# RH850/U2A-EVA Group

## Start Up Guide(OPBT)

### Introduction

This application note is intended to provide Option Bytes setting information to operate RH850/U2A-EVA Group (hereinafter referred to as U2A) in User mode and how to program Option Bytes.

Aim of this document and software is to provide supplemental information for the function on RH850/U2A. It is not intended to implement in the design for mass production.

There is no guarantee to update in this document and software to reflect the latest manual, errata, technical update and development environment. You are fully responsible for the incorporation or any other use of the information of this document in the design of your product or system, and refer to latest manual, errata, technical update and development environment.

### Target Device

- RH850/U2A-EVA Group

### Target development environment

Integrated development environment (CS+) from Renesas Electronics Corp.

Version : V8.03.00

Device file : DR7F702300.DVF

Integrated development environment (MULTI) from Green Hills Software Corp

Product : IDE for V800

Version : 2019.5.5 (v 7.1.6)

Target : V800/RH850

Device file : DR7F702300.DVF

EXEC file : ExecG3G4_V10201

Reference Document

RH850/U2A-EVA Group User's Manual: Hardware

The Hardware User's Manual provides information about functional and electrical behavior of the device.

At the release time of this application note the following manual version available:

- RH850/U2A-EVA User's Manual(Rev.1.00): R01UH0864EJ0100

## Table of Contents

# 1. Overview

The U2A differs from the previous generation products (RH850 / P1x and RH850 / F1x) in the following points when operating the U2A.

- Increased new Option Bytes setting items

Option Bytes setting items increased, and there are some new settings that require to pay attention before U2A is activated.

- Changed how to write Option Bytes

Previous generation products:

Enter the setting value in hexadecimal for each option byte (32 bits) on the Flash programmer GUI, and the input value is written to the target device via the Flash programmer.

U2A:

The option byte settings are described the its setting value on the source file as well as an user program, and writes HEX data to the target device via the flash programmer.

In this document, the above difference information is explained based on the operation procedure of the actual device.

## 1.1 Note

In the RH850/U2A series, the option byte setting values are different for each product, so please set the corresponding value. For the details of option byte, please refer to the Hardware User's Manual.

# 2. Option Bytes setting

## 2.1 Setting of U2A Normal Operating Mode (OPBT3[1:0])

U2A is possible to set to Serial Programming Mode 0 by setting Option Bytes without setting external pins. The operating mode of U2A is set to Serial Programming Mode 0 at shipping from Renesas. The purpose for this initial setting is to simplify programming to U2A in the customer ECU production process. Therefore, when debugging and stand-alone operation of U2A, the user needs to set bit 1 and 0 of OPBT3 to "00" related to operating mode setting on user program and change operating mode of U2A from Serial Programming Mode 0 to Normal Operating Mode.

Table 51.59 OPBT3 Contents

| Bit Position | Bit Name | Function |
|---|---|---|
| 1, 0 | STMSEL1, STMSEL0 | These bits select operating mode and startup area.<br>When FLMD0 pin is 0, the operating mode and startup area are selected depending on the combination of the STMSEL1 and STMSEL0. For details, see **Section 5, Operating Modes**. |

Table 5.1 Mode List

| | Pins | | | | | OPBT | | Operating Mode | Startup Area | Types of Debug Interface*1 | Flash Programming Interface |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | FLMD0 | FLMD1 | FLMD2 | MODE0 | $\overline{TRST}$ | STMSEL1 | STMSEL0 | | | | |
| User Mode | 0 | x | x | x | 0 | 0 | 0 | Normal Operating Mode | User Area*2 | Nexus/LPD | — |
| | 0 | x | x | x | 0 | 0 | 1 | User Boot Mode 0 | User Boot Area*3 | Nexus/LPD | — |
| | 0 | x | x | x | 0 | 1 | x | Serial Programming Mode 0 | Boot firmware | — | CSI |
| | 0 | x | x | x | 1*5 | x | 0 | Normal Operating Mode | User Area*2 | Nexus/LPD | — |
| | 0 | x | x | x | 1*5 | x | 1 | User Boot Mode 0 | User Boot Area*3 | Nexus/LPD | — |
| | 1 | 0 | x | x | x | x | x | Serial Programming Mode 1 | Boot firmware | — | 2-wire UART/CSI*4 |
| | 1 | 1 | 0 | x | x*5 | x | x | User Boot Mode 1 | User Boot Area*3 | Nexus/LPD | — |
| | 1 | 1 | 1 | 0 | x | x | x | Boundary Scan Mode | — | BSCAN | — |

Shpping Value

Caution

**If the operating mode setting is not changed from initial setting of OPBT3[1:0] as above, U2A operates normally when the debugger is connected but U2A doesn't operate normally after the debugger is disconnected.**

## 2.2 Setting the parameter related to MainOSC (OPBT10[28],[26:24],[22:20],[18:16],[15:12],[10:8],[6:4],[1],[0])

U2A is set parameters related to MainOSC such as frequency by the Option Bytes. It's necessary to be set bits 28, 26-24, 22-20, 18-16, 15-12, 10-8, 6-4, 1, 0 of OPBT10 related to MainOSC setting properly according to usage condition.

Table 51.65 OPBT10 Contents

| Bit Position | Bit Name | Function |
|---|---|---|
| 31 to 29 | Reserved | Set the value of valid area at the shipping. |
| 28 | MOSC_EXCLKINPUT | Main OSC input clock select.<br>0: Direct clock input to X1 (EXCLK mode). Main OSC amplifier is disabled.<br>1: Normal crystal oscillation. Main OSC amplifier is enabled. |
| 26 to 24 | MOSC_FREQ[2:0] | Main OSC frequency selection bit<br>$0\,0\,0_B$: 16 MHz<br>$0\,0\,1_B$: 20 MHz<br>$0\,1\,0_B$: 24 MHz<br>$0\,1\,1_B$: 40 MHz<br>$1\,x\,x_B$: setting prohibited (need to configure all bit) |
| 22 to 20 | MOSC_AMP_SEL_A [2:0] | Main OSC trimming configuration<br>These bits control OSC drivability during oscillation destabilization. |
| 18 to 16 | MOSC_AMP_SEL_B [2:0] | Main OSC trimming configuration<br>These bits control OSC drivability during oscillation stabilization. |
| 15 to 12 | MOSC_CAP_SEL [3:0] | Main OSC trimming configuration<br>These bits control internal capacitance. |
| 11 | Reserved | Set the value of valid area at the shipping. |
| 10 to 8 | MOSC_RD_SEL_A [2:0] | Main OSC trimming configuration<br>These bits control Damping resistor during oscillation destabilization. |
| 6 to 4 | MOSC_RD_SEL_B [2:0] | Main OSC trimming configuration<br>These bits control Damping resistor during oscillation stabilization. |
| 1 | MOSC_SHTSTBY_A | Main OSC trimming configuration<br>This bit controls OSC drivability during oscillation destabilization.<br>MOSC_SHTSTBY_A must be set to 1. |
| 0 | MOSC_SHTSTBY_B | Main OSC trimming configuration<br>This bit controls OSC drivability during oscillation stabilization.<br>MOSC_SHTSTBY_B must be set to 0. |

## 2.3 Setting CPU operating frequency (OPBT11[31:30])

CPU operating frequency for U2A is set by Option Bytes. It's necessary to be set bit 31 and 30 of OPBT11 related to CPU operating frequency according to usage condition.

Table 51.66 OPBT11 Contents

| Bit Position | Bit Name | Function |
|---|---|---|
| 31, 30 | CKDIVMD[1:0] | Products of CPU Frequency & CPU System Clock Setting<br>$0\,x_B$: 240 MHz<br>$1\,0_B$: 320 MHz<br>$1\,1_B$: 400 MHz |

## 2.4 Setting PLL operation (OPBT11[28])

Activation or deactivation of PLL at power-on for U2A is set by Option Bytes. It's necessary to be set bit 28 of OPBT11 related to PLL operation setting according to usage condition.

Table 51.66 OPBT11 Contents

| Bit Position | Bit Name | Function |
|---|---|---|
| 28 | STARTUPPLL | Start Up of Main OSC and PLL<br>0: Main OSC and PLL are enabled<br>1: Main OSC and PLL are disabled |

## 2.5 Setting SVR operation (OPBT16[31])

Activation or deactivation of SVR is set by Option Bytes. It's necessary to be set bit 31 of OPBT16 related to PLL operation setting according to usage condition.

Table 51.70 OPBT16 Contents

| Bit Position | Bit Name | Function |
|---|---|---|
| 31 | SVRENABLE | SVR Enable setting.<br>0: Disabled (default)<br>1: Enabled<br>**CAUTION**<br>Make sure that the all SVR parameters to be set to OPBT16-23 are correct before enabling SVR. Otherwise, the output voltage of Power MOSFET may be unintentional value. |

Caution

**Make sure that all SVR parameters to be set to OPBT 16-23 are correct before enabling SVR. Otherwise, the output voltage of power MOSFET may be unintentional value.**

# 3. How to write Option Bytes to U2A (CS+)

This section introduces how to write Option Bytes to U2A using Integrated Development Environment CS+ from Renesas Electronics Corp. (hereinafter referred to as CS+).

