AVR271: USB CDC Demonstration UART to USB Bridge

8-bit AVR® Microcontrollers

Application Note

Features

- **Supported by Windows® 2000 or later**
- **No driver installation**
- **Virtual Com Port Enumeration**
- **USB to RS232 Bridge with dynamic baudrate**
- **Bus powered**

1. Introduction

The RS232 interface has disappeared from the new generation of PCs replaced by the USB interface. To follow this change, applications based on UART interface have to migrate to USB. Migration to USB can mean heavy development both on the PC and on the device side. To avoid this development, Atmel offers you a solution based on the CDC class (Communication Device Class) with the following adavantages:

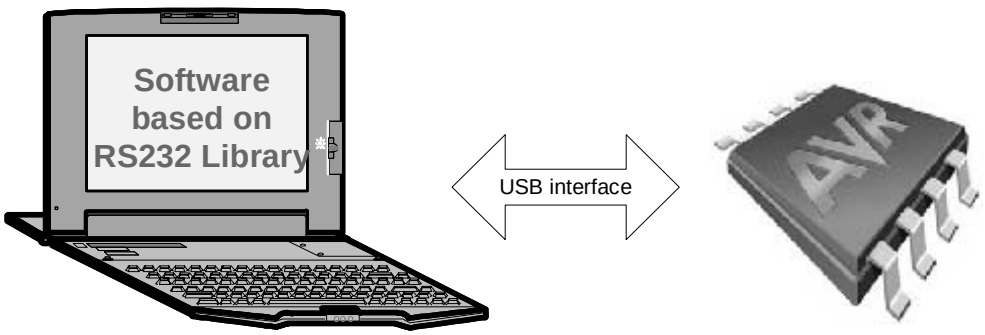
No need to change the PC application

Few modifications from the device side

The aim of this document is to describe how to start and implement a CDC (Virtual Com Port and UART to USB bridge) 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 CDC specification (http://www.usb.org) is assumed.

Figure 1-1. Virtual Com Port Application



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2. Hardware Requirements

The USB CDC application requires the following hardware:

1. AT90USB Evaluation Board (STK525)
2. AT90USB microcontroller with default factory configuration (including USB bootloader)
3. USB cable (Standard A to Mini B)
4. RS232 crossed Cable (DB9 male to DB9 female)
5. PC running on Windows® (2000, XP) with USB 1.1 or 2.0 host

Note: Another STK 525 and USB port are required if the PC has no RS232 interface.

3. Software Requirements

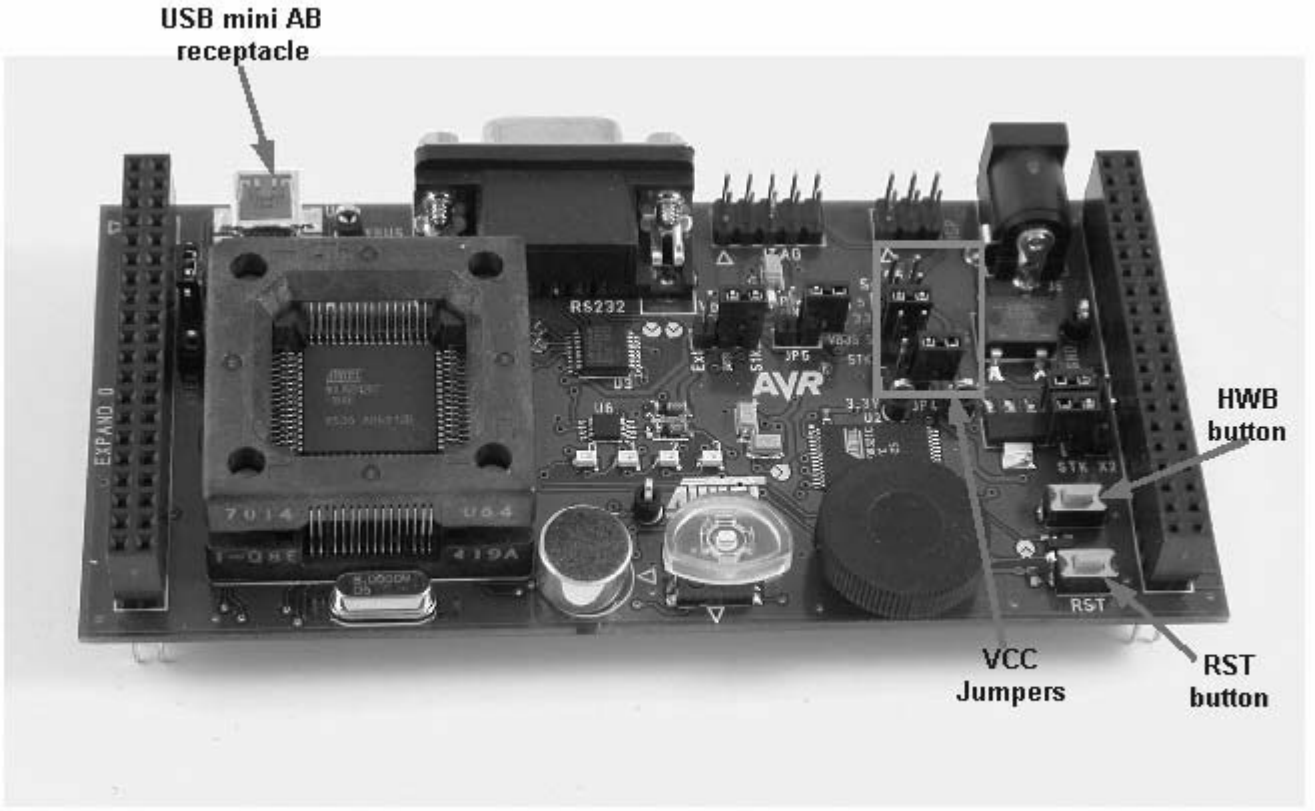
The software needed for this application:

1. FLIP software (Device Firmware Upgrade tool)
2. usb_cdc.a90 (included in USB CD-ROM)
3. Hyperterminal application or similar

4. STK525 Default Settings

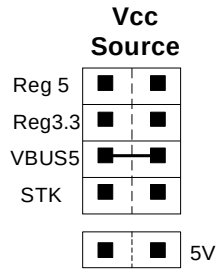
The STK525 board must be configured as below:

Figure 4-1. STK525 Board



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

Figure 4-2. Vcc Jumpers



The microcontroller must be properly placed on its socket. Please refer to STK525 Hardware User's Guide.

