

# AVR293: USB Composite Device

## Features

- Combining several USB applications using ONE DEVICE
- No HUB needed
- Bus powered

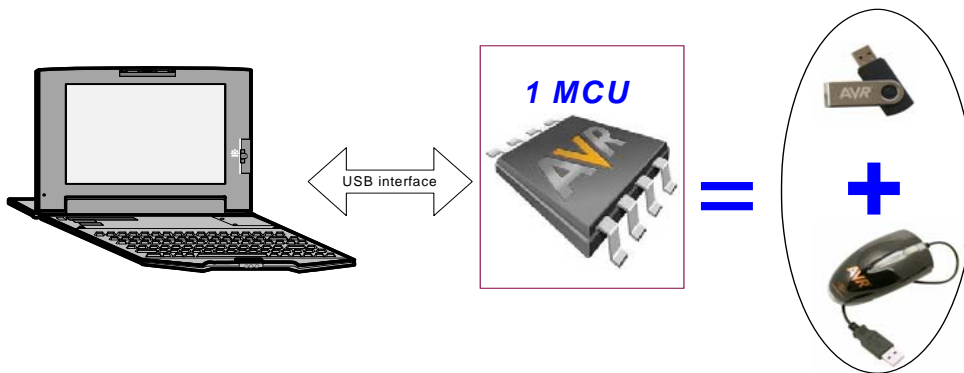
## 1. Introduction

Adding to the flexibility given to the user with the Hot Plug & Play, supplying power from the bus, the automatic detection of the insertion and remove of the device and by providing different transfer modes, the USB allows the user to manage several USB applications using ONE device called “**COMPOSITE DEVICE**”.

The aim of this document is to describe how to start and implement a composite device application.

A familiarity with *USB Software Library for AT90USBxxx Microcontrollers* (Doc 7675, Included in the CD-ROM & Atmel website) and the CDC specification (<http://www.usb.org>) is assumed.

Figure 1-1. Composite Device Application



8-bit **AVR**<sup>®</sup>  
Microcontrollers

Application Note



## 2. Hardware Requirements

The USB CDC application requires the following hardware:

1. AVR USB evaluation board (STK525, AT90USBKey, STK526, EVK527...or your own board)
2. AVR USB microcontroller
3. USB cable (Standard A to Mini B)
4. PC running on Windows® (2000, XP) with USB 1.1 or 2.0 host

Note: Another STK 52x and USB port are required if the PC has no RS232 interface.

## 3. In system programming and Device Firmware Upgrade

To program the device you can use the following methods:

- The JTAG interface using the JTAGICE MKII
- The SPI interface using the AVRISP MKII
- The USB interface thanks to the factory DFU bootloader and Flip software
- The parallel programming using the STK500 or the STK600

Please refer to the hardware user guide of the board you are using (if you are using Atmel starter kit) to see how to program the device using one of these different methods.

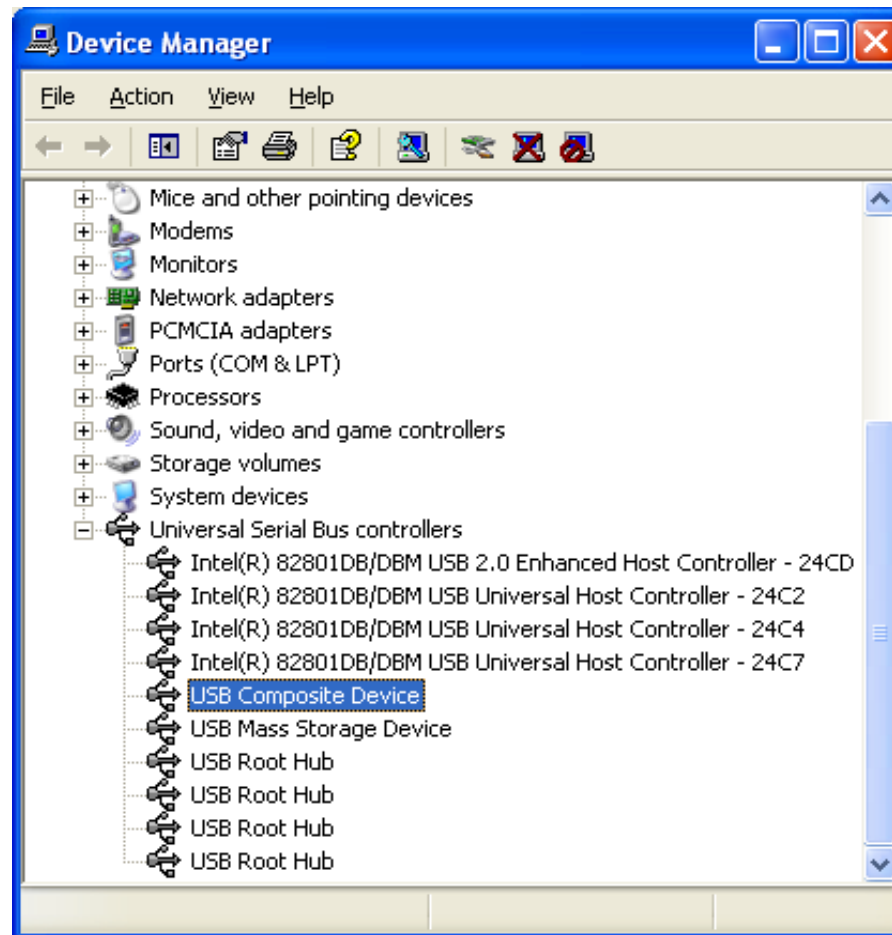
Please refer to Flip(1) help content to see how to install the USB driver and program the device through the USB interface.

