# UM0529
# User manual

## STUSB02E and STUSB03 low-speed evaluation boards: STEVAL-PCC004V1 and STEVAL-PCC003V1

## Introduction

This user manual explains the details of both the STUSB02E and STUSB03 USB low-speed evaluation boards.

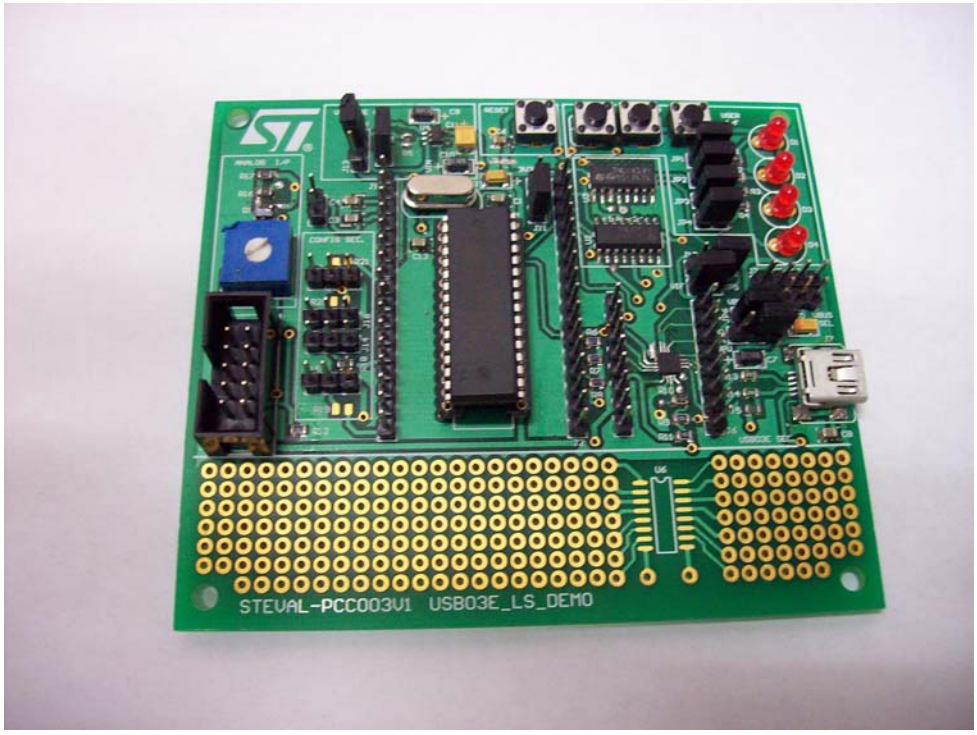
For evaluation purposes, the USB microcontroller used is the ST72F63B.

The STUSB02E or STUSB03 connected with a USB controller is ideal for use in mobile phones, digital cameras, printers, PDAs, etc.

The STUSB02E or STUSB03 USB low-speed evaluation board is designed for demonstration and evaluation purposes.

- Reference:
  - STEVAL-PCC003V1: low-speed USB evaluation board based on the STUSB03 transceiver and ST72F63B
  - STEVAL-PCC004V1: low-speed USB evaluation board based on the STUSB02E transceiver and ST72F63B

**Figure 1. USB low-speed evaluation board - STEVAL-PCC003V1**



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# 1 Getting started

## 1.1 Package contents

The STUSB02E and STUSB03 evaluation board kit package comprises the following:

### 1.1.1 Hardware

- STUSB02E / STUSB03 - low-speed evaluation board
- USB to mini-B cable

### 1.1.2 Software

- USB HID demonstration GUI

### 1.1.3 Documentation

- User manual
- Detailed presentation of applications and STUSB02EQR / STUSB03EQR features

## 1.2 Hardware installation

### 1.2.1 Powering on the board

Connect the evaluation board to the PC using the J7 connector via the USB to mini-B cable. The power status LED D2 lights up indicating successful power-up of the board.

## 1.3 Software installation

To work with the STUSB02E or STUSB03 low-speed evaluation board, install the USB HID demonstration GUI on the PC.

### 1.3.1 Drivers for evaluation board

The firmware programmed in the evaluation board is based on HID class of USB. Windows OS have built-in drivers for HID functionality

### 1.3.2 System requirements for USB HID demonstration GUI

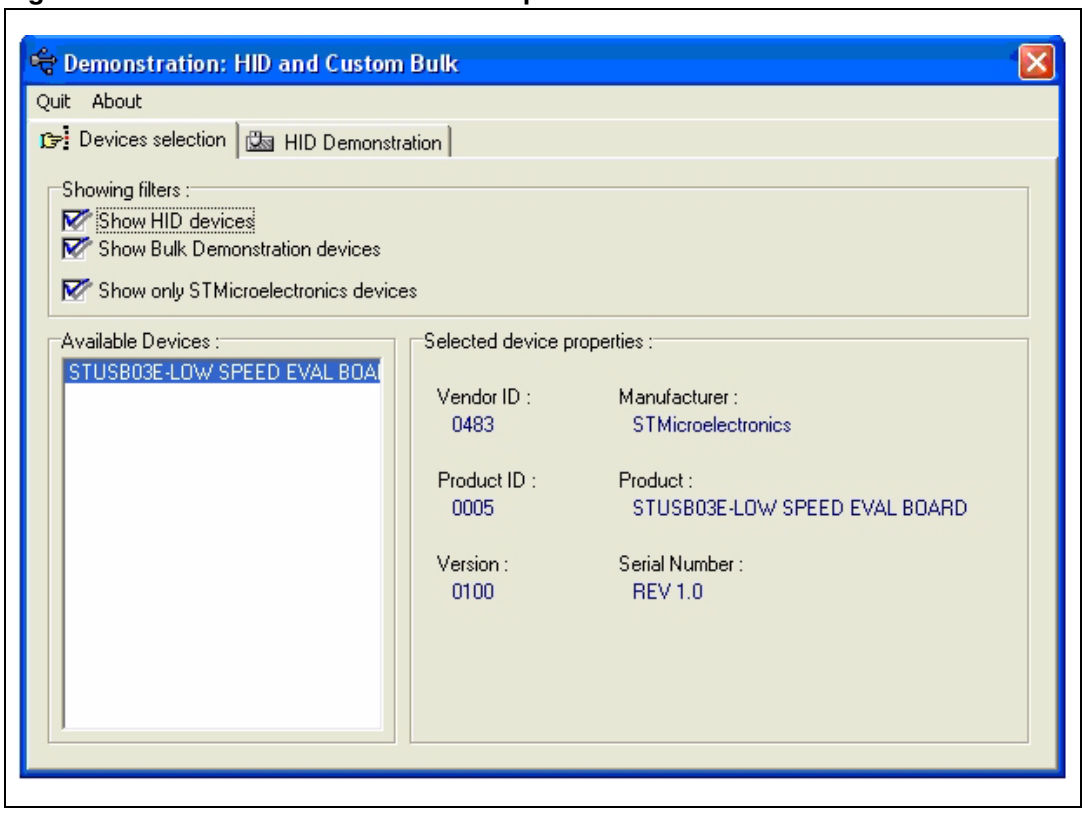
For low-speed evaluation board communication with GUI, a recent version of Windows, such as Windows 2000 or Windows XP must be installed on the PC.

