74HCT4538

Dual retriggerable precision monostable multivibrator Rev. 6 — 11 February 2021 Product data sheet

1. General description

The 74HCT4538 is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has two trigger/retrigger inputs ($n\overline{A}$ and nB), a direct reset input ($n\overline{CD}$), two complementary outputs (nQ and $n\overline{Q}$), and two pins (nREXT/CEXT and nCEXT) for connecting the external timing components C_{EXT} and R_{EXT} . Typical pulse width variation over temperature range is \pm 0.2 %. The device may be triggered by either the positive or the negative edges of the input pulse. The duration and accuracy of the output pulse are determined by the external timing components C_{EXT} and R_{EXT} . The output pulse width (T_W) is equal to 0.7 × R_{EXT} × C_{EXT} . The linear design techniques guarantee precise control of the output pulse width. A LOW level at $n\overline{CD}$ terminates the output pulse immediately. Schmitt-trigger action in the trigger inputs makes the circuit highly tolerant to slower rise and fall times. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- · Tolerant of slow trigger rise and fall times
- · High noise immunity
- Separate reset inputs
- · Triggering from falling or rising edge
- Complies with JEDEC standard no. 7A
- Wide supply voltage range from 4.5 to 5.5 V
- CMOS low power dissipation
- TTL input levels
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

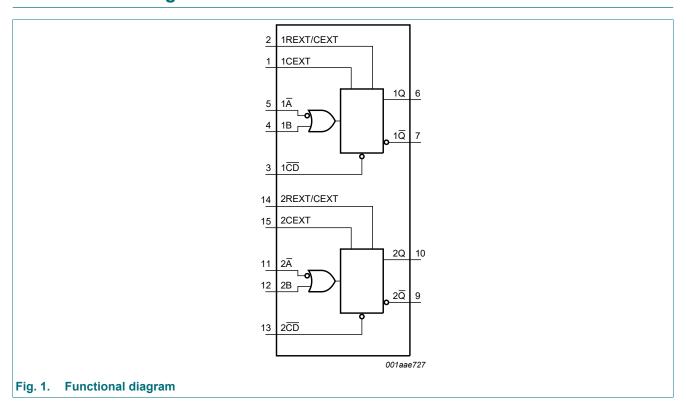
Table 1. Ordering information

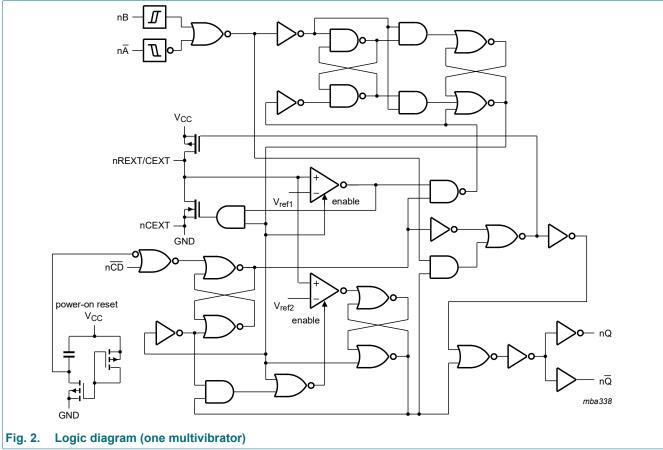
Type number	Package	ackage					
	Temperature range	Name	Description	Version			
74HCT4538D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1			
74HCT4538PW	-40 °C to +125 °C		plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1			



