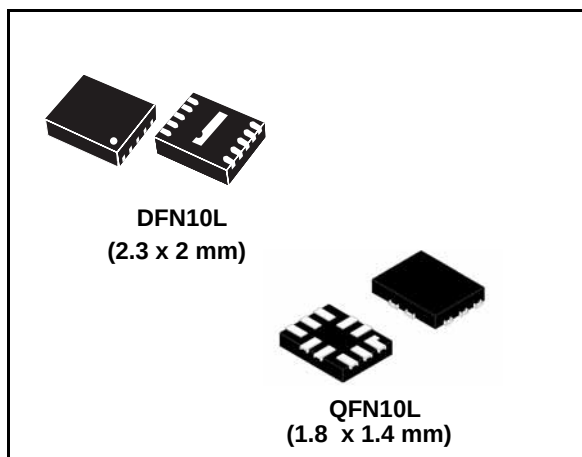


Features

- Ultra low power dissipation:
 $I_{CC} = 0.2 \mu A$ (max.) at $T_A = 85^\circ C$
- Low ON resistance $V_{IN} = 0 V$:
 - $R_{ON} = 0.45 \Omega$ (max. $T_A = 25^\circ C$) at $V_{CC} = 4.3 V$
 - $R_{ON} = 0.50 \Omega$ (max. $T_A = 25^\circ C$) at $V_{CC} = 3.6 V$
 - $R_{ON} = 0.50 \Omega$ (max. $T_A = 25^\circ C$) at $V_{CC} = 3.0 V$
- Wide operating voltage range:
 V_{CC} (OPR) = 1.65 to 4.3 V single supply
- 4.3 V tolerant and 1.8 V compatible threshold on digital control input at $V_{CC} = 2.3$ to 4.3 V
- Latch-up performance exceeds 300 mA (JESD 17)
- ESD performance:
HMB > 2 kV (MIL STD 883 method 3015)

Description

The STG3684A is a high-speed CMOS dual analog SPDT (single-pole dual-throw) switch or dual 2:1 multiplexer/demultiplexer bus switch fabricated using silicon gate C²MOS technology. Designed to operate from 1.65 to 4.3 V, this device is ideal for portable applications.



It offers very low ON resistance ($R_{ON} < 0.5 \Omega$) at $V_{CC} = 3.0 V$. The n_{IN} inputs are provided to control the independent channel switches $nS1$ and $nS2$. The switches $nS1$ are ON (connected to common ports Dn) when the n_{IN} input is held high and OFF (state of high impedance exists between the two ports) when n_{IN} is held low. The switches $nS2$ are ON (connected to common ports Dn) when the n_{IN} input is held low and OFF (state of high impedance exists between the two ports) when IN is held high. Additional key features are fast switching speed, break-before-make delay time and ultra low power consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them ESD and excess transient voltage immunity.

Table 1. Device summary

Order code	Package	Packaging
STG3684AUTR	QFN10L (1.8 x 1.4 mm)	Tape and reel
STG3684ADTR	DFN10L (2.3 x 2 mm)	Tape and reel

Contents

1	Pin settings	5
1.1	Pin connection	5
1.2	Pin description	6
2	Input equivalent circuit and truth table	7
3	Maximum rating	8
3.1	Recommended operating conditions	8
4	Electrical characteristics	9
5	Test circuit	12
6	Package mechanical data	18
7	Revision history	27

List of tables

Table 1.	Device summary	1
Table 2.	Pin description	6
Table 3.	Truth table.	7
Table 4.	Absolute maximum ratings	8
Table 5.	Recommended operating conditions	8
Table 6.	DC specifications	9
Table 7.	AC electrical characteristics ($C_L = 35 \text{ pF}$, $R_L = 50 \Omega$, $t_r = t_f \leq 6 \text{ ns}$)	10
Table 8.	Analog switch characteristics ($C_L = 5 \text{ pF}$, $R_L = 50 \Omega$, $T_A = 25 \text{ }^\circ\text{C}$)	11
Table 9.	QFN10L (1.8 x 1.4 mm) mechanical data.	19
Table 10.	DFN10L (2 x 2.3 mm) mechanical data	23
Table 11.	Document revision history	27

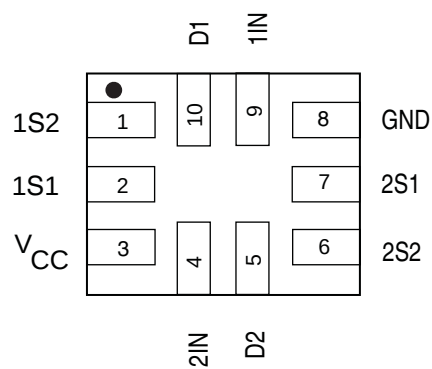
List of figures

Figure 1.	Pin connection (top through view)	5
Figure 2.	Input equivalent circuit	7
Figure 3.	ON resistance	12
Figure 4.	OFF leakage	12
Figure 5.	OFF isolation	13
Figure 6.	Bandwidth	13
Figure 7.	Channel-to-channel crosstalk	14
Figure 8.	Test circuit	14
Figure 9.	Break-before-make time delay	15
Figure 10.	Charge injection ($V_{GEN} = 0\text{ V}$, $R_{GEN} = 0\ \Omega$, $R_L = 1\text{ M}\Omega$, $C_L = 100\text{ pF}$)	16
Figure 11.	Turn-on, turn-off delay time	17
Figure 12.	QFN10L (1.8 x 1.4 mm) package outline	18
Figure 13.	QFN10L (1.8 x 1.4 mm) footprint recommendations.	19
Figure 14.	QFN10L (1.8 x 1.4 mm) carrier type	20
Figure 15.	QFN10L (1.8 x 1.4 mm) reel information - back view	21
Figure 16.	QFN10L (1.8 x 1.4 mm) reel information - front side	22
Figure 17.	DFN10L (2 x 2.3 mm) package outline	23
Figure 18.	DFN10L (2 x 2.3 mm) carrier type	24
Figure 19.	DFN10L (2 x 2.3 mm) reel information - back view.	25
Figure 20.	DFN10L (2 x 2.3 mm) reel information - front side	26

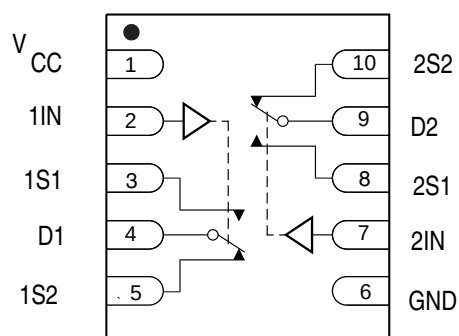
1 Pin settings

1.1 Pin connection

Figure 1. Pin connection (top through view)



QFN10L (1.8 x 1.4 mm)



DFN10L (2.3 x 2 mm)

1.2 Pin description

Table 2. Pin description

Pin number		Symbol	Name and function
QFN10L	DFN10L		
1	5	1S2	Independent channel
2	3	1S1	Independent channel
3	1	V _{CC}	Positive voltage supply
4	7	2IN	Control
5	9	D2	Common channel
6	10	2S2	Independent channel
7	8	2S1	Independent channel
8	6	GND	Ground (0V)
9	2	1IN	Control
10	4	D1	Common channel

Note: Exposed pad must be soldered to a floating plane. Do NOT connect to power or ground.

