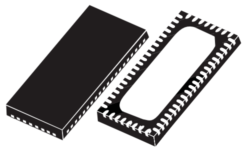
STMUX1800L

16- to 8-bit MUX/DEMUX for gigabit Ethernet LAN switch with LED switch and enhanced ESD protection

Features

- Low R_{ON}: 4.0 Ω typical
- V_{CC} operating range: 3.0 to 3.6 V
- Enhanced ESD protection: > 8 kV (contact) and 15 kV (HBM)
- Channel on capacitance: 9.5 pF typical
- Switching time speed: 9 ns
- Near to zero propagation delay: 250 ps
- Very low crosstalk: -45 dB at 250 MHz
- Bit-to-bit skew: 200 ps
- > 600 MHz -3 dB typical bandwidth (or data frequency)
- Three SPDT switches for LED support
- Rail-to-rail switching on data I/O ports (0 V to 5 V)
- Package: QFN56
- Pb-free



QFN56

Applications

- 10/100/1000 Mbit Ethernet switching
- Audio/video switching

Description

The STMUX1800L is a 16- to 8-bit multiplexer/demultiplexer low R_{ON} bidirectional LAN switch designed for various standards, such as 10/100/1000 Ethernet. It is designed for very low crosstalk, low bit-to-bit skew and low I/O capacitance.

The differential signal from the Gigabit Ethernet transceiver is multiplexed into one of two selected outputs while the unselected switch goes to Hi-Z status.

The device integrates three SPDT (single pole dual throw) switches, for LED support.

Table 1. Device summary

Order code	Package	Packing
STMUX1800LQTR	QFN56	Tape and reel

Contents

1 Pin description

Figure 1. Pin connection (top through view)

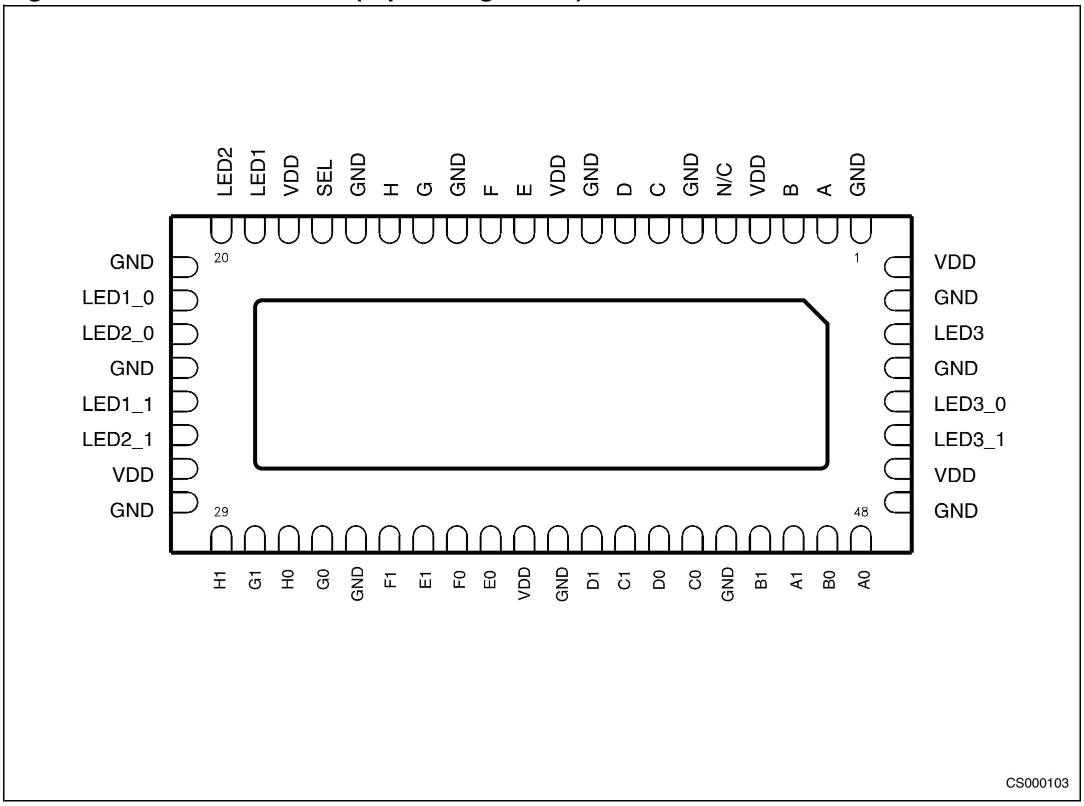


Table 2. Pin description

Pin	Symbol	Name and function
2, 3, 7, 8, 11, 12, 14, 15	A, B, C, D, E, F, G, H	8-bit bus
48, 47, 43, 42, 37, 36, 32, 31	A0, B0, C0, D0, E0, F0, G0, H0	8-bit multiplexed to bus 0
46, 45, 41, 40, 35, 34, 30, 29	A1, B1, C1, D1, E1, F1, G1, H1	8-bit multiplexed to bus 1
5	N/C	Not connected
17	SEL	Bus and LED switch selection
19, 20, 54	LED1, LED2, LED3	LED switch input
22, 23, 25, 26, 51, 52	LED1_0, LED2_0, LED1_1, LED2_1, LED3_1, LED3_0	LED switch output
4, 10, 18, 27, 38, 50, 56	V_{DD}	Supply voltage
1, 6, 9, 13, 16, 21, 24, 28, 33, 39, 44, 49, 53, 55	GND	Ground

