S1C31W74 Application Note

S1C31W74 Boot Loader Manual

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1. Overview

This document describes the boot loader sample software included in the S1C31W74 sample software package. This sample software contains an example of a boot loader that calls the flash programming library (seFlashLibrary) and a sample program that is loadable by the boot loader.

The folder configuration of this boot loader sample software is as follows:

- Examples/BootLoader/Bootloader   The boot loader
- Examples/BootLoader/Loadsample   The loadable program

* For details on how to use the sample software, refer to "S1C31W74 Peripheral Circuit Sample Software Manual".

1.1. Loadable Data Format

The loadable data format is the Motorola S-record. It is necessary that the end of the downloaded data is either the S7/S8/S9 records. As a result, the boot loader recognizes that download was completed.

1.2. S1C31W74 Pin Setting and Serial Communication Format

The boot loader uses UART Ch.0 to communicate with PC. UART Ch.0 functions are using following pins:

Pin name	Description
P16	UART/Ch.0/USIN
P17	UART/Ch.0/USOUT

UART Ch.0 has been initialized with below format:

|	
Boaudrate	230400 bps
Data length	8 bits
Parity	None
Stop bit	1 bit
Flow control	Software (XON/XOFF)

2. Function
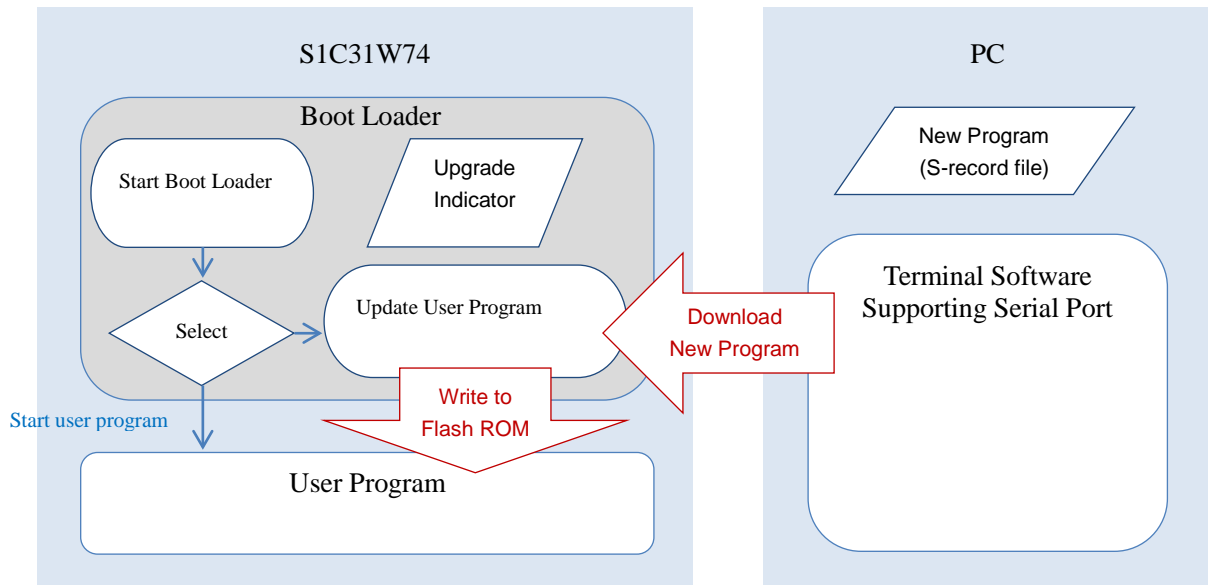
2.1 Boot Loader

The boot loader exists in the flash ROM area from 0x0000 to 0x3FFF (16KB).
When S1C31W74 is reset, the boot loader begins operating and selects either of two functions, starting or updating the user program.
If the program update is completed, the boot loader starts the user program that exists in 0x4000 or later area.
If the update is in progress, the boot loader receives the new program by using UART, and writes it into 0x4000 or later area. Since the boot loader stops when the reception of the new program is ended, please reset S1C31W74. The new program starts after reset because the update of the program is completed.
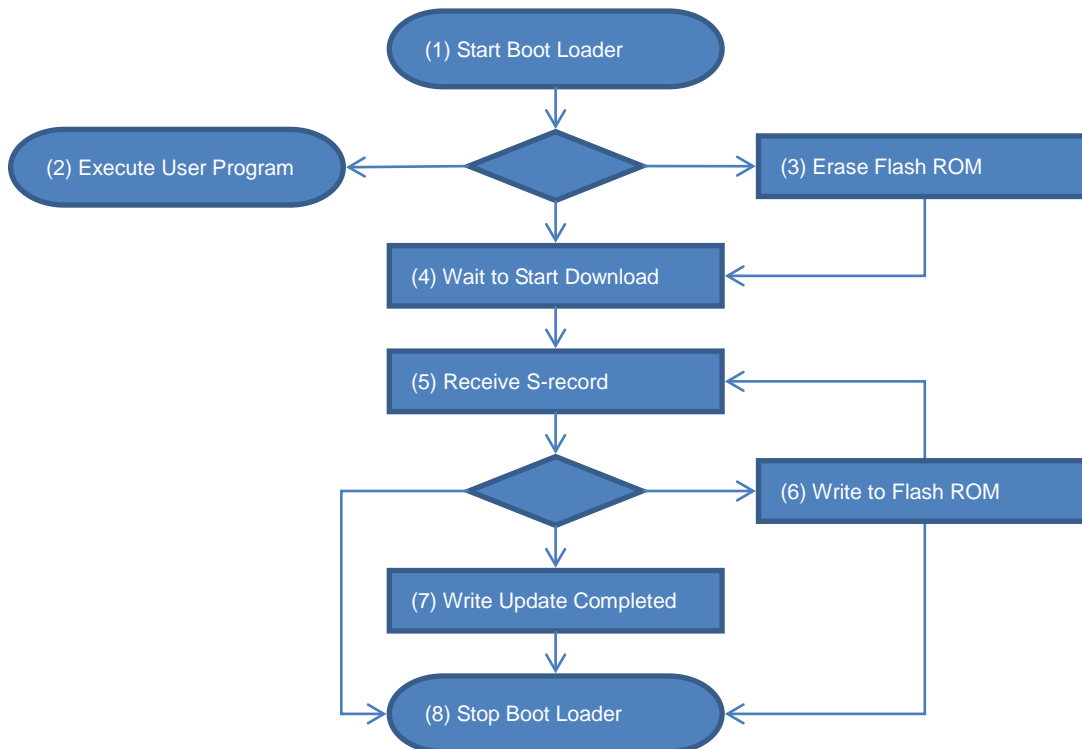
Please examine the following points when you implement the boot loader into your device:

A) Display of the upgrade start.
    When the boot loader flows from (1) to (3) (4), it is necessary to display "upgrade start" to the user. The display should guide the user to connect UART cable with appropriate timing. Otherwise, UART error will be caused when beginning to communicate.
B) Display of the upgrade end.
    When the boot loader flows from (7) to (8), it is necessary to display "upgrade end" to the user.
C) How should the boot loader operate when the problem has been detected?
    i.   Communication timeout.
            This boot loader (4) (5) monitors the UART reception or the time-out. But it retries (4) (5) again, even if the time-out occurs. The boot loader waits for time-out period (3ms) after transmitting XOFF. There is a possibility to shorten this time-out.
