74HC4040; 74HCT4040

12-stage binary ripple counter

Rev. 7 — 26 May 2021

Product data sheet

1. General description

The 74HC4040; 74HCT4040 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} .

2. Features and benefits

- 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: CMOS level
 - For 74HCT4040: TTL level
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

- Frequency dividing circuits
- · Time delay circuits
- Control counters

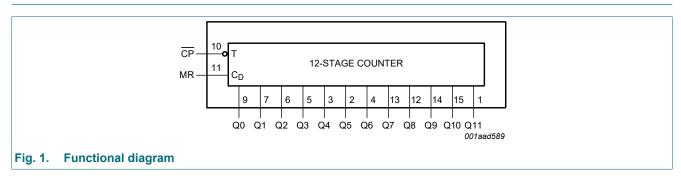


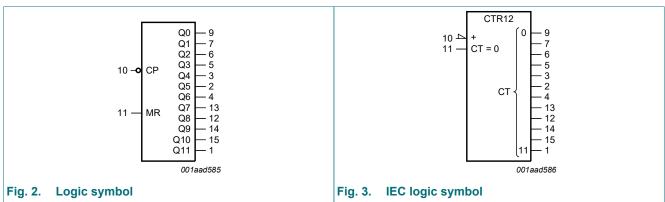
4. Ordering information

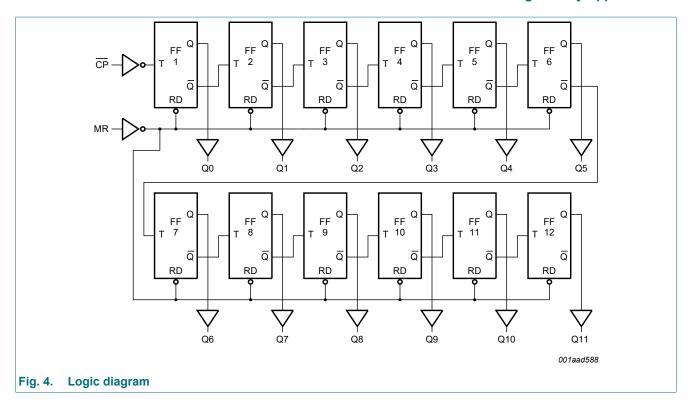
Table 1. Ordering information

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

5. Functional diagram

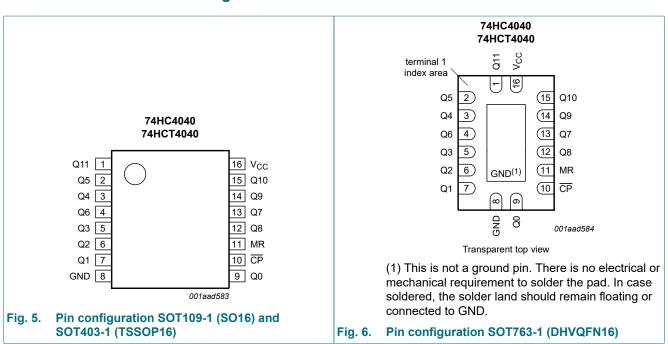






6. Pinning information

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
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

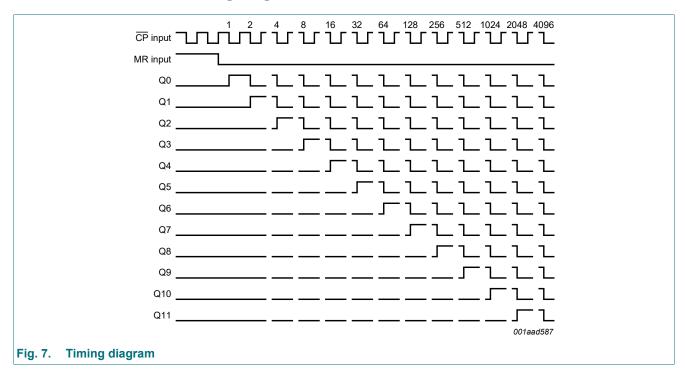
 $H = HIGH \ voltage \ level; \ L = LOW \ voltage \ level; \ X = don't \ care;$

 \uparrow = LOW-to-HIGH clock transition; \downarrow = HIGH-to-LOW clock transition.

Input		Output
CP	MR	Q0 to Q11
1	L	no change
\downarrow	L	count
X	Н	L

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7.2. 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	$V_{I} < -0.5 \text{ V or VI} > V_{CC} + 0.5 \text{ V}$	[1]	-	±20	mA
I _{OK}	output clamping current	$V_{I} < -0.5 \text{ V or } V_{I} > V_{CC} + 0.5 \text{ V}$	[1]	-	±20	mA
Io	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$		-	±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	7	4HC404	0	74	74HCT4040		
			Min	Тур	Max	Min	Тур	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
Vo	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).

