

# 74LVC821A

10-bit D-type flip-flop with 5 V tolerant inputs/outputs;  
positive-edge trigger; 3-state

Rev. 4 — 23 November 2012

Product data sheet

## 1. General description

The 74LVC821A is a 10-bit D-type flip-flop featuring separate D-type inputs for each flip-flop and 3-state outputs for bus-oriented applications. A clock input (pin CP) and an output enable input (pin  $\overline{OE}$ ) are common to all flip-flops. The ten flip-flops store the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW-to-HIGH CP transition. When pin  $\overline{OE}$  is LOW, the contents of the ten flip-flops are available at the outputs.

When pin  $\overline{OE}$  is HIGH, the outputs go to the high-impedance OFF-state. Operation of the  $\overline{OE}$  inputs does not affect the state of the flip-flops.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices as translators in mixed 3.3 V and 5 V applications.

## 2. Features and benefits

- 5 V tolerant inputs and outputs; for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Flow-through pinout architecture
- 10-bit positive edge-triggered register
- Independent register and 3-state buffer operation
- Complies with JEDEC standard:
  - ◆ 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 JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .



### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74LVC821AD	-40 °C to +125 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
74LVC821ADB	-40 °C to +125 °C	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	SOT340-1
74LVC821APW	-40 °C to +125 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1
74LVC821ABQ	-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

