

# USB 2.0 High-Speed 4-Port Hub Controller

## PRODUCT FEATURES

[Datasheet](#)

### General Description

The SMSC 4-Port Hub is low power, OEM configurable, MTT (multi transaction translator) hub controller IC with 4 downstream ports for embedded USB solutions. The 4-port hub is fully compliant with the USB 2.0 Specification and will attach to an upstream port as a Full-Speed Hub or as a Full-/High-Speed Hub. The 4-Port Hub supports Low-Speed, Full-Speed, and High-Speed (if operating as a High-Speed Hub) downstream devices on all of the enabled downstream ports.

### General Features

- Hub Controller IC with 4 downstream ports
- High-performance multiple transaction translator MultiTRAK™ Technology Provides one transaction translator per port
- Enhanced OEM configuration options available through either a single serial i2C EEPROM, or SMBus Slave Port
- 36-pin (6x6mm) and 48-Pin (7x7mm) QFN lead-free, RoHS compliant packages
- Footprint compatible with USB2513 and USB2512 (36-pin QFN) to provide designers with flexibility regarding the quantity of USB expansion ports utilized without redesign

### Hardware Features

- Low power operation
- Full Power Management with individual or ganged power control of each downstream port
- On-chip Power On Reset (POR)
- Internal 1.8V Voltage Regulator
- Fully integrated USB termination and Pull-up/Pull-down resistors
- On Board 24MHz Crystal Driver, Resonator or External 24/48MHz clock input
- USB host/device speed indicator. Per-port 3-color LED drivers that indicate the speed of USB host and device connection - hi-speed (480 Mbps), full-speed (12 Mbps), low-speed (1.5 Mbps) (48-pin QFN)
- Enhanced EMI rejection and ESD protection performance

### OEM Selectable Features

- Customize Vendor ID, Product ID, and Device ID
- Select whether the hub is part of a compound device (When any downstream port is permanently hardwired to a USB peripheral device, the hub is part of a compound device)

- Flexible port mapping and disable sequence. Ports can be disabled/reordered in any order to support multiple product SKUs. Hub will automatically reorder the remaining ports to match the Host controller's numbering scheme
- Programmable USB differential-pair pin location
- Ease PCB layout by aligning USB signal lines directly to connectors
- Programmable USB signal drive strength. Recover USB signal integrity due to compromised system environment using 4-level driving strength resolution
- Select the presence of a permanently hardwired USB peripheral device on a port by port basis
- Configure the delay time for filtering the over-current sense inputs
- Configure the delay time for turning on downstream port power
- Configure the polarity of downstream port power control signals
- Indicate the maximum current that the 4-port hub consumes from the USB upstream port
- Indicate the maximum current required for the hub controller
- Supports Custom String Descriptor up to 31 characters in length for:
  - Product String
  - Manufacturer String
  - Serial Number String
- Pin Selectable Options for Default Configuration
  - Select Downstream Ports as Non-Removable Ports
  - Select Downstream Ports as Disabled Ports
  - Select Downstream Port Power Control and Over-Current Detection on a Ganged or Individual Basis
  - Select Downstream Port Power Control Polarity
  - Select USB Signal Drive Strength
  - Select USB Differential Pair Pin location
  - Select on-chip or off-chip voltage regulator mode

### Applications

- LCD monitors and TVs
- Multi-function USB peripherals
- PC mother boards
- Set-top boxes, DVD players, DVR/PVR
- Printers and scanners
- PC media drive bay
- Portable hub boxes
- Mobile PC docking
- Embedded systems

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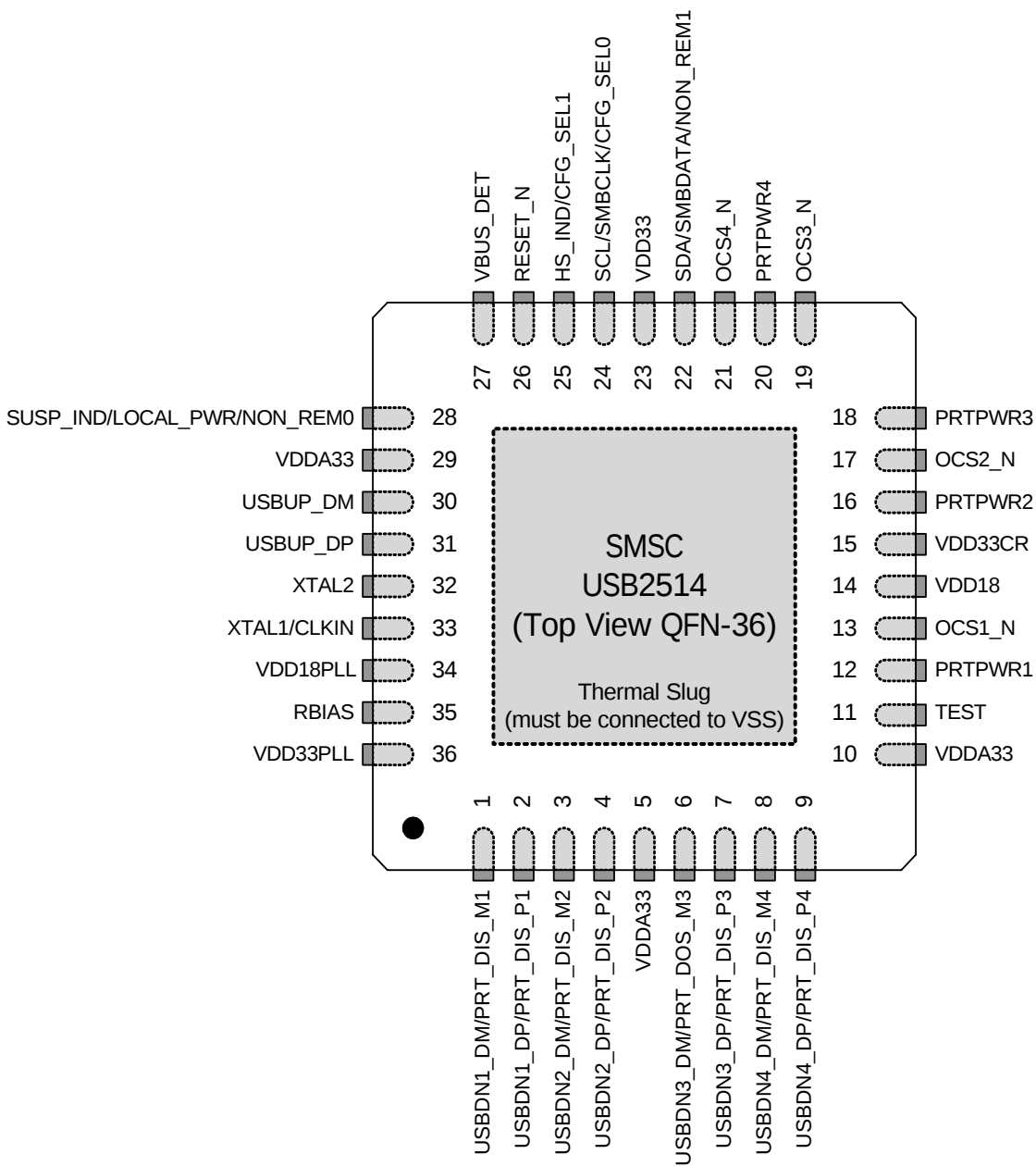
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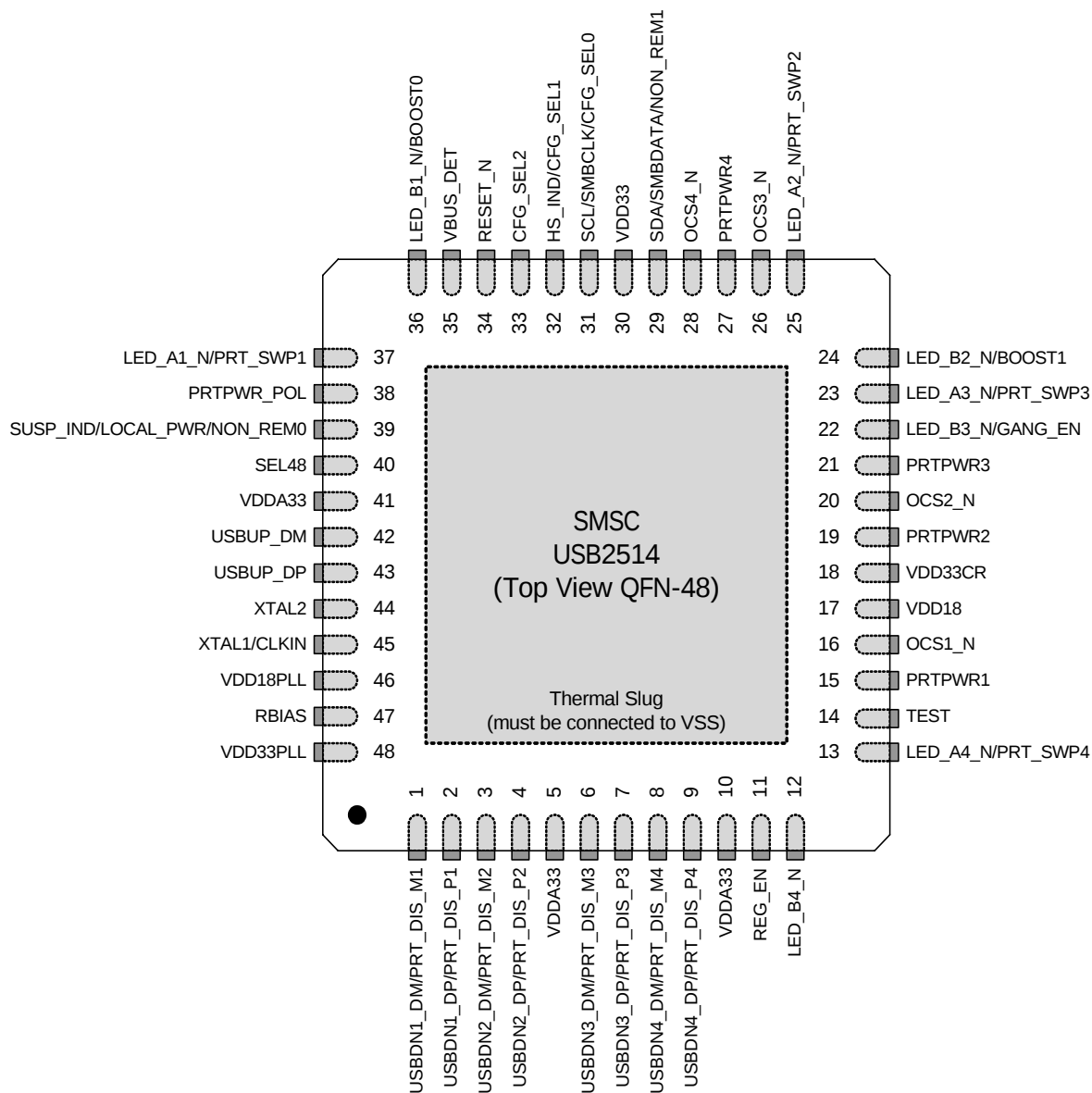
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## Chapter 1 Pin Configuration



 Indicates pins on the bottom of the device.

**Figure 1.1 USB2514 36-Pin QFN**



 Indicates pins on the bottom of the device.

**Figure 1.2 USB2514 48-Pin QFN**

## Chapter 2 Block Diagram

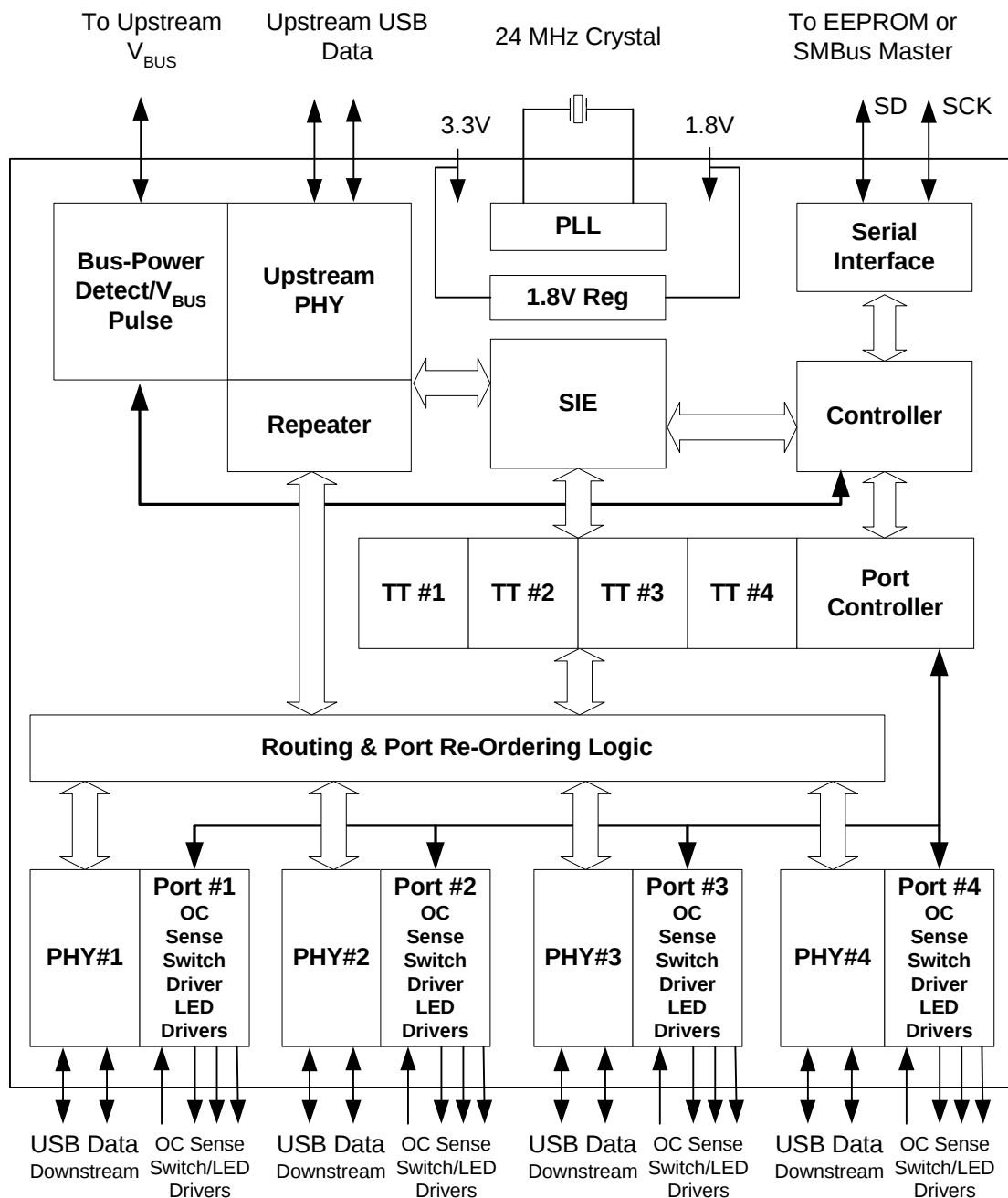


Figure 2.1 USB2514 Block Diagram

## Chapter 3 Pin Descriptions

### 3.1 PIN Descriptions

This section provides a detailed description of each signal. The signals are arranged in functional groups according to their associated interface.

