

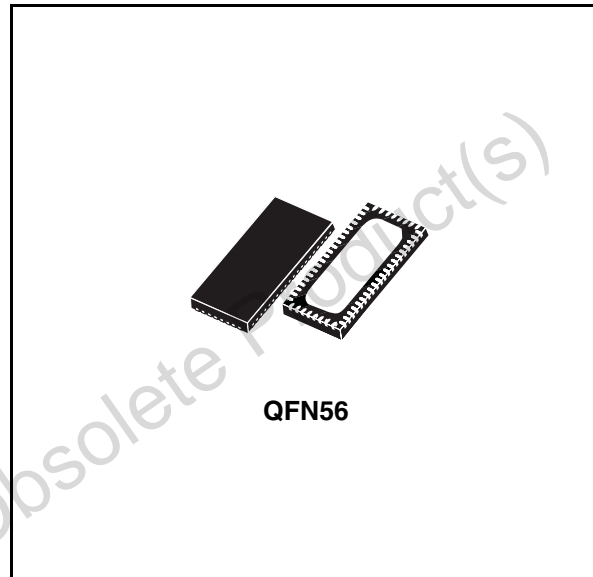
## MUX/DEMUX for 4 differential channel LVDS and DDC

### 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 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)
- Support up to 4 differential LVDS channel
- Support 2 channel for DDC
- Independent SEL control for LVDS and DDC channels
- Package: QFN56

### Applications

- Audio/video switching
- High bandwidth physical layer signals routing



### Description

The ST3DV520E is a 4 differential channel LVDS multiplexer/demultiplexer low  $R_{ON}$  bidirectional switch used to switch between multiple LVDS sources. It is designed for very low crosstalk, low bit-to-bit skew and low I/O capacitance, to maintain high signal integrity.

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

The device integrates 2 SPDT (single pole dual throw) switches, for DDC channel.

SEL for LVDS and DDC channel is controlled independently.

**Table 1. Device summary**

| Order code   | Package | Packing       |
|--------------|---------|---------------|
| ST3DV520EQTR | QFN56   | Tape and reel |

# Contents

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Obsolete Product(s) - Obsolete Product(s)

# 1 Pin description

Figure 1. Pin connection (top through view)

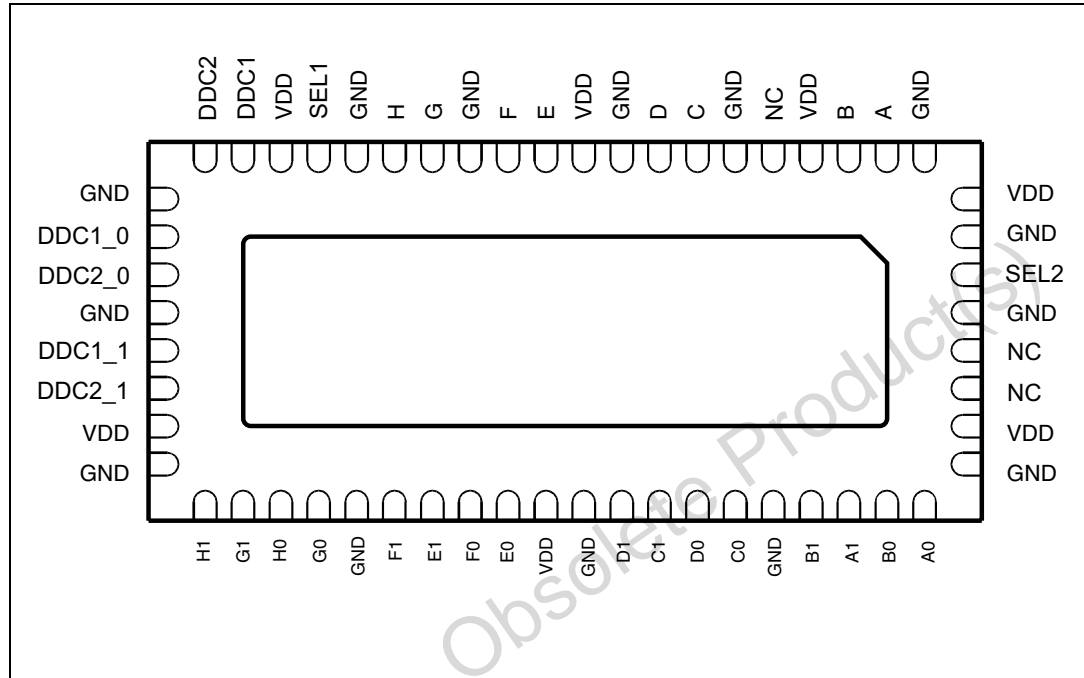


Table 2. Pin description

| 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 |
| 17  | SEL1                           | LVDS channel selection     |
| 54  | SEL2                           | DDC channel selection      |
| 19, 20  | DDC1, DDC2                     | DDC switch input           |
| 22, 23, 25, 26                                      | DDC1_0, DDC2_0, DDC1_1, DDC2_1 | DDC switch output          |
| 4, 10, 18, 27, 38, 50, 56                           | V <sub>DD</sub>                | Supply voltage             |
| 1, 6, 9, 13, 16, 21, 24, 28, 33, 39, 44, 49, 53, 55 | GND                            | Ground                     |
| 5, 51, 52   | NC                             | No internal connection     |