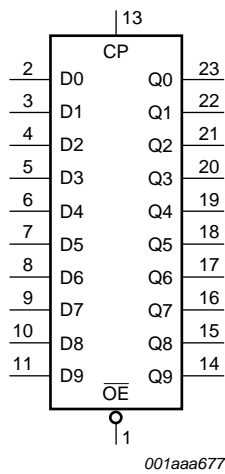


Fig 1. Logic symbol

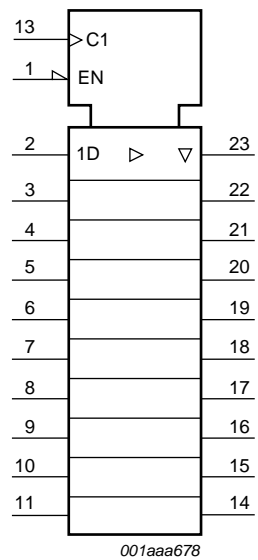


Fig 2. IEC logic symbol

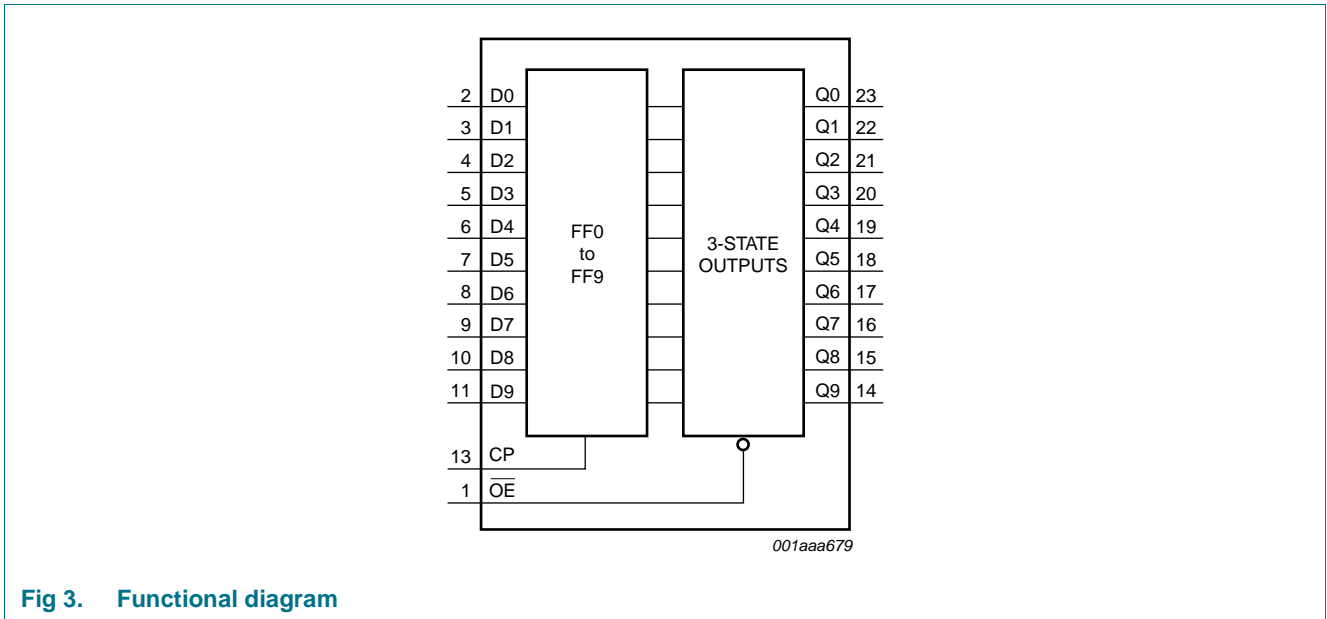


Fig 3. Functional diagram

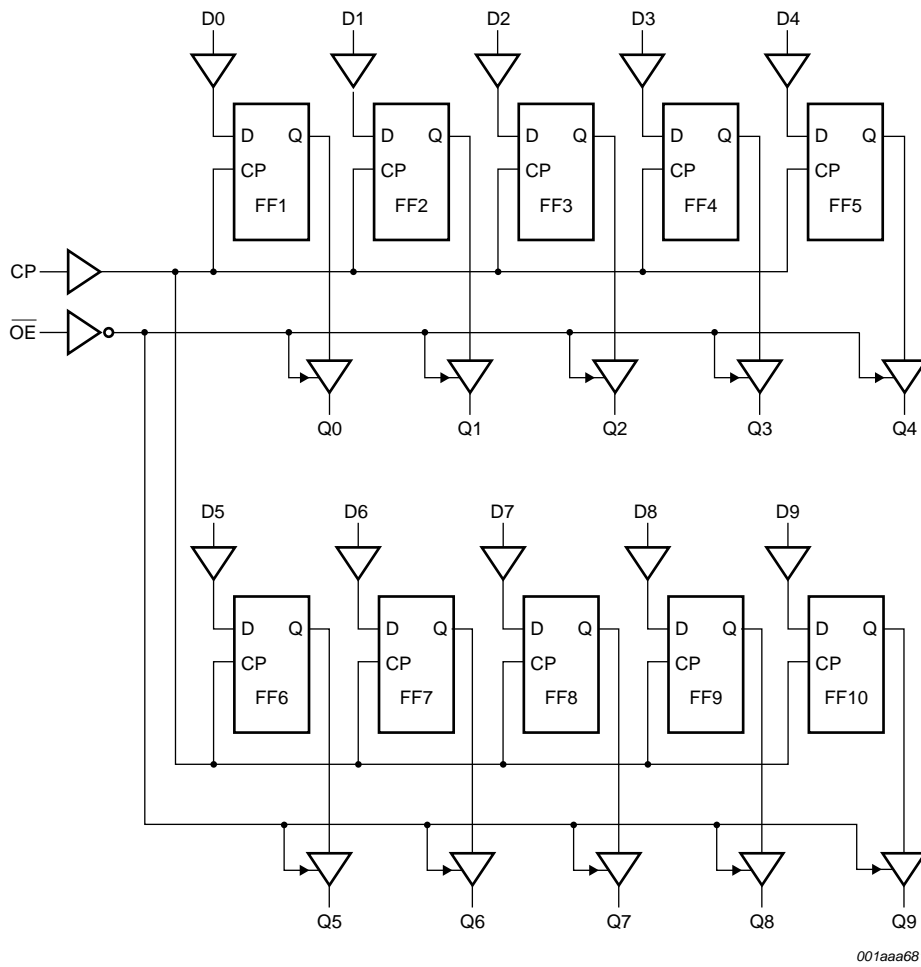


Fig 4. Logic diagram

## 5. Pinning information

### 5.1 Pinning

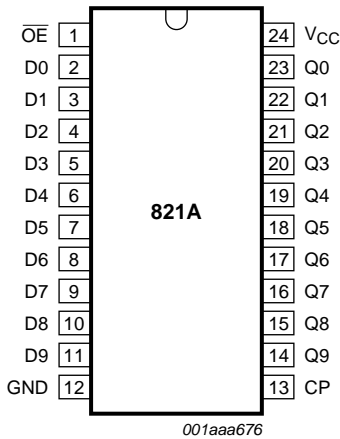
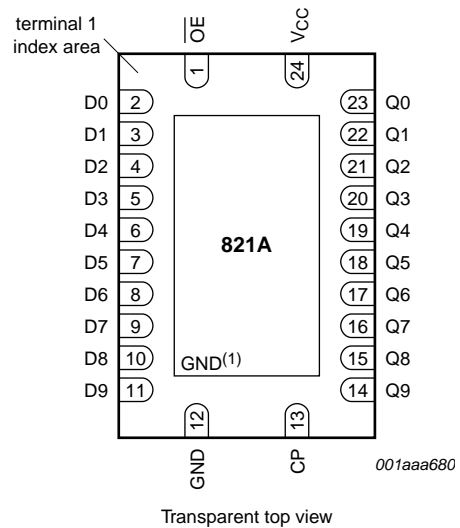


