

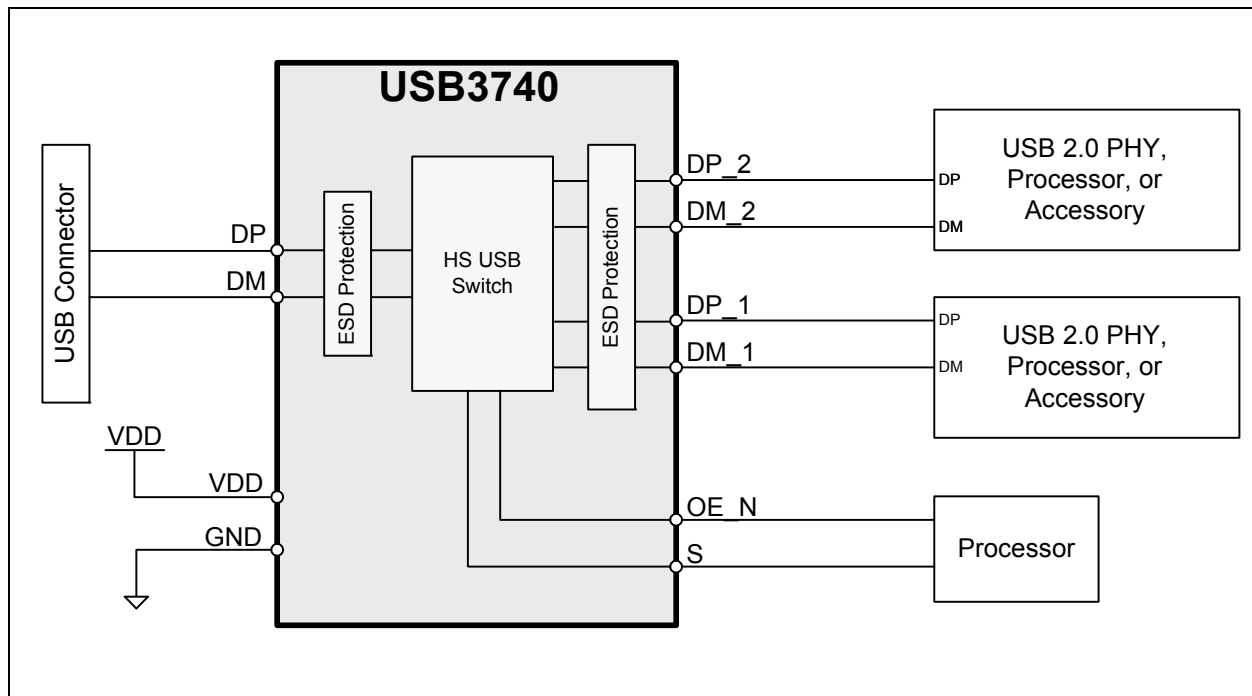
## High Speed Switch for Mobile and Portable Applications

### PRODUCT FEATURES

Datasheet

- High Speed USB Mux for multiplexing the USB lanes between different functions
  - Switch the USB connector between two different functions
  - Up to 1GHz Bandwidth
- USB Port ESD Protection (**DP/DM**)
  - ±15kV (air discharge)
  - ±15kV (contact discharge)
  - IEC 61000-4-2 level 4 ESD protection without external devices
- flexPWR™ Technology
  - 30nA Active/Standby Current
  - Extremely low power design ideal for battery powered applications
- Control inputs accommodate 1.8V to 5V inputs
- DP/DM tolerate up to 5.5V
- Industrial Operating Temperature -40°C to +85°C
- 10 pin, QFN lead-free RoHS compliant package; (1.3mm x 1.8mm x 0.55mm height, 0.4mm pitch)
- 10 pin, QFN lead-free RoHS compliant package; (1.6mm x 2.1mm x 0.55mm height, 0.5mm pitch)

### USB3740 Block Diagram



**Ordering Information:**

- USB3740B-AI2-TR for 10-pin, 1.3mm x 1.8mm QFN lead-free RoHS compliant package
- USB3740B-AI9TR for 10-pin, 1.6mm x 2.1mm QFN lead-free RoHS compliant package

**This product meets the halogen maximum concentration values per IEC61249-2-21**

**For RoHS compliance and environmental information, please visit [www.smSC.com/rohs](http://www.smSC.com/rohs)**

*Please contact your SMSC sales representative for additional documentation related to this product such as application notes, anomaly sheets, and design guidelines.*



Copyright © 2012 SMSC or its subsidiaries. All rights reserved.