Dual retriggerable precision monostable multivibrator

4. Functional diagram

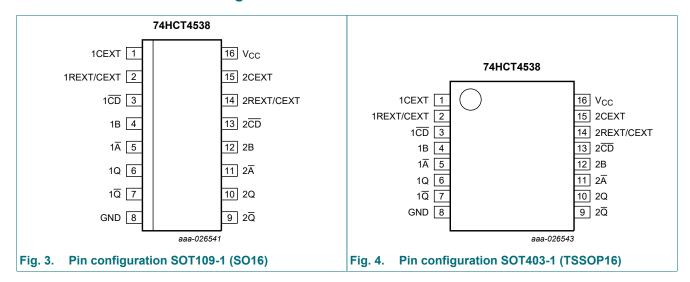




Dual retriggerable precision monostable multivibrator

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1CEXT, 2CEXT	1, 15	external capacitor connection (always connected to ground)
1REXT/CEXT, 2REXT/CEXT	2, 14	external capacitor/resistor connection
1CD, 2CD	3, 13	direct reset input (active LOW)
1B, 2B	4, 12	input (LOW to HIGH triggered)
1Ā, 2Ā	5, 11	input (HIGH to LOW triggered)
1Q, 2Q	6, 10	output
1Q, 2Q	7, 9	complementary output (active LOW)
GND	8	ground (0 V)
V _{CC}	16	supply voltage

6. Functional description

Table 3. Function table

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

 \uparrow = positive-going transition; \downarrow = negative-going transition;

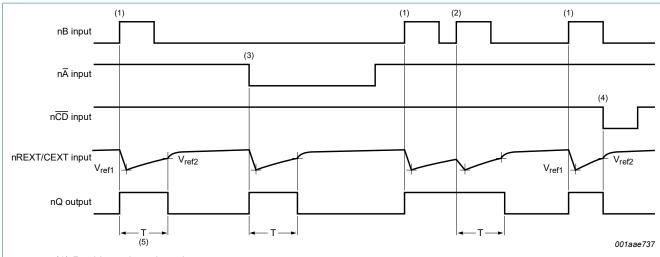
 Π = one HIGH level output pulse, with the pule width determined by C_{EXT} and R_{EXT} ;

 \coprod = one LOW level output pulse, with the pulse width determined by C_{FXT} and R_{FXT} .

Inputs		Outputs			
nĀ	nB	nCD	nQ	nQ	
Į.	L	Н	Л	Ъ	
Н	\uparrow	Н	Л	П	
X	Х	L	L	Н	

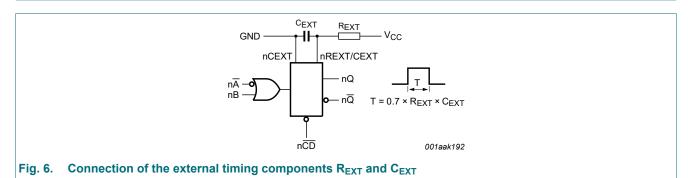
74HCT4538

Dual retriggerable precision monostable multivibrator



- (1) Positive edge triggering.
- (2) Positive edge re-triggering (pulse lengthening).
- (3) Negative edge triggering.
- (4) Reset (pulse shortening).
- (5) $T_W = 0.7 \times R_{EXT} \times C_{EXT}$ (see also Fig. 6).

Fig. 5. Timing diagram



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	+7.0	V
I _{IK}	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
I _{OK}	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
I _O	output current	$V_{O} = -0.5 \text{ V to } V_{CC} + 0.5 \text{ V}$	-	±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	$T_{amb} = -40 ^{\circ}\text{C} \text{ to } +125 ^{\circ}\text{C}$ [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.

74HCT4538

Dual retriggerable precision monostable multivibrator

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V_{CC}	supply voltage		4.5	5.0	5.5	V
VI	input voltage		0	-	V _{CC}	V
Vo	output voltage		0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 4.5 V	-	1.67	139	ns/V

9. 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	o +85 °C	-40 °C to	+125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	1
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 = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V _{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$								
output voltage		I _O = 20 μA; V _{CC} = 4.5 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	
l _l	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
		pin nREXT/CEXT; V_I = 2.0 V or GND; other inputs at V_{CC} or GND; V_{CC} = 5.5 V [1]	-	-	±0.5	-	±5	-	±10	μΑ
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	$V_I = V_{CC} - 2.1 \text{ V}; I_O = 0 \text{ A};$ other inputs at V_{CC} or GND; $V_{CC} = 4.5 \text{ V}$ to 5.5 V								
		pin nĀ, nB	-	50	180	-	225	-	245	μΑ
		pin nCD	-	65	234	-	293	-	319	μΑ
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

^[1] This measurement can only be carried out after a trigger pulse is applied.

