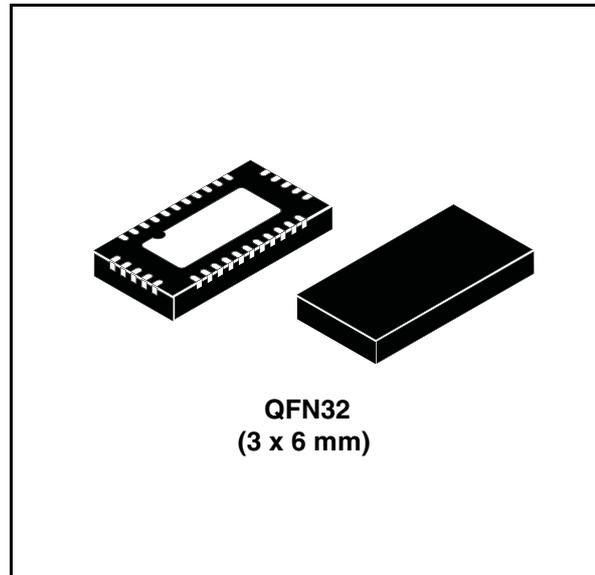


## 7-channel MUX/DEMUX for analog video signal

### Features

- Low  $R_{ON}$ : 4.0  $\Omega$  typical
- $V_{CC}$  operating range: 3.0 to 3.6 V
- Enhanced ESD protection: > 8 kV (contact) and 8 kV (HBM)
- Channel on capacitance: 7.8 pF typical
- Designed for VGA signal switching
- Integrated switches for RGB, HSYNC, VSYNC and DDC signals
- Very low crosstalk: -45 dB at 250 MHz
- > 1000 MHz -3 dB typical bandwidth (or data frequency)
- Low power mode for minimum power consumption
- Package: QFN32L



### Applications

- Audio/video switching

### Description

The STMUX7000 is a 7-channel multiplexer/demultiplexer low  $R_{ON}$  bidirectional designed for analog video signal, such as VGA. It is designed for very low crosstalk, and high bandwidth to maintain high signal integrity.

The analog video signal multiplexed from one of two selected sources in the notebook and docking station while the unselected switch goes to Hi-Z status.

The device is also protected against high ESD that supports up to 8 kV contact on all I/O pins.

The device can be put into low power mode consuming minimum power.

**Table 1. Device summary**

Order code	Package	Packing
STMUX7000QTR	QFN32 (3 x 6 x 0.8 mm)	Tape and reel

# Contents

<b>1</b>	<b>Pin description</b> .....	<b>3</b>
<b>2</b>	<b>Maximum rating</b> .....	<b>5</b>
	2.1 Recommended operating conditions .....	5
<b>3</b>	<b>Electrical characteristics</b> .....	<b>6</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>14</b>
<b>5</b>	<b>Revision history</b> .....	<b>18</b>

# 1 Pin description

Figure 1. Pin connection (top through view)

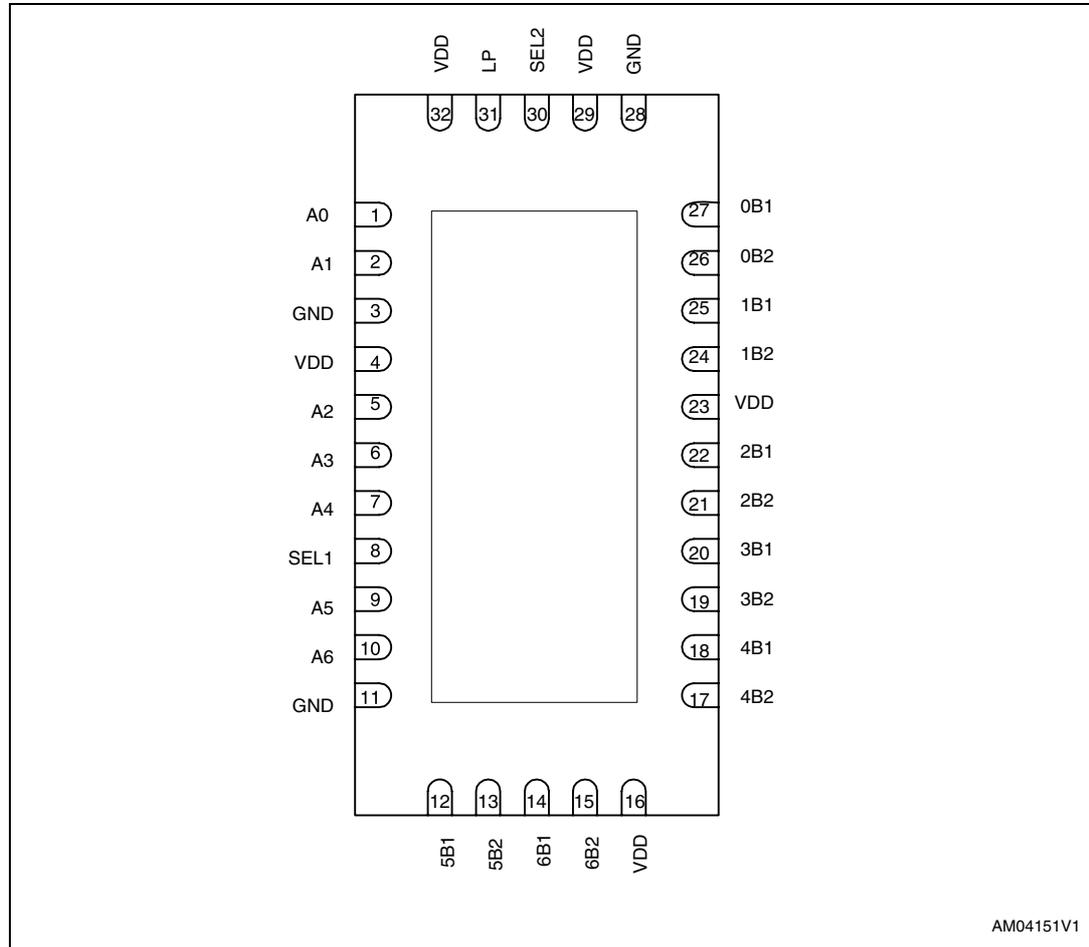


Table 2. Pin description

Pin	Symbol	Name and function
8	SEL 1	Selecion for bit 0, 1, 2, 3, 4
30	SEL 2	Selection for bit 5, 6
1, 2, 5, 6, 7, 9, 10	A0, A1, A2, A3, A4, A5, A6	8-bit bus
4, 16, 23, 29, 32	VDD	Supply voltage
3, 11, 28	GND	Ground
27, 25, 22, 20, 18, 14, 12	0B1, 1B1, 2B1, 3B1, 4B1, 5B1, 6B1	8-bit multiplexed to bus 1
26, 24, 21, 19, 17, 15, 13	0B2, 1B2, 2B2, 3B2, 4B2, 5B2, 6B2	8-bit multiplexed to bus 2
31	LP	Low power mode enable