The “N” symbol in the signal name indicates that the active, or asserted, state occurs when the signal is at a low voltage level. When “N” is not present before the signal name, the signal is asserted when at the high voltage level.

The terms assertion and negation are used exclusively. This is done to avoid confusion when working with a mixture of “active low” and “active high” signals. The term assert, or assertion, indicates that a signal is active, independent of whether that level is represented by a high or low voltage. The term negate, or negation, indicates that a signal is inactive.

**Table 3.1 USB2514 Pin Descriptions**

| SYMBOL                                     | 36 QFN               | 48 QFN               | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------|----------------------|----------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>UPSTREAM USB INTERFACES</b>             |                      |                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| USBUP_DP<br>USBUP_DM                       | 31<br>30             | 43<br>42             | IO-U        | USB Bus Data<br><br>These pins connect to the upstream USB bus data signals (Host port, or upstream hub).                                                                                                                                                                                                                                                                                                                                                           |
| VBUS_DET                                   | 27                   | 35                   | I/O12       | Detect Upstream VBUS Power<br><br>Detects state of Upstream VBUS power. The SMSC Hub monitors VBUS_DET to determine when to assert the internal D+ pull-up resistor (signaling a connect event).<br><br>When designing a detachable hub, this pin must be connected to the VBUS power pin of the USB port that is upstream of the hub.<br><br>For self-powered applications with a permanently attached host, this pin must be connected to 3.3V (typically VDD33). |
| <b>DOWNSTREAM 4-PORT USB 2.0 INTERFACE</b> |                      |                      |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| USBDN_DP[4:1]/<br>PRT_DIS_P[4:1]<br><br>&  | 9<br>7<br>4<br>2     | 9<br>7<br>4<br>2     | IO-U        | High-Speed USB Data & Port Disable Strap Option<br><br>These pins connect to the downstream USB peripheral devices attached to the hub's port.                                                                                                                                                                                                                                                                                                                      |
| USBDN_DM[4:1]/<br>PRT_DIS_M[4:1]           | 8<br>6<br>3<br>1     | 8<br>6<br>3<br>1     |             | Downstream Port Disable Strap option:<br><br>If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a> ), this pin will be sampled at RESET_N negation to determine if the port is disabled.<br><br>Both USB data pins for the corresponding port must be tied to the VDDA33 to disable the associated downstream port.                                                                                                         |
| P RTPWR[4:1]                               | 20<br>18<br>16<br>12 | 27<br>21<br>19<br>15 | O12         | USB Power Enable<br><br>Enables power to USB peripheral devices downstream. The active signal level of the P RTPWR[4:1] pins is determined by the Power Polarity Strapping function of the P RTPWR_POL pin.                                                                                                                                                                                                                                                         |

**Table 3.1 USB2514 Pin Descriptions (continued)**

| SYMBOL                        | 36 QFN | 48 QFN               | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|--------|----------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LED_A[4:1]_N/<br>PRT_SWP[4:1] | n/a    | 13<br>23<br>25<br>37 | I/O12       | Port LED Indicators & Port Swap strapping option<br><br>Indicator LED for ports 1-4. Will be active low when LED support is enabled via EEPROM or SMBus.                                                                                                                                                                                                                                                                                                                               |
|                               |        |                      |             | If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a> ), this pin will be sampled at RESET_N negation to determine the electrical connection polarity of the downstream USB Port pins (USB_DP and USB_DM).<br><br>Also, the active state of the LED will be determined as follows:<br><br>'0' = Port Polarity is normal, and the LED is active high.<br><br>'1' = Port Polarity (for USB_DP and USB_DM) is swapped, and the LED is active low. |
| LED_B4_N                      | n/a    | 12                   | I/O12       | Enhanced Port 4 LED<br><br>Enhanced Indicator LED for port 4. Will be active low when LED support is enabled via EEPROM or SMBus.                                                                                                                                                                                                                                                                                                                                                      |
| LED_B3_N/<br>GANG_EN          | n/a    | 22                   | I/O12       | Enhanced Port 3 LED & Gang Power and Overcurrent Strap Option<br><br>Enhanced Indicator LED for port 3. Will be active low when LED support is enabled via EEPROM or SMBus.                                                                                                                                                                                                                                                                                                            |
|                               |        |                      |             | GANG_EN: Selects between Gang or Individual Port power and Over Current sensing.<br><br>If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a> ), this pin will be sampled at RESET_N negation to determine the mode as follows:<br><br>'0' = Individual sensing & switching, and LED_B3_N is active high.<br><br>'1' = Ganged sensing & switching, and LED_B3_N is active low.                                                                 |
| LED_B[2:1]_N/<br>BOOST[1:0]   | n/a    | 24<br>36             | I/O12       | Enhanced Port [2:1] LED & Phy Boost strapping option<br><br>Enhanced Indicator LED for ports 1 & 2. Will be active low when LED support is enabled via EEPROM or SMBus.                                                                                                                                                                                                                                                                                                                |

Table 3.1 USB2514 Pin Descriptions (continued)

| SYMBOL      | 36 QFN               | 48 QFN               | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------|----------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |                      |                      |             | <p>BOOST[1:0], If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a>), this pin will be sampled at RESET_N negation to determine if all PHY ports (upstream and downstream) operate at a normal or boosted electrical level. Also, the active state of the LEDs will be determined as follows:</p> <p>See for BOOST values: <a href="#">Section 4.3.1.26, "Register F6h: Boost_Up"</a> and <a href="#">Section 4.3.1.27, "Register F8h: Boost_4:0"</a>.</p> <p>BOOST[1:0] = BOOST_IOUT[1:0]</p> <p>BOOST[1:0] = '00',<br/>LED_B2_N is active high,<br/>LED_B1_N is active high.</p> <p>BOOST[1:0] = '01',<br/>LED_B2_N is active high,<br/>LED_B1_N is active low.</p> <p>BOOST[1:0] = '10',<br/>LED_B2_N is active low,<br/>LED_B1_N is active high.</p> <p>BOOST[1:0] = '11',<br/>LED_B2_N is active low,<br/>LED_B1_N is active low.</p>                                                                                                                                                                              |
| P RTPWR_POL | n/a                  | 38                   | IPU         | <p>Port Power Polarity strapping</p> <p>Port Power Polarity strapping determination for the active signal polarity of the [4:1]P RTPWR pins.</p> <p>While RESET_N is asserted, the logic state of this pin will (through the use of internal combinatorial logic) determine the active state of the [4:1]P RTPWR pins in order to ensure that downstream port power is not inadvertently enabled to inactive ports during a hardware reset.</p> <p>When RESET_N is negated, the logic value will be latched internally, and will retain the active signal polarity for the P RTPWR[4:1] pins.</p> <p>'1' = P RTPWR[4:1]_P/N pins have an active 'high' polarity<br/>'0' = P RTPWR[4:1]_P/N pins have an active 'low' polarity</p> <p>Warning: Active Low port power controllers may glitch the downstream port power when system power is first applied. Care should be taken when designing with active low components!</p> <p><b>Note:</b> If P RTPWR_POL is not an available pin on the package, the hub will support active high power controllers only!</p> |
| OCS[4:1]_N  | 21<br>19<br>17<br>13 | 28<br>26<br>20<br>16 | IPU         | <p>Over Current Sense</p> <p>Input from external current monitor indicating an over-current condition.<br/>{Note: Contains internal pull-up to 3.3V supply}</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**Table 3.1 USB2514 Pin Descriptions (continued)**

| SYMBOL                              | 36 QFN | 48 QFN | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------|--------|--------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RBIAS                               | 35     | 47     | I-R         | USB Transceiver Bias<br><br>A 12.0k $\Omega$ (+/- 1%) resistor is attached from ground to this pin to set the transceiver's internal bias settings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>SERIAL PORT INTERFACE</b>        |        |        |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SDA/<br>SMBDATA/<br>NON_REM1        | 22     | 29     | I/OSD12     | Serial Data / SMB Data & Port Non Removable Strap Option<br><br>NON_REM1: Non removable port strap option.<br><br>If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a> ), this pin will be sampled (in conjunction with LOCAL_PWR/SUSP_IND/NON_REM0) at RESET_N negation to determine if imports [4:1] contain permanently attached (non-removable) devices:<br><br>NON_REM[1:0] = '00', All ports are removable,<br>NON_REM[1:0] = '01', Port 1 is nonremovable,<br>NON_REM[1:0] = '10', Ports 1 & 2 are non-removable,<br>NON_REM[1:0] = '11', Ports 1, 2 & 3 are non-removable |
| SCL/<br><br>SMBCLK/<br><br>CFG_SEL0 | 24     | 31     | I/OSD12     | Serial Clock (SCL)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                     |        |        |             | SMBus Clock (SMBCLK)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                     |        |        |             | Configuration Select_SEL0: The logic state of this multifunction pin is internally latched on the rising edge of RESET_N (RESET_N negation), and will determine the hub configuration method as described in <a href="#">Table 3.2</a> , "SMBus or EEPROM Interface Behavior".                                                                                                                                                                                                                                                                                                                                             |
| HS_IND/<br>CFG_SEL1                 | 25     | 32     | I/O12       | High-Speed Upstream port indicator & Configuration Programming Select<br><br>HS_IND: High Speed Indicator for upstream port connection speed.<br><br>The active state of the LED will be determined as follows:<br><br>CFG_SEL1 = '0',<br>HS_IND is active high,<br><br>CFG_SEL1 = '1',<br>HS_IND is active low,<br><br>'Asserted' = Hub is connected at HS<br>'Negated' = Hub is connected at FS                                                                                                                                                                                                                          |
|                                     |        |        |             | CFG_SEL1: The logic state of this pin is internally latched on the rising edge of RESET_N (RESET_N negation), and will determine the hub configuration method as described in <a href="#">Table 3.2</a> , "SMBus or EEPROM Interface Behavior".                                                                                                                                                                                                                                                                                                                                                                            |

Table 3.1 USB2514 Pin Descriptions (continued)

| SYMBOL          | 36 QFN | 48 QFN | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------|--------|--------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CFG_SEL2        | n/a    | 33     | I           | <p>Configuration Programming Select</p> <p><b>Note:</b> This pin is not available in all packages; it is held to a logic '0' when not available</p> <p>The logic state of this pin is internally latched on the rising edge of RESET_N (RESET_N negation), and will determine the hub configuration method as described in <a href="#">Table 3.2, "SMBus or EEPROM Interface Behavior"</a></p> |
| <b>MISC</b>     |        |        |             |                                                                                                                                                                                                                                                                                                                                                                                                |
| XTAL1/<br>CLKIN | 33     | 45     | ICLKx       | <p>Crystal Input/External Clock Input</p> <p>24MHz crystal or external clock input. This pin connects to either one terminal of the crystal or to an external 24/48MHz clock when a crystal is not used.</p> <p><b>Note:</b> 48MHz only available in 48 QFN.</p>                                                                                                                               |
| XTAL2           | 32     | 44     | OCLKx       | <p>Crystal Output</p> <p>24MHz Crystal<br/>This is the other terminal of the crystal, or pulled high when an external clock source is used to drive XTAL1/CLKIN. This output must not be used to drive any external circuitry other than the crystal circuit.</p>                                                                                                                              |
| RESET_N         | 26     | 34     | IS          | <p>RESET Input</p> <p>The system can reset the chip by driving this input low. The minimum active low pulse is 1 us.</p> <p>When the RESET_N pin is pulled to VDD33, the internal POR (Power on Reset) is enabled and no external reset circuitry is required. The internal POR holds the internal logic in reset until the power supplies are stable.</p>                                     |

**Table 3.1 USB2514 Pin Descriptions (continued)**

| SYMBOL                              | 36 QFN | 48 QFN | BUFFER TYPE | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|--------|--------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SUSP_IND/<br>LOCAL_PWR/<br>NON_REM0 | 28     | 39     | I/O         | <p>Active/Suspend status LED or Local-Power &amp; Non Removable Strap Option</p> <p>Suspend Indicator: Indicates USB state of the hub.<br/> 'negated' = Unconfigured, or configured and in USB Suspend<br/> 'asserted' = Hub is configured, and is active (i.e., not in suspend)</p> <p>Local Power: Detects availability of local self-power source.<br/> Low = Self/local power source is NOT available (i.e., Hub gets all power from Upstream USB VBus).<br/> High = Self/local power source is available.</p> <p>NON_REM0 Strap Option:<br/> If this strap is enabled by package and configuration settings (see <a href="#">Table 3.2</a>), this pin will be sampled (in conjunction with NON_REM1) at RESET_N negation to determine if ports [4:1] contain permanently attached (non-removable) devices. Also, the active state of the LED will be determined as follows:</p> <p>NON_REM[1:0] = '00', All ports are removable, and the LED is active high</p> <p>NON_REM[1:0] = '01', Port 1 is nonremovable, and the LED is active low</p> <p>NON_REM[1:0] = '10', Ports 1 &amp; 2 are non-removable, and the LED is active high</p> <p>NON_REM[1:0] = '11', Ports 1, 2 &amp; 3 are non-removable, and the LED is active low</p> |
| TEST                                | 11     | 14     | IPD         | <p>TEST pin</p> <p>XNOR continuity tests all signal pins on the hub, please contact your SMSC representative for a detailed description of how this test mode is enabled and utilized.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| SEL48                               | n/a    | 40     | I           | <p>Select 48 MHz clock input</p> <p>48MHz external clock input select. When the hub is clocked from an external clock source, this pin selects either 24MHz or 48MHz mode.</p> <p>'0' = 24MHz<br/> '1' = 48MHz</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| REG_EN                              | n/a    | 11     | IPU         | <p>Regulator Enable</p> <p>REG_EN: This pin is internally pulled up to enable the internal 1.8V regulators, and this pin should be treated as a no-connect.<br/> In order to disable the regulators, this pin will need to be externally connected to ground.<br/> When the internal regulator is enabled, the 1.8V power pins must be left unconnected, except for the required bypass capacitors.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

