

74HC4040-Q100; 74HCT4040-Q100

12-stage binary ripple counter

Rev. 4 — 16 February 2024

Product data sheet

1. General description

The 74HC4040-Q100; 74HCT4040-Q100 is a 12-stage binary ripple counter with a clock input ($\overline{CP}$), an overriding asynchronous master reset input (MR) and twelve parallel outputs (Q0 to Q11). The counter advances on the HIGH-to-LOW transition of $\overline{CP}$. A HIGH on MR clears all counter stages and forces all outputs LOW, independent of the state of $\overline{CP}$. Each counter stage is a static toggle flip-flop. Inputs include clamp diodes that enable 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 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- Input levels:
 - For 74HC4040-Q100: CMOS level
 - For 74HCT4040-Q100: TTL level
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

3. Applications

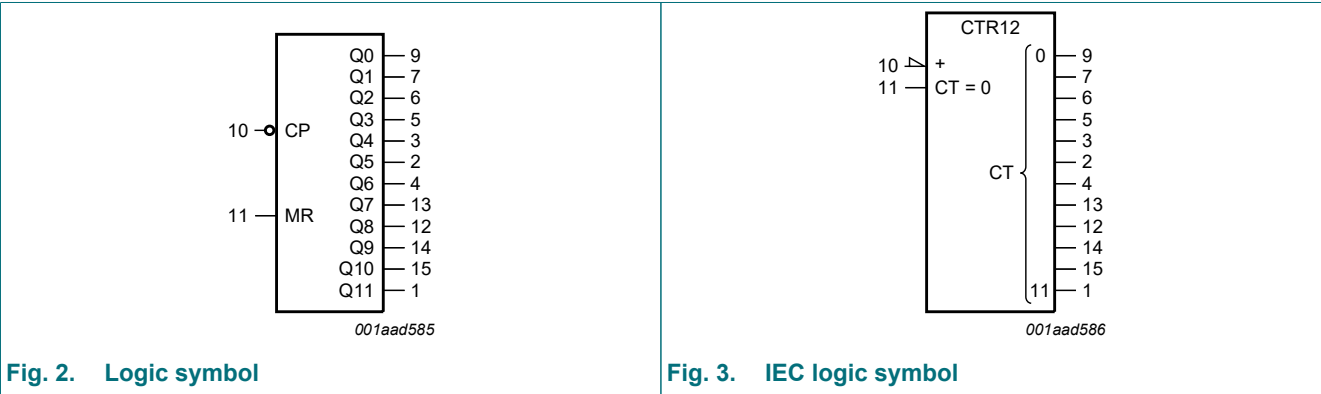
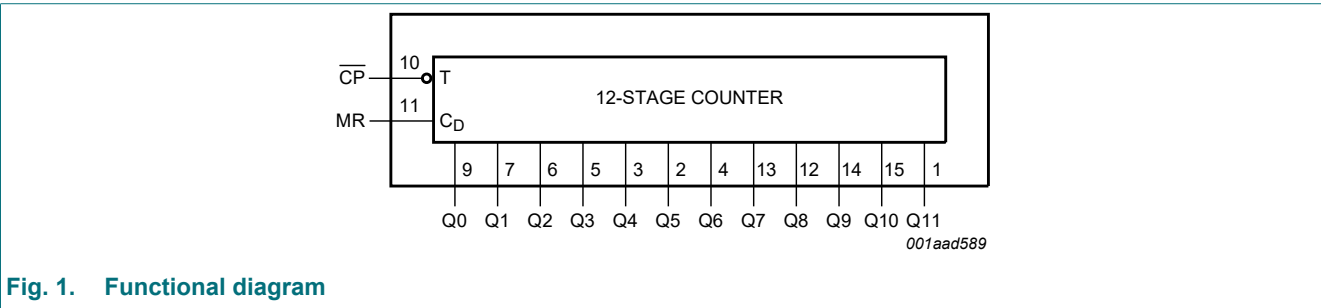
- Frequency dividing circuits
- Time delay circuits
- Control counters

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC4040D-Q100 74HCT4040D-Q100	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC4040PW-Q100 74HCT4040PW-Q100	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HC4040BQ-Q100 74HCT4040BQ-Q100	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