Figure 2. Input equivalent circuit

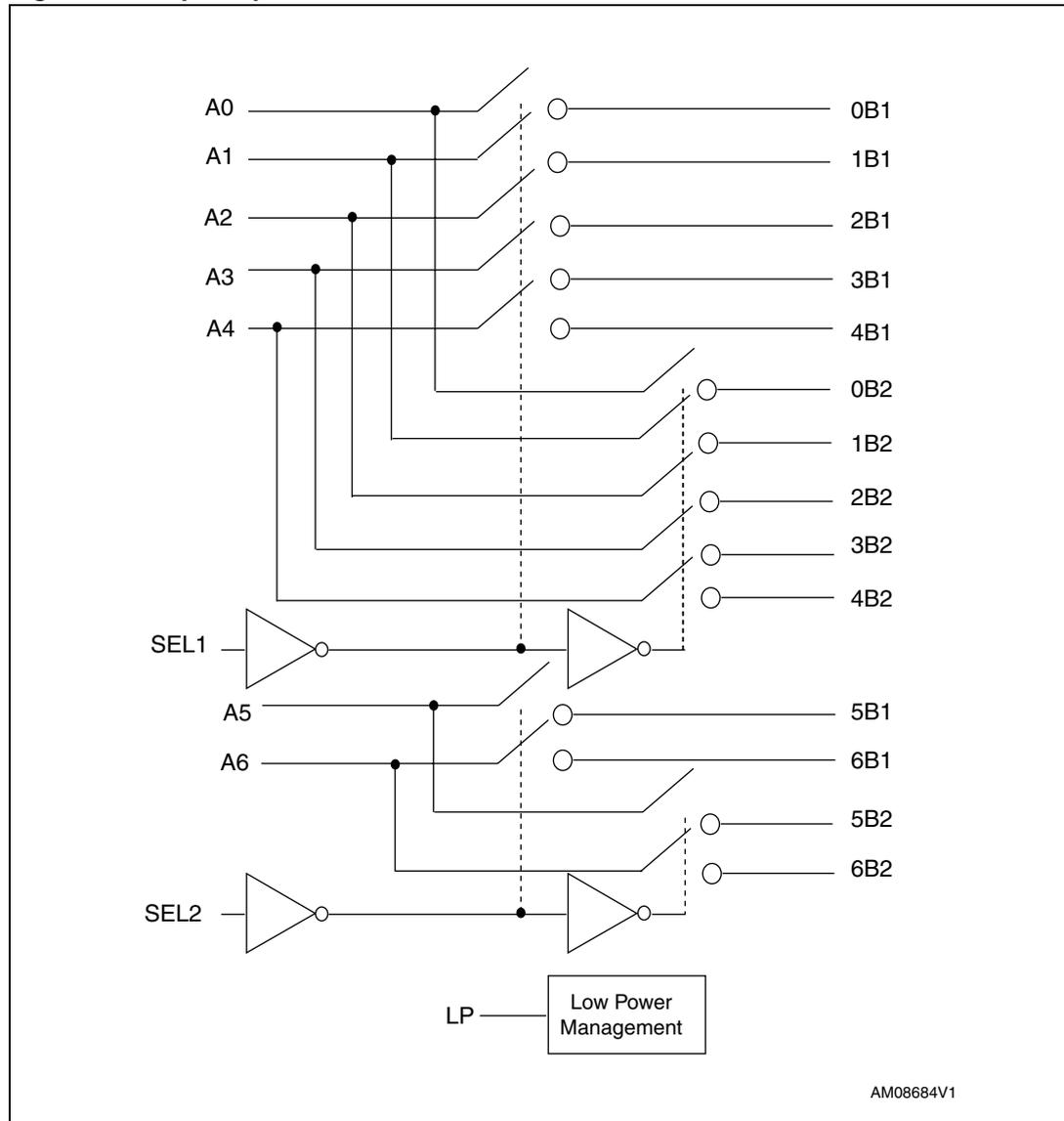


Table 3. Bit 0, 1, 2, 3, 4 switch function table

LP	SEL 1	Function
L	L	Bit 0, 1, 2, 3, 4 multiplexed to bus 1, bus 2 in Hi-Z
L	H	Bit 0, 1, 2, 3, 4 multiplexed to bus 2, bus 1 in Hi-Z
H	X	Bus 1 and 2 in Hi-Z

Table 4. Bit 5, 6 switch function table

LP	SEL 2	Function
L	L	Bit 5,6 multiplexed to bus 1, bus 2 in Hi-Z

**Table 4. Bit 5, 6 switch function table**

LP	SEL 2	Function
L	H	Bit 5,6 multiplexed to bus 2, bus 1 in Hi-Z
H	X	Bus 1 and 2 in Hi-Z

## 2 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.

**Table 5. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage to ground	-0.5 to 4.6	V
$V_{IO}$	DC input output voltage	-0.5 to 4.6	V
$V_{IC}$	DC control input voltage	-0.5 to 4.6	V
$I_O$	DC output current <sup>(1)</sup>	120	mA
$P_D$	Power dissipation	0.5	W
$T_{stg}$	Storage temperature	-65 to 150	°C
$T_L$	Lead temperature (10 sec)	300	°C

1. If  $V_{IO} \times I_O$  does not exceed the maximum limit of  $P_D$ .

### 2.1 Recommended operating conditions

**Table 6. Recommended operating conditions**

Symbol	Parameter	Value			Unit
		Min	Typ	Max	
$V_{CC}$	Supply voltage to ground	3	-	3.6	V
$V_{IC}$	DC control input voltage (SEL, LP)	0	-	5	V
$V_{IO}$	DC input/output voltage	0	-	$V_{CC}$	V
$T_A$	Operating temperature	-40	-	85	°C