Fig 5. Pin configuration SO24 and (T)SSOP24



- (1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 6. Pin configuration DHVQFN24

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
OE	1	output enable input (active LOW)
CP	13	clock input (LOW-to-HIGH, edge-triggered)
D[0:9]	2, 3, 4, 5, 6, 7, 8, 9, 10, 11	data input
Q[0:9]	23, 22, 21, 20, 19, 18, 17, 16, 15, 14	3-state flip-flop output
GND	12	ground (0 V)
VCC	24	supply voltage

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Operating mode	Input			Internal flip-flops	Output Qn
	OE	CP	Dn		
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	l	L	Z
	H	↑	h	H	Z
Hold	L	H or L	X	NC	NC

- [1] H = HIGH voltage level  
 h = HIGH voltage level one set-up time before the LOW-to-HIGH CP transition  
 L = LOW voltage level  
 l = LOW voltage level one set-up time before the LOW-to-HIGH CP transition  
 Z = high-impedance OFF-state  
 ↑ = LOW-to-HIGH clock transition  
 X = don't care  
 NC = no change

## 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
$V_{CC}$	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	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
$V_O$	output voltage	HIGH or LOW state	[2] -0.5	$V_{CC} + 0.5$	V
		3-state	[2] -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
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[3] -	500	mW

- [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.  
 [3] For SO24 package: above 70 °C derate linearly with 8 mW/K.  
 For SSOP24 and TSSOP24 packages: above 60 °C derate linearly with 5.5 mW/K.  
 For DHVQFN24 package: above 60 °C derate linearly with 4.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	HIGH or LOW state	0	-	V <sub>CC</sub>	V
		3-state	0	-	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 2.7 V to 3.6 V	0	-	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	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND	-	±0.1	±5	-	±20	μA

**Table 6. Static characteristics ...continued**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; V <sub>O</sub> = 5.5 V or GND;	-	0.1	±5	-	±20	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 5.5 V	-	0.1	±10	-	±20	μA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.1	10	-	40	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	5	500	-	5000	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	5.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	CP to Qn; see <a href="#">Figure 7</a> <sup>[2]</sup>	-	18	-	-	-	ns
		V <sub>CC</sub> = 1.2 V	-	18	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.4	8.6	17.1	2.3	19.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.8	4.5	8.8	1.6	10.1	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.1	8.5	2.2	11.0	ns
t <sub>en</sub>	enable time	OE to Qn; see <a href="#">Figure 9</a> <sup>[2]</sup>	-	20	-	-	-	ns
		V <sub>CC</sub> = 1.2 V	-	20	-	-	-	ns
		V <sub>CC</sub> = 1.65 V	1.8	7.7	17.4	1.6	20.1	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	4.3	9.6	1.3	11.0	ns
		V <sub>CC</sub> = 2.7 V	1.3	4.4	8.8	2.4	11.0	ns
t <sub>dis</sub>	disable time	OE to Qn; see <a href="#">Figure 9</a> <sup>[2]</sup>	-	9.0	-	-	-	ns
		V <sub>CC</sub> = 1.2 V	-	9.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V	2.5	4.4	10.4	1.8	12.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.4	5.9	0.6	6.8	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.3	6.8	2.2	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.5	7.6	1.5	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.0	6.2	1.9	8.0	ns



**Table 7. Dynamic characteristics ...continued**  
 Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 10](#).

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ <sup>[1]</sup>	Max	Min	Max		
t <sub>w</sub>	pulse width	clock HIGH or LOW; see <a href="#">Figure 7</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns	
		V <sub>CC</sub> = 2.7 V	3.3	-	-	3.3	-	ns	
t <sub>su</sub>	set-up time	Dn to CP; see <a href="#">Figure 8</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	3.5	-	-	3.5	-	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns	
		V <sub>CC</sub> = 2.7 V	0.9	-	-	0.9	-	ns	
t <sub>h</sub>	hold time	Dn to CP; see <a href="#">Figure 8</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns	
		V <sub>CC</sub> = 2.3 V to 2.7 V	2.0	-	-	2.0	-	ns	
		V <sub>CC</sub> = 2.7 V	1.5	-	-	1.5	-	ns	
f <sub>max</sub>	maximum frequency	see <a href="#">Figure 7</a>							
		V <sub>CC</sub> = 1.65 V to 1.95 V	100	-	-	80	-	MHz	
		V <sub>CC</sub> = 2.3 V to 2.7 V	125	-	-	100	-	MHz	
		V <sub>CC</sub> = 2.7 V	150	-	-	120	-	MHz	
t <sub>sk(o)</sub>	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V	<sup>[3]</sup>	-	-	1.0	-	1.5	ns
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>i</sub> = GND to V <sub>CC</sub>	<sup>[4]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	12.5	-	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	14.7	-	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	16.6	-	-	-	pF	

