

# AN00175: Interfacing FlashRunner with Renesas RH850 devices

FlashRunner is a Universal In-System Programmer, which uses the principles of In-Circuit Programming to program Renesas RH850 family microcontrollers.

This Application Note assumes that you are familiar with both FlashRunner and the main features of the RH850 family. Full documentation about these topics is available in the FlashRunner user's manual and in device-specific datasheets.

## 1. Introduction

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In-system programming of RH850 microcontrollers is performed through CSI protocol.

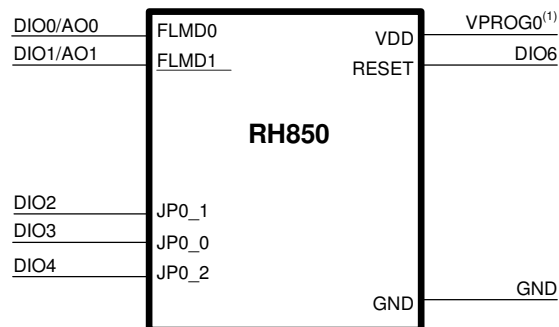
In order to use FlashRunner to perform in-system programming, you need to implement the appropriate in-circuit programming hardware interface on your application board.

## 2. Hardware Configuration

The microcontroller lines needed to program an RH850 device through CSI protocol are the following:

- **FLMD0**: Mode selection Input 0.
- **FLMD1**: Mode selection Input 1.
- **JP0\_1**: FPDT Output.
- **JP0\_0**: FPDR Input.
- **JP0\_2**: FPCK Input.
- **RESET**: Microcontroller Reset.
- **VDD**: Device power supply voltage.
- **GND**: Device power supply ground.

The lines mentioned above must be connected to the FlashRunner's "ISP" connector according to the following diagram:



<sup>(1)</sup> Connect this line if you want FlashRunner to automatically power the target device

## 3. Specific TCSETPAR Programming Commands

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### Overview

**TCSETPAR** commands set device-specific and programming algorithm-specific parameters. These commands must be sent after the **TCSETDEV** command and before a **TPSTART** / **TPEND** command block.

All of the following parameters must be correctly specified through the relative **TCSETPAR** commands (although the order with which these parameters are set is not important):

- Communication mode.
- External oscillator frequency.
- Communication frequency.
- Security code.
- Protection mode.

### TCSETPAR CMODE

Command syntax:

```
TCSETPAR CMODE <communication protocol>
```

Parameters:

**communication protocol**: Specifies the communication protocol.

Description:

Specifies the communication protocol used between FlashRunner and target microcontroller.

## TCSETPAR FOSC

Command syntax:

**TCSETPAR FOSC** <frequency Hz>

Parameters:

**frequency Hz:** External oscillator frequency, expressed in Hertz.

Description:

Specifies the external oscillator frequency.

## TCSETPAR SCLK

Command syntax:

**TCSETPAR SCLK** <frequency Hz>

Parameters:

**frequency Hz:** Communication frequency, expressed in Hertz.

Description:

This command is used to set the serial clock communication frequency.

## TCSETPAR SECURITY\_CODE

Command syntax:

**TCSETPAR SECURITY\_CODE** <security bytes>

Parameters:

**security bytes:** Specifies 16 bytes data.

Description:

This command is used to set the security bytes.

## TCSETPAR PROTECTION\_MODE

Command syntax:

**TCSETPAR PROTECTION\_MODE <protection mode>**

Parameters:

**protection mode:**        **ID\_AUTHENTICATION** or **COMMAND\_PROTECT.**

Description:

This command is used to set the protection mode type.

## TCSETPAR SOPU

Command syntax:

**TCSETPAR SOPU <condition>**

Parameters:

**condition:**        **ENA** or **DIS.**

Description:

This command is used to enable or disable the programmer data output pull up resistor. If this command is not specified, enabled is the default mode set.