Dual retriggerable precision monostable multivibrator

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); 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	
t _{PLH}	LOW to HIGH	nĀ, nB to nQ; see Fig. 7								
	propagation delay	V _{CC} = 4.5 V	-	35	60	-	75	-	90	ns
	uelay	$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$	-	30	-	-	-	-	-	ns
		nCD to nQ; see Fig. 7								
		V _{CC} = 4.5 V	-	35	60	-	75	-	90	ns
t _{PHL}	HIGH to LOW	$n\overline{A}$, nB to $n\overline{Q}$; see Fig. 7								
	propagation delay	V _{CC} = 4.5 V	-	35	60	-	75	-	90	ns
	uelay	V _{CC} = 5.0 V; C _L = 15 pF	-	30	-	-	-	-	-	ns
		nCD to nQ; see Fig. 7								
		V _{CC} = 4.5 V	-	35	60	-	75	-	90	ns
t _t	transition time	nQ and $n\overline{Q}$; see Fig. 7 [1]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	21	ns
t _W	pulse width	nA LOW; see Fig. 8								
		V _{CC} = 4.5 V	20	11	-	25	-	30	-	ns
		nB HIGH; see Fig. 8								
		V _{CC} = 4.5 V	16	5	-	20	-	24	-	ns
		nCD LOW; see Fig. 8								
		V _{CC} = 4.5 V	20	11	-	25	-	30	-	ns
		nQ and nQ HIGH or LOW; see <u>Fig. 8</u>								
		V_{CC} = 5.0 V; C_{EXT} = 0.1 μ F; R_{EXT} = 10 $k\Omega$	630	700	770	602	798	595	805	μs
t _{rec}	recovery time	nCD to nA, nB; see Fig. 8								
		V _{CC} = 4.5 V	7	2	-	9	-	11	-	ns
t _{rtrig}	retrigger time	$n\overline{A}$, nB; see <u>Fig. 8</u> ; X = C _{EXT} / (4.5 x V _{CC})								
		V _{CC} = 4.5 V	-	80+X	-	-	-	-	-	ns
R _{EXT}	external timing resistor			-	1000	-	-	-	-	kΩ
C _{EXT}	external timing capacitor	V _{CC} = 5.0 V	no limits				1			
C _{PD}	power dissipation capacitance	per multivibrator; [2] $V_I = GND$ to $V_{CC} - 1.5 V$	-	138	-	-	-	-	-	pF

[1] t_t is the same as t_{THL} and t_{TLH}.
 [2] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 P_D = C_{PD} × V_{CC}² × f_i + Σ(C_L × V_{CC}² × f_o) + 0.48 × C_{EXT} × V_{CC}² × f_o + D × 0.8 × V_{CC} where:
 f_i = input frequency in MHz;

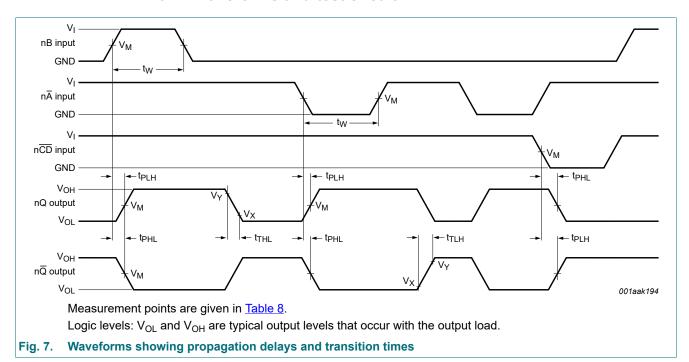
 $\Sigma(C_L \times V_{CC}^2 \times f_0)$ = sum of the outputs; C_L = output load capacitance in pF;