Figure 2. Input equivalent circuit

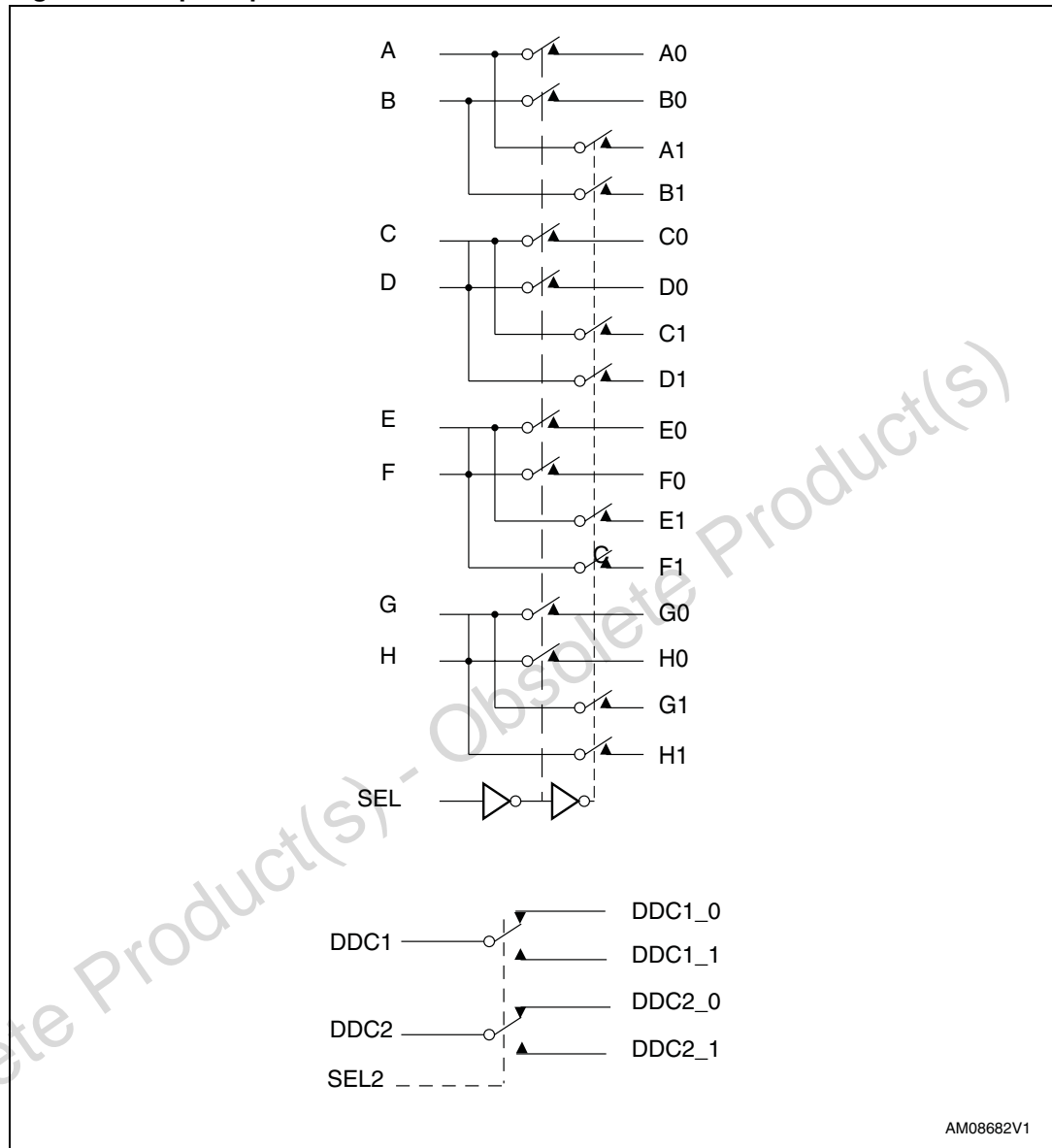


Table 3. LVDS switch function table

| SEL1 | Function                             |
|------|--------------------------------------|
| L    | 8-bit bus to 8-bit multiplexed bus 0 |
| H    | 8-bit bus to 8-bit multiplexed bus 1 |

Table 4. DDC switch function table

| SEL2 | Function  |
|------|---|
| L    | DDC switch input connected to DDC switch output X_0 |
| H    | DDC switch input connected to DDC switch output X_1 |

## 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 (SEL1, 2) | 0     | -   | $V_{CC}$ | 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**

| Symbol              | Parameter  | Test condition  | Value        |      |         | Unit          |
|---------------------|--|---|--------------|------|---------|---------------|
|                     |  |   | -40 to 85 °C |      |         |               |
|                     |  |   | Min          | Typ  | Max     |               |
| $V_{IH}$            | Voltage input high (SEL1, 2)   | High level guaranteed   | 2.4          | -    | -       | V             |
| $V_{IL}$            | Voltage input low (SEL1, 2)  | Low level guaranteed  | -0.5         | -    | 0.8     | V             |
| $V_{IK}$            | Clamp diode voltage (SEL1, 2)  | $V_{CC} = 3.6\text{ V}$<br>$I_{IN} = -18\text{ mA}$   | -            | -0.8 | -1.2    | V             |
| $I_{IH}$            | Input high current (SEL1, 2)   | $V_{CC} = 3.6\text{ V}$<br>$V_{IN} = V_{CC}$  | -            | -    | $\pm 5$ | $\mu\text{A}$ |
| $I_{IL}$            | Input low current (SEL1, 2)  | $V_{CC} = 3.6\text{ V}$<br>$V_{IN} = \text{GND}$  | -            | -    | $\pm 5$ | $\mu\text{A}$ |
| $I_{OFF(SW)}^{(1)}$ | Leakage current through the switch common terminals (A to H) (DDC1 to DDC2)              | $V_{CC} = 3.6\text{ V}$<br>A to H = $V_{CC}$<br>DDC1 to DDC2 = $V_{CC}$<br>A0 to H0 = 0 V<br>A1 to H1 = floating<br>DDCx_0 = 0 V<br>DDCx1 = floating<br>SEL1 = $V_{CC}$ , SEL2 = $V_{CC}$ | -            | -    | $\pm 1$ | $\mu\text{A}$ |
| $I_{OFF(SEL1)}$     | SEL1 pin leakage current   | $V_{CC} = 0\text{ V}$<br>SEL1, 2 = 0 to 3.6 V   | -            | -    | $\pm 1$ | $\mu\text{A}$ |
| $R_{ON}$            | Switch ON resistance <sup>(2)</sup>  | $V_{CC} = 3.0\text{ V}$<br>$V_{IN} = 1.5\text{ to }V_{CC}$<br>$I_{IN} = -40\text{ mA}$  | -            | 4.0  | 6.5     | $\Omega$      |
| $R_{FLAT}$          | ON resistance flatness <sup>(2)</sup><br>(3)   | $V_{CC} = 3.0\text{ V}$<br>$V_{IN}$ at 1.5 and $V_{CC}$<br>$I_{IN} = -40\text{ mA}$   | -            | 0.5  | -       | $\Omega$      |
| $\Delta R_{ON}$     | ON resistance match between channel<br>$\Delta R_{ON} = R_{ONMAX} - R_{ONMIN}$<br>(2)(4) | $V_{CC} = 3.0\text{ V}$<br>$V_{IN} = 1.5\text{ to }V_{CC}$<br>$I_{IN} = -40\text{ mA}$  | -            | 0.4  | 1       | $\Omega$      |