5. Device Firmware Upgrade

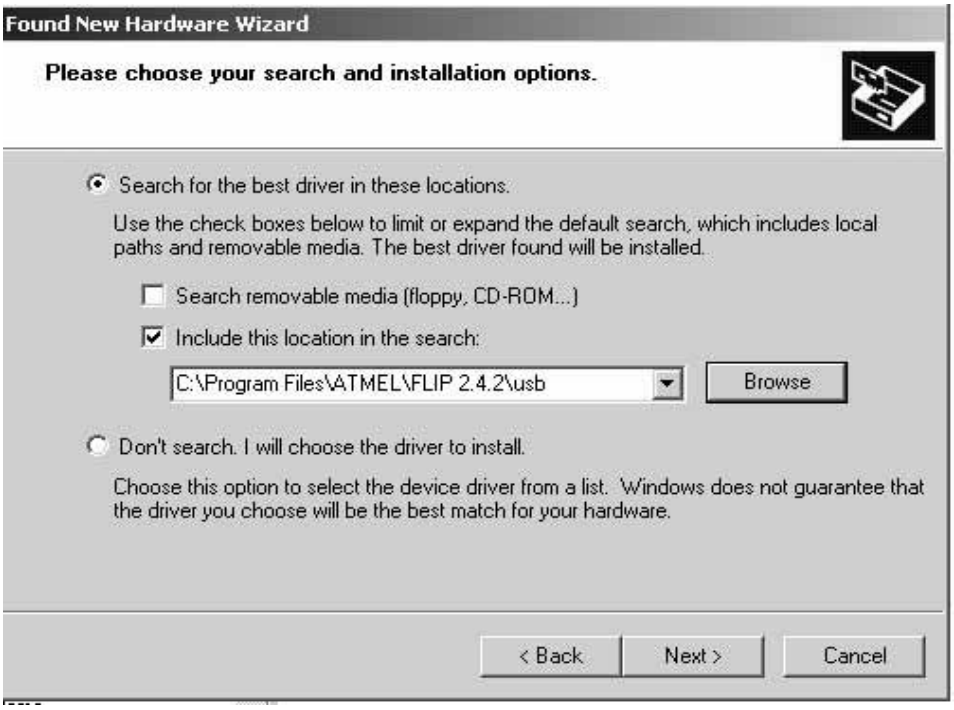
The first thing to do before starting the demo is to load the HEX file into the on-chip Flash memory of the microcontroller. The "Flip" software is the tool used to upgrade the firmware (available freely from the USB CD-ROM or Atmel website).

The following steps should be completed to allow the device starting DFU (Device Firmware Upgrade)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").

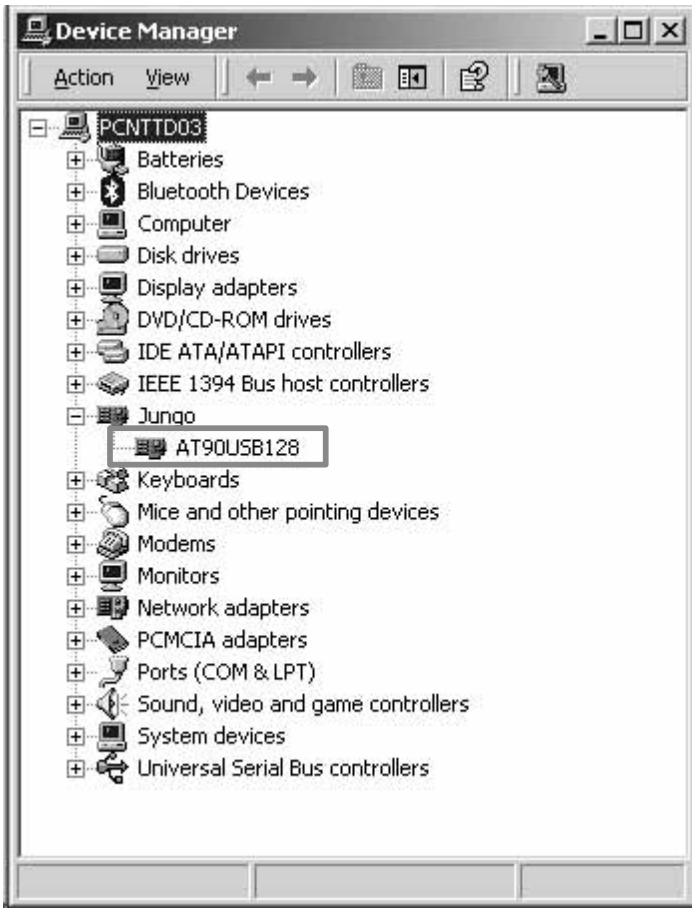
Figure 5-1. New Device Detection Wizard

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.

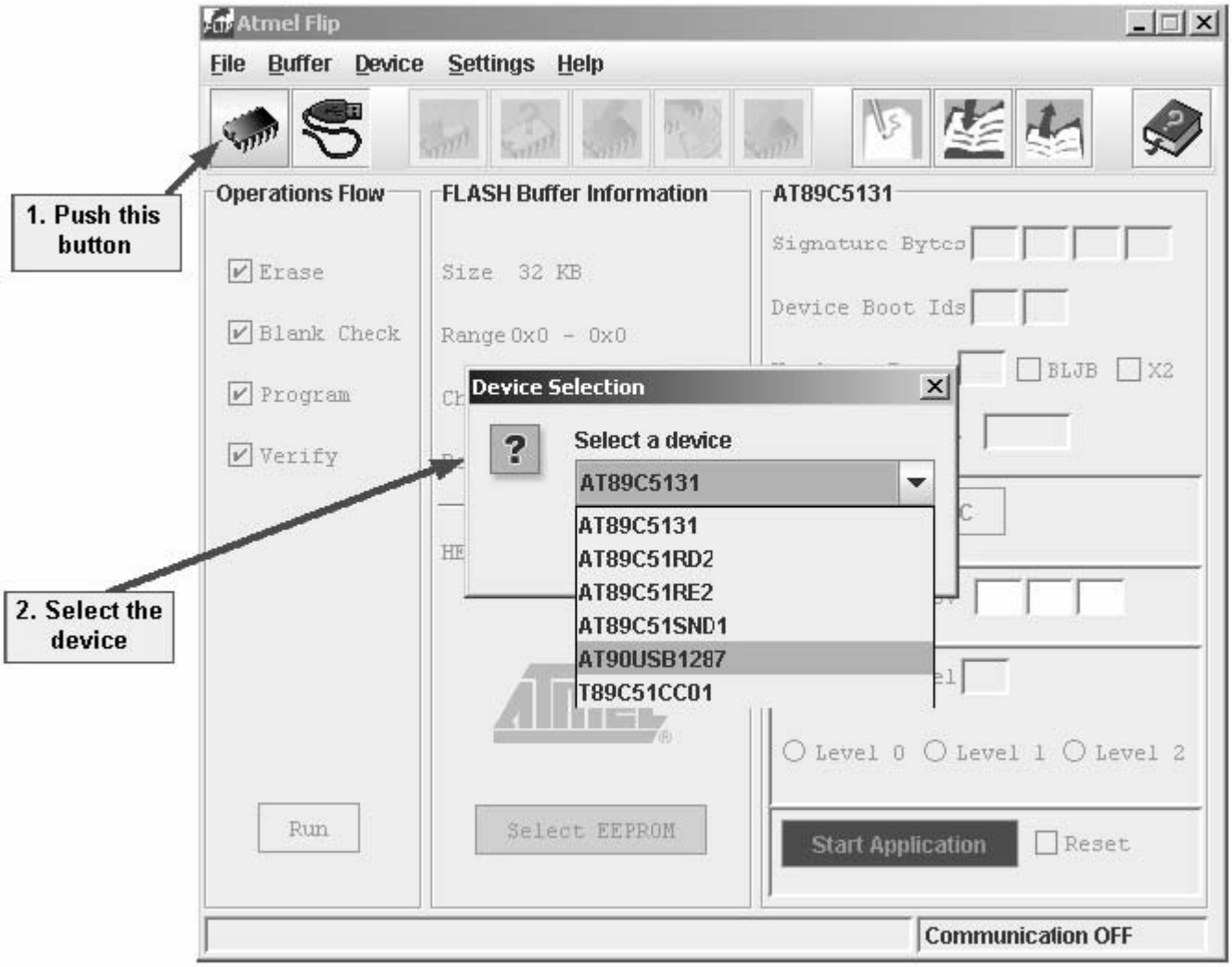
Figure 5-3. Device Manager



Once your device is connected in DFU mode with Jungo driver loaded, launch the FLIP software and follow the instructions explained below:

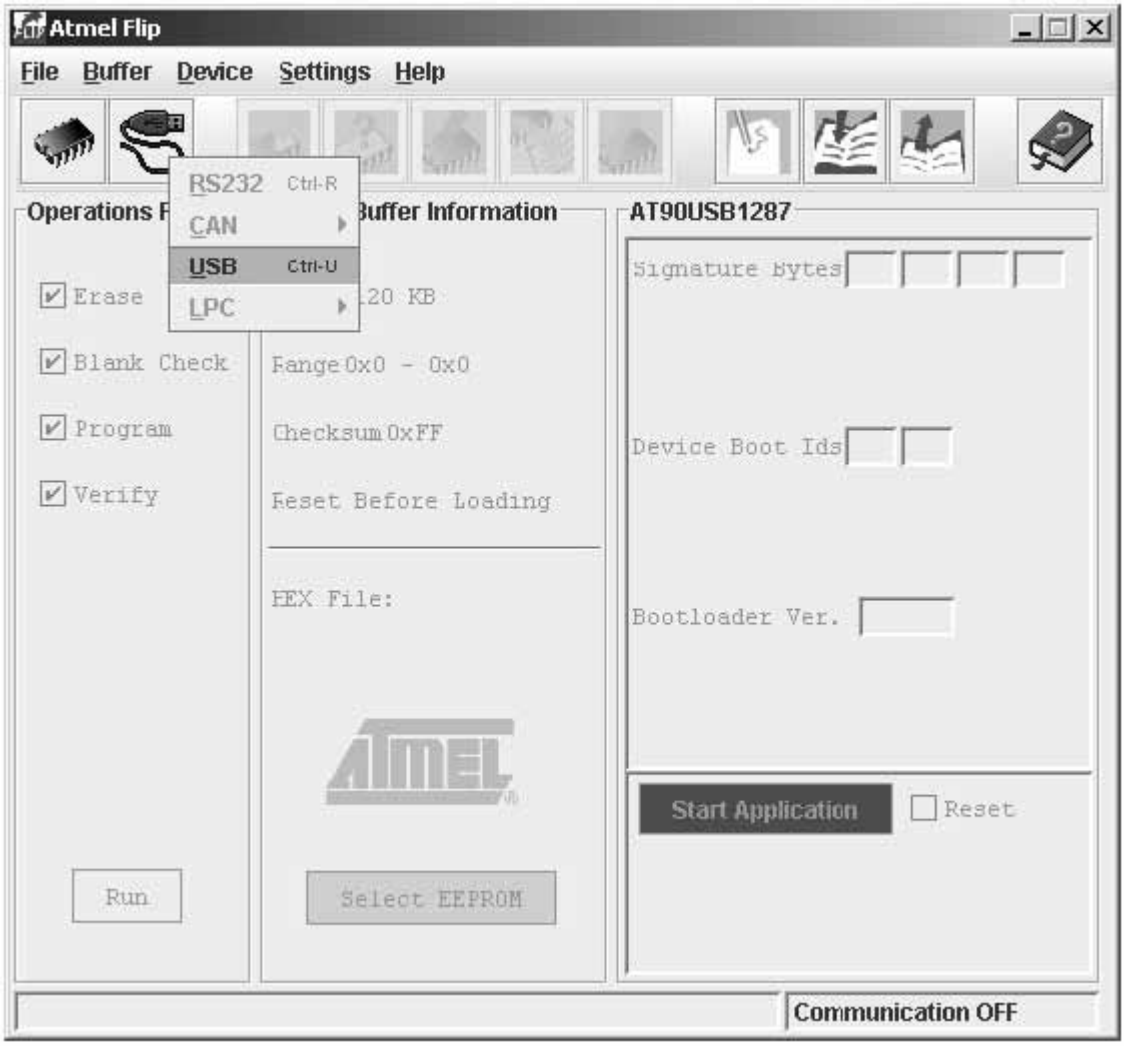
1. Select AT90USB device

Figure 5-4. Device Selection



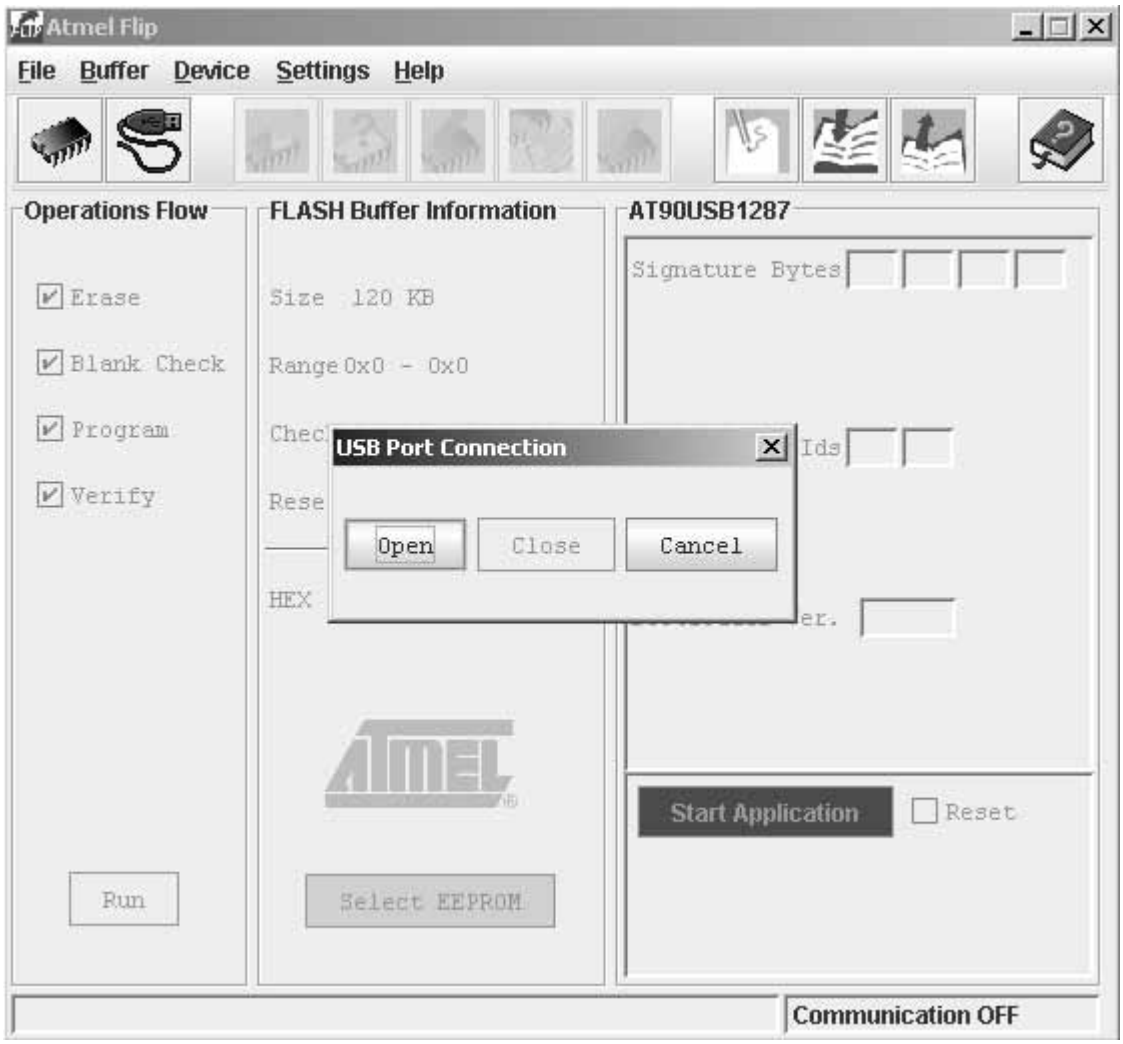
2. Select the USB as communication mode

Figure 5-5. USB Communication Mode