(1)Flip is a software provided by atmel to allow the user to program the AVR USB devices through the USB interface (No external hardware required) thanks to the factory DFU bootloader.

## 4. Quick Start

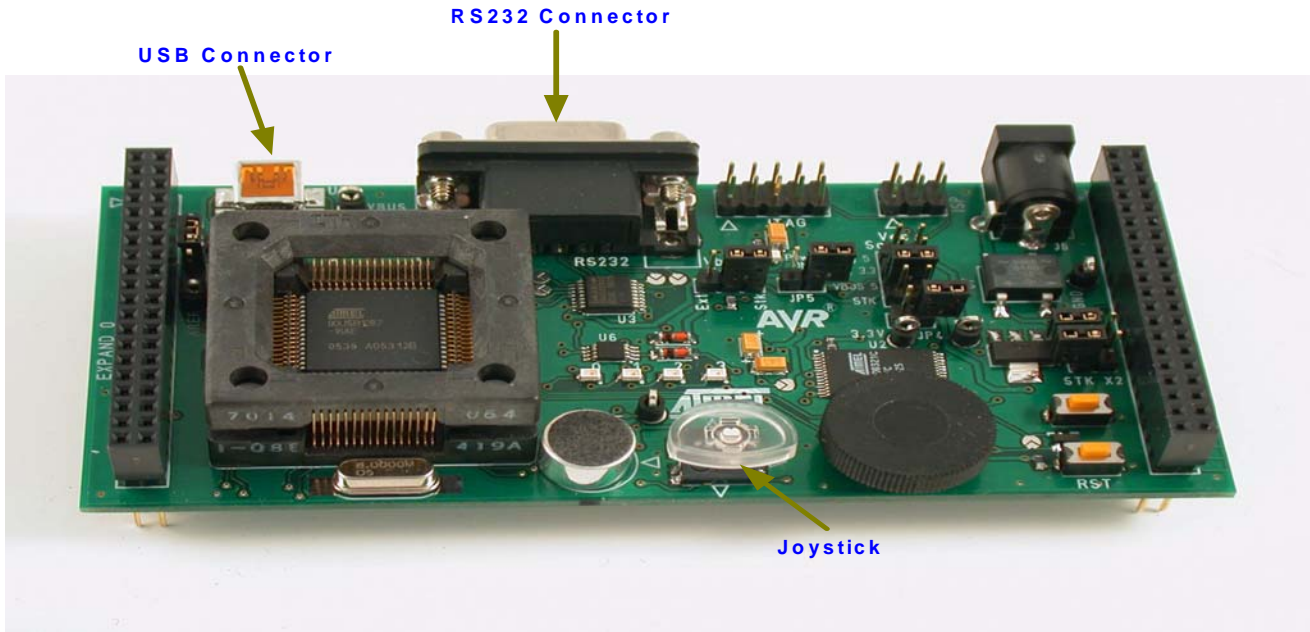
Once your device is programmed with *hex* file (depending on which composite device demo you are using), click on Start Application button on Flip or push the reset button from the used board to start the composite device demonstration. Check that your device is enumerated as composite device (see [Figure 6-1](#)), then you can use the board as a mouse, removable disk and Generic HID (you may have less or more applications depending on which demo you are using) at the same time.

**Figure 4-1.** Composite Device enumeration



The figure below shows the STK525 used by the demo (you may use another kit: AT90USBKey, STK526..., depending on the AVR USB product you are working with):

**Figure 4-2.** STK525



## 4.1 Composite Device

The purpose of the Composite Device demonstration is to show the user how to manage several USB applications using only one USB controller.