1. Refer to [Figure 4: Test circuit for leakage current \(IOFF\) on page 9](#)
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 |      |
| $C_{IN}$  | SEL1, 2 pin input capacitance <sup>(1)</sup> | DC = 0.25 V<br>AC = 0.5 V <sub>PP</sub><br>f = 1 MHz | -     | 2   | 3   | pF   |
| $C_{OFF}$ | Switch off capacitance <sup>(2)</sup>        | DC = 0.25 V<br>AC = 0.5 V <sub>PP</sub><br>f = 1 MHz | -     | 4   | 5   | pF   |
| $C_{ON}$  | Switch on capacitance <sup>(3)</sup>         | DC = 0.25 V<br>AC = 0.5 V <sub>PP</sub><br>f = 1 MHz | -     | 9.5 | 11  | pF   |

1. Refer to [Figure 5 on page 10](#)
2. Refer to [Figure 6 on page 10](#)
3. Refer to [Figure 7 on page 11](#)

**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 | -            | 150 | 500 | 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>       | $R_L = 100\ \Omega$<br>f = 250 MHz                    | -            | -45 | -   | dB   |
| $O_{IRR}$  | Off isolation <sup>(2)</sup>   | $R_L = 100\ \Omega$<br>f = 250 MHz                    | -            | -37 | -   | dB   |
| BW         | -3 dB bandwidth <sup>(3)</sup> | $R_L = 100\ \Omega$<br>$0 < V_{IN} \leq 3.6\text{ V}$ | -            | 600 | -   | MHz  |

1. Refer to [Figure 9 on page 12](#)
2. Refer to [Figure 10 on page 13](#)
3. Refer to [Figure 8 on page 11](#)

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

| 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   |
| $t_{PZH}$ ,<br>$t_{PZL}$ | Line enable time,<br>SEL to x to x0 or x to x1   | $V_{CC} = 3\text{ to }3.6\text{ V}$ | 0.5   | 6.5  | 15  | ns   |
| $t_{PHZ}$ ,<br>$t_{PLZ}$ | Line disable time,<br>SEL to x to x0 or x to x1  | $V_{CC} = 3\text{ to }3.6\text{ V}$ | 0.5   | 6.5  | 8.5 | ns   |
| $t_{SK(O)}$              | Output skew<br>between center port<br>to any other port                                | $V_{CC} = 3\text{ to }3.6\text{ V}$ | -     | 0.1  | 0.2 | ns   |
| $t_{SK(P)}$              | Skew between<br>opposite transition of<br>the same output<br>( $t_{PHL}$ , $t_{PLH}$ ) | $V_{CC} = 3\text{ to }3.6\text{ V}$ | -     | 0.1  | 0.2 | ns   |

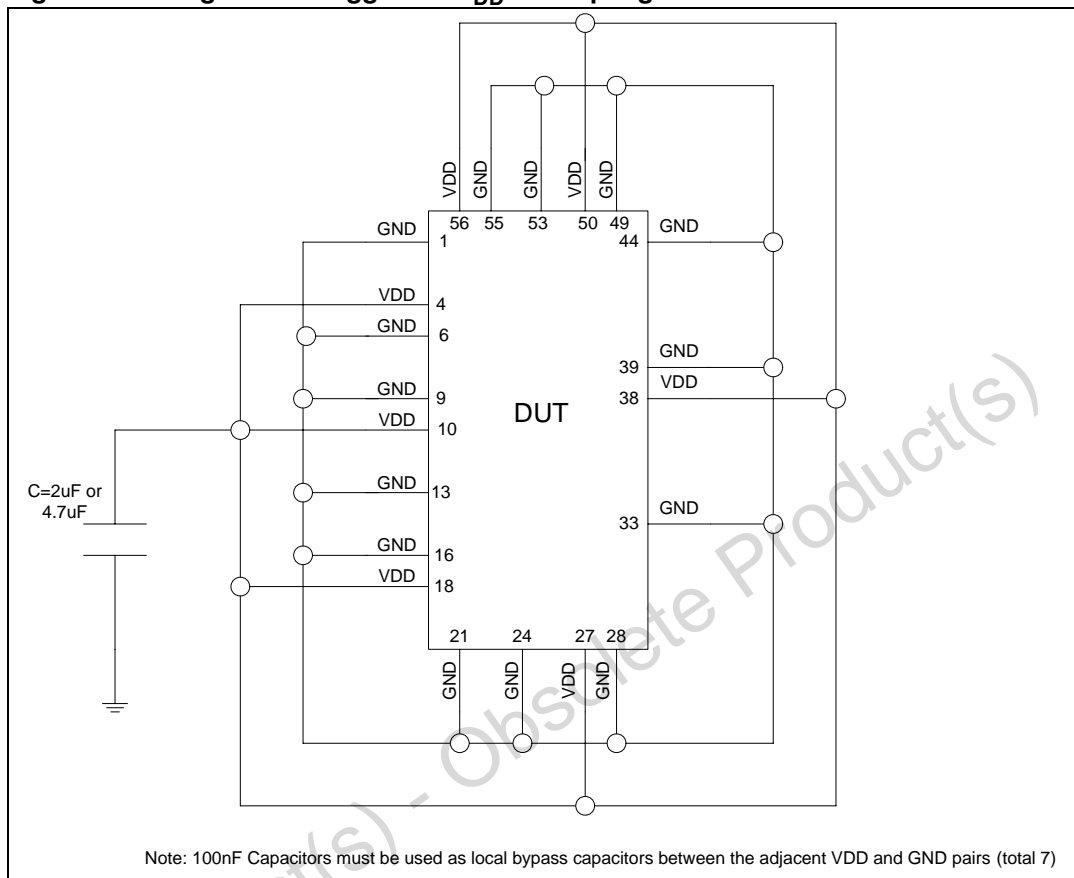
**Table 12. ESD performance**

| Symbol | Test condition                                   | Value |          |     | Unit |
|--------|--|-------|----------|-----|------|
|        |  | Min   | Typ      | Max |      |
| ESD    | Contact discharge <sup>(1)</sup><br>IEC61000-4-2 | -     | $\pm 8$  | -   | kV   |
|        | Human body model<br>(MIL-STD-883)                | -     | $\pm 15$ | -   | kV   |