74HC404 V _{IH}	Parameter	Conditions		25 °C		-40 °C to	o +85 °C	-40 °C to	+125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC404	40									
V _{IH}	HIGH-level	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	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	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
	input voltage	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	V _I = V _{IH} or V _{IL}								
	output voltage	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
		$I_O = -5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL}								
	output voltage	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	$V_1 = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	8.0	-	80	-	160	μΑ
Cı	input capacitance		-	3.5	-					pF

74HCT40	Parameter	Conditions		25 °C		-40 °C t	o +85 °C	-40 °C to	+125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	1
74HCT4	040	'				-	<u>'</u>			
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	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	Ι _Ο = -20 μΑ	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	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 V$								
	output voltage	Ι _Ο = 20 μΑ	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
l _l	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	8.0	-	80	-	160	μΑ
ΔI _{CC}	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}$; $I_O = 0 \text{ A}$; other inputs at V_{CC} or GND; $V_{CC} = 4.5 \text{ V}$ to 5.5 V								
		pin CP	-	85	306	-	383	-	417	μΑ
		pin MR	-	110	396	-	495	-	539	μΑ
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. 9.

Symbol	Parameter	Conditions		25 °C	:	-40 °C to	o +85 °C	-40 °C to	+125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC40	40			1			1	1	1	
t _{pd}	propagation	<u>CP</u> to Q0; see <u>Fig. 8</u> [1]								
	delay	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. 8								
		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	MR to Qn; see Fig. 8								
	propagation delay	V _{CC} = 2.0 V	-	61	185	-	230	-	280	ns
	delay	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 <u>Fig. 8</u> [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. 8								
		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. 8								
		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 \overline{CP} ; see Fig. 8								
		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	CP input; see Fig. 8								
	frequency	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	o +85 °C	-40 °C to	+125 °C	Unit
				Min	Тур	Max	Min	Max	Min	Max	
C _{PD}	power dissipation capacitance	V_I = GND to V_{CC}	[3]	-	20	-	-	-	-	-	pF
74HCT4	040	,									
t _{pd}	propagation	CP to Q0; see Fig. 8	[1]								
	delay	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. 8									
		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	MR to Qn; see Fig. 8									
	propagation delay	V _{CC} = 4.5 V		-	23	45	-	56	-	68	ns
t _t	transition time	Qn; see <u>Fig. 8</u>	[2]								
		V _{CC} = 4.5 V		-	7	15	-	19	-	22	ns
t _W	pulse width	CP input, HIGH or LOW; see Fig. 8									
		V _{CC} = 4.5 V		16	7	-	20	-	24	-	ns
		MR input, HIGH; see Fig. 8									
		V _{CC} = 4.5 V		16	6	-	20	-	24	-	ns
t _{rec}	recovery time	MR to CP; see Fig. 8									
		V _{CC} = 4.5 V		10	2	-	13	-	15	-	ns
f _{max}	maximum	CP input; see Fig. 8									
	frequency	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

- t_{pd} is the same as t_{PHL}, t_{PLH}.
 t_t is the same as t_{THL}, t_{TLH}.
 C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 P_D = C_{PD} x V_{CC}² x f_i x N + ∑(C_L x V_{CC}² x 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; $\sum (C_L \times V_{CC}^2 \times f_0)$ = sum of outputs.

11.1. Waveforms and test circuit

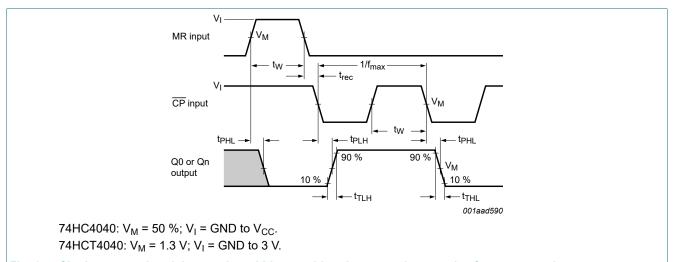
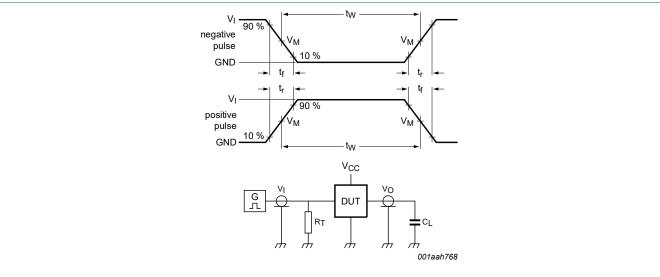


Fig. 8. Clock propagation delays, pulse width, transition times, maximum pulse frequency and master resets



Test data is given in Table 8.

Definitions test circuit:

 R_{T} = termination resistance should be equal to output impedance Z_{o} of the pulse generator.

C_L = load capacitance including jig and probe capacitance.

