

74HC7541-Q100; 74HCT7541-Q100

Octal Schmitt trigger buffer/line driver; 3-state

Rev. 1 — 24 March 2014

Product data sheet

1. General description

The 74HC7541-Q100; 74HCT7541-Q100 is an 8-bit buffer/line driver with Schmitt-trigger inputs and 3-state outputs. The device features two output enables ($\overline{OE1}$ and $\overline{OE2}$). A HIGH on $\overline{OE}n$ causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Non-inverting outputs
- Low-power dissipation
- Input levels:
 - ◆ For 74HC7541-Q100: CMOS level
 - ◆ For 74HCT7541-Q100: TTL level
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- Multiple package options

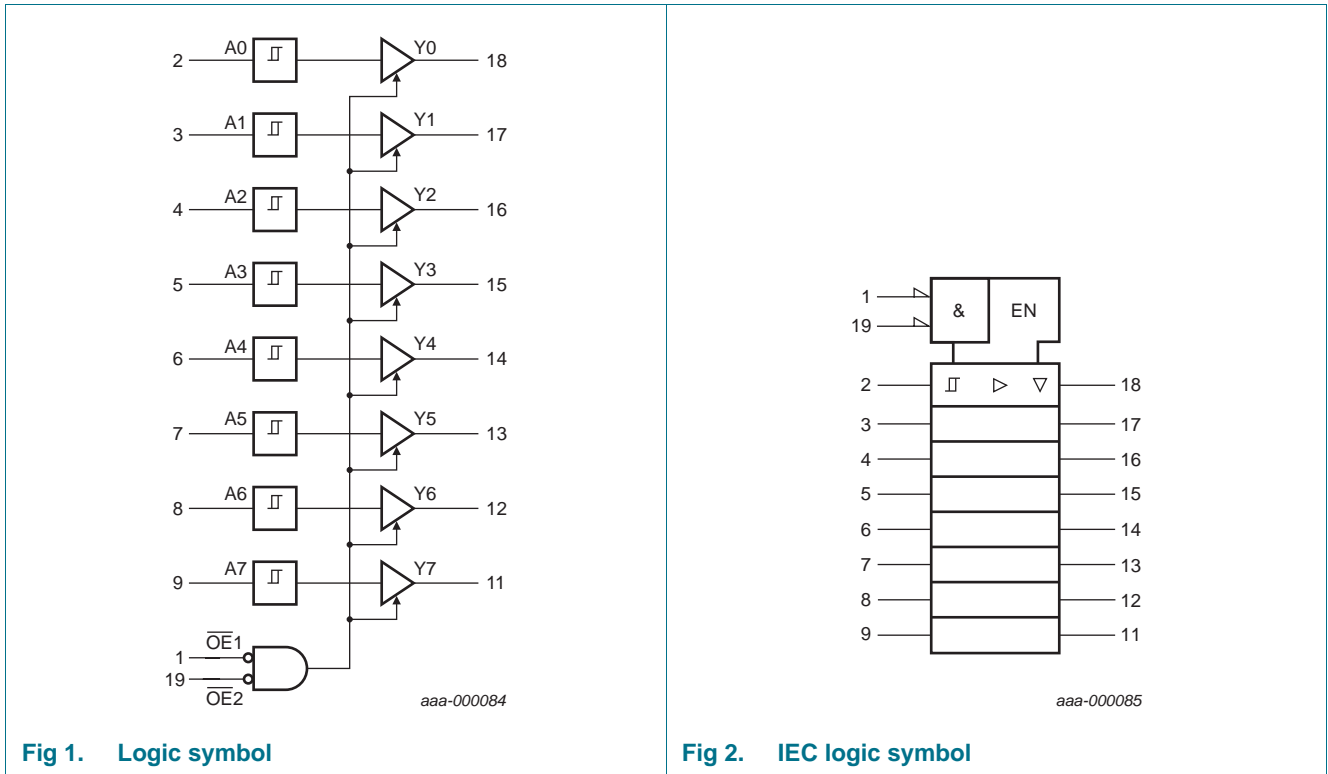
3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC7541D-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74HCT7541D-Q100				
74HC7541PW-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74HCT7541PW-Q100				

