AT91 In-system Programmer (ISP)

User Guide

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Section 1
Introduction

1.1 Overview

The AT91 In-system Programmer (ISP) provides an open set of tools for programming the AT91SAM7 and AT91SAM9 ARM®-based microcontrollers. They are based on a common dynamic linked library (DLL), the AT91Boot_DLL. It is used by SAM-BA™, SAM-PROG and all ISP tools.

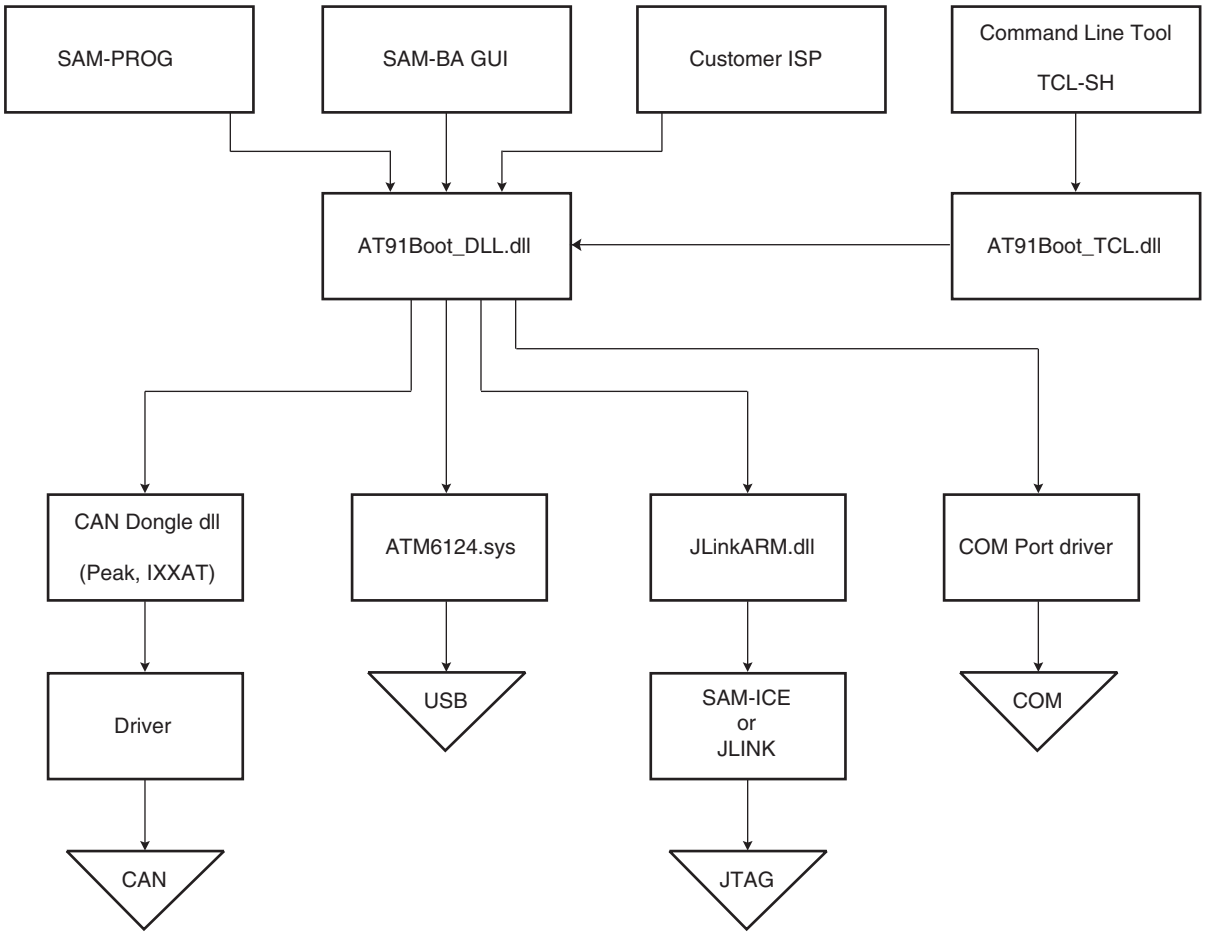
AT91Boot_DLL API is in the public domain so that custom GUI ISP solutions can be built. It avoids writing low-level functions such as Flash memory writing algorithms, etc.

AT91Boot_DLL is an OLE COM component distributed under a DLL (AT91Boot_DLL.dll) allowing automation tools.