    ii.   Communication error.
            If the error is caused in UART communication, it is necessary to demand to send the record again. This boot loader (4) (5) does not monitor the UART error, because the terminal software working on PC does not accept such request.
    iii.   Wrong data.
            This boot loader confirms the checksum of the S-record (5), and stops without writing in case of the error (8). It is better to demand to send the record again.
    iv.   Writing failure in flash ROM.
            There is possibility to rewrite data at the already written address. The same value can be written again. The value can be rewritten from 1 to 0. But the rewriting from 0 to 1 causes an error.
            The downloaded data causes this failure. When this error is caused, it is necessary to erase flash ROM, and download from the beginning again.
D) Does the boot loader work correctly even if it was reset?
    This boot loader does not erase flash ROM again form (1) to (4) when reset while updating. It will work correctly by erasing again, but it is necessary to rewrite everything.
    In case of the boot loader does not erase again, the following confirmation is necessary. These conditions cannot be judged only from the reception of the S-record. If these conditions are false, it is better to erase again.
    i.   Is the data that has already been written correct?
    ii.   Is the data newly received the same program as the data that has already been received?
E) When should the boot loader erase flash ROM?
    When the upgrade indicator is "do upgrade", this boot loader (3) erase the user program and the upgrade indicator ([indicator] area). The value of the upgrade indicator becomes 0xFF, and means "now upgrading" by the erase. The boot loader never erase until the upgrade is completed after this.
    As a result, the boot loader never erases flash ROM at each reset. But the user program becomes impossible to upgrade when itself does not work because of wrong download and so on.
    It is better to provide additional condition that the boot loader erases flash ROM.
F) How should the boot loader operate after the loading (7)?
    This boot loader activates the watchdog timer after flash programing (8) and resets the MCU. However, it is also possible to execute the new program at once.
G) Loader application on PC
    It is possible to download new user program smoothly by preparing your loaded application on PC. Such application should have the following functions:
    i.   Inspect whether the program file is correct.
    ii.   Pause an upgrade process.
    iii.   Restart an upgrade process.
    iv.   Resend a record.
    v.   Confirm the upgrade is completed.

