

S1C17 Family Application Note
S1C17 Series
Boot Loader
Sample Software

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1. Overview

This package contains an example of the boot loader that calls the C17 self-modifying library, and a sample program that is loadable by the boot loader.

The folder configuration of this package:

- s1c17xxx_bootloader The boot loader
 - s1c17xxx_loadsample The loadable program
- Note. xxx = MCU model name

1.1. Loadable Data Format

The loadable data format is the Motorola S-record. The PSA file generated with GNU17 is one of the S-record file, and was used to test this boot loader. 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. The tail of the PSA file is a S8 record.

1.2. C17 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	Function
	P00	UART/Ch.0/USOUT0
	P01	UART/CH.0/USIN0

The boot loader of MCU which can not internally generate the flash programing voltage, outputs a high/low level signal from the pin for an on/off control of external VPP (the power for flash programing). VPP control signal is output the following pins:

	Pin name	Function
	P10	VPP control signal

UART Ch.0 has been initialized with below format:

Communication speed	115200bps (C17W18, C17W23) 230400bps (other MCU models)
Data length	8bit
Parity	None
Stop bit	1bit
Flow control	Software (XON/XOFF)

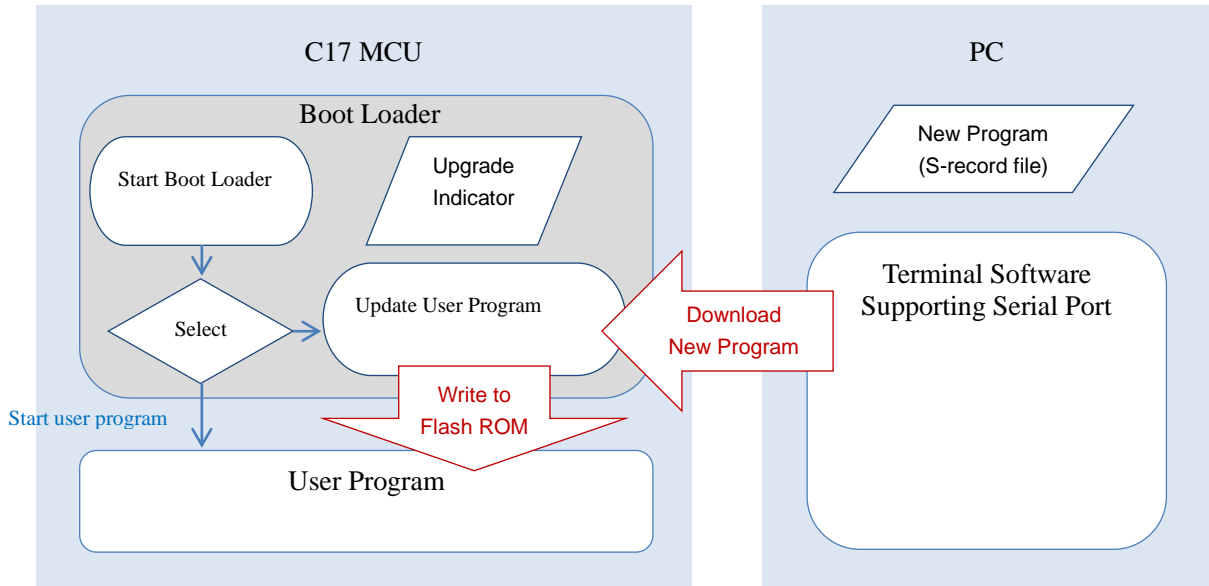
1.3. Precautions

When using this sample program, be sure to note the following points:

- Connect a capacitor to the Vpp pin as shown in the basic external connection diagram in the “S1C17(xxx) Technical Manual”, and disconnect the connection between the FLASH_VCC_OUT pin of ICDmini and the Vpp pin of the MCU.