## 4. Specific TPCMD Programming Commands

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### Overview

**TPCMD** commands perform a programming operation (i.e. mass erase, program, verify, etc.). These command must be sent within a **TPSTART** / **TPEND** command block.

Renesas RH850-specific target programming commands are the following:

- **TPCMD MASSERASE;**
- **TPCMD BLANKCHECK;**
- **TPCMD PROGRAM;**
- **TPCMD VERIFY;**
- **TPCMD BLOCKERASE;**
- **TPCMD READ;**
- **TPCMD DUMP;**
- **TPCMD PROTECT;**
- **TPCMD UNPROTECT;**
- **TPCMD GET\_SECURITY;**
- **TPCMD GET\_ID\_FOR\_AUTHENTICATION;**
- **TPCMD SET\_SECURITY\_CODE;**
- **TPCMD GET\_SECURITY\_CODE;**
- **TPCMD GET\_OB;**
- **TPCMD PRINT\_CHIP\_CHECKSUM;**
- **TPCMD CHECK\_CHIP\_CHECKSUM;**
- **TPCMD VALIDATE\_ICU\_S;**
- **TPCMD CHECK\_ICU\_S\_VALID;**
- **TPCMD RUN.**

## TPCMD MASSERASE

Command syntax:

**TPCMD MASSERASE C|F|E|I**

Command options:

**C|F|E|I**: Specifies Chip (**C**), Flash (**F**) memory, EEPROM (**E**) or ICU-S area (**I**).

Description:

'**C**' parameter mass erases Flash memory and EEPROM memory. '**F**' mass erases Flash, '**E**' mass erases EEPROM memory and '**I**' mass erases ICU-S area.

## TPCMD BLANKCHECK

Command syntax:

**TPCMD BLANKCHECK F|E|U <tgt start addr> <len>**

Command parameters and options:

**F|E|U**: Specifies Flash (**F**), EEPROM (**E**) memory, Extended user area Flash memory (**U**).

**tgt start address**: Device memory location from where the blankcheck operation will start.

**len**: Number of locations to be blankchecked.

Description:

Blankchecks Flash, EEPROM or Extended user area Flash memory. Blankchecks **len** locations starting from the address specified by **tgt start address**.

## TPCMD PROGRAM

Command syntax:

```
TPCMD PROGRAM F|E|U|O <src offset> <tgt start addr> <len>
```

Command parameters and options:

**F|E|U|O**: Specifies Flash (**F**), EEPROM (**E**) memory, Extended user area Flash memory (**U**), Option bytes (**O**)\*.

**src offset**: Offset from the beginning of the source memory.

**tgt start addr**: Device memory location from where the program operation will start.

**len**: Number of locations to be programmed.

Description:

Programs **len** locations of Flash, EEPROM or Extended user area Flash memory starting from the **tgt start addr** address.



### \*Option bytes

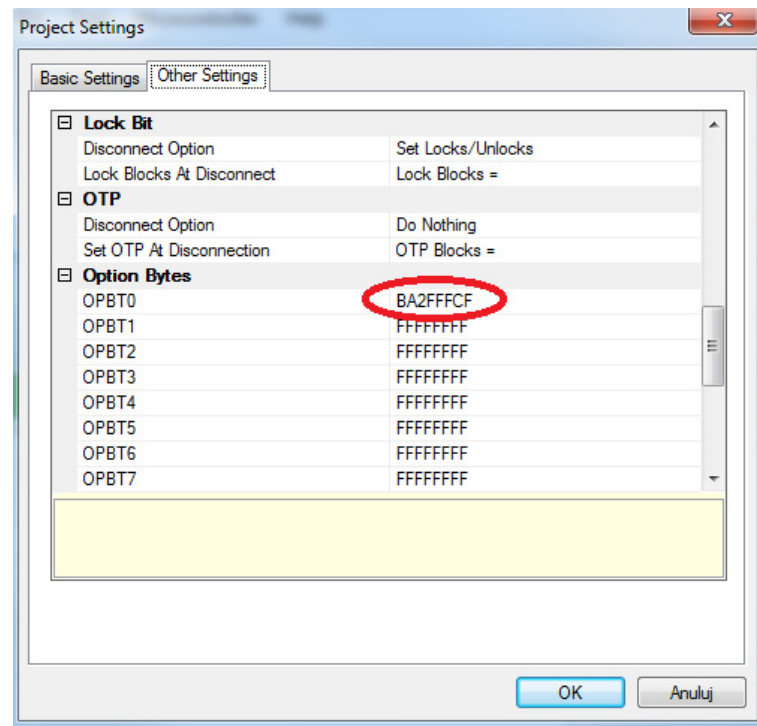
When programming the option bytes, user has always to set a length of 32 bytes.