Figure 2. Input equivalent circuit

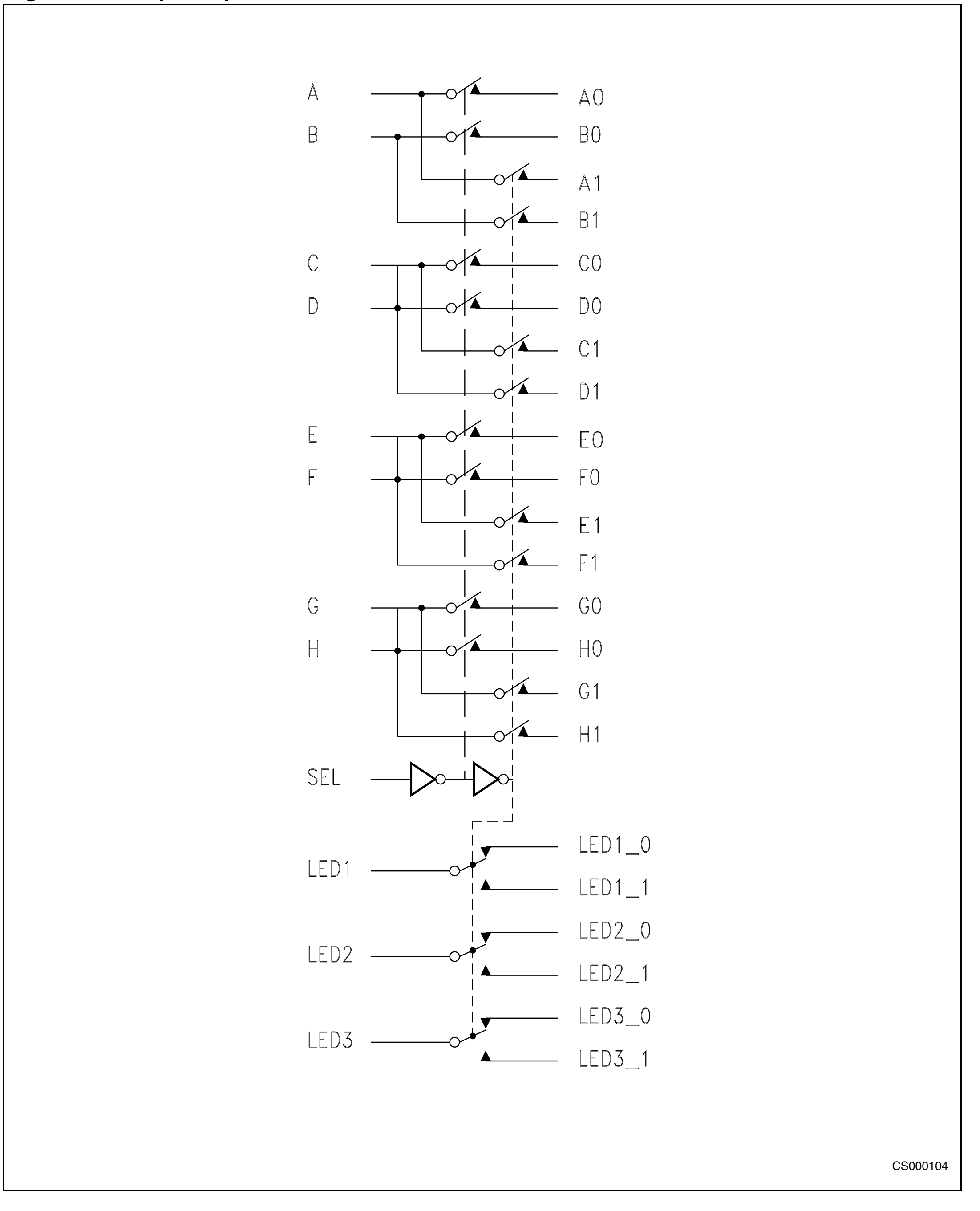


Table 3. LAN switch function table

SEL	Function
L	8-bit bus to 8-bit multiplexed bus 0
H	8-bit bus to 8-bit multiplexed bus 1

Table 4. LED switch function table

SEL	Function
L	LED switch input connected to LED switch output X_0
H	LED switch input connected to LED switch output X_1

2 Maximum ratings

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(1)	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} x 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)	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 for Gigabit Ethernet LAN8/16MUX/DEMUX (V_{CC} = 3.3 V ±10%)

Symbol	Parameter	Test condition	Value -40 to 85 °C			Unit
			Min	Typ	Max	
V_{IH}	Voltage input high (SEL)	High level guaranteed	2	–	–	V
V_{IL}	Voltage input low (SEL)	Low level guaranteed	-0.5	–	0.8	V
V_{IK}	Clamp diode voltage (SEL)	V_{CC} = 3.6 V I_{IN} = -18 mA	–	-0.8	-1.2	V
I_{IH}	Input high current (SEL)	V_{CC} = 3.6 V V_{IN} = V_{CC}	–	–	±5	µA
I_{IL}	Input low current (SEL)	V_{CC} = 3.6 V V_{IN} = GND	–	–	±5	µA
$IOFF_{(SW)}$(1)	Leakage current through the switch common terminals (A to H) (LED1 to LED3)	V_{CC} = 3.6 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}	–	–	±1	µA
$IOFF_{(SEL)}$	SEL pin leakage current	V_{CC} = 0 V SEL = 0 to 3.6 V	–	–	±1	µA
R_{ON}	Switch ON resistance(2)	V_{CC} = 3.0 V V_{IN} = 1.5 to V_{CC} I_{IN} = -40 mA	–	4.0	6.5	Ω
R_{FLAT}	ON resistance flatness (2)(3)	V_{CC} = 3.0 V V_{IN} at 1.5 and VCC I_{IN} = -40 mA	–	0.5	–	Ω
ΔR_{ON}	ON resistance match between channel $\Delta R_{ON} = R_{ONMAX} - R_{ONMIN}$ (2)(4)	V_{CC} = 3.0 V V_{IN} = 1.5 to V_{CC} I_{IN} = -40 mA	–	0.4	1	Ω

1. Refer to *Figure 4: Test circuit for leakage current (IOFF) on page 11*
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. ΔR_{ON} measured at same V_{CC}, temperature and voltage level.