Circuit diagrams and other information relating to SMSC products are included as a means of illustrating typical applications. Consequently, complete information sufficient for construction purposes is not necessarily given. Although the information has been checked and is believed to be accurate, no responsibility is assumed for inaccuracies. SMSC reserves the right to make changes to specifications and product descriptions at any time without notice. Contact your local SMSC sales office to obtain the latest specifications before placing your product order. The provision of this information does not convey to the purchaser of the described semiconductor devices any licenses under any patent rights or other intellectual property rights of SMSC or others. All sales are expressly conditional on your agreement to the terms and conditions of the most recently dated version of SMSC's standard Terms of Sale Agreement dated before the date of your order (the "Terms of Sale Agreement"). The product may contain design defects or errors known as anomalies which may cause the product's functions to deviate from published specifications. Anomaly sheets are available upon request. SMSC products are not designed, intended, authorized or warranted for use in any life support or other application where product failure could cause or contribute to personal injury or severe property damage. Any and all such uses without prior written approval of an Officer of SMSC and further testing and/or modification will be fully at the risk of the customer. Copies of this document or other SMSC literature, as well as the Terms of Sale Agreement, may be obtained by visiting SMSC's website at <http://www.smSC.com>. SMSC is a registered trademark of Standard Microsystems Corporation ("SMSC"). Product names and company names are the trademarks of their respective holders.

**SMSC DISCLAIMS AND EXCLUDES ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND AGAINST INFRINGEMENT AND THE LIKE, AND ANY AND ALL WARRANTIES ARISING FROM ANY COURSE OF DEALING OR USAGE OF TRADE. IN NO EVENT SHALL SMSC BE LIABLE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES; OR FOR LOST DATA, PROFITS, SAVINGS OR REVENUES OF ANY KIND; REGARDLESS OF THE FORM OF ACTION, WHETHER BASED ON CONTRACT; TORT; NEGLIGENCE OF SMSC OR OTHERS; STRICT LIABILITY; BREACH OF WARRANTY; OR OTHERWISE; WHETHER OR NOT ANY REMEDY OF BUYER IS HELD TO HAVE FAILED OF ITS ESSENTIAL PURPOSE, AND WHETHER OR NOT SMSC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**



## 0.1 Reference Documents

Universal Serial Bus Specification, Revision 2.0

## Table of Contents

|   |           |
|---|-----------|
| 0.1 Reference Documents .....                     | 3         |
| <b>Chapter 1 General Description .....</b>        | <b>7</b>  |
| <b>Chapter 2 Pin Layout .....</b>                 | <b>8</b>  |
| 2.1 Pin Diagram .....                             | 8         |
| 2.2 Ball/Pin Definitions .....                    | 8         |
| <b>Chapter 3 Electrical Specifications .....</b>  | <b>9</b>  |
| 3.1 Absolute Maximum Ratings .....                | 9         |
| 3.2 Electrical Specifications .....               | 9         |
| <b>Chapter 4 General Operation .....</b>          | <b>11</b> |
| <b>Chapter 5 Application Notes .....</b>          | <b>12</b> |
| 5.1 ESD Performance .....                         | 12        |
| 5.1.1 Human Body Model (HBM) Performance .....    | 12        |
| 5.1.2 EN/IEC 61000-4-2 Performance .....          | 12        |
| 5.1.2.1 Air Discharge .....                       | 12        |
| 5.1.2.2 Contact Discharge .....                   | 12        |
| <b>Chapter 6 Package Outlines .....</b>           | <b>13</b> |
| <b>Chapter 7 Datasheet Revision History .....</b> | <b>15</b> |

