

# **AT43DK355 USB Controller Development Kit for the AT43USB35X Family**

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**User Guide Version 1.0**







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# Section 1

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## Introduction

Congratulations on your purchase of the AT43DK355 USB Development Kit. The AT43DK355 is a complete starter kit and development system for Atmel's AT43USB35x family of AVR<sup>®</sup> based USB microcontrollers (MCUs). It provides all of the necessary hardware and firmware components to facilitate rapid prototyping and firmware development of the AT43USB35x applications.

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### 1.1 Features

The AT43DK355 Development Kit consists of the following:

- Development Board for the AT43USB35x USB MCUs featuring
  - An AT43USB355 full-speed USB controller programmable as a compound device, a hub only device or a function only device
  - One internal and two external downstream HUB ports
  - 1 Kbytes on-chip program SRAM
  - 24 Kbytes of program memory
  - Parallel interface to PC for In-System firmware programming
  - 8 push buttons and 8 LEDs for general use
  - Pin header connectors for access to all available GPIO pins
- Hardware design files (schematics and PCB layout)
- USB 2.0 compliant USB firmware library
- USB Wizard firmware source code generation utility
- In-System Programming tool
- Complete User Guide

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### 1.2 Device Support

The AT43DK355 Development Kit and the accompanying software tools are intended to support firmware development and prototyping for the AT43USB35x family of USB function controllers, including the

- AT43USB355
- AT43USB353M
- AT43USB351M

Binary compatibility across the AT43USB3xx family ensures that only one set of development tools (development kit, compilers, etc.) is needed for all of the AT43USB3xx based applications. Firmware written for one member of the family can be re-used for another member without modification as long as only features available on both parts are used.

- 
- 1.3 Documentation** The AT43DK355 Development Kit is accompanied by the following two documents:
- *AT43DK355 User Guide*
  - *USB Wizard User Guide*

Atmel recommends its customers read the *AT43DK355 User's Guide* prior to reading the *USB Wizard User Guide*.

- 
- 1.4 Free Downloads** The latest version of the USB Wizard can be found in the USB section of the Atmel web site at <http://www.atmel.com>. Please refer to the same section for up-to-date information on new USB product announcements, software releases and tool upgrades.



## Section 2

# Getting Started

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- 
- 2.1 Electrostatic Warning** The AT43DK355 Development Board is shipped in protective anti-static packaging. The board must not be subjected to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic elements.
- 
- 2.2 Unpacking the System** The AT43DK355 Development Kit is supplied with the following:
- AT43DK355 Development Board
  - 2-meter Fully Rated USB Cable
  - Male-male DB25 Parallel Cable
  - Atmel USB CD-ROM with Software and Documentation
- Please contact your local Atmel distribution or e-mail [usb@atmel.com](mailto:usb@atmel.com) if any of the aforementioned items is missing from the package.
- 
- 2.3 System Requirements** The minimum hardware and software requirements are:
- 486 processor (Pentium® is recommended)
  - 128 MB RAM
  - 10 MB free hard disk space
  - Windows® 98/2000/ME/XP
  - Parallel printer port
- 
- 2.4 Software Requirements** The following third party software are needed to access and modify the documents and source code in the CD-ROM:
- *OrCAD Capture*® from [www.orcad.com](http://www.orcad.com) for the .dsn file
  - *IAR* or *GNU C Compiler* for the sample C source code
  - *Microsoft*® *Word* from [www.microsoft.com](http://www.microsoft.com) for the .doc files
  - *Acrobat*® *Reader*® from [www.adobe.com](http://www.adobe.com) for the .pdf files
  - *Winzip*® from [www.winzip.com](http://www.winzip.com) to open the .zip files

