Application Note

Flash Development Toolkit

Application Note (Applications)

User Program Mode (H8S/2378F)

Renesas Electronics
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Revision 1.0

Renesas Technology Corp.

Contents

1. Introduction

This application note describes the following items with respect to the use of the Renesas Flash Development Toolkit and the use of the user program mode of the H8S/2378F (H8S Family) using the Flash Development Toolkit:

(1) Boot mode 1 (programming the user boot area)

(2) Boot mode 2 (programming the user area)

(3) User boot mode

(4) User program mode

Read the explanation of these items and understand differences among the boot mode, user boot mode, and user program mode and how to use the user program mode.

This application note also describes a sample program which programs and erases on-chip flash memory used in the user program mode. To program or erase flash memory in the user program mode, refer to this sample program.

2. H8S/2378F (H8S Family)

2.1 Flash Memory Configuration

The flash memory of the H8S/2378F has two types of memory MATs: User MAT (user area) and user boot MAT (user boot area). In addition, it has an area for storing a flash memory programming and erasing control program that is called a boot MAT (boot area). This application note calls them the user area, user boot area, and boot area, respectively. The flash memory configuration is shown in Table 2-1.

Table 2-1 Flash Memory Configuration

Area	Type	Size	Block(s)
User area	Flash memory	512 Kbytes	16 blocks Eight 4-Kbyte blocks One 32-Kbyte block Seven 64-Kbyte blocks
User boot area	Flash memory	8 Kbytes	1 block
Boot area	Control program	-	-

2.2 Operating Modes

The H8S/2378 has six operating modes (modes 1 to 5 and 7). The operating mode is selected by the setting the mode pins (MD2 to MD0).

Modes 1, 2, and 4 are externally expanded modes in which the CPU can access external memory and peripheral devices. In an externally expanded mode, each area in the external address space can be switched between 8- or 16-bit address space by the bus controller after the start of the execution of a program. If any one of the areas is set to 16-bit address space, the 16-bit bus mode is used. When all areas are set to 8-bit address space, the 8-bit bus mode is used.

Mode 7 is a single-chip activation externally expanded mode in which the CPU can switch to access external memory and peripheral devices at the start of the execution of a program.

Mode 3 is a boot mode and mode 5 is a user boot mode, both in which flash memory can be programmed or erased.

Do not change the settings of pins MD2 to MD0 during LSI operation.

For details, refer to the Hardware Manual.

Table 2-2 MCU Operating Modes

MCU Operating Mode	MD2	MD1	MD0	CPU Operating Mode	Description	On-Chip ROM	External Data Bus	
							Initial Value	Maximum Value
1	0	0	1	Advanced	Expanded mode with on-chip ROM disabled	Disabled	16 bits	16 bits
2	0	1	0	Advanced	Expanded mode with on-chip ROM disabled	Disabled	8 bits	16 bits
3	0	1	1	Advanced	Boot mode	Enabled	-	16 bits
4	1	0	0	Advanced	Expanded mode with on-chip ROM enabled	Enabled	8 bits	16 bits
5	1	0	1	Advanced	User boot mode	Enabled	-	16 bits
7	1	1	1	Advanced	Single-chip mode	Enabled	-	16 bits

2.3 On-Board Programming Modes

There are three on-board programming modes: Boot mode, user program mode, and user boot mode. The on-board programming modes are listed in Table 2-3.

Table 2-3 On-Board Programming Modes

Item	Boot Mode	User Program Mode	User Boot Mode
Operating mode	Mode 3	Mode 4 (Expanded mode with on-chip ROM enabled) Mode 7 (Single-chip mode)	Mode 5
Function	This mode is a program mode that uses an on-chip SCI interface. The user area and user boot area can be programmed. This mode can automatically adjust the bit rate between the host and the LSI. All areas in the user area and user boot area are erased first.	The user area can be programmed by using a desired interface.	The user boot program of a desired interface can be created and the user area can be programmed.
Control program	Boot area (On-chip boot program)	User area (User-created user program)	User boot area (User-created user boot program)
Programming/erasing enable area	User area User boot area	User area	User area
All erasure	✓ (Automatic)	✓	✓
Block division erasure	✓*1	✓	✓
Program-data transfer	From the host via the SCI	From a desired device via RAM	From a desired device via RAM
Reset start	On-chip boot program storage area (Boot area)	User area	User boot area*2
Transition to user program mode	Changing mode setting and reset	Changing the FLSHE bit setting	Changing mode setting and reset

Notes:
1. All-erasure is performed. After that, the specified block can be erased.
2. Firstly, the activation is made from the embedded program storage area. After the flash memory related registers are checked, the reset vector is fetched from the user boot area.

The user boot area can be programmed or erased only in the boot mode.

The user area and user boot area are entirely erased in the boot mode. Then, the user area or user boot area can be programmed by commands. However, the contents of the area cannot be read until the all-erasure state. You can program the user boot area in the boot mode then program the user area is programmed in the user boot mode, or program only the user area by not entering the user boot mode.

In the user boot mode, the boot operation via a desired interface can be performed by the mode pin setting different from that in the user program mode.

3. Functions of the Flash Development Toolkit

The Renesas Flash Development Toolkit is an on-board flash programming tool for Renesas F-ZTAT microcomputers, which offers a sophisticated and easy-to-use graphical user interface.

When it is used with Renesas High-performance Embedded Workshop (HEW), it provides users who develop embedded application software using Renesas F-ZTAT microcomputers with an integrated development environment.

The Flash Development Toolkit can also be used as an editor for S-record and hexadecimal files.

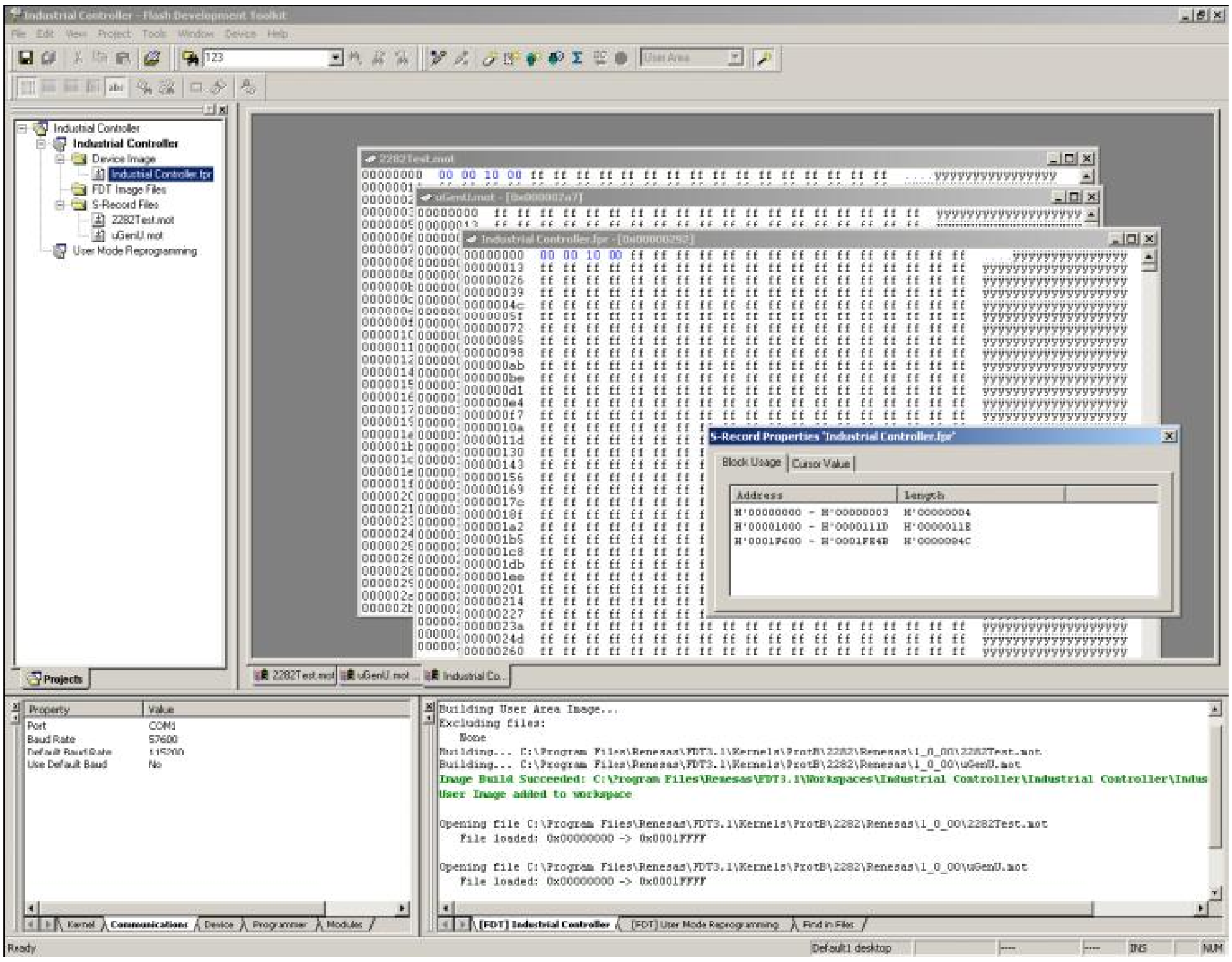
Note: F-ZTAT (Flexible-Zero Turn Around Time) is a trademark of Renesas Technology Corp.

3.1 Main Functions

- Connecting a device: Connects to a device to the interface of the Flash Development Toolkit.
- Disconnecting the device: Disconnects the device from the interface of the Flash Development Toolkit.
- Erasing blocks: Open the "Erase Block" dialog to erase all or individual blocks in flash memory on the device.
- Checking the blank status: Checks whether the flash memory on the target device is blank.
- Uploading data: Uploads data from the target device.
- Downloading a target file: Downloads an active file on the hexadecimal editor.
- Returning a checksum: Returns a checksum of data in flash memory.
- Specifying a flash area: Sets a flash area in which non-programming (such as uploading and blank check) operations are to be performed.
- The Flash Development Toolkit is available in the simple interface mode and basic simple interface mode to facilitate the usability of the kit.

For details, refer to Renesas Flash Development Toolkit 3.4 User's Manual

The graphical user interface screen of the Flash Development Toolkit is shown in Figure 3-1.



Property	Value
Port	COM1
Baud Rate	57600
Default Baud Rate	115200
Use Default Baud	No

Address	Length
H'00000000 - H'00000003	H'00000004
H'00001000 - H'0000111D	H'0000011E
H'0001F600 - H'0001F64B	H'0000004C

```
Building User Area Image...
Excluding files:
   None
Building... C:\Program Files\Renesas\FDT3.1\Kernels\ProtB\2282\Renesas\1_0_00\2282Test.mot
Building... C:\Program Files\Renesas\FDT3.1\Kernels\ProtB\2282\Renesas\1_0_00\uGenU.mot
Image Build Succeeded: C:\Program Files\Renesas\FDT3.1\Workspaces\Industrial Controller\Industrial Controller\Indus
User Image added to workspace

Opening file C:\Program Files\Renesas\FDT3.1\Kernels\ProtB\2282\Renesas\1_0_00\2282Test.mot
   File loaded: 0x00000000 -> 0x0001FFFF

Opening file C:\Program Files\Renesas\FDT3.1\Kernels\ProtB\2282\Renesas\1_0_00\uGenU.mot
   File loaded: 0x00000000 -> 0x0001FFFF
```

Figure 3-1 Graphical User Interface of the Flash Development Toolkit

4. Operating the Flash Development Toolkit

4.1 Connecting the Adapter Board

On-board programming adapter board for F-ZTAT* microcomputers HS0008EAUF1H (called the adapter board hereafter), which is connected between a host computer and user system, has a function which can write a user application program in flash memory incorporated in an F-ZTAT microcomputer on the user system (on-board) and erase it from the flash memory.

The adapter board connection is shown in Figure 4-1.

Note: F-ZTAT (Flexible-Zero Turn Around Time) is a trademark of Renesas Technology Corp.

Note: FDM (flash development module) is a former name of the adapter board.

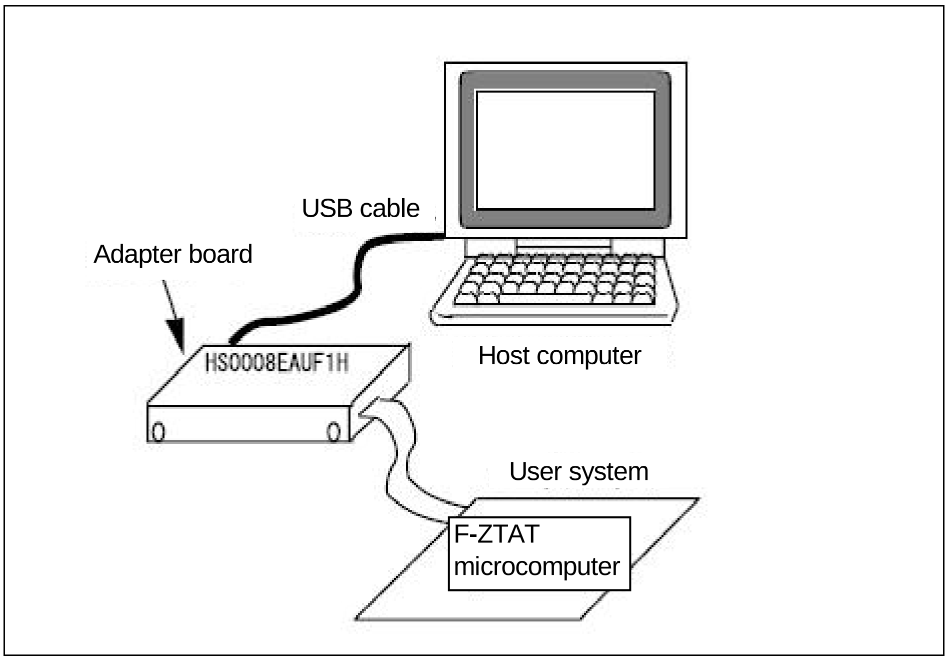


Figure 4-1 Connecting the Adapter Board

The pin numbers and corresponding signals of the user system interface cable used for connecting the adapter board and user system are shown below.

Table 4-1 Pin Numbers and Corresponding Signals of the HS0008EAUF1H User Interface Cable

No	Signal Name	No.	Signal Name
1	$\overline{\text{RES}}$	2	GND
3	FWx	4	GND
5	MD0	6	GND
7	MD1	8	GND
9	MD2 (IO0)	10	GND
11	MD3 (IO1)	12	GND
13	MD4 (IO2)	14	GND
15	RXD (TXD on the user system side)	16	GND*1
17	TXD (RXD on the user system side)	18	VIN (Vcc or PVcc)*2
19	SCK (NC)	20	VIN (PVcc)*2

Notes:

1. Be sure to connect pin No. 16 to GND to confirm that the user system is connected properly.
2. For a device with Vcc and PVcc, be sure to supply Vcc or PVcc (pin No. 18) and PVcc (pin No. 20) to the VIN pins of the user interface connector, respectively. To use a device under condition that Vcc = PVcc, or only Vcc is present in the device, be sure to supply Vcc to both VIN pins Vcc or PVcc (pin No. 18) and PVcc (pin No. 20).

Connecting the Adapter Board

An example of connecting the H8S/2378F and Renesas adapter board (HS0008EAUF1H) is shown in Figure 4-2. The pull-up and pull-down resistor values shown are only examples. Evaluate the microcomputer to determine the actual values on the user system.

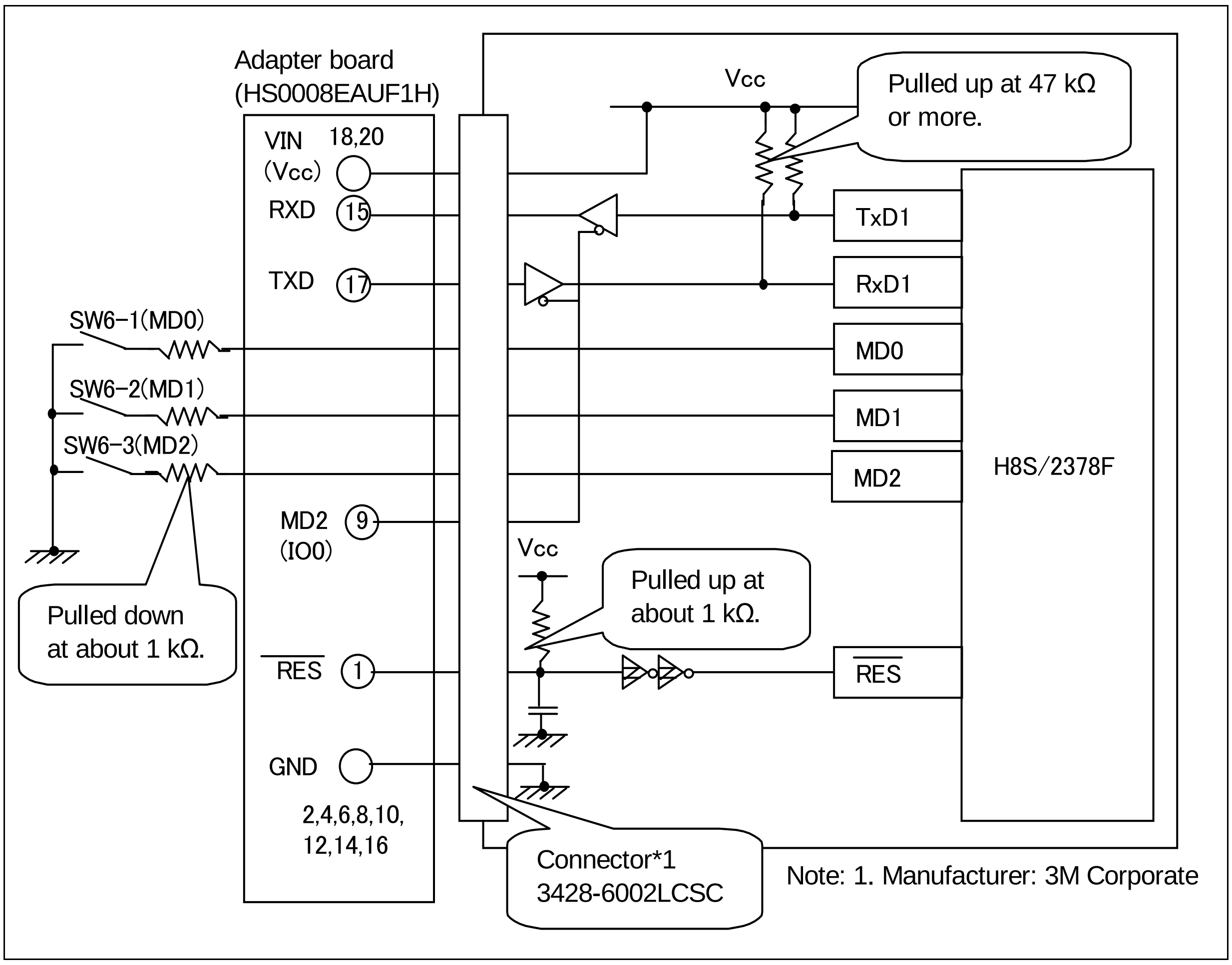


Figure 4-2 Example of Connecting the H8S/2378F and Adapter Board

4.1.1 Setting Pins on the Adapter Board

An example of setting pins for the boot mode when the H8S/2378F user system and Renesas adapter board (HS0008EAUF1H) are connected is shown in Table 4-2. Use the mode switches to set the operating mode.

Table 4-2 Example of Setting Pins on the H8S/2378F and Adapter Board (for the Boot Mode)

Pin No.	Pin on the Adapter Board	Pin on the Device	Input/Output	Output Level
1	$\overline{\text{RES}}$	$\overline{\text{RES}}$	Output (default)	Adapter board
3	FWx	Mode switch	Output	High (1)
5	MD0	NC	NC	-
7	MD1	NC	NC	-
9	MD2(IO0)	Serial I/O switch	Output	Low (0)
11	MD3(IO1)	NC	NC	-
13	MD4(IO2)	NC	NC	-
15	RXD	TXD	Input (default)	Adapter board
17	TXD	RXD	Output (default)	Adapter board
19	SCK (NC)	NC	NC (default)	-

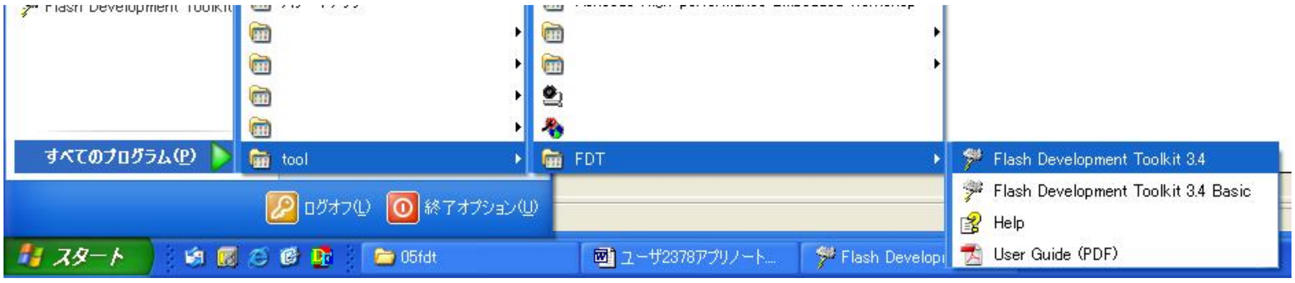
Note: NC: Means no connection.

4.2 Setting the Flash Development Toolkit

Set the Flash Development Toolkit first to write a program in flash memory.

4.2.1 Starting the Flash Development Toolkit

From the "All Programs" menu, select "Flash Development Toolkit 3.4."

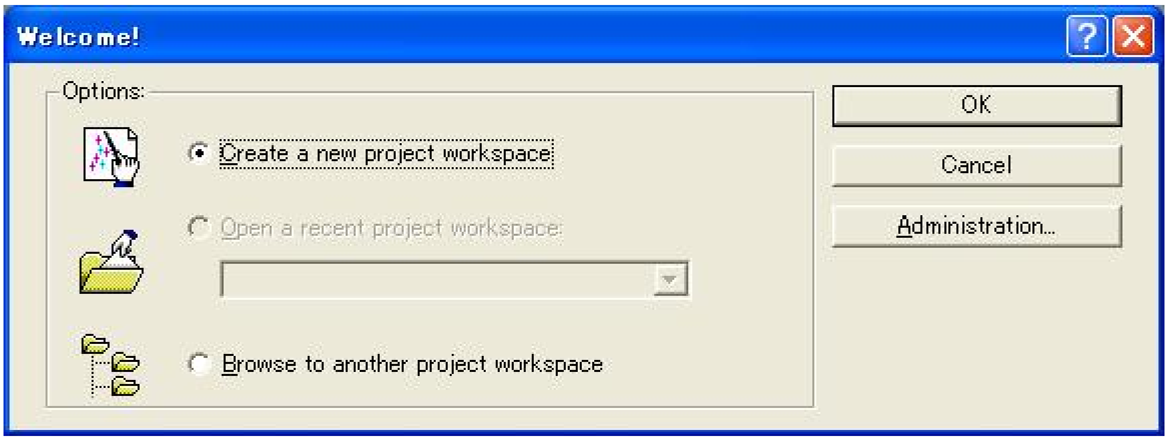


4.2.2 Selecting an Option

The "Welcome" screen of the Flash Development Toolkit appears.

Select "Create a new project workspace."

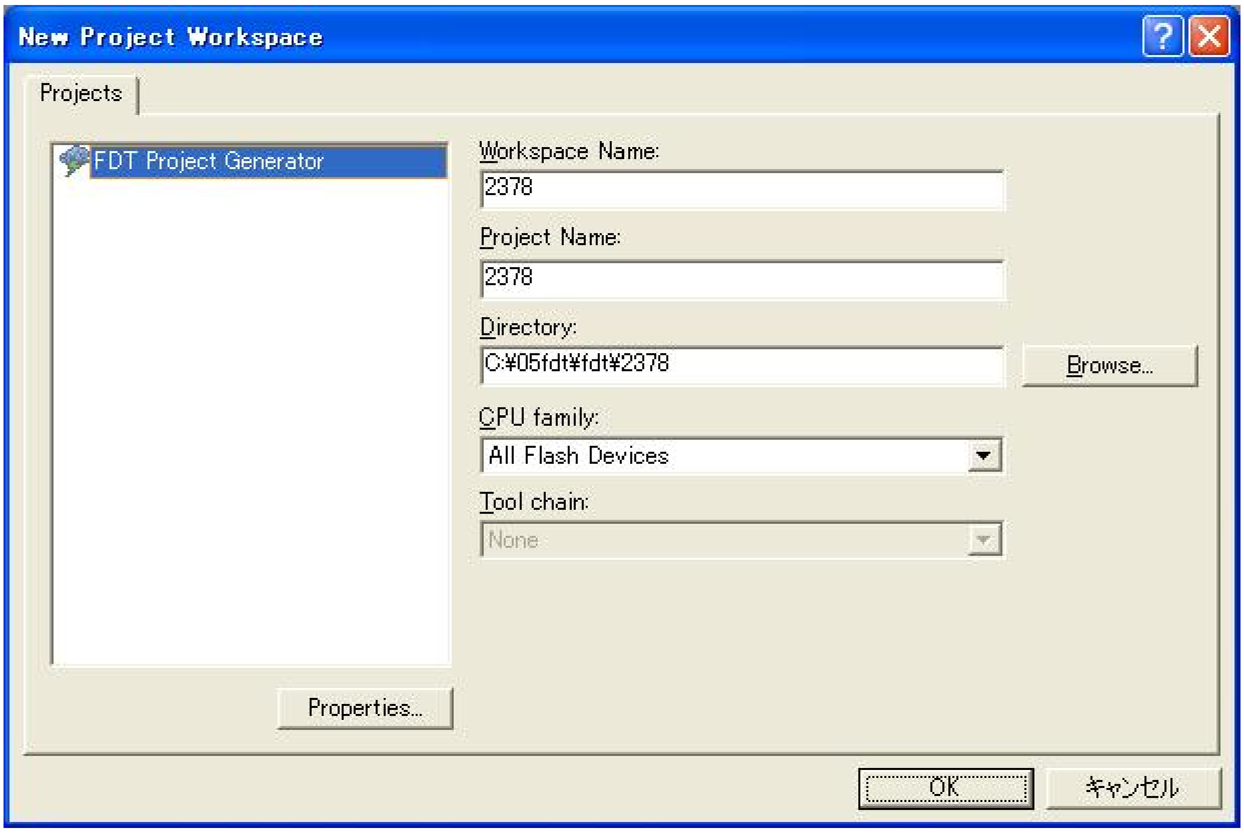
When the Flash Development Toolkit is started up for the second and subsequent times, the previously selected device and port information is retained. Select "Open a recent project workspace."


Welcome!
Options:
Create a new project workspace
Open a recent project workspace:
Browse to another project workspace
OK
Cancel
Administration...

When you have selected an option, click "OK."

4.2.3 Setting a New Project Workspace

Set a new project workspace. Use "Browse..." and select a directory, and specify the device name in "Workspace Name." Specify a project name if required. In this example, the same name is specified in "Workspace Name" and "Project Name."



New Project Workspace

Projects

FDT Project Generator

Workspace Name: 2378

Project Name: 2378

Directory: C:¥05fdt¥fdt¥2378

CPU family: All Flash Devices

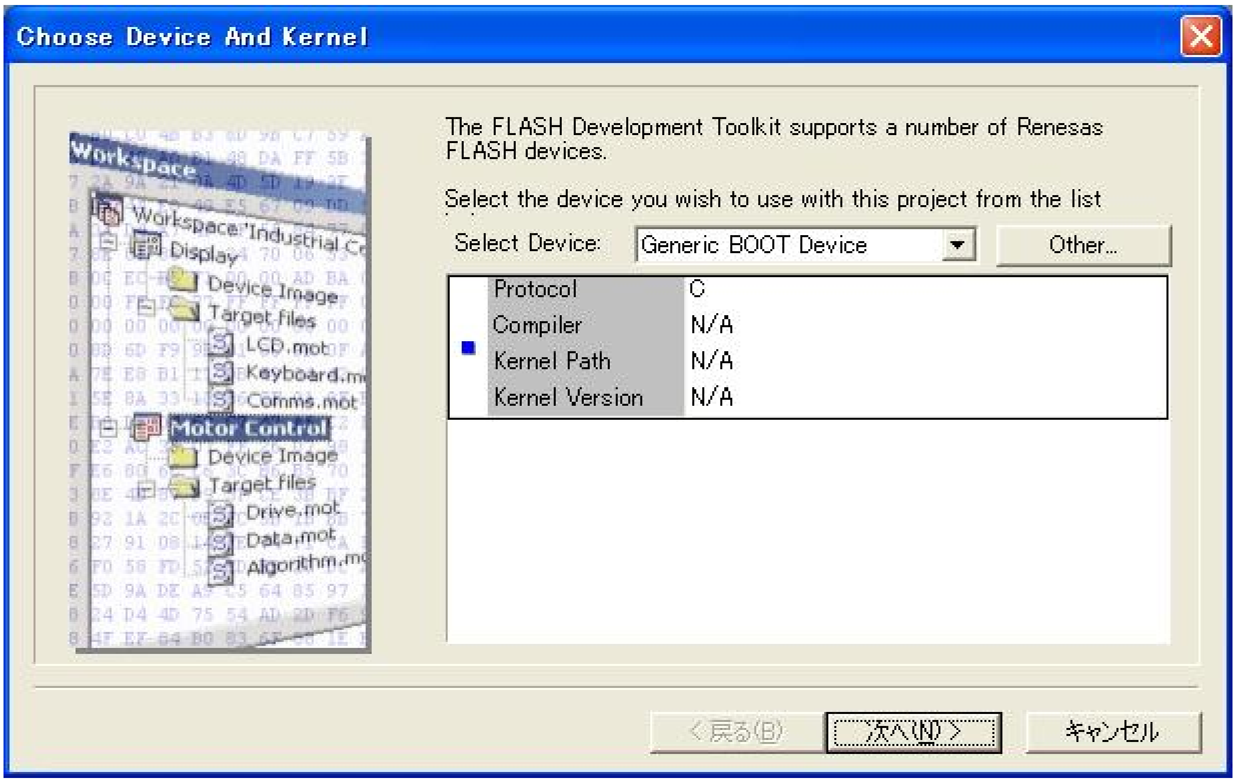
Tool chain: None

When you have set the project workspace, click "OK."

4.2.4 Selecting the Device and Kernel

Select the target device from the pull-down menu.

Select "Generic BOOT Device" because the H8S/2378F is a 0.18-μm product.



The FLASH Development Toolkit supports a number of Renesas FLASH devices.

Select the device you wish to use with this project from the list

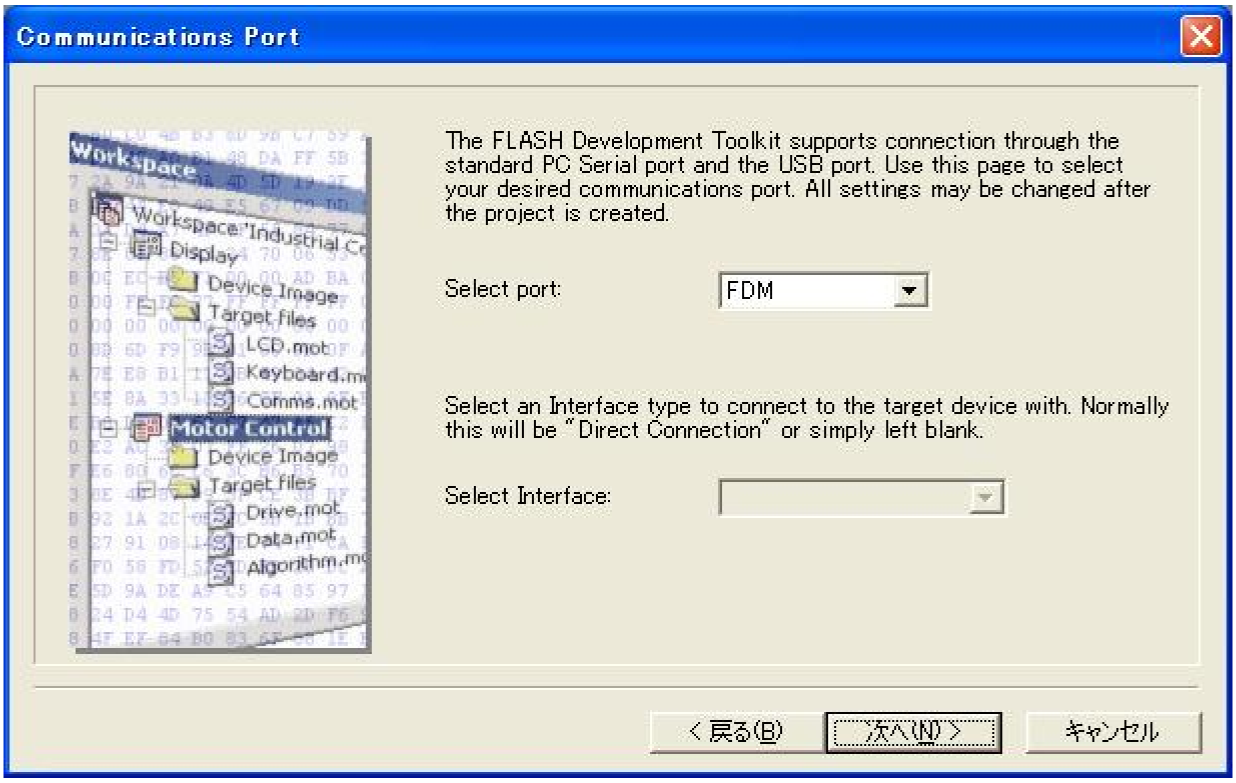
Select Device: Generic BOOT Device

Protocol	C
Compiler	N/A
Kernel Path	N/A
Kernel Version	N/A

When you have selected the device, click "Next(N)."

4.2.5 Selecting a Communications Port

Select the adapter board (FDM) from the pull-down menu.



Communications Port

The FLASH Development Toolkit supports connection through the standard PC Serial port and the USB port. Use this page to select your desired communications port. All settings may be changed after the project is created.

Select port: FDM

Select an Interface type to connect to the target device with. Normally this will be "Direct Connection" or simply left blank.

Select Interface:

When you have selected the communications port, click "Next(N)."

4.2.6 Adapter Board Pin Settings

Set the pins on the adapter board (FDM) for the boot mode.

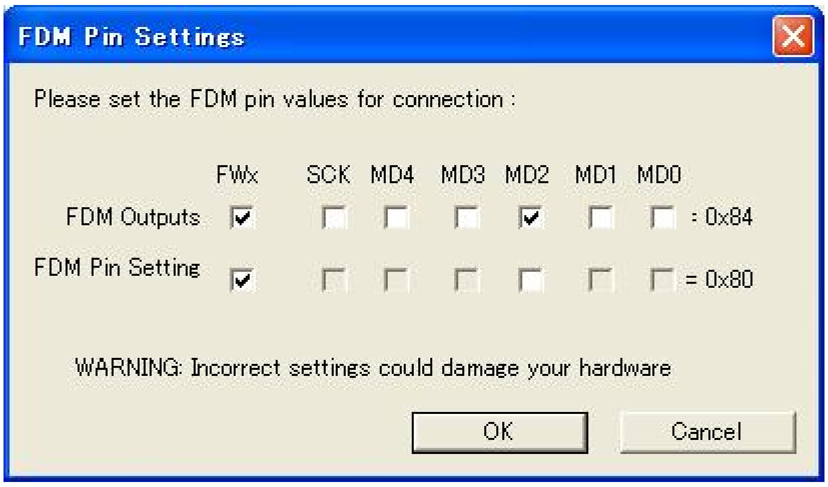
For example, set the output of FWx pin to high (1) (open jumper J15) and that of MD2 (IO0) to low (0).

In this example, the FWx pin outputs 1 for setting a mode and MD2 (IO0) outputs 0 for serial communication connection.

Turn off the power and select the boot mode (mode 3) using DIP switch 6. Set DIP switch 6 as follows. When you have set the pins, turn on the power.

Table 4-3 Operating Mode Settings

MCU Operating Mode	CPU Operating Mode	Jumper	FWE	MD2	MD1	MD0	SCI Switch
		J15	FWx (Pin 3) on the Adapter Board	SW6-3	SW6-2	SW6-1	MD2 (Pin 9) on the Adapter Board
3	Boot mode	1 (Open)	1 (Output 1)	0 (ON)	1 (OFF)	1 (OFF)	0 (Output 0)

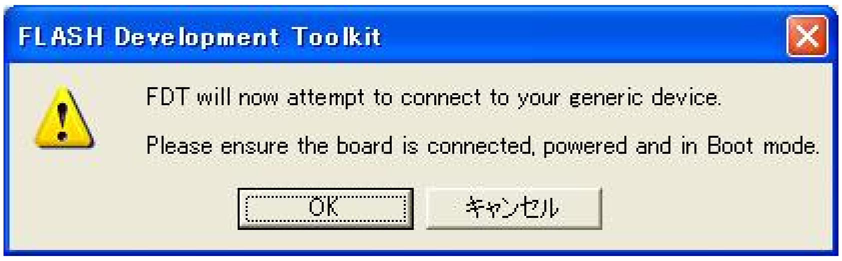

FDM Pin Settings

Please set the FDM pin values for connection :

	FWx	SCK	MD4	MD3	MD2	MD1	MD0	
FDM Outputs	✓				✓			: 0x84
FDM Pin Setting	✓							= 0x80

WARNING: Incorrect settings could damage your hardware

When you have set the pins, click "OK."


FLASH Development Toolkit

FDT will now attempt to connect to your generic device.

Please ensure the board is connected, powered and in Boot mode.

When the device has been connected, click "OK."

Note: Do not operate the mode switches during CPU operation. Be sure to operate the FWE and MD pins after turning off the power to the board or while pressing the RESET button.

An example of connecting the H8S/2378F and Renesas adapter board (HS0008EAUF1H) is shown in Figure 4-2. The pull-up and pull-down resistor values shown are only examples. Evaluate the microcomputer to determine the actual values on the user system.