## List of Figures

|            |   |    |
|------------|---|----|
| Figure 1.1 | USB3740 USB 2.0 High Speed Eye Diagram    | 7  |
| Figure 2.1 | USB3740 Package Diagram                   | 8  |
| Figure 6.1 | 10 pin, 1.3mm x 1.8mm QFN Package Outline | 13 |
| Figure 6.2 | 10 pin, 1.6mm x 2.1mm QFN Package Outline | 14 |

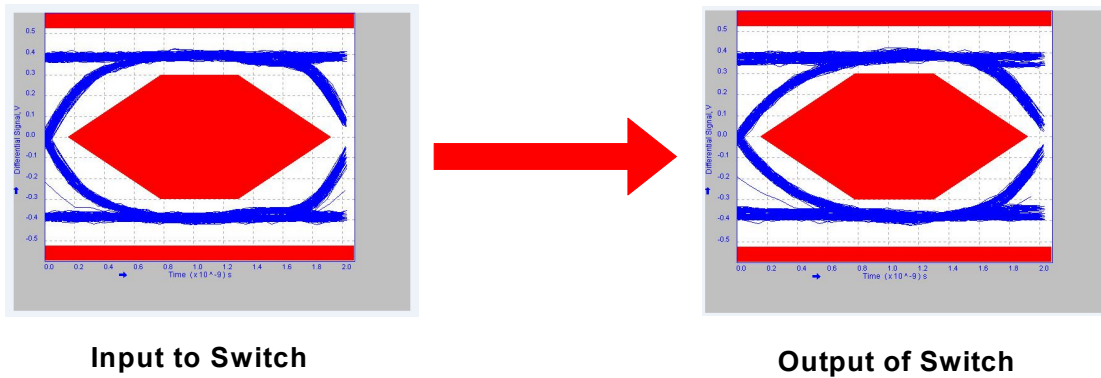
## List of Tables

|           |   |    |
|-----------|---|----|
| Table 3.1 | Absolute Maximum Ratings . . . . .        | 9  |
| Table 3.2 | Electrical Specifications . . . . .       | 9  |
| Table 4.1 | USB3740 Switch States Definition. . . . . | 11 |
| Table 7.1 | Customer Revision History . . . . .       | 15 |

## Chapter 1 General Description

The USB3740 is a USB 2.0 compliant High Speed switch that provides robust ESD protection to the interface in an extremely small package. Outstanding ESD robustness eliminates the need for external ESD protection devices to save eBOM cost and PCB area.

The high bandwidth capabilities of the USB3740 enable extremely low high frequency loss and an exceptionally clean USB 2.0 High Speed eye diagram.



**Figure 1.1 USB3740 USB 2.0 High Speed Eye Diagram**

## Chapter 2 Pin Layout

### 2.1 Pin Diagram

The USB3740 is available in both a 0.4mm pitch QFN (1.3 mm x 1.8 mm) and 0.5mm pitch QFN (1.55 mm x 2.05 mm) package.