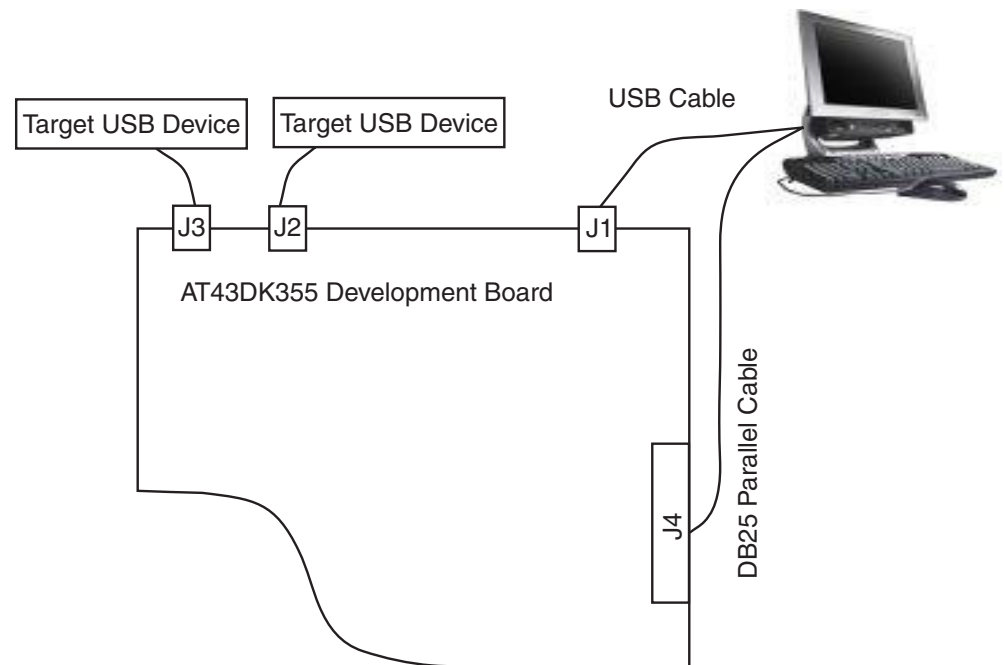
## 2.5 Connecting the Hardware

Atmel has taken great care in creating a reliable demonstration kit for its customers. The AT43DK355 Development Board is USB bus powered and requires no external power supplier. In order to ensure proper operation, the supplied components in the kit must be used in the setup shown in Figure 2-1. Atmel does NOT recommend substitution of these components.

Connect the AT43DK355 Development Board as follows:

1. Verify that Jumper JP8 and Jumper JP11 are closed.
2. Connect the USB cable from J1 Series B USB receptacle on the Development Board to the USB Series A receptacle on the PC.
3. Connect the DB25 parallel cable from J4 on the Development Board to the parallel port on the PC.

**Figure 2-1.** Connection to the AT43DK355



## 2.6 CD-ROM Contents

The CD-ROM has a top directory `\355_evx\` where **x** indicates the version of the firmware. All the directory paths used in this User Guide fall under this top directory. There are three major subdirectories:

- *BOARD*: hardware design documentation
- *Docs*: datasheets, tutorial, and user guide
- *USBWizard*: USB Wizard software tool and examples

### 2.6.1 USB Wizard Utility

USB Wizard utility is a GUI based development tool that facilitates rapid USB application development for the AT43USBxxx family of AVR USB controllers. It allows the user to generate firmware templates in ANSI C for USB and AVR® peripherals with few clicks of the mouse.

This utility is located in `\USBWizard\USBWizard` directory. This directory contains the USB Wizard executable file and other dependencies files.



Please refer to the *Readme* file on the release CD for the installing instructions. The USB Wizard executable file is supported on Windows® 98/2000/ME/XP.

Source code generated by the USB Wizard cannot be programmed directly into the on-board SEEPROM device. It must be compiled and linked first. The USB Wizard currently supports IAR and GCC compilers.

Refer to the Atmel “USB Wizard User Guide” and “USB Wizard: Application Examples and Demos” for detailed descriptions of this utility.

**Figure 2-2.** USB Wizard Application Window



- 2.6.2 Code Base Directory** This is the directory where all code base needed by USB Wizard are taken from. The name of this directory is `\USBWizard\Codebase`. There are two main groups of code base within this directory. The first one is `IARbase`, which provides necessary code for IAR. The second one is `GCCbase` which contains the code for the GCC compiler. The following is a brief summary of directory tree of this code base.

```

Code base
|
|----- IARbase
|
|----- AT43USB35x
|----- AT43USB326
|----- AT43USB325E
|
|----- GCCbase
|
|----- AT43USB35x
|----- AT43USB326
|----- AT43USB325E

```

**2.6.3 Application Example** The application examples are also included within this package. They are located in `\USBWizard\Examples\` directory. This directory contains USB Wizard configuration files (\*.usw files) and the corresponding C files for application examples. There are five sub-directories in this directory:

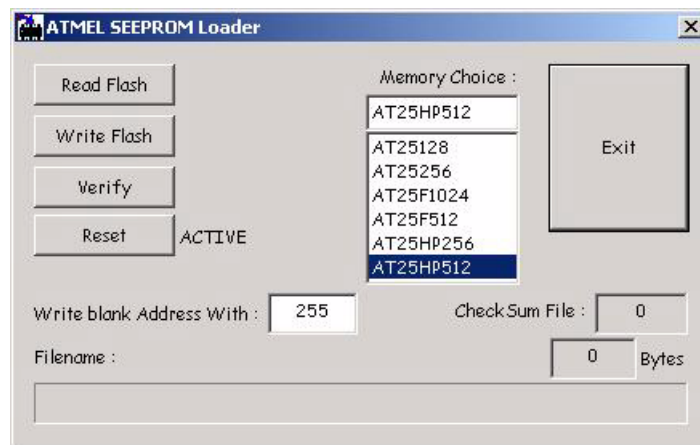
1. PWM\_ADC\_GPIO
2. OCR1A
3. OCR1B
4. SPI
5. Hub\_Disabled

**2.6.4 In-System Programming Tool** The SEEPROM Loader allows developers to program the SEEPROM device through the standard parallel port. The tool is located in `\USBWizard\ISP\` directory.

Please refer to the *Readme* file for installation instructions.

Please read Section 4 of this document or Section 3 of Atmel *USB Wizard: Application Examples and Demos* on how to use this utility.