It is also possible to execute the AT91Boot_DLL functions in command lines in a TCL shell. An intermediate DLL (AT91Boot_TCL.dll) is used to transform TCL commands into calls to AT91Boot_DLL.

Several communication links are available such as USB, serial link, CAN or JTAG.

Figure 1-1. AT91 ISP Framework Architecture



1.2 DLL Prerequisites

- Runs under Windows® 2000/XP
- A SAM-ICE or a JLink JTAG box and its associated USB drivers (only necessary to use JTAG communication link)
- CAN Dongles
  - PCAN-USB Peak dongle
  - USB-to-CAN compact IXXAT dongle
- TCL Toolchain including tclsh can be downloaded from the following URL: http://www.activestate.com/Products/ActiveTcl/

1.3 Installation

Installation is automatic using the AT91_ISP.exe install program.

1.3.1 Contents

1.3.1.1 Library Directory

All files located in the Library directory are necessary for the AT91Boot_DLL to run correctly.

- AT91Boot_DLL.dll
- AT91Boot_DLL.tlb type library file
- JLinkARM.dll
- AT91Boot_TCL.dll
- CAN Dongle dlls

1.3.1.2 Examples Directory

This directory contains some example projects using AT91Boot_DLL.dll. See the section "Using AT91Boot_DLL Project Examples" for more information on the following projects:

- OLE_MFC project under Visual C++ 6.0
- OLE_without_MFC project under Visual C++ 6.0
- CAN_TCLSH gives an example of a TCL script that can be used to program a SAM7X256-based board over the CAN network.

1.3.1.3 SAM-PROG Application

This application downloads a binary file into the Flash memory of one or more AT91SAM devices in parallel from a PC or JTAG probe.

1.3.1.4 SAM-BA Boot4CAN Directory

This directory contains binary files for AT91SAM7A3 and AT91SAM7X devices. These files must be programmed into internal Flash memory before communicating over a CAN. SAM-PROG can be used to program these files.

1.3.2 DLL Registration

AT91Boot_DLL needs to be registered in the Windows Base Register in order to be used correctly. The Install program will register AT91Boot_DLL automatically.

AT91Boot_DLL.dll uses JLinkARM dll. In order for the user to compile a project anywhere, "YOUR_INSTALL_DIRECTORY\Library" path has been added to the PATH user environment variable. If it is not the case, JLinkARM dlls has to be set in the current directory of your application in order to be found by the AT91Boot_DLL.

Note: It is also possible to copy dll contained in the Library directory into WINNT/System32 as this directory is in the PATH environment variable by default. Do not forget to register AT91Boot_DLL after moving.

To register AT91Boot_DLL manually, execute the following command from a DOS Window or directly through the Windows Start/Execute menu:

```
regsvr32 /s /c "YOUR_INSTALL_DIRECTORY\AT91Boot_DLL.dll"
```

Note: regsvr32.exe is located in WINNT/System32 directory

1.3.3 Updating JLink/SAM-ICE Software

In order to function correctly, compatibility between JLink/SAM-ICE firmware, USB drivers and JLinkARM DLL is necessary. Thus it is recommended to update JLink/SAM-ICE software.

The JLink/SAM-ICE software update, contained in a zip file, is available on the www.segger.com web site in the "Downloads", then "J-Link ARM" sub-areas. To proceed with update, carry out the following steps:

- Download the "Jlink_ARM" zip file.

- Unzip this download.
- Run the .exe file contained in it.
- Check the update in the “Doc\ReleaseNotes”.
- Run the new J-Link.exe to update the JLink/SAM-ICE firmware.
- Check if your PC driver is up to date with the delivery driver in the “USBDriver” folder contained in the .exe.
- Copy the JLinkARM.dll DLL to “YOUR_INSTALL_DIRECTORY\Library\” folder.

This completes the software update.

