74AUP1T98-Q100

Low-power configurable gate with voltage-level translator

Rev. 3 — 9 December 2020 Product data sheet

1. General description

The 74AUP1T98-Q100 is a configurable multiple function gate with level translating, Schmitt-trigger inputs. The device can be configured as any of the following logic functions MUX, AND, OR, NAND, NOR, inverter and buffer; using the 3-bit input. All inputs can be connected directly to V_{CC} or GND. Low threshold Schmitt trigger inputs allow these devices to be driven by 1.8 V logic levels in 3.3 V applications.

This device ensures very low static and dynamic power consumption across the entire V_{CC} range from 2.3 V to 3.6 V. This device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

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 2.3 V to 3.6 V
- High noise immunity
- ESD protection:
  - MIL-STD-883, method 3015 Class 3A, exceeds 5000 V
  - HBM JESD22-A114F Class 3A, exceeds 5000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Low static power consumption; I_{CC} = 1.5 µA (maximum)
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- I_{OFF} circuitry provides partial power-down mode operation

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AUP1T98GW-Q100	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363

4. Marking

Table 2. Marking

Type number	Marking code
74AUP1T98GW-Q100	aR

5. Functional diagram

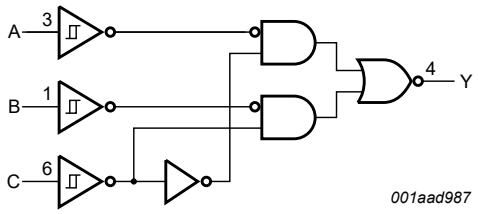


Fig. 1. Logic symbol

6. Pinning information

6.1. Pinning

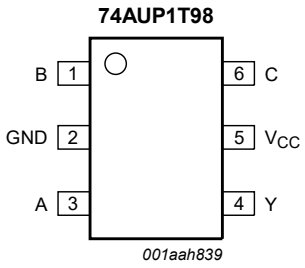


Fig. 2. Pin configuration SOT363

6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
B	1	data input
GND	2	ground (0 V)
A	3	data input
Y	4	data output
V_{CC}	5	supply voltage
C	6	data input

7. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level.

Input			Output
C	**B**	**A**	**Y**
L	L	L	H
L	L	H	H
L	H	L	L
L	H	H	L
H	L	L	H
H	L	H	L
H	H	L	H
H	H	H	L

7.1. Logic configurations

Table 5. Function selection table

Logic function	Figure
2-input MUX (inverting)	see Fig. 3
2-input NAND	see Fig. 4
2-input NOR with one input inverted	see Fig. 5
2-input AND with one input inverted	see Fig. 5
2-input NAND with one input inverted	see Fig. 6
2-input OR with one input inverted	see Fig. 6
2-input NOR	see Fig. 7
Buffer	see Fig. 8
Inverter	see Fig. 9

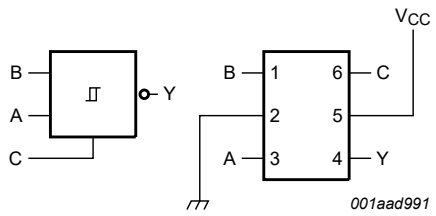


Fig. 3. 2-input MUX (inverting)

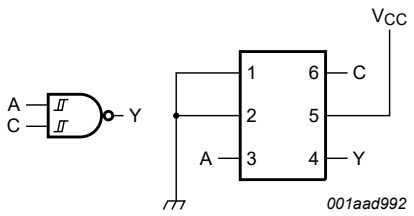


Fig. 4. 2-input NAND gate

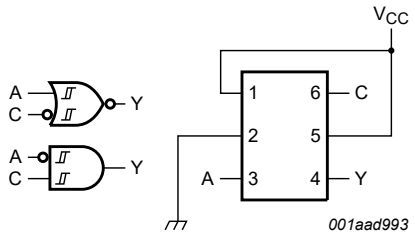


Fig. 5. 2-input AND gate with input A inverted or 2-input NOR gate with input C inverted

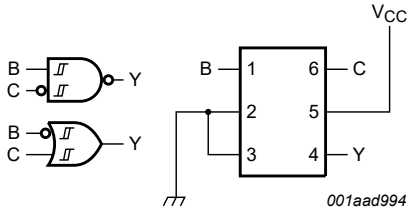


Fig. 6. 2-input OR gate with input B inverted or 2-input NAND gate with input C inverted