Table 3.2 SMBus or EEPROM Interface Behavior

|            | CFG_SEL2 | CFG_SEL1 | CFG_SEL0 | SMBUS OR EEPROM INTERFACE BEHAVIOR                                                                                                                                                           |
|------------|----------|----------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 36-Pin QFN | N/A      | 0        | 0        | Internal Default Configuration<br>■ Strap Options Enabled<br>■ Port Indicators Not Supported                                                                                                 |
| 48-Pin QFN | 0        | 0        | 0        |                                                                                                                                                                                              |
| 36-Pin QFN | N/A      | 0        | 1        | Configured as an SMBus slave for external download of user-defined descriptors.<br>■ SMBus slave address 58 (0101100x)<br>■ Strap Options Disabled<br>■ All Settings Controlled by Registers |
| 48-Pin QFN | 0        | 0        | 1        |                                                                                                                                                                                              |
| 36-Pin QFN | N/A      | 1        | 0        | Internal Default Configuration<br>■ Strap Options Enabled<br>■ Bus Power Operation<br>■ LED Mode = USB                                                                                       |
| 48-Pin QFN | 0        | 1        | 0        |                                                                                                                                                                                              |
| 36-Pin QFN | N/A      | 1        | 1        | 2-Wire I2C EEPROMS are supported.<br>■ Strap Options Disabled<br>■ All Settings Controlled by Registers                                                                                      |
| 48-Pin QFN | 0        | 1        | 1        |                                                                                                                                                                                              |
| 48-Pin QFN | 1        | 0        | 0        | Internal Default Configuration<br>■ Strap Options Disabled<br>■ Dynamic Power Switching Enabled                                                                                              |
| 48-Pin QFN | 1        | 0        | 1        | Internal Default Configuration<br>■ Strap Options Disabled<br>■ Dynamic Power Switching Enabled<br>■ LED Mode = USB                                                                          |
| 48-Pin QFN | 1        | 1        | 0        | Internal Default Configuration<br>■ Strap Options Disabled                                                                                                                                   |
| 48-Pin QFN | 1        | 1        | 1        | Internal Default Configuration<br>■ Strap Options Disabled<br>■ LED Mode = USB<br>■ Ganged Power Switching<br>■ Ganged Over-Current Sensing                                                  |

**Notes:**

Denotes 48-Pin QFN



Denotes 36-Pin QFN

**Table 3.3 USB2514 Power, Ground, No Connect**

| PACKAGE SYMBOL | 36 QFN        | 48 QFN        | FUNCTION                                                                                                                                                                                           |
|----------------|---------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VDD18          | 14            | 17            | VDD Core<br>+1.8V core power. If the internal regulator is enabled, then this pin must have a 1.0 $\mu$ F (or greater) $\pm$ 20% (ESR <0.1 $\Omega$ ) capacitor to VSS.                            |
| VDD33PLL       | 36            | 48            | VDD 3.3 PLL Regulator Reference<br>+3.3V power supply for the PLL. If the internal PLL 1.8V regulator is enabled, then this pin acts as the regulator input.                                       |
| VDDPLL18       | 34            | 46            | VDD PLL<br>+1.8V Filtered analog power for internal PLL. If the internal regulator is enabled, then this pin must have a 1.0 $\mu$ F (or greater) $\pm$ 20% (ESR <0.1 $\Omega$ ) capacitor to VSS. |
| VDDA33         | 5<br>10<br>29 | 5<br>10<br>41 | VDD Analog I/O<br>+3.3V Filtered analog PHY power, shared between adjacent ports.                                                                                                                  |
| VDD33/VDD33CR  | 23<br>15      | 30<br>18      | VDDIO/VDD 3.3 Core Regulator Reference<br>+3.3V power supply for the Digital I/O<br>If the internal core regulator is enabled, then VDD33CR acts as the regulator input.                           |
| VSS            | n/a           | n/a           | VSS<br>Ground                                                                                                                                                                                      |

## 3.2 Buffer Type Descriptions

**Table 3.4 USB2514 Buffer Type Descriptions**

| BUFFER | DESCRIPTION                                         |
|--------|-----------------------------------------------------|
| I      | Input.                                              |
| IPD    | Input with internal weak pull-down resistor.        |
| IPU    | Input with internal weak pull-up resistor.          |
| IS     | Input with Schmitt trigger.                         |
| O12    | Output 12mA.                                        |
| OD12   | Open drain... 12mA sink.                            |
| I/O12  | Input/Output buffer with 12mA sink and 12mA source. |

**Table 3.4 USB2514 Buffer Type Descriptions (continued)**

| <b>BUFFER</b> | <b>DESCRIPTION</b>                                                                                         |
|---------------|------------------------------------------------------------------------------------------------------------|
| I/OSD12       | Open drain...12mA sink with Schmitt trigger, and must meet I2C-Bus Specification Version 2.1 requirements. |
| ICLKx         | XTAL clock input.                                                                                          |
| OCLKx         | XTAL clock output.                                                                                         |
| I-R           | RBIAS.                                                                                                     |
| I/O-U         | Analog Input/Output Defined in USB specification.                                                          |
| AIO           | Analog Input/Output.                                                                                       |

## Chapter 4 Configuration Options

### 4.1 4-Port Hub

SMSC's USB 2.0 4-Port Hub is fully specification compliant to the Universal Serial Bus Specification Revision 2.0 April 27, 2000 (12/7/2000 and 5/28/2002 Errata). Please reference Chapter 10 (Hub Specification) for general details regarding Hub operation and functionality.

For performance reasons, the 4-Port Hub provides 1 Transaction Translator (TT) per port (defined as Multi-TT configuration), divided into 4 non-periodic buffers per TT.

#### 4.1.1 Hub Configuration Options

The SMSC Hub supports a large number of features (some are mutually exclusive), and must be configured in order to correctly function when attached to a USB host controller. There are three principal ways to configure the hub: SMBus, EEPROM, or by internal default settings (with or without pin strapping option over-rides). In all cases, the configuration method will be determined by the CFG\_SEL2, CFG\_SEL1 and CFG\_SEL0 pins immediately after RESET\_N negation.

##### 4.1.1.1 Power Switching Polarity

The selection of active state "polarity" for the PRTPWR pins is made by a strapping option only (the PRTPWR\_POL pin).

**Note:** If PRTPWR\_POL is not an available pin on the package, the hub will support active high power controllers only!

##### 4.1.2 VBus Detect

According to Section 7.2.1 of the USB 2.0 Specification, a downstream port can never provide power to its D+ or D- pull-up resistors unless the upstream port's VBUS is in the asserted (powered) state. The VBUS\_DET pin on the Hub monitors the state of the upstream VBUS signal and will not pull-up the D+ resistor if VBUS is not active. If VBUS goes from an active to an inactive state (Not Powered), Hub will remove power from the D+ pull-up resistor within 10 seconds.

### 4.2 36 QFN and 48 QFN Feature Differences

**Table 4.1 36 QFN and 48 QFN Feature Differences**

| 36 QFN    | 48 QFN    | FEATURE                                                                                                              |
|-----------|-----------|----------------------------------------------------------------------------------------------------------------------|
| N/A       | Available | 48MHz clock input mode                                                                                               |
| N/A       | Available | External 1.8V regulators                                                                                             |
| N/A       | Available | Port LED Indicators                                                                                                  |
| N/A       | Available | Port Swap Strapping Options                                                                                          |
| Available | N/A       | Only Active High Port Power Control is supported in 36 QFN package                                                   |
| Available | N/A       | Boost Default Level is used; see <a href="#">Table 4.2, "Internal Default, EEPROM and SMBus Register Memory Map"</a> |

## 4.3 EEPROM Interface

The SMSC Hub can be configured via a 2-wire (I2C) EEPROM (256x8). (Please see [Table 3.1](#) for specific details on how to enable configuration via an I2C EEPROM).

The Internal state-machine will (when configured for EEPROM support) read the external EEPROM for configuration data. The hub will then “attach” to the upstream USB host.

**Note:** The Hub does not have the capacity to write, or “Program,” an external EEPROM. The Hub only has the capability to read external EEPROMs. The external eeprom will be read (even if it is blank or non-populated), and the hub will be “configured” with the values that are read.

Please see Internal Register Set (Common to EEPROM and SMBus) for a list of data fields available.

### 4.3.1 Internal Register Set (Common to EEPROM and SMBus)

**Table 4.2 Internal Default, EEPROM and SMBus Register Memory Map**

| REG ADDR | R/W | REGISTER NAME                     | ABBR    | INTERNAL DEFAULT ROM | SMBUS AND EEPROM POR VALUES |
|----------|-----|-----------------------------------|---------|----------------------|-----------------------------|
| 00h      | R/W | VID LSB                           | VIDL    | 24h                  | 0x00                        |
| 01h      | R/W | VID MSB                           | VIDM    | 04h                  | 0x00                        |
| 02h      | R/W | PID LSB                           | PIDL    | 14h                  | 0x00                        |
| 03h      | R/W | PID MSB                           | PIDM    | 25h                  | 0x00                        |
| 04h      | R/W | DID LSB                           | DIDL    | 00h                  | 0x00                        |
| 05h      | R/W | DID MSB                           | DIDM    | 00h                  | 0x00                        |
| 06h      | R/W | Config Data Byte 1                | CFG1    | 9Bh                  | 0x00                        |
| 07h      | R/W | Config Data Byte 2                | CFG2    | 10h                  | 0x00                        |
| 08h      | R/W | Config Data Byte 3                | CFG3    | 00h                  | 0x00                        |
| 09h      | R/W | Non-Removable Devices             | NRD     | 00h                  | 0x00                        |
| 0Ah      | R/W | Port Disable (Self)               | PDS     | 00h                  | 0x00                        |
| 0Bh      | R/W | Port Disable (Bus)                | PDB     | 00h                  | 0x00                        |
| 0Ch      | R/W | Max Power (Self)                  | MAXPS   | 01h                  | 0x00                        |
| 0Dh      | R/W | Max Power (Bus)                   | MAXPB   | 64h                  | 0x00                        |
| 0Eh      | R/W | Hub Controller Max Current (Self) | HCMCS   | 01h                  | 0x00                        |
| 0Fh      | R/W | Hub Controller Max Current (Bus)  | HCMCB   | 64h                  | 0x00                        |
| 10h      | R/W | Power-on Time                     | PWRT    | 32h                  | 0x00                        |
| 11h      | R/W | LANG_ID_H                         | LANGIDH | 00h                  | 0x00                        |
| 12h      | R/W | LANG_ID_L                         | LANGIDL | 00h                  | 0x00                        |
| 13h      | R/W | MFR_STR_LEN                       | MFRSL   | 00h                  | 0x00                        |
| 14h      | R/W | PRD_STR_LEN                       | PRDSL   | 00h                  | 0x00                        |

**Table 4.2 Internal Default, EEPROM and SMBus Register Memory Map (continued)**

| REG ADDR | R/W | REGISTER NAME                                      | ABBR    | INTERNAL DEFAULT ROM | SMBUS AND EEPROM POR VALUES |
|----------|-----|----------------------------------------------------|---------|----------------------|-----------------------------|
| 15h      | R/W | SER_STR_LEN                                        | SERSL   | 00h                  | 0x00                        |
| 16h-53h  | R/W | MFR_STR                                            | MANSTR  | 00h                  | 0x00                        |
| 54h-91h  | R/W | PROD_STR                                           | PRDSTR  | 00h                  | 0x00                        |
| 92h-Cfh  | R/W | SER_STR                                            | SERSTR  | 00h                  | 0x00                        |
| D0h-F5h  | R/W | Reserved                                           | N/A     | 01h                  | 0x00                        |
| F6h      | R/W | Boost_Up                                           | BOOSTUP | 00h                  | 0x00                        |
| F7h      | R/W | Reserved                                           | N/A     | 00h                  | 0x00                        |
| F8h      | R/W | Boost_4:0                                          | BOOST40 | 00h                  | 0x00                        |
| F9h      | R/W | Reserved                                           | N/A     | 00h                  | 0x00                        |
| FAh      | R/W | Port Swap                                          | PRTSP   | 00h                  | 0x00                        |
| FBh      | R/W | Port Remap 12                                      | PRTR12  | 00h                  | 0x00                        |
| FCh      | R/W | Port Remap 34                                      | PRTR34  | 00h                  | 0x00                        |
| FDh-FEh  | R/W | Reserved                                           | N/A     | 00h                  | 0x00                        |
| FFh      | R/W | Status/Command<br><b>Note:</b> SMBus register only | STCD    | 00h                  | 0x00                        |

#### 4.3.1.1 Register 00h: Vendor ID (LSB)

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | VID_LSB  | Least Significant Byte of the Vendor ID. This is a 16-bit value that uniquely identifies the Vendor of the user device (assigned by USB-Interface Forum). This field is set by the OEM using either the SMBus or EEPROM interface options. |

#### 4.3.1.2 Register 01h: Vendor ID (MSB)

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                               |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | VID_MSB  | Most Significant Byte of the Vendor ID. This is a 16-bit value that uniquely identifies the Vendor of the user device (assigned by USB-Interface Forum). This field is set by the OEM using either the SMBus or EEPROM interface options. |

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**4.3.1.3 Register 02h: Product ID (LSB)**

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                      |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | PID_LSB  | Least Significant Byte of the Product ID. This is a 16-bit value that the Vendor can assign that uniquely identifies this particular product (assigned by OEM). This field is set by the OEM using either the SMBus or EEPROM interface options. |

**4.3.1.4 Register 03h: Product ID (MSB)**

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                     |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | PID_MSB  | Most Significant Byte of the Product ID. This is a 16-bit value that the Vendor can assign that uniquely identifies this particular product (assigned by OEM). This field is set by the OEM using either the SMBus or EEPROM interface options. |