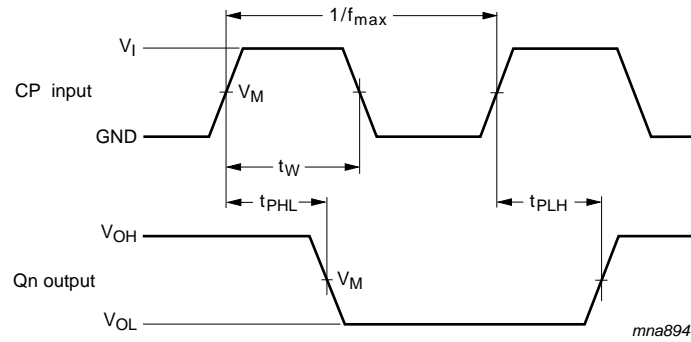
[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.  
 t<sub>en</sub> is the same as t<sub>pZL</sub> and t<sub>pZH</sub>.  
 t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

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

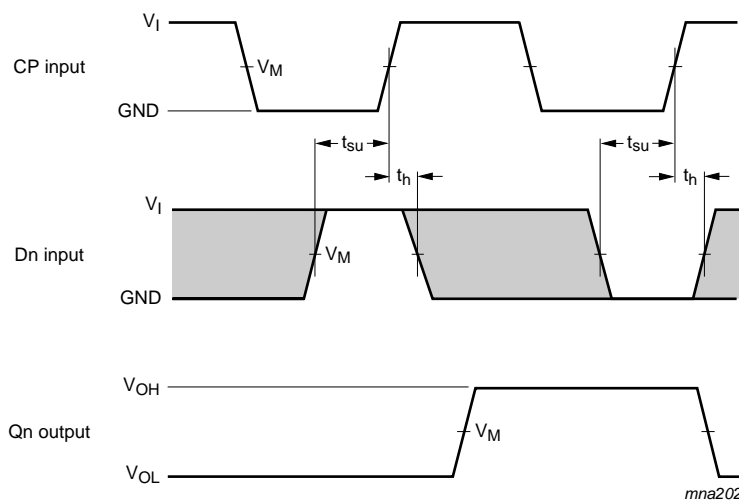
[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).  
 P<sub>D</sub> = C<sub>PD</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>i</sub> × N + Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) where:  
 f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz  
 C<sub>L</sub> = output load capacitance in pF  
 V<sub>CC</sub> = supply voltage in Volts  
 N = number of inputs switching  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs

11. Waveforms



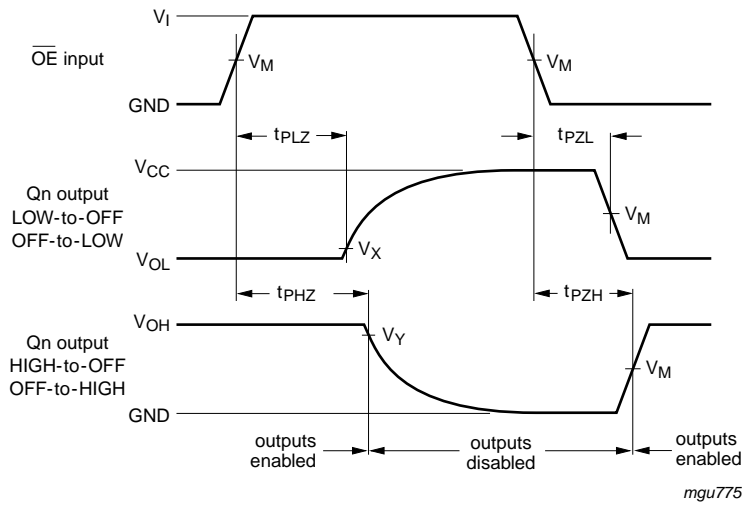
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage levels that occur with the output load.