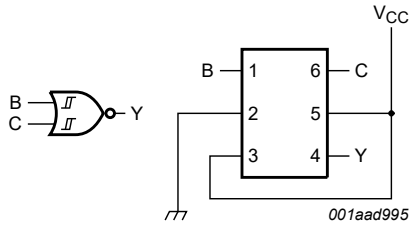


Fig. 7. 2-input NOR gate

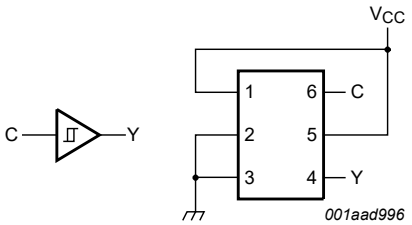


Fig. 8. Buffer

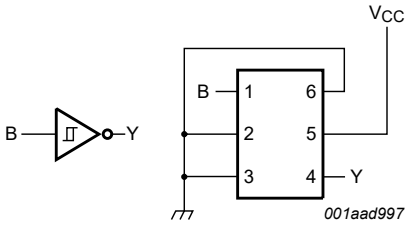


Fig. 9. Inverter

8. Limiting values

Table 6. 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	+4.6	V
I_{IK}	input clamping current	$V_I < 0$ V		-50	-	mA
V_I	input voltage		[1]	-0.5	+4.6	V
I_{OK}	output clamping current	$V_O < 0$ V		-50	-	mA
V_O	output voltage	Active mode and Power-down mode	[1]	-0.5	+4.6	V
I_O	output current	V_O = 0 V to V_{CC}		-	±20	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]	-	250	mW

[1] The minimum input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] For SOT363 (SC-88) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.

9. Recommended operating conditions

Table 7. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		2.3	3.6	V
V_I	input voltage		0	3.6	V
V_O	output voltage	Active mode	0	V_{CC}	V
		Power-down mode; V_{CC} = 0 V	0	3.6	V
T_{amb}	ambient temperature		-40	+125	°C

10. Static characteristics

Table 8. Static characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = 25 °C						
V_{T+}	positive-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.60	-	1.10	V
		V_{CC} = 3.0 V to 3.6 V	0.75	-	1.16	V
V_{T-}	negative-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.35	-	0.60	V
		V_{CC} = 3.0 V to 3.6 V	0.50	-	0.85	V
V_H	hysteresis voltage	$V_H = V_{T+} - V_{T-}$				
		V_{CC} = 2.3 V to 2.7 V	0.23	-	0.60	V
		V_{CC} = 3.0 V to 3.6 V	0.25	-	0.56	V
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = -20 µA; V_{CC} = 2.3 V to 3.6 V	V_{CC} - 0.1	-	-	V
		I_O = -2.3 mA; V_{CC} = 2.3 V	2.05	-	-	V
		I_O = -3.1 mA; V_{CC} = 2.3 V	1.9	-	-	V
		I_O = -2.7 mA; V_{CC} = 3.0 V	2.72	-	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.6	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 µA; V_{CC} = 2.3 V to 3.6 V	-	-	0.10	V
		I_O = 2.3 mA; V_{CC} = 2.3 V	-	-	0.31	V
		I_O = 3.1 mA; V_{CC} = 2.3 V	-	-	0.44	V
		I_O = 2.7 mA; V_{CC} = 3.0 V	-	-	0.31	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.44	V
I_I	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.1	µA
I_{OFF}	power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.1	µA
ΔI_{OFF}	additional power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V to 0.2 V	-	-	±0.2	µA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 A; V_{CC} = 2.3 V to 3.6 V	-	-	1.2	µA
C_I	input capacitance	V_{CC} = 0 V to 3.6 V; V_I = GND or V_{CC}	-	0.8	-	pF
C_O	output capacitance	V_O = GND; V_{CC} = 0 V	-	1.7	-	pF