## 3.1 Section setting

The section name setting and the address to be set the section have to be specified the “Configuration Setting Area” on the flash memory in which the reset vector base address and Option Bytes value are allocated.

Figure 3.1 shows the sample source file for setting the Option Bytes displayed on CS +. The section name is set on line 5, and the .dw pseudo instruction is used for setting the reset vector and each option byte value. Refer to "set_csa.asm" of sample program for details.

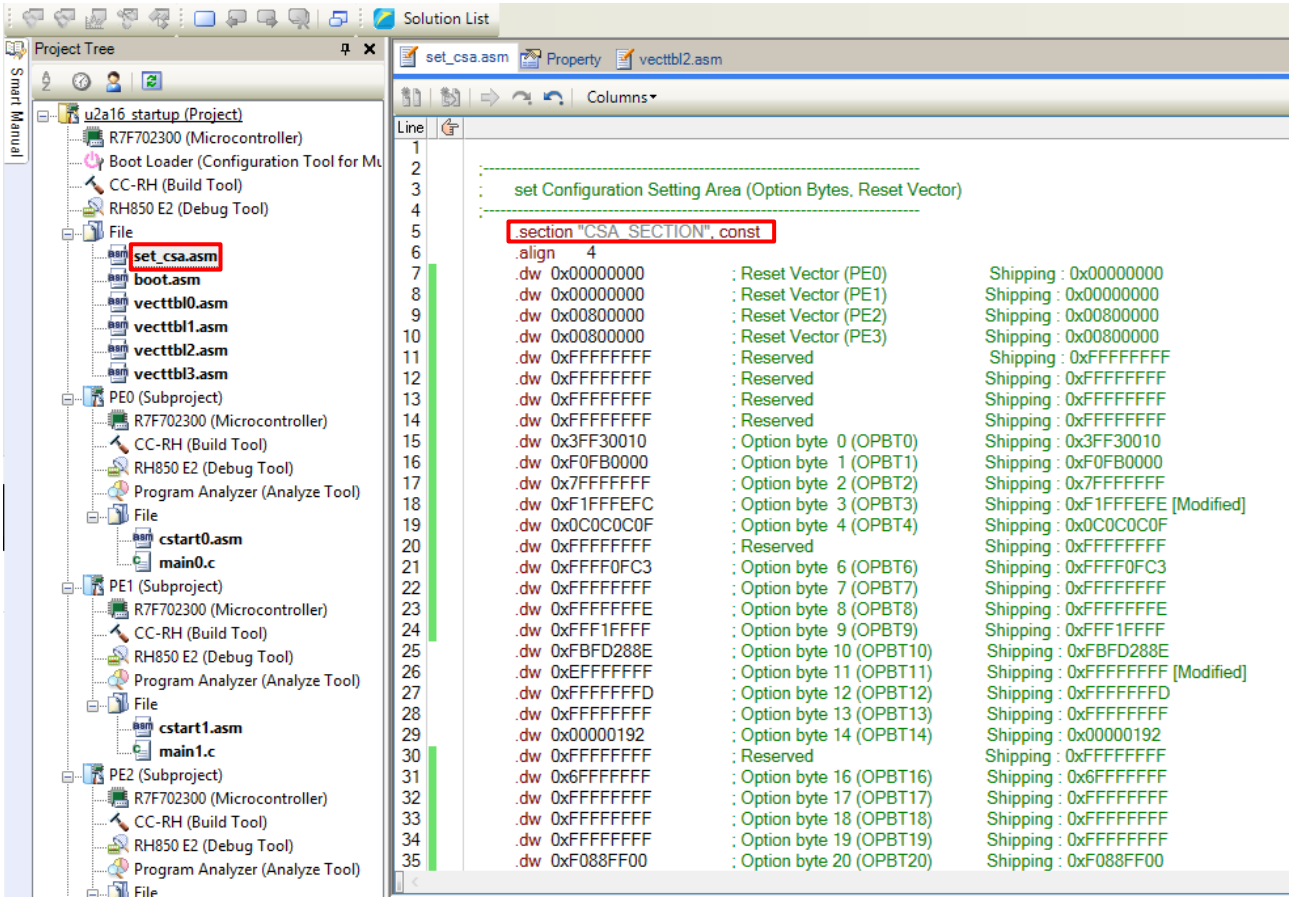



Figure 3.1 Setting Section name

Figure 3.2 shows how to set section address using Link options in CS+. As “Reset Vector (PE0)” in "Configuration Setting Area" is described after section name which is described in line 7 of set_csa.asm, the start address of section name(CSA_SECTION) corresponding to “Reset Vector (PE0)” is specified to the address FF32 1380H (FF32 1000H+ 0380H).

Table 51.10 Base address of Configuration Setting Area in case of Area 0 is valid (FSWASTAT_0.CFGVA=0)

| Base Address Name <CSAk_base> (k = f, b) | Base Address | Bus Group |
|---|---|---|
| <CSAf_base> | FF32 0800$_H$ (Configuration Setting Area 0) | P-Bus Group 1 |
| <CSAb_base> | FF32 1000$_H$ (Configuration Setting Area 1) | P-Bus Group 1 |

f ... front side (valid). b... back side (invalid).

Table 51.51 Configuration Setting Area (1/2)

| Name | Address*9 | State at the shipping*1 | Write Protection ID*2 | Read Protection ID*3 | CSAVOF/ CSAVOFC Number |
|---|---|---|---|---|---|
| Reset Vector (PE0) | <CSAk_base>+ 0380$_H$ | 0000 0000$_H$ | Customer ID A | — | 12 |

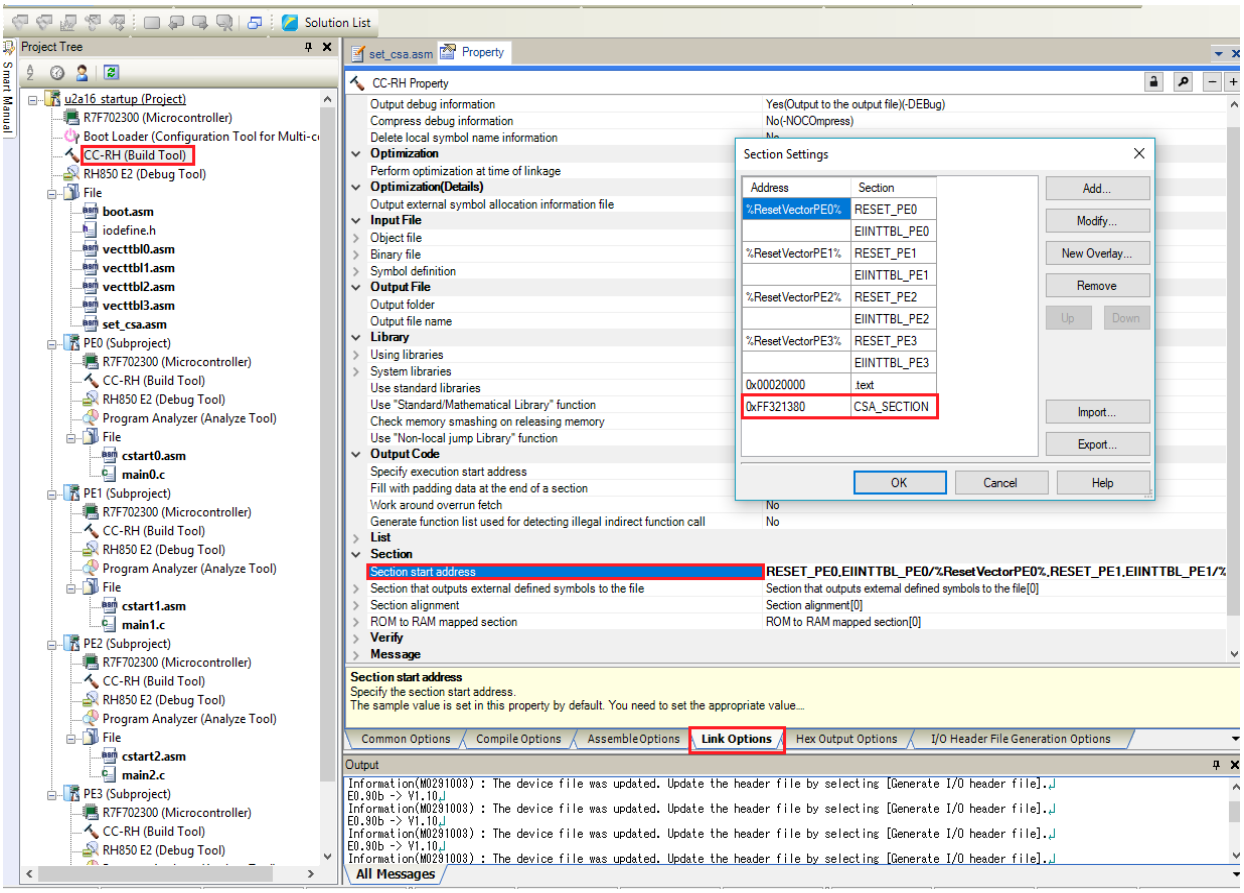



Figure 3.2 Setting section address

## 3.2 Data preparation

It sets Reset vector and each Option Bytes which allocated in Configuration Setting Area by the .dw pseudo instruction as Figure 3.3. The .dw pseudo instruction is the assembler instruction that initialize memory in units of 4 bytes. The comment "[Modified]" indicates where to change the value from the initial value. For details on the .dw instruction, check the CS + help.