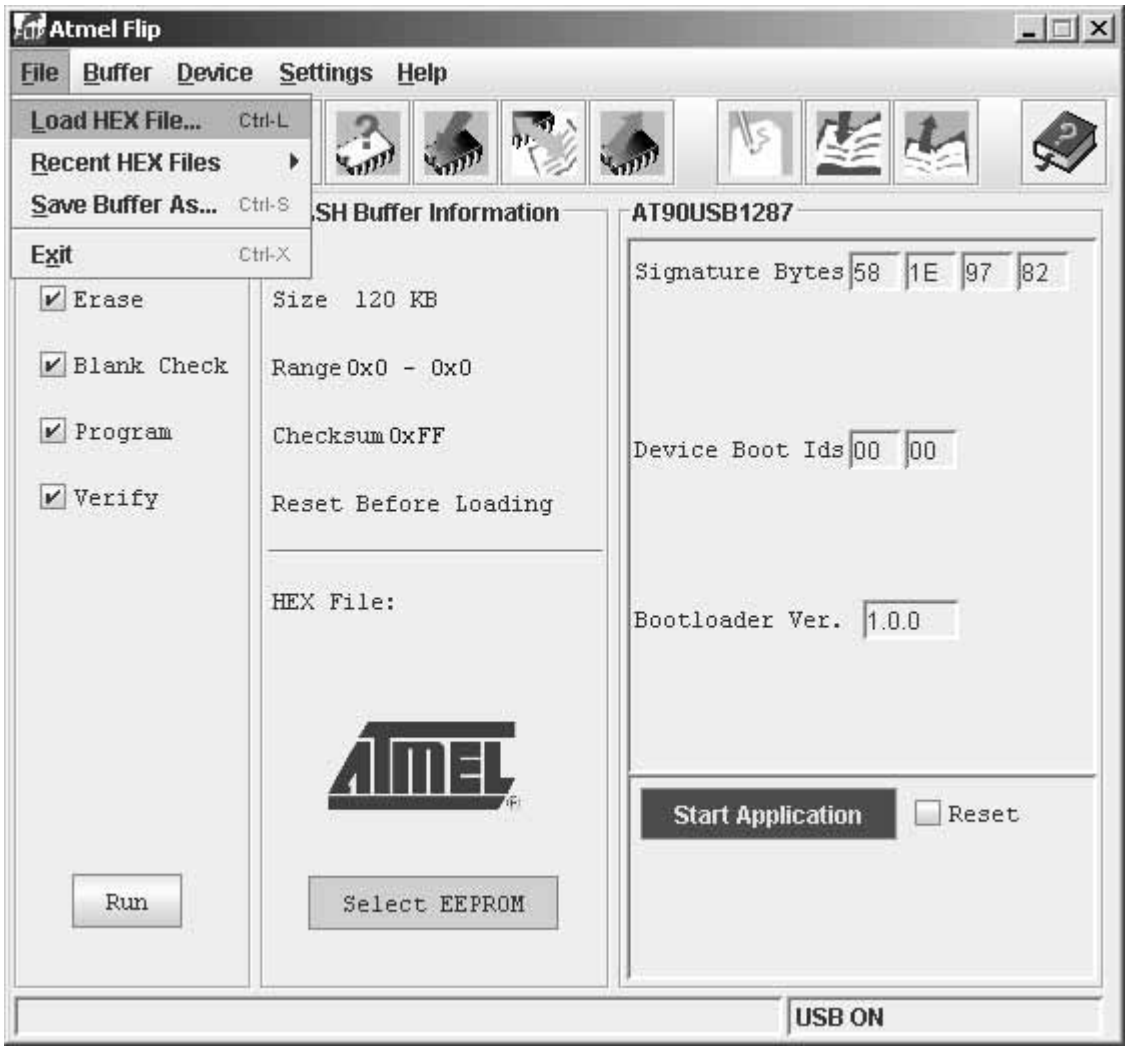
3. Open the communication

Figure 5-6. Open the USB Communication



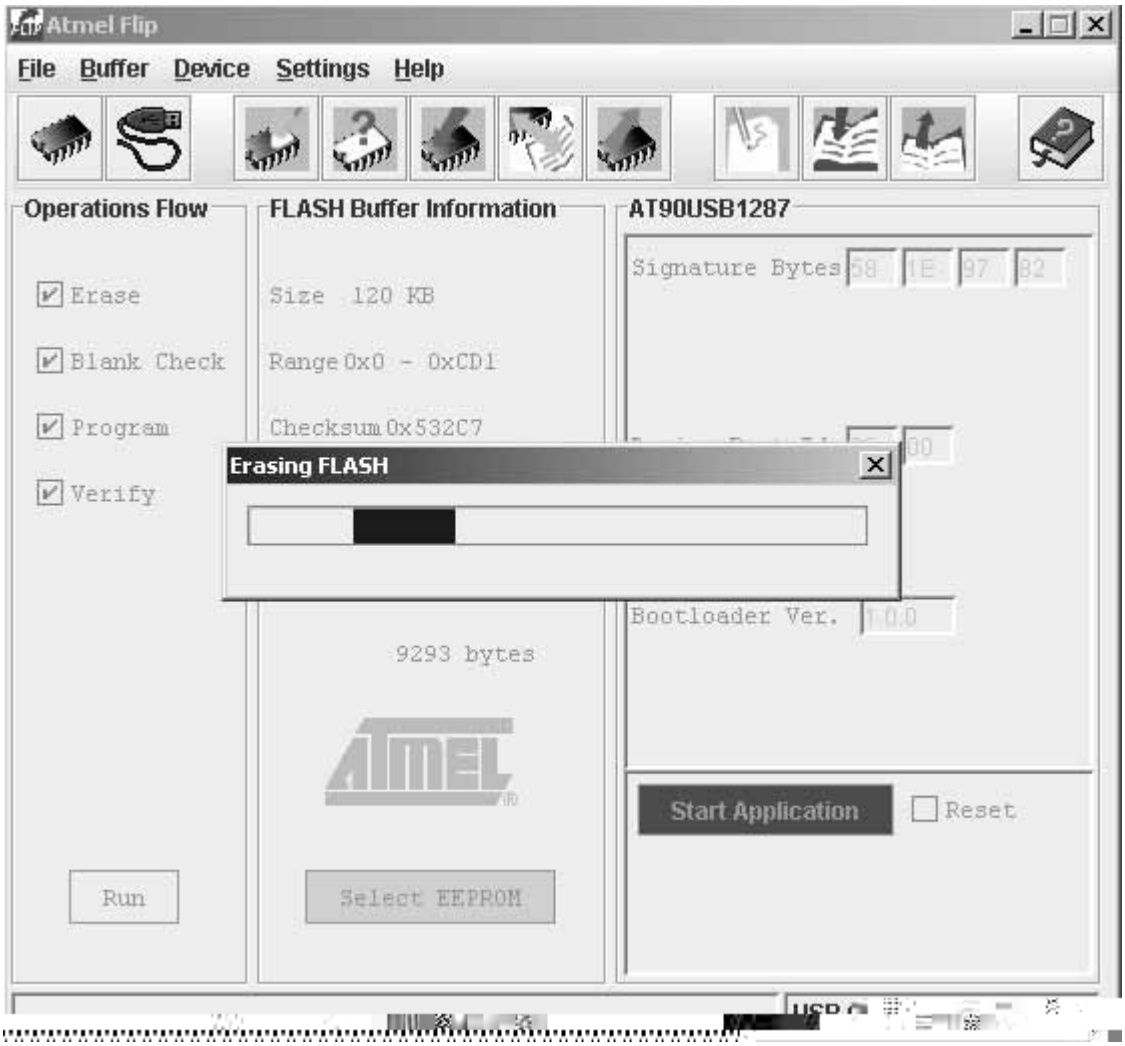
4. Choose the HEX file to load (the HEX file is included in the USB CD-ROM: usb_cdc.a90)

