AVR271: USB Keyboard Demonstration

Features

- **Runs on STK525 and AT90USBKEY**
- **Supported by Windows98 or later, Linux and MAC OS**
- **No driver installation**
- **Display a simple text message**
- **Does not support keyboard LEDs**

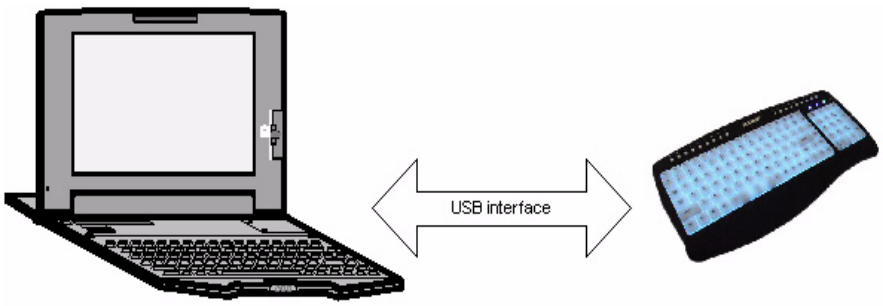
1. Introduction

The PS/2 interface is disappearing from the new generation PCs being replaced by the USB interface, which has become the standard interface between the PCs and peripherals. This change must be followed by keyboard designers, who must integrate the USB interface to connect the keyboard to the PC.

The aim of this document is to describe how to start and implement a USB keyboard application using the STK525 starter kit and FLIP in-system programming software.

A familiarity with USB firmware architecture (Doc 7603, Included in the CD-ROM & Atmel website) and the HID specification (http://www.usb.org/developers/hidpage) is assumed.

Figure 1-1. PC to Keyboard Interface



8-bit AVR® Microcontrollers

Application Note

7602A–USB–01/06

2. Hardware Requirements

The USB keyboard application requires the following hardware:

1. AT90USB Evaluation Board (STK525)
2. AT90USB microcontroller
3. USB cable (Standard A to Mini B)
4. PC running on Windows® (98SE, ME, 2000, XP) or Linux with USB 1.1 or 2.0 host

3. Software Requirements

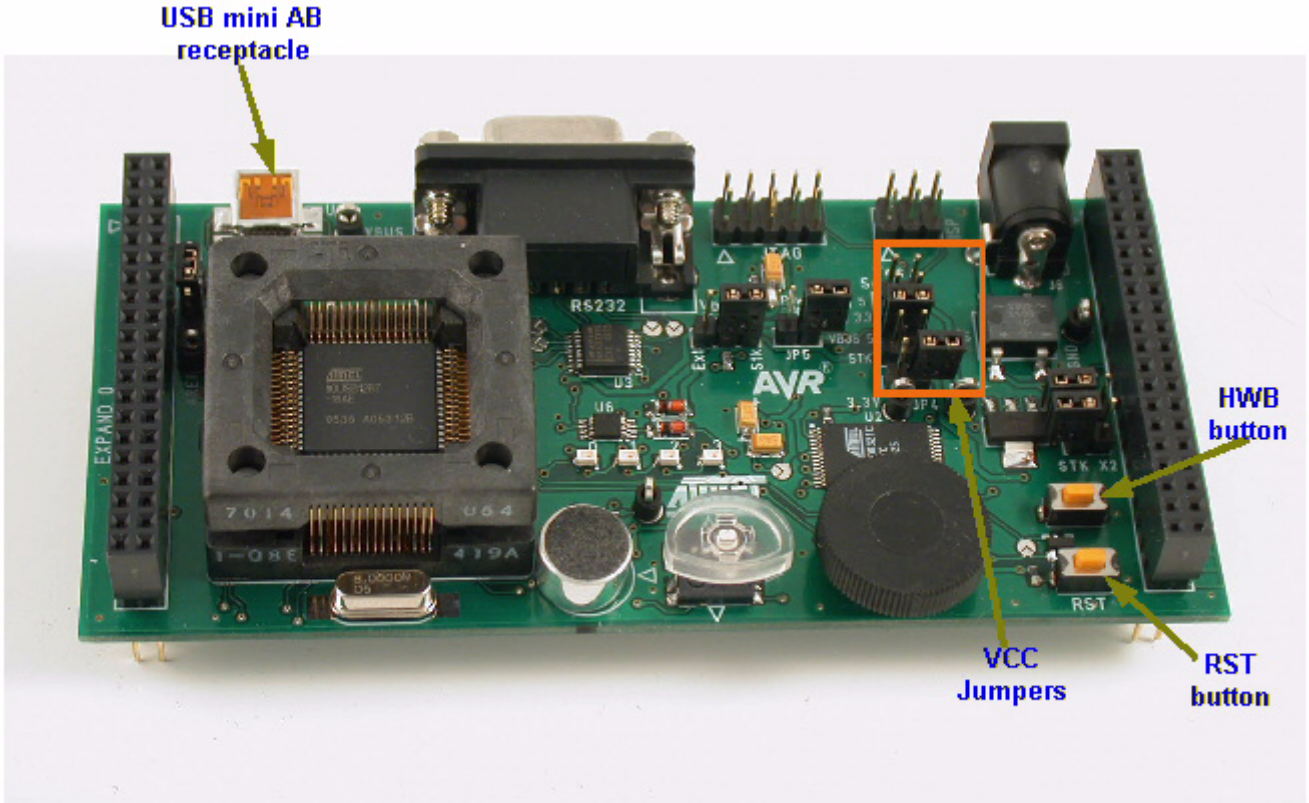
The software needed for this application:

1. FLIP software (Device Firmware Upgrade tool)
2. usb_keyboard.a90 (included in USB CD-ROM)

4. STK525 Default Settings

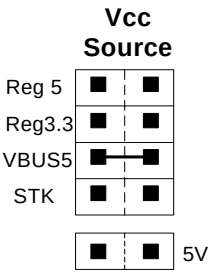
The STK525 board must be configured as below:

Figure 4-1. STK525 Board



All the jumpers should be open, only the Vcc Source jumper VBUS5 should be set as below:

Figure 4-2. Vcc Jumpers



5. Device Firmware Upgrade

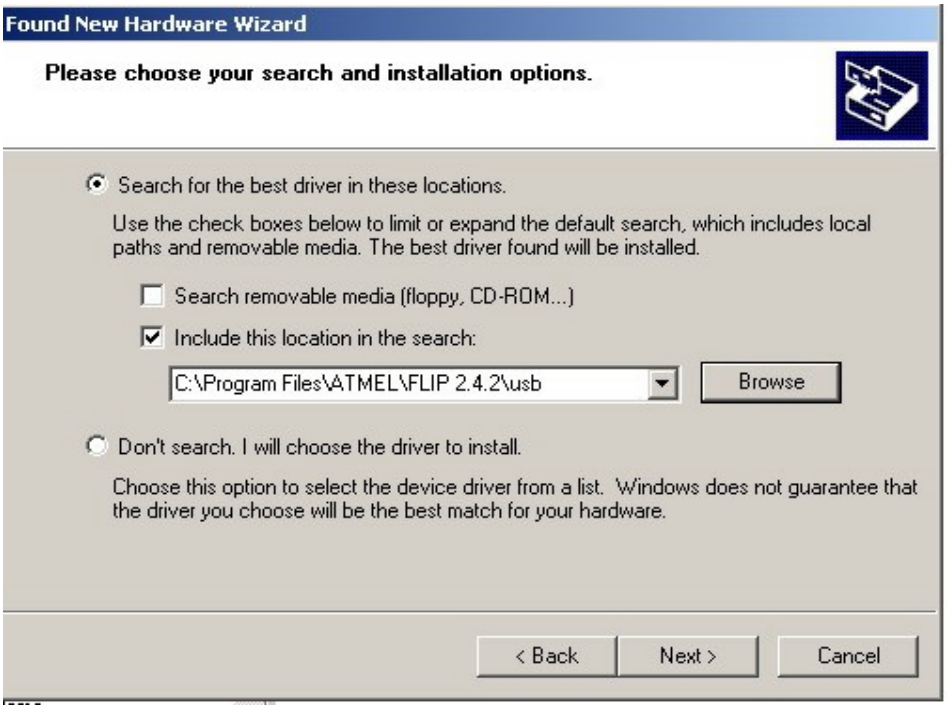
The first thing to do before starting the demo is to load the hex file into the on-chip flash memory of the microcontroller. The “Flip” software is the tool used to upgrade the firmware (available freely in the USB CD-ROM or Atmel website).

