AT91 Host Flash Loader

AT91 ARM® Thumb® Microcontrollers

Application Note

This application note describes the host Flash loader used to upload and program an application in the Flash memory of a Flash-based AT91 microcontroller.

Flash-based AT91 devices are delivered by Atmel with resident boot software able to upload program software into the Flash memory.

The following subjects are covered in this document:

- Flash requirements
- Host loader software
- Host configuration file
- Host loader software user notes

Package Contents

The file AT91Loader.zip contains all source and executable files for the computer. It also contains AT91Loader8011.ini and AT91Loader16x4.ini files, configuration files for the AT91Loader.exe file.

The file AT91Flash_uploader.zip contains all source, object and binary files for the AT91 device. It enables the user to understand and modify (if necessary) the flash uploader software. Note that fmu_flash.bin is the image of AT91 Flash production line programming.

Definition of Terms

A Flash-based AT91 is a microcontroller containing an embedded AT91 ARM7TDMI™ microcontroller with a 16-bit Flash memory.

A host Flash loader is a PC running software under Windows® 95/98.

USART is the universal synchronous/asynchronous receiver/transmitter, a serial communication port compatible with the computer serial port.

Warranty

All delivered sources are free of charge and can be copied or modified without authorization.

The software is delivered “AS IS” without warranty or condition of any kind, either express, implied or statutory. This includes, without limitation, any warranty or condition with respect to merchantability or fitness for any particular purpose, or against the infringements of intellectual property rights of others.

Rev. 2640A–ATARM–08/02

Host Loader Software

The host loader software runs under Windows. The executable file AT91Loader.exe has been generated with Microsoft® Visual Studio® 6.0. Its main functionalities are:

- To read the configuration file (Loader.ini)
- To synchronize with the AT91 boot loader software on a Flash-based AT91 microcontroller and adapt to the baud rate (defined in Loader.ini)
- To read and analyze the binary file
- To encode commands and transfer data

Configuration File

The host flash loader supports different flash configurations described in the configuration file. This file also describes additional initialization parameters for the transfer configuration. These parameters are defined in four groups:

MODE: Work mode

COM: PC serial port definition

FILE: Name of binary file to download

FLASH: Target Flash description

MODE

This field is used for the debug protocol. In general, two modes can be set, automatic mode or manual mode.

- Manual = 0: Automatic mode. All commands and sequences are managed by the PC Host Flash loader.
- Manual = 1: Manual mode. All commands can be sent in the menu “Send”. This mode is used only for debugging the serial communication channel. If this field is set, the following commands are accessible:
  - Autosync: Autosynchronisation
  - Synchro: Send the synchro command
  - Speed: Send the speed command
  - Erase sector: Select the sector to erase and send the erase sector command
  - Write: Select the address and send the write command
  - Data: Send a block of 64 data words
  - Read Data: Select the address and read a block of 64 data words
  - Verify: Select the addresses (start and end) and the checksum and send the verify command
  - Upload: Not implemented
  - ACK: Send the ack command
  - Fill input buffer: Purge the communication port

COM

This field is used to define the serial communication channel. It is divided into four fields:

- Name = COM1: Indicate the PC port connected to the target
- Synchronization = 1200: Indicate the initial connection speed. In this case the low speed choice is used. The first action of the target is waiting for a character (0x80) for baud rate measurement and to initiate the communication.
- Transfer_baud = 115200: Indicate data transfer connection speed. In general, a PC cannot support a baud rate higher than 115200. If the user PC supports a higher speed, the baud rate can be updated.

- Target_CD = 18: Indicate the target user CD value for data speed connection. This value depends on the main target oscillator. The AT91 USART Speed Definition table on page 8 can be used to choose the best CD value to optimize communication quality. This value is sent to the target after synchronization and when communication starts at the high speed data transfer rate.

FILE

Name of binary file to download. This name must use the absolute path.