Table 8. DC electrical characteristics for 10/100 Ethernet LAN8/16MUX/DEMUX (V_{CC} = 3.3 V ±10)

Symbol	Parameter	Test condition	Value -40 to 85 °C Min	Typ	Max	Unit
V_{IH}	Voltage input high (SEL)	High level guaranteed	2	–	–	V
V_{IL}	Voltage input low (SEL)	Low level guaranteed	-0.5	–	0.8	V
V_{IK}	Clamp diode voltage (SEL)	V_{CC} = 3.6 V I_{IN} = -18 mA	–	-0.7	-1.2	V
I_{IH}	Input high current (SEL)	V_{CC} = 3.6 V $V_{IN} = V_{CC}$	–	–	±5	µA
I_{IL}	Input low current (SEL)	V_{CC} = 3.6 V V_{IN} = GND	–	–	±5	µA
$IOFF_{(SW)}$(1)	Leakage current through the switch common terminals (A to H) (LED1 to LED3)	V_{CC} = 3.6 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}	–	–	±1	µA
$IOFF_{(SEL)}$	SEL pin leakage current	V_{CC} = 0 V SEL = 0 to 3.6 V	–	–	±1	µA
R_{ON}	Switch ON resistance(2)	V_{CC} = 3.0 V V_{IN} = 1.5 to V_{CC} I_{IN} = -10 to -30 mA	–	4.0	6.5	Ω
R_{FLAT}	ON resistance flatness (2) (3)	V_{CC} = 3.0 V V_{IN} at 1.5 and V_{CC} I_{IN} = -10 to -30 mA	–	0.5	–	Ω
ΔR_{ON}	ON resistance match between channel $\Delta R_{ON} = R_{ONMAX} - R_{ONMIN}$(2)(4)	V_{CC} = 3.0 V V_{IN} = 1.5 to V_{CC} I_{IN} = -10 to -30 mA	–	0.4	1	Ω

1. Refer to *Figure 4: Test circuit for leakage current (IOFF) on page 11*
2. Measured by voltage drop between channels at indicated current through the switch. ON resistance is determinate by the lower of the two voltages.
3. Flatness is defined as the difference between the R_{ONMAX} and R_{ONMIN} of ON resistance over the specified range.
4. ΔR_{ON} measured at same V_{CC}, temperature and voltage level.

Table 9. Capacitance (T_A = 25 °C, f = 1 MHz)

Symbol	Parameter	Test condition	Value			Unit
			Min	Typ	Max	
C_{IN}	SEL pin input capacitance(1)	DC = 0.25 V AC = 0.5 V_{PP} f = 1 MHz	–	2	3	pF
C_{OFF}	Switch off capacitance(2)	DC = 0.25 V AC = 0.5 V_{PP} f = 1 MHz	–	4	5	pF
C_{ON}	Switch on capacitance(3)	DC = 0.25 V AC = 0.5 V_{PP} f = 1 MHz	–	9.5	11	pF

1. Refer to *Figure 5 on page 12*
2. Refer to *Figure 6 on page 12*
3. Refer to *Figure 7 on page 13*

Table 10. Power supply characteristics

Symbol	Parameter	Test condition	Value			Unit
			-40 to 85 °C			
			Min	Typ	Max	
I_{CC}	Quiescent power supply	V_{CC} = 3.6 V, V_{IN} = V_{CC} or GND	–	150	500	µA

Table 11. Dynamic electrical characteristics (V_{CC} = 3.3 V ±10%)

Symbol	Parameter	Test condition	Value			Unit
			-40 to 85 °C			
			Min	Typ	Max	
X_{talk}	Crosstalk(1)	R_L= 100 Ω f = 250 MHz	–	-45	–	dB
O_{IRR}	Off isolation(2)	R_L= 100 Ω f = 250 MHz	–	-37	–	dB
BW	-3 dB bandwidth(3)	R_L= 100 Ω $0 < V_{IN} \leq 3.6$ V	–	600	–	MHz

1. Refer to *Figure 9 on page 14*
2. Refer to *Figure 10 on page 15*
3. Refer to *Figure 8 on page 13*

Table 12. Switching characteristics (T_A = 25 °C, V_{CC} = 3.3 V ±10%)