2. Function

2. Function



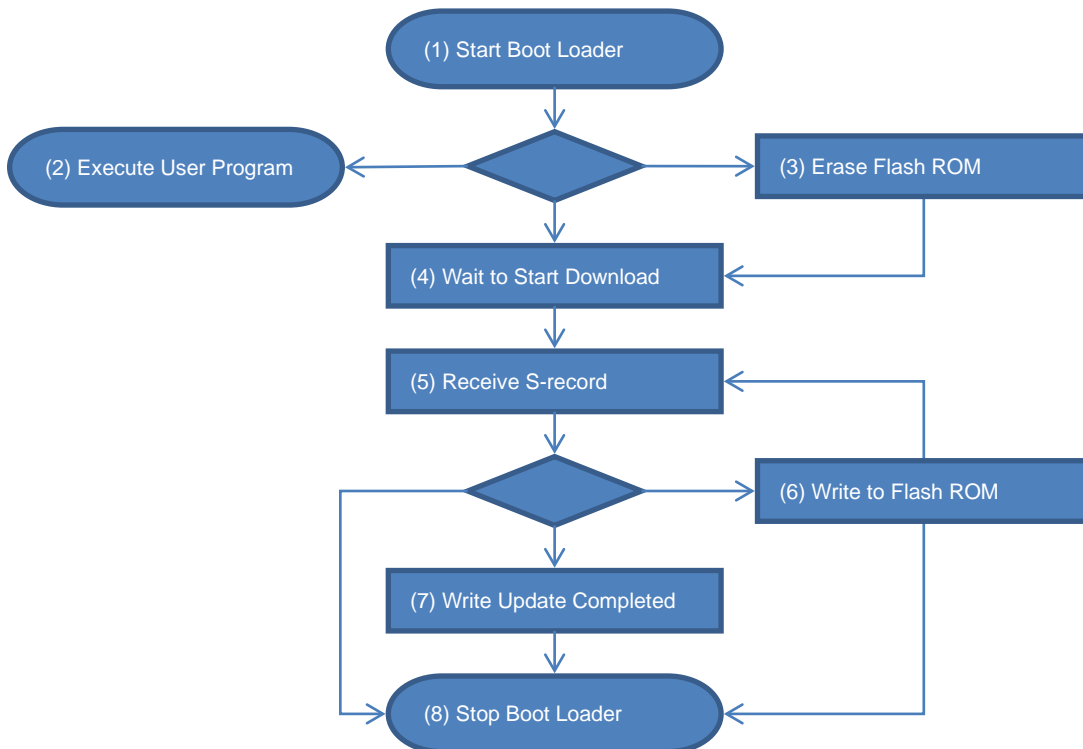
2.1 Boot Loader

The boot loader exists in the flash ROM area from 0x8000 to 0xBFFF (16KB).

When MCU is reset, the boot loader begins operating and selects either of two functions, starting or updating the user program.

If the update of the program is completed, the boot loader starts the user program that exists since 0xC000.

If the update is in progress, the boot loader receives the new program by using UART, and writes it in the area since 0xC000. Because the boot loader stops when the reception of the new program is ended, please reset C17 MCU. 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 retry (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 from (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 programming (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 loader 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. Function

2.2 User Program

Please place the user program since 0xC0000.

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 C17 MCU 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 (0x8000-). The vector number is 28 (a reserved vector). Because this function is not an interrupt handler, call as a normal function. <pre>typedef void (*bootloader_entry_t)(void); extern bootloader_entry_t __START_bootloader[]; // = 0x8000 __START_bootloader[28](); // call “start_upgrade”</pre>
Required RAM	0x0000 – 0x07FF
Required stack area	112 bytes
Used peripherals (same as the self-modifying library)	T16 Ch.1 is used to check timeout. CLG/OSC settings are changed to select OSC3 4MHz as SYSCLK.

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.