*Windows is a registered trademark of Microsoft Corporation in the United States and other countries.*

*Note: The version of the Windows OS installed on your PC can be determined by clicking on the system icon in the control panel.*

After successful installation of USB HID demonstration GUI and board connection to PC, open the USB HID demonstration GUI. The low-speed evaluation board is enumerated in the GUI as shown in *Figure 2*.

**Figure 2. STUSB02E/STUSB03E- low-speed evaluation board enumeration in GUI**




Now the evaluation board installation procedure is complete. For demonstration of the board features refer to *Section 6.1: Communication with the application board on page 21*.

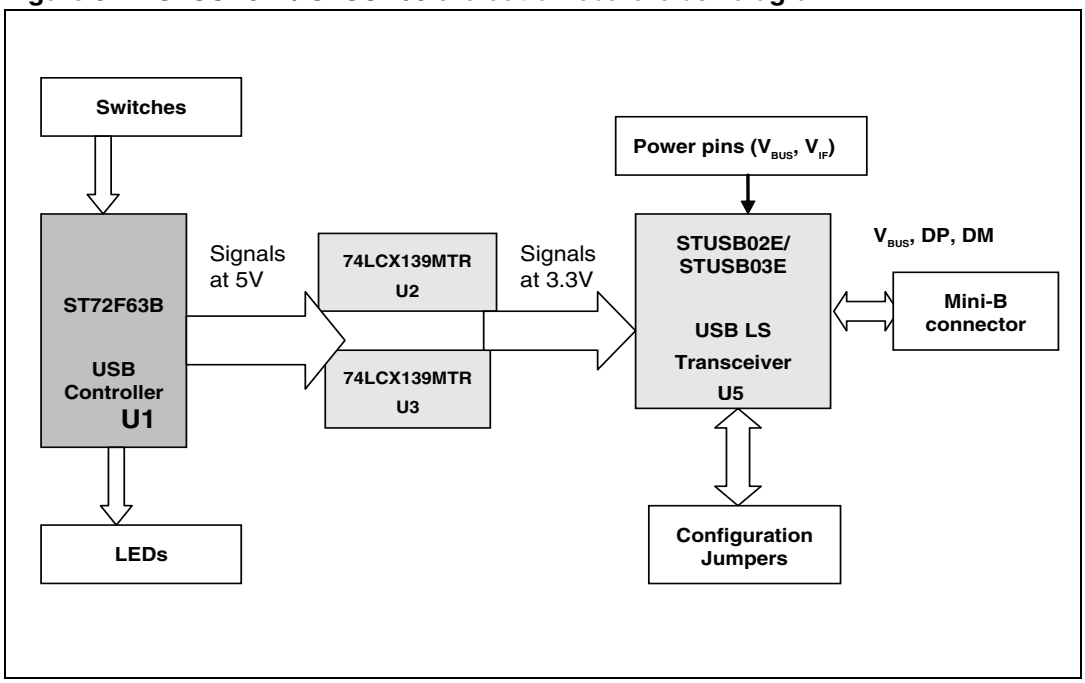
# 2 Evaluation board hardware

All the hardware components except the transceiver IC are the same for the STUSB02E and STUSB03 evaluation boards. The evaluation boards are comprised of one mini-B USB connector, one USB controller, one USB transceiver, two 2-to-4 demultiplexers and all required discrete components (pull-up resistors, series resistors and power supply capacitors). The device can be configured through a set of jumpers and the main signals can be accessed through test points.

The evaluation board is powered from a USB mini-B or optionally from an external supply. The transceiver STUSB02EQR/ STUSB03EQR is connected at the USB communication lines of the microcontroller. The USBVCC 3.3 V is obtained from the controller for providing the VIF to the transceiver and also the supply to 74LCX139. Since the ST72F63B is a USB low-speed microcontroller, therefore the pull-up resistor is connected to the D- pin of the transceiver. Hence, STUSB02E / STUSB03 acts as a low-speed transceiver. Also the SPD pin of the transceiver is connected to GND for low-speed selection.

The 74LCX139MTR is used to convert 5 V signals from the microcontroller to 3.3 V signals to STUSB02E/STUSB03E. This device is used because some signals need polarity conversion whereas other signals just need the level conversion. This is explained in *Section 3.3: 74LCX139MTR low voltage dual 2-to-4 decoder/demultiplexer U2,U3*.

**Figure 3. STUSB02E/ STUSB03 evaluation board block diagram**



# 3 Evaluation board components

## 3.1 Microcontroller U1

The microcontroller used for the STUSB02E/STUSB03E transceiver evaluation board is ST72F63B. It is programmed with firmware to support the USB HID functionality for demonstration purposes.