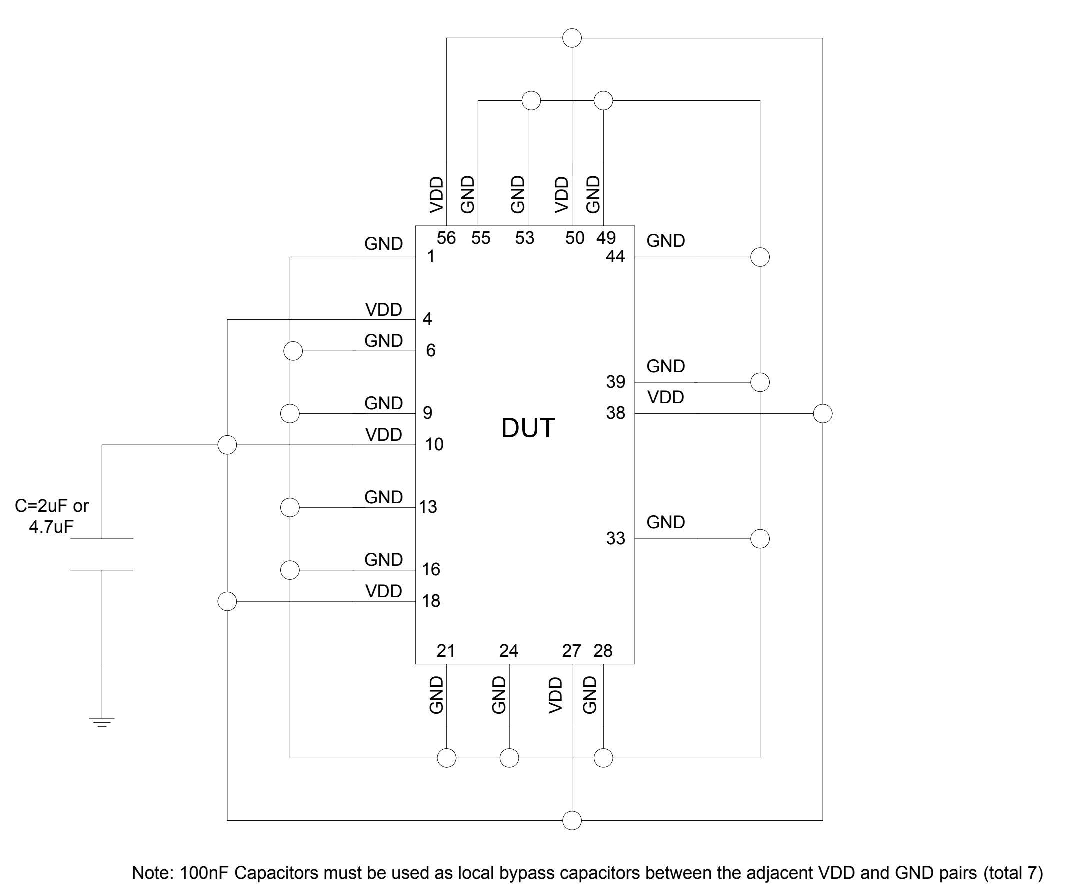
Symbol	Parameter	Test condition	Value			Unit
			Min	Typ	Max	
t_{PD}	Propagation delay	V_{CC} = 3 to 3.6 V	–	0.25	–	ns
t_{PZH}, t_{PZL}	Line enable time, SE to x to x0 or x to x1	V_{CC} = 3 to 3.6 V	0.5	6.5	15	ns
t_{PHZ}, t_{PLZ}	Line disable time, SE to x to x0 or x to x1	V_{CC} = 3 to 3.6 V	0.5	6.5	8.5	ns
$t_{SK(O)}$	Output skew between center port to any other port	V_{CC} = 3 to 3.6 V	–	0.1	0.2	ns
$t_{SK(P)}$	Skew between opposite transition of the same output (t_{PHL}, t_{PLH})	V_{CC} = 3 to 3.6 V	–	0.1	0.2	ns

Table 13. ESD performance

Symbol	Test condition	Value			Unit
		Min	Typ	Max	
ESD	Contact discharge(1) IEC61000-4-2	–	±8	–	kV
	Human body model (MIL-STD-883)	–	±15	–	kV

1. Refer to *Figure 3: Diagram for suggested VDD decoupling on page 11*.

Figure 3. Diagram for suggested V_{DD} decoupling



1. Applicable for system level ESD test

Figure 4. Test circuit for leakage current (I_{OFF})

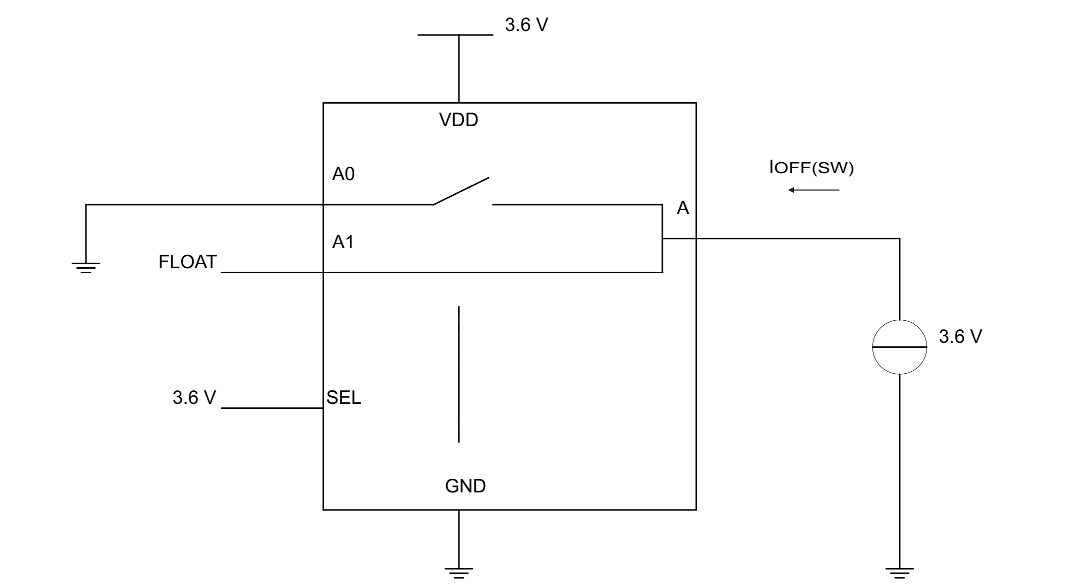


Figure 5. Test circuit for SEL pin input capacitance (C_{IN})