The following steps should be completed to allow the device starting DFU mode, and load the hex file:

1. Install Flip software (Flip version 3.0 or above is required).
2. Connect the STK525 board to the PC using the USB cable (Standard A to Mini B).
3. Push the HWB (Hardware Bootloader) button
4. Push the RST (Reset) button
5. Release the RST button
6. Release the HWB button
7. If your hardware conditions explained above are correct, a new device detection wizard will be displayed. Please follow the instructions (the INF file is located in the USB subdirectory from Flip installation: “install path:\ATMEL\FLIP\FLIPx.x.x\usb”).

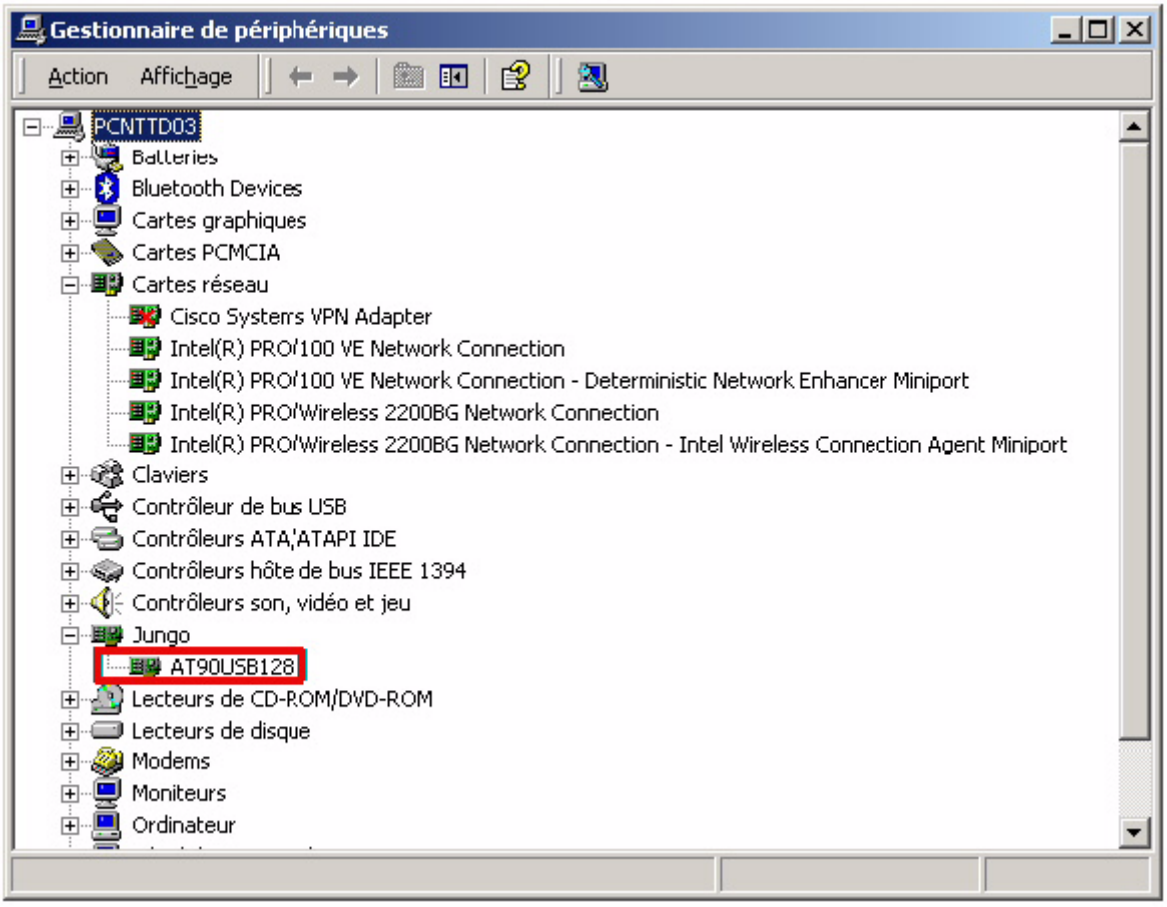
Figure 5-1. New Device Detection Wizard

Figure 5-2. Driver's Location



8. Check the Device Manager, and you should see the same icon (jungo icon) as shown in the figure below. If not start again from the step 2.