2 Input equivalent circuit and truth table

Figure 2. Input equivalent circuit

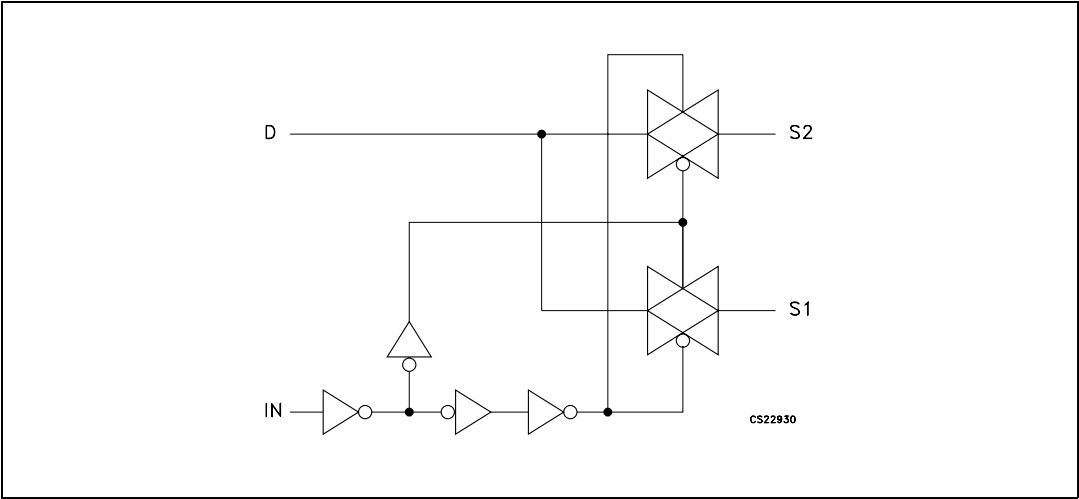


Table 3. Truth table

IN	Switch S1	Switch S2
H	ON	OFF ⁽¹⁾
L	OFF ⁽¹⁾	ON

1. High impedance

3 Maximum rating

Stressing the device above the rating listed in the “Absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	−0.5 to 5.5	V
V_I	DC input voltage	−0.5 to $V_{CC} + 0.5$	V
V_{IC}	DC control input voltage	−0.5 to 5.5	V
V_O	DC output voltage	−0.5 to $V_{CC} + 0.5$	V
I_{IKC}	DC input diode current on control pin ($V_{IN} < 0$ V)	−50	mA
I_{IK}	DC Input diode current ($V_{IN} < 0$ V)	±50	mA
I_{OK}	DC Output diode current	±20	mA
I_O	DC Output current	±300	mA
I_{OP}	DC Output current peak (pulse at 1 ms, 10% duty cycle)	±500	mA
I_{CC} or I_{GND}	DC V_{CC} or ground current	±100	mA
P_D	Power dissipation at $T_A = 70^\circ\text{C}$	1120	mW
T_{STG}	Storage temperature	−65 to 150	°C
T_L	Lead temperature (10 sec)	300	°C

3.1 Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		1.65 to 4.3	V
V_I	Input voltage		0 to V_{CC}	V
V_{IC}	Control input voltage		0 to 4.3	V
V_O	Output voltage		0 to V_{CC}	V
T_{op}	Operating temperature		−40 to 85	°C
dt/dv	Input rise and fall time control input	$V_{CC} = 1.65$ to 2.7 V	0 to 20	ns/V
		$V_{CC} = 3.0$ to 4.3 V	0 to 10	

4 Electrical characteristics

Table 6. DC specifications

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
V _{IH}	High level input voltage	1.65 – 1.95		0.65 V _{CC}			0.65 V _{CC}		V
		2.3 –2.5		1.2			1.2		
		2.7 –3.0		1.3			1.3		
		3.0 –3.6		1.4			1.4		
		4.3		1.5			1.5		
V _{IL}	Low level input voltage	1.65 – 1.95				0.25		0.25	V
		2.3 –2.5				0.25		0.25	
		2.7 –3.0				0.25		0.25	
		3.0 –3.6				0.30		0.30	
		4.3				0.40		0.40	
R _{ON}	Switch ON resistance ⁽¹⁾	4.3	V _S = 0 V to V _{CC} I _S = 100 mA		0.40	0.45		0.50	Ω
		3.6			0.40	0.50		0.60	
		3.0			0.40	0.50		0.60	
		2.3			0.48	0.70		0.80	
		1.8			0.55	0.9		1.0	
ΔR _{ON}	ON resistance match between channels ⁽¹⁾⁽²⁾	2.7	V _S = 1.5 V I _S = 100 mA		0.1				Ω
R _{FLAT}	ON resistance flatness ⁽³⁾	4.3	V _S = 1.5 V I _S = 100 mA		0.15	0.20		0.20	Ω
		3.6			0.15	0.20		0.20	
		3.0			0.15	0.20		0.20	
		2.7			0.15	0.20		0.20	
		2.3			0.20	0.25		0.25	
		1.65			0.35	0.45		0.45	
I _{OFF}	OFF state leakage current (nSn), (Dn)	4.3	V _S =0.3 or 4 V			±20		±100	nA
I _{IN}	Input leakage current	0 –4.3	V _{IN} = 0 to 4.3 V			±0.05		±1	μA

Table 6. DC specifications (continued)

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
I _{CC}	Quiescent supply current (1)	1.65 –4.3	V _{IN} = V _{CC} or GND			±0.05		±0.2	μA
I _{CCLV}	Quiescent supply current low voltage driving	4.3	V _{1IN} , V _{2IN} = 1.65 V		±37	±50		±100	μA
			V _{1IN} , V _{2IN} = 1.80 V		±33	±40		±50	
			V _{1IN} , V _{2IN} = 2.60 V		±12	±20		±30	

1. Guaranteed by design

2. $\Delta R_{ON} = R_{ON(max)} - R_{ON(min)}$

3. Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Table 7. AC electrical characteristics (C_L = 35 pF, R_L = 50 Ω, t_r = t_f ≤ 6 ns)

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
t _{PLH} , t _{PHL}	Propagation delay	1.65 –1.95			0.45				ns
		2.3 –2.7			0.40				
		3.0 –3.3			0.30				
		3.6 –4.3			0.30				
t _{ON}	Turn-ON time	1.65 –1.95	V _S = 0.8 V		120				ns
		2.3 –2.7	V _S = 1.5 V		65	85		90	
		3.0 –3.3			42	55		65	
		3.6 –4.3			40	55		65	
t _{OFF}	Turn-OFF time	1.65 –1.95	V _S = 0.8 V		45				ns
		2.3 –2.7	V _S = 1.5 V		18	30		40	
		3.0 –3.3			16	30		40	
		3.6 –4.3			15	30		40	
t _D	Break-before make time delay	1.65 –1.95	C _L = 35 pF R _L = 50 Ω V _S = 1.5 V	2	80				ns
		2.3 –2.7		2	60				
		3.0 –3.3		2	55				
		3.6 –4.3		2	50				

Table 7. AC electrical characteristics ($C_L = 35 \text{ pF}$, $R_L = 50 \Omega$, $t_r = t_f \leq 6 \text{ ns}$)

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
Q	Charge injection	1.65 –1.95	C _L = 100 pF R _L = 1 MΩ V _{GEN} = 0 V R _{GEN} = 0 Ω		43				pC
		2.3 –2.7			51				
		3.0 –3.3			51				
		3.6 –4.3			49				

Table 8. Analog switch characteristics ($C_L = 5 \text{ pF}$, $R_L = 50 \Omega$, $T_A = 25^\circ\text{C}$)

Symbol	Parameter	V _{CC} (V)	Test condition	Value					Unit
				T _A = 25 °C			-40 to 85 °C		
				Min	Typ	Max	Min	Max	
OIRR	Off isolation ⁽¹⁾	1.65 –4.3	V _S = 1 V _{RMS} f = 100 kHz		-66				dB
Xtalk	Crosstalk	1.65 –4.3	V _S = 1 V _{RMS} f = 100 kHz		-72				dB
THD	Total harmonic distortion	2.3 –4.3	R _L = 600 Ω V _{IN} = 2V _{PP} f = 20 Hz to 20 kHz		0.02				%
BW	-3dB bandwidth	1.65 –4.3	R _L = 50 Ω		55				MHz
C _{IN}	Control pin input capacitance				5				pF
C _{Sn}	Sn port capacitance	3.3	f = 1 MHz		40				
C _D	D port capacitance when switch is enabled	3.3	f = 1 MHz		114				