**Table 1. Microcontroller details**

| Feature | Description |
|---|---|
| Sales type | ST72F63BK4B1 |
| Package | PSDIP32 |
| Operating voltage | 4.0 V to 5.5 V |

### 3.1.1 Oscillator

A 12 MHz crystal is used for providing the necessary clock to the microcontroller. C3 and C4 capacitors are used along with a quartz crystal.

## 3.2 STUSB02E/STUSB03E transceiver U5

The STUSB02E and STUSB03 are single chip USB transceivers that support both USB full-speed and USB low-speed operations. Both have an integrated 5 V to 3.3 V regulator which allows direct powering from the VBUS. The transceivers also support sharing mode when VBUS is not present which allows the D+/D- lines to be shared with other serial protocols. They are also designed to operate down to 1.6 V so that they are compatible with lower system voltages of most portable systems, which include PDAs, MP3 players and cell phones.

## 3.3 74LCX139MTR low voltage dual 2-to-4 decoder/demultiplexer U2,U3

The 74LCX139MTR is a low-voltage CMOS dual 2-to-4 line decoder/ demultiplexer. It is ideal for low-power and high-speed 3.3 V applications. It can be interfaced to 5 V signal environment for inputs. The active low enable input can be used for gating or as a data input for demultiplexing applications. While the enable input is held high, all four outputs are high independently of the other inputs.

It has the same speed performance at 3.3 V as well as the 5 V, combined with lower power consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them 2 KV ESD immunity and transient excess voltage.

As explained above this device is used for interfacing between the microcontroller and STUSB02/STUSB03E for 5 V to 3.3 V signals. The 74LVX139MTR device can also be used as it also has 5 V tolerant inputs.

*Note: The 74LCX139MTR is used for interfacing* the *ST72F63B microcontroller with an operating voltage ranging from 4 V to 5.5 V in the evaluation board to transceiver. In* the *final*

*application involving* the *USB02E/USB03E, such a voltage converter is not needed as the USB microcontroller will have the $V_{IF}$ ranging from 1.6 V to 3.3 V as required for the transceiver. Also, we need signal inversion for* the *USBOE and SUS signals of transceiver. This task is also performed by* the *74LCX139MTR in this board. Hence, 74LCX139MTR usage is basically microcontroller specific.*

## 3.4 LD2985BM33R voltage regulator U4

The LD2985BM33R is a 150 mA fixed output voltage regulator. The ultra-low drop voltage and the low quiescent current make them particularly suitable for low-noise, low-power applications and in battery-powered systems. In sleep mode, quiescent current is less than 1 µA when the INHIBIT pin is pulled low. Shutdown logic control function is available on pin 3 (TTL compatible).

*Note: LD2985BM33R usage is optional in the board. By configuring jumpers J9,J13,J11, the external voltage regulator can be switched off. In this case,* the *internal voltage regulator of* the *microcontroller is used to power 74LCX139MTR and STUSB02E/ STUSB03 $V_{IF}$.*

When external voltage regulator LD2985BM33R is used for powering 74LCX139MTR and STUSB02E/ STUSB03 $V_{IF}$ , overall current consumption of the board increases.

# 4 Power requirements

The recommended supply voltages for the STUSB02E/STUSB03E USB transceivers are the following:

1. $V_{IF}$ = 1.6 - 3.6 V (typical value: $V_{IF}$ = 1.8 V)
2. $V_{BUS}$ = 4.0 - 5.5 V (typical value: $V_{BUS}$ = 5 V)

The $V_{IF}$ for the USB transceiver can be obtained from the onboard voltage regulator as well as the built-in voltage regulator of the ST72F63B.

Both evaluation boards are designed for two power supply configurations. It can be bus powered from the mini-B connector. There is another option available for powering the board using the J3 connector. J3 can be used for powering the board from an external supply. There is a three-pin jumper J4 on the board which selects the power supply configuration.

# 5 Pin assignments

## 5.1 Jumpers details

*Table 2*, *3*, and *4* show jumper assignments of the demonstration board. All the jumper settings are same for both the STUSB02E and STUSB03 evaluation boards except for jumper J10 and J12.

**Table 2. General jumper assignments**

| Jumper | Related pin(s) | Description | Default |
|---|---|---|---|
| JP1 | PB7 | **Open:** disconnects LED D1 from the microcontroller pin connected to it. | Closed |
| JP2 | PB6 | **Open:** disconnects LED D2 from the microcontroller pin connected to it. | Closed |
| JP3 | PA7 | **Open:** disconnects LED D3 from the microcontroller pin connected to it. | Closed |
| JP4 | PA6 | **Open:** disconnects LED D4 from the microcontroller pin connected to it. | Closed |
| J8 | OSCIN | **Closed:** connects main clock input for external source. | Open |

**Table 3. Voltage regulator U4 related jumper assignment**

| Jumper | Related pin(s) | Description | Default |
|---|---|---|---|
| J9 | $V_{IN}$ | **Open:** disconnects the external voltage regulator supply voltage<br>**Closed:** connects the $V_{CC}$ to IN pin of voltage regulator U4 when external regulator is to be used. | Open |
| J13 | INH | **Pin 1 and 2 closed:** connects the INHIBIT of U4 to $V_{CC}$ to switch on the external voltage regulator U4<br>**Pin 2 and 3 closed:** connects the INHIBIT pin of U4 to GND to switch off the external voltage regulator U4. | Pin 2 and 3 closed |