1. Refer to [Figure 3: Diagram for suggested VDD decoupling on page 9.](#)



Figure 3. Diagram for suggested  $V_{DD}$  decoupling



1. Applicable for system level ESD test

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

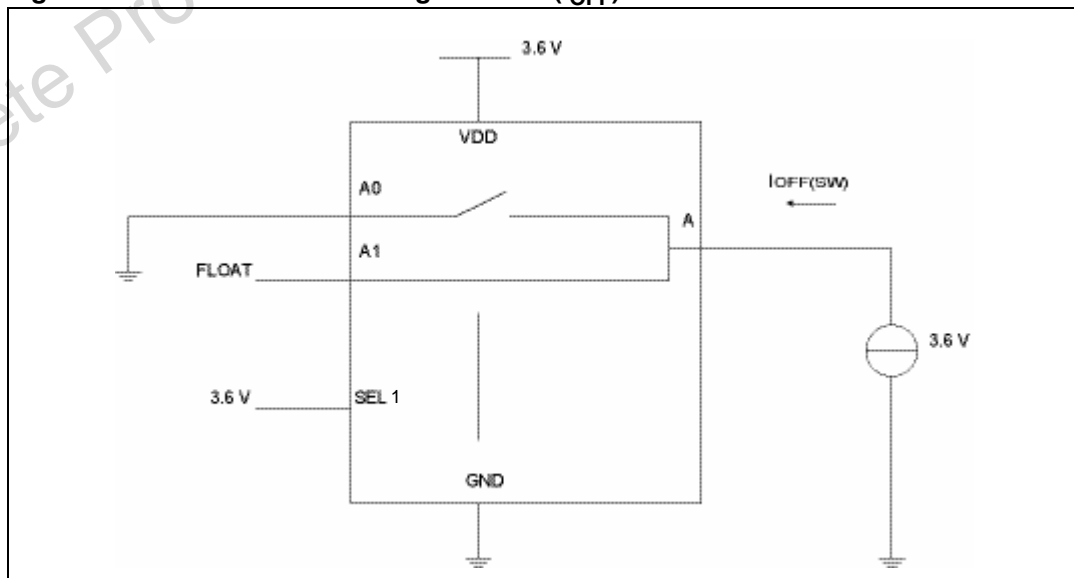


Figure 5. Test circuit for SEL pin input capacitance ( $C_{IN}$ )

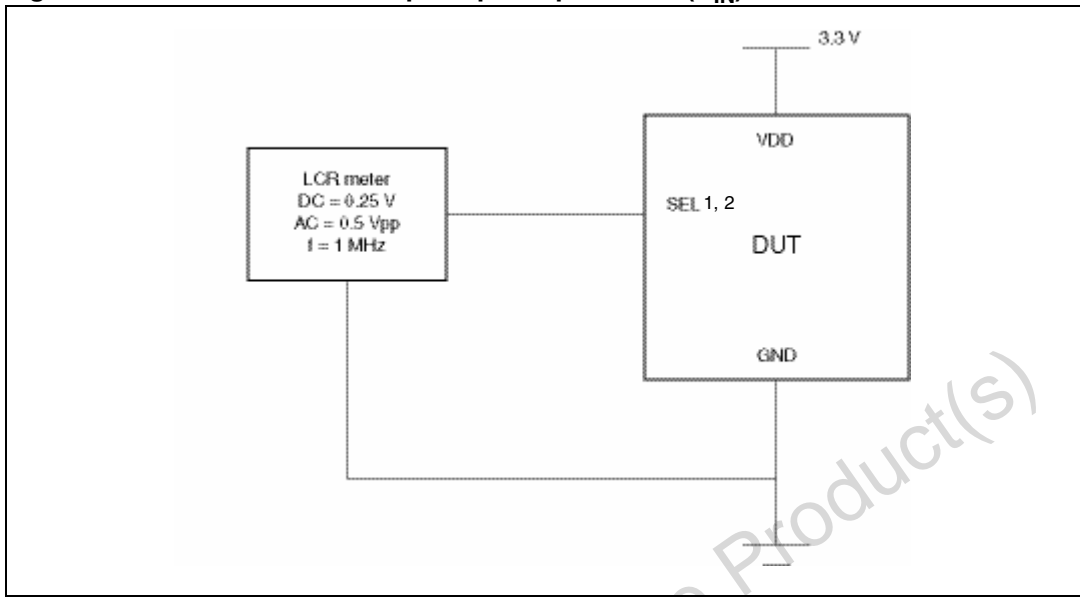


Figure 6. Test circuit for switch off capacitance ( $C_{OFF}$ )

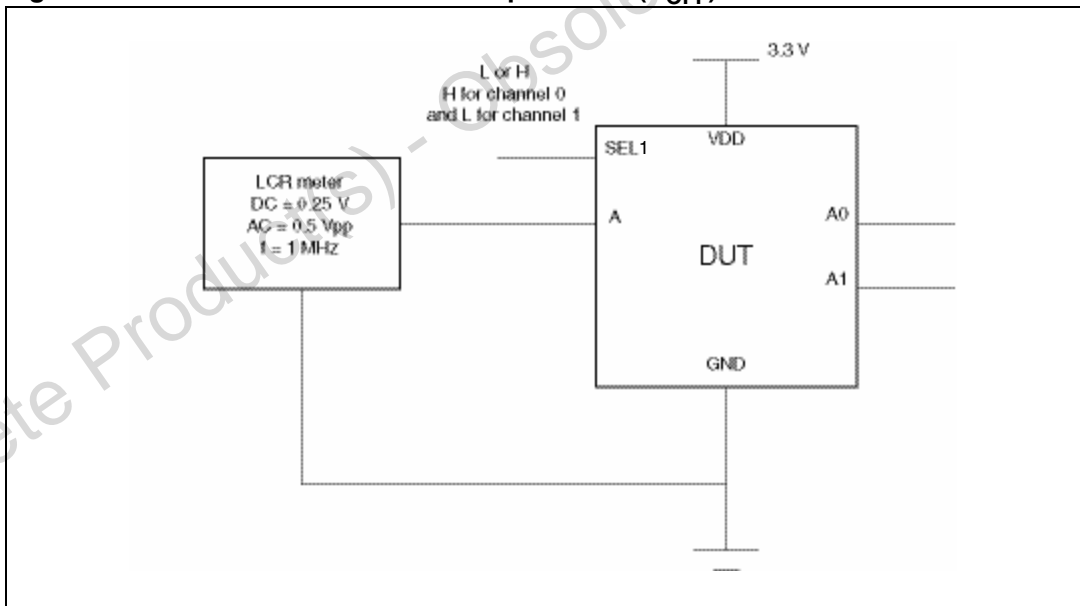


Figure 7. Test circuit for switch on capacitance ( $C_{ON}$ )