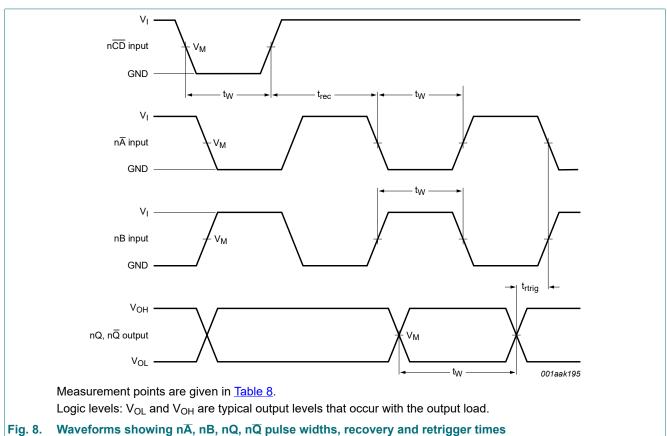
V_{CC} = supply voltage in V;

D = duty cycle factor in %; C_{EXT} = external timing capacitance in pF.

Dual retriggerable precision monostable multivibrator

10.1. Waveforms and test circuit

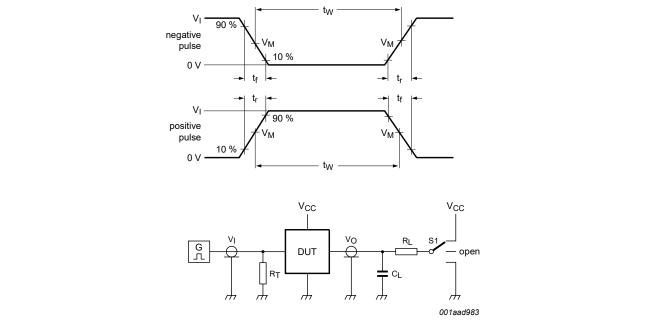




Dual retriggerable precision monostable multivibrator

Table 8. Measurement points

Input	Output		
V _M	V _M	V _X	V _Y
1.3 V	1.3 V	0.1V _{CC}	0.9V _{CC}



Test data is given in Table 9.

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.

 R_L = Load resistance.

S1 = Test selection switch

Fig. 9. Test circuit for measuring switching times

Table 9. Test data

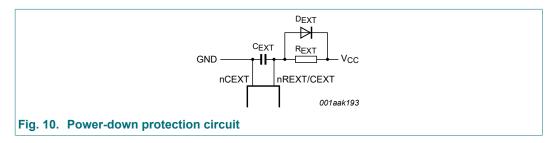
Input		Load	S1 position	
V _I	t _r , t _f	C _L R _L		t _{PHL} , t _{PLH}
3 V	6 ns	15 pF, 50 pF	1 kΩ	open

Dual retriggerable precision monostable multivibrator

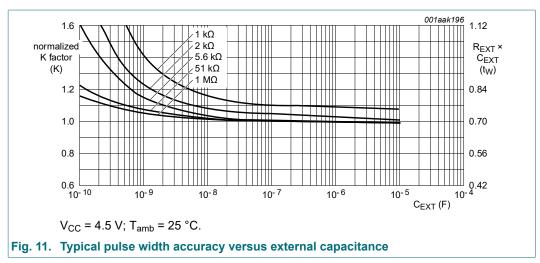
11. Application information

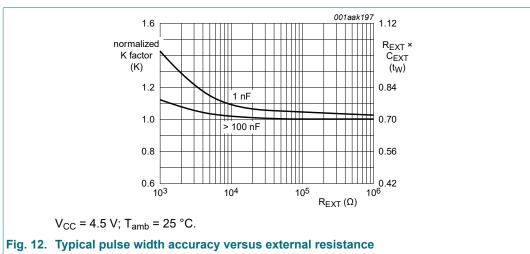
11.1. Power-down considerations

A large capacitor (C_{EXT}) may cause problems when powering-down the monostable due to energy stored in this capacitor. When a system containing this device is powered-down or rapid decrease of V_{CC} to zero occurs, the monostable may sustain damage, due to the capacitor discharging through the input protection diodes. To avoid this possibility, use a damping diode (D_{EXT}) preferably a germanium or Schottky type diode able to withstand large current surges and connect as shown in Fig. 10