5. Functional diagram



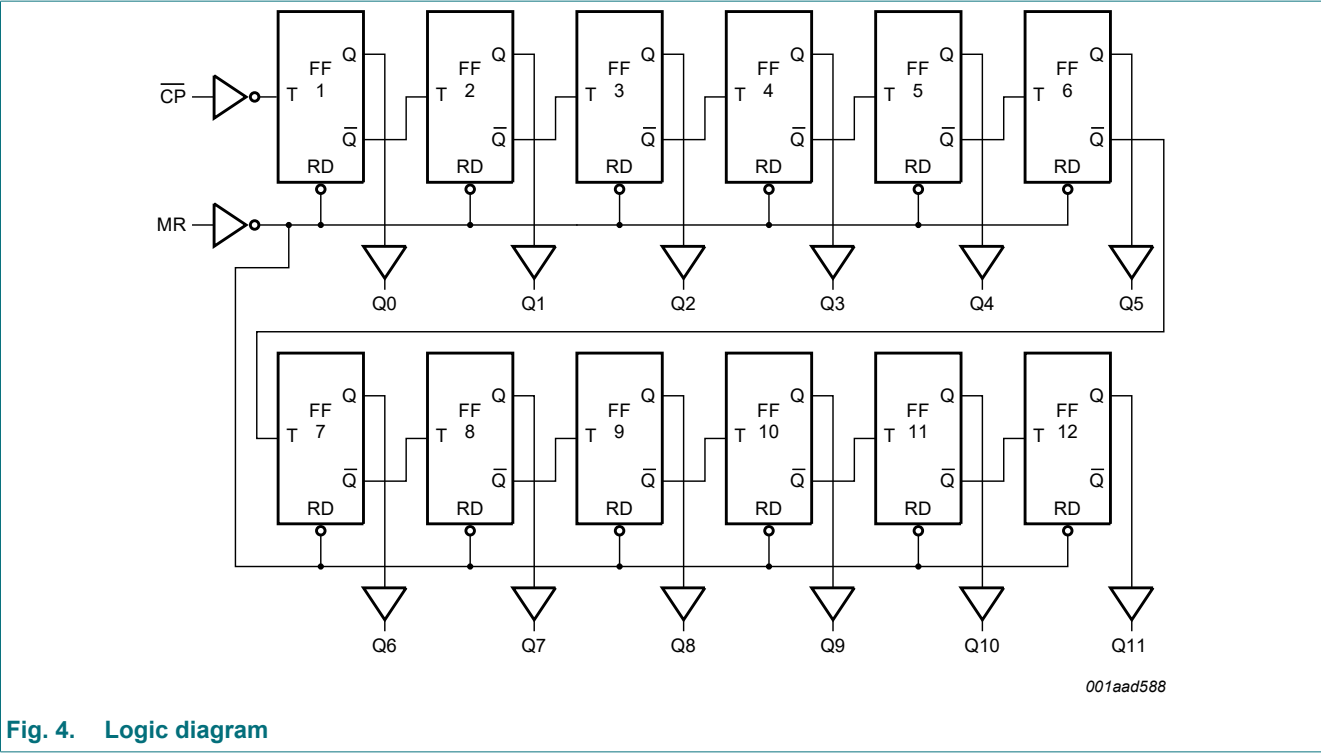
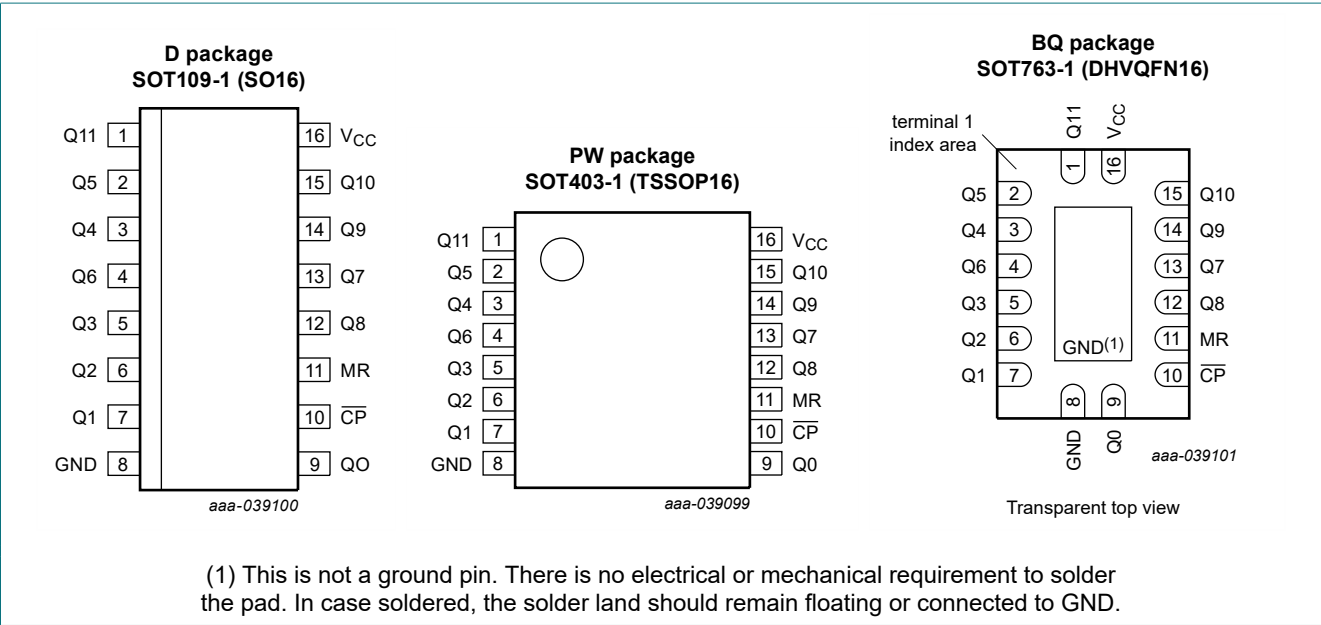


Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning



6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
Q11	1	output 11
Q5	2	output 5
Q4	3	output 4
Q6	4	output 6
Q3	5	output 3
Q2	6	output 2
Q1	7	output 1
GND	8	ground (0 V)
Q0	9	output 0
$\overline{\text{CP}}$	10	clock input (HIGH-to-LOW, edge-triggered)
MR	11	master reset input (active HIGH)
Q8	12	output 8
Q7	13	output 7
Q9	14	output 9
Q10	15	output 10
V _{CC}	16	positive supply voltage

7. Functional description

7.1. Function table

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care;
↑ = LOW-to-HIGH clock transition; ↓ = HIGH-to-LOW clock transition.

Input		Output
CP	MR	Q0 to Q11
↑	L	no change
↓	L	count
X	H	L

7.2. Timing diagram

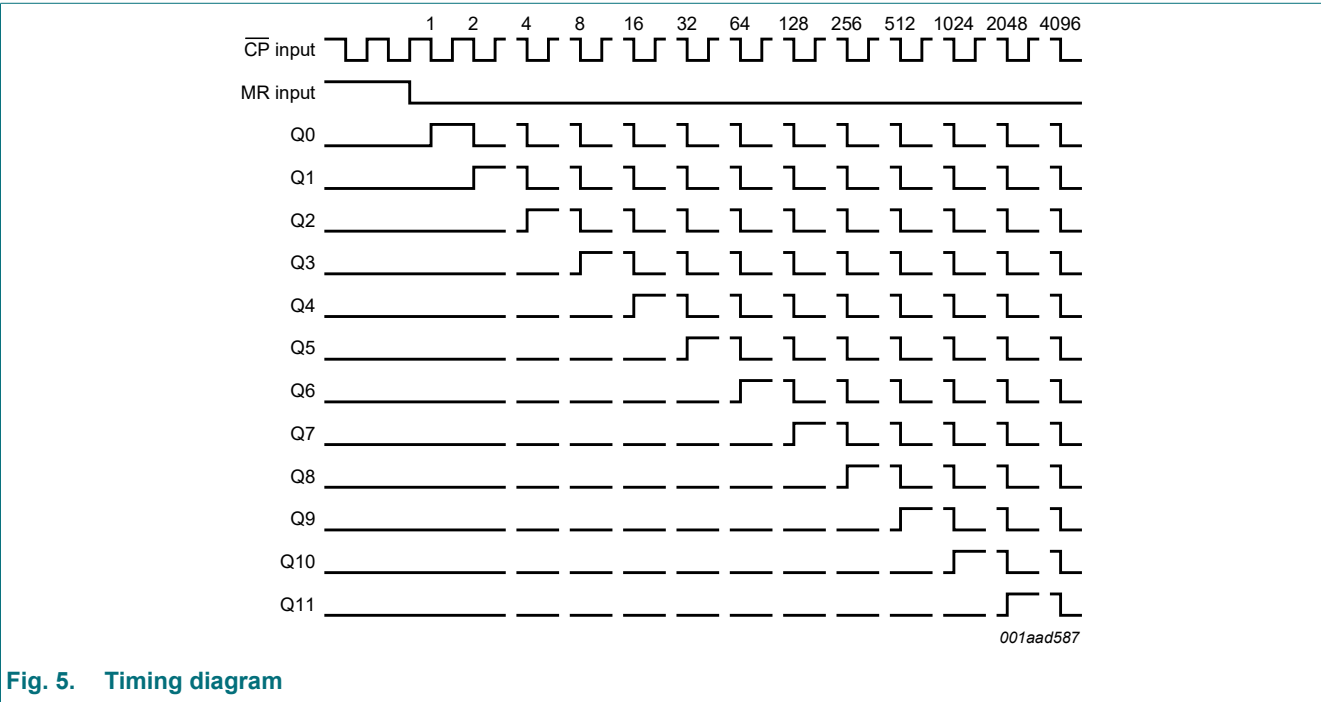


Fig. 5. Timing diagram

8. 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	+7	V
I _{IK}	input clamping current	V _I < -0.5 V or V _I > V _{CC} + 0.5 V [1]	-	±20	mA
I _{OK}	output clamping current	V _I < -0.5 V or V _I > V _{CC} + 0.5 V [1]	-	±20	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 V	-	±25	mA
I _{CC}	supply current		-	±50	mA
I _{GND}	ground current		-	±50	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 SOT109-1 (SO16) package: P_{tot} derates linearly with 12.4 mW/K above 110 °C.
For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC4040-Q100			74HCT4040-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V _I	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V _{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V _{CC} = 6.0 V	-	-	83	-	-	-	ns/V

10. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4040-Q100										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
C _I	input capacitance		-	3.5	-					pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HCT4040-Q100										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4 mA	3.98	4.32	-	3.84	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 20 µA	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	8.0	-	80	-	160	µA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V								
		pin $\overline{CP}$	-	85	306	-	383	-	417	µA
		pin MR	-	110	396	-	495	-	539	µA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see Fig. 7.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4040-Q100										
t _{pd}	propagation delay	CP to Q0; see Fig. 6 [1]								
		V _{CC} = 2.0 V	-	47	150	-	190	-	225	ns
		V _{CC} = 4.5 V	-	17	30	-	38	-	45	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	14	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	14	26	-	33	-	38	ns