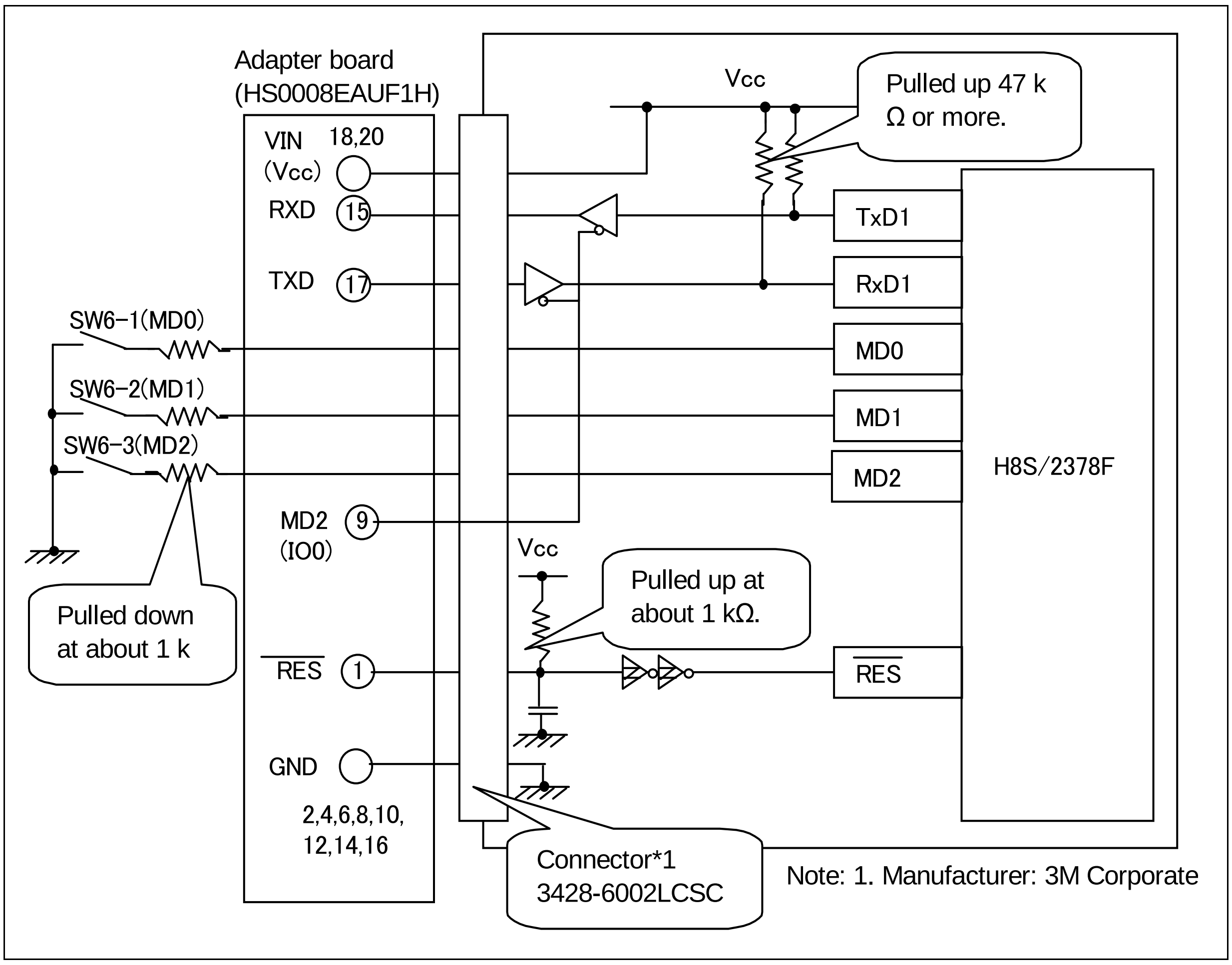


Figure 4-3 Example of Connecting the H8S/2378F and Adapter Board

An example of setting pins for the boot mode when the H8S/2378F user system and Renesas adapter board (HS0008EAUF1H) are connected is shown in Table 4-4. Use the mode switches to set the operating mode.

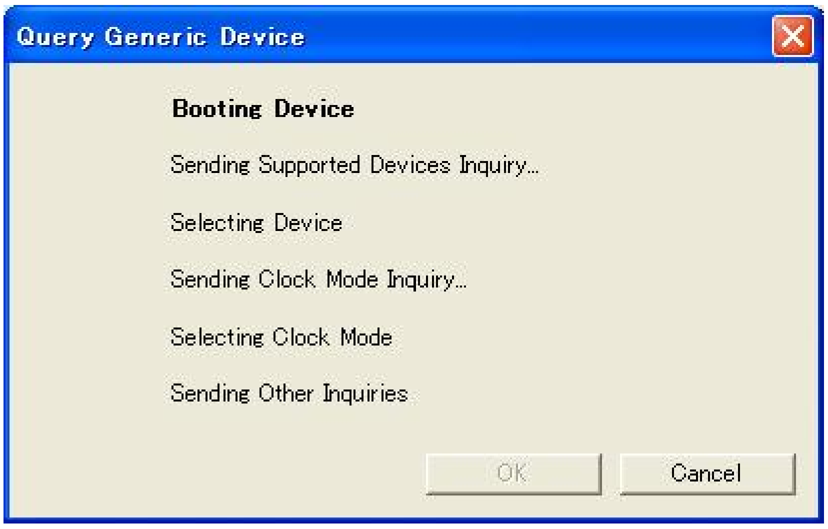
Table 4-4 Example of Setting Pins on the H8S/2378F and Adapter Board (for the Boot Mode)

Pin No.	Pin on the Adapter Board	Pin on the Device	Input/Output	Output Level
1	$\overline{\text{RES}}$	$\overline{\text{RES}}$	Output (default)	Adapter board
3	FWx	Mode switch	Output	High (1)
5	MD0	NC	NC	-
7	MD1	NC	NC	-
9	MD2 (IO0)	Serial I/O switch	Output	Low (0)
11	MD3 (IO1)	NC	NC	-
13	MD4 (IO2)	NC	NC	-
15	RXD	TXD	Input (default)	Adapter board
17	TXD	RXD	Output (default)	Adapter board
19	SCK (NC)	NC	NC (default)	-

Note: NC: Means no connection.

4.2.7 Selecting a USB Device

Check the device.


Query Generic Device

Booting Device

Sending Supported Devices Inquiry...

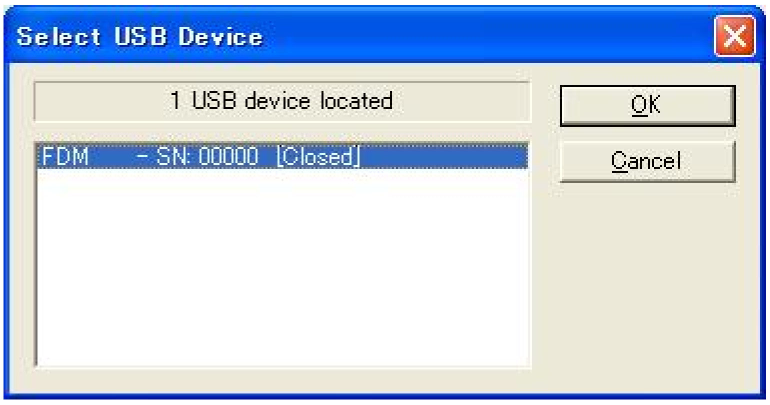
Selecting Device

Sending Clock Mode Inquiry...

Selecting Clock Mode

Sending Other Inquiries

Select the adapter board (FDM).


Select USB Device

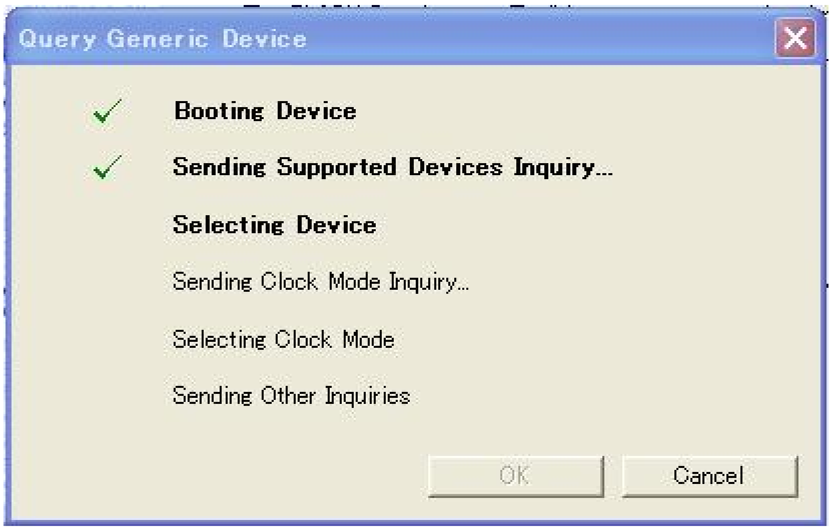
1 USB device located

FDM - SN: 00000 [Closed]

When you have selected USB device, click "OK."

4.2.8 Selecting a Device

Check the device.


Query Generic Device

✓ Booting Device

✓ Sending Supported Devices Inquiry...

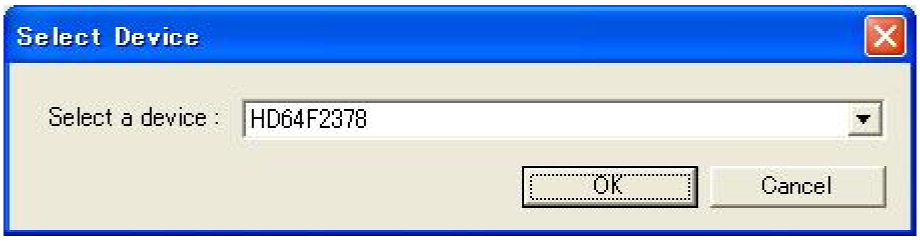
Selecting Device

Sending Clock Mode Inquiry...

Selecting Clock Mode

Sending Other Inquiries

Select HD64F2378.

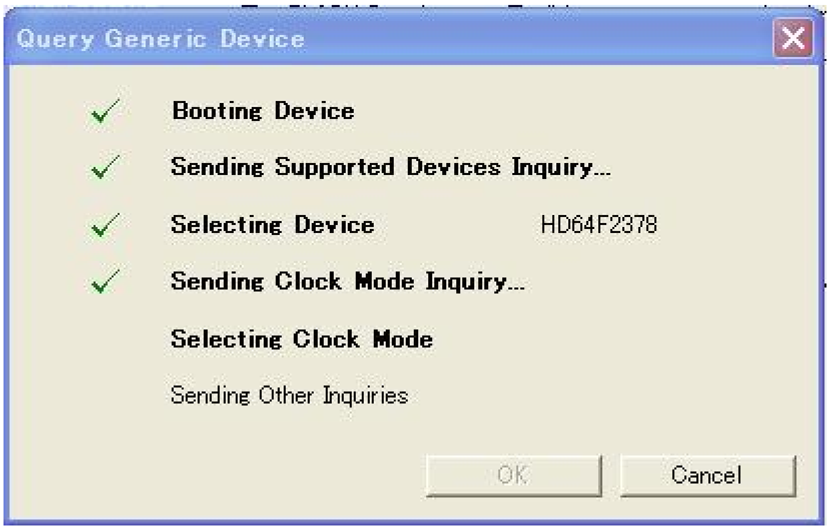

Select Device

Select a device : HD64F2378

When you have selected the device, click "OK."

4.2.9 Selecting the Clock Mode

Check the device.



✓ Booting Device

✓ Sending Supported Devices Inquiry...

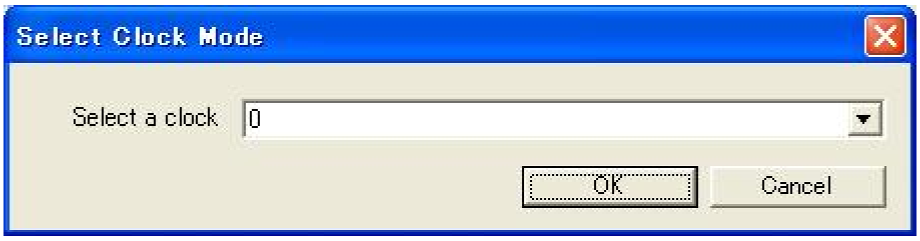
✓ Selecting Device HD64F2378

✓ Sending Clock Mode Inquiry...

Selecting Clock Mode

Sending Other Inquiries

Select the clock mode.

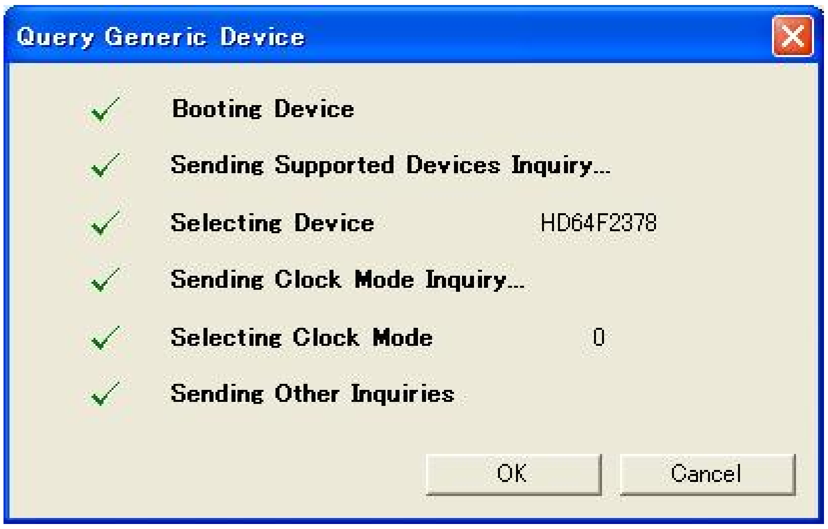


Select a clock: 0

When you have selected the clock mode, click "OK."

4.2.10 Checking the Generic Device

The device has been checked.



Query Generic Device

✓ Booting Device

✓ Sending Supported Devices Inquiry...

✓ Selecting Device HD64F2378

✓ Sending Clock Mode Inquiry...

✓ Selecting Clock Mode 0

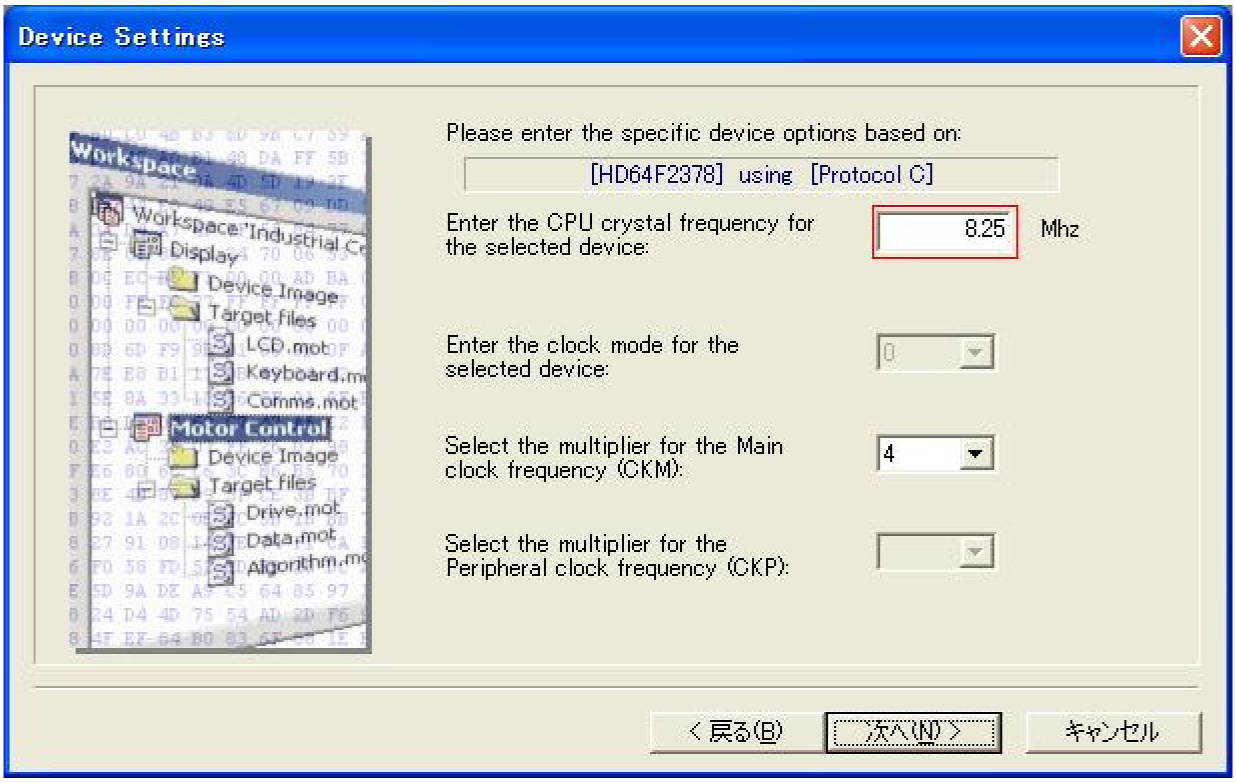
✓ Sending Other Inquiries

Click "OK."

4.2.11 Setting the Device (Input Clock)

In the first column enter the frequency of the clock used for the board in MHz. For example, enter 8.25 (MHz).

Set 4 in "Select the multiplier for the Main clock frequency (CKM):."



Please enter the specific device options based on:

[HD64F2378] using [Protocol C]

Enter the CPU crystal frequency for the selected device: 8.25 Mhz

Enter the clock mode for the selected device: 0

Select the multiplier for the Main clock frequency (CKM): 4

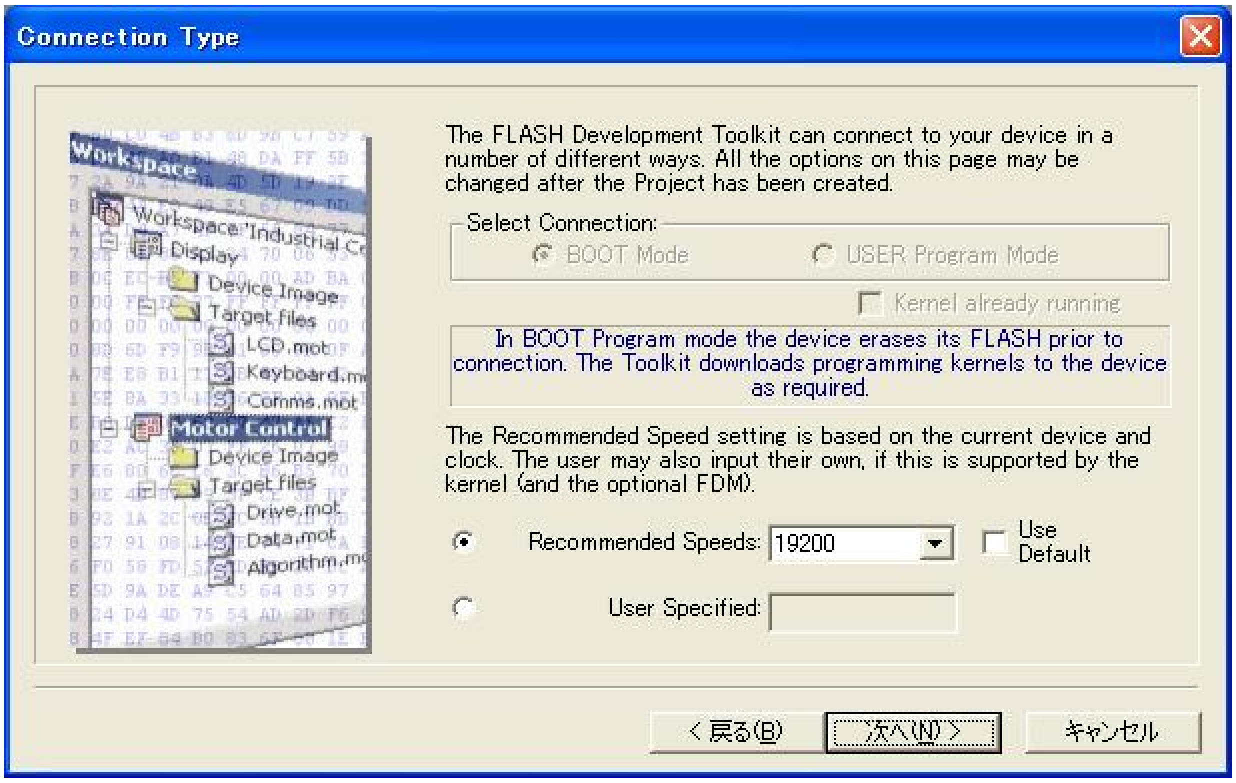
Select the multiplier for the Peripheral clock frequency (CKP):

When you have set the values, click "Next(N)."

The input clock is the frequency of the clock directly input to the microcomputer. Enter the frequency of the crystal or ceramic resonator connected to the user system with three significant digits. The input clock differs from the operating frequency (PLL output).

4.2.12 Selecting the Connection Type (Communication Speed)

Select a baud rate from the pull-down menu. For example, select 19200 (baud).



The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection: [✓ BOOT Mode] USER Program Mode

Kernel already running

In BOOT Program mode the device erases its FLASH prior to connection. The Toolkit downloads programming kernels to the device as required.

The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the optional FDM).

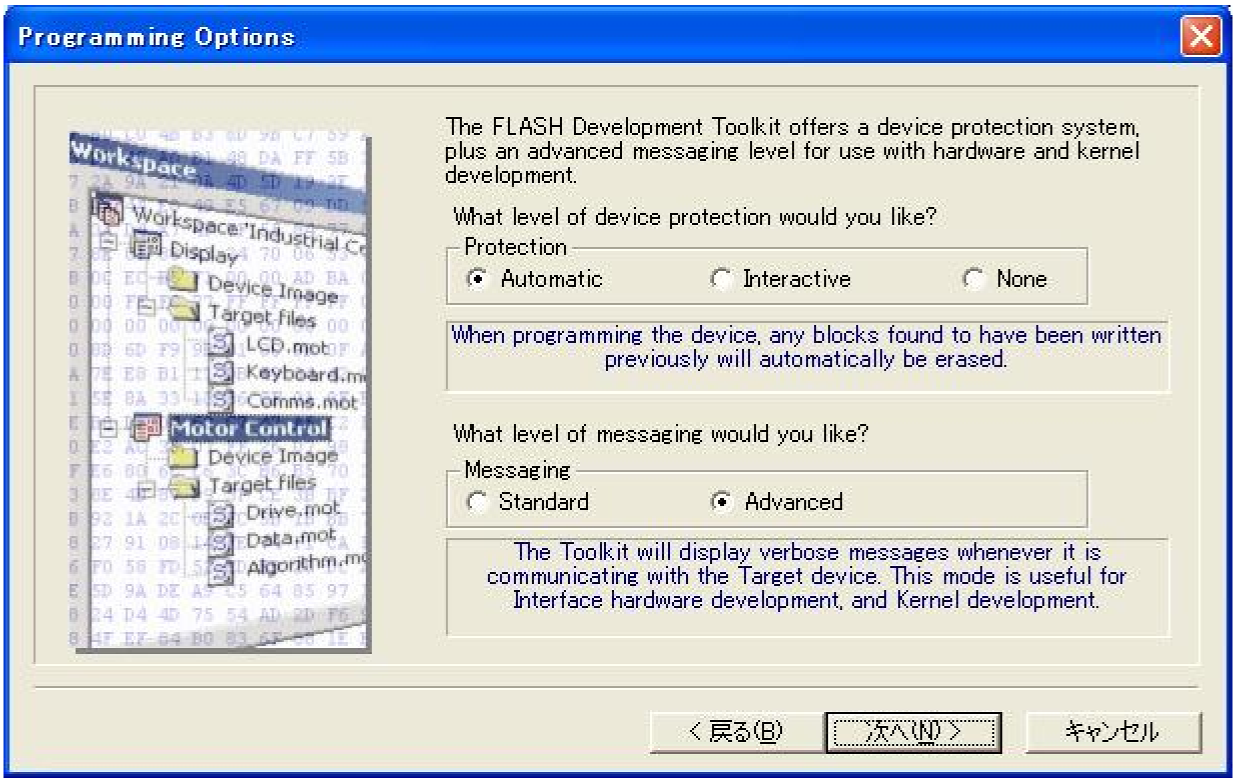
[✓ Recommended Speeds: 19200] Use Default

User Specified:

When you have selected the baud rate, click "Next(N)."

4.2.13 Selecting Programming Options (Protection Level and Messaging Level)

Select the protection level and messaging level. For example, select "Automatic" for "Protection" and "Advanced" for "Messaging."



The FLASH Development Toolkit offers a device protection system, plus an advanced messaging level for use with hardware and kernel development.

What level of device protection would you like?

Protection: [✓ Automatic] Interactive None

When programming the device, any blocks found to have been written previously will automatically be erased.

What level of messaging would you like?

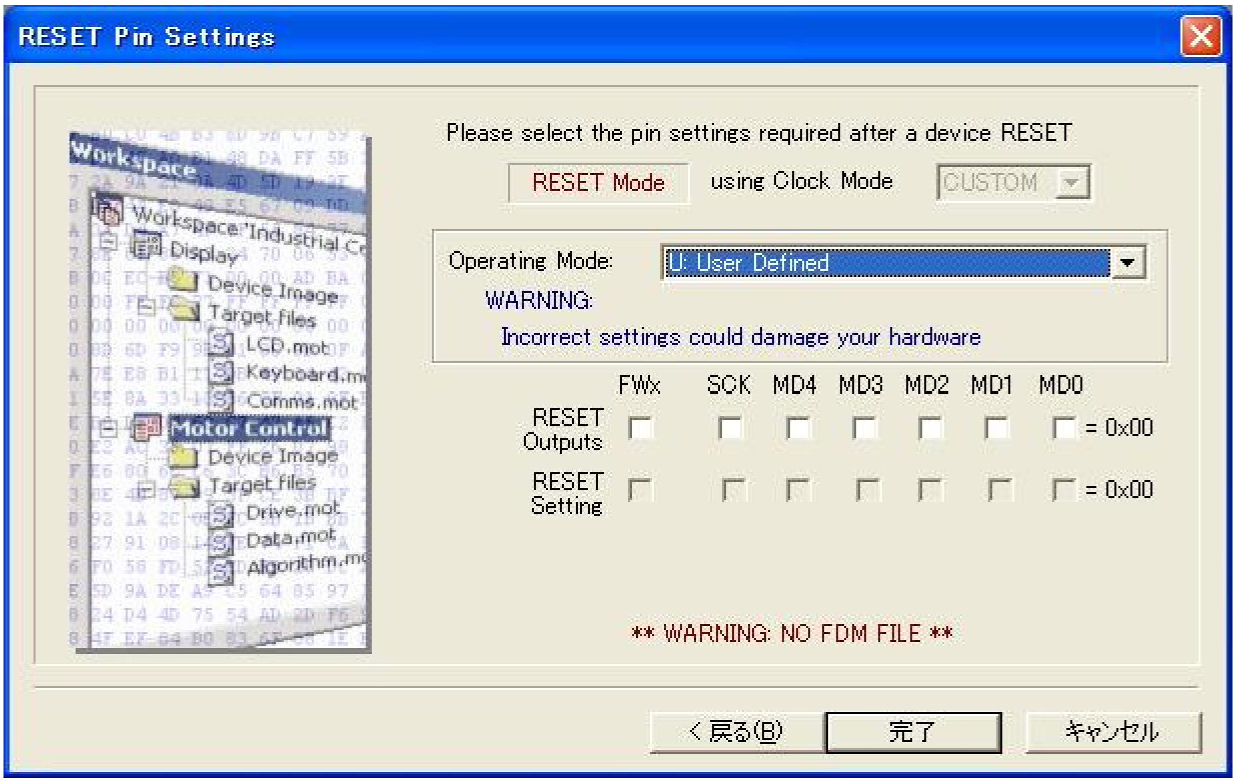
Messaging: Standard [✓ Advanced]

The Toolkit will display verbose messages whenever it is communicating with the Target device. This mode is useful for Interface hardware development, and Kernel development.

When you have selected programming options, click "Next(N)."

4.2.14 Reset Mode Pin Settings

Set pins on the adapter board for restarting the device in the reset mode. These settings are not required for this procedure.



RESET Pin Settings

Please select the pin settings required after a device RESET

RESET Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

WARNING:

Incorrect settings could damage your hardware

	FWx	SCK	MD4	MD3	MD2	MD1	MD0	
RESET Outputs	☐	☐	☐	☐	☐	☐	☐	= 0x00
RESET Setting	☐	☐	☐	☐	☐	☐	☐	= 0x00

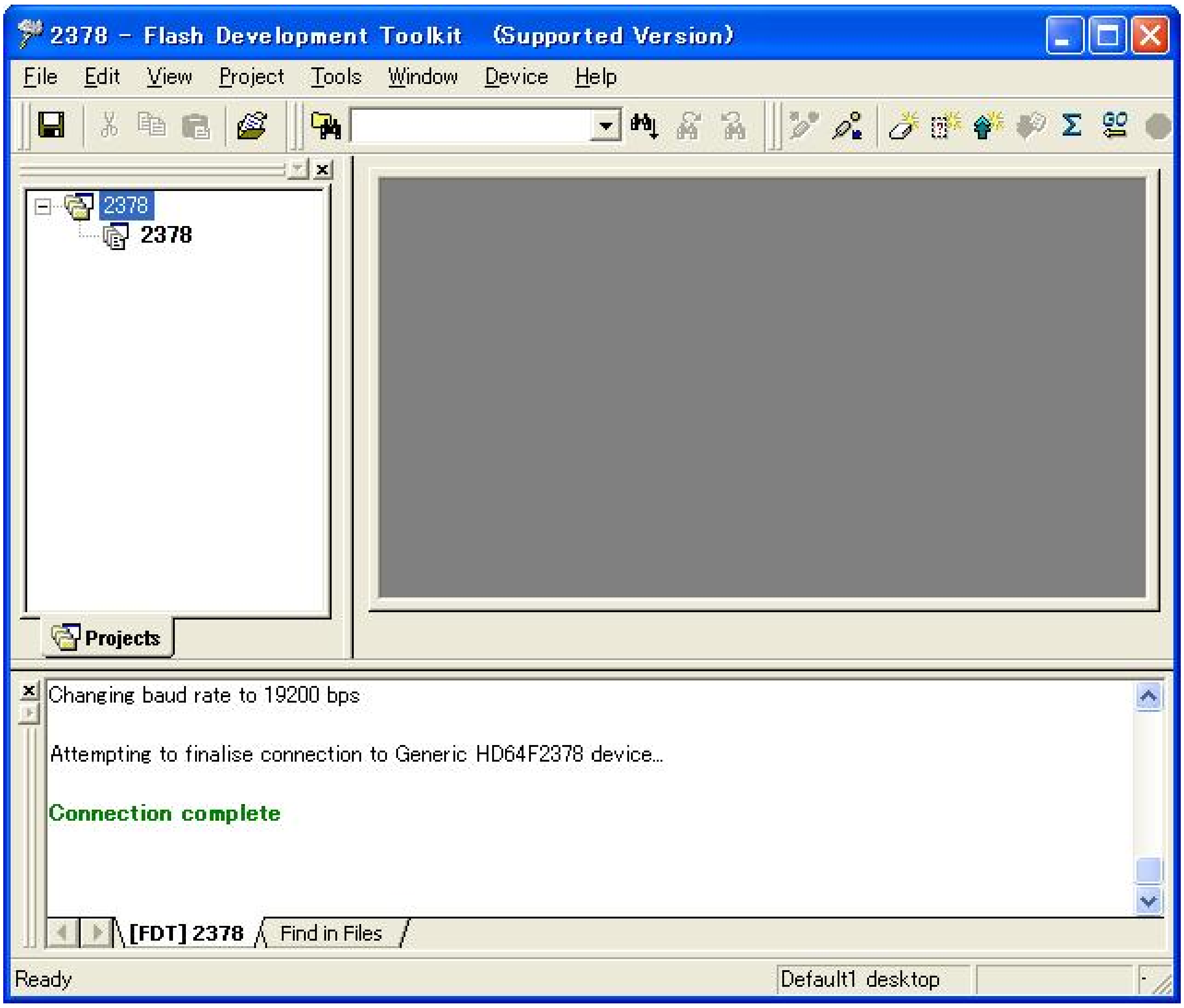
** WARNING: NO FDM FILE **

When you have set the items, click "Finish."

4.2.15 Completion of Connection

The H8S/2378F board has been connected to the Flash Development Toolkit in the boot mode.

At this time, the contents of the user boot area and user area have been erased.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
Projects
[FDT] 2378
Find in Files
Ready
Default1 desktop

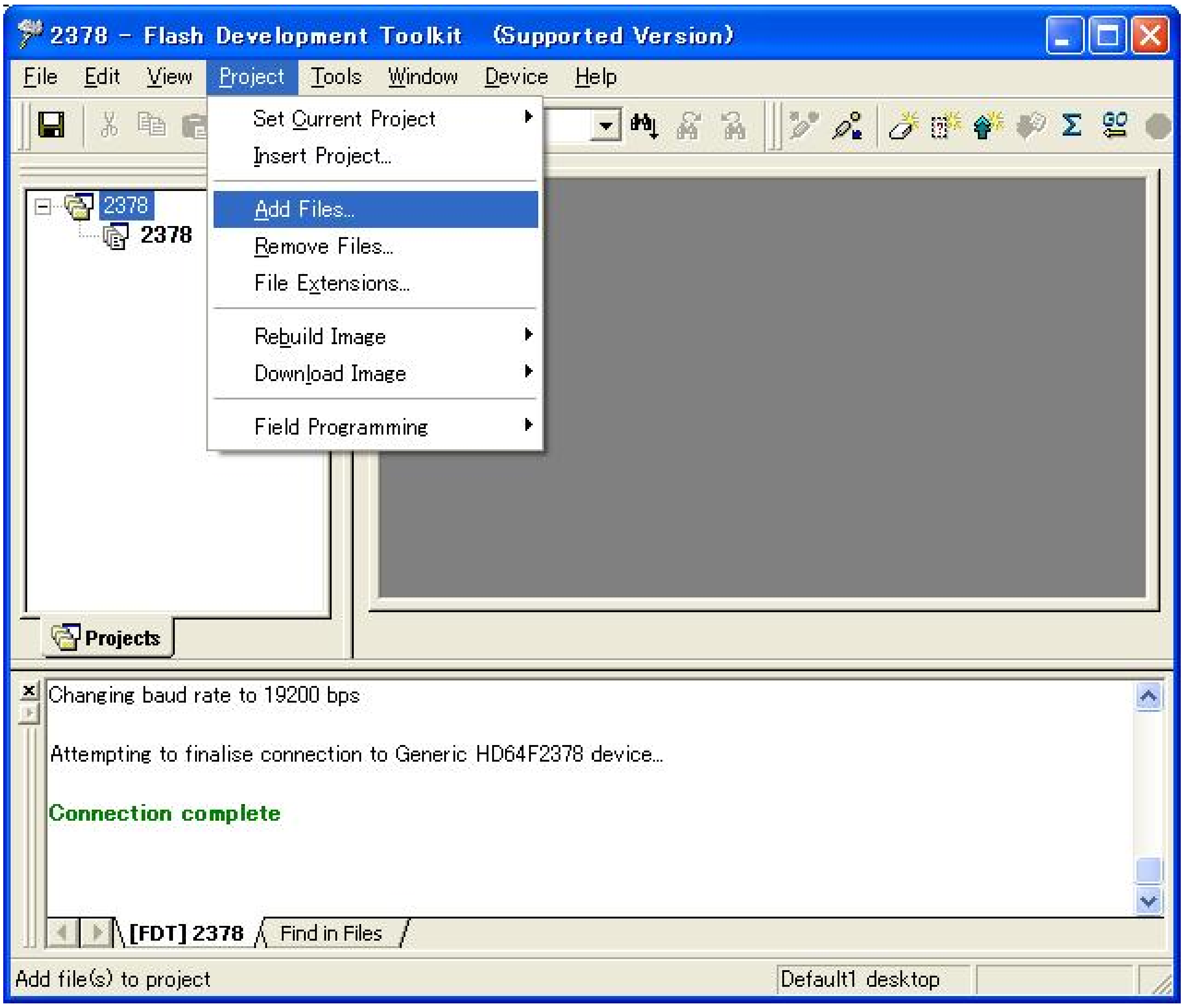
```
Changing baud rate to 19200 bps

Attempting to finalise connection to Generic HD64F2378 device...

Connection complete
```

4.3 Boot Mode 1 (Programming the User Boot Area)

Write a program in the user boot area in the boot mode. The program to be written is sample test program 2378F.mot (S-type file). The bit rate in this program has been modified according to the frequency. On how to modify the bit rate, refer to section 7.1.1, Bit Rate Setting (GenTest.h).

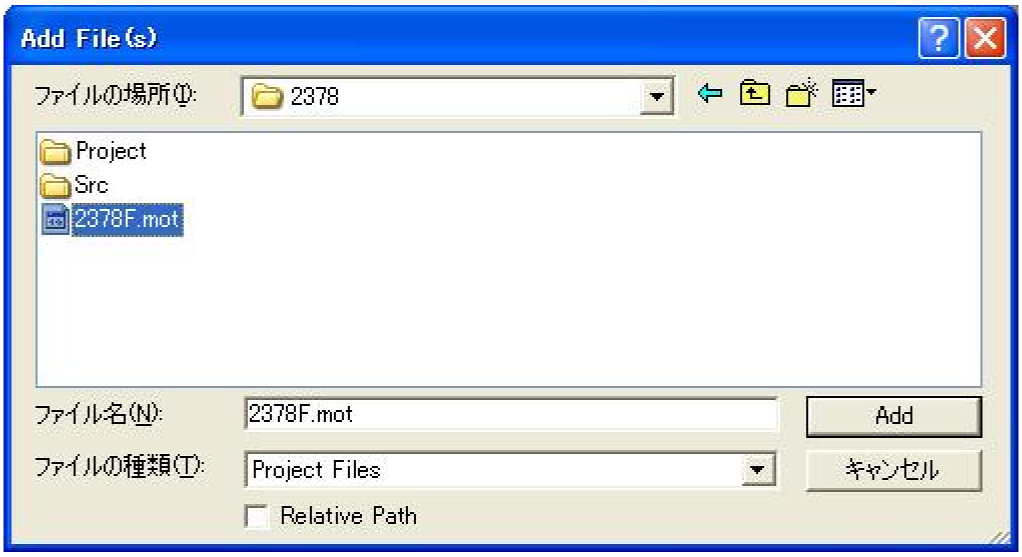
4.3.1 Selecting a File

To select a file to be programmed, select "Add Files..." from the "Project" pull-down menu.



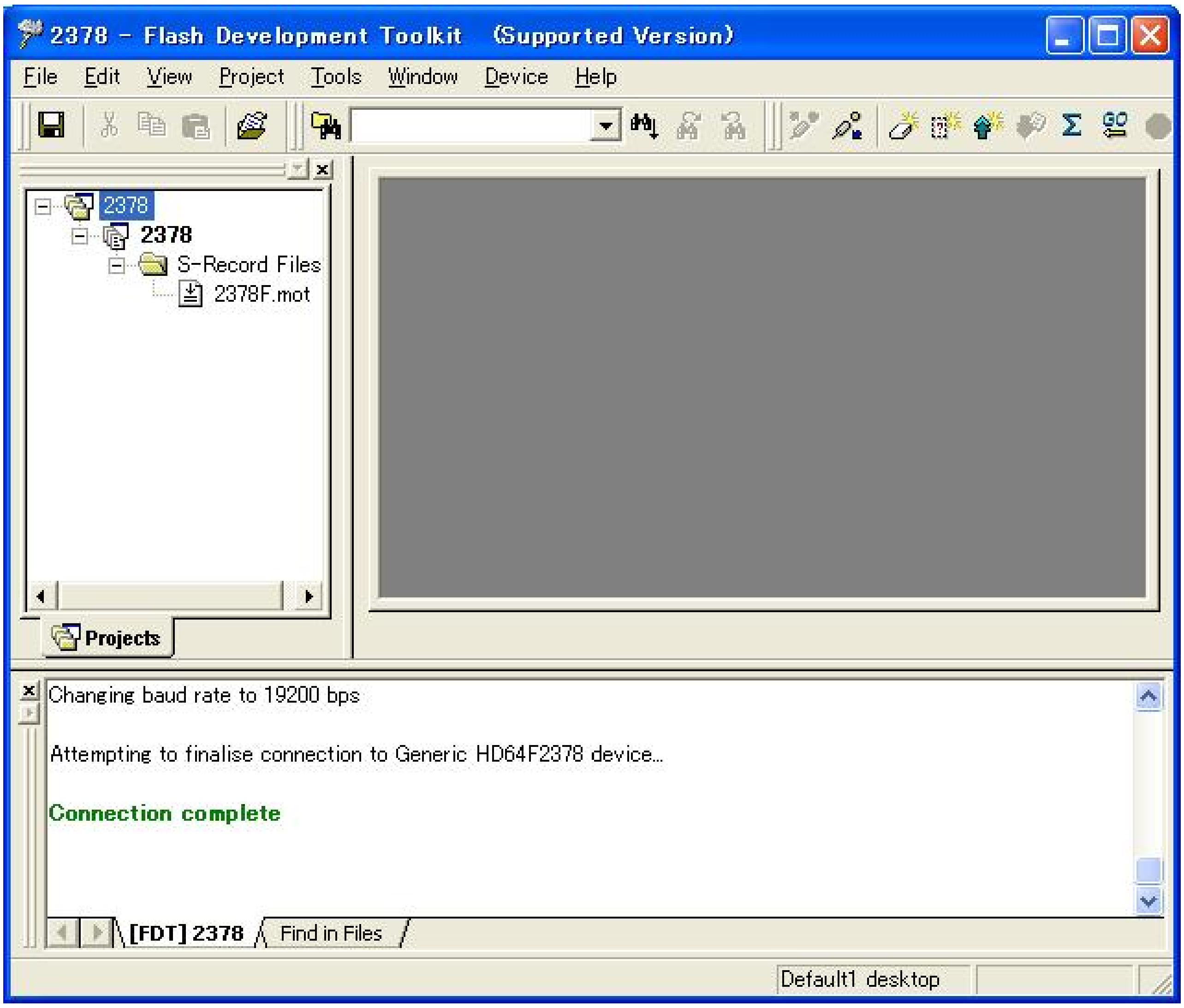
```
Changing baud rate to 19200 bps

Attempting to finalise connection to Generic HD64F2378 device...

Connection complete
```

In the "Add File(s)" dialog, add file "2378F.mot."