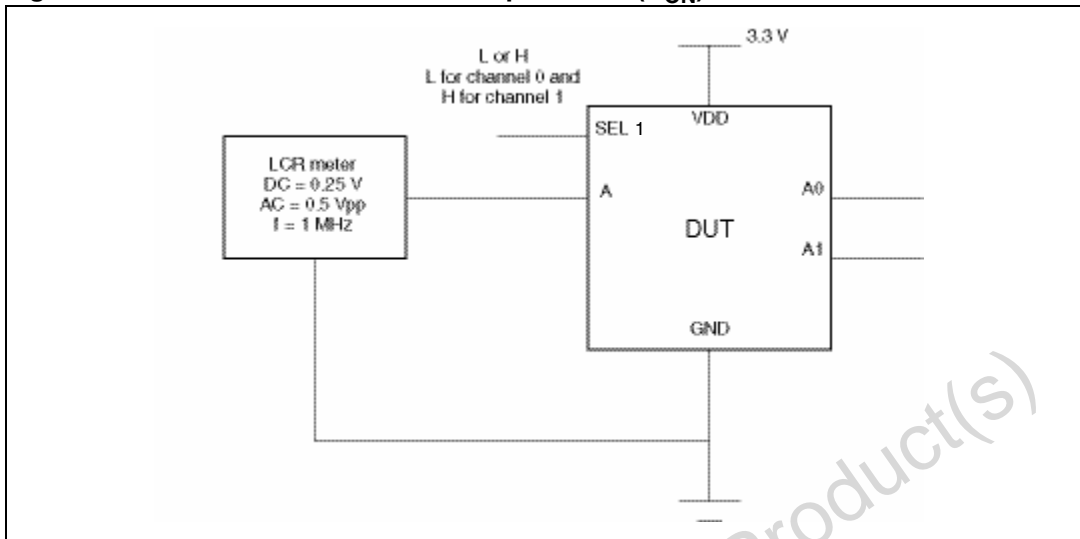
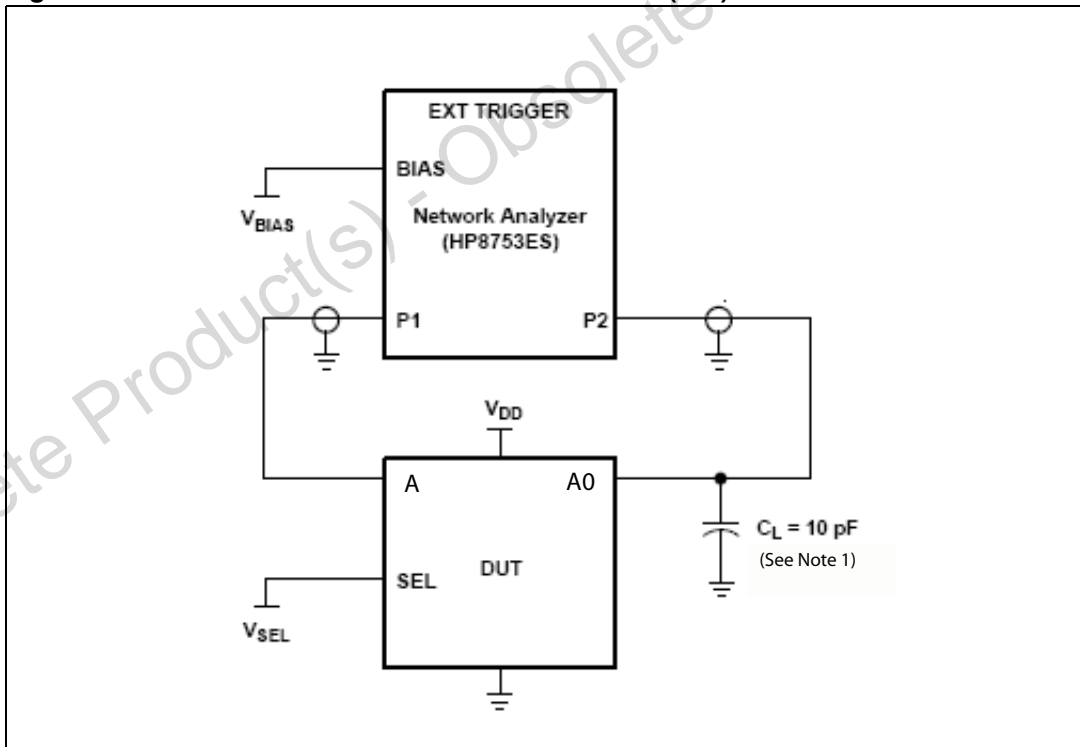


Figure 8. Test circuit for bandwidth measurement (BW)



1.  $C_L$  includes probe and jig capacitance.