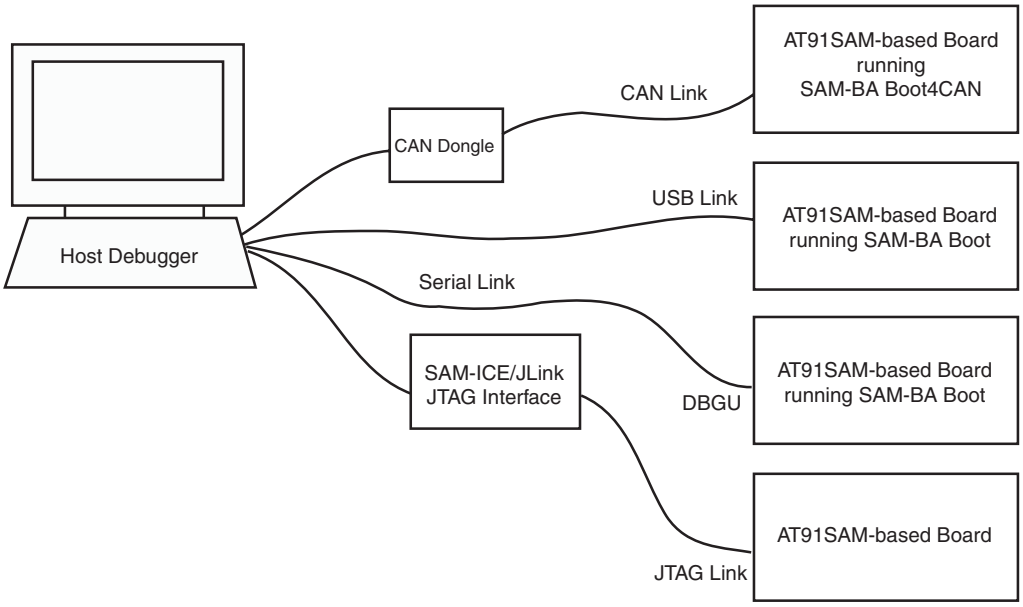
Section 2

Communicating with AT91SAM Devices

2.1 Communication Links

AT91Boot_DLL connects AT91SAM-based targets through a USB link, a serial link or a JTAG using a SAM-ICE or JLink JTAG box.

Figure 2-1. Different Ways of Communicating with AT91SAM-based Targets



Depending on which communication link is selected, the target must be in the following state:

- When using the USB link or the DBGU serial link, SAM-BA Boot must run onto the target.
- When using the CAN link, SAM-BA Boot4CAN must run onto the target.
- When using JTAG communication through SAM-ICE or JLink, the target may be in an undefined state. In this case, it is up to the user to configure the target (PLL, etc.) if necessary.

2.2 Starting Communication

The AT91Boot_DLL principle is simple. It consists of:

1. Scanning all devices connected to the PC
2. Opening communication to the selected device
3. Performing all desired actions such as writing into Flash memory
4. Closing communication

Section 3

AT91Boot_DLL Interface

3.1 Low-level Functions

A description and a code example is given for each function.

These functions are available for all AT91SAM microcontrollers.

3.1.1 AT91Boot_Scan

This function scans connected devices and returns a list of connected devices. Detection is performed in the following order:

1. USB connected devices using ATM6124.sys driver
2. Connected SAM-ICE or JLink devices
3. CAN dongles (Peak, IXXAT)
4. All available serial COM ports

Note: The AT91Boot_Scan function does not verify if an Atmel® device is really present, so even if there are no Atmel devices connected to SAM-ICE/JLink devices, CAN dongles or COM ports, these connections are returned in the connected devices list. This does not concern USB devices.

3.1.1.1 Description

void AT91Boot_Scan(char *pDevList);

Table 3-1. AT91Boot_Scan

Type	Name	Details
Input Parameters	char *pDevList	Pointer to a char* table. All table entries must have been allocated prior using the AT91Boot_Scan function. (1)
Output Parameters	char *pDevList	Strings returned in the table: - *"\usb\ARMX"* for USB connected devices - *"\jlink\ARMX"* for SAM-ICE/JLink connected devices - *"\can\AtCanPeak\ARM"* for PCAN-USB Peak connected dongle - *"\can\Ixxat\ARM"* for USB-to-CAN compact IXXAT connected dongle - *"COMX"* for available COM ports
Return Code	none	

Note: 1. Each string must be allocated from the application and must have a size superior to 80 bytes. That string is used to recover, in particular CAN dongle, USB or JTAG box device name which is then replaced by a reduced symbolic name.

3.1.1.2 Code Example

```
CHAR *strConnectedDevices[5];
for (UINT i=0; i<5; i++)
    strConnectedDevices[i] = (CHAR *)malloc(100);
AT91Boot_Scan((char *)strConnectedDevices);
```

AT91Boot_Scan may return code similar to that below:

```
strConnectedDevices[0] : \usb\ARM0
strConnectedDevices[1] : \usb\ARM1
strConnectedDevices[2] : \jlink\ARM0
strConnectedDevices[3] : \can\AtCanPeak\ARM
strConnectedDevices[4] : COM1
```

3.1.2 AT91Boot_Open

This function opens the communication link on an AT91SAM device depending on the string given in the argument:

- USB
- JTAG
- CAN
- Serial COM port

Note: At this step, the Atmel device MUST be connected to either SAM-ICE/JLink, CAN network or COM port if using such a communication link.