**Table 4. USB transceiver U5 related jumper assignment**

| Jumper | Related pin(s) | Description | Default |
|---|---|---|---|
| JP5 | USBVCC | **Closed:** connects USBVCC (=3.3V) to $V_{IF}$ in USB02E/ USB03E transceiver.<br>**Open:** disconnects USBVCC to $V_{IF}$ in USB02E/ USB03E transceiver. | Closed |
| JP6 | VBUS | **Closed:** connects USB02E/USB03E transceiver VBUS pin to $V_{CC}$ supply. | Closed |
| J4(three pin connector) | VBUS | **Pin 2 and 3 closed:** connects the $V_{BUS}$ supply to different components like microcontroller, decoder etc.<br>**Pin 1 and 2 closed:** used for powering the board through an external supply. | Pin 2 and 3 closed |
| J10 | VPU | **Pin 1 and 2 closed:** connects the 1.5 kΩ resistor between D- and VPU pin of USB transceiver for low-speed mode.<br>**Pin 2 and 3 closed:** connects the 1.5 kΩ resistor between D- and VTRM pin of USB transceiver | Pin 2 and 3 closed for STUSB03 evaluation board. (STEVAL-PCC003V1)<br>Pin 1 and 2 closed for STUSB02E evaluation board. (STEVAL-PCC004V1) |
| J11 | 3V3 SEL | **Pin 1 and 2 closed:** connects the U4 O/P to 3.3 V $V_{CC}$<br>**Pin 2 and 3 closed:** connects USB $V_{CC}$ to 3.3 V $V_{CC}$ | Pin 2 and 3 closed |
| J12 | RSL | **Pin 1 and 2 closed:** connects the RSL of U5 to GND<br>**Pin 2 and 3 closed:** connects the RSL of U5 to VIF | Pin 1 and 2 closed for STUSB03 evaluation board (STEVAL-PCC003V1)<br>Open for STUSB02E evaluation board (STEVAL-PCC004V1) |

*Note: J12 is applicable only to the STUSB03 evaluation board. It is not applicable to the STUSB02E evaluation board since RSL is NC in the STUSB02E.*

CONFIG section jumpers are provided for future user requirements.

**Table 5. CONFIG section related jumper assignment**

| Jumper | Related pin(s) | Description | Default |
|---|---|---|---|
| J14 | CFG1_PB5 | **Pin 1 and 2 closed:** connects the CFG1_PB5 to GND<br>**Pin 2 and 3 closed:** connects the CFG1_PB5 to VCC | Open |
| J15 | CFG2_PB1 | **Pin 1 and 2 closed:** connects the CFG2_PB1 to GND<br>**Pin 2 and 3 closed:** connects the CFG2_PB1 to VCC | Open |
| J16 | CFG3_PA0 | **Pin 1 and 2 closed:** connects the CFG3_PA0 to GND<br>**Pin 2 and 3 closed:** connects the CFG3_PA0 to VCC | Open |
| J17 | CFG4_PC0 | **Pin 1 and 2 closed:** connects the CFG4_PC0 to GND<br>**Pin 2 and 3 closed:** connects the CFG4_PC0 to VCC | Open |

## 5.2 Switch assignments

*Table 6* shows switch assignments of the demonstration board.

**Table 6. Evaluation board switch assignments**

| Jumper | Related pin(s) | Description) |
|---|---|---|
| SW1 | RESET | **When button is pressed**, the active low signal forces the initialization of the MCU. |
| SW2 | PA3 | **When button is pressed**, PA3 microcontroller pin is connected to ground. Not used at present. |
| SW3 | PA4 | **When button is pressed,** PA4 microcontroller pin is connected to ground. Not used at present. |
| SW4 | PA5 | **When button is pressed,** PA5 microcontroller pin is connected to ground. This is used to control the button state on the USB demonstrator software. |

## 5.3 Connector assignments

*Table 7* shows connector assignments of the evaluation board connectors.

**Table 7. Evaluation board connectors**

| Connector | Description |
|---|---|
| J7 | USB mini-B connector |
| J3 | External power supply(5 V), GND |

## 5.4 USB pin assignments

*Table 8* shows USB mini-B connector pin assignments.

**Table 8. USB mini-B pin assignments**

| Pin no. | Description |
|---|---|
| 1 | $V_{BUS}$ – connect a 5 V supply voltage when powering $V_{BUS}$ pin from mini-B connector. |
| 2 | D+ – data line |
| 3 | D- – data line |
| 4 | ID – not used |
| 5 | GND – ground reference |

## 5.5 Decoder U2/U3 pin description

*Table 9* shows the pin description of the decoder.

**Table 9. Decoder pin U2/ U3 description**

| Pin no | Symbol | Name and function |
|---|---|---|
| 1, 15 | n1G, n2G | Enable inputs |
| 2, 3 | 1A, 1B | Address inputs |
| 4, 5, 6, 7 | n1Y0 to n1Y3 | Outputs |
| 12, 11, 10, 9 | n2Y0 to n2Y3 | Outputs |
| 14, 13 | 2A, 2B | Address Inputs |
| 8 | GND | Ground (0 V) |
| 16 | VCC | Positive supply voltage |

### 5.5.1 Decoder/demultiplexer U2

*Table 10* shows the truth table for the first input of U2.

**Table 10. Truth table for first input of U2**

| Inputs | | | Outputs | | | |
|---|---|---|---|---|---|---|
| Enable | Select | | | | | |
| n1G(1) | 1B(3) = GND | 1A(2)= USBOE | nY0(4) = NC | nY1 (5) = nUSBOE | nY2(6)= NC | nY3(7) = NC |
| H | X | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |

Thus, it can be seen by comparing column 3 (input 1A) and column 5 (output Y1), that the USBOE signal is getting inverted.

*Table 11* shows the truth table for the second input of U2.

**Table 11. Truth table for second input of U2**

| Inputs | | | Outputs | | | |
|---|---|---|---|---|---|---|
| Enable | Select | | | | | |
| n2G(15) | 2B(13)=GND | 2A(14) = SUS_5 | nY0(12) =SUS_33 | nY1(11)= NC | nY2(10) = NC | nY3(9) = NC |
| H | x | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |

Thus, it can be seen by comparing column 3 (input 2A) and column 4 (output Y0), that the SUS signal is getting buffered. Hence only the voltage level conversion from 5 V to 3.3 V is done.