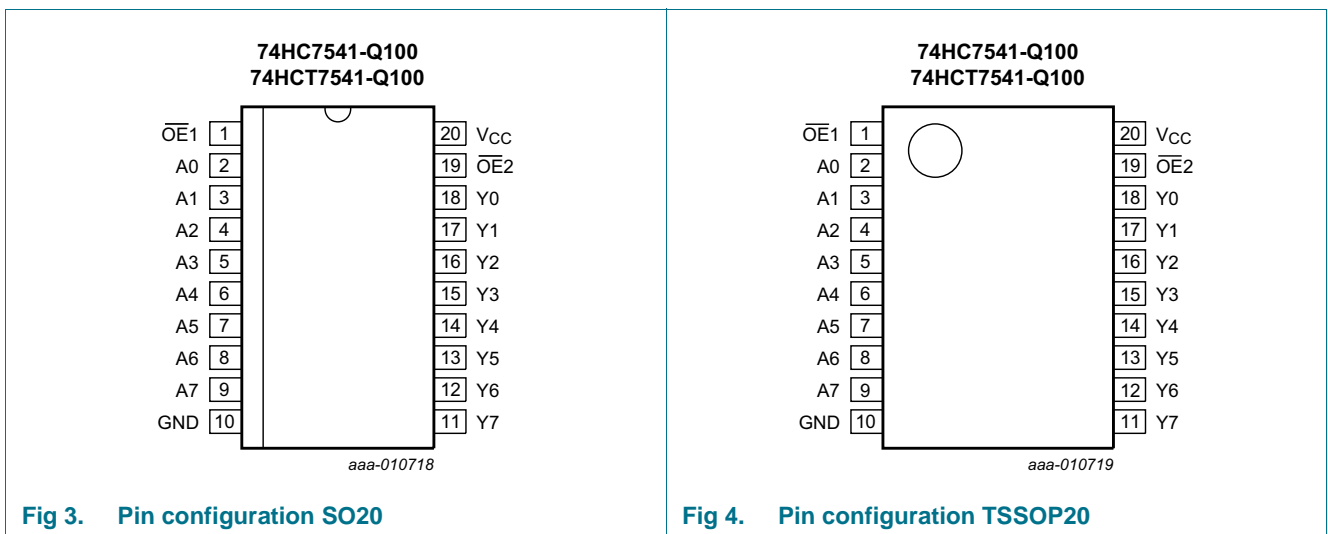


4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{OE}1$	1	output enable input (active LOW)
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0 to Y7	18, 17, 16, 15, 14, 13, 12, 11	data output
$\overline{OE}2$	19	output enable input (active LOW)
V _{CC}	20	supply voltage

6. Functional description

Table 3. Functional table^[1]

Control		Input	Output
$\overline{OE}1$	$\overline{OE}2$	A _n	Y _n
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

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

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	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 _O < -0.5 V or V _O > V _{CC} + 0.5 V	[1]	±20	mA
I _O	output current	-0.5 V < V _O < V _{CC} + 0.5 V	-	±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		[2]	500	mW

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

[2] For SO20 package: above 70 °C the value of P_{tot} derates linearly with 8 mW/K.
For TSSOP20 package: above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC7541-Q100			74HCT7541-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

9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC7541-Q100										
V _{OH}	HIGH-level output voltage	V _I = V _{T+} or V _{T-}								
		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 = -6.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -7.8 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-}								
		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 = 6.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 7.8 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 _{OZ}	OFF-state output current	per input pin; V _I = V _{T+} or V _{T-} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 6.0 V; I _O = 0 A	-	-	±0.5	-	±5.0	-	±10	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
74HCT7541-Q100										
V _{OH}	HIGH-level output voltage	V _I = V _{T+} or V _{T-} ; V _{CC} = 4.5 V								
		I _O = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -6.0 mA	3.98	4.32	-	3.84	-	3.7	-	V

Table 6. Static characteristics ...continued

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

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-} ; V _{CC} = 4.5 V								
		I _O = 20 μA;	-	0	0.1	-	0.1	-	0.1	V
		I _O = 6.0 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 _{OZ}	OFF-state output current	per input pin; V _I = V _{T+} or V _{T-} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A	-	-	±0.5	-	±5.0	-	±10	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; I _O = 0 A; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V								
		An input	-	20	72	-	90	-	98	μA
		$\overline{O}E$ n input	-	130	468	-	585	-	637	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V; C_L = 50 pF; for test circuit, see [Figure 7](#).