3.1.2.1 Description

void AT91Boot_Open(char *name, int *h_handle);

Table 3-2. AT91Boot_Open

Type	Name	Details
Input Parameters	*name	Pointer to a string returned by AT91Boot_Scan function(1)
Output Parameters	*h_handle	Communication handle: - NULL if opening connection failed - Non NULL if opening connection succeeded
Return Code	void	

Note: 1. As AT91Boot_Scan function detects only CAN dongles and not AT91SAM devices which are connected to, it is recommended to add an identifier to the end of string for each device such as, for example, *"\can\AtCanPeak\ARM0"*, *"\can\AtCanPeak\ARM1"...*

3.1.2.2 Code Example

```
AT91Boot_Open(strConnectedDevices[0], &h_handle);
AT91Boot_Open(''\can\AtCanPeak\ARM0'', &h_handle);
```

3.1.2.3 JTAG Communication Link

When opening a JTAG communication link through a SAM-ICE or a JLink by using the following command:

```
AT91Boot_Open(''\jlink\ARM0'', &h_handle);
```

the following steps are performed:

1. Open JLinkARM.dll and its associated library functions.
2. Set JTAG speed to 30 kHz in order to connect to the target even if it is running at 32 kHz.
3. Stop the target.

4. Set a hardware breakpoint at address 0.
5. Send a PROCRST command (RSTC_CR) in the Reset Controller in order to disable the Watchdog.
6. Wait for the target to reach the breakpoint.
7. Download a monitor into the target internal SRAM that allows communication only through the ARM Debug Communication Channels[1] by using the SAM-BA Boot commands[2].
8. Jump to the monitor in internal SRAM. If the target was running at 32kHz, the monitor switches on the Main Oscillator[3].
9. Set JTAG speed to 3 MHz as it is the lowest allowed crystal frequency.

Note:
1. For further information about DCC, visit www.arm.com.
2. For further informations about SAM-BA Boot commands, see the Boot Program section of the product datasheet.
3. It is recommended to configure the PLL when returning from AT91Boot_Open function in order to speed up monitor execution.

3.1.3 AT91Boot_Close

This function closes the communication link previously opened on an AT91SAM device.

3.1.3.1 Description

void AT91Boot_Close(int h_handle);

Table 3-3. AT91Boot_Close

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
Output Parameters	none	
Return Code	void	

3.1.3.2 Code Example

```
AT91Boot_Close(h_handle);
```

3.1.4 AT91Boot_CAN_Configure

This function configures the target as well as AT91Boot_DLL initialization.

It allows:

- Configuring CAN network baudrate (Set Baudrate action). It is always the first action to perform after calling AT91Boot_Open function. It opens CAN dongles dlls with correct baudrate parameter. Only baudrate value passed in uValue parameter is necessary for such an action. uParam parameter can be null.
- Connecting/Disconnecting Target. It is necessary to connect to the target after a Set Baudrate action and before trying to communicate. Both uParam and uValue parameters can be null.
- Reading/writing CAN configuration bytes on the target. See the document “AT91SAM CAN Bootloader”, Lit. No. 6220 for more information.

Note: See Examples/CAN_TCLSH/test.tcl script for more information on how to use this function.

3.1.4.1 Prerequisite

As these parameters are stored into internal Flash memory, the Embedded Flash Controller Flash Mode Register (EFC_FMR) must be programmed correctly before using this function.

Note: AT91SAM CAN Bootloader automatically switches on the Main Oscillator when starting.

3.1.4.2 Description

AT91Boot_CAN_Configure
(int h_handle, int uAction, int uParam, int *uValue, int err_code);