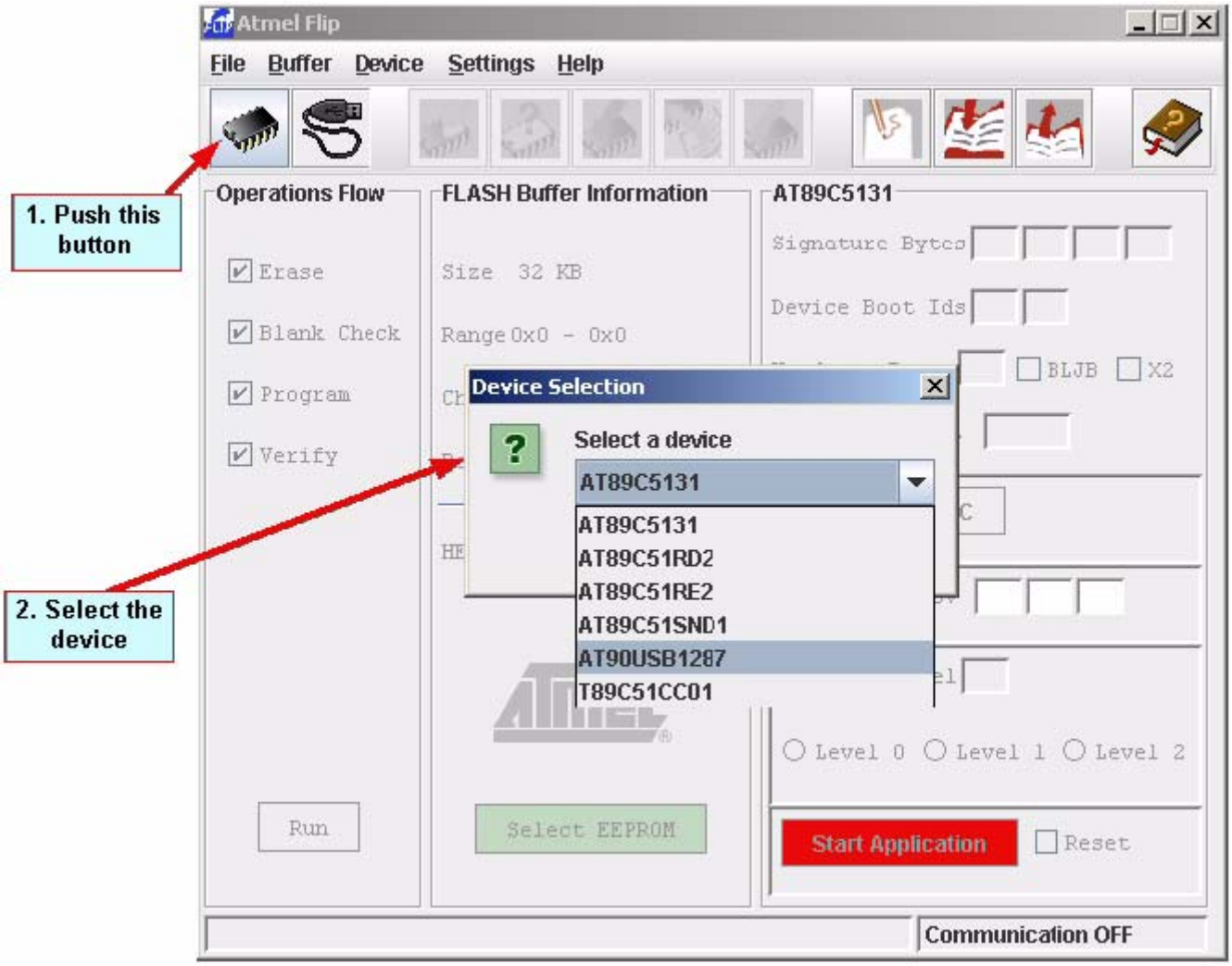
Figure 5-3. Device Manager



Once your device is in DFU mode, launch the FLIP software and follow the instructions explained below:

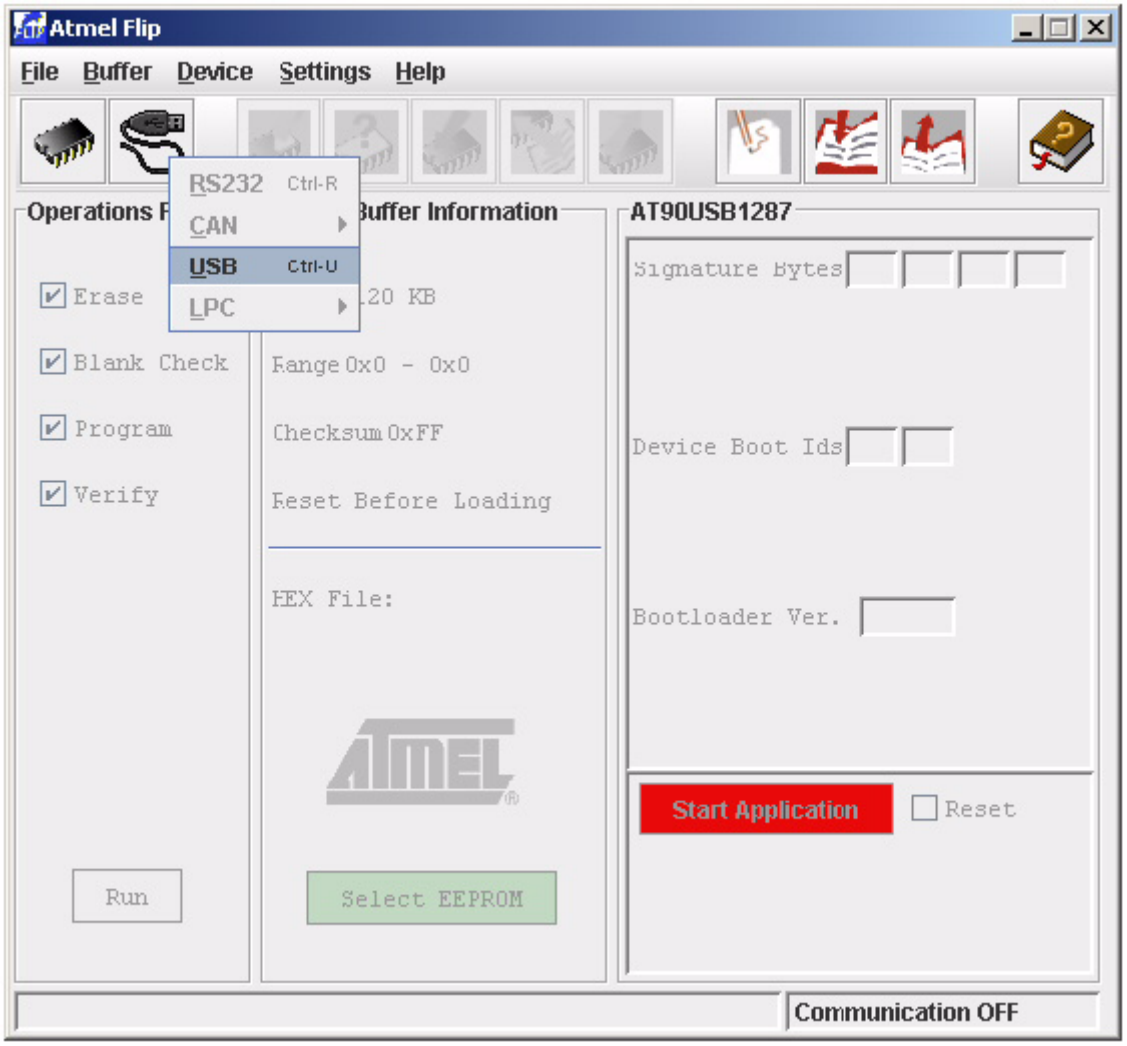
1. Select AT90USB device

Figure 5-4. Device Selection



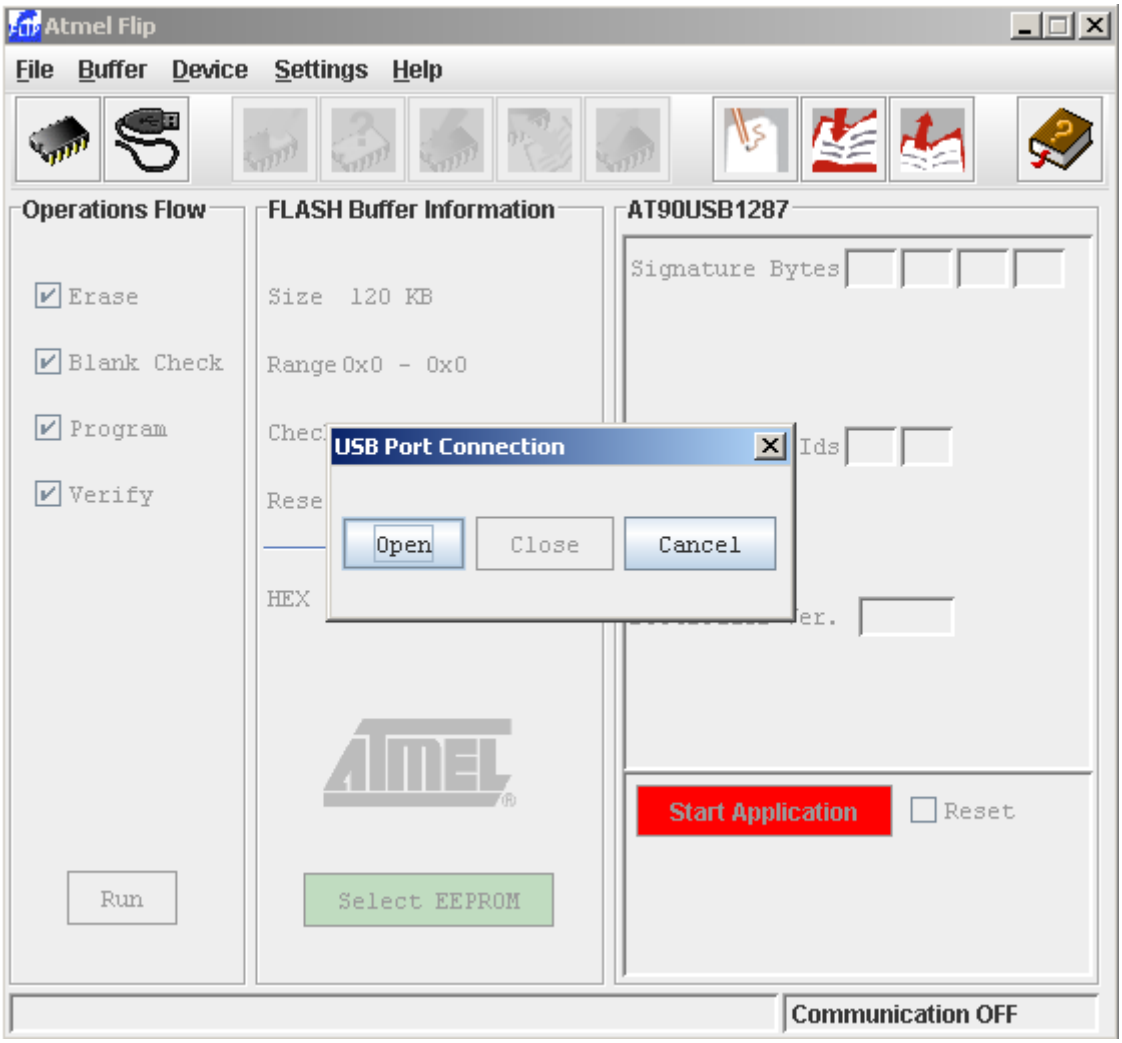
2. Select the USB as communication mode

Figure 5-5. USB Communication Mode



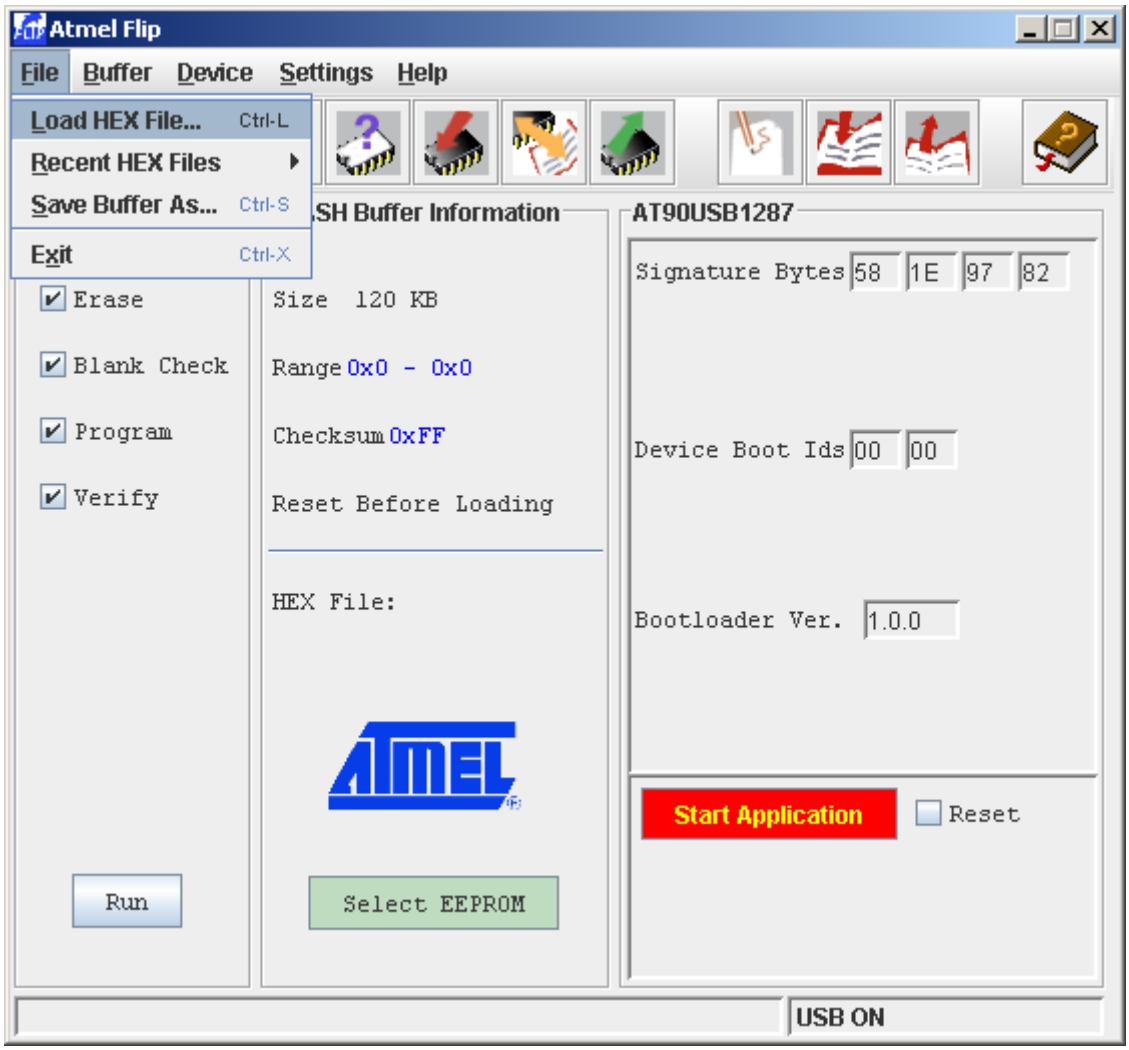
3. Open the communication

Figure 5-6. Open the USB Communication



