# USB3740

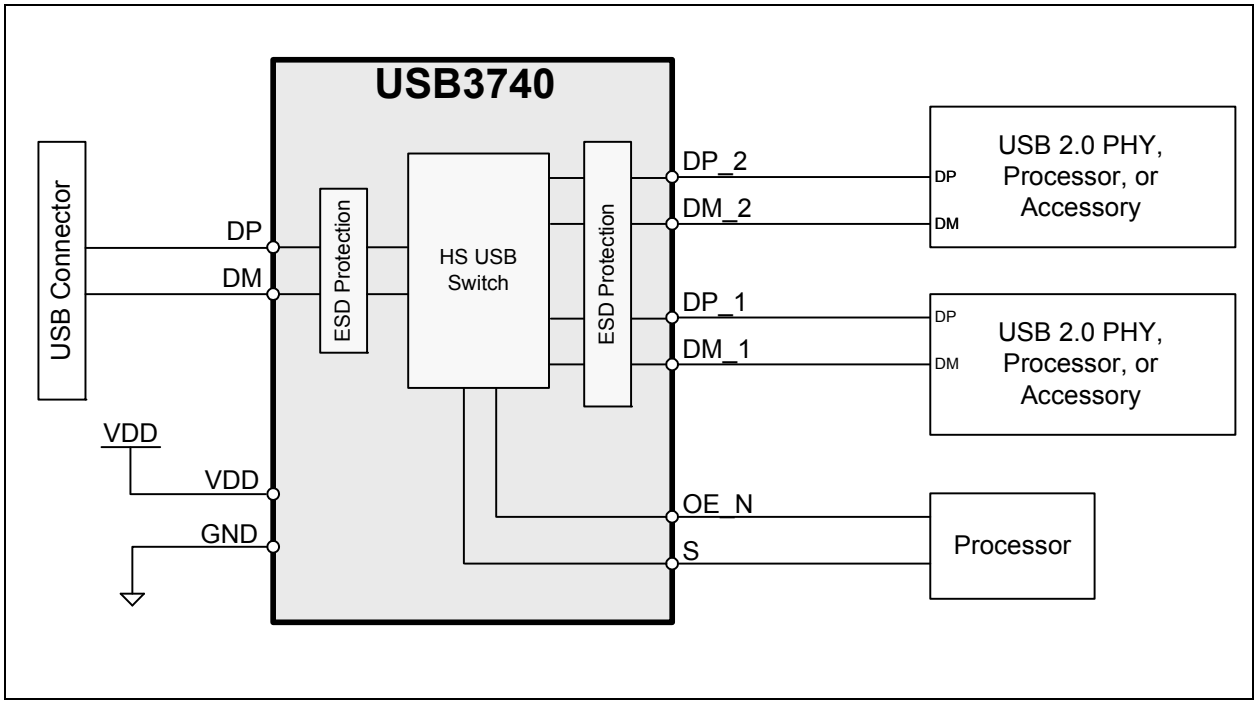
# High Speed Switch for Mobile and Portable Applications

## 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



**Order Numbers:**

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

**USB3740B-AI9-TR 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**

80 ARKAY DRIVE, HAUPPAUGE, NY 11788 (631) 435-6000 or 1 (800) 443-SEMI

## 0.1 Reference Documents

Universal Serial Bus Specification, Revision 2.0

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# 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.