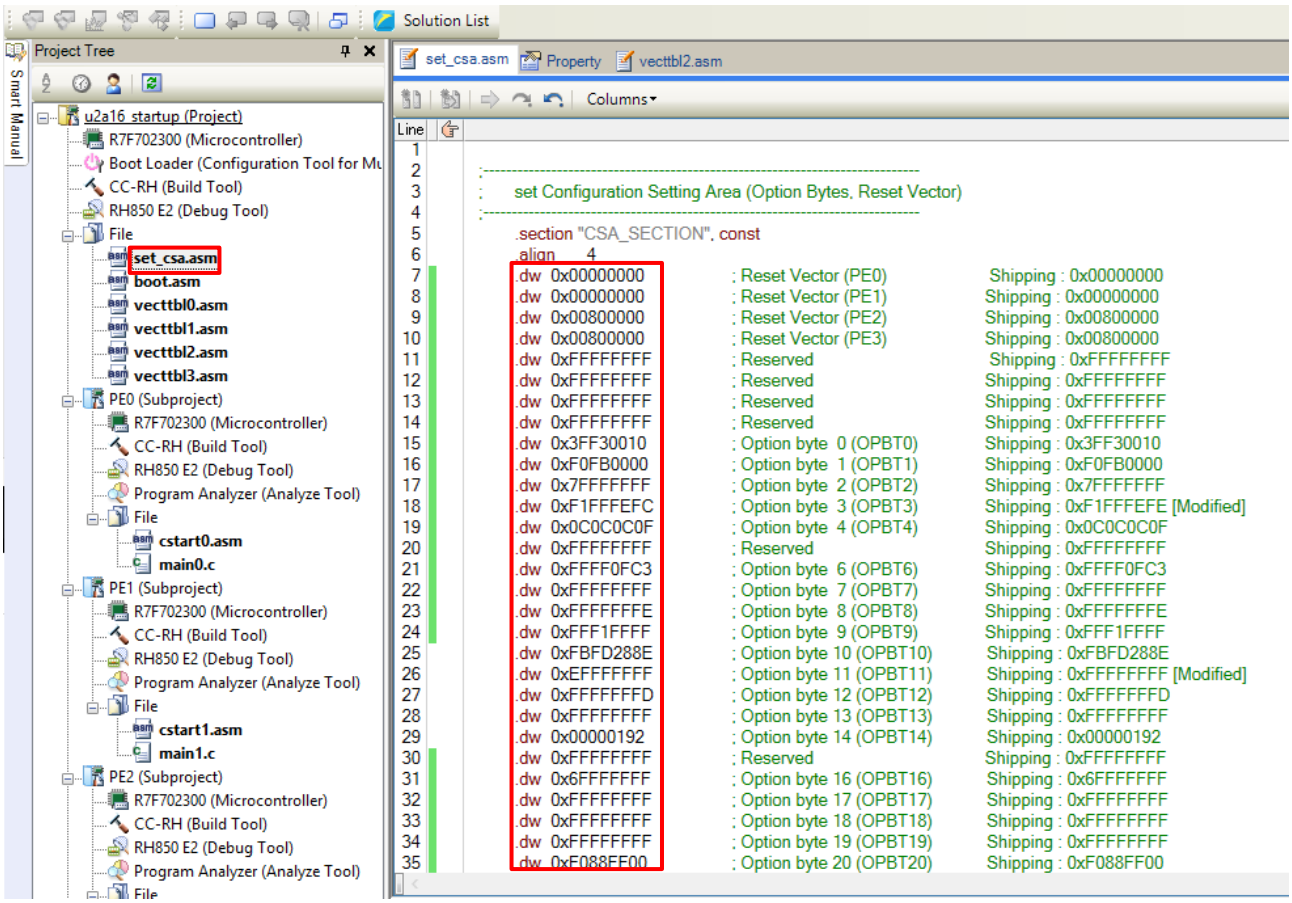



Figure 3.3 Preparation of Reset vector, Option Bytes data

## 3.3 Build project and Download to debug tool

Follow the procedure below for writing Option Bytes to U2A.
The set Option Bytes are valid from the next reset release.

① Build execution

Executes build and checks no error comment on CS+ output window.

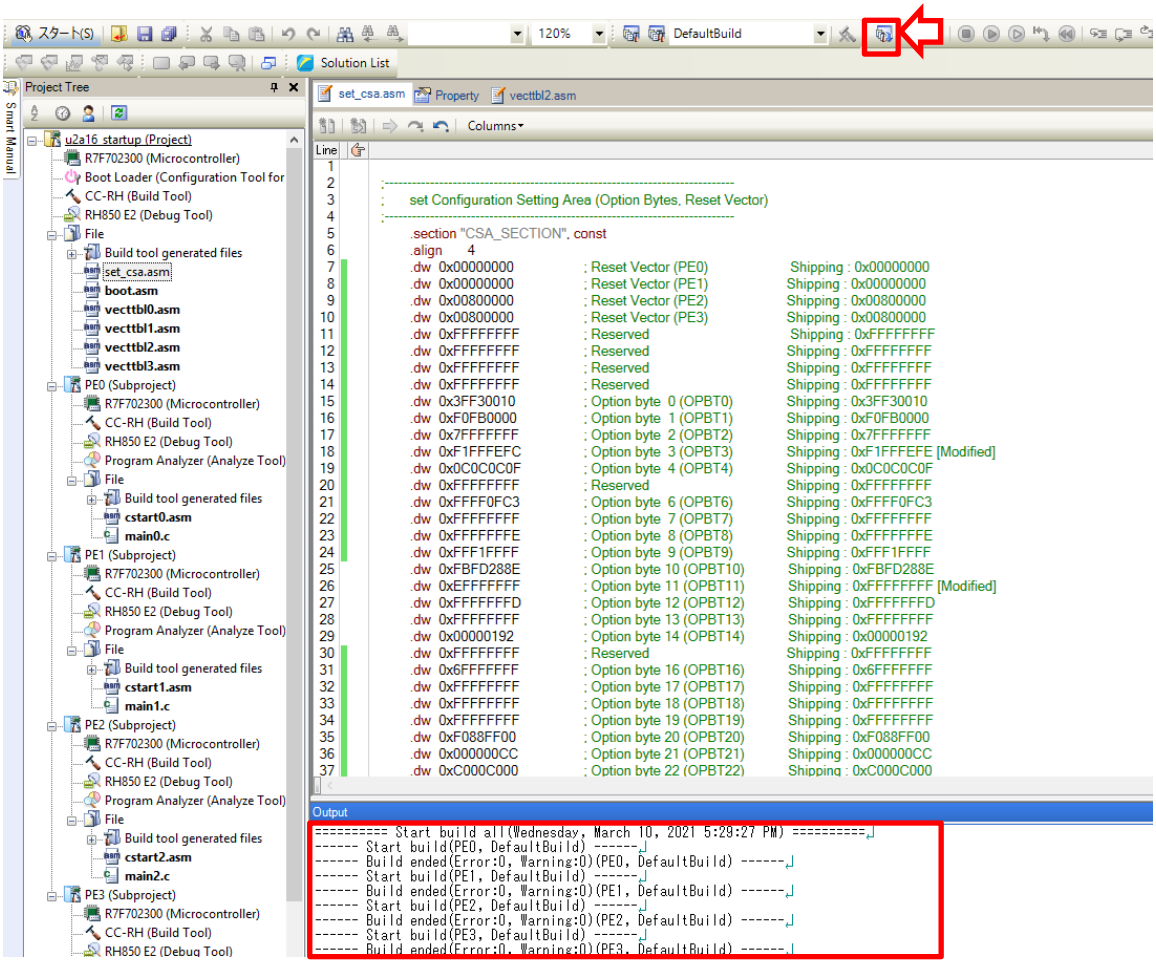



Figure 3.4 Build execution

② Allowance setting for writing Option Bytes

Sets "Yes" to the item of "Allow downloading to the configuration setting area" on the Download File settings tab of the Debug Tool.