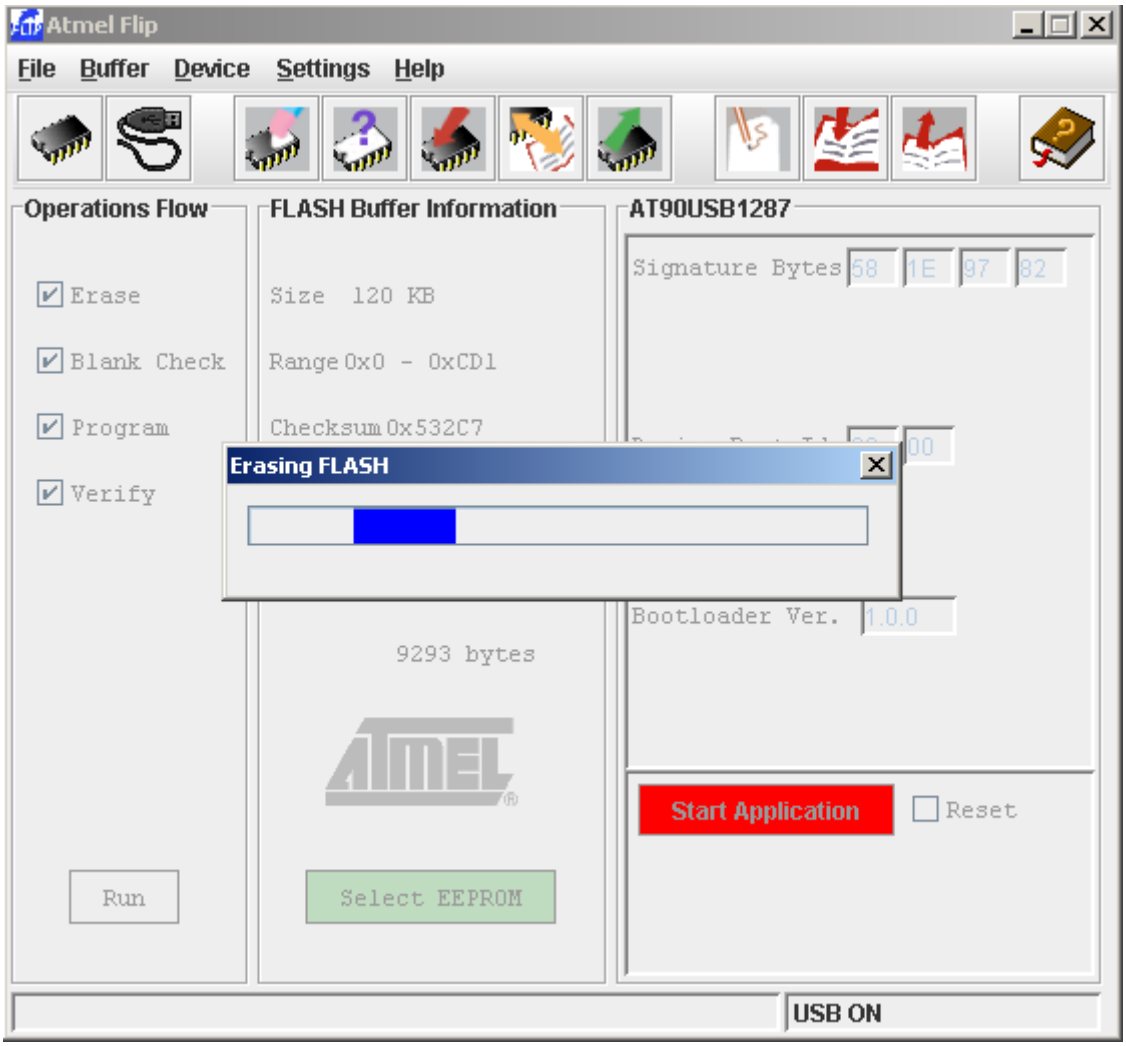
4. Choose the HEX file to load (the HEX file is including in USB CD-ROM: usb_keyboard.a90)

Figure 5-7. HEX File to Load



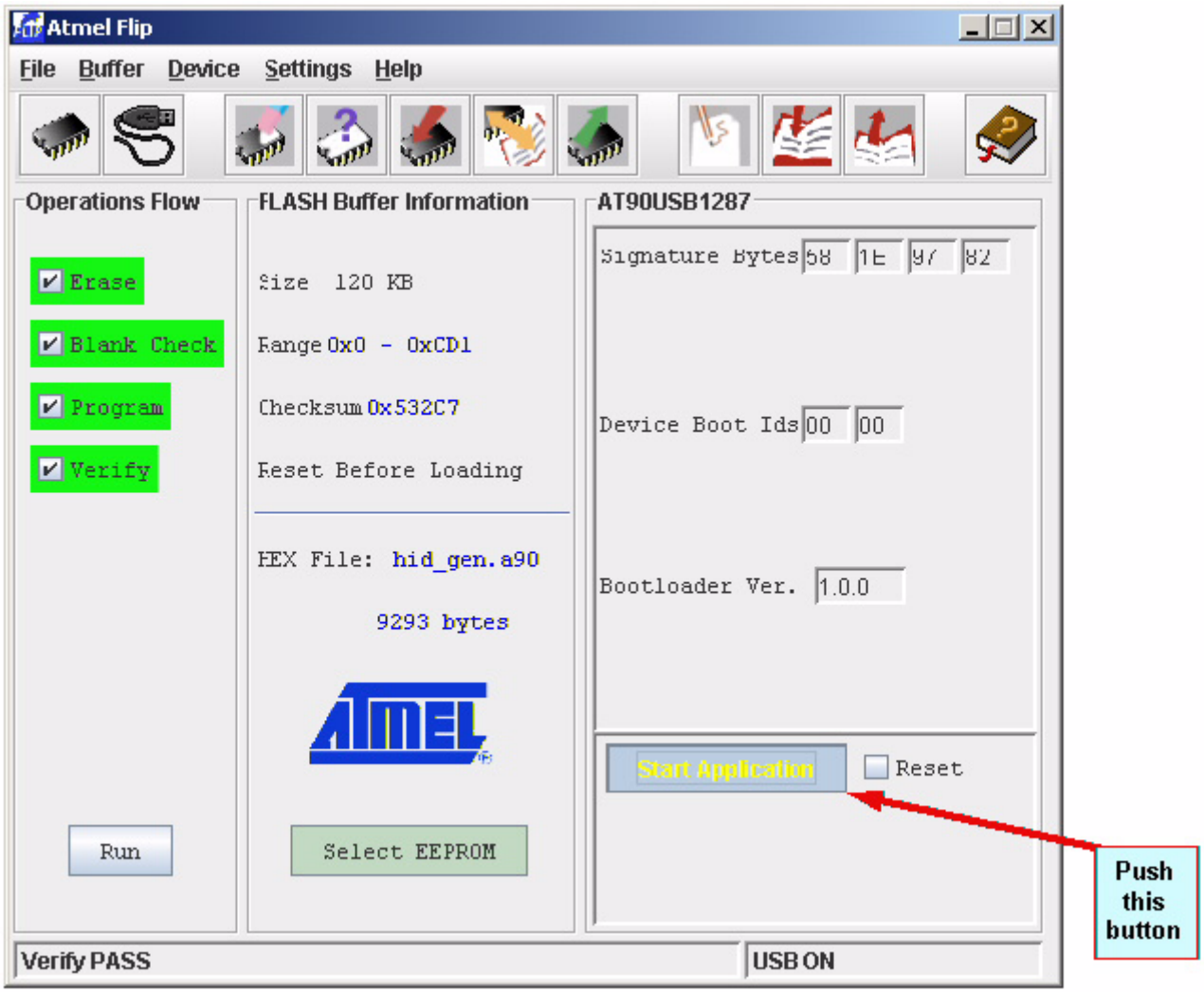
5. Load the HEX file (*Check Erase, Blank Check, Program* and *Verify*, then Push *Run* button)