Figure 5-7. HEX File to Load



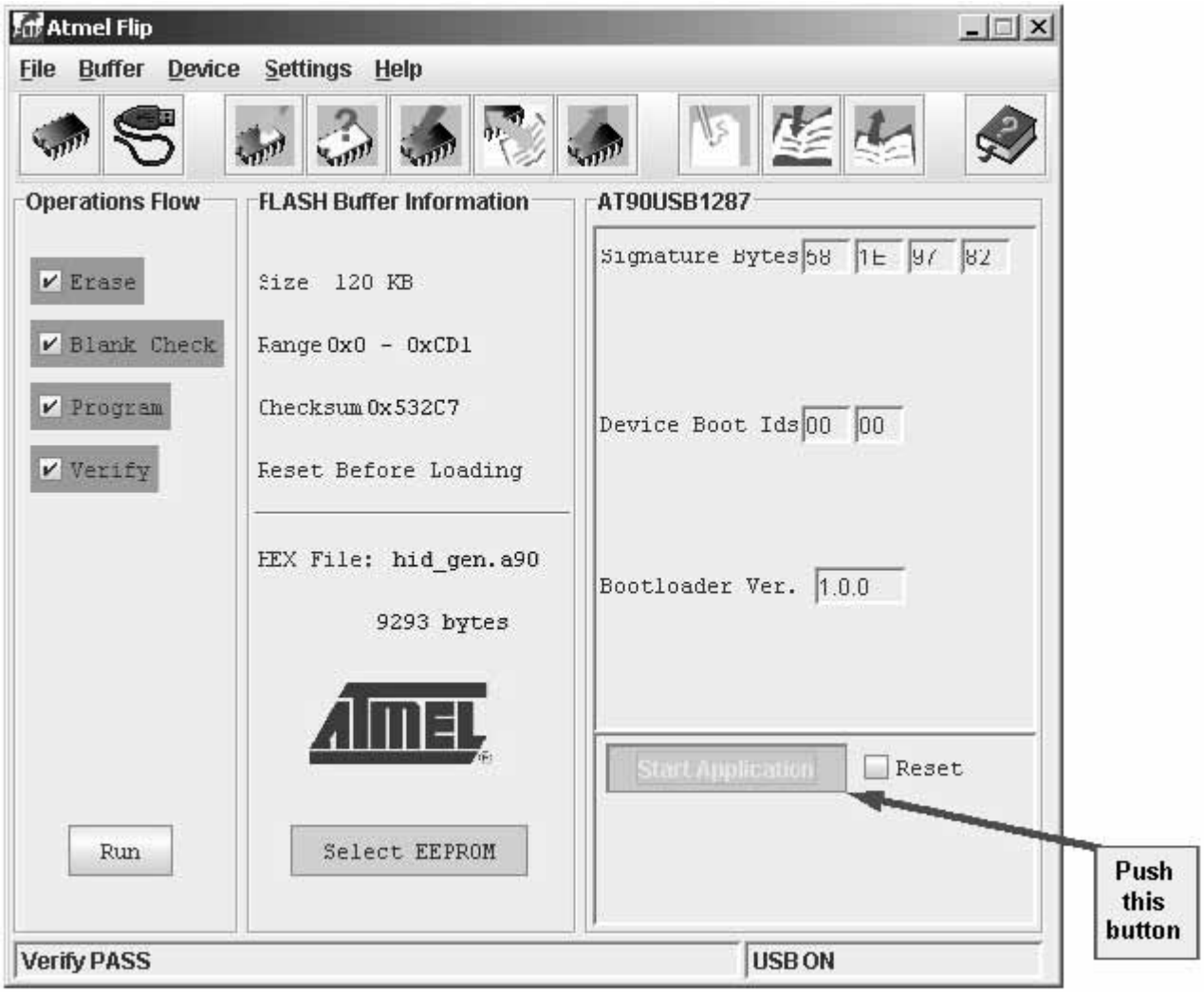
5. Load the HEX file (*Check Erase, Program* and *Verify*, then Push *Run* button)

Figure 5-8. HEX File Loading



6. Start the application.

Figure 5-9. Start Application

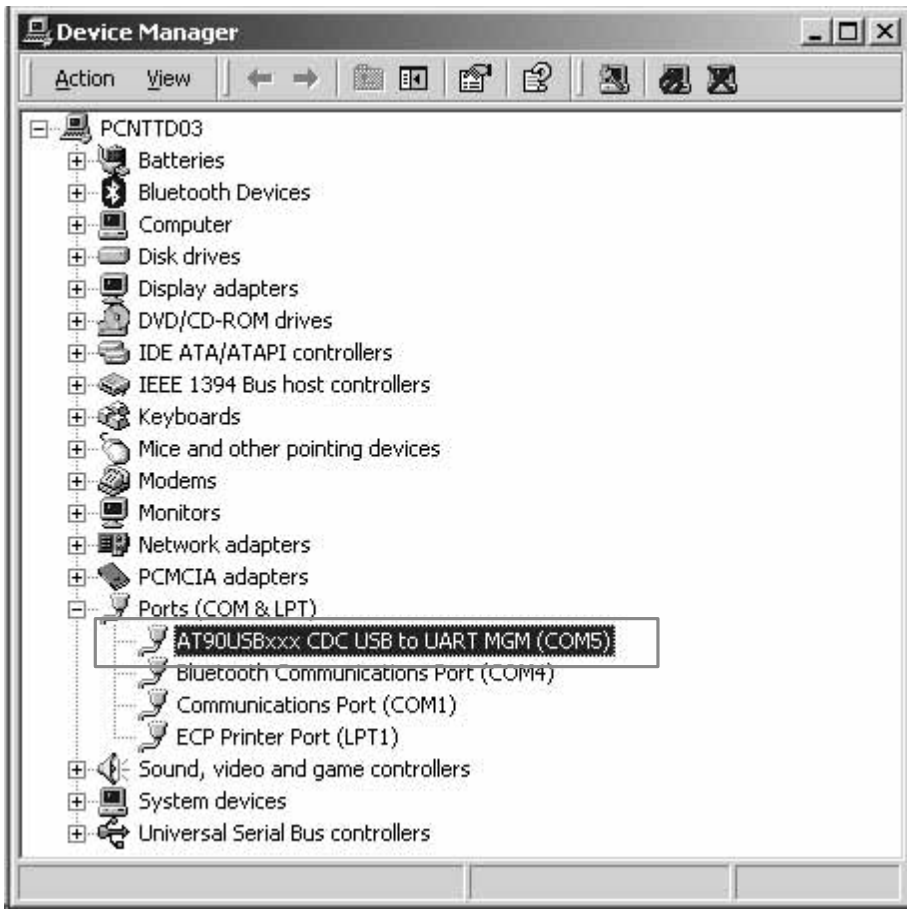


Note: The AT90USB bootloader will detach and jump into the user application when “Start Application” button is pressed.