**Fig 7. Clock (CP) to output (Qn) propagation delays, the clock pulse width, and the maximum frequency**



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage levels that occur with the output load.  
 The shaded areas indicate when the input is permitted to change for predicable output performance.

**Fig 8. Data set-up and hold times for the Dn input to the CP input**

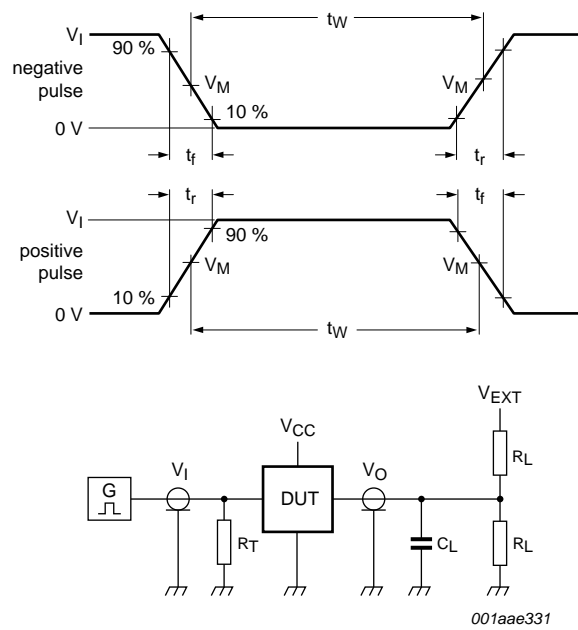


Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage levels that occur with the output load.

**Fig 9. 3-state enable and disable times**

**Table 8. Measurement points**

Supply voltage	Input		Output		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.2 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



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 output impedance  $Z_o$  of the pulse generator.