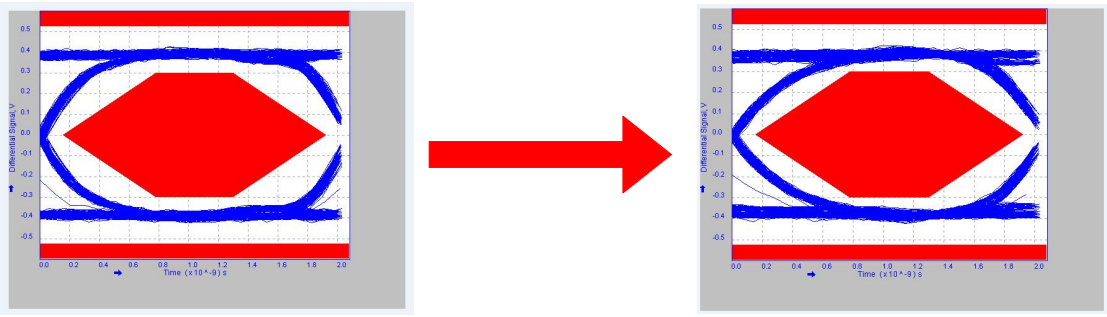



**Figure 1.1 USB3740 USB 2.0 High Speed Eye Diagram**

# 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.

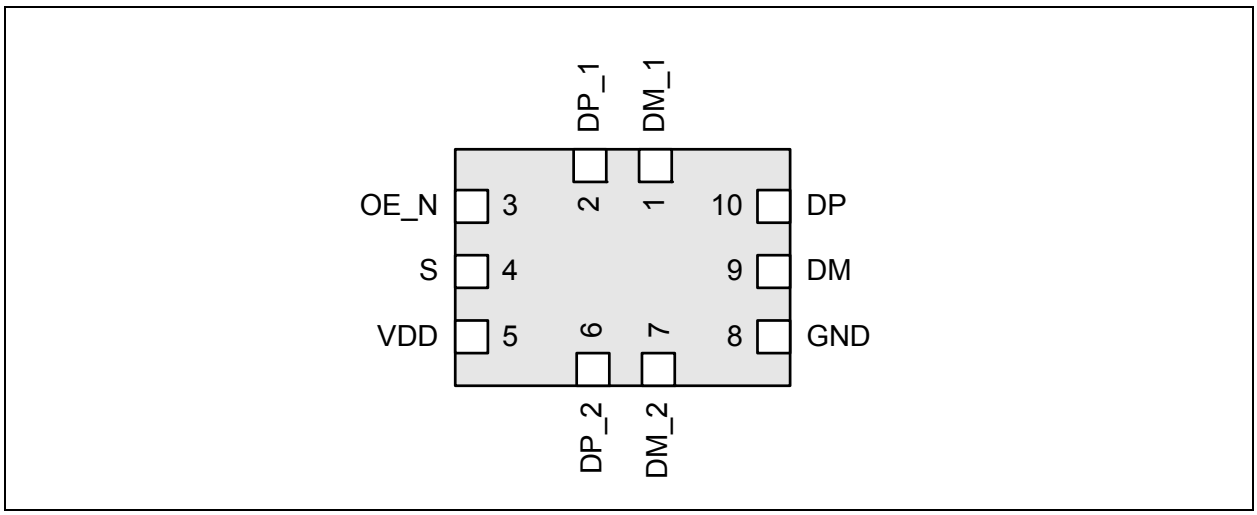



**Figure 2.1 USB3740 Package Diagram**

## 2.2 Ball/Pin Definitions

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

| PIN | NAME | TYPE/ 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. The QFN package flag should also connected to ground. |
| **5** | **VDD** | Analog | Power |

| PIN | NAME | TYPE/ DIRECTION | DESCRIPTION |
|---|---|---|---|
| **4** | **S** | Digital Input | Switch control. Refer to Table 4.1. |
| **3** | **OE_N** | Digital Input | Active low switch Output Enable. Refer to Table 4.1. |

# 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 5.5 | 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 |
|---|---|---|---|---|---|---|
| $V_{DD}$ = 5.0V, $T_A$ = -40C to 85C, all typical values at $T_A$ = 25C unless otherwise noted. | | | | | | |
| VDD Recommended Operating Conditions | | | | | | |
| Input Voltage | $V_{DD}$ | 3.0 | | 5.5 | V | |
| Active/Standby | $I_{DD}$ | | 30 | 175 | nA | |
| USB Mux Characteristics | | | | | | |
| USB Mux On Resistance | $R_{ON\_USB}$ | 1 | 2 | 5 | ohm | 0V < Vin < 3.3V |
| | | 1 | 2 | 2.5 | | 0V < Vin < 0.4V |
| USB Mux Off Leakage | $I_{OFF\_USB}$ | | 100 | 200 | nA | 0V < Vin < 3.3V |
| On Capacitance | $C_{ON\_USB}$ | | 5 | 7 | pF | $V_{DD}$ = 3V |
| Off Capacitance | $C_{OFF\_USB}$ | | 3 | 4 | pF | $V_{DD}$ = 3V |
| Off Isolation | | -30 | -32 | -40 | dB | $R_L$ = 50 ohm, F = 250MHz |
| Crosstalk | | -30 | -45 | -60 | dB | $R_L$ = 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 ohm, $C_L$ = 0pF |
| | | 850 | 950 | 980 | | $R_L$ = 50 ohm, $C_L$ = 5pF |
| | | 530 | 560 | 600 | | $R_L$ = 50 ohm, $C_L$ = 10pF |
| 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>■ Both switch paths disconnected.<br>■ Lowest power state |
| 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.