**4.3.1.5 Register 04h: Device ID (LSB)**

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                       |
|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | DID_LSB  | Least Significant Byte of the Device ID. This is a 16-bit device release number in BCD format (assigned by OEM). This field is set by the OEM using either the SMBus or EEPROM interface options. |

**4.3.1.6 Register 05h: Device ID (MSB)**

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                      |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | DID_MSB  | Most Significant Byte of the Device ID. This is a 16-bit device release number in BCD format (assigned by OEM). This field is set by the OEM using either the SMBus or EEPROM interface options. |

### 4.3.1.7 Register 06h: CONFIG\_BYTE\_1

| BIT NUMBER | BIT NAME     | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7          | SELF_BUS_PWR | <p>Self or Bus Power: Selects between Self- and Bus-Powered operation.</p> <p>The Hub is either Self-Powered (draws less than 2mA of upstream bus power) or Bus-Powered (limited to a 100mA maximum of upstream power prior to being configured by the host controller). When configured as a Bus-Powered device, the SMSC Hub consumes less than 100mA of current prior to being configured. After configuration, the Bus-Powered SMSC Hub (along with all associated hub circuitry, any embedded devices if part of a compound device, and 100mA per externally available downstream port) must consume no more than 500mA of upstream VBUS current. The current consumption is system dependent, and the OEM must ensure that the USB 2.0 specifications are not violated. When configured as a Self-Powered device, &lt;1mA of upstream VBUS current is consumed and all ports are available, with each port being capable of sourcing 500mA of current. This field is set by the OEM using either the SMBus or EEPROM interface options. Please see the description under Dynamic Power for the self/bus power functionality when dynamic power switching is enabled.</p> <p>0 = Bus-Powered operation<br/>1 = Self-Powered operation</p> <p><b>Note:</b> If Dynamic Power Switching is enabled, this bit is ignored and the LOCAL_PWR pin is used to determine if the hub is operating from self or bus power.</p> |
| 6          | Reserved     | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 5          | HS_DISABLE   | <p>High Speed Disable: Disables the capability to attach as either a High/Full-speed device, and forces attachment as Full-speed only (i.e. no High-Speed support).</p> <p>0 = High-/Full-Speed<br/>1 = Full-Speed-Only (High-Speed disabled!)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4          | MTT_ENABLE   | <p>Multi-TT enable: Enables one transaction translator per port operation.</p> <p>Selects between a mode where only one transaction translator is available for all ports (Single-TT), or each port gets a dedicated transaction translator (Multi-TT) {Note: The host may force Single-TT mode only}.</p> <p>0 = single TT for all ports<br/>1 = one TT per port (multiple TT's supported)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3          | EOP_DISABLE  | <p>EOP Disable: Disables EOP generation of EOF1 when in Full-Speed mode. During FS operation only, this permits the Hub to send EOP if no downstream traffic is detected at EOF1. See Section 11.3.1 of the USB 2.0 Specification for additional details. Note: generation of an EOP at the EOF1 point may prevent a Host controller (operating in FS mode) from placing the USB bus in suspend.</p> <p>0 = EOP generation is normal<br/>1 = EOP generation is disabled</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2:1        | CURRENT_SNS  | <p>Over Current Sense: Selects current sensing on a port-by-port basis, all ports ganged, or none (only for bus-powered hubs). The ability to support current sensing on a port or ganged basis is hardware implementation dependent.</p> <p>00 = Ganged sensing (all ports together)<br/>01 = Individual port-by-port<br/>1x = Over current sensing not supported (must only be used with Bus-Powered configurations!)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                          |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0          | PORT_PWR | <p>Port Power Switching: Enables power switching on all ports simultaneously (ganged), or port power is individually switched on and off on a port- by-port basis (individual). The ability to support power enabling on a port or ganged basis is hardware implementation dependent.</p> <p>0 = Ganged switching (all ports together)<br/>1 = Individual port-by-port switching</p> |

## 4.3.1.8 Register 07h: Configuration Data Byte 2

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7          | DYNAMIC  | <p>Dynamic Power Enable: Controls the ability of the Hub to automatically change from Self-Powered operation to Bus-Powered operation if the local power source is removed or is unavailable (and from Bus-Powered to Self-Powered if the local power source is restored). {Note: If the local power source is available, the Hub will always switch to Self-Powered operation.} When Dynamic Power switching is enabled, the Hub detects the availability of a local power source by monitoring the external LOCAL_PWR pin. If the Hub detects a change in power source availability, the Hub immediately disconnects and removes power from all downstream devices and disconnects the upstream port. The Hub will then re-attach to the upstream port as either a Bus-Powered Hub (if local-power is unavailable) or a Self-Powered Hub (if local power is available).</p> <p>0 = No Dynamic auto-switching<br/>1 = Dynamic Auto-switching capable</p> |
| 6          | Reserved | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5:4        | OC_TIMER | <p>OverCurrent Timer: Over Current Timer delay.</p> <p>00 = 0.1ms<br/>01 = 4ms<br/>10 = 8ms<br/>11 = 16ms</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3          | COMPOUND | <p>Compound Device: Allows the OEM to indicate that the Hub is part of a compound (see the USB Specification for definition) device. The applicable port(s) must also be defined as having a "Non-Removable Device".</p> <p><b>Note:</b> When configured via strapping options, declaring a port as non-removable automatically causes the hub controller to report that it is part of a compound device.</p> <p>0 = No<br/>1 = Yes, Hub is part of a compound device</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2:0        | Reserved | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

#### 4.3.1.9 Register 08h: Configuration Data Byte 3

| BIT NUMBER | BIT NAME  | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:4        | Reserved  | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3          | PRTMAP_EN | Port Re-mapping enable: Selects the method used by the hub to assign port numbers and disable ports.<br><br>'0' = Standard Mode<br>'1' = Port Re-map mode                                                                                                                                                                                                                                                                                                                                                                                          |
| 2:1        | LED_MODE  | LED Mode Selection: The LED_A[4:1]_N and LED_B[4:1]_N pins support several different modes of operation.<br><br>'00' = USB Mode<br>'01' = Speed Indication Mode<br>'10' = Same as '00', USB Mode<br>'11' = Same as '00', USB Mode<br><br>Warning: Do not enable an LED mode that requires LED pins that are not available in the specific package being used in the implementation!<br><br><b>Note:</b> The Hub will only report that it supports LED's to the host when USB mode is selected. All other modes will be reported as No LED Support. |
| 0          | STRING_EN | Enables String Descriptor Support<br><br>'0' = String Support Disabled<br>'1' = String Support Enabled                                                                                                                                                                                                                                                                                                                                                                                                                                             |

#### 4.3.1.10 Register 09h: Non-Removable Device

| BIT NUMBER | BIT NAME  | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | NR_DEVICE | Non-Removable Device: Indicates which port(s) include non-removable devices. '0' = port is removable, '1' = port is non-removable.<br><br>Informs the Host if one of the active ports has a permanent device that is undetachable from the Hub. (Note: The device must provide its own descriptor data.)<br><br>When using the internal default option, the NON_REM[1:0] pins will designate the appropriate ports as being non- removable.<br><br>Bit 7= Reserved<br>Bit 6= Reserved<br>Bit 5= Reserved<br>Bit 4= 1; Port 4 non-removable<br>Bit 3= 1; Port 3 non-removable<br>Bit 2= 1; Port 2 non-removable<br>Bit 1= 1; Port 1 non removable<br>Bit 0 is Reserved, always = '0' |

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**4.3.1.11 Register 0Ah: Port Disable For Self Powered Operation**

| BIT<br>NUMBER | BIT NAME    | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0           | PORT_DIS_SP | <p>Port Disable Self-Powered: Disables 1 or more contiguous ports. '0' = port is available, '1' = port is disabled.</p> <p>During Self-Powered operation when remapping mode is disabled (PRTMAP_EN='0'), this selects the ports which will be permanently disabled, and are not available to be enabled or enumerated by a Host Controller. The ports can be disabled in any order, the internal logic will automatically report the correct number of enabled ports to the USB Host, and will reorder the active ports in order to ensure proper function.</p> <p>Bit 7= Reserved<br/>           Bit 6= Reserved<br/>           Bit 5= Reserved<br/>           Bit 4= 1; Port 4 is disabled<br/>           Bit 3= 1; Port 3 is disabled<br/>           Bit 2= 1; Port 2 is disabled<br/>           Bit 1= 1; Port 1 is disabled<br/>           Bit 0 is Reserved, always = '0'</p> |

**4.3.1.12 Register 0Bh: Port Disable For Bus Powered Operation**

| BIT<br>NUMBER | BIT NAME    | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0           | PORT_DIS_BP | <p>Port Disable Bus-Powered: Disables 1 or more contiguous ports. '0' = port is available, '1' = port is disabled.</p> <p>During Self-Powered operation when remapping mode is disabled (PRTMAP_EN='0'), this selects the ports which will be permanently disabled, and are not available to be enabled or enumerated by a Host Controller. The ports can be disabled in any order, the internal logic will automatically report the correct number of enabled ports to the USB Host, and will reorder the active ports in order to ensure proper function.</p> <p>When using the internal default option, the PRT_DIS[1:0] pins will disable the appropriate ports.</p> <p>Bit 7= Reserved<br/>           Bit 6= Reserved<br/>           Bit 5= Reserved<br/>           Bit 4= 1; Port 4 is disabled<br/>           Bit 3= 1; Port 3 is disabled<br/>           Bit 2= 1; Port 2 is disabled<br/>           Bit 1= 1; Port 1 is disabled<br/>           Bit 0 is Reserved, always = '0'</p> |

#### 4.3.1.13 Register 0Ch: Max Power For Self Powered Operation

| BIT NUMBER | BIT NAME   | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | MAX_PWR_SP | <p>Max Power Self_Powered: Value in 2mA increments that the Hub consumes from an upstream port (VBUS) when operating as a self-powered hub. This value includes the hub silicon along with the combined power consumption (from VBUS) of all associated circuitry on the board. This value also includes the power consumption of a permanently attached peripheral if the hub is configured as a compound device, and the embedded peripheral reports 0mA in its descriptors.</p> <p><b>Note:</b> The USB 2.0 Specification does not permit this value to exceed 100mA</p> |

#### 4.3.1.14 Register 0Dh: Max Power For Bus Powered Operation

| BIT NUMBER | BIT NAME   | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | MAX_PWR_BP | <p>Max Power Bus_Powered: Value in 2mA increments that the Hub consumes from an upstream port (VBUS) when operating as a bus-powered hub. This value includes the hub silicon along with the combined power consumption (from VBUS) of all associated circuitry on the board. This value also includes the power consumption of a permanently attached peripheral if the hub is configured as a compound device, and the embedded peripheral reports 0mA in its descriptors.</p> |

#### 4.3.1.15 Register 0Eh: Hub Controller Max Current For Self Powered Operation

| BIT NUMBER | BIT NAME    | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | HC_MAX_C_SP | <p>Hub Controller Max Current Self-Powered: Value in 2mA increments that the Hub consumes from an upstream port (VBUS) when operating as a self-powered hub. This value includes the hub silicon along with the combined power consumption (from VBUS) of all associated circuitry on the board. This value does NOT include the power consumption of a permanently attached peripheral if the hub is configured as a compound device.</p> <p><b>Note:</b> The USB 2.0 Specification does not permit this value to exceed 100mA</p> <p>A value of 50 (decimal) indicates 100mA, which is the default value.</p> |

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**4.3.1.16 Register 0Fh: Hub Controller Max Current For Bus Powered Operation**

| BIT NUMBER | BIT NAME    | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | HC_MAX_C_BP | Hub Controller Max Current Bus-Powered: Value in 2mA increments that the Hub consumes from an upstream port (VBUS) when operating as a bus-powered hub. This value will include the hub silicon along with the combined power consumption (from VBUS) of all associated circuitry on the board. This value will NOT include the power consumption of a permanently attached peripheral if the hub is configured as a compound device.<br><br>A value of 50 (decimal) would indicate 100mA, which is the default value. |

**4.3.1.17 Register 10h: Power-On Time**

| BIT NUMBER | BIT NAME      | DESCRIPTION                                                                                                                                                               |
|------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | POWER_ON_TIME | Power On Time: The length of time that it takes (in 2 ms intervals) from the time the host initiated power-on sequence begins on a port until power is good on that port. |

**4.3.1.18 Register 11h: Language ID High**

| BIT NUMBER | BIT NAME  | DESCRIPTION                                         |
|------------|-----------|-----------------------------------------------------|
| 7:0        | LANG_ID_H | USB LANGUAGE ID (Upper 8 bits of a 16 bit ID field) |

**4.3.1.19 Register 12h: Language ID Low**

| BIT NUMBER | BIT NAME  | DESCRIPTION                                         |
|------------|-----------|-----------------------------------------------------|
| 7:0        | LANG_ID_L | USB LANGUAGE ID (Lower 8 bits of a 16 bit ID field) |

**4.3.1.20 Register 13h: Manufacturer String Length**

| BIT NUMBER | BIT NAME    | DESCRIPTION                                                              |
|------------|-------------|--------------------------------------------------------------------------|
| 7:0        | MFR_STR_LEN | Manufacturer String Length<br><br>Maximum string length is 31 characters |

#### 4.3.1.21 Register 14h: Product String Length

| BIT NUMBER | BIT NAME    | DESCRIPTION                                                     |
|------------|-------------|-----------------------------------------------------------------|
| 7:0        | PRD_STR_LEN | Product String Length<br>Maximum string length is 31 characters |

#### 4.3.1.22 Register 15h: Serial String Length

| BIT NUMBER | BIT NAME    | DESCRIPTION                                                    |
|------------|-------------|----------------------------------------------------------------|
| 7:0        | SER_STR_LEN | Serial String Length<br>Maximum string length is 31 characters |

#### 4.3.1.23 Register 16h-53h: Manufacturer String

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | MFR_STR  | Manufacturer String, UNICODE UTF-16LE per USB 2.0 Specification<br>Maximum string length is 31 characters (62 bytes)<br><b>Note:</b> The String consists of individual 16 Bit UNICODE UTF-16LE characters. The Characters will be stored starting with the LSB at the least significant address and the MSB at the next 8-bit location (subsequent characters must be stored in sequential contiguous address in the same LSB, MSB manner). Some EEPROM programmers may transpose the MSB and LSB, thus reversing the Byte order. Please pay careful attention to the Byte ordering or your selected programming tools. |