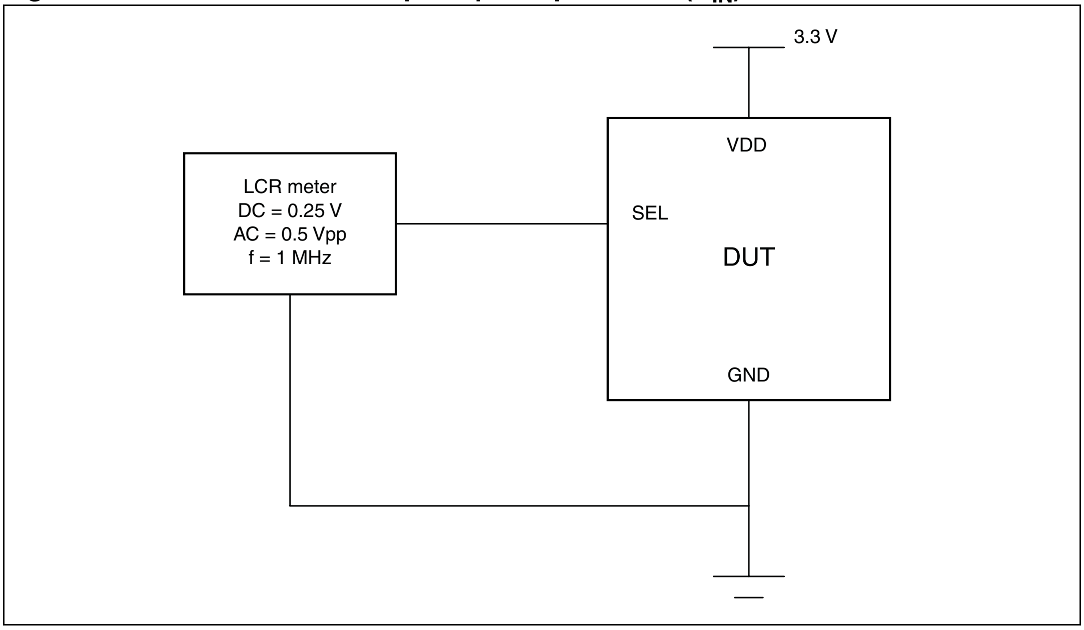


Figure 6. Test circuit for switch off capacitance (C_{OFF})

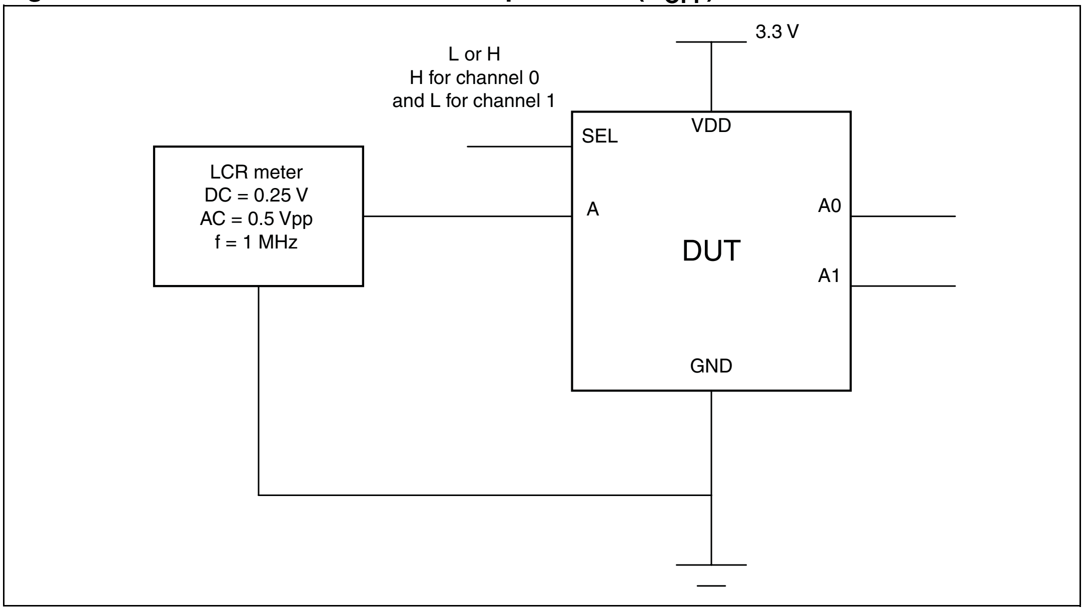


Figure 7. Test circuit for switch on capacitance (C_{ON})

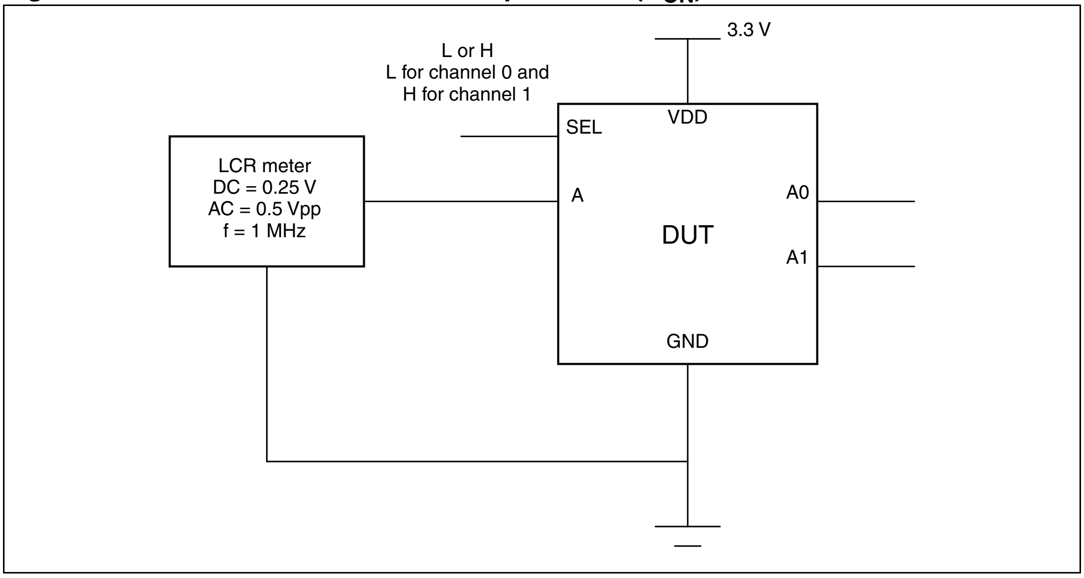
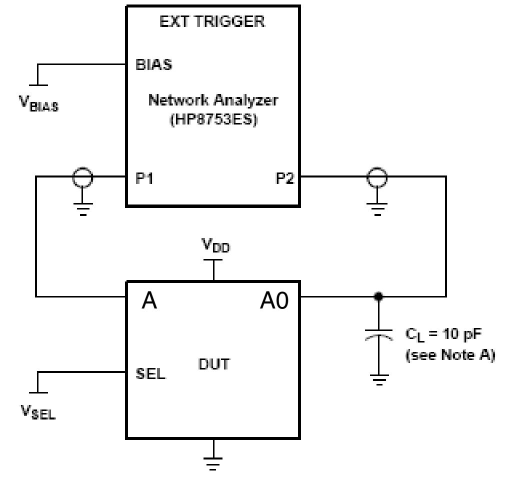