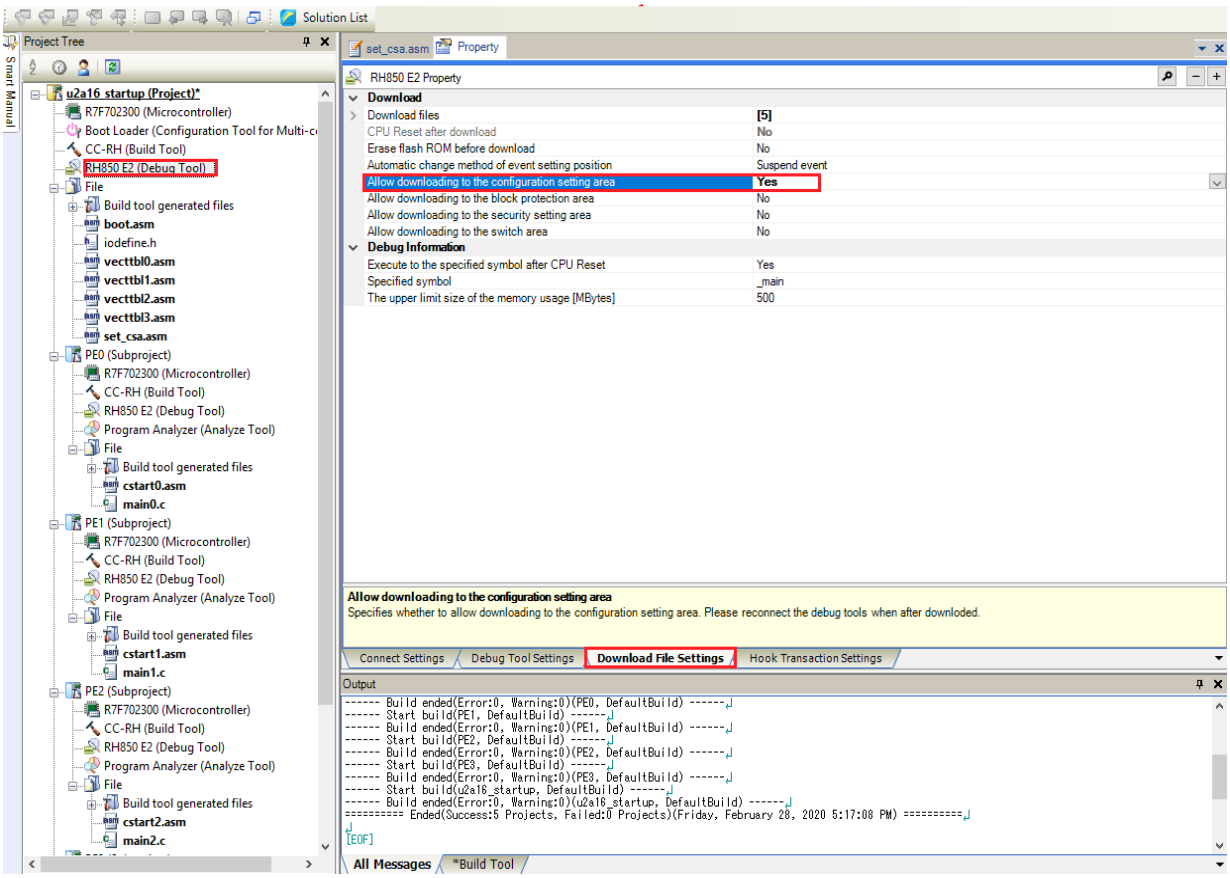



Figure 3.5 Permission setting for writing Reset vector and Option Bytes

③ Download to debug tool

After executing the download to debug tool, the Option Bytes value is written to the "Configuration Setting Area" on the flash memory.

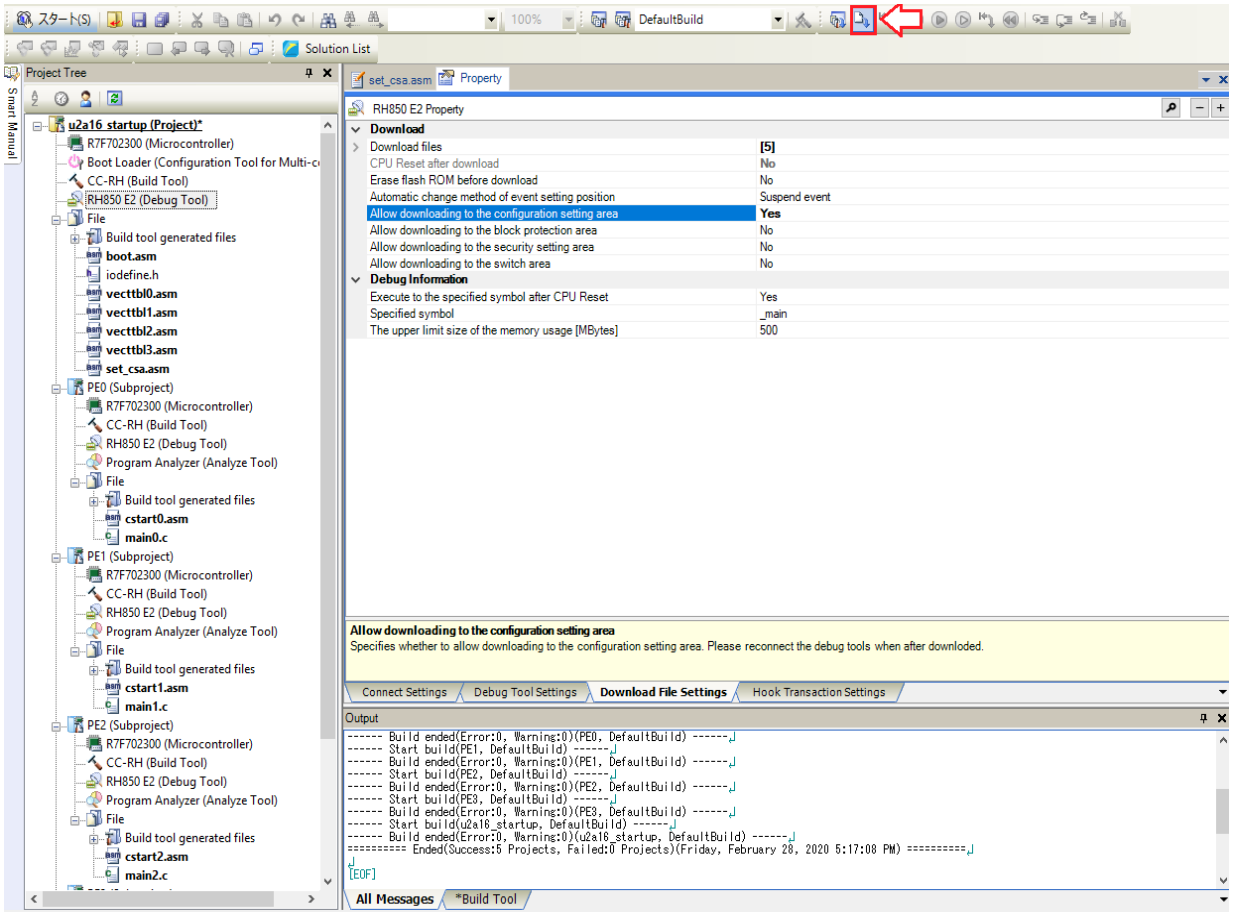



Figure 3.6 Download execution

After download successfully, the pop screen is shown on CS+ as Fig. 3.7, and the allowance setting of "Allow downloading to the configuration setting area" on the Download File Settings tab of the Debug Tool is changed to "No" automatically.