When you have selected the file, click "Add."

File 2378F.mot is added to the project.

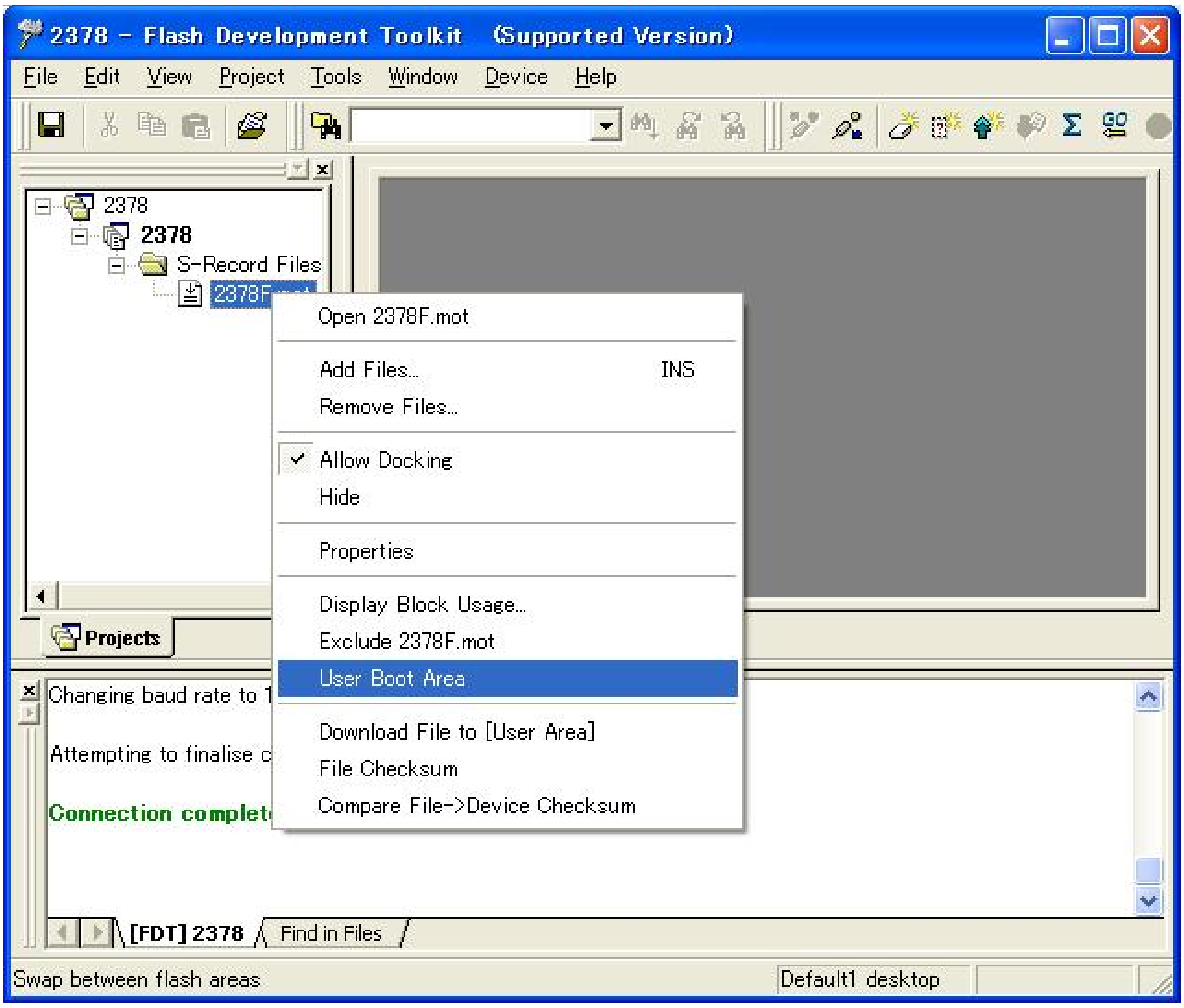


```
Changing baud rate to 19200 bps

Attempting to finalise connection to Generic HD64F2378 device...

Connection complete
```

4.3.2 Programming

To program the user boot area, set the user boot area.

Click the right mouse button on file 2378F.mot to display the pop-up menu. Click "User Boot Area" so that the file can be downloaded to the user boot area.



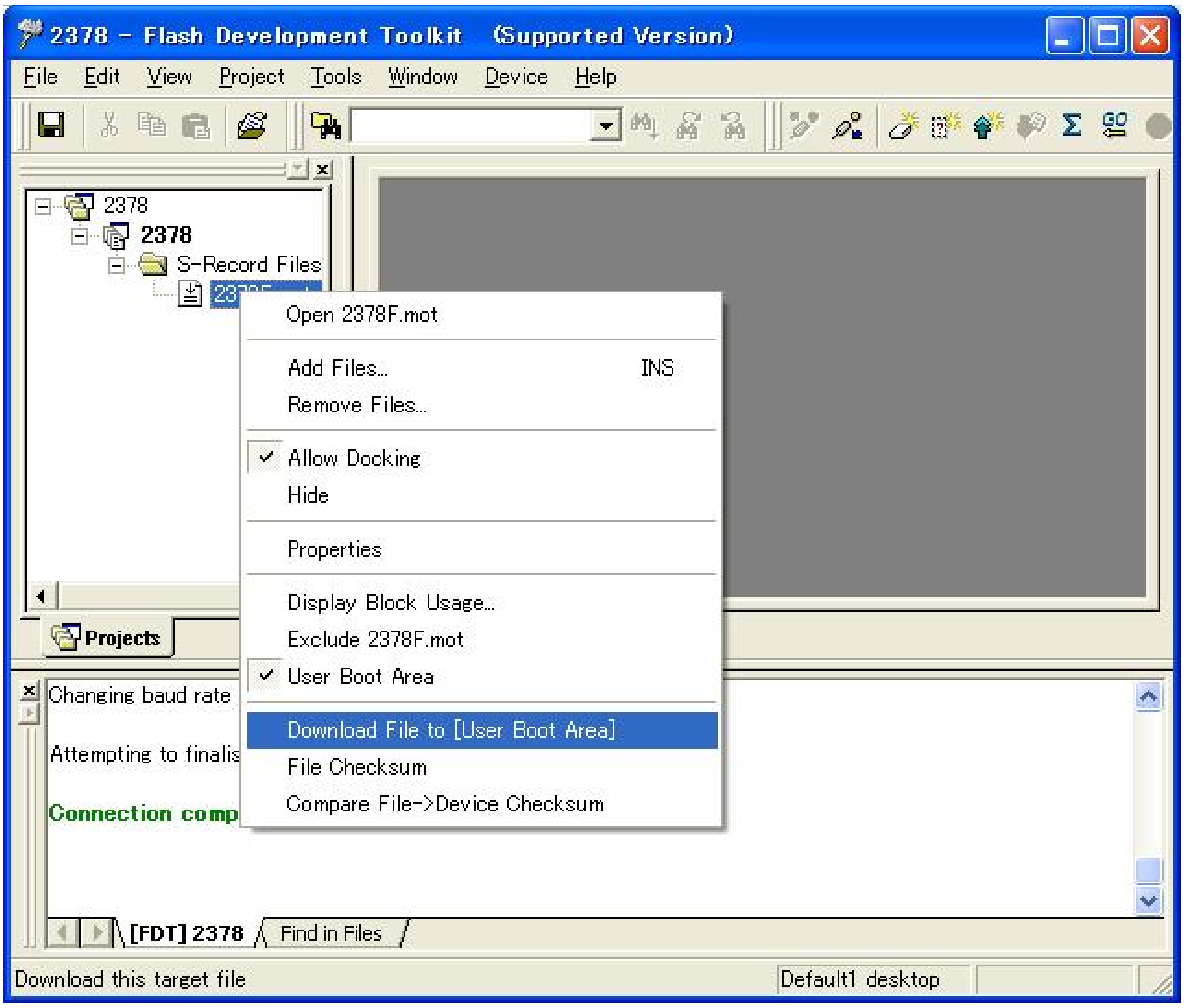
Changing baud rate to 1

Attempting to finalise c

Connection complet

Swap between flash areas

Click the right mouse button on file 2378F.mot again to display the pop-up menu. Click "Download File to [User Boot Area]" to download file 2378F.mot to the user boot area.



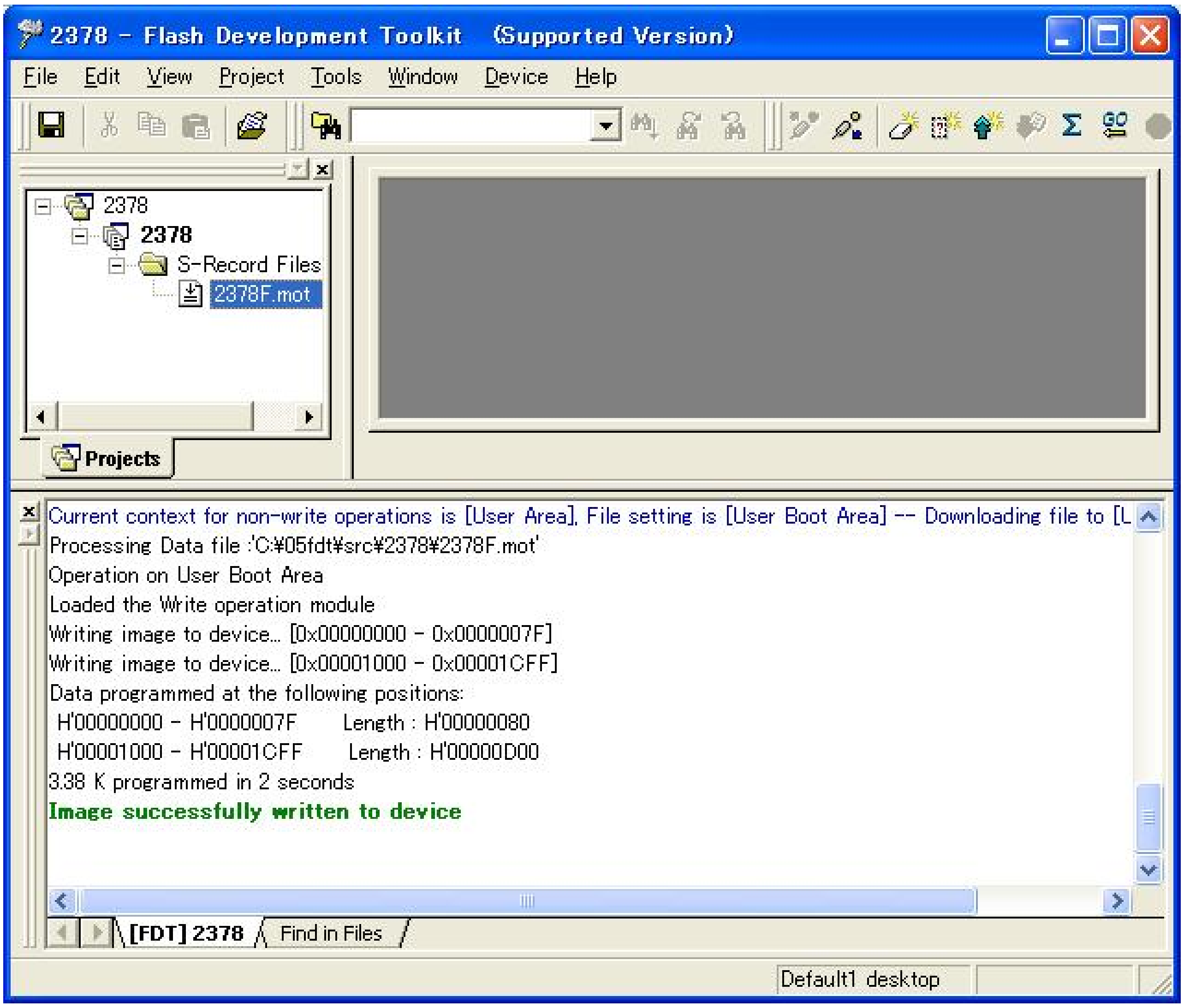
Changing baud rate

Attempting to finalis

Connection comp

Download this target file

You can check that the program has been downloaded to the user boot area.

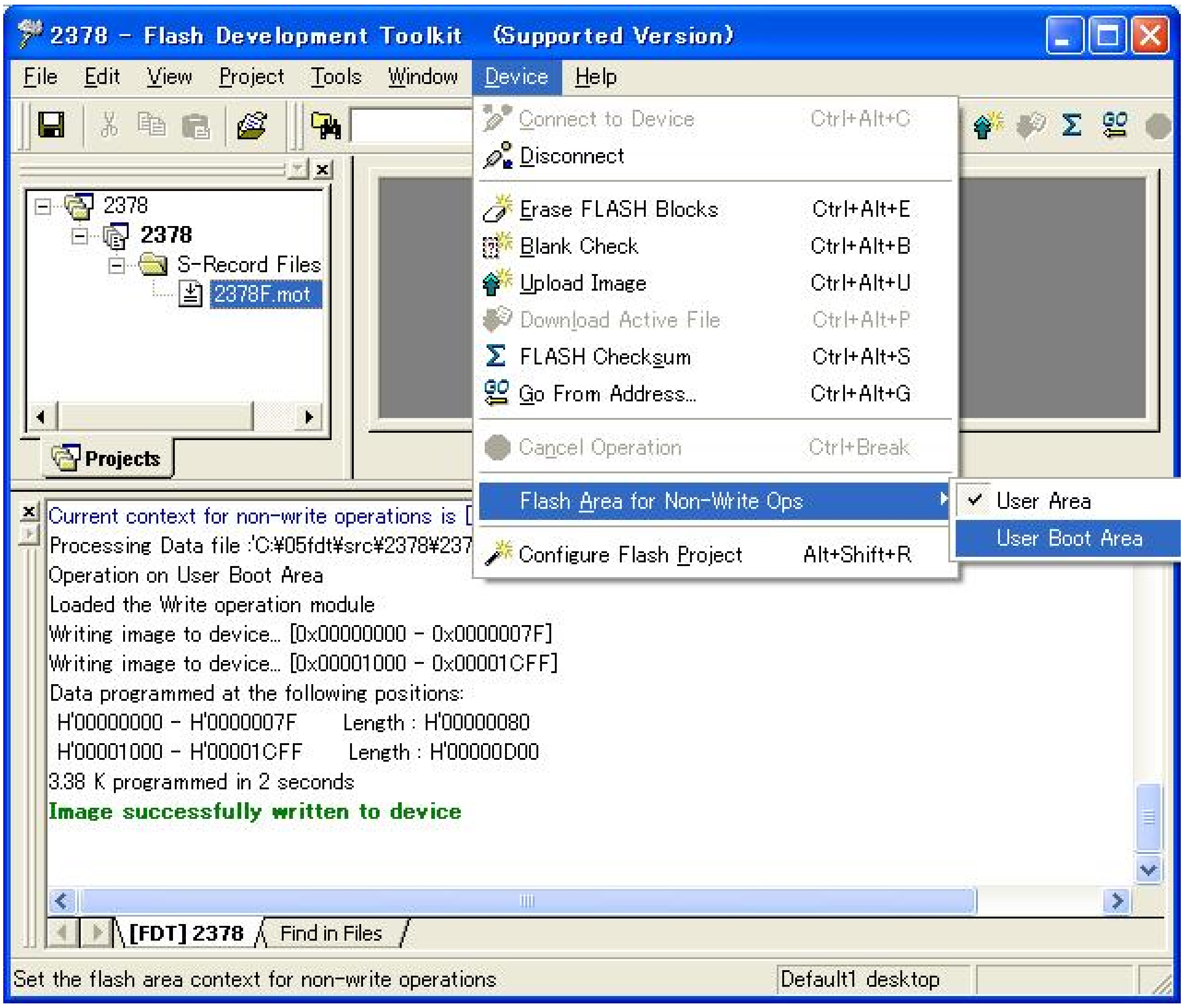

2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Current context for non-write operations is [User Area], File setting is [User Boot Area] -- Downloading file to [L
Processing Data file :'C:¥05fdt¥src¥2378¥2378F.mot'
Operation on User Boot Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device
```

4.3.3 Blank Check

To confirm that the user boot area has been programmed, perform a blank check.

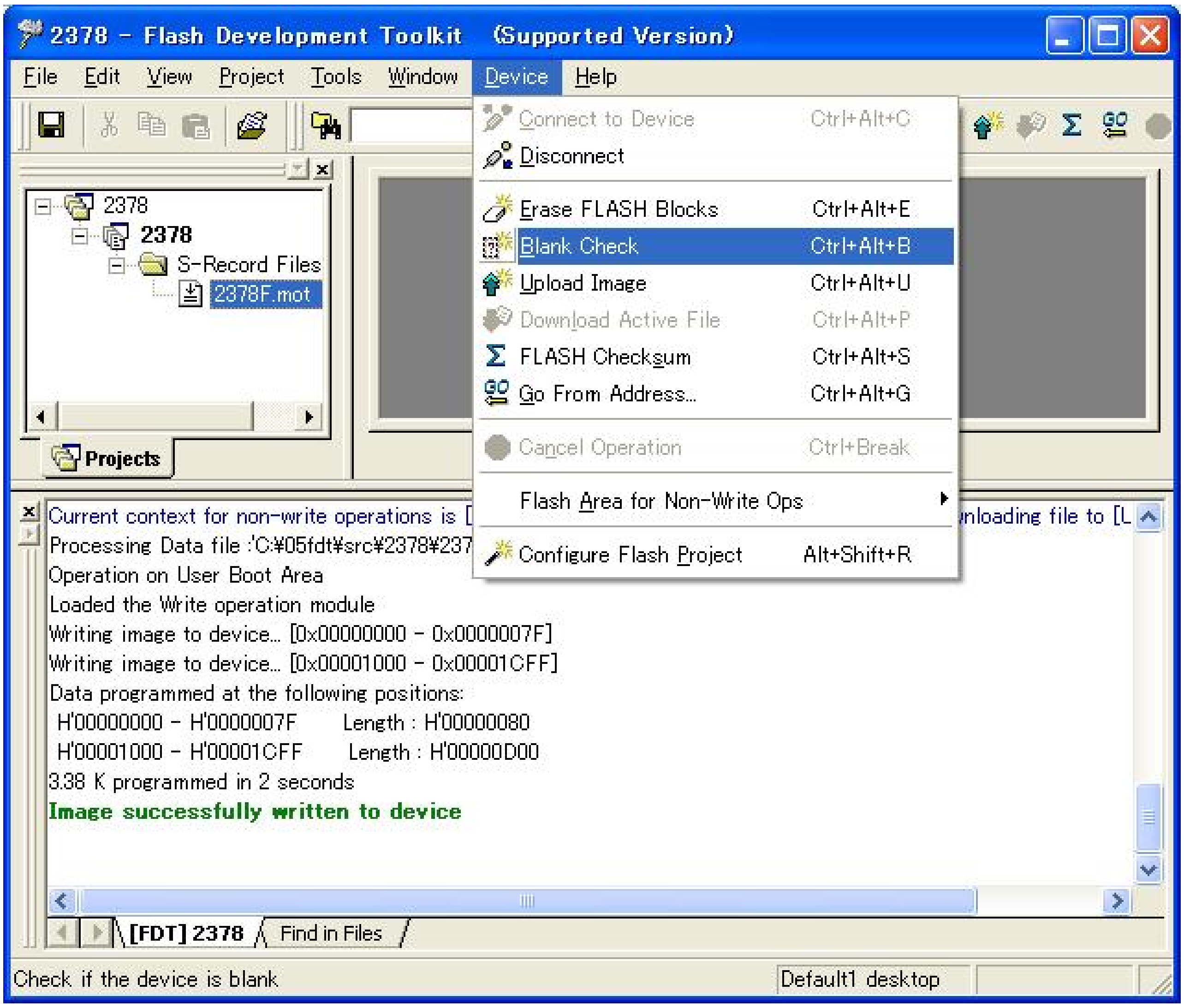
Click "Device" to open the pull-down menu and select "Flash Area for Non-Write Ops," then "User Boot Area."


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
User Area
User Boot Area
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Current context for non-write operations is [
Processing Data file :'C:¥05fdt¥src¥2378¥237
Operation on User Boot Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device
```

Set the flash area context for non-write operations

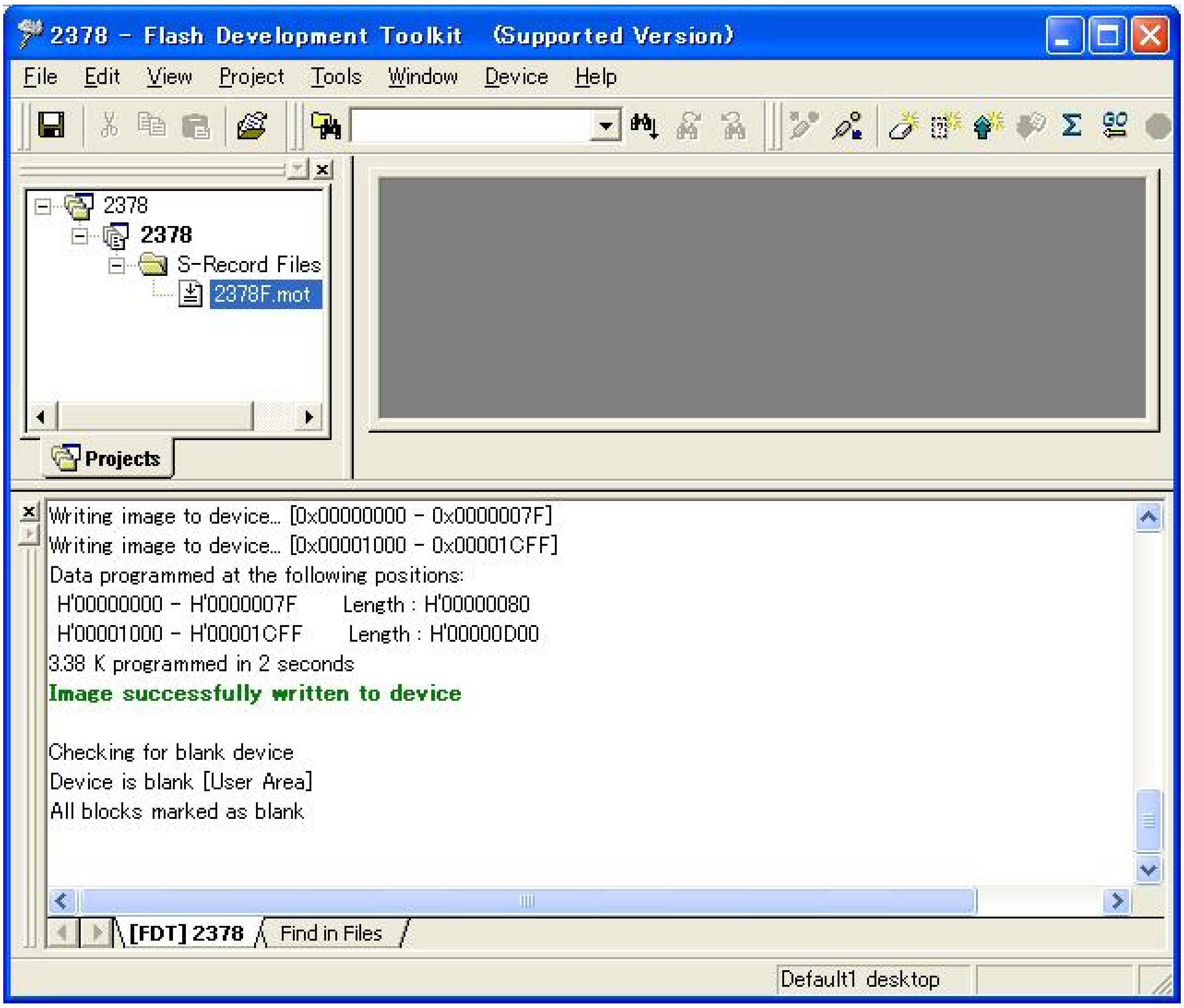
Click "Device" again to open the pull-down menu and click "Blank Check."


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Check if the device is blank
Default1 desktop

```
Current context for non-write operations is [
Processing Data file :'C:¥05fdt¥src¥2378¥237
Operation on User Boot Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device
```

The result of the blank check for the selected area is displayed.

The user boot area is not blank.

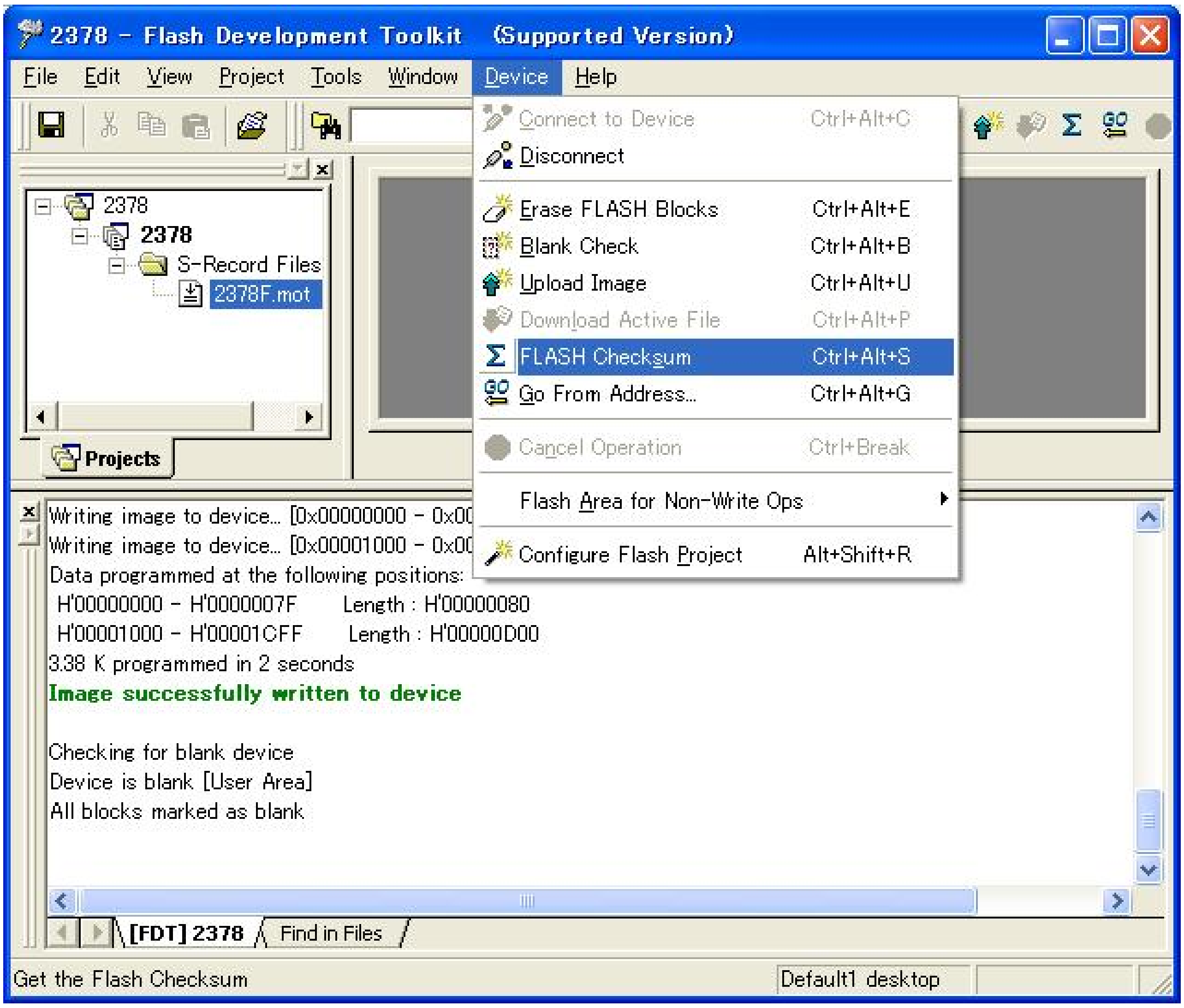


```
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Checking for blank device
Device is blank [User Area]
All blocks marked as blank
```

4.3.4 Checksum

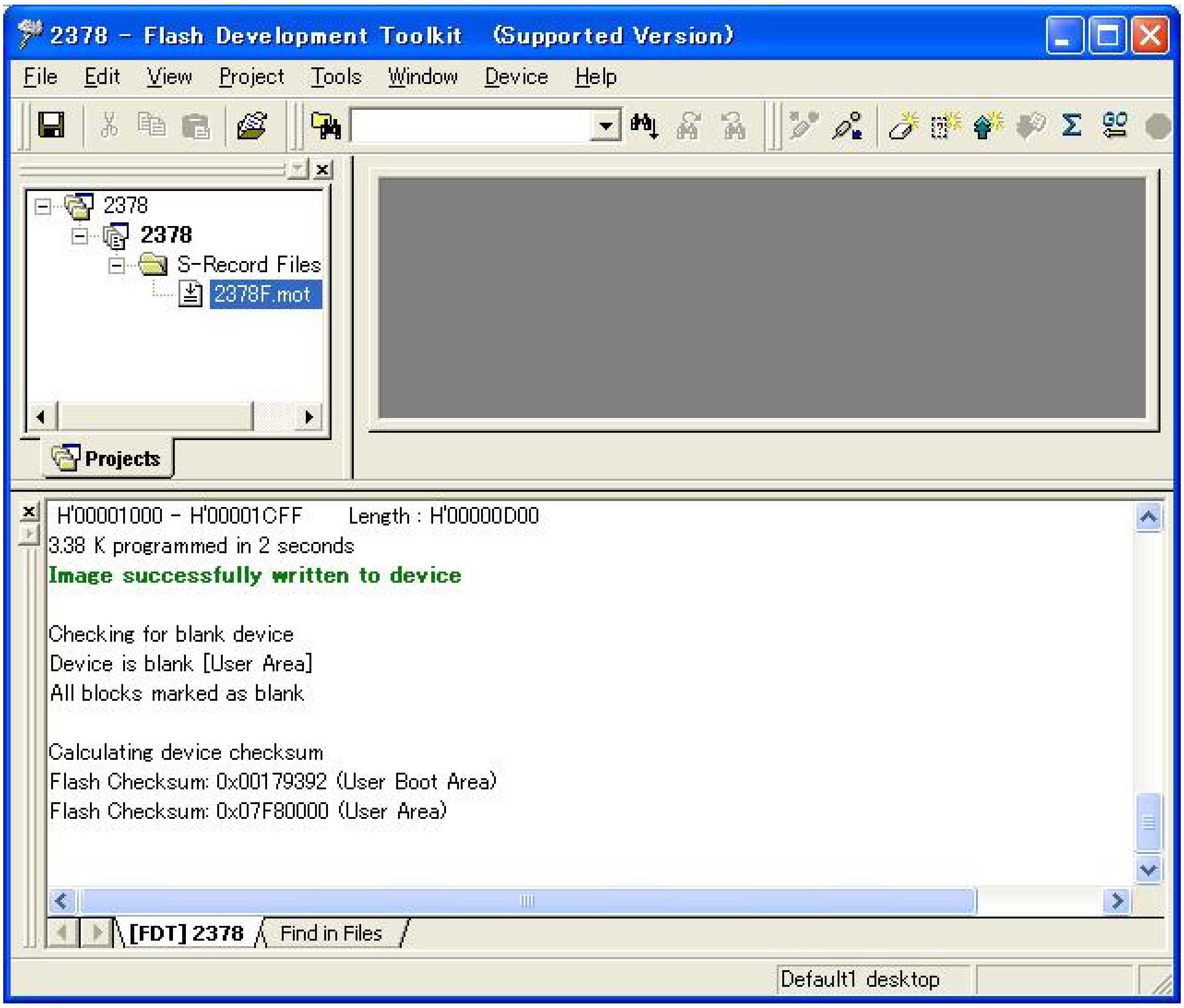
To confirm that the user boot area has been programmed, display a checksum.

Click "Device" to open the pull-down menu and click "Flash Checksum."


2378 - Flash Development Toolkit (Supported Version)
File
Edit
View
Project
Tools
Window
Device
Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Get the Flash Checksum
Default1 desktop

```
Writing image to device... [0x00000000 - 0x00
Writing image to device... [0x00001000 - 0x00
Data programmed at the following positions:
 H'00000000 - H'0000007F       Length : H'00000080
 H'00001000 - H'00001CFF       Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Checking for blank device
Device is blank [User Area]
All blocks marked as blank
```

The result of the checksum calculation is displayed.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