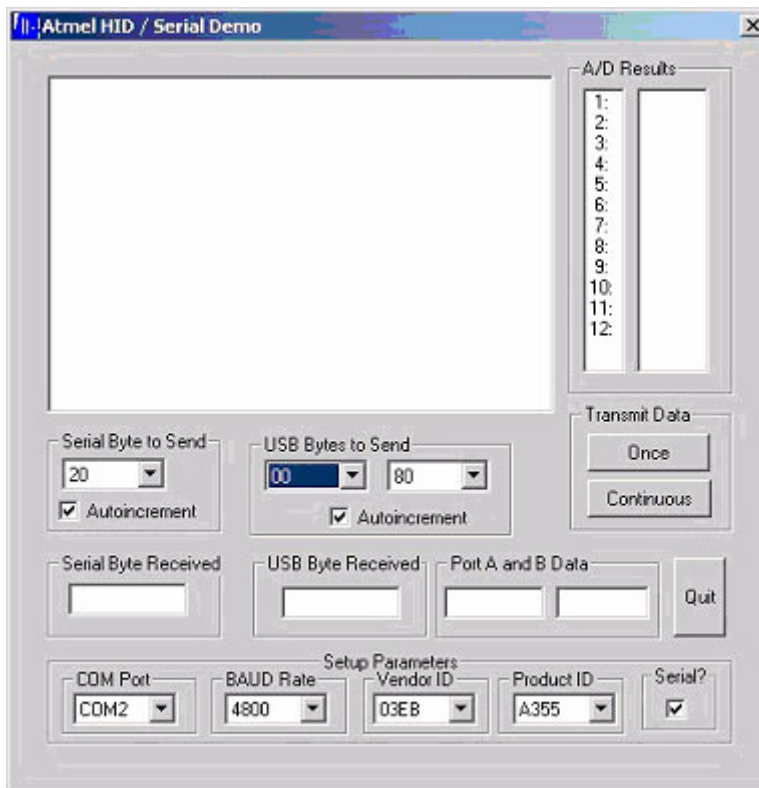
**Figure 2-3.** SEEPROM Loader Tool Window



**2.6.5 Atmel USB HID Demo Utility** This tool, located in `\USBWizard\Demo_UTILITY\`, is purposed to exercise the functionality of application examples.

To install it, copy and paste the executable file in this directory to the desired location. How to use this utility will be fully explained in Atmel *USB Wizard: Application Examples and Demos* especially for example 1 (PWM, ADC, and GPIO).

Figure 2-4. USB HID Demo Utility Window



### 2.6.6 Binary Files for Uploading

The ready-made programmable binary files for loading are located on the CD-ROM in the `\USBWizard\Binary\` directory. The files have extension \*.hex. They are located under three subdirectories:

1. OCR1A
2. OCR1B
3. PWM\_ADC\_GPIO

### 2.7 Checking the Hardware

The Development Board comes with a preprogrammed application. Connect the USB upstream port of the Development Board to the downstream port of the host (i.e.: PC). Then, check its existence in the **Device Manager** of the **System Control Panel** window. If the Development Board is working properly, it should show up in the PC as a HID compliant device.

Another way to check the proper functioning of the board is to connect a USB device such as a mouse to one of the downstream USB hub ports on the Development Board. The Development Board is functioning properly if the mouse is detected by the PC.



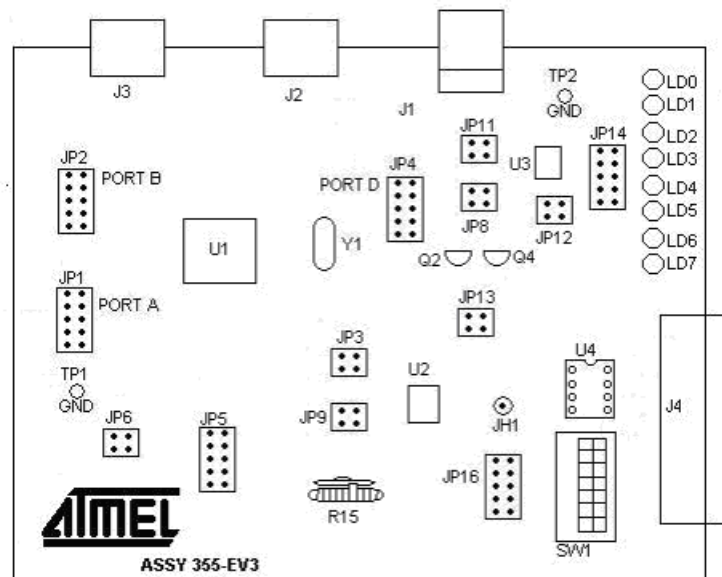


## Section 3

# Hardware Description

The following hardware description explains the Development Board in detail. The Development Board schematic can be found in Section 6.2.

**Figure 3-1.** Simple Block Diagram of the DK355 Board



- |     |                          |  |
|-----|--------------------------|--|
| 3.1 | <b>LEDs (LD0 to LD7)</b> | The AT43DK355 Development Kit includes 8 green LEDs. The anode pin of each LED is connected to the VBUS, through a resistor.                   |
| 3.2 | <b>5x2 Header JP14</b>   | Each pin of this header is connected to the cathode pin of each LED. To turn on the LED, JP14 is pulled low.                                   |
| 3.3 | <b>8 DIP Switch SW1</b>  | Positioning a switch to ON causes the corresponding SWx pin on JP16 to be pulled low while releasing it will result in a high impedance state. |