6. Quick Start

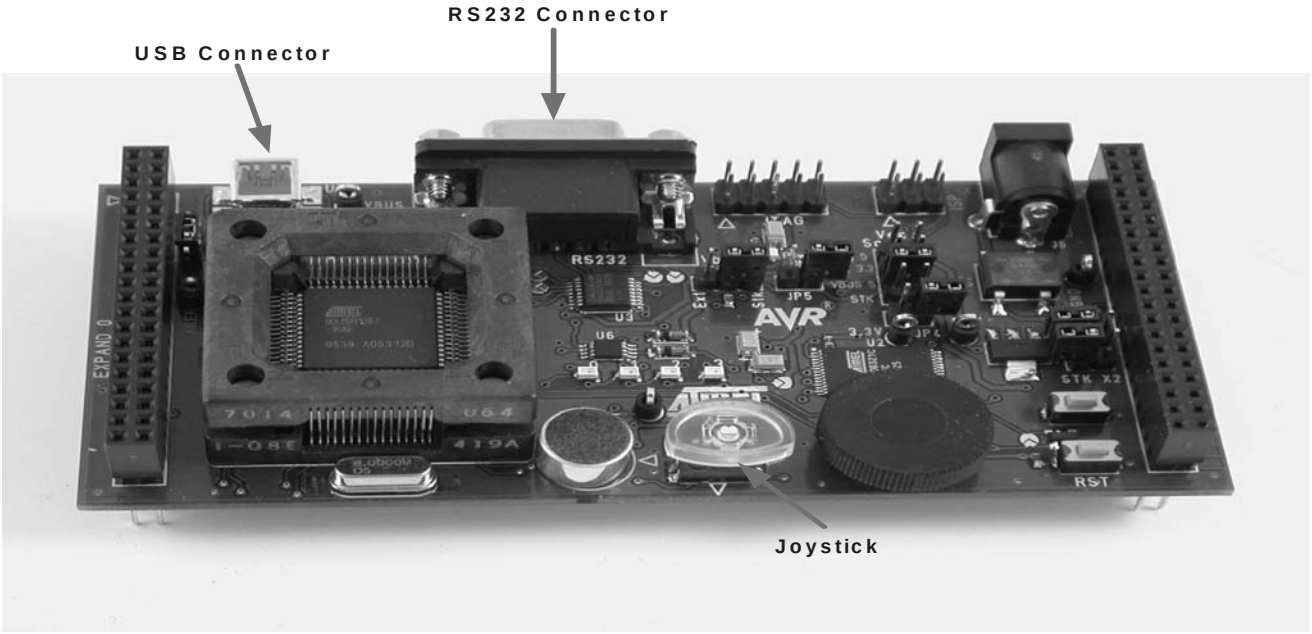
Once your device is programmed with *usb_cdc.a90* file, click on Start Application button on Flip or push the reset button from the STK525 board to start the CDC demonstration. **A new device detection wizard will appear, point the wizard to the inf folder included in the CDC package**. Check that your device is enumerated as Com port (see Figure 6-1), then you can use the STK525 as a Virtual Com Port or USB to UART bridge.

Figure 6-1. CDC enumeration



The figure below shows the Hardware used by the demo:

Figure 6-2. Hardware used



6.1 Virtual Com Port Demo

The purpose of the Virtual Com Port demonstration is to communicate with a RS232 PC application without any software modification.

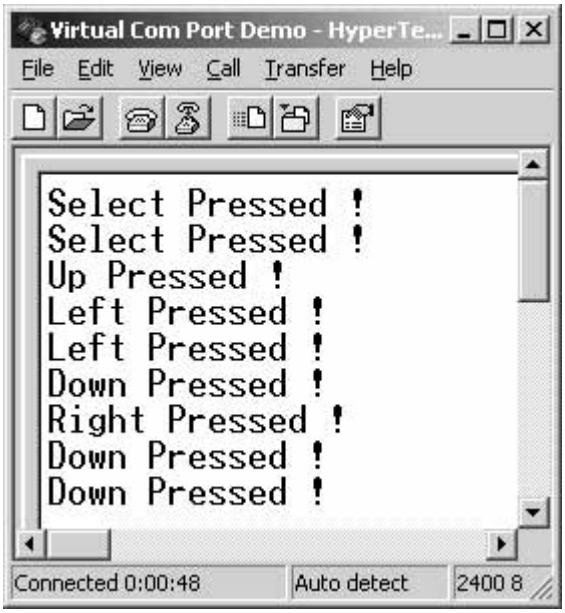
Follow the instructions below to start the demo:

1. Lauch the HyperTerminal application and select the right Com port as indicated in the device manager.

Figure 6-3. Com Port selection

2. Press the joystick and you will see the selection or the direction status written on the HyperTerminal window.

Figure 6-4. Virtual Com Port Demo



6.2 USB to UART Bridge

The aim of the USB to UART bridge is to transfer data in full duplex mode between UART and USB interface. This application can be used to connect any RS232 device to a PC which has not an RS232 interface.