Based on the figure below, the following is an example of how to set OPBT0.

In this example user loads the option bytes values in the dynamic memory before programming it. The option bytes values must be written in little-endian order:

<OPBTn> → <byte0 byte1 byte2 byte3>

The order of the option bytes in the dynamic memory (or the FRB file) must be from OPBT0 to OPBT7.



**Figure 1: Project settings window – from Renesas programming application**

Option bytes layout in the Dynamic memory and programming operations:

```

;Write option bytes values into dynamic memory
DMSET $0 $10 $CF $FF $2F $BA $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF
DMSET $10 $10 $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF $FF

;Set dynamic memory as source data
TPSETSRC DYNAMIC

;Program the option bytes
TPCMD PROGRAM 0 $0 $0 $20
  
```

## TPCMD VERIFY

Command syntax:

```
TPCMD VERIFY F|E|U R <src offset> <tgt start addr> <len>
```

Command parameters and options:

<b>F E U:</b>	Specifies Flash ( <b>F</b> ), EEPROM ( <b>E</b> ) memory, Extended user area Flash ( <b>U</b> ).
<b>R:</b>	Specifies Readout method ( <b>R</b> ).
<b>src offset:</b>	Offset from the beginning of the source memory.
<b>tgt start addr:</b>	Device memory location from where the verify operation will start.
<b>len:</b>	Number of locations to be verified.

Description:

Verifies **len** locations of Flash, EEPROM or Extended user area Flash memory starting from the **tgt start addr** address.

## TPCMD BLOCKERASE

Command syntax:

```
TPCMD BLOCKERASE F|E|U <tgt start addr> <len>
```

Command options:

<b>F E U:</b>	Specifies Flash ( <b>F</b> ) memory, EEPROM ( <b>E</b> ) or Extended user area Flash memory ( <b>U</b> ).
<b>tgt start addr:</b>	Device memory location from where the verify operation will start.
<b>len:</b>	Number of locations to be erased.

Description:

'**F**' parameter block erases Flash memory. '**E**' parameter block erases EEPROM memory. '**U**' block erases Extended user area Flash memory.

## TPCMD READ

Command syntax:

```
TPCMD READ F|E|U <tgt start addr> <len>
```

Command parameters and options:

- F|E|U:** Specifies Flash (F), EEPROM (E) memory, Extended user area Flash (U).
- tgt start addr:** Device memory location from where the read operation will start.
- len:** Number of locations to be read.

Description:

Reads **len** locations of Flash, EEPROM or Extended user area Flash memory starting from the **tgt start addr** address.

## TPCMD DUMP

Command syntax:

```
TPCMD DUMP F|E|U <src offset> <tgt start addr> <len>
```

Command parameters and options:

- F|E|U:** Specifies Flash (F), EEPROM (E) memory, Extended user area Flash memory (U).
- src offset:** Offset from the beginning of the source memory.
- tgt start addr:** Device memory location from where the dump operation will start.
- len:** Number of locations to be dumped.

Description:

Dumps **len** locations of Flash, EEPROM or Extended user area Flash memory starting from the **tgt start addr** address.

## TPCMD PROTECT

Command syntax:

**TPCMD PROTECT** <security byte>

Command parameters and options:

**security byte:**           The security byte value.

Description:

Protects the device, setting the security flags.