1. Off Isolation = $20\text{Log}_{10}(V_D/V_S)$, V_D = output. V_S = input at off switch

5 Test circuit

Figure 3. ON resistance

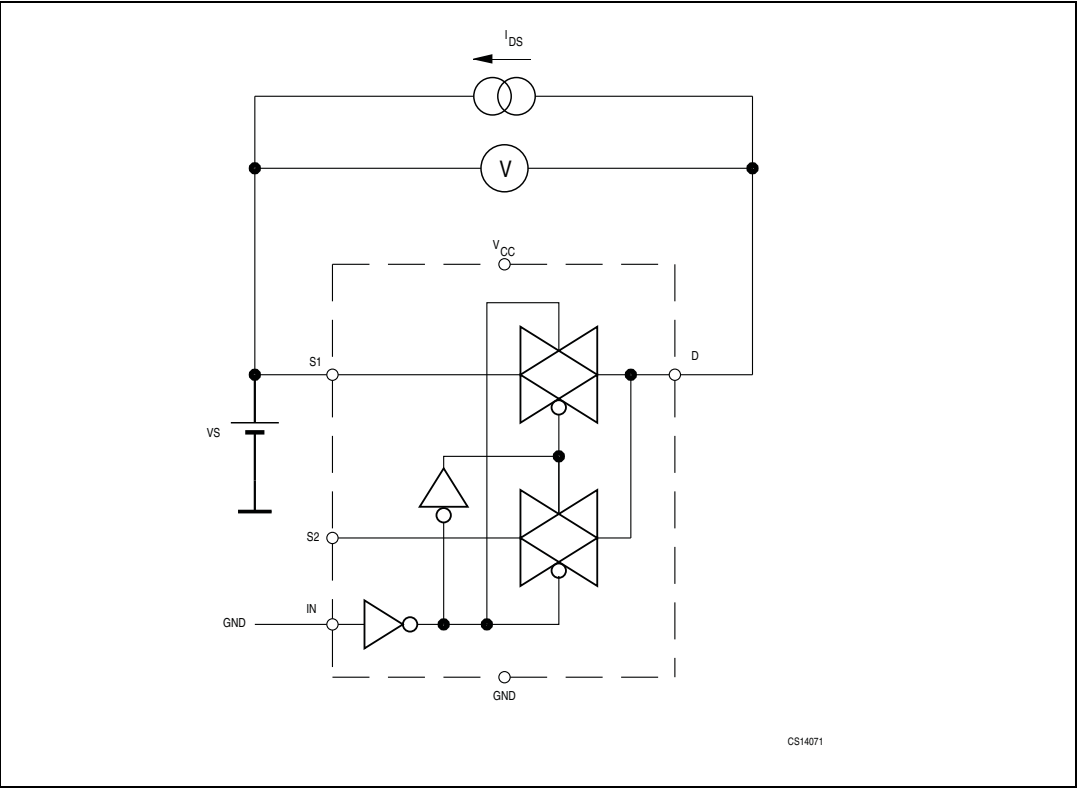


Figure 4. OFF leakage

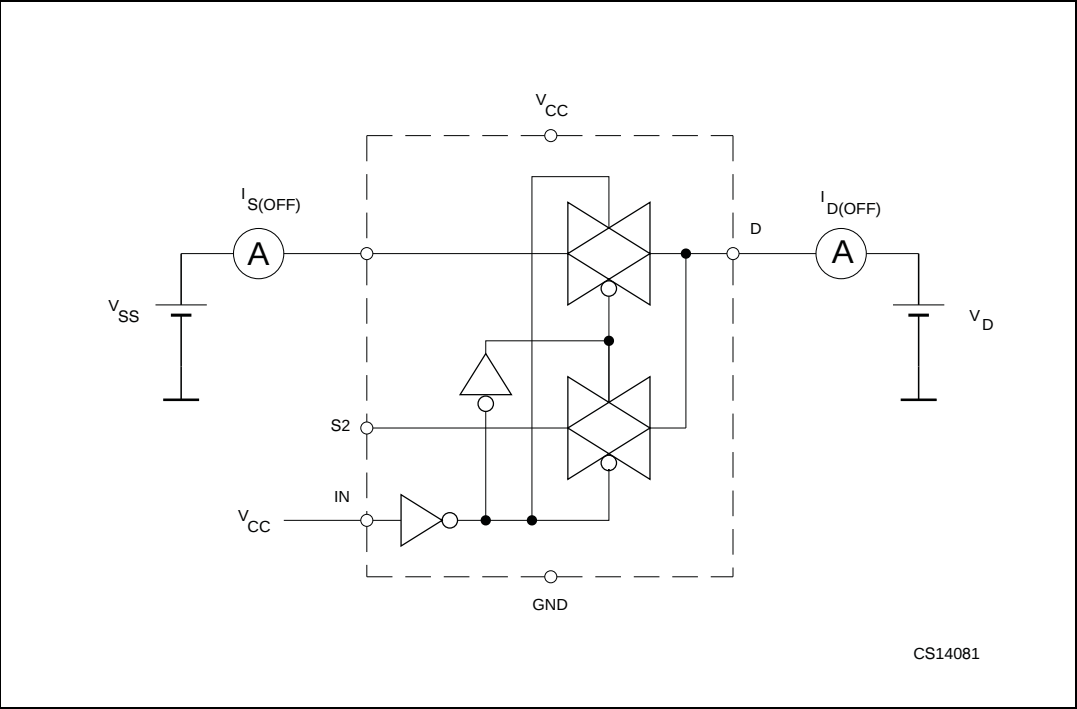


Figure 5. OFF isolation

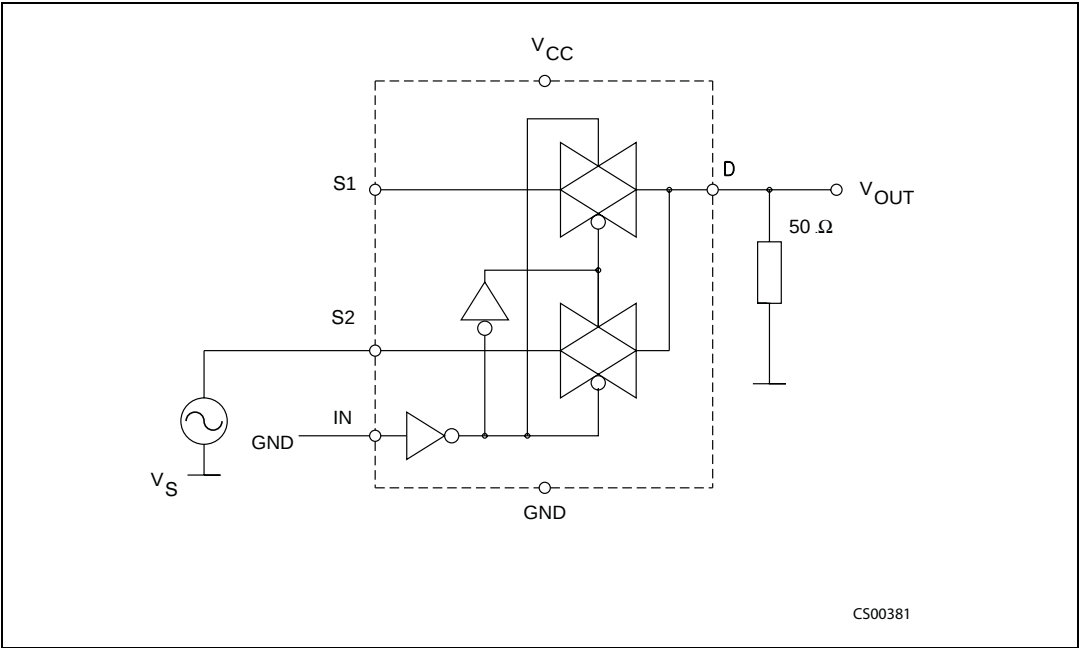


Figure 6. Bandwidth