### 5.5.2 Decoder/demultiplexer U3

The first input and other related input pins are not connected in this decoder. *Table 13* shows the truth table for second input of U3.

**Table 12. Truth table for first input of U3**

| Inputs | | | Outputs | | | |
|---|---|---|---|---|---|---|
| Enable | Select | | | | | |
| N1G(1) | 1B(3) = GND | 1A(24) = CON-5V | nY0(4) =CON-3V3 | nY1(5) = NC | nY2(6) = NC | nY3(7) = NC |
| H | x | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |

Thus it can be seen by comparing column 3 (input 1A) and column 4 (output Y0), that the CON signal is getting buffered. Hence only the voltage level conversion from 5 V to 3.3 V is done.

**Table 13. Truth table for second input of U3**

| Inputs | | | Outputs | | | |
|---|---|---|---|---|---|---|
| Enable | Select | | | | | |
| n2G(15)=VCC | 2B(13)=GND | 2A(14) = GND | nY0(12) =NC | nY1(11)= NC | nY2(10) = NC | nY3(9) = NC |
| H | x | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |

*Note: Second input of U3 is not used in the application. However, to save the current consumption, these inputs are not left floating and are tied to ground.*

## 5.6 STUSB02E and STUSB03 transceiver pin configuration

*Table 14* shows the pin description of STUSB02E transceiver.

**Table 14. Pin description for STUSB02E transceiver**

| Pin no. | Symbol | I/O | Name and function |
|---|---|---|---|
| 0 | N.C | | Not connected |
| 1 | SPD | I | Edge rate control. A logic HIGH operates at edge rates for “full-speed” operation. A logic LOW operates edge rates for “low-speed” operation. |
| 2 | RCV | O | Receive data. Output for USB differential data. |
| 3 | VP | I/O | If OE# = H, VP = receiver output (+)<br>If OE# = L, VP = driver input (+) |
| 4 | VM | I/O | If OE# = H, VM = receiver output (-)<br>If OE# = L, VM = driver input (-) |
| 5 | CON | I | CONNECT (input). Controls state of VPU. Refer to VPU pin description for details. |
| 6 | GND | | Ground reference |
| 7 | SUS | I | Suspend (active-high). Turns off internal circuits to reduce supply current. |
| 8 | N.C. | | Not connected |
| 9 | OE# | I | Output enable (active-low). Enables transceiver data transmission to the bus.<br>When not active, the transceiver is in the receive mode. |
| 10, 11 | D-, D+ | I/O | Differential data lines. |
| 12 | VTRM | O | 3.3 V reference supply output. Requires a 1.0 µF decoupling capacitor for stability. |

**Table 14. Pin description for STUSB02E transceiver (continued)**

| Pin no. | Symbol | I/O | Name and function |
|---|---|---|---|
| 13 | VPU | O | Pull-up supply voltage output. Used to connect 1.5 kΩ pull-up speed detect resistor. If CON = 0, VPU is high impedance. If CON = 1, VPU = 3.3 V ±10%. |
| 14 | VBUS | I | USB bus supply voltage (4 V to 5.5 V). Supplies power to the USB transceiver and internal circuitry. |
| 15 | VIF | I | System interface supply voltage (1.6 V To 3.6 V). Provides reference supply voltage for system I/O interface signals. |
| 16 | VBUSDET | O | VBUS indicator output. When VBUS > 2.9 V, VBUSDET = high and when < 2.2 V, VBUSDET = low. |

*Table 15* shows the pin description of the STUSB03 transceiver.

**Table 15. Pin description for STUSB03 transceiver**

| Pin no. | Symbol | I/O | Name and function |
|---|---|---|---|
| 1 | SPD | I | Edge rate control. A logic HIGH operates at edge rates for “full speed” operation. A logic LOW operates edge rates for “low speed” operation. |
| 2 | RCV | O | Receive data. Output for USB differential data. |
| 3 | VP | I/O | If OE# = H, VP = receiver output (+)<br>If OE# = L, VP = driver input (+) |
| 4 | VM | I/O | If OE# = H, VM = receiver output (-)<br>If OE# = L, VM = driver input (-) |
| 5 | CON | I | CONNECT (input). Controls state of VPU. Refer to VPU pin description for detail. |
| 6 | GND | | Ground reference |
| 7 | SUS | I | Suspend (active-high). Turns off internal circuits to reduce supply current. |
| 8 | RSL | I | Full speed pull-up resistor selection input. If RSEL = 0 the internal pull-up resistor connected to D+ is disabled and an external resistor connected to VPU pin must be used. |
| 9 | OE# | I | Output enable (active-low). Enables transceiver data transmission onto the bus. When not active, the transceiver is in the receive mode. |
| 10, 11 | D-, D+ | I/O | Differential data lines. |
| 12 | VTRM | O | 3.3 V reference supply output. Requires a 1.0 µF decoupling capacitor for stability. |
| 13 | VPU | O | Pull-up supply voltage output. Used to connect 1.5 kΩ pull-up speed detect resistor. If CON = 0, VPU is high impedance. If CON = 1, VPU = 3.3 V ±10%. |

**Table 15. Pin description for STUSB03 transceiver (continued)**

| Pin no. | Symbol | I/O | Name and function |
|---|---|---|---|
| 14 | VBUS | I | USB bus supply voltage (4 V to 5.5 V). Supplies power to the USB transceiver and internal circuitry. |
| 15 | VIF | I | System interface supply voltage (1.6 V To 3.6 V). Provides reference supply voltage for system I/O interface signals. |
| 16 | VBUSDET | O | VBUS indicator output. When VBUS > 2.9 V, VBUSDET = high and when < 2.2V , VBUSDET = low. |
| EXP | N.C. | | Not Connected |

Refer to the relevant datasheet of the device for a detailed description.