		Qn to Qn+1; see Fig. 6								
		V _{CC} = 2.0 V	-	28	100	-	125	-	150	ns
		V _{CC} = 4.5 V	-	10	20	-	25	-	30	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	8	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	8	17	-	21	-	26	ns
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Fig. 6								
		V _{CC} = 2.0 V	-	61	185	-	230	-	280	ns
		V _{CC} = 4.5 V	-	22	37	-	46	-	56	ns
		V _{CC} = 6.0 V	-	18	31	-	39	-	48	ns
t _t	transition time	Qn; see Fig. 6 [2]								
		V _{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
		V _{CC} = 6.0 V	-	6	13	-	16	-	19	ns
t _W	pulse width	CP input, HIGH or LOW; see Fig. 6								
		V _{CC} = 2.0 V	80	14	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	5	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	4	-	17	-	20	-	ns
		MR input, HIGH; see Fig. 6								
		V _{CC} = 2.0 V	80	22	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20	-	ns
t _{rec}	recovery time	MR to CP; see Fig. 6								
		V _{CC} = 2.0 V	50	8	-	65	-	75	-	ns
		V _{CC} = 4.5 V	10	3	-	13	-	15	-	ns
		V _{CC} = 6.0 V	9	2	-	11	-	13	-	ns
f _{max}	maximum frequency	CP input; see Fig. 6								
		V _{CC} = 2.0 V	6	27	-	4.8	-	4	-	MHz
		V _{CC} = 4.5 V	30	82	-	24	-	20	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	90	-	-	-	-	-	MHz
		V _{CC} = 6.0 V	35	98	-	28	-	24	-	MHz

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} [3]	-	20	-	-	-	-	-	pF
74HCT4040-Q100										
t _{pd}	propagation delay	$\overline{CP}$ to Q0; see Fig. 6 [1]								
		V _{CC} = 4.5 V	-	19	40	-	50	-	60	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns
		Qn to Qn+1; see Fig. 6								
		V _{CC} = 4.5 V	-	10	20	-	25	-	30	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	8	-	-	-	-	-	ns
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Fig. 6								
		V _{CC} = 4.5 V	-	23	45	-	56	-	68	ns
t _t	transition time	Qn; see Fig. 6 [2]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
t _W	pulse width	$\overline{CP}$ input, HIGH or LOW; see Fig. 6								
		V _{CC} = 4.5 V	16	7	-	20	-	24	-	ns
		MR input, HIGH; see Fig. 6								
		V _{CC} = 4.5 V	16	6	-	20	-	24	-	ns
t _{rec}	recovery time	MR to $\overline{CP}$; see Fig. 6								
		V _{CC} = 4.5 V	10	2	-	13	-	15	-	ns
f _{max}	maximum frequency	$\overline{CP}$ input; see Fig. 6								
		V _{CC} = 4.5 V	30	72	-	24	-	20	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	79	-	-	-	-	-	MHz
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} [3]	-	20	-	-	-	-	-	pF

[1] t_{pd} is the same as t_{PHL}, t_{PLH}.

[2] t_t is the same as t_{THL}, t_{TLH}.