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

HP8753ES setup:

Average = 4

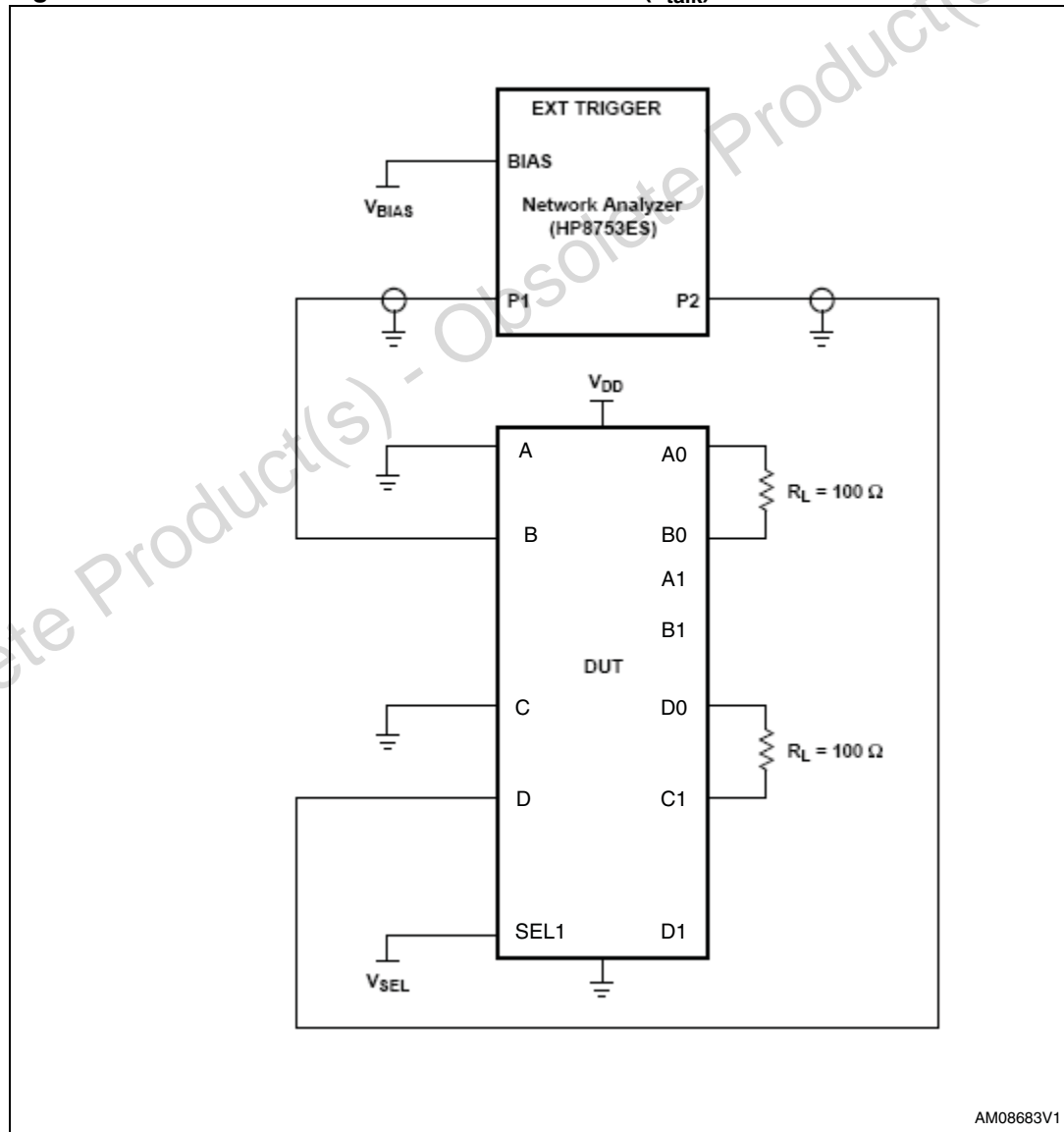
$R_{BW} = 3 \text{ kHz}$

$V_{BIAS} = 0.35 \text{ V}$

ST = 2 s

P1 = 0 dBm

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



1.  $C_L$  includes probe and jig capacitance.
2. A  $50 \Omega$  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  $V_{SEL1} = 0$ , 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

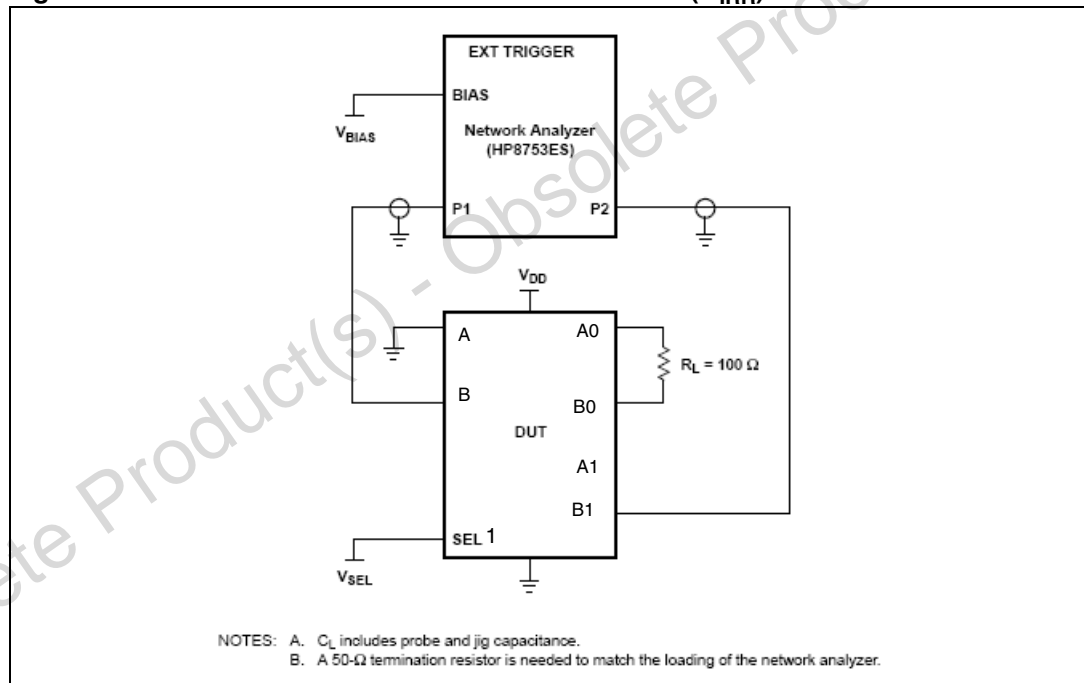
$R_{BW} = 3 \text{ kHz}$

$V_{BIAS} = 0.35 \text{ V}$

ST = 2 s

P1 = 0 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 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

$R_{BW} = 3 \text{ kHz}$

$V_{BIAS} = 0.35 \text{ V}$

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](http://www.st.com). ECOPACK® is an ST trademark.