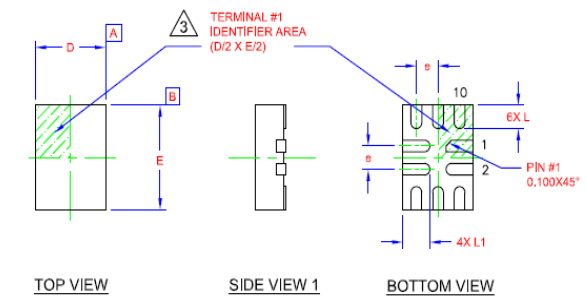
#### 5.1.2.1 Air Discharge

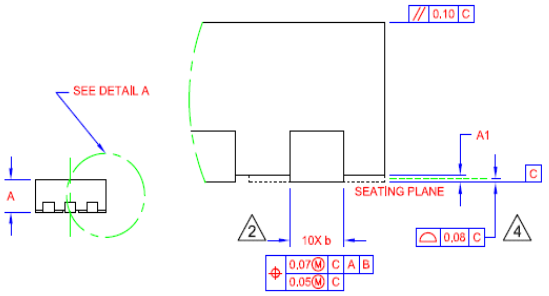
To perform this test, a charged electrode is moved close to the system being tested until a spark is generated. This test is difficult to reproduce because the discharge is influenced by such factors as humidity, the speed of approach of the electrode, and construction of the test equipment.

#### 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



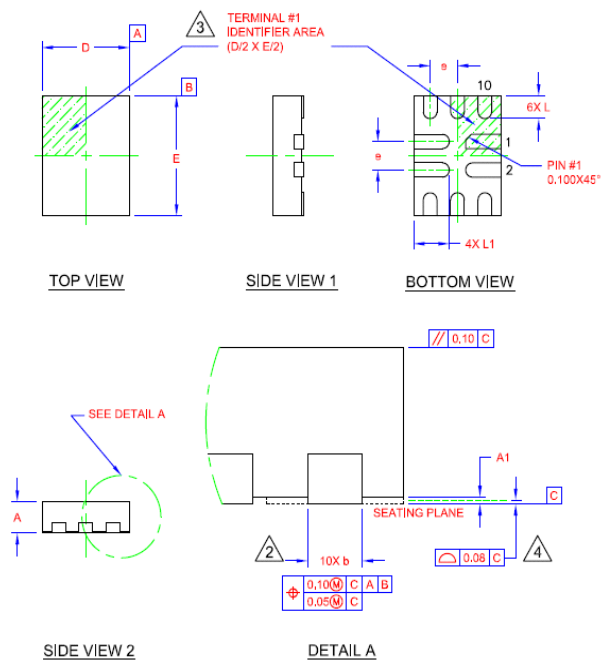




| COMMON DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| SYMBOL | MIN | NOM | MAX | NOTE | REMARK |
| A | 0.50 | 0.55 | 0.60 | - | OVERALL PACKAGE HEIGHT |
| A1 | 0.00 | 0.02 | 0.05 | - | STANDOFF |
| D | 1.20 | 1.30 | 1.40 | - | X BODY SIZE |
| E | 1.70 | 1.80 | 1.90 | - | Y BODY SIZE |
| L | 0.35 | 0.40 | 0.45 | - | TERMINAL LENGTH (SHORT SIDE) |
| L1 | 0.45 | 0.50 | 0.55 | - | TERMINAL LENGTH (LONG SIDE) |
| b | 0.15 | 0.20 | 0.25 | 2 | TERMINAL WIDTH |
| e | 0.40 BSC | | | - | TERMINAL PITCH |

**NOTES:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS "b" APPLIES TO PLATED TERMINALS AND IT IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.
3. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE AREA INDICATED. IT CAN BE EITHER A MOLD OR MARKED FEATURE.
4. UNILATERAL COPLANARITY ZONE APPLIES TO ALL TERMINALS.

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




| COMMON DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| SYMBOL | MIN | NOM | MAX | NOTE | REMARK |
| A | 0.50 | 0.55 | 0.60 | - | OVERALL PACKAGE HEIGHT |
| A1 | 0.00 | 0.02 | 0.05 | - | STANDOFF |
| D | 1.50 | 1.60 | 1.70 | - | X BODY SIZE |
| E | 2.00 | 2.10 | 2.20 | - | Y BODY SIZE |
| L | 0.35 | 0.40 | 0.45 | - | TERMINAL LENGTH (SHORT SIDE) |
| L1 | 0.60 | 0.65 | 0.70 | - | TERMINAL LENGTH (LONG SIDE) |
| b | 0.20 | 0.25 | 0.30 | 2 | TERMINAL WIDTH |
| e | 0.50 BSC | | | - | TERMINAL PITCH |

**NOTES:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS "b" APPLIES TO PLATED TERMINALS AND IT IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.
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4. UNILATERAL COPLANARITY ZONE APPLIES TO ALL TERMINALS.

**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. 1.0 (08-03-11) | Datasheet Release | |