#### 4.3.1.24 Register 54h-91h: Product String

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | PRD_STR  | Product String, UNICODE UTF-16LE per USB 2.0 Specification<br>Maximum string length is 31 characters (62 bytes)<br><b>Note:</b> The String consists of individual 16 Bit UNICODE UTF-16LE characters. The Characters will be stored starting with the LSB at the least significant address and the MSB at the next 8-bit location (subsequent characters must be stored in sequential contiguous address in the same LSB, MSB manner). Some EEPROM programmers may transpose the MSB and LSB, thus reversing the Byte order. Please pay careful attention to the Byte ordering or your selected programming tools. |

## Datasheet

## 4.3.1.25 Register 92h-CFh: Serial String

| BIT NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0        | SER_STR  | <p>Serial String, UNICODE UTF16LE per USB 2.0 Specification</p> <p>Maximum string length is 31 characters (62 bytes)</p> <p><b>Note:</b> The String consists of individual 16 Bit UNICODE UTF-16LE characters. The Characters will be stored starting with the LSB at the least significant address and the MSB at the next 8-bit location (subsequent characters must be stored in sequential contiguous address in the same LSB, MSB manner). Some EEPROM programmers may transpose the MSB and LSB, thus reversing the Byte order. Please pay careful attention to the Byte ordering or your selected programming tools.</p> |

## 4.3.1.26 Register F6h: Boost\_Up

| BIT NUMBER | BIT NAME   | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:2        | Reserved   | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 1:0        | BOOST_IOUT | <p>Upstream USB electrical signaling drive strength Boost Bit for Upstream Port.</p> <p>'00' = Normal electrical drive strength = No boost<br/>           '01' = Elevated electrical drive strength = Low (approximately 4% boost)<br/>           '10' = Elevated electrical drive strength = Medium (approximately 8% boost)<br/>           '11' = Elevated electrical drive strength = High (approximately 12% boost)</p> <p><b>Note:</b> "Boost" could result in non-USB Compliant parameters (one example would be Test J/K levels), the OEM should use a '00' value unless specific implementation issues require additional signal boosting to correct for degraded USB signalling levels.</p> |

**4.3.1.27 Register F8h: Boost\_4:0**

| <b>BIT<br/>NUMBER</b> | <b>BIT NAME</b> | <b>DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:6                   | BOOST_IOUT_4    | <p>Upstream USB electrical signaling drive strength Boost Bit for Downstream Port '4'.</p> <p>'00' = Normal electrical drive strength = No boost<br/>           '01' = Elevated electrical drive strength = Low (approximately 4% boost)<br/>           '10' = Elevated electrical drive strength = Medium (approximately 8% boost)<br/>           '11' = Elevated electrical drive strength = High (approximately 12% boost)</p> <p><b>Note:</b> "Boost" could result in non-USB Compliant parameters (one example would be Test J/K levels), the OEM should use a '00' value unless specific implementation issues require additional signal boosting to correct for degraded USB signalling levels.</p> |
| 5:4                   | BOOST_IOUT_3    | <p>Upstream USB electrical signaling drive strength Boost Bit for Downstream Port '3'.</p> <p>'00' = Normal electrical drive strength = No boost<br/>           '01' = Elevated electrical drive strength = Low (approximately 4% boost)<br/>           '10' = Elevated electrical drive strength = Medium (approximately 8% boost)<br/>           '11' = Elevated electrical drive strength = High (approximately 12% boost)</p> <p><b>Note:</b> "Boost" could result in non-USB Compliant parameters (one example would be Test J/K levels), the OEM should use a '00' value unless specific implementation issues require additional signal boosting to correct for degraded USB signalling levels.</p> |
| 3:2                   | BOOST_IOUT_2    | <p>Upstream USB electrical signaling drive strength Boost Bit for Downstream Port '2'.</p> <p>'00' = Normal electrical drive strength = No boost<br/>           '01' = Elevated electrical drive strength = Low (approximately 4% boost)<br/>           '10' = Elevated electrical drive strength = Medium (approximately 8% boost)<br/>           '11' = Elevated electrical drive strength = High (approximately 12% boost)</p> <p><b>Note:</b> "Boost" could result in non-USB Compliant parameters (one example would be Test J/K levels), the OEM should use a '00' value unless specific implementation issues require additional signal boosting to correct for degraded USB signalling levels.</p> |
| 1:0                   | BOOST_IOUT_1    | <p>Upstream USB electrical signaling drive strength Boost Bit for Downstream Port '1'.</p> <p>'00' = Normal electrical drive strength = No boost<br/>           '01' = Elevated electrical drive strength = Low (approximately 4% boost)<br/>           '10' = Elevated electrical drive strength = Medium (approximately 8% boost)<br/>           '11' = Elevated electrical drive strength = High (approximately 12% boost)</p> <p><b>Note:</b> "Boost" could result in non-USB Compliant parameters (one example would be Test J/K levels), the OEM should use a '00' value unless specific implementation issues require additional signal boosting to correct for degraded USB signalling levels.</p> |

## Datasheet

**4.3.1.28 Register FAh: Port Swap**

| BIT<br>NUMBER | BIT NAME | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:0           | PRTSP    | <p>Port Swap: Swaps the Upstream and Downstream USB DP and DM Pins for ease of board routing to devices and connectors.</p> <p>'0' = USB D+ functionality is associated with the DP pin and D- functionality is associated with the DM pin.</p> <p>'1' = USB D+ functionality is associated with the DM pin and D- functionality is associated with the DP pin.</p> <p>Bit 7= Reserved<br/>           Bit 6= Reserved<br/>           Bit 5= Reserved<br/>           Bit 4= '1'; Port 4 DP/DM is Swapped.<br/>           Bit 3= '1'; Port 3 DP/DM is Swapped.<br/>           Bit 2= '1'; Port 2 DP/DM is Swapped.<br/>           Bit 1= '1'; Port 1 DP/DM is Swapped.<br/>           Bit 0= '1'; Upstream Port DP/DM is Swapped</p> |

**4.3.1.29 Register FBh: Port Remap 12**

| BIT<br>NUMBER | BIT NAME | DESCRIPTION |
|---------------|----------|-------------|
|---------------|----------|-------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-----------------------------|--|--------|---------------------------------------------|--|--------|---------------------------------------------|--|--------|---------------------------------------------|--|--------|---------------------------------------------|--|------------------|---------------------|-----------|--------|-----------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|------------------|---------------------|
| 7:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | PRTR12           | <p>Port remap register for ports 1 &amp; 2.</p> <p>When a hub is enumerated by a USB Host Controller, the hub is only permitted to report how many ports it has; the hub is not permitted to select a numerical range or assignment. The Host Controller will number the downstream ports of the hub starting with the number '1', up to the number of ports that the hub reported having.</p> <p>The host's port number is referred to as "Logical Port Number" and the physical port on the hub is the "Physical Port Number". When remapping mode is enabled (see PRTMAP_EN in Register 08h: Configuration Data Byte 3) the hub's downstream port numbers can be remapped to different logical port numbers (assigned by the host).</p> <p><b>Note:</b> The OEM must ensure that Contiguous Logical Port Numbers are used, starting from #1 up to the maximum number of enabled ports; this ensures that the hub's ports are numbered in accordance with the way a Host will communicate with the ports.</p> |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
| <p align="center"><b>Table 4.3 Port Remap Register for Ports 1 &amp; 2</b></p> <table border="1"> <tr> <td>Bit [7:4]</td><td>'0000'</td><td>Physical Port 2 is Disabled</td></tr> <tr> <td></td><td>'0001'</td><td>Physical Port 2 is mapped to Logical Port 1</td></tr> <tr> <td></td><td>'0010'</td><td>Physical Port 2 is mapped to Logical Port 2</td></tr> <tr> <td></td><td>'0011'</td><td>Physical Port 2 is mapped to Logical Port 3</td></tr> <tr> <td></td><td>'0100'</td><td>Physical Port 2 is mapped to Logical Port 4</td></tr> <tr> <td></td><td>'0101' to '1111'</td><td>Illegal; Do Not Use</td></tr> <tr> <td rowspan="6">Bit [3:0]</td><td>'0000'</td><td>Physical Port 1 is Disabled</td></tr> <tr> <td>'0001'</td><td>Physical Port 1 is mapped to Logical Port 1</td></tr> <tr> <td>'0010'</td><td>Physical Port 1 is mapped to Logical Port 2</td></tr> <tr> <td>'0011'</td><td>Physical Port 1 is mapped to Logical Port 3</td></tr> <tr> <td>'0100'</td><td>Physical Port 1 is mapped to Logical Port 4</td></tr> <tr> <td>'0101' to '1111'</td><td>Illegal; Do Not Use</td></tr> </table> |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Bit [7:4] | '0000' | Physical Port 2 is Disabled |  | '0001' | Physical Port 2 is mapped to Logical Port 1 |  | '0010' | Physical Port 2 is mapped to Logical Port 2 |  | '0011' | Physical Port 2 is mapped to Logical Port 3 |  | '0100' | Physical Port 2 is mapped to Logical Port 4 |  | '0101' to '1111' | Illegal; Do Not Use | Bit [3:0] | '0000' | Physical Port 1 is Disabled | '0001' | Physical Port 1 is mapped to Logical Port 1 | '0010' | Physical Port 1 is mapped to Logical Port 2 | '0011' | Physical Port 1 is mapped to Logical Port 3 | '0100' | Physical Port 1 is mapped to Logical Port 4 | '0101' to '1111' | Illegal; Do Not Use |
| Bit [7:4]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | '0000'           | Physical Port 2 is Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0001'           | Physical Port 2 is mapped to Logical Port 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0010'           | Physical Port 2 is mapped to Logical Port 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0011'           | Physical Port 2 is mapped to Logical Port 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0100'           | Physical Port 2 is mapped to Logical Port 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0101' to '1111' | Illegal; Do Not Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
| Bit [3:0]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | '0000'           | Physical Port 1 is Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0001'           | Physical Port 1 is mapped to Logical Port 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0010'           | Physical Port 1 is mapped to Logical Port 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0011'           | Physical Port 1 is mapped to Logical Port 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0100'           | Physical Port 1 is mapped to Logical Port 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | '0101' to '1111' | Illegal; Do Not Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |        |                             |  |        |                                             |  |        |                                             |  |        |                                             |  |        |                                             |  |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |

#### 4.3.1.30 Register FCh: Port Remap 34

| BIT NUMBER | BIT NAME | DESCRIPTION |
|------------|----------|-------------|
|------------|----------|-------------|

## Datasheet

|           |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|-----------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-----------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|------------------|---------------------|-----------|--------|-----------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|--------|---------------------------------------------|------------------|---------------------|
| 7:0       | PRTR34           | <p>Port remap register for ports 3 &amp; 4.</p> <p>When a hub is enumerated by a USB Host Controller, the hub is only permitted to report how many ports it has; the hub is not permitted to select a numerical range or assignment. The Host Controller will number the downstream ports of the hub starting with the number '1', up to the number of ports that the hub reported having.</p> <p>The host's port number is referred to as "Logical Port Number" and the physical port on the hub is the "Physical Port Number". When remapping mode is enabled (see PRTMAP_EN in Register 08h: Configuration Data Byte 3) the hub's downstream port numbers can be remapped to different logical port numbers (assigned by the host).</p> <p><b>Note:</b> The OEM must ensure that Contiguous Logical Port Numbers are used, starting from #1 up to the maximum number of enabled ports; this ensures that the hub's ports are numbered in accordance with the way a Host will communicate with the ports.</p> <p style="text-align: center;"><b>Table 4.4 Port Remap Register for Ports 3 &amp; 4</b></p> <table border="1"> <tr> <td rowspan="6">Bit [7:4]</td><td>'0000'</td><td>Physical Port 4 is Disabled</td></tr> <tr> <td>'0001'</td><td>Physical Port 4 is mapped to Logical Port 1</td></tr> <tr> <td>'0010'</td><td>Physical Port 4 is mapped to Logical Port 2</td></tr> <tr> <td>'0011'</td><td>Physical Port 4 is mapped to Logical Port 3</td></tr> <tr> <td>'0100'</td><td>Physical Port 4 is mapped to Logical Port 4</td></tr> <tr> <td>'0101' to '1111'</td><td>Illegal; Do Not Use</td></tr> <tr> <td rowspan="6">Bit [3:0]</td><td>'0000'</td><td>Physical Port 3 is Disabled</td></tr> <tr> <td>'0001'</td><td>Physical Port 3 is mapped to Logical Port 1</td></tr> <tr> <td>'0010'</td><td>Physical Port 3 is mapped to Logical Port 2</td></tr> <tr> <td>'0011'</td><td>Physical Port 3 is mapped to Logical Port 3</td></tr> <tr> <td>'0100'</td><td>Physical Port 3 is mapped to Logical Port 4</td></tr> <tr> <td>'0101' to '1111'</td><td>Illegal; Do Not Use</td></tr> </table> | Bit [7:4] | '0000' | Physical Port 4 is Disabled | '0001' | Physical Port 4 is mapped to Logical Port 1 | '0010' | Physical Port 4 is mapped to Logical Port 2 | '0011' | Physical Port 4 is mapped to Logical Port 3 | '0100' | Physical Port 4 is mapped to Logical Port 4 | '0101' to '1111' | Illegal; Do Not Use | Bit [3:0] | '0000' | Physical Port 3 is Disabled | '0001' | Physical Port 3 is mapped to Logical Port 1 | '0010' | Physical Port 3 is mapped to Logical Port 2 | '0011' | Physical Port 3 is mapped to Logical Port 3 | '0100' | Physical Port 3 is mapped to Logical Port 4 | '0101' to '1111' | Illegal; Do Not Use |
| Bit [7:4] | '0000'           | Physical Port 4 is Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0001'           | Physical Port 4 is mapped to Logical Port 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0010'           | Physical Port 4 is mapped to Logical Port 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0011'           | Physical Port 4 is mapped to Logical Port 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0100'           | Physical Port 4 is mapped to Logical Port 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0101' to '1111' | Illegal; Do Not Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
| Bit [3:0] | '0000'           | Physical Port 3 is Disabled                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0001'           | Physical Port 3 is mapped to Logical Port 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0010'           | Physical Port 3 is mapped to Logical Port 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0011'           | Physical Port 3 is mapped to Logical Port 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0100'           | Physical Port 3 is mapped to Logical Port 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |
|           | '0101' to '1111' | Illegal; Do Not Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |           |        |                             |        |                                             |        |                                             |        |                                             |        |                                             |                  |                     |

### 4.3.1.31 Register FFh: Status/Command

| BIT NUMBER | BIT NAME   | DESCRIPTION                                                                                                                                                                                                                                               |
|------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:3        | Reserved   | Reserved                                                                                                                                                                                                                                                  |
| 2          | INTF_PW_DN | SMBus Interface Power Down<br>'0' = Interface is active<br>'1' = Interface power down after ACK has completed                                                                                                                                             |
| 1          | RESET      | Reset the SMBus Interface and internal memory back to RESET_N assertion default settings.<br>'0' = Normal Run/Idle State<br>'1' = Force a reset of registers to their default state                                                                       |
| 0          | USB_ATTACH | USB Attach (and write protect)<br>'0' = SMBus slave interface is active<br>'1' = Hub will signal a USB attach event to an upstream device, and the internal memory (address range 00h-FEh) is "write-protected" to prevent unintentional data corruption. |

## 4.3.2 I2C EEPROM

The I2C EEPROM interface implements a subset of the I2C Master Specification (Please refer to the Philips Semiconductor Standard I2C-Bus Specification for details on I2C bus protocols). The Hub's I2C EEPROM interface is designed to attach to a single "dedicated" I2C EEPROM, and it conforms to the Standard-mode I2C Specification (100kbit/s transfer rate and 7-bit addressing) for protocol and electrical compatibility.