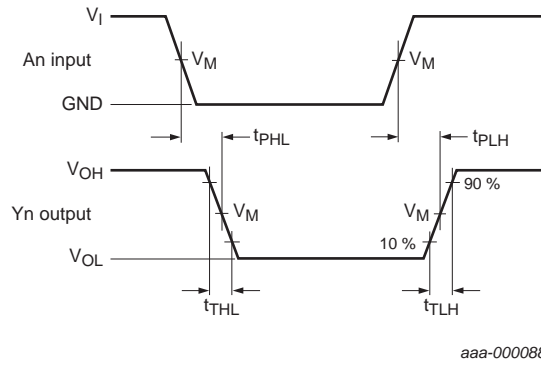
Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
74HC7541-Q100								
t _{pd}	propagation delay	An to Y _n ; see Figure 5 ^[1]						
		V _{CC} = 2.0 V	-	39	120	150	180	ns
		V _{CC} = 4.5 V	-	14	24	30	36	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	10	-	-	-	ns
		V _{CC} = 6.0 V	-	11	20	26	32	ns
t _{en}	enable time	$\overline{O}E$ n to Y _n ; see Figure 6 ^[1]						
		V _{CC} = 2.0 V	-	44	160	200	240	ns
		V _{CC} = 4.5 V	-	16	32	40	48	ns
		V _{CC} = 6.0 V	-	13	27	34	41	ns
t _{dis}	disable time	$\overline{O}E$ n to Y _n ; see Figure 6 ^[1]						
		V _{CC} = 2.0 V	-	58	160	200	240	ns
		V _{CC} = 4.5 V	-	21	32	40	48	ns
		V _{CC} = 6.0 V	-	17	27	34	41	ns

Table 7. Dynamic characteristics
GND = 0 V; C_L = 50 pF; for test circuit, see [Figure 7](#).

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Max (85 °C)	Max (125 °C)	
t _t	transition time	see Figure 5 [2]						
		V _{CC} = 2.0 V	-	14	60	75	90	ns
		V _{CC} = 4.5 V	-	5	12	15	18	ns
		V _{CC} = 6.0 V	-	4	10	13	15	ns
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} [3]	-	30	-	-	-	pF
74HCT7541-Q100								
t _{pd}	propagation delay	An to Y _n ; see Figure 5 [1]						
		V _{CC} = 4.5 V	-	19	32	40	48	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	ns
t _{en}	enable time	$\overline{\text{OEn}}$ to Y _n ; see Figure 6 [1]						
		V _{CC} = 4.5 V	-	18	32	40	48	ns
t _{dis}	disable time	$\overline{\text{OEn}}$ to Y _n ; see Figure 6 [1]						
		V _{CC} = 4.5 V	-	20	32	40	48	ns
t _t	transition time	V _{CC} = 4.5 V; see Figure 5 [2]	-	5	12	15	18	ns
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} - 1.5 V [3]	-	32	-	-	-	pF

- [1] 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}.
- [2] t_t is the same as t_{THL} and 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.

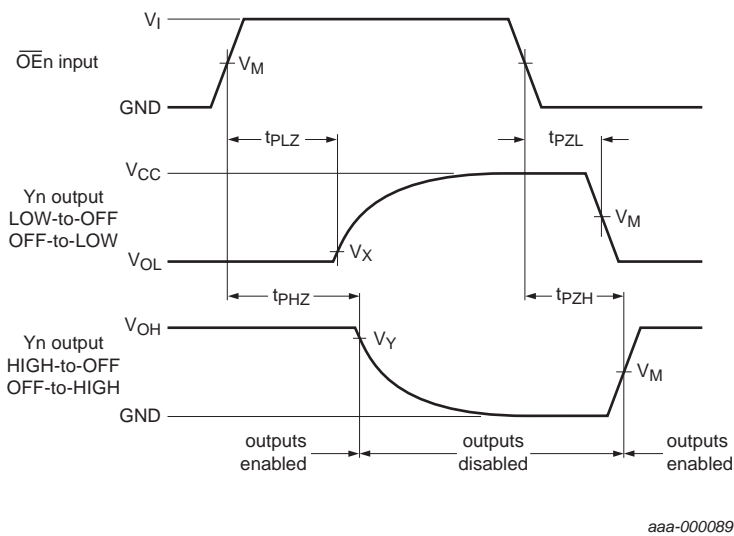
11. Waveforms



Measurement points are given in [Table 8](#).