### 3 Electrical characteristics

**Table 7. DC electrical characteristics ( $V_{CC} = 3.3 \text{ V} \pm 10\%$ )**

Symbol	Parameter	Test condition	Value			Unit
			-40 to 85 °C			
			Min	Typ	Max	
$V_{IH}$	Voltage input high (SEL, LP)	High level guaranteed	2	-	-	V
$V_{IL}$	Voltage input low (SEL, LP)	Low level guaranteed	-0.5	-	0.8	V
$V_{IK}$	Clamp diode voltage (SEL, LP)	$V_{CC} = 3.6 \text{ V}$ $I_{IN} = -18 \text{ mA}$	-	-0.8	-1.2	V
$I_{IH}$	Input high current (SEL, LP)	$V_{CC} = 3.6 \text{ V}$ $V_{IN} = V_{CC}$	-	-	$\pm 5$	$\mu\text{A}$
$I_{IL}$	Input low current (SEL, LP)	$V_{CC} = 3.6 \text{ V}$ $V_{IN} = \text{GND}$	-	-	$\pm 5$	$\mu\text{A}$
$I_{OFF(SW)}^{(1)}$	Leakage current through the switch common terminals (A to H) (LED1 to LED3)	$V_{CC} = 3.6 \text{ V}$ A to H = $V_{CC}$ LED1 to LED3 = $V_{CC}$ A0 to H0 = 0 V A1 to H1 = floating LEDx_0 = 0 V LEDx1 = floating SEL = $V_{CC}$	-	-	$\pm 1$	$\mu\text{A}$
$I_{OFF(SEL, LP)}$	SEL, LP pin leakage current	$V_{CC} = 0 \text{ V}$ SEL = 0 to 3.6 V	-	-	$\pm 1$	$\mu\text{A}$
$R_{ON}$	Switch ON resistance <sup>(2)</sup>	$V_{CC} = 3.0 \text{ V}$ $V_{IN} = 0 \text{ to } 1.2 \text{ V}$ $I_{IN} = -40 \text{ mA}$	-	4.0	6.5	$\Omega$
$R_{FLAT}$	ON resistance flatness <sup>(2)</sup> <sup>(3)</sup>	$V_{CC} = 3.0 \text{ V}$ $V_{IN}$ at 0 and 1.2 V $I_{IN} = -40 \text{ mA}$	-	0.5	-	$\Omega$
$\Delta R_{ON}$	ON resistance match between channel $\Delta R_{ON} = R_{ONMAX} - R_{ONMIN}$ <sup>(2)(4)</sup>	$V_{CC} = 3.0 \text{ V}$ $V_{IN} = 0 \text{ to } 1.2 \text{ V}$ $I_{IN} = -40 \text{ mA}$	-	0.4	1	$\Omega$

1. Refer to [Figure 4: Test circuit for leakage current \(IOFF\) on page 10](#)

2. Measured by voltage drop between channels at indicated current through the switch. ON resistance is determined by the lower of the voltages.

3. Flatness is defined as the difference between the  $R_{ONMAX}$  and  $R_{ONMIN}$  of ON resistance over the specified range.

4.  $\Delta R_{ON}$  measured at same  $V_{CC}$ , temperature and voltage level.

**Table 8. Capacitance ( $T_A = 25\text{ °C}$ ,  $f = 1\text{ MHz}$ )**

Symbol	Parameter	Test condition	Value			Unit
			Min	Typ	Max	
$C_{IN}$	SEL, LP pin input capacitance <sup>(1)</sup>	DC = 0.25 V AC = 0.5 V <sub>PP</sub> f = 1 MHz	-	2	3	pF
$C_{OFF}$	Switch off capacitance <sup>(2)</sup>	DC = 0.25 V AC = 0.5 V <sub>PP</sub> f = 1 MHz	-	2.8	6.5	pF
$C_{ON}$	Switch on capacitance <sup>(3)</sup>	DC = 0.25 V AC = 0.5 V <sub>PP</sub> f = 1 MHz	-	7.8	-	pF

1. Refer to [Figure 5 on page 11](#).
2. Refer to [Figure 6 on page 11](#).
3. Refer to [Figure 7 on page 12](#).

**Table 9. Power supply characteristics**

Symbol	Parameter	Test condition	Value			Unit
			-40 to 85 °C			
			Min	Typ	Max	
$I_{CC}$	Active mode power supply current	$V_{CC} = 3.6\text{ V}$ , $V_{IN} = V_{CC}$ or GND, LP = GND	-	150	500	μA
$I_{CC}$	Low power mode power supply current	$V_{CC} = 3.6\text{ V}$ , $V_{IN} = V_{CC}$ or GND, LP = $V_{CC}$	-	10	15	μA

**Table 10. Dynamic electrical characteristics ( $V_{CC} = 3.3\text{ V} \pm 10\%$ )**

Symbol	Parameter	Test condition	Value			Unit
			-40 to 85 °C			
			Min	Typ	Max	
$X_{talk}$	Crosstalk <sup>(1)</sup>	$R_L = 50\ \Omega$ , $R_S = 50\ \Omega$ f = 250 MHz	-	-45	-	dB
$O_{IRR}$	Off isolation <sup>(2)</sup>	$R_L = 50\ \Omega$ , $R_S = 50\ \Omega$ f = 250 MHz	-	-32	-	dB
BW	-3 dB bandwidth <sup>(3)</sup>	$R_L = 50\ \Omega$ , $R_S = 50\ \Omega$ $0 < V_{IN} \leq 1.2\text{ V}$	-	1000	-	MHz

