# NX3DV42

## Dual high-speed USB 2.0 double-pole double-throw analog switch

Rev. 3.1 — 20 October 2016 Product data sheet

## 1. General description

The NX3DV42 is a double-pole double-throw analog switch suitable for use as an analog or digital multiplexer/demultiplexer. Its wide bandwidth and low bit-to-bit skew allows the NX3DV42 to pass high-speed differential signals with good signal integrity. Its high channel to channel crosstalk rejection results in minimal noise interference. The bandwidth is wide enough to pass high-speed USB 2.0 differential signals (480 Mb/s). It consist of two switches, each with two independent input/outputs (HSDn+ and HSDn−) and a common input/output (D+ or D−). One digital input (S) is used to select the switch position. When pin $\overline{OE}$ is HIGH, the switches are turned off. Schmitt trigger action at the select input (S) and output enable input ($\overline{OE}$) makes the circuit tolerant to slower input rise and fall times across the entire $V_{CC}$ range from 3.0 V to 4.3 V.

## 2. Features and benefits

- Supply voltage range from 3.0 V to 4.3 V
- 4 Ω typical ON resistance
- 7.3 pF typical ON capacitance
- 950 MHz typical bandwidth or data frequency
- Low crosstalk of −30 dB at 240 MHz
- Break-before-make switching
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 4000 V
  - CDM AEC-Q100-011 revision B exceeds 1000 V
  - HBM exceeds 12000 V for power to GND protection
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Specified from −40 °C to +125 °C

## 3. Applications

- Cell phone, PDA, digital camera and notebook
- LCD monitor, TV and set-top box

## 4. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| NX3DV42GU | –40 °C to +125 °C | XQFN10 | plastic, extremely thin quad flat package; no leads; 10 terminals; body 1.40 x 1.80 x 0.50 mm | SOT1160-1 |
| NX3DV42GU10 | –40 °C to +125 °C | XQFN10 | plastic extremely thin small outline package; no leads; 10 terminals; body 1.3 x 1.6 x 0.5 mm | SOT1337-1 |
| NX3DV42GU33 | –40 °C to +125 °C | X2QFN10 | plastic extremely thin small outline package; no leads; 10 terminals; body 1.3 x 1.6 x 0.33 mm | SOT1430-1 |

## 5. Marking

**Table 2. Marking**

| Type number | Marking code |
|---|---|
| NX3DV42GU | x4 |
| NX3DV42GU10 | x4 |
| NX3DV42GU33 | x4 |

## 6. Functional diagram

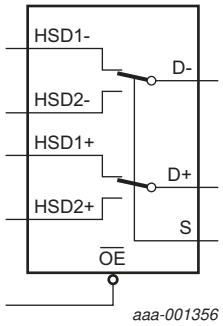



**Fig 1. Logic symbol**

# 7. Pinning information

## 7.1 Pinning

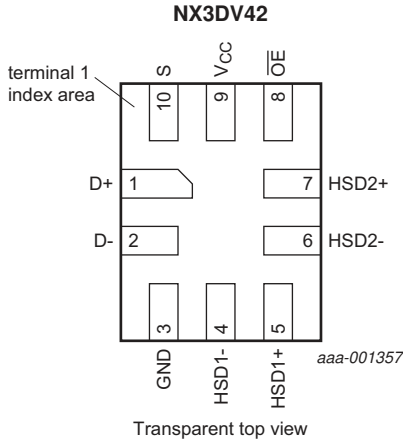



**Fig 2. Pin configuration SOT1160-1(XQFN10), SOT1337-1 (XQFN10) and SOT1430-1(X2QFN10)**

## 7.2 Pin description

**Table 3. Pin description**

| Symbol | SOT1160-1, SOT1337-1, SOT1430-1 | Description |
|---|---|---|
| HSD1−, HSD2− | 4, 6 | independent input or output |
| HSD1+, HSD2+ | 5, 7 | independent input or output |
| D+, D− | 1, 2 | common output or input |
| GND | 3 | ground (0 V) |
| $\overline{OE}$ | 8 | output enable input (active LOW) |
| S | 10 | select input |
| $V_{CC}$ | 9 | supply voltage |

# 8. Functional description

**Table 4. Function table[1]**

| Input | | Channel on |
|---|---|---|
| S | $\overline{OE}$ | |
| L | L | HSD1+ and HSD1− |
| H | L | HSD2+ and HSD2− |
| X | H | switch off |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

# 9. Limiting values

**Table 5. 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 | +5.5 | V |
| $V_I$ | input voltage | pins S and $\overline{OE}$ [1] | −0.5 | +5.5 | V |
| $V_{SW}$ | switch voltage | | −0.5 | +5.5 | V |
| $I_{IK}$ | input clamping current | $V_I$ < −0.5 V | −50 | - | mA |
| $I_{SK}$ | switch clamping current | $V_I$ < −0.5 V | −50 | - | mA |
| $I_{SW}$ | switch current | | - | ±100 | mA |
| $I_{CC}$ | supply current | | - | +50 | mA |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $P_{tot}$ | total power dissipation | $T_{amb}$ = −40 °C to +125 °C [2] | - | 250 | mW |

[1] The minimum input voltage rating may be exceeded if the input current rating is observed.