Table 3-4. AT91Boot_CAN_Configure

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uAction	Select Read or Write Action • 0x00 corresponds to a Read action • 0x01 corresponds to a Write action • 0x03 corresponds to a Set Baudrate action • 0x04 corresponds to a Connect Target action • 0x05 corresponds to a Disconnect Target action
	uParam	Select Parameters to Read/Write • 0x00 = Node Number (NNB) • 0x01 = CAN Re-locatable Identifier Segment (CRIS) • 0x02 = AutoBaud Mode (ABM) • 0x03 = Propagation Segment (PROPAG_SEG) • 0x04 = Phase Segment 1 (PHASE1_SEG) • 0x05 = Phase Segment 2 (PHASE2_SEG) • 0x06 = Baudrate Prescaler (BRP)
	*uValue	Byte to write if uAction corresponds to a Write If uAction corresponds to a Set Baudrate action, it is used only as CAN baudrate parameter for CAN baudrate configuration. The different configuration values are: • 100 (k) • 125 (k) • 250 (k) • 500 (k) • 1000 (k) (default value if no configuration passed)
Output Parameters	*uValue	Byte to read if uAction corresponds to a Read
	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK CAN Error Codes: • (int)(0x8001): CAN_Open dll function returned “fail” • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail” • (int)(0x8004): Target not disconnected • (int)(0x8005): Target not connected • (int)(0x8006): uAction parameter is not valid
Return Code	void	

3.1.4.3 Code Example

```
#define CAN_WRITE_CFG 1
#define CAN_SET_BAUDRATE 3
#define CAN_CONNECT_TARGET 4
#define CAN_DISCONNECT_TARGET 5
#define CAN_NNB 0

int err_code;

// First Set CAN Baudrate
int baudrate = 500;
AT91Boot_CAN_Configure(h_handle, CAN_SET_BAUDRATE, 0, &baudrate, &err_code);

// Then Connect to target
AT91Boot_CAN_Configure(h_handle, CAN_CONNECT_TARGET, 0, NULL, &err_code);

// DO NOT FORGET TO CONFIGURE EFC_FMR REGISTER CORRECTLY
AT91Boot_Write_Int(h_handle, 0xXXXXXXXX , 0xFFFFFF60, &err_code);

// Write a new Node Number value, for example...
int new_nnb = 0x10;
AT91Boot_CAN_Configure(h_handle, CAN_WRITE_CFG, CAN_NNB, &new_nnb,
&err_code);

// Disconnect the target
AT91Boot_CAN_Configure(h_handle, CAN_DISCONNECT_TARGET, 0, NULL, &err_code);
```

3.1.5 AT91Boot_Write_Int

This function writes a 32-bit word into the volatile memory of the connected target.

3.1.5.1 Description

void AT91Boot_Write_Int(int h_handle, int uValue, int uAddress, int *err_code);

Table 3-5. AT91Boot_Write_Int

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uValue	32-bit value to write
	uAddress	Address where to write 32-bit value
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.5.2 Code Example

```
AT91Boot_Write_Int(h_handle, 0xCAFECAFE, 0x200000, &err_code);
```

3.1.6 AT91Boot_Write_Short

This function writes a 16-bit word into the volatile memory of the connected target.

3.1.6.1 Description

void AT91Boot_Write_Short(int h_handle, short wValue, int uAddress, int *err_code);

Table 3-6. AT91Boot_Write_Short

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	wValue	16-bit value to write
	uAddress	Address where to write 16-bit value
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.6.2 Code Example

```
AT91Boot_Write_Short(h_handle, 0xCAFE, 0x200000, &err_code);
```

3.1.7 AT91Boot_Write_Byte

This function writes an 8-bit word into the volatile memory of the connected target.

3.1.7.1 Description

void AT91Boot_Write_Byte(int h_handle, char bValue, int uAddress, int *err_code);

Table 3-7. AT91Boot_Write_Byte

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	bValue	8-bit value to write
	uAddress	Address where to write 8-bit value

Table 3-7. AT91Boot_Write_Byte

Type	Name	Details
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.7.2 Code Example

```
AT91Boot_Write_Byte(h_handle, 0xFE, 0x200000, &err_code);
```

3.1.8 AT91Boot_Write_Data

This function writes X bytes into the volatile memory of the connected target.

3.1.8.1 Description

void AT91Boot_Write_Data(int h_handle, int uAddress, char *bValue, int uSize, int *err_code);

Table 3-8. AT91Boot_Write_Data

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uAddress	Address where to write 8-bit value
	*bValue	Pointer to 8-bit data buffer to write
	uSize	Buffer size in bytes
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF004): USART Communication link not opened • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.8.2 Code Example

```
char bData[10] =
{0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09};

AT91Boot_Write_Data(h_handle, 0x200000, bData, 10, &err_code);
```

3.1.9 AT91Boot_Read_Int

This function reads a 32-bit word from the connected target.

3.1.9.1 Description

void AT91Boot_Read_Int(int h_handle, int *uValue, int uAddress, int *err_code);

Table 3-9. AT91Boot_Read_Int

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	*uValue	Pointer to a 32-bit value
	uAddress	Address where to read 32-bit value
Output Parameters	*uValue	32-bit read value
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.9.2 Code Example

```
int ChipId;
AT91Boot_Read_Int(h_handle, &ChipId, 0xFFFFF240, &err_code);
```

3.1.10 AT91Boot_Read_Short

This function reads a 16-bit word from the connected target.