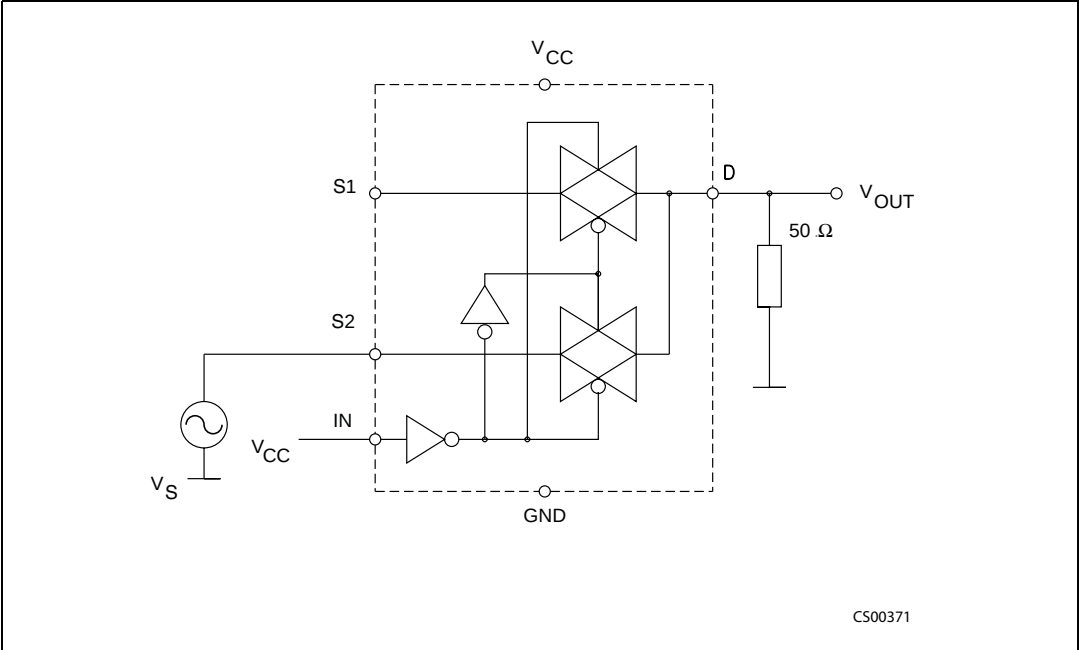


Figure 7. Channel-to-channel crosstalk

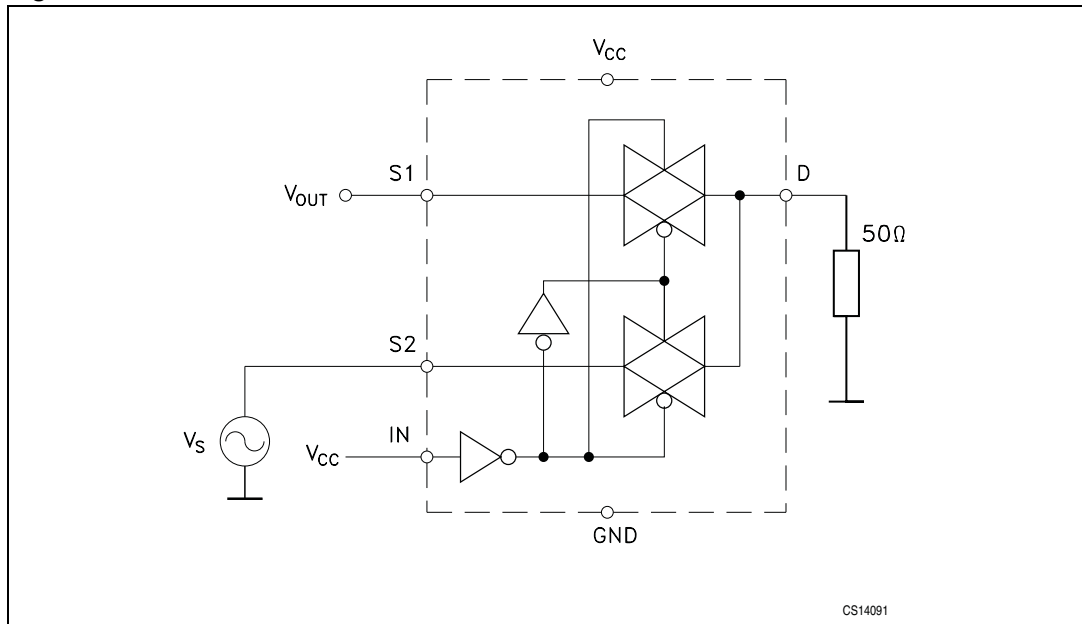
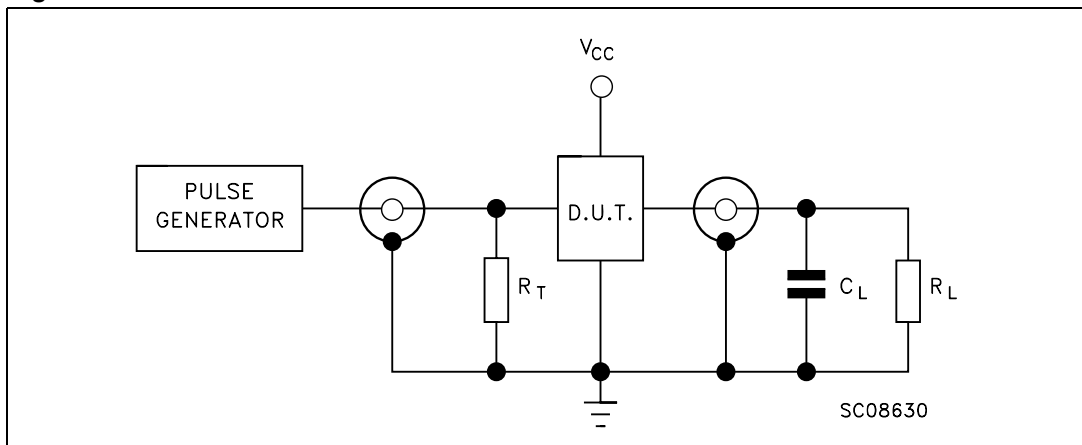


Figure 8. Test circuit

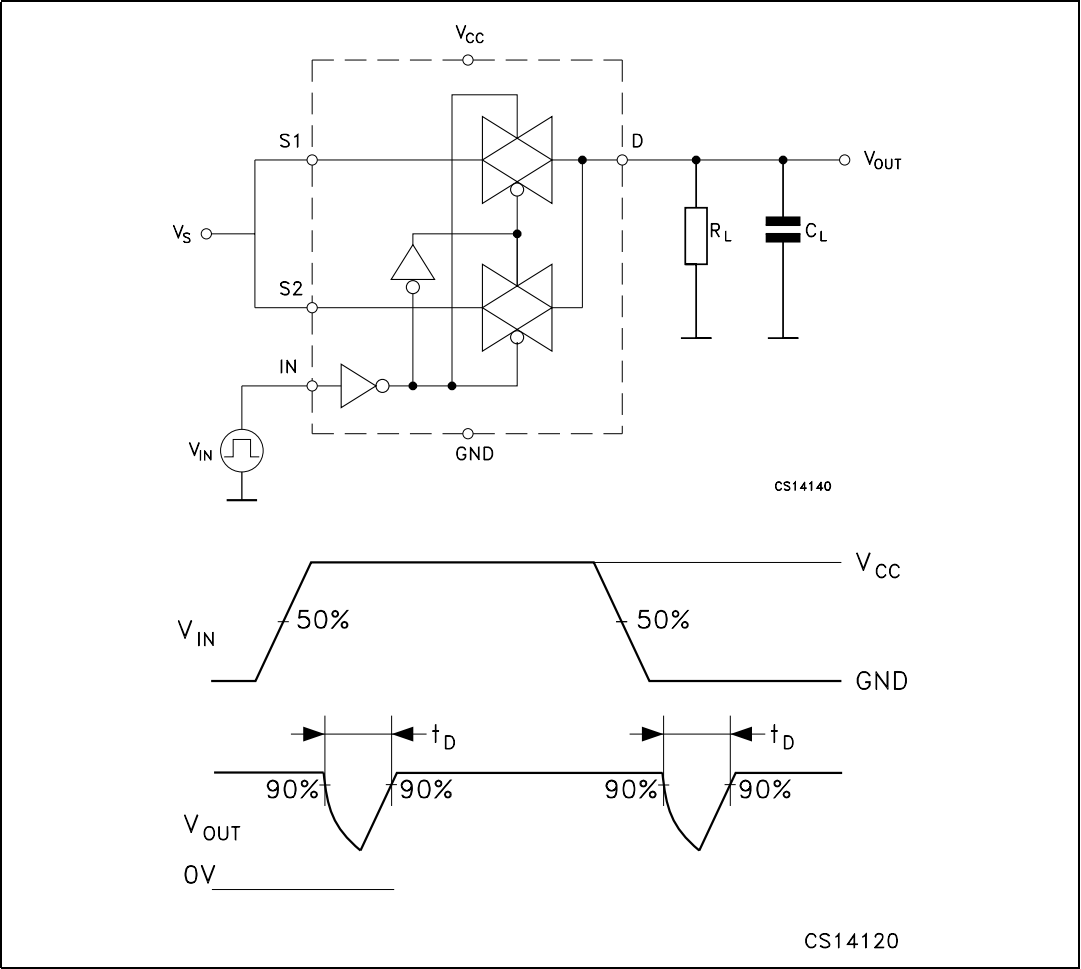


$C_L = 5/35 \text{ pF}$ or equivalent (includes jig and probe capacitance)