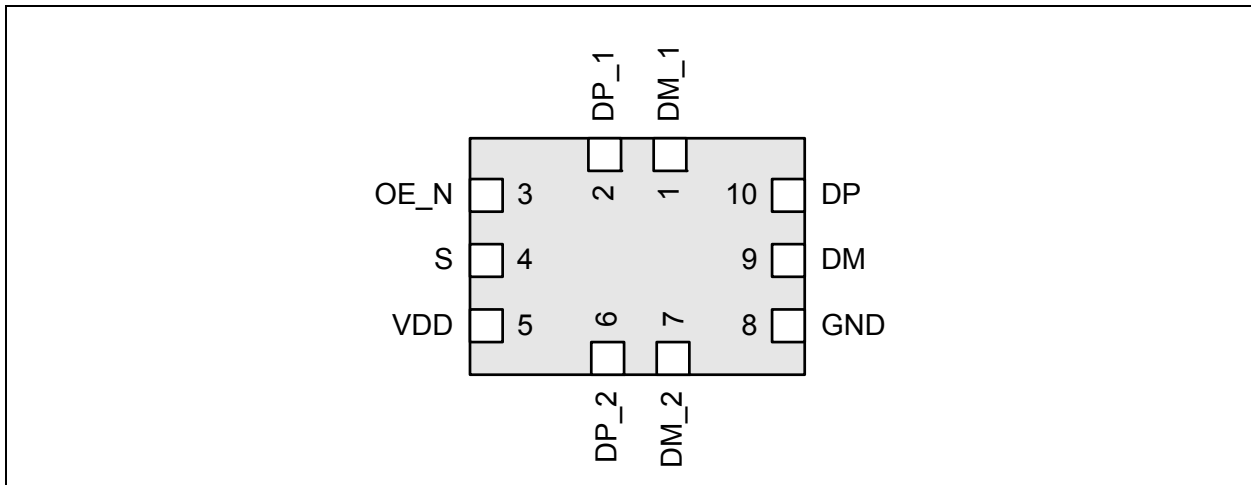


Figure 2.1 USB3740 Package Diagram

### 2.2 Ball/Pin Definitions

The following table details the ball/pin definitions for the package diagram above.

| PIN | NAME | TYPE/<br>DIRECTION | DESCRIPTION   |
|-----|------|--------------------|---|
| 10  | DP   | Analog             | USB Mux Output  |
| 9   | DM   | Analog             |   |
| 2   | DP_1 | Analog             | USB Mux Input 1   |
| 1   | DM_1 | Analog             |   |
| 6   | DP_2 | Analog             | USB Mux Input 2   |
| 7   | DM_2 | Analog             |   |
| 8   | GND  | Analog             | Ground  |
| 5   | VDD  | Analog             | Power   |
| 4   | S    | Digital Input      | Switch control. Refer to <a href="#">Table 4.1</a> .                  |
| 3   | OE_N | Digital Input      | Active low switch Output Enable. Refer to <a href="#">Table 4.1</a> . |



## Chapter 3 Electrical Specifications

### 3.1 Absolute Maximum Ratings

Table 3.1 Absolute Maximum Ratings

| DESCRIPTION                 |                     | RATING                           | UNIT |
|-----------------------------|---------------------|----------------------------------|------|
| VDD Voltage to GND          |                     | -0.3 to 6.0                      | V    |
| Any other pin to GND        |                     | -0.3 to VDD+0.5                  | V    |
| Operating Temperature Range |                     | -40 to +85                       | C    |
| Storage Temperature Range   |                     | -55 to +150                      | C    |
| ESD Rating                  | HBM (JESD 22)       | 8,000                            | V    |
|                             | HBM (Pin to Ground) | 8,000                            | V    |
|                             | IEC-61000-4-2       | 15,000 (Air)<br>15,000 (Contact) | V    |

Stresses beyond the Absolute Maximum Ratings may damage the USB3740.

### 3.2 Electrical Specifications

Table 3.2 Electrical Specifications

| CHARACTERISTIC   | SYMBOL               | MIN | TYP | MAX | UNITS | CONDITIONS                          |
|--|----------------------|-----|-----|-----|-------|-------------------------------------|
| V <sub>DD</sub> = 5.0V, T <sub>A</sub> = -40C to 85C, all typical values at T <sub>A</sub> = 25C unless otherwise noted. |                      |     |     |     |       |                                     |
| VDD Recommended Operating Conditions   |                      |     |     |     |       |                                     |
| Input Voltage  | V <sub>DD</sub>      | 3.0 |     | 5.5 | V     |                                     |
| Active/Standby   | I <sub>DD</sub>      |     | 30  | 175 | nA    |                                     |
| USB Mux Characteristics  |                      |     |     |     |       |                                     |
| USB Mux On Resistance  | R <sub>ON_USB</sub>  | 1   | 2   | 5   | ohm   | 0V < Vin < 3.3V                     |
|  |                      | 1   | 2   | 2.5 |       | 0V < Vin < 0.4V                     |
| USB Mux Off Leakage  | I <sub>OFF_USB</sub> |     | 100 | 200 | nA    | 0V < Vin < 3.3V                     |
| On Capacitance   | C <sub>ON_USB</sub>  |     | 5   | 7   | pF    | V <sub>DD</sub> = 3V                |
| Off Capacitance  | C <sub>OFF_USB</sub> |     | 3   | 4   | pF    | V <sub>DD</sub> = 3V                |
| Off Isolation  |                      | -30 | -32 | -40 | dB    | R <sub>L</sub> = 50 ohm, F = 250MHz |
| Crosstalk  |                      | -30 | -45 | -60 | dB    | R <sub>L</sub> = 50 ohm, F = 250MHz |