3.1.10.1 Description

void AT91Boot_Read_Short(int h_handle, short *wValue, int uAddress, int *err_code);

Table 3-10. AT91Boot_Read_Short

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	*wValue	Pointer to a 16-bit value
	uAddress	Address where to read 16-bit value

Table 3-10. AT91Boot_Read_Short

Type	Name	Details
Output Parameters	*wValue	16-bit read value
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.10.2 Code Example

```
short wRead;
AT91Boot_Read_Short(h_handle, &wRead, 0x200000, &err_code);
```

3.1.11 AT91Boot_Read_Byte

This function reads an 8-bit word from the connected target.

3.1.11.1 Description

void AT91Boot_Read_Byte(int h_handle, char *bValue, int uAddress, int *err_code);

Table 3-11. AT91Boot_Read_Byte

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	*bValue	Pointer to an 8-bit value
	uAddress	Address where to read 16-bit value
Output Parameters	*bValue	8-bit read value
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.11.2 Code Example

```
char bRead;
AT91Boot_Read_Byte(h_handle, &bRead, 0x200000, &err_code);
```

3.1.12 AT91Boot_Read_Data

This function reads X bytes from the connected target.

3.1.12.1 Description

void AT91Boot_Read_Data(int h_handle, int uAddress, char *bValue, int uSize, int *err_code);

Table 3-12. AT91Boot_Read_Data

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uAddress	Address where to read 8-bit data
	*bValue	Pointer to an 8-bit data buffer where to store read data
	uSize	Number of bytes to read

Table 3-12. AT91Boot_Read_Data

Type	Name	Details
Output Parameters	*bValue	Pointer to read data
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF004): USART Communication link not opened • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.12.2 Code Example

```
char bData[10];
AT91Boot_Read_Data(h_handle, 0x200000, bData, 10, &err_code);
```

3.1.13 AT91Boot_Go

This function allows starting code execution at specified address.

3.1.13.1 Description

void AT91Boot_Go(int h_handle, int uAddress, int *err_code);

Table 3-13. AT91Boot_Read_Data

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uAddress	Address where to start code execution
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.1.13.2 Code Example

```
AT91Boot_Go(h_handle, 0x200000, &err_code);
```

3.2 Internal Flash Programming Functions

These functions are available only for AT91SAM microcontrollers with Flash.

3.2.1 AT91Boot_SAM7xxx_Send_Flash

These functions make it possible to write X bytes into the internal Flash memory of the connected target. If some sectors are locked, they are unlocked in order to effectively program the internal Flash memory.

Available functions are:

- AT91Boot_SAM7S32_Send_Flash (available for SAM7S32 and SAM7S321 parts)
- AT91Boot_SAM7S64_Send_Flash
- AT91Boot_SAM7S128_Send_Flash
- AT91Boot_SAM7S256_Send_Flash
- AT91Boot_SAM7S512_Send_Flash
- AT91Boot_SAM7A3_Send_Flash
- AT91Boot_SAM7X128_Send_Flash (available for SAM7X128 and SAM7XC128 parts)
- AT91Boot_SAM7X256_Send_Flash (available for SAM7X256 and SAM7XC256 parts)
- AT91Boot_SAM7X512_Send_Flash (available for SAM7X512 and SAM7XC512 parts)
- AT91Boot_SAM7SE256_Send_Flash
- AT91Boot_SAM7SE512_Send_Flash

3.2.1.1 Prerequisite

Embedded Flash Controller Flash Mode Register (EFC_FMR) must be programmed correctly prior using one of these functions.

Note: Two Embedded Flash Controllers are embedded in AT91SAM7S512, AT91SAM7X512 and AT91SAM7SE512 parts. Both EFC_FMRx registers must be programmed correctly prior using one of these functions.