[2] For XQFN10 package: above 100 °C derate linearly with 4 mW/K.

# 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | 3.0 | 4.3 | V |
| $V_I$ | input voltage | pins S and $\overline{OE}$ | 0 | 4.5 | V |
| $V_{SW}$ | switch voltage | [1] | 0 | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | −40 | +125 | °C |

[1] To avoid sinking GND current from terminals D+ and D− when switch current flows in terminals HSDn+ and HSDn−, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminals D+ and D−, no GND current will flow from terminals HSDn+ and HSDn−. In this case, there is no limit for the voltage drop across the switch.

# 11. Static characteristics

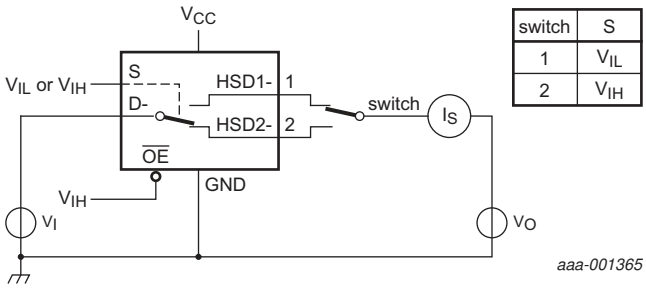
**Table 7. Static characteristics**

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

| Symbol | Parameter | Conditions | $T_{amb}$ = –40 °C to +85 °C | | | $T_{amb}$ = –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 3.0 V to 3.6 V | 1.3 | - | - | 1.3 | - | V |
| | | $V_{CC}$ = 4.3 V | 1.7 | - | - | 1.7 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 3.0 V to 3.6 V | - | - | 0.5 | - | 0.5 | V |
| | | $V_{CC}$ = 4.3 V | - | - | 0.7 | - | 0.7 | V |
| $V_{IK}$ | input clamping voltage | $V_{CC}$ = 3.0 V; $I_I$ = –18 mA | - | - | –1.2 | - | –1.2 | V |
| $I_I$ | input leakage current | pins S and $\overline{OE}$; $V_I$ = GND to 4.3 V; $V_{CC}$ = 4.3 V; see Figure 4 | - | - | ±1 | - | ±10 | µA |
| $I_{S(OFF)}$ | OFF-state leakage current | $V_{CC}$ = 4.3 V; see Figure 3 and Figure 6 | - | - | ±1 | - | ±2 | µA |
| $I_{OFF}$ | power-off leakage current | $V_I$ or $V_O$ = 0 V to 4.3 V; $V_{CC}$ = 0 V; see Figure 7 | - | - | ±1 | - | ±10 | µA |
| $I_{CC}$ | supply current | $V_I$ = $V_{CC}$ or GND; $V_{CC}$ = 4.3 V; $V_{SW}$ = GND or $V_{CC}$; see Figure 5 | - | - | 1 | - | 10 | µA |
| $\Delta I_{CC}$ | additional supply current | $V_I$ = 2.6 V; $V_{CC}$ = 4.3 V; $V_{SW}$ = GND or $V_{CC}$ | - | - | 10 | - | 10 | µA |
| | | $V_I$ = 1.8 V; $V_{CC}$ = 4.3 V; $V_{SW}$ = GND or $V_{CC}$ | - | - | 15 | - | 15 | µA |
| $C_I$ | input capacitance | pins S and OE | - | 1.0 | - | - | - | pF |
| $C_{S(OFF)}$ | OFF-state capacitance | pins HSDn+ and HSDn–; $V_{CC}$ = 3.3 V; $V_I$ = 0 V to 3.3 V | - | 2.8 | - | - | - | pF |
| $C_{S(ON)}$ | ON-state capacitance | pins D+ and D–; $V_{CC}$ = 3.3 V; $V_I$ = 0 V to 3.3 V | - | 7.3 | - | - | - | pF |

[1] Typical values are measured at $T_{amb}$ = 25 °C and $V_{CC}$ = 3.3 V.

## 11.1 Test circuit and graphs

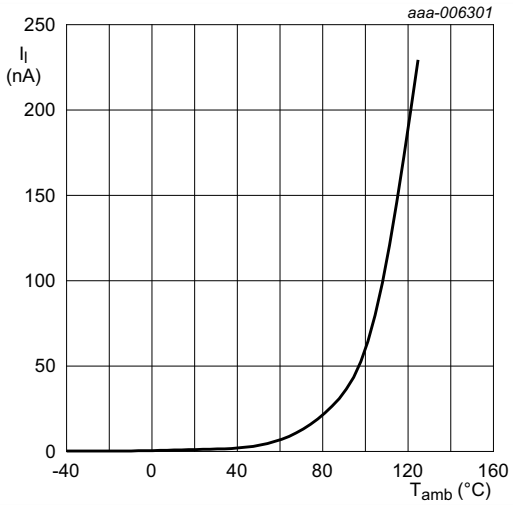



| switch | S |
|---|---|
| 1 | $V_{IL}$ |
| 2 | $V_{IH}$ |

$V_I = V_{CC}$ or GND and $V_O$ = GND or $V_{CC}$.