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ 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 V;
N = number of inputs switching;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit

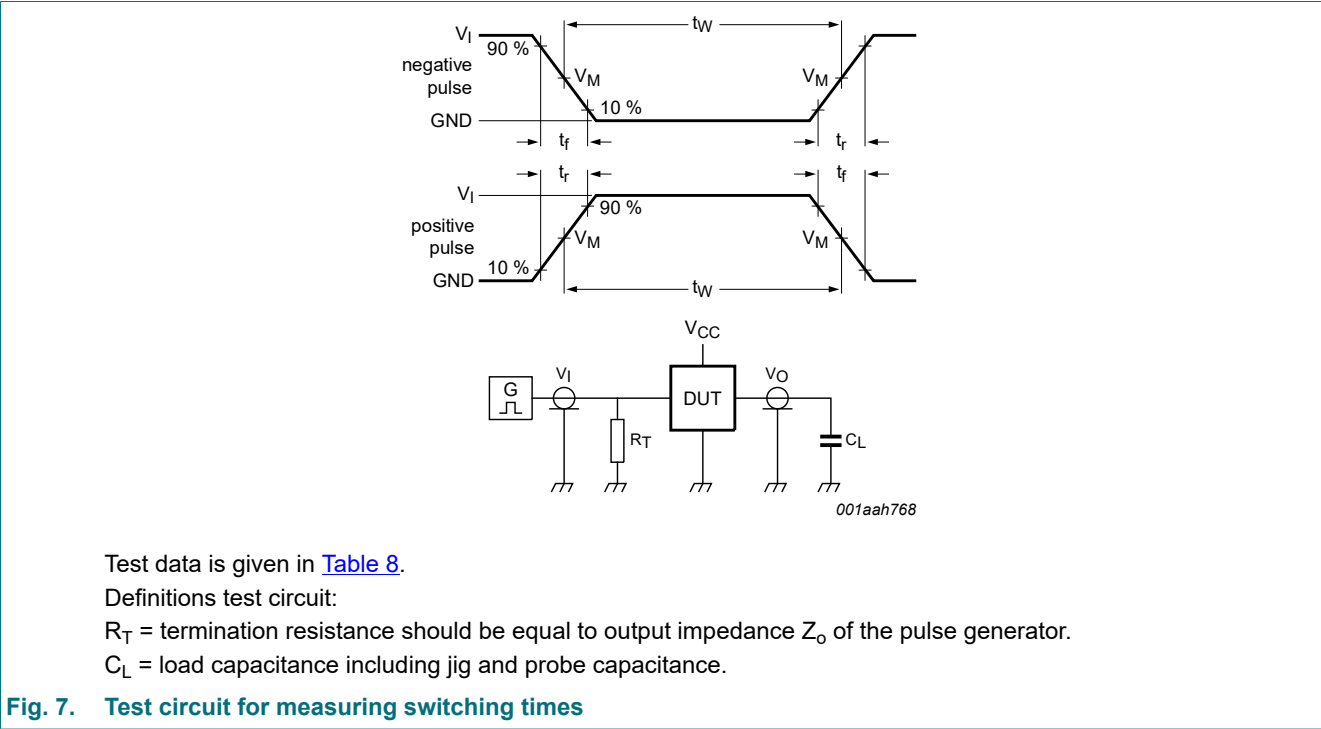
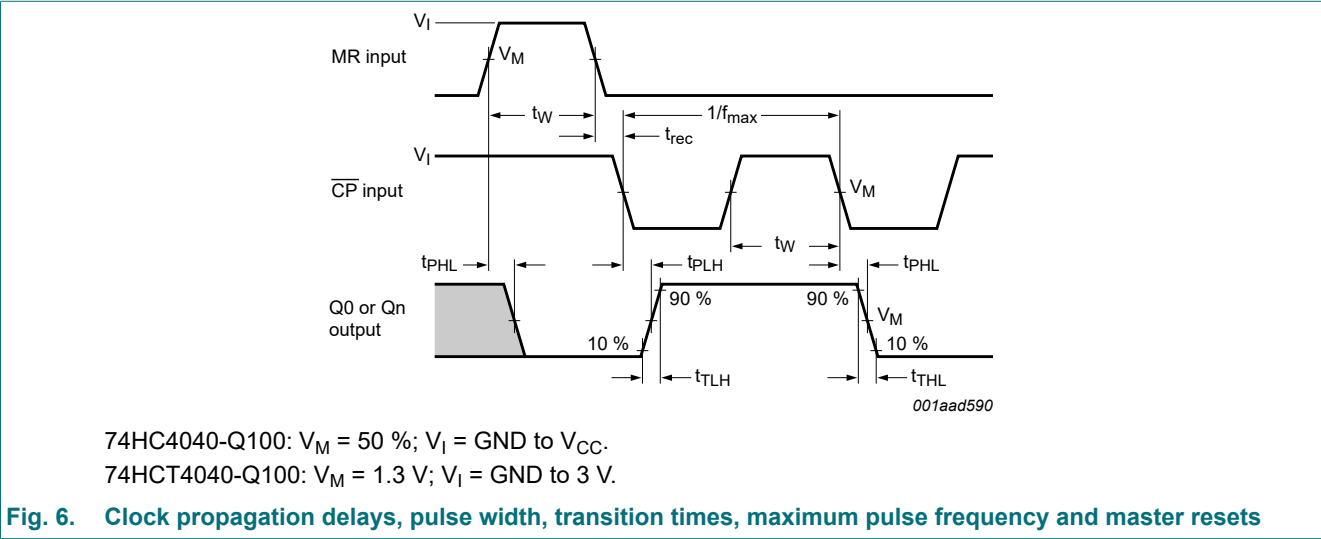


