

# 74HC1G125-Q100; 74HCT1G125-Q100

Bus buffer/line driver; 3-state

Rev. 1 — 18 June 2013

Product data sheet

## 1. General description

The 74HC1G125-Q100; 74HCT1G125-Q100 is a single buffer/line driver with 3-state output. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ .

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  $-40\text{ °C}$  to  $+85\text{ °C}$  and from  $-40\text{ °C}$  to  $+125\text{ °C}$
- Input levels:
  - ◆ For 74HC1G125-Q100: CMOS level
  - ◆ For 74HCT1G125-Q100: TTL level
- Symmetrical output impedance
- High noise immunity
- Low power consumption
- Balanced propagation delays
- ESD protection:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\ \Omega$ )

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC1G125GW-Q100	$-40\text{ °C}$ to $+125\text{ °C}$	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HCT1G125GW-Q100				
74HC1G125GV-Q100	$-40\text{ °C}$ to $+125\text{ °C}$	SC-74A	plastic surface mounted package; 5 leads	SOT753
74HCT1G125GV-Q100				

## 4. Marking

Table 2. Marking

Type number	Marking code <sup>[1]</sup>
74HC1G125GW-Q100	HM
74HCT1G125GW-Q100	TM
74HC1G125GV-Q100	H25
74HCT1G125GV-Q100	T25

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 5. Functional diagram

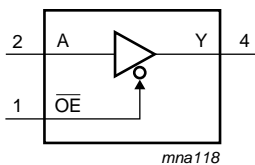


Fig 1. Logic symbol

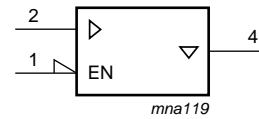


Fig 2. IEC logic symbol

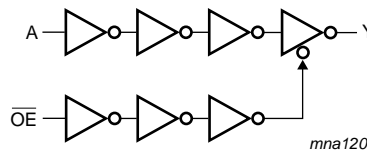


Fig 3. Logic diagram

## 6. Pinning information

### 6.1 Pinning

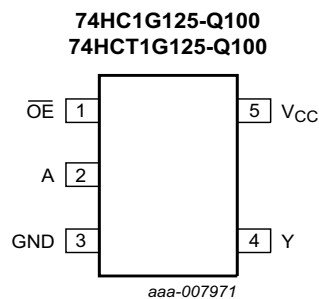


Fig 4. Pin configuration

## 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
$\overline{OE}$	1	output enable input (active LOW)
A	2	data input
GND	3	ground (0 V)
Y	4	data output
$V_{CC}$	5	supply voltage

## 7. Functional description

### 7.1 Function table

Table 4. Function table<sup>[1]</sup>

Control	Input	Output
$\overline{OE}$	A	Y
L	L	L
L	H	H
H	X	Z

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

## 8. Limiting values

Table 5. 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	+7.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	[1] -	$\pm 20$	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	[1] -	$\pm 20$	mA
$I_O$	output current	$V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$	[1] -	$\pm 35$	mA
$I_{CC}$	supply current		-	70	mA
$I_{GND}$	ground current		-70	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$	[2] -	200	mW

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

[2] Above 55 °C the value of  $P_{tot}$  derates linearly with 2.5 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	74HC1G125-Q100			74HCT1G125-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V <sub>I</sub>	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	-	139	-	-	139	ns/V
		V <sub>CC</sub> = 6.0 V	-	-	83	-	-	-	ns/V

## 10. Static characteristics

**Table 7. Static characteristics 74HC1G125-Q100**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	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> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	V
		I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V	3.84	4.32	-	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> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	V
		I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.33	V
I <sub>I</sub>	input leakage current	I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.33	V
		V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	1.0	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	5	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	10	μA
C <sub>I</sub>	input capacitance		-	1.5	-	pF

**Table 7.** Static characteristics 74HC1G125-Q100 ...continued

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	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> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	-	-	V
		I <sub>O</sub> = -6.0 mA; V <sub>CC</sub> = 4.5 V	3.7	-	-	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> = 20 μA; V <sub>CC</sub> = 2.0 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	-	0.1	V
		I <sub>O</sub> = 6.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.4	V
		I <sub>O</sub> = 7.8 mA; V <sub>CC</sub> = 6.0 V	-	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	1.0	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	10	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	20	μA