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +85 °C						
V_{T+}	positive-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.60	-	1.10	V
		V_{CC} = 3.0 V to 3.6 V	0.75	-	1.19	V
V_{T-}	negative-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.35	-	0.60	V
		V_{CC} = 3.0 V to 3.6 V	0.50	-	0.85	V
V_H	hysteresis voltage	$V_H = V_{T+} - V_{T-}$				
		V_{CC} = 2.3 V to 2.7 V	0.10	-	0.60	V
		V_{CC} = 3.0 V to 3.6 V	0.15	-	0.56	V
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = -20 µA; V_{CC} = 2.3 V to 3.6 V	V_{CC} - 0.1	-	-	V
		I_O = -2.3 mA; V_{CC} = 2.3 V	1.97	-	-	V
		I_O = -3.1 mA; V_{CC} = 2.3 V	1.85	-	-	V
		I_O = -2.7 mA; V_{CC} = 3.0 V	2.67	-	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.55	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 µA; V_{CC} = 2.3 V to 3.6 V	-	-	0.1	V
		I_O = 2.3 mA; V_{CC} = 2.3 V	-	-	0.33	V
		I_O = 3.1 mA; V_{CC} = 2.3 V	-	-	0.45	V
		I_O = 2.7 mA; V_{CC} = 3.0 V	-	-	0.33	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.45	V
I_I	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.5	µA
I_{OFF}	power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.5	µA
ΔI_{OFF}	additional power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V to 0.2 V	-	-	±0.5	µA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 A; V_{CC} = 2.3 V to 3.6 V	-	-	1.5	µA
ΔI_{CC}	additional supply current	V_{CC} = 2.3 V to 2.7 V; I_O = 0 A; One input at 0.3 V or 1.1 V, other inputs at V_{CC} or GND	-	-	4	µA
		V_{CC} = 3.0 V to 3.6 V; I_O = 0 A; One input at 0.45 V or 1.2 V, other inputs at V_{CC} or GND	-	-	12	µA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +125 °C						
V_{T+}	positive-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.60	-	1.10	V
		V_{CC} = 3.0 V to 3.6 V	0.75	-	1.19	V
V_{T-}	negative-going threshold voltage	V_{CC} = 2.3 V to 2.7 V	0.33	-	0.64	V
		V_{CC} = 3.0 V to 3.6 V	0.46	-	0.85	V
V_H	hysteresis voltage	$V_H = V_{T+} - V_{T-}$				
		V_{CC} = 2.3 V to 2.7 V	0.10	-	0.60	V
		V_{CC} = 3.0 V to 3.6 V	0.15	-	0.56	V
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = -20 µA; V_{CC} = 2.3 V to 3.6 V	V_{CC} - 0.11	-	-	V
		I_O = -2.3 mA; V_{CC} = 2.3 V	1.77	-	-	V
		I_O = -3.1 mA; V_{CC} = 2.3 V	1.67	-	-	V
		I_O = -2.7 mA; V_{CC} = 3.0 V	2.40	-	-	V
		I_O = -4.0 mA; V_{CC} = 3.0 V	2.30	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		I_O = 20 µA; V_{CC} = 2.3 V to 3.6 V	-	-	0.11	V
		I_O = 2.3 mA; V_{CC} = 2.3 V	-	-	0.36	V
		I_O = 3.1 mA; V_{CC} = 2.3 V	-	-	0.50	V
		I_O = 2.7 mA; V_{CC} = 3.0 V	-	-	0.36	V
		I_O = 4.0 mA; V_{CC} = 3.0 V	-	-	0.50	V
I_I	input leakage current	V_I = GND to 3.6 V; V_{CC} = 0 V to 3.6 V	-	-	±0.75	µA
I_{OFF}	power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±0.75	µA
ΔI_{OFF}	additional power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V to 0.2 V	-	-	±0.75	µA
I_{CC}	supply current	V_I = GND or V_{CC}; I_O = 0 A; V_{CC} = 2.3 V to 3.6 V	-	-	3.5	µA
ΔI_{CC}	additional supply current	V_{CC} = 2.3 V to 2.7 V; I_O = 0 A; One input at 0.3 V or 1.1 V, other inputs at V_{CC} or GND	-	-	7	µA
		V_{CC} = 3.0 V to 3.6 V; I_O = 0 A; One input at 0.45 V or 1.2 V, other inputs at V_{CC} or GND	-	-	22	µA

11. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 11.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
V_{CC} = 2.3 V to 2.7 V; V_I = 1.65 V to 1.95 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	2.0	3.6	5.7	0.5	6.8	0.5	7.5	ns
		C_L = 10 pF	2.5	4.2	6.3	1.0	7.9	1.0	8.7	ns
		C_L = 15 pF	2.9	4.6	6.9	1.0	8.7	1.0	9.6	ns
		C_L = 30 pF	3.9	5.8	8.3	1.5	10.8	1.5	11.9	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	Min	Max	
V_{CC} = 2.3 V to 2.7 V; V_I = 2.3 V to 2.7 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	1.7	3.4	5.6	0.5	6.0	0.5	6.6	ns
		C_L = 10 pF	2.1	4.0	6.3	1.0	7.1	1.0	7.9	ns
		C_L = 15 pF	2.5	4.5	6.9	1.0	7.9	1.0	8.7	ns
		C_L = 30 pF	3.4	5.6	8.4	1.5	10.0	1.5	11.0	ns
V_{CC} = 2.3 V to 2.7 V; V_I = 3.0 V to 3.6 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	1.3	3.2	5.2	0.5	5.5	0.5	6.1	ns
		C_L = 10 pF	1.8	3.7	5.9	1.0	6.5	1.0	7.2	ns
		C_L = 15 pF	2.2	4.2	6.5	1.0	7.4	1.0	8.2	ns
		C_L = 30 pF	3.1	5.4	7.9	1.5	9.5	1.5	10.5	ns
V_{CC} = 3.0 V to 3.6 V; V_I = 1.65 V to 1.95 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	2.0	2.9	4.1	0.5	8.0	0.5	8.8	ns
		C_L = 10 pF	2.4	3.5	4.8	1.0	8.5	1.0	9.4	ns
		C_L = 15 pF	2.8	3.9	5.4	1.0	9.1	1.0	10.1	ns
		C_L = 30 pF	3.6	5.1	6.9	1.5	9.8	1.5	10.8	ns
V_{CC} = 3.0 V to 3.6 V; V_I = 2.3 V to 2.7 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	1.5	2.8	4.4	0.5	5.3	0.5	5.9	ns
		C_L = 10 pF	2.0	3.4	5.1	1.0	6.1	1.0	6.8	ns
		C_L = 15 pF	2.4	3.9	5.7	1.0	6.8	1.0	7.5	ns
		C_L = 30 pF	3.4	5.0	7.2	1.5	8.5	1.5	9.4	ns
V_{CC} = 3.0 V to 3.6 V; V_I = 3.0 V to 3.6 V										
t_{pd}	propagation delay	A, B, C to Y; see Fig. 10 [2]								
		C_L = 5 pF	1.3	2.8	4.4	0.5	4.7	0.5	5.2	ns
		C_L = 10 pF	1.7	3.3	5.2	1.0	5.7	1.0	6.3	ns
		C_L = 15 pF	2.1	3.8	5.8	1.0	6.2	1.0	6.9	ns
		C_L = 30 pF	3.1	5.0	7.2	1.5	7.8	1.5	8.6	ns
T_{amb} = 25 °C										
C_{PD}	power dissipation capacitance	f_i = 1 MHz; V_I = GND to V_{CC} [3]								
		V_{CC} = 2.3 V to 2.7 V	-	3.6	-	-	-	-	-	pF
		V_{CC} = 3.0 V to 3.6 V	-	4.3	-	-	-	-	-	pF

[1] All typical values are measured at nominal V_{CC}.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in µW).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

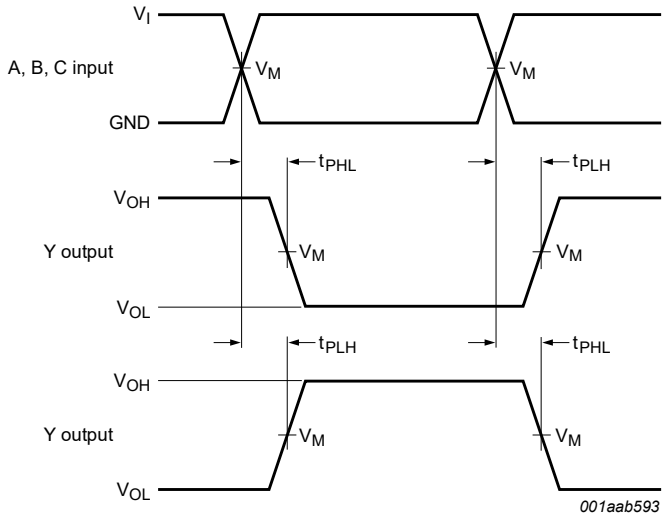
C_L = output load capacitance in pF;

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.

11.1. Waveforms and test circuits



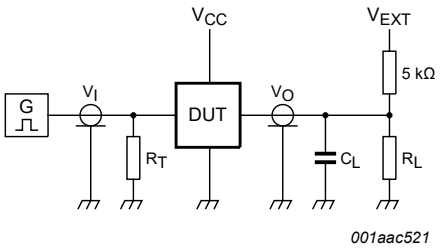
Measurement points are given in Table 10.