Depending on which demonstration you are using, when you connect your device to your PC, you will see two or more of the below applications appear in your device manager, and you can use each application in stand-alone mode:

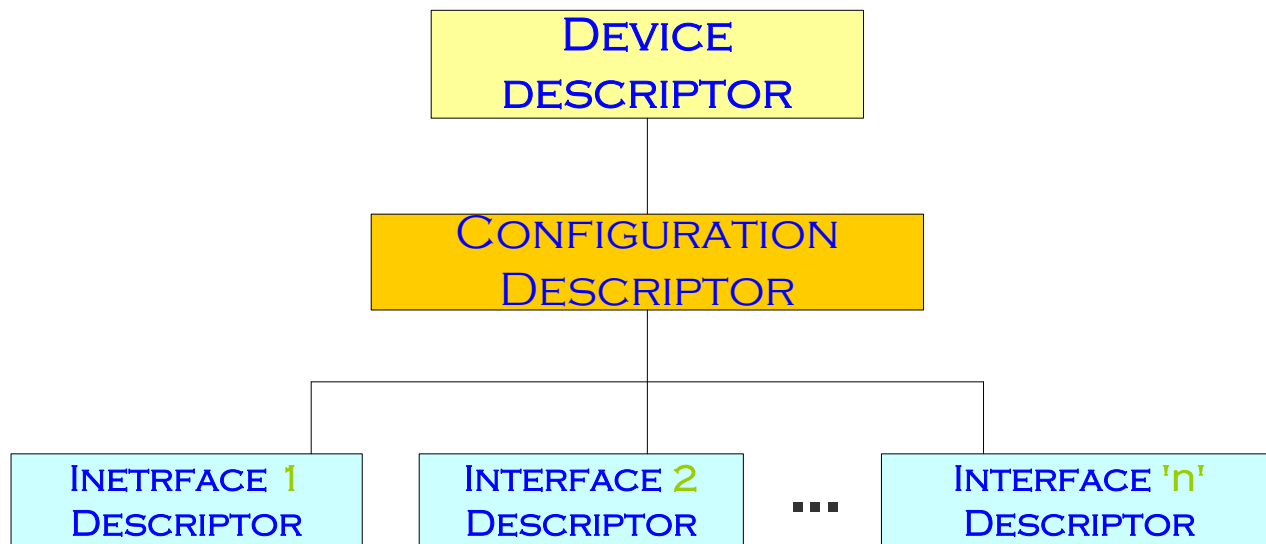
- USB mouse: you can move the mouse pointer using the joystick or the buttons of your board
- USB Mass Storage (removable disk): a new removable disk will appear, and you can transfer files with the on-board dataflash of your board (or any other memory depending on which board you are using)
- Generic HID device: please refer to the Generic HID application note: doc7599

## 5. Application Overview

To implement a Composite Device application, the user has to integrate several interfaces in his device (one for each application).

The figure below shows the descriptors structure:

Figure 5-1. Composite Device Overview



To add new interface to manage an adding application using the same controller, you have to modify the number of interfaces supported by the configuration descriptor, add the interface descriptor, the endpoint descriptors and the related specific requests management.

## 6. Firmware

As explained in the *USB Software Library for AT90USBxxx Microcontrollers* (Doc 7675, included in the USB CD-ROM ) all USB firmware packages are based on the same architecture (please refer to this document for more details).

To add new interface, the following files have to be modified:

### 6.1 usb\_descriptors.h

This file contains the definition of the descriptors' parameters. You have to modify and add the following parameters when you want to customize one of our demo to build a composite device or add a new interface to a current composite device:

- Modify the VID/PID of the device descriptor. Each USB application must have its own and unique VID/PID:

```
// USB Device descriptor
#define USB_SPECIFICATION      0x0200
#define DEVICE_CLASS            0      // each configuration has its own class
#define DEVICE_SUB_CLASS       0      // each configuration has its own sub-
class
#define DEVICE_PROTOCOL        0      // each configuration has its own
protocol
#define EP_CONTROL_LENGTH      64
#define VENDOR_ID              VID_ATMEL
#define PRODUCT_ID             PID_MegaMS
#define RELEASE_NUMBER         0x1000
#define MAN_INDEX              0x01
#define PROD_INDEX             0x02
#define SN_INDEX               0x03
#define NB_CONFIGURATION       1
```

Note: The class, subclass and protocol parameter must be set to 0 in the device descriptor. Each interface will specify its own class/subclass/protocol parameter.