1. Refer to [Figure 9 on page 13](#).
2. Refer to [Figure 10 on page 14](#).
3. Refer to [Figure 8 on page 12](#).

**Table 11. Switching characteristics ( $T_A = 25\text{ °C}$ ,  $V_{CC} = 3.3\text{ V} \pm 10\%$ )**

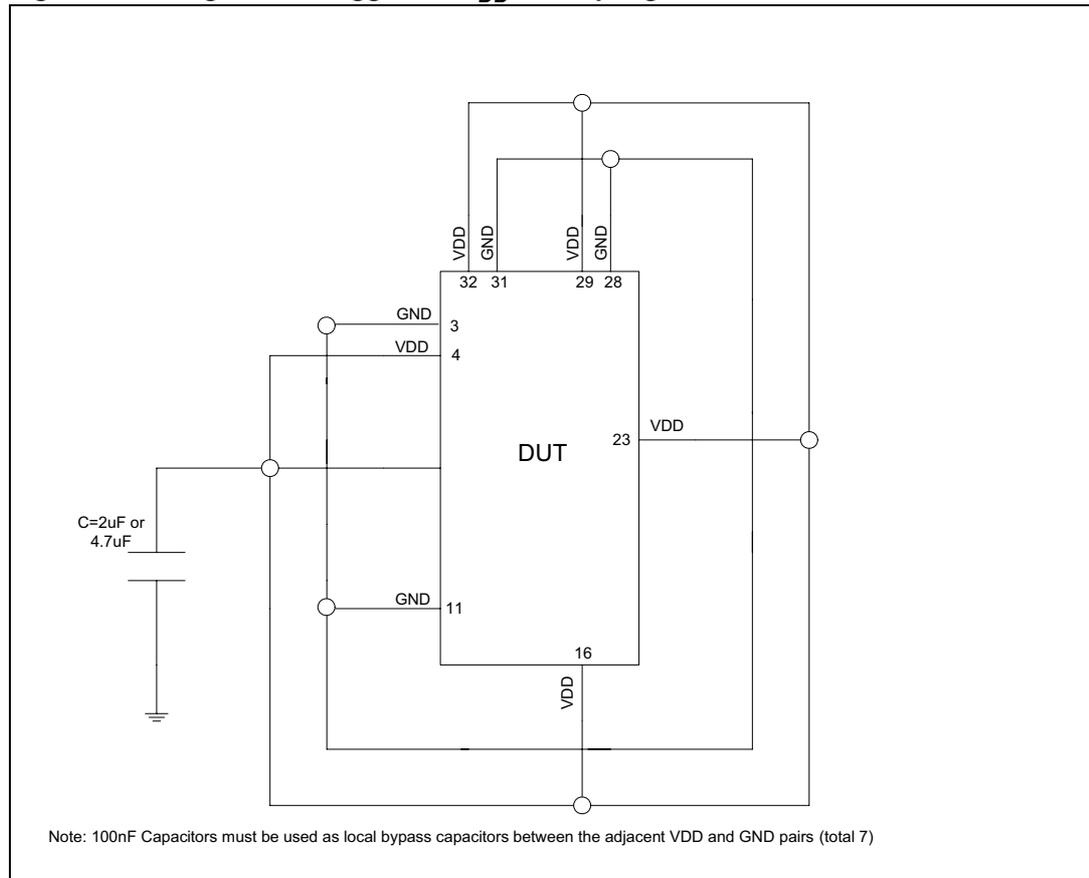
Symbol	Parameter	Test condition	Value			Unit
			Min	Typ	Max	
$t_{PD}$	Propagation delay	$V_{CC} = 3\text{ to }3.6\text{ V}$	-	0.25	-	ns
$t_{PZH}$ , $t_{PZL}$	Line enable time, SE to x to x0 or x to x1	$V_{CC} = 3\text{ to }3.6\text{ V}$ 1 K $\Omega$ pull up/down resistor at xb1 or xB2	0.5	6.5	15	ns
$t_{PHZ}$ , $t_{PLZ}$	Line disable time, SE to x to x0 or x to x1	$V_{CC} = 3\text{ to }3.6\text{ V}$ 1 K $\Omega$ pull up/down resistor at xb1 or xB2	0.5	16		ns
$t_{SK(O)}$	Output skew between center port to any other port	$V_{CC} = 3\text{ to }3.6\text{ V}$	-	0.1	0.2	ns
$t_{SK(P)}$	Skew between opposite transition of the same output ( $t_{PHL}$ , $t_{PLH}$ )	$V_{CC} = 3\text{ to }3.6\text{ V}$	-	0.1	0.2	ns

**Table 12. ESD performance**

Symbol	Test condition	Value			Unit
		Min	Typ	Max	
ESD	Contact discharge <sup>(1)</sup> IEC61000-4-2	-	$\pm 8$	-	kV
	Human body model (JESD22-A114)	-	$\pm 8$	-	kV

1. Refer to [Figure 3: Diagram for suggested VDD decoupling on page 10](#).

**Figure 3. Diagram for suggested V<sub>DD</sub> decoupling**



1. Applicable for system level ESD test

**Figure 4. Test circuit for leakage current (I<sub>OFF</sub>)**

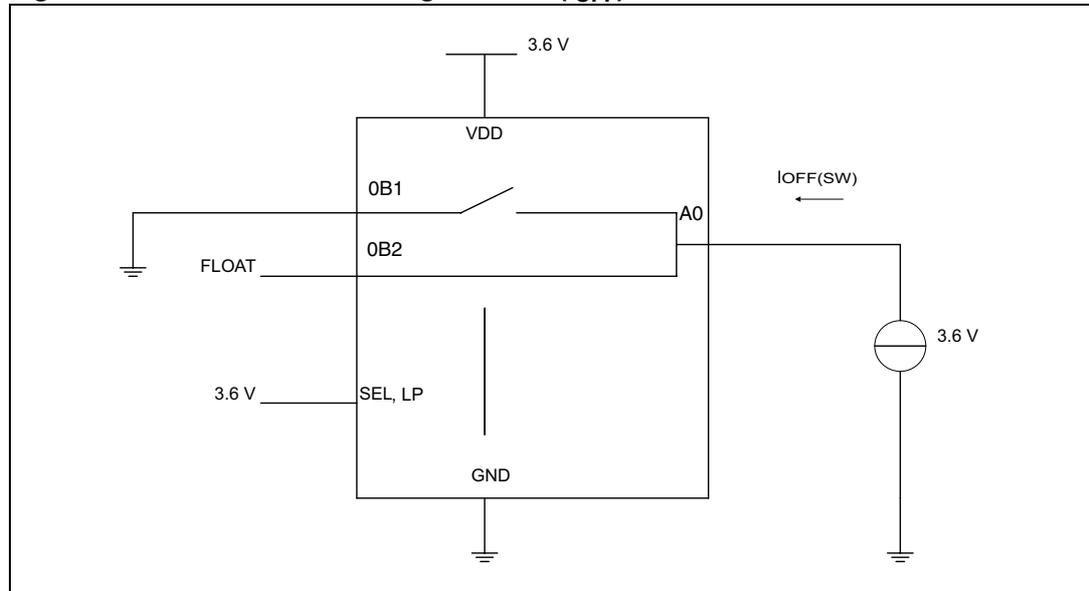


Figure 5. Test circuit for SEL pin input capacitance ( $C_{IN}$ )