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

**Table 8. Static characteristics 74HCT1G125-Q100**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math>[1]</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	2.0	1.6	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	1.2	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}; V_{CC} = 4.5\text{ V}$				
		$I_O = -20\text{ }\mu\text{A}$	4.4	4.5	-	V
		$I_O = -6.0\text{ mA}$	3.84	4.32	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}; V_{CC} = 4.5\text{ V}$				
		$I_O = 20\text{ }\mu\text{A}$	-	0	0.1	V
		$I_O = 6.0\text{ mA}$	-	0.16	0.33	V
$I_I$	input leakage current	$V_I = V_{CC}\text{ or GND}; V_{CC} = 5.5\text{ V}$	-	-	1.0	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}\text{ or }V_{IL}; V_O = V_{CC}\text{ or GND}; V_{CC} = 5.5\text{ V}$	-	-	5	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}\text{ or GND}; I_O = 0\text{ A}; V_{CC} = 5.5\text{ V}$	-	-	10	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	$V_I = V_{CC} - 2.1\text{ V}; I_O = 0\text{ A}; V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	500	$\mu\text{A}$
$C_I$	input capacitance		-	1.5	-	pF
<b><math>T_{amb} = -40\text{ °C to }+125\text{ °C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}; V_{CC} = 4.5\text{ V}$				
		$I_O = -20\text{ }\mu\text{A}$	4.4	-	-	V
		$I_O = -6.0\text{ mA}$	3.7	-	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}\text{ or }V_{IL}; V_{CC} = 4.5\text{ V}$				
		$I_O = 20\text{ }\mu\text{A}$	-	-	0.1	V
		$I_O = 6.0\text{ mA}$	-	-	0.4	V
$I_I$	input leakage current	$V_I = V_{CC}\text{ or GND}; V_{CC} = 5.5\text{ V}$	-	-	1.0	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}\text{ or }V_{IL}; V_O = V_{CC}\text{ or GND}; V_{CC} = 5.5\text{ V}$	-	-	10	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}\text{ or GND}; I_O = 0\text{ A}; V_{CC} = 5.5\text{ V}$	-	-	20	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	$V_I = V_{CC} - 2.1\text{ V}; I_O = 0\text{ A}; V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	850	$\mu\text{A}$

[1] All typical values are measured at  $T_{amb} = 25\text{ °C}$ .

## 11. Dynamic characteristics

**Table 9. Dynamic characteristics 74HC1G125-Q100**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 7](#)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C<sup>[1]</sup></b>							
$t_{pd}$	propagation delay	A to Y; see <a href="#">Figure 5</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	24	125	ns	
		$V_{CC} = 4.5$ V	-	10	25	ns	
$t_{en}$	enable time	$\overline{OE}$ to Y; see <a href="#">Figure 6</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	19	155	ns	
		$V_{CC} = 4.5$ V	-	9	31	ns	
$t_{dis}$	disable time	$\overline{OE}$ to Y; see <a href="#">Figure 6</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	18	155	ns	
		$V_{CC} = 4.5$ V	-	12	31	ns	
$C_{PD}$	power dissipation capacitance	$V_I = GND$ to $V_{CC}$					
			[3]	-	30	-	pF
<b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b>							
$t_{pd}$	propagation delay	A to Y; see <a href="#">Figure 5</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	-	150	ns	
		$V_{CC} = 4.5$ V	-	-	30	ns	
$t_{en}$	enable time	$\overline{OE}$ to Y; see <a href="#">Figure 6</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	-	190	ns	
		$V_{CC} = 4.5$ V	-	-	38	ns	
$t_{dis}$	disable time	$\overline{OE}$ to Y; see <a href="#">Figure 6</a>					
				[2]			
		$V_{CC} = 2.0$ V	-	-	190	ns	
		$V_{CC} = 4.5$ V	-	-	38	ns	
		$V_{CC} = 6.0$ V	-	-	32	ns	

[1] All typical values are measured at  $T_{amb} = 25$  °C.