**Table 3.2 Electrical Specifications (continued)**

| CHARACTERISTIC                 | SYMBOL      | MIN | TYP  | MAX  | UNITS | CONDITIONS                                |
|--------------------------------|-------------|-----|------|------|-------|---|
| Bandwidth (-3dB)               | BW          | 950 | 1000 | 1100 | MHz   | $R_L = 50 \text{ ohm}, C_L = 0\text{pF}$  |
|                                |             | 850 | 950  | 980  |       | $R_L = 50 \text{ ohm}, C_L = 5\text{pF}$  |
|                                |             | 530 | 560  | 600  |       | $R_L = 50 \text{ ohm}, C_L = 10\text{pF}$ |
| Control Signal Characteristics |             |     |      |      |       |   |
| Input Logic High Threshold     | $V_{IN\_H}$ | 1.4 |      |      | V     |   |
| Input Logic Low Threshold      | $V_{IN\_L}$ |     |      | 0.4  | V     |   |

## Chapter 4 General Operation

The USB3740 is a high bandwidth switch suitable for many applications, including High Speed USB. The mux allows high speed signals to pass through and still meet HS USB signaling requirements.

The USB3740 will protect the system from ESD stress events on all **DP** and **DM** pins. The USB3740 provides ESD protection to the IEC-61000 ESD specification.

The USB mux is designed to pass High Speed USB signals to the USB connector, and allows for two USB inputs to be multiplexed into one USB output.

The USB Mux is designed to pass USB signals from 0 to **VDD**. It is not designed to pass signals that go above **VDD** or below ground.

The USB3740 switches are controlled by the digital signals OE\_N and S, as shown in [Table 4.1](#).

**Table 4.1 USB3740 Switch States Definition**

| OE_N | S | SWITCH STATE  |
|------|---|---|
| 1    | X | STANDBY:<br><ul style="list-style-type: none"> <li>■ Both switch paths disconnected.</li> <li>■ Lowest power state</li> </ul> |
| 0    | 0 | DP = DP1, DM = DM1:   |
| 0    | 1 | DP = DP2, DM = DM2:   |

## Chapter 5 Application Notes

### 5.1 ESD Performance

The USB3740 is protected from ESD strikes. By eliminating the requirement for external ESD protection devices, board space is conserved, and the board manufacturer is enabled to reduce cost. The advanced ESD structures integrated into the USB3740 protect the device whether or not it is powered up.

#### 5.1.1 Human Body Model (HBM) Performance

HBM testing verifies the ability to withstand the ESD strikes like those that occur during handling and manufacturing, and is done without power applied to the IC. To pass the test, the device must have no change in operation or performance due to the event. The USB3740 HBM performance is detailed in [Table 3.1](#).

#### 5.1.2 EN/IEC 61000-4-2 Performance

The EN/IEC 61000-4-2 ESD specification is an international standard that addresses system-level immunity to ESD strikes while the end equipment is operational. In contrast, the HBM ESD tests are performed at the device level with the device powered down.

SMSC contracts with Independent laboratories to test the USB3740 to EN/IEC 61000-4-2 in a working system. Reports are available upon request. Please contact your SMSC representative, and request information on 3rd party ESD test results. The reports show that systems designed with the USB3740 can safely provide the ESD performance shown in [Table 3.1](#) without additional board level protection.

In addition to defining the ESD tests, EN/IEC 61000-4-2 also categorizes the impact to equipment operation when the strike occurs (ESD Result Classification). The USB3740 maintains an ESD Result Classification 1 or 2 when subjected to an EN/IEC 61000-4-2 (level 4) ESD strike.

Both air discharge and contact discharge test techniques for applying stress conditions are defined by the EN/IEC 61000-4-2 ESD document.