- 
- 3.4 5x2 Header JP16** These headers are connected to one of each DIP switch.
- 
- 3.5 DB 25 Female Parallel Port Connector J4** The parallel port connector, J4, is used for In-System Programming to upload firmware from the PC to the SEEPROM U4. A DB25 male-to-male parallel cable is supplied to connect the J4 connector to the PC parallel port. Further description on downloading code to the SEEPROM is available in Section 3 of the *USB Wizard: Application Examples and Demos* document for the AT43USB355.
- 
- 3.6 8-pin IC Socket U4** The SEEPROM device is plugged to this 8-pin socket to store programming memory. This board is supplied with an Atmel 25HP256 SEEPROM.
- 
- 3.7 Variable Resistor R15** Variable resistor R15 can be used to adjust voltage of the VREF pin of the AT43USB355 in order to test the Analog to Digital Converter (ADC) feature. This resistor produces variable voltage levels that can be fed to the ADC input header (JP6 and JP5). The voltage produced from this resistor can be accessed from pin 4 of header JP9.
- 
- 3.8 2x2 Header JP9** To use the ADC, a reference voltage must be applied to the VREF pin of the AT43USB355. This reference voltage can be fixed at the CEXT voltage by setting a jumper between pin 1 and pin 2, or the reference voltage can be adjustable (by adjusting R15) by setting a jumper between pin 3 and pin 4 of J9.
- JP9: 1-2 VREF = CEXTA (jumper installed by default)  
 3-4 VREF is adjustable
- 
- 3.9 Programmable Logic Device U2** This Development Board uses the ATF16V8CZ Electrical Erasable PLD for In-System Programming and for downloading data from SEEPROM to AT43USB355.
- 
- 3.10 5x2 Header JP5 and 2x2 Header JP6** JP5 are input pins for ADC channels zero to seven and JP6 are for ADC channels eight to eleven.
- 
- 3.11 4x2 Header General Purpose I/O PORT A/JP1** Accessing PORTA externally can be performed at this header. A number is assigned to each pin header, "0" to "7", corresponds to the port's pin number.
- 
- 3.12 4x2 Header General Purpose I/O PORT B/JP2** Accessing PORTB externally can be performed at this header. A number is assigned to each pin header, "0" to "7", corresponds to the port's pin number.

- 
- 3.13 4x2 Header General Purpose I/O PORT D/JP4** Accessing PORTD externally can be performed at this header. A number is assigned to each pin header, “0” to “7”, corresponds to the port's pin number.
- 
- 3.14 2x2 Header General Purpose I/O JP3** External access to PF0 to PF3 is available at this header. These pins are used to download programming from the SEEPROM to the AT43USB355E as soon as power is applied to the board. Once firmware is downloaded, the AT43USB355 drives PF0 high while leaving PF1-PF3 as a general purpose I/O. PF3 also has an alternate function as the ICP input capture pin for the Timer/Counter1.
- 
- 3.15 2x2 Header JP8.** This header will take effect whenever the Pulse Width Modulation (PWM) feature is enabled. The 43USB355E has two PWM features, PWM1 and PWM2, which are outputting to PD5 (PORT D pin 5) and PD6 (PORT D pin 6). Installing jumpers to these pins, connect PWM outputs to the base of transistors, Q2 and Q4 to amplify PWM signals. If the PWM feature is disabled, PD5 and PD6 will be available as general purpose I/Os.
- JP8: 1-2 PD5 = PWM1 (jumper installed by default)  
3-4 PD6 = PWM2 (jumper installed by default)
- 
- 3.16 2x2 Header JP13** There are three pins marked as PWM1, PWM2 and VBUS at this header. The PWM1 and PWM2 pins can be used to drive DC motors. The pin marked VBUS is the 5V USB upstream port voltage.
- 
- 3.17 2x2 Header JP11** This Development Board provides a ganged power switching and overcurrent sensing features for two downstream USB ports. This feature occupies PD0 and PD1 and requires the use of the Micrel MIC2026-2BM solid state power switch. The PD0 and PD1 must be connected to this power switch by installing a jumper to this header. If this system is not used, PD0 and PD1 will be available as general purpose I/Os.
- JP11: 1-2 PD1 = Downstream USB power switching enable (jumper installed by default)  
3-4 PD0 = Overcurrent protection enable (jumper installed by default)
- 
- 3.18 Solid State Power Switch U3** This device manages the ganged power switching system and overcurrent sensing feature. This board uses the Micrel MIC2026-2BM.
- 
- 3.19 2x2 Header JP12** The pin marked as VBUS provides USB downstream port voltage. If the application requires the use of the Micrel MIC2020-2BM for power switching and overcurrent protection, no jumpers are installed on JP12; otherwise, a jumper is needed between pin 1 and pin 2 of JP12.
- JP12: 1-2 Connected = No power switching  
Unconnected = Power switching (default)
- 3-4 No connection

- 
- 3.20 Header GND TP1 and TP2** This pin provides ground voltage reference.
- 
- 3.21 Header JH1**  $V_{ICP}$  input capture pin for the Timer/Counter1 feature.
- 
- 3.22 USB External Downstream Port J2 and J3 Connectors** These connectors provide downstream connection to USB devices. There are 3 downstream ports. Port 1 is permanently used by embedded functions and is not visible. On this board, be aware that J3 corresponds to USB Port 2 of 43USB355E and J2 corresponds to USB Port 3 of 43USB355E. The power source of these ports is controlled by power switch U3.
- 
- 3.23 USB Upstream Port J1 Connector** This connector provides upstream connection to a host or to another hub.
- 
- 3.24 Programmable Microcontroller U1** This board comes with the AT43USB355E microcontroller.