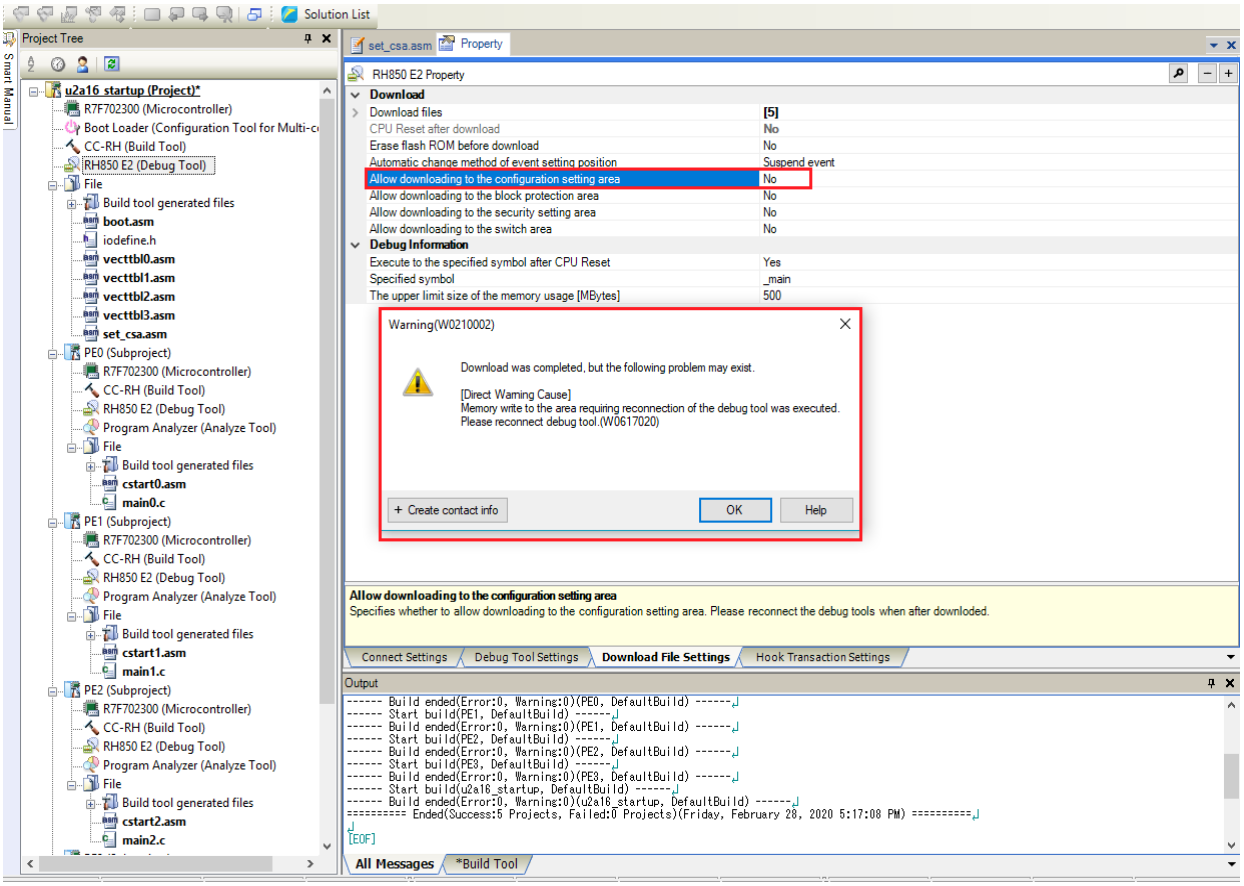



Figure 3.7 Download successfully

Writing the Option Bytes could be completed through the above procedure.

# 4. How to write Option Bytes to U2A (MULTI)

This section introduces how to write Option Bytes to U2A using MULTI as the Integrated Development Environment from Green Hills Software. (hereinafter referred to as MULTI).

## 4.1 Section setting

The section name setting and the address to be set the section have to be specified the “Configuration Setting Area” on the flash memory in which the reset vector base address and Option Bytes value are allocated.

Figure 4.1 shows the sample source file for setting the Option Bytes displayed on MULTI. The section name is set on line 5, and the .dw pseudo instruction is used for setting the reset vector and each option byte value. Refer to "set_csa.850" of sample program for details.

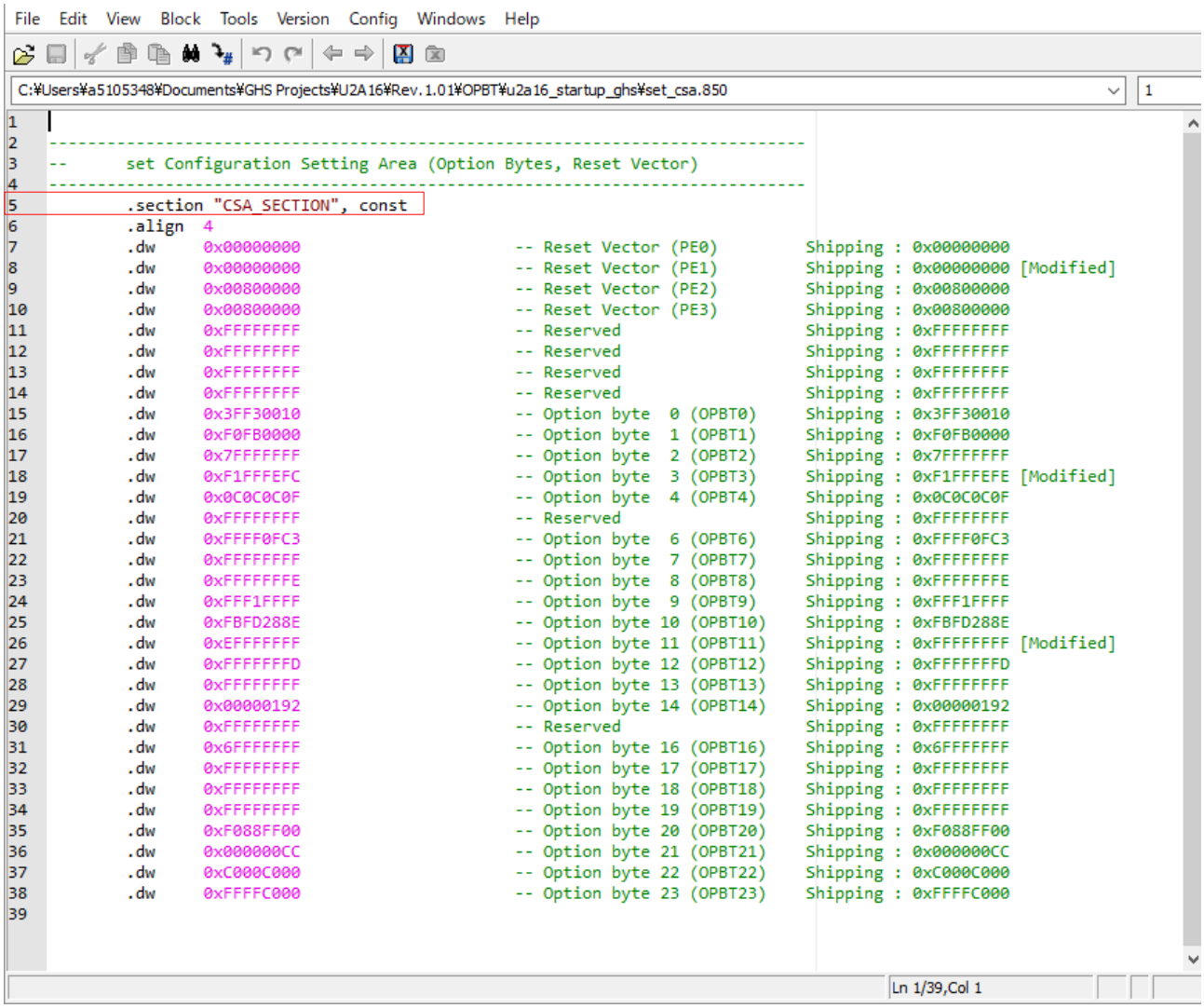



Figure 4.1 Setting Section name

Figure 4.2 shows how to set section address and size using link directive file (.ld) in MULTI.

As “Reset Vector (PE0)” in "Configuration Setting Area" is described after section name which is described in line 7 of set_csa.850, the start address of section name(CSA_SECTION) corresponding to “Reset Vector (PE0)” is specified to the address FF32 1380H (FF32 1000H+ 0380H).

Also, as the area is set between “Reset Vector(PE0)”(FF32 1380) and “OPBT23”(FF32 13FC) ,the section size is specified to 0x80 in this example of setting.

Table 51.10 Base address of Configuration Setting Area in case of Area 0 is valid (FSWASTAT_0.CFGVA=0)

| Base Address Name <CSAk_base> (k = f, b) | Base Address | Bus Group |
|---|---|---|
| <CSAf_base> | FF32 0800$_H$ (Configuration Setting Area 0) | P-Bus Group 1 |
| <CSAb_base> | FF32 1000$_H$ (Configuration Setting Area 1) | P-Bus Group 1 |

f ... front side (valid). b... back side (invalid).

Table 51.51 Configuration Setting Area (1/2)