**Note:** Extensions to the I2C Specification are not supported.

The Hub acts as the master and generates the serial clock SCL, controls the bus access (determines which device acts as the transmitter and which device acts as the receiver), and generates the START and STOP conditions.

### 4.3.2.1 Implementation Characteristics

The Hub will only access an EEPROM using the Sequential Read Protocol.

### 4.3.2.2 Pull-Up Resistor

The Circuit board designer is required to place external pull-up resistors (10K $\Omega$  recommended) on the SDA/SMBDATA & SCL/SMBCLK/CFG\_SELO lines (per SMBus 1.0 Specification, and EEPROM manufacturer guidelines) to Vcc in order to assure proper operation.

### 4.3.2.3 I2C EEPROM Slave Address

Slave address is 1010000.

**Note:** 10-bit addressing is NOT supported.

## 4.3.3 In-Circuit EEPROM Programming

The EEPROM can be programmed via ATE by pulling RESET\_N low (which tri-states the Hub's EEPROM interface and allows an external source to program the EEPROM).

## 4.4 SMBus Slave Interface

Instead of loading User-Defined Descriptor data from an external EEPROM, the SMSC Hub can be configured to receive a code load from an external processor via an SMBus interface. The SMBus interface shares the same pins as the EEPROM interface; if CFG\_SEL1 & CFG\_SEL0 activates the SMBus interface, external EEPROM support is no longer available (and the user-defined descriptor data must be downloaded via the SMBus). Due to system issues, the SMSC Hub waits indefinitely for the SMBus code load to complete and only “appears” as a newly connected device on USB after the code load is complete.

The Hub's SMBus implementation is a subset of the SMBus interface to the host. The device is a *slave-only* SMBus device. The implementation in the device is a subset of SMBus since it only supports two protocols.

The Write Block and Read Block protocols are the only valid SMBus protocols for the Hub. The Hub responds to other protocols as described in [Section 4.4.2, "Invalid Protocol Response Behavior," on page 36](#). Reference the System Management Bus Specification, Rev 1.0.

The SMBus interface is used to read and write the registers in the device. The register set is shown in [Section 4.3.1, "Internal Register Set \(Common to EEPROM and SMBus\)," on page 19](#).

### 4.4.1 Bus Protocols

Typical Write Block and Read Block protocols are shown below. Register accesses are performed using 7-bit slave addressing, an 8-bit register address field, and an 8-bit data field. The shading indicates the Hub driving data on the SMBDATA line; otherwise, host data is on the SDA/SMBDATA line.

The slave address is the unique SMBus Interface Address for the Hub that identifies it on SMBus. The register address field is the internal address of the register to be accessed. The register data field is the data that the host is attempting to write to the register or the contents of the register that the host is attempting to read.

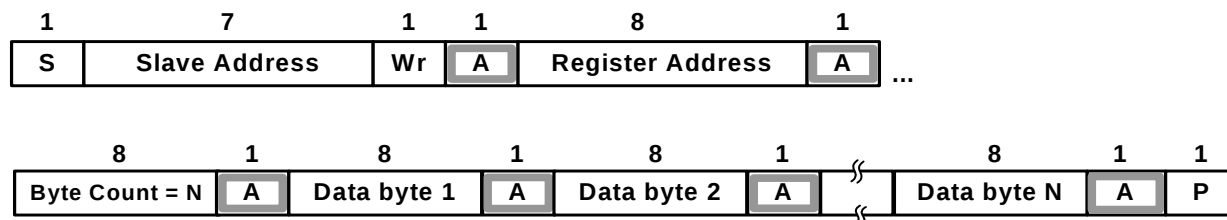
**Note:** Data bytes are transferred MSB first (msb first).

#### 4.4.1.1 Block Read/Write

The Block Write begins with a slave address and a write condition. After the command code, the host issues a byte count which describes how many more bytes will follow in the message. If a slave had 20 bytes to send, the first byte would be the number 20 (14h), followed by the 20 bytes of data. The byte count may not be 0. A Block Read or Write is allowed to transfer a maximum of 32 data bytes.

**Note:** For the following SMBus tables:

 Denotes Master-to-Slave       Denotes Slave-to-Master

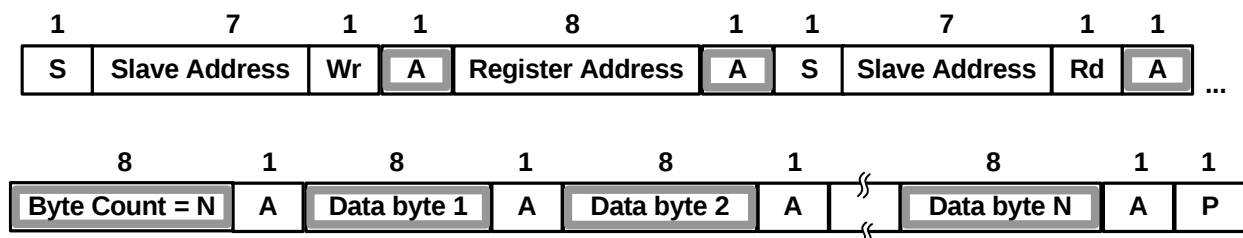


Block Write

Figure 4.1 Block Write

## Block Read

A Block Read differs from a block write in that the repeated start condition exists to satisfy the I2C specification's requirement for a change in the transfer direction.



## Block Read

Figure 4.2 Block Read

### 4.4.2 Invalid Protocol Response Behavior

Registers that are accessed with an invalid protocol are not updated. A register is only updated following a valid protocol. The only valid protocols are Write Block and Read Block, which are described above.

The Hub only responds to the hardware selected Slave Address.

Attempting to communicate with the Hub over SMBus with an invalid slave address or invalid protocol results in no response, and the SMBus Slave Interface returns to the idle state.

The only valid registers that are accessible by the SMBus slave address are the registers defined in the Registers Section. See [Section 4.4.3](#) for the response to undefined registers.

### 4.4.3 General Call Address Response

The Hub does not respond to a general call address of 0000\_000b.

### 4.4.4 Slave Device Time-Out

According to the SMBus Specification, V1.0 devices in a transfer can abort the transfer in progress and release the bus when any single clock low interval exceeds 25ms ( $T_{\text{TIMEOUT, MIN}}$ ). Devices that have detected this condition must reset their communication and be able to receive a new START condition no later than 35ms ( $T_{\text{TIMEOUT, MAX}}$ ).

**Note:** Some simple devices do not contain a clock low drive circuit; this simple kind of device typically resets its communications port after a start or stop condition. The Slave Device Time-Out must be implemented.

### 4.4.5 Stretching the SCLK Signal

The Hub supports stretching of the SCLK by other devices on the SMBus. The Hub does not stretch the SCLK.

### 4.4.6 SMBus Timing

The SMBus Slave Interface complies with the SMBus AC Timing Specification. See the SMBus timing in the "Timing Diagram" section.

#### 4.4.7 Bus Reset Sequence

The SMBus Slave Interface resets and returns to the idle state upon a START field followed immediately by a STOP field.

#### 4.4.8 SMBus Alert Response Address

The SMBALERT# signal is not supported by the Hub.

##### 4.4.8.1 Undefined Registers

The registers shown in [Table 4.2](#) are the defined registers in the Hub. Reads to undefined registers return 00h. Writes to undefined registers have no effect and do not return an error.

##### 4.4.8.2 Reserved Registers

Unless otherwise instructed, only a '0' may be written to all reserved registers or bits.

### 4.5 Default Configuration Option:

The SMSC Hub can be configured via its internal default configuration. (please see [Section 4.3.1, "Internal Register Set \(Common to EEPROM and SMBus\)"](#) for specific details on how to enable default configuration.)

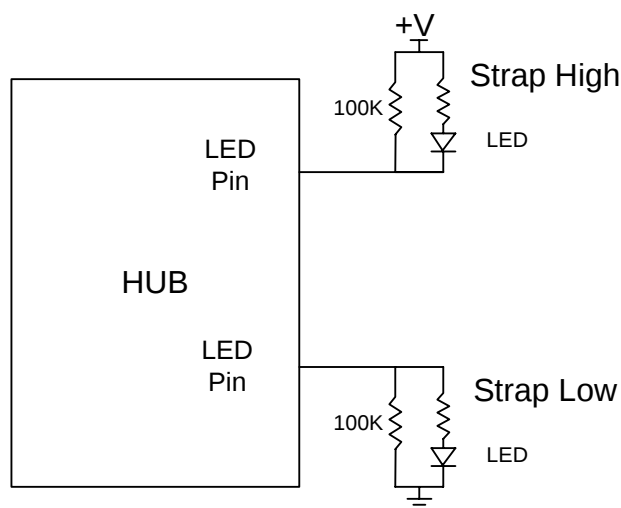
Please refer to [Table 4.2](#) for the internal default values that are loaded when this option is selected.

### 4.6 Default Strapping Options:

The USB2514 can be configured via a combination of internal default values and pin strap options. Please see [Table 3.1](#) and [Table 3.2](#) for specific details on how to enable the default/pin-strap configuration option.

The strapping option pins only cover a limited sub-set of the configuration options. The internal default values will be used for the bits & registers that are not controlled by a strapping option pin. Please refer to [Table 4.2](#) for the internal default values that are loaded when this option is selected.

The Amber and Green LED pins are sampled after RESET\_N negation, and the logic values are used to configure the hub if the internal default configuration mode is selected. The implementation shown below (see [Figure 4.3](#)) shows a recommended passive scheme. When a pin is configured with a "Strap High" configuration, the LED functions with active low signalling, and the PAD will "sink" the current from the external supply. When a pin is configured with a "Strap Low" configuration, the LED functions with active high signalling, and the PAD will "source" the current to the external LED.



**Figure 4.3 LED Strapping Option**

## 4.7 Reset

There are two different resets that the Hub experiences. One is a hardware reset (either from the internal POR reset circuit or via the RESET\_N pin) and the second is a USB Bus Reset.

### 4.7.1 Internal POR Hardware Reset

All reset timing parameters are guaranteed by design.

### 4.7.2 External Hardware RESET\_N

A valid hardware reset is defined as assertion of RESET\_N for a minimum of 1 $\mu$ s after all power supplies are within operating range. While reset is asserted, the Hub (and its associated external circuitry) consumes less than 500 $\mu$ A of current from the upstream USB power source.

Assertion of RESET\_N (external pin) causes the following:

1. All downstream ports are disabled, and PRTPOWER to downstream devices is removed.
2. The PHYs are disabled, and the differential pairs will be in a high-impedance state.
3. All transactions immediately terminate; no states are saved.
4. All internal registers return to the default state (in most cases, 00(h)).
5. The external crystal oscillator is halted.
6. The PLL is halted.
7. LED indicators are disabled.

The Hub is "operational" 500 $\mu$ s after RESET\_N is negated.

Once operational, the Hub immediately reads OEM-specific data from the external EEPROM (if the SMBus option is not disabled).