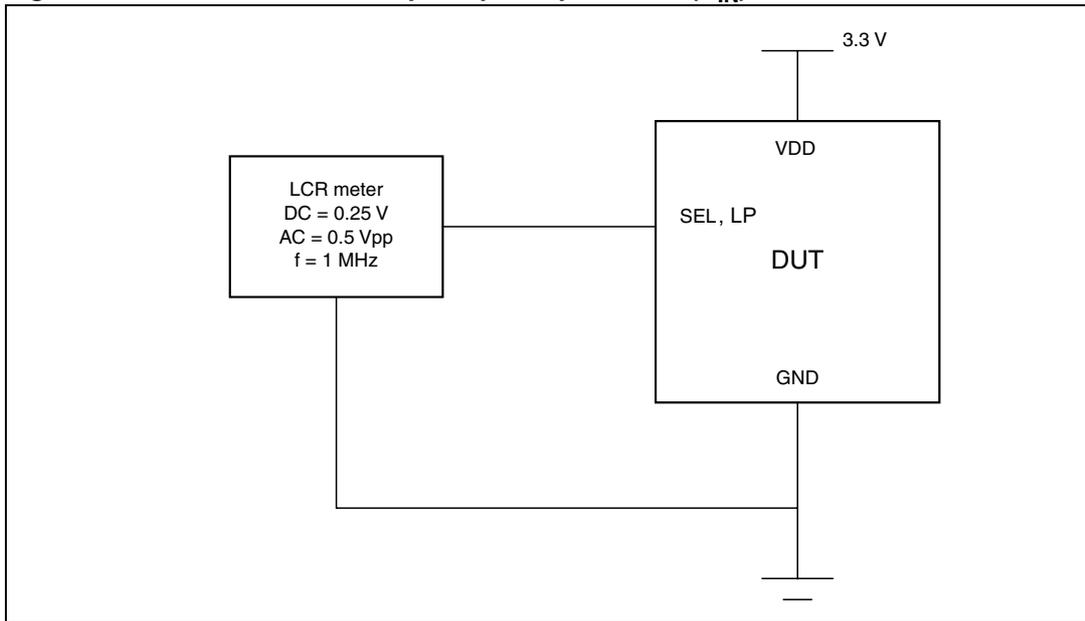
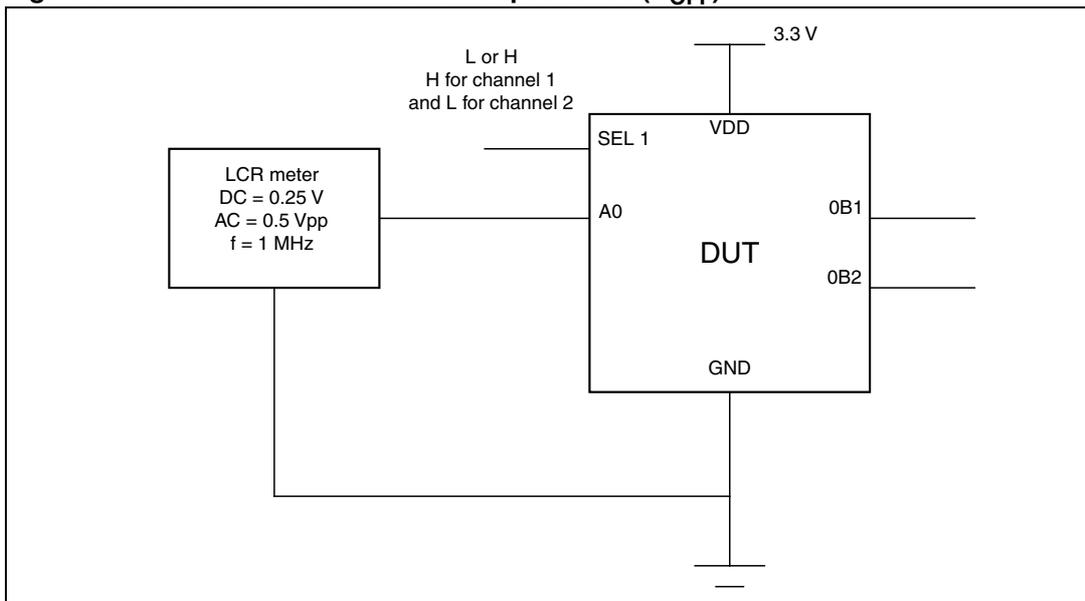
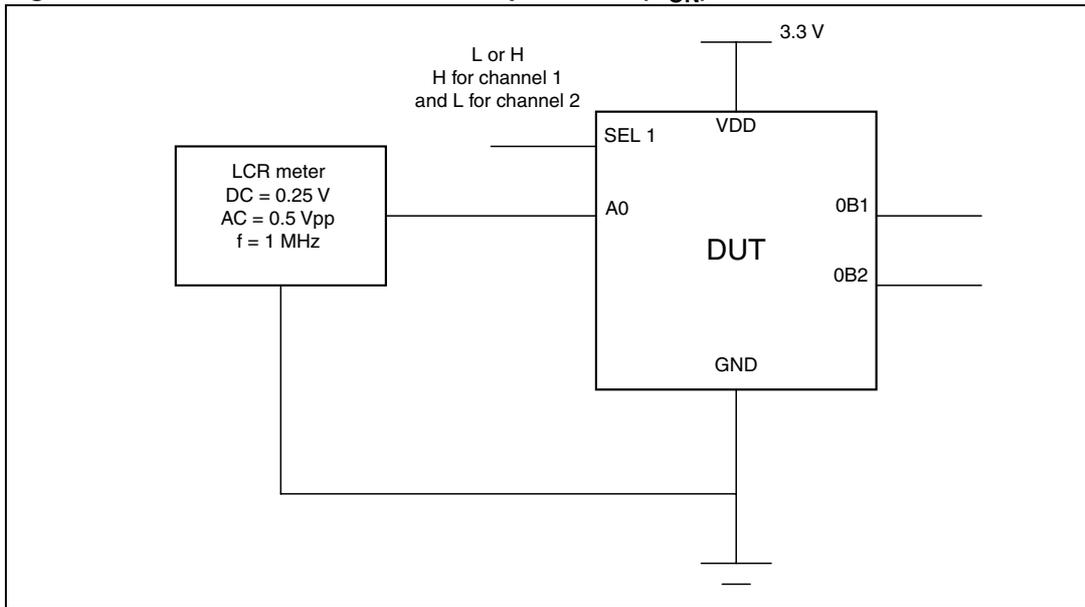


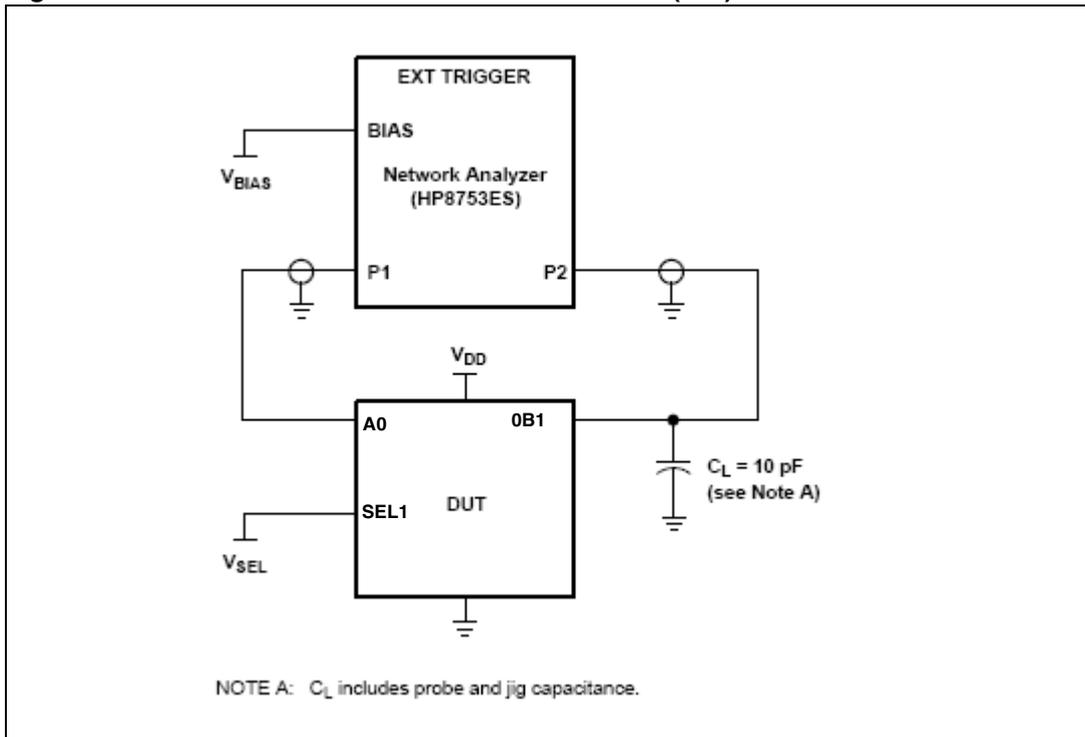
Figure 6. Test circuit for switch off capacitance ( $C_{OFF}$ )