## TPCMD UNPROTECT

Command syntax:

**TPCMD UNPROTECT**

Command parameters:

None.

Description:

Unprotect the device.

## TPCMD GET\_SECURITY

Command syntax:

**TPCMD GET\_SECURITY**

Command parameters:

None.

Description:

Print the security flags.

## TPCMD GET\_ID\_FOR\_AUTHENTICATION

Command syntax:

**TPCMD GET\_ID\_FOR\_AUTHENTICATION**

Command parameters:

None.

Description:

Print the protection mode byte: 00h for "ID\_Authentication" mode, FFh for "Command protection" mode.

## TPCMD SET\_SECURITY\_CODE

Command syntax:

**TPCMD SET\_SECURITY\_CODE <src offset> <tgt start addr> <len>**

Command parameters and options:

**src offset:** Offset from the beginning of the source memory.  
**tgt start addr:** Device memory location from where the security code will be write.  
**len:** Number of bytes to be write.

Description:

Set the password to secure the device.

## TPCMD GET\_SECURITY\_CODE

Command syntax:

**TPCMD GET\_SECURITY\_CODE**

Command parameters:

None.

Description:

Print the password set to access the device. Doesn't works after a device restart.

## **TPCMD GET\_OB**

Command syntax:

**TPCMD GET\_OB**

Command parameters:

None.

Description:

Print the 32 option bytes.

## **TPCMD PRINT\_CHIP\_CHECKSUM**

Command syntax:

**TPCMD PRINT\_CHIP\_CHECKSUM**

Command parameters:

None.

Description:

Print the checksum calculated by the programmed device.

## **TPCMD CHECK\_CHIP\_CHECKSUM**

Command syntax:

**TPCMD CHECK\_CHIP\_CHECKSUM**

Command parameters:

None.

Description:

Check the checksum calculated by the programmed device.

## **TPCMD VALIDATE\_ICU\_S**

Command syntax:

**TPCMD VALIDATE\_ICU\_S**

Command parameters:

None.

Description:

Enable the ICU-S (Intelligent Cryptographic Unit). This process is not reversible.

## **TPCMD CHECK\_ICU\_S\_VALID**

Command syntax:

**TPCMD CHECK\_ICU\_S\_VALID**

Command parameters:

None.

Description:

Check if ICU-S is set right.

## **TPCMD RUN**

Command syntax:

**TPCMD RUN**

Command parameters:

None.

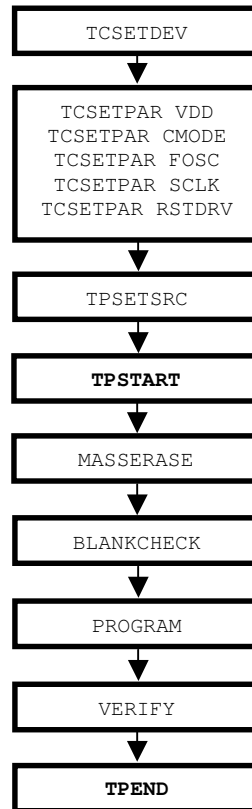
Description:

Runs the target application.

## 5. Typical Programming Flow

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The following flow chart illustrates typical steps to help you write your own script file.