3.2.1.2 Description

void AT91Boot_SAM7xxx_Send_Flash(int h_handle, int uOffset, char *bData, int uSize, int *err_code);

Table 3-14. AT91Boot_SAM7xxx_Send_Flash

Type	Name	Details
Input Parameters	h_handle	Communication handle returned by AT91Boot_Open function
	uOffset	Internal Flash Offset where to write 8-bit value
	*bData	Pointer to 8-bit data buffer to write
	uSize	Buffer size in bytes

Table 3-14. AT91Boot_SAM7xxx_Send_Flash

Type	Name	Details
Output Parameters	none	
Error Code	*err_code	• (int)(0x0000) AT91C_BOOT_DLL_OK Standard Error Codes: • (int)(0xF001): Bad h_handle parameter • (int)(0xF002): Address is not correctly aligned • (int)(0xF003): uSize is not correct • (int)(0xF004): USART Communication link not opened • (int)(0xF005): Communication link broken CAN Error Codes: • (int)(0x8002): CAN_Read dll function returned “fail” • (int)(0x8003): CAN_Write dll function returned “fail”
Return Code	void	

3.2.1.3 Code Example

```
char bData[10] =
{0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09};

// Write buffer at offset 0x100 into internal SAM7S64 Flash
AT91Boot_SAM7S64_Send_Flash(h_handle, 0x100, bData, 10, &err_code);
```

Section 4

AT91Boot_TCL Interface

Only the prototypes are defined in this chapter. A TCL script example called test.tcl is given in the Example/CAN_TCLSH directory.

4.1 Loading AT91Boot_TCL Functions

AT91Boot_TCL.dll must be loaded in order to access its functions. The command is:

```
load [file join AT91Boot_TCL.dll] At91boot_tcl
```

Note: The command is case sensitive.

4.2 Low-level Functions

These functions are available for all AT91SAM microcontrollers.

- list TCL_Scan
- set h_handle [TCL_Open $name]
- TCL_Close $h_handle
- TCL_Write_Int $h_handle $uValue $wAddress err_code
- TCL_Write_Short $h_handle $wValue $wAddress err_code
- TCL_Write_Byte $h_handle $bValue $wAddress err_code
- TCL_Write_Data $h_handle, $wAddress $bValue $size err_code
- set uValue [TCL_Read_Int $h_handle $wAddress err_code]
- set wValue [TCL_Read_Short $h_handle $wAddress err_code]
- set bValue [TCL_Read_Byte $h_handle $wAddress err_code]
- set bValue TCL_Read_Data $h_handle $wAddress $size err_code
- TCL_Go $h_handle $wAddress err_code

For Read actions:

- set uValue TCL_CAN_Configure $h_handle $uAction $uParam err_code

For other actions:

- TCL_CAN_Configure $h_handle $uAction $uParam $uValue err_code

4.3 Internal Flash Programming Functions

These functions are available only for AT91SAM microcontrollers with Flash.

- TCL_SAM7S32_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7S64_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7S128_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7S256_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7S512_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7SA3_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7X128_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7X256_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7X512_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7SE256_Send_Flash $h_handle $wOffset $bValue $size err_code
- TCL_SAM7SE512_Send_Flash $h_handle $wOffset $bValue $size err_code

4.4 TCL Script Example

The following script gives an example of how to program a binary file into a SAM7S64 internal Flash. See Section 5.2 for details on how to run the script.

```
load [file join ../../Library/AT91Boot_TCL.dll] At91boot_tcl

set DevList(0) ""
set err_code 0

# SCAN connected devices
set i 0
foreach {name} [TCL_Scan] {
set DevList($i) $name
puts "DevList($i): $DevList($i)"
incr i 1
}

# Open first one in the list
set h_handle 0
set i 0
set h_handle [TCL_Open $DevList($i)]

# TRY FLASH application.bin file into SAM7S64 internal flash
variable fileName "application.bin"
variable fileAddr 0x0

global valueOfDataForSendFile

# Open and read binary file
set f [open $fileName r]
fconfigure $f -translation binary
set size [file size $fileName]
set valueOfDataForSendFile [read $f $size]
close $f
```

```
# Write file into Flash
TCL_SAM7S64_Send_Flash $h_handle $fileAddr valueOfDataForSendFile $size
err_code

set valueOfDataForSendFile 0

# Close connection
TCL_Close $h_handle
```

Section 5

Using AT91Boot_DLL Project Examples

5.1 Visual C++ 6.0 Projects

5.1.1 Using AT91Boot_DLL with MFC

The project OLE_MFC.dsw is located in Examples\OLE_MFC folder. It scans connected devices, opens the first one, reads DBUG chip ID. If an AT91SAM7S256 is detected, it programs a small application (BasicMouse) in the internal Flash.

To use AT91Boot_DLL in such a project, the following steps must be performed:

- Create an AT91Boot_DLL class in your project. To do this, copy both at91boot_dll.cpp and at91boot_dll.h files into your project directory.