Figure 8. Test circuit for bandwidth measurement (BW)



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

HP8753ES setup:

Average = 4

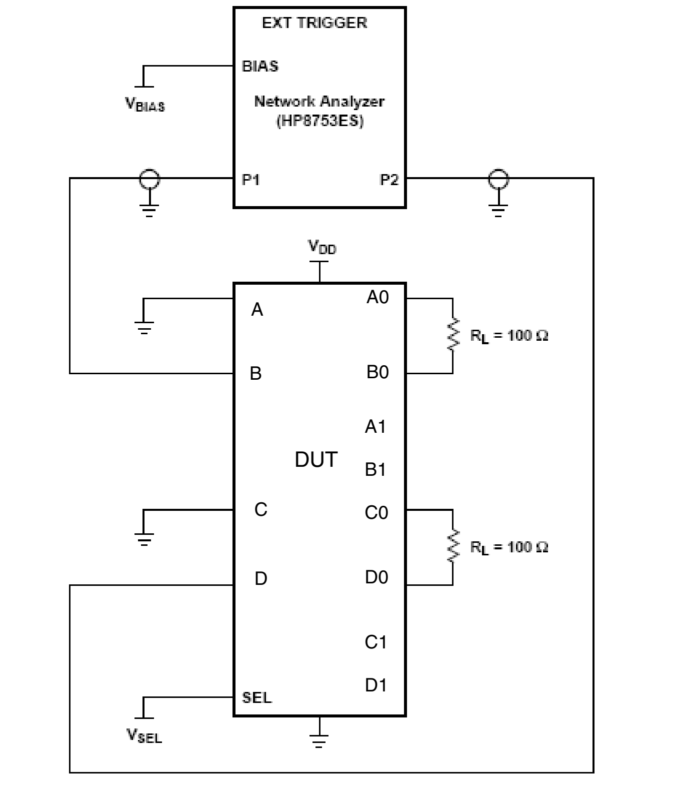
R_{BW} = 3 kHz

V_{BIAS} = 0.35 V

ST = 2 s

P1 = 0 dBm

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



NOTES: A. C_L includes probe and jig capacitance.
B. A 50-Ω termination resistor is needed to match the loading of the network analyzer.

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

HP8753ES setup:

Average = 4

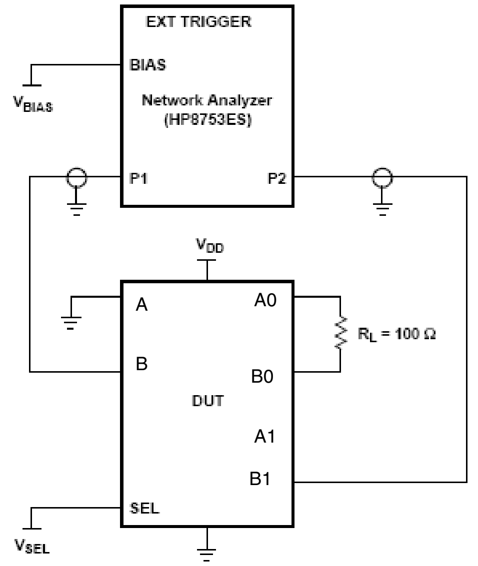
R_{BW} = 3 kHz

V_{BIAS} = 0.35 V

ST = 2 s

P1 = 0 dBm

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



NOTES: A. C_L includes probe and jig capacitance.
B. A 50-Ω termination resistor is needed to match the loading of the network analyzer.

Off isolation is measured at the output of the OFF channel. For example, when V_{SEL}=0, and B is the input, the output is measured at B1. All unused analog input ports are connected to GND and output ports are left open.

HP8753ES setup:

Average = 4

R_{BW} = 3 kHz

V_{BIAS} = 0.35 V

ST = 2 s

P1 = 0 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. ECOPACK® is an ST trademark.