11.2. Graphs





9/16

Dual retriggerable precision monostable multivibrator

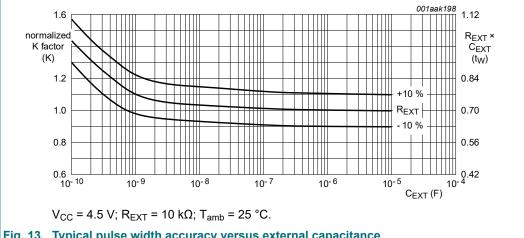
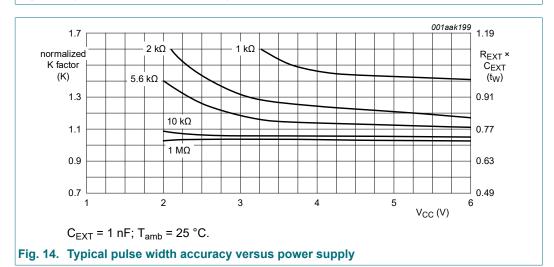
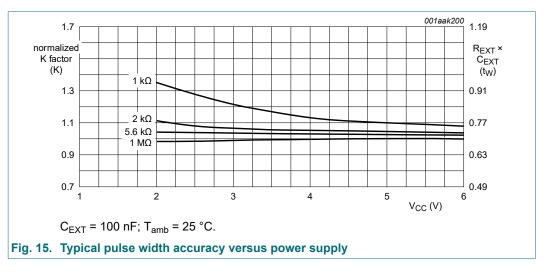


Fig. 13. Typical pulse width accuracy versus external capacitance





Dual retriggerable precision monostable multivibrator

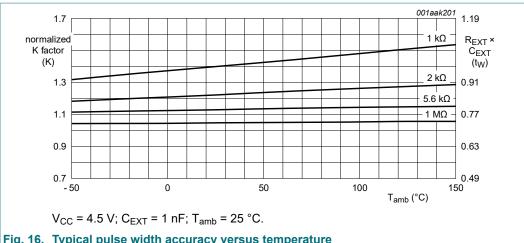
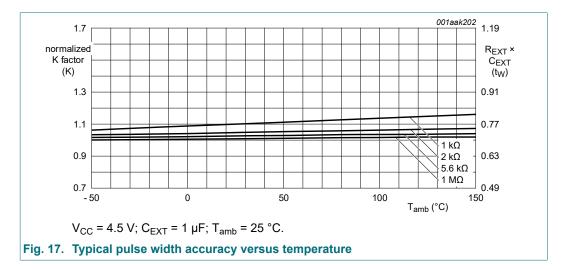


Fig. 16. Typical pulse width accuracy versus temperature

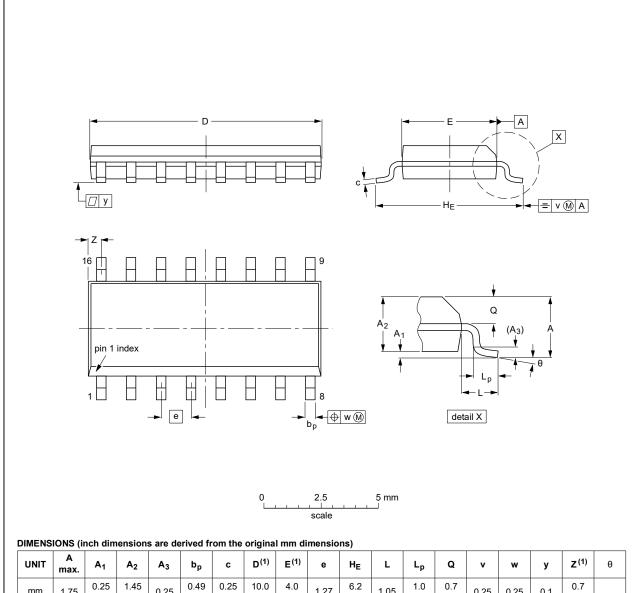


Dual retriggerable precision monostable multivibrator

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		0.16 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	RENCES	EUROPEAN	ISSUE DATE
VERSION	IEC	JEDEC	JEITA	PROJECTION	1330E DATE
SOT109-1	076E07	MS-012			99-12-27 03-02-19