2.2 User Program

Please place the user program in 0x4000 or later.
When the user program decided to upgrade itself, the program should call the "start_upgrade" function contained in the boot loader. The "start_upgrade" function changes the indicator of the boot loader to "do_upgrade", and returns to the user program (caller function). The user program can continue executing. Please reset S1C31W74 so that the update of the user program may actually begin.

Specification of the "start_upgrade" function:

How to call the function	The entry of this function is stored in the vector table for the boot loader (0x00BC-). The vector number is 47 (a reserved vector). Because this function is not an interrupt handler, call as a normal function.
	
	 static void start_upgrade(uint32_t app_link_location){
	   void (*pfMainApp)(void);
	   uint32_t *pointer;
	   __disable_interrupt();
	   pointer = (uint32_t *)app_link_location;
	   pfMainApp = (void (*)(void))(*pointer);
	   pfMainApp();
	 }
	
	  /// call "start_upgrade" function of the boot loader
	  start_upgrade(0x00BC);

Required RAM	0x2000 0000 - 0x2000 07FF
Required stack area	112 bytes
Used peripherals	T16 Ch.1 is used to check timeout.

2.3 PC

Please download the new program by using terminal software that supports the serial port. For example, "TeraTerm" has been used to test the boot loader.

   Tera Term : http://ttssh2.osdn.jp/index.html.en

To download the new program (Motorola S-record), Please operate TeraTerm as follows:

(1) Select [New connection] form [File] menu, and specify [Serial] and your [Port], then click the [OK] button.
(2) Select [Serial Port...] from [Setup] menu. The [Serial port setup] dialog box is displayed.
(3) Enter the following parameters:
    Port: COMx   (x: your port number)
    Baud Rate: 230400
    Data: 8bit
    Parity: none
    Stop: 1bit
    Flow control: Xon/Xoff
    Transmit delay: 0msec/char, 0msec/line
(4) Click the [OK] button.
(5) Select [Send File] from [File] menu, and specify the new program (Motorola S-record). "TeraTerm" starts to download the new program.