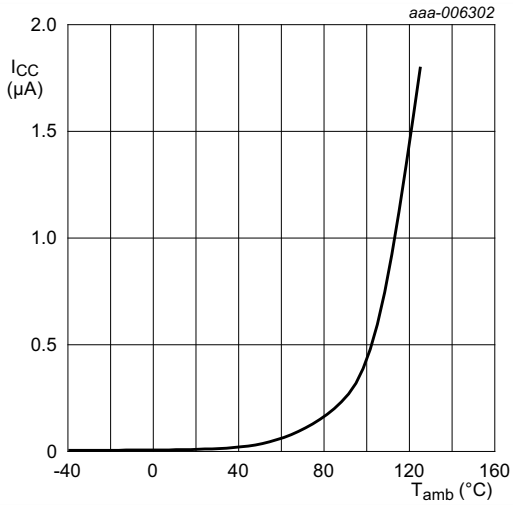
Test circuit also applies for D+, HSD1+ and HSD2+.

**Fig 3. Test circuit for measuring OFF-state leakage current**



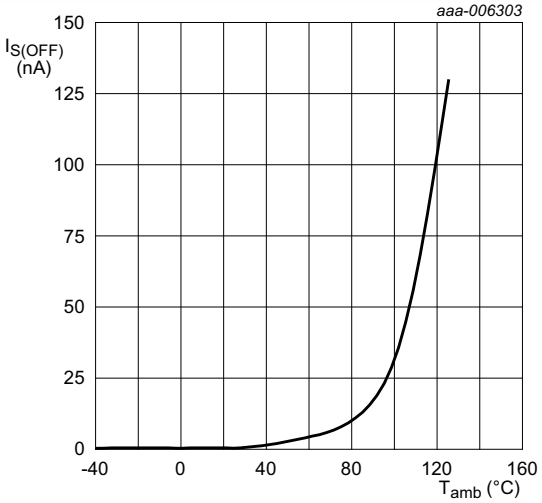

$V_{CC}$ = 4.3 V.

**Fig 4. Waveform showing the typical input leakage current versus temperature**



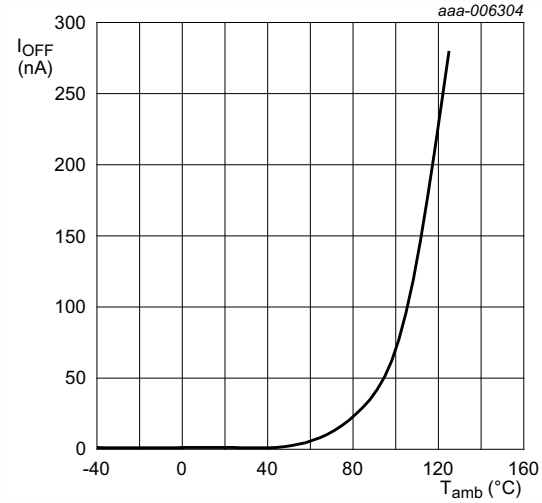

$V_{CC}$ = 4.3 V.

**Fig 5. Waveform showing the typical supply current versus temperature**




$V_{CC}$ = 4.3 V.

**Fig 6. Waveform showing the typical OFF-state leakage current versus temperature**




$V_{CC}$ = 4.3 V.

**Fig 7. Waveform showing the typical power-off leakage current versus temperature**

## 11.2 ON resistance

**Table 8. ON resistance**

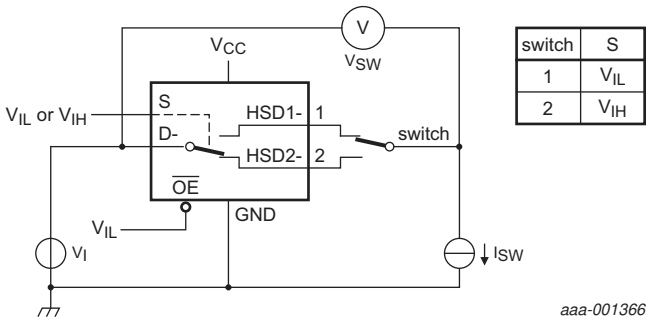
*At recommended operating conditions; voltages are referenced to GND (ground = 0 V).*

| Symbol | Parameter | Conditions | $T_{amb}$ = –40 °C to +85 °C | | | $T_{amb}$ = –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | |
| $R_{ON}$ | ON resistance | $V_I$ = 0.4 V; $I_{SW}$ = 8 mA; see Figure 8 | | | | | | |
| | | $V_{CC}$ = 3.0 V | - | 3.9 | 6.5 | - | 10 | Ω |
| $\Delta R_{ON}$ | ON resistance mismatch between channels | $V_I$ = 0.4 V; $I_{SW}$ = 8 mA [2] | | | | | | |
| | | $V_{CC}$ = 3.0 V | - | 0.65 | - | - | - | Ω |

[1] Typical values are measured at $T_{amb}$ = 25 °C.

[2] Measured at identical $V_{CC}$, temperature and input voltage.