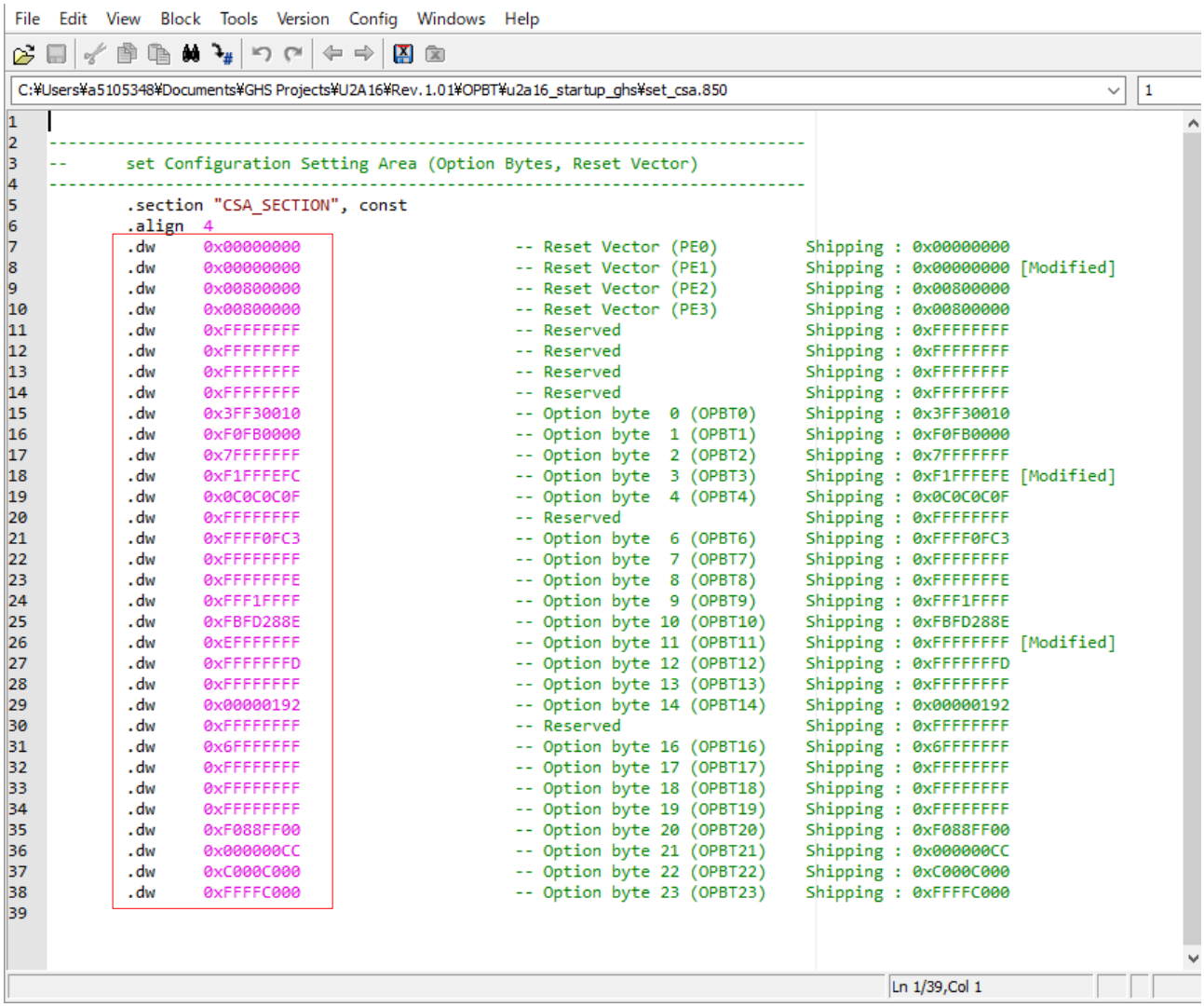
| Name | Address*9 | State at the shipping*1 | Write Protection ID*2 | Read Protection ID*3 | CSAVOF/ CSAVOFC Number |
|---|---|---|---|---|---|
| Reset Vector (PE0) | <CSAk_base>+ 0380$_H$ | 0000 0000$_H$ | Customer ID A | — | 12 |

```
CONSTANTS
{
            ⋮
   CSA_START = 0xFF321380
   CSA_SIZE   = 0x80
            ⋮
}

MEMORY
{
            ⋮
   CSA              : ORIGIN = CSA_START,                    LENGTH = CSA_SIZE
            ⋮
}

SECTIONS
{
            ⋮
    CSA_SECTION align(4) :>CSA
            ⋮
}
```

Figure 4.2 Example of Setting section address

## 4.2 Data preparation

It sets Reset vector and each Option Bytes which allocated in Configuration Setting Area by the .dw pseudo instruction as Figure 4.3. The .dw pseudo instruction is the assembler instruction that initialize memory in units of 4 bytes. The comment "[Modified]" indicates where to change the value from the initial value.




```
1
2   ------------------------------------------------------------------------
3   --      set Configuration Setting Area (Option Bytes, Reset Vector)
4   ------------------------------------------------------------------------
5           .section "CSA_SECTION", const
6           .align  4
7           .dw     0x00000000              -- Reset Vector (PE0)        Shipping : 0x00000000
8           .dw     0x00000000              -- Reset Vector (PE1)        Shipping : 0x00000000 [Modified]
9           .dw     0x00800000              -- Reset Vector (PE2)        Shipping : 0x00800000
10          .dw     0x00800000              -- Reset Vector (PE3)        Shipping : 0x00800000
11          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
12          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
13          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
14          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
15          .dw     0x3FF30010              -- Option byte  0 (OPBT0)    Shipping : 0x3FF30010
16          .dw     0xF0FB0000              -- Option byte  1 (OPBT1)    Shipping : 0xF0FB0000
17          .dw     0x7FFFFFFF              -- Option byte  2 (OPBT2)    Shipping : 0x7FFFFFFF
18          .dw     0xF1FFFEFC              -- Option byte  3 (OPBT3)    Shipping : 0xF1FFFEFE [Modified]
19          .dw     0x0C0C0C0F              -- Option byte  4 (OPBT4)    Shipping : 0x0C0C0C0F
20          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
21          .dw     0xFFFF0FC3              -- Option byte  6 (OPBT6)    Shipping : 0xFFFF0FC3
22          .dw     0xFFFFFFFF              -- Option byte  7 (OPBT7)    Shipping : 0xFFFFFFFF
23          .dw     0xFFFFFFFE              -- Option byte  8 (OPBT8)    Shipping : 0xFFFFFFFE
24          .dw     0xFFF1FFFF              -- Option byte  9 (OPBT9)    Shipping : 0xFFF1FFFF
25          .dw     0xFBFD288E              -- Option byte 10 (OPBT10)   Shipping : 0xFBFD288E
26          .dw     0xEFFFFFFF              -- Option byte 11 (OPBT11)   Shipping : 0xFFFFFFFF [Modified]
27          .dw     0xFFFFFFFD              -- Option byte 12 (OPBT12)   Shipping : 0xFFFFFFFD
28          .dw     0xFFFFFFFF              -- Option byte 13 (OPBT13)   Shipping : 0xFFFFFFFF
29          .dw     0x00000192              -- Option byte 14 (OPBT14)   Shipping : 0x00000192
30          .dw     0xFFFFFFFF              -- Reserved                  Shipping : 0xFFFFFFFF
31          .dw     0x6FFFFFFF              -- Option byte 16 (OPBT16)   Shipping : 0x6FFFFFFF
32          .dw     0xFFFFFFFF              -- Option byte 17 (OPBT17)   Shipping : 0xFFFFFFFF
33          .dw     0xFFFFFFFF              -- Option byte 18 (OPBT18)   Shipping : 0xFFFFFFFF
34          .dw     0xFFFFFFFF              -- Option byte 19 (OPBT19)   Shipping : 0xFFFFFFFF
35          .dw     0xF088FF00              -- Option byte 20 (OPBT20)   Shipping : 0xF088FF00
36          .dw     0x000000CC              -- Option byte 21 (OPBT21)   Shipping : 0x000000CC
37          .dw     0xC000C000              -- Option byte 22 (OPBT22)   Shipping : 0xC000C000
38          .dw     0xFFFFC000              -- Option byte 23 (OPBT23)   Shipping : 0xFFFFC000
39
```

Figure 4.3 Preparation of Reset vector, Option Bytes data

## 4.3 Build project and Download to debug tool

Follow the procedure below for writing Option Bytes to U2A.
The set Option Bytes are valid from the next reset release.

① Build execution

Executes build and checks no error comment on MULTI output window.