$R_L = 50 \Omega$ or equivalent

$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

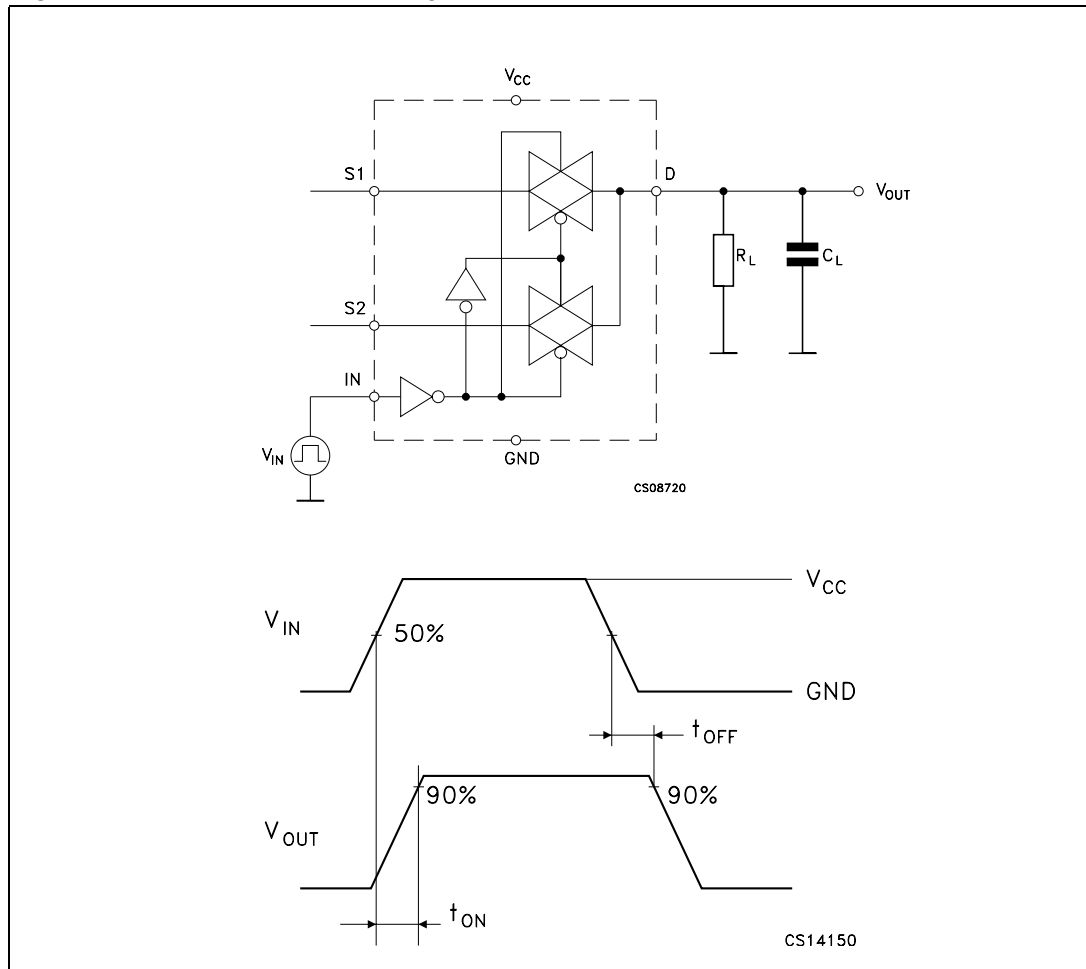
Figure 9. Break-before-make time delay



The top diagram shows a Class-D audio amplifier circuit. It features a differential-pair MOSFET output stage with a current source load, enclosed in a dashed box. The gates of the MOSFETs are driven by a differential-mode signal from an input buffer. The input signal V_{IN} is a square wave. The output node D is connected to a load resistor R_L and a load capacitor C_L . The supply voltage is V_{CC} and ground is GND . A resistor R_{GEN} is connected to the $S1$ input.

The bottom diagram is a timing diagram showing the input signal V_{IN} and the output voltage V_{OUT} across the load. V_{IN} is a square wave with 50% duty cycle, switching between V_{CC} and GND . The output V_{OUT} is a pulse-width modulated (PWM) signal. The pulse width is t_{ON} and the pulse period is t_{OFF} . The output voltage swing is ΔV_{OUT} , and the average output voltage is V_{OUT} . The relationship $Q = \Delta V_{OUT} \times C_L$ is indicated, where Q is the charge on the load capacitor.

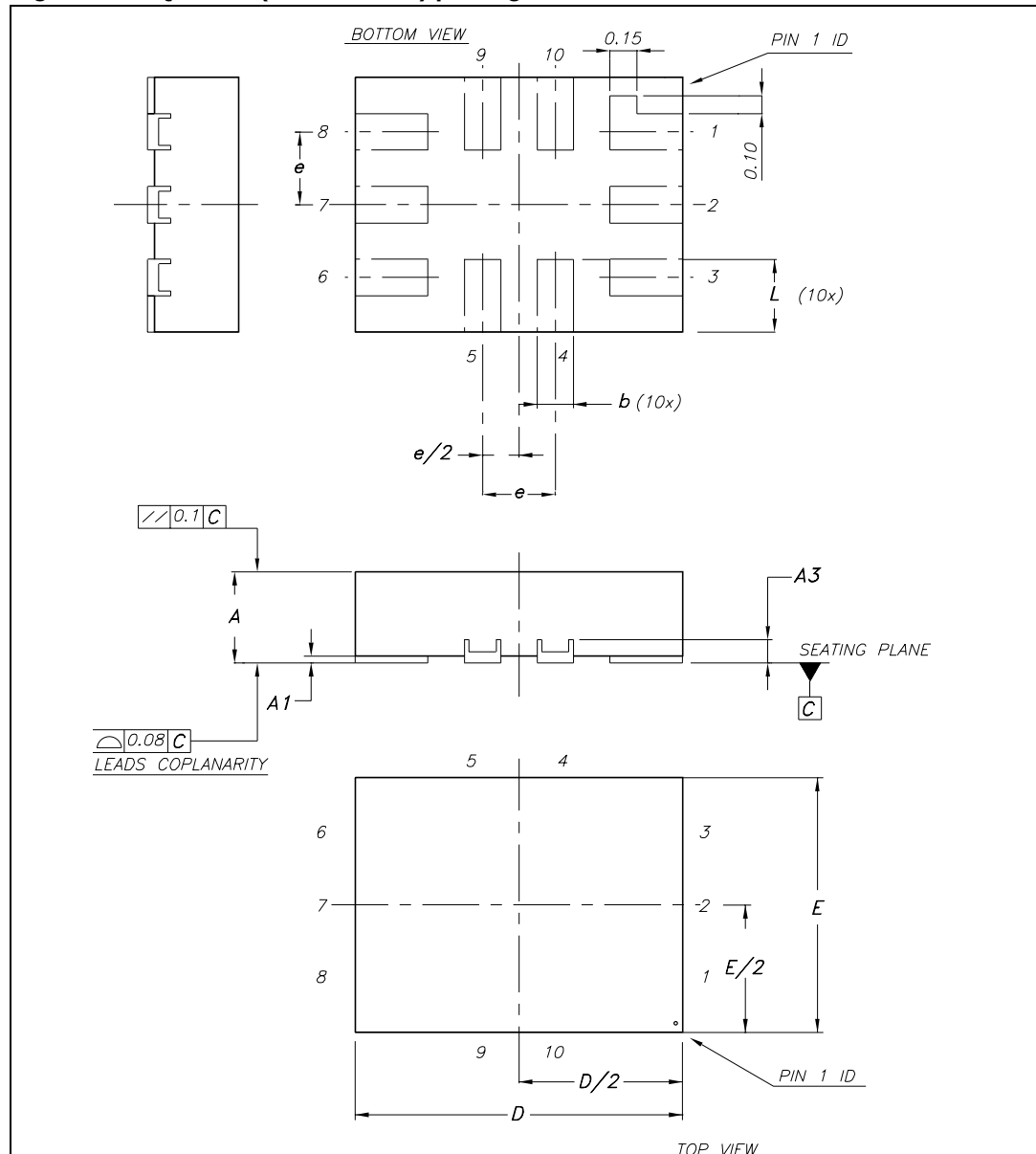
Figure 11. Turn-on, turn-off delay time



6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK[®] packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 12. QFN10L (1.8 x 1.4 mm) package outline