## 11.3 ON resistance test circuit




| switch | S |
|---|---|
| 1 | $V_{IL}$ |
| 2 | $V_{IH}$ |

$R_{ON} = V_{SW} / I_{SW}$.

Test circuit also applies for D+, HSD1+ and HSD2+.

**Fig 8. Test circuit for measuring ON resistance**

## 12. Dynamic characteristics

**Table 9. Dynamic characteristics**

*At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 12.*

| Symbol | Parameter | Conditions | $T_{amb}$ = –40 °C to +85 °C | | | $T_{amb}$ = –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ[1] | Max | Min | Max | |
| $t_{pd}$ | propagation delay | HSDn+ to D+ or HSDn– to D– or D+ to HSDn+ or D– to HSDn–; see Figure 9 [2][3] | | | | | | |
| | | $V_{CC}$ = 3.3 V | - | 0.25 | - | - | - | ns |
| $t_{en}$ | enable time | S or $\overline{OE}$ to D+ or D–; see Figure 10 [4] | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | 11.2 | 30 | - | 40 | ns |
| $t_{dis}$ | disable time | S or $\overline{OE}$ to D+ or D–; see Figure 10 [5] | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | 3.9 | 25 | - | 30 | ns |
| $t_{b-m}$ | break-before-make time | see Figure 11 [3] | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | 2.0 | 5.9 | - | 2.0 | - | ns |
| $t_{sk(p)}$ | pulse skew time | see Figure 9 | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V [3] | - | 20 | - | - | - | ps |
| $t_{jit}$ | jitter time | $R_L$ = 50 Ω; $C_L$ = 5 pF; $t_r$, $t_f$ = 500 ps (10 % to 90 %) at 480 Mbs (PRBS = $2^{15} - 1$) [3] | - | 200 | - | - | - | ps |

[1] Typical values are measured at $T_{amb}$ = 25 °C, $C_L$ = 5 pF and $V_{CC}$ = 3.3 V.

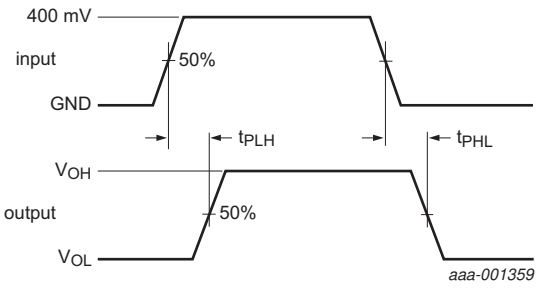
[2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.

[3] Guaranteed by design.

[4] $t_{en}$ is the same as $t_{PZH}$.

[5] $t_{dis}$ is the same as $t_{PHZ}$.

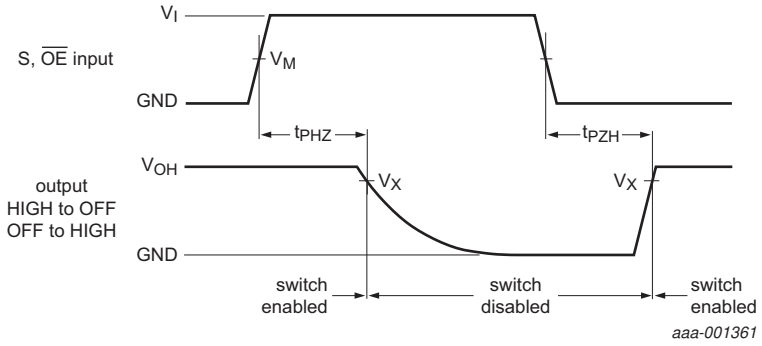
## 12.1 Waveforms and test circuits




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

$t_{sk(p)} = |t_{PHL} - t_{PLH}|$.

**Fig 9. The data input to output propagation delay times and pulse skew time**



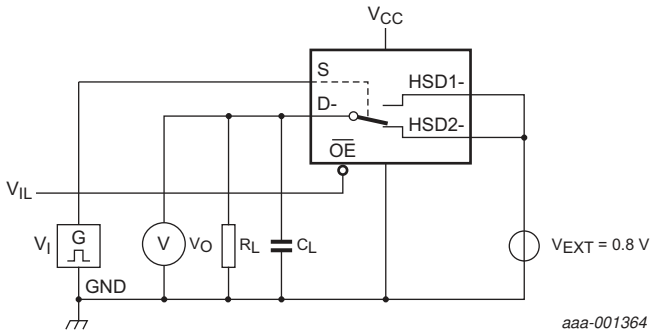

Measurement points are given in Table 10.

Logic level: $V_{OH}$ is the typical output voltage level that occurs with the output load.