##### 5.1.2.1 Air Discharge

To perform this test, a charged electrode is moved close to the system being tested until a spark is generated. This test is difficult to reproduce because the discharge is influenced by such factors as humidity, the speed of approach of the electrode, and construction of the test equipment.

##### 5.1.2.2 Contact Discharge

The uncharged electrode first contacts the USB connector to prepare this test, and then the probe tip is energized. This yields more repeatable results, and is the preferred test method. The independent test laboratories contracted by SMSC provide test results for both types of discharge methods.

## Chapter 6 Package Outlines

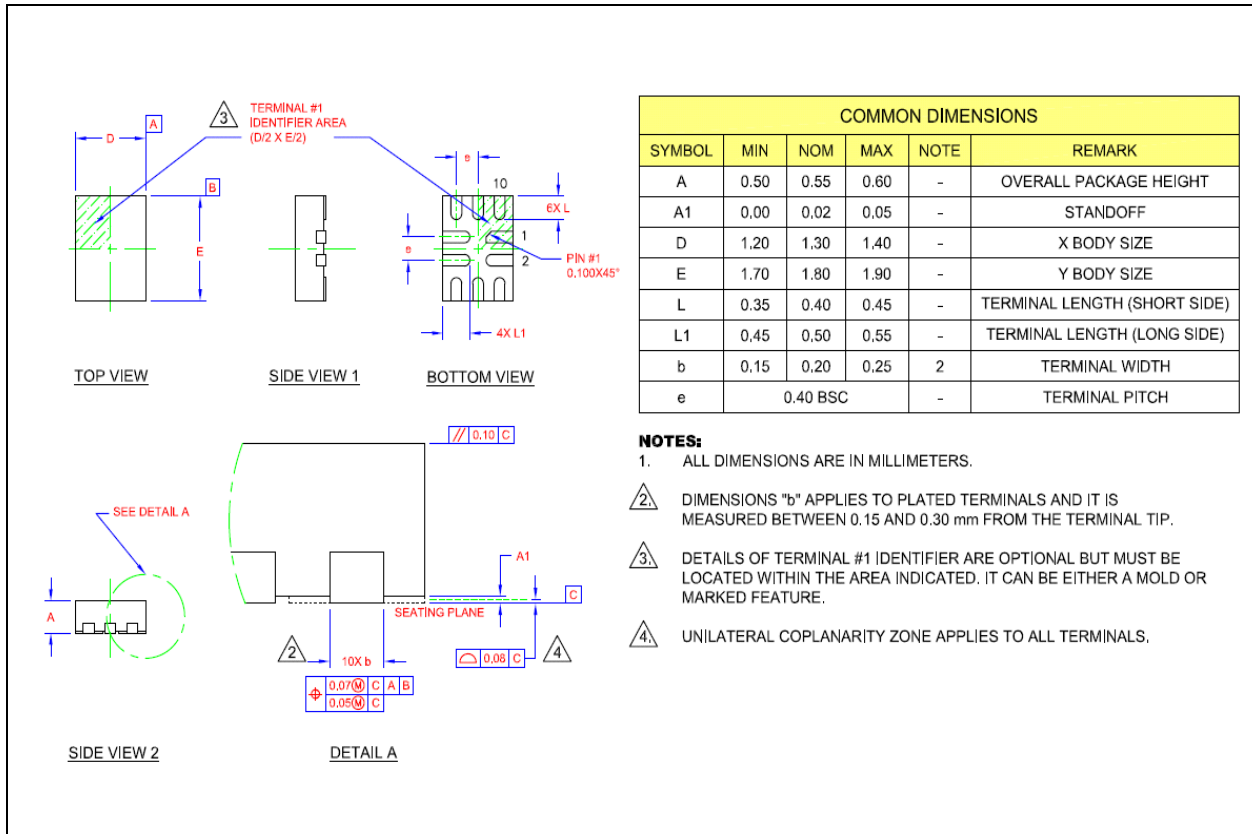