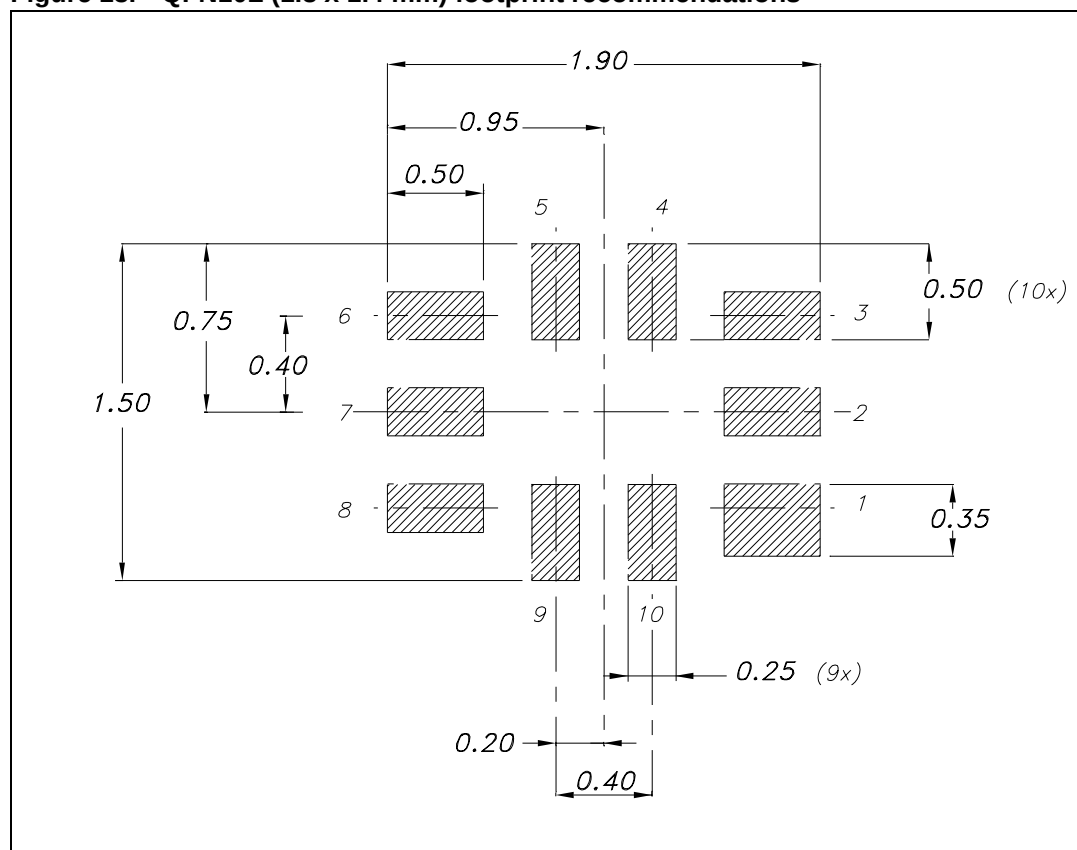


1. Drawing not to scale.

Table 9. QFN10L (1.8 x 1.4 mm) mechanical data

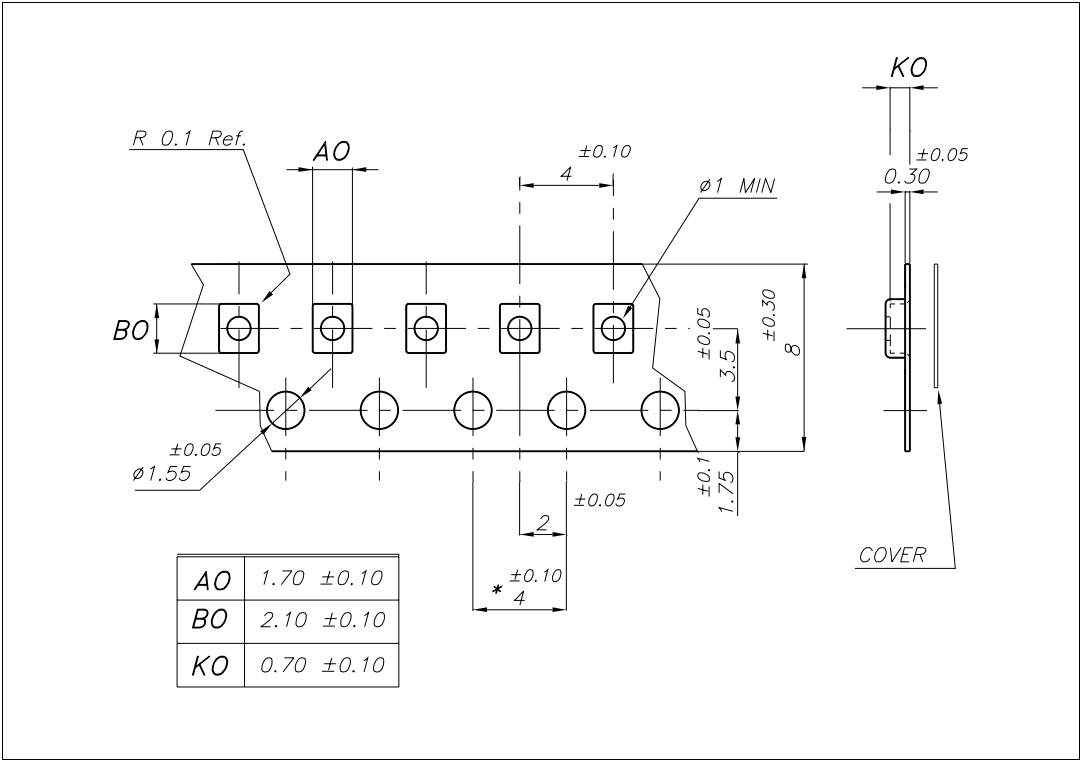
Symbol	millimeters			inches		
	Nom	Min	Max	Nom	Min	Max
A	0.50	0.45	0.55	0.020	0.017	0.021
A1	0.02	0	0.05	0.001	0	0.002
A3	0.127			0.005	0	0
b	0.20	0.15	0.25	0.007	0.006	0.010
D	1.80	1.70	1.90	0.070	0.066	0.074
E	1.40	1.30	1.50	0.055	0.051	0.059
e	0.40			0.015		
L	0.40	0.30	0.50	0.015	0.011	0.020

Figure 13. QFN10L (1.8 x 1.4 mm) footprint recommendations



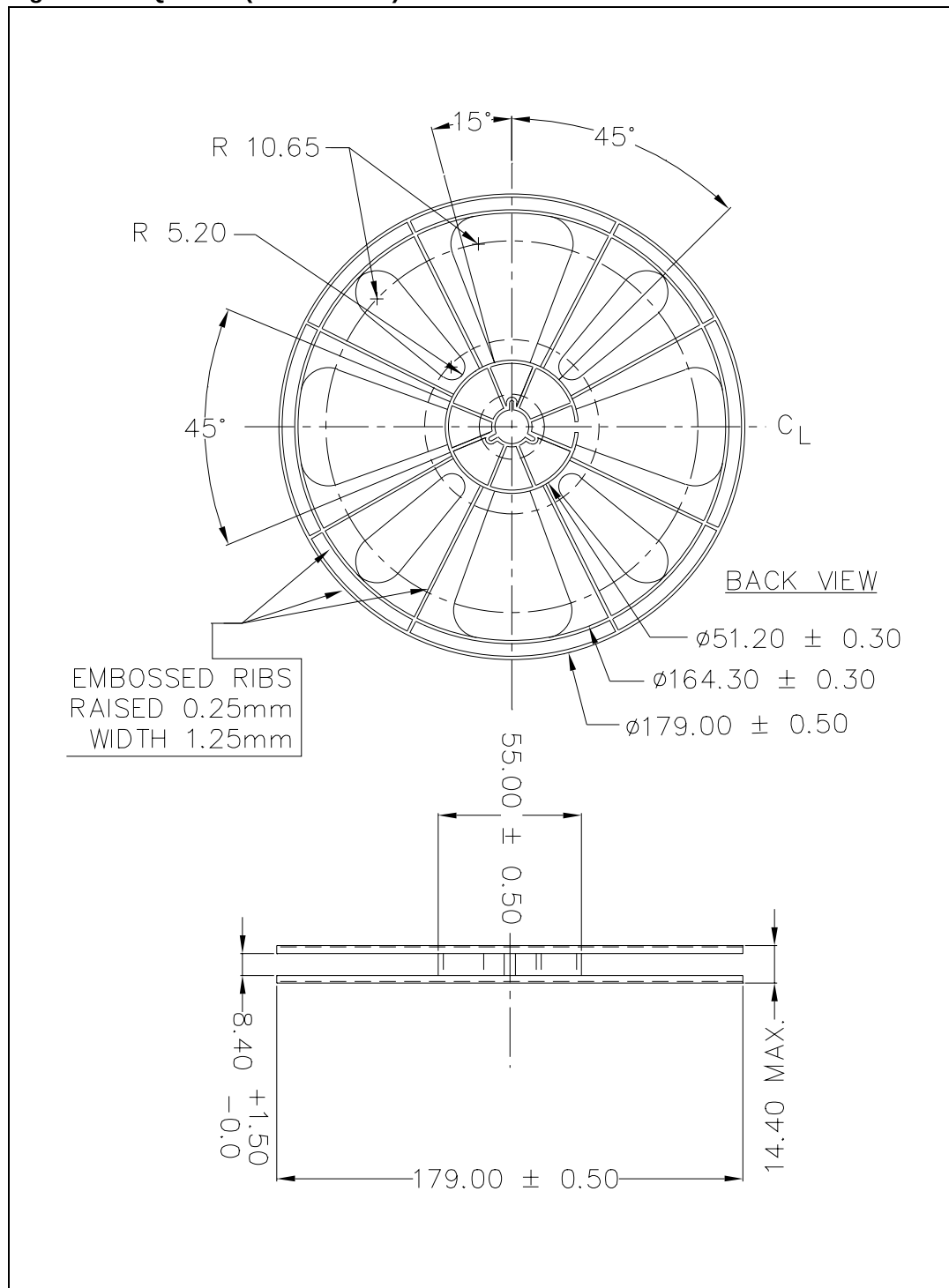
1. Drawing not to scale.