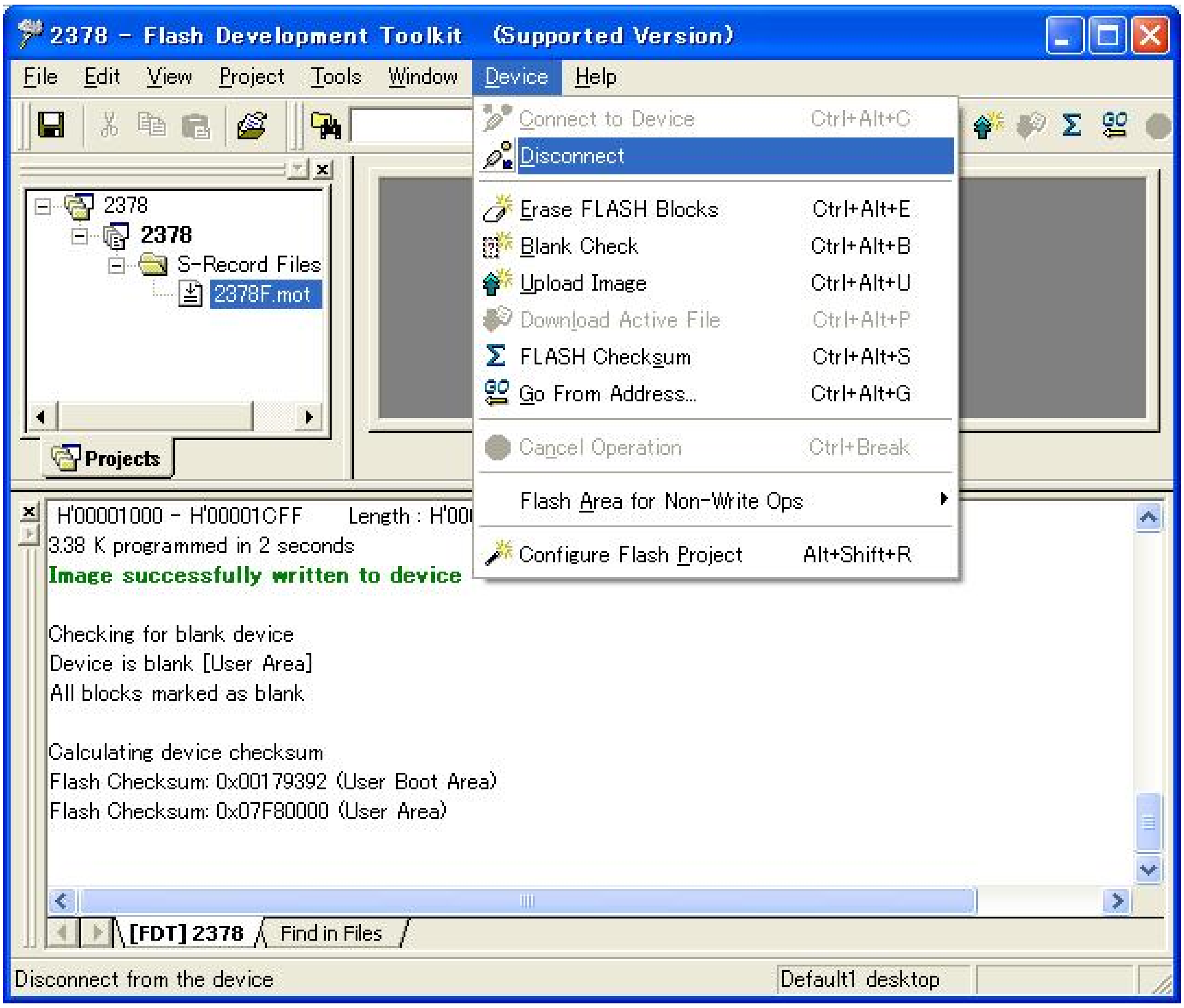
When the user boot area is blank, the following value is displayed as the result:

```
Calculating device checksum
Flash Checksum: 0x001FE000 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

4.3.5 Disconnecting the Device

After programming has been completed, disconnect the device.

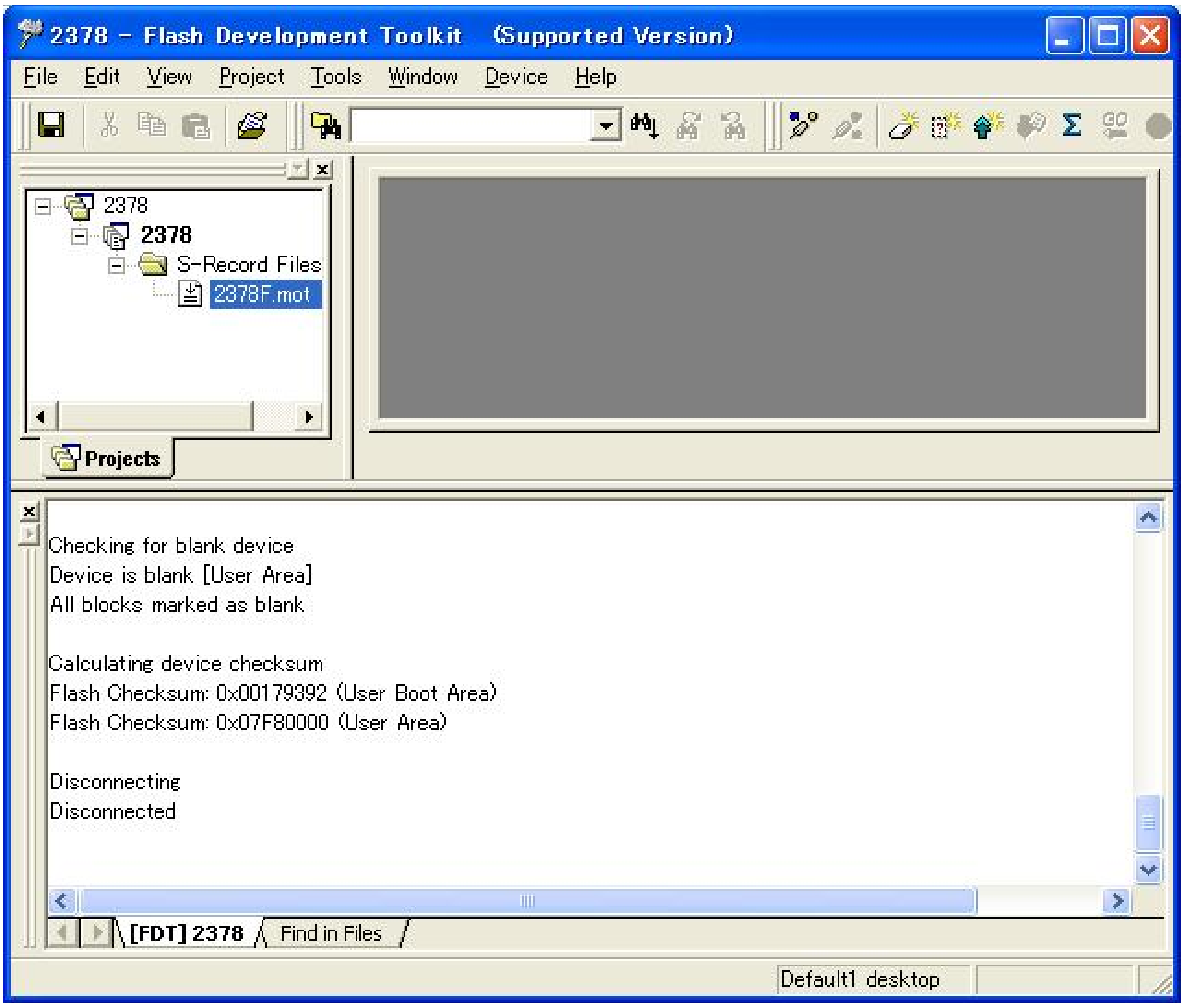
Click "Device" to open the pull-down menu and click "Disconnect."


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
H'00001000 - H'00001CFF      Length : H'00
3.38 K programmed in 2 seconds
Image successfully written to device

Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

Disconnect from the device

The device is disconnected.

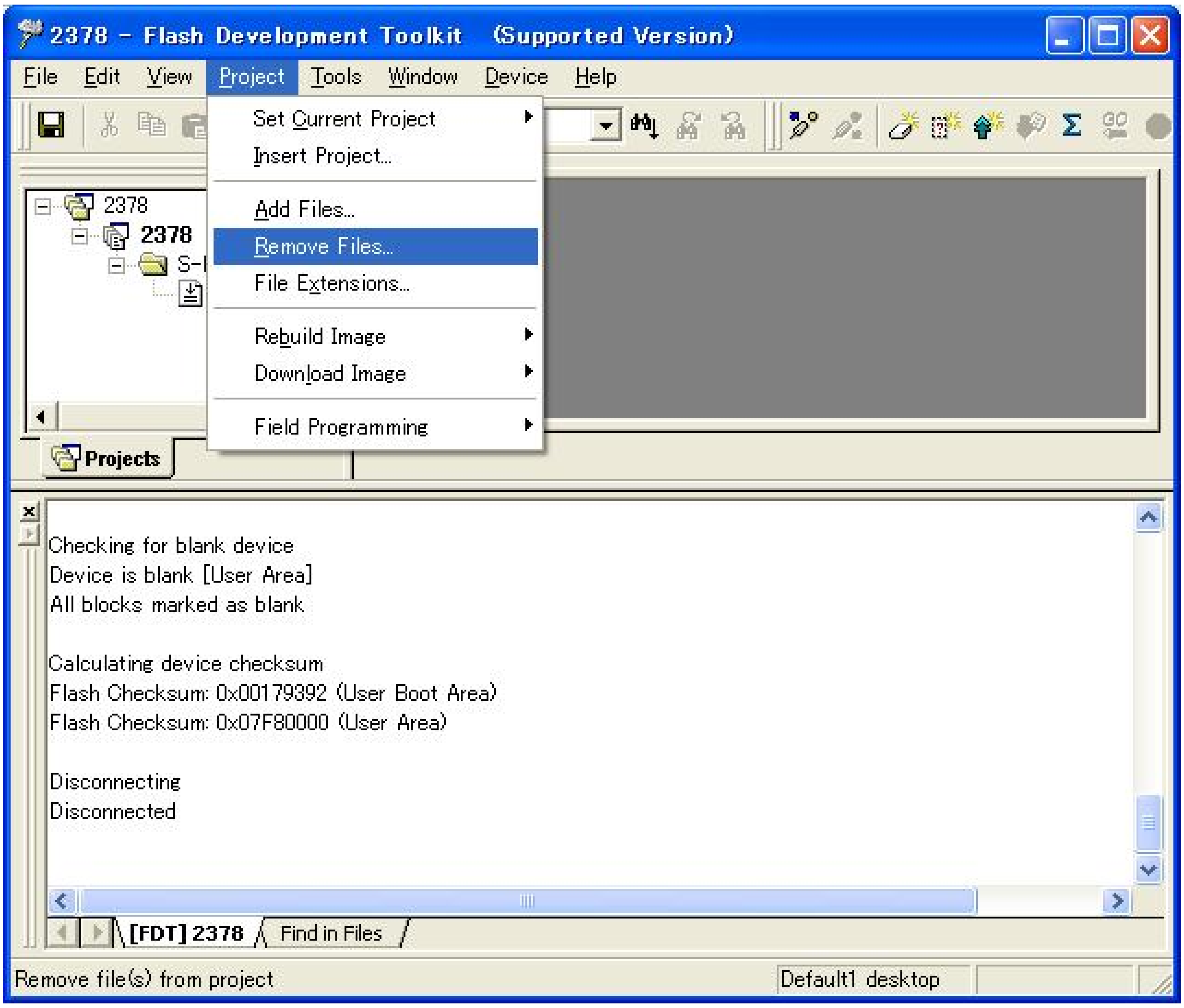

2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

4.3.6 Removing a File

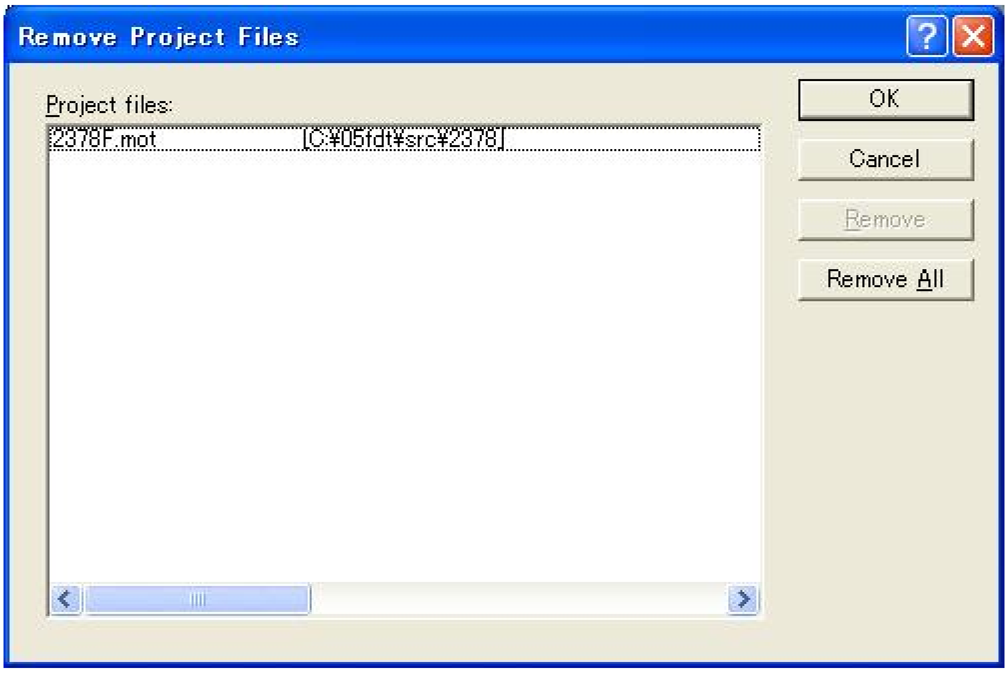
Remove a file.

Click "Project" to open the pull-down menu and click "Remove Files...."



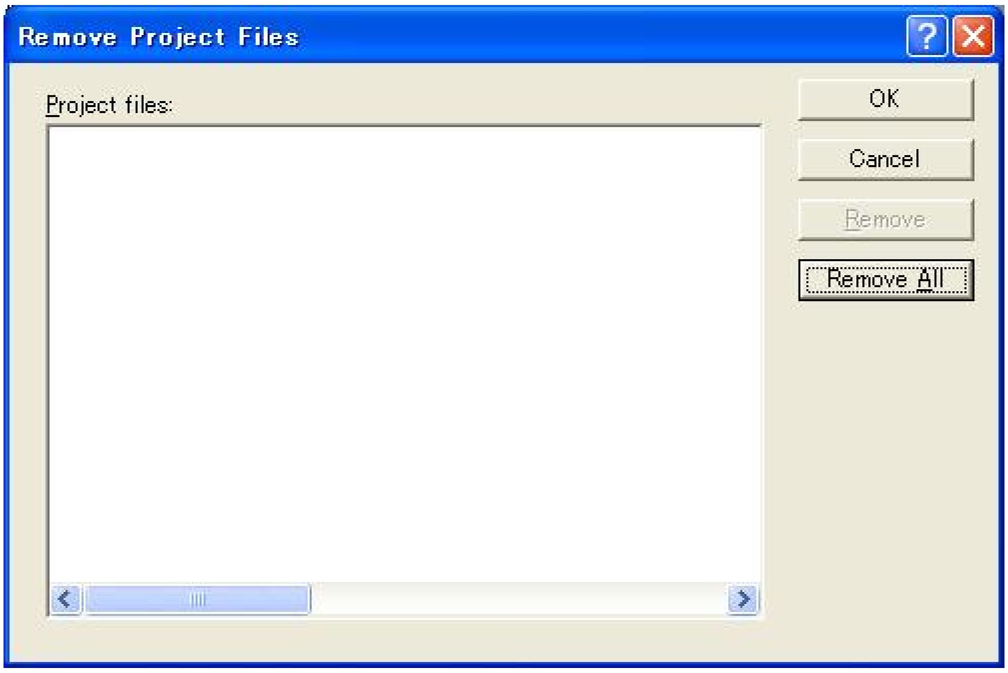
```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

The file is displayed.



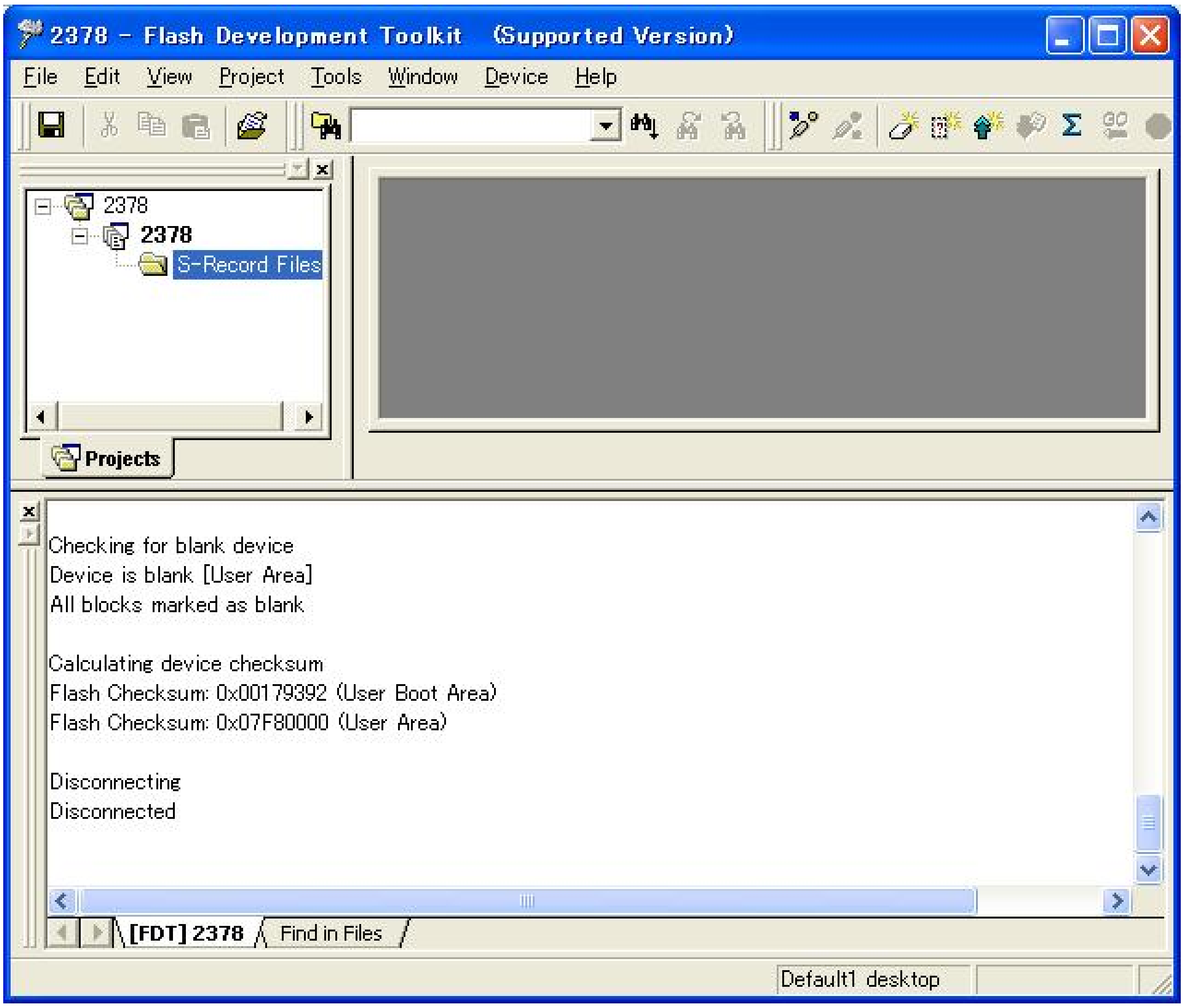
2378F.mot [C:¥05fdt¥src¥2378]

Click "Remove All."



Click "OK."

The file is removed.

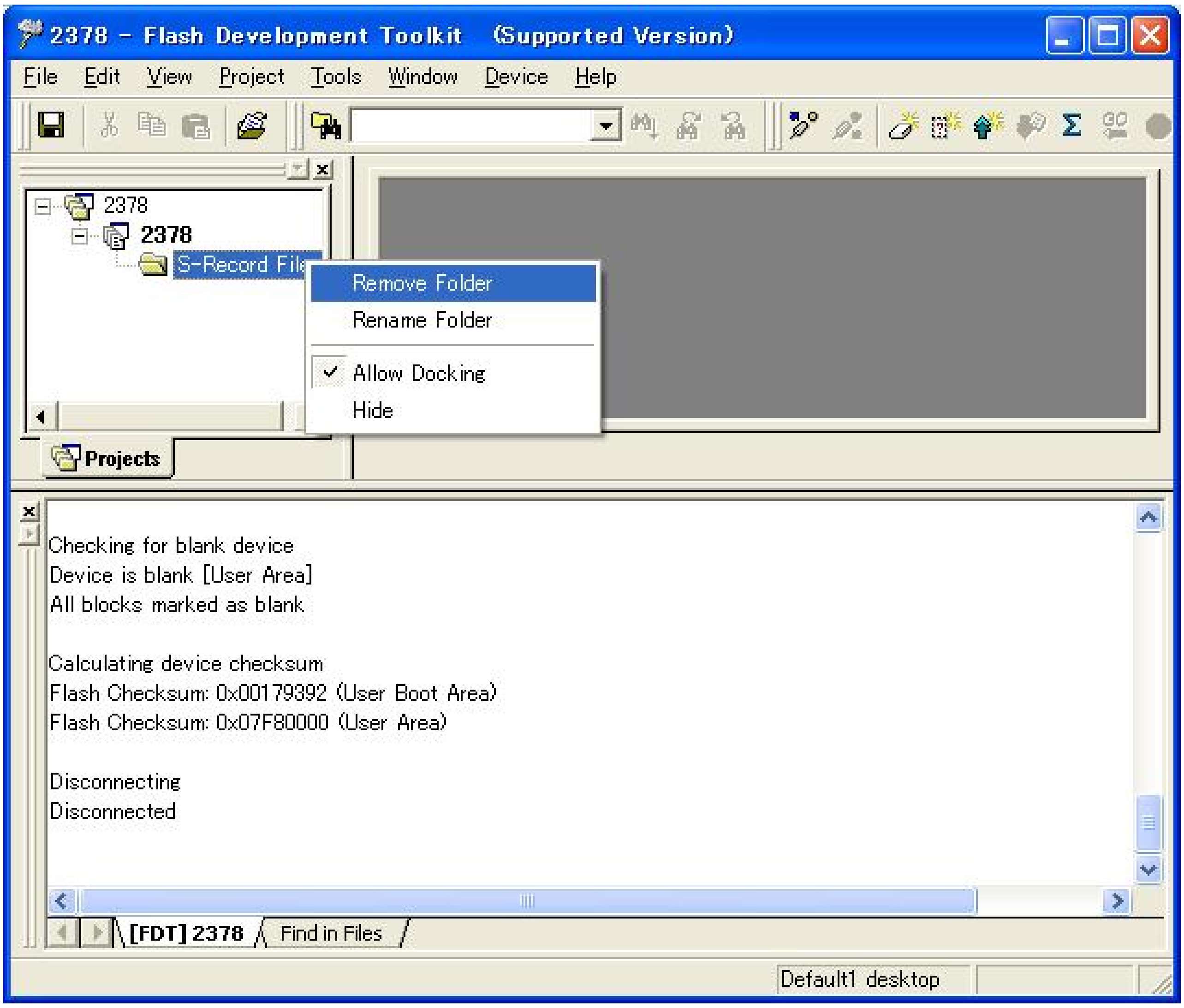

2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
S-Record Files
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

4.3.7 Removing a Folder

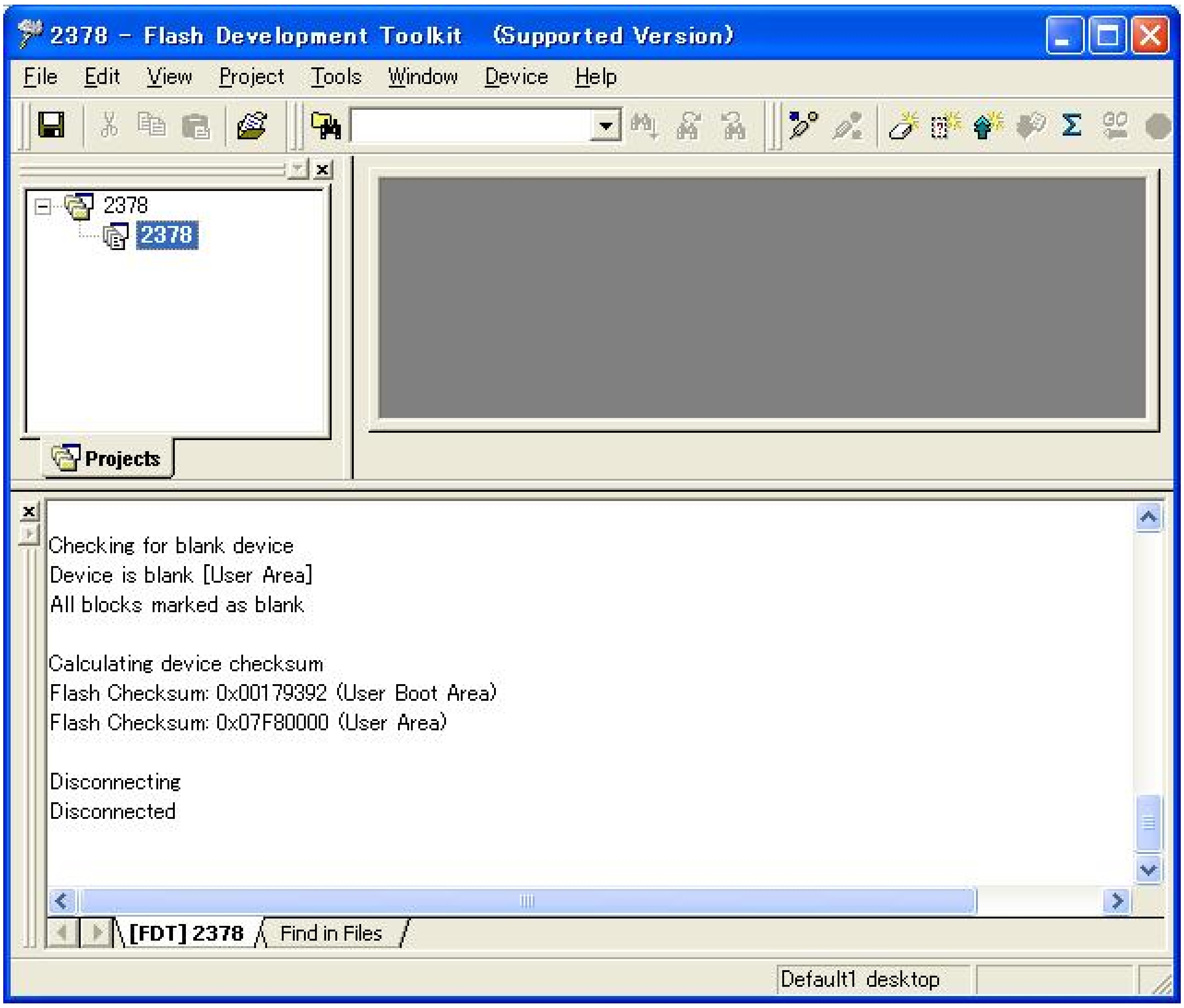
Remove a folder.

Click the right mouse button on a folder to display the pop-up menu and click "Remove Folder."



```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

The folder is removed.

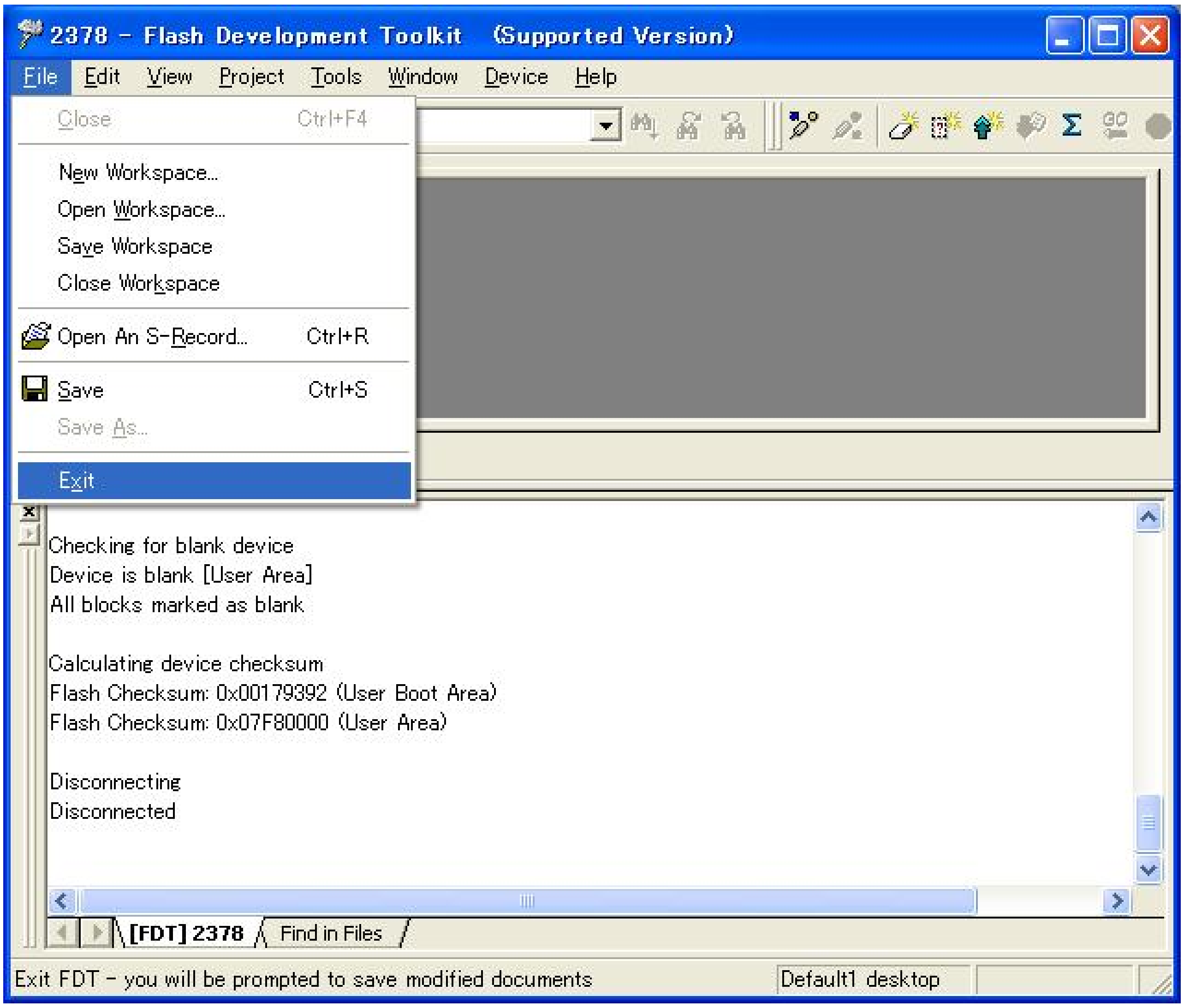

2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

4.3.8 Exiting

Save the work folder and exit the Flash Development Toolkit.

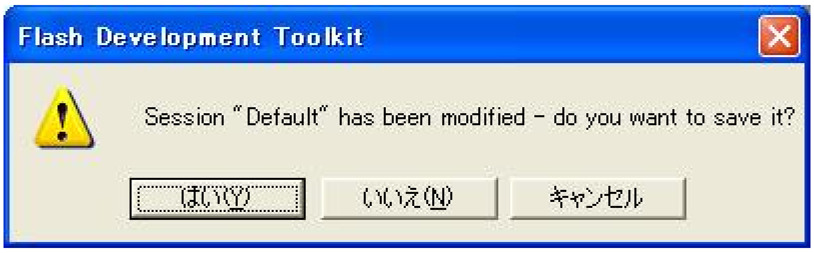
Click "File" to open the pull-down menu and click "Exit."


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Close Ctrl+F4
New Workspace...
Open Workspace...
Save Workspace
Close Workspace
Open An S-Record... Ctrl+R
Save Ctrl+S
Save As...
Exit
[FDT] 2378
Find in Files

```
Checking for blank device
Device is blank [User Area]
All blocks marked as blank

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

Exit FDT - you will be prompted to save modified documents   Default1 desktop

Choose to save the session.



Session "Default" has been modified - do you want to save it?

Click "Yes."

The Flash Development Toolkit terminates operation.

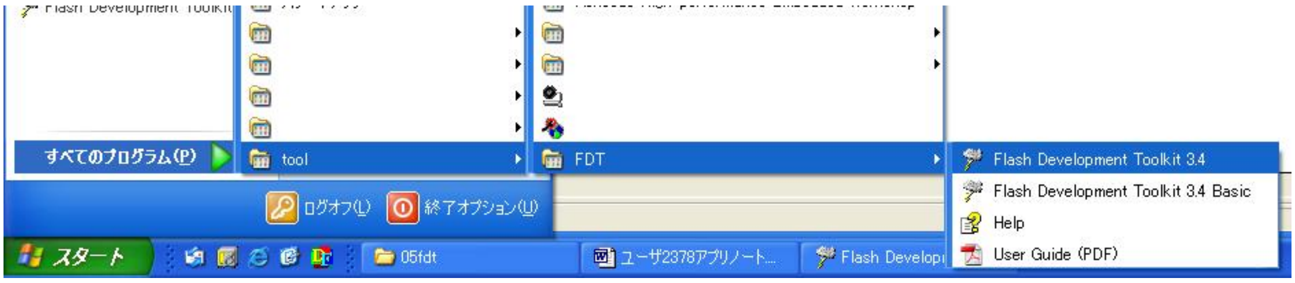
The work file space of the Flash Development Toolkit is saved as file 2378.AWS.

4.4 Boot Mode 2 (Programming the User Area)

Write a program in the user area in the boot mode. The same program as used in section 4.3, Boot Mode 1 (Programming the User Boot Area) is to be written. In this section, the saved work file space file (2378.AWS) is used to start the Flash Development Toolkit.

4.4.1 Starting the Flash Development Toolkit

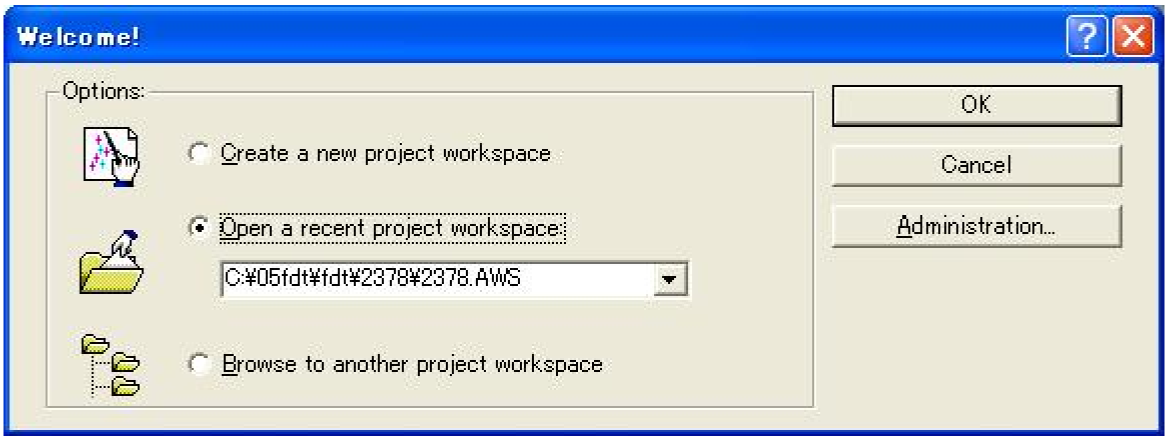
From the "All Programs" menu, select "Flash Development Toolkit 3.4."



4.4.2 Selecting an Option

The "Welcome" screen of the Flash Development Toolkit appears.

Select "Open a recent project workspace" and project workspace file 2378.AWS.


Welcome!

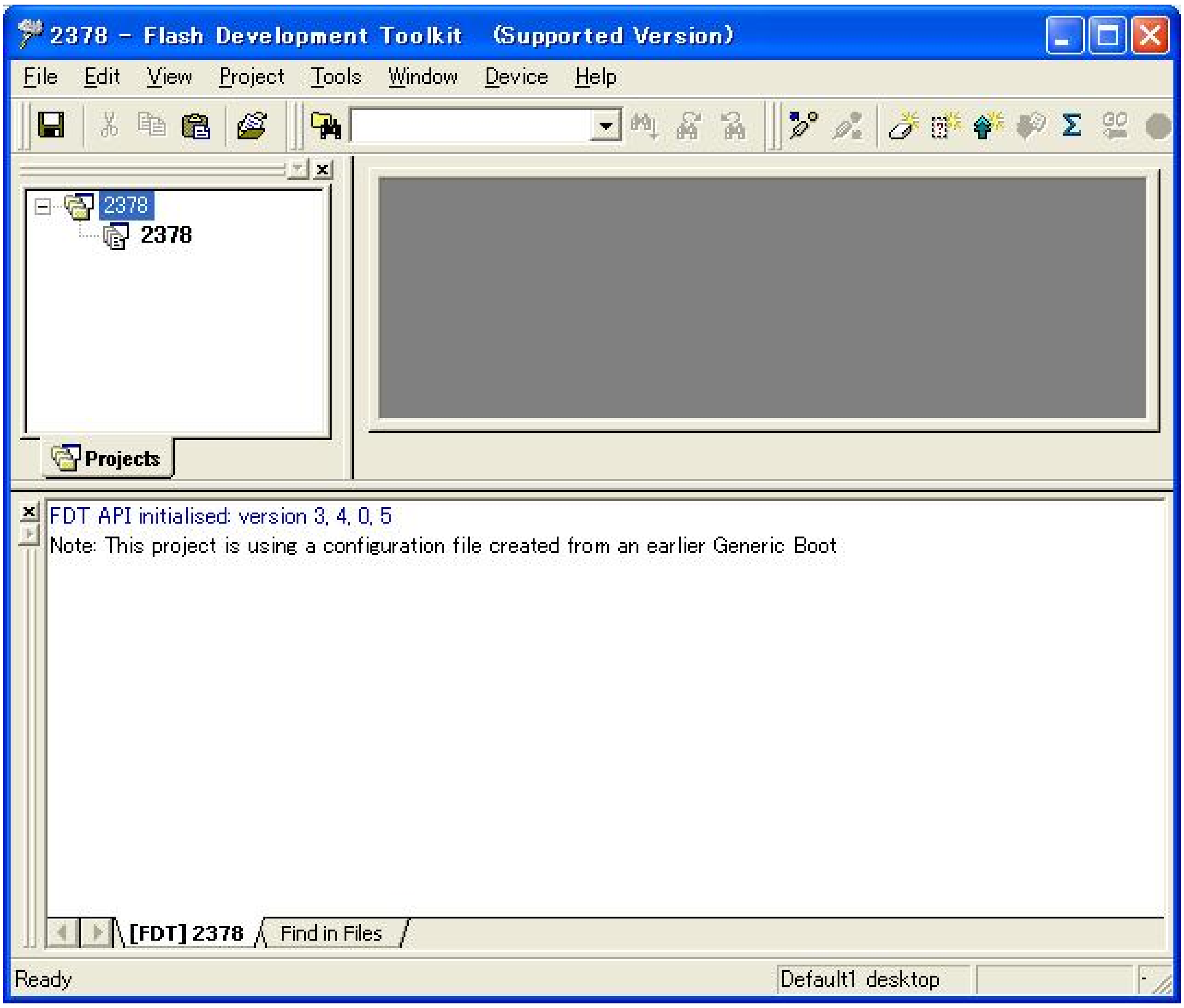
Options:

Create a new project workspace [✓ Open a recent project workspace:] Browse to another project workspace

C:¥05fdt¥fdt¥2378¥2378.AWS

When you have selected the file, click "OK."

Project 2378 is displayed.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
Projects
[FDT] 2378
Find in Files
Ready
Default1 desktop

FDT API initialised: version 3, 4, 0, 5
Note: This project is using a configuration file created from an earlier Generic Boot

The Flash Development Toolkit can also be started by directly opening (or double-clicking on) project workspace file 2378.AWS.

4.4.3 Connecting the Device

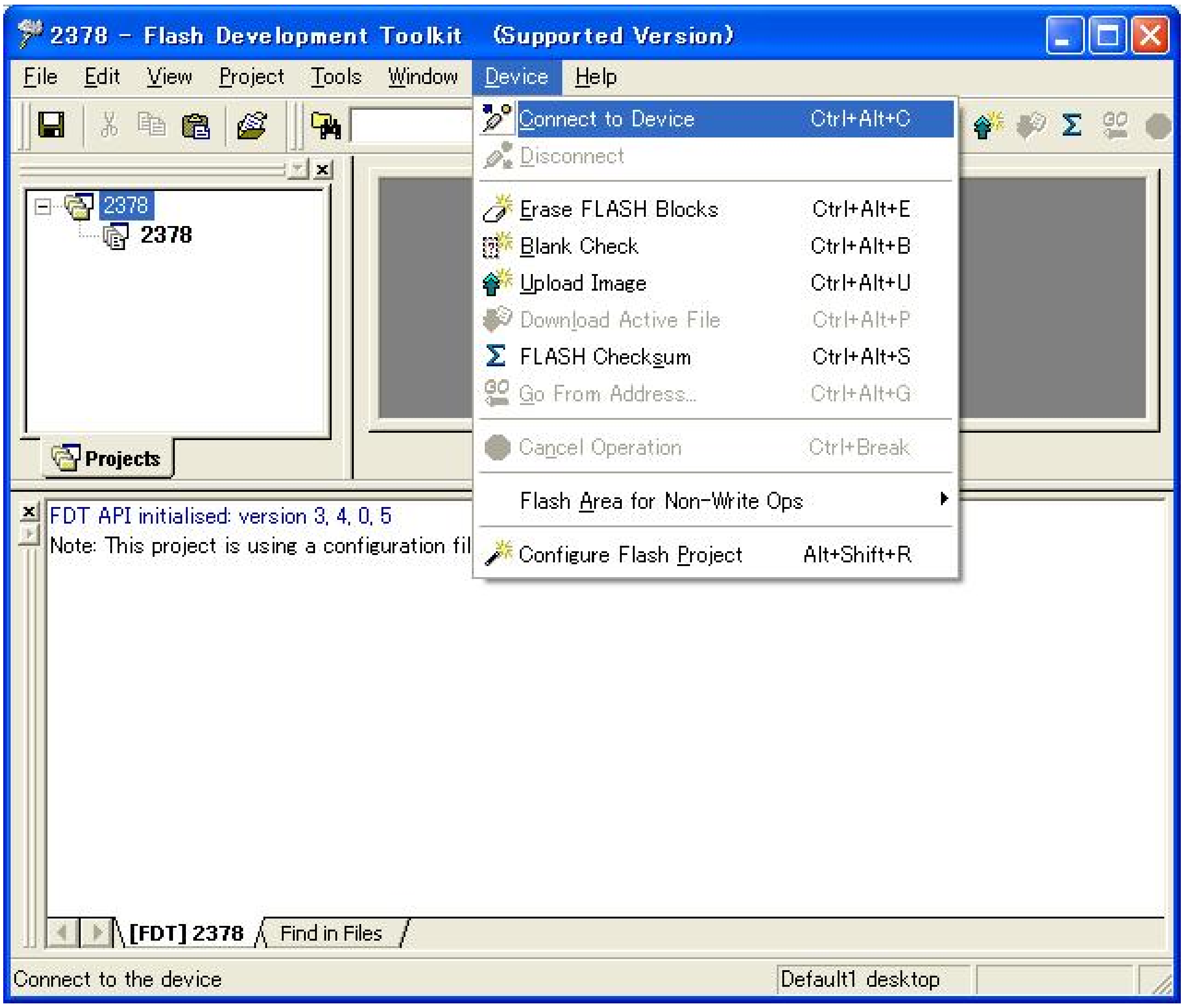
Connect the USB adapter board (FDM) to a PC and the H8S/2378F board to the adapter board and set the H8S/2378F board in the boot mode. To select the boot mode (mode 3), use DIP switch 6. Set DIP switch 6 as follows.

Table 4-5 Operating Mode Setting

MCU Operating Mode	CPU Operating Mode	Jumper	FWE	MD2	MD1	MD0	SCI Switch
		J15	FWx (Pin 3) on the Adapter Board	SW6-3	SW6-2	SW6-1	MD2 (Pin 9) on the Adapter Board
3	Boot mode	1 (Open)	1 (Output 1)	0 (ON)	1 (OFF)	1 (OFF)	0 (Output 0)

When you have set the pins, turn on the power.

After connection is complete, click "Device" to open the pull-down menu and click "Connect to Device."