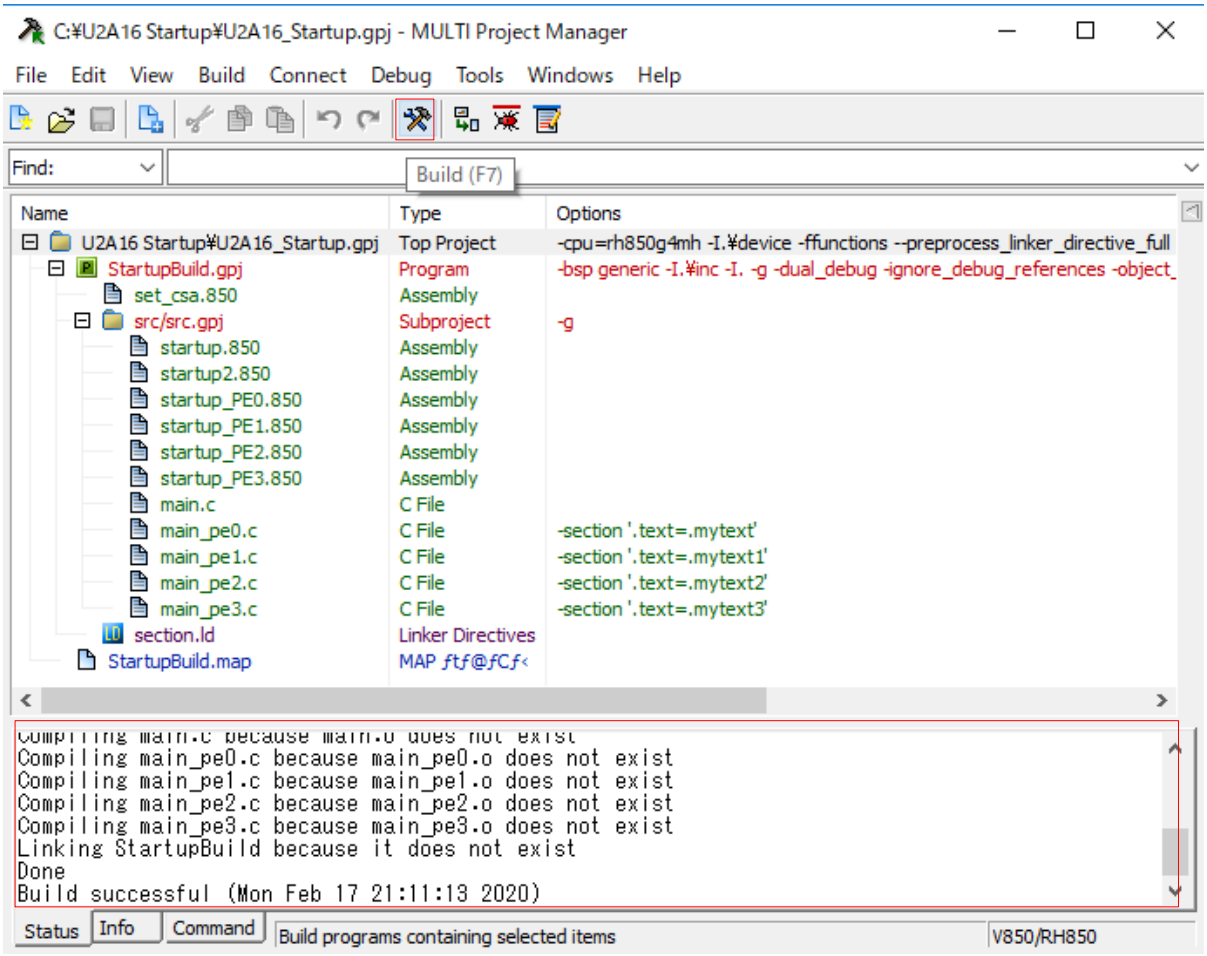



Figure 4.4 Build execution

② Debug execution

Execute debug on MULTI window.

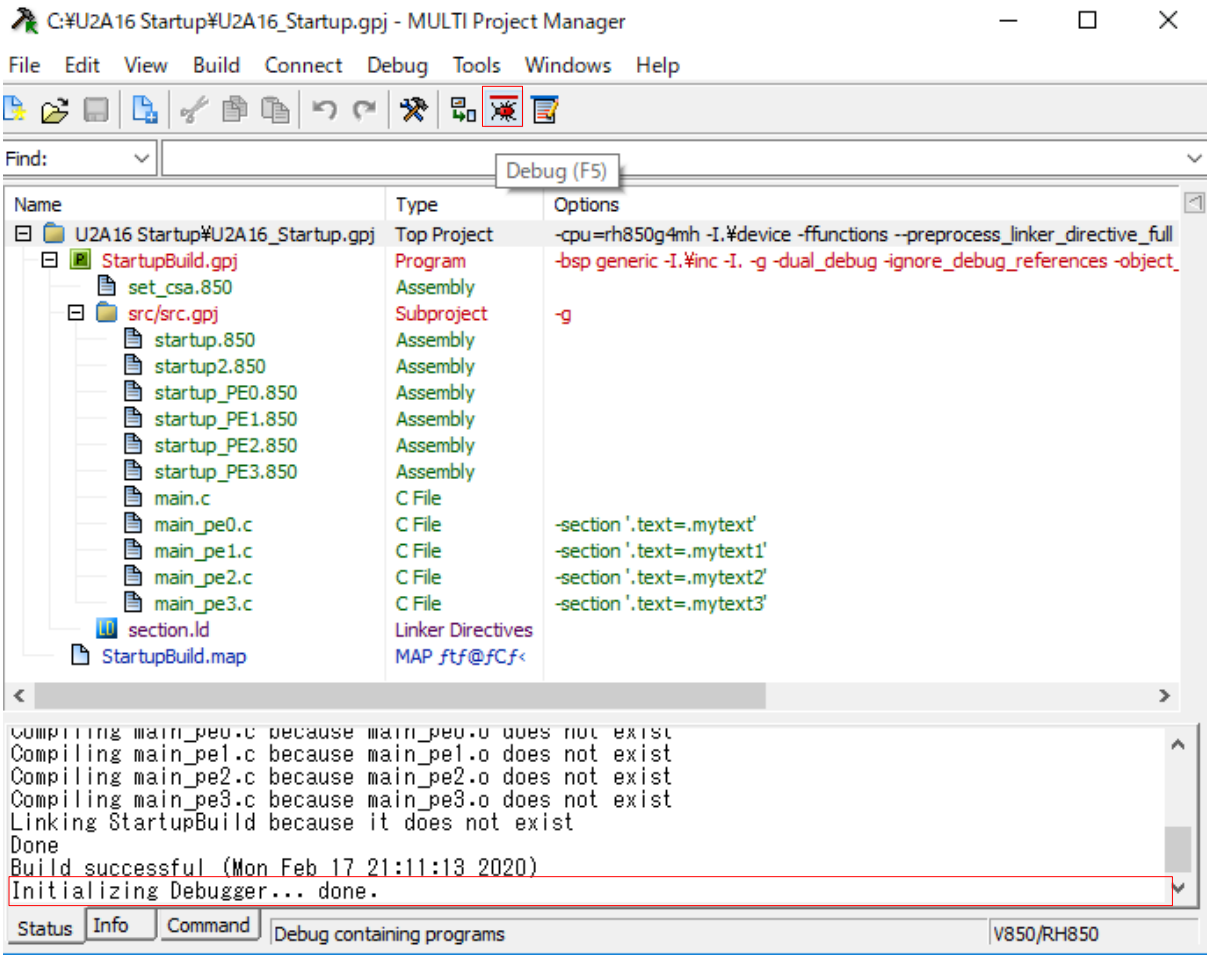



Figure 4.5 Debug execution

③ Allowance setting for writing Option Bytes

Execute the follow command on the cmd tab of MULTI Window for allowance downloading to the configuration setting area.

target FLASHEXTRA config1 on

Execute the follow command on the cmd tab of MULTI Window for checking allowance downloading to the configuration setting area.

target FLASHEXTRA

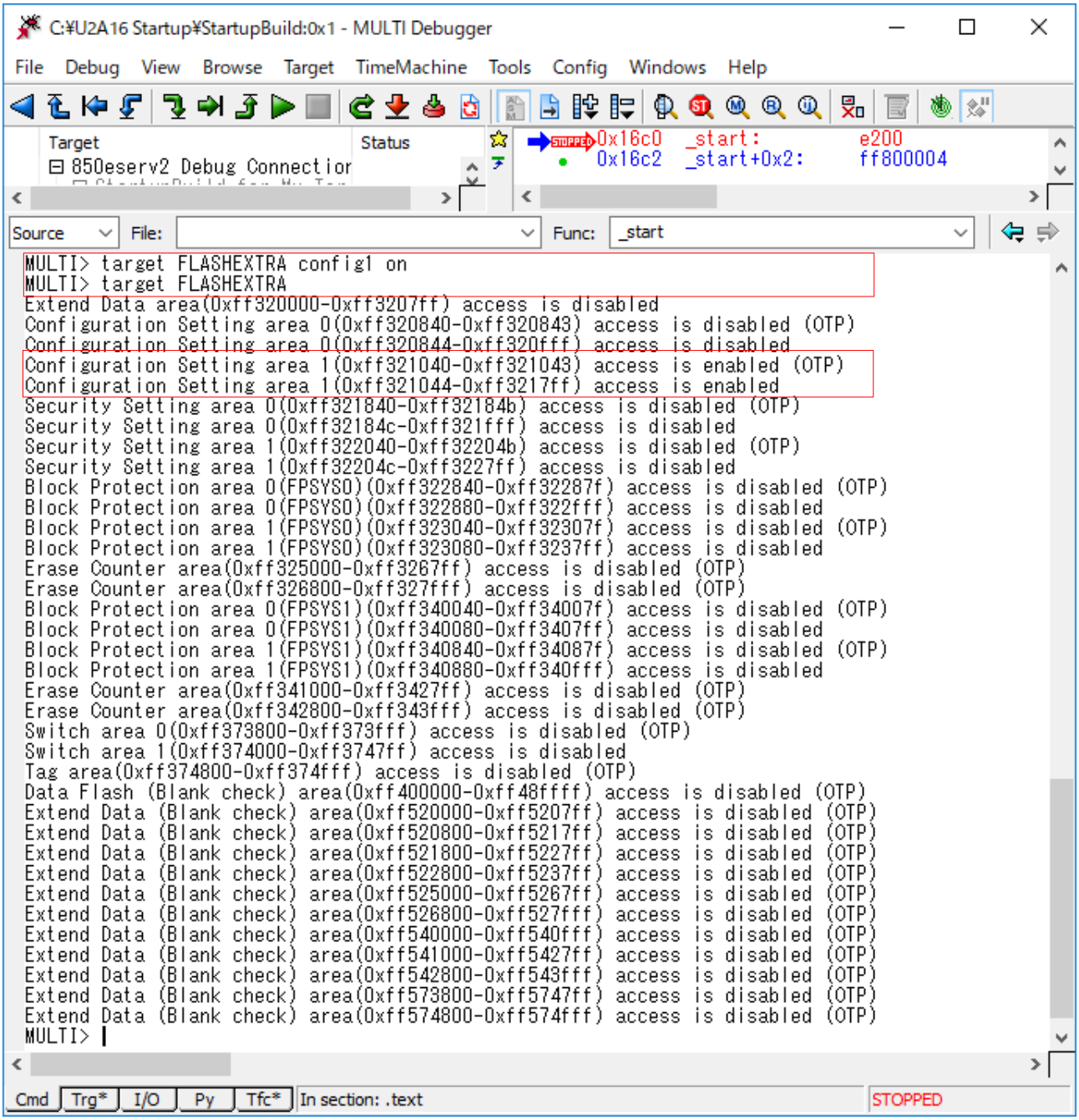



Figure 4.6 Permission setting for writing Reset vector and Option Bytes

④ Download to debug tool

After executing the download to debug tool, the Option Bytes value is written to the "Configuration Setting Area" on the flash memory.