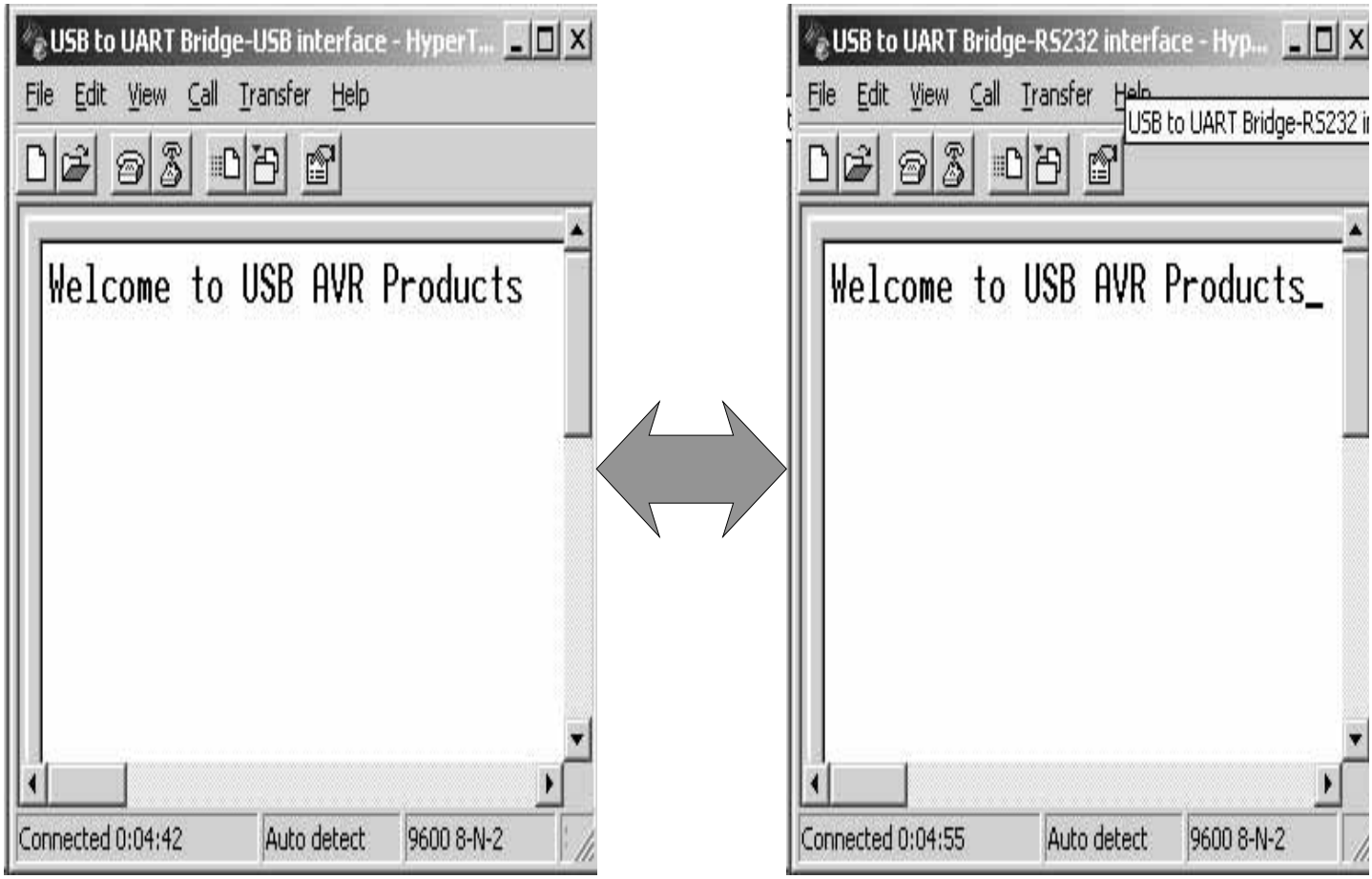
Follow the instruction hereunder to start the demo:

1. Connect the RS232 port of the STK 525 to The PC RS232 port.

Note: If the PC has no RS232 interface you can use another STK525: Connect the two boards with a RS232 crossed cable and connect Each board to an USB port of the PC.

2. Lauch two HyperTerminal applications (one with the RS232 port and the second with the Virtual Com port) with the same configuration (Baudrate, Data bits, Parity, .Stop bits, Flow control).
3. Write something in one HyperTerminal, it will be displayed in the other.

Figure 6-5. USB to UART Bridge



7. Application Overview

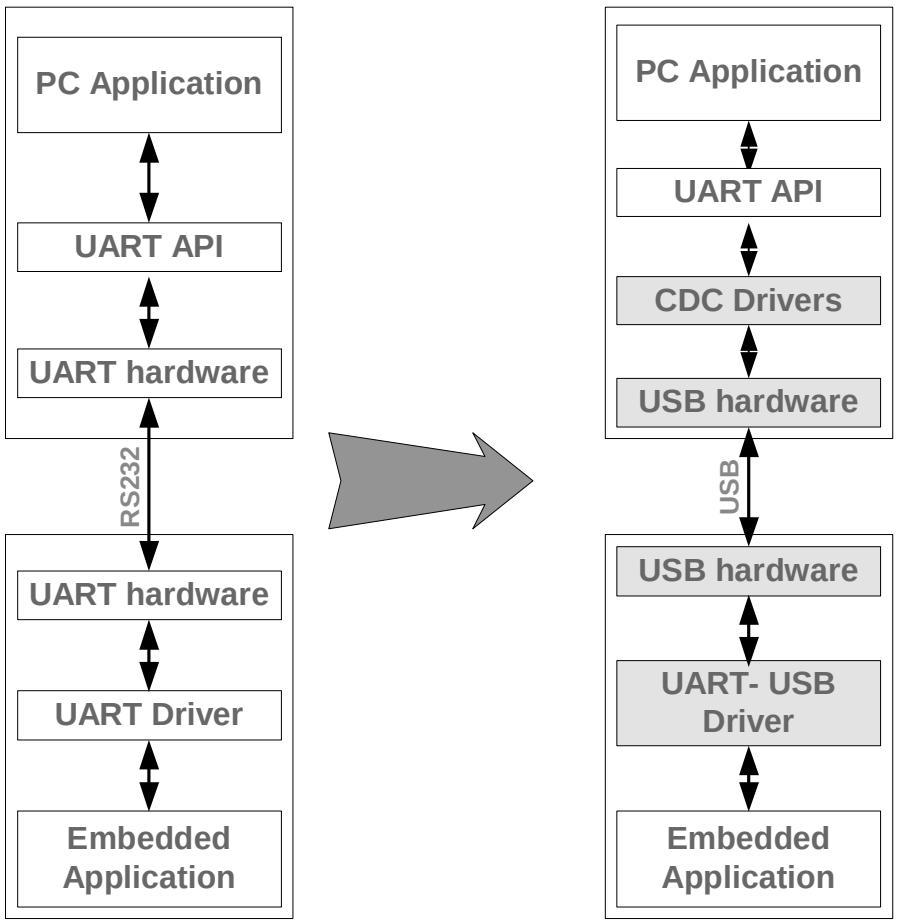
The CDC application allows the user to simulate a RS232 port using the USB hardware. The device shows as a Com port instead of USB device which allows the user to use whithout changing his PC application.

From the embedded side, the UART driver is replaced by the UART-USB Driver. The user has to use the UART-USB functions instead of the UART functions to communicate with the PC.

Once the device has enumerated, the application ensures a full duplex data transfer between the PC and the peripheral.

The figure below shows the structure:

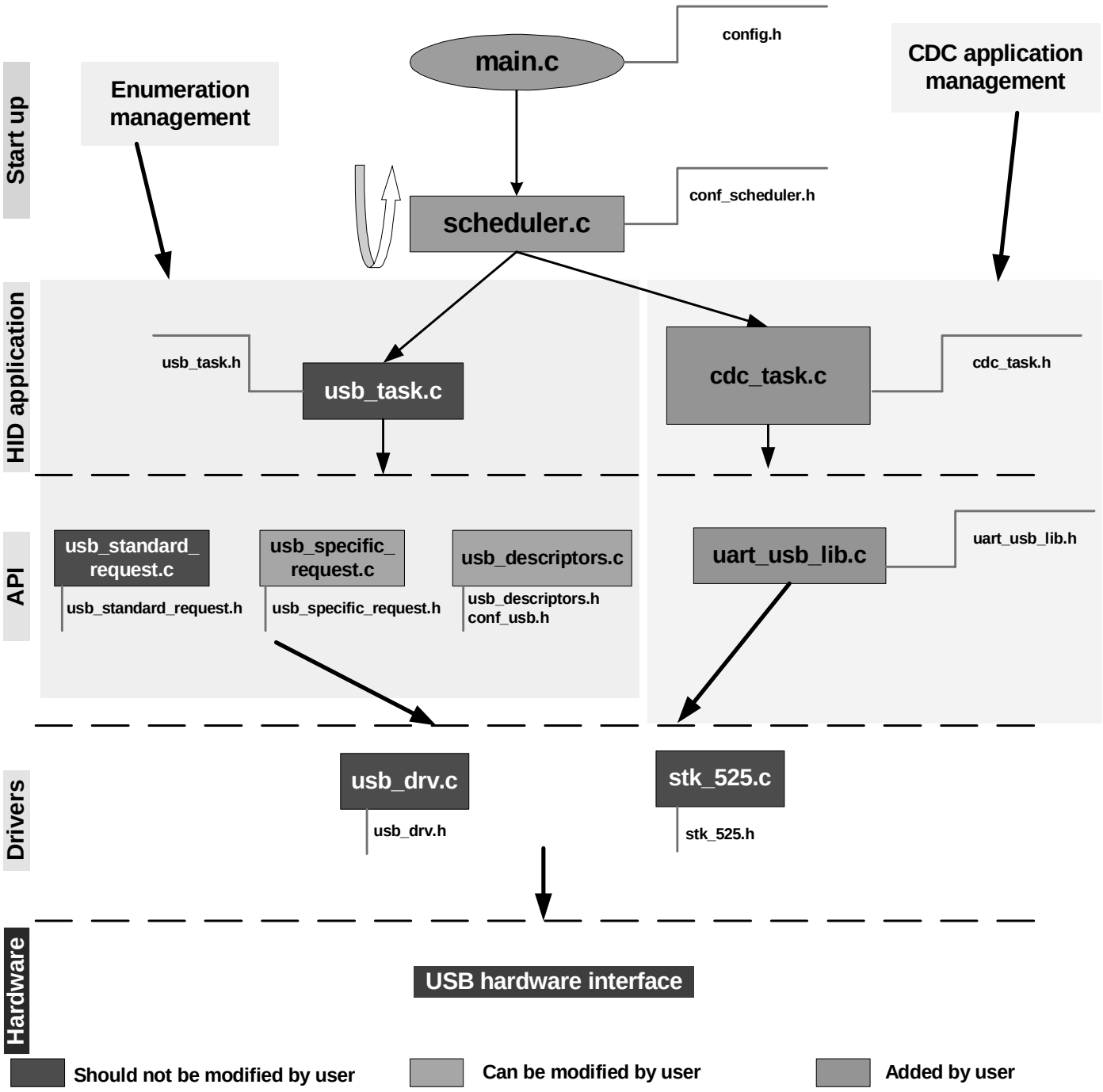
Figure 7-1. USB to UART migration



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 CDC Firmware Architecture

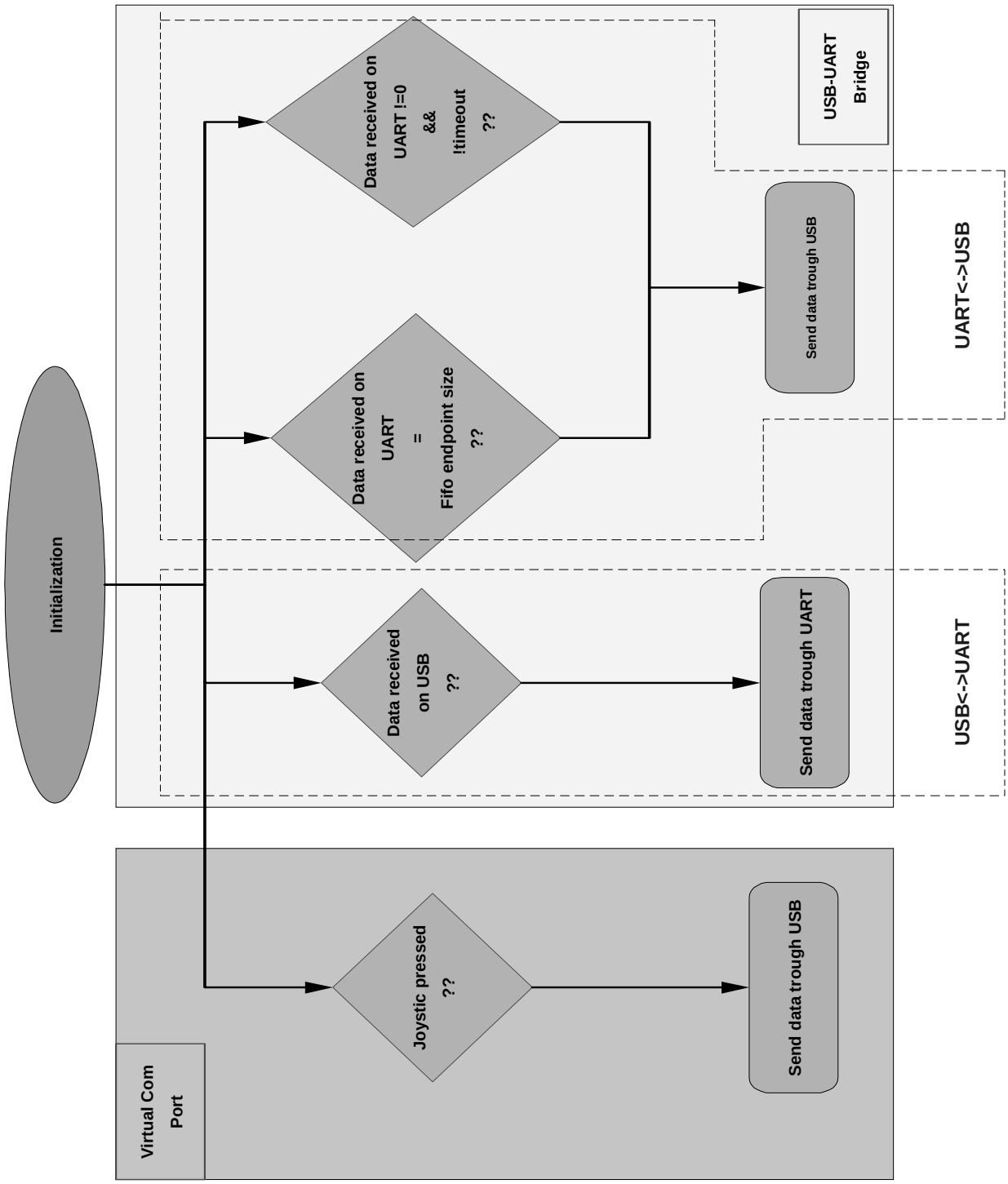


This section is dedicated to the CDC module only. The customization of the files described hereafter allow the user to build his own CDC Application.

8.1 cdc_task.c

This file contains the functions to initialize the hardware which will be used by the application, collect data and transfer it.

Figure 8-2. CDC Application



8.1.1 cdc_task_init

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

8.1.2 cdc_task

This function manages the data transfer for the two demonstrations (Virtual Com Port and UART to USB Bridge).

8.2 uart_usb_lib

8.2.1 uart_usb_test_hit

This function checks if at least one character has been received on the USB.

8.2.2 uart_usb_getchar

This function returns the byte received in the OUT endpoint FIFO.

8.2.3 uart_usb_putchar

This function writes the byte put in parameter into the USB IN endpoint FIFO. It also replaces the putchar function of the UART library. For example the printf will be based on uart_usb_putchar fuction instead of putchar.

8.2.4 uart_usb_tx_ready

This function checks if a byte can be written in the IN endpoint FIFO.

8.2.5 uart_usb_flush

This function sends data stored in the IN endpoint.

8.3 stk_525.c.

This file contains all the routines to manage the STK 525 board resources (joystick, potentiometer, temperature sensor, LEDs...).

9. PC Software

The CDC application uses the native Windows drivers. It requires only an INF file located in the inf folder from the CDC package.

10. Limitations

This application does not work with Windows 98 and ME (no native driver of CDC device).

This application can work with Linux OS, but support depends on configuration.

11. Related Documentation

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

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