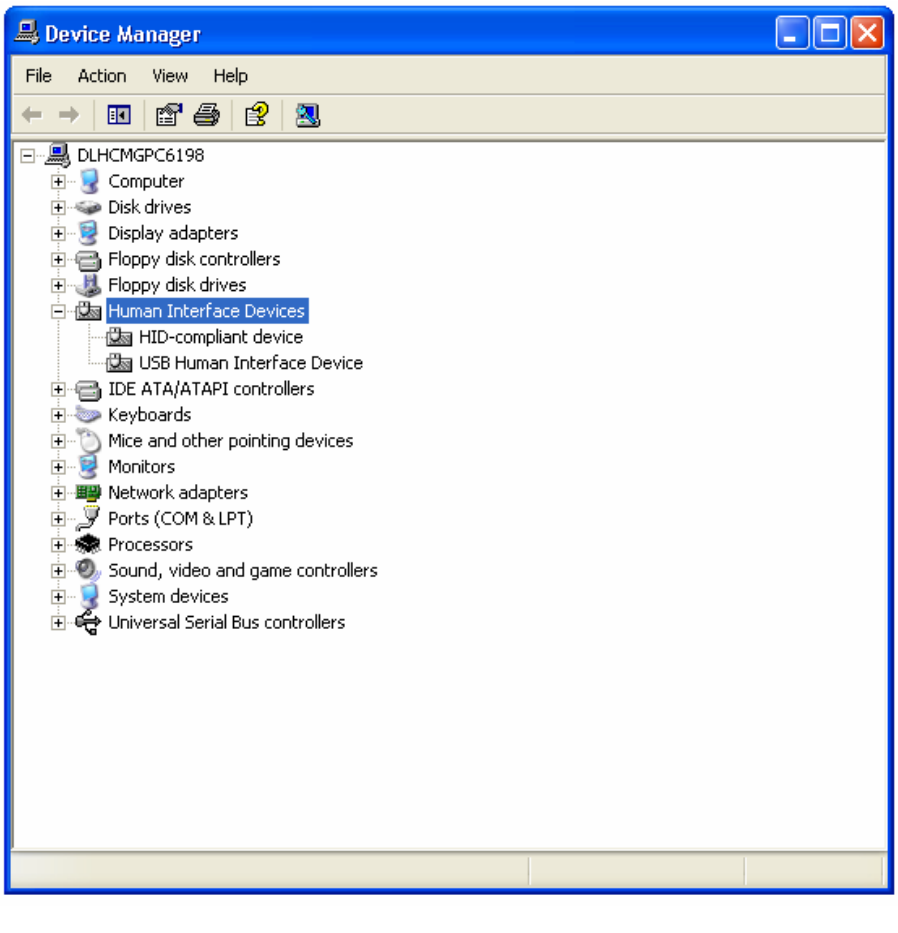
# 6 Firmware

The demo-application consists of an HID demonstrator GUI running on the PC and HID class demonstration firmware running on the board. The PC software and the firmware running on the USB microcontroller provide a clear example of data exchange between the PC and the board. The USB signals are routed through the STUSB02E/STUSB03E transceiver. The ST72F63B firmware is based on a USB core library that does all the hardware control of the USB interface. This application board incorporates basic input sources such as push-buttons, trimmers or output devices (LEDs) and a wrap area. Communications between the PC and the ST7 board are done through different USB pipes:

- control IN and OUT during the enumeration with the bi-directional endpoint 0
- interrupt IN from endpoint 1 for data transferred from ST7 to PC
- interrupt OUT to the endpoint 2 for the data transferred from PC to ST7

The evaluation board must first be connected to the PC with the USB cable. As a result, the evaluation board is enumerated as a HID device as shown in *Figure 4* and is ready to use.

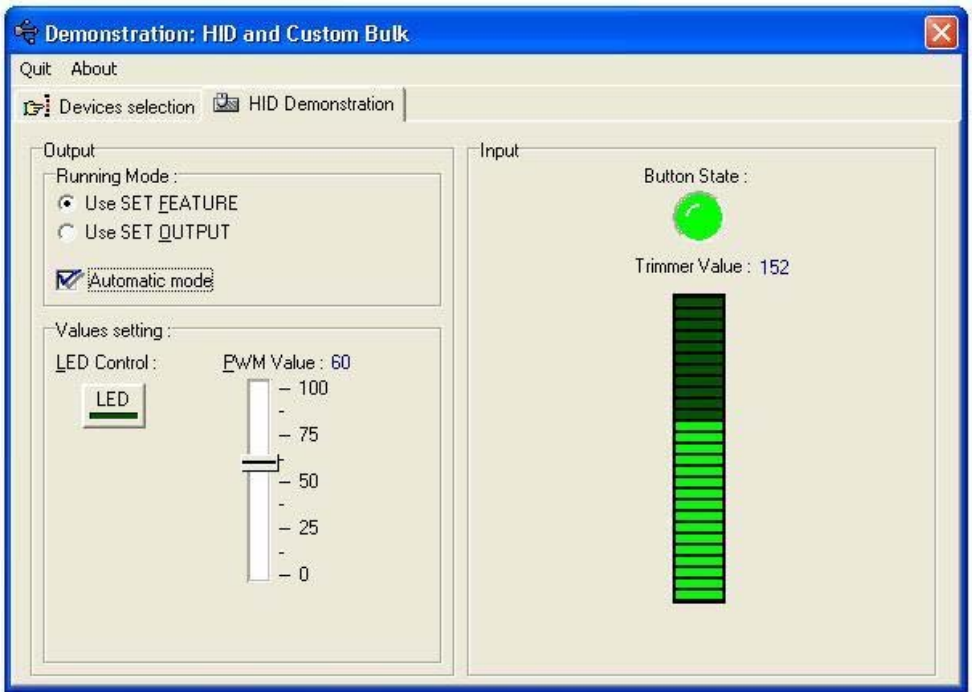
**Figure 4. STUSB02E/STUSB03E evaluation board enumeration**




By starting the HID demonstrator on the PC, you get a graphical interface for controlling the application board. This PC software is used to demonstrate the enumeration process and

data transfer between the PC and the ST7 peripheral according to the USB HID class specifications.