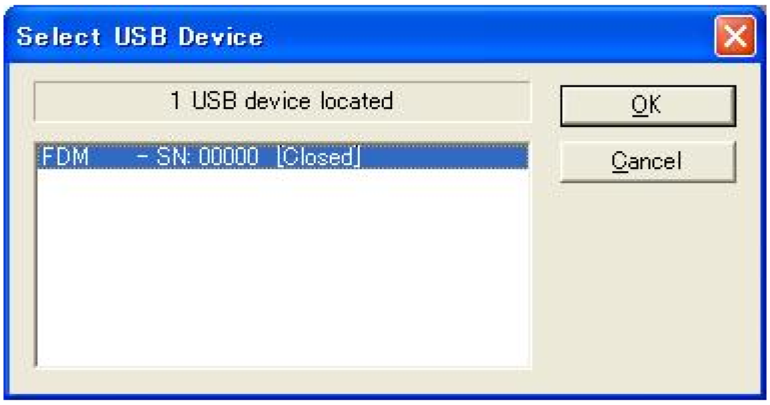

2378 - Flash Development Toolkit (Supported Version)
File
Edit
View
Project
Tools
Window
Device
Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
2378
2378
Projects
[FDT] 2378
Find in Files
Default1 desktop

FDT API initialised: version 3, 4, 0, 5
Note: This project is using a configuration fil

Connect to the device

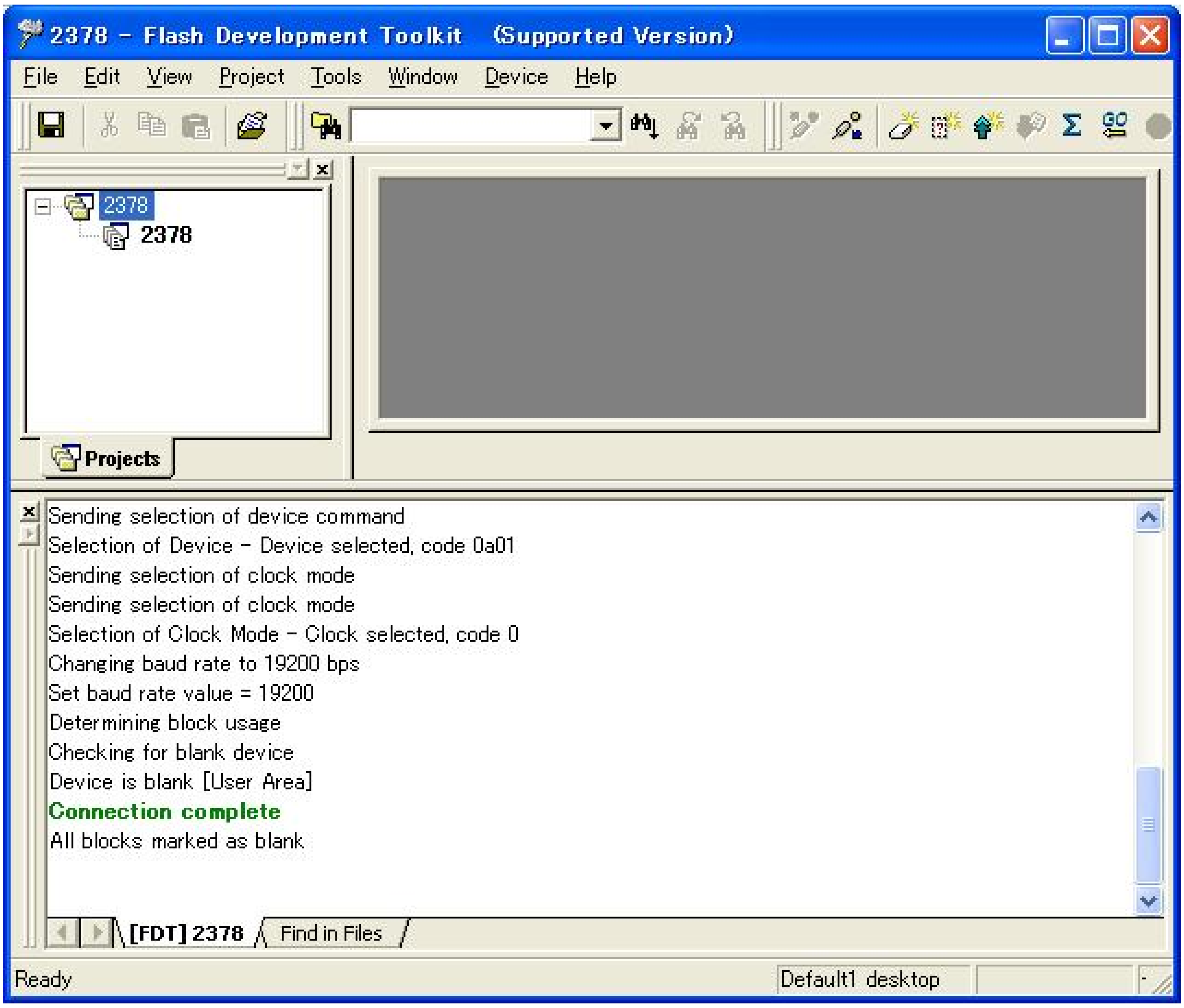
Note: Do not operate the mode switches during CPU operation. Be sure to operate the FWE and MD pins after turning off the power to the board or while pressing the RESET button.

Select the adapter board (FDM).



When you have selected USB device, click "OK."

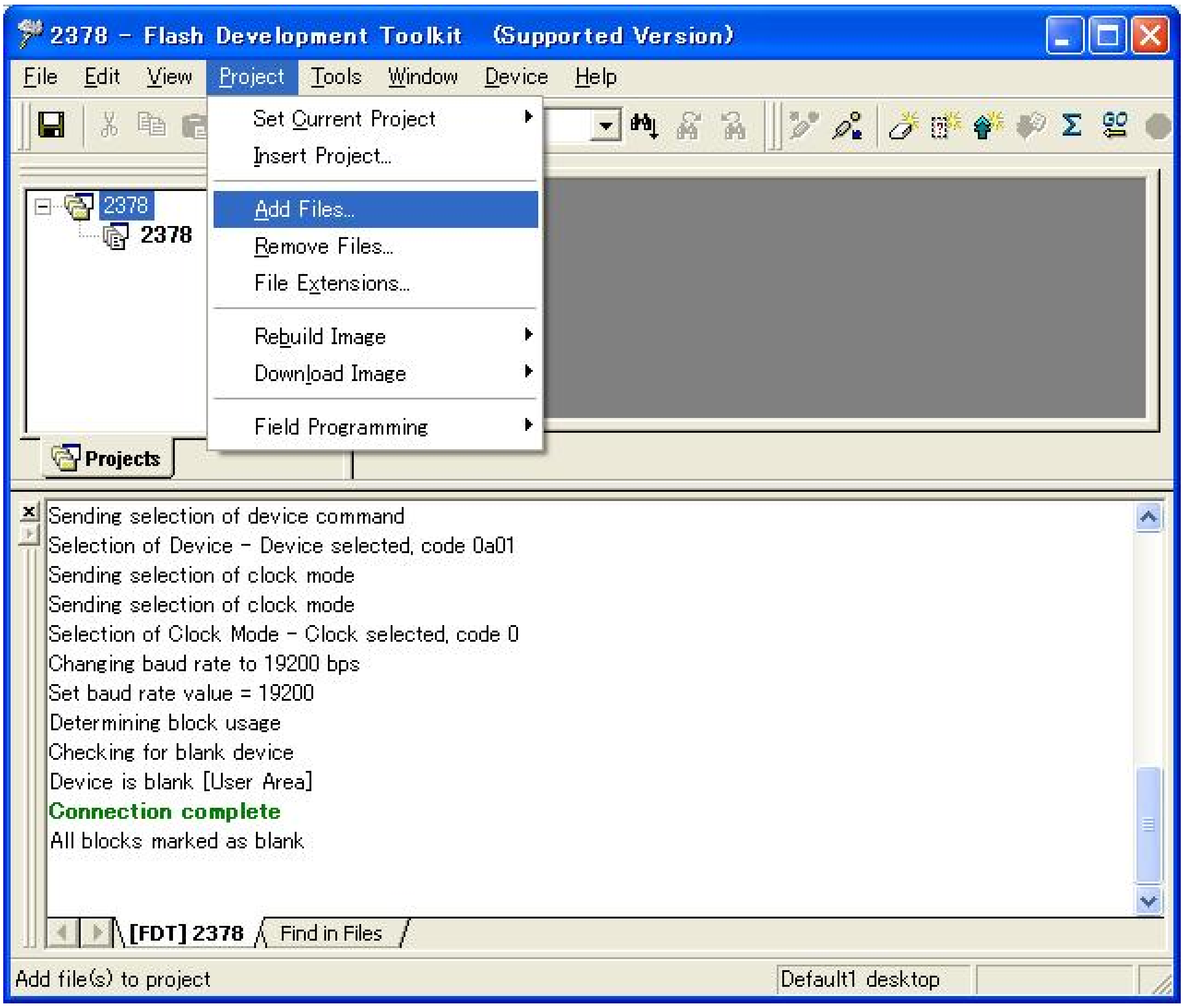
The adapter board is connected.



```
Sending selection of device command
Selection of Device - Device selected, code 0a01
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 19200 bps
Set baud rate value = 19200
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
All blocks marked as blank
```

4.4.4 Selecting a File

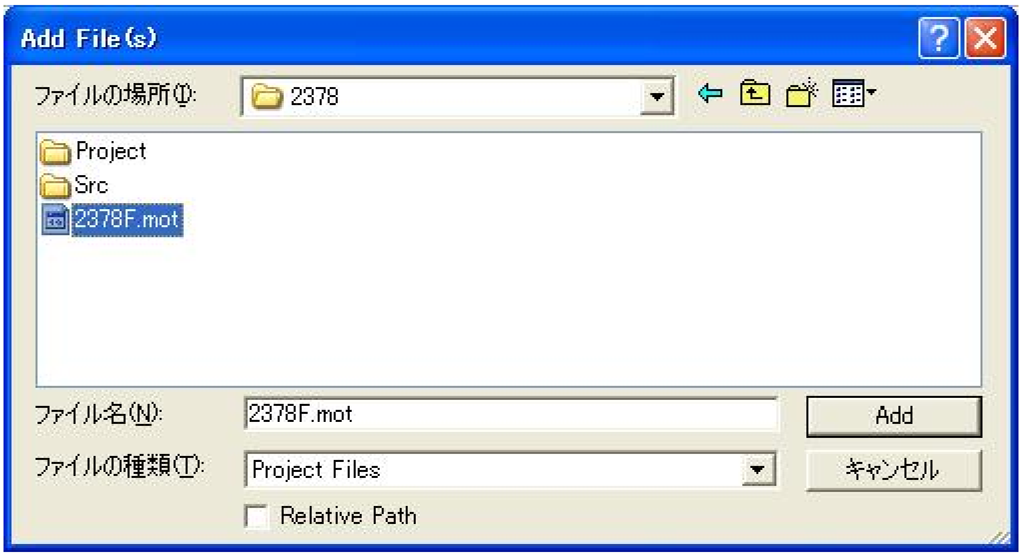
To select a file to be programmed, select "Add Files..." from the "Project" pull-down menu.



```
Sending selection of device command
Selection of Device - Device selected, code 0a01
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 19200 bps
Set baud rate value = 19200
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
All blocks marked as blank
```

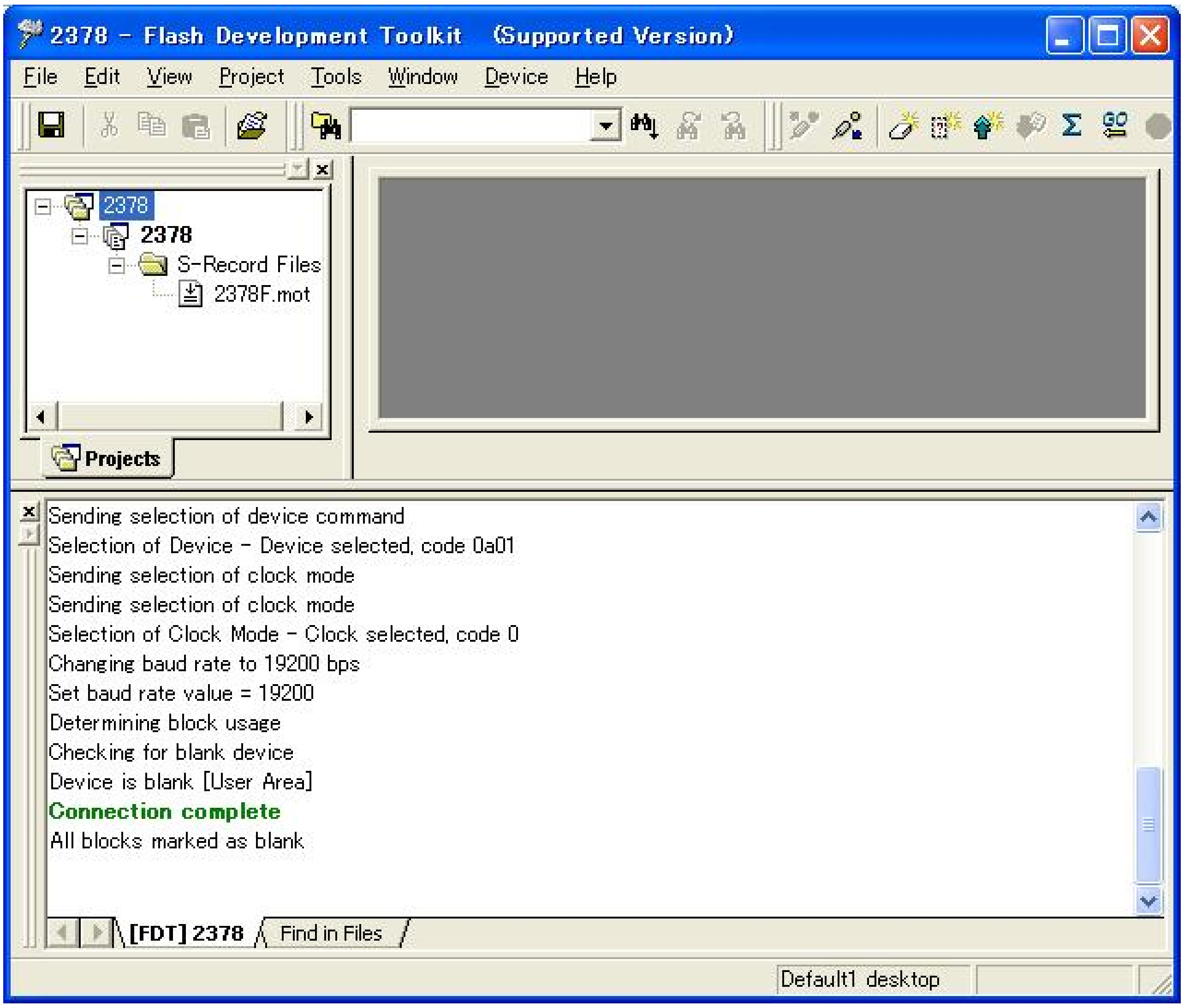
Add file(s) to project

In the "Add File(s)" dialog, add file "2378F.mot."



When you have selected the file, click "Add."

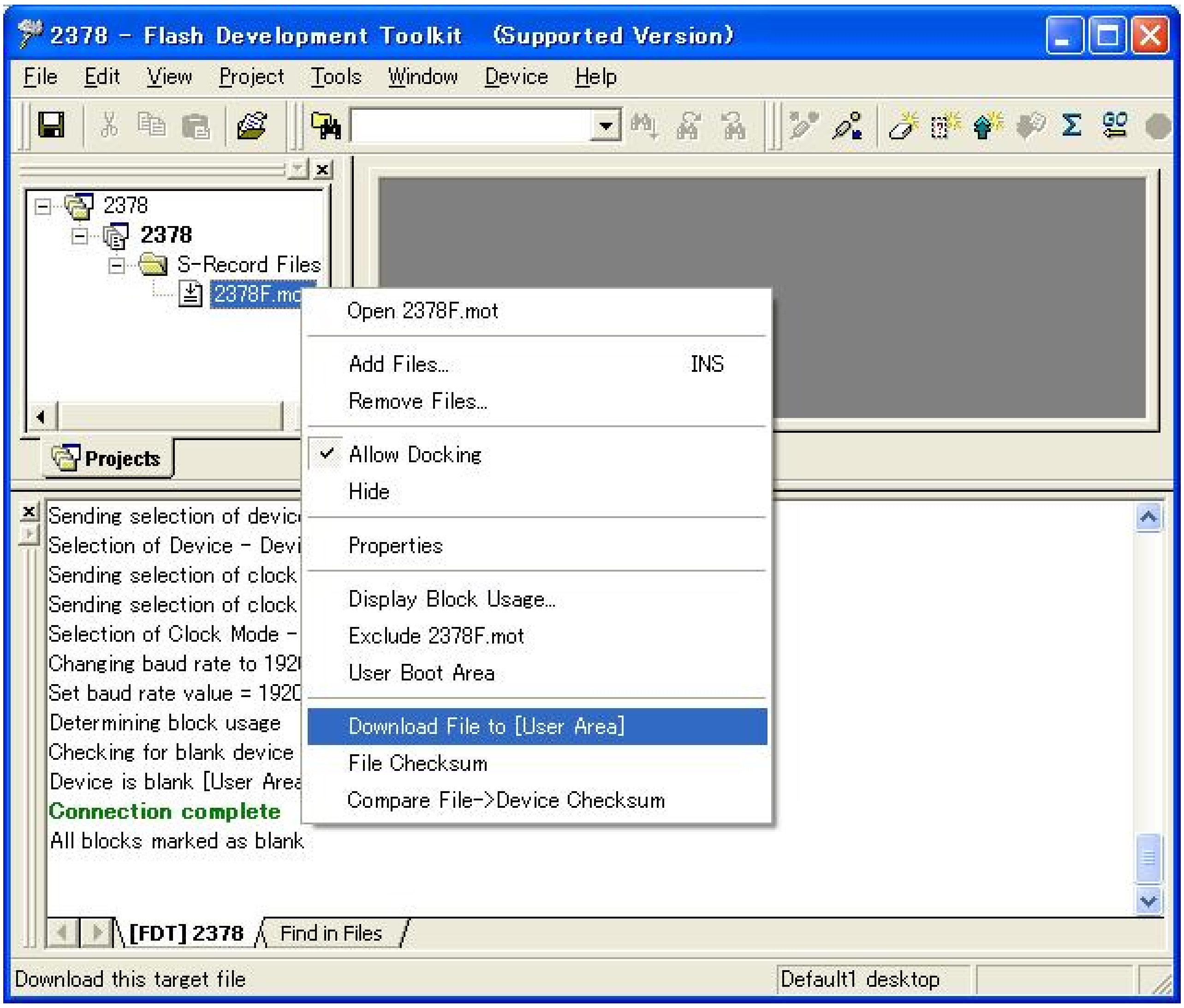
File 2378F.mot is added to the project.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Sending selection of device command
Selection of Device - Device selected, code 0a01
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 19200 bps
Set baud rate value = 19200
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
All blocks marked as blank
```

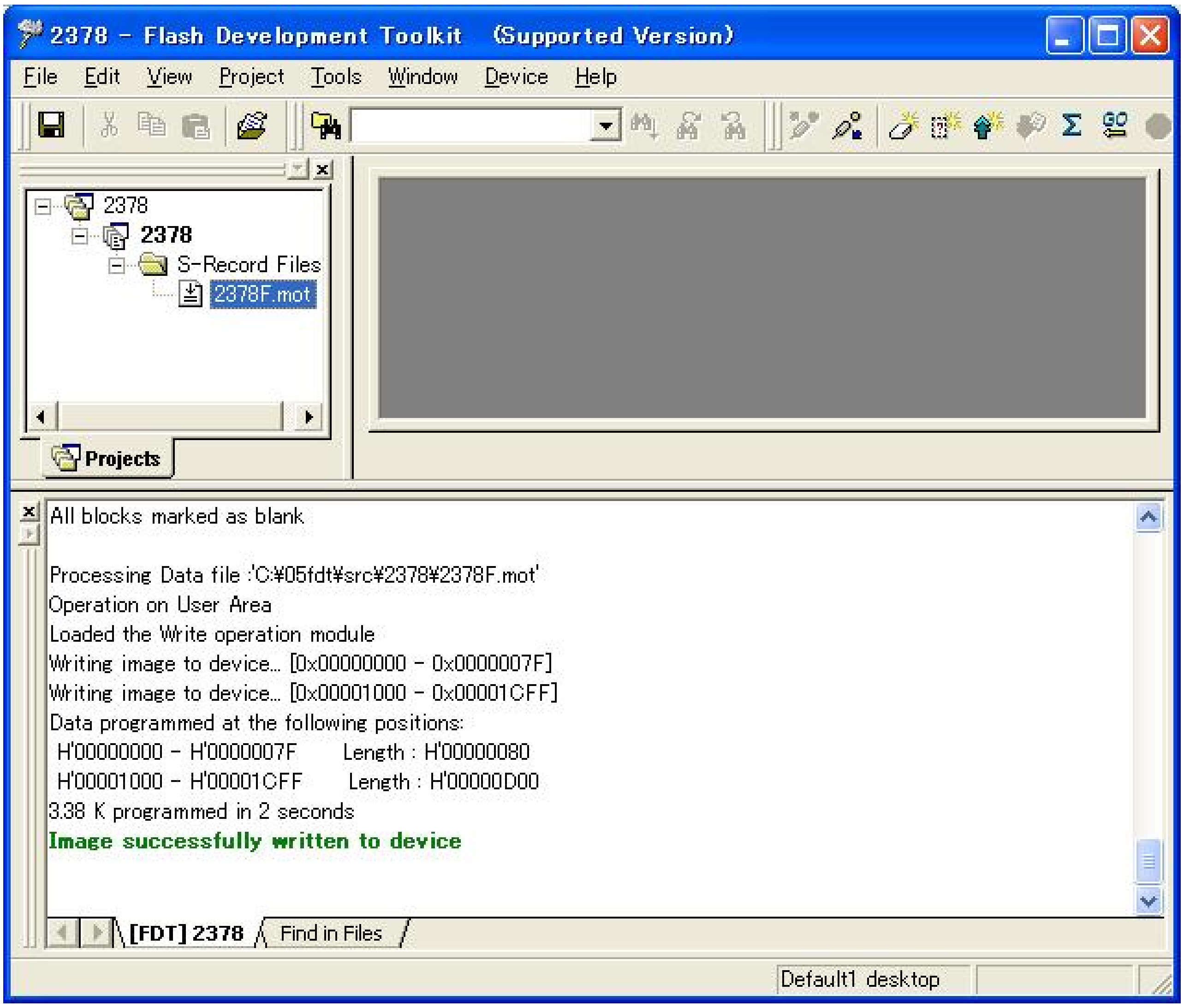
4.4.5 Programming

Click the right mouse button on file 2378F.mot to display the pop-up menu. Click "Download File to [User Area]" to download file 2378F.mot to the user area. The default is "Download File to [User Area]."



```
Sending selection of devic
Selection of Device - Devi
Sending selection of clock
Sending selection of clock
Selection of Clock Mode -
Changing baud rate to 192
Set baud rate value = 192
Determining block usage
Checking for blank device
Device is blank [User Are
Connection complete
All blocks marked as blank
```

You can check that the program has been downloaded to the user area.



```
All blocks marked as blank

Processing Data file :'C:¥05fdt¥src¥2378¥2378F.mot'
Operation on User Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device
```

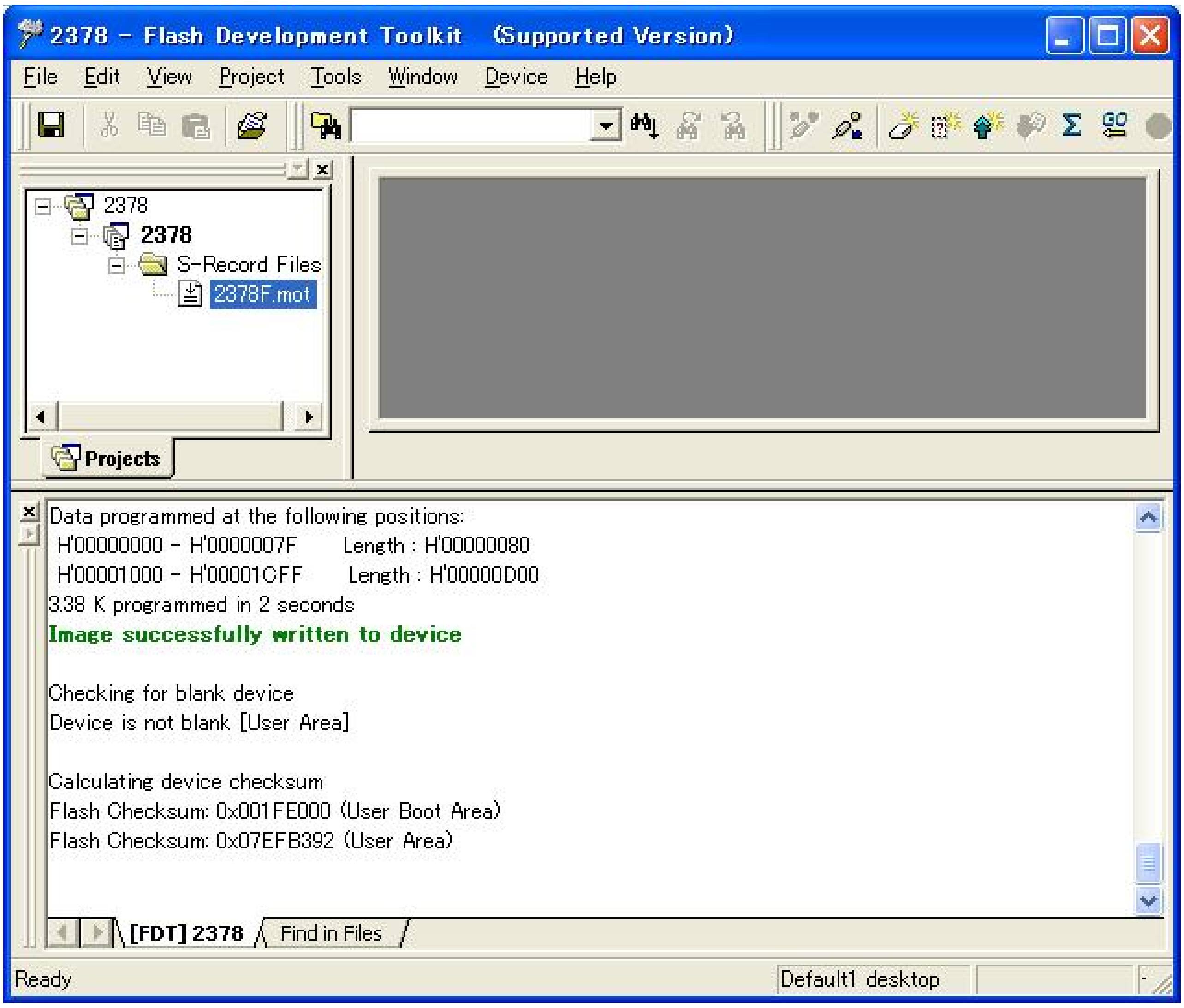
4.4.6 Blank Check and Checksum

To confirm that the user area has been programmed, perform a blank check and calculate a checksum.

Click "Device" to open the pull-down menu and click "Blank Check."

Click "Device" to open the pull-down menu and click "Flash Checksum."

The results of the blank check and checksum calculation are displayed.



```
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Checking for blank device
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x001FE000 (User Boot Area)
Flash Checksum: 0x07EFB392 (User Area)
```

4.5 User Boot Mode

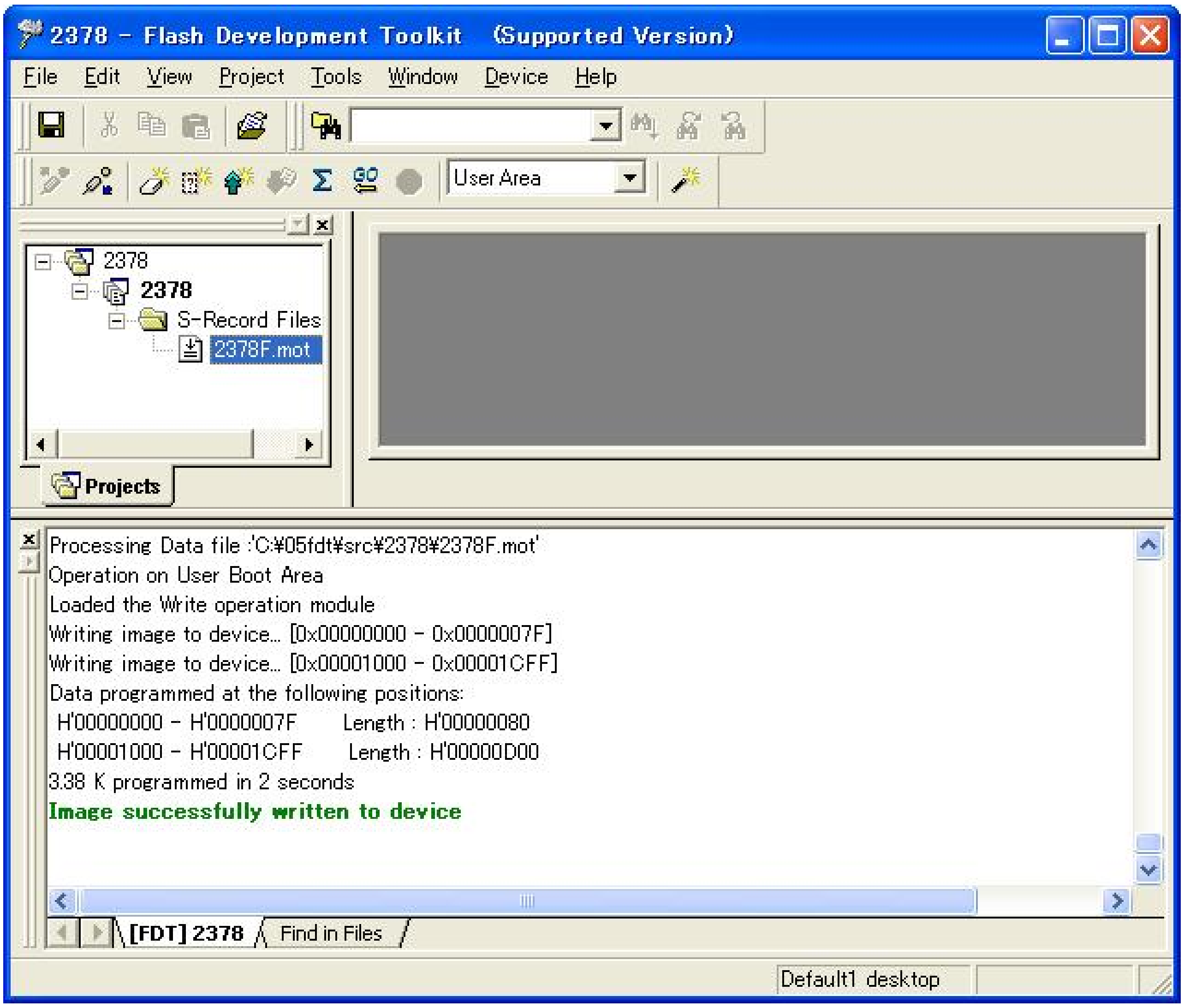
In the user boot mode, the user area can be programmed or erased. The user boot area cannot be programmed or erased.

4.5.1 Writing a Program in the User Boot Area

Start "Flash Development Toolkit 3.4" and open project workspace file 2378.AWS.

Write program file 2378F.mot in the user boot area in the boot mode.

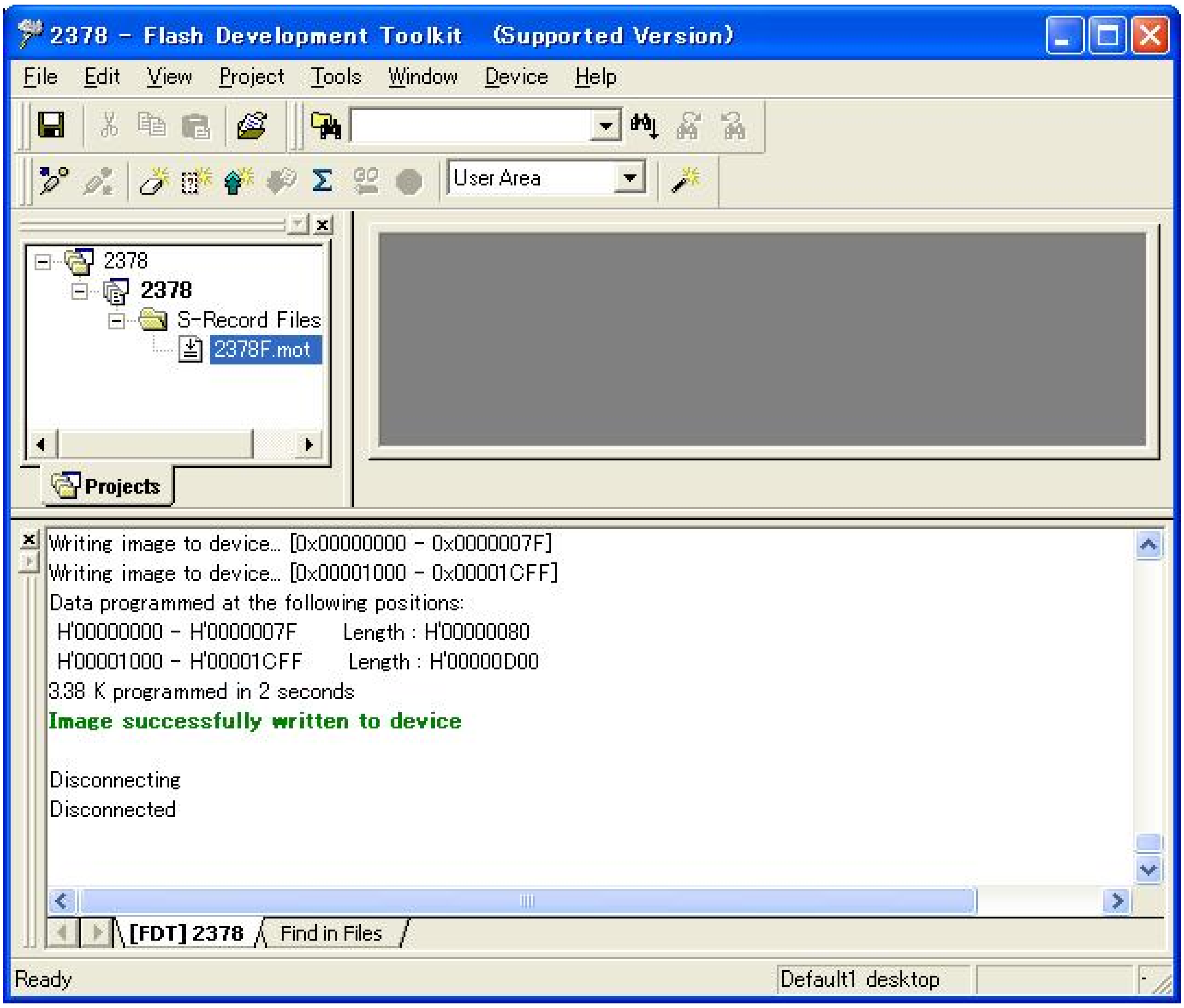
In this sample, toolbar positions are changed to display the Configure Project button.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
User Area
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Default1 desktop

```
Processing Data file :'C:¥05fdt¥src¥2378¥2378F.mot'
Operation on User Boot Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device
```

4.5.2 Disconnecting the Device

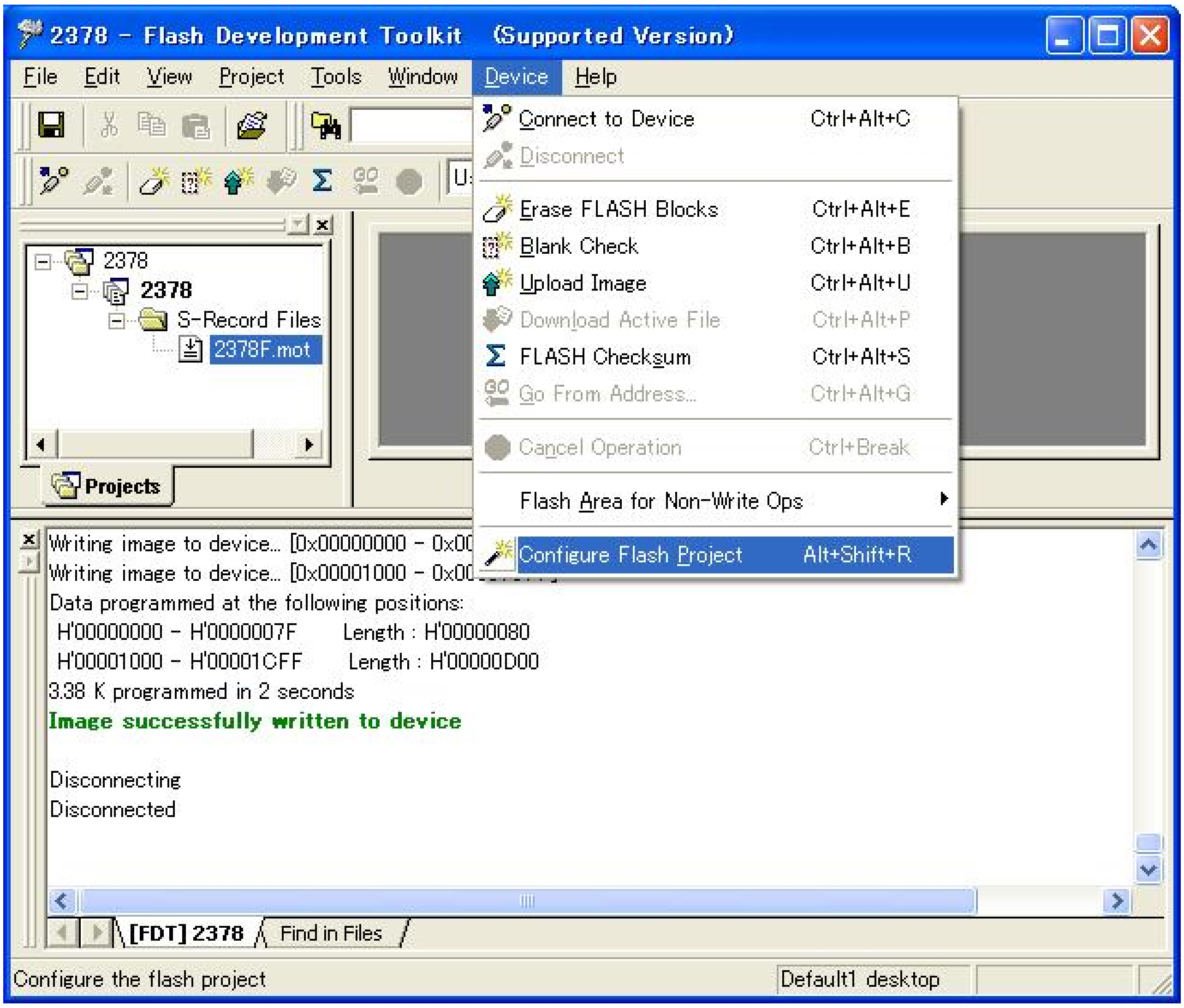
Click "Device" to open the pull-down menu and click "Disconnect."