## Section 4

# SEEPROM Loader

The SEEPROM Loader is an Atmel software tool used to program the SEEPROM via generic parallel ports. This section describes the tool briefly.

### 4.1 Setting Up the Board

Before starting the In-System Programming, please verify the following configurations:

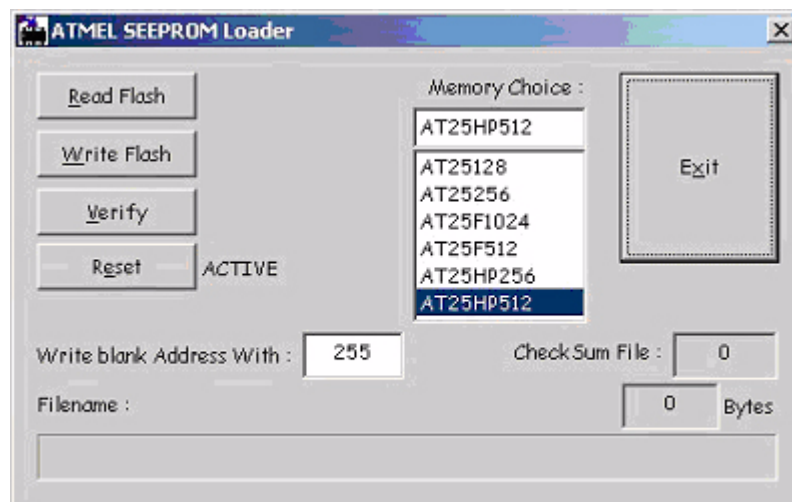
1. The EEPROM is properly plugged to U4.
2. No any jumpers installed on JP6.
3. The upstream USB port is connected to the PC. This connection is needed for board's power source.
4. J4 connector is connected to the parallel port on the PC.

### 4.2 Loading Code

After setting up the board, the next process is loading the firmware. This development kit comes with application firmware that has been properly formatted for the SEEPROM. The files are located in the subdirectories under the `\USBWizard\Binary\` directory.

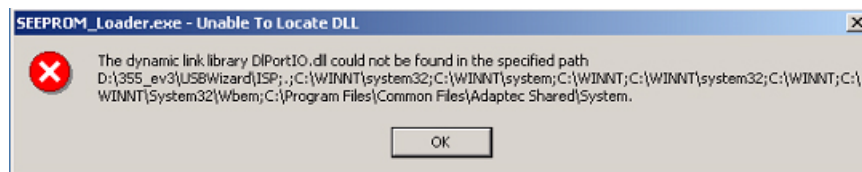
1. Open *SEEPROM Loader.exe*. It is located at in `\USBWizard\ISP\` directory on CD-ROM.

**Figure 4-1.** SEEPROM Loader Application



The following error message may appear in a pop-up window indicating that an extra DLL file needs to be downloaded and installed.

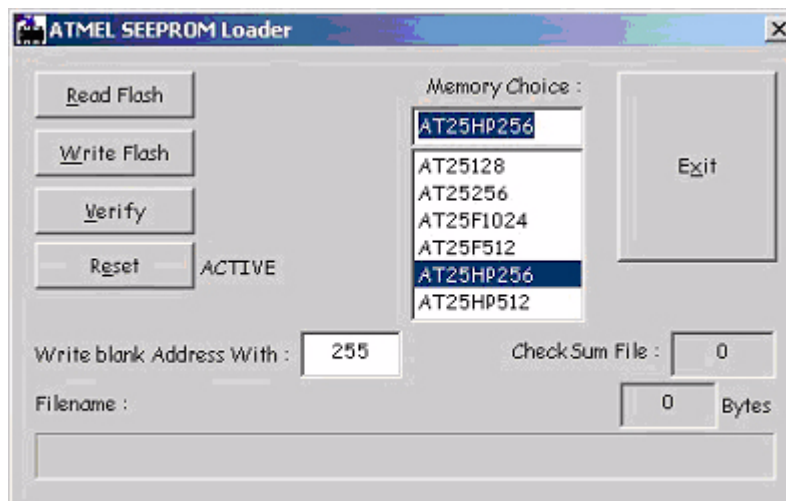
**Figure 4-2.** Error message of running SEEPROM\_Loader.exe



The SEEPROM loader uses the DriverLINX parallel port driver DLPortIO.DLL which provides the Win32 DLL hardware I/O functions. Windows® NT® and 2000 users also require the DLPortIO.SYS kernel mode driver. Both of these drivers are copyrighted Scientific Software Tools, Inc. (www.driverlinx.com). To download the drivers, follow the following steps:

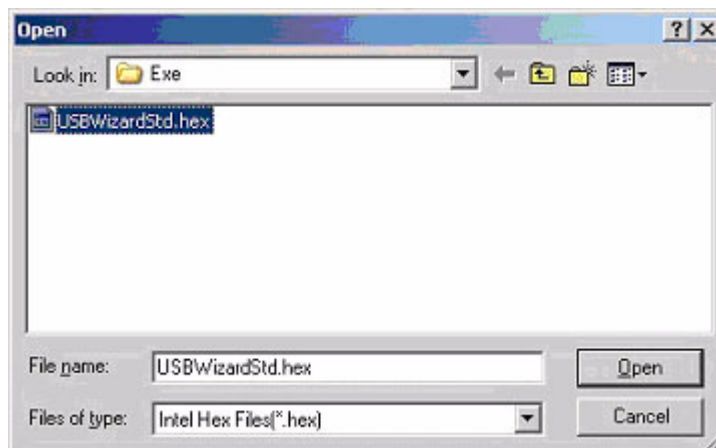
1. Go to <http://www.driverlinx.com/DownLoad/dnload.htm>
  2. Click on **Windows 95/NT Port I/O Driver**
  3. Download the **.exe** file.
2. Before selecting the memory, click on **Reset** to bring the device to the Active reset state. Then select the memory from **Memory Choice:** list box.

**Figure 4-3.** Selecting Memory Flash



- Click on **Write Flash** button. Figure 4-4 will appear.

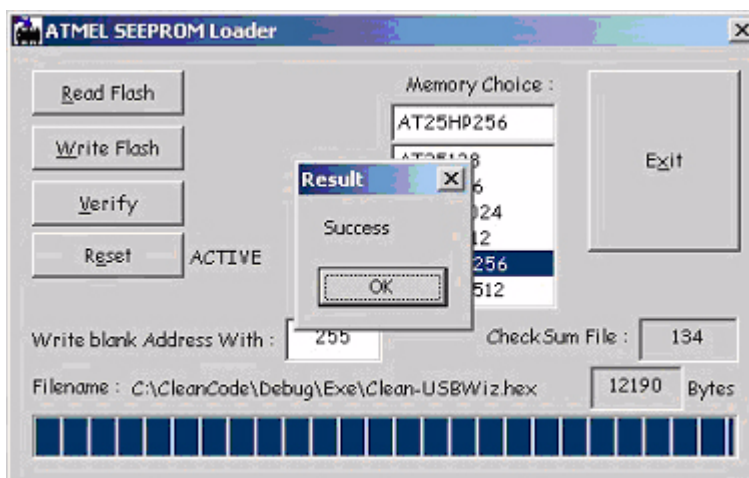
**Figure 4-4.** Selecting the File



- Locate the \*.hex file to be downloaded, and then click **Open** to start downloading. If successful, a message box will be displayed stating that the download was a success. Select one of \*.hex files which are located in the `\USBWizard\Binary\` directory.
- Once a successful upload has been completed, a message box will appear, as shown in Figure 4-5.
- Click **OK** to close the message box.
- Disconnect the DB25 parallel cable from the J4 connector, then disconnect and reconnect the board's USB upstream port to reset the evaluation board.

Another way to rest the board is to click on the Reset to make the board stay in a Non-active reset state. And then, disconnect and reconnect the board's USB upstream port.

**Figure 4-5.** A Successful Download



- Clicking **Exit** will terminate the application.





## Section 5

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# Technical Support

For technical support, please e-mail **usb@atmel.com** with the following information:

- The revision number of the AT43DK355 Development Board
- The version number of the USB Wizard
- A detailed description of the problem

Alternatively, fill out an online support form available in the **Product Section** of the Atmel web site at <http://www.atmel.com>.





# Section 6

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## Appendix

### 6.1 AT43USB355 Bill of Materials (BOM)

*Table 6-1.*

AT43USB355 USB Microcontroller/Hub				
AT43USB355_EV3      Revision: 1.0				
Bill Of Materials - November 19, 2002				
Item	Qty	Reference	Part	Supplier
1	4	C1, C11, C12, C32	0.01 UF, cer 0805, Panasonic ECU-V1H103KBG	Digikey PCC103BNCT-ND
2	7	C2, C3, C14, C16, C18, C24, C28	0.1 UF, cer 0805, Panasonic ECJ-2VB1E104K	Digikey PCC1828CT-ND
3	9	C4, C6, C8, C15, C17, C19, C21, C33, C35	0.001 UF, cer 0805, Panasonic ECU-V1H102KBG	Digikey PCC102BNCT-ND
4	1	C5	0.33 UF, cer 0805, Panasonic ECJ-2YB1C334K	Digikey PCC1817CT-ND
5	3	C7, C10, C34	2.2 UF, cer 0805, Panasonic ECJ-2YB0J225K	Digikey PCC1851CT-ND
6	1	C20	4.7 UF, el A, Panasonic ECE-V1ES4R7SR	Digikey PCE3065CT-ND
7	6	C22, C23, C26, C27, C30, C31	47 PF, cer 0603, Panasonic ECJ-1VC1H470J	Digikey PCC470ACVCT
8	2	C29, C25	220 UF, el D, Panasonic ECE-V0JA221WP	Digikey PCE3310CT-ND
9	1	JH1	Header 1x1	
10	6	JP1, JP2, JP4, JP5, JP14, JP16	Header_5X2	Jameco 67820 923810R
11	7	JP3, JP6, JP8, JP9, JP11, JP12, JP13	Header_2X2	Jameco 115027 923804R
12	1	J1	USB-B, AMP 787780-1	Digikey 787780-1
13	2	J3, J2	USB-A, AMP 787616-1	Digikey 787616-1
14	1	J4	CONNECTOR, D-SUB .318RT 25P-F	Jameco 15181, 1008-25S
15	8	LD1, LD2, LD3, LD4, LD5, LD6, LD7, LD0	LED, green	Jameco 34606, XC209G
16	6	L2, L3, L4, L5, L6, L7	Ferrite Bead, Stewart HI1206N800R-00	Digikey 240-1010-1-ND
17	2	Q2, Q4	2N4401	Jameco 38421

Table 6-1.