FLASH

Target flash description. This field is used to define the embedded Flash. It is sub-divided into six fields:

- Name = AT49BV8011. Indicate the Flash name. It is used only to provide the information corresponding to the file definition. This field is not analysed.
- Type = 0x004A. Indicate the type of embedded Flash. This information is available in the corresponding Flash datasheet in the device code field.
- Manufacturer = 0x001F. Indicate the type of embedded Flash. This information is available in the corresponding Flash datasheet in the manufacturer code field.
- base_address = 0x01000000. Indicate the first Flash sector. This value is also defined in the target by the EBI setting.
- Load_address =0x01000000. Indicate the first address to be loaded. Generally it is the same as the base address.
- Sector = 40. Indicate the sector number of the embedded Flash. This information is defined in the features presented in the Flash datasheet .
- Sector_TypeX = and Size_TypeX =
  These groups of two fields describe the Flash sector mapping. For example, if a 16-megabit 1 M words/2 M bytes Flash is used, e.g. AT49BV1604, there are forty sectors to map as shown in the following table:

Sector	No. Sector	K bytes	Sector_TypeX	Size_TypeX	X
SA0 to SA7	8	8	8	8	0
SA8 to SA9	2	32	2	32	1
SA10 to SA39	30	64	30	64	2
Total (AT49BV1604)	**40**	**2048**			

For sector type 0, there are 8 sectors of 8 K bytes (Sector_Type0 = 8; Size_Type0 =8)

For sector type 1, there are 2 sectors of 32 K bytes
(Sector_Type1 = 2; Size_Type1 =32)

For sector type 2, there are 8 sectors of 8 K bytes
(Sector_Type2 = 40; Size_Type2 =64)

This information is available in the corresponding Flash datasheet in the Sector Address Table field.

On page 4 and page 5, there are two examples of the LOADER.INI file, the first for the embedded Flash AT49BV1604, the second for the AT49BV8011.

Example of Loader.ini File for AT91F40416

The example file below is also valid for an AT91 with an embedded AT49BV16x4. The file is provided by Atmel.

```
[MODE]
Manual=0 // automatic load, all commands are managed by HOST Loader

 [COM]
Name=COM1 // COM1 serial port
Synchronization_baud=1200 // Synchronization baud rate
Transfer_baud=115200 // Transfer baud rate
Target_CD=18 // AT91 CD value for a baud rate of 115200
// Main Clock = 32.678MhZ => CD = 18
// Main Clock = 25Mhz => CD = 13

 [FILE] // name of the binary file to download
Name=C:\At91\software\projects\led_blink_eb40\flash\led_blink.bin

 [FLASH]
Name=AT49BV1604 // flash type is AT49BV1604
Type=0x00C0
Manufacturer=0x001F// ATMEL manufacturer Id
base_address=0x01000000 // base address of the flash
Load_address=0x01000000 // download address of the binary file
Sector=40 // number of sector of the flash
Sect_type0=8 // number of first sectors SA0 to SA7
Size_type0=8 // Size of the first sectors in K byte
Sect_type1=2 // number of next sectors SA8 and SA9
Size_type1=32 // Size of sectors in K byte
Sect_type2=30 // number of next sectors SA10 to SA39
Size_type2=64 // Size of sectors in K byte
[END_OF_FILE]
```

Example of Loader.ini File for AT91FR4081

The example file is also valid for an AT91 with an embedded AT49BV8011. This file is provided by Atmel.

```
[MODE]
Manual=0 // automatic load, all commands are managed by HOST Loader

 [COM]
Name=COM1 // COM1 serial port
Synchronization_baud=1200 // Synchronization baud rate
Transfer_baud=115200 // Transfer baud rate
Target_CD=18 // AT91 CD value for a baud rate of 115200
// Main Clock = 32.678MhZ => CD = 18
// Main Clock = 25Mhz => CD = 13

 [FILE] // name of the binary file to download
Name=C:\At91\software\projects\led_blink_eb40\flash\led_blink.bin
[FLASH]
Name=AT49BV8011 // flash type is AT49BV8011
Type=0x004A
Manufacturer=0x001F
base_address=0x01000000 // base address of the flash
Load_address=0x01000000 // download address of the binary file
Sector=22 // number of sector of the flash
Sect_type0=1 // number of first sectors SA0
Size_type0=16 // Size of the first sectors in K byte
Sect_type1=1 // number of next sectors SA1
Size_type1=32 // Size of sectors in K byte
Sect_type2=4 // number of next sectors SA2 to SA5
Size_type2=8 // Size of sectors in K byte
Sect_type3=1 // number of next sectors SA6
Size_type3=32 // Size of sectors in K byte
Sect_type4=1 // number of next sectors SA7
Size_type4=16 // Size of sectors in K byte
Sect_type5=14 // number of next sectors SA8 to SA21
Size_type5=64 // Size of sectors in K byte
[END_OF_FILE]
```

Host Loader Software User Notes

The download procedure is as follows:

1. If an AT91 with an AT49BV8011 Flash memory is used, copy Loader8011.ini to Loader.ini.
   If an AT91 with an AT4916x4 Flash memory is used, copy Loader16x4.ini to Loader.ini.
2. Modify the `[FILE]` field. Set the name of the binary file as follows:

   ```
   [FILE]
   Name=C:\At91\software\projects\"your project\your binary file name"
   ```

3. Connect the AT91-based system through a serial cable to the computer's COM1.
4. Power-up or reset the system to launch Flash_uploader.
5. Launch AT91Loader.exe on your computer.
   The window below should appear:

When the computer's serial COM1 is synchronized with the USAART of the AT91, Flash programming begins.