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

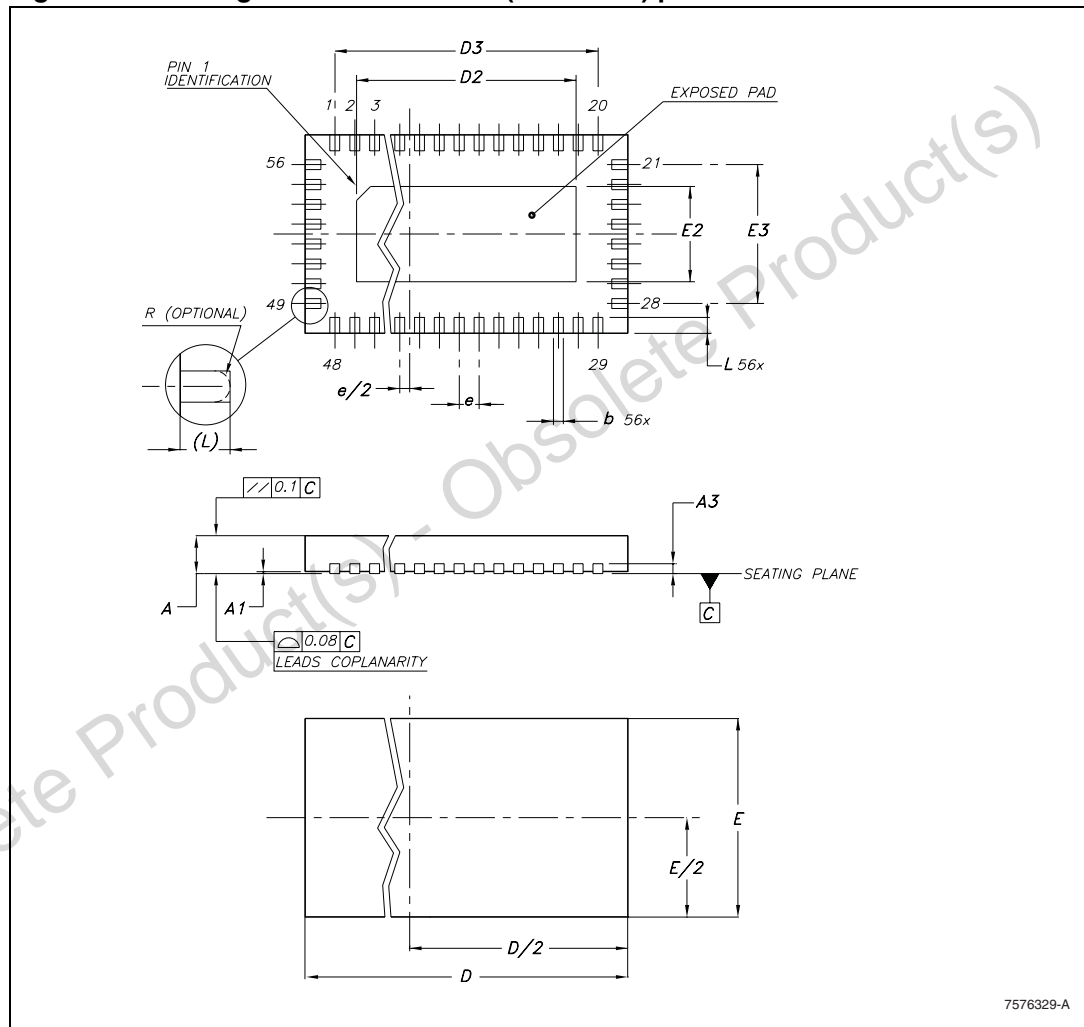


Table 13. Mechanical data for QFN56 (11 x 5 mm) pitch 0.5 mm

| 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 12. Footprint recommendation for QFN56 (11 x 5 mm) pitch 0.5 mm