## 6. Script Example

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The example below shows a typical programming flow for Renesas R7F7010143 device.

```
;
; FLASHRUNNER SCRIPT EXAMPLE FOR NEC R7F7010143
;
; Use this example as a starting point for your specific programming needs
;
; -----
;
; Hardware connections
;
; DIO0 (FLMD0)
; DIO1 (FLMD1)
; DIO2 (JP0_1) Device Output
; DIO3 (JP0_0) Device Input
; DIO4 (JP0_2) Device Clock
; DIO6 (RESET)
;
;
; RV40F Flash technology
;
; 768K byte Code Flash size
; 32K byte Data Flash size
;
;
; Turns off logging
#LOG_OFF
; Halt on errors
#HALT_ON FAIL

; Sets device
TCSETDEV RENESAS R7F7010143 RH850
; -----
```

```

;FLASHRUNNER I/O Settings
;-----

; Target voltage, mV (change as needed)
TCSETPAR VDD 5000

; Clock oscillator frequency driven by FlashRunner, Hz
; Possible frequencies are: 25000000 divided by a 16-bit prescaler, 0 (DISABLED)
TCSETPAR CLKOUT 0

; VDD rise-time, ms (from 0 ms to 65535 ms)
TCSETPAR PWUP 10

; VDD fall-time, ms (from 0 ms to 65535 ms)
TCSETPAR PWDOWN 10

; RESET rise-time, us (from 0 us to 65535 us)
TCSETPAR RSTUP 100

; RESET fall-time, us (from 0 us to 65535 us)
TCSETPAR RSTDOWN 100

; RESET drive mode: OPENDRAIN or PUSHPULL
TCSETPAR RSTDRV OPENDRAIN

;-----
;RH850 ALGO Settings
;-----

; Communication mode settings (CSI supported)
TCSETPAR CMODE CSI

; External clock source frequency, Hz (change as needed)
; For this device the maximum FOSC is 24000000 Hz
TCSETPAR FOSC 24000000

; Clock settings, Hz
; For this device the maximum SCLK is 5000000 Hz.
TCSETPAR SCLK 5000000

;-----

```

```

;Start Programming operation
;-----

; Image file to be programmed (must be placed in the \BINARIES directory)
TPSETSRC FILE TEST.FRB

; Starts programming block
TPSTART

;-----
;FLASH commands
;-----

;MASSERASE operation has the following options:
;C: Mass erases whole memory
;F: Mass erases FLASH memory
;E: Mass erases EEPROM memory
TPCMD MASSERASE F

; Blank checks Flash memory (change address and length as needed)
TPCMD BLANKCHECK F $0 $C0000

; Programs Flash memory (change addresses and length as needed)
TPCMD PROGRAM F $0 $0 $C0000

; Verifies Flash memory (change addresses and length as needed)
TPCMD VERIFY F R $0 $0 $C0000

;-----
;EXTENDED USER AREA FLASH commands
;-----

;TPCMD BLOCKERASE U $1000000 $8000

; Blank checks Extended User Area Flash memory (change address and length as needed)
;TPCMD BLANKCHECK U $1000000 $8000

; Programs Extended User Area Flash memory (change addresses and length as needed)
;TPCMD PROGRAM U $1000000 $1000000 $8000

; Verifies Extended User Area memory (change addresses and length as needed)
;TPCMD VERIFY U R $1000000 $1000000 $8000

```

```
;-----  
;EEPROM commands  
;-----  
  
; Masserases EEPROM memory  
;TPCMD MASSERASE E  
  
; Blank checks EEPROM memory (change address and length as needed)  
;TPCMD BLANKCHECK E $FF200000 $8000  
  
; Programs EEPROM memory (change addresses and length as needed)  
;TPCMD PROGRAM E $FF200000 $FF200000 $8000  
  
; Verifies EEPROM memory (change addresses and length as needed)  
;TPCMD VERIFY E R $FF200000 $FF200000 $8000  
  
; Ends programming block  
TPEND
```

The FlashRunner's system software setup will install script examples specific for each device of the RH850 family on your PC.

## 7. Programming Times

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The following table shows programming times for selected Renesas RH850 family devices.

Device	Mem. Size	Conditions	Operations	Time
R7F701411	3840KB F + 64KB E	VDD=5V,CSI,SCLK=5MHz,FOSC=8MHz	Erase+BlankCheck+Program+Verify	62,21

Programming times depend on Programming Algorithm version, target board connections, communication mode, target microcontroller mask, and other conditions. Programming times for your actual system may therefore be different than the ones listed here. SMH Technologies reserves the right to modify Programming Algorithms at any time.