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

Fig 5. Input to output propagation delays



Measurement points are given in [Table 8](#).

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

Fig 6. 3-state enable and disable times

Table 8. Measurement points

Type	Input	Output		
	V_M	V_M	V_X	V_Y
74HC7541-Q100	$0.5V_{CC}$	$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$
74HCT7541-Q100	1.3 V	1.3 V	$0.1V_{CC}$	$0.9V_{CC}$

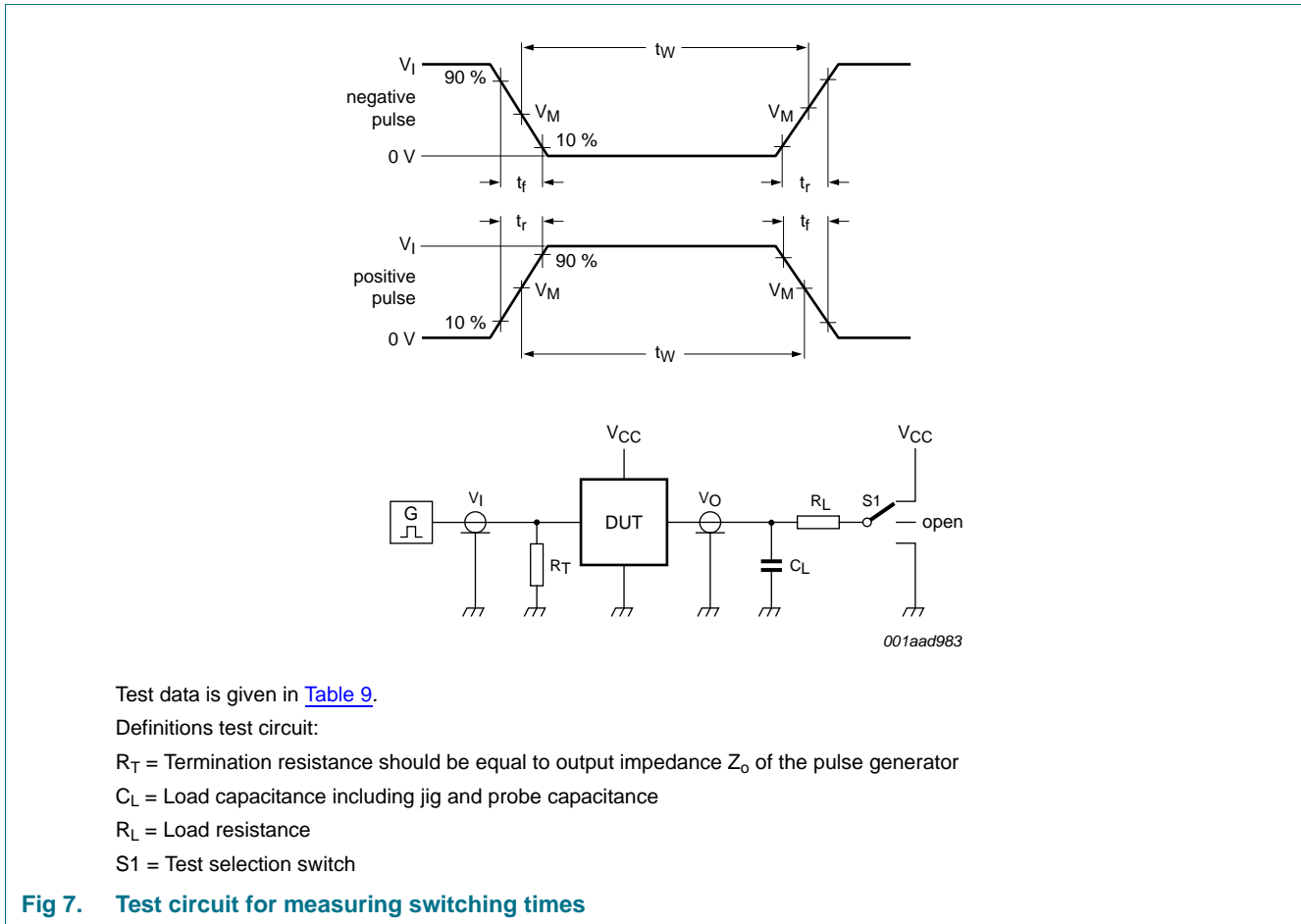


Table 9. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC7541-Q100	V_{CC}	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74HCT7541-Q100	3 V	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