```
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001CFF]
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

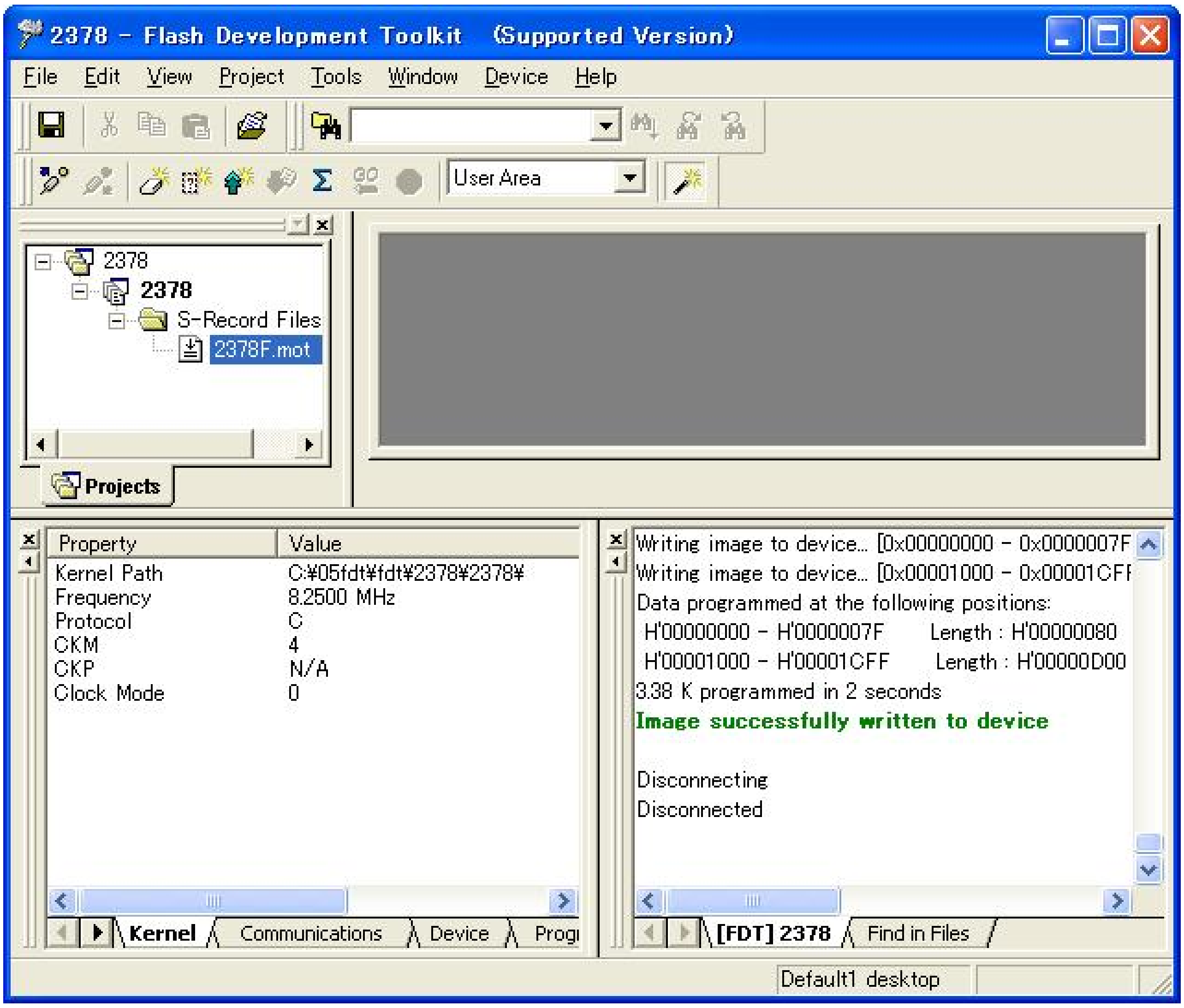
4.5.3 Configuring the Project

Click "Device" to open the pull-down menu and click "Configure Flash Project."


2378 - Flash Development Toolkit (Supported Version)
File
Edit
View
Project
Tools
Window
Device
Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Cancel Operation Ctrl+Break
Flash Area for Non-Write Ops
Configure Flash Project Alt+Shift+R
2378
2378
S-Record Files
2378F.mot
Projects
[FDT] 2378
Find in Files
Configure the flash project
Default1 desktop

```
Writing image to device... [0x00000000 - 0x00
Writing image to device... [0x00001000 - 0x00
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

The configure project window appears.

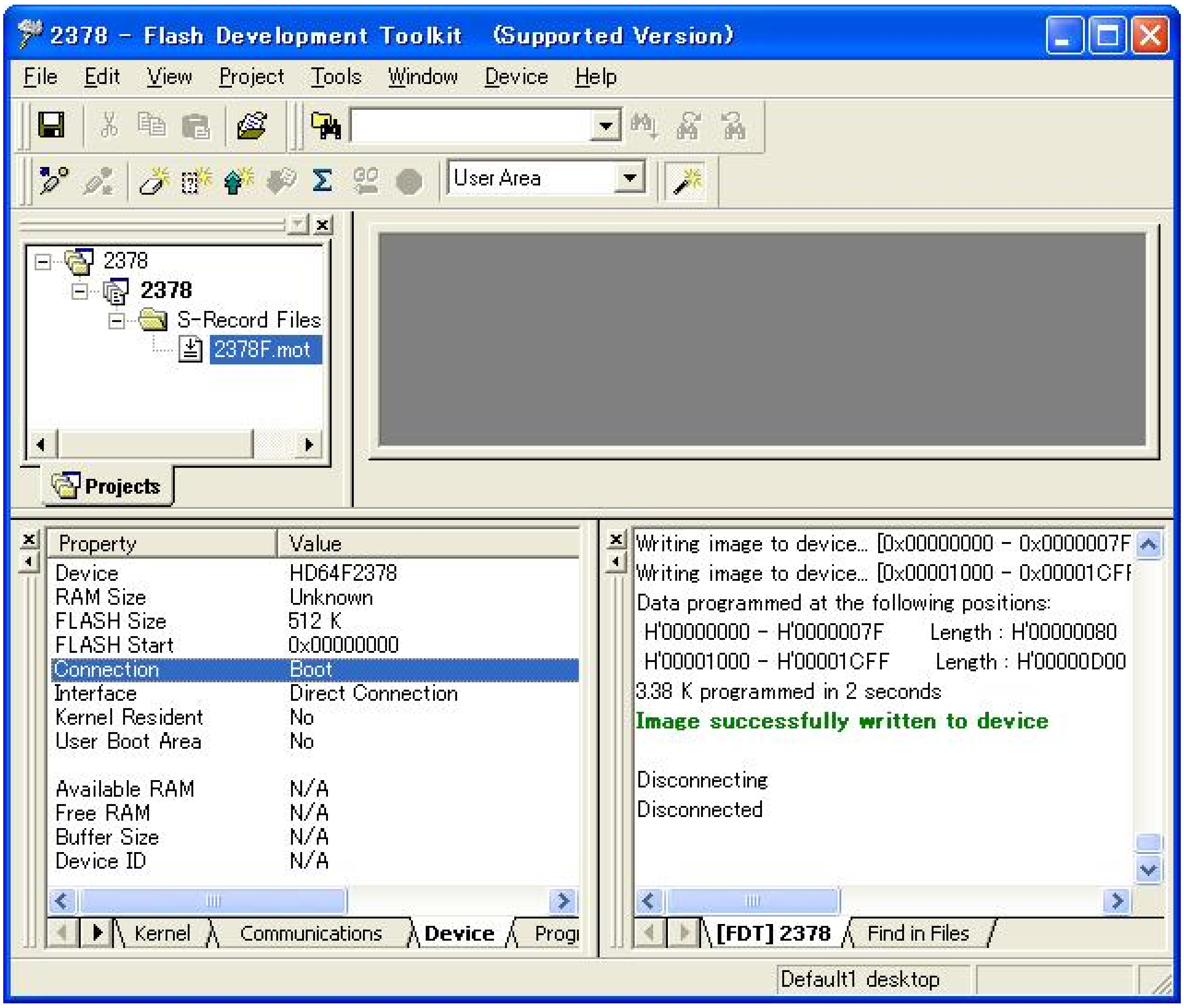

2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
User Area
2378
2378
S-Record Files
2378F.mot
Projects
Kernel Communications Device Progi
[FDT] 2378 Find in Files
Default1 desktop

Property	Value
Kernel Path	C:¥05fdt¥fdt¥2378¥2378¥
Frequency	8.2500 MHz
Protocol	C
CKM	4
CKP	N/A
Clock Mode	0

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

4.5.4 Setting the User Program Mode

Select the "Device" tab in the configure project window and double-click "Connection" and "Boot."


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
User Area
2378
2378
S-Record Files
2378F.mot
Projects
Kernel Communications Device Progr
[FDT] 2378 Find in Files
Default1 desktop

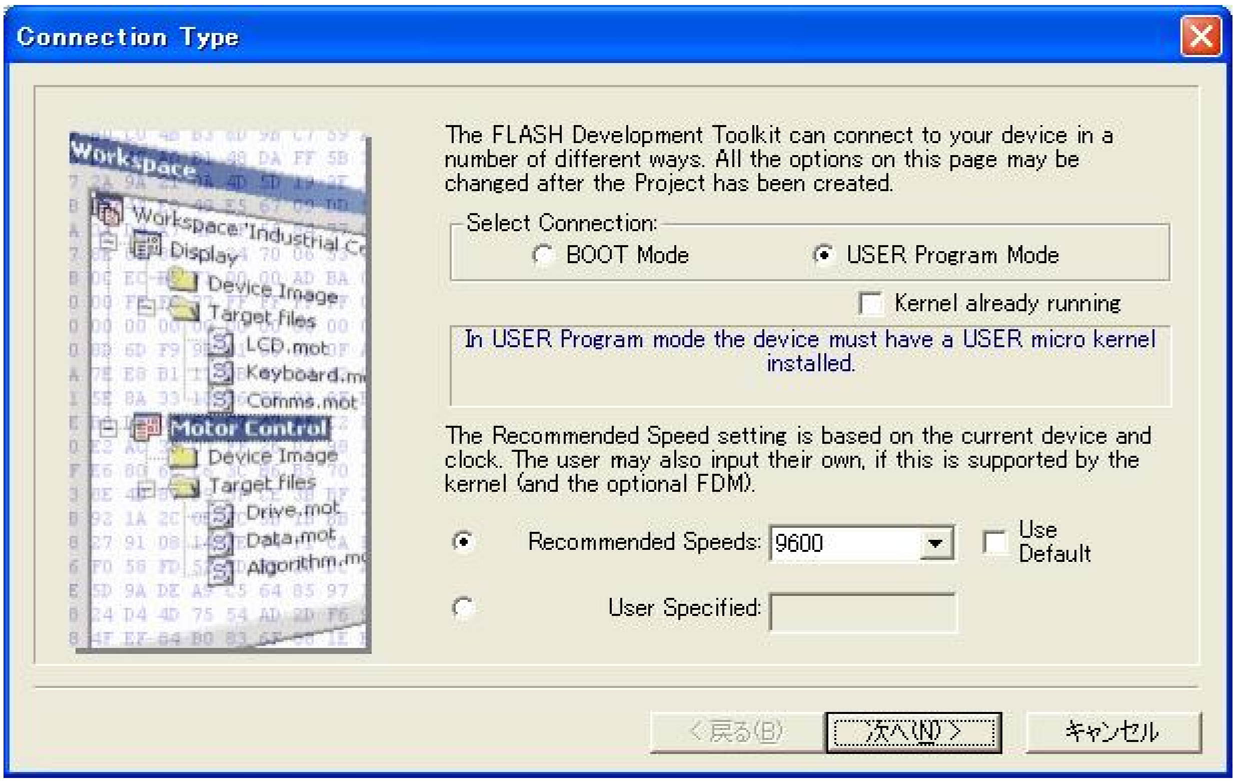
Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	Boot
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	N/A
Free RAM	N/A
Buffer Size	N/A
Device ID	N/A

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

Set the connection type.

Select "USER Program Mode" in "Select Connection:."

Set the baud rate to 9600 bps.



Connection Type

The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection: ( ) BOOT Mode [✓ USER Program Mode]

Kernel already running [ ]

In USER Program mode the device must have a USER micro kernel installed.

The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the optional FDM).

[✓ Recommended Speeds: 9600] Use Default [ ]

( ) User Specified:

When you have set the connection type, click "Next."

Set the pins on the adapter board (FDM) for the user boot mode.

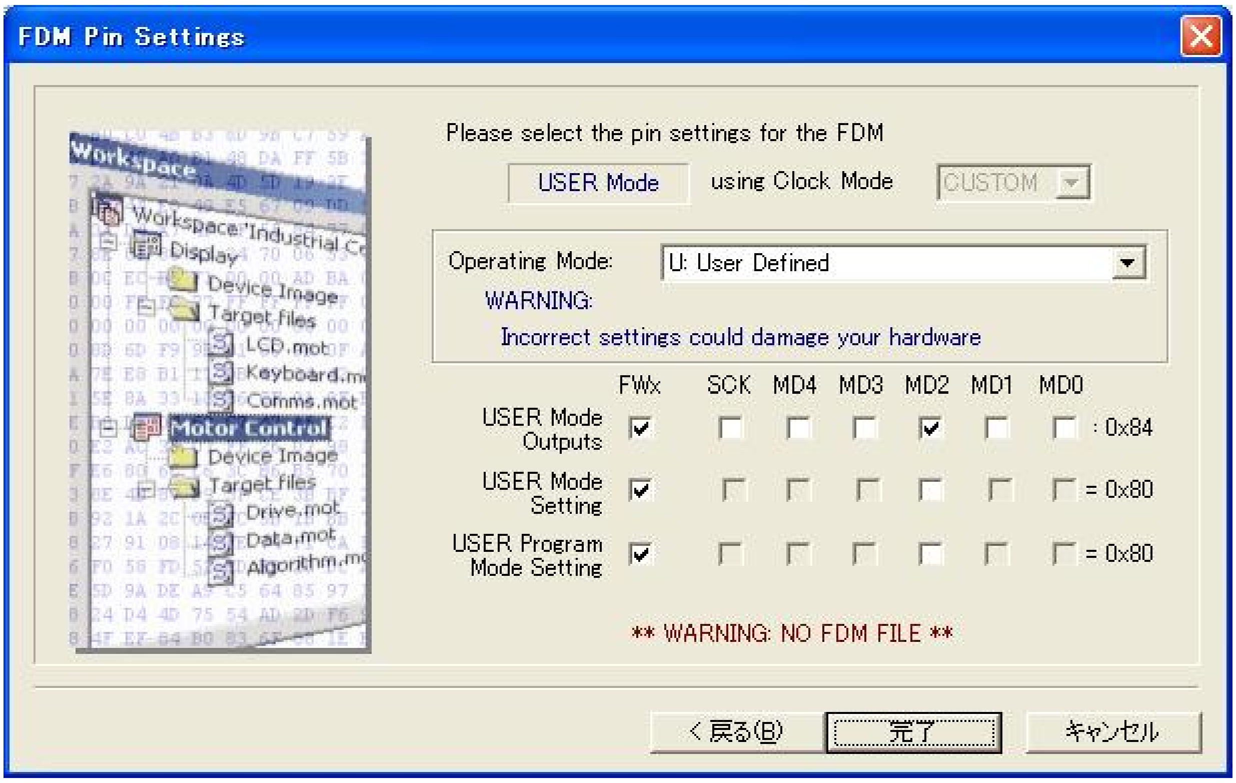
For example, set the output of FWx to high (1) and that of MD2 to low (0).

In this example, the FWx pin outputs 1 for selecting a mode (the jumper is open) and MD2 (IO0) outputs 0 for serial communication connection.

Turn the power off and select the user boot mode (mode 5) using DIP switch 6. When you have set the pins, turn on the power.

Table 4-6 Operating Mode Setting

MCU Operating Mode	CPU Operating Mode	Jumper	FWE	MD2	MD1	MD0	SCI Switch
		J15	FWx (Pin 3) on the Adapter Board	SW6-3	SW6-2	SW6-1	MD2 (Pin 9) on the Adapter Board
5	User boot mode	1 (Open)	1 (Output 1)	1 (OFF)	0 (ON)	1 (OFF)	0 (Output 0)



Please select the pin settings for the FDM

USER Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

WARNING:

Incorrect settings could damage your hardware

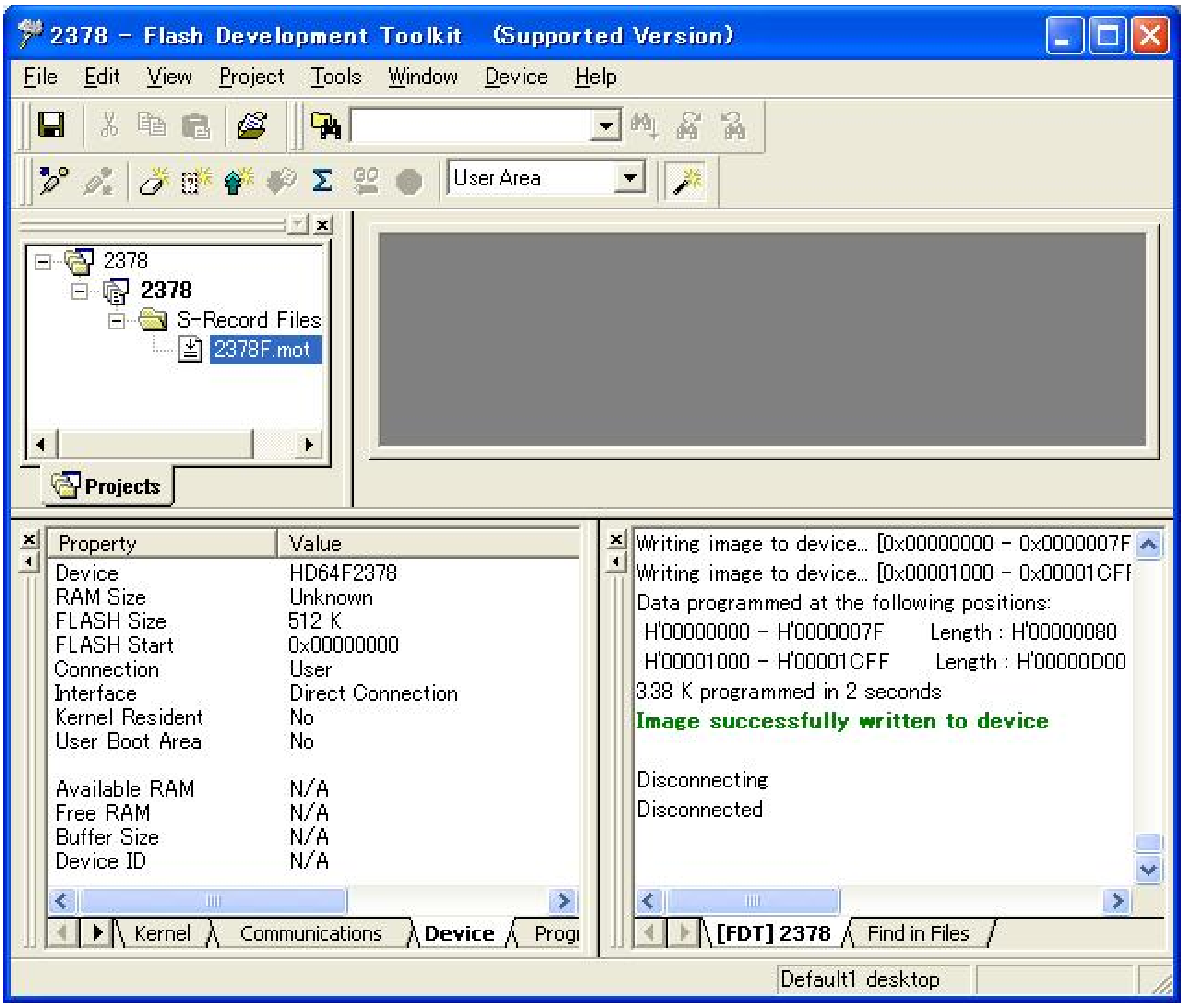
	FWx	SCK	MD4	MD3	MD2	MD1	MD0	
USER Mode Outputs	✓				✓			: 0x84
USER Mode Setting	✓							= 0x80
USER Program Mode Setting	✓							= 0x80

** WARNING: NO FDM FILE **

When you have set the items, click "Finish."

Note: Do not operate the mode switch during CPU operation. Be sure to operate the FWE and MD pins after turning the power to the board off or while pressing the RESET button.

The user boot mode has been set.



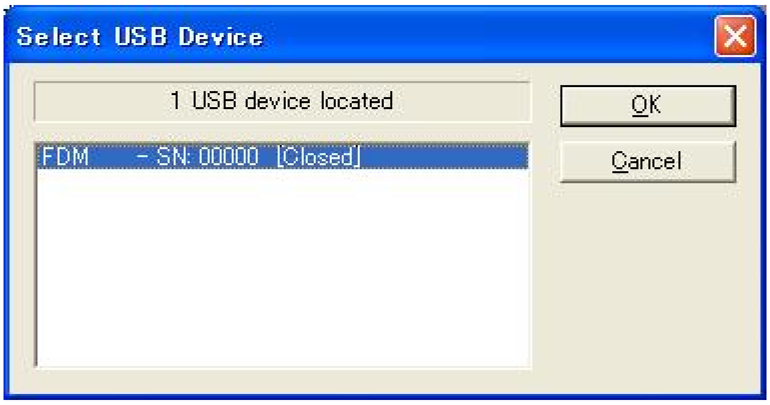
Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	N/A
Free RAM	N/A
Buffer Size	N/A
Device ID	N/A

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

4.5.5 Connecting the Device

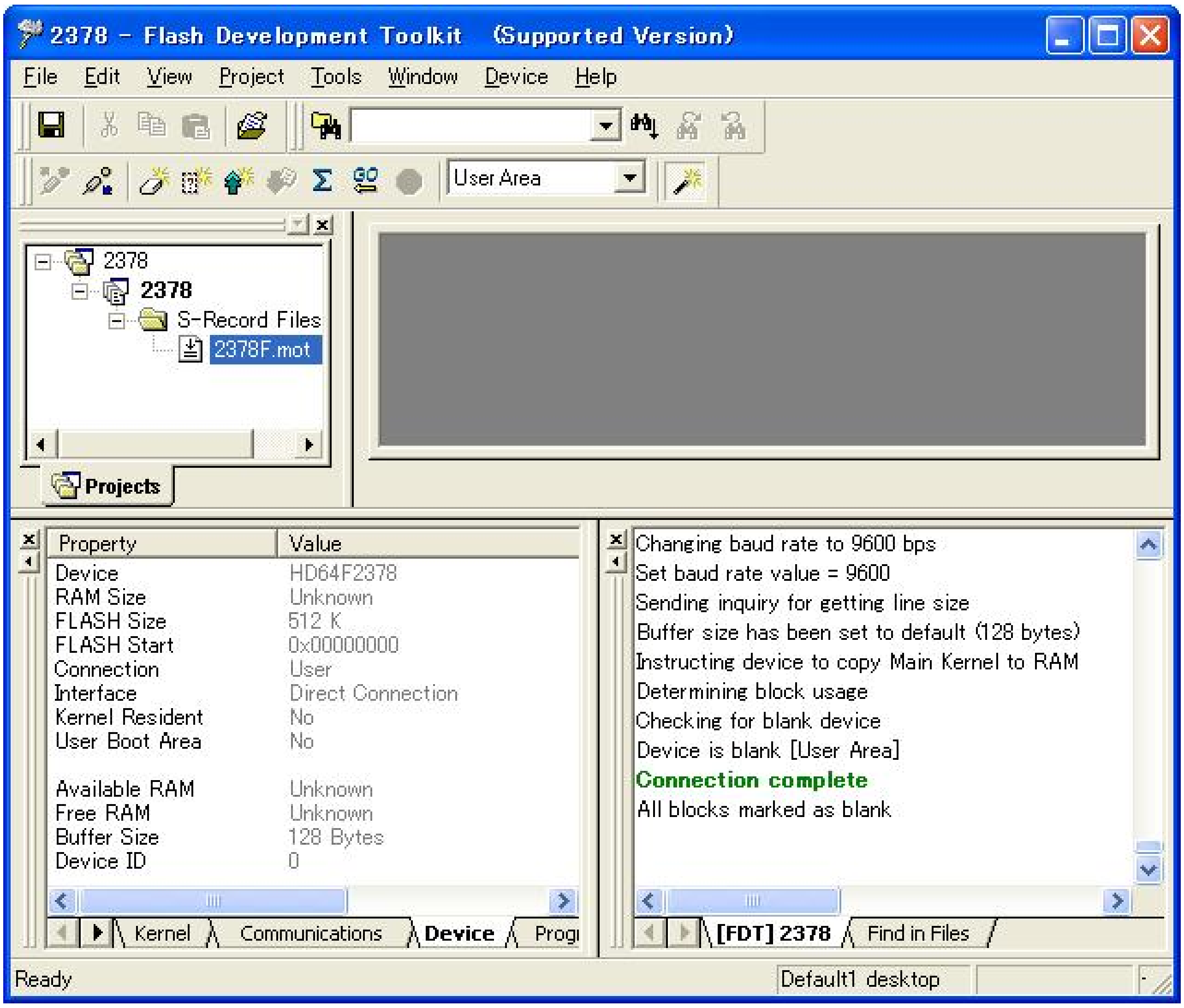
Click "Device" to open the pull-down menu and click "Connect to Device."

Select the adapter board (FDM).



When you have selected the device, click "OK."

The connection in the user boot mode is completed.



Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

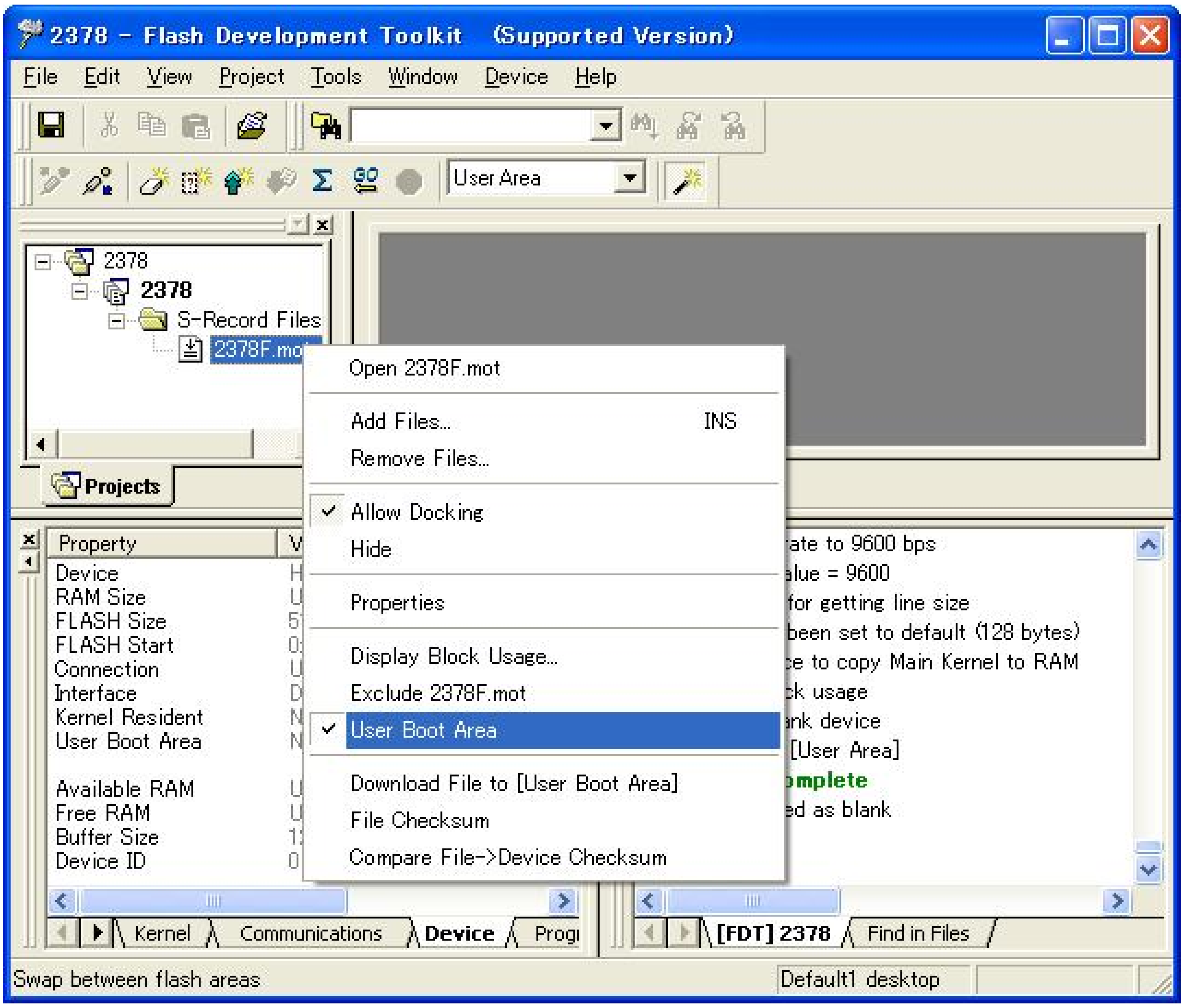
```
Changing baud rate to 9600 bps
Set baud rate value = 9600
Sending inquiry for getting line size
Buffer size has been set to default (128 bytes)
Instructing device to copy Main Kernel to RAM
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
All blocks marked as blank
```

4.5.6 Programming

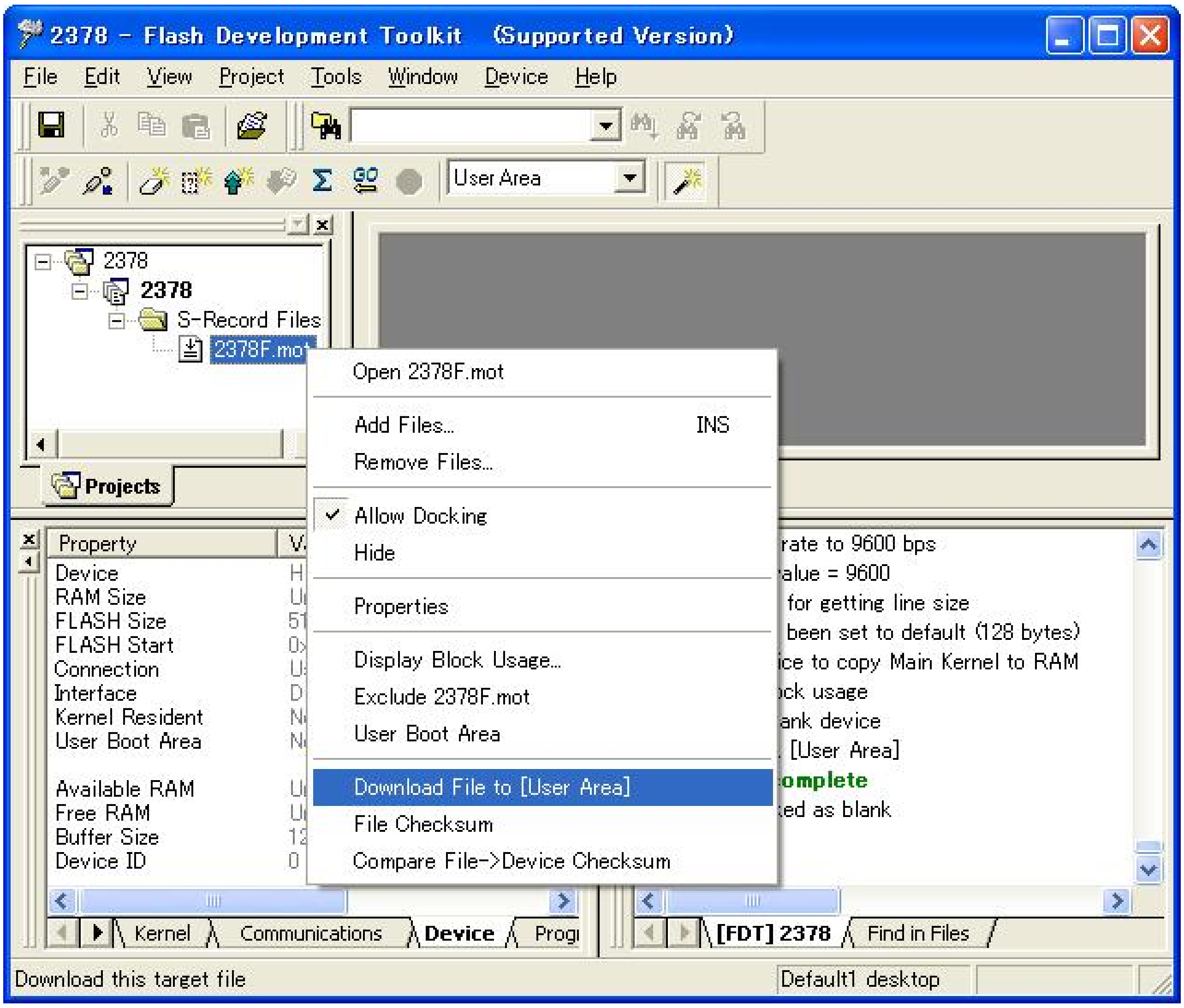
Write a program in the user area in the user boot mode.

To program a file in the user area, specify a download area.

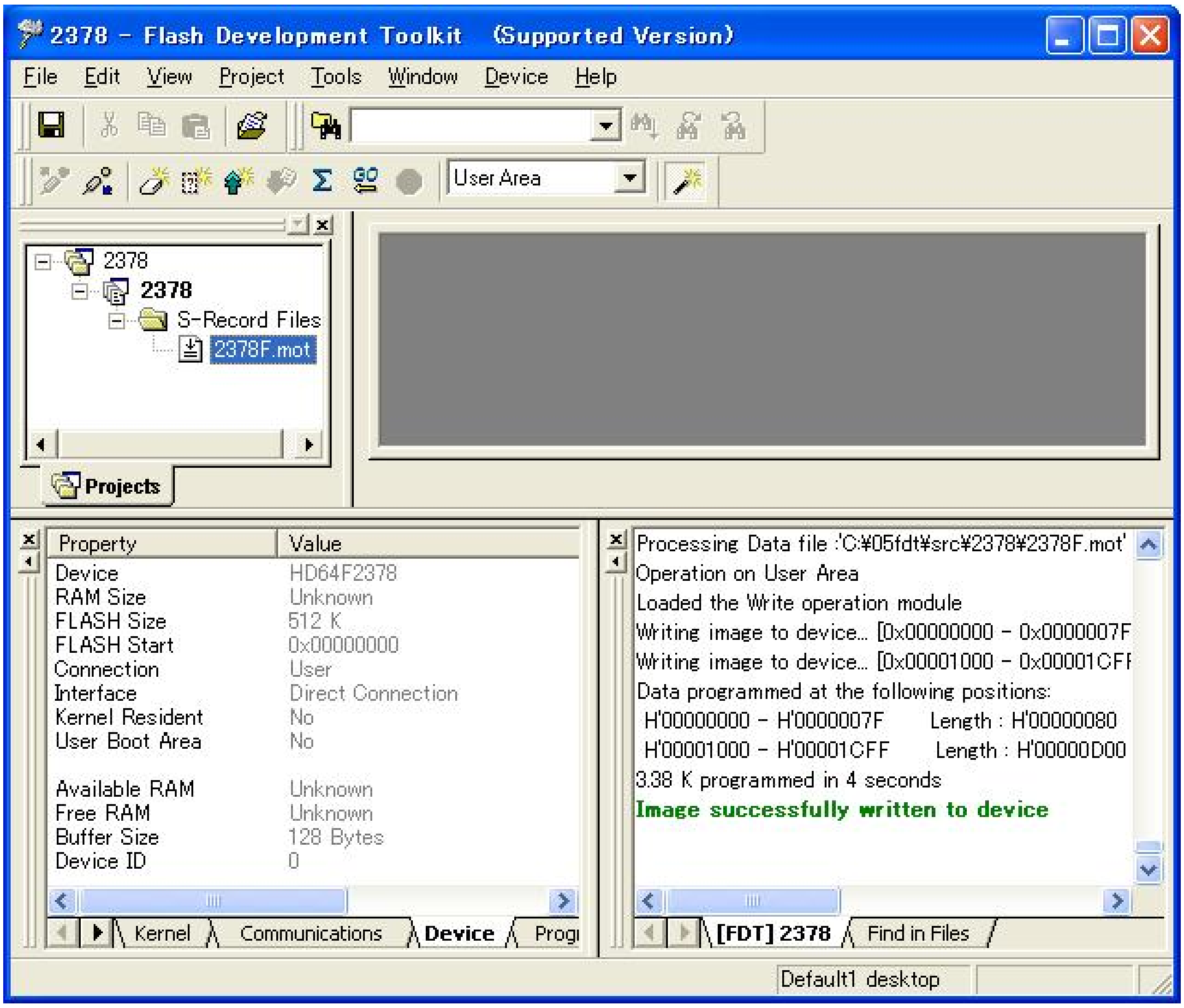
Click the right mouse button on file 2378F.mot to display the pop-up menu. Click "User Boot Area" to uncheck it so that the file can be downloaded to the user area.



Click the right mouse button on file 2378F.mot again to display the pop-up menu. Click "Download [User Area]" to download file 2378F.mot to the user area.



You can check that the program has been downloaded to the user area.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
User Area
2378
2378
S-Record Files
2378F.mot
Projects
Kernel Communications Device Progi
[FDT] 2378 Find in Files
Default1 desktop

Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

```
Processing Data file :'C:¥05fdt¥src¥2378¥2378F.mot'
Operation on User Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 4 seconds
Image successfully written to device
```

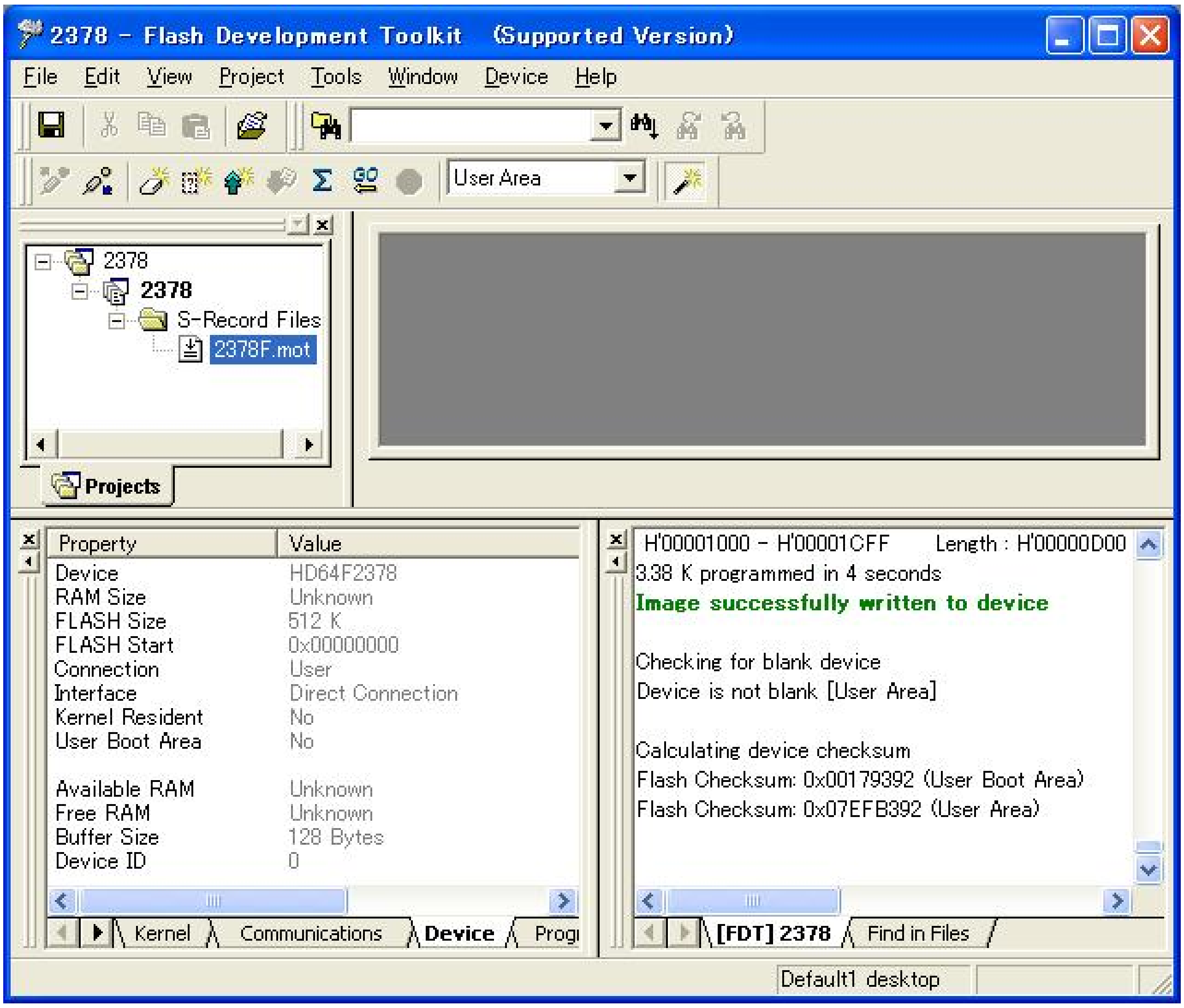
4.5.7 Blank Check and Checksum

To confirm that the user area has been programmed, perform a blank check and calculate a checksum.

Click "Device" to open the pull-down menu and click "Blank Check."

Click "Device" to open the pull-down menu and click "Flash Checksum."

The results of the blank check and checksum calculation are displayed.



Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