Fig. 9. Test circuit for measuring switching times

Table 8. Test data

Туре	Input		Load	Test
	VI	t _r , t _f	CL	
74HC4040	V _{CC}	6.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}
74HCT4040	3.0 V	6.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}

12. Package outline



SOT109-1



UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E ⁽¹⁾	е	HE	L	Lp	Q	v	w	у	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8°
inches	0.069	0.010 0.004	0.057 0.049	0.01		0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	0°

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

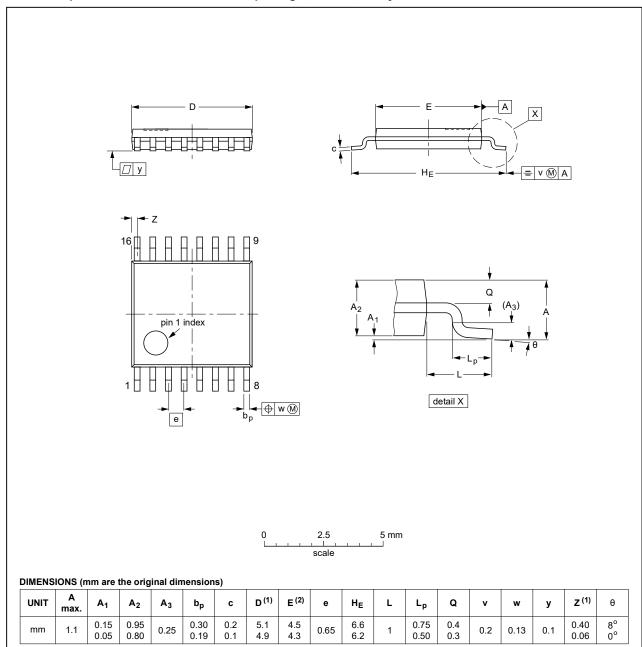
OUTLINE		REFER	ENCES	EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE
SOT109-1	076E07	MS-012			99-12-27 03-02-19

Fig. 10. Package outline SOT109-1 (SO16)

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

SOT403-1



Notes

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN	ISSUE DATE
	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT403-1		MO-153				99-12-27 03-02-18

Fig. 11. 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

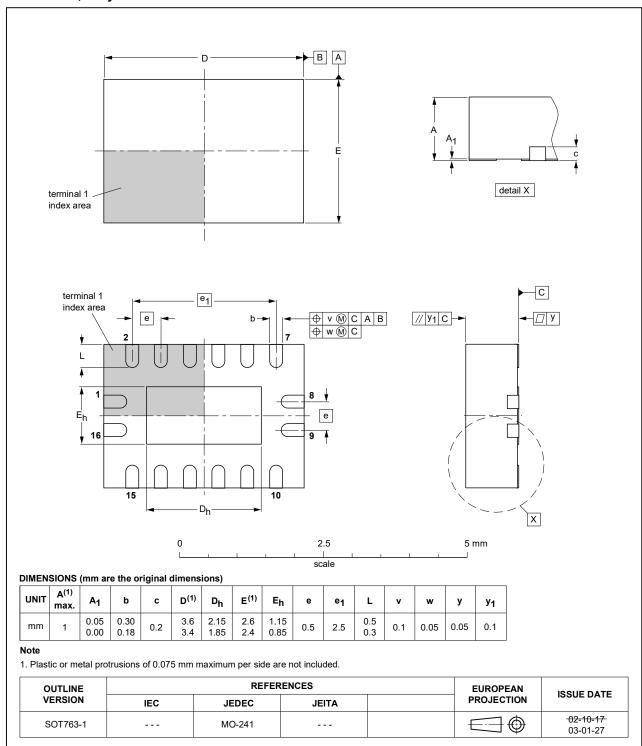


Fig. 12. Package outline SOT763-1 (DHVQFN16)

13. Abbreviations

Table 9. Abbreviations

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

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
74HC_HCT4040 v.7	20210526	Product data sheet	-	74HC_HCT4040 v.6	
Modifications:	Type number 74HCT4040DB (SOT338-1 / SSOP16) removed.				
74HC_HCT4040 v.6	20200608	Product data sheet	-	74HC_HCT4040 v.5	
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 74HC4040DB (SOT338-1/SSOP16) removed. Section 2 updated. Table 4: Derating values for Ptot total power dissipation have been updated. 				
74HC_HCT4040 v.5	20160203	Product data sheet	-	74HC_HCT4040 v.4	
Modifications:	Type numbers 74HC4040N and 74HCT4040N (SOT38-4) removed.				
74HC_HCT4040 v.4	20140320	Product data sheet	-	74HC_HCT4040 v.3	
Modifications:	 The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. 				
74HC_HCT4040 v.3	20050914	Product data sheet	-	74HC_HCT4040_CNV v.2	
74HC_HCT4040_CNV v.2	19901231	Product specification	-	-	

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.

- Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- 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 https://www.nexperia.com.

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