Figure 11. Package outline for QFN56 (11 x 5 mm) pitch 0.5 mm

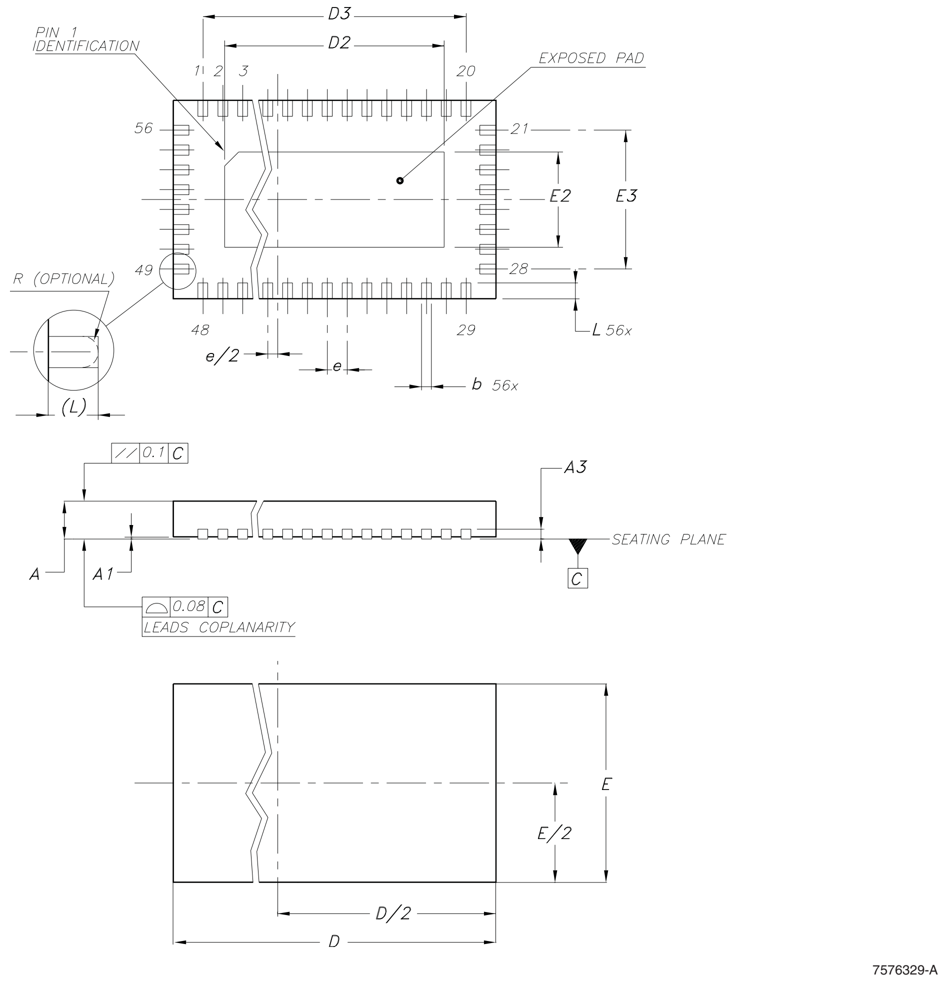


Figure 12. Mechanical data for QFN56 (11 x 5 mm) pitch 0.5 mm

Symbol	Millimeters		
	Min	Typ	Max
A	0.70	0.75	0.80
A1	–	–	0.05
A3		0.20	–
b	0.20	0.25	0.30
D	10.90	11.00	11.10
D2	8.30	8.40	8.50
D3	–	9.50	–
E	4.90	5.00	5.10
E2	2.30	2.40	2.50
E3	–	3.50	–
e	–	0.50	–
L	0.30	0.40	0.50

Figure 13. Footprint recommendation for QFN56 (11 x 5 mm) pitch 0.5 mm

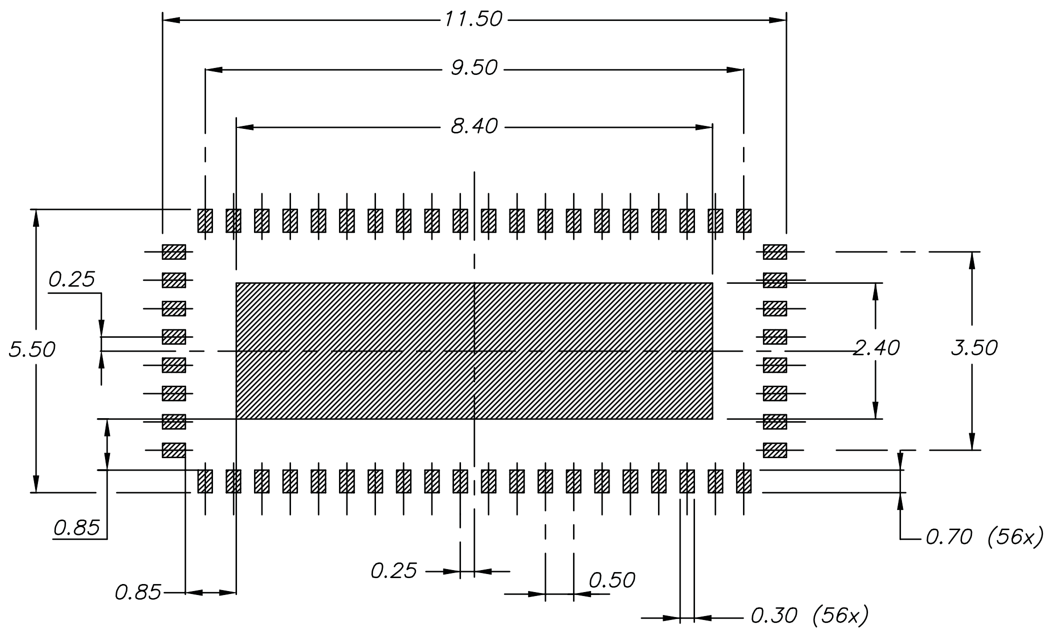
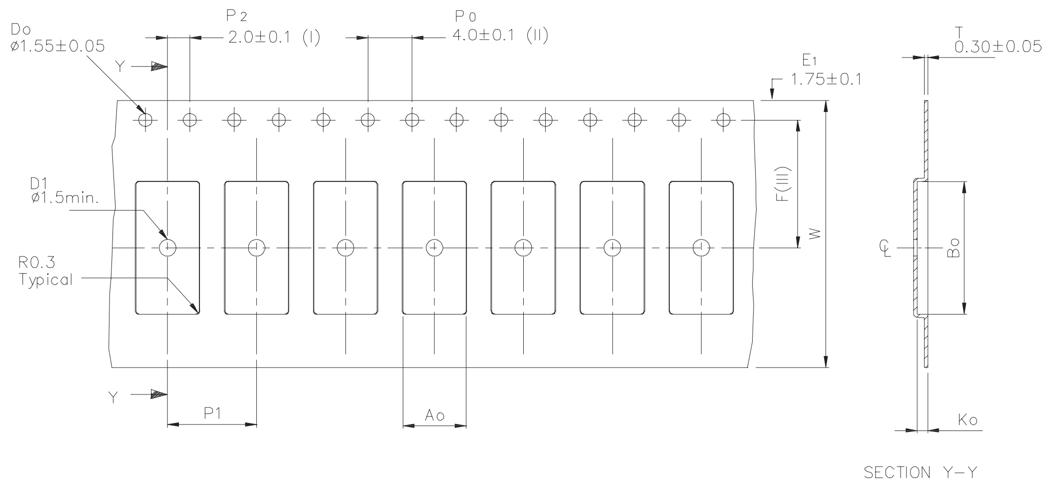