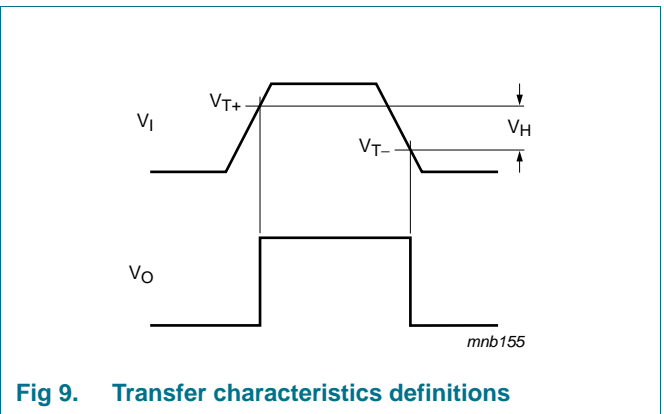
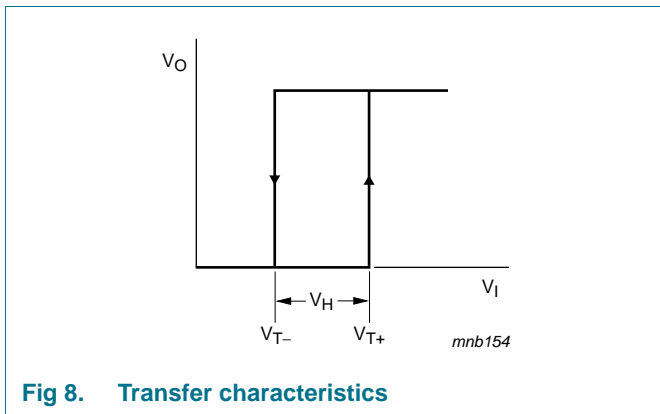
12. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 8](#) and [Figure 9](#).

Symbol	Parameter	Conditions	T _{amb} = 25 °C			T _{amb} = -40 °C to +85 °C		T _{amb} = -40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC7541-Q100										
V _{T+}	positive-going threshold voltage	V _{CC} = 2.0 V	-	-	1.5	-	1.5	-	1.5	V
		V _{CC} = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V _{CC} = 6.0 V	-	-	4.2	-	4.2	-	4.2	V
V _{T-}	negative-going threshold voltage	V _{CC} = 2.0 V	0.3	-	-	0.3	-	0.3	-	V
		V _{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V _{CC} = 6.0 V	1.8	-	-	1.8	-	1.8	-	V
V _H	hysteresis voltage	V _{CC} = 2.0 V	0.1	0.20	-	0.1	-	0.1	-	V
		V _{CC} = 4.5 V	0.25	0.40	-	0.25	-	0.25	-	V
		V _{CC} = 6.0 V	0.3	0.5	-	0.3	-	0.3	-	V
74HCT7541-Q100										
V _{T+}	positive-going threshold voltage	V _{CC} = 4.5 V	-	-	2.0	-	2.0	-	2.0	V
		V _{CC} = 5.5 V	-	-	2.1	-	2.1	-	2.1	V
V _{T-}	negative-going threshold voltage	V _{CC} = 4.5 V	0.7	-	-	0.64	-	0.6	-	V
		V _{CC} = 5.5 V	0.8	-	-	0.74	-	0.7	-	V
V _H	hysteresis voltage	V _{CC} = 4.5 V	0.17	0.23	-	-	-	-	-	V
		V _{CC} = 5.5 V	0.17	0.23	-	-	-	-	-	V