**Figure 7. Test circuit for switch on capacitance ( $C_{ON}$ )**



**Figure 8. Test circuit for bandwidth measurement (BW)**



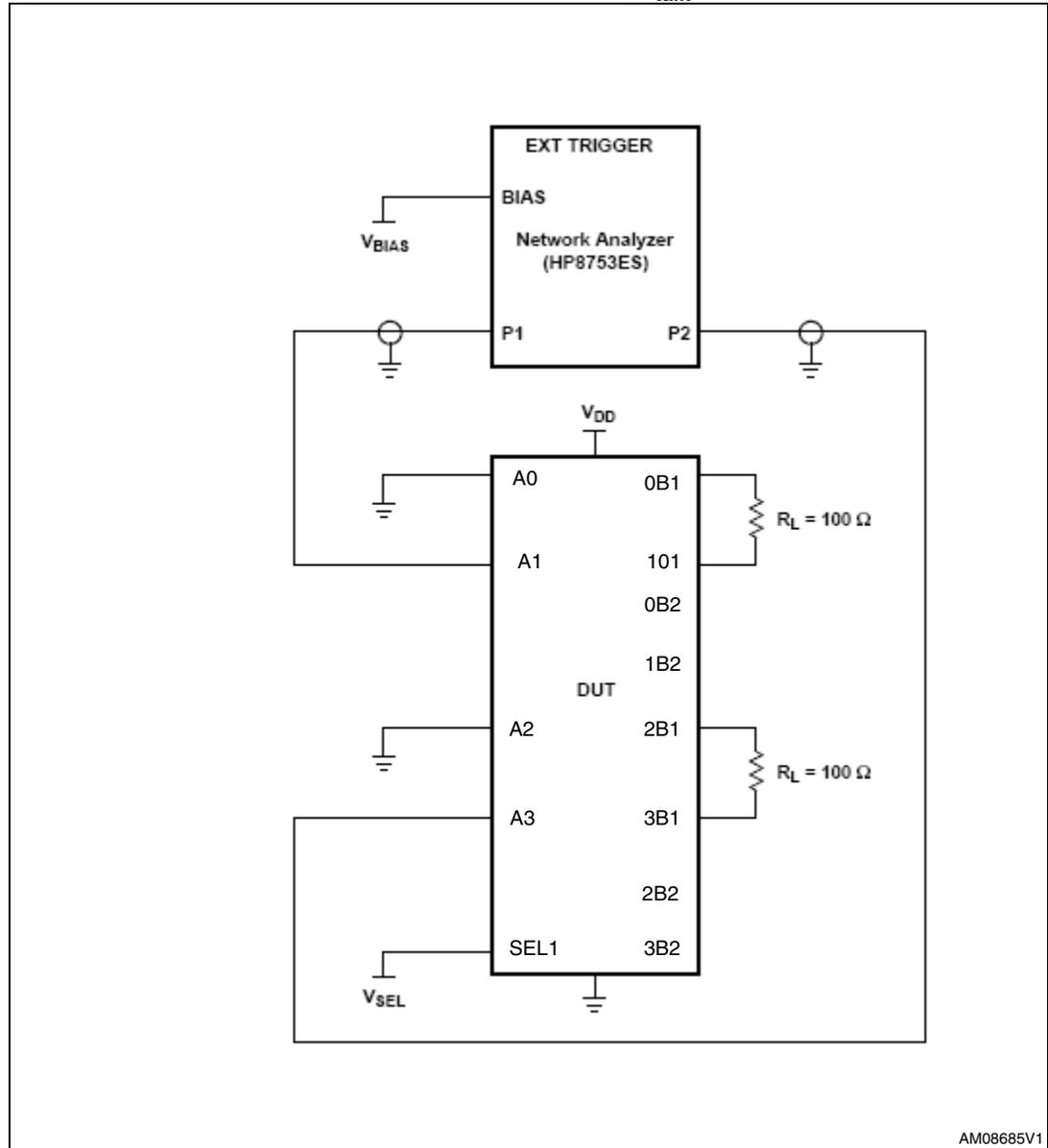
Frequency response is measured at the output of the ON channel. For example, when  $V_{SEL1} = 0$  and A0 is the input, the output is measured at OB1. All unused analog I/O ports are left open.

HP8753ES setup:

Average = 4

$R_{BW} = 3 \text{ kHz}$   
 $V_{BIAS} = 0.35 \text{ V}$   
 $ST = 2 \text{ s}$   
 $P1 = 0 \text{ dBm}$