Figure 14. Carrier tape information for QFN56 (11 x 5 mm) pitch 0.5 mm



Ao	5.70 +/– 0.1
Bo	11.90 +/– 0.1
Ko	0.95 +/– 0.1
F	11.50 +/– 0.1
P1	8.00 +/– 0.1
W	24.00 +/– 0.3

(I) Measured from centreline of sprocket hole to centreline of pocket.

(II) Cumulative tolerance of 10 sprocket holes is ± 0.20 .

(III) Measured from centreline of sprocket hole to centreline of pocket.

(IV) Other material available.

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

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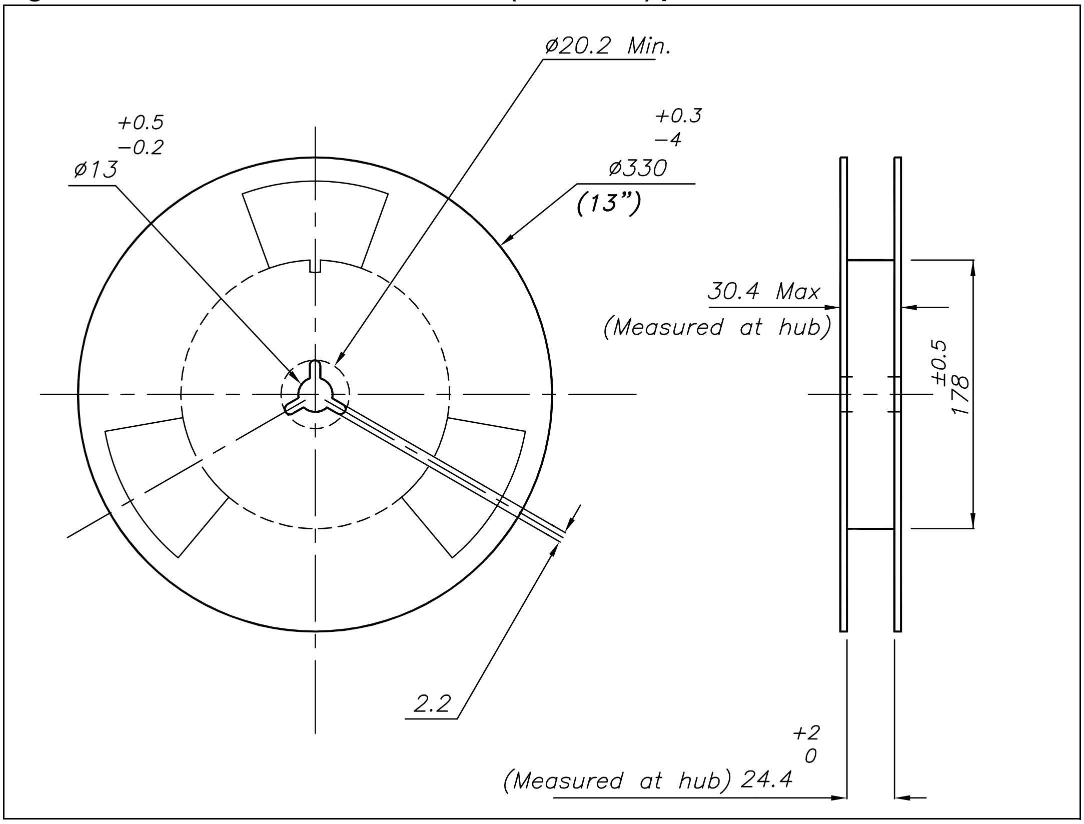
Figure 15. Reel information for QFN56 (11 x 5 mm) pitch 0.5 mm



5 Revision history

Table 14. Document revision history

Date	Revision	Changes
26-Feb-2008	1	Initial release.
24-Sep-2008	2	Modified: datasheet title, channel on capacitance value from 7.5 pF to 9.5 pF typical, *Figure 1*, *Table 2*, *Section 3: Electrical characteristics*. Added: fields of applications, *Table 6* and QFN56 footprint recommendations in *Figure 13 on page 17*.
30-Mar-2009	3	Updated: Features section, *Table 5 on page 6*, *Table 11 on page 9* and *Table 13 on page 10* and *Chapter 4: Package mechanical data*.
22-Jun-2009	4	Document promoted from Preliminary data to datasheet.