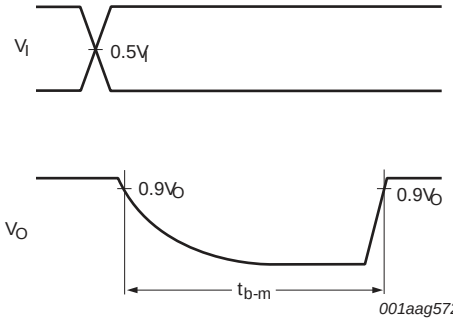
**Fig 10. Enable and disable times**

**Table 10. Measurement points**

| Supply voltage | Input | | Output |
|---|---|---|---|
| $V_{CC}$ | $V_M$ | $V_I$ | $V_X$ |
| 3.0 V to 3.6 V | $0.5V_{CC}$ | $V_{CC}$ | $0.9V_{OH}$ |



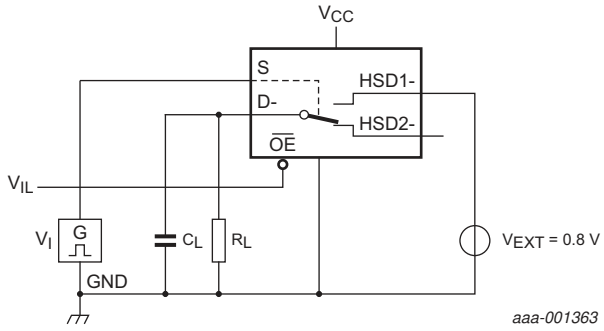

a. Test circuit.




b. Input and output measurement points.

Test circuit also applies for D+, HSD1+ and HSD2+.

**Fig 11. Test circuit for measuring break-before-make timing**




Test circuit also applies for D+, HSD1+ and HSD2+.

Test data is given in Table 11.

Definitions test circuit:

$R_L$ = Load resistance.

$C_L$ = Load capacitance including jig and probe capacitance.

$V_{EXT}$ = External voltage for measuring switching times.

$V_I$ may be connected to S or $\overline{OE}$.

**Fig 12. Test circuit for measuring switching times**

**Table 11. Test data**

| Supply voltage | Input | | Load | |
|---|---|---|---|---|
| $V_{CC}$ | $V_I$ | $t_r$, $t_f$ | $C_L$ | $R_L$ |
| 3.0 V to 3.6 V | $V_{CC}$ | ≤ 2.5 ns | 5 pF | 50 Ω |

## 12.2 Additional dynamic characteristics

**Table 12. Additional dynamic characteristics**

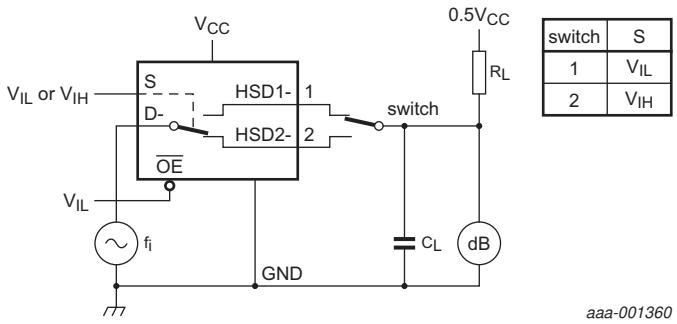
*At recommended operating conditions; voltages are referenced to GND (ground = 0 V); $V_I$ = GND or $V_{CC}$ (unless otherwise specified); $t_r = t_f$ < 2.5 ns.*

| Symbol | Parameter | Conditions | $T_{amb}$ = 25 °C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ[2] | Max | |
| $f_{(-3dB)}$ | −3 dB frequency response | $R_L$ = 50 Ω; see Figure 13 [1] | | | | |
| | | $C_L$ = 0 pF; $V_{CC}$ = 3.0 V to 3.6 V | - | 950 | - | MHz |
| | | $C_L$ = 5 pF; $V_{CC}$ = 3.0 V to 3.6 V | - | 450 | - | MHz |
| $\alpha_{iso}$ | isolation (OFF-state) | $f_i$ = 240 MHz; $R_L$ = 50 Ω; see Figure 14 [1] | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | −30 | - | dB |
| Xtalk | crosstalk | between switches; $f_i$ = 240 MHz; $R_L$ = 50 Ω; see Figure 15 [1] | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | - | −30 | - | dB |

[1] $f_i$ is biased at $0.5V_{CC}$.

[2] Typical values are measured at $T_{amb}$ = 25 °C and $V_{CC}$ = 3.3 V.

## 12.3 Test circuits

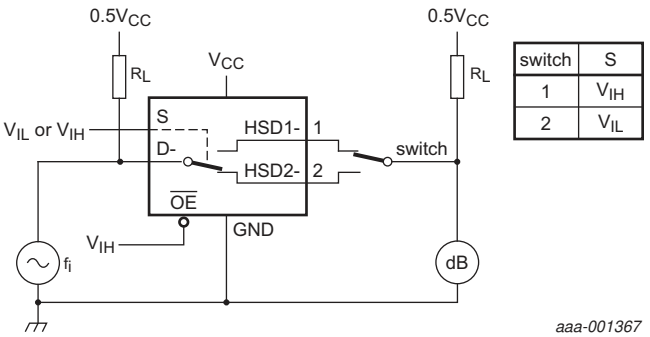



| switch | S |
|---|---|
| 1 | $V_{IL}$ |
| 2 | $V_{IH}$ |

Adjust $f_i$ voltage to obtain 0 dBm level at output. Increase $f_i$ frequency until dB meter reads −3 dB.

Test circuit also applies for D+, HSD1+ and HSD2+.