Figure 5-8. HEX File Loading



6. Start the application.

Figure 5-9. Start Application

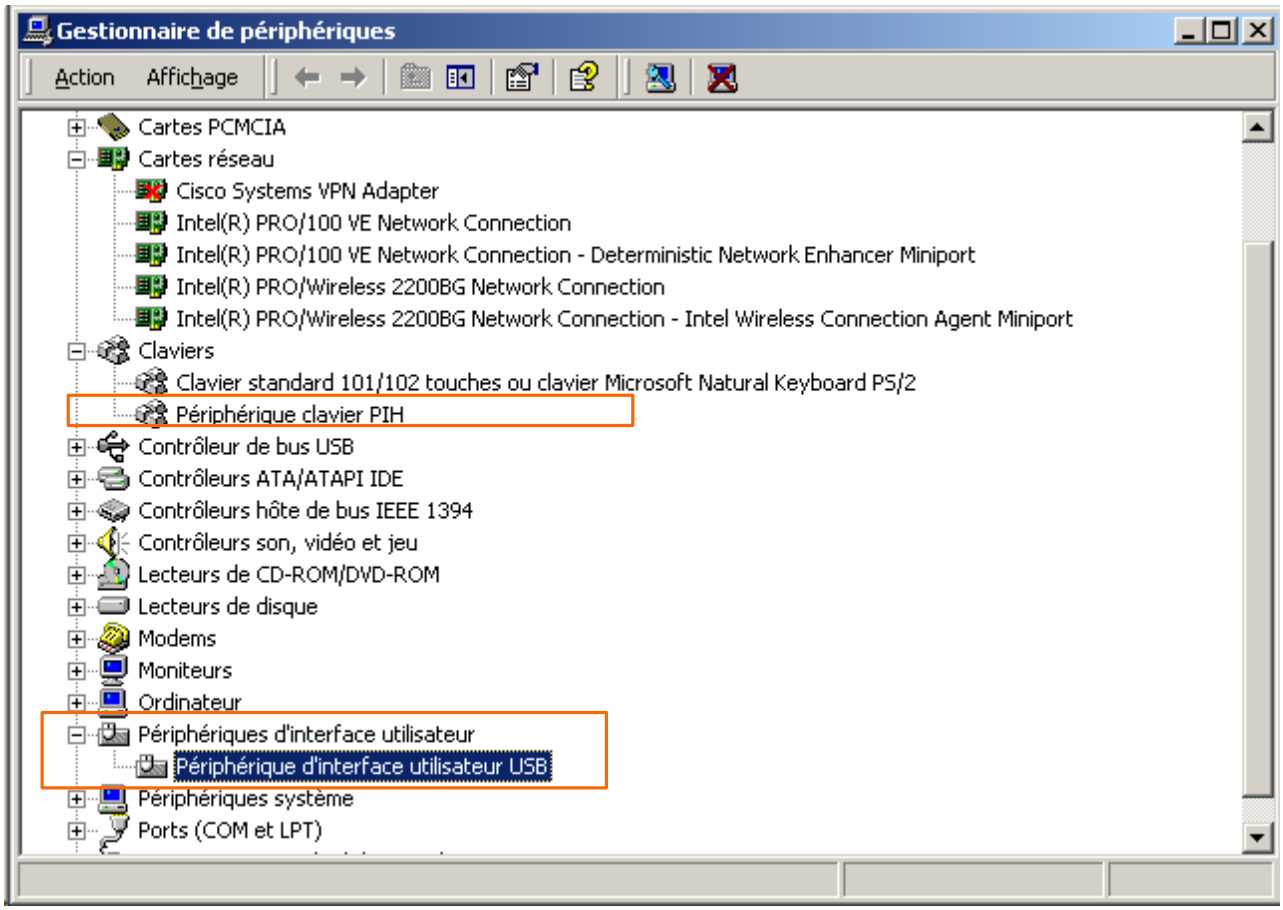


Note: The AT90USB bootloader will detach and jump into the user application when “Start Application” button is pressed.

6. Quick start

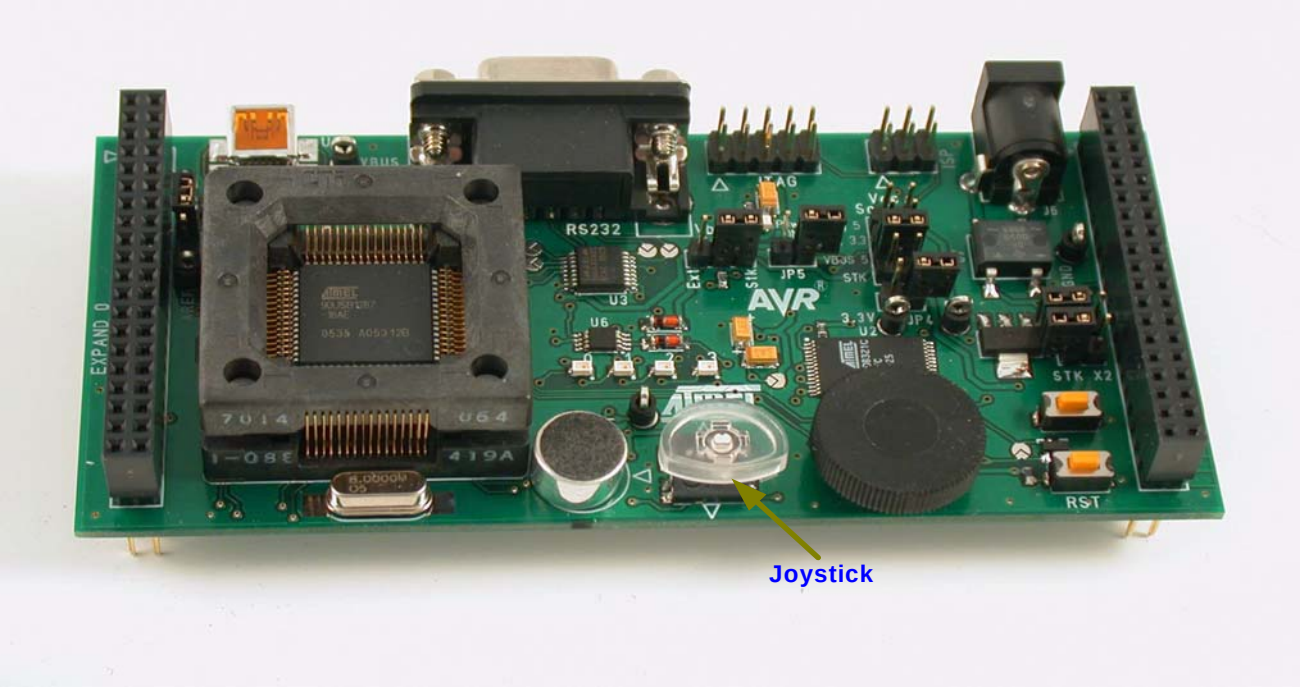
Once your device is programmed with *usb_keyboard.a90* file, you can start the keyboard demonstration. Check that your device is enumerated as keyboard (see Figure 6-1), then you can use the STK525 as a keyboard.

Figure 6-1. Keyboard enumeration



The figure below shows the Hardware used by the demo:

Figure 6-2. Hardware used

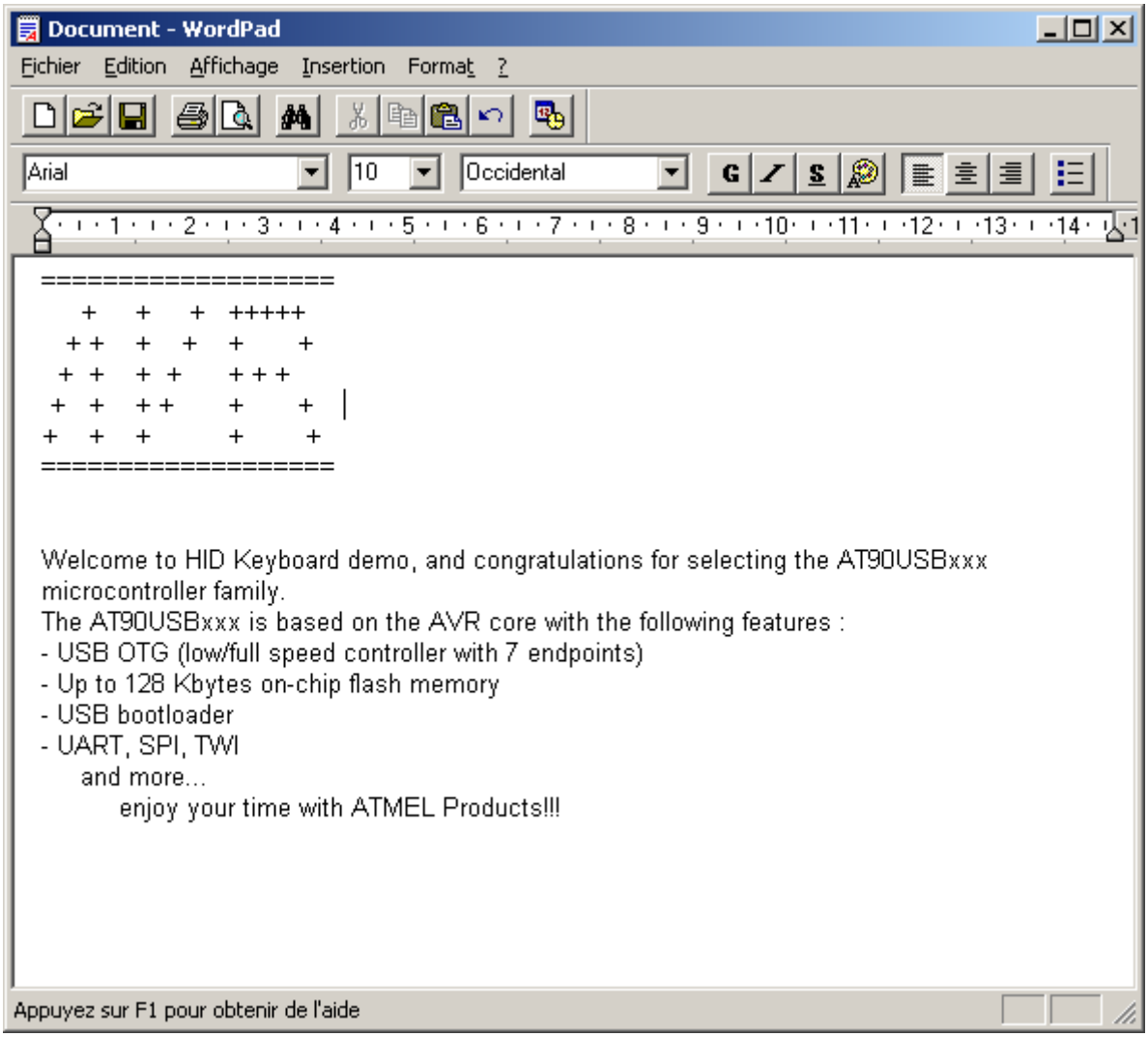


The purpose of the keyboard demonstartion is to send a character string to the PC.

Follow the instructions below to start the demo:

1. Open the Notepad application or any text editor.
2. Set your keyboard to QWERTY configuration (Otherwise, you'll see the wrong characters on your text editor).
3. Connect the STK525.
4. Push the joystick button.

Figure 6-3. Keyboard Demo



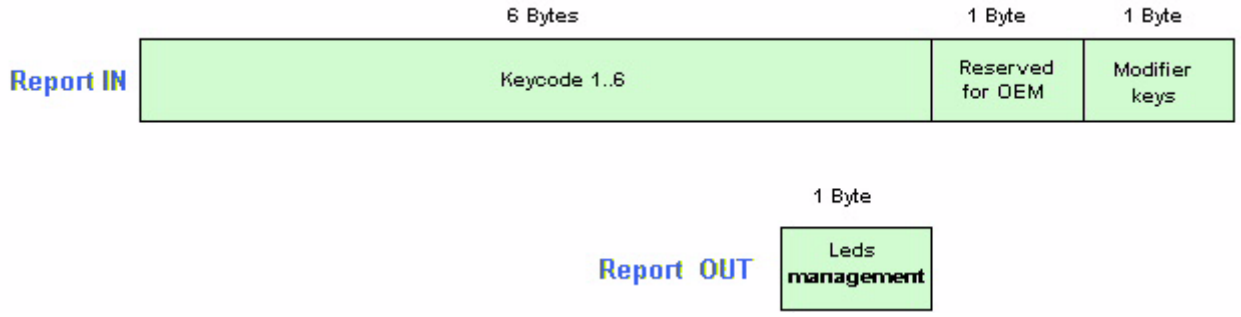
7. Application overview

The USB Keyboard application is a simple data exchange between the PC and the keyboard.

The PC asks the keyboard if there is a new data available each *P* time (polling interval time), the keyboard will send the data if it is available, otherwise, it will send a NAK (No Acknowledge) to tell the PC that there is no data available now.

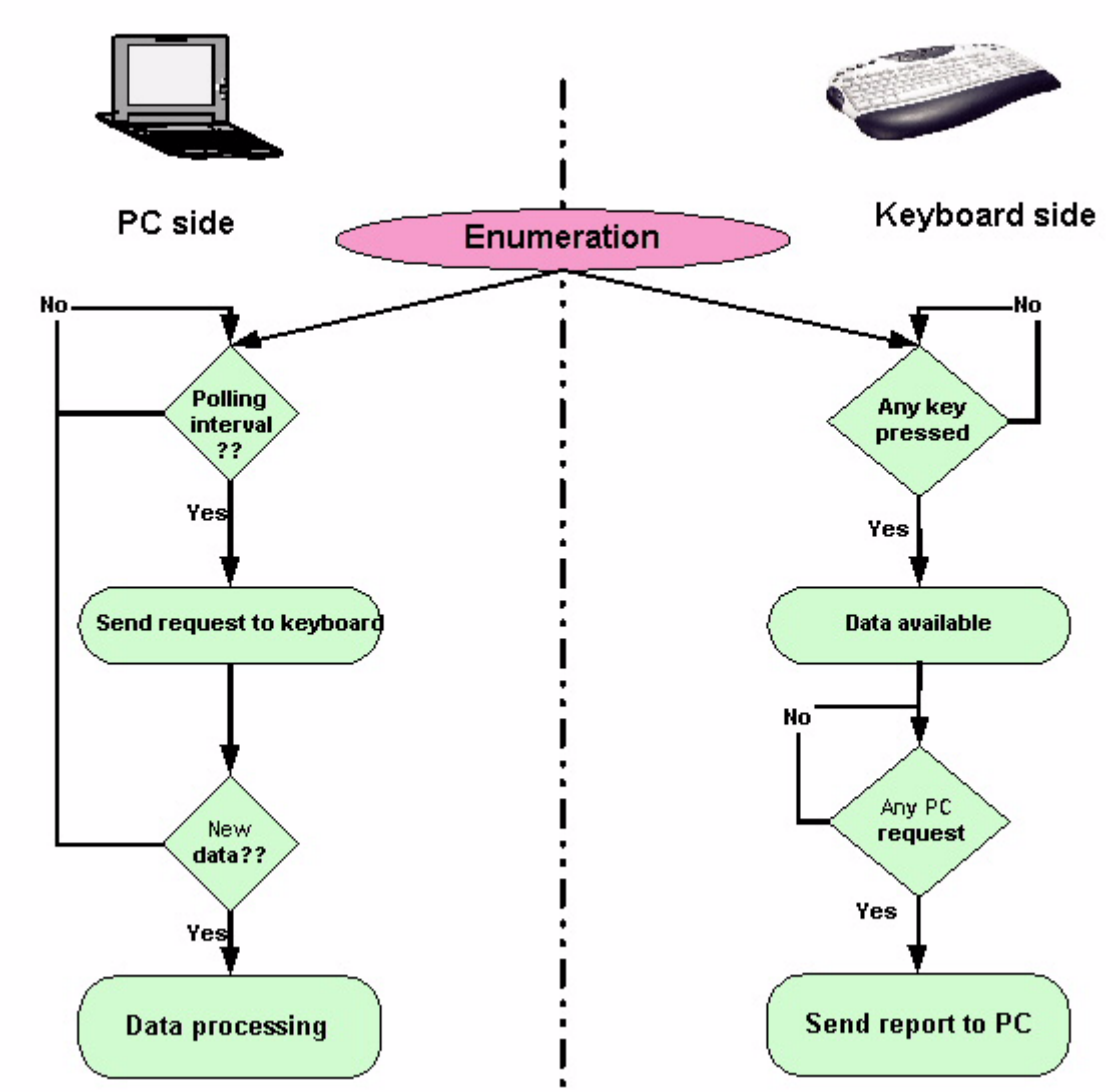
The data exchanges between the PC and the keyboard are called reports. The report which contains the keys pressed is the report IN (Keyboard to PC). The report which contains the LEDs status (NUM LOCK, CAPS LOCK, SCROLL LOCK...) is the report OUT (PC to Keyboard). The figure below shows the structure of these reports:

Figure 7-1. USB Report Structure



Note: This demonstration manages the report IN only.