Note: Do not use the ClassWizard/Add Class/From a type library... as there is a bug in Visual C++ 6.0. The bug prevents any functions containing a char variable as a parameter from being imported.

- Initialize OLE libraries by calling `AfxOleInit` function.
- Create an AT91Boot_DLL driver object to manage AT91Boot_DLL COM object.
- Create an AT91Boot_DLL COM object instance with the AT91Boot_DLL program ID[(1)](`"AT91Boot_DLL.AT91BootDLL.1"`) by using `CreateDispatch` function.

Note: 1. Program ID is stored in the base register and is an easier way to retrieve AT91Boot_DLL Class ID necessary for CreateDispatch function.

Once these four steps have been performed, DLL functions should be available. See their prototypes in at91boot_dll.h header file and for details on how to call these functions.

Note: At this step, if AT91Boot_DLL functions are not available, it is because the AT91Boot_DLL dll has not been registered correctly. See Section 1.3.2 for more information.

5.1.1.1 Code Example

```
#include "at91boot_dll.h"

IAT91BootDLL *m_pAT91BootDLL;

AfxOleInit();

m_pAT91BootDLL = new IAT91BootDLL;

m_pAT91BootDLL->CreateDispatch(_T("AT91Boot_DLL.AT91BootDLL.1"));
```

5.1.2 Using AT91Boot_DLL without MFC

This paragraph explains the project OpenRDI_OLE.dsw located in AT91Boot DLL Example\OLE without MFC folder.

To use AT91Boot_DLL in such a project, the following steps must be performed:

- Initialize COM library by calling `CoInitialize(NULL)`. Use `CoUninitialize()` to close COM Library at the end of the project.
- Import AT91Boot_DLL COM object from AT91Boot_DLL.tlb Type Library file. Eventually rename namespace if necessary.
- Add `using namespace` directive to share the same namespace as AT91Boot_DLL library.
- Create a pointer to AT91Boot_DLL COM object

5.1.2.1 Code Example

In stdafx.h header file

```
#import "YOUR_INSTALL_DIRECTORY/AT91Boot_DLL.tlb" rename_namespace
("AT91BOOTDLL_Lib")
```

In OpenRDI_OLE.cpp source file

```
using namespace AT91BOOTDLL_Lib;

CoInitialize(NULL);

  // COM Object Creation
  IAT91BootDLLPtr pAT91BootDLL(__uuidof(AT91BootDLL));
```

5.2 Running the TCL Script Example

To run this example, TCL Toolchain including tclsh must be downloaded from the URL: http://www.activestate.com/Products/ActiveTcl/

A TCL script example (test.tcl) is given in the Examples/CAN_TCLSH directory. It also gives an example on how to use AT91Boot_DLL CAN functions. The same principle can be applied in a Visual C++ project.

The script communicates with an AT91SAM7X256-based board over CAN and programs a USB Mouse application into the internal Flash memory. SAM-BA Boot4CAN is running. It has been previously programmed in the internal Flash memory with AT91SAM-PROG application.

First, connect CAN Peak or IXXAT dongle between the PC and the board.

Then, open a DOS window and execute test.tcl script by typing:

```
tclsh YOUR_INSTALL_DIRECTORY/Examples/CAN TCLSH/test.tcl
```

After script execution, the USB Mouse application must be programmed.

Section 6

Revision History

Table 6-1. Revision History

Document Ref.	Comments	Change Request Ref.
6224A	First issue.	
6224B	Added Section 1.3.3, “Updating JLink/SAM-ICE Software”.	
6224C	Updated document to refer to AT91SAM9 microcontrollers in Section 1.1 ”Overview”.	2833
6224D	In Section 3.1.2.3 ”JTAG Communication Link”, on page 3-2, added steps 4, 5 and 6. In “AT91Boot_CAN_Configure”, Section 3.1.4.2 ”Description”, on page 3-5, updated. In Section 3.1 ”Low-level Functions”, in Table 3-4 to Table 3-12 added new information on Error Code. Added new code in all sections “Code Example”. In Section 3.2 ”Internal Flash Programming Functions”, “AT91Boot_SAM7xxx_Send_Flash”, updated list of available functions, Section 3.2.1.1 ”Prerequisite”, added Error Code information to Table 3-14 and updated Section 3.2.1.3 ”Code Example”. In “AT91Boot_TCL Interface” in Section 4.2 ”Low-level Functions” and in Section 4.3 ”Internal Flash Programming Functions” updated list of functions. Updated Section 4.4 ”TCL Script Example”.	

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