[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]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

$N$  = number of inputs switching;

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

**Table 10. Dynamic characteristics 74HCT1G125-Q100**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 7](#)

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit	
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b>							
$t_{pd}$	propagation delay	A to Y; see <a href="#">Figure 5</a>	[2]				
		$V_{CC} = 4.5$ V	-	11	30	ns	
		$V_{CC} = 5$ V; $C_L = 15$ pF	-	10	-	ns	
$t_{en}$	enable time	$V_{CC} = 4.5$ V; $\overline{OE}$ to Y; see <a href="#">Figure 6</a>	[2]	-	10	35	ns
$t_{dis}$	disable time	$V_{CC} = 4.5$ V; $\overline{OE}$ to Y; see <a href="#">Figure 6</a>	[2]	-	11	31	ns
$C_{PD}$	power dissipation capacitance	$V_I = GND$ to $V_{CC} - 1.5$ V	[3]	-	27	-	pF
<b><math>T_{amb} = -40</math> °C to <math>+125</math> °C</b>							
$t_{pd}$	propagation delay	$V_{CC} = 4.5$ V; A to Y; see <a href="#">Figure 5</a>	[2]	-	-	36	ns
$t_{en}$	enable time	$V_{CC} = 4.5$ V; $\overline{OE}$ to Y; see <a href="#">Figure 6</a>	[2]	-	-	42	ns
$t_{dis}$	disable time	$V_{CC} = 4.5$ V; $\overline{OE}$ to Y; see <a href="#">Figure 6</a>	[2]	-	-	38	ns

[1] All typical values are measured at  $T_{amb} = 25$  °C.

[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]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu$ W).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

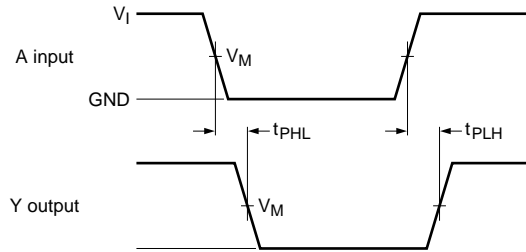
$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

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



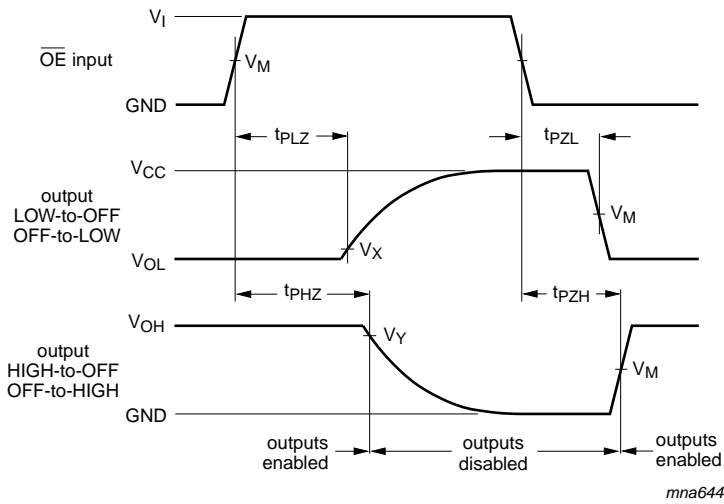
## 12. Waveforms



001aad070

Measurement points are given in [Table 11](#).

**Fig 5. Propagation delay data input (A) to output (Y)**



mna644

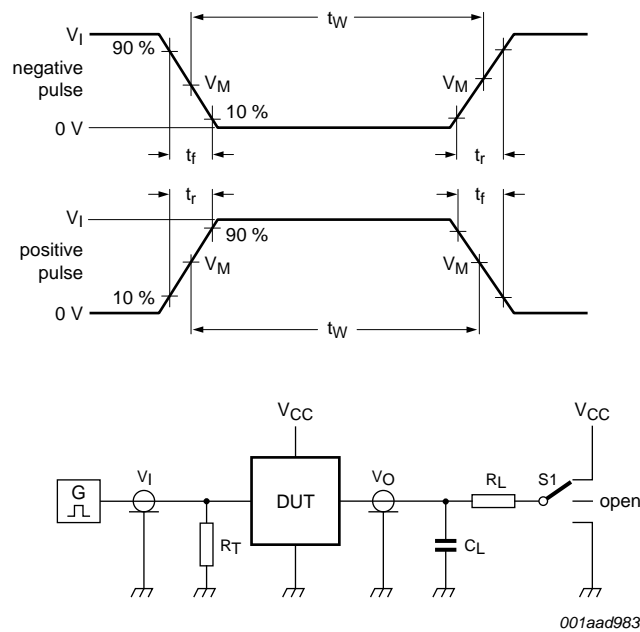
Measurement points are given in [Table 11](#).