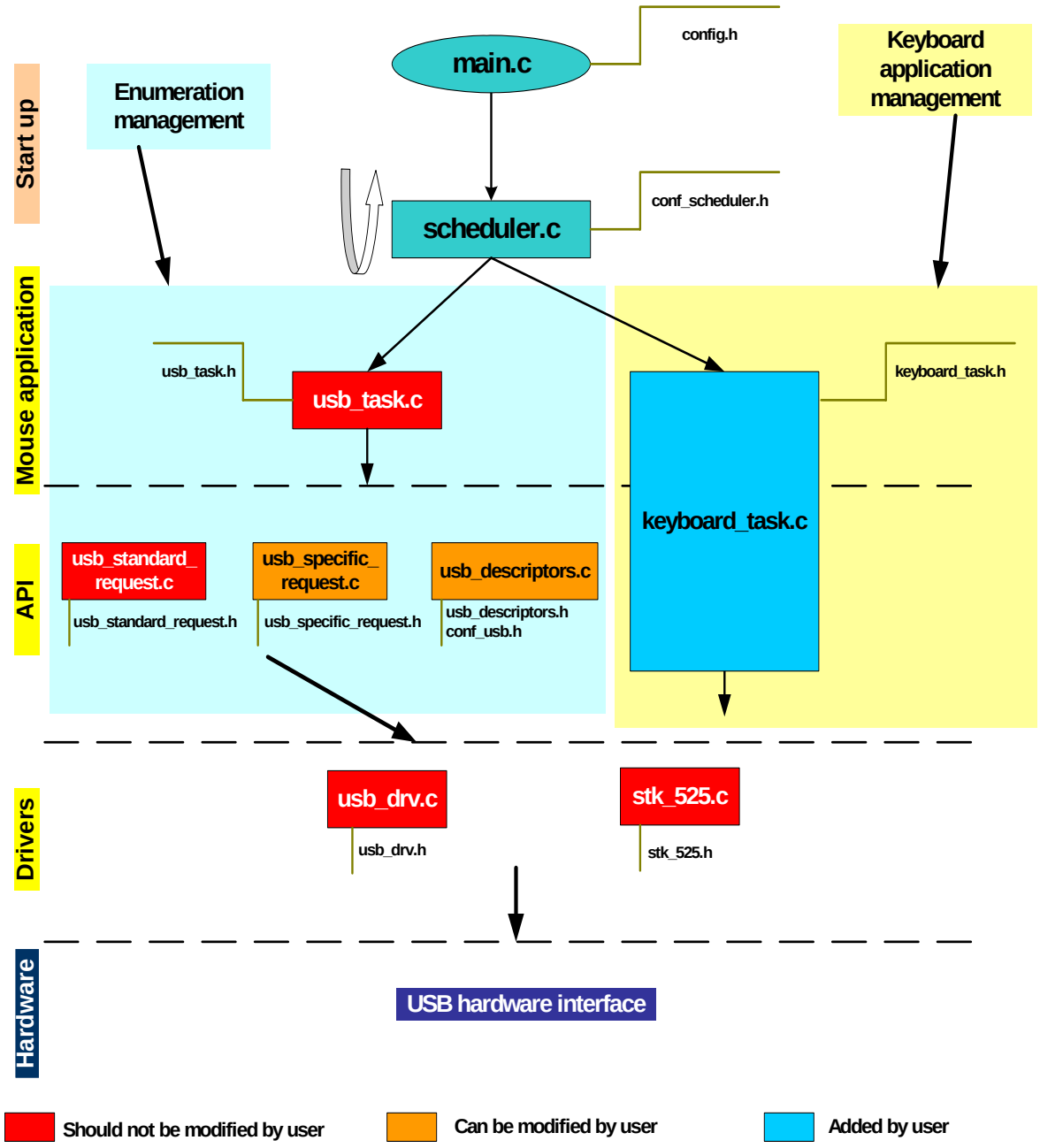
Figure 7-2. Application Overview



8. Firmware

As explained in the USB Firmware Architecture document (Doc 7603,included in the USB CD-ROM) all USB firmware packages are based on the same architecture (please refer to this document for more details).

Figure 8-1. USB Keyboard Firmware Architecture

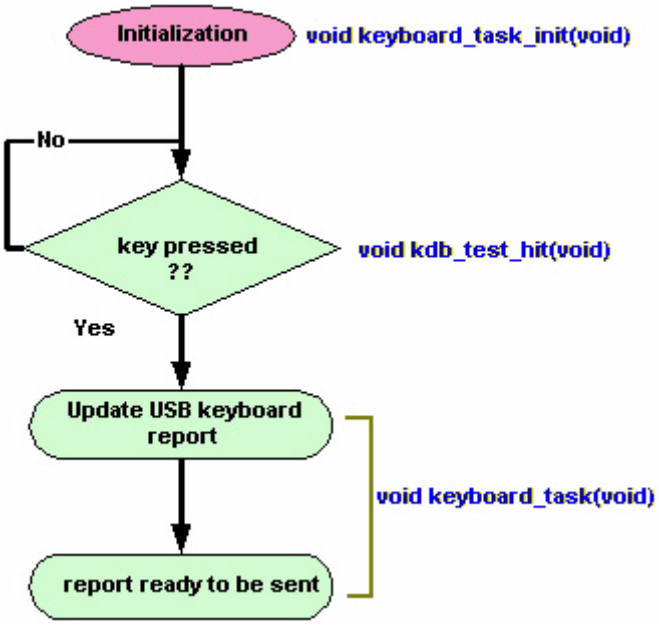


This section is dedicated to the keyboard module only. The customization of the files described hereafter allow the user to build his own keyboard Application.

8.1 keyboard_task.c

This file contains the functions to initialize the HW which will be used as keyboard, collect the report data and put it in the endpoint FIFO to be ready to be sent to the PC.

Figure 8-2. Keyboard Application



8.1.1 keyboard_task_init

This function performs the initialization of the keyboard parameters and hardware resources (joystick...).

8.1.2 kbd_test_hit

This function checks if there is a key pressed and set the *key_hit* variable to true.

8.1.3 keyboard_task

This function checks if any key is pressed (*key_hit* == *true*). If it is the case, the report IN is filled out with the related values and loaded in the usb endpoint fifo to be transmited to the host.

8.2 stk_525.c.

This file contains all the routines to manage the STK 525 board ressources (Joystick, potentiometer, Temperature sensor, LEDs...).

9. PC Software

The USB keyboard application doesn't require any PC software.

10. Limitations

The demonstration does not manage the OUT report.

11. Related documentations

- AVR USB Datasheet
- USB Firmware Architecture
- USB HID class specification

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