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

**Fig 10. Load circuitry for switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

12. Package outline

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

SOT137-1

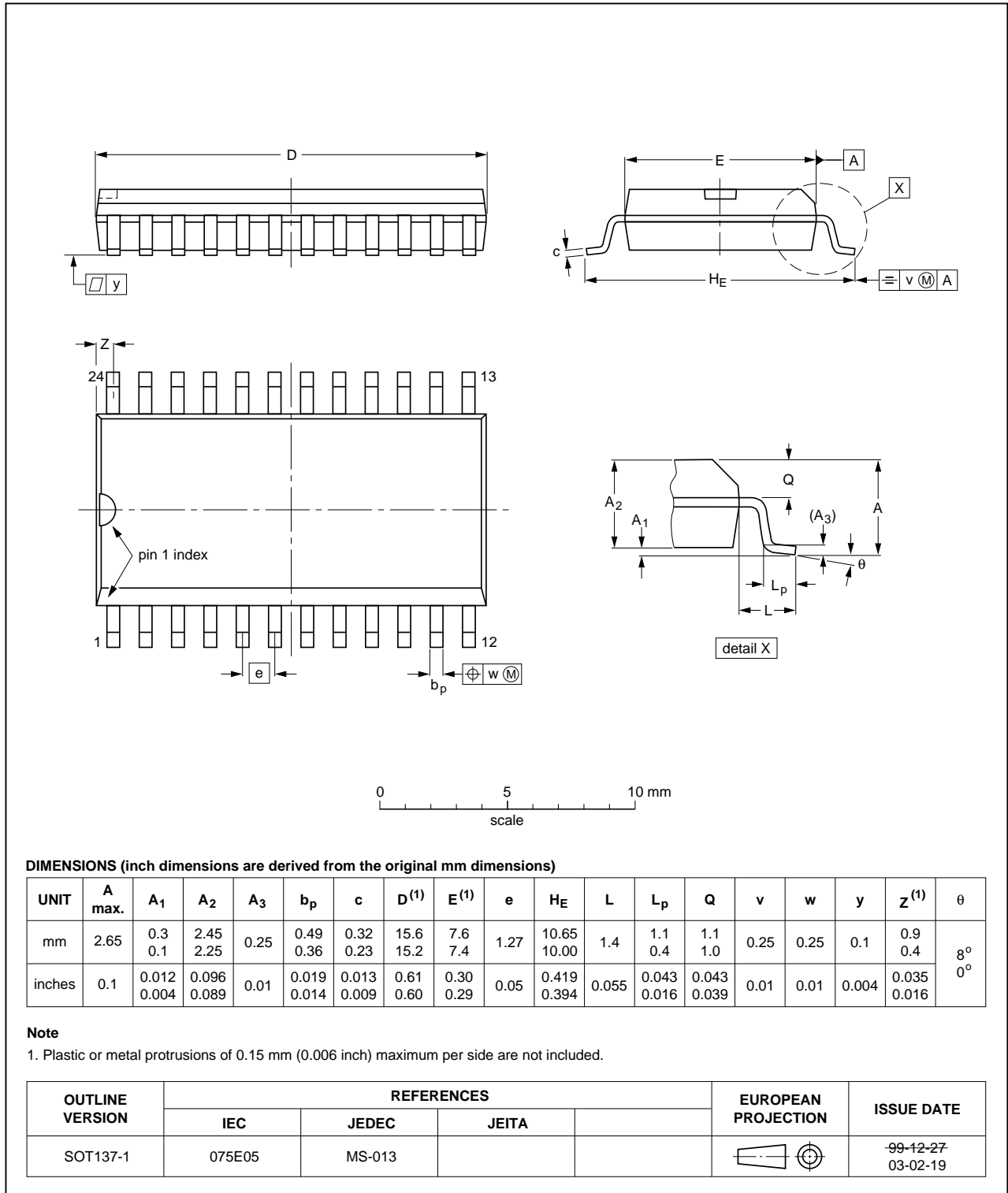


Fig 11. Package outline SOT 137-1 (SO24)