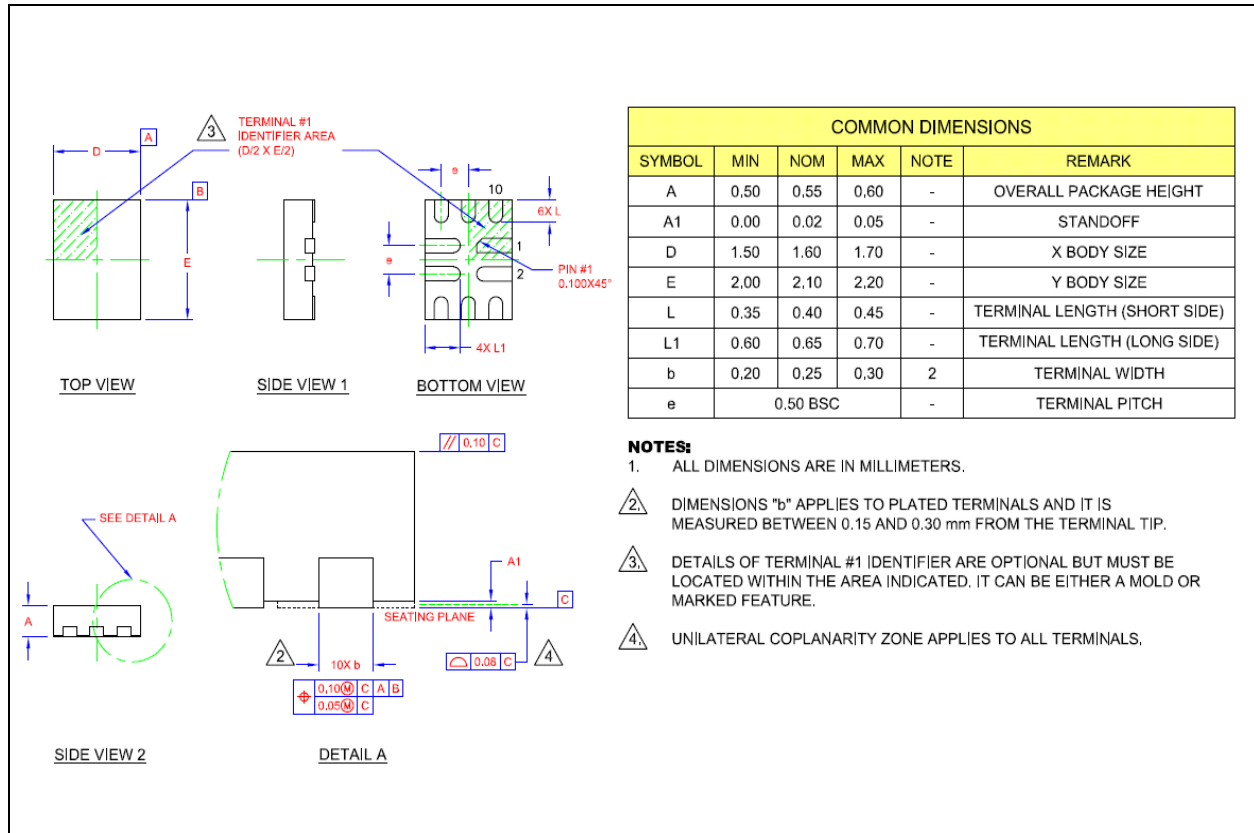


Figure 6.1 10 pin, 1.3mm x 1.8mm QFN Package Outline


**Figure 6.2 10 pin, 1.6mm x 2.1mm QFN Package Outline**

## Chapter 7 Datasheet Revision History

**Table 7.1 Customer Revision History**

| REVISION LEVEL & DATE | SECTION/FIGURE/ENTRY                             | CORRECTION  |
|-----------------------|--|---|
| Rev. 1.2 (07-30-12)   | Table 3.1, "Absolute Maximum Ratings," on page 9 | Corrected "Any other pin to GND" row's rating to "-0.3 to VDD+0.5V"       |
| Rev. 1.1 (12-15-11)   | Section 2.2, "Ball/Pin Definitions"              | In Section 2.2, changed the description of Pin #8 as follows:<br>"Ground" |
| Rev. 1.0 (08-03-11)   | Datasheet Release                                |   |