Table 8. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74HC4040-Q100	V_{CC}	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74HCT4040-Q100	3.0 V	6.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

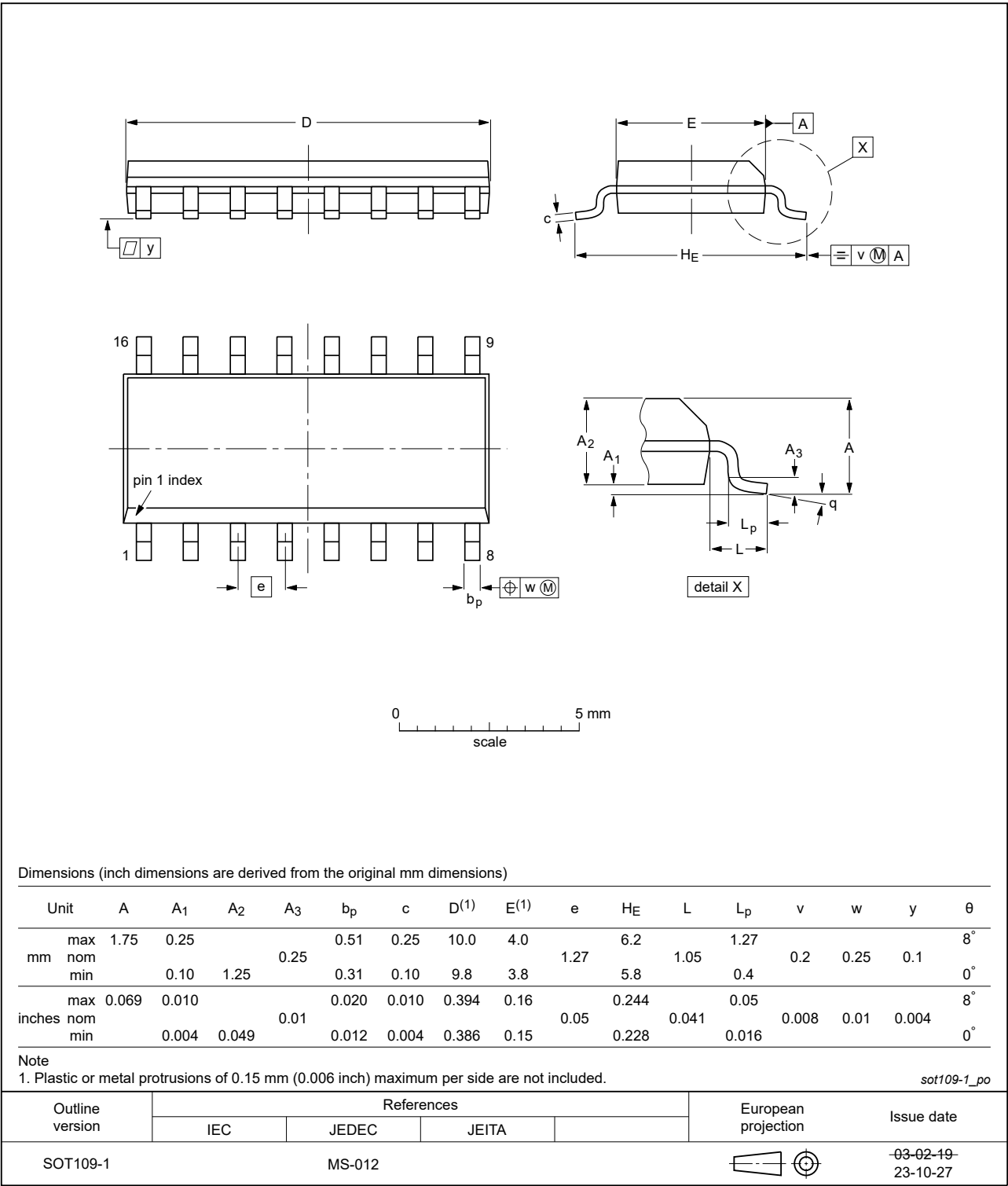