Fig. 18. Package outline SOT109-1 (SO16)

Dual retriggerable precision monostable multivibrator

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

SOT403-1

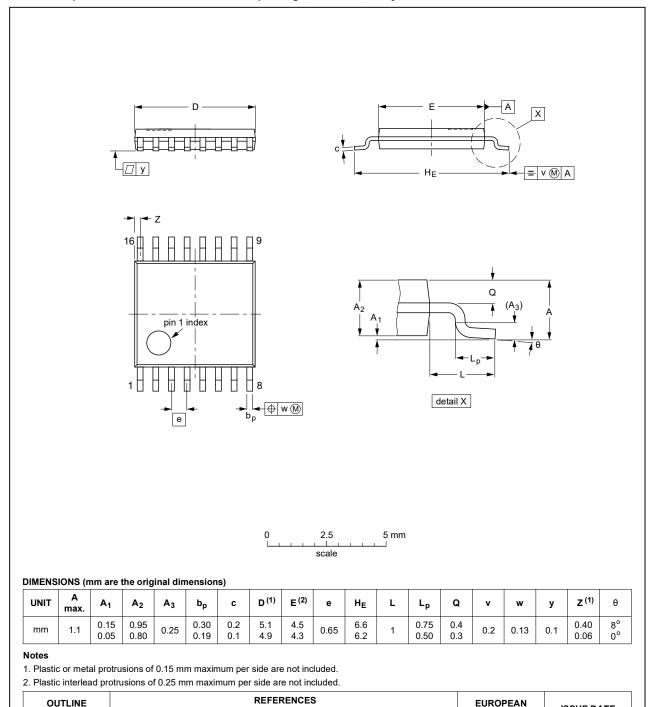


Fig. 19. Package outline SOT403-1 (TSSOP16)

IEC

JEDEC

MO-153

JEITA

ISSUE DATE

99-12-27

03-02-18

PROJECTION

VERSION

SOT403-1

Dual retriggerable precision monostable multivibrator

13. Abbreviations

Table 10. 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 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
74HCT4538 v.6	20210211	Product data sheet	-	74HCT4538 v.5	
Modifications:	 Type number 74HCT4538DB (SOT338-1 / SSOP16) removed. Section 2 updated. Section 7: Derating values for P_{tot} total power dissipation updated. 				
74HCT4538 v.5	20170317	Product data sheet	-	74HC_HCT4538 v.4	
Modifications:	Type numbers 74HC4538D, 74HC4538DB and 74HC4538PW removed.				
74HC_HCT4538 v.4	20160224	Product data sheet	-	74HC_HCT4538 v.3	
Modifications:	Type numbers 74HC4538N and 74HCT4538N (SOT38-4) removed.				
74HC_HCT4538 v.3	20090608	Product data sheet	-	74HC_HCT4538_CNV v.2	
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. Pin names changed throughout. Section Section 7, Section 8 and Section 9 added, taken from the 74HC/T HCMOS Family characteristics/specification (March 1988). Test circuit added: Fig. 9. Quick reference data incorporated in to Section 9 and Section 10. Package information added for DIP16, SO16, SSOP16 and TSSOP16 packages. 				
74HC_HCT4538_CNV v.2	19970902	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".
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74HCT4538

Dual retriggerable precision monostable multivibrator

Contents

1. General description	<i>'</i>
2. Features and benefits	
3. Ordering information	
4. Functional diagram	
5. Pinning information	
5.1. Pinning	
5.2. Pin description	
6. Functional description	
7. Limiting values	
8. Recommended operating conditions	
9. Static characteristics	
10. Dynamic characteristics	
10.1. Waveforms and test circuit	
11. Application information	
11.1. Power-down considerations	
11.2. Graphs	
12. Package outline	12
13. Abbreviations	
14. Revision history	
15. Legal information	
-	

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