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1

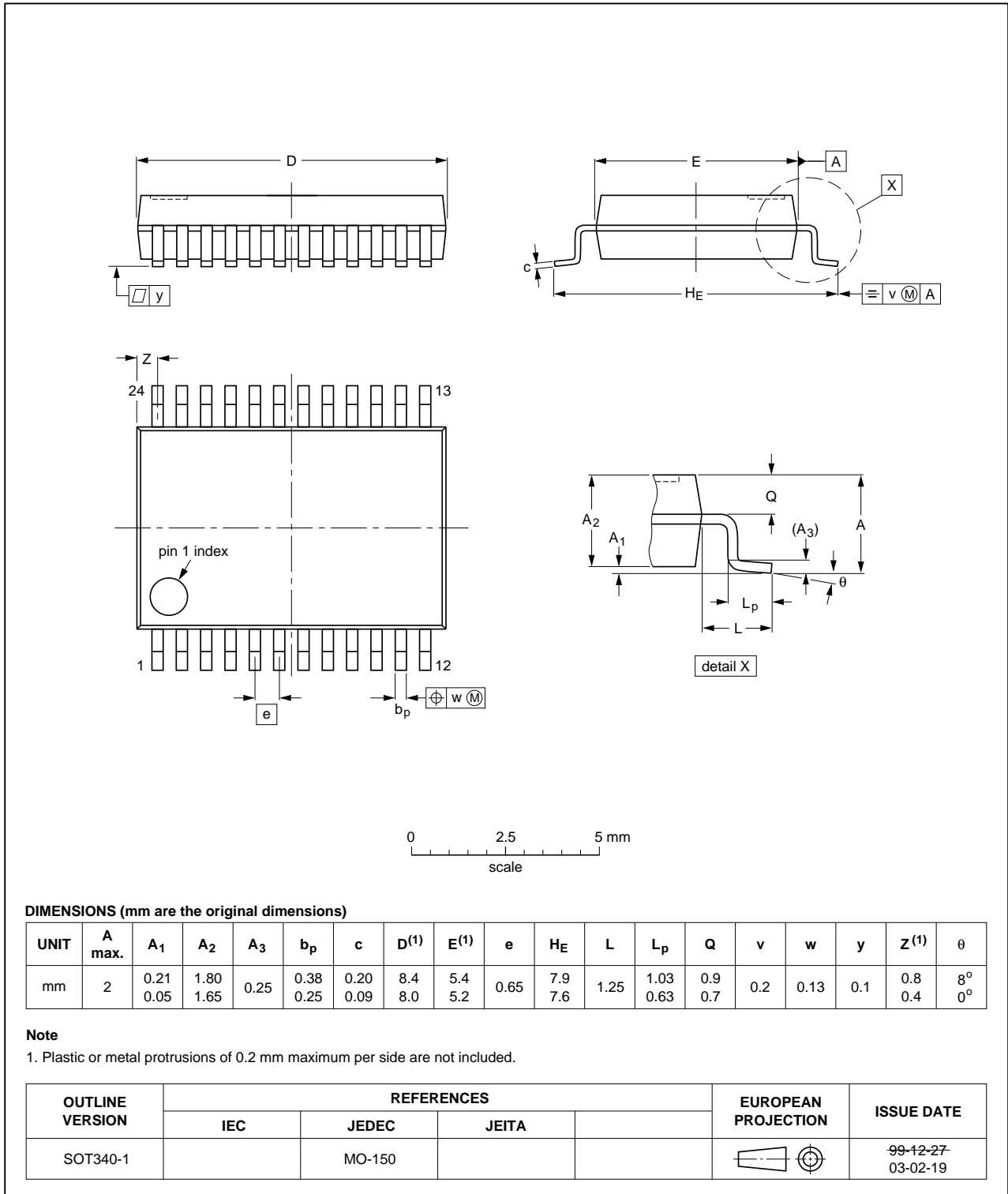


Fig 12. Package outline SOT 340-1 (SSOP24)

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

SOT355-1

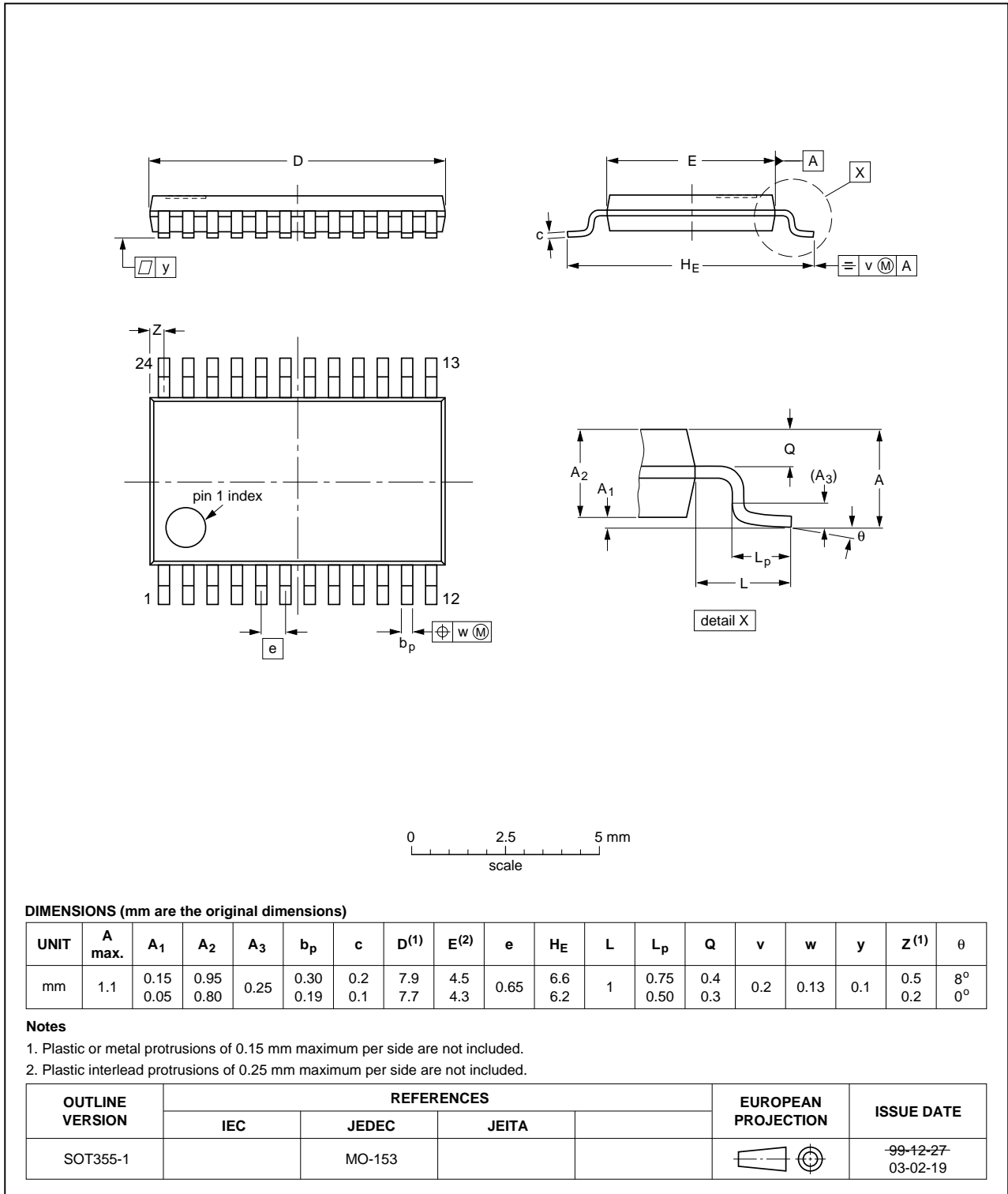


Fig 13. Package outline SOT 355-1 (TSSOP24)