**Figure 5. STUSB02E/ STUSB03 evaluation board demonstration**




## 6.1 Communication with the application board

### 6.1.1 PC software control of the evaluation board

Click on the LED button in the application dialog box to switch ON the LED D3 on the board. Click again to switch it OFF. The slider bar controls the brightness of D4 on the board. Each slider bar value is converted to a pulse width modulation (PWM) by the microcontroller. The brightness of LED D4 changes according to the slider value.

### 6.1.2 Display of evaluation board state

- Button state: this green LED changes its state when push-button SW4 of the evaluation board is pressed.
- Trimmer value: this value is the result of the analog-to-digital conversion of the VR1 trimmer output. When the position of the trimmer mounted on the evaluation board is modified, the new ADC value is transmitted via the USB bus and displayed on the progress bar of the HID demonstrator.

## 6.2 USB suspend

The evaluation board enters the standby state when the PC is put in standby mode with the board connected to the PC. In this mode, the microcontroller enters the USB suspend mode. Power status LED D2 turns off indicating the standby state of the board. The board resumes its run state when the PC exits standby mode.

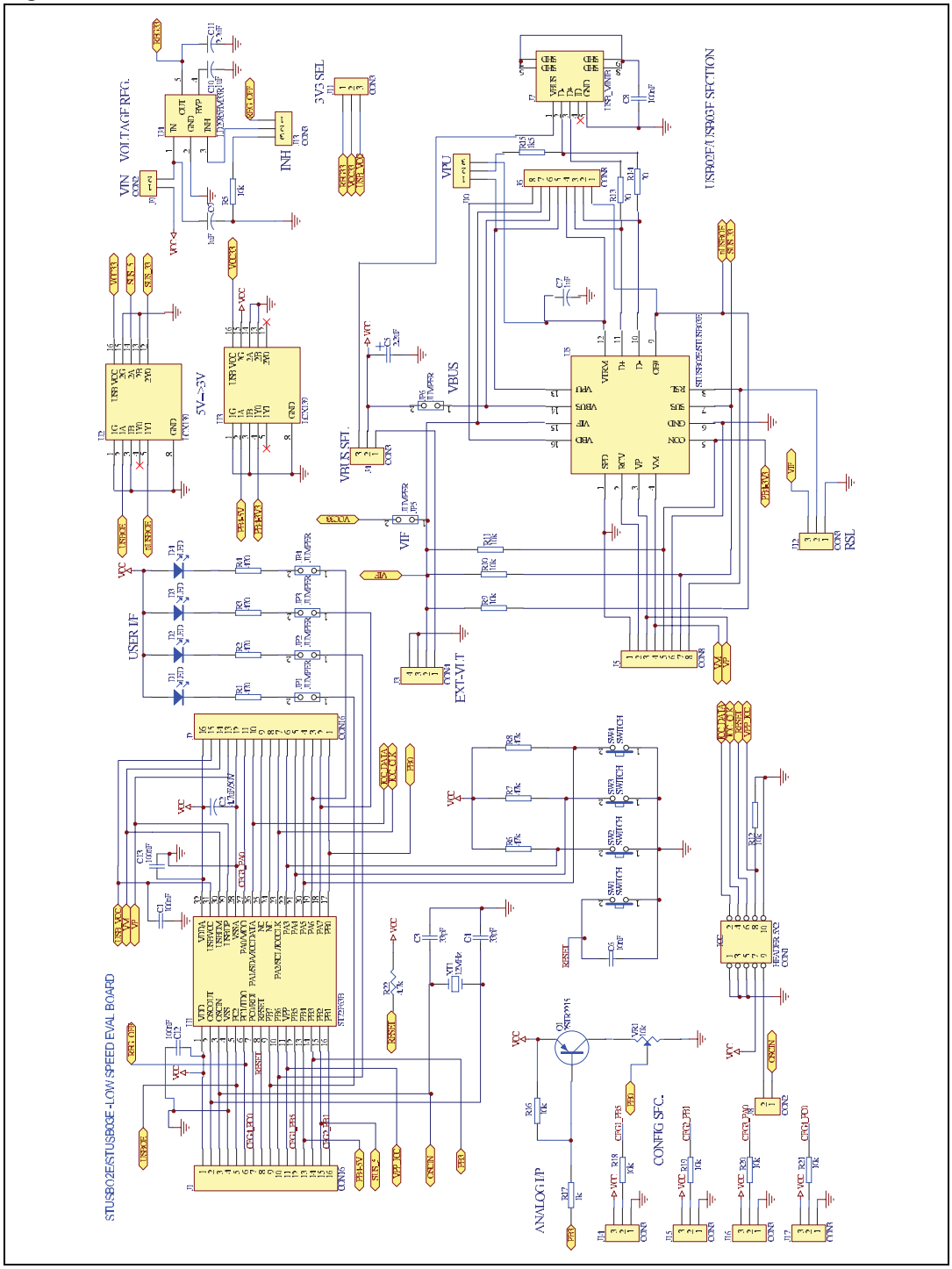
Current consumption of the evaluation board in the suspend state is according to USB specifications for low-power devices.

During suspend mode, the MCU is put in HALT mode to consume the minimum current. All I/Os of the microcontroller shall be configured for minimum current consumption. See *Appendix A: Port configuration* of detailed I/O configuration during run mode and suspend mode.

The transceiver is put in suspend mode by making the SUS pin high. Also the current flowing from the potentiometer is reduced by switching the transistor OFF.