If the download is successful, the following window appears:

If the download is unsuccessful, the following window appears:

Troubleshooting

In case of failure, the following points should be verified:

- Hardware
  - AT91 and Flash supplies are correctly connected
  - NCS0 is connected to NCSF
  - NWAIT is pulled-up and not driven always to 0
  - NRST is connected to a reliable reset circuitry
  - NRSTF is connected to a reliable reset circuitry (we suggest to connect it directly to NRST)
  - BMS is connected to 0
  - NTRI is pulled-up
- Software
  - Loader.ini contains the correct memory mapping
  - Serial port selected is the one connected to serial cable (COM1 or COM2)
  - File name path is correct
  - `Target_CD` corresponds to CD chosen based on the table “AT91 USART Speed Definition” on page 8
  - Transfer_baud corresponds to `Target_CD`
  - File downloaded is a pure binary image file (file extension .mem/ .rom/ .bin)
  - The computer's serial port is not already being used

AT91 USART Speed Definition

The baud rate parameter is selected depending on microprocessor frequency. It is entered as the value of `target_CD` in the loader.ini file.

The following table is used to select the most reliable baud rate according to the frequency of the AT91-based system. Note that in asynchronous mode, maximum error must not be greater than 5%.

USART Baud Rate = MCKI/CD x 16

MCKI (MHz)	Baud Max (Bits/s)	Standard (Bits/s)	CD Real	CD Choice	Real (Bits/s)	Error %
3 686 400	230 400	115 200	2.00	2	115 200.00	0.00%
4 915 200	307 200	115 200	2.67	3	102 400.00	12.50%
5 000 000	312 500	115 200	2.71	3	104 166.67	10.59%
6 000 000	375 000	115 200	3.26	3	125 000.00	7.84%
6 144 000	384 000	115 200	3.33	3	128 000.00	10.00%
7 372 800	460 800	115 200	4.00	4	115 200.00	0.00%
8 000 000	500 000	115 200	4.34	4	125 000.00	7.84%
10 738 635	671 165	115 200	5.83	6	111 860.78	2.99%
12 000 000	750 000	115 200	6.51	7	107 142.86	7.52%
12 288 000	768 000	115 200	6.67	7	109 714.29	5.00%
14 318 180	894 886	115 200	7.77	8	111 860.78	2.99%
14 745 600	921 600	115 200	8.00	8	115 200.00	0.00%
15 000 000	937 500	115 200	8.14	8	117 187.50	1.70%
18 432 000	1 152 000	115 200	10.00	10	115 200.00	0.00%
24 000 000	1 500 000	115 200	13.02	13	115 384.62	0.16%
24 576 000	1 536 000	115 200	13.33	13	118 153.85	2.50%
25 000 000	1 562 500	115 200	13.56	14	111 607.14	3.22%
32 000 000	2 000 000	115 200	17.36	17	117 647.06	2.08%
32 768 000	2 048 000	115 200	17.78	18	113 777.78	1.25%
40 000 000	2 500 000	115 200	21.70	22	113 636.36	1.38%

Atmel Headquarters

Corporate Headquarters
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 487-2600

Europe
Atmel Sarl
Route des Arsenaux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
TEL (41) 26-426-5555
FAX (41) 26-426-5500

Asia
Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimhatsui
East Kowloon
Hong Kong
TEL (852) 2721-9778
FAX (852) 2722-1369

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

Atmel Operations

Memory
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 436-4314

Microcontrollers
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 436-4314

La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
TEL (33) 2-40-18-18-18
FAX (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards
Zone Industrielle
13106 Rousset Cedex, France
TEL (33) 4-42-53-60-00
FAX (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
TEL (44) 1355-803-000
FAX (44) 1355-242-743

RF/Automotive
Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
TEL (49) 71-31-67-0
FAX (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906
TEL 1(719) 576-3300
FAX 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/
High Speed Converters/RF Datacom
Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
TEL (33) 4-76-58-30-00
FAX (33) 4-76-58-34-80

e-mail
literature@atmel.com

Web Site
http://www.atmel.com

2640A–ATARM–08/02 0M