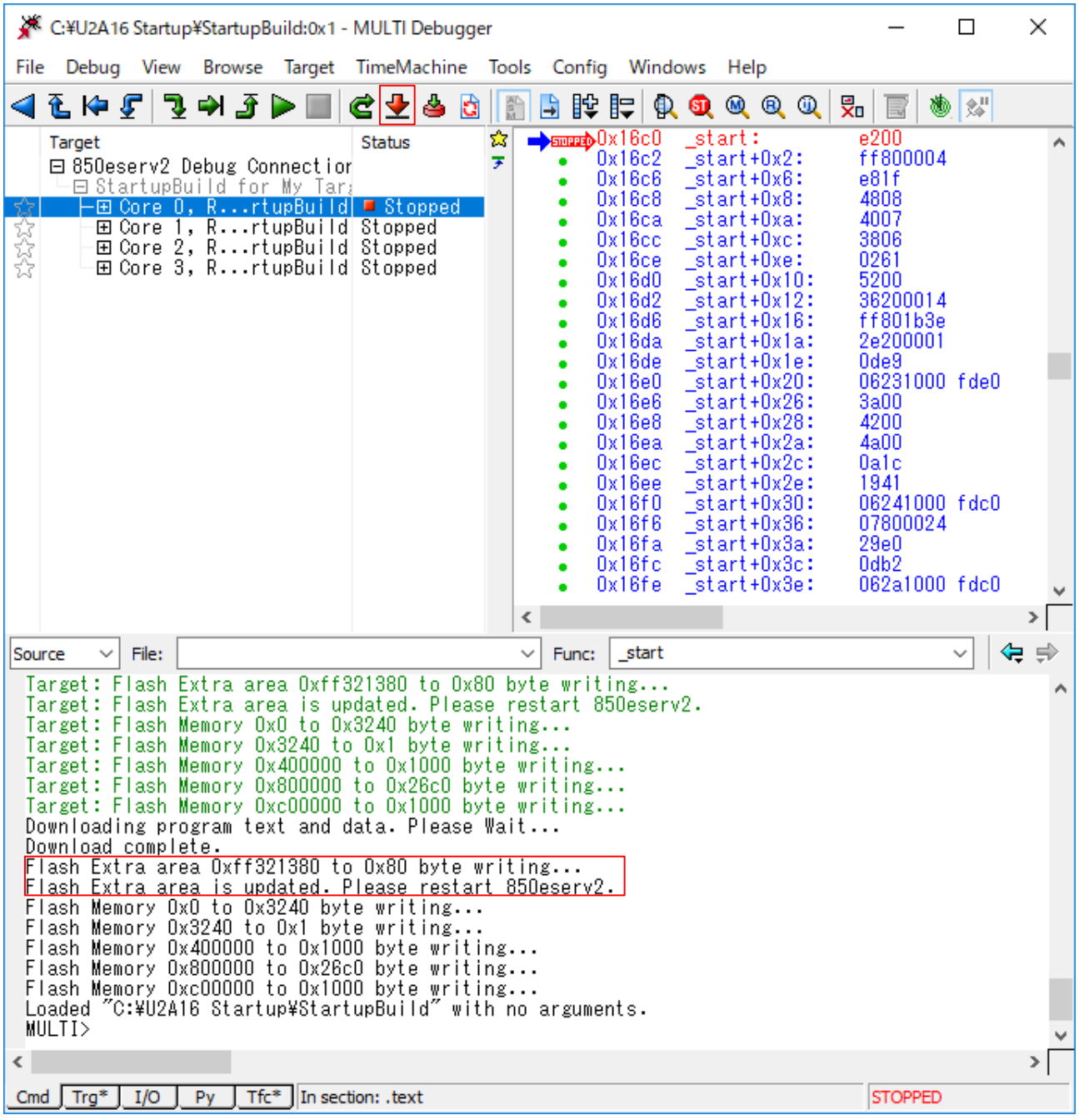



Figure 4.7 Download execution

After download successfully, the allowance setting is changed to “disabled".

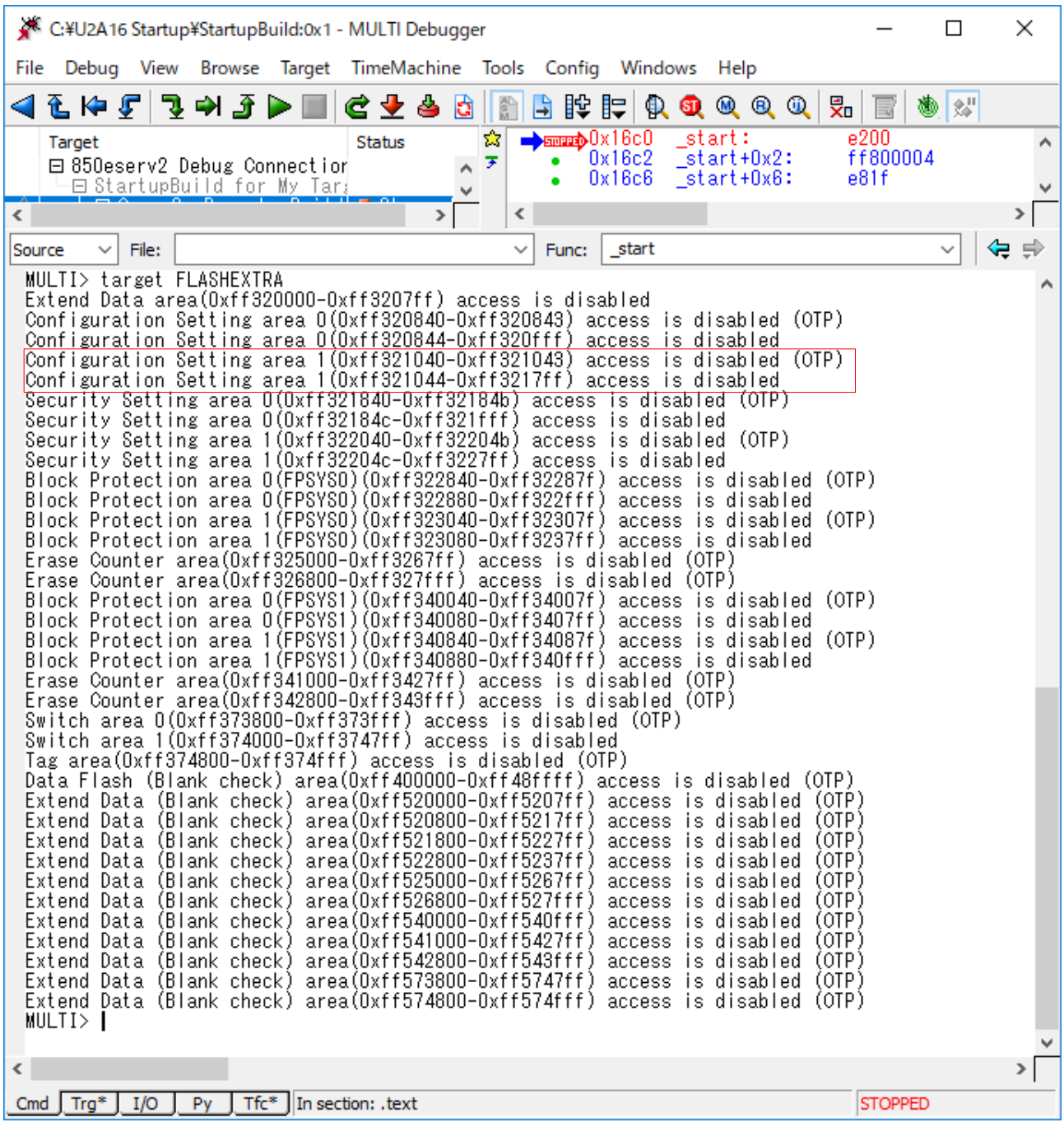



Figure 4.8 Download successfully

Writing the Option Bytes could be completed through the above procedure.

## Revision History

| Rev. | Date | Revision contents | |
|---|---|---|---|
| | | Page | Summary |
| 0.50 | 2019.04.08 | - | 1st edition |
| 0.70 | 2020.03.31 | - | Supporting U2A16<br>Adding Chapter 4. How to write Option Bytes to U2A (MULTI) |
| 1.00 | 2020.09.30 | - | Revision update |
| 1.01 | 2021.03.18 | - | Modified OPBT2 value.<br>Adding a Section 1.1 Note. |

# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between $V_{IL}$ (Max.) and $V_{IH}$ (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between $V_{IL}$ (Max.) and $V_{IH}$ (Min.).
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