Figure 14. QFN10L (1.8 x 1.4 mm) carrier type



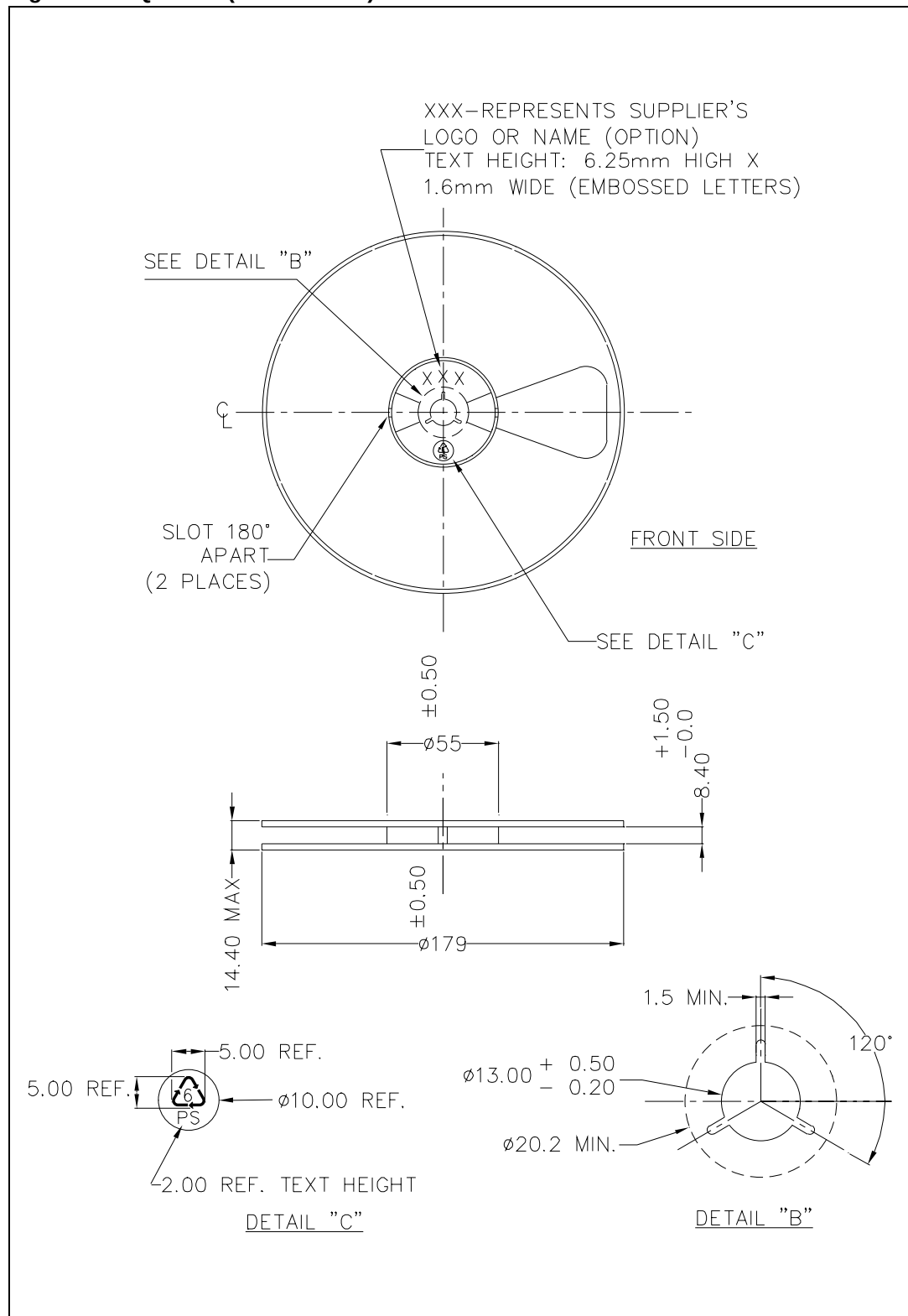
1. Drawing not to scale.

Figure 15. QFN10L (1.8 x 1.4 mm) reel information - back view



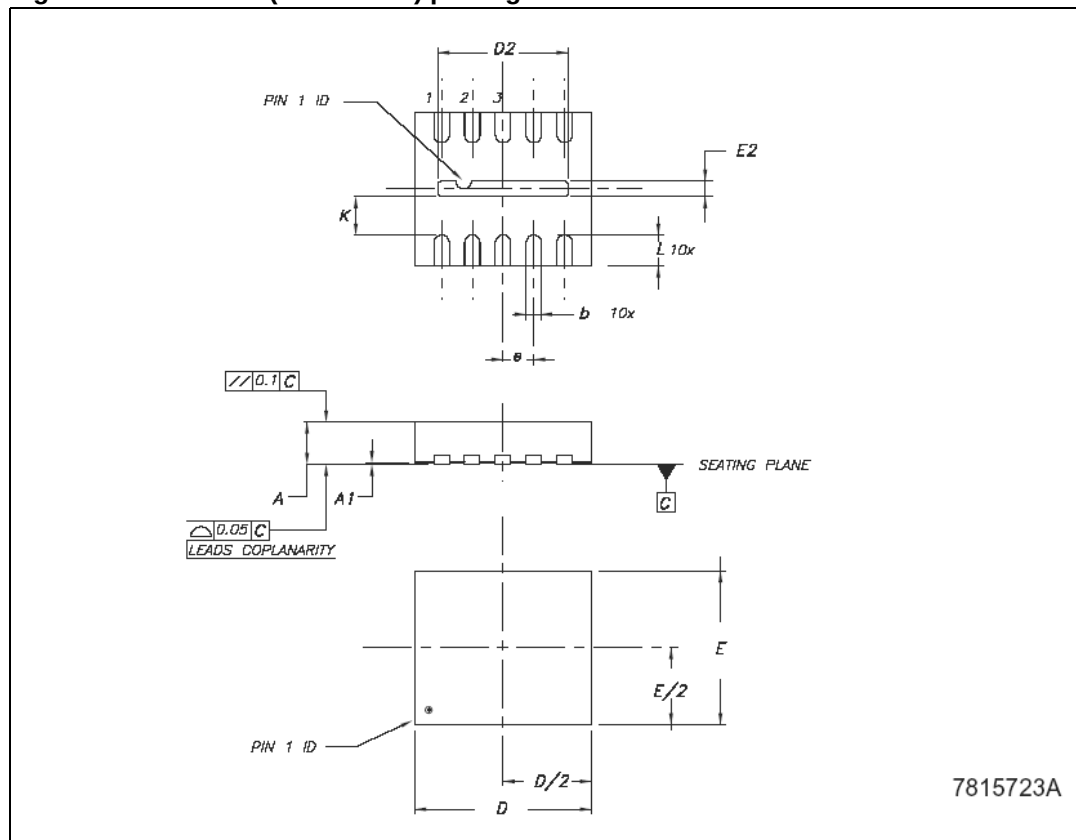
1. Drawing not to scale.