13. Transfer characteristics waveforms



14. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1

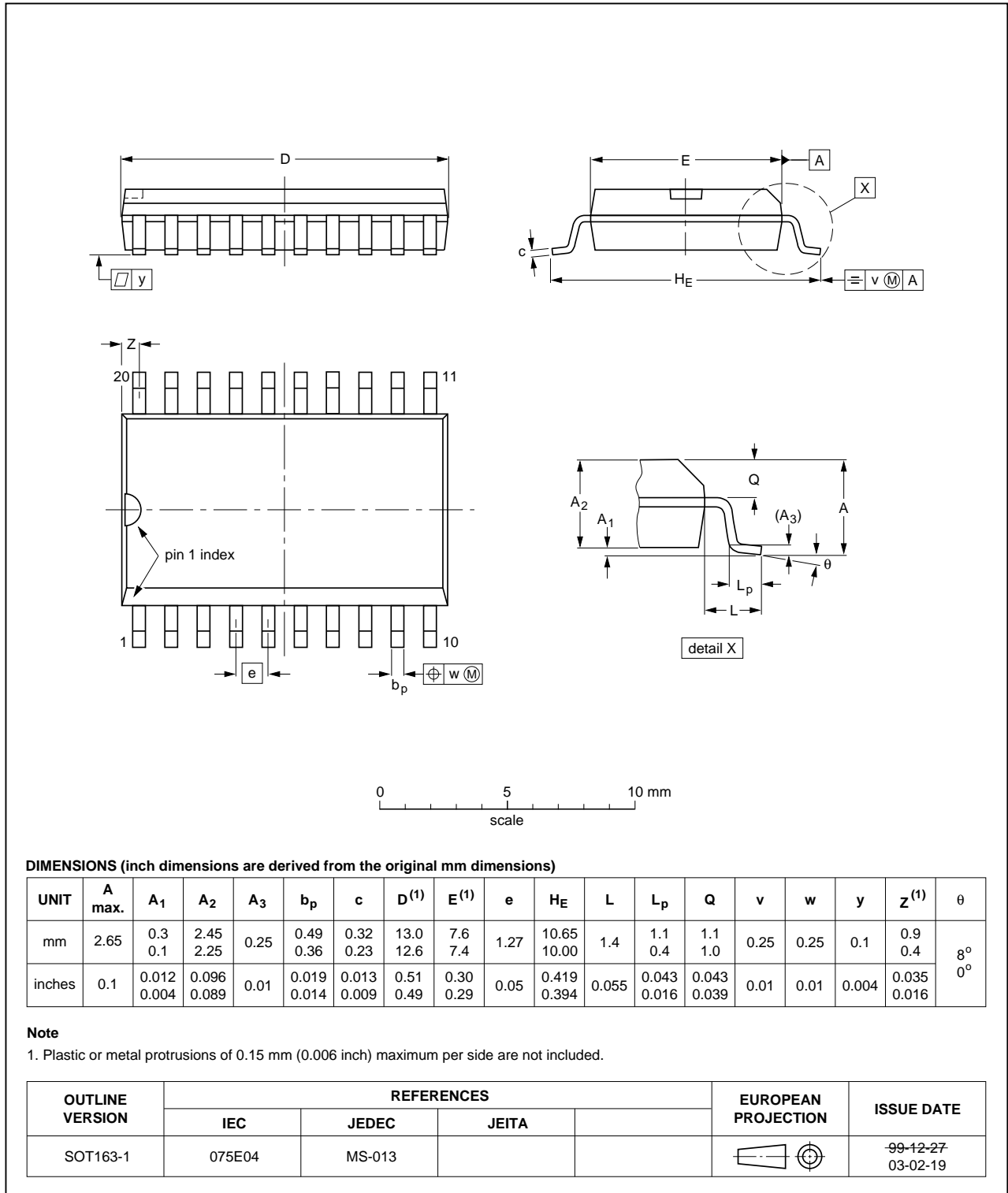


Fig 10. Package outline SOT163-1 (SO20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