```
 H'00001000 - H'00001CFF     Length : H'00000D00
3.38 K programmed in 4 seconds
Image successfully written to device

Checking for blank device
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x00179392 (User Boot Area)
Flash Checksum: 0x07EFB392 (User Area)
```

4.6 User Program Mode

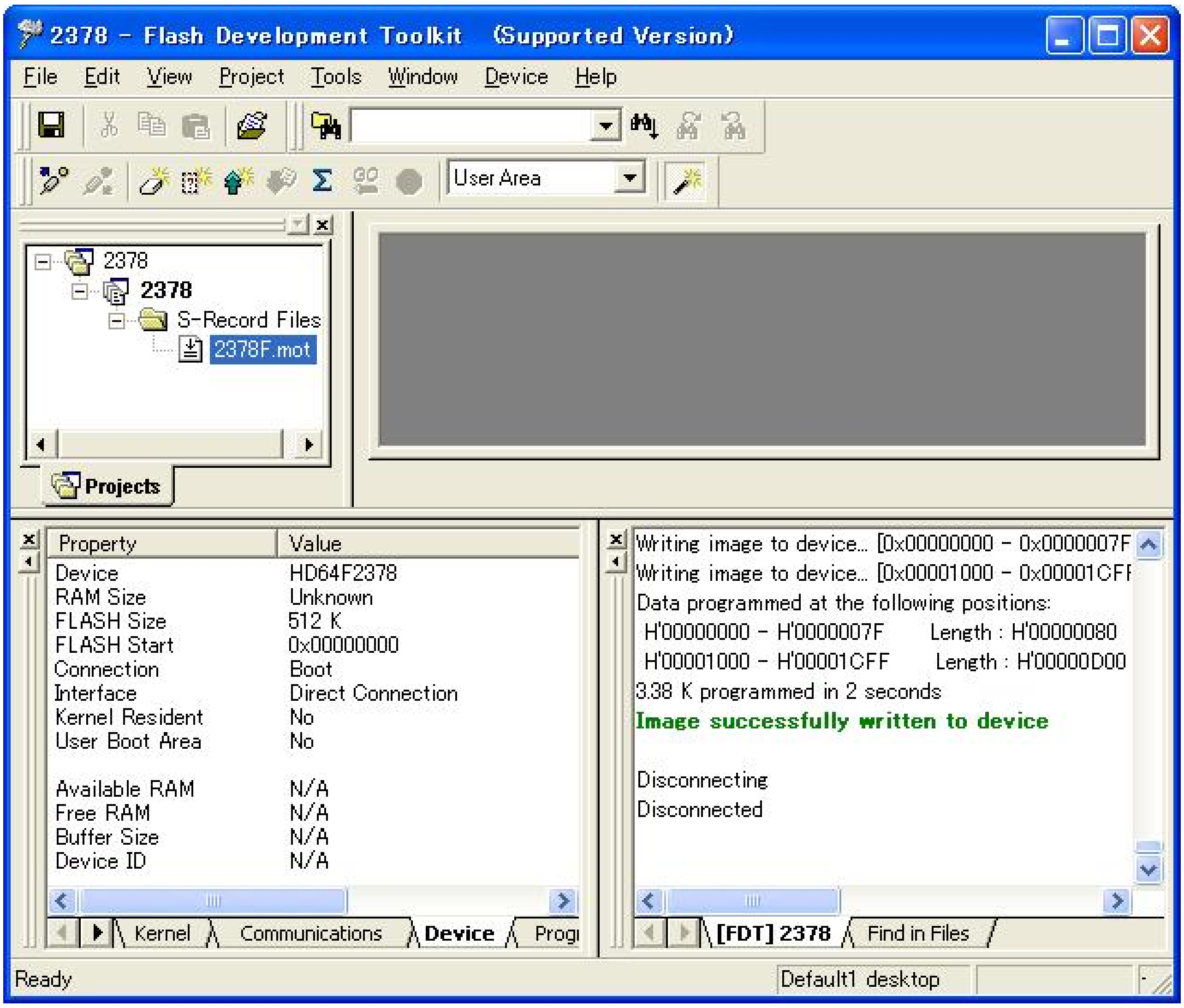
In the user program mode, the user area can be programmed or erased. The user boot area cannot be programmed or erased.

4.6.1 Writing a Program in the User Area

Start "Flash Development Toolkit 3.4" and open project workspace file 2378.AWS.

Write program file 2378F.mot in the user area in the boot mode.

After programming the file, disconnect the device and display the configure project window. On how to display the configure project window, refer to section 4.5.3, Configuring the Project.

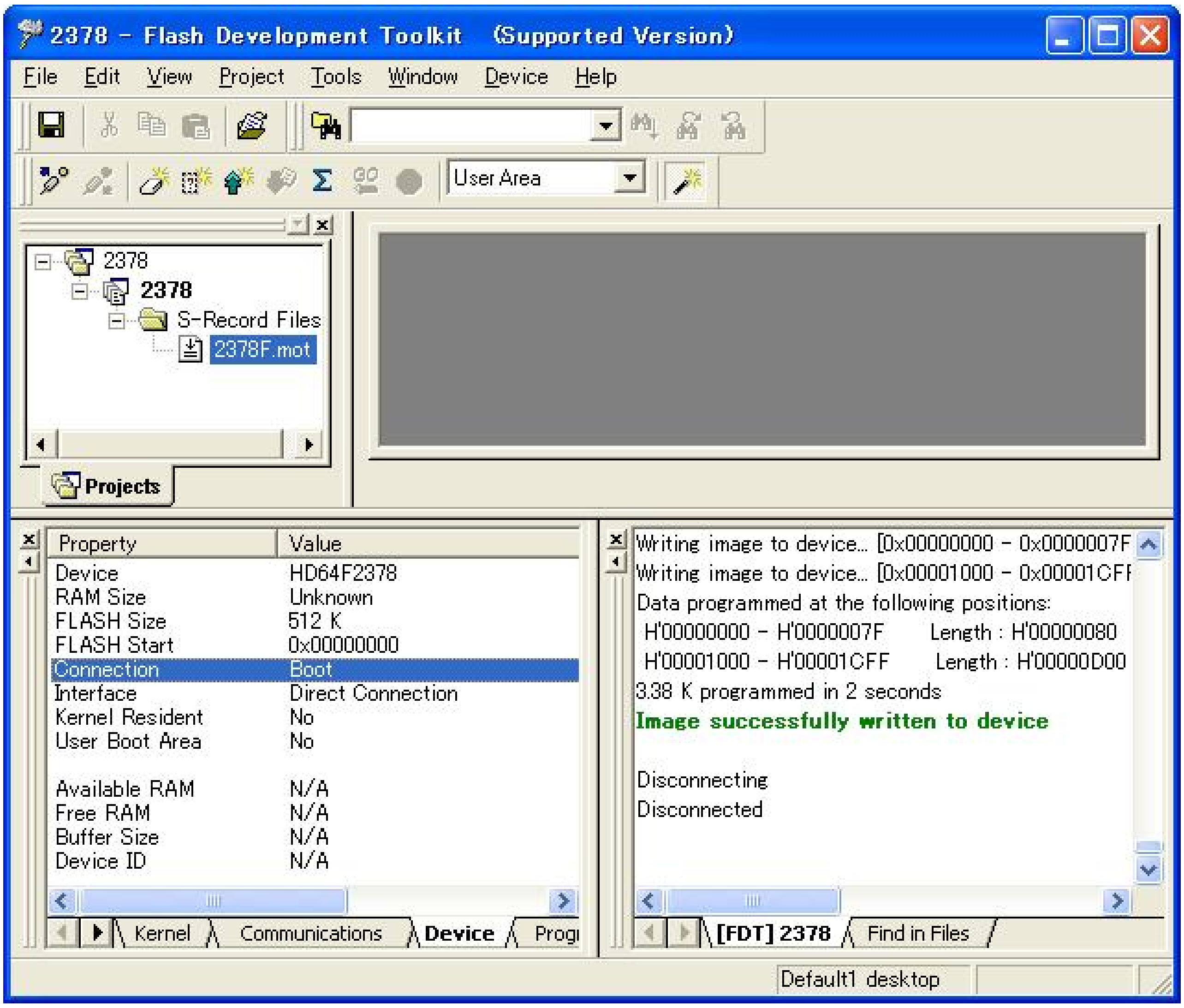


Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	Boot
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	N/A
Free RAM	N/A
Buffer Size	N/A
Device ID	N/A

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

4.6.2 Setting the User Program Mode

Select the "Device" tab in the configure project window and double-click "Connection" and "Boot."



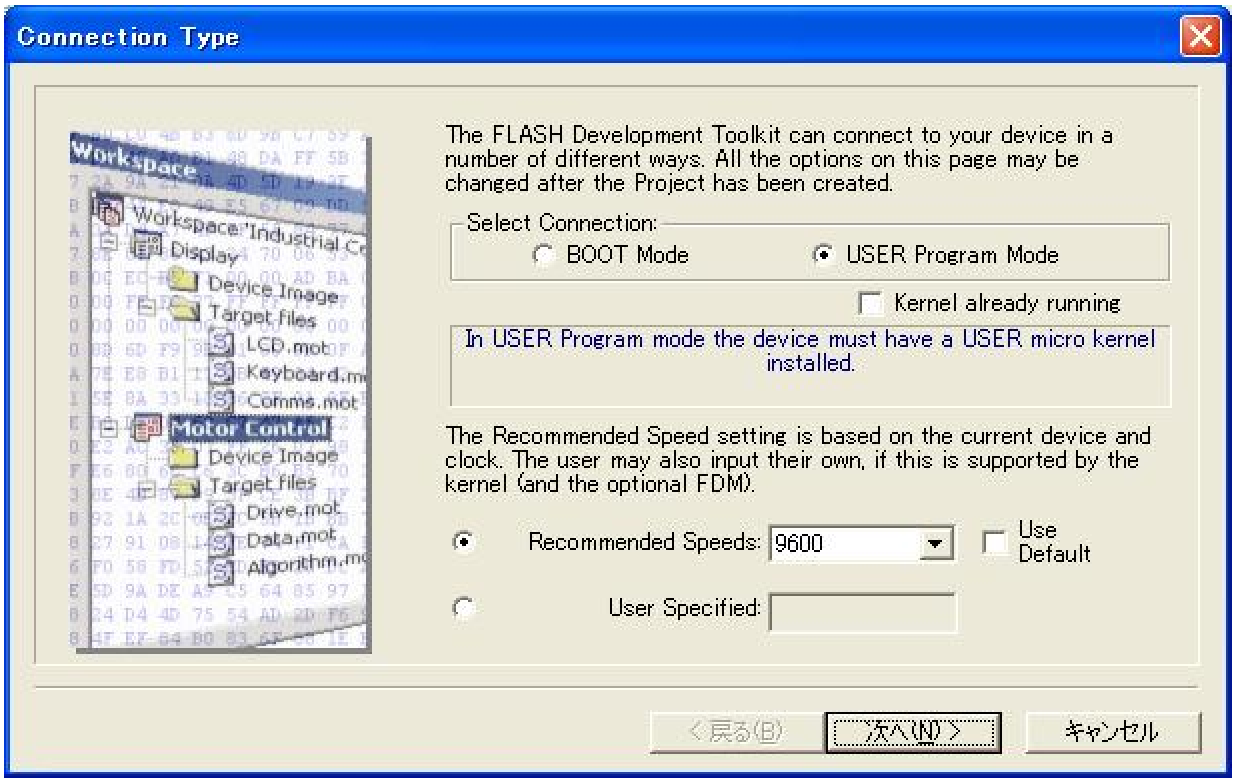
Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	Boot
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	N/A
Free RAM	N/A
Buffer Size	N/A
Device ID	N/A

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

Set the connection type.

Select "USER Program Mode" in "Select Connection:."

Set the baud rate to 9600 bps.



Connection Type

The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection: ( ) BOOT Mode [✓ USER Program Mode]

☐ Kernel already running

In USER Program mode the device must have a USER micro kernel installed.

The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the optional FDM).

[✓ Recommended Speeds:] 9600 ☐ Use Default

( ) User Specified:

When you have set the connection type, click "Next."

Set the pins on the adapter board (FDM) for the user boot mode.

For example, set the output of FWx to high (1) and that of MD2 to low (0).

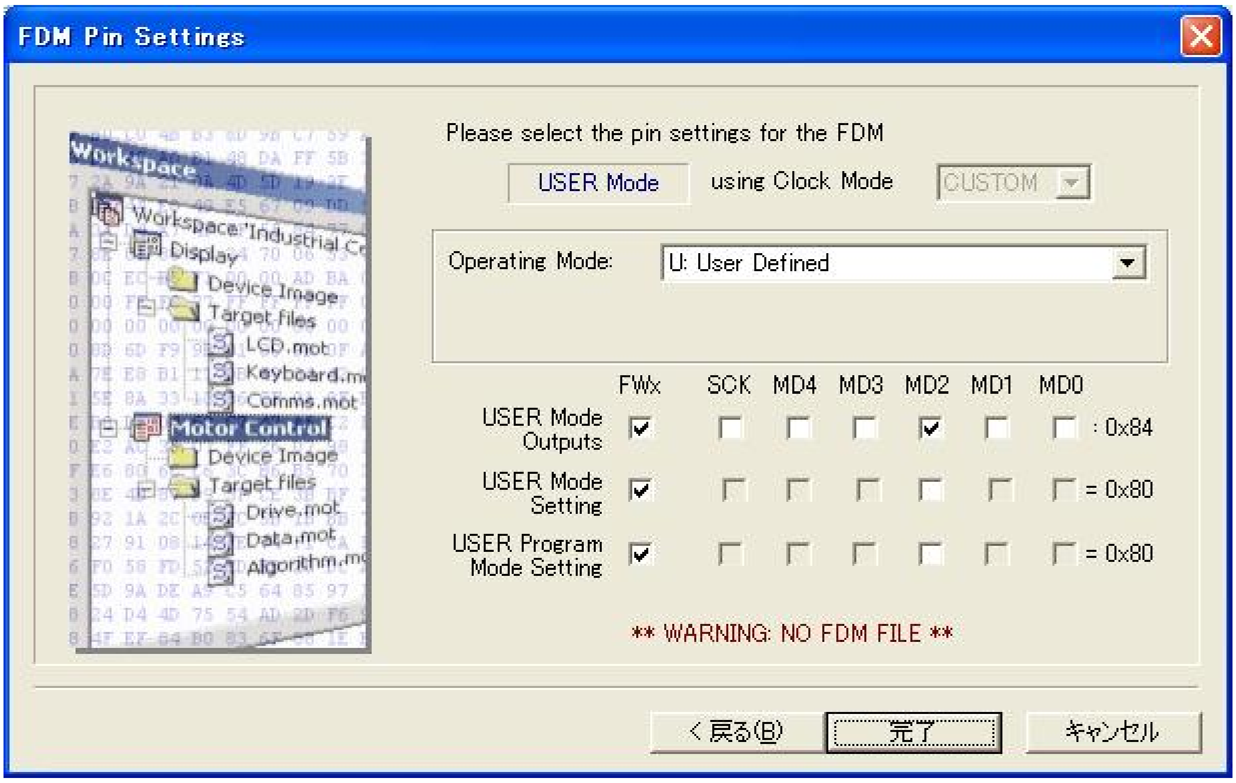
In this example, the FWx pin outputs 1 for selecting a mode (jumper J15 is open) and MD2 (IO0) outputs 0 for serial communication connection.

Turn off the power and select an expanded mode with on-chip ROM enabled (mode 4) or single-chip mode (mode 7).

To select the mode, use DIP switch 6. When you have set the pins, turn on the power.

Table 4-7 Operating Mode Settings

MCU Operating Mode	CPU Operating Mode	Jumper	FWE	MD2	MD1	MD0	SCI Switch
		J15	FWx (Pin 3) on the Adapter Board	SW6-3	SW6-2	SW6-1	MD2 (Pin 9) on the Adapter Board
4	Expanded mode with on-chip ROM enabled	1 (Open)	1 (Output 1)	1 (OFF)	0 (ON)	0 (ON)	0 (Output 0)
7	Single-chip mode	1 (Open)	1 (Output 1)	1 (OFF)	1 (OFF)	1 (OFF)	0 (Output 0)



Please select the pin settings for the FDM

USER Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

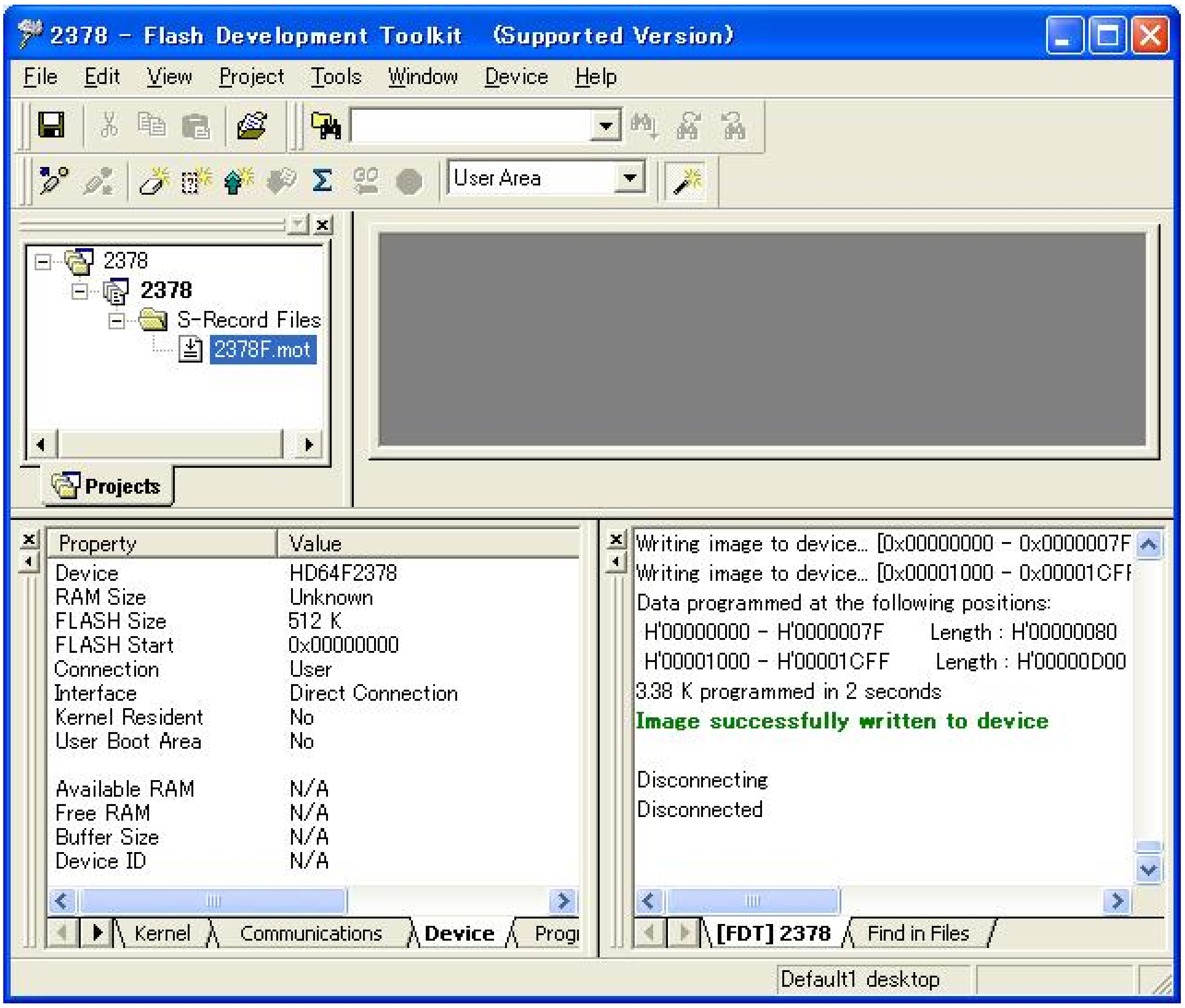
	FWx	SCK	MD4	MD3	MD2	MD1	MD0	
USER Mode Outputs	✓				✓			: 0x84
USER Mode Setting	✓							= 0x80
USER Program Mode Setting	✓							= 0x80

** WARNING: NO FDM FILE **

When you have set the items, click "Finish."

Note: Do not operate the mode switch during CPU operation. Be sure to operate the FWE and MD pins after turning the power to the board off or while pressing the RESET button.

The user program mode has been set.


2378 - Flash Development Toolkit (Supported Version)

File Edit View Project Tools Window Device Help

User Area

2378
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S-Record Files
2378F.mot

Projects

Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	N/A
Free RAM	N/A
Buffer Size	N/A
Device ID	N/A

Kernel / Communications / Device / Progi

```
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F      Length : H'00000080
 H'00001000 - H'00001CFF      Length : H'00000D00
3.38 K programmed in 2 seconds
Image successfully written to device

Disconnecting
Disconnected
```

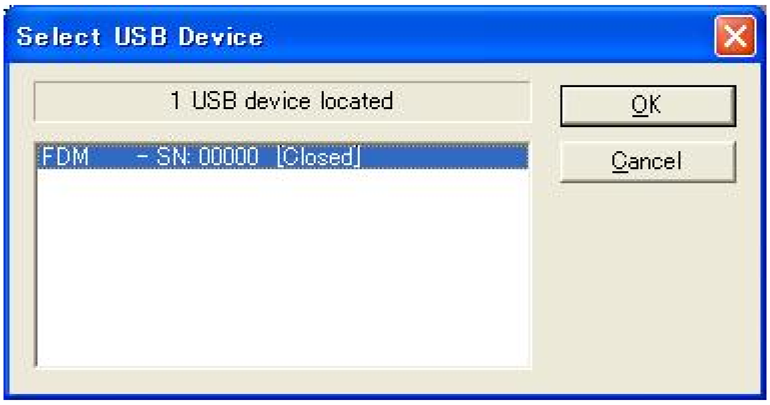
[FDT] 2378 / Find in Files

Default1 desktop

4.6.3 Connecting the Device

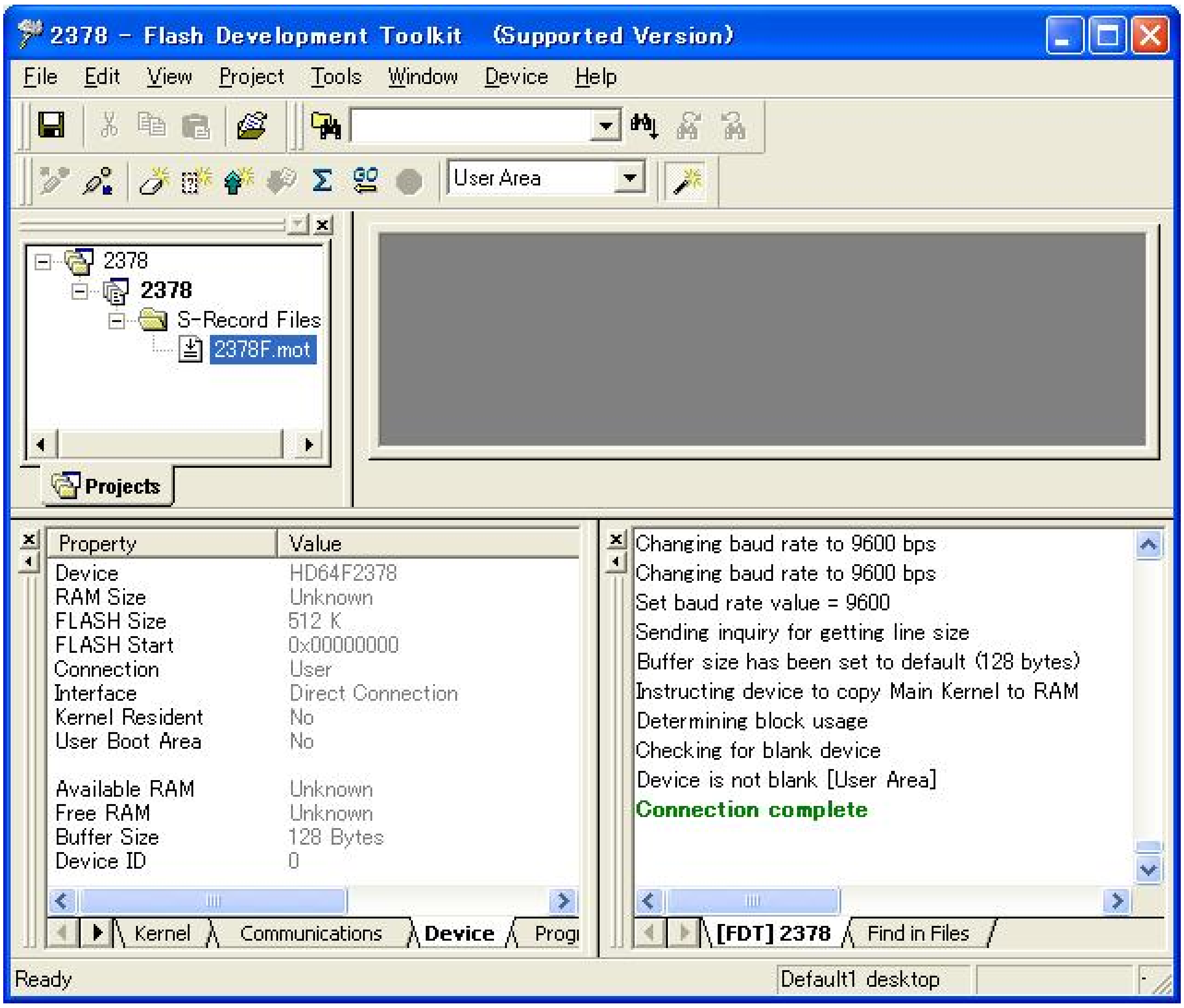
Click "Device" to open the pull-down menu and click "Connect to Device(C)."

Select the adapter board (FDM).



When you have selected USB device, click "OK."

The connection in the user program mode is completed.



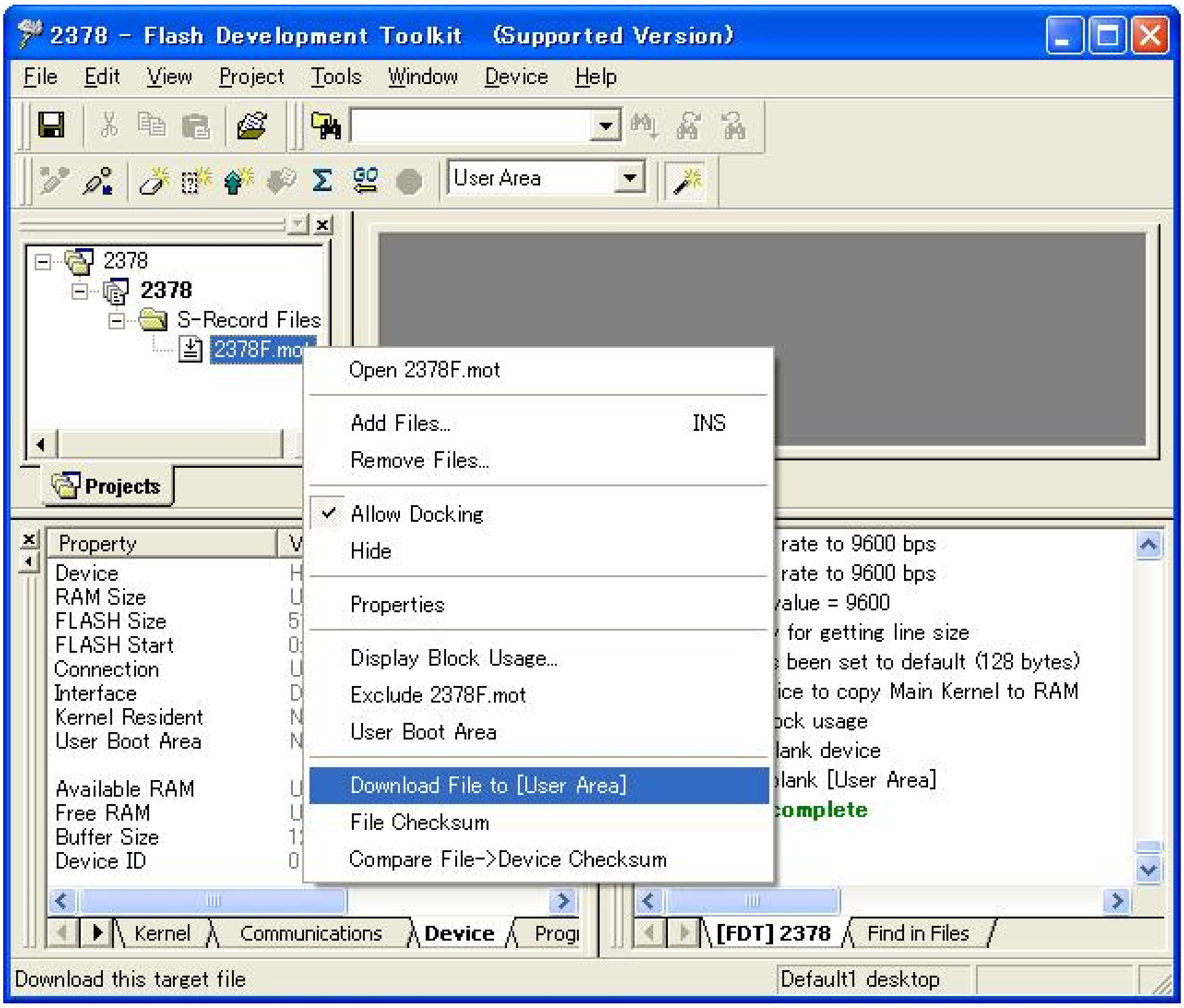
Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

```
Changing baud rate to 9600 bps
Changing baud rate to 9600 bps
Set baud rate value = 9600
Sending inquiry for getting line size
Buffer size has been set to default (128 bytes)
Instructing device to copy Main Kernel to RAM
Determining block usage
Checking for blank device
Device is not blank [User Area]
Connection complete
```

4.6.4 Programming

Write a program in the user area in the user program mode.

Click the right mouse button on file 2378F.mot to display the pop-up menu. Click "Download File to [User Area]" to download file 2378F.mot to the user area.



Property

Device
RAM Size
FLASH Size
FLASH Start
Connection
Interface
Kernel Resident
User Boot Area

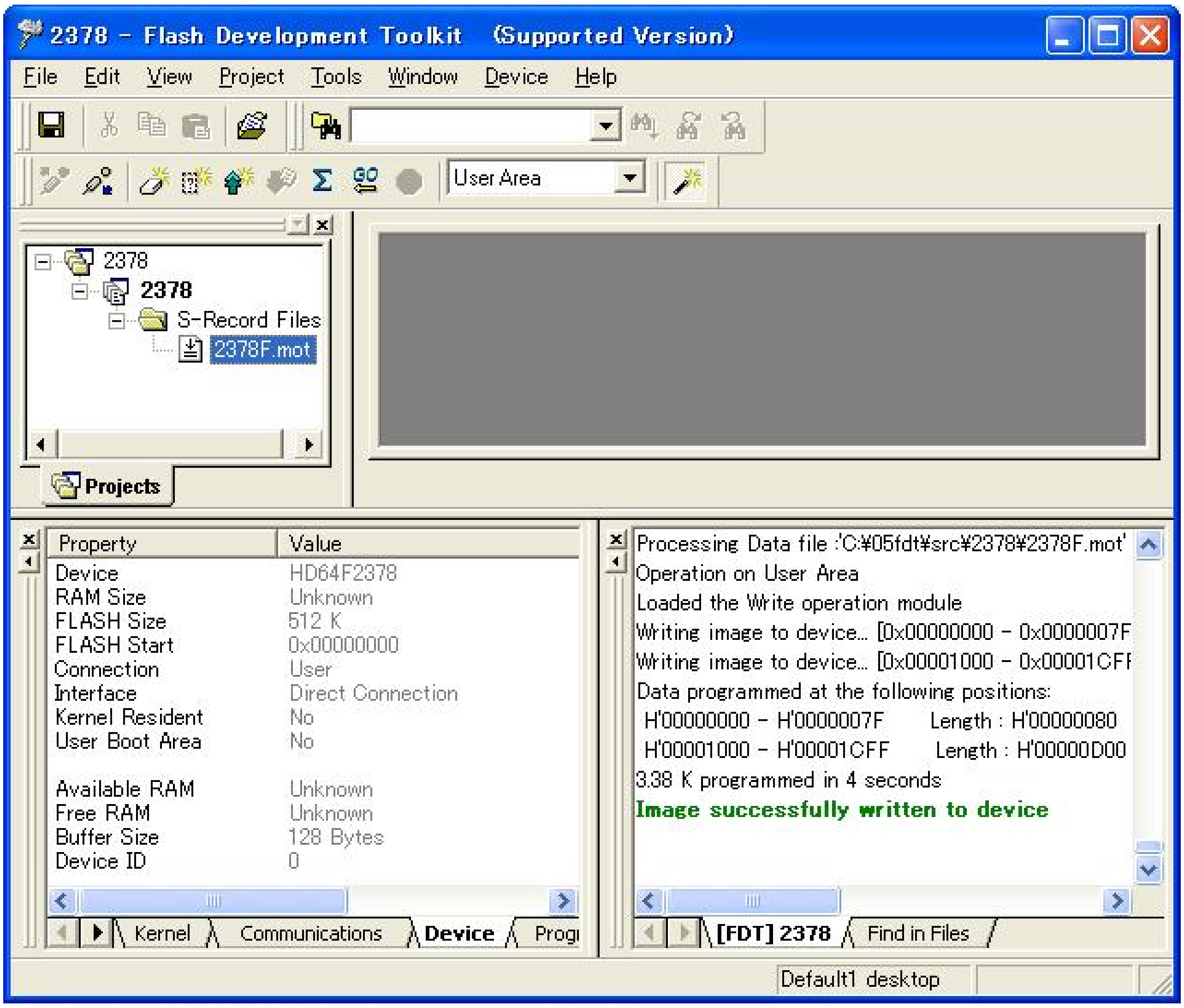
Available RAM
Free RAM
Buffer Size
Device ID

```
rate to 9600 bps
rate to 9600 bps
value = 9600
for getting line size
been set to default (128 bytes)
ice to copy Main Kernel to RAM
ock usage
lank device
lank [User Area]
complete
```

Download this target file

Default1 desktop

You can check that the program has been downloaded to the user area.



Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

```
Processing Data file :'C:¥05fdt¥src¥2378¥2378F.mot'
Operation on User Area
Loaded the Write operation module
Writing image to device... [0x00000000 - 0x0000007F
Writing image to device... [0x00001000 - 0x00001CFF
Data programmed at the following positions:
 H'00000000 - H'0000007F     Length : H'00000080
 H'00001000 - H'00001CFF     Length : H'00000D00
3.38 K programmed in 4 seconds
Image successfully written to device
```

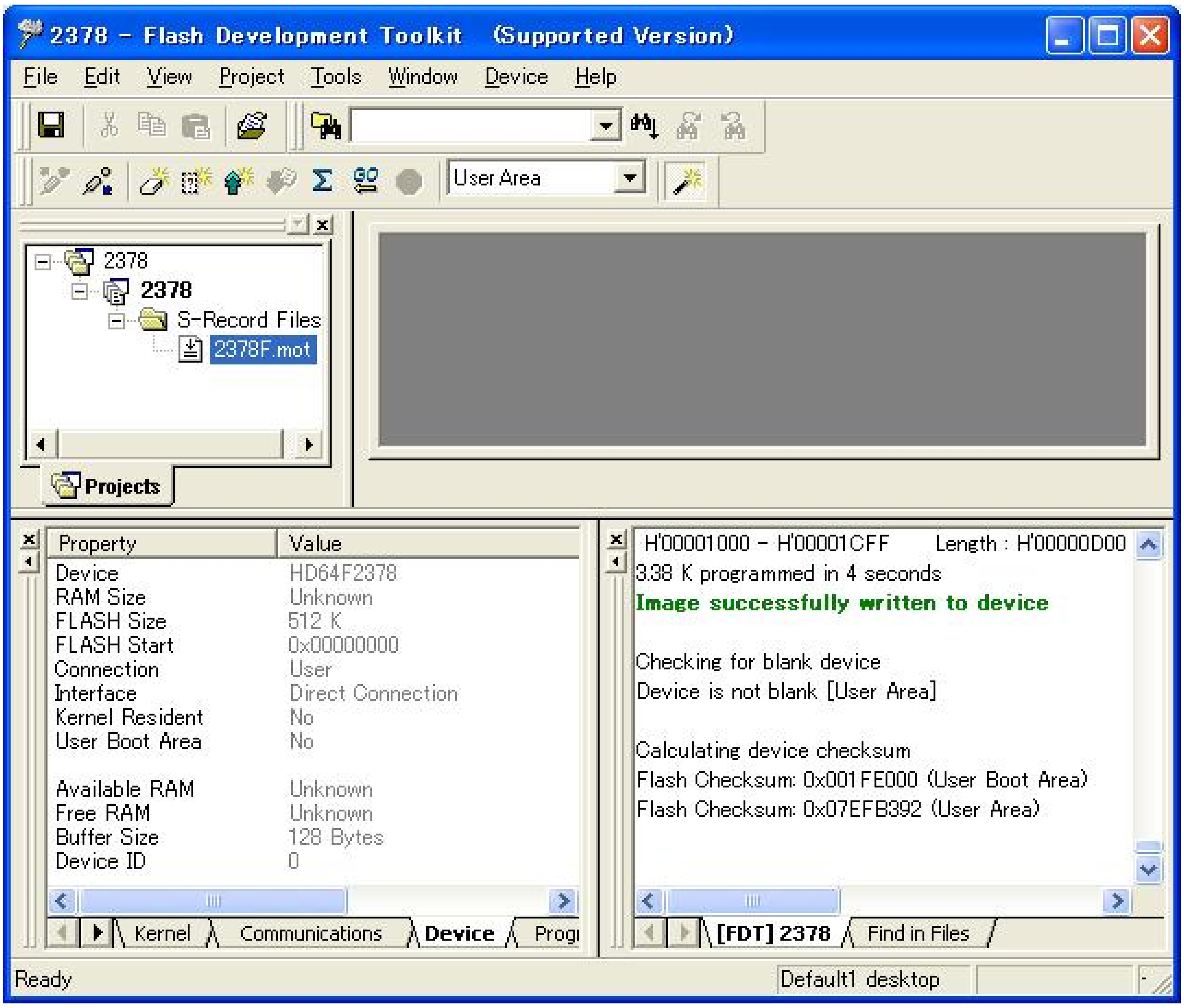
4.6.5 Blank Check and Checksum

To confirm that the user area has been programmed, perform a blank check and calculate a checksum.

Click "Device" to open the pull-down menu and click "Blank Check."

Click "Device" to open the pull-down menu and click "Flash Checksum."

The results of the blank check and checksum calculation are displayed.


2378 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
User Area
2378
2378
S-Record Files
2378F.mot
Projects
Kernel Communications Device Progi
[FDT] 2378 Find in Files
Ready
Default1 desktop

Property	Value
Device	HD64F2378
RAM Size	Unknown
FLASH Size	512 K
FLASH Start	0x00000000
Connection	User
Interface	Direct Connection
Kernel Resident	No
User Boot Area	No
Available RAM	Unknown
Free RAM	Unknown
Buffer Size	128 Bytes
Device ID	0

```
 H'00001000 - H'00001CFF     Length : H'00000D00
3.38 K programmed in 4 seconds
Image successfully written to device

Checking for blank device
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x001FE000 (User Boot Area)
Flash Checksum: 0x07EFB392 (User Area)
```

5. Flash Development Toolkit Processing

The Flash Development Toolkit can be connected in either of the following two modes: the boot mode or the user program mode. In both modes, the continuation of the execution from a previous session can be specified. The connection modes of the Flash Development Toolkit are listed in Table 5-1. Normally, a new connection processing is used. The hexadecimal code is a command code of the Flash Development Toolkit. For details, refer to the description on flash memory (0.18-µm F-ZTAT version) in the Hardware Manual.

Table 5-1 Connection Modes of the Flash Development Toolkit

Mode	New Connection Processing	Continuation of the Execution from a Previous Session
Boot mode	Baud rate adjustment H'27 (Programming unit inquiry) H'10 (Device selection) H'11 (Clock mode selection) H'3F (New baud rate setting)	H'27 (Programming unit inquiry) H'4F (Status request) H'4D (User area blank check)
User boot mode User program mode	H'27 (Programming unit inquiry) H'10 (Device selection) H'11 (Clock mode selection) H'3F (New baud rate setting)	H'27 (Programming unit inquiry) H'4F (Status request) H'4D (User area blank check)

6. Sample Program

This section describes the sample program in the user program mode of the H8S/2378F.

6.1 File Configuration

The file configuration is shown in Figure 6-1.