## Datasheet

## 4.7.2.1 RESET\_N for Strapping Option Configuration

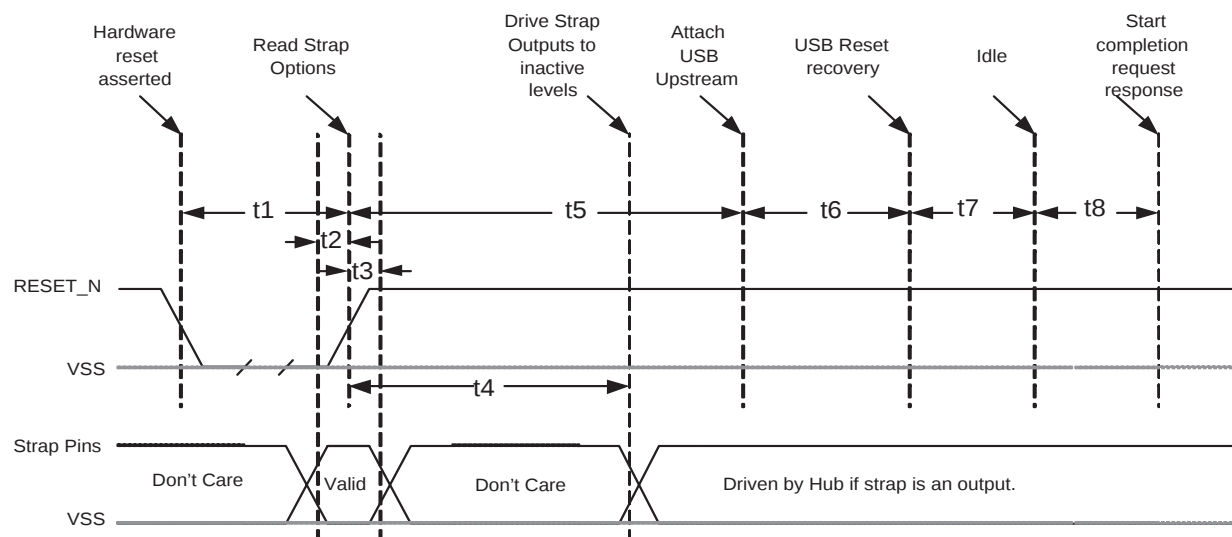


Figure 4.4 Reset\_N Timing for Default/Strap Option Mode

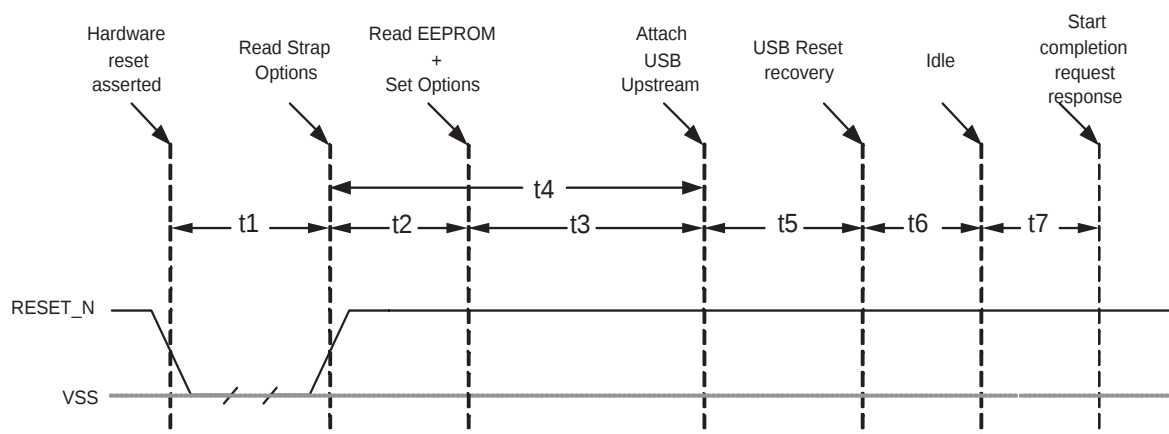
Table 4.5 Reset\_N Timing for Default/Strap Option Mode

| NAME | DESCRIPTION                                                | MIN  | TYP       | MAX  | UNITS           |
|------|------------------------------------------------------------|------|-----------|------|-----------------|
| t1   | RESET_N Asserted.                                          | 1    |           |      | $\mu\text{sec}$ |
| t2   | Strap Setup Time                                           | 16.7 |           |      | nsec            |
| t3   | Strap Hold Time.                                           | 16.7 |           | 1400 | nsec            |
| t4   | hub outputs driven to inactive logic states                |      | 1.5       | 2    | $\mu\text{sec}$ |
| t5   | USB Attach (See Note).                                     |      |           | 100  | msec            |
| t6   | Host acknowledges attach and signals USB Reset.            | 100  |           |      | msec            |
| t7   | USB Idle.                                                  |      | undefined |      | msec            |
| t8   | Completion time for requests (with or without data stage). |      |           | 5    | msec            |

**Notes:**

- When in Bus-Powered mode, the Hub and its associated circuitry must not consume more than 100mA from the upstream USB power source during  $t_1+t_5$ .
- All Power Supplies must have reached the operating levels mandated in [Chapter 5, DC Parameters](#), prior to (or coincident with) the assertion of RESET\_N.

### 4.7.2.2 RESET\_N for EEPROM Configuration



**Figure 4.5 Reset\_N Timing for EEPROM Mode**

**Table 4.6 Reset\_N Timing for EEPROM Mode**

| NAME | DESCRIPTION                                                | MIN | TYP       | MAX  | UNITS |
|------|------------------------------------------------------------|-----|-----------|------|-------|
| t1   | RESET_N Asserted.                                          | 1   |           |      | μsec  |
| t2   | Hub Recovery/Stabilization.                                |     |           | 500  | μsec  |
| t3   | EEPROM Read / Hub Config.                                  |     | 2.0       | 99.5 | msec  |
| t4   | USB Attach (See Note).                                     |     |           | 100  | msec  |
| t5   | Host acknowledges attach and signals USB Reset.            | 100 |           |      | msec  |
| t6   | USB Idle.                                                  |     | undefined |      | msec  |
| t7   | Completion time for requests (with or without data stage). |     |           | 5    | msec  |

**Notes:**

- When in Bus-Powered mode, the Hub and its associated circuitry must not consume more than 100mA from the upstream USB power source during t4+t5+t6+t7.
- All Power Supplies must have reached the operating levels mandated in [Chapter 5, DC Parameters](#), prior to (or coincident with) the assertion of RESET\_N.

## Datasheet

## 4.7.2.3 RESET\_N for SMBus Slave Configuration

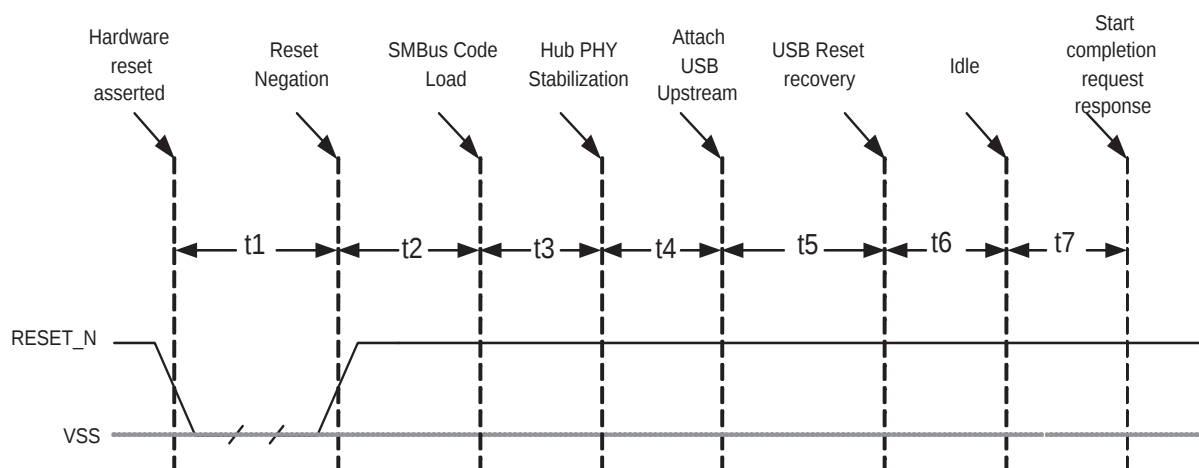


Figure 4.6 Reset\_N Timing for SMBus Mode

Table 4.7 Reset\_N Timing for SMBus Mode

| NAME | DESCRIPTION                                                | MIN | TYP       | MAX | UNITS |
|------|------------------------------------------------------------|-----|-----------|-----|-------|
| t1   | RESET_N Asserted.                                          | 1   |           |     | μsec  |
| t2   | Hub Recovery/Stabilization.                                |     |           | 500 | μsec  |
| t3   | SMBus Code Load (See Note).                                |     | 250       | 300 | msec  |
| t4   | Hub Configuration and USB Attach.                          |     |           | 100 | msec  |
| t5   | Host acknowledges attach and signals USB Reset.            | 100 |           |     | msec  |
| t6   | USB Idle.                                                  |     | Undefined |     | msec  |
| t7   | Completion time for requests (with or without data stage). |     |           | 5   | msec  |

**Notes:**

- For Bus-Powered configurations, the 99.5ms (MAX) is required, and the Hub and its associated circuitry must not consume more than 100mA from the upstream USB power source during t2+t3+t4+t5+t6+t7. For Self-Powered configurations, t3 MAX is not applicable and the time to load the configuration is determined by the external SMBus host.
- All Power Supplies must have reached the operating levels mandated in [Chapter 5, DC Parameters](#), prior to (or coincident with) the assertion of RESET\_N.

## 4.7.3 USB Bus Reset

In response to the upstream port signaling a reset to the Hub, the Hub does the following:

**Note:** The Hub does not propagate the upstream USB reset to downstream devices.

- Sets default address to 0.
- Sets configuration to: Unconfigured.
- Negates PRTPIWR[4:1] to all downstream ports.
- Clears all TT buffers.

5. Moves device from suspended to active (if suspended).
6. Complies with Section 11.10 of the USB 2.0 Specification for behavior after completion of the reset sequence.

The Host then configures the Hub and the Hub's downstream port devices in accordance with the USB Specification.

## Chapter 5 DC Parameters

### 5.1 Maximum Guaranteed Ratings

| PARAMETER              | SYMBOL                                                           | MIN  | MAX | UNITS | COMMENTS               |
|------------------------|------------------------------------------------------------------|------|-----|-------|------------------------|
| Storage Temperature    | $T_A$                                                            | -55  | 150 | °C    |                        |
| Lead Temperature       |                                                                  |      | 325 | °C    | Soldering < 10 seconds |
| 1.8V supply voltage    | $V_{DDA18PLL}$ ,<br>$V_{DD18}$                                   |      | 2.5 | V     |                        |
| 3.3V supply voltage    | $V_{DDA33}$ ,<br>$V_{DD33PLL}$ ,<br>$V_{DD33}$ ,<br>$V_{DD33CR}$ |      | 4.6 | V     |                        |
| Voltage on any I/O pin |                                                                  | -0.5 | 5.5 | V     |                        |
| Voltage on XTAL1       |                                                                  | -0.5 | 4.0 | V     |                        |
| Voltage on XTAL2       |                                                                  | -0.5 | 3.6 | V     |                        |

**Note:** Stresses above the specified parameters could cause permanent damage to the device. This is a stress rating only and functional operation of the device at any condition above those indicated in the operation sections of this specification is not implied. When powering this device from laboratory or system power supplies, it is important that the Absolute Maximum Ratings not be exceeded or device failure can result. Some power supplies exhibit voltage spikes on their outputs when the AC power is switched on or off. In addition, voltage transients on the AC power line may appear on the DC output. When this possibility exists, it is suggested that a clamp circuit be used.

### 5.2 Recommended Operating Conditions

| PARAMETER              | SYMBOL                                                            | MIN  | MAX  | UNITS | COMMENTS                                                                                              |
|------------------------|-------------------------------------------------------------------|------|------|-------|-------------------------------------------------------------------------------------------------------|
| Operating Temperature  | $T_A$                                                             | 0    | 70   | °C    |                                                                                                       |
| 1.8V supply voltage    | $V_{DDA18PLL}$ ,<br>$V_{DD18}$                                    | 1.62 | 1.98 | V     |                                                                                                       |
| 3.3V supply voltage    | $V_{DDA33}$ ,<br>$V_{DDA33PLL}$ ,<br>$V_{DD33}$ ,<br>$V_{DD33CR}$ | 3.0  | 3.6  | V     |                                                                                                       |
| Voltage on any I/O pin |                                                                   | -0.3 | 5.5  | V     | If any 3.3V supply voltage drops below 3.0V, then the MAX becomes:<br><br>(3.3V supply voltage) + 0.5 |

| PARAMETER        | SYMBOL | MIN  | MAX         | UNITS | COMMENTS |
|------------------|--------|------|-------------|-------|----------|
| Voltage on XTAL1 |        | -0.3 | $V_{DDA33}$ | V     |          |
| Voltage on XTAL2 |        | -0.3 | $V_{DD18}$  | V     |          |

**Table 5.1 DC Electrical Characteristics**

| PARAMETER                                   | SYMBOL     | MIN | TYP | MAX | UNITS | COMMENTS                                           |
|---------------------------------------------|------------|-----|-----|-----|-------|----------------------------------------------------|
| <b>I, IS Type Input Buffer</b>              |            |     |     |     |       |                                                    |
| Low Input Level                             | $V_{ILI}$  |     |     | 0.8 | V     | TTL Levels                                         |
| High Input Level                            | $V_{IHI}$  | 2.0 |     |     | V     |                                                    |
| Input Leakage                               | $I_{IL}$   | -10 |     | +10 | uA    | $V_{IN} = 0$ to $V_{DD33}$                         |
| Hysteresis ('IS' Only)                      | $V_{HYSI}$ | 250 |     | 350 | mV    |                                                    |
| <b>Input Buffer with Pull-Up (IPU)</b>      |            |     |     |     |       |                                                    |
| Low Input Level                             | $V_{ILI}$  |     |     | 0.8 | V     | TTL Levels                                         |
| High Input Level                            | $V_{IHI}$  | 2.0 |     |     | V     |                                                    |
| Low Input Leakage                           | $I_{ILL}$  | +35 |     | +90 | uA    | $V_{IN} = 0$                                       |
| High Input Leakage                          | $I_{IHL}$  | -10 |     | +10 | uA    | $V_{IN} = V_{DD33}$                                |
| <b>Input Buffer with Pull-Down (IPD)</b>    |            |     |     |     |       |                                                    |
| Low Input Level                             | $V_{ILI}$  |     |     | 0.8 | V     | TTL Levels                                         |
| High Input Level                            | $V_{IHI}$  | 2.0 |     |     | V     |                                                    |
| Low Input Leakage                           | $I_{ILL}$  | +10 |     | -10 | uA    | $V_{IN} = 0$                                       |
| High Input Leakage                          | $I_{IHL}$  | -35 |     | -90 | uA    | $V_{IN} = V_{DD33}$                                |
| <b>ICLK Input Buffer</b>                    |            |     |     |     |       |                                                    |
| Low Input Level                             | $V_{ILCK}$ |     |     | 0.5 | V     |                                                    |
| High Input Level                            | $V_{IHCK}$ | 1.4 |     |     | V     |                                                    |
| Input Leakage                               | $I_{IL}$   | -10 |     | +10 | uA    | $V_{IN} = 0$ to $V_{DD33}$                         |
| <b>O12, I/O12 &amp; I/OSD12 Type Buffer</b> |            |     |     |     |       |                                                    |
| Low Output Level                            | $V_{OL}$   |     |     | 0.4 | V     | $I_{OL} = 12\text{mA}$ @ $V_{DD33} = 3.3\text{V}$  |
| High Output Level                           | $V_{OH}$   | 2.4 |     |     | V     | $I_{OH} = -12\text{mA}$ @ $V_{DD33} = 3.3\text{V}$ |
| Output Leakage                              | $I_{OL}$   | -10 |     | +10 | uA    | $V_{IN} = 0$ to $V_{DD33}$                         |
| Hysteresis ('SD' pad only)                  | $V_{HYSC}$ | 250 |     | 350 | mV    | (Note 5.1)                                         |