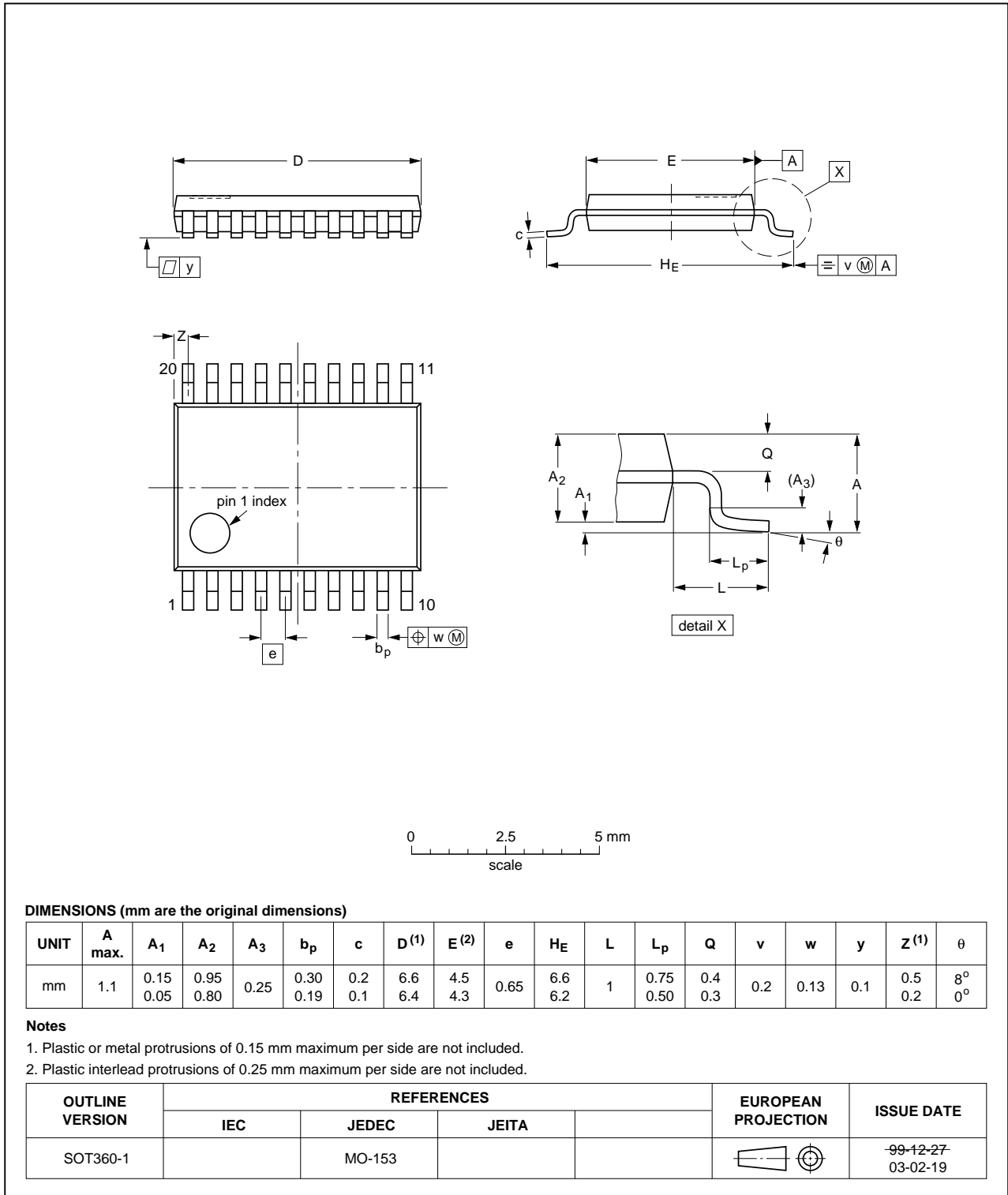


Fig 11. Package outline SOT360-1 (TSSOP20)

15. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MIL	Military
MM	Machine Model

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT7541_Q100 v.1	20140324	Product data sheet	-	-

17. Legal information

17.1 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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19. Contents

1	General description	1
2	Features and benefits	1
3	Ordering information	1
4	Functional diagram	2
5	Pinning information	2
5.1	Pinning	2
5.2	Pin description	3
6	Functional description	3
7	Limiting values	3
8	Recommended operating conditions	4
9	Static characteristics	4
10	Dynamic characteristics	5
11	Waveforms	7
12	Transfer characteristics	9
13	Transfer characteristics waveforms	9
14	Package outline	10
15	Abbreviations	12
16	Revision history	12
17	Legal information	13
17.1	Data sheet status	13
17.2	Definitions	13
17.3	Disclaimers	13
17.4	Trademarks	14
18	Contact information	14
19	Contents	15

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