```
2378    2378 folder
  │―Project    Project folder
  │    │―2378F    2378F folder
  │    │    │―Release    Release folder
  │    │    │―2378f.hwp    2378f project database file
  │    │    │―2378F.tps    Current session file
  │    │    │―defaultsession.hsf    Session file
  │    │―Project.hws    Project workspace file
  │    │―Project.tws    Current project file
  │―Src    Source file folder
  │    │―BaudRate.src    Baud rate
  │    │―CmdFunc.c    Command function
  │    │―CmdFunc.h    Command function header
  │    │―commands.h    Command header
  │    │―DeviceInfo.h    Device information header
  │    │―FDTErase.c    Erase function
  │    │―FDTUMain.c    Main function
  │    │―FDTUMain.h    Main function header
  │    │―FDTWrite.c    Programming function
  │    │―GenTest.c    Test function
  │    │―GenTest.h    Test function header
  │    │―io2378.h    I/O address header
  │    │―KAlg.h    Library header
  │    │―KDevice.h    Device header
  │    │―KStruct.h    Structure header
  │    │―KTypes.h    Type header
  │    │―rom2ram.src    RAM address definition
  │    │―Strt2378.src    Start function
  │    │―Ugenu.c    Micro function
  │    │―uGenu.h    Micro function header
  │―2378F.mot    2378F S-type file
```

Figure 6-1 File Configuration

6.2 Source Files

The source files are listed in Table 6-1.

Table 6-1 Source Files

File	File Name	Description
Baud rate	BaudRate.src	BRR calculation assembly language file
Command function	CmdFunc.c	Command processing source file
Command function header	CmdFunc.h	Command function definition file
Command header	commands.h	Command code definition file
Device information header	DeviceInfo.h	Device information definition file
Erase function	FDTErase.c	Erase function source file
Main function	FDTUMain.c	Main kernel function source file
Main function header	FDTUMain.h	Main kernel function definition file
Programming function	FDTWrite.c	Programming function source file
Test function	GenTest.c	User program mode test function source file
Test function header	GenTest.h	User program mode test definition file
I/O address header	io2378.h	Peripheral module register definition file
Library header	KAlg.h	Programming and erasing library definition file
Device header	KDevice.h	Device information definition file
Structure header	KStruct.h	Structure definition file
Type header	KTypes.h	Type definition file
RAM address definition	rom2ram.src	RAM address definition file
Start function	Strt2378.src	Start function assembly language file
Micro function	Ugenu.c	Micro kernel function source file
Micro function header	uGenu.h	Micro kernel definition file

6.3 Modules

The modules are listed in Table 6-2.

Table 6-2 Modules

File	Module	Module Name	Function
BaudRate.src	BRR calculation	cal_brr	Calculates the BRR value using the frequency and bit rate.
CmdFunc.c	Reference function	ReferFunc	Reference function
	Device selection	SelectDevice	Selects a device.
	Clock mode selection	SelectClockMode	Selects a clock mode.
	New baud rate setting	SetNewBaudRate	Sets a new baud rate.
	Program status	RequestBootPrgSts	Program status
	Sum check	SumCheck	Sum check
	ACK transmission	SendAck	Sends ACK.
	Blank check	CheckBlank	Checks the blank status.
	Memory read	ReadMemory	Reads memory.
	Command read	GetCmdData	Reads a command.
FDTErase.c	Flash erasing	EraseFLASH	Erases flash memory.
	Erase data reception	GetEraseData	Receives erase data.
	Erase initial setting	EraseInit	Performs erase initial setting.
	Erasing start	EraseStart	Starts erasing operation.
FDTUMain.c	RAM main	RamMain	RAM main processing
	Command processing	ProcessCommand	Processes commands.
	Library transfer	LibTrans	Transfers a library.
	SCO bit setting	ScoBitSet	Sets the SCO bit.
	User boot area selection	UserBootSelect	Selects the user boot area.
	User area selection	UserMatSelect	Selects the user area.
FDTWrite.c	Flash programming	WriteFLASH	Programs flash memory.
	Programming data reception	GetWriteData	Receives programming data.
	Programming initial setting	WriteInit	Performs programming initial setting.
	Programming start	WriteStart	Starts programming.
GenTest.c	Main processing	main	Test main processing
	SCI initial setting	InitSCI	Performs SCI initial setting.
	Reception	Get	Reception
	Transmission	Put	Transmission
Strt2378.src	Start	startup	Sets and starts the stack pointer.
Ugenu.c	ROM main	RomMain	ROM main processing
	Command function	CmdFunc	Receives and controls commands.
	Transfer start	TransStart	Starts transferring a program.
	Copy	RamCopy	Copies a program into RAM.

6.4 Module Hierarchical Structure

The module hierarchical structure is shown in Figure 6-2.

```
RESET_VECTOR (0x0000)   Reset vector
  │―startup (0x1000)   Start
      │―main   Main processing
          │―InitSCI   SCI initial setting
          │―RomMain   ROM main processing
              │―TransStart   Transfer start
              │   │―RamCopy   Copy
              │―CmdFunc   Command function
              │   │―Get   Reception
              │   │―SendAck   ACK transmission
              │   │   │―Put   Transmission
              │   │―ReferFunc   Reference function
              │   │   │―Put   Transmission
              │   │―GetCmdData   Command read
              │   │   │―Get   Reception
              │   │―SelectDevice   Device selection
              │   │   │―SendAck   ACK transmission
              │   │   │―ErrorCode   Error code macro
              │   │   │―Put   Transmission
              │   │―SelectClockMode   Clock mode selection
              │   │   │―SendAck   ACK transmission
              │   │   │―ErrorCode   Error code macro
              │   │   │―Put   Transmission
              │   │―SetNewBaudRate   New bit rate setting
              │   │   │―ErrorCode   Error code macro
              │   │   │―Put   Transmission
              │   │   │―cal_brr   BRR calculation
              │   │   │―SendAck   ACK transmission
              │   │   │―Get   Reception
              │   │―RequestBootPrgSts   Program status
              │   │   │―Put   Transmission
              │   │―Put   Transmission
              │―RamMain (0xFF4000)   RAM main processing
             (To be continued)
```

Figure 6-2　Module Hierarchical Structure (1)

```
(Continued)
  │—RamMain (0xFF4000)    RAM main processing
      │—ProcessCommand    Command processing
          │—Get    Reception
          │—RequestBootPrgSts    Program status
          │—SumCheck    Sum check
          │   │—UserBootSelect    User boot area selection
          │   │   │—nop    NOP macro
          │   │—UserMatSelect    User area selection
          │   │   │—nop    NOP macro
          │   │—Put    Transmission
          │—LibTrans    Library transfer
          │   │—ScoBitSet    SCO bit setting
          │        │—nop    NOP macro
          │—SendAck    ACK transmission
          │—EraseFLASH    Flash erasing
          │   │—EraseInit    Erase initial setting
          │   │   │—UserMatSelect    User area selection
          │   │   │—INIT_ADDR    Initial setting entry address
          │   │—ErrorCode    Error code macro
          │   │—Put    Transmission
          │   │—Get    Reception
          │   │—RequestBootPrgSts    Program status
          │   │—GetEraseData    Erase data reception
          │   │   │—Get    Reception
          │   │   │—ErrorCode    Error code macro
          │   │   │—Put    Transmission
          │   │—EraseStart    Erasing start
          │   │   │—WRITE_ERASE_ADDR    Programming/erasing entry address
          │   │—SendAck    ACK transmission
          │—WriteFLASH    Flash programming
          │   │—WriteInit    Programming initial setting
          │   │   │—UserMatSelect    User area selection
          │   │   │—INIT_ADDR    Initial setting entry address
          │   │—ErrorCode    Error code macro
          │   │—Put    Transmission
          │   │—Get    Reception
          │   │—RequestBootPrgSts    Program status
          │   │—GetWriteData    Programming data reception
          │   │   │—Get    Reception
          │   │   │—ErrorCode    Error code macro
          │   │   │—Put    Transmission
          │   │—WriteStart    Programming start
          │   │   │—WRITE_ERASE_ADDR    Programming/erasing entry address
          │   │—SendAck    ACK transmission
          │—GetCmdData    Command read
          │—ReadMemory    Memory read
        (To be continued)
```

Figure 6-2 Module Hierarchical Structure (2)

```
(Continued)
  │—ReadMemory    Memory read
  │    │—UserBootSelect    User boot area selection
  │    │—UserMatSelect    User area selection
  │    │—ErrorCode    Error code macro
  │    │—Put    Transmission
  │—CheckBlank    Blank check
  │    │—UserBootSelect    User boot area selection
  │    │—UserMatSelect    User area selection
  │    │—ErrorCode    Error code macro
  │    │—Put    Transmission
  │    │—SendAck    ACK transmission
  │—Put    Transmission
```

Figure 6-2　Module Hierarchical Structure (3)

6.5 Flow of the Program

This section describes the flow of the sample program with referencing the module hierarchical structure.

6.5.1 Program Processing Flow

The processing flow of the sample program is shown in Figure 6-3. In the user program mode, bit rate adjustment and user area erase processing, which are performed during boot operation, are not performed. For this reason, the program and data written in flash memory can be saved.

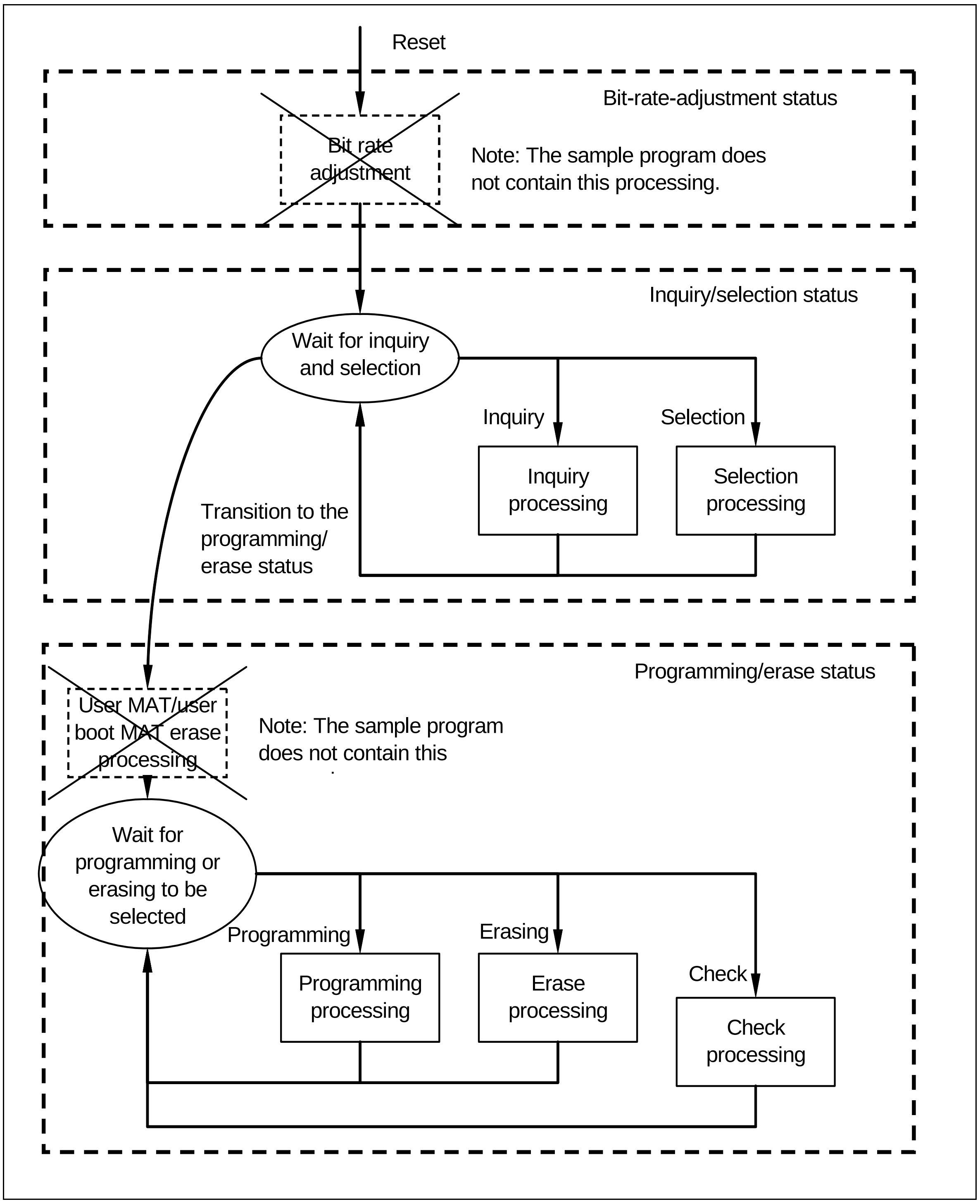

Reset
Bit-rate-adjustment status
Bit rate adjustment
Note: The sample program does not contain this processing.
Inquiry/selection status
Wait for inquiry and selection
Inquiry
Selection
Inquiry processing
Selection processing
Transition to the programming/ erase status
Programming/erase status
User MAT/user boot MAT erase processing
Note: The sample program does not contain this
Wait for programming or erasing to be selected
Programming
Erasing
Check
Programming processing
Erase processing
Check processing

Figure 6-3 Program Processing Flow

6.5.2 Main Processing (main)

The flow of main processing is shown below:

(1) The reset vector causes a branch to start (startup).

(2) Start (startup) sets the stack pointer and calls main processing (main).

(3) Main processing (main) calls SCI initial setting (InitSCI) and branches to ROM main processing (RomMain).

(4) ROM main processing (RomMain) transfers RAM main processing to RAM, receives and processes a command, and sets items.
After setting items, ROM main processing branches to RAM main processing (RamMain) in RAM.

(5) RAM main processing (RamMain) processes the received commands and performs the following processing:
Transferring the programming/erasing library (LibTrans)
Erasing flash memory (EraseFLASH)
Programming flash memory (WriteFLASH)
Reading memory in the user boot area or user area (ReadMemory)
Calculating a checksum of data in the user boot area or user area (SumCheck)
Checking the blank status of the user boot area or user area (CheckBlank)

Note: ROM main processing (RomMain) is also called a micro-kernel. It runs in ROM.
RAM main processing (RamMain) is also called a main kernel. It runs in RAM.

6.5.3 ROM Main Processing (RomMain)

The flow of ROM main processing (RomMain) is shown below:

(1) Transfer start (TransStart) transfers the program in ROM to RAM.
This operation is for performing library transfer, erasing, and programming in RAM.

(2) Command function (CmdFunc) processes each command, responds to each inquiry, and sets selection.

(3) Reference function (ReferFunc) and program status (RequestBootPrgSts) respond to each inquiry that corresponds to one of the following commands:
Supported device inquiry
Clock mode inquiry
Multiplication ratio inquiry
Operating frequency inquiry
User boot area information inquiry
User area information inquiry
Erase block information inquiry
Programming unit inquiry
Boot program status inquiry

(4) A selection setting command is set using one of the following modules:
Device selection (SelectDevice): Selects a device code.
Clock mode selection (SelectClockMode): Notifies the selected clock mode.
New bit rate setting (SetNewBaudRate): Selects a new bit rate.

(5) Inquiry/selection processing is completed and a branch is caused to RAM main processing (RamMain) transferred to RAM.

6.5.4 RAM Main Processing (RamMain)

The flow of RAM main processing (RamMain) is shown below:

(1) Command processing (ProcessCommand) processes commands. The following commands are to be processed. The sample program cannot process user boot area programming selection or block erasing for the user boot area because it runs in the user program mode.
User area programming selection
128-byte programming
Erasing selection
Block erasing
Memory read
User boot area sum check
User area sum check
User boot area blank check
User area blank check
Boot program status inquiry

(2) For the user area programming selection command, command processing transfers the programming library using library transfer (LibTrans) and branches to flash programming (WriteFLASH).

(3) Flash programming (WriteFLASH) sets the frequency using programming initial setting (WriteInit).
Then, it reads a command. When the command is 128-byte programming, programming data reception (GetWriteData) receives programming data and programming start (WriteStart) programs flash memory.
When 128-byte data is programming end address data, the programming end codes are set in data to be programmed and programming destination address to end programming (call programming start (WriteStart) actually) and programming terminates.
In this sample program, 128-byte programming end address data is H'FFFFFFFF, the programming end code of data to be programmed is H'F0F0F0F0, and the programming end code of the programming destination address is H'0F0F0F0F.

(4) For the erasing selection command, library transfer (LibTrans) transfers the erasing library and branches to flash erasing (EraseFLASH).

(5) Flash erasing (EraseFLASH) sets the frequency using erase initial setting (EraseInit).
Then, it reads a command. When the command is block erasing, erase data reception (GetEraseData) receives erase data and erasing start (EraseStart) erases the specified block.
When erase data is erasing end data, erasing terminates.

(6) For the memory read command, command read (GetCmdData) specifies the read address. Memory read (ReadMemory) reads memory in the user boot area or user area.

(7) For the user boot area sum check or user area sum check command, sum check (SumCheck) calculates a checksum of data in the user boot area or user area.

(8) For the user boot area blank check or user area blank check command, blank check (CheckBlank) checks the blank status of the user boot area or user area.

(9) For the boot program status inquiry command, program status (RequestBootPrgSts) sends the boot processing status.

7. Source Files of the Sample Program

This section describes main source files of the sample program.

7.1 Header Files

This sample program uses the following header files.

7.1.1 Bit Rate Setting (GenTest.h)

A bit rate is set.

```
                                                /* 33MHz 9600bps */
//#define MA_BRR_SCI                0x6A        /* Bit rate register channel 1 */
                                                /* 8.25MHz 9600bps */
#define MA_BRR_SCI                  0x1A        /* Bit rate register channel 1 */
```

In the user program mode, communications between the connected device is performed at 9600 bps. For this reason, the bit rate register (BRR) in the SCI module must be set according to the operating frequency. In this example, the operating frequency is 8.25 MHz. To set 9600 bps, MA_BRR_SCI is set to 26 (0x1A). The relationships between operating frequencies and BBR register settings is shown in Table 7-1.

Table 7-1 Operating Frequencies and BBR Register Settings (When the Bit Rate Is 9600 (bit/s))

Operating Frequency ϕ (MHz)	BRR Setting	Error (%)
8	25	0.16
8.25	26	-0.54
9.8304	31	0.00
10	32	-1.36
12	38	0.16
12.288	39	0.00
14	45	-0.93
14.7456	47	0.00
16	51	0.16
17.2032	55	0.00
18	58	-0.69
19.6608	63	0.00
20	64	0.16

The MA_BRR_SCI value is set according to the operating frequency of the board and built with HEW to create a program in an S-type file.

7.1.2 I/O Register Definition (io2378.h)

The registers and bits related to the SCI module and ROM are defined.

```
/****************************************************************************/
/*      H8S/2378F Internal I/O Include File                                 */
/****************************************************************************/

#define SCKCR                   (*(volatile unsigned char *)0xFFFF3B)
   #define STCS                 (unsigned char)0x08
#define SYSCR                   (*(volatile unsigned char *)0xFFFF3D)
   #define FLSHE                (unsigned char)0x08
#define MSTPCRL                 (*(volatile unsigned char *)0xFFFF41)
   #define MSTP2                (unsigned char)0x04
#define PLLCR                   (*(volatile unsigned char *)0xFFFF45)

/****************************************************************************/
/*                 SCI                                                      */
/*-------------------------------------------------------------------*/
/*                           CHANNEL 1                                      */
/****************************************************************************/
#define SCI_SMR                 (*(volatile unsigned char *)0xFFFF80)
#define SCI_BRR                 (*(volatile unsigned char *)0xFFFF81)
#define SCI_SCR                 (*(volatile unsigned char *)0xFFFF82)
  #define TE                              (unsigned char)0x20
  #define RE                              (unsigned char)0x10
  #define TE_RE                 (unsigned char)(TE | RE)
#define SCI_TDR                 (*(volatile unsigned char *)0xFFFF83)
#define SCI_SSR                 (*(volatile unsigned char *)0xFFFF84)
  #define TDRE                  (unsigned char)0x80
  #define RDRF                  (unsigned char)0x40
  #define RDRF_ERR_CLR    (unsigned char)0x87
  #define TEND                  (unsigned char)0x04
#define SCI_RDR                 (*(volatile unsigned char *)0xFFFF85)

/****************************************************************************/
/*                           FLASH                                          */
/*-------------------------------------------------------------------*/
/*                                                                          */
/****************************************************************************/
#define FCCS            (*(volatile unsigned char *)0xFFFFC4)
#define FPCS            (*(volatile unsigned char *)0xFFFFC5)
```

```
#define FECS                    (*(volatile unsigned char *)0xFFFFC6)
#define FKEY                    (*(volatile unsigned char *)0xFFFFC8)
#define FMATS                   (*(volatile unsigned char *)0xFFFFC9)
#define FTDAR                   (*(volatile unsigned char *)0xFFFFCA)
#define FLASH18 (*(volatile struct st_flash18 *)0xFFFFE800) /* FLASH18 Address*/
```

7.1.3 Macro Definition (FDTUMain.h and KAlg.h)

Labels used in the program are defined.

(1) FDTUMain.h

```
/* D E F I N E    */
enum {
        FmatsUserBootMat = 0xaa,
        FmatsUserMat = 0x00,
        WriteMode = 0x01,
        EraseMode = 0x01,
        FkeyEnable = 0xA5
};
```

(2) KAlg.h

```
/* D E F I N E S */
#define LOOP_END                        1
#define bufSize                         0x80
#define BLOCK_NO_ERROR                  0x09
#define ERASE_END                       0xFF
#define WRITE_END                       0xFFFFFFFF
#define ADDRESS_ERROR                   0x03
#define WRITE_ERASE_ENABLE              0x5A
#define ADD_WRITE_PRM0                  0xF0F0F0F0
#define ADD_WRITE_PRM1                  0x0F0F0F0F
```

7.2 Main Processing and ROM Main Processing

7.2.1 Module Hierarchical Structure

The module hierarchical structure of main processing and ROM main processing is shown in Figure 7-1.

```
RESET_VECTOR (0x0000)   Reset vector
  |—startup (0x1000)   Start
      |—main   Main processing
          |—InitSCI   SCI initial setting
          |—RomMain   ROM main processing
              |—TransStart   Transfer start
              |—CmdFunc   Command function
              |—RamMain (0xFF4000)   RAM main processing
```

Figure 7-1 Module Hierarchical Structure of Main Processing and ROM Main Processing

The reset vector causes a branch to start, which sets the stack pointer (Strt2378.src) and branches to main processing (main in GenTest.c).

Main processing performs initial setting for the SCI (InitSCI in GenTest.c) to enable transmission/reception and causes a branch to ROM main processing (RomMain in Ugenu.c).

ROM main processing transfers RAM main processing and others to RAM (TransStart in Ugenu.c) and processes commands (CmdFunc in Ugenu.c). At the end of data, ROM main processing branches to RAM main processing (RamMain in FDTUMain.c).

Main processing and ROM main processing are executed in ROM.

7.2.2 Reset Vectors (GenTest.c and GenTest.h)

The reset vectors are shown below:

(1) GenTest.c

```
/*Declare the vector table*/
#pragma section _VECT
const DWORD RESET_VECTOR = (DWORD)RESET_JMP_ADDRESS;
#pragma section
```

(2) GenTest.h

```
#define RESET_JMP_ADDRESS        0x1000
```

7.2.3 Transfer Start (Ugenu.c and rom2ram.src)

The following modules are transferred from ROM to RAM according to the transfer table (rom2ram.src) when RAM main processing and others are transferred. For the sections, ROM options are used.

Table 7-2 Transfer Modules

Section	Module
P_RAM_SCI	Get, Put (GenTest.c)
P_RAM_MAIN	RamMain and others (FDTUMain.c)
P_RAM_CMD	RequestBootPrgSts and others (CmdFunc.c)
P_RAM_WRITE	WriteFLASH and others (FDTWrite.c)
P_RAM_ERASE	EraseFLASH (FDTErase.c)

7.2.4 Command Function (Ugenu.c, commands.h, CmdFunc.c, and DeviceInfo.h)

Command function (CmdFunc) processes inquiry and setting commands. Commands are defined as macros (commands.h) and a process (CmdFunc.c) corresponding to each command is performed. For an inquiry command, a response (DeviceInfo.h) corresponding to the command is output (ReferFunc in CmdFunc.c).

7.3 RAM Main Processing

RAM main processing transfers a library, and erases and programs flash memory. This processing is executed in RAM.

7.3.1 Library Transfer (FDTUMain.c)

(1) LibTrans

When the command ID is prepareErase (0x48), FECS is set to EraseMode (0x01) and the erasing library is selected. When the command ID is other than the above (prepareUserAreaWrite, 0x43), FPCS is set to WriteMode (0x01) and the programming library is selected. FKEY is set to FkeyEnable (0xA5) to select transfer and the SCO bit is set.

```
/*
//////////////////////
// LibTrans Function //
//////////////////////
*/
void LibTrans(BYTE commandID)
{
        if (commandID == prepareErase){
                FECS = EraseMode;
        }else{
                FPCS = WriteMode;
        }

        FKEY = FkeyEnable;

        ScoBitSet();
}
```

(2) ScoBitSet

The library transfer destination address is set in the FTDAR register and the SCO bit of the FCCS register is set to 1. At least four NOP instructions are required after the SCO bit setting.

To determine whether a transfer error occurs, 0xFF is programmed in the library transfer destination address before transfer and 0x00 is checked after transfer.

```
/*
///////////////////////
// ScoBitSet Function //
///////////////////////
*/
BYTE ScoBitSet(void)
{
        /* Transmission error check initialization */
        *((volatile unsigned char *)TRANS_RAM_ADDR) = 0xFF;

        FTDAR = FTDAR_VALUE;
        FCCS |= 0x01;                                          /* SCO interruption */
        nop();
        nop();
        nop();
        nop();

        /* Transmission error check */
        if(0x00 == *((volatile unsigned char *)TRANS_RAM_ADDR)) {
                return(NORMAL);                                /* Transmission normal end */
        }

        return(ABNORMAL);                                      /* Transmission error */
}
```

TRANS_RAM_ADDR and FTDAR_VALUE are defined in KDevice.h as follows:

```
        /* SCO define */
        #define TRANS_RAM_ADDR          0xFF8000
        #define FTDAR_VALUE             0x03        /* RAMTOP+16Kb */
```

7.3.2 Area Selection (FDTUMain.c)

To select the user boot area or user area, FmatsUserBootMat (0xaa) or FmatsUserMat (0x00) is set in the FMATS register. At least two NOP instructions are required after setting.

```
/*
////////////////////////////
// UserBootSelect Function //
////////////////////////////
*/
void UserBootSelect(void)
{
        FMATS = FmatsUserBootMat;
        nop();
        nop();
}


/*
///////////////////////////
// UserMatSelect Function //
///////////////////////////
*/
void UserMatSelect(void)
{
        FMATS = FmatsUserMat;
        nop();
        nop();
}
```

7.3.3 Flash Memory Erasing (FDTErase.c)

(1) EraseInit

The user area is selected, the operating frequency is specified, and the erasing library is initialized. The operating frequency specified with FDT is transmitted to the device with new bit rate selection. For initial setting of the library, this operating frequency is used.

```
/*
///////////////////////
// EraseInit Function //
///////////////////////
*/
BYTE EraseInit(void)
{
        InitPtr ERASE_INIT = (InitPtr)INIT_ADDR;

        UserMatSelect();
        FKEY = WRITE_ERASE_ENABLE;
        return ((*ERASE_INIT)(Frequency));
}
```

(2) EraseStart

The block number for erasing is specified and the erasing library is called. The block number is received from the Flash Development Toolkit. For details, refer to Source Files of the Sample Program.

```
/*
////////////////////////
// EraseStart Function //
////////////////////////
*/
BYTE EraseStart(BYTE blk_no)
{
        ErasePtr ERASE_BLOCK = (ErasePtr)WRITE_ERASE_ADDR;

        return ((*ERASE_BLOCK)(blk_no));
}
```

INIT_ADDR and WRITE_ERASE_ADDR are defined in KDevice.h as follows:

```
        #define TRANS_RAM_ADDR          0xFF8000
        #define INIT_ADDR               (TRANS_RAM_ADDR+32)
        #define WRITE_ERASE_ADDR        (TRANS_RAM_ADDR+16)
```

7.3.4 Flash Memory Programming (FDTWrite.c)

(1) WriteInit

The user area is selected, the operating frequency is specified, and the initial setting of the programming library is performed.

```
/*
///////////////////////
// WriteInit Function //
///////////////////////
*/
BYTE WriteInit(void)
{
        InitPtr WRITE_INIT = (InitPtr)INIT_ADDR;

        UserMatSelect();
        FKEY = WRITE_ERASE_ENABLE;
        return ((*WRITE_INIT)(Frequency));
}
```

(2) WriteStart

The programming data storage address, programming destination address are specified and the programming library is called. The programming data and programming destination address are received from the Flash Development Toolkit. For details, refer to Source Files of the Sample Program.

```
/*
////////////////////////
// WriteStart Function //
////////////////////////
*/
BYTE WriteStart(BYTE *data, DWORD adr)
{
        WritePtr WRITE_DATA = (WritePtr)WRITE_ERASE_ADDR;

        return ((*WRITE_DATA)((BYTE *)data, (BYTE *)adr));
}
```

(3) Executing programming end processing (WriteFLASH)

Flash memory programming end processing is partially shown below. For details, refer to Source Files of the Sample Program.

Programming data reception (GetWriteData) receives the programming data storage address and programming destination address. When the programming destination address is WRITE_END (0xFFFFFFFF), programming end processing is performed.

The programming data storage address is set to ADD_WRITE_PRM0 (0xF0F0F0F0), the programming destination address is set to ADD_WRITE_PRM1 (0x0F0F0F0F), and the programming library is read.

```
/* Acquisition of command data    */
if (GetWriteData(pData, &pAddress, add_sum)){
        return;
}
if (pAddress == WRITE_END){
        pData = (BYTE *)ADD_WRITE_PRM0;
        pAddress = ADD_WRITE_PRM1;
        end_flg = LOOP_END;
}
/* A setup of boot status */
BootStatus = MODE_WRITE_RUN;

/* Write-in start */
if (ErrorStatus = WriteStart(pData, pAddress)){
```

8. Programming Guide

This section describes how to write a program using the 0.18-µm F-ZTAT microcomputer standard boot program. The section also contains tips on creating programs and notes. For details, refer to the Hardware Manual.

8.1 Overview

The 0.18-µm F-ZTAT microcomputer standard boot program consists of a transfer library, erasing library, and programming library. The functions are listed below:

(1) Transfers the programming library or erasing library to the specified RAM area.

(2) Specifies the operating frequency by the initial setting.

(3) Specifies a block number and erases the relevant block.

(4) Specifies data to be programmed and the programming destination address and programs the data.

(5) Selects the user boot area or user area.

8.2 Control Registers and Control Bits

The control registers and control bits related to the library transfer function and user boot area are described below.

8.2.1 Selecting a Function

To select transfer, programming, or erasing, use the FKEY register. To transfer the programming or erasing library, set the FKEY register to H'A5. To perform programming or erasing, set the register to H'5A.

Table 8-1 FKEY Register

State	Value	Function
Transfer enabled	H’A5	Can transfer a library. Can write a value to the SCO bit.
Programming/erasing enabled	H’5A	Can program or erase flash memory.

8.2.2 Starting Library Downloading

To transfer a library, set the SCO bit (bit 0 of the FCCS register) to 1.

Table 8-2 SCO Bit (Bit 0 of the FCCS Register)

State	Value	Function
Source program copy disabled	0	Does not download a library to RAM.
Source program copy enabled	1	Issues a request to download a library to RAM. H'A5 must be written to FKEY and execution in on-chip RAM must be in progress. The SCO bit is cleared to 0 when downloading is completed.

8.2.3 Selecting a Library

To select a library, set the corresponding bit of the FPCS or FECS register to 1.

Table 8-3 Registers for Selecting a Program to Be Transferred

Program to Be Transferred	Register	Bit Name	Bit
Programming program	FPCS register	PPVS bit	Bit 0
Erasing program	FECS register	EPVB bit	Bit 0

8.2.4 Selecting the User Boot Area

To select the user boot area, set the FMATS register to H'AA.

Table 8-4 FMATS Register

State	Value	Function
User area selection	Other than H'AA	Selects the user area.
User boot area selection	H’AA	Selects the user boot area.

Note: The value can be changed only in RAM.

8.2.5 Selecting the Transfer Destination

Use the FTDAR register to set the RAM address of the library transfer destination. If the setting is invalid, bit 7 of the FTDAR register is set to 1.

Table 8-5 FTDAR Register

Transfer Destination Address	Setting	Function
RAM start address + 20 Kbytes	H’00	Sets the start address to download a program to H'FF9000.
RAM start address + 24 Kbytes	H’01	Sets the start address to download a program to H'FFA000.
RAM start address + 28 Kbytes	H’02	Sets the start address to download a program to H'FFB000.
RAM start address + 16 Kbytes	H’03	Sets the start address to download a program to H'FF8000.

8.3 Using the Libraries

This section describes how to use the libraries.

8.3.1 Transfer

Perform transfer operation using the procedure below:

(1) Select the programming library or erasing library to be transferred. For the programming library, set the PPVS bit (bit 0) of the FPCS register to 1. For the erasing library, set the EPVB bit (bit 0) of the FECS register to 1.

(2) Specify the transfer destination in RAM in the FTDAR register.

(3) Set the FKEY register to H'A5 to place the chip in the transfer enable state.

(4) Set the first byte of the transfer destination in RAM to H'FF so that the transfer result can be checked.

(5) Set the SCO bit (bit 0 of the FCCS register) to 1. Insert four NOP instructions after the bit set instruction.

(6) The return value is set in the first byte in RAM. Check that the value is H'00.

8.3.2 Erasing

Perform erasing operation using the procedure below:

(1) Call the erase initial setting entry (transfer destination + 32 bytes) and set the operating frequency (ER0). The processing result is set in the R0L register.

(2) Set the FKEY register to H'5A to place the chip in the erasing/programming enable state.

(3) Select the user boot area or user area using the FMATS register. Set H'AA for the user boot area or a value other than H'AA, such as H'00, for the user area. Insert two NOP instructions after FMATS setting.

(4) Set the erase block number in the ER0 register and call the erasing entry (transfer destination + 16 bytes).

(5) The processing result is set in the R0L register.

8.3.3 Programming

Perform programming operation using the procedure below:

(1) Call the programming initial setting entry (transfer destination + 32 bytes) and set the operating frequency (ER0). The processing result is set in the R0L register.

(2) Set the FKEY register to H'5A to place the chip in the erasing/programming enabled state.

(3) Select the user boot area or user area using the FMATS register. Set H'AA for the user boot area or a value other than H'AA, such as H'00, for the user area. Insert two NOP instructions after FMATS setting.

(4) Set the address of data to be programmed in the ER0 register and the programming destination address in the ER1 register, and call the programming entry (transfer destination + 16 bytes).

(5) The processing result is set in the R0L register.

(6) At the end of programming, set H'F0F0F0F0 as the programming data storage address in the ER0 register and H'0F0F0F0F as the programming destination address in the ER1 register, and calls the programming entry.

8.4 Modules

There are the following libraries: Transfer library, erasing library, and programming library. The function of each module is shown below:

Table 8-6 Libraries and Entries

Library	Module Name	Entry	Function
Transfer	Transfer start	Setting the SCO bit to 1	Transfers the program corresponding to the specified program type and program code.
Erasing	Erase initial setting	(Transfer destination + 32 bytes)	Calculates the erasing wait time using the specified operating frequency.
	Block erasing	(Transfer destination + 16 bytes)	Erases the specified block.
Programming	Programming initial setting	(Transfer destination + 32 bytes)	Calculates the programming wait time using the specified operating frequency.
	Programming	(Transfer destination + 16 bytes)	Programs the specified data in the specified programming destination address.

8.5 Module Specifications

The library module specifications are listed below for your information. For details, refer to the Hardware Manual.

8.5.1 Transfer Start

Name	Transfer start
Type	None Sets the SCO bit of the FCCS bit to 1 to transfer a library.
Function	Transfers a program.
Argument	None
Input	For the programming library, set the PPVS bit (bit 0) of the FPCS register to 1. For the erasing library, set the EPVB bit (bit 0) of the FECS register to 1. Specify the transfer destination in RAM in the FTDAR register. Set the FKEY register to H'A5. Set the first byte of the transfer destination in RAM to H'FF.
Return Value	None
Output	FTDAR register TDER bit (bit 7): Parameter check flag Normal termination: 0 FTDAR register value error: 1 (downloading is suspended.) First byte of the transfer destination in RAM: Processing result Normal termination: H'00 FKEY register value error: H'03 Multi-selection error: H'05
Processing	Selects the library corresponding to the PPVS bit of the FPCS register or the EPVB bit of the FECS register. If a library selection error occurs, sets the processing result and returns control. If FKEY is not H'A5, sets the processing result and returns control. If an FTDAR error occurs, sets the TDER bit to 1 and returns control. Transfers the library to the RAM area specified using FTDAR. Clears the SCO bit to 0. Returns control to the instruction next to that for setting the SCO bit.

8.5.2 Erase Initial Setting

Name	Erase initial setting
Type	typedef BYTE (*InitPtr)(WORD);
Function	Performs erase initial setting.
Argument	WORD: Operating frequency
Return Value	Processing result Normal termination: H'00 Operating frequency error: H'03
Processing	Calculates the erasing wait time using the operating frequency.

8.5.3 Block Erasing

Name	Block erasing
Type	typedef BYTE (*ErasePtr)(BYTE);
Function	Erases a block.
Argument	BYTE: Erase block number
Return Value	Processing result Normal termination: H'00 Erase block number error: H'09 FKEY error: H’11 Erasing error: H’21 Error protection: H'41
Processing	Checks FWE, FKEY, and block number. If an error occurs, sets an error code and returns control. Obtains the address using the block number. Erases the address corresponding to the block. If an erasing error occurs, sets an error code and returns control. Returns control at normal termination.

8.5.4 Programming Initial Setting

Name	Programming initial setting
Type	typedef BYTE (*InitPtr)(WORD);
Function	Performs programming initial setting.
Argument	WORD: Operating frequency
Return Value	Processing result Normal termination: H'00 Operating frequency error: H'03
Processing	Calculates the programming wait time using the operating frequency.

8.5.5 Programming

Name	Programming
Type	typedef BYTE (*WritePtr)(BYTE *, BYTE *);
Function	Performs programming.
Arguments	BYTE * (first argument): Programming data storage address BYTE * (second argument): Programming destination address
Return Value	Processing result Normal termination: H'00 Programming data address error: H'03 Programming address error: H'05 FKEY error: H’11 Programming error: H'21 Error protection: H'41
Processing	Checks FWE, FKEY, and programming addresses. If an error occurs, sets an error code and returns control. Verifies and programs data. Verifies the programmed data. When there is no error, returns control. If there is an error, reprograms data. If the programming count is exceeded, returns control with a programming count error. When programming terminates normally, returns control.

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