## Datasheet

Table 5.1 DC Electrical Characteristics (continued)

| PARAMETER                                         | SYMBOL        | MIN | TYP | MAX | UNITS   | COMMENTS              |
|---------------------------------------------------|---------------|-----|-----|-----|---------|-----------------------|
| <b>IO-U</b><br>(Note 5.2)                         |               |     |     |     |         |                       |
| Supply Current<br>Unconfigured                    |               |     |     |     |         |                       |
| High-Speed Host                                   | $I_{CCINTHS}$ |     | 95  | 105 | mA      |                       |
| Full-Speed Host                                   | $I_{CCINTFS}$ |     | 80  | 90  | mA      |                       |
| Supply Current<br>Configured<br>(High-Speed Host) |               |     |     |     |         | All supplies combined |
| 1 Port HS, 1 Port LS/FS                           | $I_{HCH1C1}$  |     | 150 | 170 | mA      |                       |
| 2 Ports @ LS/FS                                   | $I_{HCC2}$    |     | 150 | 160 | mA      |                       |
| 2 Ports @ HS                                      | $I_{HCH2}$    |     | 160 | 275 | mA      |                       |
| 3 Ports @ HS                                      | $I_{HCH3}$    |     | 170 | 290 | mA      |                       |
| 4 Ports @ HS                                      | $I_{HCH4}$    |     | 175 | 305 | mA      |                       |
| Supply Current<br>Configured<br>(Full-Speed Host) |               |     |     |     |         | All supplies combined |
| 1 Port                                            | $I_{FCC1}$    |     | 140 | 150 | mA      |                       |
| 2 Ports                                           | $I_{FCC2}$    |     | 140 | 150 | mA      |                       |
| 3 Ports                                           | $I_{FCC3}$    |     | 140 | 150 | mA      |                       |
| 4 Ports                                           | $I_{FCC4}$    |     | 140 | 150 | mA      |                       |
| Supply Current<br>Suspend                         | $I_{CSBY}$    |     | 310 | 420 | $\mu$ A | All supplies combined |
| Supply Current<br>Reset                           | $I_{CRST}$    |     | 100 | 275 | $\mu$ A | All supplies combined |

**Note 5.1** Output leakage is measured with the current pins in high impedance.

**Note 5.2** See USB 2.0 Specification for USB DC electrical characteristics.

**CAPACITANCE**  $T_A = 25^\circ\text{C}$ ;  $f_c = 1\text{MHz}$ ;  $V_{DD18}, V_{DDPLL} = 1.8\text{V}$

**Table 5.2 Pin Capacitance**

| PARAMETER               | SYMBOL     | LIMITS |     |     | UNIT | TEST CONDITION                                                   |
|-------------------------|------------|--------|-----|-----|------|------------------------------------------------------------------|
|                         |            | MIN    | TYP | MAX |      |                                                                  |
| Clock Input Capacitance | $C_{XTAL}$ |        |     | 2   | pF   | All pins except USB pins (and pins under test tied to AC ground) |
| Input Capacitance       | $C_{IN}$   |        |     | 10  | pF   |                                                                  |
| Output Capacitance      | $C_{OUT}$  |        |     | 20  | pF   |                                                                  |

## Chapter 6 AC Specifications

### 6.1 Oscillator/Clock

Crystal: Parallel Resonant, Fundamental Mode, 24 MHz  $\pm 350$ ppm.

External Clock: 50% Duty cycle  $\pm 10\%$ , 24/48 MHz  $\pm 350$ ppm, Jitter < 100ps rms.

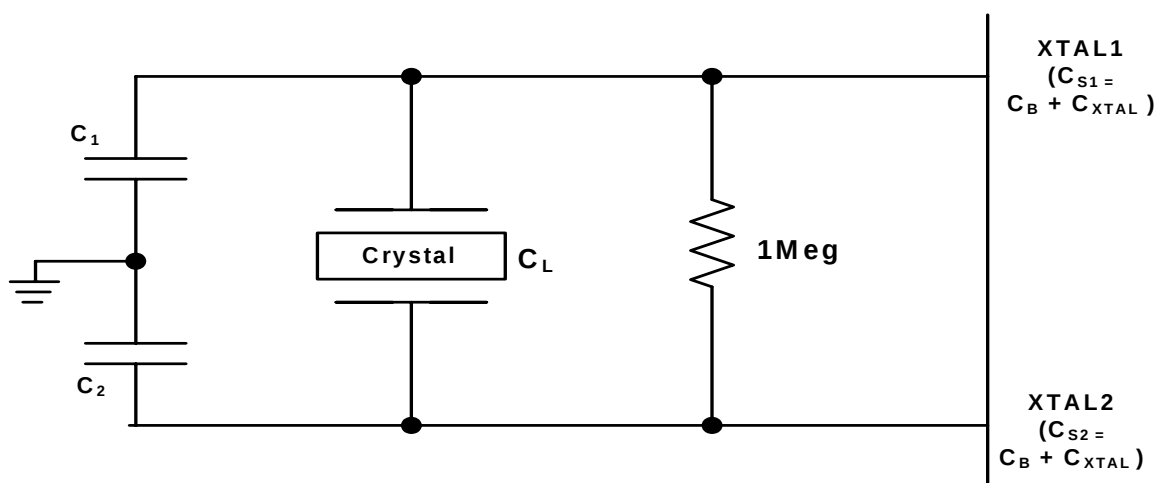


Figure 6.1 Typical Crystal Circuit

**Note:**  $C_B$  equals total board/trace capacitance.

$$\frac{(C_1 + C_{S1}) \times (C_2 + C_{S2})}{(C_1 + C_{S1} + C_2 + C_{S2})} = C_L$$

Figure 6.2 Formula to find value of  $C_1$  and  $C_2$

#### 6.1.1 SMBus Interface:

The SMSC Hub conforms to all voltage, power, and timing characteristics and specifications as set forth in the SMBus 1.0 Specification for Slave-Only devices (except as noted in [Section 4.4, "SMBus Slave Interface"](#)).

#### 6.1.2 I2C EEPROM:

Frequency is fixed at 58.6KHz  $\pm 20\%$ .

#### 6.1.3 USB 2.0

The SMSC Hub conforms to all voltage, power, and timing characteristics and specifications as set forth in the USB 2.0 Specification. Please refer to the USB 2.0 Specification for more information.

# Chapter 7 Package Outlines

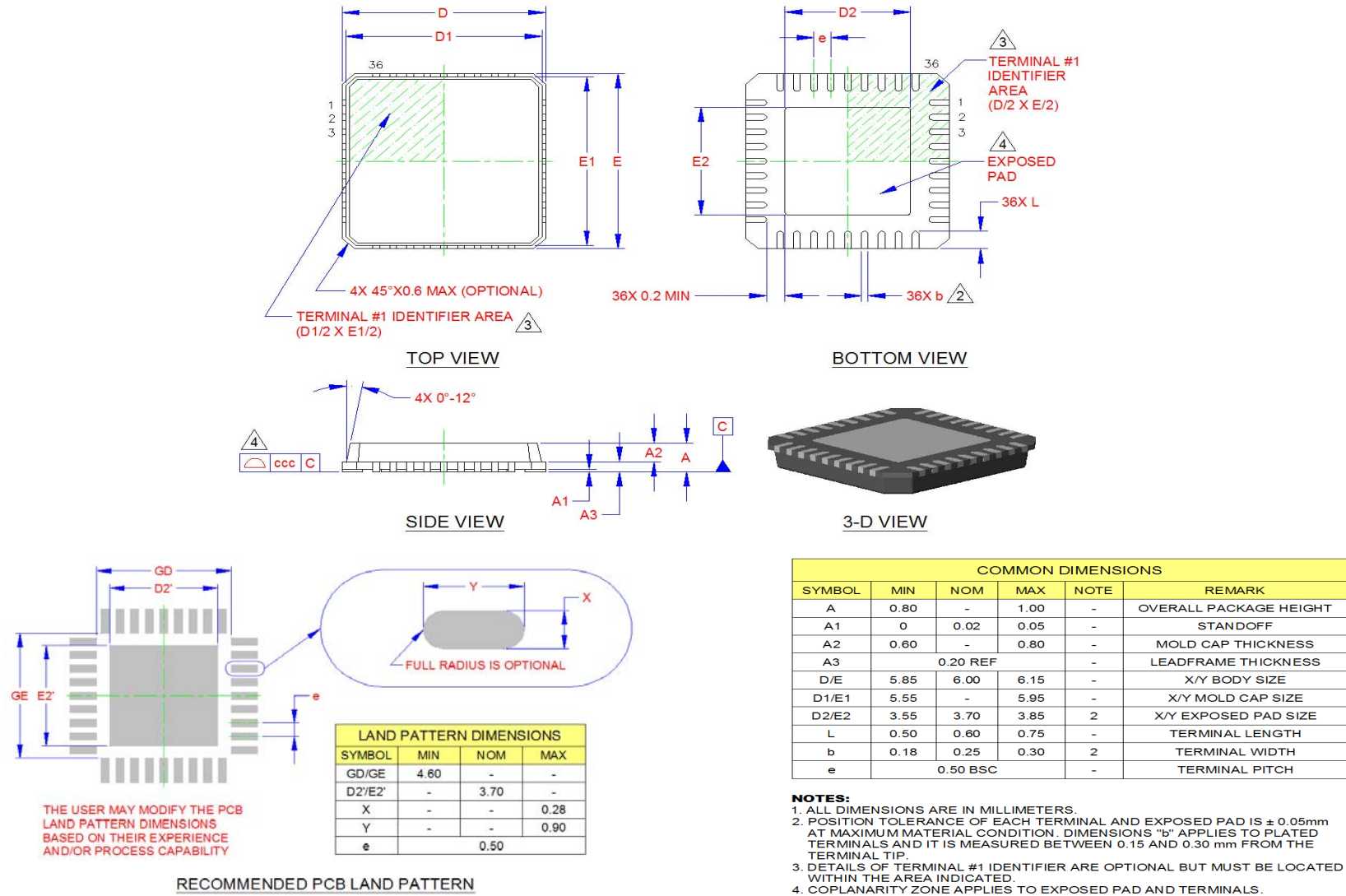


Figure 7.1 36-Pin QFN, 6x6mm Body, 0.5mm Pitch

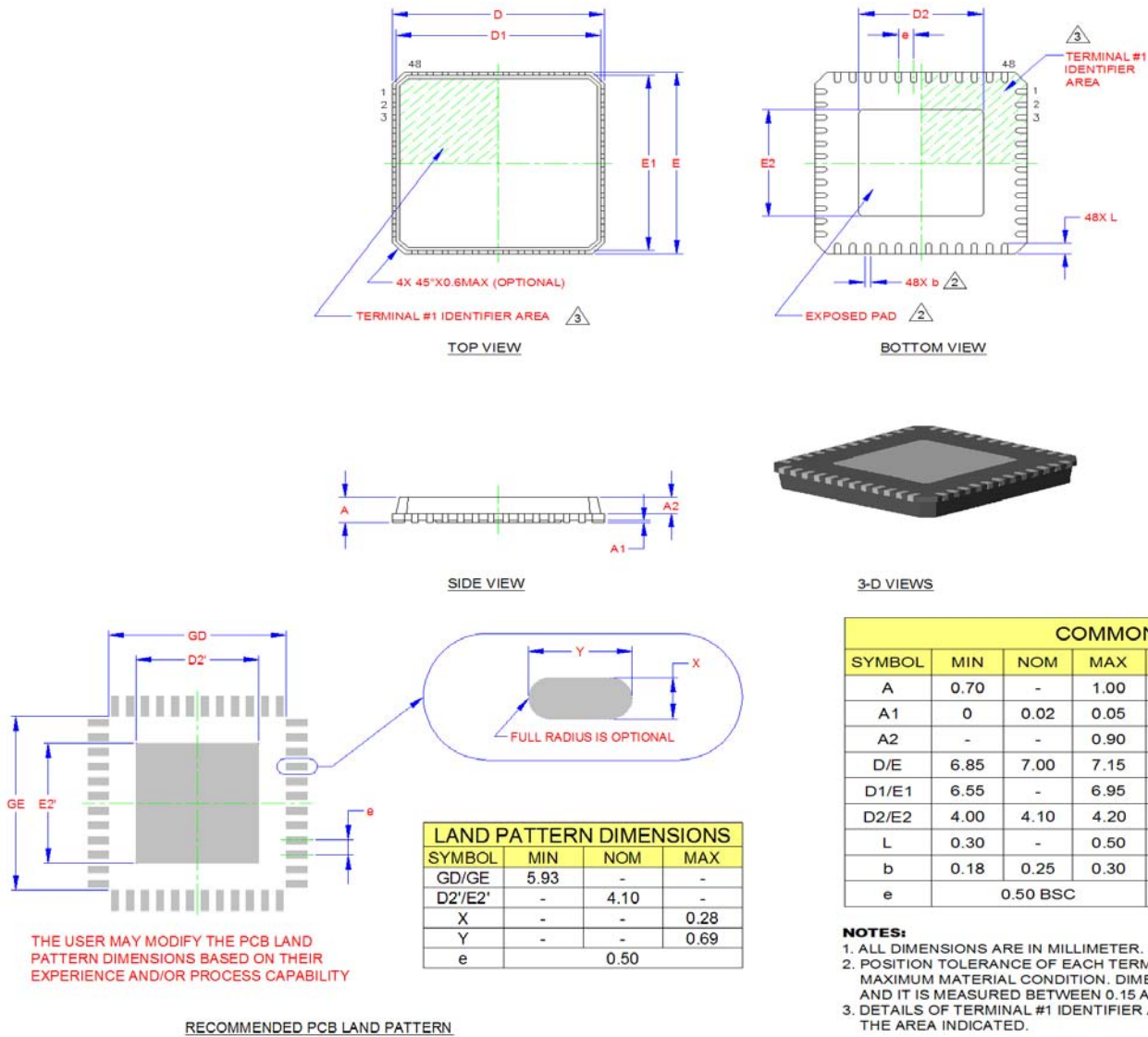


Figure 7.2 48-Pin QFN, 7x7mm Body, 0.5mm Pitch