Fig. 8. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

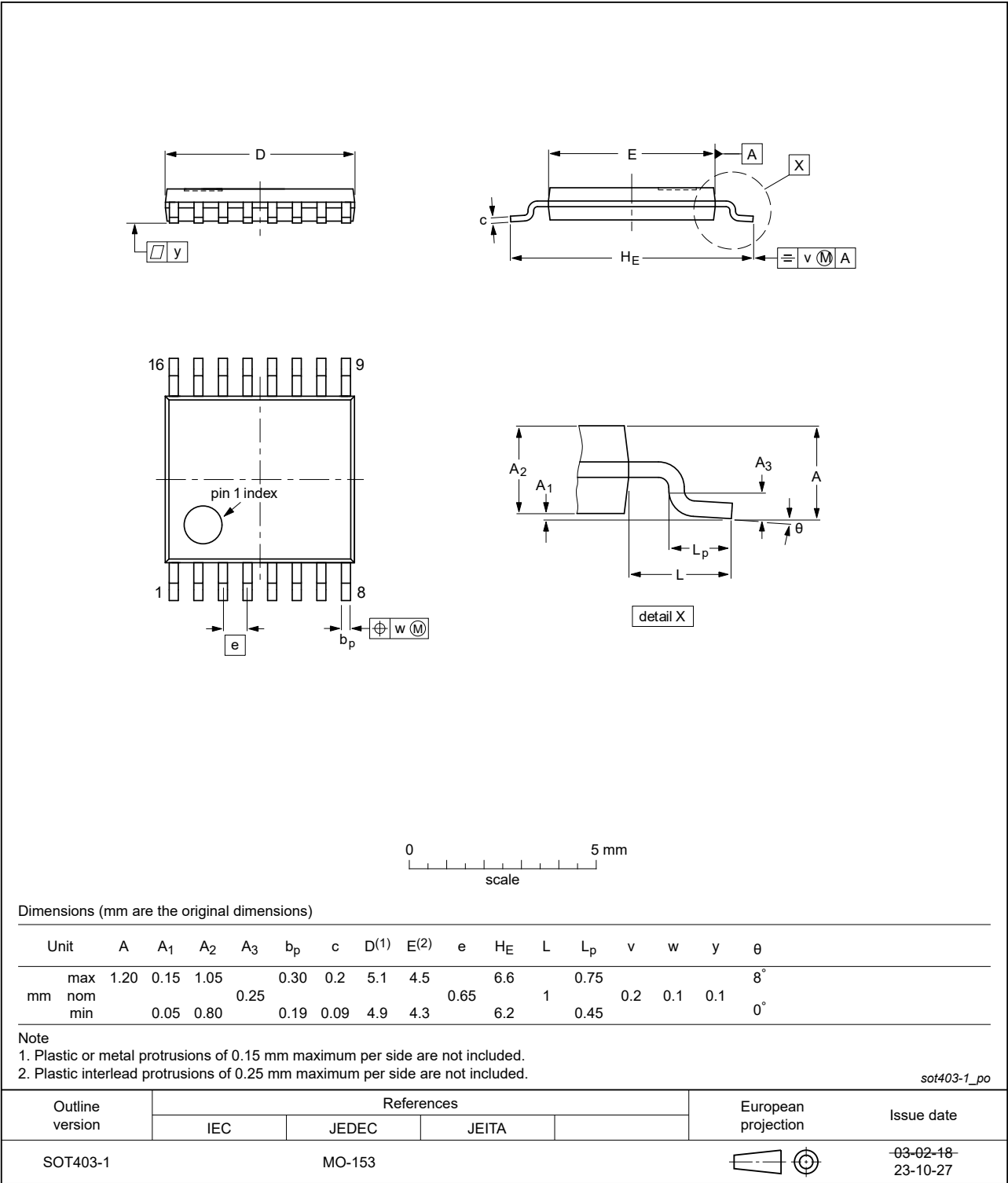


Fig. 9. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;
16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