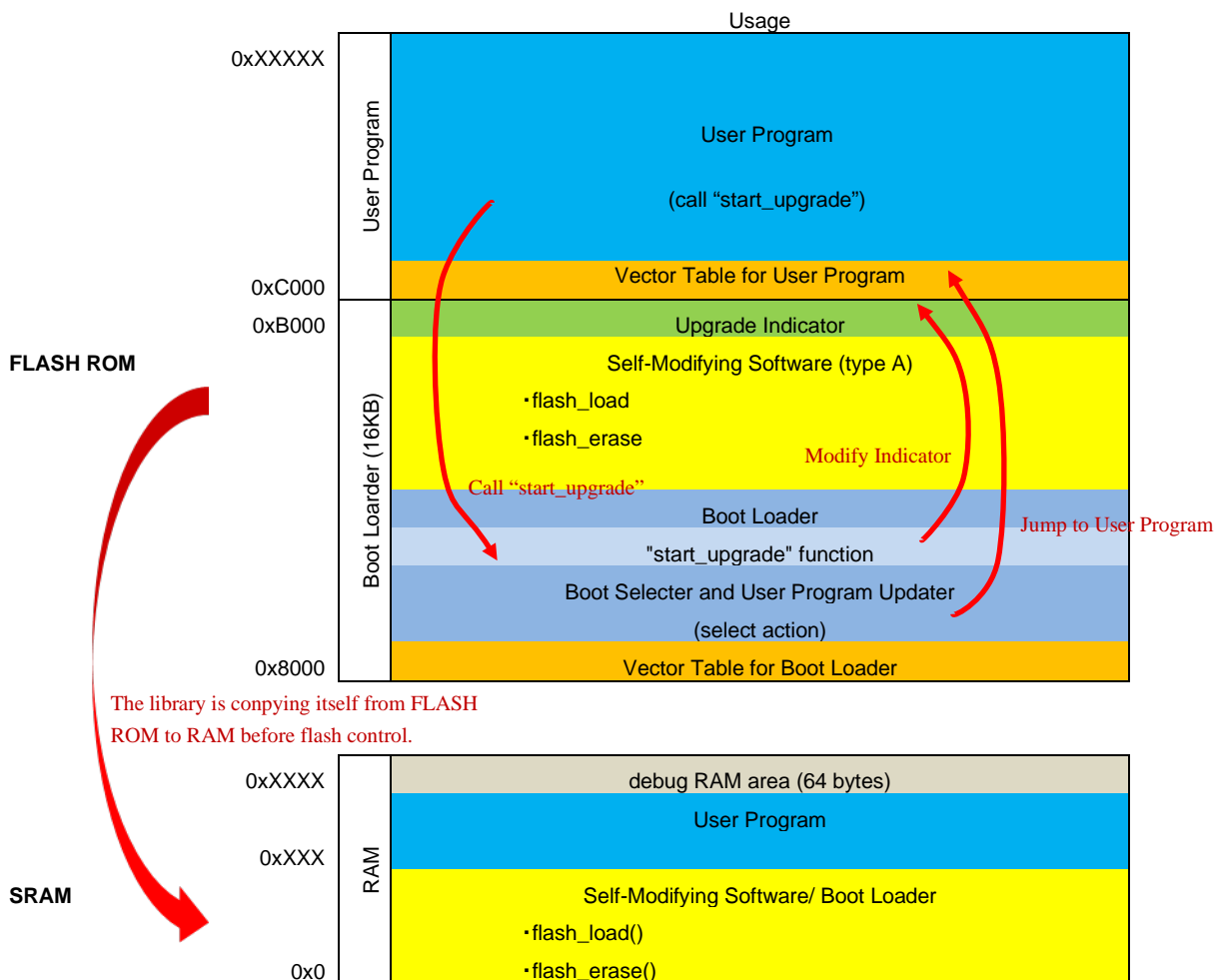
Tera Term : <http://ttssh2.osdn.jp/index.html.en>

To download the PSA file, Please operate TeraTerm as follows:

- (1) Select [New connection] from [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:	115200 or 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 your PSA file. “TeraTerm” starts to download new program.

3. Memory Usage



3.1 Update Indicator

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

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

3.2 Reserved RAM for Self-Modifying Library

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 self-modifying library included in the boot loader works. At this time, the self-modifying library uses part of RAM as working

3. Memory Usage

space. Please check the address range to be used in the map file of the boot loader project. Please arrange RAM used in the loadable program so as not to overlap with this area.

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