- Modify the number of interfaces supported by the configuration's descriptor:

```
// USB Configuration descriptor
#define NB_INTERFACE           N // Number of interfaces
#define CONF_NB                1
#define CONF_INDEX            0
#define CONF_ATTRIBUTES       USB_CONFIG_BUSPOWERED
#define MAX_POWER             50      // 100 mA
```

- Add the descriptor of your new interface. Please note that the first interface start with the number 0, the next one should be number 1 and so on. So, depending on how many interfaces you have in you application, this new one should be number (n+1). "n" is the number of the last interface. The example hereunder shows the interface's descriptor of a Mass Storage application:

```
// USB Interface descriptor
#define INTERFACE_NB          n+1 // Interface's number
#define ALTERNATE             0
#define NB_ENDPOINT          2
#define INTERFACE_CLASS       MS_CLASS      // Mass Storage Class
```

```
#define INTERFACE_SUB_CLASS MS_SUB_CLASS6 // SCSI transparent Command Set
#define INTERFACE_PROTOCOL MS_PROTOCOL // Bulk-Only Transport
#define INTERFACE_INDEX 0
```

- Than, depending on the class you added with this new interface, you have to add the related endpoint descriptors with the correct transfer mode, maximum packet length... and you may need to declare specific descriptors (for example, the HID class requires a HID descriptor and a report descriptor adding to the endpoint descriptors)
- Once all descriptors are specified and the related parameters are defined, you have to add to the structure below:

```
typedef struct
{
    S_usb_configuration_descriptor cfg;
    S_usb_interface_descriptor ifc0;
    S_usb_endpoint_descriptor ep1;
    S_usb_endpoint_descriptor ep2;
    S_usb_interface_descriptor ifc1;
    S_usb_endpoint_descriptor ep3;
    S_usb_endpoint_descriptor ep4;

} S_usb_user_configuration_descriptor;
```

Now, you have to complete the `usb_descriptors.c` file with the new descriptors values. Please, see hereunder:

## 6.2 usb\_descriptors.c

In this file, you have to add the new descriptors values in the correct order, as specified by the USB.

## 6.3 usb\_specific\_request.c

As Mentioned above, a new interface may require a specific requests management. These requests have to be manage by the `usb_specific_request.c` and specially the function ***usb\_user\_read\_request()***. A new functions may be added to this file to handle a specific tasks related to these specific requests.

This new interface has one or more endpoints. These endpoints has to be configured using the function ***usb\_configure\_endpoint()*** used by the function ***usb\_user\_endpoint\_init()***.

These modifications will allow the device to enumerate as a composite device with the new class/subclass/protocol defined by the new interface. To use this interface you have now to add the application layer by creating an ***xxx\_task.c*** to manage your application.

## 7. PC Software

Depending on which interfaces you are using, you may or not need to develop a PC application.

## 8. Limitations

- The number of interfaces is limited by the number and the size of the endpoints. Each interface requires its own physical endpoints, so the user has to check that the device has enough endpoints and DPRAM to handle the endpoints of all interfaces.
- Some Operating Systems does not support the composite device by default.

## 9. Related Documentation

- AVR USB Datasheet
- *USB Software Library for AT90USBxxx Microcontrollers*



## Headquarters

---

**Atmel Corporation**  
2325 Orchard Parkway  
San Jose, CA 95131  
USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 487-2600

## International

---

**Atmel Asia**  
Room 1219  
Chinachem Golden Plaza  
77 Mody Road Tsimshatsui  
East Kowloon  
Hong Kong  
Tel: (852) 2721-9778  
Fax: (852) 2722-1369

**Atmel Europe**  
Le Krebs  
8, Rue Jean-Pierre Timbaud  
BP 309  
78054 Saint-Quentin-en-  
Yvelines Cedex  
France  
Tel: (33) 1-30-60-70-00  
Fax: (33) 1-30-60-71-11

**Atmel Japan**  
9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
Japan  
Tel: (81) 3-3523-3551  
Fax: (81) 3-3523-7581

## Product Contact

---

**Web Site**  
[www.atmel.com](http://www.atmel.com)

**Technical Support**  
[avr@atmel.com](mailto:avr@atmel.com)

**Sales Contact**  
[www.atmel.com/contacts](http://www.atmel.com/contacts)

**Literature Requests**  
[www.atmel.com/literature](http://www.atmel.com/literature)

---

**Disclaimer:** The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© 2008 Atmel Corporation. All rights reserved. Atmel®, logo and combinations thereof, and others are registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.