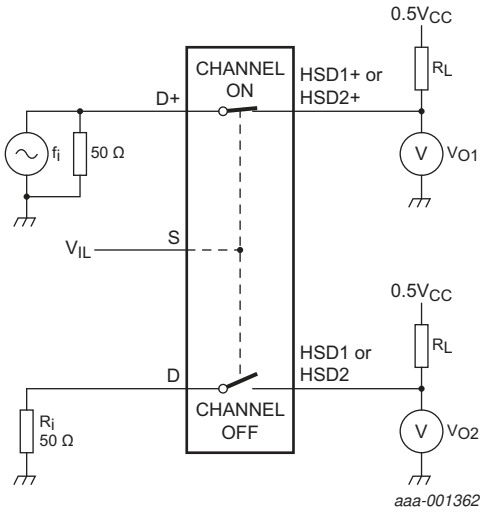
**Fig 13. Test circuit for measuring the frequency response when channel is in ON-state**




Adjust $f_i$ voltage to obtain 0 dBm level at input.

Test circuit also applies for D+, HSD1+ and HSD2+.

**Fig 14. Test circuit for measuring isolation (OFF-state)**

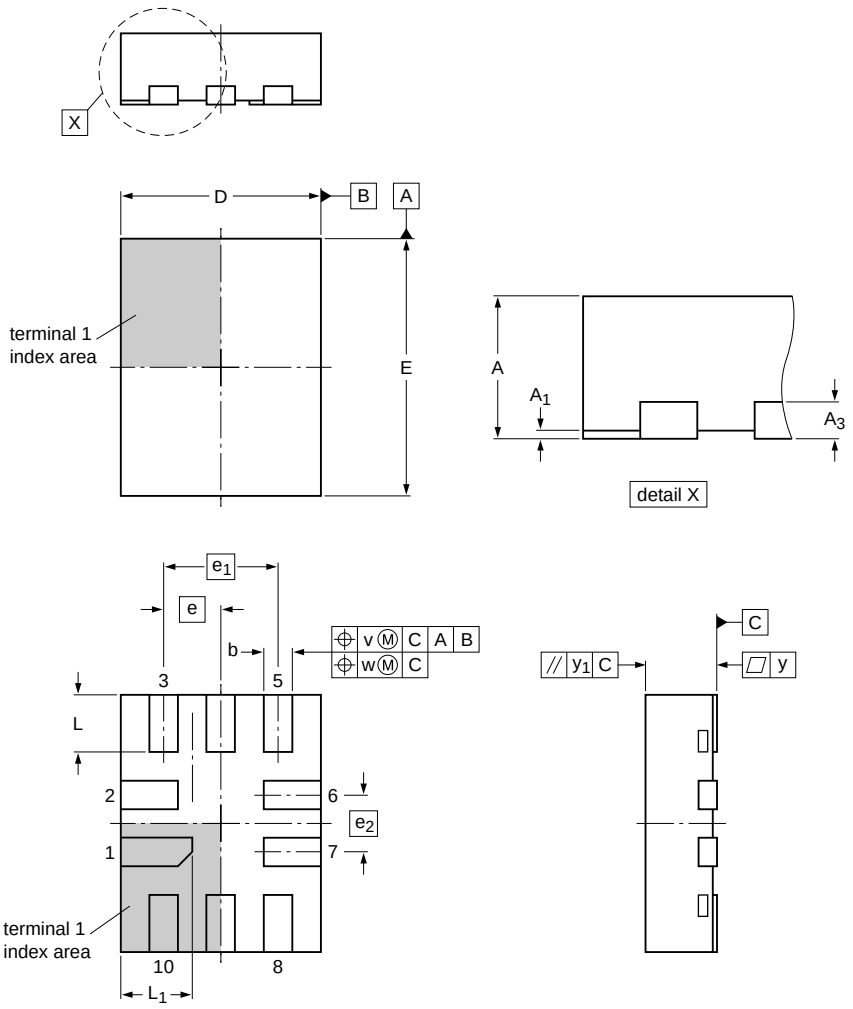



20 $\log_{10}$ ($V_{O2}/V_{O1}$) or 20 $\log_{10}$ ($V_{O1}/V_{O2}$).

**Fig 15. Test circuit for measuring crosstalk between switches**

## 13. Package outline

**XQFN10: plastic, extremely thin quad flat package; no leads; 10 terminals; body 1.40 x 1.80 x 0.50 mm** **SOT1160-1**




Dimensions

| Unit[1] | | A | $A_1$ | $A_3$ | b | D | E | e | $e_1$ | $e_2$ | L | $L_1$ | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.5 | 0.05 | | 0.25 | 1.5 | 1.9 | | | | 0.45 | 0.55 | | | | |
| mm | nom | | | 0.127 | 0.20 | 1.4 | 1.8 | 0.4 | 0.8 | 0.4 | 0.40 | 0.50 | 0.1 | 0.05 | 0.05 | 0.05 |
| | min | | 0.00 | | 0.15 | 1.3 | 1.7 | | | | 0.35 | 0.45 | | | | |