Figure 16. QFN10L (1.8 x 1.4 mm) reel information - front side



1. Drawing not to scale.

Figure 17. DFN10L (2 x 2.3 mm) package outline

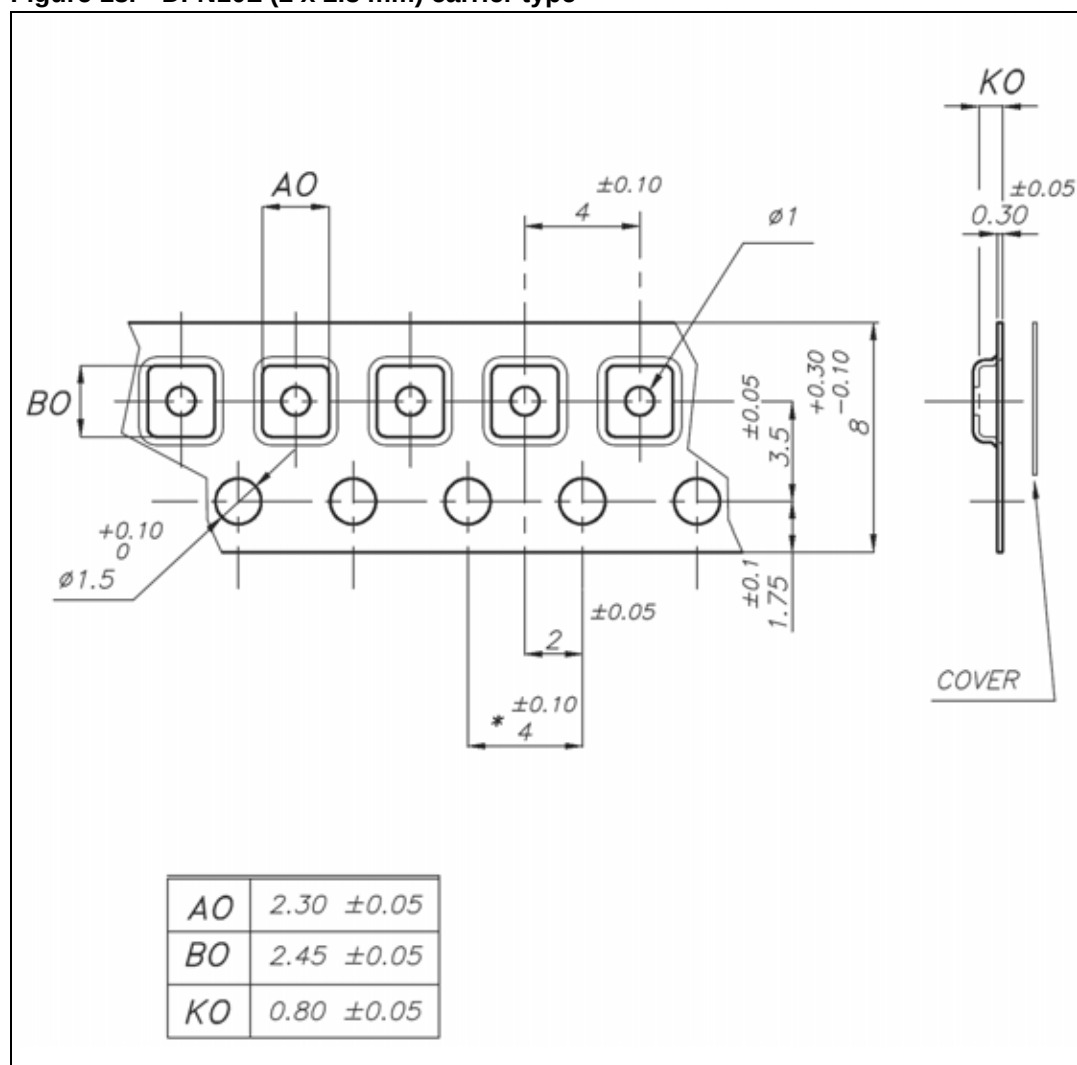


1. Drawing not to scale.

Table 10. DFN10L (2 x 2.3 mm) mechanical data

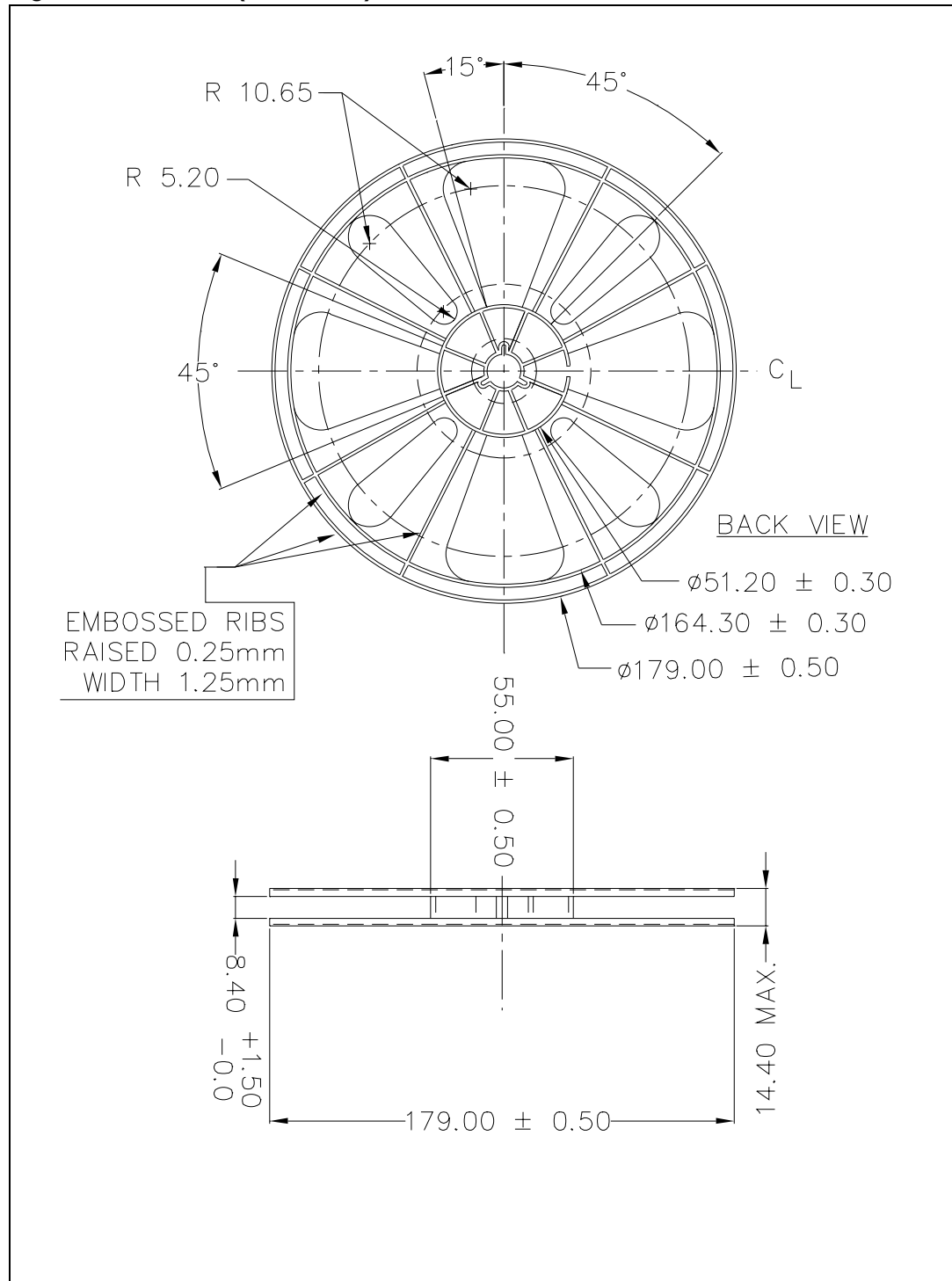
Symbol	millimeters			mils		
	Min	Typ	Max	Min	Typ	Max
A	0.50	0.55	0.60	19.7	21.7	23.6
A1		0.02	0.05		0.8	2.0
b	0.15	0.20	0.25	5.9	7.9	9.8
D	2.20	2.30	2.40	86.6	90.6	94.5
D2	1.65	1.70	1.75	65.0	66.9	68.9
E	1.90	2	2.10	74.8	78.7	82.7
E2	0.15	0.20	0.25	5.9	7.9	9.8
e		0.40			15.7	
L	0.35	0.40	0.45	13.8	15.7	17.7
K	0.20			7.9		

Figure 18. DFN10L (2 x 2.3 mm) carrier type



1. Drawing not to scale.

Figure 19. DFN10L (2 x 2.3 mm) reel information - back view



1. Drawing not to scale.

XXX—REPRESENTS SUPPLIER'S
 LOGO OR NAME (OPTION)
 TEXT HEIGHT: 6.25mm HIGH X
 1.6mm WIDE (EMBOSSED LETTERS)

SEE DETAIL "B"

SEE DETAIL "C"

FRONT SIDE

SLOT 180°
 APART
 (2 PLACES)

±0.50

±0.50

14.40 MAX

±0.50

Ø55

±1.50
 -0.0

8.40

Ø179

5.00 REF.

5.00 REF.

PS

2.00 REF. TEXT HEIGHT

DETAIL "C"

1.5 MIN.

120°

Ø13.00 + 0.50
 - 0.20

Ø20.2 MIN.

DETAIL "B"

26/28

7 Revision history

Table 11. Document revision history

Date	Revision	Changes
04-Jul-2005	1	First release
22-Aug-2005	2	The V_{CC} and V_{IC} values has been changed on Table 4 on page 8
15-May-2006	3	New template, few updates
21-Jun-2006	4	Mechanical data updated
10-Sept-2007	5	Removed STG3684QTR order code, small text changes, updated Figure 3 on page 12 , Figure 4 on page 12 , Figure 5 on page 13 , Figure 6 on page 13 , layout restructured
15-Nov-2007	6	Added list of tables and list of figures, updated Features Section on page 1 and T_{op} value in Table 5 on page 8 , removed the -55 to -125 °C values in Table 6 on page 9 and Table 7 on page 10 , minor changes to the text and layout

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