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

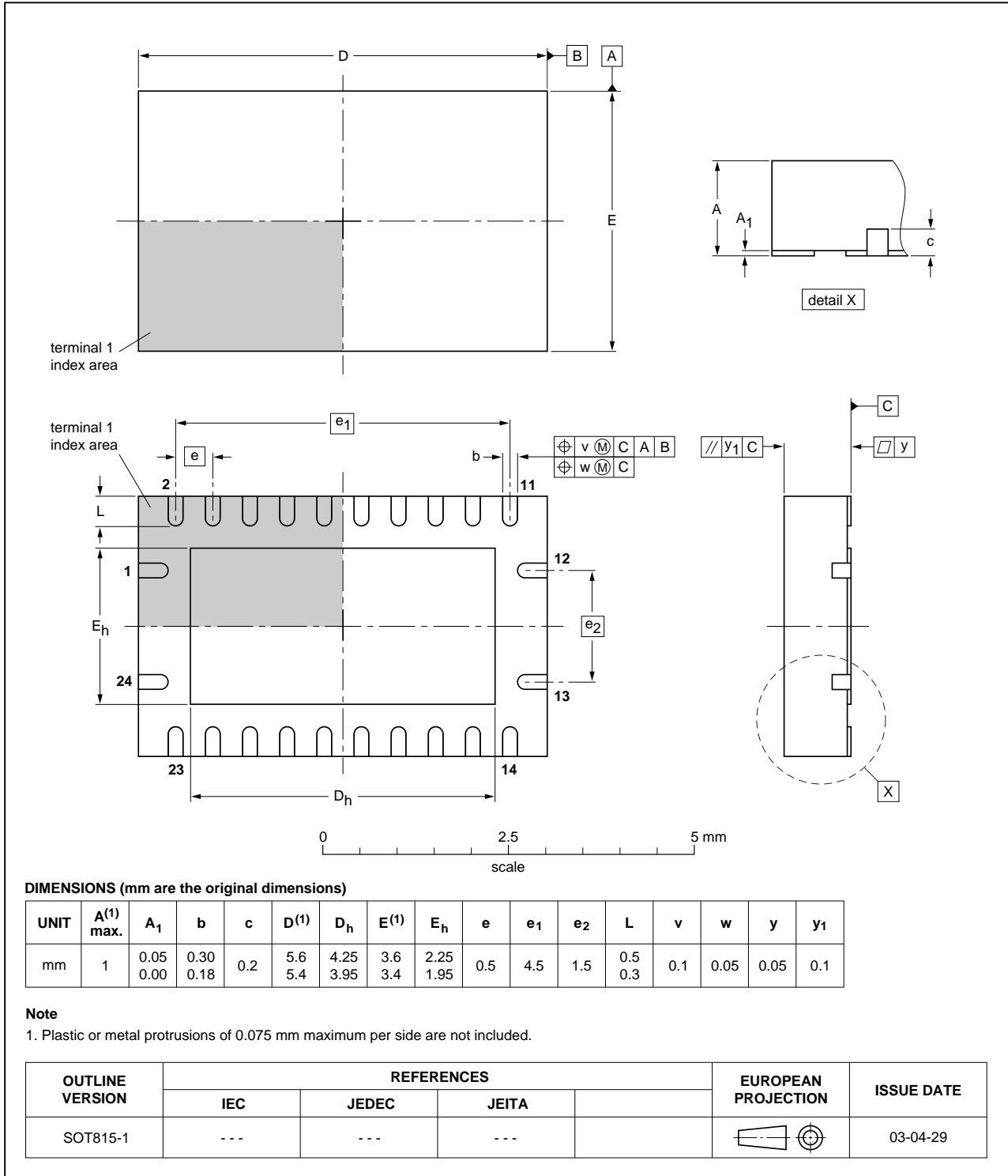


Fig 14. Package outline SOT 815-1 (DHVQFN24)



## 13. Abbreviations

Table 10. Abbreviations

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

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC821A v.4	20121123	Product data sheet	-	74LVC821A v.3
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a>, and <a href="#">Table 8</a>: values added for lower voltage ranges.</li> </ul>			
74LVC821A v.3	20040511	Product specification	-	74LVC821A v.2
74LVC821A v.2	20040415	Product specification	-	74LVC821A v.1
74LVC821A v.1	19980925	Product specification	-	-

## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.nxp.com>.

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