Note

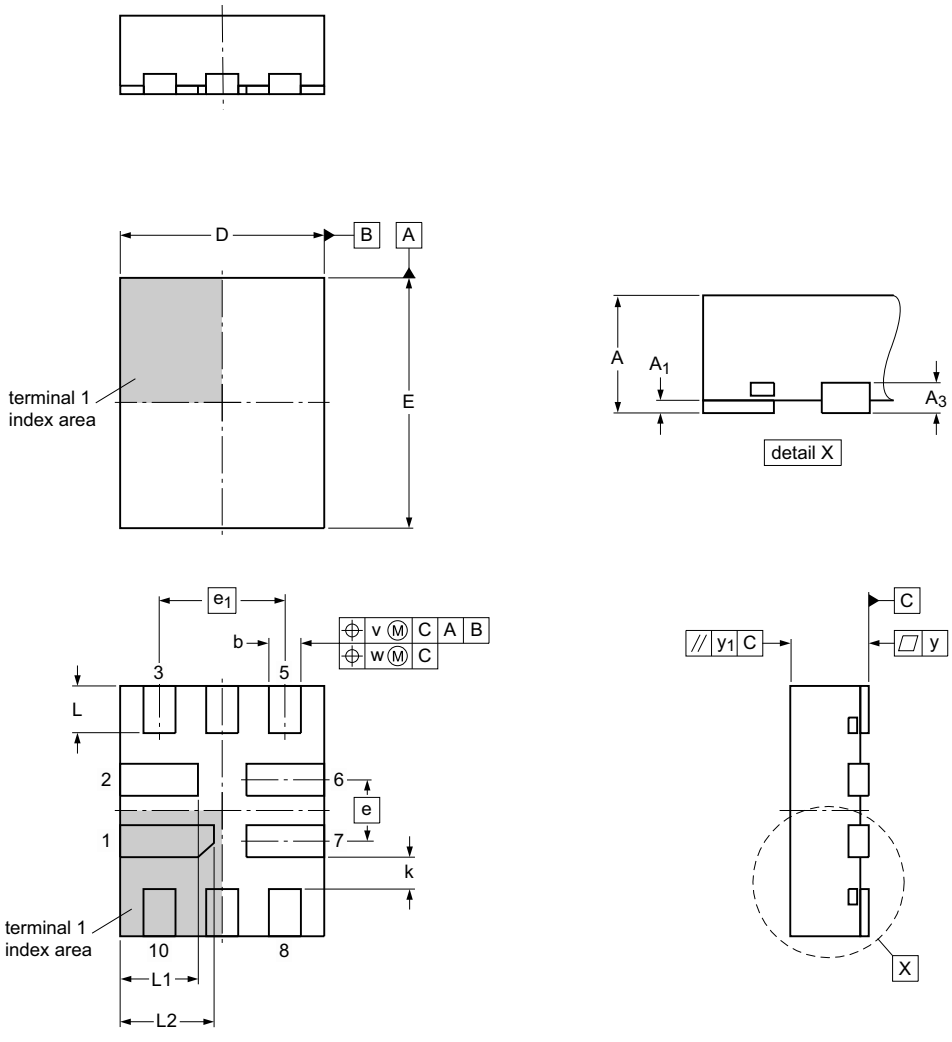
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1160-1_po*

| Outline version | References | | | European projection | Issue date |
|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | |
| SOT1160-1 | - - - | - - - | - - - | | ~~09-12-28~~ 09-12-29 |

**Fig 16. Package outline SOT1160-1 (XQFN10)**

**XQFN10: plastic extremely thin small outline package; no leads; 10 terminals; body 1.3 x 1.6 x 0.5 mm** **SOT1337-1**




Dimensions (mm are the original dimensions)

| Unit[1] | | A | $A_1$ | $A_3$ | b | D | E | e | $e_1$ | k | L | $L_1$ | $L_2$ | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.5 | 0.05 | 0.127 | 0.25 | 1.35 | 1.65 | | | | 0.35 | 0.55 | 0.65 | | | | |
| mm | nom | | | | 0.20 | 1.30 | 1.60 | 0.4 | 0.8 | | 0.30 | 0.50 | 0.60 | 0.1 | 0.05 | 0.05 | 0.05 |
| | min | | 0.00 | 0.050 | 0.15 | 1.25 | 1.55 | | | 0.2 | 0.25 | 0.45 | 0.55 | | | | |