**Figure 9. Test circuit for crosstalk measurement ( $x_{talk}$ )**



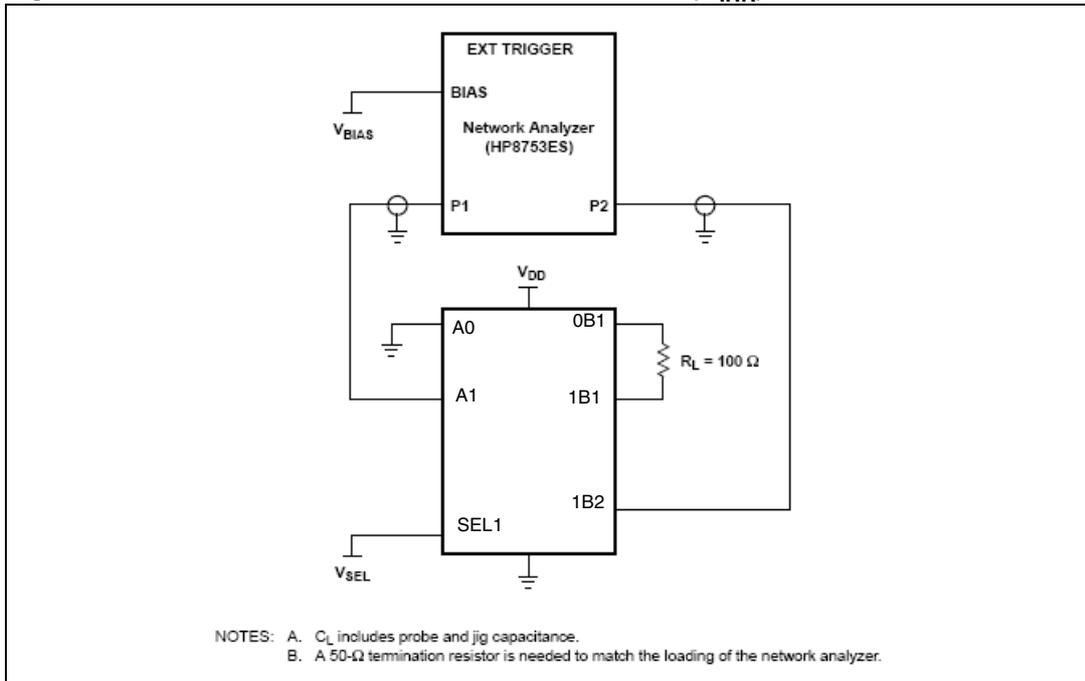
Crosstalk is measured at the output of the non-adjacent ON channel. For example, when  $V_{SEL1} = 0$ , and A1 is the input, the output is measured at A3. All unused analog input ports are connected to GND and output ports are left open.

HP8753ES setup:

Average = 4

$R_{BW} = 3 \text{ kHz}$   
 $V_{BIAS} = 0.35 \text{ V}$   
 $ST = 2 \text{ s}$   
 $P1 = 0 \text{ dBm}$

**Figure 10. Test circuit for off isolation measurement ( $O_{IRR}$ )**



Off isolation is measured at the output of the OFF channel. For example, when  $V_{SEL1} = 0$ , and A1 is the input, the output is measured at 1B2. All unused analog input ports are connected to GND and output ports are left open.

HP8753ES setup:

Average = 4  
 $R_{BW} = 3 \text{ kHz}$   
 $V_{BIAS} = 0.35 \text{ V}$   
 $ST = 2 \text{ s}$   
 $P1 = 0 \text{ dBm}$

## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

Figure 11. Package outline for QFN32L (3 x 6 x 0.8 mm) - pitch 0.4 mm

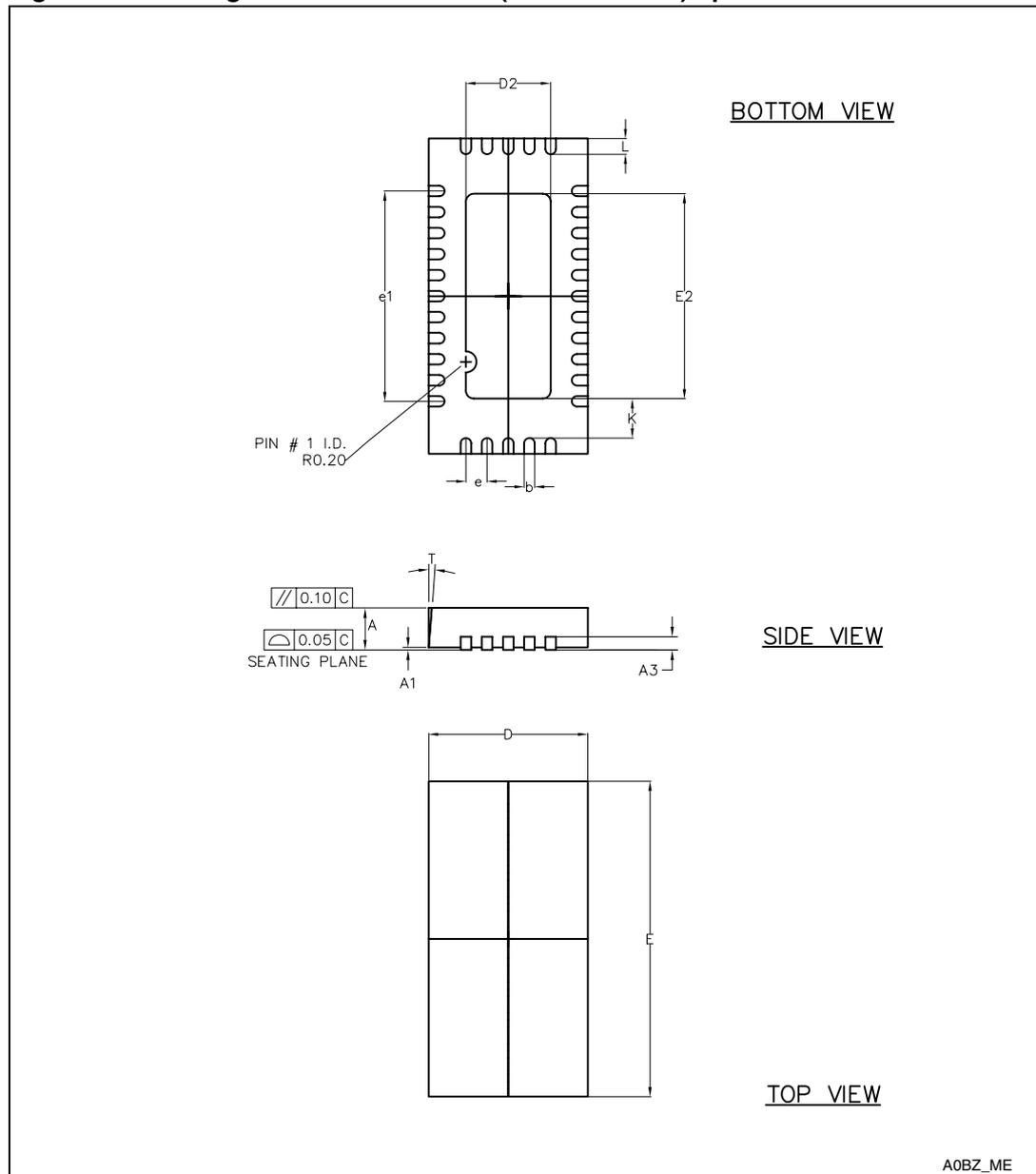


Table 13. Mechanical data for QFN32L (3 x 6 x 0.8 mm) - pitch 0.4 mm

Symbol	Millimeters		
	Min	Typ	Max
A	0.70	0.80	0.90
A1	0.00	0.05	0.08
A3		0.25	
T	0.00		12.00
b	0.15	0.20	0.25
e		0.40	
e1		4.00	
K		0.75	
D		3.00	
E		6.00	
L	0.25	0.30	0.35
D2	1.50	1.60	1.79
E2	3.80	3.90	4.00