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

Fig. 10. Input A, B and C to output Y propagation delay times

Table 10. Measurement points

Supply voltage	Input			Output
V_{CC}	V_M	V_I	$t_r = t_f$	V_M
2.3 V to 3.6 V	0.5 x V_I	1.65 V to 3.6 V	≤ 3.0 ns	0.5 x V_{CC}



Test data is given in Table 11.

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 the output impedance Z_o of the pulse generator.

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

Fig. 11. Test circuit for measuring switching times

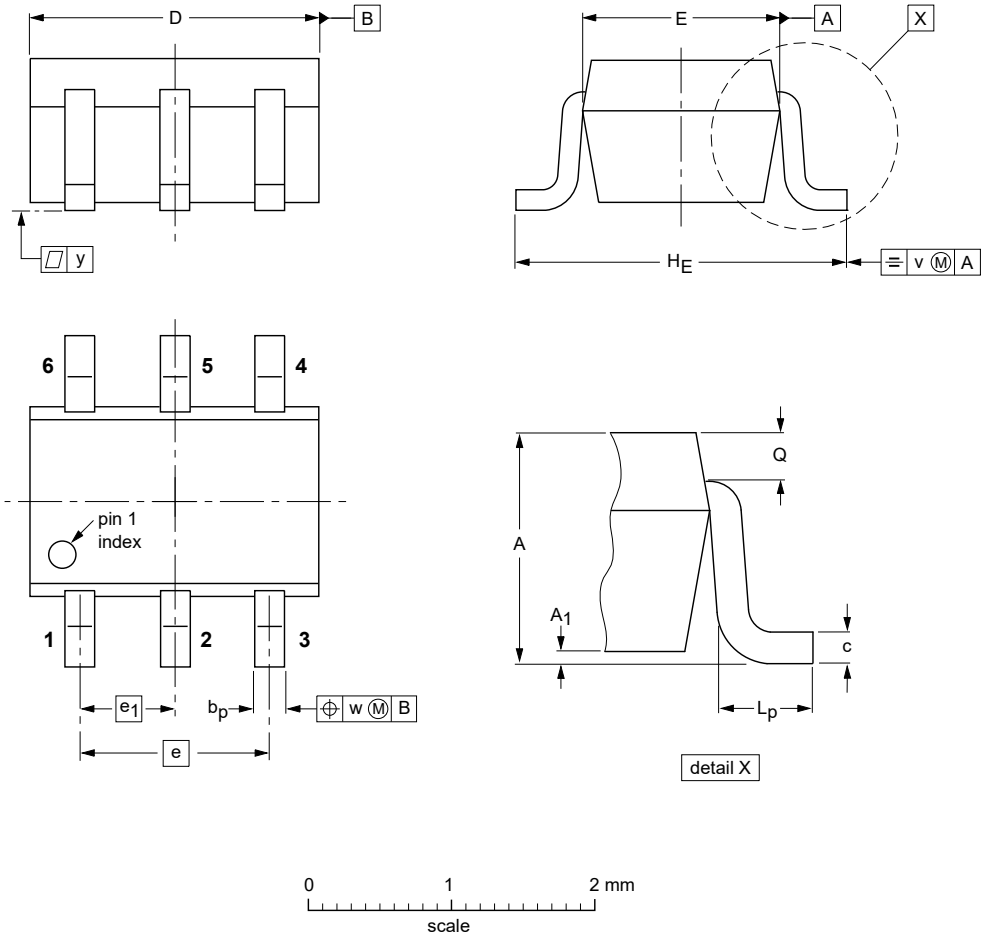
Table 11. Test data

Supply voltage	Load		V_{EXT}		
V_{CC}	C_L	R_L [1]	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
2.3 V to 3.6 V	5 pF, 10 pF, 15 pF and 30 pF	5 kΩ or 1 MΩ	open	GND	2 × V_{CC}

[1] For measuring enable and disable times R_L = 5 kΩ.
For measuring propagation delays, setup and hold times and pulse width R_L = 1 MΩ.

12. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig. 12. Package outline SOT363 (SC-88)

13. Abbreviations

Table 12. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

14. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AUP1T98_Q100 v.3	20201209	Product data sheet	-	74AUP1T98_Q100 v.2
Modifications:	• Section 1 updated. • Table 6: Derating values for P_{tot} total power dissipation updated.			
74AUP1T98_Q100 v.2	20181005	Product data sheet	-	74AUP1T98_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.			
74AUP1T98_Q100 v.1	20140519	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".
[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 https://www.nexperia.com.

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