3. Memory Usage
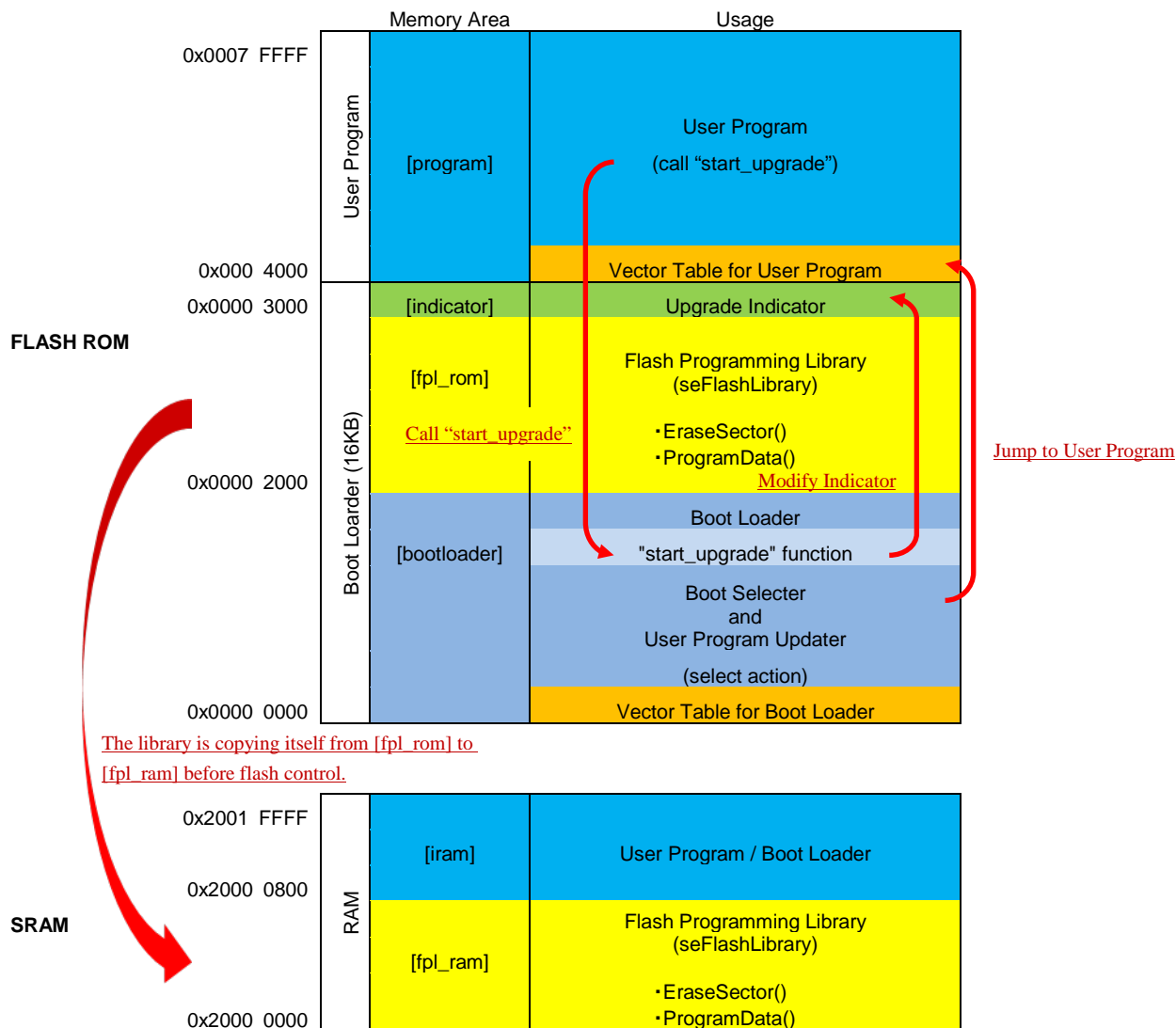
3.1 Update Indicator ([indicator] Area)

The size of the Update Indicator is 4KB. However, it is only 4 bytes that actually used. The value of 4 bytes indicates the following states:

State	Value
"upgrade completed"	0xAA, 0xAA, 0xAA, 0xAA
The upgrade has been completed, and the user program can be executed.	
"do upgrade"	0x00, 0x00, 0x00, 0x00
The user program decided to upgrade, but the upgrade has not started.	
"now upgrading"	0xFF, 0xFF, 0xFF, 0xFF
The boot loader is upgrading the user program. The upgrade is not completed.	

The unused part in this area can be used to record the progress of the upgrade.

3.2 Reserved RAM for Flash Programming Library ([fpl_ram] Area)

The self-modifying library is included in the boot loader side, and the RAM used by the library is defined as a part of the boot loader.
When the user program (loaded program) uses "start_upgrade" function of the boot loader, the flash programming library included in the boot loader works. At this time, the flash programming library uses the [fpl_ram] area as working space. Therefore, please arrange RAM used in the loadable program so as not to overlap with [fpl_ram] area.
RAM other than [fpl_ram] can be used on the loadable program side.

Revision History

Rev. No.	Date	Page	Category	Contents
Rev.1.00	Feb.26,2019	all	New	New establishment

EPSON

America

Epson America, Inc.

Headquarter:
3840 Kilroy Airport Way
Long Beach, California 90806-2452 USA
Phone: +1-562-290-4677

San Jose Office:
214 Devcon Drive
San Jose, CA 95112 USA
Phone: +1-800-228-3964 or +1-408-922-0200

Europe

Epson Europe Electronics GmbH
Riesstrasse 15, 80992 Munich,
Germany
Phone: +49-89-14005-0   FAX: +49-89-14005-110

Asia

Epson (China) Co., Ltd.
4th Floor, Tower 1 of China Central Place, 81 Jianguo Road, Chaoyang
District, Beijing 100025 China
Phone: +86-10-8522-1199   FAX: +86-10-8522-1120

Shanghai Branch
Room 1701 & 1704, 17 Floor, Greenland Center II,
562 Dong An Road, Xu Hui District, Shanghai, China
Phone: +86-21-5330-4888   FAX: +86-21-5423-4677

Shenzhen Branch
Room 804-805, 8 Floor, Tower 2, Ali Center,No.3331
Keyuan South RD(Shenzhen bay), Nanshan District, Shenzhen
518054, China
Phone: +86-10-3299-0588   FAX: +86-10-3299-0560

Epson Taiwan Technology & Trading Ltd.
15F, No.100, Songren Rd, Sinyi Dist, Taipei City 110. Taiwan
Phone: +886-2-8786-6688

Epson Singapore Pte., Ltd.
1 HarbourFront Place,
#03-02 HarbourFront Tower One, Singapore 098633
Phone: +65-6586-5500   FAX: +65-6271-3182

Seiko Epson Corp.
Korea Office
19F, KLI 63 Bldg, 60 Yoido-dong,
Youngdeungpo-Ku, Seoul 150-763, Korea
Phone: +82-2-784-6027   FAX: +82-2-767-3677

Seiko Epson Corp.
Sales & Marketing Division

Device Sales & Marketing Department
421-8, Hino, Hino-shi, Tokyo 191-8501, Japan
Phone: +81-42-587-5816   FAX: +81-42-587-5116