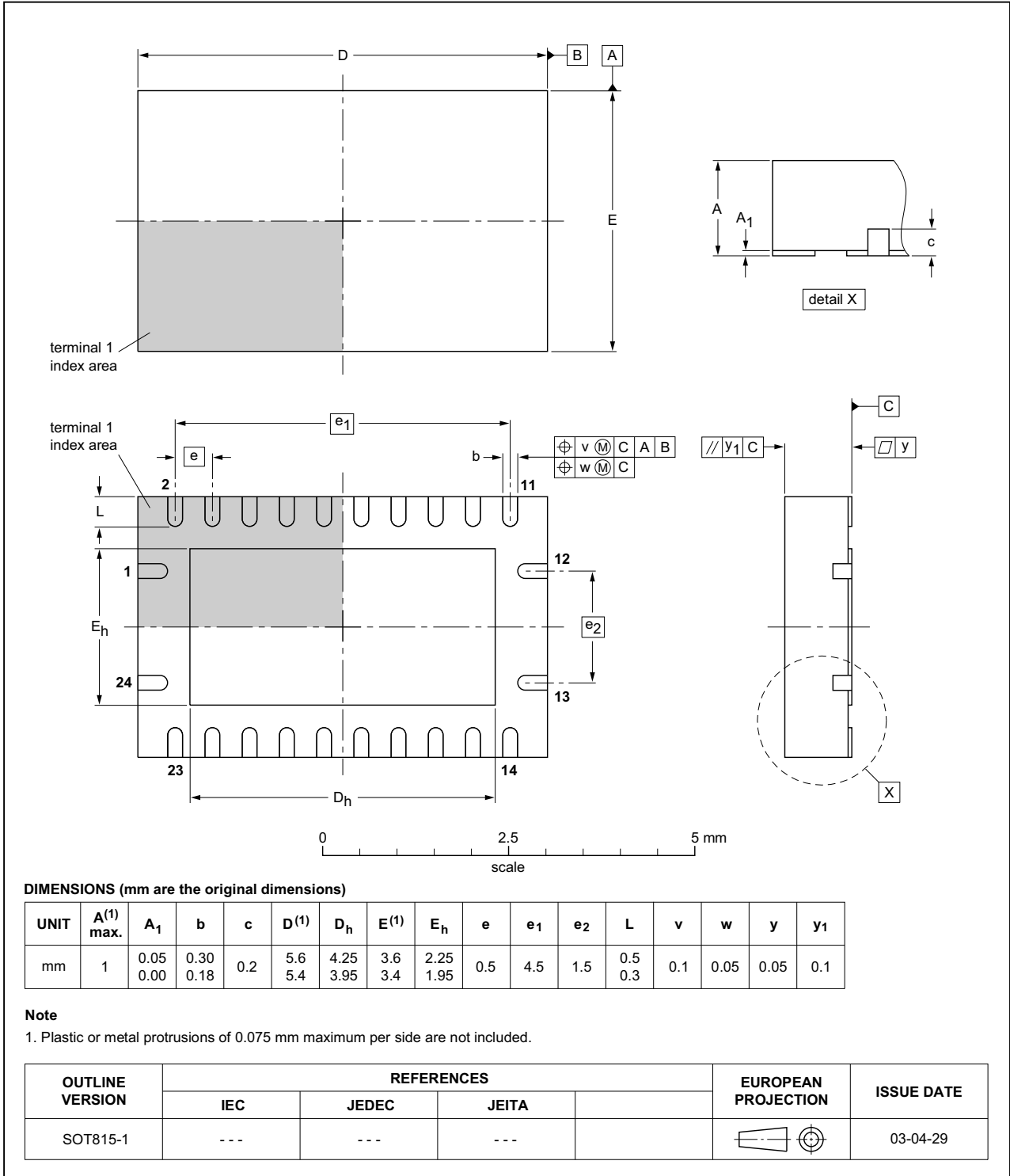


Fig 11. Package outline SOT815-1 (DHVQFN24)

13. Abbreviations

Table 9. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC4245A_Q100 v.1	20141020	Product data sheet	-	-

15. Legal information

15.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nexperia.com>.

15.2 Definitions

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16. Contact information

For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: salesaddresses@nexperia.com

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