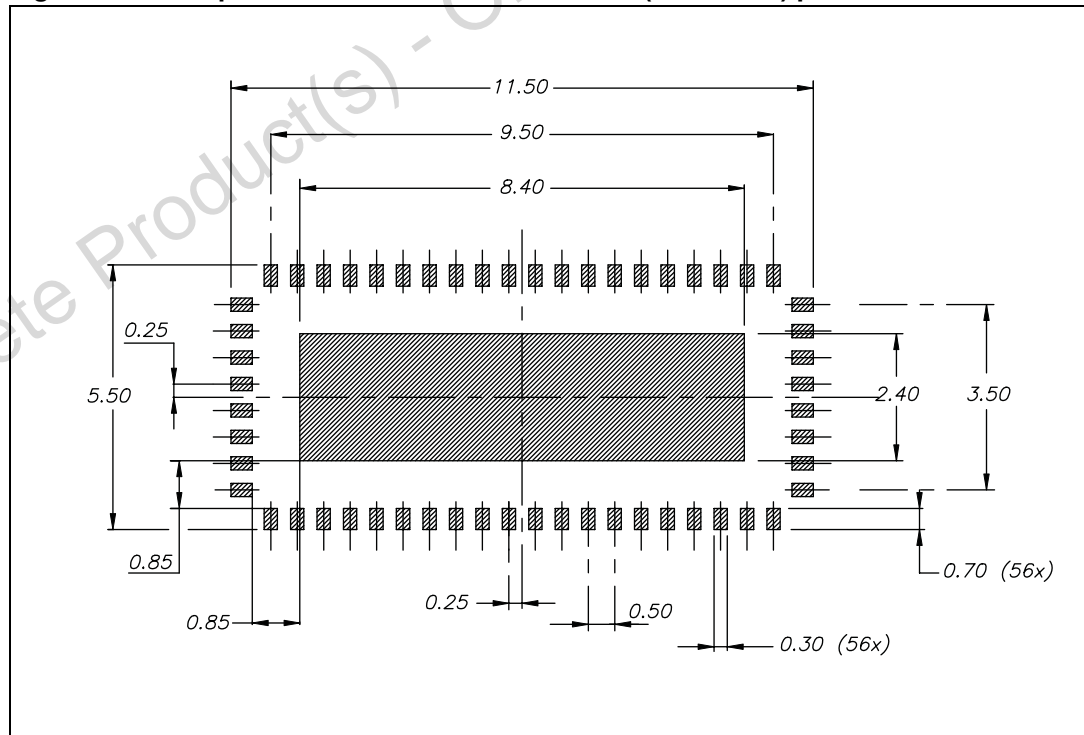


Figure 13. Carrier tape information for QFN56 (11 x 5 mm) pitch 0.5 mm

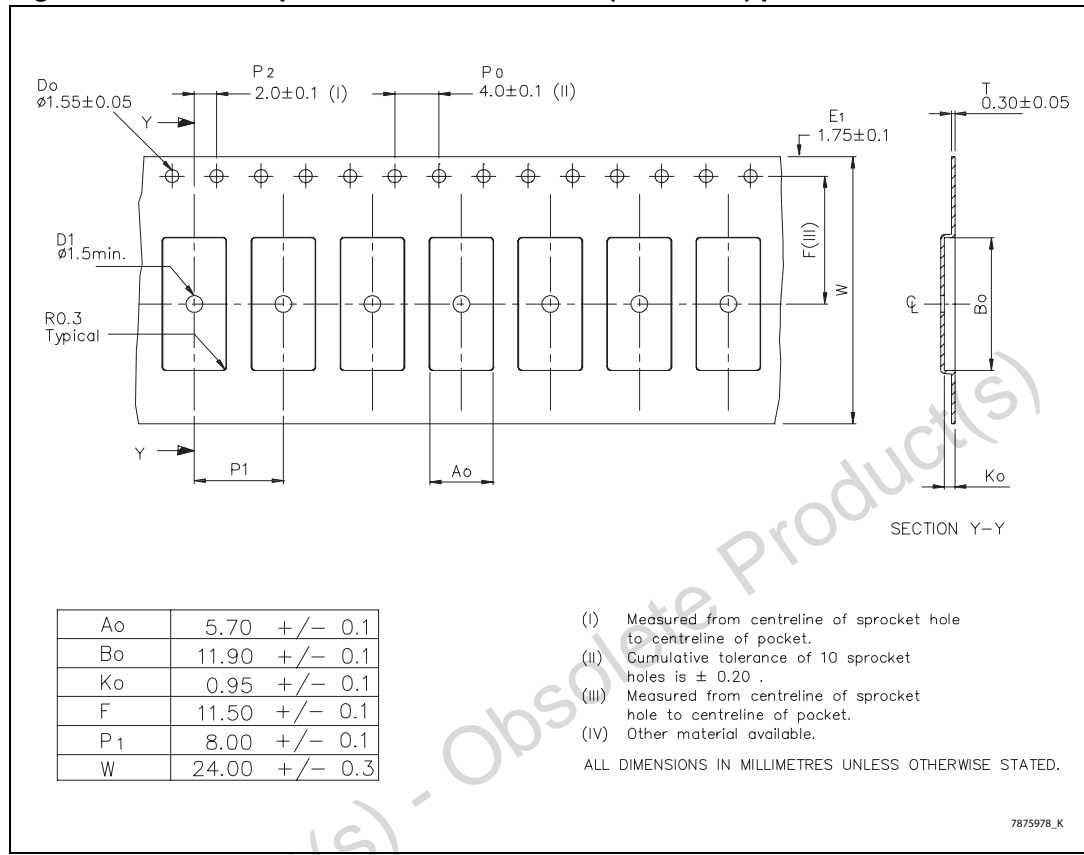
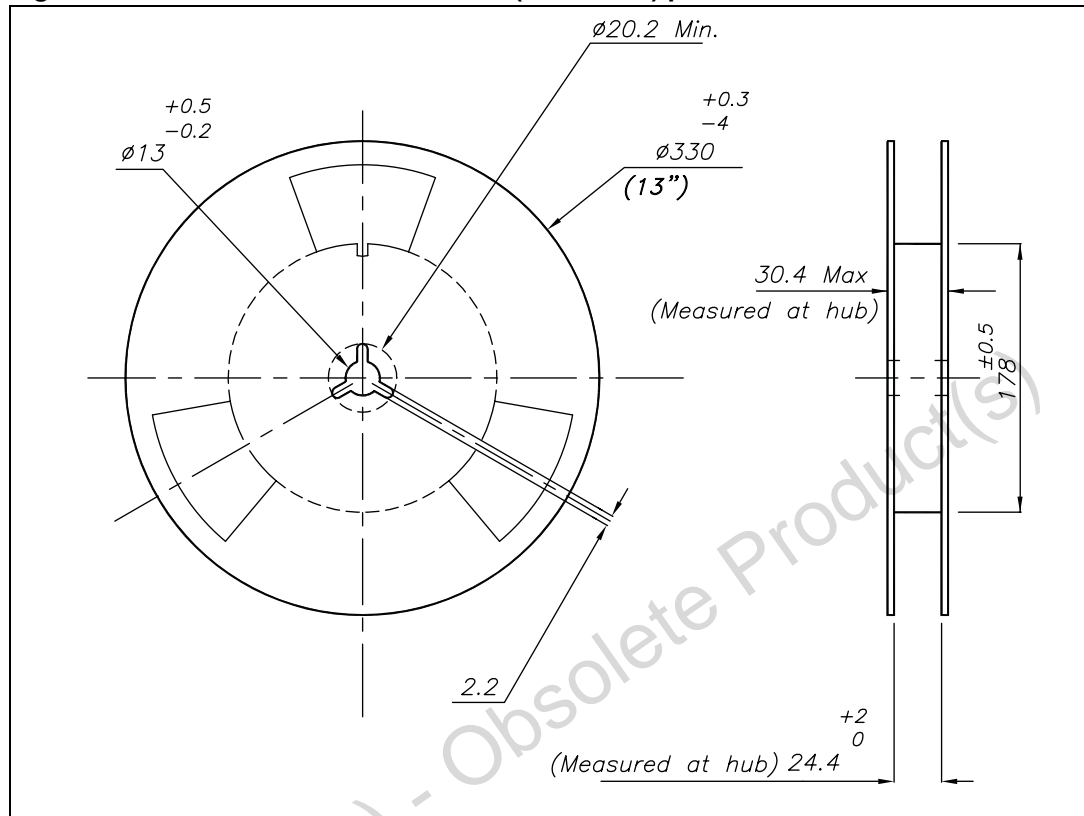




Figure 14. Reel information for QFN56 (11 x 5 mm) pitch 0.5 mm



## 5 Revision history

Table 14. Document revision history

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 08-Dec-2010 | 1        | Initial release. |

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