Figure 12. Footprint recommendation

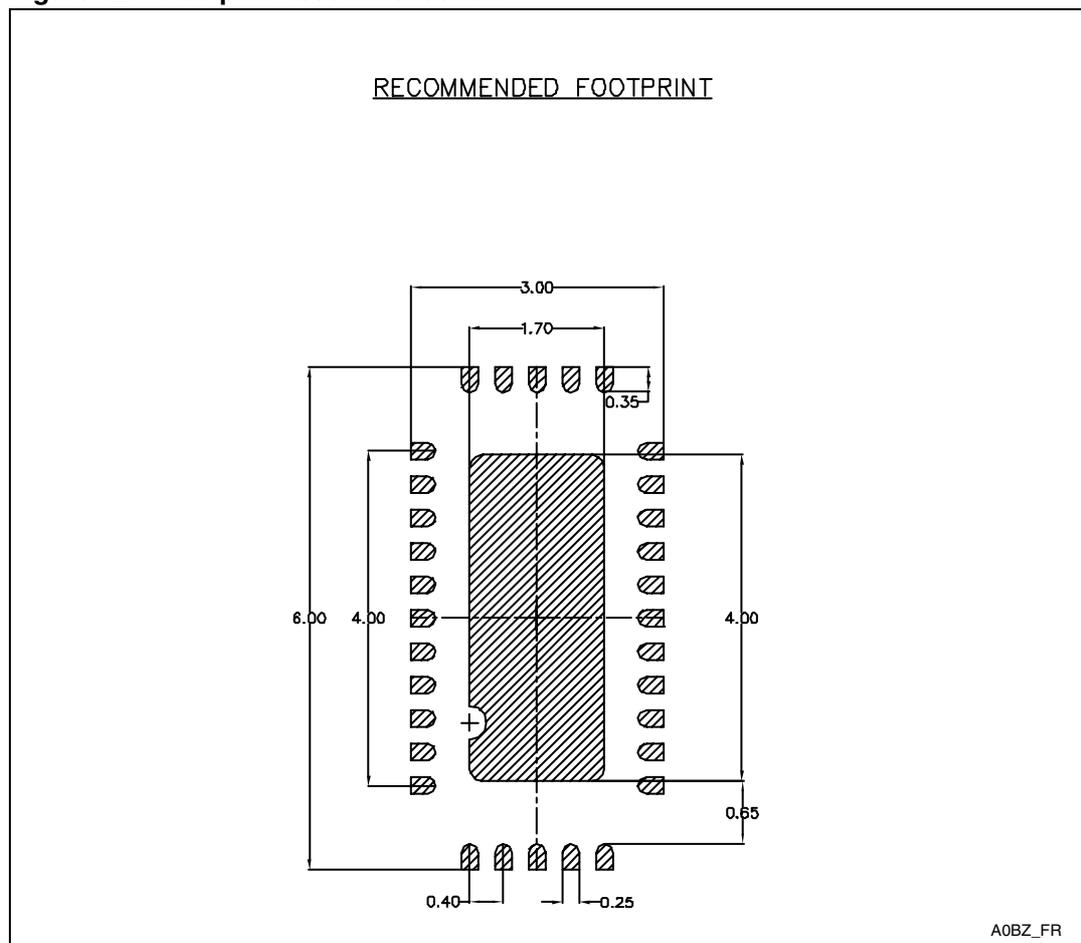
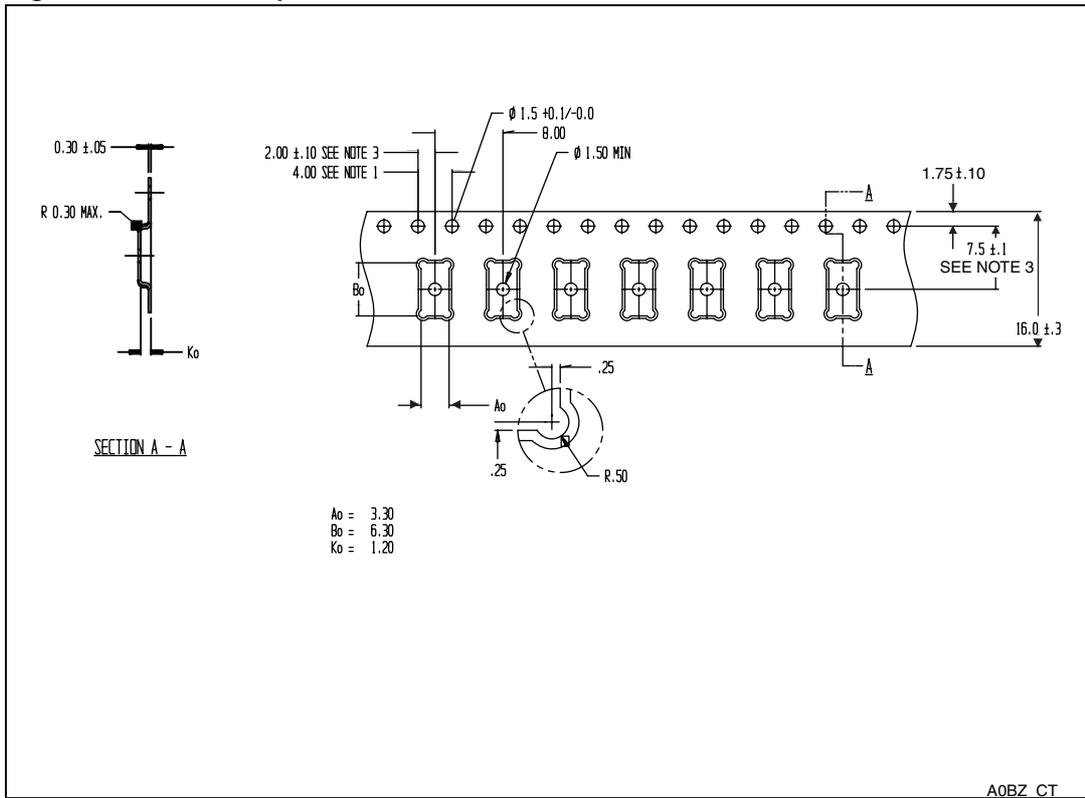


Figure 13. Carrier tape and reel information



## 5 Revision history

**Table 14. Document revision history**

Date	Revision	Changes
23-Apr-2010	1	Initial release.
16-Jun-2010	2	Modified: <a href="#">Figure 12</a> .
09-Mar-2011	3	Updated: <a href="#">Table 8</a> , <a href="#">Table 11</a> and <a href="#">Table 12</a> .

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