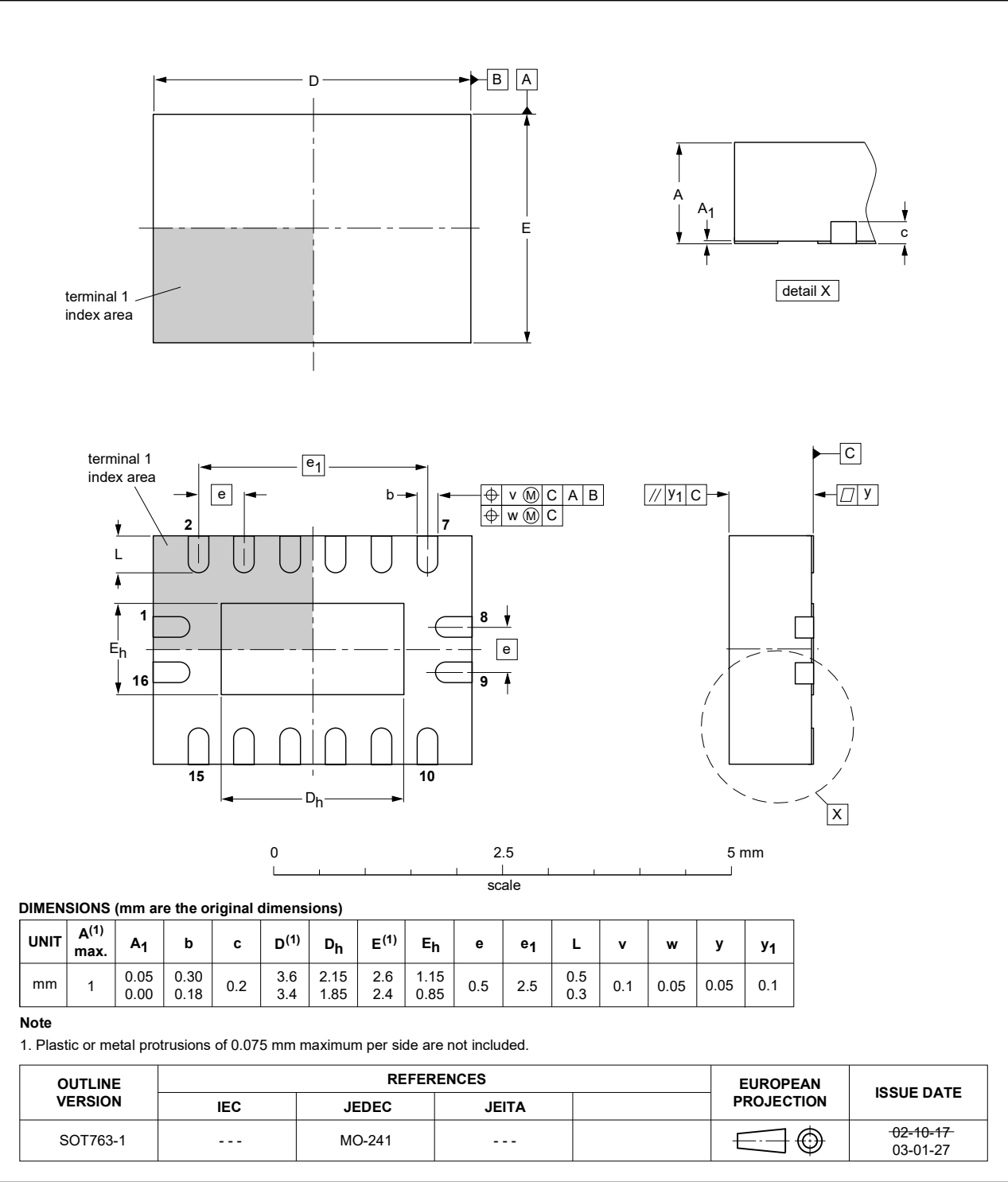


Fig. 10. Package outline SOT763-1 (DHVQFN16)

13. Abbreviations

Table 9. Abbreviations

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

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4040_Q100 v.4	20240216	Product data sheet	-	74HC_HCT4040_Q100 v.3
Modifications:	- Section 2: ESD specification updated according to the latest JEDEC standard. - Fig. 8 and Fig. 9: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153.			
74HC_HCT4040_Q100 v.3	20210907	Product data sheet	-	74HC_HCT4040_Q100 v.2
Modifications:	Type number 74HC4040DB-Q100 (SOT338-1/SSOP16) removed.			
74HC_HCT4040_Q100 v.2	20200608	Product data sheet	-	74HC_HCT4040_Q100 v.1
Modifications:	- The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. - Legal texts have been adapted to the new company name where appropriate. - Type number 74HCT4040DB-Q100 (SOT338-1/SSOP16) removed. - Section 2 updated. - Table 4: Derating values for P_{tot} total power dissipation have been updated.			
74HC_HCT4040_Q100 v.1	20140324	Product data sheet	-	-

15. Legal information

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".
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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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