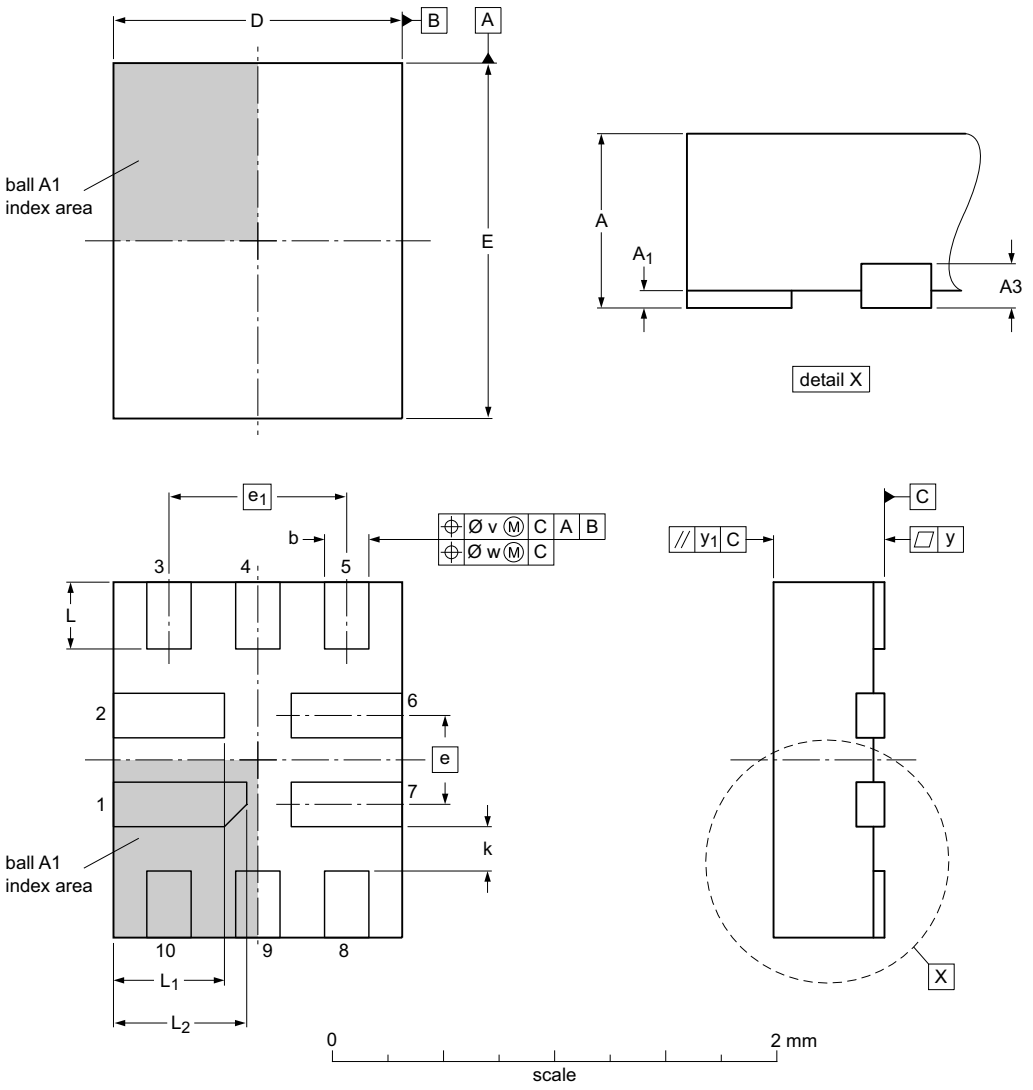
Note
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1337-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1337-1 | - - - | MO-288 | - - - | | | ~~12-08-28~~ 12-09-11 |

**Fig 17. Package outline SOT1337-1 (XQFN10)**

**X2QFN10: plastic extremely thin small outline package; no leads; 10 terminals; body 1.6 x 1.3 x 0.33 mm** **SOT1430-1**




Dimensions (mm are the original dimensions)

| Unit[1] | | A | $A_1$ | A3 | b | D | E | e | $e_1$ | k | L | L1 | L2 | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 0.33 | 0.05 | | 0.25 | 1.35 | 1.65 | | | | 0.35 | 0.55 | 0.65 | | | | |
| mm | nom | | | 0.100 | 0.20 | 1.30 | 1.60 | 0.4 | 0.8 | | 0.30 | 0.50 | 0.60 | 0.10 | 0.05 | 0.05 | 0.05 |
| | min | | 0.00 | | 0.15 | 1.25 | 1.55 | | | 0.15 | 0.25 | 0.45 | 0.55 | | | | |

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1430-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1430-1 | | MO-288 | | | | ~~14-12-16~~ 15-02-10 |

**Fig 18. Package outline X2QFN10**

## 14. Abbreviations

**Table 13. Abbreviations**

| Acronym | Description |
|---|---|
| CDM | Charged Device Model |
| CMOS | Complementary Metal-Oxide Semiconductor |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| LCD | Liquid Crystal Display |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

## 15. Revision history

**Table 14. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| NX3DV42 v.3.1 | 20161020 | Product data sheet | - | NX3DV42 v.3 |
| Modifications: | • Added NX3DV42GU33<br>• Removed NX3DV42GM | | | |
| NX3DV42 v.3 | 20130213 | Product data sheet | - | NX3DV42 v.2 |
| Modifications: | • Values added for $T_{amb}$ = +125 °C throughout the data sheet.<br>• Type number NX3DV42GU10 added (Table 1).<br>• Marking code for type number NX3DV42GU10 added (Table 2).<br>• Package outline drawing SOT1337-1 added (Figure 17). | | | |
| NX3DV42 v.2 | 20120618 | Product data sheet | - | NX3DV42 v.1 |
| Modifications: | • Package outline drawing SOT1049-2 changed to SOT1049-3 (Figure 17). | | | |
| NX3DV42 v.1 | 20120103 | Product data sheet | - | - |

# 16. Legal information

## 16.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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