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

**Fig 6. Enable and disable times**

**Table 11. Measurement points**

Type	Input	Output		
	$V_M$	$V_M$	$V_X$	$V_Y$
74HC1G125-Q100	$0.5V_{CC}$	$0.5V_{CC}$	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$
74HCT1G125-Q100	1.3 V	1.3 V	$V_{OL} + 0.3 V$	$V_{OH} - 0.3 V$



Test data is given in [Table 12](#).

Definitions for test circuit:

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

$C_L$  = Load capacitance including jig and probe capacitance

$R_L$  = Load resistor

S1 = Test selection switch

**Fig 7. Test circuit for measuring switching times**

**Table 12. Test data**

Type	Input		Load		S1 position		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
74HC1G125-Q100	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$
74HCT1G125-Q100	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1

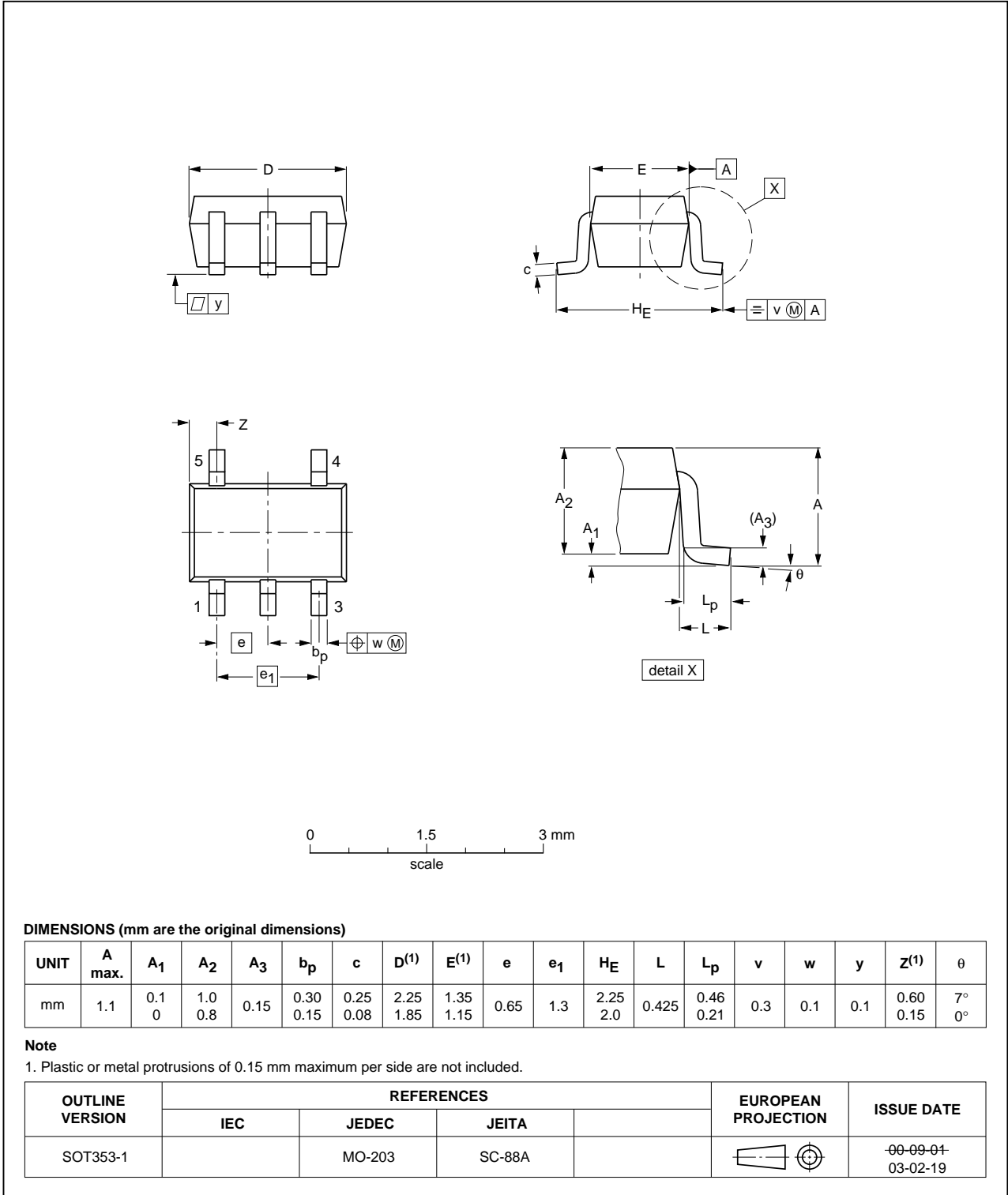


Fig 8. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

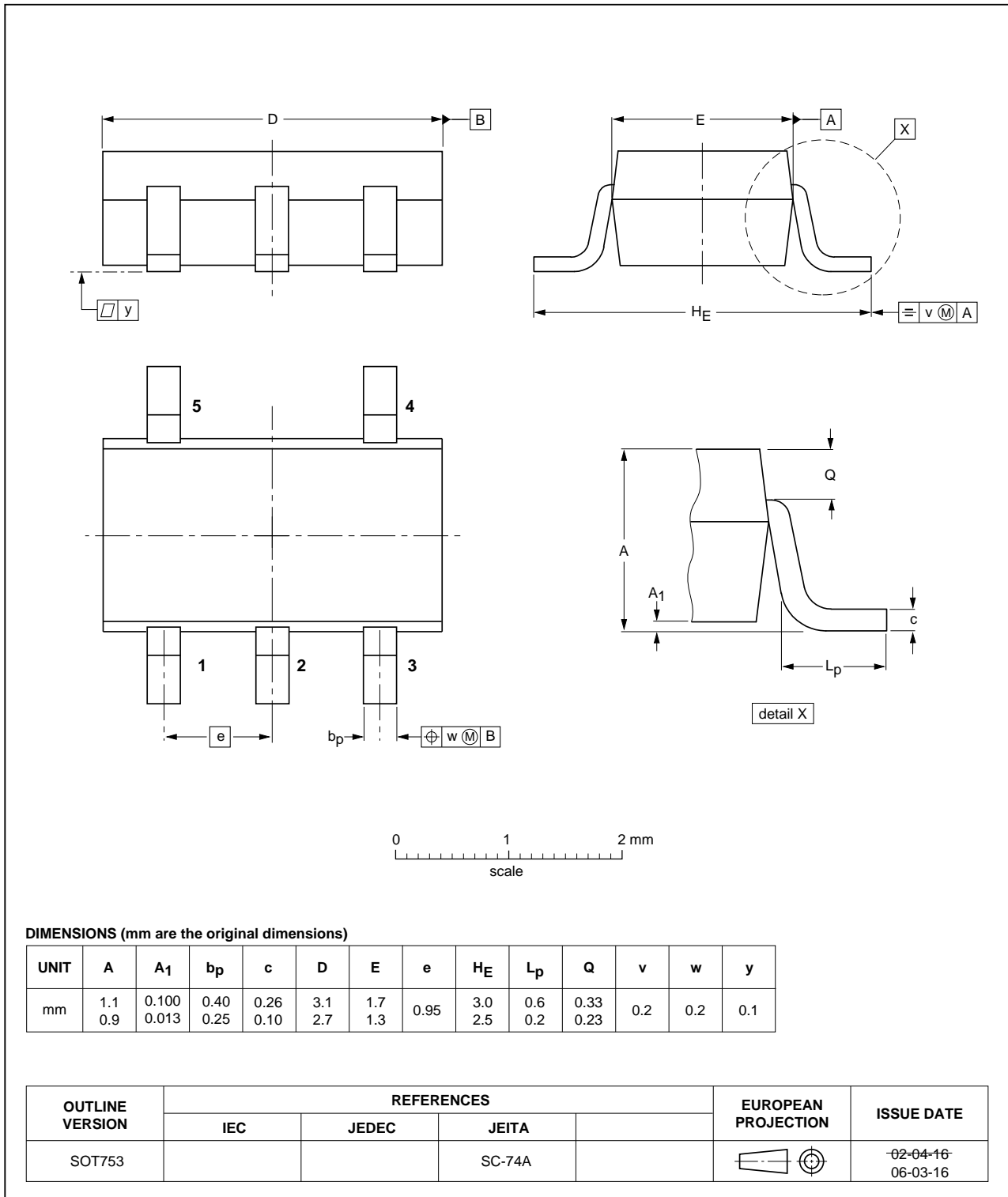


Fig 9. Package outline SOT753 (SC-74A)

## 14. Abbreviations

Table 13. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
TTL	Transistor-Transistor Logic
MM	Machine Model

## 15. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT1G125_Q100 v.1	20130618	Product data sheet	-	-

## 16. Legal information

### 16.1 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".

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