AT43USB355 USB Microcontroller/Hub				
AT43USB355_EV3 Revision: 1.0				
Bill Of Materials - November 19, 2002				
Item	Qty	Reference	Part	Supplier
18	1	R1	100, 0805 Panasonic ERJ-6GEYJ101V	Digikey P100ACT-ND
19	3	R2, R16, R17	1.5K, 0805 Panasonic ERJ-6GEYJ152V	Digikey P1.5KACT-ND
20	6	R3, R4, R5, R6, R7, R8	27, 0805 Panasonic ERJ-6GEYJ270V	Digikey P27ACT-ND
21	4	R9, R10, R11, R12	15K, 0805 Panasonic ERJ-6GEYJ153V	Digikey P15KACT-ND
22	1	R13	1M, 0805 Panasonic ERJ-6GEYJ105V	Digikey P1.0MACT-ND
23	3	R14, R18, R19	100K, 0805 Panasonic ERJ-6GEYJ104V	Digikey P100KACT-ND
24	1	R15	50K Potentiometer	Jameco 94721 X201R50K
25	8	R20, R22, R24, R25, R26, R27, R28, R29	470, 0805 Panasonic ERJ-6GEYJ471V	Digikey P470ACT-ND
26	6	R30, R31, R32, R33, R34, R39	0, 0805 Panasonic ERJ-6GEY0R00V	Digikey P0.0ACT-ND
27	4	R35, R36, R37, R38	2.2K, 0805 Panasonic ERJ-6GEYJ222V	Digikey P2.2KACT-ND
28	1	SW1	SW DIP-8, DS-08-G-01-BL	Jameco 38842
29	1	U1	AT43USB355-AC	Atmel
30	1	U2	ATF16V8CZ TSSOP	Atmel
31	1	U3	MIC2026-2BM	Micrel
32	1	U4	AT25HP256-10PC, PDIP 8-Pin socket	Jameco 51570
33	1	Y1	6.000 MHz Thru-Hole Crystal, CTS ATS060	Digikey CTX405-ND







Figure 6-3. AT43DK355 Schematic (3 of 5)