# 7 Schematics

**Figure 6. STUSB02E/STUSB03E evaluation board schematic**



# 8 Bill of material

**Table 16. BOM list**

| Index | Quantity | Ref. | Value / generic part number | Package | Manufacturer | Manufacturer's ord. code / ord. part number |
|---|---|---|---|---|---|---|
| **Devices** | | | | | | |
| 1 | 1 | U1 | Microcontroller | PSDIP32 | STMicroelectronics | ST72F63BK4B1 |
| 2 | 2 | U2, U3 | Decoder/ demultiplexer | SO-16 | STMicroelectronics | 74LCX139MTR |
| 3 | 1 | U4 | Voltage regulator | SOT-23-5L | STMicroelectronics | LD2985BM33R |
| 4 | 1 | U5 | USB transceiver | QFN16 | STMicroelectronics | STSB02EQR / STSB03EQR |
| 5 | 1 | Q1 | PNP transistor | SOT-23 | STMicroelectronics | 2STR2215 |
| LEDs | | | | | | |
| 1 | 4 | D1, D2, D3, D4 | LED | 3 mm red, through hole | Any | |
| **Crystals and oscillator** | | | | | | |
| 1 | 1 | XT1 | Quartz crystal 12 MHz | SS4 (HC49/U4H) 11.35*4.6 mm | Jauch | |
| **Connectors and jumpers** | | | | | | |
| 1 | 1 | CON1 | HEADER 5X2 | 2.54*2.54 mm | Any | |
| 2 | 2 | J1,J2(1) | HEADER 1X16 | 2.54 mm pitch | Any | |
| 3 | 1 | J3 | HEADER 1X4 | 2.54 mm pitch | Any | |
| 4 | 8 | J4, J11, J12, J13, J14, J15, J16, J17 | HEADER 1X3 | 2.54 mm pitch | Any | |
| 5 | 2 | J5, J6(1) | HEADER 1X8 | 2.54 mm pitch | Any | |
| 6 | 9 | J8, JP1, JP2, JP3, JP4, JP5, JP6, JP9, JP10 | 2 pin HDR | 2.54 mm pitch | Any | |

Table 16. BOM list (continued)

| Index | Quantity | Ref. | Value / generic part number | Package | Manufacturer | Manufacturer's ord. code / ord. part number |
|---|---|---|---|---|---|---|
| 7 | 1 | J7 | USB_MINI B | B-type mini | KYCON Inc. 30TR | |
| **Passive components** | | | | | | |
| 1 | 4 | R1, R2, R3, R4 | 470 Ω | SMD0805 | Any | |
| 2 | 10 | R5, R9, R10, R11, R12, R16, R18, R19, R20, R21 | 10 kΩ | SMD0805 | Any | |
| 3 | 2 | R14, R13 | 20 Ω | SMD0805 | Any | |
| 4 | 1 | R15 | 1.5 kΩ | SMD0805 | Any | |
| 5 | 1 | R17 | 1 kΩ | SMD0805 | Any | |
| 6 | 1 | R22 | 4.7 kΩ | SMD0805 | Any | |
| 7 | 3 | R6, R7, R8 | 47 kΩ | SMD0805 | Any | |
| 8 | 1 | (VR1) POT | 10 kΩ | 3/8” square, top adjust, triangular pattern pins | Bourns | |
| 9 | 5 | C1, C6, C8, C12, C13 | 100 nF | SMD0805 | Any | |
| 10 | 1 | C2 | 4.7 µF / 25 V tantalum | EIA 3528-21 size B | Any | |
| 11 | 2 | C3, C4 | 22 pF or 33 pF | SMD0805 | Any | |
| 12 | 3 | C7, C9, C10 | 1 µF tantalum | EIA 3216-18 size A | Any | |
| 13 | 2 | C5, C11 | 2.2 µF tantalum | EIA 3528-21 size B | Any | |
| **Switches** | | | | | | |
| 1 | 4 | SW1, SW2, SW3, SW4 | 2 pin switch | TACT switch | Any | |

1. Not mounted

*Note: For detailed datasheets of STMicroelectronics’ products, please visit www.st.com*

# Appendix A Port configuration

**Table 17. Port configuration**

| Port pin | Pin configuration | | | | |
|---|---|---|---|---|---|
| | Connection status | Run state | | Suspend state | |
| | | Input/output | 1/0 | Input/output | 1/0 |
| **Port A** | | | | | |
| PA0 | CFG3/MCO | Output | 0 | Output | 0 |
| PA1 | ICC_DATA//SDA | Output | 0 | Output | 0 |
| PA2 | ICC_CLK/SCL | Output | 0 | Output | 0 |
| PA3 | SW2 | Input | 0 | Input | 0 |
| PA4 | SW3 | Input | 0 | Input | 0 |
| PA5 | SW4 | Input | 0 | Input | 0 |
| PA6 | D4 LED | Output | 1 | Output | 1 |
| PA7 | D3 LED | Output | 1 | Output | 1 |
| **Port B** | | | | | |
| PB0 | POT VR1 PIN No.3 | Input | 0 | Input | 0 |
| PB1 | CFG2 | Output | 0 | Output | 0 |
| PB2 | SUS_5V | Output | 0 | Output | 1 |
| PB3 | Q1 On/off(0-To turn on Q1) | Output | 0 | Output | 1 |
| PB4 | CON_5V | Output | 1 | Output | 1 |
| PB5 | CFG1 | Output | 0 | Output | 0 |
| PB6 | D2 LED | Output | 0 | Output | 1 |
| PB7 | D1 LED | Output | 1 | Output | 1 |
| **Port C** | | | | | |
| PC0 | CFG4 | Output | 0 | Output | 0 |
| PC1 | REG_OFF | Output | 1 | Output | 1 |
| PC2 | USBOE | Controlled by the microcontroller as per settings in MICSR of ST72F63B | - | - | - |

# Appendix B Abbreviations

**Table 18. Abbreviations**

| Term | Description |
|---|---|
| ADC | Analog-to-digital converter |
| GUI | Graphical user interface |
| HID | Human interface devices |
| PC | Personal computer |
| USB | Universal serial bus |
| VBUS | USB bus supply voltage = 5 V |
| VIF | System interface supply voltage |
| VPU | Pull-up supply voltage |

# 9 Revision history

Table 19. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 04-Jun-2008 | 1 | Initial release |