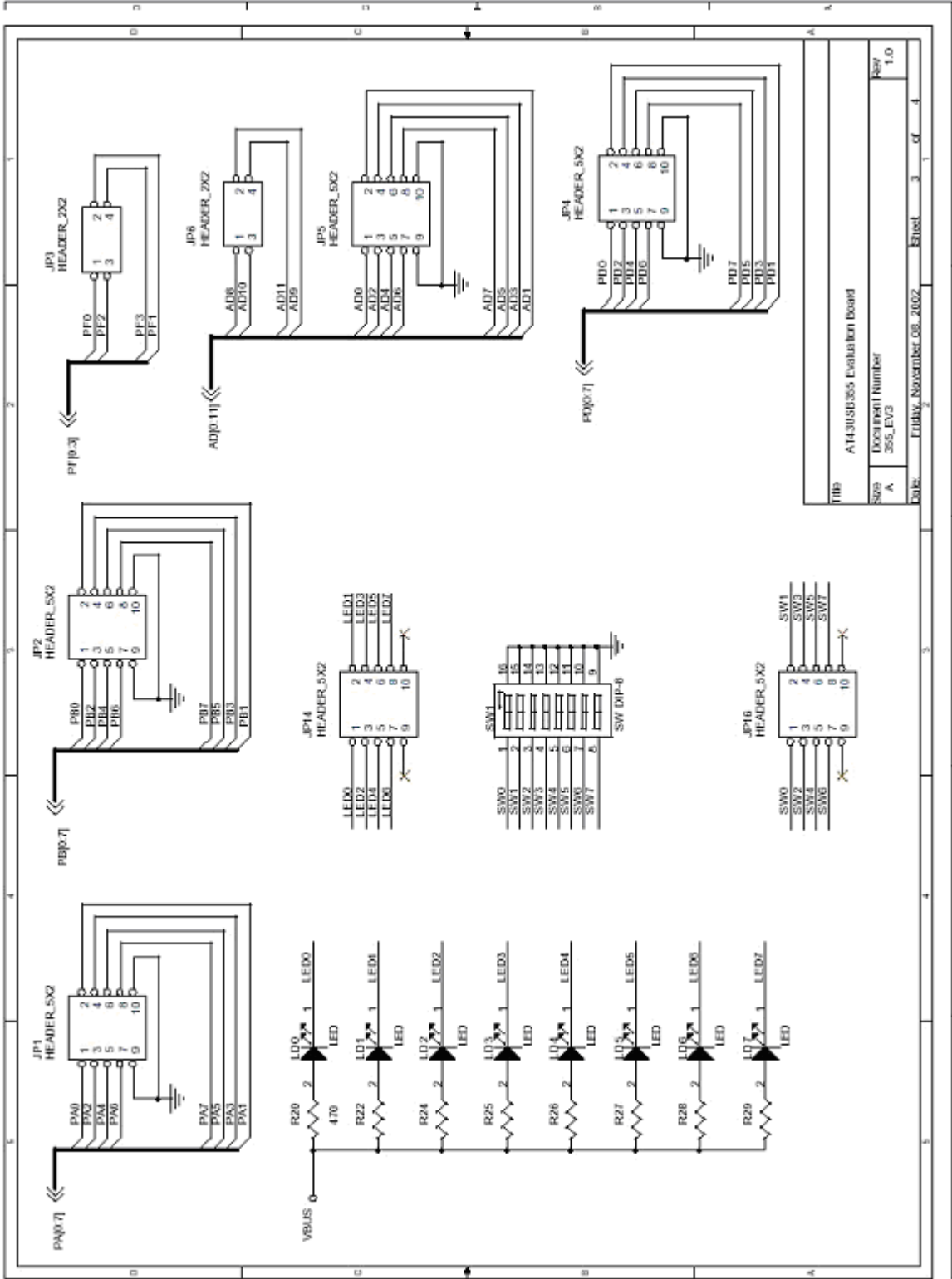
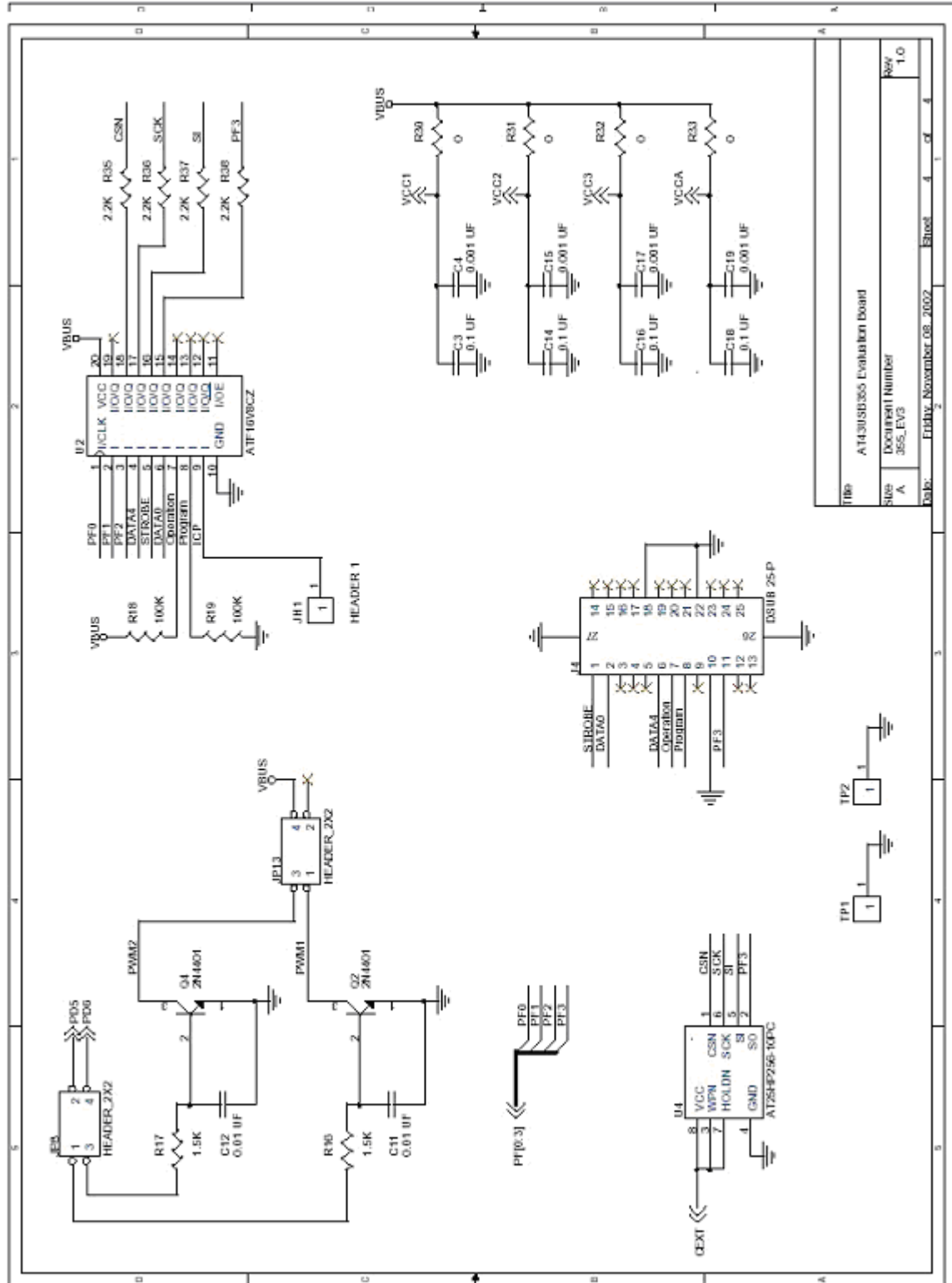


Figure 6-4. AT43DK355 Schematic (4 of 5)





## Section 7

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# Change Log

Doc. Rev.	Comments
3429C	<ul style="list-style-type: none"><li><b>Information Change:</b> Complete revision of Section 3.</li></ul>





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